Engine Management System

BMW MSD81 6 Cyl

Specification

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0 - Basic SW General Operation

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0.1 Non volatile data management general

0.1.1 Introduction

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

The non volatile data management shall provide:

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

0.1.2 Abbreviations and terms

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

FLASH EEPROM emulation means that NVMY data are stored into the flash device.
In the rest of this document the term memory designs either EEPROM or FLASH EEPROM emulation.

0.1.3 General description

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

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

0.1.4 Hardware constraints

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

EEPROM:

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

FLASH EEPROM emulation:

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

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

Two specific flash segments are requested (at least).

Recommendation:

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

Pre-emptive operation:

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

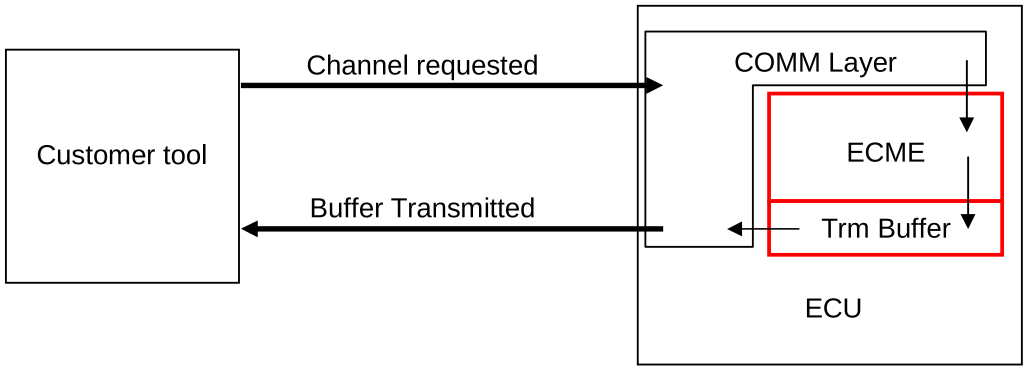
0.1.5 NVMY system events

Three related system events are defined:

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

0.1.6 Flight recorder on customer tool request

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



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

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0.2 Non volatile data management manager

Basically, this module contains the scheduler and the supervisor related to NVMY functionality.
The supervisor is a state machine that contains the way that NVMY channel s operation are performed in addition to the type of operations enabled   depending on the current state.
Furthermore, the supervisor only decides when NVMY operations should be performed.
Indeed, depending on the state of engine control management, the NVMY operations are performed either in BACKGROUND or FOREGROUND mode.
Foreground mode means that ECME s aggregate keeps   hand   till operation is finished.
On the contrary, BACKGROUND mode intends that NVMY operations are performed step by step while engine maybe running.

0.2.1 NVMY Manager

The picture below, presents all manager states :

Active tasks :
- : disabled
I : Init task enabled
W : Write task enabled
R : Read task enabled
U : Update task enabled
S : Synchronisation task enabled

Operation mode :
F : Foreground
B : Background

0.2.2 STATES description

- IDLE state
  The supervisor simply does nothing.

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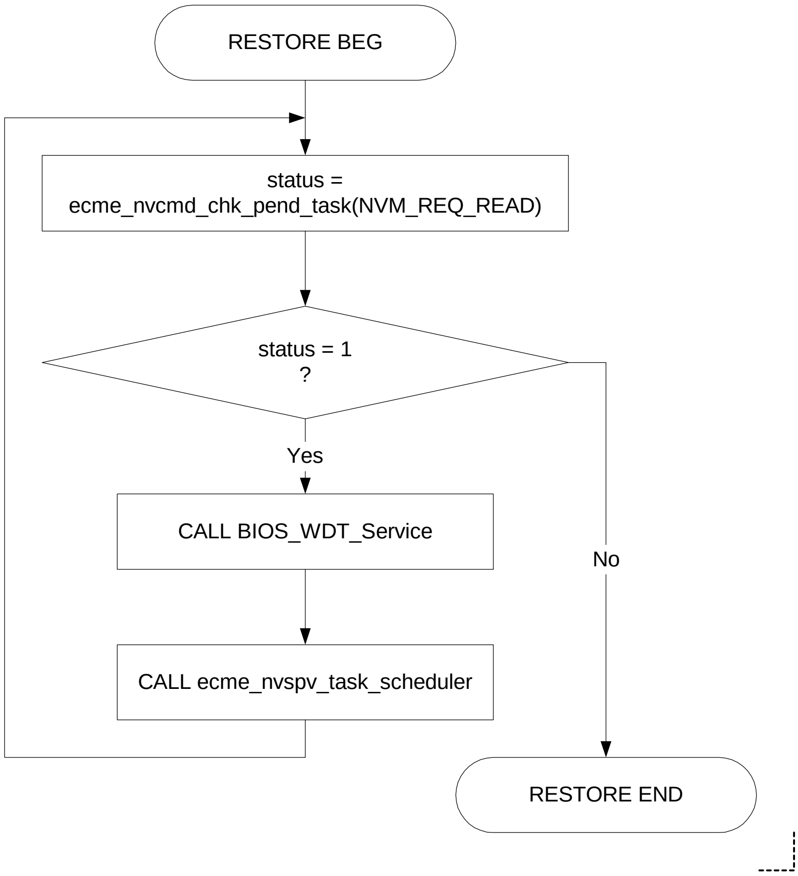
- RESTORE state :



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

- CRUISE state :

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

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

Concerning watchdog, it is rearmed within OS operation.

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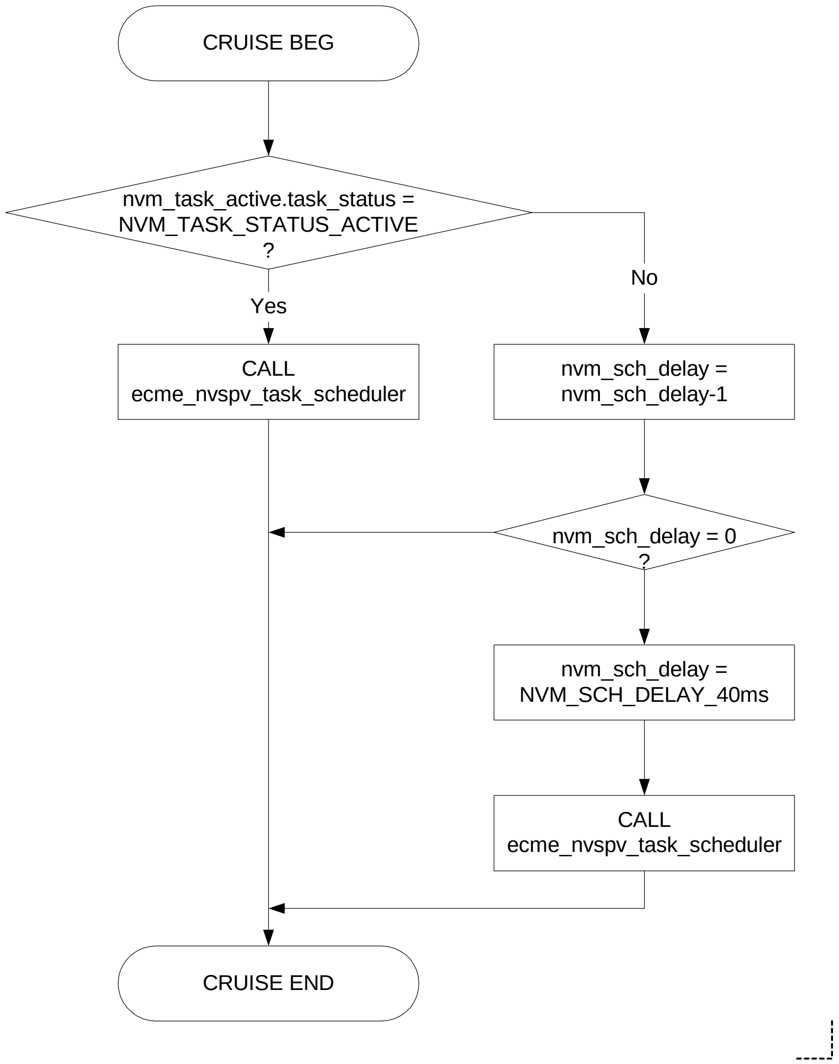

- STORE state :

The NVMY scheduler (ecme_nvspv_task_scheduler) is simply called within this state.

REMARK :

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

- SHUTDOWN STATE

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

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

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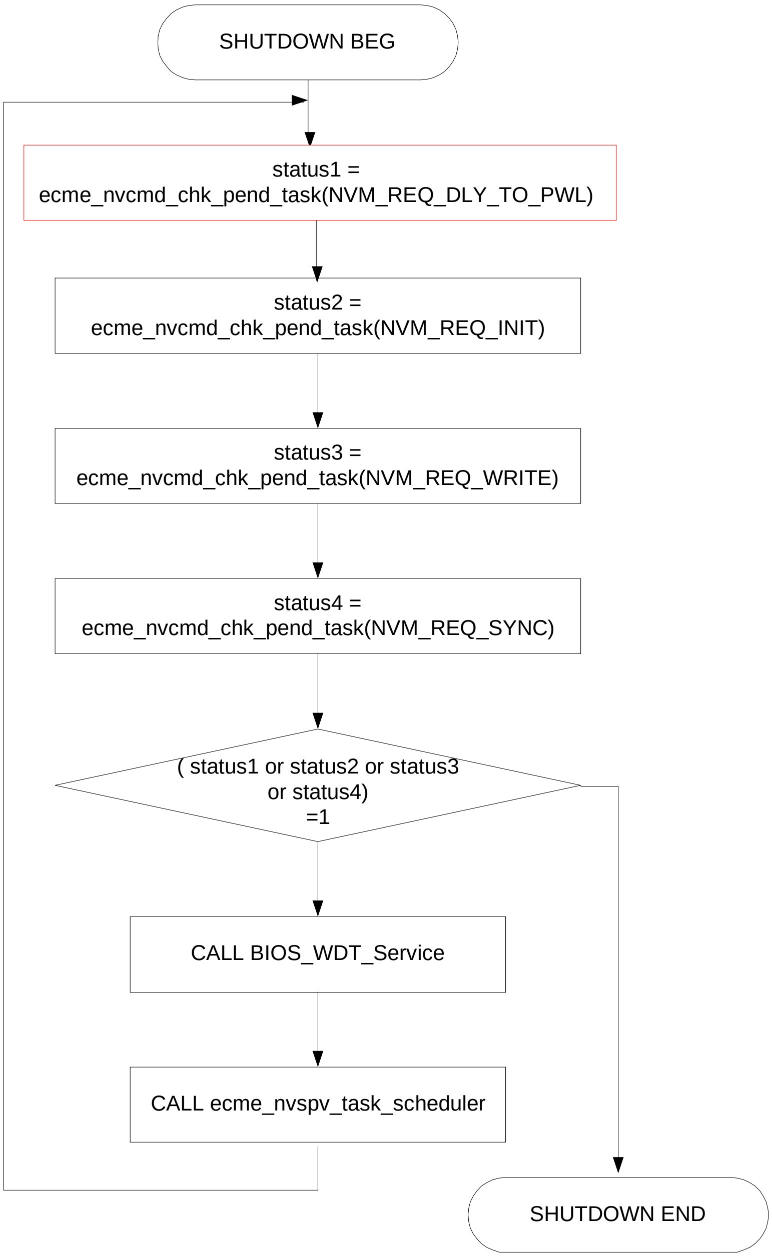

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0.3 Non volatile data management services definitions

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

0.3.1 RESTORE service (FOREGROUND)

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

- First power on initialization
- Tuning initialization

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

0.3.1.1 Implementation

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

0.3.2 CLEAR INIT request (FOREGROUND)

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

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

0.3.2.1 Implementation

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

0.3.3 READ service (FOREGROUND)

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

0.3.3.1 Implementation

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

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0.3.4 READ FOR DIAG service (BACKGROUND)

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

0.3.4.1 Implementation

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

0.3.5 WRITE service (BACKGROUND)

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

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

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

0.3.5.1 Implementation

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

0.3.6 STORE service (BACKGROUND)

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

0.3.6.1 Implementation

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

0.3.7 SHUTDOWN service (FOREGROUND)

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

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0.3.7.1 Implementation

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

0.3.8 NVMY coherency error services (FOREGROUND)

ECME aggregate provides two services for the NVMY coherency check functionality in order to set or clear coherency error.
These services are based on two macros defined below. Basically, these macros respectively set nvm_sw_coherency_err to 1 or 0.

0.3.8.1 Implementation

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

Figure 0.3.1: ECME_NVCMD

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

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0.4 Non volatile data management mechanisms

These section deals with all cases of NVMY channel initialization.

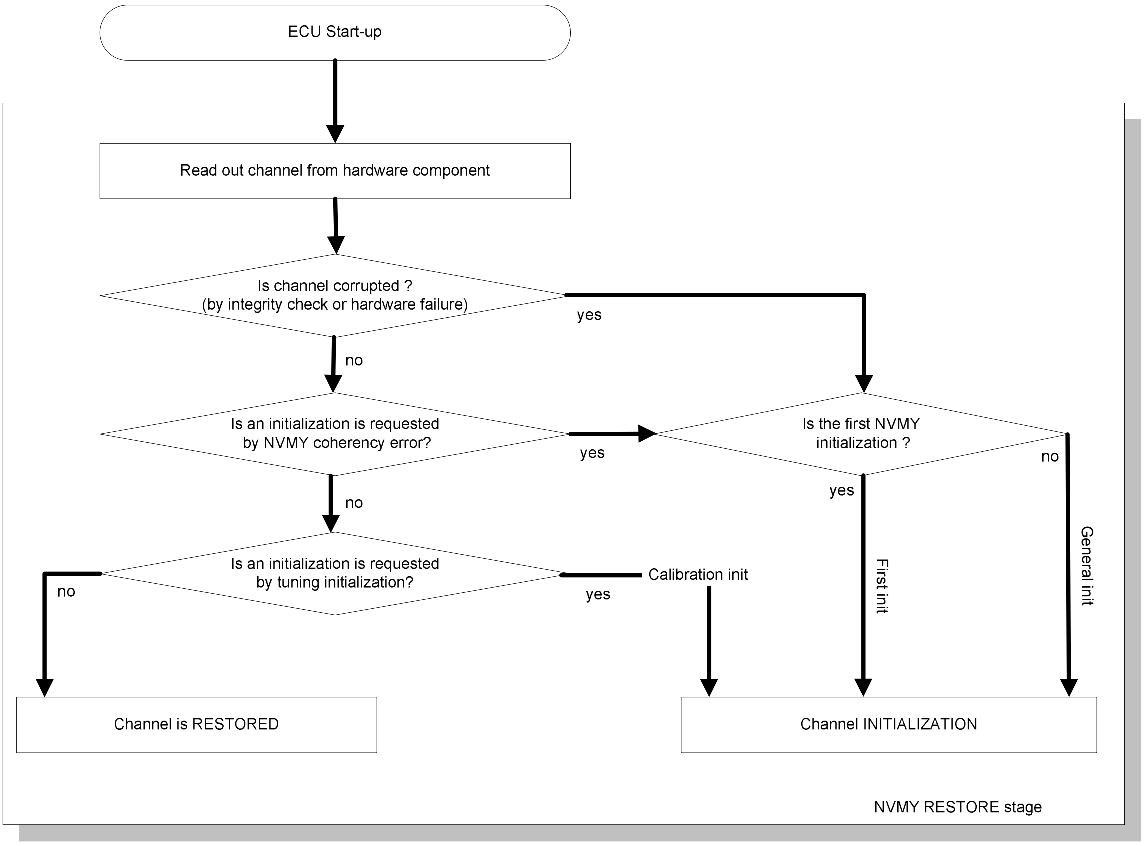
The initialization consists in initializing channel(s) with their default values.
The Channels set may be either partially or completely initialized depending on the case.

In addition, we can distinguish 3 kind of initialization:

- First initialization
- General initialization
- Calibration initialization

NVMY data initialization is performed during the NVMY RESTORE stage.

The following diagram depicts all kind of NVMY channel initialization:



0.4.1 Initialization in case of corrupted channel

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

0.4.2 Initialization in case of NVMY coherency error

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

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NVMY coherency mainly relies on a check at RESTORE stage in order to determine whether NVMY contents (all channels) is compatible or not with applicative software.
Usually, problem may occur if ECU is restarted after it has been previously reprogrammed, because channel definition may have change in between from one software version to another. Without coherency check, it may lead Applicative software to run with NVMY data that are not correct, so coherency check is mandatory before restoring whole NVMY contents.

Strategy:
The NVMY coherency check relies on two channels (named SWVER_FIX and SWVER), which contains data related to coherency check (ECU-SW coherence identifier).
In the same way, Applicative software contains the same data. At restore stage, both channels are read before applicative channel reading. If NVMY content doesn't fit with current applicative software, a status notification is sent to the NVMY manager.

The below picture defines the channel allocation.

SWVER_FIX is the first written channel.
SWVER is the last written channel.

0.4.3 Initialization in case of tuning request

NVMY function provides the possibility to force channel initialization during RESTORE stage. This is only restricted to the ECU development phase.
This kind of initialization is limited and can only be applied to a limited number of channels, pre-defined with configuration. Therefore channels are grouped according to 3 possible levels of initialization.

Tuning calibration:

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

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

0.4.4 Initialization in case of "First power-on"

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

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

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This procedure relies on one channel (named ECME_1_FIX), which contains data related to the first power-on detection. Since this data is not set, all channels are supposed to be initialized. It implies that this data is false when ECU is delivered at the customer.

0.4.5 Hard initialization

Hardware means that channel is initialized with default values within hardware component.
Since these initialization may be performed during engine running (ECME CRUISE stage), it saves up writing time at the end of the power-latch.
Though this task is applied to EEPROM and FLASH, this initialization is only relevant for EEPROM.

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0.5 Non volatile data management configuration

Input data:

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

Calibration data:

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

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

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

General information

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

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

0.5.1 Non Volatile Data – read from/write to memory

General information:

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

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

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

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

Application conditions:

Initialisation: -

Activation:

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

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

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

Deactivation: -

Recurrence: 100ms

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Function description:

Formula section:

0.5.1.1 Channel organisation

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

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

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

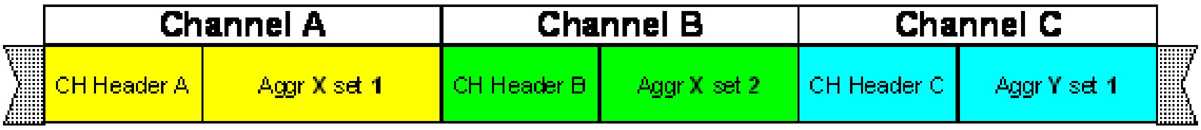

Figure 0.5.1:

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

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

0.5.1.2 Saving criteria

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

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

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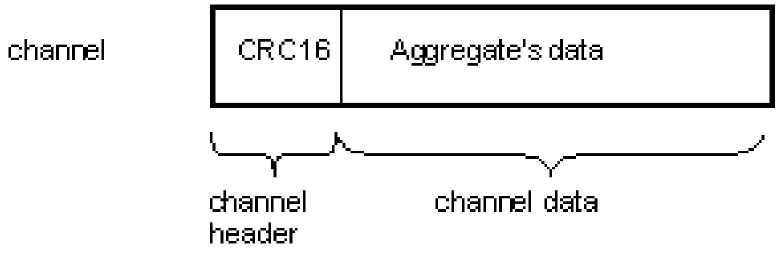

Figure 0.5.2:

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

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

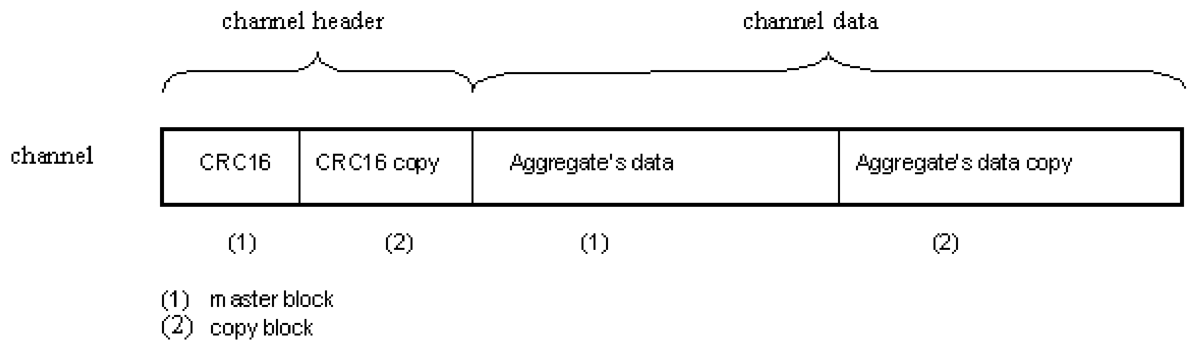

Figure 0.5.3:

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Process of restoration:

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

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

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This method is only available for EEPROM hardware component.

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

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

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

0.5.1.3 NVMY data coherency

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

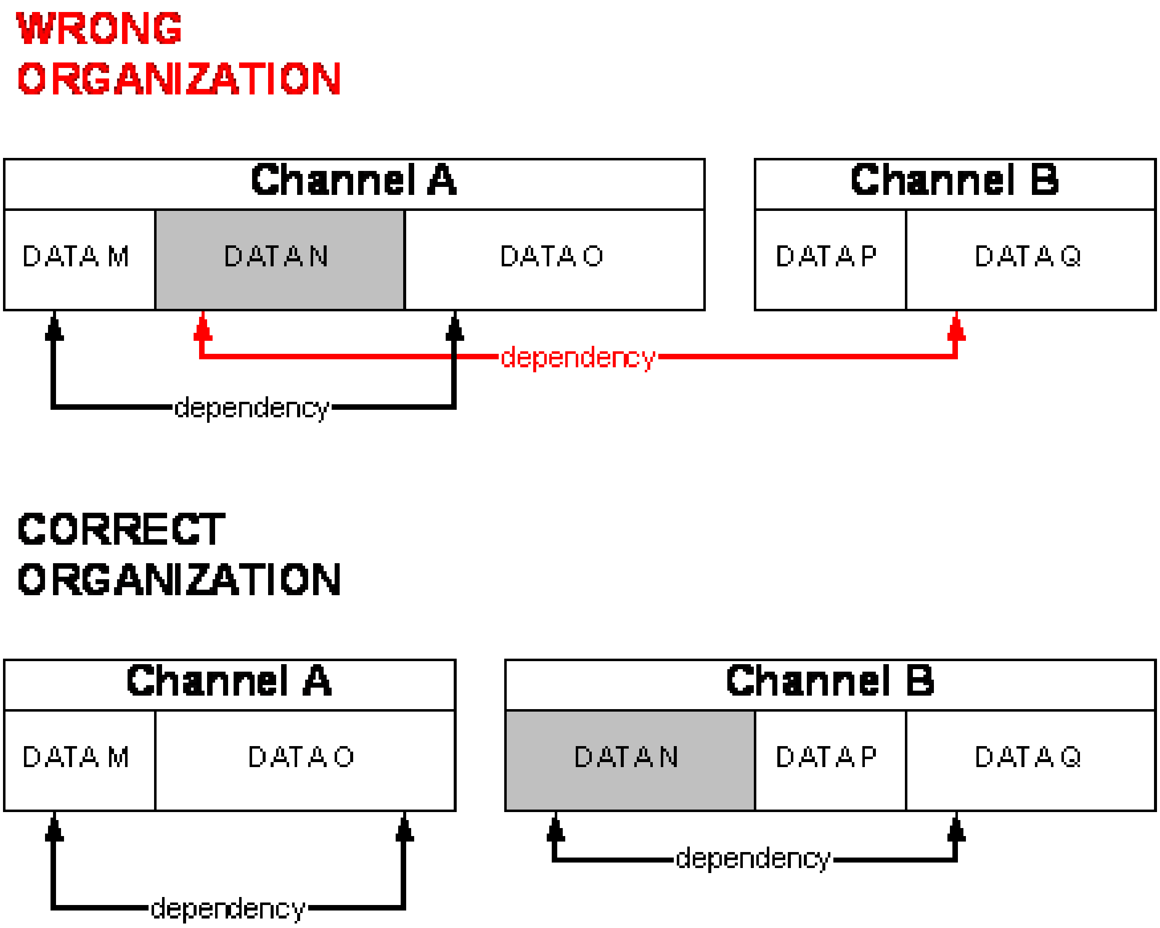

Figure 0.5.4:

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

0.5.1.4 Channel management /Standard channel

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

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

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

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

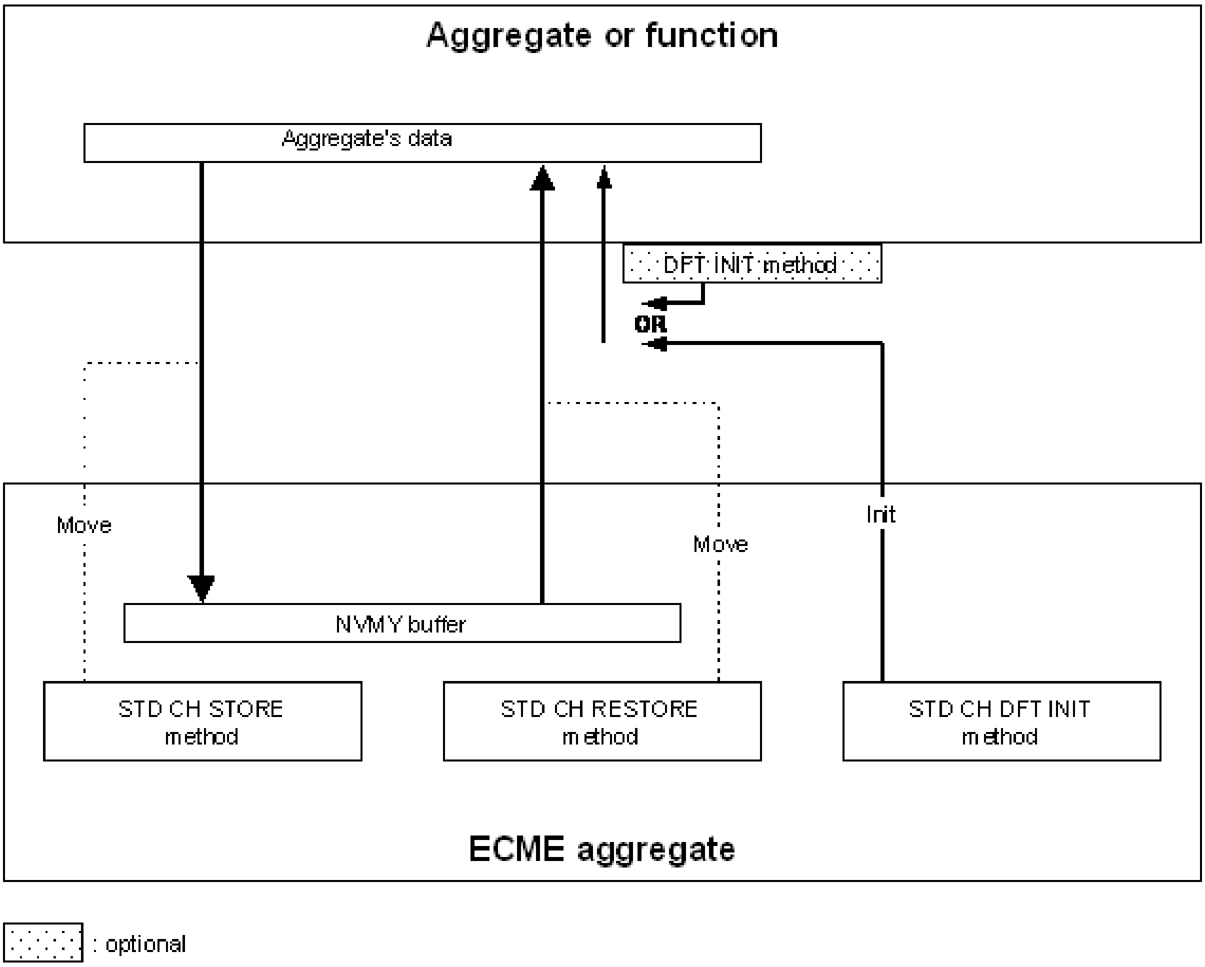

Figure 0.5.5:

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REMARK:

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

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

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

Channel configuration

An ECME aggregate provides several MACROs that help the designer in order to define Channel configuration.
This configuration takes place into the ECME_ANVM.CFG component that is described in later section of this document.

Standard channels are defined according to the following scheme:

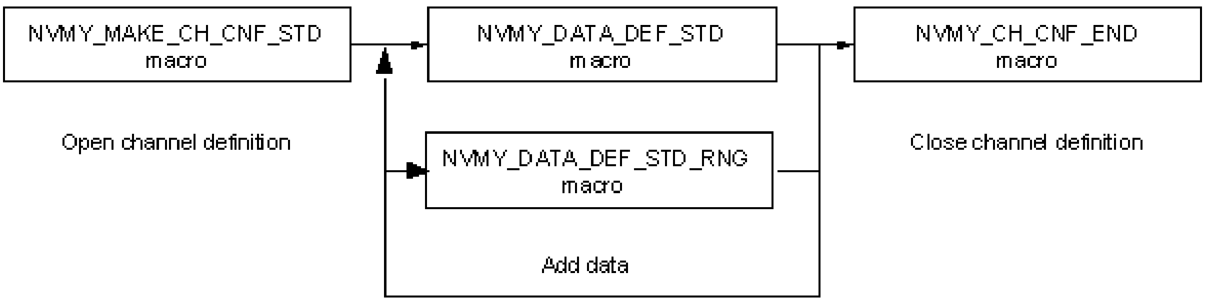

Figure 0.5.6:

MACROs description

- **NVMY_MAKE_CH_CNF_STD** (CH_ID,
  TGT_ID,
  VERSION_CHK,
  TUNING_LVL,
  SAVING_METH,
  DFT_INIT_METH)

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

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Parameters definition:

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

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Remarks:

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

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

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

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

(4): The channels that have the NO_STRQ parameter are only synchronized at powerlatch. For the first powerlatch, they are stored but in the case that the first powerlatch is interrupted the channels are not stored and will be initialized at every power on until they are stored into flash. The aggregate should take this into account and store the channel separately in case of initialization.

(5): The channels that have NO_SYNC parameter are never stored nor synchronized memory. The aggregate should take this into account and store the channel separately.

- **NVMY_DATA_DEF_STD**(nvmy_data)

  This macro helps to add a single data to the channel.
  The nvmy_data corresponds to the real name of the NVMY data.
  The name of the data must be limited to 15 characters.

- **NVMY_DATA_DEF_STD_RNG**(name, address, size)

  This macro helps to add a data to the channel.
  The name must be limited to 15 characters.
  Address corresponds to the NVMY data address begin.
  Size is the length of the NVMY data in byte and must be limited in order to not increase the channel size excessively.

- **NVMY_CH_CNF_END**(CH_ID)

  This macro closes a standard channel definition.

  CH_ID is the same as the one defined by NVMY_MAKE_CH_CNF_STD macro.

0.5.1.5 Channel management /Specific channel

Aggregates provide all methods for NVMY data management as follows:

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

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- CALLBACK routine [optional]*Call back routine called by ECME aggregate after a store operation in order to get its status.*
- READ FOR DIAGNOSIS

  From hardware component to the data used by the Read for diagnosis service

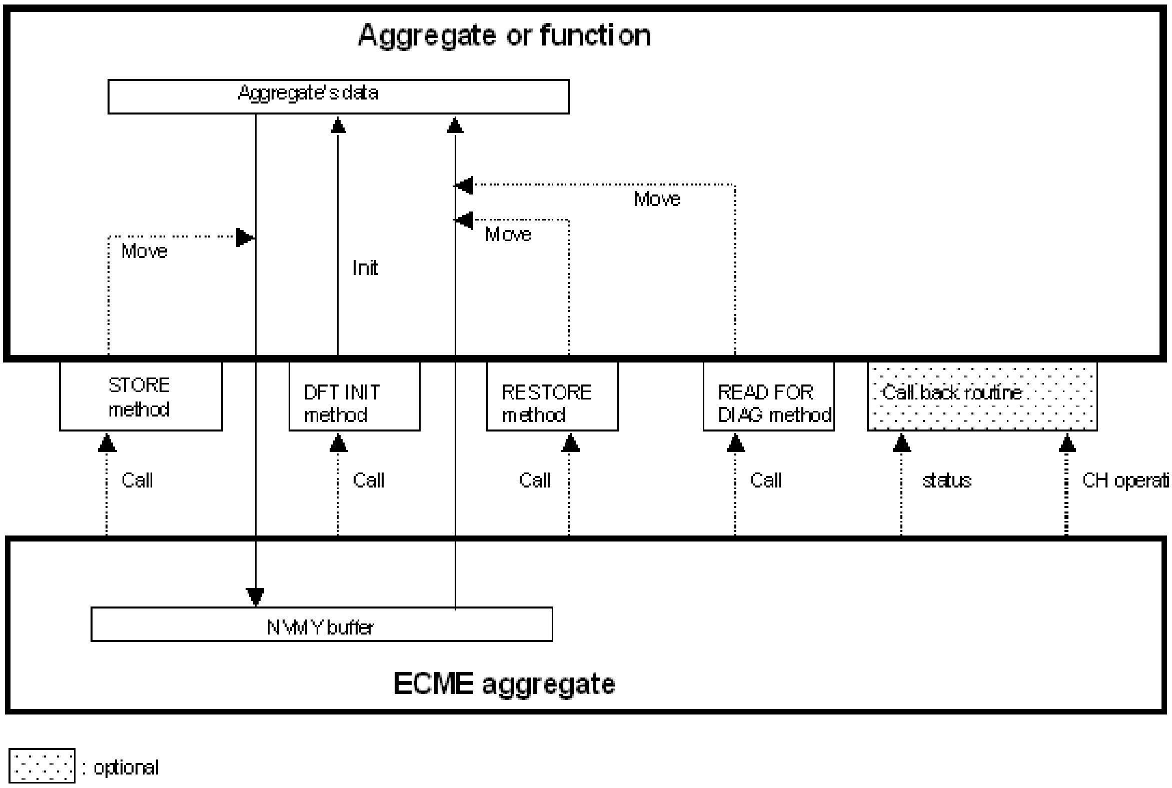

Figure 0.5.7:

REMARK:

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

Channel configuration

An ECME aggregate provides several MACROs that help the designer in order to define Channel configuration.
This configuration takes place into the ECME_ANVM.CFG component that is described in later section of this document.

Standard channel are defined according to the following scheme:

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Figure 0.5.8:

MACROs description

NVMY_MAKE_CH_CNF_SPEC (CH_ID,
TGT_ID,
VERSION_CHK,
TUNING_LVL,
SAVING_METH,
STORE_METH,
RESTORE_METH,
CBACK_METH,
DFT_INIT_METH,
READ_FOR_DIAG_METH)

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

Parameters definition:

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

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

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

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READ_FOR_ DIAG_METH	NVMY_DFT_READ_FOR_ DIAG	Aggregate uses the ECME's Read For Diag default method	Read For Diagnosis is not active for this channel
	Read for diag**function name** (3)	specific method provides by Aggregate	Aggregate provides a method in order to Read For Diagnosis channel's data.

Remarks:

(1): According to the "C coding guideline", the channel identifier name is limited to **17** characters.
For convenience, **NAME** shall refer to Aggregate's short name.
N is a digit that may be used in the case that Aggregates holds more than one channel.
The **FIX** may be added to channel identifier name if channel is not sensitive to NVMY data coherency checking._

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

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

(4): The channels that have the NO_STRQ parameter are only synchronized at powerlatch. For the first powerlatch, they are stored but in the case that the first powerlatch is interrupted the channels are not stored and will be initialized at every power on until they are stored into flash. The aggregate should take this into account and store the channel separately in case of initialization.

(5): The channels that have NO_SYNC parameter are never stored nor synchronized to memory. The aggregate should take this into account and store the channel separately.

- **NVMY_DATA_DEF_SPEC**(aggr_typedef_struct)

  This macro is used to add a package of NVMY data to channel.
  This package is defined through the typedef structure provided by Aggregate

- **NVMY_CH_CNF_END**(CH_ID)

  This macro closes a specific channel definition.

CH_ID is the same as the one defined by NVMY_MAKE_CH_CNF_SPEC macro.

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0.5.2 Non Volatile Data - Selective adaptation ranges

General information:

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

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

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

Important hints:

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

Application conditions:

Initialisation: –

Activation: –

Deactivation: –

Recurrence: 1s

Function description:

Formula section:

Initialize all Adaptation-Datas:

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

Clear the Error-memory

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

Initialize selective Non-Volatile-Datas:

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

Clear KLANN-Adaptation values:

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

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0.5.2.1 Configuration Listing Of Channels

Internal ECME-Channels (channel "ECME_1_FIX" must remain the lowest rank 0)								
NVMY-Channel (Channel ID)	Nr	Version Check	Tun-ing Level	Store Option	Saving Method	Restore	lc_ad_clr	lc_ad_clr_XXX
ECME_1_FIX	0	NO_CHK	LV0	END_PWL	CRC16	PRE_AS	0	0
SWVER_FIX	Allocated in Fix area Application-SW							
SWVER	Allocated in normal area							

Fix Area Application-SW (Don't re-arrange, channels were not initialized if SW-Version changes)								
NVMY-Channel (Channel ID)	Nr	Version Check	Tun-ing Level	Store Option	Saving Method	Restore	lc_ad_clr	lc_ad_clr_XXX
calid	1	NO_CHK	LV1	NO_SYNC	CRC16	NOR-MAL	0	0
bmw_coding	2	NO_CHK	LV1	NO_SYNC	CRC16	NOR-MAL	0	0
trt	3	NO_CHK	LV1	END_PWL	MA-COPY	NOR-MAL	0	0
dist	4	NO_CHK	LV1	END_PWL	CRC16	NOR-MAL	0	0
tecu	5	NO_CHK	LV1	END_PWL	CRC16	NOR-MAL	1	lc_ad_clr_tecu
vima	6	NO_CHK	LV1	END_PWL	CRC16	NOR-MAL	0	0
FSC_ews4_A	7	NO_CHK	LV1	NO_SYNC	CRC16	NOR-MAL	0	0
PRNG	8	NO_CHK	LV0	NO_SYNC	CRC16	PRE_CAN	0	0
bal	9	NO_CHK	LV1	END_PWL	CRC16	NOR-MAL	1	lc_ad_clr_bal
laco	10	NO_CHK	LV1	END_PWL	CRC16	NOR-MAL	1	lc_ad_clr_laco
enrd	11	NO_CHK	LV1	END_PWL	CRC16	NOR-MAL	1	lc_ad_clr_enrd
long_lam	12	NO_CHK	LV1	END_PWL	CRC16	NOR-MAL	0	0
cilc	13	NO_CHK	LV1	END_PWL	CRC16	NOR-MAL	1	lc_ad_clr_cilc

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injai_fix_mst	14	NO_ CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	lc_ad_clr_injr
tecu2	15	NO_ CHK	LV1	END_ PWL	CRC16	NOR- MAL	1	lc_ad_clr_tecu
injai_fix_cpy	16	NO_ CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	0
SWVER_FIX	17	NO_ CHK	LV0	END_ PWL	CRC16	0	0	0
fsc_xmax_fix	18	NO_ CHK	LV1	NO_ SYNC	CRC16	NOR- MAL	0	0
swt_vin_can_fix	19	NO_ CHK	LV1	NO_ SYNC	MA- COPY	NOR- MAL	0	0
nvram_fix_0	20	NO_ CHK	LV1	END_ PWL	MA- COPY	NOR- MAL after nvram channels	0	0
stc_ron	21	NO_ CHK	LV1	END_ PWL	CRC16	NOR- MAL	0	lc_ad_clr_stc_ ron

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

Continued on next page

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

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

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nvram_7	80	CHK	LV1	END_PWL	CRC16	NOR-MAL	0	0
nvram_8	81	CHK	LV1	END_PWL	CRC16	NOR-MAL	0	0
nvram_9	82	CHK	LV1	END_PWL	CRC16	NOR-MAL	0	0
nvram_10	83	CHK	LV1	END_PWL	CRC16	NOR-MAL	0	0
nvram_11	84	CHK	LV1	END_PWL	CRC16	NOR-MAL	0	0
nvram_12	85	CHK	LV1	END_PWL	CRC16	NOR-MAL	0	0
cons_end_nvram	86	CHK	LV0	END_PWL	CRC16	NOR-MAL	0	0
chkfilcap	87	CHK	LV1	END_PWL	CRC16	NOR-MAL	1	lc_ad_clr_dmtl
toil_max	88	CHK	LV1	END_PWL	CRC16	NOR-MAL	1	lc_ad_clr_toil_max
egcp	89	CHK	LV1	END_PWL	CRC16	NOR-MAL	1	lc_ad_clr_egcp
extd	90	CHK	LV1	END_PWL	CRC16	NOR-MAL	1	lc_ad_clr_extd
tam	91	CHK	LV1	END_PWL	CRC16	NOR-MAL	1	0
bsd	92	CHK	LV1	END_PWL	CRC16	NOR-MAL	1	0
insy	93	CHK	LV1	END_PWL	CRC16	NOR-MAL	1	lc_ad_clr_insy
evac	94	CHK	LV1	END_PWL	CRC16	NOR-MAL	1	lc_ad_clr_evac
rst_det	95	CHK	LV1	END_PWL	CRC16	NOR-MAL	0	0
acrc	96	CHK	LV1	END_PWL	CRC16	NOR-MAL	1	lc_ad_clr_egr
efp	97	CHK	LV1	END_PWL	CRC16	NOR-MAL	1	0
efppwm	98	CHK	LV1	END_PWL	CRC16	NOR-MAL	1	lc_efppwm_i_ad_clr
egtr	99	CHK	LV1	END_PWL	CRC16	NOR-MAL	1	0
egtr_aggr	100	CHK	LV1	END_PWL	CRC16	NOR-MAL	1	0
injr	101	CHK	LV1	END_PWL	CRC16	NOR-MAL	1	lc_ad_clr_injr
ecm2	102	CHK	LV1	END_PWL	CRC16	NOR-MAL	1	lc_ad_clr_ecm2
igre	103	CHK	LV1	END_PWL	CRC16	NOR-MAL	1	0

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

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0.6 Customer reprogramming

0.6.1 Introduction

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

0.6.2 General description

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

The car manufacturers use this feature in order to delete the Calibration data and/or ECU-SW and to program them again. With this method it is possible to avoid the exchange of the ECU when functional changes or errors of the ECU-SW occur.
The result is a considerable decrease in expenses of the after-sales service for the customer and the supplier.

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

The ECU memory is divided into three principal and functional independent parts : Boot sector, ECU-SW sector and Calibration data sector.
The reprogramming function needs always an existing Boot-SW because all the software routines for a reprogramming session are located in the Boot sector (Boot-SW).
The fundamental restriction is that this sector is not erasable.
The effects resulting from the user actions during a reprogramming session (e.g. key off/key on, false use of the tool, manipulation) and external disruptions on the communication line are not predictable. So the ECU has to ensure that unauthorized actions or failures in the reprogramming session have no impact on the operation of the Boot-SW /ECU-SW.

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

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

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

0.6.3 Communication between reprogramming Tool and ECU

The communication between the reprogramming tool and the ECU is carried out through a unique bi-directional data link (in general K-line).
The reprogramming services are part of the diagnosis services. The basic services are listed below :

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

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

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

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

0.6.4 Functional memory layout

The software is divided into three parts :

- Boot-SW cannot be reprogrammed through the customer protocol,

size depends on the used flash memory.

- ECU-SW reprogrammable, size depends on the used flash memory.
- Calibration data reprogrammable, size depends on the used flash memory.

The following picture shows the principle architecture.

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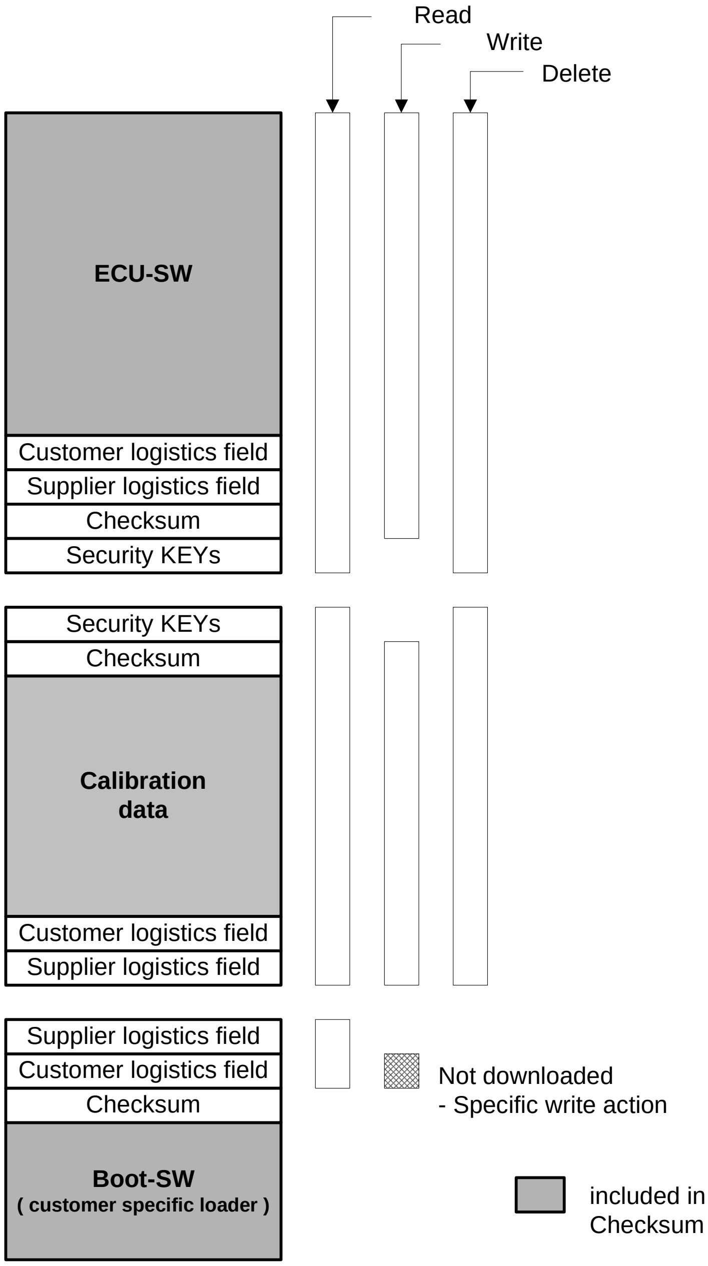

0.6.4.1 Boot-SW

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

Contents :

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

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

0.6.4.2 ECU-SW

The ECU-SW size depends on the functional system requirements. The limitation to a maximum size depends on the used flash device.
This part contains all routines of the applicative SW of the system.
The reprogramming actions affect the complete area, except the security fields (please report to chapter 1.5 - Security mechanisms).
Contents :

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

The logistic information field of the ECU-SW, the checksum information and the interrupt vector table are located at fixed addresses in the same way as the interface table for the Boot-SW.The calibration data contains all information for engine tuning.
The reprogramming actions affect the complete area, except the security fields (please report to chapter 1.5 -Security mechanisms).
Contents :

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

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

0.6.5 Security mechanisms

The effects resulting from user actions during a reprogramming session or caused by unauthorized manipulation are not predictable. So a protection is necessary to avoid erroneous flash contents as a consequence of such an influence.
The SW has to ensure a high level of security so that the above mentioned cases have no impact on the operation of the ECU. Therefore special security mechanisms are implemented. Some for protection and the other for a safe detection if correct reprogrammed.

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

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

0.6.5.1 Security Access

To avoid unauthorized manipulation (read /erase /write actions) of the ECU data, security accesses (Supplier /Customer) are implemented to allow /forbid access to the content of the flash memory.
It is not possible to reprogram the ECU-SW and/or the calibration data if the ECU is not unlocked by a successfully security access phase (according to SAE J2186) between the reprogramming tool and the ECU.
The access to higher security levels (or unlocked state) is realized by two successfully handshake messages (request /response) between the tool and the ECU. Thus the ECU certifies the tool.

0.6.5.2 Reprogramming Keys in RAM

To avoid unpredictable erase /write actions of the ECU data, the basic routines for erase and write actions are inhibited if the Reprogramming Keys are not initialized.
The Reprogramming Keys, 4 RAM bytes, are initialized at each erase /write request that concerns the reprogramming function. These keys are tested by the basic routines (erase /write).
At the end of each erase /write routine and on ECU reset, these bytes are set to 00h.

0.6.5.3 Checksum calculation

To guaranty the validity of the reprogrammed data transmitted through the communication line an independent checksum value is stored in each area (ECU-SW, Calibration data).
This checksum is tested at the end of a reprogramming session. If the calculated values do not fit with the stored values in ECU-SW area and Calibration data area, the applicative software is inhibited and there is no engine operation.

0.6.5.4 Coherence System

The Coherence System ensures that the three independent SW-parts fit together. The coherence identifiers are implemented in the Boot-SW, the ECU-SW and the Calibration data and are checked at the end of a reprogramming session and at start-up of the ECU.
If the three identifiers do not fit together, the applicative software is inhibited and there is no engine operation.

0.6.5.5 Security Keys in flash memory

To guaranty that a reprogramming session is successfully completed, a four bytes Security Key is implemented in each part, which can be reprogrammed (ECU-SW, Calibration data).
These keys are updated at the end of a reprogramming session, and tested at start-up of the ECU. If one of the Security Keys is not valid, the applicative software is inhibited and there is no engine operation.

Functional description of the Security Keys :

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

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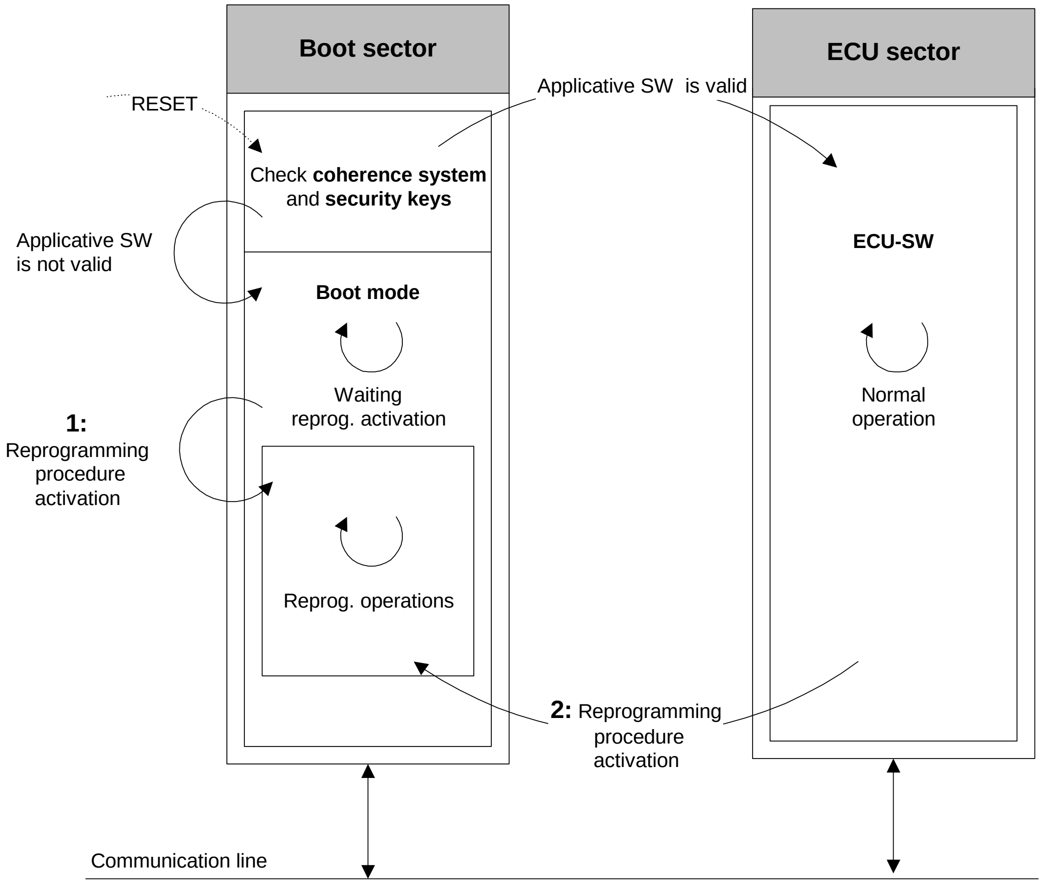
0.6.5.6 Reprogramming session status

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

0.6.6 Reprogramming procedure activation

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

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



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

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

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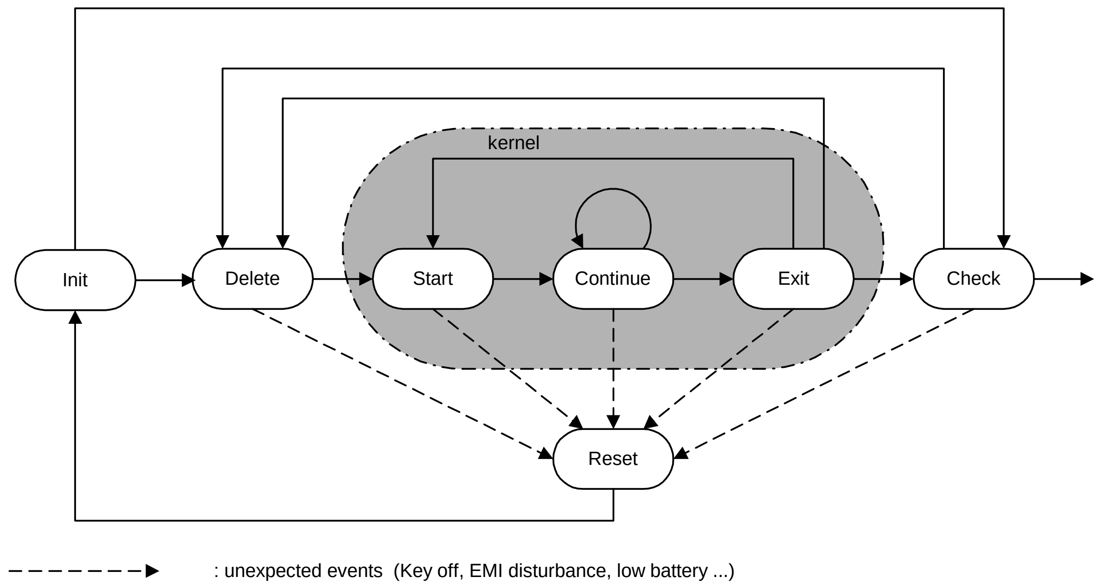
Boot-SW	ECU-SW	Calib. data	ECU action
X	[-]	[-]	ECU activates only Boot-SW, no engine operation
X	[-]	X	ECU activates only Boot-SW, no engine operation
X	[X]	X	ECU activates only Boot-SW, no engine operation
X	[X]	[X]	ECU activates only Boot-SW, no engine operation
X	X	[-]	ECU activates only Boot-SW,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

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

0.6.7 Reprogramming states

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

REPROGRAMMING STATES



0.6.7.1 State Init

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

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

0.6.7.2 State Delete

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

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0.6.7.3 State Start

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

0.6.7.4 State Continue

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

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

0.6.7.5 State Exit

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

0.6.7.6 State Check

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

0.6.7.7 State Reset

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

0.6.8 Reprogramming Status Word definition

The Reprogramming Status Word informs users on the validity of the applicative SW.
This word content is a dynamic information (RAM) and is only valid if the check of reprogramming have been previously performed.
At reset this information is lost.

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

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

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0.7 CPU measurement

Data definition:

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

Calibration data:

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

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FUNCTION DESCRIPTION:

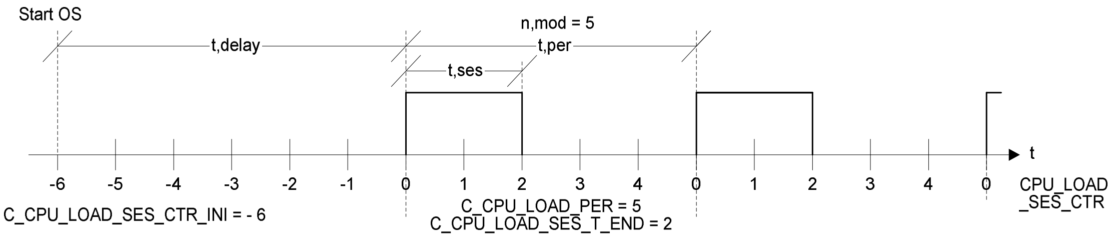
General information:

In a priority-based system, working with a background task (task configured at the lowest priority level and systematically running when no higher priority treatments are triggered), the real processor load is always 100%. Nevertheless, the CPU time spent for the background task can be considered as potential free CPU time (if a higher priority treatment is triggered, the background task will be interrupted).
As a consequence, the CPU load (CPU_LOAD) is then defined as the processor activity above the background level (priority level 0).

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

The detected minimum duration time (depending on the chosen temporization) is shown in value CPU_LOAD_TSK_PER_MIN and shall be put to C_CPU_LOAD_TSK_PER_MIN.
After having fixed C_CPU_LOAD_TSK_MES_DLY and C_CPU_LOAD_TSK_PER_MIN, these two calibrations, plus C_CPU_LOAD_PER and C_CPU_LOAD_SES_T_END (see description below) shall be set none tunable in DDS in order to make sure that no miscalibration is possible.

During a measurement session t_{ses} of period t_{per} occurring every fixed modulo counter n_{mod} (C_CPU_LOAD_PER), TASK_BG_MES is triggered once from the application and then continuously re-activates itself.
This measurement session t_{ses} starts at the beginning of the period t_{per} and can be tuned up to 100% of the period t_{per} (boundary case, where C_CPU_LOAD_SES_T_END is set equal C_CPU_LOAD_PER). The measurement session t_{ses} shall be less than or equal to 1 second. A start delay of measurement can be defined by setting the session counter CPU_LOAD_SES_CTR to a negative value at initialization (calibration C_CPU_LOAD_SES_CTR_INI).



The potential free CPU factor $\mathrm{CPU}_{\mathrm{free}}$ is obtained by multiplying the counted occurrences n (CPU_LOAD_TSK_PER_CTR) of measurement background task (TASK_BG_MES) over the measurement session with the duration of the measurement background task.

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

The CPU load value (CPU_LOAD) is then deduced from the potential $\mathrm{CPU}_{\mathrm{free}}$ value.

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

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Due to a continuous activity at priority level 1 during the measurement period, it must be noticed that the background treatments running at priority 0 will not occur during the measurement session.
CPU_LOAD_FIL is the PT_1 filtered value of CPU_LOAD with P=1 and T_1 set by C_CPU_LOAD_FTC (see description of calibration).
The variable CPU_LOAD_MAX represents the maximum detected CPU load value. The variable CPU_LOAD_FIL_MAX represents the maximum of the filtered CPU load value.

The following diagram summarizes the principle of the measurement method:

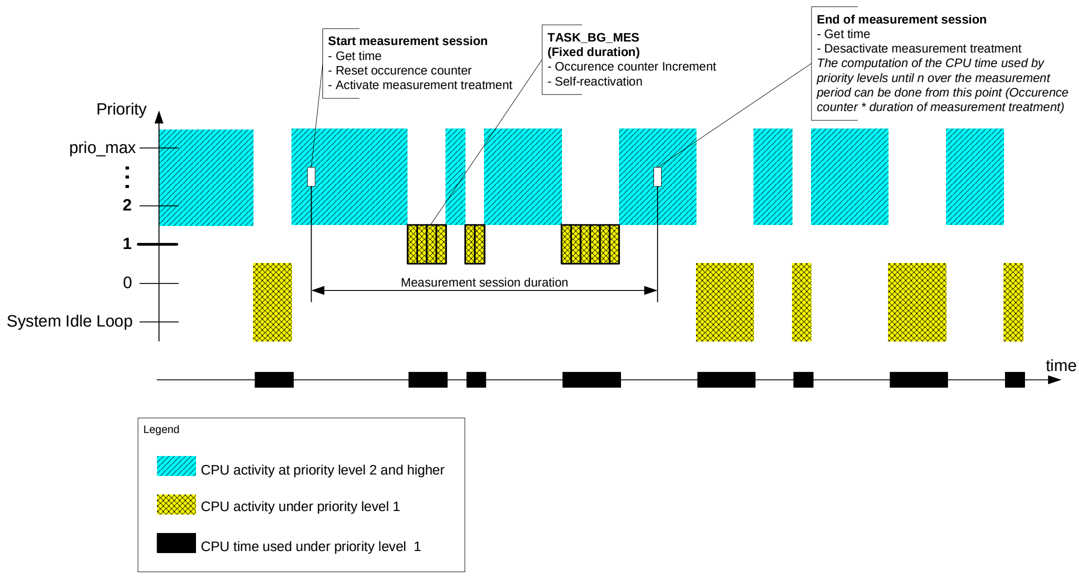

Figure 0.7.1: : The principle of the measurement method

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

Measurement enable API:

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

Measurement disable API:

Shall be used to disable measurement method.

Clear Maximum API:

Shall be used to clear CPU_LOAD_MAX and CPU_LOAD_FIL_MAX.

C_CPU_LOAD_TSK_PER_MIN and C_CPU_LOAD_TSK_MES_DLY:

The calibration C_CPU_LOAD_TSK_PER_MIN must be set equal to the value CPU_LOAD_TSK_PER_MIN after it is computed depending on the temporization value C_CPU_LOAD_TSK_MES_DLY.

C_CPU_LOAD_PER and C_CPU_LOAD_SES_T_END:

The measurement window is to be set with C_CPU_LOAD_PER (modulo counter of measurement session, measurement window always starts if counter is zero and if start is allowed) and C_CPU_LOAD_SES_T_END (measurement window stops at this counter value). If C_CPU_LOAD_PER is equal to C_CPU_LOAD_SES_T_END the duty cycle of the measurement is 100%.

C_CPU_LOAD_SES_CTR_INI:

With C_CPU_LOAD_SES_CTR_INI an easy start delay of measurement session can be set.
The content of the value is calculated with

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

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

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

C_CPU_LOAD_FTC:
Filter time constant for filtered CPU load (CPU_LOAD_FIL).

$$C\_CPU\_LOAD\_FTC = \frac{T \cdot n_{mod}}{T \cdot n_{mod} + T_1}$$, with T = recurrence of time triggered function, n_{mod} is the modulo counter C_CPU_LOAD_PER and T1 is the needed filter time.

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

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

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0.8 ECU warm reset detection

Data definition:

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

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

Input data:

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

Calibration data:

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

Configuration data:

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

Import actions:

ACTION_INFR_GetBiosAdcStatus (**OUT**<Bios_adc_status>)

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0.8.1 Export Actions

ACTION_SetRstInfo_ECM3	
Action sets reset information of ecm3 security system	

General information:

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

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

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

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

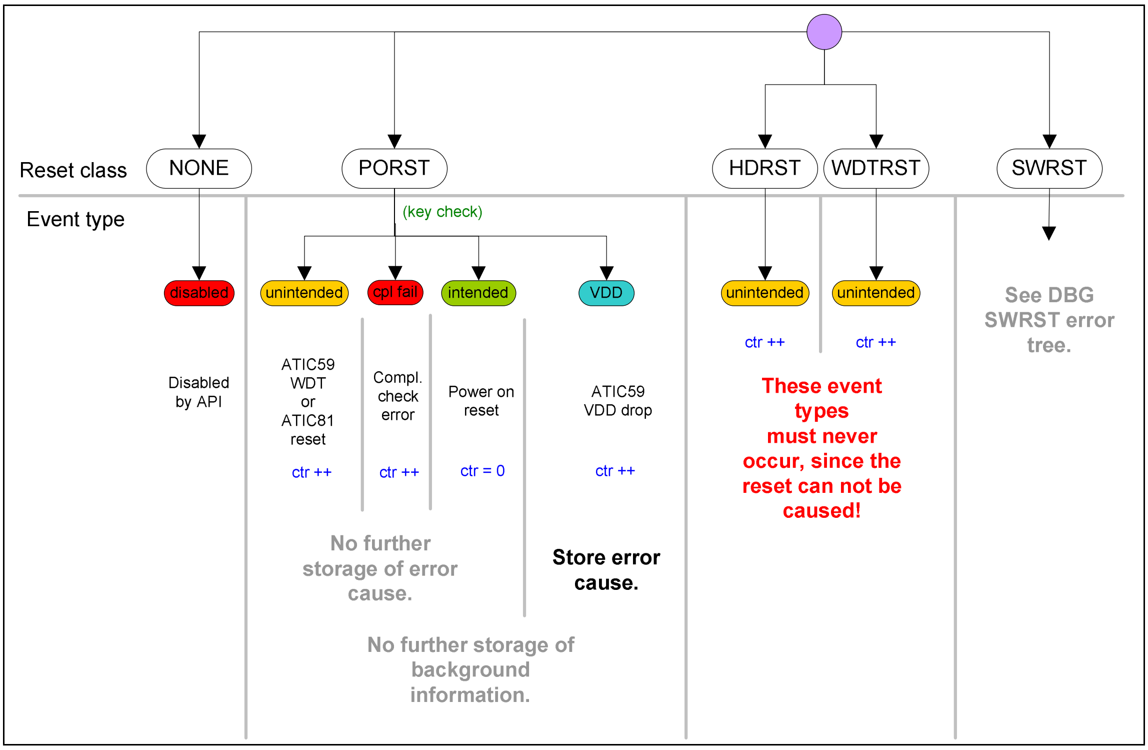

Figure 0.8.1: : DBG main reset class

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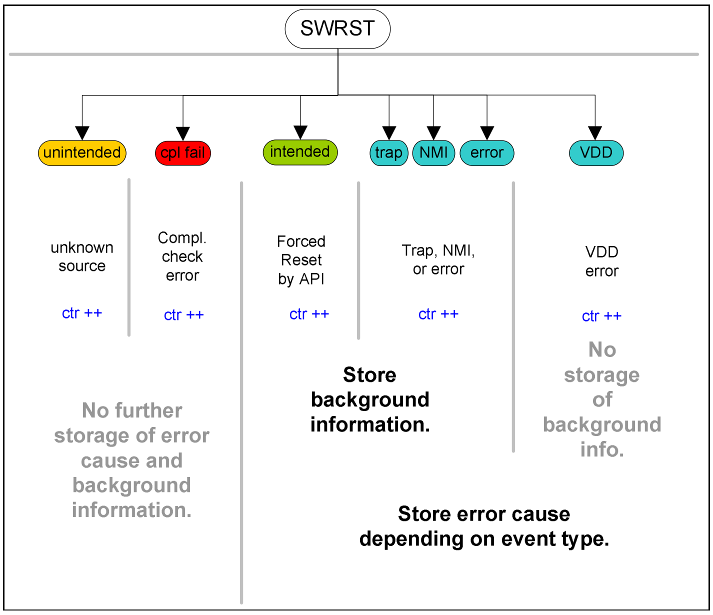

Figure 0.8.2: : DBG SWRST reset tree

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

The error cause is more detailled or is set to 0 if not valid. It is used here as RST_INFO_ADD.

The background information is only stored/updated for event types as shown above. Only some backtrace information is provided at the moment, named RST_DBG_BACKTRACE_ADDRESS. The information is marked valid or invalid through RST_DBG_BACK_INFO_VLD. The complete info is set to 0 if not valid.

In a further step a warm/cold-Reset-detection is done by following mechanism:
A reset-save key which is written at ECU power-up and destroyed at regular ECU power-down. Checking this key against its init-value allows to detect a warm-reset.
By comparing the debug driver and the reset-save key it is possible to distinguish between internal or external MC-resets.

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

RST_TYP

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

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

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

RST_SEC

This value represents, whether the implemented security mechanism ECM3 has notified the module after restart through the interface ACTION_SetRstInfo_Ecm3 (see below) about an executed reset.

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

RST_INFO_CTR

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

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

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

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

Information lists are defined as arrays:
NC_RST_DBG_LIST_SIZE (see module configuration data: e.g. MSx80=2 except MSD81.0=1, MSD85=1)
NC_RST_DBG_BACKTRACE_SIZE = 5

RST_CLAS_TYP[NC_RST_DBG_LIST_SIZE]

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

RST_CLAS_SEC[NC_RST_DBG_LIST_SIZE]

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

RST_INFO_ADD[NC_RST_DBG_LIST_SIZE]

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

RST_INFO_ADD at RST_CLAS_TYP = 42h (Intended Software Reset)

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

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

RST_INFO_ADD at RST_CLAS_TYP = 44h (Trap)
If a software reset by trap occured, the equivalent value is stored in format:

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

The trap classes represent more in detail, which type of trap occurred.
A trap occurs as a result of an event such as a Non-Maskable Interrupt (NMI), an instruction exception, memory-management exception or an illegal access. Traps are always active; i.e. they cannot be disabled by software action.
The TriCore architecture specifies general classes for traps. Each class has its own trap handler, accessed through a trap vector of 32 bytes per entry, indexed by the hardware-defined trap class number.

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

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

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

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

Info TIN in trap class 0

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

Info TIN in trap class 1

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

Info TIN in trap class 2

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

Info TIN in trap class 3

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

Info TIN in trap class 4

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

Info TIN in trap class 5

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

RST_INFO_ADD at RST_CLAS_TYP = -h (NMI)

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

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

RST_DBG_BACK_INFO_VLD[NC_RST_DBG_LIST_SIZE]

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

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

RST_DBG_BACKTRACE_ADDRESS[NC_RST_DBG_LIST_SIZE][NC_RST_DBG_BACKTRACE_SIZE]

If additional background information is valid, a list of NC_RST_DBG_BACKTRACE_SIZE
32-bit values is provided for further investigation purposes.

Hex-val	**Description**
xxxxxxxxh	Backtrace address 0
yyyyyyyyh	Backtrace address 1
zzzzzzzzh	...

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

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

Formula section:

Evaluate controller information:
RST_TYP

RST_SEC = 0 (reset to 0)

If (1) RST_TYP = 12h (Intended Power-On Reset)
Then (1)
Power-On-Reset detected
LV_WARM_RST = 0
Else (1)
warm-Reset detected
RST_INFO_CTR = Reset Counter from Debug driver
Shift all list entries by one, eg. (*first in first out* of stored informations)
RST_CLASS_TYP[NC_RST_DBG_LIST_SIZE-2]
-> RST_CLASS_TYP[NC_RST_DBG_LIST_SIZE-1]
->
RST_CLASS_TYP[0]
-> RST_CLASS_TYP[1]
Erase newest list entries, eg.
RST_CLASS_TYP[0] = 0
Evaluate and store actual values in list
RST_CLASS_TYP[0] = RST_TYP
RST_INFO_ADD[0] = Cause from Debug driver (Additional Info)
CPU_LOAD_MAX_RST_DET[0] = CPU_LOAD_MAX at reset
N_CPU_LOAD_MAX_RST_DET[0] = N_MAX at CPU_LOAD_MAX

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

Later notification from security system:

Activation: **Action at notification from ECM3 (ACTION_SetRstInfo_Ecm3)**

Formula section:

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

The safety-concept will submit the information after a reset, when rst-information from the MU is available. As it is not known, whether or when such a reset can be detected by security system, the trap reset can set error SYM_0 before it will be set to SYM_1 by security system.

Clearing of stored data can be done on demand:

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

Formula section:

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

Clear all list entries, eg.
RST_CLASS_TYP[NC_RST_DBG_LIST_SIZE-2] = 0
...
RST_CLASS_TYP[0] = 0

Activation: **Action for status ADC from interface (ACTION_GetBiosAdcStatus)**

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called every 10ms

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

Formula section:

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

ACTION_INFR_GetBiosAdcStatus **(**Bios_adc_status**)**

set counter CTR_ADC_OUT according STD_INI

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

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

0.8.2 Handling of ECU-Reset detection in error management

FUNCTION DESCRIPTION:

Description:

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

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

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

In this case actually the byte RST_CLAS_TYP[0] which include the causes of resets is additionally sent to error management.
Error symptoms are defined to this diagnosis function as follows:

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```
[ | | | ]
 |  |  |  └> -   Intended software reset (SWRST)      (= SYM_0)
 |  |  └───> -   Reset by safety-concept              (= SYM_1)
 |  └──────> -   Reset unintended by software         (= SYM_2)
 └─────────> -   Reset unintended by hardware         (= SYM_3)
```

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

at clearing FMY

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

Hint: As described also in ASW the CPU_LOAD_MAX is reset with LC_CPU_LOAD_MAX_RST.

cyclic data collection

recurrency: 10 ms

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In the warm-reset memory several data are cyclic saved every 10ms. CPU_LOAD_RST_DET is updated with CPU_LOAD. In case of an occured warm-reset the memory is read at initialisation of ECU. CPU_LOAD_RST_DET represents the CPU_LOAD at warm-reset. N_RST_DET is the related engine speed at this warm-reset. The CPU_LOAD_MAX_RST_DET is the occured maximum and saved in non-volatile memory. It gives information about several cycles. N_CPU_LOAD_MAX_RST_DET is the related engine speed at this maximum.

Related to warm-reset memory DIST_RST_DET represents the distance and TRT_RST_DET represents the total runtime at the last occured warm-reset.

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

The data listed in the table are enabled to configure in freeze frame as environment data.
If a reset occurs and send to error-management the freeze frame is saved. Via tester the data are readable on the diagnostic communication line.

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

Cyclic stored CPU_LOAD = CPU_LOAD
Cyclic stored N = N
Cyclic stored DIST = DIST
Cyclic stored TRT = TRT

if CPU_LOAD_MAX > Cyclic stored CPU_LOAD_MAX
Cyclic stored CPU_LOAD_MAX = CPU_LOAD_MAX
Cyclic stored N_MAX = N
Endif

Application conditions

Recurrence: *100ms*

Initialisation:
```
after clearing FMY
 LV_CDN_DIAG_WARM_RST = 1
 LV_RST_DET_DISP = 0
```

Activation:
```
 (LV_WARM_RST = 1 AND
    LC_WARM_RST_ENA = 1 AND
 N_RST_DET[0] > C_N_RST_DET)            //cyclic saved engine
speed//
```


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Deactivation: *(LV_WARM_RST = 0 OR*
LC_WARM_RST_ENA = 0 **OR**
N_RST_DET <= C_N_RST_DET

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

Cyclic stored CPU_LOAD_MAX = 0
Cyclic stored N_MAX = 0
Cyclic stored CPU_LOAD = 0
Cyclic stored N = 0
Cyclic stored DIST = 0
Cyclic stored TRT = 0

Formula section:

```
ERR_SYM_WARM_RST = NO_SYM
LV_ERR_WARM_RST = 0          (actual error flag is reset by error management)
IF(1)        LV_RST_DET_DISP = 0
THEN(1)
            LV_ERR_WARM_RST = 1              no debounce, set by error manager
            RST_CLAS_SEC[0] = RST_SEC          copy to actual list entry
           IF(2)                   (RST_CLAS_TYP[0] = 01h
                   or          RST_CLAS_TYP[0] = 10h)
              THEN(2)
                  IF(3)                  RST_CLAS_SEC[0] = 1
                      THEN(3)
                          ERR_SYM_WARM_RST = SYM_1
                      ELSE(3)
                          ERR_SYM_WARM_RST = SYM_3
                      ENDIF(3)
           ELSEIF(2)          (RST_CLAS_TYP[0] = F0h
                   or          RST_CLAS_TYP[0] = 12h (should not at LV_WARM_RST = 1)
                   or          RST_CLAS_TYP[0] = 13h
                   or          RST_CLAS_TYP[0] = 20h
                   or          RST_CLAS_TYP[0] = 30h)
              THEN(2)
                  ERR_SYM_WARM_RST = SYM_3
              ELSEIF(2)          RST_CLAS_TYP[0] = 40h (unintended software reset)
              THEN(2)
                  ERR_SYM_WARM_RST = SYM_2
           ELSEIF(2)          (RST_CLAS_TYP[0] = 11h (Complement err. at Power-On Reset)
                       or          RST_CLAS_TYP[0] = 41h (Complement error at Software Reset)
              THEN(2)
                  ERR_SYM_WARM_RST = SYM_3
              ELSEIF(2)          RST_CLAS_TYP[0] = 42h (intended software reset)
              THEN(2)
                  IF(3)                  (RST_INFO_ADD[0] = 00000000h (no info available)
                          OR          RST_INFO_ADD[0] = 00000400h (SUPRAM)
                         OR          RST_INFO_ADD[0] = 00000401h (NVMY)
                         OR          RST_INFO_ADD[0] = 00000402h (ADC)
```

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

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

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1 - General

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1.1 ENTE Configuration data

Input data:

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

Configuration data:

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

FUNCTION DESCRIPTION:

General information:

The logical constants NC(NLC)_xxx_CONF are necessary to adapt the Aggregate to a given system environment. The values describe either the variant of a used system component, or a vehicle component is available or not.
With use of the logical constant **NLC_ECT_CONF** the availability of an electronically controlled thermostat within the system is determined. In case of a vehicle configuration with an ECT, the component control and diagnosis is included within the aggregate version. (refer: ENTE A.I.D.)
With use of the logical constant **NLC_TCO_2_CONF** the availability of a coolant temperature sensor at radiator outlet is determined. In case of a vehicle configuration with a TCO_2 sensor, the sensor signal acquisition and diagnosis is included within the aggregate version. (refer: ENTE A.I.D.)
The configuration constant **NC_ECF_CONF** allows to determine the wanted fan control strategy. In principal it is possible to choose between a RLY- or a PWM-control architecture. A RLY/PWM fan control strategy in parallel is also existing. In this case the aggregate architecture allows switching either the control of RLY-fan(s) or the control of PWM-fan(s) during ECU runtime depending on the setting of a corresponding configuration bit. The control of both variants (RLY- and PWM-fan(s)) at the same time is not allowed and not supported within the aggregate.
Independent on the chosen fan control strategy (PWM/RLY), the configuration constant **NC_ECF_NR** describes the number of available cooling fans (hardware components) at the vehicle. In case of a PWM-fan configuration, the number of available PWM cooling fans at the vehicle is always equal to the number of PWM fan output stages provided by the ECU hardware.
Because one or more RLY-switch(es) may control only one cooling fan (hardware component) in case of a RLY-fan configuration, the number of RLY-switch(es) per cooling fan can be different. With use of the configuration constant **NC_ECF_RLY_NR**, the number of RLY output stages per cooling fan are determined.
With use of the constant **NC_ECTPWM_xxx** it is possible to adjust the PWM output range of the electronic controlled thermostat signal during normal operation conditions or when a thermostat error occurs. In case of a thermostat failure the PWM output signal is set to a defined value for safety issues.
The following describes the general rules for determination of the configuration data.

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1.1.1 Local configuration data

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

Data	Value
NLC_ECT_CONF	[1] Electronically controlled thermostat (ECT) is available
NLC_TCO_2_CONF	[1] Coolant temperature sensor at radiator outlet is available
NC_ECF_CONF	[1] Control of PWM-fan(s) requested (only PWM fan(s))
NC_ECF_NR	[1] Number of available cooling fans (hardware components) at the vehicle
NC_ECF_RLY_NR	[0] Number of RLY output stages per cooling fan (hardware components) (NC_ECF_RLY_NR=0 have to be adjusted in case of NC_ECF_CONF=1)
NC_ECTPWM_MAX	99,6 % Maximum limitation of ECTPWM signal
NC_ECTPWM_MIN	0,4 % Minimum limitation of ECTPWM signal
NC_ECTPWM_SUB_DIAG	[4,31%] - (B08**H**) Adjusted ECTPWM signal in case of failures
NC_NR_TCO_SENS	2

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1.2 System overview and description

Calibration data:

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

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

The following graphic shows examples of physical cylinder numbers:

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

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

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

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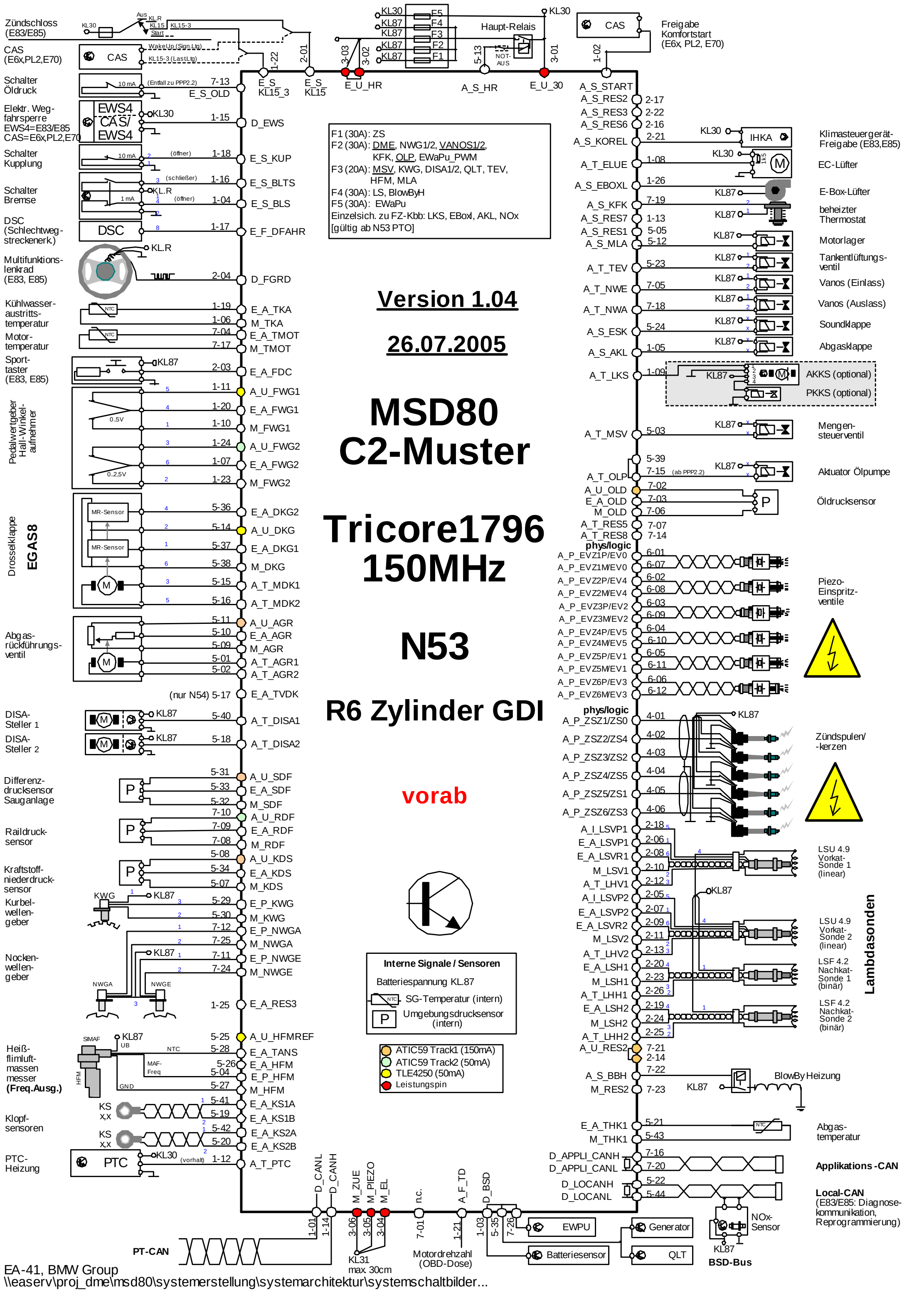
1.2.1 System Pictures



EA-41, BMW Group
\\easerv\proj_dme\msd80\systemerstellung\systemarchitektur\systemschaltbilder...

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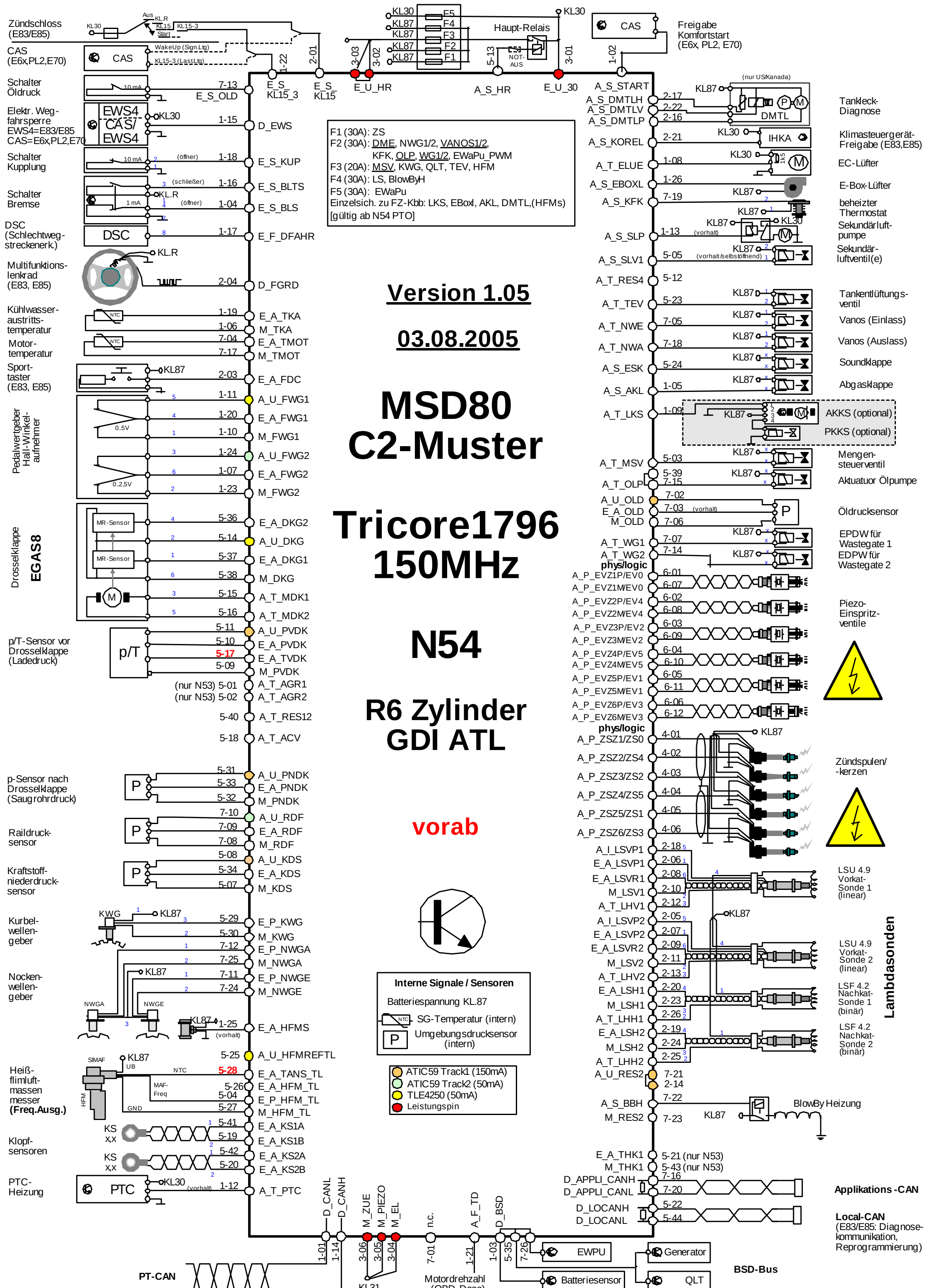

EA-41, BMW Group
\\easerv\proj_dme\msd80\systemerstellung\systemarchitektur\systemschaltbilder...

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1.2.2 Dataset identification and checksum calculation

FUNCTION DESCRIPTION:

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General information:

The INCA application tool doesn t store a dataset identifier when a dataset is sent to the ECU. Therefore it is not possible to empathise which dataset really is in an ECU. To solve this problem three calibratable variables C_DATA_ID_0, C_DATA_ID_1 and C_DATA_ID_2 are introduced. Every variable can be calibrated with 5 ASCII signs, wich are the identifier of the dataset. The variables are only visible in INCA (SAM doesn't support ascii format).

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

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1.3 Nomenclature of the used data names and abbreviations

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

A table (ID_) also can be uni- or multidimensional.
The table value is not obtained by interpolation.

The allocation of the table values to the data points is defined as follows:
A table value i applies if the input value is greater than or equal to the data point i.

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

```
                                                                    LDP 8
                                                             LDP 7        | 8
                                                 LDP 6             | 7   |______
                                                LDP 5          | 6     |______
                                     LDP 4          | 5       |_____
                                   LDP 3       | 4          |______
                         LDP 2        | 3    |_____
Table                              | 2          |_____
value 1                          |_____
______
|
|
LDP 1 (=Input value  <  LDP 2)
```

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

Example of nomenclature:

The term "IP_TIB__N__MAF" means that the index table value TIB (basic injection period) is obtained by a two-dimensional interpolation.

The dependence of the index table value is defined by the suffix __N__MAF :
TIB is a function of the engine speed data point and of the air mass data point, i.e. of the general engine speed and air mass data points.

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

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1.4 SYCF Configuration data

Input data:

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

Configuration data:

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

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

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

Description:

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

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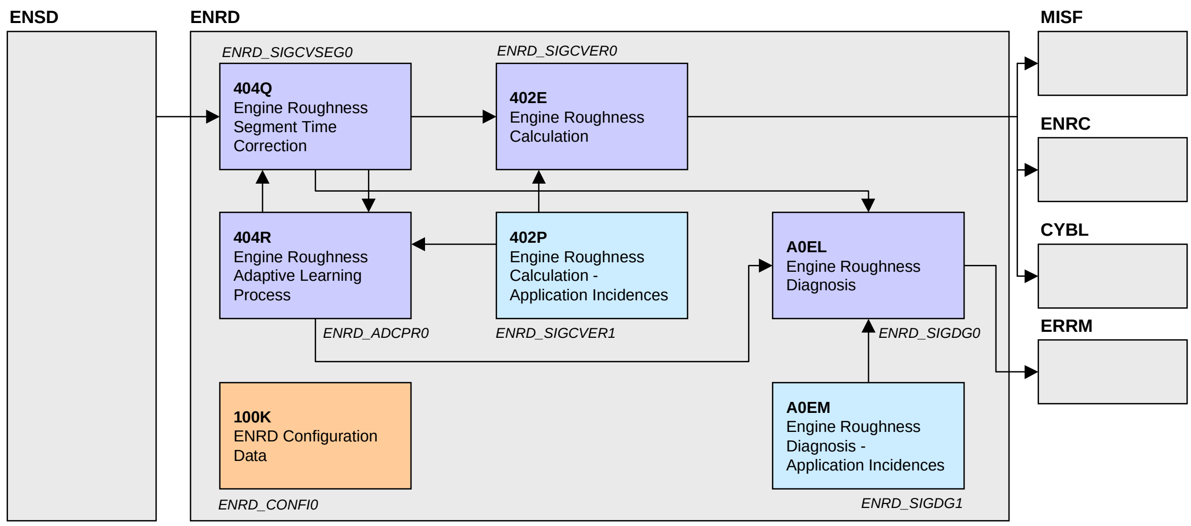
1.5 ENRD General

1.5.1 General description

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

1.5.2 Architecture Overview



1.5.3 Description of the containing functions

1.5.3.1 404Q Engine roughness segment time correction

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

1.5.3.2 402P Engine roughness calculation - Application Incidences

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

1.5.3.3 402E Engine roughness calculation

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

1.5.3.4 404R Engine roughness adaptive learning process

Engine roughness adaptive learning process provides adaptive values to 404Q module, to minimise noises produced by flywheel mechanical tolerances.
This module also consumes fade-out requests coming from 402P module.

1.5.3.5 A0EM Engine roughness diagnosis - Application Incidences

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

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1.5.3.6 A0EL Engine roughness diagnosis

This modules provides two diagnosis :

A diagnosis for the ER segment acquisition (thin synchronisation default criterion).

A check range diagnosis for the ER adaptive values obtained by the 404R module.

1.5.3.7 100K ENRD Configuration data

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

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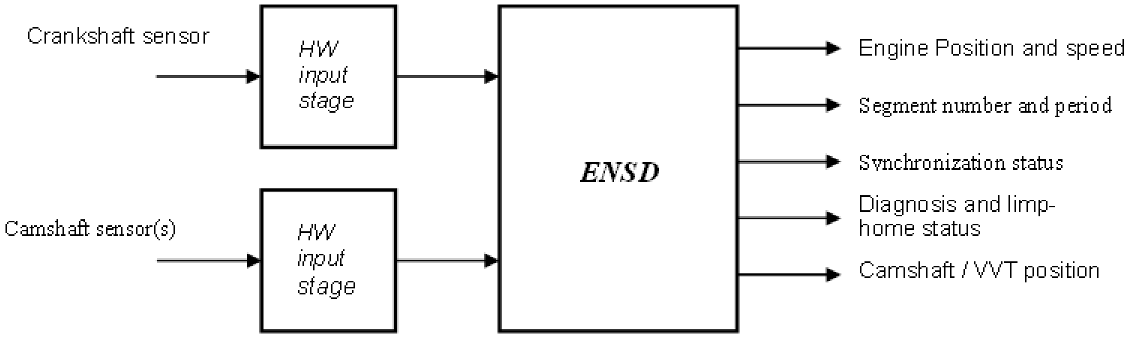
1.6 ENSD General

1.6.1 General Description



Up to 4 camshaft sensors are supported.

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

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

At engine start, three synchronization modes are activated:

1. Crankshaft (self-)synchronization:

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

1. Camshaft (self-)synchronization:

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

1. Camshaft/crankshaft synchronization:

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

Injection /Ignition can be enabled as soon as

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

A corresponding status information (LV_SYN_ENG /LV_SYN_VLD) is produced and sent to the other aggregates.

Overview

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

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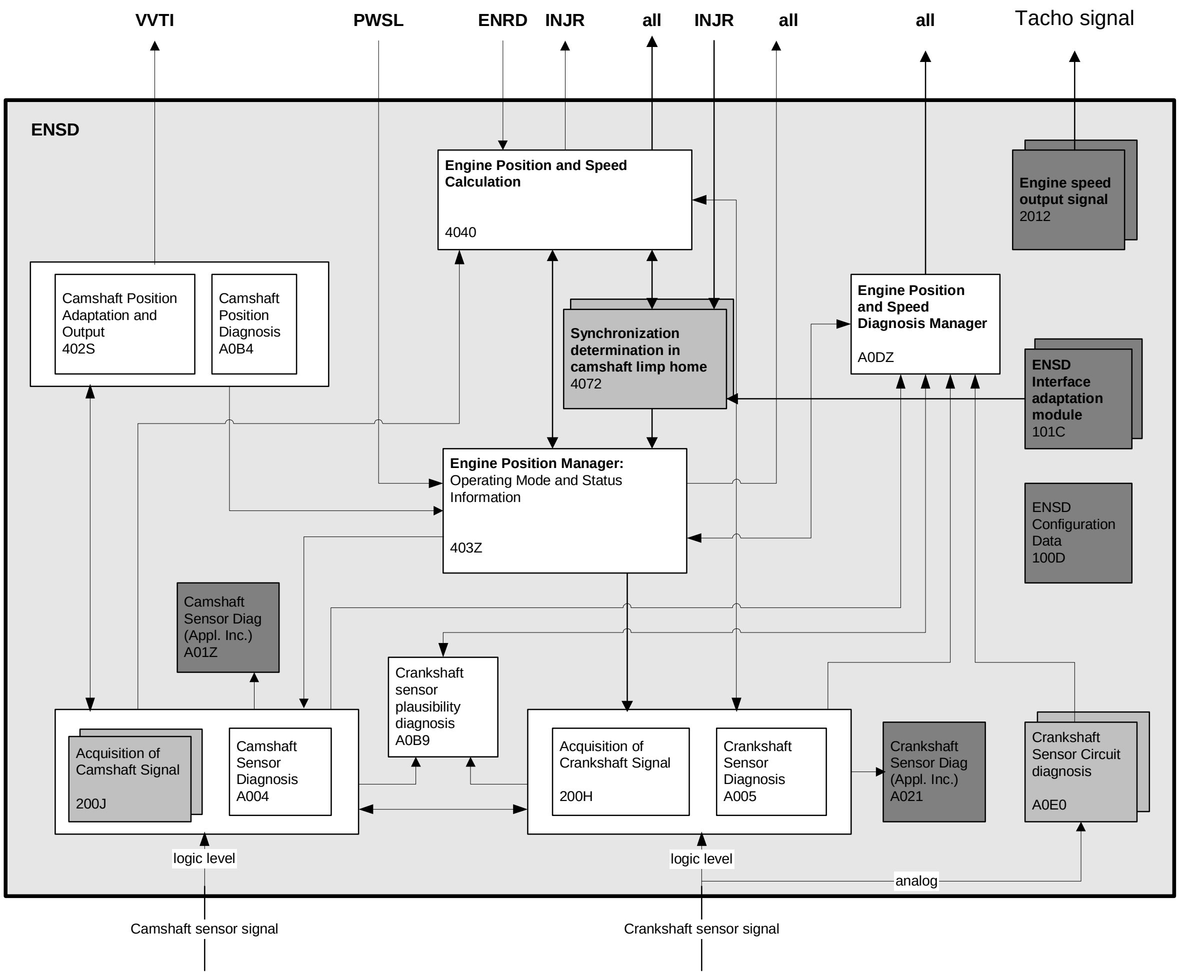

The light shaded blocs represent modules which are choosen in function of the actual system configuration (Hook modules).
The dark shaded blocs represent modules which have to be modified by the project (templates - Hook modules)

1.6.2 Short description of the containing functions

200H: Acquisition of crankshaft signal

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

200J: Acquisition of camshaft signal

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

403Z: Engine position manager

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

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4040: Engine position and speed calculation
Calculation of engine position, speed, speed gradient, fast engine speed, segment period and number.
4072: Synchronization determination in camshaft limp-home
Engine synchronization determination in camshaft camshaft limp-home by specific injection pattern management
402S: Camshaft adaptation and position output
Camshaft edge position adaptation and camshaft position feedback for VVT-controller.
A0DZ: Engine position and speed diagnosis manager
Generation of diagnosis information and diagnosis inhibition flags.
A004: Camshaft sensor diagnosis
Camshaft segment period diagnosis and camshaft ratio check.
A0B4: Camshaft position diagnosis
Diagnosis of camshaft to crankshaft reference position.
A005: Crankshaft sensor diagnosis
Crankshaft tooth number and tooth period diagnosis.
A0B9: Crankshaft sensor plausibility diagnosis
Failure detection if crankshaft synchronization cannot be achieved, if camshaft signal is missing and if camshaft signal not valid for engine synchronization.
A021: Crankshaft sensor circuit diagnosis
Detection of open circuit and short circuit for magnetic crankshaft position sensor.

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1.7 ERRM General

General Information

Architecture Overview

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

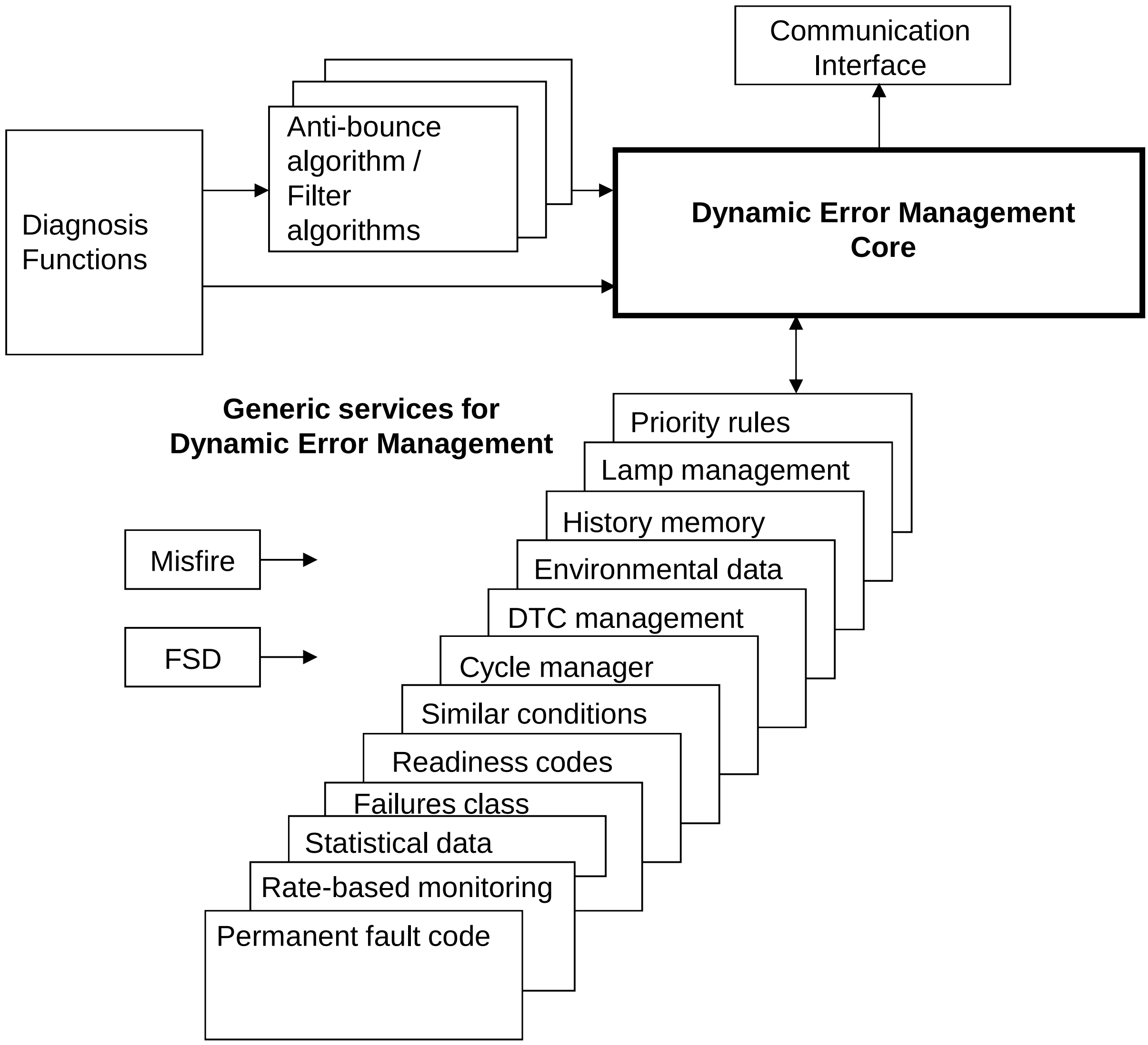

Figure 1.7.1:

Target /Objectives of ERRM function

The purpose of the Error Management is :

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

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

Description of the containing functions

- Dynamic Error Management core

The dynamic error management core manages different failures states thanks to the fault detection performed by the diagnoses : detected, present, temporary, pending, disappeared and confirmed. All failures are detected without any limitation on quantity. On the contrary, the number of present failures able to be stored into dynamic memory is limited. Management of this limitation is performed thanks to priority rules mecanism.
When a failure is stored into dynamic memory, the related environment data is stored, the lamp management may force lamp illumination (MIL, WAL,...), and DTCs management is done until failure is deleted. When deleted, failures are stored into history memory.

- History memory

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

- Debounce algorithm

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

- Multi-conditions debounce algorithm

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

- Cycle manager

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

- Failures class

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

- DTC management

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

- Communication interface

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

- Priority rules

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

- Environmental data

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

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- Similar conditions

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

- Lamp management

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

- Readiness codes

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

- Rate-based monitoring

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

- Statistical data

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

- Permanent fault code

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

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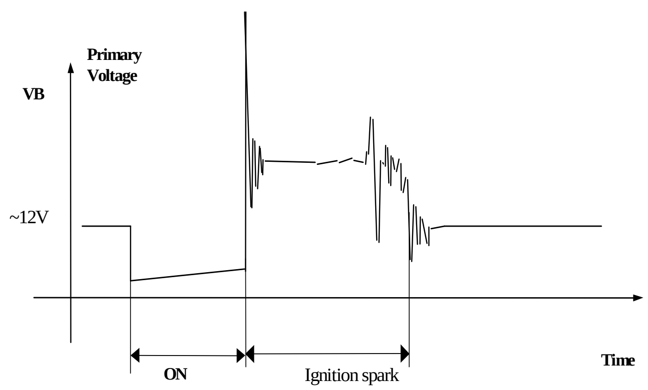
1.8 IGRE General

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

1.8.1 Purpose

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



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

Function Description

This function sets the angular position of the dwell time turn on in order to have the time to set up the necessary current in the ignition coil.
The strategy is based on a priority of the ignition angle. If dwell time priority is requested the minimum dwell time is equal to maximum dwell time.
The strategy respects ignition coils with dual and single outputs. This function could be used independently of the number of cylinders (x) and the geometry of the crankshaft target wheel.
All of the functions described in this section operate over the entire engine speed range.

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

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1.9 LACO General

General information:

The Aggregate LACO fulfils the following tasks:

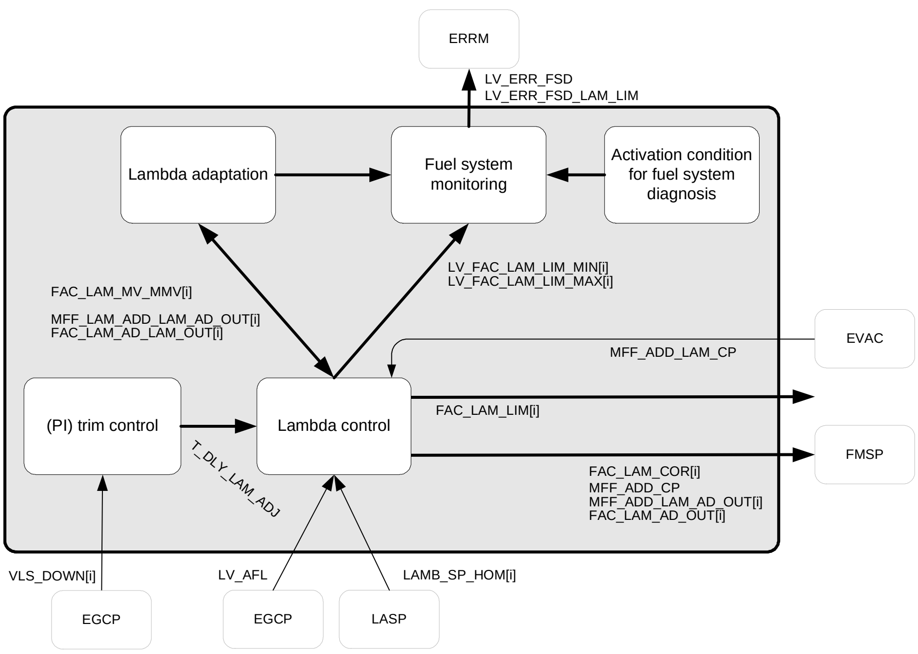
- Lambda control based von upstream oxygen sensor signal
- Trim control based on downstream oxygen sensor signal
- Lambda adaptation
- Fuel system monitoring

The aggregate is available in 2 variants:

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

Architecture Overview:

Variant 1:



Variant 2:

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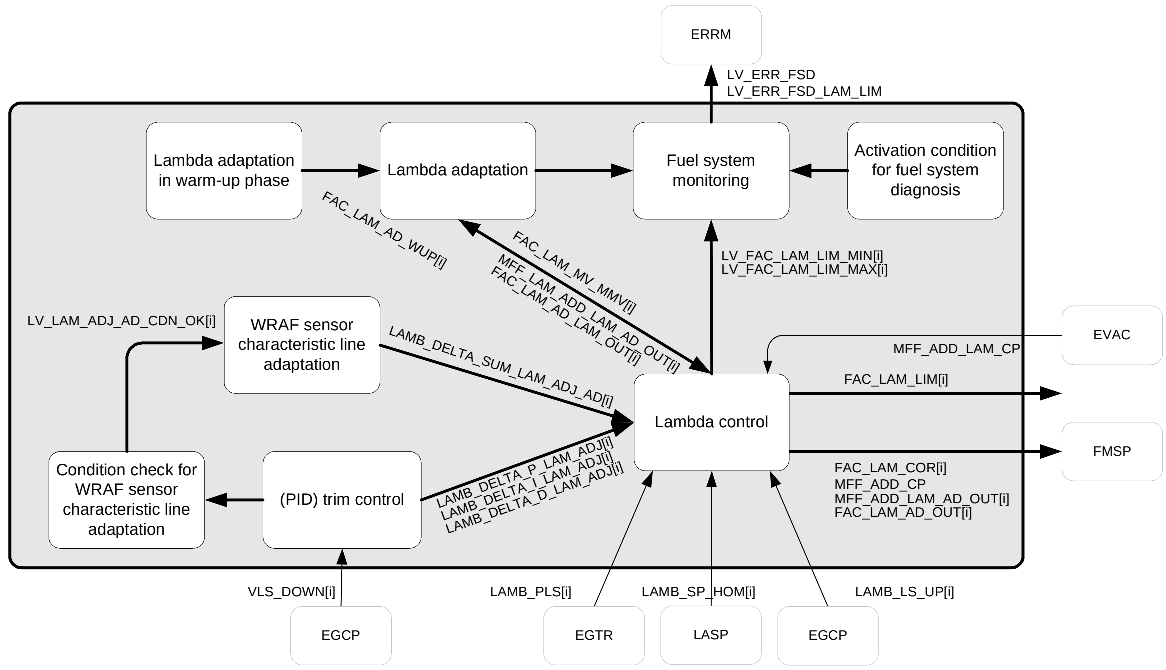

Functional Overview:

1.9.1 Lambda control

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

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

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

1.9.3 Lambda adaptation

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

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

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

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TCO dependent correction factors (%) are learned in five temperature ranges. The correction factors are derived from the Lambda controller output. They are learned in an adaptation field specified by MFF_SP[i] and N_32. They are, however, to correct the injection time for all engine states. Learning of these factors requires that the Lambda controller is in the state 'ON'.

1.9.5 Dynamic fuel trim

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

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

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

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

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

1.9.8 Mean value calculation for limited dynamics

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

1.9.9 Fuel system monitoring

The objective of the fuel system diagnosis is to monitor the lambda control output and the lambda adaptation values in various areas. It should also cover the PCV monitoring where the lambda control output is considered in the idle range.
Breaking the adaptation and lambda controller limits for a long time, which may have been caused by failures in the fuel or intake system will involve emission rise and therefore shall be diagnosed by fuel system diagnosis.

1.9.10 Activation of fuel system monitoring

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

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1.10 MISF General

General Information

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

- **CARB A misfire failure criterion:**

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

- **CARB B1 misfire failure criterion:**

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

- **CARB B4 misfire failure criterion:**

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

Architecture Overview

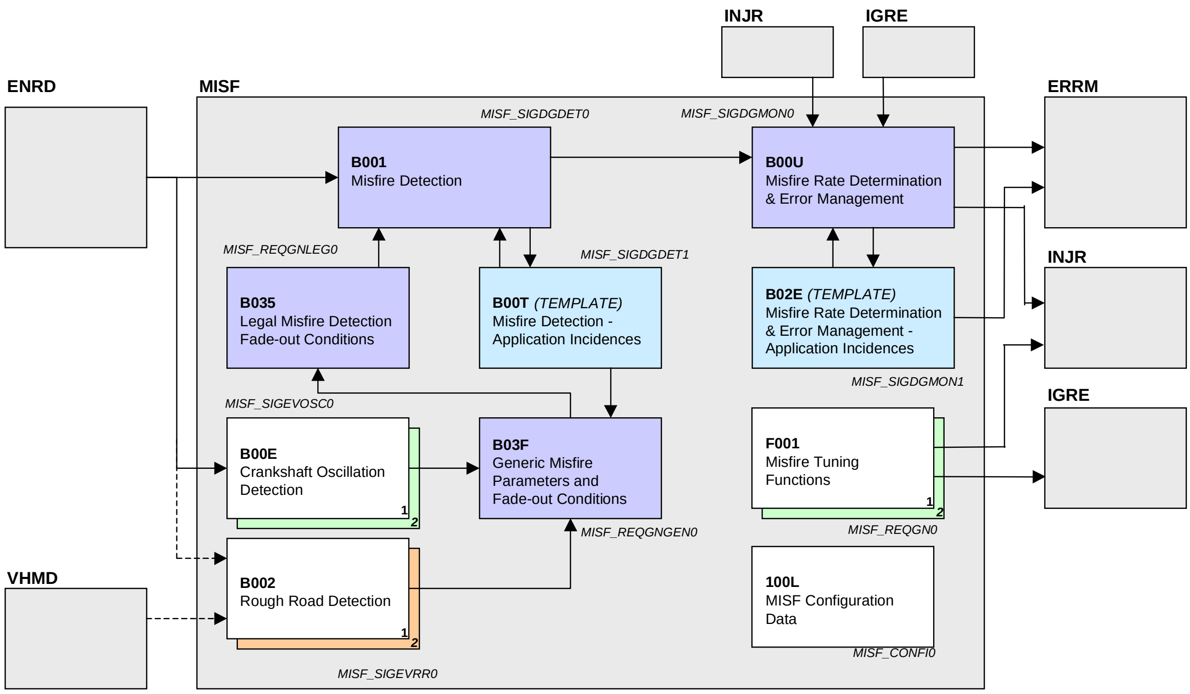

Figure 1.10.1:

Description of the containing functions

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B00E - Crankshaft oscillation detection
The crankshaft oscillation detection module uses engine roughness components to identify drivetrain oscillations than could cause wrong misfire detections in a defined engine operating area. If such oscillation occurs, this module triggers a fade-out.
B002 - Rough road detection
The rough road detection module uses informations coming from wheel speed sensor(s) or from ABS module (via harness or CAN) to identify transmission oscillations than could cause wrong misfire detections in a defined engine operating area. If such oscillation occurs, this module triggers a fade-out.
B03F - Generic misfire parameters & fade-out conditions
This module provides parameters needed for the misfire detection process (data delayed, data stacks, and zero load line...). It also managed all generic misfire fade-out conditions linked to the misfire detection method.
B035 - Legal misfire detection fade-out conditions
This module manages all legal misfire fade-out conditions defined in legal texts (US & EC).
B00T - Misfire detection - Application incidences
This module defines specific corrections for detection thresholds, application specific fade-out with standardised outputs to the generic modules.
B001 - Misfire detection
Detection core function based on engine roughness index provided by ENRD.
B00T - Misfire detection - Application incidences
Some functionality for calibration ease can be launched after detection.
B02E - Misfire rate determination & error management - Application Incidences
This module defines application specific fade-out & informations with standardised outputs to the generic misfire rate determination module. Diagnosis conditions are defined in this module.

Must be executed before B00U module.
B00U - Misfire rate determination & error management
This module defines the Misfire criterions according legal texts description *(MIS_A = misfire damage catalyst criterion, MIS_B1 = misfire emission criterion at engine warm-up & MIS_B4 = misfire emission criterion)* and identify the cylinders in failures
B02E - Misfire rate determination & error management - Application Incidences
This module defines misfire errors according the type chosen by NC_TREAT_DIAG_MIS: errors defined per misfire criterions or errors defined per cylinder.

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

Must be executed after B00U module.
F001 - Misfire Tuning Functions
This module allows to generate misfire patterns (continuous or pseudo random) via injection and/or ignition shut-off interfaces.

This module is optionnal and can be integrated during validation and calibration stages. It is strongly recommended to remove this functionally on serial product software (integration choice via NC_USE_MIS_GEN compilation switch).

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1.11 VHSL General

General information:

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

The aggregate consits of the following main functions:

Vehicle speed limitation manager
Interface not used for the fix limitation ->VHSL_1.0.0. The state variable STATE_VSL is used only as aggregate internal interface in case of a variable vehicle speed limitation.

Vehicle speed limitation controller
This modules aims to limit the vehicle speed to C_VS_MAX_VSL. A PI controller is used to define the engine torque limitation. In order to minimise speed overshoot, a predicted vehicle speed is calculated and the I controller is initilised with a calculated torque reduction.

Vehicle speed limitation output
This functionality limits the engine torque output by TQI_VS_MAX. The value of TQI_VS_MAX is initialised with the current engine output torque requirement. This will be calculated as the maximum of TQI_AV and minimum of TQI_BAS_MIN, TQI_REQ_TRA. This starting value of TQI_VS_MAX is then stored.

Vehicle speed limit calculation
A filtered vehicle acceleration, AC_VEH_MMV is used to predict a future vehicle speed VS_PRED. The vehicle speed limit, VS_MAX is also determinated at this point. For the fix limitation this limit will be given by the constant C_VS_MAX_VSL.
Another part is the calculation of the vehicle speed deviation which is an essential variable for the vehicle speed controller.

Vehicle speed limitation manager (Appl. Inc.)
This module deals with the activation of the fix vehicle speed limitation functionality. The function is switched on, LV_VS_MAX_VSL is set, when the vehicle speed, VS_HIGH_RES exceeds the set point minus an offset, C_VS_MAX_VSL - C_VS_MAX_HYS_ON. On the other hand the function is reset, and turned off, when the vehicle speed, VS_HIGH_RES drops below the set point minus a hysterisis

Vehicle speed limitation controller (Appl. Inc.)
The control dynamic is determined by LV_FAC_CTL_DYN_CHG_VSL. The I and PD control parameters are calculated based on the dynamic behaviour of the controller.

The aggregate is available in 2 variants:

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

Architecture Overview:

Variant 1:

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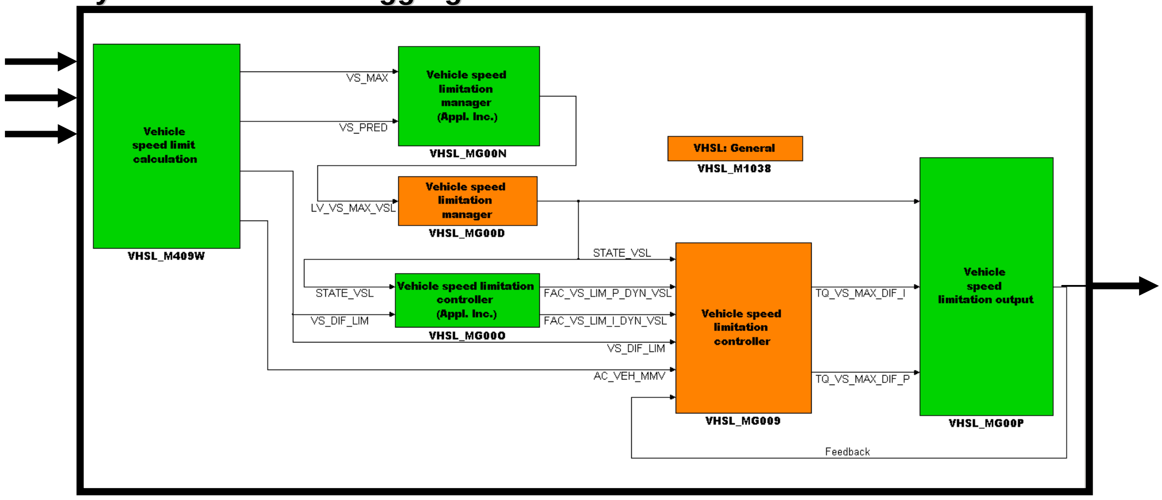
System Arhitecture Aggregate VHSL Version 1



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1.12 OBDC General

General Information

Architecture Overview

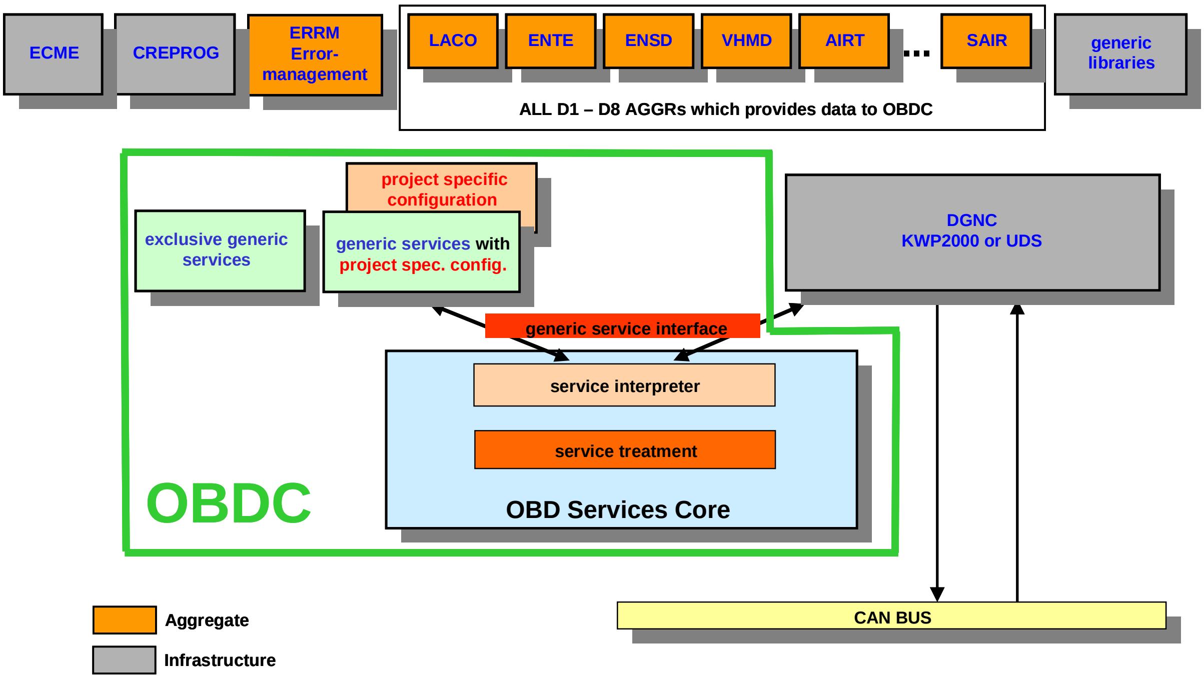

Figure 1.12.1:

Target /Objectives of EOBD function

The purpose of On Board Diagnostic Communication is:

- to provide OBD services to the scantool

Description of the containing functions

- SID 01h: Request current powertrain diagnostic data

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

- SID 02h: Request powertrain freeze frame data

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

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

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

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

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

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

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

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

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

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

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

- SID 09h: Request vehicle information

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

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

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

- OBDC Service Interpreter

This module allows to access OBD services.

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Normative reference

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

ISO Standards :

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

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1.13 INJR Configuration data

Configuration data:

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

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

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

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

INJR Configuration Data

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

General information:

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

1.13.1 Global configuration data

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

Data	Value
NC_INJ_CONF	1
NC_IV_CONF	1
NC_INJ_CONF_GDI	**1**

1.13.2 Local configuration data

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

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

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

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1.14 EVAC Configuration data

Input data:

NC_NR_CP_BUF {p. 3693}	NC_NR_CP_LAM_AD {p. 3739}	NC_PSD_DLY_CPS {p. 4708}	

General information:

The following document describes the general rules for definition of the configuation data for EVAC agregate.

1.14.1 Local configuration data

Data	Value
NC_NR_CP_LAM_AD	9
NC_NR_CP_BUF	80
NC_PSD_DLY_CPS	2

NC_NR_CP_LAM_AD: (default value = 9)
Number of fixed cp /Lambda adaptation slices after engine start. This value is used in the time control between purge and lambda adaptation (903P) to have maximum of flexibility.

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

NC_PSD_DLY_CPS: (default value = 2)
Canister purge valve diagnosis: Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met.

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1.15 IGRE Configuration data

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

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

1.15.1 Global configuration data

Data	Value

1.15.2 Local configuration data

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

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

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Note: care has to be taken with the setting of NC_TD_LIM_MAX in order to avoid Dwell Time /coil charging recovery:

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

NC_TD_LIM_MAX should be tuned in consequence to respect coil charging time no recovery and coil capacity

Formula Section:

NC_IGN_DIAG_TYP = "ATM46"

NC_TD_LIM_MIN = 1ms

NC_TD_LIM_MAX_L = 10ms

NC_TD_LIM_MAX_H = 20ms

NC_MAX_IGN_MPL_NR = 20

NC_IGC_DLY = 16

NC_MPL_T_MAX = 60ms

NC_MPL_IGN_H_RNG_CRK_MAX = 180°CRK

NC_IGC_CONF = FULL

NC_TD_AD_TYP = "Flag"

NC_INI_CTR_DEAC = 852s

NC_IGBT_CUT_OFF_T = 5ms

NC_T_MIN_SCP = 1.5ms

NC_CFB_DIAG_SCP_CHN = 1

NC_TD_AD_CHN_L = 0

NC_TD_AD_CHN_H = 1

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1.16 MISF Configuration data

Input data:

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

Configuration data:

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

General information:

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

1.16.1 Global configuration data

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

Data	Value
NLC_TREAT_DIAG_MIS	1

1.16.2 Local configuration data

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

Data	Value
NC_MISF_VERS	1
NLC_USE_ER_STND_MIS	0
NC_SIZE_THD_ER_BUF	4
NC_CONF_RR_MIS	OTHER
NLC_USE_CRK_OSC_MIS	1
NLC_USE_MIS_GEN	1
NC_CBK_EX_NR_MISF[NC_CYL_NR]	*see table below*

Configuration for NC_CBK_EX_NR_MISF:

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

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

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1.17 ENRD Configuration data

Input data:

NC_CYL_NR {p. 1526}	NC_SEG_DLY_ER_MES {p. 1448}	NC_SIZE_SEG_T_COR_BUF {p. 1448}	NLC_CONF_GAIN_ADD_ER {p. 1456}

Configuration data:

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

General information :

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

1.17.1 Local configuration data

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

Data	Value
NC_ENRD_VERS	**1**
NC_SIZE_SEG_T_COR_BUF	**7**
NC_SEG_DLY_ER_MES	**1**
NLC_CONF_GAIN_ADD_ER	**1**

Default configurations:

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

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1.18 ENSD Configuration data

Input data:

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

Configuration data:

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

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

General information :

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

1.18.1 Global configuration data

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

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

1.18.2 Local configuration data

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

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

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

Application conditions

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

Formula Section:

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

Note:

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

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1.19 ENSD interface adaptation module

Data definition:

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

Input data:

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

FUNCTION DESCRIPTION:

General information:

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

Description:

TCO_CMN and VB_CMN are stubbed

Application conditions

Initialisation: *none*

Recurrence: *at reset*

Activation: NC_CAM_LIH_SWI ≠ "INJ"

Deactivation: NC_CAM_LIH_SWI = "INJ"

Formula section:

TCO_CMN = 0
VB_CMN = 0

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

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1.20 NOXD Configuration data

Configuration data:

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

FUNCTION DESCRIPTION:

General information:

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

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

Formula section:

Global configuration data

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

Data	Value
NC_NOX_SENS_CONF	1

Local configuration data

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

Data	Value
-	

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1.21 NOXM Configuration data

Configuration data:

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

FUNCTION DESCRIPTION:

General information:

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

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

Formula section:

Global configuration data

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

Data	Value
NC_NT_NR	2

Local configuration data

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

Data	Value
NC_NT_CONF	1

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1.22 ERRM Configuration data

Input data:

NC_ABC_CONF_FCT_DIAG_XX {p. 4581}	NC_CYL_NR {p. 1526}	NC_ENVD_CUS_CMN_UPD {p. 5793}	NC_ERR_DTC_CONF {p. 5757}
NC_ERR_DTC_REQ_CUS {p. 5695}	NC_ERR_DTC_REQ_OBD {p. 5695}	NC_ERR_PRI_H {p. 5811}	NC_INJ_CONF {p. 626}
NC_LDP_1_DTC_TABLE_SIZE {p. 5757}	NC_LDP_2_DTC_MIS_TABLE_SIZE {p. 5757}	NC_LDP_2_DTC_TABLE_SIZE {p. 5757}	NC_MIL_CHK_TYP {p. 5828}
NC_NR_DIAG_RBM {p. 5871}	NC_NR_DTC_FMT {p. 5757}	NC_NR_ENVD_CUS_CMN {p. 5793}	NC_NR_ENVD_CUS_SET_CMN {p. 5793}
NC_NR_ENVD_CUS_SET_SPC {p. 5793}	NC_NR_ENVD_OBD {p. 5793}	NC_NR_ENVD_PREV {p. 5793}	NC_NR_ERR_DYN {p. 5768}
NC_NR_ERR_HIS {p. 5821}	NC_NR_ERR_INTM {p. 4610}	NC_NR_ERR_PERM {p. 5842}	NC_NR_FRF_SET {p. 5793}
NC_NR_HIS {p. 5821}	NC_NR_LAMP {p. 5840}	NC_NR_SYM_XX {p. 4640}	NC_NR_WIN_SCDN {p. 5885}
NC_STATE_STST_ENA {p. 628}	NLC_ABC_INI_DC_END_DIAG {p. 4581}	NLC_BENCH_MODE {p. 4581}	NLC_CTR_OCC_ENA {p. 5768}
NLC_INC_ERR_PRI {p. 5853}	NLC_MIL_ACT_REQ {p. 5899}	NLC_OBD_DSL {p. 5789}	NLC_OBD_ENA_PRI_PERM {p. 5853}
NLC_OBD_FRF_PND {p. 5695}	NLC_OLD_ERR_PRI {p. 5853}		

Configuration data:

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

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

1.22.1 Global configuration data

There is no global configuration data defined in this aggregate.

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

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

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

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

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

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

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

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1.23 EGCP Configuration data

Input data:

NC_FAC_10_SAMPLE {p. 1342}	NC_FAC_5_SAMPLE {p. 1342}	NC_FAC_R_REF_LS_DOWN {p. 1367}	NC_LSHPWM_BOL_LSH_DOWN {p. 2423}
NC_LSHPWM_BOL_LSH_UP {p. 2389}	NC_LSHPWM_TOL_LSH_DOWN {p. 2423}	NC_LSHPWM_TOL_LSH_UP {p. 2389}	NC_N_MIN_VLS_UP_MV {p. 1342}
NC_NR_BUF_SAMPLE_LEN {p. 1342}	NC_NR_BUF_SUM_LEN {p. 1343}	NC_NR_RAW_BUF_LEN {p. 1343}	NC_PSD_DLY_LSH_DOWN {p. 4249}
NC_PSD_DLY_LSH_UP {p. 4316}	NC_R_REF_LS_DOWN {p. 1367}	NC_T_SEG_LEN_MIN {p. 1343}	NC_VLS_DOWN_CUR_PUMP_REF {p. 1367}

Configuration data:

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

1.23.1 Global configuration data

Here are listed the configuration data specific for the projects using the Tricore processor and which can be used in other aggregates:
ATTENTION: NC_CBK_EX_NR has the value 2 for 4 and 6 cylinder engines. For N43 UL the second bank is virtual to fit the system.

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

1.23.2 Local configuration data

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

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

Notes:

- *The configuration switch NC_STATE_VLS_UP_SIG_ACQ denotes whether signal filtering shall be applied to the linear lambda sensor s raw signal provided by the BSW prior to further signal processing. If signal filtering shall be applied NC_STATE_VLS_UP_SIG_ACQ shall be set to 1. If not or if binary upstream sensor is used NC_STATE_VLS_UP_SIG_ACQ shall be set to 0.*
- *The PWM frequency for the oxygen sensor heater must be adjusted to values larger than 5Hz, i.e.* NC_FRQ_LSHPWM_UP >= 5Hz and NC_FRQ_LSHPWM_DOWN *>= 5Hz. Usually no values larger than 100 Hz are applied, the exact value has to be derived from the corresponding sensor specification.*

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1.24 FUSL Configuration data

Configuration data:

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

FUNCTION DESCRIPTION:

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

Data	Value (physical)
NC_V_CUR_VCV_MES	2 [2**H**]

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

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

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1.25 Variant coding

Data definition:

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

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

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

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
PSN_LS_1	O/V	0... FFH	0... 255	1	-
OBD-communication, OS-configuration Mode01 PID1D					
St_varkat	O/V	0... FFH	0... 255	1	-
Status Variante Abgasanlage (mono/stereo)					
STATE_LRN_ECU	O/V/S	0H 1111H 2A2AH 4E4EH 5A5AH A2A2H A5A5H AEAEH BCBCH E4E4H FFFFH	NOT_ LEARNED FAILEDC1_ LOT1 C2_LOT3 B0_LOT0 C1_LOT2 C2_LOT2 C1_LOT3 SERIAL_ECU C2_LOT1 NOT_ LEARNED ROM_NOT_ PLAUSLEARN-ING_	-	-
Variant ECU (MSD81)					
STATE_VAR_DET_CUS_1	O/V	0... FFFFFFFFH	0... 4294967295	1	-
carrier double-word 1 of all learned variants for customer environment					
STATE_VAR_DET_CUS_2	O/V	0... FFFFFFFFH	0... 4294967295	1	-
carrier double-word 2 of all learned variants for customer environment					
VAR_VEH	O/V	0H 1H 2H	E60 E65 PL2	-	-
Vehicle variant					
VIM_TYPE	O/V	0H 1H	CLOSED_ LOOP SWITCHED	-	-
VIM configuration					

Input data:

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

Calibration data:

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

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

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_VAR_EBOX_CFA	-	0... 1H	0 ...1	1	-
Configuration of LV_VAR_EBOX_CFA (if 1, LV_VAR_xx =1, else LV_VAR_xx learnt by power stage diag)					
LC_VAR_NOX	-	0... 1H	0 ...1	1	-
Switch for learning of NOx sensor					
LC_VAR_SPT_SWI	-	0... 1H	0 ...1	1	-
Calibration switch for M-Drive					
LC_VAR_TCO_2	-	0... 1H	0 ...1	1	-
configuration switch for TCO_2 sensor					

Action definition

ACTION_INFR_GetLd (**OUT**<V_VAR_LD>)	Mode: O
This action returns the LOT detection for ECU variant coding	

1.25.1 General

Certain functionalities in the engine management system can be changed over or shut off via variant code or data record identifier. The variant code can be set by means of calibratable constants via application system. After the data record identifier has been changed, the control unit must be reset as the data record identification is only updated during system initialization. A further method to descern one variant from another is the automatical learning by means of diagnosis or by utilization of variant specific input signals.

1.25.2 Automatically learnt variants

FUNCTION DESCRIPTION:

Two states have been defined for automatic learning of the vehicle equipment:
1) Vehicle without equipment xx LV_VAR_xx = 0
2) Vehicle with equipment xx LV_VAR_xx = 1

The state which is valid in each case is saved in the non-volatile memory after the ECU self-holding phase. The state is initialised with 1) in the case of a new control unit (EEPROM has been erased) and when the variants are reset via serial protocol.

In state 1) re-learning to state 2) is possible within 3 seconds after ECU- reset and within a calibratable time after ignition key on. Learning is done by receiving the equipment related CAN- message.

Transmission type

1) Variant is Manually shifted transmission or transmission variant is to be learnt:
LV_AT = 0
LV_VAR_AMT = 0
LV_VAR_TCT = 0

This state is active as long as there is no non-volatile memory entry during an ECU initialisation. After this, the CAN communication will be observed to learn variants. After a timeout for the EGS message and SSG-message, LV_AT and LV_VAR_AMT will stay inactive. This is interpreted as variant Manually shifted transmission.

2) Variant is Automatically shifted transmission with BN2000 :
LV_AT = 1
LV_VAR_AMT = 0
LV_VAR_TCT = 0

Re-learning conditions:
receiving CAN message DREHMOMENT_ANF_EGS (BN2000)

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3) Variant is Twin clutch transmission with BN2000 :
LV_VAR_TCT = 1
LV_VAR_AMT = 0
LV_AT = 0
Re-learning conditions:
receiving CAN message DREHMOMENT_ANF_DKG (BN2000)
4) Variant is Automated manual transmission (SSG) with BN2000 :
LV_AT = 0
LV_VAR_AMT = 1
LV_VAR_TCT = 0
Re-learning conditions:
receiving CAN message DREHMOMENT_ANF_SSG (BN2000)

additional 1) Variant is BN 2000 transmission (SSG, DKG or EGS) :
LV_VAR_ETCU =1
Re-learning conditions:
receiving CAN message GETRIEBEDATEN (BN2000)

additional 2) Variant is BN 2000 sportgear box" (DKG or EGS) :
LV_VAR_ETCU_SPT =1
Re-learning conditions:
receiving STATE_ETCU_SPT_SWI = 1 of CAN message GETRIEBEDATEN_2 (BN2000)

Air conditioner

1) Vehicle without air conditioner LV_VAR_ACIN = 0
2) Vehicle with air conditioner LV_VAR_ACIN = 1

Re-learning conditions:
receiving the LV_ACCIN bit (STATE_ACIN_CAN > 0H) of CAN message WAERMESTROM_KLIMA (IHKA, BN2000).

Dashboard with CAN interface

All vehicles are equipped with dashboard therefore
LV_VAR_ICL = 1 //default value

Vehicle with ASR device

1) Vehicle without ASR LV_VAR_ASR = 0
2) Vehicle with ASR LV_VAR_ASR = 1

Re-learning conditions:
receiving CAN message DREHMOMENT_ANF_DSC (BN2000)

LV_VAR_ASR_3 = 0
LV_VAR_ASR_4 = 0
LV_VAR_MSW = 0

BN-Vehicle with Multifunctional steering wheel (CRU interface) - (BN2000 only)

1) Vehicle without multifunctional steering wheel LV_VAR_BN_MSW = 0
2) Vehicle with multifunctional steering wheel LV_VAR_BN_MSW = 1

Re-learning conditions: receiving CAN-message BEDIENUNG_TEMPOMAT (SZ-Lenksäule)

Vehicle with PSTE (Power steering) device

1) Vehicle without PSTE LV_VAR_PSTE = 0

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2) Vehicle with PSTE LV_VAR_PSTE = 1

Re-learning conditions:

receiving CAN message LENKRADWINKEL (SZ-Lenksäule, BN2000)

Distance Cruise Control (BN2000 only)

1) Vehicle without DCC LV_VAR_DCC = 0

2) Vehicle with DCC LV_VAR_DCC = 1

Re-learning conditions:

receiving the CAN message DREHMOMENT_ANF_ACC (ACC, BN2000)

Anti-roll-stabilisation (BN2000 only)

1) Vehicle without ARS LV_VAR_ARS = 0

2) Vehicle with ARS LV_VAR_ARS = 1

Re-learning conditions: receiving the CAN message STAT_ARS (ARS, BN2000)

Active Front Steering (BN2000 only)

1) Vehicle without AFS LV_VAR_PSTE_2 = 0

2) Vehicle with AFS LV_VAR_PSTE_2 = 1

Re-learning conditions:

receiving the CAN message DREHMOMENT_ANF_AFS (AFS, BN2000)

Electrical Fuel Pump (BN2000 only)

1) Vehicle without EFP-control-unit LV_VAR_BN_EFP = 0

2) Vehicle with EFP-control-unit LV_VAR_BN_EFP = 1

Re-learning conditions: receiving the CAN message STAT_EKP (EKP, BN2000)

Reverse Gear via CAN (E60 - MT only)

1) MT-Vehicle without GEAR_REV LV_VAR_BN_GEAR_REV = 0

2) MT-Vehicle with GEAR_REV LV_VAR_BN_GEAR_REV = 1

Re-learning conditions:

receiving the CAN message STAT_GANG_RUECKWAERTS (LM, BN2000)

Dipped Beam via CAN (BN2000 only)

1) Vehicle without LTG_HDLP_L LV_VAR_BN_LTG_HDLP_L = 0

2) Vehicle with LTG_HDLP_L LV_VAR_BN_LTG_HDLP_L = 1

Re-learning conditions: receiving the CAN message LAMPENZUSTAND (LM, BN2000)

Längsdynamikmodul (Longitudinal dynamics module) - LDM (E9x only)

1) Vehicle without LDM LV_VAR_BN_LDM = 0

2) Vehicle with LDM LV_VAR_BN_LDM = 1

Re-learning conditions:

receiving the CAN message "Anforderung Radmoment Antriebsstrang" (LDM, BN2000)

Status Anhänger (State Trailer) - TRL (BN2000 only)

1) Vehicle without TRL LV_VAR_BN_TRL = 0

2) Vehicle with TRL LV_VAR_BN_TRL = 1

Re-learning conditions:

receiving the CAN message STAT_ANHAENGER (K-CAN/AHM, BN2000)

Steuerung Crashabschaltung EKP (BN2000 only)

1) Vehicle without EKP_CRASH on CAN LV_VAR_EFP_CRASH = 0

2) Vehicle with EKP_CRASH on CAN LV_VAR_EFP_CRASH = 1

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Re-learning conditions:
receiving the CAN message CTR_CRASH_SWO_EKP (MRSZ, BN2000)

EHB3 - Steering (BN2000 only)

1) Vehicle without EHB3 LV_VAR_PSTE_3 = 0
2) Vehicle with EHB3 LV_VAR_PSTE_3 = 1

Re-learning conditions:
receiving the CAN message DREHMOMENT_ANF_STE (EHB3, BN2000)

NOx - sensor

IF LC_VAR_NOX = 1
THEN
LV_VAR_NOX = 1
ELSE
Learning of NOx - sensor
1) Vehicle without NOx - sensor LV_VAR_NOX = 0
2) Vehicle with NOx - sensor LV_VAR_NOX = 1
Re-learning conditions:
receiving the CAN message ID = 130h **or** ID = 135h on LoCAN
ENDIF

PBR - park brake (EMF) (BN2000 only)

1. vehicle without PBR: LV_VAR_PBR = 0
2. vehicle with PBR: LV_VAR_PBR = 1

Re-learning conditions:
Receiving the CAN message STATUS_EMF (EMF, BN2000)

TQ_PBR - park brake torque information (EMF) (BN2000 only)

1. vehicle without TQ_PBR: LV_VAR_TQ_PBR = 0
2. vehicle with TQ_PBR: LV_VAR_TQ_PBR = 1

Re-learning conditions:
Receiving the CAN message ST_RQ_EMF (EMF, BN2000)

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Getriebedaten 3 - some transmission control units (BN2000 only)

1) Vehicle without ETCU_3 LV_VAR_ETCU_3 = 0
2) Vehicle with ETCU_3 LV_VAR_ETCU_3 = 1

Re-learning conditions:
receiving the CAN message GETRIEBEDATEN_3 (EGS_EL, BN2000)

Sollmomentanforderung - DXC message (BN2000 only)

1) Vehicle without DXC LV_VAR_4WD = 0
2) Vehicle with DXC LV_VAR_4WD = 1

Re-learning conditions:
receiving the CAN message SOLL_MOM_ANF (DXC, BN2000)

1.25.2.1 Sport-Switch /Sound-Flap

Sport-Mode-Switch:

Two states have been defined for automatic learning of the Sport-Switch interface:

1) Vehicle without Sport-Switch
2) Vehicle with Sport-Switch (normal sport switch /AMT sport switch)

The state which is valid in each case is saved in the non-volatile memory after the ECU holding phase. The state is initialized with 1) in the case of a new control unit and when the variant is reseted .
Re-learning from the 1 variant to 2 variant is possible at each engine operating state. Learning is based on the evaluation of LV_SOF_SWI or LV_SOF_SWI_AMT (Switch pressed).
At each engine operating state the learning is effected.

```
If          CONF_SOF_SWI = 0
  Then If          LV_SOF_SWI = 1
          Then          CONF_SOF_SWI = 1
             Else          If          LV_SOF_SWI_AMT = 1
                      Then          CONF_SOF_SWI = 2
                      Else          CONF_SOF_SWI = 0
                      Endif
             Endif
        Else          CONF_SOF_SWI = CONF_SOF_SWI
Endif
```

Application conditions

Initialisation: *in case of new control unit: CONF_SOF_SWI =0*

Recurrence: *100ms*

Activation: *at every engine operating state*

Meaning of CONF_SOF_SWI:
0: no Sport-switch
1: Sport-switch
2: Sport-switch AMTˆ

1.25.2.2 Automatically learnt variants by power stage diagnosis

FUNCTION DESCRIPTION:

Description:

The components which are automatically learnt by powerstage diagnosis are:
- -> see table in formula section.
The learning of the lambda sensors (here: via diagnosis of the lambda sensor heater) is a special case, because only specific combinations of the possibilities are valid.

Two states have been defined:
1) Vehicle without component EF, etc.
2) Vehicle with component EF, etc.

The state which is valid in each case is saved in the non-volatile memory after the ECU holding phase. The state is initialized with 1) in the case of a new control unit and when the variant is reset.
The re-learning from state 1) to state 2) is done only once after each ECU-initialisation (if the activation conditions are fulfilled). If a variant has been learnt and is afterwards reset to zero (via LC_AD_CLR_VAR), relearning is only possible after reset.

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Learning of the components is based on the evaluation of the powerstage diagnosis of the related components. Therefore the components have to be activated for the learning cycle in order to get a proper power stage diagnosis. In state 1) the diagnosis is effected, however, an entry into the failure memory is suppressed.
The diagnosis result of the first 100ms-(or 200ms-)cycle must be rejected (due to initialisation). From the second cycle on the diagnosis is effected 10 times (1 check per recurrence). If at least 7 checks are error-free (symptom open load is zero) and valid (in case of LV_VAR_xxx = 0), the variant EF, ECRAS_UP, EBOX_CFA, AEB etc. has been learnt and LV_VAR_xxx = 1. With this state, the related powerstage diagnosis is cleared completely, i.e. the error entry is enabled.
If the variant LV_VAR_ECRAS_UP has been learnt, the detection of the ECRAS_DOWN variant (the lower ECRAS flap) is enabled (LV_VAR_ECRAS_DOWN). The algorithm and setting of LV_VAR_ECRAS_DOWN is done in ECRAS diagnosis module, not in the variant coding module.
The variant LV_VAR_EBOX_CFA is only learnt if LC_VAR_EBOX_CFA = 0. If LC_VAR_EBOX_CFA = 1, then LV_VAR_EBOX_CFA is also set 1 without learning.

Application conditions

Initialisation:

```
if   new control unit           or
            failure of nonvolatile memory recognized   or
          LC_AD_CLR_VAR  01                    then          LV_
VAR_xxx   = 0
LC_AD_CLR_SOF  01                   then          LV_VAR_SOF =
0
LV_VAR_TCHA 01                        then          LV_VAR_AEB
= 0
```

Recurrence:

200 ms LSH_UP/ _DOWN (due to low PWM frequency)

100 ms all other components

Activation:

```
after every reset (once):
if       LV_CDN_VB_MIN_DIAG = 1              and
    LV_VAR_xxx = 0
```

Formula section:

Table for automatically learnt variants by power stage diagnosis - LV_VAR_xxx:

Component	**Variant Keyword xxx**	**LV_VAR_xxx = 0**	**LV_VAR_xxx = 1**
ACC-Relay	RLY_ACCOUT	no RLY_ACCOUT	RLY_ACCOUT
E-BOX-fan	EBOX_CFA	no EBOX_CFA	EBOX_CFA
Starter Relay	RLY_ST	no RLY_ST	RLY_ST
Electronically controlled radiator shutters (upper flap)	ECRAS_UP	no ECRAS_UP	ECRAS_UP
Exhaust flap	EF	no EF	EF
Sound flap	SOF	no SOF	SOF
Exhaust type	LSH_UP	no CAT, no lambda sensors	with CAT and lambda sensors
Exhaust type	LSH_DOWN	no monitor lambda sensors	with monitor lambda sensors
Active engine brackets	AEB	no AEB **or** LV_VAR_TCHA=1	AEB **and** LV_VAR_TCHA=0

Learning of LV_VAR_EBOX_CFA

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if LC_VAR_EBOX_CFA = 1
then LV_VAR_EBOX_CFA = 1
else *LV_VAR_EBOX_CFA learnt by power stage diag.*
endif

Configuration and learning of CAT/exhaust type

If C_CONF_CAT = 2 2 banks, control + monitor sensors (no learning)
then LV_VAR_LSH_UP = 1
LV_VAR_LSH_DOWN = 1
endif

If C_CONF_CAT = 1
then learning of exhaust type:
All 4 sensors will be checked by power stage diagnosis as mentioned above.

If none of the 4 sensors is recognized without CAT
then LV_VAR_LSH_UP = 0
LV_VAR_LSH_DOWN = 0
If none of the 2 monitor sensors (...DOWN...) is recognized but at least one of the 2 control sensors (...UP...) is recognized 2 banks, control sensors
then LV_VAR_LSH_UP = 1
LV_VAR_LSH_DOWN = 0

If at least 1 of the 2 monitor sensors is recognized
2 banks, control + monitor sensors
then LV_VAR_LSH_UP = 1
LV_VAR_LSH_DOWN = 1
endif

If C_CONF_CAT = 0
then limited learning of exhaust type:
Only the 2 control sensors will be checked.
If at least one sensor is recognized 2 banks, control sensors
then LV_VAR_LSH_UP = 1
LV_VAR_LSH_DOWN = 0
Else LV_VAR_LSH_UP = 0 without CAT
LV_VAR_LSH_DOWN = 0
endif

If LV_VAR_LSH_UP = 0
then no sensors available
PSN_LS = 00000000 bin
PSN_LS_1 = 00000000 bin
Endif

If LV_VAR_LSH_UP = 1 and LV_VAR_LSH_DOWN = 0
then PSN_LS = 00010001 bin(bank 1 sensor 1 and bank 2 sensor 1)

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PSN_LS_1 = 00000101 bin
endif

If LV_VAR_LSH_UP = 1 and LV_VAR_LSH_DOWN = 1
then PSN_LS = 00110011 bin(bank 1 sensor1/2 and bank 2 sensor 1/2)
PSN_LS_1 = 00001111 bin
endif

Configuration and learning of AEB/active engine brakets

If C_CONF_AEB = 0
then no learning of active engine brackets
elseif C_CONF_AEB = 1
then **if** LV_VAR_TCHA = 0
then learning of active engine brackets by powerstage diagnosis
else LV_VAR_AEB = 0
// variant active engine brackets only allowed in case of no turbo charger, because of double pin reservation
elseif C_CONF_AEB = 2
then **if** LV_VAR_TCHA = 0
then LV_VAR_AEB = 1
else LV_VAR_AEB = 0
// variant active engine brackets only allowed in case of no turbo charger, because of double pin reservation
else *//same behavior like C_CONF_AEB = 1*
learning of AEB:
Component AEB will be checked by power stage diagnosis as mentioned above.

1.25.3 Calibrateable or automatically learnt variants

1.25.3.1 Mass air flow meter (HFM)

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General information:

The aim of these function is to check the availability of a mass air flow meter (HFM). The function is solely avtive at initial operation. The lernaed availability of a HFM can be manually overwrited by the use of C_LEARN_HFM_OVERRIDE.

Application conditions

Initialisation: `LV_VAR_MAF = 0 at first reset, if learnt -> initialised from NVMY;`
`LV_VAR_MAF_LEARNT = 0 at first reset, if learnt -> initialised from NVMY`
`CTR_AVL_MAF = 0 at reset`
`CTR_NOT_AVL_MAF = 0 at reset`

Recurrence: *10ms*

Activation: **If** LV_ES = 1

Deactivation **If** LV_VAR_MAF = 1 **or**
LV_VAR_MAF_LEARNT = 1

Formula section:

If(1) C_LEARN_HFM_OVERRIDE = 0
Then(1) **If(2)** C_T_PER_MAF_FRQ_AVL_MIN < T_PER_MAF_FRQ_BAS[i]
<
C_T_PER_MAF_FRQ_AVL_MAX
Then(2) CTR_AVL_MAF ++ **and**
CTR_NOT_AVL_MAFn = CTR_NOT_AVL_MAFn-1
If(3) CTR_AVL_MAF > C_CTR_AVL_MAF
Then(3) LV_VAR_MAF = 1 **and**
LV_VAR_MAF_LEARNT = 1

Else(2) CTR_NOT_AVL_MAF ++ **and**
CTR_AVL_MAFn = CTR_AVL_MAFn-1
If(3) CTR_NOT_AVL _MAF > C_CTR_ NOT_AVL_MAF

Then(3) LV_VAR_MAF = 0 **and**
LV_VAR_MAF_LEARNT = 1
Endif(3)
Endif(2)

Else(1) **If(2)** C_LEARN_HFM_OVERRIDE = 1
Then(2) LV_VAR_MAF = 1
Else(2) **If(3)** C_LEARN_HFM_OVERRIDE = 2
Then(3) LV_VAR_MAF = 0
Endif(3)
Endif(2)
Endif(1)

1.25.4 Engine Configuration Coding

General information:

The configuration is done for multiple cylinder bank, inlet and exhaust cam available, MPI or GDI, idle speed actuator (ISA), type of camshaft disc, type of Variable Intake Manifold and configuration of sound-flap.
Theconstant NC_MAF_FAC_CYL depends on NC_CYL_NR.

Application conditions

Initialisation: **at reset:**
LV_CBK_MPL = 0
LV_IVVT_IN_AND_EX = 1
LV_INJ_CONF = 1
LV_ISA_CONF = 0
CAM_TYPE = 0
VIM_TYPE = 0

Recurrence: –

Activation: *at reset*

Deactivation: –

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1.25.5 Calibrateable Variants

1.25.5.1 Variant of DMTL

General information:

All calibratable variants are updated only during ECU initialization.
If a component is deactivated by variant coding, the related function and diagnosis will **not** be executed.

Application conditions

Initialisation: ***at reset:*** *LV_CONF_DMTL = C_CONF_DMTL*

Recurrence: –

Activation: *at every engine operating state*

Deactivation: –

Formula Section:

Meaning of LV_CONF_DMTL and C_CONF_DMTL

- 0 = no DMTL available, diagnosis of tank leakage detection is inhibited
- 1 = DMTL available, diagnosis of tank leakage detection is enabled

1.25.5.2 Variant of TCO_2

General information:

All calibratable variants are updated only during ECU initialization.
If a component is deactivated by variant coding, the related function and diagnosis will **not** be executed.

Application conditions

Initialisation: ***at reset:*** *LV_VAR_TCO_2 = LC_VAR_TCO_2*

Recurrence: –

Activation: *at every engine operating state*

Deactivation: –

Formula Section:

Meaning of LV_VAR_TCO_2 and LC_VAR_TCO_2

- 0 = no TCO_2 sensor available
- 1 = TCO_2 sensor vailable

1.25.5.3 Variant for EFP-control

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General information:

All calibratable variants are updated only during ECU initialization.
If a component is deactivated by variant coding, the related function and diagnosis will **not** be executed.

Application conditions

Initialisation: ***at reset:*** *CONF_SWI_EFP_OUT = C_CONF_SWI_EFP_OUT*

Recurrence: –

Activation: *at every engine operating state*

Deactivation: –

Formula Section:

Meaning of CONF_SWI_EFP_OUT and C_CONF_SWI_EFP_OUT

- 0 = no CAN-EFP available, EFP control via PWM output stage
- 1 = CAN-EFP signal via local CAN, EFP control via local CAN
- 2 = CAN-EFP signal via powertrain CAN, EFP control via powertrain CAN

1.25.5.4 Variant for Oil Level or Quality sensor

General information:

All calibratable variants are updated only during ECU initialization.

Application conditions

Initialisation: ***at reset:*** CONF_OIL_LEVEL_SENS = C_CONF_OIL_LEVEL_SENS

Recurrence: –

Activation: *at every engine operating state*

Deactivation: –

Formula Section:

Meaning of CONF_OIL_LEVEL_SENS

- 0 = no Sensor
- 1 = TOENS are available
- 2 = Oil quality sensor on BSD interface are available

1.25.5.5 Variant for Turbo Charger or Stratified combustion

General information:

All calibratable variants are updated only during ECU initialization.

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Application conditions

Initialisation: ***at reset:*** *LV_VAR_TCHA = LC_TCHA_CONF*

Recurrence: –

Activation: *at every engine operating state*

Deactivation: –

Formula Section:

Meaning of LC_TCHA_CONF and LV_VAR_TCHA

- 0 = N53 configuration
- 1 = N54 Configuration

LV_VAR_TCHA = 0 disabled Functions

DMTL		17B00401.00A
		17B00C01.00D
		17B00Y01.00C
CHRG	PUT-Diag	43A0GH01 43A0GI01
CHRG	RFP-Diag	43A08F01
CHRG	WG-Diag	43A0HF01

LV_VAR_TCHA = 1 disabled Functions

NOX:		
EGR	ACR	43301601.00A 30408501.00A 14601201.00B 30908I01.00B 30908J01.00B 30908K01.00B 30908L01.00A 43903J02.00A 30A0IK01.00B 30A0IL01.00B 30A0IM01.00A 30A0IN01.00A 30A0IO01.00A 30A0IP01.00A 30A0IQ01.00A 30A0IR01.00B 30A0IS01.00A 43R01801.00A

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1.25.5.6 Vehicle Variant

General information:

The manual setting of the vehicle variant is possible by using the constant C_VAR_VEH. Depending on this constant the flags for "Bordnetz" and "Power module" will be set. This makes sure the compatibility to older revisions.
Depending on the variant the flags are set in the following way:

C_VAR_VEH		LV_VAR_BN	LV_VAR_VEH
Phys. value	**Hex**		
E60	00H	1	0
E65	01H	1	1
PL2	02H	1	0

Application conditions

Initialization: `at ECU-reset`

Recurrence: –

Activation: `at reset`

// Berechnung nur bei ECU-Init
// kompatible Berechung von LV_VAR_BN und LV_VAR_VEH:

VAR_VEH = C_VAR_VEH

LV_VAR_BN = 1 *// BN2000*

if (VAR_VEH == E65)
then LV_VAR_VEH = 1 *// Vehicle with Powermodule (E65)*
else LV_VAR_VEH = 0 *// Vehicle without Powermodule (E6x)*
endif

1.25.5.7 Variant of St_varkat

Application conditions

Initialisation at reset: ***if*** *NC_CBK_EX_NR = 2*
then *St_varkat = 1*
else *St_varkat = 0*
endif

Recurrence: –

Activation: *at every engine operating state*

Deactivation: –

Formula Section: -

1.25.5.8 Variant of M-DRIVE

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Application conditions

Initialisation: `LV_VAR_SPT_SWI = LC_VAR_SPT_SWI`

Recurrence: –

Activation: *at every engine state*

Formula section:

-

1.25.6 Merge of learned variants for BMW- environment

FUNCTION DESCRIPTION:

General information:

All learned variants LV_VAR_xx must be merged in two variables for customer use. This variables (carrier double-words) are calculated once per driving cycle after the automatically learning of variants has been finished or if LV_VAR_MAF changes from 0 -> 1. The LV_VAR- bits for each variant has to be mirrored in the bits of the carrier double-words. The places of the variants in the words are described in the table in the formula section.

Application conditions

Initialisation: all 0

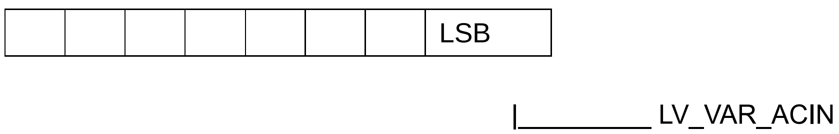
Recurrence: *1000 ms*

Activation: *at reset*

Deactivation: –

Formula section:

The table contains the LV_VAR_xx- flags, how they have to be mirrored in the carrier double-words STATE_VAR_DET_CUS_1 and STATE_VAR_DET_CUS_2. Position 0x0 is the LSB, position 0x80000000 is the MSB of the carrier double-word (like shown in the picture below).



Content of STATE_VAR_DET_CUS_1:

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Position (0 =LSB)	Position Hex	Varname
0	0x 0	LV_VAR_ACIN
1	0x 1	LV_VAR_AMT
2	0x 2	LV_VAR_ARS
3	0x 4	LV_VAR_ASR
4	0x 8	LV_VAR_ASR_3
5	0x 10	LV_VAR_ASR_4
6	0x 20	LV_VAR_BN
7	0x 40	LV_VAR_BN_EFP
8	0x 80	LV_VAR_BN_GEAR_REV
9	0x 100	LV_VAR_BN_LDM
10	0x 200	LV_VAR_BN_LTG_HDLP_L
11	0x 400	LV_VAR_BN_MSW
12	0x 800	LV_VAR_DCC
13	0x 1000	LV_VAR_EBOX_CFA
14	0x 2000	0
15	0x 4000	LV_VAR_EF
16	0x 8000	LV_VAR_ETCU
17	0x 10000	LV_VAR_ICL
18	0x 20000	LV_VAR_LSH_DOWN
19	0x 40000	LV_VAR_LSH_UP
20	0x 80000	LV_VAR_MSW
21	0x 100000	LV_VAR_PSTE
22	0x 200000	LV_VAR_PSTE_2 **OR** (LV_VAR_PSTE_3 **AND** STATE_PSTE_3_SRC=="AFS")
23	0x 400000	LV_VAR_RLY_ACCOUT
24	0x 800000	LV_VAR_RLY_ST
25	0x 1000000	LV_VAR_AEB
26	0x 2000000	*reserve*
27	0x 4000000	LV_VAR_SOF
28	0x 8000000	LV_AT
29	0x 10000000	LV_VAR_TCT
30	0x 20000000	LV_VAR_VEH
31	0x 40000000	LV_VAR_BN_TRL

Content of STATE_VAR_DET_CUS_2:

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Position (0 =LSB)	Position Hex	Varname
0	0x 0	LV_VAR_MAF
1	0x 1	0
2	0x 2	LV_VAR_ETCU_SPT
3	0x 4	0
4	0x 8	0
5	0x 10	0
6	0x 20	0
7	0x 40	0
8	0x 80	0
9	0x 100	0
10	0x 200	0
11	0x 400	0
12	0x 800	0
13	0x 1000	0
14	0x 2000	0
15	0x 4000	0
16	0x 8000	0
17	0x 10000	0
18	0x 20000	0
19	0x 40000	0
20	0x 80000	0
21	0x 100000	0
22	0x 200000	0
23	0x 400000	0
24	0x 800000	0
25	0x 1000000	0
26	0x 2000000	0
27	0x 4000000	0
28	0x 8000000	0
29	0x 10000000	0
30	0x 20000000	0
31	0x 40000000	0

1.25.7 Runtime solution

Description:

The tables show the configuration switches to inhibit function blocks. If a function block is disabled (= 1) or exceeds the engine speed threshold, the outputs of these modules are then frozen.

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Switch	Description	Modules
C_N_VAR_DIS_MISF	Misfire (AGGR MISF)	00S08201.00F
		17B00T02.00E
		17B02E02.00F
		17100L01.00C
		30F00102.00D
		17B00201.00A
		30B00E02.00C
C_N_VAR_DIS_ER	Engine roughness	00S08401.00H
		17100K01.00C
		→02P02.00D
		17A0EM01.00C
C_N_VAR_DIS_INJ	Cylinder balancing	30402U01.00B
LC_VAR_DIS_OBD_CAT	Cat efficiency	17B00801.00C
		01B00A02.00O
		01B02D02.00E
LC_VAR_DIS_NOX	NOx functions	02703O01.00C
		02703002.00E
		43705S01.00B
		43703N01.00B
		02706401.00A
		02706001.00B
		02704M01.00B
		02704F03.00C
		02705X01.00E
		02706301.00A
		02706202.00C
		02705101.00A
		02703Q03.00P
		02704G02.00F
		02704901.00I
		02703P03.00Q
		02705V01.00I
		02706I01.00C
		02705T01.00C
		43704A01.00B
		02702Z06.00E
		02703801.00E
		02A0B202.00B
LC_VAR_DIS_CRU	Cruise control	17G00101.00G
		17G00201.00H
		17G00301.00E
		17G00401.00C

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		17G00E01.00J
LC_VAR_DIS_TQ_LOSS_ARS	Torque loss - anti-roll-stabilization	17D02601.00E
LC_VAR_DIS_DMTL	LDP function	17B00C01.00J
LC_VAR_DIS_S_FCT	Lambda testing for stratified mode	43500J01.00A
Disabled functions	Sound flap diagnosis	43A0CJ01.00A

1.25.8 Learnt ECU variants

1.25.8.1 Import Actions

ACTION_ECM3_DisableReq()	ACTION_INFR_McRestart()	

Description for actions:

ACTION_INFR_GetLd(OUT <V_VAR_LD>)					
This action returns the LOT detection for ECU variant coding					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
V_VAR_LD	OUT	0 ... 7FFFH	0 ... 5	1.5259e-4	V
Voltage for LOT detection					

General information:

The detection of ECU variants is realised by a learning function. The state for a successful ECU variant detection is checked at every ECU initialisation. The according information has to be detected in a previous ECU initialisation by the learning function and has to be stored in the non-volatile memory. If the check, which ECU variant is identified, gets to a valid result, the learning function for ECU detection won t be started again. Otherwise it will start up like in the description below:

Combination table:

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Muster	Lot-Detection (v_var_ld)				
	minimal	nominal	maximal	digits(soll)	digits(limits)
B0_LOT0	0.000V	0.000V	0.097V	0	0...30
C1_LOT1	0.203V	0.300V	0.397V	93	63...123
C2 LOT2	0.484V	0.581V	0.677V	180	150..210
LOT3	0.935V	1.031V	1.129V	320	290...350
LOT4	1.226V	1.320V	1.419V	410	380...440
LOT5	1.555V	1.650V	1.748V	512	482...542
LOT6	1.890V	1.980V	2.084V	616	586...646
LOT7	2.126V	2.222V	2.319V	689	659...719
LOT8	2.400V	2.493V	2.594V	774	744... 804
LOT9	2.784V	2.877V	2.977V	893	863...923
LOT10 (Serie)	3.203V	3.300V	3.300V	1023	993...1023

For Initialization Only:

SWITCH (NC_HW_REV)
case STATE_LRN_ECU_B0_LOT0
STATE_LRN_ECU = "B0_LOT0"

case STATE_LRN_ECU_C1_LOT1
STATE_LRN_ECU = "C1_LOT1"

case STATE_LRN_ECU_C2_LOT2
STATE_LRN_ECU = "C2_LOT2"

case STATE_LRN_ECU_SERIAL_ECU
STATE_LRN_ECU = "SERIAL_ECU"

case STATE_LRN_ECU_NOT_LEARNED:
STATE_LRN_ECU = "NOT_LEARNED"

case STATE_LRN_ECU_LEARNING_FAILED:
STATE_LRN_ECU = "LEARNING_FAILED"
break
default
STATE_LRN_ECU = ROM_NOT_PLAUS /* Status cannot be stored in flash */
endswitch

For cyclical learning:

ACTION_INFR_GetLd(V_VAR_LD) /*read LOT value from the ADC */
If(1) NC_HW_REV != NC_FLS_DFT
Then(1)
Do nothing /*nc_hw_rev already set (plausible or not plausible)*/
Else(1)
If(2) STATE_LRN_ECU == NOT_LEARNED
Then(2)
If(3) CTR_LRN_ECU < 10
Then(3)

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```
            CTR_LRN_ECU++           /* time out counter*/
            If(4)               0 <= V_VAR_LD <= 0.097V              (B-Muster)
           Then(4)
                   If(5)              ++CTR_LRN_ECU_OK_B0_LOT0 >= 7
                   Then(5)           STATE_LRN_ECU = "B0_LOT0"
                   Endif(5)
           Endif(4)
            If(4)               0.203V <= V_VAR_LD <= 0.397V         (C-Muster LOT1)
           Then(4)
                If(5)              ++CTR_LRN_ECU_OK_C1_LOT1 >= 7
                   Then(5)           STATE_LRN_ECU = "C1_LOT1"
                   Endif(5)
           Endif(4)
            If(4)               0.484V <= V_VAR_LD <= 0.677V         (C-Muster LOT2)
           Then(4)
                If(5)              ++CTR_LRN_ECU_OK_C2_LOT2 >= 7
                   Then(5)           STATE_LRN_ECU = "C2_LOT2"
                   Endif(5)
         Endif(4)
            If(4)               3.203V <= V_VAR_LD <= 3.300V         (Serial ECU)
           Then(4)
                If(5)              ++CTR_LRN_ECU_OK_C2_SERIAL >= 7
                   Then(5)           STATE_LRN_ECU = "Serial ECU"
                   Endif(5)
           Endif(4)
      Else(3)
            STATE_LRN_ECU = "LEARNING_FAILED"
      Endif(3)
Else(2)
      If(3)        ACTION_ECM3_DisableReq()
      Then(3)
            Store the detected LOT immedatily into Flash
            ACTION_INFR_McRestart()
      Elsed(3)
            /*wait until MU shutdown*/
      Endif(3)

Endif(2)
Endif(1)
```

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1.26 SDA - AT library short description

General information:

1.26.1 General

This document is a short reference to all AT Library blocks. It aims to help the reading of SDA based specifications. The complete library reference is available with the current SDA installation.

Optional inputs and outputs: Some blocks can have optional inputs and outputs, which are made available when necessary. These outputs are normally not shown in the example pictures, but described on the explanations.

Maps, curves and axis: Maps and curves are related to their axis definitions. This information can be consulted at the calibration section in the given specification.

Index base: Block inputs for indices can be one-based (standard) or zero-based (special cases). The index base is shown subscripted. For instance R0 stands for "row index, zero-based". Other examples: bit_sel0, x1, y0. See "selector" block example, on this document in chapter 1.8, page 9.

Triggered blocks: Most of the blocks have an optional trigger input. This port accepts function-call connection, which determinate when these blocks shall be calculated. Example:

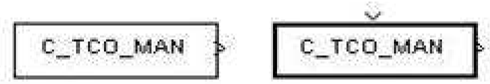

Figure 1.26.1:

1.26.2 Block versioning

The block version is shown since SDA 5.0 release. Please note the following:

- Blocks from previous SDA versions do not show any version information.
- The version information is shown on the block icon or below it in the format "*V X.Y*".
- Functional change or relevant appearance changes reflects on version information update (only on "X"). A change in "Y" is not functional or appearance relevant. For instance, the versions 5.1, 5.4, 5.13 have all the same appearance and functional behavior.
- The part "X" of the block version number is not coupled to SDA release number. The first block version since SDA 5.0 is "5." for all libraries though.
- All functional changes done to AT Library blocks between SDA releases are shown in this document and in the according library documentation within the SDA installation.

1.26.3 Functional behaviour

The blocks of version 6.x have the same functional behaviour than the blocks of version 5.x. The changes in the blocks are only related to code generation and/or to adaptation to the ASAM MBFS standard.

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1.26.4 Action Handling

Action_Data_Store (V. 5) **Action_Data_Store_Init (V. 5),** **Read_Action_Data_Store (V. 5)** **Write_Action_Data_Store (V. 5)**

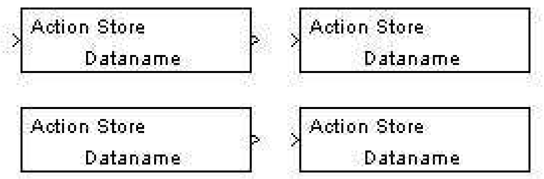

Figure 1.26.2:

These blocks are used to model the initialization and read/write access to an action internal storage that can be accessed by all instances of this action and inside the module defining the action.

If this storage is only used inside the action instance or inside the defining module it is listed as local data on the specification.

Input_Action_Signal (V. 5)

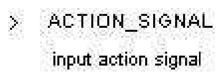

Figure 1.26.3:

This block is used to model nested Actions (reused Action inside an Action). Here the Action Signal needed for the reused Action is fed in by an Action Input.

Input_To_Action (V. 5) **Output_From_Action (V. 5)**

Figure 1.26.4:

The Input_To_Action block is used to model an input to an Action that is unique for all action instances and calculated outside of the module that defines the action.

The Output_From_Action block is used to model an output of an action (shared storage) and of the defining module. The value can be set by all instances of the action and inside the module defining the action.

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IRS (V. 5)

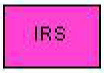

Figure 1.26.5:

This block indicates that the according subsystem belongs to an Infrastructure Requirement Specification (IRS).

Action Parameters (V. 5.)

Figure 1.26.6:

The blocks PAR_IN, PAR_OUT and PAR_INOUT are used to model action input, output and input-output parameters.

1.26.5 Application Condition

APP_CDN (V. 5) (V. 6)

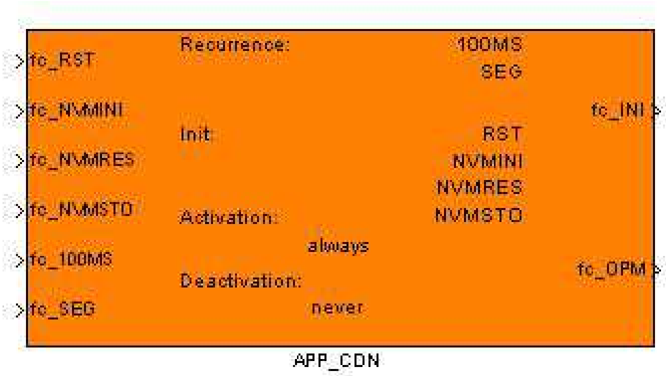

Figure 1.26.7:

The Application Condition block displays the activation conditions for the according module. It controls when the module is activated or deactivated. All function calls triggering or initializing the functionality of a module are input to the APP_CDN block. Dependent on the activation condition the function calls are fed through the block or not. The Application Conditions are displayed in textual form within the specification.

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In the above example of the block the according module is always active and never inactive. The initialization is triggered by the Reset (RST) event and the Nonvolatile Memory (NVM...) events. The according function calls are output in bus of function calls fc_INI.

The operate mode is triggered by the 100ms event and the segment synchronous event. The according function calls are output in a bus of function calls fc_OPM.

1.26.6 Basic Algorithms

DT1 Element (V. 5.) (V. 6)

The output signal y is calculated from the input signal u, the amplification factor K and the time constant T according to the following functions:

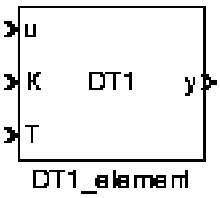

Figure 1.26.8:

z1[n] = (u*K/T);
z2[n] = z2[n-1]+ (Teff /(T+Teff))*(z1[n] - z2[n-1]);
y[n] = z1[n] - z2[n];

T	Time Constant
U	Input signal
K	Amplification factor

mean_value (V. 5.) (V. 6)

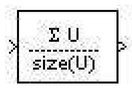

Figure 1.26.9:

This block outputs mean value of elements of a single input vector.

fading (V. 5.) (V. 6)

Figure 1.26.10:

This block implements the fading calculation:
Inputs: A, B, F.
Output: Out=A*(1-F)+B*F.

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1.26.7 Calibration_Data_Handling

Constant (V. 5.) (V. 6)

Figure 1.26.11:

Outputs the value specified by a constant or parameter, which can be a scalar or array. The example's output gives the value contained in the constant NC_CYL_NR (a configuration data).

from_data_definition (V. 5.) (V. 6)

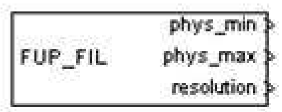

Figure 1.26.12:

This block reads chosen fields from data definition of specified data (e.g. FUP_FIL) and gives them as outputs. The possible fields to output: minimal physical value, maximal physical value, resolution and states (only for state variables).

Get Curve Index (V. 5.)

Figure 1.26.13:

This block outputs the next smallest index from the input axis value. It considers the axis of the selected curve. Indexing starts from zero.

In	Axis value on the axis of the curve
Out	Index of the axis value on the axis of the curve

Get Map Index (V. 5.) (V. 6)

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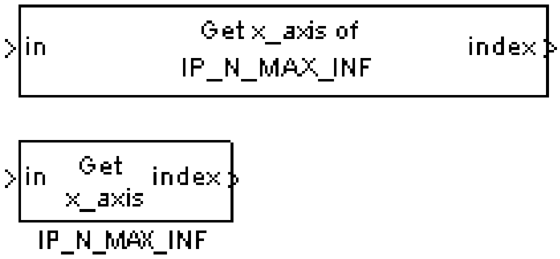

Figure 1.26.14:

This block outputs the next smallest index of the input axis value on the selected axis (x_axis or y_axis) of the selected map. Indexing starts from zero.

in	Axis value of the specified axis in a map
index	Index of the axis value on the specified axis of the map

getCurveArray (V. 5.)

Figure 1.26.15:

Generates a signal which carries the values from the selected calibration data (an array of curves).

getMapArray (V. 5.) (V. 6)

Figure 1.26.16:

Generates a signal which carries the values from the selected calibration data (an array of maps).

id_lookup (V. 5.) (V. 6)

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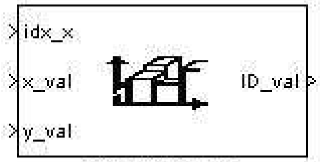

Figure 1.26.17:

This block implements the lookup operation over a non interpolated map or array of maps. A single map has one dimension (calibration curve) or two dimensions (calibration map).
The name of the map is specified by "MAP".
The block supports 3 different modes:

- "local": The map is read from base workspace and only the look up value is exported via the output
- "exported": The map is read from base workspace and the look up value together with the complete map array is exported.
- "imported": The map is read from an inport, as an array signal.

The block outputs the lookup value "ID_val" connected with the next smaller index to the axis values "x_val" and "y_val". There is no interpolation or extrapolation between axis values.

With the option "External Index Search", the search for the axis indices can be done externally (see index_search block). The ports "x_val" and "y_val" are named "x_frac" and "y_frac". In this case, the values on "x_frac" and "y_frac" are directly used as index and fraction values for the map lookup.

The ports "idx_x", "idx_y" and "idx_z" specify the indices selecting a map to be read from the given map array, if an array of maps is used. Their availability as input ports depends on the array dimensions, which can be consulted at the calibration section in the given specification.

For access to an array of maps, the block can be set to:

- "Scalar vectorization" mode: All maps in the array are read with the same inputs for "x_val" and "y_val". The output is a vector carrying the lookup values.
- "Array vectorization" mode: All maps in the array are read with separate values from the inputs "x_val" and "y_val", which are arrays. The output is a vector carrying the lookup values.
- "No vectorization" mode: The lookup operation is calculated for one map which is selected through the inputs "idx_x", "idx_y" and "idx_z". Values for "x_val" and "y_val" are than scalar, as also the output lookup value.

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index_search (V. 5.) (V. 6)

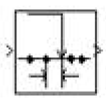

Figure 1.26.18:

The index-search block calculates the zero-based indices and interval fractions for the input value for a selected axis.

The block generates a pair of outputs for each input value by calculating the zero-based index of the breakpoint set element that is less than or equal to the input value and the resulting fractional value (*f* were: $0 <= f < 1$). This represents the input value's normalized position between the index and the next index value for in-range input.

ip_lookup (V. 5.) (V. 6)

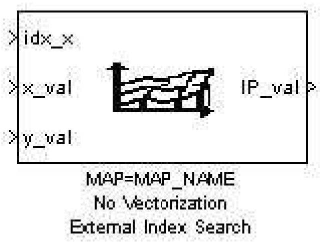

Figure 1.26.19:

This block is analogous to the id_lookup block. The difference is the output lookup value, which is interpolated.

IP_val is calculated by a linear interpolation through the map values. There is linear interpolation between axis values.
The name of the map is specified by "MAP".
The block supports 3 different modes:

- "local": The map is read from base workspace and only the look up value is exported via the output
- "exported": The map is read from base workspace and the look up value together with the complete map array is exported.
- "imported": The map is read from an inport, as an array signal.

With the option "External Index Search", the search for the axis indices can be done externally (see index_search block). The ports "x_val" and "y_val" are named "x_frac" and "y_frac". In this case, the values on "x_frac" and "y_frac" are directly used as index and fraction values for the map interpolation.

The ports "idx_x", "idx_y" and "idx_z" specify the indices selecting a map to be read from the given map array, if an array of maps is used. Their availability as input ports depends on the array dimensions, which can be consulted at the calibration section in the given specification.

For access to an array of maps, the block can be set to:

- "Scalar vectorization" mode: All maps in the array are read with the same inputs for "x_val" and "y_val". The output is a vector carrying the lookup values.
- "Array vectorization" mode: All maps in the array are read with separate values from the inputs "x_val" and "y_val", which are arrays. The output is a vector carrying the lookup values.
- "No vectorization" mode: The lookup operation is calculated for one map which is selected through the inputs "idx_x", "idx_y" and "idx_z". Values for "x_val" and "y_val" are than scalar, as also the output lookup value.

read_Map_Array (V. 5.) (V. 6)

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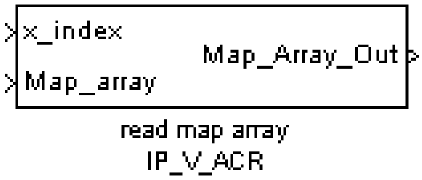

Figure 1.26.20:

This block selects and output the map specified by the input indexes "x_index", "y_index" and "z_index" as a signal. Not shown indexes have standard value "1". The input is an array of maps.

to_resolution (V. 5.) (V. 6)

Figure 1.26.21:

This block provides the possibility to reduce data with a higher resolution to a lower one. Three types of reduction are possible: truncation (ceils or floor) and round-up to a given resolution. The chosen conversion method is shown in the block icon: ROUND, CEIL or FLOOR. The resolution value can be obtained from the optional input port "res" or given as a block annotation.

write_Map_Array (V. 5.) (V. 6)

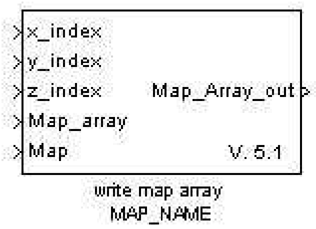

Figure 1.26.22:

Outputs a map array signal "Map_Array_out" which is a copy from the input array signal "Map_Array", where the single map specified by the input indexes "x_index", "y_index" and "z_index" is substituted by the values of the input "Map". Not shown indexes have standard value "1".

1.26.8 Control_Structures

Compiler_switch_if (V. 5.) (V. 6) **compiler_switch (V. 5.) (V. 6)**

These blocks are used to model compiler switches.

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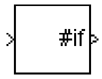


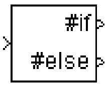
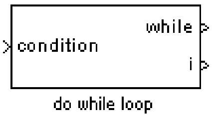


Figure 1.26.23:

compiler_switch_if : If condition is true then output function call ’#if’.
compiler_switch: If condition is true then output function call ’#if’ else output function call ’#else’

do_while_loop (V. 5.) while_loop (V. 5.)



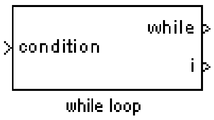


Figure 1.26.24:

While-Control Structure and Do-While-Control Structure:

As long as condition is true the function call "while" is cast. The only difference between the blocks is when the condition is checked for the first time. The while_loop block checks the condition before it performs first function call. do_while_loop performs the function call at first and only after that checks the condition. The optional output ‘i’ indicates the current number of execution.

To omit an endless loop the while is only executed as long as the number of iterations is smaller than the defined maximum (default 500, for model simulation).

for_loop (V. 5.)

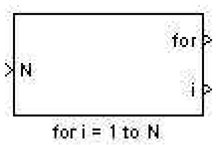


Figure 1.26.25:

For-Loop-Control Structure:

Executes for-loops function-calls, where the optional output "i" runs from 0 (or 1) to N. The output "for" is a function call signal triggering the according subsystem that contains the functionality within the for loop.

If (V. 6)

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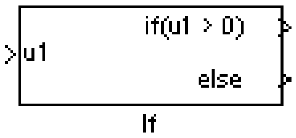

Figure 1.26.26:

If...Then...Else-Control Structure: If condition 'u1' is true then output action call 'if' else output action call 'else'. In difference to the following if-then-else blocks this block outputs SL action calls instead of function calls.

If...Then (V. 5.) (V. 6)

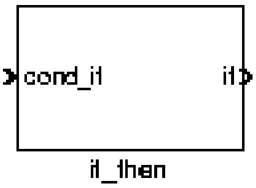

Figure 1.26.27:

If...Then-control structure: If condition 'cond_if' is true then output function-call 'if'.

If...Then...Else (V. 5.) (V. 6)

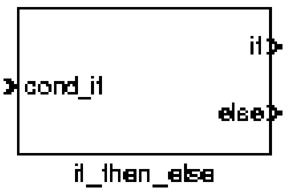

Figure 1.26.28:

If...Then...Else-Control Structure: If condition 'cond_if' is true then output function call 'if' else output function call 'else'.

sequencer (V. 5.) (V. 6)

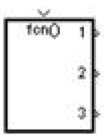

Figure 1.26.29:

This block generates an ordered sequence of function calls. The number of output ports is variable. The user has a possibility to select in the block mask between three operation variants:

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- "not triggered" - the output function calls are generated when the block is calculated;
- "function call triggered" - the output function calls are generated when the block is triggered. In this case block has an extra function call trigger input;
- "logical triggered" - the block has an extra input port "trigg". The output function calls are generated when this input has a value different than zero.

Triggeroutport_2_fcn_call (V. 5)

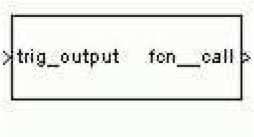

Figure 1.26.30:

This block generates a function call if the input is different to zero. The block can be used in connection with a trigger block output.

Triggeroutport_2_logical (V. 5)

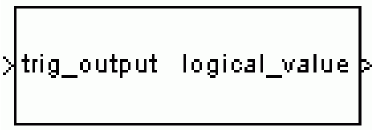

Figure 1.26.31:

Conversion of a trigger signal into a logical value. This block generates a logical 1 if the input is different to zero. The output is zero otherwise. The block can be used in connection with a trigger block output.

1.26.9 Signal Types

FROM_DATA (V. 5) **FROM_FCT_CALL (V. 5)** **FROM_TRIG (V. 5)**
FROM_VISIBLE (V. 5) **FROM_ACTION_CALL (V. 5)**

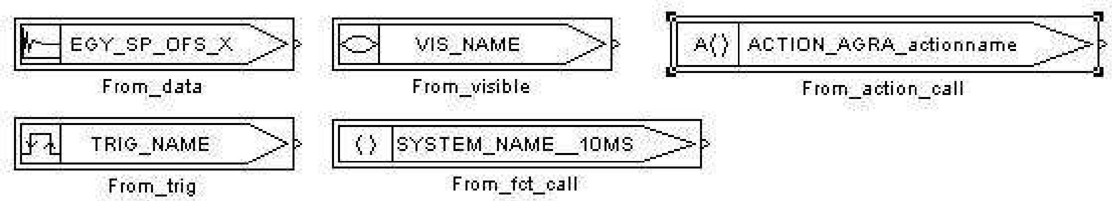

Figure 1.26.32:

From_data, From_fct_call, From_trig or From_visible is a From block with scope global for the use with global data, function call, trigger or visible signals only. This From blocks gets the signal from a corresponding Goto block.

GOTO_DATA (V. 5.) **GOTO_FCT_CALL (V. 5.)** **GOTO_TRIG (V. 5.)**
GOTO_VISIBLE (V. 5.) **GOTO_ACTION_CALL (V. 5.)**

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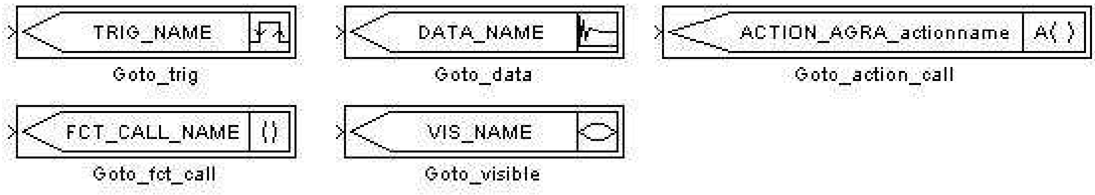

Figure 1.26.33:

Goto_data, Goto_fct_call, Goto_trig or Goto_visible is a Goto block with scope global for the use with global data, function call, trigger or visible signals only. The signal is sent to a corresponding From block.

GOTO **FROM**

Figure 1.26.34:

Goto and From blocks with scope local. The blocks represent a signal line between the Goto and the From block. In the example the signal TCO is submitted between the blocks.

1.26.10 Signals

branch (V. 5.) (V. 6)

Figure 1.26.35:

This block creates one or more copies from the input signal, which can than be directly used as input to a merge block.

Input signal can be a scalar, a vector or a bus. In case input signal is a bus, every output signal is also a bus with the same bus structure as the input.

BusMerge (V. 5.) (V. 6)

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Figure 1.26.36:

This block constructs a bus output holding the union of all elements of the input busses in a flat bus structure. Flat structure means that the exported bus has only one hierarchy level. Signals that are input on more than one of the input busses are merged separately before being added to the output bus.

case_multiport_switch (V. 5.) (V. 6)

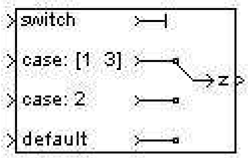

Figure 1.26.37:

The block connects one of the "case" input ports (or default port) to the output port.

It receives a value on the input port "switch", which is compared to case conditions that determine which of the other input ports is connected to the output port.

If the value on the control port "switch" does not match any case condition, the "default" input is connected to the output.

In the example picture, if the value of "switch" is 1 or 3, the port "case: [1 3]" is connected to the output. If its value is 2, than the port "case: 2". Else, the default port is used.

constant_value (V. 5.) (V. 6)

Figure 1.26.38:

Outputs a constant value with the possibility to show the icon as formula expression. The calculated value is shown on the block annotation.

FeedThrough (V. 5.) (V. 6)

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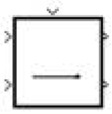

Figure 1.26.39:

The FeedThrough block outputs the input values if the function-call occurs. The output maintains its last changed value. The number of input and output ports is variable.

Selector (V. 5.) (V. 6)

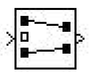

Figure 1.26.40:

The Selector block generates as output selected elements of an input vector or matrix. It accepts either vector or matrix signals as input. The block icon changes to reflect the type of input used. The way the block determines the elements to select differs slightly, depending on the type of input.

Vector Input

If the input type is vector, a Selector block outputs a vector of selected elements. The block determines the indices of the elements to select either from the block's Elements parameter or from an external signal.

The elements to be selected must be specified as a vector unless only one element is being selected. For example, the following model shows the Selector block icon and the output for an input vector of [2 4 6 8 10] and an Elements parameter value of [5 1 3].

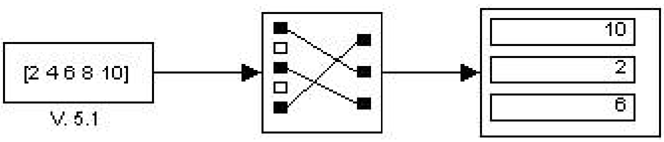

Figure 1.26.41:

The block icon displays the ordering of input vector elements graphically if the block icon is large enough. If external source for element indices is used, the block adds an input port for the element indices signal.

Matrix Input

If the input type is matrix, the Selector block outputs a matrix of elements selected from the input matrix. The block determines the row and column indices of the elements to select either from its Rows and Columns parameters or from external signals (input ports "R", for row, and "C" for column selection).

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The indices of the row and columns to be selected must be specified as vectors (or a scalar if only one row or column is to be selected). For example, the Rows expression [2 1] and the Columns expression [1 3] specifies output of a 2x2 matrix whose first row contains the first and third elements of the input matrix's second row and whose second row contains the first and third elements of the input matrix's first row.

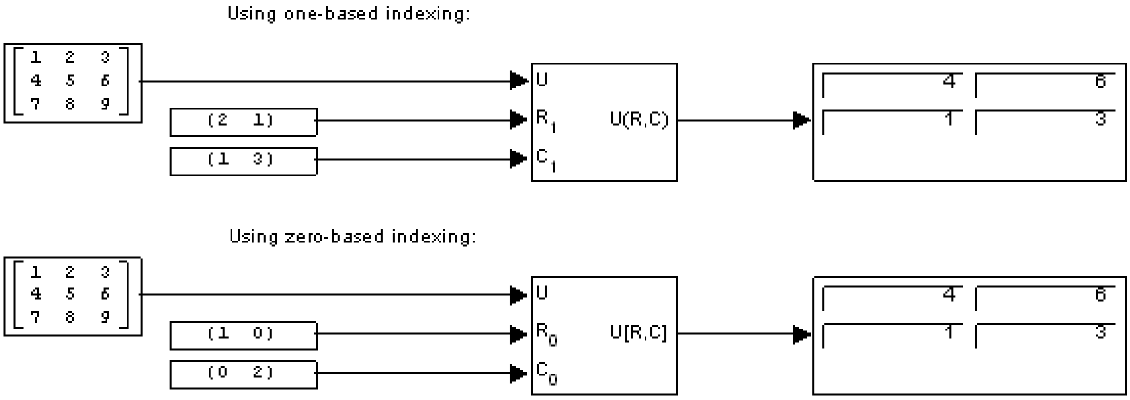

Figure 1.26.42:

Switch_Case (V. 5.) (V. 6)

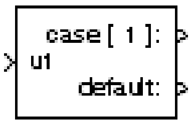

Figure 1.26.43:

The following shows a completed Simulink C-like switch control flow statement in the subsystem of the SwitchCase block.

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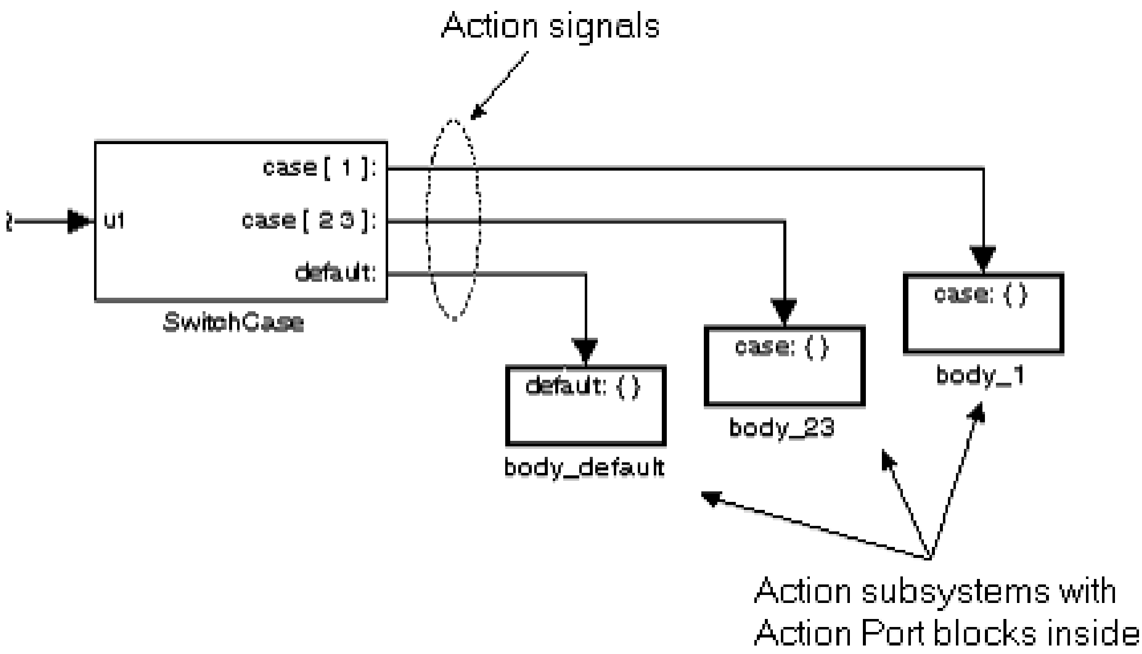

Figure 1.26.44:

As shown in the above example, a Switch_Case block receives a single input, which it uses to form case conditions that determine which Action subsystem to execute. Each output port case condition is attached to an Action subsystem. The cases are evaluated topdown starting with the top case. If a case value (in brackets) corresponds to the actual value of the input, its Action subsystem is executed.

The above switch control flow statement can be represented by the following pseudo code:

```
switch (u1) {
   case [u1=1]:
      body_1;
      break;
   case [u1=2 or u1=3]:
      body_23;
      break;
   default:
      bodydefault;
}
```

Note: As demonstrated in the pseudo code example above, cases for the SwitchCase block contain an implied break after their Action subsystem is executed. There is no "fall through" behaviour for the Simulink switch control flow statement as found in standard C switch statements.

Note: The naming "Action" in this block is not connected to "Actions" defined in the Supplier Action concept.

logical_value (V. 5.) (V. 6)

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Figure 1.26.45:

Block outputs logical TRUE or FALSE.

Merge (V. 5.) (V. 6)

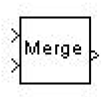

Figure 1.26.46:

The Merge block combines its inputs into a single output line whose value at any time is equal to the most recently computed output of its driving blocks. The Merge block often is used to merge a calculation signal with a reset signal.

SignalManager (V. 5.) (V. 6)

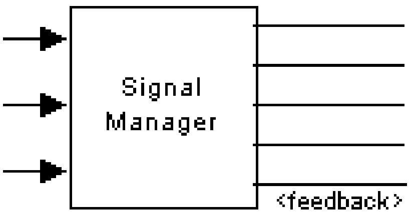

Figure 1.26.47:

This block merges signals contained in the input busses. It supports two or more input busses. Optional configurations:

- Output with "feedback" bus, which contains all merged signals. The feedback bus is routed back to the operate subsystem.

- "Show signal names on the mask". Where:

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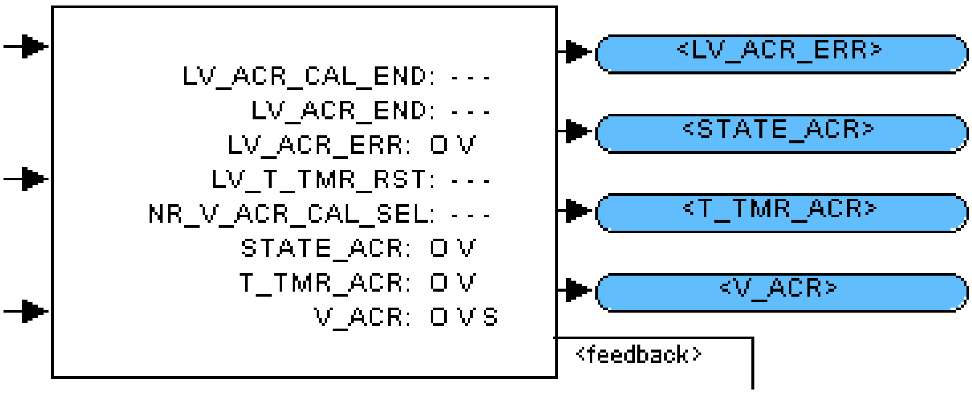

Figure 1.26.48:

- Outports represent the module outputs;
"O": module output;
"V": visible variable;
"S": NVMY data;
"- –": Local variable

Note: Only local signals that are present on one of the input busses to this block are displayed on the block mask

1.26.11 Vectors and Matrices

Assignment (V. 5.) (V. 6)

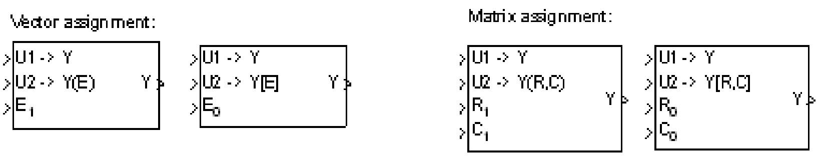

Figure 1.26.49:

The Assignment block assigns values from input U2 to selected elements of array input U1, producing the array output Y. Equivalent operation:

Vector assignment:	Matrix assignment:
Y = U1; Y[E] = U2;	Y = U1; Y[R,C] = U2;

On a vector assignment, the input E is used to select the assignment position. On a matrix assignment, the inputs R (row) and C (column) are used to select the assignment position. The assignment position can be a scalar, a vector or a matrix, depending on the dimension of E, or the combined dimensions of R and C.

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Example: iterated Assignment

The Assignment block can be used to assign values computed in an iterator (For or While) loop to a vector or matrix signal. The iterator block generates the indices required by the Assignment block. Two iterator blocks are needed to compute row and column indices separately. For example, the following model uses a For block to create a vector signal each of whose elements equals 3*i where i is the index of the assignment element.

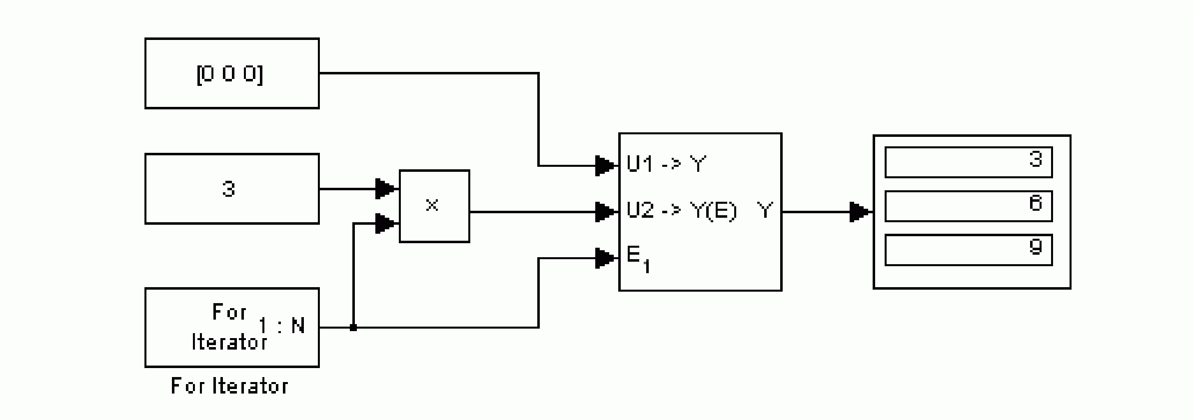

Figure 1.26.50:

Dec2Bin (V. 5.) (V. 6) **Bin2Dec (V. 5.) (V. 6)**

These blocks convert an integer into a binary number and vice versa. The number of bits can be set to 8, 16, 32 or 64. For decimal numbers the digits after the comma will be cut off. The binary numbers are displayed with leading highest exponent: [2ˆn, ...,2ˆ1,2ˆ0].

Important: these blocks suffered functional modification from version 3.1 to 4.0. See below.

Pseudo-code since SDA 4.0	**Pseudo-code for SDA 3.1**

Continued on next page

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Dec2Bin:

```
for ( i=0; i<no_bits; i++) {
   bit_vector[ no_bits - i] =
                    num_dec.i;
}
```

Bin2Dec:

```
num_dec = 0;
for ( i=0; i<no_bits; i++) {
   num_dec = num_dec +
          bit_vector[no_bits-i]
          * 2ˆi;
}
```

Figure 1.26.51:

First element in bit vector is most significant bit. E.g.**10000000 is equal to 128**

Dec2Bin:

```
for ( i=0; i<8; i++) {
   8bit_vector[i+1] = num_dec.i;
}
```

Bin2Dec:

```
num_dec = 0;
for ( i=0; i<8; i++) {
   num_dec = num_dec +
          8bit_vector[i+1]
          * 2ˆi;
}
```

Figure 1.26.52:

Figure 1.26.53:

First element in bit vector is less significant bit. E.g.**10000000 is equal to 1**

DirectLookUp (V. 5.) (V. 6)

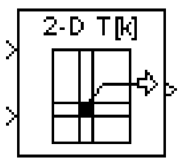

Figure 1.26.54:

Index into an N-dimensional table to retrieve a scalar, vector or 2-D matrix. The Direct Look-Up Table (n-D) block uses its block inputs as zero-based indices into an n-D table. The number of inputs varies with the shape of the output desired. The output can be a scalar, a vector, or a 2-D matrix. The look-up table uses **zero-based** indexing.

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A set of output values can be defined as the Table data parameter. The output can be a scalar, a vector or a 2-D matrix. The first input specifies the zero-based index to the first dimension higher than the number of dimensions in the output, the second input specifies the index to the next table dimension, and so on, as shown by this figure:

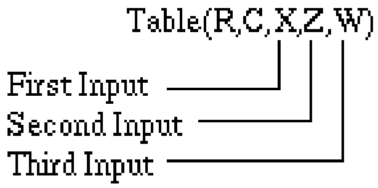

Figure 1.26.55:

The figure shows a 5-D table with an output shape set to "2-D Matrix"; the output is a 2-D Matrix with R rows and C columns.

This figure shows the set of all the different icons that the Direct Look-Up Table block shows (depending on which options you choose in the block's dialog box).

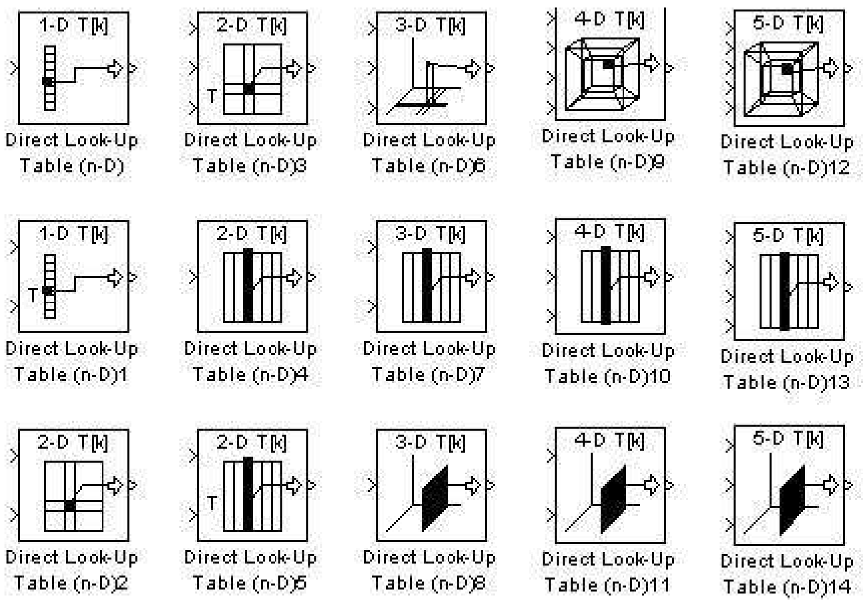

Figure 1.26.56:

With dimensions higher than 4, the icon matches the 4-D icons, but will show the exact number of dimensions in the top text, e.g., "8-D T[k]." The top row of icons is used when the block output is made from one or more single-element lookups on the table. The blocks labelled "n-D Direct Table Lookup5," 6, 8 and 12 are configured to extract a column from the table and the two blocks ending in 7 and 9 are extracting a plane from the table. Blocks in the figure ending in 10, 11 and 12 are configured to have the table be an input instead of a parameter.

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get_bit (V. 5.) (V. 6)

Figure 1.26.57:

This block gets the values of specific bits of the decimal number obtained from the input port "num_dec". The output can be either single value or vector depending on the input given through "bit_sel" input port. The input "bit_sel" can be a single value or a vector. It selects the bits used in this operation. Bits are selected by its position number from the less significant bit (position 0 or 1) to the most significant bit (7, 15, 31, 63 or 8, 16, 32, 64). The user has possibility to select between zero or one based indexing for "bit_sel".

MatrixConcatenation (V. 5.) (V. 6)

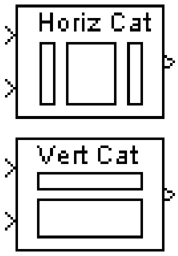

Figure 1.26.58:

The MatrixConcatenation block concatenates input matrices u_1, u_2, ..., u_n along rows or columns, where n is specified by the number of input ports.

Horizontal Matrix Concatenation

In the horizontal concatenation mode, the block concatenates the input matrices along rows.

y = [u1 u2 u3 ... un]   % Equivalent MATLAB code

For horizontal concatenation, inputs must all have the same row dimension, M, but may have different column dimensions. The output matrix has dimension M-by- Ni, where Ni is the number of columns in input ui (i = 1, 2, ..., n). When some of the inputs are length-M 1-D vectors while others are M-by-Ni matrices, the vector inputs are treated as M-by-1 matrices.

Vertical Matrix Concatenation

In the vertical concatenation mode, the block concatenates the input matrices along columns.

y = [u1;u2;u3;...;un]   % Equivalent MATLAB code

For vertical concatenation, inputs must all have the same column dimension, N, but may have different row dimensions. The output matrix has dimension Mi-by-N, where Mi is the number of rows in input ui (i = 1, 2, ..., n). When some of the inputs are length-Mi 1-D vectors while others are Mi-by-1 matrices, the vector inputs are treated as Mi-by-1 matrices. (1-D vector inputs are not accepted for vertical concatenation when the other inputs have column dimension greater than 1.)

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1-D Vector Concatenation

When all inputs to the Matrix Concatenation block are length-Mi 1-D vectors, the output is a Mi-by-1 matrix containing all input elements concatenated in port order: the elements in the vector input to the top port appear as the first elements in the output, and the elements in the vector input to the bottom port appear as the last elements in the output.

read_array (V. 5.) (V. 6)

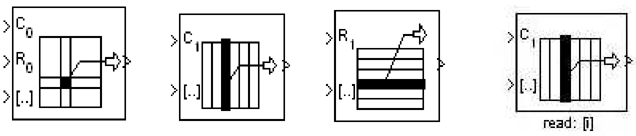

Figure 1.26.59:

This block reads elements (values, rows or columns) from input array. There are three possible modes:

- "read single value" - block reads the single value A(R,C) from the input array A at the given positions C (columns) and R (rows).
- "read row(s)" - block reads row(s) A(R) from the input array A at the given position(s) R.
- "read column(s)" - block reads column(s) A(C) from the input array A at the given position(s) C.

In the modes "read row(s)" and "read column(s)" it is possible to give a vector as an input for coordinates R or C. So it is possible to get more than one row or column in the output at once.

Each coordinate R and C can be obtained from the corresponding input port or as a block parameter. The user has a possibility to select between zero or one based indexing for coordinates R and C, indicated as subscribed 0 or 1 (e.g. C_0 or C_1).

Bus support: The input [..] can be either an array or a bus of arrays. If the input signal is a bus, the output signal is a bus with the same structure as the input. Every element of the bus signal gets the suffix specified below the block (read: [i]). The forth block shows the annotation "read: [i]" which means that every signal name in the output bus gets the suffix [i] to indicate that the i-th element of the array is selected.

set_array (V. 5.) (V. 6)

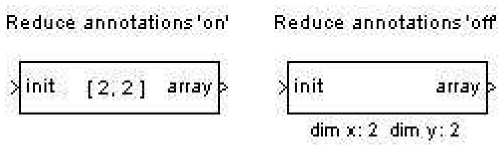

Figure 1.26.60:

This block outputs the array filled with the given initial value. The initial value can be obtained from the block input ('external source') or can be entered as the block parameter ('internal source'). The size of the output array can be entered directly as the block parameter or can be obtained from the existent data definition.

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set_bit (V. 5.) (V. 6)

Figure 1.26.61:

The block sets or resets the bits of decimal number "dec_num" chosen through input port "bit_sel" depending on the value of "bit". User can specify "bit" value either in the parameter "Bit value" or as an input port. The "bit" input port value can be a vector. In this case "bit" vector length should be the same as in "bit_sel" vector.

The decimal value can be obtained from the input port "num_dec" or it can be stored in internal memory and initialized by zero. The user has the possibility to select between zero or one based indexing for "bit_sel", indicated as subscribed 0 or 1 (e.g. bit_sel_0 or bit_sel_1).

Two_power_n (V. 5.) (V. 6)

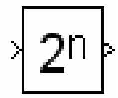

Figure 1.26.62:

This block calculates 2 to the power of n. The input n has to be an integer. Otherwise the digits after the comma are cut off (floor[n]).

Width (V. 5) (V. 6)

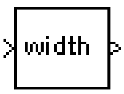

Figure 1.26.63:

Output the width of the input signal. If an the input is an array of size 3 the output is 3.

write_array (V. 5.) (V. 6)

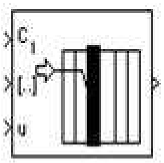

Figure 1.26.64:

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This block writes elements (values, rows or columns) into input array. It is possible to select between zero or one based indexing for coordinates.

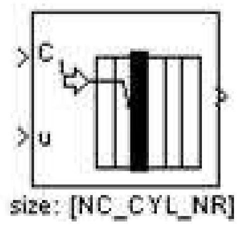

Figure 1.26.65:

There are three possible operation modes:

- "write single value" - block writes the single value A(R,C) into the input array A at the given positions R (columns) and C (rows).
- "write row(s)" - block writes row(s) A(R) into the input array A at the given position(s) R.
- "write column(s)" - block writes column(s) A(C) into the input array A at the given position(s) C.

In the modes "write row(s)" and "write column(s)" it is possible to give a vector as an input for coordinates R or C. So it is possible to write more than one row or column in the output array at once.

The input row or column in "write row(s)" or "write column(s)" mode should either be scalar (single value) or have the same length as the according dimension of the input array.

It is possible to obtain the input array A from an input port or from an internal memory. When block uses internal memory to store the array A the size of this array is shown as block annotation like in the second block example. The size of the array in this case is NC_CYL_NR. The dimension can also be obtained from an existent data definition.

Bus support: The input "[..]" can be either an array or a bus of arrays. When using a bus of arrays, the input "u" can be a single signal or a bus of signals. When both inputs are buses, there is a correspondence between signals with the same names: the signal "X_i" from "u" is used to write on the array "X" from "[..]".

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Write Matrix (V. 5.) (V. 6)

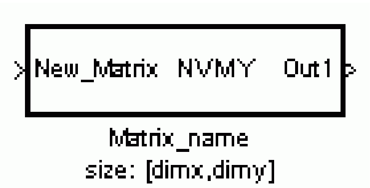

Figure 1.26.66:

The block writes a Matrix 'Matrix_name' directly in the Workspace. This block is used if data in the simulation has to be saved in the nonvolatile memory NVMY (e.g. at PWL_OFF). In the data definition table of the specification the matrix name is set to Mode S. The parameters 'Matrix_name', number of rows 'dimx Rows' and number of columns 'dimy Col' are shown in the block icon.

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Write To Matrix (V. 5.)

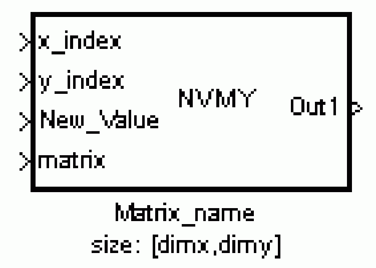

Figure 1.26.67:

The Block writes a new value to a given position in a 2-dimensional Matrix 'MatrixName' not only in the Simulation but also directly in the Workspace. The new value is given by 'New_Value' and the position in the matrix is given by the indices 'x_index' and 'y_index' (Indexing starts from zero).

This block can be used if data in the simulation has to be saved in the nonvolatile memory NVMY (e.g. at PWL_OFF). In the specification the matrix name is set to Mode S. The parameters 'Matrix_name', number of rows 'dimx Rows' and number of columns 'dimy Col' are shown in the block icon.

inverse_lookup_x (V. 5.) (V. 6)

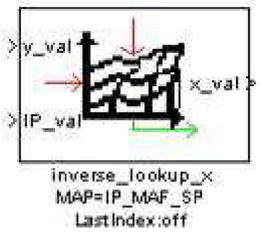

Figure 1.26.68:

This block extracts the value on the x_axis for the map given by Mapname based on the input of the actual map value and the value for the y-axis.

inverse_lookup_y (V. 5.) (V. 6)

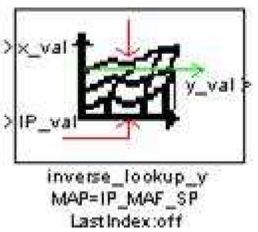

Figure 1.26.69:

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This block extracts the value on the y_axis for the map given by Mapname based on the input of the actual map value and the value for the x-axis.

1.26.12 SDA 4.0 and 3.1 specific blocks

Note: The version information is not available on block icon for blocks from SDA 4.0 and 3.1 releases.

Read Vector

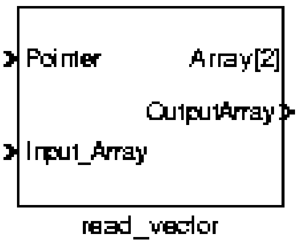

Figure 1.26.70:

Description

This block returns the value of the array element at the position selected by 'Pointer'. Indexing in this block starts from 1. The size of the array can be directly given in the 'Size of Array' parameter or by a variable set in Workspace.

Pointer	Position of the selected element in the input vector (array index)
Input_Array	input vector
OutputArray	Selected element of the input vector
Array[NC_...]	Size of array

Write Vector

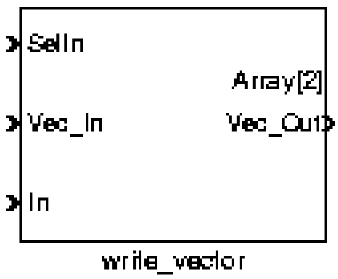

Figure 1.26.71:

Writes a given value to the selected position in the vector. The block writes a given value to the selected position in the vector. The value is given by 'In' and the position in the vector by 'SelIn' (Indexing starts from 1).The dimension of the array is specified by the 'Size of Array' parameter.

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SelIn	Index of the vector position
Vec_In	Input vector
In	Value that is written to vector position 'SelIn'
Vec_Out	Output vector
Array[NC_...]	Size of array

Set Vector

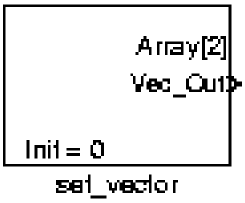

Figure 1.26.72:

The block initializes all values in a vector with the value 'Init'. The size of the vector can be given directly by the 'Size of Array' parameter or by a variable set in Workspace. 'Vec_Out' outputs the initialized vector.

Write Matrix

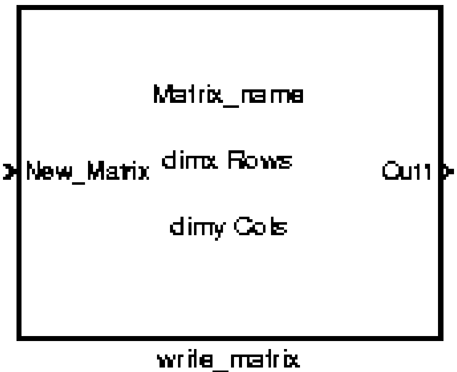

Figure 1.26.73:

The block writes a Matrix 'Matrix_name' directly in the Workspace. This block can be used if data in the simulation has to be saved in the nonvolatile memory NVMY (e.g. at PWL_OFF). In the specification the matrix name is set to Mode S. The parameters 'Matrix_name', number of rows 'dimx Rows' and number of columns 'dimy Col' are shown in the block icon.

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New_Matrix	Matrix Elements
Out	2-dimensional Matrix, written in the Workspace

Write To Matrix

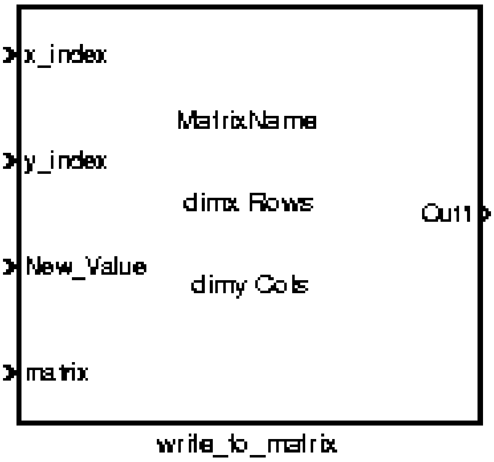

Figure 1.26.74:

The Block writes a new value to a given position in a 2-dimensional Matrix 'MatrixName' not only in the Simulation but also directly in the Workspace. The new value is given by 'New_Value' and the position in the matrix is given by the indices 'x_index' and 'y_index' (Indexing starts from zero).

This block can be used if data in the simulation has to be saved in the nonvolatile memory NVMY (e.g. at PWL_OFF). In the specification the matrix name is set to Mode S. The parameters 'Matrix_name', number of rows 'dimx Rows' and number of columns 'dimy Col' are shown in the block icon.

x_index	x-index of the matrix position
y_index	y-index of the matrix position
matrix	Input matrix
New_Value	Value that is written to matrix position 'x_index' and 'y_index'
Out	Output matrix

Lookup ID Curve

Looks up an ID_Curve (No interpolation). Outputs the 'ID_value' connected with the next smallest index to the axis value 'x_value'. There is no interpolation between axis values. The names of the axis are given by list_curve in the Workspace. There is also no extrapolation outside the axes values.

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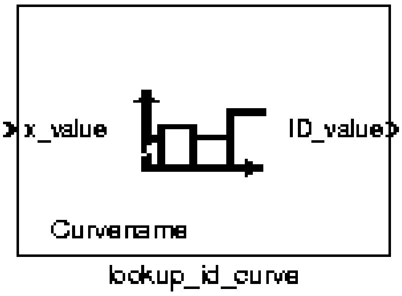

Figure 1.26.75:

triggered (optional)

x_value	Input axis value
ID_value	Output curve value connected with the next smallest index to the axis value

Lookup ID Curve Array

Looks up an ID_Curve_array (No interpolation). [triggered (optional)]

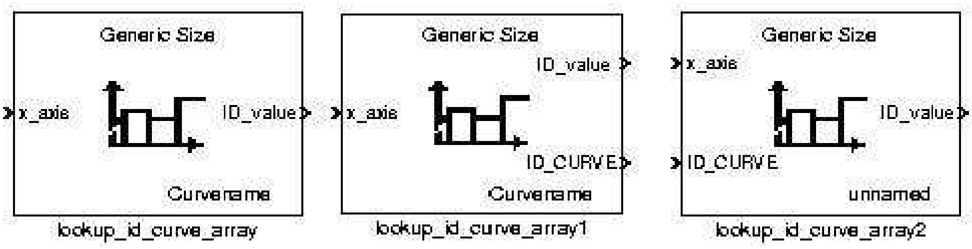

Figure 1.26.76:

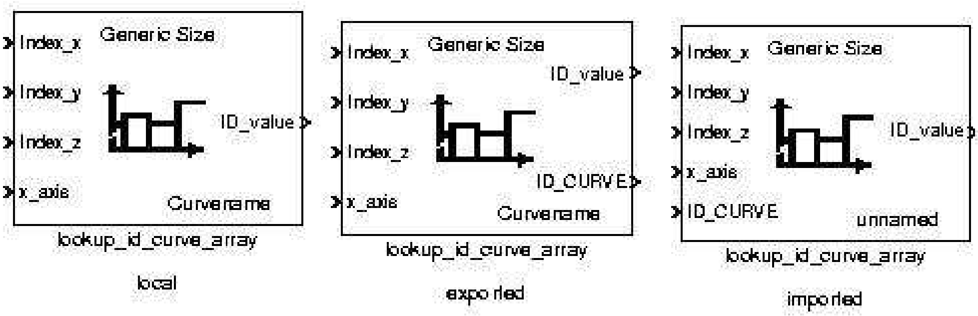

Figure 1.26.77:

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Modes

Mode local: ’Curvename’ is defined within the block in block parameter ’ID_CURVE’.

Mode exported: ’Curvename’ is defined within the block in block parameter ’ID_CURVE’ and is exported via an output (if lookup table is input to another specification).

Mode imported: ’Curvename’ is imported via an inport (if lookup table is defined in another specification).

Description

Outputs the ’ID_map’ value connected with the next smallest index to the axis value ’x_axis’. There is no interpolation between axis values. Index_x, Index_y and Index_z specify the indices of the ID_Curve in the curve array. The names of the axes and the size of the curve array are given by list_curve in the Workspace. There is no extrapolation outside the axes values.

x_axis	Input x-axis value
ID_map	Output curve value connected with the next smallest index to the x-axis value
Index_x	Input: x-index of the curve in the curve array (optional)
Index_y	Input: y-index of the curve in the curve array (optional)
Index_z	Input: z-index of the curve in the curve array (optional)
ID_CURVE	Input: imports the name of the curve (Mode: imported) (optional)
ID_CURVE	Ouput: exports the name of the curve (Mode: exported) (optional)

Lookup ID Map

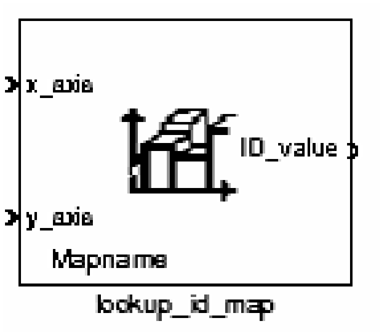

Figure 1.26.78:
Looks up an ID_Map (No interpolation).

triggered (optional)

Outputs the ’ID_map’ value connected with the next smallest index to the axis values ’x_axis’ and ’y_axis’. There is no interpolation between axis values. The names of the axes are given by list_map in the Workspace. There is no extrapolation outside the axes values.

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x_axis	Input: x-axis value
y_axis	Input: y-axis value
ID_map	Output: Map value connected with the next smallest index to the x- and y-axis values

Lookup ID Map Array

Looks up an ID_Map_array (No interpolation). [triggered (optional)]

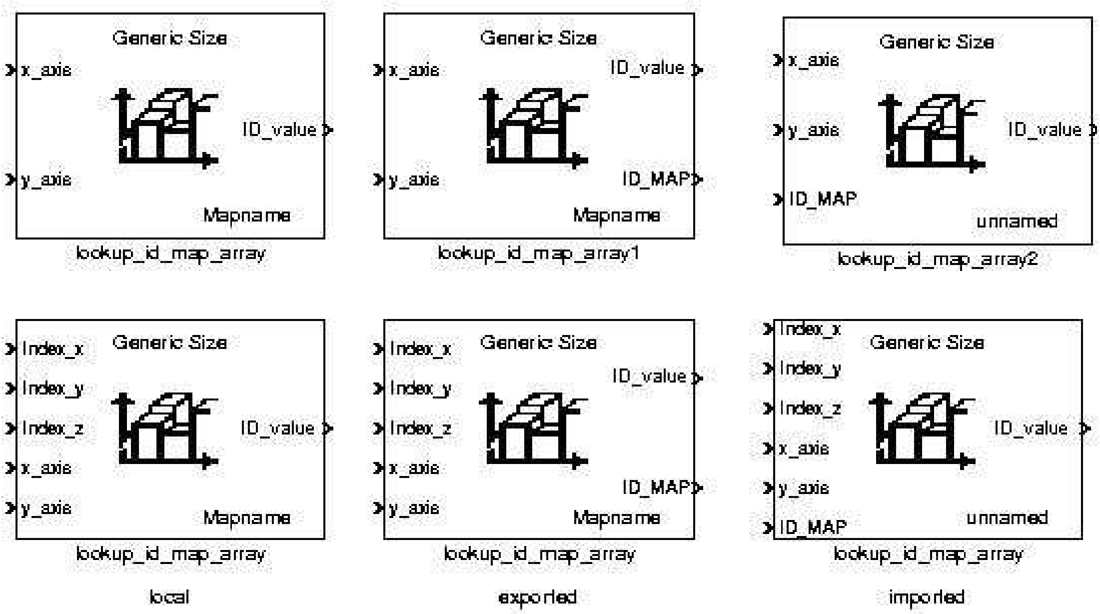

Figure 1.26.79:

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Modes

Mode local: ’Mapname’ is defined within the block in block parameter ’ID_Map’.

Mode exported: ’Mapname’ is defined within the block in block parameter ’ID_Map’ and is exported via an outport (if lookup table is input to another specification) .

Mode imported: ’Mapname’ is imported via an inport (if lookup table is defined in another specification).

Description

Outputs the ’ID_map’ value connected with the next smallest index to the axis values ’x_axis’ and ’y_axis’. There is no interpolation between axis values. Index_x, Index_y and Index_z spezify the indices of the ID_Map in the Map array. The names of the axis and the size of the map array are given by list_map in the Workspace. There is no extrapolation outside the axes values.

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x_axis	Input x-axis value
y_axis	Input y-axis value
ID_map	Map value connected with the next smallest index to the x-axis and y-axis value
Index_x	x-index of the map in the map array (optional)
Index_y	y-index of the map in the map array (optional)
Index_z	z-index of the map in the map array (optional)
ID_MAP	Imports the name of the map (Mode: imported) (optional)
ID_MAP	Exports the name of the map (Mode: exported) (optional)

Lookup IP Curve

Looks up an IP_Curve (With interpolation).

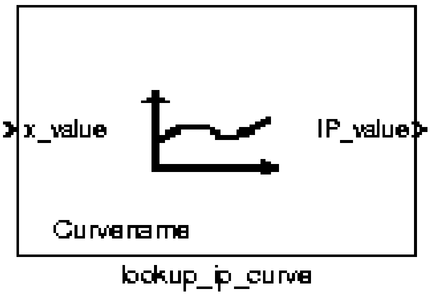

Figure 1.26.80:

triggered (optional)

Outputs the 'IP_value' connected with the linear interpolated index of the axis value 'x_value'. There is a linear interpolation between axis values. The names of the axes are given by list_curve in the Workspace. There is no extrapolation outside the axes values.

x_axis	Input x-axis value
IP_value	Value obtained interpolating the curve

Lookup IP Curve Array

Looks up an IP_Curve_array (With interpolation). [triggered (optional)]

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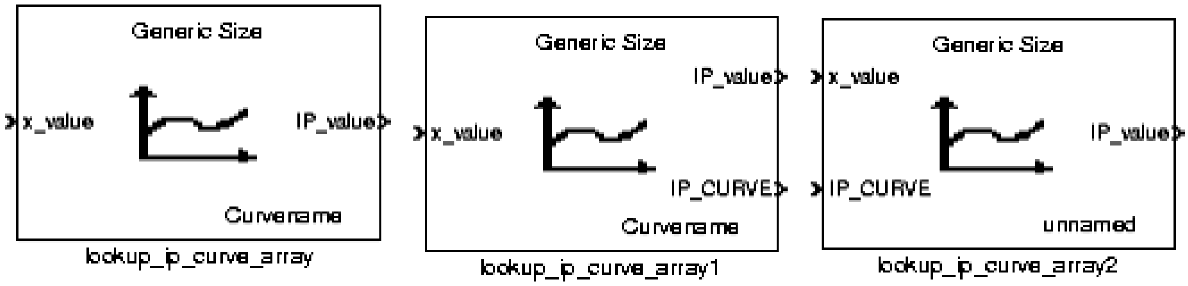

Figure 1.26.81:

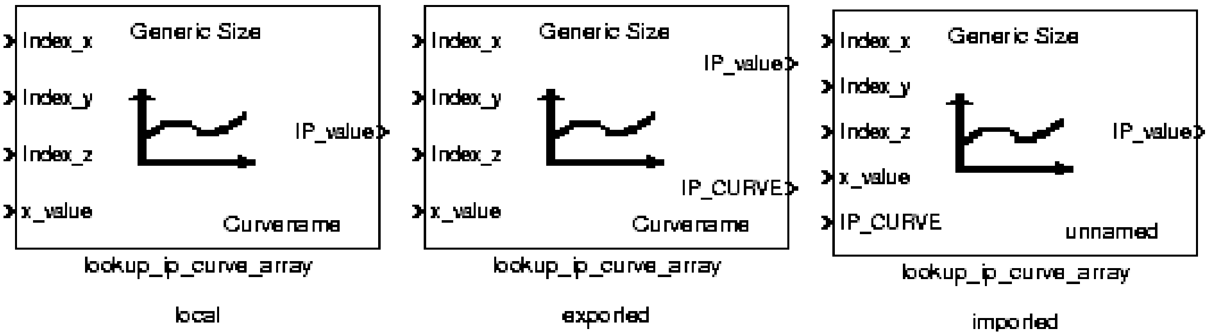

Figure 1.26.82:

Modes

Mode local: 'Curvename' is defined within the block in block parameter 'ID_CURVE'.

Mode exported: 'Curvename' is defined within the block in block parameter 'ID_CURVE and is exported via an outport (if lookup table is input to another specification).

Mode imported: 'Curvename' is imported via an inport (if lookup table is defined in another specification).

Description

Outputs the 'IP_value' connected with the linear interpolated index to the axis value 'x_value'. There is a linear interpolation between axis values. Index_x, Index_y and Index_z spezify the indices of the IP_Curve in the curve array. The names of the axis and the size of the curve array are given by list_curve in the Workspace. There is no extrapolation outside the axes values.

x_axis	Input x-axis value
IP_value	Value obtained interpolating the curve
Index_x	Input: x-index of the curve in the curve array

Continued on next page

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Index_y	Input: y-index of the curve in the curve array
Index_z	Input: z-index of the curve in the curve array
IP_CURVE	Imports the name of the curve (Mode: imported)
IP_CURVE	Exports the name of the curve (Mode: exported)

Lookup IP Map

Looks up an IP_Map (With interpolation).

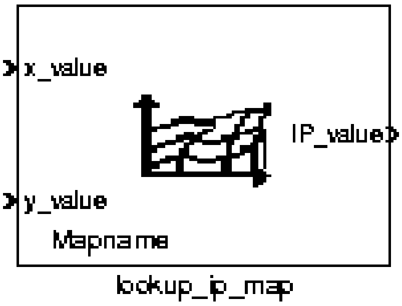

Figure 1.26.83:

triggered (optional)

Outputs the 'IP_value' connected with the linear interpolated index of the axis values 'x_value' and 'y_value'. There is a linear interpolation between axis values. The names of the axis are given by list_map in the Workspace. There is no extrapolation outside the axes values.

x_value	x-axis value
y_value	y-axis value
IP_value	Map value connected with the linear interpolated indeces to the x- and y-axis values

Lookup IP Map Array

Looks up an IP_Map_array (With interpolation).[triggered (optional)]

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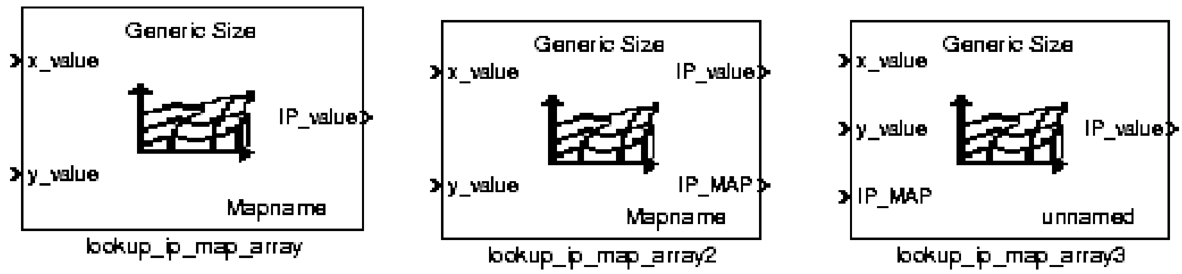

Figure 1.26.84:

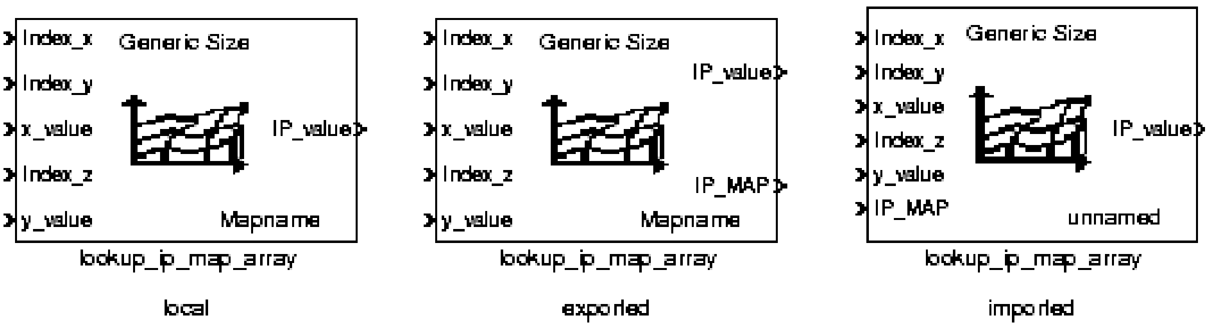

Figure 1.26.85:

Modes

Mode local: 'Mapname' is defined within the block in block parameter 'IP_Map'.

Mode exported: 'Mapname' is defined within the block in block parameter 'IP_Map' and is exported via an outport (if lookup table is input to another specification).

Mode imported: 'Mapname' is imported via an inport (if lookup table is defined in another specification).

Description

Outputs the 'IP_value' connected with the linear interpolated index to the axis values 'x_value' and 'y_value'. There is linear interpolation between axis values, but there is no extrapolation outside the axes values. 'Index_x',' Index_y' and 'Index_z' specify the indices of the IP_Map in the map array. The names of the axes and the size of the map array are given by list_map in the Workspace.

x_value	x-axis value
y_value	y-axis value
IP_value	Map value connected with the linear interpolated index to the x-axis and y-axis value

Continued on next page

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Index_x	x-index of the map in the map array
Index_y	y-index of the map in the map array
Index_z	z-index of the map in the map array
IP_MAP	Imports the name of the map (Mode: imported)
IP_MAP	Exports the name of the map (Mode: exported)

Lookup Multiple ID Curve

Looks up multiple ID_Curves (No interpolation).

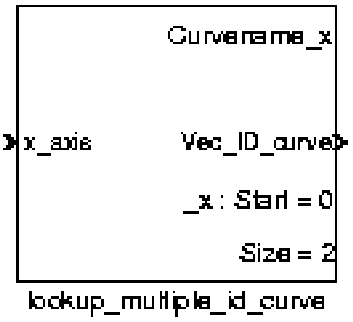

Figure 1.26.86:

triggered (optional)

If the parameter 'Curvename' contains one of the tokens (_x, _i, _j), this is replaced automatically by a given range from 1 to 'Size' or 0 to ('Size'-1). The number of curves accessed is given by 'Size'.

Outputs a vector of length 'Size' of ID_values 'Vec_ID_curve' connected with the next smallest index of the axis values 'x_value' of the different curves.

There is no interpolation between the axis values and no extrapolation outside the axes values. The axis names are given by list_curve in the Workspace.

x_axis	Axis value
Vec_ID_curve	Vector of Curve values with dimension 'Size' connected with the next smallest index of the x-axis value

Lookup Multiple ID Map

Looks up multiple ID_Maps (No interpolation).

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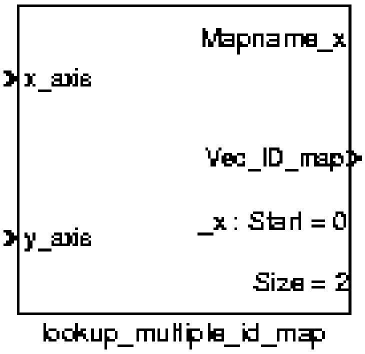

Figure 1.26.87:

triggered (optional)

If the parameter 'Curvename' contains one of the tokens (_x, _i, _j), this is replaced automatically by a given range from 1 to 'Size' or 0 to ('Size'-1). The number of maps accessed is then given by 'Size'. Outputs a vector of length 'Size' of ID_values 'Vec_ID_map' connected with the next smallest indeces to the axis values 'x_axis' and 'y_axis'. There is no interpolation between the axis values.
The axis names are given by list_curve in the Workspace. There is no extrapolation outside the axes values.

x_axis	x-axis value
y_axis	y-axis value
Vec_ID_map	Vector of Curve values connected with the next smallest index of the x-axis and y-axis value

Lookup Multiple IP Curve

Looks up multiple IP_Curves (With interpolation).

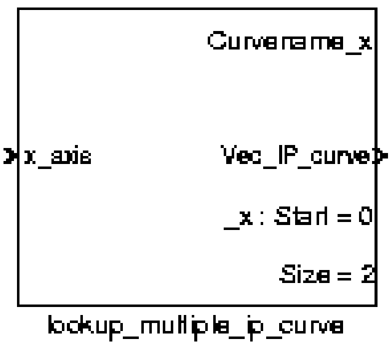

Figure 1.26.88:

triggered (optional)

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If the parameter 'Curvename' contains one of the tokens (_x, _i, _j), this is replaced automatically by a given range from 1 to 'Size' or 0 to ('Size'-1). The number of curves accessed is then given by 'Size'.

Outputs a vector of length 'Size' of IP_values 'Vec_IP_curve' connected with the linear interpolated index of the axis value 'x_axis'. There is linear interpolation between the axis values and no extrapolation outside the axes values. The axis names are given by list_curve in the Workspace.

x_axis	Axis value
Vec_IP_curve	Vector of Curve values connected with the linear interpolated index to the x-axis value

Lookup Multiple IP Map

Looks up multiple IP_Maps (With interpolation).

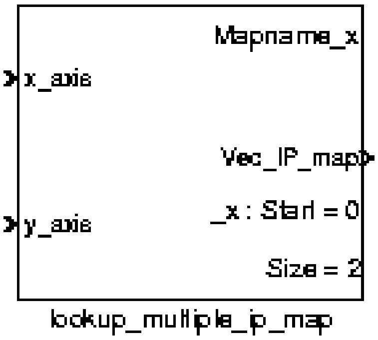

Figure 1.26.89:

triggered (optional)

If the parameter 'Curvename' contains one of the tokens (_x, _i, _j), this is replaced automatically by a given range from 1 to 'Size' or 0 to ('Size'-1). The number of maps accessed is then given by 'Size'.

Outputs a vector of length 'Size' of IP_values 'Vec_IP_map' connected with the linear interpolated index to the axis values 'x_axis' and 'y_axis'.

There is linear interpolation between the axis values, but there is no extrapolation outside the axes values. The axis names are given by list_map in the Workspace.

x_axis	x-axis value
y_axis	y-axis value
Vec_IP_map	Curve value connected with the linear interpolated index to the x-axis and y-axis value

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1.27 SDA - AT basic blocks short description

General information:

1.27.1 Remarks for block version V 5.x

Multi-rate and single-rate block versions

Some blocks have two versions: multi-rate and single-rate. The multi-rate version (with R_FC and CLC_FC inputs) is used in case of system resets have to be simulated. R_FC and CLC_FC are shortcuts for "reset function call" and "calculate function call" respectively.

Various blocks have also optional inputs and outputs, which are chosen according to the model specific needs. The following picture shows an example of a block in its both versions, single-rate and multi-rate. The third picture also shows optional inputs and outputs (internal state):

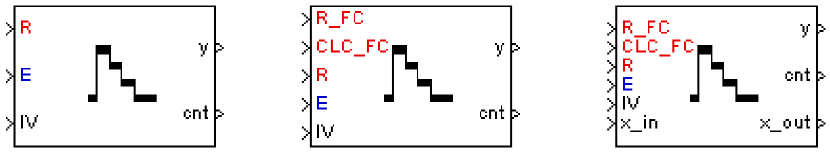

Figure 1.27.1:

For each block the functionality is described by an "Init-code" (executed at the start of simulation) and pseudo code (for methods run(), finalize(), pass(), out() and reset()) executed during simulation).

The block functionality, given with the pseudo-code and init-code, remains the same in both versions, multi-rate and single-rate.

In the multi-rate version, the block is only calculated if a function-call triggers the input R_FC or CLC_FC. Triggering the block through the input R_FC simulates a system reset. The calculation done when a R_FC triggers the block is shown in the given pseudo-code "R_FC". The block outputs are not calculated in the R_FC code. Triggering the block through the input CLC_FC runs the execution of this block, calculating a new output value. This calculation is shown in the given pseudo-code for each block.

In the single-rate version, the block calculation is executed every time the subsystem containing the block is triggered. This means, that the block calculation occurs as for every other non triggered block or subsystem. The order of calculation in the single-rate mode is exactly the same as for CLC_FC.

Besides the system reset (R_FC function call) the blocks also implement a logical reset (functional reset). There are two versions of the logical reset which can occur in single-rate mode or in multi-rate mode when CLC_FC triggers the block:

- *State based*: Reset occurs as long as signal R equals 1
  (blocks with the suffix _RE)
- *Edge based*: Reset occurs on signal RT rising edge
  (blocks with the suffix _RTE)

Unlike reset via the R_FC function call, when the logical reset occurs, the block calculates its outputs.

While no logical reset occurs in single-rate mode or while CLC_FC function-call in multi-rate mode, the block computations are defined by the value of the Enable signal E. While E is not equal to zero, the

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block performs the necessary computation and updates its internal state(s). While E is equal to zero, the internal states are not updated and the output of the block is based on the previously stored value of its internal state.

CLC_FC function uses the following sub-functions:

- reset() initializes internal state(s) with initial value(s) (IV, IV1, IV2...)
- run() performs general block computations while no logical reset is occurred and the enable signal E is not equal to zero
- finalize() performs general block computations while the logical reset is occurred or the enable signal E is not equal to zero
- pass() performs necessary computations while no logical reset is occurred and enable signal E is equal to zero.
- out() assigns values to output signal

The current implementation of these blocks is described with the following C-pseudo code:

State detecting reset blocks (-RE blocks)	**Edge detecting reset blocks (-RTE blocks)**

function R_FC ( )
{
reset();
}
	function R_FC ( )
	{
	reset();
	R_1 = 0;
	}

function CLC_FC ( )
{
if (R) {
reset();
finalize();
}
else if (E) {
run();
finalize();
}
else {
pass();
}
out();
}
	function CLC_FC ( )
	{
	if (R & !R_1) {
	reset();
	finalize();
	}
	else if (E) {
	run()
	finalize();
	}
	else {
	pass();
	}
	out();
	R_1 = R;
	}

In the description later on, for these kinds of blocks, the C-like code for each of these sub-functions is given beside the block icon as shown in the example below:

Continued on next page

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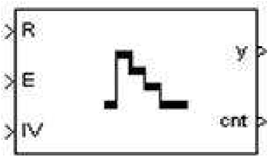
Figure 1.27.2:
	Variables:
	E: logic
	R: logic
	IV: real
	y: logic
	x: int
	cnt: int
		Init-code:
		x = 0;
		
		reset ( )
		x = round(IV);
		
		run ( )
		if (x > 0) {
		x = x - 1;
		}
			finalize( )
			
			pass ( )
			
			out ( )
			y = (x>0);
			cnt = x;

The additional inputs and outputs used to set and get internal states have the suffixes "_in" and "_out" after the referred state name respectively. These inputs and outputs are optional.

The following list shows the standard input and output names, with their corresponding descriptions:

Inputs

Port	Description
E	Enable: suppresses the block calculation while 0
R	Resets the block states to their initial values while 1
RT	Resets the block states to their initial values on rising edge 0 - ->1
IV	Initial value set upon reset
R_FC	System reset (multirate version)
CLC_FC	System calculation request (multirate version)
dT	Sample time
MX	Upper state limit
MN	Lower state limit
x_in	Direct input of an internal state if the block has one internal state
x1_in	Direct input of an internal state 1 if the block has 2 internal states
x2_in	Direct input of an internal state 2 if the block has 2 internal states

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Outputs

Port	Description
B_max	True if the upper limitation active
B_min	True if the lower limitation active
x_out	Direct output of an internal state if the block has one internal state
x1_out	Direct output of a internal state 1 if the block has 2 internal states
x2_out	Direct output of a internal state 2 if the block has 2 internal states
y	Out
cnt	Internal counter state

1.27.2 Remarks for block version V 6.x

Functional behaviour

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The blocks of version 6.x have the same functional single rate behaviour than the blocks of version 5.x. The changes in the blocks are only related to code generation and to adaptation to the ASAM MBFS standard.

Single-rate block version

Version 6 blocks do not support the multi-rate option. Many blocks have optional inputs and outputs, which are chosen according to the model specific needs. The following picture shows an example for block configuration:

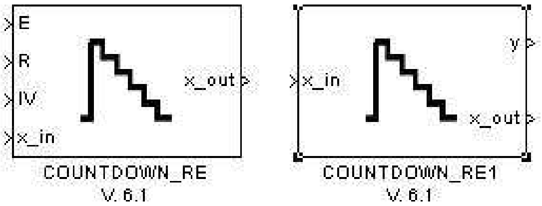

Figure 1.27.3:

In the single-rate version, the block calculation is executed every time the subsystem containing the block is triggered. This means, that the block calculation occurs as for every other non triggered block or subsystem.

While no logical reset occurs in single-rate mode, the block computations are defined by the value of the Enable signal E. While E is not equal to zero, the block is calculated and updates its internal state(s). While E is equal to zero, the internal states are not updated and the output of the block is based on the previously stored value of its internal state.

x_in and x_out interface

The inputs x_in and outputs x_out are used to export and import the internal state x of the blocks. The internal state is exported in order to be able to initialize the state at system reset via the SignalManager on top module level. This system reset handling replaces the multirate option of the blocks.

1.27.2.1 Input/Output port details for V6 blocks:

Inputs

Port	Description
E	Enable: suppresses the block calculation while 0
R	Resets the block states to their initial values while 1
RT	Resets the block states to their initial values on rising edge 0 - ->1
IV	Initial value set upon reset
dT	Sample time
MX	Upper state limit
MN	Lower state limit
x_in	Direct input of an internal state if the block has one internal state
x1_in	Direct input of an internal state 1 if the block has 2 internal states

Continued on next page

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x2_in	Direct input of an internal state 2 if the block has 2 internal states

Outputs

Port	Description
B_max	True if the upper limitation active
B_min	True if the lower limitation active
x_out	Direct output of an internal state if the block has one internal state
x1_out	Direct output of a internal state 1 if the block has 2 internal states
x2_out	Direct output of a internal state 2 if the block has 2 internal states
y	Output

1.27.3 Directly triggered blocks

The blocks without internal states (and, as a result, without reset) have the 'Triggered block' parameter. This is a checkbox which can be 'on' or 'off'. When this option is 'off' the calculation for these blocks is executed every time the subsystem, which they are placed in, is triggered. When this option is 'on', the additional control input port is added at the top of these blocks. This port accepts function-call connection (as CLC_FC does) and these blocks are calculated only when a function-call triggers the control port.

1.27.4 Block versioning

The block version is shown since SDA 5.0 release. Please note the following:

Blocks from previous SDA versions do not show any version information.

The version information is shown on the block icon or below it in the format *"V X.Y".*

Functional change or relevant appearance changes reflects on version information update (only on "X"). A change in "Y" is not functional or appearance relevant. For instance, the versions 5.1, 5.4, 5.13 have all the same appearance and functional behavior.

The part "X" of the block version number is not coupled to SDA release number. The first block version since SDA 5.0 is "5." for all libraries though.

All functional changes done to AT Library blocks between SDA releases are shown in this document and in the according library documentation within the SDA installation.

1.27.5 Arithmetic Operators

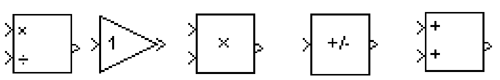

Figure 1.27.4:

Div **(V. 5) (V. 6)**

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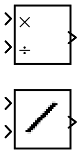

Figure 1.27.5:

The block divides the elements of the first (upper) input by the elements of the second (lower) input. Case the upper input is a vector or matrix, it performs an element-wise division.

Gain **(simulink block)**

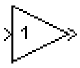

Figure 1.27.6:

The Gain block generates its output by multiplying its input by a specified gain factor. The input and gain can be a scalar, vector, or matrix. Only unitary gain is allowed in SDA models.

Mul **(V. 5) (V. 6)**

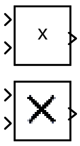

Figure 1.27.7:

The block multiplies the elements of the first (upper) input by the elements of the second (lower) input (element wise multiplication).

Neg **(V. 5) (V. 6)**

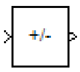

Figure 1.27.8:

Negates the input signal. The input signal can be a scalar, a vector or a matrix.

Sum **(V. 5) (V. 6)**

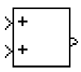

Figure 1.27.9:

The Sum block performs addition ("+" input) or subtraction ("-" input) on its inputs. This block can add or subtract scalar, vector, or matrix inputs. It can also collapse the elements of a single input vector.

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1.27.6 Comparison Operators

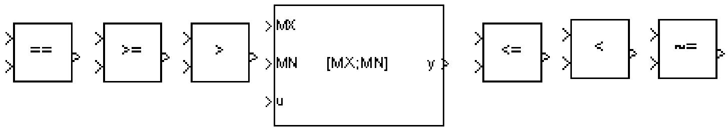
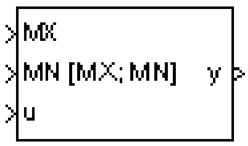


Figure 1.27.10:

Interval (V. 5) (V. 6)

Output y is true if the input signal u lies between MN and MX.


 	
Figure 1.27.11:
	Variables:
	MX: real
	MN: real
	u: real
	y: logic
		run ( )
		if((u < MX) & & (u > MN)){
		y = 1;
		}
		else {
		y = 0;
		}

The braces are used to indicate if the interval limits MX and MN are contained ("[MX...", "...MN]") or not ("]MX...", "...MN[") in the interval. The ">" or "<" signs are then changed in ">=" or "<=", accordingly.

Port	I /O	Description
u	IN	Input signal
MX	IN	Maximum value for input signal
MN	IN	Minimum value for input signal
y	OUT	Boolean value, true if u lies in the Interval [MN,MX]

EQ, GE, GT, LE, LT, NE (V. 5) (V. 6)

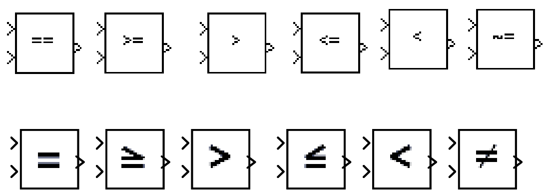


Figure 1.27.12:

The blocks EQ, GE, GT, LE, LT and NE performs a relational operation on its two inputs and produces output according to the following table.

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Operator	Output
==	TRUE if the first input is equal to the second input
~=	TRUE if the first input is not equal to the second input
<	TRUE if the first input is less than the second input
<=	TRUE if the first input is less than or equal to the second input
>=	TRUE if the first input is greater than or equal to the second input
>	TRUE if the first input is greater than the second input

If the result is TRUE, the output is 1; if FALSE, it is 0. Inputs can be specified as scalars, arrays, or a combination of a scalar and an array:

- For scalar inputs, the output is a scalar.
- For array inputs, the output is an array of the same dimensions, where each element is the result of an elementwise comparison of the input arrays.
- For mixed scalar/array inputs, the output is an array, where each element is the result of a comparison between the scalar and the corresponding array element.

The block icon displays the selected operator.

1.27.7 Counter and Timer

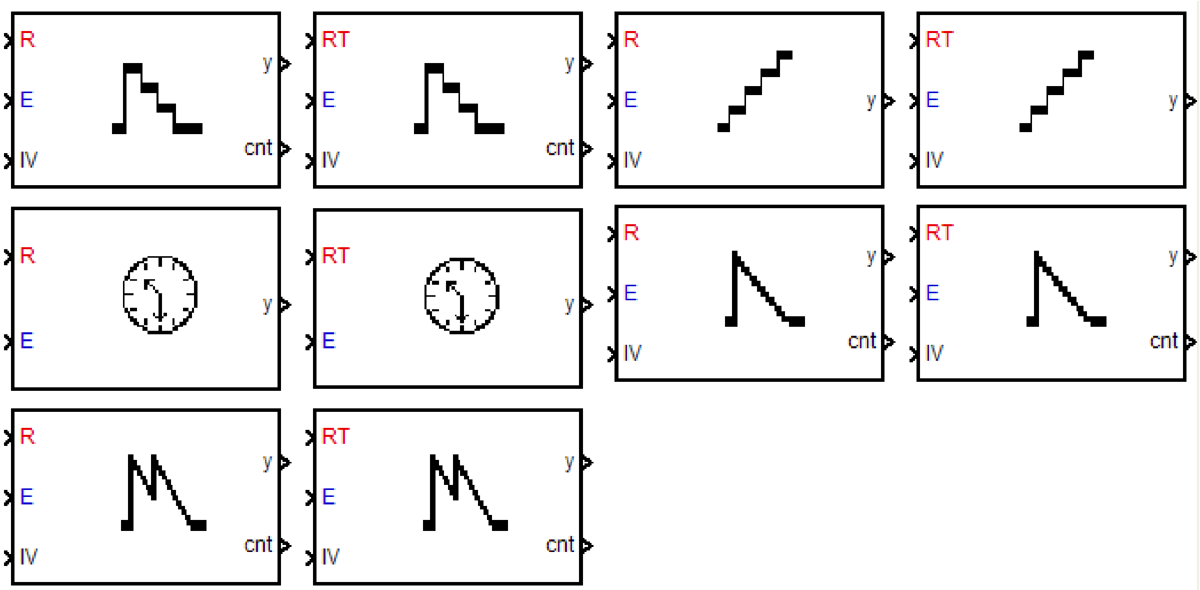

Figure 1.27.13:

Optional ports:	R, E, RT, R_FC, CLC_FC, x_in, x_out, dT

<u>CountDownRE</u> **(V. 5) (V. 6)**

Output y is true, if the number of block evaluations since the last reset is less than the initial number of block evaluations IV. The block has state based reset.

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	Variables:	Init-code:	finalize( )

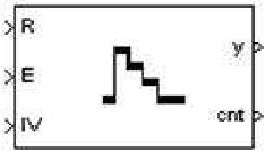
Figure 1.27.14:
	E: logic
	R: logic
	IV: real
	y: logic
	x: int
	cnt: int
		x = 0;
		
		reset ( )
		x = round(IV);
		
		run ( )
		if (x > 0) {
		x = x - 1;
		}
			pass ( )
			
			out ( )
			y = (x>0);
			cnt = x;

CountDownRTE (V. 5) (V. 6)

Output is true, if the number of block evaluations since the last reset is less than the initial number of block evaluations IV. The block has edge based reset.

	Variables:	Init-code:	finalize( )

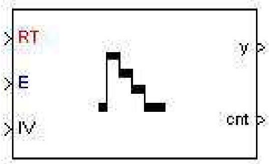
Figure 1.27.15:
	E: logic
	RT: logic
	IV: real
	y: logic
	x: int
	cnt: int
		x = 0;
		
		reset ( )
		x = round(IV);
		
		run ( )
		if (x1 > 0) {
		x = x - 1;
		}
			pass ( )
			
			out ( )
			y = (x>0);
			cnt = x;

CounterRE (V. 5) (V. 6)

Counts up and gives out the number of block evaluations since the last reset. The block has state based reset.

	Variables:	Init-code:	finalize( )

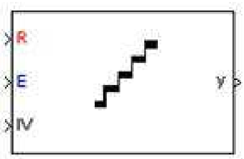
Figure 1.27.16:
	E: logic
	R: logic
	IV: real
	y: real
	x: int
		x = 0;
		
		reset ( )
		x = round(IV);
		
		run ( )
		x = x + 1;
			pass ( )
			
			out ( )
			y = x;

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CounterRTE (V. 5) (V. 6)

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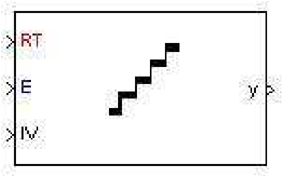
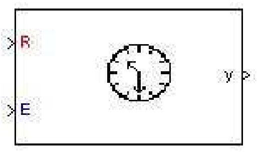
Counts up and gives out the number of block evaluations since last reset. The block has edge based reset.


 	
Figure 1.27.17:
	Variables:
	E: logic
	RT: logic
	IV: real
	y: real
	x: real
		Init-code:
		x = 0;
		
		reset ( )
		x = IV;
		
		run ( )
		x = x + 1;
		pass ( )
			finalize( )
			
			out ( )
			y = x;

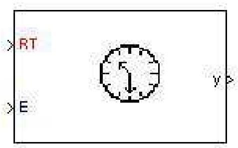
StopWatchRE (V. 5) (V. 6)

The block outputs the time since the system init or the last reset. The block has state based reset.

 Figure 1.27.18:	**Variables:** E: logic R: logic y: real x: real	**Init-code:** x = 0.0; **reset ( )** x = 0.0; **run ( )** x = x + dT	**finalize( )** **pass ( )** **out ( )** y = x;

StopWatchRTE (V. 5) (V. 6)

The block outputs the time since the system init or the last reset. The block has edge based reset.


 	
Figure 1.27.19:
	Variables:
	E: logic
	RT: logic
	y: real
	x: real
		Init-code:
		x = 0.0;
		
		reset ( )
		x =0.0;
		
		run ( )
		x = x + dT;;
			finalize( )
			
			pass ( )
			
			out ( )
			y = x;

TimerRE (V. 5) (V. 6)

The block indicates true, if the initial time IV has not passed since the last reset of the block. Reset can only be performed, if the counter has run down to zero. The block has state based reset.

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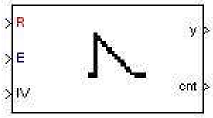
Figure 1.27.20:
	Variables:
	E: logic
	R: logic
	IV: real
	y: logic
	x: real
	cnt: real
		Init-code:
		x = 0.0;
		
		reset ( )
		if (x < = 0) {
		x = IV;
		}
		
		run ( )
		x = MAX(x - dT, 0.0);
			finalize( )
			
			pass ( )
			
			out ( )
			cnt = x;
			y = (x>0);

TimerRTE (V. 5) (V. 6)

The block indicates true, if the initial time IV has not passed since the last reset of the block. Reset can only be performed, if the counter has run down to zero. The block has edge based reset.

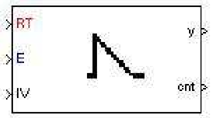
Figure 1.27.21:
	Variables:
	E: logic
	R: logic
	IV: real
	y: logic
	x: real
	cnt: real
		Init-code:
		x = 0.0;
		
		reset ( )
		if(x<= 0.0) {
		x = IV;
		}
		run ( )
		x = x - 1;
			finalize( )
			
			pass ( )
			
			out ( )
			cnt = x;
			y = (x1>0);

TimerRetriggerRE (V. 5) (V. 6)

The block indicates true, if the initial time IV has not passed since the last reset of the block. Reset is always possible and independent of the current timer value. The block has state based reset.

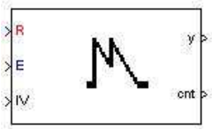
Figure 1.27.22:
	Variables:
	E: logic
	R: logic
	IV: real
	y: logic
	x: real
	cnt: real
		Init-code:
		x = 0.0;
		
		reset ( )
		x = IV;
		
		run ( )
		cnt = x;
		x = MAX(x - dT, 0.0);
			finalize( )
			
			pass ( )
			
			out ( )
			y = (x>0);

TimerRetriggerRTE (V. 5) (V. 6)

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The block indicates true, if the initial time IV has not passed since the last reset of the block. Reset is always possible and independent of the current timer value. The block has edge based reset.

	Variables:	Init-code:	finalize( )

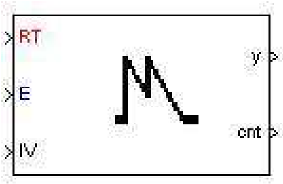
Figure 1.27.23:
	E: logic
	RT: logic
	IV: real
	y: logic
	x: real
	cnt: real
		x = 0.0;
		
		reset ( )
		x = IV;
		
		out ( )
		cnt = x;
		y = (x>0);
			
			run ( )
			x = MAX(x - dT, 0.0);
			
			pass ( )

1.27.8 Delay Blocks

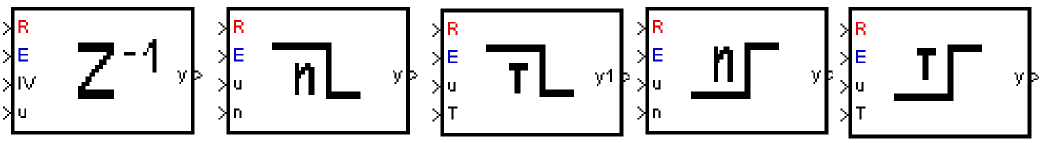

Figure 1.27.24:

Optional ports:	R, E, R_FC, CLC_FC, x_in, x_out, dT

Delay_RE (V. 5) (V. 6)

Delays the input signal u by one sample time. The reset value IV has direct influence on the output. DelayResetEnabled, Delay_RE and Unit Delay depend on individual simulation purposes.

	Variables:	Init-code:	finalize( )


Figure 1.27.25:
	E: logic
	R: logic
	IV: real
	u: real
	y: real
	x: real
		x = 0;
		
		reset ( )
		x = IV;
		y = IV
		
		run ( )
		y = x;
		x = u
			
			pass ( )
			y = x;
			
			out ( )

TurnOffDelaySample (V. 5) (V. 6)

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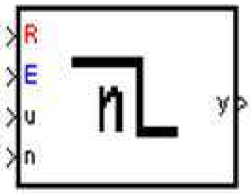
A falling edge of the input signal u is delayed by n block evaluations (E).


 	
Figure 1.27.26:
	Variables:
	E: logic
	R: logic
	n: real
	u: logic
	y: logic
	x: int
	temp: int
		Init-code:
		x = 0;
		
		reset ( )
		x = round(n);
		
		pass ( )
		
		out ( )
		y = ((temp>0) || u);
			finalize( )
			temp = x;
			if(u) {
			x = round(n);
			}
			else {
			if(temp > 0) {
			x = x - 1;
			}
			}
			
			run ( )

TurnOffDelayTime (V. 5) (V. 6)

A falling edge of the input signal u is delayed by the time T, if the input remains false for minimum the whole period T.


 	
Figure 1.27.27:
	Variables:
	T: real
	R: logic
	E: logic
	y: logic
	x: real
	temp: real
		Init-code:
		x = 0.0;
		
		reset ( )
		x = T;
		
		pass ( )
		
		out ( )
		y = ((temp>0) || u);
			finalize( )
			temp = x;
			if(u) {
			x = T;
			}
			else {
			if(temp > 0.0) {
			x = x - dT;
			}
			}
			
			run ( )

TurnOnDelaySample (V. 5) (V. 6)

A rising edge of the input signal u is delayed by n block evaluations.

Continued on next page

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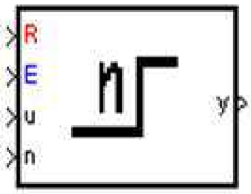
Figure 1.27.28:
	Variables:
	E: logic
	R: logic
	n: real
	u: logic
	y: logic
	x: int
	temp: int
		Init-code:
		x = 0;
		
		reset ( )
		x = round(n);
		
		pass ( )
		
		out ( )
		y =((temp<=0) & & u);
			finalize( )
			temp = x;
			if(u) {
			if(temp > 0) {
			x = x - 1;
			}
			}
			else {
			x = round(n);
			}
			
			run ( )

TurnOnDelayTime (V. 5) (V. 6)

A rising edge of the input signal u is delayed by the time T, if the input signal remains high (true) for minimum this period T.

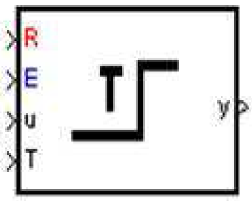
Figure 1.27.29:
	Variables:
	E: logic
	R: logic
	T: real
	y: logic
	x: real
	temp: real
		Init-code:
		x = 0.0;
		
		reset ( )
		x = T;
		
		pass ( )
		
		out ( )
		y = ((temp<=0) & & u);
			finalize( )
			temp = x;
			if(u) {
			if(temp > 0.0) {
			x = x - dT;
			}
			}
			else {
			x = T;
			}
			
			run ( )

1.27.9 Integrators

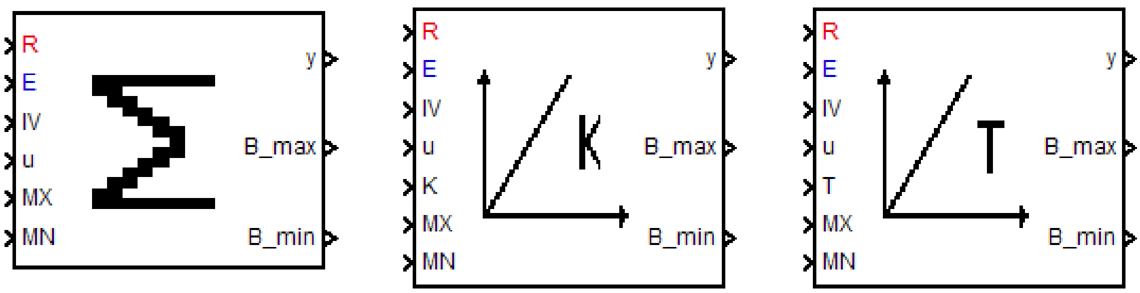

Figure 1.27.30:

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Optional ports:	R, E, R_FC, CLC_FC, x_in, x_out, dT, B_max, B_min

AccumulatorREL (V. 5) (V. 6)

A time discrete integrator. The integrator value y is limited to the maximum MX and the minimum MN.

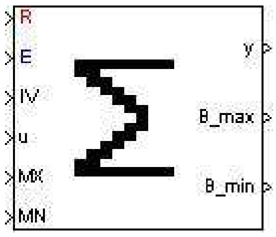
Figure 1.27.31:
	Variables:
	MX: real
	MN: real
	u: real
	E: logic
	R: logic
	IV: real
	y: real
	B_max: logic
	B_min: logic
	x: real
		Init-code:
		x = 0.0;
		
		reset ( )
		x = IV;
		
		run ( )
		x = x+ u;
		
		pass ( )
		
		finalize ( )
			out ( )
			if (x > MX) {
			x = MX;
			B_max = 1;
			B_min = 0;
			}
			else if (x < MN) {
			x = MN;
			B_max = 0;
			B_min = 1;
			}
			else {
			B_max = 0;
			B_min = 0;
			}
			y = x;

IntegratorKREL (V. 5) (V. 6)

A time discrete integrator with gain K. The integrated value and therefore the output y are limited by the inputs MX and MN.

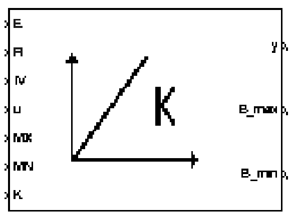
Figure 1.27.32:
	Variables:
	MX: real
	MN: real
	K: real
	u: real
	E: logic
	R: logic
	IV: real
	y: real
	B_max: logic
	B_min: logic
	x: real
		Init-code:
		x = 0.0;
		
		reset ( )
		x = IV;
		
		run ( )
		x = x + K*u*dT;
		
		pass ( )
		
		finalize( )
			out ( )
			if (x > MX) {
			x = MX;
			B_max = 1;
			B_min = 0;
			}
			else if (x < MN) {
			x = MN;
			B_max = 0;
			B_min = 1;
			}
			else {
			B_max = 0;
			B_min = 0;
			} y = x;

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IntegratorTREL (V. 5) (V. 6)

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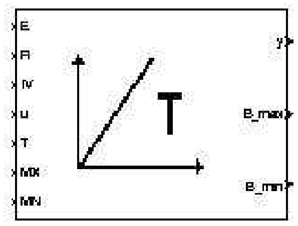
A time discrete integrator with gain 1/T. The integrated value and therefore the output y are limited by the inputs MX and MN.

 Figure 1.27.33:	**Variables:**	**Init-code:**	**out ( )**
	MX: real	x = 0.0;	if (x > MX) {
	MN: real		x = MX;
	T: real	**reset ( )**	B_max = 1;
	u: real	x = IV;	B_min = 0;
	E: logic		}
	R: logic	**run ( )**	else if (x < MN) {
	IV: real	x = x + u*dT/T;	x = MN;
	y: real		B_max = 0;
	B_max: logic	**pass ( )**	B_min = 1;
	B_min: logic		}
	x: real	**finalize( )**	else {
			B_max = 0;
			B_min = 0;
			}
			y = x;

1.27.10 Logical Operators (V. 5) (V. 6)

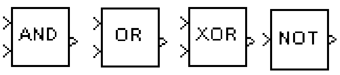


Figure 1.27.34:

Logical Operators

These blocks performs the logical operations on its inputs: AND, OR, XOR, and NOT. The output depends on the number of inputs, and their dimensionality. The output is 1 if TRUE and 0 if FALSE. The block icon shows the corresponding operator.

If the block has more than one input, the output has the same dimensions as the inputs (after scalar expansion) and each output element is the result of applying the specified logical operation to the corresponding input elements. For example, if the operation is ‘AND’ and the inputs are 2-by-2 arrays, the output is a 2-by-2 array whose top, left element is the result of applying AND to the top, left elements of the inputs, etc.

If the block has a single input and the block is not the NOT operator, the input must be vector-like, i.e. a scalar, a 1-D array, or a one-row or one-column 2-D array. The output is a scalar value equal to the result of applying the operation to the elements of the input.

When configured as a multi-input XOR gate, this block performs an addition modulo two operations as mandated by the IEEE standard for logic elements.

All blocks support **bitwise** operations. In this case, the logical operation is calculated bit by bit between the input ports. The block mode is identified by the annotation "bitwise" under its icon.

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1.27.11 Low and highpass

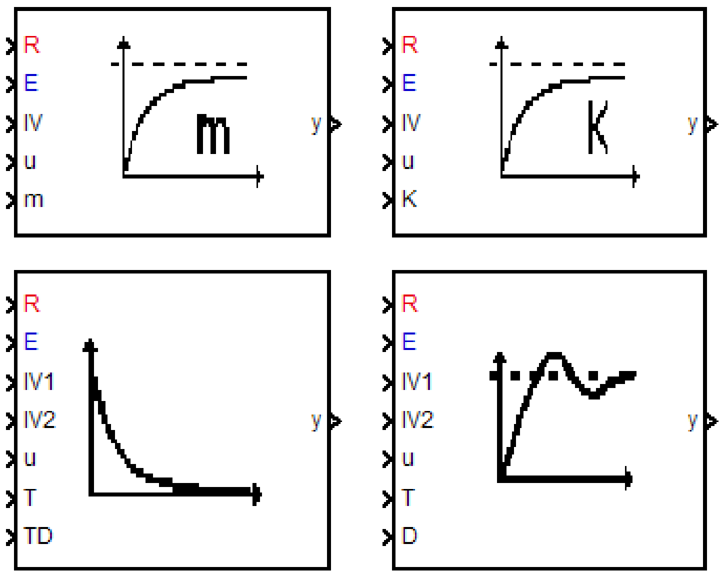

Figure 1.27.35:

Optional ports:	R, E, RT, R_FC, CLC_FC, x_in, x_in, x1_in, x2_in, x1_out, x2_out, dT

DigitalLowpassRE (V. 5) (V. 6)

A discrete time first order lowpass. Value m indicates the percentage of the current approximation of the output value to the aimed input value.

Relationship between the cut-off-frequency (fc) and m:

$m = 1 - e^{(-f_c \cdot dT \cdot 2 \cdot \pi)}$ Figure 1.27.36:	$f_c = -\frac{\ln(1-m)}{2 \cdot \pi \, dT}$ Figure 1.27.37:

with sample Time dT.

Continued on next page

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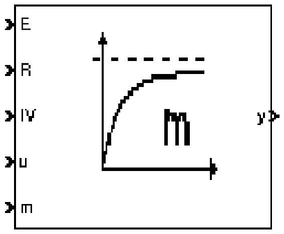
Figure 1.27.38:
	Variables:
	E: logic
	R: logic
	IV: real
	u: real
	m: real
	y: real
	x: real
		Init-code:
		x = 0.0;
		
		reset ( )
		x = IV;
		
		run ( )
		x = x + m*(u - x);
			finalize( )
			
			pass ( )
			
			out ( )
			y = x;

HighpassTRE (V. 5) (V. 6)

This block performs a discretized first order high pass filter with the continuous time Laplace notation:

$$G(s) = \frac{TD \cdot s}{1 + T \cdot s}$$

Figure 1.27.39:

If TD=T the CSD discrete highpass is recovered. In this case the relationship between the highpass cut-off-frequency (fc) and T is :

$T = \left(1 - e^{(-f_c \cdot dT \cdot 2\pi)}\right) \cdot dT$ Figure 1.27.40:	$f_c = -\frac{\ln\left(1 - \frac{T}{dT}\right)}{2 \cdot \pi \cdot dT}$ Figure 1.27.41:

with sample Time dT.

Continued on next page

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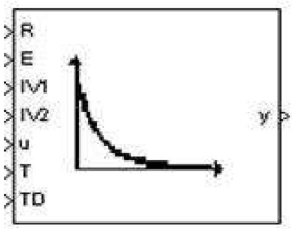
<td>

Figure 1.27.42:</td>
<td>Variables:
E: logic
R: logic
IV: real
y: logic
x1: real
x2:real
T: real
TD: real</td>
<td>Init-code:
x1 = 0.0;
x2 = 0.0;

pass ( )

out ( )
y = x1;</td>
<td>finalize( )

reset ( )
x1 = IV1;
x2 = IV2;

run ( )
x1 = x1 + (TD*(u-x2) - x1*dT)/T;
x2 = u;</td>
</tr>
</table>

Input IV1	Initial value (for time step n) set upon reset
Input IV2	Initial value (for time step n-1) set upon reset

LowpassKRE (V. 5) (V. 6)

A discrete time first order lowpass filter with time constant 1/K.
Relationship between the cut-off-frequency (f_c) and K:

$$K = \frac{\left(1 - e^{(-f_c \cdot dT \cdot 2 \cdot \pi)}\right)}{dT}$$

Figure 1.27.43:

$$f_c = -\frac{\ln\left(1 - K \cdot dT\right)}{2 \cdot \pi \cdot dT}$$

Figure 1.27.44:

with sample Time dT. The input K is the inverse time constant.

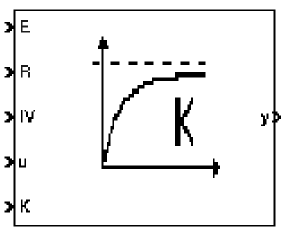
<table>
<tr>
<td>

Figure 1.27.45:</td>
<td>Variables:
E: logic
R: logic
IV: real
u: real
K: real
y: real
x: real</td>
<td>Init-code:
x = 0.0;

reset ( )
x = IV;

run ( )
x = x + K*dT*(u-x);</td>
<td>finalize( )

pass ( )

out ( )
y = x;</td>
</tr>
</table>

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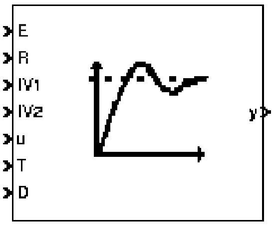
LowpassSecOrdRE (V. 5) (V. 6)

A discrete time second order lowpass filter with time constant T and damping factor D (PT2) with continuous time Laplace notation:

$$G(s) = \frac{1}{s^2 \cdot T^2 + s \cdot 2 \cdot D \cdot T + 1}$$

Figure 1.27.46:


 	
Figure 1.27.47:
	Variables:
	E: logic
	R: logic
	IV1: real
	IV2: real
	u: real
	T: real
	D: real
	y: real
	x1: real
	x2: real
	temp: real
	temp1: real
		Init-code:
		x1 = 0.0;
		x2 = 0.0;
		
		reset ( )
		x1 = IV1;
		x2 = IV2;
		
		pass ( )
		
		out ( )
		y = x1;
			finalize( )
			
			run ( )
			temp = x2;
			temp1 = pow(T,2) + 2*D*T*dT;
			x2 = x1;
			x1 = x2 + (pow(dT,2)*(u-x2))/temp1 + pow(T,2)*(x2-temp)/temp1;

T	Time constant (real)
D	Damping factor (real)
IV1	Initial value set upon reset
IV2	Initial value set upon reset

LowpassTRE (V. 5) (V. 6)

This block performs a first order lowpass filter with T as time constant. Relationship between the cut-off-frequency (fc) and T:

$K = \frac{\left(1 - e^{(-f_c \cdot dT \cdot 2 \cdot \pi)}\right)}{dT}$ Figure 1.27.48:	$f_c = -\frac{\ln(1 - K \cdot dT)}{2 \cdot \pi \cdot dT}$ Figure 1.27.49:

with sample Time dT.

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	Variables:	Init-code:	finalize( )

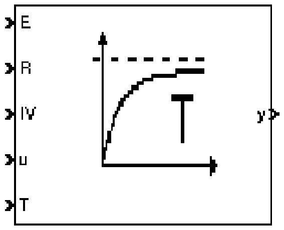
Figure 1.27.50:
	E: logic
	R: logic
	IV: real
	u: real
	T: real
	y: real
	x: real
		x = 0.0;
		
		reset ( )
		x = IV;
		
		run ( )
		x = x + dT*(u-x)/T;
			pass ( )
			
			out ( )
			y = x;

1.27.12 Memory Blocks

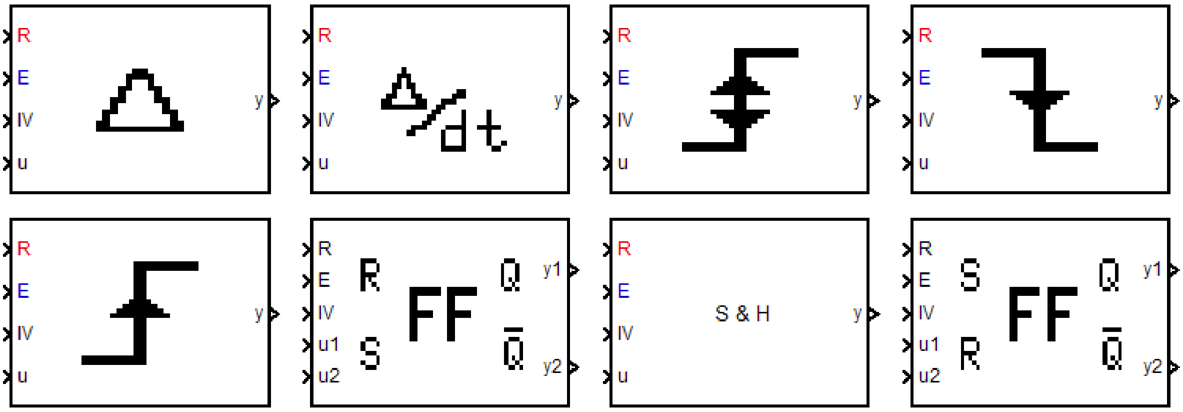

Figure 1.27.51:

Optional ports:	R, E, RT, R_FC, CLC_FC, x_in, x_out, dT

<u>**DeltaOneStep**</u> **(V. 5) (V. 6)**

Calculates the difference between the current and the last input value.

Continued on next page

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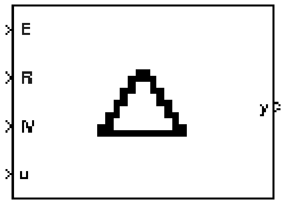

Figure 1.27.52:	Variables:
	E: logic
	R: logic
	IV: real
	u: real
	y: real
	x: real
		Init-code:
		x = 0.0;
		
		reset ( )
		x = IV;
		
		run ( )
			finalize( )
			y = u - x;
			x = u;
			
			pass ( )
			
			out ( )

DifferenceQuotient (V. 5) (V. 6)

Calculates the rate of change of the input signal over time.

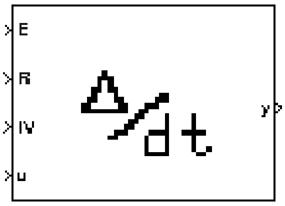

Figure 1.27.53:	Variables:
	E: logic
	R: logic
	IV: real
	u: real
	y: real
	x: real
		Init-code:
		x = 0.0;
		
		reset ( )
		x = IV;
		
		run ( )
			finalize( )
			y = (u - x)/dT;
			x = u;
			
			pass ( )
			
			out ( )

EdgeBi (V. 5) (V. 6)

The output y indicates true at any change of the logical input value.

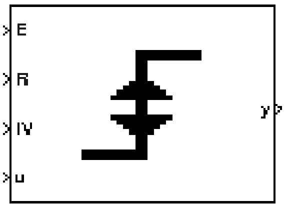

Figure 1.27.54:	Variables:
	E: logic
	R: logic
	IV: real
	u: logic
	y: logic
	x: logic
		Init-code:
		x = 0;
		
		reset ( )
		x = IV;
		
		run ( )
			finalize( )
			y = (x ! = u);
			x = u;
			
			pass ( )
			
			out ( )

EdgeFalling (V. 5) (V. 6)

The output y indicates true if the input value changes from true to false.

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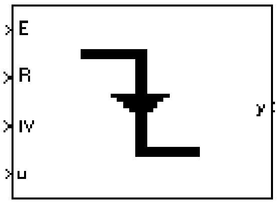

Figure 1.27.55:

Variables:	**Init-code:**	**finalize( )**

E: logic
R: logic
IV: logic
u: logic
y: logic
x: logic
	x = 0;
	
	reset ( )
	x = IV;
	
	run ( )
		y = (x & & !u);
		x = u;
		
		pass ( )
		
		out ( )

EdgeRising (V. 5) (V. 6)

The output y indicates true if the input value changes from false to true.

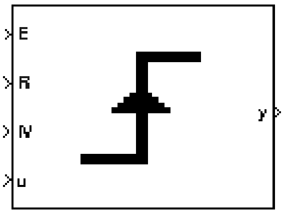

Figure 1.27.56:

Variables:	**Init-code:**	**finalize( )**

E: logic
R: logic
IV: logic
u: logic
y: logic
x: logic
	x = 0;
	
	reset ( )
	x = IV;
	
	run ( )
		y = (!x & & u);
		x = u;
		
		pass ( )
		
		out ( )

RSFlipFlop (V. 5) (V. 6)

A flip flop. The second input (reset) dominates the first input (set).

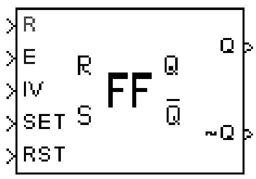

Figure 1.27.57:

Variables:	**Init-code:**	**finalize( )**

SET: logic
RST: logic
Q: logic
~Q: logic
x: logic
	x = 0;
	
	reset ( )
	x = IV;
	
	pass ( )
	
	out ( )
	Q = x;
	~Q = !x;
		
		run ( )
		if(RST) {
		x = 0;
		}
		else if(SET) {
		x = 1;
		}

SampleAndHoldRE (V. 5) (V. 6)

Sample and Hold or just a simple memory block with enable and reset ports.

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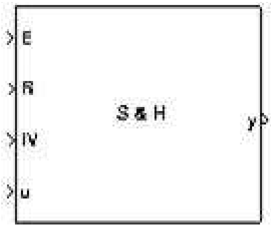
Figure 1.27.58:
	Variables:
	E: logic
	R: logic
	IV: real
	u: real
	y: real
	x: real
		Init-code:
		x = 0.0;
		
		reset ( )
		x = IV;
		
		run ( )
		x = u;
			finalize( )
			
			pass ( )
			
			out ( )
			y = x;

SRFlipFlop (V. 5) (V. 6)

A flip flop. The first input (set) dominates the second input (reset).

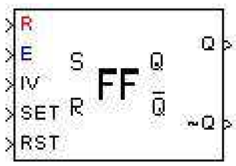
Figure 1.27.59:
	Variables:
	SET: logic
	RST: logic
	Q: logic
	~Q: logic
	x: logic
		Init-code:
		x = 0;
		
		reset ( )
		x = IV;
		
		pass ( )
		
		out ( )
		Q = x;
		~Q = !x;
			finalize( )
			
			run ( )
			if(SET) {
			x = 1;
			}
			else if(RST) {
			x = 0;
			}

1.27.13 Nonlinear Blocks - automotive blockset

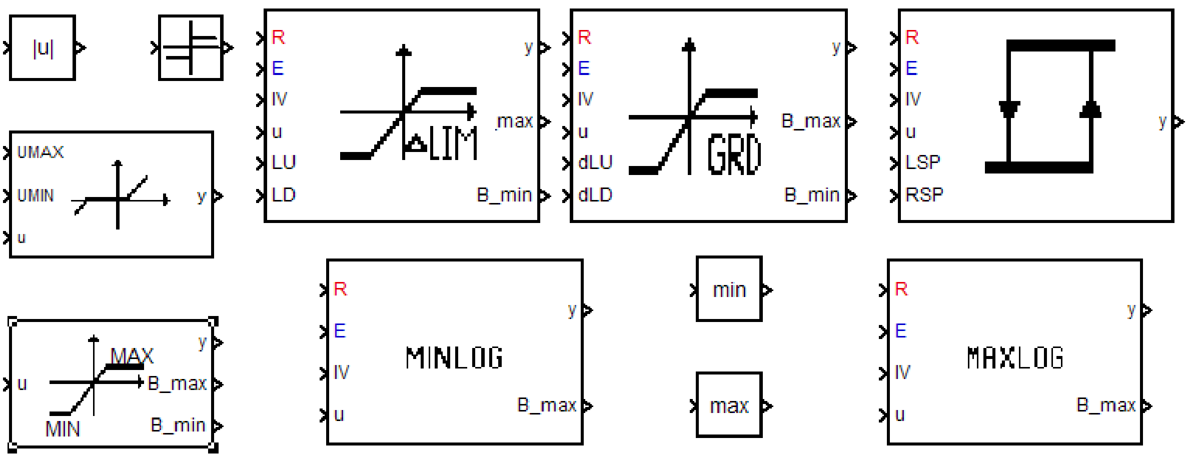

Figure 1.27.60:

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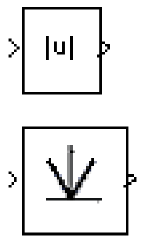
Some blocks have multirate version. The Multirate version of these blocks (with R_FC and CLC_FC inputs) is used if system resets have to be simulated. Other optional inputs and outputs in these blocks are:

Optional ports:	R, E, RT, R_FC, CLC_FC, x_in, x_out, dT, B_max, B_min

Abs (V. 5) (V. 6)

The Abs block generates as output the absolute value of the input.

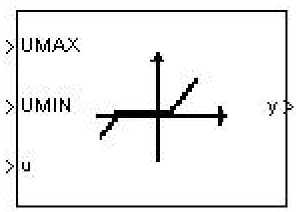
	Variables:	**run ( )**

 Figure 1.27.61:	u: real
	y: real
		if(u >= 0) {
		y = u;
		}
		else {
		y = -u;
		}

Dead Band (V. 5) (V. 6)

Outputs zero, if the input value is between UMIN and UMAX. Otherwise the output signal is the input signal reduced by the input limits.

	Variables:	**run ( )**

 Figure 1.27.62:	UMAX: real
	UMIN: real
	u: real
	y: real
		if(u < UMAX & & u > UMIN) {
		y = 0.0;
		}
		else if(u >= UMAX) {
		y = u - UMAX;
		}
		else {
		y = u - UMIN;
		}

Limit (V. 5) (V. 6)

The input signal u is limited between maximum value MX and minimum value MN. The boolean output flags B_MAX and B_MIN represent an active limitation in both directions.

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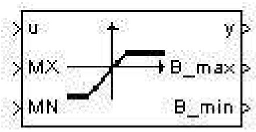
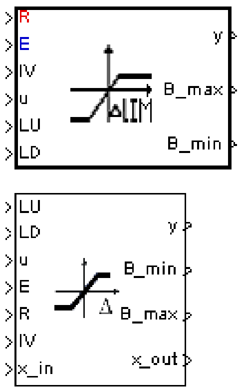

 	
Figure 1.27.63:
	Variables:
	MX: real
	MN: real
	u: real
	y: real
	B_min: logic
	B_max: logic
		run ( )
		if(u > MX) {
		y = MX;
		B_max = 1;
		B_min = 0;
		}
		else if(u < MN) {
		y = MN;
		B_max = 0;
		B_min = 1;
		}
		else {
		y = u;
		B_max = 0;
		B_min = 0;
		}

DifferenceLimiter (V. 5) (V. 6)

The output value is limited in its difference to the last input value. The maximum valid difference is LU, the minimum valid difference is LD. Only for a sampling time of 1s this block behaves like a Gradient limiter. For other sampling times this time has to be taken into account in setting the correct values for LU and LD.


 	
Figure 1.27.64:
	Variables:
	E: logic
	R: logic
	IV: real
	u: real
	LU: real
	LD: real
	y: logic
	B_max: logic
	B_min: logic
	x: real
		run ( )
		if((u-x)>LU) {
		x = x + LU;
		B_min = 0;
		B_max = 1;
		}
		else if((u - x)< LD) {
		x = x + LD;
		B_min = 1;
		B_max = 0;
		}
		else {
		x = u;
		B_min = 0;
		B_max = 0;
		}
			finalize( )
			
			pass ( )
			
			out ( )
			y = x;
			
			Init-code:
			x = 0.0;
			
			reset ( )
			x = IV;

GradientLimiter (V. 5) (V. 6)

The output value is limited in its gradient to the last input value. The maximum valid difference is dLU, the minimum valid difference is dLD. The values of dLD and dLU have to be given per second.

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	Variables:	Init-code:	run ( )

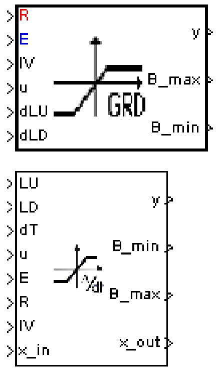
Figure 1.27.65:
	E: logic
	R: logic
	IV: real
	u: real
	dLU: real
	dLD: real
	y: real
	B_min: logic
	B_max: logic
	x: real
		x = 0.0;
		
		reset ( )
		x = IV;
		
		pass ( )
		
		finalize( )
		
		out ( )
		y = x;
			if((u - x)/dT > dLU) {
			x = x + dLU*dT;
			B_min = 0;
			B_max = 1;
			}
			else if((u - x)/dT < dLD) {
			x = x + dLD*dT;
			B_min = 1;
			B_max = 0;
			}
			else {
			x = u;
			B_min = 0;
			B_max = 0;
			}

Hysteresis (V. 5) (V. 6)

The Output of this block is a logical 1 if the input value is greater than the RSP and logical 0 if the input is below the LSP.

	Variables:	Init-code:	finalize( )

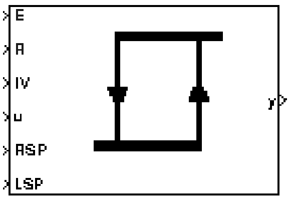
Figure 1.27.66:
	E: logic
	R: logic
	IV: logic
	u: real
	RSP: real
	LSP: real
	y: logic
	x: logic
		x = 0;
		
		reset ( )
		x = IV;
		
		pass ( )
		
		out ( )
		y = x;
			if(u > RSP) {
			x = 1;
			}
			else if(u < LSP) {
			x = 0;
			}
			
			run( )

RSP	Upper threshold value
LSP	Lower threshold value

Min, Max (V. 5) (V. 6)

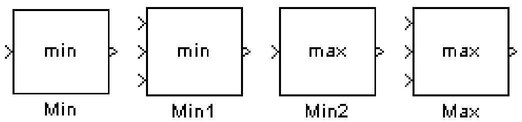

Figure 1.27.67:

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The MinMax block outputs either the minimum or the maximum element or elements of the input(s).

If the block has one input port, the input must be a scalar or a vector. The block outputs a scalar equal to the minimum or maximum element of the input vector.

If the block has multiple input ports, the nonscalar inputs must all have the same dimensions. The block expands any scalar inputs to have the same dimensions as the nonscalar inputs. The block outputs a signal having the same dimensions as the input. Each output element equals the minimum or maximum of the corresponding input elements.

MaxLogRE (V. 5) (V. 6)

The output value is the maximum value of all input values u between resets, with respect to the initial value IV.

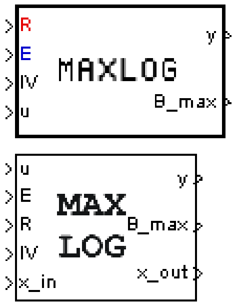
Figure 1.27.68:
	Variables:
	E: logic
	R: logic
	IV: real
	u: real
	y: real
	B_max: logic
	x: real
		Init-code:
		x = 0.0;
		B_max = 0;
		
		reset ( )
		x = IV;
		
		out ( )
		y = x;
			finalize( )
			
			run ( )
			B_max = 0;
			if(u > x) {
			x = u;
			B_max = 1;
			}
			
			pass( )

MinLogRE (V. 5) (V. 6)

The output value y is the minimum value of all input values u between resets, with respect to the initial value IV.

Continued on next page

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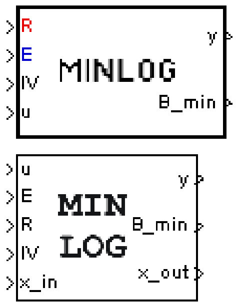
<table>
<tr>
<td>

Figure 1.27.69:</td>
<td>Variables:
E: logic
R: logic
IV: real
u: real
y: logic
B_min: logic
x: real</td>
<td>Init-code:
x = 0.0;
B_min = 0;

reset ( )
x = IV;

out ( )
y = x;</td>
<td>finalize( )

run ( )
B_min = 0;
if(u < x) {
x = u;
B_min = 1;
}

pass ( )</td>
</tr>
</table>

Sign (V. 5) (V. 6)

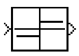


Figure 1.27.70:

The Sign block indicates the sign of the input:

- The output is 1 when the input is greater than zero.
- The output is 0 when the input is equal to zero.
- The output is -1 when the input is less than zero.

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1.27.14 Controller_Blocks (AT_Extended_Lib)

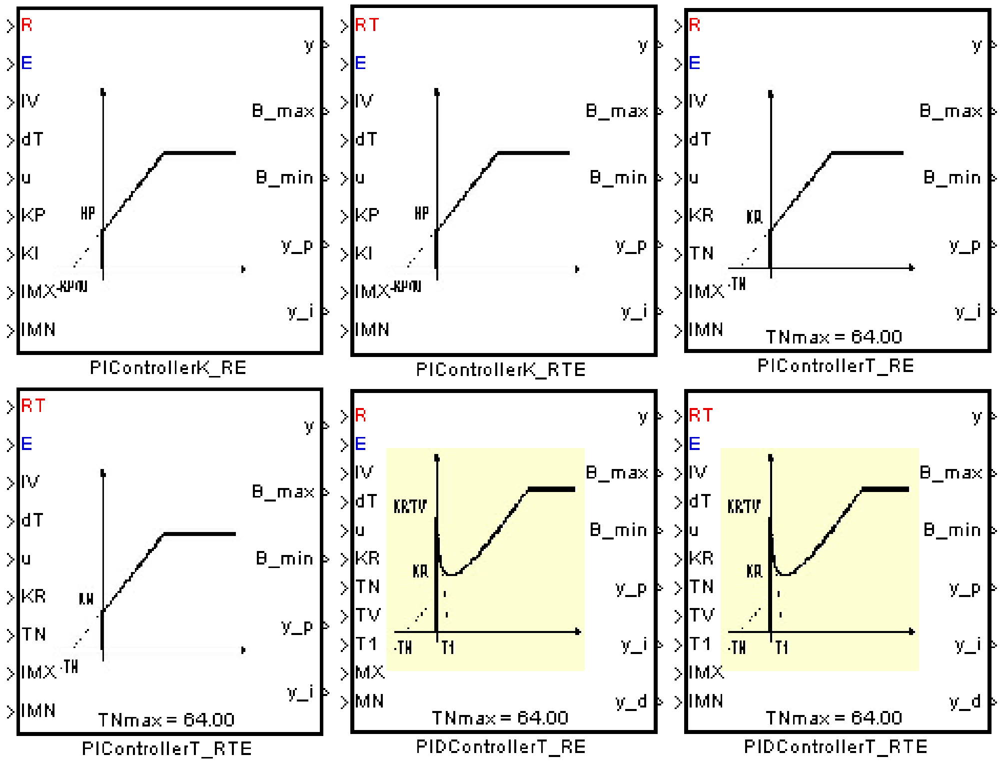

Figure 1.27.71:

The blocks could be figured for single- and multi-rate version. Multirate version (with inport R_FC and CLC_FC) are used for system reset. Each of PIControllerK, PIControllerT and PIDControllerT has two version with different function reset inport: R (state based) and RT (edge based).

Controller blocks can be configured for single- and multirate mode.

Optional ports:	R, E, RT, R_FC, CLC_FC, IV, xi_in, xd_in, xi_out, xd_out, y_p, y_i, y_d, B_max, B_min

IMX	I-state upper limitation value
IMN	I-state lower limitation value
y_p	Level of proportional part of the controller output
y_i	Level of integral part of the controller output

PIControllerK_RE (V.5) and PIControllerK_RTE (V.5)

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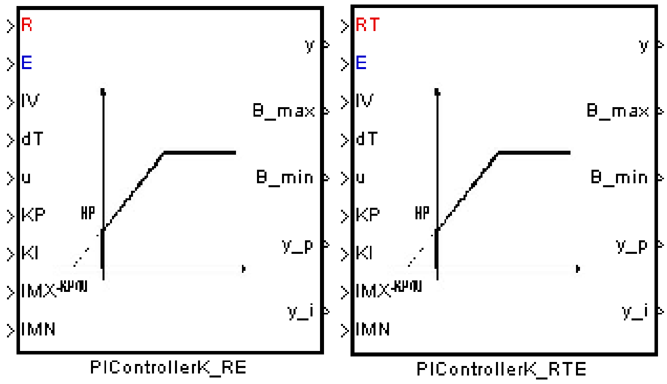

Figure 1.27.72:

This block presents a resetable (integral part) PI controller with variable parameters and state limitation. It is based on the transfer function : G(s) = KP + KI/s, but with full consideration of parameter variability and with the discretization (used method: euler backward) in integrator part.

The limits affect the integral state only. The output is the unlimited sum of the unlimited proportional part and the limited integral part.

KP	Proportional gain
KI	Integration gain
y_p	Level of proportional part of the controller output
y_i	Level of integral part of the controller output

PIControllerT_RE (V.5) and PIControllerT_RTE (V.5)

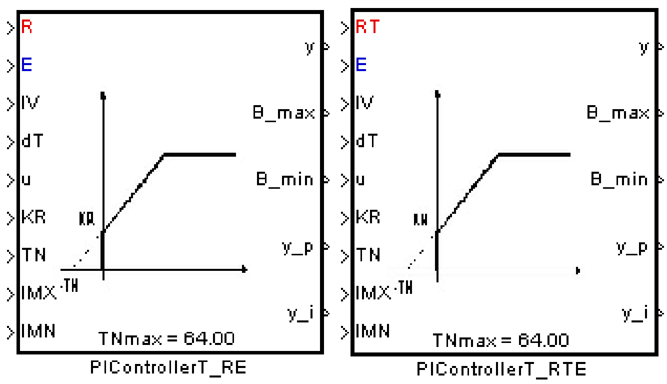

Figure 1.27.73:

state limitation. It is based on the transfer function :G(s) = KR * (1 + 1/(TN*s)), but with full consideration of parameter variability and with the discretization (used method: euler backward) in integrator part.

The limits affect the integral state only. The output is the unlimited sum of the unlimited proportional part and the limited integral part.

Setting TN to or below the sample time disables the proportional part (TN <= dt KR = 0).

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Setting TN to or above the maximum value disables integration (TN >= TNmax The integrator’s part is constant).

KR	Controller amplification
TN	Integrator adjusting time

PIDControllerT_RE (V.5) and PIDControllerT_RTE (V.5)

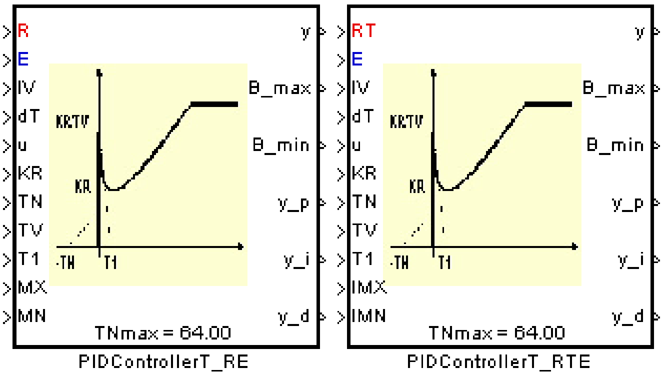

Figure 1.27.74:

This block represents resetable (integral and derivative part), limitable PID controller with variable parameters. It is based on the transfer function:

G(s) = KR * (1 + 1/(TN*s) + TV*s/(1 + T1*s))
but with full consideration of parameter variability. The discretization (used method: euler backward) is used in integrator part and derivative part (the discretization of each part is separately).

Setting TN to or below the sample time disables the proportional part.

Setting TN to or above the maximum value disables integration.

To disable the derivative part, set TV=0.

KR	Controller amplification
TN	Integrator adjusting time
TV	Derivative adjusting time
T1	Derivative adjusting time
y_d	Level of derivative part of the controller output

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1.27.15 Nonlinear

Modulo (V. 5) (V. 6)

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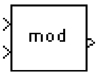

Figure 1.27.75:

The Modulo block outputs the modulus after division. The inputs must be real arrays of the same size, or real scalars.

Multiport Switch (Simulink block)

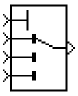

Figure 1.27.76:

The Multiport Switch block chooses between a number of inputs.

The first (top) input is the control input and the other inputs are data inputs. The value of the control input determines which data input to pass through to the output port.

If the control input is not an integer value, the Multiport Switch truncates the value to the nearest integer and issues a warning. If the (truncated) control input is less than one or greater than the number of input ports, the switch issues an out-of-bounds error. Otherwise, the switch passes the data input that corresponds to the (truncated) control input. The following table summarizes the Multiport Switch's behavior.

(Truncated) Control Input	Passes This Data Input
Less than 1	Out of bounds error
1	First input
2	Second input
etc.	etc.
Greater than the number of data inputs	Out of bounds error

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Data inputs can be scalar or vector. The control input can be a scalar or a vector. The block output is determined by these rules:

- If inputs are scalar, the output is a scalar.
- If the block has more than one data input, at least one of which is an array, the output is an array. Any scalar inputs are expanded to arrays.
- If the block has only one data input, the input must be a scalar or a vector (1-D array). If the input is a vector, the block output is the element of the vector that corresponds to the truncated value of the control input.

Quantizer (V. 5)

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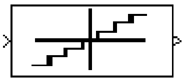

Figure 1.27.77:

The Quantizer block passes its input signal through a stair-step function so that many neighbouring points on the input axis are mapped to one point on the output axis. The effect is to quantize a smooth signal into a stair-step output. The output is computed using the round-to-nearest method, which produces an output that is symmetric about zero: y = q * round(u/q), where y is the output, u the input, and q the Quantization interval parameter.

Saturation **(V. 5)**

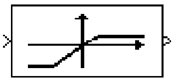

Figure 1.27.78:

The Saturation block imposes upper and lower bounds on a signal. When the input signal is within the range specified by the Lower limit and Upper limit parameters, the input signal passes through unchanged. When the input signal is outside these bounds, the signal is clipped to the upper or lower bound. When the parameters are set to the same value, the block outputs that value.

Switch **(V. 5) (V. 6)**

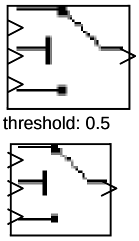

Figure 1.27.79:

The Switch block propagates one of two inputs to its output depending on the value of a third input, called the control input.

Switch with threshold: If the signal on the control (second) input is greater than or equal to the Threshold parameter, the block propagates the first input; otherwise, it propagates the third input. This figure shows the use of the block ports.

Switch with check unequal 0: If the signal on the control (second) input is unequal to 0, the block propagates the first input; otherwise, it propagates the third input.

This figure shows the use of the block ports:

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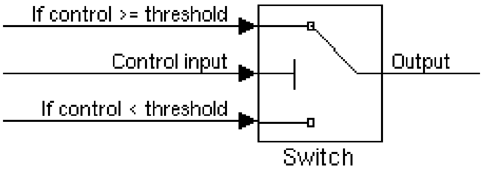

Figure 1.27.80:

1.27.16 Signals & Systems

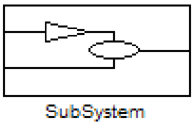

Figure 1.27.81:

Subsystem

Represent a nested subsystem within another system.

Subsystems can be virtual or atomic, depending on the value of its Treat as Atomic Unit parameter. Simulink ignores virtual subsystem boundaries when determining block update order. By contrast, Simulink executes all blocks within an atomic subsystem before moving on to the next block. Conditionally executed subsystems are atomic. Unconditionally executed subsystems are virtual by default. You can, however, designate an unconditionally executed subsystem as atomic. This is useful if you need to ensure that a subsystem is executed in its entirety before any other block is executed. An atomic subsystem is identified by bold boundaries.

Function_Call_Subsystem

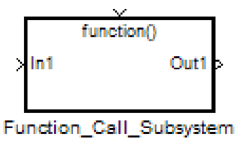

Figure 1.27.82:

Represent a subsystem that can be invoked as a function by another block. Function-call subsystems are not executed directly by Simulink; rather, the Stateflow charts or other blocks determine when to execute the subsystem. They can be executed repeatedly during the same simulation time step. When the subsystem completes execution, control returns to the caller.

For Iterator Subsystem

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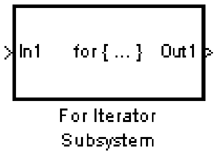

Figure 1.27.83:

This block is a Subsystem block that is preconfigured to serve as a starting point for creating a subsystem that executes repeatedly during a simulation time step. It contains the For Iterator block.

Figure 1.27.84:

The For Iterator block, when placed in a subsystem, implements a C-like for control flow statement in Simulink as a For subsystem. In the For subsystem, the For Iterator block has iterative control over any Simulink blocks present. For each iteration value of the For Iterator block, the accompanying blocks execute. The number of iterations is set internally for the For Iterator block or externally with data input. The following example shows a completed for control flow statement that increments an initial value of zero by 10 over 20 iterations.

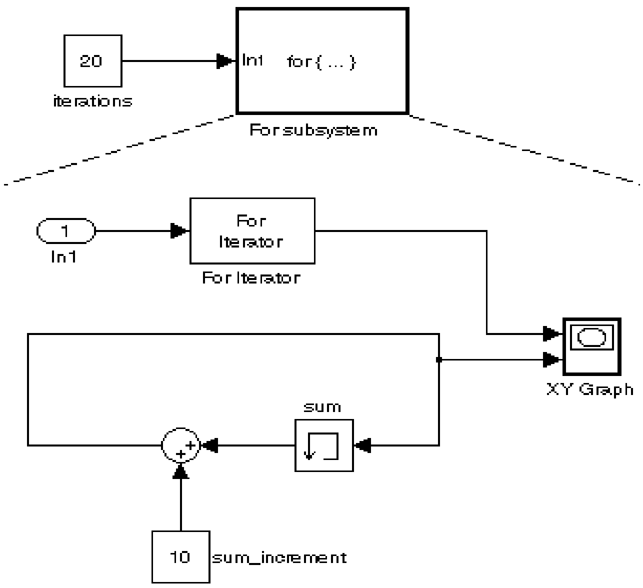

Figure 1.27.85:

In the example above, a For subsystem receives an input, which it passes to the For Iterator block inside. The For Iterator block uses this input to determine the number of times it executes the blocks of its subsystem, in this case, 20 times. Each time the blocks execute, a value of 10 is added to a sum, which is initially zero. In addition, for each time the blocks of the subsystem execute, the For Iterator block outputs a value equal to the number of times that the blocks have executed, including the current

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execution. This is referred to as the iterator value. This value, along with the sum value, is sent to an XY Graph block:

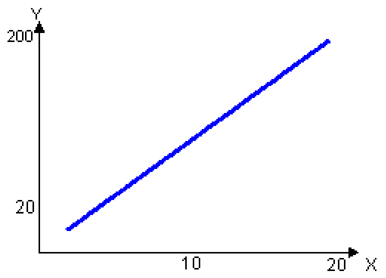

Figure 1.27.86:

The control flow statement exammple above can be represented by following pseudo code.

```
sum=0;
iterations=20;
sum_increment=10;
for (i=0; i<iterations;
i++) {
    sum=sum+sum_increment;
}
```

Example of a For loop:

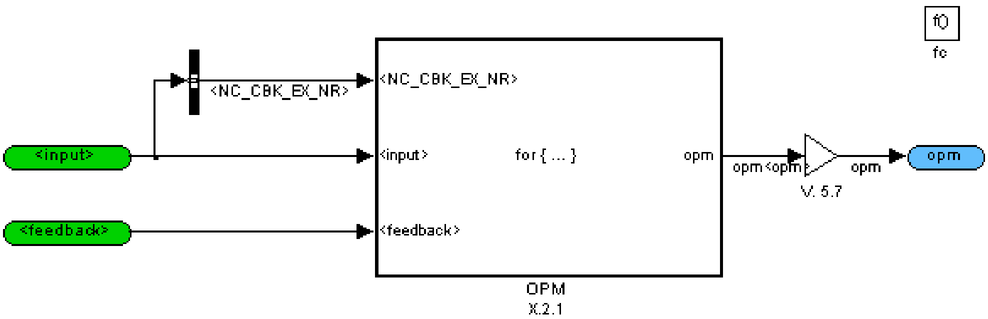

Figure 1.27.87:

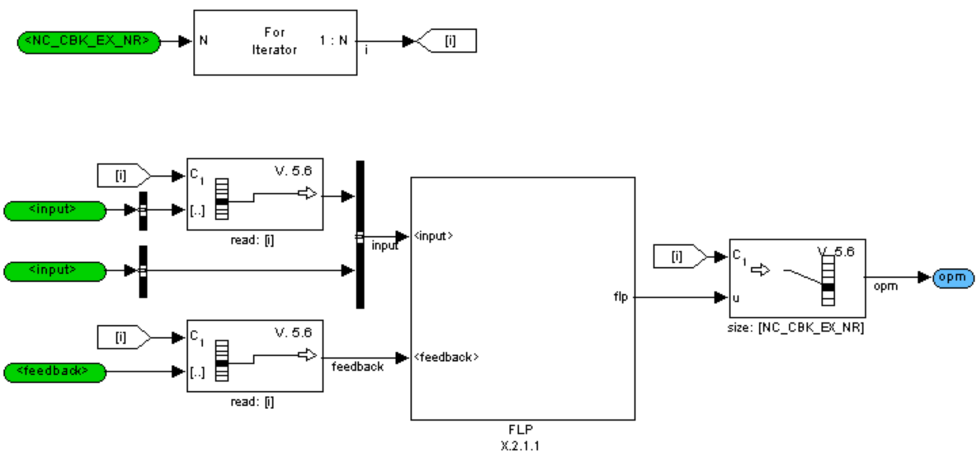

Figure 1.27.88:

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Switch Case Action Subsystem

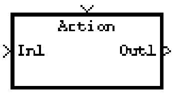

Figure 1.27.89:

This block is a Subsystem block that is preconfigured to serve as a starting point for creating a subsystem whose execution is triggered by a Switch Case block. It contains the Action Port that links to a signal from a switch case block:

Figure 1.27.90:

Note: The naming "Action" within this block is different to "Actions" which are connected to the supplier Action concept

While Iterator Subsystem

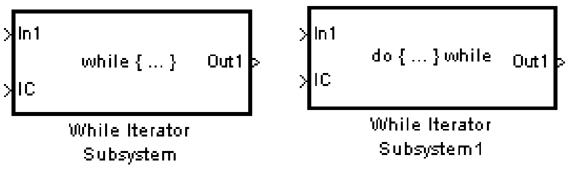

Figure 1.27.91:

Represent a subsystem that executes repeatedly while a condition is satisfied during a simulation time step. This block is a Subsystem block that is preconfigured to serve as a starting point for creating a subsystem that executes repeatedly while a condition is satisfied during a simulation time step. It contains the While Iterator block.

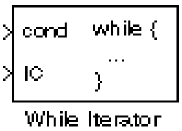

Figure 1.27.92:

The While Iterator block, when placed in a subsystem, implements a C-like while or do-while control flow statement in Simulink as a While subsystem. It has iterative control over any accompanying Simulink block programming placed in the same subsystem with it.

For each iteration of the While Iterator block, the accompanying blocks perform one execution. Iteration takes place as long as the input conditions are true. This applies to an initial condition for the first

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execution (input port labeled IC) and a condition for succeeding executions (input port labeled cond). The following While subsystem example increments an initial value of 0 by 10 for every execution.

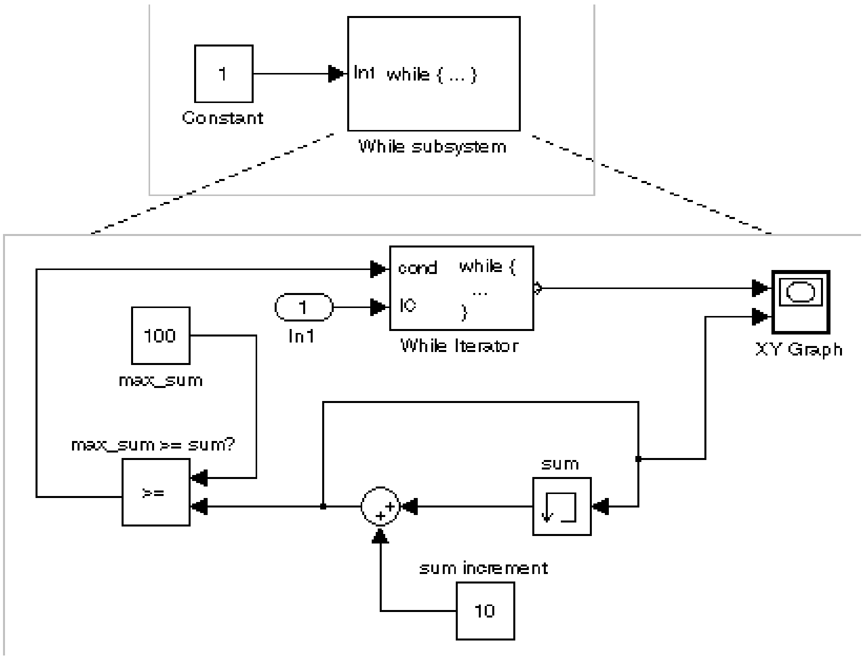

Figure 1.27.93:

In the above example, a subsystem with a While block receives an input, which it passes to the IC (initial condition) port of the While block inside. If this value is true, the While block executes the blocks of the subsystem it is in. Since this value is 1 (true), the blocks execute and a value of 10 is added to a sum, which is initially 0. The sum is then compared to a value of 100. If the sum is less than or equal to 100, a value of true is passed to the While block through the cond (condition) port. This causes the blocks to execute again and again until the value passed to the While Iterator block is false and execution ceases.

In addition, for each time the blocks of the subsystem execute, the While block outputs a value equal to the number of times that the blocks have executed, including the current execution. This value, along with the sum value, is sent to the x and y coordinate inputs, respectively, of an XY Graph block with the following result.

Continued on next page

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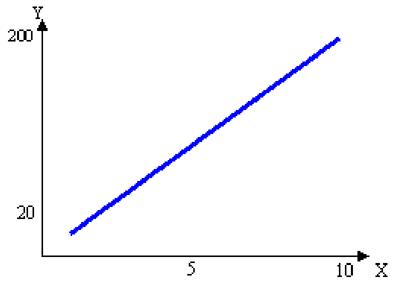

Figure 1.27.94:

The above while control flow statement example can be represented by the following pseudo code.

```
sum = 0;
IC = 1;
iteration_number = 0;
cond = IC;
while (cond != 0) {
   iteration_number       =
iteration_number + 1;
   sum = sum + sum_increment;
   if (sum >= 100 OR
iterations > max_iterations)
cond = 0;
}
```

The equivalent pseudo code for a do-while iteration in the example above (minus the IC port) is as follows:

```
sum = 0;
iteration_number = 0;
cond = 1;
do {
   iteration_number = iteration_number + 1;
   sum = sum + sum_increment;
   if (sum >= 100 AND iterations > max_iterations) cond = 0;
} while (cond);
```

When you change the While Iterator block to do-while operation, the IC (initial condition) input disappears from the While Iterator block. The important distinction between the while and do-while modes of the While Iterator block is that the do-while mode runs the While subsystem at least once. In while mode, the While subsystem may not run its blocks at all depending on the value of the initial condition (IC).

Inport

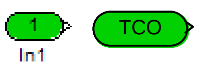

Figure 1.27.95:

Inport blocks are the links from outside a system into the system. The signal name (here: TCO) can optionally be displayed on the input

Outport

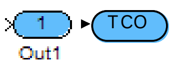

Figure 1.27.96:

Outport blocks are the links from a system to a destination outside the system. The signal name (here: TCO) can optionally be displayed on the output.

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Bus Creator

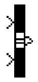

Figure 1.27.97:

The Bus Creator block combines a set of signals into a bus, i.e., a group of signals represented by a single line in a block diagram. The Bus Creator block, when used in conjunction with the Bus Selector block, reduces number of lines required to route signals from one part of a diagram to another.

Bus Selector

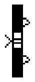

Figure 1.27.98:

Select signals from an incoming bus. The Bus Selector block accepts input from a Bus Creator block or another Bus Selector block. This block has one input port. The number of output ports depends on the state of the Muxed output check box. If you check Muxed output, then the signals are combined at the output port and there is only one output port; otherwise, there is one output port for each selected signal.

Mux

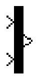

Figure 1.27.99:

Combine several input signals into a vector or bus output signal. The Mux block combines its inputs into a single output. An input can be a scalar, vector, or matrix signal. Depending on its inputs, the output of a Mux block is a vector or a composite signal, i.e., a signal containing both matrix and vector elements. If all of a Mux block's inputs are vectors or vector-like, the block's output is a vector. A vector-like signal is any signal that is a scalar (one-element vector), a vector, or a single-column or single-row matrix. If any input is a nonvector-like matrix signal, the output of the Mux is a bus signal. Bus signals can drive only virtual blocks, e.g., a Demux, Subsystem, or Go To block.

Demux

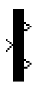

Figure 1.27.100:

Extract and output the elements of a bus or vector signal. The Demux block extracts the components of an input signal and outputs the components as separate signals. The block accepts either vector (1-D array) signals or bus signals.

Ground

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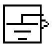

Figure 1.27.101:

The Ground block can be used to connect blocks whose input ports are not connected to other blocks. The Ground block outputs a signal with zero value. The data size of the signal is the same as that of the port to which it is connected.

Terminator

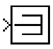

Figure 1.27.102:

The Terminator block can be used to cap blocks whose output ports are not connected to other blocks.

Enable

Figure 1.27.103:

Adding an Enable block to a subsystem makes it an enabled subsystem. An enabled subsystem executes while the input received at the Enable port placed at the top of the subsytem is greater than zero.

Trigger and function call

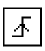

Figure 1.27.104:

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Adding a Trigger block to a subsystem makes it a triggered subsystem. A triggered subsystem executes once on each simulation step when the value of the signal that passes through the trigger port changes in a specifiable way (described below). A subsystem can contain no more than one Trigger block.

The Trigger type parameter allows you to choose the type of event that triggers execution of the subsystem:

- rising triggers execution of the subsystem when the control signal rises from a negative or zero value to a positive value (or zero if the initial value is negative).
- falling triggers execution of the subsystem when the control signal falls from a positive or a zero value to a negative value (or zero if the initial value is positive).
- either triggers execution of the subsystem when the signal is either rising or falling.
- function-call causes execution of the subsystem to be controlled by logic internal to another block (and the subsystem becomes a Function_Call_Subsystem,see

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description above).

Figure 1.27.105:

1.27.17 Stateflow

Stateflow Chart

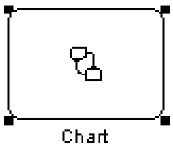

Figure 1.27.106:

This block indicates a Stateflow Chart, which is mainly used to model state machines. The chart can be triggered and contain variable number of outputs and inputs.

1.27.18 Functional differences between blocks from SDA 5.0 and blocks from 4.0 and 3.1

Version information

All SDA 5.0 blocks in Automotive Blockset show version information on the block icon. Every block has own version 5.XX.

Blocks from SDA 4.0 and 3.1 releases do not show version information on the block icon.

Functional differences

All SDA 5.0 blocks from Automotive Blockset are compatible with the MSR specification (V. 1.12). The previous (4.0 and 3.1) block versions have different functional behavior, which is listed below:

1. Group 1: Blocks which perform reset at the first calculation step after Reset signal (R) becomes zero.

2. Group 2: Blocks which do not perform functional reset (R) correctly if on first step after reset the enable signal E is not zero. In this case, the calculation uses a new state value equal to current input IV instead of stored input IV during the functional reset.

3. Group 3: Blocks which do not assign value to output if enable (E) signal is equal to zero and no logical reset (R or RT) is requested. It can produce mistakes in multi-rate mode after R_FC function call.

4. Group 4: Blocks which have wrong simulation behavior.

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Block	***1***	***2***	***3***	***4***		***Block***	***1***	***2***	***3***	***4***	
CountDownRE	*x*	*x*				*DigitalLowpassRE*	*x*	*x*	*x*		
CountDownRTE						*HighpassTRE*	*x*			*x*	
CounterRE	*x*	*x*				*LowpassKRE*	*x*	*x*	*x*		
CounterTRE						*LowpassSecOrdRE*	*x*	*x*			
StopWatchRE	*x*	*x*	*x*			*LowpassTRE*	*x*	*x*	*x*		
StopWatchTRE			*x*			*DeltaOneStep*	*x*	*x*			
TimerRetriggerRE	*x*	*x*				*DifferenceLimiter*	*x*	*x*	*x*		
TimerRetriggerRTE						*GradientLimiter*	*x*	*x*	*x*		
TimerRE			*x*			*DiffirenceQuotient*	*x*	*x*	*x*		
TimerRTE						*EdgeBi*	*x*	*x*	*x*	*x*	
DelayResetEnabled	*x*					*EdgeFalling*	*x*	*x*	*x*	*x*	
TurnOffDelaySample	*x*	*x*				*EdgeRising*	*x*	*x*	*x*	*x*	
TurnOffDelayTime	*x*	*x*				*SampleAndHoldRE*	*x*	*x*	*x*		
TurnOnDelaySample	*x*	*x*				*MaxLogRE*	*x*			*x*	
TurnOnDelayTime	*x*	*x*				*MinLogRE*	*x*			*x*	
AccumulatorREL	*x*	*x*				*Hysteresis*	*x*		*x*	*x*	
IntegratorKREL	*x*	*x*				*Delay_RE*					
IntegratorTREL	*x*	*x*									

5. TimerRE: Functional reset is different from MSR specification (see pseudo-code).

Pseudo-code from previous versions

This section lists the pseudo-code for blocks from previous versions (4.0 and 3.1) which have RE or RTE modes.

Standard ports:	Optional ports:
E: Suppresses the block calc. R: Resets to init values IV: Initial value set upon reset	State1_in: Direct input of internal state (x) State1_out: Direct output of internal state (x) R_FC: System reset request CLC_FC: System calculation request

CountDownRE
Continued on next page

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Port I/O Description	Run-Code (CLC_FC)

y: if counter state is zero
cnt: Out internal counter state
 	
System-Init-Code
x = 0;
R1 = 0;
y = 0;
cnt = 0;
 	
Init-Code (R_FC)
x = round(IV);
R1 = R;
	if (R || R1) {
	x = round(IV);
	}
	else if (E) {
	if (x > 0){
	x = x - 1;
	}
	}
	y = (x > 0);
	cnt = x;
	R1 = R;

StopWatchRE	

Port I/O Description
y Out Time since last reset
cnt: Out Internal counter state
 	
Optional ports:
dT: Sample Time input
 	
System-Init-Code
x = 0.0;
R1 = 0;
cnt = 0.0;
y = 0.0;
	Init-Code (R_FC)
	x = 0.0;
	R1 = R;
	
	Run-Code (CLC_FC)
	if (R || R1) {
	x = 0.0;
	}
	else if (E) {
	x = x + dT;
	}
	y = x;
	cnt = x;
	R1 = R;

CounterRE
Continued on next page

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Port I/O Description	Run-Code

y: Out counter value
cnt: Out Internal counter state
 	
System-Init-Code
x = 0;
R1 = 0;
cnt = 0;
y = 0;
 	
Init-Code (R_FC)
x = round (IV);
R1 = R;
	if (R || R1) {
	  x = round(IV);
	}
	else if (E) {
	  x = x + 1;
	}
	y = x;
	cnt = x;
	R1 = R;

CountDownRTE	
Port I/O Description	**Run-Code**

y: Out counter value
cnt: Out Internal counter state
 	
System-Init-Code
x = 0;
RT_1 = 0;
cnt = 0;
y = 0;
 	
Init-Code (R_FC)
x = round (IV);
RT_1 = 0;
	if (RT & & !RT_1) {
	  x = round(IV);
	}
	else if (E) {
	  if (x > 0) {
	    x = x - 1;
	  }
	}
	RT_1 = RT;
	y = (x > 0);
	cnt = x;

CounterRTE	
Port I/O Description	**Run-Code**

y: Out counter value
cnt: Out Internal counter state
 	
System-Init-Code
x = 0;
cnt = 0;
y = 0;
 	
Init-Code (R_FC)
x = round (IV);
RT_1 = 0;
	if (RT & & !RT_1) {
	  x = round(IV);
	}
	else if (E) {
	  x = x + 1;
	}
	RT_1 = RT;
	y = x;
	cnt = x;

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StopWatchRTE	

Port I/O Description
y Out Time since last reset
cnt: Out Internal counter state
 	
Optional ports:
dT: Sample Time input
 	
System-Init-Code
x = 0.0;
cnt = 0.0;
y = 0.0;
	Init-Code (R_FC)
	x = 0.0;
	RT_1 = 0;
	
	Run-Code (CLC_FC)
	if (RT & & !RT_1) {
	x = 0.0;
	}
	else if (E) {
	x = x + dT;
	}
	RT_1 = RT;
	y = x
	cnt = x;

Delay_RE	

Port I/O Description
u: Source signal (real)
y: Output signal, delay by 1
 	
System-Init-Code
x = 0;
y = 0;
 	
Init-Code (R_FC)
Not implemented.
	Run-Code (CLC_FC)
	if (R) {
	y = IV;
	x = y = IV;
	}
	else if (E) {
	y = x;
	x = u;
	}
	else {
	y = x;
	}

TimerRetriggerRE
Continued on next page

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Port I/O Description	Init-Code (R_FC)

y: Timer is running (time >0)
cnt: Out Internal counter state
 	
Optional ports:
dT: Sample Time input
 	
System-Init-Code
x = 0.0;
R1 = 0;
cnt = 0.0;
y = 0.0;
	x = IV;
	
	Run-Code (CLC_FC)
	if (R || R1) {
	  x = IV;
	}
	else if (E) {
	  x = MAX(x-dT, 0.0);
	}
	y = (x > 0.0);
	cnt = x;
	R1 = R;

TimerRetriggerRTE	
Port I/O Description	**Init-Code (R_FC)**

y: Timer is running (time >0)
cnt: Out Internal counter state
 	
Optional ports:
dT: Sample Time input
 	
System-Init-Code
x = 0.0;
cnt = 0.0;
y = 0.0;
	x = IV;
	RT_1 = 0;
	
	Run-Code (CLC_FC)
	if (RT & & !RT_1) {
	  x = IV;
	}
	else if (E) {
	  x = MAX(x-dT,0.0);
	}
	RT_1 = RT;
	y = (x > 0.0);
	cnt = x;

TimerRE (V. 4.0)	
Port I/O Description	**Init-Code (R_FC)**

y: Timer is running (time >0)
cnt: Out Internal counter state
 	
Optional ports:
dT: Sample Time input
 	
System-Init-Code
x = 0.0;
cnt = 0.0;
y = 0.0;
	x = IV;
	
	Run-Code (CLC_FC)
	if (R & & (x <= 0.0)) {
	  x = IV;
	}
	else if (E) {
	  x = MAX(x-dT, 0.0);
	}
	y = (x > 0.0);
	cnt = x;

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TimerRE (V. 3.1)	

Port I/O Description
y: Timer is running (time >0)
cnt: Out Internal counter state
 	
Optional ports:
dT: Sample Time input
 	
System-Init-Code
x = 0.0;
cnt = 0.0;
y = 0.0;
	Init-Code (R_FC)
	if (x <= 0.0){
	  x = IV;
	}
	
	Run-Code (CLC_FC)
	if (R){
	  if (x <= 0.0){
	    x = IV;
	  }
	}
	else if (E) {
	  x = MAX(x-dT, 0.0);
	}
	y = (x > 0.0);
	cnt = x;

DelayResetEnabled	

Port I/O Description
u: Source signal (real)
y: Output signal, delay by 1
 	
System-Init-Code
x = 0;
R1 = 0;
y = 0;
 	
Init-Code (R_FC)
x = IV;
R1 = R;
	Run-Code (CLC_FC)
	if (R) {
	  x = IV;
	  y = x;
	}
	else {
	  if (R1) {
	    x = IV;
	  }
	  if (E) {
	    y = x;
	    x = u;
	  }
	  else {
	    y = x;
	  }
	}
	R1 = R;

TurnOffDelaySample
Continued on next page

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Port I/O Description	Run-Code (CLC_FC)

n: Number of delays
u: Source signal (boolean)
y: Falling edge u, delay by n
 	
System-Init-Code
x = 0; /* counter */
y1 = 0; /* y */
y = 0;
R1 = 0;
 	
Init-Code (R_FC)
x = round(n);
y1 = (u || (x>0));
if (!u & & (x>0)) {
  x = x - 1;
}
R1 = R;
	if (R || R1) {
	  x = round(n);
	  y1 = (u || (x>0));
	  if (!u & & (x>0)) {
	    x = x - 1;
	  }
	}
	else if(E) {
	  y1 = (u || (x>0));
	  if (u) {
	    x = round(n);
	  }
	  else if (x > 0) {
	    x = x - 1;
	  }
	}
	y = y1;
	R1 = R;

TurnOffDelayTime

Port I/O Description	Run-Code (CLC_FC)

T: Delay time
u: Source signal (boolean)
y: Falling edge u, delay by T
 	
Optional ports:
dT: Sample Time input
 	
System-Init-Code
x = 0.0; /* timer */
y1 = 0; /* y */
y = 0;
R1 = 0;
 	
Init-Code (R_FC)
x = T
	if (R || R1) {
	  x = T; /* reset */
	  y1 =(u || (x>0.0));
	  if (!u & & (x>0)) {
	    x = x - dT;
	  }
	}
	else if (E) {
	  y1=(u||(x>0.0));
	  if (u) {
	    x = T;
	  }
	  else if (x > 0.0) {
	    x = x - dT;
	  }
	}
	y = y1;
	R1 = R;

TurnOnDelaySample

Continued on next page

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Port I/O Description	Run-Code (CLC_FC)

n: Number of delays
u: Source signal (boolean)
y: Rising edge u, delay by n
 	
System-Init-Code
x = 0; /* counter */
y1 = 0; /* y */
y = 0;
R1 = 0;
 	
Init-Code (R_FC)
x = round(n);
y1 = (u & & (x<=0));
if (u & & (x>0)) {
  x = x - 1;
}
R1 = R;
	if (R || R1) {
	  x = round(n);
	  y1 = (u & & (x<=0));
	  if (u & & (x>0)) {
	    x = x - 1;
	  }
	}
	else if(E) {
	  y1 = (u & & (x<=0));
	  if (!u) {
	    x = round(n);
	  }
	  else if (x > 0) {
	    x = x - 1;
	  }
	}
	y = y1;
	R1 = R;

TurnOnDelayTime

Port I/O Description	Run-Code (CLC_FC)

T: Delay time
u: Source signal (boolean)
y: Rising edge u, delay by n
 	
System-Init-Code
x = 0.0; /* timer */
y1 = 0; /* y */
y = 0;
R1 = 0;
 	
Init-Code (R_FC)
x = T
	if (R || R1) {
	  x = T;
	  y1=(u& & (x<=0.0));
	  if (u& & (x>0.0) {
	    x = x - dT;
	  }
	}
	else if (E) {
	  y1=(u& & (x<=0.0));
	  if (!u) {
	    x = T;
	  }
	  else if (x > 0.0) {
	    x = x - dT;
	  }
	}
	y = y1;
	R1 = R;

AccumulatorREL

Continued on next page

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Port I/O Description	Run-Code (CLC_FC)

u: Input signal to accumulate
MX: Upper state limit
MN: Lower state limit
y: u accumulated (running sum)
B_max Out True if upper limitation active
B_min Out True if lower limitation active
 	
System-Init-Code
x = 0;
R1 = 0;
y = 0;
B_min = 0;
B_max = 0;
 	
Init-Code (R_FC)
x = IV;
if (x > MX) {
  x = MX;
}
else if (x < MN) {
  x = MN;
}
R1 = R;
	if (R || R1) {
	  x = IV;
	}
	else if (E) {
	  x = x + u;
	}
	/* limit */
	if (x > MX) {
	  x = MX;
	  B_max = 1;
	  B_min = 0;
	}
	else if (x < MN) {
	  x = MN;
	  B_max = 0;
	  B_min = 1;
	}
	else {
	  B_max = 0;
	  B_min = 0;
	}
	y = x; /* out */
	R1 = R;

IntegratorKREL
Continued on next page

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Port I/O Description	Run-Code (CLC_FC)

u: Input signal to integrate
MX: Upper state limit
MN: Lower state limit
K: Gain
y: integrated value of u
B_max Out True if upper limitation active
B_min Out True if lower limitation active
 	
System-Init-Code
x = 0.0;
R1 = 0;
y = 0.0;
B_min = 0;
B_max = 0;
 	
Init-Code (R_FC)
x = IV;
if (x > MX) {
  x = MX;
}
else if (x < MN) {
  x = MN;
}
R1 = R;
	if (R || R1) {
	  x = IV;
	}
	else if (E) {
	  x = x + K*u*dT;
	}
	/* limit */
	if (x > MX) {
	  x = MX;
	  B_max = 1;
	  B_min = 0;
	}
	else if (x < MN) {
	  x = MN;
	  B_max = 0;
	  B_min = 1;
	}
	else {
	  B_max = 0;
	  B_min = 0;
	}
	y = x; /* out */
	R1 = R;

IntegratorTREL

Continued on next page

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Port I/O Description

u: Input signal to integrate
MX: Upper state limit
MN: Lower state limit
T: Time constant (1/Gain)
y: integrated value of u
B_max Out True if upper limitation active
B_min Out True if lower limitation active

System-Init-Code

```
x = 0.0;
R1 = 0;
y = 0.0;
B_min = 0;
B_max = 0;
```

Init-Code (R_FC)

```
x = IV;
if (x > MX) {
  x = MX;
}
else if (x < MN) {
  x = MN;
}
R1 = R;
```

Run-Code (CLC_FC)

```
if (R || R1) {
  x = IV;
}
else if (E) {
  x = x + u*dT/T;
}
/* limit */
if (x > MX) {
  x = MX;
  B_max = 1;
  B_min = 0;
}
else if (x < MN) {
  x = MN;
  B_max = 0;
  B_min = 1;
}
else {
  B_max = 0;
  B_min = 0;
}
y = x; /* out */
R1 = R;
```

Optional ports:

dT: Sample Time input

DigitalLowpassRE

Port I/O Description

u: Source signal (real)
m: Filter factor
y: Filtered signal

System-Init-Code

```
x = 0.0;
R1 = 0;
y = 0.0;
```

Init-Code (R_FC)

```
x = IV;
R1 = R;
```

Run-Code (CLC_FC)

```
if (R || R1) {
  x = IV;
}
else if (E) {
  x = x+ m*(u - x);
}
y = x;
R1 = R;
```

LowpassKRE

Continued on next page

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Port I/O Description
u: Source signal (real)
K: Filter factor
y: Filtered signal
 	
System-Init-Code
x = 0.0;
R1 = 0;
y = 0.0;
	Init-Code (R_FC)
	x = IV;
	R1 = R;
	
	Run-Code (CLC_FC)
	if (R || R1) {
	x = IV;
	}
	else if (E) {
	x = x+ K*dT*(u-x);
	}
	y = x;
	R1 = R;

HighpassTRE	

Port I/O Description
IV1: IV (for timestep n) at reset
IV2: IV (for timestep n-1) at reset
u: Source signal (real)
T: Time constant
TD: Time constant
y: Highpass filtered signal
 	
Optional ports:
State1_in: Direct input of internal state (x1)
State2_in: Direct input of internal state (x2)
State1_out: Direct output of internal state (x1)
State2_out: Direct output of internal state (x2)
 	
System-Init-Code
x1 = 0.0;
x2 = 0.0;
R1 = 0;
y = 0.0;
 	
Note: Wrong behavior on simulation if IV values are not constant.
	Init-Code (R_FC)
	x1 = IV1;
	x2 = IV2;
	R1 = R;
	
	Run-Code (CLC_FC)
	if (R) {
	x1 = IV1;
	x2 = IV2;
	}
	else {
	if (R1) {
	x1 = IV1;
	x2 = IV2;
	}
	if (E) {
	x1=x1+(TD*u–TD*x2–
	dT*x1)/T;
	}
	}
	y = x1;
	x2 = u;
	R1 = R;

LowpassSecOrdRE
Continued on next page

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Port I/O Description	Init-Code (R_FC)

IV1: IV (for timestep n) at reset
IV2: IV (for timestep n-1) at reset
u: Source signal (real)
T:Time constant
D: Damping constant
Y: Highpass filtered signal
 	
Optional ports:
State1_in: Direct input of internal state (x1)
State2_in: Direct input of internal state (x2)
State1_out: Direct output of internal state (x1)
State2_out: Direct output of internal state (x2)
 	
System-Init-Code
x1 = 0.0;
x2 = 0.0;
R1 = 0;
y = 0.0;
	x1 = IV1;
	x2 = IV2;
	R1 = R;
	
	Run-Code (CLC_FC)
	if (R || R1) {
	x1 = IV1;
	x2 = IV2;
	}
	else if (E) {
	temp1 =T*T+2*D*T*dT;
	x1 = x1+[dT*dT*(u–x1)
	+ T*T*(x1–x2)] /
	temp1;
	}
	y = x1;
	x2 = x1;
	R1 = R;

LowpassTRE

Port I/O Description	Init-Code (R_FC)

u: Source signal (real)
T: time constant
y: Filtered signal
 	
System-Init-Code
x = 0.0;
R1 = 0;
y = 0.0;
	x = IV;
	R1 = R;
	
	Run-Code (CLC_FC)
	if (R || R1) {
	x = IV;
	}
	else if (E) {
	x = x+ dT/T*(u-x);
	}
	y = x;
	R1 = R;

DeltaOneStep

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Port I/O Description	Init-Code (R_FC)
u: Source signal (real) y: Difference signal	x = IV; R1 = R;
System-Init-Code	**Run-Code (CLC_FC)**

x = 0.0;
R1 = 0;
y = 0.0;
	if (R || R1) {
	  x = IV;
	  y = u - x;
	}
	else if (E) {
	  y = u - x;
	}
	x = u;
	R1 = R;

EdgeBi	
Port I/O Description	**Init-Code (R_FC)**
u: Source signal (boolean) y: Edge pulse	x = IV; R1 = R;
System-Init-Code	**Run-Code (CLC_FC)**

x = 0.0;
R1 = 0;
y = 0.0;
	if (R || R1) {
	  x = IV;
	  y = (x != u);
	  x = u;
	}
	else if (E) {
	  y = (x != u);
	  x = u;
	}
	R1 = R;

EdgeFalling

Continued on next page

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Port I/O Description
u: Source signal (boolean)
y: Edge pulse
 	
System-Init-Code
x = 0.0;
R1 = 0;
y = 0.0;
 	
Init-Code (R_FC)
x = IV;
R1 = R;
	Run-Code (CLC_FC)
	if (R || R1) {
	x = IV;
	y = (x & & !u);
	x = u;
	}
	else if (E) {
	y = (x & & !u);
	x = u;
	}
	R1 = R;

EdgeRising	

Port I/O Description
u: Source signal (boolean)
y: Edge pulse
 	
System-Init-Code
x = 0.0;
R1 = 0;
y = 0.0;
 	
Init-Code (R_FC)
x = IV;
R1 = R;
	Run-Code (CLC_FC)
	if (R || R1) {
	x = IV;
	y = (!x & & u);
	x = u;
	}
	else if (E) {
	y = (!x & & u);
	x = u;
	}
	R1 = R;

SampleAndHold	

Port I/O Description
u: Source signal (real)
y: Captured signal
B_max: True if upper limitation active
B_min: True if lower limitation active
 	
System-Init-Code
x = 0.0;
R1 = 0;
y = 0.0;
	Init-Code (R_FC)
	x = IV;
	R1 = R;
	
	Run-Code (CLC_FC)
	if (R || R1) {
	x = IV;
	}
	else if (E) {
	x = u;
	}
	y = x;
	R1 = R;

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Hysteresis	

Port I/O Description
u: Source signal (real)
RSP: Upper threshold (real)
LSP: Lower threshold (real)
y: Hysteresis signal (boolean)
 	
System-Init-Code
x = 0.0;
R1 = 0;
y = 0.0;
B_max = 0;
B_min = 0;
 	
Init-Code (R_FC)
x = IV;
R1 = R;
	Run-Code (CLC_FC)
	if (R || R1) {
	x = IV;
	y = x;
	}
	if(R || R1 || E){
	if (u > RSP) {
	x = 1;
	}
	else if (u < LSP) {
	x = 0;
	}
	y = x;
	}
	R1 = R;

DifferenceQuotient	

Port I/O Description
u: Source signal (real)
y: Rate of change (gradient)
 	
System-Init-Code
x = 0.0;
R1 = 0;
y = 0.0;
	Init-Code (R_FC)
	x = IV;
	R1 = R;
	
	Run-Code (CLC_FC)
	if (R || R1) {
	x = IV;
	y = (u - x)/dT;
	x = u;
	}
	else if (E) {
	y = (u - x)/dT;
	x = u;
	}
	R1 = R;

DifferenceLimiter
Continued on next page

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Port I/O Description	Run-Code (CLC_FC)

u: Source signal (real)
LU: Upper limit of difference (real)
LD: Lower limit of difference (real)
y: Limited signal (real)
B_min: Lower limit exceeded (boolean)
B_max: Upper limit exceeded (boolean)
 	
System-Init-Code
x = 0.0;
R1 = 0;
y = 0.0;
B_max = 0;
B_min = 0;
 	
Init-Code (R_FC)
x = IV;
R1 = R;
	if (R || R1) {
	x = IV;
	y = x;
	}
	else if (E) {
	if ((u - x)> LU) {
	x = x+ LU;
	B_min = 0;
	B_ max = 1;
	}
	else if ((u - x)< LD) {
	x = x+ LD;
	B_ min = 1;
	B_ max = 0;
	}
	else {
	x = u;
	B_ min = 0;
	B_ max = 0;
	}
	y = x;
	}
	R1 = R;

DifferenceLimiter

Continued on next page

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Port I/O Description	Run-Code (CLC_FC)

u: Source signal (real)
dLU: Upper gradient [unit(u)/s] (real)
dLD: Lower gradient [unit(u)/s] (real)
y: Limited signal (real)
B_min: Lower limit exceeded (boolean)
B_max: Upper limit exceeded (boolean)
 	
System-Init-Code
x = 0.0;
R1 = 0;
y = 0.0;
B_max = 0;
B_min = 0;
 	
Init-Code (R_FC)
x = IV;
R1 = R;
	if (R || R1) {
	x = IV;
	y = x;
	}
	else if (E) {
	if ((u-x)>dLU*dT) {
	x = x+ dLU * dT;
	B_min = 0;
	B_max = 1;
	}
	else if((u-x)<
	dLD*dT)
	{
	x = x+ dLD * dT;
	B_min = 1;
	B_max = 0;
	}
	else {
	x = u;
	B_min = 0;
	B_max = 0;
	}
	y = x;
	}
	R1 = R;

MaxLogRE

Port I/O Description	Run-Code (CLC_FC)

u: Source signal (real)
y: Maximum value
B_max: Current input is new max. (boolean)
 	
System-Init-Code
x = 0.0;
R1 = 0;
y = 0.0;
B_max = 0;
 	
Init-Code (R_FC)
x = IV;
R1 = R;
	B_max = 0;
	if (R) {
	x = IV;
	}
	else {
	if (R1) {
	x = IV;
	}
	if (E) {
	if (u > x) {
	x = u;
	B_max = 1;
	}
	}
	}
	y = x;
	R1 = R;

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MaxLogRE	

Port I/O Description
u: Source signal (real)
y: Minimum value
B_min: Current input is new min. (boolean)
 	
System-Init-Code
x = 0.0;
R1 = 0;
y = 0.0;
B_min = 0;
 	
Init-Code (R_FC)
x = IV;
R1 = R;
	Run-Code (CLC_FC)
	B_min = 0;
	if (R) {
	  x = IV;
	}
	else {
	  if (R1) {
	    x = IV;
	  }
	  if (E) {
	    if (u < x) {
	      x = u;
	      B_min = 1;
	    }
	  }
	}
	y = x;
	R1 = R;

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1.28 SDA - How to read SDA based specification

General information:

[1]Matlab, Simulink, and Stateflow are registered trademarks of TheMathworks, Inc.
Other product or brand names are trademarks or registered trademarks of their respective holders.

1.28.1 Introduction

The aim of this document is to enable the reader to understand the formalism of a SDA-model based specification. It is dedicated to customers or users dealing with the graphical specification.

SDA (System Design Automation) is the Matlab/Simulink/Stateflow[1] based function development environment used at Continental AG.

To understand the benefit of this new specification structure and formalism, this document first gives a very brief overview to a SDA model. SDA models are set up as Simulink/Stateflow models and have a clearly defined and unique structure as described in the following sections. Each SDA based specification is based on part of the complete and executable Model.

1.28.2 Matlab/Simulink/Stateflow.

This subchapter describes with a few words the tool used for modeling the behavior of a complete ECU. This tool is called Matlab. Matlab abbreviates "Matrix Laboratory" and has been developed for Technical Computing.

Matlab is:

- an interactive programming environment
- a high performance language
- a developers tool and
- a library of mathematical functions.

There are various software tools featured by Matlab the so-called **Matlab-Toolboxes**. They belong to the Matlab product family and are application-specific libraries of Matlab functions that customize Matlab for solving particular classes of problems. One of these toolboxes is Simulink.

Simulink is a graphical mouse-driven program for:

- the modeling of linear and non-linear dynamic systems,
- the simulation of them
- and of their analysis.

Simulink models are developed and parameterized as block diagrams. Pictures of these block diagrams are used to describe the functionality in the automatic generated specification.

Simulink-Blocksets are application-specific libraries for Simulink models. One of these blocksets is Stateflow.

Stateflow is a special blockset of Simulink for the design of:

- complex control structures,
- i.e. for event driven systems,
- for their simulation and
- analysis.

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Stateflow models are developed and programmed as state machines. Pictures of these state machines are used to describe the functionality in the automatic generated specification.

1.28.3 SDA model overview

Model

Although the final specification represents only a sub part of a complete SDA model, this section gives a short overview of a complete SDA - model.

A SDA model consists of five main parts:

- Stimuli (STI_PRJ_AGGR)
  The stimuli subsystem provides all signals and data inputs needed for the simulation of the model

- Display (DISP_PRJ_AGGR)
  In the display subsystem all outputs of the models are collected and visualized or saved to the Matlab Workspace.

- Plant (PLA_PRJ_AGGR)
  The plant contains a model of the system that has to be controlled by the Controller Unit. The behavior of the plant can be bypassed with input data in the Stimuli.

- Controller (PRJ_AGGR)
  The Engine Control Unit (ECU) holds the functionality of the controller. It is subdivided into aggregates (see below) which are again subdivided into modules.

For each module a separate specification is generated.

Aggregates

An aggregate holds the functionality of a specific function together with its inputs and outputs. The main part of an aggregate in the SDA environment is the subsystem called "*modules_<AGGR>*", where <AGGR> stands for the aggregate name (see Figure 1). In Simulink a subsystem is a graphical mean to group any portion of a model.
The subsystem "*modules_AGGR*" includes all modules of the aggregate. The modules themselves are once again subsystems. The signal flow between the modules is represented by signal lines and signal buses. Bus selectors are used to select and distribute the appropriate signal to the modules. All data inputs and outputs are defined on this level of the aggregate as shown in the following figure. In future this figure will be used in the specification to give an overview of an aggregate.

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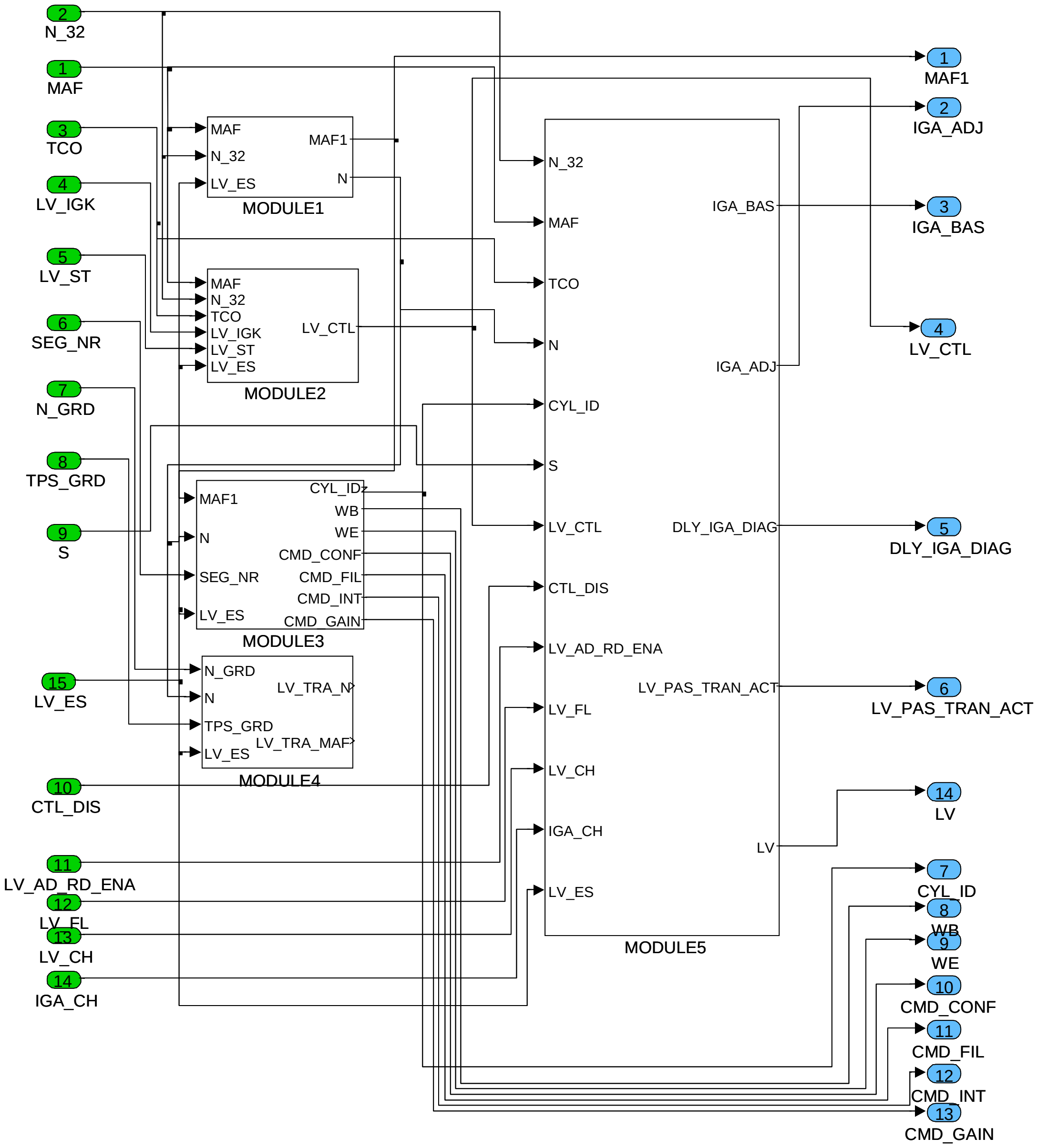

Figure 1.28.1: Schematic picture of the content of an aggregate. This picture shows the subsystem named "modules_<AGGR>" including all the five modules (Module1 to Module5) of the aggregate. For each module a separate specification is generated.

Modules

A module is the lowest level modular component in the model. All modules are included in the subsystem "modules_AGGR". The whole functionality of the model is placed inside triggered subsystems within the modules. There is no restriction to the number of subsystem levels. Content of the subsystems in the modules is shown in the graphical software requirement specification (SDA-SRS). This means that only the part relevant for the calibration is shown in the pictures in the SRS. Beside the pictures there is also some textual description for the separate functionality. These text explanations are directly followed by their respective pictures, as shown in the graphical software requirement specification (SDA-SRS).

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1.28.4 SDA specific Simulink notation

The functionality of the modules is build up with Simulink blocks that are placed inside triggered subsystems. The pictograms on the Simulink blocks represent a special functionality.
The blocks that are allowed for modeling within the SDA environment are included in separate libraries:

- the AT_Basic_Blocks ("Automotive Blockset")
- the AT_Lib library

In "Documentation Automotive Blockset" and "Documentation AT_Lib" a short description of the different blocks is given. The blocks are connected by signal lines, which represent the signal flow between them. Moreover the control flow in the model is driven by function calls that trigger the different subsystems, i.e. a function call is a signal that initiates the calculation of a functionality grouped in a subsystem.
SDA generated SRS include some special layout features that are listed here and demonstrated in the example in Figure 2:

- Thin lines mark scalar signals.
- Thick lines mark multidimensional signals e.g. arrays, vectors...
- Threefold lines.

Threefold lines represent bus signals, i.e. different signals that are collected together and represented by one "bus"-signal. This is similar to a data structure in Software. The block "bus creator" is used to collect the data "signal2" from the input "In1" and the data "Signal1" from the block "Constant1".
The block "bus_selector" is used to select dedicated signals from the bus. An example is shown in the figure with "Signal1" and "signal2". This example shows also that:

- Dashed lines represent function calls or triggers. In the example a so-called "Function-call generator" is used to initiate the evaluation of the constant block "Constant1" which write the array [1,2,3] to its output.

- Instead of signal lines local Goto/From blocks can be used to connect two subsystems as a kind of invisible signal line.

- Signal names are written beside the signal line.

- Input ports (e.g. the block "In1") and output ports (the block "Out1" or "Out2") provide the interface of the subsystem to the environment, i.e. they show the input and output data of a subsystem.

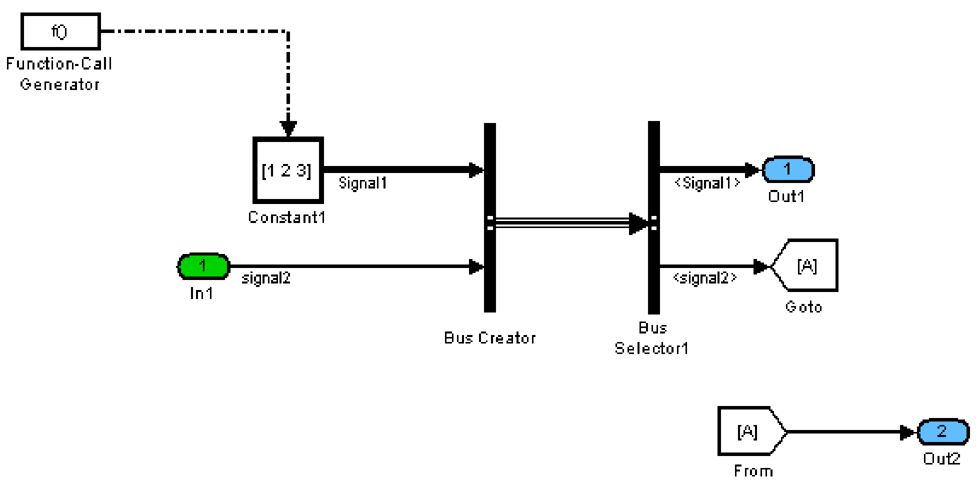

Figure 1.28.2: Example

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- The port names are shown on the respective subsystem (in this example: "In1", "Out1" and "Out2".

- There exist different **global** Goto/From blocks for data signals, visibles, function calls and triggers. E.g. the Goto blocks:

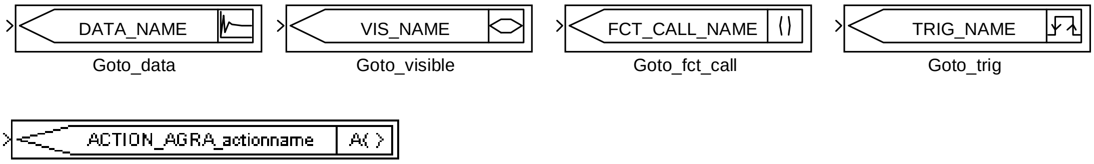


Figure 1.28.3:

- All visibles are available via the application system.

- All goto/from data are outputs/inputs of modules.

- If a subsystem has an input signal that is also an output signal of this subsystem, the suffixes "_in" are added to the input port name and "_out" to the output port name.

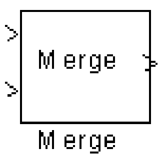
This means for example if the signal "A1" is both, input and output data of a subsystem, the input port is named "A1_in" and the output port "A1_out".

1.28.5 Structure of the SDA-Specification

The SDA-SRS layout is based on the layout of the standard WinWord Specifications. The first section includes tables of all output, input, calibration and configuration data. For output data the name, mode, hex. limits, phys. limits, resolution and unit is given in the table, whereas for the calibration and configuration data the dimension is given instead of mode. The input data table only holds the names of the variables.

An optional textual description and an overview picture of the module follow this section. Afterwards the contents of the subsystems with optional textual descriptions are included in hierarchical order. The pictures in a SRS are always shown after their respective text description.

1.28.6 Special Simulink blocks and their usage

 Figure 1.28.4:	The **Merge block** combines its inputs into a single output line. The output value at any time is equal to the most recently computed output of its driving blocks. The Merge block mainly is used to merge a "normal" operate signal with a reset signal. In order to achieve the right performance it has to be taken into account the execution order of its driving blocks.

Continued on next page

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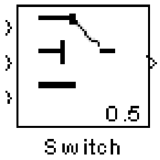
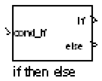
 Figure 1.28.5:	The**Switch block**propagates one of two inputs to its output, depending on the value of a third input, called the control input. If the signal on the control (second) input is greater than or equal to the Threshold parameter (shown in the block) the first input; otherwise, it propagates the third input.
 Figure 1.28.6:	The**if-then-else block**provides the possibility to implement an if-then-else control structure in Simulink. The input of this block is the condition "cond_if". If the condition is true (= 1) then the function call "if" is sent out. Else the function call "else" is sent out. These function calls can be used to trigger the corresponding subsystems.

1.28.7 How to read SDA conform Stateflow charts

Introduction

The aim of this chapter is to enable the reader of SDA based specifications to understand the Stateflow charts used in SDA models. This document is not a Stateflow reference, it shows only the usage according to the SDA Guidelines.

Stateflow objects overview

Graphical objects

Name	Description[2]
State	States are the primary objects of Stateflow. They represent modes of a system.
Transition	A transition is a pathway for a chart or state to change from one mode (state) to another.
Default transition	Default transitions tell Stateflow which of several possible states to enter first for a chart or superstate.
Connective junction	A connective junction represents a decision point between alternative transition paths.
History junction	A history junction records the most recently active state of the chart or superstate in which it is placed.
Function	Functions that are graphically defined by a flow graph. The flow graph is contained inside a box with the function name.
Box	Boxes are used to group parts of a diagram.

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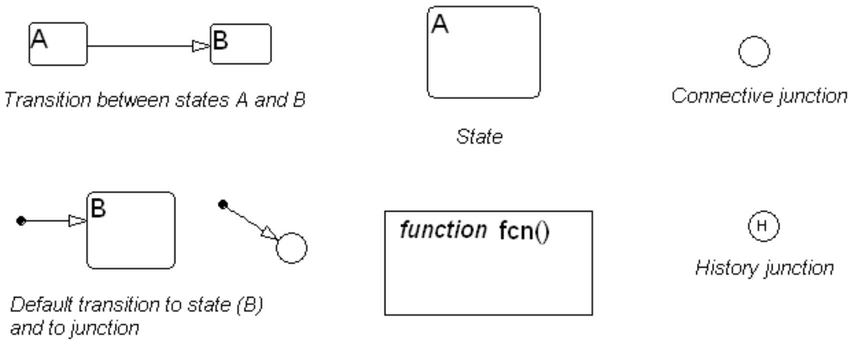

Figure 1.28.7: Symbols used to represent graphical Stateflow objects

Non graphical objects:

Data object: data used in a state chart to control its execution. It can be created in the Stateflow chart itself (local data) or be imported from the Simulink model that calls the chart (input data). Simulink models can also read the Stateflow data, when it is declared as an output from the chart (output data).

Event object: an event can trigger whole Stateflow charts or individual actions in a chart. A Stateflow chart reacts on events and can broadcast events to its internal objects or send events to the Simulink model. Events are triggers or function calls.

Interface to Simulink

Figure 5 shows the interface between a Stateflow chart and the Simulink model. As shown, function calls and triggers can awake the chart. The chart can also send events to the model, use data as inputs and produce data as outputs.

The chart runs only one event input at each time.

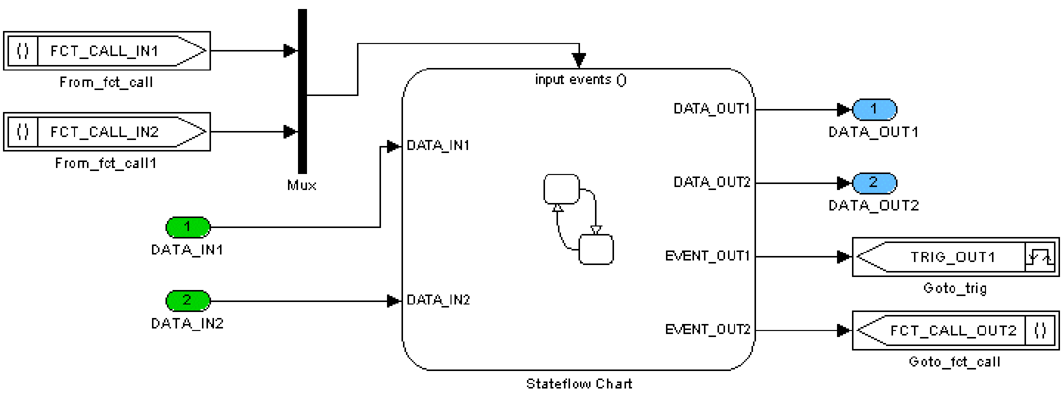

Figure 1.28.8: Interface between a Simulink model and a Stateflow chart

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States

A state describes a mode of a reactive Stateflow chart. The chart always has one or more active states. An active state tells that the chart is in this state's mode. Figure 6 shows a chart that can assume two modes: stop and running.

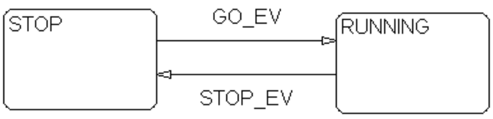

Figure 1.28.9: Transition between two states

Assume: State "STOP" is at the beginning active.

Chart reaction on certain events:

1. Event "STOP_EV" awakes the chart
   . . . nothing happens.
2. Event "GO_EV" awakes the chart.
   "STOP" is deactivated.
   "RUNNING" is activated.
3. Event "STOP_EV" awakes the chart.
   "RUNNING" is deactivated
   "STOP" is activated.

Activation

A transition between two states, state A to state B, changes state A to inactive and state B to active. A transition occurs always from an active state to an inactive state. The transitions are driven by events and controlled by conditions. The whole transition path between both active and inactive states must be evaluated and be valid so that the transition can occur.

Hierarchy

Every state is part of a hierarchy. States can be superstates, substates or just states. A state is a superstate if it contains other states, which are called substates. When a superstate turns active, one of its substates - if existent - turns also active. In the same way, when a substate turns active, it makes it superstate also active. See in Figure 7 some examples. The Stateflow chart itself is, in a SDA model, the highest hierarchical element.

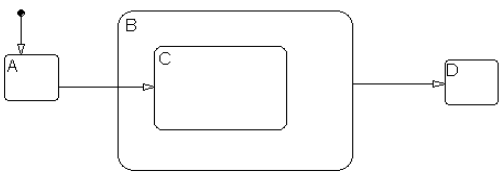

Figure 1.28.10: Hierarchical relation between states

The chart is awaken for the first time:
Default transition occurs and state A is activated.

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The chart is awaken for the second time:

1. Transition between A and C is valid
2. A is deactivated
3. Transition occurs
4. B is activated
5. C is activated

The chart is awaken for the third time:

1. Transition between B and D is valid
2. C is deactivated
3. B is deactivated
4. Transition occurs
5. D is activated

Decomposition

Each state can be decomposed in substates. There are two kinds of decomposition: AND and EXCLUSIVE OR. See an example on Figure 8.

Parallel AND decomposition: one or more substates can be active at the same time. The substates are drawn with dashed borders.

Parallel EXCLUSIVE OR decomposition: only one substate can be active. The substates are drawn with continuous borders.

Substates of an superstate with parallel AND decomposition are drawn with dashed borders. When such a superstate activates, its substates are then activated in the order they appear - beginning at the top left side and finishing at the bottom right side. Only superstates with AND parallel decomposition can have two or more active substates at the same time.

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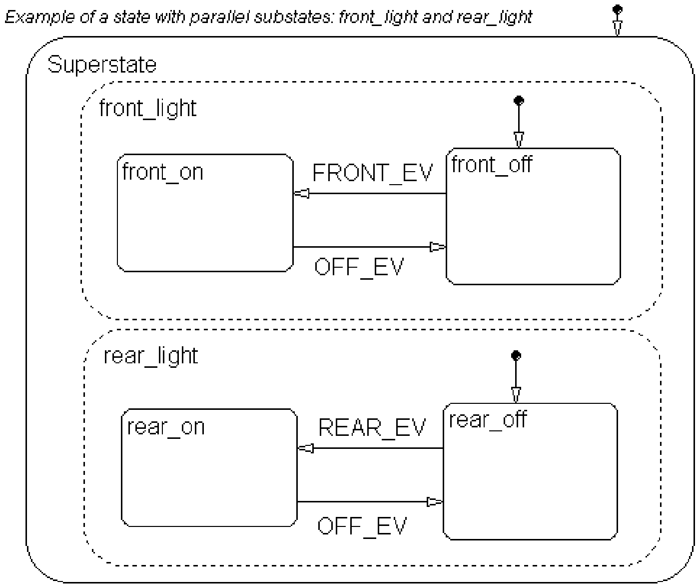

Figure 1.28.11: Example of parallel state decomposition

This example shows a chart with three hierarchy levels:

1. First level: is the chart itself, contains the state "superstate" inside.
2. Second: content from state "superstate".
3. Third: content from the states "front_light" and "rear_light"

Decomposition:

- "superstate" has AND decomposition.
- "front_light","rear_light" and the chart itself have EXCLUSIVE OR decomposition.

Activation order in the AND decomposition:

- "front_light" is activated first ("1") and then "rear_light" ("2"). Both are active during the same time.
- The deactivation of parallelal substates occurs in the inverse order.
- In this example, if "superstate" will be deactivated, first "rear_light" will is deactivated, than "front_light" and finally "superstate".

History

A state also has history that applies to its level of hierarchy in the Stateflow diagram. When a superstate deactivates, it implies that its substates are also turning deactivated. When a history junction is present, activating the superstate again will reactivate the same substate that was activated before the last deactivation.

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Stateflow actions

Stateflow action type

Actions are statements with mathematical expressions or event broadcasting. The Figure 9 shows some examples of actions.

> *In SDA Stateflow charts, actions can be either event broadcasting or value assignment. If a data is an input from Simulink, it can be used only on right hand side operations (is not possible to assign new values to it). If a data is an output to Simulink or a local data, it can be used on both sides. Multiple actions can be ordered in a list, separated with semi-colons to each other. The actions in a list are executed in the order they appear.*

State actions

> *Four action types can be specified for one state: entry:, during:, exit:, or on: <<event_name>> actions. This actions are specified in the state label, after the state name followed by a slash:*
> ***STATE_NAME/***
> **entry:**<< action list >>; /* Actions are executed right after the state activation. */
> **during:**<< action list >>; /* Actions are executed if the state is active and there is no valid transition to another state. */
> **exit:**<< action list >> /* Actions are executed right after the state deactivation. */
> **on** <<**event_name**>>**:**<< action list >> /* Actions are executed when the specified event occurs */
> *Note: entry: and exit: actions are executed always after a transition has occurred. A during: action is execution as long as no transition has occurred. Entry, during and exit are also referred as en:, du: and ex:.*

Transition evaluation

Transition path

A transition path is a sequence of transitions joined by connective junctions. A path doesn't necessary lead to a valid transition between two states.

> *Evaluating a transition doesn't mean that this transition will occur. A transition (between two states) occurs only if the hole path is valid. Nevertheless, the evaluation of all possible transitions follows always the sequence established by their precedence rules. That means, if a transition containing a condition statement is valid, its condition action (if it exists) runs at the evaluation time, without taking care if this transition is in a path that will lead to a transition between states or not. The same is not true for transition actions: they run only if the whole path containing them is true and also only* ***after*** *the transition between both states (initial and final) has occurred.*

Transition label

The switching from one state to another may be driven by events (function call, trigger) or conditions that are labeled to the transition arrow. The label notation has the following syntax:

event_name[condition_statement]{condition_ actions;}/transition_ action;

All three parts of the label notation are optional: event_name, transition action, and the set condition expression plus condition action. It is not obligatory to specify a condition action for a condition expression.

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*A transition action happens only if the whole path containing the transition is true. The action happens after the transition has occurred. Transition actions are declared after a slash at the end of the transition label. Transition actions are **not** allowed in SDA transition action labels.*

The condition label [condition_statement] is evaluated as an expression with Boolean result. A transition containing a condition statement can only be valid if the condition result is true.

A condition action happens whenever a condition is evaluated and is true. The action happens right after the condition evaluation. Condition actions are declared inside brackets {<< action list >>} after the condition declaration.

A condition statement can contain a call to an *In(<<state_name>>)* function, that is evaluated true when the state *"state_name"* is active. See the tables at the end of this documentation for more information about operations precedence and syntax. See in Figures 6, 8 and 9 some transition label examples.

Precedence rules for transition evaluation

The evaluation of transitions coming from a single source obeys the following precedence order:

1. **End point hierarchy:** *transitions whose end points are attached to higher hierarchical levels are evaluated first.*
2. **Label:** *transitions are ordered for evaluation according to the types of action language present in their labels, with precedence as follows:*
   2.1. Labels with events and conditions.
   2.2. Labels with events
   2.3. Labels with conditions
   2.4. No label
3. **Transition angular position in its source**: *evaluation order based on the angular position of the transition on the surface of the originating object:*
   A - Multiple outgoing transitions from states
   Are evaluated in a clockwise progression starting at the upper left corner of the source state.
   B - Multiple outgoing transitions from connective junctions
   Are evaluated in a clockwise progression starting at the twelve o'clock position on the junction.

The following flow chart was made observing the SDA guidelines:

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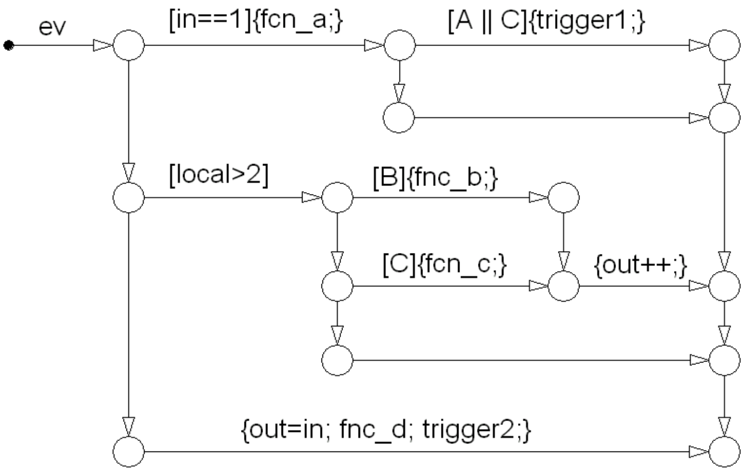

Figure 1.28.12: Example: if - then - else construction

Events:
ev, trigger1, trigger2, fnc_a, fnc_b, fnc_c, fnc_d

Data:
in, out, local, A, B, C, D

Conditions present in the chart:
ev, [in==1], [A||C], [B], [C], [local>2]

Actions present in the chart:
{fnc_a;}, {trigger1;},{fnc_b;},
{fnc_c}, {out++}, {out=in, fnc_d; trigger2;}

Attempting the precedence rules between transitions, a possible representation of this flow chart in c-like pseudo-code could be (this is not a suggestion!):

```
transition_occurred_flag=0;
if(arriving_event==ev){
        if(in==1){
                fcn_a();
                if(A||C){
                        transition_occurred_flag=1;
                        trigger(trigger1);
                }
                if(1)
                    transition_occurred_flag=1;
        }
        if(!transition_occurred_flag & & local>2){
                if(B){
                        transition_occurred_flag=1;
                    fnc_b();
                }
                if(!transition_occurred_flag & & C){
                        transition_occurred_flag=1;
```

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```
                                fnc_c();
                        }
                        if(transition_occurred_flag)
                                out++;
                        }
                        if(1)
                              transition_occurred_flag=1;
                }
                if(!transition_occurred_flag){
                      out=in;
                        fnc_d();
                        trigger(trigger2);
                        transition_occurred_flag=1;
                }
        }
```

Inner transition

An inner transition is a transition that does not exit the source state. It is represented as an internal transition from a superstate to a substate or to the superstate itself. When a inner transition occurs, it has the same result as when the superstate was deactivated and then reactivated, but the state remains active all the time.
The inner transition is part of the state it belongs to. It is evaluated only during this state, like other transitions inside the same state.

That means: when the inner transition occurs, the active substate exits and a new substate is activated. The new active substate is chosen by the inner transition. When it points to the superstate itself, the rules are the same as if the superstate is being activated from an external state. In this case, a default transition inside the superstate or a history junction will take effect. In Figure 10, the transitions 1, 3 and are inner transition of state A. Transition 4 is a inner transitions of state B. Transition 2 is self-loop transition, not a inner transition.

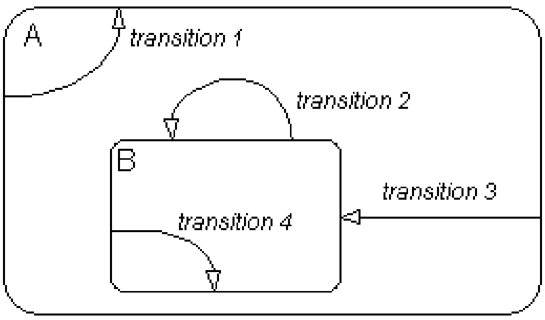

Figure 1.28.13: Inner transition examples: transitions 1, 3 and 4.

Direct event broadcast

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It is possible to broadcast an event directly to another state in the same chart (local event) using the action command*send*:

send(event_name,state_name): Broadcasts the event "*event_name*"to the state "*state_name*"and any of its offspring in the hierarchy. "state_name" must be already active in order to receive the sent event.

Notes

1. Matlab, Simulink, and Stateflow are registered trademarks of TheMathworks, Inc. Other product or brand names are trademarks or registered trademarks of their respective holders.
2. From the Matlab, Simulink and Stateflow documentation.

Tables

The following tables show the possible Stateflow operations used to write statements (Stateflow action language) and conditions. The precedence order must be considered.

Assignment operations

Example	Description[2]
a = expression	Simple assignment
a+= expression	Equivalent to a = a + expression
a -= expression	Equivalent to a = a - expression
a *= expression	Equivalent to a = a * expression
a /= expression	Equivalent to a = a /expression

In C-like bit operations:

Example	Description[2]
a |= expression	Equivalent to a = a | expression (bit operation).
a & = expression	Equivalent to a = a & expression (bit operation).
a ^= expression	Equivalent to a = a ^ expression (bit operation).

Unary operations

Example	Description[2]
~a	Logical NOT of a
!a	Logical NOT of a
-a	Negative of a

Unary actions

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Example	Description[2]
a++	Increment a
a- -	Decrement a

Binary and Bitwise operations

Example	Precedence	Description[2]
a * b	10	Multiplication
a /b	10	Division
a %% b	10	Modulus
a + b	9	Addition
a - b	9	Subtraction
a >> b	8	Shift operand a right by b bits. Noninteger operands for this operator are first cast to integers before the bits are shifted.
a << b	8	Shift operand a left by b bits. Noninteger operands for this operator are first cast to integers before the bits are shifted.
a > b	7	Comparison of the first operand greater than the second operand
a < b	7	Comparison of the first operand less than the second operand
a >= b	7	Comparison of the first operand greater than or equal to the second operand
a <= b	7	Comparison of the first operand less than or equal to the second operand
a == b	6	Comparison of equality of two operands
a ∼= b	6	Comparison of inequality of two operands
a != b	6	Comparison of inequality of two operands
a <> b	6	Comparison of inequality of two operands
a & b	5	Logical AND of two operands or Bitwise AND of two operands
a ˆ b	4	Operand a raised to power b or Bitwise XOR of two operands
a | b	3	Logical OR of two operands or Bitwise OR of two operands
a & & b	2	Logical AND of two operands
a || b	1, last precedence	Logical OR of two operands

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1.29 Initialization of variables from non implemented functions

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AC_VEH	O/V	8000... 7FFFH	-27.77088 ...27.77003	847.5e-6	m/s**2
Current vehicle acceleration					
ANG_1_RAW_VVL	O	0... 1FFFH	0... 179.97802	0.0219727	°
Recent as valid selected raw value in actual sampling time of sensor1					
ANG_DE_ABSV_PLAUS_CHK_VVL	O	0... 1FFFH	0... 179.97802	0.0219727	°
Absolute value of angle deviation between sensor 1 and 2 for plausibility check					
ANG_EXC_VVL	O	0... 238EH	0... 200	0.0219732	°
Selected current value in grad after jitter filtration					
ANG_REL_VVL	O	0... 1FFFH	0... 99.98779	0.012207	%
Selected Actulal Value of VVL angle position for position controller					
ANG_SP_CTL_VVL	O	0... 1FFFH	0... 99.98779	0.012207	%
Setpoint for the position controller					
ANG_SP_VVL	O	0... 238EH	0... 200	0.0219732	°
Desired position of the excenter shaft in degree					
ANG_SP_VVL_CUS	O	0... 238EH	0... 200	0.0219732	°
Desired position of the excenter shaft in degree for customer position controller					
ANG_STK_VVL	O	0... 238EH	0... 200	0.0219732	°
Effective stroke (linearised value)					
B_mareghub_ad	O	0... 1H	0 ...1	1	-
Flag indicating "Adaption Massenstromregler auf Hub erstmalig erfolgt"					
B_msadxcav	O/V	0... 1H	0 ...1	1	-
Bedingung MSA-Abscaltverhinderer vom DxC					
CAT_DIAG [NC_CBK_EX_NR]	O/S	0... 7FH	0... 1.98437	0.015625	-
At ended diagnosis final value for catalyst conversion capability					
CHA_CDN_BAT	O	0... FFH	0... 127.5	0.5	-
No description given					
CTR_EDGE_FALL_LOIL	O	0... FFH	0... 255	1	-
Zähler für fallende Flanken im Töns Signal					
CTR_GB_NEUT_NOT_PLAUS_SUM	O/S	0... FFH	0... 255	1	-
Sum counter for confirmed neutral gear plausibility errors					
CTR_SIG_NOT_VLD_LOIL	O	0... FFH	0... 255	1	-
Zähler für unplausible Signale					
CYC_ST	O	0... FFFFH	0... 65535	1	-
cycle counter at start and after start					
EAC_COD_SENS	O	0... FFH	0... 255	1	-
result of decoding process of the EAC sensor					
EOI_LIM [NC_CYL_NR]	O	F100... F00H	-1440 ...1440	0.375	°CRK
Cylinder individual zero position for phasing					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Exwink_ist	O	0... 238EH	0... 200	0.0219732	°
Actual position of the excenter shaft in degree					
Exwinkkor	O	DC72... 238EH	-200 ...200	0.0219732	°
Korrekturwinkel Excenterwelle zur Hubkorrektur					
F_minhub	O	0... FFFFH	0... 0.99998	15.3e-6	-
Faktor Ein-/Ausblendung Minhub über Tmot und Nkw					
F_reib_ba	-	0... FFH	0... 0.99609	3.9062e-3	-
Factor for operation mode transition					
F_tikorrvr [8]	O	0... FFFFH	0... 1.99996	30.5e-6	-
Korrekturfaktor für Einspritzung aus Verbrennungsregelung					
FAC_COR_MFF_EXT_ADJ [NC_CYL_NR]	O	0... FFFFH	0... 1.99996	0.0000305	-
temporary correction factor for OBD-demo					
FAC_COR_MFF_EXT_ADJ_NVMY [NC_CYL_NR]	O/S	0... FFFFH	0... 1.99996	0.0000305	-
correction factor for OBD-demo					
FAC_LAM_DIAGCP [NC_CBK_EX_NR]	O	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
lambda controller mean value at the beginning of CPS opening					
FAC_LAMB_SP_SA	O	0... FFFFH	0... 3.99993	61e-6	-
Lambda deviation through secondary air					
FAC_RON	O/V	0... FFH	0 ...1	3.9216e-3	-
RON factor indicating fuel quality					
GR_SUB_MT	O	0... 7H	0 ...7	1	-
Substitute gear ratio with error					
IGA_CH	O	0... 80H	-48 ...0	0.375	°CRK
dummy					
IGA_TRA_KNK	O	0... 80H	-48 ...0	0.375	°CRK
Spark retard till high MAP_DRV1 applied to engnie					
IGC_x_EXT_ADJ	O	FA60... 5A0H	-90 ...90	0.0625	°CRK
External Ignition Adjustment					
INH_CYC_IV	O	0... FFH	0... 255	1	-
Shut-off request for cylinder bitmask					
INH_IV_STST	O	0... FFH	0... 255	1	-
Cylinder shut off pattern for engine shut down due to stop request					
Ivvtmot [NC_CYL_NR]	O	8000... 7FFFH	-2048... 2047.9375	0.0625	A
Array of VVLI DC motor current					
LAMB_AV_COR	O	0... 7FFFH	0... 31.99902	976.599e-6	-
average lambda value					
LOAD_MAX_SCDN_MIS	O/S	0... FFH	0... 99.60937	0.390625	%
Maximal load of similar condition window for LV_ERR_MIS					
LOAD_MIN_SCDN_MIS	O/S	0... FFH	0... 99.60937	0.390625	%
Minimal load of similar condition window for LV_ERR_MIS					
LV_ACT_ECRAS_EXT_ADJ	O	0... 1H	0 ...1	1	-
adjustment value for radiator shutters 0 = off, 1 = on					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACT_SA_EOL	O	0... 1H	0 ...1	1	-
Activation bit for secondary air EOL test					
LV_ALTER_RD_TBL_6	O	0... 1H	0 ...1	1	-
logical variable: software switch for condition read register 6					
LV_AMT_CRAWL_ON	O	0... 1H	0 ...1	1	-
Active AMT clutch torque					
LV_AMT_DEC_ACT	O	0... 1H	0 ...1	1	-
Logical variable for torque intervention due to gear shift					
LV_AMT_INC_ACT	O	0... 1H	0 ...1	1	-
Logical variable for torque intervention due to gear shift					
LV_ASR_PLAUS	O	0... 1H	0 ...1	1	-
Logical variable plausibility ASR					
LV_BAT_CUS_CDN	O	0... 1H	0 ...1	1	-
Condition total discharge of battery					
LV_BRAKE_REQ	O	0... 1H	0 ...1	1	-
hom. mod is requested by critical break under pressure					
LV_CAM_SP_CH	O	0... 1H	0 ...1	1	-
- -					
LV_CAT_DIAG_REQ_EOL	O	0... 1H	0 ...1	1	-
Interface flag from COMS: end of line check requested for catalyst diagnosis					
LV_CH_TQ_ADD	O	0... 1H	0 ...1	1	-
Catalyst Heating Function "torque reserve" (late ignition angle)					
LV_CH_TQ_ADD_IS	O	0... 1H	0 ...1	1	-
Catalyst Heating Function "torque reserve for first idle phases"					
LV_CITY	O	0... 1H	0 ...1	1	-
City mode SSG					
LV_CMB_TRAN_ACT	O	0... 1H	0 ...1	1	-
Combustion mode transition active					
LV_CRC_DONE_BOOT	O	0... 1H	0 ...1	1	-
-					
LV_CRC_DONE_CAL	O	0... 1H	0 ...1	1	-
-					
LV_CRC_DONE_ECU	O	0... 1H	0 ...1	1	-
-					
LV_CRC_ERR_BOOT	O	0... 1H	0 ...1	1	-
-					
LV_CRC_ERR_CAL	O	0... 1H	0 ...1	1	-
-					
LV_CRC_ERR_ECU	O	0... 1H	0 ...1	1	-
-					
LV_CRC_STATUS_MU	O	0... 1H	0 ...1	1	-
Flag indicating an error in the Standard ROM Check					
LV_CTOP	O	0... 1H	0 ...1	1	-
State convertible top: 0 = closed, 1 = open					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DI_TQ_REQ_CAN_MPI_GDI	O	0... 1H	0 ...1	1	-
logical variable for disabling ARS intervention due to EMS error					
LV_DRIV_BELT_CLOSE	O	0... 1H	0 ...1	1	-
Driver seat belt fastened					
LV_ECU_SLA	O	0... 1H	0 ...1	1	-
ECU is in slave-mode 0=Master (or no Master/Slave system); 1=Slave					
LV_EFPPWM_EXT_ADJ	O	0... 1H	0 ...1	1	-
Logical variable indicating external controling of EFPPWM by service tool					
LV_END_DIAG_SA_SAFM	O	0... 1H	0 ...1	1	-
End of SAFM diagnosis					
LV_END_DIAG_SA_SAP	O	0... 1H	0 ...1	1	-
End of SA minimum flow rate - diagnosis					
LV_END_DIAG_SA_SAV	O	0... 1H	0 ...1	1	-
End of Mechanically jammed SAV-diagnosis					
LV_END_DIAG_SA_SYS	O	0... 1H	0 ...1	1	-
End of SA minimum flow rate diagnosis					
LV_ENG_EXT_HEAT	O	0... 1H	0 ...1	1	-
Logical variable indicating engine has been preheated before start by an external appliance for e.g. by a block heater or auxiliary vehicle heater					
LV_ENG_RUN_CMB	O	0... 1H	0 ...1	1	-
Running engine without starter, only through combustion					
LV_EOI_LIM_EOLP_OFS	O	0... 1H	0 ...1	1	-
Flag to indicate first start at end of line (EOL).					
LV_EOL_OBD	O	0... 1H	0 ...1	1	-
Flag which indicates that EOL is required					
LV_ER_BAL_HOM_CDN	O	0... 1H	0 ...1	1	-
Conditions for cylinder balancing homogenous reached					
LV_ERR_CAM_DE_IVVT_EX [NC_NR_CBK_IVVT]	O	0... 1H	0 ...1	1	-
Present failure: failure after filtering of diagnosis enduring exhaust camshaft deviation					
LV_ERR_CAM_DE_IVVT_IN [NC_NR_CBK_IVVT]	O	0... 1H	0 ...1	1	-
Present failure: failure after filtering of diagnosis crankshaft to inlet camshaft mechanics violation					
LV_ERR_CAN_STST	O	0... 1H	0 ...1	1	-
CAN error of MSA relevant signals					
LV_ERR_CLK_DRIFT_PBK_IV [NC_CYL_NR]	O	0... 1H	0 ...1	1	-
Error flag for clock drift failure in ATIC88 or too high input voltage in injector					
LV_ERR_COM_1_BOFF	O	0... 1H	0 ...1	1	-
Bus off error on communication bus 1 (Flexray)					
LV_ERR_COM_1_ST_UP	O	0... 1H	0 ...1	1	-
Present error flexray controller startup					
LV_ERR_COM_1_VS	O	0... 1H	0 ...1	1	-
Present error communication bus 1 (Flexray)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_COM_2_BOFF	O	0... 1H	0 ...1	1	-
Bus off error on communication bus 2 (FA-CAN)					
LV_ERR_COM_2_EFP	O	0... 1H	0 ...1	1	-
Present error communication on bus 2 (FA-CAN)					
LV_ERR_COM_2_T_ICL	O	0... 1H	0 ...1	1	-
Present error communication bus 2 (FA-CAN)					
LV_ERR_COM_3_BOFF	O	0... 1H	0 ...1	1	-
Bus off error on communication bus 3 (A-CAN)					
LV_ERR_COM_3_EFP	O	0... 1H	0 ...1	1	-
Present error communication on bus 3 (A-CAN)					
LV_ERR_COM_GB	O	0... 1H	0 ...1	1	-
Error indicating problem in communication from gearbox to engine management					
LV_ERR_CRASH_SIG	O	0... 1H	0 ...1	1	-
Boolean for error currently present on location "Crash Signal front impact"					
LV_ERR_CRIT_OVL_ECU_VVL	O	0... 1H	0 ...1	1	-
Boolean for error currently present on driver overload					
LV_ERR_CUR_H_VVL	O	0... 1H	0 ...1	1	-
Error motor current critical high					
LV_ERR_DR_SC_VVL	O	0... 1H	0 ...1	1	-
Short circuit error detected of VVL driver					
LV_ERR_EGR	O	0... 1H	0 ...1	1	-
Error currently present on exhaust gas recirculation system					
LV_ERR_FPA	O	0... 1H	0 ...1	1	-
error bit indicating fuel pressure actuator					
LV_ERR_FPS	O	0... 1H	0 ...1	1	-
Error currently present on fuel pressure sensor					
LV_ERR_MEC_IVVT_EX [NC_NR_CBK_IVVT]	O	0... 1H	0 ...1	1	-
Error Flag for functional error on the exhaust CAM adjustment					
LV_ERR_OVL_ECU_VVL	O	0... 1H	0 ...1	1	-
Boolean for error currently present on OVL_ECU_VVL					
LV_ERR_PORT [NC_PORTPWM]	O	0... 1H	0 ...1	1	-
Flag for Port-flap power stage electrical failure currently prensent					
LV_ERR_RLY_VVL	O	0... 1H	0 ...1	1	-
Boolean for error currently present on relay controll /capacitor pre-charge					
LV_ERR_SA_SAFM	O	0... 1H	0 ...1	1	-
Present failure: Component Secondary air flow meter failure					
LV_ERR_SA_SAP	O	0... 1H	0 ...1	1	-
Present failure: Minimum secondary air flow rate failure after filtering					
LV_ERR_SA_SAV	O	0... 1H	0 ...1	1	-
Present failure: Mechanically jammed SAV after filtering					
LV_ERR_SA_SAV_LSL	O	0... 1H	0 ...1	1	-
Present failure: Mechanical jammed SAV after filtering					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_SA_SYS	O	0... 1H	0 ...1	1	-
Present failure: Minimum secondary air flow rate failure after filtering					
LV_ERR_SAP	O	0... 1H	0 ...1	1	-
Boolean for error currently present on secondary air pump command signal.					
LV_ERR_SAV	O	0... 1H	0 ...1	1	-
Boolean for error currently present on secondary air valve command signal					
LV_ERR_TEG_PCAT_DOWN [NC_CBK_EX_NR]	O	0... 1H	0 ...1	1	-
Temp. after precatalyst error flag					
LV_ERR_TOUT_AMT_1	O	0... 1H	0 ...1	1	-
Logical variable timeout error CAN message SSG1					
LV_ERR_TOUT_ASR_1	O	0... 1H	0 ...1	1	-
logical variable timeout error CAN message ASC1					
LV_ERR_TOUT_ASR_3	O	0... 1H	0 ...1	1	-
Logical variable timeout error CAN message ASC3					
LV_ERR_TOUT_EFP_CAN	O	0... 1H	0 ...1	1	-
logical variable timeout error CAN message EKP					
LV_ERR_TOUT_ETCU_1	O	0... 1H	0 ...1	1	-
Logical variable timeout error CAN message EGS1					
LV_ERR_TOUT_ETCU_2	O	0... 1H	0 ...1	1	-
logical variable timeout error CAN message EGS2					
LV_ERR_TOUT_ICL_2	O	0... 1H	0 ...1	1	-
logical variable timeout error CAN message INSTR2					
LV_ERR_TOUT_ICL_3	O	0... 1H	0 ...1	1	-
Logical variable timeout error CAN message INSTR3					
LV_ERR_TOUT_ICL_7	O	0... 1H	0 ...1	1	-
Logical variable timeout error CAN message INSTR7					
LV_ERR_TOUT_PSTE_1	O	0... 1H	0 ...1	1	-
logical variable timeout error CAN message LWS1					
LV_ERR_VB	O	0... 1H	0 ...1	1	-
Present failure after filtering of diagnosis of battery voltage					
LV_ERR_VB_FB_0	O	0... 1H	0 ...1	1	-
Boolean for error detected at the voltage supply KL15Nx					
LV_ERR_VB_FB_1	O	0... 1H	0 ...1	1	-
Boolean for error detected at engine fuse KL15N1					
LV_ERR_VB_FB_2	O	0... 1H	0 ...1	1	-
Boolean for error detected at engine fuse KL15N2					
LV_ERR_VB_FB_3	O	0... 1H	0 ...1	1	-
Boolean for error detected at engine fuse KL15N3					
LV_ERR_VB_FB_DLY	O	0... 1H	0 ...1	1	-
Boolean for error detected for delayed switching of KL15Nx					
LV_ERR_VVL_ROT	O	0... 1H	0 ...1	1	-
Error flag for rotation sense diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_FAC_COR_MFF_EXT_ADJ	O	0... 1H	0 ...1	1	-
logical value for activation of temporary correction factor for OBD-demo (0 -disabled, 1 - enabled)					
LV_FAN_VAR_AD	O	0... 1H	0 ...1	1	-
-					
LV_FPAPWM_DIAG_AFS_REQ	O	0... 1H	0 ...1	1	-
hom. mod is requested by fuel pressure pwm diagnosis					
LV_FUP_HOM_REQ	O	0... 1H	0 ...1	1	-
Anforderung Diagnose-Raildruck Homogen					
LV_GP	O	0... 1H	0 ...1	1	-
LV indicating mode gearbox - AMT					
LV_IGC_x_EXT_ADJ	O	0... 1H	0 ...1	1	-
External Adjustment for Ignition Angle					
LV_IGK_OFF_ACK_PERM_DEAC	O	0... 1H	0 ...1	1	-
Bit indicating permanent deactivation of ignition off acknowledgement					
LV_IGK_OFF_ACK_TMP_DEAC	O	0... 1H	0 ...1	1	-
Bit indicating temporay deactivation of ignition off acknowledgement					
LV_IND_FCUT	O	0... 1H	0 ...1	1	-
At least one cylinder is shut off					
LV_INH_CYL_BAL_ER_LIH_CTL	O	0... 1H	0 ...1	1	-
Inhibit engine roughness adaptation because limp home mode					
LV_INH_CYL_BAL_LAM_LIH_CTL	O	0... 1H	0 ...1	1	-
Inhibit cylinder individual lambda adaptation because limpe home mode					
LV_INH_DIAG_SA	O/V	0... 1H	0 ...1	1	-
Secondary air system diagnosis: application incidence to inhibit the diagnosis					
LV_INH_DLY_DIAG_PRI_MNG [NC_CBK_EX_NR]	O	0... 1H	0 ...1	1	-
Delay Diagnosis inhibition by priority manager					
LV_INH_DPS_REG_CPSDIAG	O	0... 1H	0 ...1	1	-
- –					
LV_INH_DYN_DIAG_PRI_MNG [NC_CBK_EX_NR]	O	0... 1H	0 ...1	1	-
Dynamic Diagnosis inhibition by priority manager					
LV_INH_FCUT_AMT	O	0... 1H	0 ...1	1	-
Logical variable inhibiting FCUT during AMT-intervention					
LV_INH_S_MAN	O/S	0... 1H	0 ...1	1	-
manual inhibiting startified mode by application system					
LV_INTR_DIAG_LS_DYN [NC_CBK_EX_NR]	O	0... 1H	0 ...1	1	-
Fade out bit of linear lambda dynamic diagnosis - LAMB_MV dynamic fdout					
LV_ISC_INH_EXT_ADJ	O	0... 1H	0 ...1	1	-
Logical variable to switch off the idle speed controller					
LV_KWP_PROG_DATA	O	0... 1H	0 ...1	1	-
State variable for requesting for programming the calibration data after power latch phase					
LV_LAMB_CH	O	0... 1H	0 ...1	1	-
indicates that lambda catalyst heating is active					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MFF_S_POST_CH	O	0... 1H	0 ...1	1	-
- –					
LV_MSR_PLAUS	O	0... 1H	0 ...1	1	-
Logical variable plausibility MSR					
LV_NT_AGI_INI_EXT_ADJ_NEW_CAT	O	0... 1H	0 ...1	1	-
initialization signal for a new cat via scan tool					
LV_NT_AGI_INI_EXT_ADJ_NEW_ECU	O	0... 1H	0 ...1	1	-
initialization signal for a new ECU via scan tool					
LV_POW_IBS_ERR_DET_CDN	O	0... 1H	0 ...1	1	-
Condition for IBS powerfail detected					
LV_PUC_SA_INH	O	0... 1H	0 ...1	1	-
Inhibition of PUC during SA active for the first time					
LV_REQ_SEG_AD_RST_EOL	O	0... 1H	0 ...1	1	-
Variable to reset SAG_AD variables due to a EOL request					
LV_RLY_ST_STST	-	0... 1H	0 ...1	1	-
HW-control of the starter relay via MSA					
LV_S_REQ_EGR	O	0... 1H	0 ...1	1	-
Logical constant stratified mode requested for EGR LIH					
LV_SA_END	O	0... 1H	0 ...1	1	-
secondary air function ended for this cycle (lambda adaptation obstruct)					
LV_SAP	O	0... 1H	0 ...1	1	-
Flag for secondary air pump activation					
LV_SAV	O	0... 1H	0 ...1	1	-
Flag for secondary air valve activation					
LV_SAWUP	O	0... 1H	0 ...1	1	-
secondary air injection time correction active					
LV_SOIL_VLD_LOIL	O	0... 1H	0 ...1	1	-
Oil temperature valid					
LV_STATE_RLY_VVL	O	0... 1H	0 ...1	1	-
Pre-charge relay state, 0 = relay open, 1 = relay closed					
LV_STATE_RUN_LOIL	O	0... 1H	0 ...1	1	-
State machine once passed					
LV_STATE_STST_ENG_STOP	O	0... 1H	0 ...1	1	-
Engine stop requested by STST					
LV_STST_DEAC_ACT	O	0... 1H	0 ...1	1	-
MSA deactivation due to permanent errors					
LV_STST_ES	O	0... 1H	0 ...1	1	-
Logical variable indicating engine stop caused by start stop automatic					
LV_STST_INH_ACT	O	0... 1H	0 ...1	1	-
MSA inhibition due to reversible errors					
LV_STST_INH_CDN_AD	O	0... 1H	0 ...1	1	-
MSA inhibition due to adaption					
LV_STST_ST_REQ	O	0... 1H	0 ...1	1	-
Logical variable indicating the validated start request from start stop manager					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_STST_STOP_CYC	O	0... 1H	0 ...1	1	-
Logical variable indicating MSA stop cycle active (from stop request until start end)					
LV_STST_STOP_CYC_MEM	O	0... 1H	0 ...1	1	-
Memorized flag LV_STST_STOP_CYC for the time after end of start until engine stop					
LV_STST_STOP_REQ	O	0... 1H	0 ...1	1	-
Logical variable indicating the validated stop request from start stop manager					
LV_STST_SWI_ACT	O	0... 1H	0 ...1	1	-
Engine start stop automatic switched on					
LV_T_COOL_VLD_LOIL	O	0... 1H	0 ...1	1	-
Cool off time valid					
LV_TEMP_BOL	O	0... 1H	0 ...1	1	-
Activation of homogeneous request due to coolant temperature reasons					
LV_TEMP_MAX_SAP_COIL	O	0... 1H	0 ...1	1	-
Inhibition bit for SA-function					
LV_TQI_BOL_SET_S	O	0... 1H	0 ...1	1	-
Logical variable is set if TQI_SP_S falls below the minimim allowable torque in stratified					
LV_VAR_EAC	O/S	0... 1H	0 ...1	1	-
variant EAC					
LV_VAR_ECRAS	O/S	0... 1H	0 ...1	1	-
variant of ECRAS recognized					
LV_VAR_EFP_COM_2	O	0... 1H	0 ...1	1	-
Variant EFP at FA_CAN					
LV_VAR_EFP_COM_3	O/S	0... 1H	0 ...1	1	-
Variant EFP at A_CAN					
LV_VAR_L6	O/S	0... 1H	0 ...1	1	-
Bit indicating L6 board network					
LV_VAR_SAP	O	0... 1H	0 ...1	1	-
Vehicle with secundary air pump					
LV_VAR_SAV	O	0... 1H	0 ...1	1	-
vehicle with secundary air valve (dsk_byte_0 bit 5)					
LV_VAR_STST	O/S	0... 1H	0 ...1	1	-
Variant for engine start stop function (STST)					
LV_VAR_VVL	O	0... 1H	0 ...1	1	-
Variant with (=1) or without (=0) valvetronic.					
MAF_HB	O	0... FFH	0... 1389	5.4470588	mg/stk
-					
MAF_SP_S	O	0... FFFFH	0... 1389	0.0211948	mg/stk
MAF setpoint for stratified mode					
MAF_SUB_COR_MMV_MON	O	0... FFH	0... 1389	5.4470588	mg/stk
Low pass filtered MAF_SUB_COR_MON					
MAP_DIP_SP_MMV	O	8000... 7FFFH	-1280... 1279.96093	0.0390625	hPa
Filtered setpoint of manifold differential pressure					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MFF_AD_ADD_MMV_REL [NC_CBK_EX_NR]	O	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
Relative additive adaptive factor					
MFF_AD_FAC_MMV_REL [NC_CBK_EX_NR]	O	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Relative multiplicative adaptive factor					
MFF_ADD_EXT_ADJ [NC_CBK_EX_NR]	O	8000... 7FFFH	-694.5... 694.4788	0.02119-	mg/stk
Mass fuel flow for CO adjustment at idling, value for injection correction					
MFF_ADD_EXT_ADJ_NVMY	O/S	8000... 7FFFH	-694.5... 694.4788	0.02119-	mg/stk
Mass fuel flow for CO adjustment at idling, value for storing in NVMY					
Minhub	O	0... FFFFH	0... 65.535	0.001	mm
Ergebnis der Minhub-Adaption					
Minhub_roh	O	0... FFFFH	0... 65.535	0.001	mm
Minhubrohwert aus Adaption					
Minhubvs	O	0... FFFFH	0... 65.535	0.001	mm
Vorgabe Minhub über Tester					
Minhubvs_ist	O	0... FFFFH	0... 65.535	0.001	mm
Tatsächlich wirksamer Minhub aus Verstelleingriff (vor Ein-/Ausblendungsfaktoren)					
Minhubvsnv	O	0... FFFFH	0... 65.535	0.001	mm
dauerhaft fest programmierter Minhub					
Mrnn_test_vvt	O	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Testerwert NN VVT-Adaption					
N_VS	O/V	0... FFH	0... 255	1	rpm/(km/h)
Division n/vs					
N_WHEEL_FN_LE	O	8000... 7FFFH	-512... 511.703	0.0156207	1/s
Actual value for RPM wheel front left					
N_WHEEL_FN_RI	O	8000... 7FFFH	-512... 511.703	0.0156207	1/s
Actual value for RPM wheel front right					
N_WHEEL_RE_LE	O	8000... 7FFFH	-512... 511.703	0.0156207	1/s
Actual value for RPM wheel rear left					
N_WHEEL_RE_RI	O	8000... 7FFFH	-512... 511.703	0.0156207	1/s
Actual value for RPM wheel rear right					
NC_STATE_ECU_MST_SLA	O	0H 1H 2H 3H	NOT_MST_SLA MST_SLA MST SLA	-	-
Configuration wether ECU works in a Master/Slave system and how its role as Master or Slave is defined					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Oz_manip	O	0... FFH	0... 255	1	-
Manipulationsbyte					
PBSU	O	0... FFFFH	0... 5434	0.0829175	hPa
Absolute pressure in the brake servo					
PRS_EX_PCAT_UP	O	0... FFFFH	0... 5434	0.0829175	hPa
Exhaust gas pressure pre catalyst (absolute pressure)					
PSN_ENG_REL	O	0... 77FH	0... 719.625	0.375	°CRK
Relative engine position before next TDC					
PSN_ENG_REL_ST	O	0... 77FH	0... 719.625	0.375	°CRK
Relative engine position before next TDC at re-start					
PWM_DR_OUT_SET_VVL	O	0... 1FFH	0... 99.80468	0.1953125	%
PWM to be set by PWM generator see VVL chopper control too					
PWM_VALUE_HIV_PERC	O	0... FH	0... 150	10	%
control signal for heater inlet valve					
S_vsmnhb	O	0... FFH	0... 255	1	-
Schalter für Testereingriff					
S_vsmnhbnv	O/S	0... FFH	0... 255	1	-
Schalter für Testereingriff					
SAF_DIAG_MAX	O	0... FF00H	0... 255	3.9062e-3	kg/h
Mean diagnosis value of maximum air flow					
SAF_DIAG_MAX_SAE	O/S	0... FF00H	0... 255	3.9062e-3	kg/h
Mean diagnosis value of maximum secondary air flow for SAE					
SAF_DIAG_MIN	O	0... FF00H	0... 255	3.9062e-3	kg/h
Mean diagnosis value of minimum air flow					
SAF_DIAG_MIN_SAE	O/S	0... FF00H	0... 255	3.9062e-3	kg/h
Mean diagnosis value of minimum secondary air flow for SAE					
SAF_KGH	O	0... FFFFH	0... 1023.98437	0.015625	kg/h
Corrected value of SA mass flow					
SAF_KGH_MES_BAS	O	0... FFFFH	0... 2047.96875	0.03125	kg/h
Raw secondary air-mass flow measured					
SOI_MAX	O	0... 780H	0... 720	0.375	°CRK
Earliest possible SOI					
St_dvovrld	O	0... FFH	0... 255	1	-
carrierbyte for status of VVLI overload (overload diagnosis ECU /DC motor)					
St_vbrvs_aus	O	0... FFFFH	0... 65535	1	-
Status Verbrennungsregelung					
St_vbrvs_ein	O	0... FFH	0... 255	1	-
Status Verbrennungsregelung					
St_vvt_err	O	0... FFH	0... 255	1	-
carrierbyte for status of VVL failures (indicating the ability of the position control)					
STATE_CUT_OFF_DT	O	0... FFH	0... 255	1	-
state cut off drivetrain					
STATE_DIAG_DR_VVL	O	0... FFH	0... 255	1	-
State of ATIC61 self- diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_DIAG_SA_SAFM	O	0H 1H 2H 3H 4H 5H 6HH	SAFM_DIAG_OFF SAFM_SAFM_MONIT SAFM_MIN_DIAG SAFM_WAIT_SAV_DIAG SAFM_SAV_DIAG SAFM_DIAG_END SAFM_DIAG_CNL	-	-
States of secondary air system diagnosis					
STATE_ERR_AMT_CAN	O	0... 5H	0 ...5	1	-
State of AMT Error intervention CAN 11H					
STATE_INI_DT	O	0... FFH	0... 255	1	-
state initialisation drivetrain					
STATE_N_MAX_MON	O	0... FFFFH	0... 65535	1	-
Error bit indication					
STATE_OBD_SA	O	0... FFH	0... 255	1	-
Commanded SA-Status for Scan-Tool					
STATE_RBM_EFF_IGA_CST	O	0... FFH	0... 255	1	-
IGA efficiency monitor with Rate-Based Monitoring statistics: monitoring conditions met long enough (bit 0 = 1) monitoring inhibition because of system failure(s) (bit 1 = 1) individual RBM monitoring conditions encountered within this DC (bit 2 = 1)					
STATE_SA	O	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H AH BH CHH	SA_INACTIVE SA_DELAY SA_ACTIVE INTERRUPT SAP_DELAY FINISHED CANCELLED EXT_ADJ EXT_ADJ_FIN EOL_SA_ACT EOL_SA_SAP_ACT EOL_SA_FIN SAV_CLN	-	-
State of Secondary Air Function					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_STST_REQ_CAN	O	0H 1H 2H 3H 4H 5H 6H 7HH	NO_REQ START_REQ STOP_REQ START_INH STOP_INH NOT_USED NOT_USED INVALID_ SIGNAL	-	-
State indicating request from CAN for STST (MSA) functionality					
STATE_TBL_DRIV [8][6]	O/S	0... FFH	0... 99.60937	0.390625	%
Table of driving profile over torque request and engine speed (saved in NVMY)					
STATE_TQ_AMT_PLAUS	O	0... FFH	0... 255	1	-
Bitwise coded State for AMTintervention state					
STATE_TQ_WHEEL_DRIV_ASI	O	0... FFH	0... 255	1	-
qualifier /state of signal TQ_WHEEL_DRIV_ASI					
STATE_TQ_WHEEL_TCS_SLOW	O	0... FFH	0... 255	1	-
Qualifier concept to target wheel torque on powertrain					
STATE_VEH_ROLL_CDN	O	0... 7H	0 ...7	1	-
Rolling direction detection					
T_ACT_MIL_SAE	O/V	0... FFFFH	0... 65535	1	min
PID 4D Time run by the engine while MIL activated					
T_ACT_MIL_SAE_60	O/V	0... 3CH	0... 60	1	s
Seconds run by the engine while MIL activated for T_ACT_MIL_SAE calculation (0 ... 59)					
T_AST_DC_CON	O	0... FFFFH	0... 6553.5	0.1	s
Time after start based on driving cycle (calculation continued during DC)					
T_COOL_LOIL	O	0... FFFFH	0... 6553.5	0.1	-
Cool off time of LOIL sensor					
T_EDGE_FALL_LOIL	O	0... FFFFH	0... 655.35	0.01	s
Time between flanks					
T_REF_SIG_LEN_LOIL	O	0... FFFFH	0... 6553.5	0.1	ms
Length of reference signal of the thermal oil level sensor					
T_TEMP_SIG_LEN_LOIL	O	0... FFFFH	0... 6553.5	0.1	s
Abkühlzeit vom Töns					
TEG_TUR_UP_MES [NC_NR_TEG_SENS]	O	0... FFE0H	-273.15 ...1773.85	0.03125	°C
measured exhaust gas temperature upstream of turbo charger					
TEMP_MOT_VVL	O	E800... 7FFFH	-48... 255.99218	0.0078125	°C
Estimated DC motor temperature					
TEMP_SWI_MES_MAX_VVL	O	8000... 7FFFH	-1024... 1023.96875	0.03125	°C
Maximal measured temperature of the chopper switch transistors.					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_ADD_ST	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve at engine start					
TQ_WHEEL_TCS_FAST	O	8000... 7FFFH	-32768 ...32767	1	Nm
Target wheel torque on powertrain for fast stabilization					
TQ_WHEEL_TCS_SLOW	O	8000... 7FFFH	-32768 ...32767	1	Nm
Target wheel torque on powertrain for slow stabilization					
TQI_AMT_FAST_DEC	O	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque decrement for fast torque intervention during gear shift					
TQI_AMT_FAST_INC	O	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque increase for fast torque intervention during gear shift					
TQI_AMT_REQ	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque request SSG					
TQI_AMT_REQ_CAN	O	0... FFH	0... 99.60937	0.390625	%
Torque request SSG via CAN					
TQI_AMT_SLOW_DEC	O	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque decrement for slow torque intervention during gear shift					
TQI_AMT_SLOW_INC	O	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque increase for slow torque intervention during gear shift					
TQI_ASR_FAST_CAN	O	0... FFH	0... 99.60937	0.390625	%
Relative indicated engine torque requested by ASR (fast path)					
TQI_ASR_FAST_REQ_CAN	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Relative indicated engine torque requested by ASR (fast path)					
TQI_ASR_SLOW_REQ_CAN	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Relative indicated engine torque requested by ASR (slow path)					
TQI_BAS_MAX	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum available torque at basic conditions EFF_TOT_BAS					
TQI_GS_FAST_REQ	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
absolute torque request during gear shift intervention - fast					
TQI_GS_FAST_REQ_CAN	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
relative torque request during gear shift intervention - fast					
TQI_GS_SLOW_REQ	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
absolute torque request during gear shift intervention - slow					
TQI_GS_SLOW_REQ_CAN	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
relative torque request during gear shift intervention - slow					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_MSR_CAN	O	0... FFH	0... 99.60937	0.390625	%
Relative indicated engine torque requested by MSR					
TQI_MSR_REQ_CAN	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Relative indicated engine torque requested by MSR					
TQI_SLOW_AMT_REQ	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque request (slow) SSG					
TQI_SP_SLOW	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Slow indicated engine torque					
V_MAF	O	0... FFH	0... 4.98046	0.0195312	V
Mass air flow sensor raw acquisition.					
V_SAF	O	0... FFH	0... 4.98046	0.0195312	V
Secondary air mass flow sensor raw acquisition					
V_VCC_SENS_VVL	O	0... FFFFH	0... 511.99218	0.0078125	V
Sensor supply voltage					
V_VCC_SENS_VVL_RAW	O	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage supply for VVL sensor					
VCC_DR_VVL	O	0... FFFFH	0... 511.99218	0.0078125	V
Supply voltage filtered with fast filter					
VLFT_MIN	O/S	0... FFFFH	0... 65.535	0.001	mm
Result of adaptation of minimal variable valve lift					
VLS_NT_DOWN [NC_NOX_SENS_CONF]	O	0... 3FFH	0... 4.99511	4.8828e-3	V
voltage of lambda sensor downstream NOx-catalyst					
VP_TCO_COPL [NC_NR_TCO_SENS]	O	0... 7FFFH	0... 4.99984	152.6e-6	V
Sensor raw acquisition of all available coolant temperature sensors on master ECU					
VS_H_N_MAX	O/S	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed at highest event					
VS_HIGH_RES	O/V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed with higher resolution					
Vvt_soll	O	0... 238EH	0... 200	0.0219732	°
Desired position of the excenter shaft in degree for customer position controller					
Zylhubkor	O	0... FFH	0... 255	1	-
Für Hubkorrektur ausgewählter Zylinder					

Input data:

AC_VEH_LGT_TCS {p. 1561}	CRK_INJ_BAS [NC_CYL_NR] {p. 2122}	CYC_CAST {p. 1766}	EFF_TOT_BAS {p. 6661}
INH_IV {p. 2295}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_CLC_2SEG {p. 1825}
LV_CLC_2SEG_ENA {p. 1825}	LV_EFP_EXT_ADJ {p. 7434}	LV_ERR_ACR_AD {p. 4320}	LV_ERR_ACR_CTL {p. 4337}
LV_ERR_ACR_DR {p. 4347}	LV_ERR_CAM_TOT {p. 4455}	LV_ERR_SENS_ACR {p. 4352}	LV_ES {p. 1720}
LV_FCUT_IND {p. 2295}	MAF_SP {p. 8278}	N_VS_RATIO {p. 1302}	NC_CBK_EX_NR {p. 1829}
NC_NOX_SENS_CONF {p. 643}	NC_NR_CBK_IVVT {p. 604}	SOI_LIM {p. 2122}	STATE_CH {p. 1777}

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T_ACT_MIL {p. 5899}	T_ACT_MIL_60 {p. 5899}	TEG_CAT_UP_MDL [_i] {p. 8236}	TEG_PCAT_DOWN [NC_CBK_EX_NR] {p. 1253}
TQI_MAX {p. 8380}	TQI_REF_MAX {p. 8380}	TQI_REQ_SLOW {p. 8391}	VP_TCO [NC_NR_TCO_SENS] {p. 1100}
VS_H {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CAM_OP_EX	-	0... FFH	175.125 ...270.75	0.375	°CRK
Opening period of exhaust valve					
C_DIAM_WHEEL	-	0... FFFFH	0... 4095.9375	0.0625	mm
Wheeldiameter for speedcalculation if vehicle is on the roller test bench					
C_LAMB_BAS_COR_MIN	-	0... 7FFFH	0... 1.99993	61e-6	-
Minimal value for lambda setpoint					
C_SAF_DIAG_MAX	-	0... FF00H	0... 255	3.9062e-3	kg/h
Error detection threshold for maximum deviation					
C_SAF_DIAG_MIN	-	0... FF00H	0... 255	3.9062e-3	kg/h
Error detection threshold for minimum deviation					
LC_AD_CLR_CPS	-	0... 1H	0 ...1	1	-
Logical constant for initializing CPS nvmy data					
LC_AD_CLR_IDLE	-	0... 1H	0 ...1	1	-
Logical constant for initializing IDLE nvmy data					
LC_AD_CLR_IMM	-	0... 1H	0 ...1	1	-
Logical constant for initializing IMM nvmy data					
LC_AD_CLR_SA	-	0... 1H	0 ...1	1	-
Logical constant for initializing SA nvmy data					
LC_AD_CLR_VVL_STATE_NVMY	-	0... 1H	0 ...1	1	-
Calibration data to reset adaptation status flags					
NC_CBK_HPP_NR [1]	-	1... FFH	1... 255	1	-
System constant for number of used high pressure pumps (1 = one pump, 2 = two pumps, ...; SW: 0 = one pump; 1 = 2 pumps, ...) - Anzahl Hochdruckpumpen im System					
NC_CMB_CONF	-	0H 1H 2H 3H	AFS AFS_S AFS_AFL AFS_AFL_S	-	-
Engine combustion modes target					
NC_IN_REF	-	0... FFH	0... 255	1	-
Pattern for allocation of physical cylinders to intake bank					
NC_LAMB_REF [NC_CYL_NR]	-	0... FFH	0... 255	1	-
Pattern for allocation of physical cylinders to exhaust bank					
NC_STATE_STST_ENA	-	0... 1H	0 ...1	1	-
Switch to indicate engine stop start automatic enabled (= 1) or disabled (= 0)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

All defined LV_ERR_XXX shall not be given ENVD data for the .a2L file (normally automatically defined)
EXCEPT: LV_ERR_TEG_PCAT_DOWN[NC_CBK_EX_NR]
LV_ERR_EGR

1.29.1 Miscellaneous

Application conditions

Configuration values: **NC_CMB_CONF** = AFS_AFL_S (4H)
NC_CBK_HPP_NR = 1

Initialisation at reset: *0,*

except:
IGA_TRA_KNK = 0 °crk
PWM_VALUE_HIV_PERC = 100%
TQI_AMT_FAST_DEC = 1024 Nm
TQI_AMT_SLOW_DEC = 1024 Nm
FAC_RON = 1

Recurrence: same recurrence as corresponding input data

Formula section:

CYC_ST = CYC_CAST
LAMB_AV_COR = 0.5 * (LAMB_LS_UP[1] + LAMB_LS_UP[2])
MAF_HB = MAF
MAF_SP_S = MAF_SP

TQI_SP_SLOW = TQI_REQ_SLOW
LV_EFPPWM_EXT_ADJ = LV_EFP_EXT_ADJ

AC_VEH = AC_VEH_LGT_TCS
N_VS = N_VS_RATIO
VS_HIGH_RES = VS_H
TQI_BAS_MAX = MIN (TQI_MAX, TQI_REF_MAX * EFF_TOT_BAS)

1.29.2 Variables definition for missing Secondary air function

Application conditions

Initialisation at reset: 0, except:
FAC_LAMB_SP_SA = 1.00
LV_SA_END = 1
STATE_OBD_SA =00000100b
(SAP deactivated, Atmosphere / off)

1.29.3 Error Flags

Hinweis: Die hier definierten Bits LV_ERR_XXX unterliegen nicht der alg. Fehlerspeicherverwaltung.

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Application conditions

Initialisation at reset: *0*

Activation: *at every engine state*

Recurrence: same recurrence as corresponding input data

Formula section:

LV_ERR_TEG_PCAT_DOWN[NC_CBK_EX_NR] = LV_ERR_TEG_PCAT_DOWN
LV_ERR_EGR = LV_ERR_ACR_AD **or** LV_ERR_ACR_CTL **or** LV_ERR_ACR_DR **or** LV_ERR_SENS_ACR

1.29.4 Interfaces to chapter serial communication

In the chapter I 'Serial Communication' are a lot of variables used which are not defined yet. Since there is no update of this chapter all unsatified inputs are defined here.

Application conditions

Initialisation: *0FFFFh: St_vbrvs_aus*
0FFh: St_vbrvs_ein
0: other

1.29.5 Outputs due to aggregate implementation

FUNCTION DESCRIPTION: --

Application conditions

Initialisation: *0*

Recurrence : every segment

Activation: every state if LV_CLC_2SEG = 1 **or** LV_CLC_2SEG_ENA = 0
Configuration data: NC_IN_REF = 42 *// one intake bank*
NC_LAMB_REF = 42 *//(101010B)*

Formula section:

EOI_LIM[NC_CYL_NR] = CRK_INJ_BAS[NC_CYL_NR]
INH_CYC_IV = INH_IV
LV_IND_FCUT = LV_FCUT_IND
SOI_MAX = SOI_LIM

1.29.6 Adaptation module for non implemented VVL functions

FUNCTION DESCRIPTION: --

Application conditions

Initialisation: **0, except: ANG_EXC_VVL =** 200 °

1.29.7 Adaptation module for non implemented STST (MSA) functions

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FUNCTION DESCRIPTION:

Application conditions:

Initialisation: 0

1.29.8 Adaptation module for non implemented TÖNS functions

FUNCTION DESCRIPTION:

Application conditions:

Initialisation: 0

1.29.9 For non implemented serielle communication

FUNCTION DESCRIPTION: only for satisfaction of ISCAN-tools

Application conditions

Initialisation:

```
0FFFFh:        Exwinkkor, F_minhub, F_tikorrvr[0..7],
                 Minhub, Minhub_roh, Minhubvs, Minhubvs_ist,

                 Minhubvsnv
0FFh:          S_vsmnhb, S_vsmnhbnv, Zylhubkor,
STATE_TQ_WHEEL_TCS_SLOW,
                 STATE_TQ_WHEEL_DRIV_ASI
-32000 Nm:   TQ_WHEEL_TCS_SLOW, TQ_WHEEL_TCS_FAST
0:                other
```

Formula section: - –

1.29.10 Variable definitions for missing CAN11hex functionality

Application conditions

Initialisation: 0

Formula section: - –

1.29.11 Variables only necessary for IScan

FUNCTION DESCRIPTION: only for satisfaction of ISCAN-tools

Application conditions

Initialisation at reset: 0,

```
                  except:
                  IGA_CH          =  0 °crk

 LV_END_DIAG_SA_SAFM   = 1
 LV_END_DIAG_SA_SAP   = 1
 LV_END_DIAG_SA_SAV   = 1
LV_END_DIAG_SA_SYS   = 1
```

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Formula section: - –
PRS_EX_PCAT_UP = PRS_EX

If STATE_CH = 1h
Then LV_LAMB_CH = 1
Else LV_LAMB_CH = 0
Endif

TEG_PCAT_DOWN[NC_CBK_EX_NR] = TEG_PCAT_DOWN_i

1.29.12 Variables required by Software

Application conditions

Initialisation: 0

Formula section: - –
VP_TCO_COPL[NC_NR_TCO_SENS] = VP_TCO[NC_NR_TCO_SENS]

1.29.13 Variables used by OBDC

Application conditions

Initialisation: T_ACT_MIL_SAE = T_ACT_MIL (read from NYMY)
T_ACT_MIL_SAE_60 = T_ACT_MIL_60 (read from NYMY)

Recurrence: *1s*

Activation: *at every engine state*

Formula section:

T_ACT_MIL_SAE = T_ACT_MIL
T_ACT_MIL_SAE_60 = T_ACT_MIL_60

1.29.14 Output AGGR's - EGCP

Application conditions

Initialisation: *at reset all 0*

Recurrence: same recurrence as corresponding input data

Activation: at every engine state

Deactivation: -

Function description:

Formula section:

LV_INTR_DIAG_LS_DYN[NC_CBK_EX_NR] = 0

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1.29.15 Output AGGR's - VHMD

Application conditions

Initialisation: `at reset: all 0`
`expect: state_veh_roll_cdn = 0x04 (hex)`
`vs_plaus_ERR_IDX = no_error_ERR_IDX`

Recurrence: `same recurrence as corresponding input data`

Activation: `at every engine state`

Deactivation: -

Function description:

Formula section:

LV_ERR_COM_1_BOFF = 0
LV_ERR_COM_1_VS = 0
LV_ERR_COM_1_ST_UP = 0
STATE_VEH_ROLL_CDN = 0x04 (hex)
vs_plaus_ERR_IDX = no_error_ERR_IDX

1.29.16 Output AGGR's - DGNC

General information:

Application conditions:

Initialisation:
```
at reset:
FAC_COR_MFF_EXT_ADJ      = 1 phys.
FAC_COR_MFF_EXT_ADJ_NVMY = 1 phys.
LV_FAC_COR_MFF_EXT_ADJ   = 0
```
Recurrence: `same recurrence as corresponding input data`
Activation: *at every engine state*
Deactivation: -

Function description:

Formula section:

FAC_COR_MFF_EXT_ADJ = 1 phys.
FAC_COR_MFF_EXT_ADJ_NVMY = 1 phys.
LV_FAC_COR_MFF_EXT_ADJ = 0

1.29.17 Output AGGR's - ENSS

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General information:

Application conditions:

Initialisation:	at reset: T_AST_DC_CON = 0 phys.
Recurrence:	same recurrence as corresponding input data
Activation:	*at every engine state*
Deactivation:	-

Function description:

Formula section:

T_AST_DC_CON = 0 phys.

1.29.18 Output AGGR's - SYCF

General information:

Application conditions:

Initialisation:	at reset: LV_VAR_EFP_COM_2 = 0 LV_ERR_COM_2_EFP = 0 LV_VAR_EFP_COM_3 = 1
Recurrence:	same recurrence as corresponding input data
Activation:	*at every engine state*
Deactivation:	-

Function description:

Formula section:

LV_VAR_EFP_COM_2 = 0
LV_ERR_COM_2_EFP = 0
LV_VAR_EFP_COM_3 = 1

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1.30 OBDC Configuration data

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_CLC_CAL_ID_SRV_9	O	0... FFH	0... 255	1	-
Status to calculate CAL-ID of $09 according US (=1) or EU (=0)					
STATE_EVAP_SAE	O	0... FFH	0... 255	1	-
SAE status of EVAP monitor (0 = not supported, >0 = supported)					
STATE_PSN_FUP_SAE	O	0... FFH	0... 255	1	-
Support of Fuel Pressure Control System Data (PID 6D)					
STATE_PSN_LS_1_SAE	O	0... FFH	0... 255	1	-
Position of oxygen sensors for OBD (4 Banks 2 Sensors)					
STATE_PSN_LS_SAE	O	0... FFH	0... 255	1	-
Position of oxygen sensors for OBD (2 Banks 4 Sensors)					
STATE_PSN_MAF_SAE	O	0... FFH	0... 255	1	-
Support of Mass Air Flow Sensor Data (PID 66)					
STATE_PSN_TIA_SAE	O	0... FFH	0... 255	1	-
Support of Intake Air Temperature Sensor Data (PID 68)					
STATE_PSN_TPS_SAE	O	0... FFH	0... 255	1	-
Support of Throttle Actuator Control System Data (PID 6C)					
STATE_VAR_SAP_SAE	O	0... FFH	0... 255	1	-
SAE status of secondary air pump (0 = not supported, >0 = supported)					

Input data:

LV_CONF_DMTL {p. 654}	LV_VAR_SAP {p. 805}	PSN_LS {p. 656}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_OBD_SRV	V	0... FFFFH	0... 65535	1	-
Word which indicates the EOBD services supported by the project					
C_STATE_PSN_FUP_SAE	V	0... FFH	0... 255	1	-
Support of Fuel Pressure Control System Data (PID 6D)					
C_STATE_PSN_MAF_SAE	V	0... FFH	0... 255	1	-
Support of Mass Air Flow Sensor Data (PID 66)					
C_STATE_PSN_TIA_SAE	V	0... FFH	0... 255	1	-
Support of Intake Air Temperature Sensor Data (PID 68)					
C_STATE_PSN_TPS_SAE	V	0... FFH	0... 255	1	-
Support of Throttle Actuator Control System Data (PID 6C)					
LC_CLC_CAL_ID_SRV_9	V	0... 1H	0 ...1	1	-
Switch to calculate CAL-ID of $09 according US (=1) or EU (=0)					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_STATE_OBD_CONF	-	0... FFH	0... 255	1	-
Byte which indicates the configuration of EOBD/ARB					
NC_STATE_PID_13_PSN_LS	-	0... FFH	0... 255	1	-
Configuration of oxygen sensors (2 Banks 4 Sensors)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_STATE_PID_1D_PSN_LS	-	0... FFH	0... 255	1	-
Configuration of oxygen sensors (4 Banks 2 Sensors)					
NLC_STATE_EVAP	-	0... 1H	0 ...1	1	-
Configuration of EVAP Monitor					
NLC_STATE_PRJ_SPC_CAL	-	0... 1H	0 ...1	1	-
Indicates the usage of project specific calibration data					
NLC_STATE_VAR_SAP	-	0... 1H	0 ...1	1	-
Configuration of Commanded Secondary Air Status					

General information:

This module is for configuration of the On-Board-Diagnosis Communication functionality.

1.30.1 Configuration of OBD services

0 : the SERVICE is not supported
1 : the SERVICE is supported

C_STATE_OBD_SRV	Supported EOBD SERVICEs from 01h – 09h	
BIT	**Function**	**Supported**
0	SERVICE 01h : Request current powertrain diagnostic data	**1**
1	SERVICE 02h : Request powertrain freeze frame data	**1**
2	SERVICE 03h : Request emission-related diagnostic trouble codes	**1**
3	SERVICE 04h : Clear/reset emission-related diagnostic information	**1**
4	SERVICE 05h : Request oxygen sensor monitoring test results	0
5	SERVICE 06h : Request on-board monitoring test results for specific monitored systems	**1**
6	SERVICE 07h : Request emission-related diagnostic trouble codes detected during current or last completed driving cycle	**1**
7	SERVICE 08h : Request control of on-board system, test or component	0
8	SERVICE 09h : Request vehicle information	**1**
9	SERVICE 0Ah : Request emission-related diagnostic trouble codes with permanent status after a Clear/reset emission-related diagnostic information service	**1**
10	RESERVED	0
11	RESERVED	0
12	RESERVED	0
13	RESERVED	0
14	RESERVED	0
15	RESERVED	0

1.30.2 Autolearning and microcontroller configuration

NC_STATE_OBD_CONF	Supported EOBD/ARB Configuration	
BIT	**Function**	**Configured**

Continued on next page

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0	Internal format of the microcontroller	0
1	Sensor configuration	**1**
2	Autolearning	**1**
3	RESERVED	0
4	RESERVED	0
5	RESERVED	0
6	RESERVED	0
7	RESERVED	0

Internal format of the microcontroller	
Value	**Description**
0	The internal format of the microcontroller is INTEL
1	The internal format of the microcontroller is MOTOROLA

Sensor configuration	
Value	**Description**
0	BINARY Sensor configuration
1	LINEAR Sensor configuration

Autolearning – for O2 sensors configuration	
Value	**Description**
0	Without autolearning
1	With autolearning

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1.30.3 Configuration of project specific calibration data

Project specific calibration data - NLC_STATE_PRJ_SPC_CAL	
Value	**Description**
0	EOBD is configured by generic configuration data
1	EOBD is configured by project specific calibration data

Formula section:

NLC_STATE_PRJ_SPC_CAL = 1

1.30.4 Configuration of oxygen sensors (PID13)

NC_STATE_PID_13_PSN_LS		
BIT	**Function**	**Value**
0	Bank 1 Sensor 1 (upstream 1)	**1**
1	Bank 1 Sensor 2 (downstream 1)	**1**
2	Bank 1 Sensor 3	0
3	Bank 1 Sensor 4	0
4	Bank 2 Sensor 1 (upstream 2)	**1**
5	Bank 2 Sensor 2 (downstream 2)	**1**
6	Bank 2 Sensor 3	0
7	Bank 2 Sensor 4	0

Each bit indicates the presence or absence of the oxygen sensors for each cylinder bank, the first sensor being the nearest of the engine.
0 : sensor not present
1 : sensor present

1.30.5 Position of oxygen sensors (PID13)

Formula section:

IF (NC_STATE_OBD_CONF & 0x04)
THEN With autolearning
STATE_PSN_LS_SAE = PSN_LS *//set to the value defined by the project*
ELSE STATE_PSN_LS_SAE = NC_STATE_PID_13_PSN_LS
ENDIF

1.30.6 Configuration of oxygen sensors (PID1D)

NC_STATE_PID_1D_PSN_LS		
BIT	**Function**	**Value**
0	Bank 1 Sensor 1 (upstream 1)	0
1	Bank 1 Sensor 2 (downstream 1)	0
2	Bank 2 Sensor 1 (upstream 2)	0
3	Bank 2 Sensor 2 (downstream 2)	0
4	Bank 3 Sensor 1	0
5	Bank 3 Sensor 2	0
6	Bank 4 Sensor 1	0
7	Bank 4 Sensor 2	0

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Each bit indicates the presence or absence of the oxygen sensors for each cylinder bank, the first sensor being the nearest of the engine.
0 : sensor not present
1 : sensor present

1.30.7 Position of oxygen sensors (PID1D)

Formula section:

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STATE_PSN_LS_1_SAE = NC_STATE_PID_1D_PSN_LS

1.30.8 Configuration of secondary air pump for PID12

Configuration of secondary air pump – NLC_STATE_VAR_SAP	
Value	**Description**
0	Secondary air pump**NOT**supported
1	Secondary air pump supported

Formula section:

NLC_STATE_VAR_SAP = 1

1.30.9 Support of secondary air pump

Formula section:

IF (NC_STATE_OBD_CONF & 04h)
THEN With autolearning
STATE_VAR_SAP_SAE (bit 0) = LV_VAR_SAP
ELSE STATE_VAR_SAP_SAE is set to NLC_STATE_VAR_SAP
ENDIF

1.30.10 Configuration of EVAP Monitor

Configuration of EVAP Monitor – NLC_STATE_EVAP	
Value	**Description**
0	EVAP Monitor**NOT**supported
1	EVAP Monitor supported

Formula section:

NLC_STATE_EVAP = 1

1.30.11 Support of EVAP Monitor

Formula section:

IF (NC_STATE_OBD_CONF & 04h)
THEN With autolearning
STATE_EVAP_SAE (bit 0) = LV_CONF_DMTL
ELSE STATE_EVAP_SAE = NLC_STATE_EVAP
ENDIF

1.30.12 Support of Mass Air Flow Sensor Data (PID 66)

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Calibration of C_STATE_PSN_MAF_SAE	
Bit	**Value /Description**
0	MAF sensor A data supported (=1)
1	MAF sensor B data supported (=1)
2 - 7	Reserved (=0)

Formula section:

STATE_PSN_MAF_SAE = C_STATE_PSN_MAF_SAE

1.30.13 Support of Intake Air Temperature Sensor Data (PID 68)

Calibration of C_STATE_PSN_TIA_SAE	
Bit	**Description**
0	TIA sensor Bank 1 Sensor 1 supported (=1)
1	TIA sensor Bank 2 Sensor 1 supported (=1)
2	TIA sensor Bank 3 Sensor 1 supported (=1)
3	TIA sensor Bank 1 Sensor 2 supported (=1)
4	TIA sensor Bank 2 Sensor 2 supported (=1)
5	TIA sensor Bank 3 Sensor 2 supported (=1)
6	Reserved (=0)
7	Reserved (=0)

Formula section:

STATE_PSN_TIA_SAE = C_STATE_PSN_TIA_SAE

1.30.14 Support of Throttle Actuator Control System Data (PID 6C)

Calibration of C_STATE_PSN_TPS_SAE	
Bit	**Description**
0	Commanded TPS – A supported (=1)
1	Relative TPS – A supported (=1)
2	Commanded TPS – B supported (=1)
3	Relative TPS – B supported (=1)
4	Reserved (=0)
5	Reserved (=0)
6	Reserved (=0)
7	Reserved (=0)

Formula section:

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STATE_PSN_TPS_SAE = C_STATE_PSN_TPS_SAE

1.30.15 Support of Fuel Pressure Control System Data (PID 6D)

Calibration of C_STATE_PSN_FUP_SAE	
Bit	**Description**
0	Commanded FUP – A supported (=1)
1	Measured FUP – A supported (=1)
2	Temperature FUP – A supported (=1)
3	Commanded FUP – B supported (=1)
4	Measured FUP – B supported (=1)
5	Temperature FUP – B supported (=1)
6	Reserved (=0)
7	Reserved (=0)

Formula section:

STATE_PSN_FUP_SAE = C_STATE_PSN_FUP_SAE

1.30.16 Configuration for service $09 – CAL-ID calculation (used for L6)

Formula section:

STATE_CLC_CAL_ID_SRV_9 = LC_CLC_CAL_ID_SRV_9

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1.31 LACO Configuration data

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ERR_SYM_FSD_CONF	-	1... 2H	1 ...2	1	-
Number of failure locations in FSD					
NC_NR_FAC_GAIN_LAM	-	0... 1FH	0... 31	1	-
Number of breakpoints for Lambda controller gain parameter axis					

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

1.31.1 Local configuration data

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

Data	Value
NC_ERR_SYM_FSD_CONF	1
NC_NR_FAC_GAIN_LAM	8

To be defined by project with information from customer.

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1.32 MFMA Configuration data

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_MIS_REP_LAM_AD_INJ	O	0... FFH	0... 255	1	-
Maximum number of interruptions of lambda adapation via injection mode due to misfire per cylinder					
NC_NR_MPL_INJ_LAM_AD_INJ	O	0... FFH	0... 255	1	-
Number of multiple injections for lambda adaptation via injection mode					
NC_NR_PHA_LAM_AD_INJ	O	0... FFH	0... 255	1	-
Number of phases for lambda adaptation via injection mode					

General information:

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

1.32.1 Global Configuration Data

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

Data	Value

1.32.2 Local Configuration Data

Here are listed the configuration data, which are used:

Data	Value
NC_NR_PHA_LAM_AD_INJ	7
NC_NR_MIS_REP_LAM_AD_INJ	10
NC_NR_MPL_INJ_LAM_AD_INJ	3

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1.33 IMMO Configuration data

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IMOB_MODE	-	0... FFH	0... 255	1	-
Configuration immobilizer [IMOB] mode					
NC_SWT_MODE	-	0... FFH	0... 255	1	-
Configuration SWT mode					

FUNCTION DESCRIPTION:

General information:

The logical constants NC(NLC)_xxx Configuration data are necessary to adapt the Aggregate IMMO to a given system environment. The values describe either the variant of a used system component, or a vehicle component is available or not.
With use of the logical constant **NC_IMOB_MODE** the availability of a electronically components within the system is determined. In case of a vehicle configuration with an start stop system MSA, the component control/recognition and diagnosis is included within the aggregate version. The flexible handling is necessary because the immobilizer is different for different hardware components.
With use of the logical constant **NC_SWT_MODE** the availability of special SWT enabling functions.
The logical constants NC_SWT_MODE0X_MASKS represents one set bit in a byte and should be used for bit masking operations.

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

Local configuration data

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

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Data	Value
NC_IMOB_MODE	Compiler switch to activate special IMOB functionality **0** = No special mode active (all other projects) **1**= MSA (Motor Start/Stop-Automatik) Authentication: **Activated only for 4DB + 4DH** **2** = DH-Server 1 active (EGS) *plattform L6, preparation E71* **4** = DH-Server 2 active (N/A) reserved **8** = DH-Server 3 active (N/A) reserved 16 = N/A 32 = N/A 64 = N/A 128 = N/A
NC_SWT_MODE	Compiler switch to activate special SWTfunctionality 0 = No special SWT Mode 1= VMAX enabling with SWT /* activated for 4DS */ 2 = PMAX enabling with SWT /* activated for 4DC */ 4 = N/A 8 = N/A 16 = N/A 32 = N/A 64 = N/A 128 = N/A
NC_SWT_MODE01_ MASK	1
NC_SWT_MODE02_ MASK	2
NC_SWT_MODE03_ MASK	4
NC_SWT_MODE04_ MASK	8
NC_SWT_MODE05_ MASK	16
NC_SWT_MODE06_ MASK	32
NC_SWT_MODE07_ MASK	64
NC_SWT_MODE08_ MASK	128

For 4DS Project (S63)

NC_SWT_MODE = 1

For 4DC Project (4DC)

NC_SWT_MODE = 2

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2 - Basic SW Inputs and Outputs

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2.1 Standard analog inputs

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MAP_BAS	O	0... 3FFH	0... 4.99511	4.8828e-3	V
manifold air pressure (form mux)					
PUT_BAS	O	0... 3FFH	0... 4.99511	4.8828e-3	V
manifold air pressure up throttle (turbo)					
V_AMP	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Ambient pressure sensor raw acquisition					
V_FUP	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
LPG pressure in the fuel rail, voltage raw value (10 bits).					
V_FUP_EFP	O	8000... 7FFFH	-5... 4.99984	152.6e-6	V
Low fuel pressure EFP sensor raw acquisition					
V_IGK_BAS	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Battery voltage after key raw acquisition					
V_LS_DOWN_1	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Downstream oxygen sensor Voltage raw acquisition - Bank n° 1					
V_LS_DOWN_2	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Downstream oxygen sensor Voltage raw acquisition - Bank n° 2					
V_LS_UP_1	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Upstream oxygen sensor Voltage raw acquisition - Bank n° 1					
V_LS_UP_2	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Upstream oxygen sensor Voltage raw acquisition - Bank n° 2					
V_POIL	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Oil pressure sensor raw acquisition					
V_PVS_1	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage of pedal value sensor 1					
V_PVS_2	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage of pedal value sensor 2					
V_SOF_SWI	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage of sport switch					
V_SOF_SWI_MON	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage of sport flitch for monitoring					
V_TPS_1	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Throttle position sensor 1 raw acquisition					
V_TPS_2	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Throttle position sensor 2 raw acquisition					
V_VAR_ECU	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage for ECU Lot detection					
VB_BAS	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Battery voltage after relay raw acquisition.					
VCC_PVS_1	O/V	0... 3FFH	0... 9.99023	9.7656e-3	V
Voltage supply for pedal value sensor 1 (and TPS) raw acquisition					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VCC_PVS_2	O/V	0... 3FFH	0... 9.99023	9.7656e-3	V
Voltage supply for pedal value sensor 2 raw acquisition					

Direct analog inputs

Name	Acquisition rate (msec)	Port - Channel	Remark
V_IGK_BAS	1	2-01	
VB_BAS	1	3-01	
V_LS_UP_1	10	2-06	
V_LS_UP_2	10	2-07	
V_AMP	100	-	
V_LS_DOWN_1	10	2-20	
V_LS_DOWN_2	10	2-19	
V_PVS_1	10	1-20	
V_PVS_2	10	1-07	
VCC_PVS_1	10	1-11	only input data available
VCC_PVS_2	10	1-24	only input data available
V_TPS_1	5 and segmentsync.	5-37	
V_TPS_2	5 and segmentsync.	5-36	
V_VAR_ECU	100	-	Voltage for ECU LOT detection
V_PVS_1_MON	40	1-20	
V_PVS_2_MON	40	1-07	
V_TPS_1_MON	40	5-37	
V_TPS_2_MON	40	5-36	
V_SOF_SWI	10	2-03	Sportschalter
V_SOF_SWI_MON	10	2-03	
MAP_BAS	1	5-33	
V_FUP		7-09	
V_FUP_EFP	1	5-34	
V_POIL	10	7-03	Oil pressure sensor
V_DMTL_BAS	**1**	2-16	tank leakage sensor

Additional direct inputs for LV_VAR_TCHA = 1 (N54)

PUT_BAS	1	5-10	

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2.2 Acquisition of air mass flow for frequency air mass sensor

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_MAF_FRQ_KGH_SUM [NC_MAF_NR]	O/V	0... FFFFH	0... 65535	1	-
number of valid accumulated mass air flows during one segment					
CTR_MAF_FRQ_KGH_SUM_0 [NC_MAF_NR]	V	0... FFFFH	0... 65535	1	-
number of accumulated mass air flows during one segment					
CTR_MAF_FRQ_KGH_SUM_1 [NC_MAF_NR]	V	0... FFFFH	0... 65535	1	-
number of accumulated mass air flows during one segment					
CTR_PER_MAF_FRQ_EL [NC_MAF_NR]	V	0... FFH	0... 255	1	-
number of times without a flank					
CTR_T_PER_MAF_FRQ_GRD [NC_MAF_NR]	O/V	0... FFFFH	0... 65535	1	-
number of accumulated gradient failures during one segment					
CTR_T_PER_MAF_FRQ_GRD_0 [NC_MAF_NR]	V	0... FFFFH	0... 65535	1	-
number of accumulated gradient failures during one segment for buffer 0					
CTR_T_PER_MAF_FRQ_GRD_1 [NC_MAF_NR]	V	0... FFFFH	0... 65535	1	-
number of accumulated gradient failures during one segment for buffer 1					
CTR_T_PER_MAF_FRQ_RNG [NC_MAF_NR]	O/V	0... FFFFH	0... 65535	1	-
number of accumulated range failures during one segment					
CTR_T_PER_MAF_FRQ_RNG_0 [NC_MAF_NR]	V	0... FFFFH	0... 65535	1	-
number of accumulated range failures during one segment for buffer 0					
CTR_T_PER_MAF_FRQ_RNG_1 [NC_MAF_NR]	V	0... FFFFH	0... 65535	1	-
number of accumulated range failures during one segment for buffer 1					
LV_CTR_T_PER_MAF_FRQ_EL [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
failure (electrical) of the mean period time for frequency MAF sensor					
LV_CTR_T_PER_MAF_FRQ_GRD [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
failure (gradient) of the mean period time for frequency MAF sensor					
LV_CTR_T_PER_MAF_FRQ_RNG [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
failure (range) of the mean period time for frequency MAF sensor					
LV_CTR_T_PER_MAF_FRQ_SENS [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
failure (sensor) of the mean period time for frequency MAF sensor					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MAF_FRQ_SEG [NC_MAF_NR]	V	0... 1H	0 ...1	1	-
indicates if segment number is even or odd to choose the right buffer					
MAF_FRQ_KGH_BAS [NC_MAF_NR]	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
basic value of the air mass flow (freq. MAF)					
MAF_FRQ_KGH_MES [NC_MAF_NR]	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
measured mass air flow					
MAF_FRQ_KGH_SUM [NC_MAF_NR]	V	0... FFFFFFFFH	0... 134217727.96875	0.03125	kg/h
accumulated mass air flow					
MAF_FRQ_KGH_SUM_0 [NC_MAF_NR]	V	0... FFFFFFFFH	0... 134217727.96875	0.03125	kg/h
accumulated mass air flow measured every sampling pulse time					
MAF_FRQ_KGH_SUM_1 [NC_MAF_NR]	V	0... FFFFFFFFH	0... 134217727.96875	0.03125	kg/h
accumulated mass air flow measured every sampling pulse time					
T_PER_MAF_FRQ [NC_MAF_NR]	O/V	0... FFFFH	0... 65535	1	µs
arithmetric average of the period time					
T_PER_MAF_FRQ_BAS [NC_MAF_NR]	O/V	0... FFFFH	0... 65535	1	µs
basic arithmetric average of the period time					

Input data:

LV_ES {p. 1720}	LV_VAR_MAF {p. 656}	LV_VAR_MAF_LEARNT {p. 656}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_PER_MAF_FRQ_EL	-	0... FFH	0... 255	1	-
Maximum threshold for electrical diagnosis					
C_T_PER_MAF_FRQ_GRD_DIAG	-	0... FFFFH	0... 65535	1	µs
maximum threshold for gradient check of T_PER_MAF_FRQ_SUM					
C_T_PER_MAF_FRQ_MAX_DIAG	-	0... FFFFH	0... 65535	1	µs
maximum threshold for range check of T_PER_MAF_FRQ_SUM_j					
C_T_PER_MAF_FRQ_MIN_DIAG	-	0... FFFFH	0... 65535	1	µs
minimum threshold for range check of T_PER_MAF_FRQ_SUM_j					
C_T_PER_MAF_FRQ_SENS	-	0... FFFFH	0... 65535	1	µs
minimum threshold for range check of T_PER_MAF_FRQ_SENS					
C_T_PER_MAX_FRQ_OFS	-	0... FFFFH	0... 65535	1	µs
offset of the period time for conversion table					
ID_MAF_FRQ_TAB [NC_MAF_NR]	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_T_PER_MAF_FRQ_OFS	256	0... FFFFH	0... 65535	1	µs
conversion table for the frequency MAF sensor					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_MAF_NR	-	0... FFH	0... 255	1	-
number of MAF- sensors					

Import actions:

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ACTION_INFR_GetResultTimeStamp (**OUT**<CTR_T_PER_MAF_FRQ_SUM[NC_MAF_NR]>,**OUT**<T_PER_MAF_FRQ_SUM[NC_MAF_NR]>)

FUNCTION DESCRIPTION:

General information:

Calculation of basic air mass flow for a frequency MAF sensor
The determination of basic air mass flow from the input signal to the ECU in general is done in 3 steps.
First step:
Using these informations the mean value of time periods between falling edges during the last sampling time is calculated:
T_PER_MAF_FRQ[NC_MAF_NR] = T_PER_MAF_FRQ_SUM[NC_MAF_NR] / CTR_T_PER_MAF_FRQ_SUM[NC_MAF_NR]
Second step:
The mean value of time periods (T_PER_MAF_FRQ[NC_MAF_NR]) is converted into air mass flows (MAF_FRQ_KGH_BAS[NC_MAF_NR]) with help of a map (ID_MAF_FRQ_TAB[NC_MAF_NR]).
Third step:
During a segment time the air mass flows of each millisecond (MAF_FRQ_KGH_BAS[NC_MAF_NR]) are summed up (MAF_FRQ_KGH_SUM[NC_MAF_NR]) in order to calculate the mean value of air mass flow:
MAF_FRQ_KGH_MES[NC_MAF_NR] = MAF_FRQ_KGH_SUM[NC_MAF_NR] / CTR_MAF_FRQ_KGH_SUM[NC_MAF_NR]

Description:

This is a global overview about all input and output signals of this function. Details are shown in the following chapters.

Overview

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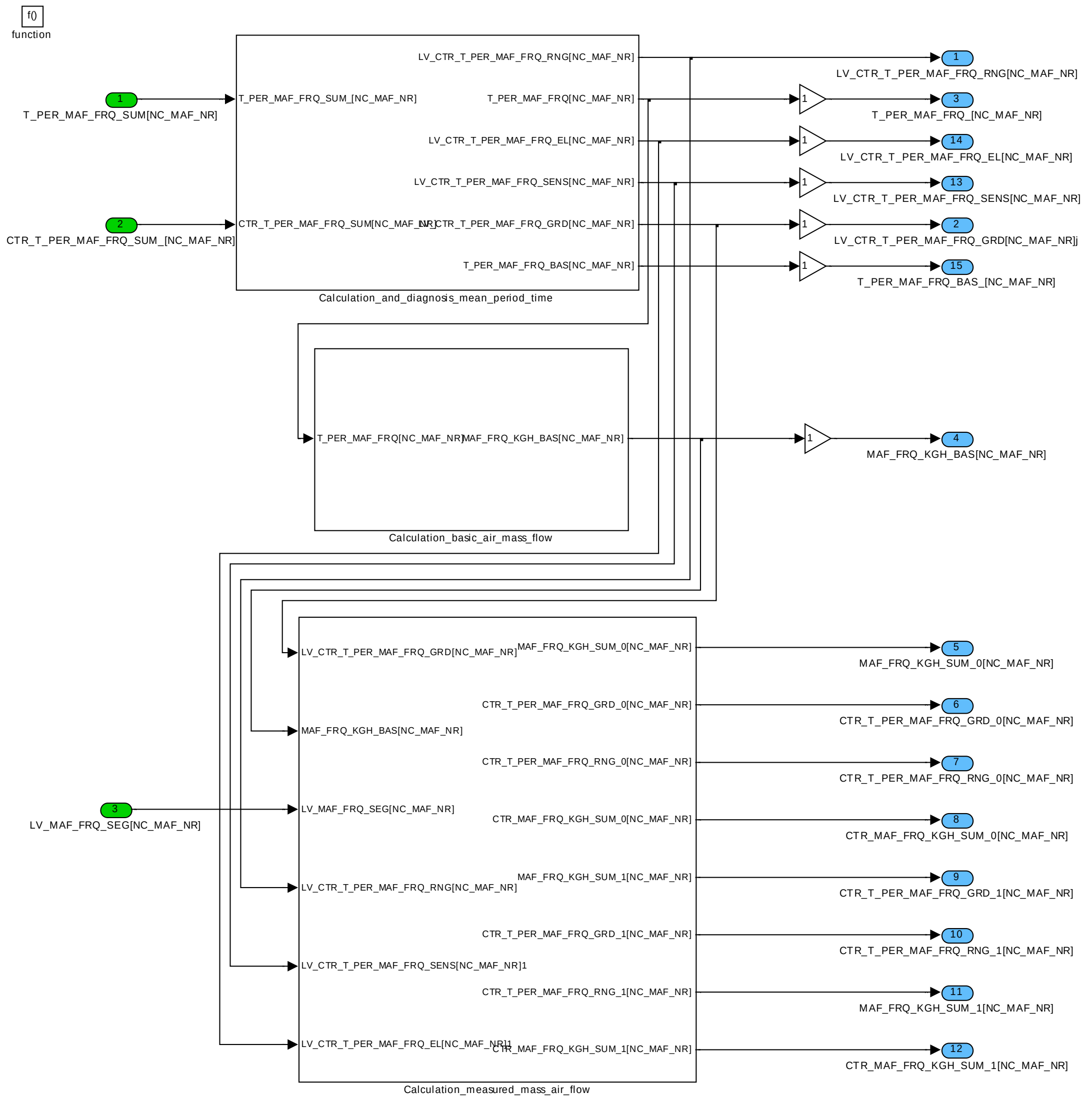

The function to do all calculations is splitted into three parts:
- calculation of mean period time
- calculation of basic mass air flow
- calculation of mean mass air flow during one segment
Besides the number of MAF sensors is fixed.

2.2.1 Calculation and Diagnosis of the mean period time

Application conditions

Initialisation: –

Recurrence: *1 ms*

Activation: **If** (LV_VAR_MAF_LEARNT = 0 **and** LV_VAR_MAF = 0) **or**

(LV_VAR_MAF_LEARNT = 0 **and** LV_VAR_MAF = 1) **or**

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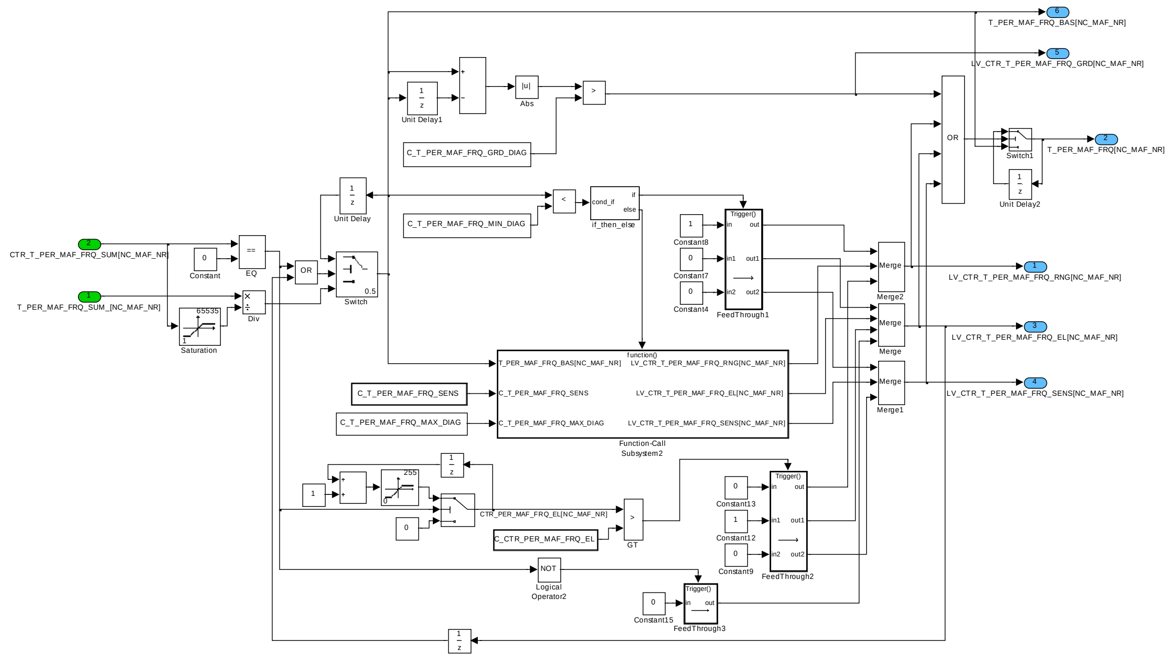
(LV_VAR_MAF_LEARNT = 1 **and** LV_VAR_MAF = 1)

Deactivation: **If** (LV_VAR_MAF_LEARNT = 1 **and** LV_VAR_MAF = 0)

FUNCTION DESCRIPTION:

The logical value LV_CTR_T_PER_MAF_FRQ_RNG[NC_MAF_NR] will be set, if the mean period time is not within a maximum and minimum threshold.
Additionally the logical value LV_CTR_T_PER_MAF_FRQ_GRD[NC_MAF_NR] will be set, if the gradient of the mean period time is higher than C_T_PER_MAF_FRQ_GRD_DIAG.
If one of the error bits LV_CTR_T_PER_MAF_FRQ_EL/SENS/RNG/GRD[NC_MAF_NR] is set, the old period time is used.
If one of the error bits LV_CTR_T_PER_MAF_FRQ_EL/SENS/RNG is set, then the other error bits has to be set to zero.
For setting of LV_CTR_T_PER_MAF_FRQ_EL[NC_MAF_NR] a counter is started everytime CTR_T_PER_MAF_FRQ_SUM[NC_MAF_NR] = 0, if the counter is over a calibratable threshold LV_CTR_T_PER_MAF_FRQ_EL[NC_MAF_NR] is set.
If LV_CTR_T_PER_MAF_FRQ_EL[NC_MAF_NR] = 1 the first value T_PER_MAF_FRQ_SUM[NC_MAF_NR] != 0 delievered by infrastructure is not used.
Signal flow diagram:



In the following 2 signal flow diagrams, the function call function call subsystem2 is shown:

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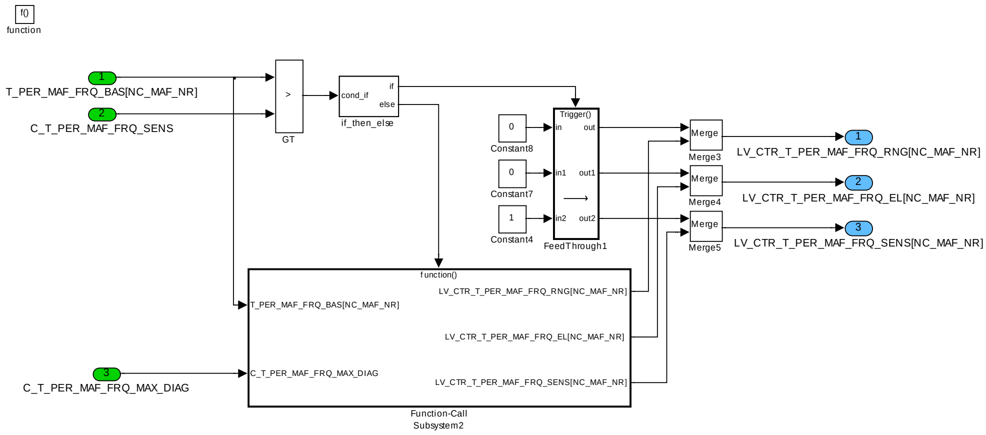

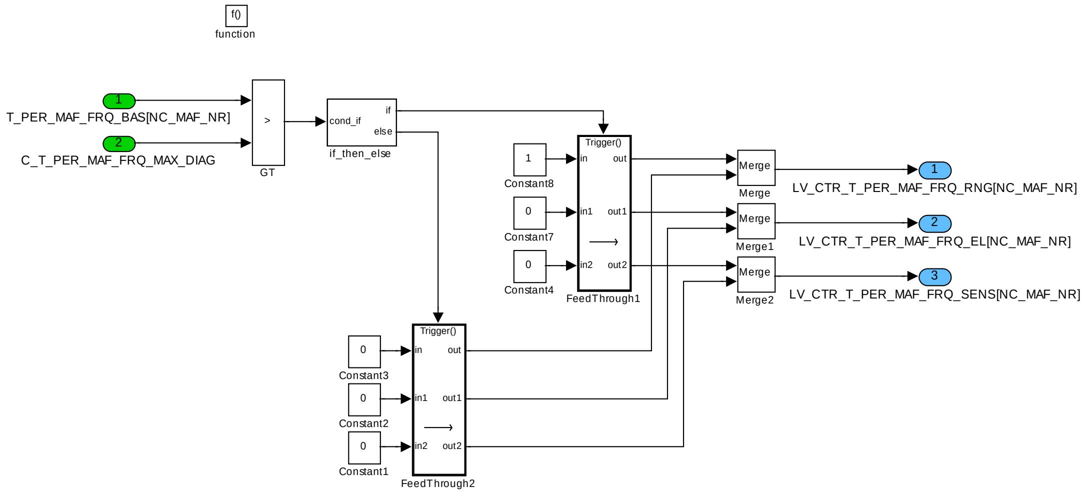

2.2.2 Basic air mass flow calculation for frequency MAF sensor

Application conditions

Initialisation: –

Recurrence: *1 ms*

Activation: **If** (LV_VAR_MAF_LEARNT = 0 **and** LV_VAR_MAF = 0) **or**

(LV_VAR_MAF_LEARNT = 0 **and** LV_VAR_MAF = 1) **or**

(LV_VAR_MAF_LEARNT = 1 **and** LV_VAR_MAF = 1)

Deactivation: **If** (LV_VAR_MAF_LEARNT = 1 **and** LV_VAR_MAF = 0)

FUNCTION DESCRIPTION:

The limited mean value of the period time T_PER_MAF_FRQ[NC_MAF_NR] are converted by a table ID_MAF_FRQ_TAB[NC_MAF_NR] into values with the unit [kg/h].

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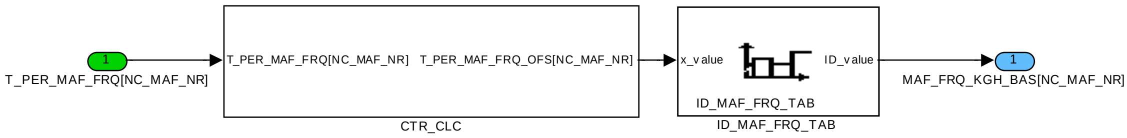
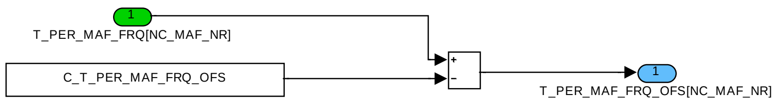
Signal flow diagram:





2.2.3 Calculation of measured air mass flow buffer

Application conditions

Initialisation: –

Recurrence: *1 ms*

Activation: **If** (LV_VAR_MAF_LEARNT = 0 **and** LV_VAR_MAF = 0) **or**

(LV_VAR_MAF_LEARNT = 0 **and** LV_VAR_MAF = 1) **or**

(LV_VAR_MAF_LEARNT = 1 **and** LV_VAR_MAF = 1)

Deactivation: **If** (LV_VAR_MAF_LEARNT = 1 **and** LV_VAR_MAF = 0)

FUNCTION DESCRIPTION:

The calculation of measured air mass flow consists of two different parts.
Accumulation of air mass flow during one segment:
The air mass flows MAF_FRQ_KGH_BAS[NC_MAF_NR] are summed up in alternating buffers, if there is no failure. The number of summed up values is counted in CTR_MAF_FRQ_KGH_SUM_0[NC_MAF_NR] or CTR_MAF_FRQ_KGH_SUM _1[NC_MAF_NR].
Depending on the logical value LV_MAF_FRQ_SEG one of the two buffers and counters is selected for writing whereas the content of the other buffer and counter is used for calculation.
After having read out one buffer, it needs to be cleared as well as the corresponding counter. Such a two-buffer-system is used to avoid incorrect mass air flow calculation. The buffer alternate at each change of segment.

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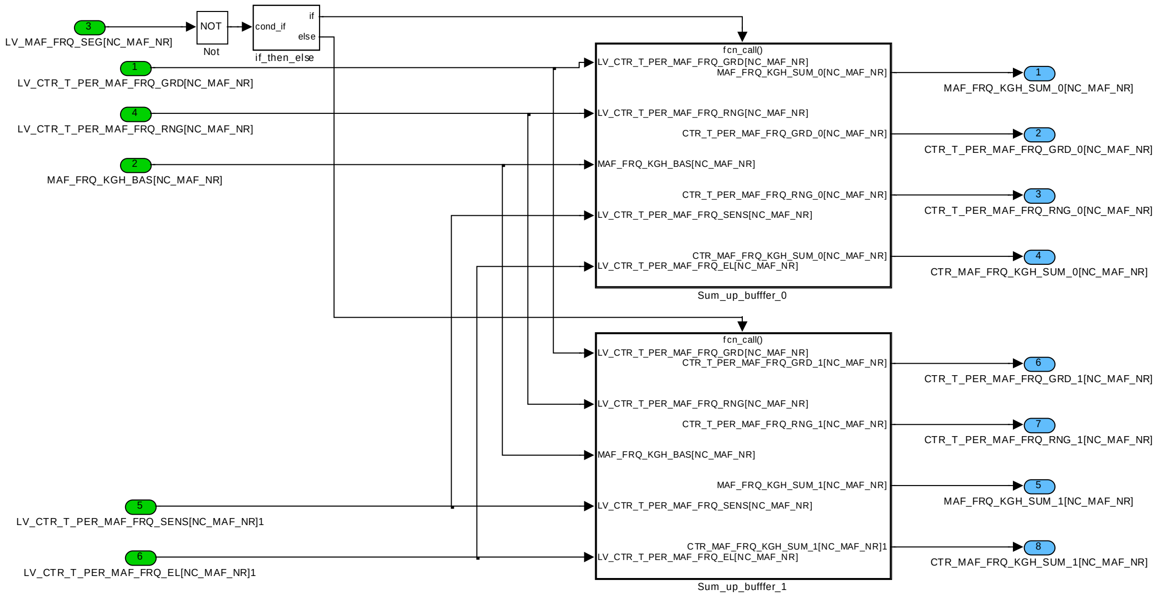
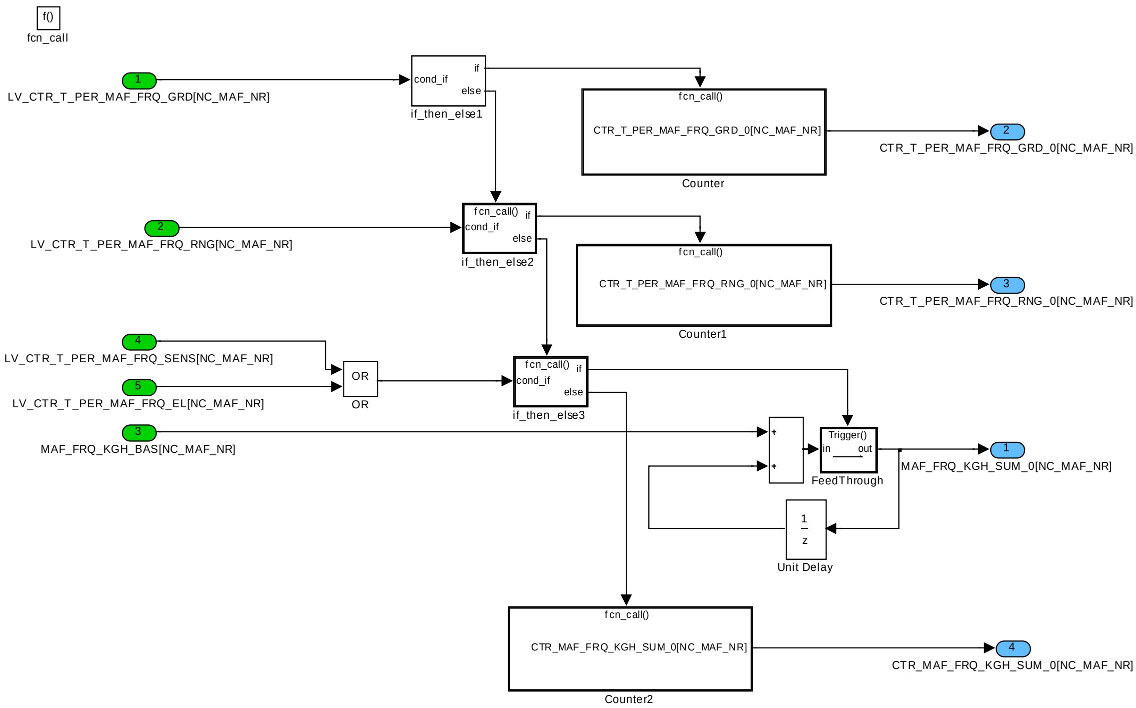
Signal flow diagram:



Sum up buffer:



Description of the defined counter:

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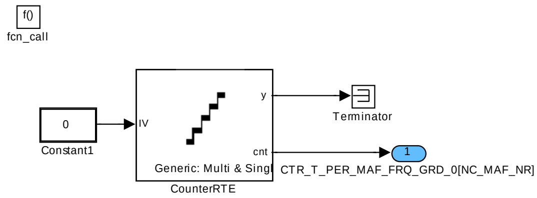

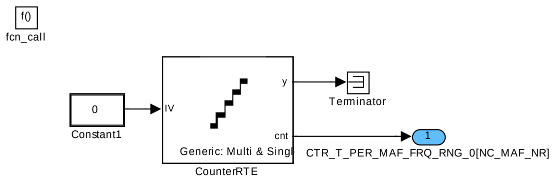

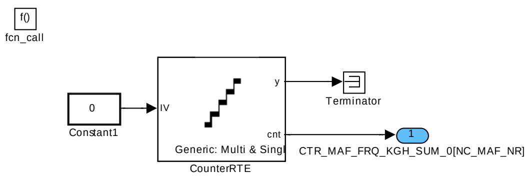

The calculation above is defined only for the buffer 0, the calculation of the necessary variables for buffer 1 has to be done analogous.

2.2.4 Calculation of measured mean value of air mass flow

Application conditions

Initialisation: *at LV_ES 0->1*, set MAF_FRQ_KGH_MES[NC_MAF_NR] = 0

Recurrence: every segment

Activation: **If** LV_ES = 0 **and**
(LV_VAR_MAF_LEARNT = 0 **and** LV_VAR_MAF = 0) **or**
(LV_VAR_MAF_LEARNT = 0 **and** LV_VAR_MAF = 1) **or**
(LV_VAR_MAF_LEARNT = 1 **and** LV_VAR_MAF = 1)

Deactivation: **If** (LV_VAR_MAF_LEARNT = 1 **and** LV_VAR_MAF = 0)

FUNCTION DESCRIPTION:

Selection of the sum up buffer:
LV_MAF_FRQ_SEG[NC_MAF_NR] = 1 - LV_MAF_FRQ_SEG[NC_MAF_NR]
switching LV_MAF_FRQ_SEG[NC_MAF_NR] once per segment

mean value of the mass air flow during a segment:

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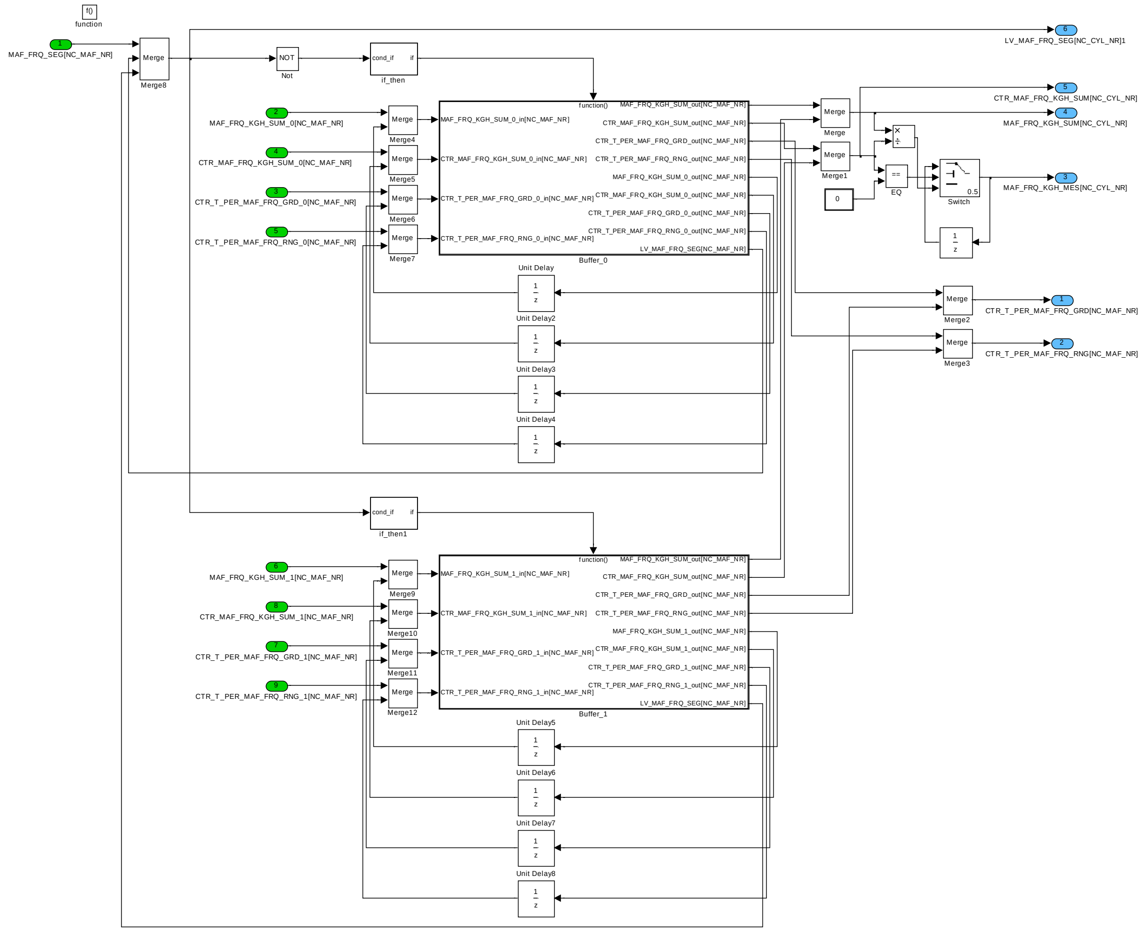
MAF_FRQ_KGH_MES[NC_MAF_NR] = MAF_FRQ_KGH_SUM[NC_MAF_NR] /CTR_ MAF_FRQ_KGH_ SUM[NC_MAF_NR]

Signal flow diagram:



The calculation above is defined only for the buffer 0, the calculation of the necessary variables for buffer 1 has to be done analogous.

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2.3 Manifold air pressure acquisition

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MAP_CTR	O/V	0... FFFFH	0... 65535	1	-
Number of MAP samples in buffer					
MAP_CTR_1	O/V	0... FFFFH	0... 65535	1	-
Number of MAP samples in buffer1					
MAP_SUM	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Acquisition sum, buffer					
MAP_SUM_1	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Acquisition sum, buffer1					
PUT_CTR	O/V	0... FFFFH	0... 65535	1	-
Number of PUT samples in buffer					
PUT_CTR_1	O/V	0... FFFFH	0... 65535	1	-
Number of PUT samples in buffer1					
PUT_SUM	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Acquisition sum pressure up throttle, buffer					
PUT_SUM_1	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Acquisition sum pressure up throttle, buffer1					

Input data:

LV_MAP_SEG {p. 1198}	LV_VAR_TCHA {p. 656}	MAP_BAS {p. 831}	PUT_BAS {p. 831}

FUNCTION DESCRIPTION:

The raw value (voltage) for MAP_BAS (PUT_BAS) is measured every 1 ms. The values (10 bit) are summed up in one of the two buffers, MAP_SUM or MAP_SUM_1 (PUT_SUM or PUT_SUM_1). The number of values is counted in MAP_CTR or MAP_CTR_1 (PUT_CTR or PUT_CTR_1).
A two-buffer-system is used to avoid incorrect MAP_MES_BAS calculation.

Calculation Description:

If (LV_MAP_SEG == 0) then

$$MAP\_SUM = \sum_{i=1}^{MAP\_CTR} MAP\_BASi$$

and in case the alternate buffer is active for writing (LV_MAP_SEG == 1)

$$MAP\_SUM\_1 = \sum_{i=1}^{MAP\_CTR\_1} MAP\_BASi$$

MAP_BASi: MAP acquisition, raw values from the ad_buffer

additional variables for LV_VAR_TCHA = 1 (turbo)

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If (LV_MAP_SEG == 0) then

PUT_CTR
PUT_SUM = PUT_BASi
i=1

and in case the alternate buffer is active for writing (LV_MAP_SEG == 1)

PUT_CTR_1
PUT_SUM_1 = PUT_BASi
i=1

PUT_BASi: PUT acquisition, raw values from the ad_buffer

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2.4 Acquisition of after relay battery voltage

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VB_MES	O	0... 3FFH	0... 28.7055	28.1e-3	V
Computed battery voltage					

Input data:

VB_BAS {p. 831}			

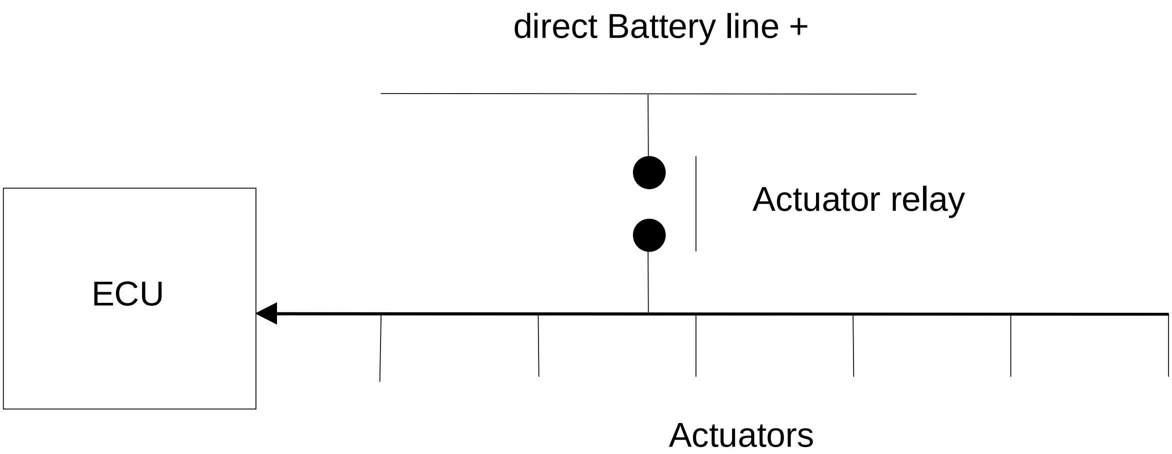
Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_VB_MAX	-	B4... 140H	18 ...32	0.1	V
Maximum battery voltage linked to the voltage dividor					
NC_VB_SAMPLE_NR	-	0... FFH	0... 255	1	-
Number of acquisition for filtering					

FUNCTION DESCRIPTION:

General information:

The acquisition of the raw values   is performed every 1 ms with the resolution of 10 bits.



Application conditions

Activation: at reset

Initialization: VB_MES = 0.

Recurrence : NC_VB_SAMPLE_NR ms

System Description:

The range of VB_BAS and VB_MES depends to the voltage divider (means 0 - 5V at ADC) at the input of the µC. The input is the ADC-value of the VB-Pin.

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Formula section:

$$VB\_MES = (1/NC\_VB\_SAMPLE\_NR) * \sum_{n=1}^{NC\_VB\_SAMPLE\_NR} VB\_BAS_n$$

$NC\_VB\_SAMPLE\_NR = 2^n$; $1 =< n =< 6$ (NC_VB_SAMPLE_NR is initialized with 4 or 8)

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2.5 Acquisition of after key battery voltage

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
V_IGK_MES	O/V	0... 3FFH	0... 28.7055	28.1e-3	V
Computed ignition key voltage					

Input data:

V_IGK_BAS {p. 831}			

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_V_IGK_MAX	-	B4... 140H	18 ...32	0.1	V
Maximum battery voltage linked to the voltage divisor of the key voltage					
NC_V_IGK_SAMPLE_NR	-	0... FFH	0... 255	1	-
Number of acquisition for filtering					

FUNCTION DESCRIPTION:

General information:
The acquisition of the raw values is performed every 1 ms with the resolution of 10 bits.
V_IGK_BAS is the same ADC-value which is used in Key on/Key off detection.

Application conditions

Activation: at reset

Initialization: V_IGK_MES = 0

Recurrence : NC_V_IGK_SAMPLE_NR ms

Formula section:

NC_V_IGK_SAMPLE_NR
V_IGK_MES = (1/NC_V_IGK_SAMPLE_NR) * V
IGK_BAS$_n$
$n=1$

NC_V_IGK_SAMPLE_NR = 2 ^{n} ; 1 =< n =< 6   (NC_V_IGK_SAMPLE_NR is initialized with 4 or 8)

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2.6 ENTE - Requirements to infrastructure interface (ECT)

Input data:

ECTPWM {p. 3858}			

2.6.1 Pulse width modulated outputs

FUNCTION DESCRIPTION:

General information:

Not all vehicles are equipped with an electronic controlled thermostat for the regulation of the coolant liquid circulation. Depending on the hardware configuration a pulse width modulated value (ECTPWM) for the electronic controlled thermostat is calculated or not. Only in case of a vehicle configuration with an electronic controlled thermostat a pulse width modulated signal is generated at the ECU output.

PWM output name	Frequency	Updating of duty cycle	Range of duty cycle
ECTPWM	hardware dependent	1000 ms	0 -100%

Application conditions

Initialisation at reset: *ECTPWM = 0%*

Activation: *at every engine operating state*

Deactivation: –

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2.7 Acquisition of combustion noise

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
KNKS [NC_CYL_NR]	O/V	0... FFFFH	0... 4.99992	76.3e-6	V
Knock noise raw signal for cylinder x					
KNKS_PRE [NC_CYL_NR]	O/V	0... FFFFH	0... 4.99992	76.3e-6	V
Knock noise raw signal for cylinder x (first window after TDC)					
KNKS_REL_NL [NC_CYL_NR]	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Relative knock value					

Input data:

KNKS_CMD_CONF [NC_CYL_NR] {p. 1961}	KNKS_CMD_FIL [NC_CYL_NR] {p. 1961}	KNKS_CMD_FIL_PRE [NC_CYL_NR] {p. 1961}	KNKS_CMD_GAIN [NC_CYL_NR] {p. 1961}
KNKS_CMD_GAIN_PRE [NC_CYL_NR] {p. 1961}	KNKS_CMD_INT [NC_CYL_NR] {p. 1961}	KNKS_CMD_INT_PRE [NC_CYL_NR] {p. 1961}	KNKWB [NC_CYL_NR] {p. 1961}
KNKWB_PRE [NC_CYL_NR] {p. 1961}	KNKWE [NC_CYL_NR] {p. 1961}	KNKWE_PRE [NC_CYL_NR] {p. 1961}	NL [NC_CYL_NR] {p. 1962}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_KNKS_REL_INI	-	0... FFFFH	0... 0.99998	15.3e-6	-
ini value of relative knock signal					

General information:

Activation : at ENG_STOP to SYN_ENG_IGK_ON
or RUN_ENG to SYN_ENG_IGK_ON
T_KNK_ENABLE

Deactivation : at SYN_ENG_IGK_ON to RUN_ENG (if supported by ECOP)
or SYN_ENG_IGK_ON to ENG_STOP
or SYN_ENG_IGK_OFF to PWL
T_KNK_DISABLE

Initialization : at reset or engine running to engine stop
KNKS_REL_NL[x] = C_KNKS_REL_INI (T_KNK_INIT)

The knock detection is performed for cylinder-individually defined measurement windows since knock-typical oscillations only occur for certain crankshaft angles. For the time of the knock window the knock signal is integrated. At the end of the knock window the integrated signal is sampled and converted to the digital value KNKSx.
KNKS_REL_NL[NC_CYL_NR] is the relative knocking value, it is the quotient of KNKS[NC_CYL_NR] and NL[NC_CYL_NR].
The knock window for cylinder x+1 is reprogrammed at the end of the knock window for cylinder x. The parameters KNKS_CMD_FIL[NC_CYL_NR], KNKS_CMD_FIL_PRE[NC_CYL_NR], KNKS_CMD_INT[NC_CYL_NR], KNKS_CMD_INT_PRE[NC_CYL_NR], KNKS_CMD_GAIN[NC_CYL_NR], KNKS_

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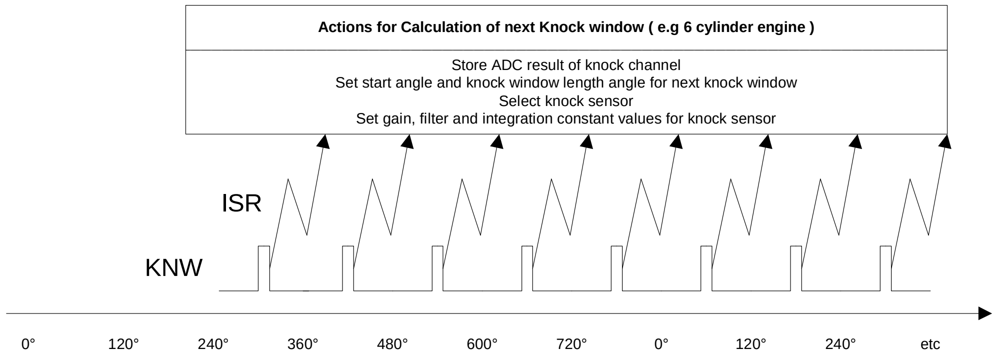
GAIN_PRE[NC_CYL_NR], KNKS_CMD_CONF[NC_CYL_NR], KNKWB KNKWB_PRE[NC_CYL_NR], KNKWE_PRE[NC_CYL_NR] and KNKWE have to be stable at this time. The knock channel adc is configured for triggering on the end of the knock window. The end of conversion generates an interrupt in which the parameters for the next knock window are set. The following picture illustrates this.



The knock function may be activated by T_KNK_INIT or T_KNK_ENABLE and deactivated by T_KNK_DISABLE.

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2.8 Standard management of logic inputs

2.8.1 Standard management of logic inputs

FUNCTION DESCRIPTION:

General information:
Logic inputs are inputs whose state is acquired by a µP port read.
Logic inputs which are connected to a pull-up inside the ECU are valid only when VBR is present. Without VBR these inputs are read as a low level.

Initialization:
See general Initialization chapter.

Logic state:
The input is ON when the voltage level is high at the ECU connector and is OFF when the voltage level is low at the ECU connector.

Recurrence:
Logical inputs are read every 10 ms with a jitter of 1 ms maximum.

Filtering of the interferences:
When the state of the logical input is changed, the acquistion is checked by another acquisition after 40 µs delay. If the new acquisition is not the same the change is ignored.
This filtering is proposed as a base in order to provide a more reliable information. In case of bigger interferences or bounces, a complementary application filtering should be added.

Diagnostic:
No diagnostic is done on logic inputs into basic software.

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2.9 Definition of logic inputs

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_IM_BLS	O/V	0... 1H	0 ...1	1	-
brake light switch					
LV_IM_BLS_MON	O	0... 1H	0 ...1	1	-
brake light switch for Monitoring					
LV_IM_BTS	O/V	0... 1H	0 ...1	1	-
brake test switch					
LV_IM_BTS_MON	O	0... 1H	0 ...1	1	-
brake test switch for Monitoring					
LV_IM_CS_PN	O/V	0... 1H	0 ...1	1	-
clutch switch					

List of logic Inputs

.

Name	Port - Channel	Logic state
LV_PIN_CS_PN	E_S_KUP	Positive Logic
LV_PIN_BTS	E_S_BLTS	Positive Logic
LV_PIN_BLS	E_S_BLS	Positive Logic

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2.10 Acquisition of crankshaft signal (internal version)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_ADD_CTR	-	0... FFH	0... 255	1	-
Crankshaft additional teeth counter					
CRK_CTR	-	0... FFH	0... 255	1	-
Crankshaft counter					
CRK_MISS_CTR	-	0... FFH	0... 255	1	-
Crankshaft missing teeth counter					
LV_CRK_FIRST_VLD_TOOTH	O	0... 1H	0 ...1	1	-
Flag for first valid crankshaft tooth detected ready to synchronize					
LV_CRK_MISS_TOOTH	O/V	0... 1H	0 ...1	1	-
At least one missing tooth has been simulated					
LV_CRK_RUN	O	0... 1H	0 ...1	1	-
Flag for Running engine					
LV_CRK_STOP	O	0... 1H	0 ...1	1	-
Flag for Stop Engine request					
LV_CRK_SYN	O/V	0... 1H	0 ...1	1	-
Flag for crankshaft acquisition synchronized					
LV_FIRST_REF_GAP	-	0... 1H	0 ...1	1	-
First Reference gap is found					
LV_LOST_SYN_CRK	O/V	0... 1H	0 ...1	1	-
Crankshaft synchronization lost					
LV_ORNG_NR_TOOTH_CRK	O/V	0... 1H	0 ...1	1	-
Crankshaft tooth count incorrect at reference gap					
LV_ORNG_TOOTH_PER_CRK	O/V	0... 1H	0 ...1	1	-
Invalid crankshaft tooth period					
LV_REF_GAP	-	0... 1H	0 ...1	1	-
Second Reference gap is found					
ST_CRK_SYN	-	0... 7H	0 ...7	1	-
Crankshaft synchronisation state					
T_CRK_WIN_ENSD	O/V	0... 7FFFFFH	0... 1.9965	237.999e-9	s
Crankshaft tooth window at end of segment					
T_SEG_ENSD	O	0... 7FFFFFH	0... 1.9965	237.999e-9	s
Fine resolution segment period					
T_SEG_ER	O/V	0... 7FFFFFH	0... 1.9965	237.999e-9	s
Crankshaft segment period for misfire detection (ER algorithm)					
T_SEG_HALF_ENSD	O	0... 7FFFFFH	0... 1.9965	237.999e-9	s
Fine resolution half-segment period					
T_TOOTH	O	0... 7FFFFFH	0... 1.9965	237.999e-9	s
Crankshaft tooth period					

Input data:

LV_ACT_CRK {p. 1505}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}	NC_NR_GAP {p. 874}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_CRK_DLY	-	0... 29083H	0... 40000	0.2380003	µs
Sensing delay time after first active crankshaft signal edge					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_FAC_TOL_CRK_TOOTH	-	0... FH	0... 0.9375	0.0625	-
LDP_N_32_ID_FAC_TOL_CRK_TOOTH	6	0... FFH	0... 8160	32	rpm
Factor for calculation of expected tooth period					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ACT_CRK_EDGE	-	0H 1H	FALLING RISING	-	-
Active edge of crankshaft signal					
NC_CRK_WIN_SEG_LEN	-	0... FFH	0... 95.625	0.375	°CRK
Width of crankshaft tooth window in °CRK at end of segment					
NC_N_CRK_WIN_ENA	-	0... 1FE0H	0... 8160	1	rpm
Minimum engine speed for enabling acceptance windows for crankshaft acquisition					
NC_N_MAX	-	0... 3FC0H	0... 16320	1	rpm
Maximum engine speed					
NC_N_MIN	-	0... 1FE0H	0... 8160	1	rpm
Minimum engine speed					
NC_N_SEG_HALF_END	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for half-segment trigger					
NC_NR_TOOTH	-	1... FFH	1... 255	1	-
Theoretical number of teeth per crankshaft revolution					
NC_NR_TOOTH_FIRST_GAP_MIN	-	1... 2H	1 ...2	1	-
Minimum number of teeth to be simulated to detect the first reference gap					
NC_NR_TOOTH_GAP	-	1... 2H	1 ...2	1	-
Number of missing teeth forming the reference gap					
NC_NR_TOOTH_STALL	-	2... 7H	2 ...7	1	-
Number of consecutive missing teeth for engine stalling detection					
NC_NR_TOOTH_TOL_ADD	-	1... 2H	1 ...2	1	-
Number of additional teeth tolerated between two reference gap occurrences					
NC_NR_TOOTH_TOL_MISS	-	1... 2H	1 ...2	1	-
Number of missing teeth tolerated between two reference gap occurrences					
NC_NR_VLD_TOOTH	-	0... FH	0... 15	1	-
Number of valid teeth necessary for validation of crankshaft rotation					
NC_OFS_TDC0_REF_CRK	-	0... 780H	0... 720	0.375	°CRK
Reference gap position in °CRK before TDC0					
NC_PHA_SEG_ER_ENSD	-	0... FFH	0... 95.625	0.375	°CRK
Misfire segment start in °CRK after TDC					
NC_PSN_SEG_TDC_REF	-	0... 780H	0... 720	0.375	°CRK
Segment start in °CRK before TDC					

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FUNCTION DESCRIPTION:

2.10.1 Crankshaft Synchronization

General information:

The crankshaft signal is generated by the crankshaft sensor in conjunction with the crankshaft target wheel. The target wheel has a theoretical number of NC_NR_TOOTH (typically 60) teeth, and NC_

NR_TOOTH_GAP missing teeth (typically 2) forming the reference gap (60-2). The crankshaft sensor converts the mechanical shape into an electrical signal.

Magnetic Crankshaft Position Sensors (MCPS) deliver an AC signal with amplitude depending primarily on crankshaft speed, and sensor air gap. The signal is shaped into a rectangular signal by the ECU input circuitry. Each edge of that signal represents a tooth or a gap of the target wheel. Only signal edges generated from teeth will be processed by software (active signal edge definition). These may be falling or rising edges, depending on sensor polarity.

Active Crankshaft Position Sensors (ACPS) switch an open collector output on and off with every tooth or gap passing. Connecting the sensor output to a pull-up resistor inside the ECU generates a signal with rectangular shape. Each edge of that signal represents a tooth or a gap of the target wheel. Only falling signal edges will be processed by software (active signal edge definition), because they are faster. Design and installation of the sensor must ensure that falling signal edges are generated from teeth.

The corresponding configuration data is NC_ACT_CRK_EDGE.

The choice is taken in a way not to use the unprecise signal edge generated in the crankshaft reference gap.

It may be 0 (falling) or 1 (rising) with MCPS, depending on sensor polarity.

With ACPS it should always be 0, because the falling edge is faster due to the sensor s open collector interface. The unprecise signal edge in the reference gap is avoided by choosing the correct installation of the sensor relativ to the target wheel motion direction.

Application conditions:

Recurrence:

For set of the RAM as flags, a mirror area is defined which contains a copy of the output and calibration data in the basic software area (see figure below).

The mirror area of the output data is updated by the lower layer at every active signal edge.

The mirror area of the calibration data is updated by the upper layer each 10ms.

The output data is copied from the mirror area every 10 ms

Crankshaft acquisition

Mirror area: updated every active edge

State Flow Diagram:

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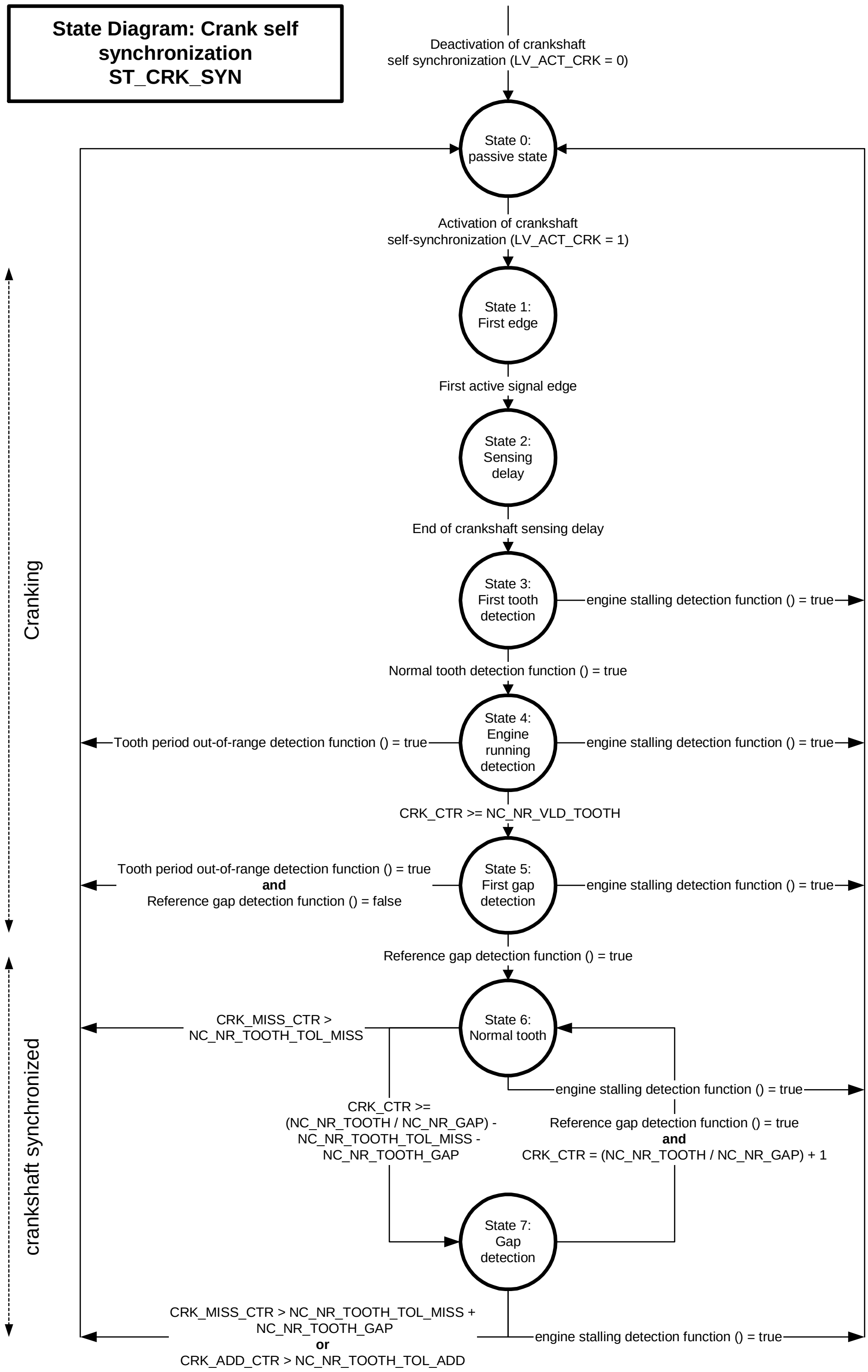

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Timing Diagram (example):

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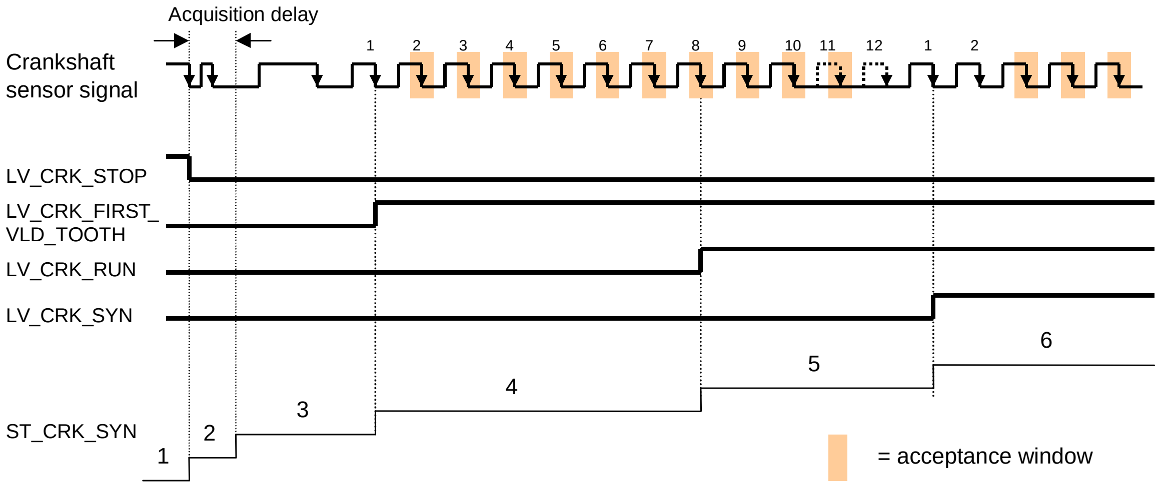

Formula section:

State 0: Crankshaft passive state

Input condition:

From state 4, 5: Tooth period out-of-range detection function () = true

From state 6: CRK_MISS_CTR > NC_NR_TOOTH_TOL_MISS

From state 7: CRK_ADD_CTR > NC_NR_TOOTH_TOL_ADD

Or

CRK_MISS_CTR > NC_NR_TOOTH_TOL_MISS + NC_NR_TOOTH_GAP

From state 3,4,5,6,7: Engine stalling detection function () = true

From EPM: LV_ACT_CRK = 0

Output condition:

To State 1: Activation of crk self-synchronization (LV_ACT_CRK = 1)

Action in the state:

LV_CRK_FIRST_VLD_TOOTH = 0
LV_CRK_SYN = 0
CRK_CTR = 0
LV_CRK_STOP = 1
LV_CRK_RUN = 0
CRK_MISS_CTR = 0
CRK_ADD_CTR = 0
LV_FIRST_REF_GAP = 0
LV_REF_GAP = 0

Transient action:

None

State 1: First signal edge

Input condition:

From state 0: Activation of crk self-synchronization (LV_ACT_CRK = 1)

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Output condition:
To state 2: First active signal edge

Action in the state:
Wait for first active signal edge
LV_CRK_STOP = 0

Transient action:
No actions

State 2: Crankshaft sensing delay

Input condition:
From state 1: First active signal edge detected

Output condition:
To state 3: End of crankshaft acquisition delay time

Action in the state:
Crankshaft signal acquisition inactive during a time interval C_T_CRK_DLY.

Transient action:
To state 3: LV_ORNG_TOOTH_PER_CRK = 0
LV_ORNG_NR_TOOTH_CRK = 0
LV_LOST_SYN_CRK =0

State 3: First tooth detection

Input condition:
From state 2: End of crankshaft acquistion delay time

Output condition:
State 4: Normal tooth detection function () = true
State 0: Engine stalling detection function () = true

Action in the state
Wait two next active signal edges in order to compute the first period
Activation of Normal tooth detection function ()
T_TOOTH n-1 = T_TOOTH n
Activation of Tooth period out-of-range detection function ()
Activation of Engine stalling detection function ()

Transient action:
To state 4: LV_CRK_FIRST_VLD_TOOTH = 1
Increment CRK_CTR

State 4: Engine running detection

Input condition:
From state 3: Normal tooth detection function () = true

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Output condition:
State 5: CRK_CTR >= NC_NR_VLD_TOOTH
State 0: Engine stalling detection function () = true
Or
Tooth period out-of-range detection function () = true

Action in the state:

If Normal tooth detection function () = true
/ tested only when no acceptance window can be applied */*
Or
Tooth period out-of-range detection function () = false
/ tested only when acceptance window can be applied */*
Then Increment CRK_CTR
Endif

If Tooth period out-of-range detection function () = true
Then LV_ORNG_TOOTH_PER_CRK = 1
Endif

Action in transient:
To state 5: LV_CRK_RUN = 1 (Engine speed can be computed)

State 5: First gap detection

Input condition:
From state 4: CRK_CTR >= NC_NR_VLD_TOOTH

Output conditions:
To state 6: Reference gap detection function () = true
To State 0: Engine stalling detection function () = true
Or
(Tooth period out-of-range detection function () = true
And
Reference gap detection function () = false)

Action in the state:
Activation of Reference gap detection function ()
Activation of Missing tooth simulation in gap position function ()
If Tooth period out-of-range detection function () = false
Then Increment CRK_CTR
Endif

If Tooth period out-of-range detection function () = true
And
Reference gap detection function () = false
Then LV_ORNG_TOOTH_PER_CRK = 1
Endif

Transient action:
To state 6: LV_CRK_SYN =1
CRK_CTR = 1
LV_FIRST_REF_GAP = 1

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State 6: Normal tooth

Input conditions:

From State 5: Reference gap detection function () = true

From State 7: Reference gap detection function () = true
And
CRK_CTR = (NC_NR_TOOTH /NC_NR_GAP) + 1

Output conditions:

To State 7: CRK_CTR >= (NC_NR_TOOTH /NC_NR_GAP) - NC_NR_TOOTH_GAP - NC_NR_TOOTH_TOL_MISS

To State 0: CRK_MISS_CTR > NC_NR_TOOTH_TOL_MISS
Or
Engine stalling detection function () = True

Action in the state:

Deactivation of Missing tooth simulation in gap position function ()
Activation of Missing tooth simulation function ()
If Normal tooth detection function () = true
/ tested only when no acceptance window can be applied */*
Or
Tooth period out-of-range detection function () = false
/ tested only when acceptance window can be applied */*
Then Increment CRK_CTR
Endif

If Tooth period out-of-range detection function () = true
Then LV_ORNG_TOOTH_PER_CRK = 1
Endif

Transient action:

To State 0: **If** CRK_MISS_CTR > NC_NR_TOOTH_TOL_MISS
Then LV_LOST_SYN_CRK = 1
Endif

State 7: Gap detection

Input condition:

From state 6: CRK_CTR >= (NC_NR_TOOTH /NC_NR_GAP) - NC_NR_TOOTH_GAP - NC_NR_TOOTH_TOL_MISS

Output condition:

To State 6: Reference gap detection function () = true
And
CRK_CTR = (NC_NR_TOOTH /NC_NR_GAP) + 1

To State 0: CRK_MISS_CTR > NC_NR_TOOTH_TOL_MISS + NC_NR_TOOTH_GAP
Or
CRK_ADD_CTR > NC_NR_TOOTH_TOL_ADD

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Or
Engine stalling detection function () = True

Action in the state:

Deactivation of Missing tooth simulation function ()
Activation of Missing tooth simulation in gap position function ()
If Tooth period out-of-range detection function () = false
Then Increment CRK_CTR
If CRK_CTR > (NC_NR_TOOTH /NC_NR_GAP) - NC_NR_TOOTH_GAP
Then Increment CRK_ADD_CTR
Endif
Endif

If Tooth period out-of-range detection function () = true
And
Reference gap detection function () = false
Then LV_ORNG_TOOTH_PER_CRK = 1
Endif

Transient action:

To state 6:
If CRK_MISS_CTR > 0
Or
CRK_ADD_CTR > 0
Then LV_ORNG_NR_TOOTH_CRK = 1
Endif
CRK_CTR = 1
CRK_MISS_CTR = 0
CRK_ADD_CTR = 0
LV_REF_GAP =1

To State 0:
If CRK_MISS_CTR > NC_NR_TOOTH_TOL_MISS + NC_NR_TOOTH_GAP
Or
CRK_ADD_CTR > NC_NR_TOOTH_TOL_ADD
Then LV_LOST_SYN_CRK = 1
Endif

2.10.2 Definition of the sub function task

2.10.2.1 Normal tooth detection function ()

General information:

The purpose of this function is to validate the tooth period of a normal tooth when no acceptance window can be applied (first valid tooth, first tooth after a reference gap ...). The function returns false when the tooth period is too small (Signal edges detected before a delay time of T_TOOTH_MIN are not valid).

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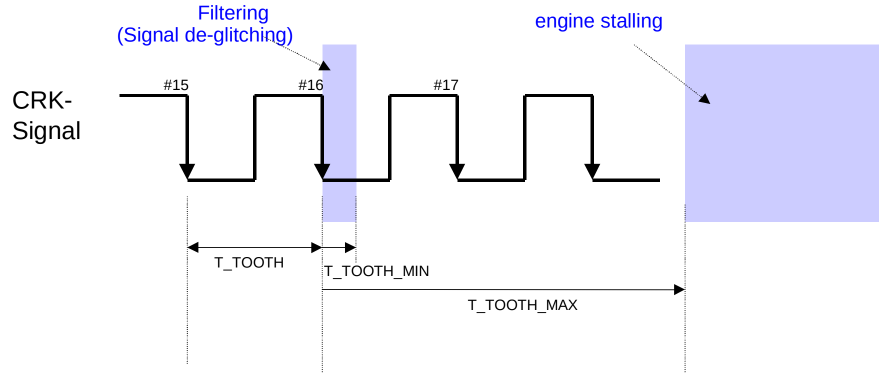


Formula section:

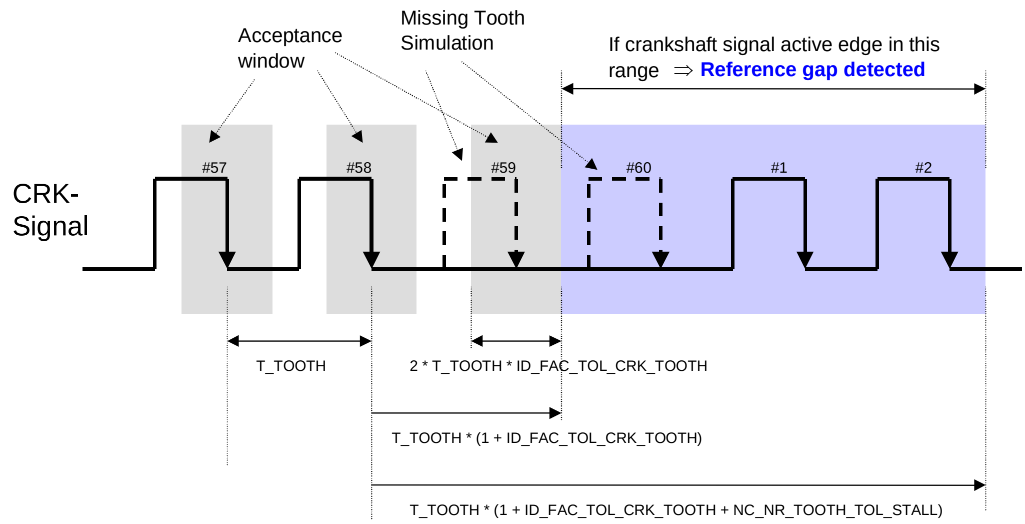
$$T\_TOOTH\_MIN = \frac{60}{NC\_NR\_TOOTH * NC\_N\_MAX}$$

If T_TOOTH => T_TOOTH_MIN
Then return (true)
Else return (false)
Endif

2.10.2.2 Reference gap detection function ()

General information:

The purpose of this function is to detect a reference gap.
A reference gap is detected if no signal edge was detected inside the crankshaft acceptance window and at least 1 (after synchronization) or NC_NR_TOOTH_FIRST_GAP_MIN (first gap detection) teeth have been completely simulated.
The follow figure shows the reference gap detection after synchronization:



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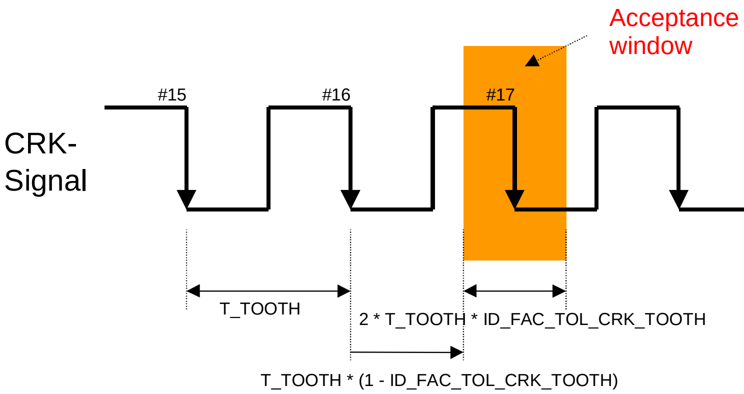
Formula section:

If LV_CRK_SYN = 1
Then **If** Number of simulated missing teeth in gap position >=1
  Then **If** (NC_NR_TOOTH /NC_NR_GAP) - CRK_MISS_CTR <=
    CRK_CTR <=
    (NC_NR_TOOTH /NC_NR_GAP) + CRK_ADD_CTR
   Then *(correct tooth counter)*
    CRK_CTR = CRK_CTR + CRK_MISS_CTR - CRK_ADD_CTR
    return (true)
   Else return (false)
  Endif
Else **If** Number of simulated missing teeth in gap position >=
    NC_NR_TOOTH_FIRST_GAP_MIN
  Then return (true)
  Endif
Endif

2.10.2.3 Tooth period out-of-range detection function ()

General information:

The purpose of this function is to check if the tooth period is within a defined window area. The function returns true if the tooth period is outside the acceptance window.



Formula section:

Before first reference gap:
If T_TOOTH n-1 * (1 - ID_FAC_TOL_CRK_TOOTH)   T_TOOTH n   T_TOOTH n-1 * (1 + ID_FAC_TOL_CRK_TOOTH)
Then return (false)
Else return (true)
After first reference gap:
If T_TOOTH n-1 * (1 - ID_FAC_TOL_CRK_TOOTH)   T_TOOTH n
Then return (false)
Else return (true)
Remark: If T_TOOTH > T_TOOTH n-1 * (1 + ID_FAC_TOL_CRK_TOOTH) after first reference gap, then a tooth is simulated (see below   Missing Tooth Simulation Function).

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The acceptance window is disabled

- on the first and second crankshaft signal edge after a reference gap detection
- on the first and second crankshaft signal edge after simulation of a missing tooth
- after engine synchronizarion, it could also be disabled below an engine speed, for example for engines having strong accelerations/decelerations at start:

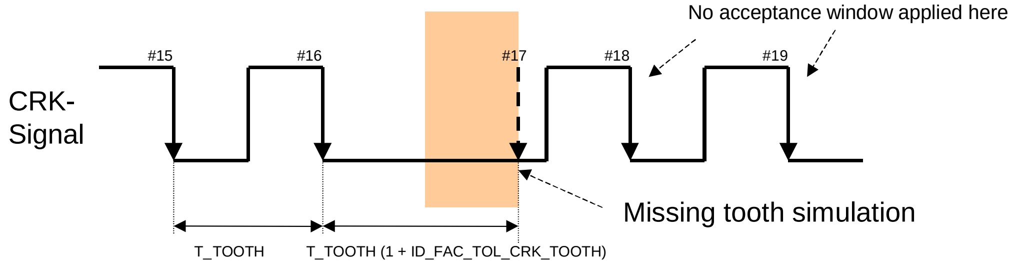
If N < NC_N_CRK_WIN_ENA
And CRK_CTR > NC_NR_TOOTH_TOL_ADD
And CRK_CTR < (NC_NR_TOOTH /NC_NR_GAP) - NC_NR_TOOTH_GAP -NC_NR_TOOTH_TOL_MIS - 2 (for latency time)

This effectively means that the acceptance window is <u>only</u> applied for GAP detection below the configured engine speed threshold.

2.10.2.4 Missing Tooth Simulation Function ()

General information:

Simulate a tooth with tooth period T_TOOTH n-1 (last measured tooth period).
All measurements shall be based on the simulated tooth not on real edges.
Simulation starts at the last (real or simulated) signal edge if no signal edge is detected inside the acceptance window defined by ID_FAC_TOL_CRK_TOOTH.



Formula section:

Increment CRK_CTR.
Increment CRK_MISS_CTR.
LV_CRK_MISS_TOOTH = 1

2.10.2.5 Missing Tooth Simulation in Gap Position Function ()

General information:

Simulate a tooth with tooth period T_TOOTH n-1 (last measured tooth period).
Simulation starts at the last (real or simulated) signal edge if no signal edge is detected inside the acceptance window defined by ID_FAC_TOL_CRK_TOOTH.
Simulation stops when a edge is detected after the first simulated missing tooth.
All measurements shall be based on the simulated tooth not on real edges.

Formula section:

Increment CRK_CTR.

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If number of simulated teeth < NC_NR_TOOTH_GAP
And
Missing tooth simulation stopped
Then Increment CRK_MISS_CTR
High acceleration during reference gap: only one tooth could be simulated
Endif

If number of simulated teeth > NC_NR_TOOTH_GAP
Then Increment CRK_ADD_CTR
High deceleration during reference gap: more than NC_NR_TOOTH_GAP teeth simulated
Endif

2.10.2.6 Engine stalling detection function ()

General information:

Engine stalling is detected when the number of consecutive simulated teeth exceeds NC_NR_TOOTH_ STALL or when the tooth period is greater than T_TOOTH_MAX.

Formula section:

$$T\_TOOTH\_MAX = \frac{60}{NC\_NR\_TOOTH * NC\_N\_MIN}$$

If more than NC_NR_TOOTH_ STALL consecutive teeth are simulated
Or
T_TOOTH (1 + ID_FAC_TOL_CRK_TOOTH) >= T_TOOTH_MAX
Then return (true)
Else return (false)
Endif

2.10.3 Requirements to infrastructure

2.10.3.1 Crankshaft Tooth Time Measurement (T_TOOTH)

General information:

System request accuracy <= 4 us
The crankshaft tooth period T_TOOTH is the measured time between two consecutive valid active crankshaft signal edges (falling or rising according to configuration).
If a missing tooth is simulated, T_TOOTH represents the time period between the last two real valid signal edges. T_TOOTH keeps the latest value until a new measured value is available.

2.10.3.2 Segment Period Measurement (T_SEG_ENSD) and Trigger Generation

General information:

System request accuracy <= 1 us

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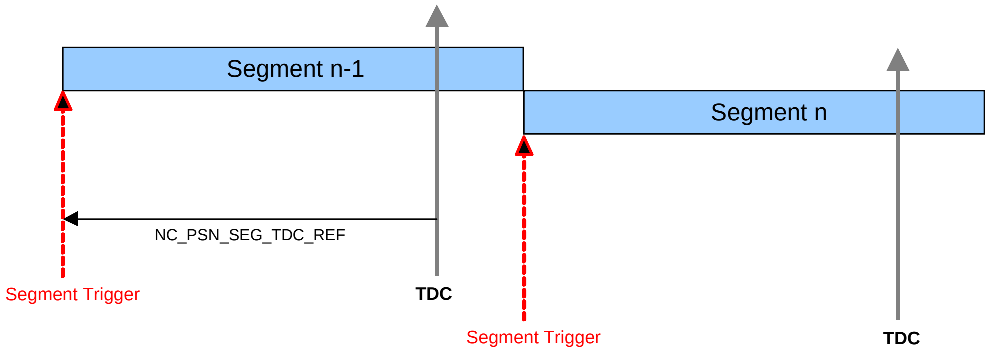
At Segment event, a trigger is defined and a control signal is generated to trigger execution of segment synchronous tasks.
The corresponding time intervals T_SEG_ENSD are measured between tooth events located NC_PSN_SEG_TDC_REF degrees before each TDC.



Application conditions

Initialisation: T_SEG_ENSD is set to the maximum value

Recurrence : before synchronization: once (when LV_CRK_RUN is set)
after synchronization: NC_PSN_SEG_TDC_REF degrees before each TDC (segment trigger)

Activation : LV_CRK_RUN = 1

Deactivation : LV_CRK_STOP = 1

Formula section:

Before synchronization, one segment time is output at the moment when crankshaft rotation is validated.
The first segment period is calculated from the most recent tooth period:
T_SEG_ENSD = (2 * T_TOOTH * NC_NR_TOOTH) /NC_CYL_NR
The same calculation applies to the first segment after synchronization.
After synchronization:
T_SEG_ENSD = time interval between tooth events located NC_PSN_SEG_TDC_REF degrees before each TDC

2.10.3.3 Half-Segment Period Measurement (T_SEG_HALF_ENSD) and Trigger Generation

General information:

System request accuracy <= 1 us
At the half of a segment (in the middle of two segment events) a half-segment event is generated and an half-segment trigger is defined and send to the ASW if the engine speed is lower than a threshold defined by NC_N_SEG_HALF_END.
This function provides a output value for the half-segment period. This measured time is send to the ASW.

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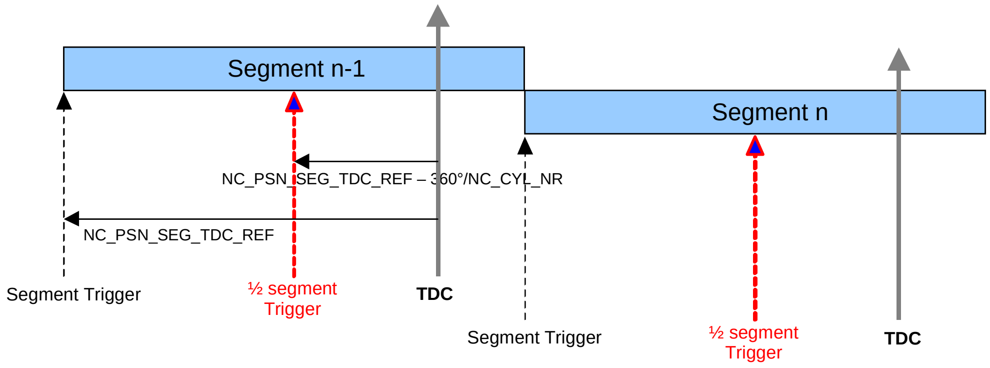

Application conditions

Initialisation: T_SEG_HALF_ENSD is set to the maximum value

Recurrence: before synchronization: once (when LV_CRK_RUN is set)
after synchronization:
NC_PSN_SEG_TDC_REF degrees before each TDC (segment trigger)
and
NC_PSN_SEG_TDC_REF – 360° CRK / NC_CYL_NR degrees before each TDC (half-segment trigger) **if** T_SEG_HALF_ENSD >= 60 / (NC_CYL_NR * NC_N_SEG_HALF_END)

Activation: LV_CRK_RUN = 1

Deactivation: LV_CRK_STOP = 1

Formula section:

The first half segment period is calculated from the most recent tooth period:

T_SEG_HALF_ENSD = (T_TOOTH * NC_NR_TOOTH) /NC_CYL_NR

After synchronization:

T_SEG_HALF_ENSD = time elapsed between

- a segment event and a half-segment event or
- a half-segment event and a segment event

2.10.3.4 Misfire Segment Period Measurement (T_SEG_ER)

General information:

System request accuracy <= 1 us
The function provides output values for the misfire segment period.
The misfire segment period T_SEG_ER corresponds to the TDC period, measured at the tooth events, which are closest to NC_PHA_SEG_ER_ENSD after each TDC.

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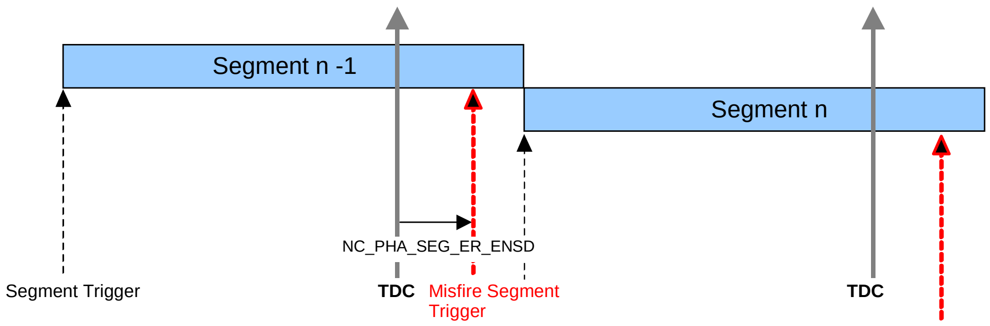

Application conditions

Initialisation: `T_SEG_ER is set to the maximum value`

Recurrence: `every misfire segment`

Formula section:

T_SEG_ER = time interval between misfire segment tooth events.

2.10.3.5 Crankshaft tooth window measurement (T_CRK_WIN_ENSD)

General information:

System request accuracy <= 1 us
The time interval elapsed between tooth events located between NC_CRK_WIN_SEG_LEN degrees before the end of each segment and the segment trigger is measured and send to the ASW segment synchronous
It provides and measures the time of the last NC_CRK_WIN_SEG_LEN teeth period before segment event.

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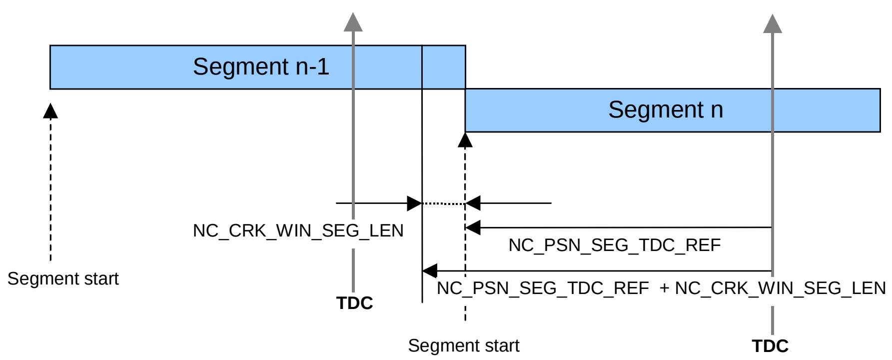

Application conditions

Initialisation: `T_CRK_WIN_ENSD is set to the maximum value`

Recurrence: `every segment`

Activation: `LV_CRK_SYN = 1`

Deactivation: `LV_CRK_STOP = 1`

Formula section:

If LV_CRK_SYN is set to 1 between NC_CRK_WIN_SEG_LEN degrees before the end of the segment and the segment trigger event
Then /* Recalculation from last available tooth period */
T_CRK_WIN = (T_TOOTH * NC_NR_TOOTH) /(360°CRK /NC_CRK_WIN_SEG_LEN)
Else /* Normal calculation */
T_CRK_WIN_ENSD = time interval between tooth events located between NC_CRK_WIN_SEG_LEN degrees before the end of each segment and the segment triger
Endif

2.10.3.6 ID_FAC_TOL_CRK_TOOTH calculation

General information:

ID_FAC_TOL_CRK_TOOTH[0rpm] is used until crankshaft synchronization (i.e. until first gap is detected, LV_CRK_SYN is set).
Then after crankshaft synchronization, ID_FAC_TOL_CRK_TOOTH is calculated depending on engine speed value (N_32).

2.10.4 System requirements to sensor signal

2.10.4.1 General

With both sensor technologies, there is an angular offset between the mechanical reference (usually the trailing edge of a tooth) and the timing reference of the sensor (zero crossing of the MCPS signal, output switching of the ACPS) for an active edge. This offset will further on be referred to as phase angle. The phase angle depends strongly on sensor tolerances, installation tolerances (air gap), and operating conditions (speed, temperature).
The tolerances given in the following paragraphs refer to the angular position of the crankshaft target wheel when an active signal edge is recognized by the input port of the µP, or to the rotation angle between such events, respectively.

2.10.4.2 Relative phase angle tolerances

The usual synchronization algorithms can accept 3% tolerance of the target wheel rotation angle between consecutive active signal edges.
e.g. for a 60-2 target wheel, this is 6° (18°) 0.2°
The sensor/target wheel combination has to fulfill this requirement at all operating conditions.
The permissible accumulation of tooth angle tolerances over a TDC segment is 0.25% of the angle for one TDC segment (720°/NC_CYL_NR) at segment reference conditions.
e.g. for four-cylinder engines 180° 0.-°
e.g. for six-cylinder engines 120° 0.3°
Segment reference conditions are: 2000rpm, 80°C.
Please note that for engines with more than 8 cylinders, this requirement is more stringent than the requirement for consecutive signal edges.

2.10.4.3 Relative phase angle stability

The angle for one TDC period measured under segment reference conditions must not have a drift > 0.0-° versus speed variation from 2000 rpm...7000 rpm and temperature variation within the complete

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range. This requirement has to be fulfilled for all tolerances and all possible displacements of the target wheel relative to the sensor (air gap, radial run-out, crankshaft flexion, bearing clearance...).
In case of MCPS sensors, phase angle stability must be measured with the ECU hardware stage.

2.10.4.4 Repeatability

Two different definitions of repeatability are functionally equal. The choice depends on the sensor test bench and measurement equipment.

1. Phase angle repeatability

(mechanical edge to signal edge for the same tooth) 0.025°

1. Interval repeatability

(signal edge to signal edge for the same pair of teeth) 0.05°

In both cases the repeatability is determined from the maximum and minimum value out of a large number of measurements under constant conditions.

2.10.5 Hardware and HAL requirements

2.10.5.1 EMI

Any signal disturbance must be suppressed as far as possible. Supplemental trigger events must not be generated due to such disturbance, particularly not at the slow zero crossing in the reference gap.

2.10.5.2 Phase shift repeatability

At constant operating conditions, the phase shift introduced by the input circuitry must be constant within 0.1 µs

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2.11 Acquisition of camshaft signal (internal version)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAM_DYW_CRK_SYN_ADC_EX	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window advance for exhaust camshaft to crankshaft reference in crankshaft synchronization mode					
CAM_DYW_CRK_SYN_ADC_IN	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window advance for intake camshaft to crankshaft reference in crankshaft synchronization mode					
CAM_DYW_CRK_SYN_RTD_EX	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window retard for exhaust camshaft to crankshaft reference in crankshaft synchronization mode					
CAM_DYW_CRK_SYN_RTD_IN	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window retard for intake camshaft to crankshaft reference in crankshaft synchronization mode					
CAM_DYW_SYN_EX	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window for angle between exhaust camshaft signal edges in crankshaft synchronization mode					
CAM_DYW_SYN_IN	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window for angle between intake camshaft signal edges in crankshaft synchronization mode					
CTR_EDGE_CAM_EX [NC_NR_CAM_CBK]	O/V	0... FFH	0... 255	1	-
Continuous camshaft signal edge counter					
CTR_EDGE_CAM_IN [NC_NR_CAM_CBK]	O/V	0... FFH	0... 255	1	-
Continuous camshaft signal edge counter					
IDX_EDGE_CAM_EX [NC_NR_CAM_CBK]	O/V	0... FH	1... 16	1	-
Index of the last camshaft signal edge					
IDX_EDGE_CAM_IN [NC_NR_CAM_CBK]	O/V	0... FH	1... 16	1	-
Index of the last camshaft signal edge					
LV_CAM_STOP_EX [NC_NR_CAM_CBK]	O	0... 1H	0 ...1	1	-
Self synchronization on Exhaust camshaft i is stopped					
LV_CAM_STOP_IN [NC_NR_CAM_CBK]	O	0... 1H	0 ...1	1	-
Self synchronization on Intake camshaft i is stopped					
LV_CAM_SYN_CRK	O/V	0... 1H	0 ...1	1	-
Camshaft acquisition ready for crankshaft synchronization.					
LV_ORNG_CAM_SYN_CRK	O/V	0... 1H	0 ...1	1	-
Camshaft signal for crankshaft synchronization out of range					
LV_ORNG_PER_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Exhaust camshaft segment period out of range					
LV_ORNG_PER_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Intake camshaft segment period out of range					
LV_ORNG_RATIO_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Exhaust camshaft segment ratio out of range					
LV_ORNG_RATIO_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Intake camshaft segment ratio out of range					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SYN_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Exhaust camshaft synchronized					
LV_SYN_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Intake camshaft synchronized					
LV_VLD_PSN_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Exhaust camshaft position measurement valid					
LV_VLD_PSN_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Intake camshaft position measurement valid					
PSN_CAM_CAM	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Theoretical angular distance between consecutive active camshaft edges					
PSN_CAM_CAM_1	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Theoretical angular distance between the active camshaft edge and the following active edge					
PSN_ENG_CRK_OFS	O	0... 2CFFH	0... 719.9375	0.0625	°CRK
Engine position offset for initialization at crankshaft synchronization.					
PSN_ENG_SYN_CAM_MAX	O	0... 2CFFH	0... 719.9375	0.0625	°CRK
Maximum engine position during crankshaft synchronization phase.					
PSN_ENG_SYN_CAM_MIN	O	0... 2CFFH	0... 719.9375	0.0625	°CRK
Minimum engine position during crankshaft synchronization phase.					
PSN_TOOTH1_CAM	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Theoretical angular distance between crankshaft tooth #1 and camshaft edge					
RATIO_PER_CAM_EX [NC_NR_CAM_CBK]	-	0... FFH	0.0625 ...16	0.0625	-
Camshaft period ratio for synchronization					
RATIO_PER_CAM_IN [NC_NR_CAM_CBK]	-	0... FFH	0.0625 ...16	0.0625	-
Camshaft period ratio for synchronization					
RATIO_PSN_EDGE_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK]	-	0... FFH	0.0625 ...16	0.0625	-
Theoretical exhaust camshaft i period ratio at edge z					
RATIO_PSN_EDGE_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK]	-	0... FFH	0.0625 ...16	0.0625	-
Theoretical intake camshaft i period ratio at edge z					
REL_ANG_CAM_REF_GAP	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Measured angular distance between reference gap and camshaft edge					
REL_ANG_CRK_CAM	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Measured angular distance between consecutive active camshaft edges					
ST_CAM_CRK_S	-	0... 4H	0 ...4	1	-
Cam crank synchronization state					
ST_CAM_PRE_INJ_S	-	0... 3H	0 ...3	1	-
Cam crank synchronization state					
ST_CAM_SS	-	0... 5H	0 ...5	1	-
Camshaft self synchronization state					
T_SEG_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 7FFFFFH	0... 1.9965	237.999e-9	s
Camshaft segment period					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_SEG_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 7FFFFFH	0... 1.9965	237.999e-9	s
Camshaft segment period					

Input data:

LV_ACT_CAM_EX [NC_NR_CAM_CBK] {p. 1505}	LV_ACT_CAM_IN [NC_NR_CAM_CBK] {p. 1505}	LV_ACT_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 1505}	LV_ACT_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 1505}
LV_CAM_LOCK_IVVT_EX [NC_NR_CBK_IVVT] {p. 8399}	LV_CAM_LOCK_IVVT_IN [NC_NR_CBK_IVVT] {p. 8399}	LV_CRK_FIRST_VLD_TOOTH {p. 853}	LV_CRK_SYN {p. 853}
LV_STOP_ENG {p. 1505}	N_32 {p. 1525}	NC_NR_TOOTH {p. 854}	NC_OFS_TDC0_REF_CRK {p. 854}
NLC_IVVT_EX {p. 8400}	NLC_IVVT_IN {p. 8401}	PSN_ENG_CRK {p. 1506}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CAM_ADJ_VVT_SYN_CRK_ADC_IN	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Extension of tolerance window CAM_DYW_CRK_SYN_ADC_IN when VVT is not in locked position at start					
C_CAM_ADJ_VVT_SYN_CRK_RTD_EX	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Extension of tolerance window CAM_DYW_CRK_SYN_RTD_EX when VVT is not in locked position at start					
C_CAM_ADJ_VVT_SYN_EX	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Extension of tolerance window CAM_DYW_SYN_EX when VVT is not in locked position at start					
C_CAM_ADJ_VVT_SYN_IN	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Extension of tolerance window CAM_DYW_SYN_IN when VVT is not in locked position at start					
C_CRK_ANG_DLY	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Crankshaft angle threshold after start of cranking to reduce the possible engine position range for pre-injection					
C_CRK_ANG_DLY_LST_CAM	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Crankshaft angle threshold after last cam edge to reduce the possible engine position range for pre-injection					
C_DYW_CAM_CRK_SYN_ADC_EX	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window advance for exhaust camshaft to crankshaft reference in crankshaft synchronization mode					
C_DYW_CAM_CRK_SYN_ADC_IN	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window advance for intake camshaft to crankshaft reference in crankshaft synchronization mode					
C_DYW_CAM_CRK_SYN_RTD_EX	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window retard for exhaust camshaft to crankshaft reference in crankshaft synchronization mode					
C_DYW_CAM_CRK_SYN_RTD_IN	-	0... 7FFH	0... 127.9375	0.0625	°CRK
Tolerance window retard for intake camshaft to crankshaft reference in crankshaft synchronization mode					
C_DYW_CAM_SYN_EX	-	0... 1FFH	0... 31.9375	0.0625	°CRK
Tolerance window for angle between exhaust camshaft signal edges in crankshaft synchronization mode					
C_DYW_CAM_SYN_IN	-	0... 1FFH	0... 31.9375	0.0625	°CRK
Tolerance window for angle between intake camshaft signal edges in crankshaft synchronization mode					
C_NR_EDGE_MIN_VLD_CAM_EX	-	0... FFH	0... 255	1	-
Number of exhaust camshaft signal edges for valid position output					
C_NR_EDGE_MIN_VLD_CAM_IN	-	0... FFH	0... 255	1	-
Number of intake camshaft signal edges for valid position output					
ID_FAC_CAM_EX	-	10... FFH	1... 15.9375	0.0625	-

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_N_32_1_ENSD	16	0... FFH	0... 8160	32	rpm
Period ratio tolerance factor for exhaust camshaft					
ID_FAC_CAM_IN	-	10... FFH	1... 15.9375	0.0625	-
LDPM_N_32_1_ENSD	16	0... FFH	0... 8160	32	rpm
Period ratio tolerance factor for intake camshaft					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ACT_CAM_EDGE_LIH	-	1... 3H	1 ...3	1	-
Active edge of camshaft signal for crankshaft limp-home					
NC_ACT_CAM_EDGE_SYN	-	1... 3H	1 ...3	1	-
Active edge of camshaft signal for cam/crk synchronization					
NC_NR_EDGE_CAM_EX	-	1... FH	1... 15	1	-
Number of signal edges per exhaust camshaft revolution					
NC_NR_EDGE_CAM_IN	-	1... FH	1... 15	1	-
Number of signal edges per intake camshaft revolution					
NC_NR_GAP	-	1... 2H	1 ...2	1	-
Number of reference gaps per engine revolution					
NC_PSN_EDGE_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK]	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Ideal engine position relative to TDC0 for exhaust camshaft i signal edge z					
NC_PSN_EDGE_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK]	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Ideal engine position relative to TDC0 for intake camshaft i signal edge z					
NC_T_SEG_MAX_CAM_EX	-	0... FFFFFFH	0... 3.99999	238.4e-9	s
Maximum time between camshaft signal edges					
NC_T_SEG_MAX_CAM_IN	-	0... FFFFFFH	0... 3.99999	238.4e-9	s
Maximum time between camshaft signal edges					
NC_T_SEG_MIN_CAM_EX	-	0... FFFFFFH	0... 3.99999	238.4e-9	s
Minimum time between camshaft signal edges					
NC_T_SEG_MIN_CAM_IN	-	0... FFFFFFH	0... 3.99999	238.4e-9	s
Minimum time between camshaft signal edges					

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General information:

This specification is dedicated to acquisition of the signal from sensors and target wheels on up to 4 camshafts (intake and exhaust, cylinder bank 1 and 2).
The operating mode of the signal acquisition is controled for each camshaft separately.
A diagnostic output is delivered to allow detection of camshaft signal failure.
The signal is used for:

1. Self synchronization of all camshafts: timing validation of the camshaft signal edges in correspondance with its theoretical position (used for VVT controler, for detection of crankshaft signal failure, and for limp-home in case of crankshaft signal failure).
2. Camshaft /crankshaft synchronization of the selected camshaft: determination of the offset for the engine position calculation.
3. Engine position interface for pre-injection (with the selected camshaft used for cam/crank synchronization)

These three functions are described with three states diagrams.

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Application conditions:

Recurrence:
For set of the RAM as flags, a mirror area is defined which contains a copy of the output and calibration data in the basic software area (see figure below).
The mirror area of the output data is updated by the lower layer at every signal edge.
The mirror area of the calibration data is updated by the upper layer each 10ms.
The output data is copied from the mirror area every 10 ms

2.11.1 Camshaft Self-Synchronization

Application conditions

Recurrence: *every camshaft signal edge (falling and rising)*

Signal flow diagram (ST_CAM_SS):

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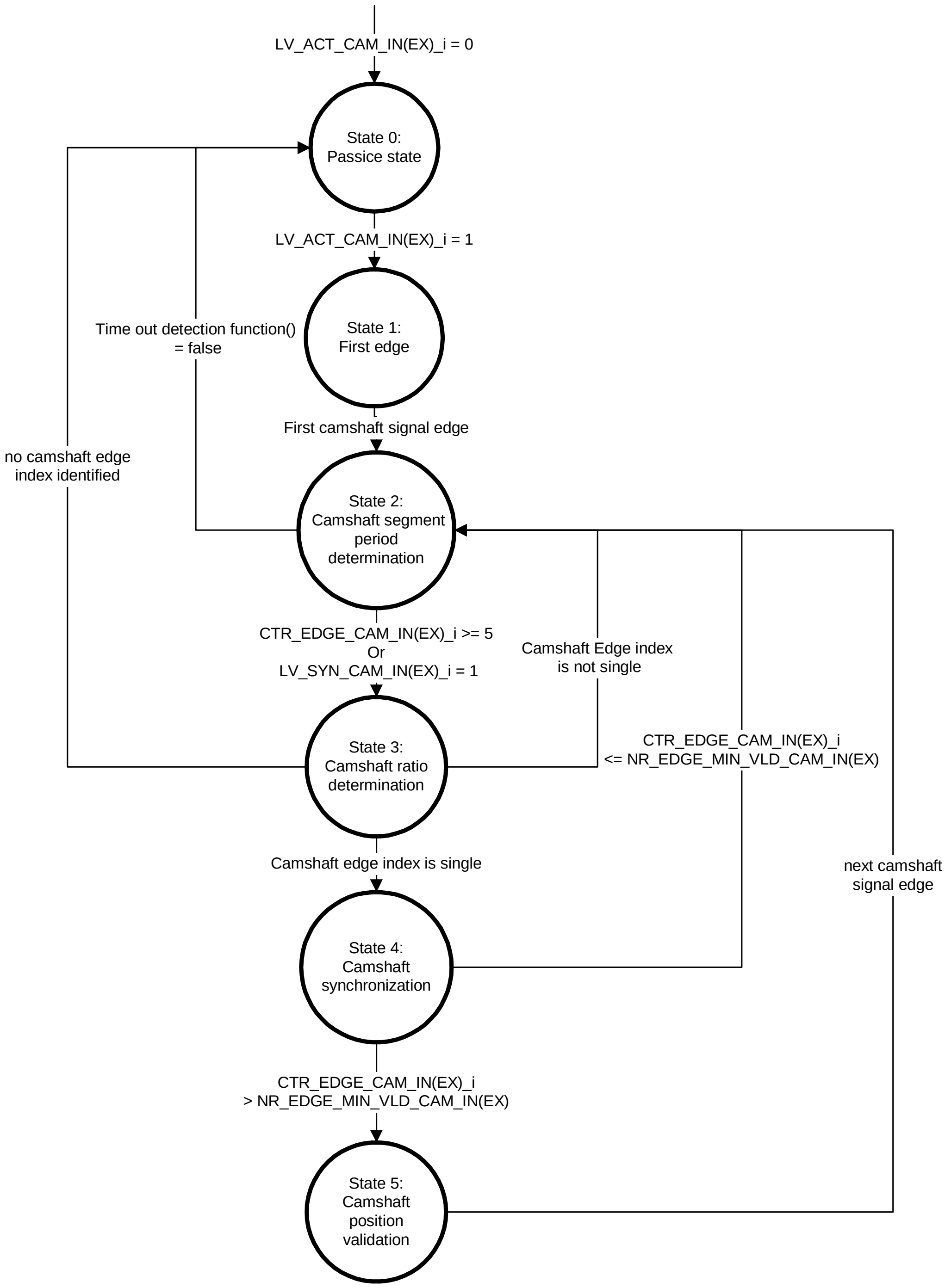

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Formula section:

i = 1...NC_NR_CAM_CBK　　　　z = 0...NC_NR_EDGE_CAM_IN(EX)

State 0: Passive State

Input condition :

From EPM :　　LV_ACT_CAM_IN(EX)[i] = 0

From state 2 :　　Time out detection function () = false

From state 3 : No cam edge index identified

Output condition :
No output conditions

Action in the state :

LV_CAM_STOP_IN[i] = LV_CAM_STOP_EX[i] = 1
T_SEG_CAM_IN[i] = NC_T_SEG_MAX_CAM_IN
T_SEG_CAM_EX[i] = NC_T_SEG_MAX_CAM_EX
LV_SYN_CAM_IN[i] = LV_SYN_CAM_EX[i] = 0
LV_VLD_PSN_CAM_IN[i] = LV_VLD_PSN_CAM_EX[i] = 0
CTR_EDGE_CAM_IN[i] = CTR_EDGE_CAM_EX[i] = 0
IDX_EDGE_CAM_IN[i] = IDX_EDGE_CAM_EX[i] = 1
RATIO_PER_CAM_IN(EX)[i] = 0
RATIO_PSN_EDGE_CAM_IN(EX)[z][i]= 0

Action in transient:
No actions

State 1: First edge

Input condition:

From state 0: LV_ACT_CAM_IN(EX)[i] = 1

Output condition:
To state 2 First camshaft signal edge

Action in the state:

LV_CAM_STOP_IN(EX)[i] = 0
LV_ORNG_PER_CAM_IN(EX)[i] = 0
LV_ORNG_RATIO_CAM_IN(EX)[i] = 0
Level detection: The indexes of the camshaft edge leading to the camshaft signal level will be determined (example: if the signal level is high, all indexes correponding to a rising signal edges).
Wait for first camshaft signal edge

Action in transient:
No actions

State 2: Camshaft segment period determination

Input condition :

From state 1 First camshaft signal edge occured
From state 3: Cam Edge index is not single
From state 4: CTR_EDGE_CAM_IN(EX)[i] <= C_NR_EDGE_MIN_VLD_CAM_IN(EX)
And next camshaft signal edge
From state 5: next camshaft signal edge

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Output condition :

To state 0 : Time out detection function () = False

To state 3 : CTR_EDGE_CAM_IN(EX)[i] >= 5
Or
LV_SYN_CAM_IN(EX)[i] = 1

Action in the state:

If Invalid segment period detection function() = true
Then LV_ORNG_PER_CAM_IN(EX)[i] = 1
Else *Activation of Time out detection function ()*
Increment CTR_EDGE_CAM_IN(EX)[i]
Indexes of the possible cam edges table are incremented by one modulo NC_NR_EDGE_CAM_IN(EX).
Endif

Action in transient:

No actions

State 3: Camshaft ratio determination

Input condition :

From state 2: CTR_EDGE_CAM_IN(EX)[i] >= 5
Or
LV_SYN_CAM_IN(EX)[i] = 1

Output condition :

To state 0: No Cam Edge index identified
To state 2: Cam Edge index is not single
To state 4: Cam Edge index is single

Action in the state :

Activation of Camshaft segment ratio calculation function ()
Activation of Camshaft edge recognition function ()

Action in transient :

To state 0: LV_ORNG_RATIO_CAM_IN(EX)[i] = 1
To state 4: LV_SYN_CAM_IN(EX)[i] = 1

State 4: Camshaft synchronization

Input condition :

From state 3: Cam Edge index is single

Output condition :

To state 2: CTR_EDGE_CAM_IN(EX)[i] <= C_NR_EDGE_MIN_VLD_CAM_IN(EX)
To state 5: CTR_EDGE_CAM_IN(EX)[i] >

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C_NR_EDGE_MIN_VLD_CAM_IN(EX)

Action in the state: IDX_EDGE_CAM_IN(EX)[i] = camshaft edge index
Wait next camshaft signal edge.

Action in transient:
To state 5: LV_VLD_PSN_CAM_IN(EX)[i] = 1

State 5: Validation of camshaft position

Input condition:
From state 4: CTR_EDGE_CAM_IN(EX)[i] >
C_NR_EDGE_MIN_VLD_CAM_IN(EX)

Output condition:
To state 2: Next camshaft signal edge

Action in the state: Wait next camshaft signal edge.

Action in transient:
None

2.11.2 Camshaft/Crankshaft Synchronization

General information:

Cam/crk synchronization is set as soon as the engine position is identified:

- Reference gap detected and
- Engine position offset determined

The engine position offset (PSN_ENG_CRK_OFF) can be

- 360° or 720° for NC_NR_GAP = 1
- 180°, 360°, 540°, 720° for NC_NR_GAP = 2

Application conditions

Recurrence:
```
every falling camshaft signal edge and every reference gap
if NC_ACT_CAM_EDGE_SYN = 1
every rising camshaft signal edge and every reference gap if
NC_ACT_CAM_EDGE_SYN = 2
every camshaft signal edge (rising and falling) and every reference
gap if NC_ACT_CAM_EDGE_SYN = 3
```

Signal flow diagram ST_CAM_CRK_S:

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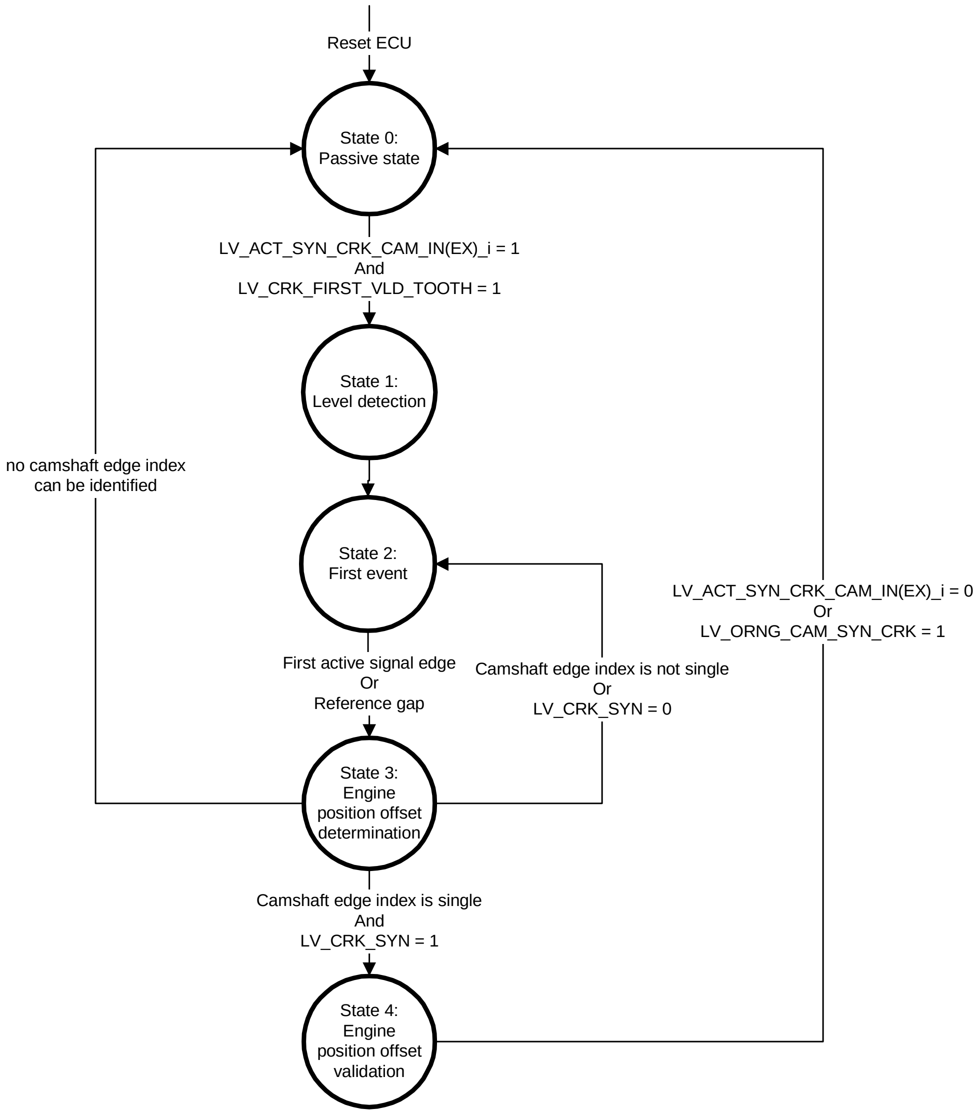

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Formula section:

State 0: Passive State

Input condition :

External event: Reset ECU

From State 4 : LV_ACT_SYN_CRK_CAM_IN(EX)[i] = 0

Or

LV_ORNG_CAM_SYN_CRK = 1

Output condition :

none

Action in the state: PSN_ENG_CRK_OFS = 0° CRK

LV_CAM_SYN_CRK = 0

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PSN_ENG_SYN_CAM_MIN = 0° CRK
PSN_ENG_SYN_CAM_MAX = 720° CRK
Activation of VVT lock check function ()

Action in transient :

none

State 1: Level Detection

Input condition:
From state 0 : LV_ACT_SYN_CRK_CAM_IN(EX)[i] = 1
And
LV_CRK_FIRST_VLD_TOOTH = 1

Output condition :
To state 2: At the end of the action in the state

Action in the state :

If NC_ACT_CAM_EDGE_SYN = 1
Then Index list = {1,3, ..., NC_NR_EDGE_CAM_IN(EX)-1}
Keep only falling camshaft edges
Keep initialization values for PSN_ENG_SYN_CAM_MIN(MAX)
Elseif NC_ACT_CAM_EDGE_SYN = 2
Then Index list = {2,4, ..., NC_NR_EDGE_CAM_IN(EX)}
Keep only rising edges
Keep initialization values for PSN_ENG_SYN_CAM_MIN(MAX)
Else The indexes of the camshaft edge leading to the camshaft signal level will be determined (p.e. if the signal level is high, all indexes correponding to a rising signal edges).
Keep initialization values for PSN_ENG_SYN_CAM_MIN(MAX)
Endif

Action in transient :
To state 2: LV_ORNG_CAM_SYN_CRK = 0

State 2: First event

Input condition :
From state 1: At the end of the action in the state 1
From state 3: Camshaft edge index is not single
Or
LV_CRK_SYN = 0

Output condition :
To state 3: camshaft signal active edge for synchronization
Or
crankshaft reference gap

Action in the state :

Wait camshaft signal active edge or reference gap

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Action in transient :

none

State 3: Engine Position Offset Determination

Input condition :

From state 3: camshaft signal active edge for synchronization
Or
crankshaft reference gap

Output condition :

To state 4 : Camshaft signal edge index is single
And
LV_CRK_SYN = 1.

To state 2 : Camshaft signal edge index is not single
Or
LV_CRK_SYN = 0

To state 0 : If no cam edge index can be identified.

Action in the state :

Activation of camshaft edge index determination function ()

Action in transient :

To state 4 : LV_CAM_SYN_CRK = 1
To state 0 : LV_ORNG_CAM_SYN_CRK = 1

State 4: Engine Position Offset Validation

Input condition :

To state 4 : Camshaft signal edge index is single
And
LV_CRK_SYN = 1.

Output condition :

To state 0 : LV_ACT_SYN_CRK_CAM_IN(EX)[i] = 0
Or
LV_ORNG_CAM_SYN_CRK = 1

Action in the state :

Activation of Cam/crk synchronization validation function()
If Cam/crk synchronization validation function() = false
Then LV_ORNG_CAM_SYN_CRK = 1
Endif

Action in transient :

None

2.11.3 Engine Position Interface for Pre-Injection

General information:

For rapid start of port-injection engines it is useful to start injection before synchronization on crankshaft signal is achieved. An approximative information about engine position is necessary for phasing the injection in a way to avoid emissions increase.

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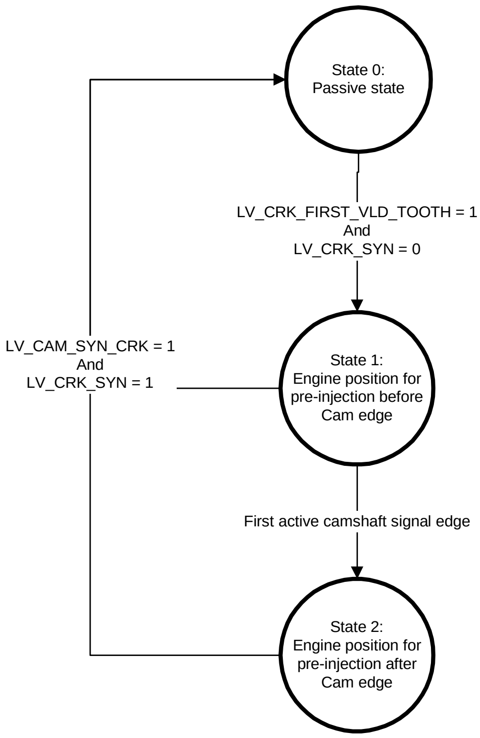
For this purpose, a minimum and the maximum engine position is determined according to the actual possible camshaft signal edge indexes found by camshaft signal acquisition for crankshaft synchronization. The minimum and the maximum position will converge gradually during the synchronization process.

Application conditions

Recurrence:

```
every falling camshaft signal edge and every reference gap
if NC_ACT_CAM_EDGE_SYN = 1
every rising camshaft signal edge and every reference gap if
NC_ACT_CAM_EDGE_SYN = 2
every camshaft signal edge (rising and falling) and every reference
gap if NC_ACT_CAM_EDGE_SYN = 3
```

Signal flow diagram (ST_CAM_PRE_INJ_S):



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Formula section:

State 0: Passive State

Input condition :

From state 1,2 : LV_CRK_SYN = 1
And
LV_CAM_SYN_CRK = 1

Output condition :

To state 1: LV_CRK_FIRST_VLD_TOOTH = 1
And

LV_CRK_SYN = 0

Action in the state :
None

Action in transient :
None

State 1: Engine position for pre-injection before cam edge state

Input condition :
From state 1: End of the state 1

Output condition :
To state 2 : camshaft signal active edge for synchronization
To state 0 : LV_CRK_SYN = 1 and LV_CAM_SYN_CRK = 1

Action in the state :
Activation of Pre-injection interface computation before cam edge function ()

Action in transient :
To state 0 : PSN_ENG_SYN_CAM_MIN
= PSN_ENG_SYN_CAM_MAX
= PSN_ENG_CRK

State 2: Engine position for pre-injection after cam edge state

Input condition :
From state 1: camshaft signal active edge for synchronization

Output condition :
To state 0 : LV_CRK_SYN = 1 and LV_CAM_SYN_CRK = 1

Action in the state :
Activation of Pre-injection interface computation after Cam edge function ()

Action in transient :
To state 0 : PSN_ENG_SYN_CAM_MIN
= PSN_ENG_SYN_CAM_MAX
= PSN_ENG_CRK

2.11.4 Definition of the sub function tasks

2.11.4.1 Time-out detection function ()

General information:

Time-out is detected when the segment period exceeds NC_T_SEG_MAX_CAM_IN(EX). Time out detection is used for engine stalling detection during crankshaft limp-home.

Formula section:

If T_SEG_CAM_IN(EX)[i] <= NC_T_SEG_MAX_CAM_IN(EX)

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Then return (true)
Else return(false)
Endif

2.11.4.2 Invalid segment period detection function ()

i = 1...NC_NR_CAM_CBK

General information:

Any signal edge detected before a delay time NC_T_SEG_MIN_CAM_IN(EX) following the previous signal edge will not produce any output.

Formula section:

If T_SEG_CAM_IN(EX)[i] < NC_T_SEG_MIN_CAM_IN(EX)
Then *Invalid segment period*
return (true)
Else return (false)
Endif

2.11.4.3 Camshaft segment ratio calculation function ()

General information:

The purpose of this function is to calculate a camshaft edge ratio from measured segment periods (measured ratio) and from designed edge positions (theoretical ratio).
i = 1...NC_NR_CAM_CBK z = 0...NC_NR_EDGE_CAM_IN(EX)

Application conditions:

Recurrence : every camshaft edge.

Formula section:

Measured ratio :
RATIO_PER_CAM_IN(EX)[i] =
(T_SEG_CAM_IN(EX)[i]n + T_SEG_CAM_IN(EX)[i]n-3) /
(T_SEG_CAM_IN(EX)[i]n-1 +T_SEG_CAM_IN(EX)[i]n-2)

Theoretical ratio :
For all remaining indexes z:
RATIO_PSN_EDGE_CAM_IN(EX)[z][i] =
(NC_PSN_EDGE_CAM_IN(EX)[z][i] - NC_PSN_EDGE_CAM_IN(EX)[z-1][i]
+ NC_PSN_EDGE_CAM_IN(EX)[z-3][i] - NC_PSN_EDGE_CAM_IN(EX)[z-4][i]) /
(NC_PSN_EDGE_CAM_IN(EX)[z-1][i] - NC_PSN_EDGE_CAM_IN(EX)[z-3][i])

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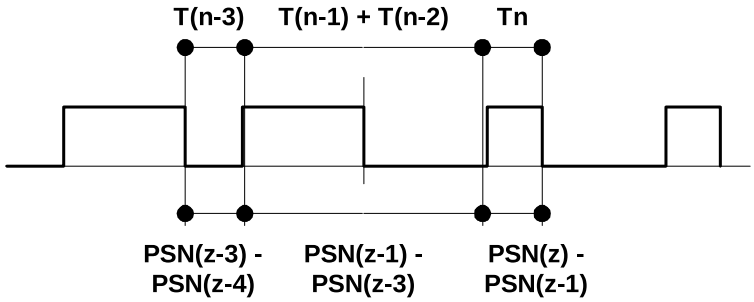

2.11.4.4 Camshaft edge recognition ()

General information:

The purpose of this function is to compare the measured camshaft edge ratio to the theoretical camshaft edge ratio. The camshaft edge is removed from the camshaft index index table if both ratios (theoretical and measured) are different more than ID_FAC_CAM_IN(EX).
i = 1...NC_NR_CAM_CBK z = 0...NC_NR_EDGE_CAM_IN(EX)

Application conditions

Recurrence: `every camshaft edge.`

Formula section:

For all remaining indexes z:
If RATIO_PSN_EDGE_CAM_IN(EX)[z][i] * ID_FAC_CAM_IN(EX) $>$ RATIO_PER_CAM_IN(EX)[i] $>$ RATIO_PSN_EDGE_CAM_IN(EX)[z][i] /ID_FAC_CAM_IN(EX)
Then keep index z in the table
Else eliminate index z from the table
Endif

2.11.4.5 Camshaft edge index determination function ()

General information:

This function determines the possible camshaft signal indexes and returns the engine position offset when the index is identified.
This function is used for

- determination of position offset for engine synchronization
- determination of min/max engine position for pre-injection

The actions and tests of this function shall be performed for all remaining indexes of the list of possible camshaft signal indexes.
i = 1...NC_NR_CAM_CBK z = 0...NC_NR_EDGE_CAM_IN(EX)

Application conditions

Recurrence: `every falling camshaft signal edge and every reference gap if NC_ACT_CAM_EDGE_SYN = 1`

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```
every rising camshaft signal edge and every reference gap if
NC_ACT_CAM_EDGE_SYN = 2
every camshaft signal edge (rising and falling) and every reference
gap if NC_ACT_CAM_EDGE_SYN = 3
```

Formula section:

If active camshaft signal edge
Then **If** NC_ACT_CAM_EDGE_SYN = 3
Then Increment indexes in the list of possible camshaft signal index by 1 modulo NC_NR_EDGE_CAM_IN(EX)
Else Increment by 2 indexes in the list of possible camshaft signal index by 2 modulo NC_NR_EDGE_CAM_IN(EX)
Endif

Calculate theoretical angular distance between crankshaft tooth #1 and camshaft edge #z:
PSN_TOOTH1_CAM = NC_OFS_TDC0_REF_CRK + NC_PSN_EDGE_CAM_IN(EX)[z][i]
Calculate theoretical angular distance between two successive active camshaft edges:
PSN_CAM_CAM is the distance between the current camshaft edge and the previous one, whereas PSN_CAM_CAM_1 is the distance between the current camshaft edge and the next one. PSN_CAM_CAM_1 is used in Test 10 in case of [CAM - CRK-Angle].
If NC_ACT_CAM_EDGE_SYN = 3
Then F*alling and rising camshaft edges*
PSN_CAM_CAM = NC_PSN_EDGE_CAM_IN(EX)[z][i] - NC_PSN_EDGE_CAM_IN(EX)[z-1][i]
PSN_CAM_CAM_1 = NC_PSN_EDGE_CAM_IN(EX)[z+1][i] - NC_PSN_EDGE_CAM_IN(EX)[z][i]

Else *Only Falling or only rising camshaft edges*
PSN_CAM_CAM = NC_PSN_EDGE_CAM_IN(EX)[z][i] - NC_PSN_EDGE_CAM_IN(EX)[z-2][i]
PSN_CAM_CAM_1 = NC_PSN_EDGE_CAM_IN(EX)[z+2][i] - NC_PSN_EDGE_CAM_IN(EX)[z][i]

Endif

The number of possible indexes z will be reduced by checking the conditions described below.
The following table shows the actions to perform in function of the current event (n), previous event (n-1) and last event (n-2).
The event is a detection of a active camshaft edge (**CAM**) for synchronization or a detection of reference gap (**GAP**). If no event took place before (**none**), the tests are executed with the measured angular distance between engine start and current event.
To reduce the possible engine position range for pre-injection, the event could also be a measured crankshaft angle (**CRK-Angle**) from the last CAM event. The event should occur when : REL_ANG_CRK_CAM = C_CRK_ANG_DLY_LST_CAM.
Note that two calibration datas are defined :

- C_CRK_ANG_DLY is the one used in case of [CRK-Angle - CAM] in Test 9 ;
- C_CRK_ANG_DLY_LST_CAM is the one used in case of [CAM - CRK-Angle] in Test 10.

This pre-injection improvement can be disabled by setting these calibration datas to 0°CRK.

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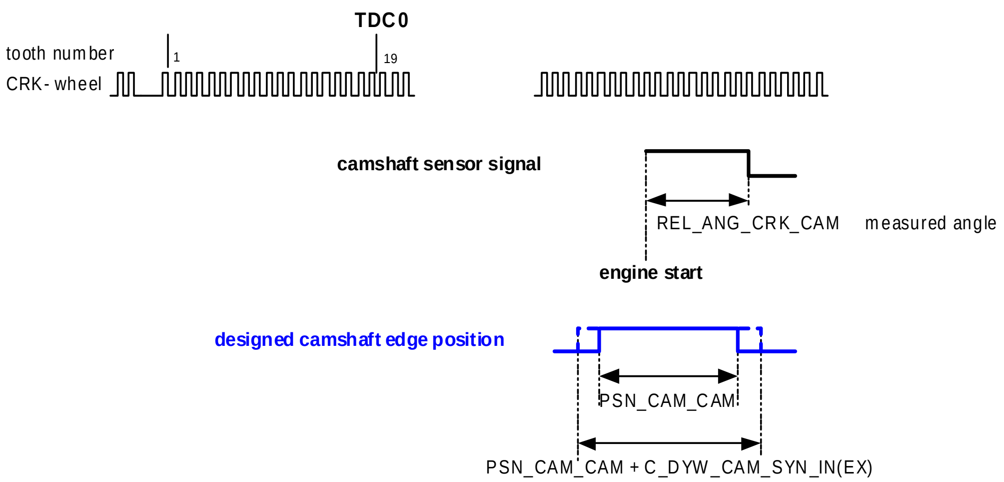
Event (n)	CAM	CAM	GAP	GAP	CAM	CAM	GAP	CRK-Angle
Event (n-1)	None	CAM	None	CAM	GAP	GAP	GAP	CAM
Event (n-2)	-	-	-	-	None	CAM	-	-
Test	Test 1 Test 9	Test 2 Test 11	Test 3 Test 12	Test 4 Test 12	Test 1 Test 5 (1)	Test 2 Test 5 (1)	(2)	Test 10 (3)

(1) The first test shall be executed with event **n** and **n-2**. The second test shall be executed with event **n** and **n-1**
(2) No Camshaft index can be identified (All remaining indexes shall be removed)
(3) CRK-Angle event will never be in position (n-1) as it will be replaced in the memory by the next event instead to be recorded in (n-1) position
NB1: The calculation of the CRK-Angle delay begins at each CAM edge, but is also reset in case of GAP event. No test should be performed in case of GAP - - CRK-Angle.
NB2: In all the following calculations, PSN_TOOTH1_CAM represents PSN_TOOTH1_CAM[z] (= PSN_TOOTH1_CAM for the camshaft edge z). If an other camshaft edge is used for computation, then PSN_TOOTH1_CAM[z] is mentioned.

Test 1:

Active camshaft edge detected. No active camshaft edge occured before.



If REL_ANG_CRK_CAM <
PSN_CAM_CAM + CAM_DYW_SYN_IN(EX)
Then (no operation)
Else Remove index z from list of possible camshaft signal edge indexes
Endif

Test 2:

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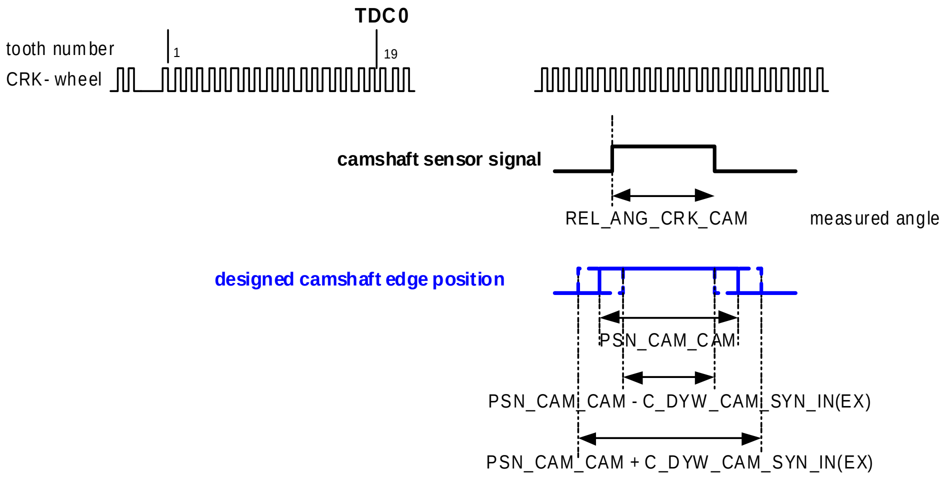
Active camshaft edge detected. Last event was also an active camshaft edge.



PSN_GAP = engine position offset for camshaft edge #z

If PSN_CAM_CAM - CAM_DYW_SYN_IN(EX)
< REL_ANG_CRK_CAM <
PSN_CAM_CAM + CAM_DYW_SYN_IN(EX)

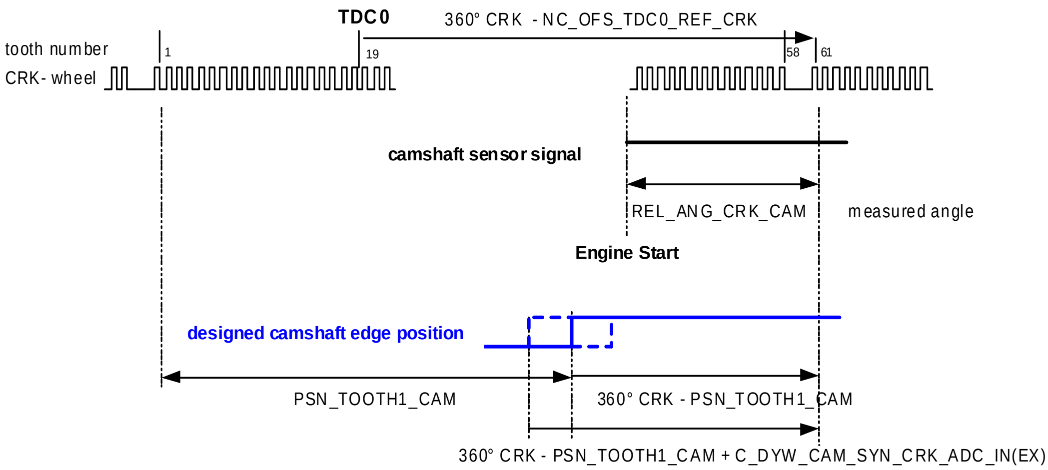
Then PSN_ENG_CRK_OFS = PSN_GAP - 360° CRK

Else Remove index z from list of possible camshaft signal edge indexes

Endif

Test 3:

First reference gap detected. No active camshaft edge occured before.



PSN_GAP = engine position offset for camshaft edge #z + 360° CRK /NC_NR_GAP

If REL_ANG_CRK_CAM <
PSN_GAP - PSN_TOOTH1_CAM + CAM_DYW_CRK_SYN_ADC_IN(EX)

And

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REL_ANG_CRK_CAM < 360° CRK /NC_NR_GAP

Then *Engine position is PSN_GAP - NC_OFS_TDC0_REF_CRK*

PSN_ENG_CRK_OFS = PSN_GAP - 360° CRK

Else

If *The camshaft edge can be found on both sides of the reference gap, it is not removed*

PSN_GAP - PSN_TOOTH1_CAM < CAM_DYW_CRK_SYN_RTD_IN(EX)

Then

Keep index z

Else

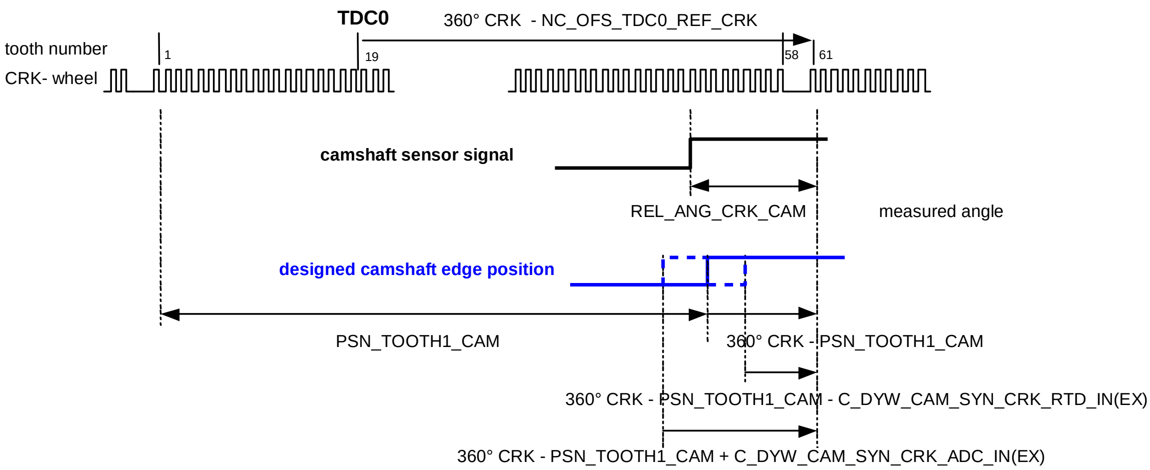
Remove index z from list of possible camshaft signal edge indexes

Endif

Endif

Test 4:

Reference gap detected. Last event was an active camshaft edge.



PSN_GAP = engine position offset for camshaft edge #z + 360° CRK /NC_NR_GAP

If PSN_GAP - PSN_TOOTH1_CAM - CAM_DYW_CRK_SYN_RTD_IN(EX)

< REL_ANG_CRK_CAM <
PSN_GAP - PSN_TOOTH1_CAM + CAM_DYW_CRK_SYN_ADC_IN(EX)

And
REL_ANG_CRK_CAM < 360° CRK /NC_NR_GAP

Then *Engine position is PSN_GAP - NC_OFS_TDC0_REF_CRK*

PSN_ENG_CRK_OFS = PSN_GAP - 360° CRK

Else

Remove index z from list of possible camshaft signal edge indexes

Endif

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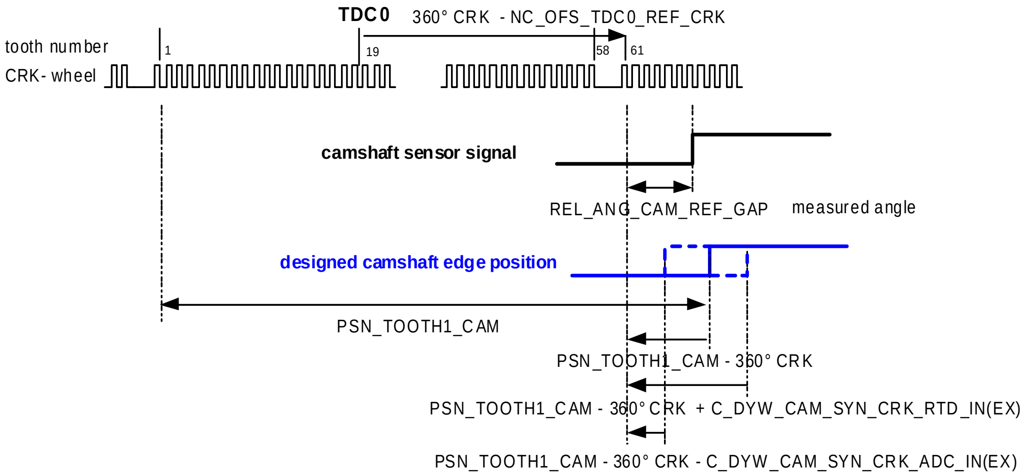
Test 5:

Active camshaft edge detected. Last event was reference gap.



PSN_GAP = engine position offset for camshaft edge #z

If PSN_TOOTH1_CAM - PSN_GAP - CAM_DYW_CRK_SYN_ADC_IN(EX)
< REL_ANG_CAM_REF_GAP <
PSN_TOOTH1_CAM - PSN_GAP + CAM_DYW_CRK_SYN_RTD_IN(EX)
And
REL_ANG_CAM_REF_GAP < 360° CRK /NC_NR_GAP

Then *Engine position is PSN_GAP - NC_OFS_TDC0_REF_CRK*
PSN_ENG_CRK_OFS = PSN_GAP - 360° CRK

Else
Remove index z from list of possible camshaft signal edge indexes

Endif

Test 9:

Active camshaft edge detected. No active camshaft edge occured before.
This test is executed after test 1 only if no GAP occurred before CAM edge.
If an angular distance greater than the crank angle delay calibration has been measured without any new event, this test allows to eliminate the corresponding camshaft edges that should occur.

If NC_ACT_CAM_EDGE_SYN = 3 (both falling and rising edges used)
And C_CRK_ANG_DLY > 0
And REL_ANG_CRK_CAM >= C_CRK_ANG_DLY
And *the cam edge z can not be seen on both sides of the reference gap*
((PSN_TOOTH1_CAM[z] - C_DYW_CAM_SYN_CRK_ADC_IN(EX)) modulo (360/NC_NR_GAP)) < ((PSN_TOOTH1_CAM[z] + C_DYW_CAM_SYN_CRK_RTD_IN(EX)) modulo (360/NC_NR_GAP))
And the *cam edge z-1 can not be seen on both sides of the reference gap*
((PSN_TOOTH1_CAM[z-1] - C_DYW_CAM_SYN_CRK_ADC_IN(EX)) modulo (360/NC_NR_GAP)) < ((PSN_TOOTH1_CAM[z-1] + C_DYW_CAM_SYN_CRK_RTD_IN(EX)) modulo (360/NC_NR_GAP))

Then
If REL_ANG_CRK_CAM <

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PSN_TOOTH1_CAM modulo (360/NC_NR_GAP) + CAM_DYW_CRK_SYN_RTD_IN(EX)

Then

Keep index z

Engine position range will be calculated in Pre-injection interface computation after Cam edge function (Pre-inj action 2)

Else

Remove index z from list of possible camshaft signal edge indexes

Endif

Else (no operation)

Endif

Test 10:

Crankshaft angle event detected. An active camshaft edge occurred before.

If C_CRK_ANG_DLY_LST_CAM > 0

Then

If REL_ANG_CRK_CAM < PSN_CAM_CAM_1 + CAM_DYW_SYN_IN(EX)

Then (No operation)

Else Remove index z from list of possible camshaft signal edge indexes

Endif

On the remaining cam edges, after the first test has been performed on all edges:

PSN_GAP = engine position offset for camshaft edge #z

If *The cam edge z can not be seen on both sides of the reference gap*

((PSN_TOOTH1_CAM[z] - C_DYW_CAM_SYN_CRK_ADC_IN(EX)) modulo (360/NC_NR_GAP)) < ((PSN_TOOTH1_CAM[z] + C_DYW_CAM_SYN_CRK_RTD_IN(EX)) modulo (360/NC_NR_GAP))

Then

If REL_ANG_CRK_CAM < (720 - PSN_TOOTH1_CAM) modulo (360/NC_NR_GAP) + CAM_DYW_CRK_SYN_ADC_IN(EX)

Then Keep index z

Engine position range will be calculated in Pre-injection interface computation after Cam edge function (Pre-inj action 5)

Engine position is PSN_GAP - NC_OFS_TDC0_REF_CRK

PSN_ENG_CRK_OFS = PSN_GAP - 360° CRK

Else

Remove index z from list of possible camshaft signal edge indexes

Endif

Else No operation

Endif

Else No operation

Endif

Test 11:

Active camshaft edge detected. Last event was also an active camshaft edge.
This test is done after test 2. So we know that any Gap is between the two camshaft edge events.
We can remove all indexes where a Gap is located between those and the previous cam edge.

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On the remaining cam edges, after the first test has been performed on all edges:

If NC_ACT_CAM_EDGE_SYN = 3 (both falling and rising edges used)

And

The cam edge z can not be seen on both sides of the reference gap

((PSN_TOOTH1_CAM[z] - C_DYW_CAM_SYN_CRK_ADC_IN(EX)) modulo (360/NC_NR_GAP)) < ((PSN_TOOTH1_CAM[z] + C_DYW_CAM_SYN_CRK_RTD_IN(EX)) modulo (360/NC_NR_GAP))

And

The cam edge z-1 can not be seen on both sides of the reference gap

((PSN_TOOTH1_CAM[z-1] - C_DYW_CAM_SYN_CRK_ADC_IN(EX)) modulo (360/NC_NR_GAP)) < ((PSN_TOOTH1_CAM[z-1] + C_DYW_CAM_SYN_CRK_RTD_IN(EX)) modulo (360/NC_NR_GAP))

Then

If PSN_TOOTH1_CAM[z-1] > PSN_TOOTH1_CAM[z]

Or

PSN_TOOTH1_CAM[z-1] < 360/NC_NR_GAP < PSN_TOOTH1_CAM[z]

Or

PSN_TOOTH1_CAM[z-1] < 360 < PSN_TOOTH1_CAM[z]

Or

PSN_TOOTH1_CAM[z-1] < 360*(2-1/NC_NR_GAP) < PSN_TOOTH1_CAM[z]

Then

Remove index z

Else

Keep index z

Endif

Endif

Test 12:

This test is executed on Gap after the test 3 or 4.
On the remaining cam edges, has been performed on all edges:

If NC_ACT_CAM_EDGE_SYN = 3 (both falling and rising edges used)

And

The cam edge z can not be seen on both sides of the reference gap

((PSN_TOOTH1_CAM[z] - C_DYW_CAM_SYN_CRK_ADC_IN(EX)) modulo (360/NC_NR_GAP)) < ((PSN_TOOTH1_CAM[z] + C_DYW_CAM_SYN_CRK_RTD_IN(EX)) modulo (360/NC_NR_GAP))

And

The cam edge z+1 can not be seen on both sides of the reference gap

((PSN_TOOTH1_CAM[z+1] - C_DYW_CAM_SYN_CRK_ADC_IN(EX)) modulo (360/NC_NR_GAP)) < ((PSN_TOOTH1_CAM[z+1] + C_DYW_CAM_SYN_CRK_RTD_IN(EX)) modulo (360/NC_NR_GAP))

Then

If PSN_TOOTH1_CAM[z] > PSN_TOOTH1_CAM[z+1]

Or

PSN_TOOTH1_CAM[z] < 360/NC_NR_GAP < PSN_TOOTH1_CAM[z+1]

Or

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PSN_TOOTH1_CAM[z] < 360 < PSN_TOOTH1_CAM[z+1]
Or
PSN_TOOTH1_CAM[z] < 360*(2-1/NC_NR_GAP) < PSN_TOOTH1_CAM[z+1]

Then

Keep index z

Else

Remove index z

Endif

Endif

2.11.4.6 Cam/crk synchronization validation function ()

General information:

The purpose of this function is to check the angular distance between cam/crk events. The function returns false is the active camshaft signal edge z is outside the defined tolerance window.
i = 1...NC_NR_CAM_CBK z = 0...NC_NR_EDGE_CAM_IN(EX)

Application conditions

Recurrence:

```
every falling camshaft signal edge and every reference gap
if NC_ACT_CAM_EDGE_SYN = 1
every rising camshaft signal edge and every reference gap if
NC_ACT_CAM_EDGE_SYN = 2
every camshaft signal edge (rising and falling) and every reference
gap if NC_ACT_CAM_EDGE_SYN = 3
```

Formula section:

If active camshaft signal edge
Then **If** NC_ACT_CAM_EDGE_SYN = 3
Then Increment indexes in the list of possible camshaft signal index by 1 modulo NC_NR_EDGE_CAM_IN(EX)
Else Increment by 2 indexes in the list of possible camshaft signal index by 2 modulo NC_NR_EDGE_CAM_IN(EX)
Endif

Calculate theoretical angular distance between crankshaft tooth #1 and camshaft edge #z:
PSN_TOOTH1_CAM = NC_OFS_TDC0_REF_CRK + NC_PSN_EDGE_CAM_IN(EX)[z][i]
Calculate theoretical angular distance between two successive active camshaft edges:
If NC_ACT_CAM_EDGE_SYN = 3
Then *Falling and rising camshaft edges*
PSN_CAM_CAM = NC_PSN_EDGE_CAM_IN(EX)[z][i] - NC_PSN_EDGE_CAM_IN(EX)[z-1][i]
Else *Only Falling or only rising camshaft edges*
PSN_CAM_CAM = NC_PSN_EDGE_CAM_IN(EX)[z][i] - NC_PSN_EDGE_CAM_IN(EX)[z-2][i]
Endif

The following table shows the actions to perform in function of the current (n) and last event (n-1).

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The event is a detection of a active camshaft signal edge for synchronization (CAM) or a detection of reference gap (GAP). Tests and edge elimination shall only be performed on active camshaft signal edges with current value of REL_ANG_CRK_CAM.

Event (n)	CAM	GAP	CAM	GAP
Event (n-1)	CAM	CAM	GAP	GAP
Test	Test 6	Test 7	Test 8	(*)

(*) No Camshaft index can be identified (All remaining indexes shall be removed)

Test 6:

Active camshaft edge detected. Last event was also a active camshaft edge.
If PSN_CAM_CAM - CAM_DYW_SYN_IN(EX)
< REL_ANG_CRK_CAM <
PSN_CAM_CAM + CAM_DYW_SYN_IN(EX)
Then *camshaft signal edge is valid*
return (true)
Else *Invalid camshaft signal edge, synchronization validation failed*
return (false)
Endif

Test 7:

Reference gap detected. Last event was a active camshaft signal edge.

PSN_GAP = current engine position offset
If PSN_GAP -PSN_TOOTH1_CAM - CAM_DYW_CRK_SYN_RTD_IN(EX)
< REL_ANG_CRK_CAM <
PSN_GAP - PSN_TOOTH1_CAM + CAM_DYW_CRK_SYN_ADC_IN(EX)
And
REL_ANG_CRK_CAM <= 360° CRK /NC_NR_GAP
Then *camshaft signal edge is valid*
return (true)
Else *Invalid camshaft signal edge*
return (false)
Endif

Test 8:

Active camshaft signal edge detected. Last event was a reference gap.

PSN_GAP = current engine position offset
If PSN_TOOTH1_CAM - PSN_GAP - CAM_DYW_CRK_SYN_ADC_IN(EX)
< REL_ANG_CAM_REF_GAP <
PSN_TOOTH1_CAM - PSN_GAP + CAM_DYW_CRK_SYN_RTD_IN(EX)
And
REL_ANG_CAM_REF_GAP <= 360° CRK /NC_NR_GAP
Then *camshaft signal edge is valid*
return (true)

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Else *Invalid camshaft signal edge*
return (false)
Endif

2.11.4.7 Pre-injection interface computation before Cam edge function ()

General information:

A truth table is used in order to define the possible engine position.

Application conditions

Recurrence : `every crankshaft edge (CRK) or every reference gap (GAP)`

Formula section:

Event (n)	CRK	GAP
Pre-inj Action	1	2

Pre-inj Action 1

PSN_ENG_SYN_CAM_MIN n = **PSN_ENG_SYN_CAM_MIN** n-1 + 360°/NC_NR_TOOTH
PSN_ENG_SYN_CAM_MAX n = **PSN_ENG_SYN_CAM_MAX** n-1

Pre-inj Action 2

PSN_ENG_SYN_CAM_MIN n = **PSN_ENG_SYN_CAM_MIN** n-1 + (NC_NR_TOOTH_GAP+1)* 360°/NC_NR_TOOTH
PSN_ENG_SYN_CAM_MAX n = **PSN_ENG_SYN_CAM_MAX** n-1

2.11.4.8 Pre-injection interface computation after Cam edge function ()

General information:

A truth table is used in order to define the possible engine position.

Application conditions

Recurrence:

```
every falling camshaft signal edge (CAM), every reference gap
(GAP) or every active crankshaft edge (CRK) if NC_ACT_CAM_
EDGE_SYN = 1
every rising camshaft signal (CAM), every reference gap (GAP)
or every active crankshaftedge(CRK) if NC_ACT_CAM_EDGE_SYN
= 2
every falling and rising camshaft signal edge (CAM), every
reference gap (GAP) or every active crankshaft edge (CRK) if
NC_ACT_CAM_EDGE_SYN = 3
```

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Formula section:

Event (n)	CRK	CRK	CAM	GAP	GAP	CRK-Angle
Event (n-1)	CRK	CAM	CRK	CRK	CAM	CRK
Pre-inj Action	1	1	2	3	4	5

Pre-inj Action 1

PSN_ENG_SYN_CAM_MIN n = **PSN_ENG_SYN_CAM_MIN** n-1 + 360°/NC_NR_TOOTH
PSN_ENG_SYN_CAM_MAX n = **PSN_ENG_SYN_CAM_MAX** n-1 + 360°/NC_NR_TOOTH

Pre-inj Action 2

PSN_ENG_SYN_CAM_MIN = NC_PSN_EDGE_CAM_IN(EX)[z][i] - CAM_DYW_SYN_IN(EX)
for the lowest possible signal edge index z
PSN_ENG_SYN_CAM_MAX = NC_PSN_EDGE_CAM_IN(EX)[z][i] + CAM_DYW_SYN_IN(EX)

for the highest possible signal edge index z
Note: The possible signal edges z are determined by checking the conditions of Camshaft Edge Index determination function() . This function must be executed before action 2.

Pre-inj Action 3

PSN_ENG_SYN_CAM_MIN n = **PSN_ENG_SYN_CAM_MIN** n-1 + (NC_NR_TOOTH_GAP+1)* 360°/NC_NR_TOOTH
PSN_ENG_SYN_CAM_MAX n = **PSN_ENG_SYN_CAM_MAX** n-1 + (NC_NR_TOOTH_GAP+1)* 360°/NC_NR_TOOTH

Pre-inj Action 4

A camshaft edge has occured during the reference gap (when the camshaft edge is detected Pre-inj Action 2 is performed and when the first crankshaft edge after the reference is detected Pre-inj Action 4 is performed)
PSN_ENG_SYN_CAM_MIN n = **PSN_ENG_SYN_CAM_MIN** n-1 + **REL_ANG_CRK_CAM**
PSN_ENG_SYN_CAM_MAX n = **PSN_ENG_SYN_CAM_MAX** n-1 + **REL_ANG_CRK_CAM**

Pre-inj Action 5

A crank-angle event has occurred. A precise calculation of the engine position for pre-injection is possible.
PSN_ENG_SYN_CAM_MIN = NC_PSN_EDGE_CAM_IN(EX)[z][i] - CAM_DYW_SYN_IN(EX) + REL_ANG_CRK_CAM
for the lowest possible signal edge index z
PSN_ENG_SYN_CAM_MAX = NC_PSN_EDGE_CAM_IN(EX)[z][i] + CAM_DYW_SYN_IN(EX) + REL_ANG_CRK_CAM
for the highest possible signal edge index z
Note: The possible signal edge z is determined by checking the conditions of Camshaft Edge Index determination function() . This function must be executed before action 5.

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2.11.4.9 VVT lock check function ()

General information:

The purpose of this function is to check the VVT lock position flag and to extend the cam/crk tolerance windows if the VVT is not in locked position at engine start.

Application conditions

Recurrence:
```
at transition of LV_STOP_ENG from 0 to 1
Or
Reset ECU
```

Formula section:

If LV_CAM_LOCK_IVVT_IN(EX)[i] = 0 for the camshaft sensor selected for cam/crk synchronization
And
NLC_IVVT_IN(EX) = 1
Then VVT not in locked position at engine start
CAM_DYW_SYN_IN = C_DYW_CAM_SYN_IN + C_CAM_ADJ_VVT_SYN_IN
CAM_DYW_SYN_EX = C_DYW_CAM_SYN_EX + C_CAM_ADJ_VVT_SYN_EX
CAM_DYW_CRK_SYN_ADC_IN = C_DYW_CAM_CRK_SYN_ADC_IN + C_CAM_ADJ_VVT_SYN_CRK_ADC_IN
CAM_DYW_CRK_SYN_ADC_EX = C_DYW_CAM_CRK_SYN_ADC_EX
CAM_DYW_CRK_SYN_RTD_IN = C_DYW_CAM_CRK_SYN_RTD_IN
CAM_DYW_CRK_SYN_RTD_EX = C_DYW_CAM_CRK_SYN_RTD_EX + C_CAM_ADJ_VVT_SYN_CRK_RTD_EX
Else
VVT in locked position at engine start or no VVT at all
CAM_DYW_SYN_IN = C_DYW_CAM_SYN_IN
CAM_DYW_SYN_EX = C_DYW_CAM_SYN_EX
CAM_DYW_CRK_SYN_ADC_IN = C_DYW_CAM_CRK_SYN_ADC_IN
CAM_DYW_CRK_SYN_ADC_EX = C_DYW_CAM_CRK_SYN_ADC_EX
CAM_DYW_CRK_SYN_RTD_IN = C_DYW_CAM_CRK_SYN_RTD_IN
CAM_DYW_CRK_SYN_RTD_EX = C_DYW_CAM_CRK_SYN_RTD_EX
Endif

2.11.5 Requirements to Infrastructure

2.11.5.1 Camshaft segment period measurement

General information:

System request accuracy <= 4 us
The camshaft segment period T_SEG_CAM_IN(EX)[i] is the measured time between two consecutive valid camshaft signal edges.

2.11.5.2 Measurement of angular distance to active camshaft edge

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General information:

The purpose of this function is to provide a measurement for

- the angular distance between the first valid crankshaft teeth and the first active camshaft edge
- the angular distance between two consecutive valid active camshaft signal edges

Only active camshaft signal edges shall be processed. The active camshaft edge for synchronization is defined by NC_ACT_CAM_EDGE_SYN.

Application conditions

Recurrence: *every active camshaft edge and every active crankshaft edge.*

Formula section:

```
If          LV_CRK_FIRST_VLD_TOOTH = 0
Then        REL_ANG_CRK_CAM = 0
Else        If      active camshaft signal edge
            Then        REL_ANG_CRK_CAM = 0
            Else        If      active crankshaft signal edge or after missing tooth simulation
                        Then        REL_ANG_CRK_CAM = REL_ANG_CRK_CAM +
                                        (360° CRK   /NC_NR_TOOTH)
                        Else        REL_ANG_CRK_CAM is frozen
                        Endif
        Endif
Endif
```

2.11.5.3 Measurement of angular distance from reference gap to active camshaft edge

General information:

The purpose of this function is to provide a measurement for

- the angular distance between a crankshaft reference gap and a active camshaft signal edge

Application conditions

Recurrence: *every active crankshaft signal edge*

Formula section:

```
If          Reference Gap is detected
Then        REL_ANG_CAM_REF_GAP = 0
Else        If      crank active edge
            Then        REL_ANG_CAM_REF_GAP = REL_ANG_CAM_REF_GAP +
                                (360° CRK /NC_NR_TOOTH)
            Else        REL_ANG_CAM_REF_GAP is frozen
            Endif
Endif
```

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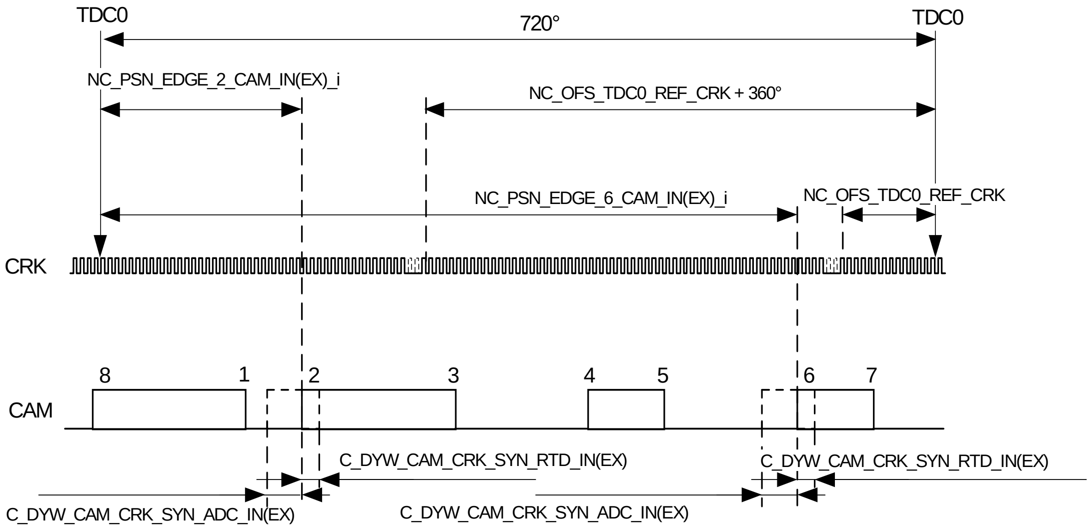

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2.12 Acquisition of wheel speed sensor

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
BIOS_VS_EDGE_CTR	O	0... FFFFH	0... 65565	1	-
Vehicle speed sensor tooth counter (free running counter)					
BIOS_VS_EDGE_T	O	0... FFFFH	0... 524280	8	(s
timestamp of last tooth (free running timer)					

FUNCTION DESCRIPTION:

General information:

The wheel sensor signal (high and low) is recorded by incrementation of the free running edge counter BIOS_VS_EDGE_CTR with one digit at every change from low to high. The value is stored as BIOS_ VS_EDGE_CTR in a free running counter too.

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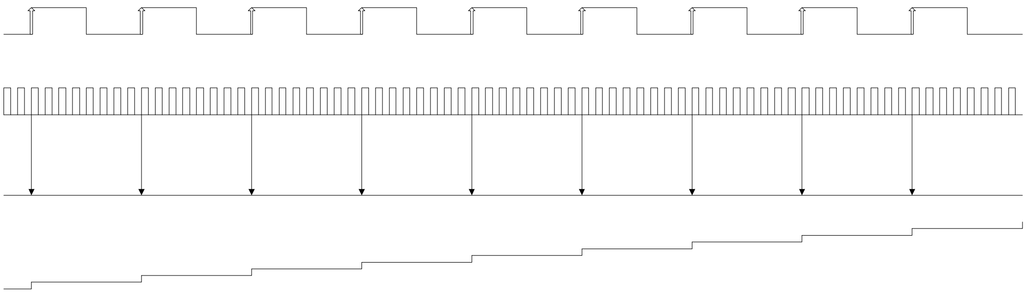

Signal flow diagram:

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2.13 Acquisition of oil sensor

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_BIOS_POIL_SWI	O/V	0... 1H	0 ...1	1	-
Logical variable for non debounced oil pressure switch signal					
LV_POIL_SWI	O/V	0... 1H	0 ...1	1	-
logical variable oil pressure switch (1= oil pressure o.k.)					
LV_POIL_SWI_SUB	-	0... 1H	0 ...1	1	-
Logical variable for oil pressure switch or oil pressure sensor					
POIL	O/V	B1E0... 4E10H	-20 ...20	1.0004e-3	bar
Oil pressure (Relative Sensor)					
T_POIL_SWI	V	0... FFH	0... 25.5	0.1	s
timer for delayed oil switch					

Input data:

AC_VEH_LGT_TCS {p. 1561}	AC_VEH_TRV_TCS {p. 1561}	C_T_MIN_PWL {p. 3776}	C_V_POIL_MAX_DIAG {p. 4365}
C_V_POIL_MIN_DIAG {p. 4365}	ECU_STATE {p. 1091}	LV_ERR_SENS_POIL {p. 4365}	LV_IGK {p. 906}
LV_POIL_SWI_CUS {p. 8202}	T_PWL {p. 3776}	V_POIL {p. 831}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_POIL_AC_VEH_LGT_TCS	-	8010... 7FF0H	-51.175 ...51.175	0.0015625	m/s**2
threshold for longitudinal acceleration for oil pressure switch					
C_POIL_AC_VEH_TRV_TCS	-	8010... 7FF0H	-51.175 ...51.175	0.0015625	m/s**2
threshold for transversal acceleration for oil pressure switch					
C_POIL_ERR_SUB	-	0... 4E20H	0... 20	0.001	bar
Substitute value of oil pressure in case of an sensor error					
C_T_POIL_SWI_BAS	-	0... FFH	0... 25.5	0.1	s
Basis time delay for oil pressure switch					
C_T_POIL_SWI_LGT	-	0... FFH	0... 25.5	0.1	s
time delay for oil pressure switch due to LGT					
C_T_POIL_SWI_TRV	-	0... FFH	0... 25.5	0.1	s
time delay for oil pressure switch due to TRV					
IP_POIL_V_POIL_REL	-	31E0... CE20H	-20 ...20	0.001	bar
LDP_V_POIL_IP_POIL_V_POIL_REL	8	0... 3FFH	0... 4.99511	4.8828e-3	V
Oil pressure sensor linearisation table for relative sensor					
LC_POIL_CTL_ENA	-	0... 1H	0 ...1	1	-
Boolean to enable oil pressure control					

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2.13.1 Acquisition of oil pressure switch

Import action:

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ACTION_INFR_GetPoilSwi(OUT <lv_bios_poil_swi>**)**
This action reads the input pin of the "POIL Switch"

FUNCTION DESCRIPTION:

General information:

In case of oil pressure is below a minimum threshold the oil pressure switch switches from ground to open circuit (warning lamp on).
To avoid malfunction at high longitudinal or transversal accelerations the delay timer T_POIL_SWI is added.
The oil pressure switch (LV_POIL_SWI) has to be monitored also during power-latch-phase (due to oil pressure switch diagnosis).

Application conditions

Initialisation: at reset LV_POIL_SWI = 0
T_POIL_SWI = C_T_POIL_SWI_BAS

Recurrence: *100 ms*

Activation: *at LV_IGK = 1*

Deactivation: –

Formula section:

```
If          LC_POIL_CTL_ENA = 0
then        ACTION_INFR_GetPoilSwi(OUT <LV_BIOS_POIL_SWI>)
             LV_POIL_SWI_SUB = LV_BIOS_POIL_SWI
else        LV_POIL_SWI_SUB = LV_POIL_SWI_CUS
endif

If    LV_IGK = 1
Then        If       LV_POIL_SWI_SUB = 1
             Then  LV_POIL_SWI = 1
                    T_POIL_SWI = C_T_POIL_SWI_BAS
             Else   If       AC_VEH_LGT_TCS < C_POIL_AC_VEH_LGT_TCS
                    Then   T_POIL_SWI = C_T_POIL_SWI_LGT
                    Else   If       abs(AC_VEH_TRV_TCS)
                                              > abs(C_POIL_AC_VEH_TRV_TCS)
                           Then   T_POIL_SWI = C_T_POIL_SWI_TRV
                           Else   If       T_POIL_SWI = 0
                                  Then   LV_POIL_SWI = 0
                                  Else    decrement T_POIL_SWI
                                  Endif
                           Endif
                    Endif
            Endif
Else        If       T_PWL < C_T_MIN_PWL
            Then   LV_POIL_SWI = LV_POIL_SWI_SUB
```

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Endif

Endif

2.13.2 Acquisition of oil pressure sensor

FUNCTION DESCRIPTION:

General information:

The sensor voltage signal V_POIL is converted via a linearisation table into the oil pressure POIL. In case of an oil sensor error a subsitude value can be used.

Application conditions

Initialisation:

```
at transition LV_IGK 0 -> 1 or  reset
If      V_POIL < C_V_POIL_MIN_DIAG     or
        V_POIL > C_V_POIL_MAX_DIAG
  then   POIL = C_POIL_ERR_SUB
  else   POIL = IP_POIL_V_POIL_REL
  endif
```

Recurrence: *10 ms*

Activation: *ECU_STATE <> PWL* ***and*** *LC_POIL_CTL_ENA = 1*

Deactivation:

```
if          ECU_STATE = PWL    or    LC_POIL_CTL_ENA = 0
  then   POIL = POIL(n-1)
  endif
```

Formula section:

If LV_ERR_SENS_POIL = 0
then POIL = IP_POIL_V_POIL_REL
else POIL = C_POIL_ERR_SUB
endif

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2.14 Key position determination

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_IGK	O/V	0... 1H	0 ...1	1	-
Key on flag					
LV_IGK_PREL	O/V	0... 1H	0 ...1	1	-
Preliminary ignition flag for 'ignition switch off'					
LV_KEY_OFF	V	0... 1H	0 ...1	1	-
Key off flag					
LV_WAKE_UP	O/V	0... 1H	0 ...1	1	-
Wake Up flag					
STATE_PLAUS_IGK_BN	O/V	0... 8H	0 ...8	1	-
state plausibility IGK - signal via CAN/via HW (BN2000 only)					
T_CAN_IGK_TOUT	O/V	0... FFH	0... 2550	10	ms
Timeout ignition key via CAN bus					
T_WAKE_UP_ON	O/V	0... FFH	0... 2550	10	ms
Timer ECU wake up					

Input data:

B_sleepwait {p. 8346}	LV_INH_PWL_TRAN_ES_EL {p. 3776}	LV_VAR_BN {p. 655}	PWL_LOCK_CDN {p. 3776}
STATE_CAN_DNM_D	STATE_IGK_CAN {p. 1574}	STATE_IGK_HW {p. 1575}	V_IGK_BAS {p. 831}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_IGK_OFF_PREL	-	0... FFH	0... 2.55	0.01	s
Delay time ignition off after driver's command					
C_T_IGK_LIH	-	0... FFH	0... 2.55	0.01	s
Timeoutzeit for LV_IGK = 1, if no Can message "Klemmenstatus" available					
C_T_TEMP_IGK_OFF_PREL	-	0... FFFFH	0... 655.35	0.01	s
Temp. time prel. ignition off after CAS-HW-error during dc					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IGK_NR	-	0... FFH	0... 255	1	-
Samples filter for key on detection (typical value : 6)					
NC_KEY_OFF_NR	-	0... FFH	0... 255	1	-
Samples filter for key off detection (typical value : 3)					
NC_KEY_OFF_THR	-	0... 3FFH	0... 28.7055	0.0280601	V
Threshold for key off detection (typical value : 142 = 4 Volts)					

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FUNCTION DESCRIPTION:

General information:

According to the battery voltage raw value (V_IGK_BAS) after ignition key, the ignition key ON /OFF recognition is performed.

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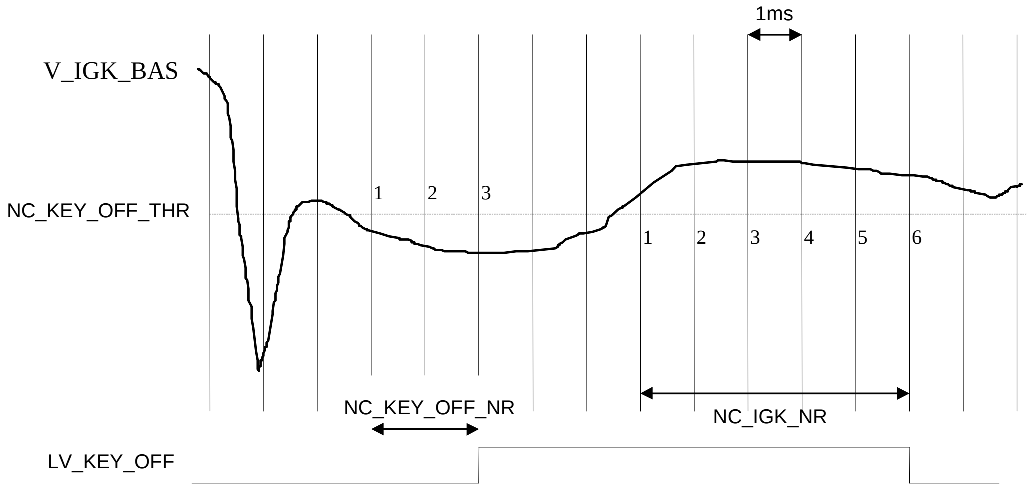

See on Analogic Acquisition Sampling chapter the recurrence of V_IGK_BAS acquisition.

Application conditions

Activation: *at reset*

Initialization:

```
if        first value V_IGK_BAS > NC_KEY_OFF_THR
          then        LV_KEY_OFF  =  0
          else              LV_KEY_OFF  =  1
          endif
Recurrency:        1ms
```

Formula section:

Ignition key ON recognised :

If V_IGK_BAS > NC_KEY_OFF_THR
for at least NC_IGK_NR number of successive samples (* 1 msec.)
then LV_KEY_OFF **= 0** (ON)

Ignition key OFF recognised :

If V_IGK_BAS NC_KEY_OFF_THR
for at least NC_KEY_OFF_NR number of successive samples (* 1 msec.)
then LV_KEY_OFF **= 1** (OFF)

2.14.1 Ignition : Key on recognition

FUNCTION DESCRIPTION:

Application conditions

Activation: *at reset*

Initialization: LV_IGK = 0

LV_WAKE_UP = 0

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```
                    T_IGK_LIH = C_T_IGK_LIH
                    LV_IGK_PREL = 1
                    T_DLY_IGK_OFF_PREL = C_T_DLY_IGK_OFF_
PREL
    T_TEMP_IGK_OFF_PREL = C_T_TEMP_IGK_OFF_PREL
Recurrency:             10ms
```

Formula section:

2.14.1.1 Vehicle without BN2000 (LV_VAR_BN = 0)

If LV_KEY_OFF = 1 **and** T_DLY_IGK_OFF_PREL > 0
then LV_IGK_PREL = 0
T_DLY_IGK_OFF_PREL - - //decremented by 10ms
if T_DLY_IGK_OFF_PREL = 0
then LV_IGK = 0
else LV_IGK = 1
endif
else
if LV_INH_PWL_TRAN_ES_EL = 1 **or** LV_KEY_OFF = 1
then LV_IGK = 0 , LV_IGK_PREL = 0
else LV_IGK = 1 , LV_IGK_PREL = 1 ,
T_DLY_IGK_OFF_PREL = C_T_DLY_IGK_OFF_PREL
endif
endif

2.14.1.2 Vehicle with BN2000 (LV_VAR_BN = 1)

Determination of LV_WAKE_UP
If LV_KEY_OFF = 0 **and** LV_INH_PWL_TRAN_ES_EL = 0
then LV_WAKE_UP = 1
T_WAKE_UP_ON++ (limit: 0xFF)

else LV_WAKE_UP = 0
T_WAKE_UP_ON = 0
endif

NM mode depending on LV_WAKE_UP and other conditions:
If LV_WAKE_UP = 1 or B_sleepwait = 1
Then NM mode awake
Else NM mode bus sleep
Endif

Determination of STATE_PLAUS_IGK_BN and of LV_IGK=1
If(1) (CAN message Klemmenstatus available **and**
no alive-counter error CAS // alive counter counts regularly **and**
no check-sum error CAS // sent checksum = calculated checksum)
then(1) T_IGK_LIH = C_T_IGK_LIH
T_CAN_IGK_TOUT = 0
if(2a) STATE_IGK_CAN = 0h
then(2a) LV_T_DLY_IGK_OFF_PREL = 1 // timer should be decremented

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```
if(3b)  LV_KEY_OFF = 0
    then(3b)        STATE_PLAUS_IGK_BN  =  1H        //SYM_0//SCB, Master CAN
    else(3b)        STATE_PLAUS_IGK_BN  =  0H        //NO_SYM
    endif(3b)
  else(2a)
    if(3c)  STATE_IGK_CAN = 1
    then(3c)        LV_IGK  =  1
                      T_DLY_IGK_OFF_PREL  =  C_T_DLY_IGK_OFF_PREL
                    LV_T_DLY_IGK_OFF_PREL = 0        //timer should be reset to max.-value
        if(4a)  LV_KEY_OFF = 0
        then(4a)        STATE_PLAUS_IGK_BN  =  0H        //NO_SYM
        else(4a)        STATE_PLAUS_IGK_BN  =  2H        //SYM_1//SCG, Master CAN
        endif(4a)
     else(3c)       STATE_PLAUS_IGK_BN  =  8H        //SYM_3//CAN-signal not plausi-
ble
        if(4b)          LV_WAKE_UP = 1
        then(4b)          LV_IGK  =  1
                      T_DLY_IGK_OFF_PREL  =  C_T_DLY_IGK_OFF_PREL
                    LV_T_DLY_IGK_OFF_PREL = 0        //timer should be reset to max.-value
        else(4b)        LV_IGK=0
    endif(4b)
    endif(3c)
  endif(2a)
else(1)
  if(2b)  STATE_CAN_DNM_D > 0 and PWL_LOCK_CDN[BN2000] = 1
  then(2b)                  T_CAN_IGK_TOUT++ (limit: 0xFF)
    if(3d)  T_IGK_LIH = 0
    then(3d)        STATE_PLAUS_IGK_BN  =  4H        //SYM_2//CAS error, Master HW
        if(4c)          LV_WAKE_UP = 1
        then(4c)          LV_IGK  =  1
                      T_DLY_IGK_OFF_PREL  =  C_T_DLY_IGK_OFF_PREL
                    LV_T_DLY_IGK_OFF_PREL = 0        //timer should reset to max-value
        else(4c)        LV_IGK=0
 endif(4c)
    else(3d)        T_IGK_LIH  - -
    endif(3d)
  else(2b)        T_IGK_LIH  =  C_T_IGK_LIH
                T_CAN_IGK_TOUT = 0xFF
endif(2b)
endif(1)
```

Calculation of Timer T_DLY_IGK_OFF_PREL

```
IF                  LV_T_DLY_IGK_OFF_PREL = 1                and
                  T_DLY_IGK_OFF_PREL > 0
THEN            T_DLY_IGK_OFF_PREL - -
                  IF          STATE_IGK_HW = 0 or T_DLY_IGK_OFF_PREL = 0
                  THEN          LV_IGK = 0
                  ENDIF
ENDIF
```

Determination of LV_IGK_PREL

```
If                  STATE_IGK_HW = 1
```

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```
Then    if      T_TEMP_IGK_OFF_PREL  > 0
          then    T_TEMP_IGK_OFF_PREL - -
          endif
else    T_TEMP_IGK_OFF_PREL =  C_T_TEMP_IGK_OFF_PREL
Endif
```

```
If           STATE_IGK_HW = 2               or
          (T_TEMP_OFF_IGK_PREL  = 0)
then    LV_IGK_PREL  =  1
else    LV_IGK_PREL  =  0
endif
```

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2.15 General management of logic outputs

2.15.1 General management of logic outputs

FUNCTION DESCRIPTION:

General information:
Logic outputs are outputs which are piloted by software without PWM or CAPCOM.
Initialization:
At initialization phase, each logical output is set or reset versus function need.
See detail file of each output.
Logic state:
Positive logic means the connector output is "active" or "ON" (current present through the load) when the corresponding boolean is true.
The output is ON when the voltage level is low at the ECU connector and is OFF when the voltage level is high at the ECU connector.
Update recurrence:
All logical outputs are updated at application recurrence except those piloted by SPI octal link which are updated at 10 ms with jitter $<$ 1ms.
Diagnostic:
Several options are proposed. For detail see chapter on output diagnostic.

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2.16 Definition of logic outputs

Input data:

LV_ACCOUT_RLY {p. 3589}	LV_CONF_DMTL {p. 654}	LV_DMTL_PUMP {p. 5963}	LV_DMTLS {p. 5963}
LV_EBOX_CFA {p. 4133}	LV_EF {p. 3614}	LV_HDMTL_ON {p. 5966}	LV_RLY_CRCV_HEAT {p. 4142}
LV_RLY_MAIN {p. 3772}	LV_RLY_ST {p. 3844}	LV_SOF {p. 3851}	LV_SWI_AEB {p. 4136}
LV_VAR_RLY_ACCOUT {p. 656}	LV_VAR_RLY_ST {p. 656}		

Description:

Name	ECU Pin Name	Definition
Switched internal	A_S_HR	main relay
Switched internal	Internal	power latch
LV_EBOX_CFA	A_S_EBOXL	E-box cooling fan
LV_ACCOUT_RLY	A_S_KOREL	air conditioning compressor relay
LV_RLY_ST	A_S_START	starter relay
LV_EF	A_S_AKL	exhaust flap, only if CONF_EF_B_KL61 = 0
LV_SWI_AEB	A_S_MLA	Automatic engine brackets
LV_SOF	A_S_ESK	sound flap
LV_RLY_CRCV_HEAT	A_T_PTC	crankcase ventilation heater relay
LV_RLY_MAIN	A_S_HR	main relay

Additional for LV_CONF_DMTL = 1

Name	ECU Pin Name	Definition
LV_DMTL_PUMP	A_S_DMTLP	tank leakage detection motor
LV_DMTLS	A_S_DMTLV	tank leakage detection vent
LV_HDMTL_ON	A_S_DMTLH	tank leakage detection heater

General information:

As there are no free logical output stages left for the activation/deactivation of the crankcase ventilation heater relay and the sound flap, PWM output stages are used for this purpose. To keep changes/efforts as lean as possible the pins which were supposed to be used for a PWM-controlled PTC-heater/sound flap are now used for the crankcase ventilation heater relay/sound flap control, thus resulting in an "incorrect" naming of the pins themself (A_T_PTC/A_T_ESK).

2.16.1 Definition of logic outputs

2.16.1.1 LV_LS_UP/DOWN_0/1

The logic outputs for the lambda sensor input resistors are set corresponding to switch SW1 described in chapter System Variables, Upstream/Downstream oxygen sensor internal resistance determination .

2.16.1.2 Logic outputs controlled by learning algorithm

ACC-Relay:
If LV_VAR_RLY_ACCOUT = 0
then the related PIN is controlled by the learning algorithm (see chapter General:

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Variant Coding/Automaticallly learnt variants via powerstage-dignosis)
else the PIN is controlled by LV_ACCOUT_RLY

Starter-Relay:
If LV_VAR_RLY_ST = 0
then the related PIN is controlled by the learning algorithm (see chapter General: Variant Coding/Automaticallly learnt variants via powerstage-dignosis)
else the PIN is controlled by LV_RLY_ST

Crankcase ventilation heater relay:
As there is a 100% installation in all variants of NG6 engines the Pin is always controlled by LV_RLY_CRCV_HEAT.

2.16.2 Engine speed signal ESS

The engine speed signal ESS (ECU Pin A_F_TD) is a tooth-fixed event. The ESS signal is set at the teeth 5, 25, -, 65, 85, 105 and reset at the teeth 15, 35, 55, 75, 95, 115. The artificially generated teeth are used in the CAM limp home. Since the cylinder group assignment for the output of the ESS signal is not decisive, the CRK limp home has no influence on the output of the ESS signal.

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2.17 General management of PWM outputs

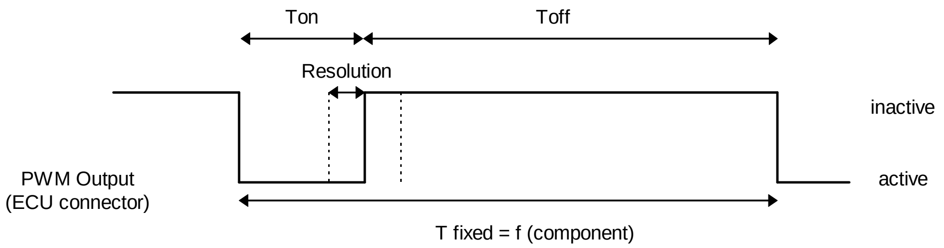
2.17.1 General management of PWM outputs :

FUNCTION DESCRIPTION:

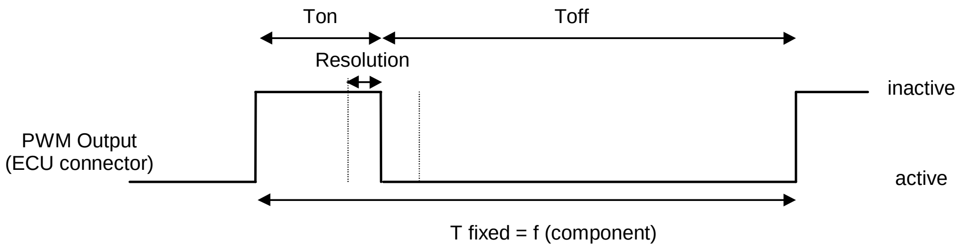
General information:

PWM management principle :

Positive PWM :



Negative PWM :



Duty cycle = Ton /T

PWM outputs are 2 types :

- True PWM using a POUT µP output. In this case the duty cycle range could be 0 . . 100%
- Pseudo PWM using a CAPCOM µP output. In this case, minimum Ton and minimum Toff are 300 µs with standard priority.

Initalization:

During hard reset and software initalization, all PWM outputs are inactive. As soon as application software start, the PWM outputs are piloted. Inactive output means inactive driver output.

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2.18 List of PWM outputs/Definition of PWM outputs

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IVVTPWM_0	O/V	0... FFFFH	0... 99.99847	1.53e-3	%
PWM for inlet VANOS					
IVVTPWM_1	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
PWM for outlet VANOS					

Input data:

CPPWM_CPS {p. 3749}	ECFPWM_ECF {p. 1045}	ECRASPWM {p. 3863}	ECTPWM {p. 3858}
FPAPWM	LC_POIL_CTL_ENA {p. 903}	LSHPWM_DOWN [NC_CBK_EX_NR] {p. 2421}	LSHPWM_UP [NC_CBK_EX_NR] {p. 2385}
LV_VAR_TCHA {p. 656}	MTCPWM {p. 6546}	POIL_PWM {p. 8203}	PWM_ACR {p. 3580}
VCVPWM	VIMPWM_1 {p. 3622}	VIMPWM_2 {p. 3622}	WGPWM [NC_CBK_EX_NR] {p. 8140}

2.18.1 List of PWM outputs

2.18.1.1 Data Definition

Name	ECU Pin Name (Output)	Definition / Remark	Frequency (Hz)
MTCPWM	A_T_MDK	Main throttle control	600
LSHPWM_UP_1	A_T_LHV1	LSH bank 1 upstream	See EGCP configuration
LSHPWM_UP_2	A_T_LHV2	LSH bank 2 upstream	
LSHPWM_DOWN_1	A_T_LHH1	LSH bank 1 downstream	
LSHPWM_DOWN_2	A_T_LHH2	LSH bank 2 downstream	
ECTPWM	A_S_KFK	electronically controlled thermostat	1
IVVTPWM_0	A_T_NWE1	VANOS unit 1 (inlet 1 or inlet)	244
IVVTPWM_1	A_T_NWE2	VANOS unit 2 (inlet 2 or outlet)	244
CPPWM_CPS	A_T_TEV	canister purge valve	Def. in EVAC
ECFPWM_ECF	A_T_ELUE1	cooling fan	100 (10 during power latch)
VCVPWM	A_T_MSV	Flow control valve	201
PWM_ACR	A_T_AGR1/2	Exhaust gas recirculation valve	976
ECRASPWM	A_T_LKS	Electronical controlled radiator shutter	200

Switchover between FPAPWM and POIL_PWM

If LC_POIL_CTL_ENA = 0

then

FPAPWM	A_T_DSV	Pressure control valve	1)

else

POIL_PWM	A_T_DSV	Electronically controlled oil pressure actuator	2)

endif

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1.) According module ’ High pressure pump control (Appl. Inc.)’
2.) According module ’Cus adap module: ENLU’

Additional for LV_VAR_TCHA = 0

Name	ECU Pin Name (Output)	Definition / Remark	Frequency (Hz)
VIMPWM_1	A_T_DISA1	variable intake manifold chanel 1	200
VIMPWM_2	A_T_DISA2	variable intake manifold chanel 2	200

Additional for LV_VAR_TCHA = 1

Name	ECU Pin Name (Output)	Definition / Remark	Frequency (Hz)
WGPWM[2]	A_T_WG2	wastegate chanel 2	300
WGPWM[1]	A_T_WG1	wastegate chanel 1	300

List of corresponding logic values:

Name	Definition
LV_MTC_DIR	direction of MTC
LV_MTC_DIS	disable MTC

2.18.2 Output PWM for inlet and outlet VANOS

The PWM outputs for both VANOS actuators are driven directly by BMW- objects via function call. To know the actual PWM- value in the system, the registers of the PWM- outputs are mirrored into system variables (IVVTPWM_0 and IVVTPWM_1). To reach a permanent micro-movement of the control piston in the valve a variable Frequency-Control is implemented driven directly by BMW- objects via function call: PWM_FRQ_NWA1(), PWM_FRQ_NWE1().
The minimum frequency, which can be adjusted, is 75 Hz

2.18.3 Output for HPDI relay

CH_PWM_DCDC = 80%

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2.19 Spark advance and dwell output

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TD_FAC_MAX	O/V	1... FFH	1... 255	1/128	-
Maximal dwell time control					
TD_FAC_MIN	O/V	1... FFH	1... 255	1/128	-
Minimal dwell time control					

Input data:

LDPM_N_32_1_IGRE	LV_ERR_CAM {p. 1505}	LV_ST {p. 1720}	N_32 {p. 1525}
NC_CYL_NR {p. 1526}	VB {p. 1185}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TD_FAC_ST_MAX	-	1... FFH	1... 255	1/128	-
Factor for maximum dwell time					
C_TD_FAC_ST_MIN	-	1... FFH	1... 255	1/128	-
Factor for minimum dwell time					
C_TD_VB_MAX	-	0... FFH	0... 26	0,102	V
Maximum battery voltage to activate MPL (typical value : 16V)					
IP_TD_FAC_MAX	-	1... FFH	1... 255	1/128	-
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Max dwell time factor					
IP_TD_FAC_MIN	-	1... FFH	1... 255	1/128	-
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Min dwell time factor					
LC_IGC_LIH_CONF	-		-	-	-
Configuration Choice for Half static Mode in case of CAM limp home: 0 = no Limp Home - 1 = Half Static					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IGC_CONF	-		-	-	-
Half static or full static (Typical value for debug = full static)					

Import actions:

ACTION_INFR_SetIgnCtl (**IN**<Ign_ctl_mod>)

FUNCTION DESCRIPTION:

This function sets the angular position of the dwell time turn on in order to have the time to set up the necessary current in the ignition coil.
The strategy is based on a priority of the ignition angle. If dwell time priority is requested the minimum dwell time is equal to maximum dwell time.
The strategy respects ignition coils with dual and single outputs. This function could be used independently of the number of cylinders (n) and the geometry of the crankshaft target wheel.

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This function could be used for homogeneous combustion mode and for stratified combustion mode. The calculation of the spark advance is in both cases the same.
All of the functions described in this section operate over the entire engine speed range.
This specification includes two mode following the IGRE version: PI or PI + DI

2.19.1 Minimum /Maximum dwell time calculation

FUNCTION DESCRIPTION:

The two values are calculated independently of all environment factors. The aim is to have a larger window at start and low engine speed to obtain a better flexibility to apply the requested ignition angle.
These 2 values are expressed in term of min/max factor to be applied to the nominal dwell time and transferred to the Basic SW
The cylinder individual nominal Dwell Time to be applied requested by ASW function is defined in TD_IGC[x] taking into account the combustion mode switch

Application conditions

Initialisation: *TD_FAC_MIN = TD_FAC_MAX = 1* at reset

Recurrence: *10 ms*

Formula section:

If LV_ST = 1
Then *(Start mode)*
  If VB > C_TD_VB_MAX
  Then TD_FAC_MAX = 1
    TD_FAC_MIN = Min[C_TD_FAC_ST_MIN , 1]
  Else TD_FAC_MAX = Max[C_TD_FAC_ST_MAX , 1]
    TD_FAC_MIN = Min[C_TD_FAC_ST_MIN , 1]
Else *(run mode)*
  If VB > C_TD_VB_MAX
  Then TD_FAC_MAX = 1
    TD_FAC_MIN = Min[IP_TD_FAC_MIN , 1]
  Else TD_FAC_MAX = Max[IP_TD_FAC_MAX , 1]
    TD_FAC_MIN = Min[IP_TD_FAC_MIN , 1]
Endif

2.19.2 Half static of full static

Recurrence: engine stop to engine run

Formula section:

Following NC_IGC_CONF = Half or full, the ignition is half static controlled or full static controlled
ACTION_INFR_SetIgnCtl(NC_IGC_CONF)

2.19.3 Limp home without cam signal

Recurrence: engine stop to engine run

Formula section:

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In case of CAM failure, the cylinder in combustion cannot be unequivocally identified. Engine phasing might be wrong. In such a case, a limp home mode function on Ignition is provided in order to have the possibility to drive the engine. Nevertheless, in this case, since the right cylinder phasing is not known, Ignition coil have to be driven in Half-Static mode to be sure to execute at least an ignition on the cylinder in combustion.

Decision to use such Limp Home functionality will depend on the setting of LC_IGC_LIH_CONF. If LC_IGC_LIH_CONF = 0, no Limp Home is provided in CAM failure and Ignition is stopped. If LC_IGC_LIH_CONF = 1, then Half-Static Ignition mode is done in case of CAM failure

If LV_ERR_CAM is active, the ignition coil control will be executed in half-static ignition-coil control mode if selected by the settings of LC_IGC_LIH_CONF

In such a case (*half-static mode activation in CAM failure*) the same Ignition and Dwell Time will be applied to the 2 Crank synchronous cylinders (*eg. on a 4 cyl engine, cyl. 1 and 4 and cyl. 2 and 3 will be fed with the same Ignition and Dwell Time*)

The limp home function could be applied only if the number of cylinders is even (2, 4, 6, ...)

If NC_IGC_CONF = full
Then **If** LV_ERR_CAM = 1 And LC_IGC_LIH_CONF = 1
Then **ACTION_INFR_SetIgnCtl**(HALF_STATIC)
Else **ACTION_INFR_SetIgnCtl**(FULL_STATIC)
EndIf
Else **ACTION_INFR_SetIgnCtl**(HALF_STATIC)
EndIf

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2.20 Ignition output diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SCG_IGC [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Diagnostic of primary short circuit to ground (cylinder selected)					
LV_SCP_IGC [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Diagnostic of primary short circuit to battery (cylinder selected)					
V_DUR_IGC [NC_CYL_NR]	O/V	0... FFFFH	0... 262.14	0,004	ms
Burn time duration for diagnosis validation					

Input data:

LV_CDN_DIAG_IGC_SCP [NC_CYL_NR] {p. 4772}	LV_SYN_ENG {p. 1506}	MFF_SP_MV {p. 2151}	N_32 {p. 1525}
NC_CYL_NR {p. 1526}	SEG_NR {p. 1525}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_V_DUR_IGC_MIN	-	0... FFFFH	0... 262.14	0,004	ms
LDP_N_32_ID_V_DUR_IGC_MIN	8	0... FFH	0... 8160	32	rpm
LDP_MFF_SP_MV_ID_V_DUR_IGC_MIN	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Minimum duration of the Burntime to detect ignition errors					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IGBT_CUT_OFF_T	-	0... FFFFH	0... 262.14	0,004	ms
Inhibition of IGBT protection cut off function					
NC_INI_CTR_DEAC	-	0... FFFFH	0... 262.14	0,004	ms
Time delay after IGBT threshold response before switching OFF the IGBT - typical value 600 us					
NC_T_MIN_SCP	-	0... FFFFH	0... 262.14	0.004ms	ms
Minimum time to detect SCB with current feedback flag					

Import actions:

ACTION_INFR_GetIgnScgDiag (**IN**<No Name available>,**IN**<No Name available>,**OUT**<No Name available>,**OUT**<No Name available>)
ACTION_INFR_GetIgnScpDiag (**IN**<No Name available>,**OUT**<No Name available>)

Each ATM46 could analyze 4 ignition coils. If diagnostics for more the than 4 coils are necessary, a parallel ATM46 has to be used.
The diagnosis is based on ignition coil primary over voltage measurement.
The input signal of the ATM 46 is the IGBT collector voltage.
In case of an ignition system with single output coils, the function does not work in camshaft limp home mode.

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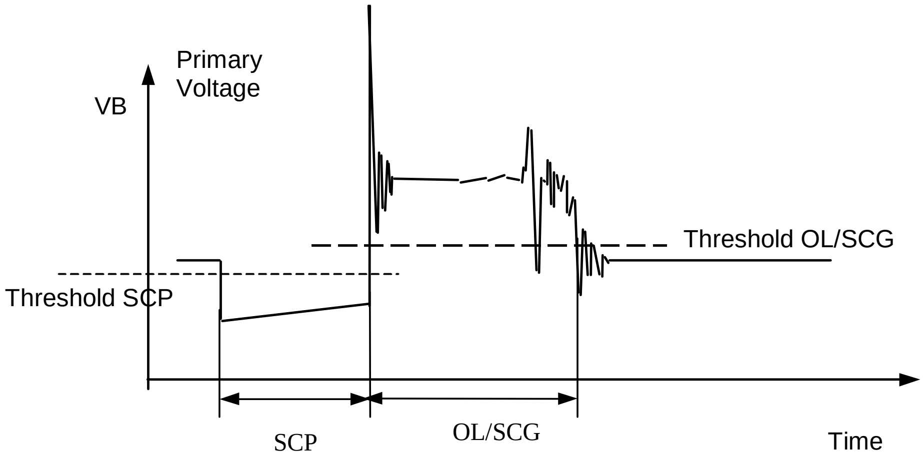

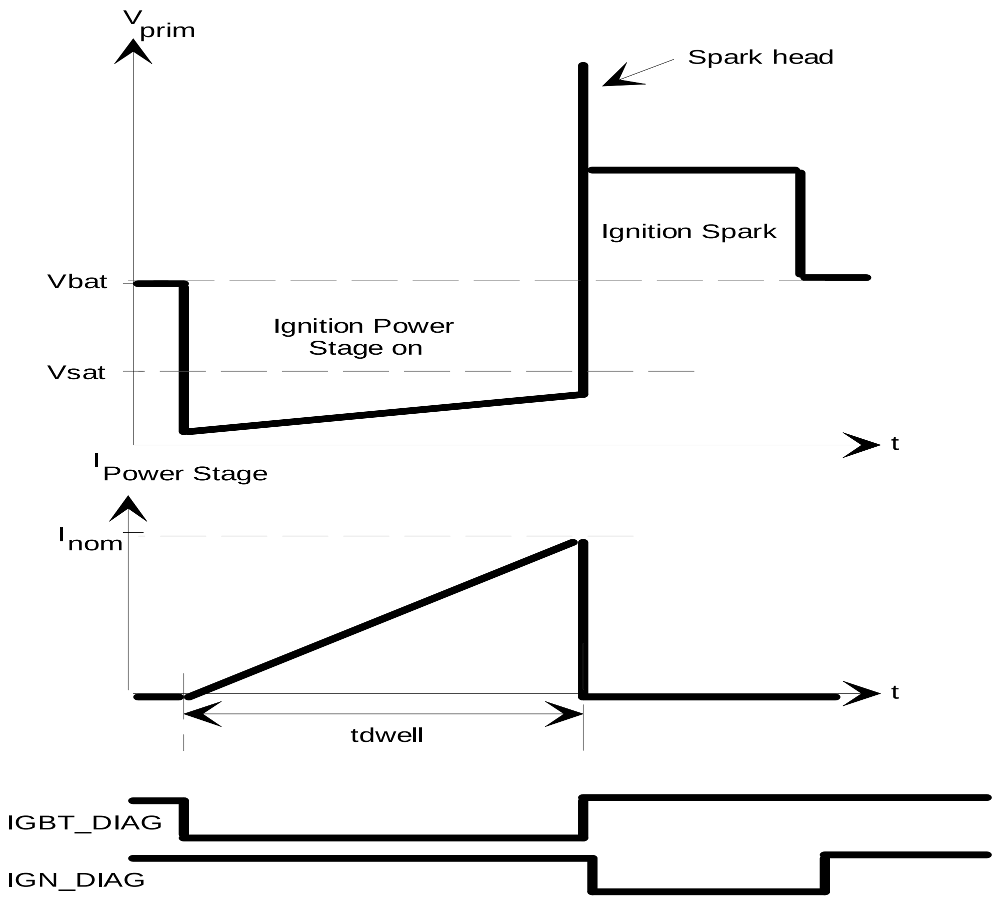

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2.20.1 IGBT Protection (with ATM46 /Combined ASIC)

FUNCTION DESCRIPTION:

The aim of the present function is to protect the ignition power stage against short circuit to battery (SCP).

The purpose of ignition power stage diagnostic is to detect a short circuit to battery voltage condition (SCP). At each Dwell Time On event, the ignition power stage is switched on. In normal condition, the current increase in the ignition power stage is limited by the inductance of the ignition coil solenoid.
In case of a short circuit to battery, the coil external device does not limit the current in the ignition power stage. In this situation the current is only limited by the current capability of the ignition power stage. This power dissipation would destroy the power stage. From the Dwell Time ON event in SCP condition, the IGBT's can withstand this overload current only for a very short time (*750μs for IGBT without shunt*). So, it is necessary to switch off this IGBT transistor for safety and protection reasons by software (*IGBT deactivation by switching off the charging command in SW*) in case of an overload condition and after a certain time delay has elapsed (NC_INI_CTR_DEAC). This time delay is necessary in order to filter parasitic spikes. On the other hand this time delay must not exceed the maximum rating of the IGBT's.
For ignition power stage diagnostic, the voltage across the ignition power stage is compared to a fixed threshold voltage. This threshold voltage is chosen to be higher than the maximum saturation voltage of the ignition power stage during a dwell time in normal operation. If there is no short to battery voltage condition, the voltage across the ignition power stage drops below this fixed threshold voltage at each dwell time. In case of a short to battery voltage failure, this voltage is not (or only for a short time) passed. A micro controller monitoring the ignition power stage diagnostic output is able to detect this fault.
This ignition power stage diagnostic circuit is designed for an engine management system including four ignition power stages. This four diagnostic information can be evaluated at one output by having a logic OR function of them.
After each deactivation from this protection function, the cut off IGBT will be reactivated again in the next ignition cycle
The function could be used for ignition systems with single-output coils and double-output coils. The IGBT protection function is cylinder selectively deactivated in case of single-output coil and linked dual cylinders for ½ static coils.

Application conditions

Activation: `LV_SYN_ENG = 1`

Formula section:

Initialization: at reset
LV_SCP_IGC[x] = 0
Update rate: segment

System description:

The ATM46 is used to generate a signal evaluated by the SW for overload condition detection.
To perform the IGBT protection and SCP diagnostic, the BSW provides one functional service (BSW driver - one driver for one ATM46 protection and SCP diagnostic line)
As only one IGBT diagnosis output signal from the "ATM 46" exists (all channels are linked by a wired "OR") and only one BSW functional service (*this BSW functional service used is described in the following paragraph*) is used in connection to this diagnosis output signal line, the function is limited to non-overlapping dwell time pulses. In case of overlapping Dwell Time, the last TD ON event that occurs will re-trigger the call of this function and thus be considered for diagnosis purpose.

Formula section:

ACTION_INFR_GetIgnScpDiag(SEG_NR -2,LV_SCP_IGC[SEG_NR-2])

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2.20.1.1 Ignition Actuator Tests Diagnosis

Formula section:

Initialization: LV_SCP_IGC[x] = 0 at reset

System description:

For ignition coil actuator tests purpose, the SCP diagnostic function has to be enabled and activated upon the tests requests
The same case and comments (see before) apply here also.

Formula section:

For x = 0 to NC_CYL_NR - 1
If LV_CDN_DIAG_IGC_SCP[x] = 1
Then **ACTION_INFR_GetIgnScpDiag**(SEG_NR -2,LV_SCP_IGC[SEG_NR-2])

EndIf
EndFor

2.20.1.2 SCG (Burn Time measurement) - Acquisition of the burn time

Description:

This ignition diagnosis function evaluates the primary over voltage duration **V_DUR_IGC[x]** provided after the ignition coil cut off.
The aim of this spark burning diagnostic function is to measure the spark duration by detecting the presence of a spark on an ignition plug. The over-voltage at the primary coil of an ignition solenoid is equal to the voltage across the spark gap of the ignition plug divided by the transmission ratio of the ignition solenoid and superimposed on the battery voltage. The time where the voltage at the primary coil of the ignition solenoid is higher than a battery voltage dependent threshold voltage (V_{BD_th}) gives the spark duration.
In the moment, when the ignition power stage (IGBT) is switched OFF *(ie. at TD OFF event occurrence)*, the voltage V_C at the collector of the IGBT rises, due to self-induction, and ignition occurs. As long as the ignition spark is burning, the voltage is well exceeding the battery voltage.
By means of a hardware defined threshold (V_{BD_TH}; typical value: V_{Bat} + 3V) the burn condition is detected and a matching signal is generated, *eg. Here by the combined ASIC ATM46*. This signal is used to measure the overall burning duration.
The Ignition Burning diagnostic signal IGN_DIAG is generated by this combined ASIC. This time for the burning spark IGN_DIAG is calculated via the duration of the diagnostic signal staying above the threshold of V_{BD_TH}.
This ATM46 ignition diagnostic circuit is designed for an engine management system including up to 4 ignition coils/solenoids. This four diagnostic information are then evaluated on one output by applying a logic NOR function on them. The output signal IGN_DIAG of the ignition diagnostic circuit is processed by the µP.
Due to combustion chamber turbulence the spark of an ignition plug is not stable. The result is an unstable primary voltage at the ignition solenoid. Therefore a filter in the output signal IGN_DIAG is necessary to prevent the µP from high frequency inputs.
The ignition coil primary over voltage on the ignition output is roughly equal to the voltage across the spark gap divided by the ignition coil transformation ratio, superimposed on the battery voltage.
The Burn Time measurement is used today only for Spark /Combustion Diagnosis Purpose. It is a rough measurement of the effective Burn Time.

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Please note that the SCG detection is equivalent to the detection of an Open Load.

Application conditions

Activation: `LV_SYN_ENG = 1`

Initialisation: `LV_SCG_IGC[x] = 0` at reset
`V_DUR_IGC[x] = 0`

Recurrence: `segment`

Formula section:

ACTION_INFR_GetIgnScgDiag(SEG_NR-2,ID_V_DUR_IGC_MIN,
V_DUR_IGC[SEG_NR-2], LV_SCG_IGC[SEG_NR-2])

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2.21 Engine speed (Tacho) output

FUNCTION DESCRIPTION:

The engine speed signal TD is a tooth-fixed event at the ECU Pin A_F_TD. The signal is set to high at the teeth 1, 21, 41, 61, 81, 101 and reset to low at the teeth 11, 31, 51, 71, 91, 111. This means: falling edge at every TDC, rising edge at every BDC (of any cylinder).
The artificially generated teeth are used in the CAM limp home. Since the cylinder group assignment is not decisive for the output of the TD signal, the CRK limp home has no influence on the output of the TD signal.

Initialisation :
The output signal is initialised with a low logic state (0).

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2.22 BIOS H-bridge diagnosis function

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
BIOS_HBR_FAULT_STATUS_VIM	O	0H 1H	NO_ERROR ETC_HBR_ ERROR	-	-
STATUS OF H-BRIDGE DISA					

FUNCTION DESCRIPTION:

General information:

The function Bios H-Bridge Diagnosis manages detection of H-Bridge faults witch deactivate the DISA H-Bridge.

Description:

The following error conditions can be distinguished:

- Undervoltage
- Overcurrent
- Overtemperature

Application conditions

Initialisation: 0

Recurrence: 10 ms

Formula section:

if one error condition is fulfilled
then BIOS_HBR_FAULT_STATUS_VIM = 1
else BIOS_HBR_FAULT_STATUS_VIM = 0
endif

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2.23 KWP 2000

General information

2.23.1 Normative reference

General information:

This implementation and the description of diagnostic communication protocol KWP 2000 is based on the following standards:

ISO/FDIS 14229, 1996	Road vehicles-Diagnostic systems - Diagnostic Services Specification
ISO/FDIS 14230-1, 1996	Road vehicles-Diagnostic systems Keyword Protocol 2000 part 1 : Physical Layer
ISO/FDIS 14230-2, 1996	Road vehicles-Diagnostic systems Keyword Protocol 2000 part 2 : Data Link Layer
ISO/FDIS 14230-3, 1996	Road vehicles-Diagnostic systems Keyword Protocol 2000 part 3 : Implementation
ISO/DIS 14230-4	Road vehicles-Diagnostic systems Keyword Protocol 2000 part 4 : KWP2000 requirements for emission-related systems
VDA/WD 14230-2, 1998	Keyword Protocol 2000 part 2 : Data Link Layer, VDA-recommended practice
VDA/WD 14230-3, 1998	Keyword Protocol 2000 part 3 : Implementation, VDA-recommended practice

Application conditions:

Initialisation: –

Activation: –

Deactivation: –

Recurrence: –

Function description:

Formula section:

2.23.2 Customers reference

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General information:

7 507 660.4 Index a	2003	CP-DME Diagnoselastenheft Revision 2.5
6 942 417.6 Index b	2003	LH Diagnose Teil 2: Systembeschreibung
6 942 418.6 Index b	2003	LH Diagnose Teil 3: Feinspezifikation
6 942 422.6 Index b	2003	LH Diagnose Teil 7: KWP2000 Diagnostic

Application conditions:

Initialisation: –
Activation: –
Deactivation: –
Recurrence: –

Function description:

Formula section:

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2.24 Segment time calculation

Action definition

ACTION_INFR_DisableT5T ()	Mode: O
This action deactivates segment time acquisition for 5 teeth- segments	

ACTION_INFR_EnableT5T ()	Mode: O
This action activates segment time acquisition for 5 teeth- segments	

ACTION_INFR_GetT5T (IN<idx>,OUT<time>)	Mode: O
Acquisition of partial segment time over 5 teeth	

ACTION_INFR_GetT5TDiag (OUT<diag>)	Mode: O
Diagnostic information for acquisition of 5-teeth- segments	

Description for actions:

ACTION_INFR_EnableT5T()					
This action activates segment time acquisition for 5 teeth- segments					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit

ACTION_INFR_DisableT5T()					
This action deactivates segment time acquisition for 5 teeth- segments					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit

ACTION_INFR_GetT5T(IN <idx>, OUT <time>)					
Signal acquisition for 5 teeth- segments					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
idx	IN	0...18H	0...23	1	[-]
Index of the array of measured partial segment time					
time	OUT	0...FFFFH	0...65,535	0,001	ms
Measured partial segment time over 5 teeth					

ACTION_INFR_GetT5T_Diag(diag)					
Diagnostic information for acquisition of 5-teeth- segments					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
diag	OUT	0...1H	0...1	1	[-]
Diagnostic for partial segment time acquisition, set to 1 when buffer content is valid					

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General information:

The function shall sample a time stamp every 5 teeth and calculate the difference of the actual and the last time stamp. The result is stored in a buffer with 24 values. The return value of ACTION_INFR_ GetT5T(idx,time) is the time from the indexed cell of the array.

Acquisition shall start at TDC cylinder 0. Values are written to the appropriate location of the array (e.g., the first partial segment time measured after TDC 0 is written to the first location of the array).
In case of overflow (below approx. 80rpm), the measured segment time is limited to the maximum value.
When enabling or disabling action is called, all buffer values are set to maximum value.
A diagnostic action delivers information about validity of the buffer contents. The return value is 0 after enabling as long as buffer content is not valid, and changes to one as soon as the buffer is ready to be read out. Buffer content is regarded as valid as soon as all 24 values in the buffer are filled.

Requirements for ACTION_INFR_ EnableT5T:

Data acquisition					
Parameter	**Absolute precision**	**Relative precision**	**Resolution**	**Coincidence with parameter**	**Comment**

Diagnosis:

Coincidence requirements:

Requirements for ACTION_INFR_ DisableT5T:

Data acquisition					
Parameter	**Absolute precision**	**Relative precision**	**Resolution**	**Coincidence with parameter**	**Comment**

Diagnosis:

Coincidence requirements:

Requirements for ACTION_INFR_ GetT5T:

Data acquisition					
Parameter	**Absolute precision**	**Relative precision**	**Resolution**	**Coincidence with parameter**	**Comment**
index	1	1	1		
time		0,001ms	0,001ms		

Diagnosis:

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Coincidence requirements: Acquisition shall start at the start of segment 0, and repeat every 5 teeth.

Requirements for ACTION_INFR_GetT5TDiag:

Data acquisition					
Parameter	**Absolute precision**	**Relative precision**	**Resolution**	**Coincidence with parameter**	**Comment**
Diag	1		1		

Diagnosis: no diagnosis done here
Coincidence requirements: end of acquisition for the buffer (all 24 values filled)

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2.25 Dwell time adaptation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_TD_AD_SWI	V	0... FFH	0... 255	1	-
Counter used for the switch in between low and high mode currents					
LV_TD_AD_ACQ_VLD	V		-	-	-
Flag indicating validity of current measurement					
LV_TD_AD_SWI	V	0... 1H	0 ...1	1	-
Flag indicating switch in between low and high mode currents					
T_SUM_TD_AD [NC_CYL_NR]	V	0... FFFFH	0... 262.14	0.004	ms
Sum of added time on TD_AD without reaching current threshold					
TD_AD [NC_CYL_NR]	O/V	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Dwell time adaptative					
TD_AD_H [NC_CYL_NR]	V/S	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Dwell time adaptative during high mode current					
TD_AD_L [NC_CYL_NR]	V/S	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Dwell time adaptative in low mode current					

Input data:

LV_ERR_CAM {p. 1505}	LV_INH_TD_AD {p. 937}	LV_SCG_IGC [NC_CYL_NR] {p. 920}	LV_SCP_IGC [NC_CYL_NR] {p. 920}
LV_TD_AD_H {p. 937}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}	SEG_NR {p. 1525}
T_THD_IGCFB {p. 937}	TD_IGC [NC_CYL_NR] {p. 1876}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_DEC_TD_AD	-	0... FFH	0... 0.996	3.9e-3	-
Factor applied on T_THD_IGCFB to calculate time to be removed to TD_AD					
C_N_32_MIN_TD_AD	-	0... FFH	0... 8160	32	rpm
Engine speed threshold at which the TD_AD calculation change its recurrence					
C_T_SUM_TD_AD_MAX	-	0... FFFFH	0... 262.14	0.004	ms
Maximum time allowed to be added in TD_AD without reaching target threshold					
C_T_THD_IGCFB_MAX	-	0... FFFFH	0... 262.14	0.004	ms
Maximum measured time for valid sample					
C_TD_AD_INC	-	0... FFH	0... 1.02	0.004	ms
Increment on dwell time in case current threshold is not reached					
C_TD_AD_MAX	-	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Maximum value for dwell time adaptative					
C_TD_AD_MIN	-	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Minimum value for dwell time adaptative					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TD_AD_THD	-	0... FFFFH	0... 262.14	0.004	ms
Definition of threshold to enable dwell adaptation					
C_TD_IGC_OL_MIN	-	0... FFFFH	0... 262.14	0.004	ms
Minimum value at which we inhibit the adaptation of dwell time in case of open load					
LC_TD_AD_CLR	-	0... 1H	0 ...1	1	-
Logical value enabling reset of variables TD_AD[x]					

Action definition

ACTION_IGRE_GetIgnDwellAdNvmy (**IN**<PRM_Cyl>,**OUT**<PRM_Td_ad_l>,**OUT**<PRM_Td_ad_h>)	Mode: O
This action allows getting the values of dwell time adaptation stored in NVMY.	

ACTION_IGRE_RstIgnDwellAdNvmy (**IN**<PRM_Cyl>)	Mode: O
This action allows resetting the values of dwell time adaptation.	

Description for actions:

ACTION_IGRE_*GetIgnDwellAdNvmy*(IN < PRM_Cyl>, OUT < PRM_Td_ad_l>, OUT < PRM_Td_ad_h>)

This action allows getting the values of dwell time adaptation stored in NVMY.
For specified cylinder Cyl, the dwell time adaptative values TD_AD_L and TD_AD_H will be read.
If cylinder number received is not in the range of the engine cylinder number, the maximum value will be put in output for TD_AD_L and TD_AD_H.

Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_Cyl	IN	0...7	0...7	1	-
Cylinder number on which we want to get the dwell time adaptative values					
PRM_Td_ad_l	OUT	8000...7FFFH	-131.072...131.068	0.004	ms
Dwell time adaptative for low current mode					
PRM_Td_ad_h	OUT	8000...7FFFH	-131.072...131.068	0.004	ms
Dwell time adaptative for high current mode					

ACTION_IGRE_*RstIgnDwellAdNvmy* (IN <PRM_Cyl>)

This action allows resetting the values of dwell time adaptation stored in NVMY.
This action will reset for the specified cylinder the adadaptive values TD_AD_L and TD_AD_H to **0 ms**.

Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_Cyl	IN	0...7	0...7	1	-
Cylinder number on which we want to reset the dwell time adaptative values					

FUNCTION DESCRIPTION:

This function should be used with ATIC71 component. Through the 2 current feedback flags of the component it is possible to measure the time spent above a given current threshold during the main dwell pulse.

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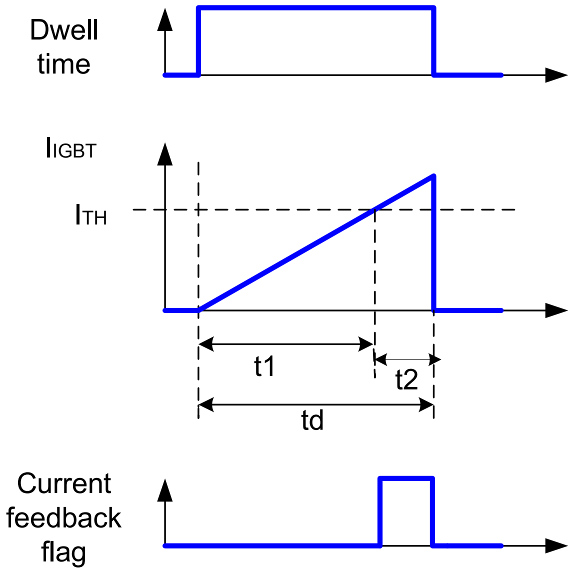

Two different current thresholds can be used depending on which engine condition we are.
The current threshold is fixed by hardware component at the current target the coils have to reach. If the threshold is not reached we increase the dwell time. In the other case we will decrease the dwell time by the time t2(time measured above the current threshold).

Please note that in this whole specification x corresponds to SEG_NR-2.

Application conditions:

Initialisation:
in case of EEPROM fault or new ECU: All TD_AD[x] = 0 ms
At reset :

if LC_TD_AD_CLR = 1
then **for** x = 0 to NC_CYL_NR-1
TD_AD_H[x] = 0
TD_AD_L[x] = 0
Endfor
Else TD_AD_H[x] = saved value
TD_AD_L[x] = saved value
endif

After power latch : all TD_AD_H[x] and all TD_AD_L[x] are stored into the non-volatile memory
At reset: T_SUM_TD_AD[x] = 0ms
TD_AD[x] = TD_AD_H[x] for all cylinders
Recurrence: segment
if N_32 > C_ N_32_MIN_TD_AD
Then recurrence = 1 out of NC_CYL_NR-1 segment
EndIf
Activation: at the 3rd segment occurence
Deactivation:

Formula section:

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Detection of current threshold switch

```
If          LV_TD_AD_H_n != LV_TD_AD_H_(n-1)
Then        for x = 0 to NC_CYL_NR-1
                    T_SUM_TD_AD[x] = 0
                Endfor
            CTR_TD_AD_SWI = NC_CYL_NR + 1
        LV_TD_AD_SWI = 1
Else
        If      CTR_TD_AD_SWI = 0
Then        nop                 // non operating: no action
  Elseif   CTR_TD_AD_SWI = 1
  Then      CTR_TD_AD_SWI = CTR_TD_AD_SWI - 1
                LV_TD_AD_SWI = 0
  Else          CTR_TD_AD_SWI = CTR_TD_AD_SWI - 1
        Endif
Endif

If      CTR_TD_AD_SWI = NC_CYL_NR
  For x = 0 to NC_CYL_NR-1
            Then        If      LV_TD_AD_H = 1
                        Then        TD_AD[x] = TD_AD_H[x]
                        Else        TD_AD[x] = TD_AD_L[x]
                    Endif
                End if
  endfor
endif
```

Check of the validity of current feedback flag result

```
If      T_THD_IGCFB              ≥      C_T_THD_IGCFB_MAX
     Or   (LV_SCG_IGC[x]      ==    1 And TD_IGC[X] > C_TD_IGC_OL_MIN)
     Or   LV_SCP_IGC[x]       ==    1
     Or   LV_ERR_CAM          ==    1
      Or        LV_INH_TD_AD            ==      1
      Or        LV_TD_AD_SWI            ==      1
Then        LV_TD_AD_ACQ_VLD        ==      0
Else        LV_TD_AD_ACQ_VLD        ==      1
Endif
```

Calculation of TD_AD

```
If      LV_TD_AD_ACQ_VLD = 1
Then
        if          T_THD_IGCFB=0
     Then    If     T_SUM_TD_AD[x]_n < C_T_SUM_TD_AD_MAX
            Then     TD_AD[x]_n = TD_AD[x]_(n-1) + C_TD_AD_INC
                   T_SUM_TD_AD[x]_n = T_SUM_TD_AD[x]_(n-1)+ C_TD_AD_INC
            Endif
     ElseIf   T_THD_IGCFB > C_TD_AD_THD
      Then                TD_AD[x]_n = TD_AD[x]_(n-1)- C_FAC_DEC_TD_AD * T_THD_IGCFB
                    T_SUM_TD_AD[x]_n= 0
```

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Else T_SUM_TD_AD[x]$_n$= 0
Endif

Limitation to maximum and minimum values authorized for dwell time adaptation
If TD_AD[x] $>$ C_TD_AD_MAX
Then TD_AD[x] = C_TD_AD_MAX
Endif
If TD_AD[x] $<$ C_TD_AD_MIN
Then TD_AD[x] = C_TD_AD_MIN
Endif

If LV_TD_AD_H= 1
Then TD_AD_H[x] = TD_AD[x]
Else TD_AD_L[x] = TD_AD[x]
Endif
Endif

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2.26 Dwell time adaptation (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_TD_AD	O/V	0... 1H	0 ...1	1	-
Flag indicating that dwell time adaptative function is inhibited					
LV_TD_AD_H	O/V	0... 1H	0 ...1	1	-
Flag indicating dwell time adaptation is done in start					
T_THD_IGCFB	O/V	0... FFFFH	0... 262.14	0.004	ms
Time measurement between current threshold and end of dwell					
TD_CLC	O/V	0... FFFFH	0... 262.14	0.004	ms
Dwell time calculated by BSW					

Input data:

LV_ST {p. 1720}	OPM_AV {p. 8137}	TCO {p. 1100}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_TD_AD_SWI	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold to enable switch from channel NC_TD_AD_CHN_ST to NC_TD_AD_CHN					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CFB_DIAG_SCP_CHN	-		-	-	-
Selection of the channel number to be used to do the SCB diagnosis whith current feedback flag 0 : CURR_TH1 1 : CURR_TH2					
NC_TD_AD_CHN_H	-		-	-	-
Selction of channel number where current feedback flag is read to do dwell time adaptation during start phase 0 : CURR_TH1 1 : CURR_TH2					
NC_TD_AD_CHN_L	-		-	-	-
Selction of channel number where current feedback flag is read to do dwell time adaptation 0 : CURR_TH1 1 : CURR_TH2					

Import actions:

ACTION_INFR_GetIgnDwellAd (**IN,**<IN>,**OUT,**<OUT>)
ACTION_INFR_SetIgnConfigDiag (**IN**<No Name available>)

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2.26.1 Channel configuration for diagnosis

FUNCTION DESCRIPTION:

In case of dwell time adaptation by current feedback flag, the SCB diagnosis is also done by current feedback flag.
It is necessary in this case to select on which channel will be done the SCB diagnosis.

Application conditions:

Initialisation:

Activation: at engine stop to engine run

Deactivation:

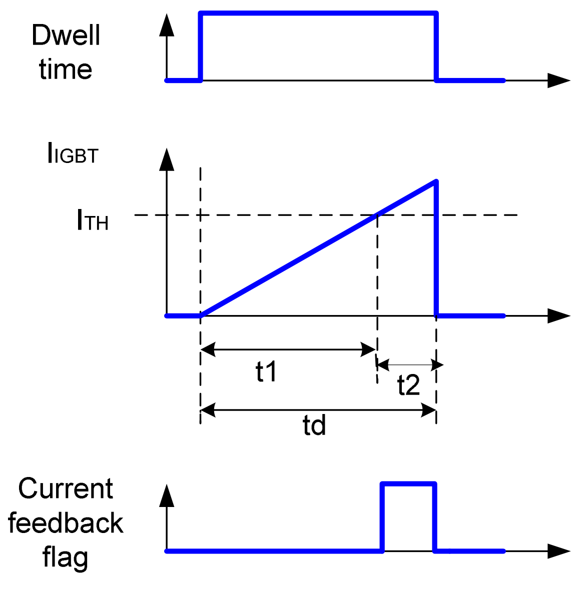
Formula section:

Channel configuration for SCB diagnosis with current feedback flag
ACTION_INFR_SetIgnConfigDiag(NC_CFB_DIAG_SCP_CHN)

2.26.2 Reading of current feedback flag for dwell time adaptation

FUNCTION DESCRIPTION:

This function should be used with ATIC71 component. Through the 2 current feedback flags of the component it is possible to measure the time spent above a given current threshold during the main dwell pulse.



Two different current thresholds can be used depending on which engine condition we are.
The current threshold is fixed by hardware component at the current target the coils have to reach. If the threshold is not reached we increase the dwell time. In the other case we will decrease the dwell time by the time t2(time measured above the current threshold).

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Application conditions:

Initialisation: at reset LV_INH_TD_AD = 0

Recurrence: segment

Activation: at the 3rd segment occurence

Deactivation:

Formula section:

Reading of the result of current feedback flag

If (LV_ST = 1) or TCO < C_TCO_TD_AD_SWI
Then
LV_TD_AD_H = 1
ACTION_INFR_GetIgnDwellAd(NC_TD_AD_CHN_H,SEG_NR-2,T_THD_IGCFB, TD_CLC)

ElseIf OPM_AV = 1H **or** OPM_AV = 3H (S or AFL = HOM_S mode)
Then
ACTION_INFR_GetIgnDwellAd(NC_TD_AD_CHN_H,SEG_NR-2,T_THD_IGCFB, TD_CLC)

LV_TD_AD_H = 1

Else LV_TD_AD_H = 0
ACTION_INFR_GetIgnDwellAd(NC_TD_AD_CHN_L,SEG_NR-2, T_THD_IGCFB, TD_CLC)
Endif

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2.27 Acquisition of fuel pressure

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_V_FUP	O/V	0... FFFFH	0... 65535	1	-
Number of samples in buffer V_FUP_SUM					
CTR_V_FUP_1	O/V	0... FFFFH	0... 65535	1	-
Number of samples in buffer V_FUP_SUM_1					
LV_FUP_SEG_OLD	O	0... 1H	0 ...1	1	-
Logical variable indicating the buffer to read the sensor voltage in BSW old value					
V_FUP	V	0... 7FFFH	0... 4.99984	152.6e-6	V
LPG pressure in the fuel rail, voltage raw value (10 bits).					
V_FUP_SUM	O/V	0... FFFFFFFFH	0... 655359.99984	152.6e-6	V
Accumulated mainfold air pressure measurements for segment number (2n-1), n=1,2,3,...					
V_FUP_SUM_1	O/V	0... FFFFFFFFH	0... 655359.99984	152.6e-6	V
Accumulated mainfold air pressure measurements for segment number (2n), n=1,2,3,...					

Input data:

LV_ES {p. 1720}	LV_FUP_SEG {p. 1283}		

Import actions:

ACTION_INFR_GetVFupSens (**OUT**<V_Fup>)

FUNCTION DESCRIPTION:

Signal flow diagram:

General information:

The raw value (voltage) for FUP is measured by continous conversion every 1 ms. The values (10 bit) are summed up in two alternating buffers, V_FUP_SUM or V_FUP_SUM_1. The numbers of values are counted in comparable buffers CTR_V_FUP or CTR_V_FUP_1. This mechanism is necessary to synchronize the measurement and the calculation of FUP_MES (build mean value with a standardized range)

Depending on the logical variable LV_FUP_SEG one of the two buffers — V_FUP_SUM or V_FUP_SUM_1 — and the respective counter — CTR_V_FUP or CTR_V_FUP_1 — are selected for writing, the contents of the other buffer (counter) is used for calculations and diagnosis (after this buffer and the corresponding counter have been read they are cleared).

After having read out one buffer — V_FUP_SUM or V_FUP_SUM_1 — the buffer has to be cleared as well as the corresponding counter — CTR_V_FUP or CTR_V_FUP_1.

A two-buffer-system is used to avoid incorrect FUP calculation.

The buffers will be filled when the segment is changing.

Application conditions

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Initialisation: **At** Reset

After HW reset, the buffers - V_FUP_SUM and V_FUP_SUM_1 - and

the corresponding counters - CTR_V_FUP and CTR_V_FUP_1 - have to be cleared.

```
V_FUP_SUM    = 0
V_FUP_SUM_1  = 0
CTR_V_FUP    = 0
CTR_V_FUP_1  = 0
LV_FUP_SEG_OLD   = 0
```

Recurrence: 1ms

Activation: -

Deactivation: -

Formula section:

If(1) (LV_FUP_SEG = 0 **and** LV_FUP_SEG_OLD = 1)
Then(1)
V_FUP_SUM =
CTR_V_FUP = 0
Else(1)
If(2) (LV_FUP_SEG =1 **and** LV_FUP_SEG_OLD = 0)
Then(2)
V_FUP_SUM_1 =
CTR_V_FUP_1 = 0
Else(2)
Do nothing
Endif(2)
Endif(1)

LV_FUP_SEG_OLD$_{(n)}$ = LV_FUP_SEG$_{(n-1)}$

If(1) (LV_FUP_SEG = 0)
Then(1)
V_FUP_SUM = V_FUP$_{(n)}$ + V_FUP$_{(n+1)}$
CTR_V_FUP$_{(n)}$ = CTR_V_FUP$_{(n-1)}$ + 1
Else(1)
V_FUP_SUM_1 = V_FUP$_{(n)}$ + V_FUP$_{(n+1)}$
CTR_V_FUP_1$_{(n)}$ = CTR_V_FUP_1$_{(n-1)}$ + 1
Endif(1)

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2.28 Multi function steering wheel interface

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
BIOS_CRU_DATA	O/V	6EH B6H DAH FCH FEH	RESUME SET_ ACCELERATE OFF DECELERATE NONE	-	-
Status off MSW module					
BIOS_CRU_NEW_DATA	O	0... 1H	0 ...1	1	-
Validation Bit for Status off MSW					
BIOS_CRU_TOG	O	0... 1H	0 ...1	1	-
Togglebit for MSW Module					

General information

The multifunction steering wheel (MSW) with buttons the position of which is transferred digitally through a serial data line serves as interface between the driver and the CRU system. According to extension stage, a distinction is made between low and high version with 8-bit and 16-bit transmission protocol. Only the 8-bit data frame is relevant for the engine control. For plausibility check whether the MSW is still active, a toggle bit is appended to the 7-bit information. This bit changes its level cyclically.

Application conditions:

Initialisation: –

Activation: –

Deactivation: –

Recurrence: `10 ms`

Function description:

Formula section:

2.28.1 Serial data line from the MSW

The buttons of the multifunction steering wheel are not interlocked mechanically against one another, which means that a priority must be introduced for the switch position. The S/A and DEC functions are an exception. Here the buttons are formed as rocker in the MSW and thus cannot be actuated simultaneously. The position of the buttons is encoded digitally the MSW control unit and transferred through a serial data line. In the 8-bit data frame, which is transmitted by the MSW, the buttons are encoded as follows:

8-bit data frame of the transmission module

S = Start bit
N = Zero bit
E = One bit

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I = Info bit

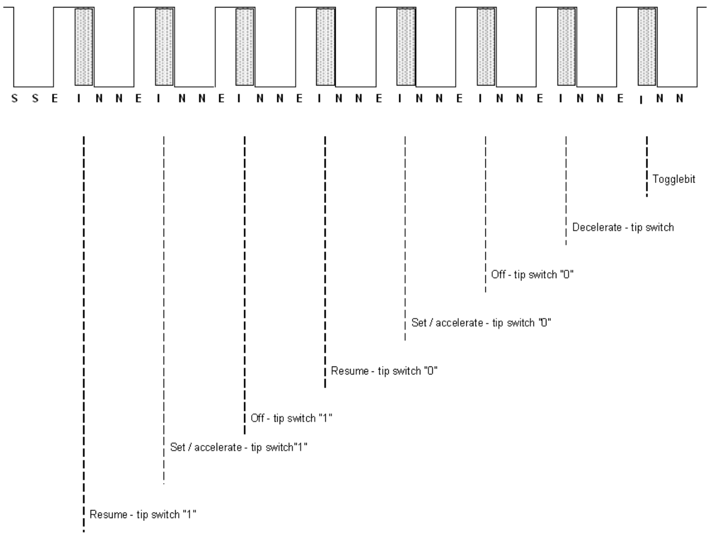

Figure 2.28.1:

Resume, setting/acceleration as well as off buttons are encoded redundantly and numbered for differentiating the information (0;1). The encoding of the buttons is high active, i.e. for a pressed button a 1 is transmitted as useful information. Furthermore a toggle bit is transmitted in the bit position 0 of the 8-bit data frame, a special bit information which changes its level cyclical. The toggle bit can thus also be used for error detection, like the switch positions, which are encoded redundantly.

The following distinctions are made in the transmitted functions of the MSW:

1. Rest: SET/ACC and DEC and RES and OFF not pressed.
2. SET/ACC: SET/ACC and no DEC pressed
3. DEC: DEC and no SET/ACC pressed
4. RES: RES pressed.
5. OFF: OFF pressed.

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2.29 EGCP configuration of infrastructure interface

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NR_CBK_EX	O/V	1... 4H	1 ...4	1	-
current number of exhaust gas cylinder banks					
NR_CONF_CBK_EX	O/V	0... FFH	0... 255	1	-
current configuration of the technical structure of the exhaust bank with its components.					

Input data:

CDN_DIAG_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	CDN_DIAG_LSH_UP [NC_CBK_EX_NR] {p. 4315}	ERR_DIAG_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	ERR_DIAG_LSH_UP [NC_CBK_EX_NR] {p. 4315}
NC_CBK_EX_NR {p. 1829}	VLS_NS [NC_NOX_SENS_CONF] {p. 992}		

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NR_CBK_EX	-	1... 4H	1 ...4	1	-
Define the number of exhaust gas cylinder banks					
C_NR_CONF_CBK_EX	-	0... FFH	0... 255	1	-
Define the technical structure of the exhaust bank with its components					

Action definition

ACTION_INFR_DisableCilc ()	Mode: O
This action sets the deactivation of CILC	

ACTION_INFR_EnableCilc ()	Mode: O
This action sets the activation of CILC (cylinder individuel lambda control)	

ACTION_INFR_GetCilc (**IN**<x>,**OUT**<v_adc>,**OUT**<ctr>)	Mode: O
Signal acquisition for CILC	

ACTION_INFR_GetElDiagLshDown (**IN**<i>,**OUT**<cdn_diag>,**OUT**<err_diag>)	Mode: O
This action reads the failure and the conditions information for each symptom from the infrastructure	

ACTION_INFR_GetElDiagLshUp (**IN**<i>,**OUT**<cdn_diag>,**OUT**<err_diag>)	Mode: O
This action reads the failure and the conditions information for each symptom from the infrastructure	

ACTION_INFR_GetHeatCoupling (**IN**<PRM_NC_CBK_EX_NR>,**OUT**<PRM_LAMB_SP_FIL_DELTA_RISE>,**OUT**<PRM_LAMB_SP_FIL_DELTA_FALL>,**OUT**<PRM_VLS_UP_DELTA_RISE>,**OUT**<PRM_VLS_UP_DELTA_FALL>)	Mode: O
This action gets the value from the WRAF controller for the heater coupling diagnosis	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_NC_CBK_EX_NR	in	0... 1H	1 ...2	1	-
Index of exhaust cylinder banks					
PRM_LAMB_SP_FIL_DELTA_RISE	out	0... 7FFFH	0... 1.9999389648437	61.0351e-6	-

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Acquired lambda model value at the rising edge of heater PWM					
PRM_LAMB_SP_FIL_DELTA_FALL	out	0... 7FFFH	0... 1.9999389648437	61.0351e-6	-
Acquired lamba model value at the falling edge of heater PWM					
PRM_VLS_UP_DELTA_RISE	out	0... 3FFH	0... 4.9951171875	0.00488281	V
Acquired oxygen sensor voltage at the rising edge of heater PWM					
PRM_VLS_UP_DELTA_FALL	out	0... 3FFH	0... 4.9951171875	0.00488281	V
Acquired oxygen sensor voltage at the falling edge of heater PWM					

ACTION_INFR_GetVAdcLsDown (**IN**<i>,**OUT**<v_adc>)	Mode: O
This action gets the oxygen sensor voltage downstream	

ACTION_INFR_GetVAdcLsUp (**IN**<i>,**OUT**<v_adc>)	Mode: O
This action gets the raw value from the upstream oxygen sensor voltage	

ACTION_INFR_GetVAdcTempLsUp (**IN**<i>,**OUT**<v_adc>)	Mode: O
This action gets the oxygen sensor voltage upstream	

ACTION_INFR_GetWrafControl (**IN**<i>,**OUT**<lv_lsl_deac>,**OUT**<state_err_vnlsl>,**OUT**<state_err_vglsl>,**OUT**<state_err_viplsl>,**OUT**<state_err_vrclsl>,**OUT**<state_err_iplsl>,**OUT**<state_err_lsl>,**OUT**<state_lsl_if_spi_rd>,**OUT**<state_lsl_if_conf_spi_rd>,**OUT**<frq_r_it_osc_lsl_if_spi_rd>,**OUT**<ctr_err_lsl_if_spi_wr>,**OUT**<ctr_err_lsl_if_spi_it_osc_ena>,**OUT**<lv_vplsl_lim>,**OUT**<lv_vnlsl_lim>)	Mode: O
This action reads the values from the WRAF controller	

ACTION_INFR_SetCilc (**IN**<x>,**IN**<crk>)	Mode: O
This action provide actual phase displacement for each cylinder	

ACTION_INFR_SetCmdLsDown (**IN**<i>,**IN**<lv_swi_ls_down>)	Mode: O
This action starts the internal resistance determination by "pumping" the sensor.	

ACTION_INFR_SetCmdLsUp (**IN**<i>,**IN**<lv_swi_ls_up>)	Mode: O
This action starts the internal resistance determination by "pumping" the sensor.	

ACTION_INFR_SetHeatCoupling (**IN**<PRM_NC_CBK_EX_NR>,**IN**<PRM_T_DLY_TRIG_LSH_UP>,**IN**<PRM_LAMB_SP_FIL_HOM>)	Mode: O
This action sets the value of the WRAF controller for the heater coupling diagnosis	

Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_NC_CBK_EX_NR	in	0... 1H	1 ...2	1	-
Index of exhaust cylinder banks					
PRM_T_DLY_TRIG_LSH_UP	in	0... FFH	0... 0.255	0.001	s
Time delay for acquisition of oxygen sensor signal and lambda model					
PRM_LAMB_SP_FIL_HOM	in	0... 7FFFH	0... 1.9999389648437	61.0351e-6	-
output signal of the WRAF sensor model for homogeneous mode					

ACTION_INFR_SetPwmLshDown (**IN**<i>,**IN**<ducy>)	Mode: O
This action sets the lambda heater downstream driver	

ACTION_INFR_SetPwmLshUp (**IN**<i>,**IN**<ducy>)	Mode: O
This action sets the lambda heater upstream driver	

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ACTION_INFR_SetWrafControl (**IN**<i>,**IN**<state_lsl_if_spi_wr>,**IN**<state_lsl_if_conf_spi_wr>,**IN**<frq_r_it_osc_lsl_if_spi_wr>,**IN**<lv_lsl_if_rst>,**IN**<lv_lsl_up_spi_com_inh>,**IN**<lv_ctr_err_lsl_if_spi_man_inc>)	Mode: O
This action sets the values of the WRAF controller	

Import actions:

ACTION_INFR_CDisableCilc ()
ACTION_INFR_CEnableCilc ()
ACTION_INFR_CGetCilc (**IN**<x>,**OUT**<v_adc>,**OUT**<ctr>)
ACTION_INFR_CGetElDiagLshDown (**IN**<i>,**OUT**<cdn_diag>,**OUT**<err_diag>)
ACTION_INFR_CGetElDiagLshUp (**IN**<i>,**OUT**<cdn_diag>,**OUT**<err_diag>)
ACTION_INFR_CGetHeatCoupling (**IN**<i>,**OUT**<lamb_sp_fil_delta_rise>,**OUT**<lamb_sp_fil_delta_fall>,**OUT**<vls_up_delta_rise>,**OUT**<vls_up_delta_fall>)
ACTION_INFR_CGetVAdcLsDown (**IN**<i>,**OUT**<v_adc>)
ACTION_INFR_CGetVAdcLsUp (**IN**<i>,**OUT**<v_adc>)
ACTION_INFR_CGetVAdcTempLsUp (**IN**<i>,**OUT**<v_adc>)
ACTION_INFR_CGetWrafControl (**IN**<i>,**OUT**<lv_lsl_deac>,**OUT**<state_err_vnlsl>,**OUT**<state_err_vglsl>,**OUT**<state_err_viplsl>,**OUT**<state_err_vrclsl>,**OUT**<state_err_iplsl>,**OUT**<state_err_lsl>,**OUT**<state_lsl_if_spi_rd>,**OUT**<state_lsl_if_conf_spi_rd>,**OUT**<frq_r_it_osc_lsl_if_spi_rd>,**OUT**<ctr_err_lsl_if_spi_wr>,**OUT**<ctr_err_lsl_if_spi_it_osc_ena>,**OUT**<lv_vplsl_lim>,**OUT**<lv_vnlsl_lim>)
ACTION_INFR_CSetCilc (**IN**<x>,**IN**<crk>)
ACTION_INFR_CSetCmdLsDown (**IN**<i>,**IN**<lv_swi_ls_down>)
ACTION_INFR_CSetCmdLsUp (**IN**<i>,**IN**<lv_swi_ls_up>)
ACTION_INFR_CSetHeatCoupling (**IN**<i>,**IN**<t_dly_trig_lsh_up>,**IN**<lamb_sp_fil_hom>)
ACTION_INFR_CSetPwmLshDown (**IN**<i>,**IN**<ducy>)
ACTION_INFR_CSetPwmLshUp (**IN**<i>,**IN**<ducy>)
ACTION_INFR_CSetWrafControl (**IN**<i>,**IN**<state_lsl_if_spi_wr>,**IN**<state_lsl_if_conf_spi_wr>,**IN**<frq_r_it_osc_lsl_if_spi_wr>,**IN**<lv_lsl_if_rst>,**IN**<lv_lsl_up_spi_com_inh>,**IN**<lv_ctr_err_lsl_if_spi_man_inc>)

Description for actions:

ACTION_INFR_SetPwmLshUp(i, ducy **)**

This action sets the lambda heater upstream driver

Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
I	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
Ducy	IN	0...FFH	0...99.609375	0.390625	%
Up Heater driver PWM duty cycle					

ACTION_INFR_SetPwmLshDown(i, ducy **)**

This action sets the lambda heater downstream driver

Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
I	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
Ducy	IN	0...FFH	0...99.609375	0.390625	%
Down Heater driver PWM duty cycle					

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ACTION_INFR_GetVAdcLsUp(i, v_adc **)**					
This action gets the raw value from the upstream oxygen sensor voltage.					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
I	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
v_adc	OUT	0...7FFFH	0...4.99984741	1.52588E-4	V
Raw value of upstream oxygen sensor voltage					

ACTION_INFR_GetVAdcLsDown(i, v_adc **)**					
This action gets the oxygen sensor voltage upstream					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
I	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
v_adc	OUT	0...7FFFH	0...4.99984741	1.52588E-4	V
Downstream oxygen sensor voltage					

ACTION_INFR_GetVAdcTempLsUp(i, v_adc **)**					
This action sets the upstream lambda sensor temperature voltage					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
I	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
v_adc	OUT	0...7FFFH	0...4.99984741	1.52588E-4	V
Upstream lambda sensor temperature voltage					

ACTION_INFR_EnableCilc()					
This action sets the activation of CILC (cylinder individuel lambda control)					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit

ACTION_INFR_DisableCilc()					
This action sets the deactivation of CILC					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit

ACTION_INFR_GetCilc(x, v_adc, ctr **)**					
Signal acquisition for CILC					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
X	IN	**0...7H**	**0...7**	**1**	**-**
logical index of cylinder to be acquired					
v_adc	OUT	0...7FFFH	0...4.99984741	1.52588E-4	V
upstream oxygen sensor acquisition (cylinder individual)					
Ctr	OUT	0...FFH	0...255	1	-
cylinder selective update counter for trigger event					

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ACTION_INFR_SetCilc(x, crk **)**					
This action provide actual phase displacement for each cylinder. Remark: The maximum angle delay which can be realized by the BSW is 720°CRK. Larger values shall be calculated beginning with 0°CRK.					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
X	IN	**0...7H**	**0...7**	**1**	**-**
logical index of cylinder to be changed					
Crk	IN	0...F0H	0...1440	6	°CRK
Value of phase displacement					

ACTION_INFR_GetElDiagLshUp(i, cdn_diag, err_diag **)**					
This action reads the failure and the conditions information for each symptom from the infrastructure The readout of the power stage is performed autonomous and the information is gathered. When calling this Action the information inside the Infrastructure is reset after returning the OUT parameters.					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
I	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
cdn_diag	OUT	0...7H	0...7	1	-
Bit 0: Set, if error symptom SCP (SYM_0) is detected Bit 1: Set, if error symptom SCG (SYM_1) is detected Bit 2: Set, if error symptom OC (SYM_2) is detected					
err_diag	OUT	0...7H	0...7	1	-
Raw value of error symptom. The relevant bit is set, if the error has been detected.					

ACTION_INFR_GetElDiagLshDown(i, cdn_diag, err_diag **)**					
This action reads the failure and the conditions information for each symptom from the infrastructure The readout of the power stage is performed autonomous and the information is gathered. When calling this Action the information inside the Infrastructure is reset after returning the OUT parameters.					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
I	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
cdn_diag	OUT	0...7H	0...7	1	-
Bit 0: Set, if error symptom SCP (SYM_0) is detected Bit 1: Set, if error symptom SCG (SYM_1) is detected Bit 2: Set, if error symptom OC (SYM_2) is detected					
err_diag	OUT	0...7H	0...7	1	-
Raw value of error symptom. The relevant bit is set, if the error has been detected.					

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ACTION_INFR_GetWrafControl(i, lv_lsl_deac, state_err_vnlsl, state_err_vglsl, state_err_viplsl, state_err_vrclsl, state_err_iplsl, state_err_lsl, state_lsl_if_spi_rd, state_lsl_if_conf_spi_rd, frq_r_it_osc_lsl_if_spi_rd, ctr_err_lsl_if_spi_wr, ctr_err_lsl_if_spi_it_osc_ena, lv_vplsl_lim, lv_vnlsl_lim **)**

This action reads the values from the WRAF controller.

Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
I	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
lv_lsl_deac	OUT	0...1H	0...1	1	-
Boolean flag indicating OBDI signal fault pending					
state_err_vnlsl	OUT	0H 1H 2H	NO_FAULT SCG SCB	1	[-]
Diagnosis status of the Nernst Cell positive pin.					
state_err_vglsl	OUT	0H 1H 2H	NO_FAULT SCG SCB	1	[-]
Diagnosis status of the Virtual Ground pin.					
state_err_viplsl	OUT	0H 1H 2H	NO_FAULT SCG SCB	1	[-]
Diagnosis status of the Pump Cell pin.					
state_err_vrclsl	OUT	0H 1H 2H	NO_FAULT SCG SCB	1	[-]
Diagnosis status of the Calibration Resistance pin.					
state_err_iplsl	OUT	0H 1H 2H	NO_FAULT CURRENT_LOW CURRENT_HIGH	1	[-]
Diagnosis status of the Pumping Current.					
state_err_lsl	OUT	0H 1H	NO_FAULT FAULT	1	[-]
OBDI General Status					
state_lsl_if_spi_rd	OUT	0...FFH	0...255	1	[-]
Bit-field, mapping verified contents of WRAF controller Configuration Register					
state_lsl_if_conf_spi_rd	OUT	0...FFH	0...255	1	[-]
Content of the configuration register comprising sensor disconnection time delay and Icp value					
frq_r_it_osc_lsl_if_spi_rd	OUT	0...7FH	0...127	1	[-]
Content of the configuration register comprising Ri-measurement frequency and bit for pin selective disabling					
ctr_err_lsl_if_spi_wr	OUT	0...FFH	0...255	1	[-]
Counter indicating number of invalid INIT_REG_x write validation cycles which have been detected					
ctr_err_lsl_if_spi_it_osc_ena	OUT	0...FFH	0...255	1	[-]
Counter indicating number of invalid transmissions of “R_IT_OSC_ENA” bit					
lv_vplsl_lim	OUT	0...1H	0...1	1	[-]
Boolean flag indicating that Pump Cell voltage has reached its limits					
lv_vnlsl_lim	OUT	0...1H	0...1	1	[-]
Boolean flag indicating overvoltage at Nernst Cell positive pin (reverse Icp cut-off)					

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ACTION_INFR_SetWrafControl(i, state_lsl_if_spi_wr, state_lsl_if_conf_spi_wr, frq_r_it_osc_lsl_if_spi_wr, lv_lsl_if_rst, lv_lsl_up_spi_com_inh, lv_ctr_err_lsl_if_spi_man_inc**)**					
This action sets the values of the WRAF controller					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
i	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
state_lsl_if_spi_wr	IN	0...FFH	0...255	1	-
Bit-field mapping of contents to be written to WRAF controller INIT_REG_1					
state_lsl_if_conf_spi_wr	IN	0...FFH	0...255	1	-
Bit-field mapping of contents to be written to WRAF controller INIT_REG_1					
frq_r_it_osc_lsl_if_spi_wr	IN	0...7FH	0...127	1	-
Mapping of contents to be written to WRAF controller INIT_REG_1					
lv_lsl_if_rst	IN	0...1H	0...1	1	-
Boolean flag to reset the WRAF controller					
lv_lsl_up_spi_com_inh	IN	0...1H	0...1	1	-
Inhibit bit for the SPI-communication related to electrical diagnosis on BSW level					
lv_ctr_err_lsl_if_spi_man_inc	IN	0...1H	0...1	1	-
BSW interface for manual increase of value of SPI communication error counter					

ACTION_INFR_SetCmdLsUp(i, lv_swi_ls_up **)**					
This action starts the internal resistance determination by "pumping" the the sensor.					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
i	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
lv_swi_ls_up	IN	0H 1H	Switch off Switch on	1	-
Digital command parameter for the setting of pump current for binary upstream lambda sensor Remark: Switch on equal to activation (high or low level)					

ACTION_INFR_SetCmdLsDown(i, lv_swi_ls_down **)**					
This action starts the internal resistance determination by "pumping" the the sensor.					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
i	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
lv_swi_ls_down	IN	0H 1H	Switch off Switch on	1	-
Digital command parameter for the setting of pump current for binary downstream lambda sensor Remark: Switch on equal to activation (high or low level)					

ACTION_INFR_SetHeatCoupling(i, t_dly_trig_lsh_up, lamb_sp_fil_hom **)**					
This action sets the value of the WRAF controller for the heater coupling diagnosis.					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
I	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
t_dly_trig_lsh_up	IN	0...FFH	0...0.255	0.001	s
Time delay for acquisition of oxygen sensor signal and lambda model					
lamb_sp_fil_hom	IN	0...7FFFH	0...1.999939	6.10351573229163 E-5	-
output signal of the WRAF sensor model for homogeneous mode					

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ACTION_INFR_GetHeatCoupling(i, lamb_sp_fil_delta_rise, lamb_sp_fil_delta_fall, vls_up_delta_rise, vls_up_delta_fall **)**					
This action gets the value from the WRAF controller for the heater coupling diagnosis.					
Name	Type	Hex. Limits	Phys. Limits	Resol.	Unit
I	IN	0H 1H	1 2	1	-
Index of exhaust cylinder banks					
lamb_sp_fil_delta_rise	OUT	0...7FFFH	0...1.99993896484375	6.10351562E-5	-
Acquired lambda model value at the rising edge of heater PWM					
lamb_sp_fil_delta_fall	OUT	0...7FFFH	0...1.99993896484375	6.10351562E-5	-
Acquired lambda model value at the falling edge of heater PWM					
vls_up_delta_rise	OUT	0...7FFFH	0...4.99984741	1.52588E-4	V
Acquired oxygen sensor voltage at the rising edge of heater PWM					
vls_up_delta_fall	OUT	0...7FFFH	0...4.99984741	1.52588E-4	V
Acquired oxygen sensor voltage at the falling edge of heater PWM					

FUNCTION DESCRIPTION:

General information:

a) **i = NC_CBK_EX_NR** (Number of exhaust gas cylinder banks)
b) **x = NC_CYL_NR** (Number of engine cylinders)

Depending on the value of NC_CBK_EX_NR and the states of the variable **NR_CONF_CBK_EX** following rules are defined which have to be used for all actions.

The symbolic item param_list represents the complete dedicated action parameters, exept the explicitly given one.

RULE 1: *%% used in general for upstream SET-ACTION*
IF NC_CBK_EX_NR = 2
THEN
Case selection NR_CBK_EX
= 1:
for i = 1: ACTION_INFR_Command(IN < i = 1 >, param_list) =
TION_INFR_CCommand(IN < i = 1 >, param_list)
for i = 2: no ACTION activity
= 2:
ACTION_INFR_Command(IN <i>, param_list) =
ACTION_INFR_CCommand (IN < i>, param_list)
ELSE
ACTION_INFR_Command(IN <i>, param_list) =
ACTION_INFR_CCommand (IN < i>, param_list)
ENDIF

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RULE 2: *%% used in general for downstream SET-ACTION*
IF NC_CBK_EX_NR = 2
THEN
Case selection NR_CONF_CBK_EX

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= 1:

for i = 1: ACTION_INFR_Command(IN < i = 1 >, param_list) =
TION_INFR_CCommand(IN < i = 1 >, param_list)

for i = 2: no ACTION activity

= 2:

ACTION_INFR_Command(IN < i >, param_list) =
ACTION_INFR_CCommand(IN < i >, param_list)

= 3:

for i = 1: no ACTION activity

for i = 2: ACTION_INFR_Command(IN < i = 2 >, param_list) =
TION_INFR_CCommand(IN < 2 >, param_list)

= 4:

for i = 1: ACTION_INFR_Command(IN < i = 1 >, param_list) =
TION_INFR_CCommand(IN < i = 1 >, param_list)

for i = 2: no ACTION activity

ELSE

ACTION_INFR_Command(IN < i >, param_list) =
ACTION_INFR_CCommand(IN < i >, param_list)

ENDIF

RULE 3: *%% used in general for upstream GET-ACTION*

IF NC_CBK_EX_NR = 2

THEN

Case selection NR_CBK_EX

= 1:

for i = 1: ACTION_INFR_Command(IN < i = 1 >, param_list) =
TION_INFR_CCommand(IN < i = 1 >, param_list)

for i = 2: ACTION_INFR_Command(IN < i = 2 >, param_list) =
TION_INFR_CCommand(IN < i = 1 >, param_list)

= 2:

ACTION_INFR_Command(IN < i >, param_list) =
ACTION_INFR_CCommand(IN < i>, param_list)

ELSE

ACTION_INFR_Command(IN < i >, param_list) =
ACTION_INFR_CCommand(IN < i >, param_list)

ENDIF

RULE 4: *%% used in general for downstream GET-ACTION*

IF NC_CBK_EX_NR = 2

THEN

Case selection NR_CONF_CBK_EX

= 1:

for i = 1: ACTION_INFR_Command(IN < i = 1 >, param_list) =
TION_INFR_CCommand(IN < i = 1 >, param_list)

for i = 2: ACTION_INFR_Command(IN < i = 2 >, param_list) =
TION_INFR_CCommand(IN < i = 1 >, param_list)

= 2:

ACTION_INFR_Command(IN < i >, param_list) =
ACTION_INFR_CCommand(IN < i>, param_list)

= 3:

for i = 1: ACTION_INFR_Command(IN < i = 1 >, param_list) =
TION_INFR_Command(IN < i = 1 >, OUT < VLS_NS[1] >)

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*% **physical** value of VLS_NS shall be output as VLS_DOWN[1]*
for i = 2: ACTION_INFR_Command(IN < i = 2 >, param_list) =
TION_INFR_CCommand(IN < i = 2 >, param_list)
= 4:
for i = 1: ACTION_INFR_Command(IN < i = 1 >, param_list) =
TION_INFR_CCommand(IN < i = 1 >, param_list)
for i = 2: ACTION_INFR_Command(IN < i = 2 >, param_list) =
TION_INFR_Command(IN < i = 2 >, OUT < VLS_NS[1] >)
*% **physical** value of VLS_NS shall be output as VLS_DOWN[2]*
# ELSE
ACTION_INFR_Command(IN < i >, param_list) =
ACTION_INFR_CCommand(IN < i >, param_list)
# ENDIF

RULE 5:

ACTION_INFR_Command(param_list) = ACTION_INFR_CCommand(param_list)

RULE 6:

%% used for upstream Heater diagnosis with ATIC39.
*%% relies on the assumption that a **call for bank 1 made immediately before the call for bank 2.***
# IF NC_CBK_EX_NR = 2
# THEN
Case selection NR_CBK_EX
= 1:
for i = 1: ACTION_INFR_Command(IN < i = 1 >, param_list) =
TION_INFR_CCommand(IN < i = 1 >, param_list)
for i = 2: ACTION_INFR_Command(IN < i = 2 >, param_list) =
TION_INFR_Command(IN < i = 2 >,
OUT < cdn_diag = CDN_DIAG_LSH_UP[1] >,
OUT < err_diag = ERR_DIAG_LSH_UP[1] >)
= 2:
ACTION_INFR_Command(IN < i >, param_list) =
ACTION_INFR_CCommand(IN < i>, param_list)
# ELSE
ACTION_INFR_Command(IN < i >, param_list) =
ACTION_INFR_CCommand(IN < i >, param_list)
# ENDIF

RULE 7:

%% used for downstream Heater diagnosis with ATIC39
*%% relies on the assumption that a **call for bank 1 made immediately before the call for bank 2**.*
# IF NC_CBK_EX_NR = 2
# THEN
Case selection NR_CBK_EX
= 1:
for i = 1: ACTION_INFR_Command(IN < i = 1 >, param_list) =
TION_INFR_CCommand(IN < i = 1 >, param_list)
for i = 2: ACTION_INFR_Command(IN < i = 2 >, param_list) =
TION_INFR_Command(IN < i = 2 >,
OUT < cdn_diag = CDN_DIAG_LSH_DOWN[1] >,

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OUT < err_diag = ERR_DIAG_LSH_DOWN[1] >)

= 2:

ACTION_INFR_Command(IN < i >, param_list) =
ACTION_INFR_CCommand(IN < i>, param_list)

ELSE

ACTION_INFR_Command(IN < i >, param_list) =
ACTION_INFR_CCommand(IN < i >, param_list)

ENDIF

Application conditions

Initialisation: `at reset:` `NR_CONF_CBK_EX = C_NR_CONF_CBK_EX`
`NR_CBK_EX = C_NR_CBK_EX`

Recurrence: `– (the assignment of NR_CONF_CBK_EX is only performed once during initialization)`

Activation: `always, under all conditions and states`

Deactivation: `– –`

Formula section:

ACTION	RULE
ACTION_INFR_SetPwmLshUp(IN <i>, **IN** <ducy>**)**	**1**
ACTION_INFR_SetPwmLshDown(IN <i>, **IN** <ducy>**)**	**2**
ACTION_INFR_GetVAdcLsUp(IN <i>, **OUT** <v_adc>**)**	**3**
ACTION_INFR_GetVAdcLsDown(IN <i>, **OUT** <v_adc>**)**	**4**
ACTION_INFR_GetVAdcTempLsUp(IN <i>, **OUT** <v_adc>**)**	**3**
ACTION_INFR_EnableCilc()	**5**
ACTION_INFR_DisableCilc()	**5**
ACTION_INFR_GetCilc(IN <x>, **OUT** <v_adc, **OUT** <ctr>**)**	**5**
ACTION_INFR_SetCilc(IN <x>, **IN** <crk>**)**	**5**
ACTION_INFR_GetElDiagLshUp(IN <i>, **OUT** <cdn_diag>, **OUT** <err_diag>**)**	**6**
ACTION_INFR_GetElDiagLshDown(IN <i>, **OUT** <cdn_diag>, **OUT** <err_diag>**)**	**7**
ACTION_INFR_GetWrafControl(IN <i>, **OUT** <lv_lsl_deac>, **OUT** <state_err_vnlsl>, **OUT** <state_err_vglsl>, **OUT** <state_err_viplsl>, **OUT** <state_err_vrclsl>, **OUT** <state_err_iplsl>, **OUT** <state_err_lsl>, **OUT** <state_lsl_if_spi_rd>, **OUT** <state_lsl_if_conf_spi_rd>, **OUT** <frq_r_it_osc_lsl_if_spi_rd>, **OUT** <ctr_err_lsl_if_spi_wr>, **OUT** <ctr_err_lsl_if_spi_it_osc_ena>, **OUT** <lv_vplsl_lim>, **OUT** <lv_vnlsl_lim>**)**	**3**
ACTION_INFR_SetWrafControl(IN <i>, **IN** <state_lsl_if_spi_wr>, **IN** <state_lsl_if_conf_spi_wr>, **IN** <frq_r_it_osc_lsl_if_spi_wr>, **IN** <lv_lsl_if_rst>, **IN** <lv_lsl_up_spi_com_inh>, **IN** <lv_ctr_err_lsl_if_spi_man_inc>**)**	**1**
ACTION_INFR_SetCmdLsUp(IN <i>, **IN** <lv_swi_ls_up>**)**	**1**
ACTION_INFR_SetCmdLsDown(IN <i>, **IN** <lv_swi_ls_down>**)**	**2**
ACTION_INFR_SetHeatCoupling(IN <i>, **IN** <t_dly_trig_lsh_up>, **IN** <lamb_sp_fil_hom>**)**	**1**
ACTION_INFR_GetHeatCoupling(IN <i>, **OUT** <lamb_sp_fil_delta_rise>, **OUT** <lamb_sp_fil_delta_fall>, **OUT** <vls_up_delta_rise>, **OUT** <vls_up_delta_fall>**)**	**3**

- *The configuration calibration data C_NR_CONF_CBK_EX define the hardware configuration of the exhaust gas as describe below:*

= 1: standard one bank

= 2: standard two banks

= 3: two bank system in a Y-configuration without lambda sensor downstream at position bank 1 and with one NOx-sensor after the NOx catalyst (NC_NOX_SENS_CONF = 1).

= 4: two bank system in a Y-configuration without lambda sensor downstream at position bank 2 and with one NOx-sensor after the NOx catalyst (NC_NOX_SENS_CONF = 1).

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2.30 O2 sensor (lin, up) SPI interface BSW

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ERR_LSL_IF_SPI_IT_OSC_ENA [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter indicating number of invalid transmissions of "R_IT_OSC_ENA" bit					
CTR_ERR_LSL_IF_SPI_WR [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Counter indicating number of invalid INIT_REG_x write validation cycles which have been detected					
FRQ_R_IT_OSC_LSL_IF_SPI_RD [NC_CBK_EX_NR]	O/V	0... 7FH	0... 127	1	-
Content of the configuration register comprising Ri-measurement frequency and bit for pin selective disabling					
LV_LSL_DEAC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating OBDI signal fault pending					
LV_VNLSL_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating overvoltage at Nernst Cell positive pin (reverse Icp cut-off)					
LV_VPLSL_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that Pump Cell voltage has reached its limits					
STATE_ERR_IPLSL [NC_CBK_EX_NR]	O/V	0H 1H 2H	NO_FAULT CURRENT_LOW CURRENT_HIGH	-	-
Diagnosis status of the Pumping Current.					
STATE_ERR_LSL [NC_CBK_EX_NR]	O/V	0H 1H	NO_FAULT FAULT	-	-
OBDI General Status					
STATE_ERR_VGLSL [NC_CBK_EX_NR]	O/V	0H 1H 2H	NO_FAULT SCG SCB	-	-
Diagnosis status of the Virtual Ground pin.					
STATE_ERR_VIPLSL [NC_CBK_EX_NR]	O/V	0H 1H 2H	NO_FAULT SCG SCB	-	-
Diagnosis status of the Pump Cell pin.					
STATE_ERR_VNLSL [NC_CBK_EX_NR]	O/V	0H 1H 2H	NO_FAULT SCG SCB	-	-
Diagnosis status of the Nernst Cell positive pin.					
STATE_ERR_VRCLSL [NC_CBK_EX_NR]	O/V	0H 1H 2H	NO_FAULT SCG SCB	-	-
Diagnosis status of the Calibration Resistance pin.					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_LSL_IF_CONF_SPI_RD [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Content of the configuration register comprising sensor disconnection time delay and Icp value					
STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Bit-field, mapping verified contents of ATIC42 Configuration Register					

Input data:

FRQ_R_IT_OSC_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 1320}	LV_CTR_ERR_LSL_IF_SPI_MAN_INC [NC_CBK_EX_NR] {p. 1318}	LV_IGK {p. 906}	LV_LSL_IF_RST [NC_CBK_EX_NR] {p. 1318}
LV_LSL_UP_SPI_COM_INH [NC_CBK_EX_NR] {p. 4293}	NC_CBK_EX_NR {p. 1829}	STATE_LSL_IF_CONF_SPI_WR [NC_CBK_EX_NR] {p. 1313}	STATE_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 1313}

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CTR_ERR_LSL_IF_SPI_OSC_ENA	-	0... FFH	0... 255	1	-
Limit of counter indicating number of invalid transmissions of "R_IT_OSC_ENA" bit					

Import actions:

ACTION_INFR_GetWrafControl (**IN**<i>,**OUT**<lv_lsl_deac>,**OUT**<state_err_vnlsl>,**OUT**<state_err_vglsl>,**OUT**<state_err_viplsl>,**OUT**<state_err_vrclsl>,**OUT**<state_err_iplsl>,**OUT**<state_err_lsl>,**OUT**<state_lsl_if_spi_rd>,**OUT**<state_lsl_if_conf_spi_rd>,**OUT**<frq_r_it_osc_lsl_if_spi_rd>,**OUT**<ctr_err_lsl_if_spi_wr>,**OUT**<ctr_err_lsl_if_spi_it_osc_ena>,**OUT**<lv_vplsl_lim>,**OUT**<lv_vnlsl_lim>)
ACTION_INFR_SetWrafControl (**IN**<i>,**IN**<state_lsl_if_spi_wr>,**IN**<state_lsl_if_conf_spi_wr>,**IN**<frq_r_it_osc_lsl_if_spi_wr>,**IN**<lv_lsl_if_rst>,**IN**<lv_lsl_up_spi_com_inh>,**IN**<lv_ctr_err_lsl_if_spi_man_inc>)

2.30.1 Acquire raw data from the Infrastructure (BSW)

FUNCTION DESCRIPTION:

General information:

Application conditions:

Initialisation: at reset the actual input data will be send to and get from the infrastructure through calling the Actions

ACTION_INFR_GetWrafControl(
IN i
OUT LV_LSL_DEAC[i]
OUT STATE_ERR_VNLSL[i]
OUT STATE_ERR_VGLSL[i]
OUT STATE_ERR_VIPLSL[i]
OUT TATE_ERR_VRCLSL[i]

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OUT STATE_ERR_IPLSL[i]
OUT STATE_ERR_LSL[i]
OUT STATE_LSL_IF_SPI_RD[i]
OUT STATE_LSL_IF_CONF_SPI_RD[i]
OUT FRQ_R_IT_OSC_LSL_IF_SPI_RD[i]
OUT CTR_ERR_LSL_IF_SPI_WR[i]
OUT CTR_ERR_LSL_IF_SPI_IT_OSC_ENA[i]
OUT LV_VPLSL_LIM[i]
OUT LV_VNLSL_LIM[i])

ACTION_INFR_SetWrafControl(
IN i
IN STATE_LSL_IF_SPI_WR[i]
IN STATE_LSL_IF_CONF_SPI_WR[i]
IN FRQ_R_IT_OSC_LSL_IF_SPI_WR[i]
IN LV_LSL_IF_RST[i]
IN LV_LSL_UP_SPI_COM_INH[i]
IN LV_CTR_ERR_LSL_IF_SPI_MAN_INC[i])

Recurrence:
T_SAMPLE = 10 ms.

Activation:
- -

Deactivation:
- -

Formula section:

has to be executed before all other functions of EGCP which have the same recurrence.
ACTION_INFR_GetWrafControl(...)

has to be executed after all other functions of EGCP which have the same recurrence.
ACTION_INFR_SetWrafControl(...)

2.30.2 Descripton of the interaction between infrastruture and the WRAF controller

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

The function shall describe the interface between the Wide Range Air-Fuel (WRAF) sensor, its controll device, the ATIC42 in its final development step (2^{nd} Silicon, B5), and ECU.

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The digital control part of the interface is realised in hardware by means of a Serial Peripheral Interface (SPI) bus between the ECU and the ATIC42. Latter acts as slave while the microcontroller acts as master. Via the SPI it shall be possible to carry out the following tasks:

- [Read from the two IC identity registers IDENT_REG_1[i] and IDENT_REG_2[i] - currently not implemented in generic SW!]
- Configure and initialise the 1-byte long **initialisation register**, which comprehends the following switches:

bit position	description
0	Set Ip measurement gain (16 or 8)
1	Enable/disable pumping current (Ip) offset measurement
2	Enable/disable reference pumping current (Icp)
3	Enable/disable Ip controller
4	Enable/disable Nernst Cell inner resistance (Ri) calibration
5	Start/stop oscillator for Ri measurement
6	Enable/disable sensor
7	Set Ri measurement range (range2, range1)

- Configure and initialise the **second configuration register** containing the 5 bit setting for the Icp-current value, and the 3-bit register for protection time prior to sensor disconnecting in case of electrical failure.
- Configure and initialise the 7-bit register containing Ri measurement frequency and the activation switch for selective pin disabling during sensor protection time.
- Read out the sensor pin electrical diagnostic register.
- Read out the general status register
- [Reset the ATIC42 - currently not implemented in generic SW!]

The individual timing requirements and the general description of the SPI may be found in the ATIC42 Component Specification and shall not be repeated here. Only those points that serve to clarify the interface between the ATIC42 and the microcontroller will be elaborated upon.

2.30.3 BSW Description

General remark regarding handling of read (RD), and write (WR) variables of SPI interface: Access to status bits which are part of STATE_LSL_IF... SPI_*RD[*i] variables has to be realized by directly addressing the individual bit STATE_LSL_IF ... SPI_*RD*[i].bitX . The contents of STATE_LSL_IF ... SPI_*WR[*i] variables can either be accessed directly via STATE_LSL_IF ... SPI_*WR[*i].bitX or by corresponding logical variables, e.g. LV_LSL_ENA_LSL_IF[i].

2.30.3.1 SPI command sequencing

Immediately after a HW-reset or after ECU RESET, the standard command sequence stated below shall be executed. All the initialization information shall be sent once. Afterwards the sequence is repeated at every recurrence of BSW, i.e. every T_SAMPLE, containing up-to-date control information (command identifiers according to ATIC42 specification dated 24/07/02 are stated in brackets):

RD_DIAG_1(M1) + RD_DIAG_2(M2)
+ WR_CONF_INIT_1(F) + WR_CONF_INIT_2(I)
+ WR_INIT_R_FRQ_1(K) + WR_INIT_R_FRQ_2(L)
+ WR_INIT_1(C) + WR_INIT_2(D)
[+ RD_IDENT_1(A1) dummy command]

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In order to receive the answer to the last write command sent, which is evaluated for communication monitoring purposes, WR_INIT_2(D), a dummy read command - has been added to the sequence.
Remark: With transmission of command n , response to command n-1 is received in communication cycle n .
WR_INIT_2(D) command is sent at the end of each communication cycle to allow for all configuration data to be updated before setting sensor status (enable/disable).

2.30.3.2 Deactivation of WRAFsensor

Decoupling of WRAF sensor due to presence of electrical fault is handled by ASW/BSW interface (Appl Inc), 403B.
With LV_LSL_UP_SPI_COM_INH[i] = 1, ATIC42 SPI-responses related to electrical diagnosis status (contents of General Status Register and Pin Diagnosis Register) are no longer used to update contents of corresponding interface variables STATE_ERR_xxx[i], LV_LSL_VP_LIM[i], and LS_VNLSL_LIM[i]. The value of these variables thus preserves OBDI error status at the very moment of successful error debouncing for the remainder of the current driving cycle.

2.30.3.3 Reading the identification registers (currently not implemented in generic SW!)

If required, the identification registers can be read via the commands RD_IDENT_1(A1) and RD_IDENT_2(A2).
The command RD_IDENT_2(A2) reads the 8 MSB of the IC code while the command RD_IDENT_1(A1) reads the 3 LSB of the IC code, the 2 bit supplier index, and the 3 bit IC version number. The received information could be placed in a 16-bit output variable STATE_LSL_IF_IC_INFO[i] (V, 0...FFFFH, 0...65535, 1, -).

2.30.3.4 Reading the diagnostic registers

Diagnostic information regarding electrical sensor failures can be retrieved with the command sequence RD_DIAG_1(M1) + RD_DIAG_2(M2) which addresses the ATIC42 status registers.
Upon reading the general status register contents , the contents of both diagnosis registers are deleted. Therefore the two commands have to be performed in the appropriate sequence specified above: first the single pin diagnosis status has to be evaluated (RD_DIAG_1(M1)), then the general status register can be read (RD_DIAG_2(M2)) - deleting all electrical diagnosis information the very same moment!
The pin diagnosis register DIAG_REG_1 contains information regarding the type and location of electrical sensor faults. The following failure categories can be detected and for each fault a diagnosis bit is latched:

bit position	description
0	Short circuit to Ground (SCG) at pin RCD
1	Short circuit to Battery (SCB) at pin RCD
2	SCG at pin VIP
3	SCB at pin VIP
4	SCG at pin VG
5	SCB at pin VG
6	SCG at pin VN
7	SCB at pin VN

Two bits are associated with every sensor pin (RCD, VIP, VG, VN). Their combination provides four possible failure states (00 = no failure, 01 = SCG, 10 = SCB, 11 = presently not used).

DIAG_REG_2 contains information regarding general failure status, Pump Cell voltage and pumping current limit status, and overvoltage at VN pin. The following diagnoses can be evaluated :

1. General status of diagnosis.

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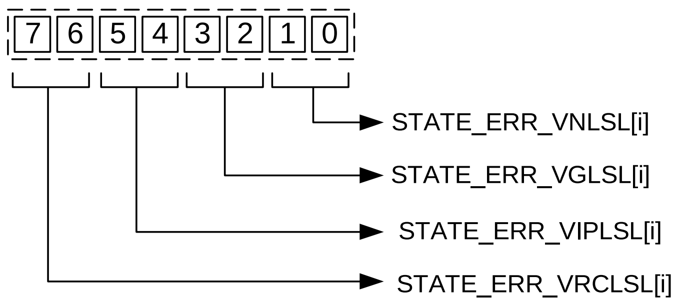
2. Pump cell voltage at allowed limits. A special bit is set but not latched - as soon as the limitation is over, this bit is reset.
3. Pumping current (Ip) at its limits. A special bit is set but not latched - as soon as the violation disappears, this bit is reset.
4. Overvoltage at Nernst Cell positive pin which might impair voltage headroom for generation of reference pumping current. Therefore Icp generation is disabled by ATIC42 HW to prevent reverse Icp. Diagnosis bit is set but not latched.

As faults may occur while reading the diagnostic registers, it is advised to verify the contents of the diagnosis registers regularly. This shall be carried out by comparing the responses related to two consecutive RD_DIAG commands.



If after two consecutive RD_DIAG_x[i] command sequences a fault persists, the function shall decode the contents of both DIAG_REG_x[i] registers. The contents of the DIAG_REG_1[i] shall be placed in the appropriate output data variables, as it is shown in the picture above.

STATE_ERR_VNLSL[i] mirrors the diagnosis of Nernst cell positive pin, STATE_ERR_VGLSL[i] the diagnosis of virtual ground pin, STATE_ERR_VIPLSL[i] the diagnosis of Pump Cell positive pin, and STATE_ERR_VRCLSL[i] the diagnosis of the RCD pin.
The following diagnosis are decoded in each STATE-variable:

00H means no fault,

01H means short circuit to ground

02H means short circuit to battery.

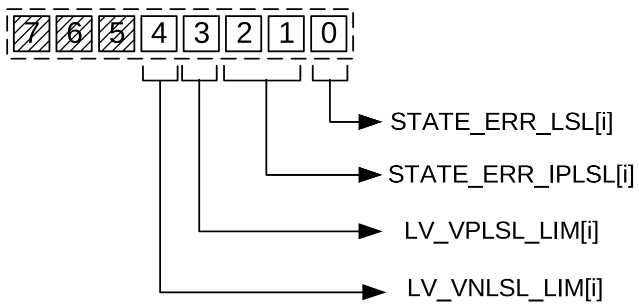


Figure 2.30.1: The contents of the DIAG_REG_2[i] shall be placed in the appropriate output data variables:

STATE_ERR_LSL[i] gives the general status of the diagnosis in the ATIC42, where 00H means no fault and 01H means a fault is present. LV_VPLSL_LIM[i] shall be activated if the pump cell voltage reaches allowed bounds. STATE_ERR_IPLSL[i] gives a diagnosis when the pump cell current is out of range, where 00H means no fault, 01H means Ip current too low and 02H means Ip current too high.

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LV_VNLSL_LIM[i] signals detection of overvoltage at positive Nernst Cell pin which leads to disabling of reference pumping current in order to avoid reverse current flow.
Additionally, a Boolean flag LV_LSL_DEAC[i] shall be set if at any time a single valid RD_DIAG_x data byte returns an electrical fault at one sensor pin (excluding Pump Cell voltage at allowed bonds, VN overvoltage, and Ip limitation). The flag shall only be reset should the function receive two valid consecutive RD_DIAG command return data bytes indicating that the specific fault is no longer present.

2.30.3.5 Writing to the initialisation register (WR_INIT)

The application software (ASW) shall be permitted to write to both configuration registers of the ATIC42 to perform control of its different functionalities.
The interface to the ASW shall be facilitated by defining input data variables STATE_LSL_IF_SPI_WR[i], STATE_LSL_IF_CONF_SPI_WR[i], FRQ_R_IT_OSC_LSL_IF_SPI_WR[i] and the communication error counter CTR_ERR_LSL_IF_SPI_RD[i].
The BSW function shall service the ASW as follows:
The WRITE commandsequence shall be carried out every recurrence, independently of any new information made available by the ASW via the interfaces STATE_LSL_IF_SPI_WR[i], STATE_LSL_IF_CONF_SPI_WR[i], FRQ_R_IT_OSC_LSL_IF_SPI_WR[i], and of the previous write command being incorrectly executed.
The function shall latch the current content of the three input data variables STATE_LSL_IF_xxx_SPI_WR[i](n) to STATE_LSL_IF_xxx_SPI_WR[i](n-1). Thus any further changes to the information during a WRITE cycle are prevented.
Next, the STATE_LSL_IF_xxx_SPI_WR[i](n-1) information shall be sent via the SPI to the ATIC42. The content written shall thereupon be verified via the corresponding answer which is received when sending the next command of the current SPI sequence.
Next, the STATE_LSL_IF_xxx_SPI_WR[i](n-1) information shall be sent via the SPI to the ATIC42. The content written shall thereupon be verified via the corresponding answer which is received when sending the next command of the current SPI sequence.

Should any WRITE command within current SPI transmission cycle be invalid or the written content not match the read content, the counter CTR_ERR_LSL_IF_SPI_WR[i] shall be incremented once.
For write validation procedure, sensor enable bit LV_LSL_ENA_LSL_IF[i] in the initialisation register is NOT considered because it is automatically reset by ATIC42 HW upon detection of an electrical sensor failure, regardless of the last transmitted SPI command. This asynchronuous change in bit value assignment does not represent a communication error.
In addition, bit6 of FRQ_R_IT_OSC_LSL_IF_SPI_xx[i] which represents the status of the Pin Selective Disabling feature shall also not be evaluated for SPI communication monitoring at present. Due to an ATIC42 HW error, command execution is performed but not monitored in ASIC response.
For manual increment of SPI communication error counter an interface to ASW (403B) is provided. This feature is introduced for purpose of SW test.

As the ATIC42 has a serial interface, the response to the currently transmitted command represents the answer to the previously executed command. As example, in the ATIC42 standard command sequence, the response received with command WR_CONF_INIT_1 corresponds to the answer to the preceding command RD_DIAG_2(M2). The BSW shall accordingly transfer the command responses to the correspondent output data variable (STATE_LSL_IF_SPI_RD[i], STATE_LSL_IF_CONF_SPI_RD[i], or FRQ_R_IT_OSC_LSL_IF_SPI _RD[i], resp.).

Up to ATIC42, 2nd Silicon, B5 step, a workaround for SPI transmission of R_IT_OSC_ENA bit has to be implemented. The ASIC shows random deviation between SPI request to set this bit and its physical reaction. If ATIC42 fails in switching on the oscillator for Ri determination, its correct response does not fit the transmitted request.
Since this behaviour does not represent a communication error, its direct evaluation shall be excluded for the regular communication error counter CTR_ERR_LSL_IF_SPI_RD[i]. To be able to distinguish between HW based mismatch of request and response and SPI communication error, an additional cascaded error counter is introduced (CTR_ERR_LSL_IF_SPI_IT_OSC_ENA[i]) to deal with the R_

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IT_OSC_ENA bit. Its value is limited to NC_CTR_ERR_LSL_IF_SPI_OSC_ENA = 3. This threshold represents maximum number of sequential retries for setting R_IT_OSC_ENA bit before SPI communication error is recognized and reported to global error counter CTR_ERR_LSL_IF_SPI_RD[i].
Should transmission be successfull before supplementary counter reaches threshold value, it is reset. Once CTR_ERR_LSL_IF_SPI_IT_OSC_ENA[i] reaches threshold value, this value is kept until next successfull processing of R_IT_OSC_ENA bit and every additional erroneous transmission leads to direct incrementation of global error counter (see also Drawing 1).

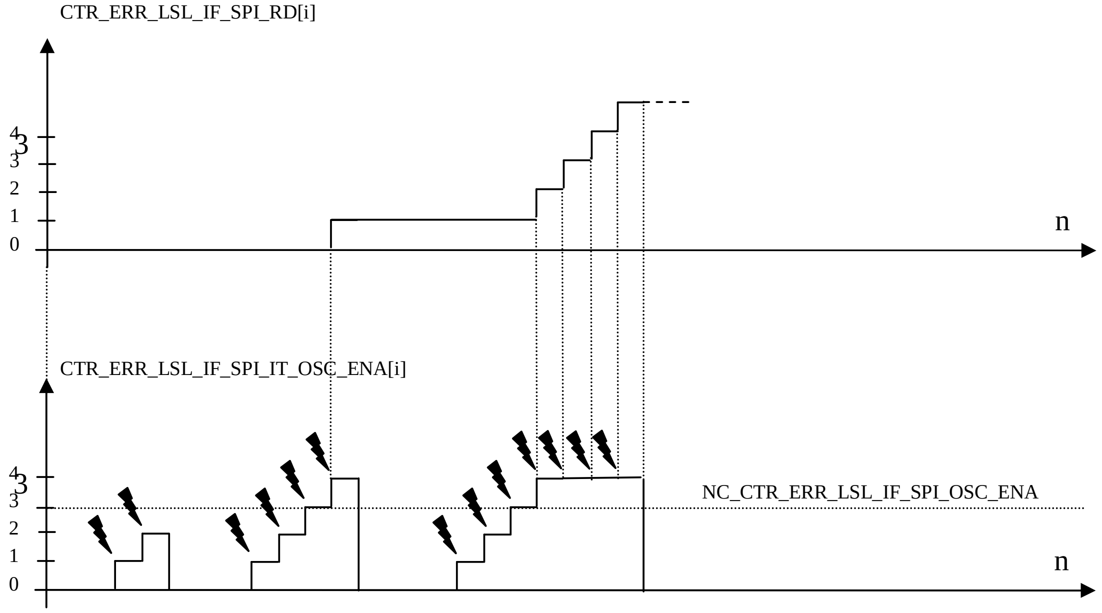

Figure 2.30.2: Drawing 1: Relation between global and cascaded communication error counter

2.30.3.6 Performing a SW reset at the ATIC42 IC (currently not implemented in generic SW!)

The command RESET_IC(O) shall be executed if there exists a request to reset the ASIC via SW (LV_LSL_IF_RST[i] = 1). The activation of this flag as well as the priority definition should be handled in the WRAF sensor interface (ASW-BSW) Appl Inc, 403B. With the reset command the internal reset line is activated and all SPI registers are set to their default state provided by ATIC42 HW!
In order to deal with daisy chain communication comprehending multiple WRAF controllers (requiring identical number of commands provided to each controller but individual data contents), two alternative reset sequences can be thought of and should be discussed with the specific project prior to implementation:

- Repeated transmission of reset commands - equaling number of commands in regular sequence - to WRAF controller which is to be reset.
- Reset performance on all connected WRAF controllers.

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Application conditions

Initialisation:

NC_CTR_ERR_LSL_IF_SPI_OSC_ENA = 3
The following variable initialisation shall take place at the activation of the BSW:
CTR_ERR_LSL_IF_SPI_WR[i] = 0
CTR_ERR_LSL_IF_SPI_IT_OSC_ENA_i = 0

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LV_LSL_DEAC[i] = 0
LV_VPLSL_LIM[i] = 0
LV_VNLSL_LIM[i] = 0
STATE_LSL_IF_SPI_RD[i] = 0
STATE_LSL_IF_CONF_SPI_RD[i] = 0
FRQ_R_IT_OSC_LSL_IF_SPI_RD[i] = 0
STATE_ERR_LSL[i] = NO FAULT (0H)
STATE_ERR_VNLSL[i] = NO FAULT (0H)
STATE_ERR_VGLSL[i] = NO FAULT (0H)
STATE_ERR_VIPLSL[i] = NO FAULT (0H)
STATE_ERR_VRCLSL[i] = NO FAULT (0H)
STATE_ERR_IPLSL[i] = NO FAULT (0H)

Note:
The interface variables STATE_LSL_IF_SPI_WR[i] and STATE_LSL_IF_CONF_SPI_WR[i] shall be initialized in the WRAF sensor interface (ASW - BSW). The corresponding ASW (Oxygen sensor temperature , 402A) shall do the initialization of FRQ_R_IT_OSC_LSL_IF_SPI_RD[i].

Recurrence:
T_SAMPLE = 10 ms.

Activation:
After every ECU RESET.

Deactivation:
- -

Formula section:

If LV_CTR_ERR_LSL_IF_SPI_MAN_INC[i] == 1
then CTR_ERR_LSL_IF_SPI_WR[i] = CTR_ERR_LSL_IF_SPI_WR[i] + 1
endif
If LV_CTR_ERR_LSL_IF_SPI_MAN_INC[i] == 1 -> 0
then CTR_ERR_LSL_IF_SPI_WR[i] = 0
endif

Valid SPI-Commands:
The following SPI-commands consist of a 4 bit command plus 4 bit data partition each:

RD_IDENT_1(A1)	0H + 1H
RD_IDENT_2(A2)	0H + 2H
WR_INIT_1(C)	2H + D0D1D2D3 (see Table 3)
WR_INIT_2(D)	3H + D4D5D6D7 (see Table 3)
WR_CONF_INIT_1(F)	5H + D0D1D2D3 (see Table 4)
WR_CONF_INIT_2(I)	8H + D4D5D6D7 (see Table 4)
WR_ INIT_R_FRQ_1(K)	AH + D0D1D2D3
WR_ INIT_R_FRQ_2(L)	BH + D4D5D6D7
RD_DIAG_1(M1)	CH + 1H (read pin diagnosis register)
RD_DIAG_2(M2)	CH + 2H (read general status register)
RESET_IC(O)	FH + FH

Following a RD_IDENT_2(A2) command, the data byte of the returned message is defined as follows:

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Bit Pos.	Bit Name	Description
0	STATE_LSL_IF_IC_INFO[i].bit_8	8 MSB of IC Code
1	STATE_LSL_IF_IC_INFO[i].bit_9	Ditto
2	STATE_LSL_IF_IC_INFO[i].bit_10	Ditto
3	STATE_LSL_IF_IC_INFO[i].bit_11	Ditto
4	STATE_LSL_IF_IC_INFO[i].bit_12	Ditto
5	STATE_LSL_IF_IC_INFO[i].bit_13	Ditto
6	STATE_LSL_IF_IC_INFO[i].bit_14	Ditto
7	STATE_LSL_IF_IC_INFO[i].bit_15	Ditto

Figure 2.30.3: Table 1: Data byte equivalence of the response to command RD_IDENT_2(A2) and the output variable STATE_LSL_IF_IC_INFO[i]

Similarly the answer to RD_IDENT_1(A1) is defined as:

Bit Pos.	Bit Name	Description
0	STATE_LSL_IF_IC_INFO[i].bit_0	Bits 0 through 2, 3 LSB of IC Code
1	STATE_LSL_IF_IC_INFO[i].bit_1	Ditto
2	STATE_LSL_IF_IC_INFO[i].bit_2	Ditto
3	STATE_LSL_IF_IC_INFO[i].bit_3	Bits 4 through 5, Supplier index
4	STATE_LSL_IF_IC_INFO[i].bit_4	Ditto
5	STATE_LSL_IF_IC_INFO[i].bit_5	Bits 6 through 7, Chip version number *)
6	STATE_LSL_IF_IC_INFO[i].bit_6	Ditto
7	STATE_LSL_IF_IC_INFO[i].bit_7	Ditto

Figure 2.30.4: Table 2: Data byte equivalence between the response to RD_IDENT_1 and STATE_LSL_IF_IC_INFO[i]

*) 000 for A1, A2, B1 samples; 001 for B2 samples!

Output data STATE_LSL_IF_SPI_RD[i] shall be defined to be a byte mirroring the content of the register INIT_REG_1, which represents a collection of individual bits as shown in the following table:

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Bit Pos.	Bit Name	Description
D0	SWI_GAIN	Set Ip measurement gain to 8 (0) or 16 (1)
D1	VLS_OFS_ADJ_ENA	IP-offset-measurement (0) disable (1) enable
D2	ICPLSL_ENA	Icp current: (0) disable (1) enable
D3	IPLSL_CTL_ENA	Ip controller: (0) disable (1) enable
D4	R_IT_CAL_ENA	Ri calibration mode: (0) disabled, (1) enabled
D5	R_IT_OSC_ENA	Oscilator: (0) off, (1) on
D6	LSL_ENA	Enable / Disable linear lambda sensor
D7	R_IT_SWI_RNG	Ri measurement gain: (0) Range 1, (1) Range 2

Figure 2.30.5: Table 3: Data byte for command WR_INIT_1(C) and WR_INIT_2(D)

Similarly the output data STATE_LSL_IF_CONF_SPI_RD[i] shall be defined to be a byte mirroring the content of the WR_CONF_INIT_1(F) and WR_CONF_INIT_2(I) as follows:

Bit Pos.	Bit Name	Description
0	ICPLSL[i].bit_0	Bits 0 through 4, Icp current
1	ICPLSL[i].bit_1	
2	ICPLSL[i].bit_2	
3	ICPLSL[i].bit_3	
4	ICPLSL[i].bit_4	
5	T_DLY_DI[i].bit_0	Bits 5 through 7, sensor protection time
6	T_DLY_DI[i].bit_1	
7	T_DLY_DI[i].bit_2	

Figure 2.30.6: Table 4: Data byte for command WR_CONF_INIT_1(F) and WR_CONF_INIT_2(I)

Following a RD_DIAG_1(M1) command, the data byte of the returned message is defined as follows:

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Bit Pos.	Bit Name	Description
0	STATE_ERR_VNLSL[i].bit_0	VN -short circuit to gnd (0) no (1) yes
1	STATE_ERR_VNLSL[i].bit_1	VN -short circuit to battery (0) no (1) yes
2	STATE_ERR_VGLSL[i].bit_0	VG -short circuit to gnd (0) no (1) yes
3	STATE_ERR_VGLSL[i].bit_1	VG -short circuit to battery (0) no (1) yes
4	STATE_ERR_VIPLSL[i].bit_0	VIP -short circuit to gnd (0) no (1) yes
5	STATE_ERR_VIPLSL[i].bit_1	VIP -short circuit to battery (0) no (1) yes
6	STATE_ERR_VRCLSL[i].bit_0	RCD -short circuit to gnd (0) no (1) yes
7	STATE_ERR_VRCLSL[i].bit_1	RCD -short circuit to battery (0) no (1) yes

Figure 2.30.7: Table 5: Data byte equivalence between the register DIAG_REG_1[i] and the diagnosis output variables

Following a RD_DIAG_2(M2) command, the data byte of the returned message is defined as follows:

Bit Pos.	Bit Name	Description
0	STATE_ERR_LSL[i]	General diagnosis status: (0) no fault, (1) fault
1	STATE_ERR_IPLSL[i].bit_0	IP current low: (0) no (1) yes
2	STATE_ERR_IPLSL[i].bit_1	IP current high: (0) no (1) yes
3	LV_VPLSL_LIM[i]	VP at the allowed bounds: (0) no (1) yes
4	LV_VNLSL_LIM[i]	Overvoltage at VN pin: (0) no (1) yes

Figure 2.30.8: Table 6: Data byte equivalence between the register DIAG_REG_2[i] and the corresponding diagnosis output variables

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2.31 O2 sensor signal acquisition general

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
V_TEMP_LS_UP [NC_CBK_EX_NR]	O	0... 3FFH	0... 4.99511	4.8828e-3	V
Upstream lambda sensor temperature voltage					
VLS_DOWN [NC_CBK_EX_NR]	O	0... 3FFH	0... 4.99511	4.8828e-3	V
Downstream sensor voltage measured					
VLS_DOWN_H_RES [NC_CBK_EX_NR]	O	0... 7FFFH	0... 4.99984	152.6e-6	V
Downstream sensor voltage measured with high resolution					
VLS_UP_RAW [NC_CBK_EX_NR]	O	0... 3FFH	0... 4.99511	4.8828e-3	V
Raw value of upstream oxygen sensor voltage					
VP_LS_DOWN	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Temporary storage for conversion of VLS_DOWN ADC value to resolution required in EGCP					
VP_LS_UP_RAW	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Temporary storage for conversion of VLS_UP ADC value to resolution required in EGCP					
VP_TEMP_LS_UP	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Temporary storage for conversion of V_TEMP_LS_UP ADC value to resolution required in EGCP					

Input data:

LV_R_IT_REQ_LS_DOWN [NC_CBK_EX_NR] {p. 1364}	LV_R_IT_REQ_LS_UP [NC_CBK_EX_NR] {p. 1320}	NC_CBK_EX_NR {p. 1829}	NC_STATE_LSL_UP_IF {p. 651}
NC_STATE_VLS_UP_SIG_ACQ {p. 651}			

Import actions:

ACTION_INFR_GetVAdcLsDown (**IN**<i>,**OUT**<v_adc>)
ACTION_INFR_GetVAdcLsUp (**IN**<i>,**OUT**<v_adc>)
ACTION_INFR_GetVAdcTempLsUp (**IN**<i>,**OUT**<v_adc>)

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FUNCTION DESCRIPTION:

General information:

Name	Acquisition recurrence	Acquisition precision	Notes
VLS_UP_RAW[i]	10ms	10bit	NC_STATE_VLS_UP_SIG_ACQ = 0
	1ms	10bit	NC_STATE_VLS_UP_SIG_ACQ = 1
V_TEMP_LS_UP[i]	10ms	10bit	-
VLS_DOWN[i]	10ms	10bit	-
VLS_DOWN_H_RES[i]	10ms	12bit	

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1

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i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

If the lambda sensor signal shall be filtered prior to further processing NC_STATE_VLS_UP_SIG_ACQ has to be set to 1, otherwise to 0.

Description:

Voltages of lambda sensors offered by Basic SW are read from infrastructure in standard ECU06 resolution and transformed to application system specific variables.

Application conditions

Activation: at every engine operating state

Deactivation: -

Update rate:
VLS_UP_RAW[i]: 10 ms for NC_STATE_VLS_UP_SIG_ACQ = 0
1 ms for NC_STATE_VLS_UP_SIG_ACQ = 1
VLS_DOWN[i] : 10 ms
VLS_DOWN_H_RES[i]: 10ms
V_TEMP_LS_UP[i]: 10 ms

Initialization: at reset: VLS_UP_RAW[i] = 0
VLS_DOWN[i] = 0
VLS_DOWN_H_RES[i] = 0
V_TEMP_LS_UP[i] = 0

Formula section:

```
# If      NC_STATE_LSL_UP_IF = 0          % Masking shall only be done for binary
sensor
# then    If     LV_R_IT_REQ_LS_UP[i] = 0
          then   acquire VLS_UP_RAW[i]
                 ACTION_INFR_GetVAdcLsUp(
                            IN          i
                            OUT         VP_LS_UP_RAW)
                 VLS_UP_RAW[i] = VP_LS_UP_RAW
          else   VLS_UP_RAW[i]_N = VLS_UP_RAW[i]_(N-1)
          endif
# else    acquire VLS_UP_RAW[i]
          ACTION_INFR_GetVAdcLsUp(
                     IN          i
                     OUT         VP_LS_UP_RAW)
          VLS_UP_RAW[i] = VP_LS_UP_RAW
          acquire V_TEMP_LS_UP[i]
          ACTION_INFR_GetVAdcTempLsUp(
                     IN          i
                     OUT         VP_TEMP_LS_UP)
          V_TEMP_LS_UP[i] = VP_TEMP_LS_UP

# endif
```

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```
If      LV_R_IT_REQ_LS_DOWN[i] = 0
then    acquire VLS_DOWN_H_RES [i]
         ACTION_INFR_GetVAdcLsDown(
                     IN          i
                     OUT         VP_LS_DOWN)
        VLS_DOWN_H_RES[i] = VP_LS_DOWN
        VLS_DOWN[i] = VLS_DOWN_H_RES[i]
else    VLS_DOWN[i]_N = VLS_DOWN[i]_{N-1}
         VLS_DOWN_H_RES[i]_N = VLS_DOWN_H_RES[i]_{N-1}
endif
```

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2.32 O2 sensor (lin, up) signal acquisition for heater coupling diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_FIL_DELTA_FALL [NC_CBK_EX_NR]	O	0... 7FFFH	0... 1.9999389648437	61.0351e-6	-
Acquired lambda model value at the falling edge of heater PWM					
LAMB_SP_FIL_DELTA_RISE [NC_CBK_EX_NR]	O	0... 7FFFH	0... 1.9999389648437	61.0351e-6	-
Acquired lambda model value at the rising edge of heater PWM					
VLS_UP_DELTA_FALL [NC_CBK_EX_NR]	O	0... 3FFH	0... 4.9951171875	0.00488281	V
Acquired oxygen sensor voltage at the falling edge of heater PWM					
VLS_UP_DELTA_RISE [NC_CBK_EX_NR]	O	0... 3FFH	0... 4.9951171875	0.00488281	V
Acquired oxygen sensor voltage at the rising edge of heater PWM					
VP_LS_UP_DELTA_FALL	-	0... 7FFFH	0... 4.9998474121093	152.587e-6	V
Temporary storage for conversion of VLS_UP ADC readout at PWM fall to resolution required in EGCP					
VP_LS_UP_DELTA_RISE	-	0... 7FFFH	0... 4.9998474121093	152.587e-6	V
Temporary storage for conversion of VLS_UP ADC readout at PWM rise to resolution required in EGCP					

Input data:

LAMB_SP_FIL_HOM [NC_CBK_EX_NR] {p. 2462}	LSHPWM_UP [NC_CBK_EX_NR] {p. 2385}	LV_LSL_DIAG_LSH_LSL_UP_DEAC {p. 5273}	NC_CBK_EX_NR {p. 1829}
T_DLY_TRIG_LSH_UP [NC_CBK_EX_NR] {p. 5276}	VLS_UP [NC_CBK_EX_NR] {p. 1341}		

Import actions:

ACTION_INFR_GetHeatCoupling	(**IN**<PRM_NC_CBK_EX_NR>,**OUT**<PRM_LAMB_SP_FIL_DELTA_RISE>,**OUT**<PRM_LAMB_SP_FIL_DELTA_FALL>,**OUT**<PRM_VLS_UP_DELTA_RISE>,**OUT**<PRM_VLS_UP_DELTA_FALL>)
ACTION_INFR_SetHeatCoupling	(**IN**<PRM_NC_CBK_EX_NR>,**IN**<PRM_T_DLY_TRIG_LSH_UP>,**IN**<PRM_LAMB_SP_FIL_HOM>)

General information

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then

i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2

otherwise (NC_CBK_EX_NR = 1)

i = 1, for single exhaust cylinder bank.

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This function shall deliver the inputs needed by the heater coupling diagnosis specific for UEGO Sensors controlled with the ATIC42. This functions describes how the upstream sensor signal and the lambda model shall be acquired synchronously with the heater signal.

Application conditions:

Initialisation:
```
at reset
VLS_UP_DELTA_RISE[i] = 0
VLS_UP_DELTA_FALL[i] = 0
LAMB_SP_FIL_DELTA_RISE[i] = 0
LAMB_SP_FIL_DELTA_FALL[i] = 0
```

Activation: - -

Deactivation: - -

Recurrence: 10 ms

Function description:

Signal flow diagram:

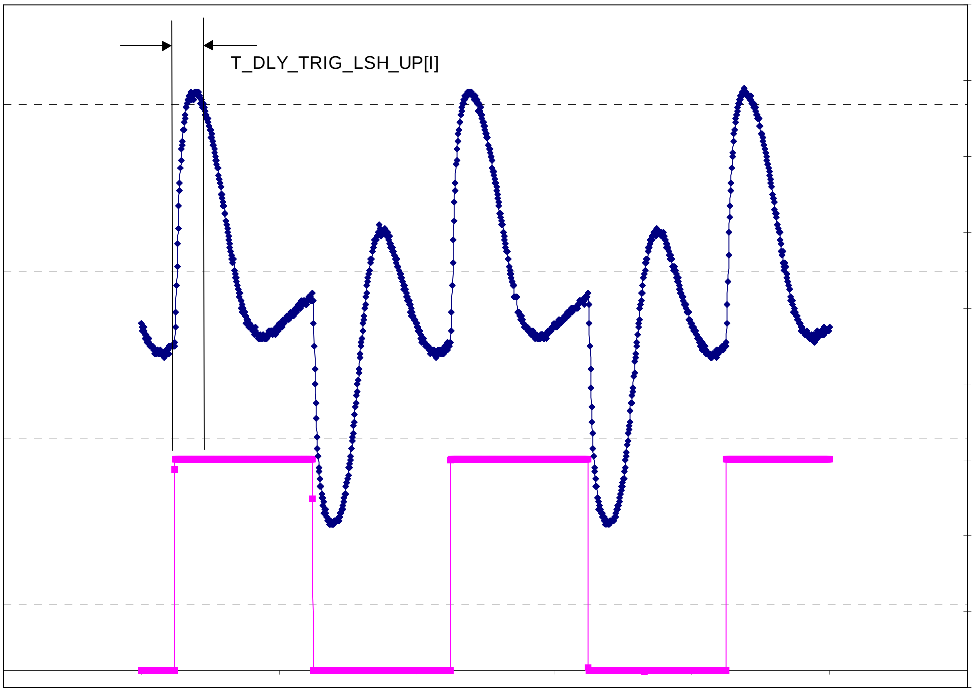

Figure 2.32.1:

Description:

In case a rising edge of the lambda sensor heater PWM is detected, the delay timer shall be started. After the delay timer expired its maximim value, the sensor signal VLS_UP[i] and the λ-model LAMB_SP_FIL[i] shall be acquired and transfered to the variables VLS_UP_DELTA_RISE[i] and LAMB_SP_FIL_DELTA_RISE[i] respectively.

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Analogously, after a lambda sensor heater PWM falling edge occurred and the delay is expired the variables VLS_UP_DELTA_FALL[i] and LAMB_SP_FIL_DELTA_FALL[i] shall be updated.

The delay timer maximum value comprehends the value of T_DLY_TRIG_LSH_UP[i] updated at the last ***falling*** edge and shall be valid for one LSHPWM_UP[i] period at least. In case an edge comes before the time delay counter is expired, neither the lambda signal nor the lambda model shall be acquired. In this case the respective variables shall retain their old values until a new update is possible.

Also at the every falling edge the variables VLS_UP_DELTA_RISE[i], VLS_UP_DELTA_FALL[i], LAMB_SP_FIL_DELTA_RISE[i] and LAMB_SP_FIL_DELTA_FALL[i] shall be handed over to the ASW.

Formula section:

```
If     LV_LSL_DIAG_LSH_LSL_UP_DEAC = 0
then   write data  to infrastructure
       ACTION_INFR_SetHeatCoupling(
             IN     i
             IN     T_DLY_TRIG_LSH_UP[i]
             IN     LAMB_SP_FIL_HOM[i])

       get data from infrastructure
       ACTION_INFR_GetHeatCoupling(
             IN     i
             OUT    LAMB_SP_FIL_DELTA_RISE[i]
             OUT    LAMB_SP_FIL_DELTA_FALL[i]
             OUT    VP_LS_UP_DELTA_RISE
             OUT    VP_LS_UP_DELTA_FALL)
       VLS_UP_DELTA_RISE[i] = VP_LS_UP_DELTA_RISE
       VLS_UP_DELTA_FALL[i] = VP_LS_UP_DELTA_FALL
endif
```

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2.33 O2 sensor (lin, up) signal acquisition for CILC

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_VLS_UP_CYL_SEL_TRIG [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
cylinder selective update counter for trigger event					
VLS_UP_CYL_SEL [NC_CYL_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
upstream oxygen sensor acquisition (cylinder individual)					
VP_LS_CYL_SEL	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Temporary storage for conversion of infrastructure data to resolution required in EGCP					

Input data:

CRK_CYL_LAM [NC_CYL_NR] {p. 2730}	LV_LAM_CYL_ENA [NC_CBK_EX_NR] {p. 2864}	NC_CYL_NR {p. 1526}	

Import actions:

ACTION_INFR_DisableCilc ()
ACTION_INFR_EnableCilc ()
ACTION_INFR_GetCilc (**IN**<x>,**OUT**<v_adc>,**OUT**<ctr>)
ACTION_INFR_SetCilc (**IN**<x>,**IN**<crk>)

FUNCTION DESCRIPTION:

General information:

The function shall serve as a detector for a precise signal acquisition of the Wide Range Air-Fuel (WRAF) sensor in accordance with the identified cylinder. Therefore, the phase displacement, CRK_CYL_LAM[x] shall be considered. Since for dual-bank engines, the signal acquisition is dual-port, the phase shift shall be allocated to the right cylinder and cylinder bank. The phase displacement CRK_CYL_LAM[x] is computed once every combustion cycle (ASW) and shall be considered for all cylinders.

The calculation shall be done for x = 0 : NC_CYL_NR -1.

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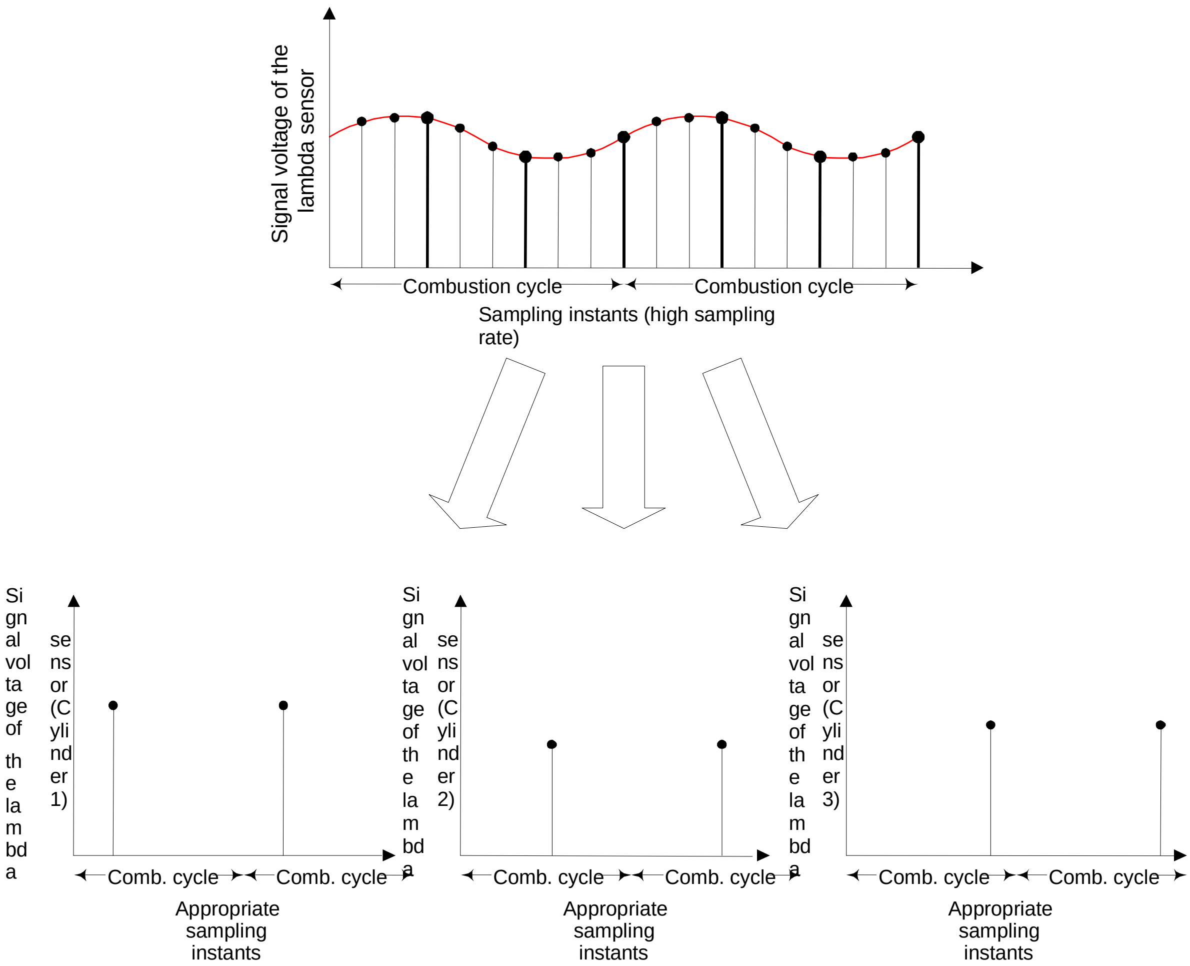

Figure 2.33.1: : Cylinder individual signal acquisition of WRAF sensor

Application conditions:

Recurrence: segment synchronous, synchron to cylinder individual lambda control (ASW)

Activation: LV_LAM_CYL_ENA[i] = 0 -> 1
ACTION_INFR_EnableCilc()

Deactivation: LV_LAM_CYL_ENA[i] = 1 -> 0
ACTION_INFR_DisableCilc()

Formula section:

write data asynchronous to infrastructure
ACTION_INFR_SetCilc(
IN x
IN CRK_CYL_LAM[x])

get data asynchronous to infrastructure
ACTION_INFR_GetCilc(

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IN x
OUT VP_LS_CYL_SEL
OUT CTR_VLS_UP_CYL_SEL_TRIG[x])
VLS_UP_CYL_SEL[x] = VP_LS_CYL_SEL

Description:

Signal acquisition and trigger event

In coordination with TDC the port selected signal voltage of the WRAF sensor shall be sampled (VLS_UP_CYL_SEL[x]) after the phase shift CRK_CYL_LAM[x] for each segment and the trigger counter for respective cylinder (CTR_VLS_UP_CYL_SEL_TRIG[x]) shall be incremented.

TDC -> CRK_CYL_LAM[x] -> VLS_UP_CYL_SEL[x] -> CTR_VLS_UP_CYL_SEL_TRIG[x] ++

Remark:

For instance, see figure 2, which represents the sensor signal acquisition for a dual-bank engine (6 cylinders).

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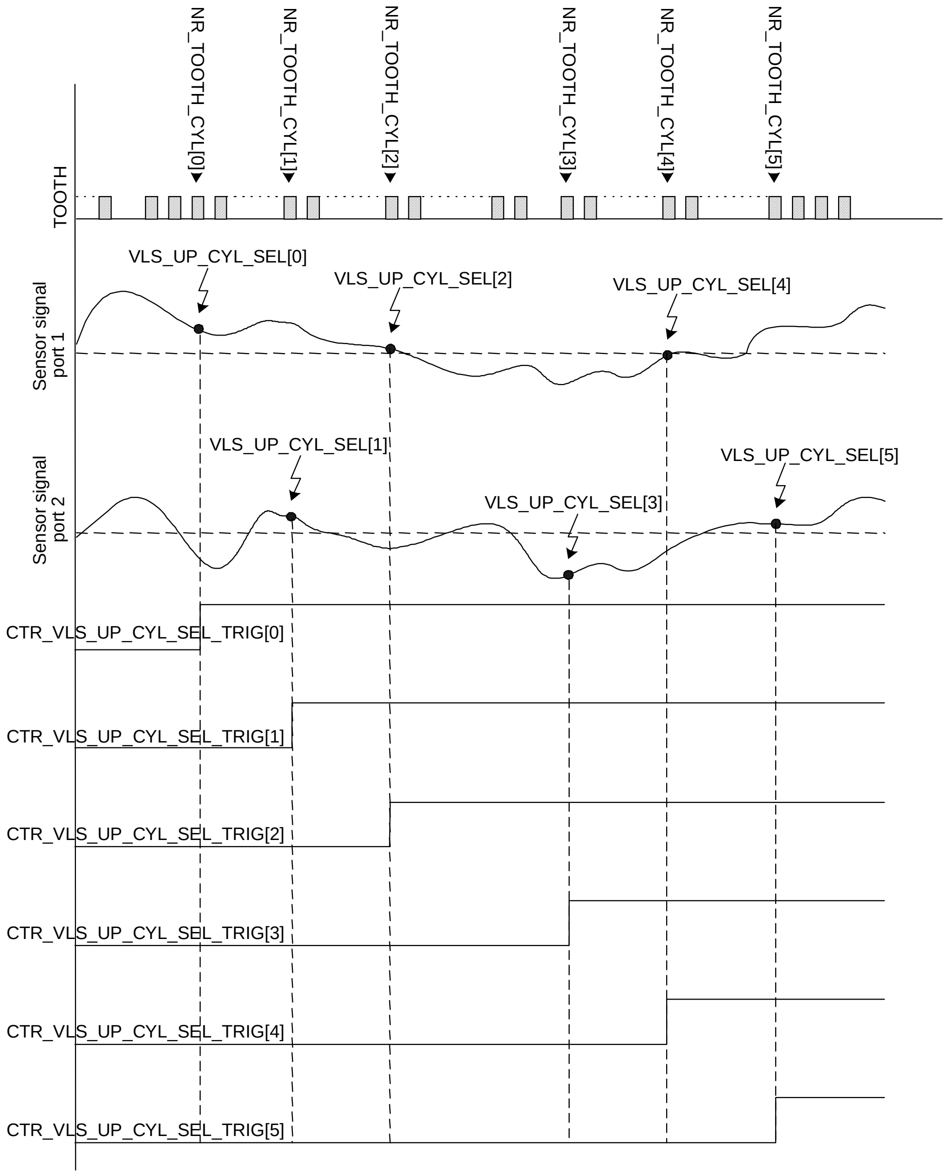

Figure 2: WRAF sensor signal acquisition of a dual-bank catalyst system (6 cylinders)

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3 - AGGR adaptation modules

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3.1 AGGR adaptation: DRPD

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
PV	-	0... 3FFH	0... 99.90234	97.6999e-3	%
Global degree of activation of the accelerator pedal (high resolution)					

Input data:

PV_AV {p. 1269}			

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation: `0 % at reset`

Recurrence : `10 ms, as input data (sequencing: input before output)`

Activation: *every engine state*

Formula section:

PV = PV_AV

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3.2 AGGR adaptation: VHMD

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
V	O/V	0... 168H	0... 360	1	km/h
Vehicle speed					

Input data:

VS {p. 1176}			

3.2.1 Outputs for BMW which are not defined as VHMD exported data

FUNCTION DESCRIPTION:

Adaption to BMW environment.

Application conditions

Initialisation: 0

Recurrence: 100ms

Activation: after reset (always)

Deactivation: –

Formula section:

Remark: all formulas are valid in a **physical** meaning

V = VS

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3.3 AGGR adaptation: VHST

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Md_na_ars	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Torque losses active rolling stabilisation					
Mdi_asr_l	O/V	0... 2710H	0... 1000	0.1	Nm
Torque decrement for slow torque intervention during TCS					
Mdi_asr_s	O/V	0... 2710H	0... 1000	0.1	Nm
Torque decrement for fast torque intervention during TCS					
Mdi_msr_l	O/V	0... 2710H	0... 1000	0.1	Nm
Torque increase for slow torque intervention during MSR					
Mdi_msr_s	O/V	0... 2710H	0... 1000	0.1	Nm
Torque increase for fast torque intervention during MSR					

Input data:

TQ_LOSS_ARS {p. 6650}	TQI_ASR_FAST {p. 6741}	TQI_ASR_SLOW {p. 6741}	TQI_MSR_FAST {p. 6741}
TQI_MSR_SLOW {p. 6742}			

3.3.1 Outputs for BMW functions which are not defined as VHST exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: The really possible physical limits of the outputs are different to the specified values due to the input data attributes.

Application conditions

Initialisation: 0

Recurrence : 10 ms

Activation: *every engine state*

Formula section:

Remark: all formulas are valid in a **physical** meaning

Md_na_ars = TQ_LOSS_ARS

Mdi_asr_l = TQI_ASR_SLOW

Mdi_asr_s = TQI_ASR_FAST

Mdi_msr_l = TQI_MSR_SLOW

Mdi_msr_s = TQI_MSR_FAST

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3.4 AGGR adaptation: TQDR

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_TOT_WOUT_IGA	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Total actual efficiency (in homogeneous mode) without EFF_IGA					
LV_MAP_PUC_LIM_ACT_LSL_GAIN_AD	O/V	0... 1H	0 ...1	1	-
Logical variable is set if MAP limitation is activated					
TQI_AV	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Actual indicated engine torque					

Input data:

EFF_LAMB_AV {p. 8379}	EFF_SCC_AV {p. 6665}	LV_S_ACT {p. 8137}	TQI_AV_HOM {p. 8380}
TQI_AV_S {p. 8380}			

FUNCTION DESCRIPTION:

Adaptation to aggregate environment.

Application conditions

Initialisation: LV_MAP_PUC_LIM_ACT_LSL_GAIN_AD = 0 (never changed after initialisatio
EFF_TOT_WOUT_IGA = 1

Recurrence: 10 ms

Activation: always

Deactivation: never

Formula section:

If LV_S_ACT = 0
Then TQI_AV = TQI_AV_HOM
Else TQI_AV = TQI_AV_S

EFF_TOT_WOUT_IGA = EFF_SCC_AV * EFF_LAMB_AV

REMARK: Actually FAC_MFF_TQ_COR_SCAV (Eta_md_uesp) should have be also added for the EFF_TOT_WOUT_IGA calculation. But this factor is already included at the TQI_REF calculation.
And due the fact that EFF_TOT_WOUT_IGA is multiplied with TQI_REF later, it is not added here.

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3.5 AGGR adaptation: INSY

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AMP	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Ambient pressure (measured or adapted)					
AMP_AD	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Ambient pressure (adapted)					
AMP_MDL	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Ambient pressure (modelled)					
LV_ERR_MAP	O/V	0... 1H	0 ...1	1	-
MAP sensor error					
LV_ERR_RATIO_CHK	O	0... 1H	0 ...1	1	-
Boolean for actual value MAF or TPS ratio check is present (yet availiable only for interface)					
MAF_INT_PUC	O/V	0... FFFFH	0... 2912.66666	0.0444444	g
air mass flow integral during pull cut off phase					
MAF_INT_PUE	O/V	0... FFFFH	0... 2912.66666	0.0444444	g
air mass flow integral out of pull cut off phase					

Input data:

AMP_MES {p. 1163}	LV_ERR_MAP_DIP_ PLAUS {p. 1062}	LV_ERR_MAP_DIP_SENS {p. 4824}	MAF_INT_PUC_ACT {p. 2942}
MAF_INT_PUC_NOT_ACT {p. 2942}			

3.5.1 Outputs for supplier aggregates

FUNCTION DESCRIPTION:

Application conditions

Initialisation: AMP = AMP_AD = AMP_MDL = AMP_MES
MAF_INT_PUC_ACT, MAF_INT_PUC_NOT_ACT 0 g at reset

Recurrence: AMP, AMP_AD, AMP_MDL 100ms
MAF_INT_PUC ; MAF_INT_PUE 20 ms, as input data (sequencing: input before output)
LV_ERR_RATIO_CHK, LV_ERR_MAP: 10ms

Activation: at every engine state

Deactivation: –

Formula section:

AMP = AMP_MES
AMP_AD = AMP_MES
AMP_MDL = AMP_MES

MAF_INT_PUC = MAF_INT_PUC_ACT

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MAF_INT_PUE = MAF_INT_PUC_NOT_ACT

LV_ERR_RATIO_CHK = 0

IF LV_ERR_MAP_DIP_SENS = 1 **OR** LV_ERR_MAP_DIP_PLAUS = 1
THEN LV_ERR_MAP = 1
ELSE LV_ERR_MAP = 0
ENDIF

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3.6 AGGR adaptation: AIRT

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_TIA_IM	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present which might affect temperature TIA_IM (after debounce)					
LV_ERR_TIA_THR	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present which might affect temperature TIA_THR (after debounce)					
TIA_IM	O/V	0... FEH	0... 142.5	0.75	°C
Air temperature in the intake manifold					
TIA_THR	O/V	0... FEH	0... 142.5	0.75	°C
Air temperature at the throttle body					
TIA_THR_ST	O/V	0... FEH	0... 142.5	0.75	°C
Air temperature at the throttle body at start					

Input data:

LV_ERR_TIA {p. 4200}	LV_ES {p. 1720}	TIA {p. 1226}	

Function Description

Adaptation of AIRT variables to MSV70 environment.

Function Description

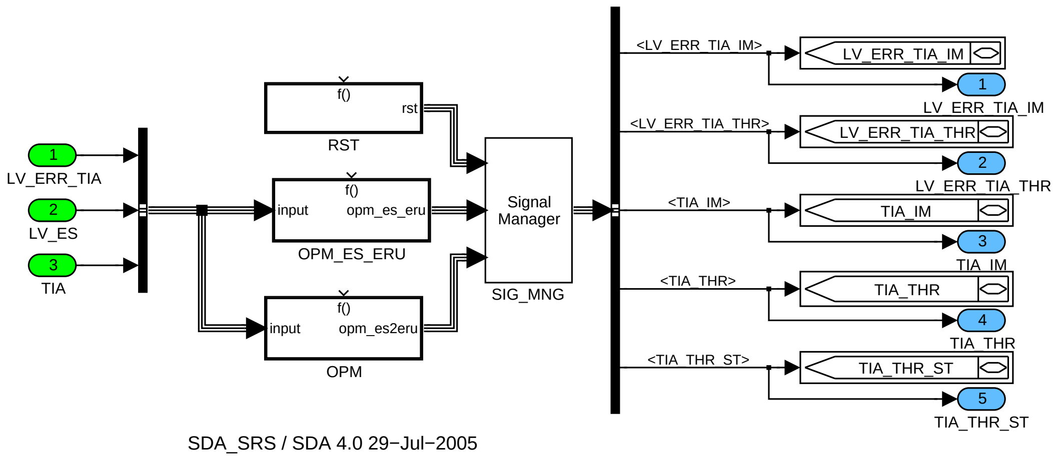

Figure 3.6.1: AIRT_M300B

3.6.1 Calculation at reset

Initialization at reset

TIA_THR_ST is initialised at engine start.

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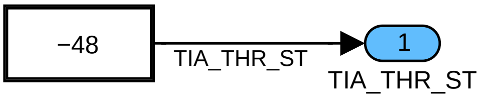

Figure 3.6.2: AIRT_M300B/RST/INI

3.6.2 Calculations at Engine stop to engine run

Initialization

TIA is assigned to output variable TIA_THR_ST

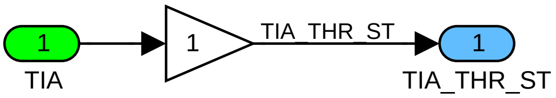

Figure 3.6.3: AIRT_M300B/OPM_ES_ERU/INI

3.6.3 Formula section

Calculation of outputs

Output variables TIA_IM, TIA_THR, LV_ERR_TIA_IM and LV_ERR_TIA_THR are calculated here. TIA is assigned to TIA_IM and TIA_THR , LV_ERR_TIA is assigned to LV_ERR_TIA_THR and LV_ERR_TIA_IM.

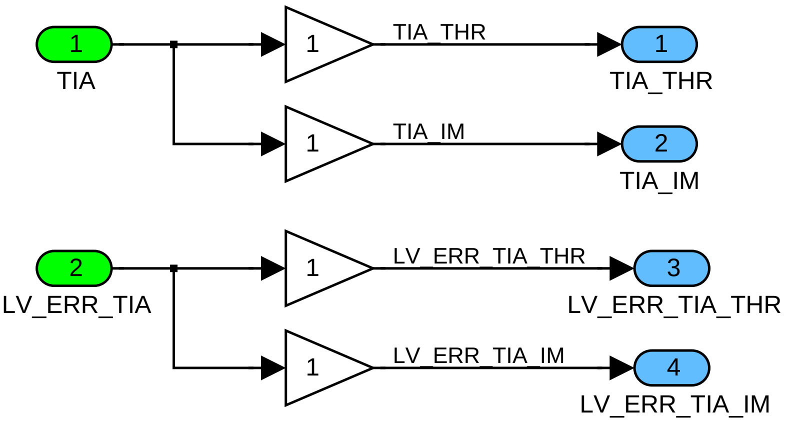

Figure 3.6.4: AIRT_M300B/OPM/SUB_CLC

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3.7 AGGR adaptation: THRO

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
V_TPS_GAIN_1	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Throttle position sensor 1 multiplied with 4 raw acquisition					

FUNCTION DESCRIPTION:

General information:

Adaptation module throttle variables

Application conditions

Initialisation: *all = 0 at reset*

Recurrence: *same as input values*

Activation: *every ECU operating state*

Deactivation: –

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3.8 AGGR adaptation: EGRC

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AV_OPEN_EGR	O/V	0... FFH	0... 99.60937	0.390625	%
Actual opening value of the EGR valve after adaptation					
LV_EGR_ACT	O/V	0... 1H	0 ...1	1	-
Logical value for EGR-control active					
LV_ER_FDOUT	O	0... 1H	0 ...1	1	-
LV_ER_FDOUT					
LV_ERR_EGR_2	O/V	0... 1H	0 ...1	1	-
Stuck valve or potentiometer failure					
STK_AV_EGR	O/V	0... FFH	0... 99.60937	0.390625	%
Actual value of the stroke of EGR valve					

Input data:

LV_PWM_ACR_OFF_REQ {p. 4345}	OPG_ACR {p. 1097}	STATE_ACR_CTL {p. 3587}	

FUNCTION DESCRIPTION:

This function is used for the adaptation of the actuator control modules to the remaining software system. The Module has to be executed after the ACRC functionality has been calculated.

Application conditions

Initialization: `at RST set all to zero and LV_ER_FDOUT = 0`

Recurrences: `10 ms`

Activation: *at all engine operating states*

Deactivation: *no deactivation*

Formula section:

AV_OPEN_EGR = OPG_ACR
STK_AV_EGR = OPG_ACR
LV_EGR_ACT = (STATE_ACR_CTL == PWM_CTL)
LV_ERR_EGR_2 = LV_PWM_ACR_OFF_REQ

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3.9 AGGR adaptation: FUSL

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFPPWM_CAN	O/V	0... FFH	0... 99.609375	0.390625	%
Pump speed of the electrical fuel pump as 8 bit PWM signal					
FUP_AD	O/V	8000... 7FFFH	-173890 ...173884	5.30669108	hPa
Adaptation value for fuel pressure adaptation					
FUP_RES_H_SP_CH	O	0... FFFFH	0... 255.99609375	0.00390625	MPa
Fuel pressure setpoint during catalyst heating					
FUP_RNG_H_SP_CH	O	0... FFFFH	0... 255.99609375	0.00390625	MPa
Fuel pressure setpoint for catalyst heating					
FUP_RNG_H_SP_OHP	O	0... FFFFH	0... 255.99609375	0.00390625	MPa
Fuel pressure setpoint for overheating prevention					
LV_ACR_EFPPWM_TEST_REQ	O	0... 1H	0 ...1	1	-
Electrical fuel pump actuator test active					
LV_ENG_OFF_N_CON	O	0... 1H	0 ...1	1	-
Logical value engine stop mode active					
LV_ERR_RLY_VCV	O	0... 1H	0 ...1	1	-
Boolean for error currently present on RLY_VCV command signal					
LV_FUP_EFP_SP_EXT_REQ	O	0... 1H	0 ...1	1	-
External request of fuel pressure setpoint (low pressure)					
LV_FUP_LIH_REQ	O	0... 1H	0 ...1	1	-
Limp home mode for HPP requested					
LV_LAM_STOP_AE	O	0... 1H	0 ...1	1	-
stop-flag for lambda controller					
LV_PIN_ICH	O	0... 1H	0 ...1	1	-
Independent car heater request for electrical fuel pump					
LV_PWL	O	0... 1H	0 ...1	1	-
The power-latch phase has started					
LV_VCV_RLY	O	0... 1H	0 ...1	1	-
Flag for controlling the volume control valve relay					
MFF_SP_HOM_MV	O	0... FFFFH	0... 1389	0.02119478	mg/stk
Mass fuel flow setpoint for homogeneous mode, mean value					
NR_CYL_VVL_H_ACT	O	0... 8H	0 ...8	1	-
Number of active cylinder for high mode					
STATE_MPLH_MOD	O	0H 1H 2H 3H	MPLH_OFF MPLH_CH MPLH_OPP MPLH_OHP	-	-
State of the multiple injection in hom. mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VFF_EFP	O/V	0... FFH	0... 255	1	l/h
Required amount of fuel					

Input data:

EFPPWM {p. 3796}	LV_ERR_RLY_MAIN {p. 4933}	LV_PWL_ACT {p. 3776}	LV_RLY_MAIN {p. 3772}
MFF_SP_FUP_CTL {p. 2151}	NC_IDX_DIAG_H_PRS_SYS_PRE	VFF_EFP_REQ {p. 3797}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_IDX_TRIM	V	0... FFH	0... 255	1	-
Index defining the trim procedure used to trim VCV and PBK_IV					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_H_PRS_SYS	O	0... FFFFH	0... 65535	1	-
ERRM diagnosis identifier of high pressure system					
NC_NR_MFF_SP_FUP_SP	O	0... 1FH	1... 32	1	-
Number of mass fuel flow datapoints for FUP_SP					
NC_NR_N_FUP_SP	O	0... 1FH	1... 32	1	-
Number of engine speed datapoints for FUP_SP					

General information

3.9.1 Outputs for SV aggregates, SV internally

General information:

Adaptation to aggregate environment.

Application conditions:

Initialisation:

```
at reset:  NC_IDX_DIAG_H_PRS_SYS = NC_IDX_DIAG_H_PRS_SYS_
PRE
           VFF_EFP     = VFF_EFP_REQ
                         MIN (VFF_EFP,FEH)
           EFPPWM_CAN  = EFPPWM
                         MIN (EFPPWM_CAN, FEH)
           FUP_AD      = 0
```

Activation: every engine operating state

Deactivation: never

Recurrence:

```
If   LV_ST_END == 1
then the recurrency is every segment

If   LV_ST_END == 0
then the recurrency is every 10 ms
```

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Function description:

Formula section:

```
VFF_EFP     = VFF_EFP_REQ
              MIN (VFF_EFP,FEH)
EFPPWM_CAN = EFPPWM
              MIN (EFPPWM_CAN, FEH)
FUP_AD = 0
```

3.9.2 Miscellaneous

General information:

NC_NR_N_FUP_SP = 8
NC_NR_MFF_SP_FUP_SP = 10

Application conditions:

Initialisation:

```
at reset:
  LV_ENG_OFF_N_CON         = 0
  LV_PIN_ICH               = 0
  LV_ACR_EFPPWM_TEST_REQ = 0
  LV_FUP_EFP_SP_EXT_REQ  = 0
  LV_FUP_LIH_REQ           = 0
  FUP_RES_H_SP_CH          = 0
  MFF_SP_HOM_MV            = MFF_SP_FUP_CTL
  STATE_MPLH_MOD           = 0
  FUP_RNG_H_SP_CH          = 0
  FUP_RNG_H_SP_OHP         = 0
  NR_CYL_VVL_H_ACT         = 0
  LV_PWL                   = LV_PWL_ACT
  LV_LAM_STOP_AE           = 0
  LV_ERR_RLY_VCV           = LV_ERR_RLY_MAIN
  LV_VCV_RLY               = LV_RLY_MAIN
```

Activation: every engine operating state

Deactivation: never

Recurrence: 100 ms

Function description:

Formula section:

```
LV_PWL         = LV_PWL_ACT
LV_ERR_RLY_VCV = LV_ERR_RLY_MAIN
LV_VCV_RLY     = LV_RLY_MAIN
MFF_SP_HOM_MV  = MFF_SP_FUP_CTL
```

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3.10 AGGR adaptation: NOXD

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_NS [NC_NOX_SENS_CONF]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda value, measured by NOx-Sensor					
LAMB_NS_DIAG [NC_NOX_SENS_CONF]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda value for diagnosis functions, measured by NOx-Sensor					
LV_ERR_NOX_SENS_CAN_BOFF	O/V	0... 1H	0 ...1	1	-
CAN bus, at which the NOx sensor is connected, has the state "busoff"					
LV_ERR_NS_CAN_BOFF	O/V	0... 1H	0 ...1	1	-
CAN bus, at which the NOx sensor is connected, has the state "busoff"					
LV_ERR_NS_CAN_MSG_LOST [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor CAN message lost failure is present					
LV_LAMB_NS_AUTH [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the Lambda signal has be reached the valid state after start					
LV_LAMB_NS_DIAG_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the Lambda signal is valid for use into the diagnosis functions					
LV_LAMB_NS_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the Lambda signal is valid					
LV_NOX_NS_AUTH [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the NOx signal has reached the valid state after the start					
LV_NOX_NS_DIAG_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the NOx signal is valid for use into the diagnosis functions					
LV_NOX_NS_MDL_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the NOx signal is valid for use. The state "valid" is debounced present.					
LV_NOX_NS_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the NOx signal is valid					
LV_TEMP_MIN_THD_CAN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Dew point recognition for NOx-Sensor					
LV_TEMP_NS_OK [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor CAN message: temperature is OK					
LV_VB_NS_OK [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor CAN message: power supply voltage is OK					
LV_VLS_NS_AUTH [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the binary O2 signal has be reached the valid state after start					
LV_VLS_NS_DIAG_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the binary O2 signal is valid for use into the diagnosis functions					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VLS_NS_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the binary O2 signal is valid					
NOX_NS [NC_NOX_SENS_CONF]	O/V	FF9C... 05DCH	-100 ...1500	1	ppm
NOx concentration value, measured by NOx-Sensor					
NOX_NS_DIAG [NC_NOX_SENS_CONF]	O/V	FF9C... 05DCH	-100 ...1500	1	ppm
NOx concentration value for diagnosis functions, measured by NOx sensor					
T_LAMB_NS_HLD [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for hold of last valid Lambda signal value					
T_NOX_NS_HLD [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for hold of last valid NOx signal value					
T_NOX_NS_MDL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 655.35	0.01	s
Timer for debounce of signal state "valid" after re-entry into state "valid"					
T_NOX_NS_MDL [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for debounce of signal state "valid" after re-entry into state "valid"					
T_TEMP_NS [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 655.35	0.01	s
Timer for debounce of NOx sensor temperature readiness					
T_VLS_NS_HLD [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for hold of last valid binary O2 signal value					
VLS_NS [NC_NOX_SENS_CONF]	O/V	0... 578H	-200 ...1200	1	mV
Binary O2 signal voltage for diagnosis functions, raw value, measured by NOx-Sensor					
VLS_NS_DIAG [NC_NOX_SENS_CONF]	O/V	0... 578H	-200 ...1200	1	mV
Binary O2 signal voltage for diagnosis functions, raw value, measured by NOx-Sensor					

Input data:

LAMB_NOX_SENS [NC_NOX_SENS_CONF] {p. 1380}	LAMB_NOX_SENS_DIAG [NC_NOX_SENS_CONF] {p. 1380}	LV_CAN_TEMP_MIN_THD [NC_NOX_SENS_CONF] {p. 1399}	LV_ERR_LOCAN_BOFF {p. 4846}
LV_ERR_TOUT_NOX_SENS [_i] {p. 4855}	LV_NOX_SENS_LAMB_AUTH [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_LAMB_DIAG_VLD [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_LAMB_VLD [NC_NOX_SENS_CONF] {p. 1380}
LV_NOX_SENS_NOX_AUTH [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_NOX_DIAG_VLD [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_NOX_MDL_VLD [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_NOX_VLD [NC_NOX_SENS_CONF] {p. 1380}
LV_NOX_SENS_VLS_AUTH [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_VLS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_VLS_VLD [NC_NOX_SENS_CONF] {p. 1381}	NC_NOX_SENS_CONF {p. 643}
NOX_NOX_SENS [NC_NOX_SENS_CONF] {p. 1381}	NOX_NOX_SENS_DIAG [NC_NOX_SENS_CONF] {p. 1381}	NOX_SENS_TEMP [NC_NOX_SENS_CONF] {p. 1381}	T_NOX_SENS_LAMB_HLD [NC_NOX_SENS_CONF] {p. 1381}
T_NOX_SENS_NOX_HLD [NC_NOX_SENS_CONF] {p. 1381}	T_NOX_SENS_NOX_MDL [NC_NOX_SENS_CONF] {p. 1382}	T_NOX_SENS_VLS_HLD [NC_NOX_SENS_CONF] {p. 1382}	VLS_NOX_SENS [NC_NOX_SENS_CONF] {p. 1382}
VLS_NOX_SENS_DIAG [NC_NOX_SENS_CONF] {p. 1382}			

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_TEMP_NS	-	0... FFFFH	0... 655.35	0.01	s
Minimum time of sensor temperature readiness to set LV_TEMP_NS_OK[i]					

FUNCTION DESCRIPTION:

General information:

This module handles all variable interfaces of aggregate NOXD. It adapts inputs to aggregate NOXD and outputs from aggregate NOXD on project specific requirements or aggregate structure requirements.

3.10.1 Inputs to aggregate NOXD - 10ms (fast variable assignments)

Application conditions

Initialisation:

```
at reset:
LV_ERR_NOX_SENS_CAN_BOFF = 0
LV_ERR_NS_CAN_BOFF = 0
LV_ERR_NS_CAN_MSG_LOST[i] = 0
```

Recurrence: *10ms*

Activation: *after reset*

Deactivation: -

Formula section:

LV_ERR_NS_CAN_BOFF = LV_ERR_LOCAN_BOFF
LV_ERR_NS_CAN_MSG_LOST[i] = LV_ERR_TOUT_NOX_SENS[i]
LV_ERR_NOX_SENS_CAN_BOFF = LV_ERR_LOCAN_BOFF

3.10.2 Outputs of aggregate NOXD - 10ms

Application conditions

Initialisation:

```
at reset:
        LV_TEMP_NS_OK[i] = 0
        LV_VB_NS_OK[i] = 0
        LV_NOX_NS_AUTH[i] = 0
        LV_TEMP_MIN_THD_CAN[i] = 0
        LV_VLS_NS_DIAG_VLD[i] = 0
        LV_LAMB_NS_DIAG_VLD[i] = 0
        LV_LAMB_NS_VLD[i] = 0
        LV_VLS_NS_VLD[i] = 0
        NOX_NS[i] = 0
        NOX_NS_DIAG[i] = 0
        LAMB_NS[i] = 0
```

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```
                                VLS_NS[i] = 0
                                LV_NOX_NS_VLD[i] = 0
                                LAMB_NS_DIAG[i] = 0
                                T_LAMB_NS_HLD[i] = 0
                                T_NOX_NS_HLD[i] = 0
                                VLS_NS_DIAG[i] = 0
                                T_VLS_NS_HLD[i] = 0
                                LV_NOX_NS_DIAG_VLD[i] = 0
                                LV_NOX_NS_MDL_VLD[i] = 0
                                T_TEMP_NS[i] = 0
                                LV_LAMB_NS_AUTH[i] = 0
                                LV_VLS_NS_AUTH[i] = 0
                T_NOX_NS_MDL[i] = 0
```

Recurrence: *10ms*

Activation: *after reset*

Deactivation: –

Formula section:

LV_TEMP_MIN_THD_CAN[i] = LV_CAN_TEMP_MIN_THD[i]

if bit0(NOX_SENS_TEMP[i]) = 1
then **if** T_TEMP_NS[i] >= C_T_TEMP_NS
then LV_TEMP_NS_OK[i] = 1
else LV_TEMP_NS_OK[i] = 0
increment T_TEMP_NS[i]
endif
else LV_TEMP_NS_OK[i] = 0
T_TEMP_NS[i] = 0
endif

LV_VB_NS_OK[i] = bit1(NOX_SENS_TEMP[i])

NOX_NS[i] = NOX_NOX_SENS[i]
NOX_NS_DIAG[i] = NOX_NOX_SENS_DIAG[i]
T_NOX_NS_HLD[i] = T_NOX_SENS_NOX_HLD[i]
LV_NOX_NS_VLD[i] = LV_NOX_SENS_NOX_VLD[i]
LV_NOX_NS_DIAG_VLD[i] = LV_NOX_SENS_NOX_DIAG_VLD[i]
LV_NOX_NS_AUTH[i] = LV_NOX_SENS_NOX_AUTH[i]
T_NOX_NS_MDL[i] = T_NOX_SENS_NOX_MDL[i]

LAMB_NS[i] = LAMB_NOX_SENS[i]
LAMB_NS_DIAG[i] = LAMB_NOX_SENS_DIAG[i]
T_LAMB_NS_HLD[i] = T_NOX_SENS_LAMB_HLD[i]
LV_LAMB_NS_VLD[i] = LV_NOX_SENS_LAMB_VLD[i]
LV_LAMB_NS_DIAG_VLD[i] = LV_NOX_SENS_LAMB_DIAG_VLD[i]
LV_LAMB_NS_AUTH[i] = LV_NOX_SENS_LAMB_AUTH[i]

VLS_NS[i] = VLS_NOX_SENS[i]
VLS_NS_DIAG[i] = VLS_NOX_SENS_DIAG[i]
T_VLS_NS_HLD[i] = T_NOX_SENS_VLS_HLD[i]
LV_VLS_NS_VLD[i] = LV_NOX_SENS_VLS_VLD[i]

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LV_VLS_NS_DIAG_VLD[i] = LV_NOX_SENS_VLS_DIAG_VLD[i]
LV_VLS_NS_AUTH[i] = LV_NOX_SENS_VLS_AUTH[i]

LV_NOX_NS_MDL_VLD[i] = LV_NOX_SENS_NOX_MDL_VLD[i]

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3.11 AGGR adaptation: NOXM

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CLU_SWI	O/V	0... 1H	0 ...1	1	-
Boolean for clutch switch detection					
LV_INH_NOX_MDL_CTRL_RGN	O/V	0... 1H	0 ...1	1	-
Prohibition of regeneration by controller controlled NOx-Signal					
LV_INH_NT_RGN_REQ	O/V	0... 1H	0 ...1	1	-
flag inhibiting the request of a NOx catalyst regeneration					
LV_INH_RGN_AD	O/V	0... 1H	0 ...1	1	-
flag inhibiting a regeneration request by NOx-Sensor or loading degree model					
LV_NOX_AD_CMPL	O/V	0... 1H	0 ...1	1	-
Logical value for active NOx emission adaptation					
LV_NT_AD_CMPL	O/V	0... 1H	0 ...1	1	-
flag for comminication with NOx catalyst aging module indicating a successfull adaptation cycle					
LV_NT_AD_VLD	O/V	0... 1H	0 ...1	1	-
flag indicating that the evaluation of the adaption values is allowed					
LV_NT_MDL_AFR	O/V	0... 1H	0 ...1	1	-
Model rich exhaust gas (stop of regeneration)					
LV_NT_O2_STC_ACT	O/V	0... 1H	0 ...1	1	-
flag for active O2_STC measurement					
LV_NT_RGN_REQ	O/V	0... 1H	0 ...1	1	-
Logical value for regeneration phase request					
LV_NT_RGN_REQ_AD	O/V	0... 1H	0 ...1	1	-
Request for a full regeneration for adaptation or elongated stratified mode					
LV_NT_RGN_STOP_SENS	O/V	0... 1H	0 ...1	1	-
Flag indicating: Stop of Rgn by sensor enabled					
LV_NT_SENS_AFR [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
downstream sensor measures rich exhaust gas (stop of regeneration)					
LV_NT_STC_MAX_AFL_ACT	O/V	0... 1H	0 ...1	1	-
flag for active lean phase of full saturation					
LV_NT_TOUT_AFR	O/V	0... 1H	0 ...1	1	-
rich exhaust gas after timeout (stop of regeneration)					
LV_RGN_REQ_AD	O/V	0... 1H	0 ...1	1	-
Request for a full regeneration for adaptation or elongated stratified mode					
NOX_AD_FAC	O/V	0... FFH	0... 1.99218	0.0078125	-
NOx emission adaptation factor					
NTL_DEC_INT_AD	O/V	0... FFFFH	0... 10485.6	0.16	mg
RAI signal during adaptation (sum of both benches)					
NTLD_MDL_DIF	O/V	8000... 7FFFH	-0.5... 0.49998	15.3e-6	-
Correction of the closed loop control NOx catalyst model					

Input data:

LV_AT {p. 654}	LV_IM_CS_PN {p. 852}	LV_INH_RGN_REQ {p. 3053}	LV_MDL_AFR {p. 2982}
LV_NT_RGN_REQ_AD {p. 996}	LV_RGN_NT_REQ {p. 2983}	LV_RGN_STOP_SENS {p. 2983}	LV_SENS_AFR [NC_NT_NR] {p. 2983}

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LV_TOUT_AFR {p. 2983}	LV_VAR_TCT {p. 656}	NC_NT_NR {p. 644}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_NOX_MDL_CTRL_ACT	-	0... 1H	0 ...1	1	-
Switch to activate closed loop control fo the NOx-Catalyst model					
LC_NOX_RGN_CMPL	-	0... 1H	0 ...1	1	-
Switch whether regenerations are "completely" or not					

FUNCTION DESCRIPTION:

General information:

This module handles all variable interfaces of aggregate NOXM. It adapts inputs to aggregate NOXM and outputs from aggregate NOXM on project specific requirements or aggregate structure requirements.

3.11.1 Inputs to aggregate NOXM - 20ms

Application conditions

Initialisation: at reset:
LV_CLU_SWI = 0

Recurrence: *20ms*

Activation: *after reset*

Deactivation: –

Formula section:

LV_CLU_SWI = (LV_IM_CS_PN = 1) **AND** (LV_AT = 0) **AND** (LV_VAR_TCT = 0)

3.11.2 Outputs of aggregate NOXM - 20ms

Application conditions

Initialisation: at reset:
LV_INH_NT_RGN_REQ = 0
LV_RGN_REQ_AD = 0
LV_NT_MDL_AFR = 0
LV_NT_RGN_STOP_SENS = 0
LV_NT_SENS_AFR[i] = 0
LV_NT_TOUT_AFR = 0
LV_NT_RGN_REQ = 0

Recurrence: *20ms*

Activation: *after reset*

Deactivation: –

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Formula section:

LV_INH_NT_RGN_REQ = LV_INH_RGN_REQ
LV_RGN_REQ_AD = LV_NT_RGN_REQ_AD
LV_NT_MDL_AFR = LV_MDL_AFR
LV_NT_RGN_STOP_SENS = LV_RGN_STOP_SENS
LV_NT_SENS_AFR[i] = LV_SENS_AFR[i]
LV_NT_TOUT_AFR = LV_TOUT_AFR
LV_NT_RGN_REQ = LV_RGN_NT_REQ

3.11.3 Non implemented functions

Initialisation: at reset:

NOx Catalyst model controller (02706I01.00D)

NTLD_MDL_DIF = 0
LV_INH_NOX_MDL_CTRL_RGN = 0

NOX Engine out Emission Adaptation (02705V01.00J)

NOX_AD_FAC = 1
LV_NOX_AD_CMPL = 0

NOx catalyst management - auxiliary functionalities (02704F03.00D)

LV_INH_RGN_AD = 0
LV_NT_RGN_REQ_AD = 0
LV_NT_STC_MAX_AFL_ACT = 0
LV_NT_O2_STC_ACT = 0
LV_NT_AD_VLD = 0
LV_NT_AD_CMPL = 0
NTL_DEC_INT_AD = 0

Recurrence: -

Activation: -

Deactivation: -

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3.12 AGGR adaptation: CYBL

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_CYL_SEL_ADJ_OFS_EXT_REQ	O/V	0... 1H	0 ...1	1	-
External request for calculation of cylinder individual lambda adaptation in the additive area					
TI_ADD [NC_CYL_NR]	O/V	8000... 7FFFH	-32.768 ...32.767	0.001	ms
Total additive correction value for cylinder balancing					
TI_FAC [NC_CYL_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
injection time correction due to external demand (interface for INJR AGGR)					

Input data:

CRK_CYL_LAM [NC_CYL_NR] {p. 2730}	FAC_TI_BAL [NC_CYL_NR] {p. 3215}	LV_LAM_CYL_ENA [NC_CBK_EX_NR] {p. 2864}	NC_CBK_EX_NR {p. 1829}
NC_CYL_NR {p. 1526}			

Application conditions:

Initialization at Reset:

LV_LAM_CYL_SEL_ADJ_OFS_EXT_REQ = 0

FOR m = 0 to NC_CYL_NR - 1
TI_ADD[m] = 0
TI_FAC[m] = 1
END FOR

Recurrence: every TDC

Activation: every engine state

Deactivation: -

Formula section:

FOR m = 0 to NC_CYL_NR - 1
TI_FAC[m] = FAC_TI_BAL[m]
END FOR

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3.13 AGGR adaptation: EVAC

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CLOSE_ACT_CP	O/V	0... 1H	0 ...1	1	-
Logical value for CPS valve closed					

Input data:

LV_CP_CLOSE_ACT {p. 3749}			

FUNCTION DESCRIPTION:

Adaptation to aggregate environment.

Application conditions

Initialisation: at reset:
LV_CLOSE_ACT_CP = LV_CP_CLOSE_ACT from NVMY

Recurrence: 20ms

Activation: at every engine state

Deactivation: –

Formula section:

LV_CLOSE_ACT_CP = LV_CP_CLOSE_ACT

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3.14 AGGR adaptation: EVAM

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CL_MMV_NORM_PURGE_END	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Canister load at the end of MAX_PURGE operation					
FLOW_SP_CPS_EVAP	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow setpoint through the CPS during functional check CPS (interface to EVAC AGGR)					
LV_CL_CALC_AVL	O/V	0... 1H	0 ...1	1	-
interface flag to cat.diag.: cl known					
LV_CL_MMV	O/V	0... 1H	0 ...1	1	-
Interface flag to functional check cps					
LV_CL_MMV_TMP	V	0... 1H	0 ...1	1	-
Intermediate value for interface flag to functional check cps					
LV_CP_NEW_RAMP_OPEN_MEM	O/V	0... 1H	0 ...1	1	-
locally memorised version of LV_CP_NEW_RAMP_OPEN					
LV_DIAGCP_CPS_ACT	O/V	0... 1H	0 ...1	1	-
Flag indicating FLOW_SP_CPS_EVAP is controlled by EVAM					
LV_ERR_CPS	O/V	0... 1H	0 ...1	1	-
Flag indicating failure on canister purge valve					
LV_ERR_EL_SOV	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on canister shut off valve command signal.					
LV_ERR_MEC_CLOSE_SOV	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present due to canister shut off valve stuck in closed position					
LV_ERR_MEC_OPEN_CPS	O/V	0... 1H	0 ...1	1	-
Boolean for CPS stuck in open position (after debounce)					
LV_FAC_LAM_DIAGCP	O/V	0... 1H	0 ...1	1	-
flag for lambda control to set initialize controller output					
LV_T_DLY_CL_MMV_READY	O/V	0... 1H	0 ...1	1	-
Flag when the first transition Wait Ramp Open to Ramp Open occurs					
LV_TLDV_REQ	O/V	0... 1H	0 ...1	1	-
Flag indicating the activation requirement for the diagnosis (1)					
STATE_CP_MEM_AD	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H AH BH	CP_NOT_ACT NO_PURGE RAMP_TO_ NO_PURGE WAIT_RAMP_ OPEN MIN_PURGE - - - RAMP_OPEN RAMP_OPEN_ FAST MAX_PURGE RAMP_CLOSE	-	-
Locally memorised version of STATE_CP					
T_DLY_CL_MMV	V	0... FFFFH	0... 1310.7	0.02	s
Delay time for setting LV_CL_MMV 0 - -> 1					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_DLY_CL_MMV_READY	V	0... FFFFH	0... 1310.7	0.02	s
Delay time after which TEV check starts once Ramp_open has been started					
T_DLY_PURGE_DIAGCPS	O/V	0... FFFFH	0... 1310.7	0.02	s
Delay time for activating DIAGCPS-diagnosis (step 2) after LV_CL_MMV 0- ->1					

Input data:

CL_MMV_CLC_END {p. 3635}	FLOW_SP_CP_DIAGCPS {p. 5926}	LV_ACT_DIAGCPS {p. 5926}	LV_CL_CLC_AVL {p. 3635}
LV_CL_MMV_CAL_ACT {p. 3699}	LV_CP_CLOSE_ACT {p. 3749}	LV_CP_NEW_RAMP_OPEN {p. 3699}	LV_ERR_EL_CPS {p. 4708}
LV_ES {p. 1720}	LV_IGK {p. 906}	STATE_CLL_DEAC_CP {p. 3637}	STATE_CP {p. 3637}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_CL_MMV	-	0... FFFFH	0... 1310.7	0.02	s
Delay time for setting LV_CL_MMV 0 - -> 1					
C_T_DLY_CL_MMV_READY	-	0... FFFFH	0... 1310.7	0.02	s
Delay time after which TEV check starts once Ramp_open has been started					
C_T_DLY_PURGE_DIAGCPS	-	0... FFFFH	0... 1310.7	0.02	s
Delay time for activating DIAGCPS-diagnosis (step 2) after LV_CL_MMV 0- ->1					

3.14.1 Interface from/to TEV-check, leak detection and other supplier internal functions

FUNCTION DESCRIPTION:

Adaptation to (non-aggregate) TEV-check and leak detection.

Application conditions

Initialisation:

```
at reset or  LV_IGK = 0 -> 1
 CL_MMV_NORM_PURGE_END        = 0
    LV_CL_MMV                 = 0
     T_DLY_PURGE_DIAGCPS         = C_T_DLY_PURGE_DIAGCPS
T_DLY_CL_MMV               = C_T_DLY_CL_MMV
 LV_DIAGCP_CPS_ACT       = 0
 LV_ERR_CPS               = 0
LV_ERR_MEC_OPEN_CPS       = 0
FLOW_SP_CPS_EVAP        = FLOW_SP_CP_DIAGCPS
LV_FAC_LAM_DIAGCP         = 0
LV_ERR_EL_SOV                = 0
LV_TLDV_REQ               = 0
 T_DLY_CL_MMV_READY        = C_T_DLY_CL_MMV_READY               LV_
T_DLY_CL_MMV_READY = 0
 LV_CL_MMV_TMP                  = 0
 LV_ERR_MEC_CLOSE_SOV = 0
at reset or LV_ES = 0 -> 1:
     LV_DIAGCP_CPS_ACT        = 0
     LV_TLDV_REQ               = 0
 all other values              = 0
```

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Recurrence : 20 ms

Activation: *every ECU state*

Deactivation: – –

Formula section:

```
// interface to leak detection
If            LV_ES = 0
Then          CL_MMV_NORM_PURGE_END = CL_MMV_CLC_END
Else          - -
Endif

// interface to functional check cps
If (1)         STATE_CP_MEM_AD = WAIT_RAMP_OPEN           and
            STATE_CP = RAMP_OPEN
Then(1)        LV_CL_MMV_TMP = 0                     /* reset interface flag */
               T_DLY_PURGE_DIAGCPS = C_T_DLY_PURGE_DIAGCPS
               T_DLY_CL_MMV = C_T_DLY_CL_MMV
               LV_T_DLY_CL_MMV_READY = 1
Else(1)
      If(2)          STATE_CP_MEM_AD            = RAMP_OPEN      and
                  STATE_CP   RAMP_OPEN                  and
                  STATE_CLL_DEAC_CP = CP_NO_DEAC      and
                  LV_CP_NEW_RAMP_OPEN_MEM = 0
      Then       (2)       T_DLY_CL_MMV = C_T_DLY_CL_MMV
      Else(2)
                  If(3)       LV_CL_MMV_CAL_ACT = 1                 and
                      STATE_CP = MAX_PURGE
                  Then(3) T_DLY_CL_MMV   - -               /*decrement counter
                      If(4) T_DLY_CL_MMV > 0
                      Then(4) LV_CL_MMV_TMP   = 0
                      Else(4) LV_CL_MMV_TMP   = 1/* set temporary interface flag when
dif         (4)                  RAMP_OPEN inished and time delay elapsed*
                  Else(3)
                      If(5)        T_DLY_CL_MMV = 0                  and
                          STATE_CP = MAX_PURGE
                      Then(5) LV_CL_MMV_TMP   = 1
                      Endif(5)
                  Endif(3)
      Endif(2)
Endif
- – -
If            LV_T_DLY_CL_MMV_READY = 1
Then          T_DLY_CL_MMV_READY - -                  /*decrement counter
Endif
- – -

If(1)             LV_CL_MMV_TMP   = 1
Then(1)
               If(2)              T_DLY_CL_MMV_READY = 0
               Then(2)         LV_CL_MMV =1
```

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Else(2) LV_CL_MMV =0
Endif(2)
Else(1) LV_CL_MMV =0
Endif(1)

- – -
If LV_CL_MMV = 1 **and**
STATE_CP = MAX_PURGE
Then T_DLY_PURGE_DIAGCPS - - /*decrement counter
Endif

// memorisation of relevant variables for next recurrence
STATE_CP_MEM_AD = STATE_CP
LV_CP_NEW_RAMP_OPEN_MEM = LV_CP_NEW_RAMP_OPEN

calibration hint:

The RAMP_OPEN interruption time C_T_DI_RAMP_OPEN_CP should be set to minimum 40ms to prevent a wrong setting of LV_CL_MMV at short RAMP_OPEN interruption.

FLOW_SP_CPS_EVAP = FLOW_SP_CP_DIAGCPS
LV_ERR_CPS = LV_ERR_EL_CPS
LV_CL_CALC_AVL = LV_CL_CLC_AVL

If LV_ACT_DIAGCPS = 1 **or**
(LV_ACT_DIAGCPS$_{n-1}$ = 1 **and** LV_ACT_DIAGCPS$_{n}$ = 0)
Then LV_DIAGCP_CPS_ACT = 1
Else LV_DIAGCP_CPS_ACT = 0
Endif

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3.15 AGGR adaptation: IGRE

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_AV [NC_CYL_NR]	O/V	0... FFH	-35.625 ...60	0.375	°CRK
Ignition Angle Applied on CYL					
IGA_AV_MV	O/V	0... FFH	-35.625 ...60	0.375	°CRK
Mean value of actual ignition angle					
IGA_IGC [NC_CYL_NR]	O/V	0... FFH	-35.625 ...60	0.375	°CRK
Applied Ignition angle					

Input data:

IGA_AV_MV_H_RNG {p. 1828}	IGA_IGC_H_RNG [NC_CYL_NR] {p. 1876}	LV_ERR_IGC_SCG [NC_CYL_NR] {p. 4772}	LV_ERR_IGC_SCP [NC_CYL_NR] {p. 4773}

3.15.1 Reset of New Ignition Angle Range to old in Integration process

Information:

Function is applied for Integration of IGRE3.0.0 to keep variables in old ignition angle range. With update to IGRE3.1.0, only new variables will be used. This, except in a few modules that will not be touched due to affection of different projects

Formula section:

IGA_AV_MV = IGA_AV_MV_H_RNG

IGA_IGC[NC_CYL_NR] = IGA_IGC_H_RNG[NC_CYL_NR]

IGA_AV[NC_CYL_NR] = IGA_IGC[NC_CYL_NR]

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3.16 AGGR adaptation: EGCP

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Bitmask of Upstream Lambda Sensor errors					
ERR_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Bit word for bank selective calculation of deactivation of lambda adaptation due to upstream oxygen sensor error.					
FAC_DYN_LSL_DIAG_SAE [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	-
Mode6 output of diagnostic result. Either from Dynamic diag or from Dynamic diag after NOx cat regeneration					
FAC_DYN_LSL_DIAG_TOL_SAE [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	-
Mode6 Output : Maximum test limit. Either from Dynamic diag (homogen) or Dynamic diag after Nox-Cat regeneration.					
LAMB_1	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda signal value of the WRAF sensor of exhaust bank 1					
LAMB_2	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda signal value of the WRAF sensor of exhaust bank 2					
LAMB_MIN	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Minimum lambda in multiple-branched exhaust gas lines					
LAMB_MV	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Mean value of lambda in multiple-branched exhaust gas lines					
LAMB_SP_1	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda set point of exhaust gas line - Bk1					
LAMB_SP_2	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda set point of exhaust gas line Bk2					
LAMB_SP_BEG_LS_ACT_TEST_1	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Initial value of lambda set point of exhaust bank 1					
LAMB_SP_BEG_LS_ACT_TEST_2	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Initial value of lambda set point of exhaust bank 2					
LAMB_SP_LS_ACT_TEST [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda set point for active plausibility test					
LV_DOWN_LS_1	O/V	0... 1H	0 ...1	1	-
Logical variable for operative readiness of downstream oxygen sensor bank 1					
LV_DOWN_LS_2	O/V	0... 1H	0 ...1	1	-
Logical variable for operative readiness of downstream oxygen sensor bank 2					
LV_ERR_LS_DOWN_1	O/V	0... 1H	0 ...1	1	-
Final diagnostic of the downstream oxygen sensor Bk1					
LV_ERR_LS_DOWN_2	O/V	0... 1H	0 ...1	1	-
Final diagnostic of the downstream oxygen sensor Bk2					
LV_ERR_LS_UP_1	O/V	0... 1H	0 ...1	1	-
Final diagnostic of the upstream oxygen sensor Bk1					
LV_ERR_LS_UP_2	O/V	0... 1H	0 ...1	1	-
Final diagnostic of the upstream oxygen sensor Bk2					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_LS_UP_DYN_VLD_1	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the validation of correspondent symptom (transmitted to the error management) Bk1					
LV_ERR_LS_UP_DYN_VLD_2	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the validation of correspondent symptom (transmitted to the error management) Bk2					
LV_ERR_LSH_DOWN_1	O/V	0... 1H	0 ...1	1	-
Error flag for downstream heater diagnosis OBD I after debouncing					
LV_ERR_LSH_DOWN_2	O/V	0... 1H	0 ...1	1	-
Error flag for downstream heater diagnosis OBD I after debouncing Bk2					
LV_ERR_LSH_UP_1	O/V	0... 1H	0 ...1	1	-
Error flag for upstream heater diagnosis OBD I after debouncing					
LV_ERR_LSH_UP_2	O/V	0... 1H	0 ...1	1	-
Error flag for upstream heater diagnosis OBD I after debouncing Bk2					
LV_ERR_OBD_LSH_DOWN_1	O/V	0... 1H	0 ...1	1	-
Lambda Sensor Heater Error in Bk1					
LV_ERR_OBD_LSH_DOWN_2	O/V	0... 1H	0 ...1	1	-
Lambda Sensor Heater Error in Bk2					
LV_ERR_VLS_DOWN_1	O/V	0... 1H	0 ...1	1	-
Lambda Sensor Electrical in Bk1					
LV_ERR_VLS_DOWN_2	O/V	0... 1H	0 ...1	1	-
Lambda Sensor Electrical Error in Bk2					
LV_INH_WIN_DET_DELTA_I_LAM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to inhibit window calculation					
LV_LAMB_PULS_DYN_DIAG	O/V	0... 1H	0 ...1	1	-
Request forced stimulation parameters specific for the WRAF sensor dynamic					
LV_LSL_OFS_PULS_1	O/V	0... 1H	0 ...1	1	-
State of the offset measurement for lambda stimulation Bk1					
LV_LSL_OFS_PULS_2	O/V	0... 1H	0 ...1	1	-
State of the offset measurement for lambda stimulation Bk2					
LV_REQ_LAMB_SP_LS_ACT_TEST [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Lambda coordination request to change set point for active plausibility test					
LV_TEMP_DEW_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that dew point is passed at lambda sensor down catalyst					
LV_TEMP_DEW_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that dew point is passed at lambda sensor up catalyst					
LV_UP_LS_1	O/V	0... 1H	0 ...1	1	-
Logical variable for operative readiness of upstream oxygen sensor bank 1					
LV_UP_LS_2	O/V	0... 1H	0 ...1	1	-
Logical variable for operative readiness of upstream oxygen sensor bank 2					
TEG_DYN_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Exhaust gas temperatures at the lambda sensor downstream catalyst					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TEG_DYN_LS_UP [NC_CBK_EX_NR]	O/V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Exhaust gas temperatures at the lambda sensor upstream catalyst					
VLS_DOWN_1	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Downstream sensor voltage measured Bk1					
VLS_DOWN_2	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Downstream sensor voltage measured Bk2					

Input data:

FAC_DYN_LSL_UP_DIAG_SAE [NC_CBK_EX_NR] {p. 5346}	FAC_DYN_LSL_UP_DIAG_TOL_SAE [NC_CBK_EX_NR] {p. 5346}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_LS_UP_MIN {p. 2313}
LAMB_LS_UP_MV {p. 2313}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LAMB_SP_BEG_DIAG_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5387}	LAMB_SP_DIAG_LS_UP_DOWN [NC_CBK_EX_NR] {p. 2437}
LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_CHG_LS_DOWN {p. 5388}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5388}
LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_LS_DOWN [NC_CBK_EX_NR] {p. 4267}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}
LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}	LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}
LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}
LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}	LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5152}	LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}
LV_LAMB_PLS_SWI_OFF [NC_CBK_EX_NR] {p. 2313}	LV_LAMB_SP_REQ_DIAG_ACT [NC_CBK_EX_NR] {p. 2437}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_LS_UP_READY [NC_CBK_EX_NR] {p. 2335}
LV_TEG_CAT_DOWN_MIN_THD [NC_CBK_EX_NR] {p. 2446}	LV_TEG_MIN_THD [NC_CBK_EX_NR] {p. 2446}	NC_CBK_EX_NR {p. 1829}	TEG_CAT_DOWN_MDL {p. 8236}

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TEG_CAT_UP_MDL [_i] {p. 8236}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}		

FUNCTION DESCRIPTION:

Adaptation to aggregate environment.
i = 1 ... NC_CBK_EX_NR

Application conditions

Initialisation: 0

Recurrence : same recurrence as corresponding input data

Activation: *every engine operating state*

Formula section:

FAC_DYN_LSL_DIAG_SAE[i] = FAC_DYN_LSL_UP_DIAG_SAE[i]
FAC_DYN_LSL_DIAG_TOL_SAE[i] = FAC_DYN_LSL_UP_DIAG_TOL_SAE[i]
LAMB_1 = LAMB_LS_UP[1]
LAMB_2 = LAMB_LS_UP[2]
LAMB_MIN = LAMB_LS_UP_MIN
LAMB_MV = LAMB_LS_UP_MV
LAMB_SP_BEG_LS_ACT_TEST_1 = LAMB_SP_BEG_DIAG_LS_UP_DOWN[1]
LAMB_SP_BEG_LS_ACT_TEST_2 = LAMB_SP_BEG_DIAG_LS_UP_DOWN[2]
LV_LAMB_PULS_DYN_DIAG = LV_LAMB_PLS_REQ_DYN_LSL_UP[1] **or** LV_LAMB_PLS_REQ_DYN_LSL_UP[2]
LV_UP_LS_1 = LV_LS_UP_READY[1]
LV_UP_LS_2 = LV_LS_UP_READY[2]
LV_ERR_LS_UP_1 = LV_ERR_LS_UP[1]
LV_ERR_LS_UP_2 = LV_ERR_LS_UP[2]
LV_ERR_LSH_UP_1 = LV_ERR_LSH_UP[1]
LV_ERR_LSH_UP_2 = LV_ERR_LSH_UP[2]
LV_ERR_LS_UP_DYN_VLD_1 = LV_ERR_DYN_VLD_LS_UP[1]
LV_ERR_LS_UP_DYN_VLD_2 = LV_ERR_DYN_VLD_LS_UP[2]
LAMB_SP_1 = LAMB_SP[1]
LAMB_SP_2 = LAMB_SP[2]
LV_DOWN_LS_1 = LV_LS_DOWN_READY[1]
LV_DOWN_LS_2 = LV_LS_DOWN_READY[2]
LV_ERR_LS_DOWN_1 = LV_ERR_LS_DOWN[1]
LV_ERR_LS_DOWN_2 = LV_ERR_LS_DOWN[2]
LV_ERR_LSH_DOWN_1 = LV_ERR_LSH_DOWN[1]
LV_ERR_LSH_DOWN_2 = LV_ERR_LSH_DOWN[2]
LV_ERR_OBD_LSH_DOWN_1 = LV_ERR_OBD_LSH_DOWN[1]
LV_ERR_OBD_LSH_DOWN_2 = LV_ERR_OBD_LSH_DOWN[2]
LV_ERR_VLS_DOWN_1 = LV_ERR_EL_LS_DOWN[1]
LV_ERR_VLS_DOWN_2 = LV_ERR_EL_LS_DOWN[2]
VLS_DOWN_1 = VLS_DOWN[1]
VLS_DOWN_2 = VLS_DOWN[2]
LV_REQ_LAMB_SP_LS_ACT_TEST[i] = LV_LAMB_SP_ REQ_DIAG_ACT[i]
LAMB_SP_LS_ACT_TEST[i] = LAMB_SP_DIAG_LS_UP_DOWN[i]

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TEG_DYN_LS_UP[i] = TEG_CAT_UP_MDL[i]
TEG_DYN_LS_DOWN[i] = TEG_CAT_DOWN_MDL[i]
LV_TEMP_DEW_LS_UP[i] = LV_TEG_MIN_THD[i]
LV_TEMP_DEW_LS_DOWN[i] = LV_TEG_CAT_DOWN_MIN_THD[i]
LV_INH_WIN_DET_DELTA_I_LAM[i] = 0
LV_LSL_OFS_PULS_1 = LV_LAMB_PLS_SWI_OFF[1]
LV_LSL_OFS_PULS_2 = LV_LAMB_PLS_SWI_OFF[2]

Calculation of EGCP- failure- bitmasks for QVM LACO

IF LV_ERR_AIR_LSL_UP[1] = 1 THEN Bit 0 of ERR_LS_UP[1] = 1
ELSE Bit 0 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_CHG_LS_UP = 1 THEN Bit 1 of ERR_LS_UP[1] = 1

ELSE Bit 1 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_CTL_LSL_UP[1] = 1 THEN Bit 2 of ERR_LS_UP[1] = 1

ELSE Bit 2 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_DELTA_I_LAM[1] = 1 THEN Bit 3 of ERR_LS_UP[1] = 1

ELSE Bit 3 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_DYN_VLD_LS_UP[1] = 1 THEN Bit 4 of ERR_LS_UP[1] = 1

ELSE Bit 4 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_EL_LSL_UP[1] = 1 THEN Bit 5 of ERR_LS_UP[1] = 1

ELSE Bit 5 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_LSH_UP[1] = 1 THEN Bit 6 of ERR_LS_UP[1] = 1

ELSE Bit 6 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_LSL_UP_IF[1] = 1 THEN Bit 7 of ERR_LS_UP[1] = 1

ELSE Bit 7 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_OBD_VLD_LSH_UP[1] = 1 THEN Bit 8 of ERR_LS_UP[1] = 1

ELSE Bit 8 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_OC_LSL_UP[1] = 1 THEN Bit 9 of ERR_LS_UP[1] = 1

ELSE Bit 9 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_OFS_LSL_UP[1] = 1 THEN Bit 10 of ERR_LS_UP[1] = 1

ELSE Bit 10 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_PUC_VLD_LS_UP[1] = 1 THEN Bit 11 of ERR_LS_UP[1] = 1

ELSE Bit 11 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_SHIFT_AFL_LSL_UP[1] = 1 THEN Bit 12 of ERR_LS_UP[1] = 1

ELSE Bit 12 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_SHIFT_AFR_LSL_UP[1] = 1 THEN Bit 13 of ERR_LS_UP[1] = 1

ELSE Bit 13 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_TTIP_MES_LSH_UP[1] = 1 THEN Bit 14 of ERR_LS_UP[1] = 1

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```
ELSE Bit 14 of ERR_LS_UP[1] = 0 ENDIF
IF LV_ERR_VLS_DOWN_DIF[1] = 1        THEN Bit 15 of ERR_LS_UP[1] = 1
ELSE Bit 15 of ERR_LS_UP[1] = 0 ENDIF

#IF NC_CBK_EX_NR = 2 THEN
IF LV_ERR_AIR_LSL_UP[2] = 1          THEN Bit  0 of ERR_LS_UP[2] = 1
ELSE Bit  0 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_CHG_LS_UP = 1              THEN Bit  1 of ERR_LS_UP[2] = 1

ELSE Bit  1 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_CTL_LSL_UP[2] = 1          THEN Bit  2 of ERR_LS_UP[2] = 1

ELSE Bit  2 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_DELTA_I_LAM[2] = 1         THEN Bit  3 of ERR_LS_UP[2] = 1

ELSE Bit  3 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_DYN_VLD_LS_UP[2] = 1       THEN Bit  4 of ERR_LS_UP[2] = 1

ELSE Bit  4 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_EL_LSL_UP[2] = 1           THEN Bit  5 of ERR_LS_UP[2] = 1

ELSE Bit  5 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_LSH_UP[2] = 1              THEN Bit  6 of ERR_LS_UP[2] = 1

ELSE Bit  6 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_LSL_UP_IF[2] = 1           THEN Bit  7 of ERR_LS_UP[2] = 1

ELSE Bit  7 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_OBD_VLD_LSH_UP[2] = 1      THEN Bit  8 of ERR_LS_UP[2] = 1

ELSE Bit  8 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_OC_LSL_UP[2] = 1           THEN Bit  9 of ERR_LS_UP[2] = 1

ELSE Bit  9 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_OFS_LSL_UP[2] = 1          THEN Bit 10 of ERR_LS_UP[2] = 1

ELSE Bit 10 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_PUC_VLD_LS_UP[2] = 1       THEN Bit 11 of ERR_LS_UP[2] = 1

ELSE Bit 11 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_SHIFT_AFL_LSL_UP[2] = 1 THEN Bit 12 of ERR_LS_UP[2] = 1

ELSE Bit 12 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_SHIFT_AFR_LSL_UP[2] = 1 THEN Bit 13 of ERR_LS_UP[2] = 1

ELSE Bit 13 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_TTIP_MES_LSH_UP[2] = 1   THEN Bit 14 of ERR_LS_UP[2] = 1

ELSE Bit 14 of ERR_LS_UP[2] = 0 ENDIF
IF LV_ERR_VLS_DOWN_DIF[2] = 1        THEN Bit 15 of ERR_LS_UP[2] = 1
ELSE Bit 15 of ERR_LS_UP[2] = 0 ENDIF
ENDIF
```

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IF LV_ERR_CHG_LS_DOWN = 1 THEN Bit 0 of ERR_LS_DOWN[1] = 1

ELSE Bit 0 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_CHK_LS_DOWN[1] = 1 THEN Bit 1 of ERR_LS_DOWN[1] = 1

ELSE Bit 1 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_DELTA_I_LAM[1] = 1 THEN Bit 2 of ERR_LS_DOWN[1] = 1
ELSE Bit 2 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_LSH_DOWN[1] = 1 THEN Bit 3 of ERR_LS_DOWN[1] = 1

ELSE Bit 3 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_OBD_LSH_DOWN[1] = 1 THEN Bit 4 of ERR_LS_DOWN[1] = 1

ELSE Bit 4 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_OC_LS_DOWN[1] = 1 THEN Bit 5 of ERR_LS_DOWN[1] = 1

ELSE Bit 5 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_PUC_LS_DOWN[1] = 1 THEN Bit 6 of ERR_LS_DOWN[1] = 1

ELSE Bit 6 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_PUE_LS_DOWN[1] = 1 THEN Bit 7 of ERR_LS_DOWN[1] = 1

ELSE Bit 7 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_SCG_LS_DOWN[1] = 1 THEN Bit 8 of ERR_LS_DOWN[1] = 1

ELSE Bit 8 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_SCP_LS_DOWN[1] = 1 THEN Bit 9 of ERR_LS_DOWN[1] = 1

ELSE Bit 9 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_SWT_LS_DOWN[1] = 1 THEN Bit 10 of ERR_LS_DOWN[1] = 1

ELSE Bit 10 of ERR_LS_DOWN[1] = 0 ENDIF
IF LV_ERR_VLS_DOWN_DIF[1] = 1 THEN Bit 11 of ERR_LS_DOWN[1] = 1
ELSE Bit 11 of ERR_LS_DOWN[1] = 0 ENDIF
//remark: Bits 12...15 always 0

#IF NC_CBK_EX_NR = 2 THEN
IF LV_ERR_CHG_LS_DOWN = 1 THEN Bit 0 of ERR_LS_DOWN[2] = 1

ELSE Bit 0 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_CHK_LS_DOWN[2] = 1 THEN Bit 1 of ERR_LS_DOWN[2] = 1

ELSE Bit 1 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_DELTA_I_LAM[2] = 1 THEN Bit 2 of ERR_LS_DOWN[2] = 1

ELSE Bit 2 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_LSH_DOWN[2] = 1 THEN Bit 3 of ERR_LS_DOWN[2] = 1

ELSE Bit 3 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_OBD_LSH_DOWN[2] = 1 THEN Bit 4 of ERR_LS_DOWN[2] = 1

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ELSE Bit 4 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_OC_LS_DOWN[2] = 1 THEN Bit 5 of ERR_LS_DOWN[2] = 1

ELSE Bit 5 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_PUC_LS_DOWN[2] = 1 THEN Bit 6 of ERR_LS_DOWN[2] = 1

ELSE Bit 6 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_PUE_LS_DOWN[2] = 1 THEN Bit 7 of ERR_LS_DOWN[2] = 1

ELSE Bit 7 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_SCG_LS_DOWN[2] = 1 THEN Bit 8 of ERR_LS_DOWN[2] = 1

ELSE Bit 8 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_SCP_LS_DOWN[2] = 1 THEN Bit 9 of ERR_LS_DOWN[2] = 1

ELSE Bit 9 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_SWT_LS_DOWN[2] = 1 THEN Bit 10 of ERR_LS_DOWN[2] = 1

ELSE Bit 10 of ERR_LS_DOWN[2] = 0 ENDIF
IF LV_ERR_VLS_DOWN_DIF[2] = 1 THEN Bit 11 of ERR_LS_DOWN[2] = 1
ELSE Bit 11 of ERR_LS_DOWN[2] = 0 ENDIF
ENDIF
//remark: Bits 12...15 always 0

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3.17 AGGR adaptation: LACO

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DELTA_LAMB_I_H_RES [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61e-6	-
High word of lambda-shift from I-share with high resolution					
ERR_INH_FSD [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Error bit word to inhibit fuel system diagnosis					
ERR_INH_LAM_AD_ACT [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Error bit word to inhibit lambda adaptation					
ERR_INH_LAM_ADJ [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Error bit word to inhibit Down stream fuel trim					
ERR_INH_LSCL [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Error bit word to inhibit lamda sensor in close loop					
FAC_LAM_AD_BAL [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lambda adaption output to be used in the MFF correction					
FAC_LAM_AD_SAE [NC_CBK_EX_NR]	O/V	0... FFH	-100... 99.21875	0.78125	%
PID07 Long term fuel trim Bank 1/3 - PID09 Long term fuel trim Bank 2 /4					
FAC_LAM_LIM_FIL [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Filtered Lambda Controller Output					
FAC_LAM_LIM_SAE [NC_CBK_EX_NR]	O/V	0... FFH	-100... 99.21875	0.78125	%
PID06 Short term fuel trim Bank 1 /3 - PID08 Short term fuel trim Bank 2 /4					
FAC_LAM_MV	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
mean value of lambda controller output bank 1 and bank 2					
FAC_LAM_PCTL_CUS [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Customer lambda pre-control value					
LAM_MV [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
sum of the controller output from the I-and I2-share					
LAM_MV_LPF_CP [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Mean value of the controller output, used by canister purge					
LAMB_DELTA_AD_LAM_ADJ_SAE [NC_CBK_EX_NR]	O/V	0... FFH	-100... 99.21875	0.78125	%
PID 56: Long Term Secondary O2 Sensor Fuel Trim Data A Bank 1; Data B Bank 3; PID 58: Long Term Secondary O2 Sensor Fuel Trim Data A Bank 2; Data B Bank 4					
LAMB_DELTA_LAM_ADJ_SAE [NC_CBK_EX_NR]	O/V	0... FFH	-100... 99.21875	0.78125	%
PID 55: Short Term Secondary O2 Sensor Fuel Trim Data A Bank1; Data B Bank 3; PID 57: Short Term Secondary O2 Sensor Fuel Trim Data A Bank 2; Data B Bank 4					
LAMB_DIF [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Controller difference (richness)					
LAMB_SP_FIL [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Output signal of the lambda-sensor model					
LAMB_SP_FIL_S_CP [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Output signal of the lambda-sensor model in stratified mode, used by canister purge					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_SAE	O/V	0... FFFFH	0... 1.99996	0.0000305	-
Lambda setpoint SAE J1979					
LV_CYL_BAL_LAM_AD_REQ_CUS	O/V	0... 1H	0 ...1	1	-
Request bit for fast adaption due to lamb shift in stratified mode or FSD error					
LV_CYL_BAL_LAM_AD_REQ_CUS_FSD	V	0... 1H	0 ...1	1	-
Request bit for fast lamb adaption due to FSD error					
LV_CYL_BAL_LAM_AD_REQ_CUS_LAM	V	0... 1H	0 ...1	1	-
Request bit for fast lamb adaption due to lamb shift in stratified mode					
LV_ERR_AMP_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for AMP error					
LV_ERR_CAM_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for CAM error					
LV_ERR_CPS_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for CPS error					
LV_ERR_CRK_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for CRK error					
LV_ERR_DET_FSD [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Error detection flag FSD diagnosis					
LV_ERR_FUEL_LOCK [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Temporary vector for FUEL error					
LV_ERR_IV_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for IV error					
LV_ERR_IVVT_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for IVVT error					
LV_ERR_LS_DOWN_FSD_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for down stream lambda sensor error relavent to FSD					
LV_ERR_LS_DOWN_LAM_AD_ACT_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for down stream lambda sensor error relavent to LAM_AD_ACT					
LV_ERR_LS_DOWN_LAM_ADJ_LOCK [NC_CBK_EX_NR]	S	0... 1H	0 ...1	1	-
Temporary vector for down stream lambda sensor error relavent to LAM_ADJ					
LV_ERR_LS_DOWN_LSCL_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for down stream lambda sensor error relavent to LSCL					
LV_ERR_LS_UP_FSD_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for up stream lambda sensor error relavent to FSD					
LV_ERR_LS_UP_LAM_AD_ACT_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for up stream lambda sensor error relavent to LAM_AD_ACT					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_LS_UP_LAM_ADJ_LOCK [NC_CBK_EX_NR]	S	0... 1H	0 ...1	1	-
Temporary vector for up stream lambda sensor error relavent to LAM_ADJ					
LV_ERR_LS_UP_LSCL_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for up stream lambda sensor error relavent to LSCL					
LV_ERR_MAF_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for MAF error					
LV_ERR_MAP_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for MAP error					
LV_ERR_MIS_FIRE_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for mis fire error					
LV_ERR_MIS_FIRE_LOCK_LSCL [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for mis fire error (LSCL)					
LV_ERR_PLAUS_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for PLAUS error					
LV_ERR_TCO_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for TCO error					
LV_ERR_TPS_LOCK [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Temporary vector for TPS error					
LV_FAC_L_RNG_LIM_MAX_EXT_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating Lambda Adaptation external to LACO is over its max. limit threshold					
LV_FAC_L_RNG_LIM_MIN_EXT_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating Lambda Adaptation external to LACO is under its min. limit threshold					
LV_LAM_AD_EXT	O/V	0... 1H	0 ...1	1	-
Logical variable indicating that Lambda Adaptation is carried out outside from LACO					
LV_LAM_COR_LIM_INTR [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Limitation under non stationary operating conditions (threshold exceeded)					
LV_LAM_STOP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation signal for the lambda controller stop mode					
LV_LAMB_DIF_AFL_ACT	V	0... 1H	0 ...1	1	-
Steady state condition for lamb signal is reached					
LV_LAMB_OHP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating enrichment for overheating prevention					
LV_LSCL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation flag of lambda control					
LV_MFF_AD_CDN	O/V	0... 1H	0 ...1	1	-
flag for time scheduler indicating good conditions for lambda adaptation					
LV_MFF_AD_END	O/V	0... 1H	0 ...1	1	-
logical value indicating temporary end of lambda adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MFF_AD_ADD_MMV_REL_QUO [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
relative additive adaptive value quotient					
MFF_AD_FAC_MMV_REL [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Relative multiplicative adaptive factor					
OBD_LAM_AD [NC_CBK_EX_NR]	-	0... FFH	-100... 99.21875	0.78125	%
Lambda adaptation factor SAE J1979					
T_LAMB_ADD_AFL	V	0... FFFFH	0... 6553.5	0.1	s
Timer indicating how long LV_CYL_BAL_LAM_AD_REQ_CUS is already requested to deactivate					
T_LAMB_DIF_AFL_STEADY [NC_CBK_EX_NR]	V	0... 9F6H	0... 255	0.1	s
Timer indicating how long la_abgas is within boundaries					
T_MFF_AD_MIN	O/V	0... FFFFH	0... 6553.5	0.1	s
Time indicating the minimum time for next requested lambda adaptation					
TI_LAM_COR [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Controller output signal in consideration of the canister purge function and lambda adaptation					
VLS_CYL [NC_CYL_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
upstream oxygen sensor acquisition (cylinder individual)					
VLS_CYL_TRIG [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
cylinder selective update counter for trigger event					

Input data:

CTR_VLS_UP_CYL_SEL_TRIG [NC_CYL_NR] {p. 973}	ERR_LS_DOWN [NC_CBK_EX_NR] {p. 1006}	ERR_LS_UP [NC_CBK_EX_NR] {p. 1006}	ERR_SYM_FSD [NC_CBK_EX_NR] {p. 6140}
FAC_DIF_LAM_IN [NC_CBK_EX_NR] {p. 2460}	FAC_LAM_AD_CUS [NC_CBK_EX_NR] {p. 8308}	FAC_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2461}	FAC_LAM_ADJ_COR_LAM_AD_CUS [NC_CBK_EX_NR] {p. 8309}
FAC_LAM_LIM [NC_CBK_EX_NR] {p. 2461}	FAC_LAM_MV_MMV_CP [NC_CBK_EX_NR] {p. 2462}	FAC_MFF_ADD_FAC_LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_MFF_ADD_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2641}
LAMB_DELTA_AD_LAM_ADJ [NC_CBK_EX_NR] {p. 2622}	LAMB_DELTA_I_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LAMB_DELTA_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LAMB_LS_UP_MV {p. 2313}
LAMB_SP_DELTA_LAM [NC_CBK_EX_NR] {p. 2544}	LAMB_SP_FIL_HOM [NC_CBK_EX_NR] {p. 2462}	LAMB_SP_FIL_S [NC_CBK_EX_NR] {p. 2462}	LAMB_SP_HOM [NC_CBK_EX_NR] {p. 8340}
LAMB_SP_S_EXT {p. 8136}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_AMP_PLAUS_CUS {p. 1061}
LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_EX [NC_NR_CAM_CBK] {p. 4455}	LV_ERR_CAM_IN [NC_NR_CAM_CBK] {p. 4455}
LV_ERR_CRK {p. 4455}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_EL_CPS {p. 4708}	LV_ERR_FUP {p. 4717}

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LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}
LV_ERR_IGC {p. 4772}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_MAF_FRQ_EL [NC_MAF_NR] {p. 4815}
LV_ERR_MAF_FRQ_GRD [NC_MAF_NR] {p. 4815}	LV_ERR_MAF_FRQ_RNG [NC_MAF_NR] {p. 4815}	LV_ERR_MAP {p. 982}	LV_ERR_MAP_DIP_PLAUS {p. 1062}
LV_ERR_MAP_DIP_SENS {p. 4824}	LV_ERR_MAP_DIP_SHIFT {p. 4824}	LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_PLAUS {p. 1062}
LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MIS_MPL {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}
LV_ERR_MTC_DR {p. 5002}	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TCO {p. 4496}
LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}	LV_ERR_TCO_PLAUS {p. 5682}	LV_ERR_TCO_STUCK {p. 5691}
LV_ERR_TCO_STUCK_RNG {p. 5675}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS {p. 4982}
LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}
LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_2 {p. 4951}
LV_ERR_VCV {p. 4729}	LV_FAC_L_RNG_LIM_MAX_LAM_AD [NC_CBK_EX_NR] {p. 2642}	LV_FAC_L_RNG_LIM_MIN_LAM_AD [NC_CBK_EX_NR] {p. 2642}	LV_FAC_LAM_LIM_NOT_STAT_CDN [NC_CBK_EX_NR] {p. 2463}
LV_FAC_LIM_MAX_LAM_AD_CUS [NC_CBK_EX_NR] {p. 8309}	LV_FAC_LIM_MIN_LAM_AD_CUS [NC_CBK_EX_NR] {p. 8309}	LV_IGK {p. 906}	LV_LAM_AD_CDN {p. 2642}
LV_LAM_AD_END {p. 2642}	LV_LAM_ADJ_D_ACT [NC_CBK_EX_NR] {p. 2589}	LV_LAM_ADJ_I_ACT [NC_CBK_EX_NR] {p. 2589}	LV_LAM_ADJ_P_ACT [NC_CBK_EX_NR] {p. 2589}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAMB_COP [NC_CBK_EX_NR] {p. 8233}	LV_MIS_STATE_A {p. 6238}	LV_S_ACT {p. 8137}

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MFF_SP [NC_CBK_EX_NR] {p. 2151}	NC_CBK_EX_NR {p. 1829}	NC_CBK_HPP_NR [1] {p. 812}	NC_IDX_DIAG_FSD [NC_CBK_EX_NR] {p. 6200}
NC_MAF_NR {p. 834}	NC_MAP_SENS_NR	STATE_LS_SAE [NC_CBK_EX_NR] {p. 2448}	STATE_MIL {p. 5827}
T_DLY_SOI_LSL_POS [NC_CBK_EX_NR] {p. 2464}	T_PRI_TOT_LAM_AD {p. 2643}	T1_LSL_UP [NC_CBK_EX_NR] {p. 2464}	TCO {p. 1100}
VLS_UP_CYL_SEL [NC_CYL_NR] {p. 973}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ERR_LS_DOWN_FSD_CBK	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective in Fuel system monitoring due to error in downstream oxygen sensor (1 = Error active)					
C_ERR_LS_DOWN_FSD_CBK_NOT	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective in Fuel system monitoring due to no error in downstream oxygen sensor (1 = Error active)					
C_ERR_LS_DOWN_LAM_AD_ACT_CBK	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective adaptation due to downstream oxygen sensor error (1 = Error active)					
C_ERR_LS_DOWN_LAM_AD_ACT_CBK_NOT	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective adaptation due to no error in downstream oxygen sensor (1 = Error active)					
C_ERR_LS_DOWN_LAM_ADJ_CBK	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective long term adaptation due to downstream oxygen sensor error (1 = Error active)					
C_ERR_LS_DOWN_LAM_ADJ_CBK_NOT	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective long term adaptation due to no error in downstream oxygen sensor (1 = Error active)					
C_ERR_LS_DOWN_LAM_LSCL_CBK	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective inhibition due to error in closed loop lambda sensor (1 = Error active)					
C_ERR_LS_DOWN_LAM_LSCL_CBK_NOT	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective inhibition due to no error in closed loop lambda sensor (1 = Error active)					
C_ERR_LS_UP_FSD_CBK	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective in Fuel system monitoring due to error in upstream oxygen sensor (1 = Error active)					
C_ERR_LS_UP_FSD_CBK_NOT	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective in Fuel system monitoring due to no error in upstream oxygen sensor (1 = Error active)					
C_ERR_LS_UP_LAM_AD_ACT_CBK	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective adaptation due to upstream oxygen sensor error (1 = Error active)					
C_ERR_LS_UP_LAM_AD_ACT_CBK_NOT	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective adaptation due to no error in upstream oxygen sensor (1 = Error active)					
C_ERR_LS_UP_LAM_ADJ_CBK	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective long term adaptation due to upstream oxygen sensor error (1 = Error active)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ERR_LS_UP_LAM_ADJ_CBK_NOT	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective long term adaptation due to no error in upstream oxygen sensor (1 = Error active)					
C_ERR_LS_UP_LAM_LSCL_CBK	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective inhibition due to error in closed loop lambda sensor (1 = Error active)					
C_ERR_LS_UP_LAM_LSCL_CBK_NOT	-	0... FFFFH	0... 65535	1	-
Calibration constant mask for bank selective inhibition due to no error in closed loop lambda sensor (1 = Error active)					
C_LAMB_DIF_AFL_STEADY	-	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda deviation allowed to define lambda as steady state					
C_N_BOL_LAMB_DIF_ACT	-	0... FFH	0... 8160	32	rpm
minimum engine speed for hom switching					
C_N_TOL_LAMB_DIF_ACT	-	0... FFH	0... 8160	32	rpm
maximum engine speed for hom switching					
C_T_DIF_AFL_STEADY	-	0... 9F6H	0... 255	0.1	s
Timer adjustment to monitor steady state of la_abgas					
C_T_MAX_LAMB_ADD_AFL	-	0... FFFFH	0... 6553.5	0.1	s
Timer adjustment to end LV_CYL_BAL_LAM_AD_REQ_CUS request					
C_T_MAX_LAMB_ADD_AFL_FSD	-	0... FFFFH	0... 6553.5	0.1	s
Timer adjustment to end LV_CYL_BAL_LAM_AD_REQ_CUS request due to FSD error					
C_TCO_LAMB_DIF_ACT	-	0... FEH	-48... 142.5	0.75	°C
Coolant temperature activation condition for HOM request					
ID_MFF_SP_BOL_LAMB_DIF_ACT	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_32_ID_MFF_SP_BOL_LAMB_DIF	8	0... FFH	0... 8160	32	rpm
minimum fuel mass set point for hom switching					
ID_MFF_SP_TOL_LAMB_DIF_ACT	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_32_ID_MFF_SP_TOL_LAMB_DIF	8	0... FFH	0... 8160	32	rpm
maximum fuel mass set point for hom switching					
IP_CRLC_FAC_LAM_LIM_FIL	V	0... FFH	0... 0.99609	3.9062e-3	-
LDP_N_IP_CRLC_FAC_LAM_LIM_FIL	8	0... 1FE0H	0... 8160	1	rpm
LDP_MAF_IP_CRLC_FAC_LAM_LIM_FIL	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Correlation constant for liltering the lambda controller output					
IP_LAMB_DIF_THD	-	0... 7FFFH	0... 31.99902	976.599e-6	-
LDP_LAMB_LS_UP_MV	8	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda deviation in stratified mode causing hom request					
LC_CYL_BAL_LAM_AD_REQ_FSD	-	0... 1H	0 ...1	1	-
Activation Flag to Request Lambda Adaption due to FSD Error					
LC_FAC_LAM_LIM_FIL_ENA	-	0... 1H	0 ...1	1	-
Logical switch to enable filtering of the lambda controller output					
LC_LAM_AD_EXT	-	0... 1H	0 ...1	1	-
Logical switch between LACO internal (=0) and external (=1) Lambda Adaptation source					

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)

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3.17.1 Outputs for SV aggregates, SV internally

FUNCTION DESCRIPTION:

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Adaptation to aggregate environment.
i = 1 ... NC_CBK_EX_NR

Application conditions

Initialisation: 0
Recurrence : same recurrence as corresponding input data
Activation: *every engine operating state*

Formula section:

LV_MFF_AD_END = LV_LAM_AD_END
LV_MFF_AD_CDN = LV_LAM_AD_CDN
LV_LSCL_i = LV_LAM_LSCL[i]
TI_LAM_COR_i = FAC_LAM_LIM[i]
LAMB_DIF_i = FAC_DIF_LAM_IN[NC_CBK_EX_NR]
LV_LAM_COR_LIM_INTR_i = LV_FAC_LAM_LIM_NOT_STAT_CDN[NC_CBK_EX_NR]
LV_LAM_STOP_i = LV_LAM_STOP[NC_CBK_EX_NR]
LAM_MV_i = FAC_LAM_MV[NC_CBK_EX_NR]
LAM_MV_LPF_CP_i = FAC_LAM_MV_MMV_CP[NC_CBK_EX_NR]
LAMB_SP_FIL_i = LAMB_SP_FIL_HOM[NC_CBK_EX_NR]
LAMB_SP_FIL_S_CP_i = LAMB_SP_FIL_S[NC_CBK_EX_NR]
T_MFF_AD_MIN = T_PRI_TOT_LAM_AD
VLS_CYL_x = VLS_UP_CYL_SEL[x]
VLS_CYL_TRIG_x = CTR_VLS_UP_CYL_SEL_TRIG[x]
LV_LAMB_OHP[i] = LV_LAMB_COP[i]
FAC_LAM_MV = (FAC_LAM_MV[0] + FAC_LAM_MV[1]) /2
DELTA_LAMB_I_H_RES_i = LAMB_DELTA_I_LAM_ADJ[NC_CBK_EX_NR]
FAC_LAM_PCTL_CUS[i] = (LAMB_SP_DELTA_LAM[i]/LAMB_SP_HOM[i]) * 100%

Note: Interface to BMW Lambda Adaptation (KLANN)
LV_LAM_AD_EXT = LC_LAM_AD_EXT

If LV_LAM_AD_EXT = 1
Then
FAC_LAM_AD_BAL[i]=
FAC_LAM_AD_CUS[i] + FAC_LAM_ADJ_COR_LAM_AD_CUS[i]
OBD_LAM_AD[i] = FAC_LAM_AD_CUS[i] %please mind the variable definition differences
LV_FAC_L_RNG_LIM_MIN_EXT_LAM_AD[i] = LV_FAC_LIM_MIN_LAM_AD_CUS[i]
LV_FAC_L_RNG_LIM_MAX_EXT_LAM_AD[i] = LV_FAC_LIM_MAX_LAM_AD_CUS[i]
Else
FAC_LAM_AD_BAL[i] =
FAC_LAM_AD_OUT[i] + FAC_LAM_ADJ_COR_LAM_AD_CUS[i]
OBD_LAM_AD[i] = FAC_MFF_ADD_FAC_LAM_AD[i]
%please mind the variable definition differences
LV_FAC_L_RNG_LIM_MIN_EXT_LAM_AD[i] = LV_FAC_L_RNG_LIM_MIN_LAM_AD[i]
LV_FAC_L_RNG_LIM_MAX_EXT_LAM_AD[i]= LV_FAC_L_RNG_LIM_MAX_LAM_AD[i]
Endif

If ERR_SYM_FSD_i $\neq$ 0
Then LV_ERR_DET_FSD[i] = 1

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Else LV_ERR_DET_FSD[i] = 0
Endif

Note: Filtering the lambda controller output (requested for the N54 engine)
If LC_FAC_LAM_LIM_FIL_ENA = 1
Then
FAC_LAM_LIM_FIL[i]$_k$ = FAC_LAM_LIM_FIL[i]$_{k-1}$*(1-IP_CRLC_FAC_LAM_LIM_FIL) + FAC_LAM_LIM[i]* IP_CRLC_FAC_LAM_LIM_FIL
Else
FAC_LAM_LIM_FIL[i] = FAC_LAM_LIM[i]
Endif

3.17.2 Activation flag for HOM-mode due to difference in lambda values in stratified

FUNCTION DESCRIPTION:

In case of drift between lamb setpoint and lamb sensor signal in stratified mode after a long time of not adapting, hom mode is requested and canister purge is inhibited.
i = 1 ... NC_CBK_EX_NR
n: current calculation cycle; n-1: calculation cycle before current one

Application conditions

Initialisation: `LV_IGK 0 -> 1: all variables set to zero`

Recurrence : `100ms`

Activation: `LV_DC = 1`

Formula section:

% Setting LV_CYL_BAL_LAM_AD_REQ_CUS = 1:
If(0) LV_S_ACT = 1 **and**
LV_CYL_BAL_LAM_AD_REQ_CUS = 0

% Observation of steady state condition for lamb signal:
If(1a) |LAMB_SP_S_EXT(n)-LAMB_SP_S_EXT(n-1)|<
C_LAMB_DIF_AFL_STEADY
Then(1a) increment T_LAMB_DIF_AFL_STEADY[i] cyl. bank selective
If(2a) (T_LAMB_DIF_AFL_STEADY[1] >= T_DLY_SOI_LSL_POS[1] +
T1_LSL_UP[1] + C_T_DIF_AFL_STEADY **and**

T_LAMB_DIF_AFL_STEADY[2] >= T_DLY_SOI_LSL_POS[2] +
T1_LSL_UP[2] + C_T_DIF_AFL_STEADY)

Then(2a) LV_LAMB_DIF_AFL_ACT = 1
Else(2a) LV_LAMB_DIF_AFL_ACT = 0
Endif(2a)
Else(1a) T_LAMB_DIF_AFL_STEADY[i] = 0
LV_LAMB_DIF_AFL_ACT = 0
Endif(1a)

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```
% Setting of HOM-Request flag:
If(1b)          |LAMB_SP_S_EXT - LAMB_LS_UP_MV| > IP_LAMB_DIF_THD    and
                N_32 > C_N_BOL_LAMB_DIF_ACT                          and
                N_32 < C_N_TOL_LAMB_DIF_ACT                          and
                (MFF_SP[1] > ID_MFF_SP_BOL_LAMB_DIF_ACT         or
                MFF_SP[2] > ID_MFF_SP_BOL_LAMB_DIF_ACT          )    and
                (MFF_SP[1] < ID_MFF_SP_TOL_LAMB_DIF_ACT              or
                MFF_SP[2] < ID_MFF_SP_TOL_LAMB_DIF_ACT          )    and
                LV_LAMB_DIF_AFL_ACT = 1                              and
                TCO >= C_TCO_LAMB_DIF_ACT
Then(1b)        LV_CYL_BAL_LAM_AD_REQ_CUS_LAM = 1
Else(1b)        LV_CYL_BAL_LAM_AD_REQ_CUS_LAM = 0
Endif(1b)
Endif(0)   %end of LV_S_ACT condition

% FSD pending status condition for HOM-request:
If(1c)          LV_CYL_BAL_LAM_AD_REQ_CUS = 0                        and
                LC_CYL_BAL_LAM_AD_REQ_FSD = 1
Then(1c)
      For(2c) i=1 to NC_CBK_EX_NR
      ACTION_ERRM_CheckPendingStatus( <NC_IDX_DIAG_FSD[i]>, <PendingStatus> )
      ACTION_ERRM_GetLvEndDiag( <NC_IDX_DIAG_FSD[i]>, <EndFlag> )
            if(3c) (PendingStatus==1or STATE_MIL==1) and EndFlag==0
            then(3c)      LV_CYL_BAL_LAM_AD_REQ_CUS_FSD = 1
            else(3c)      LV_CYL_BAL_LAM_AD_REQ_CUS_FSD = 0
            endif(3c)
   endfor(2c)
EndIf(2c)

% General Decision about HOM-Request Flag:
If(1d)          LV_CYL_BAL_LAM_AD_REQ_CUS = 0
     If(2d)          LV_CYL_BAL_LAM_AD_REQ_CUS_LAM = 1               or
                          LV_CYL_BAL_LAM_AD_REQ_CUS_FSD = 1
      Then(2d)     LV_CYL_BAL_LAM_AD_REQ_CUS = 1
      Else(2d)     do nothing
      Endif(2d)
EndIf(2d)

% ReSetting LV_CYL_BAL_LAM_AD_REQ_CUS = 0:
If(1e)          LV_CYL_BAL_LAM_AD_REQ_CUS = 1
Then(1e)      increment T_LAMB_ADD_AFL
      If(2e)          (T_LAMB_ADD_AFL   >= C_T_MAX_LAMB_ADD_AFL          and
                      LV_CYL_BAL_LAM_AD_REQ_CUS_FSD = 0              and
                      LV_CYL_BAL_LAM_AD_REQ_CUS_LAM = 1)             or
                       (T_LAMB_ADD_AFL   >= C_T_MAX_LAMB_ADD_AFL_FSD     and
                      LV_CYL_BAL_LAM_AD_REQ_CUS_FSD = 1              and
                      LV_CYL_BAL_LAM_AD_REQ_CUS_LAM = 0)             or
   Then(2e)      LV_CYL_BAL_LAM_AD_REQ_CUS = 0
   Endif(2e)
Else(1e)        T_LAMB_ADD_AFL   = 0
Endif(1e)
```

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3.17.3 Calculation of bitmasks for Lamda controller functions.

General Information

This is an aggregate adaptation module for LACO in order to Lock the diagnostic instance based on the QVM (Cross-dependence Matrix).

16 components are being used to calculate the inhibition flag for Fuel system diagnosis, Lambda adaptation, Down stream fuel trim, Linear lambda control closed loop.

1. Throttle position sensor (TPS error)
2. Infinitely variable valve timing (IVVT error)
3. Canister purge solenoid (CPS error)
4. Upstream lamda sensor (LS_UP error)
5. Downstream lamda sensor (LS_DOWN error)
6. Injection valve (IV error)
7. Misfire (MISFIRE error)
8. Camshaft sensor error (CAM error)
9. Crankshaft sensor error (CRK error)
10. Coolant temperature (TCO error)
11. Ambient pressure (AMP error)
12. Fuel pressure (FUP, VCV error)
13. Mass air flow (MAF error)
14. Manifold air pressure (MAP error)
15. Ignition Coil (IGC error)
16. Plausibility of MAP_TPS and LOAD_TPS (PLAUS error)

Adaptation to aggregate environment.
i = 1 ... NC_CBK_EX_NR

The bit pattern for each of the diagnosis is described as below

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Fuel system diagnosis	Lambda adaptation	Down stream fuel trim	Lin laco closed loop
ERR_INH_FSD [NC_CBK_EX_NR]	ERR_INH_LAM_AD_ACT [NC_CBK_EX_NR]	ERR_INH_LAM_ADJ [NC_CBK_EX_NR]	ERR_INH_LSCL [NC_CBK_EX_NR]
bit 0 TPS LOCK	bit 0 TPS LOCK	bit 0 TPS LOCK	bit 0 TPS LOCK
bit 1 IVVT LOCK	bit 1 IVVT LOCK	bit 1 IVVT LOCK	bit 1 IVVT LOCK
bit 2 CPS LOCK	bit 2 CPS LOCK	bit 2 CPS LOCK	bit 2 CPS LOCK
bit 3 LS_UP_LOCK	bit 3 LS_UP_LOCK	bit 3 LS_UP_LOCK	bit 3 LS_UP_LOCK
bit 4 LS_DOWN_LOCK	bit 4 LS_DOWN_LOCK	bit 4 LS_DOWN_LOCK	bit 4 LS_DOWN_LOCK
bit 5 IV LOCK	bit 5 IV LOCK	bit 5 IV LOCK	bit 5 IV LOCK
bit 6 MIS FIRE LOCK	bit 6 MIS FIRE LOCK	bit 6 MIS FIRE LOCK	bit 6 MIS FIRE LOCK
bit 7 CAM LOCK	bit 7 CAM LOCK	bit 7 CAM LOCK	bit 7 CAM LOCK
bit 8 CRK LOCK	bit 8 CRK LOCK	bit 8 CRK LOCK	bit 8 CRK LOCK
bit 9 TCO LOCK	bit 9 TCO LOCK	bit 9 TCO LOCK	bit 9 TCO LOCK
bit 10 AMP LOCK	bit 10 AMP LOCK	bit 10 AMP LOCK	bit 10 AMP LOCK
bit 11 FUEL LOCK (FUP , VCV)	bit 11 FUEL LOCK (FUP , VCV)	bit 11 FUEL LOCK (FUP , VCV)	bit 11 FUEL LOCK (FUP , VCV)
bit 12 MAF LOCK	bit 12 MAF LOCK	bit 12 MAF LOCK	bit 12 MAF LOCK
bit 13 MAP LOCK	bit 13 MAP LOCK	bit 13 MAP LOCK	bit 13 MAP LOCK
bit 14 IGC LOCK	bit 14 IGC LOCK	bit 14 IGC LOCK	bit 14 IGC LOCK
bit 15 PLAUS LOCK	bit 15 PLAUS LOCK	bit 15 PLAUS LOCK	bit 15 PLAUS LOCK

Application conditions:

Initialisation:	ERR_INH_FSD[NC_CBK_EX_NR], ERR_INH_LSCL[NC_CBK_EX_NR], ERR_INH_LAM_ADJ [NC_CBK_EX_NR], ERR_INH_LAM_AD_ACT[NC_CBK_EX_NR] are set to zero.
Recurrence:	10ms
Activation:	always
Deactivation:	never

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Formula section:

3.17.3.1 Calculation of Temporary vectors for each of the error lock:

{FOR i = 0; i < NC_CBK_EX_NR, i++

LV_ERR_TPS_LOCK[i] = (LV_ERR_TPS OR

LV_ERR_TPS_AD OR

LV_ERR_TPS_MAF_1 OR

LV_ERR_TPS_MAF_2 OR

LV_ERR_TPS_RATIO OR

LV_ERR_TPS_1 OR

LV_ERR_TPS_2 OR

LV_ERR_TPS_ST_CHK_2 OR

LV_ERR_MTC_CTL_2 OR

LV_ERR_MTC_CTL_3 OR

LV_ERR_MTC_DR OR

LV_ERR_TPS_AD_BOL OR)

LV_ERR_IVVT_LOCK[i] = (LV_ERR_MEC_IVVT_IN OR

LV_ERR_MEC_IVVT_EX OR

LV_ERR_SLV_IVVT_IN OR

LV_ERR_SLV_IVVT_EX OR

LV_ERR_CAM_CST_IVVT_IN_1 OR

LV_ERR_CAM_CST_IVVT_EX_1)

LV_ERR_CPS_LOCK[i] = (LV_ERR_DIAGCPS OR

LV_ERR_EL_CPS)

LV_ERR_MIS_FIRE_LOCK_LSCL[i] = LV_MIS_STATE_A

LV_ERR_CAM_LOCK[i] = (LV_ERR_SYN_CAM_IN_1 OR

LV_ERR_PLAUS_CAM_IN_1 OR

LV_ERR_PER_CAM_IN_1 OR

LV_ERR_REF_CRK_CAM_IN_1 OR

LV_ERR_TOOTH_OFF_IN_1 OR

LV_ERR_SYN_CRK_CAM_IN_1 OR

LV_ERR_SYN_CAM_EX_1 OR

LV_ERR_PLAUS_CAM_EX_1 OR

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LV_ERR_PER_CAM_EX_1 OR

LV_ERR_REF_CRK_CAM_EX_1 OR

LV_ERR_TOOTH_OFF_EX_1 OR

LV_ERR_SYN_CRK_CAM_EX_1)

LV_ERR_CRK_LOCK[i] = LV_ERR_CRK

LV_ERR_TCO_LOCK[i] = (LV_ERR_TCO_EL OR

LV_ERR_TCO_GRD OR

LV_ERR_TCO_PLAUS OR

LV_ERR_TCO_STUCK OR

LV_ERR_TCO_STUCK_RNG)

LV_ERR_AMP_LOCK[i] = (LV_ERR_AMP OR

LV_ERR_AMP_PLAUS OR

LV_ERR_AMP_PLAUS_CUS)

LV_ERR_FUP_LOCK[i] = (LV_ERR_FUP OR

LV_ERR_FUP_MFP_PLAUS OR

LV_ERR_FUP_ORNG OR

LV_ERR_H_PRS_SYS OR

LV_ERR_FUP_ST OR

LV_ERR_VCV)}

LV_ERR_MAF_LOCK[i] = (LV_ERR_MAF_FRQ_EL_1 OR

LV_ERR_MAF_FRQ_RNG_1 OR

LV_ERR_MAF_FRQ_GRD_1)}

LV_ERR_MAP_LOCK[i] = (LV_ERR_MAP_DIP_SENS OR

LV_ERR_MAP_DIP_SHIFT OR

LV_ERR_MAP_PLAUS OR

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LV_ERR_MAP_DIP_PLAUS)

LV_ERR_PLAUS_LOCK[i] = (LV_ERR_LOAD_TPS_PLAUS OR

LV_ERR_MAP_TPS_PLAUS)

End of For i}

LV_ERR_LS_UP_LSCL_LOCK[0] = (ERR_LS_UP[0] bitwise & &

C_ERR_LS_UP_LAM_LSCL_CBK) = 1 OR

(ERR_LS_UP[1] bitwise & &

C_ERR_LS_UP_LAM_LSCL_CBK_NOT) = 1
LV_ERR_LS_UP_LSCL_LOCK[1] = (ERR_LS_UP[1] bitwise & &

C_ERR_LS_UP_LAM_LSCL_CBK) = 1 OR

(ERR_LS_UP[0] bitwise & &

C_ERR_LS_UP_LAM_LSCL_CBK_NOT) = 1

LV_ERR_LS_UP_LAM_ADJ_LOCK[0] = (ERR_LS_UP[0] bitwise & &

C_ERR_LS_UP_LAM_ADJ_CBK)= 1 OR

(ERR_LS_UP[1] bitwise & &

C_ERR_LS_UP_LAM_ADJ_CBK_NOT)= 1
LV_ERR_LS_UP_LAM_ADJ_LOCK[1] = (ERR_LS_UP[1] bitwise & &

C_ERR_LS_UP_LAM_ADJ_CBK)= 1 OR

(ERR_LS_UP[0] bitwise & &

C_ERR_LS_UP_LAM_ADJ_CBK_NOT)= 1

LV_ERR_LS_UP_LAM_AD_ACT_LOCK[0] = (ERR_LS_UP[0] bitwise & &

C_ERR_LS_UP_LAM_AD_ACT_CBK)= 1 OR

(ERR_LS_UP[1] bitwise & &

C_ERR_LS_UP_LAM_AD_ACT_CBK_NOT)=1
LV_ERR_LS_UP_LAM_AD_ACT_LOCK[1] =(ERR_LS_UP[1] bitwise & &

C_ERR_LS_UP_LAM_AD_ACT_CBK)= 1 OR

(ERR_LS_UP[0] bitwise & &

C_ERR_LS_UP_LAM_AD_ACT_CBK_NOT)=1

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LV_ERR_LS_UP_FSD_LOCK[0] = (ERR_LS_UP[0] bitwise & &

C_ERR_LS_UP_FSD_CBK) = 1 OR

(ERR_LS_UP[1] bitwise & &

C_ERR_LS_UP_FSD_CBK_NOT) = 1
LV_ERR_LS_UP_FSD_LOCK[1] = (ERR_LS_UP[1] bitwise & &

C_ERR_LS_UP_FSD_CBK) = 1 OR

(ERR_LS_UP[0] bitwise & &

C_ERR_LS_UP_FSD_CBK_NOT) = 1

LV_ERR_LS_DOWN_LSCL_LOCK[0] = (ERR_LS_DOWN[0] bitwise & &

C_ERR_LS_DOWN_LAM_LSCL_CBK) = 1 OR

(ERR_LS_DOWN[1] bitwise & &

C_ERR_LS_DOWN_LAM_LSCL_CBK_NOT) = 1
LV_ERR_LS_DOWN_LSCL_LOCK[1] = (ERR_LS_DOWN[1] bitwise & &

C_ERR_LS_DOWN_LAM_LSCL_CBK) = 1 OR

(ERR_LS_DOWN[0] bitwise & &

C_ERR_LS_DOWN_LAM_LSCL_CBK_NOT) = 1

LV_ERR_LS_DOWN_LAM_ADJ_LOCK[0] = (ERR_LS_DOWN[0] bitwise & &

C_ERR_LS_DOWN_LAM_ADJ_CBK)= 1 OR

(ERR_LS_DOWN[1] bitwise & &

C_ERR_LS_DOWN_LAM_ADJ_CBK_NOT)= 1
LV_ERR_LS_DOWN_LAM_ADJ_LOCK[1] = (ERR_LS_DOWN[1] bitwise & &

C_ERR_LS_DOWN_LAM_ADJ_CBK)= 1 OR

(ERR_LS_DOWN[0] bitwise & &

C_ERR_LS_DOWN_LAM_ADJ_CBK_NOT)= 1

LV_ERR_LS_DOWN_LAM_AD_ACT_LOCK[0] = (ERR_LS_DOWN[0] bitwise & &

C_ERR_LS_DOWN_LAM_AD_ACT_CBK)=1 OR

(ERR_LS_DOWN[1] bitwise & &

C_ERR_LS_DOWN_LAM_AD_ACT_CBK_NOT)=1

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LV_ERR_LS_DOWN_LAM_AD_ACT_LOCK[1] = (ERR_LS_DOWN[1] bitwise & &

C_ERR_LS_DOWN_LAM_AD_ACT_CBK)= 1 OR

(ERR_LS_DOWN[0] bitwise & &

C_ERR_LS_DOWN_LAM_AD_ACT_CBK_NOT)=1

LV_ERR_LS_DOWN_FSD_LOCK[0] = (ERR_LS_DOWN[0] bitwise & &

C_ERR_LS_DOWN_FSD_CBK) = 1 OR

(ERR_LS_DOWN[1] bitwise & &

C_ERR_LS_DOWN_FSD_CBK_NOT)= 1
LV_ERR_LS_DOWN_FSD_LOCK[1] = (ERR_LS_DOWN[1] bitwise & &

C_ERR_LS_DOWN_FSD_CBK) = 1 OR

(ERR_LS_DOWN[0] bitwise & &

C_ERR_LS_DOWN_FSD_CBK_NOT) = 1

LV_ERR_IV_LOCK[0] = (BIT [0] of STATE_ERR_IV OR
BIT [2] of STATE_ERR_IV OR

BIT [4] of STATE_ERR_IV)

LV_ERR_IV_LOCK[1] = (BIT [1] of STATE_ERR_IV OR
BIT [3] of STATE_ERR_IV OR

BIT [5] of STATE_ERR_IV)

LV_ERR_MIS_FIRE_LOCK[0] = (LV_ERR_MIS_MPL OR

LV_ERR_MIS[0] OR

LV_ERR_MIS[2] OR

LV_ERR_MIS[4])

LV_ERR_MIS_FIRE_LOCK[1] = (LV_ERR_MIS_MPL OR

LV_ERR_MIS[1] OR

LV_ERR_MIS[3] OR

LV_ERR_MIS[5])

LV_ERR_IGC_LOCK[0] = (LV_ERR_IGC_SCG[0] OR

LV_ERR_IGC_SCG[2] OR

LV_ERR_IGC_SCG[4] OR

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LV_ERR_IGC_SCP[0] OR

LV_ERR_IGC_SCP[2] OR

LV_ERR_IGC_SCP[4])

LV_ERR_IGC_LOCK[1] = (LV_ERR_IGC_SCG[1] OR

LV_ERR_IGC_SCG[3] OR

LV_ERR_IGC_SCG[5] OR

LV_ERR_IGC_SCP[1] OR

LV_ERR_IGC_SCP[3] OR

LV_ERR_IGC_SCP[5])

Calculation of bit mask for error selection for each function
The bit pattern for ERR_INH_xxx is as described below

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Bit Pattern for ERR_INH_xxx	
Bit 0 of ERR_INH_xxx	TPS_LOCK
Bit 1 of ERR_INH_xxx	IVVT_LOCK
Bit 2 of ERR_INH_xxx	CPS_LOCK
Bit 3 of ERR_INH_xxx	LS_UP_LOCK
Bit 4 of ERR_INH_xxx	LS_DOWN_LOCK
Bit 5 of ERR_INH_xxx	IV_LOCK
Bit 6 of ERR_INH_xxx	MIS_FIRE_LOCK
Bit 7 of ERR_INH_xxx	CAM_LOCK
Bit 8 of ERR_INH_xxx	CRK_LOCK
Bit 9 of ERR_INH_xxx	TCO_LOCK
Bit 10 of ERR_INH_xxx	AMP_LOCK
Bit 11 of ERR_INH_xxx	FUEL_LOCK (FUP, VCV)
Bit 12 of ERR_INH_xxx	MAF_LOCK
Bit 13 of ERR_INH_xxx	MAP LOCK
Bit 14 of ERR_INH_xxx	IGC LOCK
Bit 15 of ERR_INH_xxx	PLAUS LOCK

1.3.2.1 Temporary vector representing bit pattern for **Fuel system diagnosis ERR_INH_FSD[NC_CBK_EX_NR]**

Bit 0 of ERR_INH_FSD[0] = LV_ERR_TPS_LOCK[0]
Bit 0 of ERR_INH_FSD[1] = LV_ERR_TPS_LOCK[1]
Bit 1 of ERR_INH_FSD[0] = LV_ERR_IVVT_LOCK[0]
Bit 1 of ERR_INH_FSD[1] = LV_ERR_IVVT_LOCK[1]
Bit 2 of ERR_INH_FSD[0] = LV_ERR_CPS_LOCK[0]
Bit 2 of ERR_INH_FSD[1] = LV_ERR_CPS_LOCK[1]
Bit 3 of ERR_INH_FSD[0] = LV_ERR_LS_UP_FSD_LOCK[0]
Bit 3 of ERR_INH_FSD[1] = LV_ERR_LS_UP_FSD_LOCK[1]
Bit 4 of ERR_INH_FSD[0] = LV_ERR_LS_DOWN_FSD_LOCK[0]
Bit 4 of ERR_INH_FSD[1] = LV_ERR_LS_DOWN_FSD_LOCK[1]
Bit 5 of ERR_INH_FSD[0] = 0(IV LOCK)
Bit 5 of ERR_INH_FSD[1] = 0(IV LOCK)
Bit 6 of ERR_INH_FSD[0] = LV_ERR_MIS_FIRE_LOCK[0]
Bit 6 of ERR_INH_FSD[1] = LV_ERR_MIS_FIRE_LOCK[1]
Bit 7 of ERR_INH_FSD[0] = LV_ERR_CAM_LOCK[0]
Bit 7 of ERR_INH_FSD[1] = LV_ERR_CAM_LOCK[1]
Bit 8 of ERR_INH_FSD[0] = 0 (CRK LOCK)
Bit 8 of ERR_INH_FSD[1] = 0 (CRK LOCK)
Bit 9 of ERR_INH_FSD[0] = LV_ERR_TCO_LOCK[0]
Bit 9 of ERR_INH_FSD[1] = LV_ERR_TCO_LOCK[1]
Bit 10 of ERR_INH_FSD[0] = LV_ERR_AMP_LOCK[0]
Bit 10 of ERR_INH_FSD[1] = LV_ERR_AMP_LOCK[1]

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Bit 11 of ERR_INH_FSD[0] = LV_ERR_FUP_LOCK[0]
Bit 11 of ERR_INH_FSD[1] = LV_ERR_FUP_LOCK[1]
Bit 12 of ERR_INH_FSD[0] = LV_ERR_MAF_LOCK[0]
Bit 12 of ERR_INH_FSD[1] = LV_ERR_MAF_LOCK[1]
Bit 13 of ERR_INH_FSD[0] = LV_ERR_MAP_LOCK[0]
Bit 13 of ERR_INH_FSD[1] = LV_ERR_MAP_LOCK[1]
Bit 14 of ERR_INH_FSD[0] = 0 (IGC_LOCK)
Bit 14 of ERR_INH_FSD[1] = 0 (IGC_LOCK)
Bit 15 of ERR_INH_FSD[0] = LV_ERR_PLAUS_LOCK[0]
Bit 15 of ERR_INH_FSD[1] = LV_ERR_PLAUS_LOCK[1]

//remark: Bits other than 0,1,2,3,4,6,7,9,10,11,12,13 and 15 are always 0

1.3.2.2 Temporary vector representing bit pattern for **closed loop lambda sensor ERR_INH_LSCL[NC_CBK_EX_NR]**

Bit 0 of ERR_INH_LSCL[0] = 0(TPS LOCK)
Bit 0 of ERR_INH_LSCL[1] = 0(TPS LOCK)
Bit 1 of ERR_INH_LSCL[0] = 0(IVVT LOCK)
Bit 1 of ERR_INH_LSCL[1] = 0(IVVT LOCK)
Bit 2 of ERR_INH_LSCL[0] = 0(CPS LOCK)
Bit 2 of ERR_INH_LSCL[1] = 0(CPS LOCK)
Bit 3 of ERR_INH_LSCL[0] = LV_ERR_LS_UP_LSCL_LOCK[0]
Bit 3 of ERR_INH_LSCL[1] = LV_ERR_LS_UP_LSCL_LOCK[1]
Bit 4 of ERR_INH_LSCL[0] = LV_ERR_LS_DOWN_LSCL_LOCK[0]
Bit 4 of ERR_INH_LSCL[1] = LV_ERR_LS_DOWN_LSCL_LOCK[1]
Bit 5 of ERR_INH_LSCL[0] = LV_ERR_IV_LOCK[0]
Bit 5 of ERR_INH_LSCL[1] = LV_ERR_IV_LOCK[1]
Bit 6 of ERR_INH_LSCL[0] = LV_ERR_MIS_FIRE_LOCK_LSCL[0]
Bit 6 of ERR_INH_LSCL[1] = LV_ERR_MIS_FIRE_LOCK_LSCL[1]
Bit 7 of ERR_INH_LSCL[0] = 0(CAM LOCK)
Bit 7 of ERR_INH_LSCL[1] = 0(CAM LOCK)
Bit 8 of ERR_INH_LSCL[0] = 0(CRK LOCK)
Bit 8 of ERR_INH_LSCL[1] = 0(CRK LOCK)
Bit 9 of ERR_INH_LSCL[0] = 0(TCO LOCK)
Bit 9 of ERR_INH_LSCL[1] = 0(TCO LOCK)
Bit 10 of ERR_INH_LSCL[0] = 0(AMP LOCK)
Bit 10 of ERR_INH_LSCL[1] = 0(AMP LOCK)
Bit 11 of ERR_INH_LSCL[0] = 0(FUP LOCK)
Bit 11 of ERR_INH_LSCL[1] = 0(FUP LOCK)
Bit 12 of ERR_INH_LSCL[0] = 0(MAF LOCK)
Bit 12 of ERR_INH_LSCL[1] = 0(MAF LOCK)
Bit 13 of ERR_INH_LSCL[0] = 0(MAP LOCK)
Bit 13 of ERR_INH_LSCL[1] = 0(MAP LOCK)
Bit 14 of ERR_INH_LSCL[0] = LV_ERR_IGC_LOCK[0]
Bit 14 of ERR_INH_LSCL[1] = LV_ERR_IGC_LOCK[1]
Bit 15 of ERR_INH_LSCL[0] = 0(PLAUS LOCK)
Bit 15 of ERR_INH_LSCL[1] = 0(PLAUS LOCK)

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//remark: Bits other than 3,4 5 6 & 14 are always 0

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1.3.2.3 Temporary vector representing bit pattern for **down stream fuel trim ERR_INH_LAM_ADJ[NC_CBK_EX_NR]**

Bit 0 of ERR_INH_LAM_ADJ[0] = LV_ERR_TPS_LOCK[0]
Bit 0 of ERR_INH_LAM_ADJ[1] = LV_ERR_TPS_LOCK[1]
Bit 1 of ERR_INH_LAM_ADJ[0] = LV_ERR_IVVT_LOCK[0]
Bit 1 of ERR_INH_LAM_ADJ[1] = LV_ERR_IVVT_LOCK[1]
Bit 2 of ERR_INH_LAM_ADJ[0] = 0(CPS LOCK)
Bit 2 of ERR_INH_LAM_ADJ[1] = 0(CPS LOCK)
Bit 3 of ERR_INH_LAM_ADJ[0] = LV_ERR_LS_UP_LAM_ADJ_LOCK[0]
Bit 3 of ERR_INH_LAM_ADJ[1] = LV_ERR_LS_UP_LAM_ADJ_LOCK[1]
Bit 4 of ERR_INH_LAM_ADJ[0] = LV_ERR_LS_DOWN_LAM_ADJ_LOCK[0]
Bit 4 of ERR_INH_LAM_ADJ[1] = LV_ERR_LS_DOWN_LAM_ADJ_LOCK[1]
Bit 5 of ERR_INH_LAM_ADJ[0] = 0(IV LOCK)
Bit 5 of ERR_INH_LAM_ADJ[1] = 0(IV LOCK)
Bit 6 of ERR_INH_LAM_ADJ[0] = 0(MIS_FIRE LOCK)
Bit 6 of ERR_INH_LAM_ADJ[1] = 0(MIS_FIRE LOCK)
Bit 7 of ERR_INH_LAM_ADJ[0] = LV_ERR_CAM_LOCK[0]
Bit 7 of ERR_INH_LAM_ADJ[1] = LV_ERR_CAM_LOCK[1]
Bit 8 of ERR_INH_LAM_ADJ[0] = LV_ERR_CRK_LOCK[0]
Bit 8 of ERR_INH_LAM_ADJ[1] = LV_ERR_CRK_LOCK[1]
Bit 9 of ERR_INH_LAM_ADJ[0] = 0(TCO LOCK)
Bit 9 of ERR_INH_LAM_ADJ[1] = 0(TCO LOCK)
Bit 10 of ERR_INH_LAM_ADJ[0] = 0(AMP LOCK)
Bit 10 of ERR_INH_LAM_ADJ[1] = 0(AMP LOCK)
Bit 11 of ERR_INH_LAM_ADJ[0] = 0(FUP LOCK)
Bit 11 of ERR_INH_LAM_ADJ[1] = 0(FUP LOCK)
Bit 12 of ERR_INH_LAM_ADJ[0] = 0(MAF LOCK)
Bit 12 of ERR_INH_LAM_ADJ[1] = 0(MAF LOCK)
Bit 13 of ERR_INH_LAM_ADJ[0] = 0(MAP LOCK)
Bit 13 of ERR_INH_LAM_ADJ[1] = 0(MAP LOCK)
Bit 14 of ERR_INH_LAM_ADJ[0] = 0(IGC LOCK)
Bit 14 of ERR_INH_LAM_ADJ[1] = 0(IGC LOCK)
Bit 15 of ERR_INH_LAM_ADJ[0] = 0(PLAUS LOCK)
Bit 15 of ERR_INH_LAM_ADJ[1] = 0(PLAUS LOCK)

//remark: Bits other than 0,1,3,4,7 & 8 are always 0

1.3.2.4 Temporary vector representing bit pattern for **Lambda adaptation ERR_INH_LAM_AD_ACT[NC_CBK_EX_NR]**

Bit 0 of ERR_INH_LAM_AD_ACT[0] = LV_ERR_TPS_LOCK[0]
Bit 0 of ERR_INH_LAM_AD_ACT[1] = LV_ERR_TPS_LOCK[1]
Bit 1 of ERR_INH_LAM_AD_ACT[0] = LV_ERR_IVVT_LOCK[0]
Bit 1 of ERR_INH_LAM_AD_ACT[1] = LV_ERR_IVVT_LOCK[1]
Bit 2 of ERR_INH_LAM_AD_ACT[0] = LV_ERR_CPS_LOCK[0]
Bit 2 of ERR_INH_LAM_AD_ACT[1] = LV_ERR_CPS_LOCK[1]
Bit 3 of ERR_INH_LAM_AD_ACT[0] = LV_ERR_LS_UP_LAM_AD_ACT_LOCK[0]

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Bit 3 of ERR_INH_LAM_AD_ACT[1] = LV_ERR_LS_UP_LAM_AD_ACT_LOCK[1]
Bit 4 of ERR_INH_LAM_AD_ACT[0] = LV_ERR_LS_DOWN_LAM_AD_ACT_LOCK[0]
Bit 4 of ERR_INH_LAM_AD_ACT[1] = LV_ERR_LS_DOWN_LAM_AD_ACT_LOCK[1]
Bit 5 of ERR_INH_LAM_AD_ACT[0] = 0(IV LOCK)
Bit 5 of ERR_INH_LAM_AD_ACT[1] = 0(IV LOCK)
Bit 6 of ERR_INH_LAM_AD_ACT[0] = LV_ERR_MIS_FIRE_LOCK[0]
Bit 6 of ERR_INH_LAM_AD_ACT[1] = LV_ERR_MIS_FIRE_LOCK[1]
Bit 7 of ERR_INH_LAM_AD_ACT[0] = LV_ERR_CAM_LOCK[0]
Bit 7 of ERR_INH_LAM_AD_ACT[1] = LV_ERR_CAM_LOCK[1]
Bit 8 of ERR_INH_LAM_AD_ACT[0] = 0(CRK LOCK)
Bit 8 of ERR_INH_LAM_AD_ACT[1] = 0(CRK LOCK)
Bit 9 of ERR_INH_LAM_AD_ACT[0] = LV_ERR_TCO_LOCK[0]
Bit 9 of ERR_INH_LAM_AD_ACT[1] = LV_ERR_TCO_LOCK[1]
Bit 10 of ERR_INH_LAM_AD_ACT[0] = LV_ERR_AMP_LOCK[0]
Bit 10 of ERR_INH_LAM_AD_ACT[1] = LV_ERR_AMP_LOCK[1]
Bit 11 of ERR_INH_LAM_AD_ACT[0] = LV_ERR_FUP_LOCK[0]
Bit 11 of ERR_INH_LAM_AD_ACT[1] = LV_ERR_FUP_LOCK[1]
Bit 12 of ERR_INH_LAM_AD_ACT[0] = LV_ERR_MAF_LOCK[0]
Bit 12 of ERR_INH_LAM_AD_ACT[1] = LV_ERR_MAF_LOCK[1]
Bit 13 of ERR_INH_LAM_AD_ACT[0] = LV_ERR_MAP_LOCK[0]
Bit 13 of ERR_INH_LAM_AD_ACT[1] = LV_ERR_MAP_LOCK[1]
Bit 14 of ERR_INH_LAM_AD_ACT[0] = 0 (IGC_LOCK)
Bit 14 of ERR_INH_LAM_AD_ACT[1] = 0 (IGC_LOCK)
Bit 15 of ERR_INH_LAM_AD_ACT[0] = LV_ERR_PLAUS_LOCK[0]
Bit 15 of ERR_INH_LAM_AD_ACT[1] = LV_ERR_PLAUS_LOCK[1]

//remark: Bits other than 0,1,2,3,4,6,7,9,10,11,12,13 and 15 are always 0

3.17.4 Update according to SAE paper

Application conditions

Initialisation: `LV_IGK 0 -> 1:  all variables set to zero`

Recurrence : `20ms`

Activation: `always`

Formula section:

FOR i=1 to NC_CBK_EX_NR
{
if STATE_LS_SAE[i] = not(CL)
then FAC_LAM_LIM_SAE[i] = 0%
else
FAC_LAM_LIM_SAE[i] = FAC_LAM_LIM[i] %limited closed-loop controller correction
w/o
end
precontrol-path correction

FAC_LAM_AD_SAE[i] = OBD_LAM_AD[i]

if (LV_LAM_ADJ_P_ACT[i] or LV_LAM_ADJ_I_ACT[i] or LV_LAM_ADJ_D_ACT[i])

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```
then    LAMB_DELTA_LAM_ADJ_SAE[i] = LAMB_DELTA_LAM_ADJ [i]
else
            LAMB_DELTA_LAM_ADJ_SAE[i] = 0%
end
LAMB_DELTA_AD_LAM_ADJ_SAE[i] = LAMB_DELTA_AD_LAM_ADJ[i]
    %fuel system in open-loop means trim-control or lambda control in open loop
        %if lambda control is open-loop, trim control is deactivated automatically

} NEXT i
```

LAMB_SP_SAE = LAMB_SP_FIL_HOM[1] %incl. forced lambda stimulation and trim control intervention

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3.18 AGGR adaptation: EGTR

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAT_DIAG_MOD_6 [NC_CBK_EX_NR]	O/V/S	0... 7FH	0... 1.98437	0.015625	-
Cat. Diag. value for OBD Scantool Mod 6 output					
CAT_MAX_DIAG_MOD_6 [NC_CBK_EX_NR]	O/V/S	0... 7FH	0... 1.98437	0.015625	-
Actually threshold for Scantool Mod 6 Output					
DELTA_LAMB_SP_O2L_MDL [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61e-6	-
lambda set point shift of catalyst O2 loading condition function					
LV_LAM_ADJ_RNG_VLD_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating Trim Ctr P-Share is inside a calibrateable window					
LV_NT_REQ_RGN	O/V	0... 1H	0 ...1	1	-
Logical value for regeneration phase request					

Input data:

EFF_CAT_DIAG_OBD [NC_CBK_EX_NR] {p. 5515}	EFF_CAT_MAX_DIAG_ OBD [NC_CBK_EX_NR] {p. 5515}	LAMB_DELTA_P_LAM_ ADJ [NC_CBK_EX_NR] {p. 2589}	LV_RGN_NT_REQ {p. 2983}
NC_CBK_EX_NR {p. 1829}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_DELTA_P_LAM_ADJ_MAX	-	F800... 800H	-0.125 ...0.125	61e-6	-
max. P share threshold of trim controller for catalyst diagnosis activation					

3.18.1 Outputs for supplier aggregates, supplier internally

FUNCTION DESCRIPTION:

Adaptation to aggregate environment.

Application conditions

Initialisation: 0

Recurrence : same recurrence as corresponding input data

Activation: *every engine operating state*

Formula section:

LV_NT_REQ_RGN = LV_RGN_NT_REQ
CAT_DIAG_MOD_6[i] = EFF_CAT_DIAG_OBD[i]
CAT_MAX_DIAG_MOD_6[i] = EFF_CAT_MAX_DIAG_OBD[i]

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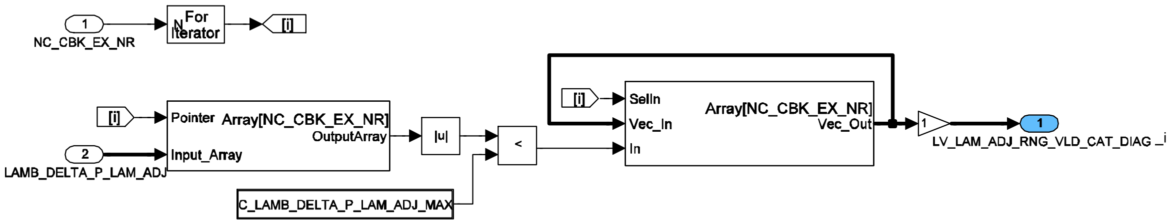

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3.19 AGGR adaptation: EXTD

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TEG_DYN_STOP	O/V/S	0... 7FF0H	0... 2047	0.0625	°C
Modelled exhaust gas temperature at last engine stop					

Input data:

TEG_DYN {p. 8236}			

FUNCTION DESCRIPTION:

Application conditions

Initialisation: at Engine run to Engine stop (ERU_to_ES)
TEG_DYN_STOP = TEG_DYN

Recurrence: –

Activation: –

Deactivation: –

Formula section:

-

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3.20 AGGR adaptation: EXTC

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_CH_MOD_IVVT	O/V	0... FFH	0... 255	1	-
Bit-coded mask, containing combustion-mode-request for catalyst heating and the desulfation strategy; 2. Prio					
STATE_CH_MOD_IVVT_REQ	O/V	0... FFH	0... 255	1	-
Bit-coded mask, containing combustion-mode-request for catalyst heating and the desulfation strategy; 1. Prio					

Input data:

LV_SO2P_REQ {p. 3129}	STATE_CH {p. 1777}	STATE_CH_MOD_REQ {p. 1796}	STATE_OPM_IVVT_CH {p. 3601}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_STATE_CH_MOD_IVVT	V	0... FFH	0... 255	1	-
LDPM_STATE_CH_MOD_REQ	5	0... 4H	0 ...4	1	-
LDPM_STATE_OPM_IVVT_CH	3	0... 2H	0 ...2	1	-
Matrix of Bit-mask for 2.Prio-Request					
ID_STATE_CH_MOD_IVVT_SO2P	V	0... FFH	0... 255	1	-
LDPM_STATE_CH_MOD_REQ	5	0... 4H	0 ...4	1	-
LDPM_STATE_OPM_IVVT_CH	3	0... 2H	0 ...2	1	-
Matrix of Bit-mask in case of desulfation for 2.Prio-Request					
ID_STATE_CH_MOD_REQ_IVVT	V	0... FFH	0... 255	1	-
LDPM_STATE_CH_MOD_REQ	5	0... 4H	0 ...4	1	-
LDPM_STATE_OPM_IVVT_CH	3	0... 2H	0 ...2	1	-
Matrix of Bit-mask for 1.Prio-Request					
ID_STATE_CH_MOD_REQ_IVVT_SO2P	V	0... FFH	0... 255	1	-
LDPM_STATE_CH_MOD_REQ	5	0... 4H	0 ...4	1	-
LDPM_STATE_OPM_IVVT_CH	3	0... 2H	0 ...2	1	-
Matrix of Bit-mask in case of desulfation for 1.Prio-Request					

General information

Adaptation to BMW environment.

Application conditions:

Initialisation: `0 at reset except`

Activation: `every engine state`

Deactivation: `–`

Recurrence: `10 ms`

Function description:

Formula section:

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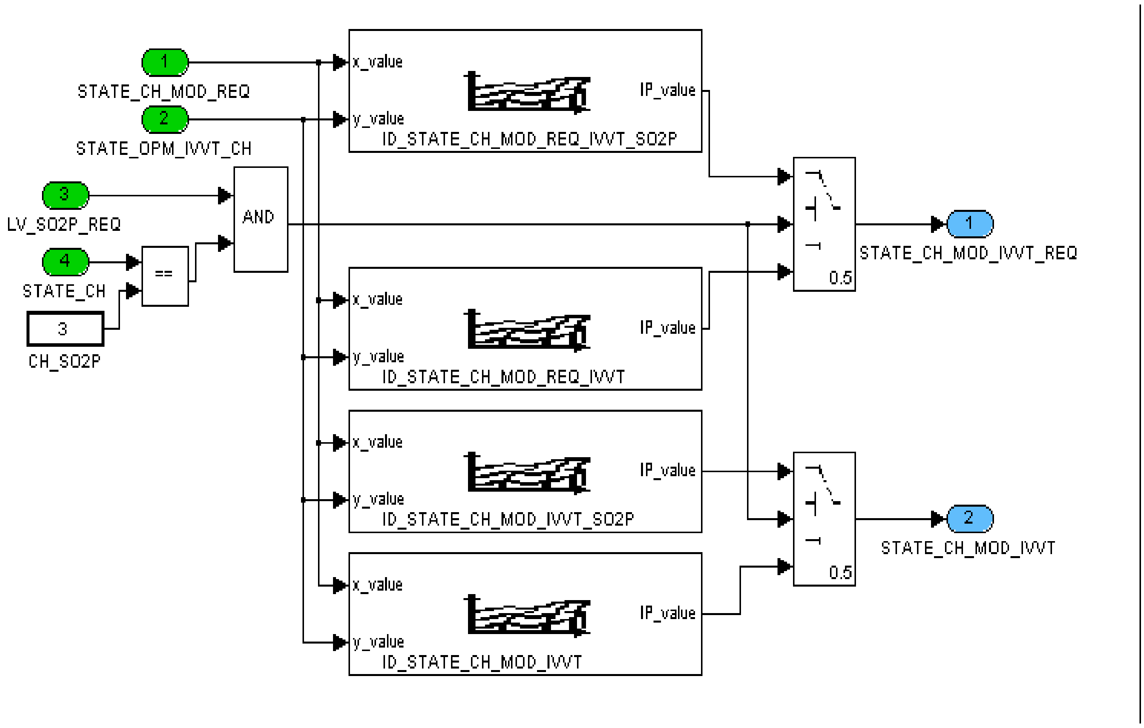

Figure 3.20.1:

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3.21 AGGR adaptation: ENSD

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_CAM_CUS	O/V	0... 1H	0 ...1	1	-
Customer specific CAM error					
LV_T_SEG_5_TOOTH_ACT	-	0... 1H	0 ...1	1	-
Flag: acquisition of partial segment times active					
LV_T_SEG_5_TOOTH_VLD	O/V	0... 1H	0 ...1	1	-
Flag: acquisition of partial segment times valid					
N_TOOTH_CUS	O/V	0... 1FE0H	0... 8160	1	rpm
fast engine speed generated especially for engine start (independently of C_N_FAST_SWI)					

Input data:

C_N_TOOTH_END {p. 1526}	LV_ERR_CAM_TOT {p. 4455}	LV_RUN_ENG {p. 1505}	N_32 {p. 1525}
NC_NR_TOOTH {p. 854}	T_TOOTH {p. 853}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_32_MAX_SEG_5_TOOTH	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for acquisition of partial segment time over 5 teet					

Import actions:

ACTION_INFR_DisableT5T ()
ACTION_INFR_EnableT5T ()
ACTION_INFR_GetT5TDiag (**OUT**<diag>)

3.21.1 Outputs for supplier functions

3.21.1.1 Generation of N_TOOTH

FUNCTION DESCRIPTION:

Description:

As there is a strong request for a fast engine speed especially for engine start, and ENSD solely has the possibility to generate one out of four (N_FAST can either be similar to N_TOOTH or three differently calculated N_FASTs - see engine position and speed calculation), N_TOOTH has to be calculated additionally in this module.

Application conditions

Initialisation: *N_TOOTH_CUS = 0*

Recurrence: *10ms*

Activation: LV_RUN_ENG = 1 **and**

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N_32 C_N_TOOTH_END

Deactivation: LV_RUN_ENG = 0 **or**
N_32 > C_N_TOOTH_END

Formula section:

N_TOOTH_CUS (phys) = 60 /(NC_NR_TOOTH * T_TOOTH)

3.21.1.2 Generation of LV_ERR_CAM_CUS

Description:

LV_ERR_CAM_CUS is for customer specific adaptations on the ENSD interface LV_ERR_CAM_TOT.

Application conditions

Initialisation: *LV_ERR_CAM_CUS = 0 at reset, LV_IGK 0->1 and clearance of failurememory*

Recurrence: *every Camshaft signal edge (just after calculation of all CAM diagnosis)*

Activation: *every engine operating state*

Formula section:

LV_ERR_CAM_CUS = LV_ERR_CAM_TOT

3.21.2 Segment time acquisition for partial segments

FUNCTION DESCRIPTION:

General information:

The function shall measure the period for segments of 5 teeth, and output the result as an array of 24 values for the whole engine cycle.

Acquisition shall start at regular segment event for cylinder 0 (SEG_NR = 0). Every 5 teeth a time stamp shall be sampled, the period calculated as the difference of the actual and the last time stamp, and written to the array of temporary values at the appropriate location (e.g., the first partial segment time measured after start of regular segment 0 is written to the first location of the array).

Application conditions

Activation: at ENG_STOP to SYN_ENG_IGK_ON
or RUN_ENG to SYN_ENG_IGK_ON

Deactivation : at SYN_ENG_IGK_ON to RUN_ENG (if supported by ECOP)
or SYN_ENG_IGK_ON to ENG_STOP
or SYN_ENG_IGK_OFF to PWL :
ACTION_INFR_DisableT5T()
LV_T_SEG_5_TOOTH_VLD = 0
LV_T_SEG_5_TOOTH_ACT = 0

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Initialization : at reset :

LV_T_SEG_5_TOOTH_VLD = 0
LV_T_SEG_5_TOOTH_ACT = 0

Recurrence: segment

Formula section:

If(1) N_32 <= C_N_32_MAX_SEG_5_TOOTH
Then(1)
If(2) (LV_T_SEG_5_TOOTH_ACT = 0)
Then(2) ACTION_INFR_EnableT5T()
LV_T_SEG_5_TOOTH_ACT = 1
Endif(2)
get diagnostic information from infrastructure
ACTION_INFR_GetT5TDiag(
OUT LV_T_SEG_5_TOOTH_VLD)
Else (1)
If(3) (LV_T_SEG_5_TOOTH_ACT = 1)
Then(3) ACTION_INFR_DisableT5T()
LV_T_SEG_5_TOOTH_ACT = 0
LV_T_SEG_5_TOOTH_VLD = 0
Endif(3)
Endif(1)

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3.22 AGGR adaptation: ENTE

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ECFPWM_ECF	O/V	0... FFH	0... 99.60937	0.390625	%
Electric fan control pulse width modulation					
LV_ERR_ECT_MEC	O/V	0... 1H	0 ...1	1	-
Boolean for electronic controlled thermostat mechanical error					
LV_ERR_TCO_EX	O/V	0... 1H	0 ...1	1	-
Adaptation of TCO_2 diagnosis to ERRM					
TCO_EX	O/V	0... FEH	-48... 142.5	0.75	°C
TCO_2 adaptation					
TCO_EX_MES	O/V	0... FEH	-48... 142.5	0.75	°C
TCO_2_MES adaptation					

Input data:

ECFPWM [NC_ECF_NR] {p. 3596}	LV_ERR_TCO_2 {p. 4572}	LV_ERR_TH {p. 5652}	LV_ES {p. 1720}
TCO_2 {p. 1218}	TCO_2_MES {p. 1218}		

FUNCTION DESCRIPTION:

Adaptation of ENTE variables to MSD70 environment.

General information:

At the MSD70 platform only one electronic controlled cooling fan is available. The number of cooling fans is configured with “1” therefore. In this case the following condition is permitted:

ECFPWM[NC_ECF_NR] = ECFPWM[1]

Application conditions

Initialisation: `all 0 at reset`
`except:`
`LV_ERR_ECT_MEC = LV_ERR_TH`

Recurrence: `1000 ms`

Activation: `every engine state`

Formula section:

TCO_EX = TCO_2
TCO_EX_MES = TCO_2_MES
LV_ERR_TCO_EX = LV_ERR_TCO_2
ECFPWM_ECF = ECFPWM[1]
LV_ERR_ECT_MEC = LV_ERR_TH

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3.23 AGGR adaptation: PWSL

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VB_CDN_OBD_1	O/V	0... 1H	0 ...1	1	-
Boolean for battery voltage condition fulfilled for OBD-I diagnosis					
LV_VB_CDN_OBD_2	O/V	0... 1H	0 ...1	1	-
Boolean for battery voltage condition fulfilled for OBD-II diagnosis					

Input data:

LV_CDN_VB_OBD1 {p. 1185}	LV_CDN_VB_OBD2 {p. 1185}		

3.23.1 Outputs for supplier aggregates, supplier internally

FUNCTION DESCRIPTION:

Adaptation to aggregate environment.

Application conditions

Initialisation: 0

Recurrence : same recurrence as corresponding input data

Activation: *every engine operating state*

Formula section:

LV_VB_CDN_OBD_1 = LV_CDN_VB_OBD1
LV_VB_CDN_OBD_2 = LV_CDN_VB_OBD2

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3.24 AGGR adaptation: STSY

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Md_na_sl	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Torque losses for power steering					
Mdi_res_afs	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Engine torque reserve active front steering					
Mdi_res_sl	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Engine torque reserve for power steering					

Input data:

TQ_ADD_PSTE {p. 6621}	TQ_ADD_PSTE_2 {p. 6621}	TQ_LOSS_PSTE {p. 6622}	

3.24.1 Outputs for BMW functions which are not defined as STSY exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions

Initialisation: 0 Nm

Recurrence : 10 ms

Activation: *every engine state*

Formula section:

Remark: all formulas are valid in a **physical** meaning

Md_na_sl = TQ_LOSS_PSTE

Mdi_res_afs = TQ_ADD_PSTE_2

Mdi_res_sl = TQ_ADD_PSTE

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3.25 AGGR adaptation: HVAC

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_korel	O/V	0... 1H	0 ...1	1	-
condition air compressor					
Md_na_ac	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
torque losses air conditioning compressor					
Mdi_res_ac	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
torque reserve for switching on air conditioning compressor					
Mdi_res_heiz	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Torque reserve for switching on additional heating by ACC					

Input data:

ECU_STATE {p. 1091}	LV_ACCIN {p. 1564}	TQ_ADD_ACC {p. 6602}	TQ_ADD_HEAT_ACC {p. 6602}
TQ_LOSS_ACC {p. 6602}			

3.25.1 Outputs for BMW functions which are defined as HVAC exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation: *0 at reset*

Recurrence : 10 ms

Activation: *every engine state*

Formula section:

Remark: all formulas are valid in a **physical** meaning
Mdi_res_ac = TQ_ADD_ACC
Mdi_res_heiz = TQ_ADD_HEAT_ACC

if ECU_STATE = 4Hex "power latch"
then B_korel = 0
Md_na_ac = 0
else B_korel = LV_ACCIN
Md_na_ac = TQ_LOSS_ACC
endif

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3.26 AGGR adaptation: ERRM

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_ALTER_BN	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error PM board network diagnosis					
ERR_SYM_ALTER_BN_BAT	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error PM battery diagnosis					
ERR_SYM_ALTER_BN_RGN	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected ALTER_BN_RGN error symptom					
ERR_SYM_AMP_PLAUS_CUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error AMP plausibility diagnosis					
ERR_SYM_BAT_SENS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BAT_SENS (component) communication					
ERR_SYM_BAT_SENS_IT	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BAT_SENS component					
ERR_SYM_BAT_SENS_IT_EL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BAT_SENS electrical					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
For each symptom : status of failure (set to 1 when failure symptom detected); exhaust during catalyst heating					
ERR_SYM_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
For each symptom : status of failure (set to 1 when failure symptom detected); inlet during catalyst heating					
ERR_SYM_EGRV_PSN_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error sympthom for exhaust gas recirculation valve position plausibility					
ERR_SYM_ER_STRAT	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error sympthom for engine roughness improvement at stratified mode					
ERR_SYM_ER_STRAT_WUP	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error sympthom for engine roughness improvement at stratified mode at warmup					
ERR_SYM_GEN	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error generator diagnosis					
ERR_SYM_GEN_CLC_V_NOT_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom CLC_V_NOT_PLAUS					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_GEN_CTL_NOT_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom in generator controller plausibility diagnosis					
ERR_SYM_GEN_EL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom in electrical generator diagnosis					
ERR_SYM_GEN_H_TEMP	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom in generator high temperature diagnosis					
ERR_SYM_GEN_H_TEMP_CLC	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom in calculated generator high temperature diagnosis					
ERR_SYM_GEN_MEC	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom in mechanical generator diagnosis					
ERR_SYM_GEN_MSG_LOST	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom GEN_MSG_LOST					
ERR_SYM_GEN_TYP_NOT_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom in generator type plausibility diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_LOAD_TPS_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom load/TPS plausibility check					
ERR_SYM_MAF_LAMB_MAX	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error sympthom for maximum mass air flow calculated from lambda					
ERR_SYM_MAP_DIP_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected MAP_DIP_PLAUS error symptom					
ERR_SYM_MAP_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom Manifold pressure plausibility diagnosis					
ERR_SYM_MAP_TPS_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error MAP ratio plausibility diagnosis					
ERR_SYM_MEC_IVVT_EX	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom on the exhaust CAM adjustment					
ERR_SYM_MEC_IVVT_IN	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom on the inlet CAM adjustment					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_N_MAX_DRIV_REQ	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error sympthom for too high engine rotation speed at vehicle stop					
ERR_SYM_N_MAX_HOMS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error engine overspeed for changing the combustion mode diagnosis					
ERR_SYM_NEUT_PSN_GB_LRN	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error Neutral gear learning diagnosis					
ERR_SYM_POIL_CTL_DYN	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error oil pressure contoller (static)					
ERR_SYM_POIL_CTL_MEC	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error Oilpressure valve diagnosis					
ERR_SYM_POIL_CTL_STAT	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error oil pressure contoller (static)					
ERR_SYM_POIL_PUMP	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error Oilpump diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_POIL_SENS_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error Oilpressure sensor diagnosis					
ERR_SYM_POIL_SYS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error Oilsystem diagnosis					
ERR_SYM_PUT_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error PUT plausibility diagnosis					
ERR_SYM_QOIL_SENS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected quality Oil Sensor Symptom					
ERR_SYM_TCHA_LEAK	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error charger leakage diagnosis					
ERR_SYM_TCHA_PRS_CTL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error charger pressure controller diagnosis					
ERR_SYM_TCHA_PRS_DIF	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error charger pressure difference diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TCHA_PRS_HIGH	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error charger pressure to high diagnosis					
ERR_SYM_TCHA_PRS_LOW	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error charger pressure to low diagnosis					
ERR_SYM_TCHA_SYS_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error charger system diagnosis 1					
ERR_SYM_TOIL_LEVEL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error TOENS sensor					
ERR_SYM_TQ_CST	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected TQ_CST error symptom					
ERR_SYM_VIM_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected VIM_PLAUS error symptom					
LV_CDN_DIAG_ALTER_BN	V	0... 1H	0 ...1	1	-
condition PM board network diagnosis					
LV_CDN_DIAG_ALTER_BN_BAT	V	0... 1H	0 ...1	1	-
condition PM battery diagnosis					
LV_CDN_DIAG_ALTER_BN_RGN	V	0... 1H	0 ...1	1	-
Diagnosis Condition ALTER_BN_RGN error					
LV_CDN_DIAG_AMP_PLAUS_CUS	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on AMP plausibility diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_BAT_SENS	V	0... 1H	0 ...1	1	-
condition for BAT_SENS-diagnosis fulfilled					
LV_CDN_DIAG_BAT_SENS_IT	V	0... 1H	0 ...1	1	-
condition for BAT_SENS-diagnosis (electrical) fulfilled					
LV_CDN_DIAG_BAT_SENS_IT_EL	V	0... 1H	0 ...1	1	-
condition for BAT_SENS-diagnosis (communication) fulfilled					
LV_CDN_DIAG_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled); exhaust during catalyst heating					
LV_CDN_DIAG_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled); inlet during catalyst heating					
LV_CDN_DIAG_EGRV_PSN_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis condtion for diagnosis instance of exhaust gas recirculation valve position plausibility					
LV_CDN_DIAG_ER_STRAT	V	0... 1H	0 ...1	1	-
Diagnosis condition for engine roughness improvement at stratified mode					
LV_CDN_DIAG_ER_STRAT_WUP	V	0... 1H	0 ...1	1	-
Diagnosis condition for engine roughness improvement at stratified mode at warmup					
LV_CDN_DIAG_GEN	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on generator diagnosis					
LV_CDN_DIAG_GEN_CLC_V_NOT_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis condition GEN_CLC_V_NOT_PLAUS					
LV_CDN_DIAG_GEN_CTL_NOT_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present for generator controller plausibility diagnosis					
LV_CDN_DIAG_GEN_EL	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present for electrical generator diagnosis					
LV_CDN_DIAG_GEN_H_TEMP	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present for generator high temperature diagnosis					
LV_CDN_DIAG_GEN_H_TEMP_CLC	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present for calculated generator high temperature diagnosis					
LV_CDN_DIAG_GEN_MEC	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present for mechanical generator diagnosis					
LV_CDN_DIAG_GEN_MSG_LOST	V	0... 1H	0 ...1	1	-
Diagnosis condition GEN_MSG_LOST					
LV_CDN_DIAG_GEN_TYP_NOT_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present for generator type plausibility diagnosis					
LV_CDN_DIAG_LOAD_TPS_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis Condition LOAD_TPS_PLAUS error					
LV_CDN_DIAG_MAF_LAMB_MAX	V	0... 1H	0 ...1	1	-
Diagnosis condition for maximum mass air flow calculated from lambda					
LV_CDN_DIAG_MAP_DIP_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis Condition MAP_DIP_PLAUS error					
LV_CDN_DIAG_MAP_PLAUS	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for Manifold pressure plausibility					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_MAP_TPS_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on MAP ratio plausibility diagnosis					
LV_CDN_DIAG_MEC_IVVT_EX	V	0... 1H	0 ...1	1	-
Diagnosis Condition exhaust CAM adjustment					
LV_CDN_DIAG_MEC_IVVT_IN	V	0... 1H	0 ...1	1	-
Diagnosis Condition inlet CAM adjustment					
LV_CDN_DIAG_N_MAX_DRIV_REQ	V	0... 1H	0 ...1	1	-
Diagnosis condition for too high engine rotation speed at vehicle stop					
LV_CDN_DIAG_N_MAX_HOMS	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on engine overspeed for changing the combustion mode diagnosis					
LV_CDN_DIAG_NEUT_PSN_GB_LRN	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on Neutral gear learning diagnosis					
LV_CDN_DIAG_POIL_CTL_DYN	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on oil pressure contoller (dynamic)					
LV_CDN_DIAG_POIL_CTL_MEC	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on Oilpressure valve diagnosis					
LV_CDN_DIAG_POIL_CTL_STAT	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on oil pressure contoller (static)					
LV_CDN_DIAG_POIL_PUMP	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on Oilpump diagnosis					
LV_CDN_DIAG_POIL_SENS_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on Oilpressure sensor diagnosis					
LV_CDN_DIAG_POIL_SYS	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on Oilsystem diagnosis					
LV_CDN_DIAG_PUT_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on PUT plausibility diagnosis					
LV_CDN_DIAG_QOIL_SENS	V	0... 1H	0 ...1	1	-
oil quality Diagnosis Condition					
LV_CDN_DIAG_TCHA_LEAK	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on charger leakage diagnosis					
LV_CDN_DIAG_TCHA_PRS_CTL	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on charger pressure controller diagnosis					
LV_CDN_DIAG_TCHA_PRS_DIF	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on charger pressure difference diagnosis					
LV_CDN_DIAG_TCHA_PRS_HIGH	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on charger pressure to high diagnosis					
LV_CDN_DIAG_TCHA_PRS_LOW	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on charger pressure to low diagnosis					
LV_CDN_DIAG_TCHA_SYS_1	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on charger system diagnosis 1					
LV_CDN_DIAG_TOIL_LEVEL	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on TOENS sensor					
LV_CDN_DIAG_TQ_CST	V	0... 1H	0 ...1	1	-
Boolean for diagnosis condition present on TQ_CST sensor					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_VIM_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis Condition VIM_PLAUS error					
LV_CDN_RBM_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Flag set if CST_IVVT diagnosis condition RBM is fulfilled					
LV_CDN_RBM_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Flag set if CST_IVVT diagnosis condition RBM is fulfilled					
LV_CDN_RBM_LOAD_TPS_PLAUS	V	0... 1H	0 ...1	1	-
Flag set if LOAD_TPS_PLAUS diagnosis condition RBM is fulfilled					
LV_CDN_RBM_MAP_DIP_PLAUS	V	0... 1H	0 ...1	1	-
Flag set if MAP_DIP_PLAUS diagnosis condition RBM is fulfilled					
LV_CDN_RBM_MEC_IVVT_EX	V	0... 1H	0 ...1	1	-
Flag set if IVVT diagnosis condition RBM is fulfilled					
LV_CDN_RBM_MEC_IVVT_IN	V	0... 1H	0 ...1	1	-
Flag set if IVVT diagnosis condition RBM is fulfilled					
LV_CDN_RBM_TQ_CST	V	0... 1H	0 ...1	1	-
Flag set if TQ_CST diagnosis condition RBM is fulfilled					
LV_END_DIAG_ALTER_BN	V	0... 1H	0 ...1	1	-
end of PM board network diagnosis					
LV_END_DIAG_ALTER_BN_BAT	V	0... 1H	0 ...1	1	-
end of PM battery diagnosis					
LV_END_DIAG_ALTER_BN_RGN	V	0... 1H	0 ...1	1	-
End of ALTER_BN_RGN error sensor diagnosis					
LV_END_DIAG_AMP_PLAUS_CUS	V	0... 1H	0 ...1	1	-
End of diagnosis AMP plausibility diagnosis					
LV_END_DIAG_BAT_SENS	V	0... 1H	0 ...1	1	-
End of Diagnosis BAT_SENS communication					
LV_END_DIAG_BAT_SENS_IT	V	0... 1H	0 ...1	1	-
End of Diagnosis BAT_SENS component					
LV_END_DIAG_BAT_SENS_IT_EL	V	0... 1H	0 ...1	1	-
End of Diagnosis BAT_SENS electrical					
LV_END_DIAG_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Diagnosis done completely at least one time; exhaust					
LV_END_DIAG_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Diagnosis done completely at least one time; inlet					
LV_END_DIAG_EGRV_PSN_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis result available for diagnosis instance exhaust gas recirculation valve position plausibility					
LV_END_DIAG_ER_STRAT	V	0... 1H	0 ...1	1	-
Diagnosis result available for daignosis instance of engine roughness improvement at stratified mode					
LV_END_DIAG_ER_STRAT_WUP	V	0... 1H	0 ...1	1	-
Diagnosis result available for daignosis instance of engine roughness improvement at stratified mode at warmup					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_GEN	V	0... 1H	0 ...1	1	-
End of diagnosis generator diagnosis					
LV_END_DIAG_GEN_CLC_V_NOT_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis GEN_CLC_V_NOT_PLAUS					
LV_END_DIAG_GEN_CTL_NOT_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis flag for generator controller plausibility diagnosis					
LV_END_DIAG_GEN_EL	V	0... 1H	0 ...1	1	-
End of diagnosis flag for electrical generator diagnosis					
LV_END_DIAG_GEN_H_TEMP	V	0... 1H	0 ...1	1	-
End of diagnosis flag for generator high temperature diagnosis					
LV_END_DIAG_GEN_H_TEMP_CLC	V	0... 1H	0 ...1	1	-
End of diagnosis flag for calculated generator high temperature diagnosis					
LV_END_DIAG_GEN_MEC	V	0... 1H	0 ...1	1	-
End of diagnosis flag for mechanical generator diagnosis					
LV_END_DIAG_GEN_MSG_LOST	V	0... 1H	0 ...1	1	-
End of diagnosis GEN_MSG_LOST					
LV_END_DIAG_GEN_TYP_NOT_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis flag for generator type plausibility diagnosis					
LV_END_DIAG_LOAD_TPS_PLAUS	V	0... 1H	0 ...1	1	-
End of LOAD_TPS_PLAUS error sensor diagnosis					
LV_END_DIAG_MAF_LAMB_MAX	V	0... 1H	0 ...1	1	-
Diagnosis result available for daignosis instance of maximum mass air flow calculated from lambda					
LV_END_DIAG_MAP_DIP_PLAUS	V	0... 1H	0 ...1	1	-
End of MAP_DIP_PLAUS error sensor diagnosis					
LV_END_DIAG_MAP_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis flag for Manifold pressure plausibility diagnosis					
LV_END_DIAG_MAP_TPS_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis MAP ratio plausibility diagnosis					
LV_END_DIAG_MEC_IVVT_EX	V	0... 1H	0 ...1	1	-
End of exhaust CAM adjustment Diagnosis					
LV_END_DIAG_MEC_IVVT_IN	V	0... 1H	0 ...1	1	-
End of inlet CAM adjustment Diagnosis					
LV_END_DIAG_N_MAX_DRIV_REQ	V	0... 1H	0 ...1	1	-
Diagnosis result available for daignosis instance of too high engine rotation speed at vehicle stop					
LV_END_DIAG_N_MAX_HOMS	V	0... 1H	0 ...1	1	-
End of diagnosis engine overspeed for changing the combustion mode diagnosis					
LV_END_DIAG_NEUT_PSN_GB_LRN	V	0... 1H	0 ...1	1	-
End of diagnosis Neutral gear learning diagnosis					
LV_END_DIAG_POIL_CTL_DYN	V	0... 1H	0 ...1	1	-
End of diagnosis oil pressure contoller (dynamic)					
LV_END_DIAG_POIL_CTL_MEC	V	0... 1H	0 ...1	1	-
End of diagnosis Oilpressure valve diagnosis					
LV_END_DIAG_POIL_CTL_STAT	V	0... 1H	0 ...1	1	-
End of diagnosis oil pressure contoller (static)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_POIL_PUMP	V	0... 1H	0 ...1	1	-
End of diagnosis Oilpump diagnosis					
LV_END_DIAG_POIL_SENS_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis Oilpressure sensor diagnosis					
LV_END_DIAG_POIL_SYS	V	0... 1H	0 ...1	1	-
End of diagnosis Oilsystem diagnosis					
LV_END_DIAG_PUT_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis PUT plausibility diagnosis					
LV_END_DIAG_QOIL_SENS	V	0... 1H	0 ...1	1	-
End of quality Oil Diagnosis					
LV_END_DIAG_TCHA_LEAK	V	0... 1H	0 ...1	1	-
End of diagnosis charger leakage diagnosis					
LV_END_DIAG_TCHA_PRS_CTL	V	0... 1H	0 ...1	1	-
End of diagnosis charger pressure controller diagnosis					
LV_END_DIAG_TCHA_PRS_DIF	V	0... 1H	0 ...1	1	-
End of diagnosis charger pressure difference diagnosis					
LV_END_DIAG_TCHA_PRS_HIGH	V	0... 1H	0 ...1	1	-
End of diagnosis charger pressure to high diagnosis					
LV_END_DIAG_TCHA_PRS_LOW	V	0... 1H	0 ...1	1	-
End of diagnosis charger pressure to low diagnosis					
LV_END_DIAG_TCHA_SYS_1	V	0... 1H	0 ...1	1	-
End of diagnosis charger system diagnosis 1					
LV_END_DIAG_TOIL_LEVEL	V	0... 1H	0 ...1	1	-
End of diagnosis TOENS sensor					
LV_END_DIAG_TQ_CST	V	0... 1H	0 ...1	1	-
End of TQ_CST error diagnosis					
LV_END_DIAG_VIM_PLAUS	V	0... 1H	0 ...1	1	-
End of VIM_PLAUS error sensor diagnosis					
LV_END_RBM_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Flag set if CST_IVVT diagnosis cycle RBM is finished					
LV_END_RBM_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Flag set if CST_IVVT diagnosis cycle RBM is finished					
LV_END_RBM_LOAD_TPS_PLAUS	V	0... 1H	0 ...1	1	-
Flag set if LOAD_TPS_PLAUS diagnosis cycle RBM is finished					
LV_END_RBM_MAP_DIP_PLAUS	V	0... 1H	0 ...1	1	-
Flag set if MAP_DIP_PLAUS diagnosis cycle RBM is finished					
LV_END_RBM_MEC_IVVT_EX	V	0... 1H	0 ...1	1	-
Flag set if IVVT diagnosis cycle RBM is finished					
LV_END_RBM_MEC_IVVT_IN	V	0... 1H	0 ...1	1	-
Flag set if IVVT diagnosis cycle RBM is finished					
LV_END_RBM_TQ_CST	V	0... 1H	0 ...1	1	-
Flag set if TQ_CST diagnosis cycle RBM is finished					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_EOL_OBD_DC	O/V	0... 1H	0 ...1	1	-
Flag for EOL activation in driving cycle					
LV_ERR_ALTER_BN	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on PM board network					
LV_ERR_ALTER_BN_BAT	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on PM battery					
LV_ERR_ALTER_BN_RGN	O/V	0... 1H	0 ...1	1	-
Error Flag for ALTER_BN_RGN error					
LV_ERR_AMP_PLAUS_CUS	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on AMP plausibility diagnosis					
LV_ERR_BAT_SENS	O/V	0... 1H	0 ...1	1	-
communication error BAT_SENS					
LV_ERR_BAT_SENS_IT	O/V	0... 1H	0 ...1	1	-
internal error (component) BAT_SENS					
LV_ERR_BAT_SENS_IT_EL	O/V	0... 1H	0 ...1	1	-
internal error (electrical) BAT_SENS					
LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	O/V	0... 1H	0 ...1	1	-
Present failure: failure after filtering of diagnosis enduring exhaust camshaft deviation at steady setpoint during catalyst heating					
LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	O/V	0... 1H	0 ...1	1	-
Present failure: failure after filtering of diagnosis enduring inlet camshaft deviation at steady setpoint during catalyst heating					
LV_ERR_EGRV_PSN_PLAUS	O/V	0... 1H	0 ...1	1	-
Error flag for position of exhaust gas recirculation valve plausibility					
LV_ERR_ER_STRAT	O/V	0... 1H	0 ...1	1	-
Error flag for engine roughness improvement at stratified mode					
LV_ERR_ER_STRAT_WUP	O/V	0... 1H	0 ...1	1	-
Error flag for engine roughness improvement at stratified mode at warmup					
LV_ERR_GEN	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on Generator					
LV_ERR_GEN_CLC_V_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
Flag for calculated generator voltage plausibility error					
LV_ERR_GEN_CTL_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
Flag for calculated generator controller plausibility error					
LV_ERR_GEN_EL	O/V	0... 1H	0 ...1	1	-
Flag for electrical generator error					
LV_ERR_GEN_H_TEMP	O/V	0... 1H	0 ...1	1	-
Flag for generator high temperature error					
LV_ERR_GEN_H_TEMP_CLC	O/V	0... 1H	0 ...1	1	-
Flag for calculated generator high temperature error					
LV_ERR_GEN_MEC	O/V	0... 1H	0 ...1	1	-
Flag for mechanical generator error					
LV_ERR_GEN_MSG_LOST	O/V	0... 1H	0 ...1	1	-
Present error GEN_MSG_LOST					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_GEN_TYP_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
Flag for generator type not plausible error					
LV_ERR_IVVT	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present IVVT system					
LV_ERR_LOAD_TPS_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean that indicates inconsistencies between actual load and throttle position					
LV_ERR_MAF_LAMB_MAX	O/V	0... 1H	0 ...1	1	-
Error flag for maximum mass air flow calculated from lambda					
LV_ERR_MAP_DIP_PLAUS	-	0... 1H	0 ...1	1	-
Error Flag for MAP_DIP_PLAUS error					
LV_ERR_MAP_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for detected error of Manifold pressure plausibility diagnosis					
LV_ERR_MAP_TPS_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for error MAP ratio plausibility diagnosis					
LV_ERR_MEC_IVVT_EX	O/V	0... 1H	0 ...1	1	-
Error Flag for functional error on the exhaust CAM adjustment					
LV_ERR_MEC_IVVT_IN	O/V	0... 1H	0 ...1	1	-
Error Flag for functional error on the inlet CAM adjustment					
LV_ERR_N_MAX_DRIV_REQ	O/V	0... 1H	0 ...1	1	-
Error flag for too high engine rotation speed at vehicle stop					
LV_ERR_N_MAX_HOMS	O/V	0... 1H	0 ...1	1	-
Boolean for error engine overspeed for changing the combustion mode					
LV_ERR_NEUT_PSN_GB_LRN	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on Neutral gear learning diagnosis					
LV_ERR_POIL_CTL_DYN	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on oil pressure contoller (dynamic)					
LV_ERR_POIL_CTL_MEC	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on Oilpressure valve diagnosis					
LV_ERR_POIL_CTL_STAT	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on oil pressure contoller (static)					
LV_ERR_POIL_PUMP	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on Oilpump diagnosis					
LV_ERR_POIL_SENS_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on Oilpressure sensor diagnosis					
LV_ERR_POIL_SYS	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on Oilsystem diagnosis					
LV_ERR_PUT_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on PUT plausibility diagnosis					
LV_ERR_QOIL_SENS	O/V	0... 1H	0 ...1	1	-
Error Flag for quality Oil Sensor					
LV_ERR_TCHA_LEAK	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on charger leakage diagnosis					
LV_ERR_TCHA_PRS_CTL	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on charger pressure controller diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_TCHA_PRS_DIF	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on charger pressure difference diagnosis					
LV_ERR_TCHA_PRS_HIGH	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on charger pressure to high diagnosis					
LV_ERR_TCHA_PRS_LOW	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on charger pressure to low diagnosis					
LV_ERR_TCHA_SYS_1	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on charger system diagnosis 1					
LV_ERR_TOIL	O/V	0... 1H	0 ...1	1	-
Flag for oil temperature error (set to "0" because TOIL_MDL is used if no value from sensor or CAN is available)					
LV_ERR_TOIL_LEVEL	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on TOENS sensor					
LV_ERR_TQ_CST	O/V	0... 1H	0 ...1	1	-
Error Flag for TQ_CST error					
LV_ERR_VIM_PLAUS	O/V	0... 1H	0 ...1	1	-
Flag to indicate VIM failure global error					
LV_INH_DIAG_RBM_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Flag set if CST_IVVT diagnosis is inhibitied due to present OBD error					
LV_INH_DIAG_RBM_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	V	0... 1H	0 ...1	1	-
Flag set if IVVT diagnosis is inhibitied due to present OBD error					
LV_INH_DIAG_RBM_LOAD_TPS_PLAUS	V	0... 1H	0 ...1	1	-
Flag set if LOAD_TPS_PLAUS diagnosis is inhibitied due to present OBD error					
LV_INH_DIAG_RBM_MAP_DIP_PLAUS	V	0... 1H	0 ...1	1	-
Flag set if MAP_DIP_PLAUS diagnosis is inhibitied due to present OBD error					
LV_INH_DIAG_RBM_MEC_IVVT_EX	V	0... 1H	0 ...1	1	-
Flag set if IVVT diagnosis is inhibitied due to present OBD error					
LV_INH_DIAG_RBM_MEC_IVVT_IN	V	0... 1H	0 ...1	1	-
Flag set if IVVT diagnosis is inhibitied due to present OBD error					
LV_INH_DIAG_RBM_TQ_CST	V	0... 1H	0 ...1	1	-
Flag set if TQ_CST diagnosis is inhibitied due to present OBD error					
STATE_RBM_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	O/V	0... FFH	0... 255	1	-
Interface of monitor CAM_CST_IVVT_EX[NC_NR_CBK_IVVT] for the rate based monitoring statistics					
STATE_RBM_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	O/V	0... 7H	0 ...7	1	-
Interface of CAM_CST_IVVT_IN monitor with the Rate-Based Monitoring statistics					
STATE_RBM_LOAD_TPS_PLAUS	O/V	0... 7H	0 ...7	1	-
Interface of LOAD_TPS_PLAUS monitor with the Rate-Based Monitoring statistics					
STATE_RBM_MAP_DIP_PLAUS	O/V	0... 7H	0 ...7	1	-
Interface of MAP_DIP_PLAUS monitor with the Rate-Based Monitoring statistics					
STATE_RBM_MEC_IVVT_EX	O/V	0... 7H	0 ...7	1	-
Interface of MEC_IVVT_EX monitor with the Rate-Based Monitoring statistics					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_RBM_MEC_IVVT_IN	O/V	0... 7H	0 ...7	1	-
Interface of MEC_IVVT_IN monitor with the Rate-Based Monitoring statistics					
STATE_RBM_TQ_CST	O/V	0... 7H	0 ...7	1	-
Interface of TQ_CST monitor with the Rate-Based Monitoring statistics					

Input data:

CTR_ABC_XX {p. 4640}	ERR_SYM_MEM [NC_NR_ERR_DYN] {p. 5756}	LV_DC {p. 5746}	LV_DC_MAX [NC_NR_ERR_DYN] {p. 5767}
LV_ERR_ACK_IGK_OFF {p. 4939}	LV_ERR_ACR_AD {p. 4320}	LV_ERR_ACR_CTL {p. 4337}	LV_ERR_ALTER_COM {p. 4834}
LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_BN_ETCU {p. 4870}	LV_ERR_BN_ICL {p. 4870}
LV_ERR_BN_TCS {p. 4870}	LV_ERR_BSD {p. 4834}	LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}	LV_ERR_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5561}
LV_ERR_COM_GB {p. 4849}	LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}
LV_ERR_CRK_TOOTH_PER {p. 4432}	LV_ERR_CS_PLAUS	LV_ERR_CWP_COM {p. 4834}	LV_ERR_CWP_INT_OFF {p. 4537}
LV_ERR_CWP_PLAUS {p. 4537}	LV_ERR_CWP_PWR {p. 4537}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}
LV_ERR_ECF_EL [NC_ECF_NR] {p. 4507}	LV_ERR_ECFPWM_FB [NC_ECF_NR] {p. 4507}	LV_ERR_ECT_EL {p. 4530}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FTL_MIN {p. 4762}
LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_LAMB_NS_PUC [NC_NOX_SENS_CONF]	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_MAF {p. 4815}
LV_ERR_MAF_FRQ_EL [NC_MAF_NR] {p. 4815}	LV_ERR_MAF_FRQ_GRD [NC_MAF_NR] {p. 4815}	LV_ERR_MAF_FRQ_RNG [NC_MAF_NR] {p. 4815}	LV_ERR_MAP_DIP_SENS {p. 4824}
LV_ERR_MAP_DIP_SHIFT {p. 4824}	LV_ERR_MEM_XX {p. 5767}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}
LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}	LV_ERR_NEUT_PSN_GB	LV_ERR_NEUT_PSN_GB_PLAUS
LV_ERR_NOX_NS_PUC [NC_NOX_SENS_CONF]	LV_ERR_NS_ACT [NC_NOX_SENS_CONF] {p. 6358}	LV_ERR_NS_AFR [NC_NOX_SENS_CONF] {p. 6389}	LV_ERR_NS_AVL [NC_NOX_SENS_CONF] {p. 6368}
LV_ERR_NS_HTP [NC_NOX_SENS_CONF] {p. 6330}	LV_ERR_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF] {p. 6396}	LV_ERR_NS_OBD_1_HTP [NC_NOX_SENS_CONF] {p. 4916}	LV_ERR_NS_OBD_1_LAMB [NC_NOX_SENS_CONF] {p. 4916}

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LV_ERR_NS_OBD_1_NOX [NC_NOX_SENS_CONF] {p. 4916}	LV_ERR_NS_OBD_1_VLS [NC_NOX_SENS_CONF] {p. 4916}	LV_ERR_NS_OFS [NC_NOX_SENS_CONF] {p. 6378}	LV_ERR_NS_PUC [NC_NOX_SENS_CONF] {p. 6405}
LV_ERR_NS_PWR [NC_NOX_SENS_CONF]	LV_ERR_NS_STOP [NC_NOX_SENS_CONF] {p. 6347}	LV_ERR_NS_VLS_DYN [NC_NOX_SENS_CONF] {p. 6338}	LV_ERR_NT_AGI {p. 6485}
LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_PBSU	LV_ERR_PBSU_PLAUS	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PND [NC_NR_ERR_DYN] {p. 5767}
LV_ERR_POIL_DR {p. 4357}	LV_ERR_PUT_EL {p. 4828}	LV_ERR_QOIL_COM {p. 4834}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_RLY_ACCOUT {p. 4627}	LV_ERR_SENS_ACR {p. 4352}	LV_ERR_SENS_BAT_SMT_COM {p. 4834}
LV_ERR_SENS_POIL {p. 4365}	LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TAM_CAN {p. 5076}
LV_ERR_TAM_PLAUS {p. 5076}	LV_ERR_TCO_2_EL {p. 4572}	LV_ERR_TCO_2_GRD {p. 4572}	LV_ERR_TCO_2_PLAUS {p. 5666}
LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}	LV_ERR_TCO_PLAUS {p. 5682}	LV_ERR_TCO_STUCK {p. 5691}
LV_ERR_TCO_STUCK_RNG {p. 5675}	LV_ERR_TEG_PCAT_DOWN {p. 4713}	LV_ERR_TH {p. 5652}	LV_ERR_TIA_PLAUS {p. 5093}
LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOUT_ASR_1 {p. 802}	LV_ERR_TOUT_ETCU_1 {p. 802}
LV_ERR_TOUT_ICL_2 {p. 802}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}
LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_VEH_POW_VAR {p. 4945}	LV_ERR_VIM_1_EL {p. 5065}	LV_ERR_VIM_2_EL {p. 5065}
LV_ERR_VIMPWM_1_FB {p. 5065}	LV_ERR_VIMPWM_2_FB {p. 5065}	LV_ERR_VLS_NS_PUC [NC_NOX_SENS_CONF]	LV_ERR_VS {p. 5021}
LV_ERR_WG_1_DR {p. 4207}	LV_ERR_WG_2_DR {p. 4207}	LV_READY_XX {p. 5881}	LV_VAR_BN {p. 655}
WAL_CONF_XX {p. 5811}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_LOAD_TPS_PLAUS	-	0... FFH	0... 255	1	-
Decrement of the load/TPS plausibility check anti-bounce counter					
C_ABC_INC_ALTER_BN	-	0... FFH	0... 255	1	-
Debounce counter increment ALTER_BN diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_ALTER_BN_BAT	-	0... FFH	0... 255	1	-
Debounce counter increment ALTER_BN_BAT diagnosis					
C_ABC_INC_ALTER_BN_RGN	-	0... FFH	0... 255	1	-
Debounce counter increment ALTER_BN_RGN diagnosis					
C_ABC_INC_AMP_PLAUS_CUS	-	0... FFH	0... 255	1	-
Debounce counter increment AMP_PLAUS_CUS diagnosis					
C_ABC_INC_BAT_SENS	-	0... FFH	0... 255	1	-
Debounce counter increment BAT_SENS diagnosis					
C_ABC_INC_BAT_SENS_IT	-	0... FFH	0... 255	1	-
Debounce counter increment BAT_SENS_IT diagnosis					
C_ABC_INC_CAM_CST_IVVT_EX	-	0... FFH	0... 255	1	-
Antibounce counter increment during catalyst heating exhaust					
C_ABC_INC_CAM_CST_IVVT_IN	-	0... FFH	0... 255	1	-
Antibounce counter increment during catalyst heating intake					
C_ABC_INC_EGRV_PSN_PLAUS	-	0... FFH	0... 255	1	-
Antibounce counter increment for exhaust gas recirculation valve position plausibility					
C_ABC_INC_ER_STRAT	-	0... FFH	0... 255	1	-
Anti-bounce increment value for engine roughness improvement at stratified mode					
C_ABC_INC_ER_STRAT_WUP	-	0... FFH	0... 255	1	-
Anti-bounce increment value for engine roughness improvement at stratified mode at warmup					
C_ABC_INC_GEN	-	0... FFH	0... 255	1	-
Debounce counter increment - GEN diagnosis					
C_ABC_INC_GEN_CLC_V_NOT_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment GEN_CLC_V_NOT_PLAUS diagnosis					
C_ABC_INC_GEN_CTL_NOT_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment GEN_CTL_NOT_PLAUS diagnosis					
C_ABC_INC_GEN_EL	-	0... FFH	0... 255	1	-
Debounce counter increment GEN_EL diagnosis					
C_ABC_INC_GEN_H_TEMP	-	0... FFH	0... 255	1	-
Debounce counter increment GEN_H_TEMP diagnosis					
C_ABC_INC_GEN_H_TEMP_CLC	-	0... FFH	0... 255	1	-
Debounce counter increment GEN_H_TEMP_CLC diagnosis					
C_ABC_INC_GEN_MEC	-	0... FFH	0... 255	1	-
Debounce counter increment GEN_MEC diagnosis					
C_ABC_INC_GEN_MSG_LOST	-	0... FFH	0... 255	1	-
Debounce counter increment GEN_MSG_LOST diagnosis					
C_ABC_INC_GEN_TYP_NOT_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment GEN_TYP_NOT_PLAUS diagnosis					
C_ABC_INC_LOAD_TPS_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment LOAD_TPS_PLAUS diagnosis					
C_ABC_INC_MAF_LAMB_MAX	-	0... FFH	0... 255	1	-
Anti-bounce increment value for mass air flow calculated from lambda					
C_ABC_INC_MAP_DIP_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment MAP_DIP_PLAUS diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_MAP_PLAUS	-	0... FFH	0... 255	1	-
Increment of the MAP Plausibility anti-bounce counter					
C_ABC_INC_MAP_TPS_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment MAP ratio plausibility diagnosis					
C_ABC_INC_MEC_IVVT_EX	-	0... FFH	0... 255	1	-
Debounce counter increment - MEC_IVVT_EX diagnosis					
C_ABC_INC_MEC_IVVT_IN	-	0... FFH	0... 255	1	-
Debounce counter increment - MEC_IVVT_IN diagnosis					
C_ABC_INC_N_MAX_DRIV_REQ	-	0... FFH	0... 255	1	-
Anti-bounce increment value for too high engine rotation speed at vehicle stop					
C_ABC_INC_N_MAX_HOMS	-	0... FFH	0... 255	1	-
Debounce counter engine overspeed for changing the combustion mode diagnosis					
C_ABC_INC_NEUT_PSN_GB_LRN	-	0... FFH	0... 255	1	-
Debounce counter increment Neutral gear learning diagnosis					
C_ABC_INC_POIL_CTL_DYN	-	0... FFH	0... 255	1	-
Debounce counter increment oil pressure controller (dynamic)					
C_ABC_INC_POIL_CTL_MEC	-	0... FFH	0... 255	1	-
Debounce counter increment Oilpressure valve diagnosis					
C_ABC_INC_POIL_CTL_STAT	-	0... FFH	0... 255	1	-
Debounce counter increment oil pressure controller (static)					
C_ABC_INC_POIL_PUMP	-	0... FFH	0... 255	1	-
Debounce counter increment Oelpump diagnosis					
C_ABC_INC_POIL_SENS_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment Oilpressure sensor diagnosis					
C_ABC_INC_POIL_SYS	-	0... FFH	0... 255	1	-
Debounce counter increment Oelsystem diagnosis					
C_ABC_INC_PUT_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment PUT_PLAUS diagnosis					
C_ABC_INC_QOIL_SENS	-	0... FFH	0... 255	1	-
Debounce counter increment - QOIL_SENS diagnosis					
C_ABC_INC_TCHA_LEAK	-	0... FFH	0... 255	1	-
Debounce counter increment charger leakage diagnosis					
C_ABC_INC_TCHA_PRS_CTL	-	0... FFH	0... 255	1	-
Debounce counter increment charger pressure controller diagnosis					
C_ABC_INC_TCHA_PRS_DIF	-	0... FFH	0... 255	1	-
Debounce counter increment charger pressure difference diagnosis					
C_ABC_INC_TCHA_PRS_HIGH	-	0... FFH	0... 255	1	-
Debounce counter increment charger pressure to high diagnosis					
C_ABC_INC_TCHA_PRS_LOW	-	0... FFH	0... 255	1	-
Debounce counter increment charger pressure to low diagnosis					
C_ABC_INC_TCHA_SYS_1	-	0... FFH	0... 255	1	-
Debounce counter increment charger system diagnosis 1					
C_ABC_INC_TOIL_LEVEL	-	0... FFH	0... 255	1	-
Debounce counter increment TOIL_LEVEL diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TQ_CST	-	0... FFH	0... 255	1	-
Debounce counter increment TQ_CST diagnosis					
C_ABC_INC_VIM_PLAUS	-	0... FFH	0... 255	1	-
Debounce counter increment VIM_PLAUS diagnosis					
C_ABC_MAX_ALTER_BN	-	1... FFH	1... 255	1	-
Debounce counter maximum value ALTER_BN diagnosis					
C_ABC_MAX_ALTER_BN_BAT	-	1... FFH	1... 255	1	-
Debounce counter maximum value ALTER_BN_BAT diagnosis					
C_ABC_MAX_ALTER_BN_RGN	-	1... FFH	1... 255	1	-
Debounce counter maximum value ALTER_BN_RGN diagnosis					
C_ABC_MAX_AMP_PLAUS_CUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value AMP_PLAUS_CUS diagnosis					
C_ABC_MAX_BAT_SENS	-	1... FFH	1... 255	1	-
Debounce counter maximum value BAT_SENS diagnosis					
C_ABC_MAX_BAT_SENS_IT	-	1... FFH	1... 255	1	-
Debounce counter maximum value BAT_SENS_IT diagnosis					
C_ABC_MAX_CAM_CST_IVVT_EX	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter during catalyst heating exhaust					
C_ABC_MAX_CAM_CST_IVVT_IN	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter during catalyst heating intake					
C_ABC_MAX_EGRV_PSN_PLAUS	-	1... FFH	1... 255	1	-
Maximal value of antibounce counter for exhaust gas recirculation valve position plasuibility					
C_ABC_MAX_ER_STRAT	-	1... FFH	1... 255	1	-
Maximal value of antibounce counter for engine roughness improvement at stratified mode					
C_ABC_MAX_ER_STRAT_WUP	-	1... FFH	1... 255	1	-
Maximal value of antibounce counter for engine roughness improvement at stratified mode at warmup					
C_ABC_MAX_GEN	-	1... FFH	1... 255	1	-
Debounce counter maximum value - GEN diagnosis					
C_ABC_MAX_GEN_CLC_V_NOT_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value GEN_CLC_V_NOT_PLAUS diagnosis					
C_ABC_MAX_GEN_CTL_NOT_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value GEN_CTL_NOT_PLAUS diagnosis					
C_ABC_MAX_GEN_EL	-	1... FFH	1... 255	1	-
Debounce counter maximum value GEN_EL diagnosis					
C_ABC_MAX_GEN_H_TEMP	-	1... FFH	1... 255	1	-
Debounce counter maximum value - GEN_H_TEMP diagnosis					
C_ABC_MAX_GEN_H_TEMP_CLC	-	1... FFH	1... 255	1	-
Debounce counter maximum value GEN_H_TEMP_CLC diagnosis					
C_ABC_MAX_GEN_MEC	-	1... FFH	1... 255	1	-
Debounce counter maximum value GEN_MEC diagnosis					
C_ABC_MAX_GEN_MSG_LOST	-	1... FFH	1... 255	1	-
Debounce counter maximum value GEN_MSG_LOST diagnosis					
C_ABC_MAX_GEN_TYP_NOT_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value GEN_TYP_NOT_PLAUS diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_LOAD_TPS_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value LOAD_TPS_PLAUS diagnosis					
C_ABC_MAX_MAF_LAMB_MAX	-	1... FFH	1... 255	1	-
Maximal value of antibounce counter for maximum of mass air flow calculated from lambda					
C_ABC_MAX_MAP_DIP_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value MAP_DIP_PLAUS diagnosis					
C_ABC_MAX_MAP_PLAUS	-	1... FFH	1... 255	1	-
Threshold to be reached, before permanently activating MAP Plausibility error					
C_ABC_MAX_MAP_TPS_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum MAP ratio plausibility diagnosis					
C_ABC_MAX_MEC_IVVT_EX	-	1... FFH	1... 255	1	-
Debounce counter maximum value - MEC_IVVT_EX diagnosis					
C_ABC_MAX_MEC_IVVT_IN	-	1... FFH	1... 255	1	-
Debounce counter maximum value - MEC_IVVT_IN diagnosis					
C_ABC_MAX_N_MAX_DRIV_REQ	-	1... FFH	1... 255	1	-
Maximal value of antibounce counter for too high engine rotation speed at vehicle stop					
C_ABC_MAX_N_MAX_HOMS	-	1... FFH	1... 255	1	-
Debounce counter maximum cengine overspeed for changing the combustion mode diagnosis					
C_ABC_MAX_NEUT_PSN_GB_LRN	-	1... FFH	1... 255	1	-
Debounce counter maximum value Neutral gear learning diagnosis					
C_ABC_MAX_POIL_CTL_DYN	-	1... FFH	1... 255	1	-
Debounce counter maximum value pressure controller (dynamic)					
C_ABC_MAX_POIL_CTL_MEC	-	1... FFH	1... 255	1	-
Debounce counter maximum value Oilpressure valve diagnosis					
C_ABC_MAX_POIL_CTL_STAT	-	1... FFH	1... 255	1	-
Debounce counter maximum value pressure controller (static)					
C_ABC_MAX_POIL_PUMP	-	1... FFH	1... 255	1	-
Debounce counter maximum value Oelpump diagnosis					
C_ABC_MAX_POIL_SENS_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value Oilpressure sensor diagnosis					
C_ABC_MAX_POIL_SYS	-	1... FFH	1... 255	1	-
Debounce counter maximum value Oelsystem diagnosis					
C_ABC_MAX_PUT_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value PUT_PLAUS diagnosis					
C_ABC_MAX_QOIL_SENS	-	1... FFH	1... 255	1	-
Debounce counter maximum value - QOIL_SENS diagnosis					
C_ABC_MAX_TCHA_LEAK	-	1... FFH	1... 255	1	-
Debounce counter maximum charger leakage diagnosis					
C_ABC_MAX_TCHA_PRS_CTL	-	1... FFH	1... 255	1	-
Debounce counter maximum charger pressure contoller diagnosis					
C_ABC_MAX_TCHA_PRS_DIF	-	1... FFH	1... 255	1	-
Debounce counter maximum charger pressure difference diagnosis					
C_ABC_MAX_TCHA_PRS_HIGH	-	1... FFH	1... 255	1	-
Debounce counter maximum charger pressure to high diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_TCHA_PRS_LOW	-	1... FFH	1... 255	1	-
Debounce counter maximum charger pressure to low diagnosis					
C_ABC_MAX_TCHA_SYS_1	-	1... FFH	1... 255	1	-
Debounce counter maximum charger lsystem diagnosis 1					
C_ABC_MAX_TOIL_LEVEL	-	1... FFH	1... 255	1	-
Debounce counter maximum value TOIL_LEVEL diagnosis					
C_ABC_MAX_TQ_CST	-	1... FFH	1... 255	1	-
Debounce counter maximum value TQ_CST diagnosis					
C_ABC_MAX_VIM_PLAUS	-	1... FFH	1... 255	1	-
Debounce counter maximum value VIM_PLAUS diagnosis					

Action definition

ACTION_ERRM_CLCed_report (**IN**<f_index>,**IN**<err_mask>,**OUT**<err_status>)	Mode: O
This action is called by customer OBJ File to inform supplier error manager concerning actual failure situation in customer OBJs. Error Status is sent back to customer OBJs.	

ACTION_ERRM_CLCed_status (**IN**<f_index>,**OUT**<err_status>)	Mode: O
This action is called by customer in order to get informations concerning a specific failure index.	

ACTION_ERRM_CLCrbm_report (**IN**<rbm_index>,**IN**<rbm_data>)	Mode: O
This action is called by customer OBJ File to inform supplier error manager concerning actual failure situation for RBM	

3.26.1 General interface description

FUNCTION DESCRIPTION:

General information:

This three Action Calls are used to exchange failure memory informations through the interface module (Layer) between supplier SW environment and Customer OBJs. The error handling is performed in the error mangement in the supplier SW. Even the anti-bounce algorithm for Customer OBJ exported failures is handled by supplier SW.

Description:

The transformation between the dynamicly created error index list (f_index) /(rbm_index) on the customer OBJ Files side and the as well dynamicly created errror index list on supplier SW side is realized by the help of the following translation table.

- -

Syntax : ACTION_ERRM_CLCed_report (IN <f_index>, IN <err_mask>, OUT <err_status>)

Parameter (in) : f_index Index of failure based on dynamic list of the customer OBJ
err_mask Includes ERR_SYM_XX and LV_CDN_DIAG_XX

Parameter (out) : err_status Includes several informations concerning the corresponding index of failure

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Short description : *This action is called by customer OBJ File to inform supplier error manager concerning actual error situation in customer OBJs. Error Status is sent back to customer OBJs.*

- -

Syntax : ACTION_ERRM_CLCrbm_report (IN <rbm_index>, IN <rbm_data>)
Parameter (in) : rbm_index Index of RBM - failure based on list of the customer OBJ
rbm_data Includes LV_END_RBM_XX and LV_INH_RBM_XX and LV_CDN_RBM_XX
Parameter (out) : - -
Short description : *This action is called by customer OBJ File to inform supplier error manager concerning actual error situation in customer OBJs for RBM statictics. There is no return value.*

- -

Syntax : ACTION_ERRM_CLCed_status (IN <f_index>, OUT <err_status>)
Parameter (in) : f_index Index of failure based on dynamic list of the customer OBJ
Parameter (out) : err_status Includes several informations concerning the corresponding index of failure
Short description : *This action is called by customer in order to get informations concerning a specific failure index.*

Application conditions

Initialisation: –

Recurrence: `depending on the index of failure`

Activation: `at action request`

Formula section:

f_index:

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f_index BMW	I/O	Failure BMW / FI_	Description BMW	Failure Flag supplier XX	Description supplier
1	I	TANS	Sensorspannung Ansauglufttemperatur	LV_ERR_TIA_EL **or** LV_ERR_TIA_PLAUS	Intake air temperature sensor
2	I	TKA	Sensorspannung Temperatur Kühlerausgang	LV_ERR_TCO_2_EL **or** LV_ERR_TCO_2_GRD **or** LV_ERR_TCO_2_PLAUS	Coolant temperature sensor (radiator out)
3	I	TMOT	Sensorspannung Motortemperatur	LV_ERR_TCO_EL **or** LV_ERR_TCO_PLAUS **or** LV_ERR_TCO_GRD **or** LV_ERR_TCO_STUCK **or** LV_ERR_TCO_STUCK_RNG	Coolant temperature sensor
4	I	UB	Batteriespg. nach HR	**Not available !**	
5	I	DK	Fehler Drosselklappe	LV_ERR_TPS_1 **or** LV_ERR_TPS_2 **or** LV_ERR_TPS_MAF_1 **or** LV_ERR_TPS_MAF_2 **or** LV_ERR_MTC_CTL_2 **or** LV_ERR_MTC_CTL_3 **or** LV_ERR_TPS_ST_CHK_2 **or** LV_ERR_TPS_AD **or** LV_ERR_TPS_AD_BOL **or** LV_ERR_MTC_DR **or** LV_ERR_TPS_RATIO	TPS - electrical diagnosis TPS - controller - diagnosis TPS - adaptation TPS - powerstage diagnosis TPS - Ratio error
6	I	HFM	Luftmassenmesser	LV_ERR_MAF_FRQ_RNG_0 **or** LV_ERR_MAF_FRQ_FRQ_0 **or** LV_ERR_MAF_FRQ_EL_0	Mass air flow sensor diagnosis (only for **6** cylinder)
6	I	HFM	Luftmassenmesser	LV_ERR_MAF	Mass air flow sensor diagnosis (only for **4** cylinder)
7	I	PUS	Umgebungsdrucksensor	LV_ERR_AMP **or** LV_ERR_AMP_PLAUS	Ambient pressure sensor signal diagnosis
8	I	DPSR	Drucksensor Saugrohr (Differenzdruck)	LV_ERR_MAP_DIP_SENS **or** LV_ERR_MAP_DIP_SHIFT	Manifold pressure electrical diagnosis (N53)
9	I	LSV	Lambda-Sonde vor Kat	LV_ERR_EL_LSL_UP_1 **or** LV_ERR_OC_LSL_UP_1	El. Diagnosis WRAF sensor
10	I	HSV	Lambdasonden-Heizung vor Katalysator	LV_ERR_LSH_UP_1	Lambda sensor upstream heater

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					diagnosis
11	I	LSV2	Lambda-Sonde vor Kat Bank 2	LV_ERR_EL_LSL_UP_2 **or** LV_ERR_OC_LSL_UP_2	El. Diagnosis WRAF sensor OBD1
12	I	HSV2	Lambdasonden-Heizung vor Katalysator Bank 2	LV_ERR_LSH_UP_2	Lambda sensor upstream heater diagnosis
13	I	KOSE	Klima-Kompressorsteurung Endstufe	LV_ERR_RLY_ACCOUT	Air cond. Compr. Relais diagnosis
14	I	ELUEE	E-Luefter Endstufe	LV_ERR_ECF_EL[NC_ECF_NR] **or** LV_ERR_ECFPWM_FB[NC_ECF_NR]	El. Cooling fan diagnosis
15	I	INS	Fehler Can-Botschaften vom Instrumentenkombi	LV_ERR_TOUT_ICL_2 v (f(LV_VAR_BN=0/1)) LV_ERR_BN_ICL	Diagnosis CAN timout (INST2) v BN2000 diagnosis KOMBI (Status)
16	I	EGS	Fehler Can-Botschaft Automatikgetriebe	LV_ERR_TOUT_ETCU_1 v (f(LV_VAR_BN=0/1)) LV_ERR_BN_ETCU	Diagnosis CAN timout (EGS1) v BN2000 diagnosis AT Gearbox (Status)
17	I	ASC	Fehler Can-Botschaft ASC	LV_ERR_TOUT_ASR_1 v (f(LV_VAR_BN=0/1)) LV_ERR_BN_TCS	Diagnosis CAN timout (ASC1) v BN2000 diagnosis Traction control system (Status DSC)
18	I	TUMG	Fehler Umgebungstemperatur	LV_ERR_TAM_CAN **or** LV_ERR_TAM_PLAUS	Ambient temperature diagnosis (CAN / Plaus)
19	O	ENWS	Fehler Einlassnockenwellensteuerung	LV_ERR_MEC_IVVT_IN	Functional diagnosis of IVVT inlet CAM
20	O	ANWS	Fehler Auslassnockenwellensteuerung	LV_ERR_MEC_IVVT_EX	Functional diagnosis of IVVT exhaust CAM
21	O	GEN	Fehler Generator	LV_ERR_GEN	Alternator diagnosis
22	O	BSD	Fehler Kommunikation		**Not supported from BWM**
23	I	ENWSE	Fehler Endstufe Einlassnockenwellensteuerung	LV_ERR_SLV_IVVT_IN	Driver diagnosis of solenoid valve IVVT inlet CAM
24	I	ANWSE	Fehler Endstufe Auslassnockenwellensteuerung	LV_ERR_SLV_IVVT_EX	Driver diagnosis of solenoid valve IVVT exhaust CAM
25	I	BM	Fehler Bezugsmarke (KW-Geber)	LV_ERR_CRK_SYN **or** LV_ERR_CRK_PLAUS **or** LV_ERR_CRK_TOOTH_PER **or** LV_ERR_CRK_TOOTH	Crankshaft sensor diagnosis; teeth not plausible
26	I	PH0_PER	Fehler Periode CAM 0	LV_ERR_PER_CAM_IN_1 **or** LV_ERR_SYN_CAM_IN_1	Camshaft sensor diagnosis
27	I	PH0_PSN	Fehler Position CAM 0	LV_ERR_REF_CRK_CAM_IN_1	Camshaft sensor diagnosis (position)

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				or LV_ERR_TOOTH_OFF_IN_1	
28	I	PH0_PLA	Fehler Plausibilisierung CAM 0	LV_ERR_PLAUS_CAM_IN_1 **or** LV_ERR_SYN_CRK_CAM_IN_1	Camshaft sensor diagnosis
29	I	PH1_PER	Fehler Periode CAM 1	LV_ERR_PER_CAM_EX_1 **or** LV_ERR_SYN_CAM_EX_1	Camshaft sensor diagnosis
30	I	PH1_PSN	Fehler Position CAM 1	LV_ERR_REF_CRK_CAM_EX_1 **or** LV_ERR_TOOTH_OFF_EX_1	Camshaft sensor diagnosis (position)
31	I	PH1_PLA	Fehler Plausibilisierung CAM 1	LV_ERR_PLAUS_CAM_EX_1 **or** LV_ERR_SYN_CRK_CAM_EX_1	Camshaft sensor diagnosis
32	O	QLT	Fehler QLT	LV_ERR_QOIL_SENS	Oil sensor diagnosis
33	O	IBS1	Fehler Kommunkationsverlust IBS	LV_ERR_BAT_SENS	Intelligent battery sensor diagnosis
34	O	IBS2	Fehler IBS unplausibel	LV_ERR_BAT_SENS_IT	Intelligent battery sensor diagnosis
35	O	IBS3	Fehler IBS allgemein	LV_ERR_BAT_SENS_IT_EL	Intelligent battery sensor diagnosis
36	O	PMBN	Fehler PM-Bordnetz	LV_ERR_ALTER_BN	Powermanagement diagnosis
37	O	PMBATT	Fehler PM-Batterie	LV_ERR_ALTER_BN_BAT	Powermanagement diagnosis
38	I	VFZ	Fehler Fahrzeuggeschwindigkeit	LV_ERR_VS	Vehicle speed signal diagnosis
39	I	MDZ0	Aussetzer Zuendung 0	LV_ERR_MIS_0	Cylinder specific misfire failure
40	I	MDZ1	Aussetzer Zuendung 1	LV_ERR_MIS_1	Cylinder specific misfire failure
41	I	MDZ2	Aussetzer Zuendung 2	LV_ERR_MIS_2	Cylinder specific misfire failure
42	I	MDZ3	Aussetzer Zuendung 3	LV_ERR_MIS_3	Cylinder specific misfire failure
43	I	MDZ4	Aussetzer Zuendung 4	LV_ERR_MIS_4	Cylinder specific misfire failure, not supported for 4-cylinder SW
44	I	MDZ5	Aussetzer Zuendung 5	LV_ERR_MIS_5	Cylinder specific misfire failure, not supported for 4-cylinder SW
-	I	MDZ6	Aussetzer Zuendung 6		**Not implemented in MSDxx**
46	I	MDZ7	Aussetzer Zuendung 7		**Not implemented in MSDxx**
47	I	KFT	Fehler Kennfeldthermostat	LV_ERR_ECT_EL **or** LV_ERR_TH	Electronically controlled thermostat diagnosis
48	I	EWAPU	Fehler elektrische Wasserpumpe	LV_ERR_CWP_PWR **or** LV_ERR_CWP_PLAUS **or** LV_ERR_CWP_INT_OFF	Cooling water pump diagnosis
49	O	WMKD	Fehler koordinierung		**Not supported from**

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			Wärmemanagement		**BWM**
50	I	PLD	Druck vor Drosselklappe	LV_ERR_PUT_EL	Pressure-up throttle sensor - electrical diagnosis (not supported for 4-cylinder SW !)
51	O	HFMPL	HFM plausibilisierung	LV_ERR_LOAD_TPS_PLAUS	Load - TPS ratio check
52	O	DISAPL	DISA plausibilisierung	LV_ERR_VIM_PLAUS	VIM plausibility diagnosis
53	O	DPSRPL	Saugrohrdrucksensor plausibilisierung	LV_ERR_MAP_DIP_PLAUS	MAP_DIP_SENS plausibility diagnosis
54	O	TEVPL	Tankent-lüftungsventil plausibilisierung		**Not supported from BWM**
55	O	SLPPL	Sekundärluftpumpe plausibilisierung		**Not supported from BWM**
56	I	DKALRN	Drosselklappe - Lernen untere Anschlag	LV_ERR_TPS_AD_BOL	TPS adaption lower position
57	I	TEVE	Endstufe Tankentlüftungsventil	LV_ERR_EL_CPS **or** LV_ERR_DIAGCPS	ATIC39 Powerstage-diagnoisis CPS / TEV check
58	I	SLPE	Endstufe Sekundärluftpumpe		**Not implemented in MSDxx**
59	I	KSD_1	Kraftstoffsystemdiagnose	LV_ERR_FSD_1 **or** LV_ERR_DELTA_I_LAM_1 **or** LV_ERR_FSD_LAM_LIM_1	Fuel-system diagnosis
60	I	KSD_2	Kraftstoffsystemdiagnose	LV_ERR_FSD_2 **or** LV_ERR_DELTA_I_LAM_2 **or** LV_ERR_FSD_LAM_LIM_2	Fuel-system diagnosis
61	I	DISAE_H	Endstufe DISA-H	LV_ERR_VIM_1_EL **or** LV_ERR_VIMPWM_1_FB	ATIC39 Powerstage-diagnoisis VIM_1
62	I	DISAE_L	Endstufe DISA-L	LV_ERR_VIM_2_EL **or** LV_ERR_VIMPWM_2_FB	ATIC39 Powerstage-diagnoisis VIM_2
63	I	BSD_0	Kommunikation BSD	LV_ERR_SENS_BAT_SMT_COM	BSD diagnosis
64	I	BSD_1	Kommunikation BSD		**Not implemented in MSDxx**
65	I	BSD_2	Kommunikation BSD		**Not implemented in MSDxx**
66	I	BSD_3	Kommunikation BSD	LV_ERR_CWP_COM	BSD diagnosis, CWP device
67	I	BSD_4	Kommunikation BSD	LV_ERR_QOIL_COM	BSD diagnosis, QOIL device
68	I	BSD_5	Kommunikation BSD		**Not implemented in MSDxx**
69	I	BSD_6	Kommunikation BSD	LV_ERR_ALTER_COM	BSD diagnosis, ALTER device
70	I	BSD_7	Kommunikation BSD		**Not implemented in MSDxx**
71	O	PMRUHVERL	Powermanagement Ruhestromverletzung	LV_ERR_ALTER_BN_RGN	Powermanagement diagnosis
72	I	BSDGLOB	Fehler BSD global	LV_ERR_BSD	BSD diagnosis
73	O	TOENS	Fehler Toens	LV_ERR_TOIL_LEVEL	TOENS fehler

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74	I	PWRVAR	Fehler OL / UL	LV_ERR_VEH_POW_VAR	Vehicle power variant not plausible
75	O	PUSPL	Fehler Umgebungsdrucksensor	LV_ERR_AMP_PLAUS_CUS	Ambient pressure sensor not plausible
76	I	DKOBD	Fehler Drosselklappe OBD relevant	LV_ERR_TPS_1 **or** LV_ERR_TPS_2 **or** LV_ERR_TPS_MAF_1 **or** LV_ERR_TPS_MAF_2 **or** LV_ERR_MTC_CTL_2 **or** LV_ERR_MTC_CTL_3 **or** LV_ERR_TPS_ST_CHK_2 **or** LV_ERR_TPS_AD **or** LV_ERR_TPS_AD_BOL **or** LV_ERR_MTC_DR	Emission relevant throttle error.
77	I	SEGRADP	Segmentzeitadaptionsfehler	LV_ERR_SEG_AD_ER	Segment-time adaptation values out of range
78	I	AGR_AD	EGR -adaptionsfehler	LV_ERR_ACR_AD	Adaptation of EGR valve
79	I	AGR_SENS	EGR -Sensorfehler	LV_ERR_SENS_ACR	EGR sensor diagnosis
80	I	AGR_DR	EGR - Endstufenfehler	LV_ERR_ACR_DR	EGR powerstage diagnosis
81	I	AGR_CTL	Fehler EGR -lageregler	LV_ERR_ACR_CTL	EGR controller diagnosis
82	I	AGR_VCC	VCC Überwachung EGR ventil	LV_ERR_V_REF_1	Power supply diagnosis PVS / EGR....
83	O	NWEKW	Versatz Einlass NW zu KW		**Not supported in MSDxx**
84	O	NWAKW	Versatz Auslass NW zu KW		**Not supported in MSDxx**
85	O	ENWSAD	Einlassnockenwellensteuerung Adaption		**Not supported in MSDxx**
86	O	ANWSAD	Auslassnockenwellensteuerung Adaption		**Not supported in MSDxx**
87	O	ATLRMX	Lader Systemdiagnosis 1	LV_ERR_TCHA_SYS_1	
88	O	PLDMN	Lader Systemdiagnosis 3	LV_ERR_TCHA_PRS_LOW	Charger pressure to low
89	O	ATLLEKFAST	Lader Systemdiagnosis 5	LV_ERR_TCHA_LEAK	Charger leakage
90	O	ATLGLS	Lader Systemdiagnosis 7	LV_ERR_TCHA_PRS_DIF	Charger pressure difference
91	O	PLDMX	Lader Systemdiagnosis 4	LV_ERR_TCHA_PRS_HIGH	Charger pressure to high
92	I	POELSENS	Öldrucksensor	LV_ERR_SENS_POIL	Oilpressure sensor error
93	I	POELREGVE	Öhldruck Regenventil Endstufe	LV_ERR_POIL_DR	Oilpressure valve powerstage error
94	O	POELRSTAT	Öldruckregellung statisch	LV_ERR_POIL_CTL_STAT	Oilpressure static - control error
95	O	POELRDYN	Öldruckregellung	LV_ERR_POIL_CTL_DYN	Oilpressure dynamic -

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			dynamisch		control error
96	I	DKRAT1	?	LV_ERR_TPS_MAF_1	
97	I	DKRAT2	?	LV_ERR_TPS_MAF_2	
98	I	DKRATIO	?	LV_ERR_TPS_RATIO	
99	I	ABGAS_TSENS	Fehler Abgastemperatur	LV_ERR_TEG_PCAT_DOWN	Exhaust temperature sensor
100	I	NOX_SENS	Fehler NOx Sensor		**Not supported in MSDxx**
101	I	DK_EF	Fehler einfach elektrisch an DK	LV_ERR_TPS_1 **or** LV_ERR_TPS_2	Electrical throttle error
102	I	PVDKDS	Fehler elektrisch Druck vor DK	LV_ERR_PUT_EL	Pressure-up throttle sensor - electrical diagnosis (not supported for 4-cylinder SW !)
103	I	PS_ABS	Drucksensor Saugrohr (Absolutdruck)	LV_ERR_MAP_DIP_SENS	Manifold pressure electrical diagnosis (N54)
104	O	PVDKDS_PL	Fehler Plausibilität Druck vor Drosselklappe	LV_ERR_PUT_PLAUS	Pressure-up throttle sensor - plausibility diagnosis
105	O	PSABS_PL	Fehler Plausibiltät Absolutdrucksensor	LV_ERR_MAP_PLAUS	Ambient pressure sensor not plausible
106	I	DK_NL	Fehler DK Notlauf		**Not defined yet**
107	O	DMDKH		LV_ERR_TQ_CST	Cold start monitoring - Torque reserve catalyst heating
108	O	POILREGV	Fehler Öldruckregelventil mechanisch	LV_ERR_POIL_CTL_MEC	Oilpressure control valve mecanical error
109	O	POILSENS_PL	Fehler Öldrucksensor	LV_ERR_POIL_SENS_PLAUS	Oilpressure sensor not plausible
110	I	PBREMSU	Fehler Bremsunterdrucksensor	LV_ERR_PBSU	Brake pressure sensor error (only 4 cylinder)
111	I	NGANG	Fehler Nullgangsensor	LV_ERR_NEUT_PSN_GB	Neutral gear sensor (only 4 cylinder)
112	O	NGLERN	Fehler Nullgangsensorlernen	LV_ERR_NEUT_PSN_GB_LRN	Neutral gear sensor learning
113	O	POILPUMP	Fehler Oeldruckpumpe	LV_ERR_POIL_PUMP	Oilpressure pump
114	O	POILSYS	Fehler Oeldrucksystem allg.	LV_ERR_POIL_SYS	Oelpressure system
115	O	GENEL	Elektrischer Fehler Generator	LV_ERR_GEN_EL	electrical generator error
116	O	GENMECH	Mechanischer Fehler Generator	LV_ERR_GEN_MEC	mechanical generator error
117	O	GENHT	Hochtemperaturfehler Generator	LV_ERR_GEN_H_TEMP	generator high temperature error
118	O	GENUPL	Generatortyp unplausibel	LV_ERR_GEN_TYP_NOT_PLAUS	generator type not plausible
119	O	GENKOMM	Keine Generatorkommunikation	LV_ERR_GEN_MSG_LOST	generator message lost
120	O	GENELB	Generatorspannung ausBerechnung unplausibel	LV_ERR_GEN_CLC_V_NOT_PLAUS	generator voltage not plausible
121	O	GENHTB	Hochtemperaturfehler Generator aus Berechnung	LV_ERR_GEN_H_TEMP_CLC	calculated generator high temperature error
122	O	GENREGUPL	Generatorregler	LV_ERR_GEN_CTL_NOT_PLAU	calculated generator

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			unplausibel	S	controller plausibility error
123	O	AGRPL	AGR - Ventil unplausibel	LV_ERR_EGRV_PSN_PLAUS	Error flag for position of exhaust gas recirculation valve plausibility
124	I	KAT	Fehler Katalysator	LV_ERR_CAT_DIAG[1] **or** LV_ERR_CAT_DIAG[2]	Present failure catalyst efficiency
125	I	WG	Fehler Wastegate Ansteuerung	LV_ERR_WG_1_DR **or** LV_ERR_WG_2_DR	Waste gate driver error cylinder bank 1 or 2 detected (only 6 cyclinder)
126	I	TVLD	Fehler Temperatursensor vor Verdichter	LV_ERR_TEG_PCAT_DOWN	TEG sensor diagnosis
127	O	ATL_CTL	Fehler Ladedruckregelung	LV_ERR_TCHA_PRS_CTL	error currently present on charger pressure controller diagnosis
128	I	KATH_DIAG	Fehlerort Katdiagnose	LV_ERR_CAT_DIAG_AFL[1] **or** LV_ERR_CAT_DIAG_AFL[2]	Present failure after filtering of diagnostic CAT_DIAG_AFL
129	I	NSOBD2	Wenn der NOx - Sensor defekt erkannt wird	LV_ERR_NS_ACT [1] **or** LV_ERR_NS_AFR[1] **or** LV_ERR_NS_AVL[1] **or** LV_ERR_NS_HTP[1] **or** LV_ERR_NS_LSL_UP_DOWN[1] **or** LV_ERR_NS_OFS[1] **or** LV_ERR_NS_PUC[1] **or** LV_ERR_NS_STOP[1] **or** LV_ERR_NS_VLS_DYN[1]	NOx sensor OBD 2 failure is present (only **6** cylinder)
130	I	NSOBD2	Wenn der NOx - Sensor defekt erkannt wird	LV_ERR_NS_ACT [1] **or** LV_ERR_NS_AFR[1] **or** LV_ERR_NS_AVL[1] **or** LV_ERR_NS_HTP[1] **or** LV_ERR_NS_LSL_UP_DOWN[1] **or** LV_ERR_NS_OFS[1] **or** LV_ERR_NS_PWR [1] **or** LV_ERR_NS_STOP[1] **or** LV_ERR_NS_VLS_DYN[1] **or** LV_ERR_VLS_NS_PUC[1] **or** LV_ERR_LAMB_NS_PUC[1] **or** LV_ERR_NOX_NS_PUC[1]	NOx sensor OBD 2 failure is present (only **4** cylinder)

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130	I	NTAGI	Wenn der NOx - Kat defekt erkannt wird	LV_ERR_NT_AGI	Error flag of NOx catalyst aging diagnosis
131	I	NSOBD1	NOX - Sensor	LV_ERR_NS_OBD_1_HTP[i] **or** LV_ERR_NS_OBD_1_NOX[i] **or** LV_ERR_NS_OBD_1_LAMB[i] **or** LV_ERR_NS_OBD_1_VLS[i]	NOx sensor 1 or 2 OBD I failure is present
132	I	EV_DIAG_0	Einspritzventil Diagnose	LV_ERR_IV[0]	at least one IV is detected as faulty
133	I	EV_DIAG_1	Einspritzventil Diagnose	LV_ERR_IV[1]	at least one IV is detected as faulty
134	I	EV_DIAG_2	Einspritzventil Diagnose	LV_ERR_IV[2]	at least one IV is detected as faulty
135	I	EV_DIAG_3	Einspritzventil Diagnose	LV_ERR_IV[3]	at least one IV is detected as faulty
136	I	EV_DIAG_4	Einspritzventil Diagnose	LV_ERR_IV[4]	at least one IV is detected as faulty (not supported in 4 cylinder sw)
‰	I	EV_DIAG_5	Einspritzventil Diagnose	LV_ERR_IV[5]	at least one IV is detected as faulty (not supported in 4 cylinder sw)
138	O	NMAX_BA	Fehler Drehzahlbegrenzung durch Notlaufmanager	LV_ERR_N_MAX_HOMS	engine overspeed for changing the combustion mode
139	O	DKPSABS_PL	Fehler Saugrohrdruck-DK Verhältnis Plausibilisierung	LV_ERR_MAP_TPS _PLAUS	Boolean for error MAP ratio plausibility diagnosis
140	I	NG_PLAUS	Plauibilität Signal Nullganssensor	LV_ERR_NEUT_PSN_GB_PLAUS	Neutral gear sensor plausibility error
141	O	MSLAM_MX	Ueberschreitung des maximalen Luftmassenstromes	LV_ERR_MAF_LAMB_MAX	Error flag for maximum mass air flow calculated from lambda
142	I	PBU_PLAUS	Plausibilität Bremsunterdrucksignal	LV_ERR_PBSU_PLAUS	Plausibility error brake pressure sensor (only for **4** cylinder)
143	O	LVS_AKTIV	Eingriff über LVS aktiv	LV_ERR_ER_STRAT	Error flag for engine roughness improvement at stratified mode
144	O	LVSWL_AKT	Eingriff über LVS aktiv im Motorwarmlauf	LV_ERR_ER_STRAT_WUP	Error flag for engine roughness improvement at stratified mode at warmup
1-	I	MSALTG	Fehler MSA Leitung	LV_ERR_ACK_IGK_OFF	Starter relay MSA power stage error (only **4** cylinder)
146	I	KUPP_PLAUS	Kupplungssignal nicht plausibel	LV_ERR_CS_PLAUS	Clutch switch plausibility error (only **4** cylinder)
147	O	PWGLL_NKW	Drehzahlreduzierung umd	LV_ERR_N_MAX_DRIV_REQ	Error flag for too high

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		RED	EML Lampe durch Vollgas		engine rotation speed at vehicle stop
148	I	GS_KOM	Kommunikation zu Getriebesteuergerät	LV_ERR_COM_GB	Gear box communication error
149	O	ENWS_KH	Einlassnockenwellensteuerung bei Katheizen	LV_ERR_CAM_CST_IVVT_IN[1]	functional error on the intake CAM adjustment at coldstart
150	O	ANWS_KH	Auslassnockenwellensteuerung bei Katheizen	LV_ERR_CAM_CST_IVVT_EX[1]	functional error on the exhaust CAM adjustment at coldstart
151	I	FTLMIN	Zylinderabschaltung wegen Tankleerfahrdiagnose	LV_ERR_FTL_MIN	Fuel tank level low Injection intervention

rbm_index:

rbm_index BMW	Failure BMW	Description BMW	RBM data supplier XX	Description supplier
0	FI_ENWS	Fehler Einlassnockenwellensteuerung	LV_END_RBM_MEC_IVVT_IN LV_INH_DIAG_RBM_MEC_IVVT_IN LV_CDN_RBM_MEC_IVVT_IN	Functional diagnosis of IVVT inlet CAM
1	FI_ANWS	Fehler Auslassnockenwellensteuerung	LV_END_RBM_MEC_IVVT_EX LV_INH_DIAG_RBM_MEC_IVVT_EX LV_CDN_RBM_MEC_IVVT_EX	Functional diagnosis of IVVT exhaust CAM
2	FI_HFMPL	HFM plausibilisierung	LV_END_RBM_LOAD_TPS_PLAUS LV_INH_DIAG_RBM_LOAD_TPS_PLAUS LV_CDN_RBM_LOAD_TPS_PLAUS	Load - TPS ratio check
3	FI_DPSRPL	Saugrohrdrucksensor plausibilisierung	LV_END_RBM_MAP_DIP_PLAUS LV_INH_DIAG_RBM_MAP_DIP_PLAUS LV_CDN_RBM_MAP_DIP_PLAUS	MAP_DIP_SENS plausibility diagnosis
4	FI_TEVPL	Tankent-lüftungsventil plausibilisierung	**Not supported !**	
5	FI_NWEKW	Fehler Versatz Einlass-NW zu KW	**Not supported !**	
6	FI_NWAKW	Fehler Versatz Auslass-NW zu KW	**Not supported !**	
7	FI_ENWSAD	Fehler Einlassnocken-wellensteuerung Anschlagsadap-tion	**Not supported !**	
8	FI_ANWSAD	Fehler Auslassnockenwellensteuerung Anschlagsadaption	**Not supported !**	
9 10 11	FI_DMDKH FI_ENWS_KH FI_ANWS_KH	No Text Fehler Einlassnockenwellensteuerung bei Katheizen Fehler Auslassnockenwellensteuerung bei Katheizen	LV_END_RBM_TQ_CST LV_INH_DIAG_RBM_TQ_CST LV_CDN_RBM_TQ_CST LV_END_RBM_CAM_CST_IVVT_IN_1 LV_INH_DIAG_RBM_CAM_CST_IVVT_IN_1 LV_CDN_RBM_CAM_CST_IVVT_IN_1 LV_END_RBM_CAM_CST_IVVT_EX_1 LV_INH_DIAG_RBM_CAM_CST_IVVT_EX_1 LV_CDN_RBM_CAM_CST_IVVT_EX_1	Cold start monitoring - Torque reserve catalyst heating functional error on the intake CAM adjustment at coldstart functional error on the exhaust CAM adjustment at coldstart

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err_mask:

ERR_SYM_XX = bit 0-3 *//detected symptom*
LV_CDN_DIAG_XX = bit 4 *//diagnosis condition*
LV_INH_DIAG_RBM_XX = bit 5 *//RBM inhibition due to OBD error, only used for RBM diagnosis*

rbm_data:

LV_END_RBM_XX = bit 0 *//diagnosis cycle for RBM finished*
LV_INH_DIAG_RBM_XX = bit 1 *//RBM inhibition due to OBD error*
LV_CDN_RBM_XX = bit 2 *//Special RBM diagnosis condition*
not used = bit 3-7

err_status:

Remark:
For some f_index BMW there are more then one LV_ERR_xx (Diagnosis instances) which fit, thus a algorithm to set the bits in the right way is defined:
e.g. f_index 1 = LV_ERR_TIA_EL **or** LV_ERR_TIA_PLAUS
=> Formula section below is described in the way LV_ERR_XX **or** LV_ERR_YY

Status of memorised symptom
bit 3-0 of error_status = ERR_SYM_MEM_IDX **with** IDX = f(XX)
(In case of more then one ERR_SYM_MEM_IDX, only the first is considered)

Status of MIL activation
bit 4 of error_status **if** LV_DC_MAX_IDX = 1
with IDX = f(XX)
& bit 2 of WAL_CONF_XX = 1 **or**
LV_DC_MAX_IDX = 1
with IDX = f(YY)
& bit 2 of WAL_CONF_YY = 1
then bit 4 of error_status = 1
else bit 4 of error_status = 0

Status of present error and passive symptom
bit 5 of error_status **if** CTR_ABC_xx 0 **or**
CTR_ABC_yy 0 **or**
LV_ERR_xx = 1 **or**
LV_ERR_yy = 1
then bit 5 of error_status = 1
else bit 5 of error_status = 0

Status of present error

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bit 6 of error_status **if** LV_ERR_XX = 1 **or**
LV_ERR_YY = 1
then bit 6 of error_status = 1
else bit 6 of error_status = 0

Status of end of diagnosis cycle
bit 7 of error_status **if** LV_END_DIAG_XX = 1 **and**
LV_END_DIAG_YY = 1
then bit 7 of error_status = 0
else bit 7 of error_status = 1

Status of OBD readiness
bit 8 of error_status **if** LV_READY_XX = 0 **and**
LV_READY_YY = 0
then bit 8 of error_status = 0
else bit 8 of error_status = 1

Status if present error is stored in ERRM
bit 9 of error_status **if** LV_ERR_MEM_XX = 1 **or**
LV_ERR_MEM_YY = 1
then bit 9 of error_status = 1
else bit 9 of error_status = 0

Status of diagnosis condition
bit 10 of error_status **if** LV_CDN_DIAG_XX = 1 **or**
LV_CDN_DIAG_YY = 1
then bit 10 of error_status = 1
else bit 10 of error_status = 0

Status of detected symtom
bit 11 of error_status **if** ERR_SYM_XX != 0 **or**
ERR_SYM_YY != 0
then bit 11 of error_status = 1
else bit 11 of error_status = 0

Status if error is pending
bit 14 of error_status **if** LV_ERR_PND_IDX = 1 **with** IDX = f(XX) **or**
LV_ERR_PND_IDX = 1 **with** IDX = f(YY)
then bit 14 of error_status = 1
else bit 14 of error_status = 0

Status if error is calibrated as OBD relevat
bit 15 of error_status **if** bit 4 of WAL_CONF_XX = 1 **or**
bit 4 of WAL_CONF_YY = 1
then bit 15 of error_status = 1
else bit 15 of error_status = 0

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3.26.2 Output - data of diagnosis handled by customer OBJ File

FUNCTION DESCRIPTION:

General information:

All failures are fed by the customer diagnosis algorithm which detects malfunctions.
The relevant informations for the error management are transferred with the help of the action call.
To give a reflection of the actual status of the failure memory management - which might as well be used for QVM related affairs (if desired) and/or for the information of system developers - the relevant supplier variables remain defined.
Since the debounce algorithm is part of the supplier failure memory management, all corresponding calibration variables (C_ABC_...) remain on supplier side.
All diagnosis are using the STD_INI debounce algorithm (not valid for LOAD_TPS_PLAUS diagnosis).

Description:

The following diagnosis LV_ERR_*(DIAG_INST)* are defined:

- ENWS (DIAG_INST = **MEC_IVVT_IN**)
- ANWS (DIAG_INST = **MEC_IVVT_EX**)
- GEN (DIAG_INST = **GEN**)
- QLT (DIAG_INST = **QOIL_SENS**)
- IBS1 (DIAG_INST = **BAT_SENS**)
- IBS2 (DIAG_INST = **BAT_SENS_IT**)
- IBS3 (DIAG_INST = **BAT_SENS_IT_EL**)
- PMBN (DIAG_INST = **ALTER_BN**)
- PMBATT (DIAG_INST = **ALTER_BN_BAT**)
- HFMPL (DIAG_INST = **LOAD_TPS_PLAUS**)
- DISAPL (DIAG_INST = **VIM_PLAUS**)
- DPSRPL (DIAG_INST = **MAP_DIP_PLAUS**)
- PMRUHVERL (DIAG_INST = **ALTER_BN_RGN**)
- TOENS (DIAG_INST = **TOIL_LEVEL**)
- PUSPL (DIAG_INST = **AMP_PLAUS_CUS**)
- PLDMN (DIAG_INST = **TCHA_PRS_LOW**)
- ATLLEKFAST (DIAG_INST = **TCHA_LEAK**)
- ATLGLS (DIAG_INST = **TCHA_PRS_DIF**)
- PLDMX (DIAG_INST = **TCHA_PRS_HIGH**)
- POELRSTAT (DIAG_INST = **POIL_CTL_STAT**)
- POELRDYN (DIAG_INST = **POIL_CTL_DYN**)
- PVDKDS_PL (DIAG_INST = **PUT_PLAUS**)
- PSABS_PL (DIAG_INST = **MAP_PLAUS**)
- DMDKH (DIAG_INST = **TQ_CST**)
- POILREGV (DIAG_INST = **POIL_CTL_MEC**)
- POILSENS_PL (DIAG_INST = **POIL_SENS_PLAUS**)
- NGLERN (DIAG_INST = **NEUT_PSN_GB_LRN**)
- POILPUMP (DIAG_INST = **POIL_PUMP**)
- POILSYS (DIAG_INST = **POIL_SYS**)
- GENEL (DIAG_INST = **GEN_EL**)
- GENMECH (DIAG_INST = **GEN_MEC**)
- GENHT (DIAG_INST = **GEN_H_TEMP**)

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- GENUPL (DIAG_INST = **GEN_TYP_NOT_PLAUS**)
- GENKOMM (DIAG_INST = **GEN_MSG_LOST**)
- GENELB (DIAG_INST = **GEN_CLC_V_NOT_PLAUS**)
- GENHTB (DIAG_INST = **GEN_H_TEMP_CLC**)
- GENREGUPL (DIAG_INST = **GEN_CTL_NOT_PLAUS**)
- AGRPL (DIAG_INST = **EGRV_PSN_PLAUS**)
- ATL_CTL (DIAG_INST = **TCHA_PRS_CTL**)
- NMAX_BA (DIAG_INST = **N_MAX_HOMS**)
- DKPSABS_PL (DIAG_INST = **MAP_TPS_PLAUS**)
- ATLRMX (DIAG_INST = **TCHA_SYS_1**)
- MSLAM_MX (DIAG_INST = **MAF_LAMB_MAX**)
- LVS_AKTIV (DIAG_INST = **ER_STRAT**)
- LVSWL_AKT (DIAG_INST = **ER_STRAT_WUP**)
- PWGLL_NKWRED (DIAG_INST = **N_MAX_DRIV_REQ**)
- ENWS_KH (DIAG_INST = **CAM_CST_IVVT_IN_1**)
- ANWS_KH (DIAG_INST = **CAM_CST_IVVT_EX_1**)

Application conditions

Initialisation: according **STD_INI** configuration
(all 0 at LV_IGK 0->1 or reset)
only for DIAG_INST = LOAD_TPS_PLAUS
according **STD_INI** and **DEC_CAL** configuration
(all 0 at LV_IGK 0->1 or reset + cal. Decrement)
only for DIAG_INST = PUT_PLAUS
according **STD** configuration
all other Output data 0 at LV_IGK 0->1 or reset

Recurrence: *see activation*

Activation: *at ACTION_ERRM_CLCed_report (IN <f_index>, IN <err_mask>, OUT <err_status>)*

Formula section:

According the data delivered by the err_masks (includes ERR_SYM_*(DIAG_INST)* and LV_CDN_DIAG_*(DIAG_INST)* the anti-bounce algorithm is called:

If ERR_SYM_*(DIAG_INST)* is not NO_SYM
Then debounce of LV_ERR_*(DIAG_INST)* using general debounce algorithm
Else rebounceof LV_ERR_*(DIAG_INST)* using general debounce algorithm
Endif

End of diagnosis calculation LV_END_DIAG_*(DIAG_INST)* = 1*:*
- -> see chapter Anti-bounce Algorithm: Calculation of end of diagnosis

3.26.3 Rate - base monitor Interface for OBJ-file diagnosis

FUNCTION DESCRIPTION:

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General information:

With this module the interface between the Object-file diagnosis and the Rate-Based Monitoring statistics is defined with STATE_RBM_xx data.
Within STATE_RBM_xx, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0) (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1) (depending on failure status: pending)
- Monitor individual RBM conditions encountered within this DC (bit 2)

xx = applied for MEC_IVVT_IN /MEC_IVVT_EX /MAP_DIP_PLAUS /LOAD_TPS_PLAUS / TQ_CST

Application conditions:

Initialisation :
at LV_DC 0   1 transition :
bit 0, bit 1 and bit 2 of STATE_RBM_xx = 0
on failure memory reset :
bit 1 of STATE_RBM_xx = 0
Recurrence: see activation
Activation: at ACTION_ERRM_CLCrbm_report (IN <rbm_index>, IN <rbm_data>)
Deactivation: LV_DC = 0

Formula section:

Algorithm must be applied sperate for each defined xx diagnosis

```
If      bit 0 of STATE_RBM_xx = 0
Then
            If      LV_END_RBM_xx = 1
                Then        bit 0 of STATE_RBM_xx = 1
                Endif
Endif
If      bit 1 STATE_RBM_xx = 0
Then
            If      LV_INH_DIAG_RBM_xx = 1
            Then    bit 1 of STATE_RBM_xx = 1
            Endif
Endif
If      bit 2 STATE_RBM_xx = 0
Then        If      LV_CDN_RBM_xx = 1
            Then    bit 2 of STATE_RBM_xx = 1
            Endif
Endif
```

3.26.4 Outputs for supplier aggregates, supplier internally

FUNCTION DESCRIPTION:

General information:

Adaptation to aggregate-environment.

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Application conditions

Initialisation: *0 at reset*

Recurrence: *same as corresponding input data*

Activation: *every engine operating state*

Formula section:

LV_EOL_OBD_DC = 0

Global error flag for IVVT system

If LV_ERR_MEC_IVVT_IN = 1
Or LV_ERR_MEC_IVVT_EX = 1
Or LV_ERR_SLV_IVVT_IN = 1
Or LV_ERR_SLV_IVVT_EX = 1
Or LV_ERR_CAM_CST_IVVT_EX[NC_NR_CBK_IVVT] = 1
Or LV_ERR_CAM_CST_IVVT_IN[NC_NR_CBK_IVVT] = 1
Then LV_ERR_IVVT = 1
Else LV_ERR_IVVT = 0
Endif

Global error flag for OIL system

If LV_ERR_TOIL_LEVEL = 1
Or LV_ERR_QOIL_SENS = 1
Then LV_ERR_TOIL = 1
Else LV_ERR_TOIL = 0
Endif

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3.27 AGGR adaptation: ECME

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_PWF	O/V	0... 1H	0 ...1	1	-
0: reading of customer adaptation block in the E2PROM was successful // 1: not sucessful					

Input data:

LV_NVMY_CUS_WRG			

General information

There are customer provided adaptation values stored in the E2Prom. Therefore the information has to be created whether the re-loading of this values out of the NVMY was successful or not. The bit B_pwf is containing this information (0 = upload was successful // 1 = upload failed).

Application conditions:

Initialisation: `B_pwf = 0 at reset`

Activation: `after up-loading the customer adaptation values out of the E2Prom`

Deactivation: `after set of B_pwf`

Recurrence: `once after up-loading of the adaptation values out of the E2Prom`

Function description:

Formula section:

```
B_pwf = LV_NVMY_CUS_WRG   if non-volatile stored data of storage class
                          .Nvram (all customer adaptation values) could not
                          be re-loaded error free out of the E2PROM
```

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3.28 AGGR adaptation: OBDC

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
SAF_DIAG_MAX_SAE	O/S	0... FF00H	0... 255	3.9063e-3	kg/h
Mean diagnosis value of maximum secondary air flow for SAE					
SAF_DIAG_MIN_SAE	O/S	0... FF00H	0... 255	3.9063e-3	kg/h
Mean diagnosis value of minimum secondary air flow for SAE					
SUM_AFL_VLS_DIAG_SA_1_SAE	O/V	0... FFFFH	0... 65535	1	-
Counter of lean events within the secondary air diagnosis					
SUM_AFL_VLS_DIAG_SA_2_SAE	O/V	0... FFFFH	0... 65535	1	-
Counter of lean events within the secondary air diagnosis					
VLS_COR_LSL [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Corrected output signal of lambda sensor					

Input data:

VLS_UP_COR [NC_CBK_EX_NR] {p. 2315}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_SUM_AFL_VLS_MIN_DIAG_SA_1	-	0... FFFFH	0... 65535	1	-
Threshold of lean events within the secondary air diagnosis					
LC_SA_SWI_ACQ	-	0... 1H	0 ...1	1	-
Logical constant for the decision SAF_KGH through model value (=0) or SAFM is used (=1)					

3.28.1 Initialization of secondary-air variables

FUNCTION DESCRIPTION:

General information:

Secondary air system diagnosis is not supported in MSD projects, thus all needed variables must be stubbed.

Application conditions

Initialisation: `at reset all variables = 0`

Recurrence: –

Activation: –

3.28.2 Calculation of non-implemented variables

FUNCTION DESCRIPTION:

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General information:

VLS_COR_LSL[i] is not supported in MSD projects, thus all needed variables must be calculated.

Application conditions

Initialisation: *at reset = 0*

Recurrence: *10ms*

Activation: *every engine operating state*

Formula section:

VLS_COR_LSL[i] = VLS_UP_COR[i] *//calculation is done in physical way*

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4 - System variables

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4.1 ECU state detection

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ECU_STATE	O/V	0H 1H 2H 3H 4H 5H 6H	ENG_STOP RUN_ENG SYN_ENG_ IGK_ON SYN_ENG_ IGK_OFF PWL ENG_LOCK WAKE_UP	-	-
information on ECU state					
FAST_ECU_TRAN_PWL_CTR	V	0... FFFFH	0... 655.35	0.01	s
fast transition counter for transition from SYN_ENG_IGK_OFF to PWL despite of engine running					

Input data:

C_VB_RLY_MAIN_DIAG {p. 4934}	ECU_LOCK_REQ {p. 654}	LV_CS {p. 8394}	LV_FIRST_VLD_TOOTH {p. 1505}
LV_IGK {p. 906}	LV_INH_PWL_TRAN_ES_EL {p. 3776}	LV_RLY_MAIN {p. 3772}	LV_RUN_ENG {p. 1505}
LV_STOP_ENG {p. 1505}	LV_SYN_ENG {p. 1506}	T_DLY_RLY_MAIN_DIAG {p. 4934}	VB {p. 1185}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DI_ENG_RUN	-	0... FFFFH	0... 655.35	0.01	s
Time of disabled ENG_RUN after engine stall during drive off					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_FAST_TRAN_PWL	-	0... FFFFH	0... 655.35	0.01	s
maximum delay for transition from SYN_ENG_IGK_OFF to PWL despite engine running					

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Application conditions

Recurrence:

```
If  LV_ES = 1    segment-synchronous
If      LV_ES = 0          10ms
```

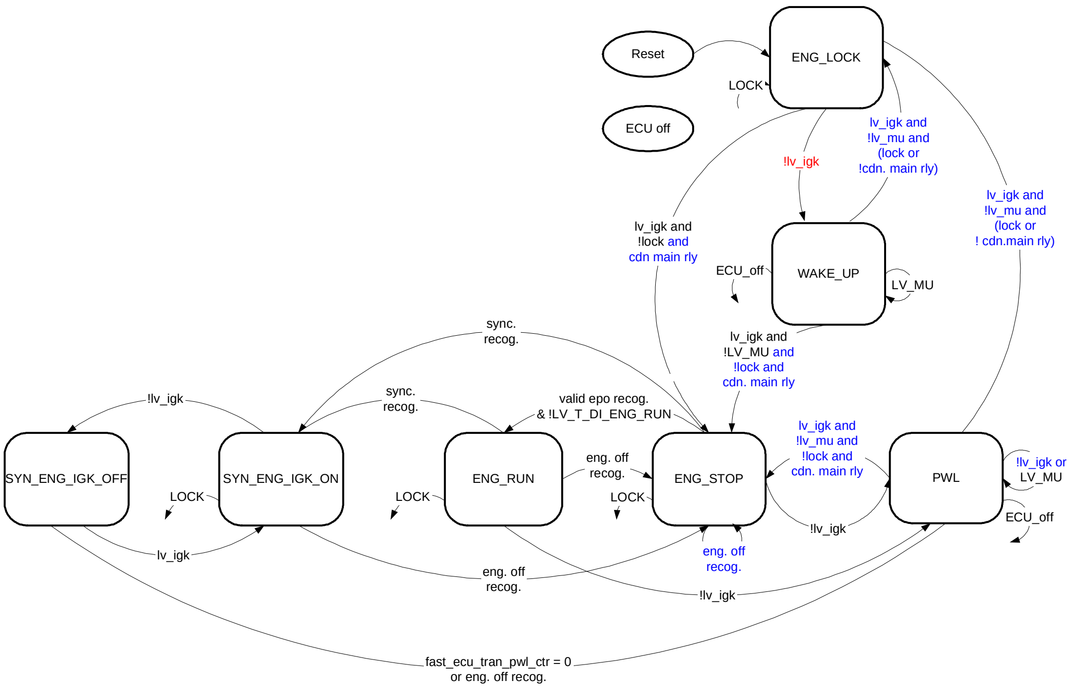
FUNCTION DESCRIPTION:

General information:

The function ECU-state manages detection of the operating states of the ECU and transitions between them referring to the main inputs key detection and crankshaft synchronization.
The ECU-state offers system events corresponding to those transitions that can be used by other functions (e.g. ignition function that asks for ignition reset on the transition engine running to engine stop).

Those actions are described in the specification chapter of the corresponding functions.
An important value to determine the ECU-state is the value ECU_LOCK_REQ. If it becomes 1, the ECU-state will become ENG_LOCK (exeption is PWL and WAKE_UP).

Signal flow diagram:



Details:
-> LOCK = ecu_lock_req
-> LV_MU = lv_inh_pwl_tran_es_el
-> eng. off recog. = lv_stop_eng
-> sync. recog. = lv_syn_eng
-> valid epo recog. = lv_run_eng and !lv_syn_eng
-> cdn. main rly = [lv_rly_main and (vb >= c_vb_rly_main_diag or t_dly_rly_main_diag = 0)]

Detection of first valid tooth:

If LV_STOP_ENG = 0 **and**
LV_FIRST_VLD_TOOTH 0 -> 1
Then offer an interface for project specific activities on this state transition
Endif

ENGINE LOCK (ENG_LOCK)

This state is dedicated to a special operating state (e.g. engine locked by immobilizer) where all essential outputs are inhibited. An interface for project specific activities on this state ENG_LOCK does exist. The ECU state is initialized with this state after reset.

ENG_LOCK => WAKE_UP
If LV_IGK = 0
Then ENG_LOCK => WAKE_UP
Endif

ENG_LOCK => ENG_STOP

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If ECU_LOCK_REQ = 0 **and**
LV_IGK = 1 **and**
LV_RLY_MAIN = 1 **and**
(VB >= C_VB_RLY_MAIN_DIAG **or**
T_DLY_RLY_MAIN_DIAG = 0**)**
Then offer an interface for project specific activities on this state transition
ECU_STATE = ENG_STOP
Endif

ENGINE STOP (ENG_STOP)

The crankshaft does not turn (no valid crank- or cam-edges are recognized), ignition key is ON and no engine lock condition is set. An interface for project specific activities on this state does exist.

ENG_STOP => PWL
If LV_IGK = 0
Then offer an interface for project specific activities
LV_T_DI_ENG_RUN = 0
ECU_STATE = PWL
Endif

ENG_STOP => ENG_LOCK
If ECU_LOCK_REQ > 0 **and**
LV_IGK = 1
Then offer an interface for project specific activities
ECU_STATE = ENG_LOCK
Endif

ENG_STOP => ENG_STOP
If LV_STOP_ENG = 1
Then offer an interface for project specific activities
ECU_STATE = ENG_STOP
Decrement timer_disable_engine_run till 0
If timer_disable_engine_run = 0
Then LV_T_DI_ENG_RUN = 0
Endif
Endif

ENG_STOP => ENG_RUN
If LV_RUN_ENG = 1 **and**
LV_SYN_ENG = 0 **and**
LV_T_DI_ENG_RUN = 0
Then offer an interface for project specific activities
ECU_STATE = RUN_ENG
Endif

ENG_STOP => SYN_ENG_IGK_ON
If LV_RUN_ENG = 1 **and**
LV_SYN_ENG = 1
Then offer an interface for project specific activities for transition of state RUN_ENG
offer a second interface for project specific activities on the state transition in state SYN_ENG_IGK_ON

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ECU_STATE = SYN_ENG_IGK_ON

Endif

RUNNING ENGINE (ENG_RUN)

This state corresponds to a turning engine without synchronization on crankshaft.
An interface for project specific activities on this state does exist.

ENG_RUN => PWL
If LV_IGK = 0
Then offer an interface for project specific activities on this state transition.
ECU_STATE = PWL
Endif

ENG_RUN => ENGINE LOCK
If ECU_LOCK_REQ > 0
Then offer an interface for projekt specific activities,
ECU_STATE = ENG_LOCK
Endif

ENG_RUN => ENG_STOP
If LV_STOP_ENG = 1
Then offer an interface for project specific activities,
ECU_STATE = ENG_STOP
Endif

ENG_RUN => SYN_ENG_IGK_ON
If LV_SYN_ENG = 1
Then offer an interface for project specific activities
ECU_STATE = SYN_ENG_IGK_ON
Endif

SYNCHRON ENGINE: IGNITION KEY ON (SYN_ENG_IGK_ON)

This state corresponds to a synchronized engine and ignition key on.

SYN_ENG_IGK_ON => ENG_LOCK
If ECU_LOCK_REQ > 0
Then offer an interface for project specific activities
ECU_STATE = ENG_LOCK
Endif

SYN_ENG_IGK_ON => ENGINE STOP
If LV_STOP_ENG = 1
Then offer an interface for project specific activities
If LV_CS = 1
Then start timer_disable_engine_run with C_T_DI_ENG_RUN
LV_T_DI_ENG_RUN = 1
Endif
ECU_STATE = ENG_STOP
Endif

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SYN_ENG_IGK_ON => SYN_ENG_IGK_OFF
If LV_IGK = 0
Then offer an interface for project specific activities,
ECU_STATE = SYN_ENG_IGK_OFF
Endif

Fast transition counter FAST_ECU_TRAN_PWL_CTR

The transition SYN_ENG_IGK_OFF => PWL FAST_ECU_TRAN_PWL_CTR is done if engine is stopped or if LV_IGK = 0 and fast transition counter FAST_ECU_TRAN_PWL_CTR = 0. The fast transition counter is started at transition from SYN_ENG_IGK_ON => SYN_ENG_IGK_OFF and is decremented at every recurrence by 10 ms.

If transition ECU_STATE = SYN_ENG_IGK_OFF => ECU_STATE = PWL
Then FAST_ECU_TRAN_PWL_CTR = FAST_ECU_TRAN_PWL_CTR - 10 ms
Else FAST_ECU_TRAN_PWL_CTR = NC_FAST_TRAN_PWL
Endif

SYNCHRON ENGINE: IGNITION KEY OFF (SYN_ENG_IGK_OFF)

This state corresponds to a synchronized engine and ignition key off.

SYN_ENG_IGK_OFF => SYN_ENG_IGK_ON
If LV_IGK = 1
Then offer an interface for project specific activities
ECU_STATE = SYN_ENG_IGK_ON
Endif

SYN_ENG_IGK_OFF => PWL
If LV_STOP_ENG = 1 **or**
FAST_ECU_TRAN_PWL_CTR = 0
Then offer an interface for project specific activities
ECU_STATE = PWL
Endif

POWER LATCH (PWL)

Non volatile data are stored and ECU shutdown is prepared. An interface for project specific activities on this state does exist.

PWL => ENG_LOCK
If LV_IGK = 1 **and**
LV_INH_PWL_TRAN_ES_EL = 0 **and**
(ECU_LOCK_REQ > 0 **or**
LV_RLY_MAIN = 0 **or**
(VB < C_VB_RLY_MAIN_DIAG **and**
T_DLY_RLY_MAIN_DIAG > 0))
Then ECU_STATE = ENG_LOCK
Endif

PWL => ENG_STOP
If LV_IGK = 1 **and**

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LV_INH_PWL_TRAN_ES_EL = 0 **and**
ECU_LOCK_REQ = 0 **and**
LV_RLY_MAIN = 1 **and**
(VB >= C_VB_RLY_MAIN_DIAG **or**
T_DLY_RLY_MAIN_DIAG = 0**)**
Then ECU_STATE = ENG_STOP
Endif

PWL => PWL
If LV_ IGK=0 **or**
LV_INH_PWL_TRAN_ES_EL = 1
Then The condition LV_INH_PWL_TRAN_ES_EL = 1 indicates that the monitoring unit disabled the powerstages of MTC and injection outputs. IGK ON recognition is not accepted without reset.
ECU_STATE = PWL
Endif

WAKE UP MODE (WAKE_UP)

The Wake UP Mode can only be reached after ECU_Reset (Shut Down Mode).
This mode indicates that the LV_WAKE_UP was set and the Ignition Key is off.

WAKE_UP => ENG_LOCK
If LV_IGK = 1 **and**
LV_INH_PWL_TRAN_ES_EL = 0 **and**
(ECU_LOCK_REQ > 0 **or**
LV_RLY_MAIN = 0 **or**
(VB < C_VB_RLY_MAIN_DIAG **and**
T_DLY_RLY_MAIN_DIAG > 0**))**
Then ECU_STATE = ENG_LOCK
Endif

WAKE_UP => ENG_STOP
If LV_IGK = 1 **and**
LV_INH_PWL_TRAN_ES_EL = 0 **and**
ECU_LOCK_REQ = 0 **and**
LV_RLY_MAIN = 1 **and**
(VB >= C_VB_RLY_MAIN_DIAG **or**
T_DLY_RLY_MAIN_DIAG = 0**)**
Then ECU_STATE = ENG_STOP
Endif

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4.2 Actuator position determination

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
OPG_ACR	O/V	0... FFFH	0... 99.9756	0.02441	%
Measured opening of the actuator valve					
V_ACR	O/V	0... 3FFH	0... 4.995117	0.00488	V
Voltage value for actuator position control delivered from the measuring system					
V_ACR_BAS	V	0... 3FFH	0... 4.995117	0.00488	V
Raw value of the measuring system for actuator position control					
V_ACR_MV	V	0... 7FFH	0... 4.997559	0.002441	V
Voltage value for actuator position control delivered from the measuring system with higher resolution					

Input data:

FAC_ACR_SLOP {p. 4320}	LV_OPG_ACR_INI_REQ {p. 4345}	V_ACR_AD_BOL {p. 4320}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_OPG_ACR_INI	-	0... FFFH	0... 99.9756	0.02441	%
Replacement value for sensor signal acquisition					

Import actions:

ACTION_INFR_GetVAcr (**OUT**<V_acr_bas>)

General information

The electrical actuator is equipped with a linear position sensor system. The propose of this module is to determine the actual valve position for the closedloop digital position control.

Application Condition

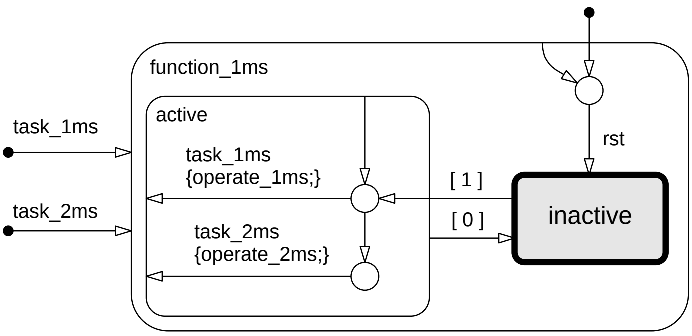

Figure 4.2.1: ACRC_position_determination/APP_CDN/APP_CDN

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Function Description

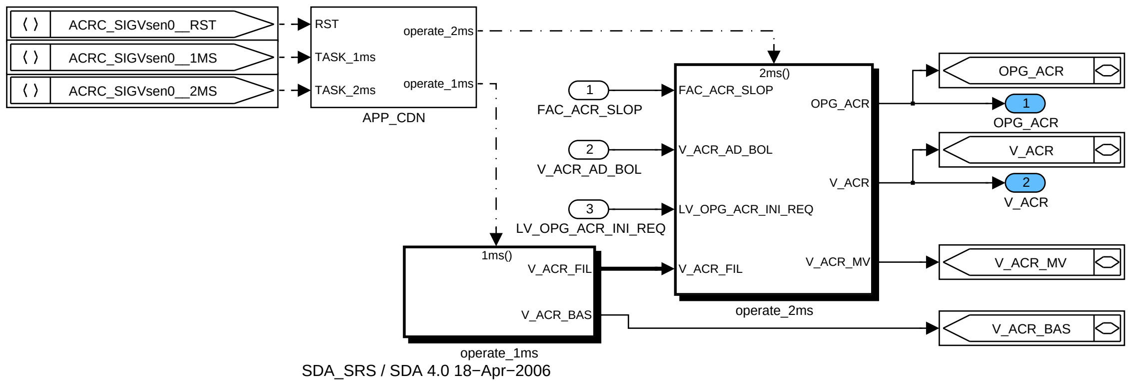

Figure 4.2.2: ACRC_POSITION_DETERMINATION

4.2.1 Signal pre processing

The described filter function is a part of signal processing. The AD value of the measuring system has a resolution of 10 bit (1024 increments) according to the AD converter. The smallest signification bit (one increment) is the fault of the AD conversion process and this bit can alternate from conversion to conversion. To compensate this behaviour the described bit filter is used, see below.

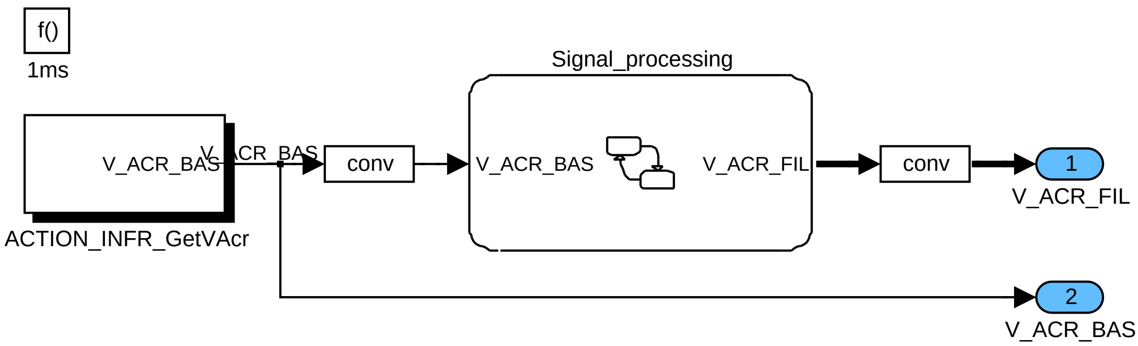

Figure 4.2.3: ACRC_POSITION_DETERMINATION/OPERATE_1MS

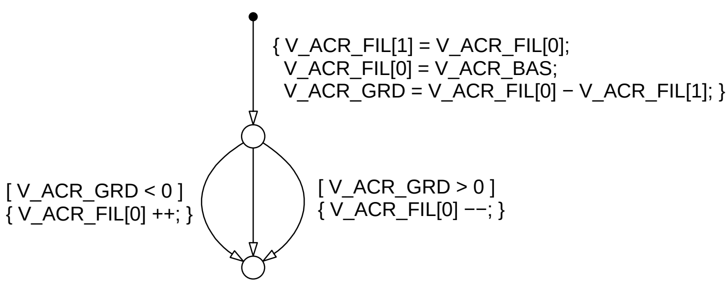

Figure 4.2.4: ACRC_position_determination/operate_1ms/Signal_processing

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4.2.2 Signal standardization

The aim of this chapter is to provide the valve position for the digital position controller. The signal voltage of the measuring system is determined by oversampling and averaging after the signal preprocessing. Afterwards the position signal is standardised by the electrical valve adaptation value and the standard slop of the measuring system and is limited in the range between 0 % and 100 %.
The output of the signal acquisition is set to C_OPG_ACR_INI if the replacement value for the sensor signal acquisition has been requested.

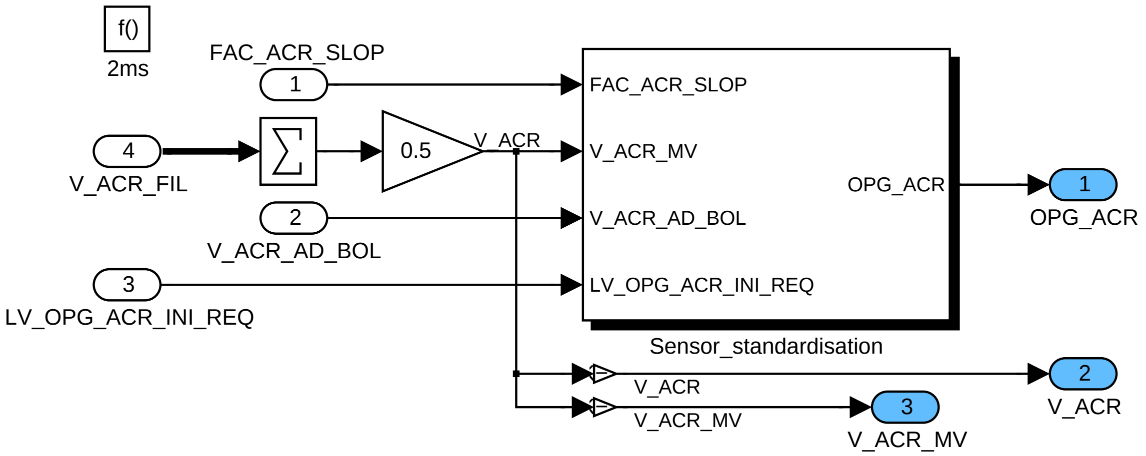

Figure 4.2.5: ACRC_POSITION_DETERMINATION/OPERATE_2MS

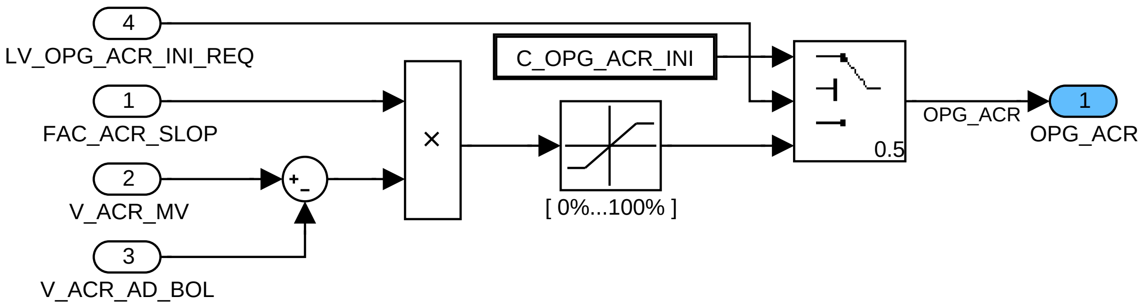

Figure 4.2.6: ACRC_POSITION_DETERMINATION/OPERATE_2MS/SENSOR_STANDARDISATION

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4.3 Coolant temperature

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_INI_TCO	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature initialisation conditions					
TCO	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature					
TCO_MES	O/V	0... FEH	-48... 142.5	0.75	°C
Measured coolant temperature					
TCO_ST	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature at start					
TCO_ST_DC	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature at first start of driving cycle					
TCO_STOP	O/V/S	0... FEH	-48... 142.5	0.75	°C
Coolant temperature at transition to engine stop (ES)					
VP_TCO [NC_NR_TCO_SENS]	O/V	0... 7FFFH	0... 4.99984	152.6e-6	V
Sensor raw acquisition of all available coolant temperature sensors					

Input data:

LV_ECU_SLA {p. 800}	LV_ERR_TCO {p. 4496}	LV_ERR_TCO_PREL {p. 4496}	LV_ERR_TIA_IM {p. 984}
LV_ES {p. 1720}	NC_NR_TCO_SENS {p. 576}	TCO_SUB {p. 1105}	TIA_IM {p. 984}
VP_TCO_COPL [NC_NR_TCO_SENS] {p. 811}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_INI_TIA_IM	-	0... FEH	-48... 142.5	0.75	°C
Coolant temperature initialization value in case of a coolant- and intake air- temperature failure					
C_TCO_MES_GRD_MAX	-	0... FEH	0... 190.5	0.75	°C
Maximum permissible temperature gradient for coolant temperature gradient monitoring					
IP_TCO_INI_TIA_IM	-	0... FEH	-48... 142.5	0.75	°C
LDP_TIA_IM_IP_TCO_INI_TIA_IM	6	0... FEH	-48... 142.5	0.75	°C
Coolant temperature initialization value in case of a coolant temperature failure					
IP_TCO_MES	-	0... FEH	-48... 142.5	0.75	°C
LDP_VP_TCO_IP_TCO_MES	16	0... 7FFFH	0... 4.99984	152.6e-6	V
Linearization of the coolant temperature sensor voltage for temperature acquisition					

Import actions:

ACTION_INFR_GetVpTco (**OUT**<No Name available>)

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FUNCTION DESCRIPTION:

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General information:

The coolant temperature raw sensor voltage is measured with use of an 10bit A/D converter by the ECU hardware. The software then is generating a modified sensor signal (VP_TCO[0]), which is requested by the application software for further execution.
The modified sensor signal (VP_TCO[0]) is converted into a measured temperature value (TCO_MES) with use of a one-dimension interpolation table (IP_TCO_MES).

Application conditions:

See separate chapters:

4.3.1 Coolant temperature gradient monitoring

FUNCTION DESCRIPTION:

General information:

The measured coolant temperature (TCO_MES) is monitored for not plausible gradients. It is checked if the temperature difference between the old and the new measured coolant temperature (TCO_MES) exceeds the permissible gradient C_TCO_MES_GRD_MAX. In this case the old measured value remains unchanged. If the temperature difference between the measured coolant temperature values is exceeding the permissible gradient again during the next measurement, the new measured value is transferred into the working memory. A measured value can be inhibited only if the gradient exceeded for one time (recurrence).
The monitoring of the coolant temperature gradient does not lead to failure entries. The only purpose is to extract implausible measured values (noise).

Application conditions

Initialisation at Reset:

```
FOR  k = 0 to NC_NR_TCO_SENS -1
        IF    LV_ECU_SLA =1
             THEN   VP_TCO[k] = VP_TCO_COPL[k]
             ELSE
               ACTION_INFR_GetVpTco(VP_TCO[k])

      ENDIF
END FOR
// all sensor values are imported and provided as output
TCO_MES(n) = TCO_MES(n-1) = IP_TCO_MES
// acquisition of the main coolant temperature measurement
signal
```

Recurrence: *100 ms*

Activation: *at every engine operating state*

Deactivation: –

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Formula section:

// all sensor values are imported and provided as output
FOR k = 0 to NC_NR_TCO_SENS - 1
IF LV_ECU_SLA =1
THEN VP_TCO[k] = VP_TCO_COPL[k]
ELSE
ACTION_INFR_GetVpTco(VP_TCO[k])
ENDIF
END FOR
// VP_TCO[0] is used as input signal for the interpolation table IP_TCO_MES
TCO_MES = IP_TCO_MES
// acquisition of the main coolant temperature measurement signal
If **I** TCO_MES(n-1) - TCO_MES(n) **I** > C_TCO_MES_GRD_MAX
then TCO_MES(n) = TCO_MES(n-1) (only one time!)
else TCO_MES(n) = TCO_MES(n)
endif

4.3.2 Coolant temperature acquisition

FUNCTION DESCRIPTION:

General information:

The actualisation of the coolant temperature value (TCO) is only executed, if no coolant temperature error /preliminary error is detected. In case of a detected error, the TCO value will be set to the calculated coolant temperature substitute value (TCO_SUB).
The initialisation of the coolant temperature value (TCO) is always performed as long as the engine operating state “Engine stop” is active.

Application conditions:

Initialisation:

at Reset TCO = TCO_MES
at Reset **or** Engine stop: LV_CDN_INI_TCO = 1

at Engine stop to Engine run (ES_to_ERU): LV_CDN_INI_TCO = 0

Activation: at every engine operating state

Deactivation: -

4.3.2.1 Coolant temperature acquisition at engine stop

Application conditions

Recurrence: `10 ms`
Activation: `LV_CDN_INI_TCO = 1`
Deactivation: `LV_CDN_INI_TCO = 0`

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Formula section:

if (1) LV_ERR_TCO = 0 **and**
LV_ERR_TCO_PREL = 0
then (1) TCO = TCO_MES
else (1)
if (2) LV_ERR_TIA_IM = 0
then (2) TCO = IP_TCO_INI_TIA_IM
else (2) TCO = C_TCO_INI_TIA_IM
endif (2)
endif (1)

4.3.2.2 Coolant temperature acquisition at engine run

Recurrence: 100 ms

Activation: LV_CDN_INI_TCO = 0

Deactivation: LV_CDN_INI_TCO = 1

Formula section:

if (1) LV_ERR_TCO = 0
then (1)
if (2) LV_ERR_TCO_PREL = 0
then (2) TCO = TCO_MES
else (2) TCO(n) = TCO(n-1)
endif (2)
else (1) TCO = TCO_SUB
endif (1)

4.3.3 Coolant temperature at engine start

FUNCTION DESCRIPTION:

General information:

The coolant temperature at engine start (TCO_ST) is determined as long as the engine operating state “Engine stop” is detected. During this time, TCO_ST is set with the actual coolant temperature value TCO.

Application conditions

Initialisation at Reset: TCO_ST = TCO_MES
TCO_ST_DC = TCO_MES

Recurrence: *10 ms*

Activation: *LV_ES = 1*

Deactivation: *LV_ES = 0*

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Formula section:

TCO_ST = TCO
TCO_ST_DC = TCO

4.3.4 Coolant Temperature at engine stop

FUNCTION DESCRIPTION:

General information:

The coolant temperature at engine stop (TCO_STOP) is determined at each transition to the engine operating state “Engine stop”. TCO_STOP will be stored in the non-volatile memory during the ECU’s self-holding phase.

Application conditions

Initialisation at Reset: TCO_STOP = TCO_STOP (stored in the non-volatile memory)

Initialization at Engine run to Engine stop (ERU_to_ES): TCO_STOP = TCO

Activation: *at every engine operating state*

Deactivation: –

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4.4 Coolant temperature substitute model

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_N_REL_CWP_H	V	0... FFH	0... 255	1	-
Counter to activate TCO-SUB correction if Heater is active					
FAC_TCO_SUB_COR	V	0... FFH	0... 1.99218	0.0078125	-
Coolant temperature substitute value correction factor					
FAC_TCO_SUB_COR_N_REL_CWP	V	0... FFFFH	0... 255.99609	3.9063e-3	-
Coolant temperature substitute value correction factor for CWP functionality					
FAC_TCO_SUB_COR_STATE_COC	V	0... FFH	0... 51	0.2	-
Coolant temperature substitute value correction factor after warm-up					
FAC_TCO_SUB_VS	V	0... FFFFH	-8... 7.99975	244.1e-6	-
Coolant temperature substitute value vehicle speed correction factor					
LV_CDN_ENA_TCO_SUB	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature substitute model initialisation condition					
N_REL_CWP_GRD	V	8000... 7FFFH	-32768 ...32767	1	-
Gradient of N _ REL _ CWP					
T_DLY_TCO_SUB	V	0... FFFFH	0... 65535	1	s
Delay time counter for coolant temperature substitute value calculation during pull fuel cutoff or idle speed					
T_DLY_TCO_SUB_COR_STATE_COC	V	0... FFFFH	0... 65535	1	s
Delay time counter for coolant temperature substitute value calculation after warm-up					
T_DLY_THD_TCO_SUB_ST	V	0... FFFFH	0... 6553.5	0.1	s
Delay time threshold for coolant temperature substitute value depending on CWP speed					
T_N_REL_CWP_GRD_H	V	0... FFH	0... 255	1	s
Timer to block coolant temperature model correction					
TCO_SUB	O/V	0... FE00H	-48... 142.5	2.9297e-3	°C
Coolant temperature substitute value					
TCO_SUB_INC	V	0... FE00H	-48... 142.5	2.9297e-3	°C
Coolant temperature substitute increment value					

Input data:

LV_ERR_TCO {p. 4496}	LV_IS {p. 1720}	LV_PL {p. 1720}	LV_PU {p. 1720}
LV_PUC {p. 1720}	LV_ST {p. 1720}	MAF_KGH {p. 1195}	N_REL_CWP {p. 4095}
OPM_AV {p. 8137}	T_AST {p. 1766}	TAM {p. 1579}	TCO {p. 1100}
TCO_ST {p. 1100}	VS {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_N_REL_CWP_H	-	0... FFH	0... 255	1	-
counter to correct TCO-SUB model via colling water pump gradient					
C_FAC_TCO_SUB_COR	-	0... FFH	0... 1.99218	0.0078125	-
Multiple Coolant temperature substitute value correction factor					
C_FAC_TCO_SUB_COR_STATE_COC	-	0... FFH	0... 51	0.2	-
Coolant temperature substitute value correction factor after warm-up					
C_N_REL_CWP_THD_COC	-	0... FFH	0... 255	1	-
CWP speed threshold for detecting running or stopped CWP					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_REL_CWP_THD_GRD_H_MIN	-	8000... 7FFFH	-32768 ...32767	1	-
Threshold to el. cooling water pump to correct TCO _ SUB model					
C_N_REL_CWP_THD_H_MIN	-	0... FFH	0... 255	1	-
Minimum cooling water pump speed for correcting coolant thermostat diagnosis					
C_T_DLY_TCO_SUB_COR_STATE_COC	-	0... FFFFH	0... 65535	1	s
Delay time after warm-up for coolant temperature substitute value correction factor					
C_T_DLY_TCO_SUB_IS_1	-	0... FFFFH	0... 65535	1	s
Delay time after idle speed to stop the coolant temperature substitute value calculation					
C_T_DLY_TCO_SUB_IS_2	-	0... FFFFH	0... 65535	1	s
Delay time after idle speed to activate the coolant temperature substitute value calculation					
C_T_DLY_TCO_SUB_PUC	-	0... FFFFH	0... 65535	1	s
Delay time after pull fuel cutoff to activate the coolant temperature substitute value calculation					
C_T_DLY_TCO_SUB_ST_CWP_OFF	-	0... FFFFH	0... 6553.5	0.1	s
Delay time after start to activate the coolant temperature substitute value calculation for stopped CWP					
C_T_DLY_TCO_SUB_ST_CWP_ON	-	0... FFFFH	0... 6553.5	0.1	s
Delay time after start to activate the coolant temperature substitute value calculation for running CWP					
C_T_N_REL_CWP_GRD_H	-	0... FFH	0... 255	1	s
Threshold to initialize timer to block TCO-SUB-Model correction					
C_TCO_SUB_COR_H_ON	-	0... FEH	-48... 142.5	0.75	°C
Correction TCO-SUB-model if el. waterpump begins to run					
C_TCO_SUB_MIN_FAC_VS	-	0... FEH	-48... 142.5	0.75	°C
Minimum model temperature to activate the vehicle speed correction factor					
IP_FAC_TCO_SUB_COR_N_REL_CWP	-	0... FFH	0... 4.98046	0.0195313	-
LDP_N_REL_CWP_IP_FAC_TCO_SUB	4	0... FFH	0... 255	1	-
Coolant temperature substitute value correction factor dependend on CWP speed					
IP_FAC_TCO_SUB_INC	V	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_MAF_KGH_IP_TCO_SUB	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDPM_TCO_SUB_IP_TCO_SUB	6	0... FE00H	-48... 142.5	2.9297e-3	°C
Increment factor for the coolant temperature substitute value calculation					
IP_FAC_TCO_SUB_INC_S	V	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_MAF_KGH_IP_TCO_SUB_S	4	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_TCO_SUB_IP_TCO_SUB_S	4	0... FE00H	-48... 142.5	2.9297e-3	°C
Increment factor for the coolant temperature substitute value calculation at operation mode stratified					
IP_FAC_TCO_SUB_VS	V	0... FFFFH	-8... 7.99975	244.1e-6	-
LDP_VS_IP_FAC_TCO_SUB_VS	6	0... FFH	0... 255	1	km/h
LDPM_MAF_KGH_IP_TCO_SUB	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Coolant temperature substitute value correction factor dependend on vehicle speed and engine load					
IP_TCO_SUB_DEC	V	0... FE00H	0... 190.5	2.9297e-3	°C
LDPM_TCO_SUB_IP_TCO_SUB	6	0... FE00H	-48... 142.5	2.9297e-3	°C
LDPM_TAM_IP_TCO_SUB	6	0... FEH	-48... 142.5	0.75	°C
Decrement value for the coolant temperature substitute value calculation					
IP_TCO_SUB_INC	V	0... FE00H	0... 190.5	2.9297e-3	°C
LDPM_MAF_KGH_IP_TCO_SUB	6	0... FFFFH	0... 2047.96875	0.03125	kg/h

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_TAM_IP_TCO_SUB	6	0... FEH	-48... 142.5	0.75	°C
Increment value for the coolant temperature substitute value calculation					
IP_TCO_SUB_INC_IS	V	0... FE00H	-48... 142.5	2.9297e-3	°C
LDP_TCO_SUB_IP_TCO_SUB_INC	6	0... FE00H	-48... 142.5	2.9297e-3	°C
LDP_TAM_IP_TCO_SUB_INC	6	0... FEH	-48... 142.5	0.75	°C
Decrement value for the coolant temperature substitute value calculation					
IP_TCO_SUB_INC_S	V	0... FE00H	0... 190.5	2.9297e-3	°C
LDPM_MAF_KGH_IP_TCO_SUB_S	4	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_TAM_IP_TCO_SUB_S	4	0... FEH	-48... 142.5	0.75	°C
Increment value for the coolant temperature substitute value calculation at operation mode stratified					
IP_TCO_SUB_MAX_TAM	-	0... FEH	-48... 142.5	0.75	°C
LDPM_TAM_IP_TCO_SUB	6	0... FEH	-48... 142.5	0.75	°C
Coolant temperature substitute maximum value dependend on ambient air temperature					

FUNCTION DESCRIPTION:

General information:

The coolant temperature substitute model (TCO_SUB) is initialized with the coolant temperature at engine start (TCO_ST) as soon as the system event “Engine stop” to “Engine run” is detected. The substitute model increment values are dependent on the actual engine performance (equivalent to mass air flow MAF_KGH), ambient temperature and vehicle speed. To take the smaller incrementation values at higher coolant temperatures into consideration, the increment values are weighted.
During “Idle speed” and “Pull fuel cutoff” phases the calculation of the coolant temperature substitute value remains activated.
A delay time after engine start to activate the incrementation of the temperature substitute value is incremented, to simulate the warm up of the real coolant temperature very efficient.
In case of a coolant temperature acquisition failure (LV_ERR_TCO = 1), the coolant temperature substitute value is reinitialized with the latest valid coolant temperature value. In this case the model incrementation starts from the initialization value on.

Application conditions

Initialisation at Engine stop to Engine run (ES_to_ERU): T_DLY_TCO_SUB = 0
T_DLY_TCO_SUB_COR_STATE_COC = 0
$TCO\_SUB_{(n)} = TCO\_SUB_{(n-1)} = TCO\_ST$
FAC_TCO_SUB_COR_STATE_COC = 1

Initialisation at Exit start (EXIT_ST): LV_CDN_ENA_TCO_SUB = 1
T_N_REL_CWP_GRD_H = C_T_N_REL_CWP_GRD_H
CTR_N_REL_CWP_H = C_CTR_N_REL_CWP_H

Initialisation at Engine run to Engine stop (ERU_to_ES): LV_CDN_ENA_TCO_SUB = 0

Recurrence: *1000 ms*

Activation: *LV_CDN_ENA_TCO_SUB = 1*

Deactivation: *LV_CDN_ENA_TCO_SUB = 0*

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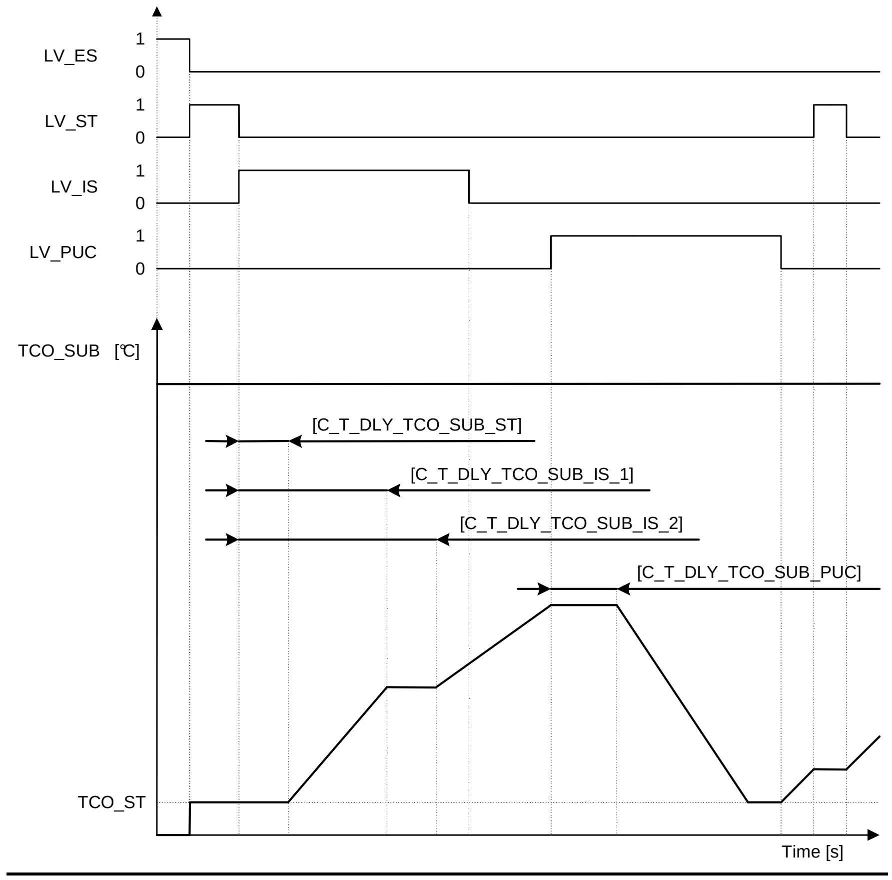
Signal flow diagram:



Formula section:

Calculation of the factor FAC_TCO_SUB_COR_STATE_COC for CWP functionality:

If N_REL_CWP < C_N_REL_CWP_THD_COC

then T_DLY_TCO_SUB_COR_STATE_COC = 0
T_DLY_THD_TCO_SUB_ST = C_T_DLY_TCO_SUB_ST_CWP_OFF
FAC_TCO_SUB_COR_STATE_COC = 1

else T_DLY_THD_TCO_SUB_ST = C_T_DLY_TCO_SUB_ST_CWP_ON

if T_DLY_TCO_SUB_COR_STATE_COC
< C_T_DLY_TCO_SUB_COR_STATE_COC

then FAC_TCO_SUB_COR_STATE_COC =
C_FAC_TCO_SUB_COR_STATE_COC

else FAC_TCO_SUB_COR_STATE_COC = 1

endif

T_DLY_TCO_SUB_COR_STATE_COC =
T_DLY_TCO_SUB_COR_STATE_COC + 1 s

endif

Calculation of factor FAC_TCO_SUB_COR_N_REL_CWP for CWP functionality:

FAC_TCO_SUB_COR_N_REL_CWP =
IP_FAC_TCO_SUB_COR_N_REL_CWP
* FAC_TCO_SUB_COR_STATE_COC

Calculation of the substitute model increment value during “Engine start”:

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If LV_ST = 1
then TCO_SUB_INC = 0
endif

Calculation of factor FAC_TCO_SUB_VS for vehicle speed functionality:

If (TCO_SUB >= C_TCO_SUB_MIN_FAC_VS)
then
FAC_TCO_SUB_VS = IP_FAC_TCO_SUB_VS
else
FAC_TCO_SUB_VS = 1
endif

Calculation of the substitute model increment value during “Part load” or “Pull”:

If (1) LV_PL = 1 **or**
LV_PU = 1
then (1)
if (2) OPM_AV= S *(at operation mode stratified)*
then (2)
TCO_SUB_INC =
IP_TCO_SUB_INC_S * IP_FAC_TCO_SUB_INC_S *
FAC_TCO_SUB_COR* FAC_TCO_SUB_COR_N_REL_CWP *
FAC_TCO_SUB_VS
else (2)
TCO_SUB_INC =
IP_TCO_SUB_INC * IP_FAC_TCO_SUB_INC * FAC_TCO_SUB_COR
* FAC_TCO_SUB_COR_N_REL_CWP * FAC_TCO_SUB_VS
endif (2)
endif (1)

Calculation of the substitute model increment value during “Pull fuel cutoff”:

If Transition: LV_PUC = 0 -> LV_PUC = 1
then T_DLY_TCO_SUB = 0
endif
if (1) LV_PUC = 1
then (1)
if (2) T_DLY_TCO_SUB < C_T_DLY_TCO_SUB_PUC
then (2) TCO_SUB_INC = 0
else (2) TCO_SUB_INC = **-(** IP_TCO_SUB_DEC **)**
endif (2)
T_DLY_TCO_SUB = T_DLY_TCO_SUB + 1 s
endif (1)

Calculation of the substitute model increment value during “Idle speed”:

If Transition: LV_IS = 0 -> LV_IS = 1
then T_DLY_TCO_SUB = 0
endif
if (1) LV_IS = 1
then (1)
if (2) T_DLY_TCO_SUB < C_T_DLY_TCO_SUB_IS_1 **or**
T_DLY_TCO_SUB > C_T_DLY_TCO_SUB_IS_2
if (3) OPM_AV= S *(at operation mode stratified)*
then (3)
TCO_SUB_INC =

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IP_TCO_SUB_INC_S * IP_FAC_TCO_SUB_INC_S*
FAC_TCO_SUB_COR* FAC_TCO_SUB_COR_N_REL_CWP
else (3)
TCO_SUB_INC =
IP_TCO_SUB_INC * IP_FAC_TCO_SUB_INC * FAC_TCO_SUB_COR
* FAC_TCO_SUB_COR_N_REL_CWP
endif (3)
else (2) TCO_SUB_INC = IP_TCO_SUB_INC_IS
endif (2)
T_DLY_TCO_SUB = T_DLY_TCO_SUB + 1 s
endif (1)

Correction of the coolant temperature substitute model value during N_REL_CWP increasing:

Gradient of N _ REL _ CWP:
N_REL_CWP_GRD = N_REL_CWP - N_REL_CWP_OLD
N_REL_CWP_OLD = N_REL_CWP

TCO_SUB correction if N _ REL _ CWP is active

If N_REL_CWP_GRD $>$ C_N_REL_CWP_THD_GRD_H_MIN
AND N_REL_CWP $>$ C_N_REL_CWP_THD_H_MIN
AND CTR_N_REL_CWP_H $>$ 0
AND T_N_REL_CWP_GRD_H = 0 (timer is finished)

then
T_N_REL_CWP_GRD_H = C_T_N_REL_CWP_GRD_H (initialize timer)
CTR_N_REL_CWP_H = CTR_N_REL_CWP_H -1 (reduce counter)
TCO_SUB = TCO_SUB + C_TCO_SUB_COR_H_ON; (reduce TCO_SUB)

endif

if T_N_REL_CWP_GRD_H $>$ 0
then
T_N_REL_CWP_GRD_H = T_N_REL_CWP_GRD_H -1 (timer)
endif

Calculation of the coolant temperature substitute model value:
If (1) LV_ERR_TCO = 0
then (1) FAC_TCO_SUB_COR = 1
else (1) FAC_TCO_SUB_COR = C_FAC_TCO_SUB_COR
endif (1)

If (1) T_AST $<$ T_DLY_THD_TCO_SUB_ST
then (1) TCO_SUB$_{(n)}$ = TCO_SUB$_{(n-1)}$
else (1)
if (2) Transition: LV_ERR_TCO = 0 -> LV_ERR_TCO =1
then (2) TCO_SUB$_{(n)}$ = TCO$_{(n-1)}$
(re-initialization of TCO_SUB with the last plausible TCO value)

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else (2)
if(3) TCO_SUB$_{(n-1)}$ <= IP_TCO_SUB_MAX_TAM **or** TCO_SUB_INC $<$ 0
then(3) TCO_SUB$_{(n)}$ = TCO_SUB$_{(n-1)}$ + TCO_SUB_INC
else(3) TCO_SUB$_{(n)}$ = TCO_SUB$_{(n-1)}$
endif(3)
endif (2)
endif (1)

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4.5 Driving off assistance

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ISC_OFF_DROF	O/V	0... 1H	0 ...1	1	-
Boolean to enable/disable idle speed controller during drive off; 1=disabled					
LV_TQ_DROF_IS_AD_INH	O/V	0... 1H	0 ...1	1	-
flag for inhibition of IS control adaptations					
N_DIF_DROF	V	8000... 7FFFH	0... 32767	1	rpm
Engine speed deviation for DROF					
N_DIF_PRED_PL_DROF	V	8000... 7FFFH	0... 32767	1	rpm
Predicted idle speed control variable at drive off support					
TQ_ADD_PL_DROF	O/V	0... 7FFFH	0... 1023.97	0.03125004	Nm
TQ reserve for drive off support					
TQ_DROF_FAST	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
TQ request for drive off assistance					
TQ_DROF_SLOW	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
TQ request for drive off assistance					

Input data:

FAC_TQ_REQ {p. 6706}	LV_AT {p. 654}	LV_BRAKE_DET {p. 4209}	LV_CS {p. 8394}
LV_ERR_CRK {p. 4455}	LV_ERR_PVS {p. 4216}	LV_ERR_VS {p. 5021}	LV_N_SP_IS_CS {p. 1122}
LV_ST_END {p. 1720}	LV_VAR_TCT {p. 656}	N {p. 1525}	N_DIF {p. 1122}
N_GRD {p. 1525}	N_SP_IS {p. 1122}	OPM_AV {p. 8137}	TIA {p. 1226}
TOIL {p. 8204}	TQ_AV {p. 6656}	VS_FIL {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_DIF_DROF_MAX	-	8000... 7FFFH	0... 32767	1	rpm
Maximum N_DIF_DROF for function TQ_DROF					
C_N_DIF_DROF_MIN	-	8000... 7FFFH	0... 32767	1	rpm
Minimum N_DIF_DROF for function TQ_DROF					
C_T_TQ_DROF_DLY_AD	-	0... FFH	0... 2.55	0.01	s
timer TQ_DROF for inhibition of IS control adaptations					
C_TQ_ADD_PL_DROF_LGRD	-	0... FFH	0... 7.96875	0.03125	Nm
Gradient limitation for drive off support TQ reserve					
C_TQ_DROF_AD	-	8000... 7FFFH	0... 1023.97	0.03125	Nm
threshold TQ_DROF for inhibition of IS control adaptations					
ID_IDX_OPM_DROF	-	0... 1H	0 ...1	1	-
LDPM_OPM_AV	8	0... 8H	0 ...8	1	
Switch map to choose DROF calculation path (OPM_1 or OPM_2) depending on OPM_AV					
ID_TQ_DROF_ENA	-	0... 1H	0 ...1	1	-
LDP_N_DIF_DROF__ID_TQ_DROF	3	0... FFFFH	0... 32767	1	rpm
LDP_N_GRD__ID_TQ_DROF	3	0... FFH	0... 4064	32	rpm/s
enable conditions					
IP_FAC_N_GRD_TQ_AV	-	0... FFFFH	0... 1.999969	305.176e3	-
LDP_TQ_AV_IP_FAC_N_GRD	4	0... FFFFH	0... 1023.97	0.03125	Nm
Weighing of additive part of N_DIF_DROF dependant from actual torque					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_TEMP_TQ_ADD_DROF_OPM_1	-	0... FFFFH	0... 1.99996948	305.176e3	-
LDP_TIA_IP_FAC_TEMP_TQ_ADD_1	6	0... FEH	0... 142.5	0.75	°C
LDP_TOIL_IP_FAC_TEMP_TQ_ADD_1	6	0... C8H	0... 160	1	°C
Temperature correction for IP_TQ_ADD_PL_DROF in operation mode 1					
IP_FAC_TEMP_TQ_ADD_DROF_OPM_2	-	0... FFFFH	0... 1.99996948	305.176e3	-
LDP_TIA_IP_FAC_TEMP_TQ_ADD_1	6	0... FEH	0... 142.5	0.75	°C
LDP_TOIL_IP_FAC_TEMP_TQ_ADD_1	6	0... C8H	0... 160	1	°C
Temperature correction for IP_TQ_ADD_PL_DROF in operation mode 2					
IP_FAC_TQ_DROF_FAC_TQ_REQ	-	0... FFFFH	0... 1.999969	305.176e3	-
LDP_FAC_TQ_REQ_IP_FAC_TQ_DROF	6	0... FFFFH	0... 1.99996	305e3	
Weighing of IP_TQ_DROF dependant from FAC_TQ_REQ					
IP_FAC_TQ_DROF_VS_OPM_1	-	0... FFFFH	0... 1.99996948	305.176e3	-
LDP_VS_FIL_IP_FAC_TQ_DROF_VS_1	6	0... FFFFH	0... 511.99218	0.0078125	km/h
LDP_N_IP_FAC_TQ_DROF_VS_1	6	0... 1FE0H	0... 8160	1	rpm
Weighing of IP_TQ_DROF dependant from engine and vehicle speed in operation mode 1					
IP_FAC_TQ_DROF_VS_OPM_2	-	0... FFFFH	0... 1.99996948	305.176e3	-
LDP_VS_FIL_IP_FAC_TQ_DROF_VS_1	6	0... FFFFH	0... 511.99218	0.0078125	km/h
LDP_N_IP_FAC_TQ_DROF_VS_1	6	0... 1FE0H	0... 8160	1	rpm
Weighing of IP_TQ_DROF dependant from engine and vehicle speed in operation mode 2					
IP_FAC_VS_TQ_ADD_PL_DROF	-	0... FFFFH	0... 1.999969	305.176e3	-
LDP_VS_FIL_IP_FAC_VS_TQ_ADD_PL	4	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction for IP_TQ_ADD_PL_DROF					
IP_N_DIF_ADD_DROF_OPM_1	-	0... FFFFH	0... 32767	1	rpm
LDP_N_GRD_IP_N_DIF_ADD_DROF_1	4	0... FFH	0... 4064	32	rpm/s
LDP_N_SP_IS_IP_N_DIF_ADD_DROF_1	4	0... 1FE0H	0... 8160	1	rpm
Additive part of N_DIF_DROF dependant from engine speed gradient in operation mode 1					
IP_N_DIF_ADD_DROF_OPM_2	-	0... FFFFH	0... 32767	1	rpm
LDP_N_GRD_IP_N_DIF_ADD_DROF_1	4	0... FFH	0... 4064	32	rpm/s
LDP_N_SP_IS_IP_N_DIF_ADD_DROF_1	4	0... 1FE0H	0... 8160	1	rpm
Additive part of N_DIF_DROF dependant from engine speed gradient in operation mode 2					
IP_T_N_DIF_OFS_PRED_DROF	-	0... FFH	0... 7.96875	0.03125	s
LDPM_N_T_N_DIF_OFS_PRED	8	0... 1FE0H	0... 8160	1	rpm
Time constant for calculation of predicted engine speed deviation at drive off support (PL)					
IP_TQ_ADD_PL_DROF_OPM_1	-	0... 7FFFH	0... 1023.97	0.03125	Nm
LDP_N_DIF_PRED_FAC_TQ_ADD_IS_1	6	0... FFFFH	0... 32767	1	rpm
LDP_FAC_TQ_REQ_DROF_1	6	0... FFFFH	0... 1.99996	305e3	
Torque reserve at part load for drive off support in operation mode 1					
IP_TQ_ADD_PL_DROF_OPM_2	-	0... 7FFFH	0... 1023.97	0.03125	Nm
LDP_N_DIF_PRED_FAC_TQ_ADD_IS_1	6	0... FFFFH	0... 32767	1	rpm
LDP_FAC_TQ_REQ_DROF_1	6	0... FFFFH	0... 1.99996	305e3	
Torque reserve at part load for drive off support in operation mode 2					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TQ_DROF_FAST_OPM_1	-	0... FFFFH	0... 1023.97	0.03125	Nm
LDPM_N_DIF_DROF_IP_TQ_DROF_1	11	0... FFFFH	0... 32767	1	rpm
LDPM_N_GRD_IP_TQ_DROF_1	10	0... FFH	0... 4064	32	rpm/s
Torque for driving off assistance, basic value value in operation mode 1					
IP_TQ_DROF_FAST_OPM_2	-	0... FFFFH	0... 1023.97	0.03125	Nm
LDPM_N_DIF_DROF_IP_TQ_DROF_1	11	0... FFFFH	0... 32767	1	rpm
LDPM_N_GRD_IP_TQ_DROF_1	10	0... FFH	0... 4064	32	rpm/s
Torque for driving off assistance, basic value value in operation mode 2					
IP_TQ_DROF_GRD_DEAC_OPM_1	-	0... 7FFFH	0... 1023.97	0.03125	Nm
LDP_TQ_DROF_GRD_DEAC_1	6	0... 7FFFH	0... 1023.97	0.03125	Nm
Decrement for the termination ramp of TQ_DROF_SLOW/_FAST in operation mode 1					
IP_TQ_DROF_GRD_DEAC_OPM_2	-	0... 7FFFH	0... 1023.97	0.03125	Nm
LDP_TQ_DROF_GRD_DEAC_2	6	0... 7FFFH	0... 1023.97	0.03125	Nm
Decrement for the termination ramp of TQ_DROF_SLOW/_FAST in operation mode 2					
IP_TQ_DROF_SLOW_OPM_1	-	0... FFFFH	0... 1023.97	0.03125	Nm
LDPM_N_DIF_DROF_IP_TQ_DROF_1	11	0... FFFFH	0... 32767	1	rpm
LDPM_N_GRD_IP_TQ_DROF_1	10	0... FFH	0... 4064	32	rpm/s
Torque for driving off assistance, basic value in operation mode 1					
IP_TQ_DROF_SLOW_OPM_2	-	0... FFFFH	0... 1023.97	0.03125	Nm
LDPM_N_DIF_DROF_IP_TQ_DROF_1	11	0... FFFFH	0... 32767	1	rpm
LDPM_N_GRD_IP_TQ_DROF_1	10	0... FFH	0... 4064	32	rpm/s
Torque for driving off assistance, basic value in operation mode 2					
LC_TQ_ADD_PL_DROF_ENA_BRAKE	-	0... 1H	0 ...1	1	-
Switch to select deactivation of drive off support TQ reserve by brake pedal; 0: deactivation when brake, 1: no deactivation when brake					
LC_TQ_DROF_ISC_OFF	-	0... 1H	0 ...1	1	-
Boolean to enable/disable idle speed controller during drive off; 1=disabled					

FUNCTION DESCRIPTION:

The function Driving off assistance shall prevent the engine from stalling at driving off. Therefore an extra torque reserve is put at disposal if the necessity is given. This is shown by LV_N_SP_IS_CS = 1.defined in Engine speed setpoint calculation
In addition, an extra torque request is calculated under individual conditions. While this extra torque is effective, the idle speed controller can be suppressed or not via LC_TQ_DROF_ISC_OFF.

Application Condition

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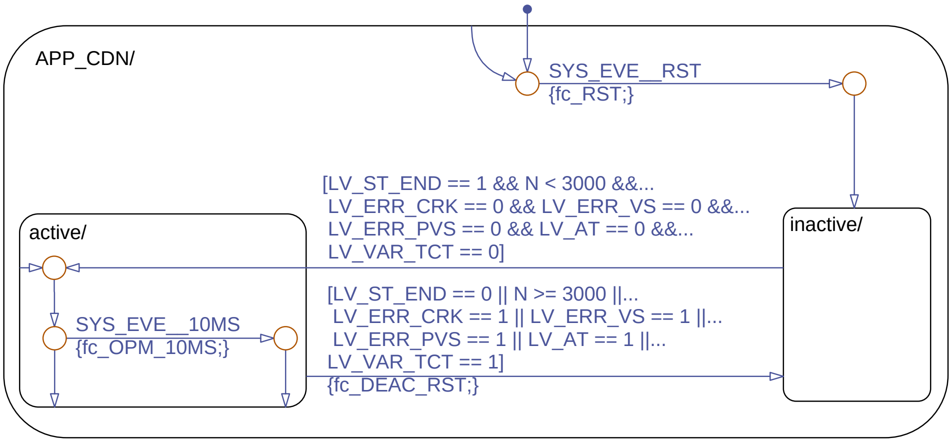

Figure 4.5.1: ENSC_M4067/APP_CDN/Chart

Function Description

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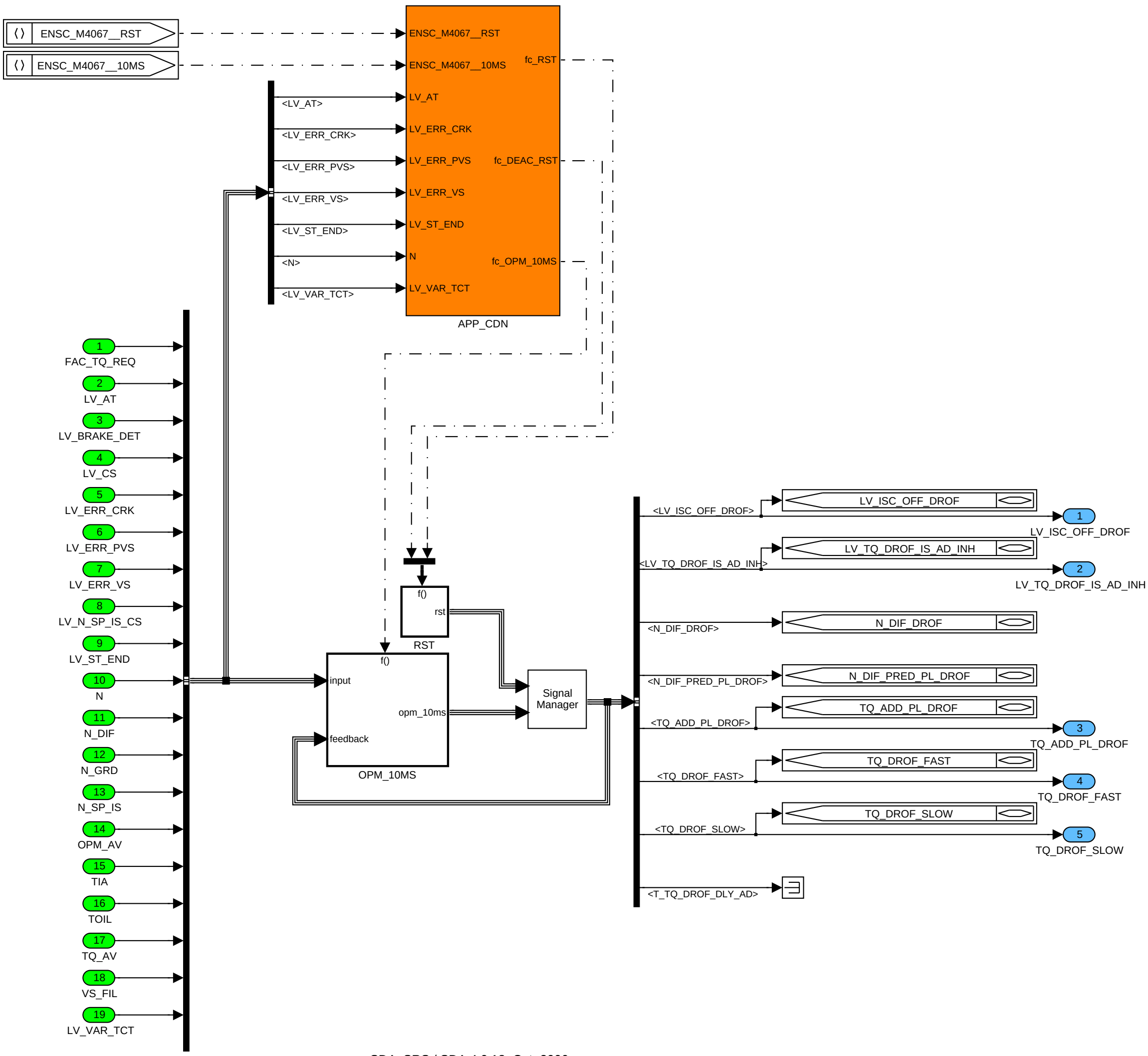

Figure 4.5.2: ENSC_M4067

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4.5.1 Initialisation:

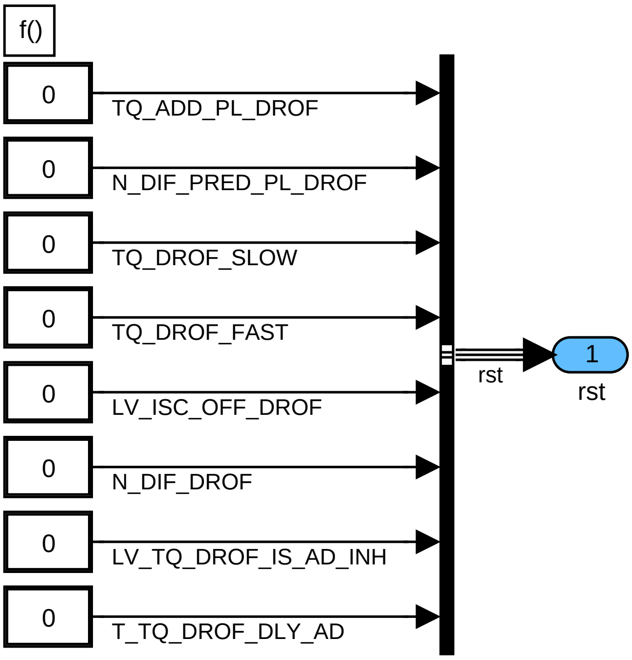

Figure 4.5.3: ENSC_M4067/RST

4.5.2 Function Overview:

Calculation of additive & predicted drive off:

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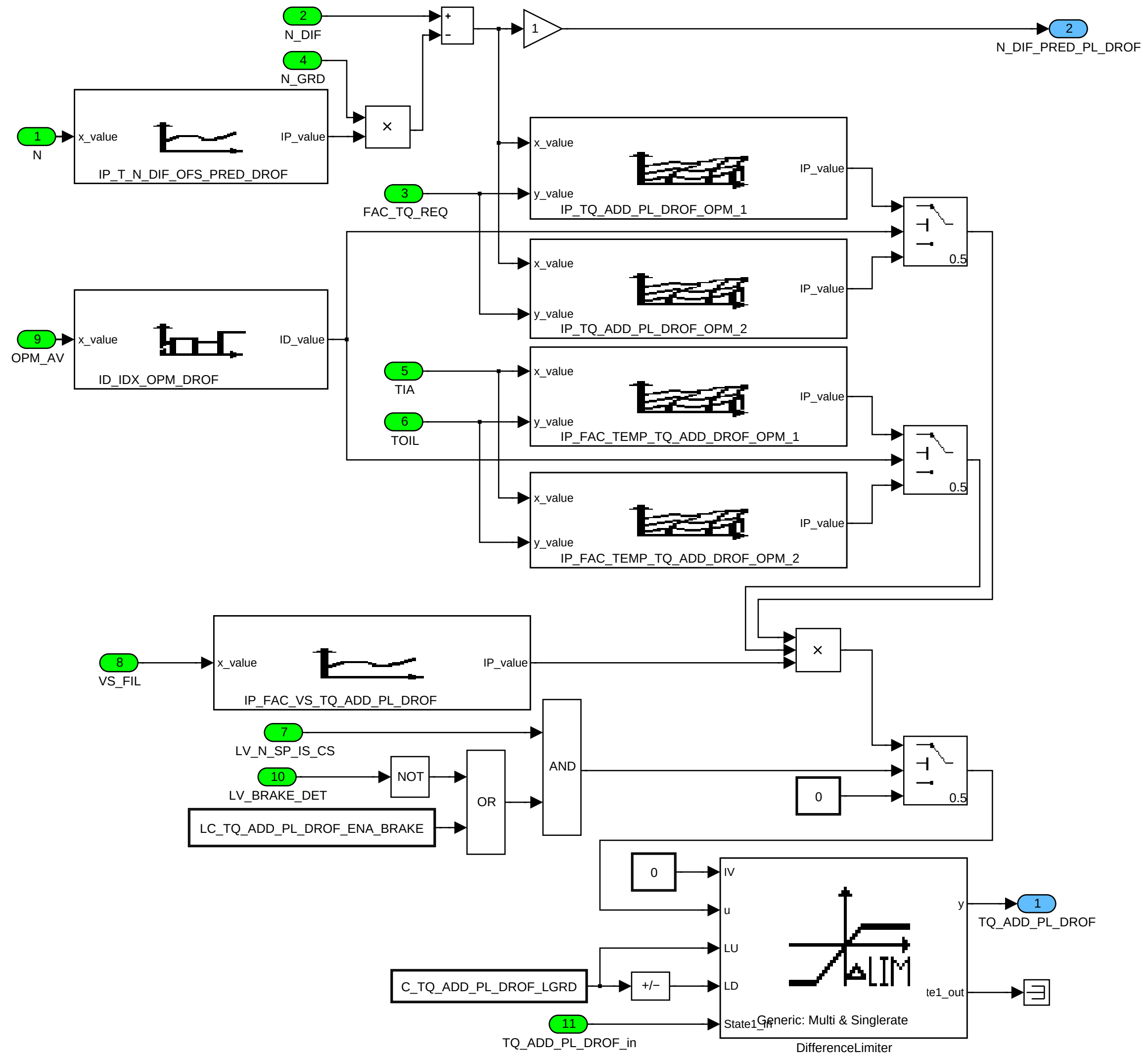

Figure 4.5.4: ENSC_M4067/OPM_10MS/CLC_TQ_ADD_PL_DROF

Determination of TQ_DROF_FAST, TQ_DROF_SLOW and LV_ISC_OFF_DROF:

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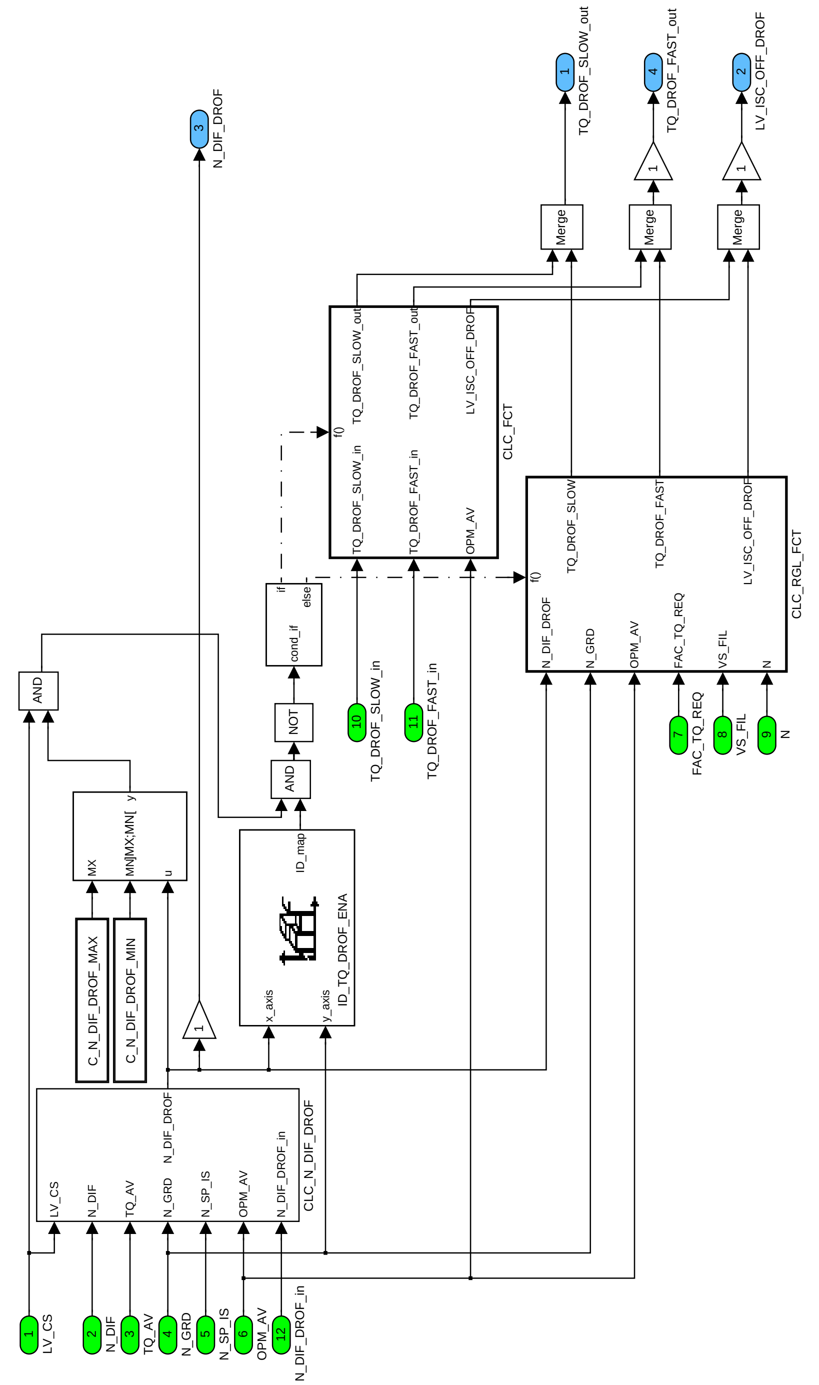

Figure 4.5.5: ENSC_M4067/OPM_10MS/CLC_INH_FAST_SLOW_DROF

Calculation of N_DIF_DROF:

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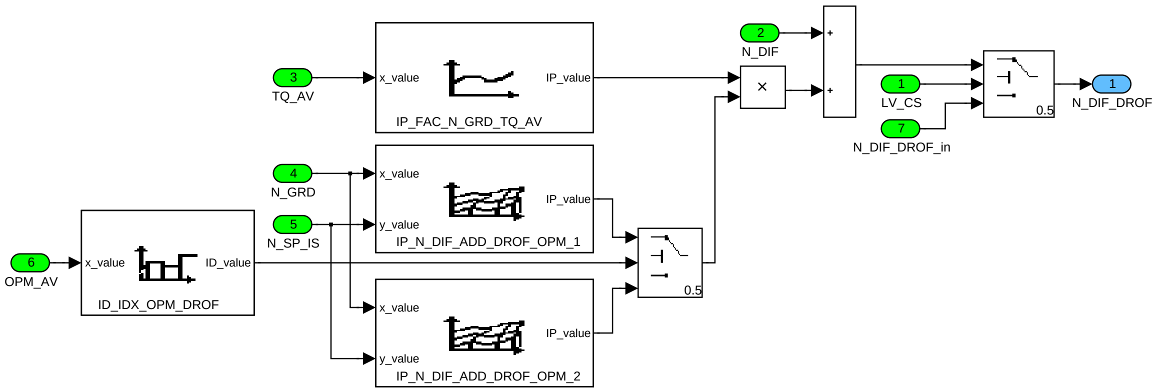

Figure 4.5.6: ENSC_M4067/OPM_10MS/CLC_INH_FAST_SLOW_DROF/CLC_N_DIF_DROF

Function termination:

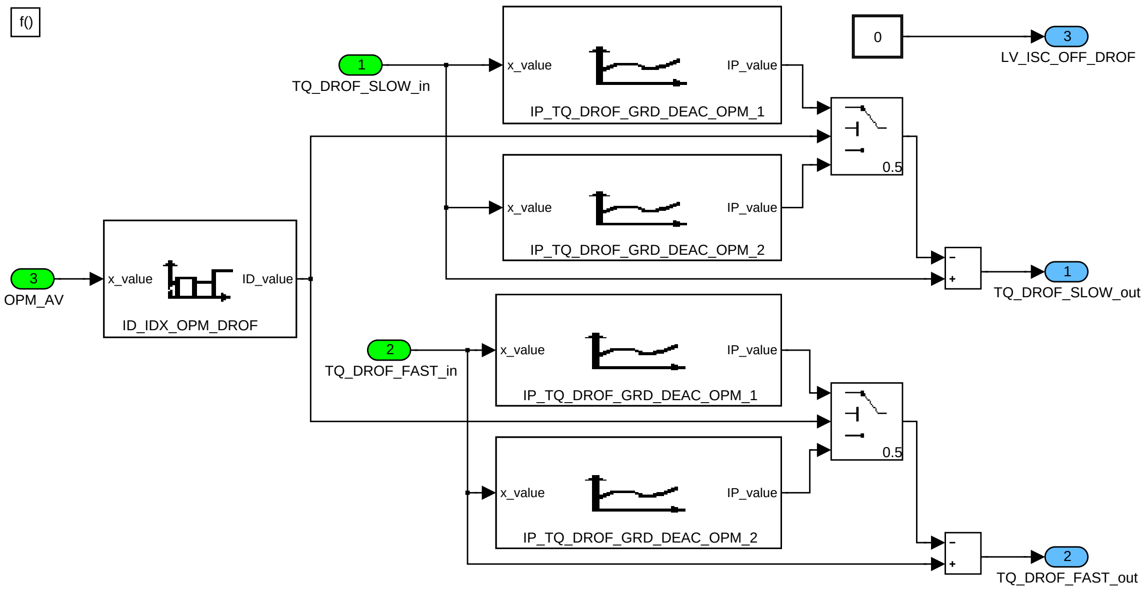

Figure 4.5.7: ENSC_M4067/OPM_10MS/CLC_INH_FAST_SLOW_DROF/CLC_FCT

Regular function:

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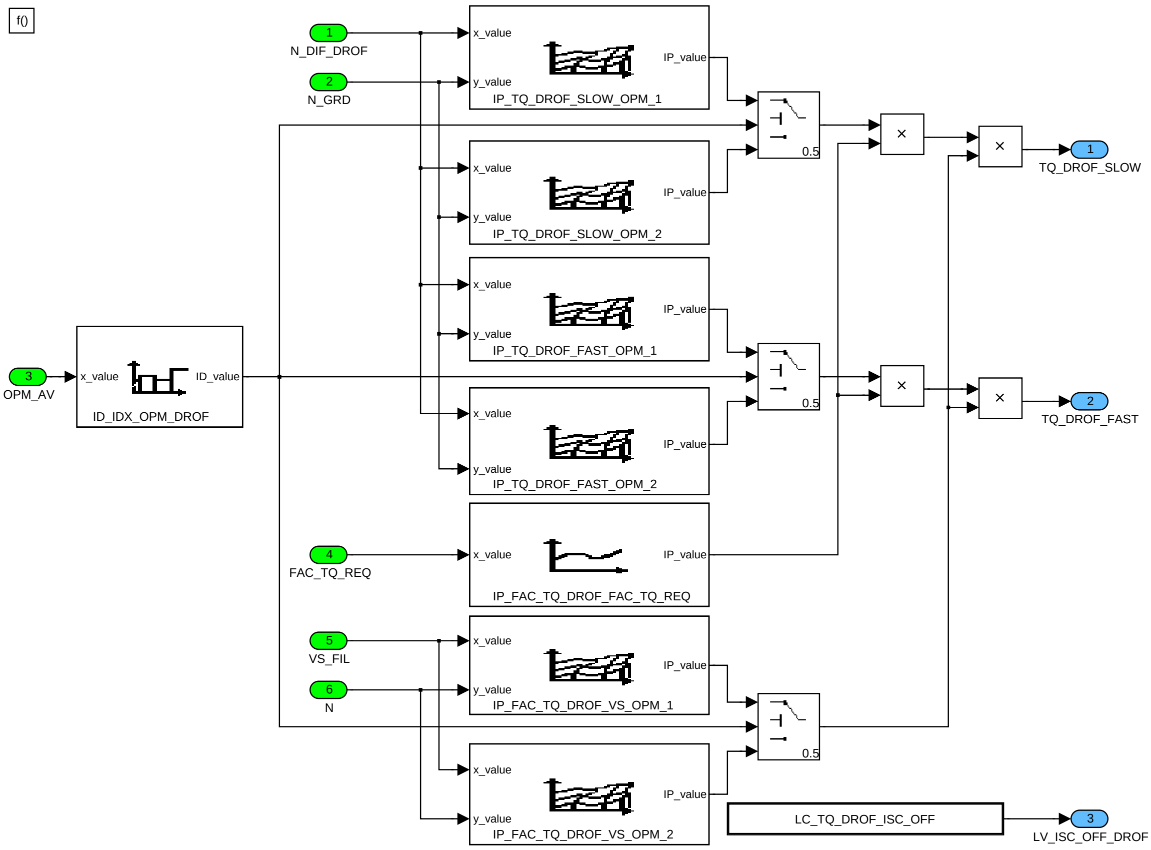

Figure 4.5.8: ENSC_M4067/OPM_10MS/CLC_INH_FAST_SLOW_DROF/CLC_RGL_FCT

Condition for initialisation of IS control adaptations:

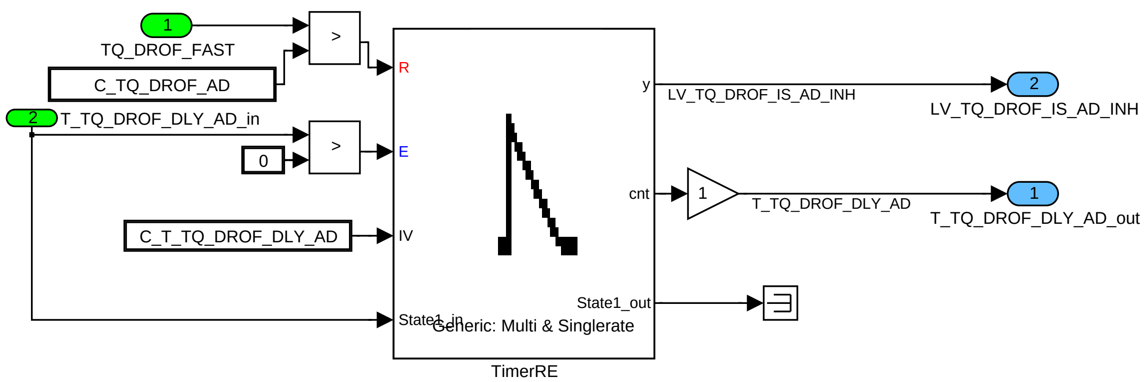

Figure 4.5.9: ENSC_M4067/OPM_10MS/CLC_IS_AD

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4.6 Engine speed setpoint calculation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_N_SP_IS_CS	O/V	0... 1H	0 ...1	1	-
1: conditions for increased idle speed /torque reserve for drive-off-support fulfilled					
LV_N_SP_IS_PSTE	O/V	0... 1H	0 ...1	1	-
1: conditions for increased idle speed /torque reserve for power steering					
LV_N_SP_IS_PSTE_2	O/V	0... 1H	0 ...1	1	-
1: conditions for increased idle speed /torque reserve for power steering for second VS threshold					
LV_REQ_HEAT_N_SP_IS	V	0... 1H	0 ...1	1	-
1: idle Speed setpoint required from heating control unit					
N_DIF	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
Engine speed deviation N_SP_IS-N					
N_DIF_COR	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
Idle speed control variable					
N_DIF_MMV	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
N_DIF moving mean value					
N_DIF_ST	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
Engine speed deviation N_MAX_TOL_ST - N					
N_MAX_TOL_ST	O/V	0... FFH	0... 8160	32	rpm
Top level end of start engine speed					
N_SP_IS	O/V	0... 1FE0H	0... 8160	1	rpm
Idle Speed Setpoint					
N_SP_IS_2	O/V	0... 1FE0H	0... 8160	1	rpm
basis idle speed setpoint					
N_SP_IS_3	V	0... 1FE0H	0... 8160	1	rpm
greatest of all idle speed setpoints					
N_SP_IS_CS	O/V	0... 1FE0H	0... 8160	1	rpm
Idle-speed setpoint given by DROF					
N_SP_IS_POW	V	0... 1FE0H	0... 8160	1	rpm
active nominal idle speed setpoint by power management active					
N_SP_IS_PWR_STAB	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint for power supply stability					
N_SP_IS_RATIO	O/V	0... FFFFH	0... 7.9998779296875	122.07e-6	-
Ratio between actual engine speed and engine speed setpoint					
N_SP_IS_TCT	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoints for TCT					

Input data:

ANG_PSTE {p. 1561}	C_N_MAX_KWP {p. 7439}	C_VS_MAX_KWP {p. 7439}	CTR_KM_CAN {p. 1563}
GEAR_INFO {p. 1564}	ID_IDX_OPM_DROF {p. 1112}	IGA_MV_ADJ_KNK_CUS {p. 8304}	LV_ACIN {p. 1564}
LV_ACT_N_SP_IS_BAS_EXT_ADJ {p. 7680}	LV_ACT_N_SP_IS_EXT_ADJ {p. 7763}	LV_ACT_SA_EOL {p. 7763}	LV_AT {p. 654}

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LV_CH_N_SP_IS {p. 1775}	LV_CS {p. 8394}	LV_DLY_N_SP_IS {p. 6710}	LV_DRI {p. 1302}
LV_ERR_FTL_MIN {p. 4762}	LV_FUP_LIH_L_PRS_CTL_REQ {p. 4001}	LV_IS {p. 1720}	LV_N_SP_IS_LIH_ACT {p. 4216}
LV_N_SP_IS_POW_ACT {p. 8368}	LV_N_SP_IS_PWR_STAB {p. 8368}	LV_NT_SO2P_EXT_ADJ_ACT {p. 3144}	LV_PL {p. 1720}
LV_PSTE_2_DISABLE {p. 6621}	LV_PSTE_3_DISABLE {p. 6621}	LV_PSTE_DISABLE {p. 6621}	LV_REQ_HEAT {p. 1567}
LV_ST_END {p. 1720}	LV_VAR_ACIN {p. 655}	LV_VAR_ARS {p. 655}	LV_VAR_PSTE_2 {p. 656}
LV_VAR_PSTE_3 {p. 656}	LV_VAR_TCT {p. 656}	N {p. 1525}	N_FAST {p. 1525}
N_SP_IS_BRAKE {p. 8212}	N_SP_IS_CH {p. 3564}	N_SP_IS_EXT_ADJ {p. 7763}	N_SP_IS_POIL_CTL {p. 8212}
N_SP_IS_POW_1 {p. 8212}	N_SP_IS_TCT_CAN {p. 1569}	N_SP_OFS_KWP {p. 7681}	OPM_AV {p. 8137}
STATE_PSTE_3_SRC {p. 1576}	T_AST {p. 1766}	TAM {p. 1579}	TCO {p. 1100}
TOIL {p. 8204}	TQ_LOSS {p. 8385}	VEL_ANG_PSTE {p. 1582}	VS {p. 1176}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ANG_EPS_ISC	V	0... 7FFFH	0... 1439.945815	0.043945	°STW
Minimum ANG_PSTE for N_SP_EPS					
C_ANG_PSTE_ISC	V	0... 7FFFH	0... 1439.945815	0.043945	°STW
Minimum ANG_PSTE for N_SP_PSTE					
C_DRI_VS_MIN_VB	V	0... FFH	0... 255	1	km/h
Minimum vehicle speed for activating battery charging in case LV_DRI = 1					
C_IGA_ADJ_HYS_N_SP_IS	V	0... 80H	-48 ...0	0.375	°CRK
Spark retard hysteresis for idle speed setpoint N_SP_IS_KNK					
C_IGA_ADJ_THD_N_SP_IS	V	0... 80H	-48 ...0	0.375	°CRK
Spark retard threshold for activating idle speed setpoint N_SP_IS_KNK					
C_N_DIF_CRLC	V	0... FFH	0... 0.99609375	0.00390625	-
Correlation factor for N_DIF_MMV calculation					
C_N_DIF_FAC	V	0... FFH	0... 0.99609375	0.00390625	-
Multiplicative factor for N_DIF_COR calculation					
C_N_DIF_MIN_MMV	V	F010... 0H	-4080 ...0	1	rpm
Minimum filtering constant					
C_N_SP_DEC_CS	V	1... FFH	0.0625... 15.9375	0.0625	rpm
Decrement engine speed setpoint for drive-off-support					
C_N_SP_DEC_IS_CH_DRI	V	1... FFH	0.0625... 15.9375	0.0625	rpm/10ms
Idle speed change limitation during catalyst heating and LV_DRI = 1					
C_N_SP_DEC_PL	V	1... FFH	0.0625... 15.9375	0.0625	rpm
Decrement idle speed setpoint for part load					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_SP_DEC_PSTE	V	1... FFH	0.0625... 15.9375	0.0625	rpm
C_N_SP_DEC_PSTE					
C_N_SP_HEAT_AT	V	0... 1FE0H	0... 8160	1	rpm
Idle speed at heater request, automatic transmission vehicle					
C_N_SP_HEAT_MT	V	0... 1FE0H	0... 8160	1	rpm
Idle speed at heater request, manual transmission vehicle					
C_N_SP_INC_CS	V	1... FFH	0.0625... 15.9375	0.0625	rpm
Increment engine speed setpoint for drive-off-support					
C_N_SP_INC_PL	V	1... FFH	0.0625... 15.9375	0.0625	rpm
Increment idle speed setpoint for part load					
C_N_SP_INC_PSTE	V	1... FFH	0.0625... 15.9375	0.0625	rpm
Increment engine speed setpoint for power steering					
C_N_SP_IS_ARS_AT	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint ARS, automatic transmission vehicle					
C_N_SP_IS_ARS_MT	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint ARS, manual transmission vehicle					
C_N_SP_IS_PSTE_2_AT	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint PSTE_2, automatic transmission vehicle					
C_N_SP_IS_PSTE_2_MT	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint PSTE_2, manual transmission vehicle					
C_N_SP_IS_PWR_STAB	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint for power supply stability					
C_N_SP_IS_PWR_STAB_DRI	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint for power supply stability and driving position engaged					
C_N_SP_IS_SA_EOL	V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint during the "secondary air function end of line test"					
C_N_SP_LGRD_IS	V	1... FFH	0.0625... 15.9375	0.0625	rpm/10ms
Nominal idle speed change limitation					
C_N_SP_LGRD_IS_LIH	V	1... FFH	0.25... 63.75	0.25	rpm/10ms
Minimum filtering constant					
C_N_SP_OFS_KWP_MAX	V	0... 7FFFH	0... 32767	1	rpm
Upper threshold for tester offset					
C_N_SP_OFS_KWP_MIN	V	8000... FFFFH	-32768 ...-1	1	rpm
C_N_SP_OFS_KWP_MIN					
C_NT_SO2P_EXT_ADJ_ACT	V	0... 1FE0H	0... 8160	1	rpm
idle speed setpoints for SO2P in service					
C_T_ANG_DLY_N_SP_DEC_PSTE	V	0... FFFFH	0... 655.35	0.01	s
Delay time for decrement engine speed setpoint for power steering angle and velocity					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_GRD_LIM	V	0... 7FFH	0... 20.47	0.01	s
Delay time of N_SP_IS gradient limitation					
C_T_VS_DLY_N_SP_DEC_PSTE	V	0... FFFFH	0... 655.35	0.01	s
Delay time for decrement engine speed setpoint for power steering vehicle speed					
C_TAM_HYS	V	0... 40H	0... 48	0.75	°C
Hysteresis for ambient temperature threshold					
C_TAM_N_SP_HEAT	V	0... FEH	-48... 142.5	0.75	°C
Ambient temperature threshold idle speed at heater request					
C_TAM_N_SP_IS_KNK	V	0... FEH	-48... 142.5	0.75	°C
Ambient temperature for N_SP_IS_KNK calculation					
C_TOIL_HYS_N_SP_IS	V	0... C8H	-40 ...160	1	°C
TOIL hysteresis for idle speed setpoint					
C_TOIL_THD_N_SP_IS	V	0... C8H	-40 ...160	1	°C
C_TOIL_THD_N_SP_IS					
C_VEL_ANG_EPS_ISC	V	0... 7FFFH	0... 1439.945815	0.043945	°STW/s
Minimum VEL_ANG_PSTE for N_SP_EPS					
C_VEL_ANG_PSTE_ISC	V	0... 7FFFH	0... 1439.945815	0.043945	°STW/s
Minimum VEL_ANG_PSTE for N_SP_PSTE					
C_VS_HYS_N_SP_CS	V	0... FFH	0... 255	1	km/h
Vehicle speed hysteresis for VS threshold drive-off-support					
C_VS_MAX_N_SP_CS	V	0... FFH	0... 255	1	km/h
Maximum vehicle speed for drive-off-support					
C_VS_MAX_N_SP_IS_ARS	V	0... FFH	0... 255	1	km/h
Maximum vehicle speed for N_SP_IS_ARS					
C_VS_MIN_N_SP_EPS	V	0... FFH	0... 255	1	km/h
Minimum vehicle speed threshould for N_SP_EPS					
C_VS_MIN_N_SP_IS_ARS	V	0... FFH	0... 255	1	km/h
Minimum vehicle speed for N_SP_IS_ARS					
C_VS_MIN_N_SP_PSTE	V	0... FFH	0... 255	1	km/h
Minimum vehicle speed threshould for N_SP_PSTE					
C_VS_MIN_N_SP_PSTE_2	V	0... FFH	0... 255	1	km/h
Minimum vehicle speed threshould for N_SP_PSTE_2					
ID_N_SP_IS_KNK_AT	V	0... 1FE0H	0... 8160	1	rpm
LDPM_IGA_N_SP_IS_KNK	4	0... 80H	-48 ...0	0.375	°CRK
Minimum idle speed for spark retard due to knocking with AT					
ID_N_SP_IS_KNK_MT	V	0... 1FE0H	0... 8160	1	rpm
LDPM_IGA_N_SP_IS_KNK	4	0... 80H	-48 ...0	0.375	°CRK
Minimum idle speed for spark retard due to knocking with MT					
IP_ACIN_N_SP_IS	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_N_SP_1	8	0... FEH	-48... 142.5	0.75	°C
Nominal idle speed with air conditioner switched on					
IP_DRI_ACIN_N_SP_IS	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_N_SP_1	8	0... FEH	-48... 142.5	0.75	°C
Nominal idle speed with DRIVE (A/T) engaged and air conditioner switched on					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_DRI_N_SP_IS	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_N_SP_1	8	0... FEH	-48... 142.5	0.75	°C
Nominal idle speed with DRIVE (A/T) engaged					
IP_DRI_N_SP_IS_LIH	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_N_SP_1	8	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint in case of limp home and engaged drivetrain					
IP_FAC_N_SP_OFS_KWP	V	0... FFH	0... 0.99609375	0.00390625	-
LDPM_TCO_N_SP_1	8	0... FEH	-48... 142.5	0.75	°C
TCO factor for N_SP_OFS_KWP					
IP_N_MAX_TOL_ST	V	0... FFH	0... 8160	32	rpm
LDPM_TCO_9	9	0... FEH	-48... 142.5	0.75	°C
Top level end of start engine speed					
IP_N_SP_IS	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_1_ENSC	6	0... FEH	-48... 142.5	0.75	°C
Nominal idle speed without additional load on the engine					
IP_N_SP_IS_CS_OPM_1	V	0... 1FE0H	0... 8160	1	rpm
LDP_TOIL_IP_N_SP_IS_CS_OPM_1	8	0... C8H	-40 ...160	1	°C
Idle speed setpoint for drive-off-support with manual transmission in operation mode 1					
IP_N_SP_IS_CS_OPM_2	V	0... 1FE0H	0... 8160	1	rpm
LDP_TOIL_IP_N_SP_IS_CS_OPM_1	8	0... C8H	-40 ...160	1	°C
Idle speed setpoint for drive-off-support with manual transmission in operation mode 2					
IP_N_SP_IS_EPS	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_N_SP_IS_PSTE	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for power steering variant EPS					
IP_N_SP_IS_LIH	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_N_SP_1	8	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint in case of limp home					
IP_N_SP_IS_PL_OPM_1	V	0... 1FE0H	0... 8160	1	rpm
LDP_N_N_SP_IS_PL_OPM_1	6	0... 1FE0H	0... 8160	1	rpm
LDP_TQ_LOSS_N_SP_IS_PL_OPM_1	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Nominal idle speed at PL in operation mode 1					
IP_N_SP_IS_PL_OPM_2	V	0... 1FE0H	0... 8160	1	rpm
LDP_N_N_SP_IS_PL_OPM_1	6	0... 1FE0H	0... 8160	1	rpm
LDP_TQ_LOSS_N_SP_IS_PL_OPM_1	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Nominal idle speed at PL in operation mode 2					
IP_N_SP_IS_PL_TCT_OPM_1	V	0... 1FE0H	0... 8160	1	rpm
LDP_N_N_SP_IS_PL_TCT_OPM_1	6	0... 1FE0H	0... 8160	1	rpm
LDP_TQ_LOSS_N_SP_IS_PL_TCT_OPM1	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Nominal idle speed at PL variant TCT in operation mode 1					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_N_SP_IS_PL_TCT_OPM_2	V	0... 1FE0H	0... 8160	1	rpm
LDP_N_N_SP_IS_PL_TCT_OPM_1	6	0... 1FE0H	0... 8160	1	rpm
LDP_TQ_LOSS_N_SP_IS_PL_TCT_OPM1	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Nominal idle speed at PL variant TCT in operation mode 2					
IP_N_SP_IS_PSTE	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_N_SP_IS_PSTE	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for power steering					
IP_N_SP_IS_PSTE_2	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_N_SP_IS_PSTE	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for power steering for VS >= C_VS_MIN_N_SP_PSTE_2					
IP_N_SP_IS_TOIL_AT	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TOIL_N_SP_IS_TOIL	4	0... C8H	-40 ...160	1	°C
Minimum idle speed for TOIL with AT					
IP_N_SP_IS_TOIL_MT	V	0... 1FE0H	0... 8160	1	rpm
LDPM_TOIL_N_SP_IS_TOIL	4	0... C8H	-40 ...160	1	°C
Minimum idle speed for TOIL with MT					
IP_T_AST_MIN_N_SP_IS_CS	V	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_N_SP_1	8	0... FEH	-48... 142.5	0.75	°C
Minimum delay time after start for drive-off-support idle speed					
LC_FUP_FTL_MIN_IS_LIH_ENA	V	0... 1H	0 ...1	1	-
Enable the use of idle speed setpoint increase in case of fuel pressure or fuel tank min level error					
LC_IS_N_SP_CS_DIS	V	0... 1H	0 ...1	1	-
LC to switch on/off LV_IS condition for drive-off-support					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_N_DIF_MIN_CRLC	V	F010... 0H	-4080 ...0	1	rpm
Non calibrated correlation factor for N_DIF_MMV calculation					

General information:

Application conditions:

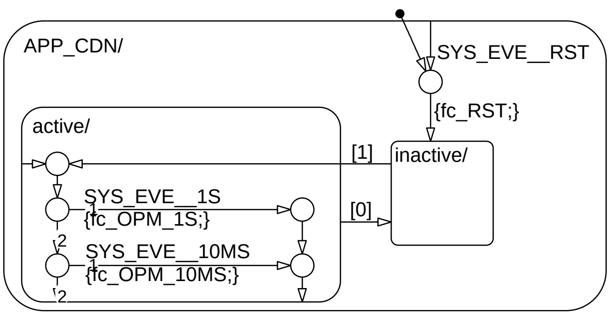

Figure 4.6.1: :

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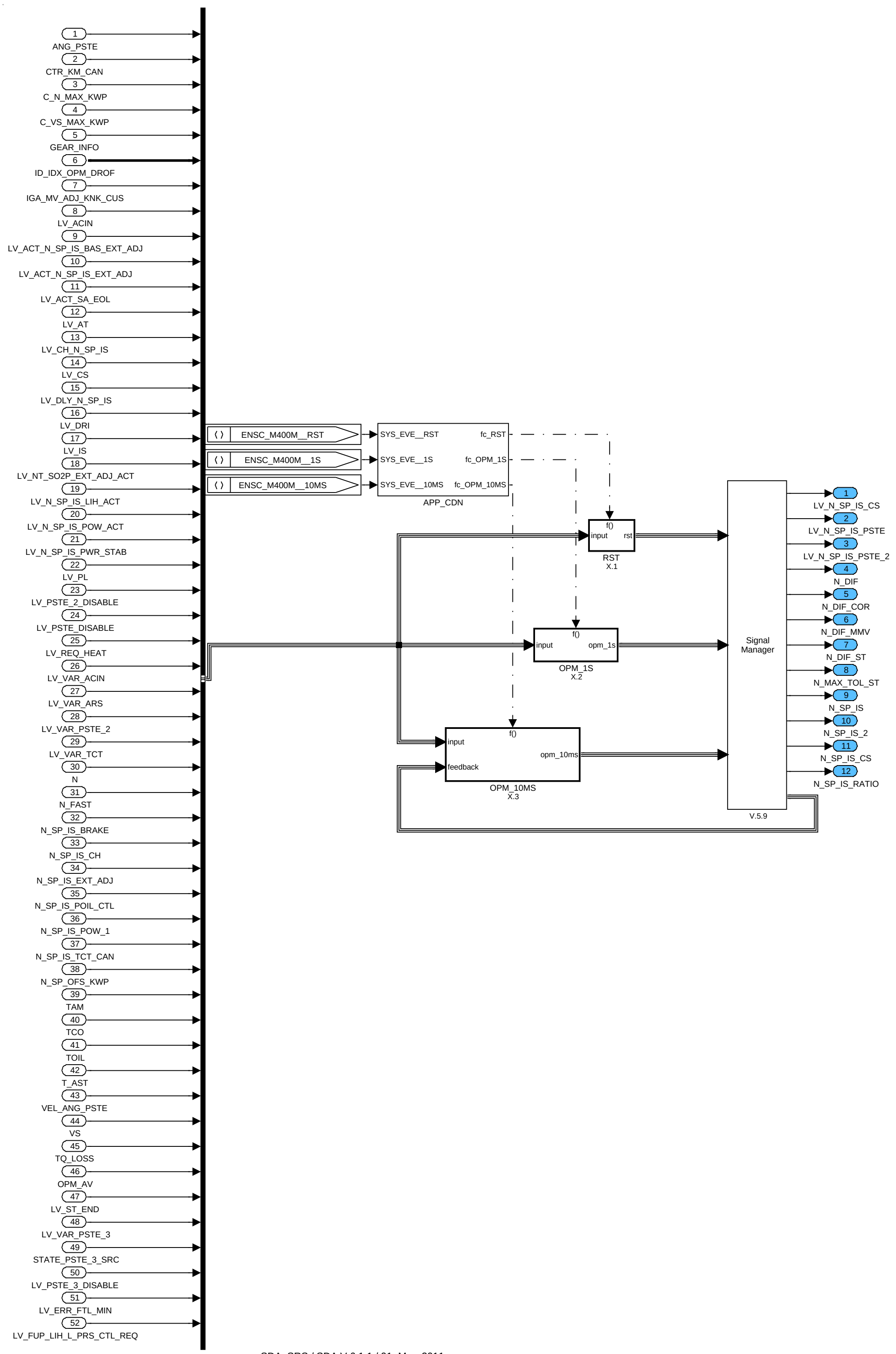
Function description:

Formula section:



SDA_SRS / SDA V 6.1.1 / 01−Mar−2011

Figure 4.6.2: :

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4.6.1 Initialisation at system event reset

All output variable are initialised at system event reset.

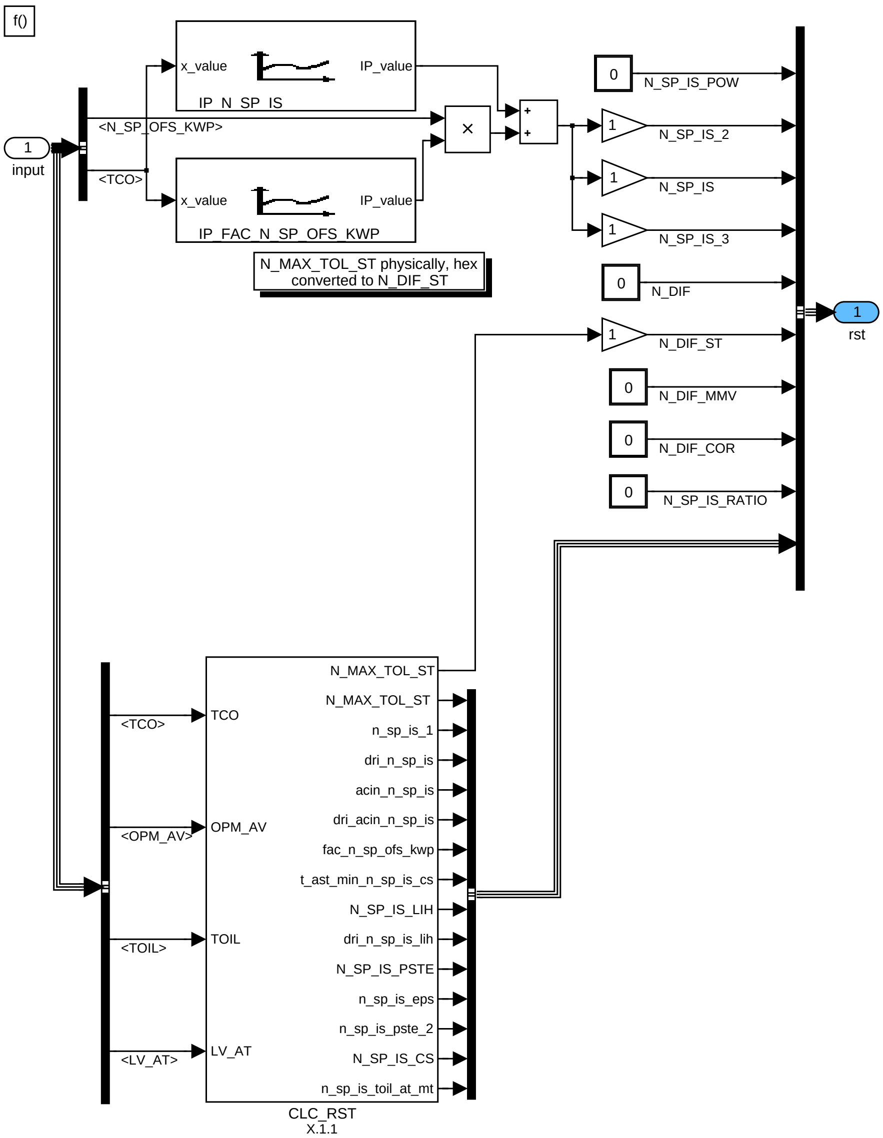

Figure 4.6.3: :

4.6.1.1 Initialisation of temperature dependent variables.

All the temperature dependent variables are initialised here from corresponding IP maps and curves.

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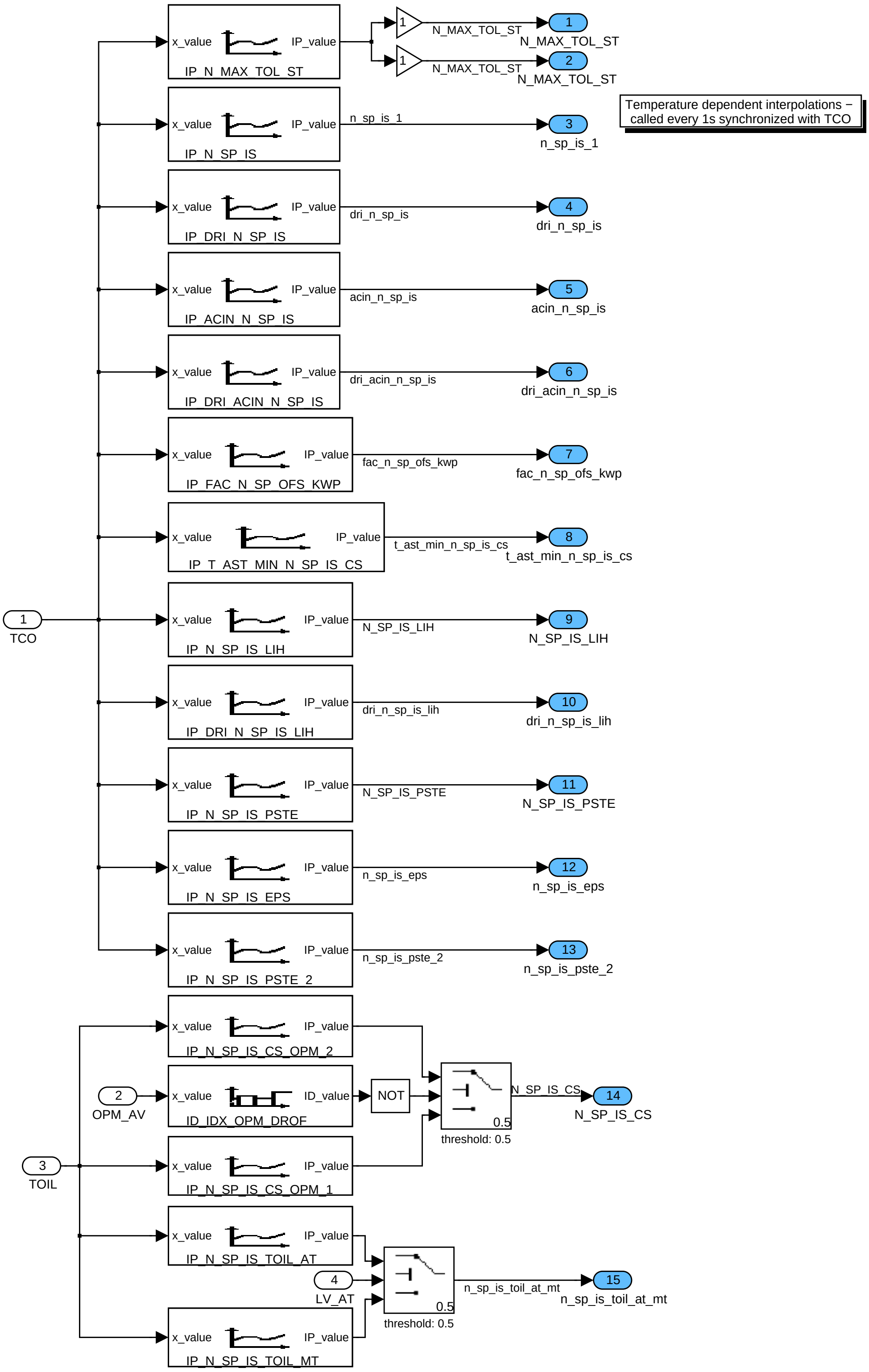

Figure 4.6.4: :

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4.6.2 Calculation at 1 second recurrence

4.6.2.1 Calculation of temperature dependent variables.

All the temperature dependent variables are calculated here from corresponding IP maps and curves.

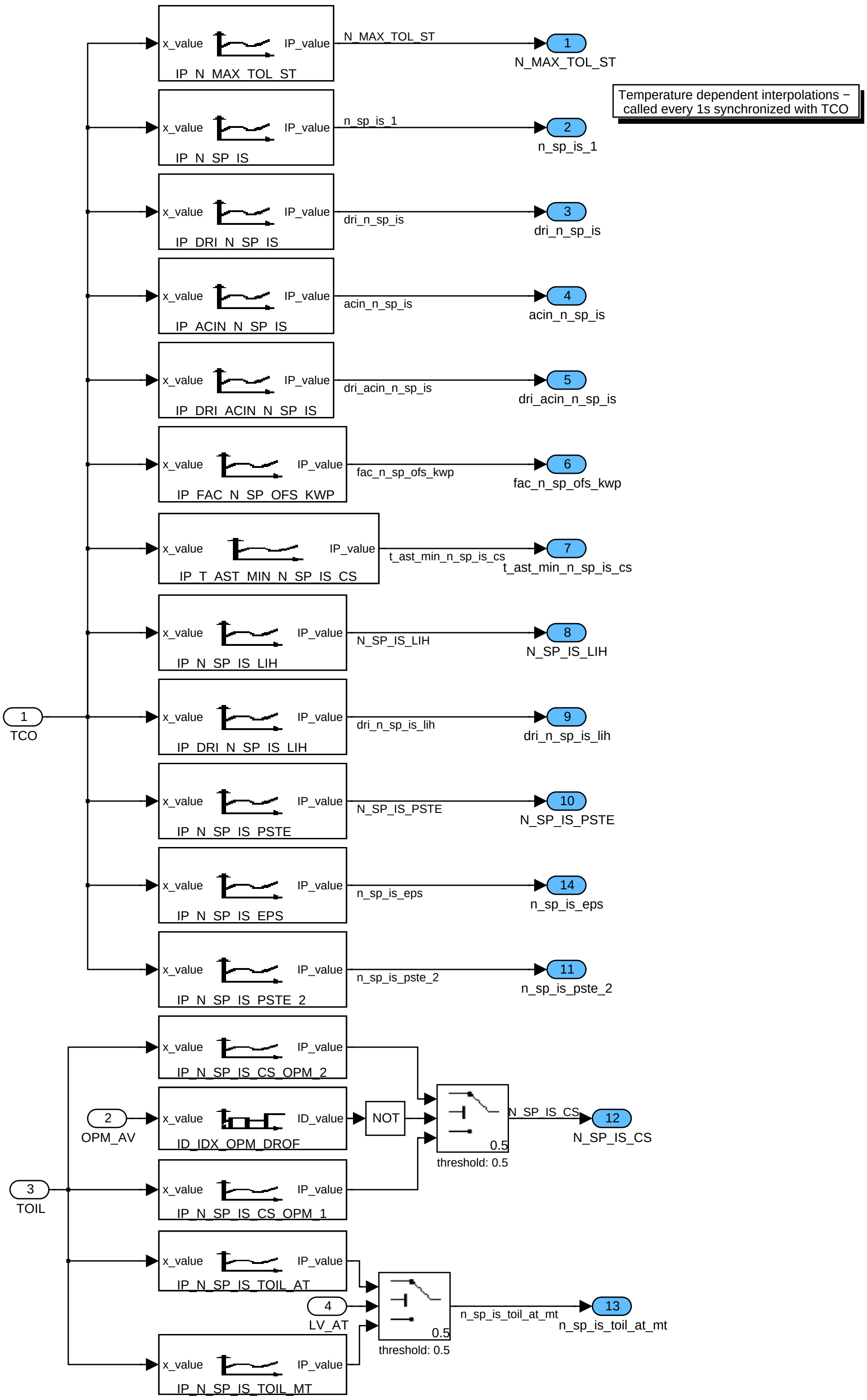

Figure 4.6.5: :

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4.6.3 Formula section.

4.6.3.1 Idle speed setpoint N_SP_IS

FUNCTION DESCRIPTION:
General information:
The input value LV_DLY_N_SP_IS (output from module Converter Torque) is derived from LV_DRI including a tuneable delay time. If drive is engaged the converter torque is build up after a short delay time (about 400 ms). If the change in engine speed setpoint for drive engaged also is delayed the new setpoint can be adjusted more stable.
In general the transition from one idle speed setpoint to another is performed with adjustable change limitations. The only exception is: no change limitation before engine start has finished (LV_ST_END = 0). This is to ensure the desired engine speed setpoint immediately after start.

4.6.3.1.1 Nominal idle speed with tester offset(Calculation of N_SP_IS_2)

The nominal idle speed setpoint calculation takes into consideration air conditioning compressor ACC on/off, drivetrain engaged (LV_DLY_N_SP_IS) and offset by tester via KWP.
Table of nominal idle speed N_SP_IS_1, dependant from ACC and drivetrain engaged:

LV_ACIN	LV_DLY_N_SP_IS	N_SP_IS_1
0	0	IP_N_SP_IS
0	1	IP_DRI_N_SP_IS
1	0	IP_ACIN_N_SP_IS
1	1	IP_DRI_ACIN_N_SP_IS

The tester offset is multiplied by a factor IP_FAC_N_SP_OFS_KWP which is TCO dependant and limited by upper and lower thresholds.
N_SP_IS_2 is calculated here depending upon logical variable LV_ACIN and LV_DLY_N_SP_IS. Using these two variables the control input is generated using the lookup table. If both variable are zero then input from port 1 of multiport switch is passed, similarly the inputs at other ports are passed depending upon these two logical variable.

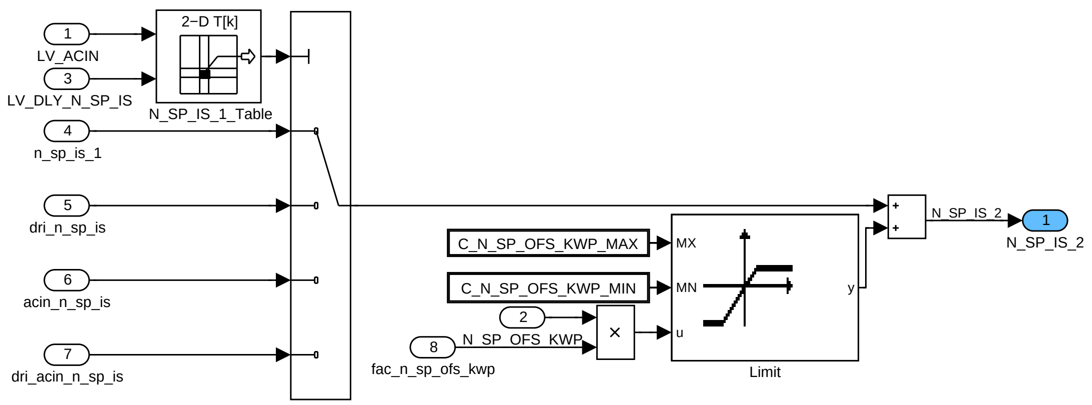

Figure 4.6.6: :

4.6.3.1.2 Pre calculation and calculation of N_SP_IS

4.6.3.1.2.1 Extraordinary engine speed setpoints(Calculation of first part of pre calculation.)

4.6.3.1.2.1.1 Idle speed setpoint due to Power Management

The engine speed setpoint N_SP_IS_POW_1 from Power Management is used if LV_N_SP_IS_POW_ACT = 1 and if it is the greatest of the speed setpoints entering the MAX-selection

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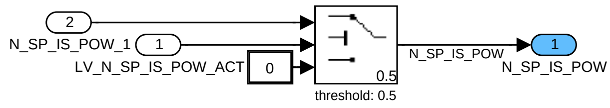

Figure 4.6.7: :

4.6.3.1.2.1.2 Idle Speed setpoint required from heating control unit

The A/C-unit sets a requirement switch LV_REQ_HEAT to raise the idle speed in order to increase the heating power. If the vehicle is not equipped with A/C, LV_REQ_HEAT is made up with ambient temperature TAM. The idle speed setpoint C_N_SP_HEAT_MT/AT will be executed if LV_REQ_HEAT = 1 and if it is the greatest of the speed setpoints entering the MAX-selection

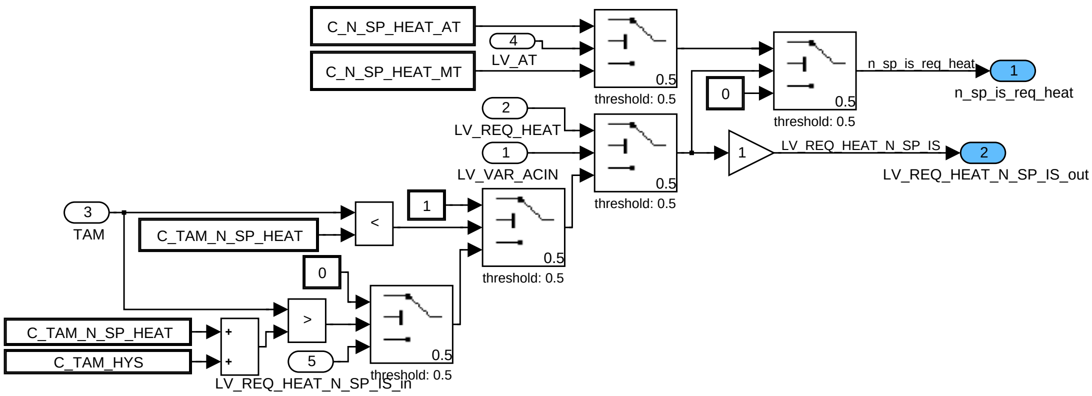

Figure 4.6.8: :

4.6.3.1.2.1.3 Idle speed setpoint due to variant of power steering 2

The engine speed setpoint N_SP_IS_VAR_PSTE_2 depends on learnt variant LV_VAR_PSTE_2.

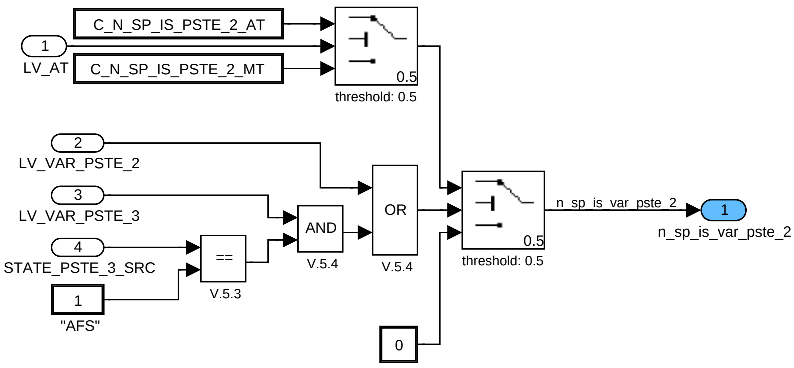

Figure 4.6.9: :

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4.6.3.1.2.1.4 Idle speed setpoint due to variant of ARS

The engine speed setpoint N_SP_IS_ARS depends on learnt variant LV_VAR_ARS and vehicle speed.

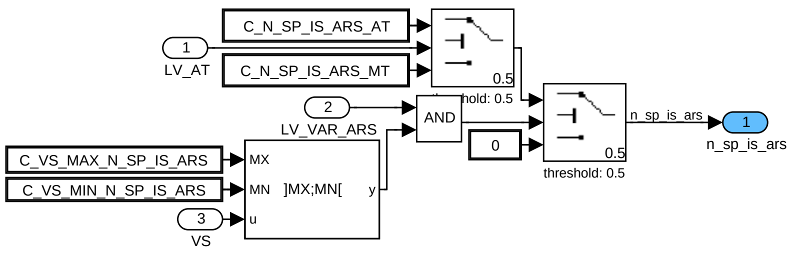

Figure 4.6.10: :

4.6.3.1.2.1.5 Idle Speed setpoint TOIL dependant

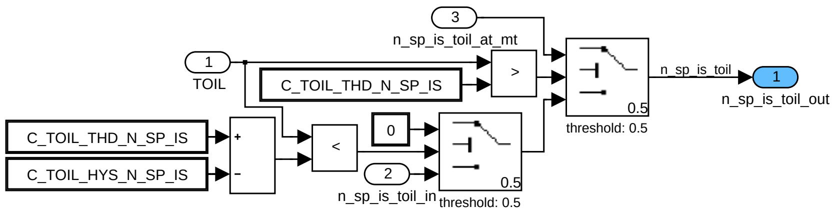

Figure 4.6.11: :

4.6.3.1.2.1.6 Idle Speed setpoint depending on average spark retard due to knocking

N_SP_IS takes care of the ignition spark retard due to knocking. Exceeding a calibrateable threshold an increased setpoint is active.

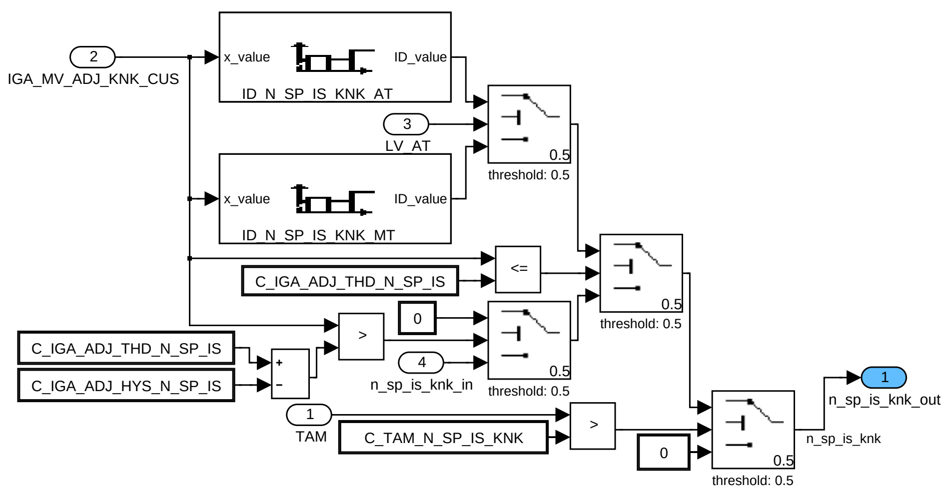

Figure 4.6.12: :

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4.6.3.1.2.1.7 Idle Speed setpoint at drive-off-support

Absolute engine speed setpoint dependant from TOIL and transmission variant, used under certain conditions where vehicle drive-off is expected and if it is the greatest of the speed setpoints entering the MAX-selection, see below. Individual gradient limitation C_N_SP_INC/DEC_CS.

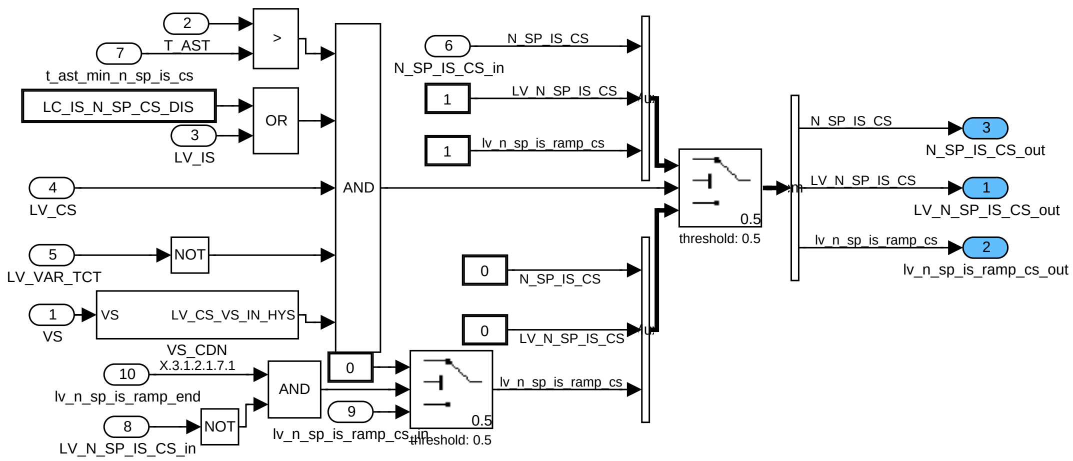

Figure 4.6.13: :

4.6.3.1.2.1.7.1 Calculation of logical variable

If VS is less than difference of maximum vehicle speed for drive of support (C_VS_MAX_N_SP_CS) and Vehicle speed hysteresis for VS threshold drive-off-support (C_VS_HYS_N_SP_CS) then generated LV_CS_VS_In_HYS_tmp is equal to 1 else if VS is greater than C_VS_MAX_N_SP_CS then . LV_CS_VS_In_HYS_tmp is set to 1 else it remains at old value.

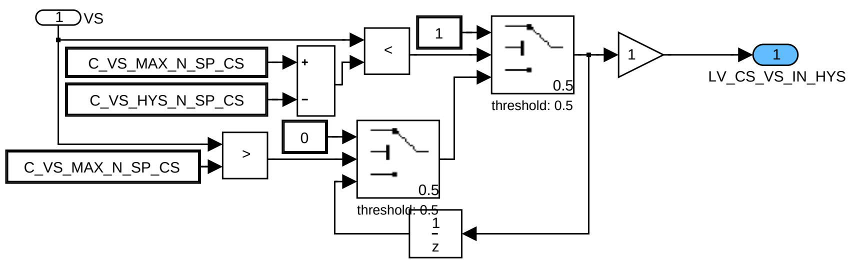

Figure 4.6.14: :

4.6.3.1.2.2 Extraordinary engine speed setpoints(Calculation of second part of pre calculation.)

4.6.3.1.2.2.1 Idle Speed setpoint for power steering (EPS /PSTE /PSTE_2)

Absolute engine speed setpoint dependant from steering angle and steering angle velocity, used under certain conditions. If it is the greatest of the speed setpoints entering the MAX-selection, see below.
For power steering variant EPS and AFS (ident: PSTE).

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4.6.3.1.2.2.1.1 Idle speed setpoint for powersteering 1

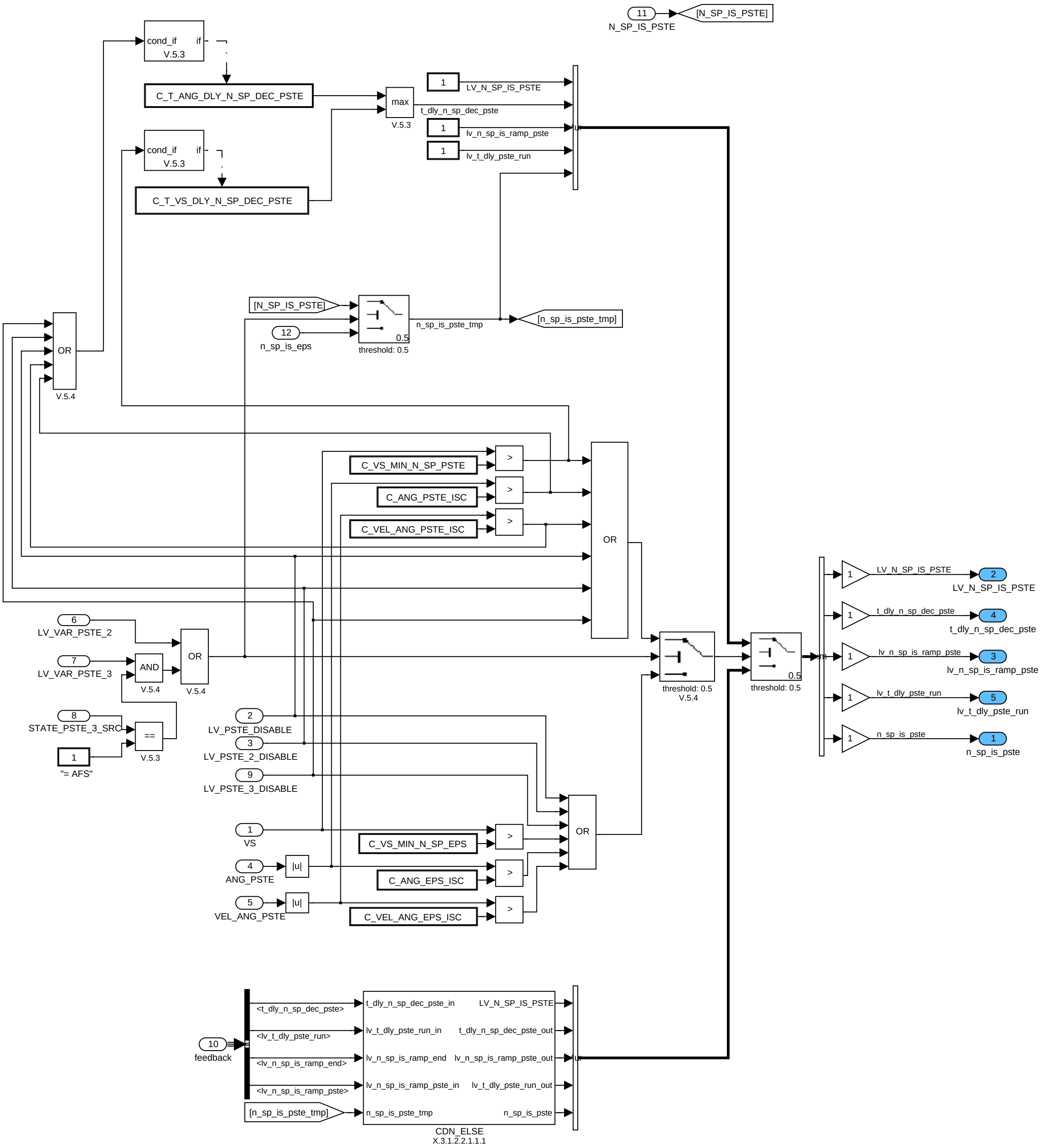

Figure 4.6.15: :

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4.6.3.1.2.2.1.1.1 Calculations when condition check fails.

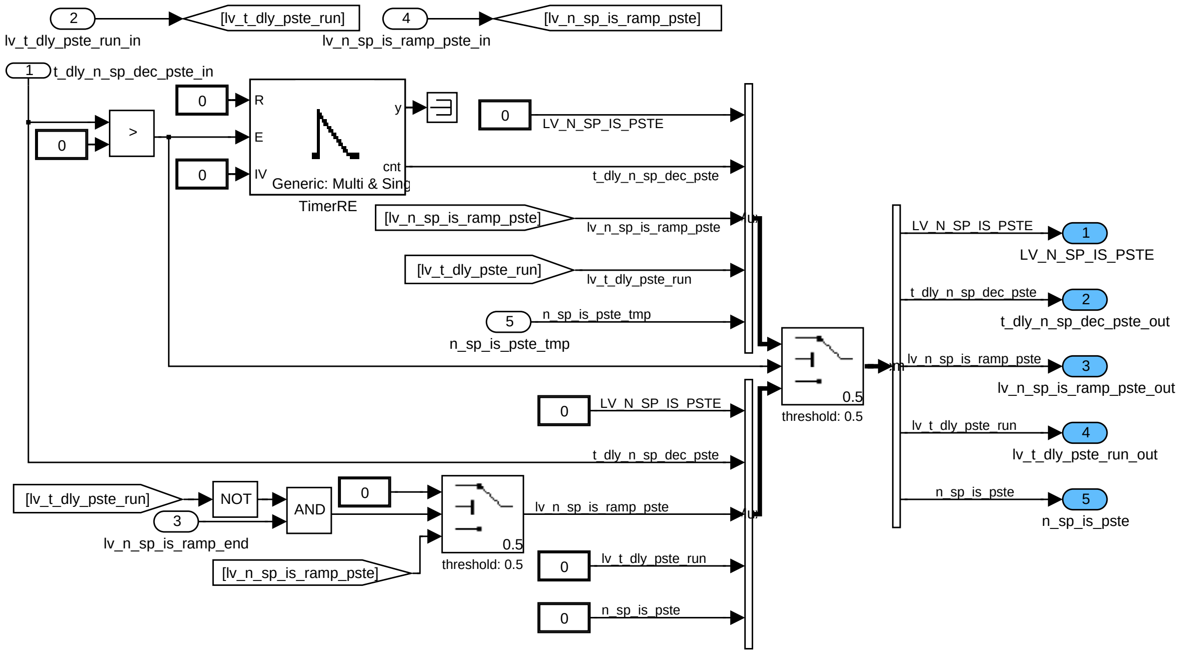

Figure 4.6.16: :

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4.6.3.1.2.2.1.2 Idle speed setpoint for powersteering 2

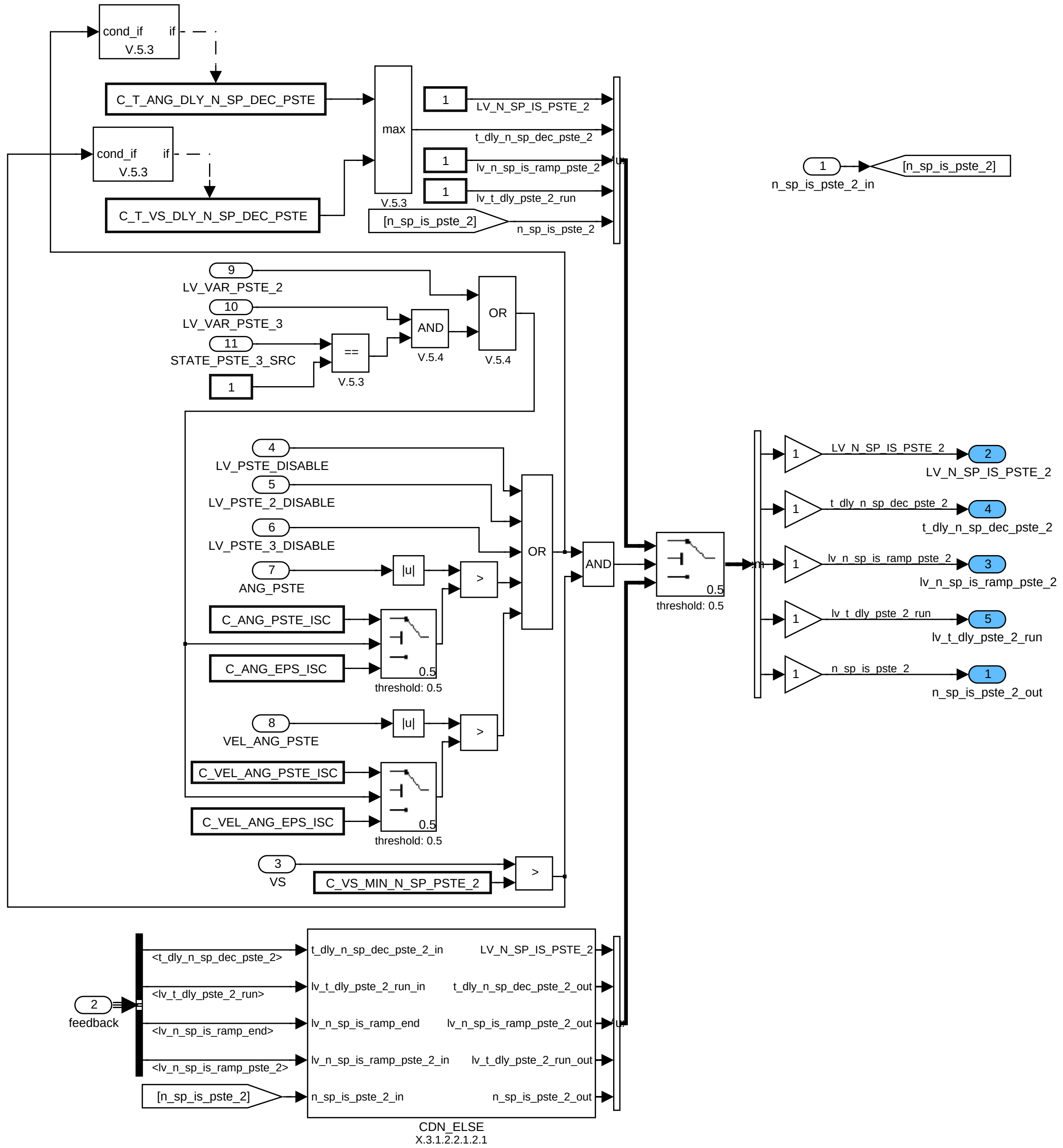

Figure 4.6.17: :

4.6.3.1.2.2.1.2.1 Calculations when condition check fails.

Calculations when condition check fails.

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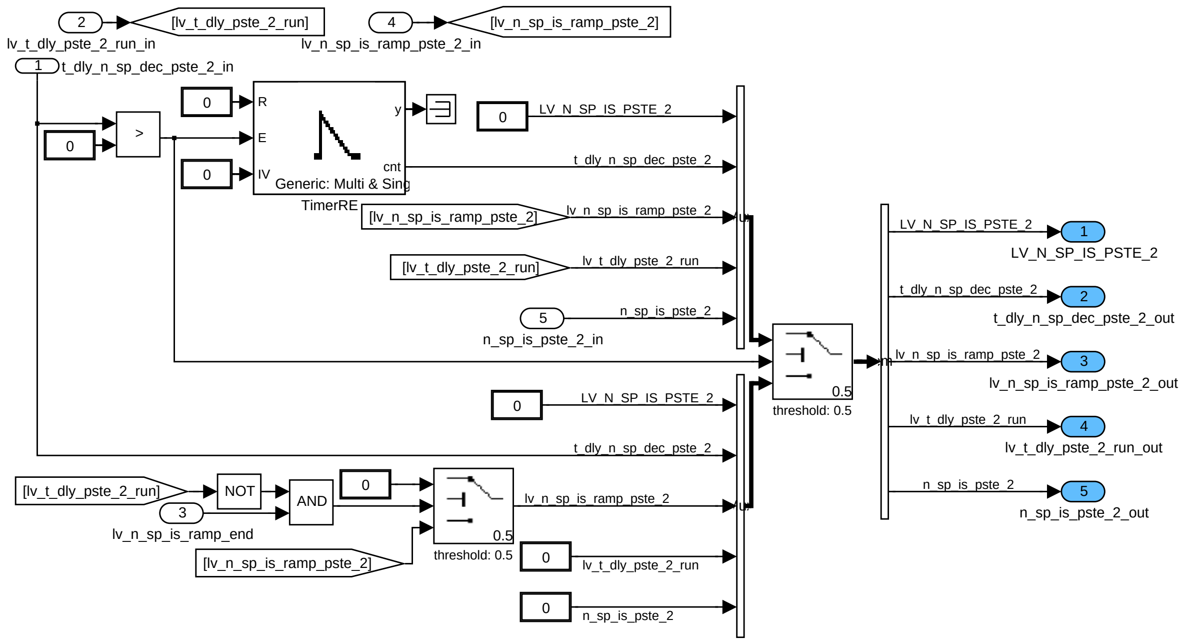

Figure 4.6.18: :

4.6.3.1.2.2.2 Idle Speed setpoint at part load (PL)

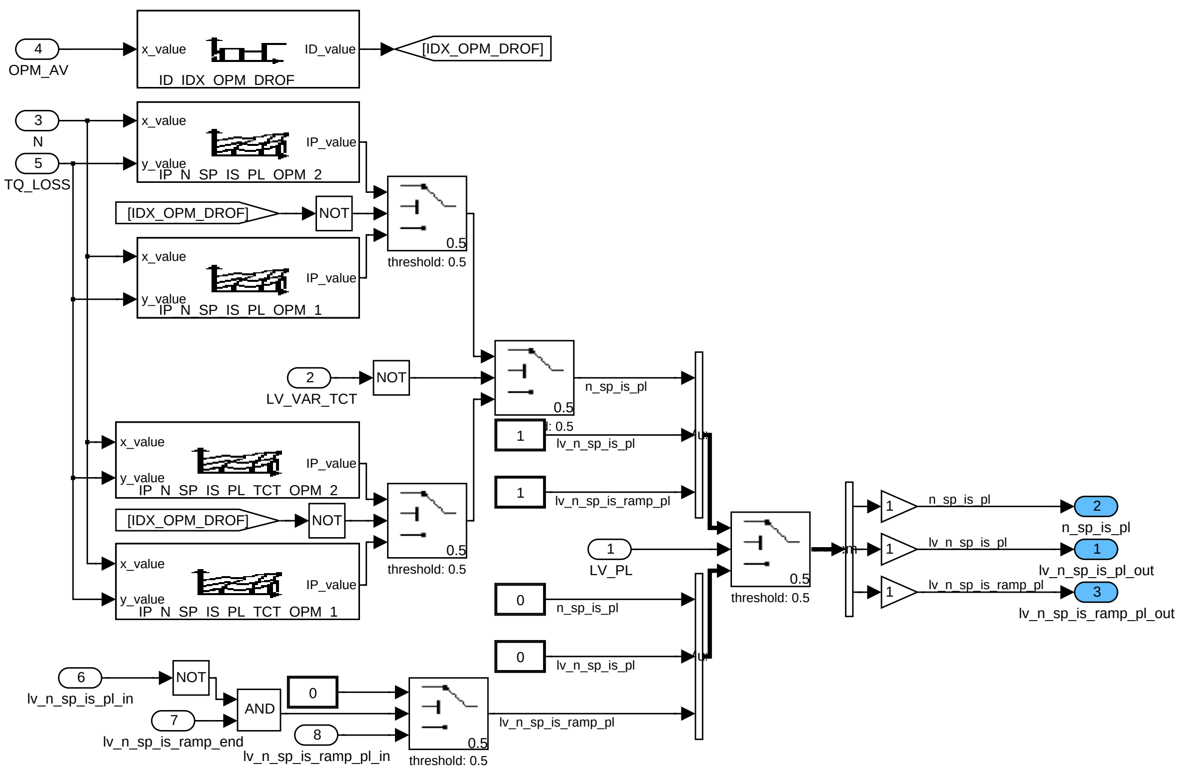

Figure 4.6.19: :

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4.6.3.1.2.2.3 Idle Speed setpoint due to power management request for power supply stability

The engine speed setpoint N_SP_IS_PWR_STAB can be activated by the power supply stability request from the power management. The height of this setpoint depends on whether the driving position is engaged or not.

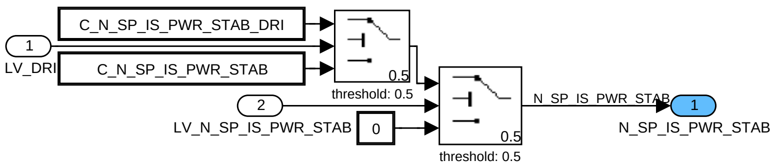

Figure 4.6.20: :

4.6.3.1.2.2.4 Idle speed set point due to TCT(twin clutch transmission)

The engine speed setpoint N_SP_IS_TCT_CAN from TCT is transmitted via CAN and used as N_SP_IS_TCT if LV_VAR_TCT = 1 and if it is the greatest of the speed setpoints entering the MAX-selection.

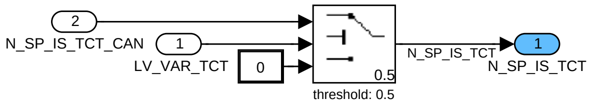

Figure 4.6.21: :

4.6.3.1.2.3 Exceptional engine speed setpoint

There are 4 other cases which are not mentioned in above formula section. First is a function which allows to bypass the MAX-selection if a correspondingly command (LV_ACT_N_SP_IS_BAS_EXT_ADJ) was received via K-line. In this case, N_SP_IS_3 is set to the basis idle speed setpoint N_SP_IS_2.
Second is a function which allows to bypass the MAX-selection if another correspondingly command (LV_ACT_N_SP_IS_EXT_ADJ) was received via K-line. In this case, N_SP_IS_3 is set to the requested idle speed setpoint N_SP_IS_EXT_ADJ.
Third is an extra idle speed setpoint -C_N_SP_IS_SA_EOL- during the secondary air function end of line test . It is valid during LV_ACT_SA_EOL = 1.
Fourth, a switch for activation of desulfatisation, LV_NT_SO2P_EXT_ADJ_ACT was introduced to increase N_SP_IS to 3000...4000 rpm.
4th case is limp home (highest priority). If PVS error and PVS limp home is requested (LV_N_SP_IS_LIH_ACT = 1) a different idle speed setpoint can be calibrated. So a higher vehicle dynamic as at nominal idle speed is possible.

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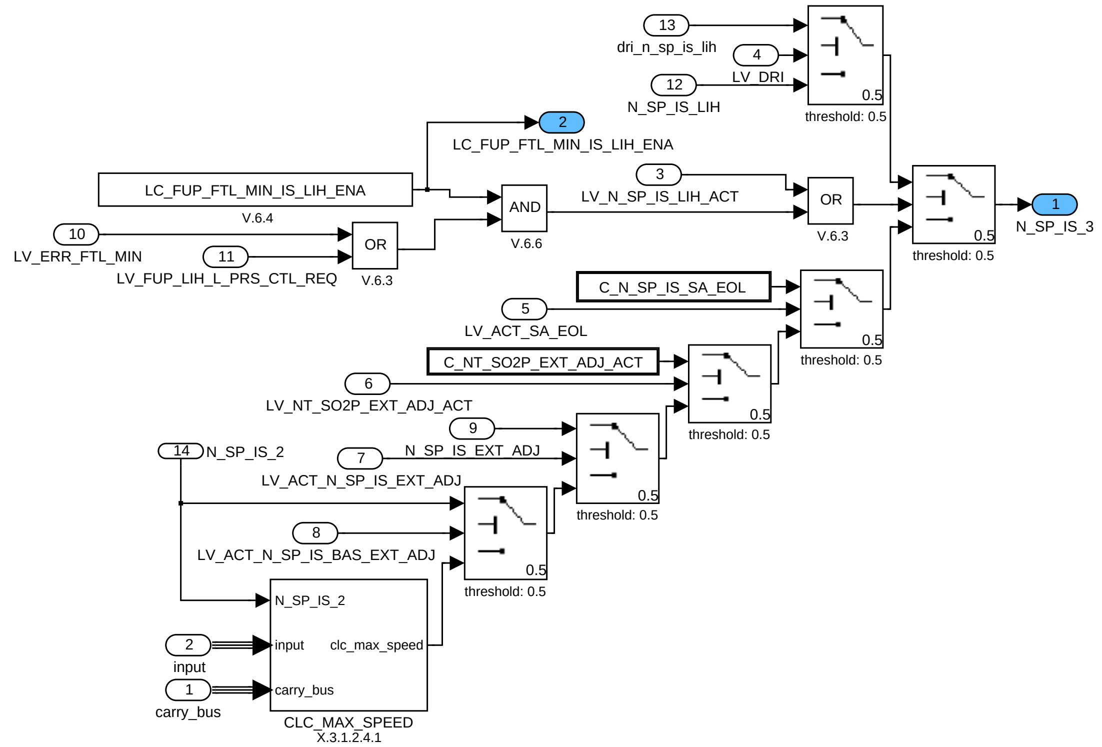

Figure 4.6.22: :

4.6.3.1.2.3.1 Calculation of maximum speed from set of idle speed. calculated in pre calculation subsystem.

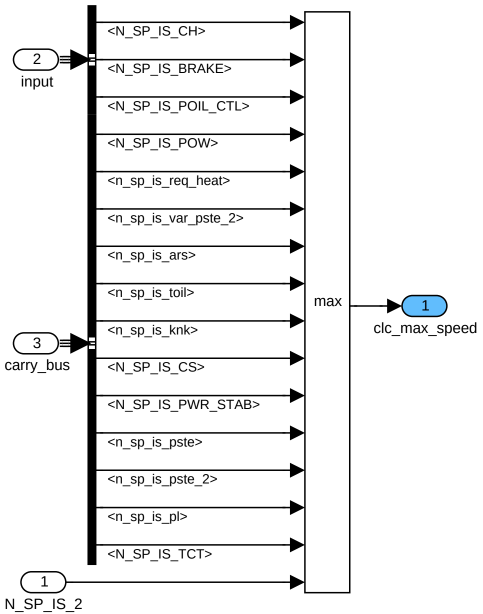

Figure 4.6.23: :

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4.6.3.1.3 Gradient limitation

The gradient limitation for N_SP_IS by C_N_SP_LGRD_IS, C_N_SP_DEC_IS_CH_DRI, C_N_SP_DEC/INC_CS or C_N_SP_DEC/INC_PSTE is finished as soon as the goal N_SP_IS_3 is reached (N_SP_IS = N_SP_IS_3)
During active limp home a special gradient limitation C_N_SP_LGRD_IS_LIH is used.

An increase of engine speed setpoint is not allowed in case of automatic transmission vehicle with drive engaged, vehicle standing or very low speed and engine operating state idle active. This is to prevent runaway of the car.

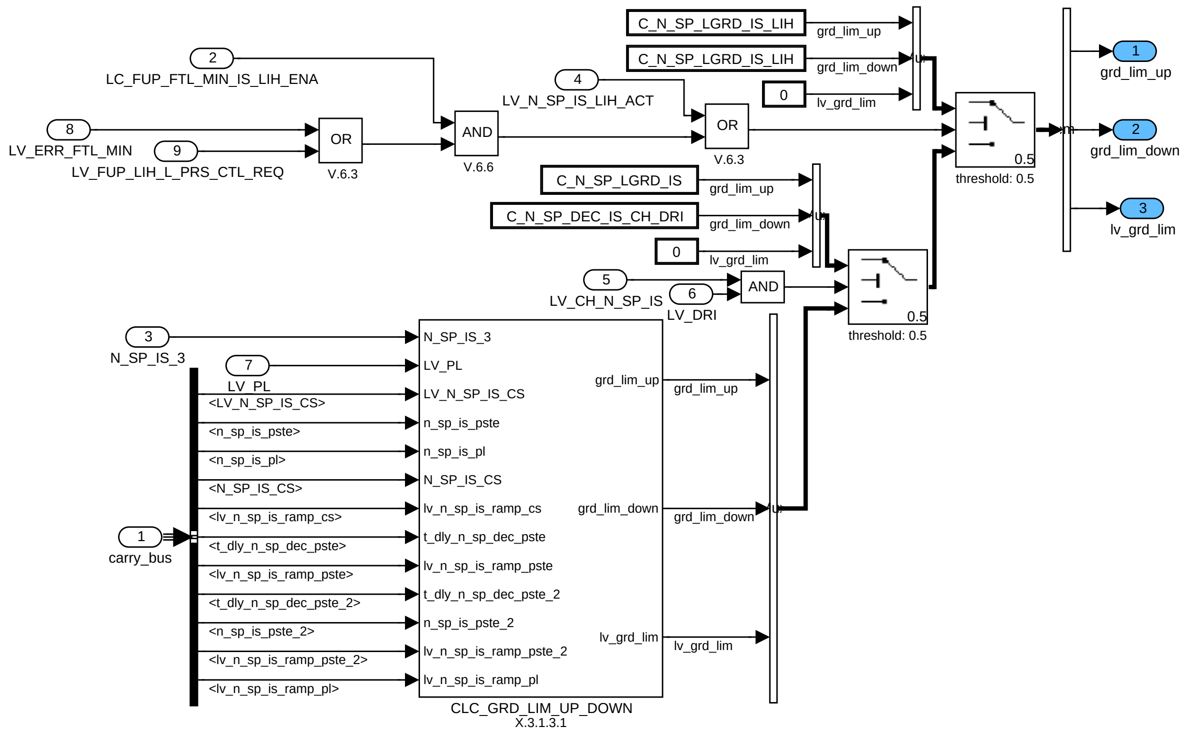

Figure 4.6.24: :

4.6.3.1.3.1 Calculation of Gradient limitation continued...

If LV_N_SP_IS_LIH_ACT is 0 and LV_DRI and LV_SH_N_SP_IS are 1 then this part is calculated.

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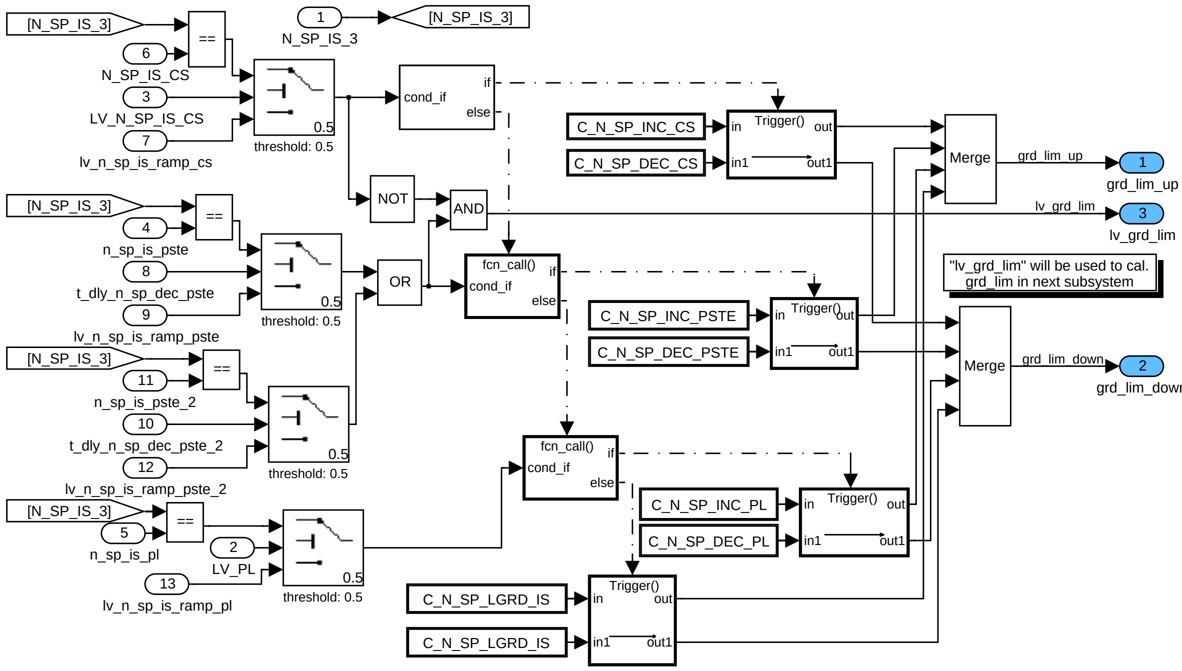

Figure 4.6.25: :

4.6.3.1.4 Determination of N_SP_IS

During start and after end of start gradient limitation of N_SP_IS can be disabled by delay time C_T_DLY_GRD_LIM.

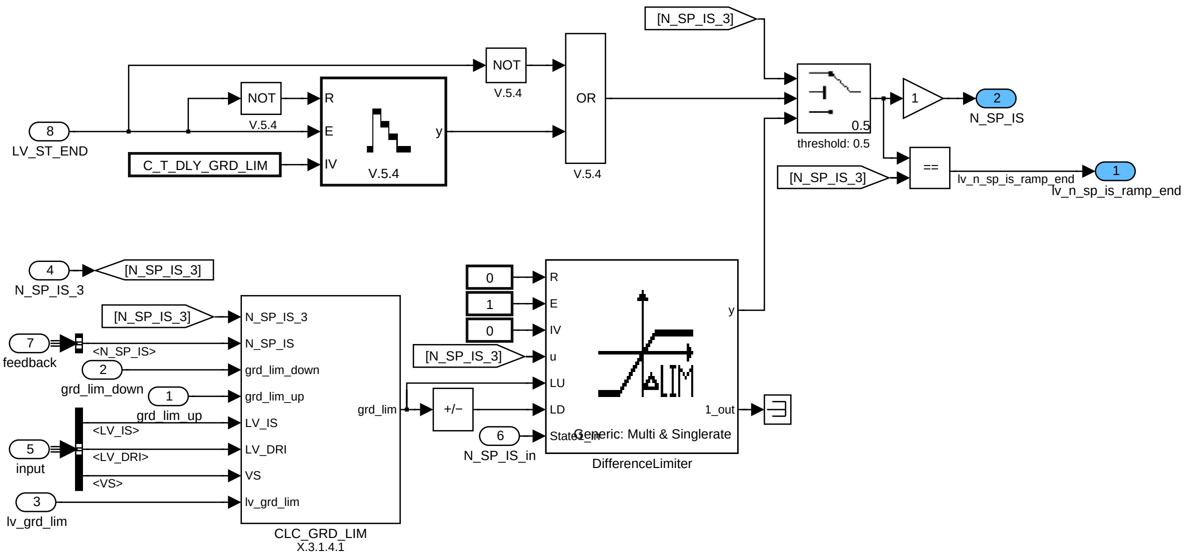

Figure 4.6.26: :

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4.6.3.1.4.1 Calculation of optimal value of gradient limitation.

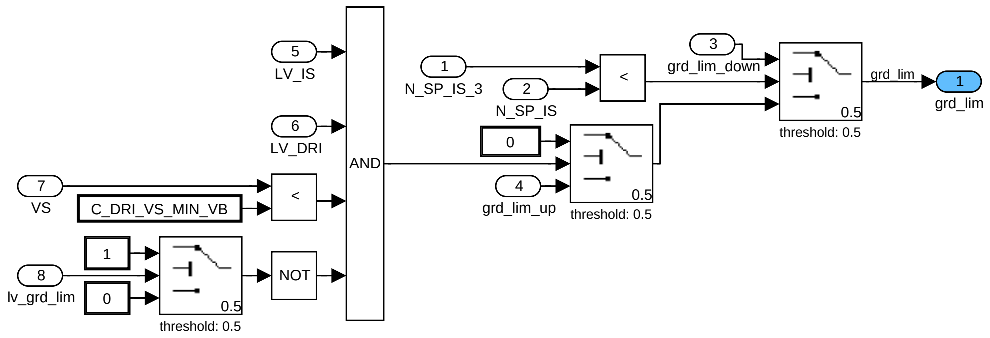

Figure 4.6.27: :

4.6.3.1.5 Calculated engine speed setpoint ratio

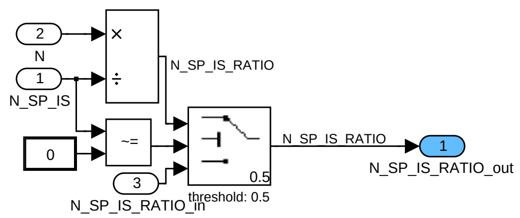

Figure 4.6.28: :

4.6.3.2 Calculation of N_DIF and N_DIF_ST

4.6.3.2.1 Engine speed deviations N_DIF, N_DIF_MMV, N_DIF_COR

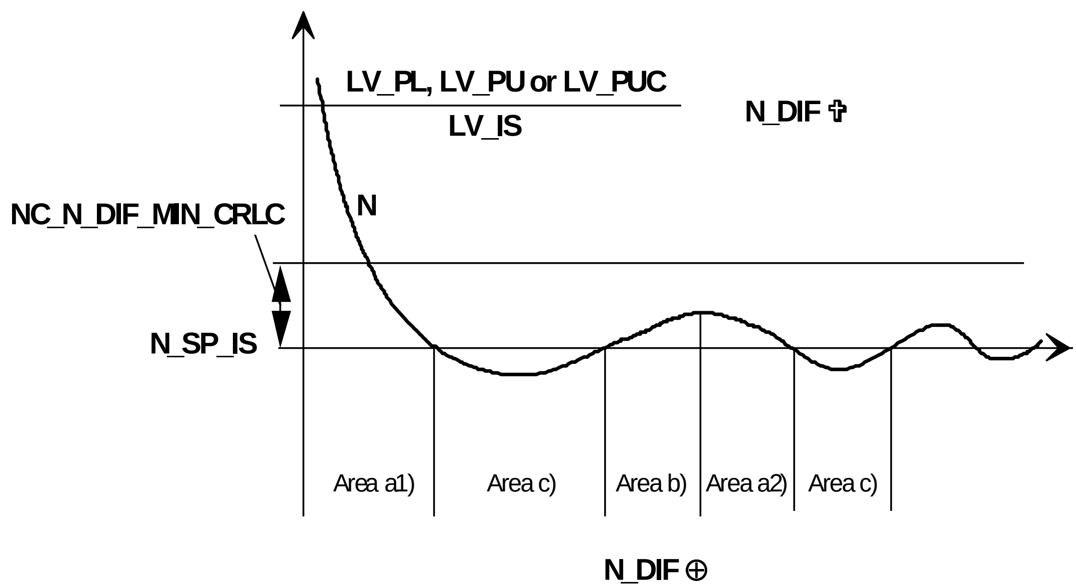

Figure 4.6.29: :

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N_DIF_MMV calculation:
After entry in Idle (LV_IS=1), N_DIF_MMV is set to N_DIF taking into account the limits defined below. Then the moving mean value is determined:

N_DIF_MMV (n) = N_DIF_MMV (n-1) + (N_DIF - N_DIF_MMV(n-1)) * N_DIF_CRLC

The correlation constant C_N_DIF_CRLC may assume 3 discrete values:

a1) Decreasing engine speed above nominal idle speed after entry in Idle (LV_IS=1) and conditions b.) and c.) not previously met (or N_DIF < NC_N_DIF_MIN_CRLC):

(N_DIF (n-3) < N_DIF (n) and N_DIF (n) < 0)

N_DIF_CRLC = C_N_DIF_CRLC (per adjustment)

a2) Decreasing engine speed above nominal idle speed

and N_DIF > NC_N_DIF_MIN_CRLC

and condition b.) previously fulfilled

N_DIF_CRLC = 1

b) Increasing engine speed above nominal idle speed

((N_DIF (n-3) >= N_DIF (n) and N_DIF (n) < 0)

N_DIF_CRLC = 1

c) Engine speed below nominal idle speed after entry at idle and is still below idle speed

(N_DIF (n) >= 0)
N_DIF_CRLC = 0

Limits of N_DIF_MMV:

C_N_DIF_MIN_MMV (N_DIF_MMV (0
N_DIF_COR calculation:

N_DIF_COR is relevant for the idle controller (idle-charge actuator and ignition timing):

N_DIF_COR = N_DIF - N_DIF_MMV * C_N_DIF_FAC

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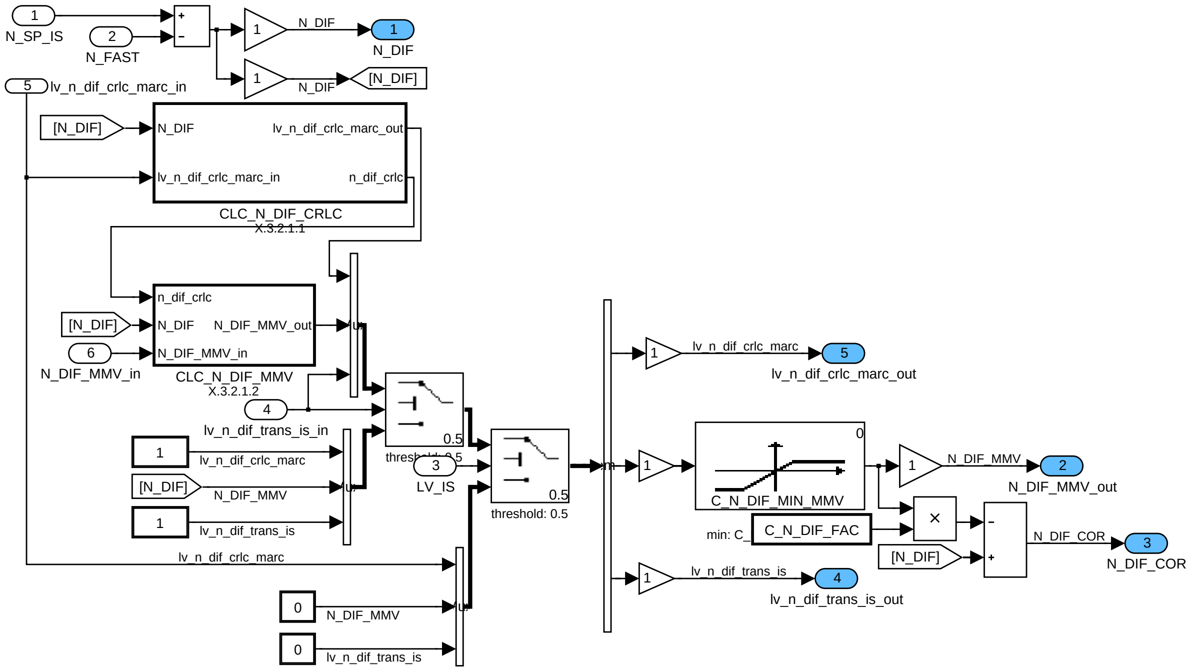

Figure 4.6.30: :

4.6.3.2.1.1 Determination of correlation factor

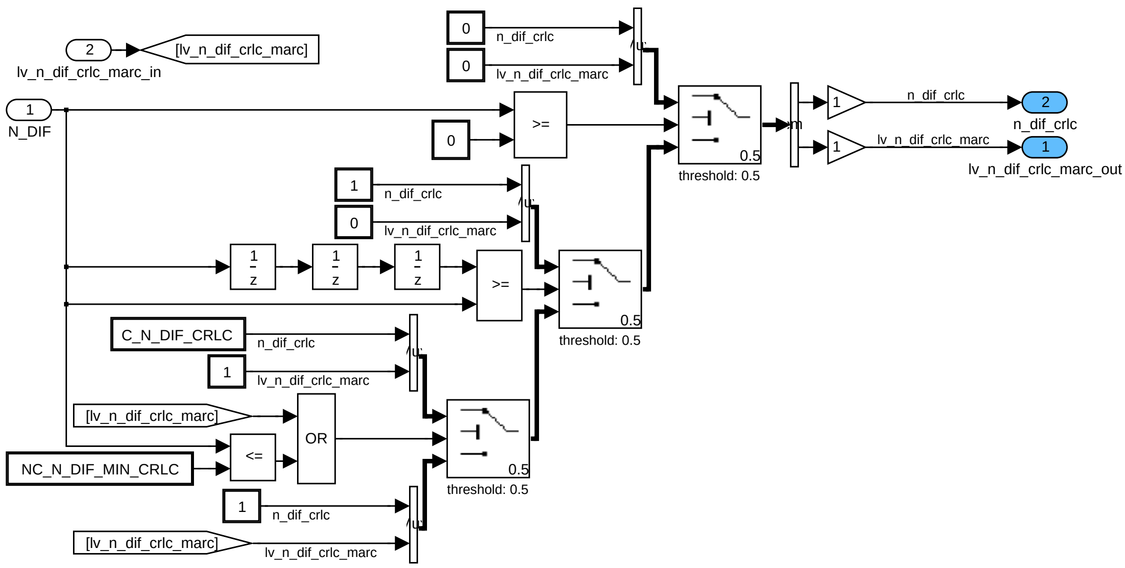

Figure 4.6.31: :

4.6.3.2.1.2 Calculation of N_DIF_MMV

N_DIF_MMV is determined here using low pass filter.

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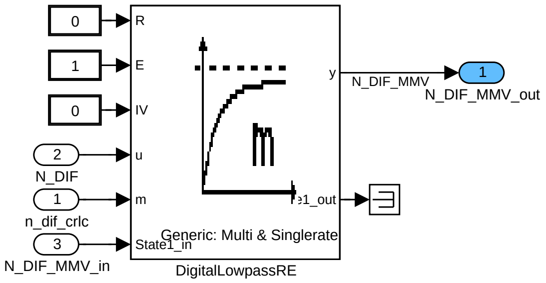

Figure 4.6.32: :

4.6.3.2.2 Engine speed deviation N_DIF_ST

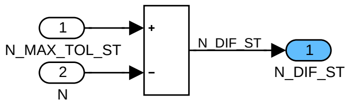

Figure 4.6.33: :

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4.7 Engine speed limit coordination

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_N_MAX_ETC_LIH	O/V	0... 1H	0 ...1	1	-
engine speed limitation (MTC or ETC_LIH) active					
LV_N_MAX_H	V	0... 1H	0 ...1	1	-
Boolean for increased engine speed limitation active					
LV_VS_MAX	O/V	0... 1H	0 ...1	1	-
Boolean for vehicle speed limitation active					
N_MAX_AT	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit for stopped AT-vehicle or at high vehicle speed					
N_MAX_DROF	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit in case of jump start					
N_MAX_EGY	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit in case of activated energy spare mode					
N_MAX_LIH_EGS	V	0... 1FE0H	0... 8160	1	rpm
Engine speed limit for AT in case of CAN error to EGS					
N_MAX_LIH_ETC	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit in case of throttle limp home required by throttle monitoring or ETC safety concept					
N_MAX_LIH_MTC	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit in case of MTC error					
N_MAX_LIH_PRS_OIL	V	0... 1FE0H	0... 8160	1	rpm
Engine speed limit for required oil pressure limp home mode					
N_MAX_MT	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit for stopped MT-vehicle					
N_MAX_THD	O/V	0... 1FE0H	0... 8160	1	rpm
Actual engine speed limit					
N_MAX_THD_1	O/V	0... 1FE0H	0... 8160	1	rpm
Actual engine speed limit depending on TOIL-orange area (BN2000)					
N_MAX_THD_2	O/V	0... 1FE0H	0... 8160	1	rpm
Actual engine speed limit depending on TOIL-red area (BN2000)					
N_MAX_THD_LIH	V	0... 1FE0H	0... 8160	1	rpm
Actual engine speed limit due to LIH					
N_MAX_VS_MAX	V	0... 1FE0H	0... 8160	1	rpm
Engine speed limit in case of vehicle speed limitation					
STATE_N_MAX_THD_LIH	O/V	0... 3H	0 ...3	1	-
Active engine speed reduction due to LIH (0..no reduce, 1..minor reduce, 2..major reduce)					
T_GEAR_VS_MAX	V	0... FFH	0... 25.5	0.1	s
Time since the last gear shift.					
VS_RATIO	V	0... FFFFH	0... 31.99951	488.299e-6	-
Ratio between vehicle speed limit and actual vehicle speed					

Input data:

C_VS_MAX_0_DFT {p. 1158}	C_VS_MAX_1 {p. 1158}	C_VS_MAX_2 {p. 1158}	C_VS_MAX_3 {p. 1158}
CTR_KM_CAN {p. 1563}	GEAR {p. 1302}	LV_AT {p. 654}	LV_CS {p. 8394}
LV_ERR_ECU_CKS {p. 4232}	LV_ERR_ECU_RAM {p. 4232}	LV_ETCU_DISABLE_CAN {p. 6718}	LV_GP {p. 803}

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LV_GS {p. 1565}	LV_INH_GP_SUP {p. 1566}	LV_MAF_BLS_DIAG {p. 4820}	LV_MTC_LIH_ACT {p. 4216}
LV_MTC_LIH_CUR_OFF {p. 4982}	LV_N_LIM_REQ_MON {p. 6877}	LV_N_LIM_REQ_RST_CHK {p. 4230}	LV_N_MAX {p. 3779}
LV_ST_END {p. 1720}	LV_TPS_MTC_N_LIM {p. 4982}	LV_VAR_BN {p. 655}	LV_VAR_TCT {p. 656}
N {p. 1525}	N_LIH_PRS_OIL {p. 8218}	N_MAX_LIH_STATE_CMB_S {p. 8218}	PV_AV {p. 1269}
STATE_EGY_MIN_KWP {p. 7483}	STATE_ETCU_PROG_INFO {p. 1574}	STATE_GEAR_REV_AT_AMT {p. 1302}	STATE_ST_TQ_LIM_GS {p. 1577}
T_AST {p. 1766}	TCO {p. 1100}	VS {p. 1176}	VS_MAX_SEL_EXT_REQ {p. 7683}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_KM_CAN_EGY_2_MAX	-	0... FFFFH	0... 655350	10	km
Maximum vehicle mileage to activate torque/engine speed-limitation due to energy spare mode 2 = "transport modus"					
C_N_MAX_DRI_RVL	-	0... 1FE0H	0... 8160	1	rpm
engine speed limit AT-vehicle in reverse gear					
C_N_MAX_EGY_1	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit in case of production energy spare mode					
C_N_MAX_EGY_2	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit in case of transportation energy spare mode					
C_N_MAX_EGY_3	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limit in case of garage energy spare mode					
C_N_MAX_LIH_EGS_LGRD	-	0... 1FE0H	0... 8160	1	rpm
Limitation gradient for n_max during AT gear shift in case of CAN error to EGS					
C_N_MAX_MTC_LIH	-	0... 1FE0H	0... 8160	1	rpm
Engine speed limitation in case of fault detected by throttle monitoring or ETC safety concept					
C_N_MAX_PRS_OIL_ADD	-	0... 1FE0H	0... 8160	1	rpm
offset for engine speed limit for oil pressure limb home mode					
C_N_MAX_THD_LIH_H	-	0... 1FE0H	0... 8160	1	rpm
Higher engine speed limit threshold (classifies minor N_MAX reduction due to LIH)					
C_N_MAX_THD_LIH_L	-	0... 1FE0H	0... 8160	1	rpm
Lower engine speed limit threshold (classifies major N_MAX reduction due to LIH)					
C_N_MAX_THD_MIN	-	0... 1FE0H	0... 8160	1	rpm
Minimum allowed engine speed threshold					
C_T_AST_ETCU_CAN_VLD	-	0... FFFFH	0... 6553.5	0.1	s
Time after start limit, until ETCU_CAN is valid					
C_T_GEAR_VS_MAX_AT	-	0... FFH	0... 25.5	0.1	s
Time for calculating N_MAX_VS_MAX after a gear shift with AT.					
C_T_GEAR_VS_MAX_MT	-	0... FFH	0... 25.5	0.1	s
Time for calculating N_MAX_VS_MAX after a gear shift with MT.					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MAX_N_MAX_H_AT	-	0... FFH	0... 25.5	0.1	s
maximum time after exceeding the VS threshold, AT vehicle					
C_T_MAX_N_MAX_H_AT_MAN	-	0... FFH	0... 25.5	0.1	s
maximum time after exceeding the VS threshold, AT vehicle in 'M' (manual) mode					
C_T_MAX_N_MAX_H_MT	-	0... FFH	0... 25.5	0.1	s
maximum time after exceeding the VS threshold, MT vehicle					
C_VS_MAX_HYS	-	0... FFH	0... 255	1	km/h
Hysteresis of vehicle speed limitation					
C_VS_THD_N_MAX_H_AT	-	0... 7FFFH	0... 327.67	0.01	km/h
VS threshold for increased engine speed limit, AT vehicle					
C_VS_THD_N_MAX_H_AT_MAN	-	0... 7FFFH	0... 327.67	0.01	km/h
VS threshold for increased engine speed limit, AT vehicle in M (manual) mode					
C_VS_THD_N_MAX_H_MT	-	0... 7FFFH	0... 327.67	0.01	km/h
VS threshold for increased engine speed limit, MT vehicle					
ID_N_DEC_N_MAX_H_AT	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
stepwidth to basic engine speed limit, AT vehicle					
ID_N_DEC_N_MAX_H_AT_MAN	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
stepwidth to basic engine speed limit, AT vehicle in 'M' (manual) mode					
ID_N_DEC_N_MAX_H_MT	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
stepwidth to basic engine speed limit, MT vehicle					
ID_N_MAX_AT	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
basic engine speed limit AT-vehicle					
ID_N_MAX_AT_MAN	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
engine speed limit AT vehicle in 'M' (manual) mode					
ID_N_MAX_H_AT	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
increased engine speed limit AT-vehicle					
ID_N_MAX_H_AT_MAN	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
increased engine speed limit AT vehicle in 'M' (manual) mode					
ID_N_MAX_H_MT	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
increased engine speed limit MT-vehicle					
ID_N_MAX_MT	-	0... 1FE0H	0... 8160	1	rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
basic engine speed limit MT-vehicle					
ID_T_N_MAX_H_AT	-	0... FFFFH	0... 6553.5	0.1	s
LDPM_GEAR	9	0... FFH	0... 255	1	-
time for increased engine speed limit, AT vehicle					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_T_N_MAX_H_AT_MAN	-	0... FFFFH	0... 6553.5	0.1	s
LDPM_GEAR	9	0... FFH	0... 255	1	-
time for increased engine speed limit, AT vehicle in 'M' (manual) mode					
ID_T_N_MAX_H_MT	-	0... FFFFH	0... 6553.5	0.1	s
LDPM_GEAR	9	0... FFH	0... 255	1	-
time for increased engine speed limit, MT vehicle					
IP_N_MAX_1_TCO	-	0... 1FE0H	0... 8160	1	rpm
LDP_TCO_N_MAX_1	4	0... C8H	-40 ...160	1	°C
Engine speed limit (orange area) depending on TCO - BN2000					
IP_N_MAX_2_TCO	-	0... 1FE0H	0... 8160	1	rpm
LDP_TCO_N_MAX_2	4	0... C8H	-40 ...160	1	°C
Engine speed limit (orange area) depending on TCO - BN2000					
IP_N_MAX_DROF__VS	-	0... 1FE0H	0... 8160	1	rpm
LDP_VS_N_MAX_DROF	8	0... FFH	0... 255	1	km/h
Engine speed limit to avoid max torque at jump start					
IP_N_MAX_LIH_EGS	-	0... 1FE0H	0... 8160	1	rpm
LDP_VS__N_MAX	8	0... FFH	0... 255	1	km/h
Engine speed limit for AT in case of CAN error to EGS					
IP_N_MAX_MTC_CUR_OFF__PV_AV	-	0... 1FE0H	0... 8160	1	rpm
LDP_PV_AV__N_MAX_MTC_CUR_OFF	4	0... FFH	0... 99.60937	0.390625	%
Engine speed limit for limp home modus due to MTC error					
LC_N_MAX_VS_MAX_ACT	-	0... 1H	0 ...1	1	-
Switch to activate vs_max limitation over N_MAX_VS_MAX					
LC_VAR_ETCU_SPT_SWI	-	0... 1H	0 ...1	1	-
LC indicating version of AT or TCT transmission (0 = ETCU without sport switch, 1 = ETCU with sport switch)					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_N_REF_MAX	-	0... 1FE0H	0... 8160	1	rpm
Threshold for not active engine speed limitation, 8160rpm					

FUNCTION DESCRIPTION:

General information:

Several conditions can activate an engine speed limit. The actual engine speed limit is calculated as minimal selection of all requests.

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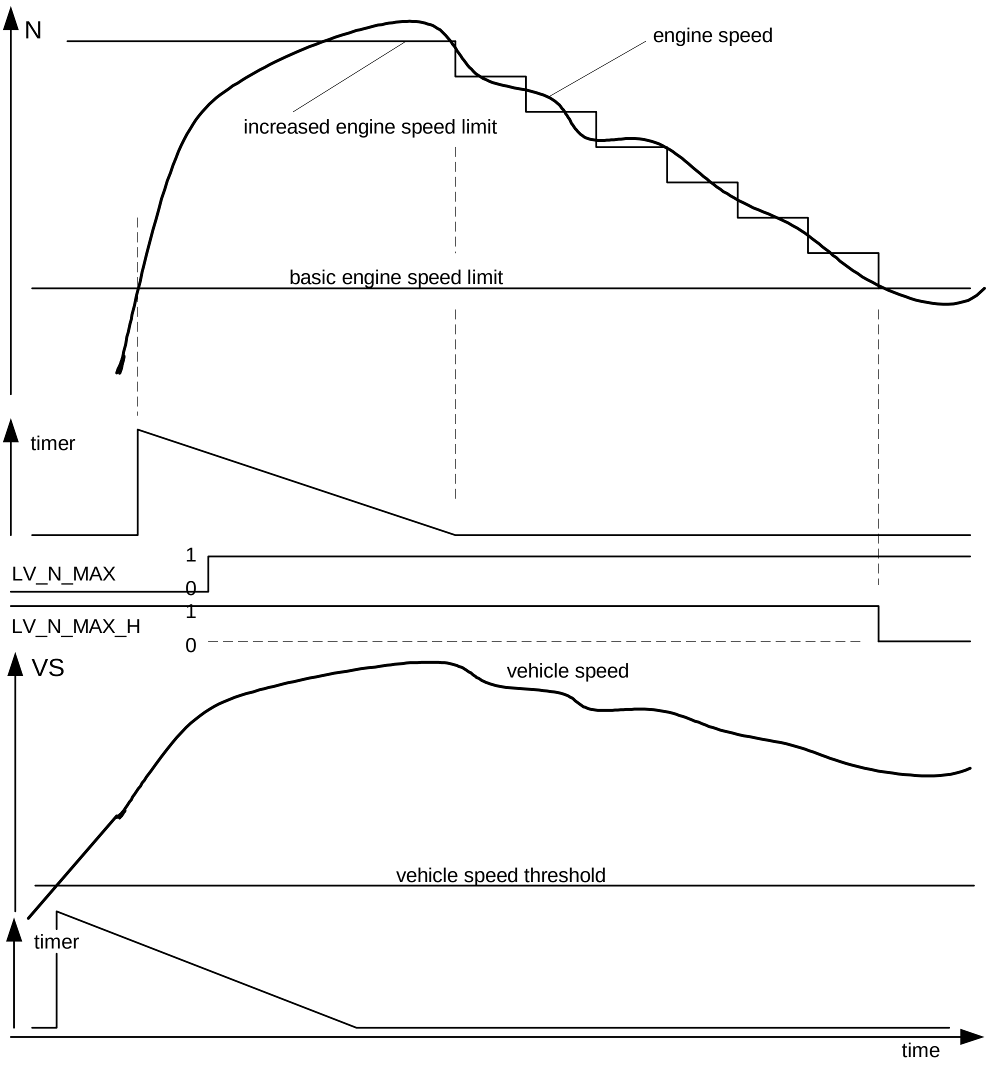

Signal flow diagram

If the vehicle speed is below a threshold or exceeded this threshold not more than a calibrateable time before, an increased speed limit is valid for a short time (this is **not** true, if the transmission variant is AT and the reverse gear is engaged, i.e. if LV_AT and STATE_GEAR_REV_AT_AMT = 1). So if the engine speed exceeds the basic engine speed limit while the time after VS exceeded C_VS_THD_N_MAX_H_xx is at the most C_T_MAX_N_MAX_H_xx, the increased engine speed limit is valid for a calibrateable time. After this time the valid limit is changed towards the basic engine speed limit via calibrateable steps. If C_T_MAX_N_MAX_H_xx is terminated without limitation being active (LV_N_MAX = 0), N_MAX_xx is set from increased speed limit to basic engine speed in one step.
A jump back to the increased engine speed limit is possible not before the engine speed limitation is finished (LV_N_MAX = 0). Furthermore the VS condition must be fulfilled (still or again). All the 4 parameters

- basic engine speed limit
- increased engine speed limit
- time for increased engine speed limit and
- stepwidth to basic engine speed limit

are seperately calibrateable for the 3 vehicle variants

- automatic or twin clutch transmission
- manual transmission

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- automatic manual transmission
- automatic ot twin clutch transmission in manual mode ’M’

and dependant from the actual gear.
C_VS_THD_N_MAX_H_xx and C_T_MAX_N_MAX_H_xx are seperately calibrateable for the 3 vehicle variants (xx = MT/AT).
Above a specific engine speed, the calculation of the stratified combustion mode is switched off. To enable a stratified limp home mode even when the stratified combustion mode calculation is switched off, the engine speed limitation N_MAX_LIH_STATE_CMB_S is introduced to reactivate stratified mode calculation.

Application conditions

Initialisation:

```
N_MAX_THD           =  NC_N_REF_MAX ( = 8160 rpm )
N_MAX_THD_1         =  0
N_MAX_THD_2         =  0
LV_VS_MAX           =  0
N_MAX_THD_LIH       =  NC_N_REF_MAX ( = 8160 rpm )
N_MAX_LIH_EGS       =  NC_N_REF_MAX ( = 8160 rpm )
STATE_N_MAX_THD_LIH =  0
```

Recurrence: *100 ms*

Activation: *at every engine operating state*

Deactivation: –

Formula section:

a1) Basic engine speed limit :

Manual transmission vehicle

```
If      (LV_AT = 0   and LV_VAR_TCT = 0)
  Then      N_MAX_MT      =   ID_N_MAX_MT
  Else      N_MAX_MT      =   NC_N_REF_MAX
Endif
```

Automatic transmission or twin clutch transmission vehicle

```
If      (LV_AT = 1 or LV_VAR_TCT = 1)
Then
        If        STATE_GEAR_REV_AT_AMT = 0
        then  if      [ (( STATE_ETCU_PROG_INFO=1 and LV_VAR_BN=0 ) or
                          ( STATE_ETCU_PROG_INFO=2 and LV_VAR_BN=1 )       )  and
                        LC_VAR_ETCU_SPT_SWI = 0 ]          or
                      [ LV_INH_GP_SUP = 1   and   LC_VAR_ETCU_SPT_SWI = 1 ]
              Then          N_MAX_AT        =   ID_N_MAX_AT_MAN
              else          N_MAX_AT        =   ID_N_MAX_AT
              endif
        Else          N_MAX_AT          =   C_N_MAX_DRI_RVL
        Endif
Else    N_MAX_AT   =    NC_N_REF_MAX
Endif
```

Remark: a change of the vehicle-(transmission-)type is done only during VS = 0 km/h.

a2) Parameters for increased engine speed limit :

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Parameter	Vehicle type *)	Value
VS-threshold	1)	C_VS_THD_N_MAX_H_MT
	3)	C_VS_THD_N_MAX_H_AT
	4)	C_VS_THD_N_MAX_H_AT_MAN
increased engine speed limit	1)	ID_N_MAX_H_MT
	3)	ID_N_MAX_H_AT
	4)	ID_N_MAX_H_AT_MAN
time before decrementation begins	1)	ID_T_N_MAX_H_MT
	3)	ID_T_N_MAX_H_AT
	4)	ID_T_N_MAX_H_AT_MAN
decrease stepwidth	1)	ID_N_DEC_N_MAX_H_MT
	3)	ID_N_DEC_N_MAX_H_AT
	4)	ID_N_DEC_N_MAX_H_AT_MAN

*) Vehicle types :
1) Manual transmission vehicle
2) Automatic manual transmission vehicle
3) Automatic/Twin clutch transmission vehicle
4) Automatic/Twin clutch transmission vehicle in ’M’ (manual) mode

Functionality (N_MAX_MT/AT = ...) : see signal flow diagram above.

Status bit for increased engine speed limit:

```
If      ID_N_MAX_MT < N_MAX_MT < NC_N_REF_MAX
    OR
    [ ID_N_MAX_AT < N_MAX_AT < NC_N_REF_MAX      and
      STATE_GEAR_REV_AT_AMT = 0                  and
      { (((STATE_ETCU_PROG_INFO != 1   and   LV_VAR_BN = 0) or
            (STATE_ETCU_PROG_INFO != 2   and   LV_VAR_BN = 1)   ) and
          LC_VAR_ETCU_SPT_SWI = 0 )        or
       (LV_INH_GP_SUP = 0   and   LC_VAR_ETCU_SPT_SWI = 1 )  }  ]
    OR
    [ ID_N_MAX_AT_MAN < N_MAX_AT < NC_N_REF_MAX     and
      STATE_GEAR_REV_AT_AMT = 0                     and
      { (((STATE_ETCU_PROG_INFO = 1   and   LV_VAR_BN = 0) or
           (STATE_ETCU_PROG_INFO = 2   and   LV_VAR_BN = 1)    ) and
         LC_VAR_ETCU_SPT_SWI = 0 )        or
    (LV_INH_GP_SUP = 1   and   LC_VAR_ETCU_SPT_SWI = 1 )  }  ]
 Then                                        LV_N_MAX_H  =  1
 Else                                        LV_N_MAX_H  =  0
Endif
```

a4) Engine speed limit if limp home mode required by throttle monitoring

In case of limp home request from main throttle controller a lower engine speed limit should be active.

```
If          LV_N_LIM_REQ_MON                ==   1   or
       LV_TPS_MTC_N_LIM                ==   1   or
       LV_MTC_LIH_ACT                  ==   1   or
            LV_N_LIM_REQ_RST_CHK  ==1               or
       LV_MAF_BLS_DIAG                 ==   1   or
       LV_ERR_ECU_CKS                  ==   1   or
       LV_ERR_ECU_RAM                  ==   1
```

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Then N_MAX_LIH_ETC = C_N_MAX_MTC_LIH
Else N_MAX_LIH_ETC = NC_N_REF_MAX
Endif

a5) Engine speed limit if limp home mode only due to MTC error
If LV_MTC_LIH_CUR_OFF == 1
Then N_MAX_LIH_MTC = IP_N_MAX_MTC_CUR_OFF(PV_AV)
Else N_MAX_LIH_MTC = NC_N_REF_MAX
Endif

If N_MAX_LIH_MTC **or** N_MAX_LIH_ETC not NC_N_REF_MAX
Then LV_N_MAX_ETC_LIH = 1
Else LV_N_MAX_ETC_LIH = 0
Endif

a6) Engine speed limit for vehicle speed limitation
In case of vehicle speed limitation the engine speed limitation will be activated.

If (1) LV_GP = 0
Then(1)
If (2) VS_MAX_SEL_EXT_REQ = 1
Then(2) VS_MAX = C_VS_MAX_1
Else(2)
If (3) VS_MAX_SEL_EXT_REQ = 2
Then(3) VS_MAX = C_VS_MAX_2
Else(3)
If (4) VS_MAX_SEL_EXT_REQ = 3
Then(4) VS_MAX = C_VS_MAX_3
Else(4) VS_MAX = C_VS_MAX_0_DFT
Endif(4)
Endif(3)
Endif(2)
Else(1) VS_MAX = 327.67
Endif(1)

VS_RATIO = VS_MAX /VS

If(1) (VS_MAX $<$ 327.67) **AND** LC_N_MAX_VS_MAX_ACT = 1
Then(1)
If(2) (VS_RATIO <= 1.0) ("Hysteresis")
Then(2) LV_VS_MAX = 1
Else(2)
If(3) VS <= VS_MAX - C_VS_MAX_HYS
Then(3) LV_VS_MAX = 0
Endif(3)
Endif(2)
If(4) GEAR $\neq$ 0 **and**
GEAR $\neq$ GEAR_PREV_VS_MAX
Then(4) GEAR_PREV_VS_MAX = GEAR
LV_GEAR_SHIFT_VS_MAX = 1
If(5) LV_AT = 1 **or** LV_VAR_TCT = 1
Then(5) T_GEAR_VS_MAX = C_T_GEAR_VS_MAX_AT

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Else(5) T_GEAR_VS_MAX = C_T_GEAR_VS_MAX_MT
Endif(5)
Else(4) decrement T_GEAR_VS_MAX
LV_GEAR_SHIFT_VS_MAX = 0
Endif(4)

If(6) VS > VS_MAX - C_VS_MAX_HYS
Then(6)
If(7) [N_MAX_VS_MAX = NC_N_REF_MAX **or** LV_GEAR_SHIFT_VS_MAX = 1 **or**
T_GEAR_VS_MAX ≠ 0] **or**
((LV_AT = 1 **or** LV_VAR_TCT = 1) **and**
STATE_CC "Closed")
Then(7) N_MAX_VS_MAX = N * VS_RATIO,
Else(7) N_MAX_VS_MAX remains
Endif(7)
Else(6) N_MAX_VS_MAX = NC_N_REF_MAX
Endif(6)

Else(1) {Engine speed limit for vehicle speed limitation deactivated
LV_VS_MAX = 0
N_MAX_VS_MAX = NC_N_REF_MAX }
Endif(1)

a7) Engine speed limit for energy spare mode (production, transportation or garage mode)
IF STATE_EGY_MIN_KWP = 1
then N_MAX_EGY = C_N_MAX_EGY_1
elseif STATE_EGY_MIN_KWP = 2 **AND**
CTR_KM_CAN <= C_CTR_KM_CAN_EGY_2_MAX
then N_MAX_EGY = C_N_MAX_EGY_2
elseif STATE_EGY_MIN_KWP = 3
then N_MAX_EGY = C_N_MAX_EGY_3
else N_MAX_EGY = 1FE0H
ENDIF

a8) Engine speed limit in order to avoid a maximum torque in powertrain due to jump start
IF LV_CS = 1
then N_MAX_DROF = IP_N_MAX_DROF(VS)
else N_MAX_DROF = 1FE0H
ENDIF

a9) Engine speed limit in order to avoid overspeed in oil pressure limb home mode

N_MAX _LIH_PRS_OIL = N_LIH_PRS_OIL + C_N_MAX_PRS_OIL_ADD

a10) Engine speed limitation for automatic transmission in case of TCU - EGS limb home (CAN error)

IF **(** LV_ETCU_DISABLE_CAN == 1 **AND**
LV_ST_END == 1 **AND**
T_AST > C_T_AST_ETCU_CAN_VLD **)** **OR**
STATE_ST_TQ_LIM_GS == 1

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```
THEN    N_MAX_LIH_EGS = IP_N_MAX_LIH_EGS (VS)
ELSE    N_MAX_LIH_EGS = N_MAX_LIH_EGS + C_N_MAX_LIH_EGS_LGRD
endif
```

b) Selection of the currently active engine speed limit N_MAX_THD:

The lowest active engine speed limitation is selected as input for the controller:

```
N_MAX_THD    =    max(    C_N_MAX_THD_MIN,
                      min(    N_MAX_MT,
                              N_MAX_AMT,
                      N_MAX_AT,
                              N_MAX_LIH_ETC,
                              N_MAX_LIH_MTC,
                              N_MAX_VS_MAX,
                              N_MAX_LIH_STATE_CMB_S,
                              N_MAX_EGY,
                              N_MAX_DROF,
                              N_MAX_LIH_PRS_OIL,
                              N_MAX_LIH_EGS )    )
```

c1) Currently active engine speed limit (BN) depending on TCO N_MAX_THD_1(orange area):

```
N_MAX_THD_1    =    IP_N_MAX_1_TCO
```

c2) Currently active engine speed limit (BN) depending on TCO N_MAX_THD_2 (red area):

```
N_MAX_THD_2    =    IP_N_MAX_2_TCO
```

d) Selection of the currently active engine speed limit due to limp home N_MAX_THD_LIH :

The lowest active engine speed limitation caused by limp home is used for determination of the level of limitation (STATE_N_MAX_THD_LIH):

```
N_MAX_THD_LIH    = min(    N_MAX_LIH_ETC,
                           N_MAX_LIH_MTC,
                           N_MAX_LIH_STATE_CMB_S,
                           N_MAX_EGY,
                           N_MAX_LIH_PRS_OIL)
```

```
If          N_MAX_THD_LIH < C_N_MAX_THD_LIH_L
Then        STATE_N_MAX_THD_LIH = 2            // major limitation of N due to LIH
Else   If        N_MAX_THD_LIH < C_N_MAX_THD_LIH_H
       Then      STATE_N_MAX_THD_LIH = 1       // minor limitation of N due to LIH
       Else      STATE_N_MAX_THD_LIH = 0       // no limitation of N due to LIH
       Endif
Endif
```

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4.8 Vehicle speed limit calculation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AC_VEH_MMV	O/V	8000... 7FFFH	-27.77088 ...27.770033	847.5e-6	m/s**2
Current Vehicle Acceleration - Filtered					
LV_VS_MAX_LIH_TCT_ACT	V	0... 1H	0 ...1	1	-
Vehicle speed maximum limphome for TCT					
VS_DIF_LIM	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	km/h
Vehicle speed deviation for speed limiter					
VS_MAX	O/V	0... 7FFFH	0... 327.67	0.01	km/h
Maximum allowed vehicle speed					
VS_PRED	O/V	0... 7FFFH	0... 327.67	0.01	km/h
Predicted Vehicle Speed for Speed Limitation					

Input data:

AC_VEH {p. 797}	LV_GP {p. 803}	LV_IGK {p. 906}	LV_SWT_VMAX_ENA
N_VS {p. 806}	PV_AV {p. 1269}	VS_HIGH_RES {p. 811}	VS_MAX_LIH_TCT {p. 1582}
VS_MAX_SEL_EXT_REQ {p. 7683}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_AC_VEH_VS_MAX	V	0... FFFFH	0... 0.99998474121	15.2588e-6	-
PT1 filter constant for low pass filter					
C_PV_MIN_LIH_TCT_ACT	V	0... FFH	0... 99.609375	0.390625	%
Pedal value position minimum limphome for TCT					
C_VS_DIF_LIH_TCT_DEAC	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed difference limphome for TCT					
C_VS_MAX_0_DFT	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed limitation threshold 0 - default value					
C_VS_MAX_1	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed limitation threshold 1					
C_VS_MAX_2	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed limitation threshold 2					
C_VS_MAX_3	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed limitation threshold 3					
C_VS_MAX_AMT	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed limitation threshold - SSG					
C_VS_MAX_LIH_TCT_DEC	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed maximum limphome for TCT decrement					
C_VS_MAX_LIH_TCT_INC	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed maximum limphome for TCT increment					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VS_MAX_SWT_ENA	V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed limitation threshold for sweeping technology					
ID_T_VS_MAX_PRED	V	0... FFH	0... 7.96875	0.03125	s
LDPM_N_VS_VS_MAX	8	0... FFH	0... 255	1	rpm/(km/h)
Prediction time for predicted engine speed for automatic transmission					

General information:

A filtered vehicle acceleration, AC_VEH_MMV is used to predict a future vehicle speed VS_PRED. The vehicle speed limit, VS_MAX is also determinated at this point. For the fix limitation this limit will be given by the constant C_VS_MAX.
Another part is the calculation of the vehicle speed deviation which is an essential variable for the vehicle speed controller.

Application conditions:

Initialisation: `RST`
Recurrence: `100MS`
Activation: `LV_IGK==1`
Deactivation: `if activation not true`

Function description:

Formula section:

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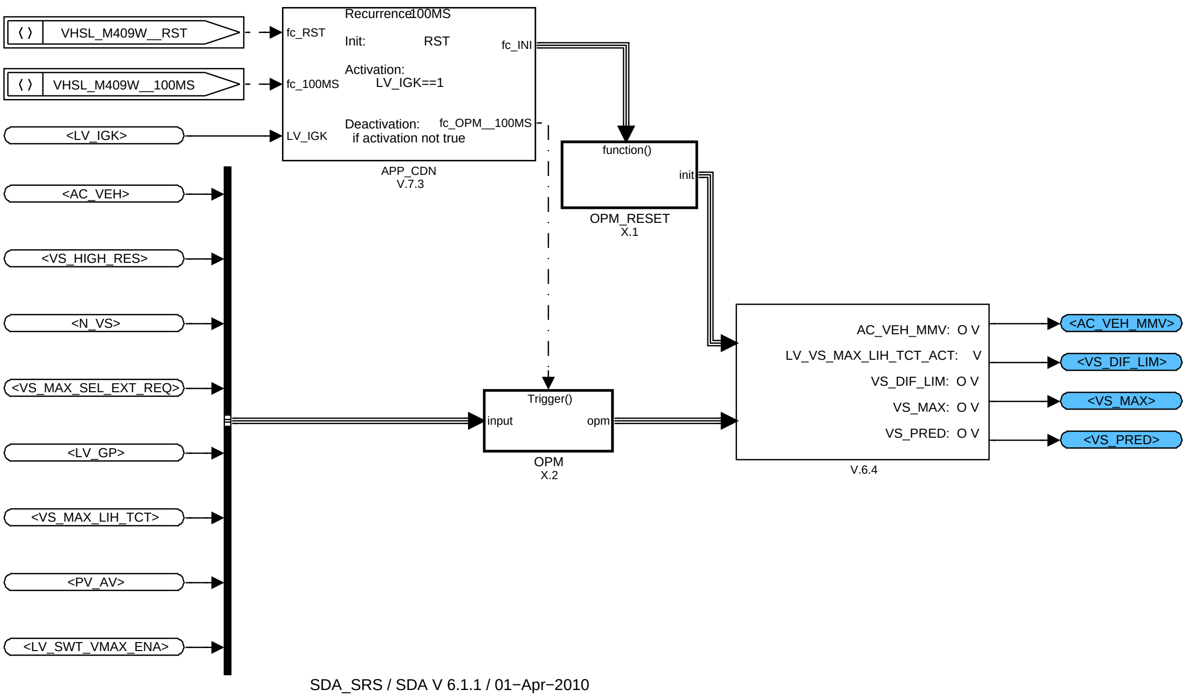

Figure 4.8.1: :

4.8.1 SUB FUNCTION: OPM_RESET

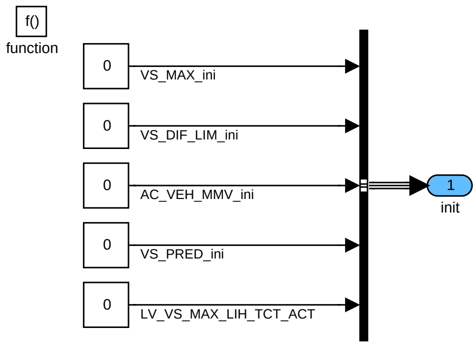

Figure 4.8.2: :

Overview

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4.8.2 SUB FUNCTION: OPM_100MS

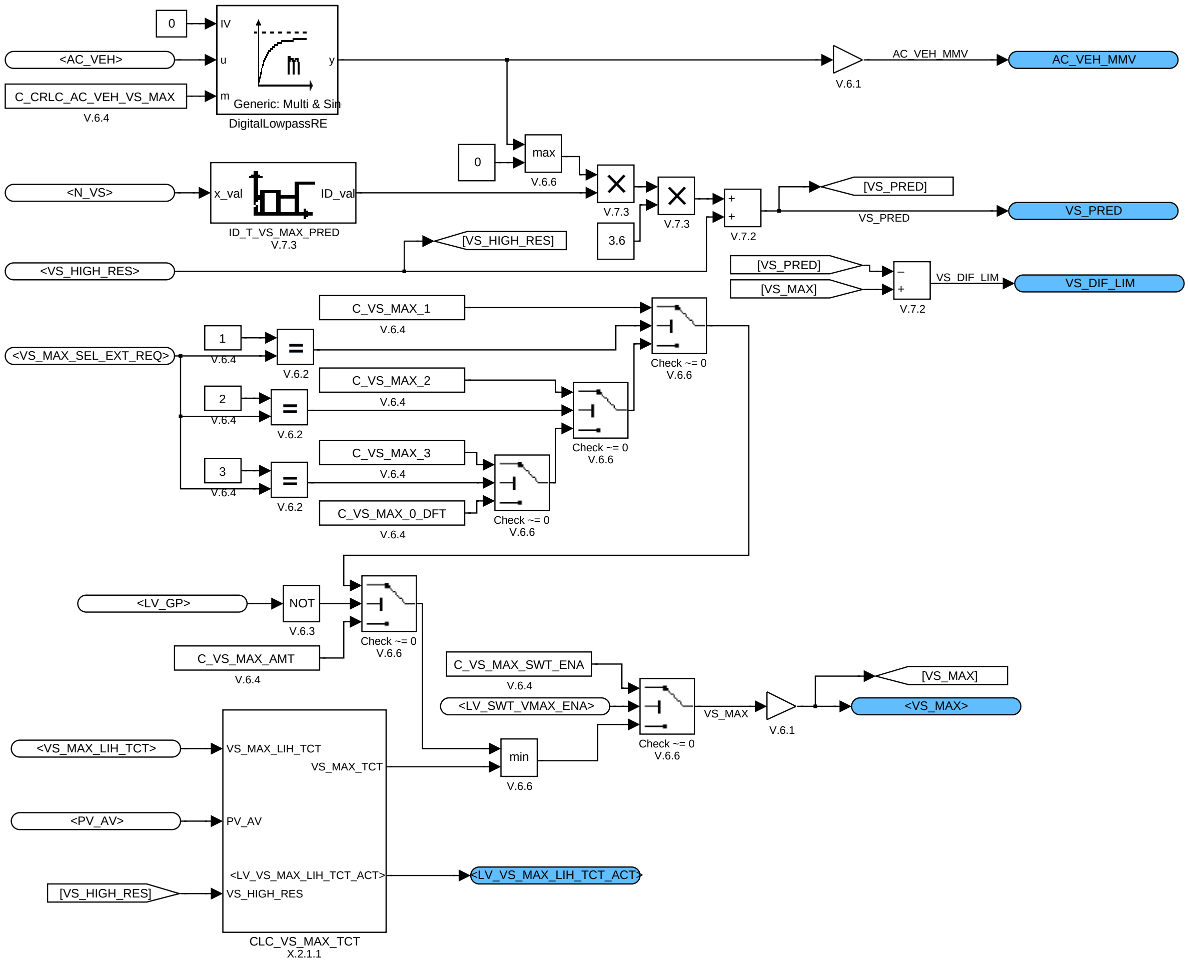

Figure 4.8.3: :

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4.8.2.1 Calculation of VS_MAX_TCT

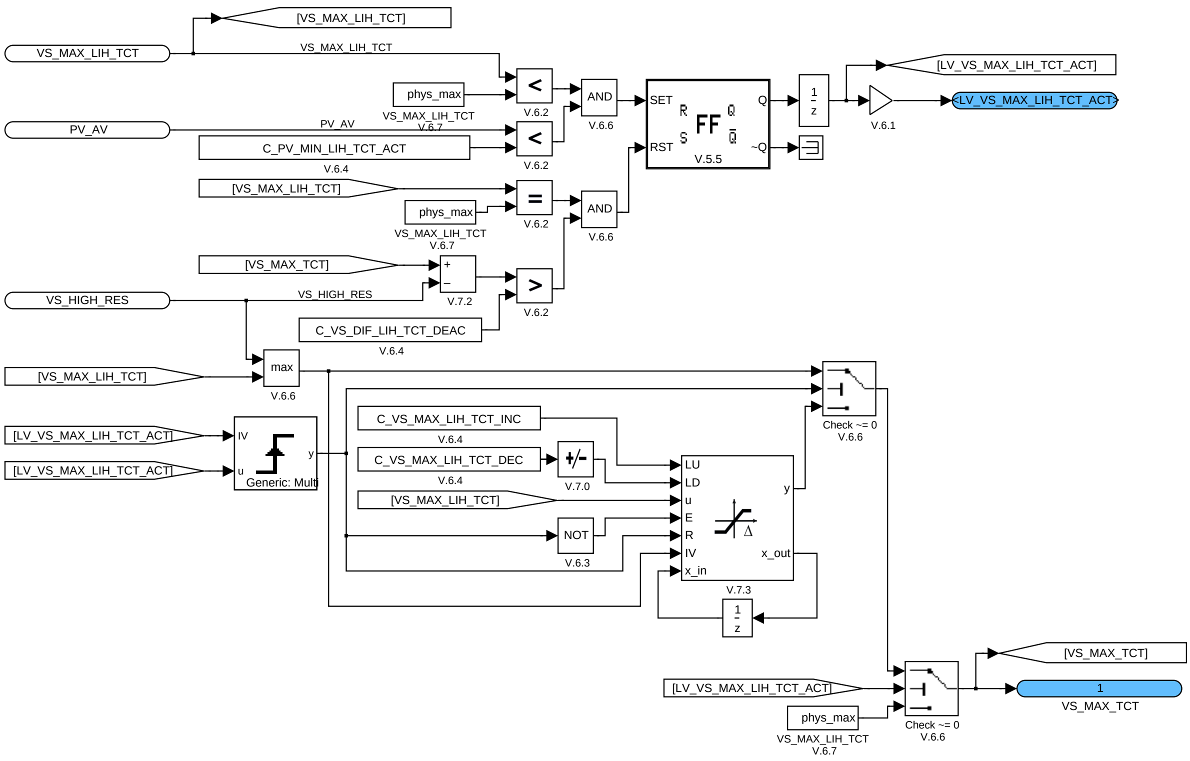

Figure 4.8.4: :

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4.9 Ambient pressure acquisition

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AMP_COR	-	0... FFFFH	0... 5434	0.0829175	hPa
Corrected ambient pressure					
AMP_MES	O/V	0... FFFFH	0... 5434	0.0829175	hPa
valid ambient pressure					
AMP_RAW	V	0... FFFFH	0... 5434	0.0829175	hPa
ambient pressure raw value					
AMP_RAW_FRZ	-	0... FFFFH	0... 5434	0.0829175	hPa
Interim value for calculation of AMP_RAW substitute value					
AMP_RAW_NEW	-	0... FFFFH	0... 5434	0.0829175	hPa
Interim value for calculation of ambiant pressure raw value					
AMP_SAE	O/V	0... FFH	0... 255	1	kPA
PID33 Ambient pressure					
CTR_SAMPLES	-	0... FFH	0... 255	1	-
counter for average determination					
FAC_AMP	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
factor of the ambient pressure related to the reference ambient pressure					
LV_AMP_GRD_MAX	V	0... 1H	0 ...1	1	-
ambient pressure maximum gradient exceeded					
SUM_AMP_RAW	-	0... FFFFFFFFH	0... 356128058	0.0829175	hPa
summarized ambient pressure raw value					
T_DLY_AMP_SUB	V	0... FFH	0... 25500	100	ms
Delay time before AMP_RAW value substitution					

Input data:

C_V_AMP_MAX_DIAG {p. 4822}	C_V_AMP_MIN_DIAG {p. 4822}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}
LV_ERR_AMP_PLAUS_CUS {p. 1061}	LV_ERR_PUT_EL {p. 4828}	LV_ERR_PUT_PLAUS {p. 1062}	LV_VAR_TCHA {p. 656}
MAF_KGH_MES {p. 1192}	PUT_MES_BAS {p. 1198}	STATE_ENG {p. 1720}	V_AMP {p. 831}
VS {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_CRLC	-	0... FFH	0... 0.99609	3.9063e-3	-
correlation value for the compensation of the noise signal of the ambient pressure signal					
C_AMP_HYS	-	0... FFFFH	0... 5434	0.0829175	hPa
maximum value between two acquired ambient pressure values					
C_AMP_REF	-	0... FFFFH	0... 5434	0.0829175	hPa
reference value of the ambient pressure					
C_FAC_AMP_MAX	-	0... FFFFH	0... 1.99996	30.5e-6	-
TOP for FAC_AMP					
C_FAC_AMP_MIN	-	0... FFFFH	0... 1.99996	30.5e-6	-
BOT for FAC_AMP					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_THD_AMP_SUB	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
MAF threshold for AMP_RAW value substitution					
C_T_DLY_AMP_SUB	-	0... FFH	0... 25500	100	ms
Delay time threshold for AMP_RAW value substitution					
IP_AMP_RAW__V_AMP	-	0... FFFFH	0... 5434	0.0829175	hPa
LDP_V_AMP__AMP_RAW	8	0... 3FFH	0 ...5	4.8876e-3	V
correlation table for the linearization of the ambient pressure value acquisition with motorola sensor					
IP_AMP_RAW_COR__VS	-	0... FFFFH	0... 5434	0.0829175	hPa
LDP_VS__AMP_RAW_COR	8	0... FFH	0... 255	1	km/h
correlation table for the linearization of the ambient pressure with the vehicle speed					

FUNCTION DESCRIPTION:

Application conditions

Activation : at every engine operating state

Deactivation : -

Initialization :

```
At Reset:
    If(1)      V_AMP < C_V_AMP_MIN_DIAG       or
     V_AMP > C_V_AMP_MAX_DIAG
    Then(1)      AMP_MES = C_AMP_REF
     FAC_AMP = 1(phys)
     LV_AMP_GRD_MAX = 1
    Else(1) If(2)             LV_ERR_AMP = 0
          Then(2)        AMP_RAW = IP_AMP_RAW__V_AMP
          Else(2)        AMP_ RAW = C_AMP_REF
          Endif(2)
          AMP_COR  =  AMP_RAW + IP_AMP_RAW_COR__VS
     AMP_MES = AMP_COR        // Calculated with first valid
measurement
     value V_AMP  //
      FAC_AMP =       AMP_MES /  C_AMP_REF  // C_FAC_AMP_MIN

      FAC_AMP    C_FAC_AMP_MAX //
      LV_AMP_GRD_MAX = 0
    Endif(1)
AMP_RAW_FRZ = C_AMP_REF
```

Update rate: 100 ms

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Formula section:

AMP_SAE = IP_AMP_RAW__V_AMP *//Conversion done is physical way, no initialization*
If(1) LV_ERR_AMP = 0 **and**
LV_ERR_AMP_PLAUS = 0 **and**
LV_ERR_AMP_PLAUS_CUS = 0
Then(1) **If(2)** V_AMP < C_V_AMP_MIN_DIAG **or**
V_AMP > C_V_AMP_MAX_DIAG
Then(2) AMP_RAW(n) = AMP_RAW(n-1) *// V_AMP out of range, keep last valid*

value //
Else(2) AMP_RAW_NEW = IP_AMP_RAW__V_AMP
If(3) LV_AMP_GRD_MAX = 0 **and**
AMP_RAW_NEW - AMP_RAW > C_AMP_HYS
Then(3) LV_AMP_GRD_MAX = 1
AMP_RAW$_{(n)}$ = AMP_RAW$_{(n-1)}$*// Keep old value //*
Else(3) AMP_RAW = AMP_RAW_NEW
LV_AMP_GRD_MAX = 0
Endif(3)

Else(1) LV_AMP_GRD_MAX = 1
If(2) LV_VAR_TCHA = 0*// Qustion if there is a turbocharger and thus also a PUT sensor //*
Then(2) AMP_RAW = C_AMP_REF
Else(2) **If(3)** LV_ERR_PUT_EL = 0 **and**
LV_ERR_PUT_PLAUS = 0 **and**
Then(3) **If(4)**MAF_KGH_MES <
C_MAF_THD _AMP_SUB **and**
STATE_ENG = 2 **or**
STATE_ENG = 4 **or**
STATE_ENG = 5
Then(4) T_DLY_AMP_SUB ++ *// timer starts counting,*

no overflow allowed //
If(5) T_DLY_AMP_SUB >
C_T_DLY_AMP_SUB
Then(5)AMP_RAW = PUT_MES_BAS
AMP_RAW_FRZ = PUT_MES_BAS

// Freeze last PUT_MES_BAS value //
Else(5) AMP_RAW = AMP_RAW_FRZ *// Use last* AMP_RAW_FRZ (= *PUT_MES_BAS) value at T_DLY_ERR_AMP > C_T_DLY_AMP_SUB conditions //*
Endif(5)

Else(4) AMP_RAW = AMP_RAW_FRZ
T_DLY_AMP_SUB = 0
Endif(4)
Else(3) AMP_RAW = C_AMP_REF
Endif(3)
Endif(2)

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Endif(1)

SUM_AMP_RAW = AMP_RAW + SUM_AMP_RAW *// summation of actual and preceding*

amp_raw values //

If(1) CTR_SAMPLES < 9
Then(1) CTR_SAMPLES ++
Else(1) AMP_RAW_NEW = SUM_AMP_RAW /10
AMP_COR = AMP_RAW_NEW + IP_AMP_RAW_COR__VS
// Compensation of the back pressure of the vehicle, due to the vehicle speed //

AMP_MES = AMP_MES + (AMP_COR - AMP_MES) * C_AMP_CRLC
// Suppression of the signal noise //

// Additionally the factor FAC_AMP is calculated which is used in several

functions and limited by C_FAC_AMP_MAX and C_FAC_AMP_MIN //

C_FAC_AMP_MIN FAC_AMP C_FAC_AMP_MAX

SUM_AMP_RAW = 0 *// Clear counter //*

CTR_SAMPLES = 0 *// Clear counter //*

Endif(1)

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4.10 Exhaust pipe variables

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MAF_FLOW_EX	O/V	0000... FFFFH	0... 2047.96875	0.03125	kg/h
air mass flow out of the exhaust manifold					
PRS_EX	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Pressure in the exhaust system					
PRS_EX_EGR	O/V	0000... FFFFH	0... 5434	0.083	hPa
Pressure in the exhaust system (for MAF_EGR-Calculation)					
PRS_EX_EGR_INC	O/V	0... FFFFH	0... 5434	0.0829	hPa
increase of exhaust pressure in comparison to ambient pressure (for MAF_EGR-Calculation)					
PRS_EX_INC	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Increase of exhaust pressure in comparison to ambient pressure					

Input data:

AMP {p. 982}	LV_IGK {p. 906}	LV_RLY_MAIN {p. 3772}	MAF_CYL {p. 8277}
MFF_SP [NC_CBK_EX_NR] {p. 2151}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
NC_MAF_FAC_CYL {p. 2889}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_PRS_EX_EGR_INC	V	0... FFFFH	0... 5434	0.0829	hPa
LDPM_MAF_FLOW_EGR	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
pressure increase in the exhaust pipe (for MAF_EGR-Calculation)					
IP_PRS_EX_INC	V	0... FFFFH	0... 5434	0.0829	hPa
LDPM_MAF_CYL_EX	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
pressure increase in the exhaust pipe					

4.10.1 Calculation of the exhaust manifold pressure PRS_EX

FUNCTION DESCRIPTION:

There is an increase of the pressure in the exhaust pipe in comparison to the ambient pressure. The increase of the pressure is higher with increasing mass flow in the exhaust pipe. The cylinder mass air flow is direct proportional to the exhaust mass flow. Therefore the pressure increase in the exhaust pipe is a function of the cylinder mass flow.
The exhaust pressure PRS_EX is a function of the ambient pressure and the increase of the pressure in the exhaust pipe. which is a function of the mass flow in the exhaust pipe.

Application conditions

Initialisation: *all = 0 at reset*

Recurrence: *1000ms*

Activation: *LV_IGK = 0 -> 1*

Deactivation: *LV_RLY_MAIN = 1 -> 0 (also calculated in PWL phase)*

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Formula section:

PRS_EX_INC = IP_PRS_EX_INC (MAF_CYL)
PRS_EX = PRS_EX_INC + AMP

MAF_FLOW_EX = MAF_CYL /NC_CBK_EX_NR +
(MFF_SP[NC_CBK_EX_NR = 2] *
NC_CYL_NR/NC_CBK_EX_NR * N /NC_MAF_FAC_CYL) -
MAF_EGR
PRS_EX_EGR_INC = IP_PRS_EX_EGR INC (MAF_FLOW_EX)
PRS_EX_EGR = PRS_EX_EGR_INC + AMP

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4.11 Mass air flow throttle sensor variables

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_TPS_GAIN_ACT_1	O/V	0... 1H	0 ...1	1	-
Logical variable for TPS_AV based on amplified TPS 1					
LV_TPS_GRD_UP	O/V	0... 1H	0 ...1	1	-
Logical variable for throttle position gradient direction					
TPS_AV	O/V	0... 3FFFH	0... 119.5	0,0073	°TPS
Opening angle of the throttle valve					
TPS_AV_1	O/V	0... 3FFFH	0... 119.5	0,0073	°TPS
Opening angle of the throttle valve of TPS-Poti 1					
TPS_AV_2	O/V	0... 3FFFH	0... 119.5	0,0073	°TPS
Opening angle of the throttle valve of TPS-Poti 2					
TPS_AV_CTL	O/V	C000... 3FFFH	-119.5 ...119.5	0,0073	°TPS
Control opening angle of the throttle valve					
TPS_AV_CTL_1	O/V	C000... 3FFFH	-119.5 ...119.5	0,0073	°TPS
Control opening angle of the throttle valve of TPS-Poti 1					
TPS_AV_CTL_2	O/V	C000... 3FFFH	-119.5 ...119.5	0,0073	°TPS
Control opening angle of the throttle valve of TPS-Poti 2					
TPS_AV_CTL_GAIN_1	V	C000... 3FFFH	-119.5 ...119.5	0,0073	°TPS
Control opening angle of the throttle valve of amplified TPS-Poti 1					
TPS_AV_GAIN_1	V	0... 3FFFH	0... 119.5	0,0073	°TPS
Opening angle of the throttle valve of amplified TPS-Poti 1					
TPS_GRD	O/V	0... FFH	0... 2987.5	11.72	°TPS/s
Throttle position gradient, absolute value					
TPS_LIH	O/V	0... 3FFFH	0... 119.5	0,0073	°TPS
Limp home position of the throttle valve					
TPS_SEG	O/V	0... 3FFFH	0... 119.5	0.0073	°TPS
Segment synchronous measured throttle valve position					
TPS_SEG_1	O/V	0... 3FFFH	0... 119.5	0.0073	°TPS
Segment synchronous measured throttle valve position channel 1					
TPS_SEG_2	O/V	0... 3FFFH	0... 119.5	0.0073	°TPS
Segment synchronous measured throttle valve position channel 2					
TPS_SEG_GAIN_1	O/V	0... 3FFFH	0... 119.5	0.0073	°TPS
Segment synchronous measured throttle valve position amplified channel 1					
V_TPS_GAIN_BOL_ENA_1	V	0... 3FFH	0 ...5	0,0049	Volt
TPS1-voltage to switch from non-amplified to amplified sensor signal					
V_TPS_GAIN_TOL_ENA_1	V	0... 3FFH	0 ...5	0,0049	Volt
TPS1-voltage to switch from amplified to non-amplified sensor signal					

Input data:

STATE_ETC_LIH {p. 4982}	STATE_TPS_DIAG {p. 4982}	TPS_AD_SLOP_GAIN_1 {p. 4951}	TPS_LIH_1 {p. 4952}
TPS_LIH_2 {p. 4952}	TPS_LIH_INI {p. 4952}	V_TPS_1 {p. 831}	V_TPS_2 {p. 831}
V_TPS_AD_EL_BOL_1 {p. 4952}	V_TPS_AD_EL_BOL_2 {p. 4952}	V_TPS_AD_LIH_1 {p. 4952}	V_TPS_AD_LIH_2 {p. 4952}
V_TPS_AD_OFS_GAIN_1 {p. 4952}	V_TPS_GAIN_1 {p. 986}		

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TPS_MAX	-	0... 3FFFH	0... 119.5	0,0073	°TPS
Maximum mechanical opening angle of the throttle valve in degree					
C_TPS_SLOP	-	0... FFFFH	0... 48	730e-6	°TPS/V
Nominal value of the slope of potis 1 and 2					
C_V_TPS_GAIN_GRD_MAX	-	0... 3FFH	0 ...5	0.0049	Volt
TPS voltage gradient limitation					
C_V_TPS_GRD_MAX	-	0... 3FFH	0 ...5	0.0049	Volt
TPS voltage gradient limitation					
C_V_TPS_HYS_GAIN_1	-	0... 3FFH	0 ...5	0.0049	Volt
Hysteresis treshold for switch amplified/non-amplified TPS1					
C_V_TPS_SWI_GAIN_1	-	0... 3FFH	0 ...5	0.0049	Volt
Offset on maximum nominal voltage for switch amplified/non-amplified TPS1					

4.11.1 Standardization of the TPS-Voltage

FUNCTION DESCRIPTION:

General information:

With the help of the determined adaptation values, the TPS-Position is standardized using the standard slope of the throttle position sensors C_TPS_SLOP.
For a better control of smaller opening angles the amplified poti 1 is used (TPS_AV_GAIN_1).
To calculate the controller difference at the lower stop a control opening angle of the throttle value with positive/negative physical limits is needed (TPS_AV_CTL).

Application conditions

Initialisation: `TPS_LIH = TPS_LIH_INI`

Recurrence: `5ms`

Activation: `at every operating state`

Formula section:

actual value 1& 2:
TPS_AV_1 = (V_TPS_1_FIL - V_TPS_AD_EL_BOL_1) * C_TPS_SLOP
TPS_AV_2 = (V_TPS_AD_EL_BOL_2 - V_TPS_2_FIL) * C_TPS_SLOP

actual contol value 1& 2:
TPS_AV_CTL_1 = (V_TPS_1_FIL - V_TPS_AD_EL_BOL_1) * C_TPS_SLOP
TPS_AV_CTL_2 = (V_TPS_AD_EL_BOL_2 - V_TPS_2_FIL) * C_TPS_SLOP

actual value: amplified poti 1:
TPS_AV_GAIN_1 =

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$$\left(\frac{V\_TPS\_GAIN\_1\_FIL - V\_TPS\_AD\_OFS\_GAIN\_1}{TPS\_AD\_SLOP\_GAIN\_1} - V\_TPS\_AD\_EL\_BOL\_1\right) * C\_TPS\_SLOP$$

actual control value: amplified poti 1:
TPS_AV_CTL_GAIN_1 =

$$\left(\frac{V\_TPS\_GAIN\_1\_FIL - V\_TPS\_AD\_OFS\_GAIN\_1}{TPS\_AD\_SLOP\_GAIN\_1} - V\_TPS\_AD\_EL\_BOL\_1\right) * C\_TPS\_SLOP$$

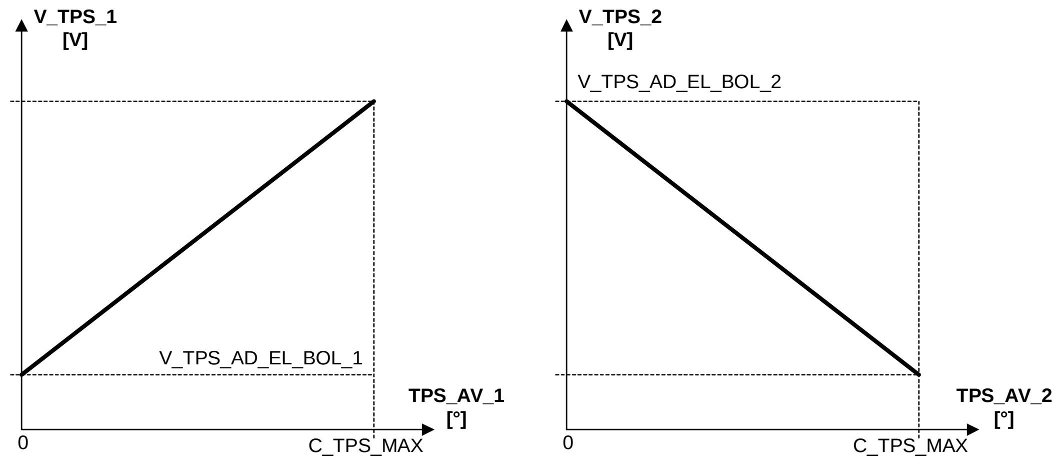

Figure 4.11.1: :Standardization of the TPS-Voltage

4.11.2 Selection of actual value TPS_AV /TPS_AV_CTL

Description:

The selection of actual value TPS_AV /TPS_AV_CTL depends on the hysteresis for amplifed/non-amplified poti1 and the status of TPS/ETC diagnosis.

Formula section:

Calculation hysteresis band:
V_TPS_GAIN_TOL_ENA_1 = 5V /TPS_AD_SLOP_GAIN_1 - C_V_TPS_SWI_GAIN_1
V_TPS_GAIN_BOL_ENA_1 = V_TPS_GAIN_TOL_ENA_1 - C_V_TPS_HYS_GAIN_1

Hysteresis for amplifed/non-amplified poti 1:

Hysteresis for use of amplified /non-amplified TPS 1:
if V_TPS_1 $<$ V_TPS_GAIN_BOL_ENA_1 **and**
LV_TPS_GAIN_ACT_1 = 0
then LV_TPS_GAIN_ACT_1 = 1
elseif V_TPS_1 $>$ V_TPS_GAIN_TOL_ENA_1 **and**
LV_TPS_GAIN_ACT_1 = 1

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```
    then      LV_TPS_GAIN_ACT_1 = 0
  endif
endif
```

Selection in errorfree case:

TPS1 & TPS2 errorfree, no TPS plausibility error:

```
if                STATE_TPS_DIAG = TPS_NO_ERROR
then
                 if         LV_TPS_GAIN_ACT_1 = 1
                 inside operation range of amplified TPS1:
                 then         TPS_AV          = TPS_AV_GAIN_1
                          TPS_AV_CTL = TPS_AV_CTL_GAIN_1
                          TPS_LIH       = TPS_LIH_1
                 outside operation range of amplified TPS1:
                 else         TPS_AV          = TPS_AV_1
                          TPS_AV_CTL = TPS_AV_CTL_1
                          TPS_LIH        = TPS_LIH_1
                 endif
endif
```

Selection in error-cases:

TPS1 & TPS2 erroneous or MTC without power:

```
if                STATE_TPS_DIAG = TPS_DBL_ERROR                 or
                 STATE_ETC_LIH = ETC_LIH_1                   or
                 STATE_ETC_LIH = ETC_LIH_2_REV               or
                 STATE_ETC_LIH = ETC_LIH_2
then          TPS_AV          = C_TPS_MAX
                 TPS_LIH           = TPS_LIH_INI
```

TPS2 erroneous:

```
elseif        STATE_TPS_DIAG = TPS_LIH_1
then
                 if         LV_TPS_GAIN_ACT_1 = 1
                 inside operation range of amplified TPS1:
                 then         TPS_AV          = TPS_AV_GAIN_1
                          TPS_AV_CTL = TPS_AV_CTL_GAIN_1
                          TPS_LIH        = TPS_LIH_1
                 outside operation range of amplified TPS1:
                 else         TPS_AV          = TPS_AV_1
                          TPS_AV_CTL = TPS_AV_CTL_1
                          TPS_LIH        = TPS_LIH_1
                 endif
```

TPS1 erroneous:

```
elseif                STATE_TPS_DIAG = TPS_LIH_2
then                 TPS_AV          = TPS_AV_2
                          TPS_AV_CTL = TPS_AV_CTL_2
                          TPS_LIH        = TPS_LIH_2
```

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TPS plausibility error:

elseif STATE_TPS_DIAG = TPS_LIH_MAX
then TPS_AV = MAX(TPS_AV_1; TPS_AV_2)
TPS_AV_CTL = MAX(TPS_AV_CTL_1; TPS_AV_CTL_2)
TPS_LIH = TPS_LIH_INI
Endif

4.11.3 TPS gradient limitation

Description:

To eliminate eventually malfunctions the potentiometer values are verified by a gradient limitation. Is the difference between the old and new potentiometer voltage value exceeding the gradient threshold then keeps the old poti value. If by the next measuring the gradient limitation exceeded again, then the new poti value will adopt.

Formula section:

IF V_TPS_X$_n$- V_TPS_X$_{n-1}$ C_V_TPS_GRD_MAX
Then V_TPS_X_FIL= V_TPS_X$_n$

Elseif V_TPS_X$_n$- V_TPS_X$_{n-1}$$>$ C_V_TPS_GRD_MAX **and**
V_TPS_X$_{n-1}$- V_TPS_X$_{n-2}$$>$ C_V_TPS_GRD_MAX

Then V_TPS_X_FIL= V_TPS_X$_n$
Else V_TPS_X_FIL= V_TPS_X_FIL$_{n-1}$
Endif

IFV_TPS_GAIN_1$_n$- V_TPS_GAIN_1$_{n-1}$ C_V_TPS_GAIN_GRD_MAX
Then V_TPS_GAIN_1_FIL$_n$= V_TPS_GAIN_1$_n$
Elseif V_TPS_GAIN_1$_n$- V_TPS_GAIN_1$_{n-1}$$>$ C_V_TPS_GAIN_GRD_MAX **and**
V_TPS_GAIN_1$_{n-1}$- V_TPS_GAIN_1$_{n-2}$$>$ C_V_TPS_GAIN_GRD_MAX

Then V_TPS_GAIN_1_FIL$_n$= V_TPS_GAIN_1$_n$
Else V_TPS_GAIN_1_FIL$_n$= V_TPS_GAIN_1_FIL$_{n-1}$
Endif

4.11.3.1 Calculation of throttle position gradient: (TPS_GRD)

Description:

The gradient is calculated as (absolute value of) difference from the actual throttle value and the throttle value i-4 (that is the throttle value which was actual 40ms before). Therefore the converted throttle values are written into a ring-buffer with 4 values.

Application conditions

Recurrence: *10ms*

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Formula section:

TPS_GRD = | (TPS_AVi - TPS_AVi-4) * 25 |
The throttle gradient direction is calculated as follows
If (TPS_AVi - TPS_AVi-4) $<$ 0
then LV_TPS_GRD_UP = 0 (negative throttle gradient)
else LV_TPS_GRD_UP = 1 (positive throttle gradient)
endif

4.11.4 Segment synchronous throttle valve position: (TPS_SEG)

Description:

The segment synchronous TPS is needed as input for the intake manifold model. The calculation is carried out segment synchronously.With the help of the adaptation values the TPS-position is standardized to a range between 0° and C_TPS_MAX degree.

Formula section:

TPS_SEG_1 = (V_TPS_1 - V_TPS_AD_EL_BOL_1) * C_TPS_SLOP
TPS_SEG_2 = (V_TPS_AD_EL_BOL_2 -V_TPS_2) * C_TPS_SLOP
TPS_SEG_GAIN_1 =

$$\left(\frac{V\_TPS\_GAIN\_1 - TPS\_AD\_OFS\_GAIN\_1}{TPS\_AD\_SLOP\_GAIN\_1} - V\_TPS\_AD\_EL\_BOL\_1\right) * C\_TPS\_SLOP$$

0° TPS_SEG_x C_TPS_MAX.

Selection in errorfree case:

TPS1 & TPS2 errorfree, no TPS plausibility error:
if STATE_TPS_DIAG = TPS_NO_ERROR
then
  if LV_TPS_GAIN_ACT_1 = 1
  inside operation range of amplified TPS1:
  then TPS_SEG = TPS_SEG_GAIN_1
  outside operation range of amplified TPS1:
  else TPS_SEG = TPS_SEG_1
  endif
endif

Selection in error-cases:

TPS1 & TPS2 erroneous:
if STATE_TPS_DIAG = TPS_DBL_ERROR
STATE_ETC_LIH = ETC_LIH_1 **or**
STATE_ETC_LIH = ETC_LIH_2_REV **or**
STATE_ETC_LIH = ETC_LIH_2
then TPS_SEG = TPS_LIH_INI

TPS2 erroneous:

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```
elseif      STATE_TPS_DIAG = TPS_LIH_1
then
                if          LV_TPS_GAIN_ACT_1 = 1
                inside operation range of amplified TPS1:
                then        TPS_SEG         = TPS_SEG_GAIN_1
                outside operation range of amplified TPS1:
                else        TPS_SEG         = TPS_SEG_1
        endif

TPS1 erroneous:
elseif      STATE_TPS_DIAG = TPS_LIH_2
then        TPS_SEG     = TPS_SEG_2

TPS plausibility error:
else        TPS_SEG     = MAX( TPS_SEG_1; TPS_SEG_2 )
endif
```

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4.12 Vehicle speed

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VS_RUN	O/V	0... 1H	0 ...1	1	-
Vehicle is moving					
LV_VST	V	0... 1H	0 ...1	1	-
boolean for stopped vehicle					
T_ERR_VS_CAN	O/V	1... FFFFH	0.01... 655.35	0.01	s
timer after VS CAN error to set VS_FIL to 0					
VS	O/V	0... FFH	0... 255	1	km/h
Vehicle speed					
VS_EDGE_CTR_AV	V	0... FFFFH	0... 65535	1	-
actual value of vehicle speed tooth counter (free running counter)					
VS_EDGE_T_AV	O/V	0... FFFFFFFFH	0... 34359738.36	0.008	ms
actual timestamp of last tooth (free running timer)					
VS_EDGE_T_AV_DIF	V	0... FFFFFFFFH	0... 34359738.36	0.008	ms
actual timestamp difference					
VS_EDGE_T_AV_MAX	V	0... FFFFFFFFH	0... 34359738.36	0.008	ms
actual maximum timestamp of last tooth (free running timer)					
VS_FIL	O/V	0... FFFFH	0... 511.9921875	0.0078125	km/h
Filtered vehicle speed					
VS_H	O/V	0... FFFFH	0... 511.9921875	0.0078125	km/h
vehicle speed high range					
VS_SAE	O/V	0... FFH	0... 255	1	km/h
PID0D measured vehicle speed raw value					
VS_SENS	O/V	0... FFFFH	0... 511.9921875	0.0078125	km/h
vehicle speed calculated from vehicle speed sensor					
VS_SENS_GB	O/V	0... FFFFH	0... 511.9921875	0.0078125	km/h
vehicle speed signal by gearbox sensor					
VS_SENS_GRD	V	8000... 7FFFH	-256... 255.9921875	0.0078125	(km/h)/ 10ms
Vehicle speed gradient calculated from VS_SENS					

Input data:

LV_ERR_BN_VS_TCS {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_N_WHEEL_FN_LE {p. 5044}	LV_ERR_N_WHEEL_FN_RI {p. 5044}
LV_ERR_N_WHEEL_RE_LE {p. 5044}	LV_ERR_N_WHEEL_RE_RI {p. 5044}	LV_ERR_TOUT_ASR_1 {p. 802}	LV_ERR_VS {p. 5021}
LV_ERR_VS_CAN {p. 1565}	LV_ERR_VS_PLAUS {p. 5021}	LV_VAR_ASR {p. 655}	N_GB_OUT {p. 1569}
N_WHEEL_RE_RI {p. 806}	RATIO_RAX	STATE_VEH_ROLL_CDN {p. 809}	VS_CAN {p. 1582}
WHEEL {p. 1582}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DIAM_WHEEL	V	0... FFFFH	0... 4095.9375	0.0625	mm
Wheeldiameter for speedcalculation if vehicle is on the roller test bench					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_VS_COM1	V	0... FFH	0... 1.9921875	0.0078125	-
Factor to adjust the VS_CAN-Signal from Flexray					
C_FAC_VS_FIL	V	0... FFH	0... 255	1	-
Filter factor					
C_T_ERR_VS_CAN	V	1... FFFFH	0.01... 655.35	0.01	s
Maximum time after VS CAN error to set VS_FIL to 0					
C_T_VST	V	1... 14H	10... 200	10	ms
Time delay for detection of vehicle stop					
C_VS_EDGE_SUM_MIN	V	1... FFH	1... 255	1	-
minimum number of wheel segments for evaluation of vehicle speed					
C_VS_FAC	V	0... 1000000H	0... 0.291271	17.3611e-9	m
Vehicle distance per segment					
C_VS_GB	V	0... FFFFH	0... 4095.9375	0.0625	mm
tire circumference					
C_VS_MIN_RUN	V	0... FFH	0... 255	1	km/h
vehicle speed threshold for running vehicle detection					
CLF_VS_SENS_ERR	V	1... FFH	1... 255	1	-
Calibration for selection of wheel sensor					

Import actions:

ACTION_INFR_GetVsPulsStamp (**OUT**<PRM_vs_edge_ctr_av>,**OUT**<PRM_vs_edge_t_av>,**OUT**<PRM_vs_edge_t_av_max>)

General information

4.12.1 Calculation of Speed Signal VS

General information:

Running vehicle is detected if vehicle speed VS$\geq$ C_VS_MIN_RUN.

Application conditions:

Initialisation: VS = 0 ; VS_H = 0 ; LV_VS_RUN = 0;

Activation: at every engine operating state

Deactivation: -

Recurrence: 10ms

Function description:

Formula section:

```
#IF  (USE_L6 == ACTIVE)  // Compiler switch to active VS-signal from Flexray
// Also means that LV_VAR_L6 = 1 switch to active VS-signal from Flexray
```

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```
#THEN
    If(2)   STATE_VEH_ROLL_CDN =4
    Then(2) VS = VS_H = VS_FIL = VS_SENS
            = (C_DIAM_WHEEL /  2000) * N_WHEEL_RE_RI * 3.6
    Else(2)
        If   LV_ERR_VS_CAN =1
        Then VS = VS_H = VS_FIL = VS_SENS = VS_SENS_GB
        Else VS = VS_CAN * C_FAC_VS_COM1
             VS_H = VS_FIL = VS_SENS = WHEEL * C_FAC_VS_COM1
        Endif
#ELSE
    If   LV_ERR_VS_PLAUS = 1  // VS sensor error
    Then VS = VS_FIL          VS_H = VS_FIL
    Else VS = VS_SENS         VS_H = VS_SENS
    Endif
#ENDIF

If   VS ≥  C_VS_MIN_RUN
Then LV_VS_RUN = 1
Else LV_VS_RUN = 0
Endif
```

4.12.2 Filter of vehicle speed

General information:

For the CAN signal WHEEL, a 1st order IIR filter is used for evaluating the vehicle speed for the CRU and the speed limitation. The jitter error of the input signal WHEEL is smaller than 1%. A jitters error smaller than 0.2% must be achieved for the control variable VS_FIL with the filter. The frequency limit of the filter is approx. fg = 0.80 (Hz). Filtration of the speed signal is performed independently of the CRU mode with a 10ms time pattern.

Application conditions:

Initialisation: `0 at reset`

Activation: `LV_VAR_ASR = 1`

Deactivation: `-`

Recurrence: `10ms`

Function description:

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Signal flow diagram:

The structure of the filter is represented as follows:

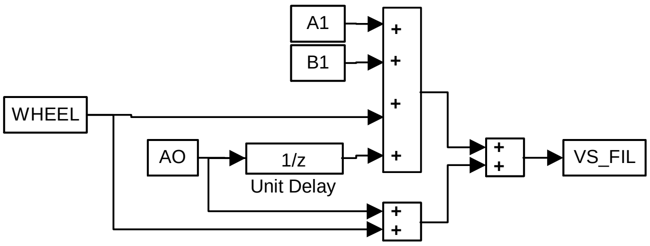

Figure 4.12.1:

z^{-1} means a delay by one sampling time. The sampling time is T_{ab} = 10(ms) and thus f_{ab} = 100 (Hz). At a quality Q = 1, the filter factors are calculated as:

Formula section:

$$A1 = A0 = \frac{1}{1+W}; \quad B1 = -\frac{1-W}{1+W}; \quad \text{with } W = \frac{1}{\mathrm{Tan}\,\frac{\pi}{\Omega}}; \quad W = \text{C\_FAC\_VS\_FIL}$$

Figure 4.12.2:

```
#IF   (USE_L6 != ACTIVE) // Compiler switch to de-active VS-signal from Flexray
// Also means that LV_VAR_L6 = 0 switch to de-active VS-signal from Flexray
#THEN
    If  LV_ERR_CAN_BOFF    = 1   or
        LV_ERR_BN_VS_TCS   = 1   or
        LV_ERR_TOUT_ASR_1  = 1
    Then
        VS_FIL = VS_SENS (converted)
    Else
        If  LV_ERR_VS_CAN  = 1
        Then
            T_ERR_VS_CAN decrements (Start value C_T_ERR_VS_CAN )
            If  T_ERR_VS_CAN  = 0
            Then
                VS_FIL  = 0
            Else
                VS_FIL_n   = VS_FIL_n-1
            Endif
        Else
            VS_FIL is calculated
            T_ERR_VS_CAN  = 0
        Endif
    Endif
#Endif
```

4.12.3 Internal vehicle speed signal

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General information:

A new edge is detected, if VS_EDGE_CTR_AV$_n$ >= VS_EDGE_CTR_AV$_{n-10ms}$. If (VS_EDGE_CTR_AV$_n$ - VS_EDGE_CTR_AV$_{n-x}$) $>$ C_VS_EDGE_SUM_MIN a new vehicle speed calculation is started. If during the time C_T_VST no changed edge is detected, the logical variable for stopped vehicle LV_VST is set to 1 and VS_SENS as well as VS_SENS_GRD are set to 0.

With the constant C_VS_FAC the adaption of the rolling circumference and the number of teeth per rotation is done.

Application conditions:

Initialisation:

```
VS_SENS = 0
VS_SENS_GRD = 0
LV_VST = 1
```

Activation:

```
#IF  (USE_L6 != ACTIVE) //Compiler switch to de-active VS-signal
from Flexray
// Also means that LV_VAR_L6 = 0 switch to de-active VS-signal
from Flexray
```

Deactivation: –

Recurrence: 10ms

Function description:

Signal flow diagram:

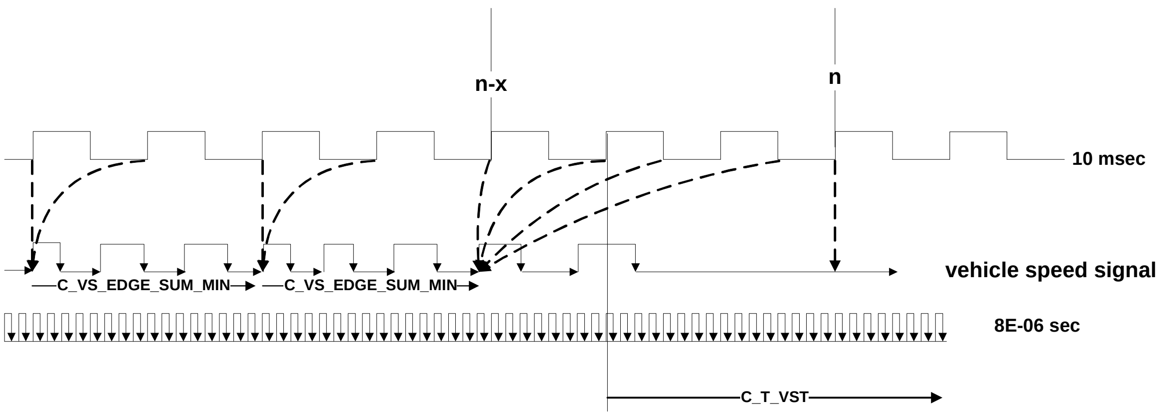

Figure 4.12.3:

Formula section:

```
ACTION_INFR_GetVsPulsStamp(VS_EDGE_CTR_AV,  VS_EDGE_T_AV, VS_EDGE_T_AV_MAX)
VS_EDGE_T_AV_DIF = VS_EDGE_T_AV n - VS_EDGE_T_AV   n-x
```

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```
IF      VS_EDGE_T_AV_DIF < 0    //    (Overflow)
THEN    VS_EDGE_T_AV_DIF = VS_EDGE_T_AV_DIF + VS_EDGE_T_AV_MAX
ELSE    VS_EDGE_T_AV_DIF = (VS_EDGE_T_AV_n  - VS_EDGE_T_AV_n-x)
ENDIF
```

C_VS_FAC = (dynamic wheel circumference [m]) /(number of teeth [-])
VS_SENS = C_VS_FAC * (VS_EDGE_CTR_AVn - VS_EDGE_CTR_AVn-x) /VS_EDGE_T_AV_DIF
VS_SENS_GRD = (VS_SENSn – VS_SENS n-x) /VS_EDGE_T_AV_DIF

4.12.4 Internal vehicle speed signal by gearbox revolution speed sensor (only FlexRay)

General information:

This function is only for L6 (FlexRay) projects: Vehicle speed calculation using the gearbox output shaft revolution speed signal.

Application conditions:

Initialisation: VS_SENS_GB = 0

Activation: #IF (USE_L6 == ACTIVE) // Compiler switch to active VS-signal from Flexray
// Also means that **L**V_VAR_L6 = 1 switch to active VS-signal from Flexray

Deactivation: –

Recurrence: 10ms

Function description:

Formula section:

VS_SENS_GB = (C_VS_GB * N_GB_OUT) / (RATIO_RAX * 16666,7)

C_VS_GB is the tire circumference in [mm]

4.12.5 Error Handling

General information:

In case of an error in the vehicle speed the PID0D measured speed raw value should be updated. The relevant sensor errors can be selected using the calibration CLF_VS_SENS_ERR.

Calibration Hint:

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CLF_VS_SENS_ERR	Wheel sensor
1	Front left wheel
2	Front right wheel
4	Rear left wheel
8	Rear right wheel

Application conditions:

Initialisation: VS_SAE = 0

Activation: Always

Deactivation: Never

Recurrence: 10ms

Function description:

Formula section:

```
IF     LV_ERR_VS = 1 or
         (LV_ERR_N_WHEEL_FN_LE = 1 AND  CLF_VS_SENS_ERR.bit0 = 1) OR
      (LV_ERR_N_WHEEL_FN_RI = 1 AND  CLF_VS_SENS_ERR.bit1 = 1) OR
      (LV_ERR_N_WHEEL_RE_LE = 1 AND  CLF_VS_SENS_ERR.bit2 = 1) OR
      (LV_ERR_N_WHEEL_RE_RI = 1 AND  CLF_VS_SENS_ERR.bit3 = 1)
THEN    VS_SAE = FFH
ELSE    VS_SAE = VS
ENDIF
```

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4.13 Distance counter

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DIST	O/V/S	00000000... H FFFFFFFFH	0... 429496729500	-	m
Distance accumulation [100m]					
DIST_KWP	O/S	0... FFFFH	0... 524280	8	Km
Distance accumulation [8km]					

Input data:

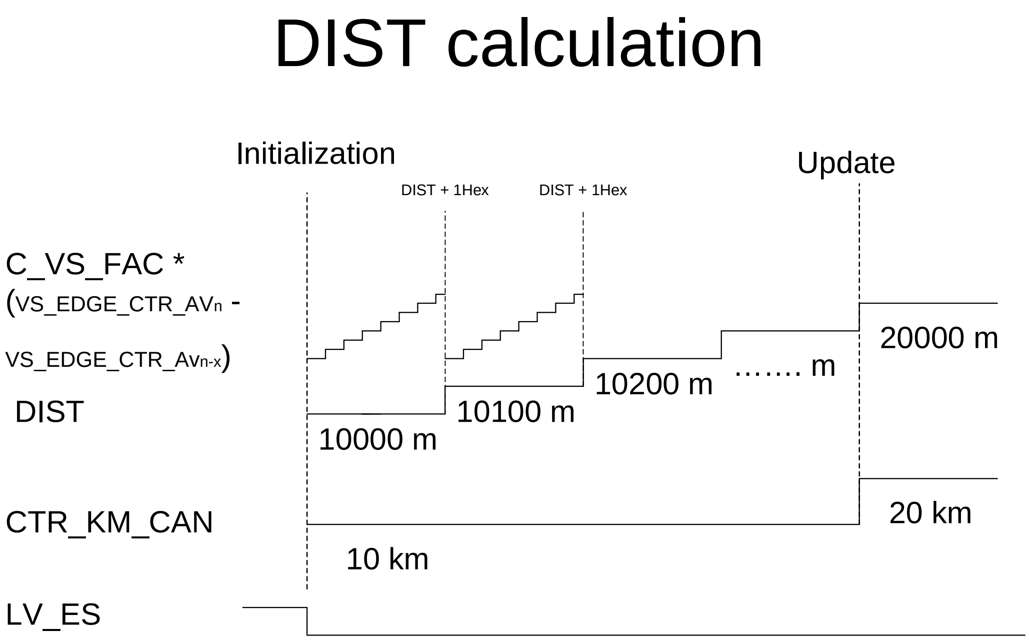
C_VS_FAC {p. 1177}	CTR_KM_CAN {p. 1563}	LV_ES {p. 1720}	VS_EDGE_CTR_AV {p. 1176}

FUNCTION DESCRIPTION:

General information:

This function is to accumulate the covered distance since the first vehicle start in resolution of 100m for EOBD propose. The information for updating of the calculation (CTR_KM_CAN, VS_EDGE_CTR_AV) is sent by CAN.

Signal flow diagram:



Application conditions

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Initialisation: *restored out of NVMY, first value = 0*

Recurrence: *200ms*

Activation: *LV_ES = 0*

Description:

After activation DIST is restored out of NVMY and the calculation starts with (C_VS_FAC * VS_EDGE_CTR_AVn - VS_EDGE_CTR_AVn-x) until DIST is incremented with 1Hex (100m).
This calculations is done until the next update of CTR_KM_CAN, then DIST is set to CTR_KM_CAN and the calculation starts from beginning.
If there is no update of CTR_KM_CAN (e.g. Timeout error), then the calculation remains active for this Driving cycle.

DIST_KWP is calculated from DIST but different resolution for BMW diagnosis tool.

Formula section:

DIST: See signal flow diagramm
DIST_KWP = DIST

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4.14 Battery voltage

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_VB_BN_DIAG	O/V	0... 1H	0 ...1	1	-
Boolean for battery voltage condition fulfilled for BN2000 diagnosis					
LV_CDN_VB_CAN_DIAG	O/V	0... 1H	0 ...1	1	-
Boolean for battery voltage condition fulfilled for CAN diagnosis					
LV_CDN_VB_CAN_TQ_DIAG	O/V	0... 1H	0 ...1	1	-
Boolean for battery voltage condition fulfilled for TQ_CAN-interfaces					
LV_CDN_VB_MIN_DIAG	O/V	0... 1H	0 ...1	1	-
Boolean for battery voltage condition fulfilled for remaining diagnosis					
LV_CDN_VB_OBD1	O/V	0... 1H	0 ...1	1	-
Boolean for battery voltage condition fulfilled for OBD diagnosis (=10V)					
LV_CDN_VB_OBD2	O/V	0... 1H	0 ...1	1	-
Boolean for battery voltage condition fulfilled for OBD-II diagnosis (=11V)					
LV_VB_JUMP	O/V	0... 1H	0 ...1	1	-
Logical value for detected overvoltage (jump start)					
V_IGK	O/V	0... FFH	0... 25.89843	0.1015625	V
Key - battery voltage					
VB	O/V	0... FFH	0... 25.89843	0.1015625	V
Relay - battery voltage					
VB_MMV	O/V	0... FFH	0... 25.89843	0.1015625	V
Moving mean value of battery voltage VB					
VB_SECU	V	0... FFH	0... 25.89843	0.1015625	V
Battery Voltage secured for dwell computation					

Input data:

LV_IGK {p. 906}	V_IGK_MES {p. 847}	VB {p. 1185}	VB_MES {p. 845}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_VB	-	0... FFH	0... 0.99609	3.91e-3	-
Low pass filter correlation constant for VB_MMV					
C_T_MIN_CAN_DIAG	-	0... FFH	0... 2550	10	ms
VB-Time-condition for CAN diagnosis					
C_VB_MAX_OBD1	-	0... FFH	0... 25.89843	0.1015625	V
VB -threshold for maximum permissible battery voltage for OBD diagnosis					
C_VB_MAX_OBD2	-	0... FFH	0... 25.89843	0.1015625	V
VB -threshold for maximum permissible battery voltage for OBD2 diagnosis					
C_VB_MIN_BN_DIAG	-	0... FFH	0... 25.89843	0.1015625	V
Battery voltage threshold for BN2000 diagnosis					
C_VB_MIN_CAN_DIAG	-	0... FFH	0... 25.89843	0.1015625	V
Battery voltage threshold for CAN diagnosis					
C_VB_MIN_CAN_TQ_DIAG	-	0... FFH	0... 25.89843	0.1015625	V
Battery voltage threshold for CAN-TQ interface diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VB_MIN_DIAG	-	0... FFH	0... 25.89843	0.1015625	V
Battery voltage threshold for low voltage detection for remaining diagnosis					
C_VB_MIN_JUMP	-	0... FFH	0... 25.89843	0.1015625	V
VB -threshold for maximum permissible battery voltage					
C_VB_MIN_OBD1	-	0... FFH	0... 25.89843	0.1015625	V
VB -threshold for minimum permissible battery voltage for OBD diagnosis					
C_VB_MIN_OBD2	-	0... FFH	0... 25.89843	0.1015625	V
VB -threshold for minimum permissible battery voltage for OBD2 diagnosis					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_FAC_VB_RATIO	-	0... FFH	0... 1.99218	0.0078125	-
Factor to adapt the HEX-range to the range of 0 to 26 V					
NC_VB_SECU	-	0... FFH	0... 25.89843	0.1015625	V
Battery voltage offset (typical value = 1,02V)					

4.14.1 Computation of VB

FUNCTION DESCRIPTION:

General information:

The battery voltage (V_IGK_MES and VB_MES (10 bit)) is measured up to 30V, 28V or 26V (means 0-5V at ADC), depending on the project-specific solution, but the range of VB (8 bit) remains 0-26 V. For the computation of VB in hex the correction factor NC_FAC_VB_RATIO is necessary; its value depends on the project-specific battery voltage range. NC_FAC_VB_RATIO is definded in the List of Configuration Datas . The following table shows how NC_FAC_VB_RATIO is formed.

Measured battery voltage range (for example)	NC_FAC_VB_RATIO
0 ..... 26 V	26V / 26V
0 .. 28,8 V	28,8V / 26V
0 ..... 30 V	30V / 26V

Application conditions

Activation: *at reset*

Initialisation:
```
VB    = 0
V_IGK          = 0
```

Recurrence: `10 ms`

Formula section:

HEX calculation:
VB = (VB_MES /4) * NC_FAC_VB_RATIO
V_IGK = (V_IGK_MES /4) * NC_FAC_VB_RATIO

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VB relay:

If VB_MES <= 26 Volt
Then VB = (VB_MES /4) * NC_FAC_VB_RATIO
Else VB = 26 Volt (FF hex)
Endif

VB key:

If V_IGK_MES <= 26 Volt
Then V_IGK = (V_IGK_MES /4) * NC_FAC_VB_RATIO
Else V_IGK = 26 Volt (FF hex)
Endif

4.14.2 Secured battery voltage computation

Description:

A secured battery voltage value is a mix of VB and V_IGK values which provides a safer battery voltage for functions especially in case of VB - relay wire to the ECU disconnection.
The securate battery voltage value can be used for exemple for dwell computation in order to protect ignition coil and ECU ignition output stage against too long dwell time.
VB_SECU = MAX(VB, V_IGK - NC_VB_SECU)
with VB_SECU - NC_VB_SECU satured to zero

4.14.3 Battery voltage conditions for diagnosis /jump start detection

FUNCTION DESCRIPTION:

General information:

Depending on VB there is a detection:

- Jump start
- Valid range for OBD1 diagnosis
- Valid range for OBD2 diagnosis
- Valid range for CAN diagnosis
- Valid range for BN2000 diagnosis
- Valid range for TQ-CAN interface diagnosis
- Valid range for remaining customer diagnosis

Application conditions

Initialisation: `all 0`
Recurrence: `10ms`
Activation: `at reset`

4.14.3.1 Detection of overvoltage (Jump start)

Description:

The bit LV_VB_JUMP is used by functions which must not run when overvoltage is detected for example secondary air injection to prevent damages to the components.

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Formula section:

Jump start detection:

If VB $>$ C_VB_MIN_JUMP
Then LV_VB_JUMP = 1
Else LV_VB_JUMP = 0
Endif

4.14.3.2 Battery voltage valid for OBD diagnosis

Description:

Depending of OBD1/OBD2 there is a different flag for the valid VB range

Formula section:

Valid range for OBD1 diagnosis:

If VB $>$ C_VB_MIN_OBD1 **and** VB $<$ C_VB_MAX_OBD1
Then LV_CDN_VB_OBD1 = 1
Else LV_CDN_VB_OBD1 = 0
Endif

Valid range for OBD2 diagnosis:

If VB $>$ C_VB_MIN_OBD2 **and** VB $<$ C_VB_MAX_OBD2
Then LV_CDN_VB_OBD2 = 1
Else LV_CDN_VB_OBD2 = 0
Endif

4.14.3.3 Minimum battery voltage detection for CAN diagnosis

Description:

Due to low battery voltage CAN messages can be mutilated. So CAN timeout diagnosis is only done if battery voltage is valid for a minimum duration time.

Signal flow diagram:

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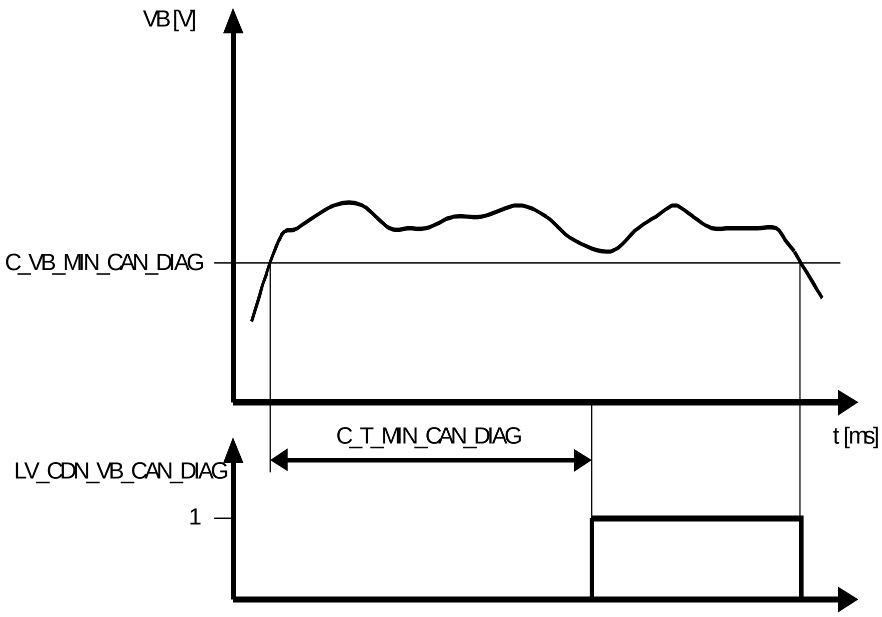

Formula section:

Valid range for CAN diagnosis:

If LV_IGK = 1 **and**
VB > C_VB_MIN_CAN_DIAG **for**
time > C_T_MIN_CAN_DIAG
(timer always started at every transition VB > C_VB_CAN_DIAG
and at transition LV_IGK 0 -> 1)
Then LV_CDN_VB_CAN_DIAG = 1
Else LV_CDN_VB_CAN_DIAG = 0
Endif

4.14.3.4 Minimum battery voltage detection for BN2000 diagnosis

Description:

Due to low battery voltage BN2000 messages can be mutilated. So BN2000 timeout diagnosis is only done if battery voltage is valid for a minimum duration time.

Signal flow diagram:

Formula section:

Valid range for BN2000 diagnosis:

If LV_IGK = 1 **and**
VB > C_VB_MIN_BN_DIAG **for**
time > C_T_MIN_CAN_DIAG
(timer always started at every transition VB > C_VB_BN_DIAG

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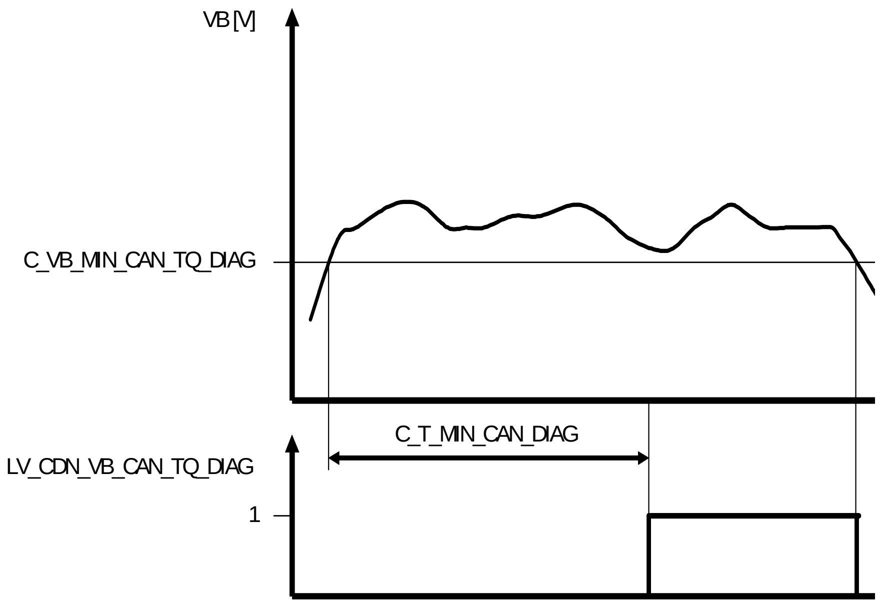
and at transition LV_IGK 0 -> 1)
Then LV_CDN_VB_BN_DIAG = 1
Else LV_CDN_VB_BN_DIAG = 0
Endif

4.14.3.5 Minimum battery voltage detection for TQ_CAN-interfaces

Description:

Due to low battery voltage CAN messages can be mutilated. So the TQ_CAN-interfaces should only be enabled if battery voltage is valid for a minimum duration time.

Signal flow diagram:



Formula section:

Valid range for BN2000 diagnosis:
If LV_IGK = 1 **and**
VB > C_VB_MIN_CAN_TQ_DIAG **for**
time > C_T_MIN_CAN_DIAG
(timer always started at every transition VB > C_VB_MIN_CAN_TQ_DIAG
and at transition LV_IGK 0 -> 1)
Then LV_CDN_VB_CAN_TQ_DIAG = 1
Else LV_CDN_VB_CAN_TQ_DIAG = 0
Endif

4.14.3.6 Minimum Battery Voltage Detection for non OBD Diagnosis

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Description:

The remaining diagnosis functions which are not covered by the above mentioned conditions are disabled below a separate threshold, which should be lower as OBD1/2 and CAN.

Formula section:

Valid range for non OBD diagnosis:
If VB $<$ C_VB_MIN_DIAG **or**
LV_IGK = 0
Then LV_CDN_VB_MIN_DIAG = 0
Else LV_CDN_VB_MIN_DIAG = 1
Endif

4.14.4 Moving average value for battery voltage

A moving average value VB_MMV is used in the chapter Engine speed setpoint calculation to define a minimum N_SP_IS in dependance of the battery voltage:

Application conditions

Activation: `at reset`

Initialization: `VB_MMV = 14 V`

Recurrence: `10 ms`

Formula section:

VB_MMV$_k$ = VB_MMV$_{k-1}$+ (VB$_k$ - VB_MMV$_{k-1}$) C_CRLC_VB.

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4.15 Air mass flow sensor variables

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MAF_PULS	O/V	0... 1H	0 ...1	1	-
Boolean for pulsation present					
MAF_KGH_MES	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Corrected mass air flow, measured per segment					
MAF_KGH_MES_BAS	O	0... FFFFH	0... 2047.96875	0.03125	kg/h
Raw air-mass flow measured (without correction, to be used for diagnosis only)					
MAF_KGH_MES_BAS_TCHA [NC_MAF_SENS_CONF]	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Raw air-mass flow up turbo charger measured (without correction, to be used for diagnosis only)					
MAF_KGH_MES_TCHA [NC_MAF_SENS_CONF]	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
corrected mass air flow up turbo charger, measured per segment					
MAF_MES	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Air-mass flow per segement					

Input data:

LV_IGK {p. 906}	LV_VAR_TCHA {p. 656}	MAF {p. 8277}	MAF_FRQ_KGH_MES [NC_MAF_NR] {p. 834}
N {p. 1525}	NC_MAF_FAC_CYL {p. 2889}	PQ_SP {p. 8278}	STATE_ENG {p. 1720}
TIA {p. 1226}	TIA_TCHA {p. 1226}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_PQ_SP_HYS_PULS	-	0... FFFFH	0... 0.99998	15.3e-6	-
Hysteresis for PQ-threshold for LV_MAF_PULS					
IP_FAC_MAF_KGH_COR	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MAF_KGH_MES_BAS	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_TIA_IP_FAC_MAF_KGH_COR	6	0... FEH	-48... 142.5	0.75	°C
Correction for MAF_KGH_MES depending on raw signal and on intake air temperature					
IP_FAC_MAF_KGH_COR_FRQ	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MAF_KGH_MES_BAS_TCHA_0	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_TIA_TCHA_IP_MAF_KGH_COR_FRQ	6	0... FEH	-48... 142.5	0.75	°C
Correction for MAF_KGH_MES_TCHA[0] depending on raw signal and on intake air temperature					
IP_PQ_SP_PULS	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_N__PQ_SP_PULS	6	0... 1FE0H	0... 8160	1	rpm
PQ-threshold for LV_MAF_PULS					

4.15.1 Air-mass flow acquisition MAF_KGH_MES

FUNCTION DESCRIPTION:

General information:

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For non turbo variant (N53) a frequency MAF sensor is used. For turbo variant (N54) a frequency MAF sensor (index [0]) is used. The analog MAF sensor (index [1]) is no longer used.
Frequency sensor: A correction is possible in order to take into consideration deviations of the measured mass air flow due to different installations of the air mass meter. This correction factor is dependant from MAF_KGH_MES_BAS itself and of the air temperature.

Application conditions

Initialisation: `all 0 at reset` **or** `LV_IGK 0->1`

Recurrence: `at STATE_ENG: ST, IS, PL, PU and PUC` `segment synchronous`
`at STATE_ENG: ES` `1s`

Activation: at all STATE_ENG
Deactivation: -

Formula section:

If LV_VAR_TCHA = 0
then *// evaluation of frequency MAF sensor (N53)*
MAF_KGH_MES_BAS = MAF_FRQ_KGH_MES[0]
MAF_KGH_MES = MAF_KGH_MES_BAS *
IP_FAC_MAF_KGH_COR(MAF_KGH_MES_BAS, TIA)
else *// evaluation of frequency MAF sensor (N54)*
MAF_KGH_MES_BAS = (MAF * N) /NC_MAF_FAC_CYL
MAF_KGH_MES = MAF_KGH_MES_BAS
MAF_KGH_MES_BAS_TCHA[0] = MAF_FRQ_KGH_MES[0]
MAF_KGH_MES_TCHA[0] = MAF_KGH_MES_BAS_TCHA[0] *
IP_FAC_MAF_KGH_COR_FRQ(MAF_KGH_MES_BAS_TCHA[0], TIA_TCHA)
// satisfaction layer interface of earlier analog MAF sensor (N54)//
MAF_KGH_MES_TCHA[1] = 0
MAF_KGH_MES_BAS_TCHA[1] = 0
endif

4.15.2 Air-mass Flow Acquisition MAF_MES

FUNCTION DESCRIPTION:

General information:

The air-mass MAF_MES in mg/stroke is calculated from the measured air-mass flow MAF_KGH_MES and the engine speed N. The non calibratable constant NC_MAF_FAC_CYL is inversly proportional to the number of cylinders, so the output MAF_MES depends on the number of cylinders.

Application conditions

Initialisation: `all 0 at reset` **or** `LV_IGK 0->1`

Recurrence: `at STATE_ENG: ST, IS, PL, PU and PUC` `segment synchronous`
`at STATE_ENG: ES` `1s`

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Activation: at all STATE_ENG
Deactivation: -

Formula section:

If N = 0
Then MAF_MES = 0

Else $MAF\_MES = \frac{MAF\_KGH\_MES}{N} * NC\_MAF\_FAC\_CYL$

Endif

4.15.3 Fade out of Mass Airflow Sensor

FUNCTION DESCRIPTION:

General information:

It is possible, that in some operating points of an engine the MAF sensor is unable to deliver the correct MAF value. Those operating points are displayed by LV_MAF_PULS = 1. This state will result in switching off the MAF feedback loop of the intake manifold model, so the load determination will be done like -/N-control .

Application conditions

Initialisation: all 0 at reset **or** LV_IGK 0->1

Recurrence: at STATE_ENG: ST, IS, PL, PU and PUC segment synchronous
at STATE_ENG: ES
1s

Activation: at all STATE_ENG
Deactivation: -

Formula section:

If PQ_SP > IP_PQ_SP_PULS
Then LV_MAF_PULS = 1
Else **If** PQ_SP < IP_PQ_SP_PULS - C_PQ_SP_HYS_PULS
Then LV_MAF_PULS = 0
Else LV_MAF_PULS remains unchanged
Endif
Endif

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4.16 Air mass flow variables

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MAF_DIF	O/V	8000... 7FFFH	-694.51059 ...694.4894	21.2e-3	mg/stk
Mass air flow difference per segment					
MAF_KGH	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Air-mass flow per segment in kg/h					
MAF_MMV	O/V	0... FFFFH	0... 1389	21.2e-3	mg/stk
MAF moving mean value					

Input data:

LV_CLC_2SEG {p. 1825}	LV_CLC_2SEG_ENA {p. 1825}	LV_MAF_CONF	LV_MAF_CTL {p. 1211}
LV_MAP_CONF	LV_MAP_CTL	MAF {p. 8277}	MAF_KGH_FG_PRED {p. 8278}
MAF_KGH_MES {p. 1192}	MAF_MDL_MV {p. 8278}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_MMV_DIF_CRLC	-	0... FFH	0... 0.99609	3.91e-3	-
MAF moving mean value filtering factor					
C_MAF_MMV_HYS	-	0... 7FFFH	0... 694.4788	21.2e-3	mg/stk
Threshold for detecting raising MAF_MMV					

Application conditions

Initialisation: *all outputs phys. 0 at reset*

Recurrence: *segment synchronous*

Activation: *LV_CLC_2SEG = 0*

Deactivation: *LV_CLC_2SEG = 1*

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4.16.1 Air-mass flow MAF_KGH

FUNCTION DESCRIPTION:

General information:

Depending on system configuration the air-mass flow MAF_KGH is calculated. If no air-mass sensor is available or if the sensor diagnosis rejects the measured value (e.g. due to pulsation), a substitution value is assigned to MAF_KGH.

Formula section:

if (LV_MAF_CONF = 1) **then**
  if (LV_MAF_CTL = 1) **then**
    MAF_KGH = MAF_KGH_MES

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```
    else
        if ( LV_MAP_CONF = 1 )    then
            if   ( LV_MAP_CTL = 1 )  then
                MAF_KGH =    MAF_KGH_FG_PRED
            else
                MAF_KGH = MAF_MDL_MV
            endif
        else
            MAF_KGH = MAF_MDL_MV
        endif
    endif
else
    MAF_KGH =  MAF_KGH_FG_PRED
endif
```

4.16.2 Air-mass flow difference between two segments

FUNCTION DESCRIPTION:

General information:

This function calculates the difference air-mass flow between two consecutive segments MAF_DIF.

Formula section:

if LV_CLC_2SEG_ENA = 0
then MAF_DIF = MAF_{n} - MAF_{n-1}
else MAF_DIF = * (MAF_{n} - MAF_{n-1})
endif

4.16.3 Air mass difference for rapidly falling load (MAF_MMV)

FUNCTION DESCRIPTION:

General information:

In the case of rapidly falling load, the transition to (LV_PUC) can be accelerated in order to avoid an engine speed run-up, which is undesirable.

To trigger this function (see the following chapters: ignition, ignition angle correction for trailing throttle) some load conditions have to be fulfilled. For this reason, the value MAF_MMV is calculated every segment from the corrected air mass MAF.

Formula section:

if MAF_DIF > C_MAF_MMV_HYS (*MAF_MMV for increasing air mass*)
then MAF_MMV = MAF
else (*MAF_MMV for decreasing air mass*)
if LV_CLC_2SEG_ENA = 0
then MAF_MMV = MAF_MMV + (MAF - MAF_MMV) * C_MAF_MMV_DIF_CRLC

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```
        else        MAF_MMV =   MAF_MMV + (MAF - MAF_MMV) * C_MAF_MMV_DIF_CRLC * 2
    endif
endif
```

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4.17 Manifold air pressure sensor variables

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MAP_SEG	O/V	0... 1H	0 ...1	1	-
Event segment, used to switch buffer					
LV_T_DLY_MAP_MES_AD	V	0... 1H	0 ...1	1	-
Logical value delay time for manifold evacuation is over					
MAP_DIP_MES_2SEG	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold differential pressure mean value over two segments, model value in case of sensor error					
MAP_DIP_MES_BAS	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold pressure per segment measured (differential pressure)					
MAP_DIP_MES_BAS_2SEG	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold pressure per second segment measured (differential pressure)					
MAP_MES	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold pressure per segment measured					
MAP_MES_BAS	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold pressure per segment measured (raw value)					
MAP_MES_BAS_2SEG	V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold pressure per second segment measured					
MAP_SAE	O/V	0... FFH	0... 255	1	kPA
Intake manifold pressure raw value for OBD					
PUT_MES_BAS	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold pressure up throttle per segment measured					
PUT_MES_BAS_2SEG	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold pressure up throttle per second segment measured					
TEMP_MAP_DIP_MDL	V	0... FEH	-48... 142.5	0.75	°C
Estimated temperature of manifold pressure sensor					
V_MAP	O/V	0... 400H	0 ...5	4.8828e-3	V
Voltage of the intake manifold pressure sensor (for diagnosis)					
V_MAP_AD	O/V/S	FE00... 200H	-2.5 ...2.5	4.8828e-3	V
Adapted voltage offset of manifold pressure sensor					
V_MAP_DIF	O/V	FE00... 200H	-2.5 ...2.5	4.8828e-3	V
Deviation to nominal output at differential pressure 0					
V_MAP_DIF_VLD	O/V	FE00... 200H	-2.5 ...2.5	4.8828e-3	V
Allowed sensor output deviation at differential pressure 0					
V_PUT	O/V	0... 400H	0 ...5	4.8828e-3	V
Voltage of the intake manifold pressure sensor up throttle					

Input data:

AMP {p. 982}	ECU_STATE {p. 1091}	LV_ERR_MAP_DIP_SENS {p. 4824}	LV_ERR_PUT_EL {p. 4828}
LV_ES {p. 1720}	LV_VAR_TCHA {p. 656}	MAP {p. 8278}	MAP_CTR {p. 843}
MAP_CTR_1 {p. 843}	MAP_SUM_1 {p. 843}	N_32 {p. 1525}	PUT {p. 1209}
PUT_CTR {p. 843}	PUT_CTR_1 {p. 843}	PUT_SUM {p. 843}	PUT_SUM_1 {p. 843}
TAM {p. 1579}	TCO {p. 1100}	TCO_EX {p. 1045}	TIA {p. 1226}
TPS_AV {p. 1169}	VS_FIL {p. 1176}		

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TEMP_MAP_DIP_TAM	-	0... FFH	0... 0.99609	3.9063e-3	-
Factor for TAM correction for MAP_DIP temperature model					
C_FAC_TEMP_MAP_DIP_TCO_EX	-	0... FFH	0... 0.99609	3.9063e-3	-
Factor for TCO_EX correction for MAP_DIP temperature model					
C_FAC_TEMP_MAP_DIP_TIA	-	0... FFH	0... 0.99609	3.9063e-3	-
Factor for TIA correction for MAP_DIP temperature model					
C_FAC_TEMP_V_MAP_AD	-	0... FFH	0... 0.99609	3.9063e-3	-
Factor on adaptation part at irregular temperature condition					
C_FAC_TEMP_V_MAP_SP_DIF_MAX	-	0... FFH	0... 1.99218	0.0078125	-
Factor on allowed sensor output deviation at stopped engine at irregular temperature condition					
C_FAC_V_MAP_AD	-	0... FFH	0... 0.99609	3.9063e-3	-
Part of sensor output deviation at stopped engine used for sensor characteristic adaptation					
C_N_MAP_PUT_CLC_SWI	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for switching between time and segment synchronous calculation					
C_NR_V_MAP_ACQ	-	0... FFH	0... 255	1	-
Number of acquisitions to build the mean value V_MAP_MV					
C_T_DLY_MAP_MES_AD	-	0... 3FFH	0... 10.23	0.01	s
Delay time after LV_ES detection before starting adaptation of sensor characteristic					
C_TEMP_MAP_DIP_MDL_FAC_MAX	-	0... FEH	-48... 142.5	0.75	°C
Upper TEMP_MAP_DIP_MDL temperature threshold to switch adaptation/diagnosis values					
C_TEMP_MAP_DIP_MDL_FAC_MIN	-	0... FEH	-48... 142.5	0.75	°C
Lower TEMP_MAP_DIP_MDL temperature threshold to switch adaptation/diagnosis values					
C_TPS_V_MAP_AD_MIN	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Minimum TPS to enable V_MAP adaptation					
C_V_MAP_AD_MAX	-	0... 200H	0... 2.5	4.8828e-3	V
Maximum absolute value of adapted voltage offset of manifold pressure sensor					
C_V_MAP_SP_AD	-	0... 200H	0... 2.5	4.8828e-3	V
Setpoint of MAP sensor output at stopped engine					
C_V_MAP_SP_DIF_MAX	-	FE00... 200H	-2.5 ...2.5	4.8828e-3	V
Allowed sensor output deviation at stopped engine at regular temperature condition					
IP_MAP_MES_BAS	-	0... FFFFH	0... 5434	0.0829175	hPa
LDP_V_MAP__MAP_MES_BAS	2	0... 400H	0 ...5	4.8828e-3	V
Conversion characteristic for MAP_DIP_MES_BAS					
IP_PUT_MES_BAS	-	0... FFFFH	0... 5434	0.0829175	hPa
LDP_V_PUT__PUT_MES_BAS	2	0... 400H	0 ...5	4.8828e-3	V
Conversion characteristic for PUT_MES_BAS					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_MAP_ABSV_REL_SWI	-	0... 1H	0 ...1	1	-
Switch for Calculation MAP_DIP_MES_BAS with measured absolute (1) or relative pressure (0)					
LC_PUT_ABSV_REL_SWI	-	0... 1H	0 ...1	1	-
Switch for Calculation PUT_MES_BAS with measured absolute (1) or relative pressure (0)					

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FUNCTION DESCRIPTION:

General information:

The raw value (voltage) MAP_BAS (PUT_BAS) is measured every 1 ms. The values (10 bit) are summed up in two alternating buffers, MAP_SUM or MAP_SUM_1 (PUT_SUM or PUT_SUM_1). The number of the values are counted in comparable buffers MAP_CTR or MAP_CTR_1 (PUT_CTR or PUT_CTR_1). This mechanism is necessary to synchronize the measurement and the calculation of MAP_DIP_MES_BAS resp. PUT_MES_BAS (build mean value with a standardized range)
Depending on the logical variable LV_MAP_SEG one of the two buffers — MAP_SUM or MAP_SUM_1 (PUT_SUM or PUT_SUM_1) — and the respective counter — MAP_CTR or MAP_CTR_1 (PUT_CTR or PUT_CTR_1) — are selected for writing, the contents of the other buffer (counter) is used for calculations and diagnosis (after this buffer and the corresponding counter have been read they are cleared).
To avoid pressure sensor diagnosis errors during initialization of the ECU, the first measured value is mirrored from buffer MAP_SUM into MAP_SUM_1 resp. PUT_SUM into PUT_SUM_1 (also the counters). This ensures, that the sensor diagnosis gets reasonable values and doesn't detect a bad sensor due to zero values in the buffer.
*MAP_DIP/PUT*_MES_BAS_2SEG is introduced to get a smooth signal of MAP_DIP_MES_BAS (filtering of possibly occurring pulsation of pressure).

Signal flow diagram:

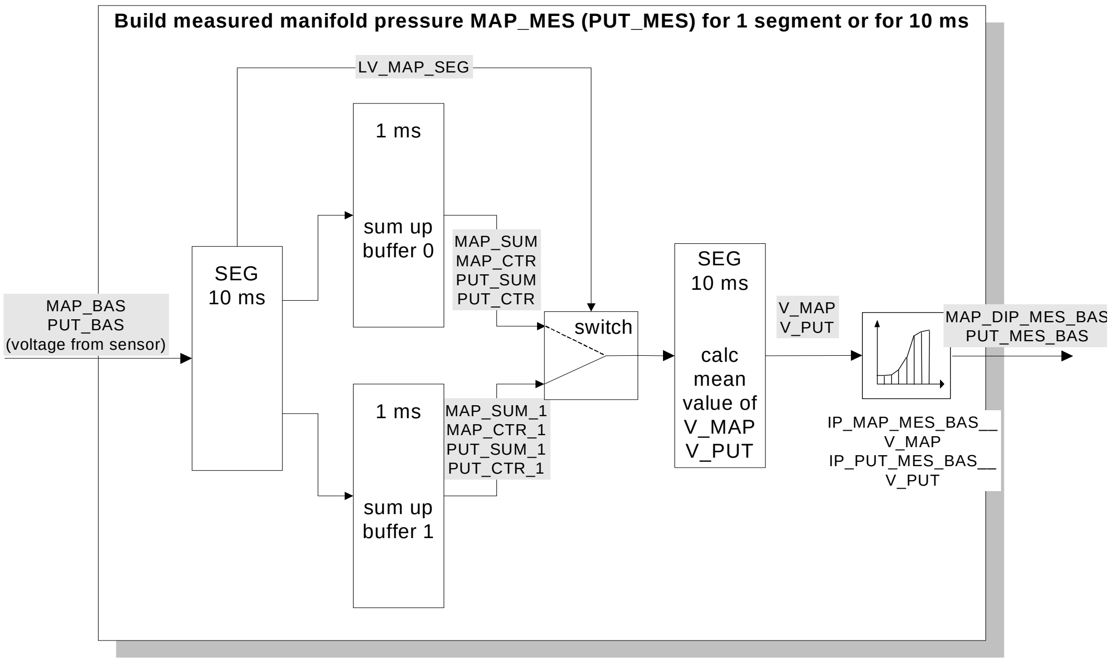

Figure 4.17.1: : Signal flow during acquisition of manifold pressure MAP_DIP_MES_BAS, PUT_MES_BAS

Description:

The application SW toggles LV_MAP_SEG either at a period of 10 ms (N_32 $<$ C_N_MAP_PUT_CLC_SWI) or at each segment (N_32 $>=$ C_N_MAP_PUT_CLC_SWI).
Because there are used two different MAP-sensors for pressure acquisition (relativ and absolute sensors) it is necessary to calculate the absolute value as input variable for the intake manifold modell.

Application conditions

Initialisation: `all: 0`

`except:`

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```
                    MAP_MES_BAS            = AMP              //
AMP must be initialized before      MAP_MES_BAS_2SEG          =
AMP        // AMP must be initialized before
   MAP_MES              = AMP       // AMP must be initialized
before
```

Recurrence: `at N_32 < C_N_MAP_PUT_CLC_SWI    all:  10ms`
`at N_32 >= C_N_MAP_PUT_CLC_SWI    all:  segment`

Activation: `at every engine state`

Deactivation: `–`

Formula section:

Calculation of V_MAP:

If LV_MAP_SEG = 1 **and**
MAP_CTR > 0

Then $V\_MAP = \frac{MAP\_SUM}{MAP\_CTR}$ - V_MAP_AD

Else

If LV_MAP_SEG = 0 **and**
MAP_CTR_1 > 0

Then $V\_MAP = \frac{MAP\_SUM\_1}{MAP\_CTR\_1}$ - V_MAP_AD

Endif

Endif

Calculation of V_MAP_1:

If MAP_CTR = 0 **and**
MAP_CTR_1 = 0

Then $V\_MAP\_1_n = V\_MAP\_1_{n-1}$

Else

If V_MAP > 0

Then $V\_MAP\_1 = \frac{(MAP\_SUM + MAP\_SUM\_1)}{(MAP\_CTR + MAP\_CTR\_1)}$ - V_MAP_AD

Else V_MAP_1 = 0

Endif

Endif

If the selected counter is zero V_MAP(_1) and MAP(_DIP)_MES_BAS(_2SEG) remain unchanged.

Calculation of MAP_MES_BAS(_2SEG) and MAP_DIP_MES_BAS(_2SEG):

V_MAP (unit: V) has to be converted in MAP(_DIP)_MES_BAS(_2SEG) (unit: hPa)

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If LC_MAP_ABSV_REL_SWI = 1
then (*N54*)
MAP_MES_BAS = IP_MAP_MES_BAS(V_MAP)
MAP_MES_BAS_2SEG = IP_MAP_MES_BAS(V_MAP_1)
MAP_DIP_MES_BAS = AMP - MAP_MES_BAS
MAP_DIP_MES_BAS_2SEG = AMP - MAP_MES_BAS_2SEG
else (*N53*)
MAP_DIP_MES_BAS = IP_MAP_MES_BAS(V_MAP)
MAP_DIP_MES_BAS_2SEG = IP_MAP_MES_BAS(V_MAP_1)
MAP_MES_BAS = AMP - MAP_DIP_MES_BAS
MAP_MES_BAS_2SEG = AMP - MAP_DIP_MES_BAS_2SEG
endif
If LV_ERR_MAP_DIP_SENS = 0
then MAP_MES = MAP_MES_BAS
MAP_DIP_MES_2SEG = MAP_DIP_MES_BAS_2SEG
else MAP_MES = MAP (*model value*)
MAP_DIP_MES_2SEG = AMP - MAP (*model value*)
endif

Calculation of OBD relevant MAP_SAE:

MAP_SAE = IP_MAP_MES_BAS(V_MAP) //Convertion must be done in physical way

Additional variables for LV_VAR_TCHA = 1 (turbo)
Calculation of V_PUT:
If LV_MAP_SEG = 1 **and**
PUT_CTR > 0

Then $V\_PUT = \frac{PUT\_SUM}{PUT\_CTR}$

Else
If LV_MAP_SEG = 0 **and**
PUT_CTR_1 > 0

Then $V\_PUT = \frac{PUT\_SUM\_1}{PUT\_CTR\_1}$

Endif
Endif
If the selected counter is zero V_PUT and PUT_MES_BAS stay unchanged.

Calculation of PUT_MES_BAS:
V_PUT (unit: V) has to be converted in PUT_MES_BAS (unit: hPa)
If LV_ERR_PUT_EL = 0

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Then **if** LC_PUT_ABSV_REL_SWI =1
then PUT_MES_BAS = IP_PUT_MES_BAS
else PUT_MES_BAS = AMP - IP_PUT_MES_BAS
endif

Else PUT_MES_BAS = PUT (calculated from Model)
Endif

Calculation of V_PUT_1:
If PUT_CTR = 0 **and**
PUT_CTR_1 = 0
Then $V\_PUT\_1_n = V\_PUT\_1_{n-1}$
Else
If V_PUT $>$ 0

Then $$V\_PUT\_1 = \frac{(PUT\_SUM + PUT\_SUM\_1)}{(PUT\_CTR + PUT\_CTR\_1)}$$

Else V_PUT_1 = 0
Endif
Endif

Calculation of PUT_MES_BAS_2SEG:

V_PUT_1 (unit: V) has to be converted into PUT_MES_BAS_2SEG (unit: hPa)
If LV_ERR_PUT_EL = 0
Then **if** LC_PUT_ABSV_REL_SWI = 1
then PUT_MES_BAS_2SEG = IP_PUT_MES_BAS
else PUT_MES_BAS_2SEG = AMP - IP_PUT_MES_BAS
endif

Else PUT_MES_BAS_2SEG = PUT (calc. from Model)
Endif

4.17.1 Adaptation of sensor characteristic

FUNCTION DESCRIPTION:

General information:

If MAP is evaluated from a differential pressure sensor (MAP_DIP), the sensor characteristic can be adapted due to the known differential pressure (0 hPa) when the engine doesn't run.

Application conditions

Initialisation:
```
V_MAP_AD from nonvolatile memory  or  = 0 V in case of memory
error or when the NVMY is reset
CTR_NR_V_MAP_ACQ = 0
LV_V_MAP_ACQ = 0
```

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```
T_DLY_MAP_MES_AD = 0                        |
LV_T_DLY_MAP_MES_AD = 0                     |
TEMP_MAP_DIP_MDL = TCO                      |-  at Activation

V_MAP_SUM = 0 V                             |
V_MAP_DIF = 0 V                             |
V_MAP_DIF_VLD = C_V_MAP_SP_DIF_MAX          ┘
```

Recurrence: 10 ms
except TEMP_MAP_DIP_MDL : 500 ms

Activation: *ECU_STATE = PWL* ***and***
LC_MAP_ABSV_REL_SWI = *0* ***and*** *//only for* DIP-Sensor

TPS_AV $\geq$ *C_TPS_V_MAP_AD_MIN* ***and*** //the manifold can be evacuated
VS_FIL = 0

Deactivation: !Activation

Formula section:

Estimation of MAP_DIP sensor temperature
Done only as long as LV_V_MAP_ACQ = 0 , every 500 ms

TEMP_MAP_DIP_MDL = (((((TCO - TCO_EX) * C_FAC_TEMP_MAP_DIP_TCO_EX
+ TCO_EX) - TIA) * C_FAC_TEMP_MAP_DIP_TIA + TIA)
- TAM) * C_FAC_TEMP_MAP_DIP_TAM + TAM

The following formulas are processed each recurrence in the same sequence as described here.

Delay collection of measurements until the manifold is evacuated
Done only as long as LV_T_DLY_MAP_MES_AD = 0

If T_DLY_MAP_MES_AD $<$ C_T_DLY_MAP_MES_AD
then T_DLY_MAP_MES_AD++ *//incremented by 10 ms*
else LV_T_DLY_MAP_MES_AD = 1
endif

Evaluation of a mean sensor output and of deviation to nominal output at differential pressure 0
Done only as long as LV_V_MAP_ACQ = 0 **and** LV_T_DLY_MAP_MES_AD = 1

If CTR_NR_V_MAP_ACQ $<$ C_NR_V_MAP_ACQ
then CTR_NR_V_MAP_ACQ++
V_MAP_SUM$_n$ = V_MAP_SUM$_{n-1}$ + V_MAP
else V_MAP_MV = V_MAP_SUM$_{n-1}$ /C_NR_V_MAP_ACQ
V_MAP_DIF = V_MAP_MV - C_V_MAP_SP_AD
LV_V_MAP_ACQ = 1
endif

Evaluation of allowed deviation and of the factor for the adaptation
Done only if LV_V_MAP_ACQ = 1

If TEMP_MAP_DIP_MDL $\geq$ C_TEMP_MAP_DIP_MDL_FAC_MIN **and**
TEMP_MAP_DIP_MDL $\leq$ C_TEMP_MAP_DIP_MDL_FAC_MAX

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```
  then      V_MAP_DIF_VLD  =  C_V_MAP_SP_DIF_MAX
             FAC_V_MAP_AD  =  C_FAC_V_MAP_AD
  else      V_MAP_DIF_VLD  =  C_V_MAP_SP_DIF_MAX *
                              C_FAC_TEMP_V_MAP_SP_DIF_MAX
             FAC_V_MAP_AD  =  C_FAC_V_MAP_AD * C_FAC_TEMP_V_MAP_AD
endif
```

Calculation of the sensor characteristic adaptation value (voltage offset)

Done only if LV_V_MAP_ACQ = 1

```
If    | V_MAP_DIF |  ≤  V_MAP_DIF_VLD
  then      V_MAP_AD  =  V_MAP_AD(old) + V_MAP_DIF * FAC_V_MAP_AD
             LV_V_MAP_ACQ  =  0                    //enables next adaptation loop
             CTR_NR_V_MAP_ACQ  =  0
             V_MAP_SUM  =  0
      if    V_MAP_AD > C_V_MAP_AD_MAX
        then          V_MAP_AD  =  C_V_MAP_AD_MAX
        else
             if    V_MAP_AD  <  -1 * C_V_MAP_AD_MAX
               then  V_MAP_AD  =  -1 * C_V_MAP_AD_MAX
             endif
      endif
endif
```

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4.18 Volumetric efficiency

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_VOL_TEMP_COR	V	0... FFFFH	0... 1.99996	30.5e-6	-
Volumetric efficiency correction factor due to temperature effects					
EFF_VOL_TEMP_COR_MMV	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Filtered volumetric efficiency correction factor due to temperature effects					

Input data:

LV_CLC_2SEG {p. 1825}	LV_CLC_2SEG_ENA {p. 1825}	MAF {p. 8277}	N_32 {p. 1525}
TCO {p. 1100}	TIA_IM {p. 984}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_STND	-	0... FEH	-48... 142.5	0.75	°C
Standard coolant temperature					
C_TCYL_STND	-	0... FEH	-48... 142.5	0.75	°C
Standard temperature in the cylinder					
C_TIA_IM_STND	-	0... FEH	-48... 142.5	0.75	°C
Standard intake air temperature					
IP_CRLC_EFF_VOL_TEMP_COR	-	0... FFH	0... 0.99609	3.91e-3	-
LDP_N_32_IP_CRLC_EFF_VOL_TEMP	6	0... FFH	0... 8160	32	rpm
Filter constant for volumetric efficiency correction					
IP_EFF_TCO_FAC__N_32__MAF	V	0... FFH	0... 0.99609	3.91e-3	-
LDPM_N_32__EFF_VOL_COR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF__EFF_VOL_COR	8	0... FFFFH	0... 1389	21.2e-3	mg/stk
Volumetric efficiency weighting factor versus cooling temperature					
IP_EFF_TIA_IM_FAC__N_32__MAF	V	0... FFH	0... 0.99609	3.91e-3	-
LDPM_N_32__EFF_VOL_COR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF__EFF_VOL_COR	8	0... FFFFH	0... 1389	21.2e-3	mg/stk
Volumetric efficiency weighting factor versus intake manifold gas temperature					

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General information:

Target of the temperature correction function is, to compensate the temperature influences onto the volumetric efficiency calculation. The air-mass flow into the cylinder is the product of the volume flow and the density of the air $\dot{m} = A \cdot w \cdot \rho(T) = \dot{V} \cdot \rho(T)$, where the density depends on the air-temperature. At low temperatures the air-density is much higher than at standard temperatures, therefore the air flowing into the cylinder at the same manifold pressure will increase. The basic volumetric efficiency usually is calibrated at standard temperatures of about 25 °C for intake air and about 90 °C for coolant temperature. To take into account the different density at operating points with other temperatures, the volumetric efficiency then has to be corrected.

Especially at speed-density systems, this temperature correction is essential, because the density of the air and therefore the air-mass flow strongly depend on the air temperature. This means all deviations from the temperatures at which the volumetric efficiency was calibrated will lead to a wrong air-mass flow value into the cylinder (e.g. wrong MAF value at cold starts without temperature corrections for a MAP system).
At systems equipped with an HFM sensor, the temperature correction is not as essential as for speed-density systems. Nevertheless, it is used to consider the heating of the air due to heat transfer from the warm intake duct to the air.
The compensation function is capable of taking into account deviations of coolant temperature and intake air temperature separately.

$$EFF\_VOL\_COR = \frac{273 + C\_TCYL\_STND}{273 + C\_TCYL\_STND + IP\_EFF\_TCO\_FAC \cdot (TCO - C\_TCO\_STND) + IP\_EFF\_TIA\_IM\_FAC \cdot (TIA\_IM - C\_TIA\_STND)}$$

Signal flow diagram:

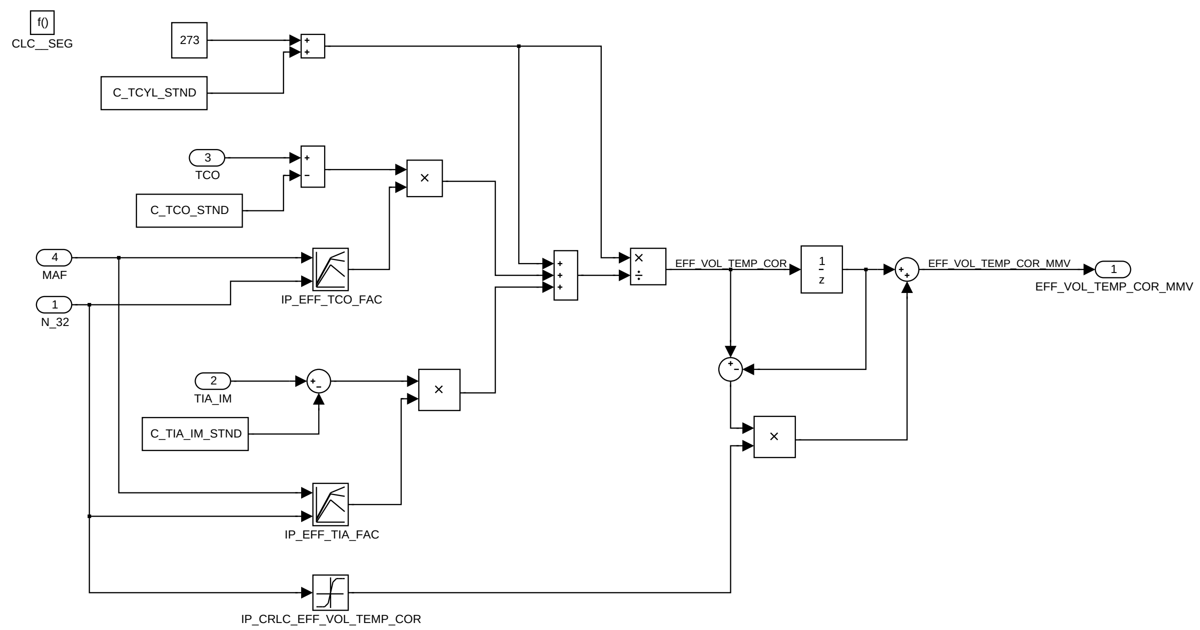

Figure 4.18.1: : Calculation algorithm for temperature correction

Description:

The temperature correction factor EFF_VOL_TEMP_COR is the ratio between air temperature in the cylinder for standard conditions TCYL compared to air temperature in the cylinder for current TCO, TIA_IM and operating point. TCO and TIA_IM are compared to standard conditions and weighted by operating point.

Application conditions

Initialisation: *at reset and engine running to stopped engine*
EFF_VOL_TEMP_COR = 1

Remark: The typical range of EFF_VOL_TEMP_COR is 0,8 to 1,5.
Activation: LV_CLC_2SEG = 0

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Deactivation: LV_CLC_2SEG = 1
Recurrence: segment synchronous

Formula section:

EFF_VOL_TEMP_COR = [273 + C_TCYL_STND] /
[273 + C_TCYL_STND + IP_EFF_TCO_FAC * (TCO - C_TCO_STND) +
IP_EFF_TIA_IM_FAC * (TIA_IM - C_TIA_IM_STND)]

Changes in the operating point cause thermal inertia effects, which have to be taken into account. Filtering EFF_VOL_TEMP_COR does this.
At first calculation EFF_VOL_TEMP_COR_MMV is = EFF_VOL_TEMP_COR.

if LV_CLC_2SEG_ENA = 0
then EFF_VOL_TEMP_COR_MMV$_n$ = EFF_VOL_TEMP_COR_MMV$_{n-1}$
+ (EFF_VOL_TEMP_COR - EFF_VOL_TEMP_COR_MMV$_{n-1}$)
* IP_CRLC_EFF_VOL_TEMP_COR
else EFF_VOL_TEMP_COR_MMV$_n$ = EFF_VOL_TEMP_COR_MMV$_{n-1}$
+ (EFF_VOL_TEMP_COR - EFF_VOL_TEMP_COR_MMV$_{n-1}$)
* 2 * IP_CRLC_EFF_VOL_TEMP_COR
endif

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4.19 Pressure decrease through the air cleaner

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
PUT	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Pressure upstream throttle					
PUT_MAX	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Maximum possible pressure upstream throttle					

Input data:

AMP_AD {p. 982}	AMP_MDL {p. 982}	AMP_MES {p. 1163}	LV_CLC_2SEG {p. 1825}
LV_ERR_PUT_EL {p. 4828}	LV_ERR_PUT_PLAUS {p. 1062}	LV_ES {p. 1720}	LV_VAR_TCHA {p. 656}
MAF_CYL {p. 8277}	PUT_MES_BAS]		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_AMP_DEC	-	0... FFFFH	0... 5434	82.8999e-3	hPa
LDP_MAF_CYL__AMP_DEC	4	0... FFFFH	0... 2047.96875	0.03125	kg/h
Pressure decrease through the air cleaner					
LC_ENA_PUT_SUB_PLAUS_ERR	-	0... 1H	0 ...1	1	-
Switch to enable PUT substitution during PUT_PLAUS_ERR					

FUNCTION DESCRIPTION:

General information:

With increasing air mass flow through the air cleaner there is a drop of pressure in the air cleaner in comparison to the ambient pressure.

Application conditions

Initialisation: `PUT = AMP_MES`
`PUT_MAX = AMP_MES at ECU reset`

Activation: `LV_CLC_2SEG = 0`

Deactivation: `LV_CLC_2SEG = 1`
`No pressure decrease will be calculated, if all elements of IP_AMP_DEC are 0.`

Recurrence: LV_ES = 10 ms
LV_ES = 0 segment synchronous

Formula section:

If LV_VAR_TCHA = 0
Then PUT = AMP_MDL - IP_AMP_DEC
PUT_MAX = AMP_AD - IP_AMP_DEC
Else **If** LV_ERR_PUT_EL = 1 **or**
(LV_ERR_PUT_PLAUS = 1 **and**

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```
                LC_ENA_ PUT_SUB_PLAUS_ERR = 1 )

        Then   PUT = AMP_MDL - IP_AMP_DEC
                PUT_MAX = AMP_AD - IP_AMP_DEC
            Else     PUT = PUT_MES_BAS
            PUT_MAX = AMP_AD - IP_AMP_DEC
        Endif
Endif
```

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4.20 Intake manifold model (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MAF_CTL	V	0... 1H	0 ...1	1	-
1: MAF controlled system					

Input data:

ERR_SYM_LOAD_TPS_ PLAUS {p. 1052}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}	LV_ERR_MAF {p. 4815}	LV_MAF_PULS {p. 1192}

Application conditions

Initialisation: *LV_MAF_CTL = 1*

Recurrence: *10 ms*

Activation: *every engine state*

Deactivation: –

Formula section:

if LV_ERR_MAF = 1
or LV_MAF_PULS = 1
or **[** LV_ERR_LOAD_TPS_PLAUS = 1 **and**
ERR_SYM_LOAD_TPS_PLAUS = SYM_0 **]**
then -/N-control: LV_MAF_CTL = 0
else MAF-control: LV_MAF_CTL = 1
endif

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4.21 Intake manifold model

Data definition:

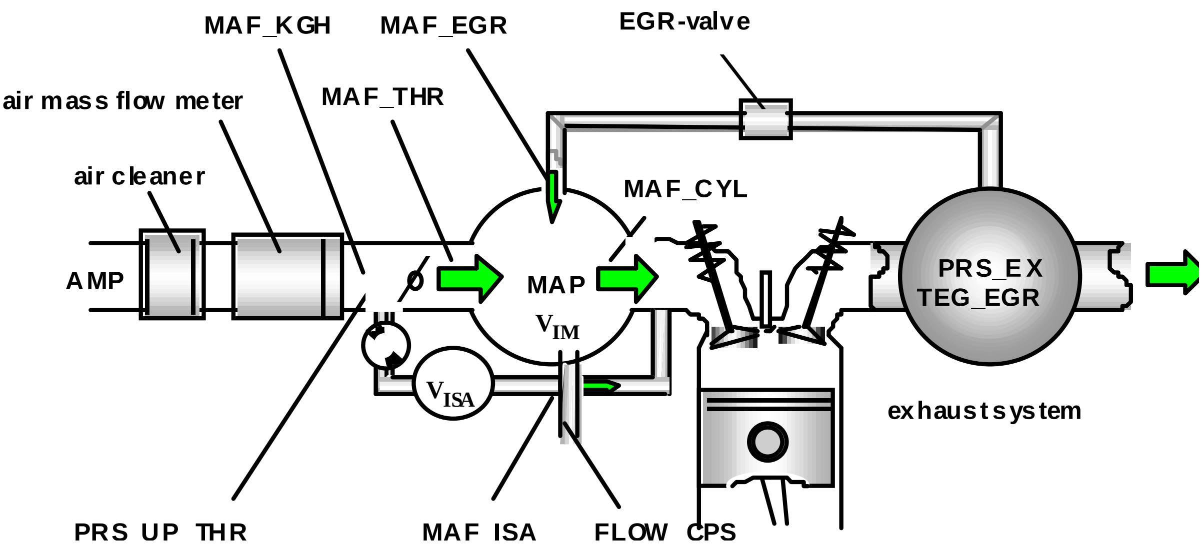
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_MAF_MAX	O/V	0... FFFFH	0 ...2	30.52e-6	-
ratio between MAF and MAF_MAX_COR					
MAF_FG_CYL	O/V	0000... FFFFH	0... 2047.96875	0.03125	kg/h
fresh air mass flow in the cylinder					
PQ_EGR	O/V	0000... FFFFH	0... 0.999985	15.2e-6	-
pressure quotient at the EGR - valve					

Input data:

MAF_CYL {p. 8277}	MAF_EGR {p. 8278}	MAF_MAX_COR {p. 8278}	MAF_SP_TQI {p. 8390}
MAP {p. 8278}	PRS_EX_EGR {p. 1167}		

General information:

The intake manifold model calculates the air mass flow at throttle, at idle speed actuator valve, the air mass flow into the cylinder and the pressure in the intake manifold. In case of



exhaust gas recirculation in addition the residual gas partial pressure and the fresh gas partial pressure are calculated. The calculation is done every segment due to charge determination for injection and ignition. Therefore it is necessary to scan the throttle- and idle speed actuator valve position also every segment.

Signal flow diagram:

Application conditions

Recurrence: *segment synchronous*

Activation: *at LV_IGK = 1*

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Deactivation: –

4.21.1 Calculation of the manifold pressure MAP

Application conditions

Initialisation: PQ_EGR =0

Formula section:

$PQ\_EGR_N = MAP_N / PRS\_EX\_EGR_N$

4.21.2 Calculation of MAP_FG

Application conditions

Initialisation: *all 0 at Reset*

Formula section:

the air entering in the cylinder presently is given by :

MAF_FG_CYL = MAF_CYL - MAF_EGR

4.21.3 Calculation of maximum possible mass air flow MAF_MAX_COR and the ratio between actual and maximum mass air flow FAC_MAF_MAX

Application conditions

Initialisation:

Formula section:

$FAC\_MAF\_MAX = MAF\_SP\_TQI_N / MAF\_MAX\_COR_N$

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4.22 Ambient air temperature calculation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TAM_ST	O/V	0... FEH	0... 142.5	0.75	°C
Ambient air temperature at Start					
TAM_STOP	O/V/S	0... FEH	0... 142.5	0.75	°C
Ambient air temperature at engine stop					

Input data:

LV_ES {p. 1720}	LV_ST {p. 1720}	TAM {p. 1579}	

Overview

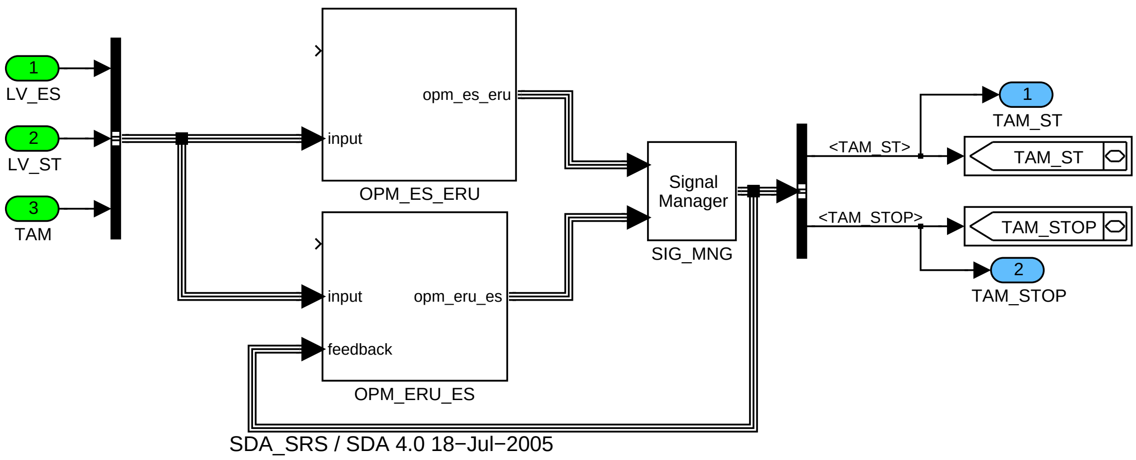

Figure 4.22.1: AIRT_M4024

4.22.1 Calculation of ambient temperature at start(ES to ERU)

General information:
TAM is received via CAN (see chapter CANmessages).
TAM_ST is determined at each transition from ES to ST.

Function Description

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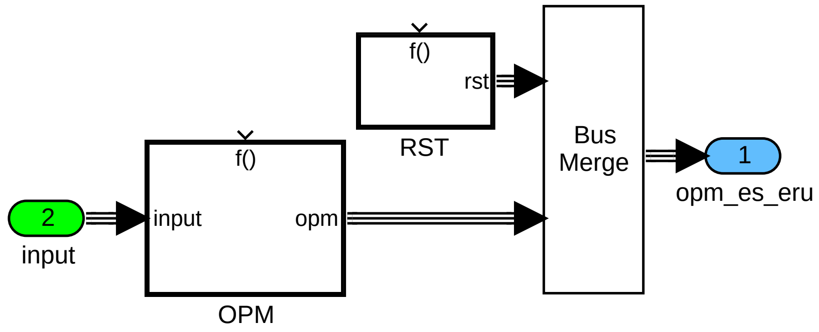

Figure 4.22.2: AIRT_M4024/OPM_ES_ERU

4.22.1.1 Initialisation at reset

Initialisation of TAM_ST to 0 at reset

Figure 4.22.3: AIRT_M4024/OPM_ES_ERU/RST

4.22.1.2 Formula section

Aissgnment of TAM_ST

TAM is assigned to TAM_ST at start.

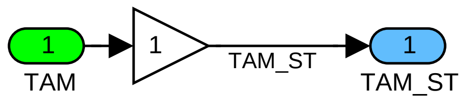

Figure 4.22.4: AIRT_M4024/OPM_ES_ERU/OPM/CLC

4.22.2 Calculation of ambient temperature at Engine stop(ERU to ES)

General information:
TAM is received via CAN (see chapter CANmessages).
TAM_STOP is determined at each transition from LV_ES 0 $>$ 1.

Function Description

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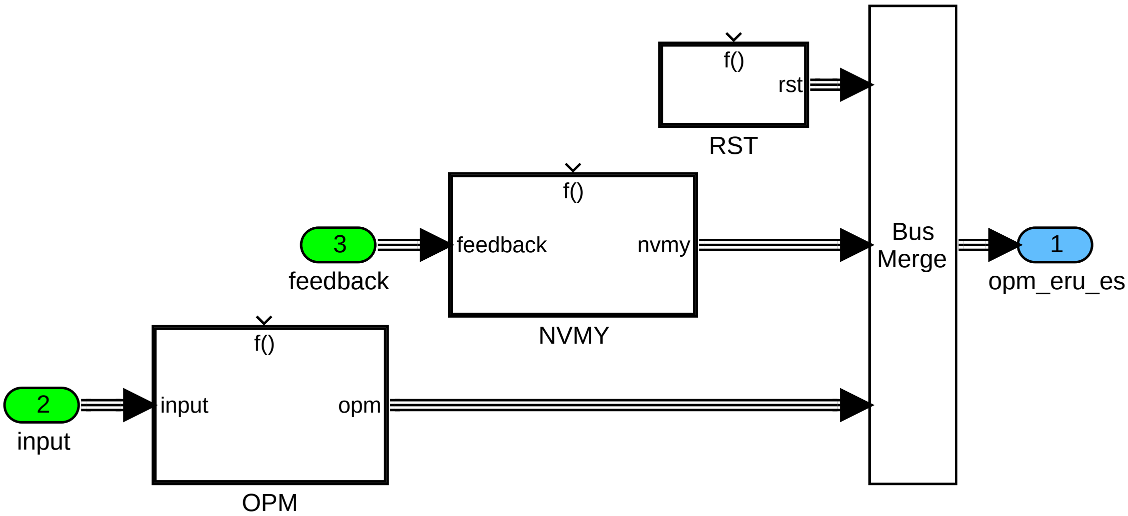

Figure 4.22.5: AIRT_M4024/OPM_ERU_ES

4.22.2.1 At reset

Initialisation

Initialisation of TAM_STOP to 0 at reset.

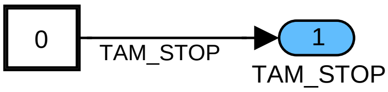

Figure 4.22.6: AIRT_M4024/OPM_ERU_ES/RST/INI

4.22.2.2 Initialisations at non volatile memory system event(NVMY).

At system event NVMY the initialisation, restore and store action to and from the non volatile memory takes place.

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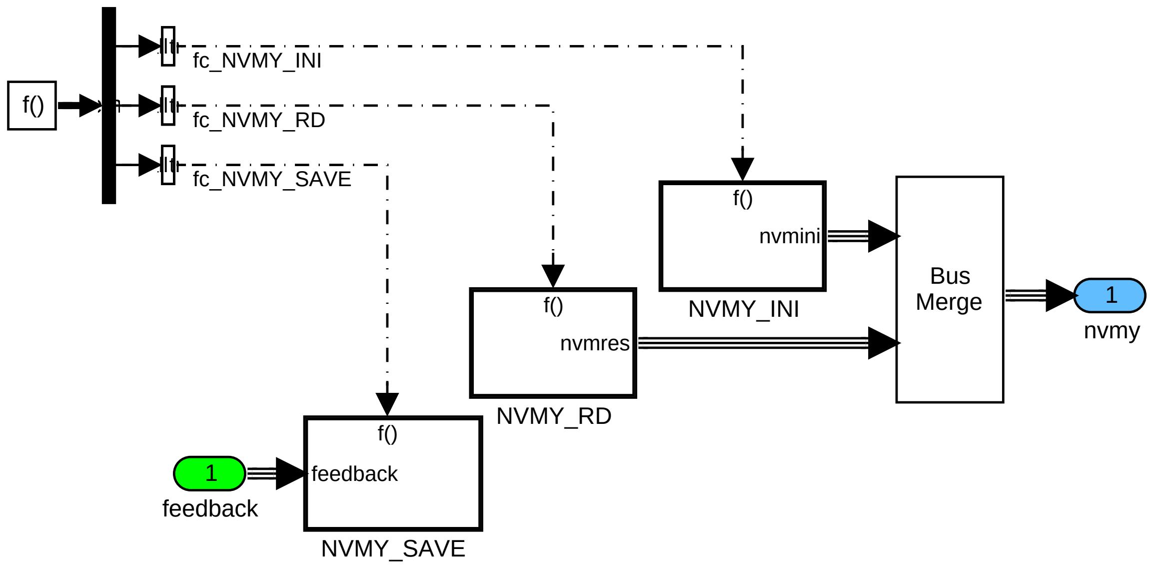

Figure 4.22.7: AIRT_M4024/OPM_ERU_ES/NVMY

4.22.2.3 Formula section

Assignment to TAM_STOP

TAM is assigned to TAM_STOP

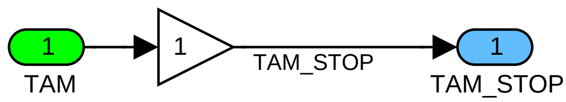

Figure 4.22.8: AIRT_M4024/OPM_ERU_ES/OPM/CLC

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4.23 Coolant temperature (radiator outlet)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_INI_TCO_2	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) initialisation conditions					
TCO_1_2	O/V	80... 7FH	-96... 95.25	0.75	°C
Coolant temperature difference between the TCO- and the TCO_2 sensor					
TCO_2	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature (radiator outlet)					
TCO_2_MES	O/V	0... FEH	-48... 142.5	0.75	°C
Measured coolant temperature (radiator outlet)					
TCO_2_MES_ST	O/V	0... FEH	-48... 142.5	0.75	°C
Measured coolant temperature (radiator outlet) at start					
TCO_2_ST	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature (radiator outlet) at start					

Input data:

LV_ERR_TCO_2 {p. 4572}	LV_ERR_TCO_2_PREL {p. 4572}	LV_ES {p. 1720}	LV_VAR_TCO_2 {p. 656}
NC_NR_TCO_SENS {p. 576}	TCO {p. 1100}	VP_TCO [NC_NR_TCO_SENS] {p. 1100}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_2_DIF_TCO	-	FFFFFF80... 7FH	-96... 95.25	0.75	°C
Temperature difference to the TCO-value in case of a coolant temperature (radiator outlet) failure					
C_TCO_2_MES_GRD_MAX	-	0... FEH	0... 190.5	0.75	°C
Maximum permissible temperature gradient for coolant temperature (radiator outlet) gradient monitoring					
C_TCO_2_SUB	-	0... FEH	-48... 142.5	0.75	°C
Substitute value for TCO_2 in case of no sensor is available					
IP_TCO_2_MES	-	0... FEH	-48... 142.5	0.75	°C
LDP_VP_TCO_2_IP_TCO_2_MES	16	0... 7FFFH	0... 4.999847412	153e-6	V
Linearization of the coolant temperature (radiator outlet) sensor voltage (VP_TCO[1]) for temperature acquisition					
LC_SWI_TCO_2_SUB	-	0... 1H	0 ...1	1	-
Minimum engine cooling temperature to activate the diagnosis condition					

FUNCTION DESCRIPTION:

General information:

The coolant temperature raw sensor voltage at radiator outlet is measured with use of an 10bit A/D converter by the ECU hardware. The software then is generating a modified sensor signal (VP_TCO[1]), which is requested by the application software for further execution.
The modified sensor signal (VP_TCO[1]) is converted into a measured temperature value at radiator outlet (TCO_2_MES) with use of a one-dimension interpolation table (IP_TCO_2_MES).
If the sensor is not available (LV_VAR_TCO_2 = 0) then TCO_2 is set to an substitute value.

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Application conditions:

See separate chapters:

4.23.1 Coolant temperature (radiator outlet) gradient monitoring

FUNCTION DESCRIPTION:

General information:

The measured coolant temperature at radiator outlet (TCO_2_MES) is monitored for not plausible gradients. It is checked if the temperature difference between the old and the new measured coolant temperature (TCO_2_MES) exceeds the permissible gradient C_TCO_2_MES_GRD_MAX. In this case the old measured value remains unchanged. If the temperature difference between the measured coolant temperature values at radiator outlet is exceeding the permissible gradient again during the next measurement, the new measured value is transferred into the working memory. A measured value can be inhibited only if the gradient exceeded for one time (recurrence).
The monitoring of the coolant temperature (radiator outlet) gradient does not lead to failure entries. The only purpose is to extract implausible measured values (noise).

Application conditions:

Initialisation at Reset:
TCO_2_MES(n) = TCO_2_MES(n-1) = IP_TCO_2_MES
// acquisition of the coolant temperature (radiator outlet) measurement signal

Recurrence: 100 ms

Activation: at every engine operating state

Deactivation: -

Formula section:

If LV_VAR_TCO_2 = 1
then
TCO_2_MES = IP_TCO_2_MES
// VP_TCO[1] is used as input signal for the interpolation table IP_TCO_2_MES
If I TCO_2_MES(n-1) - TCO_2_MES(n) I > C_TCO_2_MES_GRD_MAX
then TCO_2_MES(n) = TCO_2_MES(n-1) (only one time!)
else TCO_2_MES(n) = TCO_2_MES(n)
endif
else
If LC_SWI_TCO_2_SUB = 0
then TCO_2_MES = TCO - C_TCO_2_DIF_TCO
else TCO_2_MES = C_TCO_2_SUB
endif
endif

4.23.2 Coolant temperature (radiator outlet) acquisition

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FUNCTION DESCRIPTION:

General information:

The actualisation of the coolant temperature value at radiator outlet (TCO_2) is only executed, if no coolant temperature (radiator outlet) error /preliminary error is detected. In case of a detected error, the TCO_2 value will be set to its substitute value, which is calculated by the coolant temperature (TCO) in combination with an offset value.
The initialisation of the coolant temperature value at radiator outlet (TCO_2) is only performed once per engine run as long as the engine operating state “Engine stop” is active. If the engine stalls and in this case the engine operating state is changing to “Engine stop” again, a new initialization of the coolant temperature at radiator outlet will not be done. Power latch must always be finished before a new initialization process is performed as long as no ECU reset occurs. An ECU reset is handled like the beginning of a new engine run and an initialization of the TCO_2 value is also done in this case for at least one recurrence.

Application conditions

Initialisation at Reset `LV_CDN_INI_TCO_2 = 1`
`TCO_2 = TCO_2_MES`

Initialisation at Engine stop to Engine run (ES_to_ERU): `LV_CDN_INI_TCO_2 = 0`

Activation: *at every engine operating state*

Deactivation: –

4.23.2.1 Coolant temperature (radiator outlet) acquisition (at ES after RESET)

Application conditions

Recurrence: *10 ms*

Activation: *LV_CDN_INI_TCO_2 = 1*

Deactivation: *LV_CDN_INI_TCO_2 = 0*

Formula section:

if (1) LV_ERR_TCO_2 = 0 **and**
LV_ERR_TCO_2_PREL = 0
then (1) TCO_2 = TCO_2_MES
else (1) TCO_2 = TCO - C_TCO_2_DIF_TCO
endif (1)

4.23.2.2 Coolant temperature (radiator outlet) acquisition (at ERU /at ES after ERU_to_ES)

Application conditions

Recurrence: *100 ms*

Activation: *LV_CDN_INI_TCO_2 = 0*

Deactivation: *LV_CDN_INI_TCO_2 = 1*

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Formula section:

if (1) LV_ERR_TCO_2 = 0
then (1)
if (2) LV_ERR_TCO_2_PREL = 0
then (2) TCO_2 = TCO_2_MES
else (2) TCO_2(n) = TCO_2(n-1)
endif (2)
else (1) TCO_2 = TCO - C_TCO_2_DIF_TCO
endif (1)

4.23.3 Coolant temperature (radiator outlet) at engine start

FUNCTION DESCRIPTION:

General information:

The coolant temperature (radiator outlet) and the measured coolant temperature at engine start (TCO_2_ST, TCO_2_MES_ST) is determined as long as the engine operating state “Engine stop” is detected. During this time, TCO_2_ST is updated with the actual coolant temperature value at radiator outlet (TCO_2) and TCO_2_MES_ST is updated with the measured coolant temperature value at radiator outlet (TCO_2_MES).

Application conditions

Initialisation at Reset: TCO_2_ST = TCO_2_MES
TCO_2_MES_ST = TCO_2_MES

Recurrence: *10 ms*

Activation: *LV_ES = 1*

Deactivation: *LV_ES = 0*

Formula section:

TCO_2_ST = TCO_2
TCO_2_MES_ST = TCO_2_MES

4.23.4 Temperature difference between the coolant temperature sensors

FUNCTION DESCRIPTION:

General information:

The main coolant temperature sensor (TCO) is located next to the engine, while the second coolant temperature sensor (TCO_2) is fixed at radiator outlet. The temperature difference between the coolant temperature values (TCO_1_2) is determined and used for further calibration issues. Only positive values for the coolant temperature difference are plausible at normal driving conditions.

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Application conditions

Initialisation at Reset: `TCO_1_2 = 95.25°C`

Recurrence: *100 ms*

Activation: *at every engine operating state*

Deactivation: –

Formula section:

TCO_1_2 = TCO - TCO_2

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4.24 Oil temperature selection

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_TOIL_MAX	O/V/S	0... FFH	0... 255	1	-
event frequency counter					
DIST_TOIL_MAX	O/V/S	0... FFFFH	0... 524280	8	km
mileage at last warning threshold 1					
GEAR_TOIL_MAX	O/V/S	0... FFH	0... 255	1	-
GEAR at last warning threshold 1					
LV_CS_TOIL_MAX	O/V/S	0... 1H	0 ...1	1	-
clutch switch detection at last warning threshold 1					
LV_TOIL_THD_WARN_1	O/V	0... 1H	0 ...1	1	-
TOIL > warning threshold 1					
LV_TOIL_THD_WARN_2	O/V	0... 1H	0 ...1	1	-
TOIL > warning threshold 2					
N_TOIL_MAX	O/V/S	0... 1FE0H	0... 8160	1	rpm
N at last warning threshold 1					
PV_AV_TOIL_MAX	O/V/S	0... FFH	0... 99.6	0.39	%
PV_AV at last warning threshold 1					
TAM_TOIL_MAX	O/V/S	0... FEH	-48... 142.5	0.75	°C
ambient temperature at last warning threshold 1					
TCO_TOIL_MAX	O/V/S	0... FEH	-48... 142.5	0.75	°C
coolant temperature at last warning threshold 1					
TOIL_MAX_WARN	O/V/S	0... C8H	-40 ...160	1	°C
max. TOIL at last warning threshold 1					
TOIL_THD_TOIL_MAX	O/V/S	0... C8H	-40 ...160	1	°C
warning threshold 1					
TQI_AV_TOIL_MAX	O/V/S	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
indicated engine torque at last warning threshold 1					
VS_TOIL_MAX	O/V/S	0... FFH	0... 255	1	km/h
VS at last warning threshold 1					

Input data:

C_TOIL_CHK_CTL_1 {p. 1223}	DIST_KWP {p. 1183}	GEAR {p. 1302}	LV_CS {p. 8394}
LV_IGK {p. 906}	LV_TOIL_THD_WARN_1 {p. 1223}	N {p. 1525}	PV_AV {p. 1269}
TAM {p. 1579}	TCO {p. 1100}	TOIL {p. 8204}	TQI_AV {p. 981}
VS {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TOIL_CHK_CTL_1	-	0... FFH	-40 ...215	1	°C
warning threshold 1 for TOIL overtemperature (appl. suggestion: 155°C)					
C_TOIL_CHK_CTL_2	-	0... FFH	-40 ...215	1	°C
warning threshold 2 for TOIL overtemperature (appl. suggestion: 158°C)					

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4.24.1 Oil overtemperature detection - Detection algorithm

FUNCTION DESCRIPTION:

General information:

There are two thresholds for detecting a TOIL overtemperature. In case TOIL exceeds the first threshold a statusflag is set and a checkcontrol-message is sent, indicating that the TOIL is within the yellow area . If TOIL exceeds the second threshold a statusflag is set and a checkcontrol-message is set, indicating that the TOIL is within the red area .
The statusflags are reset if TOIL < threshold.

Application conditions

Initialisation: `LV_TOIL_THD_WARN_i = 0 at reset`

Recurrence: *1000ms*

Activation: *LV_IGK = 1*

Formula section:

Determination of LV_TOIL_THD_WARN_1:
IF (TOIL > C_TOIL_CHK_CTL_1)
THEN LV_TOIL_THD_WARN_1 = 1
ELSE LV_TOIL_THD_WARN_1 = 0
ENDIF

Determination of LV_TOIL_THD_WARN_2:
IF (TOIL > C_TOIL_CHK_CTL_2)
THEN LV_TOIL_THD_WARN_2 = 1
ELSE LV_TOIL_THD_WARN_2 = 0
ENDIF

4.24.2 Oil overtemperature detection - Environmental data

General information:

This function contains the environmental data, which should be stored in the nv-memory in case of detected oil overtemperature.

Application conditions

Initialisation: `GEAR_TMP = 0` **`at reset`**
`all xxx_TOIL_MAX - data restored out of NVMY`

Recurrence: `1000 ms`

Activation: `LV_IGK = 1`

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Formula section:

Determination of LV_TOIL_THD_1:

```
IF            LV_TOIL_THD_WARN_1     =    1
THEN     CTR_TOIL_MAX      =     CTR_TOIL_MAX + 1        /* only once per
trigger */
      IF              TOIL                   >    TOIL_MAX_WARN
   THEN             TOIL_MAX_WARN          =    TOIL
                  VS_TOIL_MAX            =    VS
                  N_TOIL_MAX             =    N
                  GEAR_TOIL_MAX          =    GEAR_TMP
                  TQI_AV_TOIL_MAX        =    TQI_AV
                  TAM_TOIL_MAX           =    TAM
                  TCO_TOIL_MAX           =    TCO
                  DIST_TOIL_MAX          =    DIST_KWP
                  PV_AV_TOIL_MAX         =    PV_AV
                  LV_CS_TOIL_MAX         =    LV_CS
                  TOIL_THD_TOIL_MAX      =    C_TOIL_CHK_CTL_1
   ENDIF
ENDIF
```

Determination of last used gear:

```
IF            (GEAR      >     0)          /* in case of HS-Gearbox, GEAR = 0 if CS is
active */
THEN     GEAR_TMP      =      GEAR
ENDIF
```

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4.25 Basic air temperature variables

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TIA	O/V	0... FEH	0... 142.5	0.75	°C
Intake air temperature					
TIA_MES	O/V	0... FEH	0... 142.5	0.75	°C
Intake air temperature raw value					
TIA_ST	O/V	0... FEH	0... 142.5	0.75	°C
Intake air temperature at ST					
TIA_SUB	O/V	0... FEH	0... 142.5	0.75	°C
Substitute value intake air temperature					
TIA_TCHA	O/V	0... FEH	0... 142.5	0.75	°C
Air temperature up turbo charger					
VP_TIA	O/V	0... 7FFFH	0... 4.99984741	15.25879e3	V
Voltage value of the intake air temperature sensor					
VP_TIA_TCHA	O/V	0... 7FFFH	0... 4.99984741	15.25879e3	V
Voltage for temperatur sensor up turbocharger					

Input data:

C_VP_TIA_MAX_DIAG {p. 4195}	C_VP_TIA_MIN_DIAG {p. 4195}	LV_ERR_TCO {p. 4496}	LV_ERR_TIA {p. 4200}
LV_ERR_TIA_TCHA_UP {p. 4189}	LV_ST {p. 1720}	LV_VAR_TCHA {p. 656}	NC_CYL_NR {p. 1526}
TCO {p. 1100}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_DIAG	-	0... FEH	0... 142.5	0.75	°C
TCO threshold for switching TIA substitute					
C_TIA_GRD_MAX_DIAG	-	0... FEH	0... 190.5	0.75	°C/500ms
Maximum permissible gradient for TIA					
C_TIA_SUB_BOL	-	0... FEH	0... 142.5	0.75	°C
Lower TIA substitute value					
C_TIA_SUB_TOL	-	0... FEH	0... 142.5	0.75	°C
Upper TIA substitute value					
IP_TIA__VP_TIA	-	0... FEH	0... 142.5	0.75	°C
LDP_VP_TIA_TIA	16	0... 7FFFH	0... 4.99984741	15.25879e3	V
NTC characteristic					
IP_TIA_TCHA__VP_TIA_TCHA	-	0... FEH	0... 142.5	0.75	°C
LDP_VP_TIA_TCHA	16	0... 7FFFH	0... 4.99984741	15.25879e3	V
NTC characteristic up turbo charger					

Import actions:

ACTION_INFR_GetVpTia (**OUT**<Vp_tia_sens>)
ACTION_INFR_GetVpTiaTcha (**OUT**<Vp_tia_tcha_sens>)

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Function description

Function Description

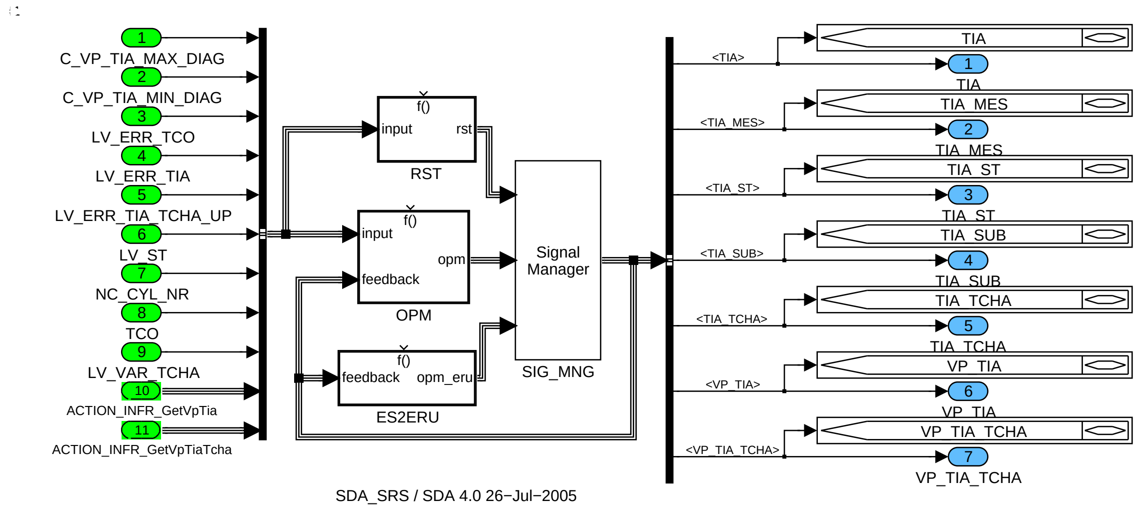

Figure 4.25.1: AIRT_M4007

4.25.1 Temperature determination

General information:
The air temperatures are measured through an A/D converter.
The conversion into physical values is made through the nonlinear characteristic IP_TIA__VP_TIA and IP_TIA__V_TANS_TCHA. In case of a present fault of the TIAsensor a substitute value will be used.

Calculation at reset

Calculation of TIA, TIA_MES, VP_TIA and VP_TIA_TCHA at reset

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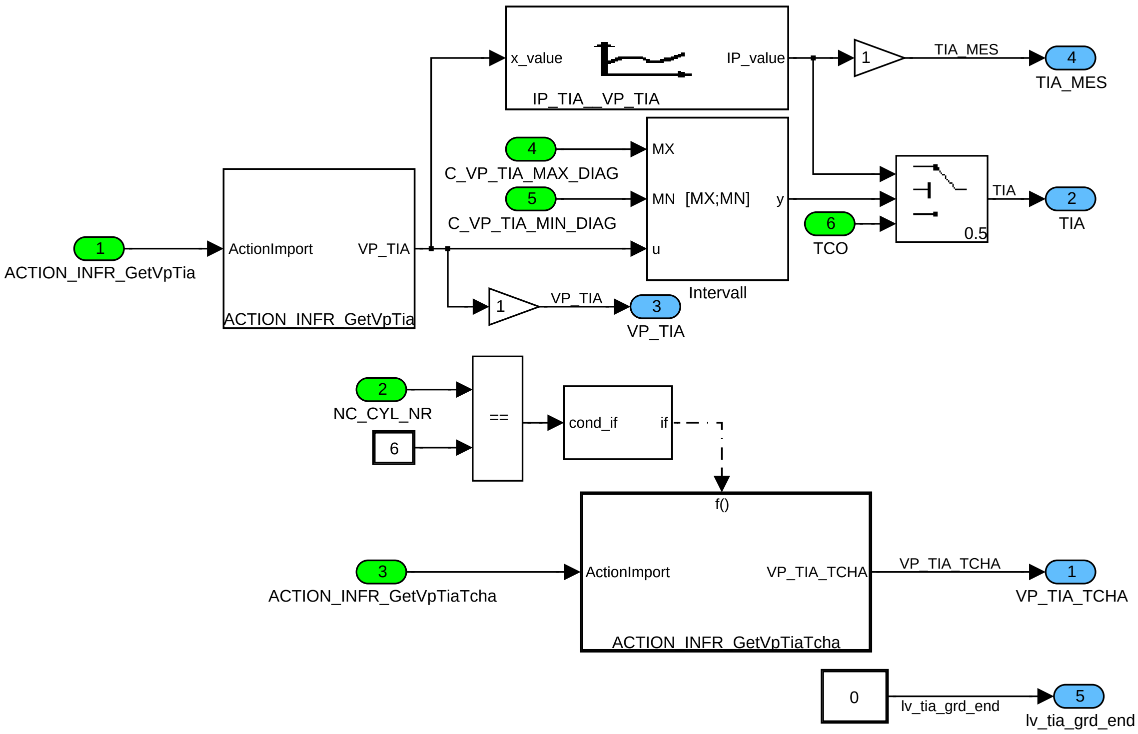

Figure 4.25.2: AIRT_M4007/RST/CLC

4.25.2 Formula section

Calculation at 100ms recurrence

Calculation of TIA, TIA_MES, TIA_SUB, VP_TIA and VP_TIA_TCHA

Action infrastructure outputs

The outputs of the air temperature sensor (VP_TIA and VP_TIA_TCHA) are calculated here using action infrastructure.

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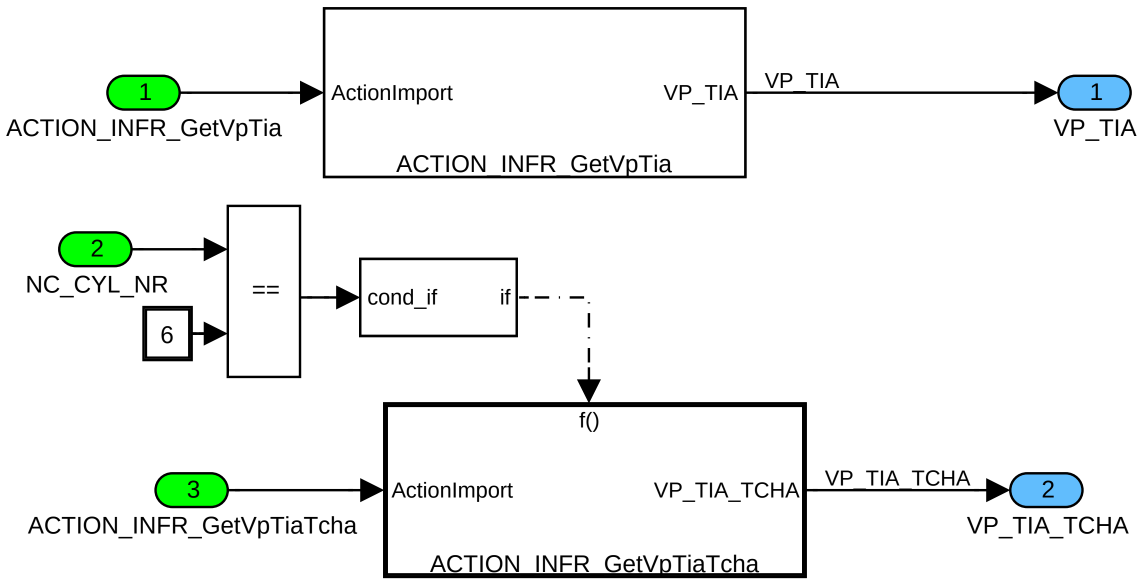

Figure 4.25.3: AIRT_M4007/OPM/CLC/CLC_1_VP_TIA

Determination of TIA , TIA_TCHA, TIA_MES and TIA_SUB

Calculation of TIA is done using TIA_SUB, Output from temperature gradient monitoring scheme and old value of TIA .TIA_TCHA is calculated using TIA and IP MAP.TIA_MES is calculated from the IP table.

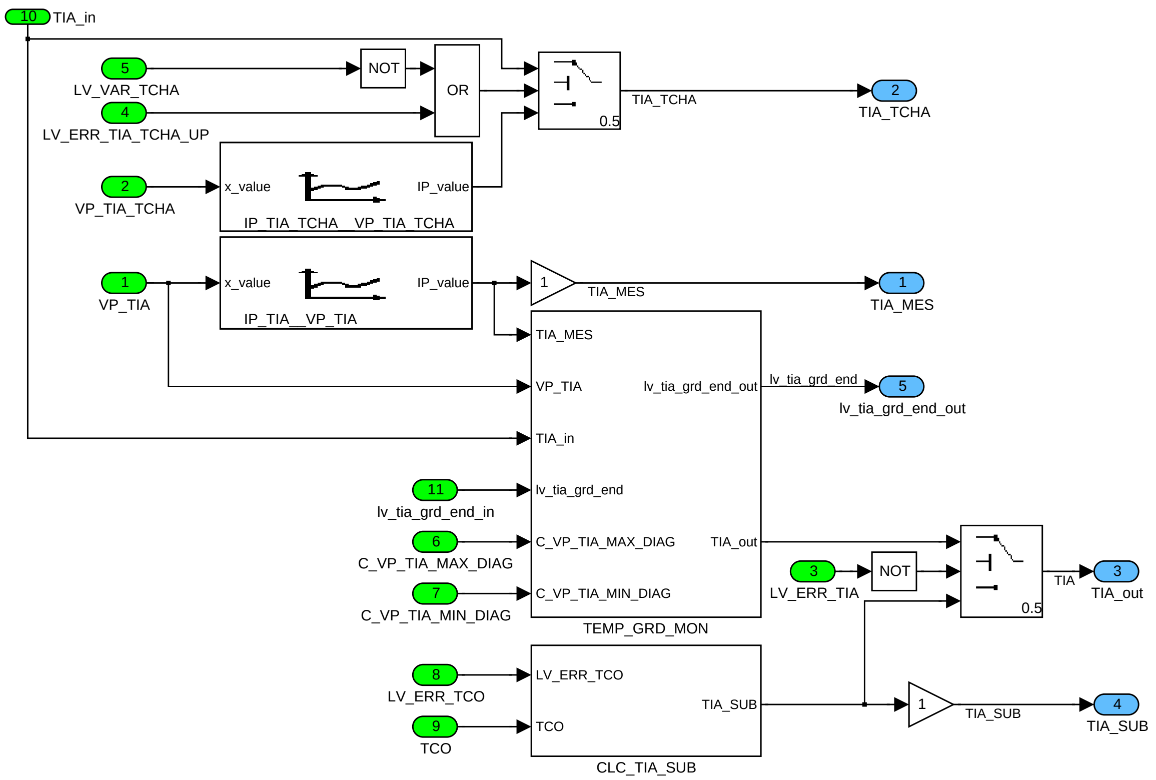

Figure 4.25.4: AIRT_M4007/OPM/CLC/CLC_2_TIA_ERR

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Determination TIA_SUB

TIA_SUB is determined from lower TIA substitute value (C_TIA_SUB_BOL) and upper TIA substitute value (C_TIA_SUB_TOL).

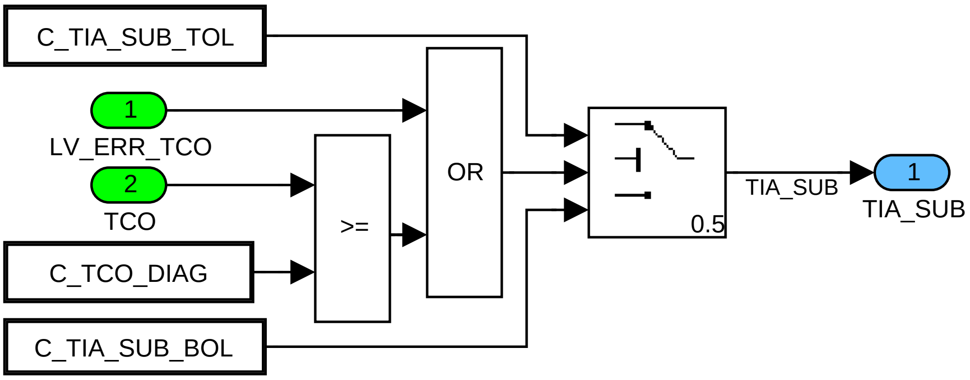

Figure 4.25.5: AIRT_M4007/OPM/CLC/CLC_2_TIA_ERR/CLC_TIA_SUB

Temperature gradient monitoring

General information:
The temperature TIA is monitored for unplausible gradients. Previously there is a check that the measured value is within the permissible value range (see chapter Diagnosis). If yes, a check is made that the difference between the old and the new measured value exceeds the permissible gradient

C_TIA_GRD_MAX_DIAG for TIA.

If this is the case, then the old measured value remains unchanged. If it is determined once again at the next measurement that the maximum gradient was exceeded, then the new measured value is taken over into the working memory. A measured value can therefore only be masked out if the gradient was exceeded for the first time.
Gradient monitoring does not lead to any error storage, but serves only for masking out not plausible measured values (disturbances).

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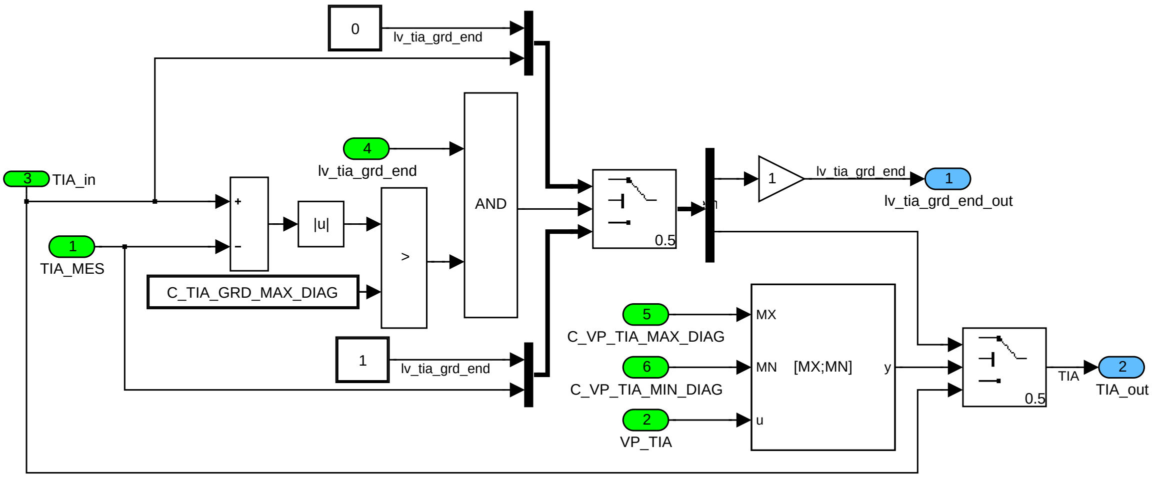

Figure 4.25.6: AIRT_M4007/OPM/CLC/CLC_2_TIA_ERR/TEMP_GRD_MON

4.25.3 Calculation at Engine stall to engine run event

Assignment of TIA to TIA_ST

TIA is assigned to TIA_ST

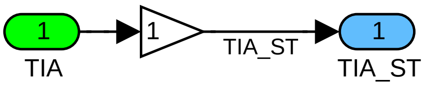

Figure 4.25.7: AIRT_M4007/ES2ERU/OPM

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4.26 Fuel temperature

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_TFU_IV_ES	V	0... 1H	0 ...1	1	-
Flag for TFU_IV calculation after engine stop and before power latch active					
TEMP_DIF_TCO_TIA	O/V	0... FEH	-48... 142.5	0.75	°C
Temperature difference between TCO_EX and TCO or TIA and TCO					
TEMP_FUEL_RAIL_SUB	V	0... FEH	-48... 142.5	0.75	°C
Modeled fuel rail temperature depending from TCO and N					
TEMP_FUEL_RAIL_WALL	V	0... FEH	-48... 142.5	0.75	°C
Modeled fuel rail wall temperature					
TFU	O/V	0... FEH	-48... 142.5	0.75	°C
Fuel temperature					
TFU_ADD_FUEL_FLOW	V	0... FEH	-48... 142.5	0.75	°C
Fuel temperature increase /decrease due to fuel flow					
TFU_EFP	O/V	0... FEH	-48... 142.5	0.75	°C
Fuel temperature for the low pressure pump					
TFU_IV	O	0... FEH	-48... 142.5	0.75	°C
Injektor fuel temperature depending from TCO, N, MFF_SP, and EWP					
TFU_IV_ST	V	0... FEH	-48... 142.5	0.75	°C
Modeled injection valve temperature at engine start, depending on TCO, T_ES, TFU_IV_SUB_STOP and TEG_DYN_STOP					
TFU_IV_SUB	O/V	0... FEH	-48... 142.5	0.75	°C
Modeled injektor fuel temperature depending from TCO, N, MFF_SP, and EWP					
TFU_IV_SUB_BAS	V	0... FEH	-48... 142.5	0.75	°C
Modeled injector fuel temperature depending an TCO, IGA_AV and MFF_SP_MV					
TFU_IV_SUB_MV	V	0... FEH	-48... 142.5	0.75	°C
Modeled injector fuel temperature depending on TFU_IV_SUB_BAS and TEMP_CAPA_IV_MV					
TFU_IV_SUB_RAW	V	0... FEH	-48... 142.5	0.75	°C
Modeled injektor fuel temperature depending from TCO, N, MFF_SP, and EWP, raw-value after first low pass filter					
TFU_IV_SUB_STOP	O/V/S	0... FEH	-48... 142.5	0.75	°C
Modeled injection valve temperature TFU_IV at last engine stop, stored in NVMY					
TFU_LPF_TCO	V	0... FEH	-48... 142.5	0.75	°C
Modeled fuel temperature with low pass filter					
TFU_OFS_AIR	V	0... FEH	-48... 142.5	0.75	°C
Fuel temperature offset depending on ambient conditions					
TFU_RAW	V	0... FEH	-48... 142.5	0.75	°C
Modeled fuel temperature raw value					
TFU_SUB_STOP	O/V/S	0... FEH	-48... 142.5	0.75	°C
Modeled fuel temperature at last engine stop					

Input data:

ECFPWM_ECF {p. 1045}	IGA_AV_MV_H_RNG {p. 1828}	LV_RUN_ENG {p. 1505}	LV_T_REL_CAN_REG {p. 1567}
MFF_SP_MV {p. 2151}	N {p. 1525}	N_REL_CWP {p. 4095}	T_AST {p. 1766}
T_ES {p. 1444}	TAM {p. 1579}	TCO {p. 1100}	TCO_EX {p. 1045}
TCO_ST {p. 1100}	TEG_DYN_STOP {p. 1039}	TEMP_CAPA_IV_MV {p. 2241}	VFF_MFF_SP_FUP_CTL {p. 3881}

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VS_H {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_TEMP_DIF_TCO_TIA	V	0... FFH	0... 0.99609375	3.90625e-3	-
Low pass filter correlation constant for difference of coolant temperature					
C_CRLC_FAC_TEMP_IV	V	0... FFH	0... 0.99609375	3.90625e-3	-
Low pass filter correlation constant for the injection valve temperature out of coolant temperature					
C_CRLC_FAC_VFF_MFF_SP_FUP_CTL	V	0... FFH	0... 0.99609375	3.90625e-3	-
Low pass filter correlation constant for the weighting factor of volume fuel flow through the injectors					
C_CRLC_FAC_VS_ECFPWM_ECF	V	0... FFH	0... 0.99609375	3.90625e-3	-
Low pass filter correlation constant for the weighting factor for air speed					
C_CRLC_TFU_IV_ES	V	0... FFFFH	0... 23.9996337891	366.211e-6	°C
Limited Gradient step for calculation of TFU_IV at engine stop befor power latch or LV_IGK = 1 after engine stop					
C_T_AST_SWI_TFU_IV	V	0... FFFFH	0... 6553.5	0.1	s
Timer after start for activation of TEMP_CAPA_IV_MV based function					
C_T_TFU_CLC	V	1... FFH	1... 255	1	s
Time recurrence for TFU calculation					
C_T_TFU_IV_SUB_CLC	V	1... FFH	1... 255	1	s
Time recurrence for TFU_IV_SUB calculation					
C_T_TFU_IV_SUB_RAW_CLC	V	1... FFH	1... 255	1	s
Time recurrence for TFU_IV_SUB_RAW calculation					
C_TFU_EFP_OFS	V	0... FEH	-48... 142.5	0.75	°C
Offset for the modelling of the fuel temperature of the low pressure pump					
C_TFU_IV_SUB_LIM_DEC	V	0... FFFFH	0... 23.9996337891	366.211e-6	°C
Limited Gradient step for TFU_IV_SUB decrement					
C_TFU_IV_SUB_LIM_INC	V	0... FFFFH	0... 23.9996337891	366.211e-6	°C
Limited Gradient step for TFU_IV_SUB increment					
C_TFU_RAW_LIM_DEC	V	0... FFFFH	0... 23.9996337891	366.211e-6	°C
Limited Gradient step for TFU_RAW decrement					
C_TFU_RAW_LIM_INC	V	0... FFFFH	0... 23.9996337891	366.211e-6	°C
Limited Gradient step for TFU_RAW increment					
C_TFU_RAW_SWI_INI	V	0... AH	0... 10	1	-
Switch for initial value for gradient limitation of TFU_RAW after reset: 1 = 0hex (-48°C), 2 = TCO, 3 = TFU_LPF_TCO					
C_TFU_SUB_STOP_INI	V	0... FEH	-48... 142.5	0.75	°C
TFU_SUB_STOP initialisation value					
IP_CRLC_TFU_IV_SUB_VFF_MFF_SP	V	0... FFFFH	0... 0.999985	15.3186e-6	-
LDP_VFF_MFF_SP_IP_CRLC_TFU_IV	9	0... FFFFH	0... 255	3.89105e-3	l/h
Low pass filter correlation depending on VFF_MFF_SP_FUP_CTL					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_CRLC_TFU_T_AST_VFF_MFF_SP	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDP_T_AST_IP_CRLC_TFU_VFF_MFF	6	0... FFFFH	0... 65535	1	s
LDP_VFF_MFF_SP_FUP_CTL_IP_CRLC	6	0... FFFFH	0... 255	3.89105e-3	l/h
Weighting factor for correction of the fuel temperature					
IP_CRLC_VFF_MFF_TFU_IV_SUB_MV	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_VFF_MFF_SP_FUP_CTL	9	0... FFFFH	0... 255	3.89105e-3	l/h
Fading factor depending on VFF_MFF_SP_FUP_CTL					
IP_D_TIV_NORM_N_MFF_SP	V	0... FEH	-48... 142.5	0.75	°C
LDP_N_IP_D_TIV_NORM_N_MFF_SP	6	0... 1FE0H	0... 8160	1	rpm
LDP_MFF_SP_IP_D_TIV_NORM_N_MFF	4	0... FFFFH	0... 1389	0.0211948	mg
load-dependent temperatur differential to coolant temperature					
IP_FAC_T_ES	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_T_ES_IP_FAC_T_ES	9	0... FFFFH	0... 65535	1	min
Factor for correction of Engine off duration time					
IP_FAC_T_ES_TFU_IV	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_T_ES_IP_FAC_T_ES_TFU_IV	9	0... FFFFH	0... 65535	1	s
Factor for correction of Engine off duration time for TFU_IV_ST					
IP_FAC_TCO_TEMP_IV_COR	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_TCO_IP_FAC_TCO_TEMP_IV_COR	6	0... FEH	-48... 142.5	0.75	°C
Correction factor for correlation between TCO and injector temperature					
IP_FAC_TEG_T_ES_TEG_DYN_STOP	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_TEG_DYN_STOP_IP_FAC_TEG	6	0... 7FF0H	0... 2047	0.0625	°C
LDP_T_ES_IP_FAC_TEG_T_ES	6	0... FFFFH	0... 65535	1	min
Weighting factor for exhaust temperature					
IP_FAC_TEG_T_ES_TFU_IV	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_TEG_IP_FAC_TFU_IV	6	0... 7FF0H	0... 2047	0.0625	°C
LDP_T_ES_IP_FAC_TFU_IV	6	0... FFFFH	0... 65535	1	min
Weighting factor for exhaust temperature and engine off duration time for TFU_IV_ST					
IP_FAC_TEMP_IV_CWP_COR	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_N_IP_FAC_TEMP_IV_CWP_COR	6	0... FFH	0... 255	1	-
Factor for correlation between RPM of cooling water pump and injector temperature					
IP_FAC_TIV_EWP_COR	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_TIV_EWP_COR_IP_FAC_TIV_EWP	6	0... FFH	0... 255	1	-
Factor for correlation between RPM of electrical water pump and injector temperature					
IP_FAC_TIV_TCO_COR	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_TIV_TCO_COR_IP_FAC_TIV_TCO	6	0... FEH	-48... 142.5	0.75	°C
Factor for correlation between TCO and injector temperature					
IP_FAC_VFF_MFF_SP_FUP_CTL	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDPM_VFF_MFF_SP_FUP_CTL	9	0... FFFFH	0... 255	3.89105e-3	l/h
Factor for conversion of required fuel volume to cooling					
IP_FAC_VS_ECFPWM_ECF	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_VS_IP_FAC_VS_ECFPWM_ECF	6	0... FFFFH	0... 511.9921875	7.8125e-3	km/h

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_ECFPWM_ECF_IP_FAC	6	0... FFH	0... 99.609375	0.390625	%
Weighting factor for air speed					
IP_TAM_ADD_TFU_IV	V	0... FEH	-48... 142.5	0.75	°C
LDP_TAM_ADD_TFU_IV	8	0... FEH	-48... 142.5	0.75	°C
Correction of the influence of ambient temperatur on TFU_IV					
IP_TAM_ADD_TFU_RAW	V	0... FEH	-48... 142.5	0.75	°C
LDP_TAM_ADD_TFU_RAW	8	0... FEH	-48... 142.5	0.75	°C
Correction of the influence of ambient temperatur on TFU_RAW					
IP_TCO_TEMP_DIF_TCO_TIA	V	0... FEH	-48... 142.5	0.75	°C
LDP_TEMP_DIF_TCO_TIA_IP_TCO	6	0... FEH	-48... 142.5	0.75	°C
Factor for correction of the coolant temperature					
IP_TEMP_DIF_N_MFF_SP_IV	V	0... FEH	-48... 142.5	0.75	°C
LDP_N_IP_TEMP_DIF_IV	6	0... 1FE0H	0... 8160	1	rpm
LDP_MFF_SP_IP_TEMP_DIF_IV	4	0... FFH	0... 1389	5.4470588	mg/stk
load dependent injektor temperatur differential to coolant temperature					
IP_TEMP_OFS_IGA_MFF_SP	V	0... FEH	-48... 142.5	0.75	°C
LDP_IGA_IP_TEMP_OFS_MFF_SP	8	0... B40H	-90 ...90	0.0625	°CRK
LDP_MFF_SP_IP_TEMP_OFS_MFF_SP	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Temperature offset to TCO based on IGA_AV_MV and MFF_SP_MV					
LC_TCO_TFU_IV_SUB	V	0... 1H	0 ...1	1	-
Switch between TCO and TFU_IV_SUB for TFU_IV					
LC_TEMP_CAPA_TFU_IV_SWI	V	0... 1H	0 ...1	1	-
Switch between TEMP_CAPA based function (1) and TCO based function (0)					
LC_TEMP_FUEL_RAIL_WALL_TAM	V	0... 1H	0 ...1	1	-
Logical switch TEMP_FUEL_RAIL_WALL and TAM for TFU_RAW calculation					
LC_TFU_TIA_TCO_EX	V	0... 1H	0 ...1	1	-
Logical switch TIA and TCO_EX for TFU_OFS_AIR calculation					

General information:

The temperature of the fuel has influence to the density and the volume of the fuel. This has consequences to several points of the function within the fuel supply aggregate and the injection timing. The influence is a lower efficiency of the pump and a influence on the injection valves due to higher temperature of different calculations of the fuel mass in the rail. Therefore two different temperature are modelled, TFU for the fuel pump control and TFU_IV for the injection valve temperature
Both fuel temperatures are expected to depend mainly on the coolant temperature. Beyond this there is an influence of the fuel volume flow, the engine temperature, the ambient temperature, the vehicle speed and time since the last engine stop and the air temperature.

Application condition:
Activation: LV_RUN_ENG = 1;
Deactivation: At power latch;

Initialisation: At reset: TFU_IV_SUB_RAW, TFU_IV_SUB, TFU_IV, TFU, TFU_RAW, TFU_LPF_TCO, TFU_IV_ST = TCO_ST;

At IGK off to on:

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PT1 filter constant of TFU_RAW = 0
local variables of gradient limiters tfu_raw_step_clc and tfu_iv_sub_step_clc = 0
local counter for calculation delay of TFU values = 0

Recurrence: every 1S
Except the the following calculation:
TFU_LPF_CLC, TFU_IV_ST_CLC Activation: LV_T_REL_CAN_REG = 1 and LV_RUN_ENG = 0 Recurrence: 100 ms
TFU_INIT_NO_T_REL_CAN Activation: LV_T_REL_CAN_REG = 0 and LV_RUN_ENG = 0 Recurrence: 100 ms
TFU, which is calculated every C_T_TFU_CLC and once at LV_T_REL_CAN_REG -> 1 change.
TFU_IV_SUB_RAW, which is calculated every C_T_TFU_IV_SUB_RAW_CLC
TFU_IV_SUB, which is calculated every C_T_TFU_IV_SUB_CLC

Application conditions:

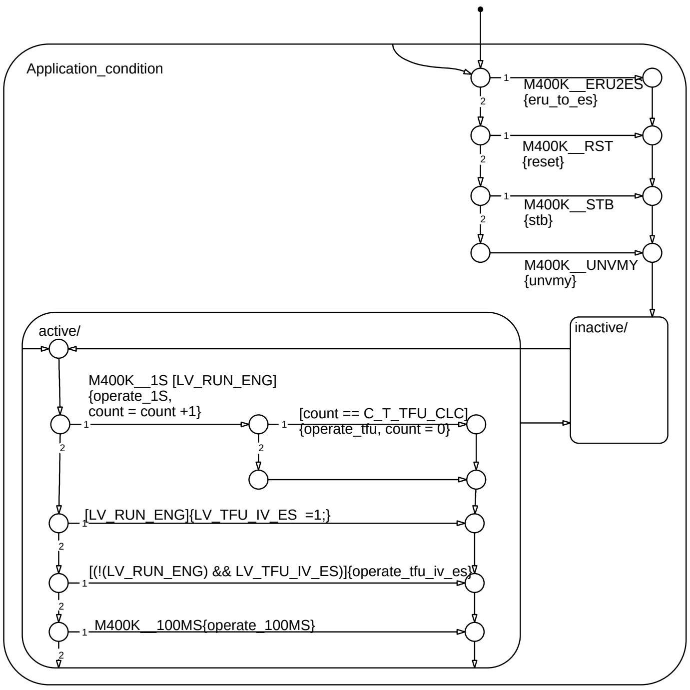

Figure 4.26.1: :

Function description:

Formula section:

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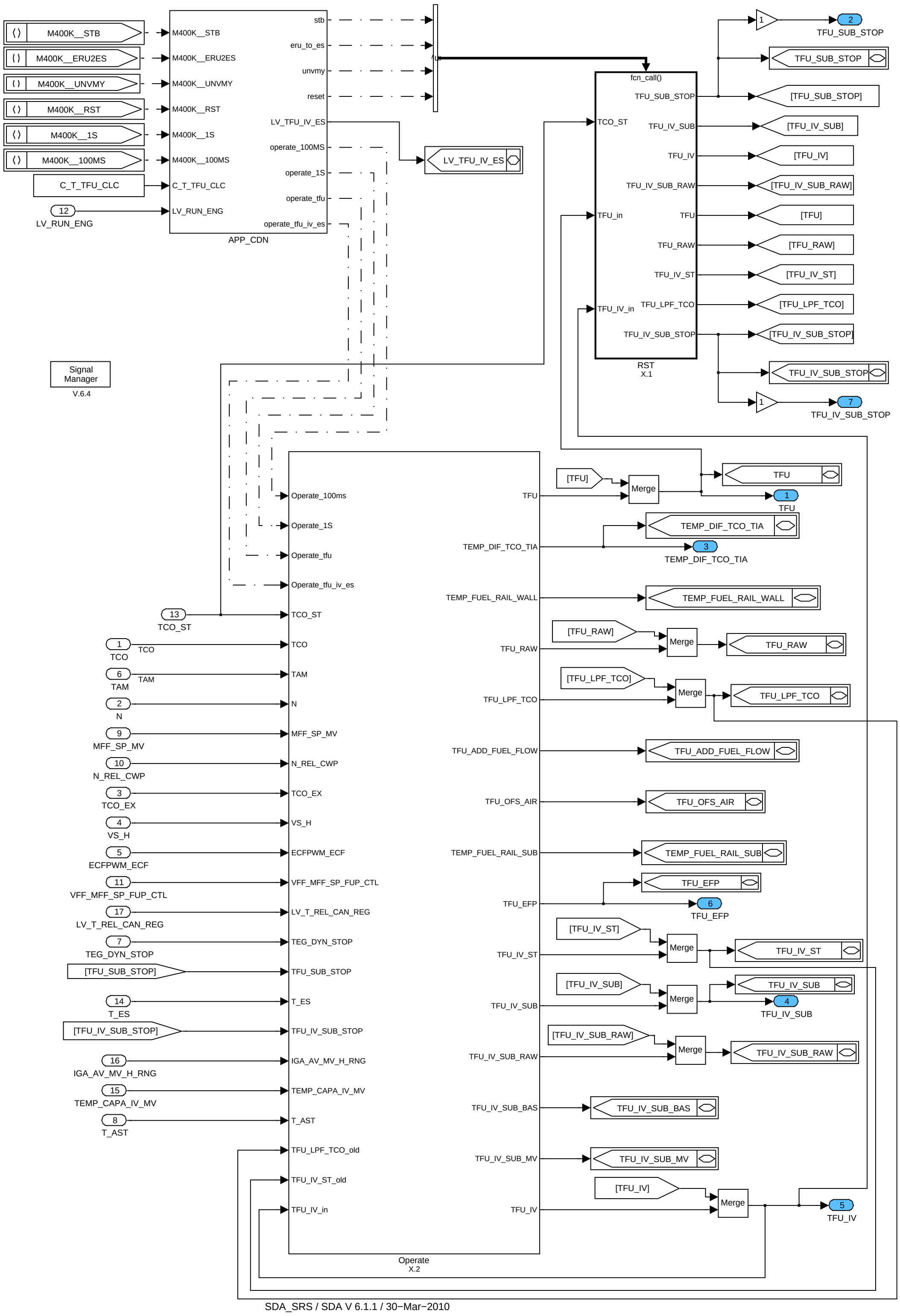

Figure 4.26.2: :

4.26.1 FUSL_M400K/RST

At ECU reset: TFU_IV_SUB_RAW, TFU_IV_SUB, TFU_IV, TFU, TFU_RAW = TCO_ST

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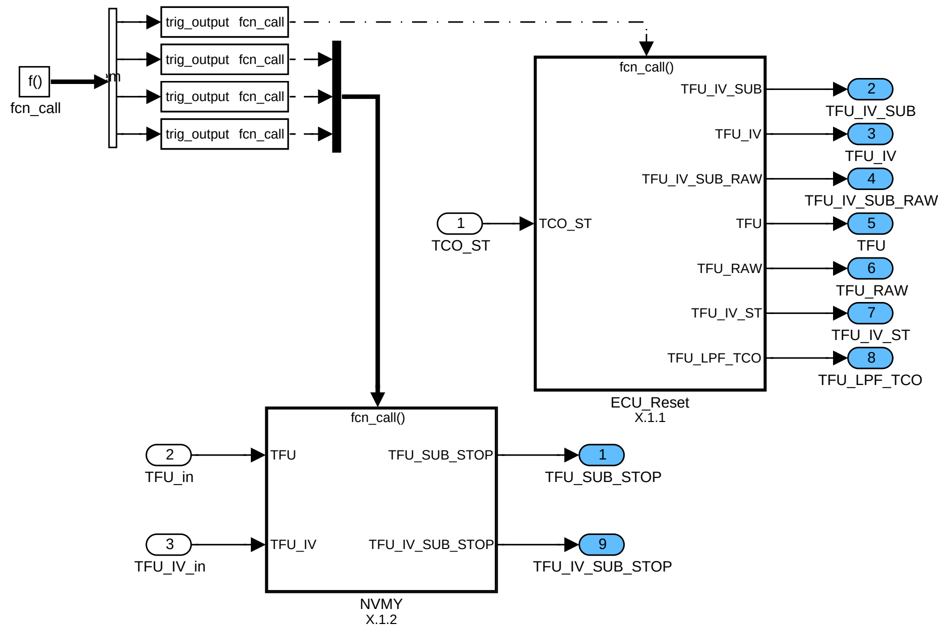

Figure 4.26.3: :

4.26.1.1 FUSL_M400K/RST/ECU_Reset

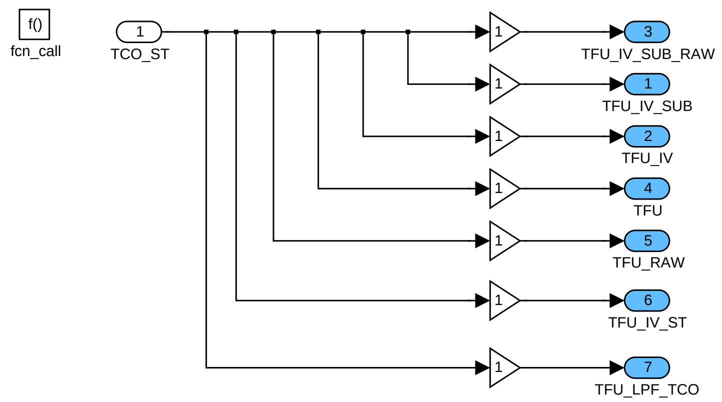

Figure 4.26.4: :

4.26.1.2 FUSL_M400K/RST/NVMY

Overview of non volatile memory functions

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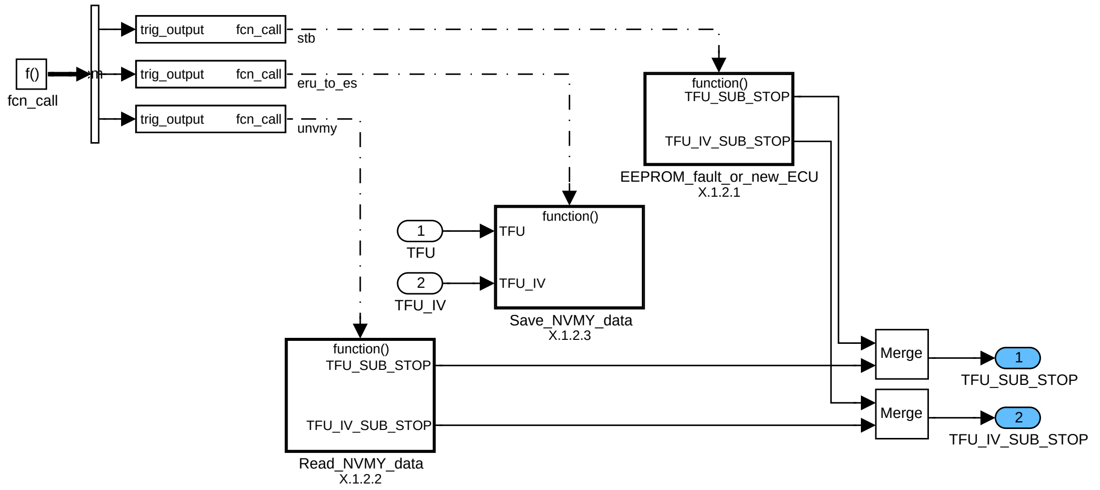

Figure 4.26.5: :

4.26.1.2.1 FUSL_M400K/RST/NVMY/EEPROM_FAULT_OR_NEW_ECU

At EEPROM failure or by using a new ECU, no NVMY are available therefore this constant C_TFU_ SUB_STOP_INI will be used as initial value.

Figure 4.26.6: :

4.26.1.2.2 FUSL_M400K/RST/NVMY/READ_NVMY_DATA

Reading stored non volatile values from last engine run.

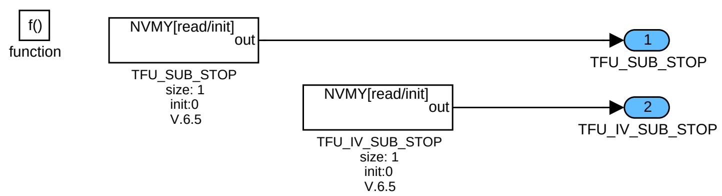

Figure 4.26.7: :

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4.26.1.2.3 FUSL_M400K/RST/NVMY/Save_NVMY_data

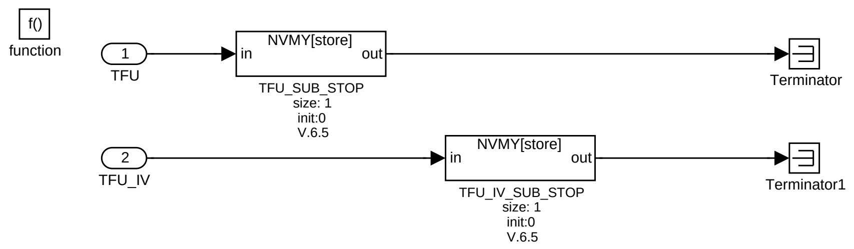

Figure 4.26.8: :

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4.26.2 FUSL_M400K/OPERATE

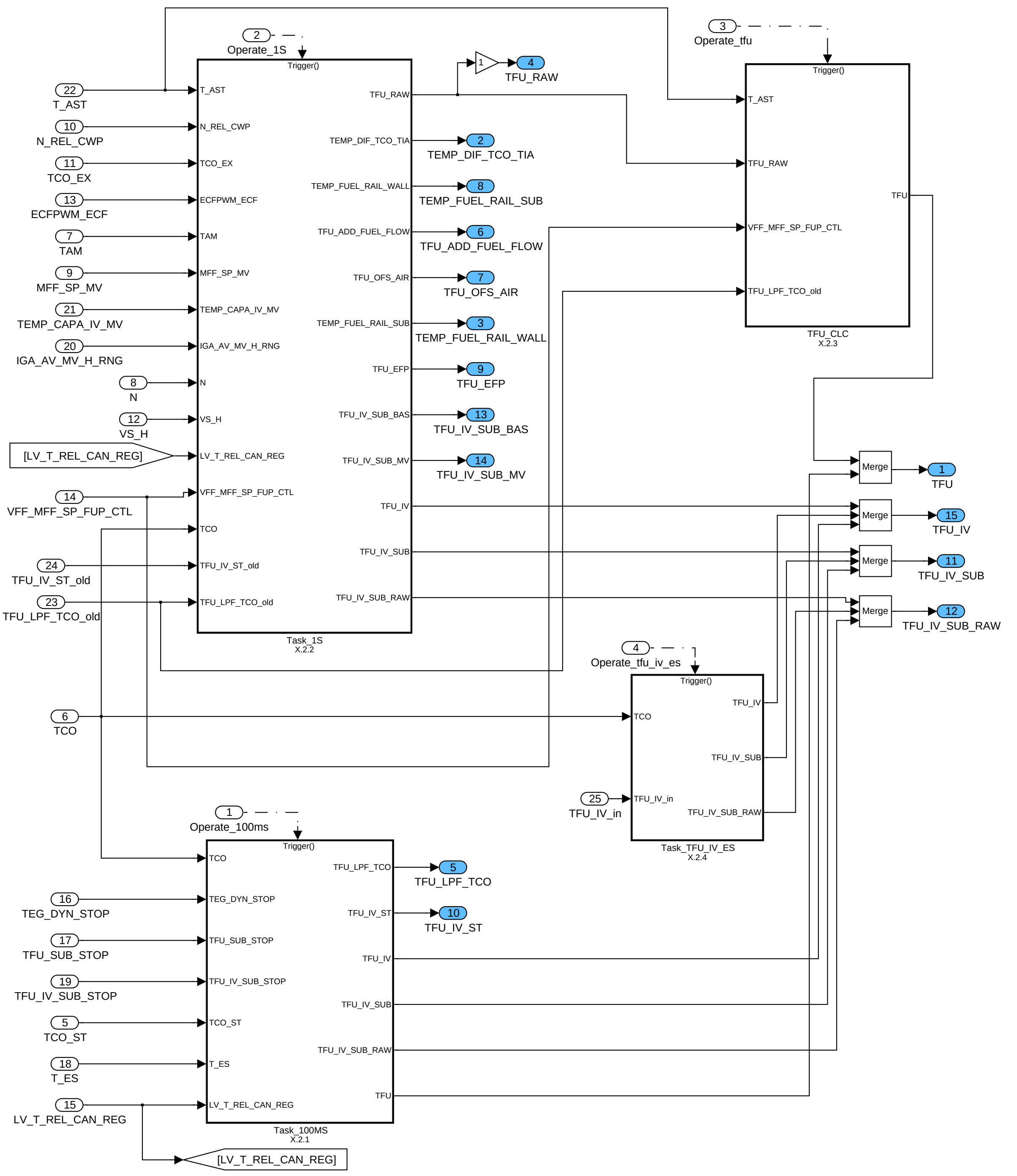

Figure 4.26.9: :

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4.26.2.1 FUSL_M400K/Operate/Task_100MS

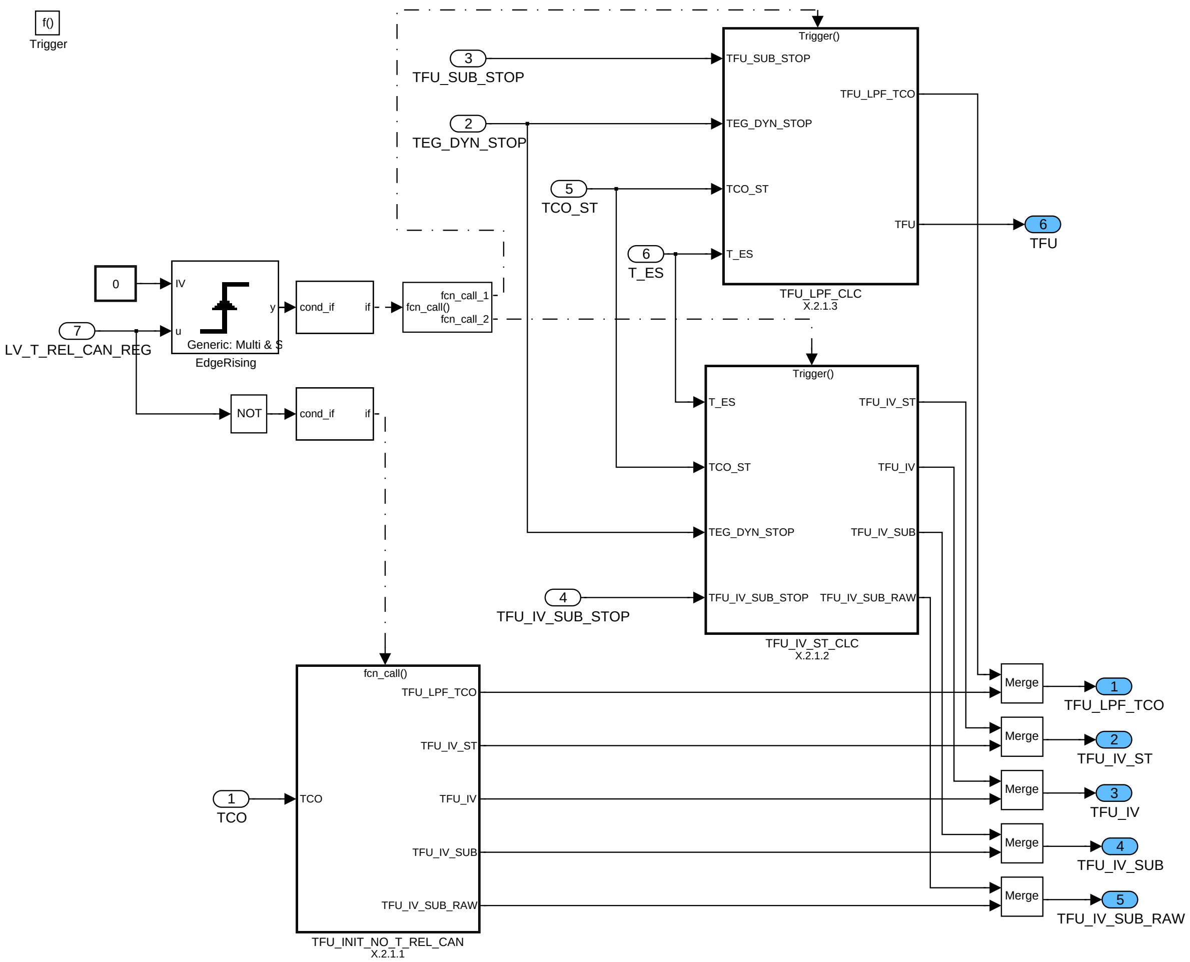

Figure 4.26.10: :

4.26.2.1.1 FUSL_M400K/Operate/Task_100MS/TFU_INIT_NO_T_REL_CAN

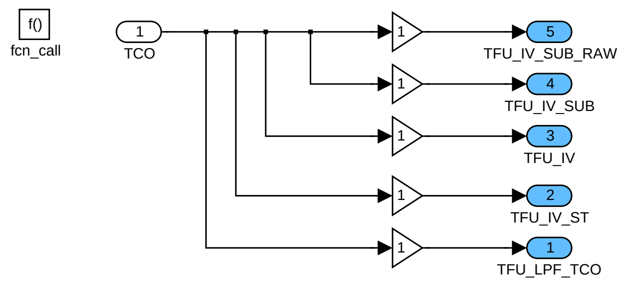

Figure 4.26.11: :

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4.26.2.1.2 FUSL_M400K/Operate/Task_100MS/TFU_IV_ST_CLC

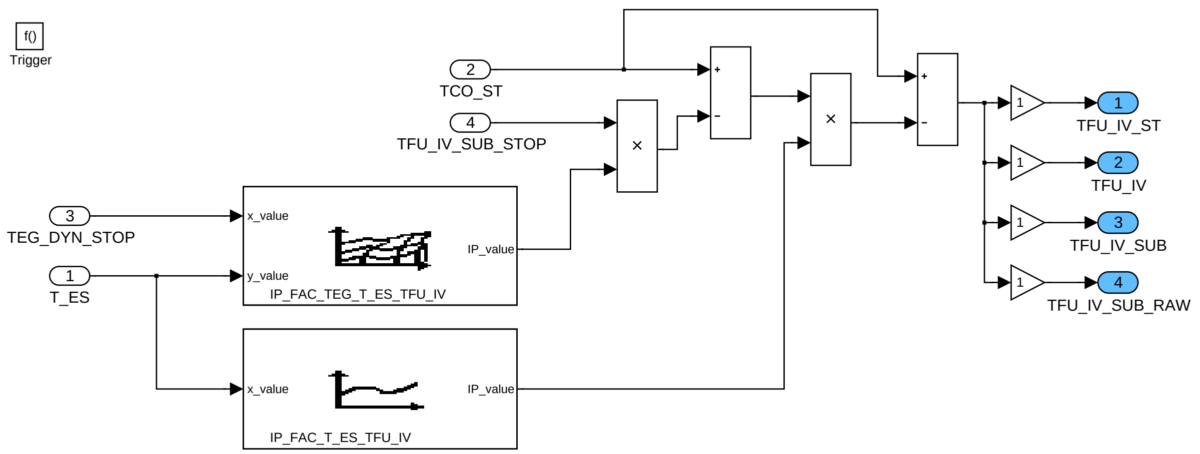

Figure 4.26.12: :

4.26.2.1.3 FUSL_M400K/Operate/Task_100MS/TFU_LPF_CLC

TFU is initialized with calculated TFU_LPF_TCO value at first LV_T_REL_CAN_REG change to true.

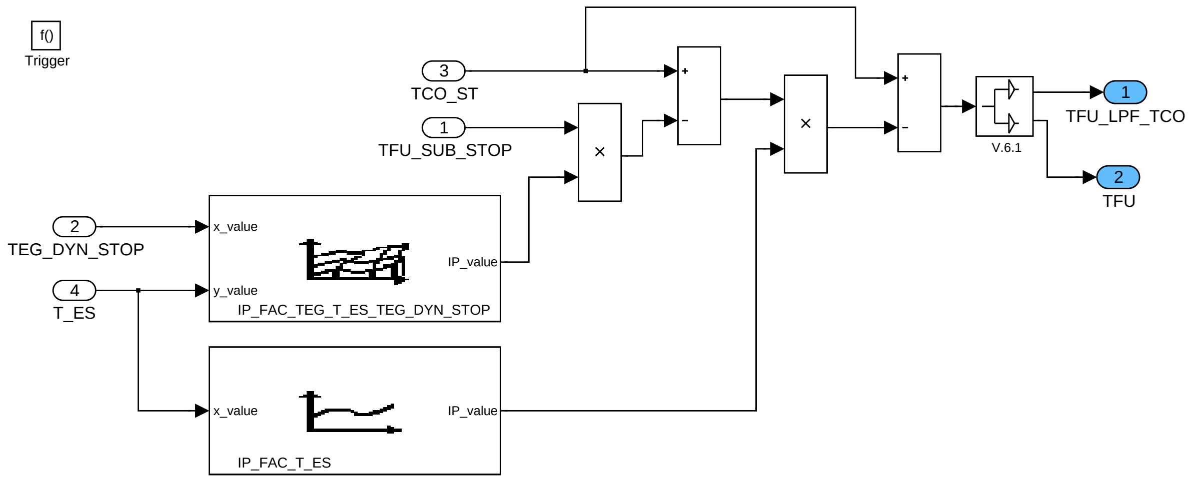

Figure 4.26.13: :

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4.26.2.2 FUSL_M400K/OPERATE/TASK_1S

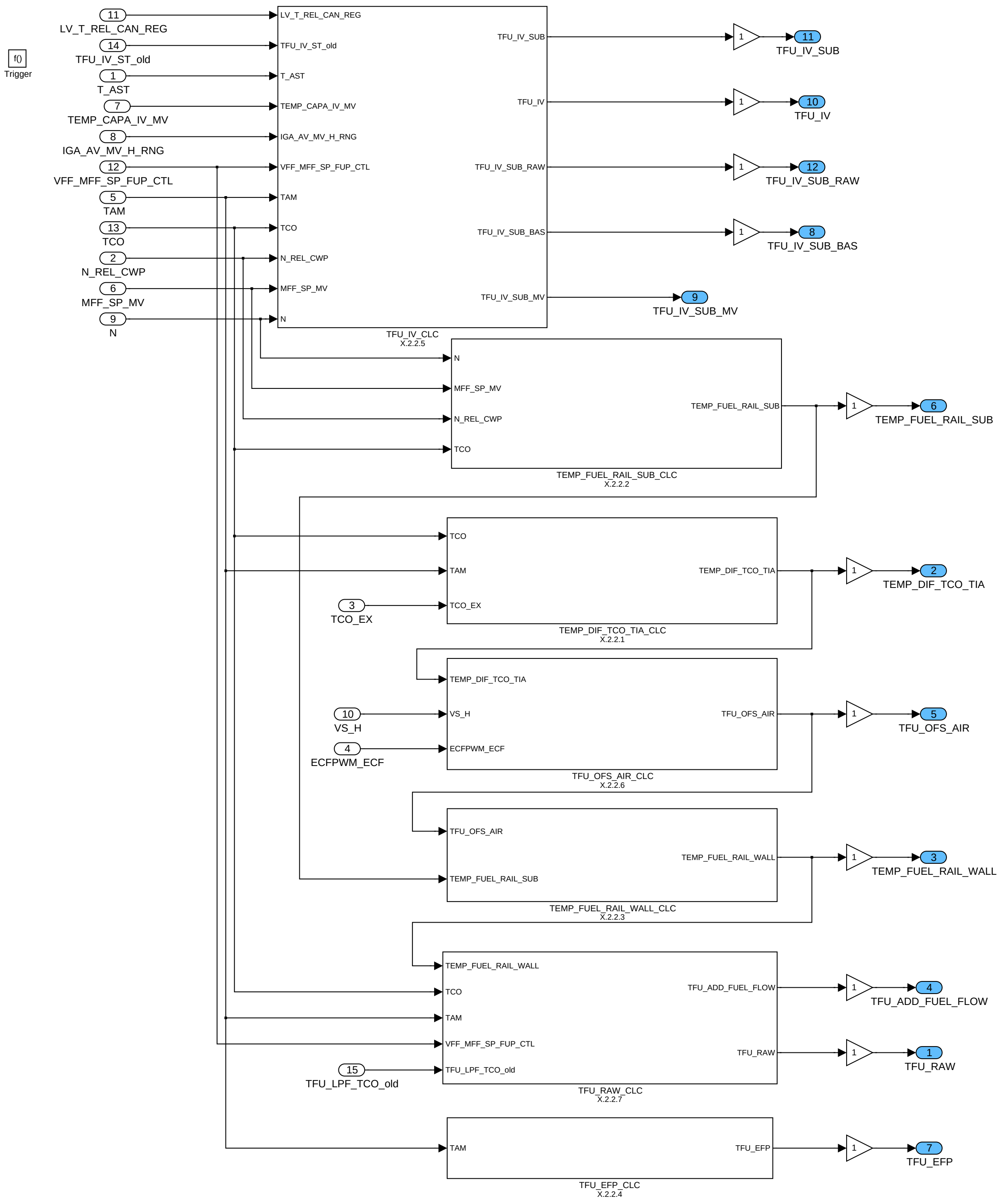

Figure 4.26.14: :

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4.26.2.2.1 FUSL_M400K/Operate/Task_1S/TEMP_DIF_TCO_TIA_CLC

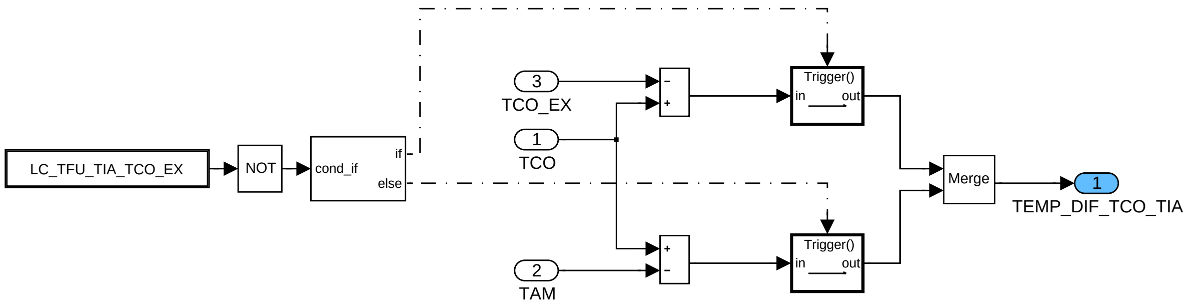

Figure 4.26.15: :

4.26.2.2.2 FUSL_M400K/Operate/Task_1S/TEMP_FUEL_RAIL_SUB_CLC

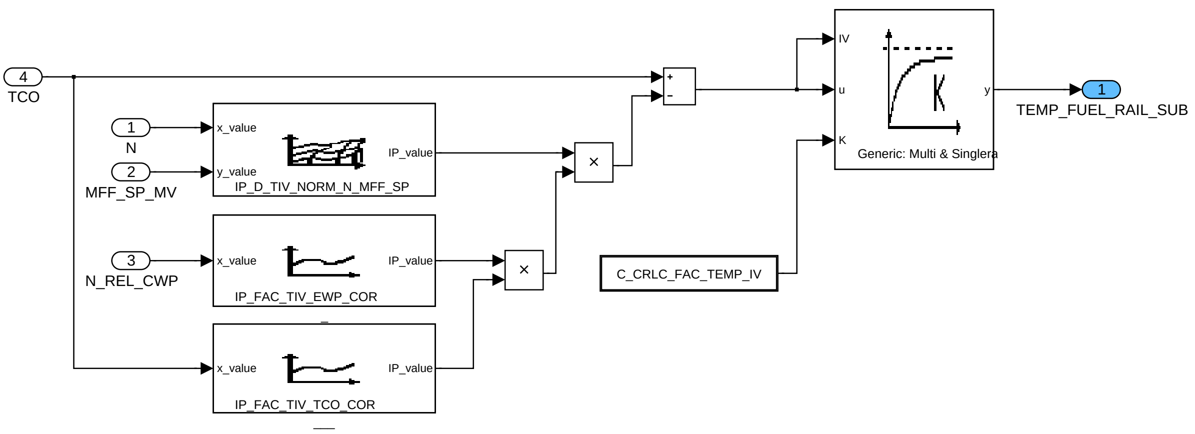

Figure 4.26.16: :

4.26.2.2.3 FUSL_M400K/Operate/Task_1S/TEMP_FUEL_RAIL_WALL_CLC

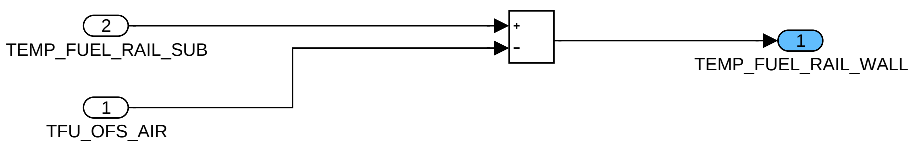

Figure 4.26.17: :

4.26.2.2.4 FUSL_M400K/Operate/Task_1S/TFU_EFP_CLC

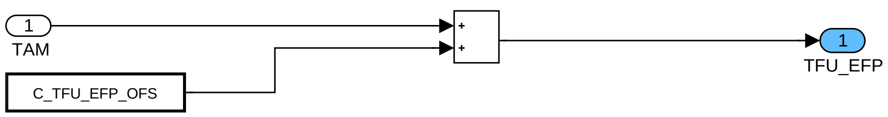

Figure 4.26.18: :

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4.26.2.2.5 FUSL_M400K/OPERATE/TASK_1S/TFU_IV_CLC

For the calculation of the injection valve temperature, two functions are available, switchable by the logical constant LC_TEMP_CAPA_TFU_IV_SWI.

1. - For TFU_IV_SUB_MV a mixed temperature of the heating influence of the combustion chamber and the fuel temperature is calculated. The heating influence of the combustion chamber rests on TCO, MFF_SP_MV and ignition angle. The fuel temperature influence is described by TEMP_CAPA_IV_MV (Temperature of the piezo stacks derived from their capacities).

With higher fuel flows through the injectors, the injector temperature is more influenced by the fuel temperature. The modeled injector temperature can be shifted by a fading factor based on the fuel flow to TEMP_CAPA_IV_MV.
The heat up phase of the injector tip during start is faster than the heating of the fuel temperature. During start phase and short after start, the fading function between TEMP_CAPA_IV_MV and TFU_IV_SUB_RAW can be blocked for a certain time by using C_T_AST_SWI_TFU_IV.

2. - The second function depends mainly on the coolant temperature, influenced by
engine speed, the mass flow through the engine, the ambient temperature and the rpm of the cooling water pump.
The output TFU_IV_SUB_RAW is filtered by a PT1 function. Because of the minimum resolution of the TFU values of 0,75°/digit, the input value of the PT1 is stored internal (not visible) and calculated with an finer resolution of 0,00036°/digit until it reaches the minimum digit.

By using C_T_TFU_IV_SUB_RAW_CLC or C_T_TFU_IV_SUB_CLC
the calculation recurrence of TFU_IV_SUB_RAW (PT1 funktion) or TFU_IV_SUB (GradientLimiter) can be reduced.
The gradient limiters for rising and falling edge, C_TFU_IV_SUB_LIM_DEC and C_TFU_IV_SUB _LIM_INC have a finer resolution than TFU_IV_SUB. It takes several
calculation cycles until TFU_IV_SUB changes. During this calculation cycles of TFU_IV_SUB a internal variable (not visible) is incremented or decremented depending on rising or failing gradient until it reaches the minimum digit of TFU_IV_SUB (0.75°C).
If the CAN values are not valid (LV_T_REL_CAN_REG = 0), TFU_IV, TFU_IV_SUB and
TFU_IV_SUB_RAW = TCO.

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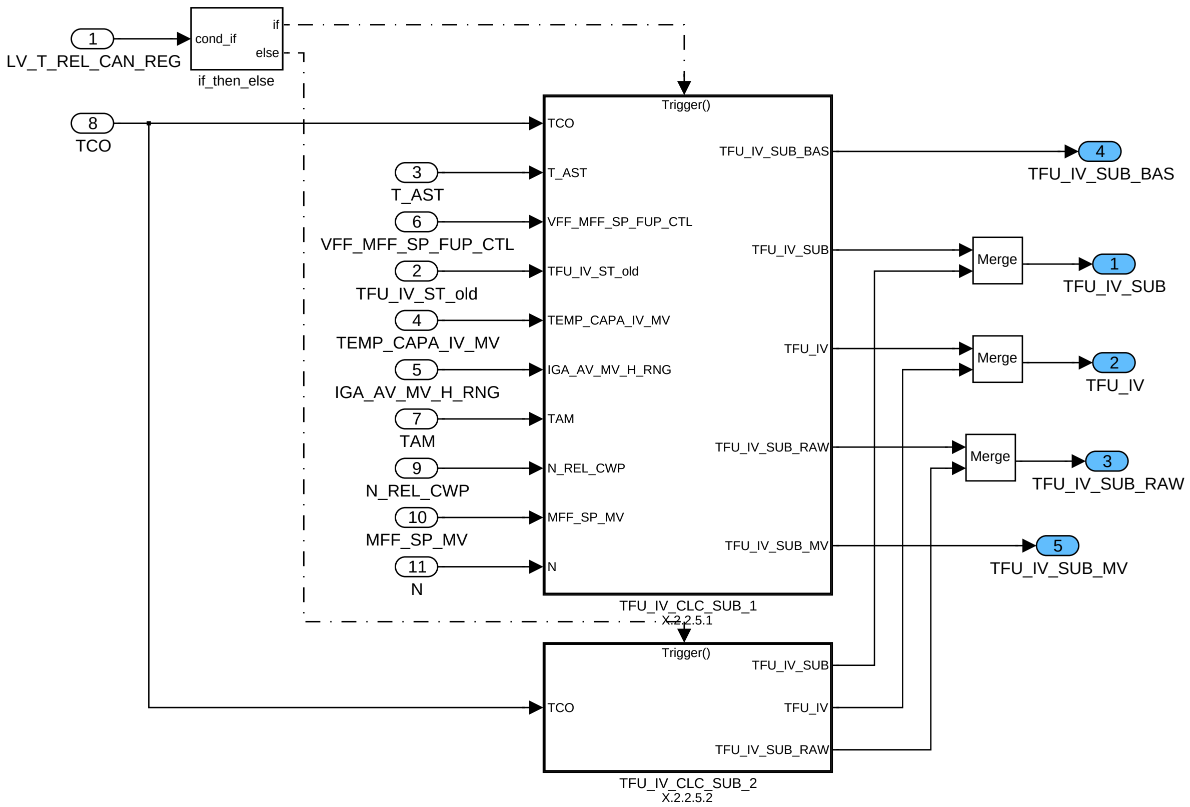

Figure 4.26.19: :

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4.26.2.2.5.1 FUSL_M400K/OPERATE/TASK_1S/TFU_IV_CLC/TFU_IV_CLC_SUB_1

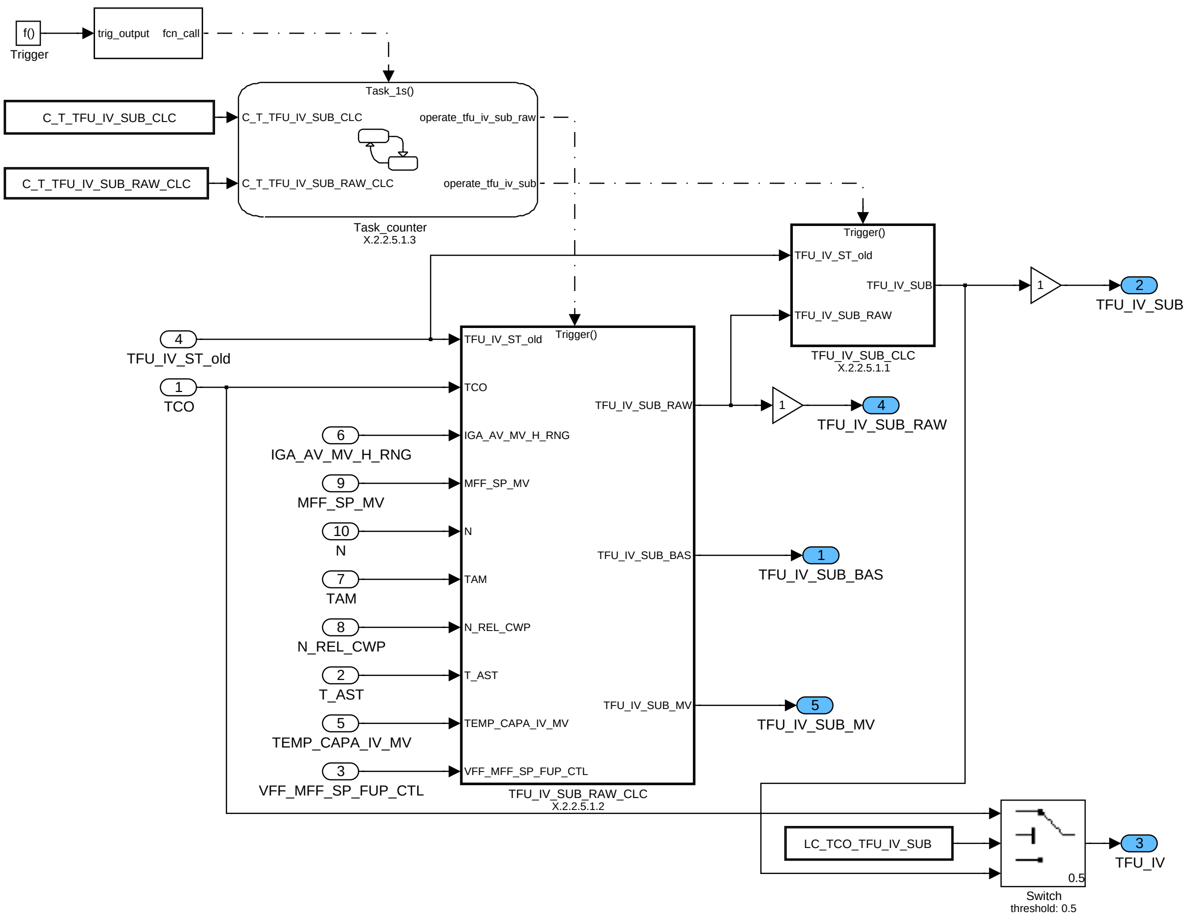

Figure 4.26.20: :

4.26.2.2.5.1.1 FUSL_M400K/Operate/Task_1S/TFU_IV_CLC/TFU_IV_CLC_SUB_1/TFU_IV_SUB_CLC

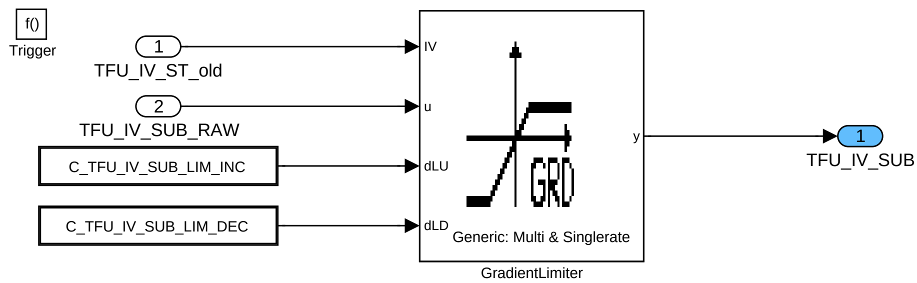

Figure 4.26.21: :

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4.26.2.2.5.1.2 FUSL_M400K/Operate/Task_1S/TFU_IV_CLC/TFU_IV_CLC_SUB_1/TFU_IV_SUB_RAW_CLC

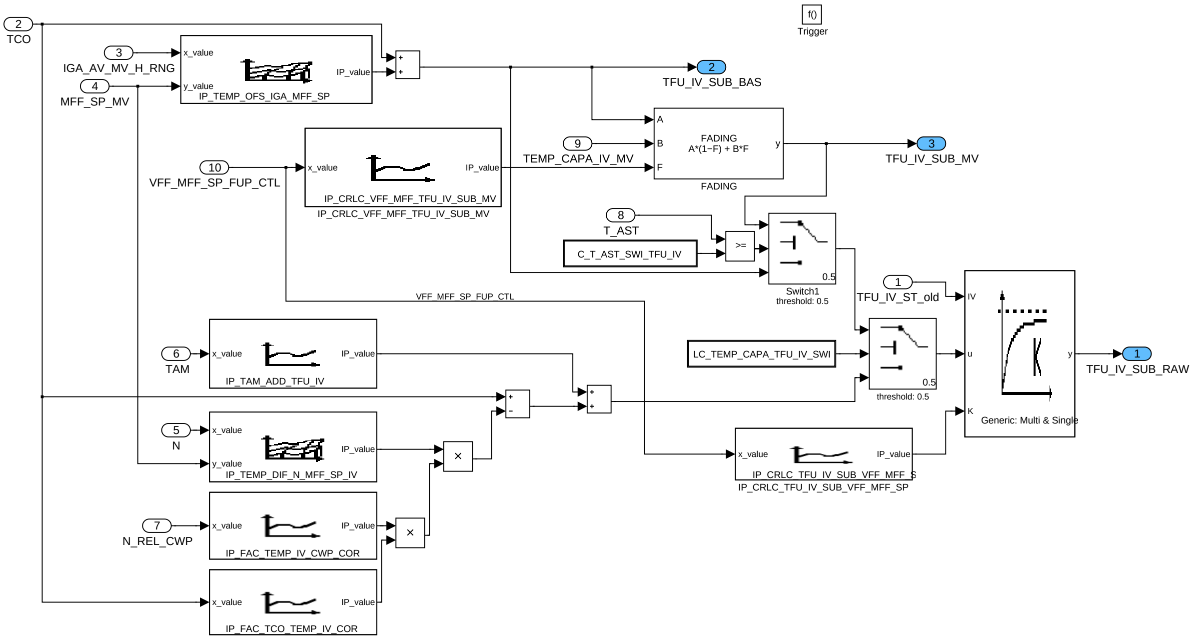

Figure 4.26.22: :

4.26.2.2.5.1.3 Task_counter

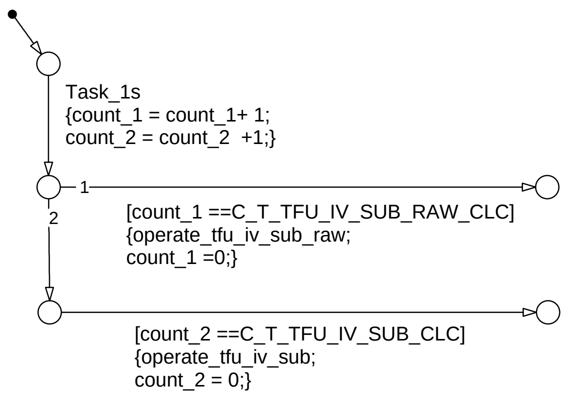

Figure 4.26.23: :

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4.26.2.2.5.2 FUSL_M400K/Operate/Task_1S/TFU_IV_CLC/TFU_IV_CLC_SUB_2

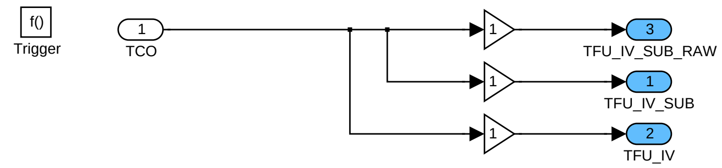

Figure 4.26.24: :

4.26.2.2.6 FUSL_M400K/OPERATE/TASK_1S/TFU_OFS_AIR_CLC

Calculation of ambient air influence on fuel temperature due to vehicle speed and electrical cooling fan.

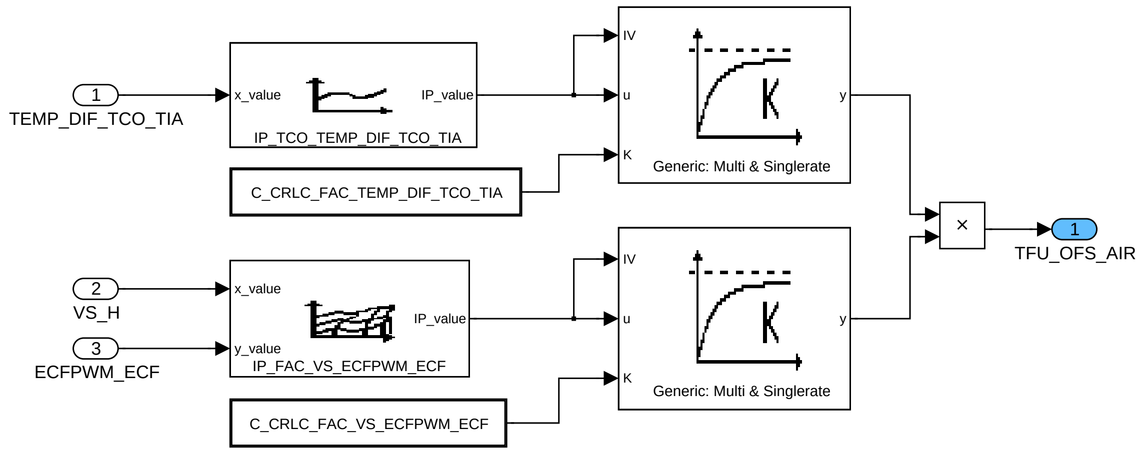

Figure 4.26.25: :

4.26.2.2.7 FUSL_M400K/OPERATE/TASK_1S/TFU_RAW_CLC

The temperature TFU_RAW is calculated from the fuel rail wall temperature reduced by the decrease of the temperature due to fuel flow through the fuel rail.
C_TFU_RAW_LIM_DEC and C_TFU_RAW_LIM_INC have a finer resolution than TFU_RAW. It takes several calculation cycles (GradientLimiter) until TFU_RAW changes. During this calculation cycles of TFU_RAW the local variable tfu_raw_step_clc is incremented or decremented depending on rising or failing gradient until it reaches the minimum digit of TFU_RAW (0.75°C). After a step of TFU_RAW the lasting value of tfu_raw_step_clc will be used for the next calculation.

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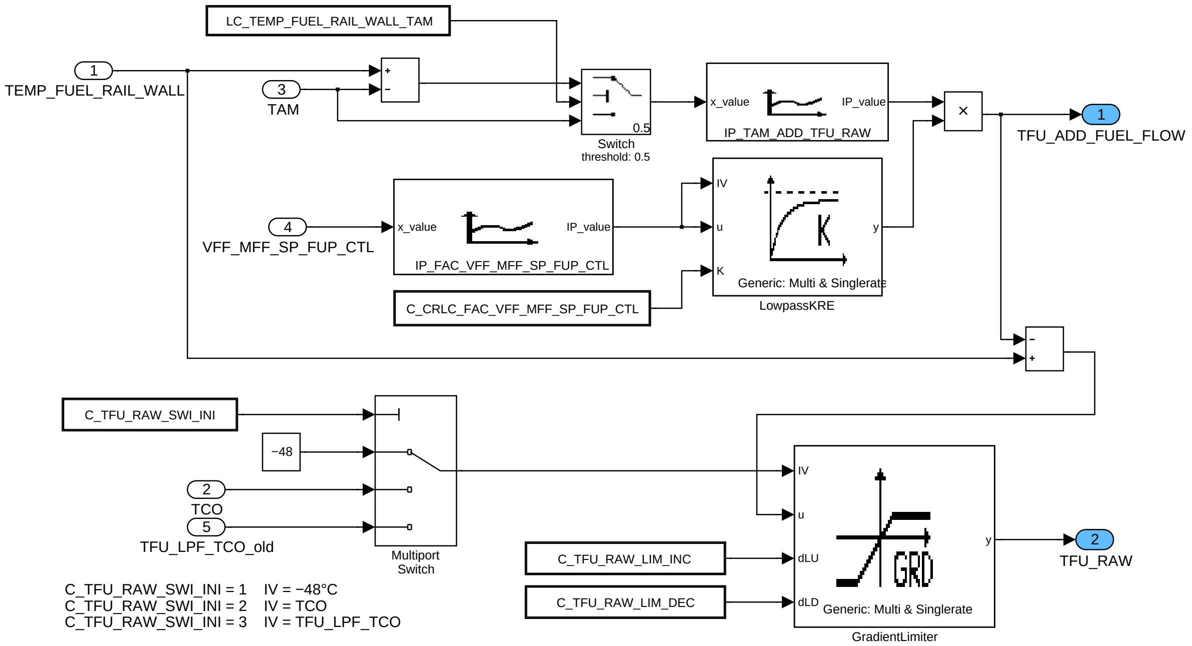

Figure 4.26.26: :

4.26.2.3 FUSL_M400K/OPERATE/TFU_CLC

Low pass filter of TFU_RAW to TFU. The initial value TFU_LPF_TCO for the low pass filter depends on TCO, the exhaust gas temperature at engine stop, the engine of time and the fuel temperature at engine stop.

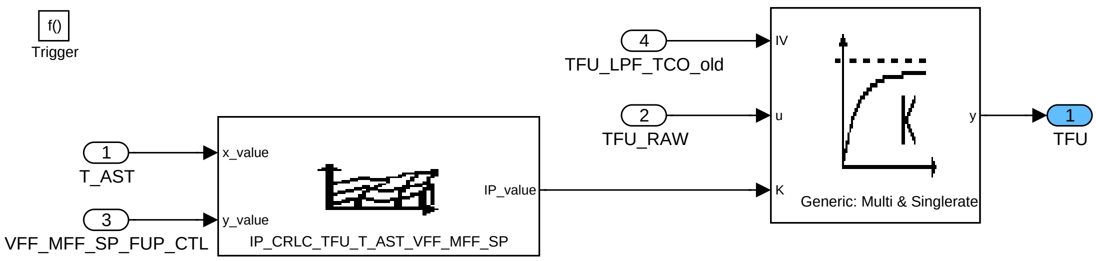

Figure 4.26.27: :

4.26.2.4 FUSL_M400K/OPERATE/TASK_TFU_IV_ES

At engine stop, a modelled injector temperature will be calculated based on TCO. Starting with the last modelled temperatures TFU_IV_SUB_RAW, TFU_IV_SUB and TFU_IV the values were incremented by the value C_CRLC_TFU_IV_ES until TCO is reached.

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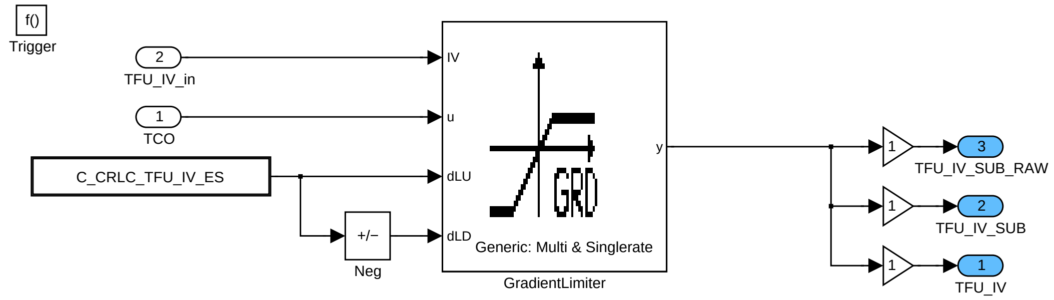

Figure 4.26.28: :

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4.27 Exhaust gas temperature

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TEG_PCAT_DOWN [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Exhaust gas temperature upstream of precat					
TEG_PCAT_DOWN_RAW	V	0... 7FFFH	0... 2047.9375	0.0625	K
Exhaust gas temp downstream of pre-catalyst, raw value i.e. not replaced by substitute value, wide range					
TEG_PCAT_DOWN_ST	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Exhaust gas temperature downstream of pre-catalyst at engine start					
TEG_PCAT_DOWN_WIDE_RNG	V	0... 7FFFH	0... 2047.9375	0.0625	K
Exhaust gas temperature downstream of pre-catalyst with wide range, unit: Kelvin					
TEG_PCAT_DOWN_WIDE_RNG_ST	O/V	0... 7FFFH	0... 2047.9375	0.0625	K
Exhaust gas temperature downstream of pre-catalyst at engine start with wide range, unit: Kelvin					
VP_TEG_PCAT_DOWN	O/V	0... 7FFFH	0... 4.99984	152.6e-6	V
Catalyst temperature sensor raw acquisition					

Input data:

LV_ERR_PREL_TEG_PCAT_DOWN {p. 4713}	LV_ERR_TEG_PCAT_DOWN {p. 4713}	LV_IGK {p. 906}	MAF_KGH {p. 1195}
TEG_CAT_DOWN_MDL {p. 8236}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TEG_PCAT_DOWN_ADD_ERR	-	0... FFH	0... 510	2	°C
Additional offset on the temperature model in case of sensor error					
C_TEG_PCAT_DOWN_ST_INI	-	0... FFFFH	0... 1023.98437	0.015625	°C
Initialisation value of TEG_PCAT_DOWN_ST_i used in case of sensor error					
IP_TEG__VP_TEG	-	0... FFFFH	0... 1023.98437	0.015625	°C
LDP_VP_TEG__TEG	16	0... 7FFFH	0... 4.99984	152.6e-6	V
conversion table of exhaust gas temp.					
IP_TEG_WIDE_RNG__VP_TEG	-	0... FFFFH	0... 2047.96875	0.03125	K
LDP_VP_TEG__TEG_WIDE_RNG	8	0... 7FFFH	0... 4.99985	0.0001526	V
conversion table of exhaust gas temp. with extended range					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_TEG_SENS	-	1... 6H	1 ...6	1	-
number of exhaust gas temperature sensor in system					

Import actions:

ACTION_INFR_GetVpTeg (**IN**<No Name available>,**OUT**<No Name available>)

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4.27.1 Aquisition of VP_TEG_PCAT_DOWN

Sampling Rate: Ta = 0.1sec

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Application conditions

Activation: `always calculated`

Deactivation: –

Global configuration data

Data	Value
NC_NR_TEG_SENS	1

ACTION_INFR_GetVpTeg(1,VP_TEG_PCAT_DOWN)

// all sensor values are imported and provided as output

4.27.2 Calculation of Exhaust Gas Temperatures

General information:

The exhaust gas temperature sensor acquisition is suitable for single branch (only one exhaust bank) and twin branch exhaust lines (two exhaust banks).
For a twin branch exhaust line the exhaust gas temp. acquisition has the same structure for both exhaust lines. To differentiate variables and calibration data the **index i** is used:

i = 1 refers to temp. sensor in the first branch of a twin branch exhaust line or the temp. sensor in a single branch exhaust line

i = 2 refers to temp. sensor in the second branch of a twin branch exhaust line

This version is intended for an engine with a configuration that uses one temperature sensor. The exhaust gas temp. downstream of pre-cat.). TEG_PCAT_DOWN is used for the temperature modelling of the NOx catalyst monolith temperature (for GDI engine).
TEG_PCAT_DOWN_ST is the exhaust gas temperature at engine start used for dew point calculation of the NOx catalyst.
As the range of TEG_PCAT_DOWN and TEG_PCAT_DOWN_ST is limited to 0..1024°C, TEG_PCAT_DOWN_WIDE_RNG and TEG_PCAT_DOWN_WIDE_RNG_ST are calculated in a similar manner with a range of 0..2048K (equals -273..1775°C) to provide information about subzero and very high temperatures.

Sampling Rate: Ta = 0.1sec

Application conditions

Activation: `Ignition on LV_IGK = 1`

Deactivation: `Ignition off LV_IGK = 0`

Initialisation:

At the transition LV_IGK 0 -> 1 (including reset) TEG_PCAT_DOWN_RAW is initialised with IP_TEG_WIDE_RNG__VP_TEG(VP_TEG_PCAT_DOWN). In that way the value TEG_PCAT_DOWN_RAW is available for the module “Exhaust gas temperature sensor diagnosis (TEG)” to make the “Plausibility

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check: Cold start". That is necessary since the module "Exhaust gas temperature sensor diagnosis (TEG)" must have been performed since a valid LV_ERR_PREL_TEG_PCAT_DOWN is needed to determine TEG_PCAT_DOWN_ST and TEG_PCAT_DOWN_WIDE_RNG_ST.
At the first calculation of the module "Exhaust gas temperature" and at transition
LV_ES 1 -> 0 TEG_PCAT_DOWN_ST and TEG_PCAT_DOWN_WIDE_RNG_ST are initialised:

If LV_ERR_PREL_TEG_PCAT_DOWN = 0
Then
TEG_PCAT_DOWN_ST = IP_TEG__VP_TEG(VP_TEG_PCAT_DOWN)
TEG_PCAT_DOWN_WIDE_RNG_ST =
IP_TEG_WIDE_RNG__VP_TEG(VP_TEG_PCAT_DOWN)
Else
TEG_PCAT_DOWN_ST = C_TEG_PCAT_DOWN_ST_INI
TEG_PCAT_DOWN_WIDE_RNG_ST = TEG_PCAT_DOWN_ST
End

FUNCTION DESCRIPTION:

The voltage VP_TEG_PCAT_DOWN is converted with a linear interpolation to an exhaust gas temperature downstream of the pre-catalyst TEG_PCAT_DOWN /TEG_PCAT_DOWN_WIDE_RNG.
The logical variable LV_ERR_PREL_TEG_PCAT_DOWN indicates a signal out of the specified range (short to ground or short to UB or line broken) or a not plausible temperature value. If active (LV_ERR_PREL_TEG_PCAT_DOWN = 1), the last valid temperature value is frozen until the error is debounced (LV_ERR_TEG_PCAT_DOWN = 1) or until a valid temp. value is obtained again.
With debounced error (LV_ERR_TEG_PCAT_DOWN = 1) a substitute value TEG_CAT_DOWN_MDL is assigned.
In normal operating mode (LV_ERR_PREL_PCAT_DOWN = 0 and LV_ERR_PCAT_DOWN = 0) the temperature depends on the temperature sensor voltage via map.

Formula section:

TEG_PCAT_DOWN_RAW$_N$ = IP_TEG_WIDE_RNG__VP_TEG(VP_TEG_PCAT_DOWN$_N$)
If LV_ERR_TEG_PCAT_DOWN = 1
Then
TEG_PCAT_DOWN_1 = TEG_CAT_DOWN_MDL - C_TEG_PCAT_DOWN_ADD_ERR
TEG_PCAT_DOWN_2 = TEG_PCAT_DOWN_1
TEG_PCAT_DOWN_WIDE_RNG = TEG_PCAT_DOWN_1
Else
If LV_ERR_PREL_TEG_PCAT_DOWN = 1
Then
TEG_PCAT_DOWN_1$_N$ = TEG_PCAT_DOWN_1$_{N-1}$
TEG_PCAT_DOWN_2$_N$ = TEG_PCAT_DOWN_2$_{N-1}$
TEG_PCAT_DOWN_WIDE_RNG$_N$ = TEG_PCAT_DOWN_WIDE_RNG$_{N-1}$
else
TEG_PCAT_DOWN_1$_N$ = IP_TEG__VP_TEG
TEG_PCAT_DOWN_2$_N$ = TEG_PCAT_DOWN_1$_N$
TEG_PCAT_DOWN_WIDE_RNG$_N$ = IP_TEG_WIDE_RNG__VP_TEG
end
end

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4.28 ECU temperature

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_STC_TECU_1	O/V/S	0... FFFFFFFFH	0... 4294970000	1	-
statistic counter 1 for TECU monitoring					
CTR_STC_TECU_2	O/V/S	0... FFFFFFFFH	0... 4294970000	1	-
statistic counter 2 for TECU monitoring					
CTR_STC_TECU_3	O/V/S	0... FFFFFFFFH	0... 4294970000	1	-
statistic counter 3 for TECU monitoring					
CTR_STC_TECU_4	O/V/S	0... FFFFFFFFH	0... 4294970000	1	-
statistic counter 4 for TECU monitoring					
CTR_STC_TECU_5	O/V/S	0... FFFFFFFFH	0... 4294970000	1	-
statistic counter 5 for TECU monitoring					
CTR_STC_TECU_6	O/V/S	0... FFFFFFFFH	0... 4294970000	1	-
statistic counter 6 for TECU monitoring					
CTR_STC_TECU_7	O/V/S	0... FFFFFFFFH	0... 4294970000	1	-
statistic counter 7 for TECU monitoring					
CTR_STC_TECU_8	O/V/S	0... FFFFFFFFH	0... 4294970000	1	-
statistic counter 8 for TECU monitoring					
LV_V_TECU_VLD	O/V	0... 1H	0 ...1	1	-
Flag indicating that a valid VP_TECU value is available at MU					
TECU	O/V	0... FEH	0... 142.5	0.75	°C
ECU temperature					
TECU_MC	O/V	0... FEH	0... 142.5	0.75	°C
Microcontroller temperature					
V_TECU_MC	O/V	0... 7FFFH	0... 4.99984741	15.25879e3	V
Voltage of microcontroller temperature sensor					
VP_TECU	O/V	0... 7FFFH	0... 4.99984741	15.25879e3	V
Voltage of ECU temperature sensor					

Input data:

LV_ERR_TECU {p. 4237}	LV_ES {p. 1720}	LV_IGK {p. 906}	TRT {p. 1504}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TECU_SUB	-	0... FEH	0... 142.5	0.75	°C
TECU substitute value					
C_TECU_THD_1	-	0... FEH	0... 142.5	0.75	°C
ETCU threshold 1 (init. Value: 40°C)					
C_TECU_THD_2	-	0... FEH	0... 142.5	0.75	°C
ETCU threshold 2 (init. Value: 50°C)					
C_TECU_THD_3	-	0... FEH	0... 142.5	0.75	°C
ETCU threshold 3 (init. Value: 60°C)					
C_TECU_THD_4	-	0... FEH	0... 142.5	0.75	°C
ETCU threshold 4 (init. Value: 70°C)					
C_TECU_THD_5	-	0... FEH	0... 142.5	0.75	°C
ETCU threshold 5 (init. Value: 85°C)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TECU_THD_6	-	0... FEH	0... 142.5	0.75	°C
ETCU threshold 6 (init. Value: 100°C)					
C_TECU_THD_7	-	0... FEH	0... 142.5	0.75	°C
ETCU threshold 7 (init. Value: 115°C)					
C_TRT_DIF_TECU	-	0... FFFFFFFFH	0... 119305	277.778e3	h
TRT difference for ETCU statistic (init. value: 0,08333h)					
IP_TECU	-	0... FEH	0... 142.5	0.75	°C
LDP_VP_TECU__TECU	16	0... 7FFFH	0... 4.99984	15.26e3	V
NTC characteristic					
LC_TECU_SWI	-	0... 1H	0 ...1	1	-
Selection of TECU source					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_TECU_MC_OFS	-	0... 7FFFH	0... 1023.97	0.03125	°C
Offset of conversion from voltage to temperature of microcontroller					
NC_TECU_MC_SLOP	-	0... FFFFH	0... 0.99998474	152.588e3	-
Slope of conversion from voltage to temperature of microcontroller					

Import actions:

ACTION_INFR_GetVpTecu (**OUT**<Vp_tecu_sens>)
ACTION_INFR_GetVTecuMc (**OUT**<V_tecu_mc_sens>)

4.28.1 ECU temperature TECU:

The ECU temperature is measured through an A/D converter. The software then is generating a modified sensor signal (VP_TECU), which is requested by the application software for further execution.

The conversion into physical values is made through the nonlinear characteristic IP_TECU. In case of a present fault of the TECUsensor a substitute value will be used.

By request (LC_TECU_SWI) the source for the TECU calculation can switch between IP_TECU(VP_TECU) and TECU_MC.
Here are listed the configuration data:

Data	Value
NC_TECU_MC_SLOP	190 °C/V *
NC_TECU_MC_OFS	231.9 °C

*Note: For SW calculation purposes NC_TECU_MC_SLOP = 0.028992584

Function Description

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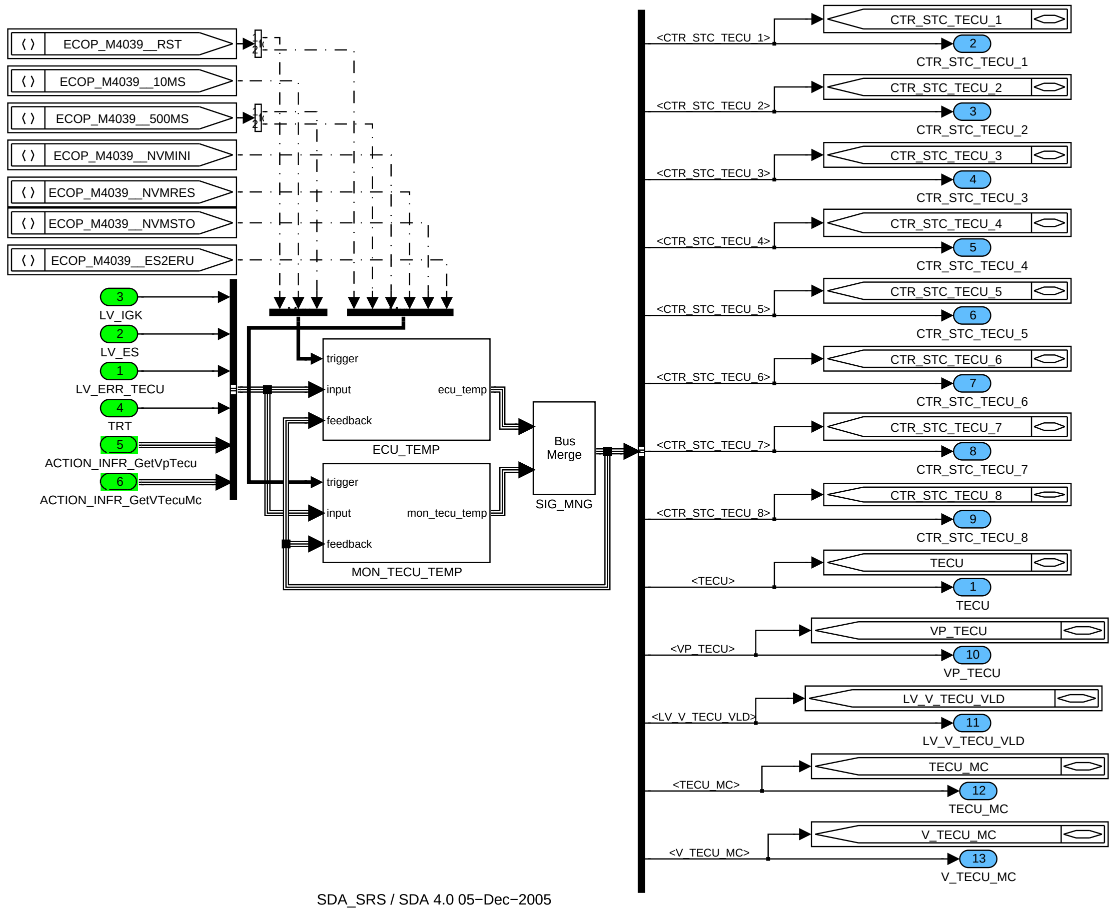

Figure 4.28.1: ECOP_M4039

4.28.1.1 ECU Temperature Calculations

Determination of TECU_MES in case of an/no TECU error

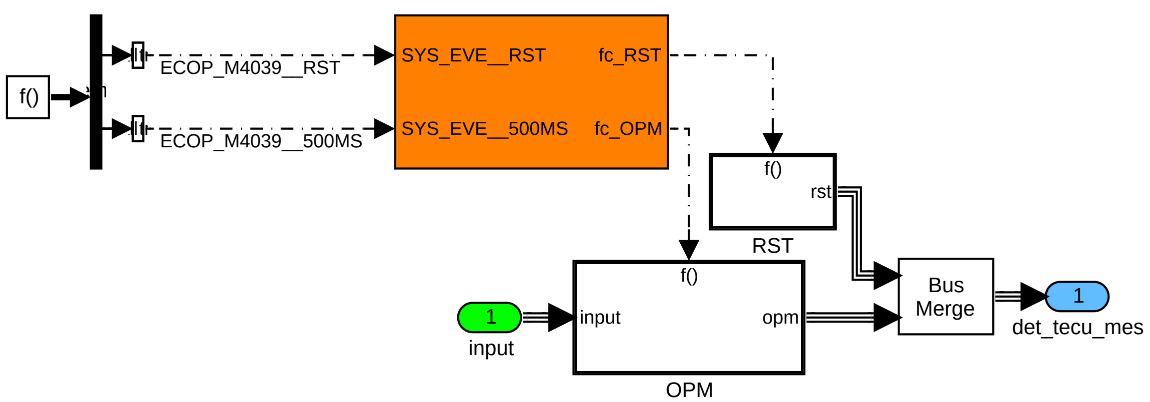

Figure 4.28.2: ECOP_M4039/ECU_TEMP/DET_TECU_MES

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Application Condition

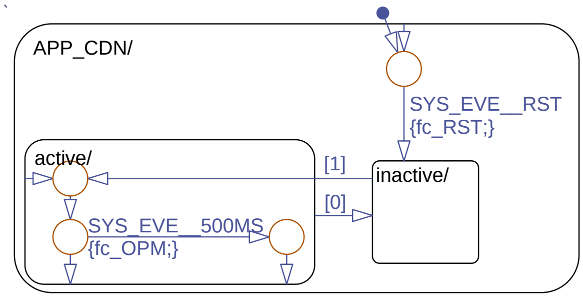

Figure 4.28.3: ECOP_M4039/ECU_TEMP/DET_TECU_MES/CHAPTER_1/Chart

Initialisation at "reset" event

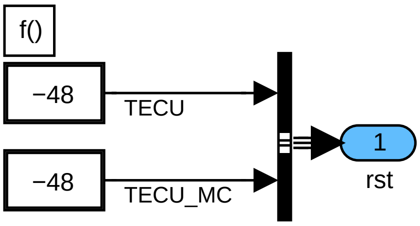

Figure 4.28.4: ECOP_M4039/ECU_TEMP/DET_TECU_MES/RST

Formula Section

Calculation V_TECU_MC , VP_TECU, TECU and TECU_MC

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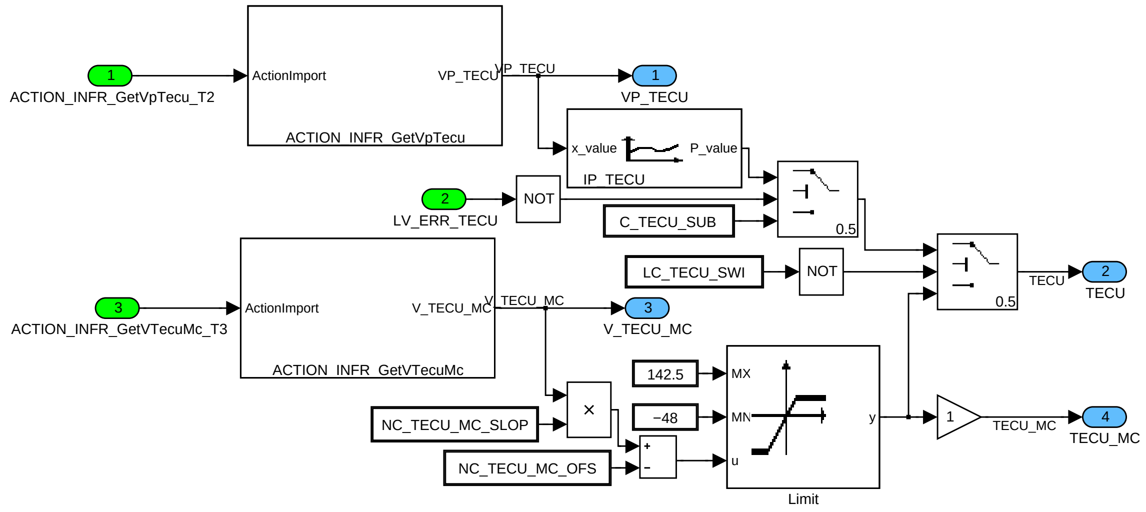

Figure 4.28.5: ECOP_M4039/ECU_TEMP/DET_TECU_MES/OPM/CLC

Detection of valid value of V_TECU (as an interface to VVL functionalites)

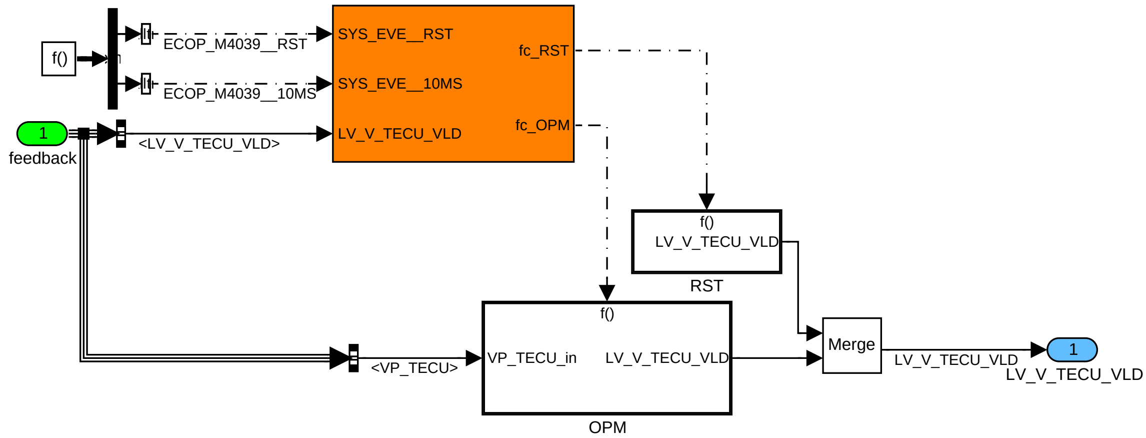

Figure 4.28.6: ECOP_M4039/ECU_TEMP/DET_VLD_V_TECU

Application condition

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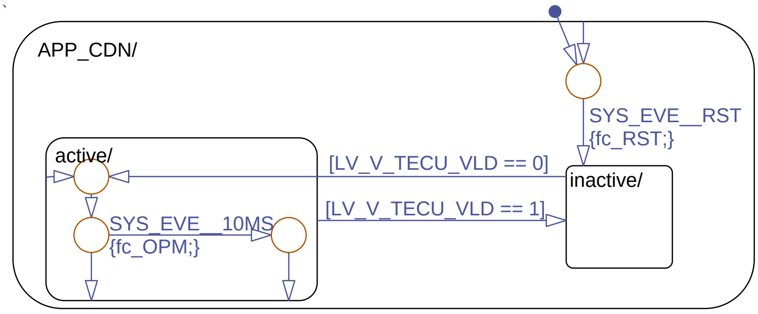

Figure 4.28.7: ECOP_M4039/ECU_TEMP/DET_VLD_V_TECU/CHAPTER_2/Chart

Initialisation at "reset" event

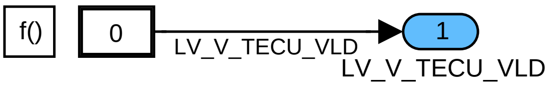

Figure 4.28.8: ECOP_M4039/ECU_TEMP/DET_VLD_V_TECU/RST

Formula Section : Calculation of LV_V_TECU_VLD

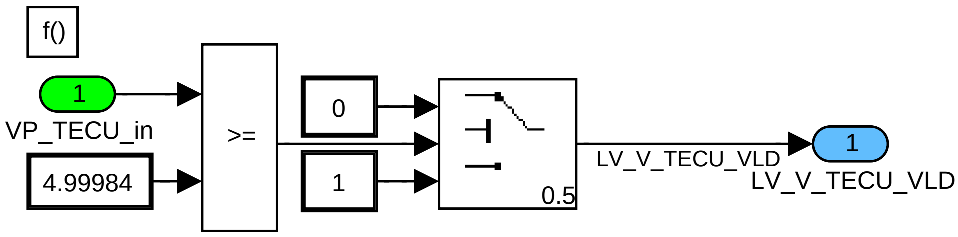

Figure 4.28.9: ECOP_M4039/ECU_TEMP/DET_VLD_V_TECU/OPM

4.28.1.2 Monitoring of the ECU - Temperature

This function should provide a statistical statement, how often the ECU temperature is in a defined temperature band. After a calibratable time the ECU temperature will be checked in which temperature band is the ECU. Then, the corresponding counter is incremented.

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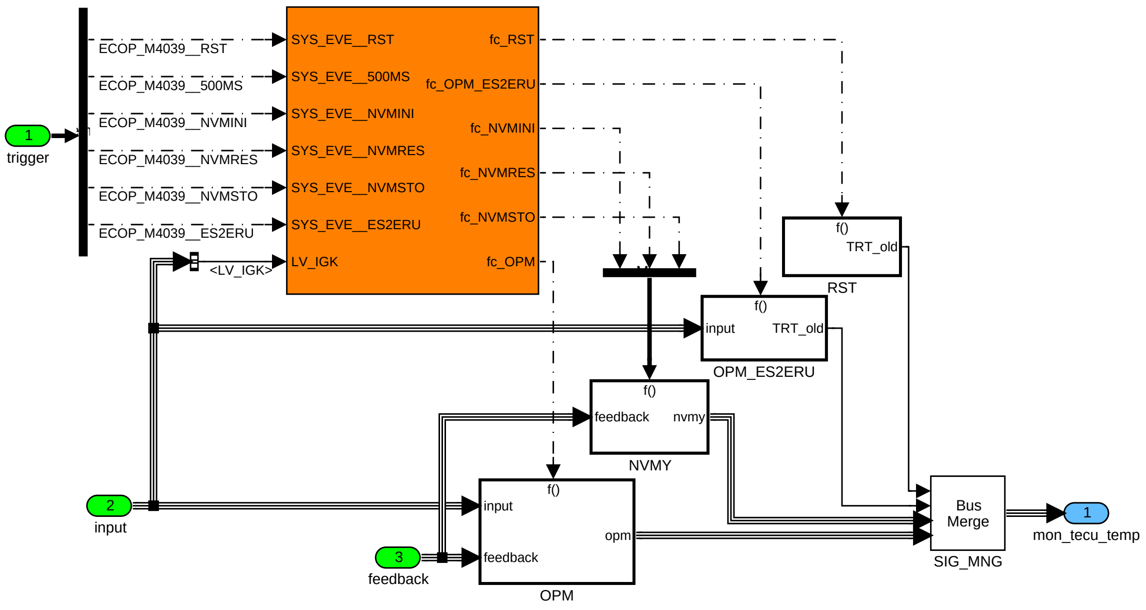

Figure 4.28.10: ECOP_M4039/MON_TECU_TEMP

Application condition

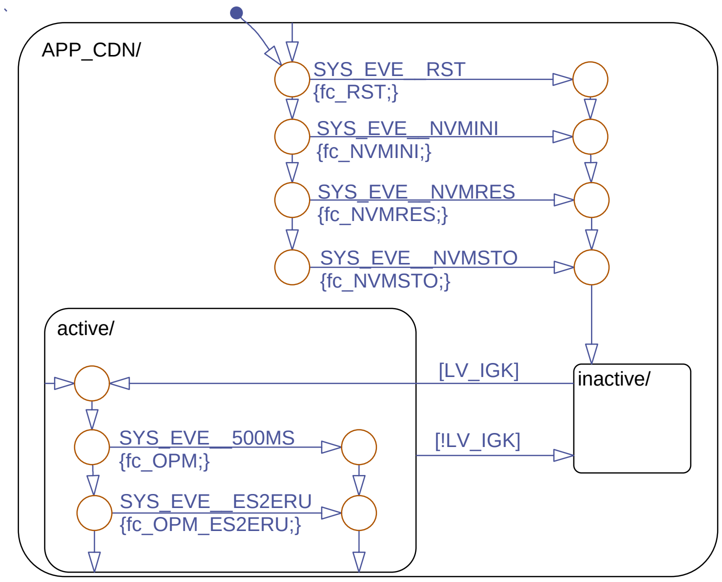

Figure 4.28.11: ECOP_M4039/MON_TECU_TEMP/ECOP_3/Chart

Initialisation of TRT_old

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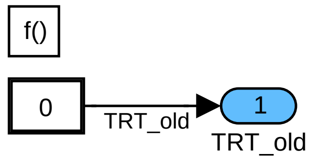

Figure 4.28.12: ECOP_M4039/MON_TECU_TEMP/RST

Initialisation at system event ES2ERU

Assignment of TRT to TRT_old at system event ES2ERU

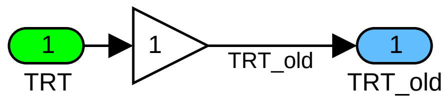

Figure 4.28.13: ECOP_M4039/MON_TECU_TEMP/OPM_ES2ERU/INI

Initialisations at system events related to NVMY

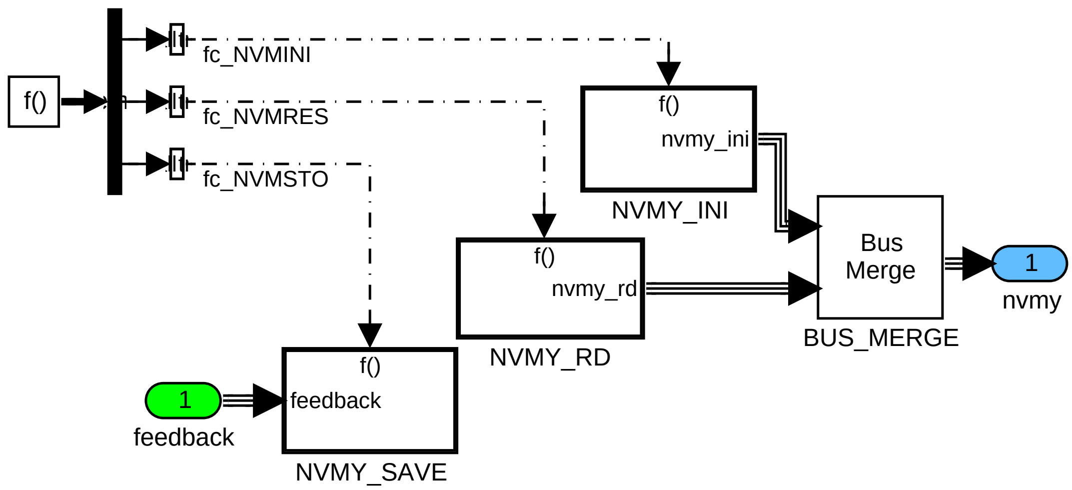

Figure 4.28.14: ECOP_M4039/MON_TECU_TEMP/NVMY

Formula Section

Condition check for the counter calculations

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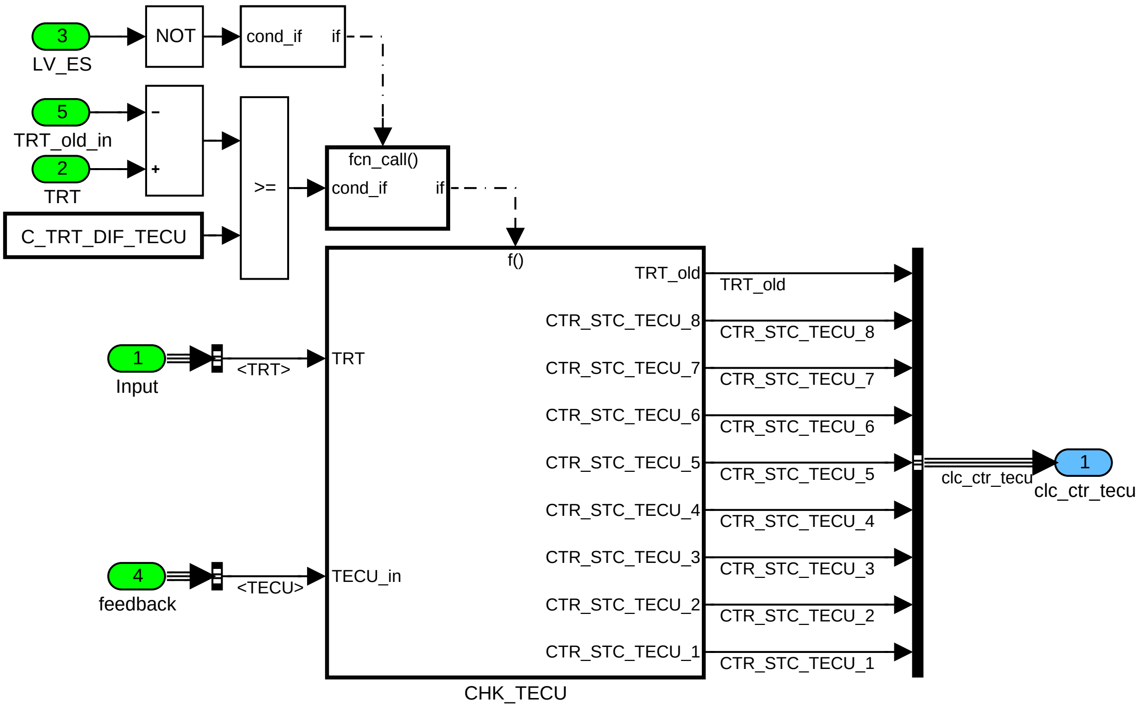

Figure 4.28.15: ECOP_M4039/MON_TECU_TEMP/OPM/CLC_CTR_TECU

Calculation of statistical counters

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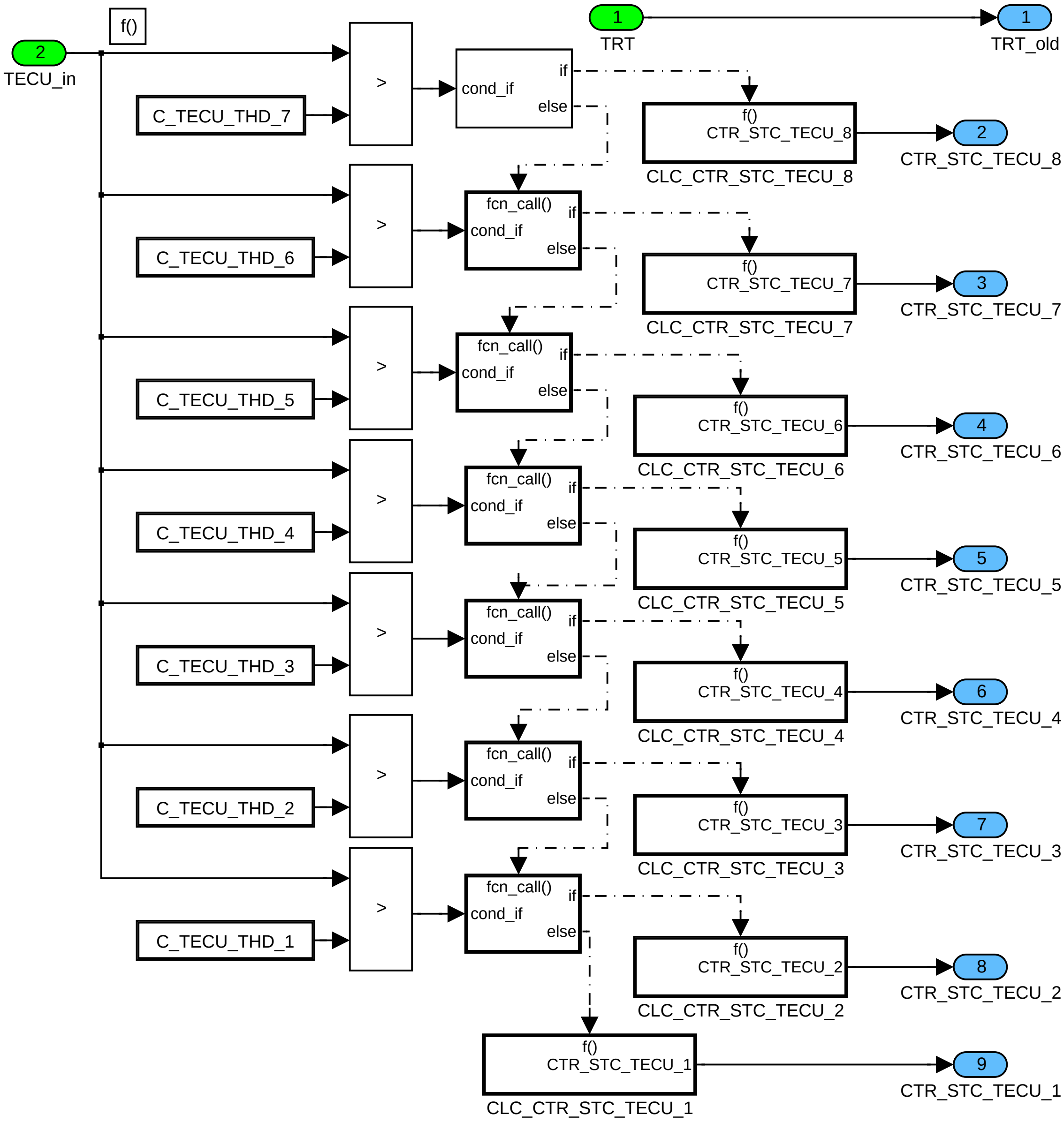

Figure 4.28.16: ECOP_M4039/MON_TECU_TEMP/OPM/CLC_CTR_TECU/CHK_TECU

Calculation of statistical counter 8

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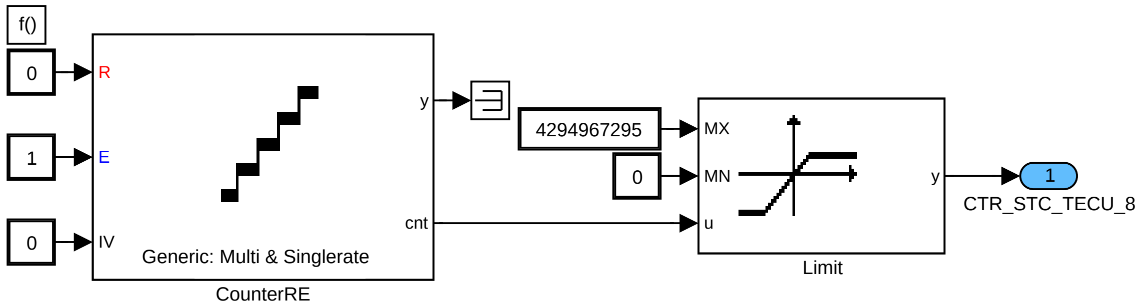

Figure 4.28.17:
ECOP_M4039/MON_TECU_TEMP/OPM/CLC_CTR_TECU/CHK_TECU/CLC_CTR_STC_TECU_8

Calculation of statistical counter 7

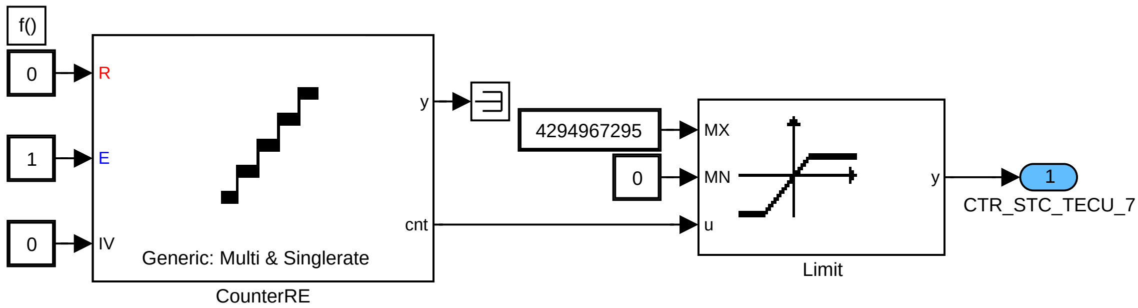

Figure 4.28.18:
ECOP_M4039/MON_TECU_TEMP/OPM/CLC_CTR_TECU/CHK_TECU/CLC_CTR_STC_TECU_7

Calculation of statistical counter 6

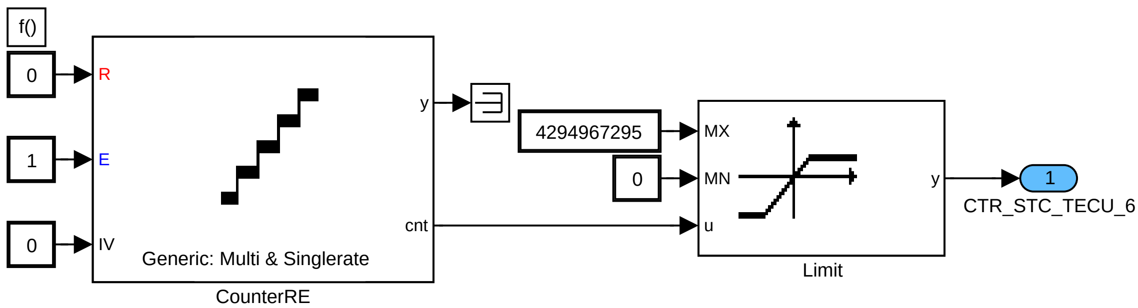

Figure 4.28.19:
ECOP_M4039/MON_TECU_TEMP/OPM/CLC_CTR_TECU/CHK_TECU/CLC_CTR_STC_TECU_6

Calculation of statistical counter 5

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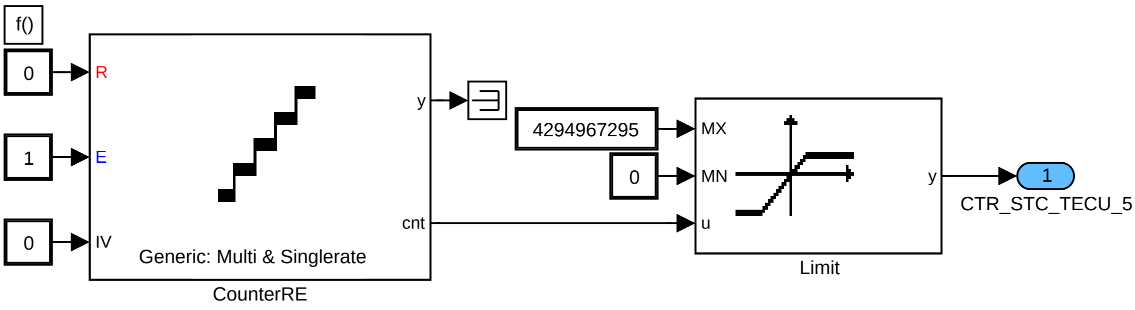

Figure 4.28.20:
ECOP_M4039/MON_TECU_TEMP/OPM/CLC_CTR_TECU/CHK_TECU/CLC_CTR_STC_TECU_5

Calculation of statistical counter 4

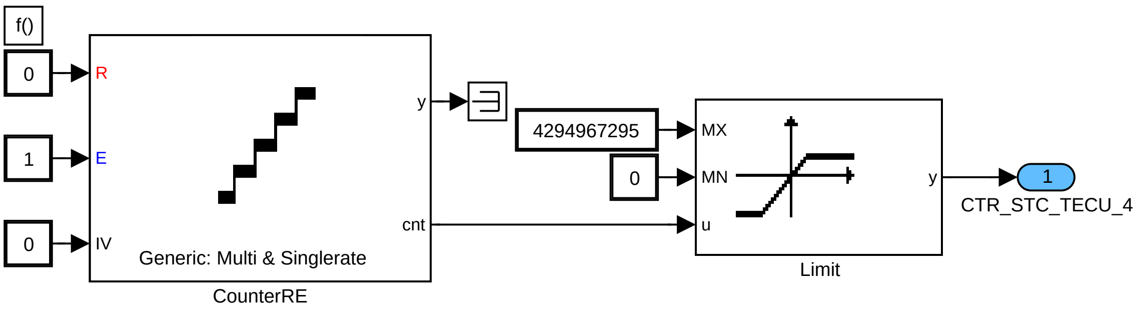

Figure 4.28.21:
ECOP_M4039/MON_TECU_TEMP/OPM/CLC_CTR_TECU/CHK_TECU/CLC_CTR_STC_TECU_4

Calculation of statistical counter 3

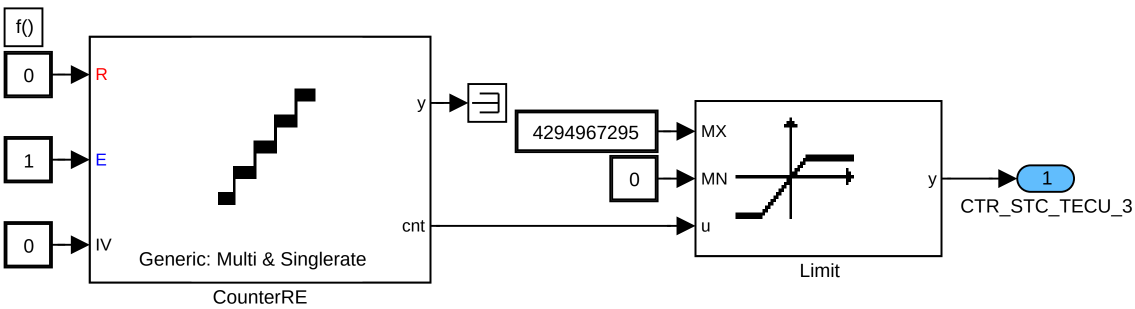

Figure 4.28.22:
ECOP_M4039/MON_TECU_TEMP/OPM/CLC_CTR_TECU/CHK_TECU/CLC_CTR_STC_TECU_3

Calculation of statistical counter 2

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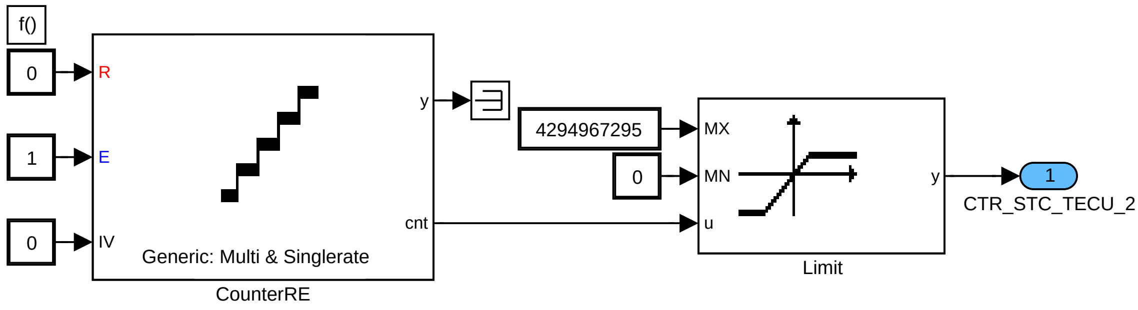

Figure 4.28.23:
ECOP_M4039/MON_TECU_TEMP/OPM/CLC_CTR_TECU/CHK_TECU/CLC_CTR_STC_TECU_2

Calculation of statistical counter 1

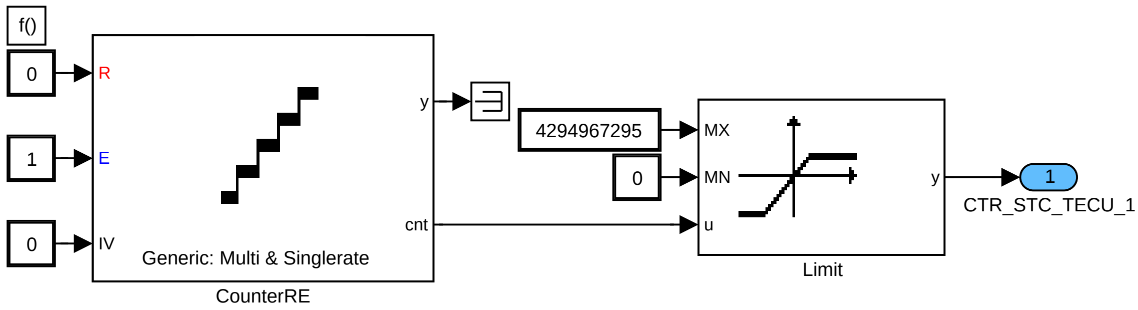

Figure 4.28.24:
ECOP_M4039/MON_TECU_TEMP/OPM/CLC_CTR_TECU/CHK_TECU/CLC_CTR_STC_TECU_1

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4.29 Pedal value sensor variables

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_PV_BAS_COR	V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
basic correction					
FAC_PV_COR	V	0... 7FFFH	0... 0.99996	30.5e-6	-
Summation of corrections					
FAC_PV_CS_COR	V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Starting correction					
FAC_PV_GS_COR	V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Gear shift correction					
LV_KD	O/V	0... 1H	0 ...1	1	-
Flag for Kick-Down-Recognition (internally recognized from both PVS-voltages)					
PV_AV	O/V	0... FFH	0... 99.60937	0.390625	%
Corrected pedal value interpretation					
PV_AV_1	O/V	0... FFH	0... 99.60937	0.390625	%
degree of activation of the accelerator pedal from PVS-channel 1					
PV_AV_2	O/V	0... FFH	0... 99.60937	0.390625	%
degree of activation of the accelerator pedal from PVS-channel 2					
PV_AV_GRD	O/V	0... FFH	-1250... 1240.23437	9.765625	%/s
Pedal value gradient					
PV_AV_RAW	O/V	0... FFH	0... 99.60937	0.390625	%
Global degree of activation of the gas pedal					
PV_CRU	O/V	0... FFH	0... 99.60937	0.390625	%
Pedal value interpretation of Cruise control					
PV_CRU_1	V	0... FFH	0... 99.60937	0.390625	%
Pedal value interpretation of Cruise control temporary					
PV_CRU_RAW	V	0... FFH	0... 99.60937	0.390625	%
Pedal value interpretation of Cruise control rawsignal					
PV_CUS	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Corrected pedal value interpretation with higher resolution for customer purpose					
PV_CUS_1	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
degree of activation of the accelerator pedal from PVS-channel 1 with higher resolution for customer purposes					
PV_CUS_2	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
degree of activation of the accelerator pedal from PVS-channel 2 with higher resolution for customer purposes					
PV_CUS_RAW	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Global degree of activation of the gas pedal with higher resolution for customer purpose					
PV_MAX	O/V	0... FFH	0... 99.60937	0.390625	%
Maximum selection of Pedal value interpretation					
V_PVS_FIL_1	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Filtered voltage of Pedal Value Sensor 1					
V_PVS_FIL_2	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Filtered voltage of Pedal Value Sensor 2					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Input data:

FAC_TQ_REQ_CRU {p. 6737}	FAC_TQ_REQ_DCC {p. 6737}	GEAR_INFO {p. 1564}	LC_RNG_L_MAN_AS {p. 6570}
LV_AT {p. 654}	LV_DET_NOT_PLAUS_ ACT {p. 4215}	LV_ERR_PVS_BLS_NOT_ PLAUS {p. 4216}	LV_IGK {p. 906}
LV_IM_CS_PN {p. 852}	LV_LDM_ENA {p. 6615}	LV_PVS_BLS_NOT_ PLAUS_ACT {p. 4216}	LV_RNG_L_REQ {p. 6570}
LV_VAR_BN_LDM {p. 655}	LV_VAR_DCC {p. 655}	LV_VAR_TCT {p. 656}	N {p. 1525}
N_32 {p. 1525}	N_DIF {p. 1122}	PV_AV_MAX_BRAKE_DET {p. 4216}	STATE_ETCU_CLU {p. 1573}
STATE_GEAR_REV_AT_ AMT {p. 1302}	STATE_GEAR_REV_CAN {p. 1574}	STATE_PVS_DIAG {p. 4216}	V_PVS_1 {p. 831}
V_PVS_2 {p. 831}	VS_FIL {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_PV_AV_BLS_NOT_PLAUS	-	0... FFH	0... 99.60937	0.390625	%
pedal position in case of an PV_AV/Brake implausibility					
C_PV_AV_BLS_NOT_PLAUS_HYS	-	0... FFH	0... 99.60937	0.390625	%
Hysteresis in case of an PV_AV/Brake implausibility					
C_PV_AV_BLS_NOT_PLAUS_LGRD	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Change limitation of pedal position in case of an PV_AV/Brake implausibility					
C_PV_GRD_LIH_MAX	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Max. (positive) pedal gradient in case of an error					
C_PVS_SLOP_1	-	0... FFH	0... 79.6875	0.3125	%/V
Slope value of the pedal value 1					
C_PVS_SLOP_2	-	0... FFH	0... 79.6875	0.3125	%/V
Slope value of the pedal value 2					
C_T_FAC_PV_CS_AT	-	1... FFFFH	0.01... 655.35	0.01	s
Timer switch off CS correction for AT					
C_T_FAC_PV_CS_MT	-	1... FFFFH	0.01... 655.35	0.01	s
Timer switch off CS correction for MT and TCT					
C_T_FAC_PV_GS	-	1... FFFFH	0.01... 655.35	0.01	s
Timer switch off GS correction					
C_THD_MAX_PV_AV	-	0... FFH	0... 99.60937	0.390625	%
Threshold for switching progression					
C_THD_MIN_PV_AV	-	0... FFH	0... 99.60937	0.390625	%
Threshold for switching progression					
C_V_PVS_HYS_FIL	-	0... FFH	0... 1.24511	4.8828e-3	V
Area of the dejitter-filters					
C_V_PVS_OFS_1	-	0... FFH	0... 1.24511	4.8828e-3	V
Offset of the pedal value 1					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_PVS_OFS_2	-	0... FFH	0... 1.24511	4.8828e-3	V
Offset of the pedal value 2					
C_V_PVS_THD_KD	-	0... FFH	0... 4.998	0.0195313	V
Pedal value to kick-down-recognition (Channel 1)					
C_V_PVS_THD_KD_HYS	-	0... FFH	0... 4.998	0.0195313	V
Hysteresis of kick down recognition Channel 1					
C_VS_MAX_FAC_PV_COR	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Starting or gear shift detection threshold					
C_VS_MAX_FAC_PV_COR_AT	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Starting or gear shift detection threshold for AT					
IP_FAC_PV_BAS_COR_AT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N__PV_FAC_COR	6	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_AV_RAW__PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Basic correction					
IP_FAC_PV_BAS_COR_AT_MAN	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N__PV_FAC_COR	6	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_AV_RAW__PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Basic correction for AT in 'M' mode (manual)					
IP_FAC_PV_BAS_COR_AT_SPT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N__PV_FAC_COR	6	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_AV_RAW__PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Basic correction for AT in 'S' mode (sport)					
IP_FAC_PV_BAS_COR_GEAR_REV_AT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL_PV_FAC_COR_GEAR_REV	6	0... FFFFH	0... 511.99218	0.0078125	km/h
Additve correction at reverse gear for AT					
IP_FAC_PV_BAS_COR_GEAR_REV_MT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL_PV_FAC_COR_GEAR_REV	6	0... FFFFH	0... 511.99218	0.0078125	km/h
Additve correction at reverse gear for MT					
IP_FAC_PV_BAS_COR_GEAR_REV_TCT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL_PV_FAC_COR_GEAR_REV	6	0... FFFFH	0... 511.99218	0.0078125	km/h
Additve correction at reverse gear for TCT					
IP_FAC_PV_BAS_COR_MT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N__PV_FAC_COR	6	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_AV_RAW__PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Basic correction					
IP_FAC_PV_BAS_COR_TCT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N__PV_FAC_COR	6	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_AV_RAW__PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Basic correction					
IP_FAC_PV_CS_COR_AT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N_DIF__PV_FAC_COR	6	0... FFFFH	-32768 ...32767	1	rpm
LDPM_PV_AV_RAW__PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Clutch intervention correction					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_PV_CS_COR_AT_RNG_L	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N_DIF__PV_FAC_COR	6	0... FFFFH	-32768 ...32767	1	rpm
LDPM_PV_AV_RAW__PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Clutch intervention correction in low range mode					
IP_FAC_PV_CS_COR_MT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N_DIF__PV_FAC_COR	6	0... FFFFH	-32768 ...32767	1	rpm
LDPM_PV_AV_RAW__PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Clutch intervention correction					
IP_FAC_PV_CS_COR_TCT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N_DIF__PV_FAC_COR	6	0... FFFFH	-32768 ...32767	1	rpm
LDPM_PV_AV_RAW__PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Clutch intervention correction					
IP_FAC_PV_GS_COR_MT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N__PV_FAC_COR	6	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_AV_RAW__PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Gear shift intervention correction					
IP_FAC_PV_GS_COR_TCT	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_N__PV_FAC_COR	6	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_AV_RAW__PV_FAC_COR	6	0... FFH	0... 99.60937	0.390625	%
Gear shift intervention correction					
IP_FAC_VS_PV_BAS_COR_AT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL__PV_FAC_COR	8	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction					
IP_FAC_VS_PV_BAS_COR_AT_MAN	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL__PV_FAC_COR	8	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction for AT in ’M’ mode (manual)					
IP_FAC_VS_PV_BAS_COR_AT_SPT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL__PV_FAC_COR	8	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction for AT in ’S’ mode (sport)					
IP_FAC_VS_PV_BAS_COR_MT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL__PV_FAC_COR	8	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction					
IP_FAC_VS_PV_BAS_COR_TCT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL__PV_FAC_COR	8	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction					
IP_FAC_VS_PV_GS_COR_MT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL__PV_FAC_COR	8	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction					
IP_FAC_VS_PV_GS_COR_TCT	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_VS_FIL__PV_FAC_COR	8	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_PV_CRU	V	0... FFH	0... 99.60937	0.390625	%
LDPM_N__FAC_TQ_REQ_DRIV	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_TQ_CRU_DCC	8	0... FFFFH	0... 1.99996	30.5e-6	-
Scaling factor for requested torque at clutch from driver					
IP_PV_CRU_RNG_L	V	0... FFH	0... 99.60937	0.390625	%
LDPM_N__FAC_TQ_REQ_DRIV	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_TQ_CRU_DCC	8	0... FFFFH	0... 1.99996	30.5e-6	-
Scaling factor for requested torque at clutch from driver in low range mode					
IP_PV_LIH_MAX	-	0... FFH	0... 99.60937	0.390625	%
LDP_N_32__PV_LIH_MAX	6	0... FFH	0... 8160	32	rpm
Max. pedal position in case of an error					

General information:

The accelerator pedal value is determined by means of a two-channeled system (PVS: pedal value sensor). Upon operating the accelerator pedal, both independently supplied sensor channels supply a synchronized Voltage signal, which shows a definite Voltage-ratio (2:1). Both Voltage-signals are adapted to the supply Voltage of the potis in order to minimize measurement inaccuracy.
Plausibility unit monitors both output signals of the pedal sensor system as well as the supply Voltages and determine from this the state of the PVS's system (see chapter PVS diagnosis).
From the Voltages of both PVS-channels the Kick-Down operation is determined.
Dependent on the System State, the driver's demand is determined from the pedal activation values. In the case of a disturbed PVS-signal (ERR_PVS 0), a selection of pedal values occurs from one of both PVS-channels and/or an output of zero.
Figure 1 shows a function overview of determination of the driver's demand.

Signal flow diagram:

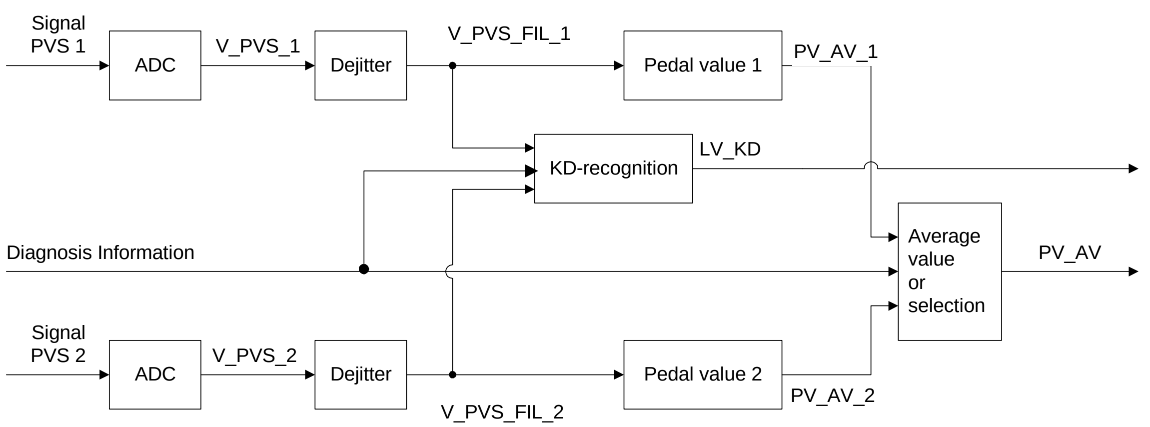

Figure 4.29.1: : Function overview of determination of the driver s demand

Comment:
Since we are dealing with a two-channel system, the letter 'X' is used for either channel 1 or 2, in order to simplify the description. The letter 'Y' indicates the other respective channel.

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Application conditions:

Recurrence: 10 ms

4.29.1 Filtration of the PVS-values

FUNCTION DESCRIPTION:

In order to maintain a stabile driver's demand, the PVS-Voltage values need to be filtered.
During the filtration, a hysteresis band is laid around the determined PVS-value (Width: 2 * C_V_PVS_HYS_FIL). The PVS-value is only changed when the current measurement value exceeds the limits of the hysteresis band. Thereby a jitter-free signal is produced, which actually hurries after the 'true' measurement value around the width of the hysteresis band. However, this signal reacts without hesitation to dynamic alterations of the driver's demand.

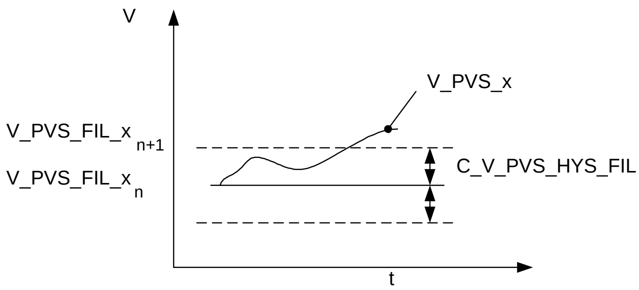

Figure 4.29.2: Filtration of PVS Voltage

Formula section:

If V_PVS_x$_{(n)}$ $>$ V_PVS_FIL_x$_{(n-1)}$ + C_V_PVS_HYS_FIL **or**
V_PVS_x$_{(n)}$ $<$ V_PVS_FIL_x$_{(n-1)}$ - C_V_PVS_HYS_FIL
Then V_PVS_FIL_X$_{(n)}$ = V_PVS_x$_{(n)}$
Else V_PVS_FIL_X$_{(n)}$ = V_PVS_FIL_x$_{(n-1)}$

4.29.2 Standardisation of the PVS-voltage value

FUNCTION DESCRIPTION:

The pedal values are normalized by the determined producer values for the potentiometer slope C_PVS_SLOP and offset C_PVS_OFS in a range between 0% and 99,6%.

Formula section:

PV_CUS_x = PV_AV_x = (V_PVS_FIL_x - C_V_PVS_OFS_x) * C_PVS_SLOP_x
Calibration hint: in order to prevent the signal PVS 2 with it's worse resolution is selected for PV_AV_RAW (see following Value selection), the offset and slope for that sensor should be calibrated accordingly. PV_AV_2 always should be a little higher than PV_AV_1. The difference should correspond to the usual occurring signal jitter which depends from the used sensor

4.29.3 Value selection

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FUNCTION DESCRIPTION:

For an error-free system, the pedal value PV_AV_RAW (PV_CUS_RAW) is determined from minimum of both pedal values PV_AV_x (PV_CUS_x). In case of an error the selection depends on the PVS Diagnostic status. The restriction of the accelerator pedal value takes place at the limp home management.
In case of a not plausible accelerator-brake plausibility the driver demand is limited to C_PVS_BLS_NOT_PLAUS to defuse a clamp driver pedal.

Application conditions

Initialisation: *0*

Recurrence: *10ms*

Activation: `LV_IGK = 1`

Deactivation: `LV_IGK = 0, set PV_AV_RAW=0, PV_CUS_RAW=0`

Formula section:

If(1) STATE_PVS_DIAG = PVS_NO_ERROR
Then(1) PV_AV_MIN = MIN (PV_AV_1; PV_AV_2)
PV_CUS_MIN = MIN (PV_CUS_1; PV_CUS_2)
If(2) LV_PVS_BLS_NOT_PLAUS_ACT = 0 **and**
LV_ERR_PVS_BLS_NOT_PLAUS = 0
Then(2) PV_AV_RAW = PV_AV_MIN
PV_CUS_RAW = PV_CUS_MIN
Else(2)If(3) LV_DET_NOT_PLAUS_ACT =1
Then(3) If(4) PV_AV_RAW $>$ C_PV_AV_BLS_NOT_PLAUS
Then(4) PV_AV_RAW$_n$ = MIN (PV_AV_MIN; PV_AV_RAW$_{n-1}$ - C_PV_AV_BLS_NOT_PLAUS_LGRD)
PV_CUS_RAW$_n$ = MIN (PV_CUS_MIN; PV_CUS_RAW$_{n-1}$ - C_PV_AV_BLS_NOT_PLAUS_LGRD)
Else(4) If(5) PV_AV_RAW $\geq$ PV_AV_MIN
Then(5) PV_AV_RAW = PV_AV_MIN
PV_CUS_RAW = PV_CUS_MIN
Else(5) PV_AV_RAW$_n$ = PV_AV_RAW$_{n-1}$
PV_CUS_RAW$_n$ = PV_CUS_RAW$_{n-1}$
Else(3)If(6) |PV_AV_RAW$_{n-1}$-PV_AV_MIN$>$C_PV_AV_BLS_NOT_PLAUS_HYS
Then(6) If(7) PV_AV_RAW$_{n-1}$ $<$ PV_AV_MIN
Then(7) PV_AV_RAW$_n$ = PV_AV_RAW$_{n-1}$ + C_PV_AV_BLS_NOT_PLAUS_LGRD
PV_CUS_RAW$_n$ = PV_CUS_RAW$_{n-1}$ + C_PV_AV_BLS_NOT_PLAUS_LGRD
Else(7) PV_AV_RAW$_n$ = PV_AV_MIN
PV_CUS_RAW$_n$ = PV_CUS_MIN
Else(6)PV_AV_RAW$_n$ = PV_AV_MIN
PV_CUS_RAW$_n$ = PV_CUS_MIN
Endif

In case of a present PVS error witch is not debounced yet, the pedal value is frozen in risen direction:
If STATE_PVS_DIAG = PVS_LIH_PRED **and**
PV_AV_1 $\geq$ PV_AV_RAW
Then PV_AV_RAW$_n$ = PV_AV_RAW$_{n-1}$

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PV_CUS_RAW$_n$ = PV_CUS_RAW$_{n-1}$
Else PV_AV_RAW$_n$ = PV_AV_1
PV_CUS_RAW$_n$ = PV_CUS_1
Endif

If STATE_PVS_DIAG = PVS_LIH_MIN **or** PVS_LIH_1 **or** PVS_LIH_2
Then PV_AV_RAW and PV_CUS_RAW are limited upwards to IP_PV_LIH_MAX and the positive gradient is restricted to
PV_AV_RAW$_n$ $\leq$ PV_AV_RAW$_{n-1}$ + C_PV_GRD_LIH_MAX
PV_CUS_RAW$_n$ $\leq$ PV_CUS_RAW$_{n-1}$ + C_PV_GRD_LIH_MAX
Endif

If STATE_PVS_DIAG = PVS_LIH_MIN
Then PV_AV_RAW = Min (PV_AV_1, PV_AV_2)
PV_CUS_RAW = Min (PV_CUS_1, PV_CUS_2)
Endif
If STATE_PVS_DIAG = PVS_LIH_1
Then PV_AV_RAW = PV_AV_1
PV_CUS_RAW = PV_CUS_1
Endif
If STATE_PVS_DIAG = PVS_LIH_2
Then PV_AV_RAW = PV_AV_2
PV_CUS_RAW = PV_CUS_2
Endif

If STATE_PVS_DIAG = PVS_DBL_ERROR **or**
STATE_PVS_DIAG = PVS_LIH_1_PRE **or**
STATE_PVS_DIAG = PVS_LIH_2_PRE **or**
STATE_PVS_DIAG = PVS_LIH_BLS
Then PV_AV_RAW = 0
PV_CUS_RAW = 0
Endif

4.29.4 Driver progression correction

FUNCTION DESCRIPTION:

PV_AV and PV_CUS are the corrected driver interpretation and are used in the torque structure, CAN outputs and other functions.
The correction is a summation out of three parts, the basic, starting and gear shift correction.

Application conditions

Initialisation: *0*

Recurrence: *10ms*

Activation: *LV_IGK = 1*

Deactivation: `LV_IGK = 0, set PV_AV=0, PV_CUS=0`

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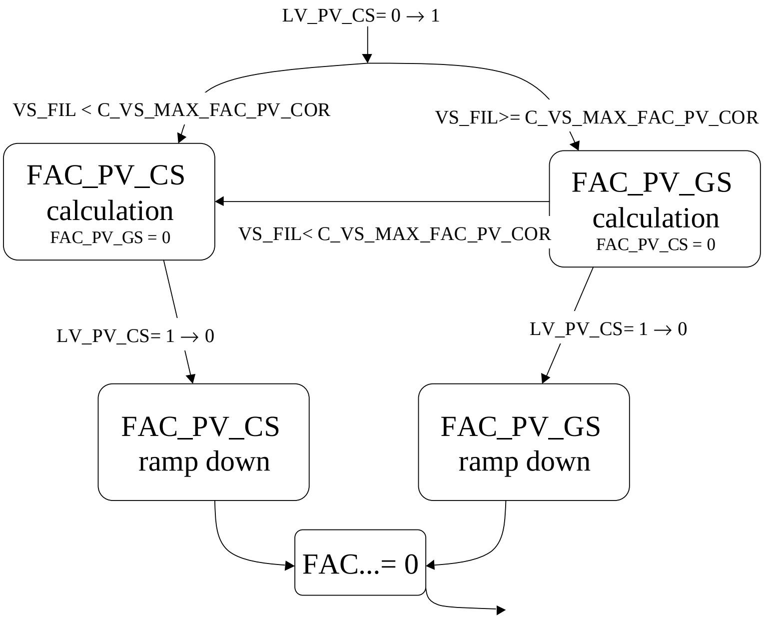
Signal flow diagram:



Formula section:

If(1) LV_AT = 1
Then(1)
If(2) GEAR_INFO = 1 **and** VS_FIL < C_VS_MAX_FAC_PV_COR_AT
Then(2) LV_PV_CS = 1
Else(2) LV_PV_CS = 0
Endif(2)
Endif(1)
Elseif(1) LV_VAR_TCT = 1
Then(3)
If(4) STATE_ETCU_CLU = 03H (CLU_CLOSED)
OR 04H (CLU_SLIP_CTRL) **OR** 05H (CLU_DYN_SLIP)
Then(4) LV_PV_CS = 0
Else(4) LV_PV_CS = 1
Endif(4)
Endif(3)
Endif(1)

If LV_AT = 0 **and** LV_VAR_TCT = 0
then LV_PV_CS = LV_IM_CS_PN
Endif

Basic correction:

PV_AV = MIN ((PV_AV_RAW * (1 - FAC_PV_COR)); PV_AV_MAX_BRAKE_DET)
PV_CUS = MIN ((PV_CUS_RAW * (1 - FAC_PV_COR)); PV_AV_MAX_BRAKE_DET)
FAC_PV_COR = min(1 ; max(0 ; (FAC_PV_CS_COR + FAC_PV_GS_COR +

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FAC_PV_BAS_COR)))

FAC_PV_COR has to be limited in the range between zero and one, so that no amplification of the raw value exists!

Progression correction at drive off FAC_PV_CS_COR:

Calculation by getting active Function LV_PV_CS = 0 to 1:

If(1) VS_FIL $<$ C_VS_MAX_FAC_PV_COR
Then(1) **If(2)** LV_VAR_TCT = 1
Then(2) FAC_PV_CS_COR = IP_FAC_PV_CS_COR_TCT
Else(2) **If(3)** LV_AT = 0
Then(3) FAC_PV_CS_COR = IP_FAC_PV_CS_COR_MT
Else(3) **If(4)** LV_RNG_L_REQ = 1
Then(4) FAC_PV_CS_COR = IP_FAC_PV_CS_COR_AT_RNG_L
Else(4) FAC_PV_CS_COR = IP_FAC_PV_CS_COR_AT
Endif(4)
Endif(3)
Endif(2)
Else(1) "see further definitions"
Endif(1)

Calculation by active Function LV_PV_CS = 1:

The calculation conditions remains from "Calculation by getting active Function:"
If there is a transition from VS_FIL $<$ C_VS_MAX_FAC_PV_COR to VS_FIL $\geq$ C_VS_MAX_FAC_PV_COR during active clutch, then the calculation remains as well as VS_FIL $<$ C_VS_MAX_FAC_PV_COR fullfilled condition . FAC_PV_CS_COR and FAC_PV_GS_COR doesn't exists at the same time.

Calculation triggered by leaving active Function LV_PV_CS = 1 to 0:

At transition LV_PV_CS 1 to 0 then FAC_PV_CS_COR is ramped down as followed:

- FAC_PV_CS_COR is basically calculated like the active function.

If(1) LV_PV_CS$_{(n)}$ = 0 and LV_PV_CS$_{(n-1)}$= 1
Then(1) **If(2)** **LV_AT = 1**
Then(2) start decremented timer T_PV_CS_COR = C_T_FAC_PV_CS_AT

If(3) LV_RNG_L_REQ = 1
Then(3) FAC_PV_CS_COR =
IP_FAC_PV_CS_COR_AT_RNG_L *
T_PV_CS_COR /C_T_FAC_PV_CS_AT
Else(3) FAC_PV_CS_COR =
IP_FAC_PV_CS_COR_AT *
T_PV_CS_COR /C_T_FAC_PV_CS_AT
Endif(3)
Else(2) start decremented timer T_PV_CS_COR = C_T_FAC_PV_CS_MT

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$$FAC\_PV\_CS\_COR = IP\_FAC\_PV\_CS\_COR\_MT * \frac{T\_PV\_CS\_COR}{C\_T\_FAC\_PV\_CS\_MT}$$

Endif(2)

Function is finished at T_PV_CS_COR = 0.

Endif(1)

The progression correction is retriggered at detection of LV_PV_CS 0 to 1 during ramp.

Progression correction at starting FAC_PV_GS_COR *(only MT or TCT):*

Calculation by transition Function LV_PV_CS = 0 to 1:

IF(1) VS_FIL $\geq$ C_VS_MAX_FAC_PV_COR

Then (1) FAC_PV_GS_COR calculation see bellow

Else (1) FAC_PV_GS_COR is not calulated FAC_PV_CS_COR is calculated furthermore

endif

Calculation by active Function LV_PV_CS = 1:

IF(1) VS_FIL $\geq$ C_VS_MAX_FAC_PV_COR

Then(1) IF(2) LV_VAR_TCT = 1

Then(2) FAC_PV_GS_COR = IP_FAC_PV_GS_COR_TCT * IP_FAC_VS_PV_GS_COR_TCT

Else (2)IF(3) LV_AT = 0

Then(3) FAC_PV_GS_COR = IP_FAC_PV_GS_COR_MT * IP_FAC_VS_PV_GS_COR_MT

Else(3) FAC_PV_GS_COR = 0

Else(1) FAC_PV_GS_COR = 0

Endif

Calculation leaving of the active function LV_PV_CS 1 to 0:

At transition LV_PV_CS 1 to 0 then FAC_PV_GS_COR is ramped down as followed:

- FAC_PV_GS_COR is basically calculated like the active function.

IF LV_PV_CS$_{(n)}$ = 0 and LV_PV_CS$_{(n-1)}$ = 1

Then start decremented timer T_PV_GS_COR = C_T_FAC_PV_GS

FAC_PV_GS_COR = (IP_FAC_PV_GS_COR_x * IP_FAC_VS_PV_GS_COR_x) * T_PV_GS_COR /C_T_FAC_PV_GS

Function is finished at T_PV_GS_COR = 0.

Endif

The progression correction is retriggered at detection of LV_PV_CS 0 to 1 during ramp.

Progression correction general FAC_PV_BAS_COR:

Dependig on the type of gearbox and state of reverse gear the general correction is calculated. This correction depends from N, VS_FIL and PV_AV_RAW.

IF STATE_GEAR_REV_AT_AMT = 1 or STATE_GEAR_REV_CAN = 1

Then FAC_PV_BAS_COR = IP_FAC_PV_BAS_COR_x * IP_FAC_VS_PV_BAS_COR_x + IP_FAC_PV_BAS_COR_GEAR_REV_y

Else FAC_PV_BAS_COR = IP_FAC_PV_BAS_COR_x * IP_FAC_VS_PV_BAS_COR_x

Endif

IF LV_VAR_TCT = 1

then x = TCT

y = TCT

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else **if** LV_AT = 1
then y = AT
(in first recurrence x is initialised with AT)
Progression changed if mode of transmission is changed (AT_SPT... sport mode, AT_MAN...manual mode), changes become only valid if PV_AV is under or above a certain threshold to avoid jumps in PV_AV signal.
if [(STATE_ETCU_PROG_INFO = 2 **and** LV_VAR_BN = 1) **or**
(STATE_ETCU_PROG_INFO = 1 **and** LV_VAR_BN = 0)] **and**
[PV_AV < C_THD_MIN_PV_AV **or**
PV_AV > C_THD_MAX_PV_AV]
Then x = AT_MAN
Elseif [(STATE_ETCU_PROG_INFO = 1 **and** LV_VAR_BN = 1) **or**
(STATE_ETCU_PROG_INFO = 2 **and** LV_VAR_BN = 0)] **and**
[PV_AV < C_THD_MIN_PV_AV **or**
PV_AV > C_THD_MAX_PV_AV]
Then x = AT_SPT
Elseif [PV_AV < C_THD_MIN_PV_AV **or**
PV_AV > C_THD_MAX_PV_AV]
Then x = AT
Else x = keep last
endif
else x = MT
y = MT
endif
endif

4.29.5 Kick-Down-Recognition

FUNCTION DESCRIPTION:

The recognition of kick-down (LV_KD) occurs, if the filtered pedal values (V_PVS_FIL_1) of channel one is exceed the respective threshold values C_V_PVS_THD_KD_x.
Because of more jitters at Channel two only Channel one is used.

Application conditions

Initialisation: *0*

Recurrence: *10ms*

Activation: *LV_IGK = 1*

Deactivation: LV_IGK = 0, set LV_KD=0

Formula section:

If(1) STATE_PVS_DIAG = PVS_NO_ERROR **or**
STATE_PVS_DIAG = PVS_LIH_PRED
Then(1)
If(2) V_PVS_FIL_1 > C_V_PVS_THD_KD **and** LV_KD = 0
Then(2) LV_KD = 1
Else(2)
If (3) V_PVS_FIL_1 < C_V_PVS_THD_KD - C_V_PVS_THD_KD_HYS **and**
LV_KD = 1

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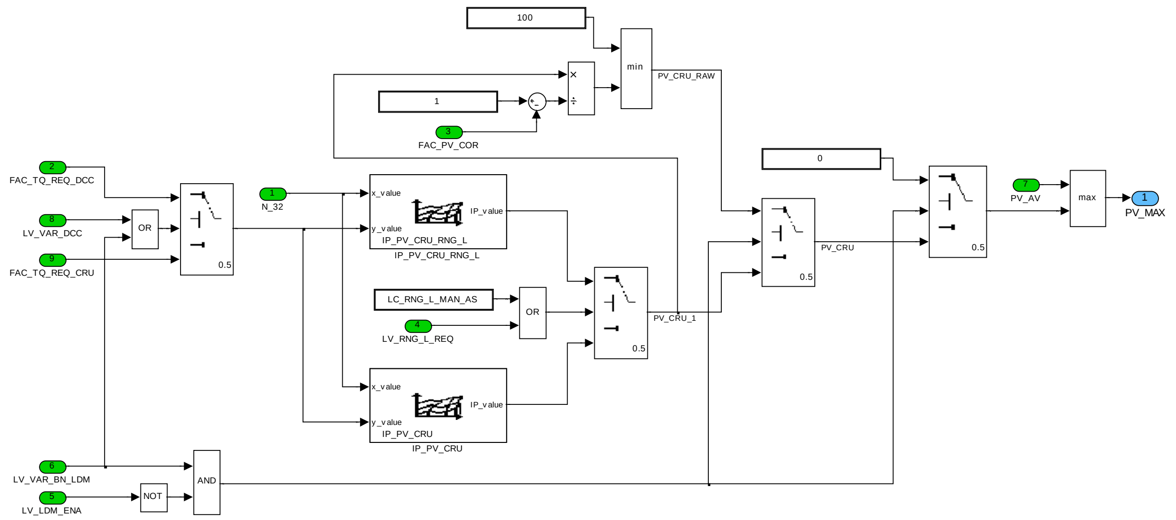
Then(3) LV_KD = 0
Else(3) LV_KD = 1
Else(1) LV_KD = 0
Endif

4.29.6 Selection of maximum pedal value

FUNCTION DESCRIPTION:

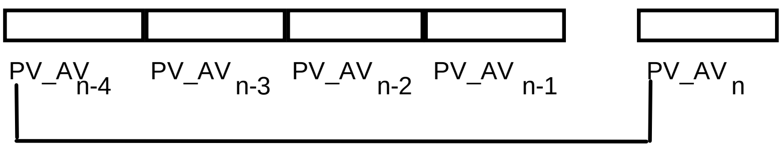
For CAN messages during cruise control and other functions the maximum selection between Pedal value and interpretation of cruise control charge request is needed.
The maps IP_PV_CRU__RNG_L and IP_PV_CRU have to be inverse maps of IP_FAC_TQ_REQ_RNG_L and IP_FAC_TQ_REQ_DRIV.

Signal flow diagram:



4.29.7 Calculation of PV_AV gradient:

The PV_AV gradient is calculated at intervals of 10 ms.
To this effect, the PV_AV values are written into the ring buffer. Thus, the last four PV_AV values are available in addition to the current PV_AV value.



The PV_AV gradient is based on a PV_AV change over 40 ms.

The PV_AV_GRD reflects the gradient of the actual driver's demand prior to the corrections.

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PV_AV_GRD = (PV_AVn - PV_AVn-4) * 25

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4.30 Fuel pressure

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FUP	O/V	0... FFFFH	0... 347776	5.30672159	hPa
Fuel pressure					
FUP_H	O/V	0... FFFFH	0... 347776	5.30672159	hPa
Fuel pressure, high range					
FUP_MES	O/V	0... FFFFH	0... 347776	5.30672159	hPa
Measured fuel pressure					
FUP_MES_MMV	V	0... FFFFH	0... 347776	5.30672159	hPa
Measured mean value fuel pressure					
FUP_RNG_H	O/V	0... FFFFH	0... 255.99609375	0.00390625	MPa
Fuel pressure					
FUP_RNG_H_MES	O/V	0... FFFFH	0... 255.99609375	0.00390625	MPa
Measured fuel pressure					
LV_FUP_MES_LIH_REQ	V	0... 1H	0 ...1	1	-
Request for fuel pressure default value in case of error detection					
LV_FUP_SEG	O/V	0... 1H	0 ...1	1	-
Logical variable indicating the buffer to read the sensor voltage in BSW					
V_FUP_MV	O/V	0... 7FFFH	0... 4.9998474121093	152.587e-6	V
Mean value of the acquired sensor voltage					

Input data:

CTR_V_FUP {p. 940}	CTR_V_FUP_1 {p. 940}	FUP_AD {p. 988}	FUP_EFP {p. 1290}
LC_FUP_EFP_AVL {p. 3801}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_FUP_LIH_L_PRS_CTL_REQ {p. 4001}	LV_ST_END {p. 1720}	V_FUP_SUM {p. 940}	V_FUP_SUM_1 {p. 940}

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_EFP_FUP_INI	V	0... FFFFH	0... 173888	2.65336079	hPa
Default value for fuel pressure initialisation by EFP system					
C_FUP_LIH_L_PRS_CRLC	V	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant for the fuel pressure value at low pressure control limphome					
C_FUP_MES_CRLC	V	0... FFH	0... 0.99609375	0.00390625	-
Filter constant for the measured fuel pressure					
C_FUP_OFS_LIH_L_PRS_CTL_REQ	V	8000... 7FFFH	-173890 ...173884	5.30669108	hPa
Offset for FUP at low pressure control limphome					
IP_FUP_MES	V	0... FFFFH	0... 347776	5.30672159	hPa
LDP_V_FUP_MV_IP_FUP_MES	8	0... 7FFFH	0... 4.9998474121093	152.587e-6	V
Fuel pressure sensor linearisation table					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_MOD_FUP_MES_LIH_REQ	V	0... 1H	0 ...1	1	-
Defines, if fuel pressure substitute value request is based on low pressure limp home request (= 0) or based on fuel high pressure sensor errors (= 1)					

General information:

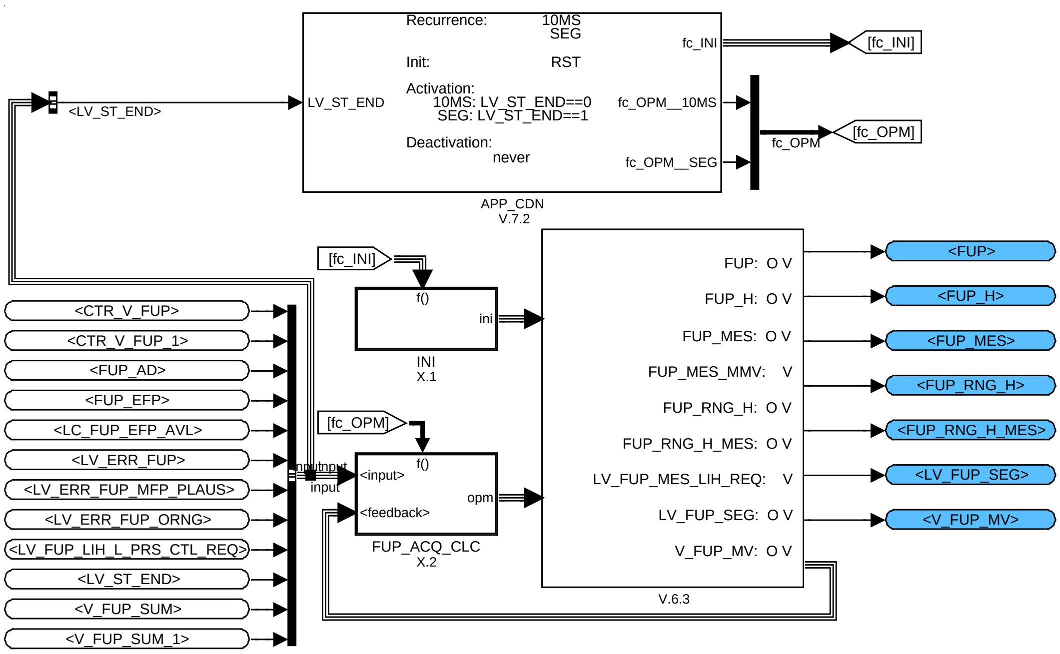
The fuel pressure sensor is delivering a voltage signal corresponding to the fuel pressure in the rail. Out of this sensor voltage a fuel pressure value is calculated via liniarisation table. An additional filter can be applied.

Application conditions:

Initialisation:	`RST`
Recurrence:	`10MS activated if LV_ST_END==0` `SEG activated if LV_ST_END==1`
Activation:	`-`
Deactivation:	`never or if activation-condition of other event is true`

Function description:

Formula section:



SDA_SRS / SDA V 6.1.1 / 01−Mar−2011

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Figure 4.30.1: :

4.30.1 Initialisation function

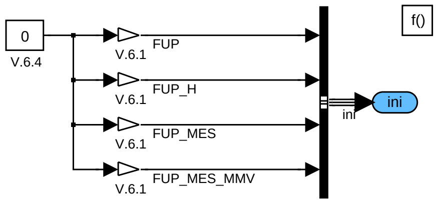

Figure 4.30.2: :

Function description

The fuel pressure calculation is split into three parts.

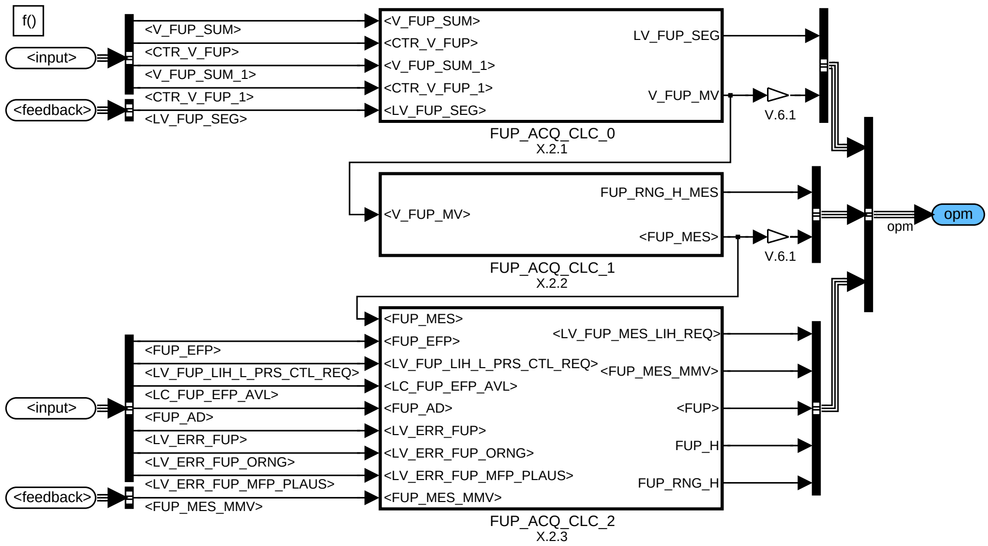

Figure 4.30.3: :

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4.30.2 Signal acquisition

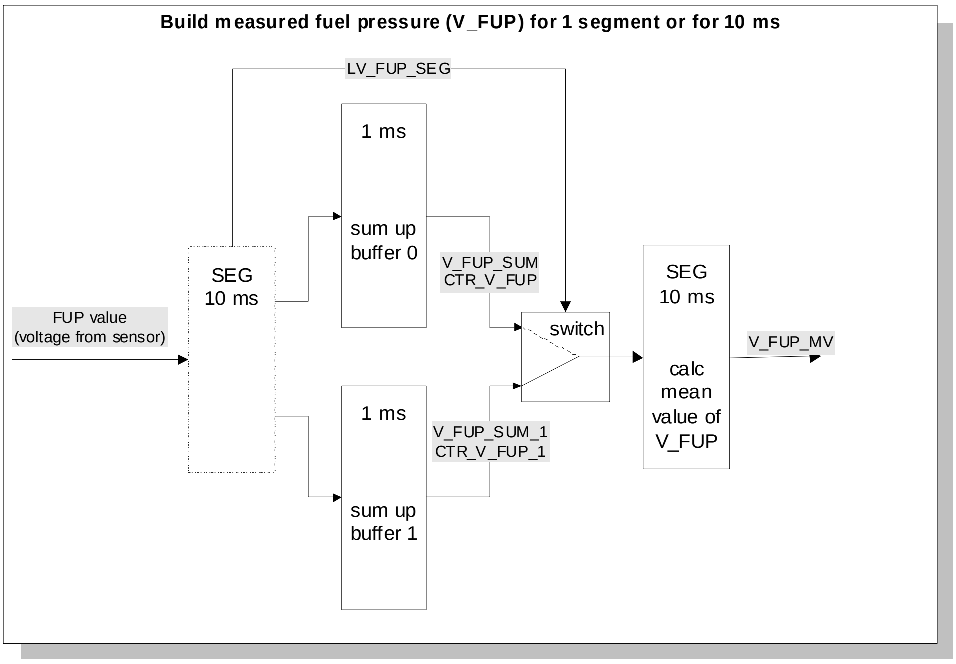

Figure 4.30.4: :

The raw value (voltage) for FUP is measured by continous conversion every 1 ms. The values (10 bit) are summed up in two alternating buffers, SUM_V_FUP or SUM_V_FUP_1. The numbers of values are counted in comparable buffers CTR_FUP or CTR_FUP_1. This mechanism is necessary to synchronize the measurement and the calculation of FUP_MES (build mean value with a standardized range) and will be done within BSW.
Depending on the logical variable LV_FUP_SEG one of the two buffers SUM_V_FUP or SUM_V_FUP_1 and the respective counter CTR_V_FUP or CTR_V_FUP_1 are selected for writing, the contents of the other buffer (counter) is used for calculations and diagnosis (after this buffer and the corresponding counter have been read they are cleared).
After having read out one buffer SUM_V_FUP or SUM_V_FUP_1 the buffer has to be cleared as well as the corresponding counter CTR_V_FUP or CTR_V_FUP_1.
A two-buffer-system is used to avoid incorrect FUP calculation.

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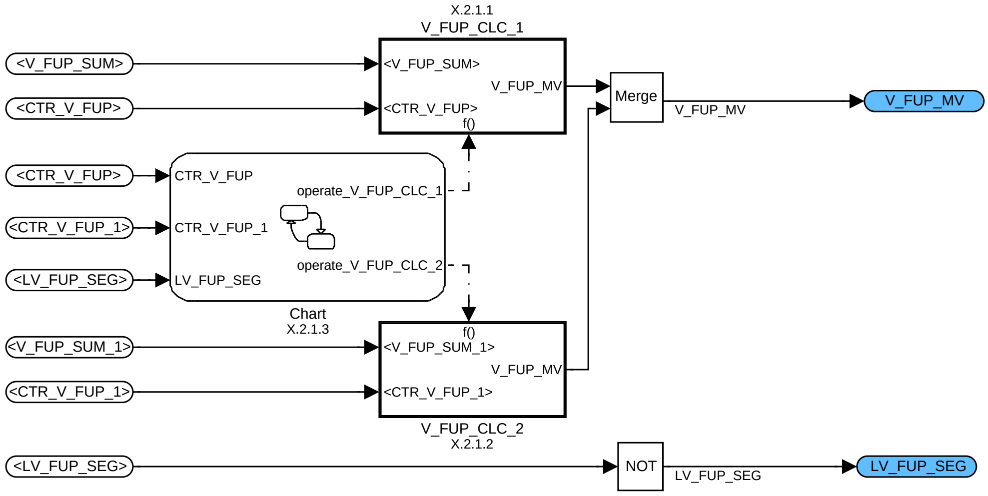

Figure 4.30.5: :

4.30.2.1 Chart

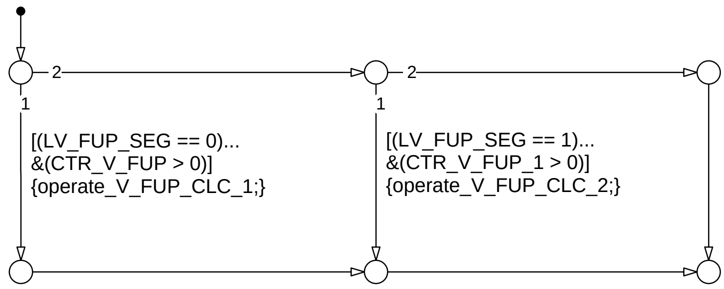

Figure 4.30.6: :

4.30.2.2 First calculation

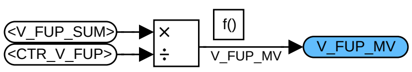

Figure 4.30.7: :

4.30.2.3 Second calculation

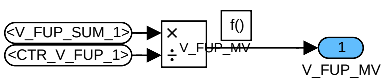

Figure 4.30.8: :

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4.30.3 Fuel pressure determination

The linearization table gives the relationship between the sensor signal and the fuel pressure. This data has to be delivered by the sensor supplier.

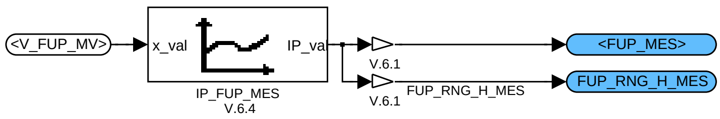

Figure 4.30.9: :

4.30.4 Coordination function for normal and LIH operation

The correlation constant gives the filter constant for the fuel pressure. This filtering could be necessary to get a more stable signal for the fuel pressure. If limp home is active and a low pressure sensor is available than the low pressure sensor value (FUP_EFP) instead of the high pressure sensor value is mapped to FUP. This transition is filtered to avoid a big steps in FUP.

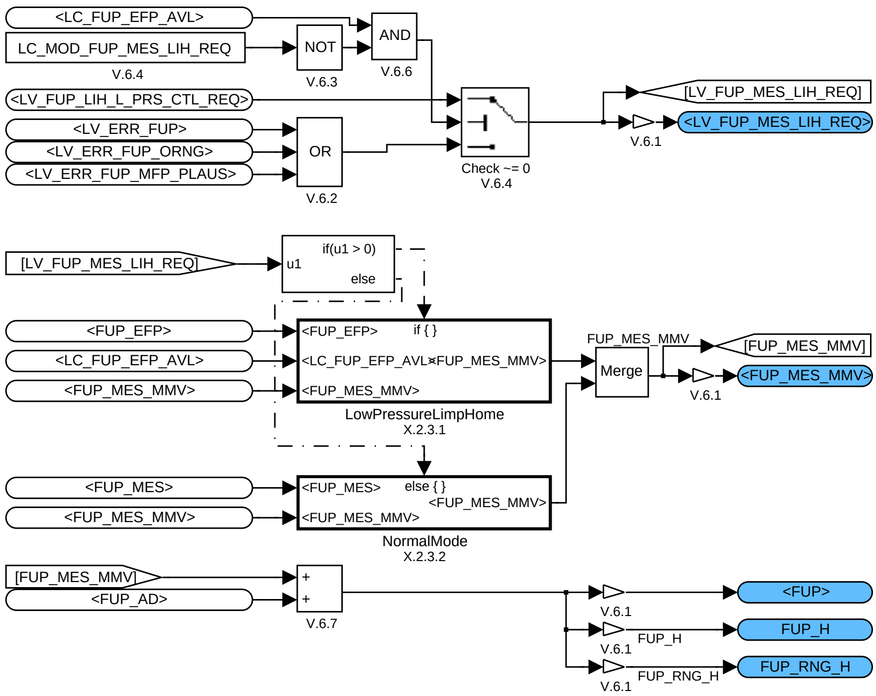

Figure 4.30.10: :

4.30.4.1 Low pressure limp-home operation

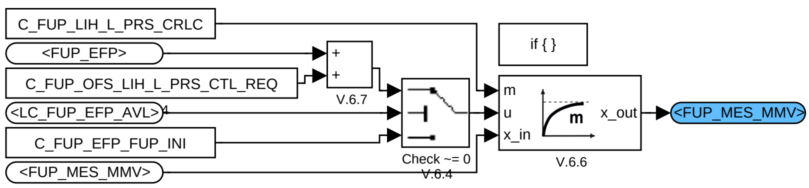

Figure 4.30.11: :

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4.30.4.2 Normal operation

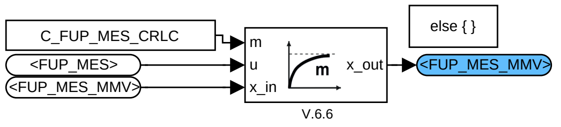

Figure 4.30.12: :

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4.31 Fuel pressure of low pressure pump

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FUP_EFP	O/V	0... FFFFH	0... 173888	2.6533608	hPa
Fuel pressure EFP					
FUP_EFP_CTR	-	0... FFFFH	0... 65535	1	-
Number of samples in buffer FUP_EFP_sum					
FUP_EFP_CTR_1	-	0... FFFFH	0... 65535	1	-
Number of samples in buffer FUP_EFP_sum_1					
FUP_EFP_MES	O/V	0... FFFFH	0... 173888	2.6533608	hPa
Measured Fuel pressure value in the feedline					
FUP_EFP_MMV	V	0... FFFFH	0... 173888	2.6533608	hPa
Mean fuel pressure value in the feedline					
FUP_EFP_SUM	-	0... FFFFFFFFH	0... 20971500	0.00488281	V
Accumulated low fuel pressure sensor measurements for segment number (2n 1), n=1,2,3,...					
FUP_EFP_SUM_1	-	0... FFFFFFFFH	0... 20971500	0.00488281	V
Accumulated low fuel pressure sensor measurements for segment number (2n), n=1,2,3,...					
LV_FUP_EFP_SEG	-	0... 1H	0 ...1	1	-
idicates if segment number is even or odd					
V_FUP_EFP	V	0... 7FFFH	0... 4.99984741	15.25879e3	V
Low fuel pressure EFP sensor raw acquisition					
V_FUP_EFP_MV	O/V	0... 7FFFH	0... 4.99984741	15.25879e3	V
Voltage of the low fuel pressure sensor (for diagnosis)					

Input data:

ERR_SYM_FUP_EFP {p. 4733}	LV_ERR_FUP_EFP {p. 4733}	LV_ES {p. 1720}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_EFP_LIH	-	0... FFFFH	0... 173888	2.6533608	hPa
Limp home value for fuel pressure of low pressure circuit (opening pressure of safety valve)					
C_FUP_EFP_MES_CRLC	-	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant for fuel pressure filter for the low pressure pump					
IP_FUP_EFP	-	0... FFFFH	0... 173888	2.6533608	hPa
LDP_V_FUP_EFP_IP_FUP_EFP	3	0... 7FFFH	0... 4.99984741	15.25879e3	V
Fuel pressure sensor linearisation table					

4.31.1 Fuel pressure acquistion of low pressure signal

The raw value (voltage) for FUP_EFP is measured by continous conversion every 1 ms. The values (10 bit) are summed up in two alternating buffers, FUP_EFP_SUM or FUP_EFP_SUM_1. The numbers of values are counted in comparable buffers FUP_EFP_CTR or FUP_EFP_CTR_1. This mechanism is necessary to synchronize the measurement and the calculation of FUP_EFP_MES (build mean value with a standardized range)
Depending on the logical variable LV_FUP_EFP_SEG one of the two buffers FUP_EFP_SUM or FUP_EFP_SUM_1 and the respective counter FUP_EFP_CTR or FUP_EFP_CTR_1 are selected for writing, the contents of the other buffer (counter) is used for calculations and diagnosis (after this buffer and the corresponding counter have been read they are cleared).

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After having read out one buffer FUP_EFP_SUM or FUP_EFP_SUM_1 the buffer has to be cleared as well as the corresponding counter FUP_EFP_CTR or FUP_EFP_CTR_1.
A twobuffersystem is used to avoid incorrect FUP_EFP calculation.
The fuel pressure of the feedline is calculated by means of the fuel pressure sensor for the feedline. Additionally in case of sensor error a substitude value will be taken.

Use **ACTION_INFR_GetVFupEfpSens(OUT** <v_fup_efp>**)**

Application Condition

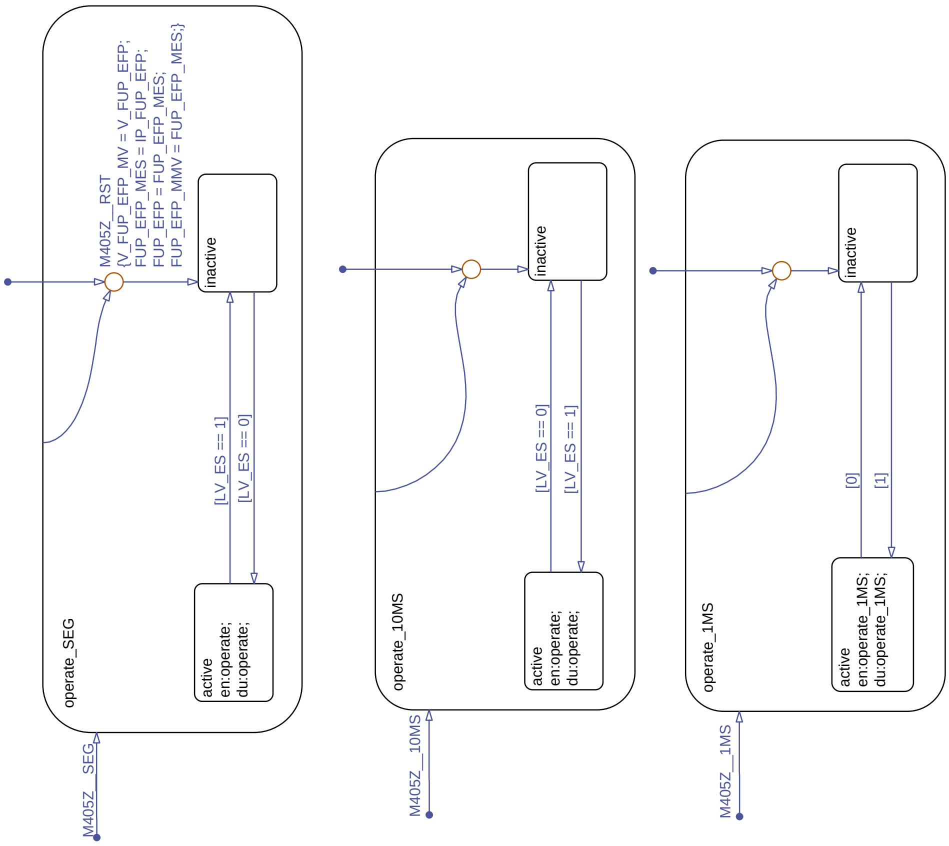

Figure 4.31.1: M405Z/APP_CDN/Chart

Function Description

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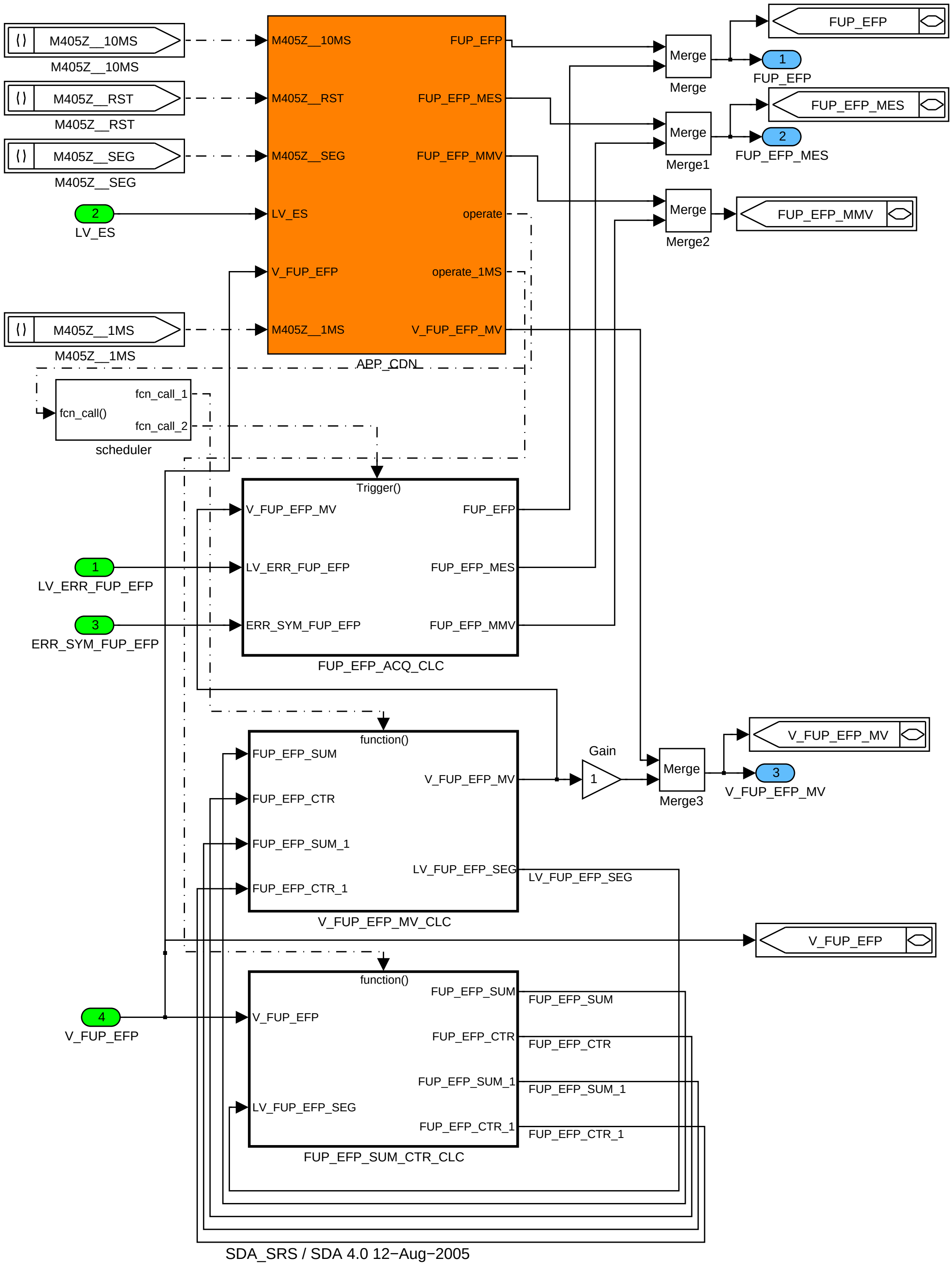

Figure 4.31.2: M405Z

4.31.1.1 <HEADER MODULE="M405Z/V_FUP_EFP_MV_CLC">

Calculation of V_FUP_EFP_MV.

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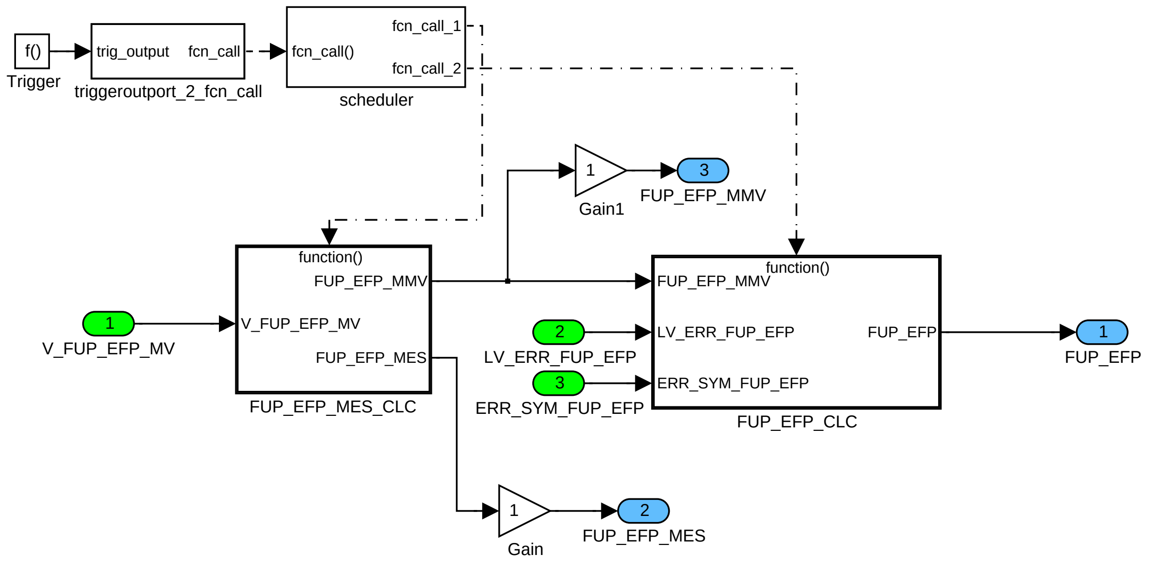

Figure 4.31.3: M405Z/FUP_EFP_ACQ_CLC

Fuel pressure of the electrical fuel pump calculation

Depending on different failure bits the mean value of the fuel pressure sensor or a subsitude value (opening point overpressure valve) is taken as FUP_EFP.

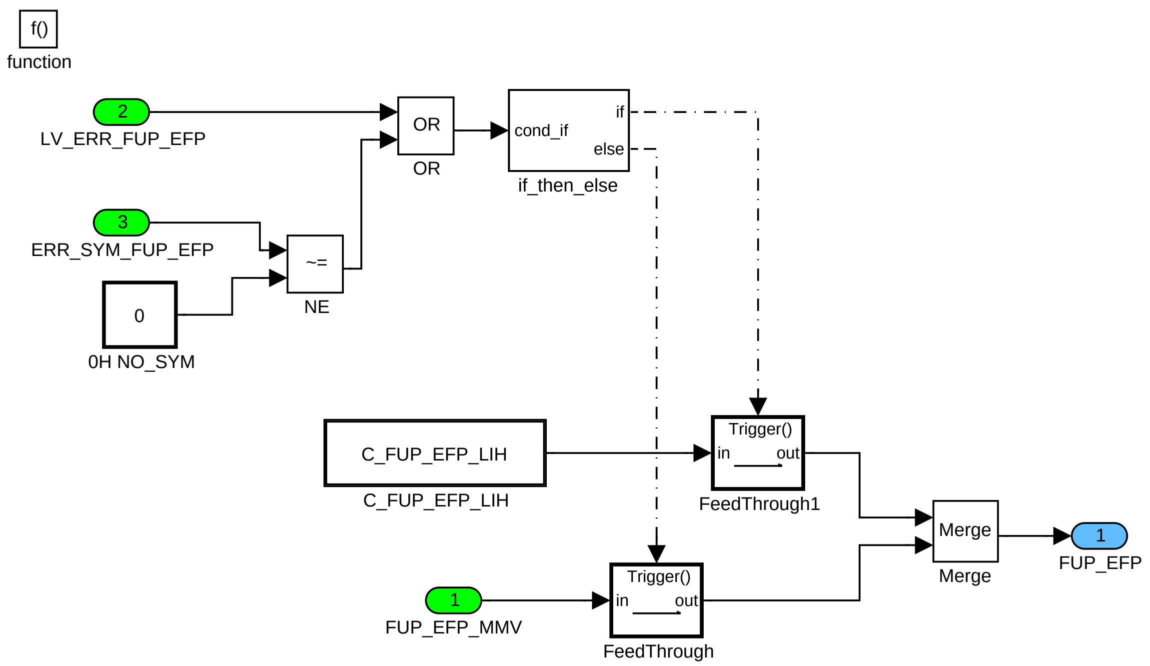

Figure 4.31.4: M405Z/FUP_EFP_ACQ_CLC/FUP_EFP_CLC

Sensor conversion

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The sensor value is converted via calibrated curve into a measured value. This value is then filtered.

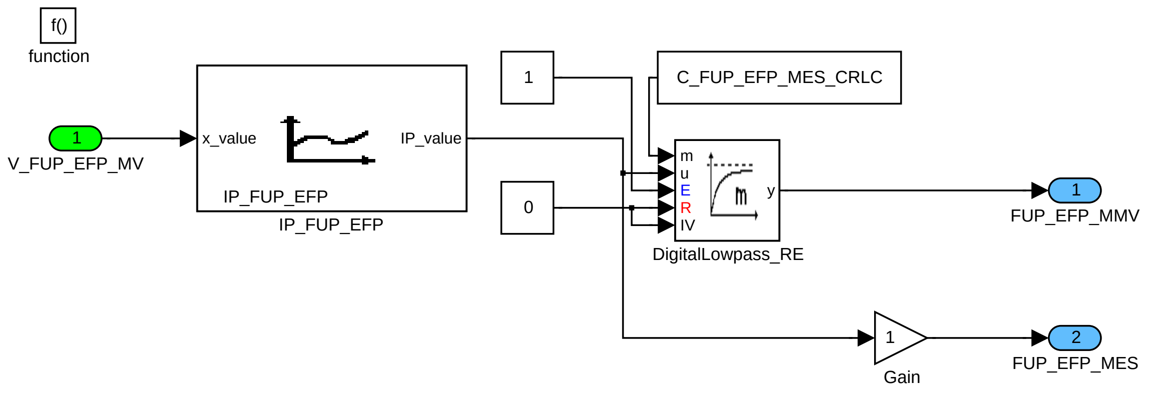

Figure 4.31.5: M405Z/FUP_EFP_ACQ_CLC/FUP_EFP_MES_CLC

4.31.1.2 M405Z/FUP_EFP_SUM_CTR_CLC

Calculation of FUP_EFP_SUM, FUP_EFP_CTR, FUP_EFP_SUM_1 and FUP_EFP_CTR_1

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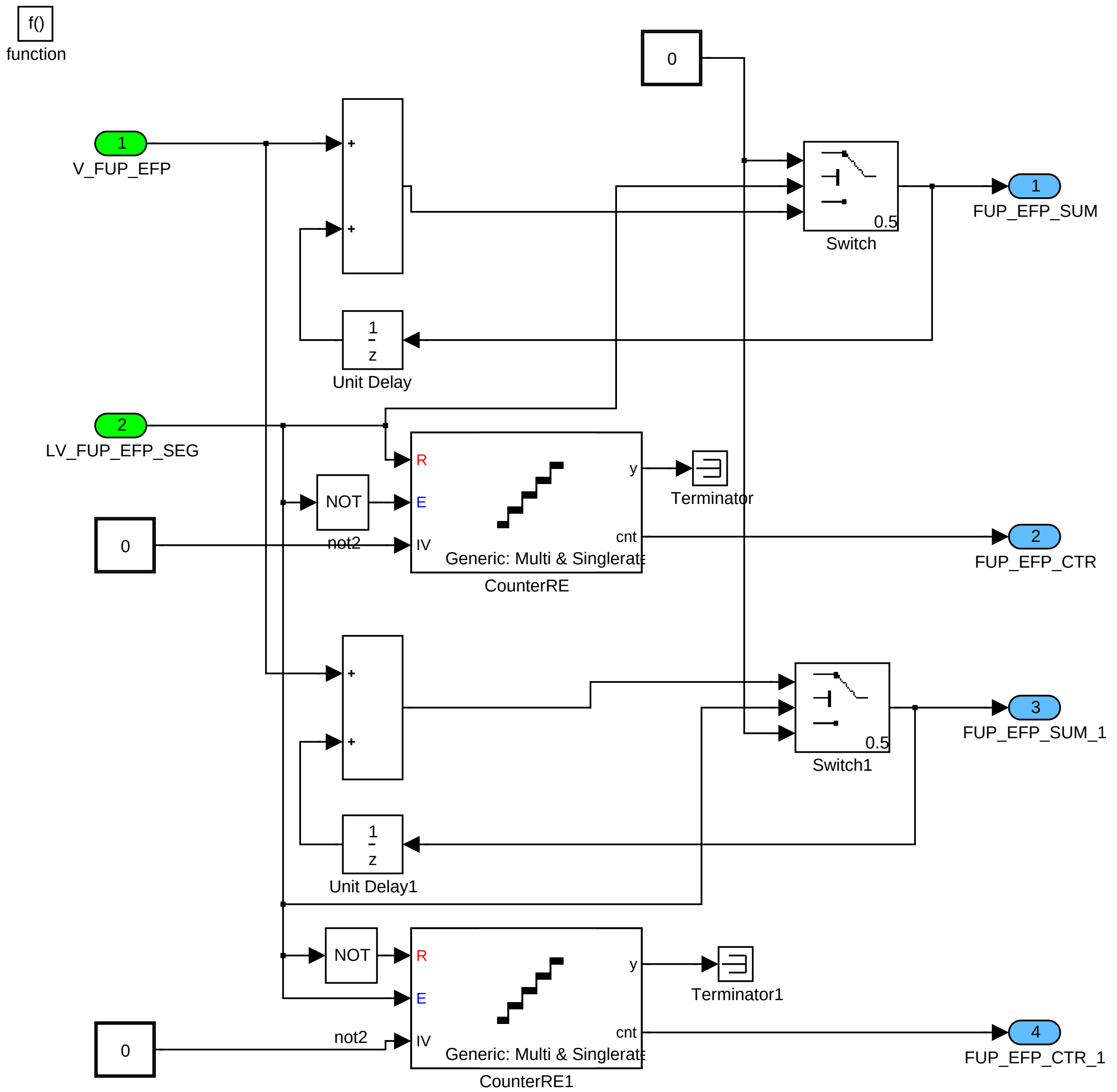

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Figure 6 M405Z/
FUP_EFP_SUM_CTR_CLC

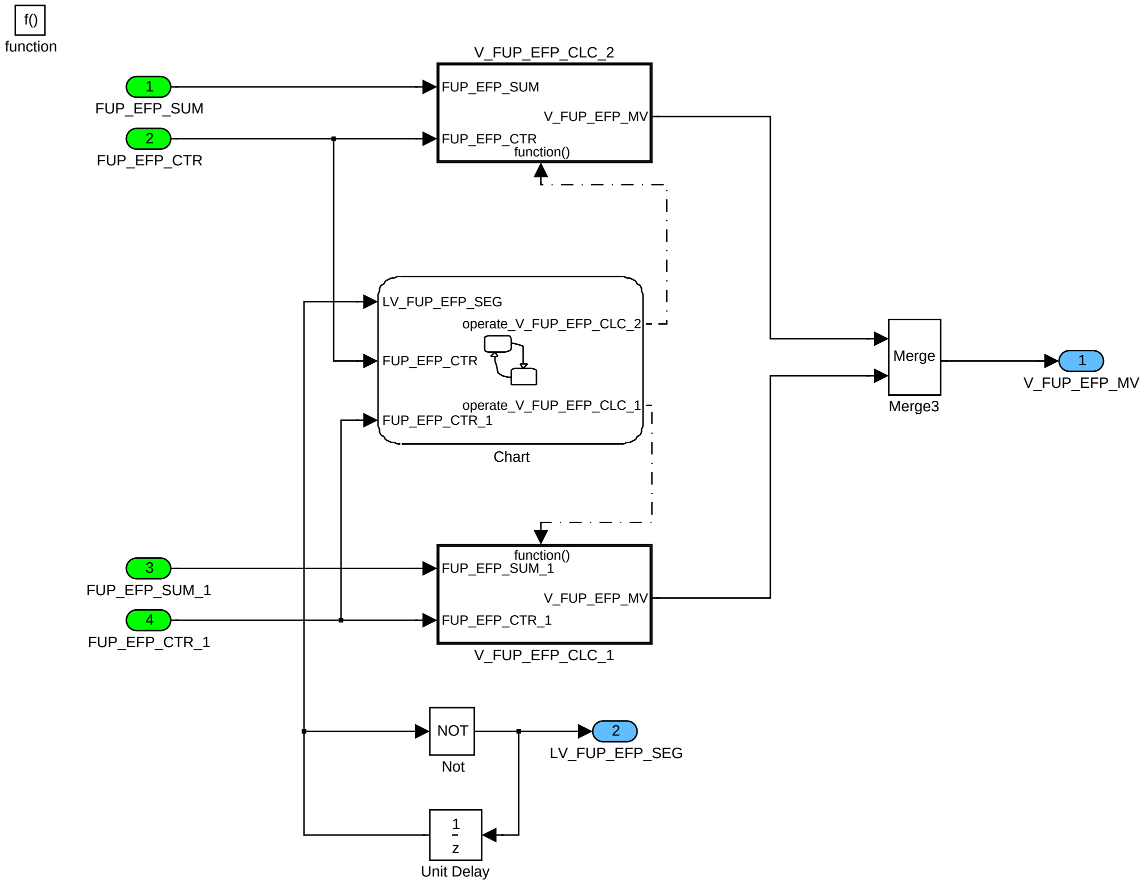

Figure 4.31.6: M405Z/V_FUP_EFP_MV_CLC

1.1.3 M405Z/V_FUP_EFP_MV_CLC/Chart

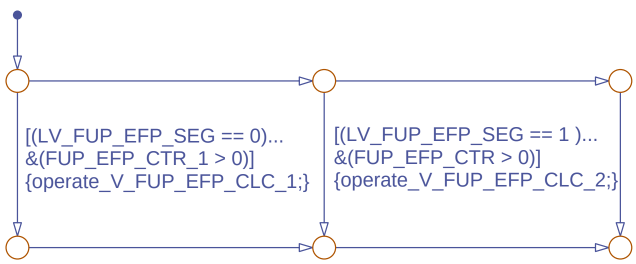

Figure 4.31.7: M405Z/V_FUP_EFP_MV_CLC/Chart

M405Z/V_FUP_EFP_MV_CLC/V_FUP_EFP_CLC_1

Calculation of V_FUP_EFP_MV.

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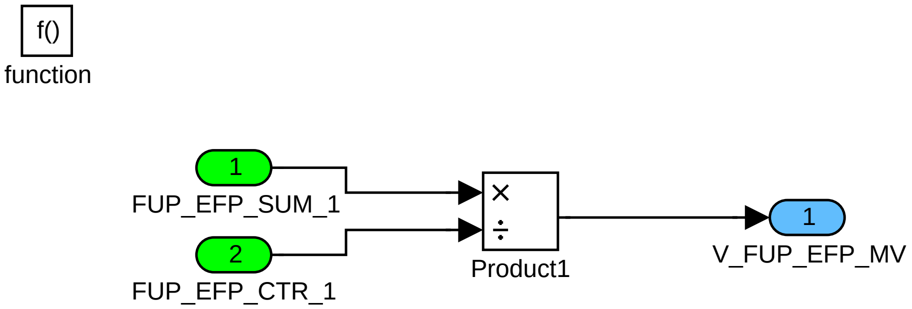

Figure 4.31.8: M405Z/V_FUP_EFP_MV_CLC/V_FUP_EFP_CLC_1

M405Z/V_FUP_EFP_MV_CLC/V_FUP_EFP_CLC_2

Calculation of V_FUP_EFP_MV.

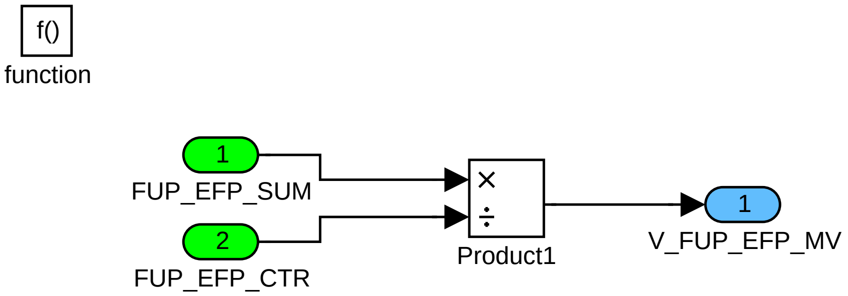

Figure 4.31.9: M405Z/V_FUP_EFP_MV_CLC/V_FUP_EFP_CLC_2

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4.32 Gear detection (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_INH_GS_IDC	V	0... FFH	0... 255	1	-
Counter for inhibiting gear-shift signal display					
GS_IDC_DISP	O/V	0... FFH	0... 255	1	-
Gear shift signal CAN - display type					
GS_IDC_GEAR	O/V	0... FFH	0... 255	1	-
Gear shift signal CAN - setpoint for gear					
LV_GS_DOWN_IDC_OFF	V	0... 1H	0 ...1	1	-
Gear shift down inhibited - CAN display off					
LV_GS_DOWN_IDC_OFF_1	V	0... 1H	0 ...1	1	-
Gear shift down 1 inhibited - CAN display off					
LV_GS_DOWN_IDC_OFF_2	V	0... 1H	0 ...1	1	-
Gear shift down 2 inhibited - CAN display off					
LV_GS_DOWN_IDC_OFF_3	V	0... 1H	0 ...1	1	-
Gear shift down 3 inhibited - CAN display off					
LV_GS_IDC_OFF	V	0... 1H	0 ...1	1	-
SPA not coded					
LV_INH_GS_IDC_1	V	0... 1H	0 ...1	1	-
Gear shift signal display 1 on CAN inhibited					
LV_INH_GS_IDC_2	V	0... 1H	0 ...1	1	-
Gear shift signal display 2 on CAN inhibited					

Input data:

GEAR {p. 1302}	GS_IDC_DISP_RAW {p. 8285}	GS_IDC_GEAR_RAW {p. 8286}	LV_AT {p. 654}
LV_ERR_BN_VS_TCS {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_CRK {p. 4455}	LV_ERR_VS_CAN {p. 1565}
LV_ERR_VS_PLAUS {p. 5021}	LV_IGK {p. 906}	LV_MTC_CUR_OFF {p. 6565}	LV_VAR_AMT {p. 655}
LV_VAR_TCT {p. 656}	N {p. 1525}	VS {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_INH_GS_IDC_DEC	-	0... FFH	0... 255	1	-
Decrement for inhibiting gear-shift signal display					
C_CTR_INH_GS_IDC_INC	-	0... FFH	0... 255	1	-
Increment for inhibiting gear-shift signal display					
C_CTR_INH_GS_IDC_MAX	-	1... FFH	1... 255	1	-
Max. counter for inhibiting gear-shift signal display					
C_GS_DISP	-	0... FFH	0... 255	1	-
Constant for calibrating gear shift condition to be checked (up/down, etc.)					
C_GS_IDC_DISP_MAX	-	0... FFH	0... 255	1	-
Max-value for display type					
C_GS_IDC_DISP_SUB	-	0... FFH	0... 255	1	-
Default-value for display type					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_GS_IDC_GEAR_MAX	-	0... FFH	0... 255	1	-
Max-value for gear display					
C_GS_IDC_GEAR_SUB	-	0... FFH	0... 255	1	-
Default-value for gear display					
ID_GS_IDC_GEAR_MIN_1	-	0... FFH	0... 255	1	-
LDP_VS_ID_GS_IDC_GEAR_MIN_1	8	0... FFH	0... 255	1	km/h
Min. gear 1 depending on VS					
ID_GS_IDC_GEAR_MIN_2	-	0... FFH	0... 255	1	-
LDP_VS_ID_GS_IDC_GEAR_MIN_2	8	0... FFH	0... 255	1	km/h
Min. gear 2 depending on VS					
LC_GS_IDC_TCT_ENA	-	0... 1H	0 ...1	1	-
Enabling plausibility also for TCT					

4.32.1 Plausibility of gear shift setpoint displayed on CAN

FUNCTION DESCRIPTION:

General information:

The calculation of gear shift signal setpoint (output BMW-layer) is based on VS and N.
Therefore the the gear shift signal setpoint should not be transmitted on CAN in case of VS-error, unplausible N or limp home mode.

Application conditions

Initialisation: *all 0 at reset*

Recurrence: *100 ms*

Activation:
```
LV_IGK = 1     and
LV_AT= 0       and
LV_VAR_AMT = 0   and
(LV_VAR_TCT = 0      or
LC_GS_IDC_TCT_ENA = 1)
```

Formula section:

Inhibition of gear shift down:

if GS_IDC_GEAR_RAW < = GEAR **and**
GS_IDC_DISP_RAW = C_GS_DISP **and**
GS_IDC_GEAR_RAW != C_GS_IDC_GEAR_SUB
Then LV_GS_DOWN_IDC_OFF_1 = 1
Else LV_GS_DOWN_IDC_OFF_1 = 0
Endif

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If GS_IDC_GEAR_RAW < ID_GS_IDC_GEAR_MIN_2 **and**
GS_IDC_GEAR_RAW != C_GS_IDC_GEAR_SUB
Then LV_GS_DOWN_IDC_OFF_2 = 1
Else LV_GS_DOWN_IDC_OFF_2 = 0

```
Endif

If        GS_IDC_GEAR_RAW <  ID_GS_IDC_GEAR_MIN_1 and
          GS_IDC_DISP_RAW ! = C_GS_DISP            and
          GS_IDC_GEAR_RAW  != C_GS_IDC_GEAR_SUB
Then      LV_GS_DOWN_IDC_OFF_3 = 1
Else      LV_GS_DOWN_IDC_OFF_3 = 0
Endif

If        LV_GS_DOWN_IDC_OFF_1 = 1    or
          LV_GS_DOWN_IDC_OFF_2 = 1    or
          LV_GS_DOWN_IDC_OFF_3 = 1
Then      LV_GS_DOWN_IDC_OFF = 1
Else      LV_GS_DOWN_IDC_OFF = 0
Endif

If        [B_spa_cist = 0        and                       // no SPA coded,
          (GS_IDC_GEAR_RAW != C_GS_IDC_GEAR_SUB or        // Spa_gang > 0
          GS_IDC_DISP_RAW ! = C_GS_IDC_DISP_SUB)]   or     // Spa_art > 0
          [GS_IDC_GEAR_RAW > C_GS_IDC_GEAR_MAX or          // Spa_gang > max.
          GS_IDC_DISP_RAW  > C_GS_IDC_DISP_MAX]              // Spa_art > max.
Then      LV_GS_IDC_OFF = 1
Else      LV_GS_IDC_OFF = 0
Endif
```

General suppressing of gear shift setpoint:

```
If        (LV_GS_DOWN_IDC_OFF = 1             OR
            LV_ERR_VS_CAN      = 1              OR     // VS-CAN-signal not valid,
                                                         // no debounced error, only
                                                         flag received via CAN
          LV_GS_IDC_OFF = 1)
Then      If       CTR_INH_GS_IDC < C_CTR_INH_GS_IDC_MAX
           Then   CTR_INH_GS_IDC = CTR_INH_GS_IDC + C_CTR_INH_GS_IDC_INC
           Else    LV_INH_GS_IDC_1 = 1
           Endif
Else      If       CTR_INH_GS_IDC > 0
           Then   CTR_INH_GS_IDC = CTR_INH_GS_IDC - C_CTR_INH_GS_IDC_DEC
           Else    LV_INH_GS_IDC_1 = 0
           Endif
Endif

If        LV_ERR_CRK = 1                      OR     // also transmitted on CAN for
                                                   // N-signal invalid
          LV_MTC_CUR_OFF = 1                  OR     // limp-home
          LV_ERR_VS_PLAUS = 1                 OR     // VS-error (PIN)
          LV_ERR_BN_VS_TCS = 1                OR     // no VS-CAN-signal CAN12H
          LV_ERR_CAN_BOFF = 1                        // CAN-bus-off
Then      LV_INH_GS_IDC_2 = 1
```

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Else LV_INH_GS_IDC_2 = 0
Endif

If LV_INH_GS_IDC_1 = 1 **or**
LV_INH_GS_IDC_2 = 1
Then GS_IDC_GEAR = C_GS_IDC_GEAR_SUB
GS_IDC_DISP = C_GS_IDC_DISP_SUB
Else GS_IDC_GEAR = GS_IDC_GEAR_RAW
GS_IDC_DISP = GS_IDC_DISP_RAW
Endif

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4.33 Gear ratio

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_GR	V	0... FFFFH	0... 1.999969	30.5175e-6	-
Factor for setpoint/actual reduction ratio of rear axle					
FAC_GR_MMV_AV	O/V/S	0... FFFFH	0... 1.999969	30.5175e-6	-
Rear axle ratio adaptation value					
GEAR	O/V	0... FFH	0... 255	1	-
Common gear, independent from AT or MT					
GEAR_EF	O/V	0... FFH	0... 255	1	-
Gear used for exhaust flap functionality					
GR_AT	O/V	0... FFH	0... 255	1	-
Automatic transmission gear					
GR_MT	O/V	0... FFH	0... 255	1	-
Manual transmission gear					
GR_RAX_AV	V	0... FFFFH	0... 255.99609375	0.00390625	-
Current rear axle ratio					
LV_DRI	O/V	0... 1H	0 ...1	1	-
Logical variable for engaged drive					
LV_RNG_L	O/V	0... 1H	0 ...1	1	-
Logical variable for engaged low range					
LV_RNG_L_AT	O/V	0... 1H	0 ...1	1	-
Logical variable for engaged low range AT					
N_MMV_GR_DET	-	0... 1FE0H	0... 8160	1	rpm
Filtered engine speed for gear ratio detection					
N_VS_RATIO	O/V	0... FFH	0... 255	1	rpm/(km/h)
engine speed /vehicle speed ratio, corrected by adaptation factor					
N_VS_RATIO_RAW	-	0... FFH	0... 255	1	rpm/(km/h)
Engine speed /vehicle speed ratio(raw value)					
STATE_GEAR_REV_AT_AMT	O/V	0... 1H	0 ...1	1	-
AT/AMT reverse gear (activ = 1, inactive = 0)					
VS_WHEEL	V	0... FFH	0... 255	1	km/h
Vehicle speed at wheel					

Input data:

C_DIAM_WHEEL {p. 1176}	GEAR_INFO {p. 1564}	GR_SUB_MT {p. 798}	LC_AD_CLR_VAR {p. 528}
LV_AT {p. 654}	LV_CITY {p. 799}	LV_CS {p. 8394}	LV_ERR_BLS_PLAUS {p. 4209}
LV_ERR_BN_VS_TCS {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_CS {p. 5015}	LV_ERR_TOUT_ASR_1 {p. 802}
LV_ERR_VS {p. 5021}	LV_ES {p. 1720}	LV_ETCU_SPT_SWI {p. 1565}	LV_IM_BLS {p. 852}
LV_PUC {p. 1720}	LV_SOF_SWI_REQ {p. 3851}	LV_ST {p. 1720}	LV_VAR_ETCU_SPT {p. 656}

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LV_VAR_TCT {p. 656}	N {p. 1525}	N_WHEEL_RE_LE {p. 806}	N_WHEEL_RE_RI {p. 806}
STATE_ETCU_PROG_INFO {p. 1574}	VS_H {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_GR	V	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant for adaptation of the rear axle					
C_CRLC_N_MMV_GR_DET	V	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant for calculation of N_MMV_GR_DET filtered value					
C_CRLC_N_VS_RATIO_RAW	V	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant for calculation of N_VS_RATIO filter value					
C_GR_RAX_SP	V	0... FFFFH	0... 255.99609375	0.00390625	-
Rear axle ratio of standard rear axle					
C_MIN_VS_RATIO	V	0... FFH	0... 255	1	km/h
Minimum engine speed for engine speed /vehicle speed ratio calculation					
C_N_VS_CRU_GEAR2_PUC_SP	V	0... FFH	0... 255	1	rpm/(km/h)
N/VS ratio in case of PUC in 2nd gear with standard rear axle					
C_N_VS_CRU_GRD_FAC_GR_MAX	V	0... FFH	0... 255	1	rpm/(km/h)
Gradient of N/VS ratio below which FAC_GR is adapted					
C_STATE_ETCU_PROG_INFO	V	0... FFH	0... 255	1	-
Manual switch for activating low range AT detection					
ID_GR_MT__N_VS_RATIO	V	0... FFH	0... 255	1	-
LDP_N_VS_RATIO_GR_MT	13	0... FFH	0... 255	1	rpm/(km/h)
Index table for Gear Ratio detection					
LC_N_VS_RATIO_N_WHL	V	0... 1H	0 ...1	1	-
Calculation of engine speed/vehicle speed ratio based on wheel speeds is selected when active, otherwise calculation based on engine speed and vehicle speed is selected					
LC_RNG_L	V	0... 1H	0 ...1	1	-
Manual switch for low range detection					

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General information

Gear ratio calculation is depending on transmission type (manual or automatic). When manual transmission is detected and (LV_AT == 0 & & LV_VAR_TCT == 0), gear ratio is detected by using engine speed /vehicle speed ratio. In case of automatic transmission, gear ratio is detected by using the CAN-information of EGS. If LV_VAR_TCT = 1 then gear ratio is calculated versus CAN informations coming from DKG.

Application conditions:

Initialisation:

```
GR_MT = 0 at [ LV_ES = 1 or LV_ST = 1 or LV_CS = 1 ]
GR_AT, LV_DRI = 0 at [ LV_ES = 1 or LV_ST = 1 ]
FAC_GR_MMV_AV  =  1.0
when  ECU is new                                          or

when  adaptation is reset by LC_AD_CLR_VAR                or
```

```
when  values of group VAR could not be read out from the non
volatile memory;
else:  FAC_GR_MMV_AV is read back from non volatile memory

GEAR = 0
GEAR_EF  =  0

N_MMV_GR_DET = N

if LC_N_VS_RATIO_N_WHL=1
then
N_VS_RATIO = N /  (((N_WHEEL_RE_LE + N_WHEEL_RE_RI) /  2)

                   * C_DIAM_WHEEL) /  (2000 /  3.6)
else
N_VS_RATIO = 255 rpm/ (km/ h)
endif
```

Activation: at all engine operating states except LV_ES and LV_ST .

Deactivation: at engine operating states LV_ES and LV_ST.

Recurrence: 10 ms **except** subchapter 1.1.1: 100 ms

Function description:

Formula section:

4.33.1 Manual transmission (LV_AT = 0 and LV_VAR_TCT = 0)

Formula section:

Executed only if LV_AT = 0 and LV_VAR_TCT = 0

if(1) [LV_ERR_VS = 1 **and** LV_ERR_CAN_BOFF = 1] **or**
[LV_ERR_VS = 1 **and** LV_ERR_BN_VS_TCS = 1] **or**
[LV_ERR_VS = 1 **and** LV_ERR_TOUT_ASR_1 = 1]
then(1) N_VS_RATIO = 0
GR_MT = GR_SUB_MT
else(1) $N\_MMV\_GR\_DET_n$ = $N\_MMV\_GR\_DET_{n-1}$ +
+ C_CRLC_N_MMV_GR_DET(N - $N\_MMV\_GR\_DET_{n-1}$)

N_WHEEL_RE_AV = (N_WHEEL_RE_LE + N_WHEEL_RE_RI) /2

VS_WHEEL = N_WHEEL_RE_AV * C_DIAM_WHEEL /(2000 /3.6)
// The resolution adaptation is 2000/(0.015625*0.0625*3.6)

N_VS_RATIO_RAW = N_MMV_GR_DET /VS_WHEEL

$N\_VS\_RATIO_n$ = $N\_VS\_RATIO_{n-1}$ +
+ C_CRLC_N_VS_RATIO_RAW(N_VS_RATIO_RAW - $N\_VS\_RATIO_{n-1}$)

if(2) LC_N_VS_RATIO_N_WHL = 1

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then(2)
if(3) VS_WHEEL $>$ C_MIN_VS_RATIO
then(3) N_VS_RATIO = N_VS_RATIO$_n$
if(4) LV_CS = 1
then(4) GR_MT = 0
else(4) GR_MT = ID_GR_MT__N_VS_RATIO
endif(4)
else(3) N_VS_RATIO = 255 rpm/(km/h)
GR_MT = 0
endif(3)
else(2)
if(5) LV_CS = 0
then(5)
if(6) VS_H $>$ C_MIN_VS_RATIO
then(6) N_VS_RATIO = N /VS_H
else(6) N_VS_RATIO = 255 rpm/(km/h)
endif(6)
GR_MT = ID_GR_MT__N_VS_RATIO
else(5) N_VS_RATIO = 0
GR_MT = 0
endif(5)
endif(2)
endif(1)

LDP_N_VS_RATIO_GR_MT = N_VS_RATIO$_n$ /FAC_GR_MMV_AV

4.33.1.1 Adaptation of different rear axle transmission ratios (only manual transmission)

Different rear axle ratios are used for the versions for different countries within the various vehicle series. The function aims at learning the rear axle ratio and to use it for correction for gear detection.
The gear detection is applied with the standard rear axle. Moreover, the standard reduction ratio is applied as fixed value. Moreover, the n/vs ratio used by the vehicle for driving in 2nd gear and trailing throttle fuel cut-off is applied.

Learning the new rear axle ratio
The adaptation of the rear axle ratio is only effected in 2nd gear and at trailing throttle fuel cut-off PUC. The quotient of the actual value and the setpoint of the n/vs ratio is used for calculation of the new rear axle ratio and the factor between the actual and setpoint reduction ratio.
The rear axle ratio is adapted via an adaptive correlation constant C_CRLC_FAC_GR.
Moreover, FAC_GR is biased with FAC_GR_MMV_AV.

Formula section:

Executed only if (LV_AT = 0 and LV_VAR_TCT = 0)

if GEAR = 2 **and**

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LV_PUC = 1 **and**
LV_CS = 0 **and**
LV_ERR_CS = 0 **and**
LV_IM_BLS = 0 **and**
LV_ERR_BLS_PLAUS = 0 **and**
|N_VS_RATIO$_{n-1}$ - N_VS_RATIO$_{n}$| $<$ C_N_VS_CRU_GRD_FAC_GR_MAX

then *Calculation of the rear axle ratio "ACTUAL to SETPOINT values - rear axle"*
FAC_GR = N_VS_RATIO /C_N_VS_CRU_GEAR2_PUC_SP

Adaptation of the rear axle ratio:
FAC_GR_MMV_AV$_{n}$ = FAC_GR_MMV_AV$_{n-1}$
+ C_CRLC_FAC_GR * (FAC_GR - FAC_GR_MMV_AV$_{n-1}$)

Reduction ratio of the currently installed rear axle:
GR_RAX_AV = C_GR_RAX_SP * FAC_GR_MMV_AV

The calculated N_VS_RATIO ratio is continually divided by the current value of FAC_GR_MMV_AV and the current multiplication result is used to obtain the correct gear from the value applied map ID_GR_MT__N_VS_RATIO.

The adaptation value FAC_GR_MMV_AV can be reset to 1 via the KWP command "delete variant".

4.33.2 Twin Clutch Transmission (LV_VAR_TCT = 1)

Gear ratio and LV_DRI are calculated versus CAN informations coming from DKG.

Formula section:

Executed only if LV_VAR_TCT = 1

GR_MT, LV_DRI = f(GEAR_INFO), see list below:

GEAR_INFO	Corresponding gear	GR_MT	LV_DRI
0H	neutral or park	0	0
1H	1st gear	1	1
2H	2nd gear	2	1
3H	3rd gear	3	1
4H	4th gear	4	1
5H	5th gear	5	1
6H	6th gear	6	1
7H	7th gear	7	1
AH	reverse gear	0	1

Figure 4.33.1:

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4.33.3 Automatic transmission (LV_AT = 1)

Gear ratio and LV_DRI are calculated versus CAN informations coming from EGS.

Formula section:

Executed only if LV_AT = 1

GR_AT, LV_DRI = f(GEAR_INFO), see list below:

GEAR_INFO	Corresponding gear	GR_AT	LV_DRI
0H	neutral or park	0	0
1H	1st gear	1	1
2H	2nd gear	2	1
3H	3rd gear	3	1
4H	4th gear	4	1
5H	5th gear	5	1
6H	6th gear	6	1
7H	7th gear	7	1
AH	reverse gear	0	1

Figure 4.33.2:

4.33.4 Information if the reverse gear (AT or TCT) is activ/inactiv :

Formula section:

If (LV_AT = 1 **or** LV_VAR_TCT = 1)
and GEAR_INFO = AH
then STATE_GEAR_REV_AT_AMT = 1
else STATE_GEAR_REV_AT_AMT = 0
endif

4.33.5 Low range detection (LV_RNG_L, LV_RNG_L_AT)

Depending on LC_RNG_L, the sport-switch and the LV_RNG_L_AT-request from EGS, the bit LV_RNG_L will be activated.

Meaning of C_STATE_ETCU_PROG_INFO:

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Bit	LV_RNG_L_AT will be set at condition:
0	*AT / TCT in "S" / "DS" ("comfort transmission"; LV_VAR_ETCU_SPT=0)*
1	*AT / TCT in manual mode "M1 ... 6" ("comfort transmission"; LV_VAR_ETCU_SPT=0)*
2	*AT- / TCT-sport-switch in "S" / "DS" ("sport transmission"; LV_VAR_ETCU_SPT=1)*
3	*AT- / TCT-sport-switch in manual mode "M1 ... 6" ("sport transmission"; LV_VAR_ETCU_SPT=1)*
4	*Gearbox-sportswitch active and AT / TCT ("comfort transmission"; LV_VAR_ETCU_SPT=0)*
5	*Gearbox-sportswitch active and AT / TCT ("sport transmission"; LV_VAR_ETCU_SPT=1)*
6	*always with MT*
7	*not used*

Figure 4.33.3:

Formula section:

If

AT /TCT "comfort" in "S-mode"
[STATE_ETCU_PROG_INFO = 1H **and**
LV_VAR_ETCU_SPT = 0 **and**
Bit 0 of C_STATE_ETCU_PROG_INFO is set**]** **or**

AT /TCT "comfort" in "M-mode"
[STATE_ETCU_PROG_INFO = 2H **and**
LV_VAR_ETCU_SPT = 0 **and**
Bit 1 of C_STATE_ETCU_PROG_INFO is set**]** **or**

AT/TCT "sport" in "S-mode"
[STATE_ETCU_PROG_INFO = 1H **and**
LV_VAR_ETCU_SPT = 1 **and**
Bit 2 of C_STATE_ETCU_PROG_INFO is set**]** **or**

AT/TCT "sport" in "M-mode"
[STATE_ETCU_PROG_INFO = 2H **and**
LV_VAR_ETCU_SPT = 1 **and**
Bit 3 of C_STATE_ETCU_PROG_INFO is set**]** **or**

AT /TCT "comfort" in "sport-mode-gearbox"
[LV_VAR_ETCU_SPT = 0 **and**
LV_ETCU_SPT_SWI = 1 **and**
Bit 4 of C_STATE_ETCU_PROG_INFO is set**]** **or**

AT /TCT "sport" in "sport-mode-gearbox"
[LV_VAR_ETCU_SPT = 1 **and**
LV_ETCU_SPT_SWI = 1 **and**
Bit 5 of C_STATE_ETCU_PROG_INFO is set**]** **or**

MT continious in "sport"-mode
[LV_AT = 0 **and** LV_VAR_TCT = 0 **and**
Bit 6 of C_STATE_ETCU_PROG_INFO is set**]**

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```
Then    LV_RNG_L_AT = 1
Else    LV_RNG_L_AT = 0
Endif

if      LC_RNG_L = 1          or   // request from application system
        LV_SOF_SWI_REQ = 1    or   // request from sport switch
        LV_RNG_L_AT = 1            // request from gearbox
then    LV_RNG_L = 1
else    LV_RNG_L = 0
endif
```

4.33.6 Common Gear Ratio Independent from AT or MT (GEAR)

Description:

At not stopped or starting engine, GEAR displays the actual gear ratio independent from transmission type.

Formula section:

```
If (1)          LV_ES = 0
     and        LV_ST = 0
then (1)
     if (2)        LV_AT = 1
     then (2)      GEAR = GR_AT
     else (2)      GEAR = GR_MT
     endif (2)
else (1)           GEAR = 0
endif (1)
```

4.33.7 Gear Ratio for exhaust flap functionality

Description:

For the exhaust flap function the detected gear shall not change during gear shift. For this purpose the variable GEAR_EF is generated from GEAR.

Formula section:

```
If      LV_CS  =  0
then    GEAR_EF  =  GEAR        no gear shift because clutch is closed
else    GEAR_EF  =  GEAR_EF     gear shift possible because open clutch, GEAR_EF remains
                                unchanged
endif
```

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4.34 Drive train engaged

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DT	O/V	0... 1H	0 ...1	1	-
Logical variable drive train engaged					

Input data:

GR_MT {p. 1302}	LV_AT {p. 654}	LV_CS {p. 8394}	LV_DRI {p. 1302}
LV_ES {p. 1720}	LV_VAR_TCT {p. 656}	VS {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VS_MIN_DT	-	0... FFH	0... 255	1	km/h
Threshold for vehicle running and drive-train closed detection					
LC_MOD_DT_TCT	-	0... 1H	0 ...1	1	-
Mode selection of drive train engaged detection for variant twin clutch transmission (0 = like MT; 1 = like AT)					

General Information

General information:
Drive train engaged active (LV_DT=1) means drive train is closed, engine torque is transmitted to the wheels and the vehicle is running (VS >= C_VS_MIN_DT).
The depedabillity to the vehicle-speed has different reason for AT and MT/AMT vehicle.
AT:
With engaged gear it s normally not necessary to have an agressive idle-speed control. The only exception is a sudden breaking at slowly moving vehicle with engaged gear. In this case it s necessary to switch to the strong P_D - parameter map of the idle-speed control to avoid idle-speed break-down.
MT:
At start of the vehicle without pushing the accelerator pedal it s necessary to switch as fast as possible to the smooth P_D idle-speed control map to avoid vehicle jerking. Depending on slip of the clutch it may last too long until a gear-position determination is possible. Therefore in this case the switching from agressive to the smooth P_D map can happen even at slow vehicle speed.
Nevertheless the actualisation of LV_DT is strongly depending on the update-rate of the input signal VS .

Application Conditions

Initialization: RST
Recurrence: 10MS
Activation: always
Deactivation: never

Function description

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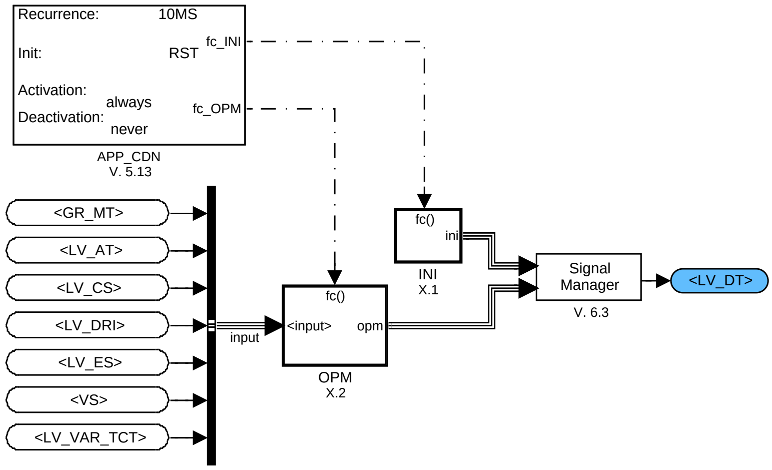

x SDA_SRS / SDA V 5.2 30−Oct−2006

Figure 4.34.1: : Path: TRSM_M400T

4.34.1 Initialisation at Reset

LV_DT = 0

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4.34.2 Formula section

4.34.2.1 Calculation of LV_DT

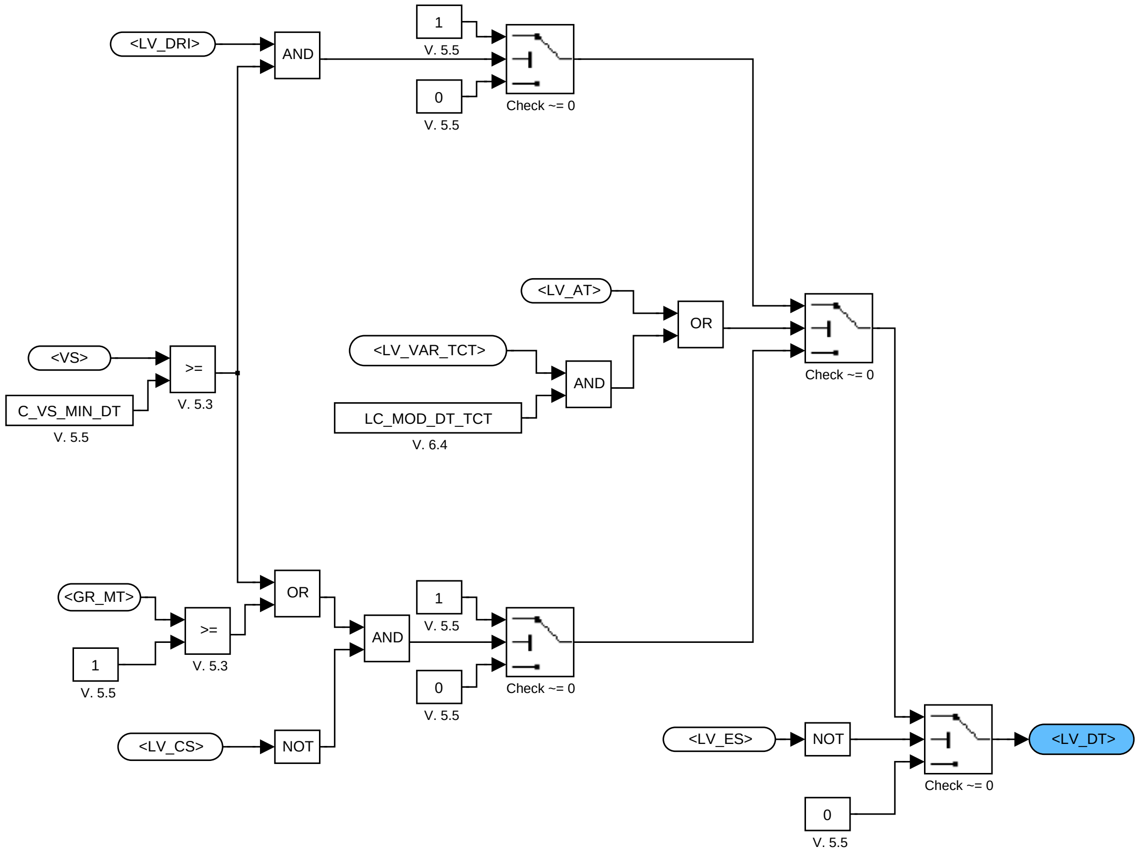

Figure 4.34.2: : Path: TRSM_M400T/OPM/CLC_LV_DT

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4.35 O2 sensor (lin, up) SPI interface ASW - BSW

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LSL_IF_SPI_RST_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating general status of ATIC42 initialisation after RESET					
STATE_LSL_IF_CONF_SPI_WR [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Mapping of contents to be written to ATIC42 INIT_REG_1					
STATE_LSL_IF_SPI_WR [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Bit-field mapping of contents to be written to ATIC42 INIT_REG_1					

Input data:

CTR_ERR_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 955}	FRQ_R_IT_OSC_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 955}	FRQ_R_IT_OSC_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 1320}	ICPLSL_LSL_IF [NC_CBK_EX_NR] {p. 2351}
LV_ICPLSL_ENA_LSL_IF [NC_CBK_EX_NR] {p. 2351}	LV_IPLSL_CTL_ENA_LSL_IF [NC_CBK_EX_NR] {p. 2351}	LV_LSL_ENA_LSL_IF [NC_CBK_EX_NR] {p. 1318}	LV_R_IT_CAL_ENA_LSL_IF [NC_CBK_EX_NR] {p. 1320}
LV_R_IT_OSC_ENA_LSL_IF [NC_CBK_EX_NR] {p. 1320}	LV_R_IT_SWI_RNG_LSL_IF [NC_CBK_EX_NR] {p. 1320}	LV_SWI_GAIN_LSL_IF [NC_CBK_EX_NR] {p. 2314}	LV_VLS_OFS_ADJ_ENA_LSL_IF [NC_CBK_EX_NR] {p. 2314}
NC_CBK_EX_NR {p. 1829}	STATE_LSL_IF_CONF_SPI_RD [NC_CBK_EX_NR] {p. 956}	STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}	T_DLY_DI_LSL_IF [NC_CBK_EX_NR] {p. 1318}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_LSL_IF_CONF_SPI_WR_INI	-	0... FFH	0... 255	1	-
Initialisation data of SPI register INIT_REG_2					
C_STATE_LSL_IF_SPI_WR_INI	-	0... FFH	0... 255	1	-
Initialisation data of SPI register INIT_REG_1					

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FUNCTION DESCRIPTION:

General information:

This function shall describe the interface between application software (ASW) and the basic software (BSW) that helps to initialise and to configure the ATIC42.
Furthermore, the function shall collect information about the status of the initialisations performed by itself and by other application software and send out a general status of the initialisation via the flag LV_LSL_IF_SPI_RST_END[i], which also indicates the readiness of the ATIC42.
The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
  i = 1, for exhaust cylinder bank 1
  i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
    i = 1, for single exhaust cylinder bank.

Description:

The function shall initialize the WRAF sensor interface **after RESETor upon erase of error management**by mirroring the contents of the calibration data C_STATE_LSL_IF_SPI_WR_INI into STATE_LSL_IF_SPI_WR[i] and C_STATE_LSL_IF_CONF_SPI_WR_INI into the variable STATE_LSL_IF_CONF_SPI_WR[i].

Table 1: Contents of the initialization variable C_STATE_LSL_IF_SPI_WR_INI

Bit	Bit Name	Meaning (value "1"/"0")
0	SWI_GAIN	IP gain 16 / 8
1	VLS_OFS_ADJ_ENA	IP offset measurement ON / OFF
2	ICPLSL_ENA	Enable / disable Icp
3	IPLSL_CTL_ENA	Enable / disable Ip control loop (2nd silicon)
4	R_IT_CAL_ENA	Enable / disable Ri calibration
5	R_IT_OSC_ENA	Ri oscillator ON / OFF
6	LSL_ENA	Sensor enable / disable
7	R_IT_SWI_RNG	Ri measurement range 2 / range 1

After this the function shall bitwise compare the contents of STATE_LSL_IF_SPI_WR[i] and STATE_LSL_IF_SPI_RD[i], and of STATE_LSL_IF_CONF_SPI_WR[i] and STATE_LSL_IF_CONF_SPI_RD[i]. The function shall also check the initialization of the Ri-measurement frequency (done by the correspondent function) by bitwise comparing FRQ_R_IT_OSC_LSL_IF_SPI_WR[i] with FRQ_R_IT_OSC_LSL_IF_SPI_RD[i].
Remark:
For write validation procedure, sensor enable bit LV_LSL_IF_LSL_ENA_i in the initialisation register is NOT considered because it is automatically reset by ATIC42 HW upon detection of an electrical sensor failure, regardless of the last transmitted SPI command. This asynchronous change in bit value assignment does not represent a communication error.
In addition, bit6 of FRQ_R_IT_OSC_LSL_IF_SPI_xx[i] which represents the status of the Pin Selective Disabling feature shall also not be evaluated for SPI communication monitoring at present. Due to an ATIC42 HW error, command execution is performed but not monitored in ASIC response.

Additionally the actual value of error counter CTR_ERR_LSL_IF_SPI_WR[i]$_{(N)}$ must be compared to its precedent value CTR_ERR_LSL_IF_SPI_WR[i]$_{(N-1)}$. If all comparisons show coincidence the flag LV_LSL_IF_SPI_RST_END[i] is set to 1.

The BSW function is defined elsewhere (Basic inputs & outputs, WRAF sensor interface). The BSW essentially observes the interface byte for changes. Should a change occur due to an ASW function, the new information is sent to the ATIC42 and the write cycle is then verified.
The function shall collect information from 8 logical variables and map these to the single byte variable STATE_LSL_IF_SPI_WR[i], which then acts as an interface to the BSW. The bit-field mapping is depicted in the following Table 2 and Figure 1.

Table 2: Bit-field mapping of contents of STATE_LSL_IF_SPI_WR[i]

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Bit Pos.	Bit Name	Associated logical variable
0	SWI_GAIN	LV_SWI_GAIN_LSL_IF[i]
1	VLS_OFS_ADJ_ENA	LV_VLS_OFS_ADJ_ENA_LSL_IF[i]
2	ICPLSL_ENA	LV_ICPLSL_ENA_LSL_IF[i]
3	IPLSL_CTL_ENA	LV_IPLSL_CTL_ENA_LSL_IF[i]
4	R_IT_CAL_ENA	LV_R_IT_CAL_ENA_LSL_IF[i]
5	R_IT_OSC_ENA	LV_R_IT_OSC_ENA_LSL_IF[i]
6	LSL_ENA	LV_LSL_ENA_LSL_IF[i]
7	R_IT_SWI_RNG	LV_R_IT_SWI_RNG_LSL_IF[i]

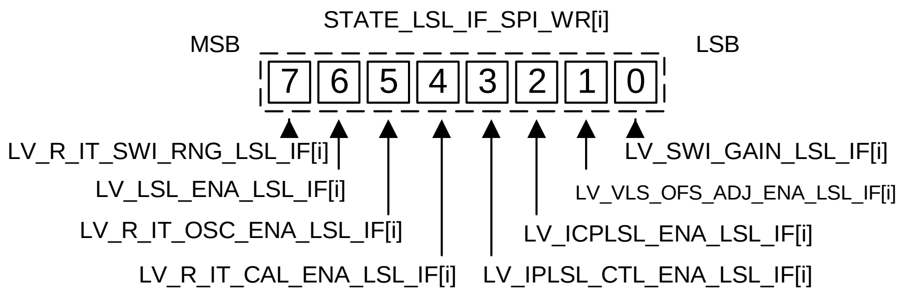

Figure 4.35.1: : Bit-field mapping of contents of STATE_LSL_IF_SPI_WR[i]

Similarly the function shall also collect the value of the 5-bit variable ICPLSL_LSL_IF[i] and the value of the 3-bit variable T_DLY_DI_LSL_IF[i] and map these into the single byte variable STATE_LSL_IF_CONF_SPI_WR[i], which also acts as an interface to the BSW - see Figure 2.

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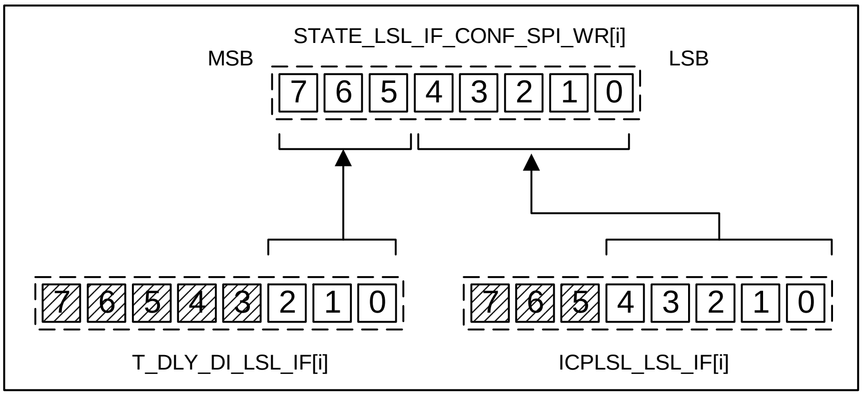

Figure 4.35.2: : Bit-field mapping of contents of STATE_LSL_IF_CONF_SPI_WR[i]

Application conditions

Initialization:

After a RESETor upon erase of error management the following initialization shall take place:
STATE_LSL_IF_SPI_WR[i] = C_STATE_LSL_IF_SPI_WR_INI
STATE_LSL_IF_CONF_SPI_WR[i] = C_STATE_LSL_IF_CONF_SPI_WR_INI
LV_LSL_IF_SPI_RST_END[i] = 0.
Store CTR_ERR_LSL_IF_SPI_WR_i$_{(N)}$ - 1.

Counter content is decremented at function initialization prior to storage to ensure that BSW is executed once the least before LV_LSL_IF_SPI_RST_END is set - and thus might falsely indicate execution of a successful write cycle for initialization. The simulated communication error (stored counter value differs from actual value) replaces time flow synchronization mechanism between ASW-BSW interface and

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BSW function which are executed at same recurrence rate. This workaround assures that BSW is able to perform one write cycle minimum regardless of contents of ATIC42 initialization registers.

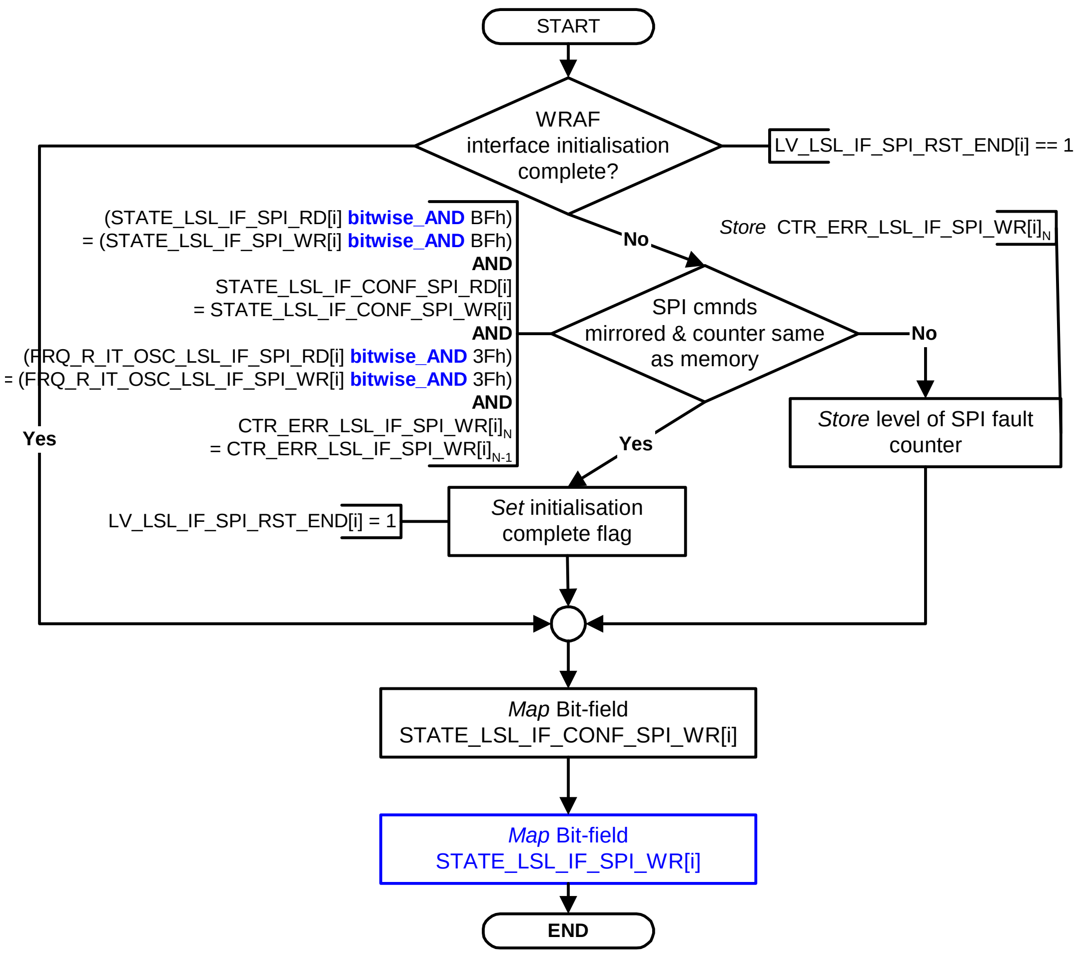
Note: after a successfull initialization of the ATIC42 the flag LV_LSL_IF_SPI_RST_END shall be activated.

Recurrence:
T_SAMPLE = 10 ms.

Activation:
In all Engine States

Deactivation:
- -

Formula section:



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4.36 O2 sensor (lin, up) SPI interface ASW - BSW (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CTR_ERR_LSL_IF_SPI_MAN_INC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
BSW interface for manual increase of value of SPI communication error counter					
LV_LSL_ENA_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag to enable/disable WRAF sensor connection					
LV_LSL_IF_RST [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag to reset the ATIC42					
T_DLY_DI_LSL_IF [NC_CBK_EX_NR]	O/V	0... 7H	0 ...7	1	-
Configuration of the Sensor Protection Time					

Input data:

LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_IGK {p. 906}	NC_CBK_EX_NR {p. 1829}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_DI_LSL_IF	V	0... 7H	0 ...7	1	-
Configuration of sensor protection time					
LC_CTR_ERR_LSL_IF_SPI_MAN_INC	V	0... 1H	0 ...1	1	-
Switch to manually increase value of SPI communication error counter within BSW					

General information

Specification defines and initializes variables and boolean flags not defined and initialized elsewhere.

In case of an electric fault (incl. Open Circuit) which is detected by WRAF sensor electric diagnosis, sensor is decoupled as long as corresponding error flags are present.

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
 i = 1, for exhaust cylinder bank 1
 i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
 i = 1, for single exhaust cylinder bank.

Description:

This function shall initialise the unused WRAF sensor interface flags.

Once OBDI sensor error is debounced (LV_ERR_EL_LSL_UP[i] == 1), WRAF sensor is decoupled (LV _LSL_ENA_LSL_IF [i] = 0) as long as error flag is present. Same action is taken once debounced OC failure is present (LV_ERR_OC_LSL_UP[i] == 1).

The following configuration data shall be used:

C_T_DLY_DI_LSL_IF = 010 = 2H (corresponds to 1ms)

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Application conditions:

Initialisation:

The following variable initialisation shall take place *after RESET*.
T_DLY_DI_LSL_IF[i] = C_T_DLY_DI_LSL_IF
LV_LSL_IF_RST[i] = 0
LV_LSL_ENA_LSL_IF[i] = 1

The following variable initialisation shall take place *at LV_IGK = 0 -> 1, or upon erase of error management*.
LV_LSL_ENA _LSL_IF[i] = 1

NOTE: The logical variable LV_LSL_ENA_LSL_IF[i] is mapped in the interface byte STATE_LSL_IF_SPI_WR[i].
Its initialization shall be done according to the corresponding bit value of C_STATE_LSL_IF_SP_WR_INI in 'ATIC42 ASW<->BSW Interface', 4033.
T_DLY_DI_LSL_IF[i] is mapped in the configuration byte STATE_LSL_IF_CONF_SPI_WR[i].

Activation: In all engine states

Deactivation: - -

Recurrence: T_SAMPLE = 10ms

Function description:

Formula section:

```
LV_CTR_ERR_LSL_IF_SPI_MAN_INC[i] = LC_CTR_ERR_LSL_IF_SPI_MAN_INC

IF     LV_IGK == 1
THEN   IF          LV_ERR_EL_LSL_UP[i] == 1
       OR          LV_ERR_OC_LSL_UP[i] == 1
       THEN        LV_LSL_ENA_LSL_IF[i] = 0
       ELSE        LV _LSL_ENA_LSL_IF[i] = 1
ENDIF
```

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4.37 O2 sensor (lin, up) element temperature determination

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_GAIN_H_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 23.9996	366e-6	-
High gain of oxygen sensor internal resistance determination circuit					
FAC_GAIN_L_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 23.9996	366e-6	-
Low gain of oxygen sensor internal resistance determination circuit					
FRQ_R_IT_OSC_LSL_IF_SPI_WR [NC_CBK_EX_NR]	O/V	0... 7FH	0... 127	1	-
Variable indicating coded information for requested Ri determination oscillator frequency					
LV_FAC_GAIN_H_VLD_R_IT_LS_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating measured high gain valid					
LV_FAC_GAIN_L_VLD_R_IT_LS_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating measured low gain valid					
LV_R_IT_CAL_ENA_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag requesting WRAF interface internal resistance adjust mode to be enabled					
LV_R_IT_OSC_ENA_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag requesting WRAF interface internal oscillator to be enabled					
LV_R_IT_REQ_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that conditions have been met and resistance determination requested					
LV_R_IT_SWI_RNG_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag requesting WRAF interface to select internal resistance gain (range)					
LV_TTIP_MES_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating validity of oxygen sensor ceramic temperature TTIP_MES_LS_UP					
LV_V_OFS_ADJ_VLD_R_IT_LS_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating offset in resistance adjust mode valid					
LV_V_OFS_MES_VLD_R_IT_LS_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating offset in resistance measurement mode valid					
LV_V_REF_VLD_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating internal resistance determination circuit references valid					
R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 16383.75	0.25	ohm
Oxygen sensor element internal resistance					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_TTIP_MES_LS_UP [NC_CBK_EX_NR]	V	0H 1H 2H 3H 4H	OFF MES_OFS ADJ_OFS ADJ_GAIN MES	-	-
State variable indicating current state of function					
T_DLY_R_IT_IPLSL_CTL_ACT [NC_CBK_EX_NR]	V	0... FFH	0... 2.55	0.01	s
Delay timer for freeze of Ri signal upon activation of Ip loop					
TCC_ERR_FAC_GAIN_H_R_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter incremented for every invalid high gain adjust measurement					
TCC_ERR_FAC_GAIN_L_R_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter incremented for every invalid low gain adjust measurement					
TCC_ERR_V_OFS_ADJ_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter incremented for every invalid offset voltage in resistance adjust mode					
TCC_ERR_V_OFS_MES_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter incremented for every invalid offset voltage in resistance measurement mode					
TCC_FAC_GAIN_H_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter incremented for every high gain adjust measurement					
TCC_FAC_GAIN_L_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter incremented for every low gain adjust measurement					
TCC_V_OFS_ADJ_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter incremented for every offset voltage in resistance adjust mode					
TCC_V_OFS_MES_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter incremented for every measured offset voltage in resistance measurement mode					
TTIP_MES_LS_UP [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Oxygen sensor ceramic temperature					
V_OFS_ADJ_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFCH	0... 4.99511	1.22e-3	V
Internal resistance determination circuit offset in resistance adjust mode					
V_OFS_MES_R_IT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFCH	0... 4.99511	1.22e-3	V
Internal resistance determination circuit offset in resistance measurement mode					

Input data:

CTR_ERR_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 955}	FRQ_R_IT_OSC_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 955}	LV_IGK {p. 906}	LV_INH_TTIP_LS_UP [NC_CBK_EX_NR] {p. 1339}
LV_LS_UP_READY [NC_CBK_EX_NR] {p. 2335}	LV_LS_UP_READY_CDN [NC_CBK_EX_NR] {p. 2335}	LV_LS_UP_READY_RAW [NC_CBK_EX_NR] {p. 2335}	LV_LSH_UP_MAN_ACT [NC_CBK_EX_NR] {p. 2385}

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LV_LSL_DEAC [NC_CBK_EX_NR] {p. 955}	LV_LSL_IF_SPI_RST_END [NC_CBK_EX_NR] {p. 1313}	LV_LSL_OFS_ADJ_ACT [NC_CBK_EX_NR] {p. 2313}	NC_CBK_EX_NR {p. 1829}
STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}	V_TEMP_LS_UP [NC_CBK_EX_NR] {p. 967}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_GAIN_H_DIF_R_IT_LS_UP	-	0... FFFFH	0... 23.9996	366e-6	-
Maximum permitted deviation of measured FAC_GAIN_H_R_IT_LS_UP [NC_CBK_EX_NR] from nominal reference value					
C_FAC_GAIN_H_R_IT_LS_UP	-	0... FFFFH	0... 23.9996	366e-6	-
Reference high gain for internal resistance determination circuit					
C_FAC_GAIN_L_DIF_R_IT_LS_UP	-	0... FFFFH	0... 23.9996	366e-6	-
Maximum permitted deviation of measured FAC_GAIN_L_R_IT_LS_UP [NC_CBK_EX_NR] from nominal reference value					
C_FAC_GAIN_L_R_IT_LS_UP	-	0... FFFFH	0... 23.9996	366e-6	-
Reference low gain for internal resistance determination circuit					
C_FAC_GAIN_R_IT_LS_UP	-	0... FFFFH	0... 76.79882	1.17e-3	1/V
Factor used when determining high gain = (C_R_IT_REF_LS_UP+R5+R6)/(5V*(R5+R6)					
C_FRQ_R_IT_OSC_LSL_IF	-	0... 7FH	0... 127	1	-
Coded information for Ri determination oscillator frequency					
C_R_IT_REF_LS_UP	-	0... FFFFH	0... 65535	1	ohm
Reference current pulse resistor for internal resistance determination circuit = (R2*R1)/(R2+R1)					
C_T_DLY_CLC_R_IT_LS_UP	-	0... FFH	0... 2.55	0.01	s
Delay required from switching from internal resistance adjust gain to measurement mode					
C_T_DLY_FAC_GAIN_R_IT_LS_UP	-	0... FFH	0... 2.55	0.01	s
Delay required from switching from internal resistance adjust offset to adjust gain mode					
C_T_DLY_OFS_ADJ_R_IT_LS_UP	-	0... FFH	0... 2.55	0.01	s
Delay required from switching from internal resistance measurement offset to adjust offset mode					
C_T_DLY_OFS_MES_R_IT_LS_UP	-	0... FFH	0... 2.55	0.01	s
Delay required from switching oscillator off or internal resistance measurement to measurement offset mode					
C_T_DLY_R_IT_IPLSL_CTL_ACT	-	0... FFH	0... 2.55	0.01	s
Delay time for freeze of Ri signal upon activation of Ip loop					
C_T_MAX_FAC_GAIN_R_IT_LS_UP	-	0... FFFFH	0... 655.35	0.01	s
Maximum permitted time for gain adjust measurement					
C_T_MAX_V_OFS_ADJ_R_IT_LS_UP	-	0... FFFFH	0... 655.35	0.01	s
Maximum permitted time for offset measurement in adjust mode					
C_T_MAX_V_OFS_MES_R_IT_LS_UP	-	0... FFFFH	0... 655.35	0.01	s
Maximum permitted time for offset measurement in measurement mode					
C_V_DIF_MAX_OFS_ADJ_R_IT_LS_UP	-	0... FFCH	0... 4.99511	1.22e-3	V
Maximum permitted deviation of V_OFS_ADJ_R_IT_LS_UP [NC_CBK_EX_NR] to nominal reference value					
C_V_DIF_MAX_OFS_MES_R_IT_LS_UP	-	0... FFCH	0... 4.99511	1.22e-3	V
Maximum permitted deviation of V_OFS_MES_R_IT_LS_UP [NC_CBK_EX_NR] to nominal reference value					
C_V_OFS_REF_R_IT_LS_UP	-	0... FFCH	0... 4.99511	1.22e-3	V
Reference offset voltage for internal resistance determination circuit					
IP_TTIP_MES_LS_UP	-	0... 7FFFH	0... 2047.9375	0.0625	°C

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_R_IT_LS_UP_IP_TTIP_LS_UP	8	0... FFFFH	0... 16383.75	0.25	ohm
Oxygen sensor temperature vs. internal resistance characteristic					
LC_R_RNG_REQ_LS_UP_LSL_IF	-	0... 1H	0 ...1	1	-
Boolean flag selecting internal resistance determination circuit gain when manual switching enabled					
LC_R_RNG_REQ_SWI_LS_UP_LSL_IF	-	0... 1H	0 ...1	1	-
Boolean flag enabling manual switching of internal resistance determination circuit gain					
LC_V_REF_R_IT_LS_UP	-	0... 1H	0 ...1	1	-
Boolean flag enabling internal resistance determination circuit reference measurement					

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

The purpose of this function shall be to:

- Initialise the WRAF sensor interface with respect to all resistance determination parameters, i.e. switches and oscillator frequency.
- Switch between internal resistance ranges upon detection of operative readiness or when manually requested.
- Convert an acquired voltage (V_TEMP_LS_UP[i]) into an oxygen sensor element ceramic temperature and internal resistance.
- Periodically measure the offset and gain of the internal resistance determination circuit in order to minimise errors in the measured resistance and therefore ceramic temperature determination.

Signal flow diagram:

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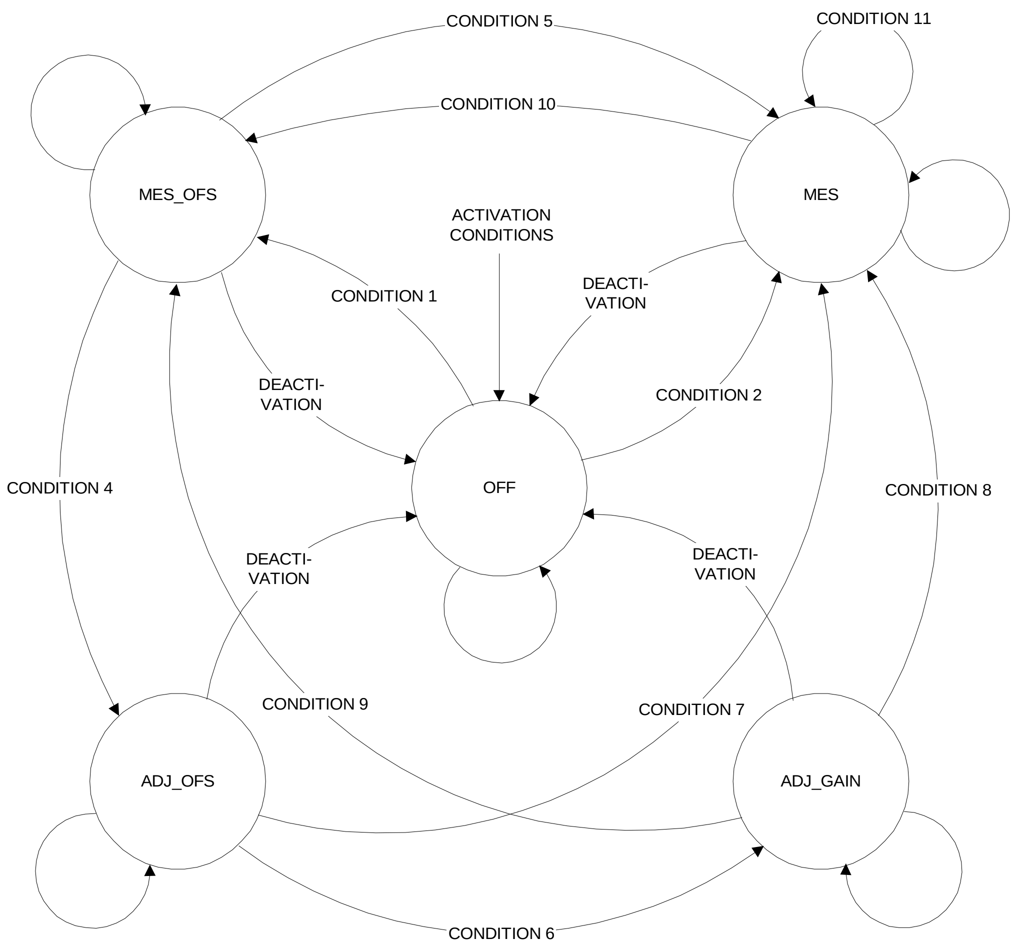

Description:

The function, once activated, shall provide the ceramic tip temperature of the oxygen sensor every 100 ms derived from the measured internal resistance. This temperature may then be used for temperature control and diagnosis purposes. In order to increase the system accuracy, the equation linking the measured voltage (measure of internal resistance) to the internal resistance may be compensated for drifts in offset and gain of the measurement circuit. The compensation shall be carried out periodically, when triggered by the input variable LV_LSL_OFS_ADJ_ACT[i] being set and when switching between internal resistance ranges. This former condition ensures that the oscillator, used to measure the internal resistance, is off when the lambda output offset measurement is carried out. The latter condition ensures that the different gain associated with the different range is re-measured.
The offsets shall be measured in both the measurement mode (oxygen sensor attached to WRAF sensor interface) and adjustment mode (reference calibration resistor attached to WRAF sensor interface) by switching the oscillator off and measuring the voltage output of the circuit. The gain shall be measured by switching to the adjust mode and taking the voltage reading with the calibration resistor in place. With reading and the knowledge of the value of the calibration resistor, stimulus resistor and previously measured offset in adjustment mode, the function shall compute the gain. This gain value of the internal amplifier is the same for both adjustment mode and measurement mode. However, the offsets may differ from one another due to CM (common mode) errors in the internal amplifier and due to the differing potentials at the VN amplifier input in adjustment mode (VGND) and measurement mode (VGND + VS). Hence the gain is calculated with the adjustment mode offset and the measured internal resistance is calculated with the measurement offset.
The **initialisation** of the function output data variables shall be carried out as follows:

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- The SW initialisation of the WRAF sensor interface shall be carried out directly after a reset. FRQ_R_IT_OSC_LSL_IF_SPI_WR[i] shall be set to C_FRQ_R_IT_OSC_LSL_IF. The ASW interface function shall then determine whether the WRAF sensor interface has been successfully initialised by comparing the information returned from the WRAF interface ASIC with the corresponding initialisation request. Once all initialisations have been completed, the flag LV_LSL_IF_SPI_RST_END[i] is set indicating that the complete initialisation has been completed.
- The internal resistance R_IT_LS_UP[i] shall be initialised to its maximum value and the ceramic temperature TTIP_MES_LS_UP[i] to 0, i.e. cold sensor.
- The state machine shall be initialised to the OFF state and the temperature validity flag LV_TTIP_MES_VLD_LS_UP[i] shall be reset.
- The validity flags, LV_V_REF_VLD_R_IT_LS_UP[i], LV_V_OFS_MES_VLD_R_IT_LS_UP[i], LV_V_OFS_ADJ_VLD_R_IT_LS_UP[i], LV_FAC_GAIN_H_VLD_R_IT_LS_UP[i] & LV_FAC_GAIN_L_VLD_R_IT_LS_UP[i] shall be initialised dependent on the state of activation logical constant LC_V_REF_R_IT_LS_UP. Should the function be set to be active via this constant, then the flags shall be initialised with 0. Hence should the function be set to be inactive, the flags shall be set to 1, i.e. show that the offset and gain measurements are valid. This permits the function to be disabled via LC_V_REF_R_IT_LS_UP without affecting the functions that use the ceramic temperature information.
- The test cycle and frequency counters used to measure the number of reference measurements carried out (TCC_...) and the number of reference measurements out of bounds (FRC_...) shall be initialised after completion of engine start.
- The offset variables V_OFS_MES_R_IT_LS_UP[i] & V_OFS_ADJ_R_IT_LS_UP[i] and gain variables FAC_GAIN_H_R_IT_LS_UP[i] & FAC_GAIN_L_R_IT_LS_UP[i] shall be initialised with the appropriate C_... constant.

Upon **deactivation** of the function, when the engine start flag is reset, the function shall indicate to other functions that the ceramic temperature is no longer valid by setting the STATE_TTIP_MES_LS_UP[i] to OFF, resetting the general validity flag LV_TTIP_MES_VLD_LS_UP[i], the internal resistance measurement oscillator shall be switched off, the internal resistance measurement mode set to normal measurement mode and the resistance range shall be set the value LC_R_RNG_REQ_LS_UP_LSL_IF.

The function shall be **activated** with LV_IGK = 1, no inhibition bit set (LV_INH_TTIP_LS_UP[i] == 1), no electrical OBD fault have been detected for the WRAF sensor which leads to sensor decoupling (STATE_LSL_IF_SPI_RD[i] (*bit* LSL_ENA) == 1), and either the raw or conditional operative readiness has been detected (LV_LS_UP_READY_RAW[i] = 1 or LV_LS_UP_READY_CDN[i] = 1), or forced sensor pre-heating has been activated (LV_LSH_UP_MAN_ACT[i] == 1).

It shall be **deactivated** for LV_IGK = 0, at presence of function inhibition through corresponding application incidence, upon detection of an electrical OBD fault for the WRAF sensor resulting in sensor decoupling, or the raw and conditional operative readiness be reset together with passivated forced sensor pre-heating.

The validity of the ceramic temperature measurement shall be computed every recurrence and indicated by the Boolean flag LV_V_REF_VLD_R_IT_LS_UP[i]. This flag shall be set when both offset measurements have been determined to be valid, as indicated by LV_V_OFS_MES_VLD_R_IT_LS_UP[i] and LV_V_OFS_ADJ_VLD_R_IT_LS_UP[i], and when the gain has been determined to be valid, as indicated by LV_FAC_GAIN_H_VLD_R_IT_LS_UP[i] or LV_FAC_GAIN_L_VLD_R_IT_LS_UP[i] depending on the selected resistance range (LV_R_IT_SWI_RNG_LSL_IF[i]).

The function shall be implemented as a state machine with five states. The state of the state machine shall be indicated by the variable STATE_TTIP_MES_LS_UP[i]. The state machine may be described as follows:

STATE_TTIP_MES_LS_UP[i] = OFF

In state OFF, the ceramic temperature validity flag LV_TTIP_MES_VLD_LS_UP[i] shall be set to 0, indicating that the temperature shall not be used by other functions. The state machine may exit to one of either two states:

Exit to measurement mode offset measurement, **MES_OFS**: Shall occur when the SPI interface has been determined to have been initialised via flag LV_LSL_IF_SPI_RST_END[i] and should the cali-

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bration flag LC_V_REF_R_IT_LS_UP be set, thus permitting the calibration procedure to take place. Should these conditions be met, then *TIMER_1* & *TIMER_2* shall be reset, *TIMER_1* started. Additionally, the current value of the SPI fault counter CTR_ERR_LSL_IF_SPI_WR[i] shall be stored, the state STATE_TTIP_MES_LS_UP[i] set to MES_OFS, the oscillator switched off via LV_R_IT_OSC_ENA_LSL_IF[i] = 0 and the measurement mode activated via LV_R_IT_CAL_ENA_LSL_IF[i] = 0.

Exit to normal resistance measurement mode, **MES**: Shall occur when the SPI interface has been determined to have been initialised via flag LV_LSL_IF_SPI_RST_END[i] and should the calibration flag LC_V_REF_R_IT_LS_UP be reset, thus preveting the calibration procedure from taking place. Should these conditions be met, then *TIMER_2* shall be reset, the current value of the SPI fault counter CTR_ERR_LSL_IF_SPI_WR[i] shall be stored, the state STATE_TTIP_MES_LS_UP[i] set to MES, the oscillator switched on via LV_R_IT_OSC_ENA_LSL_IF[i] = 1 and the measurement mode activated via LV_R_IT_CAL_ENA_LSL_IF[i] = 0.

STATE_TTIP_MES_LS_UP[i] = MES_OFS

In state MES_OFS, the offset shall be determined as follows:

The function shall determine whether a fault in the SPI communication has occurred since the WRAF sensor interface control byte flags LV_R_IT_OSC_ENA_LSL_IF[i], LV_R_IT_CAL_ENA_LSL_IF[i], & LV_R_IT_SWI_RNG_LSL_IF[i] were programmed. This is facilitated by comparing the value of the SPI fault counter with the value stored prior to setting the flags. Additionally the status of the sensor coupling shall be determined. Should a communication fault have occurred either sending the information to the interface or should the information have changed in the interface control byte since programming, CTR_ERR_LSL_IF_SPI_WR[i] shall be incremented by the appropriate SPI communication function. This difference or the decoupling of the sensor, signalled by LV_LSL_DEAC[i] = 1 or STATE_LSL_IF_SP_RD[i].LSL_ENA = 0 shall cause the *TIMER_2* to be reset and the new value of the counter to be stored.

The SPI communication function operates an automatic retry strategy, thus if the desired contents could not be programmed or should the contents read back are not those programmed, then the SPI communication function shall continue to re-send the information until either it is successful or a debounced fault is recognised and further communication halted (check of FRQ_R_IT_OSC_LSL_IF_SP_RD[i]).

Should no SPI fault or decoupling of the sensor be determined to have occurred, the function shall verify that the desired contents have been programmed by reading the appropriate bits (IT_OSC_ENA, R_LS_CAL_ENA & R_LS_RNG) of the interface byte STATE_LSL_IF_SP_RD[i]. This byte mirrors the current contents of the WRAF sensor interface control byte. Due to the finite time that is required to program the WRAF sensor interface, the programming may not have taken place. In this instance the function shall await the next recurrence. If the programmed contents can be verified, the function shall wait until delay C_T_DLY_OFS_MES_R_IT_LS_UP has passed facilitated by *TIMER_2* and then take 4 V_TEMP_LS_UP[i] samples over the current and next 3 recurrences.

The absolute difference between the average of the 4 samples and the constant C_V_OFS_REF_R_IT_LS_UP shall then be compared to C_V_DIF_MAX_OFS_MES_R_IT_LS_UP to determine whether the measured offset is in bounds. If this is the case, the appropriate validity flag LV_V_OFS_MES_VLD_R_IT_LS_UP[i] set. If not the case, the frequency counter TCC_ERR_V_OFS_MES_R_IT_LS_UP[i] shall be incremented, indicating a faulty offset measurement, and LV_V_OFS_MES_VLD_R_IT_LS_UP[i] shall be reset. V_OFS_MES_R_IT_LS_UP[i] shall take on the value of the average, within bounds or not.

Test cycle counter TCC_V_OFS_MES_R_IT_LS_UP[i] shall be incremented, indicating that another measurement mode offset measurement has been carried out.

The state machine may exit to one of either two states:

Exit to adjustment mode offset measurement, **ADJ_OFS**: Shall occur when the offset measurement has been determined to have been completed. Should this condition be met, then the flag LV_R_IT_CAL_ENA_LSL_IF[i] shall be set, switching to adjust mode (calibration resistor), *TIMER_1* & *TIMER_2* shall be reset, *TIMER_1* started. Additionally, the current value of the SPI fault counter CTR_ERR_LSL_IF_SPI_WR[i] shall be stored and the state STATE_TTIP_MES_LS_UP[i] set to ADJ_OFS.

Exit to normal resistance measurement mode, **MES**: Shall occur when the time limit C_T_MAX_V_OFS_MES_R_IT_LS_UP has been determined to have been exceeded, facilitated by *TIMER_1*. This provides a time out to ensure that the function does not lock up should SPI communication faults continuously prevent the offset measurement from being completed. Should these conditions be met, then the

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oscillator shall be switched on by setting flag LV_R_IT_CAL_ENA_LSL_IF[i], *TIMER_2* shall be reset, the current value of the SPI fault counter CTR_ERR_LSL_IF_SPI_WR[i] shall be stored and the state STATE_TTIP_MES_LS_UP[i] set to MES.

STATE_TTIP_MES_LS_UP[i] = ADJ_OFS

In state ADJ_OFS, the offset shall be determined by exactly the same method as described for state MES_OFS, the only differences being:

- When checking that the programmed information has been correctly mirrored, bit STATE_LSL_IF_SP_RD[i].IT_OSC_ENA shall be 0, STATE_LSL_IF_SP_RD[i].R_LS_CAL_ENA shall be 1 and STATE_LSL_IF_SP_RD[i].R_LS_RNG shall equal LV_R_IT_SWI_RNG_LSL_IF[i].
- The *TIMER_2* delay shall be C_T_DLY_OFS_ADJ_R_IT_LS_UP.
- The absolute difference between the sample averages and constant C_V_OFS_REF_R_IT_LS_UP shall be compared to C_V_DIF_MAX_OFS_ADJ_R_IT_LS_UP.
- The adjustment mode offset variable shall be V_OFS_ADJ_R_IT_LS_UP[i], the validity flag shall be LV_V_OFS_ADJ_VLD_R_IT_LS_UP[i], the frequency counter TCC_ERR_V_OFS_ADJ_R_IT_LS_UP[i] and test cycle counter TCC_V_OFS_ADJ_R_IT_LS_UP[i].

The state machine may exit to one of either two states:

Exit to adjustment mode gain measurement, **ADJ_GAIN**: Shall occur when the offset measurement has been determined to have been completed and the lambda offset calibration has been completed, thus ensuring that the oscillator being off does not disturb the lambda output. Should these conditions be met, then the flag LV_R_IT_OSC_ENA_LSL_IF[i] shall be set, switching the oscillator on, *TIMER_1* & *TIMER_2* shall be reset and *TIMER_1* started. Additionally, the current value of the SPI fault counter CTR_ERR_LSL_IF_SPI_WR[i] shall be stored and the state STATE_TTIP_MES_LS_UP[i] set to ADJ_GAIN.

Exit to normal resistance measurement mode, **MES**: Shall occur when the time limit C_T_MAX_V_OFS_ADJ_R_IT_LS_UP has been determined to have been exceeded, facilitated by *TIMER_1* providing a time out as described and the lambda output offset compensation has been completed as determined by LV_LSL_OFS_ADJ_ACT[i] = 0. Should these conditions be met, then the oscillator shall be switched on by setting flag LV_R_IT_CAL_ENA_LSL_IF[i], the mode set to measurement mode by resetting LV_R_IT_CAL_ENA_LSL_IF[i], *TIMER_2* shall be reset, the current value of the SPI fault counter CTR_ERR_LSL_IF_SPI_WR[i] shall be stored and the state STATE_TTIP_MES_LS_UP[i] set to MES.

STATE_TTIP_MES_LS_UP[i] = ADJ_GAIN

In state ADJ_GAIN, the gain shall be determined by similarly to the method as described for state MES_OFS, the only differences being:

- When checking that the programmed information has been correctly mirrored, bit STATE_LSL_IF_SP_RD[i].IT_OSC_ENA shall be 1, STATE_LSL_IF_SP_RD[i].R_LS_CAL_ENA shall be 1 and STATE_LSL_IF_SP_RD[i].R_LS_RNG shall equal LV_R_IT_SWI_RNG_LSL_IF[i].
- The *TIMER_2* delay shall be C_T_DLY_FAC_GAIN_R_IT_LS_UP.
- After having taken the 4 samples, the gain shall be computed using the equation in the formula section. The gain calculated and the constants used in the calculation shall depend on the selected resistance range.
- The absolute difference between the gain and constant C_GAIN_TEMP_LS_UP shall be compared to C_GAIN_TEMP_LS_UP_DIF.
- The adjustment mode gain variable shall be FAC_GAIN_H_R_IT_LS_UP[i], the validity flag shall be LV_FAC_GAIN_H_VLD_R_IT_LS_UP[i], the frequency counter TCC_ERR_FAC_GAIN_H_R_LS_UP[i] and test cycle counter TCC_FAC_GAIN_H_R_IT_LS_UP[i] or FAC_GAIN_L_R_IT_LS_UP[i], the validity flag shall be LV_FAC_GAIN_L_VLD_R_IT_LS_UP[i], the frequency counter TCC_ERR_FAC_GAIN_L_R_LS_UP[i] and test cycle counter TCC_FAC_GAIN_L_R_IT_LS_UP[i] dependent on the selected resistance range (LV_R_IT_SWI_RNG_LSL_IF[i]).

The state machine may exit to one of either two states:

Exit to normal internal resistance measurement mode, **MES**: Shall occur when the gain measurement has been determined to have been successfully completed (LV_V_REF_VLD_R_IT_LS_UP[i] = 1) or when the time limit C_T_MAX_FAC_GAIN_R_IT_LS_UP has been determined to have been exceeded,

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facilitated by *TIMER_1* providing a time out as described previously. Should these conditions be met, then the mode shall be set to measurement mode by resetting LV_R_IT_CAL_ENA_LSL_IF[i], *TIMER_2* shall be reset, the current value of the SPI fault counter CTR_ERR_LSL_IF_SPI_WR[i] shall be stored and the state STATE_TTIP_MES_LS_UP[i] set to MES.

Exit to measurement mode offset measurement, **MES_OFS**: Shall occur should the gain measurement have been unsuccessfully completed (LV_V_REF_VLD_R_IT_LS_UP[i] = 0) or if the lambda output offset compensation be requested (LV_LSL_OFS_ADJ_ACT[i] = 1). Should either of these conditions be met, then the oscillator shall be switched off via LV_R_IT_OSC_ENA_LSL_IF[i] = 0 and the measurement mode activated via LV_R_IT_CAL_ENA_LSL_IF[i] = 0, *TIMER_1* & *TIMER_2* shall be reset, *TIMER_1* started. Additionally, the current value of the SPI fault counter CTR_ERR_LSL_IF_SPI_WR[i] shall be stored, the state STATE_TTIP_MES_LS_UP[i] set to MES_OFS.

STATE_TTIP_MES_LS_UP[i] = MES

In state MES, the internal resistance shall be determined as follows:

The function shall determine whether a fault in the SPI communication or if the sensor has been decoupled as described previously. Should either of these conditions be true, the ceramic temperature validity flag LV_TTIP_MES_VLD_LS_UP[i] shall be reset, thus suspending further use of the temperature information, *TIMER_2* shall be reset and the new value of the counter to be stored.

Should no SPI fault or decoupling of the sensor be determined to have occurred, function checks for rising edge of ATIC42 pump current control enable bit. To avoid erroneous Ri readings due to electrical disturbance on Ri measurement circuit during Ip activation, Ri value is frozen for calibratable delay time C_T_DLY_R_IT_IPLSL_CTL_ACT triggered by rising edge detection. Same holds true for falling edge. During signal freeze LV_TTIP_MES_VLD_LS_UP[i] shall be reset.

Next the function shall verify that the desired control byte contents have been programmed by reading the appropriate bits (IT_OSC_ENA = 1, R_LS_CAL_ENA = 0, R_LS_RNG = LV_R_IT_SWI_RNG_LSL_IF[i]) of the interface byte STATE_LSL_IF_SP_RD. If not the case the function shall await the next recurrence. If the programmed contents can be verified, the function shall wait until delay C_T_DLY_CLC_R_IT_LS_UP has passed facilitated by *TIMER_2* and then compute the internal resistance from the measurement mode offset, V_OFS_MES_R_IT_LS_UP[i], the average of up to 8 V_TEMP_LS_UP[i] samples, the value of the stimulus resistor, C_R_IT_REF_LS_UP and dependent on the value of LV_R_IT_SWI_RNG_LSL_IF[i] either FAC_GAIN_H_R_IT_LS_UP[i] or FAC_GAIN_L_R_IT_LS_UP[i].

The ceramic temperature validity flag LV_TTIP_MES_VLD_LS_UP[i] shall be set and the ceramic temperature TTIP_MES_LS_UP[i] shall be determined from the map IP_TTIP_MES_LS_UP.

The state machine may exit to one state:

Exit to state, measurement mode offset measurement, **MES_OFS**: Shall occur should the calibration flag LC_V_REF_R_IT_LS_UP be set, thus permitting the calibration procedure to take place and either when the lambda offset correction has been determined to have been requested, LV_LSL_OFS_ADJ_ACT[i] = 1 or should the operative readiness be detected or finally should a manual switching of the gain be requested. The non-operative readiness condition ensures that should any of the time-outs occur in the states MES_OFS, ADJ_OFS or ADJ_GAIN, and the operative readiness not yet have been detected, then the function may restart the calibration process. Should these conditions be met, then, dependent on whether a manual range switch was requested, the resistance range shall be set to the Boolean constant LC_R_RNG_REQ_LS_UP_LSL_IF or to the negation of LV_LS_UP_READY[i], the ceramic temperature validity flag LV_TTIP_MES_VLD_LS_UP[i] shall be reset, the oscillator shall be switched off via LV_R_IT_OSC_ENA_LSL_IF[i] = 0, *TIMER_1* & *TIMER_2* shall be reset, *TIMER_1* started. Additionally, the current value of the SPI fault counter CTR_ERR_LSL_IF_SPI_WR[i] shall be stored, the state STATE_TTIP_MES_LS_UP[i] set to MES_OFS.

Should the calibration flag LC_V_REF_R_IT_LS_UP be reset, thus disabling the calibration procedure to take place but the operative readiness be detected or should a manual switching of the gain be requested then , dependent on whether a manual range switch was requested, the resistance range shall be set to the Boolean constant LC_R_RNG_REQ_LS_UP_LSL_IF or to the negation of LV_LS_UP_READY[i], the ceramic temperature validity flag LV_TTIP_MES_VLD_LS_UP[i] shall be reset, *TIMER_1* & *TIMER_2* shall be reset, *TIMER_1* started. Additionally, the current value of the SPI fault counter CTR_ERR_LSL_IF_SPI_WR[i] shall be stored, but the state STATE_TTIP_MES_LS_UP[i] shall **remain in MES**.

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In addition to the aforementioned state conditions, the state machine may **exit to state OFFfrom all other states**. This shall occur should the function be deactivated. In this case certain variables may be reset as described previously in the section regarding the initialisation.

Initialisation:
The following initialisation shall take place directly **after RESET**:
FRQ_R_IT_OSC_LSL_IF_SPI_WR[i] = C_FRQ_R_IT_OSC_LSL_IF

The following variable initialisation shall take place **after RESET, at LV_IGK = 0 -**> **1**, or **upon erase of error management**:
TTIP_MES_LS_UP[i] = 0
R_IT_LS_UP[i] = 16383.75 (i.e. FFFFH)
STATE_TTIP_MES_LS_UP[i] = OFF
LV_V_OFS_MES_VLD_R_IT_LS_UP[i] = **!** LC_V_REF_R_IT_LS_UP
LV_V_OFS_ADJ_VLD_R_IT_LS_UP[i] = **!** LC_V_REF_R_IT_LS_UP
LV_FAC_GAIN_H_VLD_R_IT_LS_UP[i] = **!** LC_V_REF_R_IT_LS_UP
LV_FAC_GAIN_L_VLD_R_IT_LS_UP[i] = **!** LC_V_REF_R_IT_LS_UP
LV_TTIP_MES_VLD_LS_UP[i] = 0
LV_V_REF_VLD_R_IT_LS_UP[i] = ! LC_V_REF_R_IT_LS_UP
TCC_V_OFS_MES_R_IT_LS_UP[i] = 0
TCC_V_OFS_ADJ_R_IT_LS_UP[i] = 0
TCC_FAC_GAIN_H_R_IT_LS_UP[i] = 0
TCC_FAC_GAIN_L_R_IT_LS_UP[i] = 0
TCC_ERR_V_OFS_MES_R_IT_LS_UP[i] = 0
TCC_ERR_V_OFS_ADJ_R_IT_LS_UP[i] = 0
TCC_ERR_FAC_GAIN_H_R_LS_UP[i] = 0
TCC_ERR_FAC_GAIN_L_R_LS_UP[i] = 0
V_OFS_MES_R_IT_LS_UP[i] = C_V_OFS_REF_R_IT_LS_UP
V_OFS_ADJ_R_IT_LS_UP[i] = C_V_OFS_REF_R_IT_LS_UP
FAC_GAIN_H_R_IT_LS_UP[i] = C_FAC_GAIN_H_R_IT_LS_UP
FAC_GAIN_L_R_IT_LS_UP[i] = C_FAC_GAIN_L_R_IT_LS_UP
LV_R_IT_REQ_LS_UP[i] = 0
T_DLY_R_IT_IPLSL_CTL_ACT[i] = 0

Reset internal timers TIMER_1 & TIMER_2

Recurrence:
The function shall run at a recurrence of 10 ms.
The computation of a new internal resistance value shall be carried out once every 100 ms provided the applicable conditions have been met.

Activation:
The functions *General validity of ceramic temperature measurement* , *Reset statistical counters after diagnosis completion* & *State Machine* shall be carried out according to the following conditions:
LV_INH_TTIP_LS_UP[i] == 0
and LV_IGK == 1
and STATE_LSL_IF_SPI_RD[i] (*bit* LSL_ENA) == 1
and **(** LV_LS_UP_READY_RAW[i] == 1
or LV_LS_UP_READY_CDN[i] == 1
or LV_LSH_UP_MAN_ACT[i] == 1 **)**

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Deactivation:

LV_INH_TTIP_LS_UP[i] ==1
or LV_IGK == 0
or STATE_LSL_IF_SPI_RD[i] (*bit* LSL_ENA) == 0
or **(** LV_LS_UP_READY_RAW[i] == 0
and LV_LS_UP_READY_CDN[i] == 0
and LV_LSH_UP_MAN_ACT[i] == 0 **)**

The following variable initialisation shall take place upon deactivation:
STATE_TTIP_MES_LS_UP[i] = OFF
LV_TTIP_MES_VLD_LS_UP[i] = 0

In addition upon deactivation, the following variables shall be conditionally initialised:
If LV_LSL_IF_SPI_RST_END[i] == 1
then LV_R_IT_CAL_ENA_LSL_IF[i] = 0
LV_R_IT_OSC_ENA_LSL_IF[i] = 0
If LC_R_RNG_REQ_SWI_LS_UP_LSL_IF == 1
then LV_R_IT_SWI_RNG_LSL_IF[i] = LC_R_RNG_REQ_LS_UP_LSL_IF
else LV_R_IT_SWI_RNG_LSL_IF[i] = **!** LV_LS_UP_READY[i]
endif
endif

Formula section:

General validity of ceramic temperature measurement:
If LV_R_IT_SWI_RNG_LSL_IF[i] == 0
then LV_V_REF_VLD_R_IT_LS_UP[i]
= LV_V_OFS_MES_VLD_R_IT_LS_UP[i]
& LV_V_OFS_ADJ_VLD_R_IT_LS_UP[i]
& LV_FAC_GAIN_H_VLD_R_IT_LS_UP[i]
else LV_V_REF_VLD_R_IT_LS_UP[i]
= LV_V_OFS_MES_VLD_R_IT_LS_UP[i]
& LV_V_OFS_ADJ_VLD_R_IT_LS_UP[i]
& LV_FAC_GAIN_L_VLD_R_IT_LS_UP[i]
endif

State Machine

The state machine shall remain in its current state and carry out the actions specified to occur within that state once per recurrence unless otherwise specified. The state machine shall only move to another state when one of the conditions has been determined to be met.
Notes:
1. The priorities of the conditions to change between states shall be defined by the order in which these conditions are listed within the appropriate state as described below.
2. TIMER_1 & TIMER_2 refer to SW internal variables. TIMER_1 & TIMER_2 are not visible output variables.
3. The assignment store CTR_ERR_LSL_IF_SPI_WR[i] $_N$ ***denotes that the current counter value shall be noted by the SW until the next assignment occurs.***

STATE_TTIP_MES_LS_UP[i] = OFF
Actions:
LV_TTIP_MES_VLD_LS_UP[i] = 0

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Note: The above listed actions must be carried out at least once when the state has been entered for the first time or from any other state!

Condition 1: *OFF to MES_OFS*
LV_LSL_IF_SPI_RST_END[i] = 1 **&**
LC_V_REF_R_IT_LS_UP = 1
Transition actions:
Reset *TIMER_1*
Start *TIMER_1*
Reset *TIMER_2*
Store CTR_ERR_LSL_IF_SPI_WR[i]$_N$
STATE_TTIP_MES_LS_UP[i] = MES_OFS
LV_R_IT_OSC_ENA_LSL_IF[i] = 0
LV_R_IT_CAL_ENA_LSL_IF[i] = 0
Condition 2: *OFF to MES*
LV_LSL_IF_SPI_RST_END[i] = 1 **&**
LC_V_REF_R_IT_LS_UP = 0
Transition actions:
Reset *TIMER_2*
Store CTR_ERR_LSL_IF_SPI_WR[i]$_N$
STATE_TTIP_MES_LS_UP[i] = MES
LV_R_IT_OSC_ENA_LSL_IF[i] = 1
LV_R_IT_CAL_ENA_LSL_IF[i] = 0

STATE_TTIP_MES_LS_UP[i] = MES_OFS
Actions:

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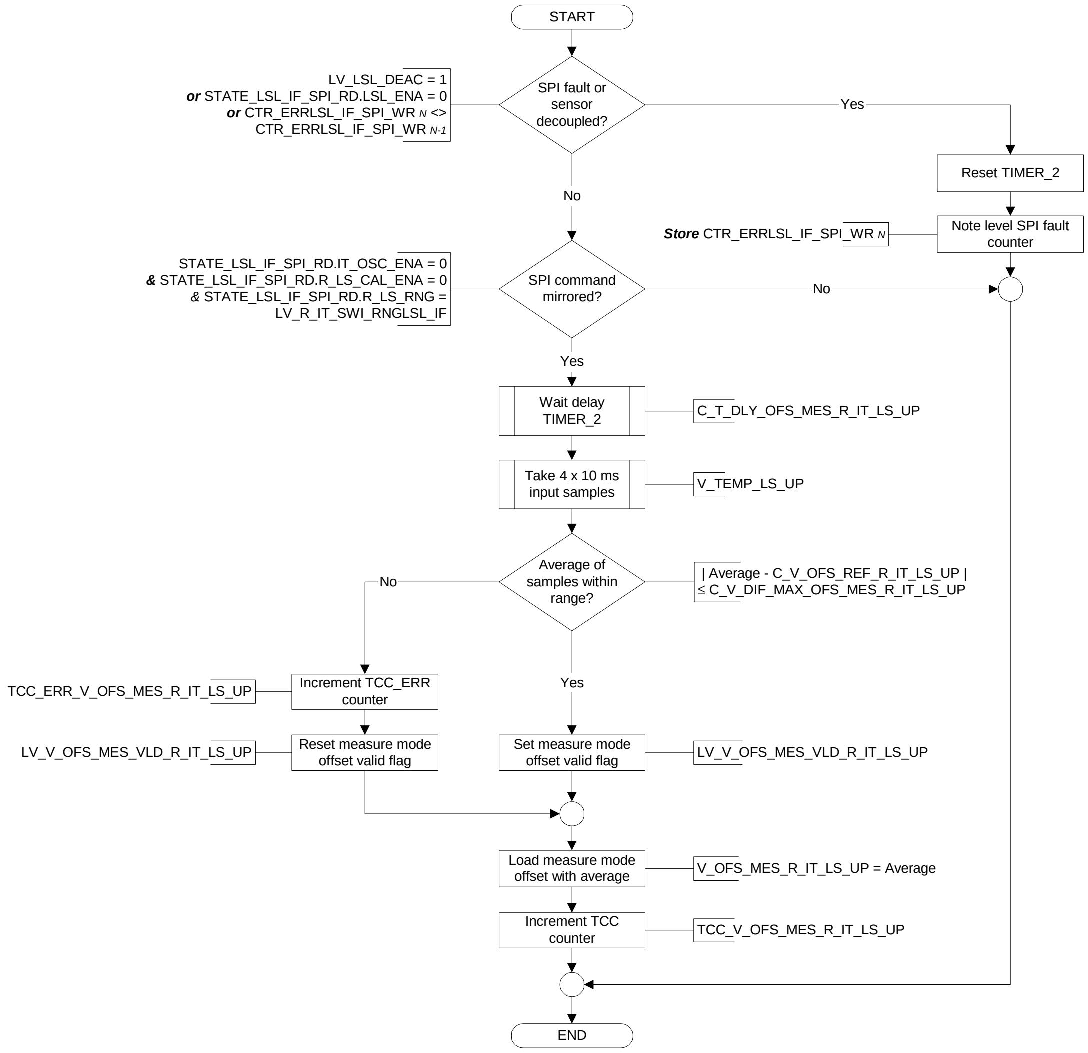

Note: TCC_V_OFS_MES_R_IT_LS_UP[i] & TCC_ERR_V_OFS_MES_R_IT_LS_UP[i] shall not be permitted to overflow.

Condition 4: *MES_OFS to ADJ_OFS*

MES_OFS procedure complete (valid or invalid)

Transition actions:

LV_R_IT_CAL_ENA_LSL_IF[i] = 1

Reset *TIMER_1*

Start *TIMER_1*

Reset *TIMER_2*

Store CTR_ERR_LSL_IF_SPI_WR[i]$_N$

STATE_TTIP_MES_LS_UP[i] = ADJ_OFS

Condition 5: *MES_OFS to MES*

TIMER_1 C_T_MAX_V_OFS_MES_R_IT_LS_UP

Transition actions:

LV_R_IT_OSC_ENA_LSL_IF[i] = 1

Reset *TIMER_2*

Store CTR_ERR_LSL_IF_SPI_WR[i]$_N$

STATE_TTIP_MES_LS_UP[i] = MES

STATE_TTIP_MES_LS_UP[i] = ADJ_OFS

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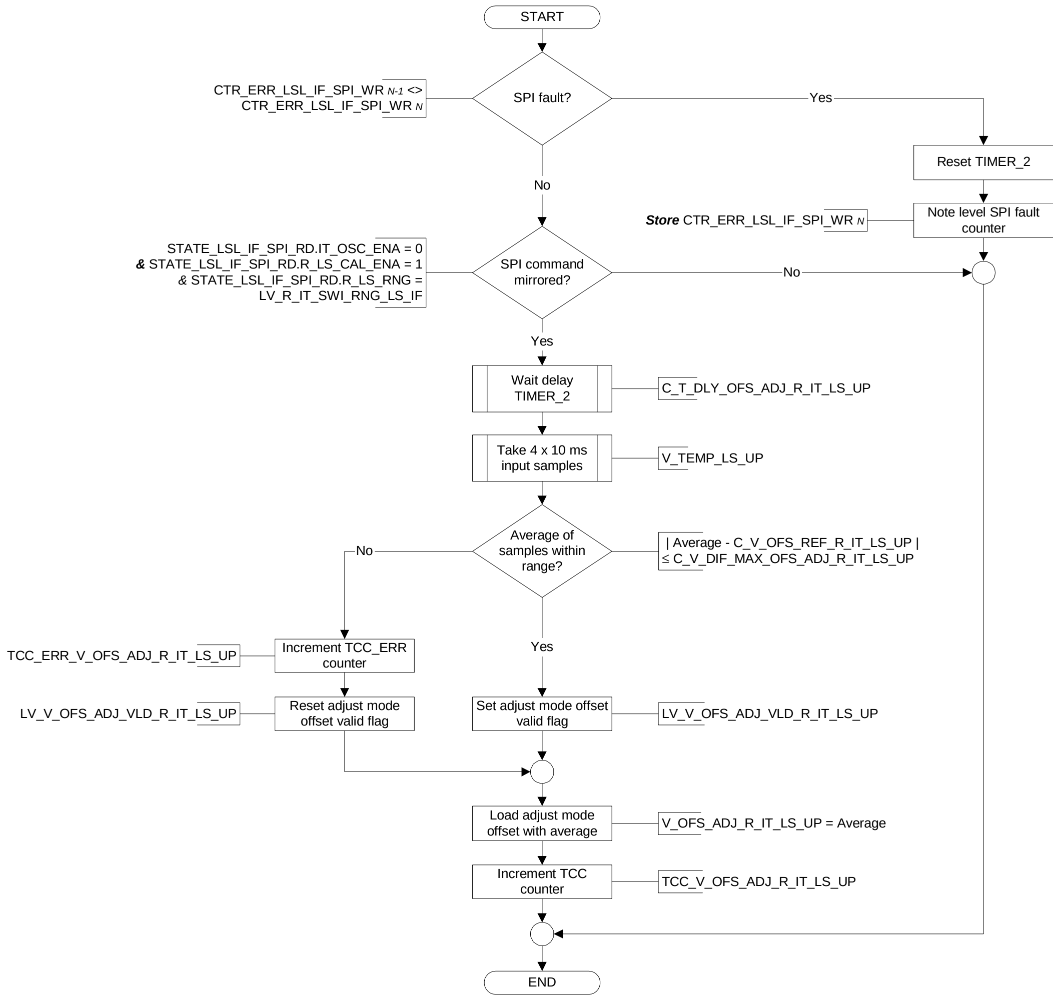
Actions:



Note: TCC_V_OFS_ADJ_R_IT_LS_UP[i] & TCC_ERR_V_OFS_ADJ_R_IT_LS_UP[i] shall not be permitted to overflow.

Condition 6:   *ADJ_OFS   to   ADJ_GAIN*

ADJ_OFS procedure complete (valid or invalid) **&**

LV_LSL_OFS_ADJ_ACT[i] = 0

Transition actions:

LV_R_IT_OSC_ENA_LSL_IF[i] = 1

Reset *TIMER_1*

Start *TIMER_1*

Reset *TIMER_2*

Store CTR_ERR_LSL_IF_SPI_WR[i]$_N$

STATE_TTIP_MES_LS_UP[i] = ADJ_GAIN

Condition 7:   *ADJ_OFS   to   MES*

TIMER_1   C_T_MAX_V_OFS_ADJ_R_IT_LS_UP **&**

LV_LSL_OFS_ADJ_ACT[i] = 0

Transition actions:

LV_R_IT_OSC_ENA_LSL_IF[i] = 1

LV_R_IT_CAL_ENA_LSL_IF[i] = 0

Reset *TIMER_2*

Store CTR_ERR_LSL_IF_SPI_WR[i]$_N$

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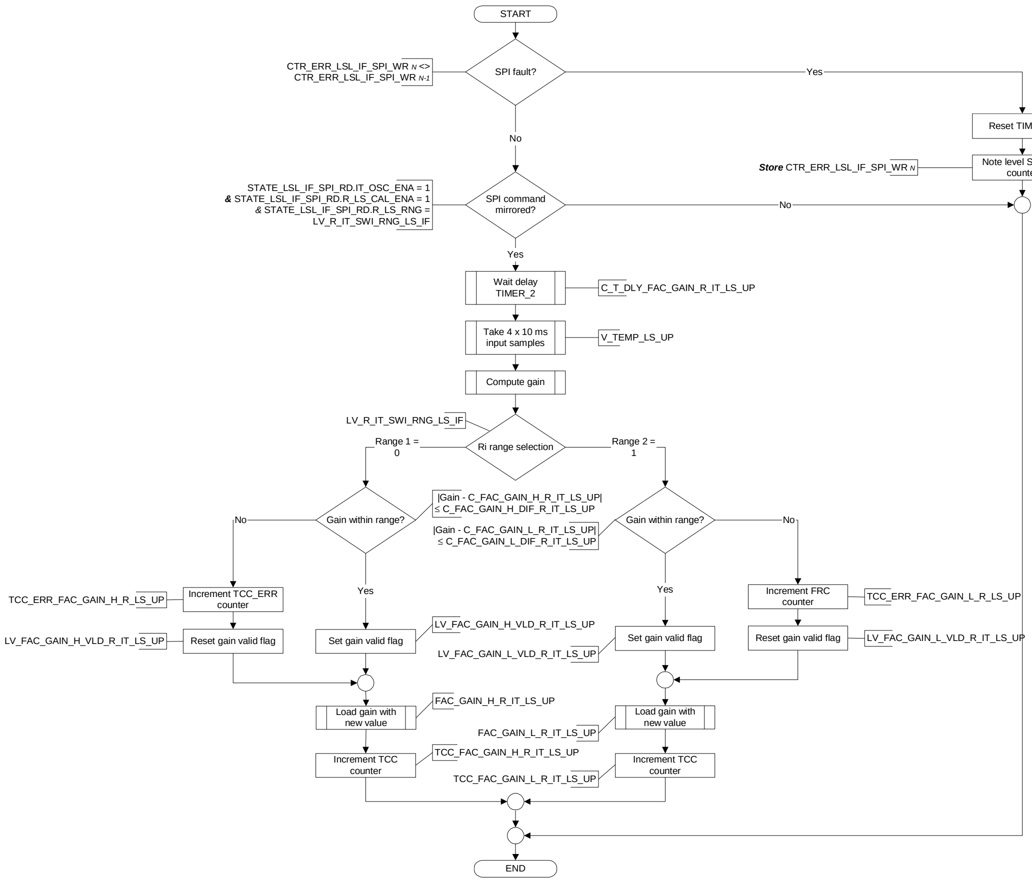
STATE_TTIP_MES_LS_UP[i] = MES

STATE_TTIP_MES_LS_UP[i] = ADJ_GAIN

Actions:



Note: TCC_FAC_GAIN_L_R_IT_LS_UP[i], TCC_ERR_FAC_GAIN_L_R_LS_UP[i], TCC_FAC_GAIN_H_R_IT_LS_UP[i] & TCC_ERR_FAC_GAIN_H_R_LS_UP[i] shall not be permitted to overflow.

Compute gain of internal resistance measurement circuit:

The gain shall be computed from the measurement circuit offset and the average of four (4) V_TEMP_LS_UP[i] samples in the adjustment mode using the following formula:

If LV_R_IT_SWI_RNG_LSL_IF[i] == 0
then FAC_GAIN_H_R_IT_LS_UP[i]
= **(** AV(V_TEMP_LS_UP[i]) - V_OFS_ADJ_R_IT_LS_UP[i] **)**
* C_FAC_GAIN_R_IT_LS_UP
else FAC_GAIN_L_R_IT_LS_UP[i]
= **(** AV(V_TEMP_LS_UP[i]) - V_OFS_ADJ_R_IT_LS_UP[i] **)**
* C_FAC_GAIN_R_IT_LS_UP
endif

Where AV(V_TEMP_LS_UP[i]) is the average of the 4 previously samples taken at 10 ms intervals as shown in the appropriate flow chart.

Note: The difference in voltages (V_TEMP_LS_UP[i] - V_OFS_ADJ_R_IT_LS_UP[i]) shall be limited to 0 to prevent negative values.

Condition 9: ADJ_GAIN to MES_OFS

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LV_LSL_OFS_ADJ_ACT[i] = 1 **or**
(ADJ_GAIN procedure complete **&**
LV_V_REF_VLD_R_IT_LS_UP[i] = 0)
Transition actions:
LV_R_IT_OSC_ENA_LSL_IF[i] = 0
LV_R_IT_CAL_ENA_LSL_IF[i] = 0
Reset *TIMER_1*
Start *TIMER_1*
Reset *TIMER_2*
Store CTR_ERR_LSL_IF_SPI_WR[i]$_N$
STATE_TTIP_MES_LS_UP[i] = MES_OFS
Condition 8: *ADJ_GAIN* *to* *MES*
TIMER_1 C_T_MAX_FAC_GAIN_R_IT_LS_UP **or**
(ADJ_GAIN procedure complete **&**
LV_V_REF_VLD_R_IT_LS_UP[i] = 1)
Transition actions:
LV_R_IT_CAL_ENA_LSL_IF[i] = 0
Reset *TIMER_2*
Store CTR_ERR_LSL_IF_SPI_WR[i]$_N$
STATE_TTIP_MES_LS_UP[i] = MES

STATE_TTIP_MES_LS*_UP[i] = *MES
Actions:

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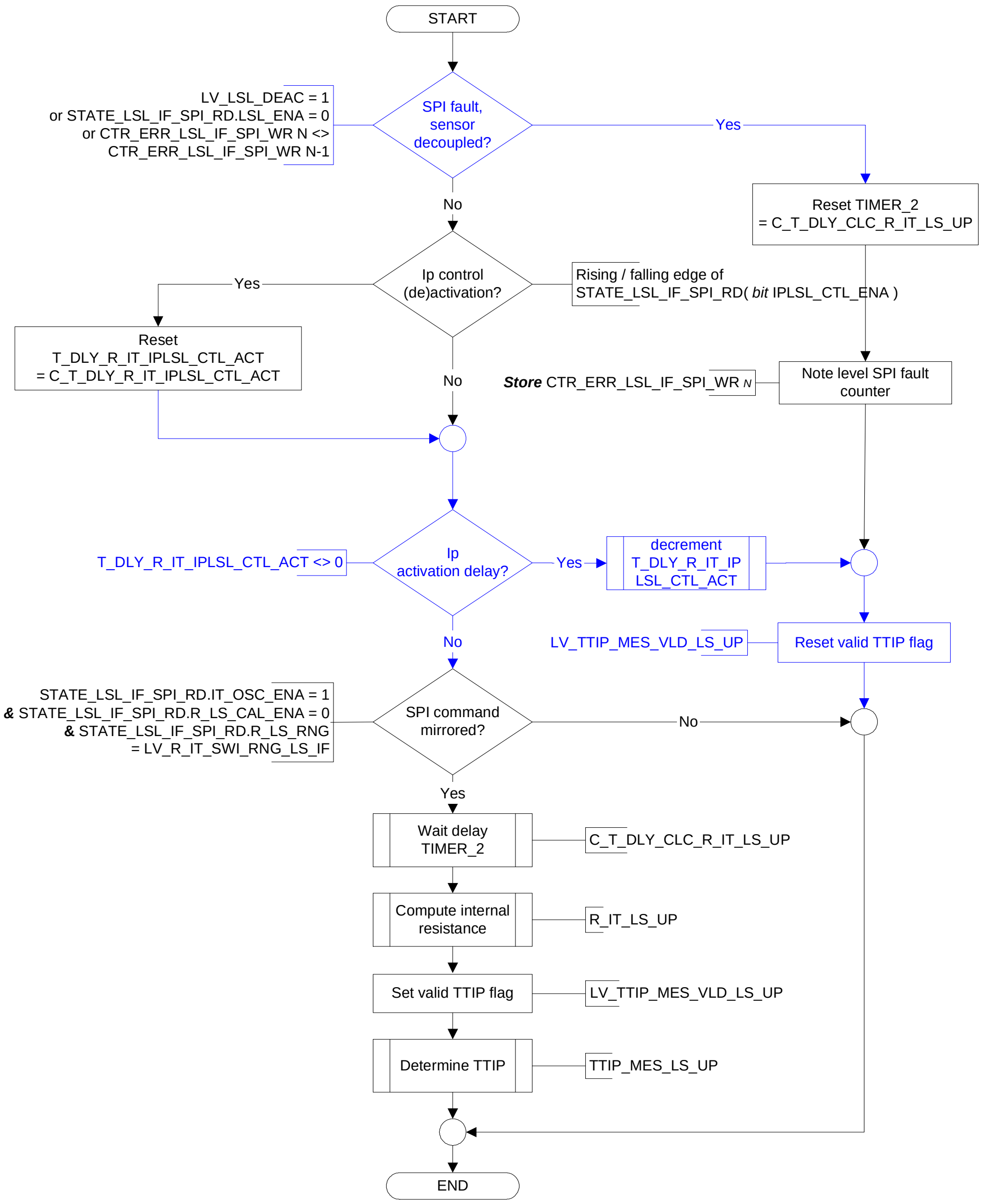

Compute internal resistance of oxygen sensor element: (Deviating recurrence, see above)

The internal resistance shall be computed from the offset voltage determined in the measurement mode with the oscillator off, the measurement circuit gain determined in the adjust mode and AV(V_TEMP_LS_UP[i]). Once the active Ri determination conditions have been met as denoted above, the resistance shall be determined from the following formula.

If LV_R_IT_SWI_RNG_LSL_IF[i] == 0
then R_IT_LS_UP[i] = C_R_IT_REF_LS_UP
* **{** AV(V_TEMP_LS_UP[i]) - V_OFS_MES_R_IT_LS_UP[i] **}**
/**{** 5V * FAC_GAIN_H_R_IT_LS_UP[i]
- **(** AV(V_TEMP_LS_UP[i]) - V_OFS_MES_R_IT_LS_UP[i] **)}**
else R_IT_LS_UP[i] = C_R_IT_REF_LS_UP
* **{** AV(V_TEMP_LS_UP[i]) - V_OFS_MES_R_IT_LS_UP[i] **}**
/**{** 5V * FAC_GAIN_L_R_IT_LS_UP[i]
- **(** AV(V_TEMP_LS_UP[i]) - V_OFS_MES_R_IT_LS_UP[i] **) }**

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endif
Where AV(V_TEMP_LS_UP[i]) is either the average of the 8 previously samples taken at 10 ms intervals as shown in the appropriate flow chart or should the 100 ms task, in which the resistance is computed, be called before 8 samples could be taken then the latest V_TEMP_LS_UP[i] value shall be used. Should the timing be such that no current V_TEMP_LS_UP[i] are available then the resistance and hence ceramic temperature shall be calculated in the next 100 ms recurrence. Additionally, in this instance LV_TTIP_MES_VLD_LS_UP[i] would remain reset until the next recurrence.
Note: The difference in voltages (V_TEMP_LS_UP[i] - V_OFS_MES_R_IT_LS_UP[i]) shall be limited to 0 to prevent negative values.
Should internal resistance determination be suspended due to an adjustment measurement request, the value R_IT_LS_UP[i] shall be maintained at the value computed prior to suspension but the variable(s) used to compute the average shall be reinitialised.

Determine ceramic temperature from mapped characteristic oxygen sensor element temperature vs. internal resistance:
TTIP_MES_LS_UP[i] = IP_TTIP_MES_LS_UP (R_IT_LS_UP[i])

Condition 10: *MES to MES_OFS*
LC_V_REF_R_IT_LS_UP = 1 **&**
(LV_LSL_OFS_ADJ_ACT[i] = 1 **or**
LV_LS_UP_READY[i] *transition* 0 1 **or**
LC_R_RNG_REQ_SWI_LS_UP_LSL_IF *transition* 0 1)
Transition actions:
If (LC_R_RNG_REQ_SWI_LS_UP_LSL_IF = 1)
then
LV_R_IT_SWI_RNG_LSL_IF[i] = LC_R_RNG_REQ_LS_UP_LSL_IF
else
LV_R_IT_SWI_RNG_LSL_IF[i] = **!** LV_LS_UP_READY[i]
endif.
LV_TTIP_MES_VLD_LS_UP[i] = 0
LV_R_IT_OSC_ENA_LSL_IF[i] = 0
Reset *TIMER_1*
Start *TIMER_1*
Reset *TIMER_2*
Store CTR_ERR_LSL_IF_SPI_WR[i]$_N$
STATE_TTIP_MES_LS_UP[i] = MES_OFS
Condition 11: *MES to MES*
LC_V_REF_R_IT_LS_UP = 0 **&**
(LV_LS_UP_READY[i] *transition* 0 1 **or**
LC_R_RNG_REQ_SWI_LS_UP_LSL_IF *transition* 0 1)
Transition actions:
If (LC_R_RNG_REQ_SWI_LS_UP_LSL_IF = 1)
then
LV_R_IT_SWI_RNG_LSL_IF[i] = LC_R_RNG_REQ_LS_UP_LSL_IF
else
LV_R_IT_SWI_RNG_LSL_IF[i] = **!** LV_LS_UP_READY[i]
endif.
LV_TTIP_MES_VLD_LS_UP[i] = 0
Reset *TIMER_2*
Store CTR_ERR_LSL_IF_SPI_WR[i]$_N$

Additional variable /constant definitions
FRQ_R_IT_OSC_LSL_IF_SPI_WR[i] and C_FRQ_R_IT_OSC_LSL_IF shall be defined as follows:

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Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	D6	D5	D4	D3	D2	D1	D0

Where:
X denotes don t care
D0 through D5 denotes the 6 bit coded oscillator frequency information. A value of 00H represents 2.0 kHz and each step 125 Hz. Hence 3F represents 9.875 kHz.
D6 denotes the bit used to selectively disable pins inside of the protection time under fault conditions. 0 pins will be decoupled after the protection time has passed. 1 the pin at which the fault is detected will immediately be decoupled, i.e. inside the protection time before the remaining pins are decoupled after the passing of the protection time.

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4.38 O2 sensor (lin, up) element temperature determination (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_TTIP_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that upstream oxygen sensor ceramic temperature determination shall be inhibited					

Input data:

LV_DIAG_OC_IF_OSC_DI_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ES {p. 1720}	LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}
STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}			

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

The Boolean flag LV_INH_TTIP_LS_UP[i] shall indicate whether the upstream oxygen sensor ceramic temperature determination shall be permitted to take place. When set, no temperature determination shall take place.

Description:

Application conditions:

Initialisation:
The following initialisation shall be carried out after RESET and upon leaving the engine state Engine Stop (LV_ES).
LV_INH_TTIP_LS_UP[i] = 0
Recurrence: 1s
Activation:
LV_ST_END == 1
Deactivation:
LV_ST_END == 0

Formula section:

If LV_DIAG_OC_IF_OSC_DI_LSL_UP[i] == 1
or STATE_LSL_IF_SPI_RD[i] *bit* LSL_ENA == 0

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then LV_INH_TTIP_LS_UP[i] = 1
else LV_INH_TTIP_LS_UP[i] = 0
endif

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4.39 O2 sensor (lin, up) basic signal processing

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VLS_UP_INIT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the buffer initialisation after switching between Gain 16 & Gain 8 values of WRAF Controller or after Offset adjustment of WRAF sensor					
LV_VLS_UP_VLD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating whether clipping of the WRAF sensor signal is taking place (1 No clipping, 0 clipping)					
NR_BUF_SAMPLE [NC_NR_BUF_SAMPLE_ LEN][NC_CBK_EX_NR]	-	0... FFH	0... 255	1	-
Ring buffer for saving the number of samples taken for intermediate sum.					
NR_SAMPLE_1_SUM	V	0... FFH	0... 255	1	-
Number of samples taken for Intermediate Sum 1					
NR_SAMPLE_2_SUM	V	0... FFH	0... 255	1	-
Number of samples taken for Intermediate Sum 2					
NR_SAMPLE_TOT_MV [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Total number of samples taken for mean value calculation					
NR_VALUE_BUF_SAMPLE	V	0... FFH	0... 255	1	-
Number of values to be taken from NR_BUF_SAMPLE for mean value calculation					
NR_VALUE_BUF_SUM	V	0... FFH	0... 255	1	-
Number of values to be taken from VLS_BUF_SUM for mean value calculation					
NR_VLS_UP_BUF_IDX [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Index for the ring buffer NR_BUF_SAMPLE					
NR_VLS_UP_RAW_BUF_IDX	V	0... FFH	0... 255	1	-
Index for the ring buffer VLS_UP_RAW_BUF as well as the Counter to trigger the mean value calculation of WRAF sensor signal					
NR_VLS_UP_RAW_SAMPLE_MV	V	0... FFH	0... 255	1	-
Total number of samples required for mean value calculation					
STATE_LSL_IF_SPI_RD_OLD [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
past initialization status register information for WRAF controller					
STATE_LSL_IF_SPI_WR_OLD [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
past initialization write status register information for WRAF controller					
T_DLY_VLS_UP_INIT [NC_CBK_EX_NR]	V	0... FFH	0... 2.55	0.01	s
reset timer for LV_VLS_UP_INIT					
T_SEG_LEN	V	0... FFH	0... 0.255	0.001	s
Actual segment time measured in msec					
VLS_BUF_SUM [NC_NR_BUF_SUM_LEN][NC_CBK_EX_NR]	-	0... FFFFH	0... 319.995117	0.00488281	V
Ring buffer for saving the intermediate sums of raw sensor signal					
VLS_UP [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511719	0.00488281	V
Upstream oxygen sensor voltage Bank 1					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VLS_UP_10_RAW [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511719	0.00488281	V
Raw value of WRAF sensor voltage signal Recurrence 10.0 msec					
VLS_UP_INTER_1_SUM [NC_CBK_EX_NR]	V	0... FFFFH	0... 319.995117	0.00488281	V
Intermediate sum 1					
VLS_UP_INTER_2_SUM [NC_CBK_EX_NR]	V	0... FFFFH	0... 319.995117	0.00488281	V
Intermediate sum 2					
VLS_UP_MV [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511719	0.00488281	V
Mean value of Upstream Oxygen sensor voltage					
VLS_UP_RAW_BUF [NC_NR_RAW_BUF_LEN][NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511719	0.00488281	V
Ring Buffer for storing the raw signal of WRAF sensor every 1 msec					
VLS_UP_TOT_SUM_MV [NC_CBK_EX_NR]	V	0... FFFFFFFFH	0... 20971500	0.00488281	V
Total sum of raw signal voltages taken for mean value calculation					

Input data:

LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	N {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}	STATE_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 1313}	VLS_UP_RAW [NC_CBK_EX_NR] {p. 967}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_MAX_VLS_UP_MV	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed threshold for calculating mean value (background : save CPU load)					
C_T_DLY_VLS_UP_INIT	-	1... FFH	0.01 ...2.55	0.01	s
reset timer for LV_VLS_UP_INIT, Initial value = 1					
C_T_DLY_VLS_UP_INIT_MAX	-	1... FFH	0.01 ...2.55	0.01	s
initial value for delay timer in case of gain switching or offset adjustment					
C_VLS_UP_THD_BOL	-	0... 3FFH	0... 4.995117	0.00488281	V
Lower voltage threshold for WRAF sensor signal					
C_VLS_UP_THD_TOL	-	0... 3FFH	0... 4.995117	0.00488281	V
Upper voltage threshold for WRAF sensor signal					
LC_VLS_UP_MV_ON	-	0... 1H	0 ...1	1	-
Calibration flag to switch between raw value and filtered value (1 filtered, 0 raw)					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_FAC_10_SAMPLE	-	0... FFH	0... 255	1	-
Factor for multiplication, if segment time is less than NC_T_SEG_LEN_MIN					
NC_FAC_5_SAMPLE	-	0... FFH	0... 255	1	-
Factor for multiplication, if segment time is less than 5 msec					
NC_N_MIN_VLS_UP_MV	-	0... 1FE0H	0... 8160	1	rpm
Minimum engine speed threshold for calculating the mean value					
NC_NR_BUF_SAMPLE_LEN	-	0... FFH	0... 255	1	-
Buffer size for storing the number of samples taken for intermediate sum 1 (for minimum speed of 500 RPM)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_BUF_SUM_LEN	-	0... FFH	0... 255	1	-
Buffer size for storing the intermediate sums of sensor signal every 10 ms (for minimum speed of 500 RPM)					
NC_NR_RAW_BUF_LEN	-	0... FFH	0... 255	1	-
Ring buffer size for storing the raw sensor signal every 1 msec					
NC_T_SEG_LEN_MIN	-	0... FFH	0... 0.255	0.001	s
Minimum segment time required for mean value calculation					

4.39.1 EGCP_SIGCVLSL3

The WRAF sensor s signal is influenced by the pressure fluctuations in the exhaust manifold. The dynamic pressure peaks in exhaust gas results in momentary increase of oxygen concentration inside the reference cell of WRAF sensor & the same is refelected at the sensor output signal. Pressure fluctuation comes mainly from segment timing, quick open & close of exhaust valve, misfiring and may be some other parameter. Out of all these most dominant influence comes from segment timing. To remove segment timing influence from from the signal a mean value is evaluated.
The calculation shall be done for all exhaust cylinder banks.
NC_CBK_EX_NR defines the number of exhaust banks. For vector elements, the variable extension _i is used in the model instead of [i] as found in the textual description.
To evaluate segment synchronous mean value, the raw voltage signal is captured every 1 ms (from BSW) and stored in a ring buffer. The size of this ring buffer is defined by NC_NR_RAW_BUF_LEN and it is **fixed** at 10. All other calculations in this function is triggered soon after the 10^{th} value is written in to the buffer. The segment time in msec is calculated every 10 ms.
In order to save the memory space, 2 intermediate sums is built out of the earlier 10 values and stored in a second ring buffer. At the same time, the number of samples taken for first intermediate sum calculation is stored in the third ring buffer. The number of samples required for mean value as well as intermediate sums is calculated dynamically based on the segment time.
The final mean value is calculated by reading the buffers filled with intermediate sums and corresponding number of samples. The values are filled in all the three ring buffers from bottom to top.
It is possible to switch off this function using the switch LC_VLS_UP_MV_ON, in which case only the raw sensor signal is delivered at 10 ms recurrence.
The ring buffer size for storing the intermediate sums and number of samples is calculated for a minimum engine speed of 500 rpm (Engine having 4 cyl and 2 exhaust bank - worst case). Hence the default values are
NC_N_MIN_VLS_UP_MV = 500 rpm
NC_NR_BUF_SAMPLE_LEN = 12
NC_NR_BUF_SUM_LEN = 2 * NC_NR_BUF_SAMPLE_LEN = 24

Application Condition

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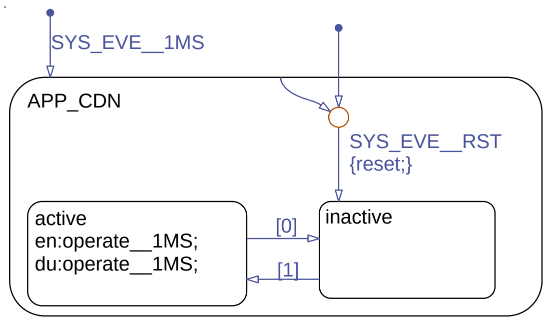

Figure 4.39.1: EGCP_SIGCVLSL3/APP_CDN/Chart

Function Description

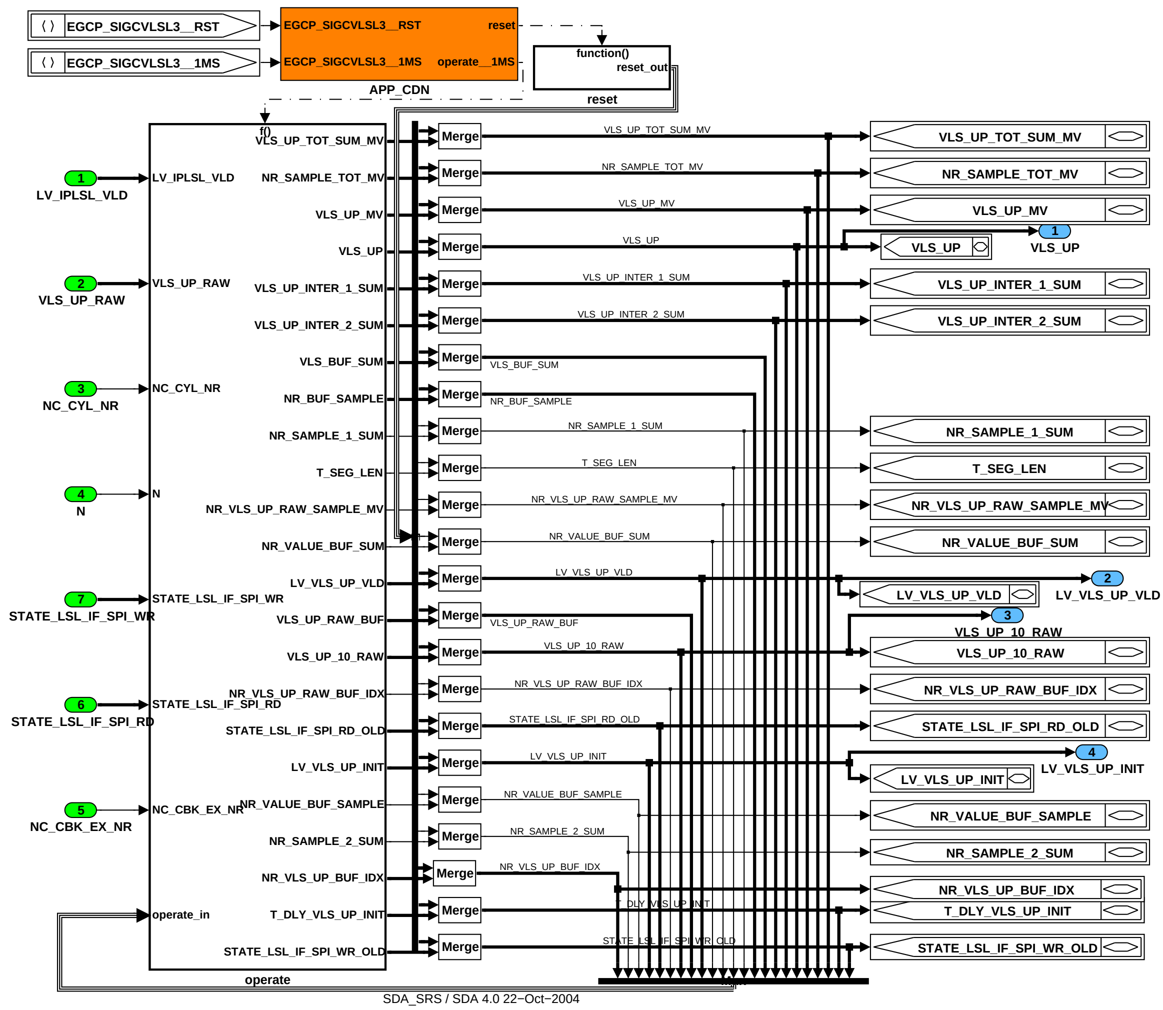

Figure 4.39.2: EGCP_SIGCVLSL3

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4.39.1.1 SUBFUNCTION: operate

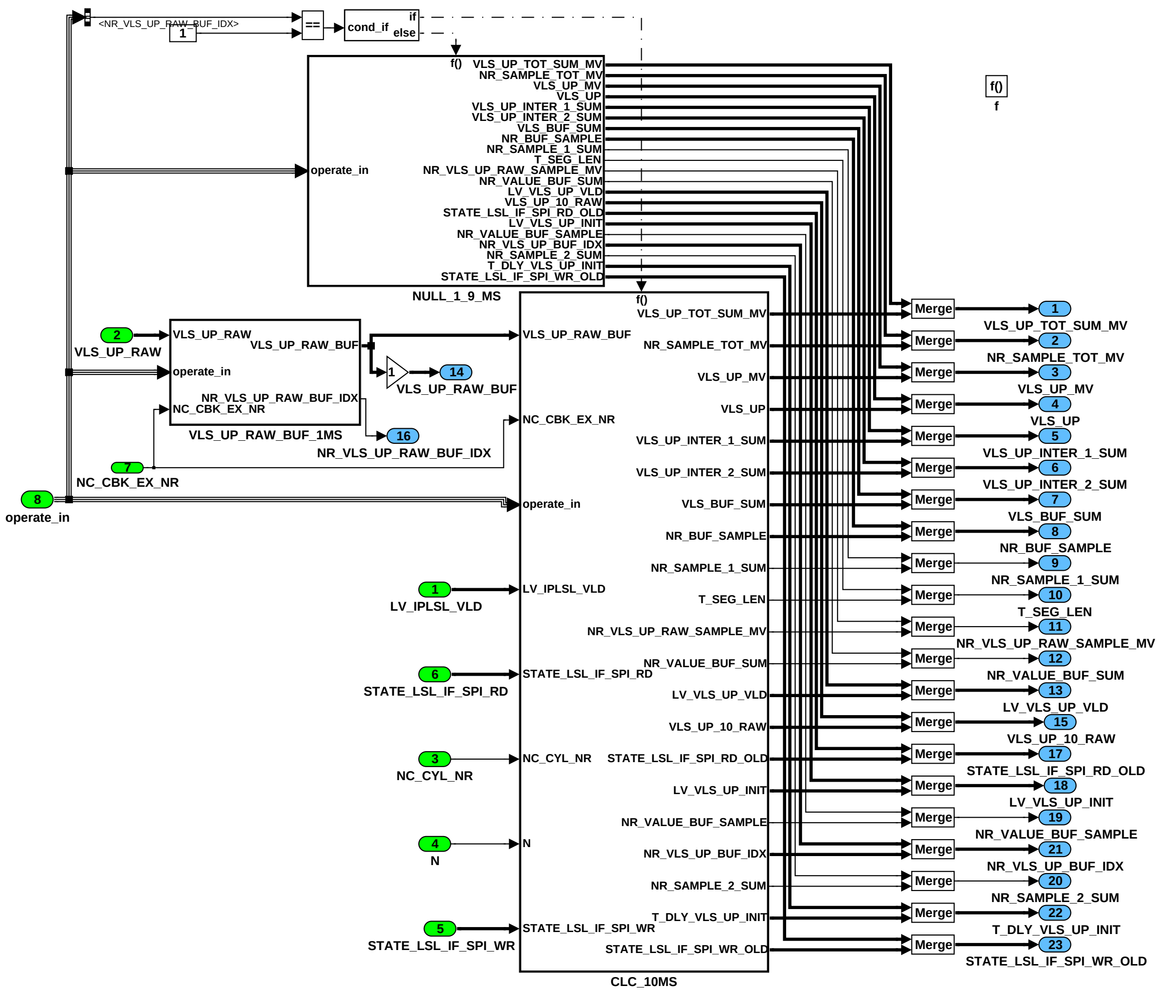

Figure 4.39.3: EGCP_SIGCVLSL3/operate

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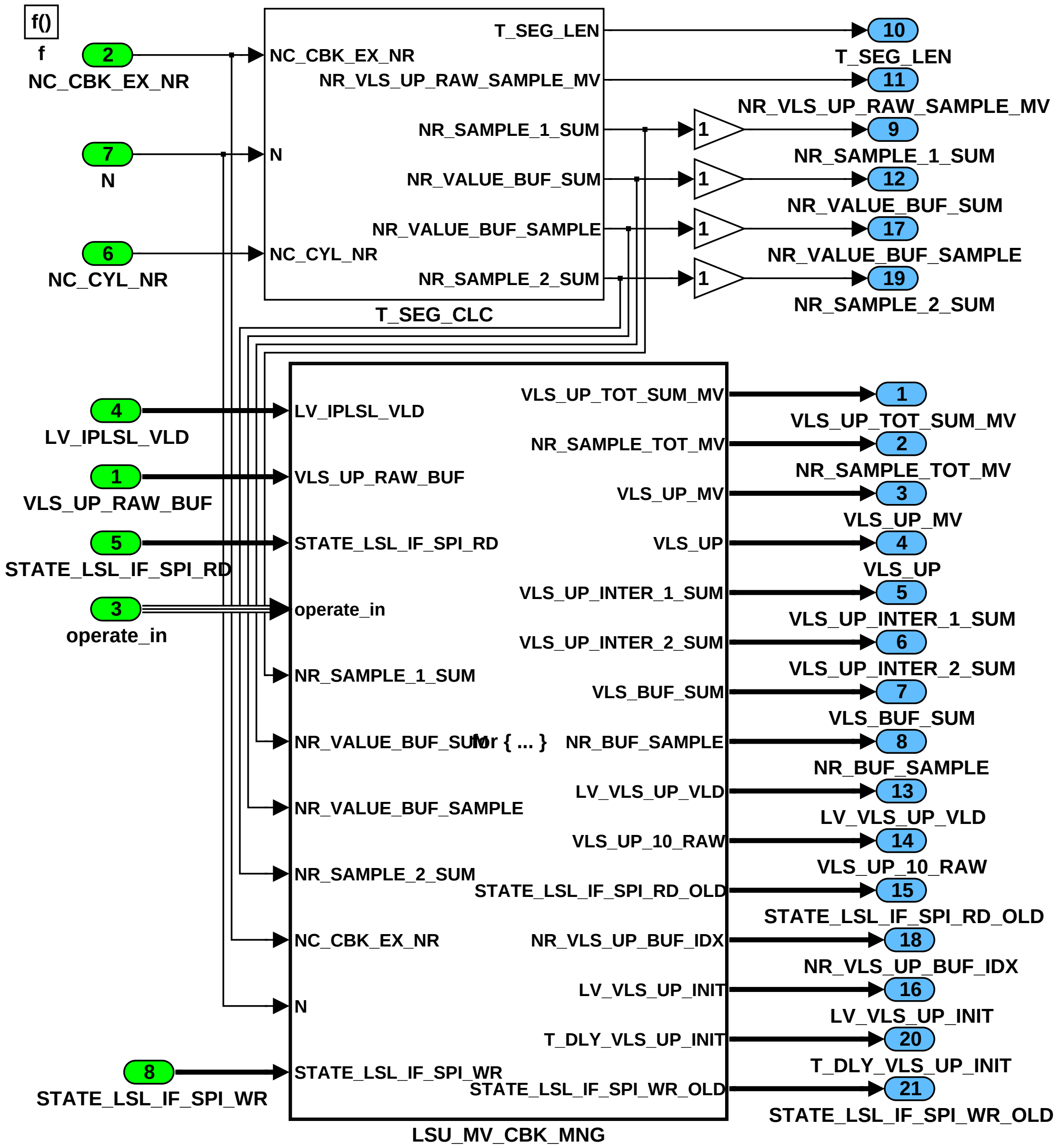

Figure 4.39.4: EGCP_SIGCVLSL3/operate/CLC_10MS

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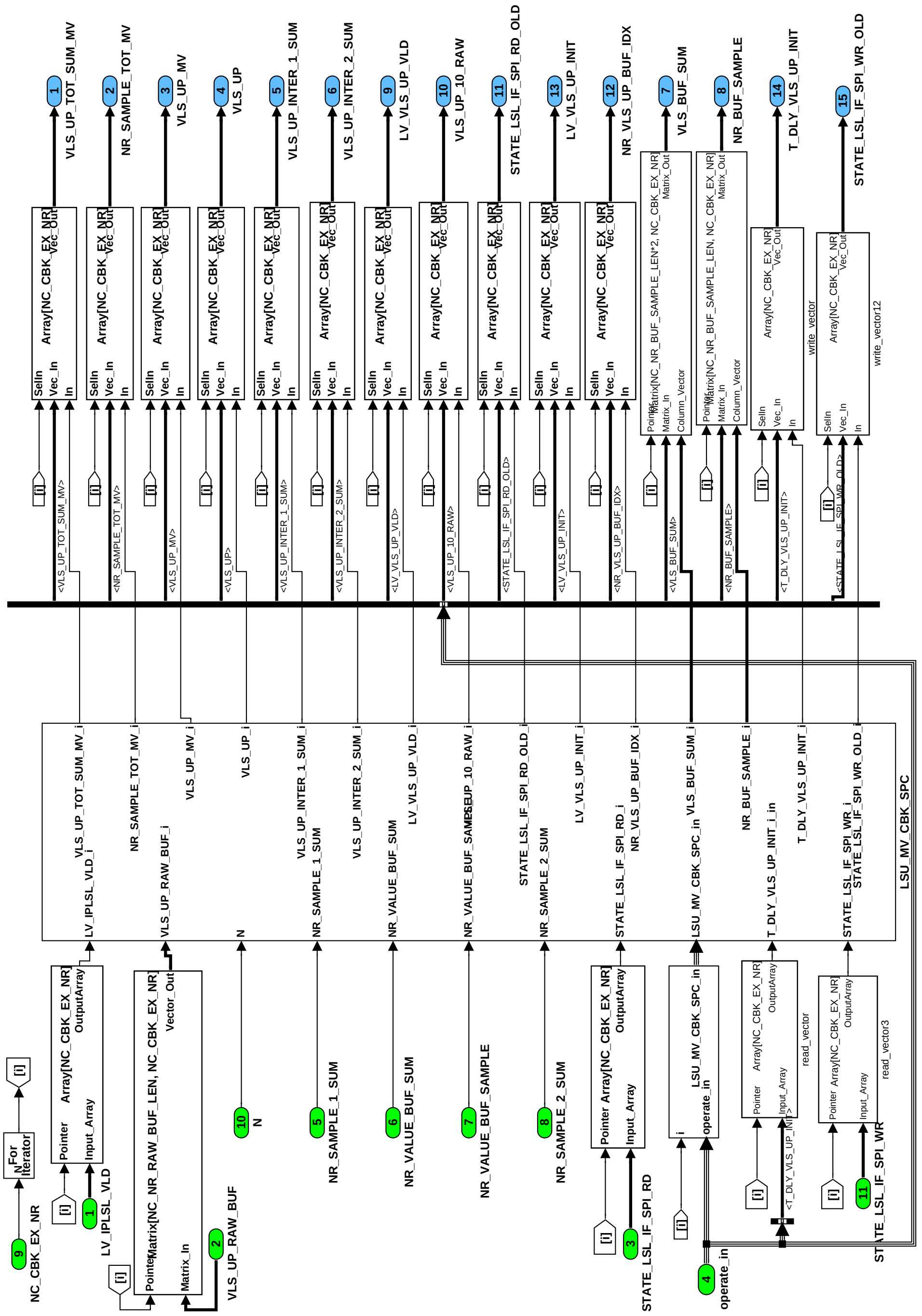

Figure 4.39.5: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG

Re initialisation of buffers

The raw signal voltage is always compared with limitting values and clipped if any. Accordingly the flag LV_VLS_UP_VLD is set.

The bit LV_VLS_UP_INIT is set to 1 whenever any one of the 2 LSBs of STATE_LSL_IF_SPI_WR toggles. T_DLY_VLS_UP_INIT is initialized to calibration value whenever any one of the 2 LSBs of STATE_LSL_IF_SPI_WR toggles. The bit LV_VLS_UP_INIT reset to 0 after expiry of timer T_DLY_ VLS_UP_INIT.

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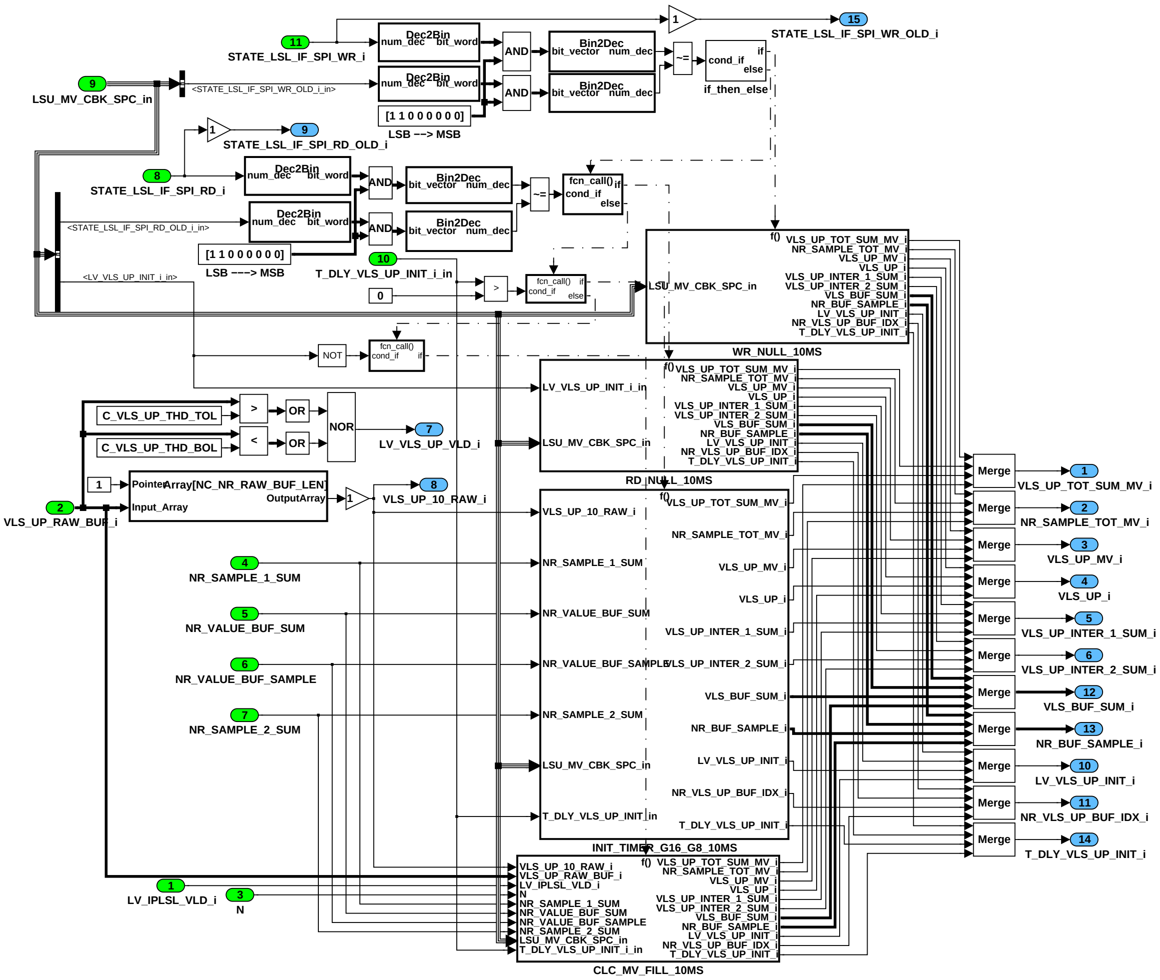

Figure 4.39.6: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC

Filling ring buffers with current values

During engine starting, the buffers are filled with current sensor values till the conditions for mean value calculation are fulfilled. In this case, VLS_UP would be same as VLS_UP_10_RAW (every 10^{th} raw signal value stored in VLS_UP_RAW_BUF).

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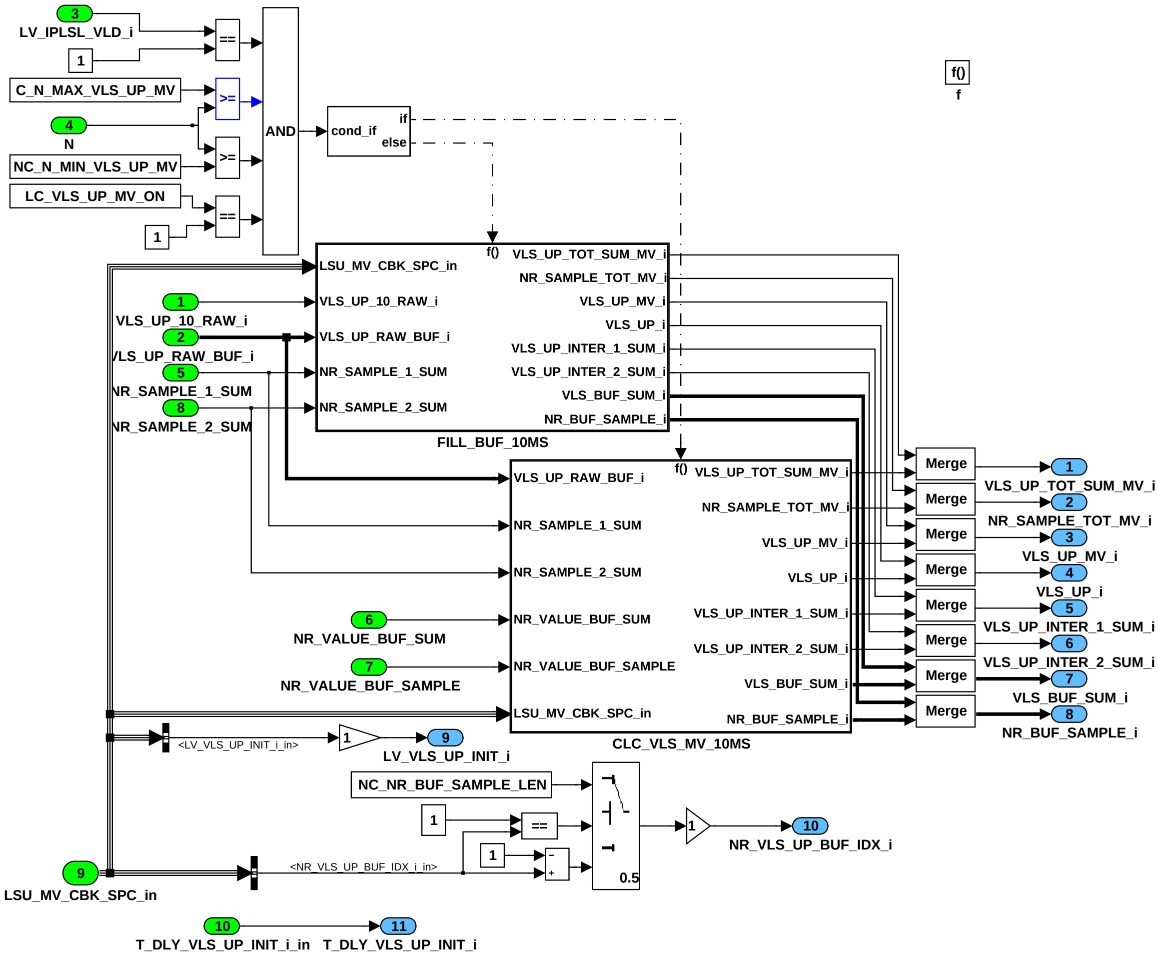

Figure 4.39.7: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/ CLC_MV_FILL_10MS

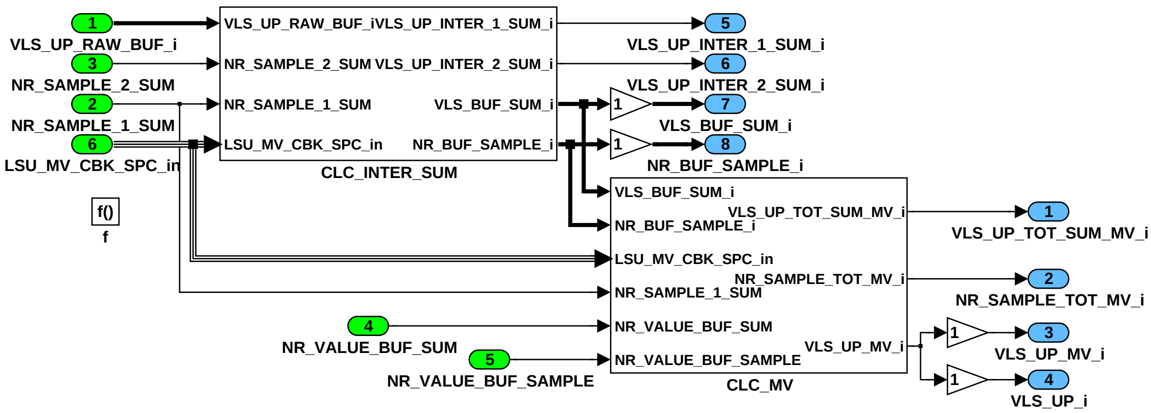

Figure 4.39.8: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/ CLC_MV_FILL_10MS/CLC_VLS_MV_10MS

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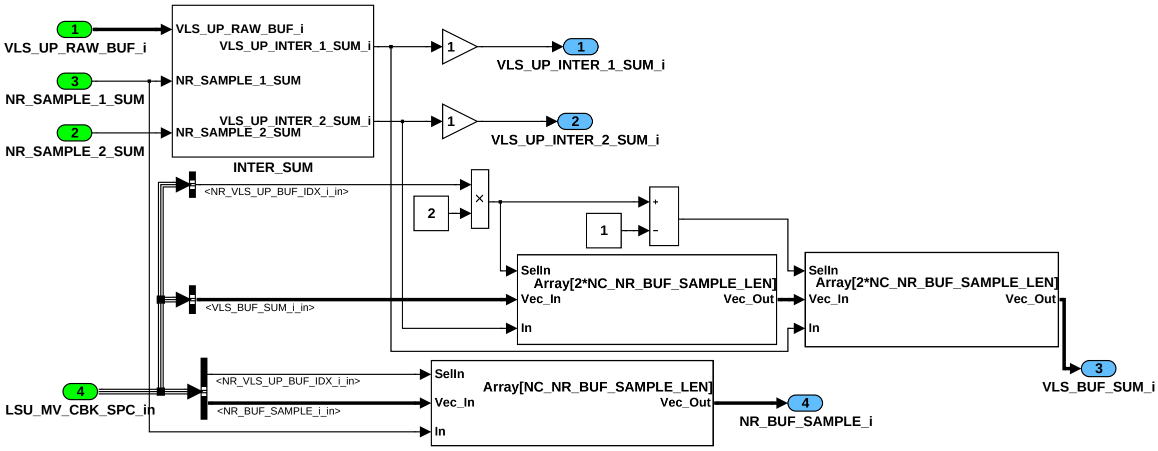

Figure 4.39.9: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/ CLC_MV_FILL_10MS/CLC_VLS_MV_10MS/CLC_INTER_SUM

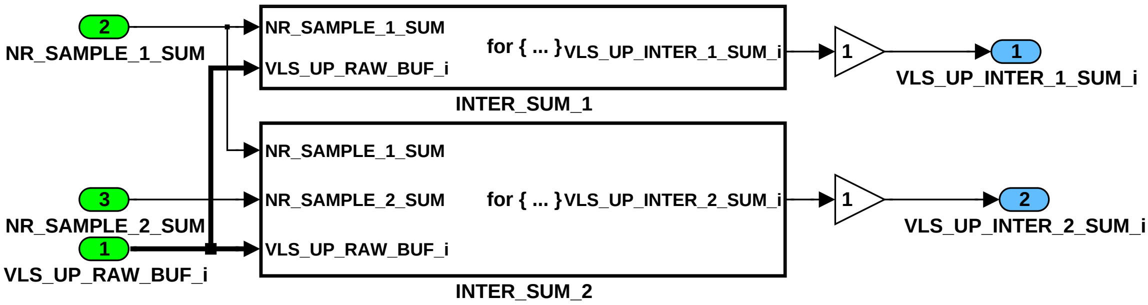

Figure 4.39.10: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/ CLC_MV_FILL_10MS/CLC_VLS_MV_10MS/CLC_INTER_SUM/INTER_SUM

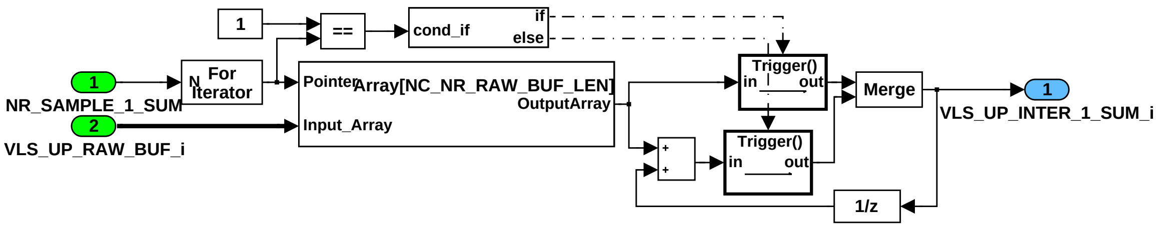

Figure 4.39.11: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/ CLC_MV_FILL_10MS/CLC_VLS_MV_10MS/CLC_INTER_SUM/INTER_SUM/INTER_SUM_1

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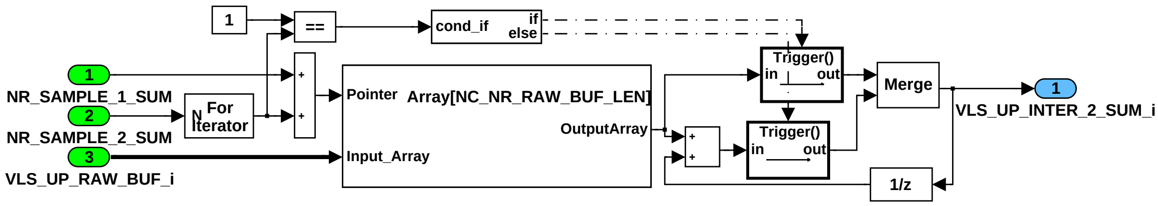

Figure 4.39.12: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/CLC_MV_FILL_10MS/CLC_VLS_MV_10MS/CLC_INTER_SUM/INTER_SUM/INTER_SUM_2

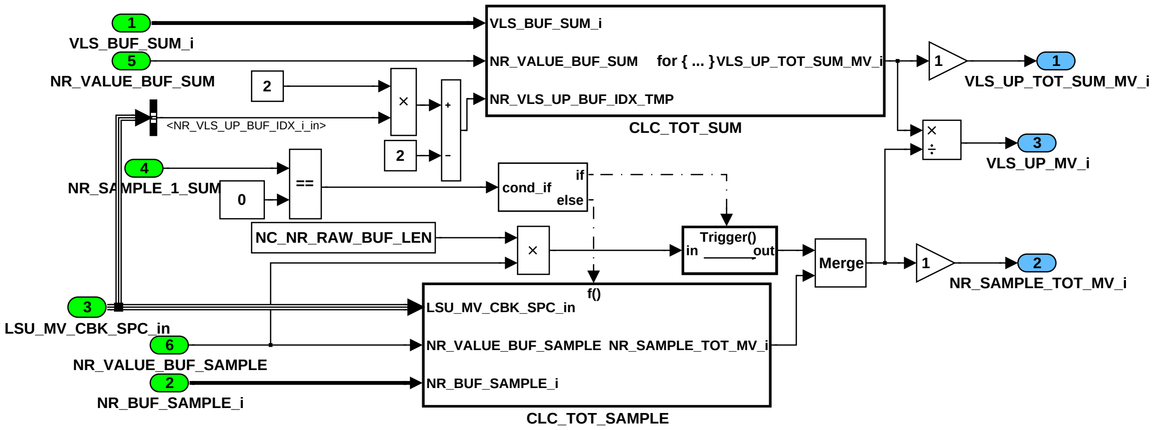

Figure 4.39.13: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/CLC_MV_FILL_10MS/CLC_VLS_MV_10MS/CLC_MV

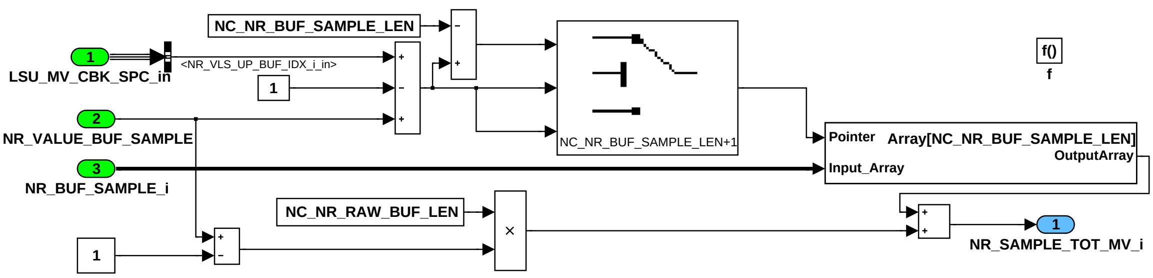

Figure 4.39.14: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/CLC_MV_FILL_10MS/CLC_VLS_MV_10MS/CLC_MV/CLC_TOT_SAMPLE

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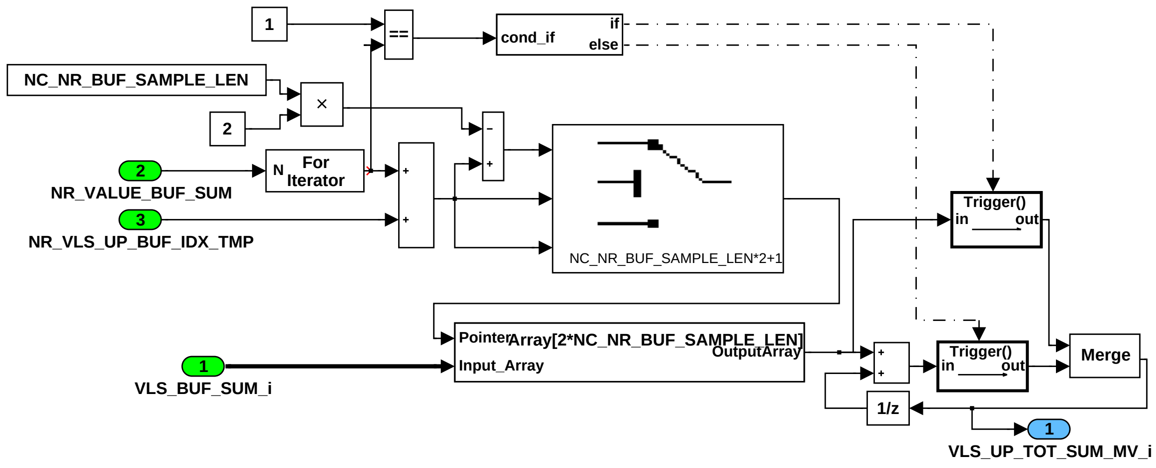

Figure 4.39.15: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/CLC_MV_FILL_10MS/CLC_VLS_MV_10MS/CLC_MV/CLC_TOT_SUM

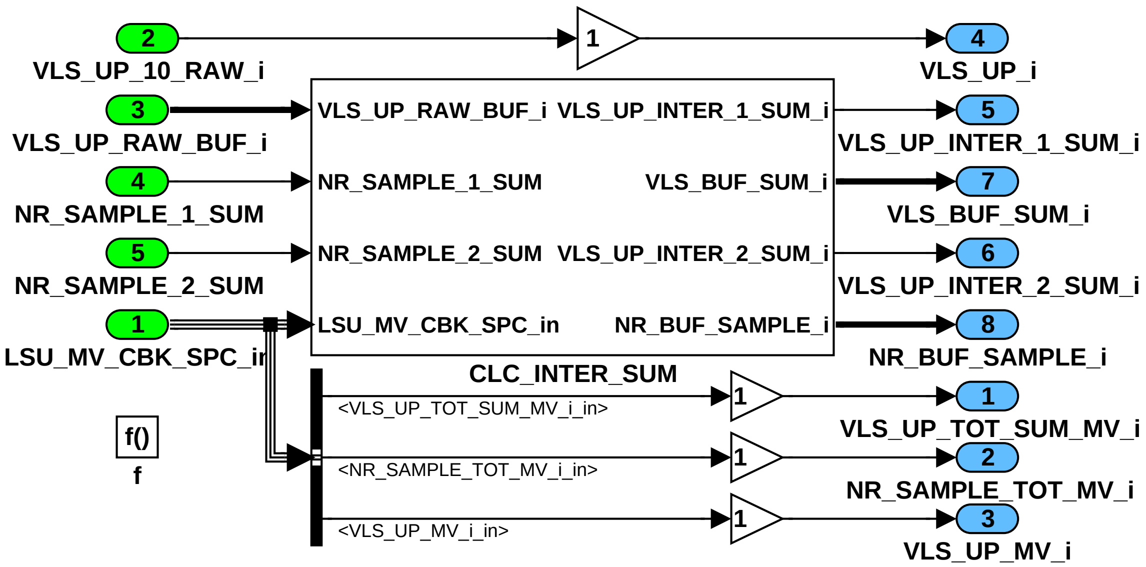

Figure 4.39.16: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/CLC_MV_FILL_10MS/FILL_BUF_10MS

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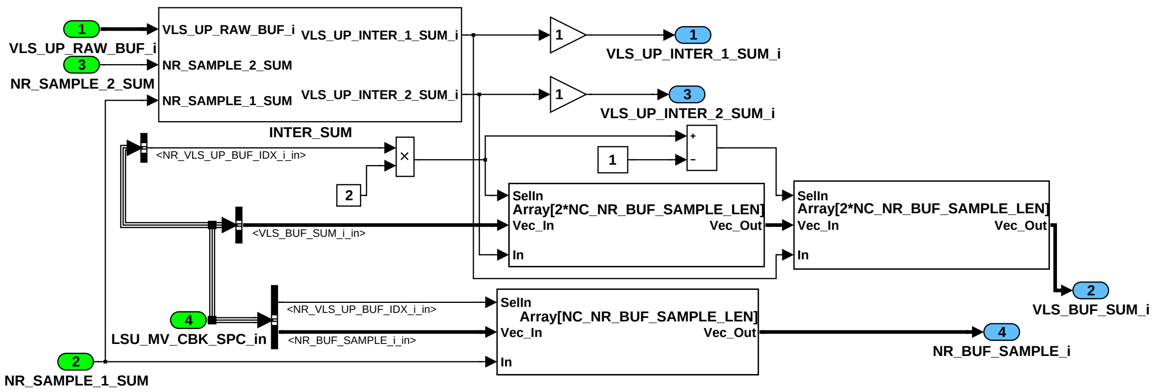

Figure 4.39.17: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/CLC_MV_FILL_10MS/FILL_BUF_10MS/CLC_INTER_SUM

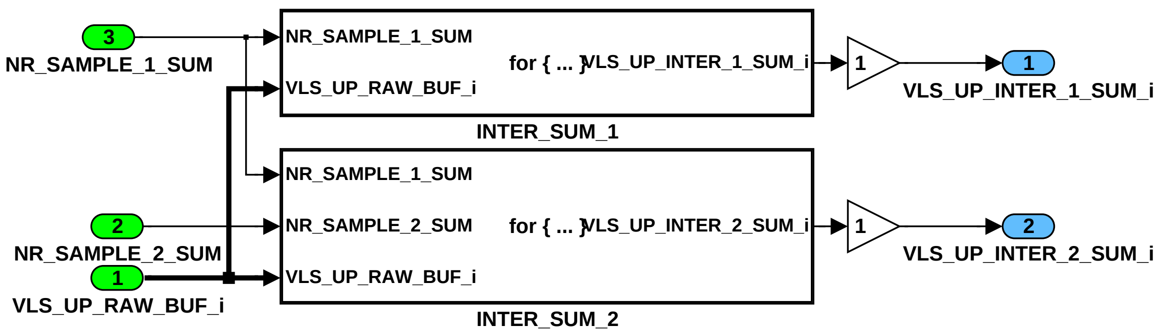

Figure 4.39.18: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/CLC_MV_FILL_10MS/FILL_BUF_10MS/CLC_INTER_SUM/INTER_SUM

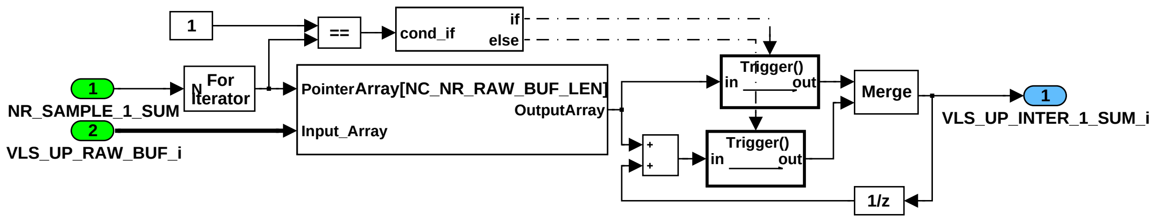

Figure 4.39.19: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/CLC_MV_FILL_10MS/FILL_BUF_10MS/CLC_INTER_SUM/INTER_SUM/INTER_SUM_1

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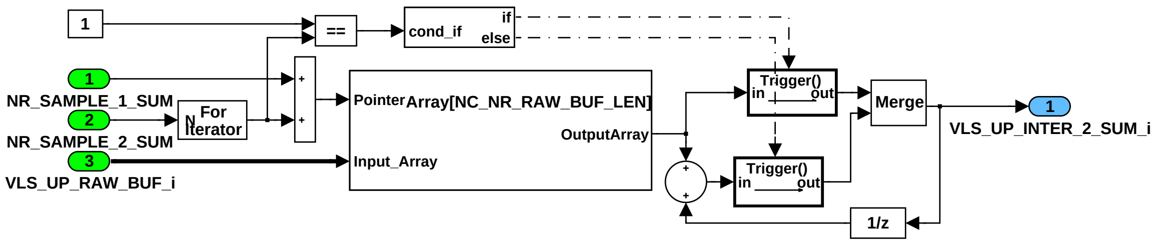

Figure 4.39.20: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/ CLC_MV_FILL_10MS/FILL_BUF_10MS/CLC_INTER_SUM/INTER_SUM/INTER_SUM_2

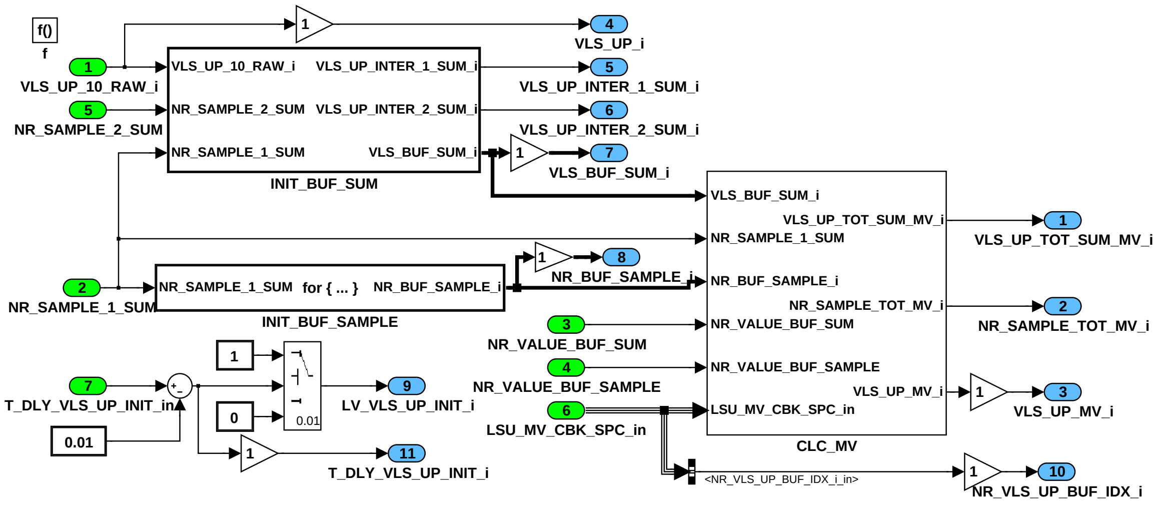

Figure 4.39.21: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/ INIT_TIMER_G16_G8_10MS

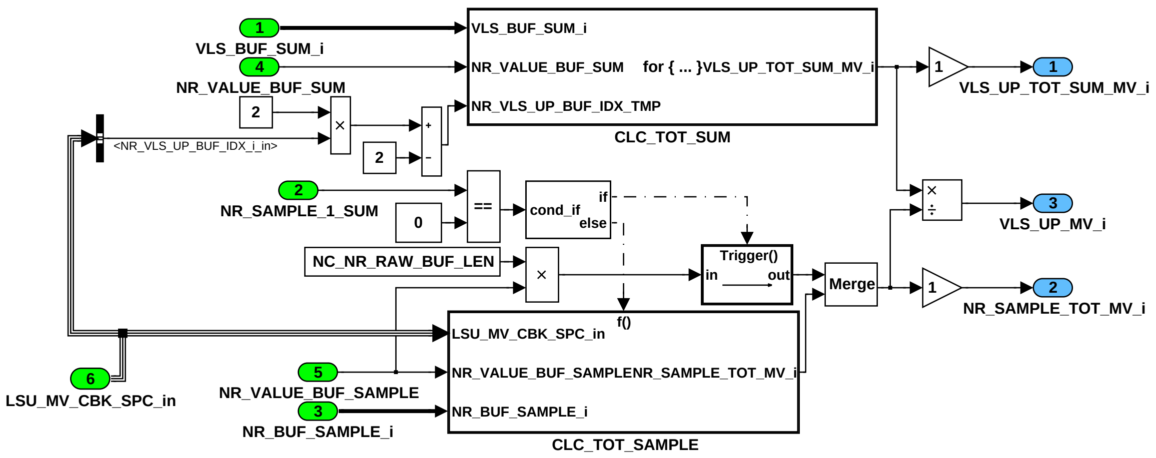

Figure 4.39.22: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/ INIT_TIMER_G16_G8_10MS/CLC_MV

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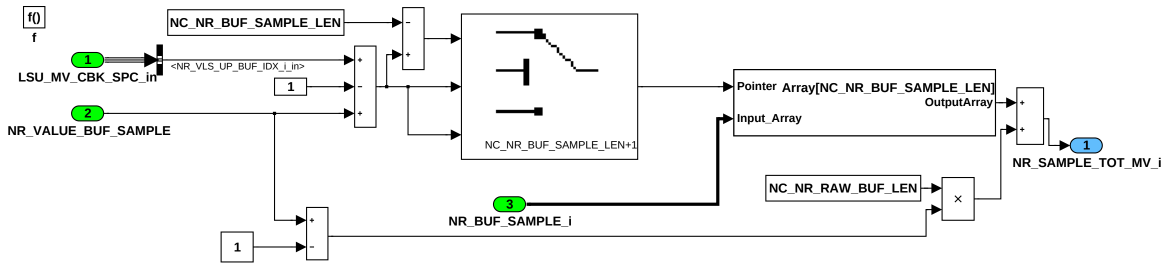

Figure 4.39.23: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/ INIT_TIMER_G16_G8_10MS/CLC_MV/CLC_TOT_SAMPLE

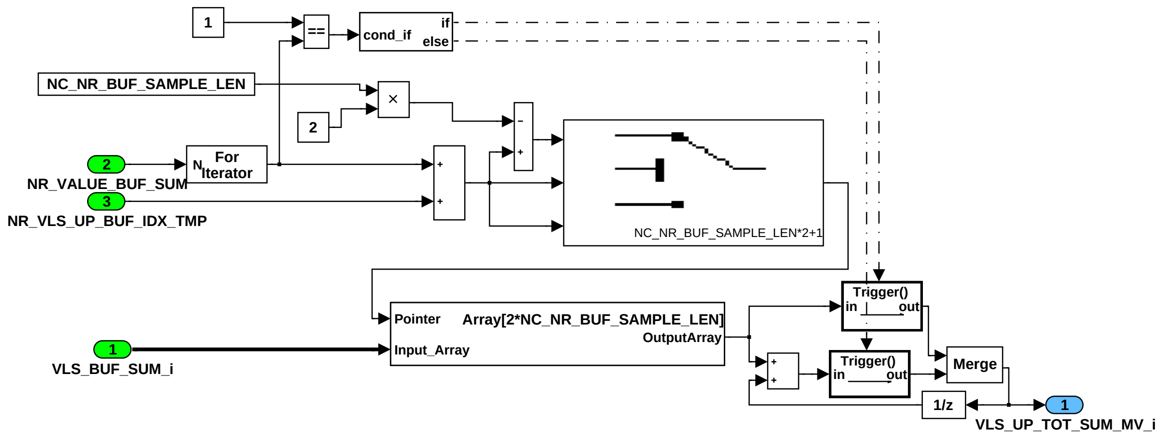

Figure 4.39.24: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/ INIT_TIMER_G16_G8_10MS/CLC_MV/CLC_TOT_SUM

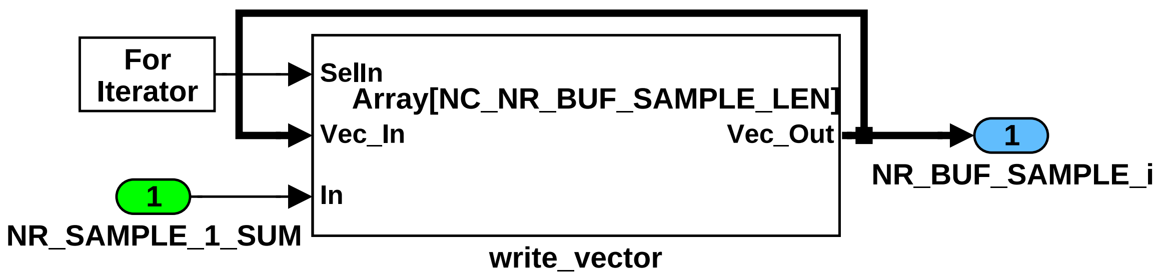

Figure 4.39.25: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/ INIT_TIMER_G16_G8_10MS/INIT_BUF_SAMPLE

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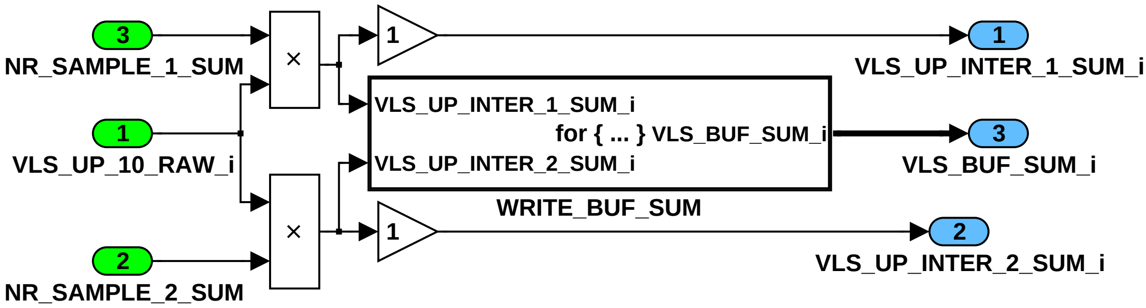

Figure 4.39.26: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/INIT_TIMER_G16_G8_10MS/INIT_BUF_SUM

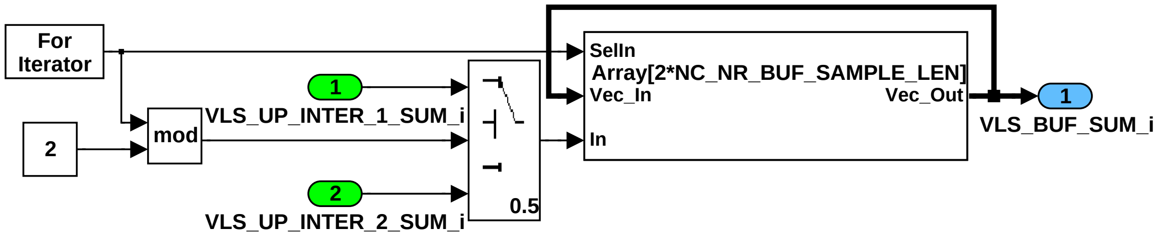

Figure 4.39.27: EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/INIT_TIMER_G16_G8_10MS/INIT_BUF_SUM/WRITE_BUF_SUM

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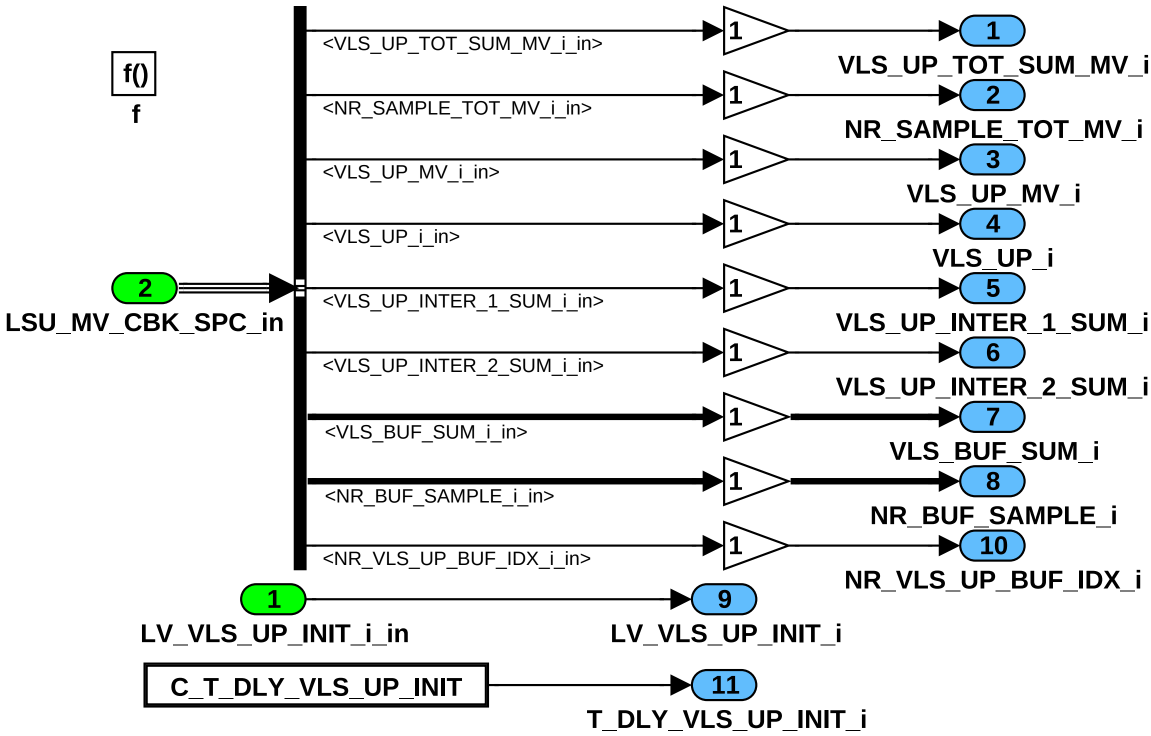

Figure 4.39.28:
EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/RD_NULL_10MS

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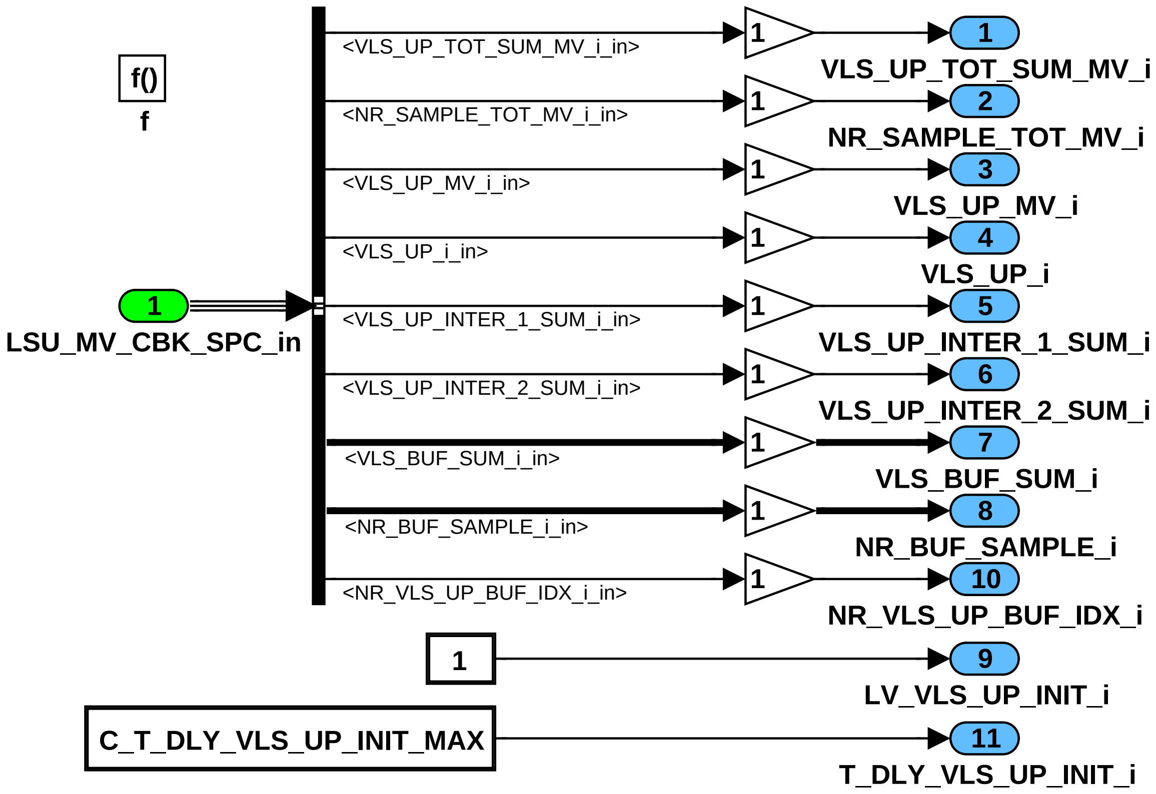

Figure 4.39.29:
EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_CBK_SPC/WR_NULL_10MS

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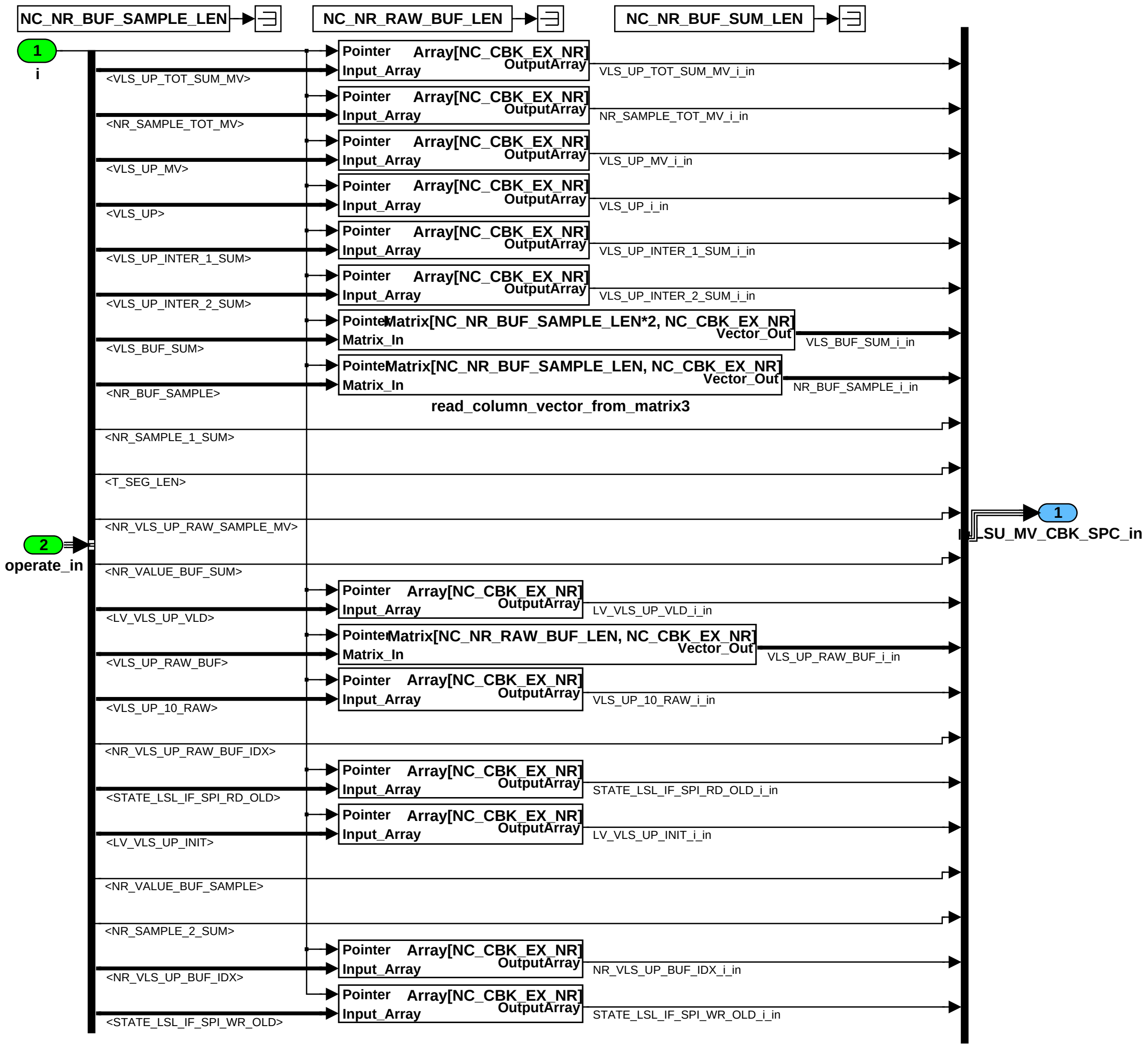

Figure 4.39.30:
EGCP_SIGCVLSL3/operate/CLC_10MS/LSU_MV_CBK_MNG/LSU_MV_SIG_CBK_MNG

Calculation of segment time and number of samples for mean value

The segment time will be calculated after every 10^{th} raw signal value is written in to the buffer. The number of samples required for mean value calculation depend on the segment time. The minimum segment time is fixed using NC_T_SEG_LEN_MIN. If the measured segment time is less than the minimum, then number of samples will be calculated by corresponding multiplication factors.

The default values are

NC_T_SEG_LEN_MIN = 0.01 s

NC_FAC_10_SAMPLE = 2

NC_FAC_5_SAMPLE = 4

2 * 60 * 1000 * no_of_cyl_bank

T_SEG_LEN = (ms)

N_in_rpm * no_of_cyl

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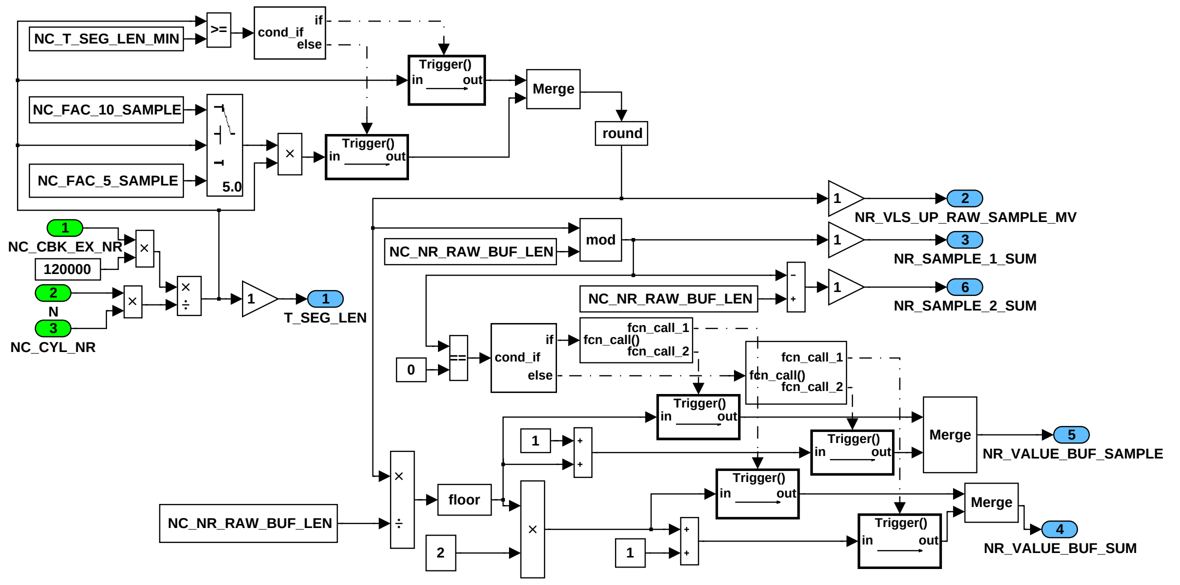

Figure 4.39.31: EGCP_SIGCVLSL3/operate/CLC_10MS/T_SEG_CLC

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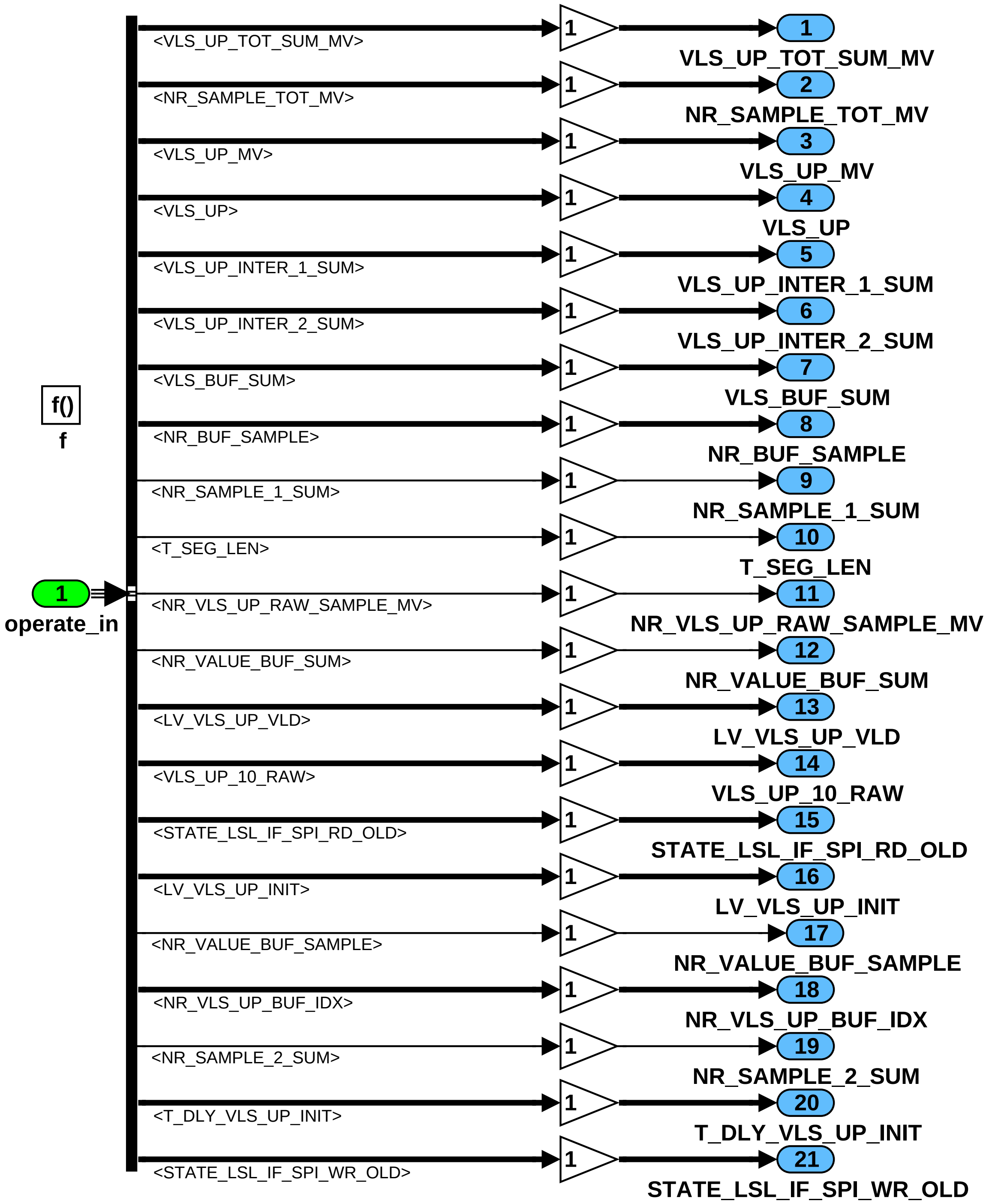

Figure 4.39.32: EGCP_SIGCVLSL3/operate/NULL_1_9_MS

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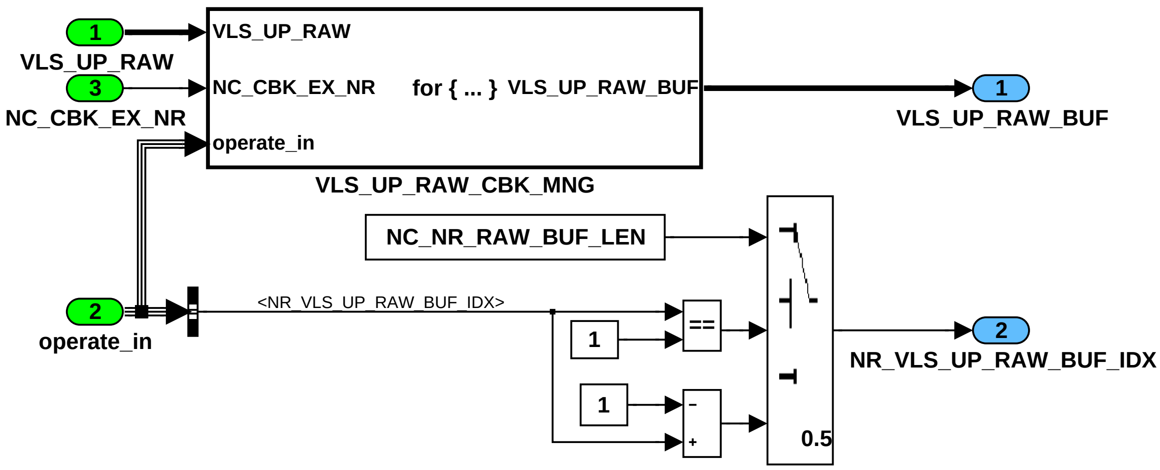

Figure 4.39.33: EGCP_SIGCVLSL3/operate/VLS_UP_RAW_BUF_1MS

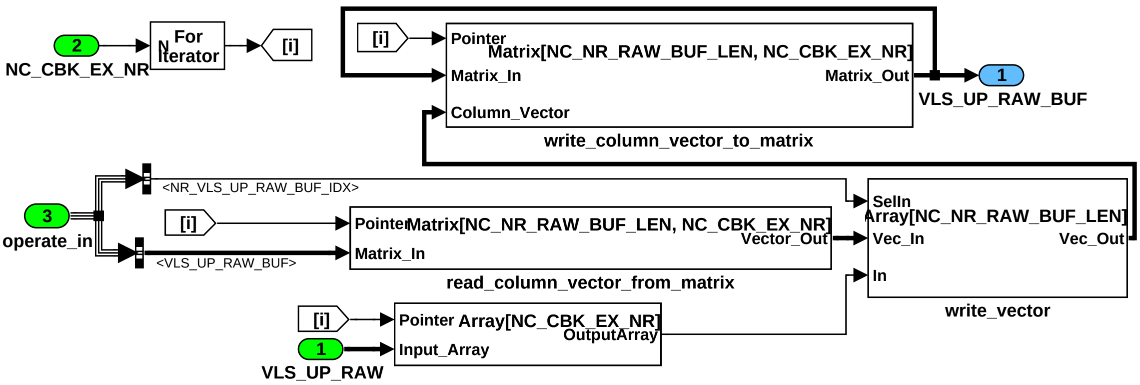

Figure 4.39.34: EGCP_SIGCVLSL3/operate/VLS_UP_RAW_BUF_1MS/VLS_UP_RAW_CBK_MNG

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4.39.1.2 SUBFUNCTION: reset

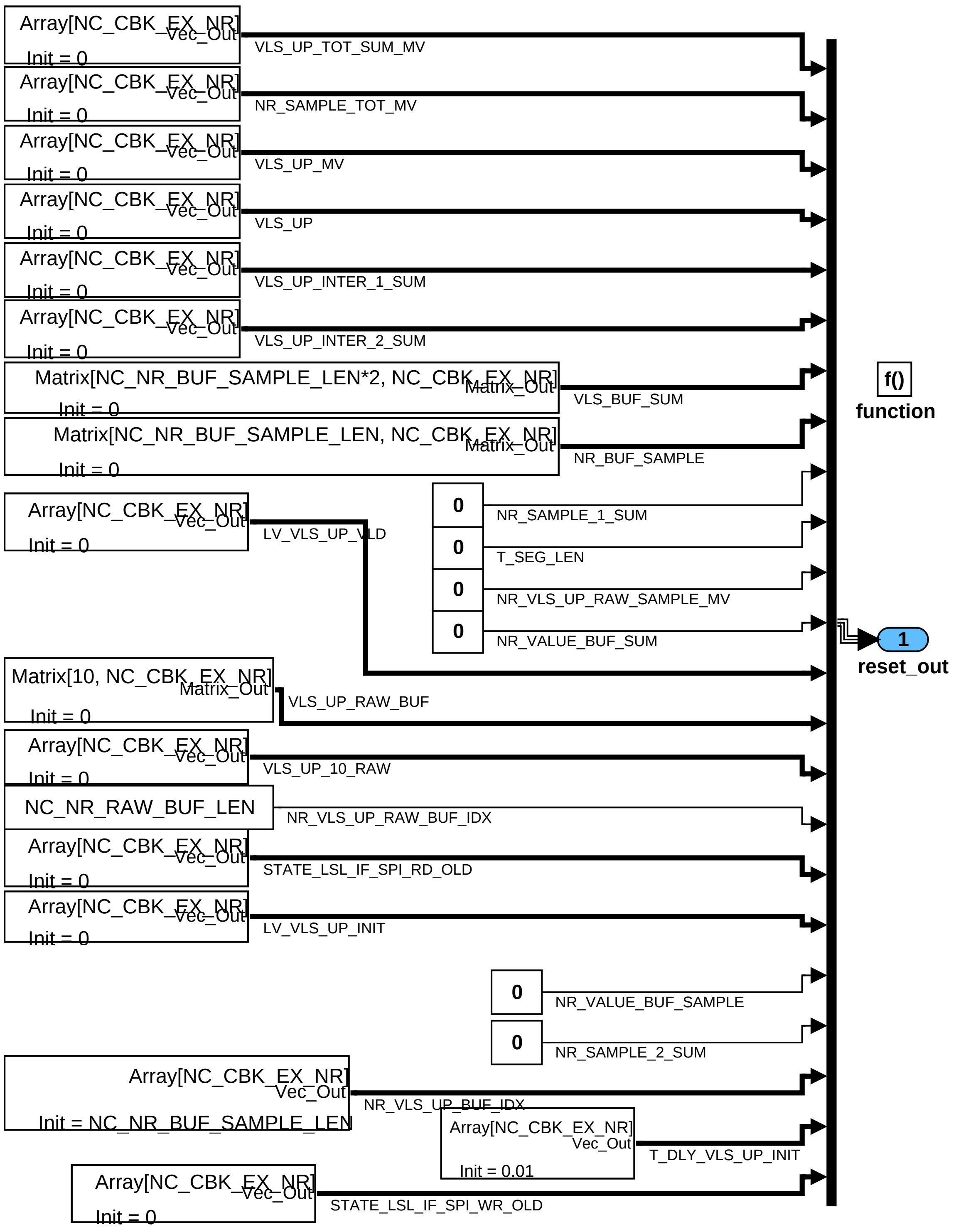

Figure 4.39.35: EGCP_SIGCVLSL3/reset

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4.40 O2 sensor (bin, down) element temperature determination

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CYCNR_R_IT_LS_DOWN_VLD [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Handshake counter indicating the number of valid resistance values determined since initial activation					
FAC_T_VLS_DOWN_MMV_DRV1 [NC_CBK_EX_NR]	V	0... FFH	0... 63.75	0.25	-
Multiplicative factor modifies DRV1_VLS_DOWN_MMV_MIN_THD dependent on T_VLS_CYC_AFL_HLD					
FAC_T_VLS_DOWN_MMV_DRV1_ABS [NC_CBK_EX_NR]	V	0... FFH	0... 15.9375	0.0625	-
Multiplicative factor modifies C_VLS_DOWN_MMV_DRV1_ABS_MAX dependent on T_VLS_CYC_AFL_HLD					
LV_R_IT_DET_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating that resistance has already been determined (lock out)					
LV_R_IT_REQ_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that conditions have been met and resistance determination requested					
LV_VLS_DOWN_DRV1_CDN_R_LS [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating that low gradient condition met					
LV_VLS_DOWN_RNG_CDN_R_LS [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating that VLS_DOWN at low gradient condition met					
POW_MMV_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 84.49871	1.2894e-3	W
Moving mean value of downstream oxygen sensor heater power					
R_IT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	Ohm
Internal resistance of downstream oxygen sensor (Released)					
R_IT_MDL_LS_DOWN_NEW [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	Ohm
Internal resistance of downstream oxygen sensor (Modelled for new sensor)					
R_IT_MES_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	Ohm
Internal resistance of downstream oxygen sensor (Measured)					
T_AFL_CYC_HLD_R_IT_LS_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 2.55	0.01	s
Lean mixture cycle time (measured upstream), held until next threshold crossing downstream					
T_SAMPLE_R_IT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 655.35	0.01	s
Time measured between internal resistance samples					
TTIP_MES_BOL_LS_DOWN [NC_CBK_EX_NR]	V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Downstream oxygen sensor ceramic temperature, Lower limit, Unfiltered					
TTIP_MES_BOL_MMV_LS_DOWN [NC_CBK_EX_NR]	V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Downstream oxygen sensor ceramic temperature, Lower limit, Filtered					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TTIP_MES_LS_DOWN [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Downstream oxygen sensor ceramic temperature					
TTIP_MES_TOL_LS_DOWN [NC_CBK_EX_NR]	V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Downstream oxygen sensor ceramic temperature, Upper limit, Unfiltered					
TTIP_MES_TOL_MMV_LS_DOWN [NC_CBK_EX_NR]	V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Downstream oxygen sensor ceramic temperature, Upper limit, Filtered					
TTIP_REF_MDL_MMV_LS_DOWN [NC_CBK_EX_NR]	V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Reference of downstream oxygen sensor ceramic temperature (Modelled for new sensor)					
VLS_DOWN_CUR_PUMP_OFF [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Downstream oxygen sensor voltage prior to switching on pump current switch					
VLS_DOWN_CUR_PUMP_ON [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Downstream oxygen sensor voltage C_T_CUR_PUMP_ON_LS_DOWN after switching on pump current switch					
VLS_DOWN_MMV_DRV1_THD_MAX [NC_CBK_EX_NR]	V	8000... 7FFFH	-2.5... 2.4999	76.3e-6	V/10ms
Upper variable VLS_DOWN gradient threshold					
VLS_DOWN_MMV_DRV1_THD_MIN [NC_CBK_EX_NR]	V	8000... 7FFFH	-2.5... 2.4999	76.3e-6	V/10ms
Lower variable VLS_DOWN gradient threshold					
VP_LS_DOWN_TMP	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Temporary VLS_DOWN measurement from ADC for conversion to range required in EGCP					

Input data:

CTR_AFL_CYC [NC_CBK_EX_NR] {p. 2439}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ES {p. 1720}	LV_INH_R_IT_LS_DOWN [NC_CBK_EX_NR] {p. 1379}
LV_ST_END {p. 1720}	LV_VLS_DOWN_MMV_ACT [NC_CBK_EX_NR] {p. 2409}	LV_VLS_DOWN_MMV_LIM [NC_CBK_EX_NR] {p. 2409}	MAF_KGH {p. 1195}
NC_CBK_EX_NR {p. 1829}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	T_AFL_CYC_HLD [NC_CBK_EX_NR] {p. 2439}	TEG_DYN_LS_DOWN [NC_CBK_EX_NR] {p. 1007}
V_EFC_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_DOWN_BOL [NC_CBK_EX_NR] {p. 2409}	VLS_DOWN_DRV1_ABS_MAX [NC_CBK_EX_NR] {p. 2409}
VLS_DOWN_DRV1_MMV [NC_CBK_EX_NR] {p. 2409}	VLS_DOWN_DRV1_MMV_MIN [NC_CBK_EX_NR] {p. 2409}	VLS_DOWN_MMV_MAX [NC_CBK_EX_NR] {p. 2409}	VLS_DOWN_MMV_MIN [NC_CBK_EX_NR] {p. 2409}
VLS_DOWN_TOL [NC_CBK_EX_NR] {p. 2409}			

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_POW_MMV_LSH_DOWN	-	0... FFH	0... 0.99609	3.91e-3	-
Correlation (filter) constant for moving mean value of downstream heater power					
C_CRLC_TTIP_FALL_R_IT_LS_DOWN	-	0... FFH	0... 0.99609	3.91e-3	1/s
Correlation (filter) constant for falling ceramic temperature, limit calculation					
C_CRLC_TTIP_RISE_R_IT_LS_DOWN	-	0... FFH	0... 0.99609	3.91e-3	1/s
Correlation (filter) constant for rising ceramic temperature, limit calculation					
C_CTR_AFL_CYC_MIN_RI_IT_LS_DOWN	-	0... FFFFH	0... 65535	1	-
Min. no. AF cycles post lambda controller activation to permit use of T_VLS_CYC_AFL_HLD dependency					
C_FAC_R_IT_ERR_NEG_LS_DOWN	-	0... FFH	0... 0.99609	3.91e-3	-
Internal resistance measurement negative error (i.e. 100% to 0%)					
C_FAC_R_IT_ERR_POS_LS_DOWN	-	0... FFH	0... 0.99609	3.91e-3	-
Internal resistance measurement positive error (i.e. 0% to 100%)					
C_FAC_VLS_DOWN_MMV_DRV1_THD	-	0... FFH	0... 1.99218	0.0078125	-
Multiplicative factor used to weight gradient thresholds dependent on VLS_DOWN_MMV_xxx[NC_CBK_EX_NR] amplitude					
C_FAC_VLS_DOWN_MMV_DRV1_THD_MIN	-	0... FFH	0... 0.99609	3.91e-3	-
Hysteresis factor of DRV1_VLS_DOWN_MMV_MIN governing limiting of DRV1_VLS_DOWN_MMV_MIN_THD					
C_MAF_KGH_MAX_R_IT_LS_DOWN	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Maximum MAF_KGH threshold for activation of internal resistance determination					
C_T_CUR_PUMP_OFF_LS_DOWN	-	0... FFFFH	0... 655.35	0.01	s
Minimum delay between consecutive pump current activation					
C_T_CUR_PUMP_ON_LS_DOWN	-	0... 8H	0... 0.008	0.001	s
Duration for pump current active					
C_T_DLY_CUR_PUMP_LS_DOWN	-	0... FFH	0... 0.255	0.001	s
Duration in which VLS_DOWN[NC_CBK_EX_NR] signal masked directly after Ri determination					
C_TEG_MIN_CUR_PUMP_ON_LS_DOWN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Temperature threshold for the activation of sensor pumping					
C_VLS_DOWN_MMV_DRV1_ABS_MAX	-	0... FFFFH	0... 4.99992	76.3e-6	V/10ms
Threshold for absolute maximum 1st derivative of VLS_DOWN[NC_CBK_EX_NR] signal for Ri determination					
C_VLS_DOWN_MMV_DRV1_THD_MAX	-	8000... 7FFFH	-2.5... 2.4999	76.3e-6	V/10ms
Maximum threshold for mean 1st derivative of VLS_DOWN[NC_CBK_EX_NR] signal for Ri determination					
C_VLS_DOWN_MMV_DRV1_THD_MIN	-	8000... 7FFFH	-2.5... 2.4999	76.3e-6	V/10ms
Minimum threshold for mean 1st derivative of VLS_DOWN[NC_CBK_EX_NR] signal for Ri determination					
C_VLS_DOWN_MMV_MIN_RNG_BOL_R_IT	-	0... FFFFH	0... 4.99992	76.3e-6	V
Permitted range of VLS_DOWN[NC_CBK_EX_NR] below VLS_DOWN_MMV_MIN[NC_CBK_EX_NR] at low gradient for Ri determination					
C_VLS_DOWN_MMV_MIN_RNG_TOL_R_IT	-	0... FFFFH	0... 4.99992	76.3e-6	V
Permitted range of VLS_DOWN[NC_CBK_EX_NR] above VLS_DOWN_MMV_MIN[NC_CBK_EX_NR] at low gradient for Ri determination					
C_VLS_HYS_R_IT_LS_DOWN	-	0... 3FFH	0... 4.99511	4.88e-3	V
Voltage hysteresis for evaluation if VLS_DOWN[i] shall be masked after Ri determination					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_CRLC_TTIP_REF_MDL_LS_DOWN	-	0... FFH	0... 0.99609	3.91e-3	-
LDPM_MAF_KGH_1_EGCP	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correlation map for calculation of reference downstream tip temperature (modelled for new sensor)					
IP_FAC_T_DRV1_VLS_DOWN_MMV	-	0... FFH	0... 63.75	0.25	-
LDPM_T_AFL_CYC_HLD_1_EGCP	8	0... FFH	0... 2.55	0.01	s
Multiplicative factor modifies DRV1_VLS_DOWN_MMV_MIN_THD dependent on T_VLS_CYC_AFL_HLD					
IP_FAC_T_VLS_DOWN_MMV_DRV1_ABS	-	0... FFH	0... 15.9375	0.0625	-
LDPM_T_AFL_CYC_HLD_1_EGCP	8	0... FFH	0... 2.55	0.01	s
Multiplicative factor modifies C_VLS_DOWN_MMV_DRV1_ABS_MAX dependent on T_VLS_CYC_AFL_HLD					
IP_R_IT_MDL_LS_DOWN_NEW	V	0... FFFFH	0... 65535	1	ohm
LDP_POW_MMV_LSH_DOWN_IP_LS_DOWN	8	0... FFFFH	0... 84.49871	1.2894e-3	W
LDP_TTIP_REF_MDL_MMV_LS_DOWN_R	8	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Internal resistance of a new downstream oxygen sensor (modelled)					
IP_TTIP_MES_LS_DOWN	-	0... 7FFFH	0... 2047.9375	0.0625	°C
LDP_R_IT_MES_LS_DOWN_IP_LS_DOWN	8	0... FFFFH	0... 65535	1	ohm
Oxygen sensor temperature vs. internal resistance characteristic					
LC_R_IT_LS_DOWN_PUC_ACT	-	0... 1H	0 ...1	1	-
Switch to activate Ri-measurement regardless activation conditions. For test purpose only !					
LC_R_IT_VLD_INH_LS_DOWN	-	0... 1H	0 ...1	1	-
Boolean flag inhibiting internal resistance determination validity function					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_FAC_R_REF_LS_DOWN	-	0... FFFFH	0... 3.99993	61e-6	-
Pump current limiting to pull down resistance ratio (RPump/R2)					
NC_R_REF_LS_DOWN	-	0... FFFFH	0... 65535	1	ohm
Reference resistance for pump current (RPump)					
NC_VLS_DOWN_CUR_PUMP_REF	-	0... 3FFH	0... 4.99511	4.88e-3	V
Reference voltage value (4.82 V)					

Import actions:

ACTION_INFR_GetVAdcLsDown (**IN**<i>,**OUT**<v_adc>)
ACTION_INFR_SetCmdLsDown (**IN**<i>,**IN**<lv_swi_ls_down>)

FUNCTION DESCRIPTION:

General information:

The function shall provide the output variable R_IT_LS_DOWN[i], the internal resistance of the oxygen sensor. The resistance is dependent on the operating temperature of the sensor and may be used for oxygen sensor diagnosis.
The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1

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i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

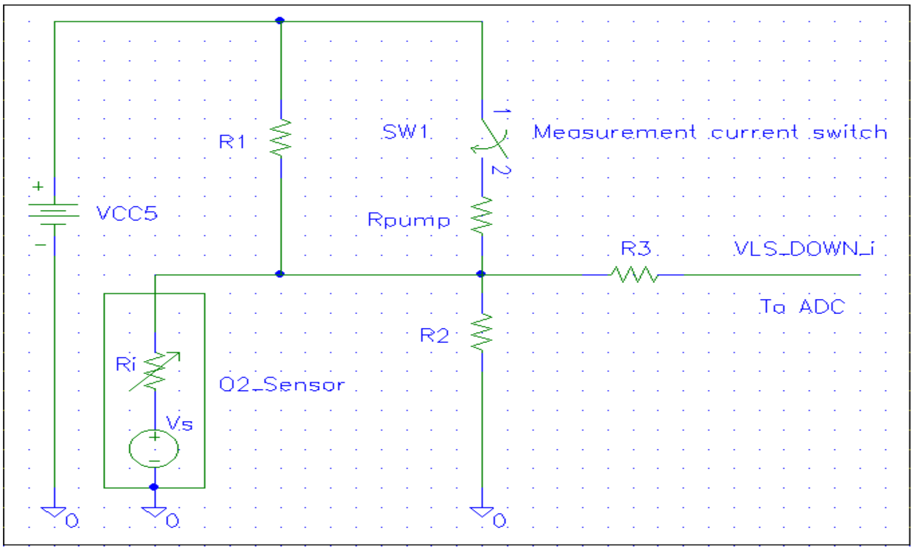

Figure 4.40.1: Simplified measurement circuit schematic, Internal resistance determination

Signal flow diagram:

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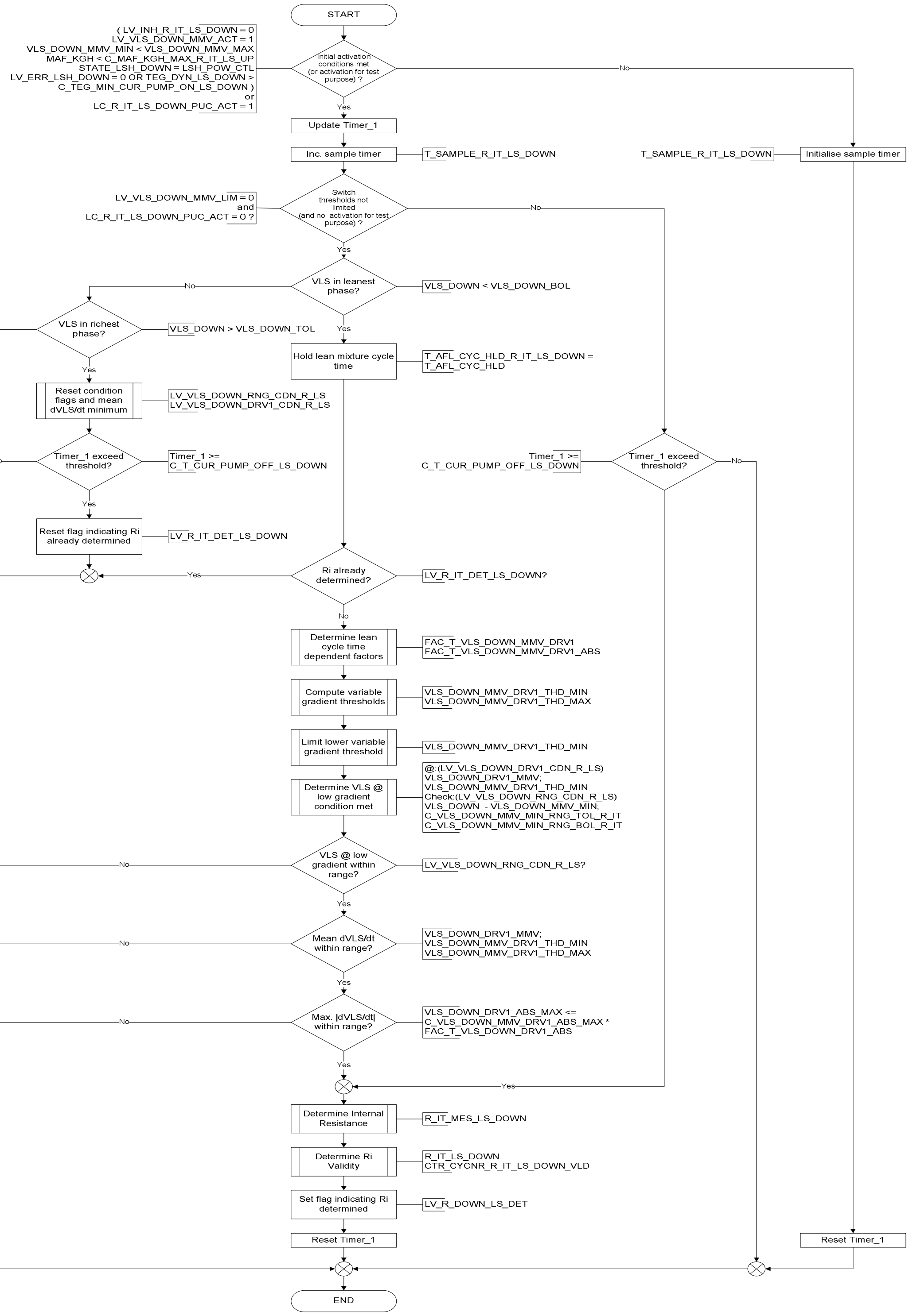

Figure 4.40.2: Function flow chart, Internal resistance determination

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Description:

The internal resistance of the oxygen sensor shall be determined by use of the oxygen sensor interface circuit *Figure 1* (Capacitors not shown). The internal resistance provides information as to the tip

temperature of the sensor and may be used for diagnosis purposes and operative readiness determination.
Under normal conditions, the switch SW1 shall be open and the oxygen sensor signal voltage (VLS_DOWN[i]) is measured by the microcontroller.
The potential divider (resistors R_1 & R_2) shall be permit the operation readiness of the oxygen sensor to be determined and enable electrical fault conditions to be detected.
Periodically, for a limited amount of time, the switch SW1 shall be closed and a voltage of approx. 4.8 V connected through resistor R_{pump} to the oxygen sensor signal connection. This shall cause current to flow into the sensor and through the internal resistance R_i, thereby pumping the sensor. The resultant voltage acquired at the microcontroller input shall permit the internal resistance of the sensor to be calculated by use of a formula shown in the formula section below.
Prior to permitting the determination of the internal resistance, a number of conditions shall be determined to be met:
The initial activation conditions shall require that: No function inhibit is requested (LV_INH_R_IT_LS_DOWN[i] = 0); Delay since deactivation since last overrun fuel cut-off passed (LV_VLS_DOWN_MMV_ACT[i]); The initial post initialisation transients have passed for the VLS_DOWN_MMV_xxx[i] inputs (VLS_DOWN_MMV_MIN[i] < VLS_DOWN_MMV_MAX[i]); The engine load threshold has not been exceeded (MAF_KGH < C_MAF_KGH_MAX_R_IT_LS_DOWN); The oxygen sensor heater state LSH_POW_CTL has been reached; No heater OBDI error has been detected in the relevant heater driver (LV_ERR_LSH_DOWN[i]) or should a heater driver fault have been detected, the modelled exhaust gas temperature at downstream sensor position TEG_DYN_LS_DOWN[i] shall exceed the threshold C_TEG_MIN_CUR_PUMP_ON_LS_DOWN.
With the switch LC_R_IT_LS_DOWN_PUC_ACT the initial activation conditions can be ignored, and Ri-determination is activated. Bypass of initial activation conditions is allowed for test purpose only. For serial calibration LC_R_IT_LS_DOWN_PUC_ACT has to be set to 0 !
Once the above conditions have been met, an internal timer (*TIMER_1*) shall be started and timer T_SAMPLE_R_IT_LS_DOWN[i] shall be updated. The latter timer shall be initialised with its maximum value of 655.35 s. This ensures that the temperature limits for the validity function are correctly initialised. The further procedure shall depend on the status of the oxygen sensor signal, as determined by LV_VLS_DOWN_MMV_LIM (Again, with LC_R_IT_LS_DOWN_PUC_ACT this condition can be forced to be fulfilled). Should the VLS_DOWN_MMV_xxx[i] signals be limited, i.e. no or little oxygen sensor amplitude is present, the function shall determine the internal resistance every (C_T_CUR_PUMP_OFF_LS_DOWN + C_T_CUR_PUMP_ON_LS_DOWN + C_T_DLY_CUR_PUMP_LS_DOWN). Otherwise the oxygen sensor signal shall be determined to have significant amplitude and the internal resistance determination shall only be carried out in lean phases where the oxygen sensor signal is relatively flat and stable. This is achieved by the following conditions:
If the oxygen sensor signal is lean (VLS_DOWN[i] < VLS_DOWN_BOL[i]) and neither the resistance determination has been carried out yet in this lean phase nor the determination be locked out due to the minimum off time (LV_R_IT_DET_LS_DOWN[i] = 0) then the function shall determine the lean cycle time dependent factors FAC_T_VLS_DOWN_MMV_DRV1[i] & FAC_T_VLS_DOWN_MMV_DRV1_ABS[i] from the appropriate maps IP_FAC_T_DRV1_VLS_DOWN_MMV & IP_FAC_T_VLS_DOWN_MMV_DRV1_ABS respectively. These factors shall be dependent on the held lean cycle time from the previous lean cycle (T_AFL_CYC_HLD_R_IT_LS_DOWN[i]). Should the cycle time decrease then it is intended that the factors shall increase and vice versa.
The thresholds for the gradient condition shall then be computed. These thresholds (VLS_DOWN_MMV_DRV1_THD_MAX[i] & VLS_DOWN_MMV_DRV1_THD_MIN[i]) are directly proportional to the amplitude of the difference between VLS_DOWN_MMV_xxx[i] signals. Furthermore, VLS_DOWN_MMV_DRV1_THD_MIN[i] shall be modified by factor FAC_T_VLS_DOWN_MMV_DRV1[i]. The factor FAC_T_VLS_DOWN_MMV_DRV1[i] shall be set to 1 unless C_CTR_AFL_CYC_MIN_RI_IT_LS_DOWN AF cycles have passed since the last lambda controller activation, as counted by CTR_AFL_CYC[i]. This ensures that T_AFL_CYC_HLD_R_IT_LS_DOWN[i] is valid.
The variable threshold VLS_DOWN_MMV_DRV1_THD_MIN[i] shall be limited so that its value is not less than that of VLS_DOWN_DRV1_MMV_MIN[i] * C_FAC_VLS_DOWN_MMV_DRV1_THD_MIN.
The function shall then wait for the oxygen sensor signal gradient to exceed the minimum threshold (VLS_DOWN_DRV1_MMV[i] VLS_DOWN_MMV_DRV1_THD_MIN[i]) and then determine whether the absolute oxygen sensor signal voltage is within a particular range of the VLS_DOWN_MMV_MIN[i] sig-

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nal (VLS_DOWN_MMV_MIN[i] - C_VLS_DOWN_MMV_MIN_RNG_BOL_R_IT VLS_DOWN[i] VLS_DOWN_MMV_MIN[i] + C_VLS_DOWN_MMV_MIN_RNG_TOL_R_IT). If this is the case, the VLS_DOWN[i] shall be considered to be consistent with previous lean phase amplitudes and resistance determination may be carried out. This condition shall only be carried out once per lean phase. i.e. at transition from rich to lean. The fulfilment of the gradient condition is indicated by LV_VLS_DOWN_DRV1_CDN_R_LS[i] and the fulfilment of the range condition by LV_VLS_DOWN_RNG_CDN_R_LS[i].

If the range condition has been met, the gradient is in a particular range (VLS_DOWN_MMV_DRV1_THD_MIN[i] VLS_DOWN_DRV1_MMV[i] VLS_DOWN_MMV_DRV1_THD_MAX[i]) and the oxygen sensor signal is determined to be stable in the short term (VLS_DOWN_DRV1_ABS_MAX[i] C_VLS_DOWN_MMV_DRV1_ABS_MAX * FAC_T_VLS_DOWN_MMV_DRV1_ABS[i]) then resistance determination is requested (LV_R_IT_REQ_LS_DOWN[i] = 1). The factor FAC_T_VLS_DOWN_MMV_DRV1_ABS[i] shall be set to 1 unless C_CTR_AFL_CYC_MIN_RI_IT_LS_DOWN AF cycles have passed since the last lambda controller activation, as counted by CTR_AFL_CYC[i]. This ensures that T_AFL_CYC_HLD_R_IT_LS_DOWN[i] is valid.

Once internal resistance determination has been requested, the Basic SW shall take a single VLS_DOWN[i] sample and store as VLS_DOWN_CUR_PUMP_OFF[i]. SW1 shall be switched ON, at time C_T_CUR_PUMP_ON_LS_DOWN[i] and the VLS_DOWN[i] shall be masked. A second oxygen sensor signal voltage sample shall be taken and stored as VLS_DOWN_CUR_PUMP_ON[i]. SW1 shall then be switched OFF and masking shall continue for a time C_T_DLY_CUR_PUMP_LS_DOWN, after which the VLS_DOWN[i] shall return to normal following of the oxygen sensor signal voltage. Masking shall be discontinued if the oxygen sensor signal voltage exceeds VLS_DOWN_CUR_PUMP_ON[i] + C_VLS_HYS_R_IT_LS_DOWN during the time C_T_DLY_CUR_PUMP_LS_DOWN after switching off SW1. Adding the voltage hysteresis shall prevent the function to discard lambda sensor voltage masking if the first VLS_DOWN[i] value after switching off the pump current is larger than the last VLS_DOWN[i] value while pumping due to signal noise.

The internal resistance R_IT_MES_LS_DOWN[i] shall be determined using the formula stated with the main variables being oxygen sensor voltage prior to pumping, VLS_DOWN_CUR_PUMP_OFF[i], and signal voltage during pumping, VLS_DOWN_CUR_PUMP_ON[i].

The internal resistance shall be calculated every time the oxygen sensor is pumped. For each new resistance value detected, a counter CTR_CYCNR_R_IT_LS_DOWN_VLD[i] shall be incremented to indicate to other functions that a new resistance value is available.

NOTE: During the time where SW1 is switched on, (LV_R_IT_REQ_LS_DOWN[i]=1) the output voltage of the oxygen sensor (VLS_DOWN[i]) does not represent the true A/F ratio and is therefore invalid and shall not be used as such. The basic software shall mask the response of the sensor to pumping by keeping the voltage constant during this time by using the last VLS_DOWN[i] sample prior to activating SW1.

The internal resistance shall be calculated every time the oxygen sensor is pumped. For each new resistance value detected, the validity of the resistance shall be checked:

Should the validity function not be inhibited (LC_R_IT_VLD_INH_LS_DOWN = 0), then the tip temperature of the ceramic shall be determined from a map. TTIP_MES_LS_DOWN[i] represents the nominal temperature, TTIP_MES_TOL_LS_DOWN[i] represents the maximum temperature (R_IT_MES_LS_DOWN[i] * (1 - C_FAC_R_IT_ERR_NEG_LS_DOWN)), i.e. temperature for resistance with negative measurement error and TTIP_MES_BOL_LS_DOWN[i] represents the minimum temperature (R_IT_MES_LS_DOWN[i] * (1 + C_FAC_R_IT_ERR_NEG_LS_DOWN)), i.e. temperature for resistance with positive measurement error. A low pass filter shall then be applied to the upper and lower temperature limits to represent the maximum possible temperature gradient between resistance samples. Dependent on the direction of change of resistance between two measurements, either constant C_CRLC_TTIP_RISE_R_IT_LS_DOWN (rising temp.) or C_CRLC_TTIP_FALL_R_IT_LS_DOWN (falling temp.) shall be applicable. The final filter constant used, limited to a maximum of 1, shall be the aforementioned constant multiplied by the time between resistance samples (T_SAMPLE_R_IT_LS_DOWN[i]). This shall be to compensate for the irregular sample time.

Should then the ceramic tip temperature fall within the temperature limit bounds, the measured resistance shall be considered to be valid, shall be passed to the output variable R_IT_LS_DOWN[i], the counter CTR_CYCNR_R_IT_LS_DOWN_VLD[i] shall be incremented to indicate to other functions that a new resistance value is available and the T_SAMPLE_R_IT_LS_DOWN[i] shall be reset. If the above

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temperature condition is not met, R_IT_LS_DOWN[i] shall be maintained at its last value and the filtered temperature limits shall be reset to their previous values, i.e. the resistance value shall be ignored.
Should the validity function be inhibited then for each new resistance the R_IT_MES_LS_DOWN[i] shall be passed to R_IT_LS_DOWN[i] and the counter CTR_CYCNR_R_IT_LS_DOWN_VLD[i] shall be incremented.
In the case of significant oxygen sensor amplitude (LV_VLS_DOWN_MMV_LIM = 0) and the sensor signal be in the rich phase (VLS_DOWN[i] > VLS_DOWN_TOL[i]), the flags LV_VLS_DOWN_RNG_CDN_R_LS[i] & LV_VLS_DOWN_DRV1_CDN_R_LS[i] shall be reset. Furthermore, if these conditions have been met and the timer *TIMER_1* exceeds C_T_CUR_PUMP_OFF_LS_DOWN then LV_R_IT_DET_LS_DOWN[i] shall be reset, thereby permitting the internal resistance to be determined in the next cycle should the appropriate conditions be met.
For reference reasons of OBD II diagnosis the value R_IT_MDL_LS_DOWN_NEW[i] is calculated out of heating power, exhaust gas temperature and MAF_KGH.

Application conditions

Recurrence: `T_SAMPLE_1 = 10 ms`

The function shall be carried out once every 10 ms. The internal resistance value shall only be calculated after pumping the oxygen sensor. See recurrence there. Reference internal rsistance shall be calculated with recurrence 1 s.
Initialisation:
at reset:
ACTION_INFR_SetCmdLsDown(
IN i
IN 0)
The following initialisation shall be carried out after a RESET and upon leaving the engine state Engine Stop (LV_ES).
R_IT_LS_DOWN[i] = 65535
R_IT_MES_LS_DOWN[i] = 65535
R_IT_MDL_LS_DOWN_NEW[i] = 65535
POW_MMV_LSH_DOWN[i] = 0
VLS_DOWN_CUR_PUMP_ON[i] = 0
VLS_DOWN_CUR_PUMP_OFF[i] = 0
CTR_CYCNR_R_IT_LS_DOWN_VLD[i] = 0
LV_VLS_DOWN_DRV1_CDN_R_LS[i] = 0
LV_VLS_DOWN_RNG_CDN_R_LS[i] = 0
LV_R_IT_REQ_LS_DOWN[i] = 0
LV_R_IT_DET_LS_DOWN[i] = 0
VLS_DOWN_MMV_DRV1_THD_MIN[i] = 0
VLS_DOWN_MMV_DRV1_THD_MAX[i] = 0
T_AFL_CYC_HLD_R_IT_LS_DOWN[i] = 0
FAC_T_VLS_DOWN_MMV_DRV1[i] = 0
FAC_T_VLS_DOWN_MMV_DRV1_ABS[i] = 0
TTIP_REF_MDL_MMV_LS_DOWN[i] = 0
TTIP_MES_LS_DOWN[i] = 0
TTIP_MES_TOL_LS_DOWN[i] = 0
TTIP_MES_BOL_LS_DOWN[i] = 0
TTIP_MES_TOL_MMV_LS_DOWN[i] = 0
TTIP_MES_BOL_MMV_LS_DOWN[i] = 0
T_SAMPLE_R_IT_LS_DOWN[i] = 655.35

NOTE: All N-1 variables shall also be initialised to the associated value specified above.
Activation /Deactivation:

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```
If      LV_ST_END = 1
then    Function activated
else    Function deactivated
endif
```

Formula section:

```
If          [ LV_INH_R_IT_LS_DOWN[i] = 0
and            LV_VLS_DOWN_MMV_ACT[i] = 1
and            VLS_DOWN_MMV_MIN[i] < VLS_DOWN_MMV_MAX[i]
and            MAF_KGH < C_MAF_KGH_MAX_R_IT_LS_DOWN
and            STATE_LSH_DOWN[i] = "LSH_POW_CTL"
and            (LV_ERR_LSH_DOWN[i] = 0
or           TEG_DYN_LS_DOWN[i] > C_TEG_MIN_CUR_PUMP_ON_LS_DOWN) ]
or           LC_R_IT_LS_DOWN_PUC_ACT = 1
then      Update TIMER_1
            Increment T_SAMPLE_R_IT_LS_DOWN[i]
            If        LV_R_IT_REQ_LS_DOWN[i] = 0
            then      If        LV_VLS_DOWN_MMV_LIM[i] = 0
                      and       LC_R_IT_LS_DOWN_PUC_ACT = 0
                      then      If        VLS_DOWN[i] < VLS_DOWN_BOL[i]
                                then      T_AFL_CYC_HLD_R_IT_LS_DOWN[i] =
                                          T_AFL_CYC_HLD[i]
                                          If        LV_R_IT_DET_LS_DOWN[i] = 0
                                          then      "Determine lean cycle time dependent factors"
                                                    "Compute variable gradient thresholds"
                                                    "Limit lower variable gradient threshold"
                                                    "Determine VLS_DOWN at low gradient condition met"
                                                    If        LV_VLS_DOWN_RNG_CDN_R_LS[i] = 1
                                                    and       VLS_DOWN_DRV1_MMV[i]
                                                              VLS_DOWN_MMV_DRV1_THD_MIN[i]
                                                    and       VLS_DOWN_DRV1_MMV[i]
                                                              VLS_DOWN_MMV_DRV1_THD_MAX[i]
                                                    and       VLS_DOWN_DRV1_ABS_MAX[i]
                                                              C_VLS_DOWN_MMV_DRV1_ABS_MAX *
                                                              FAC_T_VLS_DOWN_MMV_DRV1_ABS[i])
                                                    then      LV_R_IT_REQ_LS_DOWN[i] = 1
                                                              VLS_DOWN_CUR_PUMP_OFF[i] = VLS_DOWN[i]

                                                              Switch SW1 ON
                                                                "Determine internal resistance" started
                                                                ACTION_INFR_SetCmdLsDown(
                                                                                IN        i
                                                                                IN        1)

                                                    endif
                                          endif
                                else      If        VLS_DOWN[i] > VLS_DOWN_TOL[i]
                                          then      LV_VLS_DOWN_RNG_CDN_R_LS[i] = 0
                                                    LV_VLS_DOWN_DRV1_CDN_R_LS[i] = 0
                                                    If        TIMER_1
                                                              C_T_CUR_PUMP_OFF_LS_DOWN
```

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then LV_R_IT_DET_LS_DOWN[i] = 0
endif
endif
endif
else **If** (*TIMER_1* C_T_CUR_PUMP_OFF_LS_DOWN)
then LV_R_IT_REQ_LS_DOWN[i] = 1
VLS_DOWN_CUR_PUMP_OFF[i] = VLS_DOWN[i]
Switch SW1 ON
"Determine internal resistance" started
ACTION_INFR_SetCmdLsDown(
IN i
IN 1)

endif
endif
endif
If LV_R_IT_REQ_LS_DOWN[i] = 1 -> 0
then *"Calculation of Internal resistance"*
LV_R_IT_DET_LS_DOWN[i] = 1
Reset *TIMER_1*
endif
else ***Reset*** *TIMER_1*
T_SAMPLE_R_IT_LS_DOWN[i] = 655.35 (i.e. FFFFH)
LV_R_IT_DET_LS_DOWN[i] = 0
LV_VLS_DOWN_DRV1_CDN_R_LS[i] = 0
LV_VLS_DOWN_RNG_CDN_R_LS[i] = 0
endif
"Calculation of internal resistance reference"
NOTES:

1. ***TIMER_1 refers to a SW internal timer and not a visible output data variable.***
2. ***T_SAMPLE_R_LS_DOWN[i] shall not be permitted to overflow. When the specified maximum value has been reached, this shall be held until the timer is reset by the function.***

Calculation of internal resistance reference:
% This calculation is carried out with the recurrence: T_SAMPLE_2 = 1 s.
POW_MMV_LSH_DOWN[i]$_n$ = POW_MMV_LSH_DOWN[i]$_{n-1}$ *
(1 - C_CRLC_POW_MMV_LSH_DOWN) + C_CRLC_POW_MMV_LSH_DOWN *
V_EFC_LSH_DOWN[i]^2 * T_SAMPLE_2 * [W/(s*V$^{2)}$]
TTIP_REF_MDL_MMV_LS_DOWN[i]$_n$ = TTIP_REF_MDL_MMV_LS_DOWN[i]$_{n-1}$ *
(1 - IP_CRLC_TTIP_REF_MDL_LS_DOWN) +
IP_CRLC_TTIP_REF_MDL_LS_DOWN * TEG_DYN_LS_DOWN[i]
% IP (MAF_KGH)
R_IT_MDL_LS_DOWN_NEW[i] = IP_R_IT_MDL_LS_DOWN_NEW
% IP (POW_MMV_LSH_DOWN[i]; TTIP_REF_MDL_MMV_LS_DOWN[i])

Determine lean cycle time dependent factors:
If (CTR_AFL_CYC[i] C_CTR_AFL_CYC_MIN_RI_IT_LS_DOWN)
then FAC_T_VLS_DOWN_MMV_DRV1[i] =
IP_FAC_T_DRV1_VLS_DOWN_MMV (T_AFL_CYC_HLD_R_IT_LS_DOWN[i])
FAC_T_VLS_DOWN_MMV_DRV1_ABS[i] =
IP_FAC_T_VLS_DOWN_MMV_DRV1_ABS (T_AFL_CYC_HLD_R_IT_LS_DOWN[i])
else FAC_T_VLS_DOWN_MMV_DRV1[i] = 1
FAC_T_VLS_DOWN_MMV_DRV1_ABS[i] = 1

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endif.

Compute variable gradient thresholds:

VLS_DOWN_MMV_DRV1_THD_MAX[i] = C_VLS_DOWN_MMV_DRV1_THD_MAX *
C_FAC_VLS_DOWN_MMV_DRV1_THD *
(VLS_DOWN_MMV_MAX[i] -
VLS_DOWN_MMV_MIN[i])

VLS_DOWN_MMV_DRV1_THD_MIN[i] = C_VLS_DOWN_MMV_DRV1_THD_MIN *
C_FAC_VLS_DOWN_MMV_DRV1_THD *
(VLS_DOWN_MMV_MAX[i] -
VLS_DOWN_MMV_MIN[i]) *
FAC_T_VLS_DOWN_MMV_DRV1[i]

Limit lower variable gradient threshold:

VLS_DOWN_MMV_DRV1_THD_MIN[i] = MAX(VLS_DOWN_MMV_DRV1_THD_MIN[i],
VLS_DOWN_DRV1_MMV_MIN[i] *
C_FAC_VLS_DOWN_MMV_DRV1_THD_MIN)

Determine VLS_DOWN at low gradient condition met:

If (LV_VLS_DOWN_DRV1_CDN_R_LS[i] = 0) **&**
(VLS_DOWN_DRV1_MMV[i] VLS_DOWN_MMV_DRV1_THD_MIN[i])
then LV_VLS_DOWN_DRV1_CDN_R_LS[i] = 1
If (VLS_DOWN[i]
(VLS_DOWN_MMV_MIN[i] + C_VLS_DOWN_MMV_MIN_RNG_TOL_R_IT)) **&**
(VLS_DOWN[i]
(VLS_DOWN_MMV_MIN[i] - C_VLS_DOWN_MMV_MIN_RNG_BOL_R_IT))
then LV_VLS_DOWN_RNG_CDN_R_LS[i] = 1
else LV_VLS_DOWN_RNG_CDN_R_LS[i] = 0
endif
endif.

NOTE: VLS_DOWN_MMV_MIN[i] + C_VLS_DOWN_MMV_MIN_RNG_TOL_R_IT shall not cause an overflow and VLS_DOWN_MMV_MIN[i] - C_VLS_DOWN_MMV_MIN_RNG_BOL_R_IT shall not cause an underflow.

Determine internal resistance:

Recurrence: T_SAMPLE_3 = 1 ms
If LV_R_IT_REQ_LS_DOWN[i] = 1
then

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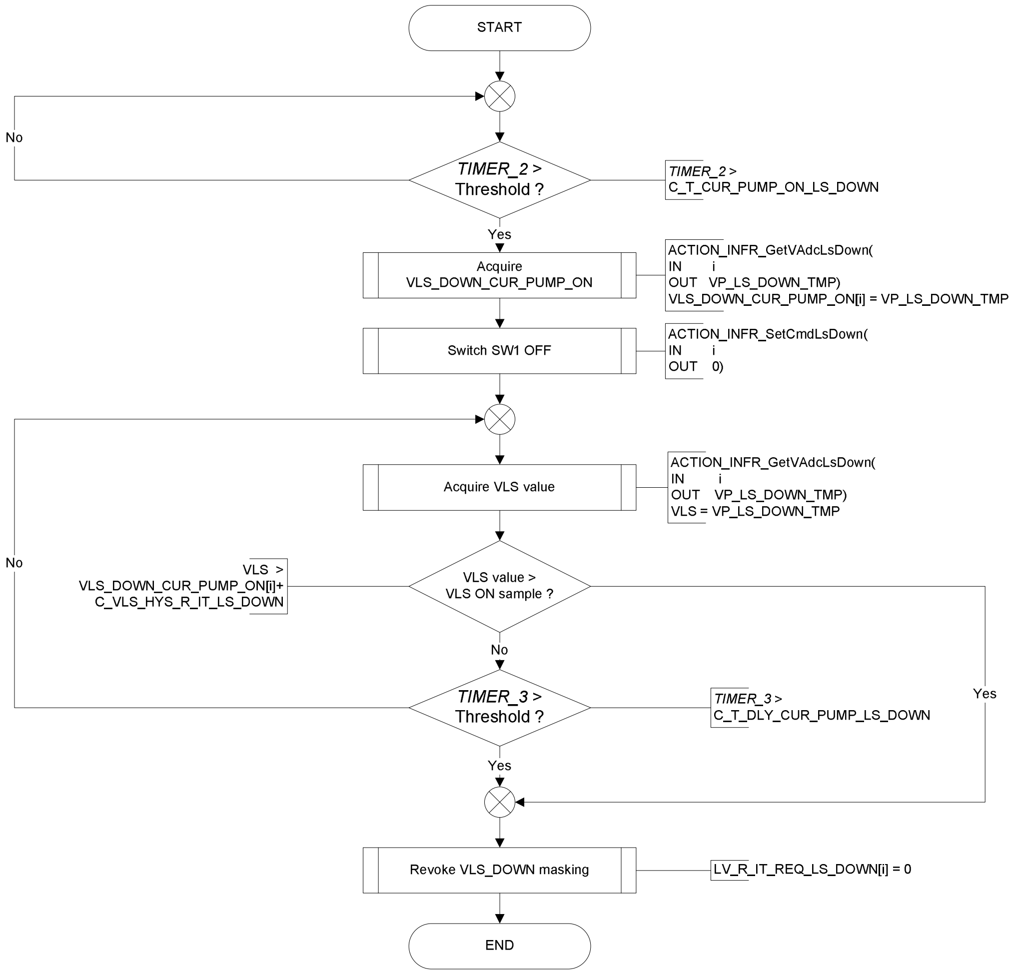

Figure 4.40.3: Function flow chart, Internal resistance determination

endif

Calculation of Internal resistance:
The internal resistance shall be determined as follows:
R_IT_MES_LS_DOWN[i] = NC_R_REF_LS_DOWN * (VLS_DOWN_CUR_PUMP_ON[i] - VLS_DOWN_CUR_PUMP_OFF[i]) /{NC_VLS_DOWN_CUR_PUMP_REF - (VLS_DOWN_CUR_PUMP_ON[i] - VLS_DOWN_CUR_PUMP_OFF[i])* NC_FAC_R_REF_LS_DOWN - VLS_DOWN_CUR_PUMP_ON[i]}

Determine internal resistance validity:
The following function shall be carried once out for every new resistance value determined.

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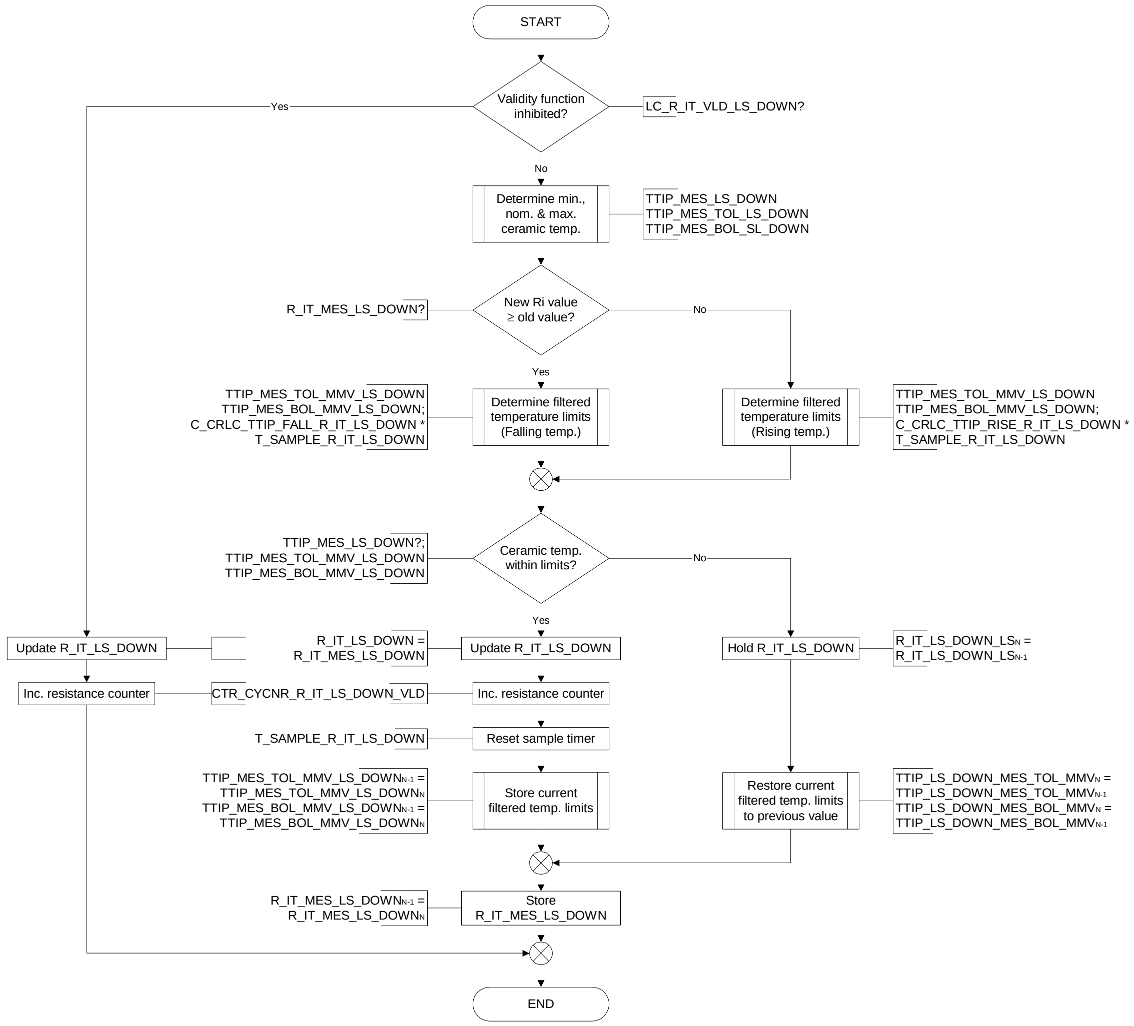

Figure 4.40.4: Function flow chart, Internal resistance validity determination

If (LC_R_IT_VLD_INH_LS_DOWN = 0)
then
TTIP_MES_LS_DOWN[i] = IP_TTIP_MES_LS_DOWN (R_IT_MES_LS_DOWN[i])
TTIP_MES_TOL_LS_DOWN[i] = IP_TTIP_MES_LS_DOWN (R_IT_MES_LS_DOWN[i] * (1 - C_FAC_R_IT_ERR_NEG_LS_DOWN))
TTIP_MES_BOL_LS_DOWN[i] = IP_TTIP_MES_LS_DOWN (R_IT_MES_LS_DOWN[i] * (1+ C_FAC_R_IT_ERR_POS_LS_DOWN))
If (R_IT_MES_LS_DOWN[i]$_N$ R_IT_MES_LS_DOWN[i]$_{N-1}$)
then
TTIP_MES_TOL_MMV_LS_DOWN[i]$_N$ = TTIP_MES_TOL_MMV_LS_DOWN[i]$_{N-1}$ + (TTIP_MES_TOL_LS_DOWN[i] - TTIP_MES_TOL_MMV_LS_DOWN[i]$_{N-1}$) * MIN(1, C_CRLC_TTIP_FALL_R_IT_LS_DOWN * T_SAMPLE_R_IT_LS_DOWN[i])
TTIP_MES_BOL_MMV_LS_DOWN[i]$_N$ = TTIP_MES_BOL_MMV_LS_DOWN[i]$_{N-1}$ + (TTIP_MES_BOL_LS_DOWN[i] - TTIP_MES_BOL_MMV_LS_DOWN[i]$_{N-1}$) * MIN(1, C_CRLC_TTIP_FALL_R_IT_LS_DOWN * T_SAMPLE_R_IT_LS_DOWN[i])
else
TTIP_MES_TOL_MMV_LS_DOWN[i]$_N$ = TTIP_MES_TOL_MMV_LS_DOWN[i]$_{N-1}$ + (TTIP_MES_TOL_LS_DOWN[i] - TTIP_MES_TOL_MMV_LS_DOWN[i]$_{N-1}$) *

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MIN(1, C_CRLC_TTIP_RISE_R_IT_LS_DOWN * T_SAMPLE_R_IT_LS_DOWN[i])
TTIP_MES_BOL_MMV_LS_DOWN[i]$_{N}$ = TTIP_MES_BOL_MMV_LS_DOWN[i]$_{N-1}$ +
(TTIP_MES_BOL_LS_DOWN[i] - TTIP_MES_BOL_MMV_LS_DOWN[i]$_{N-1}$) *
MIN(1, C_CRLC_TTIP_RISE_R_IT_LS_DOWN * T_SAMPLE_R_IT_LS_DOWN[i])
endif
If ((TTIP_MES_LS_DOWN[i]   TTIP_MES_TOL_MMV_LS_DOWN[i]) **&**
(TTIP_MES_LS_DOWN[i]   TTIP_MES_BOL_MMV_LS_DOWN[i]))
then
R_IT_LS_DOWN[i] = R_IT_MES_LS_DOWN[i]$_{N}$
Increment CTR_CYCNR_R_IT_LS_DOWN_VLD[i]
Reset T_SAMPLE_R_IT_LS_DOWN[i]
TTIP_MES_TOL_MMV_LS_DOWN[i]$_{N-1}$ = TTIP_MES_TOL_MMV_LS_DOWN[i]$_{N}$
TTIP_MES_BOL_MMV_LS_DOWN[i]$_{N-1}$ = TTIP_MES_BOL_MMV_LS_DOWN[i]$_{N}$
else
R_IT_LS_DOWN[i]$_{N}$ = R_IT_LS_DOWN[i]$_{N-1}$
TTIP_MES_TOL_MMV_LS_DOWN[i]$_{N}$ = TTIP_MES_TOL_MMV_LS_DOWN[i]$_{N-1}$
TTIP_MES_BOL_MMV_LS_DOWN[i]$_{N}$ = TTIP_MES_BOL_MMV_LS_DOWN[i]$_{N-1}$
endif
R_IT_MES_LS_DOWN[i]$_{N-1}$ = R_IT_MES_LS_DOWN[i]$_{N}$
else
R_IT_LS_DOWN[i] = R_IT_MES_LS_DOWN[i]$_{N}$
Increment CTR_CYCNR_R_IT_LS_DOWN_VLD[i]
endif.

NOTES:

1. ***The difference (VLS_DOWN_CUR_PUMP_ON[i] - VLS_DOWN_CUR_PUMP_OFF[i]) shall be limited to 0 for negative values as the voltage during pumping should be greater than that without.***
2. ***If the incrementation would cause the counter CTR_CYCNR_R_IT_LS_DOWN_VLD[i] to overflow then the counter shall be reset to 0.***
3. ***The basic software (BSW) shall mask the VLS_DOWN[i] signal during resistance determination by retaining the value of the last sample prior to activating the resistance determination. This shall be indicated by setting LV_R_IT_REQ_LS_DOWN[i]. Upon revoking the masking the last oxygen sensor signal voltage VLS value determined by the BSW shall be used for the VLS_DOWN[i] signal and LV_R_IT_REQ_LS_DOWN[i] shall be reset.***
4. ***Should C_T_CUR_PUMP_ON_LS_DOWN = 0, SW1 shall not be activated.***

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4.41 O2 sensor (bin, down) element temperature determination (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_R_IT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that downstream sensor internal resistance determination shall be inhibited when set					

Input data:

LV_ES {p. 1720}	LV_VAR_LSH_DOWN {p. 656}	NC_CBK_EX_NR {p. 1829}	TCO {p. 1100}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_CUR_ON_LS_DOWN_MIN	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold for detection of R_IT_LS_DOWN					

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.

The Boolean flag(s) LV_INH_R_IT_LS_DOWN[NC_CBK_EX_NR] shall indicate whether the downstream oxygen sensor internal resistance determination shall be permitted to take place. When set, no resistance determination shall take place.

Application conditions

Initialisation: The following initialisation shall be carried out upon leaving the engine state Engine Stop (LV_ES).
LV_INH_R_IT_LS_DOWN[NC_CBK_EX_NR] = 0

Recurrence: *1s*

Activation: *at every engine operating state*

Deactivation: –

Formula section:

If LV_VAR_LSH_DOWN = 1 **and** TCO > C_TCO_CUR_ON_LS_DOWN_MIN
then LV_INH_R_IT_LS_DOWN[NC_CBK_EX_NR] = 0
else LV_INH_R_IT_LS_DOWN[NC_CBK_EX_NR] = 1
endif

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4.42 NOx sensor interface

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_NS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
NOx sensor failure byte					
LAMB_NOX_SENS [NC_NOX_SENS_CONF]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda value, measured by NOx sensor					
LAMB_NOX_SENS_DIAG [NC_NOX_SENS_CONF]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda value for diagnosis functions, measured by NOx sensor					
LAMB_NS_DIAG_GRD_OSC [NC_NOX_SENS_CONF]	V	8000... 7FFFH	-32... 31.99902	976.599e-6	-
Gradient of NOx sensor lambda signal for detection of NOx signal oscillations					
LAMB_NS_DIAG_OLD_OSC [NC_NOX_SENS_CONF]	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Old value of NOx sensor lambda signal for detection of NOx signal oscillations					
LV_NOX_SENS_LAMB_AUTH [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the Lambda signal has be reached the valid state after start					
LV_NOX_SENS_LAMB_DIAG_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the Lambda signal is valid for use into the diagnosis functions					
LV_NOX_SENS_LAMB_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the Lambda signal is valid					
LV_NOX_SENS_NOX_AUTH [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the NOx signal has be reached the valid state after the start					
LV_NOX_SENS_NOX_DIAG_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the NOx signal is valid for use into the diagnosis functions					
LV_NOX_SENS_NOX_MDL_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the NOx signal is valid for use. The state "valid" is debounced present.					
LV_NOX_SENS_NOX_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the NOx signal is valid					
LV_NOX_SENS_VLS_AUTH [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the binary O2 signal has be reached the state "valid" after start					
LV_NOX_SENS_VLS_DIAG_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the binary O2 signal is valid for use into the diagnosis functions					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_NOX_SENS_VLS_VLD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Indicator that the binary O2 signal is valid					
LV_NS_SHIFT_DIAG_ERR [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Sensor self diagnosis result from NOx sensor					
NOX_NOX_SENS [NC_NOX_SENS_CONF]	O/V	FF9C... 05DCH	-100 ...1500	1	ppm
NOx concentration value, measured by NOx-Sensor					
NOX_NOX_SENS_DIAG [NC_NOX_SENS_CONF]	O/V	FF9C... 05DCH	-100 ...1500	1	ppm
NOx concentration value for diagnosis functions, measured by NOx-Sensor					
NOX_NOX_SENS_DIAG_H_RES [NC_NOX_SENS_CONF]	-	FF9C0000... 05DC0000H	-100 ...1500	1/0x10000	ppm
32bit variable of NOX_NOX_SENS_DIAG_i for internal use only					
NOX_NOX_SENS_H_RES [NC_NOX_SENS_CONF]	-	FF9C0000... 05DC0000H	-100 ...1500	1/0x10000	ppm
32bit variable of NOX_NOX_SENS_i for internal use only					
NOX_SENS_TEMP [NC_NOX_SENS_CONF]	O/V	0... 3H	0 ...3	1	-
Indicator for state of sensor heater management					
STATE_ENG_OLD_OSC	-	0H 1H 2H 3H 4H 5H	ES ST IS PL PU PUC	-	-
Old value of engine operating state for detection of NOx signal oscillations					
STATE_NOX_OLD_OSC	-	0H 1H 2H 3H 4H 5H	PASSIV LOAD REGENERATION WAIT STOP WARMUP	-	-
Old value of NOx catalyst state for detection of NOx signal oscillations					
STATE_NS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
NOx sensor state					
T_NOX_NS_OSC [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Time since last reason for an oscillation of NOx signal was detected					
T_NOX_SENS_LAMB_HLD [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for hold of last valid Lambda signal value					
T_NOX_SENS_NOX_HLD [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for hold of last valid NOx signal value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_NOX_SENS_NOX_MDL [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for debounce of signal state "valid" after re-entry into state "valid"					
T_NOX_SENS_PWR [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 655.35	0.01	s
Timer for debounce of NOx sensor power supply failures					
T_NOX_SENS_VLS_HLD [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for hold of last valid binary O2 signal value					
VLS_NOX_SENS [NC_NOX_SENS_CONF]	O/V	0... 578H	-200 ...1200	1	mV
Binary O2 signal voltage, raw value, measured by NOx sensor					
VLS_NOX_SENS_DIAG [NC_NOX_SENS_CONF]	O/V	0... 578H	-200 ...1200	1	mV
Binary O2 signal voltage for diagnosis functions, raw value, measured by NOx sensor					

Input data:

C_STATE_NS_MASK_MODE_1 {p. 1400}	C_STATE_NS_MASK_MODE_2 {p. 1400}	C_STATE_NS_MASK_MODE_5 {p. 1400}	CAN_ERR_NOX_SENS [NC_NOX_SENS_CONF] {p. 1398}
CAN_LAMB_NOX_SENS [NC_NOX_SENS_CONF] {p. 1398}	CAN_NOX_NOX_SENS [NC_NOX_SENS_CONF] {p. 1398}	CAN_STATE_DIAG_NS [NC_NOX_SENS_CONF] {p. 1398}	CAN_STATE_NOX_SENS [NC_NOX_SENS_CONF] {p. 1398}
CAN_STATE_NS_TMP [NC_NOX_SENS_CONF] {p. 1398}	CAN_VLS_NOX_SENS [NC_NOX_SENS_CONF] {p. 1399}	LAMB_NS_DIAG [NC_NOX_SENS_CONF] {p. 991}	LV_CAN_TEMP_MIN_THD [NC_NOX_SENS_CONF] {p. 1399}
LV_ERR_NS_CAN_BOFF {p. 991}	LV_ERR_NS_CAN_MSG_LOST [NC_NOX_SENS_CONF] {p. 991}	LV_IGK {p. 906}	NC_NOX_SENS_CONF {p. 643}
NOX_SENS_TEMP [NC_NOX_SENS_CONF] {p. 1381}	STATE_ENG {p. 1720}	STATE_NOX {p. 2986}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_NOX_NOX_SENS	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for 1st NOx signal filter					
C_CRLC_NOX_NOX_SENS_DIAG	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for 2nd NOx signal filter					
C_ERR_NOX_SENS [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Manual value for error byte					
C_LAMB_NOX_SENS [NC_NOX_SENS_CONF]	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Manual Lambda value					
C_LAMB_NS_GRD_MAX_OSC	-	0... 7FFFH	0... 31.99902	976.599e-6	-
NOx signal oscillations will be detected if gradient of NOx sensor lambda signal is higher than this value					
C_LAMB_NS_GRD_MIN_OSC	-	8000... 0H	-32 ...0	976.599e-6	-
NOx signal oscillations will be detected if gradient of NOx sensor lambda signal is lower than this negative value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NOX_NOX_SENS [NC_NOX_SENS_CONF]	-	FF9C... 05DCH	-100 ...1500	1	ppm
Manual NOx concentration value					
C_STATE_DIAG_NS_MAN [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Switch for manual set of NOx sensor self diagnosis state					
C_STATE_LAMB_NS_MASK	-	0... FFH	0... 255	1	-
Bit-mask for detection of valid Lambda signal from NOx sensor					
C_STATE_NOX_NS_MASK	-	0... FFH	0... 255	1	-
Bit-mask for detection of valid NOx signal from NOx sensor					
C_STATE_VLS_NS_MASK	-	0... FFH	0... 255	1	-
Bit-mask for detection of valid Binary O2 signal from NOx sensor					
C_T_NOX_SENS_LAMB_AUTH	-	0... FFFFH	0... 655.35	0.01	s
Minimum time of Lambda signal readiness to set the authorisation bit					
C_T_NOX_SENS_LAMB_HLD	-	0... FFFFH	0... 655.35	0.01	s
Maximum time of hold the last valid Lambda signal value					
C_T_NOX_SENS_NOX_AUTH	-	0... FFFFH	0... 655.35	0.01	s
Minimum time of full NOx sensor readiness to set the NOx signal authorisation bit					
C_T_NOX_SENS_NOX_HLD	-	0... FFFFH	0... 655.35	0.01	s
Maximum time of hold the last valid NOx signal value					
C_T_NOX_SENS_NOX_MDL	-	0... FFFFH	0... 655.35	0.01	s
Minimum NOx signal "valid" time for set of model "valid" bit					
C_T_NOX_SENS_PWR_HLD	-	0... FFFFH	0... 655.35	0.01	s
Debounce time for NOx sensor power supply failures					
C_T_NOX_SENS_VLS_AUTH	-	0... FFFFH	0... 655.35	0.01	s
Minimum time of binary O2 signal readiness to set the authorisation bit					
C_T_NOX_SENS_VLS_HLD	-	0... FFFFH	0... 655.35	0.01	s
Maximum time of hold the last valid binary O2 signal value					
C_VLS_NOX_SENS [NC_NOX_SENS_CONF]	-	0... 578H	-200 ...1200	1	mV
Manual binary O2 value					
LC_NOX_SENS_ERR_MAN [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Manual setting of error byte on/off					
LC_NOX_SENS_LAMB_MAN [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Manual setting of Lambda value on/off					
LC_NOX_SENS_LAMB_VLD [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Permanently authorisation Lambda signal on/off					
LC_NOX_SENS_NOX_MAN [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Manual setting of NOx concentration value on/off					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_NOX_SENS_NOX_VLD [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Permanently authorisation NOx signal on/off					
LC_NOX_SENS_VLS_MAN [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Manual setting of binary O2 value on/off					
LC_NOX_SENS_VLS_VLD [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Permanently authorisation binary O2 signal on/off					
LC_STATE_ENG_CHG_OSC	-	0... 1H	0 ...1	1	-
Enable observation of changes of STATE_ENG for detection of NOx signal oscillations					
LC_STATE_NOX_CHG_OSC	-	0... 1H	0 ...1	1	-
Enable observation of changes of STATE_NOX for detection of NOx signal oscillations					

FUNCTION DESCRIPTION:

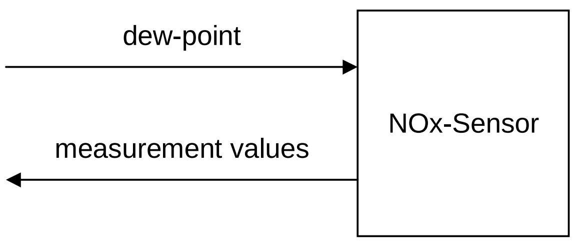
General information:

The number of NOx sensors in the system is defined by NC_NOX_SENS_CONF. The value of NC_NOX_SENS_CONF is to set within the project specific module List of Configuration Data .

```
if      NC_NOX_SENS_CONF = 0
then        the system contains no NOx sensor
        nothing is to calculate, no NOx sensor variables are declared
else        if      NC_NOX_SENS_CONF = 1
        then        the system contains 1 NOx sensor
                all NOx sensor variables are xxx_1 (i = 1)
        else        if      NC_NOX_SENS_CONF = 2
                then        the system contains 2 NOx sensors
                        all NOx sensor variables for exhaust line 1 are xxx_1 (i = 1)
                        all NOx sensor variables for exhaust line 2 are xxx_2 (i = 2)
                endif
        endif
endif
```

The NOx sensor Interface handles the variables and CAN messages for the use of NOx sensor into the EMS.

CAN bus



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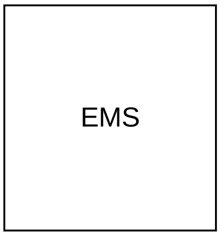

The EMS sends the dew point to the NOx sensor and receives measurement values and sensor status information from the NOx sensor via CAN bus. The CAN message structure and the CAN message ID s are defined project specific, e.g. at module NOx sensor Interface (Application Incidences) .
The dew point handling is also performed in a project specific module, e.g. at module NOx sensor Interface (Application Incidences) .

Description:

The NOx sensor sends messages with actual measurement values, sensor status and a failure byte to the EMS.
The information from the NOx sensor status byte are combined with the CAN bus failure information s to the signal valid indicators. These CAN bus failures are lost message from the NOx sensor and the state CAN busoff.

Application conditions

Recurrence:	*10 ms*
Activation:	*LV_IGK = 1*
Deactivation:	*LV_IGK = 0*

4.42.1 NOx concentration signal

FUNCTION DESCRIPTION:

General information:

The EMS receives the NOx concentration signal from the NOx sensor by CAN. After that the NOx concentration signal is evaluated by NOx sensor status information and filtered within the EMS.

Description:

The NOx output signal NOX_NOX_SENS_DIAG_i is used for the NOx sensor diagnosis functions. It is generated by filter of CAN_NOX_NOX_SENS_i, which is received from the NOx sensor.
The NOx output signal NOX_NOX_SENS_i is used for the NOx catalyst control functions. It is generated by filter of CAN_NOX_NOX_SENS_i after an analysis of sensor status information CAN_STATE_NOX_SENS_i. A new NOX_NOX_SENS_i value is calculated if no CAN bus error is occurred and CAN_STATE_NOX_SENS_i indicates full sensor readiness by CAN_STATE_NOX_SENS_i = 1EH. All other bits of CAN_STATE_NOX_SENS_i have no relevance for full readiness. So the system is authorised to use the NOx signal.
The bit LV_NOX_SENS_NOX_AUTH_i is set to 1 after the NOx sensor was uninterrupted full ready for at least C_T_NOX_SENS_NOX_AUTH. LV_NOX_SENS_NOX_AUTH_i is reset to 0 when the temperature of NOx sensor element is out of control range and the power supply of NOx sensor is out of specified range (bit PWR_OK of NOX_SENS_TEMP_i = 0) or when the engine is stopped or when the

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NOx sensor dew point is reset. This is necessary in order to deactivate the NOx sensor OBD II diagnosis functions.
The variable LV_NOX_SENS_NOX_DIAG_VLD_i is reset to 0 every time when the sensor loses the full readiness. So the diagnosis functions are informed in order to exclude a wrong diagnosis. At the same time starts the timer T_NOX_SENS_NOX_HLD_i. It runs up to the maximum value. An overflow is not allowed. The timer is stopped and reset, when the sensor reaches its full readiness.
The variable LV_NOX_SENS_NOX_MDL_VLD_i is used in the module NOx catalyst model controller . The variable LV_NOX_SENS_NOX_MDL_VLD_i informs this module about the NOx signal state. It is reset to 0 every time when the sensor loses the full readiness. It is set to 1 after the NOx signal was valid for the time C_T_NOX_SENS_NOX_MDL.
Note! The timer T_NOX_SENS_NOX_MDL_i runs up to the maximum value. An overflow is not allowed.
If the permanently authorisation of NOx signal is activated by LC_NOX_SENS_NOX_VLD_i = 1 and LV_NOX_SENS_NOX_AUTH_i = 1 then it is allowed to calculate a new NOX_NOX_SENS_i value without full sensor readiness. The variable LV_NOX_SENS_NOX_VLD_i is set to 1 so that the system is authorised to use the NOx signal. After the engine start the permanently authorisation of NOx signal is blocked up to the use of sensor signals is allowed by LV_NOX_SENS_NOX_AUTH_i = 1. Then the calculation of NOX_NOX_SENS_i values is started.
When the sensor loses its full readiness the last valid NOx signal value NOX_NOX_SENS_i and LV_NOX_SENS_NOX_VLD_i are held up to the time C_T_NOX_SENS_NOX_HLD is passed. After that the NOx signal NOX_NOX_SENS_i is set to C_NOX_NOX_SENS_i and LV_NOX_SENS_NOX_VLD_i is reset.
If the manual setting of NOx values is active LC_NOX_SENS_NOX_MAN_i = 1 then NOX_NOX_SENS_DIAG_i and NOX_NOX_SENS_i are set to C_NOX_NOX_SENS_i, LV_NOX_SENS_NOX_VLD_i is set to 1 and LV_NOX_SENS_NOX_DIAG_VLD_i is reset.

The calculation of NOX_NOX_SENS_i and NOX_NOX_SENS_DIAG_i shall be done with an internal resolution of 32 bit.

Application conditions

Initialisation:

```
at reset, at LV_IGK = 1 -> 0:
NOX_NOX_SENS_i = C_NOX_NOX_SENS_i
NOX_NOX_SENS_DIAG_i = C_NOX_NOX_SENS_i
LV_NOX_SENS_NOX_VLD_i = 0
LV_NOX_SENS_NOX_DIAG_VLD_i = 0
LV_NOX_SENS_NOX_AUTH_i = 0
LV_NOX_SENS_NOX_MDL_VLD_i = 0
T_NOX_SENS_NOX_HLD_i = 0
T_NOX_SENS_NOX_MDL_i = 0
```

Formula section:

If(1) LC_NOX_SENS_NOX_MAN_i = 0 **AND**
LV_CAN_TEMP_MIN_THD_i = 1 **AND**
CAN_STATE_NS_TMP[i] = C_STATE_NS_MASK_MODE_2
then(1)
if(2) LV_ERR_NS_CAN_MSG_LOST[i] = 0 **AND**
LV_ERR_NS_CAN_BOFF = 0 **AND**
(CAN_STATE_NOX_SENS[i] **bitwise AND**
C_STATE_NOX_NS_MASK) = C_STATE_NOX_NS_MASK

then(2)

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if(3) LV_NOX_SENS_NOX_AUTH_i = 1
then(3) T_NOX_SENS_NOX_HLD_i = 0
LV_NOX_SENS_NOX_DIAG_VLD_i = 1
LV_NOX_SENS_NOX_VLD_i = 1
increment T_NOX_SENS_NOX_MDL_i
if(4) T_NOX_SENS_NOX_MDL_i >= C_T_NOX_SENS_NOX_MDL
then(4) LV_NOX_SENS_NOX_MDL_VLD_i = 1
endif(4)
else(3) increment T_NOX_SENS_NOX_HLD_i
if(5) T_NOX_SENS_NOX_HLD_i >= C_T_NOX_SENS_NOX_AUTH
then(5) LV_NOX_SENS_NOX_AUTH_i = 1
LV_NOX_SENS_NOX_VLD_i = 1
LV_NOX_SENS_NOX_DIAG_VLD_i = 1
endif(5)
endif(3)
if(6) LV_NOX_SENS_NOX_DIAG_VLD_i(n-1) = 0 **AND** LV_NOX_SENS_NOX_DIAG_VLD_i(n) = 1
then(6) NOX_NOX_SENS_i(n) =
CAN_NOX_NOX_SENS_i * C_CRLC_NOX_NOX_SENS
+
NOX_NOX_SENS_DIAG_i(n-1) * (1 - C_CRLC_NOX_NOX_SENS)
else(6) NOX_NOX_SENS_i(n) =
CAN_NOX_NOX_SENS_i * C_CRLC_NOX_NOX_SENS
+
NOX_NOX_SENS_i(n-1) * (1 - C_CRLC_NOX_NOX_SENS)
endif(6)
else(2) LV_NOX_SENS_NOX_DIAG_VLD_i = 0
T_NOX_SENS_NOX_MDL_i = 0
LV_NOX_SENS_NOX_MDL_VLD_i = 0
if(7) LV_NOX_SENS_NOX_AUTH_i = 1
then(7) increment T_NOX_SENS_NOX_HLD_i
else(7) T_NOX_SENS_NOX_HLD_i = 0
NOX_NOX_SENS_i = C_NOX_NOX_SENS_i
LV_NOX_SENS_NOX_VLD_i = 0
endif(7)
if(8) LC_NOX_SENS_NOX_VLD_i = 1 **AND** LV_NOX_SENS_NOX_AUTH_i = 1
then(8) NOX_NOX_SENS_i(n) =
CAN_NOX_NOX_SENS_i * C_CRLC_NOX_NOX_SENS
+
NOX_NOX_SENS_i(n-1) * (1 - C_CRLC_NOX_NOX_SENS)
LV_NOX_SENS_NOX_VLD_i = 1
else(8)
if(9) T_NOX_SENS_NOX_HLD_i >= C_T_NOX_SENS_NOX_HLD

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then(9) NOX_NOX_SENS_i = C_NOX_NOX_SENS_i
LV_NOX_SENS_NOX_VLD_i = 0
endif(9)
endif(8)
endif(2)
if(10) **(** LV_NOX_SENS_NOX_AUTH_i = 1
LV_NOX_SENS_NOX_DIAG_VLD_i = 0 **AND**
Bit PWR_OK of NOX_SENS_TEMP_i = 0 **)**
then(10) NOX_NOX_SENS_i = C_NOX_NOX_SENS_i
NOX_NOX_SENS_DIAG_i = C_NOX_NOX_SENS_i
LV_NOX_SENS_NOX_VLD_i = LC_NOX_SENS_NOX_MAN_i
LV_NOX_SENS_NOX_DIAG_VLD_i = 0
LV_NOX_SENS_NOX_AUTH_i = LC_NOX_SENS_NOX_MAN_i
LV_NOX_SENS_NOX_MDL_VLD_i = 0
T_NOX_SENS_NOX_HLD_i = 0
T_NOX_SENS_NOX_MDL_i = 0
else(10) NOX_NOX_SENS_DIAG_i(n) =
CAN_NOX_NOX_SENS_i * C_CRLC_NOX_NOX_SENS_DIAG +
NOX_NOX_SENS_DIAG_i(n-1) * (1 - C_CRLC_NOX_NOX_SENS_DIAG)
endif(10)
else(1) NOX_NOX_SENS_i = C_NOX_NOX_SENS_i
NOX_NOX_SENS_DIAG_i = C_NOX_NOX_SENS_i
LV_NOX_SENS_NOX_VLD_i = LC_NOX_SENS_NOX_MAN_i
LV_NOX_SENS_NOX_DIAG_VLD_i = 0
LV_NOX_SENS_NOX_AUTH_i = LC_NOX_SENS_NOX_MAN_i
LV_NOX_SENS_NOX_MDL_VLD_i = 0
T_NOX_SENS_NOX_HLD_i = 0
T_NOX_SENS_NOX_MDL_i = 0
endif(1)

Prediction of NOx signal oscillations

LAMB_NS_DIAG_GRD_OSC_i = LAMB_NS_DIAG_i - LAMB_NS_DIAG_OLD_OSC_i

If(11) **(** LC_STATE_NOX_CHG_OSC **AND**
STATE_NOX **!=** STATE_NOX_OLD_OSC **)** **OR**
(LC_STATE_ENG_CHG_OSC **AND**
STATE_ENG **!=** STATE_ENG_OLD_OSC **)** **OR**
LAMB_NS_DIAG_GRD_OSC_i > C_LAMB_NS_GRD_MAX_OSC **OR**
LAMB_NS_DIAG_GRD_OSC_i < C_LAMB_NS_GRD_MIN_OSC
Then(11) T_NOX_NS_OSC_i = 0
Else(11) **increment** T_NOX_NS_OSC_i *(10ms)*
Endif(11)

LAMB_NS_DIAG_OLD_OSC_i = LAMB_NS_DIAG_i
STATE_NOX_OLD_OSC = STATE_NOX
STATE_ENG_OLD_OSC = STATE_ENG

4.42.2 Lambda signal

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FUNCTION DESCRIPTION:

General information:

The EMS receives the Lambda signal from the NOx sensor by CAN. The Lambda signal is issued in the kind of 1000/. The 1000/ value was chosen for an easy data transmission by CAN.

Description:

The Lambda signal CAN_LAMB_NOX_SENS_i, which is received from the NOx sensor, is converted from 1000/ value to and then it is stored at LAMB_NOX_SENS_DIAG_i. After that the Lambda signal is evaluated by the sensor status CAN_STATE_NOX_SENS_i.
The value of LAMB_NOX_SENS_DIAG_i is copied to LAMB_NOX_SENS_i if no CAN bus error is occurred and CAN_STATE_NOX_SENS_i indicates at least level 2 sensor readiness by CAN_STATE_NOX_SENS_i = 0EH. For level 2 sensor readiness must be checked the bits B1, B2, B3 and B6 of CAN_STATE_NOX_SENS_i. All other bits of CAN_STATE_NOX_SENS_i have no relevance for level 2 readiness. At the same time the variables LV_NOX_SENS_LAMB_VLD_i and LV_NOX_SENS_LAMB_DIAG_VLD_i are set to 1. So the system is authorised to use the Lambda signal.
The variable LV_NOX_SENS_LAMB_DIAG_VLD_i is reset to 0 every time when the sensor loses the level 2 readiness. So the diagnosis functions are informed in order to exclude a wrong diagnosis. At the same time starts the timer T_NOX_SENS_LAMB_HLD_i. It runs up to the maximum value. An overflow is not allowed. The timer is stopped and reset, when the sensor reaches the level 2 readiness.
If the permanently authorisation of Lambda signal is activated by LC_NOX_SENS_LAMB_VLD_i = 1 and LV_NOX_SENS_NOX_AUTH_i = 1 then it is allowed to pass the Lambda signal to LAMB_NOX_SENS_i without level 2 sensor readiness. The variable LV_NOX_SENS_LAMB_VLD_i is set to 1 so that the system is authorised to use the Lambda signal. After the engine start the permanently authorisation of Lambda signal is blocked up to LV_NOX_SENS_LAMB_AUTH_i = 1. Then the Lambda signal values are passed to LAMB_NOX_SENS_i.
When the sensor loses the level 2 readiness the last valid Lambda signal value LAMB_NOX_SENS_i and LV_NOX_SENS_LAMB_VLD_i are held up to the time C_T_NOX_SENS_LAMB_HLD is passed. After that the Lambda signal LAMB_NOX_SENS_i is set to C_LAMB_NOX_SENS_i and LV_NOX_SENS_LAMB_VLD_i is reset.
If the manual setting of Lambda values is active (LC_NOX_SENS_LAMB_MAN_i = 1) then LAMB_NOX_SENS_DIAG_i and LAMB_NOX_SENS_i are set to C_LAMB_NOX_SENS_i, LV_NOX_SENS_LAMB_VLD_i is set to 1 and LV_NOX_SENS_LAMB_DIAG_VLD_i is reset.

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Application conditions

Initialisation:

```
at reset, at LV_IGK = 1 -> 0:
        LAMB_NOX_SENS_DIAG_i = C_LAMB_NOX_SENS_i
        LAMB_NOX_SENS_i = C_LAMB_NOX_SENS_i
        LV_NOX_SENS_LAMB_VLD_i = 0
        LV_NOX_SENS_LAMB_DIAG_VLD_i = 0
    LV_NOX_SENS_LAMB_AUTH_i = 0
    T_NOX_SENS_LAMB_HLD_i = 0
```

Formula section:

if(1) LC_NOX_SENS_LAMB_MAN_i = 0 **AND**
LV_CAN_TEMP_MIN_THD_i = 1 **AND**
(CAN_STATE_NS_TMP[i] = C_STATE_NS_MASK_MODE_1 **O**
CAN_STATE_NS_TMP[i] = C_STATE_NS_MASK_MODE_2 **O**
CAN_STATE_NS_TMP[i] = C_STATE_NS_MASK_MODE_5)

then(1) LAMB_NOX_SENS_DIAG_i = 1000 /CAN_LAMB_NOX_SENS_i
if(2) LV_ERR_NS_CAN_MSG_LOST[i] = 0 **AND**

LV_ERR_NS_CAN_BOFF = 0 **AND**
(CAN_STATE_NOX_SENS[i] **bitwise AND**
C_STATE_LAMB_NS_MASK) = C_STATE_LAMB_NS_MASK

then(2) LAMB_NOX_SENS_i = LAMB_NOX_SENS_DIAG_i
if(3) LV_NOX_SENS_LAMB_AUTH_
i = 1
then(3) LV_NOX_SENS_LAMB_VLD_i = 1
LV_NOX_SENS_LAMB_DIAG_VLD_i = 1
T_NOX_SENS_LAMB_HLD_i = 0
else(3) increment T_NOX_SENS_LAMB_HLD_i
if(4) T_NOX_SENS_LAMB_HLD_i >= C_T_NOX_SENS_LAMB_
AUTH
then(4) LV_NOX_SENS_LAMB_AUTH_i = 1
LV_NOX_SENS_LAMB_VLD_i = 1
LV_NOX_SENS_LAMB_DIAG_VLD_i = 1
endif(4)
endif(3)
else(2)
if(5) LV_NOX_SENS_LAMB_AUTH_i = 1
then(5)
if(6) Bit PWR_OK of
NOX_SENS_TEMP_i = 1
then(6) LV_NOX_SENS_LAMB_DIAG_VLD_i = 0
increment T_NOX_SENS_LAMB_HLD_i
if(7) LC_NOX_
SENS_LAMB_VLD_i = 1
then(7) LAMB_NOX_SENS_i = LAMB_NOX_SENS_DIAG_
i
LV_NOX_SENS_LAMB_VLD_i = 1
else(7)
if(8) T_NOX_
SENS_LAMB_HLD_i >=
C_T_
NOX_SENS_LAMB_HLD
then(8) LAMB_NOX_SENS_i = C_LAMB_NOX_
SENS_i
LV_NOX_SENS_LAMB_VLD_i = 0
endif(8)
endif(7)
else(6)
LAMB_NOX_SENS_i = C_LAMB_NOX_SENS_i
LAMB_NOX_SENS_DIAG_i = C_LAMB_NOX_SENS_i
LV_NOX_SENS_LAMB_VLD_i = LC_NOX_SENS_LAMB_MAN_i
LV_NOX_SENS_LAMB_DIAG_VLD_i = 0
LV_NOX_SENS_LAMB_AUTH_i = LC_NOX_SENS_LAMB_MAN_
i
T_NOX_SENS_LAMB_HLD_i = 0
endif(6)
else(5) LAMB_NOX_SENS_i = C_LAMB_NOX_SENS_i
LAMB_NOX_SENS_DIAG_i = C_LAMB_NOX_SENS_i
LV_NOX_SENS_LAMB_VLD_i = LC_NOX_SENS_LAMB_MAN_i

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LV_NOX_SENS_LAMB_DIAG_VLD_i = 0
LV_NOX_SENS_LAMB_AUTH_i = LC_NOX_SENS_LAMB_MAN_i
T_NOX_SENS_LAMB_HLD_i = 0
endif(5)
endif(2)
else(1) LAMB_NOX_SENS_i = C_LAMB_NOX_SENS_i
LAMB_NOX_SENS_DIAG_i = C_LAMB_NOX_SENS_i
LV_NOX_SENS_LAMB_VLD_i = LC_NOX_SENS_LAMB_MAN_i
LV_NOX_SENS_LAMB_DIAG_VLD_i = 0
LV_NOX_SENS_LAMB_AUTH_i = LC_NOX_SENS_LAMB_MAN_i
T_NOX_SENS_LAMB_HLD_i = 0
endif(1)

4.42.3 Binary O2 signal

FUNCTION DESCRIPTION:

General information:

The EMS receives the binary O2 signal from the NOx sensor by CAN. The principle characteristic of the NOx sensor s binary signal is the same as of a binary O2 sensor.

Description:

The binary O2 signal CAN_VLS_NOX_SENS_i, which is received from the NOx sensor, is copied to VLS_NOX_SENS_DIAG_i. After that the binary O2 signal is evaluated by the sensor status CAN_STATE_NOX_SENS_i.
The value of CAN_VLS_NOX_SENS_i is copied to VLS_NOX_SENS_i if no CAN bus error is occurred and CAN_STATE_NOX_SENS_i indicates at least level 2 sensor readiness by CAN_STATE_NOX_SENS_i = 0EH. For level 2 sensor readiness must be checked the bits B1, B2, B3 and B6 of CAN_STATE_NOX_SENS_i. All other bits of CAN_STATE_NOX_SENS_i have no relevance for level 2 readiness. At the same time the variables LV_NOX_SENS_VLS_VLD_i and LV_NOX_SENS_VLS_DIAG_VLD_i are set to 1. So the system is authorised to use the binary O2 signal.
The variable LV_NOX_SENS_VLS_DIAG_VLD_i is reset to 0 every time when the sensor loses the level 2 readiness. So the diagnosis functions are informed in order to exclude a wrong diagnosis. At the same time starts the timer T_NOX_SENS_VLS_HLD_i. It runs up to the maximum value. An overflow is not allowed. The timer is stopped and reset, when the sensor reaches the level 2 readiness.
If the permanently authorisation of binary O2 signal is activated by LC_NOX_SENS_VLS_VLD_i = 1 and LV_NOX_SENS_NOX_AUTH_i = 1 then it is allowed to pass the binary O2 signal to VLS_NOX_SENS_i without level 2 sensor readiness. The variable LV_NOX_SENS_VLS_VLD_i is set to 1 so that the system is authorised to use the binary O2 signal. After the engine start the permanently authorisation of binary O2 signal is blocked up to LV_NOX_SENS_VLS_AUTH_i = 1. Then the binary O2 signal values are passed to VLS_NOX_SENS_i.
When the sensor loses the level 2 readiness the last valid binary O2 signal value VLS_NOX_SENS_i and LV_NOX_SENS_VLS_VLD_i are held up to the time C_T_NOX_SENS_VLS_HLD is passed. After that the binary O2 signal VLS_NOX_SENS_i is set to C_VLS_NOX_SENS_i and LV_NOX_SENS_VLS_VLD_i is reset.
If the manual setting of binary O2 values is active LC_NOX_SENS_VLS_MAN_i = 1 then VLS_NOX_SENS_DIAG_i and VLS_NOX_SENS_i are set to C_VLS_NOX_SENS_i, LV_NOX_SENS_VLS_VLD_i is set to 1 and LV_NOX_SENS_VLS_DIAG_VLD_i is reset.

Application conditions

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Initialisation: *at reset, at LV_IGK = 1 -> 0:*
VLS_NOX_SENS_DIAG_i = C_VLS_NOX_SENS_i
VLS_NOX_SENS_i = C_VLS_NOX_SENS_i
LV_NOX_SENS_VLS_VLD_i = 0
LV_NOX_SENS_VLS_DIAG_VLD_i = 0
LV_NOX_SENS_VLS_AUTH_i = 0
T_NOX_SENS_VLS_HLD_i = 0

Formula section:

if(1) LC_NOX_SENS_VLS_MAN_i = 0 **AND**
LV_CAN_TEMP_MIN_THD_i = 1 **AND**
(CAN_STATE_NS_TMP[i] = C_STATE_NS_MASK_MODE_1 **O**
CAN_STATE_NS_TMP[i] = C_STATE_NS_MASK_MODE_2 **O**
CAN_STATE_NS_TMP[i] = C_STATE_NS_MASK_MODE_5)
then(1) VLS_NOX_SENS_DIAG_i = CAN_VLS_NOX_SENS_i
if(2) LV_ERR_NS_CAN_MSG_LOST[i] = 0 **AND**

LV_ERR_NS_CAN_BOFF = 0 **AND**
(CAN_STATE_NOX_SENS[i] **bitwise AND**
C_STATE_VLS_NS_MASK) = C_STATE_VLS_NS_MASK

then(2) VLS_NOX_SENS_i = VLS_NOX_SENS_DIAG_i
if(3) LV_NOX_SENS_VLS_AUTH_i =
1
then(3) LV_NOX_SENS_VLS_VLD_i = 1
LV_NOX_SENS_VLS_DIAG_VLD_i = 1
T_NOX_SENS_VLS_HLD_i = 0
else(3) increment T_NOX_SENS_VLS_HLD_i
if(4) T_NOX_SENS_VLS_HLD_i >= C_T_NOX_SENS_VLS_AUTH

then(4) LV_NOX_SENS_VLS_AUTH_i = 1
LV_NOX_SENS_VLS_VLD_i = 1
LV_NOX_SENS_VLS_DIAG_VLD_i = 1
endif(4)
endif(3)
else(2)
if(5) LV_NOX_SENS_VLS_AUTH_i =
1
then(5)
if(6) Bit PWR_OK of
NOX_SENS_TEMP_i = 1
then(6) LV_NOX_SENS_VLS_DIAG_VLD_i = 0
increment T_NOX_SENS_VLS_HLD_i
if(7) LC_NOX_
SENS_VLS_VLD_i = 1
then(7) VLS_NOX_SENS_i = VLS_NOX_SENS_DIAG_
i
LV_NOX_SENS_VLS_VLD_i = 1
else(7)
if(8) T_NOX_
SENS_VLS_HLD_i >=
C_T_
NOX_SENS_VLS_HLD

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```
                              then(8)                    VLS_NOX_
                              SENS_i = C_VLS_NOX_SENS_i
                                    LV_NOX_SENS_VLS_VLD_i = 0
                              endif(8)
                        endif(7)
                  else(6)     VLS_NOX_SENS_i = C_VLS_NOX_SENS_i
                        VLS_NOX_SENS_DIAG_i = C_VLS_NOX_SENS_i
                        LV_NOX_SENS_VLS_VLD_i = LC_NOX_SENS_VLS_MAN_i
                        LV_NOX_SENS_VLS_DIAG_VLD_i = 0
                        LV_NOX_SENS_VLS_AUTH_i = LC_NOX_SENS_VLS_MAN_
                  i
                        T_NOX_SENS_VLS_HLD_i = 0
                  endif(6)
            else(5)     VLS_NOX_SENS_i = C_VLS_NOX_SENS_i
                  VLS_NOX_SENS_DIAG_i = C_VLS_NOX_SENS_i
                  LV_NOX_SENS_VLS_VLD_i = LC_NOX_SENS_VLS_MAN_i
                  LV_NOX_SENS_VLS_DIAG_VLD_i = 0
                  LV_NOX_SENS_VLS_AUTH_i = LC_NOX_SENS_VLS_MAN_i
                  T_NOX_SENS_VLS_HLD_i = 0
            endif(5)
      endif(2)
else(1)     VLS_NOX_SENS_i = C_VLS_NOX_SENS_i
      VLS_NOX_SENS_DIAG_i = C_VLS_NOX_SENS_i
      LV_NOX_SENS_VLS_VLD_i = LC_NOX_SENS_VLS_MAN_i
      LV_NOX_SENS_VLS_DIAG_VLD_i = 0
      LV_NOX_SENS_VLS_AUTH_i = LC_NOX_SENS_VLS_MAN_i
      T_NOX_SENS_VLS_HLD_i = 0
endif(1)
```

4.42.4 NOx sensor errors

FUNCTION DESCRIPTION:

General information:

The NOx sensor monitors the connection between the NOx sensor interface unit and the sensor element. The sensor interface is able to detect open wires and short circuits between the sensor connection wires.
The NOx sensor sends the monitoring result together with the measurement data as failure byte to the EMS. The EMS uses this failure byte for the NOx sensor diagnosis.

Description:

The NOx sensor's failure byte is valid, if no CAN bus error is occurred. In this case the failure byte CAN_ERR_NOX_SENS_i is copied to the variable ERR_NS[i], so that it can be evaluated by the NOx sensor diagnosis function. Otherwise the variable ERR_NS[i] is reset.
If the manual setting of error byte is active LC_NOX_SENS_ERR_MAN_i = 1 then ERR_NS[i] is set to C_ERR_NOX_SENS_i.

Application conditions

Initialisation: *at reset, at LV_IGK = 1 -> 0:* *ERR_NS[i] = 0*

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Formula section:

```
if        LC_NOX_SENS_ERR_MAN_i = 0
then
        if                                    LV_ERR_NS_CAN_MSG_LOST[i] = 0

            LV_ERR_NS_CAN_BOFF = 0
        then        ERR_NS[i] = CAN_ERR_NOX_SENS_i
        else        ERR_NS[i] = 0
        endif
else        ERR_NS[i] = C_ERR_NOX_SENS_i
endif
```

4.42.5 Sensor temperature

FUNCTION DESCRIPTION:

General information:

The NOx sensor interface unit controls the temperature of the sensor element. The state of the temperature control is transmitted to the EMS by the status byte.
The NOx sensor observes its power supply voltage. If the power supply voltage is in the range MIN $<$ voltage $<$ MAX then the bit B0 of CAN_STATE_NOX_SENS_i is 0.
In the case of voltage $<$ MIN (specification value of sensor) it is possible that the sensor can not control the correct sensor element temperature. Because of this the sensor loses the readiness. The possible reasons of undervoltage are a to low battery voltage or a high voltage drop over the power supply wire (e.g. connector problem).
In the case of voltage $>$ MAX (specification value of sensor) the sensor is shut down up to the power supply voltage is again in the allowed range (self-protection mode).
At both cases the NOx sensor diagnosis functions must be deactivated in order to prevent wrong diagnoses.

Description:

The state of sensor temperature control and the state of sensor power supply voltage are indicated by bits of NOX_SENS_TEMP_i. The meaning of each bit of NOX_SENS_TEMP_i is described at the table below.

NOX_SENS_TEMP_i	Description
Bit B0 ... TEMP_OK	Sensor temperature is ok.
Bit B1 ... PWR_OK	Sensor power supply is ok.
Bit B2	not used
Bit B3	not used
Bit B4	not used
Bit B5	not used
Bit B6	not used
Bit B7	not used

The sensor temperature is valid if no CAN bus error is occurred and the status byte CAN_STATE_NOX_SENS_i indicates level 1 readiness.

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The level 1 readiness is indicated by CAN_STATE_NOX_SENS_i = 02H. For the level 1 readiness must be checked the bits B1 and B6 of CAN_STATE_NOX_SENS_i. All other bits of CAN_STATE_NOX_SENS_i have no relevance for level 1 readiness.
If the level 1 readiness is ok then bit TEMP_OK of NOX_SENS_TEMP_i is set. Otherwise bit TEMP_OK of NOX_SENS_TEMP_i is reset.
With bit B0 of CAN_STATE_NOX_SENS_i = 0 indicates the sensor that the power supply is in the correct range. Then bit PWR_OK of NOX_SENS_TEMP_i is set to 1.
At undervoltage or at overvoltage the sensor sets bit B0 of CAN_STATE_NOX_SENS_i = 1. This information is combined with the temperature information from the sensor and the timer T_NOX_SENS_PWR_i in order to debounce short power supply peaks, which are reported by sensor.

Application conditions

Initialisation: *at reset:* *NOX_SENS_TEMP_i = 0*
T_NOX_SENS_PWR_i = 0

Formula section:

if LV_ERR_NS_CAN_MSG_LOST[i] = 0 **AND**
LV_ERR_NS_CAN_BOFF = 0
then
if Bit B1 of CAN_STATE_NOX_SENS_i = 1 **AND**
Bit B6 of CAN_STATE_NOX_SENS_i = 0
then Bit TEMP_OK of NOX_SENS_TEMP_i = 1
else Bit TEMP_OK of NOX_SENS_TEMP_i = 0
endif
if CAN_STATE_NOX_SENS_i = 255 **OR**
Bit B0 of CAN_STATE_NOX_SENS_i = 0
then Bit PWR_OK of NOX_SENS_TEMP_i = 1
T_NOX_SENS_PWR_i = 0
else
if Bit B0 of CAN_STATE_NOX_SENS_i = 1 **AND**
Bit B1 of CAN_STATE_NOX_SENS_i = 0
T_NOX_SENS_PWR_i >= C_T_NOX_SENS_PWR_HLD
then Bit PWR_OK of NOX_SENS_TEMP_i = 0
else increment T_NOX_SENS_PWR_i
endif
endif
endif

4.42.6 NOx sensor self diagnosis states

FUNCTION DESCRIPTION:

General information:

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The NOx sensor indicates its self diagnosis state by CAN_STATE_DIAG_NS[i]. Into this state information is the diagnosis process state and the diagnosis result coded. These information are decoded here.

Description:

Application conditions

Initialisation: *at reset:* *STATE_NS[i] = 0*
LV_NS_SHIFT_DIAG_ERR[i] = 0

Formula section:

if C_STATE_DIAG_NS_MAN[i] = 0
then
if LV_ERR_NS_CAN_MSG_LOST[i] = 0

LV_ERR_NS_CAN_BOFF = 0 **AND**
CAN_STATE_NS_TMP[i] = C_STATE_NS_MASK_MODE_5
then
case selection on CAN_STATE_DIAG_NS[i]:
case: CAN_STATE_DIAG_NS[i] = 0
Sensor self diagnosis is running.
STATE_NS[i] = 1
LV_NS_SHIFT_DIAG_ERR[i](n) = LV_NS_SHIFT_DIAG_ERR[i](n-1)

case: CAN_STATE_DIAG_NS[i] = 1
Sensor self diagnosis was aborted.
Sensor is returning to normal operation mode.
STATE_NS[i] = 2
LV_NS_SHIFT_DIAG_ERR[i](n) = LV_NS_SHIFT_DIAG_ERR[i](n-1)

case: CAN_STATE_DIAG_NS[i] = 2
Sensor self diagnosis was completed. Result: "Sensor is ok".
Sensor is returning to normal operation mode.
STATE_NS[i] = 3
LV_NS_SHIFT_DIAG_ERR[i] = 0

case: CAN_STATE_DIAG_NS[i] = 3
Sensor self diagnosis was completed. Result: "Sensor is faulty".
Sensor is returning to normal operation mode.
STATE_NS[i] = 3
LV_NS_SHIFT_DIAG_ERR[i] = 1

default:
Sensor self diagnosis is "off".
STATE_NS[i] = 0
LV_NS_SHIFT_DIAG_ERR[i](n) = LV_NS_SHIFT_DIAG_ERR[i](n-1)
end case selection

else *Sensor self diagnosis is "off".*
STATE_NS[i] = 0
LV_NS_SHIFT_DIAG_ERR[i](n) = LV_NS_SHIFT_DIAG_ERR[i](n-1)

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endif
else
case selection on C_STATE_DIAG_NS_MAN[i]:
case: C_STATE_DIAG_NS_MAN[i] = 1
Sensor self diagnosis is running.
STATE_NS[i] = 1
LV_NS_SHIFT_DIAG_ERR[i](n) = LV_NS_SHIFT_DIAG_ERR[i](n-1)

case: C_STATE_DIAG_NS_MAN[i] = 2
Sensor self diagnosis was aborted.
Sensor is returning to normal operation mode.
STATE_NS[i] = 2
LV_NS_SHIFT_DIAG_ERR[i](n) = LV_NS_SHIFT_DIAG_ERR[i](n-1)

case: C_STATE_DIAG_NS_MAN[i] = 3
Sensor self diagnosis was completed. Result: "Sensor is ok".
Sensor is returning to normal operation mode.
STATE_NS[i] = 3
LV_NS_SHIFT_DIAG_ERR[i] = 0

case: C_STATE_DIAG_NS_MAN[i] = 4
Sensor self diagnosis was completed. Result: "Sensor is faulty".
Sensor is returning to normal operation mode.
STATE_NS[i] = 3
LV_NS_SHIFT_DIAG_ERR[i] = 1

default:
Sensor self diagnosis is "off".
STATE_NS[i] = 0
LV_NS_SHIFT_DIAG_ERR[i](n) = LV_NS_SHIFT_DIAG_ERR[i](n-1)
end case selection
endif

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4.43 NOx sensor interface (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAN_ERR_NOX_SENS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
NOx sensor error byte					
CAN_HW_NS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
NOx sensor hardware version number					
CAN_LAMB_NOX_SENS [NC_NOX_SENS_CONF]	O/V	0... 0604H	0... 1540	1	-
Lambda value as [1000/Lambda], measured by NOx sensor					
CAN_NOX_DIAG_NS [NC_NOX_SENS_CONF]	O/V	8000... 7FFFH	-32768 ...32767	1	-
NOx signal - Diagnosis value					
CAN_NOX_NOX_SENS [NC_NOX_SENS_CONF]	O/V	FF9C... 05DCH	-100 ...1500	1	ppm
NOx concentration value, measured by NOx sensor					
CAN_NOX_REF_NS [NC_NOX_SENS_CONF]	O/V	8000... 7FFFH	-32768 ...32767	1	-
NOx signal - Diagnosis reference value					
CAN_R_RATIO_NOX_SENS [NC_NOX_SENS_CONF]	O/V	8000... 7FFFH	-32768 ...32767	1	-
Sensor element temperature depended resistance ratio as 1000 * R/R25					
CAN_STATE_DIAG_NS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
NOx sensor self diagnosis state					
CAN_STATE_NOX_SENS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
NOx sensor status byte					
CAN_STATE_NS_DIAG_REQ [NC_NOX_SENS_CONF]	O/V	0... FH	0... 15	1	-
Request to NOx sensor for doing a sensor self diagnosis					
CAN_STATE_NS_TMP [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
NOx sensor state - Temporary signal for sensor mode switching					
CAN_SW_NS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
NOx sensor software version number					
CAN_TMP_BYTE_1 [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Temporary signal from CAN message buffer - byte 1					
CAN_TMP_BYTE_2 [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Temporary signal from CAN message buffer - byte 2					
CAN_TMP_BYTE_3 [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Temporary signal from CAN message buffer - byte 3					
CAN_TMP_BYTE_4 [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Temporary signal from CAN message buffer - byte 4					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAN_TMP_BYTE_5 [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Temporary signal from CAN message buffer - byte 5					
CAN_TMP_BYTE_6 [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Temporary signal from CAN message buffer - byte 6					
CAN_TMP_BYTE_8 [NC_NOX_SENS_CONF]	-	0... FFH	0... 255	1	-
Temporary signal from CAN message buffer - byte 8					
CAN_TMP_WORD_1 [NC_NOX_SENS_CONF]	V	8000... 7FFFH	-32768 ...32767	1	-
Temporary signal from CAN message buffer - word 1					
CAN_VLS_NOX_SENS [NC_NOX_SENS_CONF]	O/V	0... 578H	-200 ...1200	1	mV
Binary O2 signal voltage, raw value, measured by NOx sensor					
LV_CAN_TEMP_MIN_THD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor dew point					
LV_MDL_TEMP_MIN_THD [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Temperature model has reached the dew point for NOx sensor					
LV_NS_VERS_REQ_1 [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Request to NOx sensor for transmission of sensor identification data					
LV_NS_VERS_REQ_2 [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Selection of NOx sensor identification data part 1 or 2					

Input data:

CAN_HW_NS [NC_NOX_SENS_CONF] {p. 1398}	CAN_R_RATIO_NOX_SENS [NC_NOX_SENS_CONF] {p. 1398}	CAN_STATE_NS_DIAG_REQ [NC_NOX_SENS_CONF] {p. 1398}	LV_CAN_TEMP_MIN_THD [NC_NOX_SENS_CONF] {p. 1399}
LV_DIAG_REQ_NS_SHIFT [NC_NOX_SENS_CONF] {p. 6426}	LV_IGK {p. 906}	LV_NS_VERS_REQ_1 [NC_NOX_SENS_CONF] {p. 1399}	LV_NS_VERS_REQ_2 [NC_NOX_SENS_CONF] {p. 1399}
LV_TNT_MIN_THD_2 {p. 3181}	NC_NOX_SENS_CONF {p. 643}	STATE_NS_VERS [NC_NOX_SENS_CONF] {p. 6313}	T_AST_SAE {p. 1766}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CAN_STATE_NS_TMP_MASK	-	0... FFH	0... 255	1	-
Base bit-mask for selection of NOx sensor mode					
C_R_RATIO_NOX_SENS_MIN	-	8000... 7FFFH	-32768 ...32767	1	-
Minimum sensor element temperature for set of dew point ahead of temperature model					
C_STATE_DIAG_NS_REF	-	0... FFH	0... 255	1	-
Configuration label for distinction between "Diagnosis reference value" and "Diagnosis value"					
C_STATE_NS_DIAG_REQ_MASK_A	-	0... FH	0... 15	1	-
Bit-Mask "A" for request of NOx sensor self diagnosis ("A" ... at Lambda=1.0 conditions)					
C_STATE_NS_DIAG_REQ_MASK_OFF	-	0... FH	0... 15	1	-
Bit-Mask for NOx sensor self diagnosis request "OFF"					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_NS_MASK_MODE_1	-	0... FFH	0... 255	1	-
Bit-mask for detection of NOx sensor data transfer mode 1 - Wait on dew point					
C_STATE_NS_MASK_MODE_2	-	0... FFH	0... 255	1	-
Bit-mask for detection of NOx sensor data transfer mode 2 - Measuring					
C_STATE_NS_MASK_MODE_3_A	-	0... FFH	0... 255	1	-
Bit-mask "A" for detection of NOx sensor data transfer mode 3 - Sensor identification data, part 1					
C_STATE_NS_MASK_MODE_3_B	-	0... FFH	0... 255	1	-
Bit-mask "B" for detection of NOx sensor data transfer mode 3 - Sensor identification data, part 1					
C_STATE_NS_MASK_MODE_4_A	-	0... FFH	0... 255	1	-
Bit-mask "A" for detection of NOx sensor data transfer mode 4 - Sensor identification data, part 2					
C_STATE_NS_MASK_MODE_4_B	-	0... FFH	0... 255	1	-
Bit-mask "B" for detection of NOx sensor data transfer mode 4 - Sensor identification data, part 2					
C_STATE_NS_MASK_MODE_5	-	0... FFH	0... 255	1	-
Bit-mask for detection of NOx sensor data transfer mode 5 - Sensor self diagnosis					
C_STATE_NS_VERS_REQ_CAN_MAN	-	0... 2H	0 ...2	1	-
Manual set of request for read out of NOx sensor identification data					
C_STATE_NS_VERS_REQ_MASK_1	-	0... FFH	0... 255	1	-
STATE_NS_VERS bit-mask for request of NOx sensor identification data part 1					
C_STATE_NS_VERS_REQ_MASK_2	-	0... FFH	0... 255	1	-
STATE_NS_VERS bit-mask for request of NOx sensor identification data part 2					
C_T_AST_CAN_HW_NS_MAX	-	0... FFFFH	0... 65535	1	s
Maximum engine running time for receiving of NOx sensor hardware information					
C_T_RUN_DIAG_NS_SHIFT	-	0... FFH	0... 25.5	0.1	s
NOx sensor self diagnosis run-in time					
LC_CAN_R_RATIO_NOX_SENS_CONT	-	0... 1H	0 ...1	1	-
CAN_R_RATIO_NOX_SENS calculation mode selection; 0..."follow-up" pointer; 1...continuous					
LC_NOX_SENS_2	-	0... 1H	0 ...1	1	-
NOx sensor of exhaust line 2 exists (yes/no)					

General information:

The number of NOx sensors in the system is defined by NC_NOX_SENS_CONF.

if NC_NOX_SENS_CONF = 0
then The system contains no NOx sensor
no output variables shall be generated
else
  if NC_NOX_SENS_CONF = 1
  then The system contains one NOx sensor
  i = 1 ... all NOx sensor variables are xxx[i = 1]
  else
    if NC_NOX_SENS_CONF = 2
    then The system contains two NOx sensors
    i = 1 ... the NOx sensor variables for exhaust line 1 are xxx[i = 1]
    i = 2 ... the NOx sensor variables for exhaust line 2 are xxx[i = 2]
    endif
  endif
endif

4.43.1 NOx sensor activation data

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FUNCTION DESCRIPTION:

General information:

This chapter is used as interface between the variables on the CAN bus and the system variables.
The NOx sensor needs from the EMS the information, that the dew point is passed. This information is necessary for the heater management of the NOx sensor. It protects the NOx sensor in order to avoid damages by water splash of condense water in the exhaust system. The dew point recognition is performed in the NOx catalyst monolith temperature model .
If the NOx sensor has been received the dew point from the EMS, then the heater management warms up the sensor on the normal operating temperature.

Description:

The dew point flag for the NOx sensor LV_CAN_TEMP_MIN_THD_i is set, if the dew point, which is calculated by the NOx catalyst monolith temperature model, is reached or if the NOx sensor’s ceramic (sensor element) was sufficiently heated up by exhaust gas. The detection of sufficient sensor element heating uses a temperature dependent resistance ratio signal, which is sent by the NOx sensor while the NOx sensor is waiting for the dew point.
The resistance ratio signal is sent instead of the NOx signal. This resistance ratio signal represents the momentary temperature of sensor element. It is defined as:

$$\text{CAN\_R\_RATIO\_NOX\_SENS\_i} = \frac{R}{R_{25}} = 911 \cdot \left(1 + \alpha \cdot T + \beta \cdot T^2\right)$$

α ... material constant, α = 3.92*10^{-3} K^{-1}
... material constant, = -0.6*10^{-6} K^{-2}
T ... temperature of sensor element [°C]

The scope of dew point detection by sensor element temperature is an earlier set of dew point in comparison with the dew point set by NOx catalyst monolith temperature model.
The dew point is detected by sensor element temperature when the resistance ratio signal from the NOx sensor exceeds the threshold C_R_RATIO_NOX_SENS_MIN. The set of dew point by sensor element temperature is allowed only 1x after engine start. A reset of dew point is possible by the NOx catalyst temperature model within a driving cycle (e.g. very long pull fuel cutoff phase). In this case the sensor temperature condition has not the right to set the dew point again. Hence the resistance ratio signal is set to maximum value after the dew point was reached the 1^{st} time within a driving cycle and is reset to "0" at every engine start.
Calibration hints:
A typical sensor element temperature threshold for set of dew point is:
T 300°C => C_R_RATIO_NOX_SENS_MIN = 1936
Other values for C_R_RATIO_NOX_SENS_MIN can be calculated by use of definition equation (see above).
This function can be switched off by calibration
C_R_RATIO_NOX_SENS_MIN = maximum value (7FFFH or 32767)

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Application conditions

Initialisation:

```
at reset:
LV_CAN_TEMP_MIN_THD_i = 0
LV_MDL_TEMP_MIN_THD_i = 0
```

```
CAN_STATE_NS_DIAG_REQ[i] = 0
LV_NS_VERS_REQ_1[i] = 0
LV_NS_VERS_REQ_2[i] = 0
```

Recurrence: *corresponding to EMS send message with CAN-ID = 140H*

Activation: *after reset, at every engine state*

Deactivation: -

Formula section:

if LV_IGK = 1
then
  if LV_TNT_MIN_THD_2 = 1
  then LV_CAN_TEMP_MIN_THD_i = 1 *(valid for i = 1 and i = 2)*
  LV_MDL_TEMP_MIN_THD_i = 1 *(valid for i = 1 and i = 2)*
  else
    if LV_MDL_TEMP_MIN_THD_i = 0 **AND**
    CAN_R_RATIO_NOX_SENS_i > C_R_RATIO_NOX_SENS_MIN
    then LV_CAN_TEMP_MIN_THD_i = 1
    else LV_CAN_TEMP_MIN_THD_i = 0
    endif
  endif
  if LV_DIAG_REQ_NS_SHIFT[i] = 1 **AND**
  LV_CAN_TEMP_MIN_THD[i] = 1
  then CAN_STATE_NS_DIAG_REQ[i] = C_STATE_NS_DIAG_REQ_MASK_A
  else CAN_STATE_NS_DIAG_REQ[i] = C_STATE_NS_DIAG_REQ_MASK_OFF
  endif

else LV_CAN_TEMP_MIN_THD_i = 0 *(valid for i = 1 and i = 2)*
LV_MDL_TEMP_MIN_THD_i = 0 *(valid for i = 1 and i = 2)*
CAN_STATE_NS_DIAG_REQ[i] = C_STATE_NS_DIAG_REQ_MASK_OFF
endif

if C_STATE_NS_VERS_REQ_CAN_MAN > 0
then *Manual controlled set of request for NOx sensor identification data*
case selection on C_STATE_NS_VERS_REQ_CAN_MAN:
  case: C_STATE_NS_VERS_REQ_CAN_MAN = 1
  Sensor identification data, part 1 are requested
  LV_NS_VERS_REQ_1[i] = 1
  LV_NS_VERS_REQ_2[i] = 0

  case: C_STATE_NS_VERS_REQ_CAN_MAN = 2
  Sensor identification data, part 2 are requested
  LV_NS_VERS_REQ_1[i] = 1
  LV_NS_VERS_REQ_2[i] = 1

  default:
  No sensor identification data are requested
  LV_NS_VERS_REQ_1[i] = 0
  LV_NS_VERS_REQ_2[i] = 0

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end case selection

else *Regular controlled set of request for NOx sensor identification data*
if CAN_HW_NS[i] > 0 **OR** T_AST_SAE >= C_T_AST_CAN_HW_NS_MAX
then
case selection on STATE_NS_VERS[i]:
case: STATE_NS_VERS[i] = C_STATE_NS_VERS_REQ_MASK_1
Sensor identification data, part 1 are requested
LV_NS_VERS_REQ_1[i] = 1
LV_NS_VERS_REQ_2[i] = 0
case: STATE_NS_VERS[i] = C_STATE_NS_VERS_REQ_MASK_2
Sensor identification data, part 2 are requested
LV_NS_VERS_REQ_1[i] = 1
LV_NS_VERS_REQ_2[i] = 1
default:
No sensor identification data are requested
LV_NS_VERS_REQ_1[i] = 0
LV_NS_VERS_REQ_2[i] = 0
end case selection
else *Sensor identification data, part 2 are requested until received or time out*
LV_NS_VERS_REQ_1[i] = 1
LV_NS_VERS_REQ_2[i] = 1
endif
endif

4.43.2 CAN Protocol

General information:

The following control units participate to CAN-communication:
EMS: Engine management system
NOX1: NOx sensor on exhaust line 1
NOX2: NOx sensor on exhaust line 2

CAN communication is based on messages. A message is defined at the identifier number. Valid identifier numbers are numbers from 1 to 1023 (short identifier). Messages with lower identifier number have higher priority. The length of a message can vary from 1 to 8 bytes.

Baudrate: 500 kBaud
Data format: Motorola

The NOx sensor in exhaust line 1 sends its measurement values on CAN Messages with the ID = 130H. The NOx sensor in exhaust line 2 sends its measurement values on CAN Messages with the ID = 135H.
The NOx sensors in all exhaust lines receive the dew point on the CAN Message with the ID = 140H.

4.43.2.1 Send messages by EMS

4.43.2.1.1 ID = 140H - NOx sensor dew point

General information:

ATTENTION!!!

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The CAN message description in this function specification is **for information only!** It is not included within NOx sensor component change management!

This message transfers the dew point and special operation mode requests from the EMS to all NOx sensors within the system. The sending of this message is permanently active.

Description:

The calibration value NOx sensor self diagnosis run-in time C_T_RUN_DIAG_NS_SHIFT allows to overwrite the NOx sensor internal default value of this parameter. For a explanation of NOx sensor self diagnosis, its parameters and effects contact the NOx sensor supplier or see NOx sensor component specification.

Calibration hint:

It is strongly recommended to use the NOx sensor internal default value of this parameter. Hence use the According to the definitions into the NOx sensor component specification for project MSD80, the following calibration is recommended:

1. activation of functionality:
   C_T_RUN_DIAG_NS_SHIFT > 0.0 s
2. deactivation of functionality (use of NOx sensor internal default value):
   C_T_RUN_DIAG_NS_SHIFT = 0.0 s

Application conditions

Initialisation: –

Recurrence: *100ms*

Activation: *after reset*

Deactivation: –

Formula section:

CAN Frame and Signal Definitions:

ID = 140H, base time = 100ms - NOx sensor dew point								
Bit:	7 MSB	6	5	4	3	2	1	0 LSB
Byte: 0	Dew point for sensor ID=130H	0	0	0	Sensor identification request 1 for sensor ID=130H	0	Sensor identification request 2 for sensor ID=130H	0
1	Dew point for sensor ID=135H	0	0	0	Sensor identification request 1 for sensor ID=135H	0	Sensor identification request 2 for sensor ID=135H	0
2	0	0	0	0	Diagnosis request for sensor ID=130H			
3	0	0	0	0	Diagnosis request for sensor ID=135H			
4	Diagnosis run-in time							
5	00H							
6	00H							
7	00H							

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ID	Signal	Hex Range	Phys. Range	Resolution	Unit	Init Value	Default Value
140H	Dew point for sensor ID=130H & 135H	0...1H	0...1	1	[-]	0	0
140H	Sensor identification request 1 for sensor ID=130H & 135H	0...1H	0...1	1	[-]	0	0
140H	Sensor identification request 2 for sensor ID=130H & 135H	0...1H	0...1	1	[-]	0	0
140H	Diagnosis request for sensor ID=130H & 135H	0...FH	0...15	1	[-]	0	0
140H	Diagnosis run-in time	0...FFH	0.0...25.5	0.1	[s]	0	0

ID	Signal	Signal value	Description
140H	Dew point for sensor ID=130H & 135H	0	Dew point is not reached
		1	Dew point is reached
140H	Sensor identification request 1 for sensor ID=130H & 135H	0	No request
		1	Request for sensor identification data
140H	Sensor identification request 2 for sensor ID=130H & 135H	0	Request for part 1 of sensor identification data
		1	Request for part 2 of sensor identification data
140H	Diagnosis request for sensor ID=130H & 135H	0H (0000b)	No request, sensor self diagnosis = "off"
		1H (0001b)	Conditions for sensor self diagnosis at λ=1.0 present
		2H (0010b)	Conditions for sensor self diagnosis at pull fuel cutoff (Schub) present
		4H (0100b)	Conditions for sensor self diagnosis at λ=xxx present
		8H (1000b)	Conditions for sensor self diagnosis at λ=xxx present
		other values	Other values are not defined. => Hence they are not allowed.
140H	Diagnosis run-in time	0.0 s	No diagnosis run-in time change request from EMS. Use sensor internal value (default value).
		0.1...25.5 s	Diagnosis run-in time from EMS

ID	Signal	ECU signal variable name
140H	Dew point for sensor ID=130H	LV_CAN_TEMP_MIN_THD[1]
140H	Dew point for sensor ID=135H	LV_CAN_TEMP_MIN_THD[2] [5)]
140H	Sensor identification request 1 for sensor ID=130H	LV_NS_VERS_REQ_1[1]
140H	Sensor identification request 2 for sensor ID=130H	LV_NS_VERS_REQ_2[1]
140H	Sensor identification request 1 for sensor ID=135H	LV_NS_VERS_REQ_1[2] [5)]
140H	Sensor identification request 2 for sensor ID=135H	LV_NS_VERS_REQ_2[2] [5)]
140H	Diagnosis request for sensor ID=130H	CAN_STATE_NS_DIAG_REQ[1]
140H	Diagnosis request for sensor ID=135H	CAN_STATE_NS_DIAG_REQ[2] [5)]
140H	Diagnosis run-in time	C_T_RUN_DIAG_NS_SHIFT

5) If NC_NOX_SENS_CONF = 1 then use the i = 1 variables instead of i = 2 variables.

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4.43.2.2 Received messages by EMS

General information:

For all received messages are applicable:
if LV_IGK = 0 **OR**
lost message error of a particular message is detected
then
if default values for this message are defined
then the default values are used
else the previous values of this message are used
endif
else the received message values are used
endif

Description:

The NOx sensor transmits different signals, which can identified by the "Sensor status" signal. Detailed information are included into the next section with the CAN message description.
ATTENTION!!!
The CAN message description in this function specification is **for information only!** It is not included within NOx sensor component change management!

Calibration hint:
According to the definitions into the NOx sensor component specification for project MSD80, the following calibration is recommended:

C_CAN_STATE_NS_TMP_MASK = 1110 0000b = E0H =
(decimal)
C_STATE_NS_MASK_MODE_1 = 0100 0000b = 40H = 6
(decimal)
C_STATE_NS_MASK_MODE_2 = 0000 0000b = 00H = 0
(decimal)
C_STATE_NS_MASK_MODE_3_A = 1000 0000b = 80H =
(decimal)
C_STATE_NS_MASK_MODE_3_B = 1100 0000b = C0H =
(decimal)
C_STATE_NS_MASK_MODE_4_A = 1010 0000b = A0H =
(decimal)
C_STATE_NS_MASK_MODE_4_B = 1110 0000b = E0H =
(decimal)
C_STATE_NS_MASK_MODE_5 = 0010 0000b = 20H = 3
(decimal)

A functionality can be deactivated by mode mask calibration of 0FH.

Application conditions

Initialisation:
```
at reset:
CAN_R_RATIO_NOX_SENS[i] = 0
CAN_STATE_NS_TMP[i] = 0
CAN_SW_NS[i] = 0
CAN_HW_NS[i] = 0
CAN_STATE_DIAG_NS[i] = 0
CAN_NOX_REF_NS[i] = 0
CAN_NOX_DIAG_NS[i] = 0
```

Recurrence: *10ms*

Activation: *after reset, at every engine state*

Deactivation: –

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Formula section:

Signals, which are to copy from CAN message buffer without any condition
CAN_STATE_NOX_SENS[i] = *CAN Message buffer "Sensor status"*
CAN_STATE_NS_TMP[i] = CAN_STATE_NOX_SENS[i] **bit-wise AND** C_CAN_STATE_NS_TMP_MASK

case selection on CAN_STATE_NS_TMP[i]:

case 1: CAN_STATE_NS_TMP[i] = C_STATE_NS_MASK_MODE_1

Mode 1 - Wait on dew point (Mask: 010x xxxx)
Resistance ratio was received
CAN_NOX_NOX_SENS[i] = 0
if CAN_R_RATIO_NOX_SENS[i](n-1) < CAN_TMP_WORD_1[i] **OR** LC_CAN_R_RATIO_NOX_SENS_CONT = 1
then CAN_R_RATIO_NOX_SENS[i] = CAN_TMP_WORD_1[i]
else *Resistance ratio remains unchanged*
CAN_R_RATIO_NOX_SENS[i](n) = CAN_R_RATIO_NOX_SENS[i](n-1)
endif
CAN_ERR_NOX_SENS[i] = CAN_TMP_BYTE_8[i]

Signals, which are to copy from CAN message buffer
CAN_LAMB_NOX_SENS[i] = *CAN Message buffer "Lambda signal"* *
CAN_VLS_NOX_SENS[i] = *CAN Message buffer "Binary O2 signal"* *
*...The CAN Message buffer value has to read out as **signed integer** value!

Frozen signals (nothing is to do)
CAN_SW_NS[i](n) = CAN_SW_NS[i](n-1)
CAN_HW_NS[i](n) = CAN_HW_NS[i](n-1)
CAN_STATE_DIAG_NS[i](n) = CAN_STATE_DIAG_NS[i](n-1)
CAN_NOX_REF_NS[i](n) = CAN_NOX_REF_NS[i](n-1)
CAN_NOX_DIAG_NS[i](n) = CAN_NOX_DIAG_NS[i](n-1)

case 2: CAN_STATE_NS_TMP[i] = C_STATE_NS_MASK_MODE_2

Mode 2 - Measuring (Mask: 000x xxxx)
NOx signal and error signal were received
CAN_NOX_NOX_SENS[i] = CAN_TMP_WORD_1[i]
CAN_ERR_NOX_SENS[i] = CAN_TMP_BYTE_8[i]

Signals, which are to copy from CAN message buffer
CAN_LAMB_NOX_SENS[i] = *CAN Message buffer "Lambda signal"* *
CAN_VLS_NOX_SENS[i] = *CAN Message buffer "Binary O2 signal"* *
*...The CAN Message buffer value has to read out as **signed integer** value!

Frozen signals (nothing is to do)
CAN_R_RATIO_NOX_SENS[i](n) = CAN_R_RATIO_NOX_SENS[i](n-1)
CAN_SW_NS[i](n) = CAN_SW_NS[i](n-1)
CAN_HW_NS[i](n) = CAN_HW_NS[i](n-1)
CAN_STATE_DIAG_NS[i](n) = CAN_STATE_DIAG_NS[i](n-1)
CAN_NOX_REF_NS[i](n) = CAN_NOX_REF_NS[i](n-1)
CAN_NOX_DIAG_NS[i](n) = CAN_NOX_DIAG_NS[i](n-1)

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case 3: CAN_STATE_NS_TMP[i] = C_STATE_NS_MASK_MODE_3_A **OR**
CAN_STATE_NS_TMP[i] = C_STATE_NS_MASK_MODE_3_B

Mode 3 - Sensor identification data, part 1 (Mask: 1x0x xxxx -> 100... or 110...)
Sensor identification data, part 1 was received
- part number data are ignored
- software version is recorded
CAN_SW_NS[i] = CAN_TMP_BYTE_8[i]

Signals, which are to copy from CAN message buffer
- –

Frozen signals (nothing is to do)
CAN_NOX_NOX_SENS[i](n) = CAN_NOX_NOX_SENS[i](n-1)
CAN_LAMB_NOX_SENS[i](n) = CAN_LAMB_NOX_SENS[i](n-1)
CAN_VLS_NOX_SENS[i](n) = CAN_VLS_NOX_SENS[i](n-1)
CAN_ERR_NOX_SENS[i](n) = CAN_ERR_NOX_SENS[i](n-1)
CAN_R_RATIO_NOX_SENS[i](n) = CAN_R_RATIO_NOX_SENS[i](n-1)
CAN_HW_NS[i](n) = CAN_HW_NS[i](n-1)
CAN_STATE_DIAG_NS[i](n) = CAN_STATE_DIAG_NS[i](n-1)
CAN_NOX_REF_NS[i](n) = CAN_NOX_REF_NS[i](n-1)
CAN_NOX_DIAG_NS[i](n) = CAN_NOX_DIAG_NS[i](n-1)

case 4: CAN_STATE_NS_TMP[i] = C_STATE_NS_MASK_MODE_4_A **OR**
CAN_STATE_NS_TMP[i] = C_STATE_NS_MASK_MODE_4_B

Mode 4 - Sensor identification data, part 2 (Mask: 1x1x xxxx -> 101... or 111...)
Sensor identification data, part 2 was received
- parameter list data is ingnored
- individual part number data are ignored
- quality status is recorded
CAN_HW_NS[i] = CAN_TMP_BYTE_8[i]

Signals, which are to copy from CAN message buffer
- –

Frozen signals (nothing is to do)
CAN_NOX_NOX_SENS[i](n) = CAN_NOX_NOX_SENS[i](n-1)
CAN_LAMB_NOX_SENS[i](n) = CAN_LAMB_NOX_SENS[i](n-1)
CAN_VLS_NOX_SENS[i](n) = CAN_VLS_NOX_SENS[i](n-1)
CAN_ERR_NOX_SENS[i](n) = CAN_ERR_NOX_SENS[i](n-1)
CAN_R_RATIO_NOX_SENS[i](n) = CAN_R_RATIO_NOX_SENS[i](n-1)
CAN_SW_NS[i](n) = CAN_SW_NS[i](n-1)
CAN_STATE_DIAG_NS[i](n) = CAN_STATE_DIAG_NS[i](n-1)
CAN_NOX_REF_NS[i](n) = CAN_NOX_REF_NS[i](n-1)
CAN_NOX_DIAG_NS[i](n) = CAN_NOX_DIAG_NS[i](n-1)

case 5: CAN_STATE_NS_TMP[i] = C_STATE_NS_MASK_MODE_5

Mode 5 - Sensor self diagnosis (Mask: 001x xxxx)

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Diagnosis signals were received
CAN_STATE_DIAG_NS[i] = CAN_TMP_BYTE_8[i]
if CAN_STATE_DIAG_NS[i] <= C_STATE_DIAG_NS_REF
then *Diagnosis reference value was received*
CAN_NOX_REF_NS[i] = CAN_TMP_WORD_1[i]
else *Diagnosis value was received*
CAN_NOX_DIAG_NS[i] = CAN_TMP_WORD_1[i]
endif
Signals, which are to copy from CAN message buffer
CAN_LAMB_NOX_SENS[i] = *CAN Message buffer "Lambda signal"* *
CAN_VLS_NOX_SENS[i] = *CAN Message buffer "Binary O2 signal"* *
*...The CAN Message buffer value has to read out as **signed integer** value!

Frozen signals (nothing is to do)
CAN_NOX_NOX_SENS[i](n) = CAN_NOX_NOX_SENS[i](n-1)
CAN_ERR_NOX_SENS[i](n) = CAN_ERR_NOX_SENS[i](n-1)
CAN_R_RATIO_NOX_SENS[i](n) = CAN_R_RATIO_NOX_SENS[i](n-1)
CAN_SW_NS[i](n) = CAN_SW_NS[i](n-1)
CAN_HW_NS[i](n) = CAN_HW_NS[i](n-1)

default case:
This part is reached in case of wrong system calibration or at receive of not allowed "Sensor status" signal combination - Mask 011x xxxx.
Nothing is done in this case. All signals are frozen.

Frozen signals (nothing is to do)
CAN_NOX_NOX_SENS[i](n) = CAN_NOX_NOX_SENS[i](n-1)
CAN_LAMB_NOX_SENS[i](n) = CAN_LAMB_NOX_SENS[i](n-1)
CAN_VLS_NOX_SENS[i](n) = CAN_VLS_NOX_SENS[i](n-1)
CAN_ERR_NOX_SENS[i](n) = CAN_ERR_NOX_SENS[i](n-1)
CAN_R_RATIO_NOX_SENS[i](n) = CAN_R_RATIO_NOX_SENS[i](n-1)
CAN_SW_NS[i](n) = CAN_SW_NS[i](n-1)
CAN_HW_NS[i](n) = CAN_HW_NS[i](n-1)
CAN_STATE_DIAG_NS[i](n) = CAN_STATE_DIAG_NS[i](n-1)
CAN_NOX_REF_NS[i](n) = CAN_NOX_REF_NS[i](n-1)
CAN_NOX_DIAG_NS[i](n) = CAN_NOX_DIAG_NS[i](n-1)

end case selection

4.43.2.3 ID = 130H - NOx sensor 1 data and ID = 135H - NOx sensor 2 data

General information:

ATTENTION!!!
The CAN message description in this function specification is **for information only!** It is not included within NOx sensor component change management!

This messages transfers the measurement data, diagnosis data and sensor identification data from the NOx sensor 1 and NOx sensor 2 to the EMS.
The message content depends on sensor operation mode. It exists following sensor operation modes:

- Mode 1 - Wait on dew point
- Mode 2 - Measuring
- Mode 3 - Sensor identification data, part 1

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- Mode 4 - Sensor identification data, part 2
- Mode 5 - Sensor self diagnosis

The sensor indicates its operation mode by the signal "Sensor status" which is included within each transmitted message.

Formula section:

CAN Frame and Signal Definitions:

Mode 1 - Wait on dew point: Sensor status: 0 1 0 x x x x x (b)

ID = 130H, base time = 10ms - NOx sensor 1 data ID = 135H, base time = 10ms - NOx sensor 2 data								
Bit:	7 MSB	6	5	4	3	2	1	0 LSB
Byte: 0	Resistance ratio signal, High byte							
1	Resistance ratio signal, Low byte							
2	Lambda signal, High byte							
3	Lambda signal, Low byte							
4	Binary O2 signal voltage, High byte							
5	Binary O2 signal voltage, Low byte							
6	Sensor status							
7	Error status							

ID	Signal	Hex Range	Phys. Range	Resolution	Unit	Init Value	Default Value
130H, 135H	Resistance ratio	8000H... 7FFFH	-32768... 32767	1	[-]	00H	
130H, 135H	Lambda signal	8000H... 7FFFH	-32768... 32767	1	[-]	00H	
130H, 135H	Binary O2 signal	8000H... 7FFFH	-32968... 32567	1	[mV]	00H	
130H, 135H	Sensor status[1)]	0...FFH	0...255	1	[-]	01H	01H
130H, 135H	Error status[2)]	0...FFH	0...255	1	[-]	0	0

NOx Sensor 1 - NC_NOX_SENS_CONF >= 1

ID	Signal	ECU signal variable name
130H	Resistance ratio	CAN_TMP_WORD_1[1]
130H	Lambda signal	CAN_LAMB_NOX_SENS[1]
130H	Binary O2 signal	CAN_VLS_NOX_SENS[1]
130H	Sensor status[1)]	CAN_STATE_NOX_SENS[1]
130H	Error status[2)]	CAN_TMP_BYTE_8[1]

NOx Sensor 2 - NC_NOX_SENS_CONF = 2

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ID	Signal	ECU signal variable name
135H	Resistance ratio	CAN_TMP_WORD_1[2]
135H	Lambda signal	CAN_LAMB_NOX_SENS[2]
135H	Binary O2 signal	CAN_VLS_NOX_SENS[2]
135H	Sensor status1)	CAN_STATE_NOX_SENS[2]
135H	Error status2)	CAN_TMP_BYTE_8[2]

Mode 2 - Measuring: Sensor status: 0 0 0 x x x x x (b)

ID = 130H, base time = 10ms - NOx sensor 1 data
ID = 135H, base time = 10ms - NOx sensor 2 data

Bit:	7 MSB	6	5	4	3	2	1	0 LSB
Byte: 0	NOx signal, High byte							
1	NOx signal, Low byte							
2	Lambda signal, High byte							
3	Lambda signal, Low byte							
4	Binary O2 signal voltage, High byte							
5	Binary O2 signal voltage, Low byte							
6	Sensor status							
7	Error status							

ID	Signal	Hex Range	Phys. Range	Resolution	Unit	Init Value	Default Value
130H, 135H	NOx signal	8000H... 7FFFH	-32768... 32767	1	[ppm]	00H	
130H, 135H	Lambda signal	8000H... 7FFFH	-32768... 32767	1	[-]	00H	
130H, 135H	Binary O2 signal	8000H... 7FFFH	-32968... 32567	1	[mV]	00H	
130H, 135H	Sensor status1)	0...FFH	0...255	1	[-]	01H	01H
130H, 135H	Error status2)	0...FFH	0...255	1	[-]	0	0

NOx Sensor 1 - NC_NOX_SENS_CONF >= 1

ID	Signal	ECU signal variable name
130H	NOx signal	CAN_TMP_WORD_1[1]
130H	Lambda signal	CAN_LAMB_NOX_SENS[1]
130H	Binary O2 signal	CAN_VLS_NOX_SENS[1]
130H	Sensor status1)	CAN_STATE_NOX_SENS[1]
130H	Error status2)	CAN_TMP_BYTE_8[1]

NOx Sensor 2 - NC_NOX_SENS_CONF = 2

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ID	Signal	ECU signal variable name
135H	NOx signal	CAN_TMP_WORD_1[2]
135H	Lambda signal	CAN_LAMB_NOX_SENS[2]
135H	Binary O2 signal	CAN_VLS_NOX_SENS[2]
135H	Sensor status[1)]	CAN_STATE_NOX_SENS[2]
135H	Error status[2)]	CAN_TMP_BYTE_8[2]

Mode 3 - Sensor identification data, part 1: **Sen-sor status: 1 x 0 x x x x x (b)**

ID = 130H, base time = 10ms - NOx sensor 1 data ID = 135H, base time = 10ms - NOx sensor 2 data								
Bit:	7 MSB	6	5	4	3	2	1	0 LSB
Byte: 0	Part number, byte 1 (MSB), (BCD coded)							
1	Part number, byte 2, (BCD coded)							
2	Part number, byte 3, (BCD coded)							
3	Part number, byte 4, (BCD coded)							
4	Part number, byte 5, (BCD coded)							
5	Part number, byte 6 (LSB), (BCD coded)							
6	Sensor status							
7	Software version							

ID	Signal	Hex Range	Phys. Range	Resolution	Unit	Init Value	Default Value
130H, 135H	Part number, byte 1 (MSB)	0... FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Part number, byte 2	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Part number, byte 3	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Part number, byte 4	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Part number, byte 5	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Part number, byte 6 (LSB)	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Sensor status[1)]	0...FFH	0...255	1	[-]	01H	01H
130H, 135H	Software version	0...FFH	0...255	1	[-]	0	0

NOx Sensor 1 - NC_NOX_SENS_CONF >= 1

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ID	Signal	ECU signal variable name
130H	Part number, byte 1 (MSB)	CAN_TMP_BYTE_1[1]
130H	Part number, byte 2	CAN_TMP_BYTE_2[1]
130H	Part number, byte 3	CAN_TMP_BYTE_3[1]
130H	Part number, byte 4	CAN_TMP_BYTE_4[1]
130H	Part number, byte 5	CAN_TMP_BYTE_5[1]
130H	Part number, byte 6 (LSB)	CAN_TMP_BYTE_6[1]
130H	Sensor status[1)]	CAN_STATE_NOX_SENS[1]
130H	Software version	CAN_TMP_BYTE_8[1]

NOx Sensor 2 - NC_NOX_SENS_CONF = 2

ID	Signal	ECU signal variable name
135H	Part number, byte 1 (MSB)	CAN_TMP_BYTE_1[2]
135H	Part number, byte 2	CAN_TMP_BYTE_2[2]
135H	Part number, byte 3	CAN_TMP_BYTE_3[2]
135H	Part number, byte 4	CAN_TMP_BYTE_4[2]
135H	Part number, byte 5	CAN_TMP_BYTE_5[2]
135H	Part number, byte 6 (LSB)	CAN_TMP_BYTE_6[2]
135H	Sensor status[1)]	CAN_STATE_NOX_SENS[2]
135H	Software version	CAN_TMP_BYTE_8[2]

Mode 4 - Sensor identification data, part 2: Sen-
sor status: 1 x 1 x x x x x (b)

ID = 130H, base time = 10ms - NOx sensor 1 data
ID = 135H, base time = 10ms - NOx sensor 2 data

Bit:	7 MSB	6	5	4	3	2	1	0 LSB
Byte: 0	Parameter list (BCD coded)							
1	Individual part number, byte 1 - year (BCD coded)							
2	Individual part number, byte 2 - month (BCD coded)							
3	Individual part number, byte 3 - day (BCD coded)							
4	Individual part number, byte 4 - number 1 (MSB), (BCD coded)							
5	Individual part number, byte 5 - number 2 (LSB), (BCD coded)							
6	Sensor status							
7	Quality status, (BCD coded)							

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ID	Signal	Hex Range	Phys. Range	Resolution	Unit	Init Value	Default Value
130H, 135H	Parameter list	0... FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Individual part number, byte 1 - year	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Individual part number, byte 2 - month	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Individual part number, byte 3 - day	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Individual part number, byte 4 - number 1 (MSB)	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Individual part number, byte 5 - number 2 (LSB)	0...FFH	0...99 (BCD coded)	1	[-]	00H	00H
130H, 135H	Sensor status[1)]	0...FFH	0...255	1	[-]	01H	01H
130H, 135H	Quality status	0...FFH	0...99 (BCD coded)	1	[-]	0	0

NOx Sensor 1 - NC_NOX_SENS_CONF >= 1

ID	Signal	ECU signal variable name
130H	Parameter list	CAN_TMP_BYTE_1[1]
130H	Individual part number, byte 1 - year	CAN_TMP_BYTE_2[1]
130H	Individual part number, byte 2 - month	CAN_TMP_BYTE_3[1]
130H	Individual part number, byte 3 - day	CAN_TMP_BYTE_4[1]
130H	Individual part number, byte 4 - number 1 (MSB)	CAN_TMP_BYTE_5[1]
130H	Individual part number, byte 5 - number 2 (LSB)	CAN_TMP_BYTE_6[1]
130H	Sensor status[1)]	CAN_STATE_NOX_SENS[1]
130H	Quality status	CAN_TMP_BYTE_8[1]

NOx Sensor 2 - NC_NOX_SENS_CONF = 2

ID	Signal	ECU signal variable name
135H	Parameter list	CAN_TMP_BYTE_1[2]
135H	Individual part number, byte 1 - year	CAN_TMP_BYTE_2[2]
135H	Individual part number, byte 2 - month	CAN_TMP_BYTE_3[2]
135H	Individual part number, byte 3 - day	CAN_TMP_BYTE_4[2]
135H	Individual part number, byte 4 - number 1 (MSB)	CAN_TMP_BYTE_5[2]
135H	Individual part number, byte 5 - number 2 (LSB)	CAN_TMP_BYTE_6[2]
135H	Sensor status[1)]	CAN_STATE_NOX_SENS[2]
135H	Quality status	CAN_TMP_BYTE_8[2]

Mode 5 - Sensor self diagnosis: Sensor status: 0 0 1 x x x x x (b)

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ID = 130H, base time = 10ms - NOx sensor 1 data ID = 135H, base time = 10ms - NOx sensor 2 data								
Bit:	7 MSB	6	5	4	3	2	1	0 LSB
Byte: 0	Diagnosis signal, High byte							
1	Diagnosis signal, Low byte							
2	Lambda signal, High byte							
3	Lambda signal, Low byte							
4	Binary O2 signal voltage, High byte							
5	Binary O2 signal voltage, Low byte							
6	Sensor status							
7	Diagnosis status							

ID	Signal	Hex Range	Phys. Range	Resolution	Unit	Init Value	Default Value
130H, 135H	Diagnosis signal[4)] - Diagnosis reference value - Diagnosis value	8000H... 7FFFH	-32768... 32767	1	[-]	00H	
130H, 135H	Lambda signal	8000H... 7FFFH	-32768... 32767	1	[-]	00H	
130H, 135H	Binary O2 signal	8000H... 7FFFH	-32968... 32567	1	[mV]	00H	
130H, 135H	Sensor status[1)]	0...FFH	0...255	1	[-]	01H	01H
130H, 135H	Diagnosis status[3)]	0...FFH	0...255	1	[-]	0	0

NOx Sensor 1 - NC_NOX_SENS_CONF >= 1

ID	Signal	ECU signal variable name
130H	Diagnosis signal[4)]	CAN_TMP_WORD_1[1]
130H	Lambda signal	CAN_LAMB_NOX_SENS[1]
130H	Binary O2 signal	CAN_VLS_NOX_SENS[1]
130H	Sensor status[1)]	CAN_STATE_NOX_SENS[1]
130H	Diagnosis status[3)]	CAN_TMP_BYTE_8[1]

NOx Sensor 2 - NC_NOX_SENS_CONF = 2

ID	Signal	ECU signal variable name
135H	Diagnosis signal[4)]	CAN_TMP_WORD_1[2]
135H	Lambda signal	CAN_LAMB_NOX_SENS[2]
135H	Binary O2 signal	CAN_VLS_NOX_SENS[2]
135H	Sensor status[1)]	CAN_STATE_NOX_SENS[2]
135H	Diagnosis status[3)]	CAN_TMP_BYTE_8[2]

1) The following table describes the meaning of byte "Sensor status":

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Byte: "Sensor status"								
B7	B6	B5	B4	B3	B2	B1	B0	Function
							X	Power supply bit. 0 ... 11.5V <= VB <= 15.5V 1 ... VB < 11.5V or VB > 15.5V) VB...battery voltage measured by NOx sensor ECU inside of NOx sensor ECU
						X		Sensor temperature indication bit. 0 ... Sensor temperature is not ok (out of operating range) 1 ... Sensor temperature is ok (within operating range)
					X			Ip1 ready indication bit. 0 ... not ok (out of operating range) 1 ... ok (within operating range)
				X				Ip0 ready indication bit. 0 ... not ok (out of operating range) 1 ... ok (within operating range)
			X					Ip2 ready indication bit. 0 ... not ok (out of operating range) 1 ... ok (within operating range)
		X						Mode switch for read out of sensor identification data and sensor self diagnosis mode For details see NOx sensor specification. Bit B7 = 0: 0 ... Normal sensor operation mode 1 ... Sensor self diagnosis mode Bit B7 = 1 (sensor identification data read out mode): 0 ... Sensor transmits sensor identification data part 1 1 ... Sensor transmits sensor identification data part 2
	X							Dew point bit. 0 ... Sensor has received dew point Byte 1 and 2 contains NOx signal. 1 ... Sensor is waiting for dew point Byte 1 and 2 contains resistance ratio.
X								Mode switch for read out of sensor identification data. For details see NOx sensor specification. 0 = normal sensor operation or sensor self diagnosis mode 1 = sensor identification data read out mode
								Important combinations:
0	0	0	0	0	0	0	0	0 (00H): NOx sensor is not yet active.
0	1	0	0	0	0	0	0	64 (40H): NOx sensor is waiting for dew point.
0	0	0	0	0	0	0	1	1 (01H): NOx sensor can not reach any readiness level because of power supply problem
0	0	0	0	0	0	1	0	2 (02H): NOx sensor readiness is level 1. Temperature is ok.
0	0	0	0	1	1	1	0	14 (0EH): NOx sensor readiness is level 2. Lambda and binary O2 signal are valid.
0	0	0	1	1	1	1	0	30 (1EH): NOx sensor has full readiness. NOx, Lambda and binary O2 signals are valid.
0	0	0	1	1	1	1	1	31 (1FH): NOx sensor has full readiness. All signals are valid. But a power supply problem is present.

2) The following table describes the meaning of byte "Error status":

Byte: "Error status"								
B7	B6	B5	B4	B3	B2	B1	B0	Function
0	0	0	0	0	0	0	0	NOx sensor no failure
							X	NOx sensor error 1, Open wire at heater
						X		NOx sensor error 2, Open wire at NOx function
					X			NOx sensor error 3, Open wire at Lambda function
				X				NOx sensor error 4, Open wire at binary O2 function
			X					NOx sensor error 5, Short circuit at heater
		X						NOx sensor error 6, Short circuit at NOx function
	X							NOx sensor error 7, Short circuit at Lambda function
X								NOx sensor error 8, Short circuit at binary O2 function

3) The following table describes the meaning of byte "Diagnosis status":

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Byte: "Diagnosis status"	
Value	Function
0 (00H)	Sensor self diagnosis is running
1 (01H)	Sensor self diagnosis was aborted. Sensor is returning to normal operation mode.
2 (02H)	Sensor self diagnosis was completed. Result: "Sensor is ok". Sensor is returning to normal operation mode.
3 (03H)	Sensor self diagnosis was completed. Result: "Sensor is faulty". Sensor is returning to normal operation mode.
other values	Other values are not defined yet.

4) The following table describes the meaning of byte "Diagnosis signal":

Byte: "Diagnosis status"		Byte: "Diagnosis signal"	
Value	Function	Signal	ECU signal variable name
0 (00H)	Diagnosis runs	Diagnosis reference value	CAN_NOX_REF_NS[i]
1 (01H)	Diagnosis aborted	Diagnosis reference value	CAN_NOX_REF_NS[i]
2 (02H)	Diagnosis completed	Diagnosis value	CAN_NOX_DIAG_NS[i]
3 (03H)	Diagnosis completed	Diagnosis value	CAN_NOX_DIAG_NS[i]
other values	not defined	not defined	not defined

4.43.2.3.1 Selection of NOx sensor configuration

General information:

The EMS system MSD80 is designed for various exhaust gas system configurations (e.g. N43UL - 1 branch system, N43OL - Y system with 1 NOx catalyst, N53 - Y system with 2 NOx catalysts, N53 development samples - full 2 branch system). Hence the adjusted value of NC_NOX_SENS_CONF (number of NOx sensors within the system) does not correspond always correctly with the number of really necessary or really used NOx sensors. Therefore NC_NOX_SENS_CONF is adjusted mostly on 2 NOx sensors even if only 1 NOx sensor is really necessary or really used.
example: MSD80 - N53

1. full 2 branch system with 2 NOx sensors:
   NC_NOX_SENS_CONF has to be adjusted to 2.
2. Y system with 2 NOx catalysts and 1 NOx sensor:
   NC_NOX_SENS_CONF should be adjusted to 1 but is adjusted to 2 because it is the same software like as for full 2 branch system.

So that these different exhaust system configurations can be handled with 1 ECU software it was implemented a functionality for copying of NOx sensor signals from line i = 1 to line i = 2.

Application conditions

Initialisation: –
Recurrence: *10ms*
Activation: *after reset*
Deactivation: –

Formula section:

if NC_NOX_SENS_CONF = 2
then

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```
    if        LC_NOX_SENS_2 = 0
    then
              CAN_NOX_NOX_SENS_2 = CAN_NOX_NOX_SENS_1
              CAN_LAMB_NOX_SENS_2 = CAN_LAMB_NOX_SENS_1
              CAN_VLS_NOX_SENS_2 = CAN_VLS_NOX_SENS_1
              CAN_STATE_NOX_SENS_2 = CAN_STATE_NOX_SENS_1
              CAN_ERR_NOX_SENS_2 = CAN_ERR_NOX_SENS_1
    else
              CAN_NOX_NOX_SENS_2 = CAN message data from ID=135H
              CAN_LAMB_NOX_SENS_2 = CAN message data from ID=135H
              CAN_VLS_NOX_SENS_2 = CAN message data from ID=135H
              CAN_STATE_NOX_SENS_2 = CAN message data from ID=135H
              CAN_ERR_NOX_SENS_2 = CAN message data from ID=135H
    endif
endif
```

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4.44 Clutch switch

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CS_CUS	O/V	0... 1H	0 ...1	1	-
Boolean for clutch switch detection					

Input data:

LV_AT {p. 654}	LV_IM_CS_PN {p. 852}	LV_VAR_TCT {p. 656}	STATE_ETCU_CLU {p. 1573}

General information:

Clutch switch detection is required for function management at transient conditions. It´s only necessary for cars with manual transmission.
At determination of the ´real´ clutch-switch closing (LV_IM_CS_PN=1) LV_CS_CUS resets at change of LV_IM_CS_PN from 1 $\rightarrow$ 0 or STATE_ETCU_CLU 03H/4H/5H.

Application conditions

Activation: LV_AT = 0

Deactivation : LV_AT = 1

Initialisation:

```
if    LV_AT=0 and LV_VAR_TCT = 0
   then  LV_CS_CUS  =  LV_IM_CS_PN
time recurrency   :    10ms
```

Formula section:

```
if     LV_VAR_TCT = 0
  then         LV_CS_CUS  =  LV_IM_CS_PN
  elseif       STATE_ETCU_CLU = 3H or 4H or 5H
         then          LV_CS_CUS  =  0
         else                 LV_CS_CUS  =  1
       endif
endif
```

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4.45 Power steering acquisition

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ANG_PSTE_END_LE_AD	O/V/S	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW
relative steering wheel sensor left side adaptation					
ANG_PSTE_END_RI_AD	O/V/S	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW
relative steering wheel sensor angle right					
ANG_PSTE_STND	O/V	8000... 7FFFH	-100... 99.9969482422	3.05176e-3	%
Relative steering wheel sensor angle					
LV_STG_RI_ACT	V	0... 1H	0 ...1	1	-
LV indicating steering active (direction: 1 = right , 0 = left)					
LV_VEL_ANG_PSTE_MIN_DET	V	0... 1H	0 ...1	1	-
LV indicating "released" steering wheel					
T_VEL_ANG_PSTE	V	0... FFH	0... 2.55	0.01	s
Time for detecting "released" steering wheel					
VEL_ANG_PSTE_COR	O/V	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
Filtered steering-wheel-angle velocity					
VEL_ANG_PSTE_MMV	V	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
moving mean value of steering-wheel-angle velocity					

Input data:

ANG_PSTE {p. 1561}	LV_ERR_ANG_PSTE_CAN {p. 1565}	LV_IGK {p. 906}	VEL_ANG_PSTE {p. 1582}
VS {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ANG_PSTE_AD_LGRD	-	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW
ANG_PSTE_AD incrementation					
C_ANG_PSTE_END_DIF	-	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW
cal. difference between ANG_PSTE_END_LE/RI_AD out of NVMY and init-value (at reset)					
C_ANG_PSTE_END_LE_INI	-	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW
initialisation value left ANG_PSTE_STND (positiv)					
C_ANG_PSTE_END_RI_INI	-	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW
initialisation value right ANG_PSTE_STND (negativ)					
C_CRLC_VEL_ANG_PSTE	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for steering wheel angle velocity					
C_T_ANG_PSTE_AD	-	0... FFFFH	0... 655.35	0.01	s
Time during which adaptation of steering wheel angle is inhibited					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_VEL_ANG_PSTE	-	0... FFH	0... 2.55	0.01	s
Time for detecting "released" steering wheel					
C_VEL_ANG_PSTE_MAX_AD	-	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
VEL_ANG_PSTE-threshold for adaptation of steering wheel angle					
C_VEL_ANG_PSTE_MIN_1	-	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
Minimum threshold VEL_ANG_PSTE_MMV for detection of steering active					
C_VEL_ANG_PSTE_MIN_2	-	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
Minimum threshold VEL_ANG_PSTE_MMV for detection of "released" steering wheel					
C_VS_PSTE	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for power steering					
LC_VEL_ANG_PSTE_COR	-	0... 1H	0 ...1	1	-
Calculation of VEL_ANG_PSTE_COR depending on steering wheel state					

General Information

Application Conditions

Initialization: RST, NVMINI, NVMRES, NVMSTO
Recurrence: 10MS
Activation: LV_IGK==1
Deactivation: LV_IGK==0

Function description

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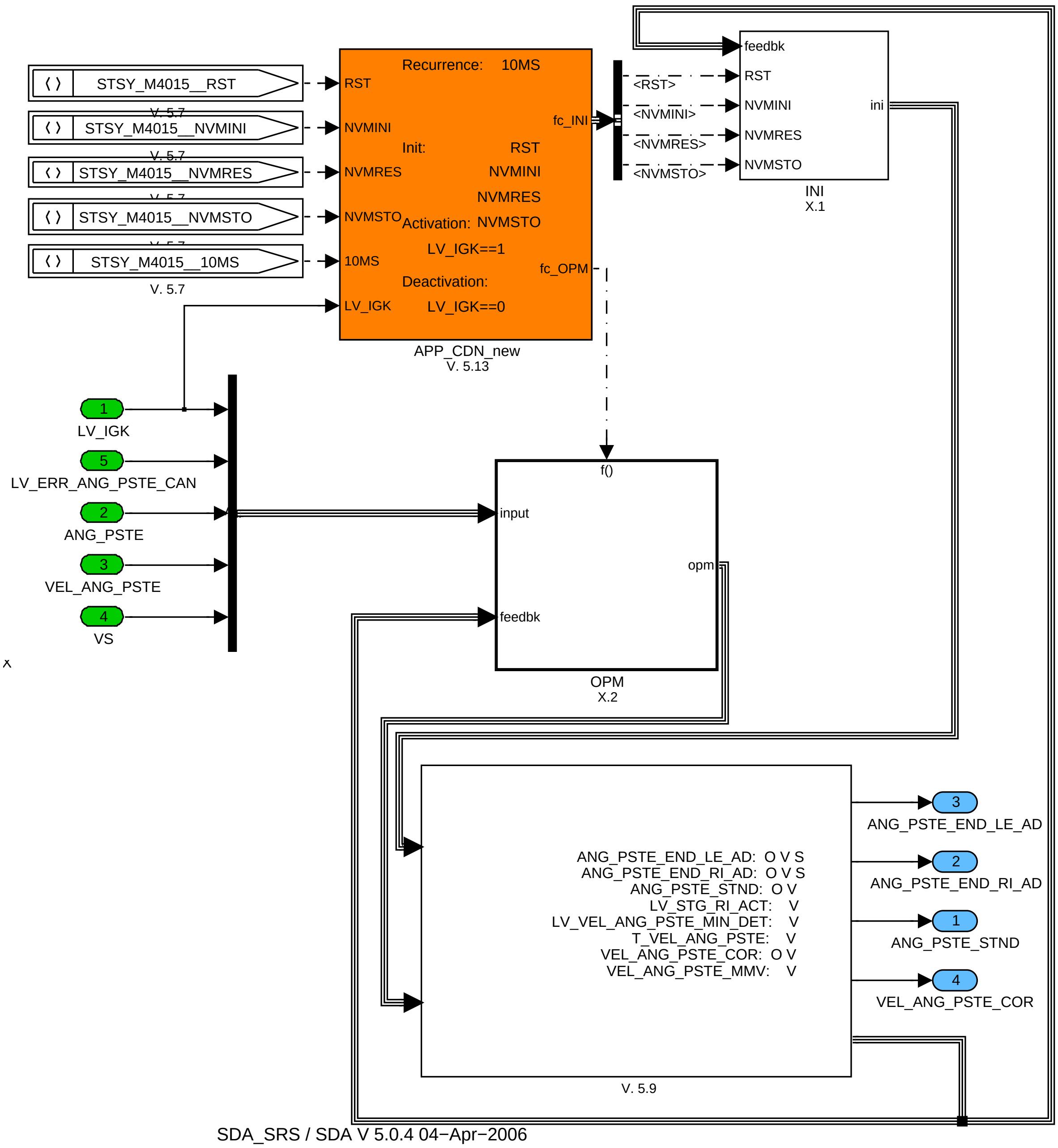

Figure 4.45.1: : Path: STSY_M4015

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4.45.1 Initialisation

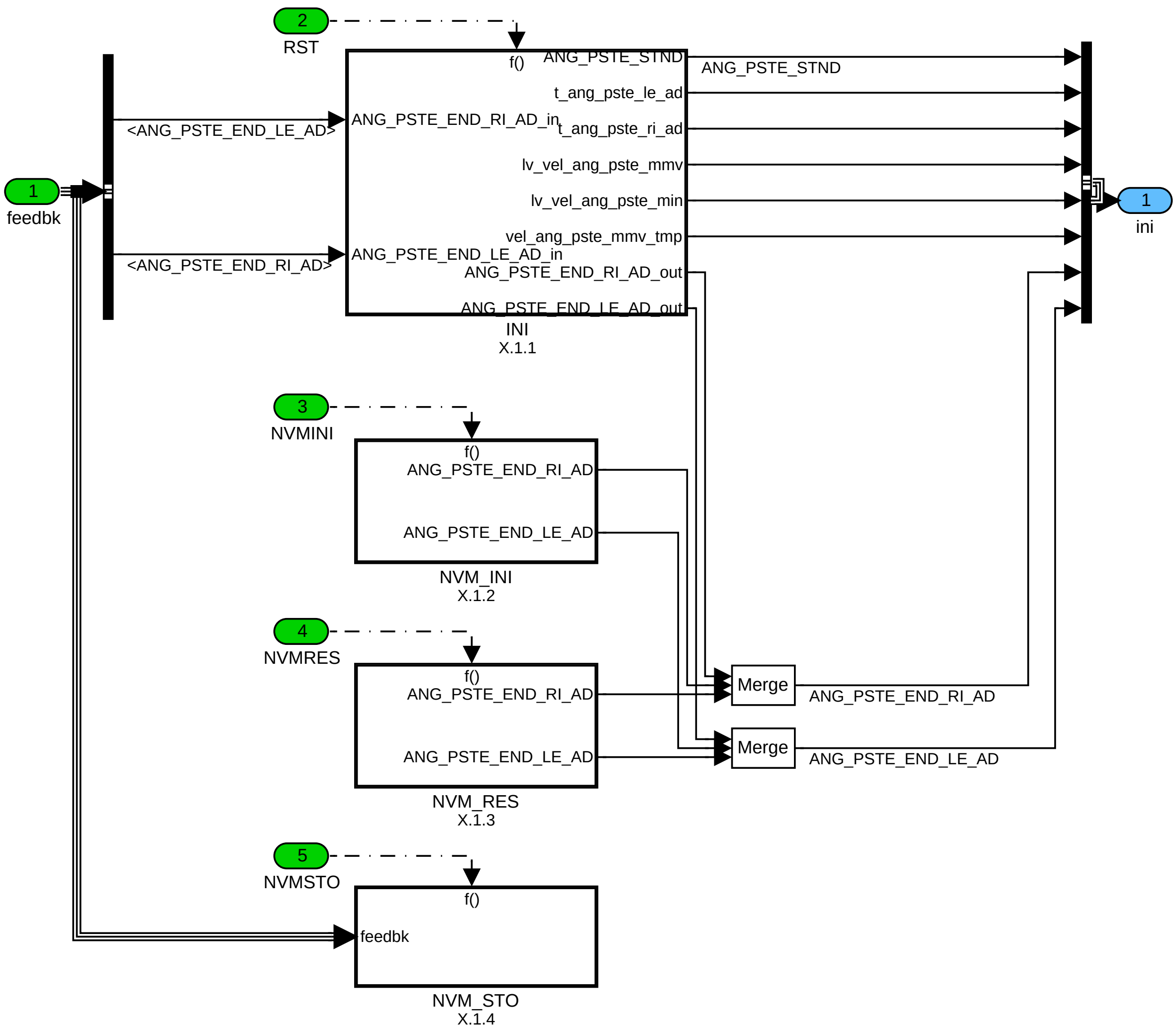

Figure 4.45.2: : Path: STSY_M4015/INI

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4.45.1.1 Initialisation at reset

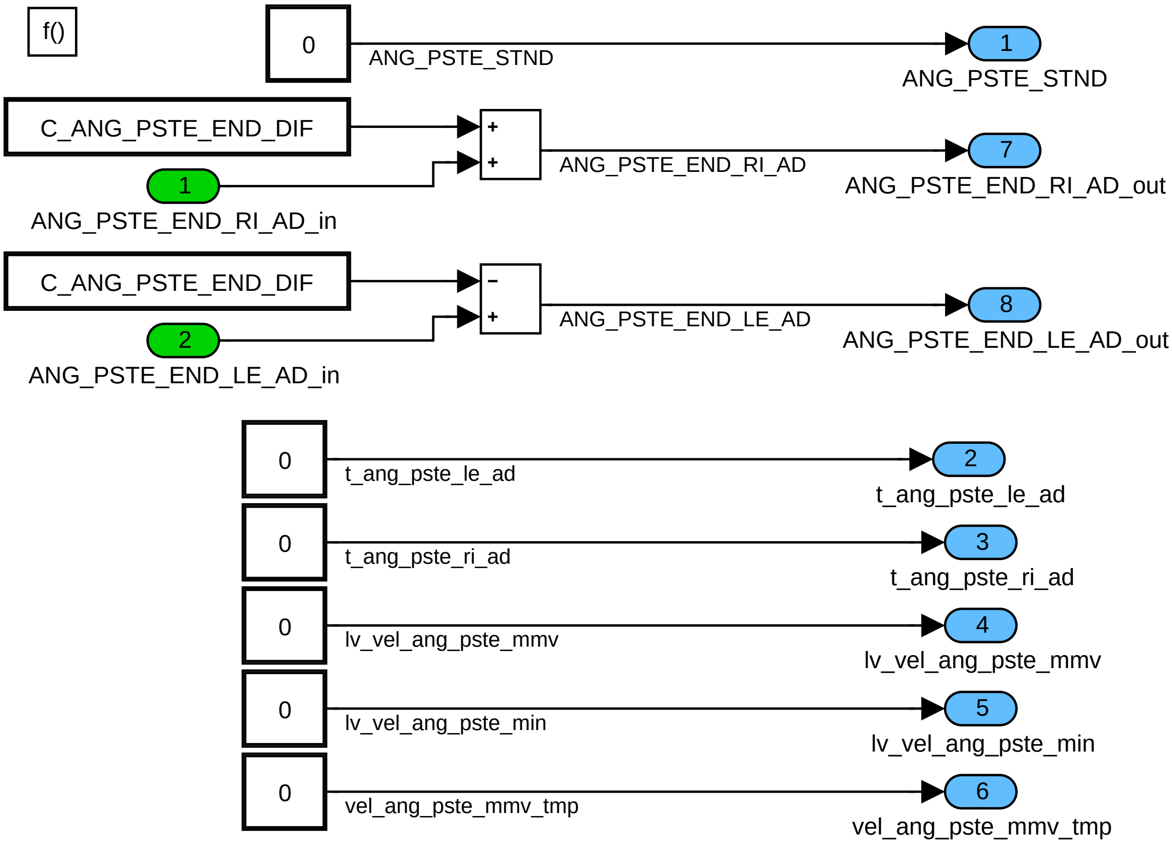

Figure 4.45.3: : Path: STSY_M4015/INI/INI

4.45.1.2 Initialisation at NVMY

In case of new ECU or if reading non-volatile memory not possible

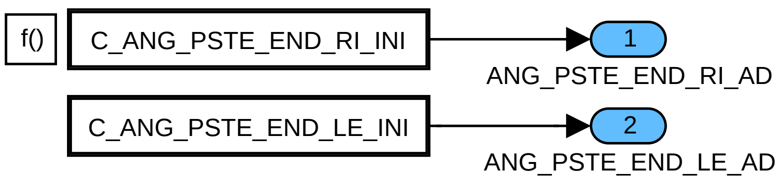

Figure 4.45.4: : Path: STSY_M4015/INI/NVM_INI

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4.45.1.3 Restore of NVMY variable

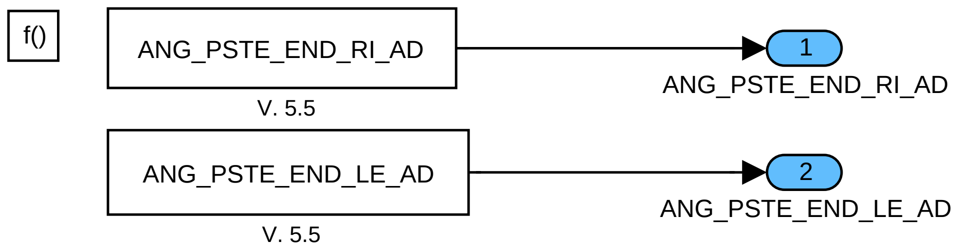

Figure 4.45.5: :   Path: STSY_M4015/INI/NVM_RES

4.45.1.4 Storing of NVMY variable

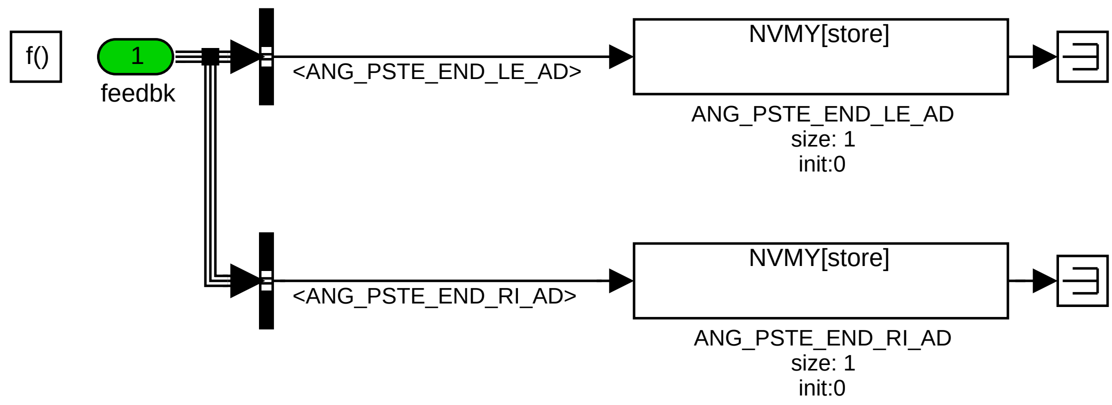

Figure 4.45.6: :   Path: STSY_M4015/INI/NVM_STO

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4.45.2 Function overview

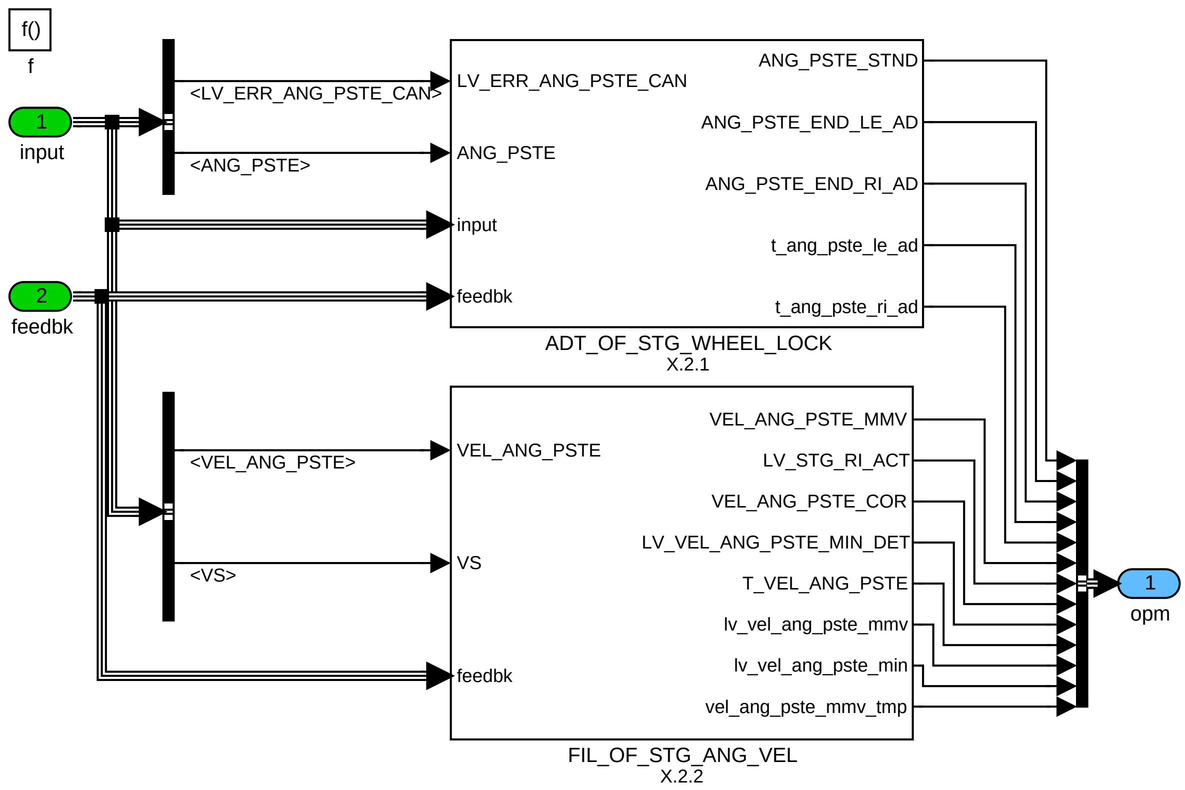

Figure 4.45.7: : Path: STSY_M4015/OPM

4.45.2.1 Adaptation of steering wheel lock

General information:
This module contains the calculation of the relative steering wheel sensor (ANG_PSTE_STND) and relating adaptations (ANG_PSTE_END_RI_AD, ANG_PSTE_END_LE_AD) depending on the steering wheel angle ANG_PSTE received via CAN.

To enable a new adaptation of the steering wheel angles after every reset, the values ANG_PSTE_ END_LE/_RI_AD should be initialised as follows:
the adaptation values restored out of the non-volatile memory minus a calibratable constant.
Signal flow diagram:

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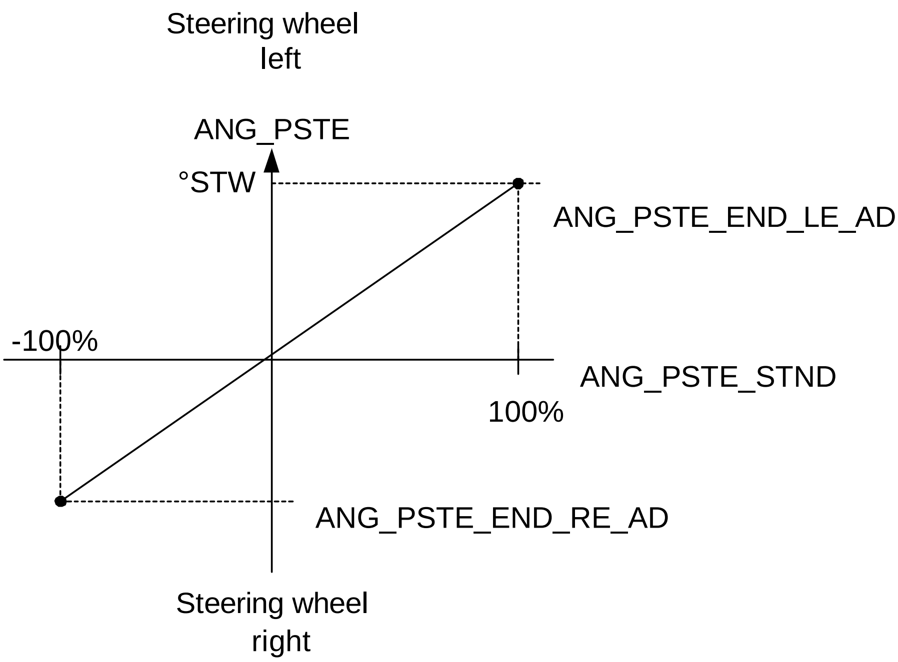

Application hint:

to ensure a proper adaptation of ANG_PSTE_END_LE/RI please note that the range of the adaptation incrementation should be calibrated within the following range
C_ANG_PSTE_AD_LGRD = 0.1 °STW ... 1.5 °STW

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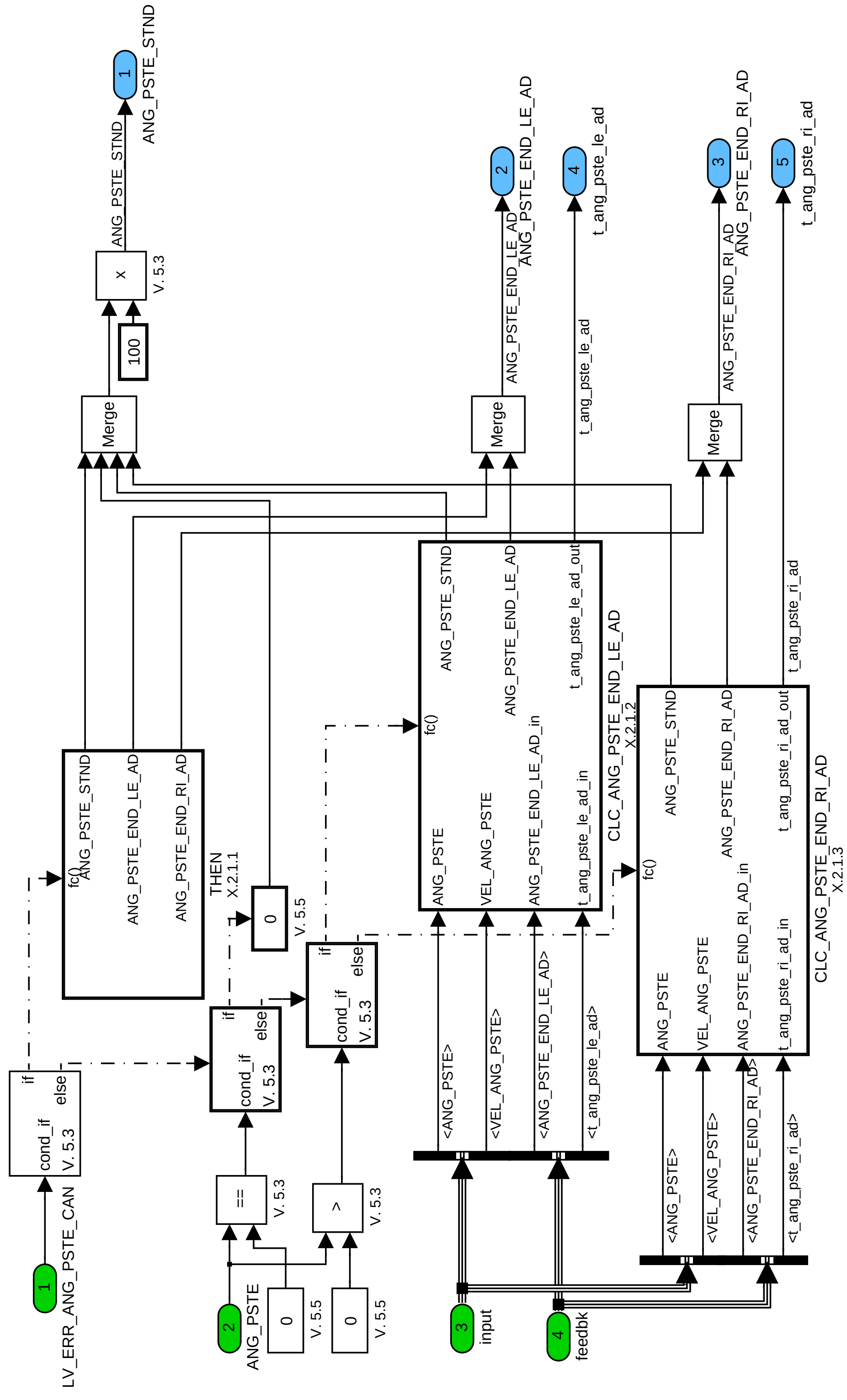

Figure 4.45.8: : Path: STSY_M4015/OPM/ADT_OF_STG_WHEEL_LOCK

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4.45.2.1.1 Initialisation for variables

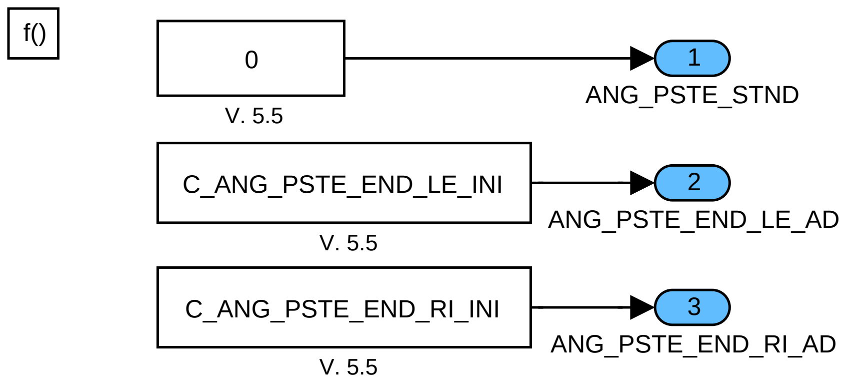

Figure 4.45.9: : Path: STSY_M4015/OPM/ADT_OF_STG_WHEEL_LOCK/THEN

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4.45.2.1.2 Condition for calcualtion for the ANG_PSTE_END_LE_AD

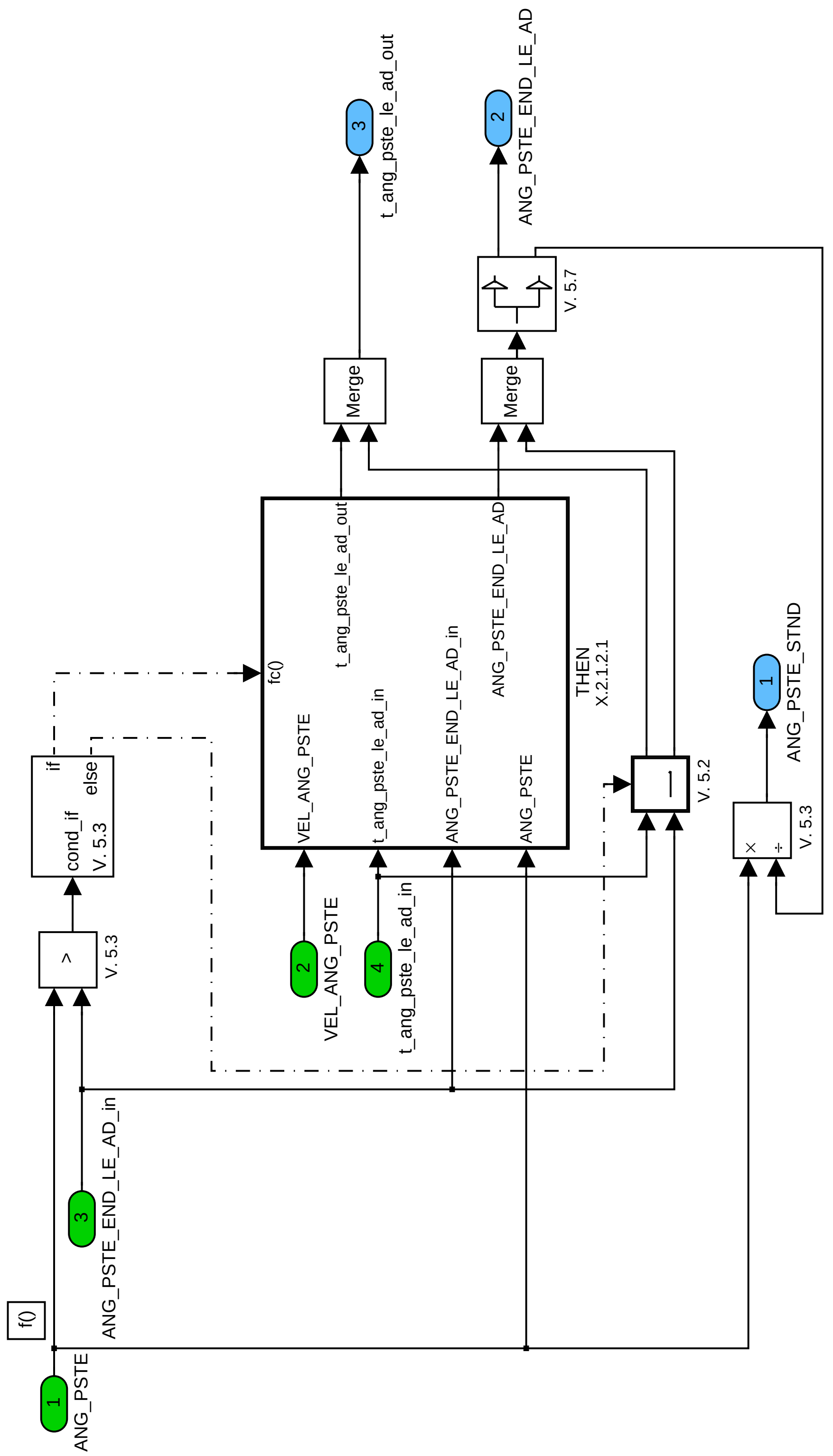

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Figure 4.45.10: : Path:
STSY_M4015/OPM/ADT_OF_STG_WHEEL_LOCK/CLC_ANG_PSTE_END_LE_AD

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4.45.2.1.2.1 Caluculation of ANG_PSTE_END_LE_AD

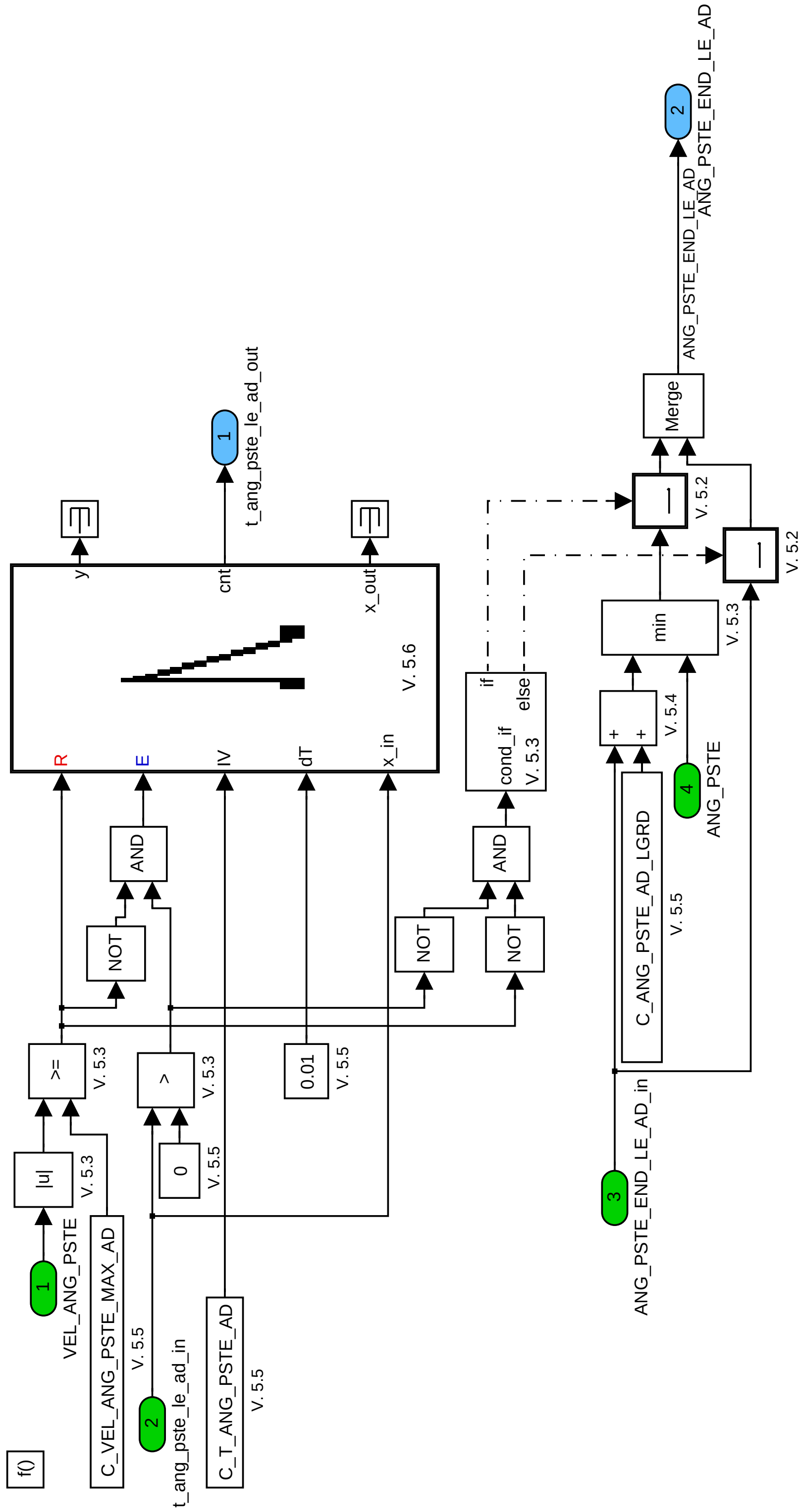

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Figure 4.45.11: : Path:
STSY_M4015/OPM/ADT_OF_STG_WHEEL_LOCK/CLC_ANG_PSTE_END_LE_AD/THEN

4.45.2.1.3 Condition for calcualtion for the ANG_PSTE_END_RI_AD

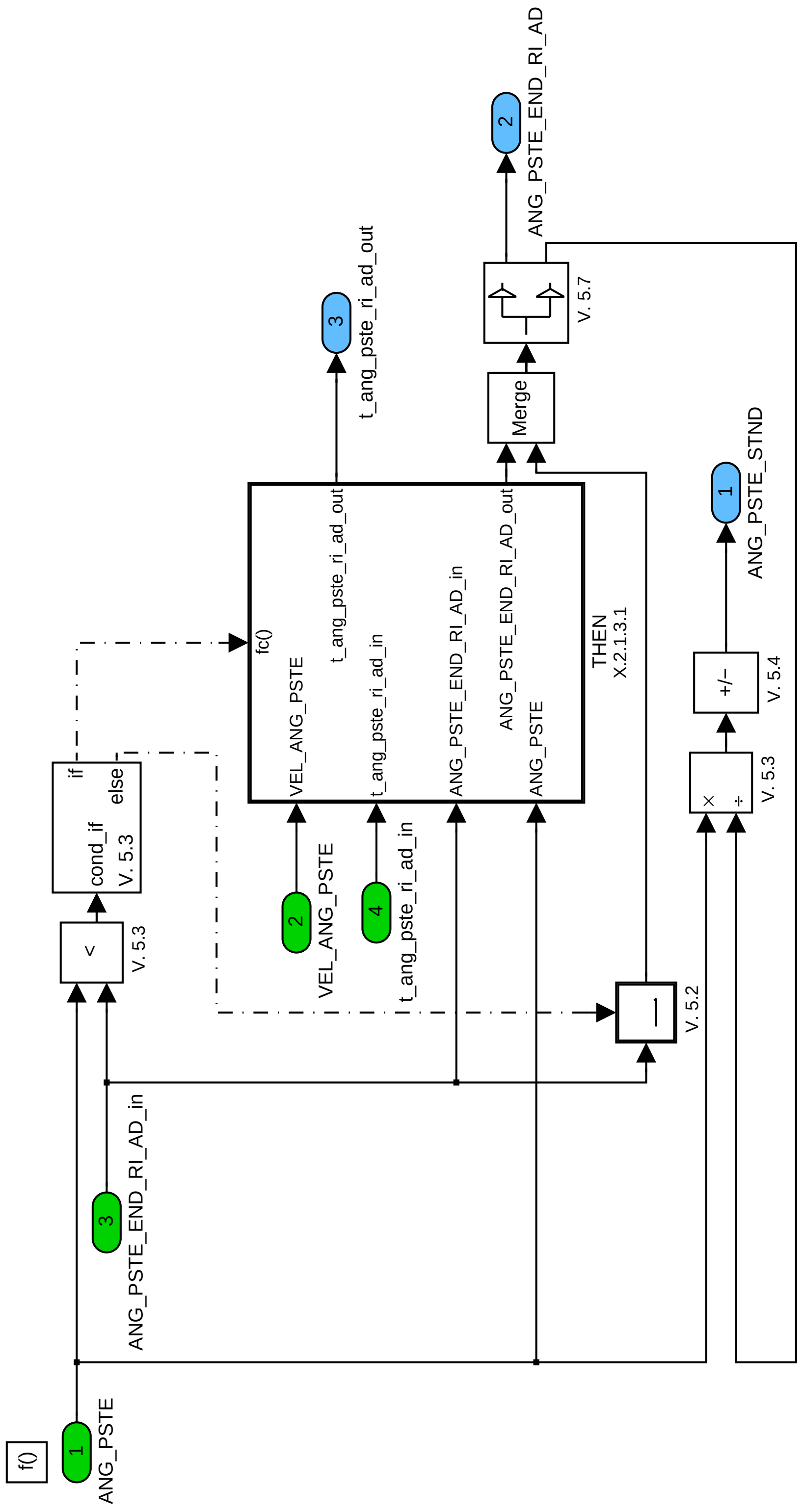

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Figure 4.45.12: : Path:
STSY_M4015/OPM/ADT_OF_STG_WHEEL_LOCK/CLC_ANG_PSTE_END_RI_AD

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4.45.2.1.3.1 Caluculation of ANG_PSTE_END_LE_AD

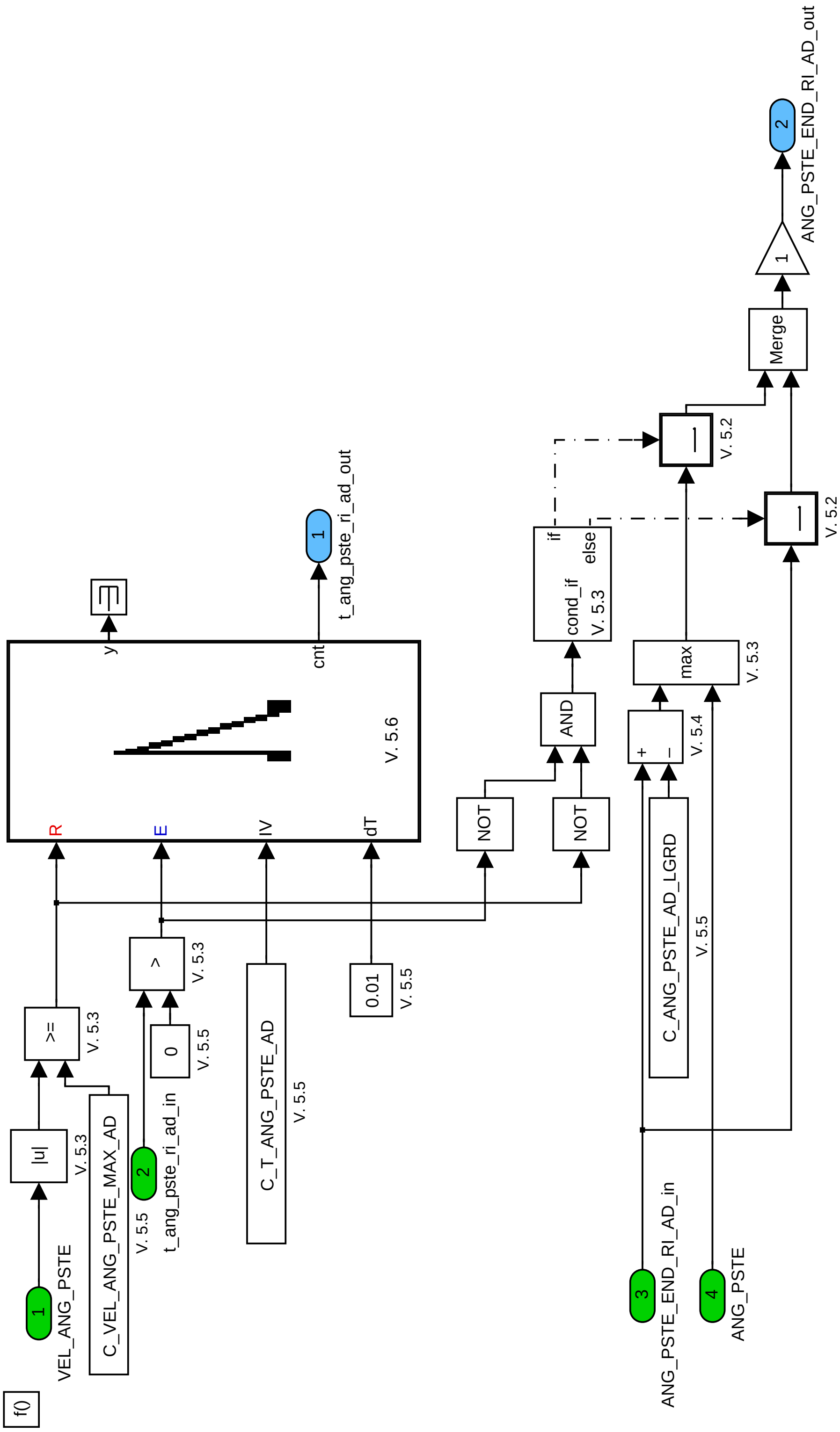

Figure 4.45.13: : Path:
STSY_M4015/OPM/ADT_OF_STG_WHEEL_LOCK/CLC_ANG_PSTE_END_RI_AD/THEN

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4.45.2.2 Filtering of steering wheel angle velocity

General information:
This module contains the filtering of the steering-wheel angle velocity as well as the detection of the steering direction change and the state of the steering wheel (steering wheel: released or held tight). It is used as an input for the torque loss for power-steering-calculation: if the steering-wheel is held tight the providing of a torque loss for power-steering is necessary; whereas if the steering-wheel is released only the torque (Schleppmoment) of the power-steering pump itself is sufficient.

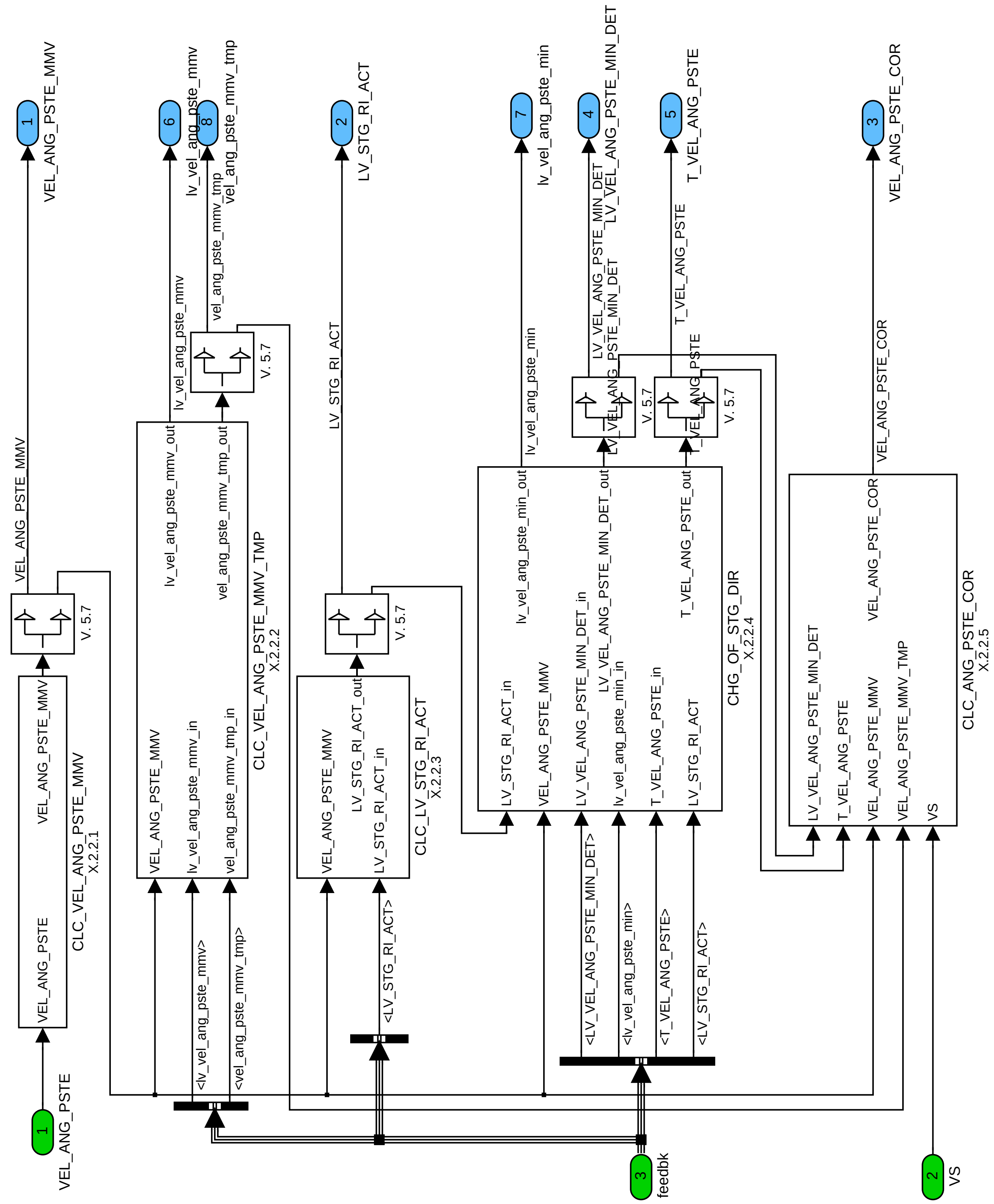

Figure 4.45.14: : Path: STSY_M4015/OPM/FIL_OF_STG_ANG_VEL

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4.45.2.2.1 Moving mean value VEL_ANG_PSTE_MMV:

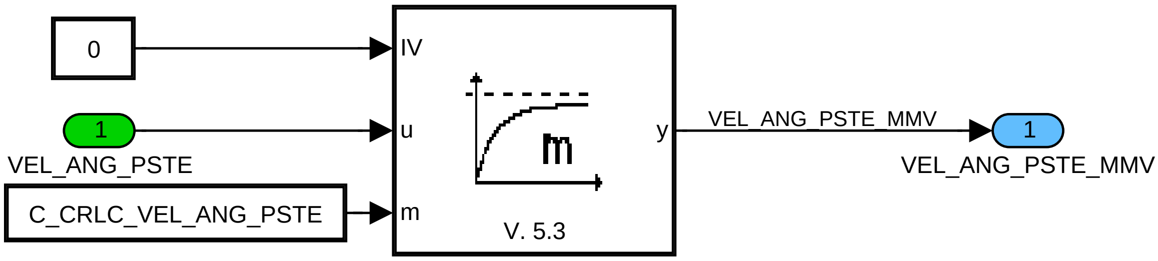

Figure 4.45.15: : Path: STSY_M4015/OPM/FIL_OF_STG_ANG_VEL/CLC_VEL_ANG_PSTE_MMV

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4.45.2.2.2 Temporary moving mean value VEL_ANG_PSTE_MMV_TMP:

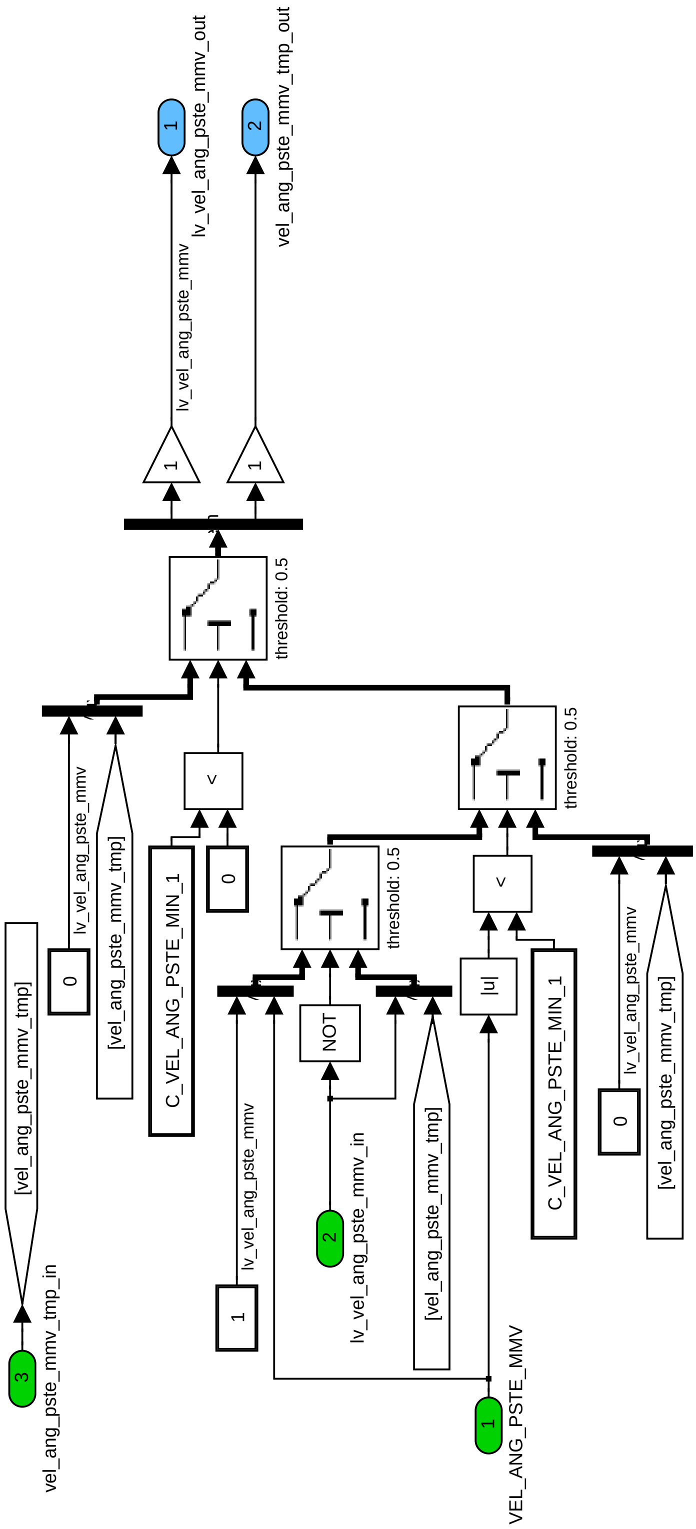

Figure 4.45.16: : Path: STSY_M4015/OPM/FIL_OF_STG_ANG_VEL/CLC_VEL_ANG_PSTE_MMV_TMP

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4.45.2.2.3 Recognition of steering-direction:

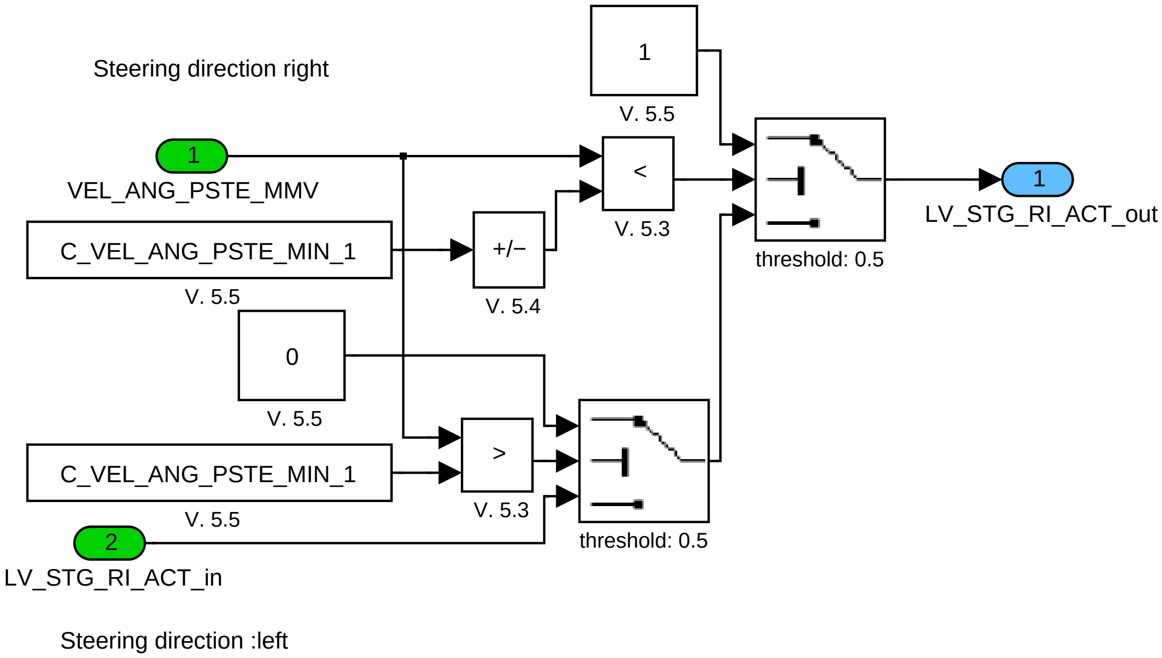

Figure 4.45.17: : Path: STSY_M4015/OPM/FIL_OF_STG_ANG_VEL/CLC_LV_STG_RI_ACT

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4.45.2.2.4 Change of steering direction:

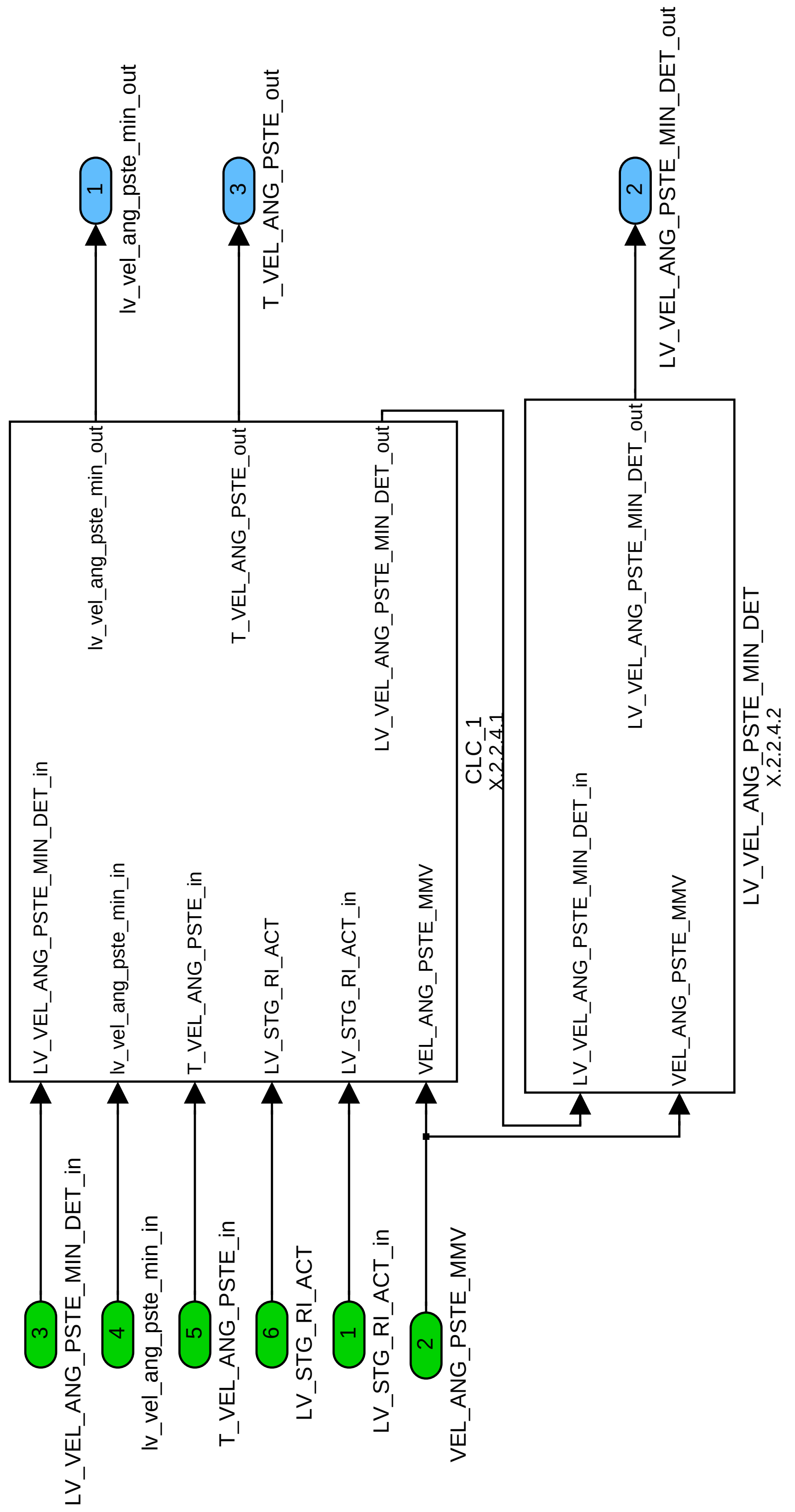

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Figure 4.45.18: : Path: STSY_M4015/OPM/FIL_OF_STG_ANG_VEL/CHG_OF_STG_DIR

4.45.2.2.4.1 Calculation of T_VEL_ANG_PSTE

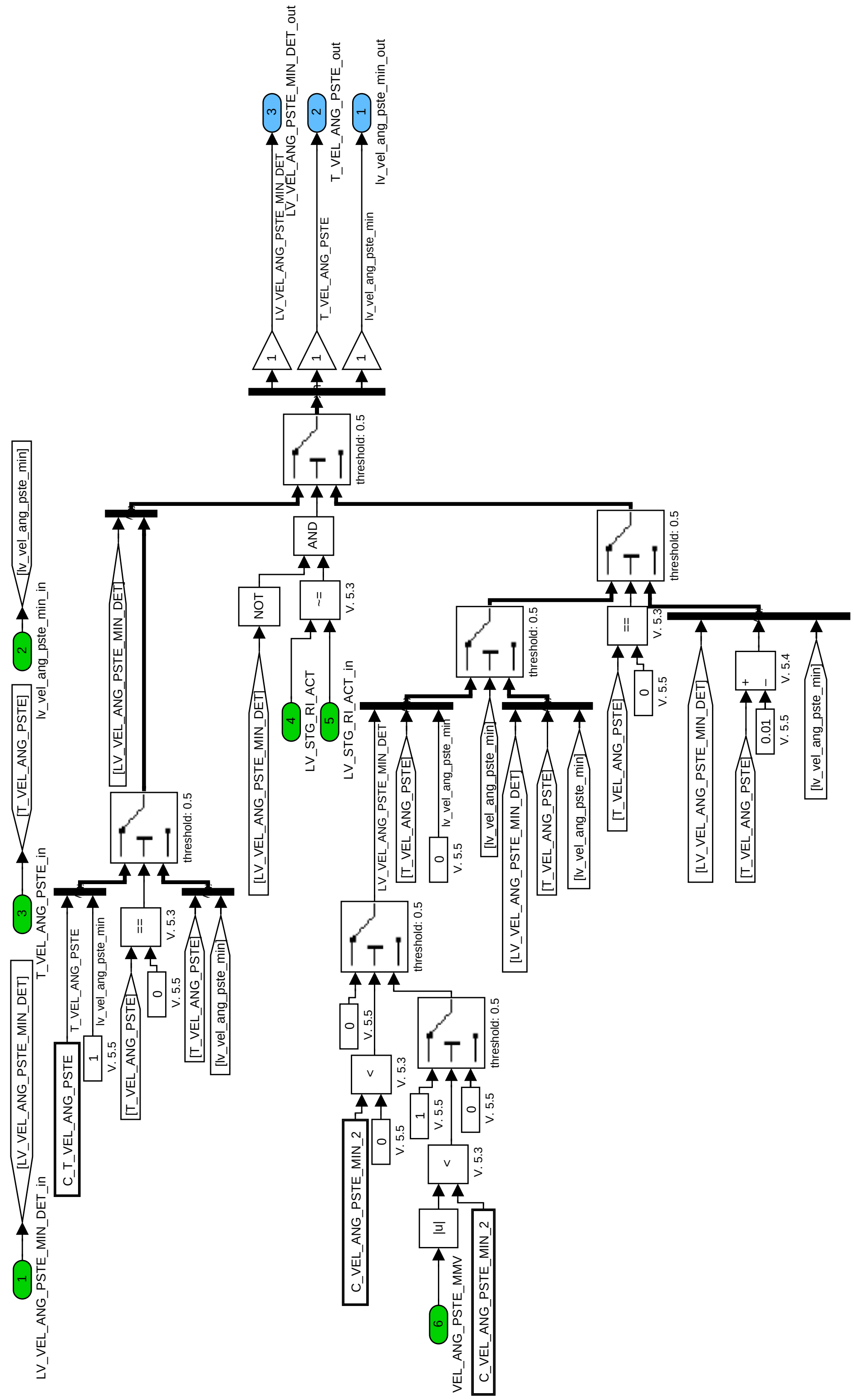

Figure 4.45.19: : Path: STSY_M4015/OPM/FIL_OF_STG_ANG_VEL/CHG_OF_STG_DIR/CLC_1

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4.45.2.2.4.2 Calculation of LV_VEL_ANG_PSTE_MIN_DET

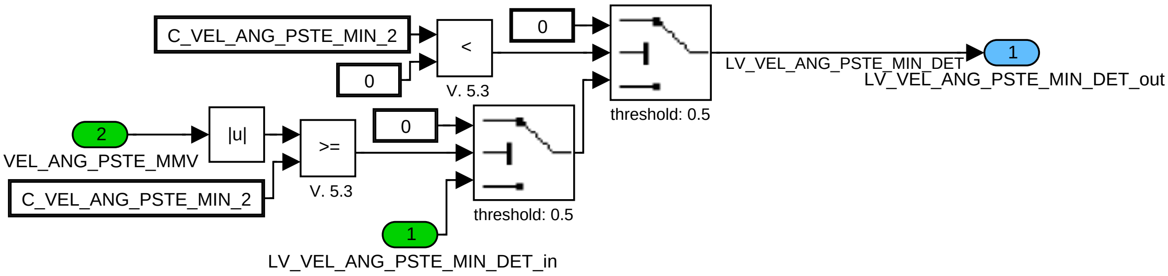

Figure 4.45.20: : Path:
STSY_M4015/OPM/FIL_OF_STG_ANG_VEL/CHG_OF_STG_DIR/LV_VEL_ANG_PSTE_MIN_DET

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4.45.2.2.5 Filtered steering wheel angle velocity VEL_ANG_PSTE_COR:

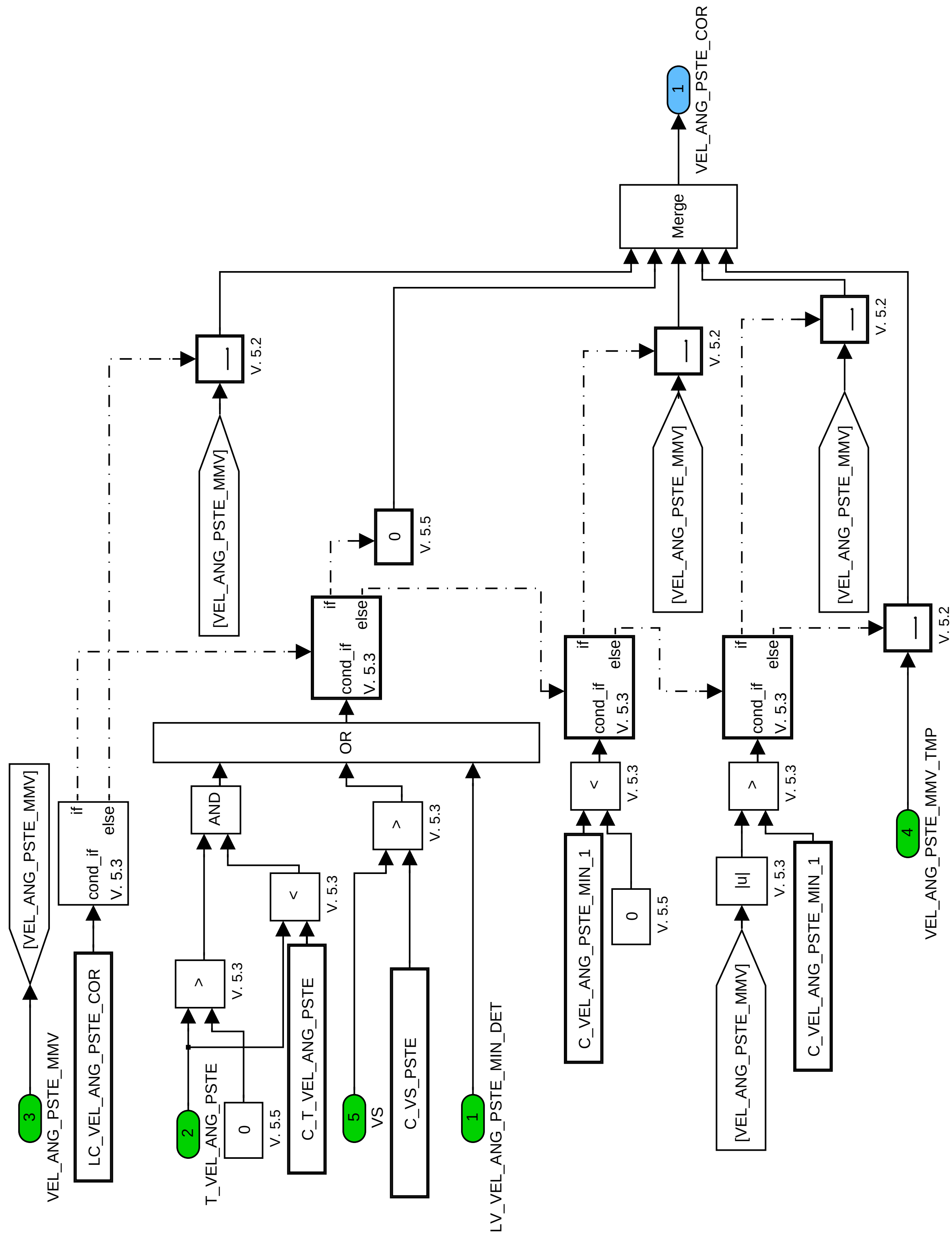

Figure 4.45.21: : Path: STSY_M4015/OPM/FIL_OF_STG_ANG_VEL/CLC_ANG_PSTE_COR

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4.46 Detection of driver request passive

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CT	O/V	0... 1H	0 ...1	1	-
Logical variable for detecting driver request passive					

Input data:

FAC_TQ_REQ_CLU_LDM {p. 6706}	LV_MTC_CUR_OFF {p. 6565}	N_32 {p. 1525}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_REQ_CLU_IS_HYS	-	0... FFFFH	0... 1.99996	30.5e-6	-
Hysteresis on threshold on FAC_TQ_REQ_CLU for IS detection					
IP_FAC_TQ_REQ_CLU_IS__N_32	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_N_32__FAC_TQ_REQ_CLU_IS	0	1... FFH	32... 8160	32	rpm
Threshold on FAC_TQ_REQ_CLU for IS detection					

General information:

The detection of LV_CT = 0 (no torque request from driver or cruise control or LDM) is done by evaluating the torque scaling factor FAC_TQ_REQ_CLU_LDM (driver /cruise /LDM).
In case of LV_MTC_CUR_OFF = 1 (no more throttle control), the throttle will remain in the fixed limp home position, which is around 8° (depending on the used throttle); this is a part load position (LV_CT=0). All torque requests can only be realized by spark advance interaction or single cylinder cut off coordination. For this purpose the driver passive detection is deactivated (LV_CT=0).

Formula section:

If LV_MTC_CUR_OFF = 1
Then LV_CT = 0
Else **if** LV_CT = 1
Then **if** FAC_TQ_REQ_CLU_LDM IP_FAC_TQ_REQ_CLU_IS__N_32
Then LV_CT = 0
Endif
Else **if** (FAC_TQ_REQ_CLU_LDM IP_FAC_TQ_REQ_CLU_IS__N_32 - C_FAC_TQ_REQ_CLU_IS_HYS)
Then LV_CT = 1
Endif
Endif
Endif

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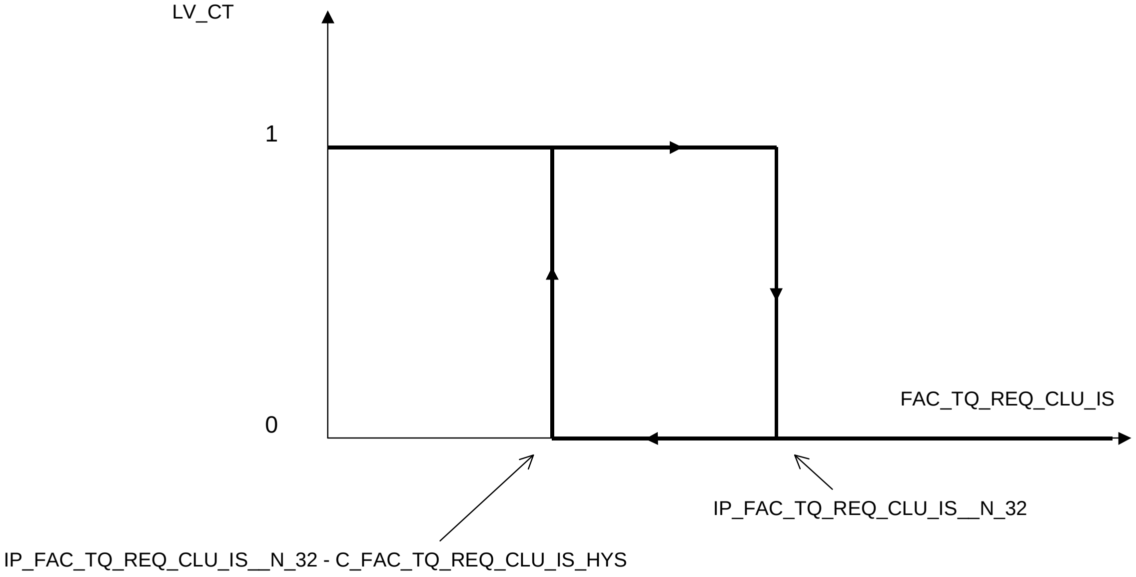

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4.47 Engine off duration

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ST_END_T_ES	V	0... 1H	0 ...1	1	-
Flag used to allow T_REL_CAN_ES setting when engine stops					
T_ES	O/V	0... FFFFH	0... 65535	1	min
Engine off duration time					
T_ES_2	O/V	0... FFFFH	0... 65535	1	s
Engine off duration time in second					
T_ES_CUS	O/V	0... FFFFH	0... 65535	1	min
Engine off duration time for customer - value holds while engine is running					
T_REL_CAN_ES	V/S	0... FFFFFFFFH	0... 4294967295	1	min
Time counter value at the start of engine off phase					
T_REL_CAN_ES_2	V/S	0... FFFFFFFFH	0... 4294967295	1	s
Time counter value at the end of start of engine off phase					
T_REL_CAN_ST	V	0... FFFFFFFFH	0... 4294967295	1	min
Time counter value at the end of engine off phase					
T_REL_CAN_ST_2	V	0... FFFFFFFFH	0... 4294967295	1	s
Time counter value at the end of engine off phase					

Input data:

LV_ERR_T_ES {p. 4466}	LV_ERR_T_ES_TCO_ FAST {p. 4466}	LV_ERR_T_ES_TCO_ SLOW {p. 4466}	LV_ES {p. 1720}
LV_IGK {p. 906}	LV_ST_END {p. 1720}	LV_T_REL_CAN_REG {p. 1567}	T_REL_CAN {p. 1579}
T_REL_CAN_2 {p. 1579}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_ES_SUB	-	0... FFFFH	0... 65535	1	min
substitute value of T_ES					
C_T_REL_CAN_ST_2_MAN	-	0... FFFFFFFFH	0... 4294967295	1	s
Manual value for T_REL_CAN_ST_2 in seconds					
LC_T_REL_CAN_ST_MAN	-	0... 1H	0 ...1	1	-
Switch to enable manual setting of T_REL_CAN_ST and T_REL_CAN_ST_2					

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FUNCTION DESCRIPTION:

The time T_ES describes the engine off duration time. For this the relative time counter of CAN Message XXXX is evaluated. This counter is incremented every minute by 1 Hex.
At the transition into the Engine State LV_ES the last valid Value of T_REL_CAN is hand over to the non-volatile memory as T_REL_CAN_ES.
As soon as the condition LV_ES and LV_IGK = 1 is recognised the Value of T_REL_CAN is hand over to T_REL_CAN_ST and will be updated every minute until the State LV_ES is leaving.
As soon as T_REL_CAN_ST is present the Time T_ES is calculated and will be updated every minute until the State LV_ES is leaving too.

The time T_ES_2 calculated in every second. This is needed for the calculation of restart factor of the mass fuel flow (fac_st_rest). Simular to T_ES, as soon as T_REL_CAN_ST_2 is present the Time T_ES_2 is calculated and will be updated every second until the State LV_ES is leaving too.

General information:

The engine off duration time will be used mainly in temperature critical functions like injection and dew point recognition

Application conditions:

Initialization at reset:

T_ES = 0
T_ES_2 = 0
T_REL_CAN_ES_2= 0 (out of NVMY)
T_REL_CAN_ST_2= 0
T_REL_CAN_ES = 0 (out of NVMY)
T_REL_CAN_ST = 0
LV_ST_END_T_ES = 0
T_ES_CUS = 0

Recurrence: 100ms
Activation: always

Formula section:

If(1) (LV_T_REL_CAN_REG = 1 **and**
LV_ST_END_T_ES = 1 **and**
LV_ES$_n$ =1 and LV_ES$_{n-1}$=0) *//When the transition to engine stop is recognized, then the timers at the start of the engine off phase are set//*
Then(1) T_REL_CAN_ES = T_REL_CAN *(non volatile)*
LV_ST_END_T_ES = 0
T_REL_CAN_ES_2 = T_REL_CAN_2 *(non volatile)*
Endif(1)

Calculation of T_ES:

If(1) LV_ST_END = 0
Then (1)
If (2) LV_ERR_T_ES = 0 **and**
LV_ERR_T_ES_TCO_SLOW = 0 **and**
LV_ERR_T_ES_TCO_FAST = 0
Then (2)
If (3) LC_T_REL_CAN_ST_MAN = 1 // flag for testing
Then(3) T_REL_CAN_ST= (C_T_REL_CAN_ST_2_MAN /60)
Else(3) T_REL_CAN_ST = T_REL_CAN
EndIf(3)
T_ES = T_REL_CAN_ST - T_REL_CAN_ES
Else(2) T_ES = C_T_ES_SUB
Endif (2)
Else(1) T_ES = 0
LV_ST_END_T_ES = 1
Endif (1)

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Calculation of T_ES_2:

If(1) LV_ST_END = 0
Then (1)
If (2) LV_ERR_T_ES = 0 **and**
LV_ERR_T_ES_TCO_SLOW = 0 **and**
LV_ERR_T_ES_TCO_FAST = 0

Then (2)
If (3) LC_T_REL_CAN_ST_MAN = 1 // flag for testing
Then(3) T_REL_CAN_ST_2 = C_T_REL_CAN_ST_2_MAN
Else(3) T_REL_CAN_ST_2 = T_REL_CAN_2
EndIf(3)
T_ES_2 = T_REL_CAN_ST_2 - T_REL_CAN_ES_2
Else(2) T_ES_2 = C_T_ES_SUB * 60
Endif (2)
Else(1) T_ES_2= 0
Endif (1)

Calculation of T_ES_CUS:

//Remark: T_ES_CUS must be calculated after T_ES is calculated!

If (1) LV_ST_END = 0
Then (1) T_ES_CUS = T_ES
Else (1) *//engine has started//*
if(2) LV_ERR_T_ES = 1 **or**
LV_ERR_T_ES_TCO_SLOW = 1 **or**
LV_ERR_T_ES_TCO_FAST = 1
Then(2) T_ES_CUS = C_T_ES_SUB *//if T_ES error is detected, then T_ES_CUS is set to the substitute value//*
Else(2) T_ES_CUS$_n$ = T_ES_CUS$_{n-1}$*//if no error detected, then T_ES_CUS remains constant, equal to the value of T_ES before the engine started//*
Endif(2)
Endif(1)

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4.48 Engine roughness segment time correction

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ENA_SEG_T_MES	O/V	0... 1H	0 ...1	1	-
Engine roughness segment time validity flag					
SEG_AD_COR_ER	V	8000... 7FFFH	-7.8125 ...7.81226	238.4e-6	°/oo
ER segment adaptive values correction versus engine speed (for each segment)					
SEG_NR_MES	O/V	0... 7H	0 ...7	1	-
Phasing reference of ER segment acquisition					
SEG_T_COR	O/V	0... FFFFH	0... 65535	1	µs
Current ER corrected segment time					
SEG_T_COR_BUF [NC_SIZE_SEG_T_COR_BUF]	O	0... FFFFH	0... 65535	1	µs
ER corrected segment times buffer (after adaptation)					
SEG_T_MES	V	0... FFFFH	0... 65535	1	µs
Engine roughness raw segment time relative to former TDC					
SEG_T_MES_CYL [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	µs
Buffer of cylinder engine roughness raw segment times					

Input data:

LV_AT {p. 654}	LV_ENA_SEG_T_MES {p. 1447}	LV_ERR_CRK {p. 4455}	LV_INH_MIS_CRK {p. 4432}
LV_LIH_ERR_CRK {p. 1505}	LV_SYN_ENG {p. 1506}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}
SEG_AD_COR_ER {p. 1447}	SEG_AD_MMV_ER [NC_CYL_NR] {p. 1474}	SEG_NR {p. 1525}	SEG_NR_MES {p. 1447}
SEG_T_MES {p. 1447}	T_SEG_ER {p. 853}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_SEG_T_MES_MAX	-	0... FFFFH	0... 65535	1	µs
ER maximum valid segment time					
C_SEG_T_MES_MIN	-	0... FFFFH	0... 65535	1	µs
ER minimum valid segment time					
IP_SEG_AD_COR_ER_AT_1	-	0... FFFFH	-7.8125 ...7.81226	238.4e-6	°/oo
LDPM_N_32_6_ENRD	6	0... FFH	0... 8160	32	rpm
Adaptive value correction versus engine speed in AT for segment 1					
IP_SEG_AD_COR_ER_AT_2	-	0... FFFFH	-7.8125 ...7.81226	238.4e-6	°/oo
LDPM_N_32_6_ENRD	6	0... FFH	0... 8160	32	rpm
Adaptive value correction versus engine speed in AT for segment 2					
IP_SEG_AD_COR_ER_AT_3	-	0... FFFFH	-7.8125 ...7.81226	238.4e-6	°/oo
LDPM_N_32_6_ENRD	6	0... FFH	0... 8160	32	rpm
Adaptive value correction versus engine speed in AT for segment 3					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_SEG_AD_COR_ER_AT_4	-	0... FFFFH	-7.8125 ...7.81226	238.4e-6	°/oo
LDPM_N_32_6_ENRD	6	0... FFH	0... 8160	32	rpm
Adaptive value correction versus engine speed in AT for segment 4					
IP_SEG_AD_COR_ER_MT_1	-	0... FFFFH	-7.8125 ...7.81226	238.4e-6	°/oo
LDPM_N_32_1_ENRD	6	0... FFH	0... 8160	32	rpm
Adaptive value correction versus engine speed in MT for segment 1					
IP_SEG_AD_COR_ER_MT_2	-	0... FFFFH	-7.8125 ...7.81226	238.4e-6	°/oo
LDPM_N_32_1_ENRD	6	0... FFH	0... 8160	32	rpm
Adaptive value correction versus engine speed in MT for segment 2					
IP_SEG_AD_COR_ER_MT_3	-	0... FFFFH	-7.8125 ...7.81226	238.4e-6	°/oo
LDPM_N_32_1_ENRD	6	0... FFH	0... 8160	32	rpm
Adaptive value correction versus engine speed in MT for segment 3					
IP_SEG_AD_COR_ER_MT_4	-	0... FFFFH	-7.8125 ...7.81226	238.4e-6	°/oo
LDPM_N_32_1_ENRD	6	0... FFH	0... 8160	32	rpm
Adaptive value correction versus engine speed in MT for segment 4					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_SEG_DLY_ER_MES	-	0... 2H	0 ...2	1	-
Delay between ER segment and Cylinder measured segment					
NC_SIZE_SEG_T_COR_BUF	-	0... FFH	0... 255	1	-
Size of the array of engine roughness corrected segment times					

4.48.1 Phasing reference for the acquisition of engine roughness segment time

FUNCTION DESCRIPTION:

The ER segments provided by the aggregate ENSD, are used to observe in-cylinder combustion effects on crankshaft. The cylinder x combustion is located between cylinder X tdc and cylinder X+1 tdc. Consequently, at X+1 tdc, the T_SEG_ER obtained is relative to cylinder X combustion, a delay of 1 tdc between SEG_NR value at cylinder observed *(NC_SEG_DLY_ER_MES=1)*.
Exceptionally, if the segment is located after ER segment, this delay must be cancelled *(NC_SEG_DLY_ER_MES=0)*, because in such case the phasing reference SEG_NR is updated after T_SEG_ER acquisition.
SEG_NR_MES, the ER segments phasing reference, will be used to identify which cylinder is observed with the current engine roughness segment, it's particularly useful for ER segment adaptive values identification.

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Application conditions

Initialisation: *at ECU reset, Engine Stop* ***Or*** *Deactivation event*
SEG_NR_MES = 0

Recurrence: *Segment*

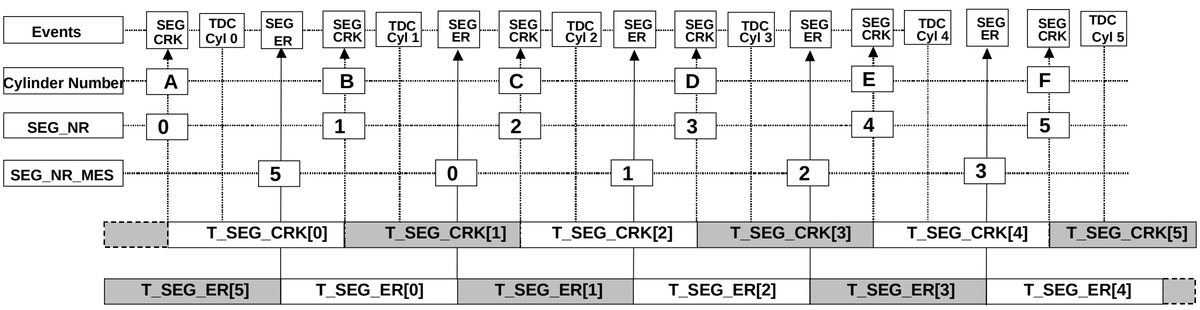
Activation: *LV_SYN_ENG = 1*

Deactivation: *LV_SYN_ENG = 0*

Formula section:

SEG_NR_MES = (SEG_NR - NC_SEG_DLY_ER_MES) % NC_CYL_NR

Implant scheme:



6 Cylinder Engine Example : ***NC_SEG_DLY_ER_MES = 1***

4.48.2 Engine roughness segment time acquisition and control

General information:

Here's described the segment time buffers management & control

ER current raw segment time:

T_SEG_ER *(input from ENSD)*

Coming directly from the ENSD aggregate and update at each ER segment task according ER segment counter *(SEG_NR_MES)*.

Actual ER segment time sample is considered **unvalid** if :

- Engine synchronisation is disable (LV_SYN_ENG = 0)
- When on one crankshaft revolution at least one tooth less or more has been detected (LV_INH_MIS_CRK = 1 before antibounce counter),
- When the crahshaft error or limp home is activated (LV_ERR_CRK = 1 or LV_LIH_ERR_CRK = 1)
- SEG_T_MES obtained exceeds a defined valid range (C_SEG_T_MES_MIN & C_SEG_T_MES_MAX)

Cylinder ER raw segment times:

SEG_T_MES & SEG_T_MES_CYL[NC_CYL_NR] *(outputs)*

This is a buffer where T_SEG_ER values *(after data casting)* are stored according SEG_NR_MES counter. It allows having a memory of raw ER segments on a complete engine cycle. These values will be used by the ER adaptive learning process.

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Application conditions

Initialisation: `at ECU reset, Engine Stop` **`Or`** `Deactivation event`

SEG_T_MES = FFFFH

For x = 0 ... NC_CYL_NR-1

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SEG_T_MES_CYL[x] = FFFFH
EndFor
LV_ENA_SEG_T_MES = 0
Recurrence: Segment
Activation: LV_SYN_ENG = 1
Deactivation: LV_SYN_ENG = 0

Formula section:

SEG_T_MES = T_SEG_ER *// physical equivalence conversion*
If LV_SYN_ENG = 0
Or SEG_T_MES > C_SEG_T_MES_MAX
Or SEG_T_MES < C_SEG_T_MES_MIN
Or LV_INH_MIS_CRK = 1
Or LV_ERR_CRK = 1
Or LV_LIH_ERR_CRK = 1
Then LV_ENA_SEG_T_MES = 0
SEG_T_MES = FFFFH
Else LV_ENA_SEG_T_MES = 1
EndIf
SEG_T_MES_CYL[SEG_NR_MES] = SEG_T_MES

4.48.2.1 Correction of the engine roughness segment adaptive values

FUNCTION DESCRIPTION:

General information:

Due to crankshaft flexion appearance at high engine speed that decreases the misfire detection efficiency, an open-loop adaptive correction value depending on engine speed for each cylinder can be introduced per type of transmission.
A correction can be applied only for each singular segment of the flywheel.

Application conditions

Initialisation: *at ECU reset, Engine Stop* ***Or*** *Deactivation event*
SEG_AD_COR_ER = 0
Recurrence: *Segment*
Activation: *LV_ENA_SEG_T_MES = 1*
Deactivation: *LV_ENA_SEG_T_MES = 0*

Formula section:

SEG_AD_COR_ER is updated according the following table *(function of NC_CYL_NR and the current value of SEG_NR_MES)*

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SEG_NR_MES	NC_CYL_NR = 3	NC_CYL_NR = 4	NC_CYL_NR = 5	NC_CYL_NR = 6	NC_CYL_NR = 8
0	SEG_AD_COR_ER = 0				
1	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_1(N_32)				
2	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_2(N_32)	SEG_AD_COR_ER = 0	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_2(N_32)	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_2(N_32)	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_2(N_32)
3		SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_1(N_32)	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_3(N_32)	SEG_AD_COR_ER = 0	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_3(N_32)
4			SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_4(N_32)	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_1(N_32)	SEG_AD_COR_ER = 0
5				SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_2(N_32)	SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_1(N_32)
6					SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_2(N_32)
7					SEG_AD_COR_ER = IP_SEG_AD_COR_ER_xT_3(N_32)

_xT stands for _AT if LV_AT = 1 else stands for _MT

4.48.3 Engine roughness segment time correction

FUNCTION DESCRIPTION:

General information:

The prerequisite for a reliable engine roughness evaluation is an accurate ER segment time measurement.
As the crankshaft flywheel teeth are subject to manufacturing tolerances, geometrical run-out and off-center installation which result in angles modulation, consequently the measured raw segment periods aren't similar and have systematic inaccuracies regarding other segments.
As these inaccuracies are systematic, they can be "learned" by an adaptive process during fuel cut-off periods and used for ER segment time correction. This adaptive process is described in the module : Engine roughness adaptive learning process.
ER segment adaptive values: SEG_AD_MMV_ER[NC_CYL_NR] *(inputs)*
ER adaptive values are stored according SEG_NR_MES counter. These adaptive values are obtained and updated by the ER segment adaptive values learning process. There's one ER segment adaptive value per engine cylinder.
Remark: The SEG_AD_MMV_ER_x are stored in ECU non-volatile memory.
ER current corrected segment time: SEG_T_COR *(output)*
This value is the current result of the ER segment correction process obtained with T_SEG_ER as input.
ER corrected segment times buffer: SEG_T_COR_BUF[NC_SIZE_SEG_T_COR_BUF] *(outputs)*
This is a buffer where are stored SEG_T_COR values (ER corrected segment time current value) who are needed for ER calculation.
SEG_T_COR is stored according a FIFO management (first in, first out).
SEG_T_COR_BUF buffer size depends on engine type:

- NC_SIZE_SEG_T_COR_BUF *= 11 segment time samples for a 5 cylinder engine*
- NC_SIZE_SEG_T_COR_BUF *= 9 segment time samples for 4 & 8 cylinder engine*
- NC_SIZE_SEG_T_COR_BUF *= 7 segment time samples for 3 & 6 cylinder engine*

This size NC_SIZE_SEG_T_COR_BUF *is determined by the ER sample number required by ER calculation according engine type.*

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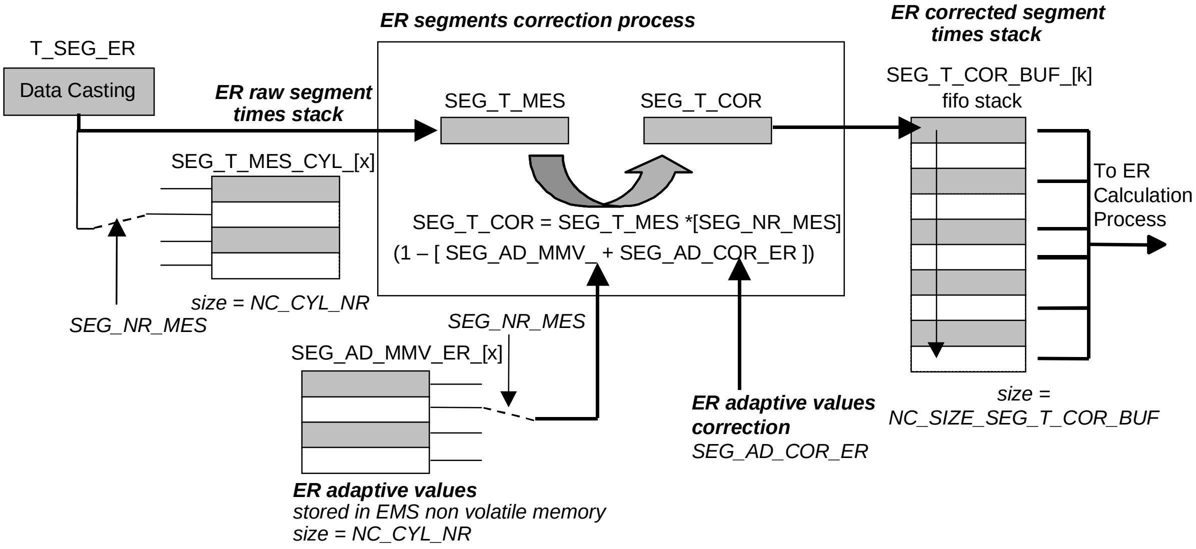

Application conditions

Initialisation: at ECU reset, Engine Stop **Or** Deactivation event

SEG_T_COR = FFFFH
For k = 0 to NC_SIZE_SEG_T_COR_BUF-1
SEG_T_COR_BUF[k] = FFFFH
EndFor
Recurrence: Segment
Activation: LV_SYN_ENG = 1
Deactivation: LV_SYN_ENG = 0

Formula section:

If(1) LV_ENA_SEG_T_MES = 0
Then(1) SEG_T_COR = FFFFH
For(2)k = 0 to NC_SIZE_SEG_T_COR_BUF-1
SEG_T_COR_BUF[k] = FFFFH
EndFor(2)
Else(1) SEG_T_COR =
SEG_T_MES * (1 - [SEG_AD_MMV_ER[SEG_NR_MES] + SEG_AD_COR_ER])
For(2)k : 1 to NC_SIZE_SEG_T_COR_BUF-1
SEG_T_COR_BUF[k] is managed as a FIFO stack *(SEG_T_COR_BUF last value is lost)*

EndFor(2)
SEG_T_COR_BUF[0] = SEG_T_COR
EndIf(1)
Where:
SEG_T_MES : *Current uncorrected ER segment time after data casting*
SEG_T_COR : *Current ER corrected segment time*
SEG_AD_MMV_ER[SEG_NR_MES] :
ER segment adaptive value corresponding to current T_SEG_ER phasing
SEG_AD_COR_ER :

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Adaptive value correction versus engine speed corresponding to current T_SEG_ ER phasing

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4.49 Engine roughness calculation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRLC_DRV2_ER	V	0... FFH	0... 0.99609	3.9063e-3	-
Correlation factor for engine roughness curvature component calculation					
DRV0_ER	O/V	7FFFFFFFH 80000000... H	2147483647 -2147483648...	-	µs
Engine roughness static component					
DRV1_ER	O/V	8000... 7FFFH	-32768 ...32767	1	µs
Engine roughness dynamic component					
DRV2_ER	V	0... FFFFH	0... 65535	1	µs
Engine roughness curvature component					
DRV2_MMV_ER	V	0... FFFFH	0... 65535	1	µs
Averaged engine roughness curvature component					
ER	O/V	8000... 7FFFH	-32768 ...32767	1	µs
Engine roughness					
ER_CYL [NC_CYL_NR]	V	8000... 7FFFH	-32768 ...32767	1	µs
Cylinder normalised engine roughness values					
ER_RAW	O/V	8000... 7FFFH	-32768 ...32767	1	µs
Engine roughness without curvature component					
ER_STND	O/V	8000... 7FFFH	-32768 ...32767	1	-
Normalised engine roughness					
ER_STND_CYL [NC_CYL_NR]	V	8000... 7FFFH	-32768 ...32767	1	-
Cylinder normalised engine roughness values					
FAC_ADD_ER [NC_CYL_NR]	V	8000... 7FFFH	-32768 ...32767	1	µs
ER additive correction components					
FAC_DRV2_ER	V	0... 3FCH	0 ...4	3.9216e-3	-
Weighting factor for engine roughness curvative component calculation (correction amount)					
FAC_GAIN_ER [NC_CYL_NR]	V	0... 1FFH	0... 1.99609	3.9063e-3	-
ER multiplicative correction components					
LV_ENA_ER	O/V	0... 1H	0 ...1	1	-
Engine roughness valid calculation control flag					
SEG_NR_ER	O/V	0... 7H	0 ...7	1	-
ER segment counter for segment identification (0 ... NC_CYL_NR - 1)					

Input data:

C_SEG_DLY_ER {p. 1455}	CTR_T_ZDLY_MIS {p. 6225}	LOAD_MIS {p. 6213}	LV_AT {p. 654}
LV_ENA_ER {p. 1454}	LV_ENA_SEG_T_MES {p. 1447}	LV_IS {p. 1720}	LV_SYN_ENG {p. 1506}
LV_VAR_TCT {p. 656}	N {p. 1525}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}
SEG_NR {p. 1525}	SEG_T_COR {p. 1447}	SEG_T_COR_BUF [NC_SIZE_SEG_T_COR_BUF] {p. 1447}	TCO {p. 1100}
THD_AD_ER {p. 1474}			

Calibration data:

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_DRV2_ZDLY_ER	-	0... FFH	0... 0.99609	3.9062e-3	-
Correlation factor for engine roughness curvature component calculation after start					
C_FAC_SCA_ER_STND	-	0... FFH	0... 255	1	-
Scaling factor used for normalised engine roughness calculation					
C_N_32_MAX_DRV2_ER_IS	-	0... FFH	0... 8160	32	rpm
Maximum engine speed to apply DRV2 specific weighting factor in idle speed					
C_N_MAX_ER	-	0... 1FE0H	0... 8160	1	rpm
maximum engine speed for engine roughness calculation					
C_N_MAX_ER_STND	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed to compute normalised engine roughness					
C_N_MIN_ER	-	0... 1FE0H	0... 8160	1	rpm
minimum engine speed for engine roughness calculation					
C_SEG_DLY_ER	-	0... CH	0... 12	1	-
Delay of ER segment reference					
C_T_DRV2_ZDLY_ER	-	0... FFFFH	0... 655.35	0.01	s
Delay for specific curvative component calculation during after start					
IP_CRLC_DRV2_ER_AT	-	0... FFH	0... 0.99609	3.9062e-3	-
LDP_N_32_IP_CRLC_DRV2_ER_AT	4	0... FFH	0... 8160	32	rpm
Correlation factor for engine roughness curvature component calculation (correction duration) - AT vehicle					
IP_CRLC_DRV2_ER_MT	-	0... FFH	0... 0.99609	3.9062e-3	-
LDP_N_32_IP_CRLC_DRV2_ER_MT	4	0... FFH	0... 8160	32	rpm
Correlation factor for engine roughness curvature component calculation (correction duration) - MT vehicle					
IP_CRLC_DRV2_ER_TCT	-	0... FFH	0... 0.99609	3.9062e-3	-
LDP_N_32_IP_CRLC_DRV2_ER_TCT	4	0... FFH	0... 8160	32	rpm
Correlation factor for engine roughness curvature component calculation (correction duration) - TCT vehicle					
IP_FAC_ADD_ER_AT [NC_CYL_NR]	V	0... FFFFH	-32768 ...32767	1	µs
LDPM_N_32_5_ENRD [NC_CYL_NR]	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_IP_FAC_ADD_ER_AT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER cylinder x additive segment-dependent factor for torsion correction with AT					
IP_FAC_ADD_ER_MT [NC_CYL_NR]	V	0... FFFFH	-32768 ...32767	1	µs
LDPM_N_32_3_ENRD [NC_CYL_NR]	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_IP_FAC_ADD_ER_MT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER cylinder x additive segment-dependent factor for torsion correction with MT					
IP_FAC_ADD_ER_TCT [NC_CYL_NR]	V	0... FFFFH	-32768 ...32767	1	µs
LDP_N_32_8_ENRD [NC_CYL_NR]	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_IP_FAC_ADD_ER_TCT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER cylinder x additive segment-dependent factor for torsion correction with TCT					
IP_FAC_DRV2_ER_AT	V	0... 3FCH	0 ...4	3.9216e-3	-
LDP_N_32_IP_FAC_N_DRV2_ER_AT	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_MIS_IP_FAC_DRV2_ER_AT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for DRV2 component calculation - AT vehicle					
IP_FAC_DRV2_ER_IS_AT	V	0... 3FCH	0 ...4	3.9216e-3	-
LDP_N_IP_FAC_N_DRV2_ER_IS_AT	4	0... 1FE0H	0... 8160	1	rpm

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_LOAD_IP_FAC_DRV2_ER_IS_AT	4	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for DRV2 component calculation - AT vehicle in idle speed					
IP_FAC_DRV2_ER_IS_MT	V	0... 3FCH	0 ...4	3.9216e-3	-
LDP_N_IP_FAC_N_DRV2_ER_IS_MT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_FAC_DRV2_ER_IS_MT	4	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for DRV2 component calculation - MT vehicle in idle speed					
IP_FAC_DRV2_ER_IS_TCT	V	0... 3FCH	0 ...4	3.9216e-3	-
LDP_N_IP_FAC_N_DRV2_ER_IS_TCT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_FAC_DRV2_ER_IS_TCT	4	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for DRV2 component calculation - TCT vehicle in idle speed					
IP_FAC_DRV2_ER_MT	V	0... 3FCH	0 ...4	3.9216e-3	-
LDP_N_32_IP_FAC_N_DRV2_ER_MT	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_MIS_IP_FAC_DRV2_ER_MT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for DRV2 component calculation - MT vehicle					
IP_FAC_DRV2_ER_TCT	V	0... 3FCH	0 ...4	3.9216e-3	-
LDP_N_32_IP_FAC_N_DRV2_ER_TCT	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_MIS_IP_FAC_DRV2_ER_TCT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for DRV2 component calculation - TCT vehicle					
IP_FAC_DRV2_ZDLY_ER	-	0... 3FCH	0 ...4	3.9216e-3	-
LDP_TCO_IP_FAC_DRV2_ZDLY_ER	6	0... FEH	-48... 142.5	0.75	°C
Weighting factor for engine roughness curvative component calculation (correction amount) after start					
IP_FAC_GAIN_ER_AT [NC_CYL_NR]	-	0... 1FFH	0... 1.99609	3.9063e-3	-
LDPM_N_32_4_ENRD [NC_CYL_NR]	6	0... FFH	0... 8160	32	rpm
ER cylinder x multiplicative segment-dependent factor for torsion correction with AT					
IP_FAC_GAIN_ER_MT [NC_CYL_NR]	-	0... 1FFH	0... 1.99609	3.9063e-3	-
LDPM_N_32_2_ENRD [NC_CYL_NR]	6	0... FFH	0... 8160	32	rpm
ER cylinder x multiplicative segment-dependent factor for torsion correction with MT					
IP_FAC_GAIN_ER_TCT [NC_CYL_NR]	-	0... 1FFH	0... 1.99609	3.9063e-3	-
LDP_N_32_7_ENRD [NC_CYL_NR]	6	0... FFH	0... 8160	32	rpm
ER cylinder x multiplicative segment-dependent factor for torsion correction with TCT					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_CONF_GAIN_ADD_ER	-	0... 1H	0 ...1	1	-
ER multiplicative and additive correction enable					

General information

The engine roughness index (ER) is a system variable relative to crankshaft segments behaviour. This index is mainly used by the misfire monitoring & algorithms dedicated to combustion process control.
Integration version for 3,4,5,6 & 8 cylinder engines.
The engine roughness system variable is calculated each ER window end occurrence, every time the engine is running & synchronised.

4.49.1 Engine roughness segment reference

Due to engine roughness definition, there is a delay of C_SEG_DLY_ER segments between ER actual value and the segment that was observed by this ER value.
SEG_NR_ER will be used to identify which cylinder is observed with the engine roughness system variable, it’s particularly useful for misfire cylinder identification.

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The segment counter SEG_NR_ER with the limit 0...(NC_CYL_NR - 1) is incremented in the same way as the common segment counter SEG_NR.

Application conditions

Initialisation: *at ECU reset, Engine Stop* ***Or*** *Deactivation condition event*
SEG_NR_ER = 0

Recurrence: *Segment*

Activation: *LV_SYN_ENG = 1*

Deactivation: *LV_SYN_ENG = 0*

Formula section:

SEG_NR_ER = (SEG_NR + 2 * NC_CYL_NR - C_SEG_DLY_ER) % NC_CYL_NR

4.49.2 Engine roughness segments control process

Description:

All ER components calculations are based on corrected segment time acquisitions buffer values SEG_T_COR_BUF.
As soon as an invalid segment has been detected during acquisition process (LV_ENA_SEG_T_MES = 0) or segment adaptive calculation, ER calculation & misfire detection have to be disabled (LV_ENA_ER = 0).

Application conditions

Initialisation: *at ECU reset, Engine Stop* ***Or*** *Deactivation condition event*
LV_ENA_ER = 0

Recurrence: *Segment*

Activation:

Engine roughness calculation is executed only if:
NC_SIZE_SEG_T_COR_BUF consecutive valid ER segment times have been acquired & stored in SEG_T_COR_BUF buffer.
"**Valid**" stands for:
LV_ENA_SEG_T_MES = 1 on NC_SIZE_SEG_T_COR_BUF consecutive ER segments
And no ER components calculation overflow on current segment *(DRV0, DRV1, DRV2 and ER components)*
And N <= C_N_MAX_ER
And N >= C_N_MIN_ER
In this case:
ER components are calculated as described below.
LV_ENA_ER = 1 *(if no overflow occurs during ER components calculation)*

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Deactivation:

Engine roughness calculation is stopped & initialised when at least one of the NC_SIZE_SEG_T_COR_BUF consecutive segment times have been acquired & stored in SEG_T_COR_BUF buffer have been detected unvalid.
"**Unvalid**" stands for:
LV_ENA_SEG_T_MES = 0 at least one time on NC_SIZE_SEG_T_COR_BUF consecutive ER segments
Or at least one calculation overflow occurs one of ER components *(DRV0, DRV1, DRV2 or ER component)* on current segment.
Or N > C_N_MAX_ER
Or N < C_N_MIN_ER
In that case :

LV_ENA_ER = 0
ER components are initialised to 0

4.49.3 Cylinder specific engine roughness components correction

#IF NLC_CONF_GAIN_ADD_ER = 1

FUNCTION DESCRIPTION:

General information:

The misfire detection based on ER index can be complicated by the torsional/flexion vibrations especially with multiple cylinder engines with a long crankshaft. This affects on misfire detection efficiency, especially at high engine speed.
To balance this phenomenon, after segment timing correction with ER adaptive values *(see ER segment correction process)*, an irregular operation is determined from the measured cylinder segment times, cylinder specific additive and multiplicative corrections are applied on the raw engine roughness value *(ER_RAW)*.
FAC_ADD_ER[NC_CYL_NR] and FAC_GAIN_ER[NC_CYL_NR] correction coefficients are based on calibration tables specific to each cylinder and to transmission type (MT/AT).

Application conditions

Initialisation: *at ECU reset, at Engine Stop* ***Or*** *on Deactivation condition event*

```
 For   x = 0 to NC_CYL_NR-1
 FAC_GAIN_ER[x]  = 1
 FAC_ADD_ER[x]  = 0
EndFor
```

Recurrence: Segment

Activation: *LV_ENA_ER = 1*

Deactivation: LV_ENA_ER = 0

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Formula section:

If(1) LV_AT = 1
Then(1)
XX= AT

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ElseIf(2) LV_VAR_TCT = 1
Then(2)
XX= TCT
Else(2)
XX= MT
Endif(2)
Endif(1)

FAC_GAIN_ER[SEG_NR_ER] = IP_FAC_GAIN_ER_xx[SEG_NR_ER](N_32)
FAC_ADD_ER[SEG_NR_ER] = IP_FAC_ADD_ER_xx[SEG_NR_ER](N_32,LOAD_MIS)
#ENDIF

4.49.4 Engine roughness DRV2 components filter & gain determination

FUNCTION DESCRIPTION:

This function allows to determinate the coefficients relative to DRV2 components of the engine roughness, according different configurations:
If used *(see project/customer legal requirements concerning misfire monitoring after engine start)*, during zero delay misfire monitoring activation period, specific gain & filter coefficient can be apply to DRV2 component to be able to detect misfire just after engine start *(dynamic correction modified).*
Else, FAC_DRV2_ER & CRLC_DRV2_ER are defined according transmission type *(AT/MT)*.

Application conditions

Initialisation: *at ECU reset, at Engine Stop* ***Or*** *on Deactivation condition event*
FAC_DRV2_ER = IP_FAC_DRV2_ZDLY_ER(TCO)
CRLC_DRV2_ER = C_CRLC_DRV2_ZDLY_ER

Recurrence: *Segment*

Activation: *LV_ENA_ER = 1*

Deactivation: *LV_ENA_ER = 0*

Formula section:

If(1) LV_AT = 1
Then(1)
XX= AT
ElseIf(2) LV_VAR_TCT = 1
Then(2)
XX= TCT
Else(2)
XX= MT
Endif(2)
Endif(1)

If(1) CTR_T_ZDLY_MIS > C_T_DRV2_ZDLY_ER
Then(1) *// Zero delay misfire monitoring activation period*
FAC_DRV2_ER = IP_FAC_DRV2_ZDLY_ER(TCO)
CRLC_DRV2_ER = C_CRLC_DRV2_ZDLY_ER

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ElseIf(2)
If(3) LV_IS = 1 **And** N_32 < C_N_32_MAX_DRV2_ER_IS
Then(3) FAC_DRV2_ER = IP_FAC_DRV2_ER_IS_xx(N, LOAD_MIS)
Else(3) FAC_DRV2_ER = IP_FAC_DRV2_ER_ xx (N_32, LOAD_MIS)
EndIf(3)
CRLC_DRV2_ER = IP_CRLC_DRV2_ER_ xx (N_32)
EndIf(2)
EndIf(1)

4.49.5 Engine roughness components calculation

General information:

The engine roughness calculation needs three individual components: a static component (DRV0_ER), a dynamic component (DRV1_ER) and a curvature component (DRV2_ER). These component definitions are specific to the engine cylinder number (see following related subchapters).
DRV2_MMV_ER is the filtered curvature component correction (DRV2_ER) who allows adding an artificial positive offset on ER value in case of dynamic curvature effects. This feature had a safety effect against wrong detection in case of segment oscillations.
ER_RAW is the engine roughness value without curvature component (DRV2_MMV_ER), used by cylinder balancing and engine warm up monitoring modules.

Application conditions

Initialisation: *at ECU reset, at Engine Stop* ***Or*** *on Deactivation condition event*
DRV0_ER = 0
DRV1_ER = 0
DRV2_ER = 0
DRV2_MMV_ER = 0
ER_RAW = 0

Recurrence: *Segment*

Activation: *LV_ENA_ER = 1*

Deactivation: *LV_ENA_ER = 0*

Formula section:

Engine roughness static component:
DRV0_ER(n) = NC_CYL_NR * [SEG_T_COR(n) - SEG_T_COR(n+1)]
Engine roughness dynamic and curvature components:
DRV1_ER and DRV2_ER components are engine type specific.
3 Cylinder Engine
#If NC_CYL_NR = 3
DRV1_ER(n) = SEG_T_COR(n-2) - SEG_T_COR(n+1)
DRV2_ER(n) = FAC_DRV2_ER *
max(0,[SEG_T_COR(n-3)- SEG_T_COR(n)] - [SEG_T_COR(n) - SEG_T_COR(n+3)])
#EndIf
4 or 8 Cylinder Engine
#If NC_CYL_NR = 4 or 8
DRV1_ER (n) = SEG_T_COR(n-2) - SEG_T_COR(n+2)
DRV2_ER (n) = FAC_DRV2_ER *
max(0,[SEG_T_COR(n-4)- SEG_T_COR(n)] - [SEG_T_COR(n) -SEG_T_COR(n+4)])

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#EndIf

5 Cylinder Engine

#If NC_CYL_NR = 5

DRV1_ER (n) = SEG_T_COR(n-2) - SEG_T_COR(n+3)

DRV2_ER (n) = FAC_DRV2_ER *
max(0,[SEG_T_COR(n-5)- SEG_T_COR(n)] - [SEG_T_COR(n)-SEG_T_COR(n+5)])

#EndIf

6 Cylinder Engine

#If NC_CYL_NR = 6

DRV1_ER (n) = SEG_T_COR(n-3) - SEG_T_COR(n+3)

DRV2_ER (n) = FAC_DRV2_ER *
max(0,[SEG_T_COR(n-3)- SEG_T_COR(n)] - [SEG_T_COR(n)-SEG_T_COR(n+3)])

#EndIf

Implant scheme for 3 cylinder engine:

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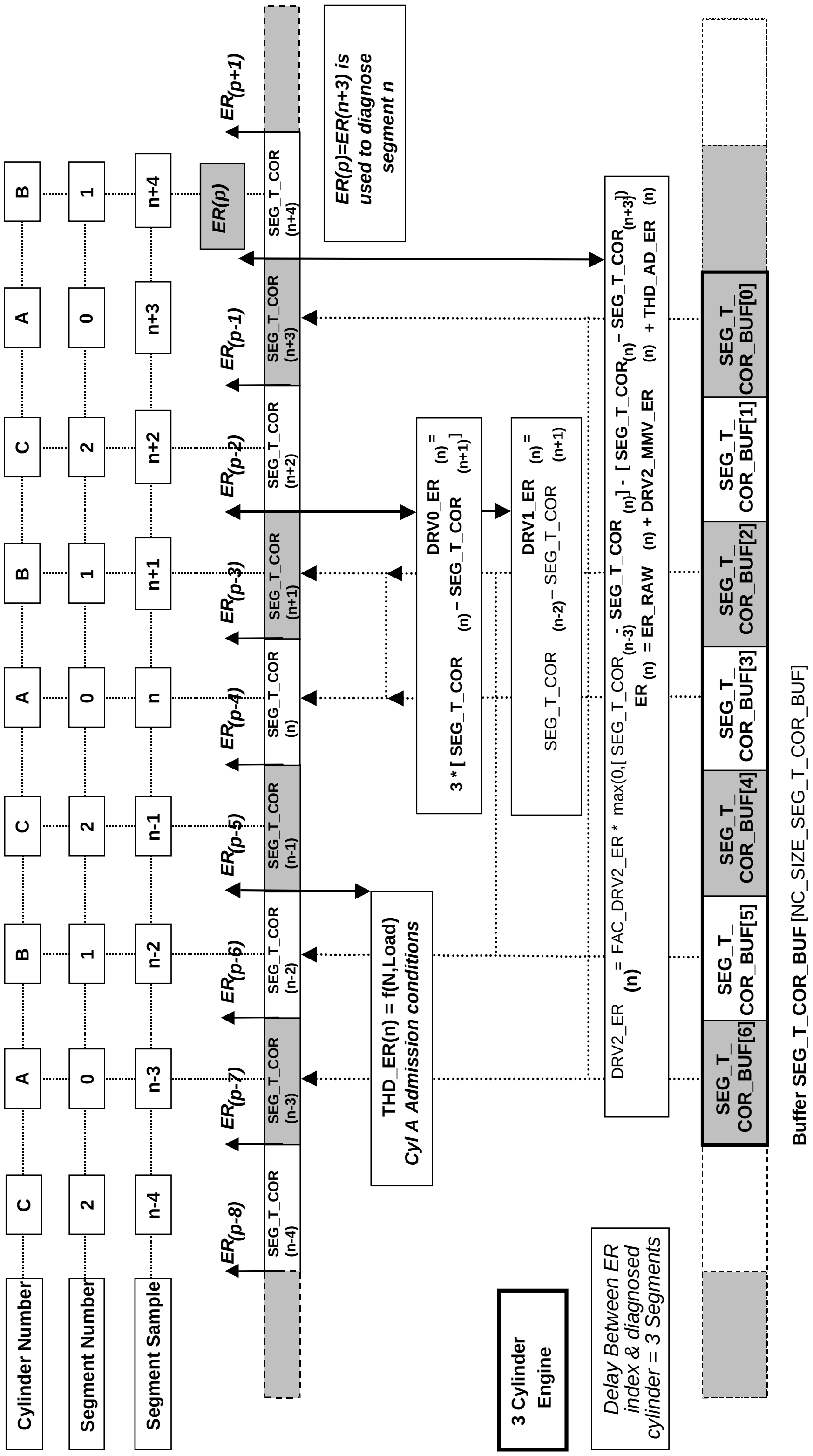

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Implant scheme for 4 cylinder engine:

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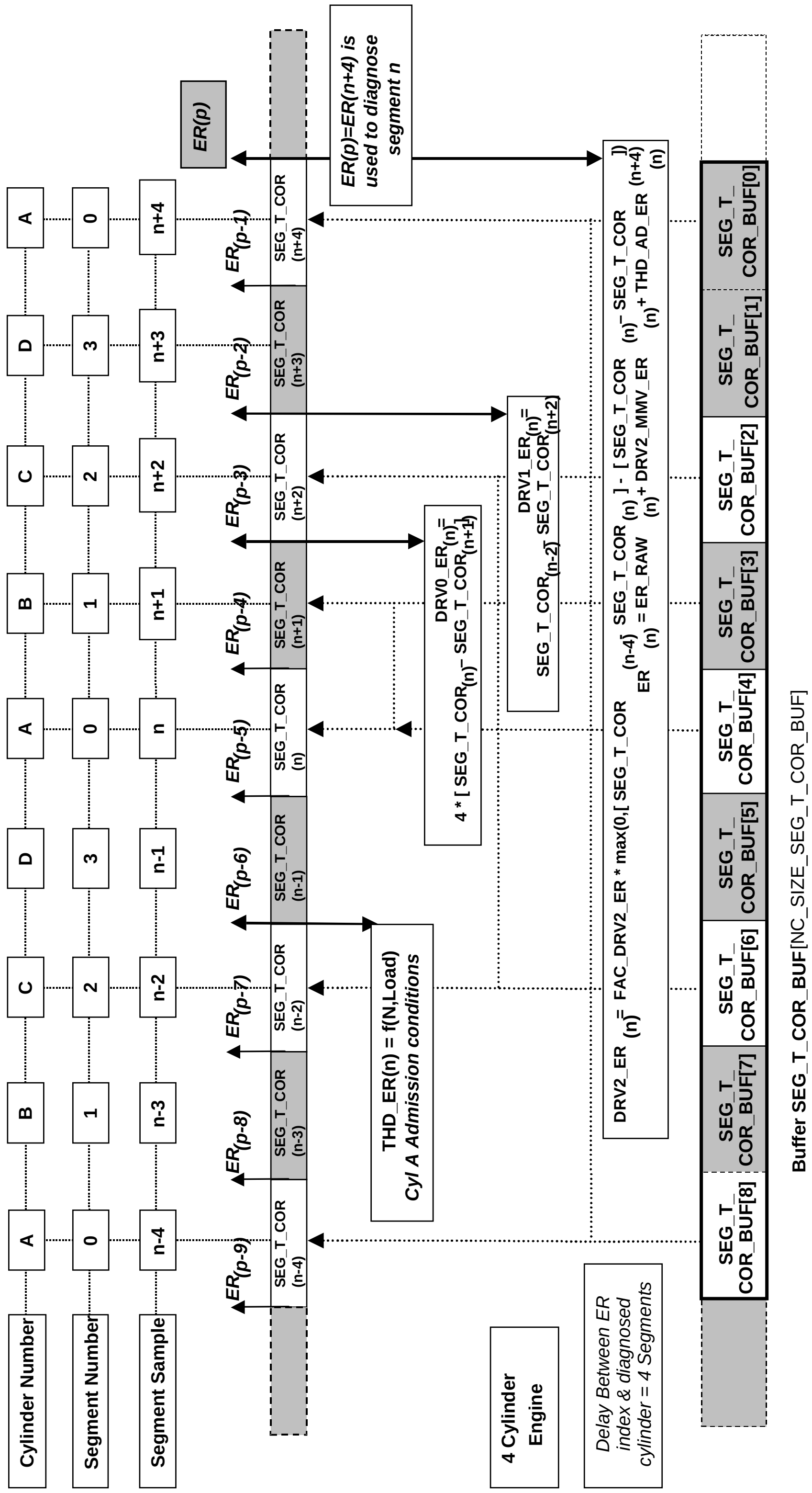
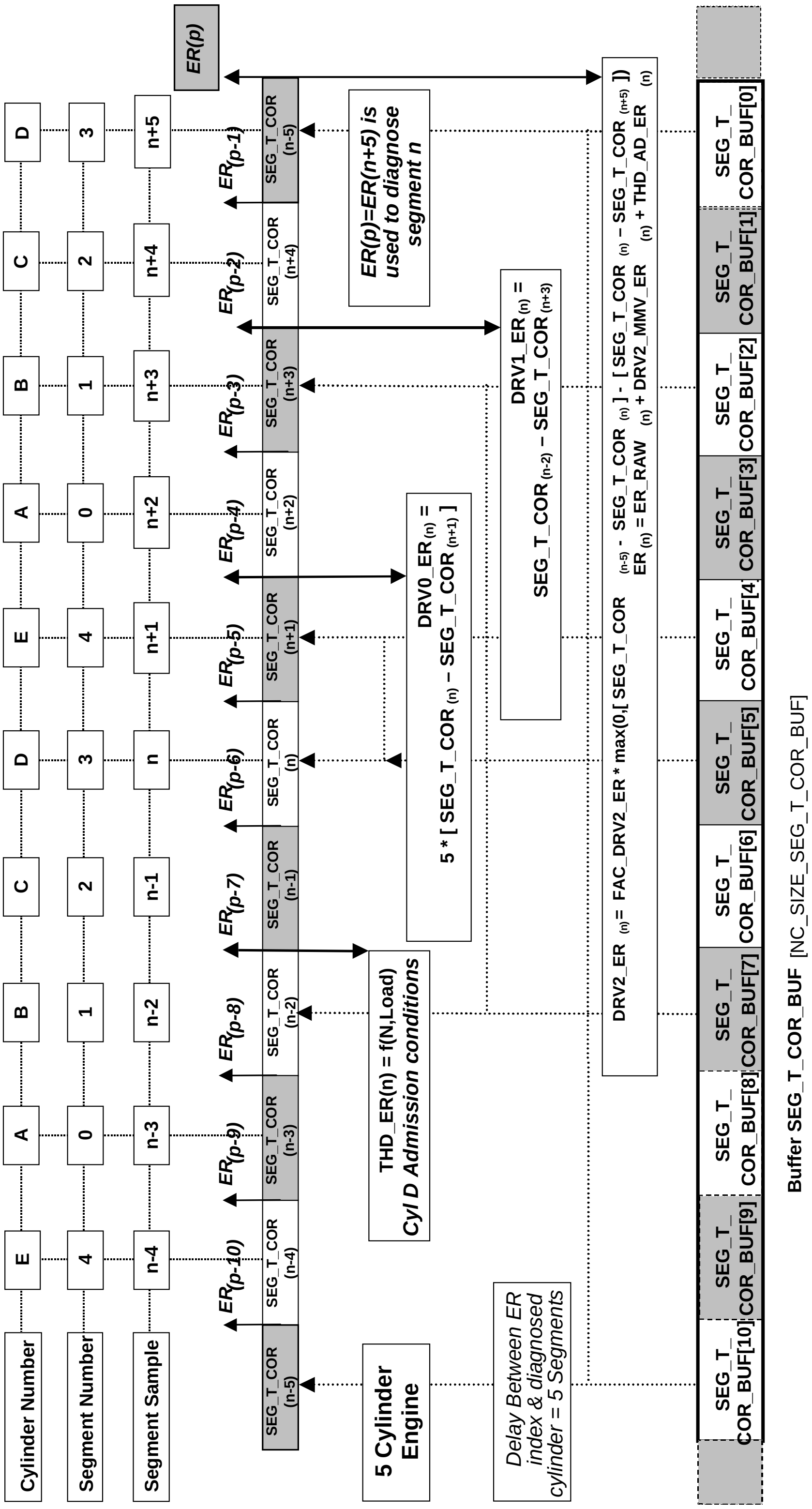


Implant scheme for 5 cylinder engine:



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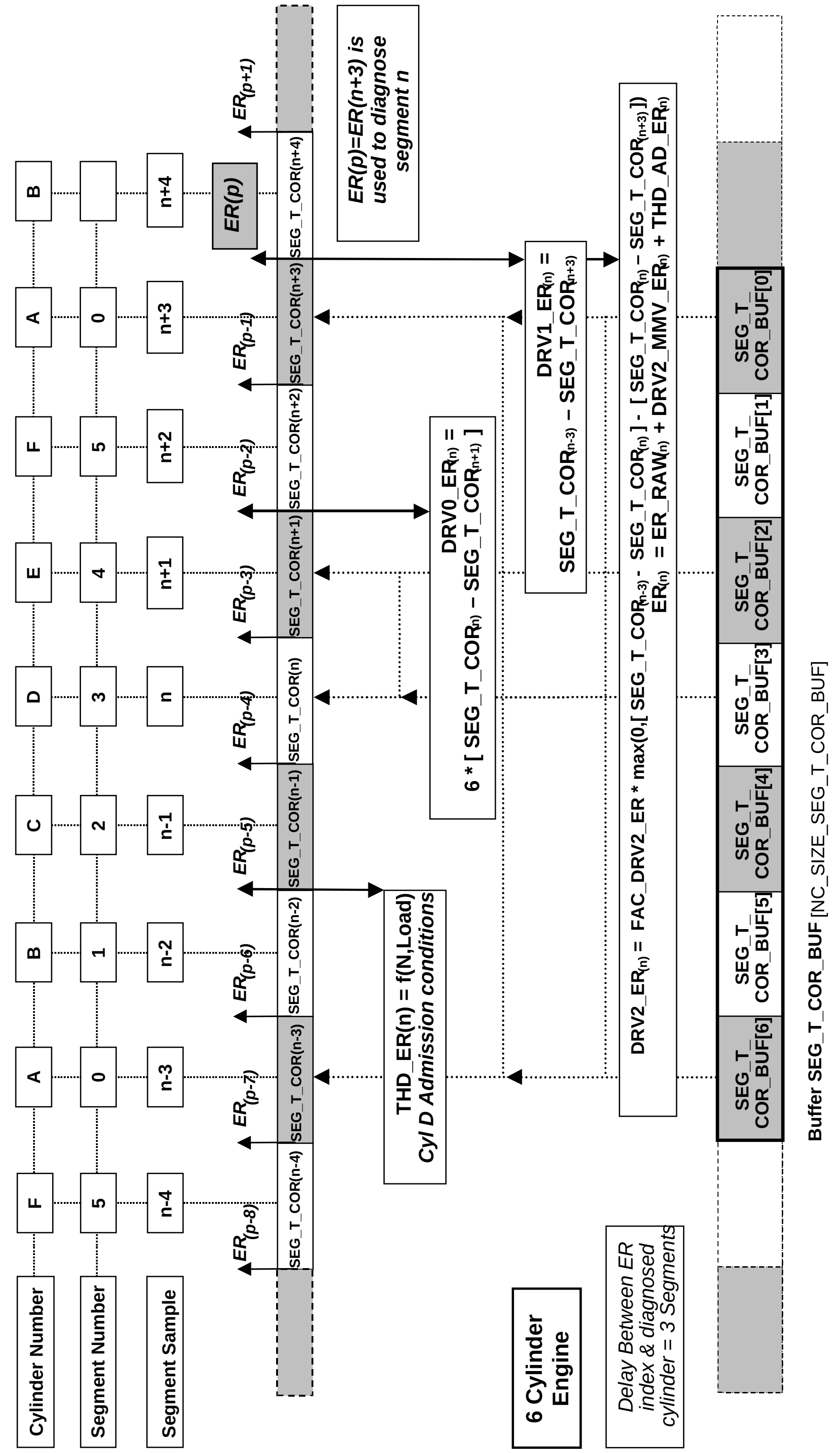
Implant scheme for 6 cylinder engine:



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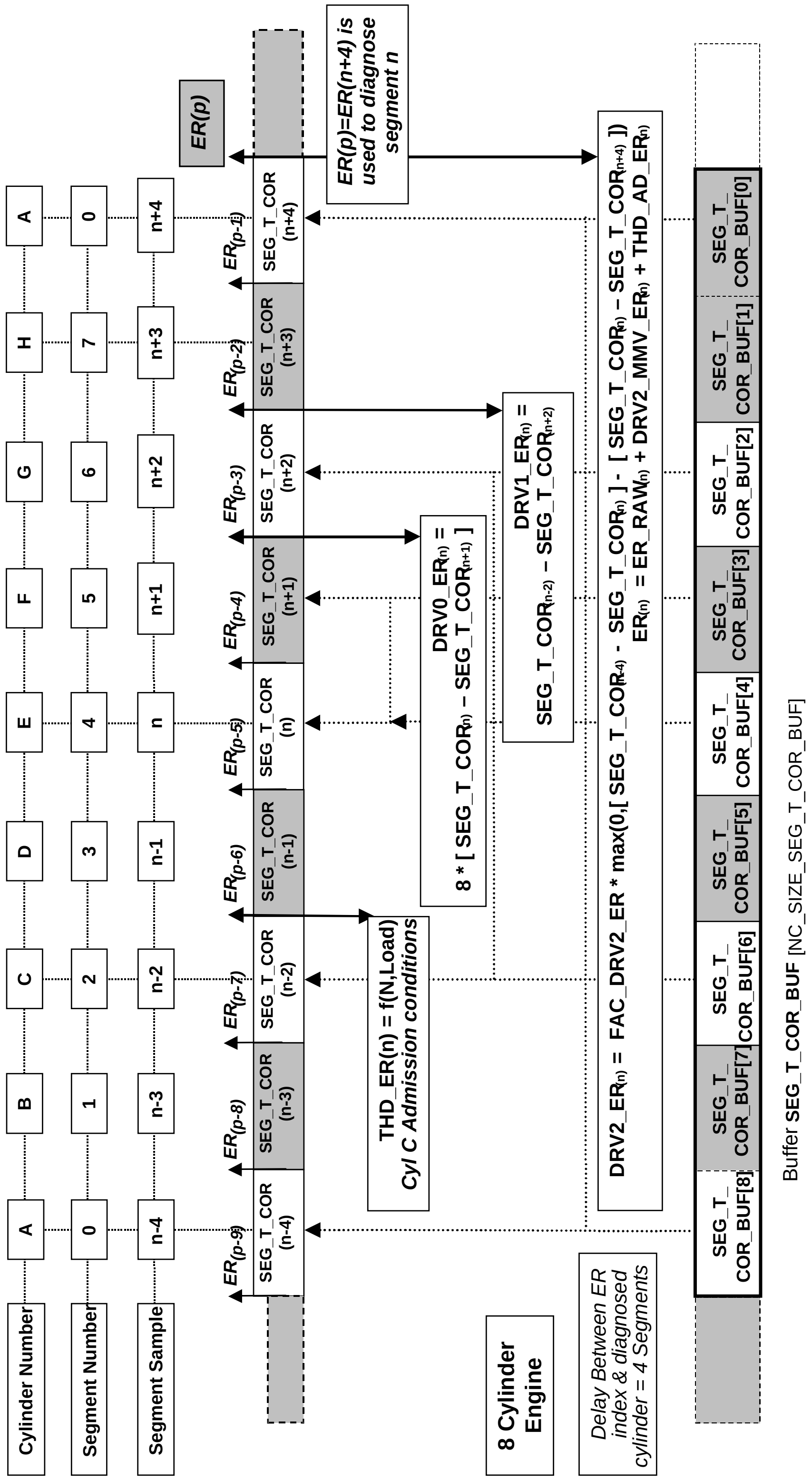
Implant scheme for 8 cylinder engine:



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Engine roughness filtered curvature component:

$$DRV2\_MMV\_ER_{(n)} = DRV2\_MMV\_ER_{(n-1)} + CRLC\_DRV2\_ER * (DRV2\_ER_{(n)} - DRV2\_MMV\_ER_{(n-1)})$$

Engine roughness value without curvature component:

#If NLC_CONF_GAIN_ADD_ER = 1

ER_RAW = FAC_GAIN_ER[SEG_NR_ER] *
(DRV0_ER - DRV1_ER - FAC_ADD_ER[SEG_NR_ER])

#Else

ER_RAW = DRV0_ER - DRV1_ER

#EndIf

4.49.6 Engine roughness values determination

Description:

ER is the complete engine roughness value including all ER components (DRV0_ER, DRV1_ER & DRV2_MMV_ER), specified & used by misfire detection module.
ER_STND is the normalised engine roughness value versus engine speed that could be amplified by a gain C_FAC_SCA_ER_STND. This is the nominal engine roughness value divided by the corresponding cubic corrected ER segment time $(SEG\_T\_COR\_BUF[C\_SEG\_DLY\_ER])^3$. The cubic segment time is calculated by using a mantisse and an exponent.
ER & ER_STND calculation formula are generic to all engine type.
A positive offset (THD_AD_ER) is added to ER components as long as the ER adaptive learning process hasn't been executed. This, in a way to avoid wrong misfire detection in engine operation areas where crankshaft decelerations due to a misfire are very close to ER noise due to the flywheel mechanical tolerances.
This offset decreases as the ER adaptive learning progress. At the end of the learning process, this offset is null *(see next chapter ER adaptive values learning process for more informations)*.
Once the ER fast adaptive learning stage has been executed, these flywheel mechanical tolerances are sufficiently reduced to able to detect misfire in full legal range without adding a positive offset.
ER_CYL_x and ER_STND_CYL_x are the engine roughness values obtained for corresponding cylinder x, these values are switched according SEG_NR_ER segment reference.

Application conditions

Initialisation: *at ECU reset, at Engine Stop* ***Or*** *on Deactivation condition event*

```
ER = 0
ER_STND = 0
For  x = 0 to NC_CYL_NR-1
ER_CYL[x] = 0
ER_STND_CYL[x] = 0
EndFor
```

Recurrence: *Segment*

Activation: *LV_ENA_ER = 1*

Deactivation: LV_ENA_ER = 0

Formula section:

Engine roughness:

ER = ER_RAW + DRV2_MMV_ER + THD_AD_ER

ER_CYL[SEG_NR_ER] = ER

Normalised Engine roughness versus engine speed:

If N < C_N_MAX_ER_STND

Then

$ER\_STND = ER /(SEG\_T\_COR\_BUF[C\_SEG\_DLY\_ER])^3 * 2^{(16+C\_FAC\_SCA\_ER\_STND)}$

ER_STND_CYL[SEG_NR_ER] = ER_STND

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Else

ER_STND = 0

ER_STND_CYL[SEG_NR_ER] = 0

EndIf

Note: if C_SEG_DLY_ER ≥ NC_SIZE_SEG_T_COR_BUF, SEG_T_COR_BUF[C_SEG_DLY_ER] data is limited to the last cell of the buffer.

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4.50 Engine roughness calculation (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ER_AV_QUO	V	0... FFH	0... 2.55	0.01	-
Quotient of ER/THD_ER (to simplify calibration and testing)					
LV_INH_APP_ER_AD	O/V	0... 1H	0 ...1	1	-
ER segment adaptive process inhibition flag relative application specific conditions					
LV_INH_OBD_ER_AD	O/V	0... 1H	0 ...1	1	-
ER segment adaptive process inhibition flag.					
LV_REQ_SEG_AD_MMV_ER_APP	O/V	0... 1H	0 ...1	1	-
Flag indicating request to reload stored segment adaptive values					
LV_SEG_AD_RST_ER_EOL	O/V	0... 1H	0 ...1	1	-
EOL specific request to reset ER segment adaptive values					
SEG_AD_MMV_ER_APP [NC_CYL_NR]	O/V	8000... 7FFFH	-7.8125 ...7.8123	0.000238	
ER filtered adaptive values used for reload (for each segment) if segment adaptive process not valid					

Input data:

ER {p. 1454}	GR_AT {p. 1302}	GR_MT {p. 1302}	LV_AT {p. 654}
LV_ENA_ER {p. 1454}	LV_ENA_SEG_T_MES {p. 1447}	LV_EOL_OBD {p. 800}	LV_ERR_CPS {p. 1001}
LV_ERR_CRK {p. 4455}	LV_ERR_DIAGCPS {p. 5926}	LV_ES {p. 1720}	LV_REQ_INH_MIS {p. 6225}
LV_REQ_SEG_AD_RST_EOL {p. 804}	LV_ST {p. 1720}	LV_SYN_ENG {p. 1506}	STATE_ERR_IV {p. 4803}
THD_ER {p. 6276}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_GR_INH_ER_AD_AT	-	0... FFH	0... 255	1	-
Bitfield used to inhibit engine roughness adaptive according current AT gear ratio (Gear corresponding bit = 1, ER_AD inhibited)					
C_GR_INH_ER_AD_MT	-	0... FFH	0... 255	1	-
Bitfield used to inhabit engine roughness adaptive according current MT gear ratio (Gear corresponding bit = 1, ER_AD inhibited)					
LC_SEG_AD_RST_ENA_EOL	-	0... 1H	0 ...1	1	-
Specific EOL request enable flag to reset ER segment adaptive values & learning process					

4.50.1 Inhibition of engine roughness adaptive process - Application specific

FUNCTION DESCRIPTION:

Engine roughness segments adaptive process is inhibited when one of the following system conditions occurs. See application specific accessories that could have an impact on the transmission behaviour (CVT, Automatic gear shifting, specific gear ratios...).

Application conditions

Initialisation: `at ECU reset and engine Stop:`

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```
  LV_INH_APP_ER_AD = 0
  at ECU reset:
LV_REQ_SEG_AD_MMV_ER_APP = 0
  SEG_AD_MMV_ER_APP[NC_CYL_NR] = 0
```

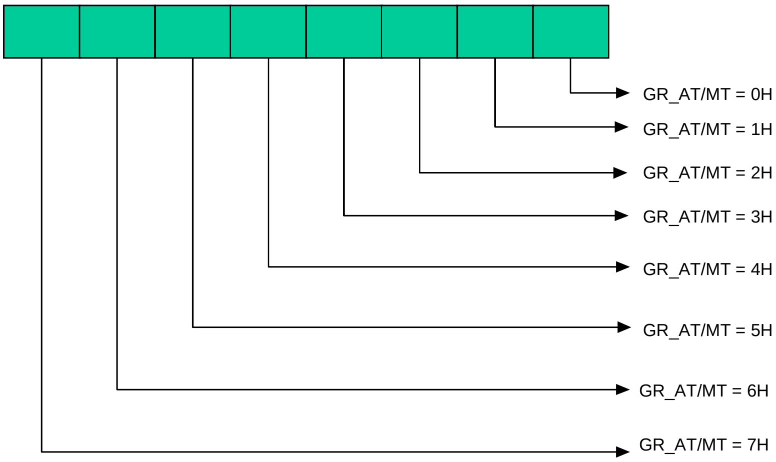
Update rate: *Engine roughness segment*

Activation: *LV_ENA_SEG_T_MES = 1*

Deactivation: LV_ENA_SEG_T_MES = 0

Diagram:

Bit-position within C_GR_INH_ER_AD_MT/AT



Example: Inhibition should be in 1st gear and 2st gear: => C_GR_INH_ER_AD_MT/AT = 6H

Formula section:

If (LV_AT = 1 **And** C_GR_INH_ER_AD_AT[GR_AT] = 1)
Or (LV_AT = 0 **And** C_GR_INH_ER_AD_MT[GR_MT] = 1)
Then LV_INH_APP_ER_AD = 1
Else LV_INH_APP_ER_AD = 0
EndIf

4.50.2 ER segment adaptive process inhibition related to OBDI diagnosis

General information:

ER segment adaptive process is inhibited when one of the mentioned OBD I errors occurs.

Application conditions

Initialization: *0 at reset*

Update rate: *Engine roughness segment*

Activation: *LV_SYN_ENG = 1*

Deactivation: *LV_SYN_ENG = 0*

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Formula section:

If STATE_ERR_IV <> 0 **or**
LV_ERR_CPS = 1 **or**
LV_ERR_DIAGCPS = 1 **or**
LV_ERR_CRK = 1

Then LV_INH_OBD_ER_AD = 1
Else LV_INH_OBD_ER_AD = 0
EndIf

4.50.3 End of line & After sale service request to reset ER segment adaptive values

General information:

During end of line plant and/or for After sale services, a request is generated via communication protocol, to reset ER segment adaptive values & learning process *(see project communication protocol).*

Application conditions

Initialization: *0 at reset*

Update rate: *Engine roughness segment*

Activation: *LV_ENA_SEG_T_MES = 1*

Deactivation: *LV_ENA_SEG_T_MES = 0*

Formula section:

If LV_EOL_OBD = 1 *// OBD end of line process request*
And LC_SEG_AD_RST_ENA_EOL = 1
And LV_REQ_SEG_AD_RST_EOL = 1
// EOL request to reset segment adaptive values
Then LV_SEG_AD_RST_ER_EOL = 1
Else LV_SEG_AD_RST_ER_EOL = 0
EndIf

4.50.4 Normalised engine roughness quotient for calibration

FUNCTION DESCRIPTION:

General information:

To simplify the calibration, testing and controlling of the misfire function the variable ER_AV_QUO is defined.

Application conditions

Initialisation: *ER_AV_QUO = 0 at reset*

Recurrence: *updated every segment*

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Activation: *LV_ENA_ER = 1*

Deactivation: *LV_ENA_ER = 0*

Formula section:

If LV_ES = 1 **or**
LV_ST = 1 **or**
LV_REQ_INH_MIS = 1 **or**
ER $>$ 0
Then ER_AV_QUO = 0
Else ER_AV_QUO = ER /THD_ER
Endif

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4.51 Engine roughness adaptive learning process

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRLC_SEG_AD_ER	V	0... FFFFH	0... 0.99998	15.3e-6	-
ER segment adaptive values filtering coefficient					
CTR_SEG_AD_ER	V/S	0... FFFFH	0... 65535	1	-
Counter of ER segment adaptation learning process					
DELTA_CRK_DIF_MAX_ER	V/S	0... FFFFH	0... 999.98474	15.3e-3	°/oo
Limitation of adaptation range (mech. Tolerance)					
LV_INH_ACC_ER_AD	V	0... 1H	0 ...1	1	-
ER adaptive process fade out request flag due to Air conditioner activation					
LV_INH_LOAD_GRD_MAX_ER_AD	V	0... 1H	0 ...1	1	-
ER adaptive process fade out request flag due to engine load transient condition					
LV_INH_MAF_DIF_ER_AD	V	0... 1H	0 ...1	1	-
ER adaptive process fade out request flag due to MAF transient condition					
LV_INH_TPS_GRD_ER_AD	V	0... 1H	0 ...1	1	-
ER adaptive process fade out request flag due to TPS transient condition					
LV_SEG_AD_AVL_ER	O/V/S	0... 1H	0 ...1	1	-
Segment adaptation process state : no adaptive process executed (=0) fast adaptive process achieved (=1)					
LV_SEG_AD_DIF_MAX_ER	O/V	0... 1H	0 ...1	1	-
Maximum ER adaptive values difference on same physical segment					
LV_SEG_AD_ER	O/V	0... 1H	0 ...1	1	-
ER segment adaptation process enable					
LV_SEG_AD_FDOUT_ER	V	0... 1H	0 ...1	1	-
Boolean for segment adaptation fade out condition					
LV_SEG_AD_FDOUT_ER_EOL	V	0... 1H	0 ...1	1	-
EOL specific request for ER segment adaptive learning process					
LV_SEG_AD_LIM_ER	O/V/S	0... 1H	0 ...1	1	-
ER filtered adaptive values out of range					
LV_SEG_AD_RAW_ER	V	0... 1H	0 ...1	1	-
ER segment adaptation process monitoring enable					
SEG_AD_DIF_ER_0	V	0... 7FFFH	0... 7.81226	237.999e-6	°/oo
ER adaptive values difference on same physical segment (Segment 0 & Identical)					
SEG_AD_DIF_ER_1	V	0... 7FFFH	0... 7.81226	237.999e-6	°/oo
ER adaptive values difference on same physical segment (Segment 1 & Identical)					
SEG_AD_DIF_ER_2	V	0... 7FFFH	0... 7.81226	237.999e-6	°/oo
ER adaptive values difference on same physical segment (Segment 2 & Identical)					
SEG_AD_DIF_ER_3	V	0... 7FFFH	0... 7.81226	237.999e-6	°/oo
ER adaptive values difference on same physical segment (Segment 3 & Identical)					
SEG_AD_FDOUT_ER_CDN	V	0... FFH	0... 255	1	-
Segment adaptation fade out conditions carrier byte (before masking)					
SEG_AD_FDOUT_ER_CDN_NR	V	0... 8H	0 ...8	1	-
Segment adaptation fade out conditions number (after masking)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
SEG_AD_MMV_ER [NC_CYL_NR]	O/V/S	8000... 7FFFH	-7.8125 ...7.81226	237.999e-6	°/oo
ER filtered adaptive values used for learning process (for each segment)					
SEG_AD_RAW_MMV_ER [NC_CYL_NR]	V	8000... 7FFFH	-7.8125 ...7.81226	237.999e-6	°/oo
ER filtered adaptive values used for learning process monitoring (for each segment)					
THD_AD_ER	O/V	0... FFFFH	0... 65535	1	µs
Engine roughness threshold correction factor during segment adaptation learning process.					

Input data:

CRLC_SEG_AD_ER {p. 1473}	CTR_SEG_AD_ER {p. 1473}	DRV1_ER {p. 1454}	LOAD_GRD_MIS {p. 6213}
LOAD_MIS {p. 6213}	LV_ACCOUT_RLY {p. 3589}	LV_AT {p. 654}	LV_ENA_ER {p. 1454}
LV_ENA_SEG_T_MES {p. 1447}	LV_EOL_OBD {p. 800}	LV_INH_APP_ER_AD {p. 1469}	LV_INH_OBD_ER_AD {p. 1469}
LV_INJ_CUT {p. 2295}	LV_REQ_SEG_AD_MMV_ER_APP {p. 1469}	LV_SEG_AD_AVL_ER {p. 1473}	LV_SEG_AD_DIF_MAX_ER {p. 1473}
LV_SEG_AD_ER {p. 1473}	LV_SEG_AD_FDOUT_ER {p. 1473}	LV_SEG_AD_FDOUT_ER_EOL {p. 1473}	LV_SEG_AD_LIM_ER {p. 1473}
LV_SEG_AD_RAW_ER {p. 1473}	LV_SEG_AD_RST_ER_EOL {p. 1469}	LV_STATE_RR {p. 6301}	LV_VAR_TCT {p. 656}
MAF {p. 8277}	MAF_DIF {p. 1195}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}
SEG_AD_MMV_ER_APP [NC_CYL_NR] {p. 1469}	SEG_AD_RAW_MMV_ER [NC_CYL_NR] {p. 1474}	SEG_NR_MES {p. 1447}	SEG_T_COR {p. 1447}
SEG_T_MES_CYL [NC_CYL_NR] {p. 1447}	TPS_AV {p. 1169}	TPS_GRD {p. 1169}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRK_DIF_MAX_ER	-	0... 1FFH	0... 7.79724	0.0152588	°/oo
Limitation of ER adaptation range (mechanical tolerance)					
C_CRLC_FAST_SEG_AD_ER	-	0... FFFFH	0... 0.99998	15.3e-6	-
Fast ER segment adaptive values filtering coefficient (fast learning phase)					
C_CRLC_FAST_SEG_AD_ER_TCT	-	0... FFFFH	0... 0.99998	15.3e-6	-
Fast ER segment adaptive values filtering coefficient (fast learning phase - TCT vehicule)					
C_CRLC_SEG_AD_ER	-	0... FFFFH	0... 0.99998	15.3e-6	-
Nominal ER segment adaptive values filtering coefficient					
C_CRLC_SEG_AD_ER_EOL	-	0... FFFFH	0... 0.99998	15.3e-6	-
EOL specific filtering coefficient for ER segment adaptive values learning process					
C_CRLC_SEG_AD_ER_TCT	-	0... FFFFH	0... 0.99998	15.3e-6	-
Nominal ER segment adaptive values filtering coefficient (TCT vehicule)					
C_CRLC_SEG_AD_RAW_ER	-	0... FFFFH	0... 0.99998	15.3e-6	-
Filter coefficient for ER segment adaptive values monitoring					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DRV1_MAX_SEG_AD_ER	-	0... 7FFFH	0... 32767	1	µs
Maximum value of DRV1_ER (dynamic part of engine roughness) for crankshaft target wheel learning.					
C_DRV1_MAX_SEG_AD_ER_EOL	-	0... 7FFFH	0... 32767	1	µs
Maximum value of DRV1_ER (dynamic part of engine roughness) for crankshaft target wheel learning for EOL request mode					
C_MASK_SEG_AD_FDOUT_ER	-	0... FFH	0... 255	1	-
Configuration mask for SEG_AD_FDOUT_ER_CDN fade out carrier structure					
C_N_MAX_SEG_AD_ER_AT	-	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold for crankshaft target wheel learning with AT					
C_N_MAX_SEG_AD_ER_EOL_AT	-	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold for crankshaft target wheel learning for EOL request mode in AT					
C_N_MAX_SEG_AD_ER_EOL_MT	-	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold for crankshaft target wheel learning for EOL request mode in MT					
C_N_MAX_SEG_AD_ER_EOL_TCT	-	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold for crankshaft target wheel learning for EOL request mode in TCT					
C_N_MAX_SEG_AD_ER_MT	-	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold for crankshaft target wheel learning with MT					
C_N_MAX_SEG_AD_ER_TCT	-	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold for crankshaft target wheel learning with TCT					
C_N_MIN_SEG_AD_ER_AT	-	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for crankshaft target wheel learning with AT					
C_N_MIN_SEG_AD_ER_EOL_AT	-	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for crankshaft target wheel learning for EOL request mode in AT					
C_N_MIN_SEG_AD_ER_EOL_MT	-	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for crankshaft target wheel learning for EOL request mode in MT					
C_N_MIN_SEG_AD_ER_EOL_TCT	-	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for crankshaft target wheel learning for EOL request mode in TCT					
C_N_MIN_SEG_AD_ER_MT	-	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for crankshaft target wheel learning with MT					
C_N_MIN_SEG_AD_ER_TCT	-	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for crankshaft target wheel learning with TCT					
C_N_SEG_T_AD_RAW_MAX_ER	-	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold for crankshaft target wheel monitoring					
C_N_SEG_T_AD_RAW_MIN_ER	-	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for crankshaft target wheel monitoring					
C_NR_SEG_AD_ACT_MIN_ER	-	0... FFH	0... 255	1	-
Minimum segments number in fuel cut-off mode before triggering ER segment adaptive learning process					
C_NR_SEG_AD_ACT_MIN_ER_EOL	-	0... FFH	0... 255	1	-
Minimum segments number in fuel cut-off mode before triggering ER segment adaptive learning process for EOL request mode					
C_NR_SEG_AD_AVL_ER	-	0... FFH	0... 255	1	-
Segments number to achieve the first adaptive process phase					
C_NR_SEG_DRV1_MIN_ER	-	0... FFH	0... 255	1	-
Minimum number of segments for engine roughness dynamic part					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NR_SEG_DRV1_MIN_ER_EOL	-	0... FFH	0... 255	1	-
Minimum number of segments for engine roughness dynamic part for EOL request mode					
C_SEG_AD_DIF_MAX_ER	-	0... 7FFFH	0... 7.81226	237.999e-6	°/oo
Maximum range for difference between same physical segment adaptive values					
C_SEG_AD_MAX_ER	-	0... 7FFFH	0... 7.81226	237.999e-6	°/oo
Limitation of ER segment adaptation range (mechanical tolerance).					
C_T_ACCOUT_DLY_ER_AD	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when air-conditioning compressor has been switched on or off					
C_T_LOAD_GRD_DLY_ER_AD	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when maximum actual torque gradient has been detected.					
C_T_MAF_DIF_DLY_ER_AD	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when maximum air-mass gradient has been detected.					
C_T_TPS_GRD_DLY_ER_AD	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when maximum throttle gradient has been detected.					
IP_LOAD_GRD_ER_AD	-	0... 7FFFH	0... 99.99694	3.05e-3	%
LDP_LOAD_MIS_IP_LOAD_GRD_ER_AD	6	0... 7FFFH	0... 99.99694	3.05e-3	%
Maximum actual torque gradient fade out condition.					
IP_MAF_DIF_MAX_ER_AD	-	0... FFFFH	0... 1389	21.2e-3	mg/stk
LDP_MAF_IP_MAF_DIF_MAX_ER_AD	6	0... FFFFH	0... 1389	21.2e-3	mg/stk
Maximum air-mass gradient per SEG for fade out condition.					
IP_TPS_GRD_MAX_ER_AD	-	0... FFH	0... 2987.5	11.7156863	°TPS/s
LDP_TPS_AV_IP_TPS_GRD_MAX_ER	6	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Maximum throttle gradient threshold for fade out condition.					
LC_SEG_AD_ER_REQ_EOL	-	0... 1H	0 ...1	1	-
Specific EOL request enable flag for ER segment adaptive value learning process					
LC_SEG_AD_LIM_REAC_ER	-	0... 1H	0 ...1	1	-
Reactivation of the ER segment adaptation range check at each learning phase					

General information:

To reduce systematic noises generated by target wheel mechanical tolerances, an adaptive learning process is required to improve the signal noise ratio on engine roughness variable and to avoid wrong misfire detection at high engine speed /low load.
ER segment adaptive values learning process is based on ER segments timing observation according a geometrical reference (ER segment time 0, SEG_NR_MES = 0).
During an engine deceleration in fuel cut-off mode on all cylinders (LV_INJ_CUT, no engine combustion influences), due to crankshaft inertia, engine speed can be considered in a short horizon as constant, thus on one engine cycle (720°Crk) timing dissimilarities between segment reference and others will be observed. For longer horizon observation, a deceleration is applied according current segment position in the engine cycle.
When all adaptation conditions fulfilled (smooth deceleration in fuel cut-off conditions), an adaptive values learning process is performed every **720° crank angle**, starting with **segment 0** *(adaptive process reference)*.
If there is no cylinder specific mechanical damage or crankshaft torsion/flexion, the adaptation values for cylinders with the same mechanical segment will be approximately identical:

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3 cylinder engine	4 cylinder engine	5 cylinder engine	6 cylinder engine	8 cylinder engine
SEG_AD_ER_0 *(geometrically singular)*	SEG_AD_ER_0 ≅ SEG_AD_ER_2	SEG_AD_ER_0 *(geometrically singular)*	SEG_AD_ER_0 ≅ SEG_AD_ER_3	SEG_AD_ER_0 ≅ SEG_AD_ER_4
SEG_AD_ER_1 *(geometrically singular)*	SEG_AD_ER_1 ≅ SEG_AD_ER_3	SEG_AD_ER_1 *(geometrically singular)*	SEG_AD_ER_1 ≅ SEG_AD_ER_4	SEG_AD_ER_1 ≅ SEG_AD_ER_5
SEG_AD_ER_2 *(geometrically singular)*		SEG_AD_ER_2 *(geometrically singular)*	SEG_AD_ER_2 ≅ SEG_AD_ER_5	SEG_AD_ER_2 ≅ SEG_AD_ER_6
		SEG_AD_ER_3 *(geometrically singular)*		SEG_AD_ER_3 ≅ SEG_AD_ER_7
		SEG_AD_ER_4 *(geometrically singular)*		
Segments length : *240°Crk*	*Segments length :* *180°Crk*	*Segments length :* *144°Crk*	*Segments length :* *120°Crk*	*Segments length :* *90°Crk*

4.51.1 Fade out conditions of engine roughness segment adaptive process

FUNCTION DESCRIPTION:

Description:

LV_SEG_AD_FDOUT_ER combines all system conditions to generate a fade out condition as input for the generic segment adaptation process.

Update rate: segment occurrence for conditions & data process
10ms for free running decounters

Application conditions

Activation: `LV_ENA_SEG_T_MES = 1`

Deactivation: `LV_ENA_SEG_T_MES = 0`

Action on deactivation event ***Or*** *ECU reset:*

LV_SEG_AD_FDOUT_ER = 1
SEG_AD_FDOUT_ER_CDN = 0xFF
SEG_AD_FDOUT_ER_CDN_NR = 8

Definition of segment adaptation fade out conditions carrier:

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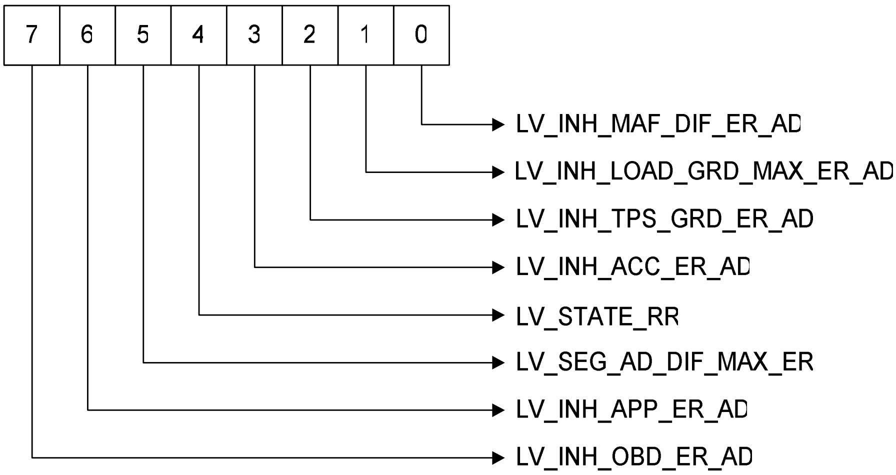
SEG_AD_FDOUT_ER_CDN : *Carrier used for fade-out conditions merge*



4.51.1.1 Configurable Fade-out Management

Application conditions:

The Fade out management of the segment adaptive process can be configured with a bitfield mask calibration that allow to take in account or not some conditions set in the carrier.
If the corresponding bit in the SEG_AD_FDOUT_ER_CDN carrier structure is set to 0 in C_MASK_SEG_AD_FDOUT_ER calibration, then the corresponding condition will not fade-out the segment adaptive process via LV_SEG_AD_FDOUT_ER.
The number of fade-out conditions not masked by this calibration is set in SEG_AD_FDOUT_ER_CDN_NR.

Formula section:

SEG_AD_FDOUT_ER_CDN_NR =
sum (SEG_AD_FDOUT_ER_CDN **&** C_MASK_SEG_AD_FDOUT_ER)
! (bitfield operation) !
If SEG_AD_FDOUT_ER_CDN_NR $\neq$ 0
Then LV_SEG_AD_FDOUT_ER = 1
Else LV_SEG_AD_FDOUT_ER = 0
EndIf

4.51.1.2 Maximum air-mass gradient

Due to trailing throttle /acceleration transition problems it is necessary to disable ER segment learning process for a short period when the air-mass gradient per segment exceeds a calibration value.

Application conditions:

ER segment adaptation is disabled while the absolute of the air-mass gradient exceeds the value mentioned below:
After the last triggering of this segment adaptation is suppressed for a period of C_T_MAF_DIF_DLY_ER_AD.

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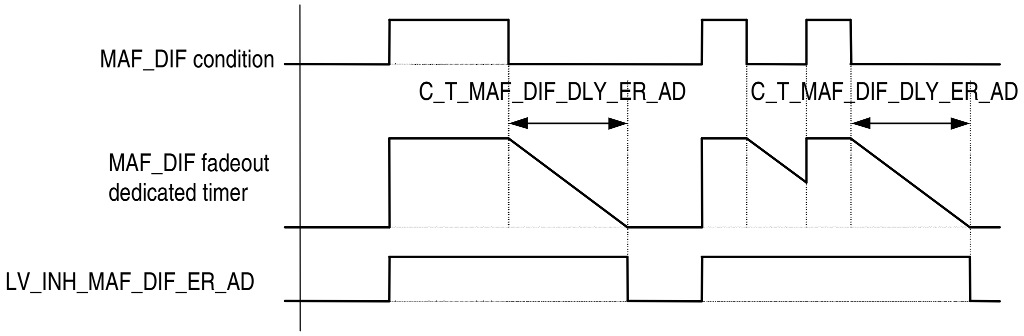
Formula section:

If | MAF_DIF | > IP_MAF_DIF_MAX_ER_AD(MAF)
Then
After condition rising edge triggering, LV_INH_MAF_DIF_ER_AD flag is set to 1 as long as condition is true.
After condition falling edge triggering, LV_INH_MAF_DIF_ER_AD flag is hold to 1 for a period of C_T_MAF_DIF_DLY_ER_AD.
EndIf

Fade out behaviour summary:



4.51.1.3 Maximum actual load gradient

Due to general intervention of the torque model it's necessary to disable ER segment adaptation for a short period when the actual torque gradient exceeds a calibration value.

Application conditions:

ER segment adaptation is disabled while the absolute of the torque gradient - here LOAD_GRD_MIS the reference for Misfire detection process - exceeds the value mentioned below.
After the last triggering of this segment adaptation is suppressed for a period of C_T_LOAD_GRD_DLY_ER_AD.

Formula section:

If LOAD_GRD_MIS > IP_LOAD_GRD_ER_AD(LOAD_MIS)
Then
After condition rising edge triggering, LV_INH_LOAD_GRD_MAX_ER_AD flag is set to 1 as long as condition is true.
After condition falling edge triggering, LV_INH_LOAD_GRD_MAX_ER_AD flag is hold to 1 for a period of C_T_LOAD_GRD_DLY_ER_AD.
EndIf

Fade out behaviour summary:

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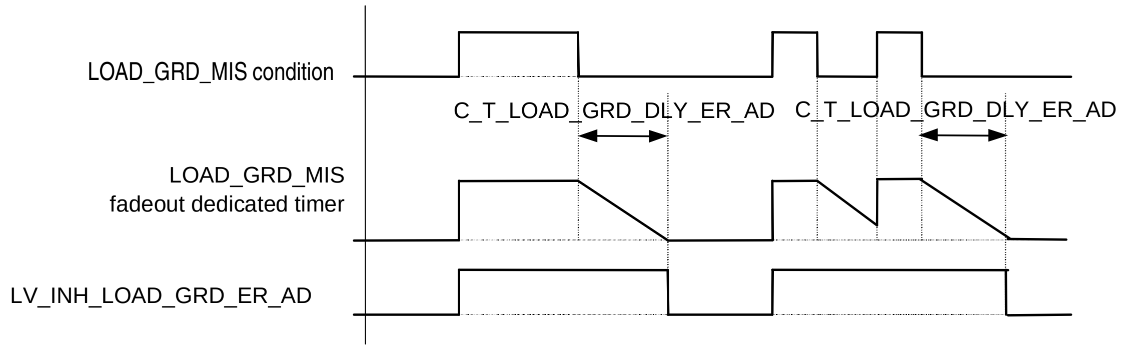


4.51.1.4 Maximum throttle gradient

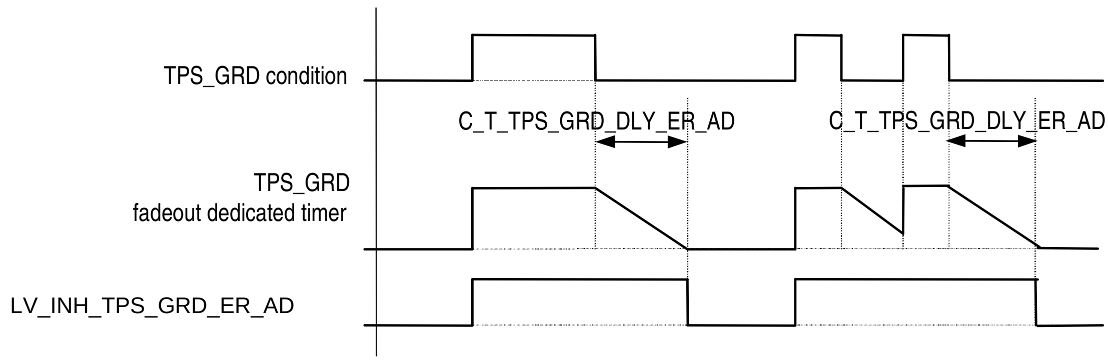
Due to trailing throttle /acceleration transient problems at low load it is necessary to disable ER segment adaptation for a short period when the throttle gradient exceeds a calibration value.

Application conditions:

ER segment adaptation is disabled while the throttle position gradient exceeds the value mentioned below.
After the last triggering of this segment adaptation is suppressed for a period of C_T_TPS_GRD_DLY_ER_AD.

Formula section:

If TPS_GRD > IP_TPS_GRD_MAX_ER_AD(TP_AV)
Then
After condition rising edge triggering, LV_INH_TPS_GRD_ER_AD flag is set to 1 as long as condition is true.
After condition falling edge triggering, LV_INH_TPS_GRD_ER_AD flag is hold to 1 for a period of C_T_TPS_GRD_DLY_ER_AD.
EndIf



4.51.1.5 Air - conditioning compressor activation

When the air - conditioning compressor is switched on, an additional load is briefly applied to the engine.
This load jump can cause an ER segment period jump and crankshaft vibration.

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Application conditions:

Engine roughness segment adaptation can be suppressed for the applicable constant period C_T_ACCOUT_DLY_ER_AD, starting if the air - conditioning compressor is switched on or off (LV_ACCOUT_RLY changes from 0 to 1 or from 1 to 0), during this period LV_INH_ACC_ER_AD is set to 1.

Formula section:

If LV_ACCOUT_RLY = 0 $\rightarrow$ 1
Or LV_ACCOUT_RLY = 1 $\rightarrow$ 0
Then LV_INH_ACC_ER_AD is set to 1 during C_T_ACCOUT_DLY_ER_AD
EndIf

4.51.1.6 Rough road condition active

Due to possible feedback from the driven wheels to the crankshaft it is necessary to fade out. ER segment adaptation when rough road condition is active (LV_STATE_RR = 1).

4.51.1.7 Engine roughness adaptive values on the same physical segment out of range

Due to possible feedback from Dual Mass Flywheel oscillations *(see transmission/crankshaft design)* in adaptive process engine speed range, fluctuations on ER adaptive values of identical physical segments can induce dissimilarity in ER segment correction. LV_SEG_AD_DIF_MAX_ER indicates that the engine roughness adaptive values difference on the same physical segment is out of range.
This flag is produced in the following chapter called: Engine roughness adaptive values difference on the same physical segment out of range.

4.51.1.8 Application specific inhibition request for engine roughness adaptive process

Due to possible accessories triggering specific to the application (CVT shifts...), an inhibition of the engine roughness adaptive process can be applied.
The inhibition is applied when LV_INH_APP_ER_AD = 1.

4.51.1.9 Inhibition request for engine roughness adaptive process linked to OBD errors

Due to possible troubles induced by OBD I sensors errors (CAM, CRK...), the engine roughness adaptive process can be inhibited by the flag LV_INH_OBD_ER_AD.
The inhibition is applied when LV_INH_OBD_ER_AD = 1.

4.51.2 End of line specific request for ER segment adaptive values learning process

General information:

During end of line plant, specific conditions to activate ER adaptive process can be used. If OBD end of line process occurs, this request has priority on nominal conditions.
Update rate: ER segment occurrence

Application conditions

Activation: `LV_ENA_SEG_T_MES = 1`

Deactivation: `LV_ENA_SEG_T_MES = 0`

*Action on deactivation event **Or** ECU reset:*
LV_SEG_AD_FDOUT_ER_EOL = 1

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Description:

If LV_EOL_OBD = 1 *// OBD end of line process request*
And LV_INJ_CUT = 1 *(all cylinders shut-off)* during last C_NR_SEG_AD_ACT_MIN_ER_EOL segments since last SEG_NR_MES = 0
And { [LV_AT = 1 **And** N_32 < C_N_MAX_SEG_AD_ER_EOL_AT
And N_32 > C_N_MIN_SEG_AD_ER_EOL_AT]
Or [LV_AT = 0 **And** N_32 < C_N_MAX_SEG_AD_ER_EOL_MT
And LV_VAR_TCT = 0 **And** N_32 > C_N_MIN_SEG_AD_ER_EOL_MT] **Or** [LV_AT = 0 **And** N_32 < C_N_MAX_SEG_AD_ER_EOL_TCT
And LV_VAR_TCT = 1 **And** N_32 > C_N_MIN_SEG_AD_ER_EOL_TCT] }

And DRV1_ER < C_DRV1_MAX_SEG_AD_ER_EOL during NR_SEG_DRV1_MIN_ER_EOL segments
And LC_SEG_AD_ER_REQ_EOL = 1
Then *// Request in specific EOL range for segment adaptive process*
LV_SEG_AD_FDOUT_ER_EOL = 0
Else *// No specific request*
LV_SEG_AD_FDOUT_ER_EOL = 1
EndIf

4.51.3 Engine roughness adaptive learning process management

Description:

The adaptive process is managed in two phases:

- A fast adaptive process for end of line procedures (EOL), who allow a fast convergence to ER flywheel adaptive values.
- At the end of the fast adaptive process, a slow adaptive process who will monitor ER adaptive values during the engine lifetime.

An end of line specific filtering mode, to be used on EOL or special service request.
At the beginning of the segment adaptation learning process, it is necessary to upper the engine roughness value with an additional offset (THD_AD_ER), depending on the target wheel tolerances to be excepted.
For instance, a flywheel with a ± 0.3°Crk mechanical tolerance on the ER segment corresponds to following segment drift:

Engine Type	ER Segment length	Induced Drift with ± 0.3°Crk tolerance on ER segment
3 cyl engine	240°Crk	2.5‰
4 cyl engine	180°Crk	3.33‰
5 cyl engine	144°Crk	4.17‰
6 cyl engine	120°Crk	5‰
8 cyl engine	90°Crk	6.68‰

The value by which the ER is increased at the beginning is gradually reduced to zero in a linear way until the 95% correction is obtained.
This number of steps is controlled by an internal adaptation counter CTR_SEG_AD_ER.

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4.51.3.1 Engine roughness adaptive learning process

First time initialisation :

The ER segment adaptive values learning process is initialised when :

- ECU is initialised for the first time *(flash memory formatting)*
- A loss of adaptation values has been detected *(flash memory corrupted)*.
- A specific external tool request occurs *(use of **LV_SEG_AD_RST_ER_EOL**)*

// ER segment adaptive process control variables reseted

CTR_SEG_AD_ER = 0
DELTA_CRK_DIF_MAX_ER = NC_CYL_NR * 4 * C_CRK_DIF_MAX_ER
LV_SEG_AD_AVL_ER = 0

Update rate: ER segment task, every engine cycle when SEG_NR_MES = 0 ; SEG_T_MES_0 segment acquired.

Application conditions:

Activation/Deactivation: (based on LV_SEG_AD_RAW_ER evaluation)

// Raw adaptive value monitoring activation

If LV_INJ_CUT = 1 *// All cylinders shut-off*
And N_32 < C_N_SEG_T_AD_RAW_MAX_ER
And N_32 > C_N_SEG_T_AD_RAW_MIN_ER
And LV_ENA_SEG_T_MES = 1
Then LV_SEG_AD_RAW_ER = 1
Else LV_SEG_AD_RAW_ER = 0
LV_SEG_AD_ER = 0
EndIf

Formula section:

// Adaptive value learning process activation

If(1) LV_SEG_AD_FDOUT_ER = 0
And [(LV_INJ_CUT = 1 *(all cylinders shut-off)* during last C_NR_SEG_AD_ACT_MIN_ER segments since last SEG_NR_MES = 0 **)**
And { **[** LV_AT = 1 **And** N_32 < C_N_MAX_SEG_AD_ER_AT
And N_32 > C_N_MIN_SEG_AD_ER_AT **]**
Or
[LV_AT = 0 **And** N_32 < C_N_MAX_SEG_AD_ER_TCT
And LV_VAR_TCT = 1 **And** N_32 > C_N_MIN_SEG_AD_ER_ TCT **]**
}
Or
[LV_AT = 0 **And** N_32 < C_N_MAX_SEG_AD_ER_MT
And LV_VAR_TCT = 0 **And** N_32 > C_N_MIN_SEG_AD_ER_ MT **]**
}

And DRV1_ER < C_DRV1_MAX_SEG_AD_ER during C_NR_SEG_DRV1_MIN_ER segments **)**
Or LV_SEG_AD_FDOUT_ER_EOL = 0 **]**
Then(1) LV_SEG_AD_ER = 1 *// ER adaptive learning process enable*
If(2) LV_SEG_AD_AVL_ER = 0
Then (2) *// First adaptive process phase*
If(3) LV_SEG_AD_FDOUT_ER_EOL = 0

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Then(3) CRLC_SEG_AD_ER = C_CRLC_SEG_AD_ER_EOL
Else(3)
If(4) LV_VAR_TCT = 0
Then(4)
CRLC_SEG_AD_ER = C_CRLC_FAST_SEG_AD_ER
Else(4)
CRLC_SEG_AD_ER = C_CRLC_FAST_SEG_AD_ER_TCT
EndIf(4)
EndIf(3)
DELTA_CRK_DIF_MAX_ER(n) = DELTA_CRK_DIF_MAX_ER(n-1)
- “NC_CYL_NR * 4 * C_CRK_DIF_MAX_ER * CRLC_SEG_AD_ER
3
CTR_SEG_AD_ER = CTR_SEG_AD_ER + 1 *(with saturation to max value)*
If(3) CTR_SEG_AD_ER C_NR_SEG_AD_AVL_ER
Then(3) LV_SEG_AD_AVL_ER = 1 *// First adaptive process phase achieved*
EndIf(3)
Else(2) *// Engine lifetime adaptive process phase*
CTR_SEG_AD_ER = CTR_SEG_AD_ER + 1 *(with saturation to max value)*
If(2) LV_SEG_AD_FDOUT_ER_EOL = 0
Then(2) CRLC_SEG_AD_ER = C_CRLC_SEG_AD_ER_EOL
Else(2)
If(4) LV_VAR_TCT = 0
Then(4)
CRLC_SEG_AD_ER = C_CRLC_SEG_AD_ER
Else(4)
CRLC_SEG_AD_ER = C_CRLC_SEG_AD_ER_TCT
EndIf(4)
EndIf(2)

EndIf(1)
Else(1) LV_SEG_AD_ER = 0 *// ER adaptive learning process disable*
EndIf(1)

4.51.3.2 Engine roughness offset during first adaptive process phase

Update rate: ER segment task

Application conditions

Activation: *LV_ENA_ER = 1*

Deactivation: *LV_ENA_ER = 0*

Action on deactivation condition ***Or*** *ECU reset :* THD_AD_ER = 0

Formula section:

If LV_SEG_AD_AVL_ER = 0
Then *// The ER offset factor THD_AD_ER is decreased via DELTA_CRK_DIF_MAX_ER value*
THD_AD_ER = DELTA_CRK_DIF_MAX_ER * SEG_T_COR
Else THD_AD_ER = 0
EndIf

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4.51.4 Engine roughness adaptive values calculation & filtering

FUNCTION DESCRIPTION:

This function allows to determinate the coefficients for ER segment adaptive values filters used in the learning process. Three different stages can be differentiate :

- Nominal ER segment adaptive values filtering mode, used to monitor adaptive values during engine lifetime.
- Fast ER segment adaptive values filtering mode, used to quickly obtain valid adaptive values when the EMS is new.
- EOL specific filtering mode, to be used on EOL or special service request.

LV_SEG_AD_LIM_ER is set if at least one SEG_AD_MMV_ER_x value exceeds C_SEG_AD_MAX_ER.

First time initialisation :

The ER segment adaptive values learning process is initialised when :

- ECU is initialised for the first time *(flash memory formatting)*
- A loss of adaptation values has been detected *(flash memory corrupted)*.
- A specific external tool request occurs *(use of LV_SEG_AD_RST_ER_EOL defined in Application Incidences file)*

// ER segment adaptive values reseted

For x = 0 ... [NC_CYL_NR-1]
SEG_AD_MMV_ER[x] = 0
EndFor
LV_SEG_AD_LIM_ER = 0

Initialisation at ECU reset:

For x = 0...(NC_CYL_NR - 1)
SEG_AD_RAW_MMV_ER[x] = SEG_AD_MMV_ER[x]
EndFor
Update rate: ER segment occurrence

Application conditions:

This process is executed every engine cycle when SEG_T_MES_0 (reference segment) is acquired and when the monitoring of the adaptive learning process is active
Activation: LV_SEG_AD_RAW_ER = 1
Process on activation transient:
If LC_SEG_AD_LIM_REAC_ER = 1 *// reactivation of the adaptive values range check*
Then LV_SEG_AD_LIM_ER = 0
Else No Operation
EndIf
Deactivation: LV_SEG_AD_RAW_ER = 0
Formula section: *Temporary data are in italic*
For(1) x = 0 ... to ... [NC_CYL_NR-1]
Deceleration correction factor *(temporary data)*:
FAC_DECE_SEG_AD_ER[x] =
(x /NC_CYL_NR) * (SEG_T_MES_CYL[0] - *SEG_T_MES_CYL[0]_prev*)
Raw adaptive values:

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SEG_AD_ER[x] =
[(SEG_T_MES_CYL[x] - *SEG_T_MES_CYL[0]_prev*) - *FAC_DECE_SEG_AD_ER[x]*] /*SEG_T_MES_CYL[0]_prev*

Engine roughness adaptive values filtering for monitoring and learning process:

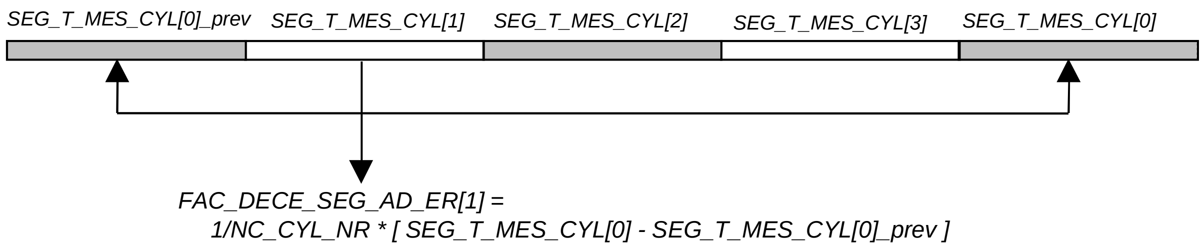
SEG_AD_RAW_MMV_ER[x]$_i$ = SEG_AD_RAW_MMV_ER[x]$_{i-1}$ +
C_CRLC_SEG_AD_RAW_ER * (*SEG_AD_ER[x]*$_i$ - SEG_AD_RAW_MMV_ER[x]$_{i-1}$)
If(2) LV_SEG_AD_ER = 1
Then(2) **If**(3) CTR_SEG_AD_ER = 1
Then(3) SEG_AD_MMV_ER[x]$_i$ = SEG_AD_ER[x]$_i$
Else(3) SEG_AD_MMV_ER[x]$_i$ = SEG_AD_MMV_ER[x]$_{i-1}$ +
CRLC_SEG_AD_ER * [*SEG_AD_ER*[x]$_i$ - SEG_AD_MMV_ER[x]$_{i-1}$]
EndIf(3)

Engine roughness adaptive values out of range check:

If(3) | SEG_AD_MMV_ER[x] | >= C_SEG_AD_MAX_ER
Then(3) LV_SEG_AD_LIM_ER = 1
EndIf(3)
EndIf(2)
If(2) LV_SEG_AD_ER = 1 → 0
And LV_SEG_AD_AVL_ER = 1
//no risk because THD_AD_ER = 0, CTR_SEG_AD_ER no more used
And LV_REQ_SEG_AD_MMV_ER_APP = 1
Then(2) SEG_AD_MMV_ER[x] = SEG_AD_MMV_ER_APP[x]
LV_SEG_AD_LIM_ER = 0
EndIf(2)
EndFor(1)

where:

SEG_AD_ER[x] : *raw adaptive value for logical segment x, temporary data*
FAC_DECE_SEG_AD_ER[x] : *deceleration correction factor, temporary data*
SEG_AD_RAW_MMV_ER[x] : *fast filtered adaptive value for logical segment x*
SEG_AD_MMV_ER[x] : *filtered adaptive value for logical segment x*
SEG_T_MES_CYL[0]_prev : *raw segment period of reference segment (SEG_NR_MES=0), on previous engine cycle, temporary data, oldest value*
SEG_T_MES_CYL[0] : *raw segment period of reference segment (SEG_NR_MES=0) after NC_CYL_NR segments (720° crank angle), newest value*



4.51.5 Engine roughness adaptive values difference on the same physical segment out of range

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Due to possible feedback from Dual Mass Flywheel oscillations *(see transmission/crankshaft design)* in adaptive process engine speed range, fluctuations on ER adaptive values of identical physical segments can induce dissimilarity in ER segment correction.
If difference between identical physical segments ER fast filtered adaptive values exceeds a calibratable gap, a fade out is applied.
ER identical physical segments adaptive value differences are evaluated each 720°Crk, for that this process is executed every engine cycle when SEG_T_MES_0 (*SEG_NR_MES = 0)* is acquired and when the adaptive monitoring process is active.
Update rate: *ER segment occurrence,*

Application conditions

Activation:
```
SEG_NR_MES = 0
And     LV_SEG_AD_RAW_ER = 1
```

Deactivation:
```
SEG_NR_MES != 0
Or      LV_SEG_AD_RAW_ER = 0
```

Initialisation :
```
on ECU reset:
LV_SEG_AD_DIF_MAX_ER = 0
#If       NC_CYL_NR = 4, 6 or 8
 SEG_AD_DIF_ER_0 = 0
 SEG_AD_DIF_ER_1 = 0
#EndIf
#If       NC_CYL_NR = 6 or 8
 SEG_AD_DIF_ER_2 = 0
#EndIf
#If       NC_CYL_NR = 8
 SEG_AD_DIF_ER_3 = 0
#EndIf
```

Formula section:

```
#If   NC_CYL_NR = 3 Or NC_CYL_NR = 5
  LV_SEG_AD_DIF_MAX_ER = 0
#EndIf
#If   NC_CYL_NR = 4
  SEG_AD_DIF_ER_0 = | SEG_AD_RAW_MMV_ER_0 - SEG_AD_RAW_MMV_ER_2 |
  SEG_AD_DIF_ER_1 = | SEG_AD_RAW_MMV_ER_1 - SEG_AD_RAW_MMV_ER_3 |
  If        SEG_AD_DIF_ER_0 >= C_SEG_AD_DIF_MAX_ER
                Or       SEG_AD_DIF_ER_1 >= C_SEG_AD_DIF_MAX_ER
  Then   LV_SEG_AD_DIF_MAX_ER = 1
  Else   LV_SEG_AD_DIF_MAX_ER = 0
  EndIf
#EndIf
#If   NC_CYL_NR = 6
  SEG_AD_DIF_ER_0 = | SEG_AD_RAW_MMV_ER_0 - SEG_AD_RAW_MMV_ER_3 |
  SEG_AD_DIF_ER_1 = | SEG_AD_RAW_MMV_ER_1 - SEG_AD_RAW_MMV_ER_4 |
  SEG_AD_DIF_ER_2 = | SEG_AD_RAW_MMV_ER_2 - SEG_AD_RAW_MMV_ER_5 |
  If        SEG_AD_DIF_ER_0 >= C_SEG_AD_DIF_MAX_ER
                Or       SEG_AD_DIF_ER_1 >= C_SEG_AD_DIF_MAX_ER
                      Or       SEG_AD_DIF_ER_2 >= C_SEG_AD_DIF_MAX_ER
  Then   LV_SEG_AD_DIF_MAX_ER = 1
  Else   LV_SEG_AD_DIF_MAX_ER = 0
  EndIf
```

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#EndIf
#If NC_CYL_NR = 8
SEG_AD_DIF_ER_0 = | SEG_AD_RAW_MMV_ER_0 - SEG_AD_RAW_MMV_ER_4 |
SEG_AD_DIF_ER_1 = | SEG_AD_RAW_MMV_ER_1 - SEG_AD_RAW_MMV_ER_5 |
SEG_AD_DIF_ER_2 = | SEG_AD_RAW_MMV_ER_2 - SEG_AD_RAW_MMV_ER_6 |
SEG_AD_DIF_ER_3 = | SEG_AD_RAW_MMV_ER_3 - SEG_AD_RAW_MMV_ER_7 |
If SEG_AD_DIF_ER_0 >= C_SEG_AD_DIF_MAX_ER
Or SEG_AD_DIF_ER_1 >= C_SEG_AD_DIF_MAX_ER
Or SEG_AD_DIF_ER_2 >= C_SEG_AD_DIF_MAX_ER
Or SEG_AD_DIF_ER_3 >= C_SEG_AD_DIF_MAX_ER
Then LV_SEG_AD_DIF_MAX_ER = 1
Else LV_SEG_AD_DIF_MAX_ER = 0
EndIf
#EndIf

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4.52 Engine roughness signal preparation for cylinder balancing

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DLY_DRV1_STND_BAL	V	0... FFFFH	0... 65535	1	-
Segment delay counter for acceleration fade out of cylinder balancing					
DLY_DRV1_STND_BAL	V	0... FFFFH	0... 65535	1	-
Segment delay for acceleration fade out of cylinder balancing					
DRV1_STND_BAL	V	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Standardized acceleration component of the ER value					
ER_STD_BAL [NC_CYL_NR]	V	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Standard deviation of the engine roughness					
ER_STD_DIF_BAL	V	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Difference of the filtered normalized and normalized engine roughness values for calc. of the standard deviation					
ER_STD_MMV_BAL [NC_CYL_NR]	O/V/S	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Filtered standard deviation of the engine roughness					
ER_STND_BAL	V	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Normalized cylinder selective engine roughness values					
ER_STND_FIL_BAL	V	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Normalized cylinder selective engine roughness values after median filter					
ER_STND_MMV_BAL [NC_CYL_NR]	O/V/S	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Filtered normalized cylinder selective engine roughness values					
ER_STND_MMV_DIF_BAL [NC_CYL_NR]	O/V	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Difference of filtered normalized and average engine roughness value					
ER_STND_MMV_MV_BAL	V	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Mean value of all engine roughness values of the last [NC_CYL_NR] segments					
ER_STND_MMV_STD_BAL [NC_CYL_NR]	O/V/S	8000... 7FFFH	-325.78 ...325.77	0.00994202	1/s**2
Filtered normalized engine roughness values for calculation of the standard deviation					
LV_DRV1_STND_BAL_FDOUT	O/V	0... 1H	0 ...1	1	-
Flag for acceleration fade out of cylinder balancing					

Input data:

DRV1_ER {p. 1454}	ER {p. 1454}	LV_DRV1_ER_BAL_ACT {p. 4022}	LV_ER_STND_ER_BAL_ ACT {p. 4022}
N_32 {p. 1525}	NC_CYL_NR {p. 1526}	SEG_NR_ER {p. 1454}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_ER_STD_BAL	-	0... FFH	0... 0.99609307	0.00390625	-
Correlation constant for ER_STND_FIL_BAL value filter for standard deviation					
C_CRLC_ER_STD_MMV_BAL	-	0... FFH	0... 0.99609307	0.00390625	-
Correlation constant for ER_STD_BAL value filter					
C_CRLC_ER_STND_BAL	-	0... FFH	0... 0.99609307	0.00390625	-
Correlation constant for ER_STND_FIL_BAL value filter					
C_CTR_DLY_DRV1_STND_BAL_DEC	-	0... FFH	0... 255	1	-
Segment delay counter decrement value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_ER_STD_NEG_BAL	-	0... FFH	0... 0.99609307	0.00390625	-
Weighting factor for negative ER_STD_DIF_BAL values					
C_FAC_ER_STD_POS_BAL	-	0... FFH	0... 0.99609307	0.00390625	-
Weighting factor for positive ER_STD_DIF_BAL values					
IP_DLY_DRV1_STND_BAL	-	0... FFFFH	0... 65535	1	-
LDP_DRV1_STND_BAL_IP_DLY_BAL	8	0... FFFFH	-325.78 ...325.77	0.0099313	1/s**2
Segment delay counter start value					

General information:

Attention - This specification version (402U01) is only valid for software variants which are providing the input variables ER and DRV1_ER as 16 bit values.

The engine roughness signal ER as well as the dynamic part of the engine roughness signal DRV1_ER are used as basis for the calculation of the input signal for the cylinder balancing control functions. The calculations are kept cylinder individual corresponding on the actual segment number SEG_NR_ER.

The module "Engine roughness signal preparation for cylinder balancing" is divided in two separate chapters. Within the first part the calculation of the input signals for the cylinder balancing controller is done, while the second part is providing fade out conditions while cylinder balancing has to be interrupted.

Application Condition

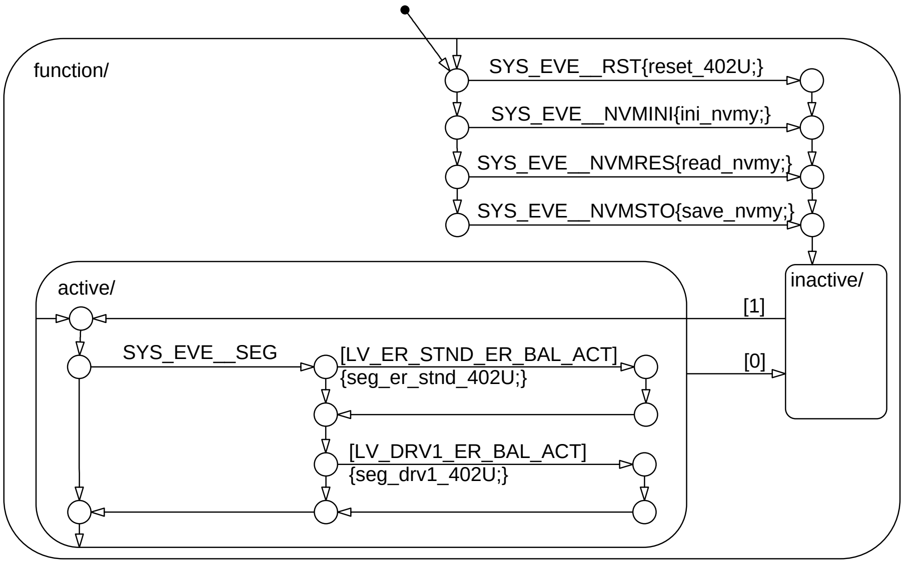

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Figure 4.52.1: CYBL_SIGNAL/APP_CDN/Chart

Function Description

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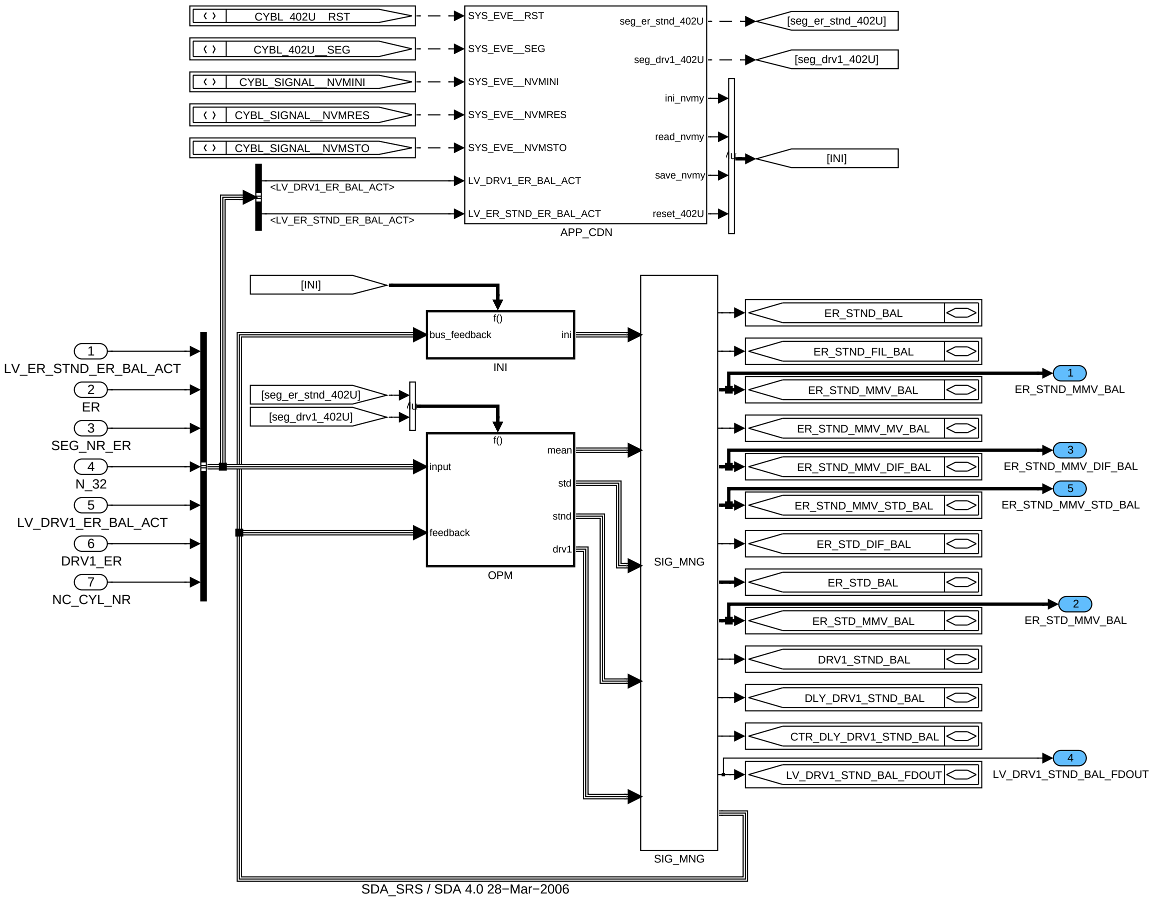

Figure 4.52.2: CYBL_SIGNAL

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4.52.1 SUBFUNCTION: INI

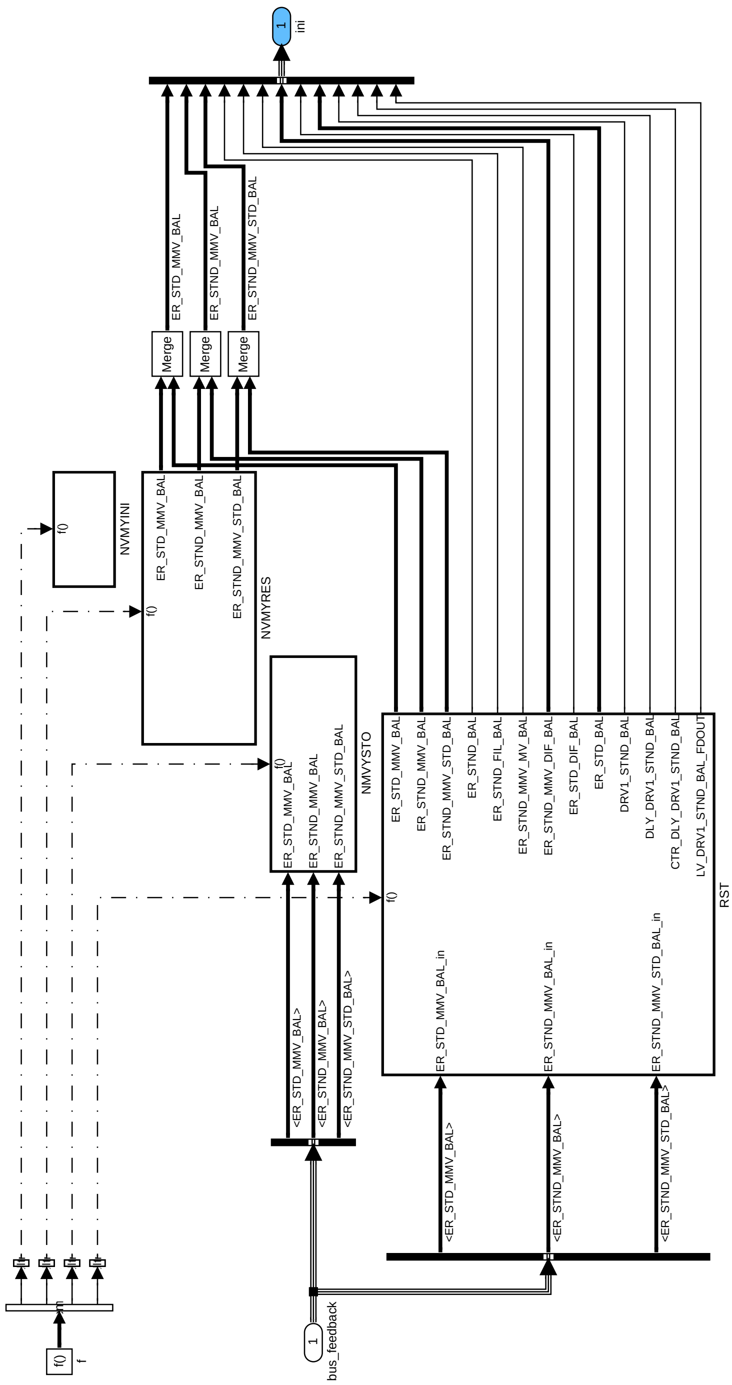

Figure 4.52.3: CYBL_SIGNAL/INI

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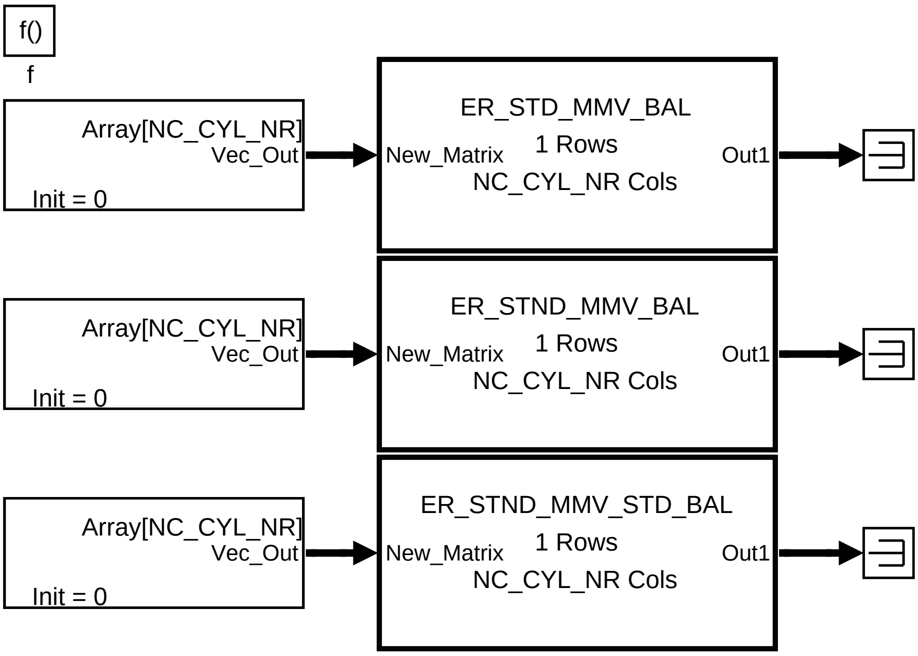

Figure 4.52.4: CYBL_SIGNAL/INI/NVMYINI

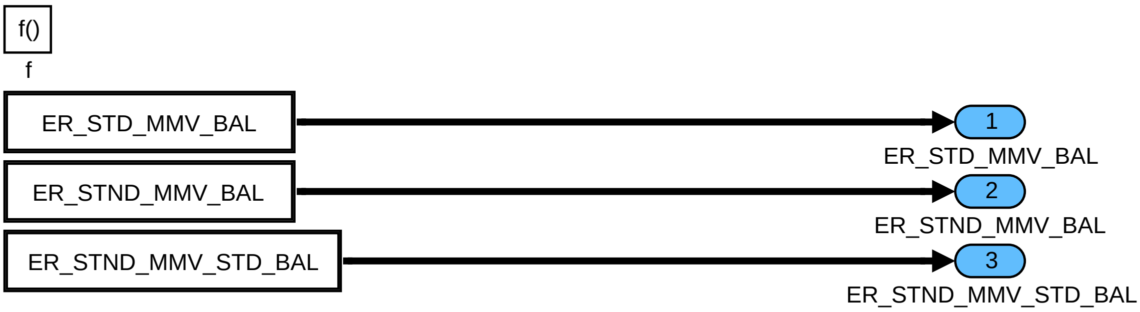

Figure 4.52.5: CYBL_SIGNAL/INI/NVMYRES

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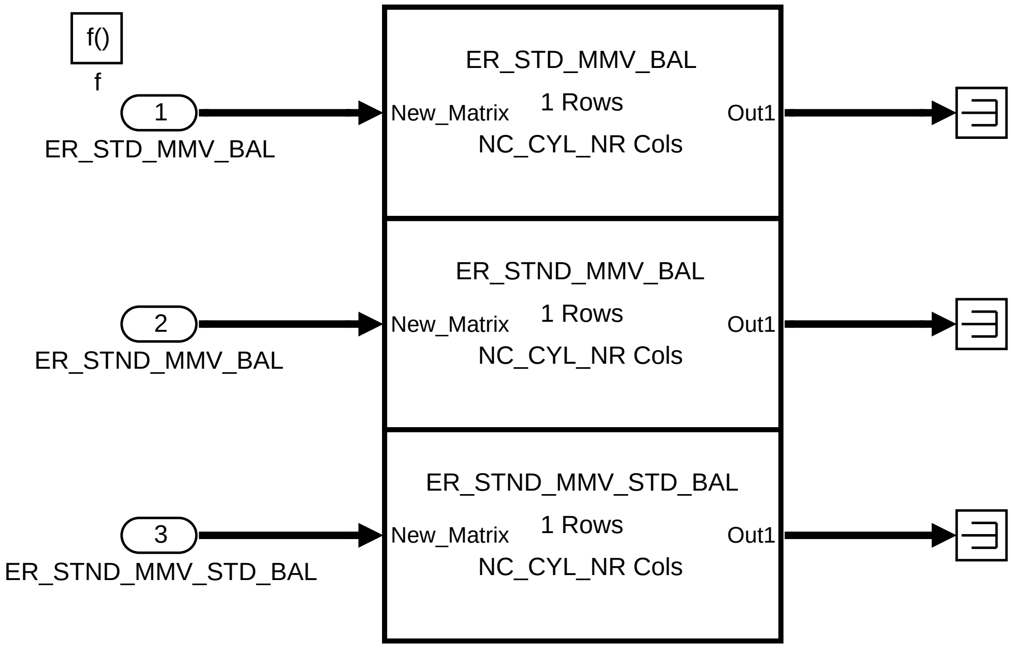

Figure 4.52.6: CYBL_SIGNAL/INI/NMVYSTO

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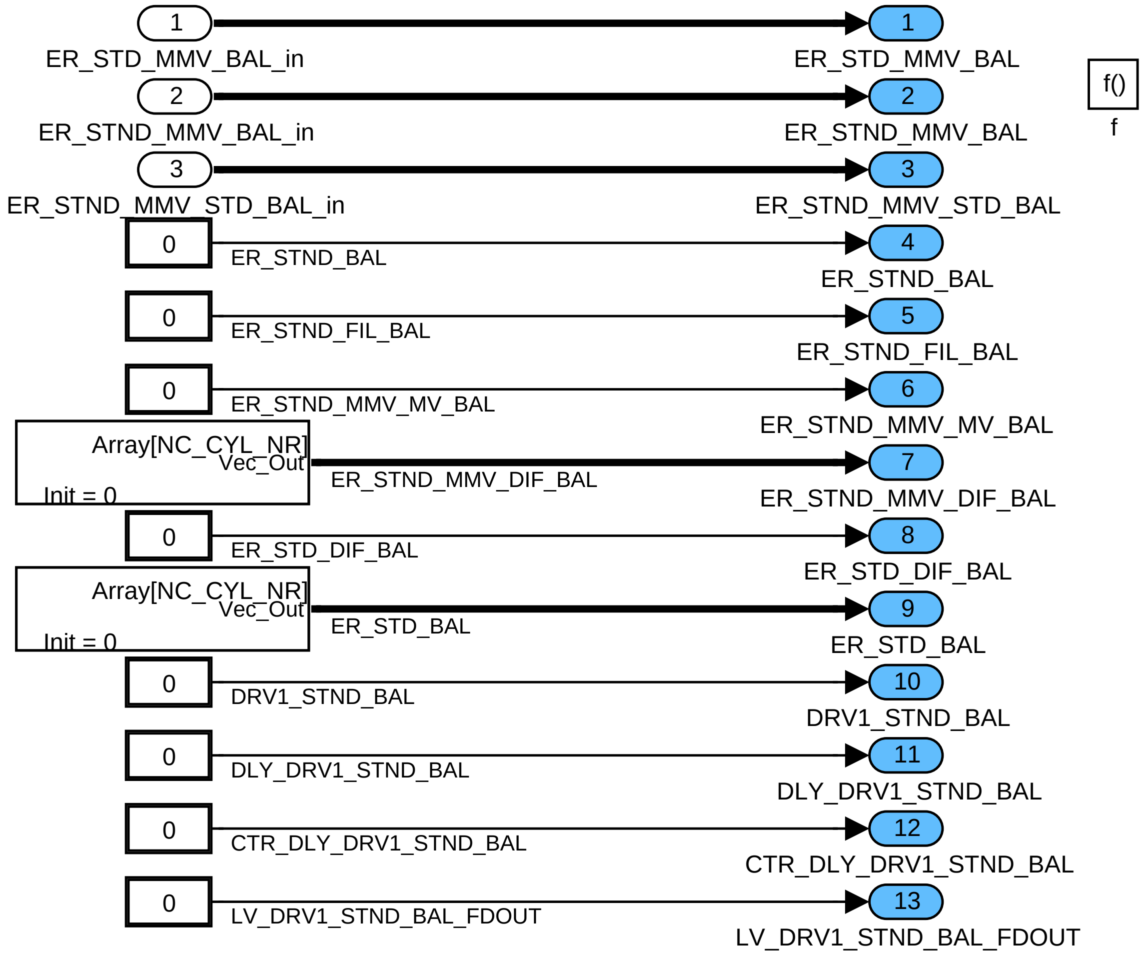

Figure 4.52.7: CYBL_SIGNAL/INI/RST

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4.52.2 Calculation of OPR_ER_STND and OPR_DRV1 - tasks

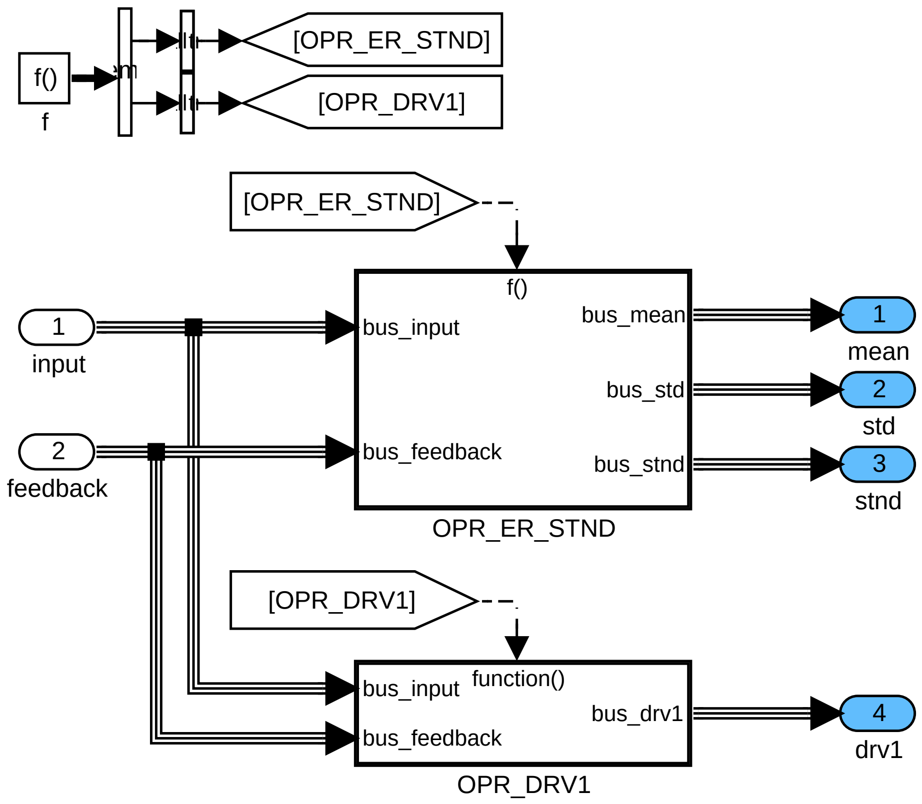

Figure 4.52.8: CYBL_SIGNAL/OPM

Input signals for cylinder balancing adaptation functions

The ER values are used to calculate normalized cylinder selective engine roughness values ER_STND_BAL. After normalization (multiplication by N_32ˆ3), the cylinder selective values are filtered by a Median Filter and a PT1-Filter.

In addition, moving mean values are built (ER_STND_MMV_STD_BAL[SEG_NR_ER]) for the calculation of cylinder specific standard deviations (ER_STD_BAL[SEG_NR_ER]).

The standard deviation ER_STD_DIF_BAL is calculated by subtracting the moving mean values ER_STND_MMV_STD_BAL[SEG_NR_ER] from the ER_STND_BAL values.
The resulting difference ER_STD_DIF_BAL is multiplied with a weighting factor for negative and positive values (C_FAC_ER_STD_NEG/POS_BAL). Afterwards a moving mean value is calculated based on this weighted signal.

To allow a cylinder specific adaptation via the engine roughness, a specific signal has to be created for each cylinder. Therefore, from the variable ER_STND_MMV_BAL[SEG_NR_ER] the value ER_STND_MMV_MV_BAL (average value of all cylinder specific moving mean values) is subtracted.

The values ER_STD_MMV_BAL[SEG_NR_ER], ER_STND_MMV_BAL[SEG_NR_ER] and ER_STND_MMV_STD_BAL[SEG_NR_ER] are stored in the non-volatile memory (NVMY) and used for initialization issues at next engine run.

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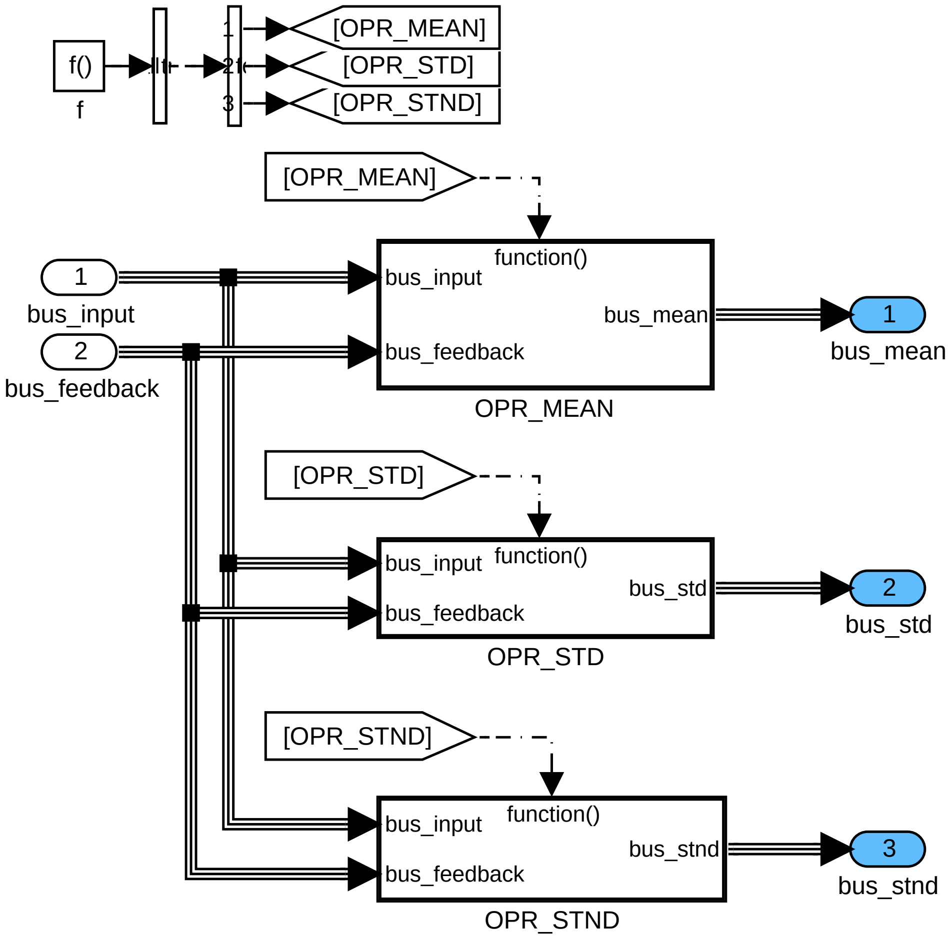

Figure 4.52.9: CYBL_SIGNAL/OPM/OPR_ER_STND

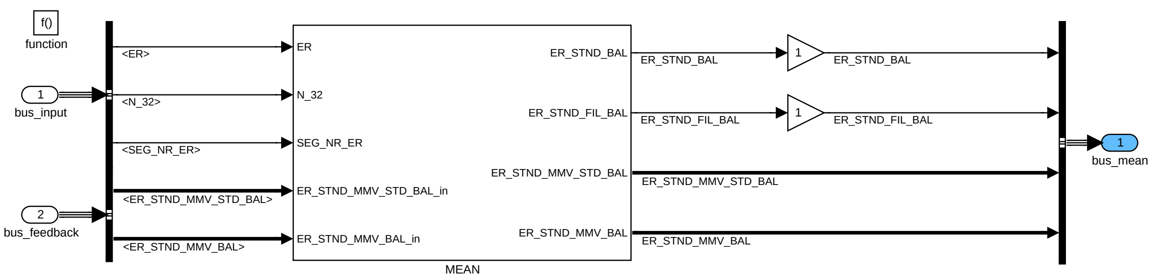

Figure 4.52.10: CYBL_SIGNAL/OPM/OPR_ER_STND/OPR_MEAN

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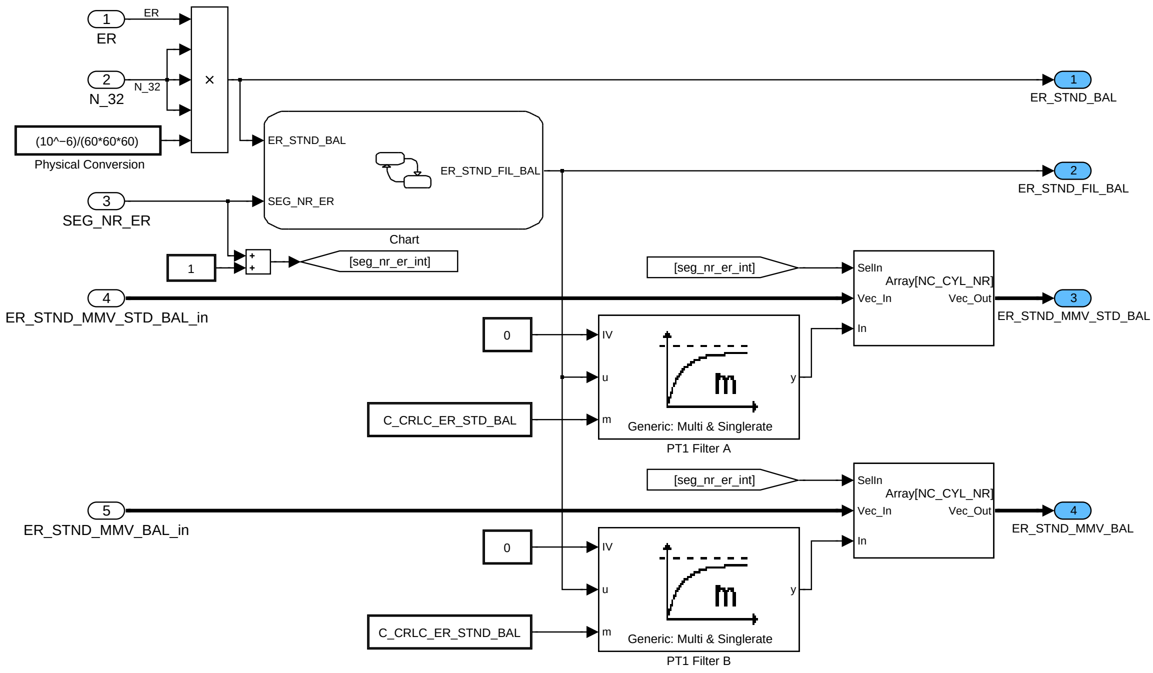

Figure 4.52.11: CYBL_SIGNAL/OPM/OPR_ER_STND/OPR_MEAN/MEAN

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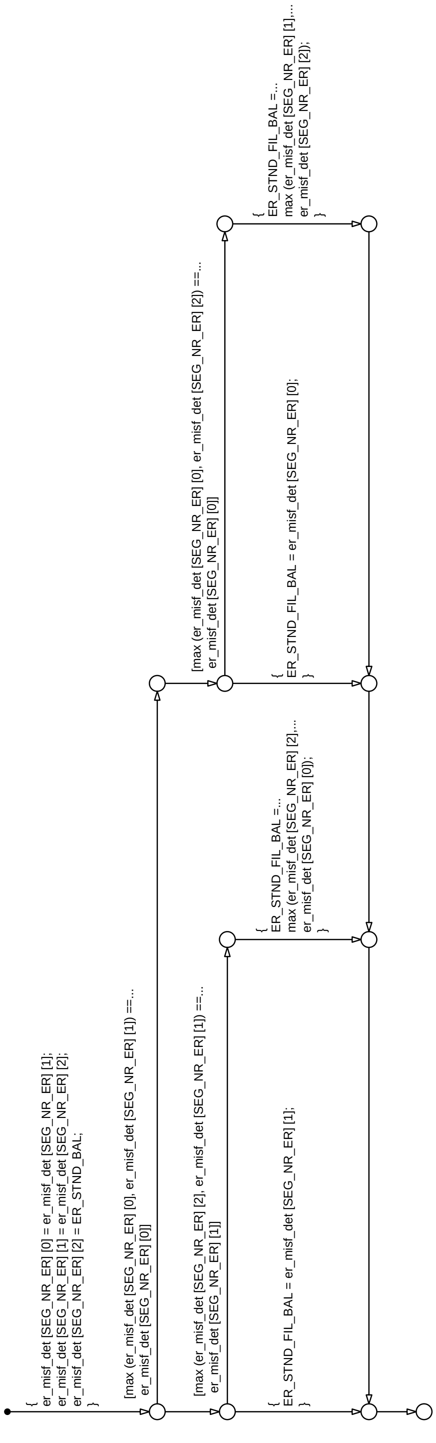

Figure 4.52.12: CYBL_SIGNAL/OPM/OPR_ER_STND/OPR_MEAN/MEAN/Chart

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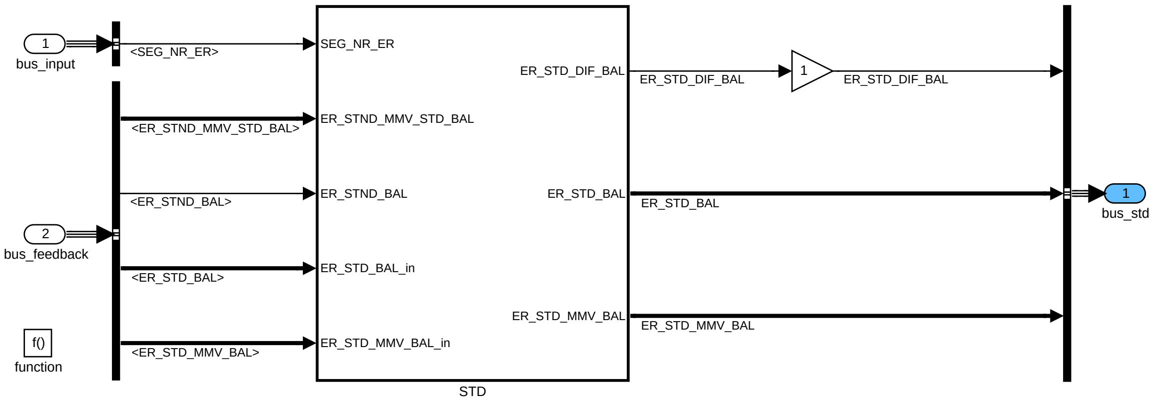

Figure 4.52.13: CYBL_SIGNAL/OPM/OPR_ER_STND/OPR_STD

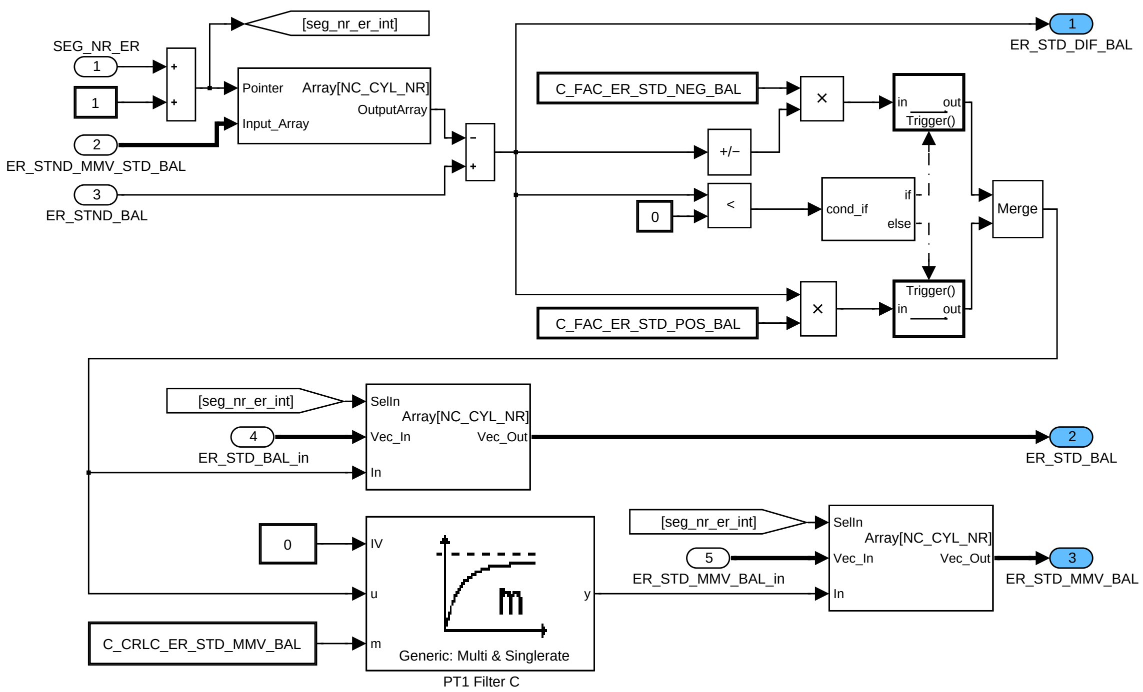

Figure 4.52.14: CYBL_SIGNAL/OPM/OPR_ER_STND/OPR_STD/STD

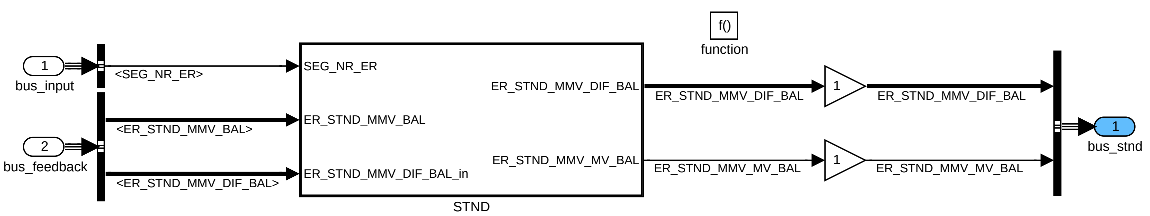

Figure 4.52.15: CYBL_SIGNAL/OPM/OPR_ER_STND/OPR_STND

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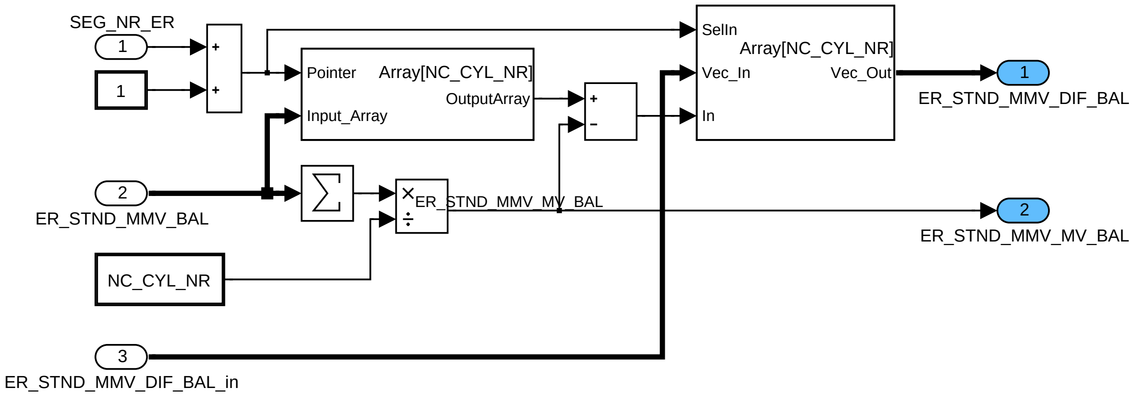

Figure 4.52.16: CYBL_SIGNAL/OPM/OPR_ER_STND/OPR_STND/STND

Calculation of cylinder balancing acceleration fade out conditions

Multiplying the dynamic component (DRV1_ER) part of the engine roughness calculation with the engine speed by the power of three normalizes the signal. The defined signal is reproducing the engine acceleration in numbers. If the acceleration is quite high or low, in case of speeding up or down, the cylinder balancing adaptation is stopped for a certain number of segments. The number of segments are stored in a counter, which is counting back to zero in certain steps as mentioned in the signal flow diagram.

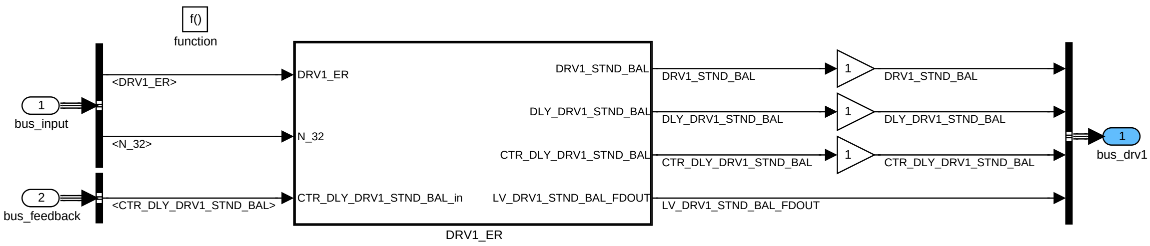

Figure 4.52.17: CYBL_SIGNAL/OPM/OPR_DRV1

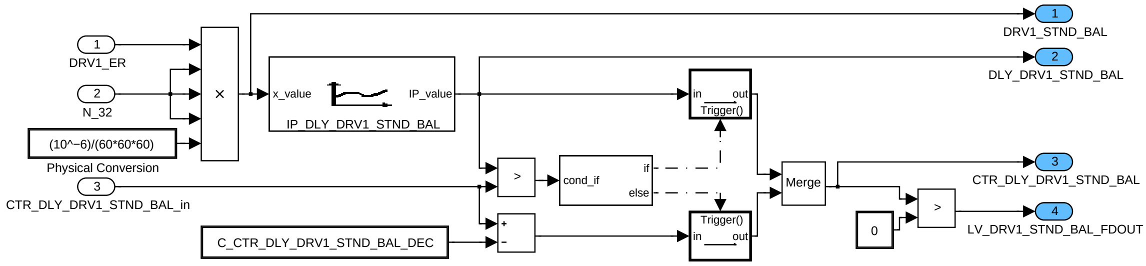

Figure 4.52.18: CYBL_SIGNAL/OPM/OPR_DRV1/DRV1_ER

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4.52.3 SUBFUNCTION: SIG_MNG

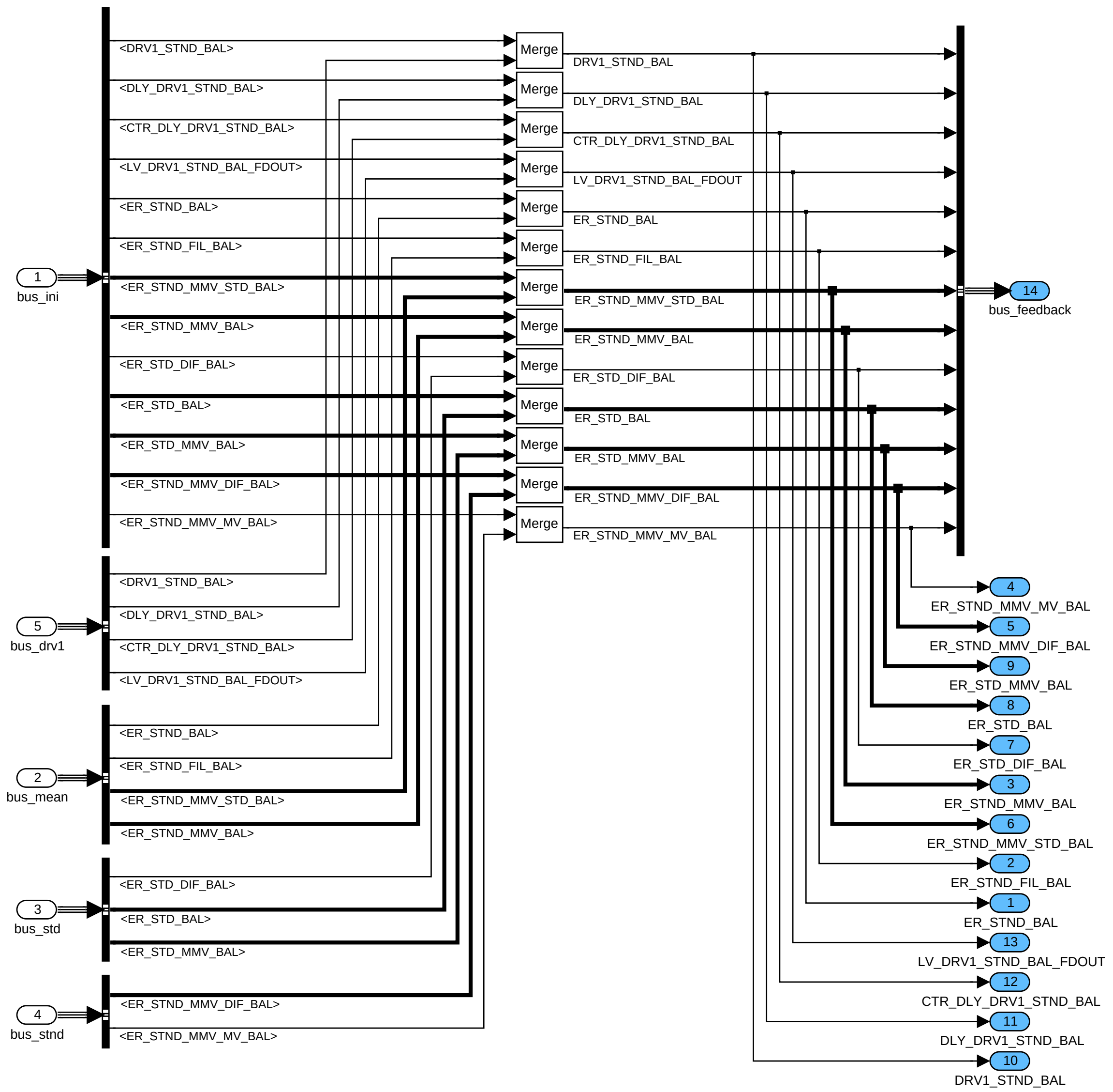

Figure 4.52.19: CYBL_SIGNAL/SIG_MNG

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4.53 Emission related variables definition

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VLS_DOWN_MAX_DC [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Max Voltage Value in a DC					
VLS_DOWN_MIN_DC [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Min Voltage Value in a DC					

Input data:

LV_DC {p. 5746}	LV_END_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_END_DIAG_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}

4.53.1 Calculation of minimum /maximum downstream lambda sensor voltage for service $06

FUNCTION DESCRIPTION:

VLS_DOWN_MIN/MAX_DC[NC_CBK_EX_NR] are used for OBD communication (MODE 06h), indicating the maximum/minimum downstream voltage to check if sensors are not aged or damaged. Once the electical diagnosis (SCP and SCG) of the downstream lambda sensors has been completed in a driving cycle, VLS_DOWN_MIN/MAX_DC [NC_CBK_EX_NR] are updated respectively by VLS_DOWN[NC_CBK_EX_NR].

Application conditions

Initialisation: `VLS_DOWN_MIN_DC[NC_CBK_EX_NR = 0.425[V]`
`VLS_DOWN_MAX_DC[NC_CBK_EX_NR = 0.425[V]`
`at reset` **or** `clearing FMY` **or** `LV_DC 0->1`

Recurrence: *100ms*

Activation: *LV_DC = 1*

Formula section:

IF LV_END_DIAG_SCG_LS_DOWN[NC_CBK_EX_NR] =1 **AND**
VLS_DOWN[NC_CBK_EX_NR] < VLS_DOWN_MIN_DC[NC_CBK_EX_NR]
THEN VLS_DOWN_MIN_DC[NC_CBK_EX_NR] = VLS_DOWN[NC_CBK_EX_NR]
ENDIF
IF LV_END_DIAG_SCP_LS_DOWN[NC_CBK_EX_NR] =1 **AND**
VLS_DOWN[NC_CBK_EX_NR] > VLS_DOWN_MAX_DC[NC_CBK_EX_NR]

THEN VLS_DOWN_MAX_DC[NC_CBK_EX_NR] = VLS_DOWN[NC_CBK_EX_NR]
ENDIF

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4.54 Runtime counters

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TRT	O/V/S	0... FFFFFFFFH	0... 119304.64708	27.7999e-6	h
Total running time					

Input data:

LV_ES {p. 1720}	LV_IGK {p. 906}		

Function description:

The total running time is incremented by 100ms each if the conditions "ignition key ON" and "engine running" has been detected.
The total running time is saved in the non-volatile memory at the end of the driving cycle.

Formula section:

IF LV_IGK = 1 UND LV_ES = 0
THEN TRT = TRT + 2,7778e-5h
ELSE TRT = TRT

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4.55 Engine position control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_VLD_CAM_SYN_CRK	V	0... FFH	0... 255	1	-
Counter for validation of camshaft signal for crankshaft synchronization					
LV_ACT_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Selfsynchronisation activated on exhaust camshaft i					
LV_ACT_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Selfsynchronisation activated on intake camshaft i					
LV_ACT_CRK	O/V	0... 1H	0 ...1	1	-
Crankshaft acquisition active					
LV_ACT_LIH_CRK_CAM_EX [NC_NR_CAM_CBK]	V	0... 1H	0 ...1	1	-
Crankshaft limp-home operating mode activated on exhaust camshaft i					
LV_ACT_LIH_CRK_CAM_IN [NC_NR_CAM_CBK]	V	0... 1H	0 ...1	1	-
Crankshaft limp-home operating mode activated on intake camshaft i					
LV_ACT_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Crankshaft synchronization operating mode activated on exhaust camshaft i					
LV_ACT_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Crankshaft synchronization operating mode activated on intake camshaft i					
LV_CRK_MISS_RUN_ENG	O/V	0... 1H	0 ...1	1	-
Boolean information engine running after engine stop request					
LV_ENG_BACK_CFM	O/V	0... 1H	0 ...1	1	-
Engine backwards rotation confirmed					
LV_ENG_BACK_DET	O/V	0... 1H	0 ...1	1	-
Engine backwards rotation detected					
LV_ERR_CAM	O/V	0... 1H	0 ...1	1	-
Failure on all camshaft sensor signals in normal mode					
LV_ERR_LIH_CRK_CAM	V	0... 1H	0 ...1	1	-
No more camshaft sensor signals available for crankshaft limp-home mode					
LV_FIRST_VLD_TOOTH	O/V	0... 1H	0 ...1	1	-
First tooth detected after engine stop					
LV_LIH_ERR_CAM	V	0... 1H	0 ...1	1	-
Camshaft limp-home mode (failure on all camshaft sensors)					
LV_LIH_ERR_CRK	O/V	0... 1H	0 ...1	1	-
Crankshaft limp-home mode (crankshaft sensor failure)					
LV_RUN_ENG	O/V	0... 1H	0 ...1	1	-
Engine running					
LV_STOP_ENG	O	0... 1H	0 ...1	1	-
Boolean information for engine stop request					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SYN_ENG	O/V	0... 1H	0 ...1	1	-
Boolean information for engine synchronization completed.					
LV_SYN_VLD	O/V	0... 1H	0 ...1	1	-
Engine synchronization validated					
PSN_ENG_CAM_LIH_CRK	O	0... 2CFFH	0... 719.9375	0.0625	°CRK
Engine position in crankshaft limp-home mode					
PSN_ENG_CRK	O	0... 2CFFH	0... 719.9375	0.0625	°CRK
Engine position from crankshaft					
ST_EPM	-	0... 8H	0 ...8	1	-
Engine position manager state					

Input data:

C_DYW_CAM_CRK_SYN_ ADC_EX {p. 873}	C_DYW_CAM_CRK_SYN_ ADC_IN {p. 873}	C_DYW_CAM_CRK_SYN_ RTD_EX {p. 873}	C_DYW_CAM_CRK_SYN_ RTD_IN {p. 873}
C_N_NOT_REST {p. 4456}	IDX_EDGE_CAM_EX [NC_NR_CAM_CBK] {p. 871}	IDX_EDGE_CAM_IN [NC_NR_CAM_CBK] {p. 871}	LC_ENG_BACK_INH {p. 4457}
LV_CAM_LIH_EXT_ENA {p. 1717}	LV_CAM_STOP_EX [NC_NR_CAM_CBK] {p. 871}	LV_CAM_STOP_IN [NC_NR_CAM_CBK] {p. 871}	LV_CAM_SYN_CRK {p. 871}
LV_CRK_FIRST_VLD_ TOOTH {p. 853}	LV_CRK_MISS_TOOTH {p. 853}	LV_CRK_RUN {p. 853}	LV_CRK_STOP {p. 853}
LV_CRK_SYN {p. 853}	LV_ERR_CAM_EX [NC_NR_CAM_CBK] {p. 4455}	LV_ERR_CAM_IN [NC_NR_CAM_CBK] {p. 4455}	LV_ERR_CRK {p. 4455}
LV_IGK {p. 906}	LV_LOST_SYN_CRK {p. 853}	LV_ORNG_CAM_SYN_ CRK {p. 871}	LV_ORNG_RATIO_CAM_ EX [NC_NR_CAM_CBK] {p. 871}
LV_ORNG_RATIO_CAM_ IN [NC_NR_CAM_CBK] {p. 871}	LV_SEG_NR_UPD_REQ {p. 1717}	LV_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 872}	LV_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 872}
LV_SYN_VLD_CAM_LIH {p. 1717}	N {p. 1525}	N_TOOTH {p. 1525}	NC_ACT_CAM_EDGE_LIH {p. 874}
NC_ACT_CAM_EDGE_ SYN {p. 874}	NC_NR_TOOTH {p. 854}	NC_OFS_TDC0_REF_CRK {p. 854}	NC_PSN_EDGE_CAM_EX [NC_NR_EDGE_CAM_ EX][NC_NR_CAM_CBK] {p. 874}
NC_PSN_EDGE_CAM_IN [NC_NR_EDGE_CAM_ IN][NC_NR_CAM_CBK] {p. 874}	PSN_EDGE_AD_CAM_EX [NC_NR_EDGE_CAM_ EX][NC_NR_CAM_CBK] {p. 1534}	PSN_EDGE_AD_CAM_IN [NC_NR_EDGE_CAM_ IN][NC_NR_CAM_CBK] {p. 1534}	PSN_ENG_CRK_OFS {p. 872}
PSN_ENG_ENSD {p. 1525}	PSN_ENG_SYN_CAM_ MIN {p. 872}		

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_STOP_ENG	-	0... FFH	0... 2550	10	ms
Delay time for engine running after engine stop request					
ID_NR_VLD_CAM_SYN_CRK	-	0... FFH	0... 255	1	-
LDP_N_ID_NR_VLD_CAM_SYN_CRK	2	0... 1FE0H	0... 8160	1	rpm
Number of camshaft signal edges to validate cam/crk synchronization					
LC_INH_LIH_CAM	-	0... 1H	0 ...1	1	-
Inhibition of camshaft limp-home mode					
LC_INH_LIH_CRK	-	0... 1H	0 ...1	1	-
Inhibition of crankshaft limp-home mode					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_CAM_CBK	-	1... 2H	1 ...2	1	-
Camshaft sensor(s) present on one or two cylinder banks					
NC_PRI_LIH_CAM_CBK	-	1... 2H	1 ...2	1	-
Priority for limp-home mode on camshaft sensor(s) of cylinder bank 1 or 2					
NC_PRI_LIH_CAM_IN	-	0... 1H	0 ...1	1	-
Priority for limp-home mode on intake camshaft sensor(s)					
NC_PRI_SYN_CAM_CBK	-	1... 2H	1 ...2	1	-
Priority for synchronization on camshaft sensor(s) of cylinder bank 1 or 2					
NC_PRI_SYN_CAM_IN	-	0... 1H	0 ...1	1	-
Priority for synchronization mode on intake camshaft sensor(s)					
NLC_CAM_EX	-	0... 1H	0 ...1	1	-
Exhaust camshaft sensor(s) present in the system					
NLC_CAM_IN	-	0... 1H	0 ...1	1	-
Intake camshaft sensor(s) present in the system					
NLC_LIH_CAM_EX	-	0... 1H	0 ...1	1	-
Exhaust camshaft sensor(s) available for crankshaft limp-home					
NLC_LIH_CAM_IN	-	0... 1H	0 ...1	1	-
Intake camshaft sensor(s) available for crankshaft limp-home					

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FUNCTION DESCRIPTION:

General information:

The Engine Position Manager provides a summary of camshaft and crankshaft synchronization status information to the system. It sets the operating modes of camshaft and crankshaft acquisition depending on synchronization status, availability, and detected failures. The signal source for engine position will be selected based on the activated operating mode.
Camshaft and crankshaft signal acquisition will be set passive for a calibrated delay after key-off has been detected at low engine speed, and for another calibrated delay after a loss of synchronization at low engine speed. This avoids wrong injection, ignition and diagnosis with backward rotation after rapid key-off/on or stalling.
i = 1...NC_NR_CAM_CBK z = 0...NC_NR_EDGE_CAM_IN/EX

Description:

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Engine synchronized (LV_SYN_ENG)	Yes (LV_SYN_ENG = 1)	No (LV_SYN_ENG = 0)
Crankshaft sensor available (LV_ERR_CRK = 0) At least one camshaft sensor available (LV_ERR_CAM = 0)	Standard Mode: Engine position and speed calculation with crankshaft sensor signal	Standard Mode Engine synchronisation with camshaft and crankshaft sensor information
Crankshaft sensor available (LV_ERR_CRK = 0) Failure on **all** Camshaft sensors (LV_ERR_CAM = 1)	Limp home Cam: Engine position and speed calculation with crankshaft sensor signal	Limp home Cam: Engine synchronisation without camshaft sensor information
Crankshaft sensor failure (LV_ERR_CRK = 1) At least one camshaft sensors available for crank limp-home (LV_ERR_LIH_CRK_CAM = 0)	Limp home Crank: Engine position and speed calculation without crankshaft sensor signal.	Limp home Crank: Engine synchronisation without crankshaft sensor information
Crankshaft sensor failure (LV_ERR_CRK = 1) Failure on **all** Camshaft sensors available for crank limp-home (LV_ERR_LIH_CRK_CAM = 1)		Engine synchronization fiasco: Engine cannot be synchronized

Application conditions

Recurrence: 10 ms

4.55.1 State flow diagram

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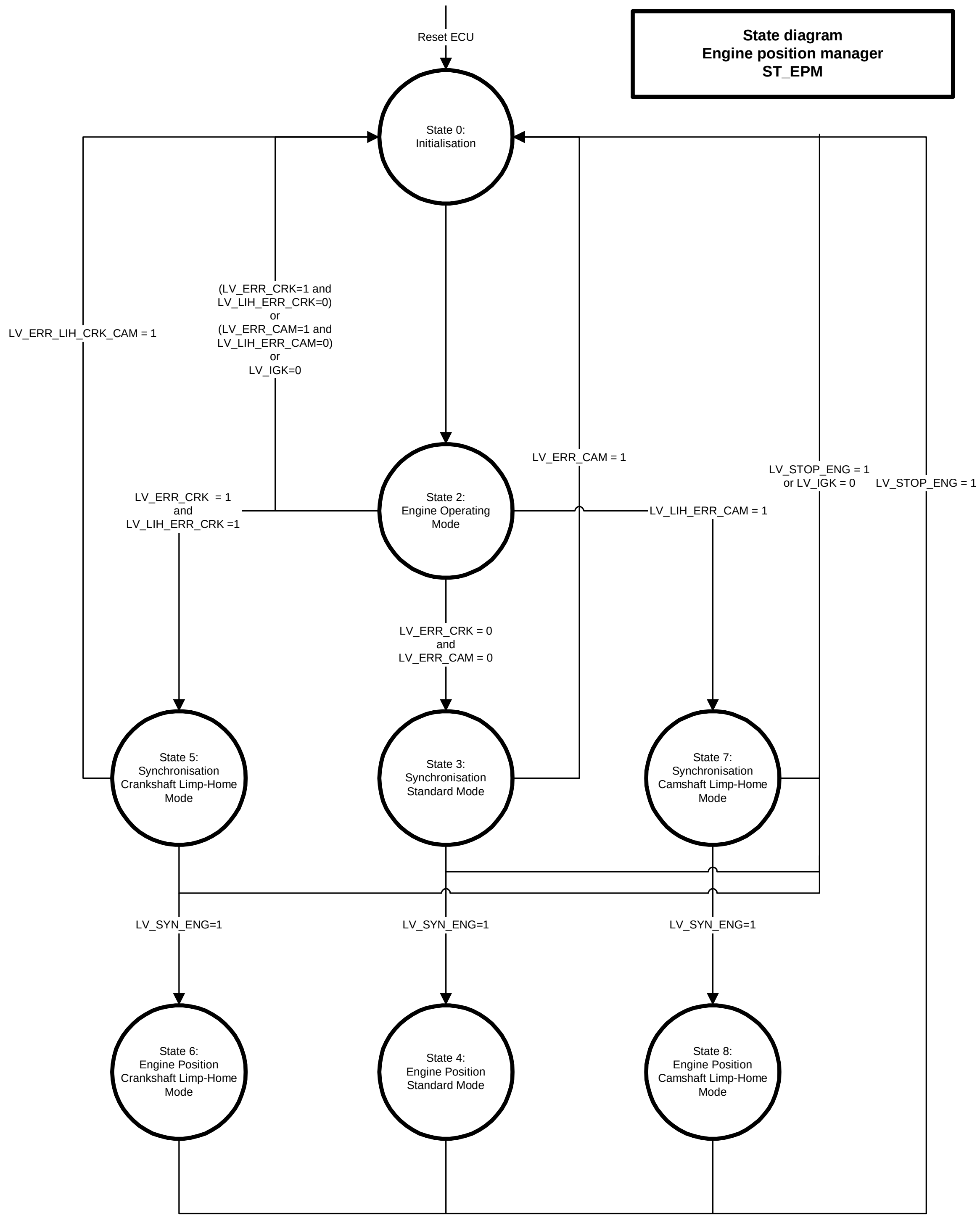

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Initialisation:

LV_ERR_CAM is reset at 0 to 1 transition of LV_IGK

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LV_CRK_MISS_RUN_ENG is reset and timer C_T_DLY_STOP_ENG stopped at 1 to 0 transition of LV_IGK

Formula section:

State 0 : Initialisation

Initialization of output data and deactivation of all state flow diagrams.

Input conditions:
External event: ECU Reset
From state 2: (LV_ERR_CRK = 1 And LV_LIH_ERR_CRK = 0)
Or
(LV_ERR_CAM = 1 And LV_LIH_ERR_CAM = 0)
Or
LV_IGK = 0
From state 3: LV_ERR_CAM = 1
From state 5: LV_ERR_LIH_CRK_CAM = 1
From state 3,5,7: LV_STOP_ENG = 1
Or
LV_IGK = 0
From state 4,6,8: LV_STOP_ENG = 1

Output conditions:
To State 2 : End of initialisation

Action in the state:
LV_STOP_ENG = 1
LV_FIRST_VLD_TOOTH = 0
LV_RUN_ENG = 0
LV_SYN_ENG = 0
LV_SYN_VLD = 0
PSN_ENG_CRK = PSN_ENG_CAM_LIH_CRK = 0
CTR_VLD_CAM_SYN_CRK = 0
LV_LIH_ERR_CRK = 0
LV_LIH_ERR_CAM = 0
LV_ERR_LIH_CRK_CAM = 0

Deactivation of Crankshaft self-synchronisation:
LV_ACT_CRK = 0
Deactivation of Camshaft self-synchronisation for all camshaft signals:
LV_ACT_CAM_IN(EX)[i] = 0
Deactivation of Camshaft/Crankshaft synchronisation for all camshaft signals:
LV_ACT_SYN_CRK_CAM_IN(EX)[i] = 0
Deactivation of limp-home mode for all camshaft signals:
LV_ACT_LIH_CRK_CAM_IN(EX)[i] = 0
Deactivation of synchronization determination in camshaft limp home
LV_CAM_LIH_EXT_ENA = 0
LV_SYN_VLD_CAM_LIH = 0
LV_SEG_NR_UPD_REQ = 0

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Deactivation of synchronization validation in camshaft limp home

Transition action:

None

State 2 : Engine Operating Mode

Select engine operating mode in function of diagnostic information and limp home status.

Input conditions:

From State 0: End of initialisation

Output conditions:

To state 0:
(LV_ERR_CRK = 1 And
(LC_INH_LIH_CRK = 1 Or LV_ERR_LIH_CRK_CAM = 1))
Or
(LV_ERR_CAM = 1 And
LC_INH_LIH_CAM = 1 And LV_ERR_CRK = 0)
Or
LV_IGK = 0

To state 3: LV_ERR_CRK = 0 And LV_ERR_CAM = 0

To state 5: LV_LIH_ERR_CRK = 1 And LV_ERR_CRK = 1

To state 7: LV_LIH_ERR_CAM = 1

Action in the state:

If LV_ERR_CRK = 1
Then **If** LC_INH_LIH_CRK = 0
And LV_ERR_LIH_CRK_CAM = 0
Then *Select Crankshaft limp-home mode*
LV_LIH_ERR_CRK = 1
Else *Crankshaft limp-home not possible*
Endif
Else **If** LV_ERR_CAM = 1
And LC_INH_LIH_CAM = 0
Then *Select Camshaft limp-home mode*
LV_LIH_ERR_CAM = 1
Else *Camshaft limp-home not possible*
Endif
Endif

Transition action:

To state 3,5,7: LV_STOP_ENG = 0

To state 3: Activation of Crankshaft self-synchronisation:
LV_ACT_CRK = 1
Activation of Camshaft self-synchronisation for all camshaft signals:
LV_ACT_CAM_IN(EX)[i] = 1
Activation of camshaft selection for synchronisation ()
Activation of Camshaft/Crankshaft synchronisation for the selected camshaft signal.

To state 5: Activation of Camshaft self-synchronisation for all the camshaft signals:

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LV_ACT_CAM_IN(EX)[i] = 1
Activation of camshaft selection for limp-home ()

To state 7: Activation of Camshaft self-synchronisation for all the camshaft signals:
LV_ACT_CAM_IN(EX)[i] = 1
Activation of Crankshaft self-synchronisation:
LV_ACT_CRK = 1

State 3 : Synchronisation Standard Mode

Engine synchronisation with camshaft and crankshaft sensor information.

Input conditions:
From state 2: LV_ERR_CRK = 0 And LV_ERR_CAM = 0

Output conditions:
To state 0: LV_STOP_ENG = 1
Or
LV_IGK = 0
Or
LV_ERR_CAM = 1
To state 4: LV_SYN_ENG = 1

Action in the state:
LV_FIRST_VLD_TOOTH = LV_CRK_FIRST_VLD_TOOTH
LV_RUN_ENG = LV_CRK_RUN
Activation of calculation of PSN_ENG_CRK in standard mode()
If *LV_FIRST_VLD_TOOTH = 1*
Then *Activation of synchronization validation ()*
End if
Activation of engine position calculation standard mode ()
Activation of Camshaft self-synchronisation reactivation ()
Activation of engine stop detection ()

If LV_RUN_ENG = 1
Then Activation of engine speed calculation
Endif

On 0 to 1 transition of LV_CAM_SYN_CRK:
If LV_ERR_CAM_IN(EX)[i] = 0
For all available camshaft sensors
Then *Activation of fast synchronization ()*
Else *Activation of slow synchronization ()*
Endif

Transition action:
To state 4: LV_CRK_MISS_RUN_ENG = 0
Stop timer C_T_DLY_STOP_ENG

State 4 : Engine Position Standard Mode

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Engine position and speed calculation with crankshaft sensor signal.

Input conditions:
From state 3: LV_SYN_ENG = 1

Output conditions:
To state 0: LV_STOP_ENG = 1

Action in the state:
Reactivation of Camshaft self-synchronisation ()
Activation of engine position calculation standard mode ()
Activation of segment period calculation ()
Activation of speed gradient calculation ()
Activation of crankshaft sensor phase angle correction ()
Activation of engine stop detection ()

If LV_SYN_VLD = 1
Then *Activation of Camshaft adaptation and position output ()*
Endif
Activation of Engine backwards rotation detection ()

Transition action:
To state 0: **If** C_T_DLY_STOP_ENG > 0
And LV_IGK = 1
And LV_CRK_MISS_RUN_ENG = 0
Then LV_CRK_MISS_RUN_ENG = 1
Start timer C_T_DLY_STOP_ENG
Reset LV_CRK_MISS_RUN_ENG after timer has elapsed
Endif

State 5 : Synchronisation Crankshaft Limp-Home Mode

Engine synchronisation without crankshaft sensor signal.

Input conditions:
From state 2: LV_LIH_ERR_CRK = 1
And
LV_ERR_CRK = 1

Output conditions:
To state 0: LV_STOP_ENG = 1
Or
LV_IGK = 0
Or
LV_ERR_LIH_CRK_CAM = 1
To state 6: LV_SYN_ENG=1

Action in the state:
Activation of crankshaft limp-home synchronization() for the selected camshaft signal
Activation of calculation of PSN_ENG_CAM_LIH_CRK()

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Activation of engine position calculation crankshaft limp-home mode
Reactivation of Camshaft self-synchronisation ()
Activation of engine stop detection ()

If LV_RUN_ENG = 1
Then Activation of engine speed calculation
Endif

Transition action:
To state 6: LV_CRK_MISS_RUN_ENG = 0
Stop timer C_T_DLY_STOP_ENG

State 6 : Engine Position Crankshaft Limp-Home Mode

Engine position and speed calculation without crankshaft sensor signal.

Input conditions:
From state 5: LV_SYN_ENG = 1

Output conditions:
To state 0: LV_STOP_ENG = 1

Action in the state:
Activation of engine position calculation crankshaft limp-home mode
Activation of Camshaft self-synchronisation reactivation ()
Activation of segment period calculation
Activation of speed gradient calculation
Activation of engine stop detection ()

Transition action:
To state 0: **If** C_T_DLY_STOP_ENG > 0
And LV_IGK = 1
And LV_CRK_MISS_RUN_ENG = 0
Then LV_CRK_MISS_RUN_ENG = 1
Start timer C_T_DLY_STOP_ENG
Reset LV_CRK_MISS_RUN_ENG after timer has elapsed
Endif

State 7 : Synchronisation Camshaft Limp-Home Mode

Engine synchronisation without camshaft sensor signal.

Input conditions:
From state 2: LV_LIH_ERR_CAM = 1

Output conditions:
To state 0: LV_STOP_ENG = 1
Or
LV_IGK = 0
To state 8: LV_SYN_ENG = 1

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Action in the state:

Activation of camshaft limp-home synchronization()
LV_FIRST_VLD_TOOTH = LV_CRK_FIRST_VLD_TOOTH
LV_RUN_ENG = LV_CRK_RUN
Activation of calculation of PSN_ENG_CRK in camshaft limp-home mode()

Activation of engine position calculation standard mode
Activation of engine stop detection ()

If LV_RUN_ENG = 1
Then Activation of engine speed calculation
Endif

Transition action:
To state 8: LV_CRK_MISS_RUN_ENG = 0
Stop timer C_T_DLY_STOP_ENG

State 8 : Engine Position Camshaft Limp-Home Mode

Engine position and speed calculation without camshaft sensor signal.

Input conditions:
From state 7: LV_SYN_ENG = 1

Output conditions:
To state 0: LV_STOP_ENG = 1

Action in the state:

Activation of Synchronization determination in camshaft limp home()
Activation of Synchronization validation in camshaft limp home()
Reactivation of Camshaft self-synchronisation ()
Activation of PSN_ENG_CRK correction in camshaft limp home()
Activation of engine position calculation standard mode
Activation of segment period calculation
Activation of segment number correction in camshaft limp home()
Activation of speed gradient calculation
Activation of crankshaft sensor phase angle correction
Activation of engine stop detection ()
Activation of Engine backwards rotation detection ()

Transition action:
To state 0: **If** C_T_DLY_STOP_ENG > 0
And LV_IGK = 1
And LV_CRK_MISS_RUN_ENG = 0
Then LV_CRK_MISS_RUN_ENG = 1
Start timer C_T_DLY_STOP_ENG
Reset LV_CRK_MISS_RUN_ENG after timer has elapsed
Endif

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4.55.2 Definition of the sub-function tasks

4.55.2.1 Fast Engine synchronization

General information:

Fast engine synchronization is in charge to synchronize as soon as the crankshaft signal acquisition is synchronized and a camshaft signal information is available on the selected camshaft.

Application conditions

Recurrence: `on 0 to 1 transition of LV_CAM_SYN_CRK`

Formula section:

If LV_CAM_SYN_CRK = 1
Then LV_SYN_ENG = 1
Endif

4.55.2.2 Slow Engine synchronization

General information:

Slow engine synchronization is activated when a failure was detected on at least one camshaft sensor. The engine is synchronized as soon as a number of calibratable camshaft edges has occured (engine synchronized when synchronization is validated). This avoids multiple injection and ignition events with wrong synchronization.

Application conditions

Recurrence: `at every active camshaft edge and on 0 to 1 transition of LV_CAM_SYN_CRK`

The active camshaft edge for synchronization is defined by NC_ACT_CAM_EDGE_SYN.

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Formula section:

The engine speed value used to calculate NR_VLD_CAM_SYN_CRK is the one determined at transition from 0 to 1 of LV_CAM_SYN_CRK (see Synchronization validation)
If LV_CAM_SYN_CRK = 1
Then **If** CTR_VLD_CAM_SYN_CRK > NR_VLD_CAM_SYN_CRK
Then LV_SYN_ENG = 1
Endif
Endif
Remark: CTR_VLD_CAM_SYN_CRK is incremented in "synchronization validation ()" function

4.55.2.3 Crankshaft limp-home synchronization

General information:

Only the informations of the selected camshaft signal is used to perform the engine synchronization.
i = 1...NC_NR_CAM_CBK z = 0...NC_NR_EDGE_CAM_IN/EX

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Application conditions

Recurrence: `at every camshaft edge`

Formula section:

If LV_SYN_CAM_IN(EX)[i] = 1 for the selected camshaft signal
Then LV_FIRST_VLD_TOOTH = 1
LV_RUN_ENG = 1
LV_SYN_ENG = 1
Endif

4.55.2.4 Camshaft limp-home synchronization

General information:

No camshaft signals are available for the Crank/Cam synchronization so the engine synchronization is performed as soon as the crankshaft is synchronized (the engine revolution can not be identified so a default value is used).

Application conditions

Recurrence: `at every reference gap`

Formula section:

If LV_CRK_SYN = 1
Then LV_SYN_ENG = 1
Endif

4.55.2.5 Synchronisation validation

General information:

Synchronisation is validated as soon as a number of calibratable camshaft edges has occured. During validation phase, the angular distance between cam/crk events is checked. Engine synchronisation is reset if one of the tests fails.
i = 1...NC_NR_CAM_CBK z = 0...NC_NR_EDGE_CAM_IN/EX

Application conditions

Recurrence: `at every active camshaft edge and on 0 to 1 transition of LV_CAM_SYN_CRK as long as LV_SYN_VLD = 0`

The active camshaft edge for synchronization is defined by NC_ACT_CAM_EDGE_SYN.

Formula section:

At transition from 0 to 1 of LV_CAM_SYN_CRK, NR_VLD_CAM_SYN_CRK = ID_NR_VLD_CAM_SYN_CRK.
Increment CTR_VLD_CAM_SYN_CRK
If LV_CAM_SYN_CRK = 1

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Then **If** CTR_VLD_CAM_SYN_CRK > NR_VLD_CAM_SYN_CRK
Then LV_SYN_VLD = 1
Deactivation of Camshaft/Crankshaft synchronisation for the camshaft signal selected for this synchronization:
LV_ACT_SYN_CRK_CAM_IN(EX)[i] = 0
Endif
Endif

4.55.2.6 Synchronisation validation in camshaft limp home

General information:

Synchronization validation information is set as soon as it is requested by Synchronization determination in camshaft limp home module which is then deactivated.

Application conditions

Initialisation: *none*

Recurrence: *each segment event*

Formula section:

If LV_SYN_VLD_CAM_LIH = 1
Then LV_SYN_VLD = 1
Deactivation of Synchronization determination in camshaft limp home()
End if

4.55.2.7 Camshaft Selection for synchronisation

General information:

Target wheels on intake and exhaust camshafts may be different, and all may be useable for synchronization. A camshaft signal can only be selected if no error is detected on the respective camshaft (LV_ERR_CAM_IN(EX)[i] = 0). For port-injection engines activation of synchronization mode on intake camshafts should be preferred. Pre-injection needs to be synchronized with intake timing, and the engine position for pre-injection is calculated from the synchronization signal.
i = 1...NC_NR_CAM_CBK z = 0...NC_NR_EDGE_CAM_IN/EX

Formula section:

The selection order is given by the following table:

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	NC_PRI_SYN_CAM_CBK = 1	NC_PRI_SYN_CAM_CBK = 2
NC_PRI_SYN_CAM_IN = 0	CAM_EX_1 CAM_EX_2 CAM_IN_1 CAM_IN_2	CAM_EX_2 CAM_EX_1 CAM_IN_2 CAM_IN_1
NC_PRI_SYN_CAM_IN = 1	CAM_IN_1 CAM_IN_2 CAM_EX_1 CAM_EX_2	CAM_IN_2 CAM_IN_1 CAM_EX_2 CAM_EX_1

The first camshaft sensor in the above list which fulfills the following conditions is selected:

- physically present in the system (configuration data NLC_CAM_IN, NLC_CAM_EX and NC_NR_CAM_CBK)
- no failure reported on it (LV_ERR_CAM_IN(EX)[i] = 0)

The crankshaft synchronization mode is activated on one camshaft signal by setting LV_ACT_SYN_CRK_CAM_IN(EX)[i] for the selected camshaft.

LV_ERR_CAM is set if all available camshaft sensors report and error.

4.55.2.8 Camshaft Selection for limp-home

General information:

Target wheels on intake and exhaust camshafts may be different, and not all may be useable for limp-home. The availability of camshaft sensors for limp-home is given by NLC_LIH_CAM_IN(EX) and NC_NR_CAM_CBK. A camshaft signal can only be selected if no error is detected on the respective camshaft (LV_ERR_CAM_IN(EX)[i] = 0).
i = 1...NC_NR_CAM_CBK z = 0...NC_NR_EDGE_CAM_IN/EX

Formula section:

The selection order is given by the following table:

	NC_PRI_LIH_CAM_CBK = 1	NC_PRI_LIH_CAM_CBK = 2
NC_PRI_LIH_CAM_IN = 0	CAM_EX_1 CAM_EX_2 CAM_IN_1 CAM_IN_2	CAM_EX_2 CAM_EX_1 CAM_IN_2 CAM_IN_1
NC_PRI_LIH_CAM_IN = 1	CAM_IN_1 CAM_IN_2 CAM_EX_1 CAM_EX_2	CAM_IN_2 CAM_IN_1 CAM_EX_2 CAM_EX_1

The first camshaft sensor in the above list which fulfills the following conditions is selected:

- physically present in the system (configuration data NLC_CAM_IN, NLC_CAM_EX_IN and NC_NR_CAM_CBK)
- no failure reported on it (LV_ERR_CAM_IN(EX)[i] = 0)
- available for crankshaft limp-home (NLC_LIH_CAM_IN = 1 or NLC_LIH_CAM_EX = 1)

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The crankshaft limp-home mode is activated on one camshaft signal by setting LV_ACT_LIH_CRK_CAM_IN(EX)[i] for the selected camshaft.

LV_ERR_LIH_CRK_CAM is set if no more camshaft sensors is available.

4.55.2.9 Engine stop detection

Application conditions

Recurrence: 10ms

Formula section:

LV_STOP_ENG is set if one of the conditions in the table below are met:

In Standard mode (States 3 and 4)	In Camshaft limp-home mode (States 7 and 8)	In Crankshaft limp-home mode (States 5 and 6)	In Engine position Standard and Camshaft limp-home mode (States 4 and 8)
LV_CRK_STOP = 1	LV_CRK_STOP = 1	LV_CAM_STOP_IN(EX)[i] = 1 for the selected camshaft signal	LV_ENG_BACK_CFM switches from 0 to 1
LV_ORNG_CAM_SYN_CRK = 1 (*)			
LV_ERR_CRK = 1 And LC_INH_LIH_CRK = 0			

(*) This information is available as long as LV_SYN_VLD = 0.

4.55.2.10 Camshaft self-synchronisation reactivation

General information:

When the self-synchronization of a camshaft signal goes to the fiasco state (LV_CAM_STOP_IN(EX)[i] = 1), the self-synchronization on this camshaft signal will be reactivated as soon as possible. If this camshaft is selected for the synchronization in crankshaft limp-home mode an engine stop is detected (by *engine stop detection()* sub-function task) and a new synchronization is restarted.
i = 1...NC_NR_CAM_CBK z = 0...NC_NR_EDGE_CAM_IN/EX

Application conditions

Recurrence: 10ms

Formula section:

For all available camshaft signal sensors:

If LV_CAM_STOP_IN(EX)[i] = 1

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And LV_ACT_LIH_CRK_CAM_IN(EX)[i] = 0
Then Activation of Camshaft self-synchronisation for this camshaft signal
Endif

4.55.2.11 Calculation of PSN_ENG_CRK in standard mode()

General information:

Formula section:

Before synchronization (LV_SYN_ENG = 0):

Truth table					
LV_CRK_SYN n	0	1			
LV_CRK_SYN n-1	0	0		1	
LV_CAM_SYN_CRK n	0	0	1	0	1
LV_CAM_SYN_CRK n-1	0	0	0	0	0
Engine position action	**1**	**2**	**3**	**4**	**5**

Action 1:
PSN_ENG_CRK = PSN_ENG_SYN_CAM_MIN

Action 2:
PSN_ENG_CRK = PSN_ENG_SYN_CAM_MIN
PSN_ENG_CRK_GAP = 360° - NC_OFS_TDC0_REF_CRK

Action 3:
PSN_ENG_CRK = 360° - NC_OFS_TDC0_REF_CRK + PSN_ENG_CRK_OFS

Action 4:
PSN_ENG_CRK = PSN_ENG_SYN_CAM_MIN
PSN_ENG_CRK_GAP n = PSN_ENG_CRK_GAP n-1 + (360°/NC_NR_TOOTH)

Action 5:
PSN_ENG_CRK = PSN_ENG_CRK_GAP + PSN_ENG_CRK_OFS

After the synchronization (LV_SYN_ENG = 1):
PSN_ENG_CRK is incremented on the tooth signal and jitter from 0 to 720°.

4.55.2.12 Calculation of PSN_ENG_CRK in camshaft limp-home mode()

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Formula section:

Before synchronization (LV_SYN_ENG = 0):

Truth table		
LV_CRK_SYN n	0	1
LV_CRK_SYN n-1	0	0
Engine position action	**1**	**2**

Action 1:
PSN_ENG_CRK is incremented on the tooth signal and jitter from 0 to 360°

Action 2:
PSN_ENG_CRK = 720° - NC_OFS_TDC0_REF_CRK

After the synchronization (LV_SYN_ENG = 1):
PSN_ENG_CRK is incremented on the tooth signal and jitter from 0 to 720°

4.55.2.13 PSN_ENG_CRK correction in camshaft limp-home()

General information:

This function updates PSN_ENG_CRK depending on synchronization determination test result in camshaft limp home.

Application conditions

Initialisation: *none*

Recurrence: *none*

Activation: *LV_SEG_NR_UPD_REQ = 1*

Deactivation: *LV_SEG_NR_UPD_REQ = 0*

Formula section:

PSN_ENG_CRK = PSN_ENG_CRK + (360°CRK /NC_NR_GAP)

4.55.2.14 Calculation of PSN_ENG_CAM_LIH_CRK()

General information:

The purpose of this function is to provide engine position during crankshaft limp-home. In crankshaft limp-home, the engine position is calculated from the camshaft sensor selected by LV_ACT_LIH_CRK_CAM_IN(EX)[i].
i = 1...NC_NR_CAM_CBK z = 0...NC_NR_EDGE_CAM_IN/EX

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Application conditions

Initialization: PSN_ENG_CAM_LIH_CRK = 0

Recurrence: every camshaft signal edge

Activation: LV_SYN_ENG = 1

Deactivation: LV_SYN_ENG = 0

Formula section:

For z = IDX_EDGE_CAM_IN(EX)[i] and the camshaft sensor selected for crankshaft limp home by LV_ACT_LIH_CRK_CAM_IN(EX)[i]:

If z is a falling camshaft signal edge
Then **If** NC_ACT_CAM_EDGE_LIH = 1
Or
NC_ACT_CAM_EDGE_LIH = 3
Then PSN_ENG_CAM_LIH_CRK = NC_PSN_EDGE_CAM_IN(EX)[z][i] + Average value of PSN_EDGE_AD_CAM_IN(EX)[z][i] for all falling camshaft signal edges
Else *no update of PSN_ENG_CAM_LIH_CRK*
Endif
Else **If** NC_ACT_CAM_EDGE_LIH = 2
Or
NC_ACT_CAM_EDGE_LIH = 3
Then PSN_ENG_CAM_LIH_CRK = NC_PSN_EDGE_CAM_IN(EX)[z][i] + Average value of PSN_EDGE_AD_CAM_IN(EX)[z][i] for all rising camshaft signal edges
Else *no update of PSN_ENG_CAM_LIH_CRK*
Endif
End

4.55.2.15 Engine backwards rotation detection ()

General information:

The aim of this function is to detect a change in the direction of engine rotation which would lead to a false crankshaft teeth counter value and thus to a wrong timing for injection and/or ignition events. This could occur at low engine speed with hard compression phases.
This functionality gets a lower performance if camshaft target wheel is symmetrical as only the tests on crankshaft signal can be done (Action 1 and Test 2).
i = 1...NC_NR_CAM_CBK z = 0...NC_NR_EDGE_CAM_IN/EX

Application conditions

Initialisation: at reset or engine stalling (LV_STOP_ENG transition from 0 to 1)
LV_ENG_BACK_DET = 0
LV_ENG_BACK_CFM = 0

Recurrence: 10ms and every camshaft edge (for all camshaft sensors) and every reference gap and at engine stalling (LV_STOP_ENG transition from 0 to 1)

Activation: *LC_ENG_BACK_INH = 0*

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Deactivation: when application conditions are not fulfilled

Formula section:

If **(** N_TOOTH < C_N_NOT_REST **And** LV_CRK_MISS_TOOTH = 1 **)**
or LV_ENG_BACK_DET = 1
Then LV_ENG_BACK_DET = 1
Activation of Engine backwards rotation confirmation ()
Else LV_ENG_BACK_DET = 0
LV_ENG_BACK_CFM = 0
End
LV_CRK_MISS_TOOTH is reset after reading.

Engine backwards rotation confirmation ():
The following table shows the test or action to perform in function of the current event.The event is a detection of a camshaft edge (CAM) or a detection of reference gap (GAP) or an engine stall (Engine stall).

Event	GAP	Engine stall	CAM
Test / Action	Action 1	Test 2	Test 3

Action 1:
This event means that the reference gap has been detected at the expected position (the number of teeth between 2 gaps is correct) and thus that engine backwards rotation is not confirmed.
LV_ENG_BACK_DET = 0

Test 2:
This event means that the number of teeth between 2 gaps is not correct due to engine backwards rotation which is thus confirmed.
If LV_LOST_SYN_CRK = 1
Then LV_ENG_BACK_CFM = 1

Test 3:
This test is only done on the camshaft signal that generated the event. It checks wether camshaft signal position is correct versus crankshaft signal or versus previous camshaft signal. If not, engine backwards rotation is confirmed.
If LV_ERR_CAM_IN(EX)[i] = 0
Then **if** **{**
(LV_SYN_CAM_IN(EX)[i] = 1 ’z value, which represents camshaft edge number, is know as camshaft is self-synchronized
And
(PSN_ENG_ENSD = NC_PSN_EDGE_CAM_IN(EX)[z][i] - C_DYW_CAM_CRK_SYN_ADC_IN(EX)
Or PSN_ENG_ENSD = NC_PSN_EDGE_CAM_IN(EX)[z][i] + C_DYW_CAM_CRK_SYN_RTD_IN(EX)) **)**
Or
LV_ORNG_RATIO_CAM_IN(EX)[i] = 1 **}**
Then LV_ENG_BACK_CFM = 1
Else **if** LV_SYN_CAM_IN(EX)[i] = 1
Then LV_ENG_BACK_DET = 0
End
End
End

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4.56 Engine position and speed calculation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
N	O/V	0... 1FE0H	0... 8160	1	rpm
Engine speed - resolution 1 rpm					
N_32	O/V	0... FFH	0... 8160	32	rpm
Engine speed -Resolution 32 rpm					
N_CRK_WIN	-	0... 1FE0H	0... 8160	1	rpm
Engine speed on crankshaft tooth window at end of segment					
N_FAST	O/V	0... 1FE0H	0... 8160	1	rpm
Fast engine speed					
N_GRD	O/V	80... 7FH	-4096 ...4064	32	rpm/s
Engine speed gradient					
N_GRD_H_RES	O/V	F000... 0FFFH	-4096 ...4095	1	rpm/s
High resolution engine speed gradient					
N_MMV	O/V	0... 1FE0H	0... 8160	1	rpm
Engine Speed moving mean value					
N_TOOTH	O/V	0... 1FE0H	0... 8160	1	rpm
Engine Speed calculated on last crankshaft tooth period (update rate 10ms)					
PSN_ENG	O	0... 780H	0... 720	0.375	°CRK
Exported engine position					
PSN_ENG_ENSD	O	0... 2CFFH	0... 719.9375	0.0625	°CRK
Actual engine position in fine resolution					
PSN_ENG_SYN_MAX	O/V	0... 780H	0... 720	0.375	°CRK
Maximum engine position during crankshaft synchronization phase.					
PSN_ENG_SYN_MIN	O/V	0... 780H	0... 720	0.375	°CRK
Minimum engine position during crankshaft synchronization phase.					
SEG_CTR	O/V	0... FFFFH	0... 65535	1	-
Continuous segment counter (saturated at maximum value)					
SEG_NR	O/V	0... 7H	0 ...7	1	-
Actual segment number (from 0 to NC_CYL_NR-1)					
T_REV_AV	-	0... 7FFFFFH	0... 1.9965	237.999e-9	s
Actual revolution time					
T_REV_PREV	-	0... 7FFFFFH	0... 1.9965	237.999e-9	s
Previous revolution time					
T_SEG_AV	O/V	0... FFFFH	0... 0.26214	0.000004	s
Segment period (saturated at low engine speed).					
T_SEG_HALF_AV	O/V	0... FFFFH	0... 0.26214	0.000004	s
Exported half-segment period					

Input data:

LV_CRK_SYN {p. 853}	LV_RUN_ENG {p. 1505}	LV_SEG_NR_UPD_REQ {p. 1717}	LV_STOP_ENG {p. 1505}
NC_CRK_WIN_SEG_LEN {p. 854}	NC_NR_TOOTH {p. 854}	NC_PSN_SEG_TDC_REF {p. 854}	PSN_ENG_CAM_LIH_CRK {p. 1506}
PSN_ENG_CRK {p. 1506}	PSN_ENG_SYN_CAM_MAX {p. 872}	PSN_ENG_SYN_CAM_MIN {p. 872}	T_CRK_WIN_ENSD {p. 853}

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T_SEG_ENSD {p. 853}	T_SEG_HALF_ENSD {p. 853}	T_TOOTH {p. 853}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_N_FAST	-	0... FFH	0... 0.99609	3.91e-3	-
Factor for fast engine speed prediction					
C_N_FAST_SWI	-	0... 4H	0 ...4	1	-
Switch case choice for N_FAST calculation mode					
C_N_TOOTH_END	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for N_TOOTH calculation at engine start					
ID_CRK_PHA_COR	-	0... FFH	0... 15.9375	0.0625	°CRK
LDP_N_32_ID_CRK_PHA_COR	16	0... FFH	0... 8160	32	rpm
Table for crankshaft transmitter phase offset correction					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CYL_NR	-	1... 8H	1 ...8	1	-
count of cylinder					

FUNCTION DESCRIPTION:

At engine stalling (LV_STOP_ENG 0 to 1), all output data are set to initialization value.

4.56.1 Engine Position Calculation Standard Mode

General information:

The function provides output values for engine position in standard operating mode.

Application conditions

Initialisation: `PSN_ENG =PSN_ENG_ENSD = 0`

Recurrence: `every update of the corresponding input values`

Formula section:

PSN_ENG = PSN_ENG_ENSD (resolution conversion)
PSN_ENG_ENSD = PSN_ENG_CRK + ID_CRK_PHA_COR
PSN_ENG_SYN_MIN = PSN_ENG_SYN_CAM_MIN
PSN_ENG_SYN_MAX = PSN_ENG_SYN_CAM_MAX
The resolution of variables that are exported outside the aggregate is different from the resolution used internally!

4.56.2 Engine Position Calculation Crankshaft Limp-Home Mode

General information:

The function provides output values for engine position in crankshaft limp-home mode.

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Application conditions

Initialisation: `PSN_ENG =PSN_ENG_ENSD = 0`

Recurrence: `every update of the corresponding input values`

Formula section:

PSN_ENG = PSN_ENG_ENSD (resolution conversion)
PSN_ENG_ENSD = PSN_ENG_CAM_LIH_CRK
PSN_ENG_SYN_MIN = PSN_ENG_SYN_CAM_MIN
PSN_ENG_SYN_MAX = PSN_ENG_SYN_CAM_MAX
The resolution of variables that are exported outside the aggregate is different from the resolution used internally!

4.56.3 Segment Period Calculation

General information:

The function provides output values for the segment period.
The engine cycle is divided into a number of TDC periods corresponding to the number of cylinders NC_CYL_NR. The corresponding time intervals T_SEG_AV are measured between tooth events located NC_PSN_SEG_TDC_REF degrees before each TDC.
The segment number SEG_NR indicates the number of the cylinder that will be next in the firing order.
A control signal is generated to trigger execution of segment synchronous tasks.

Application conditions

Initialisation:
```
T_SEG_AV is set to the maximum value
 SEG_CTR = 0
 SEG_NR = 0
```

Activation: `LV_RUN_ENG = 1`

Recurrence :
```
when LV_RUN_ENG is set
 And when LV_CRK_SYN is set
And every segment trigger
```

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Formula section:

T_SEG_AV = T_SEG_ENSD saturated to maximum value at low speed.
At engine synchronization, SEG_NR is initialized with current segment number.
SEG_CTR is incremented at every segment.

4.56.4 Segment number correction in camshaft limp home

General information:

This function updates SEG_NR value in camshaft limp home mode depending on synchronization determination test result.

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Application conditions

Initialisation: *none*

Recurrence: *none*

Activation: *LV_SEG_NR_UPD_REQ = 1*

Deactivation: *LV_SEG_NR_UPD_REQ = 0*

Formula section:

SEG_NR = SEG_NR + NC_CYL_NR /(2 * NC_NR_GAP)

4.56.5 Engine speed N, N_32, N_MMV

General information:

The engine speed is determined in each segment from the segment period T_SEG_ENSD.

Application conditions:

Activation: LV_RUN_ENG = 1
Recurrence: when LV_RUN_ENG is set
And when LV_CRK_SYN is set
And every segment trigger

Formula section:

$$N = \frac{2*60}{NC\_CYL\_NR * T\_SEG\_ENSD} \quad \text{for T\_SEG\_ENSD in s}$$

N_32 = N in resolution 32 rpm
Before synchronization and at synchronization, one engine speed is output at the moment when crankshaft rotation is validated. The output value will be calculated from the most recent tooth period (see Segment Period Calculation)

N_MMV is the moving mean value calculated on the last 720° CRK:

$$N\_MMV = \frac{N_n + N_{n-1} + \ldots + N_{n-NC\_CYL\_NR}}{NC\_CYL\_NR}$$

Before engine synchronisation N_MMV = N. After engine synchronisation and before the first engine cycle is completed, N_MMV is calculated as the mean value of the most recent segments of this cycle.

Set N_FAST to N if no fast engine speed calculation is required.
If C_N_FAST_SWI = 0
Then N_FAST = N
Endif

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4.56.6 Fast Engine speed based on last tooth period

General information:

Provide engine speed calculated every 10ms on the last crankshaft tooth period during cranking, synchronisation and start phase. Calculation is done until speed threshold is reached.
If, during running, Engine speed becomes lower than this threshold, this calculation is started again
In the formula after, T_TOOTH in s is the time for the last crankshaft tooth period, acquired in BSW just before the 10ms trigger event used for update rate of N_TOOTH here.

Application conditions:
Initialisation: N_TOOTH = 0
Recurrence : 10ms
Activation: LV_RUN_ENG = 1

Deactivation: LV_RUN_ENG = 0

Formula section:

If N_32 <= C_N_TOOTH_END
Then N_TOOTH = 60 /(NC_NR_TOOTH * T_TOOTH)
Endif
If C_N_FAST_SWI = 1
Then N_FAST = N_TOOTH
Endif

4.56.7 Fast Engine Speed based on Half-Segment Period Calculation

General information:

This function provides fast engine speed based on half-segment period.

Application conditions

Initialisation: T_SEG_HALF_AV is set to the maximum value

Recurrence: before synchronization: once at transition from LV_RUN_ENG from 0 to 1
after synchronization: every segment trigger **and** segment trigger

Activation: LV_RUN_ENG = 1

Formula section:

If C_N_FAST_SWI = 2

Then
$$N\_FAST = \frac{60}{NC\_CYL\_NR * T\_SEG\_HALF\_ENSD}$$

Endif

T_SEG_HALF_AV = T_SEG_HALF_ENSD saturated to maximum value at low speed.

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4.56.8 Fast Engine Speed based on Crankshaft Tooth Window

General information:

This function provides fast engine speed output based on a crankshaft window at the end of each segment. Updated every segment

Application conditions

Initialisation: N_FAST = 0

Recurrence : every segment trigger

Activation: LV_RUN_ENG = 1
And
(C_N_FAST_SWI = 3 **Or** C_N_FAST_SWI = 4)

Deactivation: C_N_FAST_SWI <> 3 **And** C_N_FAST_SWI <> 4

Formula section:

$$N\_CRK\_WIN = \frac{60}{T\_CRK\_WIN\_ENSD} \; \frac{NC\_CRK\_WIN\_SEG\_LEN}{360° \, CRK}$$

If C_N_FAST_SWI = 3
Then N_FAST = N + C_FAC_N_FAST * (N_CRK_WIN n - N_CRK_WIN n-1)
Endif
If C_N_FAST_SWI = 4
Then N_FAST = N + C_FAC_N_FAST * (N n - N_CRK_WIN n-1)
Endif

4.56.9 Engine speed gradient N_GRD, N_GRD_H_RES

General information:

The engine speed gradient is the acceleration of the crankshaft in rpm/s. For engins with an even number of cylinders (2...8), the gradient is calculated from the duration of the most recent engine revolution, and the duration of the previous engine revolution. With this calculation, the gradient is free from errors due to mechanical tolerances of the crankshaft target wheel.
For three-cylinder engins, the gradient is calculated from the most recent segment time, and the segment time before. Errors from mechanical tolerances of the crankshaft target wheel are not corrected, but are supposed to have a minor effect due to the greater angle of the segments.

Application recurrence: every segment trigger

Formula section:

For even cylinder numbers, the duration of the most recent engine revolution is the sum of the most recent NC_CYL_NR/2 segment times. For e.g. a four-cylinder engine, this is:

T_REV_AV = T_SEG_ENSDn + T_SEG_ENSDn-1

The duration of the previous engine revolution is for the example of a four-cylinder engine:

T_REV_PREV = T_SEG_ENSDn-2 + T_SEG_ENSDn-3

N_GRD calculation:

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N_GRD_H_RES =

$$\frac{60*(T\_REV\_PREV - T\_REV\_AV)}{T\_REV\_PREV * T\_REV\_AV * 0.5*(T\_REV\_PREV + T\_REV\_AV)}$$

for T_REV_AV and T_REV_PREV in s
N_GRD = N_GRD_H_RES in resolution 32 rpm/s.

The resolution of the segment time introduces an error into the calculation of the engine speed gradient, depending on engine speed.
For a timer resolution of 0.25µs, a difference of 1 timer tick between T_REV_AV and T_REV_PREV corresponds to:

0.015 rpm/s at 600 rpm
and 15 rpm/s at 6000 rpm

For three-cylinder engins, the gradient is calculated as follows:
N_GRD_H_RES =

$$\frac{2*60*(T\_SEG\_ENSD_{n-1} - T\_SEG\_ENSD_{n})}{3*T\_SEG\_ENSD_{n-1} * T\_SEG\_ENSD_{n} * 0.5*(T\_SEG\_ENSD_{n-1} + T\_SEG\_ENSD_{n})}$$

N_GRD = N_GRD_H_RES in resolution 32 rpm/s.

The resolution of the segment time introduces an error into the calculation of the engine speed gradient, depending on engine speed.
A difference of 1 timer tick between T_SEG_ENSDn and T_SEG_ENSDn-1 corresponds to:

0.51 rpm/s at 600 rpm
and 51 rpm/s at 6000 rpm

4.56.10 Crankshaft Sensor Phase Angle Correction

General information:

The sensor phase angle is defined as the rotation angle of the target wheel between the mechanical reference and the electrical reference for a tooth of the target wheel.
The mechanical reference in the target wheel drawing usually is the trailing edge of a tooth in the defined rotation direction. The mechanical reference position is reached when the center of the sensor is aligned to that angular reference.
The electrical reference may be on the falling or on the rising edge of the sensor output signal, see active edge definition in the acquisition of crankshaft signal. The reference position is reached when the sensor output signal switches (for active sensors) respectively has its zero crossing (for VR sensors).
A retard of the electrical reference relative to the mechanical edge is defined as a positive phase angle.
With most sensors, the signal edge is generated at the center of each tooth at low speed. At high speed the signal edge may be retarded.
The typical phase angle ID_CRK_PHA_COR (at typical air gap and operating temperature) of the used sensor/target wheel combination is calibrated in a table versus engine speed. The value corresponding to the actual engine speed is added to the actual engine position delivered from crankshaft acquisition, in order to obtain a corrected engine position (see position calculation in the first chapter of this specification).

Application conditions:

Recurrence: every segment trigger
Activation: LV_CRK_SYN = 1

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Deactivation: LV_CRK_SYN = 0

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4.57 Camshaft adaptation and position output

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAM_PSN_LST_REF_AD_EX [NC_NR_CAM_CBK]	O/V	0... 3FFH	-32... 31.9375	0.0625	°CRK
Adapted exhaust camshaft i signal position after last correct reference adaptation					
CAM_PSN_LST_REF_AD_IN [NC_NR_CAM_CBK]	O/V	0... 3FFH	-32... 31.9375	0.0625	°CRK
Adapted intake camshaft i signal position after last correct reference adaptation					
CTR_REV_AD_REF_CAM_EX [NC_NR_CAM_CBK]	V	0... FFH	0... 255	1	-
Exhaust camshaft reference position adaptation revolution counter					
CTR_REV_AD_REF_CAM_IN [NC_NR_CAM_CBK]	V	0... FFH	0... 255	1	-
Intake camshaft reference position adaptation revolution counter					
LV_AD_END_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Exhaust camshaft reference position adaptation successful					
LV_AD_END_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Intake camshaft reference position adaptation successful					
LV_CAM_AD_PWL_NOT_SAVE_EX [NC_NR_CAM_CBK]	-	0... 1H	0 ...1	1	-
Camshaft adaptive values storage in NVMY not allowed, for exhaust i					
LV_CAM_AD_PWL_NOT_SAVE_IN [NC_NR_CAM_CBK]	-	0... 1H	0 ...1	1	-
Camshaft adaptive values storage in NVMY not allowed, for intake i					
LV_CAM_AD_SAVE_EX [NC_NR_CAM_CBK]	O/V/S	0... 1H	0 ...1	1	-
Confirmation that adaptative values at exhaust i have already been stored					
LV_CAM_AD_SAVE_IN [NC_NR_CAM_CBK]	O/V/S	0... 1H	0 ...1	1	-
Confirmation that adaptative values at intake i have already been stored					
LV_TOOTH_OFF_DET_ENA_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Confirmation that a reference adaptation occurred after the very first one, to allow the one_tooth_off detection (exhaust i)					
LV_TOOTH_OFF_DET_ENA_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Confirmation that a reference adaptation occurred after the very first one, to allow the one_tooth_off detection (intake i)					
PSN_AD_CAM_EX [NC_NR_CAM_CBK]	O/V	0... FFH	-48... 47.625	0.375	°CRK
Adapted exhaust camshaft position relative to designed passive position					
PSN_AD_CAM_IN [NC_NR_CAM_CBK]	O/V	0... FFH	-48... 47.625	0.375	°CRK
Adapted intake camshaft position relative to designed passive position					
PSN_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1FFH	-96... 95.625	0.375	°CRK
Actual exhaust camshaft position relative to adapted passive position					
PSN_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1FFH	-96... 95.625	0.375	°CRK
Actual intake camshaft position relative to adapted passive position					
PSN_DIF_EDGE_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 780H	0... 720	0.375	°CRK
Crankshaft angle between the previous and the current exhaust camshaft i position determination					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
PSN_DIF_EDGE_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 780H	0... 720	0.375	°CRK
Crankshaft angle between the previous and the current intake camshaft position determination					
PSN_EDGE_AD_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK]	O/V/S	0... 3FFH	-32... 31.9375	0.0625	°CRK
Adapted exhaust camshaft i signal edge z position					
PSN_EDGE_AD_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK]	O/V/S	0... 3FFH	-32... 31.9375	0.0625	°CRK
Adapted intake camshaft i signal edge z position					
PSN_EDGE_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK]	O	0... FFFH	-128... 127.9375	0.0625	°CRK
Actual exhaust camshaft position relative to adapted passive position at signal edge index z					
PSN_EDGE_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK]	O	0... FFFH	-128... 127.9375	0.0625	°CRK
Actual intake camshaft position relative to adapted passive position at signal edge index z					
PSN_ENG_CAM_EX [NC_NR_CAM_CBK]	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Engine position at the last exhaust camshaft i edge					
PSN_ENG_CAM_IN [NC_NR_CAM_CBK]	-	0... 2CFFH	0... 719.9375	0.0625	°CRK
Engine position at the last intake camshaft i edge					
T_DIF_EDGE_CAM_EX [NC_NR_CAM_CBK]	O/V	0... FFFFFFFFH	0... 17179.86918	0.000004	s
Time between the previous and current camshaft signal edge					
T_DIF_EDGE_CAM_IN [NC_NR_CAM_CBK]	O/V	0... FFFFFFFFH	0... 17179.86918	0.000004	s
Time between the previous and current camshaft signal edge					

Input data:

C_TOL_REF_CRK_CAM_EX {p. 4422}	C_TOL_REF_CRK_CAM_IN {p. 4422}	IDX_EDGE_CAM_EX [NC_NR_CAM_CBK] {p. 871}	IDX_EDGE_CAM_IN [NC_NR_CAM_CBK] {p. 871}
LC_NOT_ADJ_CAM_IVVT_EX [NC_NR_CBK_IVVT] {p. 8400}	LC_NOT_ADJ_CAM_IVVT_IN [NC_NR_CBK_IVVT] {p. 8400}	LV_DI_AD_REF_CAM_IVVT_EX {p. 8399}	LV_DI_AD_REF_CAM_IVVT_IN {p. 8399}
LV_SYN_VLD {p. 1506}	LV_VLD_PSN_CAM_EX [NC_NR_CAM_CBK] {p. 872}	LV_VLD_PSN_CAM_IN [NC_NR_CAM_CBK] {p. 872}	N_32 {p. 1525}
NC_NR_EDGE_CAM_EX {p. 874}	NC_NR_EDGE_CAM_IN {p. 874}	NC_PSN_EDGE_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK] {p. 874}	NC_PSN_EDGE_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK] {p. 874}
NLC_IVVT_EX {p. 8400}	NLC_IVVT_IN {p. 8401}	PSN_ENG_ENSD {p. 1525}	T_SEG_CAM_EX [NC_NR_CAM_CBK] {p. 872}
T_SEG_CAM_IN [NC_NR_CAM_CBK] {p. 873}			

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_AD_CAM_EX	-	0... FFH	0... 0.99609	3.9063e-3	-
Averaging constant for continuous adaptation					
C_CRLC_AD_CAM_IN	-	0... FFH	0... 0.99609	3.9063e-3	-
Averaging constant for continuous adaptation					
C_CRLC_AD_REF_CAM_EX	-	0... FFH	0... 0.99609	3.9063e-3	-
Averaging constant for reference position adaptation					
C_CRLC_AD_REF_CAM_IN	-	0... FFH	0... 0.99609	3.9063e-3	-
Averaging constant for reference position adaptation					
C_GRD_AD_MAX_CAM_EX	-	0... FFH	0... 15.9375	0.0625	°CRK
Max. permissible drift of reference edge position for continuous adaptation					
C_GRD_AD_MAX_CAM_IN	-	0... FFH	0... 15.9375	0.0625	°CRK
Max. permissible drift of reference edge position for continuous adaptation					
C_GRD_AD_REF_MAX_CAM_EX	-	0... FFH	0... 15.9375	0.0625	°CRK
Max. permissible drift of reference edge position for reference position adaptation					
C_GRD_AD_REF_MAX_CAM_IN	-	0... FFH	0... 15.9375	0.0625	°CRK
Max. permissible drift of reference edge position for reference position adaptation					
C_NR_REV_AD_REF_CAM_EX	-	0... FFH	0... 255	1	-
Number of camshaft revolutions for reference position adaptation					
C_NR_REV_AD_REF_CAM_IN	-	0... FFH	0... 255	1	-
Number of camshaft revolutions for reference position adaptation					
C_TOL_TOOTH_OFF_CAM_EX	-	0... 1FFH	0... 31.9375	0.0625	°CRK
Reference position tolerance for tooth off detection for exhaust camshaft					
C_TOL_TOOTH_OFF_CAM_IN	-	0... 1FFH	0... 31.9375	0.0625	°CRK
Reference position tolerance for tooth off detection for intake camshaft					
ID_CAM_PHA_COR	-	0... 5FFH	-48... 47.9375	0.0625	°CRK
LDP_N_32_ID_CAM_PHA_COR	16	0... FFH	0... 8160	32	rpm
Table for camshaft transmitter phase offset correction					

FUNCTION DESCRIPTION:

General information:

The function provides a feedback about the actual camshaft position relative to the engine position measured with the crankshaft sensor. The signals of one, two or four camshaft sensors are treated (intake and/or exhaust camshaft on one or two cylinder banks).

The actual engine position is captured with every camshaft signal edge. The camshaft position is calculated as the difference between the captured engine position, and the engine position measured on the respective camshaft. The difference may be due to tolerances, or due to an intentional displacement by a camshaft phasing system (VVTI).

Two different adaptive learning algorithms eliminate the tolerances, in order to measure exactly the VVTI displacement.

The reference position adaptation is done for all signal edges. It is performed on all intake camshafts as long as LV_DI_AD_REF_CAM_IVVT_IN = 0. It is performed on all exhaust camshafts as long as LV_DI_AD_REF_CAM__IVVT_EX = 0. The camshafts are then situated in their respective VVTI passive positions. After the completion of the adaptation LV_AD_END_CAM_IN(EX)[i] is set and PSN_AD_CAM_IN(EX)[i] is calculated as the mean value of all adaptated signal edges. The reference edge has the index 1. It is the first electrical falling edge of the camshaft signal after TDC0.

The position of other signal edges is adapted continuously relative to the reference signal edge, in order to always deliver a coherent position information.

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Both adaptation algorithms are performed only at a limited dynamic variation of the camshaft position measured at the reference edge.
The logical calibration bit LC_NOT_ADJ_CAM_IVVT_IN(EX)[i] is set if the VVTI system is inhibited on the corresponding camshafts. The respective camshafts will be treated like being constantly in the VVTI passive position. If an engine has more camshaft sensors then VVTI actuators, then NLC_IVVT_IN(EX) = 0 indicates that VVTI is not existing on intake or on exhaust camshafts.

4.57.1 Engine Position Determination from Camshaft signal

General information:

As soon as camshaft is self-synchronized, the actual engine position is calculated at every camshaft signal edge from theorical position plus adaptation value for the actual signal edge index.
i = 1...NC_NR_CAM_CBK z = 0...NC_NR_EDGE_CAM_IN/EX

Description:

Recurrence : *every CAM active edge*

Formula section:

for z = IDX_EDGE_CAM_IN(EX)[i]
PSN_ENG_CAM_IN(EX)[i] (n) = NC_PSN_EDGE_CAM_IN(EX)[z][i] +
PSN_EDGE_AD_CAM_IN(EX)[z][i] (n-1) +
ID_CAM_PHA_COR

4.57.2 Camshaft Position Output

Application conditions:

Activation:
LV_VLD_PSN_CAM_IN(EX)[i] = 1 **And** LV_SYN_VLD = 1
Recurrence: *every update of IDX_EDGE_CAM_IN(EX)[i]*
Initialization:
PSN_CAM_IN(EX)[i] = 0
PSN_EDGE_CAM_IN(EX)[z][i] = 0

Formula section:

for z = IDX_EDGE_CAM_IN(EX)[i]
PSN_EDGE_CAM_IN(EX)[z][i] = PSN_ENG_ENSD - PSN_ENG_CAM_IN(EX)[i]
In the following calculations, the resolution has to be converted:
PSN_CAM_IN(EX)[i] = PSN_EDGE_CAM_IN(EX)[z][i]
PSN_DIF_EDGE_CAM_IN(EX)[i] = PSN_ENG_ENSD (n) - PSN_ENG_ENSD (n-1)
T_DIF_EDGE_CAM_IN(EX)[i] = T_SEG_CAM_IN(EX)[i]

4.57.3 Camshaft Position Adaptation

4.57.3.1 Reference Position Adaptation

General information:

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The reference position adaptation is done whenever it is not disabled by the corresponding flag from VVTI, or if there is no VVTI on that camshaft, and if the condition for limited dynamic variation of the camshaft position is true. A flag is set to signal successful adaptation.

The flag is reset when the adaptation inhibit conditions become false.

If LV_DI_AD_REF_CAM_IVVT_IN(EX) = 1

Then LV_AD_END_CAM_IN(EX)[i] = 0

The camshaft position output value should be zero in VVTI passive position. At each ocurrence of the reference camshaft signal edge, a portion of the position deviation is added to the previous adaptation value, as long as adaptation conditions are true, this is done for all the camshaft signal edges.

If the conditions stay true for a number of revolutions, then the flag for successful end of adaptation is set (LV_AD_END_CAM_IN(EX)[i] = 1).

i = 1...NC_NR_CAM_CBK z = 0...NC_NR_EDGE_CAM_IN/EX

Application conditions:

Activation:

LV_VLD_PSN_CAM_IN(EX)_I =1 **And** LV_SYN_VLD = 1

And

LV_DI_AD_REF_CAM_IVVT_IN(EX) = 0 **Or** LC_NOT_ADJ_CAM_IVVT_IN(EX)[i] = 1 **Or** NLC_IVVT_IN(EX) = 0

Recurrence: every reference camshaft signal edge (IDX_EDGE_CAM_IN(EX)[i] = 1)

Initialization:

LV_AD_END_CAM_IN(EX)[i] = 0

CTR_REV_AD_REF_CAM_IN(EX)[i] = 0

PSN_EDGE_AD_CAM_IN(EX)[z][i] from saved value in NVMY (if adaptation value has never been learned or if the stored value could not be read, PSN_EDGE_AD_CAM_IN(EX)[z][i] are initialized to 0)

PSN_AD_CAM_IN(EX)[i] = Sum **(** PSN_EDGE_AD_CAM_IN(EX)[z][i]
for z = 1...NC_NR_EDGE_CAM_IN(EX) **)** /NC_NR_EDGE_CAM_IN(EX)
(resolution conversion)

LV_CAM_AD_SAVE_IN(EX)[i] from saved value in NVMY (if adaptation value has never been learned or if the stored value could not be read, LV_CAM_AD_SAVE_IN(EX)[i] is initialized to 0)

PSN_EDGE_AD_CAM_IN(EX)[z][i] and LV_CAM_AD_SAVE_IN(EX)[i] shall be saved in NVMY only if: LV_CAM_AD_PWL_NOT_SAVE_IN(EX)[i] =0 (otherwise the last stored values, which have been stored after last driving cycle without error, shall not be changed)

At reset: CAM_PSN_LST_REF_AD_IN(EX)[i] = PSN_EDGE_AD_CAM_IN(EX)[1][i]

(All these adaptive values has to be reset in case of cam/crk mechanical change (Chain change, camshaft sensor change...))

Formula section:

If |PSN_EDGE_CAM_IN(EX)[1][i] (n) - PSN_EDGE_CAM_IN(EX)[1][i] (n-1)| < C_GRD_AD_REF_MAX_CAM_IN(EX)

Then increment CTR_REV_AD_REF_CAM_IN(EX)[i]

The adaptation values are calculated for all indexes (for z = 1...NC_NR_EDGE_CAM_IN(EX))

PSN_EDGE_AD_CAM_IN(EX)[z][i] (n) = PSN_EDGE_AD_CAM_IN(EX)[z][i] (n-1) + C_CRLC_AD_REF_CAM_IN(EX) * PSN_EDGE_CAM_IN(EX)[z][i]

Else CTR_REV_AD_REF_CAM_IN(EX)[i] = 0

Endif

If CTR_REV_AD_REF_CAM_IN(EX)[i] >= C_NR_REV_AD_REF_CAM_IN(EX)

Then CTR_REV_AD_REF_CAM_IN(EX)[i] = 0

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PSN_AD_CAM_IN(EX)[i] = Sum **(** PSN_EDGE_AD_CAM_IN(EX)[z][i]
for z = 1...NC_NR_EDGE_CAM_IN(EX) **)** /NC_NR_EDGE_CAM_IN(EX)
(resolution conversion)

If LV_CAM_AD_SAVE_IN(EX)[i] = 1
Then **If** |CAM_PSN_LST_REF_AD_IN(EX)[i] - PSN_EDGE_AD_CAM_IN(EX)[1][i]| < C_TOL_TOOTH_OFF_CAM_IN(EX)
Then CAM_PSN_LST_REF_AD_IN(EX)[i] = PSN_EDGE_AD_CAM_IN(EX)[1][i]

Else nothing
Endif
LV_TOOTH_OFF_DET_ENA_IN(EX)[i] = 1 *(to allow the ONE_TOOTH_OFF diagnosis only if a reference adaptation has been done after the very first one)*
Else **If** C_TOL_TOOTH_OFF_CAM_IN(EX) <> 0
Then CAM_PSN_LST_REF_AD_IN(EX)[i] = PSN_EDGE_AD_CAM_IN(EX)[1][i]

LV_CAM_AD_SAVE_IN(EX)[i] = 1 *(set at the end of the very first reference adaptation)*
Else nothing
Endif
Endif
LV_AD_END_CAM_IN(EX)[i] = 1
Else
LV_TOOTH_OFF_DET_ENA_IN(EX)[i] = 0
Endif

If LV_DI_AD_REF_CAM_IVVT_IN(EX) = 1
Then CTR_REV_AD_REF_CAM_IN(EX)[i] = 0
Endif

4.57.3.2 Continuous Edge Position Adaptation

The continuous position adaptation is enabled at a limited dynamic variation of the camshaft position measured at the reference signal edge.
The difference of the actual camshaft position measured at the reference edge, and the actual camshaft position measured at any other signal edge, is calculated once per camshaft revolution. That difference is multiplied with a cofficient (<<1) and added to the previous adaptation value to form the new adaptation value, which is applied in the following camshaft revolution. This way the camshaft position output value calculated at any signal edges will approach the camshaft position output value calculated at the reference signal edge.

Application conditions:

Activation:
LV_VLD_PSN_CAM_IN[i] = 1 **And** LV_SYN_VLD = 1
And
LV_DI_AD_REF_CAM_IVVT_IN(EX) = 1 **And** LC_NOT_ADJ_CAM_IVVT_IN(EX)[i] = 0 **And** NLC_IVVT_IN(EX) = 1
Recurrence: *every reference camshaft signal edge (IDX_EDGE_CAM_IN(EX)[i] = 1)*
Initialization:
PSN_EDGE_AD_CAM_IN(EX)[z][i] from saved value in NVMY (if adaptation value has never been learned or if the stored value could not be read, PSN_EDGE_AD_CAM_IN(EX)[z][i] is initialized to 0)

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PSN_EDGE_AD_CAM_IN(EX)[z][i] and LV_CAM_AD_SAVE_IN(EX)[i] shall be saved in NVMY only if: LV_CAM_AD_PWL_NOT_SAVE_IN(EX)[i] =0 (otherwise the last stored values, which have been stored after last driving cycle without error, shall not be changed)

Formula section:

For the following equations, the index z of the camshaft signal edges equals IDX_EDGE_CAM_IN(EX)[i] (z=1 for reference edge). The adaptation values are calculated for all indexes from 2 to NC_NR_EDGE_CAM_IN(EX).

If |PSN_EDGE_CAM_IN(EX)[1][i] (n) - PSN_EDGE_CAM_IN(EX)[1][i] (n-1)| < C_GRD_AD_MAX_CAM_IN(EX)
Then PSN_EDGE_AD_CAM_IN(EX)[z][i] (n) = PSN_EDGE_AD_CAM_IN(EX)[z][i] (n-1) + C_CRLC_AD_CAM_IN(EX) * (PSN_EDGE_CAM_IN(EX)[z][i] - PSN_EDGE_CAM_IN(EX)[1][i])
Endif

4.57.3.3 Reference adaptive values save authorization at Powerlatch

Before saving the adaptive values in NVMY during PWL, it is important to check if they are correct. Even if the REF_CRK_CAM error is not set, the calculated adaptive values can be wrong (for example, the error flag could have been reset on a quick key 0 to 1 transition).

Application conditions:

Activation:
ECU_STATE = PWL
Recurrence: *once during PWL, for all camshaft edges of all present camshaft sensors, before saving the NVMY adaptive values*
Initialization:
LV_CAM_AD_PWL_NOT_SAVE_IN(EX)[i] =0

Formula section:

If PSN_EDGE_AD_CAM_IN(EX)[z][i] < - C_TOL_REF_CRK_CAM_IN(EX)
or PSN_EDGE_AD_CAM_IN(EX)[z][i] > C_TOL_REF_CRK_CAM_IN(EX)
Then LV_CAM_AD_PWL_NOT_SAVE_IN(EX)[i] = 1
Else
If LV_CAM_AD_SAVE_IN(EX)[i] = 1
And
CAM_PSN_LST_REF_AD_IN(EX)[i] <> PSN_EDGE_AD_CAM_IN(EX)[1][i]
And
C_TOL_TOOTH_OFF_CAM_IN(EX) <> 0
Then LV_CAM_AD_PWL_NOT_SAVE_IN(EX)[i] = 1
Else *nothing, (if LV_CAM_AD_PWL_NOT_SAVE_IN(EX)[i] has been set to 1 due to anyone of the camshaft edges, it must stay to 1 and the adaptive will not be saved. Contrary, if all the camshaft edges are correct, adaptive values can be saved, LV_CAM_AD_PWL_NOT_SAVE_IN(EX)[i] must stay at 0)*
Endif
Endif

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4.58 Evaporative emission control variables

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_CP_DYW	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
FAC_LAM_CP average value for dynamic window					
LAMB_SP_S_DYW_CP	V	0... 7FFFH	0... 31.99902	976.599e-6	-
LAMB_SP_S average value for dynamic window					
LV_CP_CAT_PURGE	O/V	0... 1H	0 ...1	1	-
Catalyst purge acivated					
LV_CP_CAT_PURGE_AFL	O/V	0... 1H	0 ...1	1	-
Catalyst purge AFL acivated					
LV_CP_CDN_MIN_PURGE_FAST	O/V	0... 1H	0 ...1	1	-
flag for usage of CL-model; =1: MIN_PURGE forced, no CL-mdl usage possible					
LV_CP_CLOSE_REQ	O/V	0... 1H	0 ...1	1	-
Request to close the CPS valve					
LV_CP_CMU_CMB	O/V	0... 1H	0 ...1	1	-
Commutation combustion active					
LV_CP_DYW	O/V	0... 1H	0 ...1	1	-
Dynamic window for canister purge					
LV_CP_PU	V	0... 1H	0 ...1	1	-
Flag to interupt the purge in PU mode					
LV_CP_PUC	V	0... 1H	0 ...1	1	-
CP interruption due to engine state PUC					
LV_CP_WIN	V	0... 1H	0 ...1	1	-
Engine operation within CP window (n & maf)					
LV_LAM_LIM_CP	V	0... 1H	0 ...1	1	-
Lambda controller reached limits (defined in lambda controller module)					
LV_LAM_OUT_CP	V	0... 1H	0 ...1	1	-
Lambda controller reached limits (defined in this module)					
LV_N_MAX_CP	O/V	0... 1H	0 ...1	1	-
Maximum engine speed for canister purge calculations limit reached					
MAF_DYW_CP	V	0... FFFFH	0... 1389	0.0211948	mg/stk
MAF average value for dynamic window					
N_DYW_CP	V	0... 1FE0H	0... 8160	1	rpm
N average value for dynamic window					
PRS_CPS	O/V	8000... 7FFFH	-2717.04 ...2716.96	0.0829175	hPa
Pressure difference envirionment over CP line					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_CDN_CP	O/V	0H 1H 2H 3H 4H 5H	NO_CDN CDN_NO_PURGE CDN_MIN_PURGE CDN_RAMP_OPEN CDN_RAMP_FAST CDN_NO_FAST	-	-
Activation conditions for evaporative emission control function					
T_DLY_CAT_PURGE_CP_AFL_TMP	-	0... FFFFH	0... 6553.5	0.1	s
timer for LV_CP_CAT_PURGE_AFL calculation					
T_DLY_CAT_PURGE_CP_TMP	-	0... FFFFH	0... 6553.5	0.1	s
timer for LV_CP_CAT_PURGE calculation					
T_DLY_CMU_CP_TMP	-	0... FFFFH	0... 6553.5	0.1	s
timer for LV_CP_CMU_CMB calculation					
T_DLY_CP_PU_TMP	-	0... FFFFH	0... 6553.5	0.1	s
timer for LV_CP_PU calculation					
T_DLY_CP_PUC_TMP	-	0... FFFFH	0... 6553.5	0.1	s
timer for LV_CP_PUC calculation					
T_DLY_DYW_CP	-	0... FFFFH	0... 1310.7	0.02	s
timer for LV_CP_DYW calculation					
T_DLY_LAM_LIM_CP_TMP	-	0... FFFFH	0... 6553.5	0.1	s
timer for LV_LAM_LIM_CP calculation					
T_DLY_LAM_OUT_CP_TMP	-	0... FFFFH	0... 6553.5	0.1	s
timer for LV_LAM_OUT_CP calculation					
TQI_DYW_CP	V	0... 7FFFH	0... 1023.97	0.03125	Nm
TQI_SP_S average value for dynamic window					

Input data:

AMP {p. 982}	FAC_LAM_CP {p. 3698}	FAC_LAM_MV_MMV_CP [NC_CBK_EX_NR] {p. 2462}	LAMB_SP_S {p. 1820}
LV_CAT_PURGE_REQ_POST_AFL [NC_NT_NR] {p. 2982}	LV_CL_MDL_END_CAT_PURGE {p. 3728}	LV_CMB_TRAN_ACT {p. 799}	LV_CP_CLL {p. 3636}
LV_CP_CLOSE_1 {p. 3679}	LV_CP_CLOSE_2 {p. 3679}	LV_CP_CLOSE_3 {p. 3679}	LV_CP_DYW_EXT {p. 3679}
LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR] {p. 2463}	LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR] {p. 2463}	LV_FCUT_IND {p. 2295}	LV_HOM_ACT {p. 8136}
LV_INH_CP {p. 3679}	LV_INH_CP_CLL {p. 3679}	LV_INH_CP_FAST {p. 3679}	LV_IS {p. 1720}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_LAM_STOP_SHO_PER [NC_CBK_EX_NR] {p. 2448}	LV_LDC_LAM_AD [NC_CBK_EX_NR] {p. 2721}

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LV_NT_RGN_REQ {p. 996}	LV_PU {p. 1720}	LV_PUC {p. 1720}	MAF {p. 8277}
MAP {p. 8278}	N {p. 1525}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}
PRS_CPS_EXT {p. 3680}	STATE_CLL_DEAC_CP {p. 3637}	STATE_CP {p. 3637}	STATE_LOCK_CP {p. 3638}
T_AST {p. 1766}	T_DLY_MAX_CP {p. 3638}	TCO {p. 1100}	TIA_THR {p. 984}
TQI_SP_S {p. 8391}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LAM_DYW_CP	-	0... FFH	0... 0.99609	3.9063e-3	-
Filter constant for limited dynamics calculation on lambda controller controller in non-normal purge					
C_CRLC_LAMB_SP_S_DYW_CP	-	0... FFH	0... 0.99609	3.9063e-3	-
Filter constant for limited dynamics calculation on lambda setpoint in stratified					
C_CRLC_MAF_DYW_CP	-	0... FFH	0... 0.99609	3.9063e-3	-
Filter constant for limited dynamics calculation on MAF					
C_CRLC_N_DYW_CP	-	0... FFH	0... 0.99609	3.9063e-3	-
Filter constant for limited dynamics calculation on engine speed					
C_CRLC_TQI_DYW_CP_1	-	0... FFH	0... 0.99609	3.9063e-3	-
Filter constant for limited dynamics calculation on tqi_sp in stratified					
C_CRLC_TQI_DYW_CP_2	-	0... FFH	0... 0.99609	3.9063e-3	-
Filter constant for limited dynamics calculation on tqi_sp in stratified for RampOpenFast and MaxPurge					
C_DLY_N_MAF_DYW_CP	-	0... FFFFH	0... 1310.7	0.02	s
Time delay to have stabilization condition					
C_DLY_N_TQI_DYW_CP_1	-	0... FFFFH	0... 1310.7	0.02	s
Time delay to have stabilization condition for RampOpen					
C_DLY_N_TQI_DYW_CP_2	-	0... FFFFH	0... 1310.7	0.02	s
Time delay to have stabilization condition for RampOpenFast and MaxPurge					
C_FAC_LAM_CP_BOL	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Limit on FAC_LAM_CP value to start RAMP_OPEN					
C_FAC_LAM_CP_DYW	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Dynamic window value on FAC_LAM_CP					
C_FAC_LAM_CP_TOL	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Limit on FAC_LAM_CP value to start RAMP_OPEN					
C_LAMB_SP_S_CP_BOL	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Bottom limit on the LAMB_SP_S value					
C_LAMB_SP_S_CP_TOL	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Top limit on the LAMB_SP_S value					
C_LAMB_SP_S_DYW_CP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Dynamic window on LAMB_SP_S value					
C_MAF_CP_BOL_HYS	-	0... FFH	0... 1389	5.4470588	mg/stk
Hysteresis for minimum mass air flow limit for activation of the RAMP_OPEN operation (homogeneous					
C_MAF_DYW_CP	-	0... FFFFH	0... 1389	0.0211948	mg/stk
MAF window for limited dynamics					
C_N_2_CP_BOL	-	0... FFH	0... 8160	32	rpm
Minimum speed limit for activation of the RAMP_OPEN operation (stratified)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_2_CP_TOL	-	0... FFH	0... 8160	32	rpm
Maximum speed limit for activation of the RAMP_OPEN operation (stratified)					
C_N_2_DYW_CP	-	0... 1FE0H	0... 8160	1	rpm
engine speed window for limited dynamics					
C_N_CP_BOL	-	0... FFH	0... 8160	32	rpm
Minimum speed limit for activation of the RAMP_OPEN operation (homogeneous)					
C_N_CP_TOL	-	0... FFH	0... 8160	32	rpm
Maximum speed limit for activation of the RAMP_OPEN operation (homogeneous)					
C_N_DYW_CP	-	0... 1FE0H	0... 8160	1	rpm
engine speed window for limited dynamics					
C_N_HYS_MAX_CP	-	0... FFH	0... 8160	32	rpm
Hysteresis value for canister purge calculations (CPU load reduction)					
C_N_MAX_CP	-	0... FFH	0... 8160	32	rpm
Maximum engine speed value for canister purge calculations (CPU load reduction)					
C_PRS_MAX_CPS	-	8000... 7FFFH	-2717.04 ...2716.96	0.0829175	hPa
Pressure difference limit (environment-intake manifold) for activation of the canister purge					
C_PRS_MAX_CPS_2	-	8000... 7FFFH	-2717.04 ...2716.96	0.0829175	hPa
Pressure difference limit (environment-intake manifold) for direct switch to NO_PURGE (no ramp)					
C_T_DLY_CAT_PURGE_AFL_CP	-	1... FFFFH	0.1... 6553.5	0.1	s
Delay time at strart cathalyst purge AFL					
C_T_DLY_CAT_PURGE_CP	-	1... FFFFH	0.1... 6553.5	0.1	s
Delay time after cathalyst purge					
C_T_DLY_LAM_CP	-	1... FFFFH	1... 65535	1	s
Delay on lambda control stabilization to restart RAMP_OPEN					
C_T_DLY_PU_CPS	-	1... FFFFH	0.1... 6553.5	0.1	s
CPS interrupt time during PU					
C_T_DLY_PUC_CP	-	1... FFFFH	0.1... 6553.5	0.1	s
caniser purge interrupt time after PUC					
C_T_LAM_LIM_CP	-	0... FFFFH	0... 6553.5	0.1	s
Additionnal time to stay in MIN_PURGE after LV_FAC_LAM_LIM_XXX					
C_TIA_MIN_CP	-	0... FEH	-48... 142.5	0.75	°C
Minimum intake air temperature for closing of the CPS					
C_TQI_CP_BOL_HYS	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Hysteresis for minimum mass air flow limit for activation of the RAMP_OPEN operation (homogeneous					
C_TQI_DYW_CP	-	0... 7FFFH	0... 1023.97	0.03125	Nm
Dynamic window value on TQI_SP_S					
IP_MAF_CP_BOL	-	0... FFH	0... 1389	5.4470588	mg/stk
LDPM_N_32_3_EVAC	8	0... FFH	0... 8160	32	rpm
Minimum mass air flow limit for activation of the RAMP_OPEN operation (homogeneous)					
IP_MAF_CP_TOL	-	0... FFH	0... 1389	5.4470588	mg/stk
LDPM_N_32_3_EVAC	8	0... FFH	0... 8160	32	rpm
Maximum mass air flow limit for activation of the RAMP_OPEN operation (homogeneous)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_T_DLY_CMU_CPS	-	0... FFFFH	0... 6553.5	0.1	s
LDP_N_32_IP_T_DLY_CMU_CPS	6	0... FFH	0... 8160	32	rpm
Stabilization delay on lambda regulation after commutation					
IP_TQI_CP_BOL	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32_3_EVAC	8	0... FFH	0... 8160	32	rpm
Minimum torque limit for sctivation of the RAMP_OPEN operation (stratified)					
IP_TQI_CP_TOL	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32_3_EVAC	8	0... FFH	0... 8160	32	rpm
Maximum torque limit for sctivation of the RAMP_OPEN operation (stratified)					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_CDN_CP_MAN	-	0H 1H 2H 3H 4H 5H	NO_CDN CDN_NO_ PURGE CDN_MIN_ PURGE CDN_RAMP_ OPEN CDN_RAMP_ FAST CDN_NO_ FAST	-	-
manual selection of STATE_CDN_CP					
C_STATE_LAM_LIM_CP	-	0H 1H 2H	NONE NO_PURGE MIN_PURGE	-	-
state to be forced if lambda control limitation reached					
C_STATE_WIN_CP_NOT	-	0H 1H 2H	NONE NO_PURGE MIN_PURGE	-	-
state to be forced if engine operation outside CP window					
LC_CP_CAT_PURGE_AFL_ACT	-	0... 1H	0 ...1	1	-
Canister purge AFL in closed loop with CL-Model					
LC_CP_CAT_PURGE_OFF	-	0... 1H	0 ...1	1	-
Canister purge off during catalyst purge					
LC_CP_CAT_PURGE_OPL	-	0... 1H	0 ...1	1	-
Canister purge in open loop during cathalyst purge					
LC_CP_CLL_INH_MAN	-	0... 1H	0 ...1	1	-
switch for deactivation of closed loop canister purge ("normal purge")					
LC_CP_CLL_S_INH	-	0... 1H	0 ...1	1	-
Selection of MIN_PURGE during stratified mode (=1)					
LC_CP_DYW_CLC_ENA	-	0... 1H	0 ...1	1	-
1: calculation of dynamic window conditions					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_CP_DYW_CLC_MAX_ENA	-	0... 1H	0 ...1	1	-
1: calculate lim.dynamics /lambda contr.limits etc. also with n_max_cp exceeded					
LC_CP_DYW_LAM_AD	-	0... 1H	0 ...1	1	-
1: use the limited dynamics flag of the lambda adaptation (common flag lamb ad /cp)					
LC_CP_INH_MAN	-	0... 1H	0 ...1	1	-
switch for deactivation of canister purge and force NO_PURGE					
LC_LAM_DYW_CP_INI_DEAC	-	0... 1H	0 ...1	1	-
1: deactivate dynamic window on lambda control at deactivated normal purge					
LC_PRS_CPS_EXT	-	0... 1H	0 ...1	1	-
switch to use externally calculated value for PRS_CPS					
LC_STATE_CDN_CP_MAN	-	0... 1H	0 ...1	1	-
switch to activate test mode // manual setting of STATE_CDN_CP					

Input data table order: External inputs - Inputs from other EVAC modules
(If the system includes an OBD sequencer, LV_CP_CLOSE_CP_x will be imported from outside the EVAC aggregate, if the system does not include an OBD sequencer, the flags will be provide within the aggregate (within the appl.inc. module))

General information:

- -

Application conditions

Initialisation: - -

Recurrence: 20 ms

Activation: - -

Deactivation: - -

Signal flow diagram:

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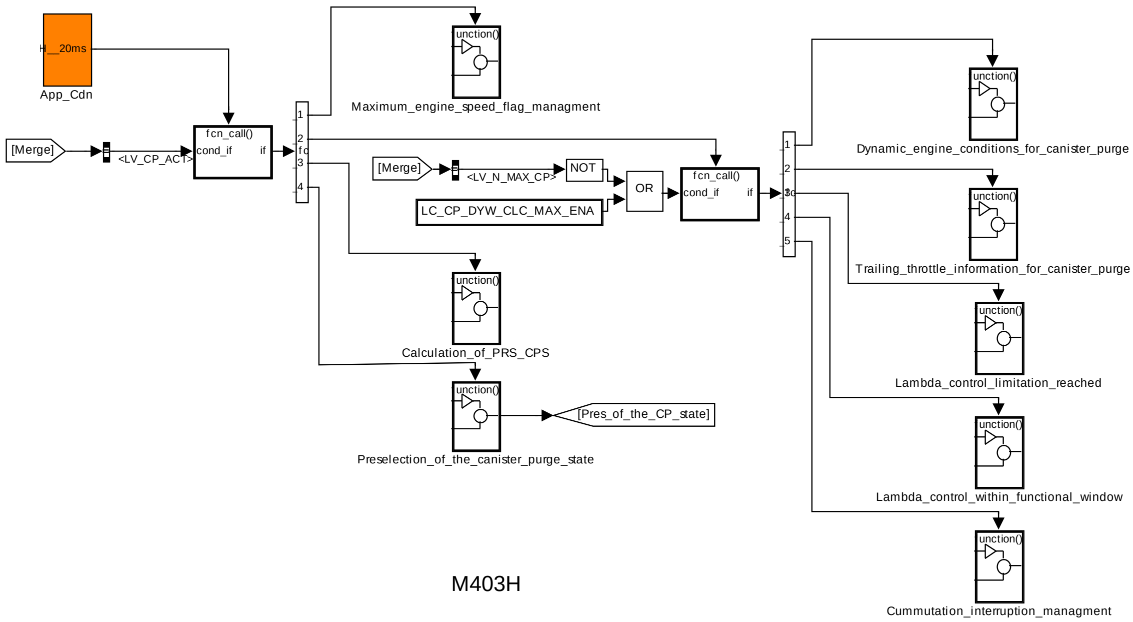

Formula section:

if LV_CP_ACT = 1
then call “Maximum engine speed flag management”
  if [LV_N_MAX_CP = 0
  or LC_CP_DYW_CLC_MAX_ENA = 1]
  then call “Dynamic engine conditions for canister purge”
    call “Trailling throttle information for canister purge”
    call "Canister purge prohibition after "trailing fuel cut off""
    call “Lambda control limitation reached”
    call “Lambda control within functional window”
    call “Commutation interruption management”
    call "Catalyst purge interruption management"
  endif
  call “Calculation of PRS_CPS”
  call “Preselection of the canister purge state”
end

4.58.1 Maximum engine speed flag management

General information:

When the CPU load is critical it is possible to disable some of the canister purge calculations when the engine speed is above a threshold.

Application conditions

Initialisation: `at RST or IGKON`
`LV_N_MAX_CP = 0`

Recurrence: *called by superior block*

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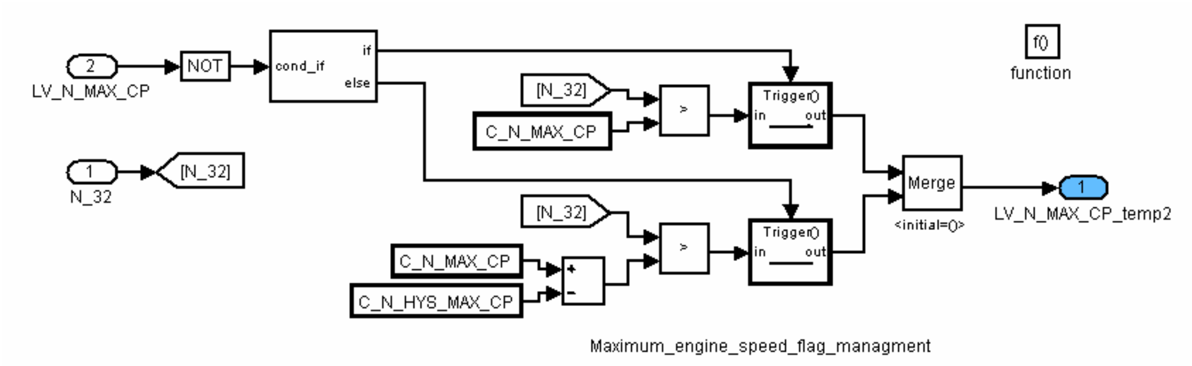
Activation: *called by superior block*

Deactivation: - -

Signal flow diagram:



Formula section:

if LV_N_MAX_CP = 0
then LV_N_MAX_CP = [N_32 > C_N_MAX_CP]
else LV_N_MAX_CP = [N_32 > C_N_MAX_CP - C_N_HYS_MAX_CP]
endif
end

4.58.2 Dynamic engine conditions for canister purge

General information:

The limited dynamic condition for a variable exist if the current value stays inside a tolerance window. If the values of n & maf (homogeneous) rsp. n, tqi_sp_s and lamb_sp_s (stratified) stay within a window around the moving mean value of this variable for a certain time, limited dynamic is detected. C_FAC_LAM_CP_DYW should be always greater than C_FAC_LAM_DIF_MAX_CP.

Application conditions

Initialisation:

```
at RST or IGKON
   N_DYW_CP         = 0
   MAF_DYW_CP        = 0
   TQI_DYW_CP        = 0
   LAMB_SP_S_DYW_CP  = 0
   FAC_LAM_CP_DYW       = 0
   T_DLY_DYW_CP     = 0
```

Recurrence: *called by superior bloc*

Activation: *called by superior block*

Deactivation: - -

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Formula section:

```
if      LC_CP_DYW_CLC_ENA      = 1
and     LC_CP_CLL_INH_MAN      = 0
then  call   "Dynamic window calculation"
        else   LV_CP_DYW = 1
endif
if      LC_CP_DYW_LAM_AD = 1          // use dyw flag from lambda adaptation
then  LV_CP_DYW = [LV_CP_DYW and LV_LDC_LAM_AD [1] and LV_LDC_LAM_AD [2]]
endif
end
```

4.58.2.1 Dynamic window calculation

```
if      [      LV_HOM_ACT = 1             // limited dynamic cond. for homogeneous operation
        and  abs  (N_DYW_CP       - N)            < C_N_DYW_CP
        and  abs  (MAF_DYW_CP   - MAF)             < C_MAF_DYW_CP
        and  abs  (FAC_LAM_CP_DYW   - FAC_LAM_CP)       < C_FAC_LAM_ CP_DYW]
or      [      LV_HOM_ACT = 0             // limited dynamic conditions for stratified operation
        and  abs  (N_DYW_CP       - N)            < C_N_2_DYW_CP
        and  abs  (TQI_DYW_CP    - TQI_SP_S)          < C_TQI_DYW_CP
        and  abs  (LAMB_SP_S_DYW_CP - LAMB_SP_S)       < C_LAMB_SP_S_DYW_CP ]
then  call   "Timer and MMV calculation"          // LDC fulfilled
else  call   "Timer and MMV init"                  // LDC not fulfilled
endif
LV_CP_DYW =
          [  T_DLY_DYW_CP   = 0
and   LV_CP_DYW_EXT= 1 ]                      // external dyn.win.flag from appl.inc. module
end
```

4.58.2.2 Timer and MMV calculation

$N\_DYW\_CP_n$ = $N\_DYW\_CP_{n-1}$ + (N - $N\_DYW\_CP_{n-1}$) * C_CRLC_N_DYW_CP

if LV_HOM_ACT = 1

  $MAF\_DYW\_CP_n$ = $MAF\_DYW\_CP_{n-1}$ +
  (MAF - $MAF\_DYW\_CP_{n-1}$) * C_CRLC_MAF_DYW_CP
  if LV_CP_CLL = 1 // no ldc on lambda controller in normal purge
  or [STATE_CLL_DEAC_CP $\neq$ CP_NO_DEAC **and** LC_LAM_DYW_CP_INI_DEAC = 1]
  then FAC_LAM_ CP_DYW = FAC_LAM_CP
  else $FAC\_LAM\_CP\_DYW_n$ = $FAC\_LAM\_CP\_DYW_{n-1}$+
    (FAC_LAM_CP - $FAC\_LAM\_CP\_DYW_{n-1}$) * C_CRLC_LAM_DYW_CP
  endif

else

  if (STATE_CP = RAMP_OPEN_FAST or STATE_CP = MAX_PURGE
  or STATE_CLL_DEAC_CP = MAX_PURGE_DEAC
  or STATE_CLL_DEAC_CP = RAMP_FAST_DEAC
  or T_DLY_MAX_CP $>$ 0)
  then $TQI\_DYW\_CP_n$ = $TQI\_DYW\_CP_{n-1}$+
    (TQI_SP_S - $TQI\_DYW\_CP_{n-1}$) * C_CRLC_TQI_DYW_CP_2
  else $TQI\_DYW\_CP_n$ = $TQI\_DYW\_CP_{n-1}$+
    (TQI_SP_S - $TQI\_DYW\_CP_{n-1}$) * C_CRLC_TQI_DYW_CP_1
  endif
  $LAMB\_SP\_S\_DYW\_CP_n$ = $LAMB\_SP\_S\_DYW\_CP_{n-1}$ +
    (LAMB_SP_S - $LAMB\_SP\_S\_DYW\_CP_{n-1}$) * C_CRLC_LAMB_SP_S_DYW_CP

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endif
T_DLY_DYW_CP = **max** (0, T_DLY_DYW_CP - TA) // timer decrementation
end

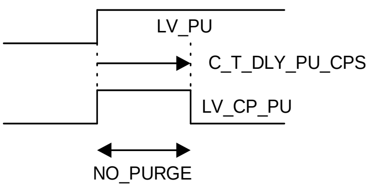
4.58.2.3 Timer and MMV init

N_DYW_CP = N
if LV_HOM_ACT = 1
  MAF_DYW_CP = MAF
  FAC_LAM_CP_DYW = FAC_LAM_CP
  T_DLY_DYW_CP = C_DLY_N_MAF_DYW_CP
else
  TQI_DYW_CP = TQI_SP_S
  LAMB_SP_S_DYW_CP = LAMB_SP_S
  if (STATE_CP = RAMP_OPEN_FAST **or** STATE_CP = MAX_PURGE
    or STATE_CLL_DEAC_CP = MAX_PURGE_DEAC
    or STATE_CLL_DEAC_CP = RAMP_FAST_DEAC
    or T_DLY_MAX_CP > 0)
  then T_DLY_DYW_CP = C_DLY_N_TQI_DYW_CP_2
  else T_DLY_DYW_CP = C_DLY_N_TQI_DYW_CP_1
  endif
endif
end

4.58.3 Trailling throttle information for canister purge

General information:

In case of trailling throttle condition LV_PU, the fuel coming from the purge could be important compared to the fuel injected. To prevent any malfunction we need to close immediatly the purge valve during a delay C_T_DLY_PU_CPS. During this time the flag LV_CP_PU is set to 1.



Application conditions

Initialisation: at RST or IGKON
  LV_CP_PU = 0
  T_DLY_CP_PU_TMP = 0

Recurrence: *called by superior block*

Activation: *called by superior block*

Deactivation: - -

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Formula section:

if LV_PU 0 1
then T_DLY_CP_PU_TMP = C_T_DLY_PU_CPS
else T_DLY_CP_PU_TMP = **max** (0, T_DLY_CP_PU_TMP - TA)
endif
LV_CP_PU = [*T_DLY_CP_PU_TMP* > 0]
end

4.58.4 Canister purge prohibition after "trailing fuel cut off"

After a fuel cut off phase (PUC) the engine needs a ceratain time to stabilize the air fuel ratio. During this phase the lambda controller has a deviation. To prevent that this deviation has an influence on the CL calculation, canister purge will be disabled after a PUC phase.

Application conditions

Initialisation: `at RST or IGKON`
`LV_CP_PUC = 0`
`T_DLY_CP_PUC_TMP = 0`

Recurrence: *called by superior block*

Activation: *called by superior block*

Deactivation: – –

Formula section:

if LV_PUC = 1
then T_DLY_CP_PUC_TMP = C_T_DLY_PUC_CP
else T_DLY_CP_PUC_TMP = **max** (0, T_DLY_CP_PUC_TMP - TA)
endif
LV_CP_PUC = [*T_DLY_CP_PUC_TMP* > 0]
end

4.58.5 Lambda control limitation reached

General information:

When the lambda control reaches a minimum or maximum value, the information LV_FAC_LAM_LIM_MIN rsp. LV_FAC_LAM_LIM_MAX is set. As soon as the lambda control value is again in its limits, the bit information is reset. In order to memorize this information and to wait for a lambda control value stabilized, an information is managed LV_LAM_LIM_CP.
This value is set to TRUE as long as any lambda control limit is exceeded and reset after a delay C_T_LAM_LIM_CP after the lambda control is within its limits again.

Application conditions

Initialisation: `at RST or IGKON`
`LV_LAM_LIM_CP = 0`
`T_DLY_LAM_LIM_CP_TMP = 0`
Recurrence: `called by superior block`

Activation: *called by superior block*

Deactivation: – –

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Formula section:

if LV_FAC_LAM_LIM_MIN [i] = 1 at least one bench
or LV_FAC_LAM_LIM_MAX [i] = 1 at least one bench
then T_DLY_LAM_LIM_CP_TMP = C_T_LAM_LIM_CP
else T_DLY_LAM_LIM_CP_TMP = **max** (0, T_DLY_LAM_LIM_CP_TMP - TA)
endif
LV_LAM_LIM_CP = [T_DLY_LAM_LIM_CP_TMP > 0]
end

4.58.6 Lambda control within functional window

General information:

Parallel to the observation of lamba control limits using the flags LV_FAC_LAM_LIM_MIN and LV_FAC_LAM_LIM_MAX coming from the lambda controller, the canister purge strategy provides two independent limits C_FAC_LAM_CP_BOL & C_FAC_LAM_CP_TOL.
As long as at least one lambda controller is not running in a window defined by [C_FAC_LAM_CP_BOL, C_FAC_LAM_CP_TOL] an information is set to TRUE and reset after a delay C_T_DLY_LAM_CP after all lambda controllers are within [C_FAC_LAM_CP_BOL, C_FAC_LAM_CP_TOL] again.

Application conditions

Initialisation: `at RST or IGKON`
`LV_LAM_OUT_CP = 0`
`T_DLY_LAM_OUT_CP_TMP = 0`

Recurrence: *called by superior block*

Activation: *called by superior block*

Deactivation: - -

Formula section:

if FAC_LAM_MV_MMV_CP [i] <= C_FAC_LAM_CP_BOL at least one bench
or FAC_LAM_MV_MMV_CP [i] >= C_FAC_LAM_CP_TOL at least one bench
then T_DLY_LAM_OUT_CP_TMP = C_T_DLY_LAM_CP
else T_DLY_LAM_OUT_CP_TMP = **max** (0, T_DLY_LAM_OUT_CP_TMP - TA)
endif
LV_LAM_OUT_CP = [*T_DLY_LAM_OUT_CP_TMP* > 0]
end

4.58.7 Commutation interruption management

General information:

Before a combustion commutation, the CPS valve may be closed to purge the intake manifold. A delay will be added to wait for lambda stabilisation and manifold purge. During the commutation the evaporative emission control is in state NO_PURGE

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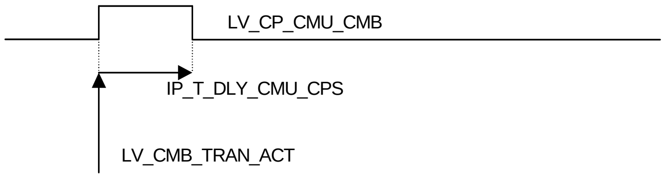

Application conditions

Initialisation: `at RST or IGKON`
```
LV_CP_CMU_CMB    = 0
T_DLY_CMU_CP_TMP   = 0
```

Recurrence: *called by superior block*

Activation: *called by superior block*

Deactivation: - -

Formula section:

if LV_CMB_TRAN_ACT
then T_DLY_CMU_CP_TMP = IP_T_DLY_CMU_CPS (N_32)
else T_DLY_CMU_CP_TMP = **max** (0, T_DLY_CMU_CP_TMP - TA)
endif
LV_CP_CMU_CMB = [*T_DLY_CMU_CP_TMP* $>$ 0]
end

4.58.8 Catalyst purge interruption management

General information:

During NO_x regeneration of the catalyst and a time delay after that, the canister purge can be set configurable to off, open loop or closed loop.

Application conditions

Initialisation: `at RST or IGKON`
```
LV_CP_CAT_PURGE          = 0
T_DLY_CAT_PURGE_CP_TMP  = 0
```

Recurrence: *called by superior block*

Activation: *called by superior block*

Deactivation: - -

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Formula section:

```
if      LV_HOM_ACT = 1
        and    [LV_NT_RGN_REQ
        or         (LV_CAT_PURGE_REQ_POST_AFL[i]          // at least one of these flags
                and LC_CP_CAT_PURGE_AFL_ACT)]
then  T_DLY_CAT_PURGE_CP_TMP = C_T_DLY_CAT_PURGE_CP
else  T_DLY_CAT_PURGE_CP_TMP =  max (0, T_DLY_CAT_PURGE_CP_TMP - TA)
endif
LV_CP_CAT_PURGE = [T_DLY_CAT_PURGE_CP_TMP > 0 ]
end

if      [LV_HOM_ACT = 1
        and    LV_CAT_PURGE_REQ_POST_AFL[i] transition 0 -> 1 // at least one of these flags
then  T_DLY_CAT_PURGE_CP_AFL_TMP = C_T_DLY_CAT_PURGE_AFL_CP
else  T_DLY_CAT_PURGE_CP_AFL_TMP
                              = max (0, T_DLY_CAT_PURGE_CP_AFL_TMP - TA)
endif
LV_CP_CAT_PURGE_AFL = [T_DLY_CAT_PURGE_CP_AFL_TMP > 0 ]
end
```

4.58.9 Calculation of PRS_CPS

General information:

PRS_CPS is the pressure drop over the CP system, i.e. the difference between ambient air pressure and intake manifold pressure

Application conditions

Initialisation: `at RST or IGKON`
`PRS_CPS = 0`

Recurrence: *called by superior block*

Activation: *called by superior block*

Deactivation: - -

Formula section:

```
if      LC_PRS_CPS_EXT
then PRS_CPS   = PRS_CPS_EXT
else  PRS_CPS  = AMP - MAP
end
```

4.58.10 Preselection of the canister purge state

General information:

After activation of the function (LV_CP_ACT=1) there is a continuous check of the activation conditions.

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Application conditions

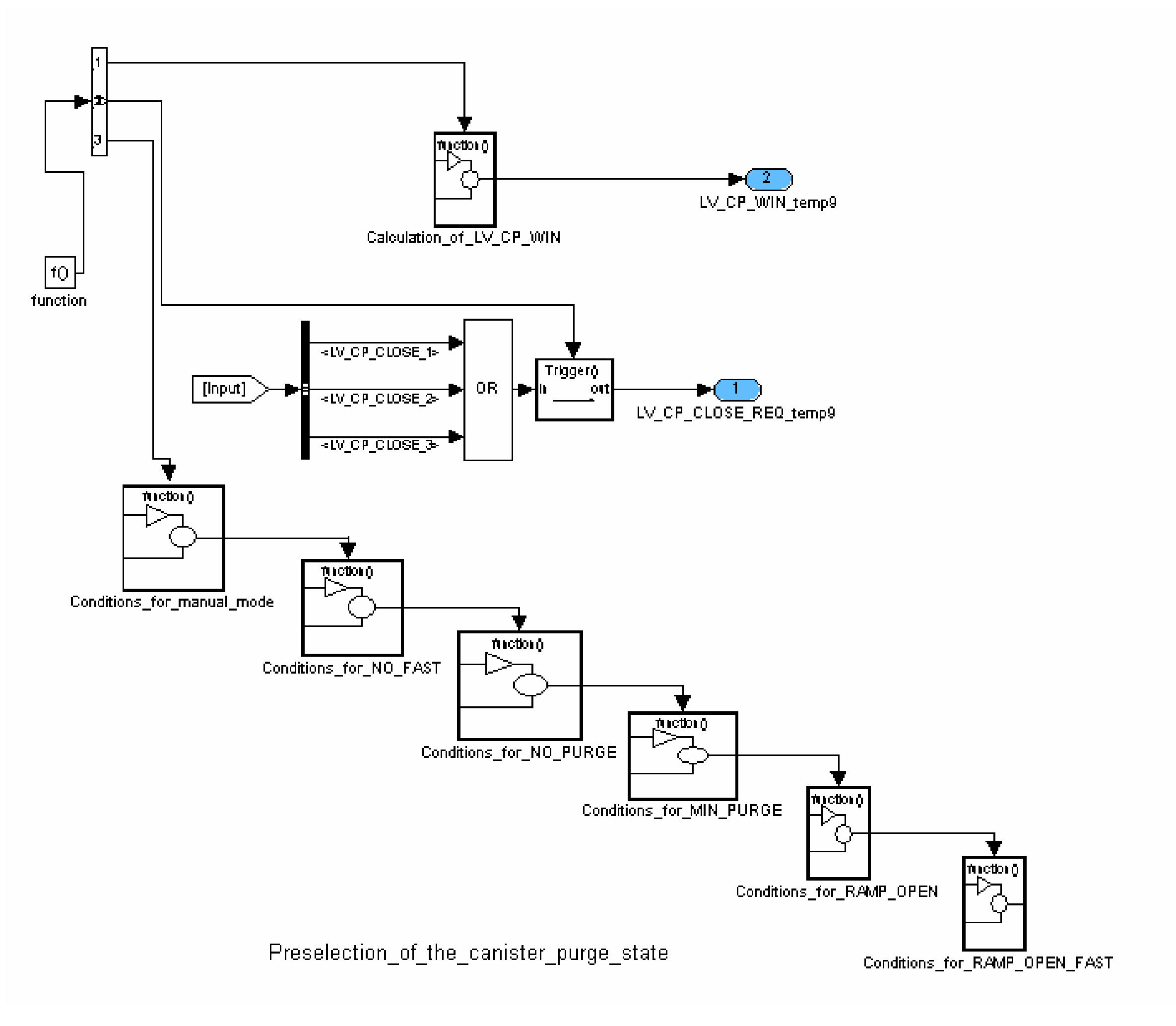
Initialisation: at RST or IGKON
all the values are set to zero.

Recurrence: *called by superior block*

Activation: *called by superior block*

Deactivation: - -

Signal flow diagram:



Formula section:

if LV_HOM_ACT = 1
then **if** LV_CP_WIN = 1
then LV_CP_WIN = // Engine operation window for CP, hom.
[N_32 > C_N_CP_BOL
and N_32 < C_N_CP_TOL
and MAF > [IP_MAF_CP_BOL (N_32) - C_MAF_CP_BOL_HYS]
and MAF < IP_MAF_CP_TOL (N_32)]

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```
        else LV_CP_WIN =                       // Engine operation window for CP, hom.
                [       N_32        > C_N_CP_BOL
                and     N_32        < C_N_CP_TOL
                and     MAF         > [ IP_MAF_CP_BOL (N_32) + C_MAF_CP_BOL_HYS ]
                and     MAF         < IP_MAF_CP_TOL (N_32)]
        endif
else    if LV_CP_WIN = 1
        then  LV_CP_WIN =                      // Engine operation window for CP, strat.
                [       N_32        > C_N_2_CP_BOL
                and     N_32        < C_N_2_CP_TOL
                and     TQI_SP_S    > [ IP_TQI_CP_BOL (N_32) - C_TQI_CP_BOL_HYS ]
                and     TQI_SP_S    < IP_TQI_CP_TOL (N_32)]
        else            LV_CP_WIN =                // Engine operation window for CP, strat.
                [       N_32        > C_N_2_CP_BOL
                and     N_32        < C_N_2_CP_TOL
                and     TQI_SP_S    > [ IP_TQI_CP_BOL (N_32) + C_TQI_CP_BOL_HYS ]
                and     TQI_SP_S    < IP_TQI_CP_TOL (N_32)]
        endif
endif

LV_CP_CLOSE_REQ =
[       LV_CP_CLOSE_1                   // request to close CPS with high speed
or      LV_CP_CLOSE_2                   // request to close CPS with medium speed
or      LV_CP_CLOSE_3 ]                 // request to close CPS with normal speed
```

<u>Conditions for manual mode:</u>

1. Test mode activated
   (LC_STATE_CDN_CP_MAN = 1)
   // in this case the conditions below are no more checked

STATE_CDN_CP = C_STATE_CDN_CP_MAN

<u>Conditions for immediate switch to NO_PURGE (without ramp):</u>

1. Fuel cut off active
   (LV_FCUT_IND = 1) **or**
2. Trailing throttle operation started
   (LV_CP_PU = 1) **or**
3. Prohibition after PUC
   (LV_CP_PUC = 1) **or**
4. Deactivation due to high engine speed /CPU load
   (LV_N_MAX_CP = 1) **or**
5. Difference pressure intake manifold-environment below threshold
   (relevant for supercharger engine or high engine load)
   (PRS_CPS < C_PRS_MAX_CPS_2) **or**
6. Request for fast closing from appl.inc. module
   (LV_INH_CP_FAST = 1)

STATE_CDN_CP = CDN_NO_FAST

<u>Conditions for NO_PURGE:</u>

(closing of the CPS required)

1. Conditions for NO_FAST are not fulfilled **and**
2. {canister purge manually forced to NO_PURGE
   (LC_CP_INH_MAN=1) **or**

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3. Application incidences flag to inhibit canister purge and switch to NO_PURGE
(LV_INH_CP=1) **or**
4. NO_PURGE locked for a certain time by EVAC control
(STATE_LOCK_CP = NO_PURGE) **or**
5. Request to close CPS from OBD2 sequenceur
(LV_CP_CLOSE_REQ=1) **or**
6. Difference pressure intake manifold-environment below threshold
(relevant for supercharger engine)
(PRS_CPS < C_PRS_MAX_CPS) **or**
7. Idle speed active and ambient air temperature below threshold
(acoustic problems with the CPS at low ambient temperatures)
[(LV_IS=1) **and** (TIA_THR < C_TIA_MIN_CP)] **or**
8. Combustion commutation and stabilization
(LV_CP_CMU_CMB=1) **or**
9. Engine operation point outside CP window and NO_PURGE selected for this event
[(LV_CP_WIN = 0) **and** (C_STATE_WIN_CP_NOT = NO_PURGE)] **or**

1. Lambda controller reached limits and no purge state is desired

[(LV_LAM_LIM_CP = 1) **and** (C_STATE_LAM_LIM_CP = NO_PURGE)] **or**
11. Catalyst purge requests state NoPurge
[(LV_CP_CAT_PURGE = 1
and (LC_CP_CAT_PURGE_OFF = 1 or LV_CL_MDL_END_CAT_PURGE = 1)] **or**
[LV_CP_CAT_PURGE_AFL = 1]

STATE_CDN_CP = CDN_NO_PURGE

<u>Conditions for MIN_PURGE:</u>

1. *"hard" conditions for MIN_PURGE:*

The "hard" condtitions for MIN_PURGE force MIN_PURGE, i.e. no usage of the canister load model is possible.

LV_CP_CDN_MIN_PURGE_FAST =
1. {closed loop canister purge (“normal puge”) manually deactivated
(LC_CP_CLL_INH_MAN=1) **or**
2. Application incidences flag to inhibit normal purge and switch to MIN_PURGE
(LV_INH_CP_CLL=1) **or**
3. MIN_PURGE locked for a certain time by EVAC control
(STATE_LOCK_CP = MIN_PURGE) **or**
4. Trailing throttle
(LV_PU = 1) **or**
5. Switch for not allowing NORMAL_PURGE in stratified set
(LV_HOM_ACT=0 **and** LC_CP_CLL_S_INH=1) **or**
6. Engine operation point outside CP window and MIN_PURGE selected for this event
[(LV_CP_WIN = 0) **and** (C_STATE_WIN_CP_NOT = MIN_PURGE)] } **or**
7. Catalyst purge requests open loop
[(LV_CP_CAT_PURGE = 1) and (LC_CP_CAT_PURGE_OPL = 1)]

1. *combination of all conditions for MIN_PURGE:*

1. Conditions for NO_FAST are not fulfilled **and**
2. Conditions for NO_PURGE are not fulfilled **and**
3. [Any of the "hard" conditions for MIN_PURGE is given (LV_CP_CDN_MIN_PURGE_FAST = 1) **or**
4. Lambda control in open-loop state in homogeneous mode
(LV_HOM_ACT=1 **and** LV_LAM_LSCL[i] = 0)

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(at least one bank) **or**

5. Lambda control stopped in homogeneous mode
(LV_HOM_ACT=1 **and** LV_LAM_STOP[i] = 1 **and** LV_LAM_STOP_SHO_PER[i] = 0)
(at least one bank, both conditions has to be true for one bank) **or**
6. Lambda controller reached limits and min purge state is desired
[(LV_LAM_LIM_CP=1) **and** (C_STATE_LAM_LIM_CP = MIN_PURGE)]

STATE_CDN_CP = CDN_MIN_PURGE

Conditions for RAMP_OPEN:

1. Conditions for NO_FAST are not fulfilled **and**
2. Conditions for NO_PURGE are not fulfilled **and**
3. Conditions for MIN_PURGE are not fulfilled **and**
4. Limited dynamics for canister purge fulfilled
(LV_CP_DYW=1) **and**
5. [Lambda control in defined limits in homogeneous mode
(LV_HOM_ACT=1 **and** LV_LAM_OUT_CP=0) **or**
6. Lambda setpoint within defined limits in stratified mode
[LV_HOM_ACT=0 **and** (C_LAMB_SP_S_CP_BOL < LAMB_SP_S <C_LAMB_SP_S_CP_TOL)]
] **and**
7. Engine operation within CP window (LV_CP_WIN = 1)

STATE_CDN_CP = CDN_RAMP_OPEN

Conditions for RAMP_OPEN_FAST :

1. Conditions for NO_FAST are not fulfilled **and**
2. Conditions for NO_PURGE are not fulfilled **and**
3. Conditions for MIN_PURGE are not fulfilled **and**
4. Limited dynamics for canister purge fulfilled
(LV_CP_DYW=1) **and**
5. [Lambda control in defined limits in homogeneous mode
(LV_HOM_ACT=1 **and** LV_LAM_OUT_CP=0) **or**
6. Lambda setpoint within defined limits in stratified mode
[LV_HOM_ACT=0 **and** (C_LAMB_SP_S_CP_BOL < LAMB_SP_S <C_LAMB_SP_S_CP_TOL)]
]

STATE_CDN_CP = CDN_RAMP_FAST

(the only difference between conditions for RAMP_OPEN and for RAMP_OPEN_FAST is the engine operation window.)

if none of the above conditions are fulfilled
STATE_CDN_CP = NO_CDN

The calculation of STATE_CDN_CP is done in the following order:

if Conditions for manual mode fulfilled
then STATE_CDN_CP = C_STATE_CDN_CP_MAN
elseif Conditions for NO_FAST fulfilled
then STATE_CDN_CP = CDN_NO_FAST
elseif Conditions for NO_PURGE fulfilled
then STATE_CDN_CP = CDN_NO_PURGE
elseif Conditions for MIN_PURGE fulfilled
then STATE_CDN_CP = CDN_MIN_PURGE
elseif Conditions for RAMP_OPEN fulfilled
then STATE_CDN_CP = CDN_RAMP_OPEN
elseif Conditions for RAMP_OPEN_FAST fulfilled

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then STATE_CDN_CP = CDN_RAMP_FAST
else STATE_CDN_CP = NO_CDN
endif
end

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4.59 Multiplexed variable definition

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_IGC_0_5_H_RNG	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Ignition angle applied on the respective cylinder (0 to 5)					
IGA_KNK_0_5	V	0... 80H	-48 ...0	0.375	°CRK
Spark retard due to knocking combustion of the respective cylinder (0 to 5)					
KNK_THD_0_5	V	0... FFH	0... 4.998	19.5e-3	V
Knock threshold of the respective cylinder (0 to 5)					
KNKS_0_5	V	0... FFFFH	0... 4.99992	76.3e-6	V
Knock control signal of the respective cylinder (0 to 5)					
KNKS_REL_NL_0_5	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Relative knock value					
NL_0_5	V	0... FFFFH	0... 4.99992	76.3e-6	V
Noise level of the respective cylinder (0 to 5)					
TI_1_HOM_0_5	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, homogeneous mode, first pulse (0 to 5)					
TI_1_S_0_5	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, stratified mode, fist pulse (0 to 5)					
TI_2_HOM_0_5	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, homogeneous mode, second pulse (0 to 5)					
TI_2_S_0_5	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, stratified mode, second pulse (0 to 5)					

Input data:

C_IGA_INI_H_RNG {p. 1829}	C_KNK_THD_MAX {p. 1963}	IGA_IGC_H_RNG [NC_CYL_NR] {p. 1876}	IGA_KNK [NC_CYL_NR] {p. 1960}
KNK_THD [NC_CYL_NR] {p. 1960}	KNKS [NC_CYL_NR] {p. 849}	KNKS_REL_NL [NC_CYL_NR] {p. 849}	NL [NC_CYL_NR] {p. 1962}
TI_1_HOM [NC_CYL_NR] {p. 2002}	TI_1_S [NC_CYL_NR] {p. 2003}	TI_2_HOM [NC_CYL_NR] {p. 2003}	TI_2_S [NC_CYL_NR] {p. 2003}

FUNCTION DESCRIPTION:

General information:

The purpose of introducing multiplexed segment-synchronous variables is to be able to watch several online-values (segment-synchronous) via only one variable during calibration. This way the number of used online-variables can be reduced during measurements while still having the possibility to measure the data of all cylinders.

Description:

E.g.: The variable IGA_0_5 shows the ignition angle of the currently firing cylinder as online-output-data by writing the different succeeding IGA-values (firing order) into the respective segments of the variable.

Application conditions

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Initialisation:

```
IGA_IGC_0_5_H_RNG = C_IGA_INI _H_RNG
KNK_THD_0_5 = 5V at reset and engine running to engine stop
 IGA_KNK_0_5 initialised as IGA_KNK_x
 KNKS_0_5 initialised as KNKS_x
 NL_0_5 = C_KNK_THD_MAX at reset or engine running to engine
stop
 TI_1/ 2_HOM/ S_0_5 = 0 ms
 KNKS_REL_NL_0_5 = initialised as KNKS_REL_NL_x
```

Recurrence: *(update rate) every segment*

Activation: *every engine operating state*

Deactivation: - – – -

Formula section:

IGA_IGC_0_5_H_RNG: IGA_IGCH_RNG of cylinder x = value segment x
IGA_KNK_0_5: IGA_KNK of cylinder x = value segment x
KNK_THD_0_5: KNK_THD of cylinder x = value segment x
KNKS_0_5: KNKS of cylinder x = value segment x
NL_0_5: NL of cylinder x = segment x
TI_1_HOM_0_5: calculated out of TI_1_HOM[NC_CLY_NR]
TI_2_HOM_0_5: calculated out of TI_2_HOM[NC_CLY_NR]
TI_1_S_0_5: calculated out of TI_1_S[NC_CLY_NR]
TI_2_S_0_5: calculated out of TI_2_S[NC_CLY_NR]
KNKS_REL_NL_0_5: KNKS_REL_NL x = segment x

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4.60 CAN messages engine management system

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AC_VEH_LGT_TCS	O/V	8010... 7FF0H	-51.175 ...51.175	0.0015625	m/s**2
Vehicle acceleration longitudinal					
AC_VEH_TRV_TCS	O/V	8010... 7FF0H	-51.175 ...51.175	0.0015625	m/s**2
Vehicle acceleration transversal					
AC_WHEEL_PBR	O/V	10... FFF0H	-51.175 ...51.175	0.0015625	m/s**2
request deceleration wheel torque EMF electromechanic park brake (PBR)					
AMP_CAN	-	0... FEH	598... 1106	2	hPa
AMP (converted for CAN)					
ANG_PSTE	O/V	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW
Steering wheel sensor angle					
BRAKE_PRS	O/V	0... FFH	0... 255	1	bar
Brake pressure					
CC_ID	O/V	0... FFFFH	0... 65535	1	-
Checkcontrol ID					
CKS_CAN_CAS	O/V	0... FH	0... 15	1	-
check sum CAS from CAN					
CKS_CAN_ETCU	O/V	0... FFH	0... 255	1	-
checksum ETCU from CAN					
CKS_CAN_ETCU_3	O/V	0... FFH	0... 255	1	-
check sum ETCU_3 from CAN					
CKS_CAN_LDM	O/V	0... FFH	0... 255	1	-
Checksum LDM from CAN					
CKS_CAN_MSW	O/V	0... FFH	0... 255	1	-
Checksum MSW - SZL					
CKS_CAN_PBR	O/V	0... FFH	0... 255	1	-
checksum PBR from CAN					
CKS_CAN_REQ_PBR	O/V	0... FFH	0... 255	1	-
checksum REQ_PBR from CAN					
CKS_CAN_TQ_AMT	O/V	0... FFH	0... 255	1	-
check sum TQ_AMT from CAN					
CKS_CAN_TQ_DCC	O/V	0... FFH	0... 255	1	-
Checksum TQ_DCC from CAN					
CKS_CAN_TQ_ETCU	O/V	0... FFH	0... 255	1	-
check sum TQ_ETCU from CAN					
CKS_CAN_TQ_PBR	O/V	0... FFH	0... 255	1	-
Checksum AC_WHEEL_PBR					
CKS_CAN_TQ_PSTE_2	O/V	0... FFH	0... 255	1	-
Checksum TQ_PSTE_2 from CAN					
CKS_CAN_TQ_PSTE_3	O/V	0... FFH	0... 255	1	-
Check sum TQ_PSTE_3					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CKS_CAN_TQ_TCS	O/V	0... FFH	0... 255	1	-
check sum traction control system TQ_TCS from CAN					
CKS_CAN_TQ_TCT	O/V	0... FFH	0... 255	1	-
checksum TQ_TCT from CAN					
CKS_CAN_VEH_MOD	O/V	0... FH	0... 15	1	-
check sum VEH_MOD from CAN					
CKS_CLC_CAS	O/V	0... FH	0... 15	1	-
Check sum CAS					
CKS_CLC_ECU1	O/V	0... FFH	0... 255	1	-
Check sum ECU 1					
CKS_CLC_ECU2	O/V	0... FFH	0... 255	1	-
Check sum ECU 2					
CKS_CLC_ECU3	O/V	0... FFH	0... 255	1	-
Check sum ECU 3					
CKS_CLC_ETCU	O/V	0... FFH	0... 255	1	-
Checksum ETCU					
CKS_CLC_ETCU_3	O/V	0... FFH	0... 255	1	-
Checksum ETCU_3					
CKS_CLC_GS_IDC	O/V	0... FFH	0... 255	1	-
Checksum GS_IDC (gear shift indication)					
CKS_CLC_LDM	O/V	0... FFH	0... 255	1	-
Check sum LDM					
CKS_CLC_MSW	O/V	0... FFH	0... 255	1	-
Check sum CRU (SZL)					
CKS_CLC_PBR	O/V	0... FFH	0... 255	1	-
Checksum PBR					
CKS_CLC_REQ_PBR	O/V	0... FFH	0... 255	1	-
Checksum REQ_PBR					
CKS_CLC_TQ_AMT	O/V	0... FFH	0... 255	1	-
Check sum TQ_AMT					
CKS_CLC_TQ_DCC	O/V	0... FFH	0... 255	1	-
Check sum TQ_DCC					
CKS_CLC_TQ_ETCU	O/V	0... FFH	0... 255	1	-
Check sum TQ_ETCU					
CKS_CLC_TQ_PBR	O/V	0... FFH	0... 255	1	-
Check sum AC_WHEEL_PBR					
CKS_CLC_TQ_PSTE_2	O/V	0... FFH	0... 255	1	-
Check sum TQ_PSTE_2					
CKS_CLC_TQ_PSTE_3	O/V	0... FFH	0... 255	1	-
Check sum EHB3 (PSTE 3)					
CKS_CLC_TQ_TCS	O/V	0... FFH	0... 255	1	-
Check sum TQ_TCS					
CKS_CLC_TQ_TCT	O/V	0... FFH	0... 255	1	-
Checksum TQ_TCT					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CKS_CLC_TQ_WHEEL_1	O/V	0... FFH	0... 255	1	-
Check sum TQ_WHEEL_1					
CKS_CLC_TQ_WHEEL_2	O/V	0... FFH	0... 255	1	-
Check sum TQ_WHEEL_2					
CKS_CLC_VEH_MOD	O/V	0... FFH	0... 255	1	-
Check sum VEH_MOD (CAS)					
CTL_SHIFT_LOCK_CAN	O/V	0... 3H	0 ...3	1	-
Control shift-lock					
CTR_DLY_MSG_OIL	V	0... FFH	0... 255	1	-
CTR for delay of oil-message					
CTR_FTL_LE_NOT_VLD	V	0... FFH	0... 255	1	-
Counter for messages with invalid FTL_LE-value					
CTR_FTL_NOT_VLD	V	0... FFH	0... 255	1	-
Counter for messages with invalid FTL-value					
CTR_FTL_RI_NOT_VLD	V	0... FFH	0... 255	1	-
Counter for messages with invalid FTL_RI-value					
CTR_IMOB_RESP_RCV_CAN	O	0... FFH	0... 255	1	-
CAS-response					
CTR_KM_BN	O/V	0... FFFFFFH	0... 16777215	1	km
vehicle kilometer BN reading from Kombi - for OBD					
CTR_KM_CAN	O/V/S	0... FFFFH	0... 655350	10	km
vehicle kilometer reading from Kombi					
CTR_RST_BOS_RST	O/V	0... FFH	0... 255	1	-
reset BOS service counter reset					
CTR_STATE_ERR_CAN	-	0... FFH	0... 255	1	-
Timeout counter for service message OBD diagnosis					
CTR_TOUT_N_ECF_CAN	O/V	0... FFH	0... 255	1	-
Counter for timeout-detection ext. ECF-request					
CUR_ENG_EFP	O/V	0... FFH	0... 25.5	0.1	A
Engine current of the EFP					
CUR_SC_MAX_CAN	O/V/S	0... FFH	0... 2550	10	A
Maximum short-current (vehicle-specific)					
CUR_SC_MIN_CAN	O/V/S	0... FFH	0... 2550	10	A
Minimum short-current (vehicle-specific)					
CUR_WKU_CAN	O/V/S	0... FFH	0... 0.255	0.001	A
Quiescent-current (vehicle-specific)					
CYC_CTR_CC	O	0... FFH	0... 255	1	-
Checkcontrol counter					
CYC_CTR_CC_SAVE	O	0... FFH	0... 255	1	-
Checkcontrol counter buffer					
dm_ab_fws	O	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Fahrwiderstand (Moment zur Bergkompensation)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ECF_REQ_EXT	V	0... FFH	0... 255	1	-
Ext. ECU (AFS, EPS) requiring ECF speed					
FAC_GB_GAIN	O/V	0... FFFFH	0... 8191.875	0.125	1/m
gearbox-drive-train gain					
FAC_IS_INC_REQ	O/V	0... FFH	0... 255	1	-
Request IS-increase					
FAC_POW_MNG_VST_CNS [15]	O/V/S	0... FFH	0... 255	1	-
Powermanagement Standverbraucher					
FTL	O/V	0... 7FH	0... 127	1	l
Fuel tank level					
FTL_LE	O/V	0... 7FH	0... 127	1	l
Fuel tank level left					
FTL_RI	O/V	0... 7FH	0... 127	1	l
Fuel tank level right					
GEAR_INFO	O/V	0... FH	0... 15	1	-
gear information from EGS-ECU					
HEAT_REQ_PERC	O/V	0... C8H	0... 100	0.5	%
heat-flow request air-conditioning					
IDX_BAT_CAN	O/V/S	0... FFH	0... 255	1	-
implemented battery					
IMOB_RCV_RESP_CAN [_x]	O		-	-	-
CAS-response					
ipm_typ_fp	O	0... FFH	0... 255	1	-
IPM-Fahrertyp zur Beeinflussung der Pedalauswertung					
ipm_typ_mdkw	O	0... FFH	0... 255	1	-
IPM-Fahrertyp zur Beeinflussung der Soll-Momentenbestimmung					
LV_ACCIN	O/V	0... 1H	0 ...1	1	-
logical variable ACC request					
LV_ACIN	O/V	0... 1H	0 ...1	1	-
logical variable ACC readiness					
LV_AMT_ES	O/V	0... 1H	0 ...1	1	-
LV indicating engine stop via CAN					
LV_AMT_LIH_CAN	O/V	0... 1H	0 ...1	1	-
Logical variable AMT intervention limp home					
LV_CC_ID_BENCH	-	0... 1H	0 ...1	1	-
Bit indicating if the sending condition of CC test message true					
LV_CC_ID_TRA	-	0... 1H	0 ...1	1	-
Bit indicating if the sending condition of CC TRA message true					
LV_CC_ID_XX	-	0... 1H	0 ...1	1	-
LV indicating if the sending conditions of CC-messages are true due to present (1) or healed (0) error					
LV_CC_TEST_BENCH_ACT	V	0... 1H	0 ...1	1	-
Checkcontrol test bench active					
LV_CFT_MOD_PBR	O/V	0... 1H	0 ...1	1	-
Bit indicating comfort mode of parking brake (get from CAN)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CS_2	O/V	0... 1H	0 ...1	1	-
Clutch switch 2 information					
LV_CTOP	O/V	0... 1H	0 ...1	1	-
State convertible top: 0 = closed, 1 = open					
LV_DCC_LIH_CAN	O/V	0... 1H	0 ...1	1	-
LV indicating DCC intervention limp home					
LV_DCC_OFF_ACK	O/V	0... 1H	0 ...1	1	-
Acknowledge bit for switch-off DCC					
LV_DCC_PUC_INH	O/V	0... 1H	0 ...1	1	-
inhibitation of PUC required by DCC					
LV_DRIV_DOOR_OPEN	O/V	0... 1H	0 ...1	1	-
Driver door open					
LV_ECRAS_CTL_CAN_1	O/V	0... 1H	0 ...1	1	-
ECRAS control via CAN step 1					
LV_ECRAS_CTL_CAN_2	O/V	0... 1H	0 ...1	1	-
ECRAS control via CAN step 2					
LV_EFP_OFF_EXT_ADJ_CAN	O/V	0... 1H	0 ...1	1	-
Switch OFF of EFP via CAN (tester diagnosis)					
LV_EFP_ON_EXT_ADJ_CAN	O/V	0... 1H	0 ...1	1	-
Switch ON of EFP via CAN (tester diagnosis)					
LV_ERR_ANG_PSTE_CAN	O/V	0... 1H	0 ...1	1	-
Interface bit for TQ_LOSS_PSTE calculation in case of error via CAN					
LV_ERR_TQ_LOSS_ARS_AV_CAN	O/V	0... 1H	0 ...1	1	-
interface bit for TQ_LOSS_ARS calculation in case of error via CAN					
LV_ERR_TQ_LOSS_ARS_SP_CAN	O/V	0... 1H	0 ...1	1	-
interface bit for TQ_LOSS_ARS calculation in case of error via CAN					
LV_ERR_VS_CAN	O/V	0... 1H	0 ...1	1	-
Logical variable for VS_CAN error					
LV_ETCU_LIH_CAN	O/V	0... 1H	0 ...1	1	-
logical variable ETCU gear shift intevention limp home					
LV_ETCU_SPT_SWI	O/V	0... 1H	0 ...1	1	-
Sport mode set in gearbox					
LV_FTL_CAN_ERR	O/V	0... 1H	0 ...1	1	-
Logical value erroneous fuel tank level signal					
LV_FTL_LE_CAN_ERR	O/V	0... 1H	0 ...1	1	-
Logical value erroneous fuel tank level (left) signal					
LV_FTL_OBD_INH_L	O/V	0... 1H	0 ...1	1	-
logical variable fuel reserve					
LV_FTL_RI_CAN_ERR	O/V	0... 1H	0 ...1	1	-
Logical value erroneous fuel tank level (right) signal					
LV_FTL_TOT_CAN_ERR	O/V	0... 1H	0 ...1	1	-
logical value erroneous fuel tank level signal total FTL					
LV_GS	O/V	0... 1H	0 ...1	1	-
LV indicating active gear shift (get from transmission)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_GS_IDC_LDM	O/V	0... 1H	0 ...1	1	-
Request gear shift indication for LDM (gear shitt down)					
LV_HOOD_OPEN	O/V	0... 1H	0 ...1	1	-
Engine hood open					
LV_INH_GP_SUP	O/V	0... 1H	0 ...1	1	-
Bit indicating inhibition of shift up for gearbox protection (info get from ETCU)					
LV_KEY_AUX	O/V	0... 1H	0 ...1	1	-
status Kl. R					
LV_KEY_VLD	O/V	0... 1H	0 ...1	1	-
Valid key recognized - CAS					
LV_KEY_VLD_MSG_FAILED	O/V	0... 1H	0 ...1	1	-
Valid key message failed - CAS					
LV_LDM_CAN_INI	O/V	0... 1H	0 ...1	1	-
Ini-values sent via CAN					
LV_LDM_LIH_CAN	O/V	0... 1H	0 ...1	1	-
LDM LIH via CAN					
LV_LEVEL_IS	O/V	0... 1H	0 ...1	1	-
Status switch level rpm					
LV_LTG_HDLP_L_ON	O/V	0... 1H	0 ...1	1	-
State low beam: 0 off, 1 on					
LV_LTG_INL_ON	O/V	0... 1H	0 ...1	1	-
State interior lighting: 0 off, 1 on					
LV_MIL_CAN	O/V	0... 1H	0 ...1	1	-
Boolean indicating MIL					
LV_MIL_CAN_1	-	0... 1H	0 ...1	1	-
Auxiliary bit for LV_MIL CC-messages					
LV_MIL_FLL	O/V	0... 1H	0 ...1	1	-
bit for MIL flash light					
LV_MIL_REQ_ETCU	O/V	0... 1H	0 ...1	1	-
Bit indicating MIL request from transmission control unit					
LV_MSG_PROG_STEP_CRU	O/V	0... 1H	0 ...1	1	-
Message of "Programmierung Stufentempomat" received					
LV_N_DISP_DYN	O/V	0... 1H	0 ...1	1	-
Bit indicating reqeust to calculate dynamisation of N for display in ICL (Kombi)					
LV_N_SP_TCT	O/V	0... 1H	0 ...1	1	-
LV indicating valid Target N during TCT-intervention (N-regulation active)					
LV_N_SP_TCT_REQ	O/V	0... 1H	0 ...1	1	-
LV indicating N-regultation requested by DKG					
LV_NO_VECH_REQ	O	0... 1H	0 ...1	1	-
Bit indicating, that service "Anfrage: Fahrgestellnummer" has to be sent					
LV_OBD_SCAN_REQ	V	0... 1H	0 ...1	1	-
Bit indicating that OBD tester is connected and has send request once					
LV_OBD_TAM_RCV	V	0... 1H	0 ...1	1	-
ambient temperature sensor data for OBD received					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_PLAUS_ASR_CTL	O/V	0... 1H	0 ...1	1	-
logical variable for ASR intervention is active					
LV_PLAUS_ESP_CTL	O/V	0... 1H	0 ...1	1	-
logical variable for DSC intervention is active					
LV_POW_CLAS_VEH_CAN_RCV	O/V	0... 1H	0 ...1	1	-
Status vehicle power class received via CAN					
LV_PSTE_2_ERR	O/V	0... 1H	0 ...1	1	-
LV indicating AFS error (sent by AFS via CAN)					
LV_PSTE_3_INTV	O/V	0... 1H	0 ...1	1	-
PSTE 3 (EHB3) torque intervention active					
LV_PUMP_AMT_ON	O/V	0... 1H	0 ...1	1	-
LV indicating status of hydraulic pump - AMT					
LV_REQ_ACK_IGK_OFF	V	0... 1H	0 ...1	1	-
intermediate state for CAN message control of ACK_IGK_OFF					
LV_REQ_HEAT	O/V	0... 1H	0 ...1	1	-
LV increased heater power request					
LV_REQ_PWL_DMTL_SND	O/V	0... 1H	0 ...1	1	-
Bit indicating power latch time for DMTL requested via CAN					
LV_REQ_TCO_L	O/V	0... 1H	0 ...1	1	-
LV requirement for low coolant temperature					
LV_RLY_ST_CAN	O/V	0... 1H	0 ...1	1	-
status starter relay					
LV_SEND_CC_ID_BENCH	-	0... 1H	0 ...1	1	-
Bit indicating sending of CC test message					
LV_SEND_CC_ID_TRA	-	0... 1H	0 ...1	1	-
Bit indicating sending of CC TRA message					
LV_SEND_CC_ID_XX	-	0... 1H	0 ...1	1	-
LV indicating the CC-message which conditions for sending are fulfilled					
LV_STATE_ERR_CAN_ACT	-	0... 1H	0 ...1	1	-
OBD sensor diagnosis message received at least once					
LV_STATE_ERR_CAN_RCV	-	0... 1H	0 ...1	1	-
OBD sensor diagnosis message received cyclic					
LV_STATE_ERR_CAN_TOUT	O/V	0... 1H	0 ...1	1	-
Timeout detected of service message OBD diagnosis					
LV_STATE_TRL	O/V	0... 1H	0 ...1	1	-
State trailer: 0 off, 1 on					
LV_T_REL_CAN_REG	O/V	0... 1H	0 ...1	1	-
T_REL_CAN receiving of INSTR2 message					
LV_TAM_CAN_ERR	O/V	0... 1H	0 ...1	1	-
TAM-failure present					
LV_TCS_CTL_ACT	O/V	0... 1H	0 ...1	1	-
Bit indicating active chassis control functions					
LV_TCS_LIH_CAN	O/V	0... 1H	0 ...1	1	-
logical variable traction control system limp home					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_TCT_ES	O/V	0... 1H	0 ...1	1	-
LV indicating ES requested by DKG					
LV_TCT_LIH_CAN	O/V	0... 1H	0 ...1	1	-
logical variable TCT gear shift intevention limp home					
LV_TQ_AMT_DEC_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable indicating torque decrease due to AMT intervention					
LV_TQ_AMT_INC_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable indicating torque increase due to AMT intervention					
LV_TQ_ASR_REQ	O/V	0... 1H	0 ...1	1	-
logical variable ASR intervention required					
LV_TQ_DCC_INC_REQ	O/V	0... 1H	0 ...1	1	-
LV indicating torque increse required by DCC					
LV_TQ_GS_DEC_REQ	O/V	0... 1H	0 ...1	1	-
LV indicating TQ decrease requested by transmission					
LV_TQ_GS_INC_REQ	O/V	0... 1H	0 ...1	1	-
LV indicating TQ increase requested by transmission					
LV_TQ_MSR_REQ	O/V	0... 1H	0 ...1	1	-
logical variable MSR intervention required					
LV_TQ_PSTE_3_CAN_DI	O/V	0... 1H	0 ...1	1	-
PSTE 3 (EHB3) torque request via CAN disabled					
LV_TQ_PSTE_3_CAN_ENA	O/V	0... 1H	0 ...1	1	-
PSTE 3 (EHB3) torque request via CAN enabled					
LV_TQ_PSTE_3_CAN_LIH	O/V	0... 1H	0 ...1	1	-
PSTE 3 (EHB3) torque request via CAN in limp home					
LV_TQ_WHEEL_LDM_BN_ERR	O/V	0... 1H	0 ...1	1	-
LV indicating torque request by ldm invalid					
LV_TQ_WHEEL_LDM_REQ	O/V	0... 1H	0 ...1	1	-
LDM requested via CAN					
LV_VAR_VEH_MOD	O/V	0... 1H	0 ...1	1	-
auxiliary bit for activation of BN-Diag					
LV_WAL_1_CAN	O/V	0... 1H	0 ...1	1	-
Boolean indicating WAL_1					
LV_WHEEL_CAN_FN_LE_ERR	O/V	0... 1H	0 ...1	1	-
Logical variable for error on CAN wheel front left signal					
LV_WHEEL_CAN_FN_RI_ERR	O/V	0... 1H	0 ...1	1	-
Logical variable for error on CAN wheel front right signal					
LV_WHEEL_CAN_RE_LE_ERR	O/V	0... 1H	0 ...1	1	-
Logical variable for error on CAN wheel rear left signal					
LV_WHEEL_CAN_RE_RI_ERR	O/V	0... 1H	0 ...1	1	-
Logical variable for error on CAN wheel rear right signal					
N_CAN	-	0... 7F80H	0... 8160	0.25	rpm
engine speed (converted for BN 2000)					
N_ECF	O/V	0... FH	0... 15	1	-
Setpoint step of electric cooling fan speed					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
N_ECF_CAN	O/V	0... FFH	0... 99.60937	0.390625	%
relative desired ECF speed from ext. ECU (AFS, EPS)					
N_ECF_CAN_2	V	0... FFH	0... 99.60937	0.390625	%
relative desired ECF speed from ext. ECU (AFS, EPS)					
N_EFP_AV	O/V	0... FFH	0... 12750	50	rpm
Engine speed of the EFP					
N_GB	O/V	0... FFFEH	0... 8191.75	0.125	rpm
Input shaft speed turbine/gearbox (AT)					
N_GB_OUT	O/V	0... FFFFH	-32768 ...32767	1	rpm
Output speed drive train gearbox					
N_MAX_AMT_CAN	O/V	0... 1FE0H	0... 8160	1	rpm
Engine speed limit AMT via CAN					
N_MAX_THD_1_CAN	-	0... FFH	0... 12750	50	rpm
Actual engine speed limit orange engine speed area (converted for CAN)					
N_MAX_THD_2_CAN	-	0... FFH	0... 12750	50	rpm
Actual engine speed limit red engine speed area (converted for CAN)					
N_SP_IS_TCT_CAN	O/V	0... 1FE0H	0... 8160	1	rpm
Target N_SP_IS requested during TCT-intervention					
N_SP_TCT	O/V	0... 1FE0H	0... 8160	1	rpm
Target N during TCT-intervention (N-regulation active)					
NR_VS_CRU_IF	O/V	0... FH	0... 15	1	-
Current vehicle speed step via CAN					
OBD_TAM	O/V	0... FFH	-40 ...215	1	°C
Ambient air temperature SAE J1979					
PV_LDM_REQ_CAN	-	0... 1000H	0... 100	0.0244141	%
pedal value requested from LDM (converted for BN 2000)					
PV_MAX_CAN	-	0... FEH	0... 99.21875	0.390625	%
maximum selection pedal value (converted for BN 2000)					
QOIL_DS_RST_CAN_1_5	O/V	8000... 7FFFH	-32768 ...32767	1	-
Restlaufleistung_BOS_Rückstellung_1					
QOIL_DS_RST_CAN_2_1	O/V	0... FFH	0... 255	1	-
ID2_BOS_resetting_2					
QOIL_DS_RST_CAN_2_2	O/V	0... FFFFH	0... 65535	1	-
ID_function_BOS_resetting_2					
QOIL_DS_RST_CAN_2_3	O/V	0... FFH	0... 255000	1000	km
Prognose_Intervall_Weg_BOS_Rückstellung_2					
QOIL_DS_RST_CAN_2_4	O/V	0... FFH	0... 255	1	-
Zieltermin_Monat_BOS_Rückstellung_2					
QOIL_DS_RST_CAN_2_5	O/V	0... FFH	0... 255	1	-
Zieltermin_Jahr_BOS_Rückstellung_2					
QOIL_DS_RST_CAN_2_6	O/V	0... FFH	0... 255	1	-
Prognose_Intervall_Zeit_BOS_Rückstellung_2					
STATE_ACIN_CAN	O/V	0... 7H	0 ...7	1	-
state air-conditioning request signal CAN					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_ACK_IGK_OFF	O/V	0... 3H	0 ...3	1	-
Ignition off request from CAS acknowledged					
STATE_AMT	O/V	0H 1H 2H 3H 7H	NO_INTERV TORQUE_DEC N_REGUL TORQUE_INC INVALID_ SIGNAL	-	-
Status shift-process AMT via CAN					
STATE_AMT_INTV	O/V	0H 1H 2H 3H	NO_INTV TQ_INC TQ_DEC LOCKED	-	-
status torque target AMT via CAN					
STATE_AMT_OBD	O/V	0H 2H 4H 6H 8H AH CH EH FH	MIL_OFF MIL_OFF MIL_ON MIL_ON MIL_FLL MIL_FLL IDLE INI_VALUE INVALID_ SIGNAL	-	-
Status OBD gearbox					
STATE_AMT_OBD_ERR	O/V	0H 1H 2H	NO_OBD_ ERROR OBD_ERROR INVALID_ SIGNAL	-	-
Status OBD-relevant error - AMT					
STATE_ARS_CAN	O/V	0H 1H 3H	INACTIVE ACTIVE INVALID_ SIGNAL	-	-
status anti roll stabilization via CAN					
STATE_AVL_BOS_RST	O/V	0... FFH	0... 255	1	-
availibility_BOS_resetting					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_BN_MSW	O/V	0H 1H 2H 4H 8H 10H 40H 41H 42H 44H 48H 50H 7FH	NO_ACTION TIP_PRE PRESS_PRE TIP_POST PRESS_POST TIP_UP_ DOWN TIP_AXIAL TIP_AXIAL TIP_AXIAL TIP_POST PRESS_POST TIP_UP_ DOWN INVALID_ SIGNAL	-	-
Status MSW BN (CAN)					
STATE_BRAKE_PRS	O/V	0... 3H	0 ...3	1	-
status brake pressure via CAN					
STATE_CC	O/V	0H 1H 2H 3H	OPEN CONTROLLED CLOSED NOT_DEFINED	-	-
State of converter clutch (CC)					
STATE_CC_KEY	V	0... FH	0... 15	1	-
CC-message transmission-condition ID xx					
STATE_CC_TEST_BENCH_OBD_1	-	0... FFH	0... 255	1	-
Bit coded readiness 1 for CC test bench					
STATE_CC_TEST_BENCH_OBD_2	-	0... FFH	0... 255	1	-
Bit coded readiness 2 for CC test bench					
STATE_CLU_AMT	O/V	0H 1H 2H 3H 7H	CLU_OPEN CREEPING DRIVE_OFF CLU_CLOSED INVALID_ SIGNAL	-	-
Status shift-process AMT via CAN					
STATE_CRU_BN	V	0... 7H	0 ...7	1	-
Status of Cruise Control for BN-CAN					
STATE_CUS_LDM_CAN	O/V	0... FFFFH	0... 65535	1	-
auxiliary state for LDM test required by customer					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_DCC	O/V	0H 1H 2H 3H 4H 5H 6H 7H	INACTIVE STAND_BY NORMAL RESERVE BRAKE_ ACTIVE DRIVER_ ACTIVE RESERVE INVALID_ SIGNAL	-	-
Status DCC					
STATE_DCC_CTL	O/V	0... 7H	0 ...7	1	-
Status DCC control					
STATE_DCC_INTV	O/V	0H 1H 2H 3H	NO_INTER- VENTION TORQUE_ INCREASE INVALID_ SIGNAL INVALID_ SIGNAL	-	-
status torque target DCC via CAN interface					
STATE_DCC_OFF_REQ	O/V	0H 1H 2H 3H	RESERVED SYS_OFF SYS_OK INVALID_ SIGNAL	-	-
status switch-off DCC					
STATE_DCC_PUC_INH	O/V	0H 1H 3H	NO_REQUEST INHIBIT_PUC INVALID_ SIGNAL	-	-
status request PUC-inhibitation via CAN interface - DCC					
STATE_DHL_CTL	O/V	0... FH	0... 15	1	-
status of hill descent control function					
STATE_DI_PUC	O/V	0H 1H 3H	NO_REQUEST DISABLE_PUC INVALID_ SIGNAL	-	-
state disable pull cut off					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_DIAG_EFP	O/V	0... FFH	0... 255	1	-
Diagnosis state of the CAN-EFP					
STATE_EFP_CAN	O/V	0... 3H	0 ...3	1	-
EFP - state for EOL and ASA diagnosis					
STATE_EFP_CRASH_CAN	O/V	0... 3H	0 ...3	1	-
Request for switch off fuel pump after crash					
STATE_EFP_CTL	O/V	0... 3H	0 ...3	1	-
State which EFP-control is active					
STATE_EFP_CTL_ECU	O/V	0... FFH	0... 255	1	-
State EFP-control CAN					
STATE_ERR_SYM_FTL_LE_CAN	O/V	0H 1H 2H 4H	NO_SYM SCP SCG OL	-	-
Error symptom for left fuel tank level sensor get via CAN					
STATE_ERR_SYM_FTL_RI_CAN	O/V	0H 1H 2H 4H	NO_SYM SCP SCG OL	-	-
Error symptom for right fuel tank level sensor get via CAN					
STATE_ERR_SYM_TAM_CAN	O/V	0H 1H 2H 4H	NO_SYM SCP SCG OL	-	-
Error symptom for TAM sensor get via CAN					
STATE_ETCU_CLU	O/V	0H 1H 2H 3H 4H 5H 6H 7HH	CLU_OPEN CREEPING DRIVE_OFF CLU_CLOSED CTL_SLIP DRIVE_ DYNAMIC UNUSED INVALID_ SIGNAL	-	-
State gearbox for starting-clutch					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_ETCU_INTV	O/V	0H 1H 2H 3H	NO_INTV TQ_INC TQ_DEC LOCKED	-	-
status torque target ETCU system via CAN					
STATE_ETCU_OBD	O/V	0H 2H 4H 6H 8H AH CH EH FH	MIL_OFF MIL_OFF MIL_ON MIL_ON MIL_FLL MIL_FLL IDLE INI_VALUE INVALID_ SIGNAL	-	-
status OBD gearbox					
STATE_ETCU_OBD_ERR	O/V	0H 1H 2H	NO_OBD_ ERROR OBD_ERROR INVALID_ SIGNAL	-	-
state OBD error					
STATE_ETCU_PROG_INFO	O/V	0... FH	0... 15	1	-
State mode ETCU					
STATE_ETCU_SPT_SWI	O/V	0... 3H	0 ...3	1	-
Status if gearbox has built in sport switch					
STATE_EXT_POW_CNS	O/V	0... C8H	0... 100	0.5	%
State power consumption (Sonderverbraucher)					
STATE_GAP_MSW	-	0... 3H	0 ...3	1	-
Status MSW BN (CAN)					
STATE_GEAR_REV_CAN	O/V	0... 1H	0 ...1	1	-
State reverse gear: 0 inactive, 1 active					
STATE_HLD_PBR	O/V	0... 3H	0 ...3	1	-
State of holding vehicle with parking brake (get from CAN)					
STATE_ID_FCT_BOS_RST	O/V	0... FFFFH	0... 65535	1	-
ID_function_BOS_resetting					
STATE_ID2_BOS_RST	O/V	0... FFH	0... 255	1	-
ID2_BOS_resetting					
STATE_IF_ICL_BN_MSW	O/V	0... 7H	0 ...7	1	-
status interface ICL/cruise control					
STATE_IGK_CAN	O/V	0H 1H 2H	IGK_OFF IGK_ON INVALID_ SIGNAL	-	-
status ignition key via CAN					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_IGK_HW	O/V	0... 3H	0 ...3	1	-
status ignition key (HW) via CAN					
STATE_LDM	O/V	0... FH	0... 15	1	-
state ldm					
STATE_LDM_INTV	O/V	0... 3H	0 ...3	1	-
state ldm					
STATE_MAX_AC_ST	O/V	0H 1H 2H 3HH	NO_RACE_ST RACE_ST_ ACT RACE_ST_ PREP INVALID_ SIGNAL	-	-
Status of race start (maximum acceleration at start)					
STATE_MOD_GB	O/V	0H 1H 2H 3H 7H	SSC_SBC_ OFF SSC_ON SBC_ON SSC_SBC_ON INVALID_ SIGNAL	-	-
State mode gearbox : SSC (Sleeping Starter Clutch), SBC (Stand By Control)					
STATE_OBD_CYC_BN	O/V	0... 3FH	0... 63	1	-
OBD cycle state new definition					
STATE_PBR	O/V	0... FH	0... 15	1	-
State of the parking brake (get from CAN)					
STATE_PBR_ACT	O/V	0... FH	0... 15	1	-
Status actuator EMF (electromechanic park brake PBR)					
STATE_PBR_ACT_QLY	O/V	0... FH	0... 15	1	-
Qualifier Status actuator EMF (electromechanic park brake PBR)					
STATE_POW_CLAS_VEH	O/V	0... 3H	0 ...3	1	-
status vehicle power class via CAN					
STATE_PSTE_2_INTV	O/V	0H 1H 2H 3H	NO_INTV TQ_INC TQ_DEC INVALID_ SIGNAL	-	-
status torque target PSTE_2 via CAN interface					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_PSTE_3_ERR	O/V	0H 1H 2H 3H 4H 5H 6H 7HH	NO_ERROR NO_SENSOR SENSOR_ ERROR SENSOR_ AND_ MODEL_ ERROR SENSOR_ ERROR_TEMP SENSOR_ AND_ MODEL_ ERROR_TEMP NOT_USED SIGNAL_ INVALID	-	-
Error state of PSTE 3 (EHB3)					
STATE_PSTE_3_INTV	O/V	0H 1H 2H 3HH	RESERVED NO_ INTER-VENTION INTERVEN-TION_ACTIVE INVALID_ SIG-NAL	-	-
state of PSTE 3 (EHB3) torque intervention					
STATE_PSTE_3_SRC	O/V	0H 1H 2H 3H 4HH	NORMAL_ STEERING AFS EPS RESERVED INVALID_ SIGNAL	-	-
Source of torque request due to steering					
STATE_SENS_ANG_PSTE	O/V	0... 7H	0 ...7	1	-
Status of steering wheel sensor					
STATE_SP_DYN_WHEEL	O/V	0... FFH	0... 255	1	-
state follow dynamic					
STATE_SPT_SWI	O/V	0... 3H	0 ...3	1	-
State of sport switch					
STATE_ST_TQ_LIM_AMT	O/V	0H 1H 3H	NO_INTV INTV INVALID_ SIGNAL	-	-
State starting torque limitation AMT					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_ST_TQ_LIM_GS	O/V	0H 1H 3H	NO_INTV INTV INVALID_ SIGNAL	-	-
State starting torque limitation					
STATE_SWI_OFF_VB	O/V	0... 3H	0 ...3	1	-
state switch off battery voltage (kl30)					
STATE_TCS_CAN	O/V	0H 1H 2H 4H 6H 7H	VALID PASSIVE DEFECT TRACTION_ MODE UNDERVOLTAGE INVALID_ SIGNAL	-	-
status traction control system via CAN					
STATE_TCS_CTL	O/V	0H 1H 2H 4H 8H 10H 20H 40H FEH FFHH	NO_CONTROL ABS_ CONTROL ASR_ CONTROL TCS_ CONTROL HBA_ CONTROL MSR_ CONTROL EBV_ CONTROL DYNO_ACTIVE MULTI_ CONTROL SIGNAL_ INVALID	-	-
status closed-loop-control via CAN					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_TCS_DECE	O/V	0H 1H 2H 3H 15H	NO_INTV DCC_INTV_OK EMF_INTV_OK HBA_INTV_OK INVALID_ SIGNAL	-	-
status deceleration (actual value) via CAN					
STATE_TCS_INTV	O/V	0H 1H 2H 3H	NO_INTV MSR_INTV ASR_INTV INTERFACE_ LOCKED	-	-
status traction control system via CAN					
STATE_TCT_INTV	O/V	0H 2H 3H 4H 6H CH DH FHH	NO_INTV CREEP TCT_ INTV_DEC TCT_INTV_INC N_ REGULATION TQ_DEC TCT_ES INVALID	-	-
status torque target TCT system via CAN					
STATE_TEMP_GB	O/V	0H 1H 2H 3H	NO_REQUEST ACTIVE_ STEP_1 ACTIVE_ STEP_2 INVALID_ SIGNAL	-	-
State overtemperature gearbox (AT) - request for cooling (overheating protection) via ECT/ECF					
STATE_TQ_WHEEL_PBR_QLY	O/V	0... FH	0... 15	1	-
Qualifier Status actuator EMF (electromechanic park brake PBR)					
STATE_VEH_CNS [10]	O/V	0... FFH	0... 255	1	-
State vehicle consumer (Verbraucherstatus)					
STATE_VEH_CNS_FCT	O/V	0... 3H	0 ...3	1	-
State functionality of vehicle consumer					
STATE_VEH_MOD	O/V	0... FH	0... 15	1	-
vehicle mode					
STATE_VS_ICL_DISP	O/V	0H 1H 3H	KM/H MPH INVALID_ SIGNAL	-	-
status scaling of speedometer (displayed vehicle speed)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_WAL_CAN	V	0H 1H 2H 3H	OFF YELLOW INVALID_ SIGNAL INVALID_ SIGNAL	-	-
logical variable fuel reserve					
T_CAN	O/V	0... FFFFH	0... 65535	1	d
day counter absolute (counts the days at sufficient mains voltage)					
T_CLK_ICL_DISP_1	O/V	0... FFH	0... 255	1	-
Display of date (day)					
T_CLK_ICL_DISP_2	O/V	0... FFH	0... 255	1	-
Display of date (month)					
T_CLK_ICL_DISP_3	O/V	0... FFFFH	0... 65535	1	-
Display of date (year)					
T_CTR_REL_CAN	V	0... FFFFFFFFH	0... 4294967295	1	s
relative time counter (reset at Kl. 30 OFF), E65					
T_CTR_SWI_OFF_VB	O/V	0... FFH	0... 255	1	s
shutdown counter battery-main-switch					
T_ERR_N_ENG	V	0... FFH	0... 2.55	0.01	s
Timer for sending RPM_ENG_ERR true or false without debounced CRK error					
T_INH_ACK_IGK_OFF	V	0... FFH	0... 2.55	0.01	s
Timer for recognition if ignition off acknowledge is allowed					
T_REL_CAN	O/V	0... FFFFFFFFH	0... 4294967295	1	min
Relative time counter					
T_REL_CAN_2	O/V	0... FFFFFFFFH	0... 4294967295	1	s
Relative time counter, resolution in seconds					
TAM	O/V	0... FEH	-48... 142.5	0.75	°C
Ambient temperature					
TCC_CAN_ARS	O/V	0... EH	0... 14	1	-
free running test cycle counter ARS (alive counter)					
TCC_CAN_CAS	O/V	0... EH	0... 14	1	-
free running test cycle counter CAS (alive counter)					
TCC_CAN_DISP_ECU	V	0... EH	0... 14	1	-
free running test cycle counter					
TCC_CAN_ECU	V	0... EH	0... 14	1	-
free running test cycle counter ECU1 (alive counter)					
TCC_CAN_ECU1	V	0... EH	0... 14	1	-
free running test cycle counter ECU1 (alive counter)					
TCC_CAN_ECU2	V	0... EH	0... 14	1	-
free running test cycle counter ECU2 (alive counter)					
TCC_CAN_ECU3	V	0... EH	0... 14	1	-
free running test cycle counter ECU3 (alive counter)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TCC_CAN_ETCU	O/V	0... FH	0... 15	1	-
free running test cycle counter ETCU (alive counter)					
TCC_CAN_ETCU_3	O/V	0... FH	0... 15	1	-
free running test cycle counter ETCU_3 (alive counter)					
TCC_CAN_GS_IDC	V	0... EH	0... 14	1	-
free running test cycle counter					
TCC_CAN_ICL	O/V	0... EH	0... 14	1	-
free running test cycle counter instrument cluster (alive counter)					
TCC_CAN_LDM	O/V	0... FH	0... 15	1	-
free running test cycle counter TQ_DCC (alive counter)					
TCC_CAN_MSW	O/V	0... EH	0... 14	1	-
Alive counter MSW - SZL					
TCC_CAN_PBR	O/V	0... FH	0... 15	1	-
free running test cycle counter PBR (alive counter)					
TCC_CAN_REQ_PBR	O/V	0... FH	0... 15	1	-
free running test cycle counter REQ_PBR (alive counter)					
TCC_CAN_TQ_AMT	O/V	0... EH	0... 14	1	-
free running test cycle counter TQ_AMT (alive counter)					
TCC_CAN_TQ_DCC	O/V	0... EH	0... 14	1	-
free running test cycle counter TQ_DCC (alive counter)					
TCC_CAN_TQ_ETCU	O/V	0... EH	0... 14	1	-
free running test cycle counter TQ_ETCU (alive counter)					
TCC_CAN_TQ_PBR	V	0... EH	0... 14	1	-
Alive counter TQ_PBR					
TCC_CAN_TQ_PSTE_2	O/V	0... EH	0... 14	1	-
free running test cycle counter TQ_PSTE_2 (alive counter)					
TCC_CAN_TQ_PSTE_3	V	0... EH	0... 14	1	-
free running test cycle counter PSTE_3 (alive counter)					
TCC_CAN_TQ_TCS	O/V	0... EH	0... 14	1	-
free running test cycle counter TQ_TCS (alive counter)					
TCC_CAN_TQ_TCT	O/V	0... FH	0... 15	1	-
free running test cycle counter TQ_TCT (alive counter)					
TCC_CAN_VEH_MOD	O/V	0... EH	0... 14	1	-
free running test cycle counter VEH_MOD (alive counter)					
TEMP_GB	O/V	0... FFH	-40 ...215	1	°C
Temperature gearbox (AT) - request for cooling (overheating protection) via ECF					
TOIL_CAN	-	0... FFH	-48 ...207	1	°C
Oil temperature (converted for BN 2000)					
TQ_ACCIN_CAN	O/V	0... FFH	0... 127.5	0.5	Nm
ACC-torque from CAN					
TQ_AMT_FAST_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque target (fast) for AMT via CAN interface					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_AMT_SLOW_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque target (slow) for AMT via CAN interface					
TQ_CONV_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
converter torque from ETCU					
TQ_DCC_FAST_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque target (fast) for DCC via CAN interface					
TQ_DCC_SLOW_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque target (slow) for DCC via CAN interface					
TQ_EMS_BN	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
actual engine torque - driver s choice (converted for BN)					
TQ_GS_FAST_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque target (fast) for GS via CAN interface					
TQ_GS_SLOW_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque target (slow) for GS via CAN interface					
TQ_LOSS_ARS_AV_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque loss actual value ARS from CAN					
TQ_LOSS_ARS_SP_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque loss setpoint ARS from CAN					
TQ_LOSS_PSTE_2_AV_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque loss actual value PSTE_2 from CAN					
TQ_LOSS_PSTE_2_SP_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque loss setpoint PSTE_2 from CAN					
TQ_LOSS_PSTE_3_AV_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
actual torque value for steering					
TQ_LOSS_PSTE_3_SP_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
setpoint torque value for steering					
TQ_MAF	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
actual engine torque - spare, positive					
TQ_MAX_ACC_CAN	V	0... FFH	0... 127.5	0.5	Nm
air-conditioning-compressor limited torque after switch on					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_TCS_FAST_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque target (fast) due to TCS via CAN					
TQ_TCS_SLOW_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque target (slow) due to TCS via CAN					
TQ_TCT_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque clutch for TCT via CAN interface					
TQ_WHEEL_LDM_BN	O/V	8000... 7FFFH	-32768 ...32767	1	Nm
Torque request by ldm					
TQI_MAF	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Indicated engine torque after charging interventions (converted for CAN)					
V_ENG_EFP	O/V	0... FFH	5... 30.5	0.1	V
Engine voltage of the EFP					
V_GEN_TAR	O/V	0... FFH	10.6... 16.975	0.025	V
target generator voltage					
VB_EFP	O/V	0... FFH	5... 30.5	0.1	V
VB measured by EFP					
VEH_KEY_NR	O/V	0... FH	0... 15	1	-
vehicle key number					
VEL_ANG_PSTE	O/V	8000... 7FFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
Steering wheel sensor velocity					
VIN_CAN [NC_VIN_CAN_LEN]	O/V	0	ASCII	1	-
VIN received on CAN from CAS (ASCII coded string)					
VIN_CAN [NC_VIN_CAN_LEN]	O/V	0	ASCII	1	-
VIN received over CAN					
VS_CAN	O/V	0... FFH	0... 255	1	km/h
Vehicle speed signal from CAN					
VS_ICL_DISP	O/V	0... FFEH	0... 409.4	0.1	km/h
displayed vehicle speed (speedometer)					
VS_MAX_LIH_TCT	O/V	0... 7FFFH	0... 327.67	0.01	km/h
Vehicle speed limitation from TCT gear box in case of limp home					
VS_STEP_IF_1	O/V	0... FFEH	0... 409.4	0.1	km/h
Vehicle speed step from CAN					
VS_STEP_IF_2	O/V	0... FFEH	0... 409.4	0.1	km/h
Vehicle speed step from CAN					
VS_STEP_IF_3	O/V	0... FFEH	0... 409.4	0.1	km/h
Vehicle speed step from CAN					
WHEEL	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed signal from CAN for cruise control					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
WHEEL_CAN_FN_LE	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	km/h
Wheel speed front left via CAN					
WHEEL_CAN_FN_RI	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	km/h
Wheel speed front right via CAN					
WHEEL_CAN_RE_LE	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	km/h
Wheel speed rear left via CAN					
WHEEL_CAN_RE_RI	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	km/h
Wheel speed rear right via CAN					

Input data:

AMP {p. 982}	B_ccbtnach {p. 8342}	B_ccbttdfk {p. 8342}	B_ccpmerr {p. 8342}
B_ccprio {p. 8342}	B_ccruhver {p. 8342}	B_notafu {p. 8345}	B_poel_gelb {p. 8346}
Bostoken {p. 8155}	C_T_DMTL_MAX {p. 5974}	CONF_SOF_SWI {p. 654}	CONF_SWI_EFP_OUT {p. 654}
CTR_CDN_OBD_RBM {p. 5858}	CTR_ERR_DYN_NR {p. 5767}	CUR_GEN {p. 8368}	CUR_RNG_CTL {p. 8285}
DIST {p. 1183}	DIST_RESI_OIL {p. 8202}	DIST_RESI_OIL_KM {p. 8202}	ECU_STATE {p. 1091}
EFF_IGA_AV_CAN {p. 1845}	EFF_IGA_BAS_COR {p. 1845}	EFF_LAMB_AV {p. 8379}	EFF_LAMB_BAS_COR {p. 8379}
EFF_SCC_AV_CAN {p. 6665}	EFPPWM_CAN {p. 988}	ERR_SYM_BN_ARS {p. 4860}	ERR_SYM_BN_TQ_DCC {p. 4864}
ERR_SYM_BN_TQ_ETCU {p. 4864}	ERR_SYM_BN_TQ_TCS {p. 4865}	ERR_SYM_BN_TQ_TCT {p. 4865}	ERR_SYM_FTL_LE_CAN {p. 4745}
ERR_SYM_FTL_RI_CAN {p. 4745}	FCO {p. 3846}	GS_IDC_DISP {p. 1298}	GS_IDC_GEAR {p. 1298}
Id_bosrtak {p. 8159}	idbosmsg {p. 8202}	idfbosmg_w {p. 8286}	IMOB_TRM_CHAL [_x]
LC_ETCU_FRF {p. 5010}	LC_IGK_OFF_ACK {p. 3772}	LOAD_CLC {p. 5801}	LV_ACCOUT_RLY {p. 3589}
LV_ACT_MIL_EXT_ADJ {p. 7432}	LV_ACT_N_SP_IS_EXT_ ADJ {p. 7763}	LV_ACT_WAL_1_EXT_ADJ {p. 7433}	LV_AT {p. 654}
LV_CAN_SND_MSG_ PWR_MNG_0 {p. 8286}	LV_CAN_SND_MSG_ PWR_MNG_1 {p. 8286}	LV_CHK_FUC_OPEN_CAN {p. 5918}	LV_CRU_ACT_INH {p. 7227}
LV_CRU_DISP_HUD {p. 7201}	LV_CRU_MAIN_SWI {p. 7220}	LV_CRU_OFF_IRR {p. 7227}	LV_DC_PERM {p. 5746}
LV_DC_RBM {p. 5858}	LV_DCC_OFF_ECU {p. 5051}	LV_ERR_ACK_IGK_OFF {p. 4939}	LV_ERR_AMP {p. 4822}
LV_ERR_BLS_PLAUS {p. 4209}	LV_ERR_BN_ARS {p. 4869}	LV_ERR_BN_CDN_DOOR {p. 4869}	LV_ERR_BN_DHL_CTL {p. 4869}
LV_ERR_BN_EFP {p. 4869}	LV_ERR_BN_ETCU_2 {p. 4870}	LV_ERR_BN_ETCU_3 {p. 4870}	LV_ERR_BN_GEAR_REV {p. 4870}
LV_ERR_BN_LTG_HDLP_ L {p. 4870}	LV_ERR_BN_PBR {p. 4870}	LV_ERR_BN_REQ_PBR {p. 4870}	LV_ERR_BN_STAT_TCT {p. 4870}

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CC_ID_TEST_BENCH	-	0... FFFFH	0... 65535	1	-
Checkcontrol ID for test message					
C_CC_ID_TRA	-	0... FFFFH	0... 65535	1	-
Checkcontrol ID for TRA message					
C_CC_MESS	-	0... FFH	0... 255	1	-
ID2 check-control message standard ID2_CC_MESS_STD (Standard CC-report: 40H)					
C_CTR_DLY_MSG_OIL	-	0... FFH	0... 255	1	-
counter for transmitting Layer-values after Kl.15 on					
C_CTR_ERR_DYN_CC_TEST_BENCH	-	0... FFH	0... 255	1	-
Threshold for number of failures stored in dynamic memory					
C_CTR_FTL_NOT_VLD	-	0... FFH	0... 255	1	-
Counter threshold for messages with invalid FTL_XX-value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_LDM_CAN_INI	-	0... FFH	0... 255	1	-
Counter for sending ini-value of ST_INTF_PT					
C_CTR_TOUT_N_ECF_CAN	-	0... FFH	0... 255	1	-
Threshold for counter timeout-detection ext. ECF-request					
C_CTR_TOUT_STATE_ERR_CAN	-	0... FFH	0... 255	1	-
Threshold for counter timeout-detection of OBD diagnosis service message					
C_ICL_DISP_FRQ	-	0... 3H	0 ...3	1	-
calibratable constant for display messages on ICL					
C_N_32_THD_CC_POIL_SWI	-	0... FFH	0... 8160	32	rpm
N_32-Threshold for activating CC-message LV_POIL_SWI					
C_N_DISP_DYN_ENA	-	0... 2H	0 ...2	1	-
Condition for sending DISP_RPM_ENG on CAN (0...message not sent, 1...=N_DISP_DYN, 2...=N_CAN)					
C_N_ECF_CAN	-	0... FFH	0... 99.60937	0.390625	%
Default value for ECF-request					
C_N_SP_IS_THD_CAN	-	0... 1FE0H	0... 8160	1	rpm
Engine speed setpoint threshold for reconition of ST_SW_LEV_RPM condition					
C_STATE_CC_ID_BENCH	-	0... FH	0... 15	1	-
sending-condition for CC- test - message					
C_STATE_CC_ID_TRA	-	0... FH	0... 15	1	-
sending-condition for CC-message					
C_STATE_CC_ID_xx	-	0... FH	0... 15	1	-
sending-condition for CC-message (e.g. LV_IGK, LV_KEY_AUX, etc.)					
C_STATE_CC_TEST_BENCH	-	0... FFH	0... 255	1	-
Bit coded trigger conditions for activating Checkcontrol test bench					
C_STATE_CC_TEST_BENCH_OBD_1	-	0... FFH	0... 255	1	-
Bit coded readiness code status 1 threshold for CC bench mode					
C_STATE_CC_TEST_BENCH_OBD_2	-	0... FFH	0... 255	1	-
Bit coded readiness code status 2 threshold for CC bench mode					
C_STATE_CC_TEST_MASK_OBD_1	-	0... FFH	0... 255	1	-
Bit mask for readiness code completion status 1					
C_STATE_CC_TEST_MASK_OBD_2	-	0... FFH	0... 255	1	-
Bit mask for readiness code completion status 2					
C_STATE_COC_MAX_CC_TEST_BENCH	-	0... FFH	0... 255	1	-
maximum state of coolant circuit management for CC test bench					
C_STATE_COC_MIN_CC_TEST_BENCH	-	0... FFH	0... 255	1	-
minimum state of coolant circuit management for CC test bench					
C_STATE_LOIL_SUB	-	0... FFH	0... 255	1	s
Default value for transmitting layer-values					
C_STATE_OPM_MAX_CC_TEST_BENCH	-	0... 8H	0 ...8	1	-
maximum trigger threshold (OPM_AV) for CC bench mode					
C_STATE_OPM_MIN_CC_TEST_BENCH	-	0... 8H	0 ...8	1	-
minimum trigger threshold (OPM_AV) for CC bench mode					
C_T_CTR_SWI_OFF_VB_MIN	-	0... FFH	0... 255	1	s
Threshold shutdown counter battery-main-switch					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_CYC_CAN_ECU_2	-	0... FFH	10... 2560	10	ms
Constant for cycle time of output CAN-message "TORQUE_2" (default = 10ms)					
C_T_CYC_DISP_ICL_CAN	-	0... FH	0... 15	1	s
recurrence for transmission of check control message (appl. suggestion: 10 s)					
C_T_DLY_ERR_PSTE	-	0... FFH	0... 2.55	0.01	s
Time delay threshold to suppress error steering angle					
C_T_MAX_INH_ACK_IGK_OFF	-	0... FFH	0... 2.55	0.01	s
threshold to allow igk off acknowledge					
C_TAM_MAN_AS	-	0... FEH	-48... 142.5	0.75	°C
Ambient temperature TAM by application system					
C_TAM_SUB	-	0... FEH	-48... 142.5	0.75	°C
Substitute TAM-temperature in case of TAM-failure					
C_TEMP_GB_SUB	-	0... FFH	-40 ...215	1	°C
Default temperature for automatic gearbox in case of error TEMP_GB					
C_TQ_ACCIN	-	0... FFH	0... 127.5	0.5	Nm
Minimum torque ACCIN					
C_TQ_MAX_ACC	-	0... FFH	0... 127.5	0.5	Nm
air-conditioning-compressor limit torque after switch on					
C_V_SP_GEN	-	0... FFH	10.6... 16.975	0.025	V
Generator voltage (substitute value in case of invalid signal from CAN)					
IP_T_DLY_POIL_SWI_CAN__TOIL	-	0... FFFFH	0... 6553.5	0.1	s
LDP_TOIL__T_DLY_POIL_SWI_CAN	6	0... C8H	-40 ...160	1	°C
Delay-time for first activation of CC-message LV_POIL_SWI					
LC_CC_TEST_BENCH	-	0... 1H	0 ...1	1	-
LC for enabling CC test bench					
LC_ENA_CC_MIL_1	-	0... 1H	0 ...1	1	-
LC for enabling MIL_1 checkcontrol-message					
LC_ENA_REQ_PWL_DMTL_CAN	-	0... 1H	0 ...1	1	-
Switch to enable requests to get additional powerledge time for DMTL via CAN (only relevant for E70)					
LC_MSR_BN	-	0... 1H	0 ...1	1	-
LC for allowing MSR-intervention in case of TQ_TCS_FAST_BN <> TQ_TCS_SLOW_BN by DSC					
LC_PSTE_3_SUB_ENA	-	0... 1H	0 ...1	1	-
Enable substitute values for PSTE_3 interface					
LC_SND_MSG_OIL_KEY_AUX	-	0... 1H	0 ...1	1	-
LC for transmitting Layer-values independent of Kl.15					
LC_TAM_MAN_AS	-	0... 1H	0 ...1	1	-
Logical constant switch TAM from CAN or application system					
LC_TQI_MAF_MAN	-		-	-	-
Logical constant to switch between two paths of the TQI_MAF calculation					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MAX_ERR_N_ENG	-	0... FFH	0... 2.55	0.01	s
Threshold for sending RPM_ENG_ERR true or false without debounced CRK error					
LC_EFPPWM_CTL	-	0... 1H	0 ...1	1	-
Switch between PT-CAN definition and EKP Ctl functionality					
NC_VIN_CAN_LEN	-	0... FFH	0... 255	1	-
Length of VIN message over CAN					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Action definition

ACTION_COMM_SEND_CHAL_CAN_TRIG ()	Mode: O
-	

ACTION_INTC_NO_VECH_REQ ()	Mode: O
When this action is called the service "Anfrage:Fahregestellnummer" is requested.	

General information:

The basis of this CAN communication is the specification for "BN 2000" integration revision 6.3.0 (E65) and 4.1.0 (E60). All messages are transmitted as a complete frame, that means every label which is not defined will be transmitted with its "invalid" value (not initialization value!!).

The network management is done by the standard core, so it isn t described in that document.

The allocation of the messages to the two CAN- controller follows the BMW- Excel- Sheet Verteilung_ CAN_Kanäle_2CANController.xls from 25-06-2003. The messages which are according to this sheet transmitted in channel 0 ... 13, Basic 1 and Basic 2 are sent via CAN- controller 1. The messages in channel 14 ... 27, Basic 3 and Basic 4 are sent via CAN- controller 2.

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4.60.1 Input messages overview

message / *identifier*	BN2000 definition	ECU definition
ACC-Modul	**adaptive cruise control**	
DREHMOMENT_ANF_ACC	ST_TORQ_CLCTR_ACC	STATE_DCC_CTL
	ST_ACC_MOD_DME	STATE_DCC
	ST_ACC_SWO_SYS_DME	STATE_DCC_OFF_REQ
	CHKSM_TORQ_ACC	CKS_CAN_TQ_DCC
	ALIV_TORQ_ACC	TCC_CAN_TQ_DCC
	TORQ_TAR_ACC	TQ_DCC_FAST_BN
	TORQ_TAR_ADJR_POS_ACC	TQ_DCC_SLOW_BN
	ST_TORQ_TAR_ACC	STATE_DCC_INTV
	RQ_PREV_INFS_ACC	STATE_DCC_PUC_INH
ARS-Modul	**anti roll stabilization**	**ARS (anti roll stabilization)**
STAT_ARS	ALIV_COU_ARS	TCC_CAN_ARS
	ST_CLCTR_ARS	STATE_ARS_CAN
	TORQ_TAR_ARS	TQ_LOSS_ARS_SP_CAN
	TORQ_AVL_ARS	TQ_LOSS_ARS_AV_CAN
AFS-Modul	**active front steering**	**PSTE_2 (power steering 2)**
DREHMOMENT_ANF_AFS	ALIV_COU_AFS	TCC_CAN_TQ_PSTE_2
	CHKSM_TORQ_AFS	CKS_CAN_TQ_PSTE_2
	ST_TORQ_TAR_AFS	STATE_PSTE_2_INTV
	TORQ_TAR_AFS	TQ_LOSS_PSTE_2_SP_CAN
	TORQ_AVL_AFS	TQ_LOSS_PSTE_2_AV_CAN
	ST_RQ_TORQ_AFS_ERR	LV_PSTE_2_ERR
CAS	**car access system**	
FAHRGESTELLNUMMER	NO_VECH_x	VIN_CAN[NC_VIN_CAN_LEN]
KLEMMENSTATUS	ST_KL_R	LV_KEY_AUX
	ST_KL_15	STATE_IGK_CAN
	ST_KL_50	LV_RLY_ST_CAN
	NO_KEY	VEH_KEY_NR
	ST_STCD_PENG_MSA	LV_CS_2
	ST_KL_15_HW	STATE_IGK_HW (STATE_ACK_IGK_OFF)
	ALIV_KL	TCC_CAN_CAS
	CHKSM_KL	CKS_CAN_CAS
	ST_KEY_VLD	LV_KEY_VLD
CODIERUNG_PM	I_SC_MAX_VEH	CUR_SC_MAX_CAN
	I_SC_MIN_VEH	CUR_SC_MIN_CAN
	QC_VEH	CUR_WKU_CAN
	CLAS_BT	IDX_BAT_CAN
FAHRZEUGTYP	TYP_VEH	Not in use yet
	TYP_BODY	Not in use yet
	QUAN_CYL	Not in use yet
	QUAN_GR	Not in use yet
	TYP_ENG	Not in use yet
	TYP_STE	Not in use yet
	TYP_GRB	Not in use yet

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	CLAS_PWR	STATE_POW_CLAS_VEH
	TYP_CNT	Not in use yet
	TYP_CAPA	Not in use yet
STAT_ZV_KLAPPEN	ST_DSW_DRD	LV_DRIV_DOOR_OPEN
	ST_CT_BON	LV_HOOD_OPEN
Response from CAS	See formula section	See formula section
SZM		
FAHRZEUGMODUS	MOD_VEH	STATE_VEH_MOD
	ALIV_MOD_VEH	TCC_CAN_VEH_MOD
	CHKSM_MOD_VEH	CKS_CAN_VEH_MOD
CTR_CRASH_SWO_EKP	CTR_CRASH_SWO_EKP	STATE_EFP_CRASH_CAN
DSC-Modul		**TCS (traction control system)**
DREHMOMENT_ANF_DSC	CHKSM_TORQ_DSC	CKS_CAN_TQ_TCS
	ALIV_TORQ_DSC	TCC_CAN_TQ_TCS
	TORQ_TAR_DSC	TQ_TCS_FAST_BN
	TORQ_TAR_ADJR_POS_DSC	TQ_TCS_SLOW_BN
	ST_TORQ_TAR_DSC	STATE_TCS_INTV (LV_TQ_ASR_REQ, LV_TQ_MSR_REQ, LV_TCS_LIH_CAN)
GESCHWINDIGKEIT	V_VEH	VS_CAN, WHEEL
	ACLN_VEH_LN_DSC	AC_VEH_LGT_TCS
	ACLN_VEH_ACRO_DSC	AC_VEH_TRV_TCS
GESCHWINDIGKEIT_RAD	V_WHL_FLH	not in use → CAN11H
	V_WHL_FRH	not in use → CAN11H
	V_WHL_RLH	not in use → CAN11H
	V_WHL_RRH	not in use → CAN11H
STAT_DSC	ST_CLCTR	STATE_TCS_CTL (LV_PLAUS_ASR_CTL, LV_PLAUS_ESP_CTL, LV_TCS_CTL_ACT)
	ST_DSC	STATE_TCS_CAN
	ST_DCRN_AVL	STATE_TCS_DECE
	ST_BRP	STATE_BRAKE_PRS
	BRP	BRAKE_PRS
EGS-Modul	**elektr. Getriebesteuerung**	**ETCU (electronic transmission control unit)**
DREHMOMENT_ANF_EGS	CHKSM_TORQ_EGS	CKS_CAN_TQ_ETCU
	ALIV_TORQ_EGS	TCC_CAN_TQ_ETCU
	TORQ_TAR_EGS	TQ_GS_FAST_ BN
	TORQ_TAR_ADJR_POS_EGS	TQ_GS_SLOW_ BN
	ST_TORQ_TAR_EGS	STATE_ETCU_INTV (LV_TQ_GS_INC_REQ, LV_TQ_GS_DEC_REQ, LV_ETCU_LIH_CAN)
	ST_OBD_GRB	STATE_ETCU_OBD
	ST_OBD_ERR_GRB	STATE_ETCU_OBD_ERR
	ST_LIM_STORQ	STATE_ST_TQ_LIM_GS

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	TORQ_DRAW_GRB	TQ_CONV_CAN
	TEMP_GRB	TEMP_GB
	ST_OTMP_GRB	STATE_TEMP_GB
SSG-Modul	**sequentielles Schaltgetriebe**	**AMT (automated manual transmission)**
DREHMOMENT_ANF_SSG	CHKSM_TORQ_SSG	CKS_CAN_TQ_AMT
	ALIV_TORQ_SSG	TCC_CAN_TQ_AMT
	TORQ_TAR_SSG	TQ_AMT_FAST_ BN
	TORQ_TAR_ADJR_POS_SSG	TQ_AMT_SLOW_ BN
	ST_TORQ_TAR_SSG	STATE_AMT_INTV (LV_TQ_AMT_INC_REQ, LV_TQ_AMT_DEC_REQ, LV_AMT_LIH_CAN)
	ST_OBD_GRB_SSG	STATE_AMT_OBD
	ST_OBD_ERR_GRB_SSG	STATE_AMT_OBD_ERR
	ST_LIM_STORQ_SSG	STATE_ST_TQ_LIM_AMT
	ST_SHPS_SSG	STATE_AMT
	ST_CLT_SSG	STATE_CLU_AMT
	RQ_Motorstop	LV_AMT_ES
	LIM_RPM_ENG	N_MAX_AMT_CAN
	ST_GRLV_ACV	LV_GS
DKG-Modul (TCT)	**Doppelkupplungagetriebe**	**TCT (twin clutch transmission)**
DREHMOMENT_ANF_DKG	CHKSM_TORQ_DKG	CKS_CAN_TQ_TCT
	ALIV_TORQ_DKG	TCC_CAN_TQ_TCT
	TORQ_TAR_DKG	TQ_GS_FAST_BN
	TORQ_TAR_ADJR_POS_DKG	TQ_GS_SLOW_BN
	ST_MOD_DKG	STATE_TCT_INTV (LV_TQ_GS_INC_REQ, LV_TQ_GS_DEC_REQ, LV_TCT_LIH_CAN, LV_TCT_ES, LV_N_SP_TCT_REQ)
	TORQ_CLT_DKG	TQ_TCT_CAN
	RPM_TAR_ENG_DKG	N_SP_TCT (LV_N_SP_TCT)
ST_DKG	RQ_AUXWP	Not used
	ST_OTMP_DKG	STATE_TEMP_GB
	TEMP_DKG	TEMP_GB
Transmission units	**Getriebeinformationen**	**Transmission data**
GETRIEBEDATEN		
	ST_GR_GRB	GEAR_INFO
	GRDT_REIN	FAC_GB_GAIN
only EGS (LV_AT) ->	ST_CCLT	STATE_CC
only EGS (LV_AT) ->	ST_MOD_GRB	STATE_MOD_GB
only SSG (LV_VAR_AMT) ->	ST_HYPP_ACV	LV_PUMP_AMT_ON
only DKG or EGS (LV_VAR_TCT or LV_AT) ->	ST_GRLV_ACV	LV_GS
only DKG (LV_VAR_TCT) ->	ST_RSTA	STATE_MAX_AC_ST
GETRIEBEDATEN_2		

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	RPM_GRB_TURB	N_GB
	ST_RCOG_FSHUP	LV_INH_GP_SUP
only DKG (LV_VAR_TCT) ->	RQ_BST_RPM_IDLG	N_SP_IS_TCT_CAN
only DKG (LV_VAR_TCT) ->	ST_STCLT	STATE_ETCU_CLU
	RPM_GRB_NEGL_2	N_GB_OUT
	RQ_GRB_DYNS_DISP_RPM_ENG	LV_N_DISP_DYN
	ST_GRB_SW	STATE_ETCU_SPT_SWI
GETRIEBEDATEN_3		
	TORQ_DVCH_RISE	dm_ab_fws
	IDX_ACPD	ipm_typ_fp
	IDX_TORQ_FIL	ipm_typ_mdkw
only DKG (LV_VAR_TCT) ->	RQ_MIL_GRB	LV_MIL_REQ_ETCU
only DKG (LV_VAR_TCT) ->	LIM_MAX_V_GRB_EMMOD	VS_MAX_LIH_TCT
ANZEIGE_GETRIEBEDATEN		
	CTR_DISP_PRG_GRB	STATE_ETCU_PROG_INFO
	CTR_DISP_SPMOD_GRB	LV_ETCU_SPT_SWI
IHKA		
WAERMESTROM_KLIMA	HTFL_RQ_AIC	HEAT_REQ_PERC
	HTFL_ST_AIC	not in use, value initialised FFh
	TORQ_TAR_ACCM	TQ_ACCIN_CAN
	CTR_EFAN_AIC	N_ECF
	CTR_AIC_SPFN	LV_REQ_HEAT , LV_REQ_TCO_L
	CTR_CLMP	LV_REQ_TCO_L
	CTR_AIC_RDI	STATE_ACIN_CAN
	ST_PWR_SPCOS	STATE_EXT_POW_CNS
	CTR_FAN_FLAP	LV_ECRAS_CTL_CAN_1/_2
Kombi		
A_TEMP_RELATIVZEIT	TEMP_EX	TAM
	T_SEC_COU_REL	T_CTR_REL_CAN (E65) bzw. T_REL_CAN (E60), T_REL_CAN_2
	T_DAY_COU_ABSL	T_CAN
BOS_RUECKSTELLUNG	ID2_BOS_RSTG	STATE_ID2_BOS_RST
	ID_FN_BOS_RSTG	STATE_ID_FCT_BOS_RST
	AVAI_BOS_RSTG	STATE_AVL_BOS_RST
	COU_RSTG_BOS_RSTG	CTR_RST_BOS_RST
	RMMI_BOS_RSTG	QOIL_DS_RST_CAN_1_5
BOS_RUECKSTELLUNG_2	ID2_BOS_RSTG_2	QOIL_DS_RST_CAN_2_1
	ID_FN_BOS_RSTG_2	QOIL_DS_RST_CAN_2_2
	FRC_INTM_WAY_BOS_RSTG_2	QOIL_DS_RST_CAN_2_3
	TARD_MON_BOS_RSTG_2	QOIL_DS_RST_CAN_2_4
	TARD_YR_BOS_RSTG_2	QOIL_DS_RST_CAN_2_5
	FRC_INTM_T_BOS_RSTG_2	QOIL_DS_RST_CAN_2_6
KILOMETERSTAND	MILE_KM	CTR_KM_CAN

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	FLLV_FUTA	FTL
	FLLV_FUTA_LH	FTL_LE
	FLLV_FUTA_RH	FTL_RI
	ST_FLLV_FUTA_SPAR	LV_FTL_OBD_INH_L
	RNG	not defined
STAT_KOMBI	V_VEH_SPDM	VS_ICL_DISP
	ST_UN_V_SPDM	STATE_VS_ICL_DISP
	ST_INTF_CCTRA_KI	STATE_IF_ICL_BN_MSW
	ALIV_COU_KI	TCC_CAN_ICL
	ST_WALI_ENG	STATE_WAL_CAN
UHRZEIT_DATUM	DISP_HR	Not in use yet
	DISP_MN	Not in use yet
	DISP_SEC	Not in use yet
	DISP_DATE_DAY	T_CLK_ICL_DISP_1
	DISP_DATE_WDAY	Not in use yet
	DISP_DATE_MON	T_CLK_ICL_DISP_2
	DISP_DATE_YR	T_CLK_ICL_DISP_3
	ST_DISP_CTI_DATE	Not in use yet
LDM	**Längsdynamikmodul**	
Anforderung Radmoment Antriebsstrang	Byte 7 + Byte 6	STATE_CUS_LDM_CAN
	FOLDYN_WMOM_PT_TAR	STATE_DI_PUC
	ST_DRASY_PT	STATE_LDM
	WMOM_PT_TAR	TQ_WHEEL_LDM_BN
	WMOM_PT_ENBL	STATE_LDM_INTV
	FOLDYN_WMOM_PT_TAR	STATE_SP_DYN_WHEEL
	ALIV_RQ_WMOM_PT	TCC_CAN_LDM
	CHKSM_RQ_WMOM_PT	CKS_CAN_LDM
	RQ_GSI_CLCTR_LN	LV_GS_IDC_LDM
Power-Modul		
POWERMGMT_ BATTERIESPANNUNG	ST_BTSW	see **2.8 Power-Modul**
	ST_SWO_KL_30	STATE_SWI_OFF_VB
	SDWN_COU_BTSW	T_CTR_SWI_OFF_ VB
	T_SEC_COU_REL_ RED	T_REL_CAN (E65) T_REL_CAN_2 (E65)
POWERMGMT_ LADESPANNUNG	CTR_GEN_U_TAR	V_GEN_TAR
	RPM_IDLG_SPEC	FAC_IS_INC_REQ
	TEMP_BT	not defined
SZ-Lenksäule		
BEDIENUNG_TEMPOMAT	CHKSM_CCTR	CKS_CAN_MSW
	ALIV_CCTR	TCC_CAN_MSW
	OP_PUBU_CCTR_ACC	STATE_BN_MSW
	OP_GAPC_ACC	STATE_GAP_MSW
LENKRADWINKEL		
	STWA	ANG_PSTE
	STWA_V	VEL_ANG_PSTE

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	STWA_ERR	STATE_SENS_ANG_PSTE
K_CAN: LM		
STAT_GANG_RUECKWAERTS	ST_GR_BAC	STATE_GEAR_REV_CAN
LAMPENZUSTAND	ST_DIPB	LV_LTG_HDLP_L_ON
CTR_LICHT	CTR_ITLI	LV_LTG_INL_ON
STAT_ANHAENGER	ST_TRAI	LV_STATE_TRL
STAT_VERDECK_CABRIO	ST_PO_FLDT_CAB	LV_CTOP
EKP		
STAT_EKP	ST_DIAG_FU_PP_EL	STATE_DIAG_EFP
	ST_FU_PP_EL	STATE_EFP_CAN
	U_ENG_FU_PP_EL	V_ENG_EFP
	I_ENG_FU_PP_EL	CUR_ENG_EFP
	RPM_AVL_FU_PP_EL	N_EFP_AV
	U_KL_30_FU_PP_EL	VB_EFP
	FLQUAN_TAR_FU_PP_EL	not defined yet
	SETQ_FU_PP_EL	not defined yet
	ST_FU_CLCTR_FU_PP_EL	STATE_EFP_CTL
K_CAN: CCC_GW, M_ASK		
PRGG_CCTR	IDX_NO_PRGG_CCTR	NR_VS_CRU_IF
	V_PRGG_CCTR_IDX_NO_1	VS_STEP_IF_1
	V_PRGG_CCTR_IDX_NO_2	VS_STEP_IF_2
	V_PRGG_CCTR_IDX_NO_3	VS_STEP_IF_3
K_CAN		
PM_STANDVERBRAUCHER	ID_FN_PWGM	FAC_POW_MNG_VST_CNS, formula section
	ST_PCOS_PWGM	FAC_POW_MNG_VST_CNS, formula section
VERBRAUCHERSTATUS	ID_FN_COS	STATE_VEH_CNS[10], see formula section
	ST_FN_COS	STATE_VEH_CNS_FCT, see formula section
ANFORDERUNG_ELUEFTER		see formula section
OBD Sensor Diagnosestatus		see formula section
EHB3		
DREHMOMENT_ANF_STE	CHKSM_TORQ_STE	CKS_CAN_TQ_ PSTE_3
	ALIV_TORQ_STE	TCC_CAN_TQ_ PSTE_3
	SRC_RQ_TORQ_STE	STATE_PSTE_3_SCR
	TORQ_AVL_STE	TQ_LOSS_PSTE_3_AV_CAN
	TORQ_TAR_STE	TQ_LOSS_PSTE_3_SP_CAN
	ST_TORQ_TAR_STE	STATE_PSTE_3_INTV (LV_PSTE_3_INTV)
	ST_RQ_TORQ_STE_ERR	STATE_PSTE_3_ERR (LV_TQ_ PSTE_3_CAN_ENA LV_TQ_ PSTE_3_CAN_LIH LV_TQ_ PSTE_3_CAN_DI)

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EMF (PBR)		
STELLANF_EMF	ST_HYD_RETA_2	STATE_HLD_PBR
	ST_CFFU_EMF_2	LV_CFT_MOD_PBR
STATUS_EMF	ST_EMF_LOCA_2	STATE_PBR
ST_RQ_EMF	ST_ACT_EMF	STATE_PBR_ACT
	QU_ST_ACT_EMF	STATE_PBR_ACT_QLY
	RQ_DCRN_EMF	AC_WHEEL_PBR
	QU_RQ_DCRN	STATE_TQ_WHEEL_PBR_QLY
	ALIV_ST_RQ_EMF	TCC_CAN_TQ_PBR
	CHKSM_ST_RQ_EMF	CKS_CAN_TQ_PBR
	SAFG_RQ_WMOM_EMF	not used
DXC		
SOLL_MOM_ANF	ST_HDC_FN	STATE_DHL_CTL
BEDIENUNG_MDRV		
Signals see according chapter		
FAHRGESTELLNUMMER		
	NO_VECH	VIN_CAN

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4.60.2 Output messages overview

message / *identifier*	**BN2000 definition**	**ECU definition**
DME1		
ANFRAGE	ID2_INQY	see chapter 3
	ID_FN_INQY	see chapter 3
DISP_CC_MSG_EXT	ID2_CC_MESS_EXT	not defined
	NO_CC_MESS_EXT	not defined
	ST_CC_MESS_EXT	not defined
	TRANF_CC_MESS_EXT	not defined
	ST_IDC_CCLK_CC_MESS_EXT	not defined
	NO_FRM_CC_MESS_EXT	not defined
	QUAN_FRM_CC_MESS_EXT	not defined
	UTDT_CC_MESS	not defined
DISP_CC_MSG	ID2_CC_MESS_STD	01000000b
	NO_CC_MESS_STD	depending on dif. condition
	ST_CC_MESS_STD	depending on dif. condition
	TRANF_CC_MESS_STD	C_T_CYC_DISP_ICL_CAN
	ST_IDC_CCLK_CC_MESS_STD	C_ICL_DISP_FRQ
BOS_MELDUNG	ID2_BOS_MESS	idbosmsg
	ID_FN_BOS_MESS	idfbosmg_w
	RMMI_BOS	DIST_RESI_OIL
	ST_UN_BOS	DIST_RESI_OIL_KM
	AVAI_BOS_MESS	STATE_OIL_AVL
	COU_RSTG_BOS_MESS	zrbosmld
BOS_MELDUNG_2	ID2_BOS_MESS_2	QOIL_DS_CAN_2_1
	ID_FN_BOS_MESS_2	QOIL_DS_CAN_2_2
	FRC_INTM_WAY_BOS_MESS_2	QOIL_DS_CAN_2_3
	TARD_YR_BOS_MESS_2	QOIL_DS_CAN_2_4
	TARD_MON_BOS_MESS_2	QOIL_DS_CAN_2_5
	FRC_INTM_T_BOS_MESS_2	QOIL_DS_CAN_2_6
TORQUE_1	CHKSM_TORQ_1_DME	CKS_CLC_ECU1
	ALIV_TORQ_1_DME	TCC_CAN_ECU1
	TORQ_AVL	TQ_AV (converted for BN)
	ST_TORQ_AVL	SF_TQD, LV_DI_TQ_REQ_CAN_MPI_GDI
	TORQ_AVL_DMEE	TQ_ECU_ETCU
	ST_SW_CLT	LV_IM_CS_PN
	ST_DMEA_SWO	LV_DCC_OFF_ECU
	RCPT_ACC_SWO_SYS_DME	LV_DCC_OFF_ACK
	ST_RCPT_ENG_ACC	STATE_TQ_INTV_DCC
	ST_RCPT_ENG_ARS	STATE_TQ_INTV_ARS
	ST_RCPT_ENG_DSC	STATE_TQ_INTV_TCS
	ST_RCPT_ENG_EGS	STATE_TQ_INTV_ETCU, STATE_TQ_INTV_AMT, STATE_TQ_INTV_TCT
	ST_OBD_CTFN_GRB	STATE_DIAG_GS
	ST_CT_BRPD_DME	BLS-/BTS-conditions

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TORQUE_2	CHKSM_TORQ_2_DME	CKS_CLC_ECU2
	ALIV_TORQ_2_DME	TCC_CAN_ECU2
	ST_SW_LEV_RPM	N_SP_IS-conditions
	ST_INFS	LV_PUC
	TORQ_AVL_MIN	TQ_LOSS (converted for BN)
	TORQ_AVL_MAX	TQ_MAX_CLU (converted for BN)
	TORQ_AVL_SPAR_NEG	TQ_REF_IGA_MIN_LAMB (converted for BN)
	TORQ_AVL_SPAR_POS	TQ_MAF (converted for BN)
TORQUE_3	CHKSM_TORQ_3_DME	CKS_CLC_ECU3
	ALIV_TORQ_3_DME	TCC_CAN_ECU3
	TORQ_DVCH	TQ_EMS_BN
	ANG_ACPD	PV_MAX_CAN
	RPM_ENG	N_CAN
	RPM_ENG_ERR	LV_ERR_CRK
	ST_IDLG_ENG	! LV_IS
	ST_CLCTR_V	STATE_CRU_CAN, STATE_TQ_DCC, STATE_TQ_LDM
	RQAM_FU	VFF_EFP / EFPPWM_CAN
ENGINE_RPM	RPM_TEMP_DOM_1	N_MAX_THD_1_CAN
	RPM_TEMP_DOM_2	N_MAX_THD_2_CAN
ENGINE_1	TEMP_ENG	TCO (converted)
	TEMP_EOI	TOIL_CAN
	ALIV_COU_DME	TCC_CAN_ECU
	ST_ENG_RUN	LV_ES and LV_ST conditions
	ST_SW_WAUP	LV_WUP_CAN; LV_LIH_COC_ON
	AIP_ENG	AMP_CAN
	IJV_FU	FCO (like CAN11h)
	CTR_SLCK	CTL_SHIFT_LOCK_CAN
	ST_SW_CLT	LV_IM_CS_PN
	RDUC_DOCTR_RPM	STATE_N_MAX_THD_LIH
	RPM_IDLG_TAR	N_SP_IS
	ST_RBMCYC	LV_DC_RBM (see formula)
ENGINE_2	RQ_STASS	B_notafu
GESCHWINDIGKEIT_ TEMPOMAT	V_CLCTR_CCTR	VS_SP_DRIV_CRU_CAN
	ST_V_CLCTR_CCTR	depending on conditions
	CTR_DISP_CCTR	LV_STEP_ON_ICL
	CTR_DISP_CCTR_HUD	LV_CRU_DISP_HUD
	RCPT_ACTVN_CCTR_DR	LV_CRU_ACT_INH
	IDX_NO	NR_VS_CRU
	V_CCTR_IDX_NO_1	VS_STEP_CAN_1
	V_CCTR_IDX_NO_2	VS_STEP_CAN_2
	V_CCTR_IDX_NO_3	VS_STEP_CAN_3
WAERMESTROM_MOTOR	HTFL_RQ_DME	FFh

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	HTFL_ST_DME	N_REL_CWP
	ACCM_LIM_TORQ	TQ_MAX_ACC_CAN
	ST_CRAW_ENG	STATE_CUR_ENG_CNS
	ST_I_GEN	CUR_GEN
	ST_GEN	STATE_ALTER
	ST_LDST_GEN	st_ldstgen
	CTR_APE_WV	PWM_VALUE_HIV_PERC
	LDST_GEN	POW_REL_ALTER_CLC
POWERMANAGEMENT_BATTERIESPANNUNG *(in case of E60, LV_VAR_VEH = 0)*	T_SEC_COU_REL_RED	*invalid value: FFFFFFH*
	SDWN_COU_BTSW	*invalid value: FFH*
	ST_SWO_KL_30	*invalid value: 11b = 3H*
	ST_COS_SWO	*invalid value: 11b = 3H*
	ST_HT_RSCR	*invalid value: 11b = 3H*
	ST_PCOS	stpcos
	CTR_PRED_PRIO_CF	POW_CTL_PRI_PEAK_RED_CFT
	CTR_PRED_PRIO	POW_CTL_PRI_PEAK_RED
	ST_SW_DSTB	*invalid value: 11b = 3H*
	ST_BTSW	*invalid value: 11b = 3H*
	U_BT	VB_POW_MNG
	ACKM_RQ_SWO_KL_15	STATE_ACK_IGK_OFF
POWERMANAGEMENT_VERBRAUCHERSTEUERUNG *(in case of E60, LV_VAR_VEH = 0)*	CTR_PCOS	POW_CTL_PARK_CNS
	RQ_PCOS	rqpcos
	CTR_CBR	CUR_RNG_CTL
	CTR_PWR_COS	POW_CTL_PWR_CNS_1
	CTR_PWR_SPCOS	POW_CTL_PWR_CNS_2
	SLCTN_SPCOS	selspcos
	ULEV	ulev
Radmoment Antriebsstrang 1	ST_PENG	STATE_ENGG_POS
	ANG_ACPD_TAR	PV_LDM_REQ_CAN
	WMOM_PT_AVL	TQ_WHEEL
	ANG_ACPD_REAL	PV_AV
	ALIV_WMOM_PT_1	TCC_CAN_TQ_WHEEL_1
	CHKSM_WMOM_PT_1	CKS_CLC_TQ_WHEEL_1
Radmoment Antriebsstrang 2	WMOM_PT_MAX	TQ_MAX_WHEEL
	WMOM_PT_MIN_LOW	TQ_MIN_WHEEL_L
	WMOM_PT_MAX	TQ_MAX_WHEEL
	ST_PT_INIT	LV_LDM_OFF, LV_LDM_OFF_ECU

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	ALIV_WMOM_PT_2	TCC_CAN_TQ_WHEEL_2
	CHKSM_WMOM_PT_2	CKS_CLC_TQ_WHEEL_2
Challenge to CAS	See formula section	See formula section
Status EKP	ST_FU_CLCTR_DME	STATE_EFP_CTL_ECU
OBD_DT_MOTOR	PO_THVA_ENG	OBD_TPS_1
	CALCVL_LD_ENG	LOAD_CLC
	ST_PFC_CYC	STATE_PFC_CYC_BN
ST_BATT	CND_BT	Qv_out_m
	CND_BT_ACCY	Qv_quali_m
	CND_BT_CHNG	Qvc_status_4
	CND_BT_T	Qv_td
	ST_CND_BT	Qvc_status_3
DISP_GSI	ALIV_DISP_GSI	TCC_CAN_GS_IDC
	DISP_TARG	Spa_gang
	DISP_GSI	Spa_art
	CHKSM_ DISP_GSI	CKS_CLC_GS_IDC
DISP_ENGDAT	ALIV_DISP_ENGDAT	TCC_CAN_DISP_ECU
	DISP_RPM_ENG	N_DISP_DYN
ST_MDRV	Signals see accoring chapter	
DME2		

4.60.3 Enable conditions for BN 2000 diagnosis

General information:

The CAN diagnosis for BN input messages is only to be enabled if the variant has been recognized. In case of a modul (e.g. TCS) which is not a variant but implemented in every vehicle the diagnosis is always enabled.
If BN diagnosis for message XXX is enabled (conditions see table below) then the conditions for activating the BN diagnosis have to be checked: only if LV_CDN_DIAG_BN_XXX =1 then the BN diagnosis is to be activated. For activation conditions see Chapter BN2000 diagnosis .
In the following the input messages, their keywords, the symptoms which have to be dectected (timeout, alive, checksum) and the enable conditions for each diagnosis are described.
The XXX in the Chapter BN2000 diagnosis have to be replaced by the respective keyword in the table below.
As soon as an TOUT/CKS/TCC-symptom is detected the last CAN-signals of the corresponding message are freezed until the LV_ERR_BN_xxx is debounced, no more new values are taken over. After the LV_ERR_BN_xxx is debounced the signals are set to default-values.
The diagnosis of the symptoms TOUT/CKS/TCC can be inhibited by setting the corresponding calibration constant C_CTR_DIAG_TOUT/CKS/TCC_CAN_MAX_xxx to 0. In this case the CAN-signals will be taken over.

Table of BN input messages

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message / *identifier*	**Keyword for BN-diagnosis (XXX):**	**Enable conditions for BN-diagnosis:**	**Diagnosis of symptoms:**
ACC-Modul	**(Distance Cruise Control)**		
DREHMOMENT_ANF_ACC	**TQ_DCC**	LV_VAR_DCC = 1	TCC_CAN_**TQ_DCC**
			CKS_CAN_**TQ_DCC**
			Timeout **TQ_DCC**
ARS-Modul	**(Anti-roll-stabilisation)**		
STAT_ARS	**ARS**	LV_VAR_ARS = 1	TCC_CAN_**ARS**
			Timeout **ARS**
AFS-Modul	**(Active Front Steering)**		
DREHMOMENT_ANF_ACC	**TQ_PSTE_2**	LV_VAR_PSTE_2 = 1	TCC_CAN_**TQ_PSTE_2**
			CKS_CAN_**TQ_PSTE_2**
			Timeout **TQ_PSTE_2**
EHB3-Modul	**(Electric Power Steering)**		
DREHMOMENT_ANF_STE	**TQ_PSTE_3**	LV_VAR_PSTE_3 = 1	TCC_CAN_**TQ_PSTE_3**
			CKS_CAN_**TQ_PSTE_3**
			Timeout **TQ_PSTE_3**
CAS	**(Car-access-system)**		
KLEMMENSTATUS	**CAS**	always enabled	TCC_CAN_**CAS**
			CKS_CAN_**CAS**
			Timeout **CAS**
FAHRZEUGMODUS	**VEH_MOD**	LV_VAR_VEH_MOD = 1	TCC_CAN_**VEH_MOD**
			CKS_CAN_**VEH_MOD**
			Timeout **VEH_MOD**
STAT_ZV_KLAPPEN	**CDN_DOOR**	always enabled	Timeout **CDN_DOOR**
DSC-Modul	**(Traction-control-system)**		
DREHMOMENT_ANF_DSC	**TQ_TCS**	always enabled	TCC_CAN_**TQ_TCS**
			CKS_CAN_**TQ_TCS**
			Timeout **TQ_TCS**
GESCHWINDIGKEIT	**VS_TCS**	always enabled	Timeout **VS_TCS**
GESCHWINDIGKEIT_RAD		**not in use**	**--------------------------**
STAT_DSC	**TCS**	always enabled	Timeout **TCS**
EGS-Modul			
DREHMOMENT_ANF_EGS	**TQ_ETCU**	LV_AT = 1	TCC_CAN_**TQ_ETCU**
			CKS_CAN_**TQ_ECTU**
			Timeout **TQ_ETCU**

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SSG-Modul			
DREHMOMENT_ANF_SSG	**TQ_AMT**	LV_VAR_AMT = 1	TCC_CAN_**TQ_AMT**
			CKS_CAN_**TQ_AMT**
			Timeout **TQ_AMT**
DKG-Modul			
DREHMOMENT_ANF_DKG	**TQ_TCT**	LV_VAR_TCT = 1	TCC_CAN_**TQ_TCT**
			CKS_CAN_**TQ_TCT**
			Timeout **TQ_TCT**
ST_DKG	**STAT_TCT**	LV_VAR_TCT = 1	Timeout **STAT_TCT**
Transmission units			
GETRIEBEDATEN	**ETCU**	LV_VAR_ETCU = 1	TCC_CAN_**ETCU**
			CKS_CAN_**ETCU**
			Timeout **ETCU**
GETRIEBEDATEN_2	**ETCU_2**	LV_AT = 1 **or** LV_VAR_TCT = 1	Timeout **ETCU_2**
GETRIEBEDATEN_3	**ETCU_3**	LV_VAR_ETCU_3	TCC_CAN_**ETCU_3**
			CKS_CAN_**ECTU_3**
			Timeout **ETCU_3**
ANZEIGE_GETRIEBEDATE N	**ETCU_DISP**	LV_AT = 1 **or** LV_VAR_TCT = 1	Timeout **ETCU_DISP**
IHKA			
WAERMESTROM_KLIMA	**ACC**	LV_VAR_ACIN = 1	Timeout **ACC**
Kombi			
A_TEMP_RELATIVZEIT	**T_ICL**	LV_VAR_ICL = 1	Timeout **T_ICL**
BOS_RUECKSTELLUNG			
KILOMETERSTAND	**KM_ICL**	LV_VAR_ICL = 1	Timeout **KM_ICL**
STAT_KOMBI	**ICL**	LV_VAR_ICL = 1	TCC_CAN_**ICL**
			Timeout **ICL**
UHRZEIT_DATUM	**T_CLK**	LV_VAR_ICL = 1	Timeout **T_CLK**
Power-Modul			
POWERMGMT_ BATTERIESPANNUNG	**POW_VB**	LV_VAR_VEH = 1	Timeout **POW_VB**
POWERMGMT_ LADESPANNUNG	**POW_GEN**	LV_VAR_VEH = 1	Timeout **POW_GEN**
SZ-Lenksäule			
BEDIENUNG_TEMPOMAT	**MSW**	LV_VAR_BN_MSW = 1	TCC_CAN_**MSW**
			CKS_CAN_**MSW**
			Timeout **MSW**
LENKRADWINKEL	**ANG_PSTE**	LV_VAR_PSTE = 1	Timeout **ANG_PSTE**
SZM			
Steuerung Crashabschaltung EKP	EFP_CRASH	LV_VAR_EFP_CRASH = 1	Timeout **EFP_CRASH**
EKP			
STAT_EKP	**EFP**	LV_VAR_BN_EFP = 1	Timeout **EFP**
K_CAN: LM			
STAT_GANG_RUECKWAE RTS	**GEAR_REV**	LV_VAR_BN_GEAR_R EV = 1	Timeout **GEAR_REV**
LAMPENZUSTAND	**LTG_HDLP_**	LV_VAR_BN_LTG_HDL	Timeout **LTG_HDLP_L**

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	L	P_L = 1	
STAT_ANHAENGER	**TRL**	LV_VAR_BN_TRL = 1	Timeout **TRL**
LDM			
Anforderung Radmoment Antriebsstrang	**LDM**	LV_VAR_BN_LDM = 1	TCC_CAN_**LDM**
			CKS_CAN_**LDM**
			Timeout **LDM**
EMF-Modul	**(Electric mechanical park brake)**		
STELLANF_EMF	**REQ_PBR**	LV_VAR_PBR = 1	TCC_CAN_**REQ_PBR**
			CKS_CAN_**REQ_PBR**
			Timeout **REQ_PBR**
STATUS_EMF	**PBR**	LV_VAR_PBR = 1	TCC_CAN_**PBR**
			CKS_CAN_**PBR**
			Timeout **PBR**
ST_RQ_EMF	**TQ_PBR**	LV_VAR_TQ_PBR = 1	Timeout **TQ_PBR** TCC_CAN_**TQ_PBR** CKS_CAN_**TQ_PBR**
DXC-Modul	**(4 wheel drive ECU)**		
SOLL_MOM_ANF	**DHL_CTL**	LV_VAR_4WD = 1	Timeout DHL_CTL

4.60.4 Input messages

General information:

The handling of default-values in case of a CAN-error is as follows: if one of the symptoms (timeout, alive or checksum) is detected the last received value should be freezed until the error is debounced. After debounce the respective default-value should be used until rebounce.

4.60.4.1 ACC-Modul

Formula section:

DREHMOMENT_ANF_ACC:

IF LV_ERR_BN_TQ_DCC = 0 **AND**
LV_ERR_CAN_BOFF = 0
THEN *// checksum_torque_ACC:*
CKS_CAN_TQ_DCC = CHKSM_TORQ_ACC

// alive_torque_ACC:
TCC_CAN_TQ_DCC = ALIV_TORQ_ACC

// Torque_target _ACC:
TQ_DCC_FAST_BN = TORQ_TAR_ACC

// Torque_target_adjustment-range_posisitive _ACC:
TQ_DCC_SLOW_BN = TORQ_TAR_ADJR_POS_ACC

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```
// state ACC-intervention:
if          ST_TORQ_TAR_ACC        = 00H
then            STATE_DCC_INTV          =NO_INTERVENTION
            LV_TQ_DCC_INC_REQ      = 0
elseif           ST_TORQ_TAR_ACC        = 01H
            then      STATE_DCC_INTV           =TORQUE_INCREASE
                      LV_TQ_DCC_INC_REQ     = 1
            else      LV_TQ_DCC_INC_REQ       = 0
                 endif
elseif           ST_TORQ_TAR_ACC        = 02H          or
                   ST_TORQ_TAR_DCC      = 03H
            then      STATE_DCC_INTV           =INVALID_SIGNAL
                      LV_DCC_LIH_CAN          = 1
            else      LV_DCC_LIH_CAN            = 0
endif

// request_prevention_over-run-fuel-shutoff:
IF          STATE_DCC_PUC_INH       =    01H
THEN            LV_DCC_PUC_INH          =    1
ELSE            LV_DCC_PUC_INH          =    0
ENDIF

STATE_DCC_PUC_INH = RQ_PREV_INFS_ACC


// status_ACC_switch-off_system_DME:
IF          STATE_DCC_OFF_REQ       =    01H
THEN            LV_DCC_OFF_ACK          =    1
ELSE            LV_DCC_OFF_ACK          =    0
ENDIF

STATE_DCC_OFF_REQ         = ST_ACC_SWO_SYS_DME


// status_ACC_mode_DME:
IF          ST_ACC_MOD_DME      =    00H
THEN            STATE_DCC             =    INACTIV
ELSEIF      ST_ACC_MOD_DME      =    01H
THEN            STATE_DCC             =    STAND_BY
ELSEIF      ST_ACC_MOD_DME      =    02H
THEN            STATE_DCC             =    NORMAL
ELSEIF      ST_ACC_MOD_DME      =    03H
THEN            STATE_DCC             =    RESERVE
ELSEIF      ST_ACC_MOD_DME      =    04H
THEN            STATE_DCC             =    BRAKE_ACTIVE
ELSEIF      ST_ACC_MOD_DME      =    05H
THEN            STATE_DCC             =    DRIVER_ACTIVE
ELSEIF      ST_ACC_MOD_DME      =    06H
THEN            STATE_DCC             =    RESERVE
ELSEIF      ST_ACC_MOD_DME      =    07H
THEN            STATE_DCC             =    INVALID_SIGNAL
```

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ENDIF

// status_torque_control_ACC:
STATE_DCC_CTL = ST_TORQ_CLCTR_ACC

ELSE *// checksum_torque_ACC:*
CKS_CAN_TQ_DCC = FFH

// alive_torque_ACC:
TCC_CAN_TQ_DCC = FH

// Torque_target _ACC:
TQ_DCC_FAST_BN = 8000H

// Torque_target_adjustment-range_posistive _ACC:
TQ_DCC_SLOW_BN = 8000H

// state ACC-intervention:
STATE_DCC_INTV = 3H
LV_TQ_DCC_INC_REQ = 0
LV_DCC_LIH_CAN = 1

// request_prevention_over-run-fuel-shutoff:
STATE_DCC_PUC_INH = 0H
LV_DCC_PUC_INH = 0

// status_ACC_switch-off_system_DME:
STATE_DCC_OFF_REQ = 03H
LV_DCC_OFF_ACK = 0

// status_ACC_mode_DME:
STATE_DCC = 0H

// status_torque_control_ACC:
STATE_DCC_CTL = 7H // invalid signal

ENDIF

4.60.4.2 ARS-Modul

Formula section:

STAT_ARS
IF LV_ERR_BN_ARS = 0 **AND**
LV_ERR_CAN_BOFF = 0
THEN *// free running test cycle counter anti roll stabilization :*
TCC_CAN_ARS = ALIV_COU_ARS

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// status anti roll stabilization :
if ST_CLCTR_ARS = 00b
then STATE_ARS_CAN = INACTIVE
elseif ST_CLCTR_ARS = 01b
then STATE_ARS_CAN = ACTIVE
else STATE_ARS_CAN = INVALID_SIGNAL
endif

// target value torque loss ARS :
TQ_LOSS_ARS_SP_CAN = TORQ_TAR_ARS (converted from BN 2000)

IF TORQ_TAR_ARS = FFH
THEN LV_ERR_TQ_LOSS_ARS_SP_CAN = 1
ELSE LV_ERR_TQ_LOSS_ARS_SP_CAN = 0
ENDIF

// actual value torque loss ARS :
TQ_LOSS_ARS_AV_CAN = TORQ_AVL_ARS (converted from BN 2000)

IF TORQ_AVL_ARS = FFH
THEN LV_ERR_TQ_LOSS_ARS_AV_CAN = 1
ELSE LV_ERR_TQ_LOSS_ARS_AV_CAN = 0
ENDIF
ELSE *// free running test cycle counter anti roll stabilization :*
TCC_CAN_ARS = FH

// status anti roll stabilization :
STATE_ARS_CAN = 3H

// target value torque loss ARS :
TQ_LOSS_ARS_SP_CAN = 8000H
LV_ERR_TQ_LOSS_ARS_SP_CAN = 1

// actual value torque loss ARS :
TQ_LOSS_ARS_AV_CAN = 8000H
LV_ERR_TQ_LOSS_ARS_AV_CAN = 1
ENDIF

4.60.4.3 AFS-Modul

Formula section:

DREHMOMENT_ANF_AFS:

IF LV_ERR_BN_TQ_PSTE_2 = 0 **AND**
LV_ERR_CAN_BOFF = 0
THEN *// checksum_torque_AFS:*

CKS_CAN_TQ_PSTE_2 = CHKSM_TORQ_AFS

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// alive_torque_AFS:

TCC_CAN_TQ_PSTE_2 = ALIV_TORQ_AFS

// target value torque loss AFS :
TQ_LOSS_PSTE_2_SP_CAN = TORQ_TAR_AFS (converted from BN 2000)

// actual value torque loss AFS :
TQ_LOSS_PSTE_2_AV_CAN = TORQ_AVL_AFS (converted from BN 2000)

// state AFS-intervention:

if ST_TORQ_TAR_AFS = 00H
then STATE_PSTE_2_INTV =NO_INTERVENTION
elseif ST_TORQ_TAR_AFS = 01H
then STATE_PSTE_2_INTV =TORQUE_INCREASE
elseif ST_TORQ_TAR_AFS = 02H
then STATE_PSTE_2_INTV =TORQUE_DECREASE
elseif ST_TORQ_TAR_AFS = 03H
then STATE_PSTE_2_INTV =INVALID_SIGNAL
endif

if ST_RQ_TORQ_AFS_ERR = 02H **or**
ST_RQ_TORQ_AFS_ERR = 04H
then LV_PSTE_2_ERR = 1
else LV_PSTE_2_ERR = 0
endif

ELSE *// checksum_torque_AFS:*

CKS_CAN_TQ_PSTE_2 = FFH

// alive_torque_AFS:

TCC_CAN_TQ_PSTE_2 = FH

// target value torque loss AFS :
TQ_LOSS_PSTE_2_SP_CAN = 8000H

// actual value torque loss AFS :
TQ_LOSS_PSTE_2_AV_CAN = 8000H

// state AFS-intervention:
STATE_PSTE_2_INTV =3H
LV_PSTE_2_ERR = 1
ENDIF

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4.60.4.4 CAS (car access system)

Formula section:

Part calculated with 10ms recurrence (at every engine state):

```
If        LV_STST_ST_REQ_CUS = 1
Then      T_INH_ACK_IGK_OFF = 0 s
Else      increment T_INH_ACK_IGK_OFF      (until max reached)
Endif
```

KLEMMENSTATUS:

```
IF        LV_ERR_BN_CAS = 0                AND
          LV_ERR_CAN_BOFF = 0
THEN      // status_klemme_R:
          if      ST_KL_R              = 01H
          then    LV_KEY_AUX           = 1
          else    LV_KEY_AUX           = 0
          endif

          // status klemme 15 :
          if      ST_KL_15             = 00b
          then    STATE_IGK_CAN        = IGK_OFF
          elseif  ST_KL_15             = 01b
          then    STATE_IGK_CAN        = IGK_ON
          else    STATE_IGK_CAN        = INVALID_SIGNAL
          endif

          //status positive engagement clutch:
             If      ST_STCD_PENG_MSA = 1
             Then    LV_CS_2 = 1
             Else    LV_CS_2 = 0
          Endif

          // status klemme 15 HW :
          If      ST_KL_15_HW = 3H
          Then    STATE_IGK_HW = 2
          Else    STATE_IGK_HW         = ST_KL_15_HW
          Endif

          If      STATE_IGK_HW 2->1
          Then    LV_REQ_ACK_IGK_OFF =1
          Else    If      STATE_IGK_HW != 1
                  Then    LV_REQ_ACK_IGK_OFF =0
                  Else // do nothing
                  Endif
          Endif

          // status if IGK-off request from CAS can be acknowledged:
          // hint:   LC_IGK_OFF_ACK active = 1
          If      LC_IGK_OFF_ACK             = 1          and
                  LV_REQ_ACK_IGK_OFF = 1             and
                  VS                         = 0 km/h     and
```


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LV_ERR_VS = 0 **and**
ECU_STATE = ENG_STOP **and**
LV_STST_ST_REQ_CUS = 0 **and**
LV_OBD_SCAN_REQ = 0 **and** //see NOTE below
T_INH_ACK_IGK_OFF >= C_T_MAX_INH_ACK_IGK_OFF
Then STATE_ACK_IGK_OFF= 1
Else STATE_ACK_IGK_OFF= 0
Endif

NOTE : Bit LV_OBD_SCAN_REQ is supplied via network layer. Purpose of this part is to make sure that Kl15 will be deactivated only by pressing START/STOP button once OBD scan tool has been connected to vehicle and one of the messages in table below was sent. Switching off KL15 by power managment is not possible in this state.

Requirements for LV_OBD_SCAN_REQ :
- is initialised with "0" at reset
- after disconnecting OBD scan tool Kl15 can be switched off by pressing START/STOP button.
- is set when OBD scan tool is connected to vehicle can and one of the messages listed in table has been sent successfully once.

CAN identifier (hex)	Description
7DF	CAN identifier for functionally addressed request messages sent by the external test equipment.
7E0	Physical request CAN identifier from the external test equipment to ECU #1
7E1	Physical request CAN identifier from the external test equipment to ECU #2
7E2	Physical request CAN identifier from the external test equipment to ECU #3
7E3	Physical request CAN identifier from the external test equipment to ECU #4
7E4	Physical request CAN identifier from the external test equipment to ECU #5
7E5	Physical request CAN identifier from the external test equipment to ECU #6
7E6	Physical request CAN identifier from the external test equipment to ECU #7
7E7	Physical request CAN identifier from the external test equipment to ECU #8

// status_klemme_50:
if ST_KL_50 = 01H
then LV_RLY_ST_CAN = 1
else LV_RLY_ST_CAN = 0
endif

// key number :
VEH_KEY_NR = NO_KEY

// checksum_klemme CAS :
CKS_CAN_CAS = CHKSM_KL

// alive_klemme CAS :
TCC_CAN_CAS = ALIV_KL

// status_key_valid:
LV_KEY_VLD_MSG_FAILED = 0
If(1) ST_KEY_VLD = 01H
Then(1) LV_KEY_VLD = 1

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```
        Else(1)     if(2)           ST_KEY_VLD          = 00H
                    Then(2)         LV_KEY_VLD          = 0
                    Else(2)         LV_KEY_VLD          = 0
                                     LV_KEY_VLD_MSG_FAILED = 1
                    Endif(2)
        Endif(1)

ELSE            // checksum_klemme CAS :
                CKS_CAN_CAS         =           FH
                // alive_klemme CAS :
                TCC_CAN_CAS         =           FH
                // status klemme 15 HW :
                STATE_IGK_HW            = 2H
                // status_key_valid:
                LV_KEY_VLD          = 0
                LV_KEY_VLD_MSG_FAILED = 1
                //status positive engagement clutch:
                LV_CS_2 = 0
               // status if IGK-off request from CAS can be acknowledged:
                STATE_ACK_IGK_OFF= 0
ENDIF
```

CODIERUNG_PM

current_short-circuit_maximum_vehicle:
CUR_SC_MAX_CAN = I_SC_MAX_VEH

current_short-circuit_minimum_vehicle:
CUR_SC_MIN_CAN = I_SC_MIN_VEH

quiescent-current_vehicle:
CUR_WKU_CAN = QC_VEH

class_battery:
IDX_BAT_CAN = CLAS_BT

Fahrzeugtyp

Class_power
STATE_POW_CLAS_VEH = CLAS_PWR
meesage Fahrzeugtyp is received :
LV_POW_CLAS_VEH_CAN_RCV = 1

STAT_ZV_KLAPPEN

```
IF                  LV_ERR_BN_CDN_DOOR = 0          AND
                  LV_ERR_CAN_BOFF = 0
THEN
        // status_door-switch_DRD
        If          ST_DSW_DRD = 00 h
        then            LV_DRIV_DOOR_OPEN = 0
        else            LV_DRIV_DOOR_OPEN = 1
```

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endif
// status_contact_bonnet
If ST_CT_BON = 00 h
then LV_HOOD_OPEN = 0
else LV_HOOD_OPEN = 1
endif
ELSE
LV_DRIV_DOOR_OPEN = 1
LV_HOOD_OPEN = 1
ENDIF

Response CAS (EWS):

Frame 1:
ID a see LH EWS
IMOB_RCV_RESP_CAN_x

CTR_IMOB_RESP_RCV_CAN = CTR_IMOB_RESP_RCV_CAN **or** 0x1

Frame 2:
ID b see LH EWS
IMOB_RCV_RESP_CAN_x

CTR_IMOB_RESP_RCV_CAN = CTR_IMOB_RESP_RCV_CAN **or** 0x2

4.60.4.5 SZM

FAHHRZEUGMODUS
IF LV_ERR_BN_VEH_MOD = 0 **AND**
LV_ERR_CAN_BOFF = 0
THEN *// mode_vehicle:*
STATE_VEH_MOD = MOD_VEH

// checksum_mode_vehicle:
CKS_CAN_VEH_MOD = CHKSM_MOD_VEH

// alive_mode_vehicle:
TCC_CAN_VEH_MOD = ALIV_MOD_VEH

// enable conditions for BN-Diag VEH_MOD :
IF CONF_SOF_SWI = 1
THEN LV_VAR_VEH_MOD = 1
ELSE LV_VAR_VEH_MOD = 0
ENDIF
ELSE *// mode_vehicle:*
STATE_VEH_MOD = 1

// checksum_mode_vehicle:
CKS_CAN_VEH_MOD = FFH

// alive_mode_vehicle:
TCC_CAN_VEH_MOD = FH

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```
ENDIF


CTR_CRASH_SWO_EKP
control_crash_switch-off_EKP:
IF              LV_ERR_BN_EFP_CRASH = 0          and
              LV_ERR_CAN_BOFF = 0
THEN        IF        CTR_CR_SWO_EKP = AH
              THEN          STATE_EFP_CRASH_CAN = 2H
              ELSE          STATE_EFP_CRASH_CAN = 0H
              ENDIF
ELSE        STATE_EFP_CRASH_CAN = FFH
ENDIF
```

4.60.4.6 DSC-Modul

Formula section:

```
DREHMOMENT_ANF_DSC
IF              LV_ERR_BN_TQ_TCS = 0                AND
              LV_ERR_CAN_BOFF = 0
THEN        // checksum_torque_DSC:
    CKS_CAN_TQ_TCS       =      CHKSM_TORQ_DSC

    // free running test cycle counter TCS :
    TCC_CAN_TQ_TCS       =      ALIV_TORQ_DSC

    // Torque_target _DSC:
    TQ_TCS_FAST_BN       =      TORQ_TAR_DSC

    // Torque_target_adjustment-range_posistive _DSC:
    IF        LV_TQ_MSR_REQ = 1        AND
            LC_MSR_BN = 1
    THEN     TQ_TCS_SLOW_BN = TQ_TCS_FAST_BN
    ELSE     TQ_TCS_SLOW_BN = TORQ_TAR_ADJR_POS_TCS
    ENDIF


// state TCS-intervention :
if          ST_TORQ_TAR_DSC           =           00b
then          STATE_TCS_INTV                 =       NO_INTERVENTION
elseif                  ST_TORQ_TAR_DSC          =        01b
              then          STATE_TCS_INTV                  =       MSR_INTERVENTION
                              LV_TQ_MSR_REQ = 1
              else          LV_TQ_MSR_REQ = 0
              endif
elseif                  ST_TORQ_TAR_DSC          =        10b
          then          STATE_TCS_INTV                 =       ASR_INTERVENTION
                              LV_TQ_ASR_REQ = 1
      else          LV_TQ_ASR_REQ = 0
      endif
elseif                  ST_TORQ_TAR_DSC          =        11b
```

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```
        then        STATE_TCS_INTV              =       INTERFACE_LOCKED
                            LV_TCS_LIH_CAN = 1
                else        LV_TCS_LIH_CAN = 0
                        endif
endif
ELSE        // checksum_torque_DSC:
            CKS_CAN_TQ_TCS          =       FFH

            // free running test cycle counter TCS :
            TCC_CAN_TQ_TCS          =       FH

            // Torque_target _DSC:
            TQ_TCS_FAST_BN          =       8000H

            // Torque_target_adjustment-range_posistive _DSC:
            TQ_TCS_SLOW_BN =        8000H

            // state TCS-intervention :
            STATE_TCS_INTV                  =       3H
            LV_TCS_LIH_CAN                  =       1
            LV_TQ_MSR_REQ                   =       0
            LV_TQ_ASR_REQ                   =       0

ENDIF

Geschwindigkeit:
IF                  LV_ERR_BN_VS_TCS = 0                AND
                LV_ERR_CAN_BOFF = 0
THEN        //speed_vehicle:
        VS_CAN              =   V_VEH           (converted from BN2000)
        WHEEL               =   V_VEH           (converted from BN2000)

        IF              V_VEH           =       FFFH
        THEN                LV_ERR_VS_CAN = 1
        ELSE                LV_ERR_VS_CAN = 0
        ENDIF

        // acceleration_vehicle_longitudinal_DSC:
        IF              ACLN_VEH_LN_DSC   =         800H        //Signal invalid
        THEN                AC_VEH_LGT_TCS              =       0 m/s**2
        ELSE                AC_VEH_LGT_TCS    =         ACLN_VEH_LN_DSC
                        (converted from BN2000)
        ENDIF


        // acceleration_vehicle_across_DSC:
        IF              ACLN_VEH_ACRO_DSC   =       800H        //Signal invalid
        THEN                AC_VEH_TRV_TCS              =       0 m/s**2
        ELSE                AC_VEH_TRV_TCS    =         ACLN_VEH_ACRO_DSC
                    (converted from BN2000)
        ENDIF
```

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```
ELSE      //speed_vehicle:
          VS_CAN    =    FFH
          WHEEL     =    FFFFH
          LV_ERR_VS_CAN = 1

          // acceleration_vehicle_longitudinal_DSC:
          AC_VEH_LGT_TCS    =    0 m/s**2

          // acceleration_vehicle_across_DSC:
          AC_VEH_TRV_TCS    =    0 m/s**2

ENDIF
```

Geschwindigkeit_Rad:
This message will not be read into internal variables and evaluated as for rough road detection the function of CAN11h will be used.

STAT_DSC:

```
IF        LV_ERR_BN_TCS = 0        AND
          LV_ERR_CAN_BOFF = 0
THEN      // status close-loop-control via CAN:
if        ST_CLCTR            = 0000 0000b
then      STATE_TCS_CTL       = NO_CONTROL
elseif    ST_CLCTR            = 0000 0001b
then      STATE_TCS_CTL       = ABS_CONTROL
elseif    ST_CLCTR            = 0000 0010b
then      STATE_TCS_CTL       = ASR_CONTROL
elseif    ST_CLCTR            = 0000 0100b
then      STATE_TCS_CTL       = TCS_CONTROL
elseif    ST_CLCTR            = 0000 1000b
then      STATE_TCS_CTL       = HBA_CONTROL
elseif    ST_CLCTR            = 0001 0000b
then      STATE_TCS_CTL       = MSR_CONTROL
elseif    ST_CLCTR            = 0010 0000b
then      STATE_TCS_CTL       = EBV_CONTROL
elseif    ST_CLCTR            = 0100 0000b
then      STATE_TCS_CTL       = DYNO_ACTIVE
elseif    ST_CLCTR            = 1111 1111b
then      STATE_TCS_CTL       = SIGNAL_INVALID
else      STATE_TCS_CTL       = MULTI_CONTROL
endif

IF        ST_CLCTR != 1111 1111b          AND
          (ST_CLCTR[Bit 0] = 1     OR     //ABS_CONTROL
           ST_CLCTR[Bit 1] = 1     OR     //ASR_CONTROL
           ST_CLCTR[Bit 4] = 1)           //MSR_CONTROL
THEN      LV_PLAUS_ASR_CTL = 1
ELSE      LV_PLAUS_ASR_CTL = 0
ENDIF

IF        ST_CLCTR != 1111 1111b          AND
```

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```
            ST_CLCTR[Bit 2] = 1                  // DSC/TCS_CONTROL
THEN         LV_PLAUS_ESP_CTL = 1
ELSE         LV_PLAUS_ESP_CTL = 0
ENDIF

// chassis control function active:
IF                  ST_CLCTR != 1111 1111b          AND
             (ST_CLCTR[Bit 0] = 1      OR           //ABS_CONTROL
                 ST_CLCTR[Bit 1] = 1     OR              //ASR_CONTROL
                 ST_CLCTR[Bit 2] = 1     OR              //DSC_CONTROL
                 ST_CLCTR[Bit 3] = 1)               //HBA_CONTROL
THEN         LV_TCS_CTL_ACT = 1
ELSE         LV_TCS_CTL_ACT = 0
ENDIF

// status traction control system via CAN :
if        ST_DSC                   =       000b
then         STATE_TCS_CAN          =          VALID
elseif        ST_DSC                =       001b
then         STATE_TCS_CAN          =          PASSIV
elseif        ST_DSC                =       010b
then         STATE_TCS_CAN          =          DEFECTIVE
elseif        ST_DSC                =       100b
then         STATE_TCS_CAN          =          TRACTION_MODE
elseif        ST_DSC                =       110 b
then         STATE_TCS_CAN          =          UNDERVOLTAGE_TCS
elseif        ST_DSC                =       111b
then         STATE_TCS_CAN          =          INVALID_SIGNAL
endif


// ST_DSC - status deceleration actual-value:
if        ST_DCRN_AVL          =            0H
then         STATE_TCS_DECE          =          NO_INTERVENTION
elseif        ST_DCRN_AVL         =            1H
then         STATE_TCS_DECE          =          DCC_INTV_ACCEPTED
elseif        ST_DCRN_AVL         =            2H
then         STATE_TCS_DECE          =          EMF_INTV_ACCEPTED
elseif        ST_DCRN_AVL         =            3H
then         STATE_TCS_DECE          =          HBA_INTV_ACCEPTED
elseif        ST_DCRN_AVL         =            FH
then         STATE_TCS_DECE          =          SIGNAL_INVALID
endif

// status brake-pressure:
STATE_BRAKE_PRS            =            ST_BRP

// brake-pressure:
BRAKE_PRS                  =            BRP
ELSE
  // status close-loop-control via CAN:
      STATE_TCS_CTL       = 0H
```

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LV_PLAUS_ASR_CTL = 0
LV_PLAUS_ESP_CTL = 0

//status chassis control functions
LV_TCS_CTL_ACT = 0

// status traction control system via CAN :
STATE_TCS_CAN = 7H

// ST_DSC - status deceleration actual-value:
STATE_TCS_DECE = 0H

// status brake-pressure:
STATE_BRAKE_PRS = 2H

// brake-pressure:
BRAKE_PRS = FFH

ENDIF

4.60.4.7 EGS-Modul

Formula section:

DREHMOMENT_ANF_EGS
IF(1) LV_ERR_BN_TQ_ETCU = 0 **AND**
LV_ERR_CAN_BOFF = 0
THEN(1) *// Checksum ETCU:*
CKS_CAN_TQ_ETCU = CHKSM_TORQ_EGS
// Alive-Counter ETCU:
TCC_CAN_TQ_ETCU = ALIV_TORQ_EGS
// Torque_target _EGS:
TQ_GS_FAST_BN = TORQ_TAR_EGS
// Torque_target_adjustment-range_posistive _EGS:
TQ_GS_SLOW_BN = TORQ_TAR_ADJR_POS_EGS
// state ETCU-intervention :
if ST_TORQ_TAR_EGS = 00H
then STATE_ETCU_INTV = NO_INTERVENTION
elseif ST_TORQ_TAR_EGS = 01H
then STATE_ETCU_INTV = TORQUE_INCREASE
LV_TQ_GS_INC_REQ = 1
else LV_TQ_GS_INC_REQ = 0
endif
elseif ST_TORQ_TAR_EGS = 02H
then STATE_ETCU_INTV = TORQUE_DECREASE
LV_TQ_GS_DEC_REQ = 1
else LV_TQ_GS_DEC_REQ = 0
endif
elseif ST_TORQ_TAR_EGS = 03H
then STATE_ETCU_INTV = INTERFACE_LOCKED

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```
                    LV_ETCU_LIH_CAN = 1
            else        LV_ETCU_LIH_CAN = 0
            endif
endif

// status_OBD_gearbox ST_OBD_GRB:
IF          ST_OBD_GRB          =   00H
THEN        STATE_ETCU_OBD      =   MIL_OFF
ELSEIF      ST_OBD_GRB          =   02H
THEN        STATE_ETCU_OBD      =   MIL_OFF
ELSEIF      ST_OBD_GRB          =   04H
THEN        STATE_ETCU_OBD      =   MIL_ON
ELSEIF      ST_OBD_GRB          =   06H
THEN        STATE_ETCU_OBD      =   MIL_ON
ELSEIF      ST_OBD_GRB          =   08H
THEN        STATE_ETCU_OBD      =   MIL_FLL
ELSEIF      ST_OBD_GRB          =   0AH
THEN        STATE_ETCU_OBD      =   MIL_FLL
ELSEIF      ST_OBD_GRB          =   0CH
THEN        STATE_ETCU_OBD      =   IDLE
ELSEIF      ST_OBD_GRB          =   0EH
THEN        STATE_ETCU_OBD      =   INI_VALUE
ELSEIF      ST_OBD_GRB          =   0FH
THEN        STATE_ETCU_OBD      =   INVALID_SIGNAL
ENDIF

// status_OBD_error_gearbox:
IF          ST_OBD_ERR_GRB      =   00H
THEN        STATE_ETCU_OBD_ERR  =   NO_OBD_ERROR
ELSEIF      ST_OBD_ERR_GRB      =   01H
THEN        STATE_ETCU_OBD_ERR  =   OBD_ERROR
ELSEIF      ST_OBD_ERR_GRB      =   02H
THEN        STATE_ETCU_OBD_ERR  =   INVALID_SIGNAL
ENDIF

// Status starting torque limitation:
IF          ST_LIM_STORQ        = 00H
THEN        STATE_ST_TQ_LIM_GS  = NO_INTERVENTION
ELSEIF      ST_LIM_STORQ        = 01H
THEN        STATE_ST_TQ_LIM_GS  = INTERVENTION
ELSEIF      STATE_ST_TQ_LIM_GS  = INVALID_SIGNAL
ENDIF

// Torque_draw gearbox:
if          TORQ_DRAW_GRB       = FFH
then        TQ_CONV_CAN         = 0 Nm
else        TQ_CONV_CAN         = TORQ_DRAW_GRB
endif

// Temperature gearbox:
IF          LV_AT = 1
THEN        IF      TEMP_GRB    = FFH
```

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```
                THEN        TEMP_GB         = C_TEMP_GB_SUB
                ELSE        TEMP_GB         = TEMP_GRB
                ENDIF
ELSE        TEMP_GB         = -40 °C
ENDIF
```

// Status_overtemperature_gearbox:

```
IF                  LV_AT = 1
THEN        IF              ST_OTMP_GRB         = 00b
                THEN            STATE_TEMP_GB           = NO_REQUEST
                ELSEIF      ST_OTMP_GRB         = 01b
                THEN            STATE_TEMP_GB           = ACTIVE_STEP_1
                ELSEIF      ST_OTMP_GRB         = 10b
                THEN            STATE_TEMP_GB           = ACTIVE_STEP_2
                ELSEIF      ST_OTMP_GRB         = 11b
                THEN            STATE_TEMP_GB           = INVALID_SIGNAL
                ENDIF
ELSE                STATE_TEMP_GB = NO_REQUEST
ENDIF
```

ELSE(1) *// Checksum ETCU:*
CKS_CAN_TQ_ETCU = FFH

// Alive-Counter ETCU:
TCC_CAN_TQ_ETCU = FH

// Torque_target _EGS:
TQ_GS_FAST_BN = 8000H

// Torque_target_adjustment-range_posistive _EGS:
TQ_GS_SLOW_BN = 8000H

// state ETCU-intervention :
STATE_ETCU_INTV = 3H
LV_ETCU_LIH_CAN = 1
LV_TQ_GS_INC_REQ = 0
LV_TQ_GS_DEC_REQ = 0

// status_OBD_gearbox ST_OBD_GRB:
STATE_ETCU_OBD = EH

// status_OBD_error_gearbox:
STATE_ETCU_OBD_ERR = 3H

// Status starting torque limitation:
STATE_ST_TQ_LIM_GS = INVALID_SIGNAL (3H)

// Torque_draw gearbox:
TQ_CONV_CAN = 0 Nm

// Temperature gearbox:
TEMP_GB = 0H

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// Status_overtemperature_gearbox:
STATE_TEMP_GB = 0H

ENDIF(1)

4.60.4.8 SSG-Modul

Formula section:

DREHMOMENT_ANF_SSG
IF LV_ERR_BN_TQ_AMT = 0 **AND**
LV_ERR_CAN_BOFF = 0
THEN *// Checksum TQ_AMT:*
CKS_CAN_TQ_AMT = CHKSM_TORQ_SSG

// Alive-Counter TQ_AMT:
TCC_CAN_TQ_AMT = ALIV_TORQ_SSG

// Torque_target _SSG:
TQ_AMT_FAST_BN = TORQ_TAR_SSG

// Torque_target_adjustment-range_positive:
TQ_AMT_SLOW_BN = TORQ_TAR_ADJR_POS_SSG

// state ETCU-intervention STATE_AMT_INTV:
if ST_TORQ_TAR_SSG = 00H
then STATE_AMT_INTV =NO_INTERVENTION
elseif ST_TORQ_TAR_SSG = 01H
then STATE_AMT_INTV =TORQUE_INCREASE
LV_TQ_AMT_INC_REQ = 1
else LV_TQ_AMT_INC_REQ = 0
endif
elseif ST_TORQ_TAR_SSG = 02H
then STATE_AMT_INTV =TORQUE_DECREASE
LV_TQ_AMT_DEC_REQ = 1
else LV_TQ_AMT_DEC_REQ = 0
endif
elseif ST_TORQ_TAR_SSG = 03H
then STATE_AMT_INTV =INTERFACE_LOCKED
LV_AMT_LIH_CAN = 1
else LV_AMT_LIH_CAN = 0
endif
endif

// status_OBD_gearbox ST_OBD_GRB_SSG:
IF ST_OBD_GRB_SSG = 00H
THEN STATE_AMT_OBD = MIL_OFF
ELSEIF ST_OBD_GRB_SSG = 02H
THEN STATE_AMT_OBD = MIL_OFF
ELSEIF ST_OBD_GRB_SSG = 04H
THEN STATE_AMT_OBD = MIL_ON

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```
ELSEIF    ST_OBD_GRB_SSG          =    06H
THEN           STATE_AMT_OBD           =    MIL_ON
ELSEIF    ST_OBD_GRB_SSG          =    08H
THEN           STATE_AMT_OBD           =    MIL_FLL
ELSEIF    ST_OBD_GRB_SSG          =    0AH
THEN           STATE_AMT_OBD           =    MIL_FLL
ELSEIF    ST_OBD_GRB_SSG          =    0CH
THEN           STATE_AMT_OBD           =    IDLE
ELSEIF    ST_OBD_GRB_SSG          =    0EH
THEN           STATE_AMT_OBD           =    INI_VALUE
ELSEIF    ST_OBD_GRB_SSG          =    0FH
THEN           STATE_AMT_OBD           =    INVALID_SIGNAL
ENDIF

// status_OBD_error_gearbox ST_OBD_ERR_GRB_SSG:
IF             ST_OBD_ERR_GRB_SSG          = 00H
THEN           STATE_AMT_OBD_ERR           = NO_OBD_ERROR
ELSEIF    ST_OBD_ERR_GRB_SSG          = 01H
THEN           STATE_AMT_OBD_ERR           = OBD_ERROR
ELSE           STATE_AMT_OBD_ERR           = INVALID_SIGNAL
ENDIF

// Status starting torque limitation:
IF             ST_LIM_STORQ_SSG          = 00H
THEN           STATE_ST_TQ_LIM_AMT           = NO_INTERVENTION
ELSEIF    ST_LIM_STORQ_SSG          = 01H
THEN           STATE_ST_TQ_LIM_AMT           = INTERVENTION
ELSE           STATE_ST_TQ_LIM_AMT           = INVALID_SIGNAL
ENDIF

// Status shift-process SSG:
IF             ST_SHPS_SSG          = 00H
THEN           STATE_AMT           = NO_INTERVENTION
ELSEIF    ST_SHPS_SSG          = 01H
THEN           STATE_AMT           = TORQUE_DECREASE
ELSEIF    ST_SHPS_SSG          = 02H
THEN           STATE_AMT           = N_REGULATION
ELSEIF    ST_SHPS_SSG          = 03H
THEN           STATE_AMT           = TORQUE_INCREASE
ELSEIF    ST_SHPS_SSG          = 07H
THEN           STATE_AMT           = INVALID_SIGNAL
ENDIF

// Status clutch SSG:
IF             ST_CLT_SSG          = 00H
THEN           STATE_CLU_AMT           = CLU_OPEN
ELSEIF    ST_CLT_SSG          = 01H
THEN           STATE_CLU_AMT           = CREEPING
ELSEIF    ST_CLT_SSG          = 02H
THEN           STATE_CLU_AMT           = DRIVE_OFF
ELSEIF    ST_CLT_SSG          = 03H
THEN           STATE_CLU_AMT           = CLU_CLOSED
```

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ELSEIF ST_CLT_SSG = 07H
THEN STATE_CLU_AMT = INVALID_SIGNAL
ENDIF

// Request engine-stop:
IF RQ_MOTORSTOP = 01H
THEN LV_AMT_ES = 1
ELSE LV_AMT_ES = 0
ENDIF

// Limit_RPM_engine:
N_MAX_AMT_CAN = LIM_RPM_ENG
(converted from BN2000)

// Status gear-shift SSG:
IF ST_GRLV_ACV = 01H
THEN LV_GS = 1
ELSE LV_GS = 0
ENDIF
ELSE *// Checksum TQ_AMT:*
CKS_CAN_TQ_AMT = FFH

// Alive-Counter TQ_AMT:
TCC_CAN_TQ_AMT = FH

// Torque_target _SSG:
TQ_AMT_FAST_BN = 8000H

// Torque_target_adjustment-range_positive:
TQ_AMT_SLOW_BN = 8000H

// state ETCU-intervention STATE_AMT_INTV:
STATE_AMT_INTV =3H
LV_AMT_LIH_CAN = 1
LV_TQ_AMT_INC_REQ = 0
LV_TQ_AMT_DEC_REQ = 0

// status_OBD_gearbox ST_OBD_GRB_SSG:
STATE_AMT_OBD = EH

// status_OBD_error_gearbox ST_OBD_ERR_GRB_SSG:
STATE_AMT_OBD_ERR = INVALID_SIGNAL (2)

// Status starting torque limitation:
STATE_ST_TQ_LIM_AMT = INVALID_SIGNAL (3H)

// Status shift-process SSG:
STATE_AMT = 0

// Status clutch SSG:
STATE_CLU_AMT = 0

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// Request engine-stop:
LV_AMT_ES = 0

// Limit_RPM_engine:
N_MAX_AMT_CAN = 0H

// Status gear-shift SSG:
LV_GS = 0
ENDIF

4.60.4.9 DKG-Modul (TCT)

DREHMOMENT_ANF_DKG (ID = B8h)

Application conditions

Initialisation: *all 0*

Recurrence: *message received with recurrence 10ms (tmin = 9ms, tmax = 11ms)*

Activation: *LV_VAR_TCT = 1*

Formula section:

IF(1) LV_ERR_BN_TQ_TCT = 0 **AND**
LV_ERR_CAN_BOFF = 0
THEN(1)
// Checksum TCT:
CKS_CAN_TQ_TCT = CHKSM_TORQ_DKG
// Alive-Counter TCT:
TCC_CAN_TQ_TCT = ALIV_TORQ_DKG
// Torque_target _TCT:
TQ_GS_FAST_BN = TORQ_TAR_DKG (converted)
// Torque_target_adjustment-range_posistive _TCT:
TQ_GS_SLOW_BN = TORQ_TAR_ADJR_POS_DKG (converted)

// state TCT-mode :
LV_TQ_GS_INC_REQ = 0
LV_TQ_GS_DEC_REQ = 0
LV_TCT_LIH_CAN = 0
LV_TCT_ES = 0
LV_N_SP_TCT_REQ = 0
if ST_MOD_DKG = 00H
then STATE_TCT_INTV = NO_INTERVENTION
elseif ST_MOD_DKG = 02H
then STATE_TCT_INTV = CREEP
elseif ST_MOD_DKG = 03H
then STATE_TCT_INTV = TCT_INTV_DEC
LV_TQ_GS_DEC_REQ = 1
elseif ST_MOD_DKG = 04H
then STATE_TCT_INTV = TCT_INTV_INC
LV_TQ_GS_INC_REQ = 1

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```
elseif    ST_MOD_DKG          =    06H
then      STATE_TCT_INTV        =    N_REGULATION
          LV_N_SP_TCT_REQ = 1
elseif    ST_MOD_DKG          =    0CH
then      STATE_TCT_INTV        =    TQ_DEC
elseif    ST_MOD_DKG          =    0DH
then      STATE_TCT_INTV        =    TCT_ES
          LV_TCT_ES      = 1
elseif    ST_MOD_DKG          =    0FH
then      STATE_TCT_INTV        =    INVALID
          LV_TCT_LIH_CAN = 1
endif

// torque_clutch_DKG:
IF        TORQ_CLT_DKG      = FFFH
THEN      TQ_TCT_CAN = 0 Nm
ELSE      TQ_TCT_CAN = MAX (0 Nm; TORQ_CLT_DKG)    (converted)
ENDIF

//RPM_target_engine_DKG:
If        RPM_TAR_ENG_DKG != FFFH
Then      N_SP_TCT = RPM_TAR_ENG_DKG   (converted)

          LV_N_SP_TCT = LV_N_SP_TCT_REQ
Else      N_SP_TCT = 0
          LV_N_SP_TCT = 0
Endif

// status_OBD_gearbox ST_OBD_GRB:
STATE_ETCU_OBD        =        EH

// status_OBD_error_gearbox:
STATE_ETCU_OBD_ERR        =        3H

// Status starting torque limitation:
STATE_ST_TQ_LIM_GS        =  INVALID_SIGNAL  (3H)

// Torque_draw gearbox:
TQ_CONV_CAN        = 0 Nm

ELSE(1)
// Checksum ETCU:
CKS_CAN_TQ_TCT        =        FFH

// Alive-Counter ETCU:
TCC_CAN_TQ_TCT        =        FH

// Torque_target _EGS:
TQ_GS_FAST_BN        =        8000H

// Torque_target_adjustment-range_posistive _EGS:
TQ_GS_SLOW_BN        =        8000H
```

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```
// state ETCU-intervention :
STATE_TCT_INTV          =       FH
LV_TCT_LIH_CAN          =       1
LV_TQ_GS_INC_REQ        =       0
LV_TQ_GS_DEC_REQ        =       0
LV_TCT_ES               =       0
LV_N_SP_TCT_REQ         =       0

// torque_clutch_DKG:
TQ_TCT_CAN       =       0H

//RPM_target_engine_DKG:
N_SP_TCT = 0H
LV_N_SP_TCT = 0

// status_OBD_gearbox ST_OBD_GRB:
STATE_ETCU_OBD          =       EH

// status_OBD_error_gearbox:
STATE_ETCU_OBD_ERR      =       3H

// Status starting torque limitation:
STATE_ST_TQ_LIM_GS      =  INVALID_SIGNAL  (3H)

// Torque_draw gearbox:
TQ_CONV_CAN             = 0 Nm
ENDIF (1)
```

ST_DKG (Status DKG)   (ID =37D h)

Application conditions

Initialisation: *at reset TEMP_GB = -40 °C, STATE_TEMP_GB = NO_REQUEST*

Recurrence: *1 s (tmin=0.9s, tmax=1.1s)*

Activation: *LV_VAR_TCT = 1*

Formula section:

```
:
IF          LV_ERR_CAN_BOFF = 0 AND
            LV_ERR_BN_STAT_TCT = 0
THEN
            // Temperature gearbox:
            IF        TEMP_DKG = FFH
            THEN        TEMP_GB         = C_TEMP_GB_SUB
      ELSE    TEMP_GB      = TEMP_DKG
      ENDIF

            // Status_overtemperature_gearbox:
            IF        ST_OTMP_DKG           = 00b
```

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```
        THEN    STATE_TEMP_GB    = NO_REQUEST
        Elseif  ST_OTMP_DKG      = 01b
        THEN    STATE_TEMP_GB    = ACTIVE_STEP_1
        Elseif  ST_OTMP_DKG      = 10b
        THEN    STATE_TEMP_GB    = ACTIVE_STEP_2
        Elseif  ST_OTMP_DKG      = 11b
        THEN    STATE_TEMP_GB    = INVALID_SIGNAL
    ENDIF

ELSE    setting default values:
        TEMP_GB          = -40 °C
        STATE_TEMP_GB    = NO_REQUEST
ENDIF
```

4.60.4.10 Transmission Data (from EGS, SSG or DKG)

GETRIEBEDATEN (ID = BAh)

Application conditions

Initialisation: *all 0*

Recurrence: *message received with recurrence 20ms (tmin = 19ms, tmax = 21ms)*

Activation: *LV_VAR_ETCU = 1*

Formula section:

```
IF      LV_ERR_BN_ETCU = 0          AND
        LV_ERR_CAN_BOFF = 0
THEN    // checksum ETCU :
        CKS_CAN_ETCU = CHKSM_GRB
        // Alive counter ETCU:
        TCC_CAN_ETCU = ALIV_GRB

        // target gear information from ETCU :
        if          ST_GR_GRB    = 0000b   (reserve)
              or    ST_GR_GRB    = 0001b   (Neutral)
              or    ST_GR_GRB    = 0011b   (Park)
              or    ST_GR_GRB    = 1111b   (invalid signal)
        then    GEAR_INFO    = 00H
        elseif  ST_GR_GRB    = 0101b   (1.gear)
        then    GEAR_INFO    = 01H
        elseif  ST_GR_GRB    = 0110b   (2.gear)
        then    GEAR_INFO    = 02H
        elseif  ST_GR_GRB    = 0111b   (3.gear)
        then    GEAR_INFO    = 03H
        elseif  ST_GR_GRB    = 1000b   (4.gear)
        then    GEAR_INFO    = 04H
        elseif  ST_GR_GRB    = 1001b   (5.gear)
        then    GEAR_INFO    = 05H
```

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```
elseif    ST_GR_GRB       = 1010b     (6.gear)
then      GEAR_INFO       = 06H
elseif    ST_GR_GRB       = 1011b     (7.gear)
then      GEAR_INFO       = 07H
elseif    ST_GR_GRB       = 0010b     (reverse gear)
then      GEAR_INFO       = 0AH
endif

      //gearbox-drive-train_reinforcement:
If        GRDT_REIN       <       FFEH
Then      FAC_GB_GAIN         = GRDT_REIN
Else      FAC_GB_GAIN         = 00H
Endif

      //data sent only by EGS (LV_AT):
      IF        LV_AT = 1
      THEN
                // Status_torque-converter-lockup-clutch:
        IF                ST_CCLT         = 0H
        THEN                  STATE_CC        = CC open
        ELSEIF        ST_CCLT         = 1H
        THEN                  STATE_CC        = CC controlled
        ELSEIF        ST_CCLT         = 02H
        THEN                  STATE_CC        = CC closed
        ELSEIF        ST_CCLT         = 03H
        THEN                  STATE_CC        = Signal invalid
        ENDIF

         // Status_mode_gearbox:
        IF                ST_MOD_GRB          = 00H
        THEN                  STATE_MOD_GB        = SSC_SBC_OFF
        ELSEIF        ST_MOD_GRB          = 01H
        THEN                  STATE_MOD_GB        = SSC_ON
        ELSEIF        ST_MOD_GRB          = 02H
        THEN                  STATE_MOD_GB        = SBC_ON
        ELSEIF        ST_MOD_GRB          = 03H
        THEN                  STATE_MOD_GB        = SSC_SBC_ON
        ELSEIF        ST_MOD_GRB          = 07H
        THEN                  STATE_MOD_GB        = INVALID SIGNAL
        ENDIF
      ENDIF

      //data sent only by SSG (LV_VAR_AMT):
      IF        LV_VAR_AMT = 1
      THEN
        // Status_hydraulic-pump_active ST_HYPP_ACV:
        IF                ST_HYPP_ACV         = 1
        THEN                  LV_PUMP_AMT_ON = 1
        ELSE                  LV_PUMP_AMT_ON = 0
        ENDIF
      ENDIF
```

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```
        //data received from DKG or EGS (LV_VAR_TCT or LV_AT):
            IF          LV_VAR_TCT = 1 or  LV_AT = 1
            THEN
                    // Status gear-shift:
                IF              ST_GRLV_ACV = 01H
                THEN                LV_GS = 1
                ELSE                LV_GS = 0
                ENDIF
            ENDIF

        //data sent only by DKG (LV_VAR_TCT):
            IF          LV_VAR_TCT = 1
            THEN
                // status race start:
                STATE_MAX_AC_ST = ST_RSTA
            ENDIF

ELSE
         // target gear information from ETCU :
        GEAR_INFO           = 00H

            //gearbox-drive-train_reinforcement:
        FAC_GB_GAIN          = 00H

        // Status_torque-converter-lockup-clutch:
        STATE_CC            = 3H

        // Status_mode_gearbox:
        STATE_MOD_GB            = 07H

        // Status_hydraulic-pump_active ST_HYPP_ACV:
        LV_PUMP_AMT_ON = 0

         IF         LV_VAR_TCT = 1   or   LV_AT = 1
            THEN
                // Status gear-shift EGS:
                LV_GS = 0
        ENDIF

         IF         LV_VAR_TCT = 1
            THEN
                // Status race start:
                STATE_MAX_AC_ST = 11b
        ENDIF

         // checksum ETCU :
            CKS_CAN_ETCU = FFH
            // Alive counter ETCU:
        TCC_CAN_ETCU = FH

ENDIF
```

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GETRIEBEDATEN 2 (ID = 1A2h)

Application conditions

Initialisation: *all 0*

Recurrence: *message received with recurrence 20ms (tmin = 19ms, tmax = 21ms)*

Activation: *LV_VAR_TCT = 1* ***or*** *LV_AT = 1*

Formula section:

```
If      LV_ERR_CAN_BOFF = 0 and
        LV_ERR_BN_ETCU_2 = 0
Then    //RPM_gearbox_turbine:
        N_GB = RPM_GRB_TURB

        //data sent only by DKG (LV_VAR_TCT):
        IF      LV_VAR_TCT = 1
            THEN
                // request_boost_RPM_idling:
                if      RQ_BST_RPM_IDLG     ! =     FFH
                Then    N_SP_IS_TCT_CAN     =       RQ_BST_RPM_IDLG
                Else    N_SP_IS_TCT_CAN     =       0
                Endif
                // Status_starting_clutch:
                STATE_ETCU_CLU = ST_STCLT
            ENDIF

            //status if forced-shift up is active in actual gear shift mode:
            IF      ST_RCOG_FSHUP = 0
            THEN    LV_INH_GP_SUP = 0
            ELSE    LV_INH_GP_SUP = 1
            ENDIF

            //RPM_at_gearbox_output /drivetrain turbine:
            N_GB_OUT = RPM_GRB_NEGL_2          (converted)

        //request dynamisation of engine-rpm signal for display (kombi) :
            IF      RQ_GRB_DYNS_DISP_RPM_ENG = 01b
            THEN    LV_N_DISP_DYN = 1
            ELSE    LV_N_DISP_DYN = 0
            ENDIF

            //status of gearbox sport switch:
            STATE_ETCU_SPT_SWI = ST_GRB_SSW

Else
        // request_boost_RPM_idling:
        N_SP_IS_TCT_CAN = 0H

        //RPM_gearbox_turbine:
```

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N_GB = 0
// Status_starting_clutch:
STATE_ETCU_CLU = 0
//status if forced-shift up is active in actual gear shift mode:
LV_INH_GP_SUP = 1
//RPM_at_gearbox_output /drivetrain turbine:
N_GB_OUT = 0 rpm
//request dynamisation of engine-rpm signal for display (kombi) :
LV_N_DISP_DYN = 0
//status of gearbox sport switch:
STATE_ETCU_SPT_SWI = 3H
ENDIF

GETRIEBEDATEN 3 (ID = 3B1h):

Application conditions

Initialisation: all 0
except: VS_MAX_LIH_TCT = 7FFFH

Recurrence: *message received with recurrence 100ms (tmin = 90ms, tmax = 110ms) and event triggered (tmin=50ms)*

Activation: *LV_VAR_ETCU_3 = 1*

Formula section:

If LV_ERR_CAN_BOFF = 1 **or**
LV_ERR_BN_ETCU_3 = 1
Then TCC_CAN_ETCU_3 = FH
CKS_CAN_ETCU_3 = FFH
ipm_typ_fp = 0
ipm_typ_mdkw = 0
dm_ab_fws = -32768 Nm
//data sent only by DKG (LV_VAR_TCT):
IF LV_VAR_TCT = 1
THEN
LV_MIL_REQ_ETCU = 0
VS_MAX_LIH_TCT = 7FFFH
ENDIF
Else *// Checksum ETCU:*
CKS_CAN_ETCU_3 = CHKSM_GRB_3
// Alive-Counter ETCU:
TCC_CAN_ETCU_3 = ALIV_GRB_3
if IDX_ACPD > 5H *// not defined and invalid case*
then ipm_typ_fp = 0
else ipm_typ_fp = IDX_ACPD
endif
if IDX_TORQ_FIL > 5H *// not defined and invalid case*
then ipm_typ_mdkw = 0
else ipm_typ_mdkw = IDX_TORQ_FIL
endif
if TORQ_DVCH_RISE = FFFH *// invalid case*

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```
then        dm_ab_fws         =  -32768 Nm
    else        dm_ab_fws         =  TORQ_DVCH_RISE (converted from BN)
    endif
//data sent only by DKG (LV_VAR_TCT):
IF          LV_VAR_TCT = 1
    THEN
        // bit requesting Mil illumination by transmission control unit:
        if          RQ_MIL_GRB = 1H
            then        LV_MIL_REQ_ETCU = 0
            else        If          RQ_MIL_GRB = 2H
                then        LV_MIL_REQ_ETCU = 1
                endif
            endif
        //limitation maximum speed gearbox limp home:
        if          LIM_MAX_V_GRB_EMMOD = 3FH    // invalid case
        then        VS_MAX_LIH_TCT   = 7FFFH
        else        VS_MAX_LIH_TCT   =  LIM_MAX_V_GRB_EMMOD (converted from
        BN)
            endif
    ENDIF
Endif
```

ANZEIGE GETRIEBEDATEN (ID = 1D2h):

Application conditions

Initialisation: *all 0*

Recurrence: *message received with recurrence 200ms (tmin = 90ms, tmax = 110ms) and event triggered (tmin=50ms)*

Activation: *LV_AT = 1* ***or*** *LV_VAR_TCT*

Formula section:

```
If              LV_ERR_CAN_BOFF         =       1       or
                LV_ERR_BN_ETCU_DISP          = 1
Then        STATE_ETCU_PROG_INFO            = FH
                LV_ETCU_SPT_SWI = 0
Else        STATE_ETCU_PROG_INFO            = CTR_DISP_PRG_GRB
                //control display sport mode gearbox:
            IF          CTR_DISP_SPMOD_GRB = 1H
                Then        LV_ETCU_SPT_SWI = 1
                Else        LV_ETCU_SPT_SWI = 0
                Endif

Endif
```

4.60.4.11 IHKA

Formula section:

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WAERMESTROM_KLIMA

```
IF          LV_ERR_BN_ACC = 0          AND
            LV_ERR_CAN_BOFF = 0
THEN        // torque target air-conditioning-compressor:

  if        TORQ_TAR_ACCM        <        C_TQ_ACCIN
  then        TQ_ACCIN _CAN      =        0
  else        TQ_ACCIN_CAN       =        TORQ_TAR_ACCM
  endif

  // logical variable ACC request LV_ACCIN :
  if        STATE_ACIN_CAN       >        0
  then        LV_ACCIN = 1
  else        LV_ACCIN = 0
  endif

  // control electric-fan air-conditioning:
  if        CTR_EFAN_AIC         =        ! 0FH
  then        N_ECF        =        CTR_EFAN_AIC
  else        N_ECF        =        0
  endif

  // control_air-conditioning_special-function /control_cooling-map-system:
  IF        CTR_AIC_SPFN         = 01H
  THEN        LV_REQ_HEAT        = 1
  ELSE        LV_REQ_HEAT        = 0
  ENDIF

  IF        CTR_AIC_SPFN         = 02H                OR
              CTR_CLMP               = 01H
  THEN        LV_REQ_TCO_L       = 1
  ELSE        LV_REQ_TCO_L       = 0
  ENDIF

  // control air-conditioning readiness:
  STATE_ACIN_CAN        =        CTR_AIC_RDI
  IF                  STATE_ACIN_CAN = 0
     THEN     LV_ACIN = 0
  ELSEIF          STATE_ACIN_CAN = 2H             OR
              STATE_ACIN_CAN = 4H
  THEN        LV_ACIN = 1
  ELSEIF          STATE_ACIN_CAN = 1H             AND
                      LV_IS = 1
  THEN          IF        LV_ACIN = 0
                THEN        LV_ACIN = 0
                ELSE        LV_ACIN = 1 until LV_IS <> 1
              ENDIF
  ELSEIF          STATE_ACIN_CAN = 7H
  THEN        freeze   value of LV_ACIN (until STATE_ACIN <> 7H)
  ENDIF

  //heat-flow_request_air-conditioning:
```

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if HTFL_RQ_AIC = FFh
then HEAT_REQ_PERC = 0
else HEAT_REQ_PERC = HTFL_RQ_AIC
endif

//state_power_special-consumer:
if ST_PWR_SPCOS = FFH
then STATE_EXT_POW_CNS = 0
else STATE_EXT_POW_CNS = ST_PWR_SPCOS
endif

// control_fan_flap:
LV_ECRAS_CTL_CAN_1 = Bit 0 of CTR_FAN_FLAP
LV_ECRAS_CTL_CAN_2 = Bit 1 of CTR_FAN_FLAP

ELSE *// torque target air-conditioning-compressor:*
TQ_ACCIN _CAN = 0H
LV_ACCIN = 0

// control electric-fan air-conditioning:
N_ECF = 0

// control_air-conditioning_special-function /control_cooling-map-system:
LV_REQ_HEAT = 0
LV_REQ_TCO_L = 0

// control air-conditioning readiness:
STATE_ACIN_CAN = 7H
LV_ACIN = 0

//heat-flow_request_air-conditioning:
HEAT_REQ_PERC = 0

//state_power_special-consumer:
STATE_EXT_POW_CNS = 0

// control_fan_flap:
LV_ECRAS_CTL_CAN_1 = 1
LV_ECRAS_CTL_CAN_2 = 1
endif

Not in use:

The following messages are not in use by the IHKA. Therefore the values are initialised with FFh and the messages are not evaluated.
heat-flow_status_air-conditioning:
HTFL_ST_AIC = FFh

4.60.4.12 Kombi

Application conditions

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Initialisation: *at reset:* *TAM = TIA*

Formula section:

A_TEMP_RELATIVZEIT
Ambient temperature TAM:
IF (0) LV_VAR_ICL = 1
THEN (0)
If (1) LC_TAM_MAN_AS = 0

then (1)

if (2) TEMP_EX = FFH **OR**
LV_ERR_BN_T_ICL = 1 **OR** *(TAM-failure)*
LV_ERR_CAN_BOFF = 1
then (2)
if (3) TAM-failure was not present the recurrence before
then (3)TAM_n = TAM_{n-1} *(last valid TAM remains)*
LV_TAM_CAN_ERR = 1
else (3) TAM = C_TAM_SUB (*TAM-failure present*
TAM_CAN_ERR = 1 *since ECU initialisation)*
endif (3)
else (2) LV_TAM_CAN_ERR = 0
if (4) LV_ERR_TAM_PLAUS = 1
then (4) TAM = C_TAM_SUB
else (4) TAM = TEMP_EX (*CAN)*
endif (4)
endif (2)
else (1) TAM = C_TAM_MAN_AS (*application system)*
endif (1)

IF LV_ERR_BN_T_ICL = 0 **AND**
LV_ERR_CAN_BOFF = 0
THEN T_CTR_REL_CAN = T_SEC_COU_REL // for E65 only
T_CAN = T_DAY_COU_ABSL
ELSE T_CTR_REL_CAN = T_REL_CAN converted // for E65 only
T_CAN = FFFFH
ENDIF
ELSE (0) do nothing
ENDIF (0)

BOS_RUECKSTELLUNG + BOS_RUECKSTELLUNG_2
//detection if messages were used and reset of STATE_ID_FCT_BOS_RST and QOIL_DS_RST_CAN_2_2: this part has to be calculated every 100ms:
if LV_ERR_CAN_BOFF = 0 **and**
Id_bosrtak =STATE_ID_FCT_BOS_RST **and**
Id_bosrtak $>$ 0
then STATE_ID_FCT_BOS_RST = 0
QOIL_DS_RST_CAN_2_2 = 0

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```
endif

BOS_RUECKSTELLUNG
IF          LV_ERR_CAN_BOFF          = 0
THEN    if      new message received BOS_RUECKSTELLUNG
        then        STATE_ID2_BOS_RST           = ID2_BOS_RSTG
                    STATE_ID_FCT_BOS_RST        = ID_FN_BOS_RSTG
                    STATE_AVL_BOS_RST           = AVAI_BOS_RSTG
                    CTR_RST_BOS_RST             = COU_RSTG_BOS_RSTG
                    QOIL_DS_RST_CAN_1_5         = RMMI_BOS_RSTG
        else    variables unchanged
        endif
ELSE    STATE_ID2_BOS_RST           = FFH
        STATE_ID_FCT_BOS_RST        = FFFFH
        STATE_AVL_BOS_RST           = FFH
        CTR_RST_BOS_RST             = FFH
        QOIL_DS_RST_CAN_1_5         = 8000H
ENDIF

BOS_RUECKSTELLUNG_2
IF          LV_ERR_CAN_BOFF          = 0
THEN    if      new message received BOS_RUECKSTELLUNG_2
        then        QOIL_DS_RST_CAN_2_1         = ID2_BOS_RSTG_2
                    QOIL_DS_RST_CAN_2_2         = ID_FN_BOS_RSTG_2
                    QOIL_DS_RST_CAN_2_3         = FRC_INTM_WAY_BOS_RSTG_2
                    QOIL_DS_RST_CAN_2_4         = TARD_MON_BOS_RSTG_2
                QOIL_DS_RST_CAN_2_5         = TARD_YR_BOS_RSTG_2
                QOIL_DS_RST_CAN_2_6         = FRC_INTM_T_BOS_RSTG_2
        else    variables unchanged
        endif
ELSE    QOIL_DS_RST_CAN_2_1                 = FFH
        QOIL_DS_RST_CAN_2_2                 = FFFFH
        QOIL_DS_RST_CAN_2_3                 = FFH
        QOIL_DS_RST_CAN_2_4                 = FH
        QOIL_DS_RST_CAN_2_5                 = FFH
        QOIL_DS_RST_CAN_2_6                 = FFH
ENDIF


KILOMETERSTAND
IF          LV_ERR_BN_KM_ICL = 0            AND
            LV_ERR_CAN_BOFF = 0

THEN    // mileage_kilometre
if          MILE_KM = FFFFFFH
then    CTR_KM_CAN = DIST
elseif  MILE_KM < 655350 km (9FFF6H)
then    CTR_KM_CAN = MILE_KM
else    CTR_KM_CAN = 655340 km (FFFEH)
endif
```

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```
// Kilometerstand - BN (1km-Auflösung)
if              MILE_KM < 16777215
then        CTR_KM_BN = MILE_KM
else        CTR_KM_BN = 16777214 (FFFFFFH)
endif

if          LV_IGK = 1
then
   // fluid-level_fuel-tank:
   if          FLLV_FUTA < 7FH
   then            FTL = FLLV_FUTA              and         LV_FTL_TOT_CAN_ERR = 0
                 CTR_FTL_NOT_VLD = 0
   elseif          7FH ≤ FLLV_FUTA < FFH
           then            FTL = 126l                   and         LV_FTL_TOT_CAN_ERR = 0
                CTR_FTL_NOT_VLD = 0
   elseif          FLLV_FUTA = FFH
            then            if          CTR_FTL_NOT_VLD >= C_CTR_FTL_NOT_VLD
                 then            FTL = 0          and         LV_FTL_TOT_CAN_ERR   =   1
                 else            CTR_FTL_NOT_VLD = ++
                                keep last value
                 endif
   endif
else            keep last value
endif

fluid-level_fuel-tank_left-hand:
if          LV_IGK = 1
then
   if          FLLV_FUTA_LH < 7FH
      then        FTL_LE = FLLV_FUTA_LH      and LV_FTL_LE_CAN_ERR = 0
                CTR_FTL_LE_NOT_VLD = 0
   elseif          7FH ≤ FLLV_FUTA_LE < FFH
           then            FTL_LE = 62l                      and         LV_FTL_LE_CAN_ERR = 0
                     CTR_FTL_LE_NOT_VLD = 0
           elseif          FLLV_FUTA_LE = FFH
   then          if          CTR_FTL_LE_NOT_VLD >= C_CTR_FTL_NOT_VLD
              then            FTL_LE = 0           and         LV_FTL_LE_CAN_ERR = 1
                 else            CTR_FTL_LE_NOT_VLD = ++
                                    keep last value
                 endif
   endif
else            keep last value
endif

fluid-level_fuel-tank_right-hand:
if          LV_IGK = 1
then
   if          FLLV_FUTA_RH < 7FH
   then            FTL_RI = FLLV_FUTA_RH           and         LV_FTL_RI_CAN_ERR = 0
                 CTR_FTL_RI_NOT_VLD = 0
   elseif          7FH ≤ FLLV_FUTA_RH < FFH
   then            FTL_RI = 62l                    and         LV_FTL_RI_CAN_ERR = 0
```

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```
                    CTR_FTL_RI_NOT_VLD = 0
          elseif          FLLV_FUTA_RH = FFH
      then     if     CTR_FTL_RI_NOT_VLD >= C_CTR_FTL_NOT_VLD
                    then          FTL_RI = 0          and          LV_FTL_RI_CAN_ERR = 1
                    else          CTR_FTL_RI_NOT_VLD = ++
                                  keep last value
                    endif
          endif
else          keep last value
endif
```

status fluid-level fuel-tank spare :

```
if                    ST_FLLV_FUTA_SPAR = 01b
                    or          ST_FLLV_FUTA_SPAR = 10b
                    or          ST_FLLV_FUTA_SPAR = 11b
then          LV_FTL_OBD_INH_L = 1
else          LV_FTL_OBD_INH_L = 0
endif
```

ELSE

// mileage_kilometre

CTR_KM_CAN = DIST

// fluid-level_fuel-tank:

```
  FTL = 0                    and          LV_FTL_CAN_ERR = 1
          LV_FTL_TOT_CAN_ERR = 1
```

fluid-level_fuel-tank_left-hand:

```
          FTL_LE =   0                    and          LV_FTL_LE_CAN_ERR = 1
```

fluid-level_fuel-tank_right-hand:

```
          FTL_RI =   0                    and          LV_FTL_RI_CAN_ERR = 1
```

status fluid-level fuel-tank spare :

LV_FTL_OBD_INH_L = 0

ENDIF

//setting of LV_FTL_LE_CAN_ERR in dependency of LV_ERR_xxx

```
If                    LV_FTL_LE_CAN_ERR = 0   and
                [(LV_ERR_FTL_LE_CAN = 1   and    ERR_SYM_FTL_LE_CAN != SYM_3 and
          ERR_SYM_FTL_LE_CAN != NO_SYM)
                or (LV_ERR_TOUT_ICL_7 = 1 or LV_STATE_ERR_CAN_TOUT = 1 )]
Then          LV_FTL_LE_CAN_ERR = 1
Endif
```

//setting of LV_FTL_RI_CAN_ERR in dependency of LV_ERR_xxx

```
If                    LV_FTL_RI_CAN_ERR = 0          and
                [(LV_ERR_FTL_RI_CAN = 1   and   ERR_SYM_FTL_RI_CAN != SYM_3 and
                ERR_SYM_FTL_RI_CAN != NO_SYM)
                or (LV_ERR_TOUT_ICL_7 = 1 or LV_STATE_ERR_CAN_TOUT = 1 )]
Then          LV_FTL_RI_CAN_ERR = 1
Endif
```

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```
If          LV_FTL_TOT_CAN_ERR = 1      or
            LV_FTL_LE_CAN_ERR = 1       or
            LV_FTL_RI_CAN_ERR = 1
Then        LV_FTL_CAN_ERR = 1
Else        LV_FTL_CAN_ERR = 0
Endif
```

STAT_KOMBI

```
IF          LV_ERR_BN_ICL = 0           AND
            LV_ERR_CAN_BOFF = 0
THEN        // speed_vehicle_speedometer:
VS_ICL_DISP         =       V_VEH_SPDM

// status_unit-of-measurement_speed_speedometer:
STATE_VS_ICL_DISP       =       ST_UN_V_SPDM

// status_interface_cruise-control:
STATE_IF_ICL_BN_MSW         =       ST_INTF_CCTRA_KI

// alive_ICL:
TCC_CAN_ICL         =       ALIV_COU_KI

STATE_WAL_CAN           =       ST_WALI_ENG
ELSE        // speed_vehicle_speedometer:
VS_ICL_DISP         =       FFFH

// status_unit-of-measurement_speed_speedometer:
STATE_VS_ICL_DISP       =       3H

// status_interface_cruise-control:
STATE_IF_ICL_BN_MSW         =       1H

// alive_ICL:
TCC_CAN_ICL         =       FH

STATE_WAL_CAN           =       3H
```

UHRZEIT_DATUM

```
IF          LV_ERR_BN_T_CLK = 0         AND
            LV_ERR_CAN_BOFF = 0
THEN        // display day:
            IF      0 < DISP_DATE_DAY < 32
            THEN        T_CLK_ICL_DISP_1 = DISP_DATE_DAY
            ELSE        T_CLK_ICL_DISP_1 = 255
            ENDIF
        // display month:
        IF      0 < DISP_DATE_MON < 13
            THEN        T_CLK_ICL_DISP_2 = DISP_DATE_DAY
            ELSE        T_CLK_ICL_DISP_2 = 255
```

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```
            ENDIF
        // display year:
        IF          0 < DISP_DATE_YR < 65535
            THEN          T_CLK_ICL_DISP_3 = DISP_DATE_YR
            ELSE          T_CLK_ICL_DISP_3 = 65535
            ENDIF

ELSE        T_CLK_ICL_DISP_1 = 255
            T_CLK_ICL_DISP_2 = 255
        T_CLK_ICL_DISP_3 = 65535
ENDIF
```

4.60.4.13 LDM

Formula section:

```
Anforderung Radmoment Antriebsstrang:
IF              LV_ERR_BN_LDM              = 0           AND
            LV_ERR_CAN_BOFF         = 0

THEN        // checksum LDM:
            CKS_CAN_LDM          =       CHKSM_RQ_WMOM_PT
        // alive LDM:
            TCC_CAN_LDM          =       ALIV_RQ_WMOM_PT
        // follow-dynamic_wheel-moment_power-train_target:
        STATE_SP_DYN_WHEEL   =  FOLDYN_WMOM_PT_TAR   (Bit 0 ... Bit 3)
        // request_prevention_inertia-fuel-shutoff:
        STATE_DI_PUC          =          FOLDYN_WMOM_PT_TAR (Bit 0)
        // wheel-moment_power-train_target:
        If          WMOM_PT_TAR = FFFFH
        Then            LV_TQ_WHEEL_LDM_BN_ERR = 1
                TQ_WHEEL_LDM_BN          =          - 32000 Nm
        Else            LV_TQ_WHEEL_LDM_BN_ERR = 0
                if          WMOM_PT_TAR   <= 32000 Nm
                then          TQ_WHEEL_LDM_BN          =          WMOM_PT_TAR
                else          TQ_WHEEL_LDM_BN          =          32000 Nm
                endif
        Endif
        // status_driver-assistence-system_powertrain:
        STATE_LDM          =          ST_DRASY_PT
        // Wheel-moment power-train enable:
        STATE_LDM_INTV          =          WMOM_PT_ENBL
        If          STATE_LDM_INTV = 0
        Then            LV_TQ_WHEEL_LDM_REQ = 0
                LV_LDM_LIH_CAN = 0
        Elseif          STATE_LDM_INTV = 1
        Then            LV_TQ_WHEEL_LDM_REQ = 1
                LV_LDM_LIH_CAN = 0
        Else            LV_TQ_WHEEL_LDM_REQ = 0
                LV_LDM_LIH_CAN = 1
        Endif
```

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//request gear shift indicator for LDM:
If RQ_GSI_CLCTR_LN = 1
Then LV_GS_IDC_LDM = 1
Else LV_GS_IDC_LDM = 0
Endif

ELSE *// checksum LDM:*
CKS_CAN_LDM = FFh
// alive LDM:
TCC_CAN_LDM = Fh
// follow-dynamic_wheel-moment_power-train_target:
STATE_SP_DYN_WHEEL = Fh
// wheel-moment_power-train_target:
TQ_WHEEL_LDM_BN = -32000 Nm
LV_TQ_WHEEL_LDM_BN_ERR = 0
// Wheel-moment power-train enable:
STATE_LDM_INTV = 3H
LV_TQ_WHEEL_LDM_REQ = 0
LV_LDM_LIH_CAN = 1
// request_prevention_inertia-fuel-shutoff:
STATE_DI_PUC = 0H (nur Auswertung Bit 3)
// status_driver-assistence-system_powertrain:
STATE_LDM = FH
// auxiliary bytes for LDM test required by customer:
STATE_CUS_LDM_CAN = FFFFh
//request gear shift indicator for LDM:
LV_GS_IDC_LDM = 0

ENDIF

4.60.4.14 Power-Modul

Application conditions

Initialisation: `V_GEN_TAR = C_V_SP_GEN (valid for BN2000 and CAN11H)`

Formula section:

POWERMGMT_BATTERIESPANNUNG
status_battery-main-switch:
The signal cannot be evaluated as it is transmitted only after transition KL30 ON OFF.

status_switch-off_klemme_30:
STATE_SWI_OFF_VB = ST_SWO_KL_30
The signal is only to be read into the internal variable STATE_SWI_OFF_VB but not evaluated.

shutdown counter battery-main-switch :
if LV_IGK = 0 **and** VS = 0 **and** LV_ES = 1 (engine stopped)
then **if** SDWN_COU_BTSW = FFH
then T_CTR_SWI_OFF_ VB = 254
else T_CTR_SWI_OFF_ VB = SDWN_COU_BTSW
if T_CTR_SWI_OFF_VB ≤ C_T_CTR_SWI_OFF_VB_MIN **and**

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```
                          PWL is active (before NM)
then          shut down operating system
endif
endif
else          T_CTR_SWI_OFF_VB = 254
endif
```

time second counter relative Redundant :

```
IF                  LV_ERR_CAN_BOFF = 0
THEN          IF                  LV_VAR_VEH = 1              // E65
              THEN          IF          LV_ERR_BN_POW_VB = 0
                     THEN         T_REL_CAN =   T_SEC_COU_REL_Redundant ( converted)
                               //from Powermodul, message POWERMGMT_BATTERIESPANNUNG
                               T_REL_CAN_2 = T_SEC_COU_REL_Redundant
                               //setting bit indicating t_rel_can received:
                             LV_T_REL_CAN_REG = 1
                         ELSEIF          LV_ERR_BN_T_ICL = 0
                             THEN          T_REL_CAN = T_SEC_COU_REL (converted)
                                 T_REL_CAN_2 = T_SEC_COU_REL
                             ELSE          T_REL_CAN = 0
                                 T_REL_CAN_2 = 0
                         ENDIF
              ELSEIF          LV_VAR_VEH = 0              // E60
              THEN          IF          LV_ERR_BN_T_ICL = 0
                     THEN         T_REL_CAN = T_SEC_COU_REL (converted)
                               T_REL_CAN_2 = T_SEC_COU_REL
                             // from Kombi, message A_TEMP_RELATIVZEIT
                             //setting bit indicating t_rel_can received:
                             LV_T_REL_CAN_REG = 1
                         ELSE          T_REL_CAN = 0
                               T_REL_CAN_2 = 0
                         ENDIF
             ENDIF
ELSE          T_REL_CAN = 0
                 T_REL_CAN_2 = 0
ENDIF
```

POWERMGMT_LADESPANNUNG

```
IF                  LV_ERR_BN_POW_GEN = 0          AND
                  LV_ERR_CAN_BOFF = 0
THEN          // Control_generator_voltage_target:
if        CTR_GEN_U_TAR = FFH
then          V_GEN_TAR = C_V_SP_GEN
else                  V_GEN_TAR = CTR_GEN_U_TAR ( converted)
endif
```

RPM_idling_specification:

```
if        RPM_IDLG_SPEC = 3H
then          FAC_IS_INC_REQ = 0
else          FAC_IS_INC_REQ = RPM_IDLG_SPEC
```

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endif

ELSE *// Control_generator_voltage_target:*
V_GEN_TAR = C_V_SP_GEN

RPM_idling_specification:
FAC_IS_INC_REQ = 0
ENDIF

4.60.4.15 SZ-Lenksäule

Formula section:

LENKRADWINKEL (Sender SZL/E65, DSC/E60)

IF (LV_IGK = 0 **AND** LV_ES = 1) **OR**
(LV_IGK = 1 **AND** T_WAKE_UP_ON < C_T_DLY_ERR_PSTE) **OR**
(ECU_STATE = 'Wake_up' **AND** T_PWL < C_T_DLY_ERR_PSTE)
THEN ANG_PSTE = 0°
LV_ERR_ANG_PSTE_CAN = 0
STATE_SENS_ANG_PSTE = 0H
VEL_ANG_PSTE = 0°/s
ELSE **IF** LV_ERR_BN_ANG_PSTE = 0 **AND**
LV_ERR_CAN_BOFF = 0
THEN **IF** STWA_ERR = 1
THEN ANG_PSTE = 0°
VEL_ANG_PSTE = 0°/s
LV_ERR_ANG_PSTE_CAN = 0
STATE_SENS_ANG_PSTE = 0H
ELSE **IF** STWA = 8000H **or** STWA_ERR >= 1
THEN ANG_PSTE = 0
LV_ERR_ANG_PSTE_CAN = 1
VEL_ANG_PSTE = 0°/s
ELSE ANG_PSTE = STWA
LV_ERR_ANG_PSTE_CAN = 0
VEL_ANG_PSTE = STWA_V
ENDIF
STATE_SENS_ANG_PSTE = STWA_ERR
ENDIF
ELSE ANG_PSTE = 0°
LV_ERR_ANG_PSTE_CAN = 1
STATE_SENS_ANG_PSTE = 3H
VEL_ANG_PSTE = 0°/s
ENDIF
ENDIF

BEDIENUNG_TEMPOMAT

IF LV_ERR_BN_MSW = 0 **AND**
LV_ERR_CAN_BOFF = 0
THEN CKS_CAN_MSW = CHKSM_CCTR

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```
              TCC_CAN_MSW = ALIV_CCTR

IF                 OP_PUBU_CCTR_ACC          = 00H
THEN           STATE_BN_MSW                = NO_ACTION
ELSEIF          OP_PUBU_CCTR_ACC          = 10H              OR
                 OP_PUBU_CCTR_ACC          = 50H
THEN           STATE_BN_MSW                = TIP UP or DOWN              // OFF
ELSEIF          OP_PUBU_CCTR_ACC          = 04H              OR
                 OP_PUBU_CCTR_ACC          = 44H
THEN           STATE_BN_MSW                = TIP_POST
ELSEIF          OP_PUBU_CCTR_ACC          = 08H
                 OP_PUBU_CCTR_ACC          = 48H
THEN           STATE_BN_MSW                = PRESS_POST
ELSEIF          OP_PUBU_CCTR_ACC          = 40H              OR
                 OP_PUBU_CCTR_ACC          = 41H            OR
                 OP_PUBU_CCTR_ACC          = 42H
THEN           STATE_BN_MSW                = TIP_AXIAL
ELSEIF          OP_PUBU_CCTR_ACC          = 01H
THEN           STATE_BN_MSW                = TIP_PRE
ELSEIF          OP_PUBU_CCTR_ACC          = 02H
THEN           STATE_BN_MSW                = PRESS_PRE
ELSEIF          OP_PUBU_CCTR_ACC          = 7F
THEN           STATE_BN_MSW                = INVALID SIGNAL
ENDIF
```

STATE_GAP_MSW = OP_GAPC_ACC // this variable will only be used for the checksum-calculation of the message Bedienung Tempomat

```
ELSE          CKS_CAN_MSW           = FFH
                 TCC_CAN_MSW          = FH
                 STATE_BN_MSW          = 0H
ENDIF
```

4.60.4.16 K_CAN: LM

Formula section:

STATUS_GANG_RÜCKWÄRTS

```
IF                 LV_ERR_CAN_BOFF = 0            and
                 LV_ERR_BN_GEAR_REV = 0
THEN           if           ST_GR_BAC = 2H
then           STATE_GEAR_REV_CAN = 1
else          STATE_GEAR_REV_CAN = 0
endif
ELSE          STATE_GEAR_REV_CAN = 0
ENDIF
```

LAMPENZUSTAND

```
IF                 LV_ERR_CAN_BOFF = 0            and
                 LV_ERR_BN_ LTG_HDLP_L = 0
THEN           if           ST_DIPB = 1
then           LV_LTG_HDLP_L_ON = 1
```

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else LV_LTG_HDLP_L_ON = 0
endif
ELSE LV_LTG_HDLP_L_ON = 0
ENDIF

CTR_LICHT
IF LV_ERR_CAN_BOFF = 0
THEN **if** CTR_ITLI = 1
then LV_LTG_INL_ON = 1
else LV_LTG_INL_ON = 0
endif
ELSE LV_LTG_INL_ON = 0
ENDIF

STAT_ANHÄNGER
IF LV_ERR_CAN_BOFF = 0 **AND**
LV_ERR_BN_TRL = 0 **AND**
ST_TRAI < 2
THEN LV_STATE_TRL = ST_TRAI
ELSE LV_STATE_TRL = 0
ENDIF

STAT_VERDECK_CABRIO (27EH)

General information:

The state of the cabrio top must be available in the ECU For handling of the sound flap.

Application conditions

Initialisation: *at reset LV_CTOP = 0*

Recurrence: *message received event triggered (tmin=100ms)*

Activation: *every engine state*

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Formula section:

IF LV_ERR_CAN_BOFF = 0
THEN *setting LV_CTOP:*
If ST_PO_FLDT_CAB = 0
OR ST_PO_FLDT_CAB = 4
OR ST_PO_FLDT_CAB = 7
Then LV_CTOP = 0
Elseif ST_PO_FLDT_CAB = 1
OR ST_PO_FLDT_CAB = 2
OR ST_PO_FLDT_CAB = 3
Then LV_CTOP = 1
Endif
ELSE *setting default value:*
LV_CTOP = 0
ENDIF

4.60.4.17 EKP

General information:

In case of LV_VAR_BN_EFP = 1 (e.g. LEVII-vehicles) the EKP sends its data concerning the DME interface on the PT-CAN, message ID = 335h.

Application conditions

Initialisation:
```
at reset and LV_IGK = 1:
    LV_EFP_ON_EXT_ADJ_CAN = 0H
    LV_EFP_OFF_EXT_ADJ_CAN = 0H
    STATE_DIAG_EFP = FFH
    STATE_EFP_CAN = 0H
    V_ENG_EFP = 5V
    CUR_ENG_EFP = 0A
    N_EFP_AV = 0 rpm
    VB_EFP = 5V
    STATE_EFP_CTL = 3H
```

Recurrence: 1 s **or**Event controlled

Activation: *LV_IGK = 1 and LV_VAR_BN_EFP = 1*

Formula section:

```
If      LV_ERR_BN_EFP = 0          AND
        LV_ERR_CAN_BOFF = 0
Then        STATE_DIAG_EFP     =   ST_DIAG_FU_PP_EL
            STATE_EFP_CAN      =   ST_FU_PP_EL
            V_ENG_EFP          =   U_ENG_FU_PP_EL
            CUR_ENG_EFP        =   I_ENG_FU_PP_EL
            N_EFP_AV           =   RPM_AVL_FU_PP_EL
            VB_EFP             =   U_KL_30_FU_PP_EL
            STATE_EFP_CTL      =   ST_FU_CLCTR_FU_PP_EL
Else        STATE_DIAG_EFP     =   FFH
            STATE_EFP_CAN      =   0H
            V_ENG_EFP          =   5V
            CUR_ENG_EFP        =   0A
            N_EFP_AV           =   0 rpm
            VB_EFP             =   5V
            STATE_EFP_CTL      =   3H
Endif

If      STATE_EFP_CAN = 1
        Then    LV_EFP_ON_EXT_ADJ_CAN     = 1
LV_EFP_OFF_EXT_ADJ_CAN    = 0
        Else if        STATE_EFP_CAN      = 2
            Then    LV_EFP_ON_EXT_ADJ_CAN     = 0
LV_EFP_OFF_EXT_ADJ_CAN    = 1
            Else    LV_EFP_ON_EXT_ADJ_CAN     = 0
LV_EFP_OFF_EXT_ADJ_CAN    = 0
Endif
Endif
```

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4.60.4.18 K_CAN: CCC_GW, M_ASK

General information:

Application conditions

Initialisation:

Recurrence: *event controlled*

Activation: *LV_IGK = 1*

Formula section:

Programmierung Stufentempomat:
handshake with stepped cruise-control function:
IF message Programmierung Stufentempomat has been received
THEN LV_MSG_PROG_STEP_CRU = 1
input for stepped cruise control-function
resetting of bit through stepped cruise control function
ENDIF

index_number_programming_cruise-control
NR_VS_CRU_IF = IDX_NO_PRGG_CCTR

speed_programming_cruise-control_index_number_1
VS_STEP_IF_1 = V_PRGG_CCTR_IDX_NO_1

speed_programming_cruise-control_index_number_2
VS_STEP_IF_2 = V_PRGG_CCTR_IDX_NO_2

speed_programming_cruise-control_index_number_3
VS_STEP_IF_3 = V_PRGG_CCTR_IDX_NO_3

4.60.4.19 K_CAN/PT-CAN

Application conditions

Initialisation:
```
at  LV_IGK 0 - -> 1:
             FAC_POW_MNG_VST_CNS  (index 0) = 255,
             FAC_POW_MNG_VST_CNS (index i) = 0
        at reset        N_ECF_CAN = 0 %
                     N_ECF_CAN_2 = 0 %
                     ECF_REQ_EXT = 0
```

Activation:
```
Powermanagement_Standverbraucher :    LV_IGK = 1
   Anforderung_E-Lüfter:    bus_active
```

DIENSTENACHRICHTEN:
Powermanagement_Standverbraucher
IF ID2 = 08H
THEN Dienstenachricht Powermanagement_Standverbraucher
ENDIF

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```
IF                    ST_PCOS_PWMG = ON            //  Status Standverbraucher PM
THEN      IF          FAC_POW_MNG_VST_CNS (index 0) = 255
            THEN          FAC_POW_MNG_VST_CNS (index 0) = SV-ID
            ELSE      IF       FAC_POW_MNG_VST_CNS (index i) = SV-ID
                  THEN        no action                      //  SV already in list
                  ENDIF
            ELSE      IF       FAC_POW_MNG_VST_CNS (index i) = 0
                  THEN        FAC_POW_MNG_VST_CNS (index i) = SV-ID
                    //  free position found
                  ENDIF
            ENDIF
ELSE      IF          ST_PCOS_PWMG = OFF                //  Status Standverbraucher PM
          THEN        IF       FAC_POW_MNG_VST_CNS (index i) = SV-ID
               THEN       FAC_POW_MNG_VST_CNS (index i) = 0                 //  SV
           found, delete from list
               ENDIF
               IF         FAC_POW_MNG_VST_CNS (index i) = 0
               THEN FAC_POW_MNG_VST_CNS (index 0) = 255
               ENDIF
            ENDIF
ENDIF
```

Standverbraucher (SV)	SV-ID (ID_FN_PWMG)
Anhängerlicht	1
Bordmonitor (MMI)	2
Diebstahlwarnanlage	3
Licht	4
Standheizen	5
Standlüften	6
Getriebe	7
Restwärme	8
Telefon (ECE)	9
Telefon (USA)	10
Standklimatisierung	11
APU	12
Frontscheibenheizung	13

Verbraucherstatus

```
IF              ID2 = 6EH
THEN        Dienstenachricht   Verbraucherstatus
ENDIF
```

STATE_VEH_CNS[10] = ID_FN_COS
STATE_VEH_CNS_FCT = ST_FN_COS

Bit 0	Bit 1	Status
0	0	Verbraucherfunktion aus
0	1	Verbraucherfunktion ein
1	0	Ungültiger Zustand
1	1	Signal ungültig

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Byte	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
Byte 1	V0	V0	V1	V1	V2	V2	V3	V3
Byte 2	V4	V4	V5	V5	V6	V6	V7	V7
Byte 3	V8	V8	V9	V9	V10	V10	V11	V11
Byte 4	V12	V12	V13	V13	V14	V14	V15	V15
Byte 5	V16	V16	V17	V17	V18	V18	V19	V19
Byte 6	V20	V20	V21	V21	V22	V22	V23	V23
Byte 7	V24	V24	V25	V25	V26	V26	V27	V27
Byte 8	V28	V28	V29	V29	V30	V30	V31	V31
Byte 9	V32	V32	V33	V33	V34	V34	V35	V35
Byte 10	V36	V36	V37	V37	V38	V38	V39	V39

Anforderung_E-Lüfter

```
IF          ID2_RQ_STG_EFAN = 15h
        // Dienstenachricht Anforderung E-Lüfter
THEN      LV_N_ECF_CAN_ACT = 1
        //Dienstenachricht E-Lüfter zum 1. Mal angefordert
          LV_N_ECF_CAN_RCV = 1
        //Dienstenachricht zyklisch erhalten (1s-Raster)
          IF   ((ID_FN_RQ_STG_EFAN != FFH) AND (RQ_STG_EFAN != FH))
          THEN      N_ECF_CAN_2   = RQ_STG_EFAN        //conversion from CAN
                ECF_REQ_EXT = ID_FN_RQ_STG_EFAN
             //anforderndes Steuergerät
             IF        RQ_STG_EFAN = 0
             THEN         LV_N_ECF_CAN_ACT = 0
             //Anforderung E-Lüfter zurückgenommen
             ENDIF
          ELSE       If        (ID_FN_RQ_STG_EFAN != FFH)
             Then         N_ECF_CAN_2   = C_N_ECF_CAN
             Else         N_ECF_CAN_2   = 0
             Endif
                ECF_REQ_EXT = 0
        ENDIF
ENDIF
```

Monitoring of Anforderung_E-Lüfter (cyclic transmission, 1s):

```
IF          LV_N_ECF_CAN_ACT = 1
        // Dienstenachricht Anforderung E-Lüfter wird angefordert
THEN      IF        LV_N_ECF_CAN_RCV = 1
          //Dienstenachricht E-Lüfter wird zyklisch erhalten
          THEN      CTR_TOUT_N_ECF_CAN = 0
                LV_N_ECF_CAN_RCV = 0
             ELSE       IF        CTR_TOUT_N_ECF_CAN>=C_ CTR_TOUT_N_ECF_
     CAN
                     THEN         N_ECF_CAN_2 = C_N_ECF_CAN
                      ECF_REQ_EXT = 0
                ELSE         CTR_TOUT_N_ECF_CAN   ++
                ENDIF
        ENDIF
ENDIF
```

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//setting of N_ECF_CAN (add. check if component protection neccessary): This part has to be calculated with recurrence of 1s (independent on message received or not)

If [LV_ERR_CAN_BOFF = 1 **or** LV_ERR_BN_TQ_PSTE_3 = 1] **and**
[LV_VAR_ECRAS_UP = 1 **or** LV_VAR_ECRAS_DOWN = 1]
Then *// setting of min value for component protection:*
N_ECF_CAN =MAX(N_ECF_CAN_2,C_N_ECF_CAN)
Else *// setting value like requested by CAN message (Anforderung E-Lüfter):*
N_ECF_CAN = N_ECF_CAN_2
Endif

OBD Sensor Diagnosestatus (condition based service)

Application conditions

Initialisation: *ODB_TAM = TAM (has to be initialised after TAM initialisation),*

all other = 0

Recurrence: *10s*

Activation: *LV_IGK = 1*

Formula section:

IF ID2 = 8CH *//Dienstenachricht OBD Sensor Diagnosestatus*
THEN
LV_STATE_ERR_CAN_ACT = 1
//Dienstenachricht OBD Sensor Diagnosestatus zum 1. Mal angefordert
LV_STATE_ERR_CAN_RCV = 1
//Dienstenachricht zyklisch erhalten (10s-Raster)
If ID_OBD_SEN = 0H
Then *// get symptom of TAM sensor*
if ERR_OBD_SEN_1 = 1H
then *// short circuit to ground*
STATE_ERR_SYM_TAM_CAN = SCG
elseif ERR_OBD_SEN_1 = 2H
then *// short circuit to vbatt (plus) or open line (can't be distinguished)*
STATE_ERR_SYM_TAM_CAN = SCP
else STATE_ERR_SYM_TAM_CAN = NO_SYM
endif
// get raw value of TAM for OBD:
OBD_TAM =RWDT_OBD_SEN_1
(converted. -> OBD_TAM = [hex] /2 - 40°C)
// TAM value received:
LV_OBD_TAM_RCV = 1

Elseif ID_OBD_SEN = 1H
Then *// get symptom of FTL_RI sensor*
if ERR_OBD_SEN_2 = 1H
then *// short circuit to ground*
STATE_ERR_SYM_FTL_RI_CAN = SCG
elseif ERR_OBD_SEN_2 = 2H
then *// short circuit to vbatt (plus) or open line (can't be distinguished)*

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```
                STATE_ERR_SYM_FTL_RI_CAN = SCP
          else         STATE_ERR_SYM_FTL_RI_CAN = NO_SYM
             endif
          // get symptom of FTL_LE sensor
          if          ERR_OBD_SEN_1 = 1H
             then         // short circuit to ground
                STATE_ERR_SYM_FTL_LE_CAN = SCG
             elseif          ERR_OBD_SEN_1 = 2H
             then         // short circuit to vbatt (plus) or open line (can't be distinguished)
                STATE_ERR_SYM_FTL_LE_CAN = SCP
             else          STATE_ERR_SYM_FTL_LE_CAN = NO_SYM
             endif
      Else          no changes
      Endif
ENDIF
```

Monitoring of Dienstenachricht OBD Diagnosestatus (cyclic transmission, 10s):

```
IF                 LV_STATE_ERR_CAN_ACT = 1
          // Dienstenachricht OBD Diagnosestatus wird angefordert
THEN        IF          LV_STATE_ERR_CAN_RCV = 1
                        //Dienstenachricht OBD Diagnosestatus wird zyklisch erhalten
             THEN          CTR_STATE_ERR_CAN = 0
                        LV_STATE_ERR_CAN_RCV = 0
                        LV_STATE_ERR_CAN_TOUT = 0
          ELSE          IF          CTR_STATE_ERR_CAN>=C_CTR_TOUT_STATE_ERR_CAN

                 THEN          LV_STATE_ERR_CAN_TOUT = 1
                          STATE_ERR_SYM_FTL_LE_CAN = NO_SYM
                            STATE_ERR_SYM_FTL_RI_CAN = NO_SYM
                            STATE_ERR_SYM_TAM_CAN = NO_SYM
                        ELSE          CTR_STATE_ERR_CAN   ++
                        ENDIF
          ENDIF
ENDIF
```

Application conditions

Recurrence: `1s`

Activation: `at every engine state`

//setting of OBD_TAM if message not received yet (after reset a time gap up to 10s until first receive of message is possible). This part has to be calculated with recurrence of 1s (independent on message received or not):

```
If                LV_OBD_TAM_RCV = 0
Then        // setting of OBD_TAM = TAM for initialisation:
          OBD_TAM = TAM            (converted)
Else        do nothing
Endif
```

4.60.4.20 EHB3 - DREHMOMENT_ANF_STE

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Formula section:

DREHMOMENT_ANF_STE:

```
IF(1)      LV_ERR_BN_TQ_PSTE_3 = 0        AND
              LV_ERR_CAN_BOFF = 0
THEN(1)
// checksum_torque_STE:
CKS_CAN_TQ_ PSTE_3                 = CHKSM_TORQ_STE

// alive_torque_STE:
TCC_CAN_TQ_ PSTE_3                 = ALIV_TORQ_STE

// source torque_STE
if                SRC_RQ_TORQ_STE = 0H
then        STATE_PSTE_3_SRC = NORMAL_STEERING
elseif       SRC_RQ_TORQ_STE = 1H
then        STATE_PSTE_3_SRC = AFS
elseif       SRC_RQ_TORQ_STE = 2H
then        STATE_PSTE_3_SRC = EPS
elseif       SRC_RQ_TORQ_STE= 4H
then        STATE_PSTE_3_SRC = RESERVED
elseif       SRC_RQ_TORQ_STE= FH
then        STATE_PSTE_3_SRC = INVALID_SIGNAL
endif

   if (2) STATE_PSTE_3_SRC = AFS AND LC_PSTE_3_SUB_ENA = 1
   then
      TQ_LOSS_PSTE_3_AV_CAN = 0
      TQ_LOSS_PSTE_3_SP_CAN = 0
      STATE_PSTE_3_INTV = 2
      LV_PSTE_3_INTV = 1
      STATE_PSTE_3_ERR = 0
      LV_TQ_PSTE_3_CAN_ENA = 1
      LV_TQ_PSTE_3_CAN_LIH = 0
      LV_TQ_PSTE_3_CAN_DI = 0
    else (2)

   // actual value torque loss STE :
   if           TORQ_AVL_STE = FFH
   then      TQ_LOSS_PSTE_3_AV_CAN = 8000H
   else      TQ_LOSS_PSTE_3_AV_CAN = TORQ_AVL_STE (converted from BN 2000)
   endif

   // target value torque loss STE
   if           TORQ_TAR_STE = FFH
   then      TQ_LOSS_PSTE_3_SP_CAN = 8000H
   else      TQ_LOSS_PSTE_3_SP_CAN = TORQ_TAR_STE (converted from BN 2000)
   endif

   // state STE-intervention:
   STATE_PSTE_3_INTV = ST_TORQ_TAR_STE
```

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```
if      STATE_PSTE_3_INTV =02H
then    LV_PSTE_3_INTV          = 1
else    LV_PSTE_3_INTV          = 0
endif

// state torque_STE_error
STATE_PSTE_3_ERR = ST_RQ_TORQ_STE_ERR

if      STATE_PSTE_3_ERR = 00H
then    LV_TQ_PSTE_3_CAN_ENA = 1
else    LV_TQ_PSTE_3_CAN_ENA = 0
endif

if      STATE_PSTE_3_ERR = 01H or
        STATE_PSTE_3_ERR = 02H or
        STATE_PSTE_3_ERR = 04H
then    LV_TQ_PSTE_3_CAN_LIH = 1
else    LV_TQ_PSTE_3_CAN_LIH = 0
endif

if      STATE_PSTE_3_ERR = 03H or
        STATE_PSTE_3_ERR = 05H or
        STATE_PSTE_3_ERR = 06H or
        STATE_PSTE_3_ERR = 07H
then    LV_TQ_PSTE_3_CAN_DI = 1
else    LV_TQ_PSTE_3_CAN_DI = 0
endif
Endif(2)


ELSE(1)         // substitute values_STE:
    // checksum_torque_STE
    CKS_CAN_TQ_PSTE_3       = FFH

    // alive_torque_STE:
    TCC_CAN_TQ_PSTE_3       = FH

    // source torque_STE
    STATE_PSTE_3_SRC        = 4H

    // actual value torque loss STE :
    TQ_LOSS_PSTE_3_AV_CAN = 8000H

    // target value torque loss STE :
    TQ_LOSS_PSTE_3_SP_CAN = 8000H

    // state STE-intervention:
    STATE_PSTE_3_INTV       = 3H
    LV_PSTE_3_INTV          = 0H

    // state torque_STE_error
```

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STATE_PSTE_3_ERR = 7H
LV_TQ_PSTE_3_CAN_ENA = 0H
LV_TQ_PSTE_3_CAN_LIH = 0H
LV_TQ_PSTE_3_CAN_DI = 1H

ENDIF(1)

4.60.4.21 EMF Modul (PBR) electromechanic park brake

STELLANF_EMF

Formula section:

IF LV_ERR_BN_REQ_PBR = 0 **AND**
LV_ERR_CAN_BOFF = 0
THEN
// checksum:
CKS_CAN_REQ_PBR = CHKSM_PRQ_EMF
// alive counter:
TCC_CAN_REQ_PBR = ALIV_PRQ_EMF
// status indicating holding of vehicle with parking brake
STATE_HLD_PBR = ST_HYD_RETA_2
// comfort mode of parking brake
If ST_CFFU_EMF_2 < 2H
Then LV_CFT_MOD_PBR = ST_CFFU_EMF_2
Else LV_CFT_MOD_PBR = 0
Endif
ELSE *// substitute values:*

// checksum
CKS_CAN_REQ_PBR = FFH
// alive_counter:
TCC_CAN_REQ_PBR = FH
// status indicating holding of vehicle with parking brake
STATE_HLD_PBR = 3H
// comfort mode of parking brake
LV_CFT_MOD_PBR = 0
ENDIF

STATUS_EMF

Formula section:

IF LV_ERR_BN_PBR = 0 **AND**
LV_ERR_CAN_BOFF = 0
THEN
// checksum:
CKS_CAN_PBR = CHKSM_ST_EMF
// alive counter:
TCC_CAN_PBR = ALIV_COU_EMF_2

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//status of parking brake
STATE_PBR = ST_EMF_LOCA_2

ELSE *// substitute values*
// checksum
CKS_CAN_PBR = FFH
// alive_counter:
TCC_CAN_PBR = FH
//status of parking brake
STATE_PBR = FH
ENDIF

ST_RQ_EMF (Status Anforderung EMF) (ID =1FDH)

Application conditions

Initialisation: `at reset all 0`

Recurrence: `40 ms (tmin=36 ms, tmax=44 ms)`

Activation: `LV_VAR_TQ_PBR = 1`

Formula section:

IF LV_ERR_CAN_BOFF = 0 **AND**
LV_ERR_BN_TQ_PBR = 0
THEN
// Checksum:
CKS_CAN_TQ_PBR = CHKSM_ST_RQ_EMF
// Alive-Counter:
TCC_CAN_TQ_PBR = ALIV_ST_RQ_EMF
// status actuator EMF:
STATE_PBR_ACT = ST_ACT_EMF
STATE_PBR_ACT_QLY = QU_ST_ACT_EMF
// request deceleration EMF:
AC_WHEEL_PBR = RQ_DCRN_EMF (converted)
STATE_TQ_WHEEL_PBR_QLY = QU_RQ_DCRN
ELSE *//setting default values:*
STATE_PBR_ACT = FH
STATE_PBR_ACT_QLY = FH
AC_WHEEL_PBR = 0 m/s**2
STATE_TQ_WHEEL_PBR_QLY = FH
TCC_CAN_TQ_PBR = FH
CKS_CAN_TQ_PBR = FFH
ENDIF

4.60.4.22 DXC - SOLL_MOM_ANF (Status hill descent control - HDC)

Formula section:

IF LV_ERR_BN_DHL_CTL = 0 **AND**
LV_ERR_CAN_BOFF = 0
THEN

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//status of hill descent control:
STATE_DHL_CTL = ST_HDC_FN
ELSE *//default value:*
STATE_DHL_CTL = Fh
ENDIF

4.60.4.23 FAHRGESTELLNUMMER (Vehicle Identification Number, ID = 380 hex)

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte6	NO_VECH_7 -> **VIN_CAN[6]**							

Figure 4.60.1: Byte6

Byte5	NO_VECH_6 -> **VIN_CAN[5]**

Figure 4.60.2: Byte5

Byte4	NO_VECH_5 -> **VIN_CAN[4]**

Figure 4.60.3: Byte4

Byte3	NO_VECH_4 -> **VIN_CAN[3]**

Figure 4.60.4: Byte3

Byte2	NO_VECH_3 -> **VIN_CAN[2]**

Figure 4.60.5: Byte2

Byte1	NO_VECH_2 -> **VIN_CAN[1]**

Figure 4.60.6: Byte1

Byte0	NO_VECH_1 -> **VIN_CAN[0]**

Figure 4.60.7: Byte0

Figure 4.60.8: Signals

Signals	Range	Conversion	Invalid-case
NO_VECH_x	**0..FFh**	**ASCII**	**FFh**

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Application conditions

Initialisation: `all zero at Reset`

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Recurrence: *Event triggered:* *Debounce time = 200ms*

Activation: *Bus active*

Formula section:

/* NO_VECH_7 = least significant digit of vehicle identification number (Fahrgestellnummer)
NC_VIN_CAN_LEN = 7

VIN_CAN [0]	=	NO_VECH_1
VIN_CAN [1]	=	NO_VECH_2
VIN_CAN [2]	=	NO_VECH_3
VIN_CAN [3]	=	NO_VECH_4
VIN_CAN [4]	=	NO_VECH_5
VIN_CAN [5]	=	NO_VECH_6
VIN_CAN [6]	=	NO_VECH_7

Checksum calculation:

No checksum calculation
No diagnosis possible -> message received only event triggered

 # IF (NC_SPORT_SZL != 0) // Compiler switch for deactivation of functionality

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4.60.4.24 BEDIENUNG_MDRV (MDRIVE switch, ID = 1D9 hex)

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	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte2					ALIV_COU_OP_PUBU_MDRV			
Byte1	OP_PUBU_MDRV							
Byte0	OP_PUBU_MDRV_COMP							

Figure 4.60.9: Signals

Signals	Range	Conversion	Invalid-case
ALIV_COU_OP_PUBU_MDRV	**0..Eh**	**-**	**Fh**
OP_PUBU_MDRV	**0..1**	**-**	**3h**
OP_PUBU_MDRV_COMP	**0..3**	**-**	**3h**

Application conditions

Initialisation: *all zero at Reset*

Recurrence: 1s
Event triggered: Debounce time = 100ms

Activation: *LV_VAR_SPT_SWI = 1*

Formula section:

// Alive-Counter:
TCC_CAN_ SPT_SWI = ALIV_COU_OP_PUBU_MDRV

IF LV_ERR_BN_SPT_SWI = 0 **AND**
LV_ERR_CAN_BOFF = 0
THEN
// only read signal if OP_POBU_MDRV_COMP is the complement (= bitwise
// inverted value) of OP_PUBU_MDRV
IF OP_POBU_MDRV_COMP = (~OP_PUBU_MDRV)
THEN STATE_SPT_SWI = OP_PUBU_MDRV
ELSE STATE_SPT_SWI = 0 **ENDIF**
ELSE
STATE_SPT_SWI = 0
ENDIF
#ENDIF

4.60.4.25 FAHRGESTELLNUMMER (Vehicle Identification Number, ID = 380 hex)

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

Figure 4.60.10: Byte6

Byte6	NO_VECH_7 -> **VIN_CAN[6]**

Figure 4.60.11: Byte5

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Byte5 NO_VECH_6 -> **VIN_CAN[5]**

Figure 4.60.12: Byte4

Byte4 NO_VECH_5 -> **VIN_CAN[4]**

Figure 4.60.13: Byte3

Byte3 NO_VECH_4 -> **VIN_CAN[3]**

Figure 4.60.14: Byte2

Byte2 NO_VECH_3 -> **VIN_CAN[2]**

Figure 4.60.15: Byte1

Byte1 NO_VECH_2 -> **VIN_CAN[1]**

Figure 4.60.16: Byte0

Byte0 NO_VECH_1 -> **VIN_CAN[0]**

Figure 4.60.17: Signals

Signals	Range	Conversion	Invalid-case
NO_VECH_x	**0..FFh**	**ASCII**	**FFh**

Application conditions

Initialisation: *all zero at Reset*

Recurrence: *Event triggered:* *Debounce time = 200ms*

Activation: *Bus active*

Formula section:

/* NO_VECH_7 = least significant digit of vehicle identification number (Fahrgestellnummer)
NC_VIN_CAN_LEN = 7

VIN_CAN [0] = NO_VECH_1
VIN_CAN [1] = NO_VECH_2
VIN_CAN [2] = NO_VECH_3
VIN_CAN [3] = NO_VECH_4
VIN_CAN [4] = NO_VECH_5
VIN_CAN [5] = NO_VECH_6
VIN_CAN [6] = NO_VECH_7

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Checksum calculation:

No checksum calculation
No diagnosis possible -> message received only event triggered

4.60.4.26 GESCHWINDIGKEIT_RAD (CAN-ID = CE hex)

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

Figure 4.60.18: Byte7

Byte7	V_WHL_RRH

Figure 4.60.19: Byte6

Byte6	V_WHL_RRH

Figure 4.60.20: Byte5

Byte5	V_WHL_RLH

Figure 4.60.21: Byte4

Byte4	V_WHL_RLH

Figure 4.60.22: Byte3

Byte3	V_WHL_FRH

Figure 4.60.23: Byte2

Byte2	V_WHL_FRH

Figure 4.60.24: Byte1

Byte1	V_WHL_FLH

Figure 4.60.25: Byte0

Byte0	V_WHL_FLH

Application conditions

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Initialisation: `at reset all 0`

Recurrence: `20ms (tmin = 18ms, tmax = 22ms)`

Activation: `at every engine state`

Formula section:

IF LV_ERR_BN_WHEEL_CAN = 0 **AND**
LV_ERR_CAN_BOFF = 0

THEN

// speed_wheel_RLH
WHEEL_CAN_RE_LE = V_WHL_RLH (converted from BN2000)
If V_WHL_RLH = 8000 h
then LV_WHEEL_CAN_RE_LE_ERR = 1
else LV_WHEEL_CAN_RE_LE_ERR = 0
endif
// speed_wheel_RRH
WHEEL_CAN_RE_RI = V_WHL_RRH (converted from BN2000)
If V_WHL_RRH = 8000 h
then LV_WHEEL_CAN_RE_RI_ERR = 1
else LV_WHEEL_CAN_RE_RI_ERR = 0
endif
// speed_wheel_FLH
WHEEL_CAN_FN_LE = V_WHL_FLH (converted from BN2000)
If V_WHL_FLH = 8000 h
then LV_WHEEL_CAN_FN_LE_ERR = 1
else LV_WHEEL_CAN_FN_LE_ERR = 0
endif
// speed_wheel_FRH
WHEEL_CAN_FN_RI = V_WHL_FRH (converted from BN2000)
If V_WHL_FRH = 8000 h
then LV_WHEEL_CAN_FN_RI_ERR = 1
else LV_WHEEL_CAN_FN_RI_ERR = 0
endif

ELSE

// speed_wheel_RLH
WHEEL_CAN_RE_LE = 8000 h
// speed_wheel_RRH
WHEEL_CAN_RE_RI = 8000 h
// speed_wheel_FLH
WHEEL_CAN_FN_LE = 8000 h
// speed_wheel_FRH
WHEEL_CAN_FN_RI = 8000 h

ENDIF

4.60.5 Output messages of the DME to the CAN bus

Application conditions

Initialisation: `N_MAX_THD_1_CAN = 0 at reset`

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```
    N_MAX_THD_2_CAN = 0          at reset
    STATE_TQ_INTV_DCC = 0H
 LV_POW_CLAS_VEH_CAN_RCV = 0 at transition LV_IGK 1 - -> 0
 CTR_LDM_CAN_INI = 0            at reset
 LV_ENG_RUN_CAN = 0            at reset
 LV_LDM_CAN_INI = 1            at reset
 STATE_EFP_CTL_ECU = 03H      at reset
 T_ERR_N_ENG = 0 s            at reset
```

Recurrence:

TORQUE_1 = 10 ms
TORQUE_2 = C_T_CYC_CAN_ECU_2
BOS_MELDUNG:
at transition LV_IGK and at signal change (time for debounce is 1 s) **or** at transition of Bostoken form 0 -> !0 (time for debounce is 1 s)
BOS_MELDUNG_2:
at transition LV_IGK and at signal change of either BOS_MELDUNG **or** BOS_MELDUNG_2 (time for debounce is 1 s) **or** at transition of
Bostoken form 0 -> !0 (time for debounce is 1 s)
Status Kraftstoffregelung DME:
General: 10s
at transition LV_IGK and at signal change (time for debounce is 160ms);
at transition LV_IGK 0 1 the message has to be sent 3 times,
recurrency 160ms
ENGINE_1 = 100 ms
ENGINE_2: cyclic = 1s and at signal change (tmin = 50 ms)
ENGINE_RPM = 1 s

POWERMANAGEMENT_BATTERIESPANNUNG
always when LV_CAN_SND_MSG_PWR_MNG_1 is set
(recurrency of LV_CAN_SND_MSG_PWR_MNG_1 is 100ms)
reset LV_CAN_SND_MSG_PWR_MNG_1 after the message is sent
POWERMANAGEMENT_VERBRAUCHERSTEUERUNG
always when LV_CAN_SND_MSG_PWR_MNG_0 is set
(recurrency of LV_CAN_SND_MSG_PWR_MNG_0 is 100ms)
reset LV_CAN_SND_MSG_PWR_MNG_0 after the message is sent
GESCHWINDIGKEIT_TEMPOMAT
cyclic: 200ms; event triggered: min. time for sending 100ms
RADMOM_PT_1 and RADMOM_PT_2 = 20 ms
ELEKTRONISCHER MOTORÖLMESSSTAB
cyclic: 10 s, event triggered (at transition KL.R off - -> on and at signal change): min. time for sending 100ms and on request
WAERMESTROM_MOTOR:
Cyclic: 1000ms, event-triggered, min. time 10 ms
OBD_DT_MOTOR: cyclic 1000ms
ST_BATT: event triggered at signal change (tmin = 200 ms) -> the message has to be sent 3 times with recurrence 160ms
DISP_GSI: 100ms (tmin = 90ms, tmax = 110ms)
DISP_ENGDAT: 100ms (tmin=90ms, tmax=110ms)

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Activation:

```
 POWERMANAGEMENT_BATTERIESPANNUNG   AND
    POWERMANAGEMENT_VERBRAUCHERSTEUERUNG
    only if LV_VAR_VEH = 0 (E60)
    GESCHWINDIGKEIT_TEMPOMAT at Kl.15 on and  LV_VAR_DCC =
0
    and  LV_VAR_BN_LDM = 0
 RADMOM_PT_1  and RADMOM_PT_2  only if LV_VAR_BN_LDM = 1
    ELEKTRONISCHER MOTORÖLMESSSTAB at bus_active (always)
    Status Kraftstoffregelung DME: Kl.  15 on
  OBD_DT_MOTOR:  LV_IGK = 1            and
    LC_ETCU_FRF = 0          and
    (LV_AT = 1 or  LV_VAR_TCT =1)
    ST_BATT: LV_IGK = 1
    DISP_GSI:  LV_IGK = 1
    ENGINE_2:  LV_IGK = 1
    DISP_ENGDAT: C_N_DISP_DYN_ENA != 0
```

Deactivation:

```
GESCHWINDIGKEIT_TEMPOMAT at Kl.15 off
    ELEKTRONISCHER MOTORÖLMESSSTAB at Kl.15 off
    Status Kraftstoffregelung DME: Kl.  15 off
    DISP_GSI:  LV_IGK = 0
    DISP_ENGDAT: C_N_DISP_DYN_ENA = 0
```

Formula section:

4.60.5.1 DME1

4.60.5.2 Anfrage

requested by DME:

IF B_codierpm = 1
THEN Anfrage: Codierung Powermanagement is reqested by DME from CAS
ID 395H // (recurrency 5 sec)
ENDIF

IF LV_POW_CLAS_VEH_CAN_REQ 0->1
THEN Anfrage: Fahrzeutyp is reqested by DME from CAS
ID 388H // once per trigger
ENDIF

IF LV_NO_VECH_REQ = 1 // recurrence 10ms
THEN Anfrage: Fahrgestellnummer is requested by DME from CAS
ID 380H
LV_NO_VECH_REQ = 0 // reset trigger after sending

Description for actions:

ACTION_INTC_ NO_VECH_REQ( )					
When this action is called the service "Anfrage:Fahregestellnummer" is requested.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
-	-	-	-	-	-
-					

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FUNCTION DESCRIPTION:

LV_NO_VECH_REQ = 1

requested from DME by other STG:

```
IF          ID2_INQY      =     1

THEN     IF      ID_FB_INQY = 897 dez// please note : motorola-format

            THEN         Anfrage: Elektronischer Ölmeßstab   is requested from DME
                     By STG (ID 580 + STG)
                     - -> description of message see 3.1.2
            ELSE         IF        ID_FN_INQY          =          910 dez
                         // please note that the positions of high byte
                         and low byte are changed (Intel-format)

                THEN         Anfrage: Startdrehzahl   is reqested from DME
                         by STG   (ID 580H + STG)
                         RPM_ENG_STA = N_ST_POW_MOD   (converted)
                ENDIF
         ENDIF
ENDIF
```

4.60.5.3 Elektronischer Ölmeßstab

Please note: this message is sent:

- cyclic
- event-triggered
- on request (see 3.1.1)

```
If     LV_IGK = 0
   Then     CTR_DLY_MSG_OIL = 0
   Else     if     CTR_DLY_MSG_OIL < C_CTR_DLY_MSG_OIL
            Then     CTR_DLY_MSG_OIL ++
            Endif
   Endif

 If          CTR_DLY_MSG_OIL >= C_CTR_DLY_MSG_OIL   or
               LC_SND_MSG_OIL_KEY_AUX = 1
      Then          RECM_RFLV_EOI =   STATE_OIL_REQ
               If          STATE_LOIL = 0
         Then          FLLV_EOI = C_STATE_LOIL_SUB
         Else          FLLV_EOI = STATE_LOIL
         Endif
      Else          FLLV_EOI = C_STATE_LOIL_SUB
               RECM_RFLV_EOI =   0
      Endif
```

4.60.5.4 BOS_MELDUNG

ID2_BOS_MESS	=	idbosmsg
ID_FN_BOS_MESS	=	idfbosmg_w
RMMI_BOS	=	DIST_RESI_OIL
ST_UN_BOS	=	DIST_RESI_OIL_KM
AVAI_BOS_MESS	=	STATE_OIL_AVL

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COU_RSTG_BOS_MESS = zrbosmld

4.60.5.5 BOS_MELDUNG_2

ID2_BOS_MESS_2 = QOIL_DS_CAN_2_1
ID_FN_BOS_MESS_2 = QOIL_DS_CAN_2_2
FRC_INTM_WAY_BOS_MESS_2 = QOIL_DS_CAN_2_3
TARD_YR_BOS_MESS_2 = QOIL_DS_CAN_2_4
TARD_MON_BOS_MESS_2 = QOIL_DS_CAN_2_5
FRC_INTM_T_BOS_MESS_2 = QOIL_DS_CAN_2_6

4.60.5.6 TORQUE_1

check control torque_1 DME :
CHKSM_TORQ_1_DME = CKS_CLC_ECU1

alive counter torque_1 DME :
ALIV_TORQ_1_DME = TCC_CAN_ECU1
$TCC\_CAN\_ECU1_{N}$ = $TCC\_CAN\_ECU1_{N-1}$ + 10 ms

torque actual-value:
TORQ_AVL = TQ_AV (converted for BN2000)

status torque actual-value:
If SF_TQD = 3 **or**
LV_DI_TQ_REQ_CAN_MPI_GDI = 1
Then ST_TORQ_AVL = 3
Else ST_TORQ_AVL = SF_TQD
Endif

TORQ_AVL_DMEE = TQ_ECU_ETCU (converted for BN2000)
TQI_MAF:
IF LC_TQI_MAF_MAN = 1
Then TQI_MAF = TQI_SP_CAN
Else TQI_MAF = TQI_REF * EFF_IGA_AV_CAN * EFF_SCC_AV_CAN * EFF_LAMB_AV
Endif
calculation of TQ_MAF:
TQ_MAF = TQI_MAF + TQ_LOSS

Status_switch_clutch:
IF LV_AT = 1 **OR** LV_VAR_AMT = 1
THEN ST_SW_CLT = 3H
ELSE ST_SW_CLT = LV_IM_CS_PN
ENDIF

status DME/ACC switch-off:
IF LV_DCC_OFF_ECU = 0
THEN ST_DMEA_SWO = 0H
ELSE ST_DMEA_SWO = 1H
ENDIF

receipt_ACC_switch-off_system_DME:

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```
IF        LV_DCC_OFF_ACK          =   0
THEN      RCPT_ACC_SWO_SYS_DME    =   0H
ELSE      RCPT_ACC_SWO_SYS_DME    =   1H
ENDIF
```

status_receipt_engine_ACC:

```
IF        LV_VAR_DCC              =   0
THEN      STATE_TQ_INTV_DCC       =   3H
ELSEIF    LV_ERR_BN_TQ_DCC        =   0
THEN      STATE_TQ_INTV_DCC       =   0H
ELSEIF    ERR_SYM_BN_TQ_DCC       =   SYM_1    OR
          ERR_SYM_BN_TQ_DCC       =   SYM_3
THEN      STATE_TQ_INTV_DCC       =   1H
ELSEIF    ERR_SYM_BN_TQ_DCC       =   SYM_2
THEN      STATE_TQ_INTV_DCC       =   2H
ENDIF
```

ST_RCPT_ENG_ACC = STATE_TQ_INTV_DCC

status_receipt_engine_ARS:

```
IF        LV_VAR_ARS              =   0
THEN      STATE_TQ_INTV_ARS       =   3H
ELSEIF    LV_ERR_BN_ARS           =   0
THEN      IF        LV_TQ_MAX_ARS          =   1
           THEN     STATE_TQ_INTV_ARS      =   1H
           ELSE     STATE_TQ_INTV_ARS      =   0H
           ENDIF
ELSEIF    ERR_SYM_BN_ARS          =   SYM_1    OR
          ERR_SYM_BN_ARS          =   SYM_3    OR
          LV_TQ_MAX_ARS           =   1
THEN      STATE_TQ_INTV_ARS       =   1H
ELSEIF    LV_ERR_BN_ARS           =   1        AND
          ERR_SYM_BN_ARS          =   SYM_2
THEN      STATE_TQ_INTV_ARS       =   2H
ENDIF
```

ST_RCPT_ENG_ARS = STATE_TQ_INTV_ARS

status_receipt_engine_DSC:

```
IF        LV_VAR_ASR              =   0
THEN      STATE_TQ_INTV_TCS       =   3H
ELSEIF    LV_ERR_BN_TQ_TCS        =   0
THEN      STATE_TQ_INTV_TCS       =   0H
ELSEIF    ERR_SYM_BN_TQ_TCS       =   SYM_1    OR
          ERR_SYM_BN_TQ_TCS       =   SYM_3
THEN      STATE_TQ_INTV_TCS       =   1H
ELSEIF    ERR_SYM_BN_TQ_TCS       =   SYM_2    OR
THEN      STATE_TQ_INTV_TCS       =   2H
ENDIF
```

ST_RCPT_ENG_DSC = STATE_TQ_INTV_TCS

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status_receipt_engine_EGS/SSG/TCT:

```
IF       LV_AT = 1
THEN     ST_RCPT_ENG_EGS = STATE_TQ_INTV_ETCU
ELSEIF   LV_VAR_AMT = 1
THEN     ST_RCPT_ENG_EGS = STATE_TQ_INTV_AMT
ELSEIF   LV_VAR_TCT = 1
THEN     ST_RCPT_ENG_EGS = STATE_TQ_INTV_TCT
ENDIF

IF       LV_AT = 0
THEN     STATE_TQ_INTV_ETCU = 3H
ELSEIF   LV_ERR_BN_TQ_ETCU = 0
THEN     STATE_TQ_INTV_ETCU = 0H
ELSEIF   ERR_SYM_BN_TQ_ETCU = SYM_1 OR
         ERR_SYM_BN_TQ_ETCU = SYM_3
THEN     STATE_TQ_INTV_ETCU = 1H
ELSEIF   LV_ERR_BN_TQ_ETCU = 1 AND
         ERR_SYM_BN_TQ_ETCU = SYM_2 OR
THEN     STATE_TQ_INTV_ETCU = 2H
ENDIF

IF       LV_VAR_AMT = 0
THEN     STATE_TQ_INTV_AMT = 3H
ELSEIF   STATE_ERR_AMT_CAN = 0H
THEN     STATE_TQ_INTV_AMT = 0H
ELSEIF   STATE_ERR_AMT_CAN = 2H OR
         STATE_ERR_AMT_CAN = 3H OR
THEN     STATE_TQ_INTV_AMT = 1H
ELSEIF   STATE_ERR_AMT_CAN = 1H
THEN     STATE_TQ_INTV_AMT = 2H
ELSE     STATE_TQ_INTV_AMT = 3H
ENDIF

IF       LV_VAR_TCT = 0
THEN     STATE_TQ_INTV_TCT = 3H
ELSEIF   LV_ERR_BN_TQ_TCT = 0
THEN     STATE_TQ_INTV_TCT = 0H
ELSEIF   ERR_SYM_BN_TQ_TCT = SYM_1 OR
         ERR_SYM_BN_TQ_TCT = SYM_3
THEN     STATE_TQ_INTV_TCT = 1H
ELSEIF   LV_ERR_BN_TQ_TCT = 1 AND
         ERR_SYM_BN_TQ_TCT = SYM_2
THEN     STATE_TQ_INTV_TCT = 2H
ENDIF
```

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status_OBD_control-function_gearbox ST_OBD_CTFN_GRB:

ST_OBD_CTFN_GRB = STATE_DIAG_GS

status_contact_brake-pedal_DME:

if LV_ERR_BLS_PLAUS = 1
then ST_CT_BRPD_DME = 111b
elseif LV_IM_BTS = 0 **and** LV_IM_BLS = 0
then ST_CT_BRPD_DME = 000b
elseif LV_IM_BTS = 1 **and** LV_IM_BLS = 0
then ST_CT_BRPD_DME = 010b
elseif LV_IM_BTS = 0 **and** LV_IM_BLS = 1
then ST_CT_BRPD_DME = 001b
else ST_CT_BRPD_DME = 011b
endif

4.60.5.7 TORQUE_2

checksum_torque_2_DME:
CHKSM_TORQ_2_DME = CKS_CLC_ECU2

status_over-run-fuel-shutoff:
IF LV_PUC=0 **and** LV_TQ_DCC_INC_REQ=1 **and**
TQI_DCC_FAST_INC $<$ TQI_REF_IGA_MIN_LAMB
Then ST_INFS =02H
else ST_INFS = LV_PUC
endif

alive counter torque_2 DME **:**
ALIV_TORQ_2_DME = TCC_CAN_ECU2
TCC_CAN_ECU2$_N$ = T CC_CAN_ECU2$_{N-1}$ + 10 ms

status_switch_level_RPM:
if N_SP_IS $>$ C_N_SP_IS_THD_CAN
then ST_SW_LEV_RPM = 00b
LV_LEVEL_IS = 0
else ST_SW_LEV_RPM = 01b
LV_LEVEL_IS = 1
endif

torque_actual-value_minimum:
TORQ_AVL_MIN = TQ_LOSS (converted for BN2000)

torque_actual-value_maximum:
TORQ_AVL_MAX = TQ_MAX_CLU (converted for BN2000)

torque_actual-value_spare_negative:
TORQ_AVL_SPAR_NEG = TQ_REF_IGA_MIN_LAMB (converted for BN2000)
TQ_REF_IGA_MIN_LAMB = TQI_REF_IGA_MIN_LAMB + TQ_LOSS

torque_actual-value_spare_positive:
TORQ_AVL_SPAR_POS = TQ_MAF (converted for BN2000)

4.60.5.8 TORQUE_3

checksum_torque_3_DME:
CHKSM_TORQ_3_DME = CKS_CLC_ECU3

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alive counter torque_2 DME :
ALIV_TORQ_3_DME = TCC_CAN_ECU3
$TCC\_CAN\_ECU3_N$ = $TCC\_CAN\_ECU3_{N-1}$ + 10 ms

torque_driver's-choice:
TORQ_DVCH = TQ_EMS_BN (converted)
TQ_EMS_BN = TQ_LOSS + MIN [MAX(TQI_EMS;TQI_DCC_FAST_INC);
TQI_REF_MAX*EFF_IGA_BAS_COR]

angle_accelerator-pedal:
PV_MAX_CAN = PV_MAX (converted)

If PV_MAX_CAN $<$ FFH
Then ANG_ACPD = PV_MAX_CAN
Else ANG_ACPD = FEH
Endif

// save "engine should run-status" without need of ENSD
If LV_ST_END = 1
Then LV_ENG_RUN_CAN = 1
T_ERR_N_ENG = 0 s
Else **If** ECU_STATE = PWL
Then LV_ENG_RUN_CAN = 0
Endif
Endif

RPM_engine and RPM_engine_error:
If N $>$ 0
Then N_CAN = N (converted)
RPM_ENG_ERR = LV_ERR_CRK
Else **if** (LV_ENG_RUN_CAN = 1 AND LV_STALL=0)
Then **if** (T_ERR_N_ENG $>$= C_T_MAX_ERR_N_ENG) **and** LV_ERR_CRK=0
then LV_ENG_RUN_CAN = 0
T_ERR_N_ENG = 0 s
N_CAN = 0
RPM_ENG_ERR = 00H
else T_ERR_N_ENG = T_ERR_N_ENG + 0,01 s
N_CAN = FFFFH // CRK error active but not de-bounced
RPM_ENG_ERR = 01H // RPM_ENG=FFFH RPM_ENG_ERR=1
endif
Else N_CAN = 0
RPM_ENG_ERR = LV_ERR_CRK
Endif
Endif
RPM_ENG = N_CAN

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status_idling_engine:
ST_IDLG_ENG = ! LV_IS

status closed-loop-control speed:

```
IF        STATE_CRU_CAN  = 7H              // DEC
THEN          STATE_CRU_BN  = 4H
ELSEIF    STATE_CRU_CAN  = 1H              // CONST/TIP
THEN          STATE_CRU_BN  = 5H
ELSEIF    STATE_CRU_CAN  = 3H              // RES
THEN          STATE_CRU_BN  = 6H
ELSEIF    STATE_CRU_CAN  = 5H              // SET_ACC
THEN          STATE_CRU_BN  = 7H
ELSEIF    (STATE_CRU_CAN  = 0H     AND     //PASSIVE
           PV_AV     = 0%)
THEN          STATE_CRU_BN  = 8H
ELSEIF    (STATE_CRU_CAN  = 0H     AND     //PASSIVE
           PV_AV     <> 0%)
THEN          STATE_CRU_BN  = 9H
ENDIF
```

```
if        LV_MTC_CUR_OFF   = 1
then      ST_CLCTR_V   = FH
elseif    LV_KD  =  1
then      ST_CLCTR_V   = 0BH
elseif    LV_VAR_DCC = 1
then      ST_CLCTR_V   = STATE_TQ_DCC
elseif    LV_VAR_BN_LDM = 1
then      ST_CLCTR_V   = STATE_TQ_LDM
else      ST_CLCTR_V   = STATE_CRU_BN
endif
```

Required_amount_of_fuel:

```
IF        CONF_SWI_EFP_OUT   =   !1
THEN      IF          LC_EFPPWM_CTL = 0
              THEN        RQAM_FU   =   VFF_EFP
              ELSE        RQAM_FU   =   EFPPWM_CAN
ENDIF
```

4.60.5.9 ENGINE_RPM

actual engine speed limit (orange area) depending on TCO:

```
IF        N_MAX_THD_1        >    N_MAX_THD_1_CAN
THEN      N_MAX_THD_1_CAN    =    N_MAX_THD_1
ENDIF
RPM_TEMP_DOM_1   =   N_MAX_THD_1_CAN
```

```
IF        LV_ERR_TCO    = 0
THEN      RPM_TEMP_DOM_1 = N_MAX_THD_1_CAN
ELSE      RPM_TEMP_DOM_1 = FFH
```

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ENDIF

actual engine speed limit (red area) depending on TCO:
IF N_MAX_THD_2 > N_MAX_THD_2_CAN
THEN N_MAX_THD_2_CAN = N_MAX_THD_2
ENDIF

IF LV_ERR_TCO = 0
THEN RPM_TEMP_DOM_2 = N_MAX_THD_2_CAN
ELSE RPM_TEMP_DOM_2 = FFH
ENDIF

4.60.5.10 ENGINE_1

temperature engine :

if LV_ERR_TCO = 1
then TEMP_ENG = FFH
else TEMP_ENG = TCO (converted)
endif

alive counter DME :
ALIV_COU_DME$_{N}$ = TCC_CAN_ECU
TCC_CAN_ECU$_{N}$ = TCC_CAN_ECU$_{N-1}$ + 200 ms

temperature engine oil :
TOIL_CAN = TOIL (converted)
if LV_ERR_QOIL_SENS = 1 **and**
(ERR_SYM_QOIL_SENS = SYM_0 **or**
ERR_SYM_QOIL_SENS = SYM_2)
then TEMP_EOI = FFH
else TEMP_EOI = TOIL_CAN
endif

status engine run :
if LV_ES = 1
then ST_ENG_RUN = 00b
elseif LV_ST = 1
then ST_ENG_RUN = 01b
elseif LV_ES = 0
and LV_ST = 0
then ST_ENG_RUN = 10b
endif

status switch warm-up ST_SW_WAUP **:**
if LV_LIH_COC_ON = 1
then ST_SW_WAUP = 10b
elseif LV_WUP_CAN = 0
then ST_SW_WAUP = 00b
else ST_SW_WAUP = 01b
endif
air-pressure engine AIP_ENG :
AMP_CAN = AMP_MES

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```
if          LV_ERR_AMP        =    1
then        AIP_ENG           =    FFH
else        AIP_ENG           =    AMP_CAN
endif
```

Injection-volume_fuel:

IJV_FU = FCO (like CAN11h)

Control_shift-lock:

```
IF          (LV_ACT_N_SP_IS_EXT_ADJ    = 1        AND
            LV_IS      = 1                        AND
            VS       = 0
THEN        CTL_SHIFT_LOCK_CAN = 10b              intervention
ELSE        CTL_SHIFT_LOCK_CAN = 01b              no intervention (default)
ENDIF
CTR_SLCK    =    CTL_SHIFT_LOCK_CAN
```

Active engine speed limit in case of limp home:

RDUC_DOCTR_RPM = STATE_N_MAX_THD_LIH

RPM_idling_target:

RPM_IDLG_TAR = N_SP_IS

Status_rbm-cycle:

```
IF          LV_DC_RBM = 1
THEN        ST_RBMCYC = 10b
ELSE        ST_RBMCYC = 00b
ENDIF
```

4.60.5.11 ENGINE_2 (Motordaten 2, ID=383h)

Request starting assistance:

```
If          B_notafu = 0
Then        RQ_STASS = 0
Else        RQ_STASS = 1
Endif
```

4.60.5.12 GESCHWINDIGKEIT_TEMPOMAT

speed_closed-loop-control_cruise-control:

V_CLCTR_CCTR = VS_SP_DRIV_CRU_CAN

status_speed_closed-loop-control_cruise-control ST_V_CLCTR_CCTR:

```
IF          LV_PROG_STEP_1      =    0
THEN        IF           LV_CRU_MAIN_SWI       = 0
THEN                 ST_V_CLCTR_CCTR       = 00H     "Off"
ELSE                 IF       STATE_CRU            =     "PASSIVE"
                          THEN     ST_V_CLCTR_CCTR =     01H     "inactive"
                          ELSE     ST_V_CLCTR_CCTR =     02H     "active"
                          ENDIF
            ENDIF
ELSE        ST_V_CLCTR_CCTR =    01H     "inactive"
ENDIF
```

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control_display_cruise-control:
CTR_DISP_CCTR = LV_STEP_ON_ICL

control_display_cruise-control_HUD:
CTR_DISP_CCTR_HUD = LV_CRU_DISP_HUD

receipt_activation_cruise-control_DR:
RCPT_ACTVN_CCTR_DR = LV_CRU_ACT_INH

index_number:
IDX_NO = NR_VS_CRU

speed_cruise-control_index_number_i :
V_CCTR_IDX_NO_i = VS_STEP_CAN_i (i = 1,2,3)

4.60.5.13 WAERMESTROM_MOTOR

air-conditioning-compressor_limit_torque:
IF LV_ACCOUT_RLY = 0
THEN TQ_MAX_ACC_CAN = 0
ELSE TQ_MAX_ACC_CAN = min(TQ_MAX_ACC, C_TQ_MAX_ACC)
ENDIF
ACCM_LIM_TORQ = TQ_MAX_ACC_CAN

heat-flow_request_DME:
HTFL_RQ_DME = FFh

heat-flow_status_DME:
HTFL_ST_DME = N_REL_CWP

status_current-raw_engine:
ST_CRAW_ENG = STATE_CUR_ENG_CNS

status_current_generator:
ST_I_GEN = CUR_GEN

status_generator:
ST_GEN = STATE_ALTER

status_load-state_generator:
ST_LDST_GEN = st_ldstgen

control_aperture_water-valve:
CTR_APE_WV = PWM_VALUE_HIV_PERC

load-state_generator:
LDST_GEN = POW_REL_ALTER_CLC

4.60.5.14 POWERMANAGEMENT_BATTERIESPANNUNG

(in case of E60, LV_VAR_VEH = 0)

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T_SEC_COU_REL_RED = FFFFFFH
SDWN_COU_BTSW = FFH
ST_SWO_KL_30 = 3H
ST_COS_SWO = 3H
ST_HT_RSCR = 3H
ST_PCOS = stpcos
CTR_PRED_PRIO_CF = POW_CTL_PRI_PEAK_RED_CFT
CTR_PRED_PRIO = POW_CTL_PRI_PEAK_RED
ST_SW_DSTB = 3H
ST_BTSW = 3H
U_BT = VB_POW_MNG
If LV_ERR_ACK_IGK_OFF = 1
then ACKM_RQ_SWO_KL_15 = 0
else ACKM_RQ_SWO_KL_15 = STATE_ACK_IGK_OFF
endif

4.60.5.15 POWERMANAGEMENT_ VERBRAUCHERSTEUERUNG

(in case of E60, LV_VAR_VEH = 0)

CTR_PCOS = POW_CTL_PARK_CNS
RQ_PCOS = rqpcos
CTR_CBR = CUR_RNG_CTL
CTR_PWR_COS = POW_CTL_PWR_CNS_1
CTR_PWR_SPCOS = POW_CTL_PWR_CNS_2
SLCTN_SPCOS = selspcos
ULEV = ulev

4.60.5.16 Radmoment Antriebsstrang 1

CHKSM_WMOM_PT_1 = CKS_CLC_TQ_WHEEL_1

ALIV_WMOM_PT_1 = TCC_CAN_TQ_WHEEL_1
TCC_CAN_TQ_WHEEL_1_N = TCC_CAN_TQ_WHEEL_1_{N-1} + 20 ms

ST_PENG = STATE_ENGG_POS
WMOM_PT_AVL = TQ_WHEEL

IF LV_TQ_WHEEL_LDM_BN_ERR = 1
THEN PV_LDM_REQ_CAN = FFFH
ELSE PV_LDM_REQ_CAN = PV_CRU (converted)
ENDIF

ANG_ACPD_TAR = PV_LDM_REQ_CAN

ANG_ACPD_REAL = PV_AV

IF CTR_LDM_CAN_INI $>$ = C_CTR_LDM_CAN_INI
Then ST_INTF_PT = 0
LV_LDM_CAN_INI = 0
If LV_LDM_OFF_ECU = 1 **or**
LV_ERR_LDM_INH_MON = 1

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Then Bit 1 of ST_INTF_PT is set to 1
Else Bit 1 of ST_INTF_PT is reset to 0
Endif

If LV_LDM_OFF = 1
Then Bit 0 of ST_INTF_PT is set to 1
Else Bit 0 of ST_INTF_PT is reset to 0
Endif
Else Bit 0, Bit 1, Bit 2 and Bit 3 of ST_INTF_PT are set, Bit 4 is reset to 0
// ST_INTF_PT = FH
if LV_IGK = 1
then CTR_LDM_CAN_INI ++
//incremented with cyclic transmission of message
endif
Endif

4.60.5.17 Radmoment Antriebsstrang 2

CHKSM_WMOM_PT_2 = CKS_CLC_TQ_WHEEL_2

ALIV_WMOM_PT_2 = TCC_CAN_TQ_WHEEL_2
TCC_CAN_TQ_WHEEL_2$_N$ = TCC_CAN_TQ_WHEEL_2$_{N-1}$ + 20 ms

WMOM_PT_MAX = TQ_MAX_WHEEL
WMOM_PT_MIN_LOW = TQ_MIN_WHEEL_L
WMOM_PT_COODT_TAR = Md_rad_ksoll (converted to BN! see LH)

4.60.5.18 Challenge to CAS (EWS):

The frame n+1 will only be send if the frame n has be confirmed by the can-driver
Frame 1:
ID c see LH EWS
IMOB_TRM_CHAL_x

Frame 2:
ID d see LH EWS
IMOB_TRM_CHAL_x

Frame 3:
ID e see LH EWS
IMOB_TRM_CHAL_x

ACTION_COMM_SEND_CHAL_CAN_TRIG() :
ctr_imob_resp_rcv_can = 0 (delete receive-counter)
Start Transmission

4.60.5.19 Status Kraftstoffregelung DME

status_fuel_closed-loop-control_DME:
IF LC_EFPPWM_CTL = 0
THEN STATE_EFP_CTL_ECU = 01H
ELSE STATE_EFP_CTL_ECU = 02H
ENDIF
ST_FU_CLCTR_DME = STATE_EFP_CTL_ECU

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4.60.5.20 OBD_DT_MOTOR (OBD Daten Motor)

Message Layout:

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

Figure 4.60.26: Byte2

Byte2			STATE_OBD_CYC_BN -> ST_PFC_CYC

Figure 4.60.27: Byte1

Byte1	LOAD_CLC -> CALCVL_LD_ENG

Figure 4.60.28: Byte0

Byte0	OBD_TPS_1 -> PO_THVA_ENG

Position of throttle valve (converted from 0...FFh -> 0...FEh):
if OBD_TPS_1 > 7Fh
then PO_THVA_ENG = OBD_TPS_1 - 1h *(shift for conversion)*
else PO_THVA_ENG = OBD_TPS_1
endif

Calculated value for enginge load (converted from 0...FFh -> 0...FEh):
if LOAD_CLC > 7Fh
then CALCVL_LD_ENG = LOAD_CLC - 1h *(shift for conversion)*
else CALCVL_LD_ENG = LOAD_CLC
endif

State PFC-Cycle
If LV_DC_PERM = 0
Then STATE_OBD_CYC_BN = 0 0 (bin) *// 'Kein PFC-Zyklus',*
Else STATE_OBD_CYC_BN = 0 1 (bin) *// 'PFC-Zyklus erfüllt'*
Endif

ST_PFC_CYC = STATE_OBD_CYC_BN

4.60.5.21 ST_BATT (Status Battterie - ID:38Bh)

Condition battery:
CND_BT = Qv_out_m *// converted* -> Ph = 2 * [hex] %

Condition battery accuracy:
CND_BT_ACCY = Qv_quali_m *// converted* -> Ph = 2 * [hex] %

Condition battery change:
CND_BT_CHNG = Qvc_status_4 *// converted* -> Ph = 2 * [hex] - 128

Condition battery time (resolution 4 h, Qv_td -> resolution 1h):

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If Qv_td1 /4 < 255
Then CND_BT_T = Qv_td1 /4 *//residue not used*
Else CND_BT_T = FEh
Endif

Status condition battery:
If Qvc_status_3 < FH
Then ST_CND_BT = Qvc_status_3
Else ST_CND_BT = 1
Endif

4.60.5.22 DISP_GSI (Anzeige Schalthinweis - ID:2F3h)

Formula section:

alive counter display gear shift indication :
ALIV_DISP_GSI = TCC_CAN_GS_IDC
$TCC\_CAN\_GC\_IDC_n$ = $TCC\_CAN\_GS\_IDC_{n-1}$ + 1

display target gear:
DISP_TARG = GS_IDC_GEAR (copy lowest 4 bit)

display gear shift indication :
DISP_GSI = GS_IDC_DISP (copy lowest 2 bit)

Checksum for gear shift indication :
CHKSM_DISP_GSI = CKS_CLC_GS_IDC

4.60.5.23 DISP_ENGDAT (Anzeige Motordaten - ID:175h)

alive counter display gear shift indication :
ALIV_DISP_ENGDAT = TCC_CAN_DISP_ECU
$TCC\_CAN\_DISP\_ECU_n$ = $TCC\_CAN\_DISP\_ECU_{n-1}$ + 1

display rpm of engine:
If C_N_DISP_DYN_ENA = 1
Then DISP_RPM_ENG = N_DISP_DYN
Else DISP_RPM_ENG = N_CAN
Endif

4.60.5.24 Dienste - Anforderung Bus/Teilnetz (ID2 = 12/Ch)

General information:

This message is sent to guarantee a defined PWL time for DMTL-diagnosis. The maximum power latch time is requested only once per driving cycle. This Function is only necessary for vehicle platforms which have a switched Klemme 30 by CAS. Message Layout:

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	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte7								
Byte6								
Byte5	DUR_FLLUPT							
Byte4	ST_LAW_RQ				ST_RQ_BUS			
Byte3	ID_RQ_BUS							
Byte2	ID_FN_RQ_BUS							
Byte1	ID_FN_RQ_BUS							
Byte0	12-Anforderung Bus/Teilnetz							

Application conditions

Initialisation: *LV_REQ_PWL_DMTL_SND = 0 at reset or LV_IGK 0->1*

Recurrence: *event triggered (tmin=100ms, sent 3 times with recurrence 160ms)*
-> see formula section

Activation: LC_ENA_REQ_PWL_DMTL_CAN = 1

Formula section:

If LV_REQ_PWL_DMTL = 0 -> 1 **and** LV_REQ_PWL_DMTL_SND = 0
Then send message 3 times with recurrence 160ms (as described below)
//ID_function_request_bus : tank leakage diagnosis:
ID_FN_RQ_BUS = 110h
//request bus "Klemme 30g":
ID_RQ_BUS = 50
// status of request bus : activation:
ST_RQ_BUS = 0
// request due to law:
ST_LAW_RQ = 1
// requested powerledge time (converted and limited):
DUR_FLLUPT = C_T_DMTL_MAX
(DUR_FLLPT = 0 ... 254 min, (PH) = (HEX) [min])
If *sending finished*
Then LV_REQ_PWL_DMTL_SND = 1
Endif
Endif
 # IF (NC_SPORT_SZL != 0) // Compiler switch for deactivation of functionality

4.60.5.25 ST_MDRV (status MDRIVE, ID = 399 hex)

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte5		unused				unused		
Byte4	unused		CTR_DISP_MDRV		unused			
Byte3	unused				unused			
Byte2	ST_MDRV_CHC_ENG				ST_MDRV_STG_GRB			
Byte1	ST_MDRV_MOD_GRB			ST_MDRV_DSC			unused	
Byte0	ALIV_ST_MDRV				CHKSM_ST_MDRV			

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Figure 4.60.29: Signal

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Signal	Range	Conversion	Invalid-case
CHKSM_ST_MDRV	0...15	-	-
ALIV_ST_MDRV	0...Eh	-	Fh
ST_MDRV_DSC	0...111b	000 Keine Änderung 001 DSC AUS 010 DSC EIN 100 DSC EIN Sport 101 DTC EIN M-Track-Mode 111 Signal ungültig	111b
ST_MDRV_MOD_GRB	0...7h	000: Keine Änderung 001: Automatik 010: Sequentiell 111: Signal ungültig	111b
ST_MDRV_STG_GRB	0...15h	0: Keine Änderung 1..6: Stufe 1..6 15: Signal ungültig	1111b
ST_MDRV_CHC_ENG	0...15h	0: keine Änderung 1: Kennlinie 1 2: Kennlinie 2 15: Signal ungültig	1111b
CTR_DISP_MDRV	0...3h	00 M-Drive-Anzeige AUS 01 M-Drive-Anzeige EIN 10 M-Drive-Anzeige EIN, BLINKEN 11 Signal ungültig	3h

Application conditions

Initialisation: *all zero at Reset*

Recurrence:
- 10s (tmin = 9s, tmax = 11s)
- at signalchange (tmin = 160 ms)
- 3 times when LV_IGK 1- ->0 (tmin = 160 ms)

Activation: *LV_VAR_SPT_SWI = 1*

Formula section:

CTR_DISP_MDRV = STATE_SPT_DISP_CAN ///copy lowest bits
ST_MDRV_DSC = STATE_SPT_ESP_CAN ///copy lowest bits
ST_MDRV_CHC_ENG = STATE_SPT_ECU_CAN ///copy lowest bits
ST_MDRV_MOD_GRB = STATE_SPT_MOD_GB ///copy lowest bits
ST_MDRV_STG_GRB = STATE_SPT_STEP_GB ///copy lowest bits

Checksum and alive counter calculation:
$ALIV\_ST\_MDRV_N$ = $ALIV\_ST\_MDRV_{N-1}$ + 1
CHKSM_ST_MDRV = CRC_CLC_CAN_STMDRV (Standart 4bit checksum)

 # ENDIF

4.60.6 Checkcontrol- Messages

General Information:

Activation: LV_KEY_AUX = 1 **OR** LV_IGK = 1
Update rate: 100ms
Initialisation: at reset or at transition KL.15 0 - -> 1 :
LV_CC_POIL_SWI_INH = 1

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```
                    LV_CC_TEST_BENCH_ACT = 0
                at LV_ST_END = 0 -> 1:
                    T_DLY_POIL_SWI_CAN = IP_T_DLY_POIL_SWI_CAN__TOIL
            at reset:
        CYC_CTR_CC              = 0
        LV_CC_ID_XX             = 0
        LV_SEND_CC_ID_XX        = 0
        LV_CC_ID_BENCH          = 0
        LV_SEND_CC_ID_BENCH     = 0
        CC_ID = 0
            at deactivation:
                LV_MIL_CAN_1            = 0
                LV_MIL_CAN_1 n-1        = 0
                LV_CC_ID_34             = 0
                LV_SEND_CC_ID_34        = 0
```

Formula section:

conditions for sending of CC-messages:

- -> to be calculated only in 100ms recurrency:

```
if          (LV_ES = 0)
then        STATE_CC_KEY = 3            // Motor läuft
else        if      (LV_IGK = 1)
            then    STATE_CC_KEY = 2            // Kl. 15 an
            else    if      (LV_KEY_AUX = 1)
                    then    STATE_CC_KEY = 1    // Kl. R an
                    else    STATE_CC_KEY = 0
                    endif
            endif
endif
```

// Auxiliary bit for suppressing EML during predrive-check:

- -> to be calculated only in 500ms recurrency

```
if          LV_WAL_1_EXT_ADJ = 1
then        LV_WAL_1_CAN = LV_ACT_WAL_1_EXT_ADJ
elseif      (LV_WAL_ST = 1)                     //predrive check active
then        LV_WAL_1_CAN = 0;
else        LV_WAL_1_CAN = LV_WAL_1
endif

if          LV_MIL_EXT_ADJ = 1
then        LV_MIL_CAN = LV_ACT_MIL_EXT_ADJ
else        LV_MIL_CAN = LV_MIL
endif
```

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// Auxiliary bit for MIL-Lamp only (or flash) CC-message:

```
- -> to be calculated only in  500ms recurrency
if            STATE_MIL_ON_DIS_EXT_REQ = 02h or  LC_ENA_CC_MIL_1 = 0
              //MIL-OFF by coding or calibration
then          LV_MIL_CAN_1 = 0
elseif        LV_MIL_EXT_ADJ = 1  // external adjustment by tester
then          LV_MIL_CAN_1 = LV_ACT_MIL_EXT_ADJ
elseif        STATE_MIL = 2
      then       if        STATE_MIL N-1 <> 2
       then         LV_MIL_CAN_1 = 0
          else         LV_MIL_CAN_1 =1
          endif
  else        if        [LV_MIL =1 and
                  ( LV_WAL_ST= 1 orSTATE_MIL = 1 or  LV_MIL_ACT_REQ=1)]
       then         LV_MIL_CAN_1 = 1
        else          LV_MIL_CAN_1 = 0
        endif
      endif
endif
```

//Auxiliary bit for FUC CC-message:

```
- -> to be calculated only in  500ms recurrency
if                  LV_FUC_CAN = 1                   or
                    LV_CHK_FUC_OPEN_CAN = 1
then                LV_FUC_CAN_BN = 1
else                LV_FUC_CAN_BN = 0
endif
```

//Auxiliary bit for BLS defect   CC-message:

```
- -> to be calculated only in  500ms recurrency
if                  (VAR_VEH = PL2  & &
                  LV_ERR_BLS_PLAUS = 1)
then              LV_BLS_PLAUS_CAN = 1
else              LV_BLS_PLAUS_CAN = 0
endif
```

// activation of Bench mode

```
- -> to be calculated in 100ms recurrency:
if              (LC_CC_TEST_BENCH = 1)
then          STATE_CC_TEST_BENCH_OBD_1 = STATE_READY_OBD_1 nor
                 C_STATE_CC_TEST_MASK_OBD_1 // (bitweise Verknüpfung)
             STATE_CC_TEST_BENCH_OBD_2 = STATE_READY_OBD_2 nor C_STATE_CC_TEST_
             MASK_OBD_2 // (bitweise Verknüpfung)
             if          [(C_STATE_CC_TEST_BENCH [Bit 0] = 1) and
                      (CTR_ERR_DYN_NR >= C_CTR_ERR_DYN_CC_TEST_BENCH)] or
                      [(C_STATE_CC_TEST_BENCH [Bit 1] = 1) and
```

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```
                    (OPM_AV >= C_STATE_OPM_MIN_CC_TEST_BENCH) and
                    (OPM_AV <= C_STATE_OPM_MAX_CC_TEST_BENCH)]          or
                   [(C_STATE_CC_TEST_BENCH [Bit 2] = 1) and
                    (STATE_COC >= C_STATE_COC_MIN_CC_TEST_BENCH) and
                    (STATE_COC <= C_STATE_COC_MAX_CC_TEST_BENCH)]          or
                   [(C_STATE_CC_TEST_BENCH [Bit 3] = 1) and
                   (CTR_CDN_OBD_RBM > CTR_CDN_OBD_RBMn-1)]                 or
                   [(C_STATE_CC_TEST_BENCH [Bit 4] = 1) and
                   (LV_WUP = 0)]                                       or
                   [(C_STATE_CC_TEST_BENCH [Bit 5] = 1) and
                   (STATE_CC_TEST_BENCH_OBD_1 =
                    C_STATE_CC_TEST_BENCH_OBD_1            or
                   STATE_CC_TEST_BENCH_OBD_2 =
                    C_STATE_CC_TEST_BENCH_OBD_2 )]
            then          LV_CC_TEST_BENCH_ACT = 1
            else         LV_CC_TEST_BENCH_ACT = 0

            endif
else        LV_CC_TEST_BENCH_ACT = 0
endif


 // Auxiliary bit and transmission for CC message   low oil pressure :

- -> to be calculated only in   100ms recurrency:
 If              N_32         >  C_N_32_THD_CC_POIL_SWI       AND
                         LV_ST_END = 1
 Then        if          T_DLY_POIL_SWI_CAN          >        0
          then    T_DLY_POIL_SWI_CAN     =     T_DLY_POIL_SWI_CAN - 100 ms
         else   LV_CC_POIL_SWI_INH    =    0
            endif
       else          LV_CC_POIL_SWI_INH = 1
       endif

- -> to be calculated only in   500ms recurrency:
 If              LV_CC_POIL_SWI_INH = 0                  and
                          LV_POIL_SWI       = 0              // oil-pressure low
 then       LV_POIL_SWI_CAN          = 1
 else       LV_POIL_SWI_CAN          = 0
 endif

 // Auxiliary bit and transmission for CC message   TRA-mode :
   • to be calculated only in   500ms recurrency:
If              LV_ERR_EGY_MIN_2 = 1              // transportation mode
          then         LV_TRA_MODE_CAN = 1
 else       LV_TRA_MODE_CAN = 0
 endif


// If an error occurs CC-message has to be activated
// If an error already exists and a new error occurs the actual
// counter has to be stopped and the new error has to be transmitted first
```

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```
// before the old error is transmitted again

if          (CYC_CTR_CC % 5 = 0 )                    // to be calculated only in  500ms recur-
rency
      // CC-message MIL-flash-light:
      if        (LV_MIL_CAN_1!= LV_MIL_CAN_1 n-1
                & & STATE_CC_KEY >= C_STATE_CC_ID_34)
      then        CYC_CTR_CC_SAVE = CYC_CTR_CC
            CYC_CTR_CC = 0
            LV_SEND_CC_ID_34 = true
            if        (LV_MIL_CAN_1=1 )
            then        LV_CC_ID_34 = true
            elseif        (LV_MIL_CAN_1= 0 )
            then        LV_CC_ID_34 = false
            endif
            LV_EVE_CC_MSG = 1
        // CC-message Misfire B:
      elseif      (LV_MIS_STATE_A!= LV_MIS_STATE_A n-1
                & & STATE_CC_KEY >= C_STATE_CC_ID_33)
      then          CYC_CTR_CC_SAVE = CYC_CTR_CC
            CYC_CTR_CC = 5
            LV_SEND_CC_ID_33 = true
            if        (LV_MIS_STATE_A= 1 )
            then        LV_CC_ID_33 = true
            elseif        (LV_MIS_STATE_A   = 0 )
            then        LV_CC_ID_33 = false
            endif
            LV_EVE_CC_MSG = 1

      // CC-message   Engine temperature (warning 1)
      elseif          (LV_TEMP_ENG_WARN_1 != LV_TEMP_ENG_WARN_1 n-1
                & & STATE_CC_KEY >= C_STATE_CC_ID_257)
                 // only at transition
                // nur Übergang beachten
      then          CYC_CTR_CC_SAVE = CYC_CTR_CC
            CYC_CTR_CC = 10
            LV_SEND_CC_ID_257 = true
            if        (LV_TEMP_ENG_WARN_1 = 1 )
            then        LV_CC_ID_257 = true
            elseif        (LV_TEMP_ENG_WARN_1 = 0 )
            then        LV_CC_ID_257 = false
            endif
                  LV_EVE_CC_MSG = 1

      // CC_message   Engine temperature (warning 2) :
      if          (LV_ TEMP_ENG_WARN_2 != LV_TEMP_ENG_WARN_2 n-1
                & & STATE_CC_KEY >= C_STATE_CC_ID_39)
                // only at transition
                  // only at transition
      then          CYC_CTR_CC_SAVE = CYC_CTR_CC
            CYC_CTR_CC = 15
            LV_SEND_CC_ID_39 = true
```

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```
        if       (LV_ TEMP_ENG_WARN_2   = 1 )
        then        LV_CC_ID_39 = true
        elseif       (LV_ TEMP_ENG_WARN_2   = 0 )
        then        LV_CC_ID_39 = false
        endif
                LV_EVE_CC_MSG = 1

// CC_message   low oil pressure :
elseif         (LV_POIL_SWI_CAN != LV_POIL_SWI_CAN n-1
           & & STATE_CC_KEY >= C_STATE_CC_ID_212)
then         CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 20
        LV_SEND_CC_ID_212 = true
        if       (LV_POIL_SWI_CAN= 1)
        then        LV_CC_ID_212 = true
        else        LV_CC_ID_212 = false
                endif
          LV_EVE_CC_MSG = 1

// CC_message STATE_ALTER:
elseif         (STATE_ALTER     != STATE_ALTER n-1
           & & STATE_CC_KEY >= C_STATE_CC_ID_213)
then         CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 25
        LV_SEND_CC_ID_213= true
        if       (STATE_ALTER= 02H)
        then        LV_CC_ID_213 = true
        elseif       (STATE_ALTER = ! 02H   )
        then        LV_CC_ID_213 = false
                endif
          LV_EVE_CC_MSG = 1

// CC_message CRU_OFF_IRR:
elseif         (LV_CRU_OFF_IRR!= LV_CRU_OFF_IRR n-1
           & & STATE_CC_KEY >= C_STATE_CC_ID_26)
then         CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 30
        LV_SEND_CC_ID_26 = true
        if       (LV_CRU_OFF_IRR= 1 )
                LV_CC_ID_26 = true
        elseif       (LV_CRU_OFF_IRR= 0 )
        then        LV_CC_ID_26 = false
        endif
                LV_EVE_CC_MSG = 1

// CC_message   oil level below minimum :
elseif         (LV_OIL_CNS_WARN_2!= LV_OIL_CNS_WARN_2 n-1
           & & STATE_CC_KEY >= C_STATE_CC_ID_28)
then         CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 35
        LV_SEND_CC_ID_28 = true
        if       (LV_OIL_CNS_WARN_2= 1 )
```

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```
        then       LV_CC_ID_28 = true
        elseif      (LV_OIL_CNS_WARN_2= 0 )
        then       LV_CC_ID_28 = false
        endif
              LV_EVE_CC_MSG = 1
```

// CC_message EML:

```
elseif         (LV_WAL_1_CAN   != LV_WAL_1_CAN n-1
          & & STATE_CC_KEY >= C_STATE_CC_ID_29)
then          CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 40
        LV_SEND_CC_ID_29 = true
        if        ( LV_WAL_1_CAN= 1 )
        then       LV_CC_ID_29 = true
        elseif      ( LV_WAL_1_CAN= 0 )
        then       LV_CC_ID_29 = false
        endif
              LV_EVE_CC_MSG = 1
```

// CC_message "transportation mode":

```
elseif         (LV_TRA_MODE_CAN   != LV_TRA_MODE_CAN n-1
          & & STATE_CC_KEY >= C_STATE_CC_ID_TRA)
then          CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = -
        LV_SEND_CC_ID_TRA = true
        if        (LV_TRA_MODE_CAN = 1 )
        then       LV_CC_ID_TRA = true
        elseif      (LV_TRA_MODE_CAN = 0 )
        then       LV_CC_ID_TRA = false
        endif
        LV_EVE_CC_MSG = 1
```

// CC_message   Zwangsschaltung aktiv :

```
elseif         (LV_LIH_COC_ON!= LV_LIH_COC_ON n-1
          & & STATE_CC_KEY >= C_STATE_CC_ID_155)
then          CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 50
        LV_SEND_CC_ID_155 = true
        if        ( LV_LIH_COC_ON= 1 )
        then       LV_CC_ID_155 = true
        elseif      ( LV_LIH_COC_ON= 0 )
        then       LV_CC_ID_155 = false
        endif
              LV_EVE_CC_MSG = 1
```

// CC_message   oil level at minimum :

```
elseif         (LV_OIL_CNS_WARN_1!= LV_OIL_CNS_WARN_1 n-1
          & & STATE_CC_KEY >= C_STATE_CC_ID_27)
then          CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 55
```

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```
        LV_SEND_CC_ID_27 = true
        if      (LV_OIL_CNS_WARN_1= 1 )
        then        LV_CC_ID_27 = true
        elseif      (LV_OIL_CNS_WARN_1= 0 )
        then        LV_CC_ID_27 = false
        endif
            LV_EVE_CC_MSG = 1
```

// CC_message close filler cap :

```
elseif          ( LV_FUC_CAN_BN!= LV_FUC_CAN_BN n−1
            & & STATE_CC_KEY >= C_STATE_CC_ID_32)
then         CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 60
        LV_SEND_CC_ID_32 = true
        if      ( LV_FUC_CAN_BN= 1 )
        then        LV_CC_ID_32 = true
        elseif      ( LV_FUC_CAN_BN   = 0 )
        then        LV_CC_ID_32 = false
        endif
            LV_EVE_CC_MSG = 1
```

// CC_message error oil level sensor :

```
elseif          ( LV_ERR_QOIL_SENS!= LV_ERR_QOIL_SENS n−1
            & & STATE_CC_KEY >= C_STATE_CC_ID_182)
then         CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 65
        LV_SEND_CC_ID_182 = true
        if      ( LV_ERR_QOIL_SENS= 1 )
        then        LV_CC_ID_182 = true
        elseif      ( LV_ERR_QOIL_SENS = 0 )
        then        LV_CC_ID_182 = false
        endif
        LV_EVE_CC_MSG = 1
```

// CC_message reload 12V-battery :

```
elseif          ( B_ccbtnach!= B_ccbtnach n−1
            & & STATE_CC_KEY >= C_STATE_CC_ID_229)
then         CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 70
        LV_SEND_CC_ID_229 = true
        if      ( B_ccbtnach= 1 )
        then        LV_CC_ID_229 = true
        elseif      ( B_ccbtnach = 0 )
        then        LV_CC_ID_229 = false
        endif
        LV_EVE_CC_MSG = 1
```

// CC_message no battery monitoring :

```
elseif          ( B_ccpmerr!= B_ccpmerr n−1
            & & STATE_CC_KEY >= C_STATE_CC_ID_247)
then         CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 75
```

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```
        LV_SEND_CC_ID_247 = true
        if      ( B_ccpmerr= 1 )
        then        LV_CC_ID_247 = true
        elseif      ( B_ccpmerr = 0 )
        then        LV_CC_ID_247 = false
        endif
        LV_EVE_CC_MSG = 1

// CC_message   stand-by-current error :
elseif        ( B_ccruhver!= B_ccruhver n-1
           & & STATE_CC_KEY >= C_STATE_CC_ID_220)
then          CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 80
        LV_SEND_CC_ID_220 = true
        if      ( B_ccruhver= 1 )
        then        LV_CC_ID_220 = true
        elseif      ( B_ccruhver = 0 )
        then        LV_CC_ID_220 = false
        endif
        LV_EVE_CC_MSG = 1

// CC_message   check battery :
elseif        ( B_ccbttdfk!= B_ccbttdfk n-1
           & & STATE_CC_KEY >= C_STATE_CC_ID_304)
then          CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 85
        LV_SEND_CC_ID_304 = true
        if      ( B_ccbttdfk= 1 )
        then        LV_CC_ID_304 = true
        elseif      ( B_ccbttdfk = 0 )
        then        LV_CC_ID_304 = false
        endif
        LV_EVE_CC_MSG = 1

// CC_message   check battery contacts :
elseif        ( B_ccbttknt!= B_ccbttknt n-1
           & & STATE_CC_KEY >= C_STATE_CC_ID_305)
then          CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 90
        LV_SEND_CC_ID_305 = true
        if      ( B_ccbttknt= 1 )
        then        LV_CC_ID_305 = true
        elseif      ( B_ccbttknt = 0 )
        then        LV_CC_ID_305 = false
        endif
        LV_EVE_CC_MSG = 1

// CC_message   consumer switch off :
elseif        ( B_ccprio!= B_ccprio n-1
           & & STATE_CC_KEY >= C_STATE_CC_ID_306)
then          CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 95
```

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```
        LV_SEND_CC_ID_306 = true
        if      ( B_ccprio= 1 )
        then        LV_CC_ID_306 = true
        elseif      ( B_ccprio = 0 )
        then        LV_CC_ID_306 = false
        endif
        LV_EVE_CC_MSG = 1
```

// CC_message   brake light switch defect :

elseif (LV_BLS_PLAUS_CAN != LV_BLS_PLAUS_CAN $_{n-1}$
& & STATE_CC_KEY $>$= C_STATE_CC_ID_148)
then CYC_CTR_CC_SAVE = CYC_CTR_CC

```
        CYC_CTR_CC = 100
        LV_SEND_CC_ID_148 = true
        if      ( LV_BLS_PLAUS_CAN= 1 )
        then        LV_CC_ID_148 = true
        elseif      ( LV_BLS_PLAUS_CAN = 0 )
        then        LV_CC_ID_148 = false
        endif
        LV_EVE_CC_MSG = 1
```

// CC_message   gear-shift up :

elseif (LV_GS_UP != LV_GS_UP $_{n-1}$
& & STATE_CC_KEY $>$= C_STATE_CC_ID_276)
then CYC_CTR_CC_SAVE = CYC_CTR_CC

```
        CYC_CTR_CC = 105
        LV_SEND_CC_ID_276 = true
        if      ( LV_GS_UP= 1 )
        then        LV_CC_ID_276 = true
        elseif      ( LV_GS_UP = 0 )
        then        LV_CC_ID_276 = false
        endif
        LV_EVE_CC_MSG = 1
```

// CC_message   gear-shift down :

elseif (LV_GS_DOWN != LV_GS_DOWN $_{n-1}$
& & STATE_CC_KEY $>$= C_STATE_CC_ID_278)
then CYC_CTR_CC_SAVE = CYC_CTR_CC

```
        CYC_CTR_CC = 110
        LV_SEND_CC_ID_278 = true
        if      ( LV_GS_DOWN= 1 )
        then        LV_CC_ID_278 = true
        elseif      ( LV_GS_DOWN = 0 )
        then        LV_CC_ID_278 = false
        endif
        LV_EVE_CC_MSG = 1
```

// CC_message   request for gear-shift up (temperature warning 3) :

elseif (LV_TEMP_ENG_WARN_3 != LV_TEMP_ENG_WARN_3 $_{n-1}$
& & STATE_CC_KEY $>$= C_STATE_CC_ID_367)
then CYC_CTR_CC_SAVE = CYC_CTR_CC

```
        CYC_CTR_CC = 115
```

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```
        LV_SEND_CC_ID_367 = true
        if      ( LV_TEMP_ENG_WARN_3= 1 )
        then        LV_CC_ID_367 = true
        elseif      (LV_TEMP_ENG_WARN_3 = 0 )
        then        LV_CC_ID_367 = false
        endif
        LV_EVE_CC_MSG = 1
```

// CC_message "MSA failure":

```
elseif      ( LV_ERR_STST != LV_ERR_STST_{n-1}
         & & STATE_CC_KEY >= C_STATE_CC_ID_397
         & & LV_VAR_STST = 1)
then        CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 120
        LV_SEND_CC_ID_397 = true
        if      (LV_ERR_STST = 1 )
        then        LV_CC_ID_397 = true
        elseif      (LV_ERR_STST = 0 )
        then        LV_CC_ID_397 = false
        endif
        LV_EVE_CC_MSG = 1
```

// CC_message "oil pressure lamp - yellow":

```
elseif      ( B_poel_gelb != B_poel_gelb_{n-1}
         & & STATE_CC_KEY >= C_STATE_CC_ID_427)
then        CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 125
        LV_SEND_CC_ID_427 = true
        if      (B_poel_gelb = 1 )
        then        LV_CC_ID_427 = true
        elseif      (B_poel_gelb = 0 )
        then        LV_CC_ID_427 = false
        endif
        LV_EVE_CC_MSG = 1
```

// CC_message "condition MSA deactivated":

```
elseif      ( LV_INH_STST_CDN != LV_INH_STST_CDN_{n-1}
         & & STATE_CC_KEY >= C_STATE_CC_ID_-0
         & & LV_VAR_STST = 1)
then        CYC_CTR_CC_SAVE = CYC_CTR_CC
        CYC_CTR_CC = 130
        LV_SEND_CC_ID_-0 = true
        if      (LV_INH_STST_CDN = 1 )
        then        LV_CC_ID_-0 = true
        elseif      (LV_INH_STST_CDN = 0 )
        then        LV_CC_ID_-0 = false
        endif
        LV_EVE_CC_MSG = 1
```

// CC_testmessage (bench mode):

```
elseif      ( LV_CC_TEST_BENCH_ACT != LV_CC_TEST_BENCH_ACT_{n-1}
         & & STATE_CC_KEY >= C_STATE_CC_ID_BENCH)
```

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```
        then        CYC_CTR_CC_SAVE = CYC_CTR_CC
                CYC_CTR_CC = 135
                LV_SEND_CC_ID_BENCH = true
                if      (LV_CC_TEST_BENCH_ACT = 1 )
                then        LV_CC_ID_BENCH = true
                elseif      (LV_CC_TEST_BENCH_ACT = 0 )
                then        LV_CC_ID_BENCH = false
                endif
                LV_EVE_CC_MSG = 1
        endif
endif


// If an error is present the corresponding CC-message is transmitted depending on the
// counter value. Due to the 100ms-recurrency and the calculation-steps of 5 it is secured that
// the messages are only transmitted with a recurrency of 500ms
If          ( CYC_CTR_CC = 0 & & LV_SEND_CC_ID_34 = True )
        then        CC_ID = 34
                if          ( STATE_MIL = 2 )                   // MIL flash light requested

                then        LV_MIL_FLL = true                   //Activation   MIL flash light
                else        LV_MIL_FLL = false                  // MIL: no flash light
                endif
                ST_CC_MESS_STD = LV_CC_ID_34

        elseif          ( CYC_CTR_CC = 5 & & LV_SEND_CC_ID_33 = True )
        then            CC_ID = 33
                LV_MIL_FLL = false
            ST_CC_MESS_STD = LV_CC_ID_33

  elseif          ( CYC_CTR_CC = 10 & & LV_SEND_CC_ID_257 = True )
        then            CC_ID = 257
                LV_MIL_FLL = false
                ST_CC_MESS_STD = LV_CC_ID_257

        elseif          ( CYC_CTR_CC = 15 & & LV_SEND_CC_ID_39 = True )
        then            CC_ID = 39
                LV_MIL_FLL = false
                ST_CC_MESS_STD = LV_CC_ID_39

        elseif          ( CYC_CTR_CC = 20 & & LV_SEND_CC_ID_212 = True )
        then            CC_ID = 212
                LV_MIL_FLL = false
                ST_CC_MESS_STD = LV_CC_ID_212

        elseif          ( CYC_CTR_CC = 25 & & LV_SEND_CC_ID_213 = True )
        then            CC_ID = 213
                LV_MIL_FLL = false
                ST_CC_MESS_STD = LV_CC_ID_213

      elseif    ( CYC_CTR_CC = 30 & & LV_SEND_CC_ID_26 = True )
        then            CC_ID = 26
```

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LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_26

elseif (CYC_CTR_CC = 35 & & LV_SEND_CC_ID_28 = True)
then CC_ID = 28
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_28

elseif (CYC_CTR_CC = 40 & & LV_SEND_CC_ID_29 = True)
then CC_ID = 29
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_29

elseif (CYC_CTR_CC == - & & LV_SEND_CC_ID_TRA == True)
then CC_ID = C_CC_ID_TRA
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_TRA

elseif (CYC_CTR_CC = 50 & & LV_SEND_CC_ID_155 = True)
then CC_ID = 155
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_155

elseif (CYC_CTR_CC = 55 & & LV_SEND_CC_ID_27 = True)
then CC_ID = 27
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_27

elseif (CYC_CTR_CC = 60 & & LV_SEND_CC_ID_32 = True)
then CC_ID = 32
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_32

elseif (CYC_CTR_CC = 65 & & LV_SEND_CC_ID_182 = True)
then CC_ID = 182
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_182

elseif (CYC_CTR_CC = 70 & & LV_SEND_CC_ID_229 = True)
then CC_ID = 229
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_229

elseif (CYC_CTR_CC = 75 & & LV_SEND_CC_ID_247 = True)
then CC_ID = 247
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_247

elseif (CYC_CTR_CC = 80 & & LV_SEND_CC_ID_220 = True)
then CC_ID = 220
LV_MIL_FLL = false

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```
ST_CC_MESS_STD = LV_CC_ID_220

elseif    ( CYC_CTR_CC = 85 & & LV_SEND_CC_ID_304 = True )
then      CC_ID = 304
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_304

elseif    ( CYC_CTR_CC = 90 & & LV_SEND_CC_ID_305 = True )
then      CC_ID = 305
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_305

elseif    ( CYC_CTR_CC = 95 & & LV_SEND_CC_ID_306 = True )
then      CC_ID = 306
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_306

elseif    ( CYC_CTR_CC = 100 & & LV_SEND_CC_ID_148 = True )
then      CC_ID = 148
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_148

elseif    ( CYC_CTR_CC = 105 & & LV_SEND_CC_ID_276 = True )
then      CC_ID = 276
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_276

elseif    ( CYC_CTR_CC = 110 & & LV_SEND_CC_ID_278 = True )
then      CC_ID = 278
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_278

elseif    ( CYC_CTR_CC = 115 & & LV_SEND_CC_ID_367 = True )
then      CC_ID = 367
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_367

elseif    ( CYC_CTR_CC = 120 & & LV_SEND_CC_ID_397 = True )
then      CC_ID = 397
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_397

elseif    ( CYC_CTR_CC = 125 & & LV_SEND_CC_ID_427 = True )
then      CC_ID = 427
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_427

elseif    ( CYC_CTR_CC = 130 & & LV_SEND_CC_ID_-0 = True )
then      CC_ID = -0
LV_MIL_FLL = false
ST_CC_MESS_STD = LV_CC_ID_-0
```

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```
  elseif        ( CYC_CTR_CC = 135 & & LV_SEND_CC_ID_BENCH = True )
        then          CC_ID = C_CC_ID_TEST_BENCH
                  LV_MIL_FLL = false
              ST_CC_MESS_STD = LV_CC_ID_BENCH

  else          CC_ID = 0

        endif

If          (LV_SEND_CC_ID_26 = True || .....  || LV_SEND_CC_ID_-0 || LV_SEND_CC_ID_BENCH
=True || LV_SEND_CC_ID_TRA == True )
Then            ID2_CC_MESS_STD = C_CC_MESS
                  NO_CC_MESS_STD = CC_ID
                  // ST_CC_MESS_STD see above
                  TRANF_CC_MESS_STD = C_T_CYC_DISP_ICL_CAN
                  If          LV_MIL_FLL = 1
                        ST_IDC_CCLK_CC_MESS_STD = C_ICL_DISP_FRQ
              else          ST_IDC_CCLK_CC_MESS_STD = 00H
              endif
                  CAN_SendMessage()
endif

if          LV_EVE_CC_MSG = 1
then            CYC_CTR_CC = CYC_CTR_CC_SAVE
              if          (CYC_CTR_CC>=5)
              then          CYC_CTR_CC = CYC_CTR_CC - 4
              else          CYC_CTR_CC = 136
              endif
else          if          CYC_CTR_CC < 140
              then          CYC_CTR_CC++
              else          CYC_CTR_CC = 0
              endif
endif
```

status indicate-direction frequency check-control message standard :
C_ICL_DISP_FRQ name

00H	"Kein Blinken"
01H	"Langsames Blinken"
02H	"Schnelles Blinken"
03H	"Signal ungültig"

// If an error is not present any longer, the transmission-request of the corresponding
// CC-message has to be reset to 0.

```
if                        LV_MIL_CAN_1 != LV_MIL_CAN_1 n-1
                      & & STATE_CC_KEY >= C_STATE_CC_ID_34
      then            if      LV_MIL_CAN_1 n-1 = 1
                      then          LV_SEND_CC_ID_34          =          false
                          endif
                      LV_MIL_CAN_1 n-1 = LV_MIL_CAN_1
```

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elseif LV_MIS_STATE_A!= LV_MIS_STATE_A $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_33
then **if** LV_MIS_STATE_A $_{n-1}$ = 1
then LV_SEND_CC_ID_33 = false
endif
LV_MIS_STATE_A $_{n-1}$ = LV_MIS_STATE_A
elseif LV_TEMP_ENG_WARN_1!= LV_TEMP_ENG_WARN_1 $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_257
then **if** LV_TEMP_ENG_WARN_1 $_{n-1}$ = 1
then LV_SEND_CC_ID_257 = false
endif
LV_TEMP_ENG_WARN_1 $_{n-1}$ = LV_TEMP_ENG_WARN_1
elseif LV_TEMP_ENG_WARN_2!= LV_TEMP_ENG_WARN_2 $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_39
then **if** LV_TEMP_ENG_WARN_2 $_{n-1}$ = 1
then LV_SEND_CC_ID_39 = false
endif
LV_TEMP_ENG_WARN_2 $_{n-1}$ = LV_TEMP_ENG_WARN_2
elseif LV_POIL_SWI_CAN!= LV_POIL_SWI_CAN $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_212
then **if** LV_POIL_SWI_CAN $_{n-1}$ = 1
then LV_SEND_CC_ID_212 = false
endif
LV_POIL_SWI_CAN $_{n-1}$ = LV_POIL_SWI_CAN
elseif STATE_ALTER != STATE_ALTER $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_213
then **if** STATE_ALTER $_{n-1}$ = 1
then LV_SEND_CC_ID_213 = false
endif
STATE_ALTER $_{n-1}$ = STATE_ALTER
elseif LV_CRU_OFF_IRR != LV_CRU_OFF_IRR $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_26
then **if** LV_CRU_OFF_IRR $_{n-1}$ = 1
then LV_SEND_CC_ID_26 = false
endif
LV_CRU_OFF_IRR $_{n-1}$ = LV_CRU_OFF_IRR
elseif LV_OIL_CNS_WARN_2!= LV_OIL_CNS_WARN_2 $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_28
then **if** LV_OIL_CNS_WARN_2 $_{n-1}$ = 1
then LV_SEND_CC_ID_28 = false
endif
LV_OIL_CNS_WARN_2 $_{n-1}$ = LV_OIL_CNS_WARN_2
elseif LV_WAL_1_CAN != LV_WAL_1_CAN $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_29
then **if** LV_WAL_1_CAN $_{n-1}$ = 1
then LV_SEND_CC_ID_29 = false
endif
LV_WAL_1_CAN $_{n-1}$ = LV_WAL_1_CAN
elseif LV_TRA_MODE_CAN != LV_TRA_MODE_CAN $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_TRA
then **if** LV_TRA_MODE_CAN $_{n-1}$ = 1
then LV_SEND_CC_ID_TRA = false

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endif
LV_TRA_MODE_CAN $_{n-1}$ = LV_TRA_MODE_CAN
elseif LV_LIH_COC_ON!= LV_LIH_COC_ON $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_155
then **if** LV_LIH_COC_ON $_{n-1}$ = 1
then LV_SEND_CC_ID_155 = false
endif
LV_LIH_COC_ON $_{n-1}$ = LV_LIH_COC_ON
elseif LV_OIL_CNS_WARN_1!= LV_OIL_CNS_WARN_1 $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_27
then **if** LV_OIL_CNS_WARN_1 $_{n-1}$ = 1
then LV_SEND_CC_ID_27 = false
endif
LV_OIL_CNS_WARN_1 $_{n-1}$ = LV_OIL_CNS_WARN_1
elseif LV_FUC_CAN_BN!= LV_FUC_CAN_BN $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_32
then **if** LV_FUC_CAN_BN $_{n-1}$ = 1
then LV_SEND_CC_ID_32 = false
endif
LV_FUC_CAN_BN $_{n-1}$ = LV_FUC_CAN_BN
elseif LV_ERR_QOIL_SENS != LV_ERR_QOIL_SENS $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_182
then **if** LV_ERR_QOIL_SENS $_{n-1}$ = 1
then LV_SEND_CC_ID_182 = false
endif
LV_ERR_QOIL_SENS $_{n-1}$ = LV_ERR_QOIL_SENS
elseif B_ccbtnach != B_ccbtnach $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_229
then **if** B_ccbtnach $_{n-1}$ = 1
then LV_SEND_CC_ID_229 = false
endif
B_ccbtnach $_{n-1}$ = B_ccbtnach
elseif B_ccpmerr != B_ccpmerr $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_247
then **if** B_ccpmerr $_{n-1}$ = 1
then LV_SEND_CC_ID_247 = false
endif
B_ccpmerr $_{n-1}$ = B_ccpmerr
elseif B_ccruhver != B_ccruhver $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_220
then **if** B_ccruhver $_{n-1}$ = 1
then LV_SEND_CC_ID_220 = false
endif
B_ccruhver $_{n-1}$ = B_ccruhver
elseif B_ccbttdfk != B_ccbttdfk $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_304
then **if** B_ccbttdfk $_{n-1}$ = 1
then LV_SEND_CC_ID_304 = false
endif
B_ccbttdfk $_{n-1}$ = B_ccbttdfk
elseif B_ccbttknt != B_ccbttknt $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_305

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then **if** B_ccbttknt $_{n-1}$ = 1
then LV_SEND_CC_ID_305 = false
endif
B_ccbttknt $_{n-1}$ = B_ccbttknt
elseif B_ccprio != B_ccprio $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_306
then **if** B_ccprio $_{n-1}$ = 1
then LV_SEND_CC_ID_306 = false
endif
B_ccprio $_{n-1}$ = B_ccprio
elseif LV_BLS_PLAUS_CAN != LV_BLS_PLAUS_CAN $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_148
then **if** LV_BLS_PLAUS_CAN $_{n-1}$ = 1
then LV_SEND_CC_ID_148 = false
endif
LV_BLS_PLAUS_CAN $_{n-1}$ = LV_BLS_PLAUS_CAN
elseif LV_GS_UP != LV_GS_UP $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_276
then **if** LV_GS_UP $_{n-1}$ = 1
then LV_SEND_CC_ID_276 = false
endif
LV_GS_UP $_{n-1}$ = LV_GS_UP
elseif LV_GS_DOWN != LV_GS_DOWN $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_278
then **if** LV_GS_DOWN $_{n-1}$ = 1
then LV_SEND_CC_ID_278 = false
endif
LV_GS_DOWN $_{n-1}$ = LV_GS_DOWN
elseif LV_TEMP_ENG_WARN_3 != LV_TEMP_ENG_WARN_3 $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_367
then **if** LV_TEMP_ENG_WARN_3 $_{n-1}$ = 1
then LV_SEND_CC_ID_367 = false
endif
LV_TEMP_ENG_WARN_3 $_{n-1}$ = LV_TEMP_ENG_WARN_3
elseif LV_ERR_STST != LV_ERR_STST $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_397
then **if** LV_ERR_STST $_{n-1}$ = 1
then LV_SEND_CC_ID_397 = false
endif
LV_ERR_STST $_{n-1}$ = LV_ERR_STST
elseif B_poel_gelb != B_poel_gelb $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_427
then **if** B_poel_gelb $_{n-1}$ = 1
then LV_SEND_CC_ID_427 = false
endif
B_poel_gelb $_{n-1}$ = B_poel_gelb
elseif LV_INH_STST_CDN != LV_INH_STST_CDN $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_-0
then **if** LV_INH_STST_CDN $_{n-1}$ = 1
then LV_SEND_CC_ID_-0 = false
endif
LV_INH_STST_CDN $_{n-1}$ = LV_INH_STST_CDN

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elseif LV_CC_TEST_BENCH_ACT != LV_CC_TEST_BENCH_ACT $_{n-1}$
& & STATE_CC_KEY >= C_STATE_CC_ID_BENCH
then **if** LV_CC_TEST_BENCH_ACT $_{n-1}$ = 1
then LV_SEND_CC_ID_BENCH = false
endif
LV_CC_TEST_BENCH_ACT $_{n-1}$ = LV_CC_TEST_BENCH

endif
C_STATE_CC_ID_xxx = 0, 1, 2 oder 3

1 = CC ab Kl.R senden
2 = CC ab Kl.15 senden
3 = CC ab Motor läuft senden
...
FH = CC nie senden

4.60.7 Check Sum Calculation

FUNCTION DESCRIPTION:

The check sum calculation is additional to the "alive counter" a further possibility to supervise the data transmitted via CAN. From all safety relevant controllers, the ECU included, a check sum over all sent data including his own CAN-ID (11 bit) is calculated and sent together with the data frame. The receiver of the data frame can calculate the check sum over the received data and compare it with the received check sum. If both check sums are not the same a transmission error occured. For check sum calculation see newest BN 2000 specification.
The check sums CKS_CLC_TQ_DCC, CKS_CLC_CAS, CKS_CLC_TQ_TCS, CKS_CLC_TQ_ETCU, CKS_CLC_TQ_AMT, CKS_CLC_MSW, CKS_CLC_LDM, CKS_CLC_TQ_PSTE_3, CKS_CLC_PBR, CKS_CLC_ETCU, CKS_CLC_TQ_TCT
CKS_CLC_TQ_PBR are calculated with received data (see description below).

CKS_CLC_ECU1, CKS_CLC_ECU2 and CKS_CLC_ECU3, CKS_CLC_TQ_WHEEL_1, CKS_CLC_TQ_WHEEL_2, CKS_CLC_GS_IDC are calculated with sent data from ECU.

Formula section:

Check sum ECU1
CKS_CLC_ECU1
Torque_1 - ID A8H

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

Figure 4.60.30: Byte7

Byte7	ST_CT_BRPD_DME	ST_OBD_CTFN_GRB

Figure 4.60.31: Byte6

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Byte6	ST_RCPT_ENG_EGS	ST_RCPT_ENG_DSC	ST_RCPT_ENG_ARS	ST_RCPT_ENG_ACC

Figure 4.60.32: Byte5

Byte5	RCPT_ACC_SWO_SYS_DME	ST_DMEA_SWO	ST_RTIR	ST_SW_CLT

Figure 4.60.33: Byte4

Byte4	TORQ_AVL_DMEE

Figure 4.60.34: Byte3

Byte3	TORQ_AVL_DMEE	ST_TORQ_AVL

Figure 4.60.35: Byte2

Byte2	TORQ_AVL

Figure 4.60.36: Byte1

Byte1	TORQ_AVL	ALIV_TORQ_1_DME

Figure 4.60.37: Byte0

Byte0	CHKSM_TORQ_1_DME

Check sum ECU2
CKS_CLC_ECU2

Torque_2 - IDA9H

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

Figure 4.60.38: Byte7

Byte7	TORQ_AVL_SPAR_POS

Figure 4.60.39: Byte6

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Byte6	TORQ_AVL_SPAR_POS	TORQ_AVL_SPAR_NEG

Figure 4.60.40: Byte5

Byte5	TORQ_AVL_SPAR_NEG

Figure 4.60.41: Byte4

Byte4	TORQ_AVL_MAX

Figure 4.60.42: Byte3

Byte3	TORQ_AVL_MAX	TORQ_AVL_MIN

Figure 4.60.43: Byte2

Byte2	TORQ_AVL_MIN

Figure 4.60.44: Byte1

Byte1	ST_INFS	ST_SW_LEV_RPM	ALIV_TORQ_2_DME

Figure 4.60.45: Byte0

Byte0	CHKSM_TORQ_2_DME

Check sum ECU3
CKS_CLC_ECU3
Torque_3 - ID AAH

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

Figure 4.60.46: Byte7

Byte7	RQAM_FU

Figure 4.60.47: Byte6

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Byte6	ST_CLCTR_V	ST_IDLG_ENG	RPM_ENG_ERR

Figure 4.60.48: Byte5

Byte5	RPM_ENG

Figure 4.60.49: Byte4

Byte4	RPM_ENG

Figure 4.60.50: Byte3

Byte3	ANG_ACPD

Figure 4.60.51: Byte2

Byte2	TORQ_DVCH

Figure 4.60.52: Byte1

Byte1	TORQ_DVCH	ALIV_TORQ_3_DME

Figure 4.60.53: Byte0

Byte0	CHKSM_TORQ_3_DME

Check sum TQ_WHEEL_1

CKS_CLC_TQ_WHEEL_1

RADMOM_PT_1 - ID B4H

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

Figure 4.60.54: Byte7

Byte7	ST_INTF_PT	ST_PENG

Figure 4.60.55: Byte6

Byte6	--	ANG_ACPD_TAR

Figure 4.60.56: Byte5

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Byte5	ANG_ACPD_TAR

Figure 4.60.57: Byte4

Byte4	WMOM_PT_AVL

Figure 4.60.58: Byte3

Byte3	WMOM_PT_AVL

Figure 4.60.59: Byte2

Byte2	ANG_ACPD_REAL

Figure 4.60.60: Byte1

Byte1	ANG_ACPD_REAL	ALIV_WMOM_PT_1

Figure 4.60.61: Byte0

Byte0	CHKSM_WMOM_PT_1

Check sum TQ_WHEEL_2
CKS_CLC_TQ_WHEEL_2
RADMOM_PT_2 - ID ACH

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

Figure 4.60.62: Byte7

Byte7	WMOM_PT_MAX

Figure 4.60.63: Byte6

Byte6	WMOM_PT_MAX

Figure 4.60.64: Byte5

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Byte5	WMOM_PT_MIN_LOW

Figure 4.60.65: Byte4

Byte4	WMOM_PT_MIN_LOW

Figure 4.60.66: Byte3

Byte3	WMOM_COODT_TAR

Figure 4.60.67: Byte2

Byte2	WMOM_COODT_TAR

Figure 4.60.68: Byte1

Byte1					ALIV_WMOM_PT_2

Figure 4.60.69: Byte0

Byte0	CHKSM_WMOM_PT_2

Check sum GS_IDC
CKS_CLC_GS_IDC
DISP_GSI - ID 2F3H

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte2	CHKSM_DISP_GSI							

Figure 4.60.70: Byte1

Byte1							DISP_GSI

Figure 4.60.71: Byte0

Byte0	DISP_TARG	ALIV_DISP_GSI

Check sum TQ_DCC
CKS_CLC_TQ_DCC
DREHMOMENT_ANF_ACC - ID B7H

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	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte5	ST_TORQ_CTRL_ACC			ST_ACC_MOD_DME			ST_ACC_SWO_SYS_DME	
Byte4	RQ_PREV_INFS_ACC		ST_TORQ_TAR_ACC		TORQ_TAR_ADJR_POS_ACC			
Byte3	TORQ_TAR_ADJR_POS_ACC							
Byte2	TORQ_TAR_ACC							
Byte1	TORQ_TAR_ACC				ALIV_TORQ_ACC			
Byte0	CHKSM_TORQ_ACC							

Check sum TQ_PSTE_2 (AFS)
CKS_CLC_TQ_PSTE_2
DREHMOMENT_ANF_AFS - ID B9H

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte5					ST_RQ_TORQ_AFS_ERR			
Byte4			ST_TORQ_TAR_AFS		TORQ_TAR_AFS			
Byte3	TORQ_TAR_AFS							
Byte2	TORQ_AVL_AFS							
Byte1	TORQ_AVL_AFS				ALIV_TORQ_AFS			
Byte0	CHKSM_TORQ_AFS							

Check sum CAS :
CKS_CLC_CAS

KLEMMENSTATUS - ID 130H

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 4	CHKSM_KL				ALIV_KL			
Byte 3	ST_KL15_HW							
Byte 2	ST_STCD_PENG_MSA							
Byte 1					NO_KEY			
Byte 0	ST_KEY_VLD		ST_KL_50		ST_KL_15		ST_KL_R	

Check sum TQ_TCS :
CKS_CLC_TQ_TCS

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DREHMOMENT_ANF_DSC - ID B6H

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 4			ST_TORQ_TAR_DSC		TORQ_TAR_ADJR_POS_DSC			
Byte 3	TORQ_TAR_ADJR_POS_DSC							
Byte 2	TORQ_TAR_DSC							
Byte 1	TORQ_TAR_DSC				ALIV_TORQ_DSC			
Byte 0	CHKSM_TORQ_DSC							

Check sum TQ_ETCU :
CKS_CLC_TQ_ETCU

DREHMOMENT_ANF_EGS - ID B5H

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 7	TEMP_GRB							
Byte 6	TORQ_DRAW_GRB							
Byte 5	ST_LIM_STORQ		ST_OBD_ERR_GRB		ST_OBD_GRB			
Byte 4	ST_OTMP_GRB		ST_TORQ_TAR_EGS		TORQ_TAR_ADJR_POS_EGS			
Byte 3	TORQ_TAR_ADJR_POS_EGS							
Byte 2	TORQ_TAR_EGS							
Byte 1	TORQ_TAR_EGS				ALIV_TORQ_EGS			
Byte 0	CHKSM_TORQ_EGS							

Check sum TQ_AMT :
CKS_CLC_TQ_AMT
DREHMOMENT_ANF_SSG - ID BDH

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte7	LIM_RPM_ENG							
Byte6	RQ_Motorstop		ST_CLT_SSG			ST_SHPS_SSG		
Byte5	ST_LIM_STORQ_SSG		ST_OBD_ERR_GRB_SSG		ST_OBD_GRB_SSG			
Byte4			ST_TORQ_TAR_SSG		TORQ_TAR_ADJR_POS_SSG			
Byte3	TORQ_TAR_ADJR_POS_SSG							
Byte2	TORQ_TAR_SSG							
Byte1	TORQ_TAR_SSG				ALIV_TORQ_SSG			
Byte0	CHKSM_TORQ_SSG							

Check sum MSW (SZL)
CKS_CLC_MSW
BEDIENUNG_TEMPOMAT - ID 194H

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

Figure 4.60.72: Byte3

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Byte3						

Figure 4.60.73: Byte2

Byte2	OP_PUBU_CCTR_ACC

Figure 4.60.74: Byte1

Byte1					ALIV_CCTR

Figure 4.60.75: Byte0

Byte0	CHKSM_CCTR

Check sum VEH_MOD (CAS)
CKS_CLC_VEH_MOD
VEH_MOD - ID 315H

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte1					MOD_VEH			
Byte0	ALIV_MOD_VEH				CHKSM_MOD_VEH			

Check sum LDM
CKS_CLC_LDM
ANF_RADMOM_PT - ID BFH

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

Figure 4.60.76: Byte4

Byte4 RQ_GSI_CLCTR_LN WMOM_PT_ENBL ST_DRASY_PT

Figure 4.60.77: Byte3

Byte3 WMOM_PT_TAR

Figure 4.60.78: Byte2

Byte2 WMOM_PT_TAR

Figure 4.60.79: Byte1

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Byte1	FOLDYN_WMOM_PT_TAR	ALIV_RQ_WMOM_PT

Figure 4.60.80: Byte0

Byte0	CHKSM_RQ_WMOM_PT

Check sum EHB3 (TQ_PSTE_3)
CKS_CLC_TQ_PSTE_3
DREHMOMENT_ANF_STE - ID B1H

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte4				ST_RQ_TORQ_STE_ERR			ST_TORQ_TAR_STE	
Byte3	TORQ_TAR_STE							
Byte2	TORQ_AVL_STE							
Byte1	SRC_RQ_TORQ_STE				ALIV_TORQ_STE			
Byte0	CHKSM_TORQ_STE							

Check sum ETCU_3
CKS_CLC_ETCU_3
GETRIEBEDATEN_3 - ID 3B1H

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

Figure 4.60.81: Byte5

Byte5	LIM_MAX_V_GRB_EMMOD	
Byte4	RQ_MIL_GRB	ST_MSA_GRB

Figure 4.60.82: Byte3

Byte3	IDX_TORQ_FIL	IDX_ACPD

Figure 4.60.83: Byte2

Byte2	TORQ_DVCH_RISE

Figure 4.60.84: Byte1

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Byte1	TORQ_DVCH_RISE	ALIV_GRB_3

Figure 4.60.85: Byte0

Byte0	CHKSM_GRB_3

Check sum REQ_PBR

CKS_CLC_REQ_PBR

STELLANF_EMF - ID 1A7H

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

Figure 4.60.86: Byte3

Byte3				ST_CFFU_EMF_2	ST_HYD_RETA_2

Figure 4.60.87: Byte2

Byte2	

Figure 4.60.88: Byte1

Byte1			ALIV_PRQ_EMF

Figure 4.60.89: Byte0

Byte0	CHKSM_PRQ_EMF

Check sum PBR

CKS_CLC_PBR

STATUS_EMF - ID 201H

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

Figure 4.60.90: Byte3

Byte3	

Figure 4.60.91: Byte2

Byte2		

Figure 4.60.92: Byte1

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Byte1	ST_EMF_LOCA_2	ALIV_COU_EMF_2

Figure 4.60.93: Byte0

Byte0	CHKSM_ST_EMF

Check sum ETCU

CKS_CLC_ETCU

GETRIEBEDATEN - ID BAH

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

Figure 4.60.94: Byte7

Byte7				ST_HYPP_ACV

Figure 4.60.95: Byte6

Byte6		ST_MOD_GRB	ALIV_GRB

Figure 4.60.96: Byte5

Byte5	CHKSM_GRB

Figure 4.60.97: Byte4

Byte4	

Figure 4.60.98: Byte3

Byte3	

Figure 4.60.99: Byte2

Byte2			GRDT_REIN

Figure 4.60.100: Byte1

Byte1	GRDT_REIN

Figure 4.60.101: Byte0

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Byte0	ST_CCLT	ST_GRLV_ACV	ST_GR_GRB

Check sum TQ_TCT

CKS_CLC_TQ_TCT

DREHMOMENT_ANF_DKG - ID B8H

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

Figure 4.60.102: Byte7

Byte7	RPM_TAR_ENG_DKG

Figure 4.60.103: Byte6

Byte6	RPM_TAR_ENG_DKG	ST_MOD_DKG

Figure 4.60.104: Byte5

Byte5	TORQ_CLT_DKG

Figure 4.60.105: Byte4

Byte4	TORQ_CLT_DKG	TORQ_TAR_ADJR_POS_DKG

Figure 4.60.106: Byte3

Byte3	TORQ_TAR_ADJR_POS_DKG

Figure 4.60.107: Byte2

Byte2	TORQ_TAR_DKG

Figure 4.60.108: Byte1

Byte1	TORQ_TAR_DKG	ALIV_TORQ_DKG

Figure 4.60.109: Byte0

Byte0	CHKSM_TORQ_DKG

Check sum ST_RQ_EMF

CKS_CLC_TQ_PBR

ST_RQ_EMF - ID 1FDH

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	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

Figure 4.60.110: Byte5

Byte5	ST_ACT_EMF	QU_ST_ACT_EMF

Figure 4.60.111: Byte4

Byte4	SAFG_RQ_WMOM_EMF

Figure 4.60.112: Byte3

Byte3	RQ_DCRN_EMF

Figure 4.60.113: Byte2

Byte2	RQ_DCRN_EMF

Figure 4.60.114: Byte1

Byte1	QU_RQ_DCRN_EMF	ALIV_ST_RQ_EMF

Figure 4.60.115: Byte0

Byte0	CHKSM_ST_RQ_EMF

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4.61 CAN messages engine management system (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_SYM_TQ_DCC_CS	O/V	0... 1H	0 ...1	1	-
Logical bit for TQ_REQ_CAN error due to DCC torque intervention clutch switch					
T_TQ_DCC_CS	V	0... FFH	0... 2.55	0.01	s
Time of clutch switch intervention during DCC active					
TQ_AMT_FAST_DEC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
fast torque decreased intervention due to AMT					
TQ_AMT_FAST_INC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
fast torque increased intervention due to AMT					
TQ_AMT_SLOW_DEC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
slow torque decreased intervention due to AMT					
TQ_AMT_SLOW_INC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
slow torque increased intervention due to AMT					
TQ_ASR_FAST_DEC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
fast torque decreased intervention due to TCS					
TQ_ASR_SLOW_DEC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
slow torque decreased intervention due to TCS					
TQ_DCC_FAST_INC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
fast torque increased intervention due to DCC					
TQ_DCC_SLOW_INC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
slow torque increased intervention due to DCC					
TQ_GS_FAST_DEC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
fast torque decreased intervention due to GS					
TQ_GS_FAST_INC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
fast torque increased intervention due to GS					
TQ_GS_SLOW_DEC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
slow torque decreased intervention due to GS					
TQ_GS_SLOW_INC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
slow torque increased intervention due to GS					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_MSR_FAST_INC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
fast torque increased intervention due to TCS					
TQ_MSR_SLOW_INC_BN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
slow torque increased intervention due to TCS					
TQ_WHEEL_LDM_INC_DEC_BN	O/V	8000... 7FFFH	-32768 ...32767	1	Nm
torque increased intervention due to LDM					

Input data:

LV_AMT_LIH_CAN {p. 1564}	LV_AT {p. 654}	LV_DCC_LIH_CAN {p. 1565}	LV_ETCU_LIH_CAN {p. 1565}
LV_IGK {p. 906}	LV_IM_CS_PN {p. 852}	LV_TCT_LIH_CAN {p. 1568}	LV_TQ_AMT_DEC_REQ {p. 1568}
LV_TQ_AMT_INC_REQ {p. 1568}	LV_TQ_ASR_REQ {p. 1568}	LV_TQ_DCC_INC_REQ {p. 1568}	LV_TQ_GS_DEC_REQ {p. 1568}
LV_TQ_GS_INC_REQ {p. 1568}	LV_TQ_MSR_REQ {p. 1568}	LV_TQ_WHEEL_LDM_BN_ ERR {p. 1568}	LV_TQ_WHEEL_LDM_ REQ {p. 1568}
LV_VAR_AMT {p. 655}	LV_VAR_BN {p. 655}	LV_VAR_BN_LDM {p. 655}	LV_VAR_TCT {p. 656}
N {p. 1525}	STATE_AMT_INTV {p. 1570}	STATE_DCC_CTL {p. 1572}	STATE_DCC_INTV {p. 1572}
STATE_ETCU_INTV {p. 1574}	STATE_TCS_INTV {p. 1578}	STATE_TCT_INTV {p. 1578}	TQ_AMT_FAST_BN {p. 1580}
TQ_AMT_SLOW_BN {p. 1581}	TQ_DCC_FAST_BN {p. 1581}	TQ_DCC_SLOW_BN {p. 1581}	TQ_GS_FAST_BN {p. 1581}
TQ_GS_SLOW_BN {p. 1581}	TQ_TCS_FAST_BN {p. 1582}	TQ_TCS_SLOW_BN {p. 1582}	TQ_WHEEL_LDM_BN {p. 1582}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_TQ_DCC_CS_DEC	-	0... FFH	0... 0.99609	3.9063e-3	-
Correlation constant for decrement TQ_DCC_CS intervention					
C_CRLC_TQ_DCC_CS_INC	-	0... FFH	0... 0.99609	3.9063e-3	-
Correlation constant for increment TQ_DCC_CS intervention					
C_THD_T_TQ_DCC_CS	-	0... FFH	0... 2.55	0.01	s
Threshold for maximum allowed torque intervention concerning clutch switch					
IP_TQ_DCC_CS	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_TQ_DCC_CS	6	0... 1FE0H	0... 8160	1	rpm
Intended DCC torque during clutch switch on					
LC_ENA_TQ_DCC_CS	-	0... 1H	0 ...1	1	-
Logical constant to set the TQ_DCC_CS intervention active					

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FUNCTION DESCRIPTION:

General information:

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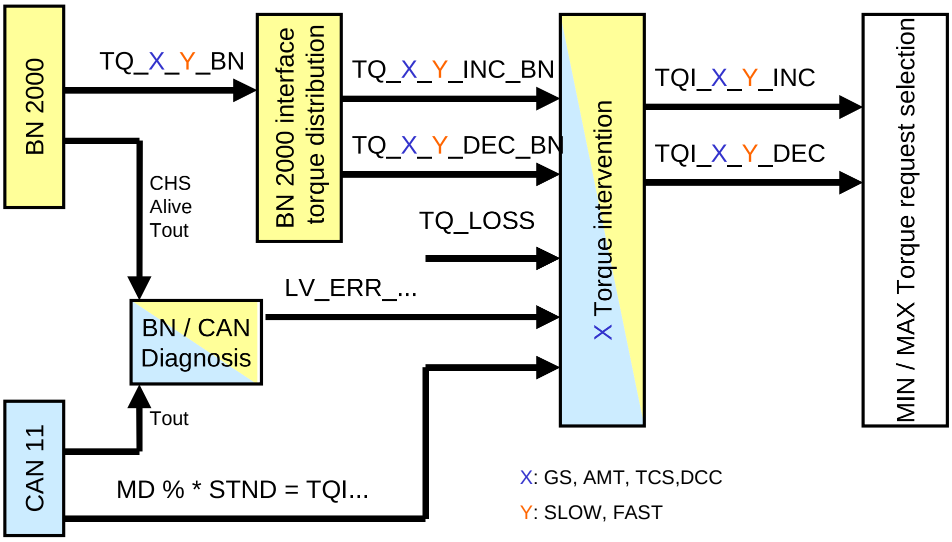
Some functions of BN 2000 contain a torque request. For the torque structure interfaces it's necessary to define the direction of torque request as increased or decreased. The BN delivers just one torque request and an additional direction information bit. This module combines the direction information bit of BN with the torque request and supported the torque structure interfaces.

Signal flow diagram:



Application conditions

Initialisation:

*TQ_**X** _FAST_DEC_BN = 1023.97Nm*
*TQ_**X** _SLOW_DEC_BN = 1023.97Nm*
*TQ_**X** _FAST_INC_BN = -1024 Nm*
*TQ_**X** _SLOW_INC_BN = -1024 Nm*
TQ_WHEEL_LDM_INC_DEC_BN = -32000 Nm
LV_RST_T_TQ_DCC_CS = 1
T_TQ_DCC_CS = 0
LV_ERR_SYM_TQ_DCC_CS = 0

Recurrence: *10ms*

Activation: *LV_VAR_BN = 1 and LV_IGK = 1*

Description:

INDEX	Functionality				
Customer	EGS	DSC	SSG	ACC	LDM
Y	ETCU	TCS	AMT	DCC	LDM
X_INC	GS_INC	MSR	AMT_INC	DCC_INC	LDM_INC _DEC
X_DEC	GS_DEC	ASR	AMT_DEC	-	-
Z	GS	TCS	AMT	DCC	LDM

(The DCC function delivers only an increased Torque request. By using this template the initialisation of LV_TQ_DCC_DEC_REQ with 0 is necessary.) Beside of this, it is necessary that under defined conditions the torque request of the DCC is controlled by the ECU.

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Formula section:

Torque CAN selection for intervention :

If STATE_**Y**_INTV = NO_INTERVENTION (00H)
or LV_**Y**_LIH_CAN = 1
or TQ_**Z** _FAST_BN = -1024 Nm
or TQ_**Z** _SLOW_BN = -1024 Nm
then TQ_**X** _FAST_**DEC**_BN = 1023.97 Nm
TQ_**X** _SLOW_**DEC**_BN = 1023.97 Nm
TQ_**X** _FAST_**INC**_BN = -1024 Nm
TQ_**X** _SLOW_**INC**_BN = -1024 Nm
elseif LV_TQ_**X**_**INC**_REQ (*X_INC-intervention)*
then TQ_**X** _FAST_**DEC**_BN = 1023.97 Nm
TQ_**X** _SLOW_**DEC**_BN = 1023.97 Nm
TQ_**X** _FAST_**INC**_BN = TQ_**Z** _FAST_BN (converted)
TQ_**X** _SLOW_**INC**_BN = TQ_**Z** _SLOW_BN (converted)
elseif LV_TQ_**X**_**DEC**_REQ (*X_DEC-intervention)*
then TQ_**X** _FAST_**DEC**_BN = TQ_**Z** _FAST_BN (converted)
TQ_**X** _SLOW_**DEC**_BN = TQ_**Z** _SLOW_BN (converted)
TQ_**X** _FAST_**INC**_BN = -1024 Nm
TQ_**X** _SLOW_**INC** BN = -1024 Nm
endif
endif
endif

DCC Torque CAN selection for intervention

If(1) STATE_**DCC**_INTV = NO_INTERVENTION (00H)
or LV_**DCC**_LIH_CAN = 1
or TQ_**DCC** _FAST_BN = -1024 Nm
or TQ_**DCC** _SLOW_BN = -1024 Nm
then(1) TQ_**DCC** _FAST_**DEC**_BN = 1023.97 Nm
TQ_**DCC**_SLOW_**DEC**_BN = 1023.97 Nm
TQ_**DCC**_FAST_**INC**_BN = -1024 Nm
TQ_**DCC**_SLOW_**INC**_BN = -1024 Nm
LV_RST_T_TQ_DCC_CS = 1
LV_ERR_SYM_TQ_DCC_CS = 0
Else(1) if(2) LV_TQ_**DCC**_**INC**_REQ = 1
Then(2) If(3) (LV_AT = 0 **and** LV_VAR_AMT = 0 **and** LV_VAR_TCT = 0)
and
LC_ENA_TQ_DCC_CS = 1
Then(3) **if(4)** LV_IM_CS_PN = 1 **and**
(STATE_DCC_CTL = 0 H **or**
STATE_DCC_CTL = 2 H) **and**
LV_ERR_SYM_TQ_DCC_CS = 0
Then(4)TQ_DCC_FAST_INC_BN = TQ_DCC_FAST_INC_BN$_{(n-1)}$ +
C_CRLC_TQ_DCC_CS_DEC * (IP_TQ_DCC_CS -
TQ_DCC_FAST_INC_BN$_{(n-1)}$)
TQ_DCC_SLOW_INC_BN = TQ_DCC_SLOW_INC_BN$_{(n-1)}$

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+ C_CRLC_TQ_DCC_CS_DEC * (IP_TQ_DCC_CS -
TQ_DCC_SLOW_INC_BN$_{(n-1)}$)
If(4´) LV_RST_T_TQ_DCC_CS = 1
Then(4´) T_TQ_DCC_CS = 0
LV_RST_T_TQ_DCC_CS = 0
Else(4') T_TQ_DCC_CS = T_TQ_DCC_CS + 10 ms
If(4´´) T_TQ_DCC_CS C_THD_T_TQ_DCC_CS
Then(4´´) LV_ERR_SYM_TQ_DCC_CS = 1
Else(4´´) LV_ERR_SYM_TQ_DCC_CS = 0
Endif(4´´)
Endif(4´)
Else(4) TQ_DCC_FAST_INC_BN =
TQ_DCC_FAST_INC_BN$_{(n-1)}$ +
C_CRLC_TQ_DCC_CS_INC * (TQ_DCC_FAST_BN$_{(n)}$-
TQ_DCC_FAST_INC_BN$_{(n-1)}$)
TQ_DCC_SLOW_INC_BN=TQ_DCC_SLOW_INC_BN$_{(n-1)}$+
C_CRLC_TQ_DCC_CS_INC * (TQ_DCC_SLOW_BN$_{(n)}$ -
TQ_DCC_SLOW_INC_BN$_{(n-1)}$)
LV_RST_T_TQ_DCC_CS = 1
Endif(4)
Else(3) TQ_**DCC**_FAST_**INC**_BN = TQ_**DCC**_FAST_BN (converted)
TQ_**DCC**_SLOW_**INC**_BN = TQ_**DCC**_SLOW_BN (converted)
TQ_**DCC**_FAST_**DEC**_BN = 1023.97 Nm
TQ_**DCC**_SLOW_**DEC**_BN = 1023.97 Nm
LV_ERR_SYM_TQ_DCC_CS = 0
Endif(3)
Then(2) TQ_**DCC**_FAST_**DEC**_BN = 1023.97 Nm
TQ_**DCC**_SLOW_**DEC**_BN = 1023.97 Nm
TQ_**DCC**_FAST_**INC**_BN = TQ_**DCC**_FAST_BN (converted)
TQ_**DCC**_SLOW_**INC**_BN = TQ_**DCC**_SLOW_BN (converted)
LV_RST_T_TQ_DCC_CS = 1
LV_ERR_SYM_TQ_DCC_CS = 0
Endif(2)
Endif(1)

LDM Torque CAN selection for intervention

If(1) LV_TQ_WHEEL_**LDM**_REQ = 1 **and**
LV_TQ_WHEEL_LDM_BN_ERR = 0
then(1) TQ_WHEEL_**LDM_INC_DEC**_BN = TQ_WHEEL_LDM_BN
Else(1) TQ_WHEEL_**LDM_INC_DEC**_BN = -32000 Nm
Endif(1)

DKG Torque CAN selection for intervention :

If STATE_**TCT**_INTV = NO_INTERVENTION (00H)
or LV_**TCT**_LIH_CAN = 1
or TQ_**GS** _FAST_BN = -1024 Nm
or TQ_**GS**_SLOW_BN = -1024 Nm
then TQ_**GS** _FAST_**DEC**_BN = 1023.97 Nm
TQ_**GS** _SLOW_**DEC**_BN = 1023.97 Nm

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```
                TQ_GS _FAST_INC_BN = -1024 Nm
                TQ_GS _SLOW_INC_BN   = -1024 Nm
elseif        LV_TQ_GS_INC_REQ = 1
                then     TQ_GS_FAST_DEC_BN   = 1023.97 Nm
                         TQ_GS_SLOW_DEC_BN   = 1023.97 Nm
                         TQ_GS_FAST_INC_BN   = TQ_GS_FAST_BN (converted)
                         TQ_GS_SLOW_INC_BN   = TQ_GS_SLOW_BN (converted)
                elseif  LV_TQ_GS_DEC_REQ = 1
                         then     TQ_GS_FAST_DEC_BN   = TQ_GS_FAST_BN (converted)
                                  TQ_GS_SLOW_DEC_BN   = TQ_GS_SLOW_BN (converted)
                                  TQ_GS_FAST_INC_BN   = -1024 Nm
                                  TQ_GS_SLOW_INC BN   = -1024 Nm
                         endif
                endif
endif
```

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4.62 CAN messages gateway

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STMIN_ECU	-	0... FFH	0... 255	1	ms
STMIN for gateway from EGS to tester					

Description:

ECU is in case of 11hex gateway between EGS on PT-CAN and Tester on Lo-CAN (e.g reprogramming via tester). The table below describes the way of routing the named diagnosis messages. Routing by hardware means that the controller is used (no application software involved). Routing by software means that the related message is received and if necessary modified and than sent to designated receiver (e.g. tester).

Messages	ID	Routing by ..	Sent from..	Sent to..
Diagnosis-Messages	6F0-6FF	Hardware	Tester	EGS
Diagnosis-Messages	618	Software	EGS	Tester

Formula section:

Rule for software routing:

receive message (buffer byte 0-7)
If byte 1 of received message == 30hex (FlowControl)
Then **if** byte 3 of received message < C_STMIN_ECU (STMIN)
Then byte 3 = C_STMIN_ECU
Endif
Endif
send message (buffer byte 0-7)

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4.63 Synchronisation determination in camshaft limp home

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CAM_LIH_EXT_ENA	O/V	0... 1H	0 ...1	1	-
Camshaft limp home with external help enabled					
LV_SEG_NR_UPD_REQ	O/V	0... 1H	0 ...1	1	-
SEG_NR update request					
LV_SYN_VLD_CAM_LIH	O/V	0... 1H	0 ...1	1	-
Engine synchronization determined in camshaft limp home mode					

Input data:

INH_INJ {p. 2295}	LV_VS_RUN {p. 1176}	N {p. 1525}	N_GRD {p. 1525}
NC_CAM_LIH_SWI {p. 638}	SEG_CTR {p. 1525}	SEG_NR {p. 1525}	TCO_CMN {p. 642}
VB_CMN {p. 642}			

FUNCTION DESCRIPTION:

General information:

This functions aims at initializing the variables used by ENSD or others aggregates in case no camshaft limp home method has been selected.

Description:

Application conditions

Initialisation: *none*

Recurrence: *at reset*

Activation: *NC_CAM_LIH_SWI = None*

Deactivation: *NC_CAM_LIH_SWI None*

Formula section:

LV_SYN_VLD_CAM_LIH = 0
LV_CAM_LIH_EXT_ENA = 0
LV_SEG_NR_UPD_REQ = 0

Remark: as this module is only a stub, N, N_GRD, SEG_CTR, LV_VS_RUN, INH_INJ, TCO_CMN, VB_CMN and SEG_NR are not used.

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5 - Engine operating states

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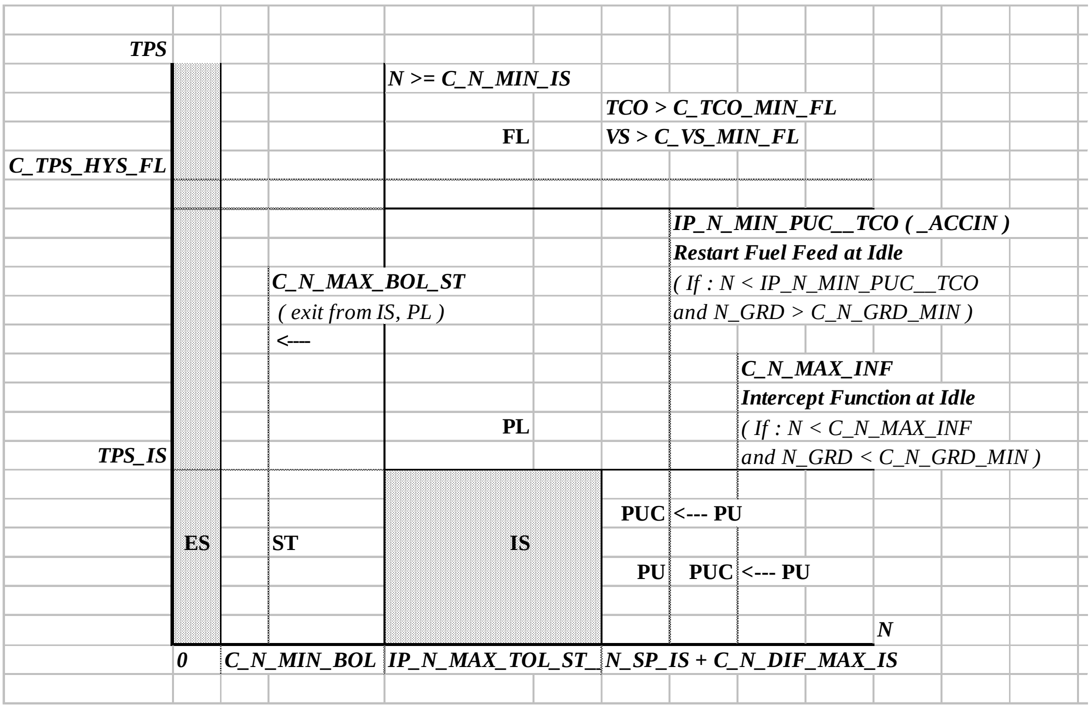
5.1 General drawing



LV_ES : Engine Stopped
LV_ST : Start
LV_IS : Idle Speed
LV_PL : Part Load
LV_PU : Trailing Throttle
LV_PUC : Trailing Throttle Fuel Cut Off

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5.2 Basic operating states

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CS_PUC	V	0... 1H	0 ...1	1	-
Clutch switch information including AMT					
LV_ES	O/V	0... 1H	0 ...1	1	-
Engine operating state "Engine stopped"					
LV_IGA_MIN_PUC	O/V	0... 1H	0 ...1	1	-
conditions for IGA_MIN_PUC					
LV_IS	O/V	0... 1H	0 ...1	1	-
Engine operating state "Idle Speed"					
LV_PL	O/V	0... 1H	0 ...1	1	-
Engine operating state "Part Load"					
LV_PU	O/V	0... 1H	0 ...1	1	-
Engine operating state "Trailing throttle"					
LV_PUC	O/V	0... 1H	0 ...1	1	-
Engine operating state "trailing throttle fuel cut off "					
LV_PUC_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable trailing throttle fuel cut off request					
LV_ST	O/V	0... 1H	0 ...1	1	-
Engine operating state "Start"					
LV_ST_END	O/V	0... 1H	0 ...1	1	-
Engine operating state "Start" not active					
N_HYS_ACT_PUC	V	0... FFH	0... 8160	32	rpm
Actual effective engine speed hysteresis for LV_PUC					
N_HYS_MIN_PUC	V	0... FFH	0... 8160	32	rpm
Minimum engine speed hysteresis for LV_PUC					
N_MIN_PUC	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for the activation of LV_PUC.					
STATE_ENG	V	0H 1H 2H 3H 4H 5H	ES ST IS PL PU PUC	-	-
engine operating state					
T_IS	O/V	0... FFFFH	0... 655.35	0.01	s
Time since the activation of the state idle speed.					
T_PU	O/V	0... FFFFH	0... 655.35	0.01	s
Time elapsed into LV_PU					

Input data:

C_N_DIF_FAC {p. 1123}	C_N_GRD_MIN {p. 1759}	CYC_CAST {p. 1766}	GR_AT {p. 1302}
GR_MT {p. 1302}	IP_N_MAX_INF {p. 1760}	LV_ACCOUT_RLY {p. 3589}	LV_AT {p. 654}
LV_CS {p. 8394}	LV_CT {p. 1442}	LV_DCC_INC_ACT {p. 6731}	LV_DCC_PUC_INH {p. 1565}

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LV_DT {p. 1310}	LV_ETCU_PUC_REQ {p. 8209}	LV_GS_INC_ACT {p. 6718}	LV_INF {p. 1759}
LV_INH_PUC_CUS {p. 8209}	LV_LDM_PUC_INH {p. 6615}	LV_MSR_ACT {p. 6741}	LV_PUC_INH_TEMP_CAT {p. 8233}
LV_PUC_LOCK_TNT {p. 8199}	LV_PUC_SA_INH {p. 804}	LV_RGN_NT_REQ {p. 2983}	LV_RNG_L_REQ {p. 6570}
LV_S_ACT {p. 8137}	LV_TQI_BOL_SET {p. 8379}	LV_TQI_BOL_SET_S {p. 805}	LV_VAR_TCT {p. 656}
N {p. 1525}	N_32 {p. 1525}	N_DIF_MMV {p. 1122}	N_GRD {p. 1525}
N_MAX_TOL_ST {p. 1122}	N_SP_IS {p. 1122}	NC_N_MIN {p. 854}	OPM_AV {p. 8137}
STATE_ETCU_CLU {p. 1573}	STATE_TCT_INTV {p. 1578}	T_AST {p. 1766}	TCO {p. 1100}
TQ_LOSS_ADD {p. 8385}	TQ_LOSS_ARS_SP_CAN {p. 1581}	TQ_LOSS_PSTE_2_SP_ CAN {p. 1581}	VS {p. 1176}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CLC_STATE_ETCU_CLU	-	0... FFH	0... 255	1	-
Constant to define closed clutch depending on shift-process TCT via CAN					
C_CYCNR_HYS_PUC	-	0... FFFFH	0... 65535	1	°CRK
Cycle counter to reset the LV_PUC engine speed hysteresis					
C_CYCNR_HYS_PUC_ST	-	0... FFFFH	0... 65535	1	°CRK
Cycle counter to reset the LV_PUC engine speed hysteresis in cold condition					
C_N_DIF_AST	-	0... 1FE0H	0... 8160	1	rpm
Additional engine speed hysteresis to avoid "LV_PU" direct after start					
C_N_DIF_MAX_HYS_IS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hys. for transition to IS with stopped car					
C_N_DIF_MAX_HYS_PUC	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hys. for transition PU to PUC					
C_N_MAX_BOL_ST	-	0... FFH	0... 8160	32	rpm
Engine speed threshold to detect LV_ST or LV_PL from LV_IS					
C_T_MAX_PU	-	0... FFFFH	0... 655.35	0.01	s
Maximum delay time of PUC activation after entry of PU					
C_T_MIN_PU_MSR	-	0... FFFFH	0... 655.35	0.01	s
Minimum delay time of PUC activation after MSR					
C_T_MIN_PU_RNG_L	-	0... FFFFH	0... 655.35	0.01	s
Minimum delay time of PUC activation after entry of PU for LV_RNG_L_REQ = 1					
C_T_MIN_PU_VS	-	0... FFFFH	0... 655.35	0.01	s
Minimum delay time of PUC activation after entry of PU					
C_T_MIN_PU_VS_CS	-	0... FFFFH	0... 655.35	0.01	s
Minimum delay time for enry PUC due to clutch switch for MT					
C_T_N_DIF_AST	-	0... FFFFH	0... 6553.5	0.1	s
Time after start where C_N_DIF_AST is additional calculated to engine speed hysteresis					
C_TCO_MIN_PUC_ST	-	0... FEH	-48... 142.5	0.75	°C
Coolant temperature to select the LV_PUC engine speed hysteresis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VS_MIN_PU	-	0... FFH	0... 255	1	km/h
minimum vehicle speed of IGA_Min of PU					
C_VS_PU_CS_MAX	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for delayed PUC due to clutch switch for MT					
C_VS_PU_CS_MIN	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed for delayed PUC due to clutch switch for MT					
ID_N_HYS_MAX_PUC__GR_AT	-	0... FFH	0... 8160	32	rpm
LDPM_GR_AT_3	9	0... FFH	0... 255	1	-
Engine speed hysteresis set entering LV_PUC					
ID_N_HYS_MAX_PUC__GR_MT	-	0... FFH	0... 8160	32	rpm
LDPM_GR_MT_3	9	0... FFH	0... 255	1	-
Engine speed hysteresis set entering LV_PUC for MT transmissions					
ID_N_HYS_MIN_PUC__GR_AT	V	0... FFH	0... 8160	32	rpm
LDPM_GR_AT_3	9	0... FFH	0... 255	1	-
LDPM_VS	4	0... FFH	0... 255	1	km/h
Engine speed hysteresis reset when C_CYCNR_HYS_PUC_xx achieved					
ID_N_HYS_MIN_PUC__GR_MT	V	0... FFH	0... 8160	32	rpm
LDPM_GR_MT_3	9	0... FFH	0... 255	1	-
LDPM_VS	4	0... FFH	0... 255	1	km/h
Engine speed hysteresis reset when C_CYCNR_HYS_PUC_xx achieved					
ID_N_HYS_PUC_ST__GR_AT	-	0... FFH	0... 8160	32	rpm
LDPM_GR_AT_3	9	0... FFH	0... 255	1	-
Engine speed hysteresis set entering LV_PUC in cold condition for AT transmission					
ID_N_HYS_PUC_ST__GR_MT	-	0... FFH	0... 8160	32	rpm
LDPM_GR_MT_3	9	0... FFH	0... 255	1	-
Engine speed hysteresis set entering LV_PUC in cold condition for MT transmission.					
IP_CYC_CAST__TCO	-	0... FFFFH	0... 65535	1	-
LDPM_TCO_9	9	0... FEH	-48... 142.5	0.75	°C
Cycle counter to define the duration of the start phase charcterised by LV_ST					
IP_N_ACCOUT_MIN_PUC__TCO__GR_AT	V	0... FFH	0... 8160	32	rpm
LDPM_TCO_1_6	6	0... FEH	-48... 142.5	0.75	°C
LDPM_GR_AT_3	9	0... FFH	0... 255	1	-
LV_PUC engine speed threshold with air conditioned compressor active					
IP_N_ACCOUT_MIN_PUC__TCO__GR_MT	V	0... FFH	0... 8160	32	rpm
LDPM_TCO_1_6	6	0... FEH	-48... 142.5	0.75	°C
LDPM_GR_MT_3	9	0... FFH	0... 255	1	-
LV_PUC engine speed threshold with air conditioning compressor active					
IP_N_DIF_MAX_IS	-	0... 1FE0H	0... 8160	1	rpm
LDP_N_GRD_N_DIF_MAX_IS	6	0... FFH	-4096 ...4064	32	rpm/s
Engine speed hysteresis before "Idle Speed" (LV_IS)					
IP_N_MIN_PUC__TCO__GR_AT	V	0... FFH	0... 8160	32	rpm
LDPM_TCO_1_6	6	0... FEH	-48... 142.5	0.75	°C

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_GR_AT_3	9	0... FFH	0... 255	1	-
LV_PUC engine speed threshold					
IP_N_MIN_PUC__TCO__GR_MT	V	0... FFH	0... 8160	32	rpm
LDPM_TCO_1_6	6	0... FEH	-48... 142.5	0.75	°C
LDPM_GR_MT_3	9	0... FFH	0... 255	1	-
LV_PUC engine speed threshold					
IP_N_MIN_PUC_ADD	-	0... FFH	0... 8160	32	rpm
LDP_TQ_LOSS_ADD__PUC	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Additive term for reactivation engine speed					
IP_N_MIN_PUC_ADD_ARS	-	0... FFH	0... 8160	32	rpm
LDP_TQ_LOSS_ARS_SP_CAN__PUC	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Additive term for reactivation engine speed					
IP_N_MIN_PUC_ADD_PSTE_2	-	0... FFH	0... 8160	32	rpm
LDP_TQ_LOSS_PSTE_2_SP_CAN__PUC	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Additive term for reactivation engine speed					
IP_T_MIN_PU__N__TCO	V	0... FFFFH	0... 655.35	0.01	s
LDP_N__T_MIN_PU	8	0... 1FE0H	0... 8160	1	rpm
LDP_TCO__T_MIN_PU	6	0... FEH	-48... 142.5	0.75	°C
Minimum delay time of PUC activation					
IP_T_MIN_PU_HOM	-	0... FFFFH	0... 655.35	0.01	s
LDPM_N_T_MIN_PU_OPM	3	0... 1FE0H	0... 8160	1	rpm
Minimum delay time of PUC activation after entry of PU in homogenius mode					
IP_T_MIN_PU_RNG_L__N__TCO	V	0... FFFFH	0... 655.35	0.01	s
LDP_N__T_MIN_PU	8	0... 1FE0H	0... 8160	1	rpm
LDP_TCO__T_MIN_PU	6	0... FEH	-48... 142.5	0.75	°C
Minimum delay time of PUC activation					
IP_T_MIN_PU_S	-	0... FFFFH	0... 655.35	0.01	s
LDPM_N_T_MIN_PU_OPM	3	0... 1FE0H	0... 8160	1	rpm
Minimum delay time of PUC activation after entry of PU in s mode					
LC_INH_DT_PU	-	0... 1H	0 ...1	1	-
Manual inhibition bit for deactivation drivetrain impact for controlling transition to PUC					
LC_INH_PUC_NT_REQ	-	0... 1H	0 ...1	1	-
Manual switch to inhibit PUC due to regeneration request of NOx management					
LC_N_HYS_CYL_CUT_OFF_AT_CONF	-	0... 1H	0 ...1	1	-
Logical constant for premature reset to minimum engine speed hysteresis, vehicle with automatic transmission					
LC_N_HYS_CYL_CUT_OFF_MT_CONF	-	0... 1H	0 ...1	1	-
Logical constant for premature reset to minimum engine speed hysteresis, vehicle with manual transmission					

General information:

From the 6 different basic operating states only 1 can be active at the same time. So this function can be realised as a state machine. This specification describes the transition conditions.

Application conditions:

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Initialisation:	`RST, ERU2ES, ES2ERU`
Recurrence:	`10MS, SEG`
Activation:	`10MS: always` `SEG: always`
Deactivation:	`never`

Function description:

Formula section:

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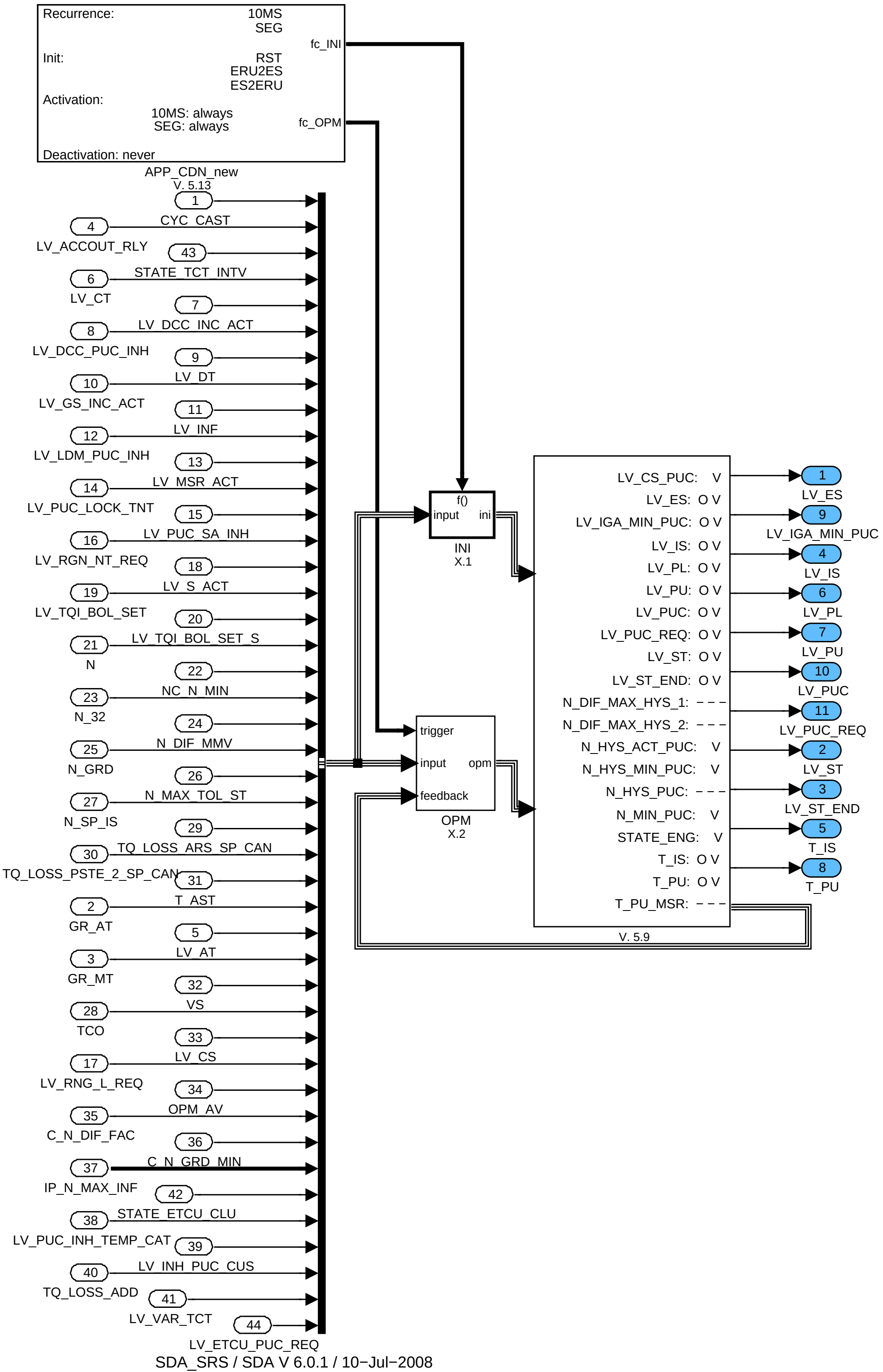

Figure 5.2.1: :

5.2.1 Engine operating state "engine stopped"

Initialisation of Variables at Reset,ES2ERU and ERU2ES

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LV_ES is the operating state which is set during ECU initialisation.
The engine operating state Engine Stopped (LV_ES) is characterized by N_32 < NC_N_MIN. In this engine operating state, the functions are assigned to initialisation values.
The entire scope of diagnosis and actuator control is accessible.

5.2.1.1 Initilisation of Variables at Reset

LV_ES is the operating state which is set during ECU initialisation

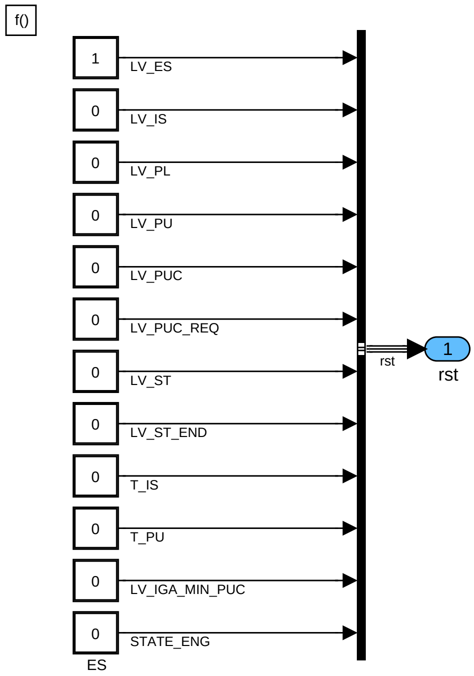

Figure 5.2.2: :

5.2.1.2 Initilisation of Variables at ERU2ES Event

The initialization of variables are done at ERU2ES event

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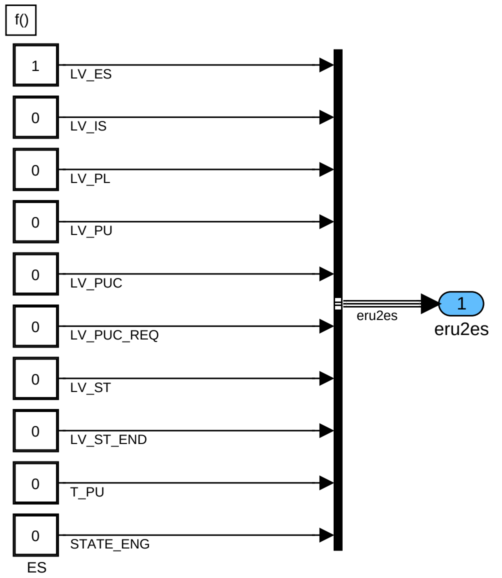

Figure 5.2.3: :

5.2.1.3 Initialization of Variables at ES2ERU

The initialization of variables are done at ES2ERU event

5.2.1.3.1 Initialization of N_HYS_PUC

The trigger for the calculation of N_HYS_PUC

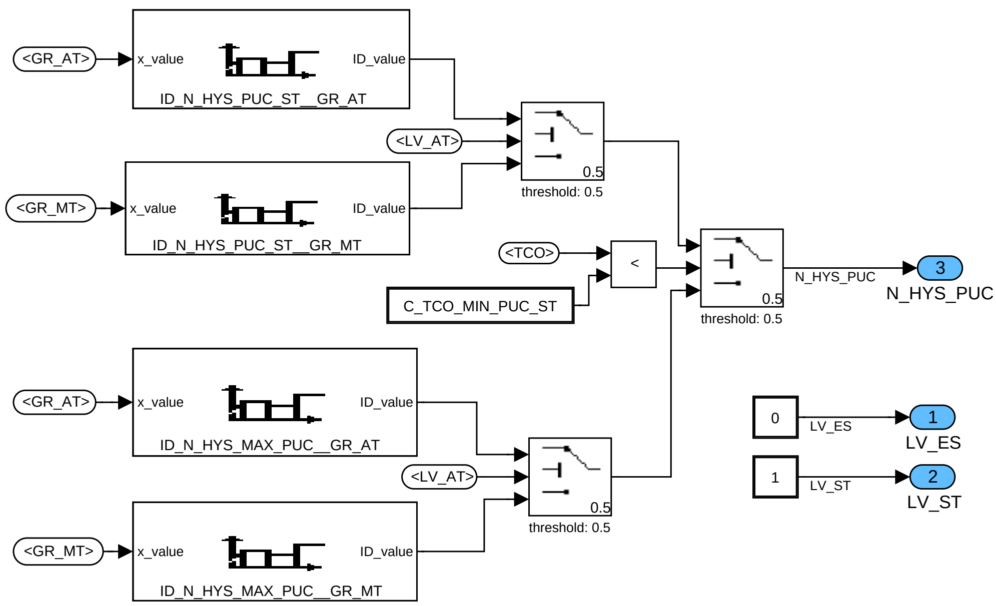

Figure 5.2.4: :

5.2.2 Formula Section

All the variables are calculated under 10 MS and SEG recurrence

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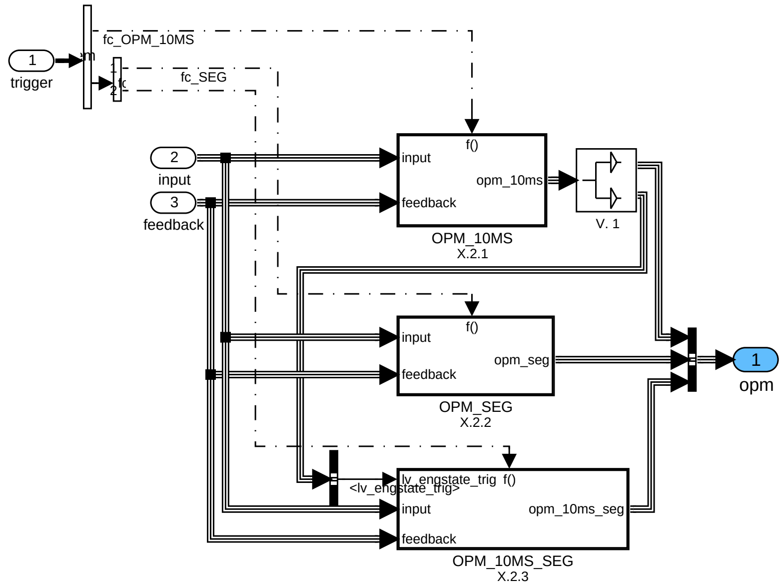

Figure 5.2.5: :

5.2.2.1 Formula Section for 10 ms Recurrence

The timer values are calculated in this block at 10 ms recurrence.

5.2.2.1.1 Calculation of Timer T_IS

The timer is calculated in this subchapter

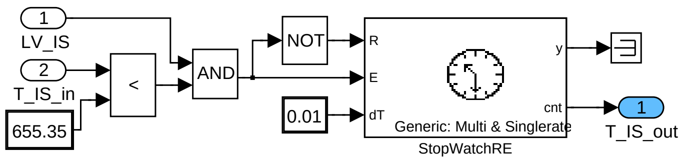

Figure 5.2.6: :

5.2.2.1.2 Activation of the timer T_PU:

Timer T_PU is calculated in this block

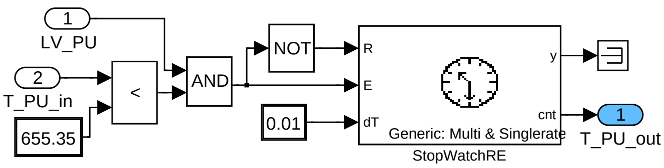

Figure 5.2.7: :

5.2.2.1.3 Calculation of T_PU_MSR

This block computes T_PU_MSR

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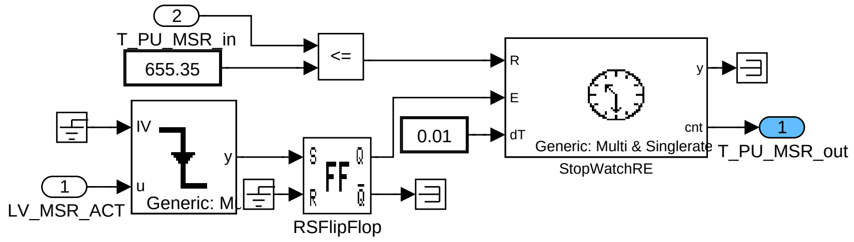

Figure 5.2.8: :

5.2.2.1.4 Set engine state trigger flag

lv_engstate_trig is set to 1

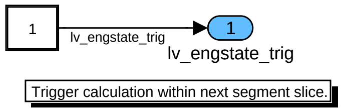

Figure 5.2.9: :

5.2.2.2 Calculation of speed for segment recurrence

N_HYS_PUC is calculated.

5.2.2.2.1 Calculation of Flag

N_HYS_PUC is calculated by checking the values of LV_PUC flag.

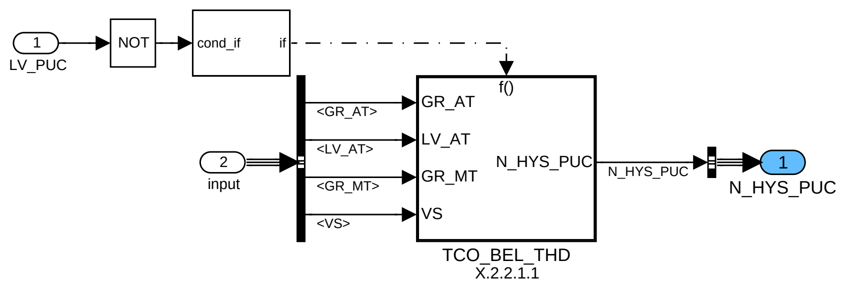

Figure 5.2.10: :

5.2.2.2.1.1 Calculation of N_HYS_PUC

N_HYS_PUC is calculated in this block.

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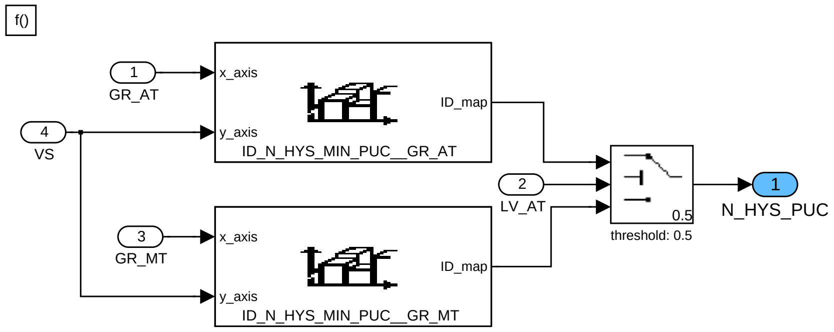

Figure 5.2.11: :

5.2.2.3 Calculation of engine state every segment synchronized with 10ms slice

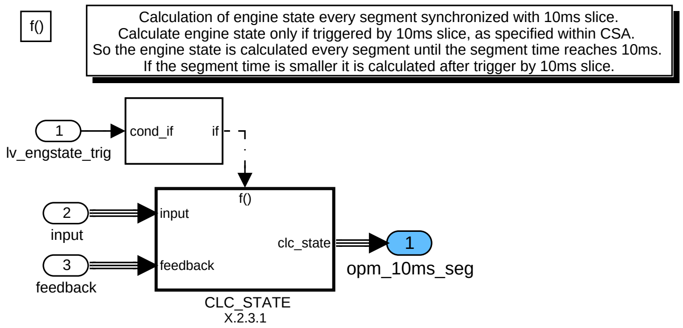

Figure 5.2.12: :

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5.2.2.3.1 Calculation at 10 MS and SEGMENT recurrence

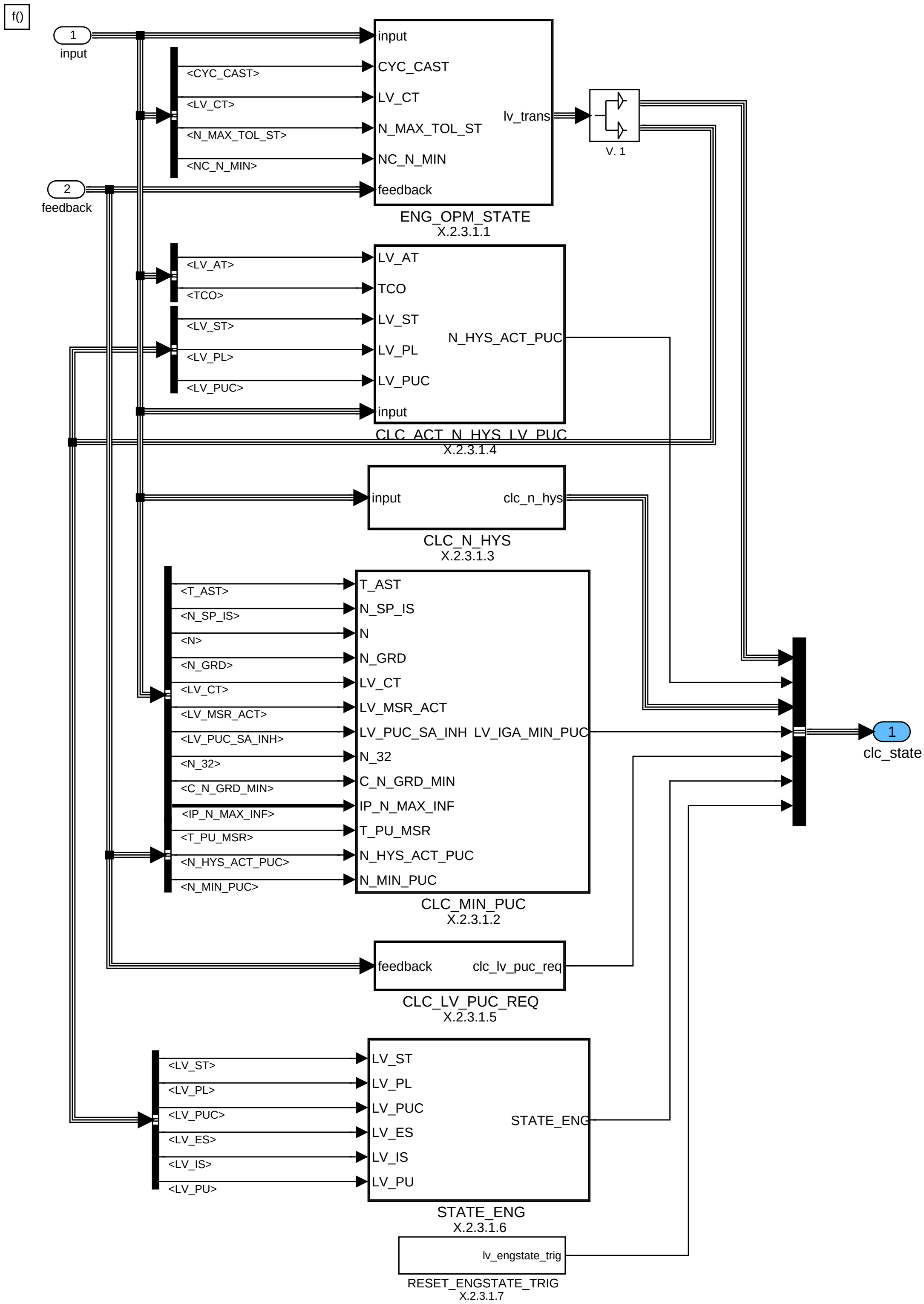

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Figure 5.2.13: :

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5.2.2.3.1.1 Calculation of Engine States

The State variables are calculated.
Additional calculation of LV_ST_END: The engine operating state Start (LV_ST) (cold start and hot start) is detected from all engine operating states via means of engine speed. The boolean LV_ST_END displays the transition from start to running engine .

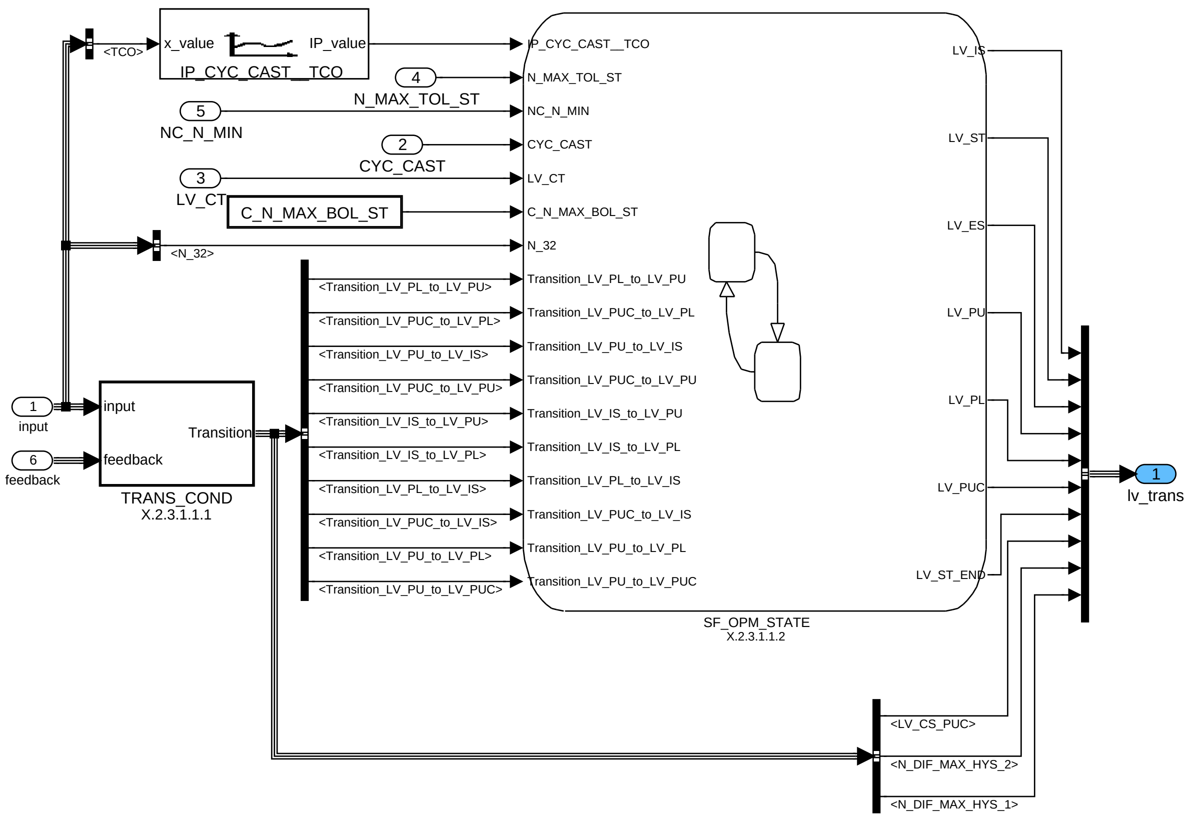

Figure 5.2.14: :

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5.2.2.3.1.1.1 Boolean condition calculations for Stateflow

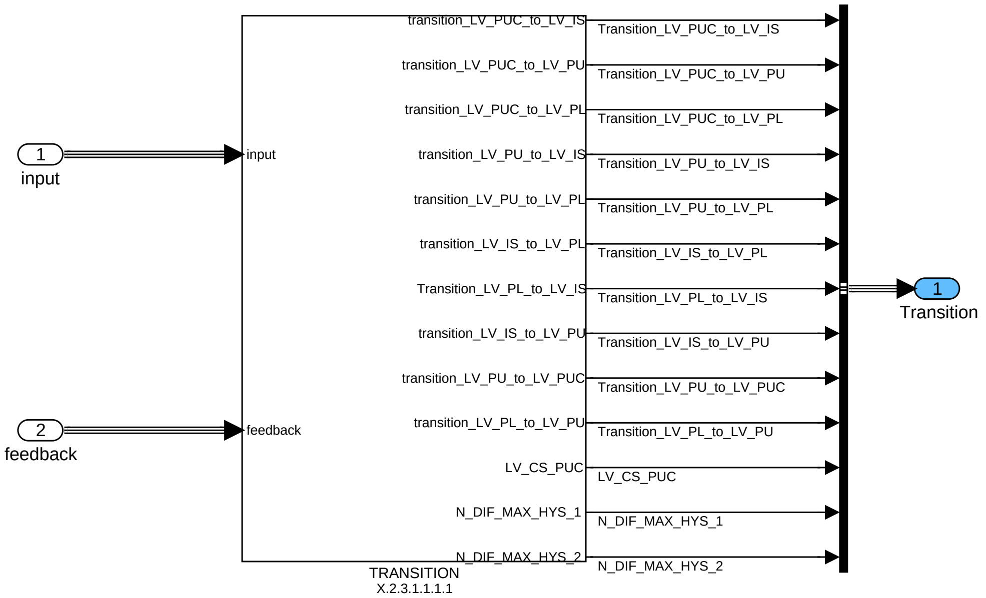

Figure 5.2.15: :

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5.2.2.3.1.1.1.1 Calculation of Engine Transition Conditions

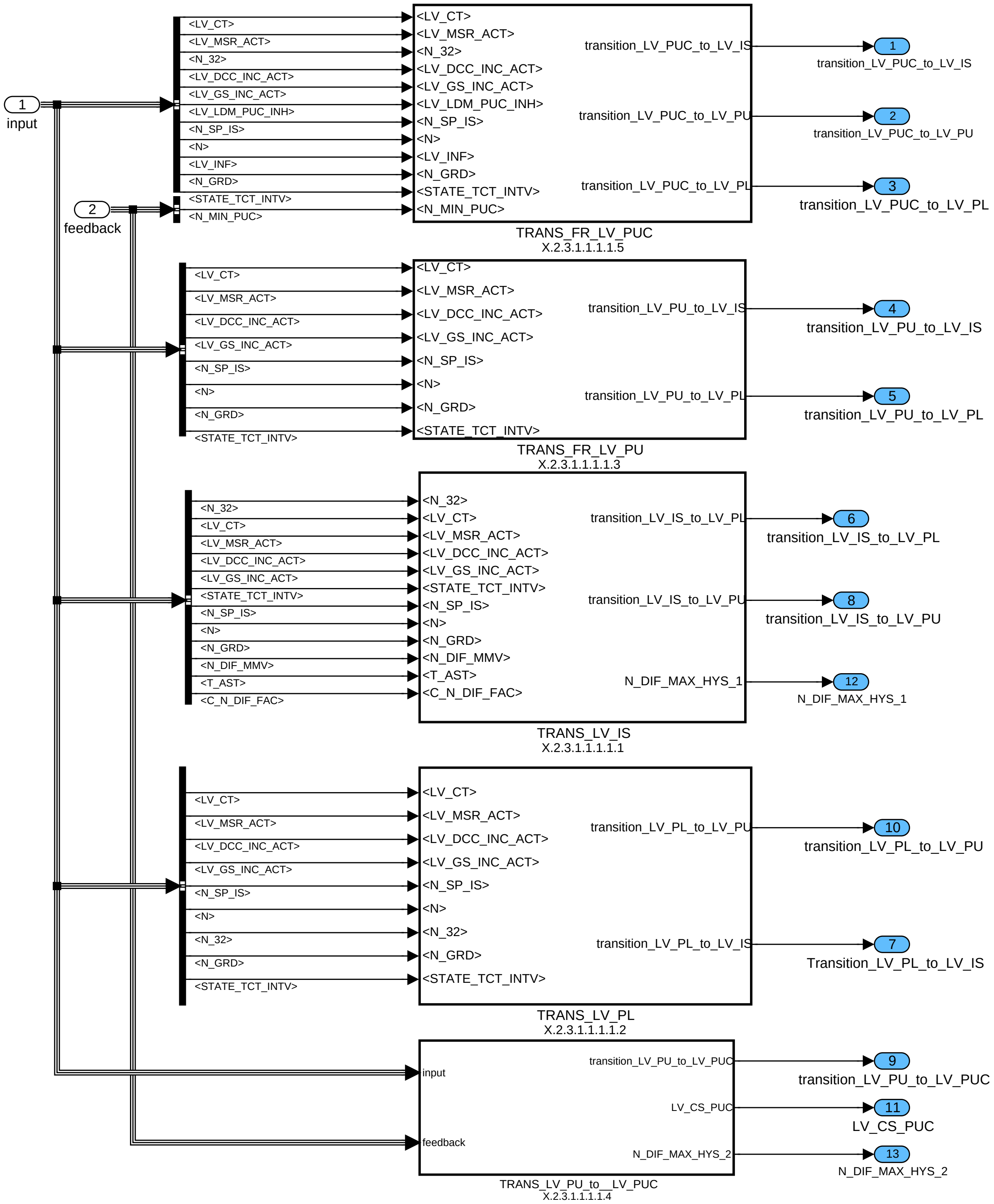

Figure 5.2.16: :

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5.2.2.3.1.1.1.1.1 Calculation of Transition Condition

Engine operating state : Idle Speed (LV_IS)The Transition condition for various To facilitate this documentation, N_SP_IS and N_DIF_MMV are described in the chapter System Variables . The following states are calculated in this part
Exit to LV_PL : Part Load, Exit to LV_PU : Trailing Throttle
states are calculated below.

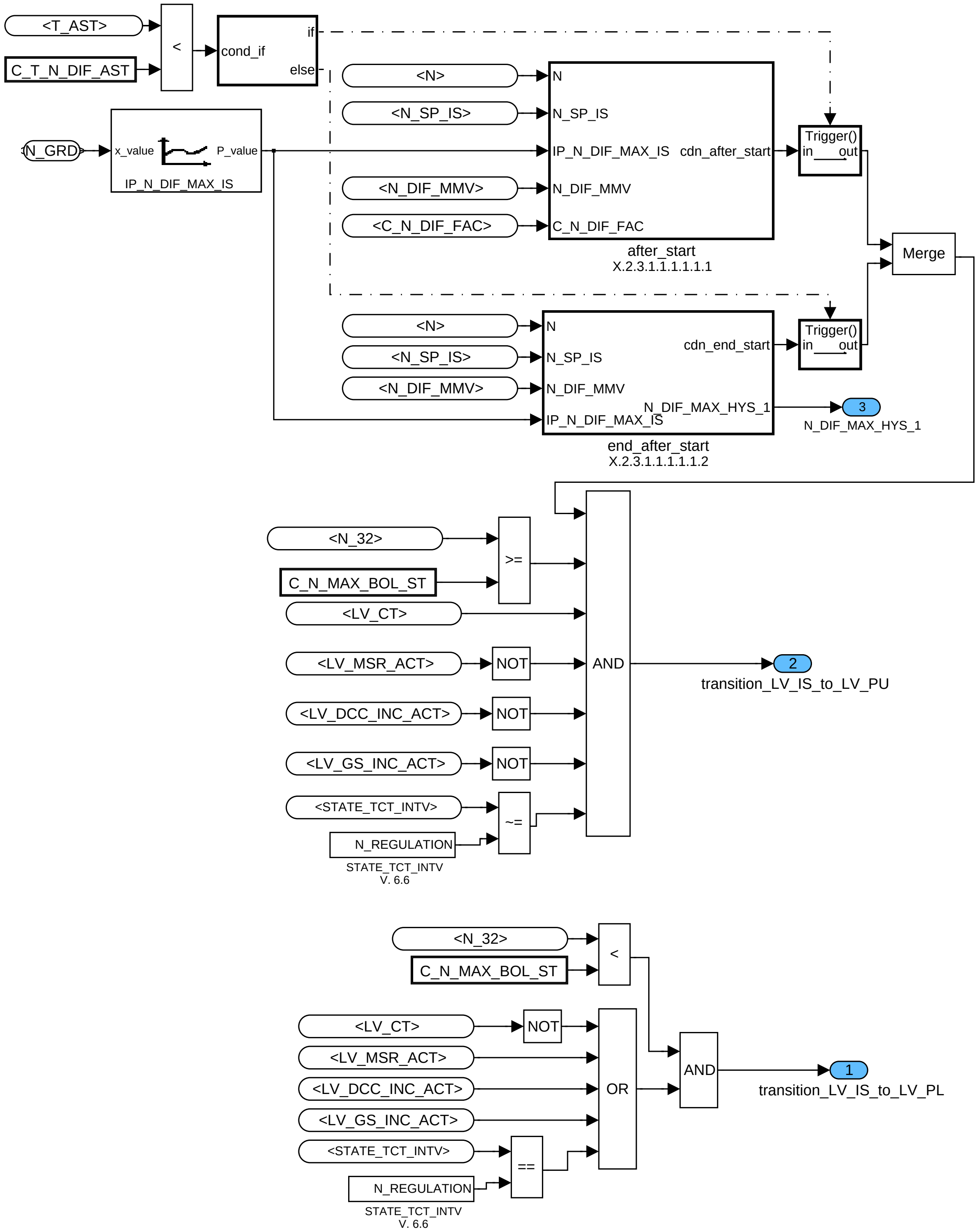

Figure 5.2.17: :

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5.2.2.3.1.1.1.1.1.1 Condition 1

This condition represents AFTER START

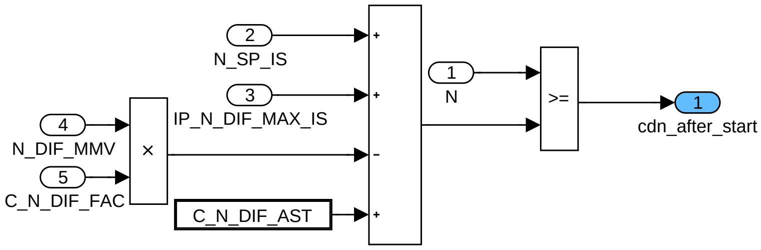

Figure 5.2.18: :

5.2.2.3.1.1.1.1.1.2 Condition 2

This condition represents END AFTER START

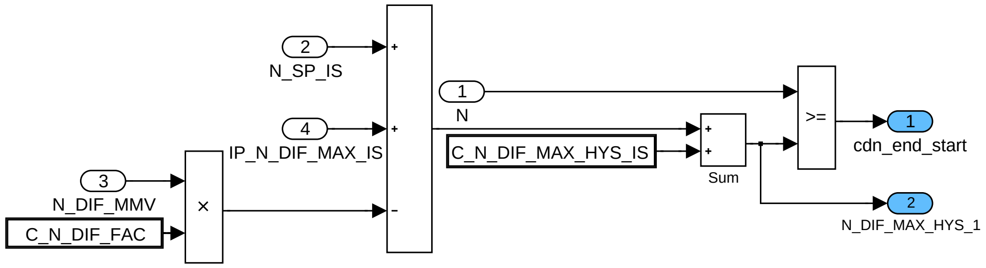

Figure 5.2.19: :

5.2.2.3.1.1.1.1.2 Engine operating state : "Part Load" (LV_PL)

To facilitate this documentation, N_SP_IS is described in the chapter System Variables . The following states are calculated in this subchapter Exit to LV_IS : Idle Speed, Exit to LV_PU : Trailing Throttle.

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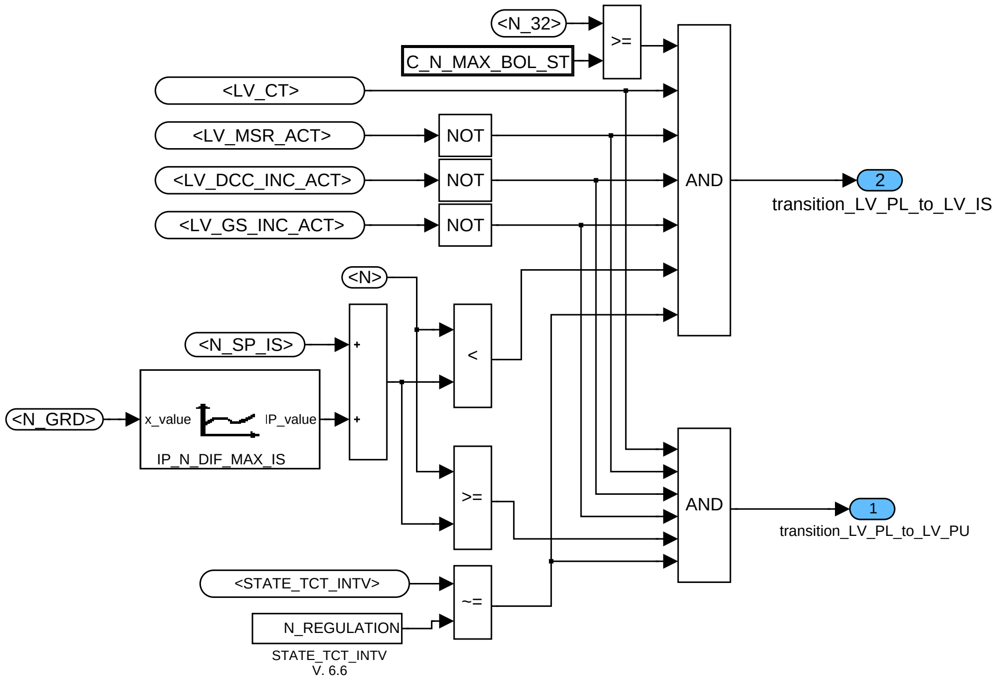

Figure 5.2.20: :

5.2.2.3.1.1.1.1.3 Engine operating state : "Trailing Throttle" (LV_PU)

To facilitate this documentation, N_GRD and N_SP_IS are described in the chapter System Variables . The following state transitions are calculated - Exit to LV_PL : Part Load, Exit to LV_IS : Idle Speed

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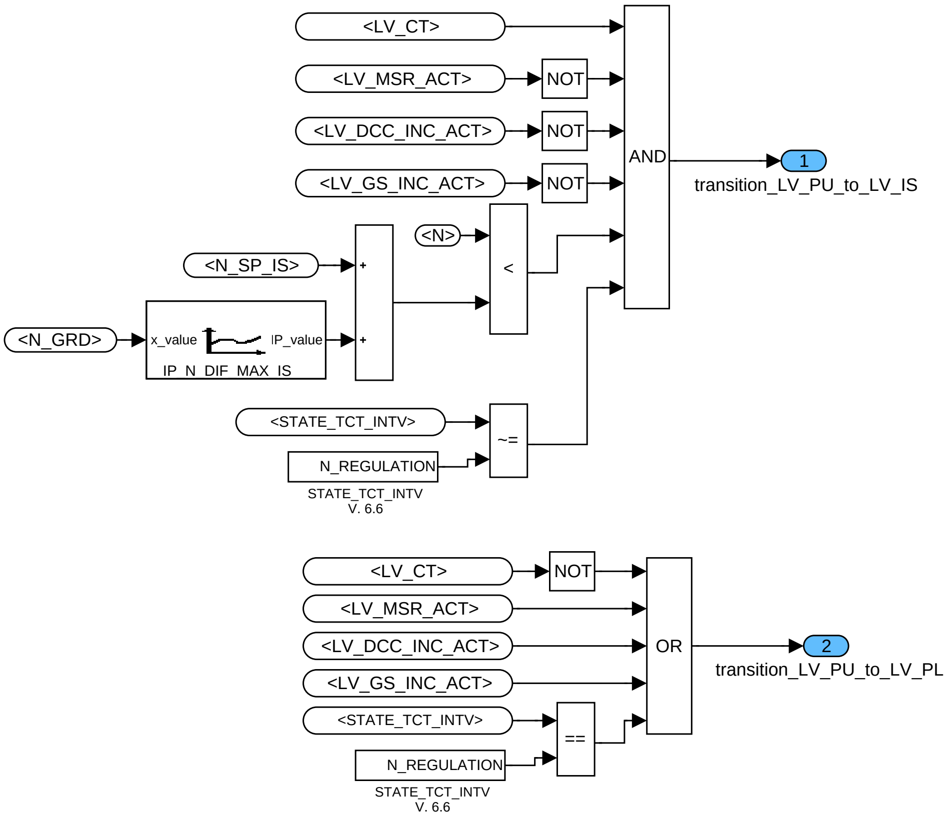

Figure 5.2.21: :

5.2.2.3.1.1.1.1.4 Exit to LV_PUC : Trailing Throttle Fuel Cut Off

After active MSR function a delay time for entrance into PUC is started to suppress a jittering of MSR function.
T_PU_MSR started at LV_MSR_ACT 1 to 0

In order to avoid a sudden entry in PUC especially for TCT variant the flag LV_CS_PUC in dependence of STATE_ETCU_CLU is defined. The driveability in stop and go conditions is improved by using a delayed clutch switch for entry in PUC.

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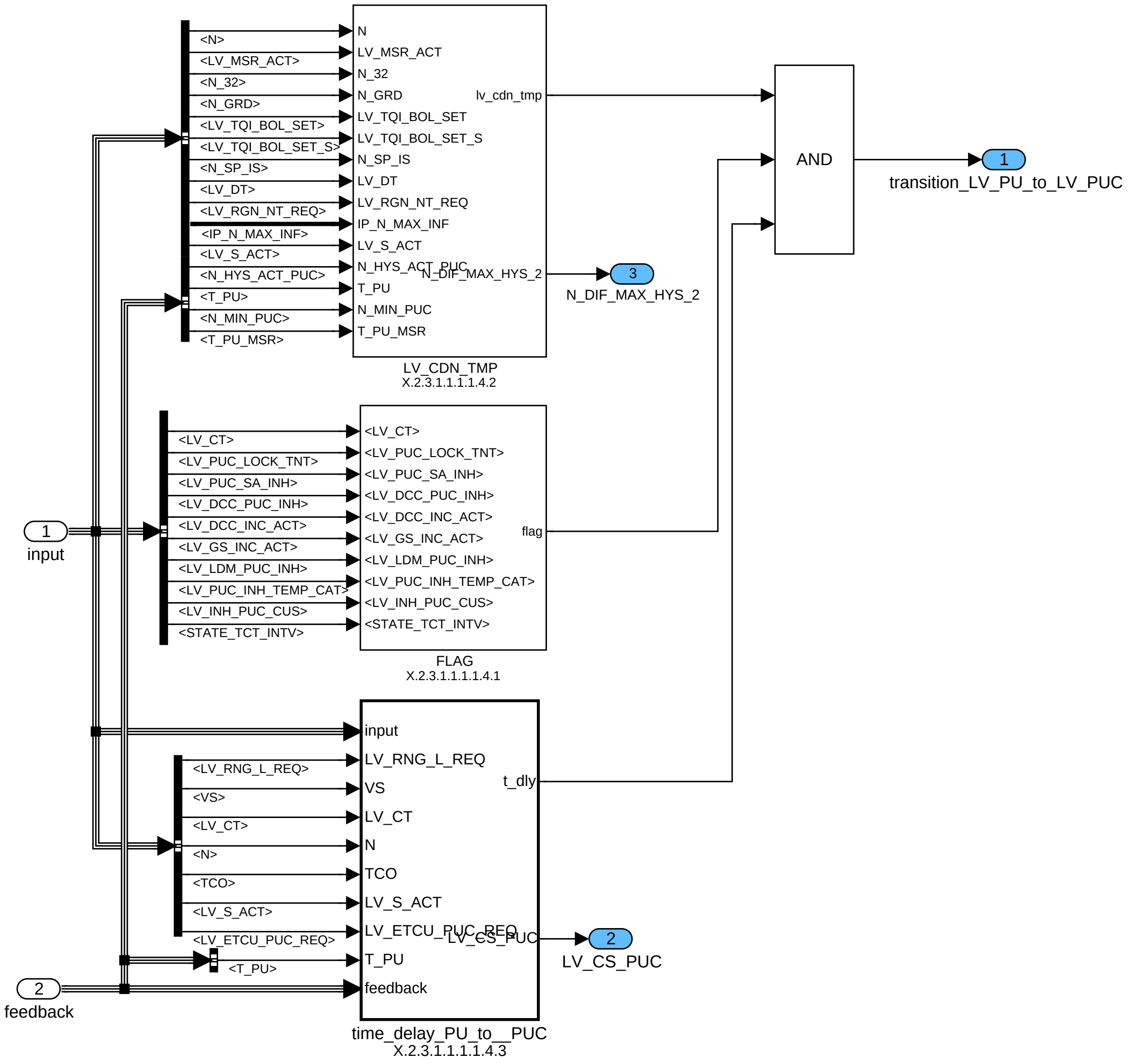

Figure 5.2.22: :

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5.2.2.3.1.1.1.4.1 Calculation of Flag

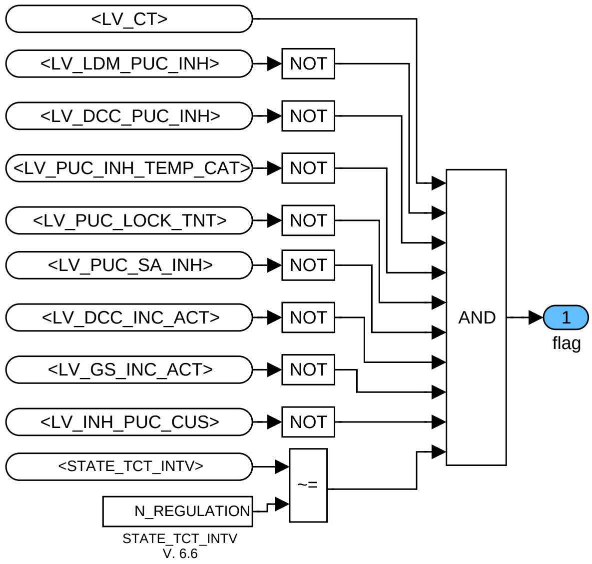

Figure 5.2.23: :

5.2.2.3.1.1.1.4.2 Calculation of lv_cdn_tmp

In order to avoid a sudden entry in PUC especially for TCT variant the flag LV_CS_PUC in dependence of STATE_ETCU_CLU is defined. The driveability in stop and go conditions is improved by using a delayed clutch switch for entry in PUC.

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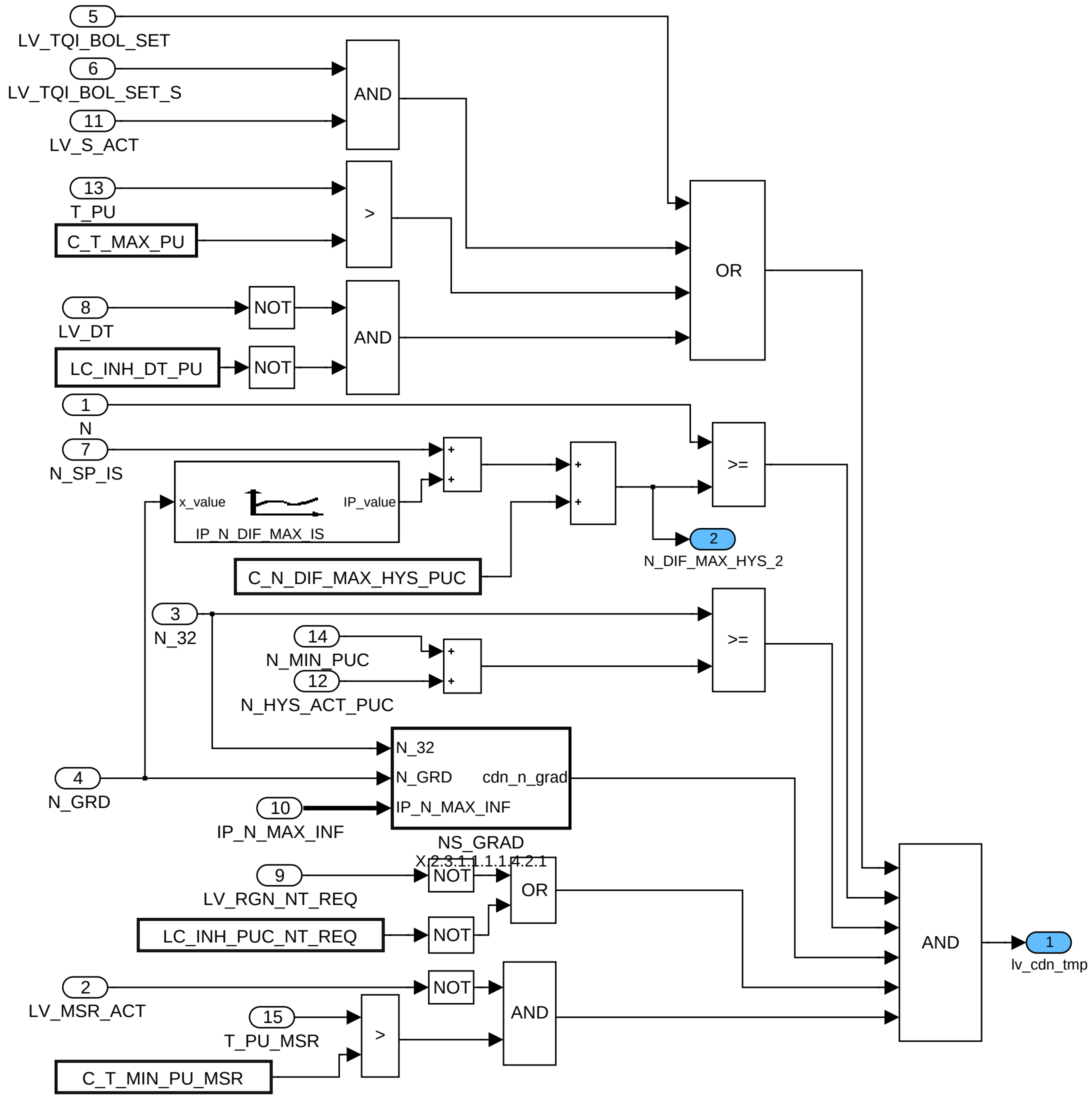

Figure 5.2.24: :

5.2.2.3.1.1.1.1.4.2.1 Calculation of N_GRD

The following condition is satisfied in this block
N_GRD (C_N_GRD_MIN (only if N_32 < IP_N_MAX_INF)

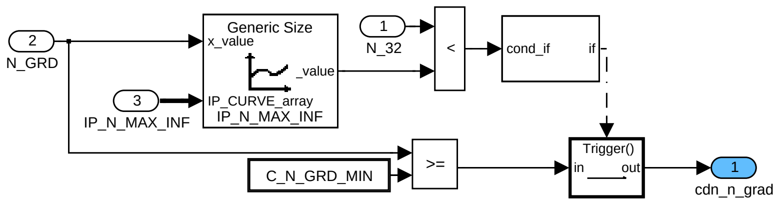

Figure 5.2.25: :

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5.2.2.3.1.1.1.1.4.3 Calculation of t_dly

After trailing throttle downshifts a direct transition from PL to PUC can be realized by LV_ETCU_PUC_REQ = 1 in order to avoid jerks.

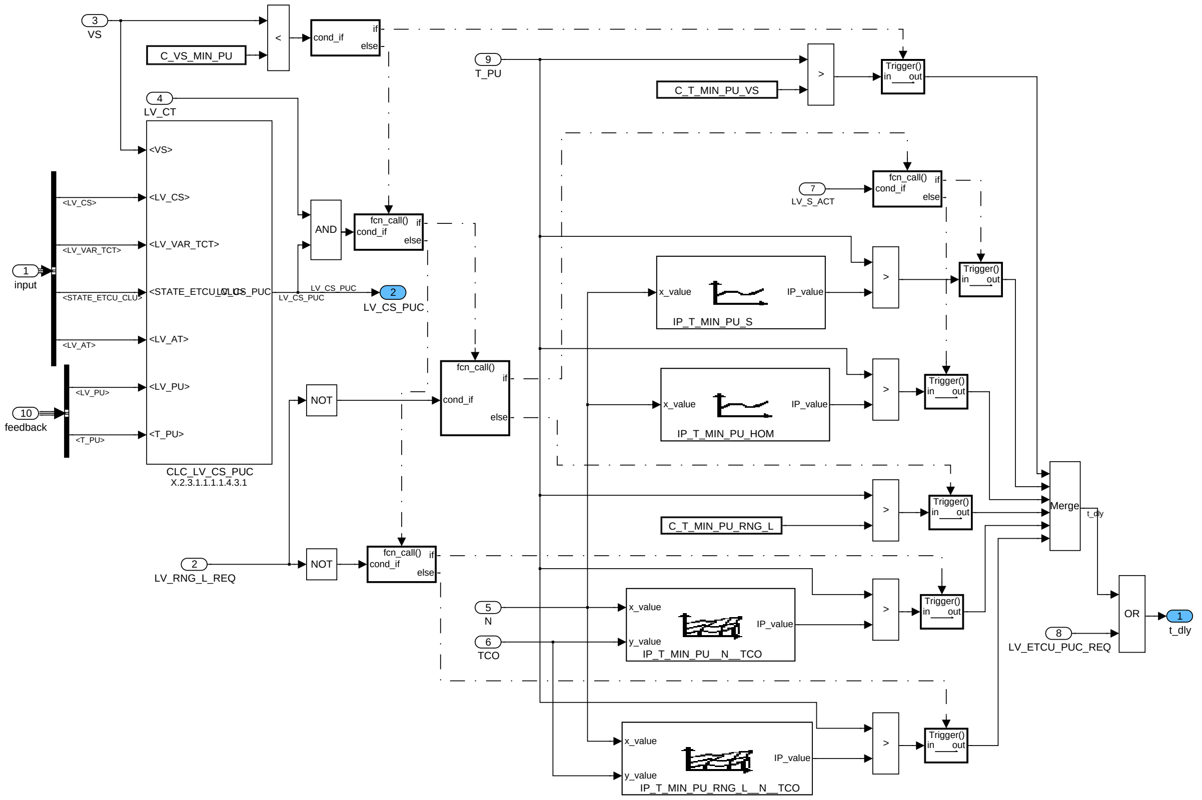

Figure 5.2.26: :

5.2.2.3.1.1.1.1.4.3.1 Calculation of LV_CS_PUC

LV_CS_PUC is calculated based on Vehicle speed.

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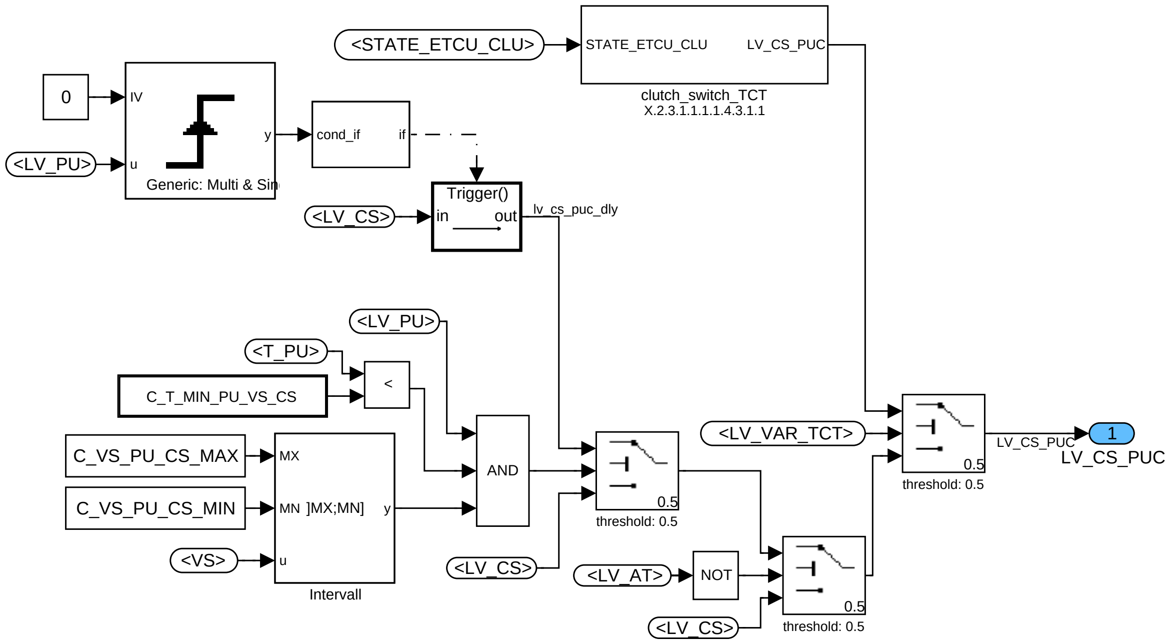

Figure 5.2.27: :

5.2.2.3.1.1.1.1.4.3.2 Bit Wise Operator

LV_CS_PUC_RAW is calculated in this block for the gearbox variant twin clutch transmission

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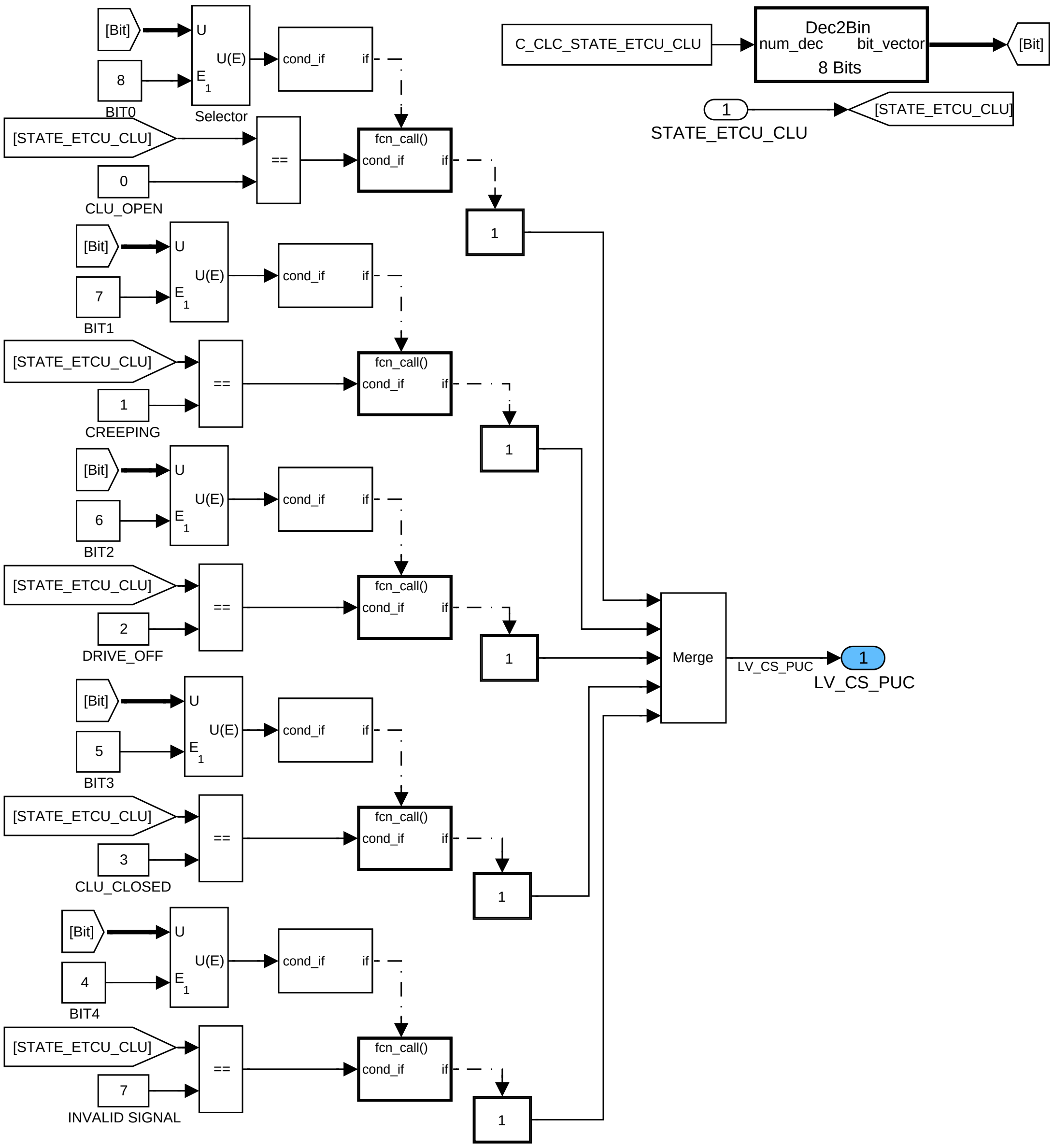

Figure 5.2.28: :

5.2.2.3.1.1.1.1.5 Calculation of Transition from LV_PUC

The following transitions are involved in LV_PUC state- Exit to LV_IS : Idle Speed, Exit to LV_PU : Trailing Throttle, Exit to LV_PL: Part Load

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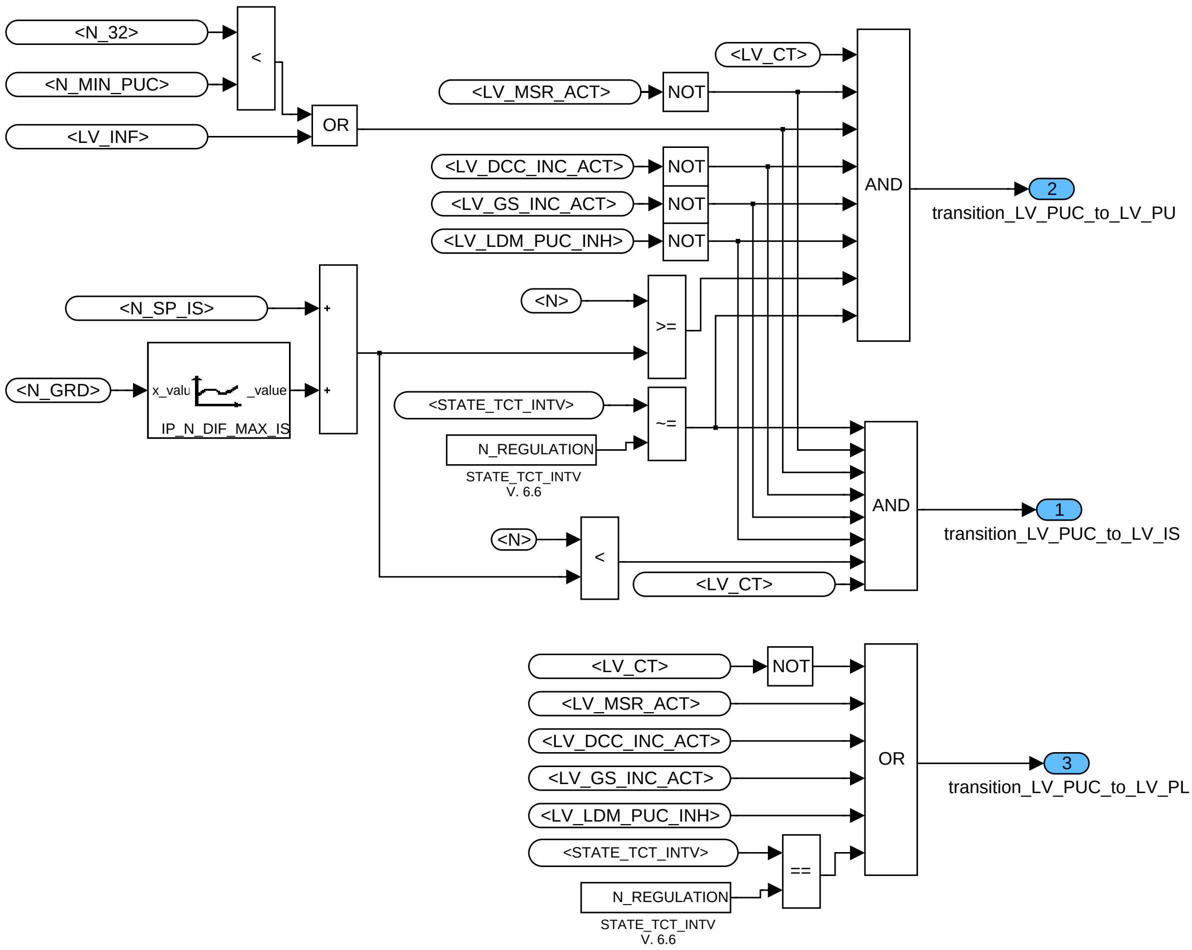

Figure 5.2.29: :

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5.2.2.3.1.1.2 SF_OPM_STATE

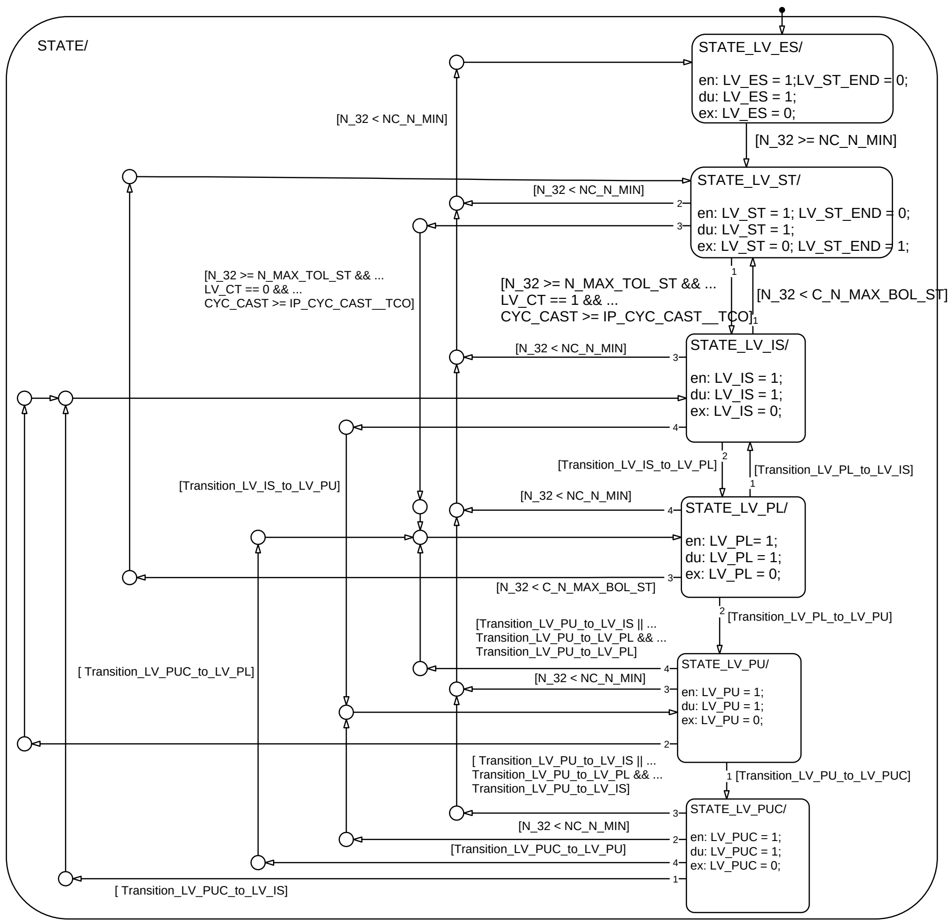

Figure 5.2.30: :

5.2.2.3.1.2 Conditions for minimum ignition angle PUC:

LV_IGA_MIN_PUC is calculated in this sub block

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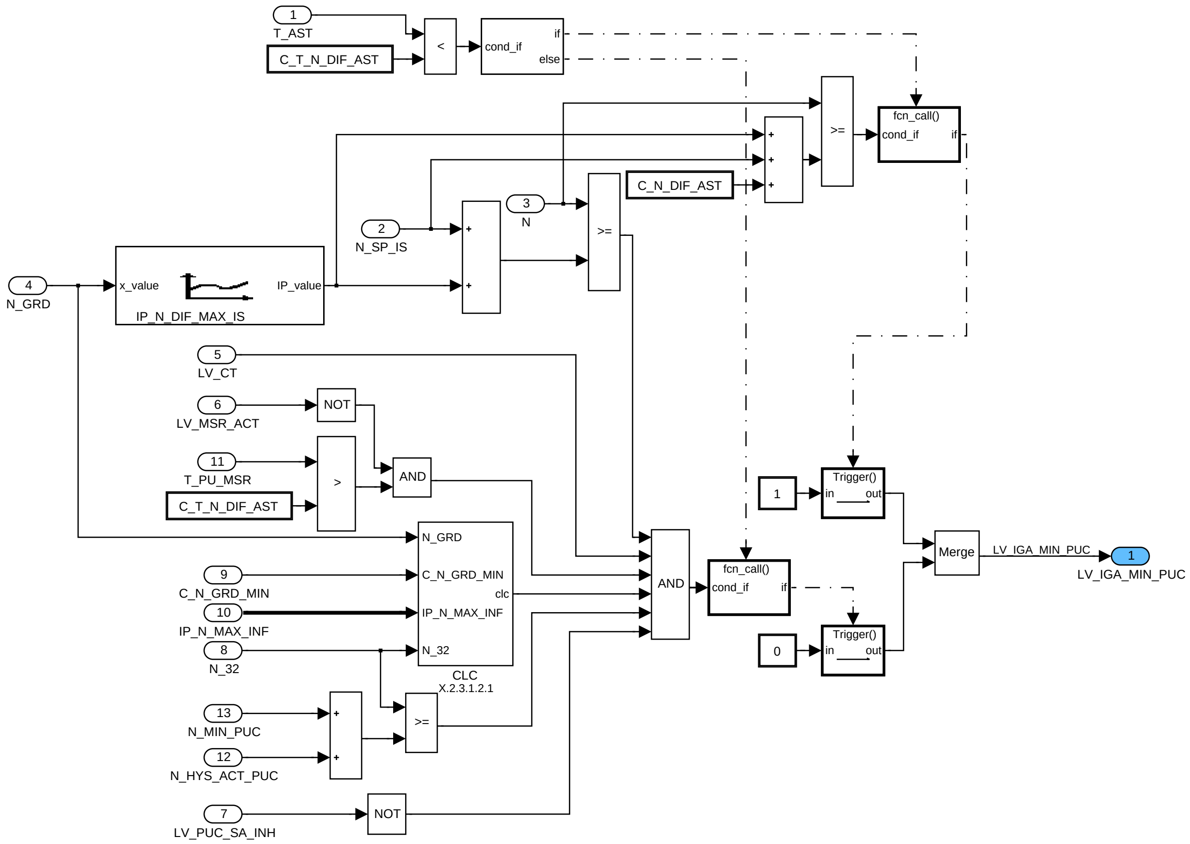

Figure 5.2.31: :

5.2.2.3.1.2.1 N_GRD and C_N_GRD_MIN - -Check

The flag is set if and only if   N_32 < IP_N_MAX_INF

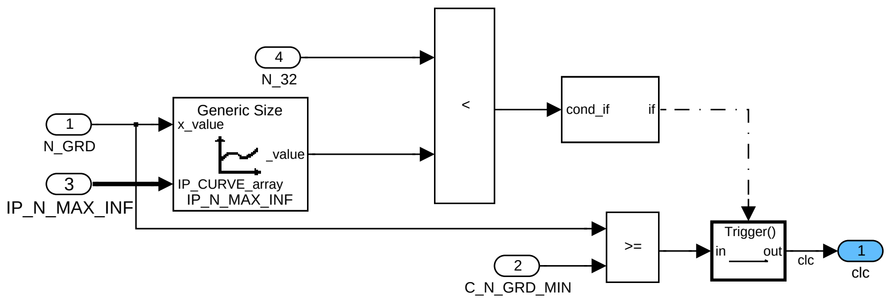

Figure 5.2.32: :

5.2.2.3.1.3 Calculation of N_HYS variables

To facilitate this documentation, N_SP_IS is described in the chapter   System Variables .
To facilitate this documentation, N_SP_IS is described in the chapter   System Variables .
The engine speed threshold for termination of PUC (reactivation of injection at decreasing engine speed) is the reactivation engine speed N_MIN_PUC. It is dependant from TCO, gear ratio, vehicle type (trans-

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mission) and TQ_LOSS_ADD (additional torque losses). ARS and PSTE torque request maps remain preserved to keep the opportunity of separate treatment.

Function 'LV_PUC Hysteresis':
To avoid toggling PUC <- -> PU or PUC <- -> IS there is a hysteresis for the engine speed threshold which determines this transition. Transition from PUC when N < threshold (N_MIN_PUC); transition to PUC when N > threshold + hysteresis (N_MIN_PUC + N_HYS_ACT_PUC).
When entering Trailing Throttle Fuel Cut Off (LV_PUC), the engine speed hysteresis is set to a larger value, ID_N_HYS_MAX_PUC__GR_xx (xx = MT, AT), and a cycle counter is loaded with an adjustable number, C_CYCNR_HYS_PUC. The cycle counter is decremented once per program cycle in any engine operating state except 'Trailing Throttle Fuel Cut Off' (LV_PUC).
When the counter has reached its lower limit 0, the engine speed hysteresis is reset to the value ID_N_HYS_MIN_PUC__GR_xx. This value depends on gear GR_xx and vehicle speed VS and is the minimum engine speed hysteresis for LV_PUC. The hysteresis is reset to this minimum value also, if during counter decrementation the engine operating state changes to partload and this reset is enabled by calibration switch LC_N_HYS_CYL_CUT_OFF_xx_CONF.
If the coolant temperature is below the threshold C_TCO_MIN_PUC_ST when the engine is started, then the engine speed hysteresis for the detection of LV_PUC is increased to an adjustable value ID_N_HYS_PUC_ST__GR_xx, for an adjustable number of cycles C_CYCNR_HYS_PUC_ST. This results in faster catalyst heat-up during trailing throttle operation.
For the customer request LV_INH_PUC_CUS = 1, the engine operating state LV_PUC is inhibited.
Description:

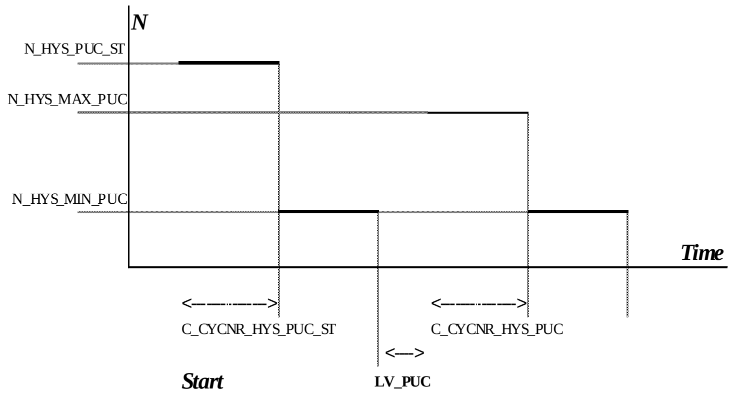

Figure 5.2.33: :

Figure 1: overview N hysteresis for PUC versus time

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5.2.2.3.1.3.1 Engine operating state : "Trailing Throttle Fuel Cut Off" (LV_PUC)

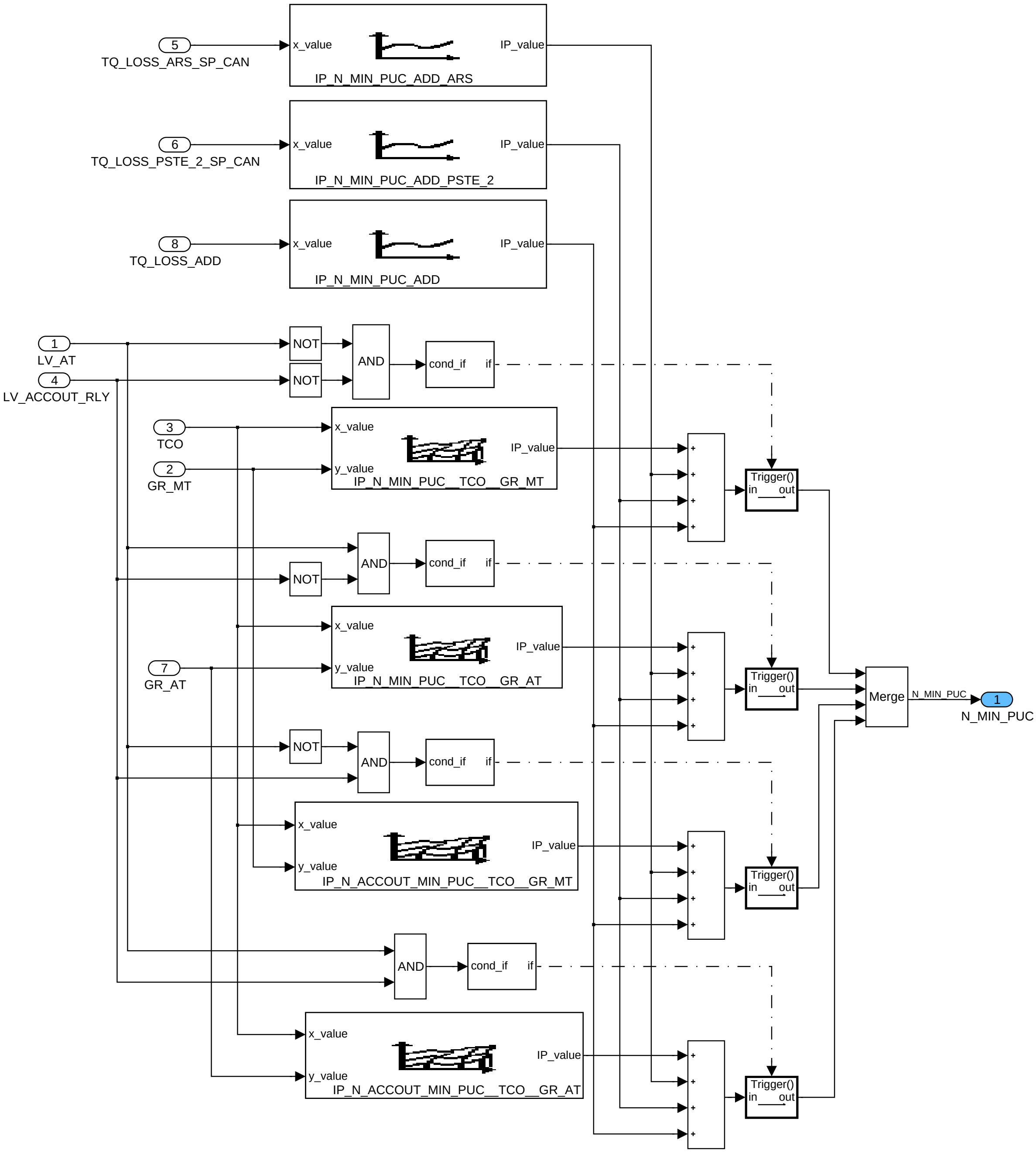

Figure 5.2.34: :

5.2.2.3.1.3.2 Calculation of minimum engine speed hysteresis for LV_PUC:

Calculation of N_HYS_MIN_PUC

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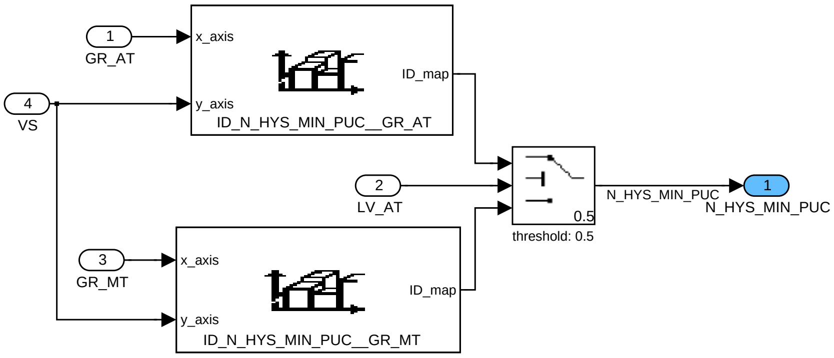

Figure 5.2.35: :

5.2.2.3.1.4 Calculation of actual effective engine speed hysteresis for LV_PUC

N_HYS_ACT_PUC is calculated in this block.

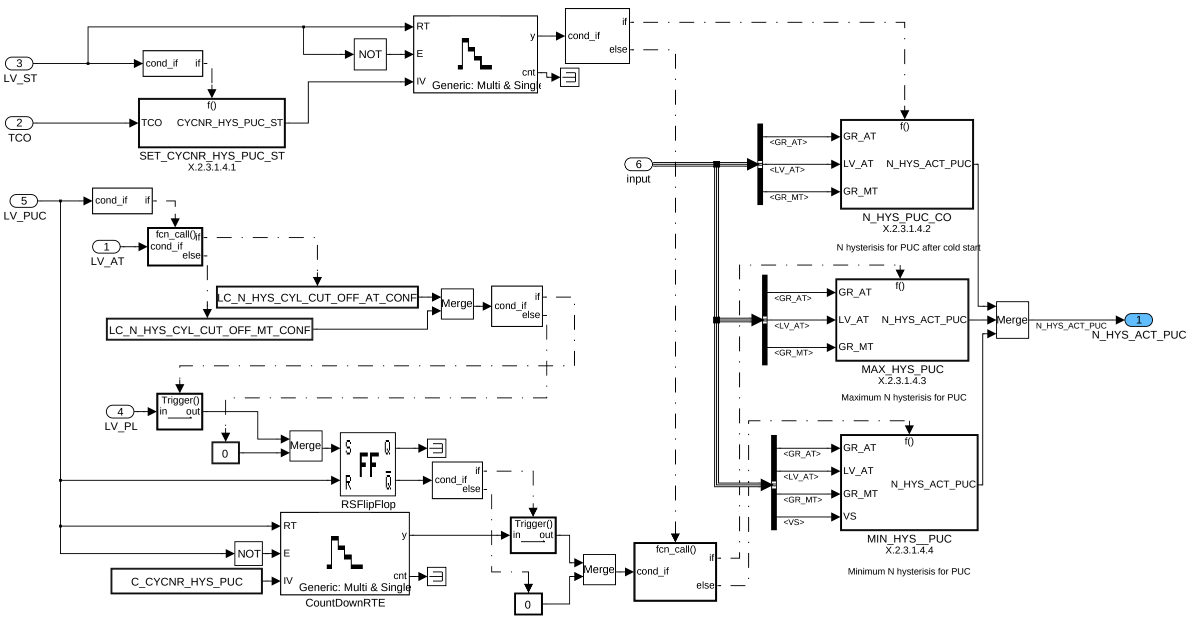

Figure 5.2.36: :

5.2.2.3.1.4.1 SET_CYCNR_HYS_PUC_ST

CYCNR_HYS_PUC_ST is set.

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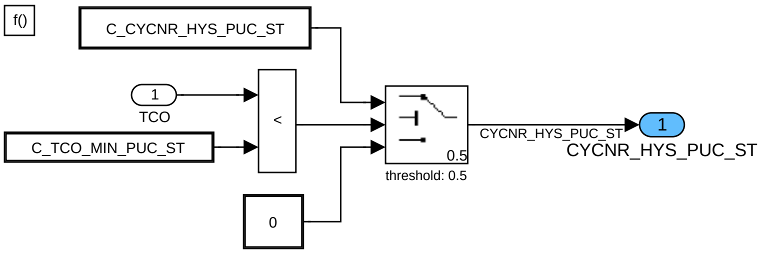

Figure 5.2.37: :

5.2.2.3.1.4.2 Calculation at Coldstart

N_HYS_ACT_PUC is calculated in this block

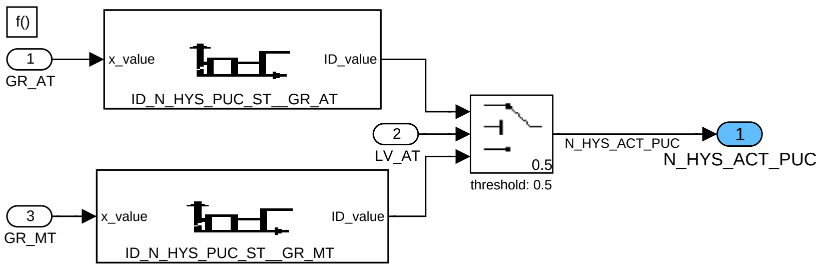

Figure 5.2.38: :

5.2.2.3.1.4.3 Maximum Speed Hysteresis for PUC

N_HYS_ACT_PUC is calculated in this block.

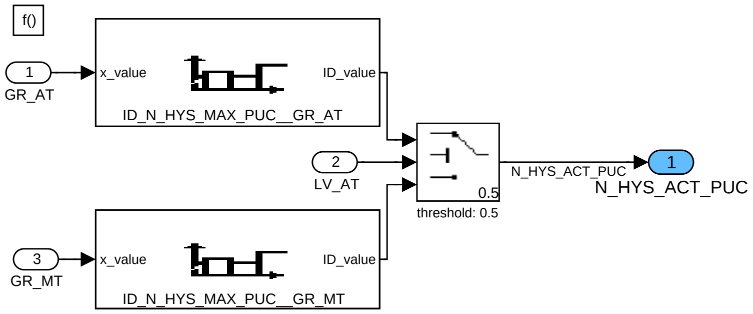

Figure 5.2.39: :

5.2.2.3.1.4.4 Minimum Speed Hysteresis for PUC

N_HYS_ACT_PUC is calculated in this block.

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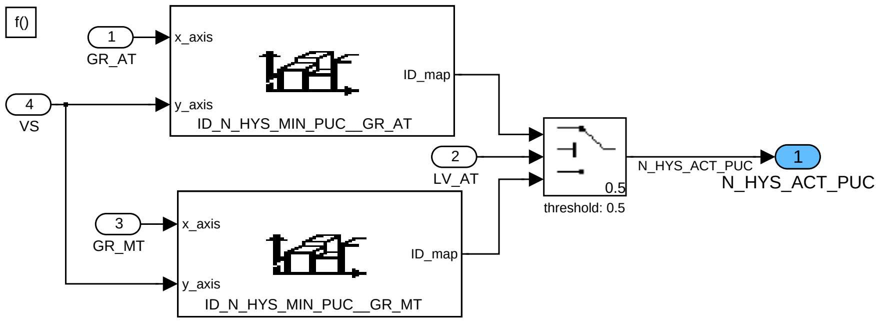

Figure 5.2.40: :

5.2.2.3.1.5 Logical variable trailing throttle fuel cut-off request LV_PUC_REQ

LV_PUC_REQ is set at trailing throttle conditions. It is evaluated in the module Minimum torque at clutch .

5.2.2.3.1.5.1 No title given

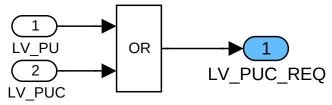

Figure 5.2.41: :

5.2.2.3.1.6 Engine operating state : "Status byte" (STATE_ENG)

The status-byte STATE_ENG gives a quick overview of the engine operating state for e.g. calibration.

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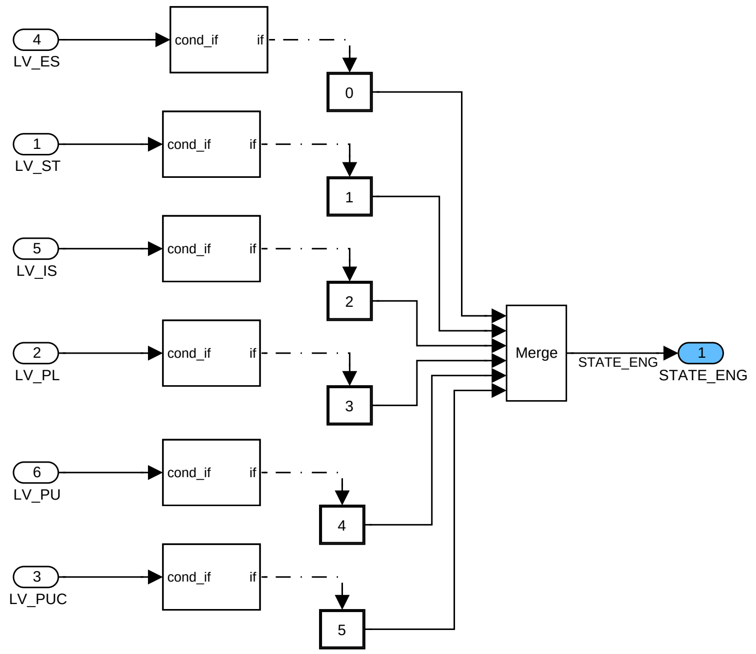

Figure 5.2.42: :

5.2.2.3.1.7 Reset engine state trigger flag

lv_engstate_trig is reset to 0.

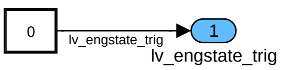

Figure 5.2.43: :

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5.3 Administration of calculation optimization

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CBK_EX_NR_ST_CLC	O/V	0... 1H	1 ...2	1	-
Start number of exhaust bank for calculations					
CTR_CBK_EX_NR_STOP_CLC	O/V	0... 1H	1 ...2	1	-
Stop number of exhaust bank for calculations					
CTR_CBK_IN_NR_ST_CLC	O/V	0... 1H	1 ...2	1	-
Start number of intake bank for calculations					
CTR_CBK_IN_NR_STOP_CLC	O/V	0... 1H	1 ...2	1	-
Stop number of intake bank for calculations					
CTR_CYL_NR_ST_CLC	O/V	0... 7H	0 ...7	1	-
Number of first cylinder in calculation order					
CTR_CYL_NR_STOP_CLC	O/V	0... 7H	0 ...7	1	-
Number of last cylinder in calculation order					
STATE_CLC_RED	O/V	0... FFH	0... 255	1	-
Calculation reduction state for runtime optimization					

Input data:

LV_ST_END {p. 1720}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}	NC_IN_REF {p. 812}
NC_LAMB_REF [NC_CYL_NR] {p. 812}	SEG_NR {p. 1525}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_CTR_CYL_NR_CLC	-	0... 7H	0 ...7	1	-
LDP_SEG_NR_ID_CTR_CYL_NR_CLC	NC_ CYL_ NR	0... 7H	0 ...7	1	-
Cylinderandsegmentrelationforruntimereduction			-	-	-
C_N_32_THD_CLC_RED	1	0... FFH	0... 8160	32	rpm
Enginespeedthresholdforactivationofruntimere-duction			-	-	-
C_N_32_HYS_CLC_RED	1	0... 3FH	0... 2016	32	rpm
Enginespeedhysteresisfordeactivationofrun-timereduction			-	-	-
C_SEG_NR_ST_CLC_RED	1	0... 7H	0 ...7	1	-
Startsegmentnumberforruntimereductionactiva-tion			-	-	-
Start segment number for runtime reduction activation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_STATE_CLC_RED_ACT	-	0... FFH	0... 255	1	-
Constant defined to indicate that calculation reduction is active					
NC_STATE_CLC_RED_CLC_DEAC	-	0... FFH	0... 255	1	-
Constant defined to indicate that the calculation of a module has not been done at next activation call					
NC_STATE_CLC_RED_MASK_1	-	0... FFH	0... 255	1	-
Mask to isolate calculation recurrence information					
NC_STATE_CLC_RED_MASK_2	-	0... FFH	0... 255	1	-
Mask to isolate activation information					
NC_STATE_CLC_RED_SEG_05	-	0... FFH	0... 255	1	-
Constant defined to indicate that the calculation of a module is done twice per segment					
NC_STATE_CLC_RED_SEG_1	-	0... FFH	0... 255	1	-
Constant defined to indicate that the calculation of a module is done on every segment					
NC_STATE_CLC_RED_SEG_2	-	0... FFH	0... 255	1	-
Constant defined to indicate that the calculation of a module is done on every second segment					
NC_STATE_CLC_RED_SEG_4	-	0... FFH	0... 255	1	-
Constant defined to indicate that the calculation of a module is done on every fourth segment					

FUNCTION DESCRIPTION:

General information:
This module is used for administration of runtime reduction and calculation optimization steps.
Pay Attention! This module has to be placed in the operating system immediately after the calculation of N_32 and SEG_NR, which are calculated by the ENSD aggregate. All aggregates, which are affected by calculation optimization, have to be calculated afterwards.

5.3.1 Runtime reduction

Application conditions

Activation : *every engine state*

Deactivation : -

Initialization:
```
at reset:  STATE_CLC_RED = NC_STATE_CLC_RED_SEG_1
CTR_CYL_NR_ST_CLC = 0
CTR_CYL_NR_STOP_CLC = (NC_CYL_NR - 1)
CTR_CBK_IN_NR_ST_CLC = 1                    (physical meaning)
CTR_CBK_IN_NR_STOP_CLC = NC_CBK_IN_NR
CTR_CBK_EX_NR_ST_CLC = 1                    (physical meaning)
CTR_CBK_EX_NR_STOP_CLC = NC_CBK_EX_NR
```

Recurrence :
```
LV_ST_END = 0:  10 ms
LV_ST_END = 1:  segment synchronous
```

This chapter describes runtime reduction steps. First step is to reduce cylinder dependent calculations from all cylinders to one cylinder, dependent on the engine speed. An additional step is to reduce bank dependent calculations to the intake or exhaust bank, which is allocated to the related cylinder by NC_IN_REF and NC_LAMB_REF.

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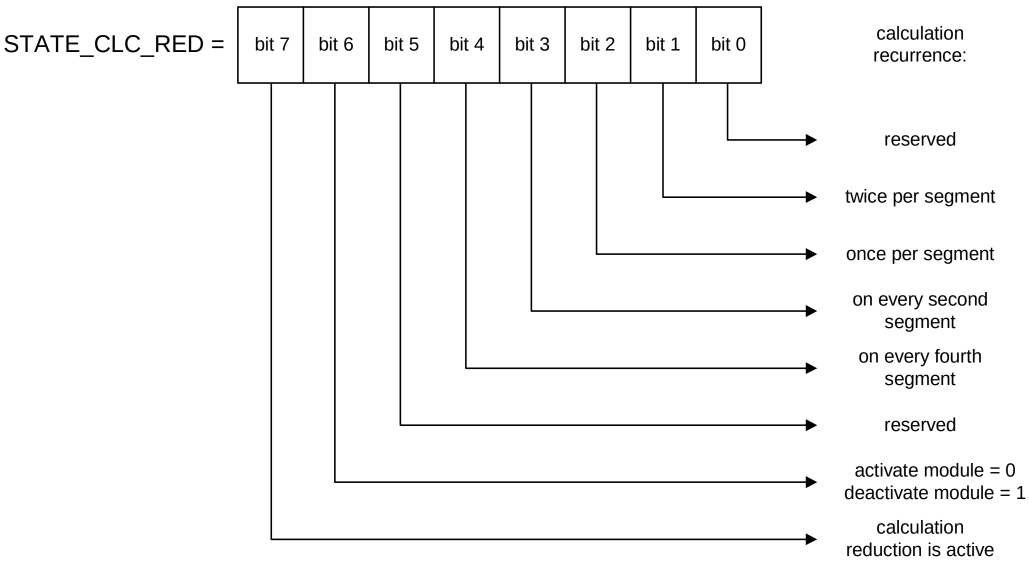
Formula Section :

5.3.1.1 Definition of STATE_CLC_RED



5.3.1.1.1 Definitions of the non calibrateable constants to generate STATE_CLC_RED

NC_STATE_CLC_RED_SEG_05 = 0x02H
NC_STATE_CLC_RED_SEG_1 = 0x04H
NC_STATE_CLC_RED_SEG_2 = 0x08H
NC_STATE_CLC_RED_SEG_4 = 0x10H
NC_STATE_CLC_RED_CLC_DEAC = 0x40H
NC_STATE_CLC_RED_ACT = 0x80H
NC_STATE_CLC_RED_MASK_1 = 0x1EH
NC_STATE_CLC_RED_MASK_2 = 0xC0H

5.3.1.2 Check runtime reduction activation conditions

(1) IF (STATE_CLC_RED **AND** NC_STATE_CLC_RED_ACT) = 0 ... bitwise
AND
N_32 > C_N_32_THD_CLC_RED
AND
SEG_NR = C_SEG_NR_ST_CLC_RED
(1) THEN (runtime reduction has to be activated)
STATE_CLC_RED = NC_STATE_CLC_RED_ACT
OR NC_STATE_CLC_RED_SEG_2 ...
bitwise

(1) ELSE
(2) IF (STATE_CLC_RED **AND** NC_STATE_CLC_RED_ACT) =
bitwise NC_STATE_CLC_RED_ACT
AND

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N_32 < (C_N_32_THD_CLC_RED - C_N_32_HYS_CLC_RED)
AND
SEG_NR = C_SEG_NR_ST_CLC_RED
(2) THEN
STATE_CLC_RED = NC_STATE_CLC_RED_SEG_1
(runtime reduction will be deactived)
(2) ENDIF
(1) ENDIF

5.3.1.3 Determine cylinder and bank numbers for follow up calculations

(3) IF (STATE_CLC_RED **AND** NC_STATE_CLC_RED_ACT) = ... bitwise NC_STATE_CLC_RED_ACT
(3) THEN
STATE_CLC_RED = STATE_CLC_RED
ExOR NC_STATE_CLC_RED_CLC_DEAC ... bitwise

CTR_CYL_NR_ST_CLC = ID_CTR_CYL_NR_CLC
(SEG_NR is input data for ID_CTR_CYL_NR_CLC)
CTR_CYL_NR_STOP_CLC = CTR_CYL_NR_ST_CLC
(4) IF Bit related to cylinder CTR_CYL_NR_ST_CLC of NC_IN_REF = 1
(4) THEN
CTR_CBK_IN_NR_ST_CLC = 2 (physical meaning)
CTR_CBK_IN_NR_STOP_CLC = 2 (physical meaning)
(4) ELSE
CTR_CBK_IN_NR_ST_CLC = 1 (physical meaning)
CTR_CBK_IN_NR_STOP_CLC = 1 (physical meaning)
(4) ENDIF
(5) IF Bit related to cylinder CTR_CYL_NR_ST_CLC of NC_LAMB_REF = 1
(5) THEN
CTR_CBK_EX_NR_ST_CLC = 2 (physical meaning)
CTR_CBK_EX_NR_STOP_CLC = 2 (physical meaning)
(5) ELSE
CTR_CBK_EX_NR_ST_CLC = 1 (physical meaning)
CTR_CBK_EX_NR_STOP_CLC = 1 (physical meaning)
(5) ENDIF
(3) ELSE
CTR_CYL_NR_ST_CLC = 0
CTR_CYL_NR_STOP_CLC = (NC_CYL_NR - 1)
CTR_CBK_IN_NR_ST_CLC = 1 (physical meaning)
CTR_CBK_IN_NR_STOP_CLC = NC_CBK_IN_NR (physical meaning)
CTR_CBK_EX_NR_ST_CLC = 1 (physical meaning)
CTR_CBK_EX_NR_STOP_CLC = NC_CBK_EX_NR (physical meaning)
(3) ENDIF

Application hint

ID_CTR_CYL_NR_CLC describe the cylinder number, which will be calculated exclusive on the segment with the number SEG_NR, even if the runtime reduction is active. Therefor you have to specify the segment cylinder relation here proper to your engine type.
For example (8 cyl. engine):

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SEG_NR Segment number	ID_CTR_CYL_NR_CLC Exclusive calculated cylinder
0	3
1	4
2	5
3	6
4	7
5	0
6	1
7	2

Note that the related intake and exhaust banks will be calculated automatically by NC_IN_REF and NC_LAMB_REF.

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5.4 Basic functions

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_FL	O/V	0... 1H	0 ...1	1	-
Basic function FL					
LV_FL_RAW	O/V	0... 1H	0 ...1	1	-
LV condition pedal value is fullfilled					
LV_INF	O/V	0... 1H	0 ...1	1	-
Basic function " Intercept "					

Input data:

CL_MMV {p. 3698}	FAC_TQ_REQ_DRIV {p. 6570}	LOAD_THD_FL {p. 8390}	LV_AT {p. 654}
LV_CT {p. 1442}	LV_IS {p. 1720}	LV_PU {p. 1720}	LV_PUC {p. 1720}
LV_TI_LIM_ACT {p. 8270}	LV_TQ_LIM_INTV {p. 6692}	N {p. 1525}	N_32 {p. 1525}
N_GRD {p. 1525}	N_SP_IS {p. 1122}	STATE_ETC_LIH {p. 4982}	STATE_TPS_DIAG {p. 4982}
T_AST {p. 1766}	T_MIN_D_ISA	TCO {p. 1100}	VS {p. 1176}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MMV_THD_FL	-	0... FFFFH	0 ...2	30.5e-6	-
threshold for high canister load					
C_FAC_TQ_REQ_FL_HYS	-	0... FFFFH	0... 1.999969	30.518e-6	-
Hysteresis for driver wish threshold for Full load recognition					
C_LOAD_THD_FL_HYS	-	0... FFFFH	0... 3.99993897	0.000061	-
Hysteresis for load threshold for Full load recognition					
C_N_GRD_MIN	-	80... 00H	-4096 ...0	32	min-1/s
engine speed gradient threshold for activating the intercept function					
C_N_MAX_FL_DLY	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for Full load recognition					
C_N_MIN_CP_FL	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for FL at high canister purge load					
C_N_MIN_FL	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for FL					
C_N_MIN_FL_DLY	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for Full load recognition					
C_T_MAX_FL_DLY	-	0... FFFFH	0... 6553.5	0,1	s
Time after Start- Threshold value for Full load recognition					
C_T_MIN_FL_DLY	-	0... FFFFH	0... 6553.5	0,1	s
Time after Start- Threshold for Full load recognition					
C_T_TI_DLY_FL_1	-	0... FFFFH	0... 655.35	0,01	s
Delay time Full load					
C_T_TI_DLY_FL_2	-	0... FFFFH	0... 655.35	0,01	s
Delay time Full load					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_TI_DLY_FL_AT_1	-	0... FFFFH	0... 655.35	0,01	s
Delay time Full load t AT					
C_T_TI_DLY_FL_AT_2	-	0... FFFFH	0... 655.35	0,01	s
Delay time Full load AT					
C_TCO_MIN_FL	-	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for FL					
C_VS_MIN_FL	-	0... FFH	0... 255	1	km/h
Minimum velocity for FL					
IP_FAC_TQ_REQ_DRIV_FL	-	0... FFFFH	0... 1.999969	30.518e-6	-
LDPM_N_2_3	16	0... 1FE0H	0... 8160	1	rpm
Driver wish threshold for Full load recognition					
IP_LOAD_THD_FL	-	0... FFFFH	0... 3.99993897	0.000061	-
LDPM_N_2_3	16	0... 1FE0H	0... 8160	1	rpm
Load threshold for Full load recognition					
IP_N_MAX_INF	-	0... FFH	0... 8160	32	min-1
LDP_N_GRD_N_MAX_INF	6	80... 00H	-4096 ...0	32	min-1/s
Maximum engine speed for intercept function					

5.4.1 Full Load: (LV_FL)

FUNCTION DESCRIPTION:

General information:
Main parameter for full load is an engine speed dependent load threshold. Additional parameters to disable full load are several failure conditions, coolant temperature, engine speed and vehicle speed. After fullfillment of all other conditions, the state LV_FL can be suppressed for a certain time.

Application conditions

Activation : at every engine operating state

Deactivation : -

Initialization : LV_FL and LV_FL_RAW = 0
LV_FL_1 and LV_FL_2 and LV_FL_3 = 0

Update rate : 10 ms

Formula section:

Intermediary values:
check pedal value for full load request, including hysteresis:

```
if     FAC_TQ_REQ_DRIV      IP_FAC_TQ_REQ_DRIV_FL
  then    LV_FL_1  =  1
  else
    if     FAC_TQ_REQ_DRIV  <  IP_FAC_TQ_REQ_DRIV_FL - C_FAC_TQ_REQ_FL_HYS
      then    LV_FL_1  =  0
      else         LV_FL_1   remains unchanged
    endif
endif
```

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```
check requested torque setpoint for full load request, including hysteresis:
if      LOAD_THD_FL     IP_LOAD_THD_FL
  then      LV_FL_2   =   1
  else
    if      LOAD_THD_FL   <   IP_LOAD_THD_FL - C_LOAD_THD_FL_HYS
      then      LV_FL_2   =   0
      else          LV_FL_2   remains unchanged
    endif
endif

check conditions that prevent full load:
if      LV_CT = 1                                               or
    STATE_ETC_LIH   ETC_NO_LIH   and   STATE_ETC_LIH   ETC_LIH_1      or
    STATE_TPS_DIAG   TPS_LIH_MAX                                  or
    LV_TI_LIM_ACT = 1                                                 or
    LV_TQ_LIM_INTV = 1
  then      LV_FL_3   =   0
  else          LV_FL_3   =   1
endif


if              LV_FL_1 = 1     and     LV_FL_2 = 1     and     LV_FL_3 = 1 and
                TCO         C_TCO_MIN_FL
  then      LV_FL_RAW   =   1
  else          LV_FL_RAW   =   0
endif


Full load recognition:
if      LV_FL_RAW   =   1
 then
          check engine/vehicle conditions for full load:
          if      ( CL_MMV              C_CL_MMV_THD_FL     and
                N_32              C_N_MIN_FL                        and
              VS              C_VS_MIN_FL )     at least one time since reset         or
                ( CL_MMV >         C_CL_MMV_THD_FL     and
                N_32              C_N_MIN_CP_FL                 and
              VS              C_VS_MIN_FL )         at least one time since reset
          then      start timer T_TI_DLY_FL if not yet started
                  check full load time delay:
                if C_N_MIN_FL_DLY                 N_32      <   C_N_MAX_FL_DLY   and
                 C_T_MIN_FL_DLY                 T_AST <   C_T_MAX_FL_DLY
                  then
                        if          T_TI_DLY_FL   > C_T_TI_DLY_FL(_AT)_2      (LV_AT = 0/1)
                        then      LV_FL   =   1
                        endif
                  else
                        if          T_TI_DLY_FL   >C_T_TI_DLY_FL(_AT)_1      (LV_AT = 0/1)
                        then      LV_FL   =   1
                        endif
                  endif
```

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```
            increment timerT_TI_DLY_FL
      else    reset timer T_TI_DLY_FL
            LV_FL  =  0
      endif
else        LV_FL        =  0
endif
```

5.4.2 Intercept function : (LV_INF)

FUNCTION DESCRIPTION:

General information:

In the engine operating states trailing throttle (LV_PU) or trailing throttle fuel cut off (LV_PUC), the **intercept function(LV_INF)** can be enabled below an engine speed threshold IP_N_MAX_INF.

For this purpose, the engine speed gradient N_GRD is monitored.

If the negative engine speed gradient exceeds the adjustable constant C_N_GRD_MIN during trailing throttle fuel cut off the injection will be reactivated to counteract the high negative engine speed gradient.

Application conditions

Activation : at every engine operating state

Initialization : LV_INF = 0

Update rate : every segment

Formula section:

```
If          LV_CT          =  1              and
            N_32           <  IP_N_MAX_INF   and
            N_GRD          <  C_N_GRD_MIN
then        LV_INF     =  1
else        LV_INF     =  0
```

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5.5 Auxiliary functions

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
OPM_EXT_REQ	O/V	0... FFFFH	0... 65535	1	-
Operation mode request from tester					
OPM_EXT_REQ_TMP	-	0... FFFFH	0... 65535	1	-
Operation mode request from tester without EOL request					

Input data:

LV_ACT_VLS_EOL_EXT_ ADJ {p. 7763}	LV_IGK {p. 906}	STATE_HOM_AFS_REQ_ EXT_ADJ {p. 7683}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_OPM_EXT_REQ_1	-	0... FFFFH	0... 65535	1	-
Constant 1 for operation mode request from tester					
C_OPM_EXT_REQ_2	-	0... FFFFH	0... 65535	1	-
Constant 2 for operation mode request from tester					
C_OPM_EXT_REQ_3	-	0... FFFFH	0... 65535	1	-
Constant 3 for operation mode request from tester					
C_OPM_EXT_REQ_4	-	0... FFFFH	0... 65535	1	-
Constant 4 for operation mode request from tester					
C_OPM_EXT_REQ_5	-	0... FFFFH	0... 65535	1	-
Constant 5 for operation mode request from tester					
C_OPM_EXT_REQ_6	-	0... FFFFH	0... 65535	1	-
Constant 6 for operation mode request from tester					
C_OPM_EXT_REQ_7	-	0... FFFFH	0... 65535	1	-
Constant 7 for operation mode request from tester					
C_OPM_EXT_REQ_8	-	0... FFFFH	0... 65535	1	-
Constant 8 for operation mode request from tester					
C_OPM_EXT_REQ_VLS_EOL	-	0... FFFFH	0... 65535	1	-
Constant for operation mode request from tester (end of line test)					

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FUNCTION DESCRIPTION:

General Information:
Via tester an operation mode (e.g. homogenous) can be requested. This is necessary e.g. for end of line tests. This information is used in this module, to switch between several calibratable operation modes. The generated information word OPM_EXT_REQ is send to the customer software via layer.

Application Condition

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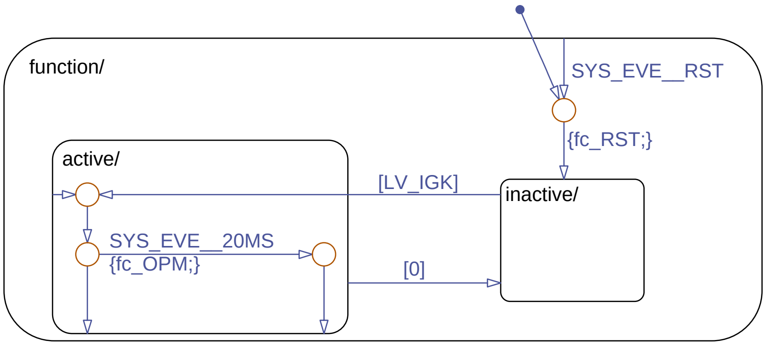

Figure 5.5.1: ENOS_M5004/APP_CDN/Chart

Function Description

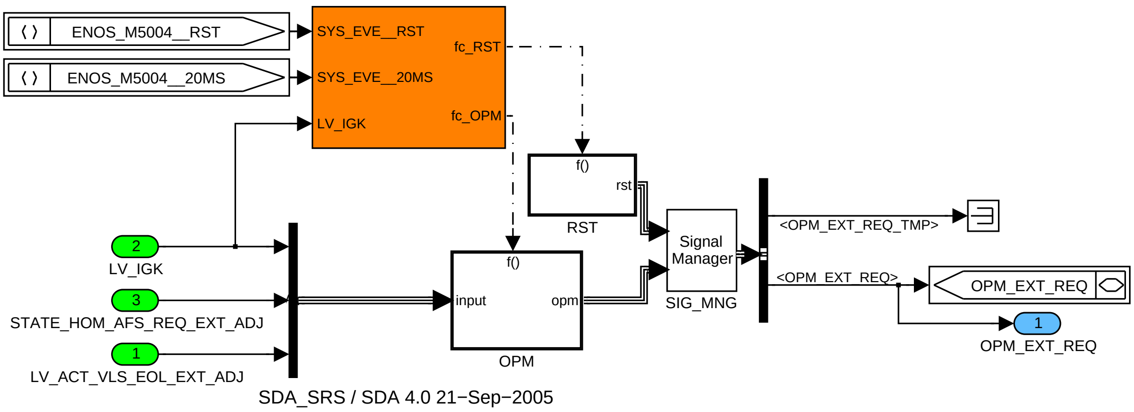

Figure 5.5.2: ENOS_M5004

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5.5.1 Initialization

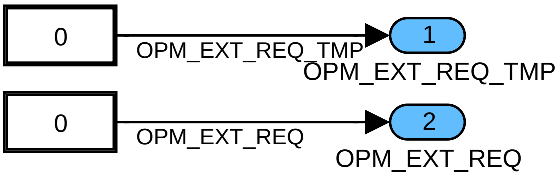

Figure 5.5.3: ENOS_M5004/RST/INI

5.5.2 Formula section

Calculation

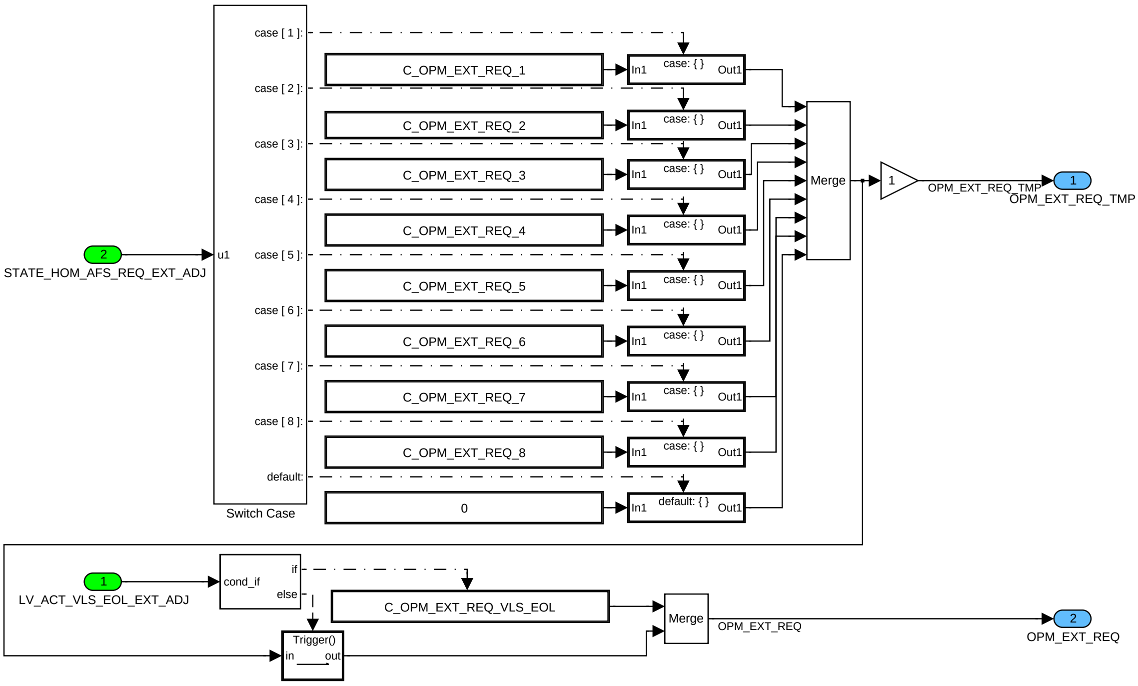

Figure 5.5.4: ENOS_M5004/OPM/CLC_OPM_EXT_REQ

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5.6 Auxiliary start functions

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_N_WIN_STALL	V	0... FFH	0... 255	1	-
Number of events inside the STALL rpm range					
CYC_CAST	O/V	0... FFFFH	0... 65535	1	-
Cycle counter at start and after start					
LV_AST	O/V	0... 1H	0 ...1	1	-
Auxiliary function "After-start"					
LV_REST	O/V	0... 1H	0 ...1	1	-
Auxiliary function "Re-start"					
LV_ST_ES	O/V	0... 1H	0 ...1	1	-
Detection of engine start break off (passive /active)					
LV_STALL	O/V/S	0... 1H	0 ...1	1	-
Auxiliary function "Engine Stall detected"					
LV_WUP_CAN	O/V	0... 1H	0 ...1	1	-
0 = catalyst hating/warm up - 1 = engine at operating temperature					
T_AST	O/V	0... FFFFH	0... 6553.5	0.1	s
Time after start					
T_AST_DIAG	O/V	0... FFFFH	0... 32767.5	0.5	s
After start time for common sensor diagnosis					
T_AST_REST	O/V/S	0... FFFFH	0... 6553.5	0.1	s
After start time for re-start					
T_AST_SAE	O/V	0... FFFFH	0... 65535	1	s
PID1F Cumulated time since engine start					
T_ST_ES	V	1... FFFFH	0.1... 6553.5	0.1	s
Time after transition from LV_ST to LV_ES					
TCO_REST	V/S	0... FEH	-48... 142.5	0.75	°C
Coolant temperature, stored to detect a re-start					

Input data:

LV_AST_END {p. 2100}	LV_DC {p. 5746}	LV_ES {p. 1720}	LV_IGK {p. 906}
LV_IS {p. 1720}	LV_PL {p. 1720}	LV_ST {p. 1720}	LV_ST_END {p. 1720}
N_32 {p. 1525}	N_TOOTH_CUS {p. 1042}	TCO {p. 1100}	TI_CAST {p. 2100}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_N_WIN_STALL	-	0... FFH	0... 255	1	-
Counter of N true events					
C_CYC_CAST_MAX_ST_ES	-	0... FFFFH	0... 65535	1	-
Max value of CYC_CAST for the beginning of incrementation if LV_ST_ES is set					
C_CYC_CAST_MIN_ST_ES	-	0... FFFFH	0... 65535	1	-
Min value of CYC_CAST for the detection of LV_ST_ES					
C_N_MAX_CDN_STALL	-	0... 1FE0H	0... 8160	1	rpm
Engine-speed threshold for deactivation of stalling detection					
C_T_MAX_REST	-	1... FFH	1... 255	1	s
Time delay after switching on from LV_ST to detect LV_REST					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MIN_ECU_REST	-	1... FFFFH	0.1... 6553.5	0.1	s
Time threshold to detect new start after start-break off.					
C_TCO_DIF_MAX_REST	-	0... 50H	0... 60	0.75	°C
Coolant temperature threshold to detect LV_REST					
C_TCO_SWI_WUP	-	0... FEH	-48... 142.5	0.75	°C
TCO condition for setting LV_WUP_CAN					
IP_N_BOL_STALL	-	0... 1FE0H	0... 8160	1	rpm
LPDM_TCO__N_STALL	9	0... FEH	-48... 142.5	0.75	°C
Minimum engine speed for engine stalling detection					
IP_N_TOL_STALL	-	0... 1FE0H	0... 8160	1	rpm
LPDM_TCO__N_STALL	9	0... FEH	-48... 142.5	0.75	°C
Maximum engine speed for engine stalling detection					
IP_T_AST_SWI_WUP__CTR_KM_CAN	-	0... FFFFH	0... 6553.5	0.1	s
LPDM_CTR_KM_CAN	4	0... FFFEH	0... 655340	10	km
Time condition for setting LV_WUP_CAN					

5.6.1 Cycle counter CYC_CAST

FUNCTION DESCRIPTION:

General information:

1. CYC_CAST shows the number of 120°crk cycles that have elapsed during the actual start phase (LV_ST=1). The start value is either zero or limited by the constant C_CYC_CAST_MAX_ST_ES (if start break off was detected).
2. During actual after start phase (LV_AST from 0 to 1), the counter is reseted and restarts counting the number of cycles after start. When LV_AST is finished CYC_CAST remains at its last value.

Application conditions

Activation: *LV_ST = 1 or LV_AST = 1*

Deactivation: *LV_ST = 0 and LV_AST = 0*

Initialization: CYC_CAST = 0 at ECU-reset

Recurrence: Every TDC

Formula section:

If LV_AST 0 => 1
then CYC_CAST = 0
else if LV_ST or LV_AST is 1 and CYC_CAST $<$ 65535
then $CYC\_CAST_n = CYC\_CAST_{n-1} + 1$
else $CYC\_CAST_n = CYC\_CAST_{n-1}$
if LV_ST_ES = 1
then if CYC_CAST $>$ C_CYC_CAST_MAX_ST_ES
then CYC_CAST = C_CYC_CAST_MAX_ST_ES
endif
endif

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5.6.2 Start Break off LV_ST_ES

Description:

Activation:

For *engine stall during start phase*, i.e. transition from LV_ST to LV_ES before N_32 reaching IP_N_MAX_TOL_ST__TCO, the flag **LV_ST_ES** is set to 1, if LV_ST was active for a minimum number of cycles C_CYC_CAST_MIN_ST_ES. (Hint: At the same time the counter CYC_CAST will be frozen to its actual value).

Deactivation and application:

Case 1 (start after C_T_MIN_ECU_REST elapsed or powerlatch ended):

A timer T_ST_ES is started at the transition from LV_ST to LV_ES. If the timer elapses before a new start takes place (T_ST_ES   C_T_MIN_ECU_REST), LV_ST_ES is reset and CYC_CAST is set to zero in the next start.

Application conditions

Initialisation: T_ST_ES = 0 at ECU reset

Recurrence: 100 ms

Formula section:

If transition LV_ST → LV_ES
and LV_ST_END = 0 ; eng.op.state Start *not left*
and CYC_CAST   C_CYC_CAST_MIN_ST_ES
then LV_ST_ES = 1
endif
If LV_AST   0 => 1
and LV_ST   1 => 0
or T_ST_ES   C_T_MIN_ECU_REST
then LV_ST_ES = 0
endif

If LV_ST_ES = 1 **and** LV_ES=1
then T_ST_ESn = T_ES_STn-1 + 1
If T_ST_ES >= C_T_MIN_ECU_REST
then LV_ST_ES = 0
CYC_CAST = 0
endif
else T_ST_ES = 0
endif

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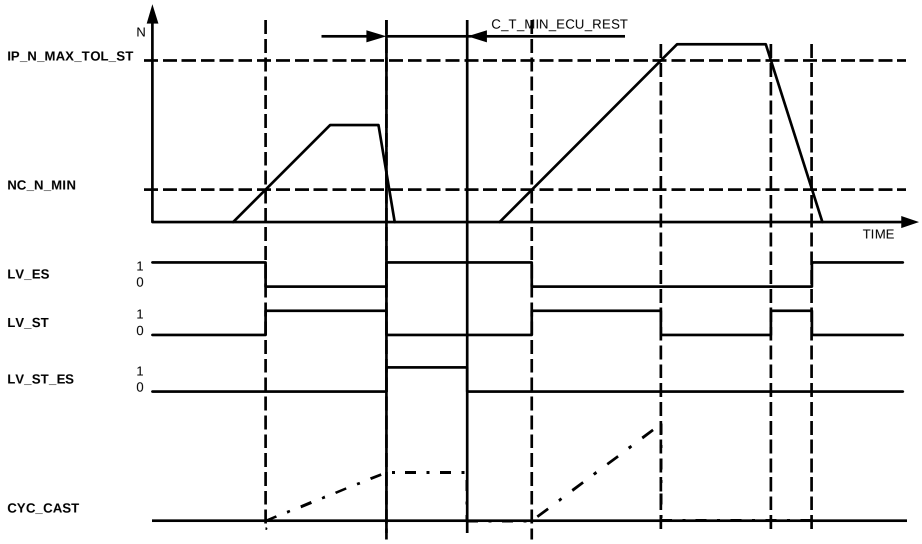
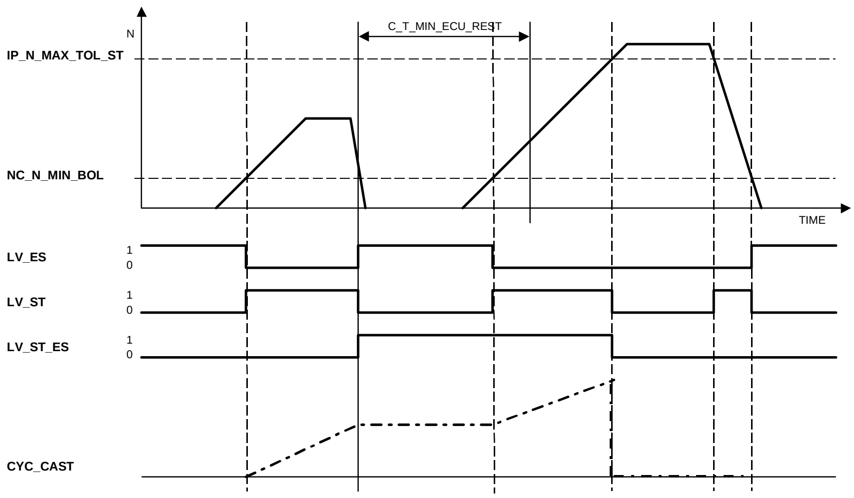


Case 2 (start within C_T_MIN_ECU_REST):

If a new start takes place before the timer has elapsed (T_ST_ES < C_T_MIN_ECU_REST), LV_ST_ES remains set until the engine operation state start is exited to part load or idle,
In this case the counter CYC_CAST starts with the previous frozen CYC_CAST-value *limited to a adjustable maximum value (see definition of CYC_CAST).*



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Remark :

If C_T_MIN_ECU_REST > C_T_MAX_ECU (power latch time) and powerlatch-phase ended the value of CYC_CAST is reseted to zero for the next engine start after “start break off”-event.

5.6.3 Restart function detection (LV_REST)

FUNCTION DESCRIPTION:

General information:

The re-start function is requested as an injection time correction during start.

- If the CAN clock timing is available LV_T_REL_CAN_REG=1 the re-start factor is calculated by TCO_STOP, T_AST_REST and T_ES (see “Fuel mass setpoint and pre-injection time calculation”).
- If the CAN clock timing is not available LV_T_REL_CAN_REG=0 the re-start factor is calculated as a substitue from IP_TI_ST_REST.

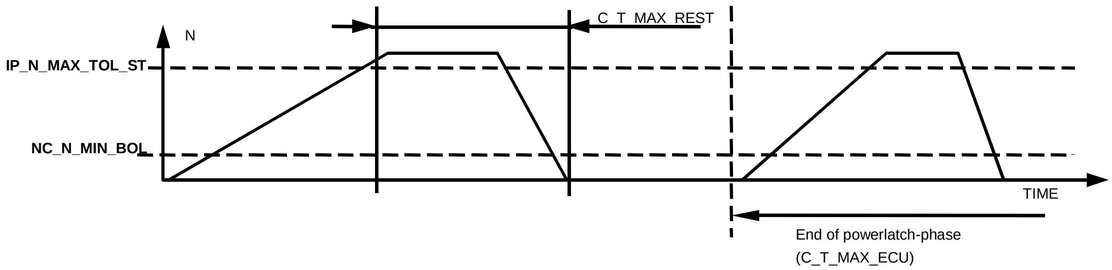
Application conditions:

Activation:
After transition from engine start (LV_ST = 1) to engine stop (LV_ES = 1) LV_REST is checked to the end of the powerlatch-phase. As the engine was operated in part load or idle before engine stop, the next start is considered as a restart if following conditions are fullfilled:

If TCO_REST $<$ FFH (no flash-error)
and TCO TCO_REST - C_TCO _DIF_MAX_REST

then LV_REST = 1
else LV_REST = 0

Therefore the restart-flag LV_REST is set to **1** before the next start, if the start happens before the end of the powerlatch-phase and the coolant temperature did not drop too much.
The calculation of start injection time deactivation factor will start with CYC_CAST = 0.



Deactivation:
A counter T_AST is started at transition LV_ST → (LV_IS or LV_PL) .
If the engine operating state engine stopped (LV_ES) is detected before the counter has reached its maximum value C_T_MAX_REST, the related coolant temperature is stored :
(TCO → TCO_REST) in a non volatile memory.

Recurrence: segment

5.6.4 Engine stall detection LV_STALL

General information:

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Engine stall detection is used for injection and CRK diagnosis.

If engine is stopped with ignition-key-on there are two different possibilities:

- Engine is stalling
- CRK error is active

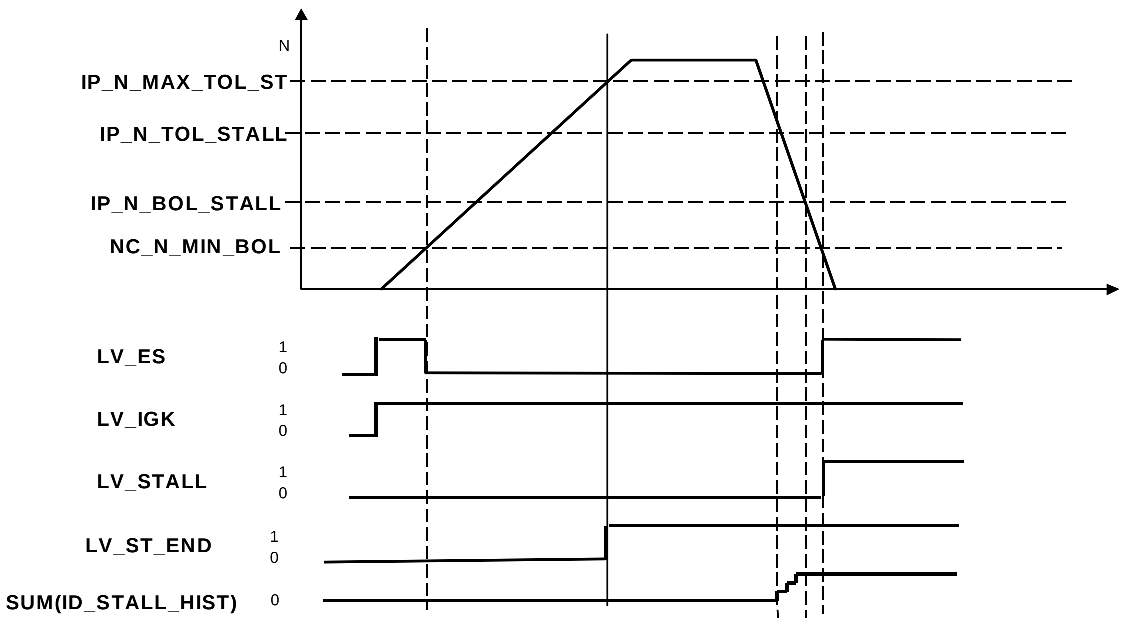
In order to detect a real engine stalling the engine speed value N_TOOTH_CUS is monitored. The reason for monitoring N_TOOTH_CUS instead of N is that N_TOOTH_CUS is calculated with a recurrency of 10ms, whereas N is calculated segment-syncronous. With engine-speed-values of $<$ 1500 rpm the segment-time increases, the resulting update-rate of N is not precise enough for the different cases of engine-stall-detection.
If a CRK error occurs N_TOOTH_CUS is set to 0. If the engine is stalling N_TOOTH_CUS is passing a defined stalling-window.

Description:

ID_STALL_HIS is a buffer for the 32 last update rates (= 320ms History).

If N_TOOTH_CUS is between IP_N_TOL/BOL_STALL then the value in the buffer is set to 1 (=true-event).
After transition from engine running (LV_ST_END = 1) to engine stop (LV_ES = 1) with **turned on ignition** (LV_IGK = 1), it is checked if the sum of true-events in the buffer is bigger then a stalling - threshold.

Signal flow diagram:



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Application conditions

Initialisation: *LV_STALL is restored out of NVMY*

Recurrence: *10ms*

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Activation: *N_TOOTH_CUS < C_N_MAX_CDN_STALL* **and** *LV_ST_END = 1*

Formula section:

Reset of event-counter and ring-buffer after activation:
ID_STALL_HIS = 0
CTR_N_WIN_STALL = 0

Caclulation of LV_STALL:
if IP_N_BOL_STALL < N_TOOTH_CUS < IP_N_TOL_STALL
then ID_STALL_HIS = 1
CTR_N_WIN_STALL ++ *(stop ++ if FFH is reached)*
else ID_STALL_HIS = 0
CTR_N_WIN_STALL = 0
endif

If LV_ES 0 => 1
and LV_ST_END = 1
and LV_IGK = 1
and SUM(ID_STALL_HIS) > C_CTR_N_WIN_STALL
then LV_STALL = 1
endif

Reset LV_STALL
if LV_ST_END 0 => 1
then LV_STALL = 0
endif

5.6.5 After-Start function : (LV_AST)

FUNCTION DESCRIPTION:

General information:

The after-start function serves to supply the extra injection quantity required after start by the cold walls of the combustion chamber.
The after-start function (**LV_AST**) is requested whenever the engine exits the operating state start (LV_ST) and is executed simultaneously with other engine operating states, except engine stopped (LV_ES) and start (LV_ST).
The value of T_AST when engine stopped (LV_ES=1) - after LV_ST_END = 1 has reached once - detected is transfered in T_AST_REST and safed in the non volatile memory at the end of the powerlatch - phase.

The variable T_AST indicates the time after leaving start-state. After reaching it's maximum value, T_AST is frozen. Reset occurs with every new start (Transition from LV_ST = 0 to 1).

T_AST_DIAG is calculated from T_AST to satisfy OBD requirements: recurrency must be 500ms for input signal aquisition/diagnosis.

Application conditions:

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Activation:

The state **LV_AST** is activated as soon as the engine operating state start (LV_ST) is exited to go to the engine operating states idle speed (LV_IS) or part load (LV_PL).

Deactivation:

TI_CAST = 0 (refer to Chapter : “ Injection “).

Recurrence:

Segment (LV_AST), 100ms (T_AST/T_AST_REST), 500ms (T_AST_DIAG)

Formula section:

If LV_ES = 0 **AND** LV_ST = 0
then
if T_AST $<$ max. Value
then increment T_AST
endif
endif
T_AST_DIAG = T_AST (physical meaning)

If LV_ES = 1 **or** LV_ST = 1 **or** LV_AST_END = 1
Then LV_AST = 0
Else LV_AST = 1
Endif

If LV_ST_END$_n$ = 0 and LV_ST_END$_{n-1}$ = 1000 **and**
LV_ES$_n$ = 1 and LV_ES$_{n-1}$ = 0
Then T_AST_REST = T_AST
Endif

5.6.6 State warm up

FUNCTION DESCRIPTION:

General information:

Calculation of state warm up. When end of warm up phase and catalyst heating is detected, LV_WUP_CAN is set to 1.

Application conditions

Initialisation: *0*

Recurrence: *100 ms*

Formula section:

IF T_AST $>$ IP_T_AST_SWI_WUP__CTR_KM_CAN **or**
TCO $>$ C_TCO_SWI_WUP
THEN LV_WUP_CAN = 1 (catalyst heating ended indication, engine at operating temperature)
ELSE LV_WUP_CAN = 0

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5.6.7 Cumulated time since engine start for OBD scan tool (PID1F)

FUNCTION DESCRIPTION:

General information:

Time after start is needed for OBD scan tool (PID1F)

Application conditions

Initialisation: `at reset or transition LV_DC = 1->0 set T_AST_SAE = 0 s`

Recurrence: *1s*

Activation: *LV_ST_END = 1*

Deactivation: *LV_ST_END = 0*

Formula section:

T_AST_SAEn = T_AST_SAEn-1 + 1s

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5.7 Catalyst heating functions

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CH_N_SP_IS	O/V	0... 1H	0 ...1	1	-
Catalyst Heating Function "increased idle speed setpoint"					
LV_TI_CH	O/V	0... 1H	0 ...1	1	-
Catalyst Heating Function "lean injection"					
LV_WUP	O/V	0... 1H	0 ...1	1	-
Warm up functions active					

Input data:

LV_ES {p. 1720}	STATE_CH {p. 1777}	TI_WUP_1_ADD {p. 2109}	

5.7.1 Catalyst Heating functions

General information:

Logical catalyst heating variables that have been used up to now are set depending on STATE_CH.

Application conditions

Initialisation: *all outputs = 0 at ECU initialization*
Recurrence: *100 ms*
Activation: *at every engine operating state*
Deactivation: –

Formula section:

If STATE_CH = 1
Then
LV_TI_CH = 1
Else
LV_TI_CH = 0
Endif

IF STATE_CH = 1 **OR** 2
Then
LV_CH_N_SP_IS = 1
Else
LV_CH_N_SP_IS = 0
endif

5.7.2 Warm-up function : (LV_WUP)

FUNCTION DESCRIPTION:

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General information:

The injection is corrected with the warm-up enrichment.
The states warm-up (LV_WUP) and catalyst heating (LV_TI_CH) are used parallel.

Application conditions

Initialisation : LV_WUP = 1

Recurrence : once per segment (720 °crk / NC_CYL_NR)

Activation : at all engine operating states

Deactivation : TI_WUP_1_ADD = 0 (refer to chapter : " Injection "). Is activated again at STATE_ENG = LV_ES

Formula section:

```
if    LV_ES = 1
   then      LV_WUP  =  1
endif

if    LV_WUP = 1
    then     if       TI_WUP_1_ADD > 0
                  then          LV_WUP   unchanged   (stays at value 1)
                  else                   LV_WUP   =   0
                endif
    else     LV_WUP   unchanged   (stays at value 0)
endif
```

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5.8 Catalyst heating coordination

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CH_AST_CDN	V	0... 1H	0 ...1	1	-
Indicates if conditions for after start catalyst heating are fulfilled					
LV_CH_L_CDN	V	0... 1H	0 ...1	1	-
Indicates if conditions for low load catalyst heating are fulfilled					
LV_CH_L_RGN	O/V	0... 1H	0 ...1	1	-
Low load catalyst heating for NOx-trap - heating after regeneration is active					
LV_CH_SO2P_CDN	V	0... 1H	0 ...1	1	-
Indicator for conditions of desulfation catalyst heating					
STATE_CH	O/V	0H 1H 2H 3H	CH_OFF CH_AST CH_L_LOAD CH_SO2P	-	-
State of catalyst heating					
TEMP_CAT_DIF_CH_L	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	K
Difference between actual catalyst temperature and deactivation threshold for low load CH					
TNT_DIF_CH_L	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	K
Difference between actual NOx-trap-temperature and deactivation threshold for low load CH					
TNT_MDL_L_COR_CH_L	V	0... FFFFH	0... 1023.984375	0.015625	°C
Lowest NOx-Trap temperature - adapted for low load catalyst heating activation					
TQI_REQ_FAST_FIL_CH_SO2P	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Filtered torque request (fast path) for desulfation catalyst heating activation					
VS_FIL_CH_SO2P	V	0... FFH	0... 255	1	km/h
Filtered vehicle speed					

Input data:

CTR_KM_CAN {p. 1563}	FTL {p. 1564}	LV_CH_AST_ENA {p. 1789}	LV_CH_AST_REQ_TCHA_DIAG {p. 8232}
LV_CH_L_ENA {p. 1789}	LV_HOM_ACT {p. 8136}	LV_NT_RGN_REQ {p. 996}	LV_NT_SO2P_EXT_ADJ_ACT {p. 3144}
LV_SO2P_REQ_2 {p. 3073}	LV_ST_END {p. 1720}	LV_STATE_CH_SO2P_ENA {p. 1789}	N_32 {p. 1525}
NT_AGI {p. 3073}	T_AST_COR_CH {p. 1801}	T_ES_CUS {p. 1444}	TCO {p. 1100}
TCO_ST {p. 1100}	TEMP_CAT {p. 8237}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	TNT_MDL_H {p. 8237}
TNT_MDL_L {p. 8237}	TQI_REQ_FAST {p. 8391}	VS {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQI_FIL_CH_SO2P	-	0... FFFFH	0 ...1	15.259e-6	-
Correlation factor to filter the requested torque					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_VS_FIL_CH_SO2P	-	0... FFFFH	0 ...1	15.259e-6	-
Correlation factor to filter the vehicle speed					
C_FTL_HYS_CH_SO2P	-	0... 7FH	0... 127	1	l
Hysteresis of fuel tank level threshold for deactivation of desulfation catalyst heating					
C_FTL_MIN_CH_SO2P	-	0... 7FH	0... 127	1	l
Minimum fuel tank level, deactivates desulfation catalyst heating					
C_N_32_MIN_NT_SO2P_EXT_ADJ_CH	-	0... FFH	0... 8160	32	rpm
Minimum engine speed to start catalyst heating for desulfation, activated by external adjustment					
C_N_32_THD_CH_L_OFF	-	0... FFH	0... 8160	32	rpm
Threshold of engine speed that disables CH_L					
C_N_32_THD_CH_L_ON	-	0... FFH	0... 8160	32	rpm
Threshold of engine speed that enables CH_L					
C_STATE_CH_MAN	-	0H 1H 2H 3H	CH_OFF CH_AST CH_L_LOAD CH_SO2P	-	-
Manual setting of state of cat. heating					
C_T_MAX_CH_L_RGN	-	0... FFFFH	0... 6553.5	0.1	s
Maximum duration of low load heating after regeneration phase					
C_TCO_HYS_CH_SO2P	-	0... FEH	-48... 142.5	0.75	°C
Hysteresis of coolant temperature threshold for activation of catalyst heating for desulfation					
C_TCO_MIN_CH_SO2P	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature for activation of catalyst heating for desulfation					
C_TEMP_CAT_DYN_MDL_THD_CH_SO2P	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Threshold of catalyst temperature for desulfation catalyst heating					
C_TEMP_CAT_MAX_CH_AST	-	0... FFFFH	-33... 990.984375	0.015625	°C
Threshold of catalyst temperature for catalyst heating after start					
C_TEMP_CAT_THD_CH_L_HOM_ON	-	0... FFFFH	-33... 990.984375	0.015625	°C
Threshold of catalyst temperature for homogeneous CH_L					
C_TEMP_CAT_THD_CH_L_OFF	-	0... FFFFH	-33... 990.984375	0.015625	°C
Threshold of catalyst temperature for deactivation of low load CH					
C_TEMP_CAT_THD_CH_L_S_ON	-	0... FFFFH	-33... 990.984375	0.015625	°C
Threshold of catalyst temperature for stratified CH_L					
C_TNT_HYS_CH_L_RGN	-	8000... 7FFFH	-512... 511.984375	0.015625	°C
Hysteresis for activation of low load catalyst heating for heating after regeneration					
C_TNT_MAX_CH_AST	-	0... FFFFH	0... 1023.984375	0.015625	°C
Maximum nox trap temperature for catalyst heating after start					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TNT_MAX_CH_SO2P	-	0... FFFFH	0... 1023.984375	0.015625	°C
Maximum temperature of TNT for desulfation catalyst heating					
C_TNT_MIN_CH_L_RGN	-	0... FFFFH	0... 1023.984375	0.015625	°C
Minimum NOx-Trap temperature for activation of low load catalyst heating for heating after regeneration					
C_TNT_MIN_CH_SO2P	-	0... FFFFH	0... 1023.984375	0.015625	°C
Minimum temperature of TNT for desulfation catalyst heating					
C_TNT_THD_CH_L_HOM_ON	-	0... FFFFH	0... 1023.984375	0.015625	°C
Threshold NOx-trap-temperature that activates CH in homogeneous					
C_TNT_THD_CH_L_OFF	-	0... FFFFH	0... 1023.984375	0.015625	°C
Threshold NOx-trap-temperature that deactivates CH in stratified and homogeneous					
C_TNT_THD_CH_L_RGN	-	0... FFFFH	0... 1023.984375	0.015625	°C
If NOx-Trap temperature falls below this threshold low load catalyst heating for heating after regeneration is activated					
C_TNT_THD_CH_L_S_ON	-	0... FFFFH	0... 1023.984375	0.015625	°C
Threshold NOx-trap-temperature that activates CH in stratified					
C_TQI_REQ_FAST_THD_CH_L_OFF	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Threshold of TQI_REQ_FAST that disables CH_L					
C_TQI_REQ_FAST_THD_CH_L_ON	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Threshold of TQI_REQ_FAST that enables CH_L					
C_TQI_THD_CH_SO2P	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Threshold of requested torque to activate desulfation catalyst heating					
C_VS_MAX_CH_AST	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for after start catalyst heating					
C_VS_THD_CH_SO2P	-	0... FFH	0... 255	1	km/h
threshold of vehicle speed to activate desulfation catalyst heating					
IP_T_AST_THD_CH_AST	V	0... FFFFH	0... 6553.5	0.1	s
LDP_TCO_ST_IP_T_AST_THD_CH_AST	8	0... FEH	-48... 142.5	0.75	°C
LDPM_CTR_KM_CAN_1_EXTC	4	0... FFFFH	0... 655350	10	km
Threshold of time after start for catalyst heating after start					
IP_T_ES_THD_CH_AST	-	0... FFFFH	0... 65535	1	min
LDP_TCO_ST_IP_T_ES_THD_CH_AST	8	0... FEH	-48... 142.5	0.75	°C
Threshold of engine off duration time which stops catalyst heating after start					
IP_TNT_ADD_CH_L_NT_AGI	-	0... FFFFH	-1024... 1023.96875	0.03125	K
LDP_NT_AGI_IP_TNT_ADD_CH_L	4	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Additive temperature value on low-load-catalyst-heating-activation-thresholds					
IP_TQI_REQ_FAST_THD_CH_L_RGN	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_TQI_REQ_CH_L_RGN	4	0... FFH	0... 8160	32	rpm
Torque - threshold to deactivate low load catalyst heating after regeneration					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_STATE_CH_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of state of cat. heating					

General Information

This module has to be calculated before any other catalyst heating module.
In this module the decision is made if catalyst heating after start, in low load or for desulfation is active.
STATE_CH indicates the actual status and triggers other modules.

Application Conditions

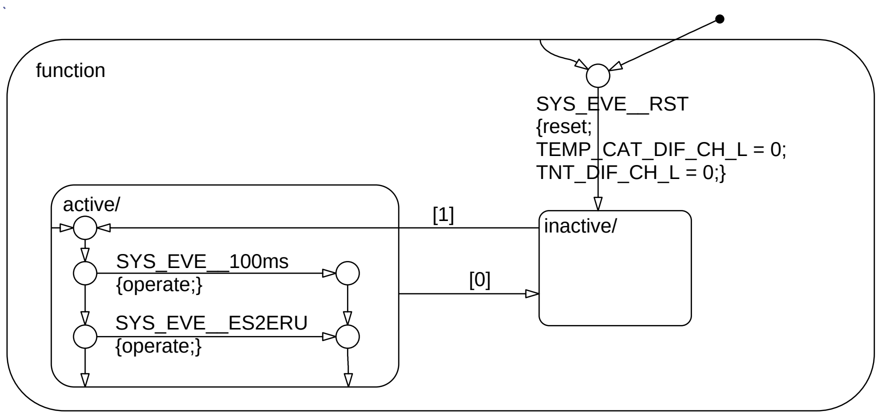

Figure 5.8.1: : Path: EXTC_ISPCLCHC0/APP_CDN/Chart

Function description

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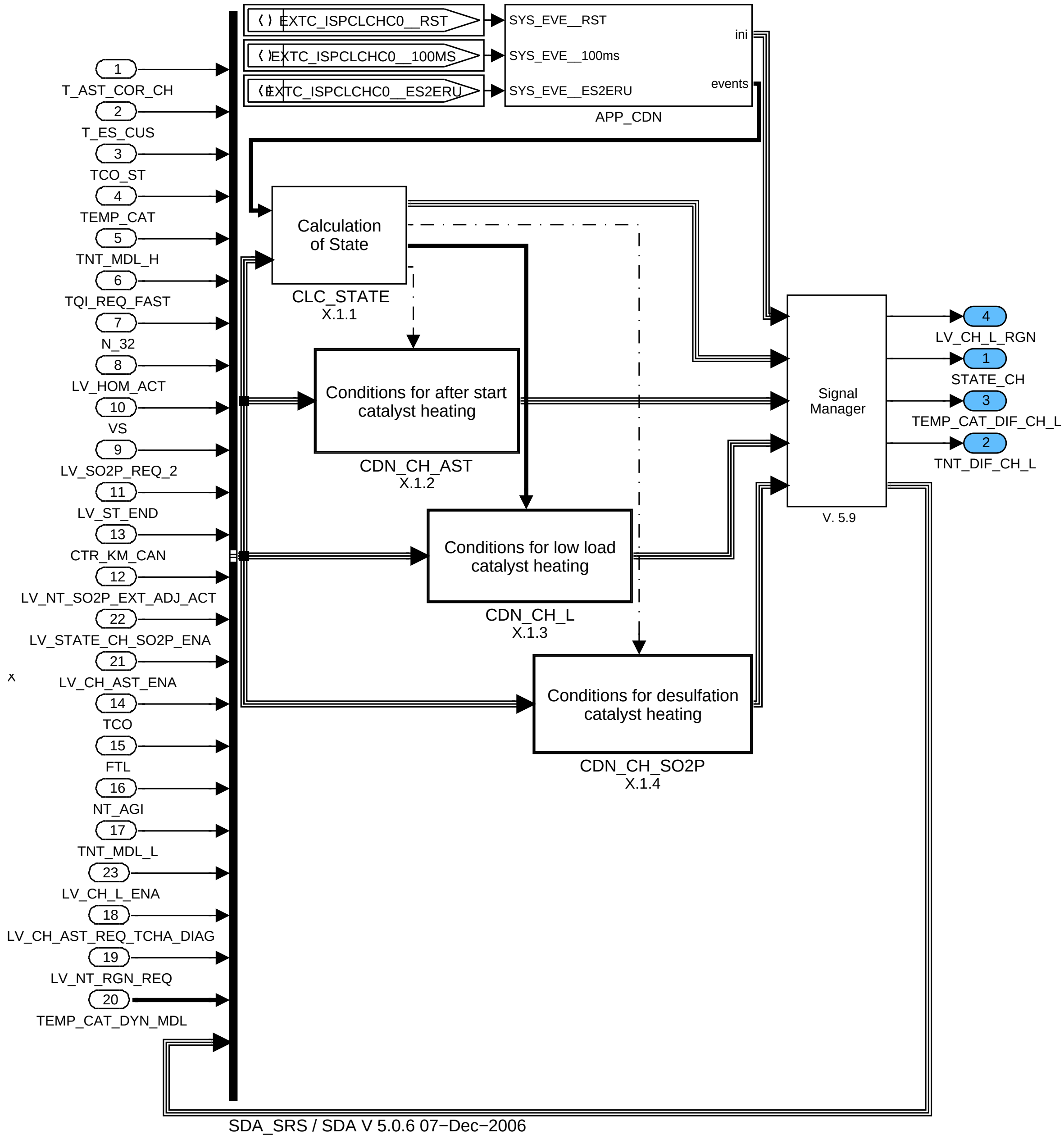

Figure 5.8.2: : Path: EXTC_ISPCLCHC0

5.8.1 State machine

5.8.1.1 State machine - Subsystem

The conditions for activation of several catalyst heating measures are not calculated if another measure is active see stateflow chart.

With to LC_STATE_CH_MAN_ACT it is possible to switch STATE_CH manually.

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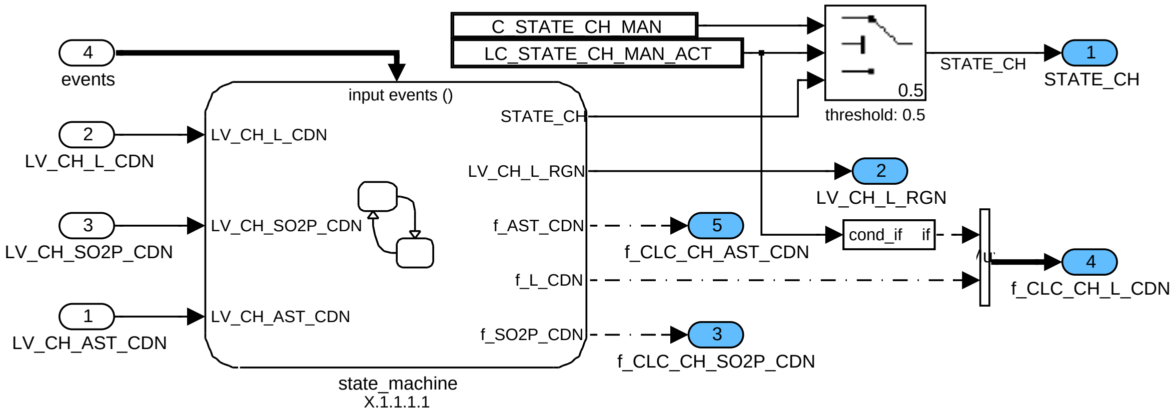

Figure 5.8.3: : Path: EXTC_ISPCLCHC0/CLC_STATE/SUB

5.8.1.1.1 state_machine

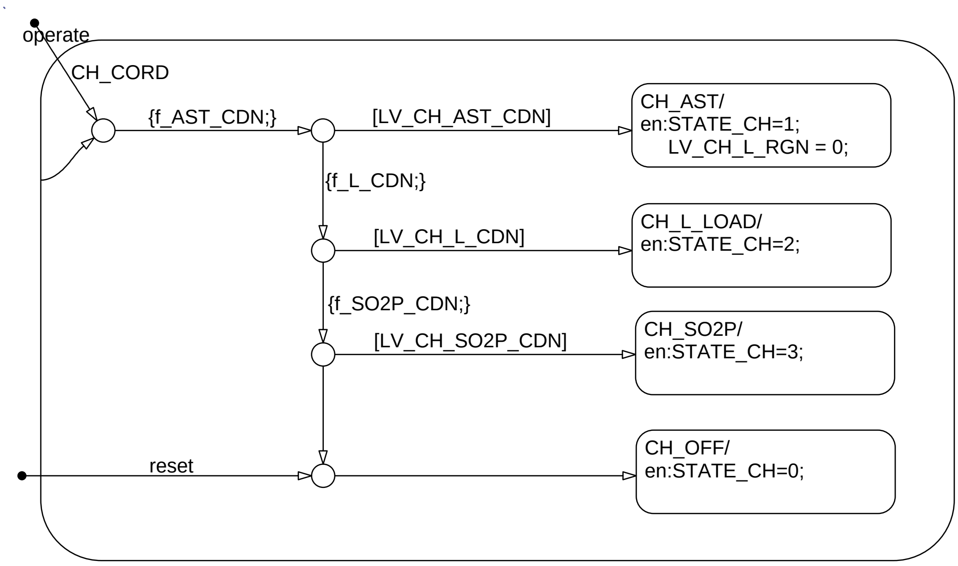

Figure 5.8.4: : Path: EXTC_ISPCLCHC0/CLC_STATE/SUB/state_machine

5.8.2 Conditions for after start heating

5.8.2.1 Conditions for after start heating - Subsystem

T_ES_CUS is the time with stopped engine. If one of the conditions stops catalyst heating, it only can be re-activated after next start.

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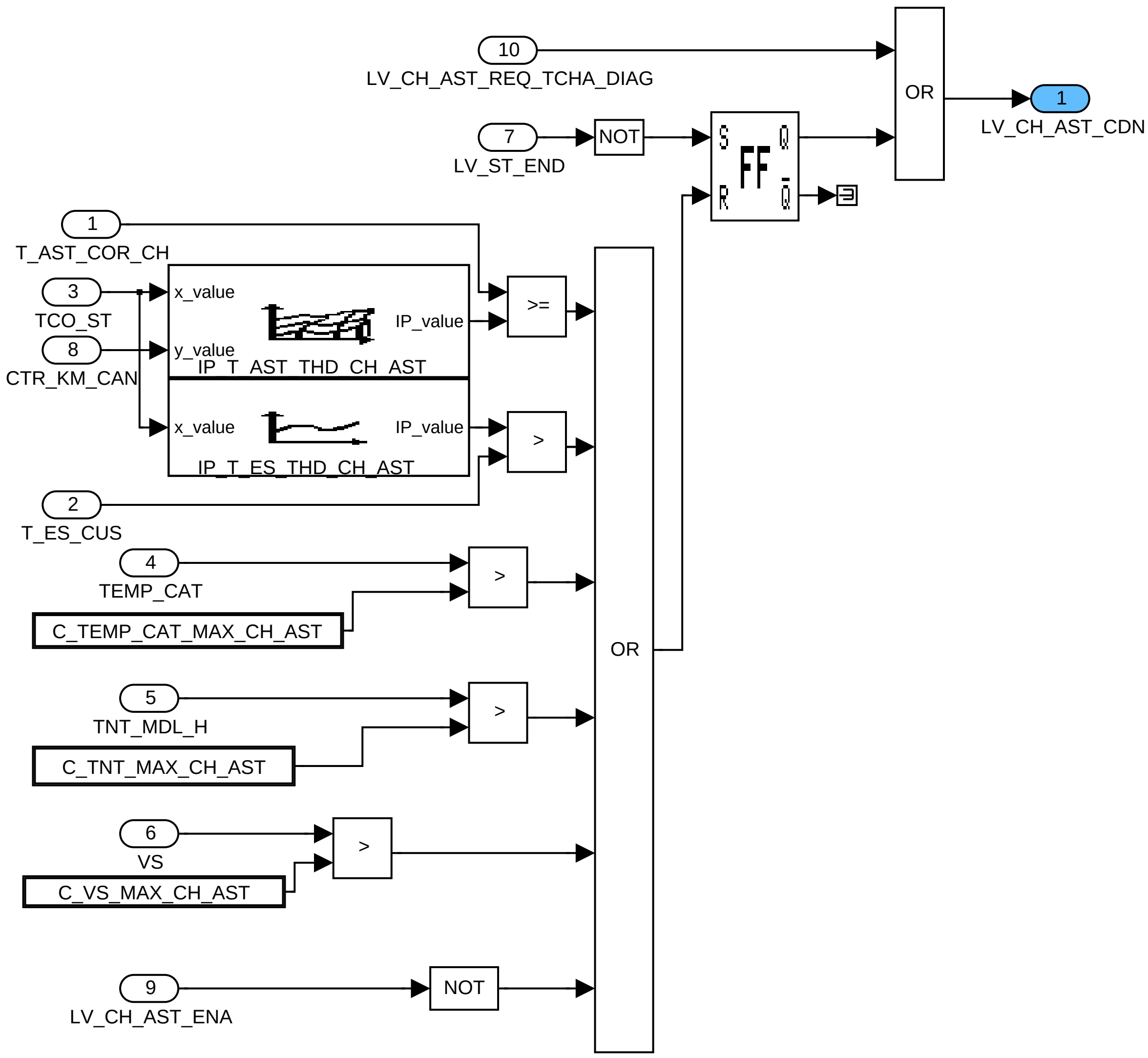

Figure 5.8.5: : Path: EXTC_ISPCLCHC0/CDN_CH_AST/SUB

5.8.3 Conditions for low load heating

5.8.3.1 Conditions for low load heating - Subsystem

TNT_MDL_L can be adjusted depending on NOx-trap aging.
Low load catalyst heating can be activated due to low temperatures in NOx-Trap or Pre-catalyst ('CH_L_CDN') or after regeneration of NOx-trap. In 2nd case the lambda-split function is activated (LV_CH_L_RGN = 1).
The differences between the actual temperatures and the thresholds TNT_DIF_CH_L and TEMP_CAT_DIF_CH_L are used as mapinputs in the setpoint calculation modules e.g. for torque reserve.

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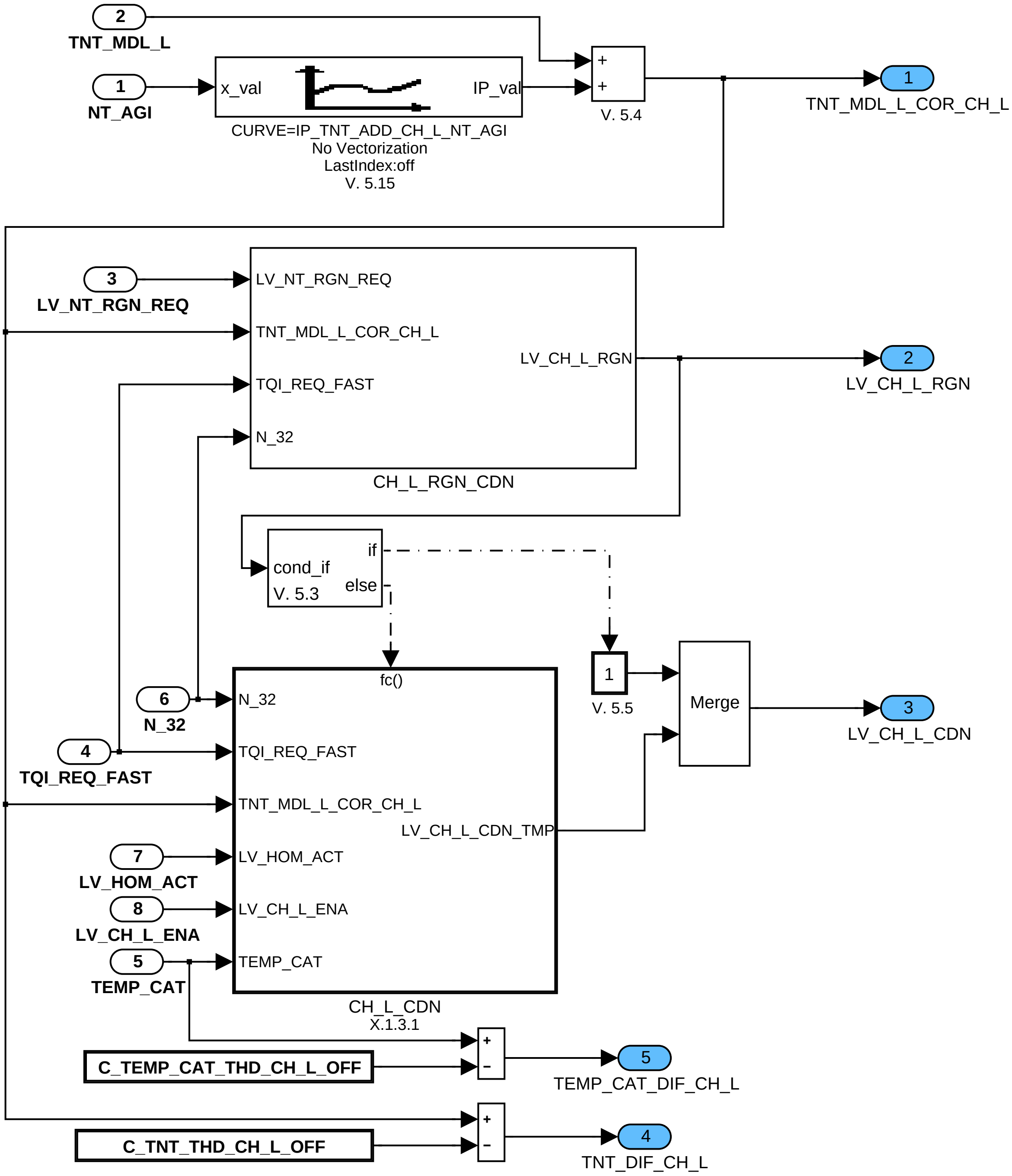

Figure 5.8.6: : Path: EXTC_ISPCLCHC0/CDN_CH_L/SUB

5.8.3.1.1 Conditions for low load heating - Subsystem

For torque, engine speed and temperature there are each two thresholds for hysteresis application. For homogenous and stratified mode there are several activation thresholds for catalyst temperature. Attention: In low load catalyst heating one measure is to request homogeneous mode at too low temperatures! (See "Catalyst heating low load strategy"). These temperature thresholds have to be calibrated cohesive.

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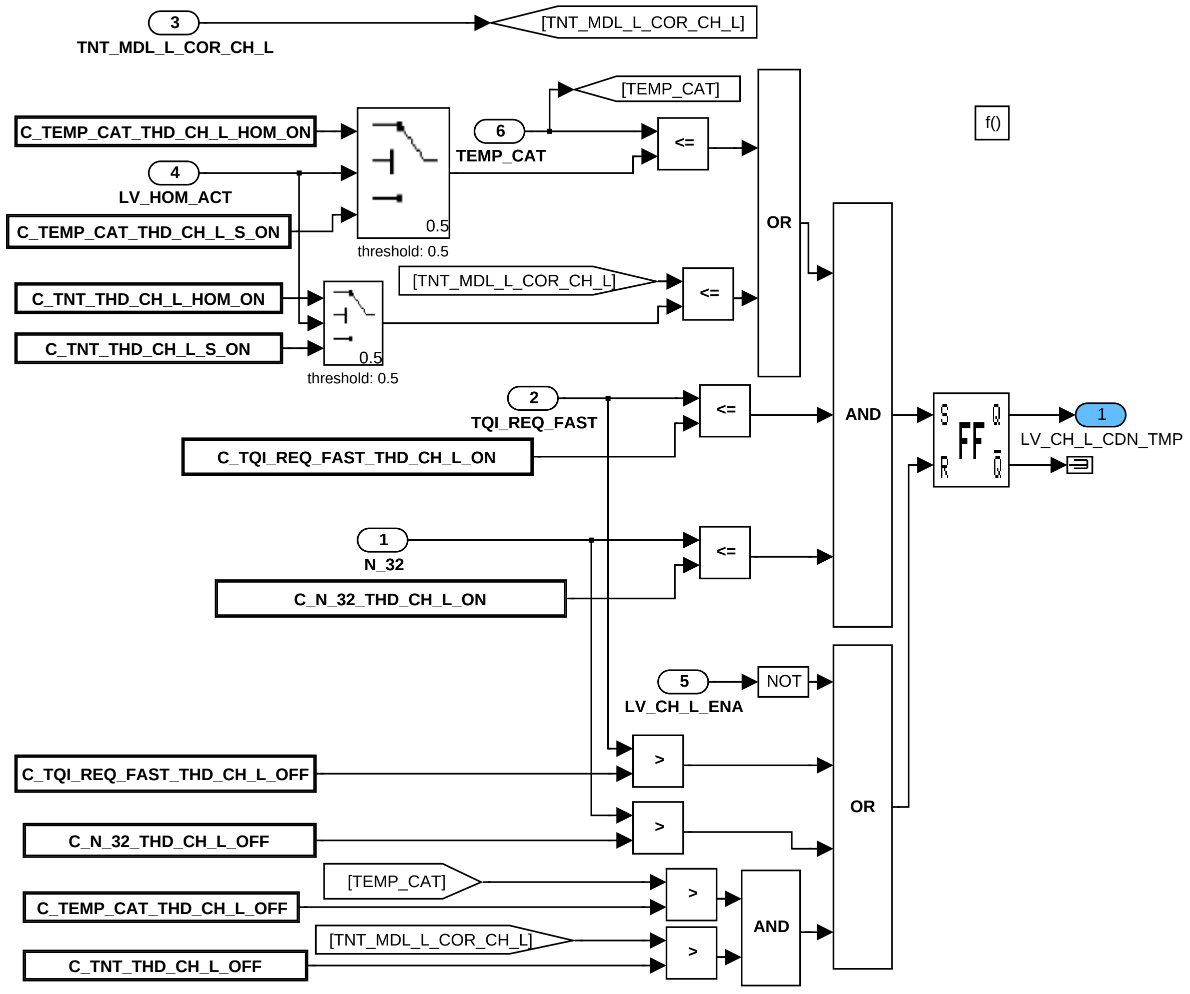

Figure 5.8.7: : Path: EXTC_ISPCLCHC0/CDN_CH_L/SUB/CH_L_CDN

5.8.3.1.2 Conditions for low load heating after regeneratin (lambda split function)

LV_NT_RGN_REQ is 1 at active regeneration. The function can be deactivated depending on load-, temperature- or time threshold.

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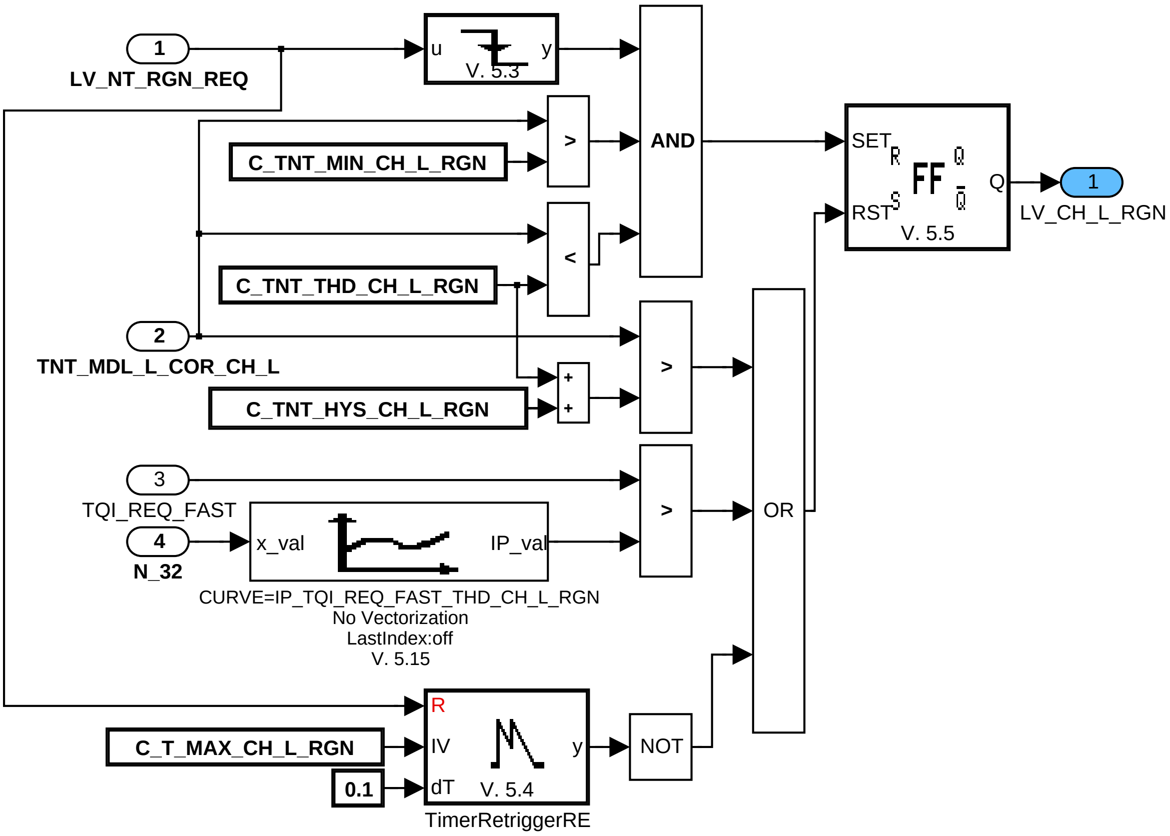

Figure 5.8.8: : Path: EXTC_ISPCLCHC0/CDN_CH_L/SUB/CH_L_RGN_CDN

5.8.4 Conditions for desulfation catalyst heating

5.8.4.1 Conditions for desulfation catalyst heating - 1st part

Vehicle speed and requested torque are filtered to avoid often on and off switching. TCO and FTL thresholds can only be re-set at engine off.

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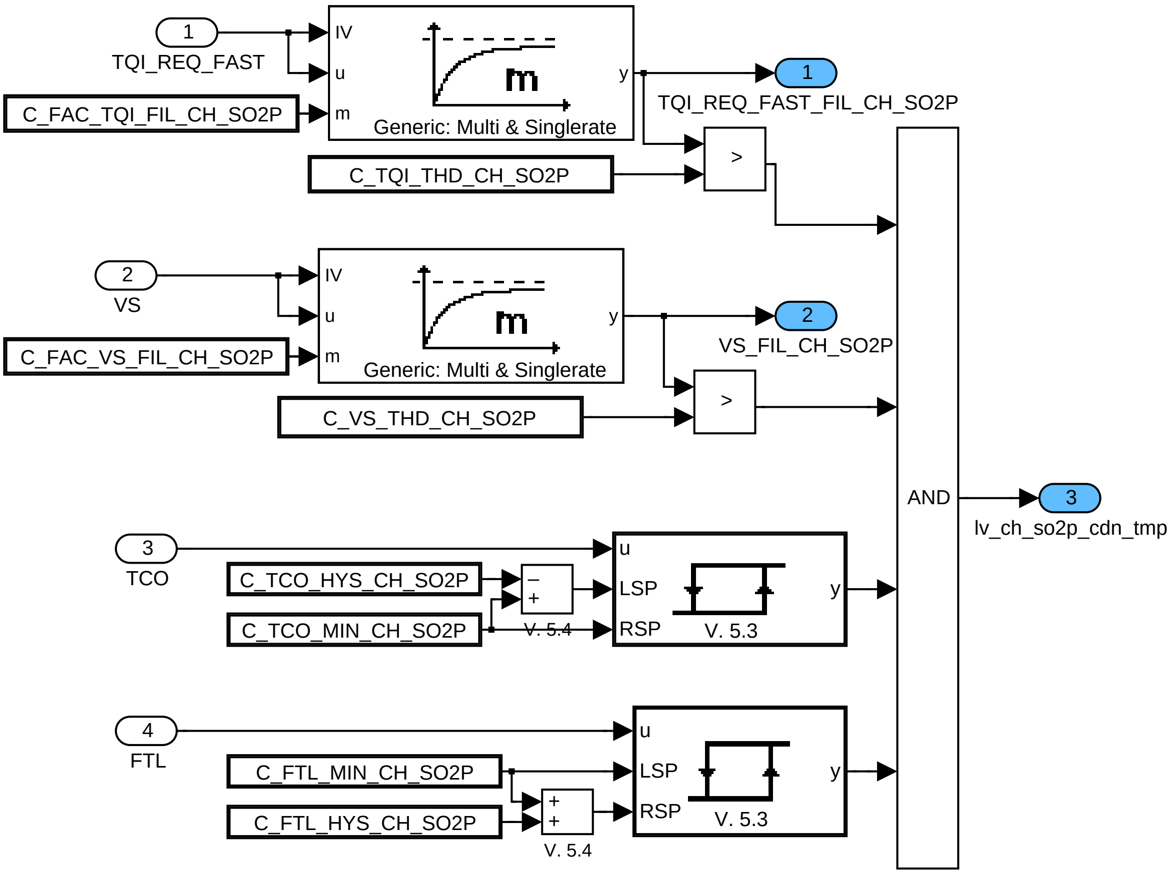

Figure 5.8.9: : Path: EXTC_ISPCLCHC0/CDN_CH_SO2P/SUB_1

5.8.4.2 Conditions for desulfation catalyst heating - 2nd part

LV_SO2P_REQ_2 indicates that catalyst heating is necessary due to imperatively desulfation.

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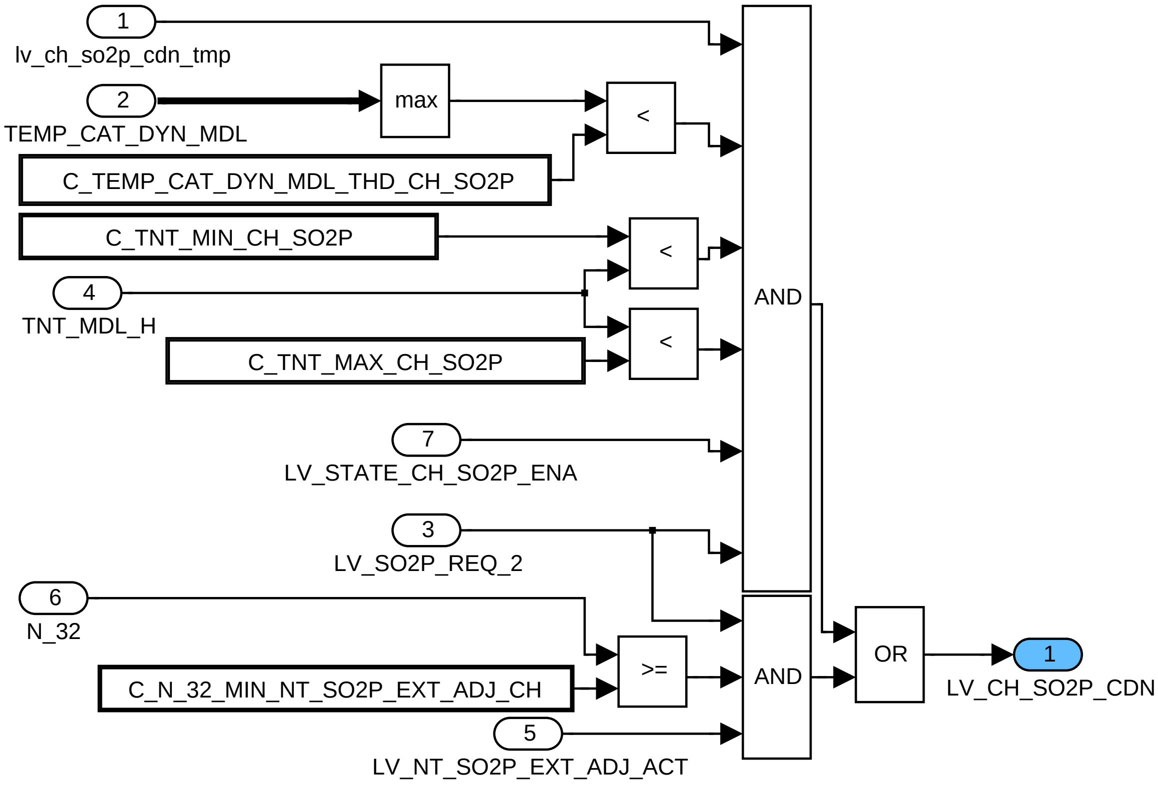

Figure 5.8.10: : Path: EXTC_ISPCLCHC0/CDN_CH_SO2P/SUB_2

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5.9 Catalyst heating coordination (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CH_SO2P	O/V/S	0... FFH	0... 255	1	-
Counter of not effectual trials to heat the NOx - Trap for desulfation					
CTR_KM_CH_SO2P_INH	O/V/S	0... FFFFH	0... 655350	10	km
Mileage at inhibition of catalyst heating for desulfation due to CTR_CH_SO2P or T_CH_SO2P_ACT					
CTR_KM_SO2P_END	O/V/S	0... FFFFH	0... 655350	10	km
Mileage at last successful desulfation					
DIST_CH_SO2P_INH	O/V	0... FFFFH	0... 655350	10	km
Km - counter since inhibition of catalyst heating for desulfation due to CTR_CH_SO2P or T_CH_SO2P_ACT					
DIST_SO2P_END	O/V	0... FFFFH	0... 655350	10	km
Km - counter since last end of desulfation					
LV_CH_AST_ENA	O/V	0... 1H	0 ...1	1	-
indicates if after start catalyst heating is enabled					
LV_CH_L_ENA	O/V	0... 1H	0 ...1	1	-
Inhibition of catalyst heating in low load					
LV_CTR_KM_CH_SO2P_INH	V	0... 1H	0 ...1	1	-
Start of mileage counter CTR_KM_CH_SO2P_INH					
LV_STATE_CH_SO2P_ENA	O/V	0... 1H	0 ...1	1	-
Catalyst heating for desulfation is enabled					
T_CH_SO2P_ACT	O/V/S	0... FFFFH	0... 6553.5	0.1	s
Time with active catalyst heating for desulfation without active desulfation					

Input data:

C_TNT_SP_CH_SO2P {p. 1814}	CTR_KM_CAN {p. 1563}	LV_CH {p. 8232}	LV_CH_INH {p. 8232}
LV_CH_SO2P_WOUT_LIM {p. 3144}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_IV [NC_CYL_NR] {p. 4802}
LV_ERR_LOAD_TPS_ PLAUS {p. 1062}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_TEG_PCAT_ DOWN {p. 4713}
LV_SO2P_REQ {p. 3129}	LV_SO2P_REQ_2 {p. 3073}	NC_CYL_NR {p. 1526}	NT_AGI_SUL {p. 3073}
STATE_CH {p. 1777}	T_AST_DC_CON {p. 809}	TNT_MDL_MV {p. 8237}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_CH_SO2P_MAX	V	0... FFH	0... 255	1	-
Maximum allowed heating activations within calibratable km - distance					
C_DIST_CH_SO2P_INH_MAX	V	0... FFFFH	0... 655350	10	km
Maximum km-counter since inhibition of catalyst heating for desulfation - to allow heating again					
C_DIST_SO2P_END_MIN	V	0... FFFFH	0... 655350	10	km
Minimum km since last desulfation to activate catalyst heating for desulfation					
C_T_AST_MAX_CH_AST	V	0... FFFFH	0... 6553.5	0.1	s
Maximum time after start to activate catalyst heating after start					
C_T_CH_SO2P_ACT_MAX	V	0... FFFFH	0... 6553.5	0.1	s
Maximum heating time without activation of desulfation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TNT_DELTA_MAX_CH_SO2P	V	0... FFFFH	0... 1023.984375	0.015625	°C
LDP_NT_AGI_SUL_IP_TNT_CH_SO2P	6	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Permissible temperature difference to be bridged					

General information:

In this module additional conditions for catalyst heating for desulfation of NOx Trap are defined.

Application conditions:

Initialisation: `RST, NVMINI, NVMRES, NVMSTO, IGKON`
Recurrence: `100MS`
Activation: `always`
Deactivation: `never`

Function description:

Formula section:

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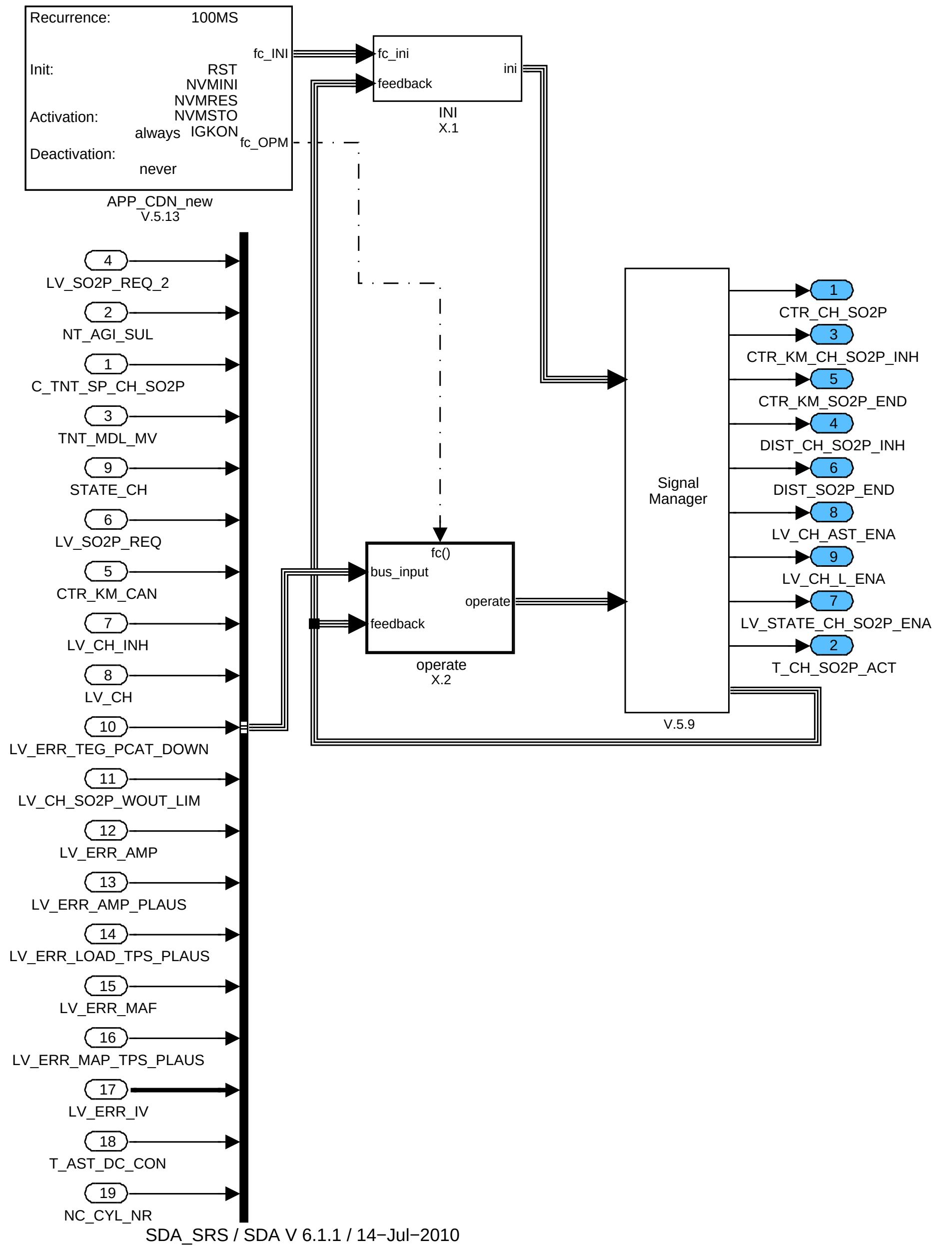

Figure 5.9.1: :

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5.9.1 Initialisation /NVMY - Handling

5.9.1.1 Initialisation at reset

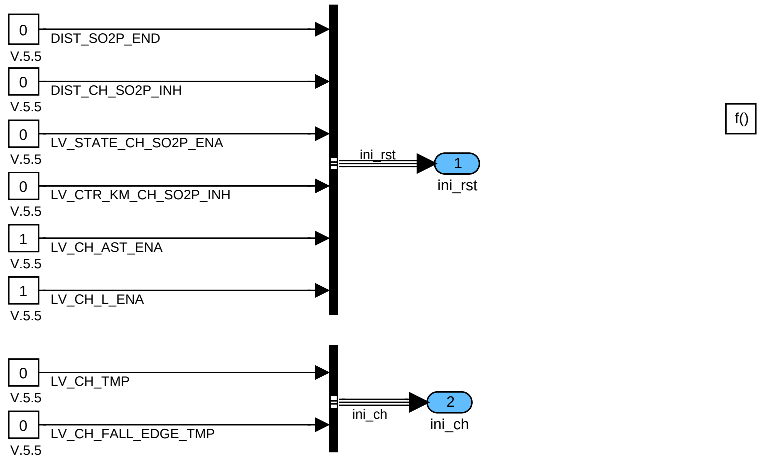

Figure 5.9.2: :

5.9.1.2 Initialisation at ignition key on

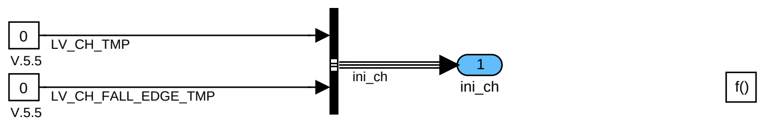

Figure 5.9.3: :

5.9.2 Operate Subsystem

5.9.2.1 Conditions for desulfation - catalyst heating

LV_CTR_KM_CH_SO2P_INH_INI starts the kilometre counter DIST_CH_SO2P_INH.

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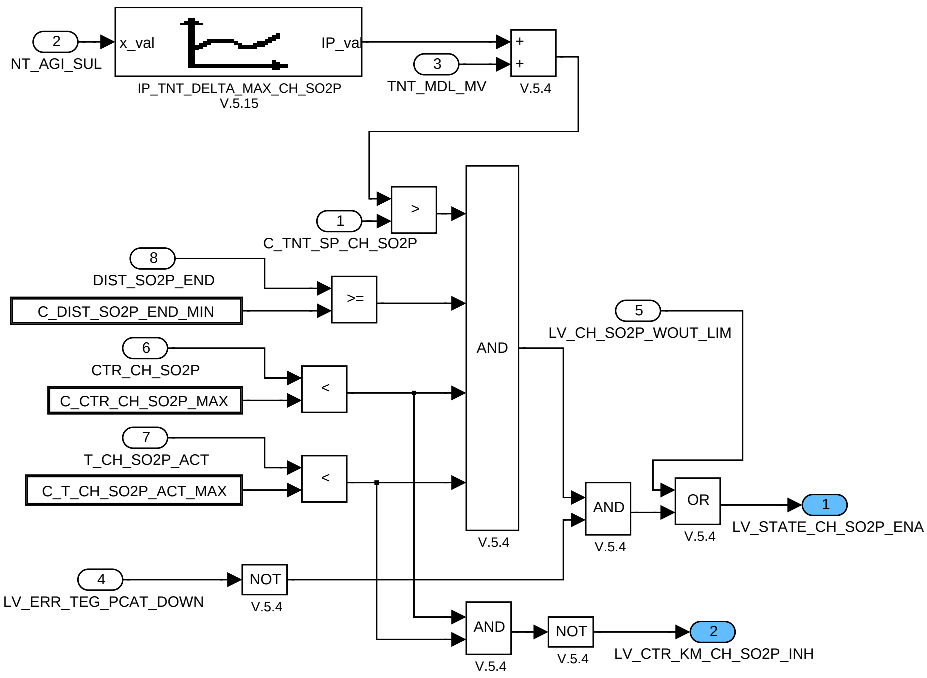

Figure 5.9.4: :

5.9.2.2 Calculation of timer and counter - for desulfation catalyst heating

CTR_CH_SO2P counts the ineffective tryings to heat up the catalyst. T_CH_SO2P_ACT is the time, the catalyst is heated without started desulfation (temperature for desulfation not reached).DIST_SO2P_END are the kilometres that have been driven since the last successful desulfation. DIST_CH_SO2P_INH are the kilometres that have been driven since the time- or counter-threshold was reached. After C_DIST_CH_SO2P_INH_MAX is reached, the timer and the counter are initialized and the catalyst is heated again.

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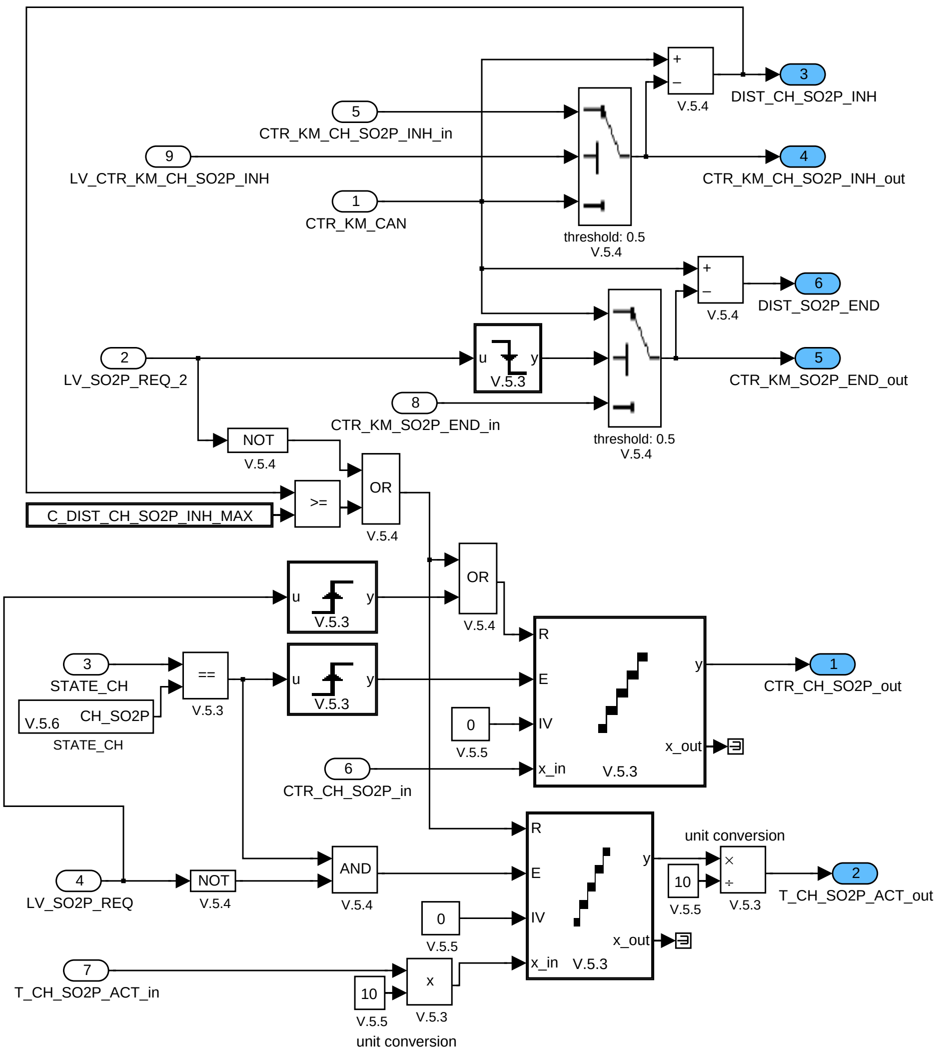

Figure 5.9.5: :

5.9.2.3 External conditions for after start catalyst heating

LV_CH_AST_INH_OPM and LV_CH_AST_INH_OPM are set to 0 at system event ignition key on.

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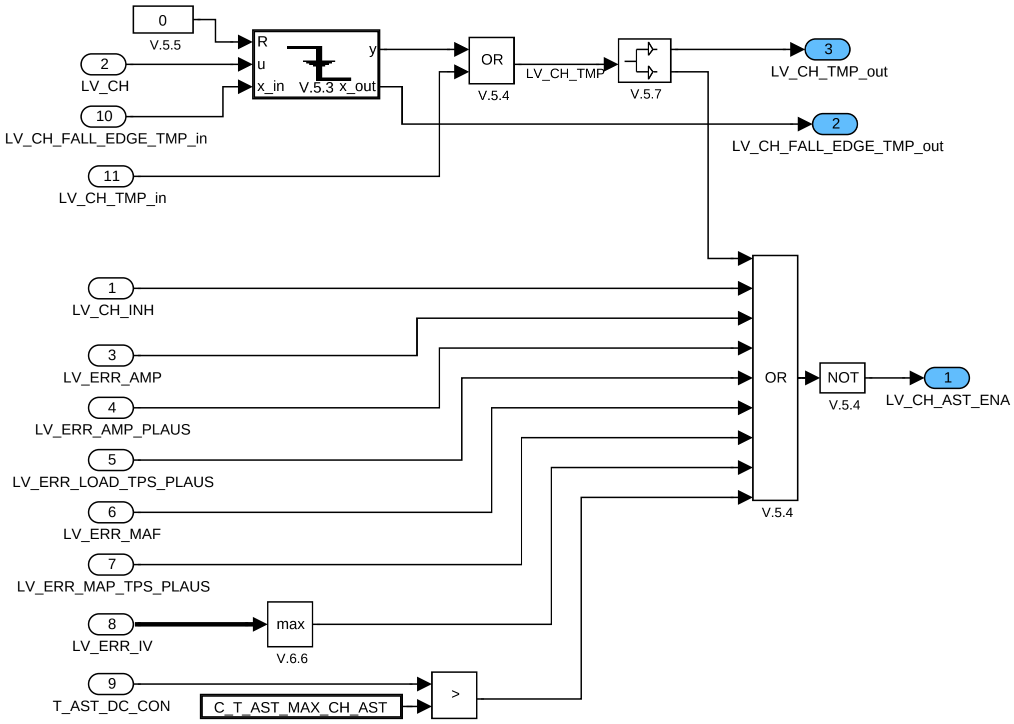

Figure 5.9.6: :

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5.10 Catalyst heating strategy

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NR_PRI_CH_MOD	O/V	80... 7FH	-128 ...127	1	-
Priority of catalyst heating strategy					
NR_PRI_CH_MOD_REQ	O	80... 7FH	-128 ...127	1	-
Priority of requested catalyst heating strategy					
STATE_CH_MOD	O/V	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_HOM CH_MOD_MPLH CH_MOD_MPLP CH_MOD_HOMS	-	-
Catalyst heating strategy					
STATE_CH_MOD_REQ	O	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_HOM CH_MOD_MPLH CH_MOD_MPLP CH_MOD_HOMS	-	-
Requested CH-strategy (combustion mode) for catalyst heating					

Input data:

LV_CH_AST_REQ_TCHA_DIAG {p. 8232}	LV_DLY_CH_MOD_REQ_SO2P_HOM {p. 1813}	NR_PRI_CH_MOD_REQ_L {p. 1809}	STATE_CH {p. 1777}
STATE_CH_MOD_AST {p. 1801}	STATE_CH_MOD_L {p. 1809}	STATE_CH_MOD_REQ_AST {p. 1801}	STATE_CH_MOD_REQ_L {p. 1809}
STATE_CH_MOD_REQ_SO2P {p. 1813}	STATE_CH_MOD_SO2P {p. 1813}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NR_PRI_CH_MOD	-	80... 7FH	-128 ...127	1	-
Priority of catalyst heating strategy					
C_NR_PRI_CH_MOD_REQ	-	80... 7FH	-128 ...127	1	-
Priority of requested catalyst heating strategy					
C_NR_PRI_CH_MOD_REQ_TCHA_DIAG	-	80... 7FH	-128 ...127	1	-
Priority of requested strategy - at activated catalyst heating function for turbo charger diagnosis					

General Information

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This modul merges the STATE_.. values from after start and low load catalyst heating.

Application Conditions

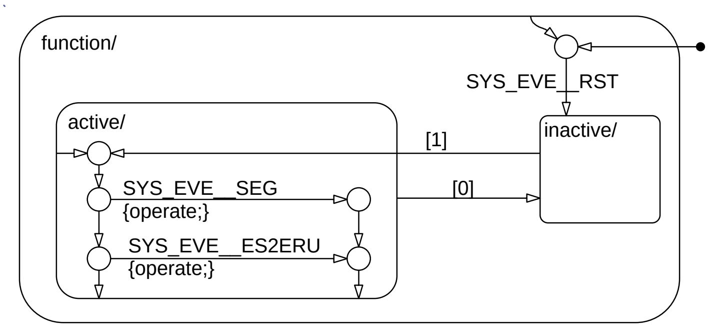

Figure 5.10.1: : Path: EXTC_REQCOMOD0/APP_CDN/Chart

Function description

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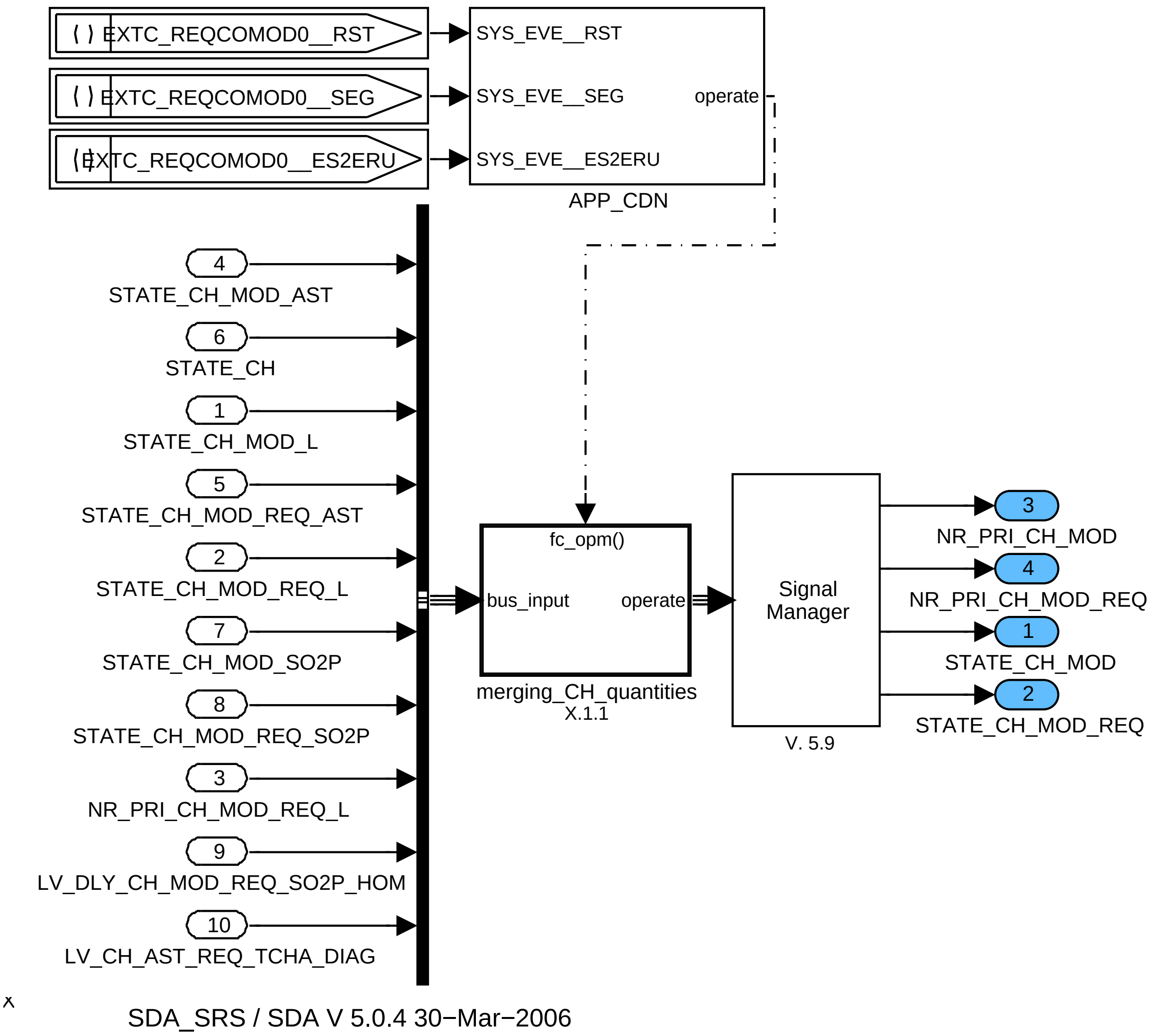

Figure 5.10.2: : Path: EXTC_REQCOMOD0

5.10.1 Operate Subsystem

5.10.1.1 Generation of STATE_CH_MOD

STATE_CH indicates the actual active catalyst heating state CH_AST, CH_L_LOAD or CH_SO2P. STATE_CH_MOD is set to the corresponding value.

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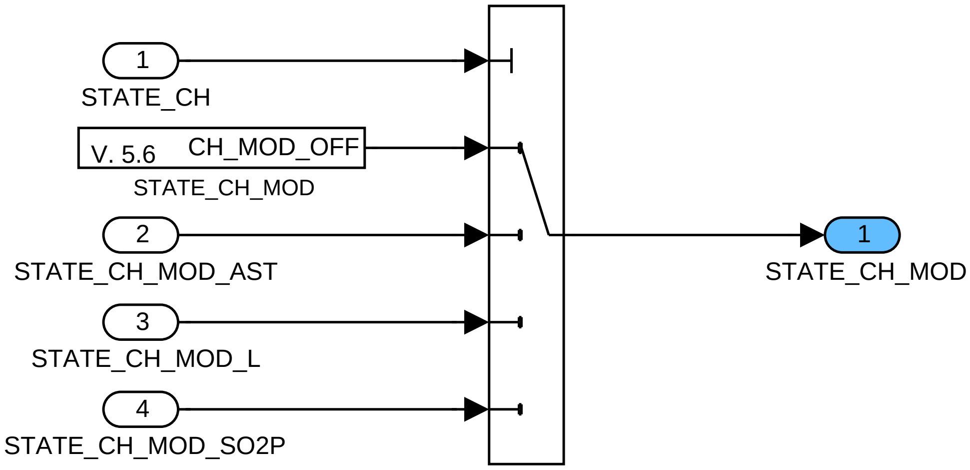

Figure 5.10.3: : Path: EXTC_REQCOMOD0/merging_CH_quantities/CLC_STATE_CH_MOD

5.10.1.2 Generation of STATE_CH_MOD_REQ

Same procedere as for STATE_CH_MOD. At LV_DLY_CH_MOD_REQ_SO2P_HOM = 1, it is possible that STATE_CH_MOD_REQ requests homogeneous mode although STATE_CH is CH_OFF. At LV_CH_AST_REQ_TCHA_DIAG = 1, MPLH is requested.

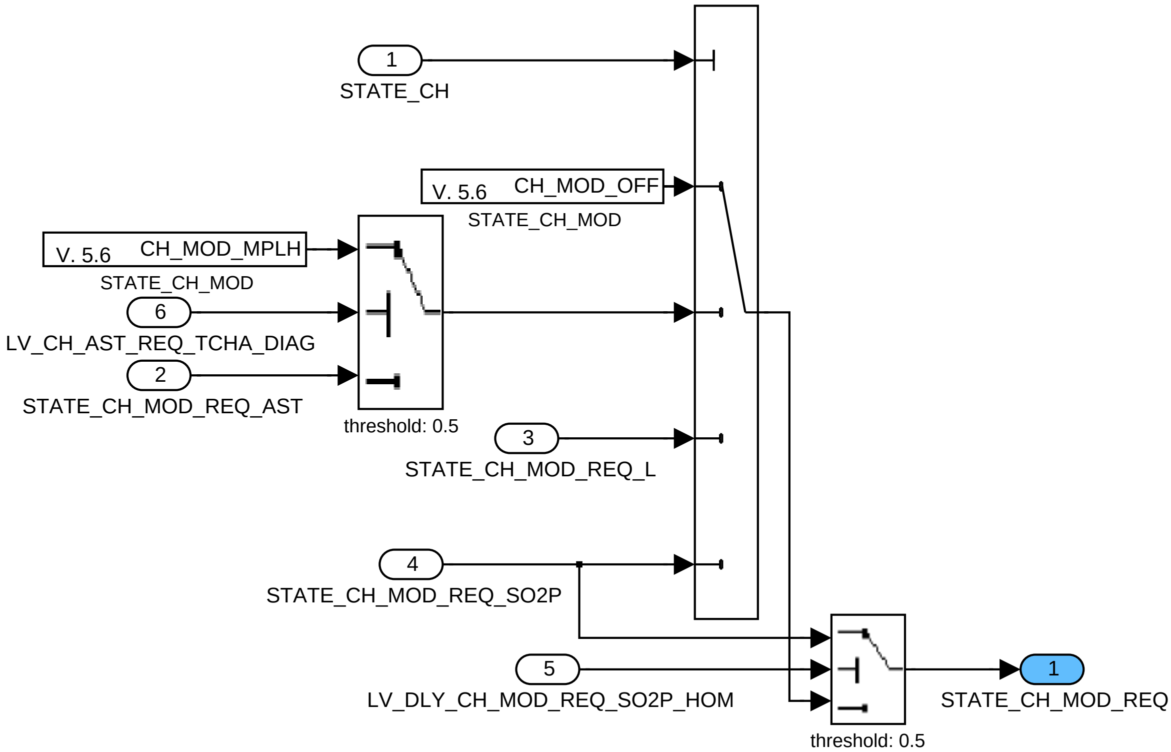

Figure 5.10.4: : Path: EXTC_REQCOMOD0/merging_CH_quantities/CLC_STATE_CH_MOD_REQ

5.10.1.3 Generation of priority for operation mode requests

At active turbo diagnosis a separate value is used.

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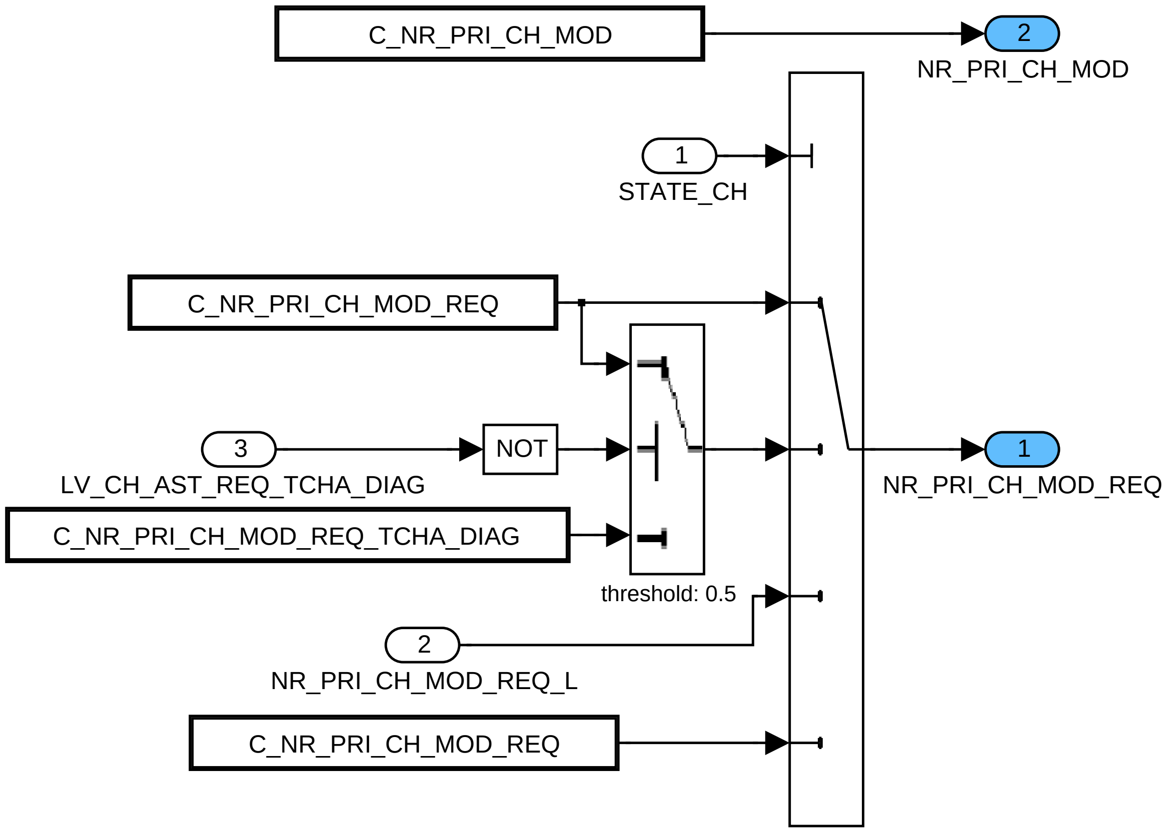

Figure 5.10.5: : Path: EXTC_REQCOMOD0/merging_CH_quantities/CLC_NR_PRI

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5.11 Catalyst heating after start strategy

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CH_AST_MPLH_CDN	V	0... 1H	0 ...1	1	-
Indicates if conditions for after start catalyst heating with multiple injection in homogenous are fulfilled					
LV_CH_AST_MPLP_CDN	V	0... 1H	0 ...1	1	-
Indicates if conditions for after start catalyst heating with post injection in stratified are fulfilled					
STATE_CH_MOD_AST	O/V	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_HOM CH_MOD_MPLH CH_MOD_MPLP CH_MOD_HOMS	-	-
Catlyst heating strategy					
STATE_CH_MOD_REQ_AST	O/V	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_HOM CH_MOD_MPLH CH_MOD_MPLP CH_MOD_HOMS	-	-
Requested CH-strategy (combustion mode) for after start catalyst heating					
T_AST_COR_CH	O/V	0... FFFFH	0... 6553.5	0.1	s
Catalyst age depending correction of T_AST for after start catalyst heating					

Input data:

CTR_KM_CAN {p. 1563}	LV_ES {p. 1720}	LV_HOM_ACT {p. 8136}	LV_HOM_ENA {p. 8136}
LV_HOMS_ACT {p. 8269}	LV_MPLH_ACT {p. 8269}	LV_MPLP_ACT {p. 8270}	LV_S_ACT {p. 8137}
LV_S_ENA {p. 8137}	LV_ST_END {p. 1720}	N_32 {p. 1525}	PV {p. 978}
STATE_CH {p. 1777}	T_AST {p. 1766}	TCO_ST {p. 1100}	TQI_REQ_FAST {p. 8391}
VS {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CH_MOD_MAN	-	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_HOM CH_MOD_MPLH CH_MOD_MPLP CH_MOD_HOMS	-	-
Manual setting of catalyst heating strategy					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_MAX_MPLH_CH_AST	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for after start catalyst heating in homogeneous mode with split injection					
C_N_MAX_MPLP_CH_AST	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for after start catalyst heating in stratified mode with post injection					
C_N_MIN_MPLH_CH_AST	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for after start catalyst heating in homogeneous mode with split injection					
C_N_MIN_MPLP_CH_AST	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for after start catalyst heating in stratified mode with post injection					
C_T_MIN_PV_THD_MPLH_CH_DEAC	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time to deactivate MPLH_CH after exceeded pedal value					
C_TQI_MAX_MPLP_CH_AST	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum of indicated torque request for after start catalyst heating with post injection					
C_TQI_MIN_MPLP_CH_AST	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Minimum of indicated torque request for after start catalyst heating with post injection					
C_VS_MAX_MPLP_CH_AST	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for post injection during after start catalyst heating					
ID_CH_MOD_BAS	V	0... 3H	0 ...3	1	-
LDPM_T_AST_COR_CH_1_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDP_TCO_ST_ID_CH_MOD_BAS	8	0... FEH	-48... 142.5	0.75	°C
Basic catalyst heating strategy					
IP_PV_THD_MPLH_CH_AST	-	0... 3FFH	0... 99.90234375	0.0976563	%
LDP_TCO_ST_IP_PV_THD_MPLH_CH	8	0... FEH	-48... 142.5	0.75	°C
Pedal value threshold for multiple injection in homogeneous for after start catalyst heating					
IP_T_AST_COR_CH	-	0... FFFFH	0... 6553.5	0.1	s
LDP_CTR_KM_CAN_IP_T_AST_COR_CH	6	0... FFFFH	0... 655350	10	km
Catalyst age (in fact driven km) corrected time after start for after start catalyst heating					
LC_CH_MOD_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of catalyst heating strategy					

General Information

The engine states during catalyst heating can be homogeneous (HOM), homogeneous with multiple injection (MPLH), stratified with post injection (MPLP) and homogeneous-stratified (HOMS). STATE_CH_MOD_AST, generated in this module, contains the information which catalyst heating strategy is active and is used for CH-setpoint calculation (for example fuel mass setpoint or lambda). Further the request which combustion mode is the most efficient for catalyst heating is generated in this module.

Application Conditions

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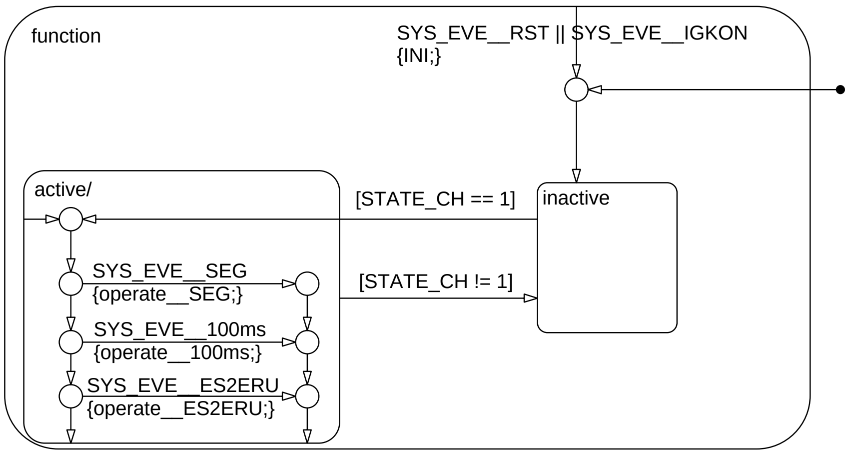

Figure 5.11.1: : Path: EXTC_ISPCLMODAS0/APP_CDN/Chart

Function description

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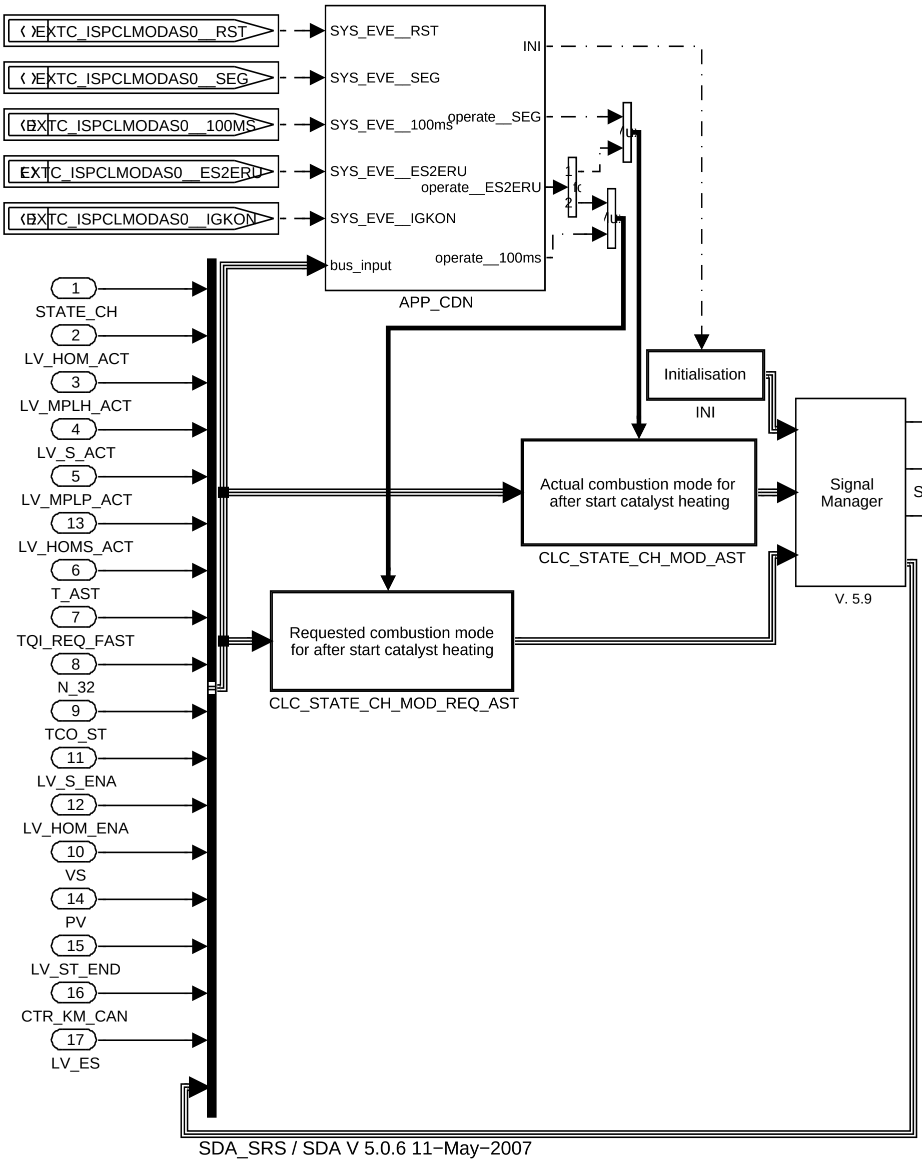

Figure 5.11.2: : Path: EXTC_ISPCLMODAS0

5.11.1 Initialisation

5.11.1.1 No title given

The outputs are initialised at reset and function deactivation.

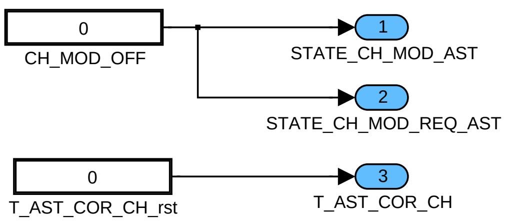

Figure 5.11.3: : Path: EXTC_ISPCLMODAS0/INI/SUB

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5.11.2 Actual combustion mode for after start catalyst heating

5.11.2.1 No title given

STATE_CH_MOD_AST is set according to the bit-variables that show the actual mode (HOM, MPLH, HOMS or MPLP). If no mode is requested for catalyst heating (STATE_CH_MOD_REQ_AST = 0) also the actual mode is set to 0. It is also possible to set STATE_CH_MOD_AST manually.

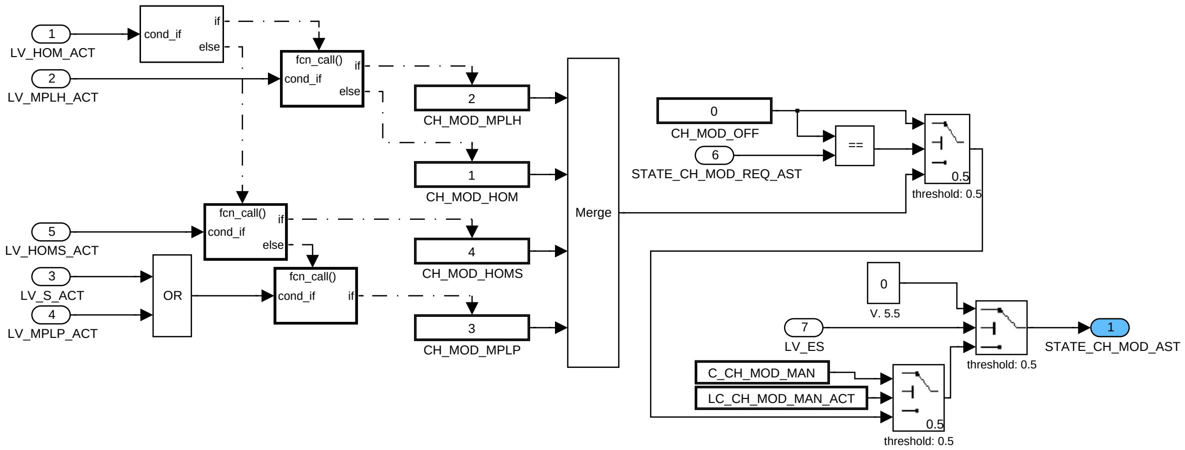

Figure 5.11.4: : Path: EXTC_ISPCLMODAS0/CLC_STATE_CH_MOD_AST/SUB

5.11.3 Requested combustion mode for catalyst heating

5.11.3.1 No title given

ID_CH_MOD_BAS contains the strategy-order for catalyst heating.

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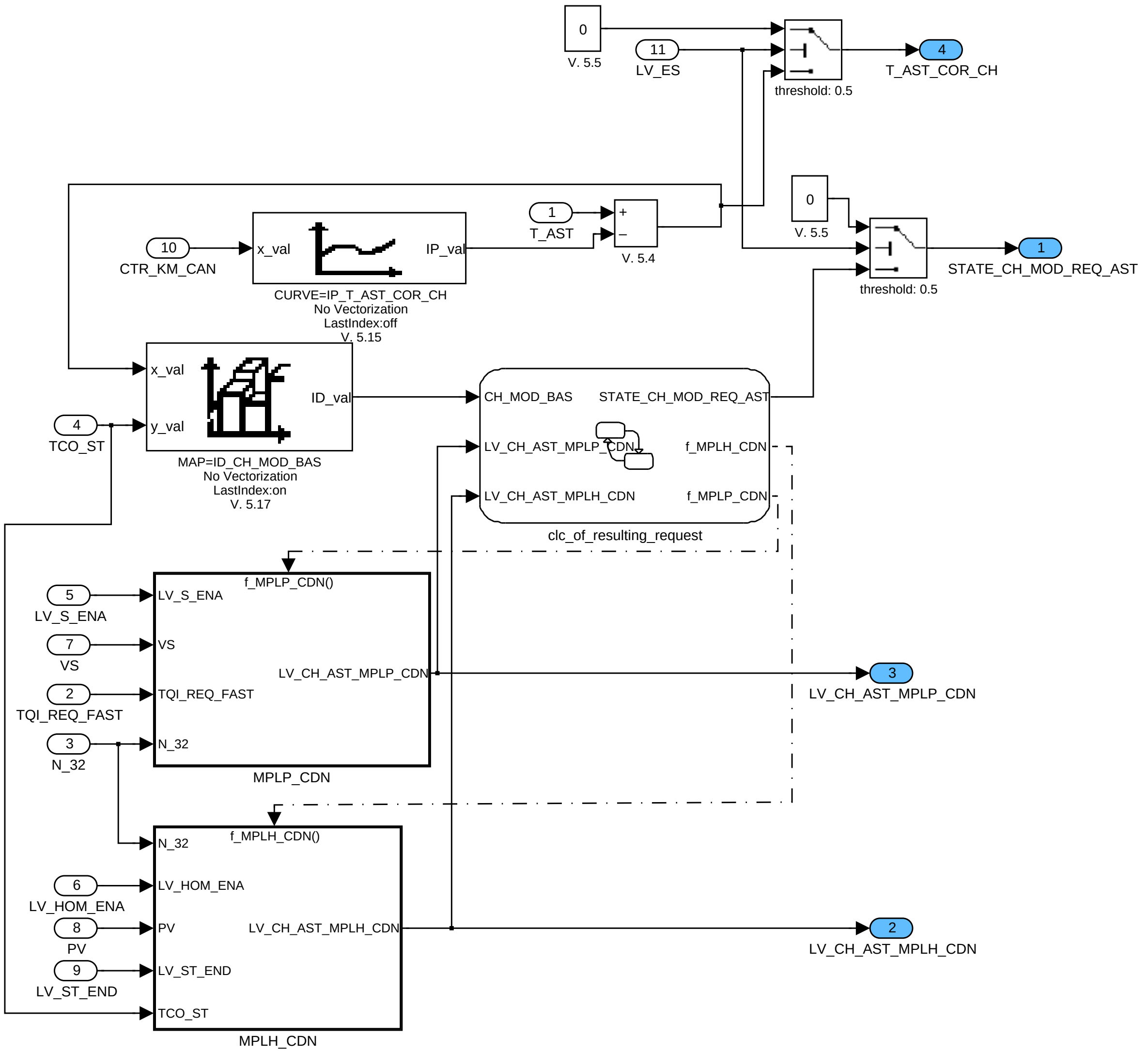

Figure 5.11.5: : Path: EXTC_ISPCLMODAS0/CLC_STATE_CH_MOD_REQ_AST/SUB

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5.11.3.1.1 clc_of_resulting_request

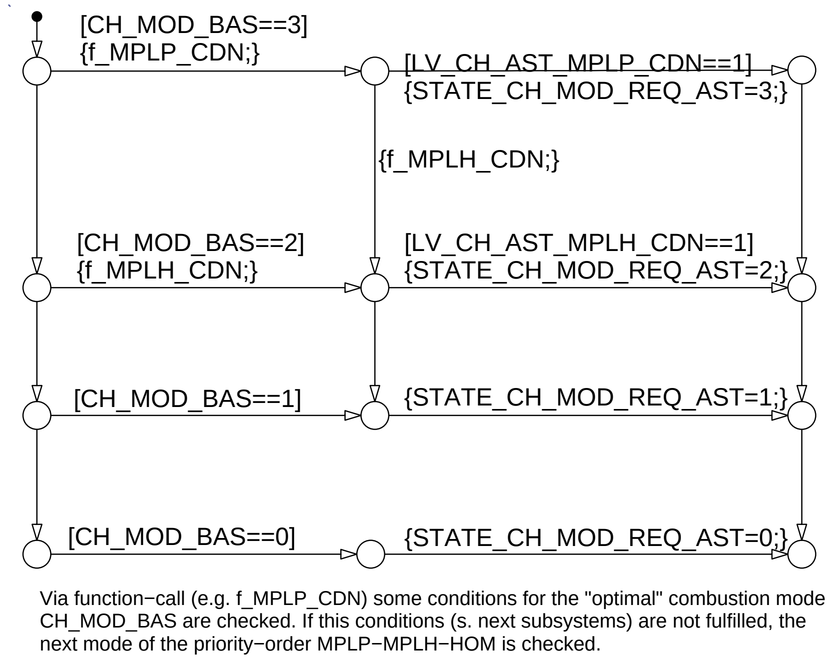

Figure 5.11.6: : Path: EXTC_ISPCLMODAS0/CLC_STATE_CH_MOD_REQ_AST/SUB/clc_of_resulting_request

5.11.3.1.2 Conditions for homogenous mode with multiple injection

LV_CH_AST_MPLH_CDN indicates if conditions for MPLH for catalyst heating are fulfilled. It is set to 0 if the engine speed is not in-between a calibratable range, LV_HOM_ENA is 0 or the pedal value exceeds C_PV_MAX_MPLH_CH for a certain time (C_T_MIN_PV_THD_MPLH_CH_DEAC). The bit LV_CH_AST_MPLH_CDN can only be set to 1 again after next engine start.

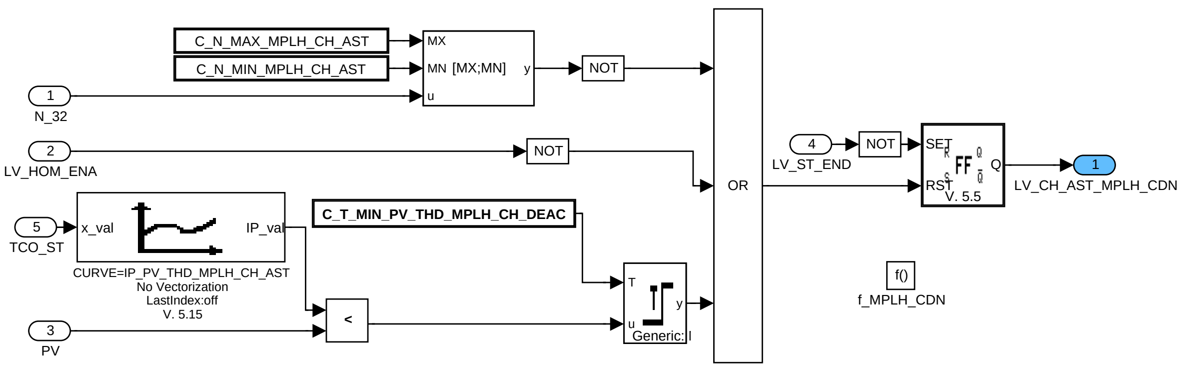

Figure 5.11.7: : Path: EXTC_ISPCLMODAS0/CLC_STATE_CH_MOD_REQ_AST/SUB/MPLH_CDN

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5.11.3.1.3 Conditions for stratified mode

For stratified mode with post injection the torque request and the engine speed has to be in-between a calibratable range, the vehicle speed must be below a limit and LV_S_ENA must indicate that stratified mode is enabled.

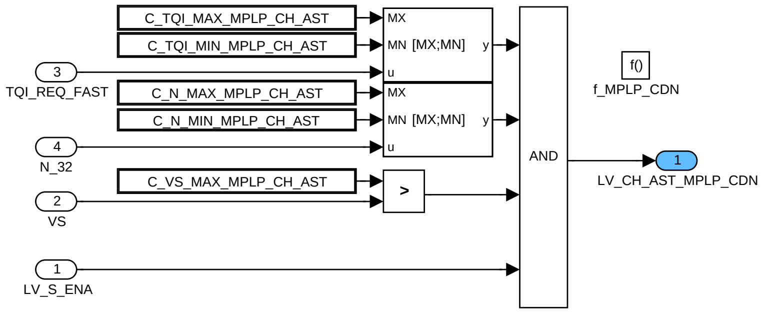

Figure 5.11.8: : Path: EXTC_ISPCLMODAS0/CLC_STATE_CH_MOD_REQ_AST/SUB/MPLP_CDN

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5.12 Catalyst heating low load strategy

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NR_PRI_CH_MOD_REQ_L	O/V	80... 7FH	0... 127	1	-
Priority of requested catalyst heating strategy for low load catalyst heating					
STATE_CH_MOD_L	O/V	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_HOM CH_MOD_MPLH CH_MOD_MPLP CH_MOD_HOMS	-	-
Catalyst heating strategy for low load heating					
STATE_CH_MOD_REQ_L	O/V	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_HOM CH_MOD_MPLH CH_MOD_MPLP CH_MOD_HOMS	-	-
Requested CH strategy (combustion mode) for low load catalyst heating					

Input data:

C_CH_MOD_MAN {p. 1801}	LC_CH_MOD_MAN_ACT {p. 1802}	LV_HOMS_ACT {p. 8269}	LV_MPLP_ACT {p. 8270}
LV_S_ACT {p. 8137}	STATE_CH {p. 1777}	TEMP_CAT {p. 8237}	TNT_MDL_H {p. 8237}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NR_PRI_CH_MOD_REQ_L_ACT	-	80... 7FH	0... 127	1	-
Priority of requested catalyst heating strategy for switching to homogeneous mode					
C_NR_PRI_CH_MOD_REQ_L_PAS	-	80... 7FH	0... 127	1	-
Priority of passive requested catalyst heating strategy in low load catalyst heating					
C_TEMP_CAT_MIN_SWI_HOM_CH_L	-	0... FFFFH	0... 990.984375	0.015625	°C
Below this catalyst temperature the homogeneous mode is requested for low load catalyst heating					
C_TEMP_CAT_MIN_SWI_HOMS_CH_L	-	0... FFFFH	0... 990.984375	0.015625	°C
Below this catalyst temperature the homogeneous stratified mode is requested for low load catalyst heating					
C_TEMP_HYS_SWI_HOM_CH_L	-	0... FFFFH	0... 1023.98	0.015625	°C
Hysteresis of temperature threshold for switching in homogenous mode in low load catalyst heating					
C_TEMP_HYS_SWI_HOMS_CH_L	-	0... FFFFH	0... 1023.98	0.015625	°C
Hysteresis of temperature threshold for switching in homogenous stratified mode in low load catalyst heating					
C_TNT_MIN_SWI_HOM_CH_L	-	0... FFFFH	0... 1023.98	0.015625	°C
Below this NOx trap temperature the homogeneous mode is requested for low load catalyst heating					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TNT_MIN_SWI_HOMS_CH_L	-	0... FFFFH	0... 1023.98	0.015625	°C
Below this NOx trap temperature the homogeneous stratified mode is requested for low load catalyst heating					

General information

This module has to be calculated after Catalyst heating coordination and Catalyst heating after start strategy and before any other catalyst heating module.

The output STATE_CH_MOD_L will be merged in Catalyst heating strategy into STATE_CH_MOD. This value is used to trigger setpoint calculation modules. STATE_CH_MOD_REQ_L will be merged into STATE_CH_MOD_REQ.

Application Condition

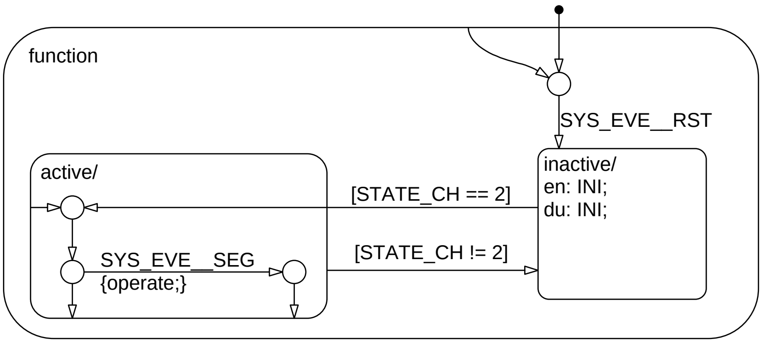

Figure 5.12.1: EXTC_ISPCLmodll0/APP_CDN/Chart

Function Description

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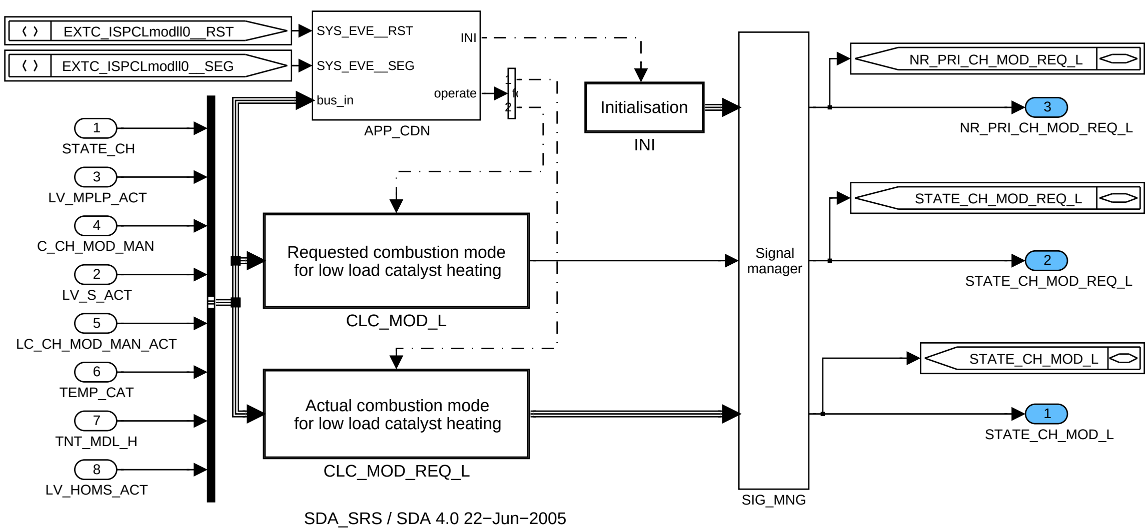

Figure 5.12.2: EXTC_ISPCLmodll0

5.12.1 Initialization

All outputs are set to 0 at reset and deactivated function.

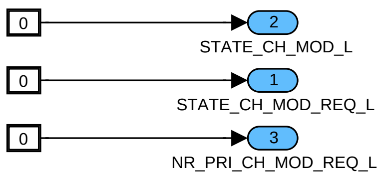

Figure 5.12.3: EXTC_ISPCLmodll0/INI/INI_SUB

5.12.2 Actual combustion mode for low load catalyst heating

Depending on the actual active combustion mode, STATE_CH_MOD_L is set to HOMS, MPLP or HOM. With (L)C_CH_MOD_MAN(_ACT) it is possible to set it manually.

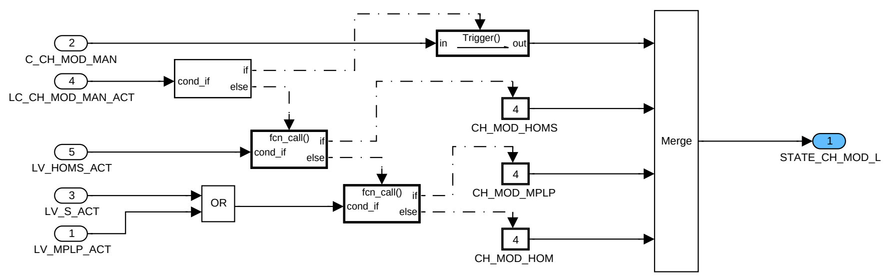

Figure 5.12.4: EXTC_ISPCLmodll0/CLC_MOD_L/CLC_MOD_L_SUB

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5.12.3 Requested combustion mode for low load catalyst heating

If catalyst or NOxTrap temperature falls below C_TEMP_CAT_MIN_SWI_HOMS_CH_L or C_TNT_MIN_SWI_HOMS_CH_L the HOMS - mode is requested to inhibit that the catalyst cools down under the working temperature. If one of the temperatures falls even below C_TEMP_CAT_MIN_SWI_HOM_CH_L or C_TNT_MIN_SWI_HOM_CH_L homogenous mode is requested. NR_PRI_CH_MOD_REQ_L is increased via C_NR_PRI_CH_MOD_REQ_L_ACT if the request shell be active.

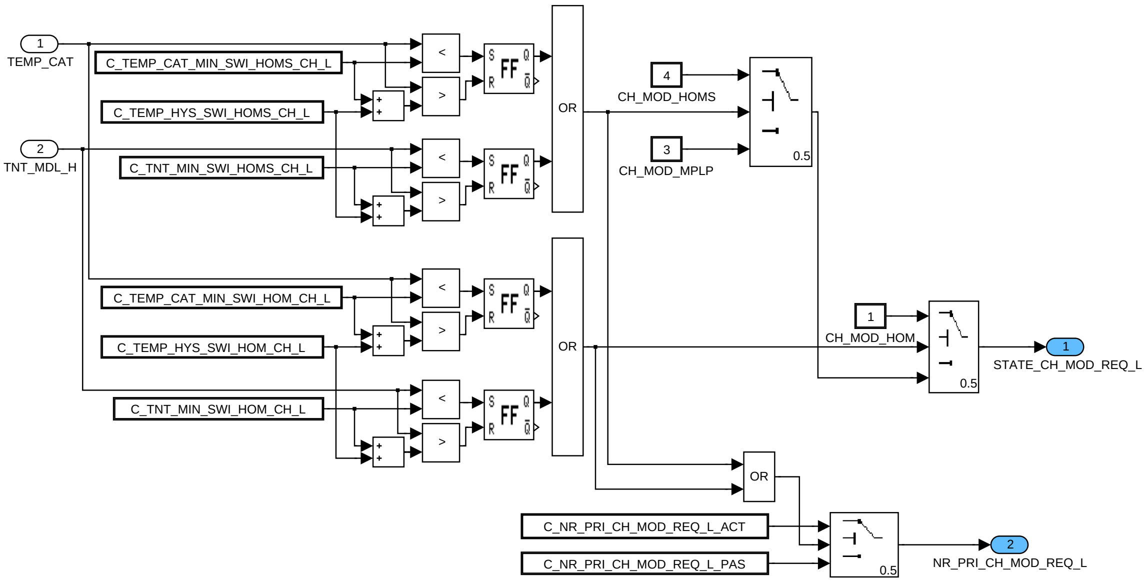

Figure 5.12.5: EXTC_ISPCLmodll0/CLC_MOD_REQ_L/CLC_MOD_REQ_L_SUB

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5.13 Catalyst heating for desulfation strategy

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DLY_CH_MOD_REQ_SO2P_HOM	O/V	0... 1H	0 ...1	1	-
Indicates if homogeneous mode is requested after active desulfation catalyst heating					
STATE_CH_MOD_REQ_SO2P	O/V	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_HOM CH_MOD_MPLH CH_MOD_MPLP CH_MOD_HOMS	-	-
Requested CH-strategy (combustion mode) for desulfation catalyst heating					
STATE_CH_MOD_SO2P	O/V	0H 1H 2H 3H 4H	CH_MOD_OFF CH_MOD_HOM CH_MOD_MPLH CH_MOD_MPLP CH_MOD_HOMS	-	-
Catalyst heating strategy for desulfation catalyst heating					
TNT_DIF_CH_SO2P	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	K
Difference between desulfation setpoint and actual value of TNT					

Input data:

LV_MPLH_ACT {p. 8269}	LV_NT_SO2P_EXT_ADJ_ACT {p. 3144}	LV_S_ACT {p. 8137}	LV_STATE_CH_SO2P_ENA {p. 1789}
MAF {p. 8277}	N_32 {p. 1525}	STATE_CH {p. 1777}	TNT_MDL_L {p. 8237}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_SO2P_ACT_HYS	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass air flow hysteresis to avoid toggle of switch over the SO2P heating request					
C_N_32_SO2P_ACT_HYS	-	0... FFH	0... 8160	32	rpm
Engine speed hysteresis to avoid toggle of switch over the SO2P heating request					
C_STATE_CH_MOD_SO2P_MAN	-	0H 1H 2H	CH_MOD_OFF CH_MOD_HOM CH_MOD_MPLH	-	-
Manual setting of catalyst heating strategy for desulfation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_STATE_CH_MOD_REQ_SO2P	-	0... FFFFH	0... 6553.5	0.1	s
Time to request homogeneous mode after deactivation of desulfation catalyst heating					
C_TNT_SP_CH_SO2P	-	0... FFFFH	0... 1023.984375	0.015625	°C
Setpoint of TNT for desulfation catalyst heating					
C_TNT_SP_CH_SO2P_EXT_ADJ	-	0... FFFFH	0... 1023.984375	0.015625	°C
Setpoint of TNT for desulfation catalyst heating activated by external adjustment					
ID_STATE_CH_MOD_REQ_SO2P	V	0... 2H	0 ...2	1	-
LDP_N_32_ID_CH_MOD_REQ_SO2P	6	0... FFH	0... 8160	32	rpm
LDP_MAF_ID_CH_MOD_REQ_SO2P	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Requested combustion mode for desulfation catalyst heating					
LC_STATE_CH_MOD_SO2P_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of catalyst heating strategy for desulfation					

General Information

This module has to be calculated after Catalyst heating coordination , Catalyst heating after start strategy , Catalyst heating low load strategy and before any other catalyst heating module.

The engine states during catalyst heating for desulfation can be homogeneous (HOM) and homogeneous with multiple injection (MPLH). STATE_CH_MOD_SO2P, generated in this module, contains the information which catalyst heating strategy is active and is used for CH-setpoint calculation (for example fuel mass setpoint or lambda). It will be merged in Catalyst heating strategy into STATE_CH_MOD. STATE_CH_MOD_REQ_SO2P will be merged into STATE_CH_MOD_REQ. Further a request is generated that contains the most efficient combustion mode for desulfation catalyst heating.

Application Conditions

Initialization: RST
Activation: 100MS: STATE_CH == 3
SEG: STATE_CH == 3
Deactivation: STATE_CH != 3 & & STATE_CH_MOD_REQ_SO2P == 0

Function description

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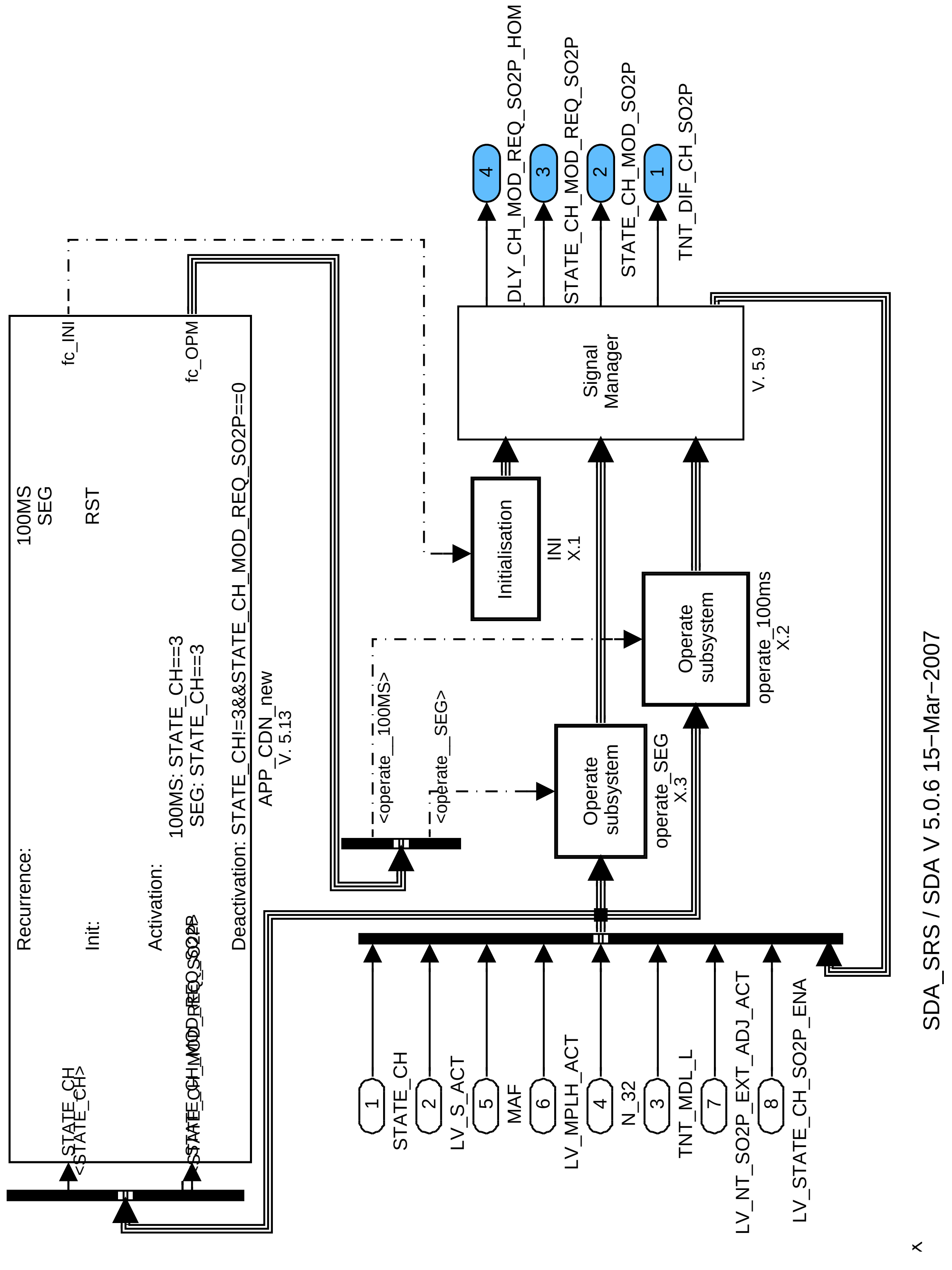

Figure 5.13.1: : Path: EXTC_ISPCLMODSO0

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5.13.1 Initialisation

5.13.1.1 Initialisation - Subsystem

The outputs are initialised at reset and function deactivation.

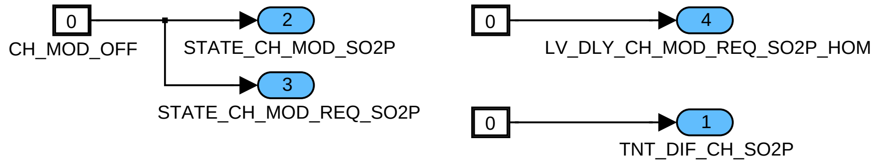

Figure 5.13.2: : Path: EXTC_ISPCLMODSO0/INI/SUB

5.13.2 100 ms - Task

5.13.2.1 100 ms - Task - Subsystem

At deactivation of desulfation catalyst heating due to torque or vehicle speed threshold (STATE_CH == 0 and LV_STATE_CH_SO2P_ENA=1) there is the possibility to request homogenous mode for a calibratable time.

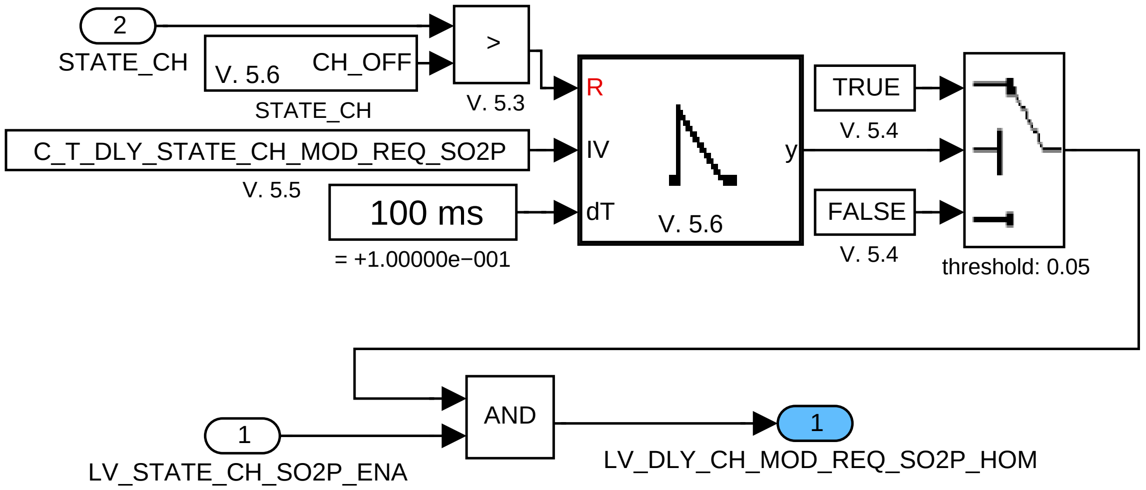

Figure 5.13.3: : Path: EXTC_ISPCLMODSO0/operate_100ms/SUB

5.13.3 Segment synchronous task

5.13.3.1 Segment synchronous task - Subsystem

TNT_DIF_CH_SO2P is the difference between the NOx-trap temperature setpoint and the actual value. It is negative if there is necessity to heat. The ID and the calibration data for manual setting have other physical meaning as the output of the spec because for catalyst heating for desulfation only HOM and MPLH can be used.

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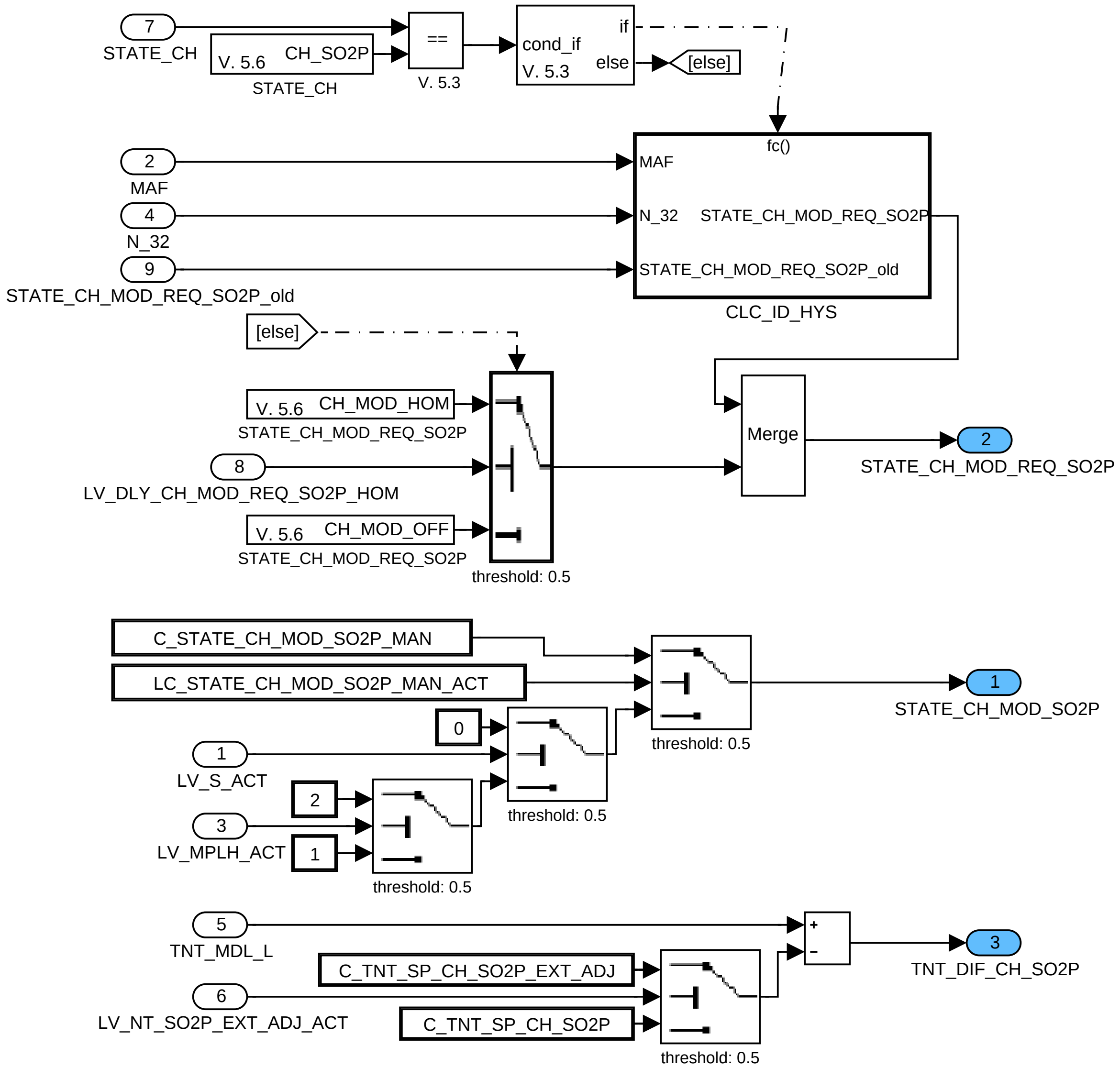

Figure 5.13.4: : Path: EXTC_ISPCLMODSO0/operate_SEG/SUB

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5.13.3.1.1 EXTC_ISPCLMODSO0/OPERATE_SEG/SUB/CLC_ID_HYS

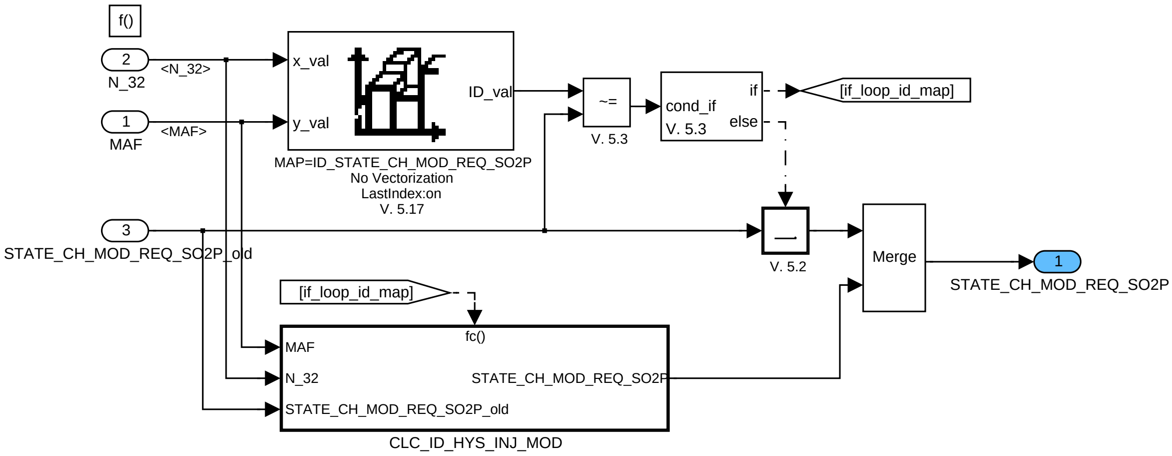

Figure 5.13.5: : Path: EXTC_ISPCLMODSO0/operate_SEG/SUB/CLC_ID_HYS

5.13.3.1.1.1 Change of injection mode

The basic for the changing of the injection mode is the hysteresis of N_32 and MAF to avoid the toggle between the injection modes. The actual values of N_32 and MAF are detected by the corresponding breakpoints. These indexes are going to the map ID_STATE_CH_MOD_REQ_SO2P. The hysteresis is calculated with the value of the corresponding breakpoint and the calibration constant. The changing of the injection mode is only possible after reaching the maximum threshold of the hysteresis. Example: Actual engine speed is 3000rpm. Corresponding breakpoint is 1632rpm. Calibration value is 200rpm. Result of the hysteresis is 1632rpm + 200rpm = 1832rpm. The calculation of MAF is the same.

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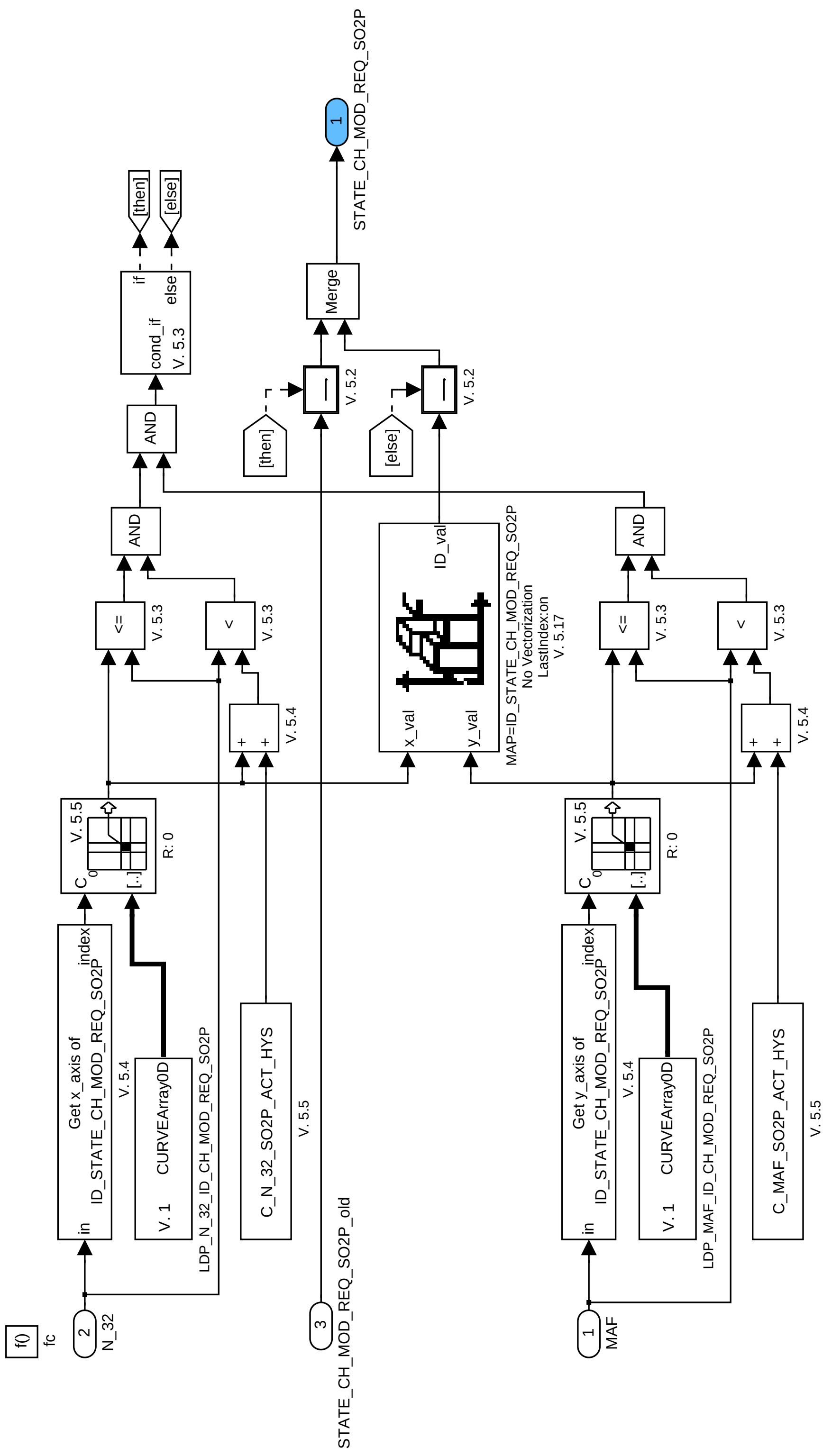

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Figure 5.13.6: : Path:
EXTC_ISPCLMODSO0/operate_SEG/SUB/CLC_ID_HYS/CLC_ID_HYS_INJ_MOD

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5.14 Lambda testing for stratified mode

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_S	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda setpoint for stratified mode					
LAMB_SP_S_RAW	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Raw value lambda setpoint for stratified mode					

Input data:

LAMB_SP_S_EXT {p. 8136}	LV_S_CLC {p. 1822}	MAF_SP_S {p. 805}	MFF_CP {p. 3700}
MFF_SP_S {p. 8243}	N_32 {p. 1525}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LAMB_SP_S	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation filter constant for LAMB_SP_S filtering					
C_FAC_LAMB_AFS	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Air fuel stoichometric factor (typical value 14.71)					
C_LAMB_SP_S_INI	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Initialization value for LAMB_SP_S after reset.					
LC_LAMB_SP_S_RAW_EXT	-	0... 1H	0 ...1	1	-
Switch between Layer and internal calculatiopn of LAMB_SP_S					

FUNCTION DESCRIPTION:

General information:

The lambda LAMB_SP_S in stratified has to be limited to a minimum lambda value. If the lambda setpoint LAMB_SP_S is below the minimum threshold LAMB_MIN_S then the stratified combustion is not authorized.

Description:

Application conditions

Activation: *LV_S_CLC = 1*

Deactivation: *LV_S_CLC = 0*

Initialization:
```
at reset:
    LAMB_SP_S(n-1) = C_LAMB_SP_S_INI
    at the transition of LV_S_CLC from 0 to 1:
    LAMB_SP_S_RAW has to be calculated for the initialization.
    LAMB_SP_S(n-1) = LAMB_SP_S_RAW.
```

Update rate: 10 ms

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Formula section:

IF LC_LAMB_SP_S_RAW_EXT = 0
Then LAMB_SP_S_RAW =
MAF_SP_S /(C_FAC_LAMB_AFS * (MFF_SP_S + MFF_CP))
ELSE LAMB_SP_S_RAW = LAMB_SP_S_EXT ("from Layer")
endif
LAMB_SP_S(n) =
C_CRLC_LAMB_SP_S * (LAMB_SP_S_RAW - LAMB_SP_S(n-1)) + LAMB_SP_S(n-1)

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5.15 Combustion state manager (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_AFL_CLC	O/V		-	-	-
Logical variable for the deactivation of all AFL- mode relevant modules.					
LV_INH_AFL	O/V		-	-	-
Inhibit of AFL mode due to project specific requests.					
LV_INH_S	O/V		-	-	-
Inhibit of stratified mode due to project specific requests.					
LV_S_CLC	O/V		-	-	-
Logical variable for the deactivation of all straified mode relevant modules.					

Input data:

LV_BRAKE_REQ {p. 799}	LV_ERR_EGR {p. 801}	LV_ERR_FPS {p. 801}	LV_ERR_NOX_SENS_CAN_BOFF {p. 991}
LV_ERR_PORT [NC_PORTPWM] {p. 801}	LV_FPAPWM_DIAG_AFS_REQ {p. 803}	LV_INH_S_MAN {p. 803}	LV_MIS_STATE_A {p. 6238}
LV_MIS_STATE_B {p. 6238}	LV_SAWUP {p. 804}	LV_TEMP_BOL {p. 805}	N_32 {p. 1525}
STATE_CMB_CTL {p. 8137}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_AFL_CLC	-	0... FFH	0... 8160	32	rpm
Engine speed limit for the deactivation of the AFL mode related modules.					
C_N_AFL_CLC_HYS	-	0... FFH	0... 8160	32	rpm
Engine speed hysteresis for the deactivation of the AFL mode related modules.					
C_N_S_CLC	-	0... FFH	0... 8160	32	rpm
Engine speed limit for the deactivation of the stratified mode related modules.					
C_N_S_CLC_HYS	-	0... FFH	0... 8160	32	rpm
Engine speed hysteresis for the deactivation of the stratified mode related modules.					

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FUNCTION DESCRIPTION:

There are several project specific requests to inhibit the stratified and AFL mode. Within this function all these requests lead to the bits LV_INH_S and LV_INH_AFL to simpify the combustion manager.

To reduce the processor load all stratified mode related modules shall no longer be calculated, if LV_S_CLC = 0. All AFL-mode relevant modules including the combustion manager shall no longer be calculated, if LV_AFL_CLC = 0.

Application conditions

Initialisation:

```
at reset:    LV_INH_S = 1
         LV_INH_AFL = 1
         LV_S_CLC = 1
         LV_AFL_CLC = 1
```

Recurrence: *10 ms*

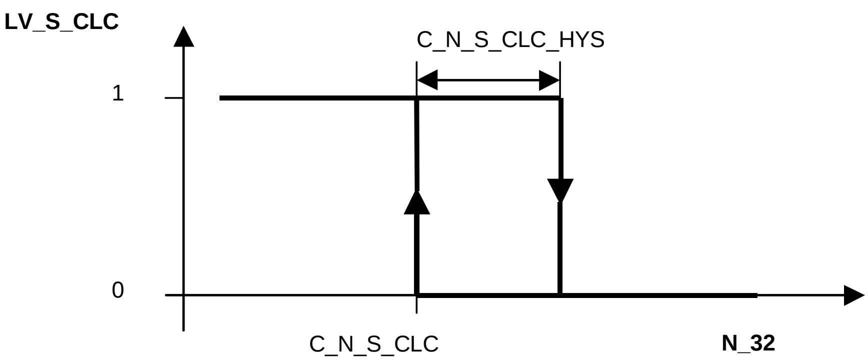
Activation: *every engine state*

Deactivation: -

Formula section:

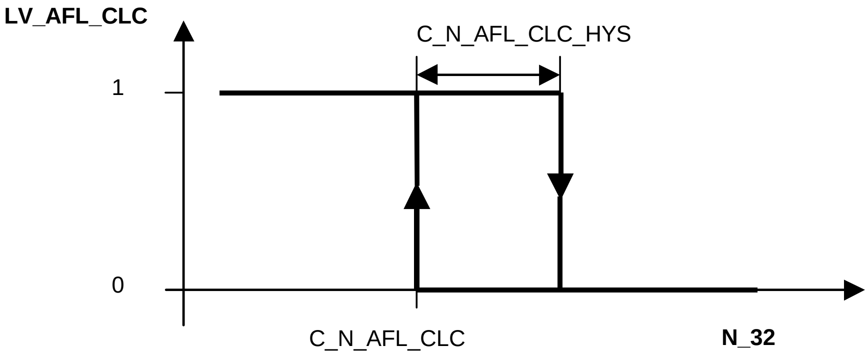
Definition of LV_S_CLC:

This calculation will only be done if the STATE_CMB_CTL = HOM_AFS.



Definition of LV_AFL_CLC:

This calculation will only be done if the STATE_CMB_CTL = HOM_AFS.



IF LV_INH_S_MAN or
LV_MIS_STATE_A or
LV_MIS_STATE_B or
LV_ERR_PORT or
LV_ERR_EGR or
LV_ERR_NOX_SENS_CAN_BOFF or
LV_ERR_FPS or
LV_ERR_NOX_SENS_CAN_MSG_LOST_i or
LV_SAWUP or
LV_FPAPWM_DIAG_AFS_REQ or
LV_BRAKE_REQ or
LV_TEMP_BOL or
Not LV_S_CLC or

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Then LV_INH_S = 1
Else LV_INH_S = 0

IF LV_MIS_STATE_A or
LV_MIS_STATE_B or
LV_ERR_PORT or
LV_ERR_EGR or
LV_ERR_NOX_SENS_CAN_BOFF or
LV_ERR_FPS or
LV_ERR_NOX_SENS_CAN_MSG_LOST_i or
LV_SAWUP or
LV_FPAPWM_DIAG_AFS_REQ or
LV_BRAKE_REQ or
LV_TEMP_BOL or
Not LV_AFL_CLC or
Then LV_INH_AFL = 1
Else LV_INH_AFL = 0

5.15.1 Variables of Non implemented Functions for combustion management

Initialisation:
NT_AGI_S_RED = 0 (if functionallity is not implemented yet)
LV_NT_STC_MAX_ACT = 0 (if functionallity is not implemented yet)
LV_PUC_INH_TEMP_CAT = 0 (if functionallity is not implemented yet)
MFF_CP = 0 mg/stk (if functionallity is not implemented yet)

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5.16 Run time optimization by recurrency switch

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CLC_2SEG	O/V	0... 1H	0 ...1	1	-
Toggle-Bit for activation/deactivation of the segment synchronously calculation					
LV_CLC_2SEG_ENA	O/V	0... 1H	0 ...1	1	-
Activation flag for correction modes for non segment synchronously calculation					

Input data:

N_32 {p. 1525}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_SEG_2_ENA	V	0... FFH	0... 8160	32	rpm
engine speed threshold for the activation of the calculation recurrence change to every second segment					

General information

At a high engine speed, run time problems may occur. Overstepping a certain engine speed threshold, the Toggle-Bit created in this module can evoke modules calculated segment synchronuously to switch to a recurrency of every second segment.

Application conditions:

Initialisation: `LV_CLC_2SEG = 0; LV_CLC_2SEG_ENA = 0`

Activation: `every other engine state`

Deactivation: `engine stopped or engine start detected: LV_ES = 1 or LV_ST = 1`

Recurrence: `every segment`

Function description:

Formula section:

Activation of Toggle-Bit:

As soon as the engine speed exceeds a threshold C_N_SEG_2_ENA, the Toggle-Bit LV_CLC_2SEG gets activated and changes its value from zero to one the next segment and back to zero again the subsequent segment.

Activation of Correction-Bit:

At the same time, the bit LV_CLC_2SEG_ENA is set to one. This bit enables calculation corrections in files that use a segment counter or have to be corrected by any other influences caused by a calculation recurrence only every second segment.

Deactivation:

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The deactivation of both bits is done as soon as the engine speed threshold is underspent again.

```
if   N_32 >   C_N_SEG_2_ENA
then      LV_CLC_2SEG_ENA     =  1
          LV_CLC_2SEG         =  0 → 1→ 0 → 1 → 0 → 1 →0 → ...(toggling)
else      LV_CLC_2SEG_ENA = 0
          LV_CLC_2SEG   = 0
endif
```

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6 - Ignition

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6.1 Ignition angle general

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA [NC_CYL_NR]	O/V	0... FFH	0... 60	0.375	°CRK
Basic ignition angle application correction and knock control included					
IGA_AV_H_RNG [NC_CYL_NR]	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Homogeneus ignition angle in wide range applied on cylinder x					
IGA_AV_H_RNG_1 [NC_CYL_NR]	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Intermediate ignition angle in wide range till gradient limitation after start is terminated					
IGA_AV_H_RNG_HOMS [NC_CYL_NR]	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Homogeneus ignition angle in wide range applied on cylinder x					
IGA_AV_H_RNG_S [NC_CYL_NR]	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
homogeneus ignition angle in high range applied on cylinder x					
IGA_AV_MV_CAN_H_RNG	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Mean value of actual ignition angle in wide range					
IGA_AV_MV_CBK_H_RNG [NC_CBK_EX_NR]	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Mean value of actual ignition angle bank selective in wide range					
IGA_AV_MV_H_RNG	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Mean value of actual ignition angle in wide range					
IGA_MIN_CBK_H_RNG [NC_CBK_EX_NR]	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Minimum ignition angle in wide range bank selective					
IGA_MIN_H_RNG	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Minimum ignition angle in wide range					
IGA_SP_MAX_1_CAN_H_RNG	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Maximum ignition angle depending on torque intervention in wide range					
IGA_SP_MAX_1_CBK_H_RNG [NC_CBK_EX_NR]	O/V	FA60... 5A0H	0... 90	0.0625	°CRK
Maximum ignition angle depending on torque intervention in wide range bank selective					
IGA_WOUT_KNK [NC_CYL_NR]	O/V	0... FFH	0... 60	0.375	°CRK
Actual ignition angle (incl. application corrections without knock interception)					
LV_IGA_GRD_ACT	O/V	0... 1H	0 ...1	1	-
Flag for ignition angle gradient limitation out of start active					

Input data:

IGA_ADD_CMB_CTL [NC_CYL_NR] {p. 8266}	IGA_ADJ_KNK [NC_CYL_NR] {p. 1960}	IGA_AV_H_RNG_HOMS_1 [NC_CYL_NR] {p. 8266}	IGA_AV_H_RNG_S_1 [NC_CYL_NR] {p. 8266}
IGA_BAS_COR_CBK [NC_CBK_EX_NR] {p. 8266}	IGA_DIF_MIN_H_RNG {p. 1925}	IGA_IS_TQ_KNK {p. 8304}	IGA_REF_COR_CBK [NC_CBK_EX_NR] {p. 8266}
IGA_SP_CBK_CAN_H_RNG [NC_CBK_EX_NR] {p. 1948}	IGA_SP_CBK_H_RNG [NC_CBK_EX_NR] {p. 1948}	IGA_ST {p. 1912}	IGA_TRA_KNK {p. 798}
LV_ES {p. 1720}	LV_N_MAX_ETC_LIH {p. 1148}	LV_ST {p. 1720}	N {p. 1525}
TCO {p. 1100}			

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_IGA_AS	-	80... 7FH	0... 47.625	0.375	°CRK
Spark retard by application system global					
C_IGA_AS_CYL [NC_CYL_NR]	-	80... 7FH	0... 47.625	0.375	°CRK
Spark retard by application system cylinderindividual					
C_IGA_INI_H_RNG	-	FA60... 5A0H	0... 90	0.0625	°CRK
Init value for ignition angle in wide range					
C_IGA_MAN_H_RNG	-	FA60... 5A0H	0... 90	0.0625	°CRK
Absolute spark retard input by application system in wide range					
C_IGA_MIN_ETC_LIH	-	0... FFH	0... 60	0.375	°CRK
Absolute possible spark retard at ETC LIH					
C_N_MAX_IGA_10MS_CLC	-	0... 1FE0H	0... 8160	1	rpm
Max. engine speed threshold above which the 10ms tasks are deactivated					
IP_IGA_LGRD_AST	-	0... FFH	0... 95.625	0.375	°CRK
LDPM_TCO_1_IGSP	8	0... FEH	0... 142.5	0.75	°C
Gradient limitation IGA after start phase					
LC_IGA_MAN	-	0... 1H	0 ...1	1	-
Switch for absolute spark retard input by application system					
LC_IGA_ST_ENA	-	0... 1H	0 ...1	1	-
Logical constant for separated start ignition angle					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CBK_EX_NR	-	1... 4H	1 ...4	1	-
Number of exhaust cylinder banks					
NC_CYL_NR	-	1... 8H	1 ...8	1	-
count of cylinder					

6.1.1 IGSP_M6001

General information:

This module coordinates different ignition angle requests and calculates the ignition angles IGA_AV_H_RNG[x] and IGA_AV_H_RNG_S[x].

IGA_SP is the output from the torque management functions to realize the torque setpoint. IGA_SP is limited to IGA_MIN the minimum ignition angle which can be applied to the engine.

IGA_BAS_COR is the corrected basic igniton angle which is realized normally if no other requests like knock control or torque requests (via IGA_SP) requires a retarded ignition angle.

The reference ignition angle IGA_REF_COR is a theoretical ignition angle at maximum engine torque. It is the reference value to all ignition angles to calculate the ignition angle differences (IGA_DIF_xxx) for the calculation of EFF_IGA_xxx values.

According to application choice (through logical application incidence flag LC_IGA_ST_ENA) the ignition angle during start phase is not managed through the torque but by the specific value IGA_ST. In this case, the corresponding ignition efficiencies are set to 1. At the end of start phase the transition from IGA_ST to the set point ignition delivered by torque calculation IGA_AV_1[x] is approached through a gradient limitation (the ignition gradient step is calibrateable).

This module delivers the homogeneus ignition angle IGA_AV_H_RNG[x] and the stratified ignition angle IGA_AV_H_RNG_S[x] for the MSD70 project in IGRE. For the MSV70, the stratified ignition angle is a copy of the homogeneus one. Therefore, this HOM /S switch is also visible in MSV70, but effectiv.

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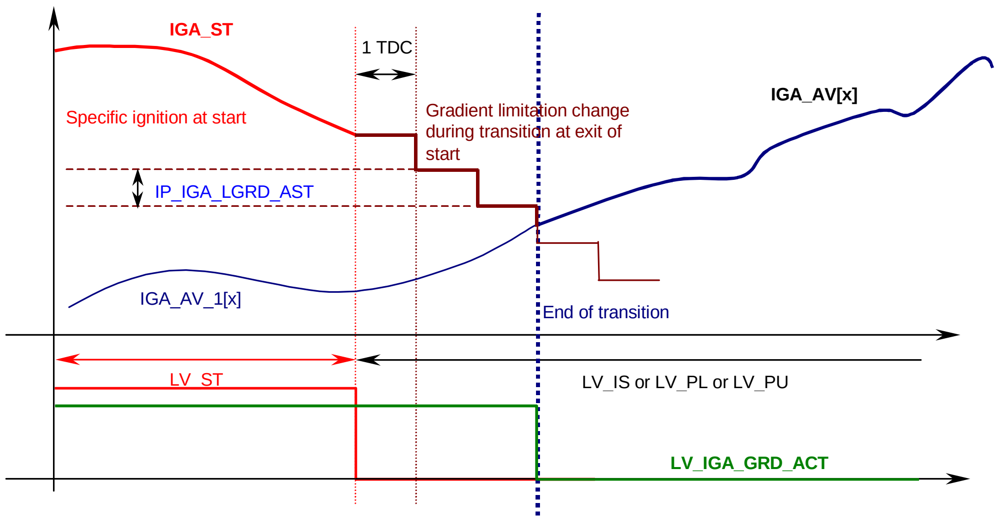

Picture: example for transition after start with IGA gradient limitation

Application conditions:

Initialisation:	IGA_AV_H_RNG[x] = C_IGA_INI_H_RNG	at reset
	IGA_MIN = 90 °crk	at reset
	LV_IGA_GRD_ACT = 0	*at engine stalling*
Recurrence:	every 10 ms and every TDC	
Activation:	at every engine operating state	
Deactivation:		

Application Condition

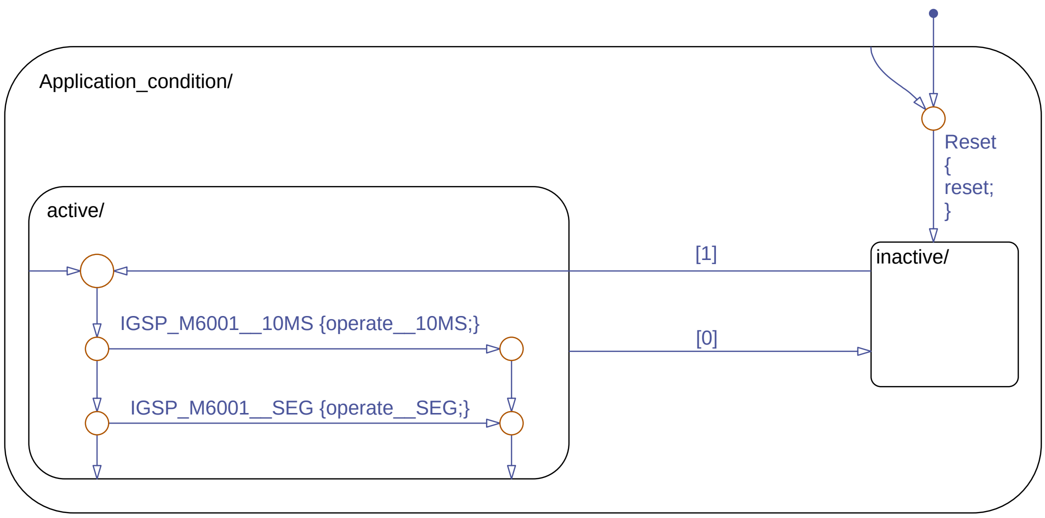

Figure 6.1.1: IGSP_M6001/APP_CDN/APPCND

Function Description

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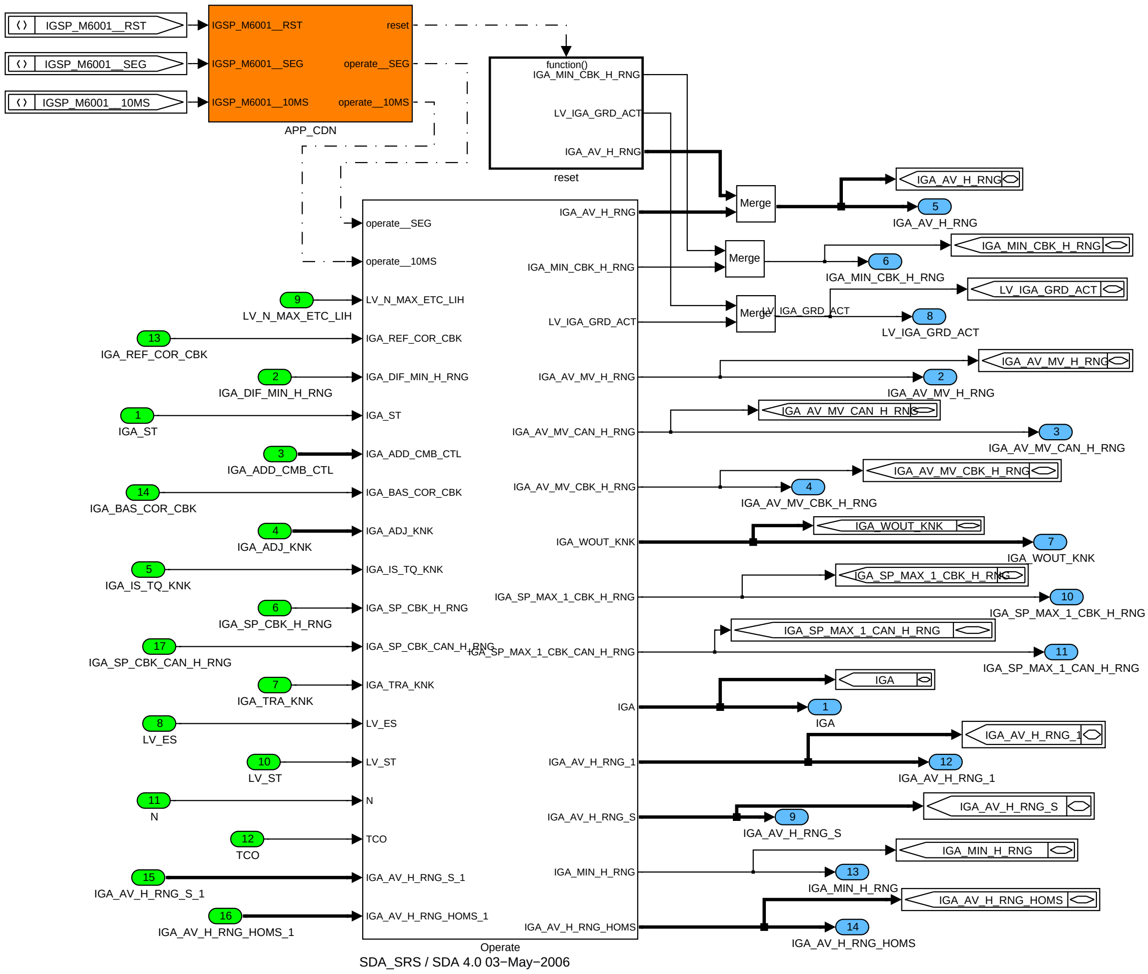

Figure 6.1.2: IGSP_M6001

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6.1.1.1 SUBFUNCTION: Operate

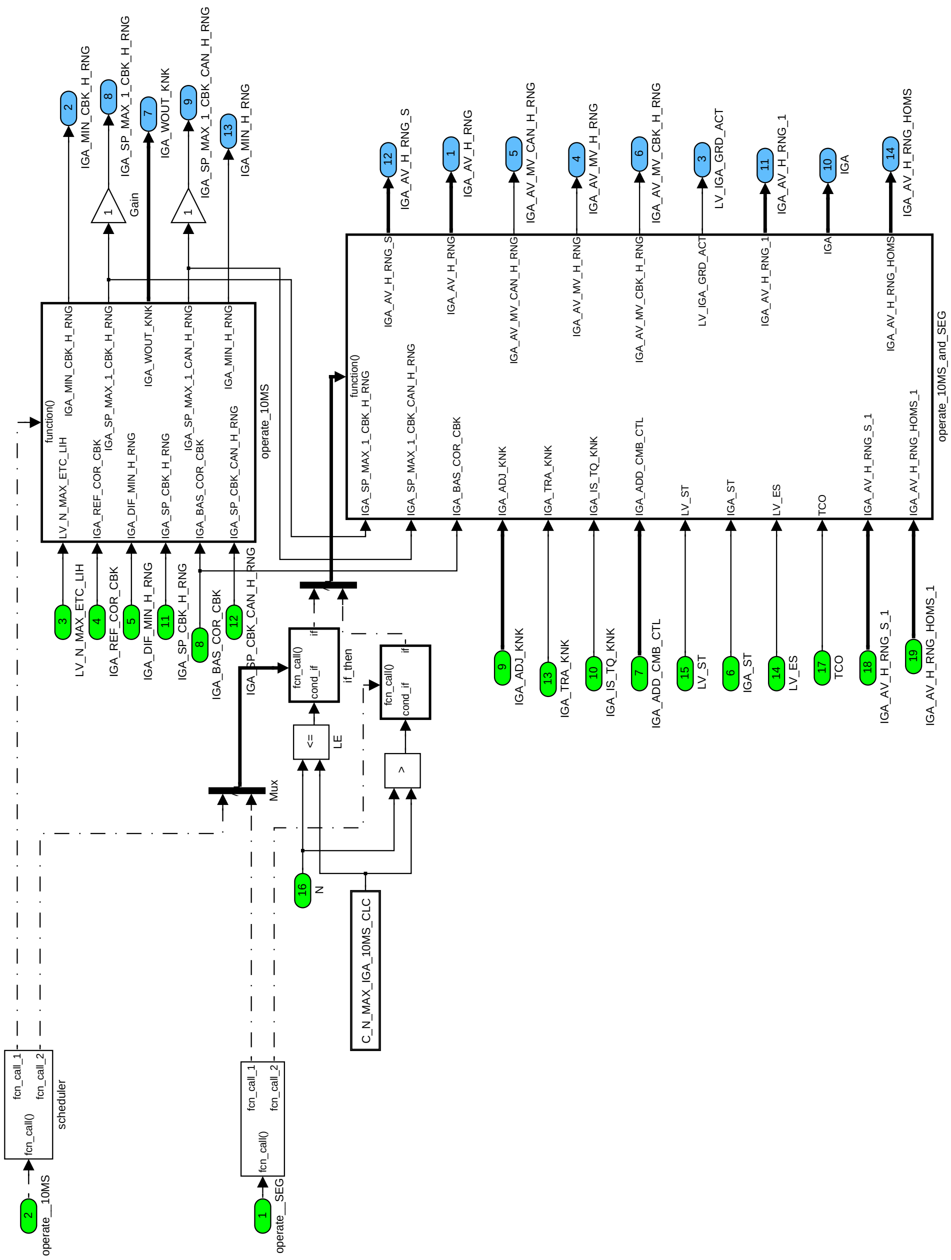

Figure 6.1.3: IGSP_M6001/Operate

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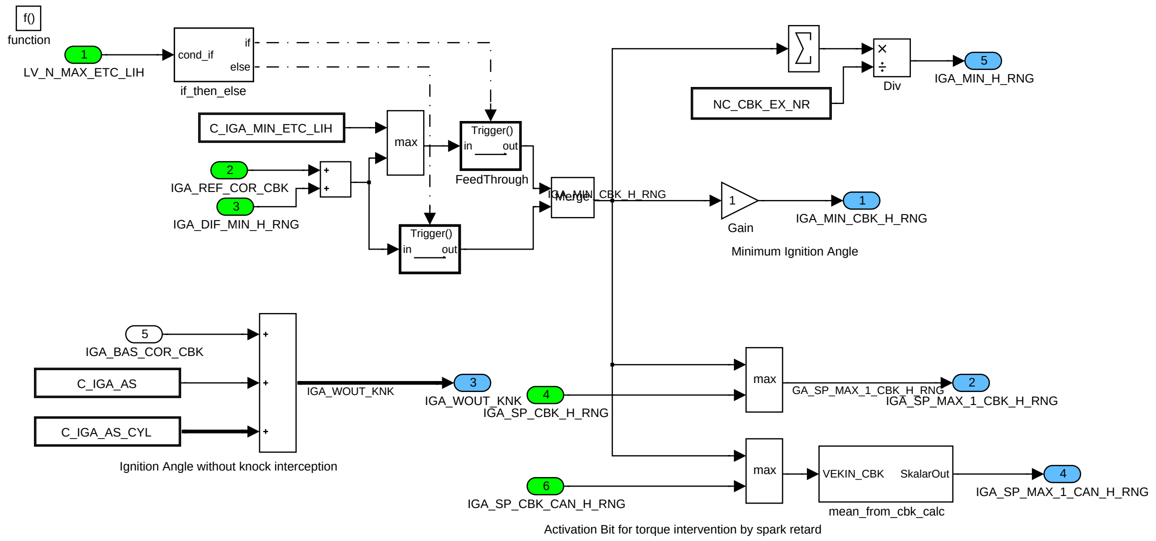

Figure 6.1.4: IGSP_M6001/Operate/operate_10MS

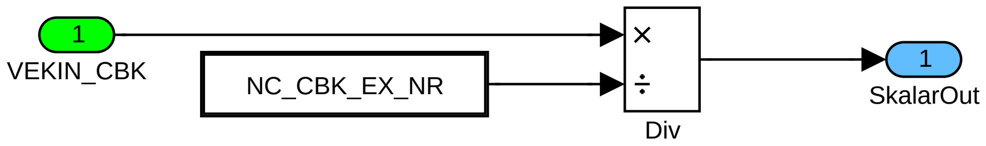

Figure 6.1.5: IGSP_M6001/Operate/operate_10MS/mean_from_cbk_calc

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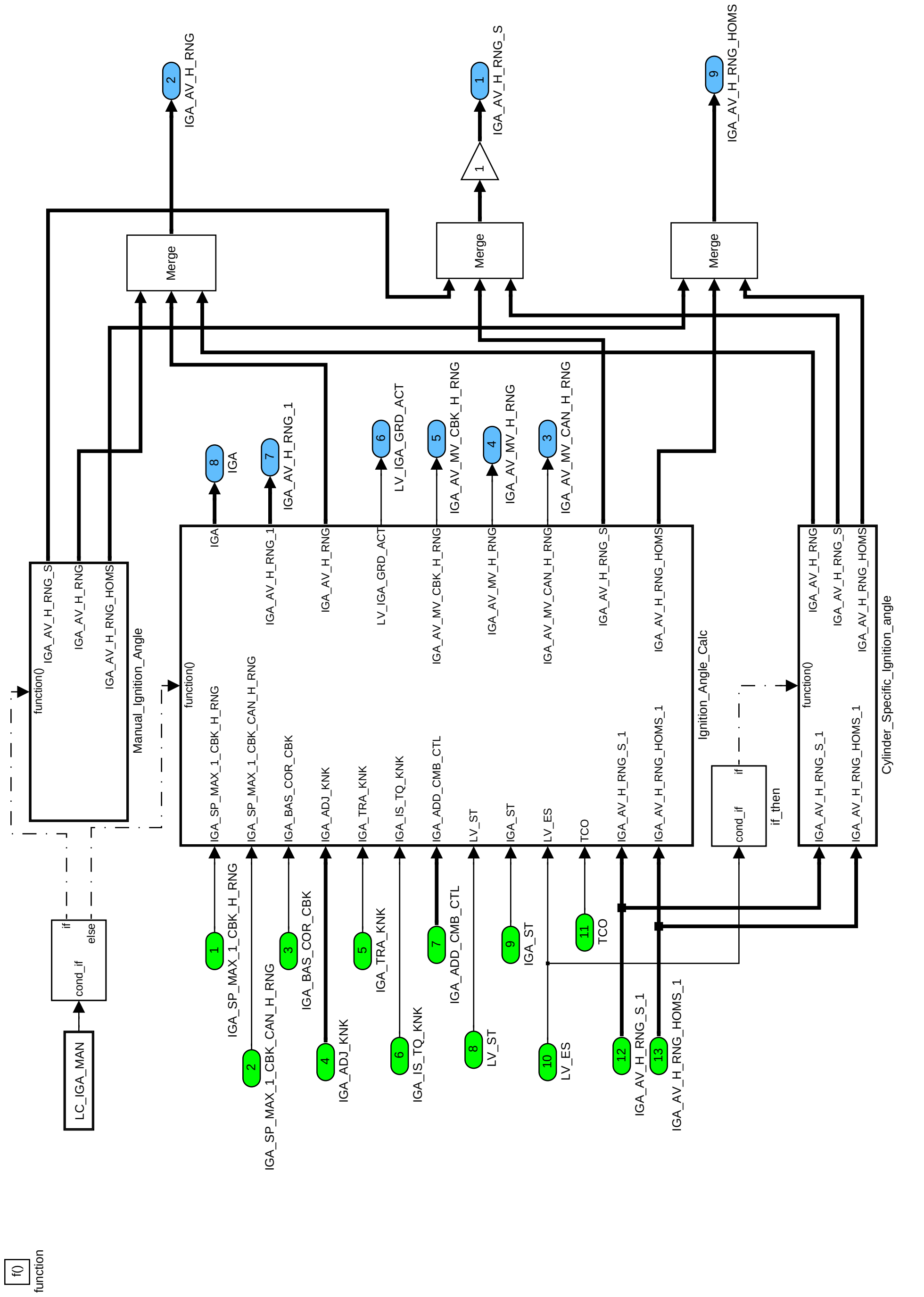

Figure 6.1.6: IGSP_M6001/Operate/operate_10MS_and_SEG

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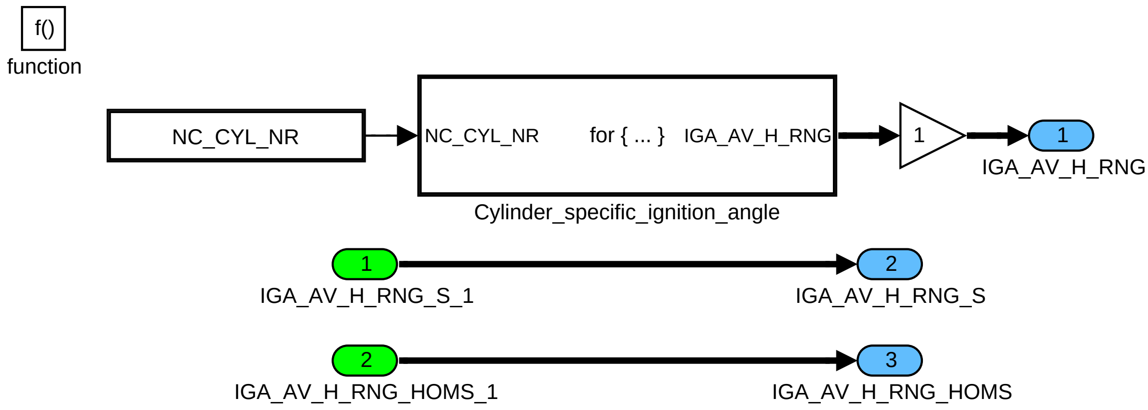

Figure 6.1.7: IGSP_M6001/Operate/operate_10MS_and_SEG/Cylinder_Specific_Ignition_angle

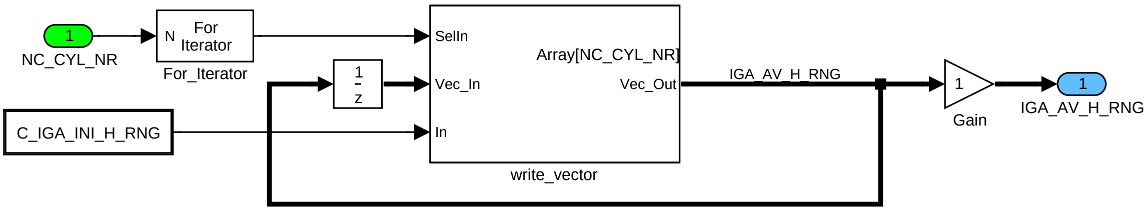

Figure 6.1.8: IGSP_M6001/Operate/operate_10MS_and_SEG/Cylinder_Specific_Ignition_angle/
Cylinder_specific_ignition_angle

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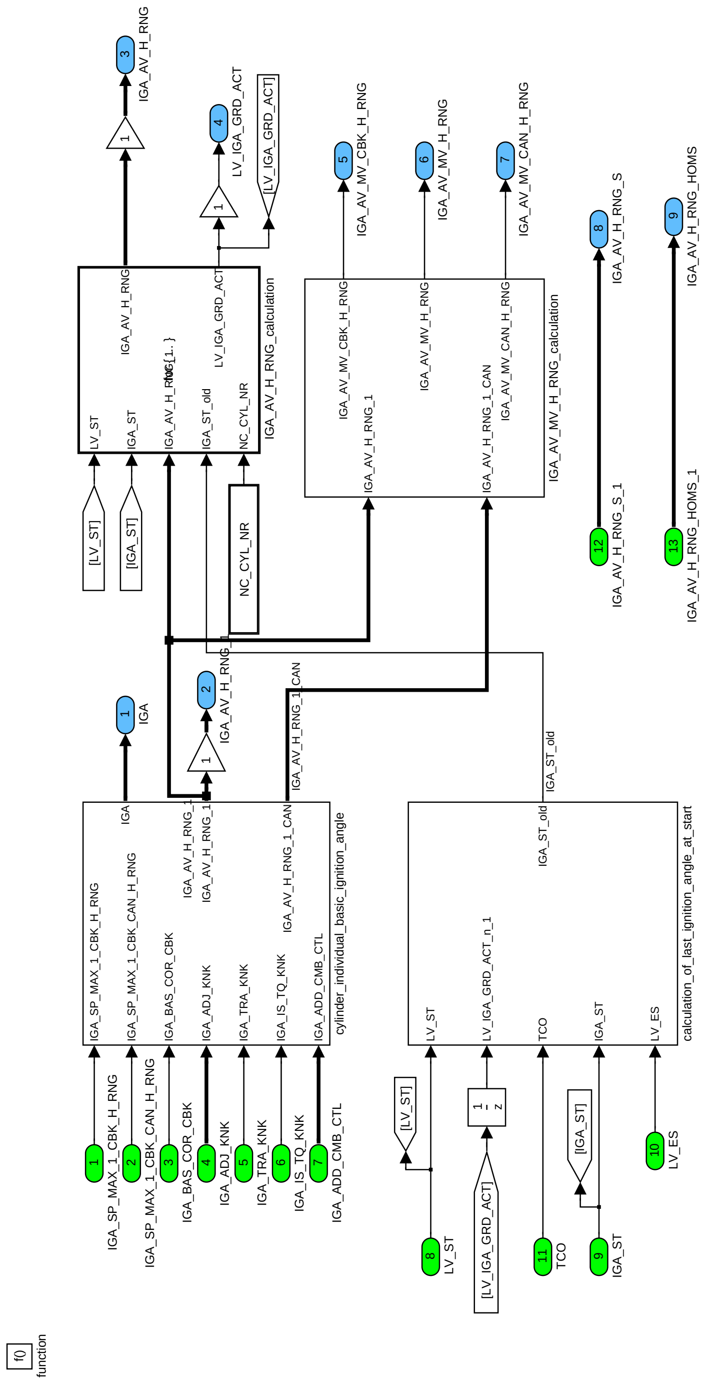

Figure 6.1.9: IGSP_M6001/Operate/operate_10MS_and_SEG/Ignition_Angle_Calc

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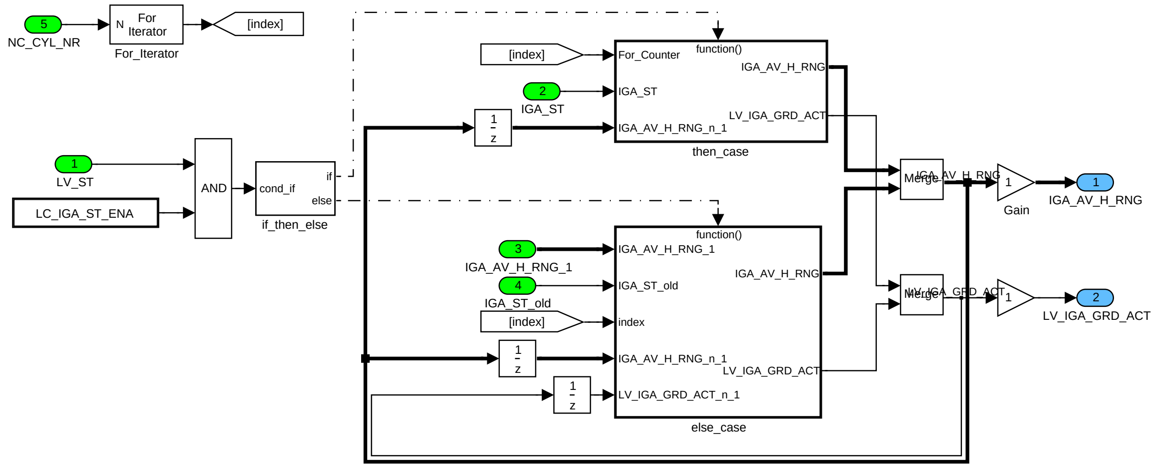

Figure 6.1.10:
IGSP_M6001/Operate/operate_10MS_and_SEG/Ignition_Angle_Calc/IGA_AV_H_RNG_calculation

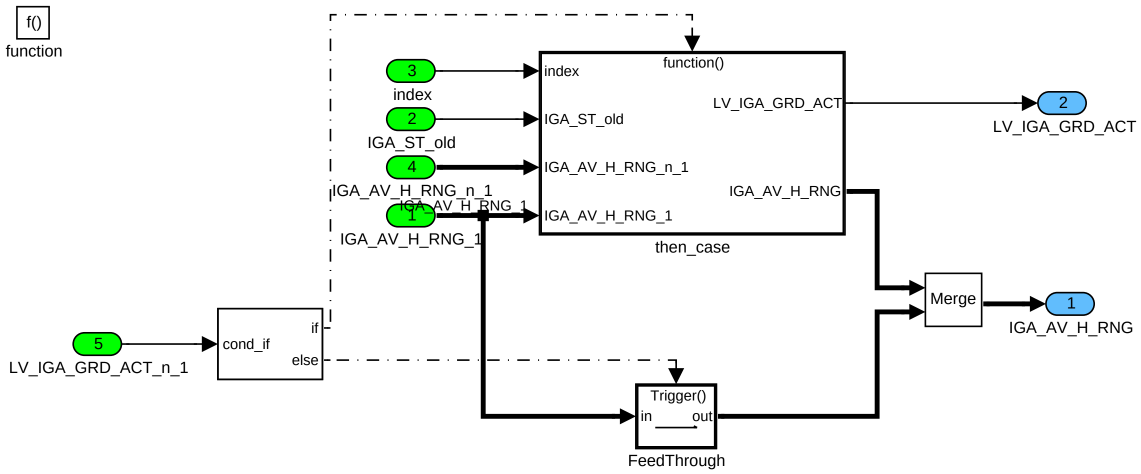

Figure 6.1.11: IGSP_M6001/Operate/operate_10MS_and_SEG/Ignition_Angle_Calc/
IGA_AV_H_RNG_calculation/else_case

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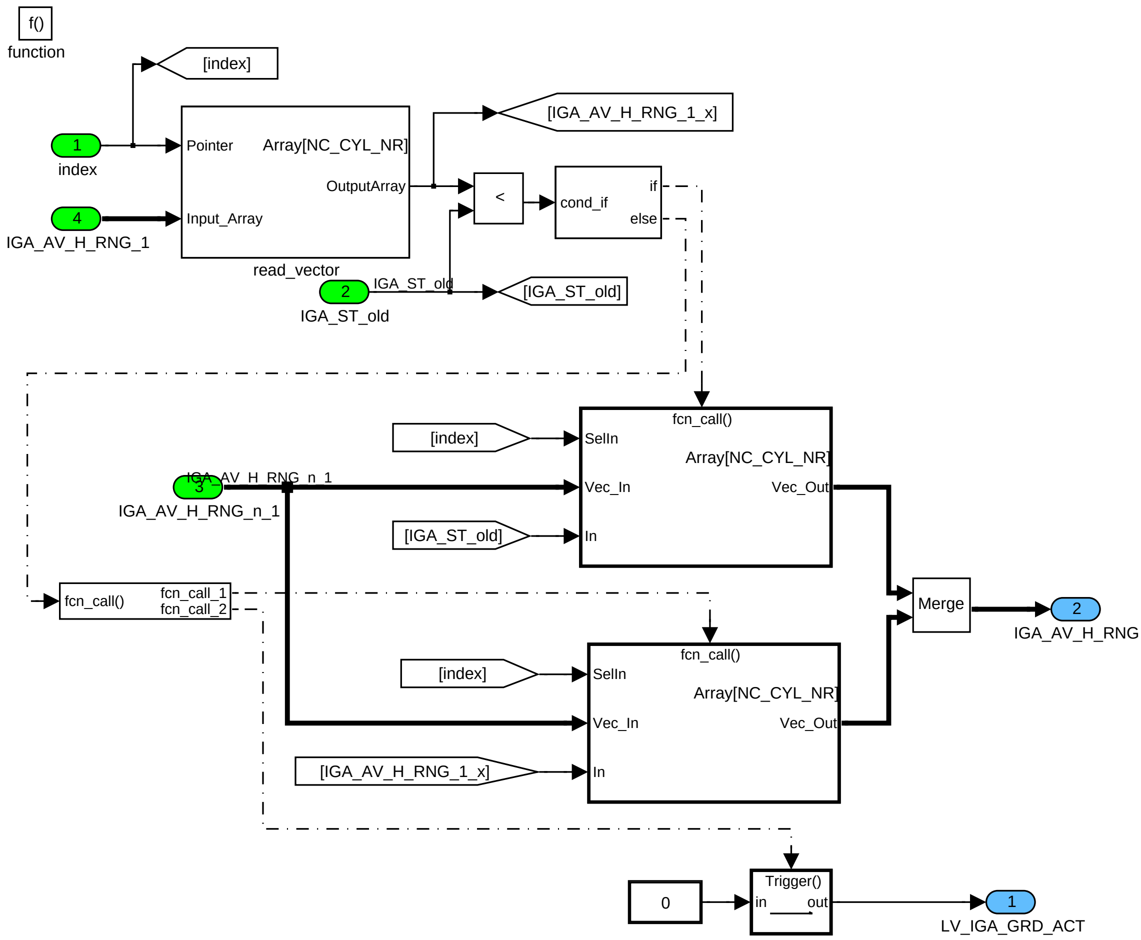

Figure 6.1.12: IGSP_M6001/Operate/operate_10MS_and_SEG/Ignition_Angle_Calc/
IGA_AV_H_RNG_calculation/else_case/then_case

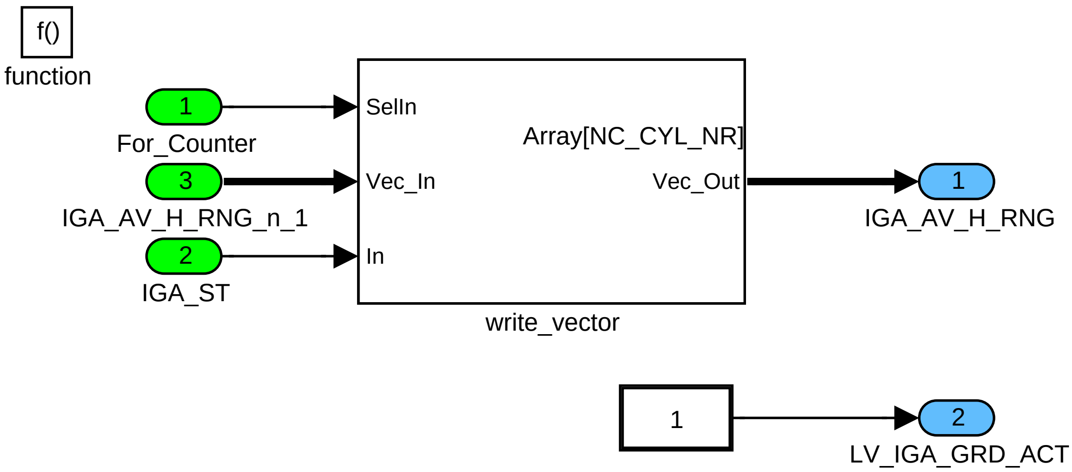

Figure 6.1.13: IGSP_M6001/Operate/operate_10MS_and_SEG/Ignition_Angle_Calc/
IGA_AV_H_RNG_calculation/then_case

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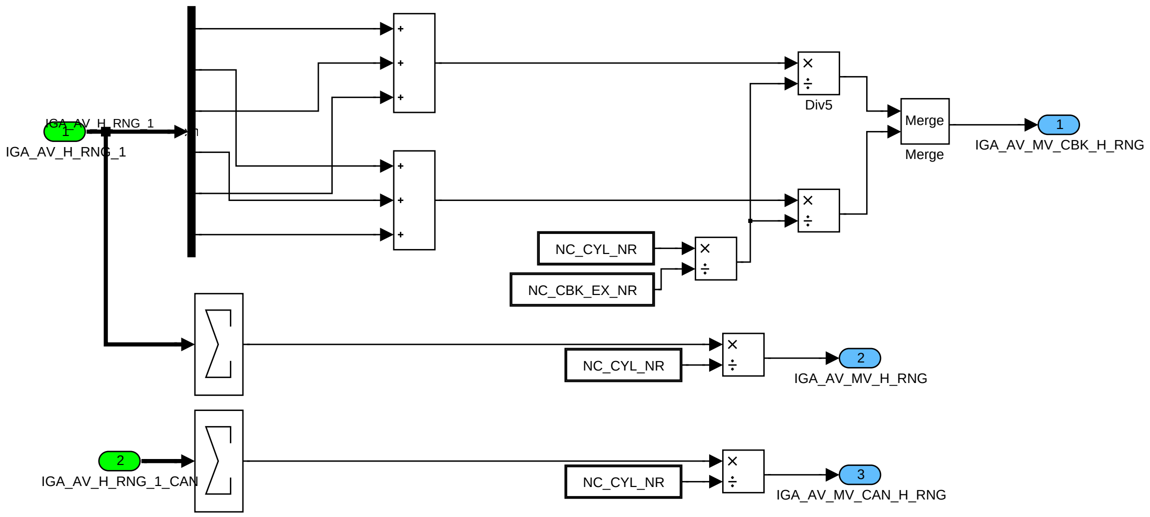

Figure 6.1.14: IGSP_M6001/Operate/operate_10MS_and_SEG/Ignition_Angle_Calc/IGA_AV_MV_H_RNG_calculation

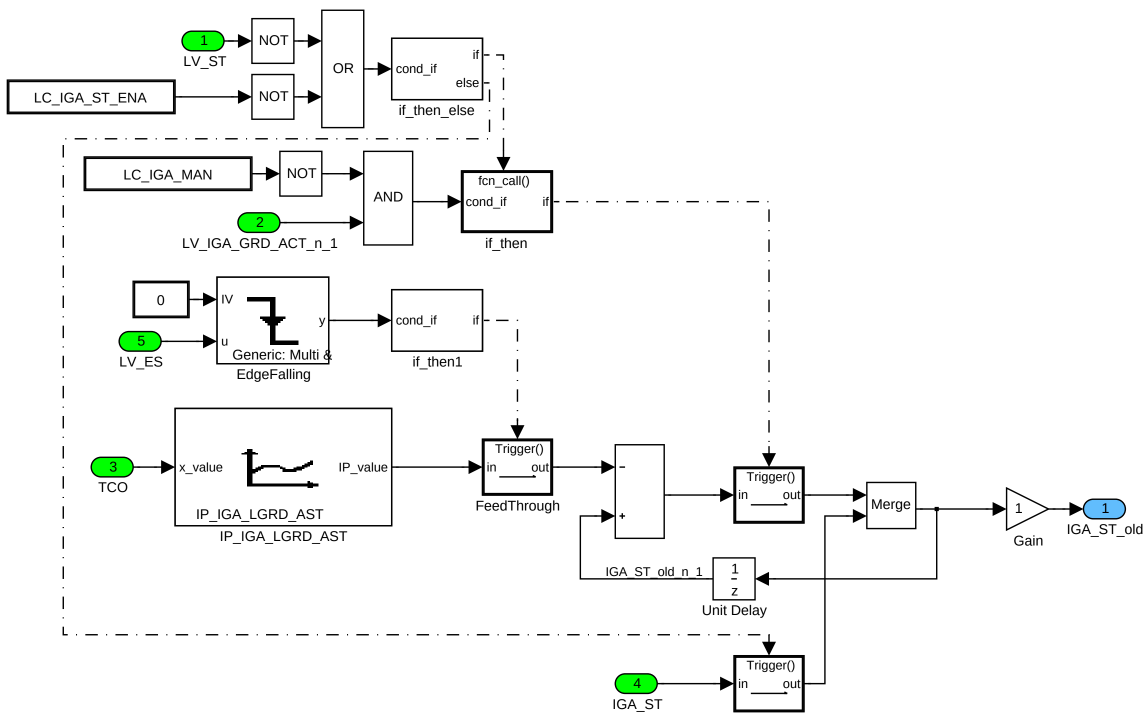

Figure 6.1.15: IGSP_M6001/Operate/operate_10MS_and_SEG/Ignition_Angle_Calc/calculation_of_last_ignition_angle_at_start

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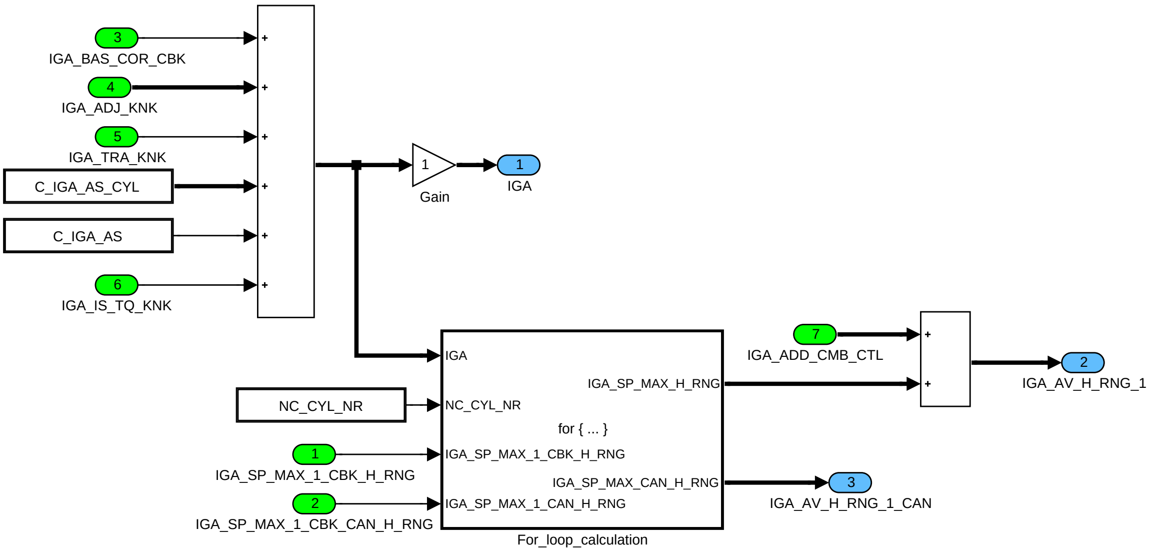

Figure 6.1.16: IGSP_M6001/Operate/operate_10MS_and_SEG/Ignition_Angle_Calc/
cylinder_individual_basic_ignition_angle

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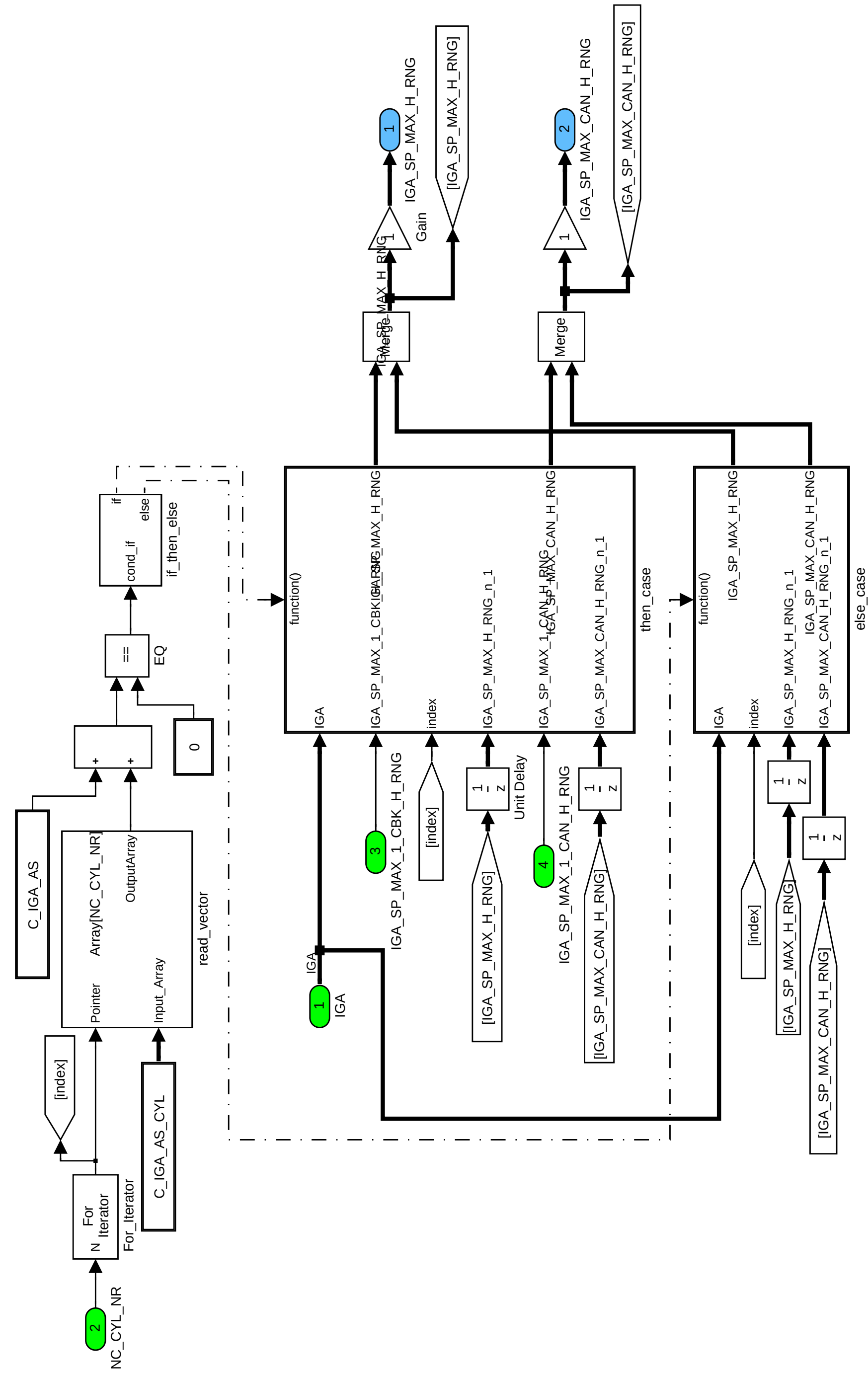

Figure 6.1.17: IGSP_M6001/Operate/operate_10MS_and_SEG/Ignition_Angle_Calc/
cylinder_individual_basic_ignition_angle/For_loop_calculation

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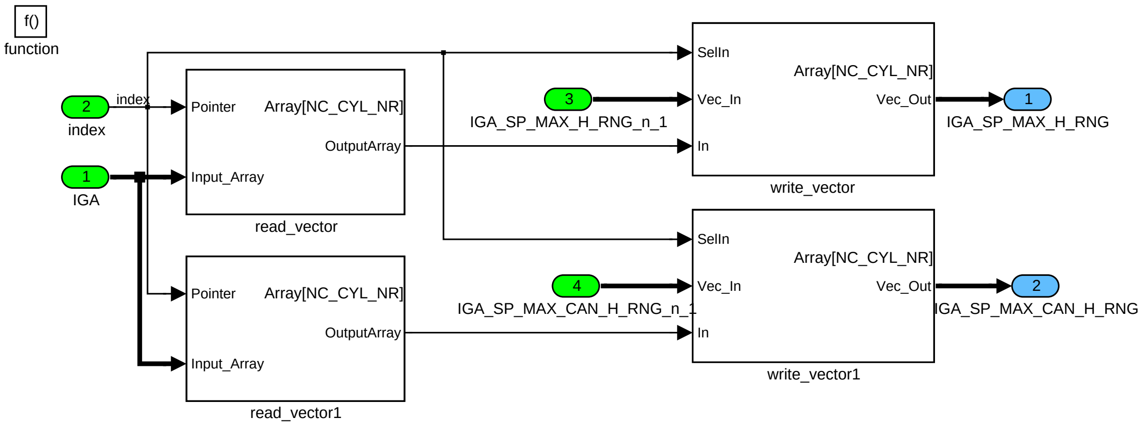

Figure 6.1.18: IGSP_M6001/Operate/operate_10MS_and_SEG/Ignition_Angle_Calc/
cylinder_individual_basic_ignition_angle/For_loop_calculation/else_case

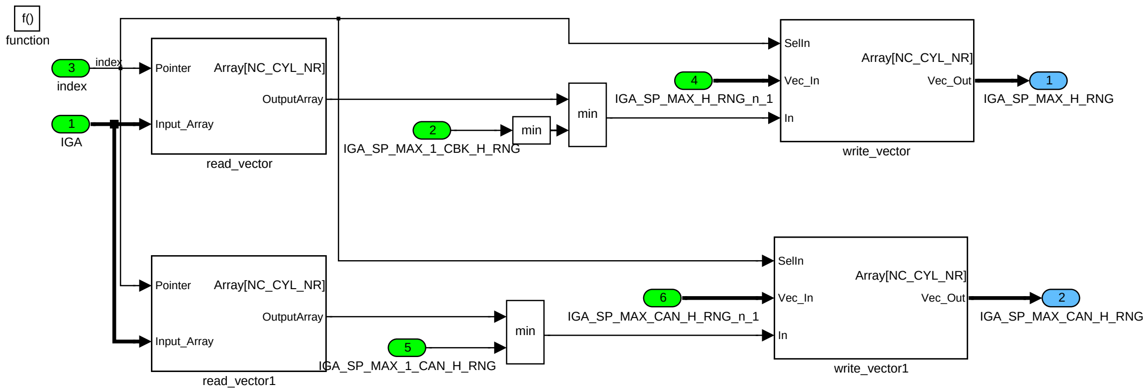

Figure 6.1.19: IGSP_M6001/Operate/operate_10MS_and_SEG/Ignition_Angle_Calc/
cylinder_individual_basic_ignition_angle/For_loop_calculation/then_case

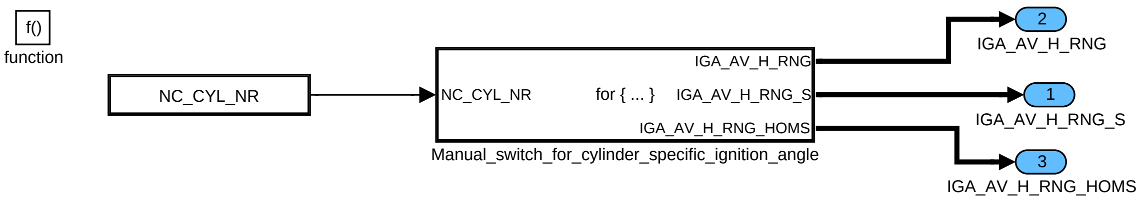

Figure 6.1.20: IGSP_M6001/Operate/operate_10MS_and_SEG/Manual_Ignition_Angle

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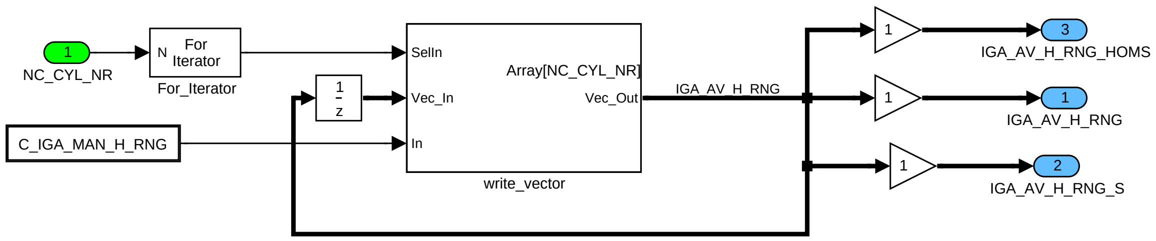

Figure 6.1.21: IGSP_M6001/Operate/operate_10MS_and_SEG/Manual_Ignition_Angle/
Manual_switch_for_cylinder_specific_ignition_angle

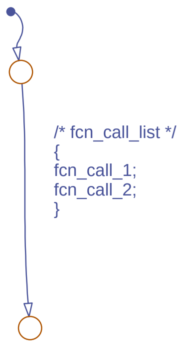

Figure 6.1.22: IGSP_M6001/Operate/scheduler2/module_scheduler

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6.1.1.2 SUBFUNCTION: reset

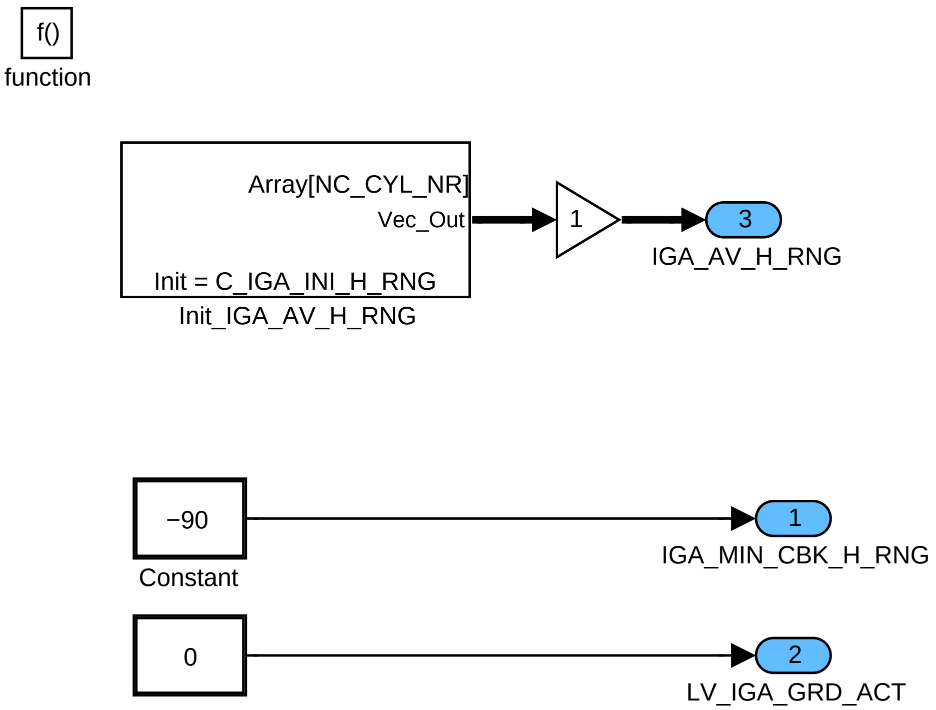

Figure 6.1.23: IGSP_M6001/reset

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6.2 Ignition angle efficiency

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_IGA_AV	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Ignition efficiency actual ignition angle bank selective					
EFF_IGA_AV_CAN	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Ignition efficiency actual ignition angle for CAN					
EFF_IGA_AV_CBK [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Ignition efficiency actual ignition angle bank selective					
EFF_IGA_BAS_COR	O/V	0... FFFFH	0... 1.999969	305.176e3	-
Ignition efficiency basic ignition angle					
EFF_IGA_BAS_COR_CBK [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Ignition efficiency basic ignition angle (Bank selective)					
EFF_IGA_BAS_COR_KNK_FIL	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Ignition efficiency referenced to IGA_BAS_COR_KNK_FIL					
EFF_IGA_MIN	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Ignition efficiency minimum ignition angle					
EFF_IGA_MIN_TEG	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
possible ignition efficiency minimum according to the exhaust gas temperature					
EFF_IGA_SEG_AV	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Ignition efficiency actual ignition angle segment synchronous					
FAC_EFF_IGA	O/V	0... FFH	0... 11.22	0.044	-
Factor for basic ignition efficiency correction depening on engine operation mode					
FAC_EFF_IGA_CH_COR	O/V	0... FFH	0... 11.22	0.044	-
Factor for basic ignition efficiency correction depening on engine operation mode					
IGA_BAS_COR_KNK_ADD	V	0... FFH	0... 60	0.375	°CRK
Basic corrected ignition angle knock mean value IGA_MV_ADJ_KNK included					
IGA_BAS_COR_KNK_FIL_CBK [NC_CBK_EX_NR]	V	0... FFH	0... 60	0.375	°CRK
Corrected basic ignition angle with mean knock correction bank selective					
IGA_DIF_AV_CAN_H_RNG	V	0... B40H	0 ...0	0.0625	°CRK
Difference of actual ignition angle to reference ignition angle for CAN					
IGA_DIF_AV_CBK_H_RNG [NC_CBK_EX_NR]	V	0... B40H	0 ...0	0.0625	°CRK
Difference of actual ignition angle to reference ignition angle bank selective					
IGA_DIF_AV_H_RNG	V	0... B40H	0 ...0	0.0625	°CRK
Difference of actual ignition angle to reference ignition angle					
IGA_DIF_BAS_CBK [NC_CBK_EX_NR]	V	0... FFH	0 ...0	0.375	°CRK
Difference of basic ignition angle to reference ignition angle bank selective					
IGA_DIF_BAS_KNK_FIL	O/V	0... FFH	0 ...0	0.375	°CRK
Difference of IGA_BAS_COR_KNK_FIL to reference ignition angle					
IGA_DIF_SEG_AV_H_RNG	V	0... B40H	0 ...0	0.0625	°CRK
Difference of actual ignition angle to reference ignition angle segment synchronous					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_MV_KNK_FIL	V	80... 7FH	0... 47.625	0.375	°CRK
Filtered mean knock correction					

Input data:

FAC_CAM_CH {p. 8379}	FAC_EFF_IGA_CH {p. 8379}	FAC_EFF_IGA_SCAV {p. 8379}	FAC_EFF_IGA_SECU {p. 8379}
FAC_IGA_OPM_SEL {p. 8266}	FAC_MAF_REL {p. 8277}	IGA_AV_MV_CAN_H_RNG {p. 1828}	IGA_AV_MV_CBK_H_RNG [NC_CBK_EX_NR] {p. 1828}
IGA_AV_MV_H_RNG {p. 1828}	IGA_BAS_COR_CBK [NC_CBK_EX_NR] {p. 8266}	IGA_DIF_MIN_H_RNG {p. 1925}	IGA_DIF_MIN_TEG_H_ RNG {p. 1939}
IGA_MV_CBK_ADJ_KNK [NC_CBK_EX_NR] {p. 1960}	IGA_REF_COR_CBK [NC_CBK_EX_NR] {p. 8266}	LC_IGA_ST_ENA {p. 1829}	LV_IS {p. 1720}
LV_ST {p. 1720}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_IGA_KNK	-	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant knock correction filter					
IP_EFF_IGA	-	0... 4E20H	0... 100	0.005	%
LDP_IGA_DIF_IP_EFF_IGA	16	0... B40H	0 ...0	0.0625	°CRK
Basic Ignition Angle Efficiency					
IP_FAC_EFF_IGA_CH_COLD_IS_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_8_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_5_TQDR	10	0... BB8H	0... 300	0.1	%
Factor for catalyst heating cold engine during IS in normal mode					
IP_FAC_EFF_IGA_CH_COLD_IS_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_9_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_6_TQDR	10	0... BB8H	0... 300	0.1	%
Factor for catalyst heating cold engine during IS in throttled mode					
IP_FAC_EFF_IGA_CH_COLD_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_13_TQDR	12	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_1_TQDR	10	0... BB8H	0... 300	0.1	%
Factor for catalyst heating cold engine in normal mode					
IP_FAC_EFF_IGA_CH_COLD_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_16_TQDR	12	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_2_TQDR	10	0... BB8H	0... 300	0.1	%
Factor for catalyst heating cold engine in throttled mode					
IP_FAC_EFF_IGA_CH_IS_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_8_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_5_TQDR	10	0... BB8H	0... 300	0.1	%
Factor for catalyst heating warm engine during IS in normal mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_EFF_IGA_CH_IS_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_9_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_6_TQDR	10	0... BB8H	0... 300	0.1	%
Factor for catalyst heating warm engine during IS in throttled mode					
IP_FAC_EFF_IGA_CH_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_2_TQDR	12	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_1_TQDR	10	0... BB8H	0... 300	0.1	%
Factor for catalyst heating warm engine in normal mode					
IP_FAC_EFF_IGA_CH_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_11_TQDR	12	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_2_TQDR	10	0... BB8H	0... 300	0.1	%
Factor for catalyst heating warm engine in throttled mode					
IP_FAC_EFF_IGA_COLD_IS_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_21_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_11_TQDR	10	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency depending on cold engine, IS, and engine operation mode 1					
IP_FAC_EFF_IGA_COLD_IS_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_22_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_12_TQDR	8	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency depending on cold engine, IS, and engine operation mode 2					
IP_FAC_EFF_IGA_COLD_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_19_TQDR	12	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_9_TQDR	10	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency depending on cold engine and engine operation mode 1					
IP_FAC_EFF_IGA_COLD_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_20_TQDR	12	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_10_TQDR	10	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency depending on cold engine and engine operation mode 2					
IP_FAC_EFF_IGA_COLD_SCAV_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_23_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_13_TQDR	8	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency for cold engine regarding scavenging operation (OPM 1)					
IP_FAC_EFF_IGA_COLD_SCAV_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_24_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_14_TQDR	8	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency for cold engine regarding scavenging operation (OPM 2)					
IP_FAC_EFF_IGA_IS_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_17_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_7_TQDR	10	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency depending on engine in IS mode operation mode 1					
IP_FAC_EFF_IGA_IS_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_18_TQDR	8	0... FFH	0... 8160	32	rpm

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_FAC_MAF_REL_8_TQDR	10	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency depending on engine in IS mode operation mode 2					
IP_FAC_EFF_IGA_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_10_TQDR	20	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_3_TQDR	16	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency depending on engine operation mode 1					
IP_FAC_EFF_IGA_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_12_TQDR	20	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_4_TQDR	16	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency depending on engine operation mode 2					
IP_FAC_EFF_IGA_SCAV_OPM_1	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_23_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_13_TQDR	8	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency regarding scavenging operation (OPM 1)					
IP_FAC_EFF_IGA_SCAV_OPM_2	-	0... FFH	0... 11.22	0.044	-
LDPM_N_32_24_TQDR	8	0... FFH	0... 8160	32	rpm
LDPM_FAC_MAF_REL_14_TQDR	8	0... BB8H	0... 300	0.1	%
Factor to correct the basic ignition efficiency regarding scavenging operation (OPM 2)					

6.2.1 Ignition angle efficiency

The ignition efficiency values EFF_IGA_AV (actual efficiency), EFF_IGA_BAS_COR (basic efficiency), EFF_IGA_BAS_COR_KNK_FIL (efficiency with mean knock correction) and EFF_IGA_MIN (minimum efficiency due to IGA_MIN) provide the link from an ignition angle to a torque efficiency. They are used in different torque modules to calculate the actual indicated engine torque, basic indicated engine torque values or the minimum indicated engine torque.
The efficiency calculation follows always the same strategy:
calculation of all specific delta ignition angle IGA_DIF...
calculation of efficiencies using engine mode depending function "EFF_IGA(IGA_DIF...)".

Application Condition

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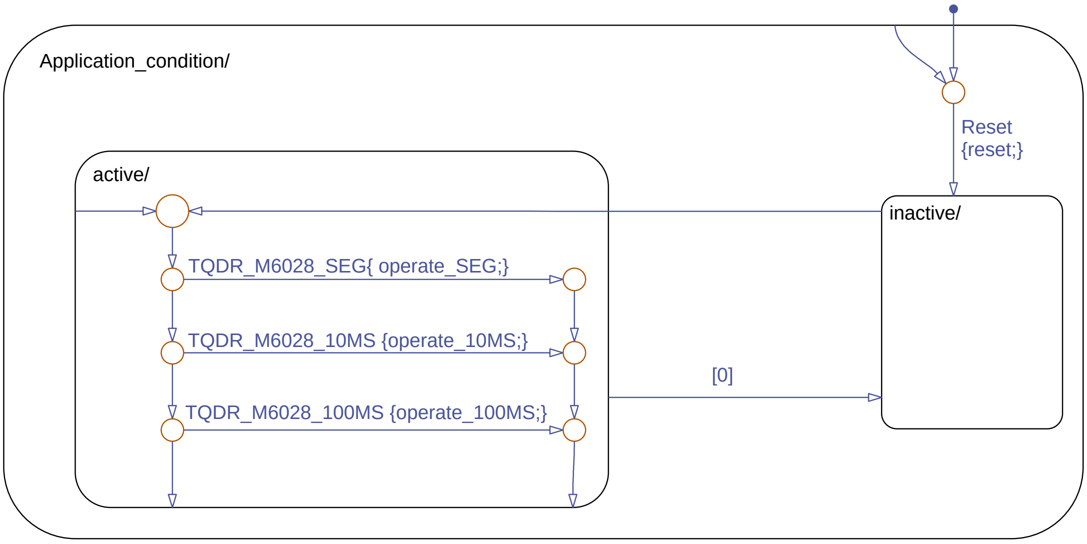

Figure 6.2.1: TQDR_M6028/APP_CDN/APPCND

Function Description

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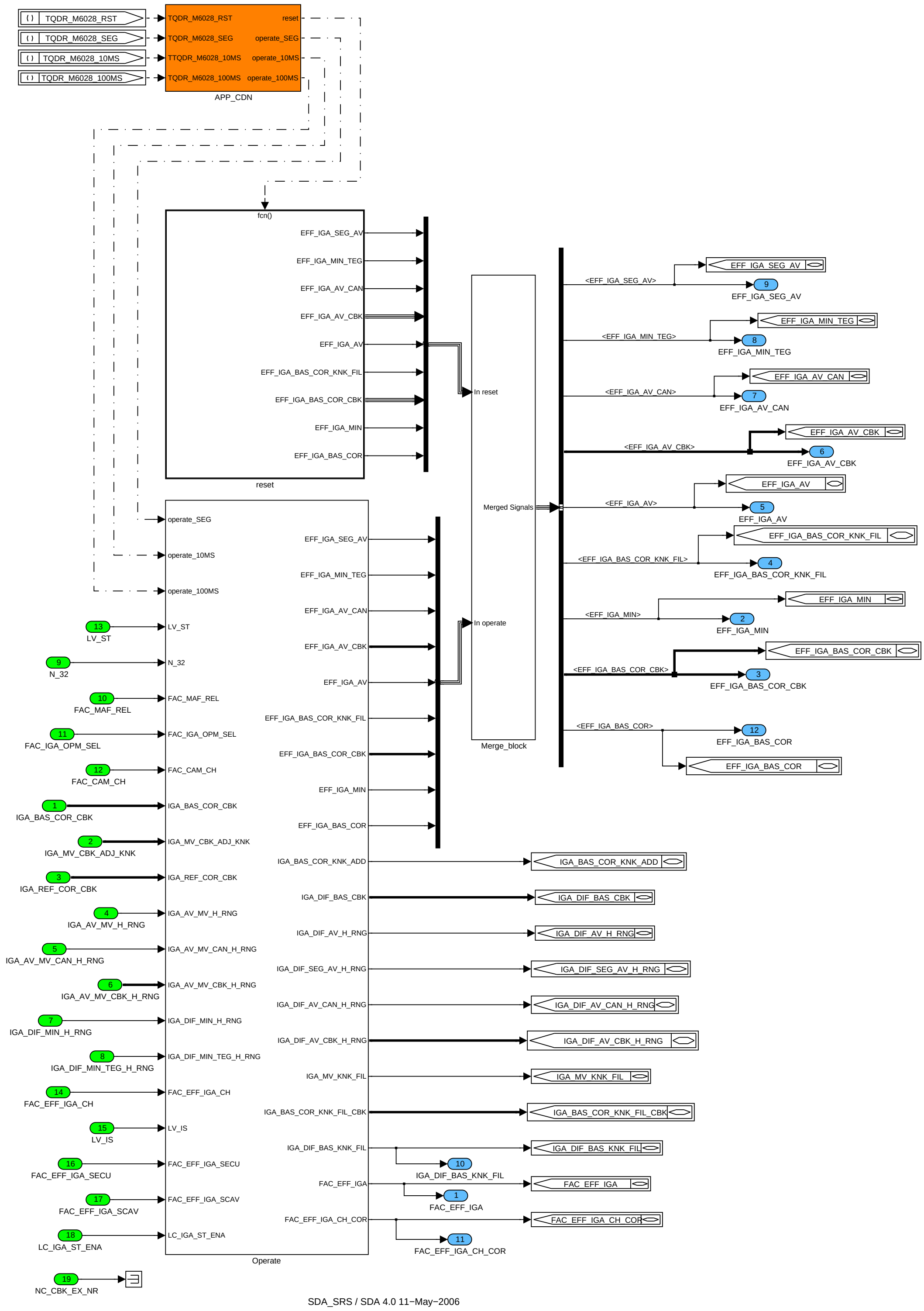

Figure 6.2.2: TQDR_M6028

6.2.1.1 RESET

Resetting efficiencies.

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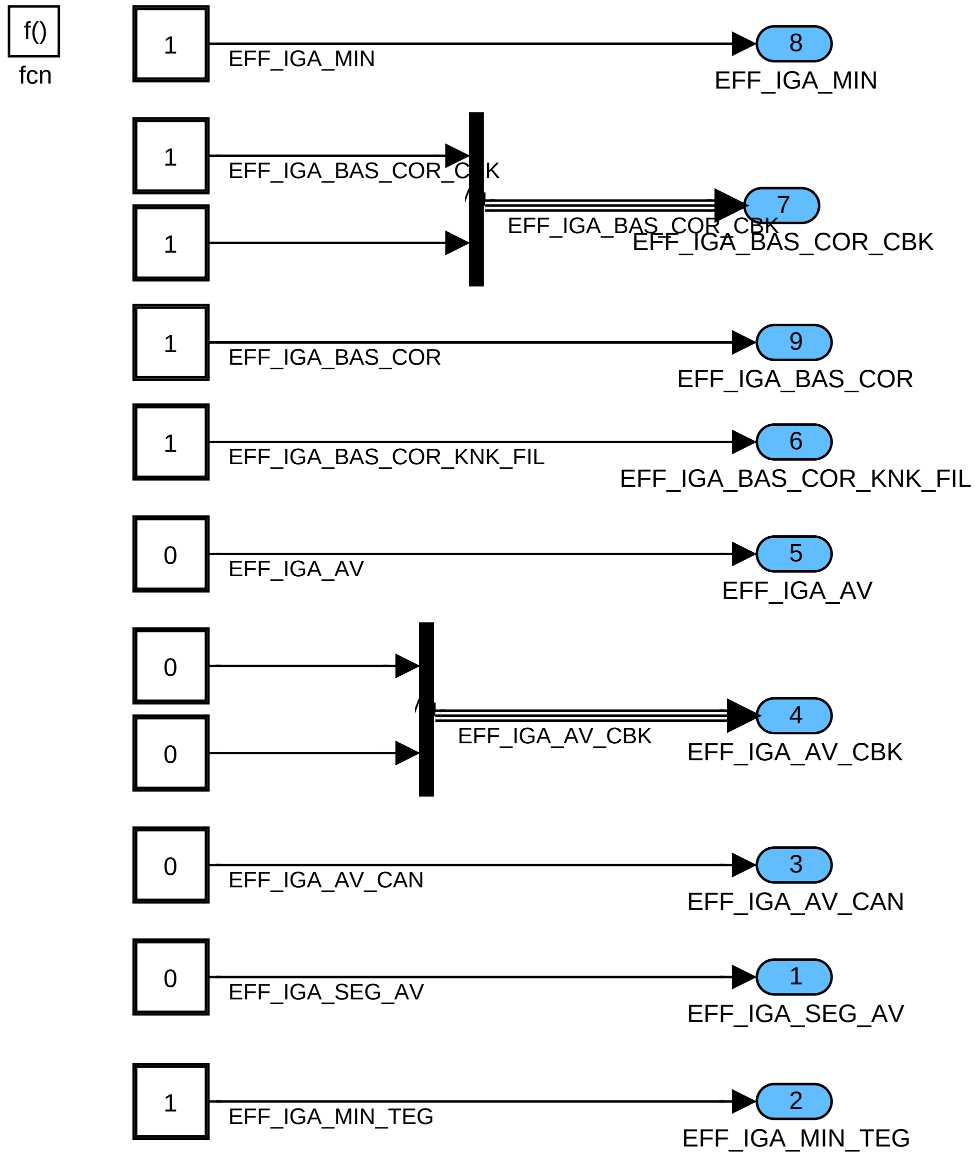

Figure 6.2.3: TQDR_M6028/reset

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6.2.1.2 OPERATE

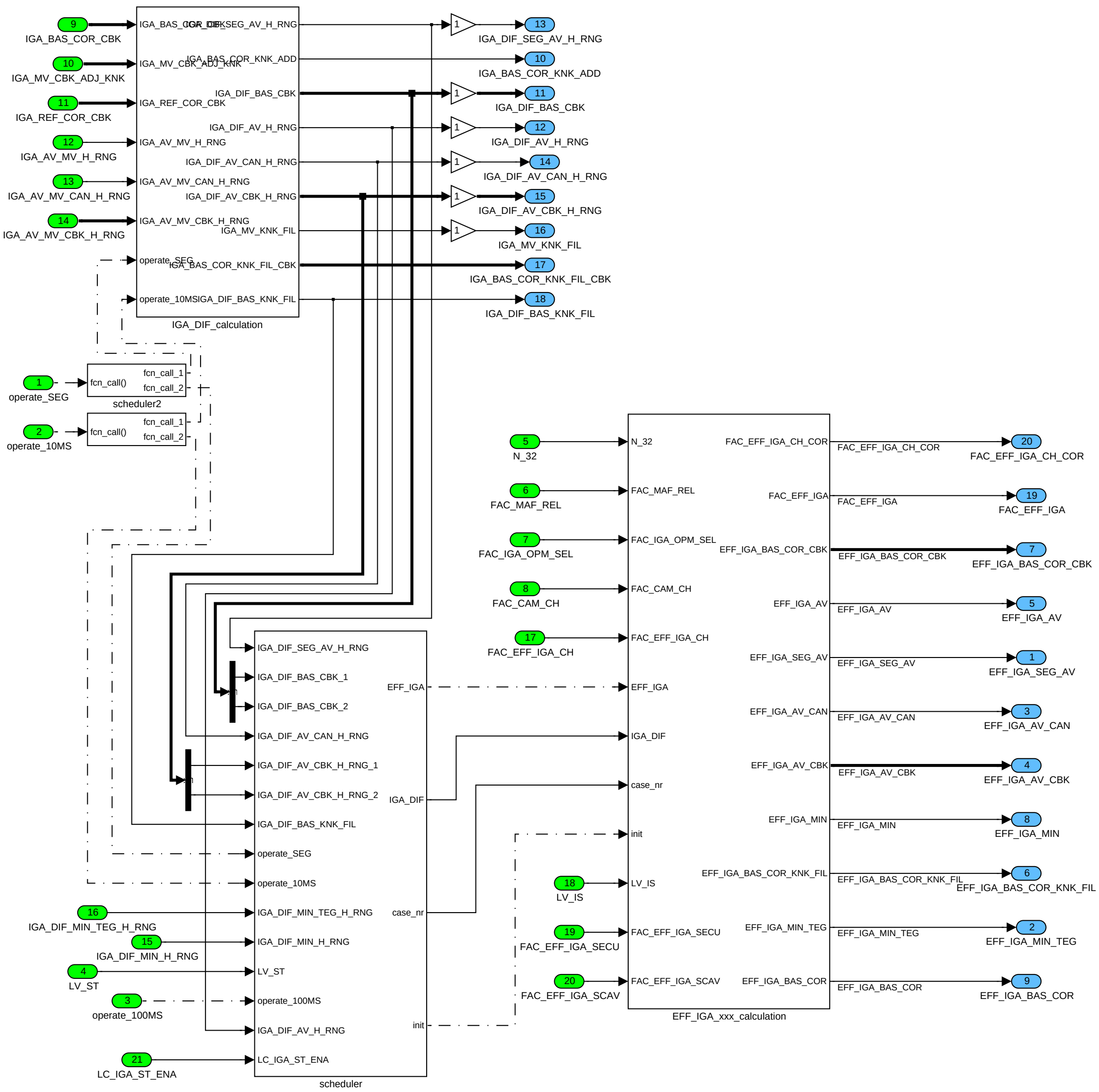

Figure 6.2.4: TQDR_M6028/Operate

IGA_DIF_CALCULATION

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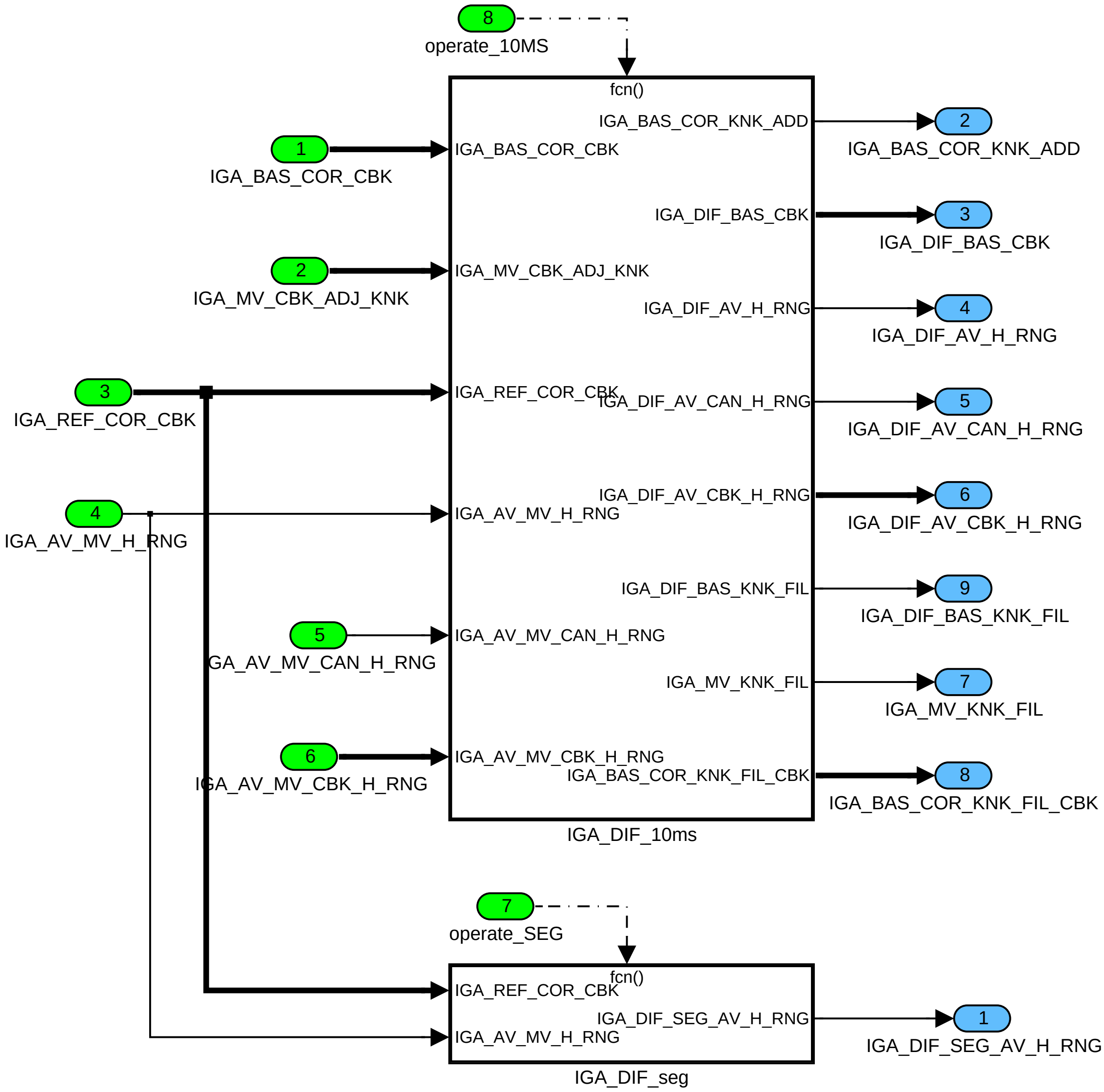

Figure 6.2.5: TQDR_M6028/Operate/IGA_DIF_calculation

IGA_DIF_10MS

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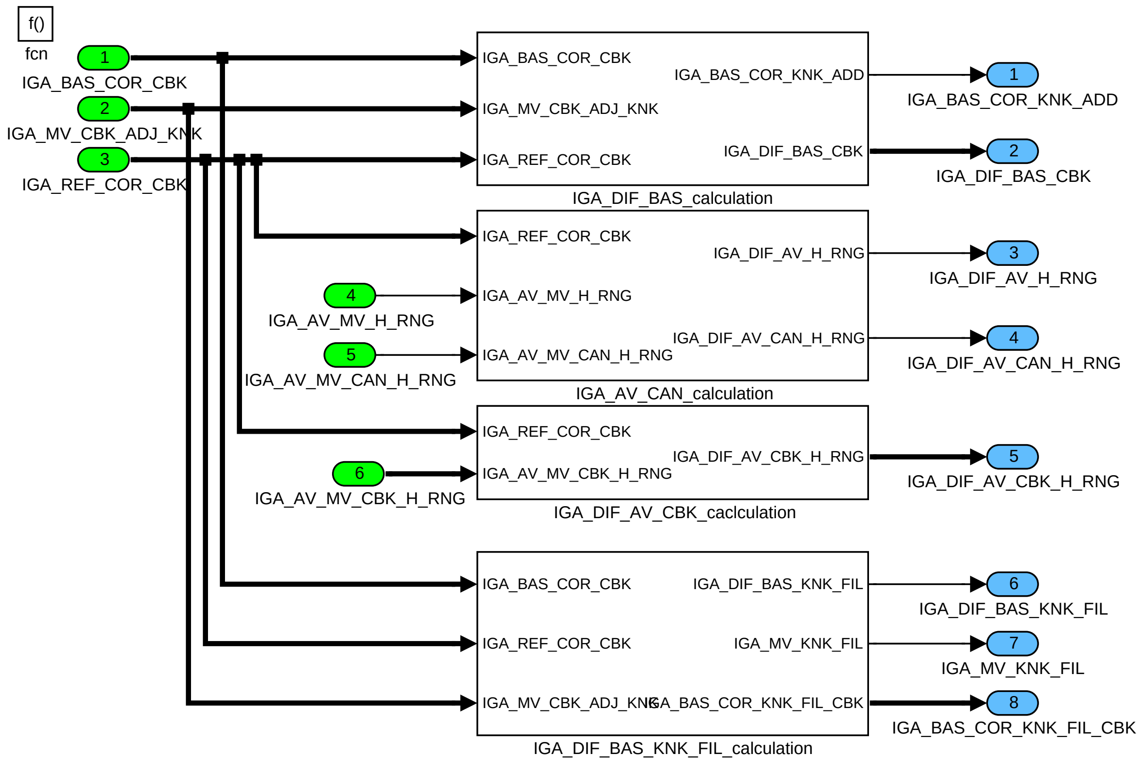

Figure 6.2.6: TQDR_M6028/Operate/IGA_DIF_calculation/IGA_DIF_10ms

IGA_DIF_BAS_CALCULATION

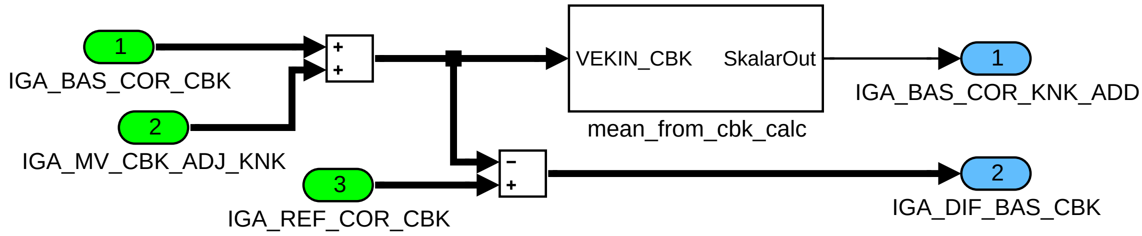

Figure 6.2.7: TQDR_M6028/Operate/IGA_DIF_calculation/IGA_DIF_10ms/IGA_DIF_BAS_calculation

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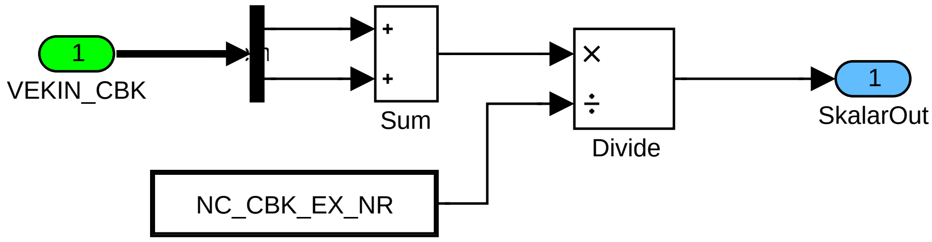

Figure 6.2.8: TQDR_M6028/Operate/IGA_DIF_calculation/IGA_DIF_10ms/IGA_DIF_BAS_calculation/mean_from_cbk_calc

IGA_AV_CAN_CALCULATION

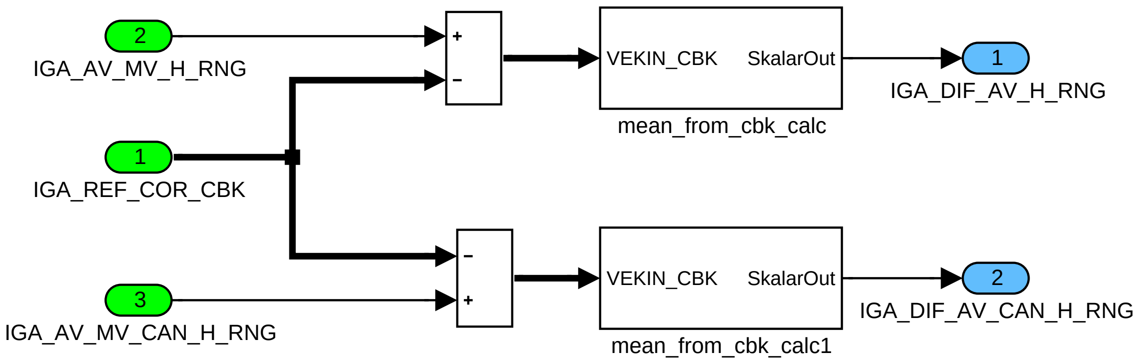

Figure 6.2.9: TQDR_M6028/Operate/IGA_DIF_calculation/IGA_DIF_10ms/IGA_AV_CAN_calculation

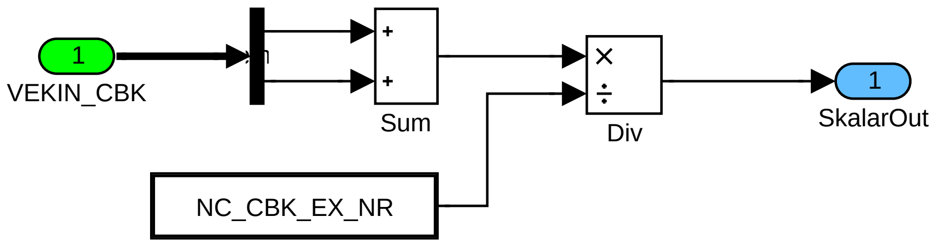

Figure 6.2.10: TQDR_M6028/Operate/IGA_DIF_calculation/IGA_DIF_10ms/IGA_AV_CAN_calculation/mean_from_cbk_calc

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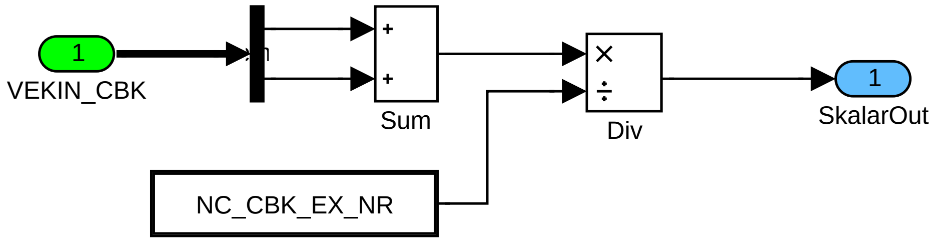

Figure 6.2.11: TQDR_M6028/Operate/IGA_DIF_calculation/IGA_DIF_10ms/IGA_AV_CAN_calculation/ mean_from_cbk_calc1

IGA_DIF_AV_CBK_CACLCULATION

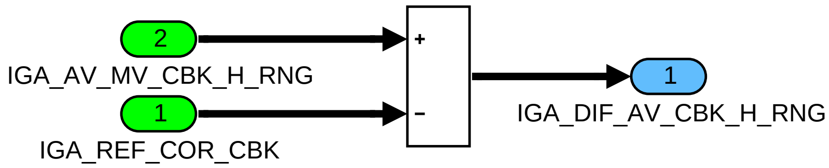

Figure 6.2.12: TQDR_M6028/Operate/IGA_DIF_calculation/IGA_DIF_10ms/IGA_DIF_AV_CBK_caclculation

IGA_DIF_BAS_KNK_FIL_CALCULATION

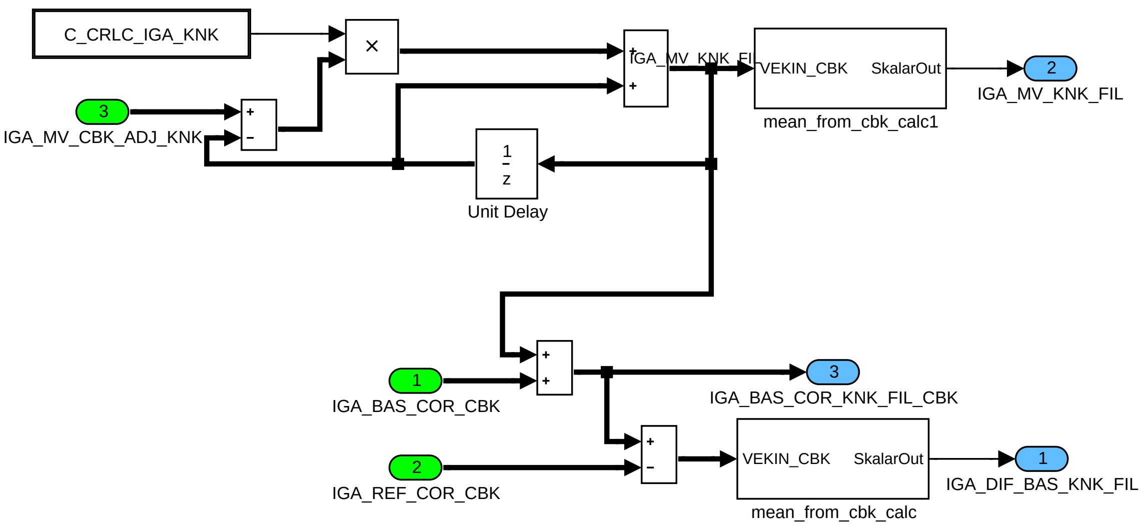

Figure 6.2.13: TQDR_M6028/Operate/IGA_DIF_calculation/IGA_DIF_10ms/IGA_DIF_BAS_KNK_FIL_calculation

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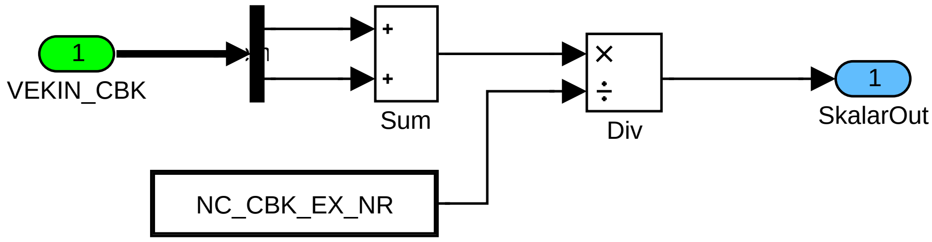

Figure 6.2.14: TQDR_M6028/Operate/IGA_DIF_calculation/IGA_DIF_10ms/
IGA_DIF_BAS_KNK_FIL_calculation/mean_from_cbk_calc

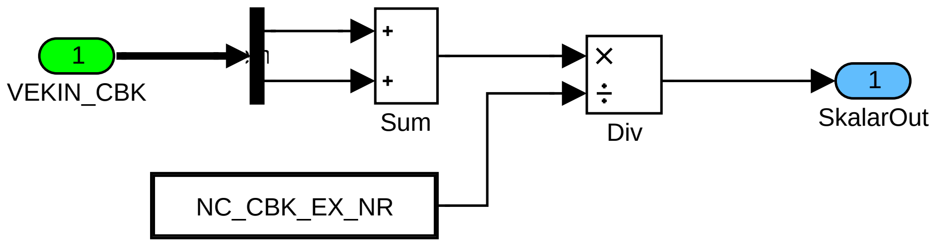

Figure 6.2.15: TQDR_M6028/Operate/IGA_DIF_calculation/IGA_DIF_10ms/
IGA_DIF_BAS_KNK_FIL_calculation/mean_from_cbk_calc1

IGA_DIF_SEG

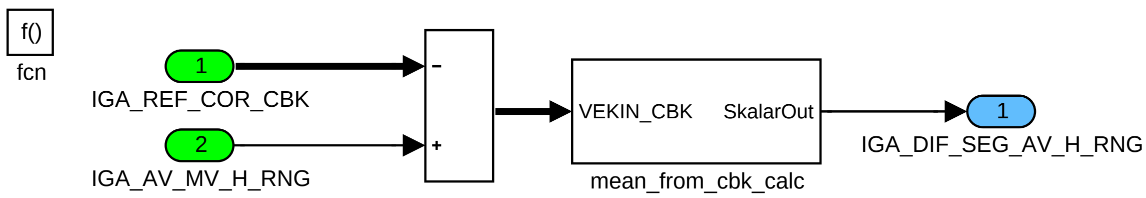

Figure 6.2.16: TQDR_M6028/Operate/IGA_DIF_calculation/IGA_DIF_seg

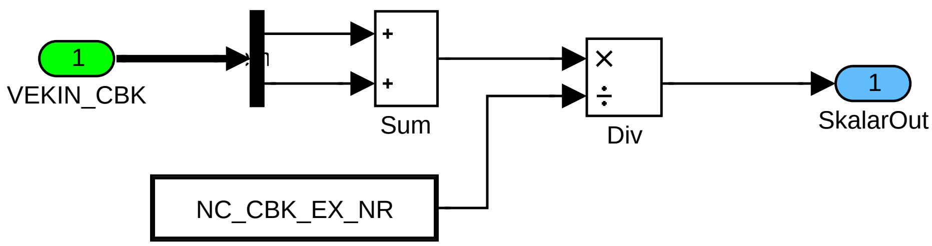

Figure 6.2.17: TQDR_M6028/Operate/IGA_DIF_calculation/IGA_DIF_seg/mean_from_cbk_calc

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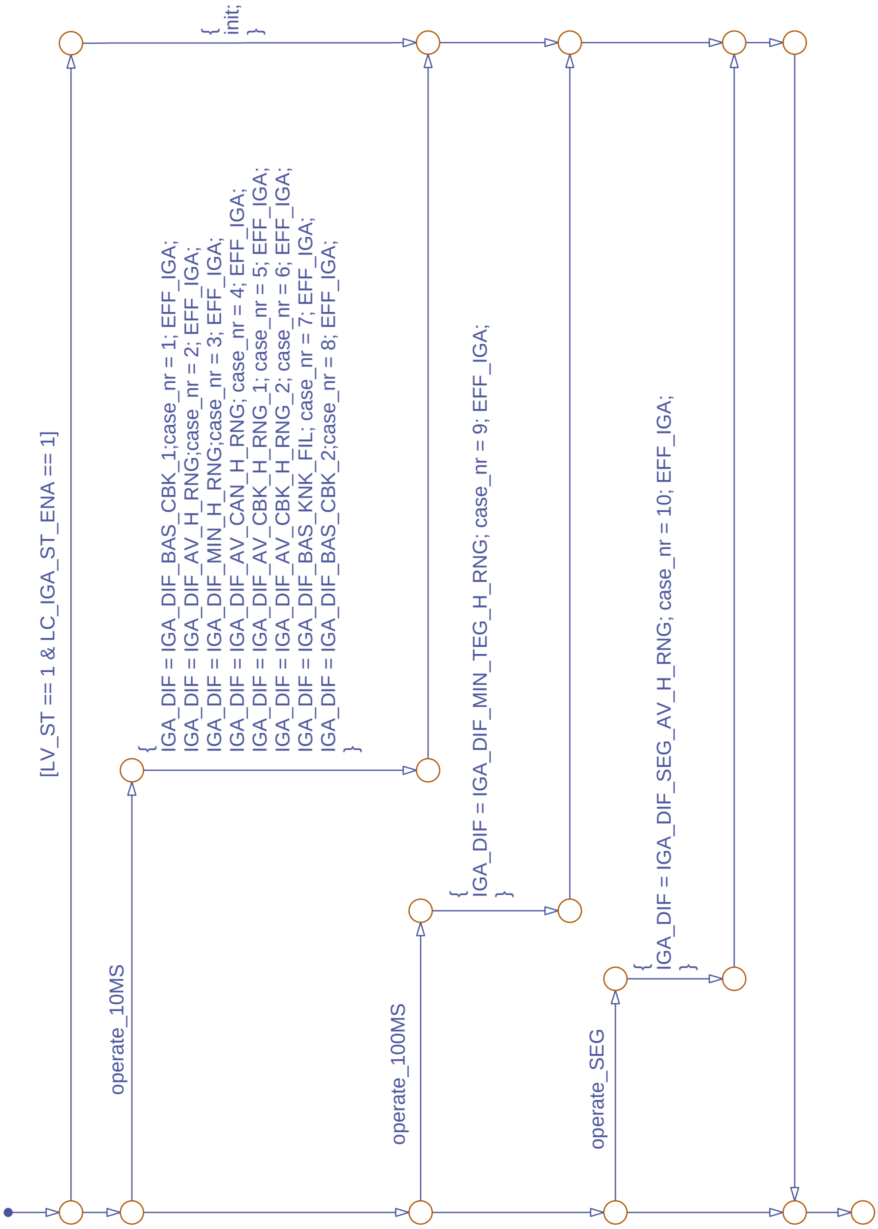

Figure 6.2.18: TQDR_M6028/Operate/scheduler/scheduler

EFF_IGA_XXX_CALCULATION

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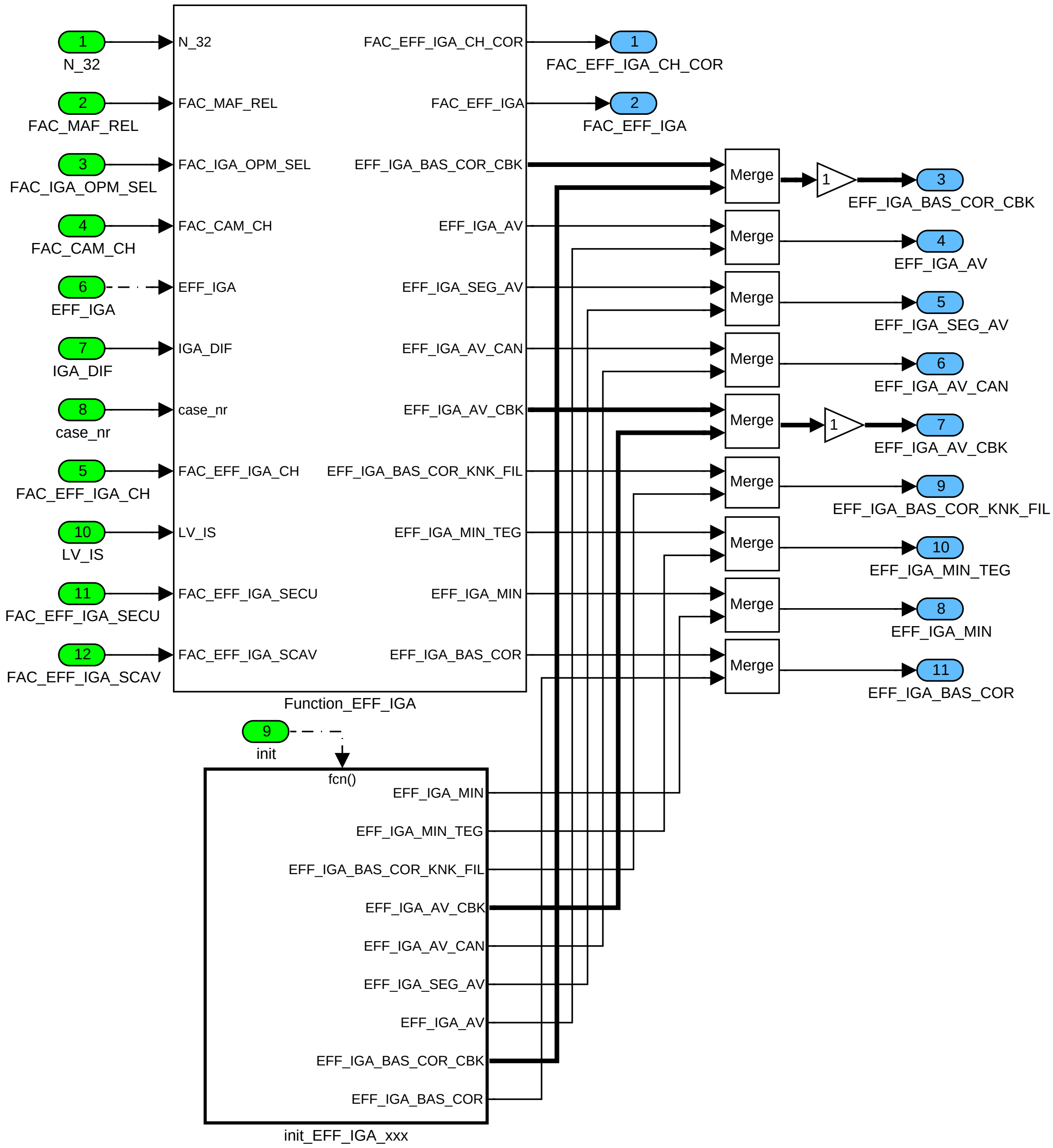

Figure 6.2.19: TQDR_M6028/Operate/EFF_IGA_xxx_calculation

INIT_EFF_IGA_XXX

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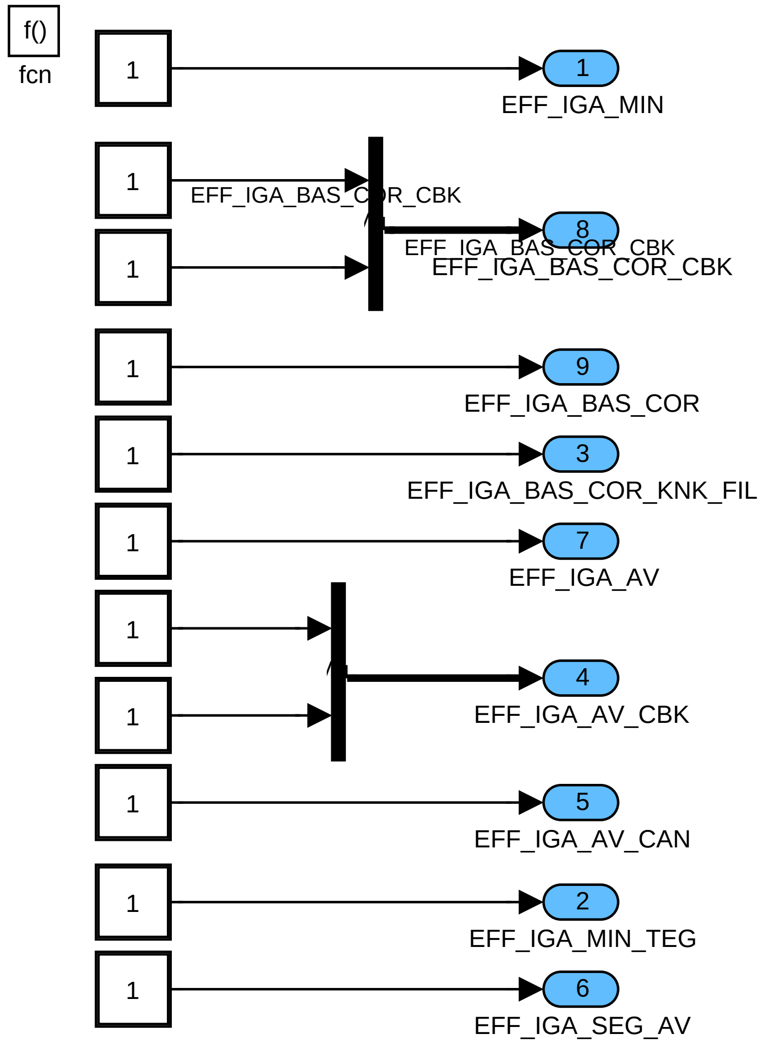

Figure 6.2.20: TQDR_M6028/Operate/EFF_IGA_xxx_calculation/init_EFF_IGA_xxx

FUNCTION_EFF_IGA

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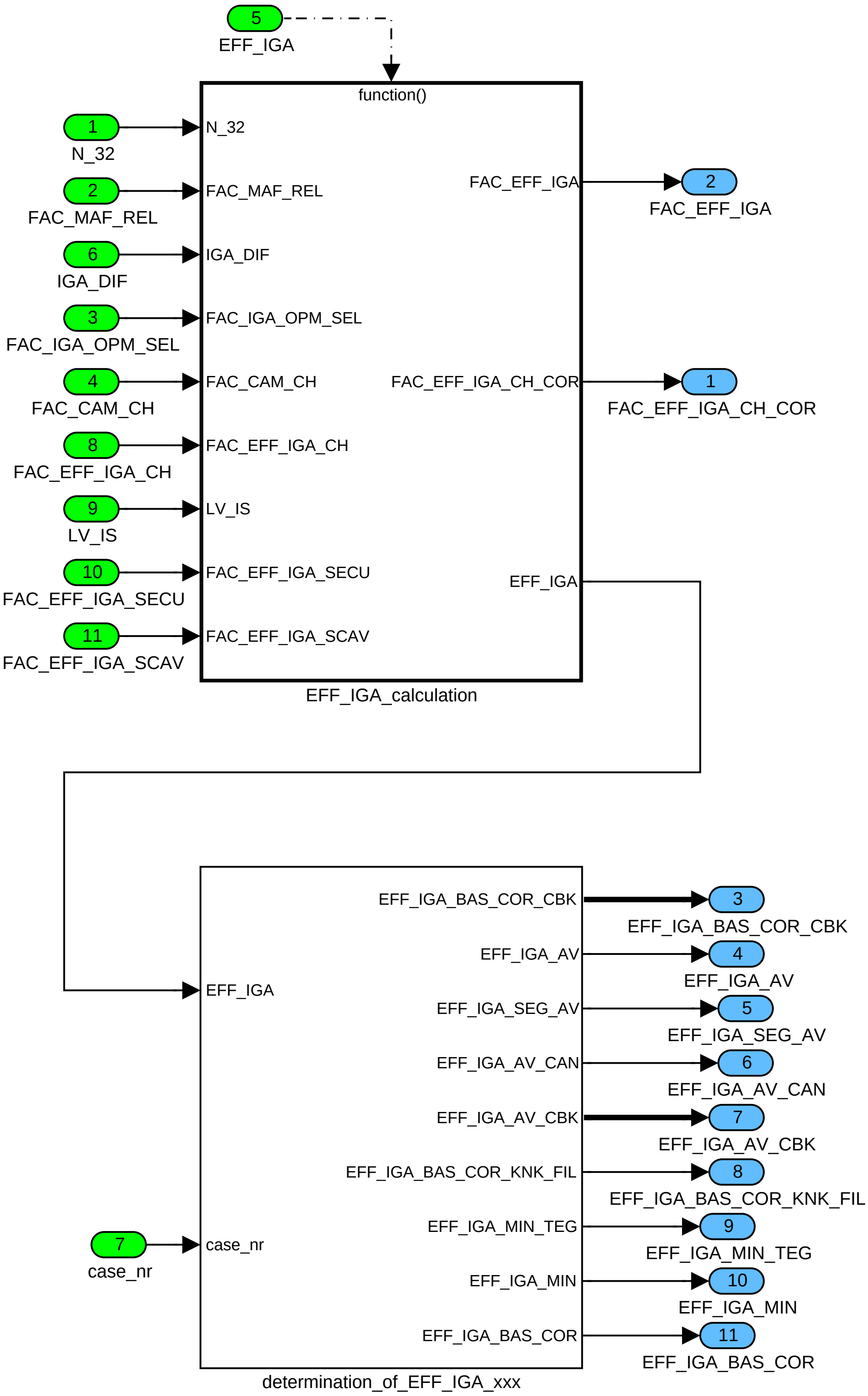

Figure 6.2.21: TQDR_M6028/Operate/EFF_IGA_xxx_calculation/Function_EFF_IGA

EFF_IGA_CALCULATION

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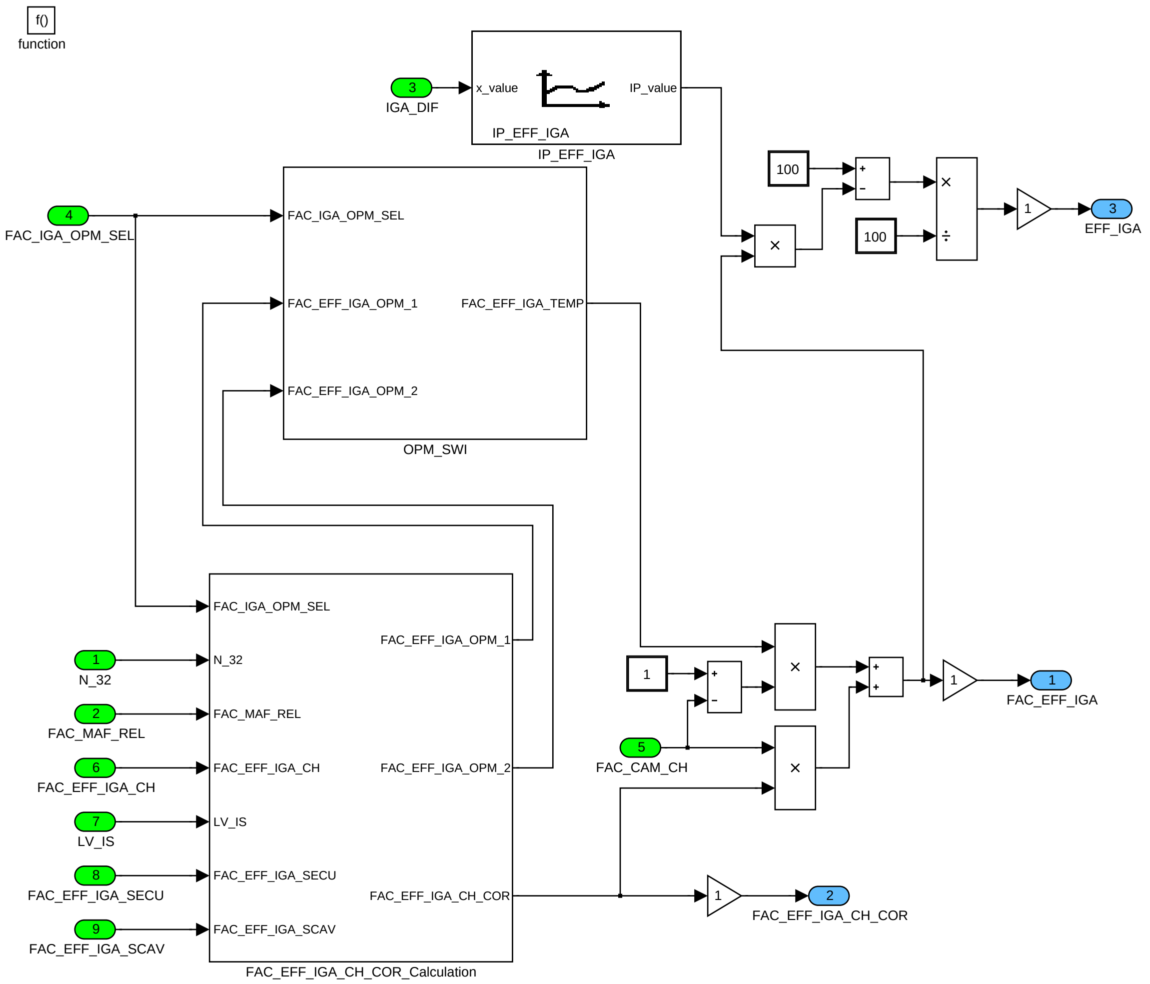

Figure 6.2.22:
TQDR_M6028/Operate/EFF_IGA_xxx_calculation/Function_EFF_IGA/EFF_IGA_calculation

FAC_EFF_IGA_CH_COR_CALCULATION

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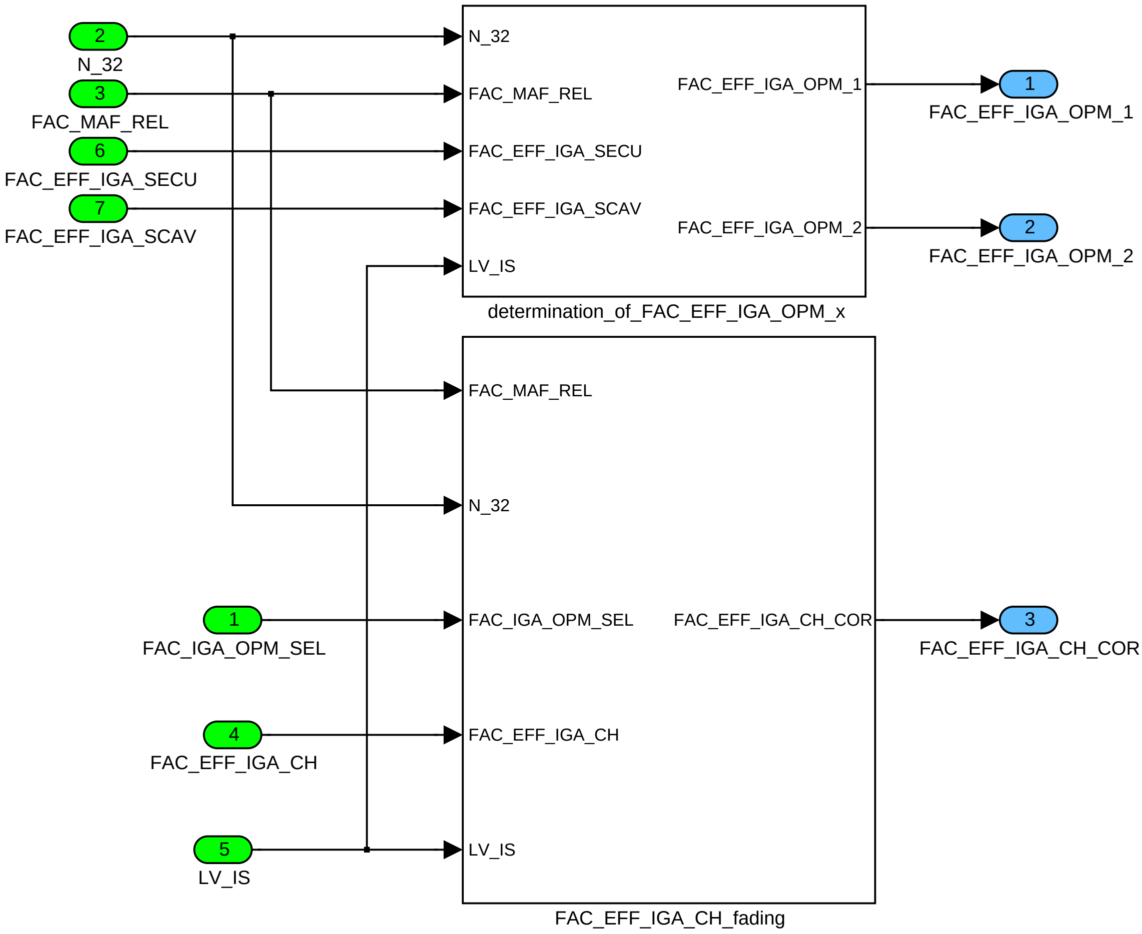

Figure 6.2.23: TQDR_M6028/Operate/EFF_IGA_xxx_calculation/Function_EFF_IGA/EFF_IGA_calculation/FAC_EFF_IGA_CH_COR_Calculation

DETERMINATION_OF_FAC_EFF_IGA_OPM_X

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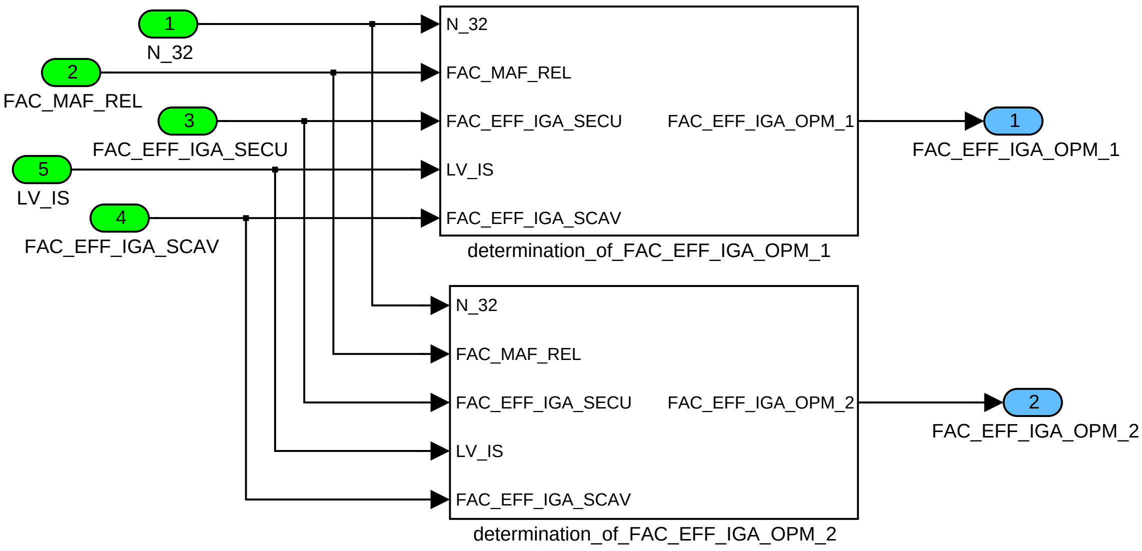

Figure 6.2.24: TQDR_M6028/Operate/EFF_IGA_xxx_calculation/Function_EFF_IGA/EFF_IGA_calculation/FAC_EFF_IGA_CH_COR_Calculation/determination_of_FAC_EFF_IGA_OPM_x

DETERMINATION_OF_FAC_EFF_IGA_OPM_1

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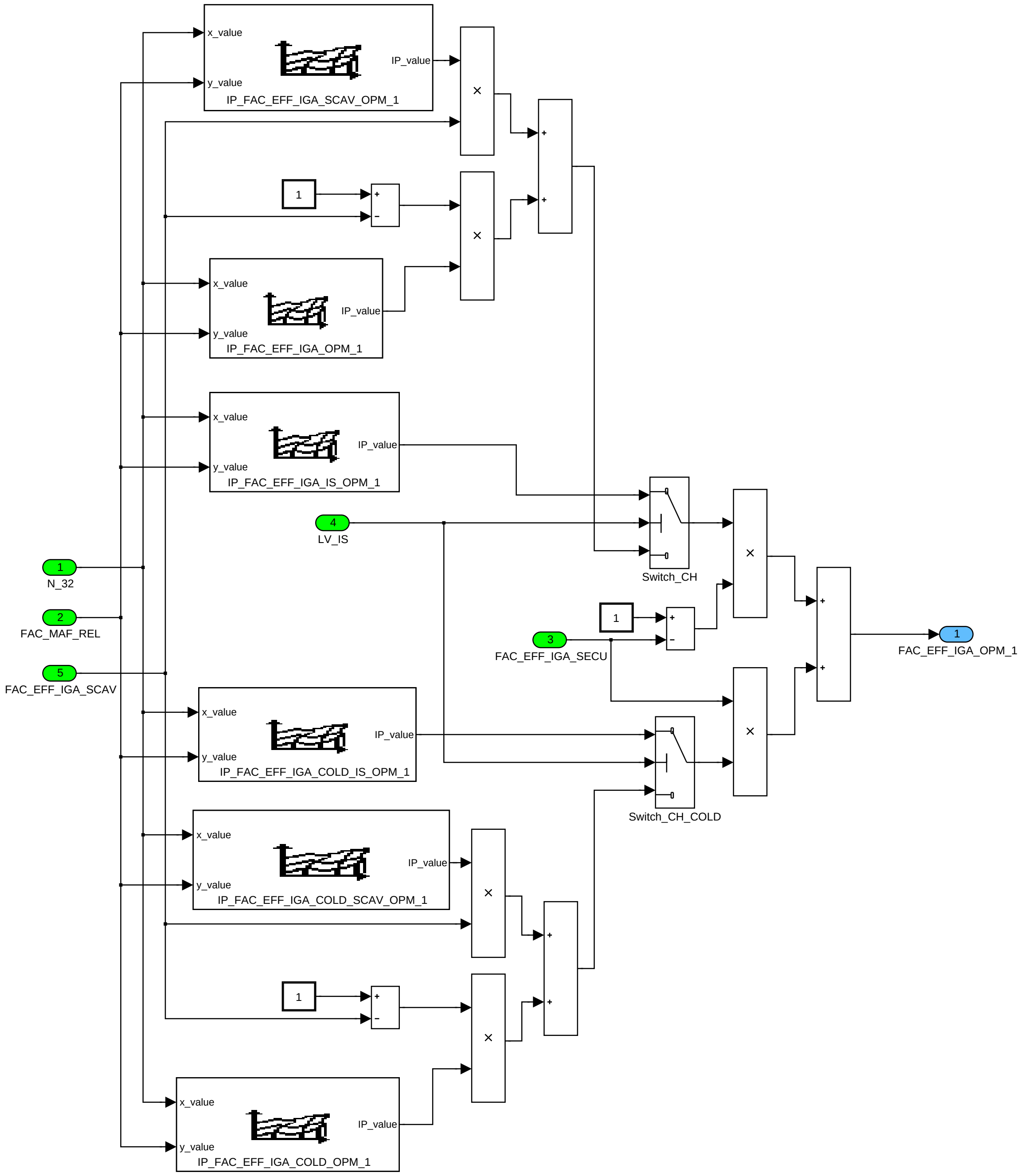

Figure 6.2.25: TQDR_M6028/Operate/EFF_IGA_xxx_calculation/Function_EFF_IGA/EFF_IGA_calculation/FAC_EFF_IGA_CH_COR_Calculation/determination_of_FAC_EFF_IGA_OPM_x/determination_of_FAC_EFF_IGA_OPM_1

DETERMINATION_OF_FAC_EFF_IGA_OPM_2

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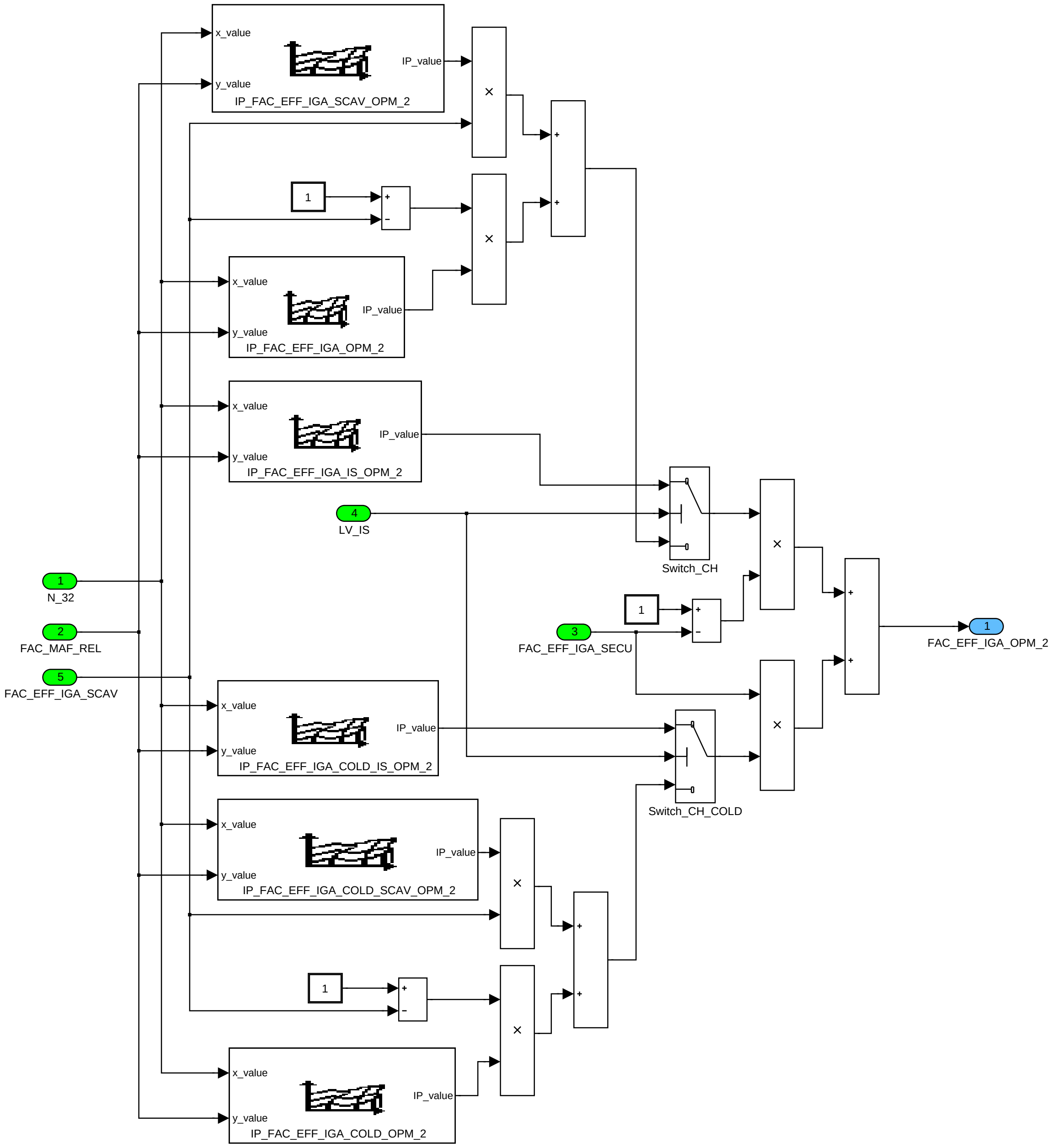

Figure 6.2.26: TQDR_M6028/Operate/EFF_IGA_xxx_calculation/Function_EFF_IGA/EFF_IGA_calculation/FAC_EFF_IGA_CH_COR_Calculation/determination_of_FAC_EFF_IGA_OPM_x/determination_of_FAC_EFF_IGA_OPM_2

FAC_EFF_IGA_CH_FADING

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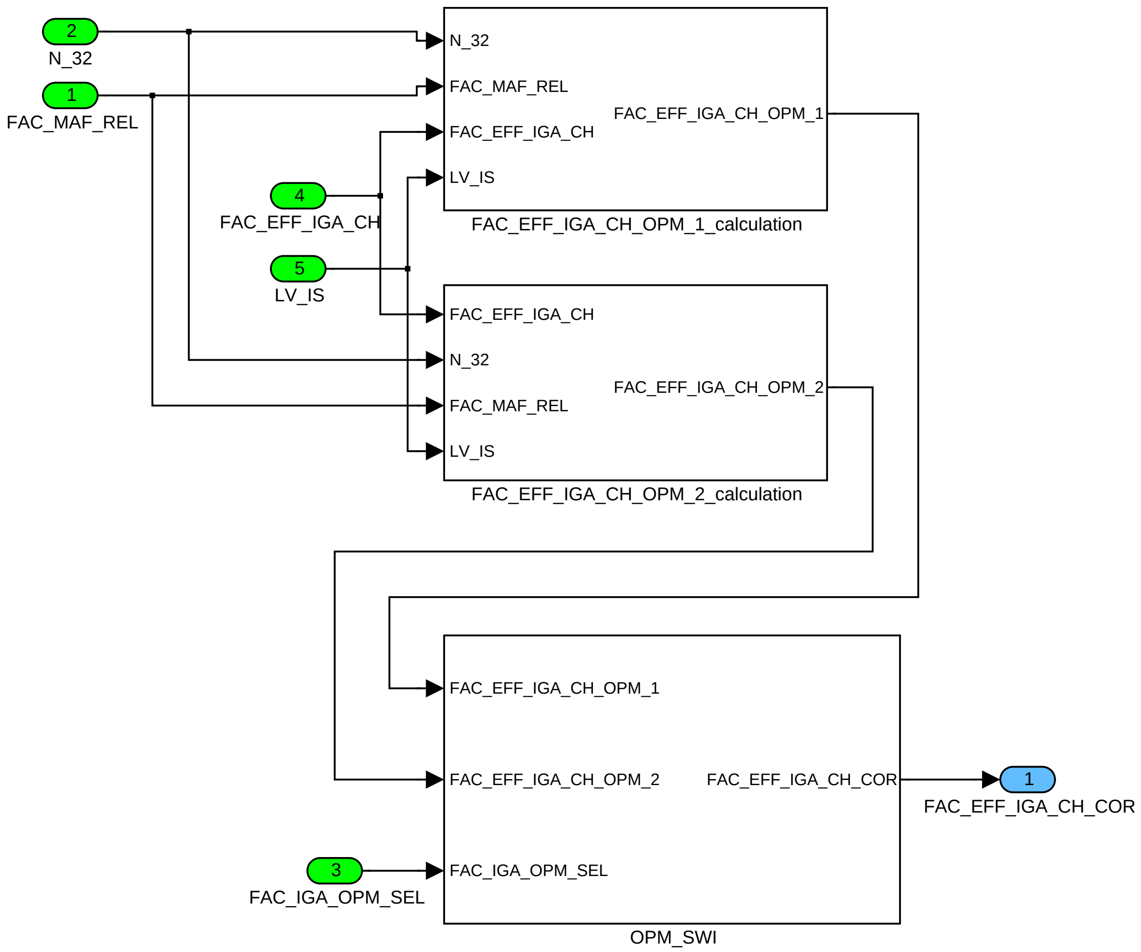

Figure 6.2.27: TQDR_M6028/Operate/EFF_IGA_xxx_calculation/Function_EFF_IGA/
EFF_IGA_calculation/FAC_EFF_IGA_CH_COR_Calculation/FAC_EFF_IGA_CH_fading

FAC_EFF_IGA_CH_OPM_1_CALCULATION

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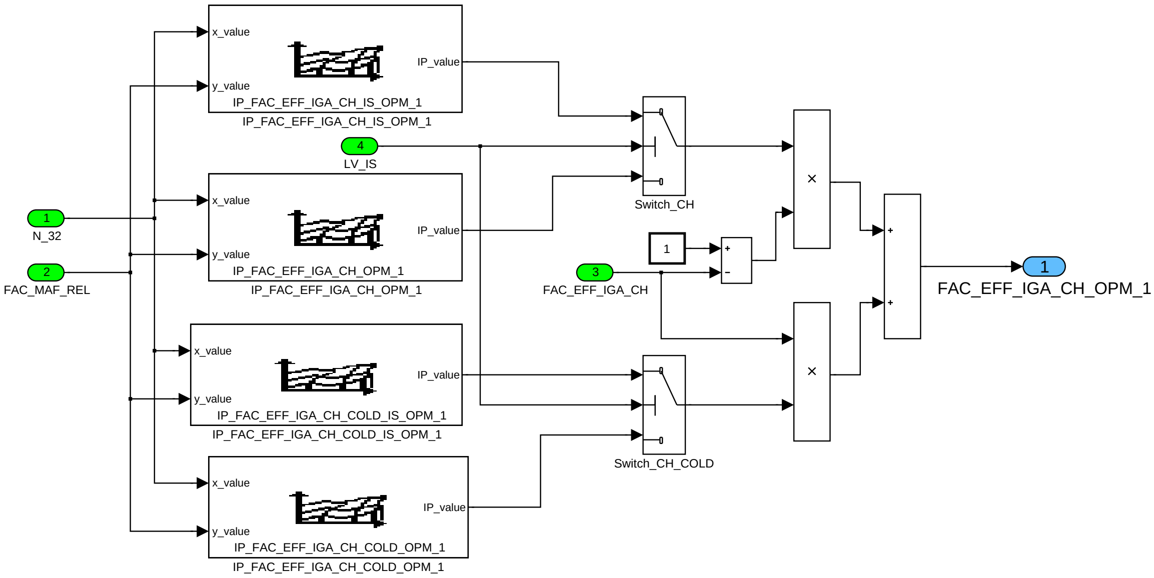

Figure 6.2.28: TQDR_M6028/Operate/EFF_IGA_xxx_calculation/Function_EFF_IGA/EFF_IGA_calculation/FAC_EFF_IGA_CH_COR_Calculation/FAC_EFF_IGA_CH_fading/FAC_EFF_IGA_CH_OPM_1_calculation

FAC_EFF_IGA_CH_OPM_2_CALCULATION

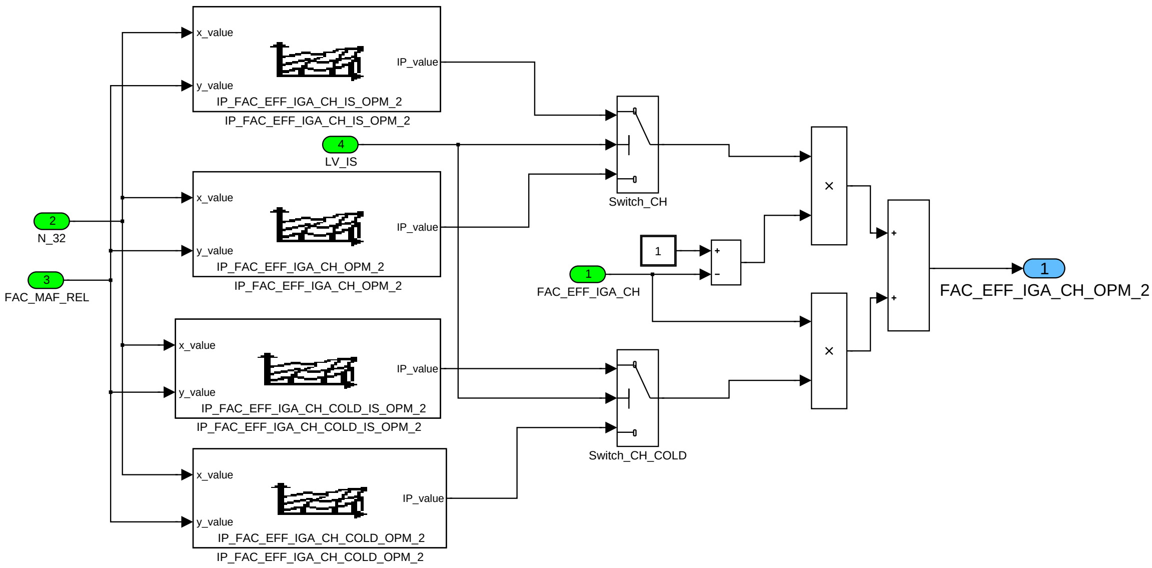

Figure 6.2.29: TQDR_M6028/Operate/EFF_IGA_xxx_calculation/Function_EFF_IGA/EFF_IGA_calculation/FAC_EFF_IGA_CH_COR_Calculation/FAC_EFF_IGA_CH_fading/FAC_EFF_IGA_CH_OPM_2_calculation

OPM_SWI

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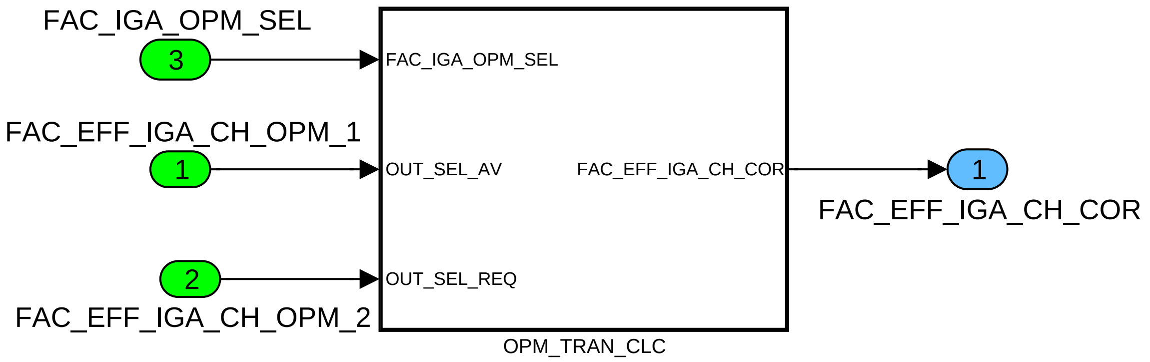

Figure 6.2.30: TQDR_M6028/Operate/EFF_IGA_xxx_calculation/Function_EFF_IGA/EFF_IGA_calculation/FAC_EFF_IGA_CH_COR_Calculation/FAC_EFF_IGA_CH_fading/OPM_SWI

OPM_TRAN_CLC

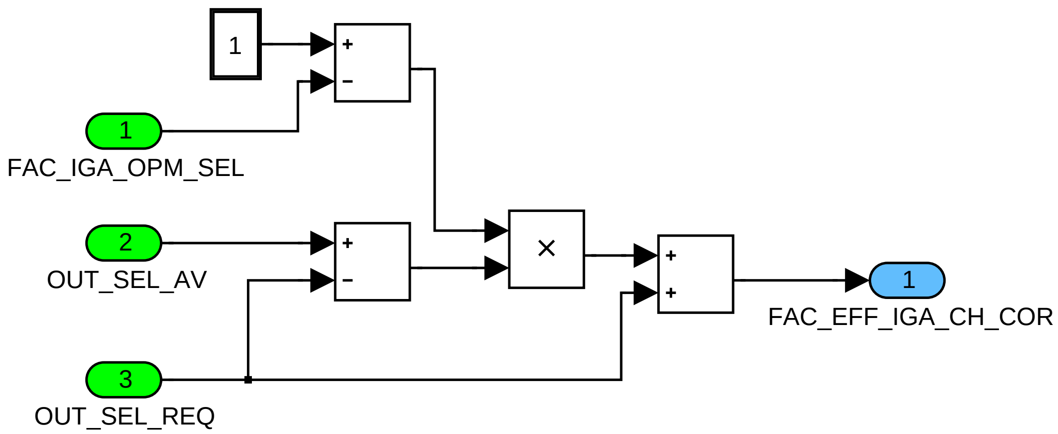

Figure 6.2.31: TQDR_M6028/Operate/EFF_IGA_xxx_calculation/Function_EFF_IGA/EFF_IGA_calculation/FAC_EFF_IGA_CH_COR_Calculation/FAC_EFF_IGA_CH_fading/OPM_SWI/OPM_TRAN_CLC

OPM_SWI

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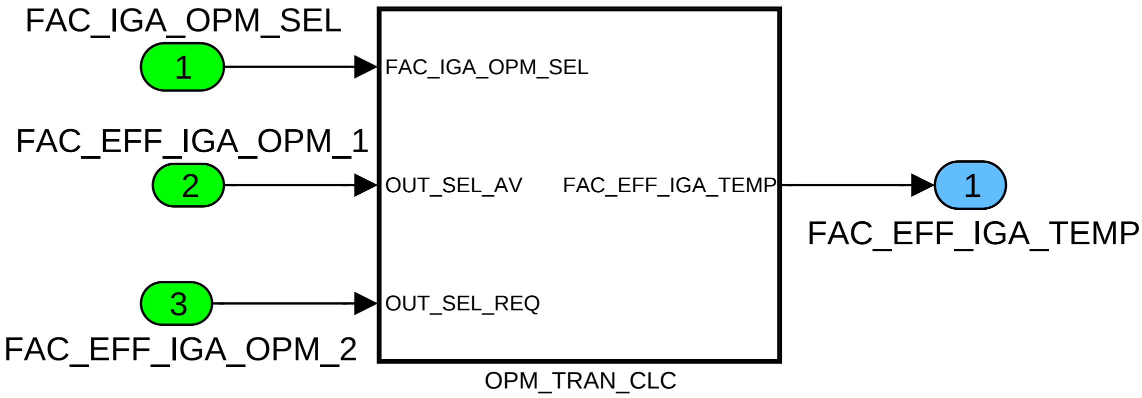

Figure 6.2.32: TQDR_M6028/Operate/EFF_IGA_xxx_calculation/Function_EFF_IGA/EFF_IGA_calculation/OPM_SWI

OPM_TRAN_CLC

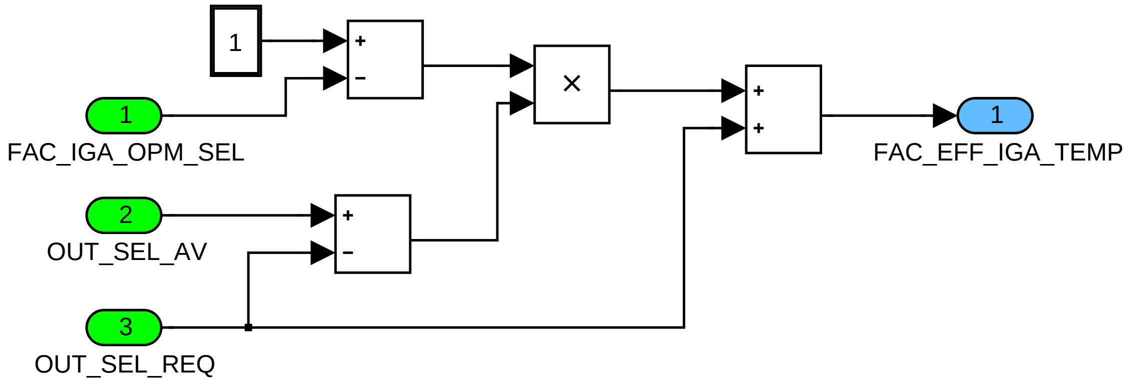

Figure 6.2.33: TQDR_M6028/Operate/EFF_IGA_xxx_calculation/Function_EFF_IGA/EFF_IGA_calculation/OPM_SWI/OPM_TRAN_CLC

FUNCTION_EFF_IGA/DETERMINATION_OF_EFF_IGA_XXX

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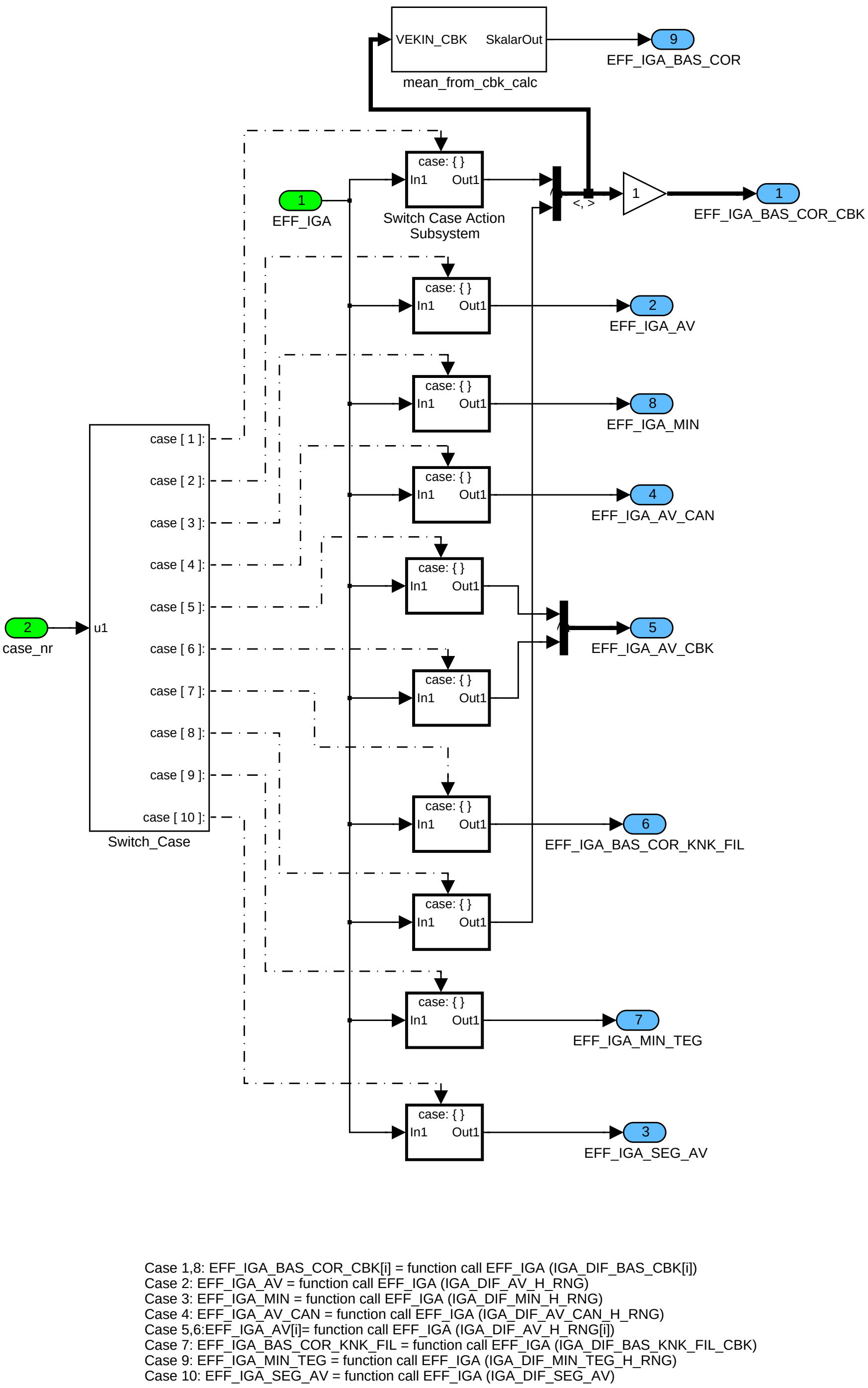

Figure 6.2.34:
TQDR_M6028/Operate/EFF_IGA_xxx_calculation/Function_EFF_IGA/determination_of_EFF_IGA_xxx

6.2.1.3 MERGE BLOCK

Signals merged from states reset and operate.

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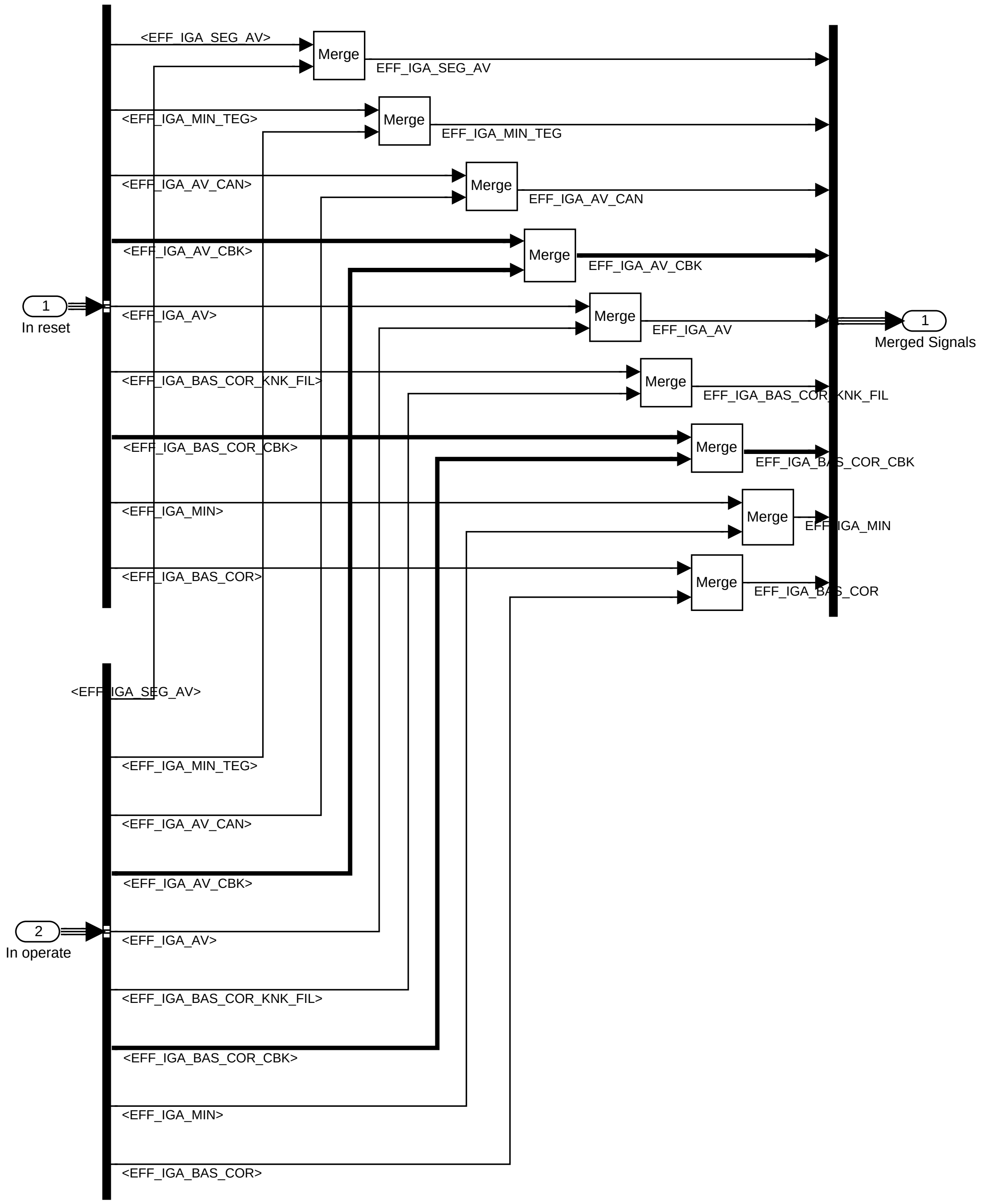

Figure 6.2.35: TQDR_M6028/Merge_block

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6.3 Dwell time period

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TD	O/V	0... FFFFH	0... 262.14	0,004	ms
Dwell time					

Input data:

C_TD_S_AS {p. 1875}	IP_TD_S {p. 1875}	LV_HOM_RUN {p. 8136}	LV_TD_AD_H {p. 937}
N_32 {p. 1525}	TD_FAC {p. 1874}	VB {p. 1185}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TD_AS	-	F800... 7F0H	-8.192 ...8.128	0,004	ms
Dwell time offset usual value: 0 ms					
C_TD_INI	-	0... FFFFH	0... 262.14	0,004	ms
initial value for dwell time control (typ. Value 3ms for standart coils and <2ms for pencil coils)					
IP_TD	V	0... FFFFH	0... 262.14	0,004	ms
LDPM_VB_1_IGRE	8	0... FFH	0... 26	0,102	V
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Dwell time correction versus battery voltage and engine speed					

6.3.1 Dwell time calculation

FUNCTION DESCRIPTION:

The dwell time raw value calculation is based on the simulation done by the HW-group. At any time an adaptation or correction factor has to be multiplied or added in this chapter.
The dwell time open-loop control value is stored in terms of a battery voltage and engine speed related characteristics.

Application conditions

Initialisation: *TD = C_TD_INI* at reset

Recurrence: *10 ms*

Activation: at every engine state ***if*** *LV_HOM_RUN = 1*

Formula section

If LV_TD_AD_H == 1
Then TD = IP_TD_S(VB, N_32) * TD_FAC + C_TD_S_AS
Else TD = IP_TD(VB, N_32) * TD_FAC + C_TD_AS
Endif

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6.4 Dwell time factor calculation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TD_FAC	O/V	0... FFH	0... 1.99218	0.0078125	-
Basic dwell time factor					
TD_FAC_TCO	V	1... FFH	0.00781 ...1.99218	0.0078125	-
Adjustment factor with TCO dependence					

Input data:

TCO {p. 1100}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TD_FAC_TCO	-	1... FFH	0.00781 ...1.99218	0.0078125	-
LDPM_TCO_TD_FAC	8	0... FEH	-48... 142.5	0.75	°C
Adjustment Factor for dwell time					

FUNCTION DESCRIPTION:

General information:
The output data could be only TD_FAC. All other factors should be only visible values.
The dwell time factor regroups all adjustment factors as coil temperature factor or a boost factor for start. Here the boost factor is not taken into account as we use for MSD8X project an adaptation of Dwell Time at hight current target at start.

Initialisation : at reset
TD_FAC = 1
TD_FAC_TCO = 1
Recurrence: 10 ms

Formula section:

TD_FAC_TCO = IP_TD_FAC_TCO
TD_FAC = TD_FAC_TCO

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6.5 Dwell time period for stratified mode

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TD_S	O/V	0... FFFFH	0... 262.14	0,004	ms
Dwell time for stratified mode					

Input data:

LDPM_N_32_1_IGRE	LDPM_VB_1_IGRE	LV_S_RUN {p. 8137}	N_32 {p. 1525}
TD_FAC {p. 1874}	VB {p. 1185}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TD_S_AS	-	F800... 7F0H	-8.192 ...8.128	0.004	ms
Application intervention for stratified mode (typ. Value : 0 ms)					
C_TD_S_INI	-	0... FFFF H	0... 262.14	0.004	ms
Init. value for dwell time control (same for homogeneous and stratified mode)					
IP_TD_S	V	0... FFFFH	0... 262.14	0,004	ms
LDPM_VB_1_IGRE	8	0... FFH	0... 26	0,102	V
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Dwell time correction versus battery voltage and engine speed for stratified mode					

FUNCTION DESCRIPTION:

The following function is similar to the dwell time calculation for homogeneous combustion. Only the calibration data should be adapted to stratified combustion.
The dwell time value calculation is based on the simulation done by the HW-group. The dwell time open-loop control value is stored in terms of a battery voltage-related characteristic.

Application conditions

Initialisation: *TD_S* = *C_TD_S_INI* at reset

Recurrence: *10 ms*

Activation: *LV_S_RUN* = *1*

Deactivation: LV_S_RUN = 0

Formula section:

TD_S = IP_TD_S(VB,N_32) * TD_FAC + C_TD_S_AS

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6.6 Dwell time and ignition angle switches for different combustion modes

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_IGC_H_RNG [NC_CYL_NR]	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Ignition angle (high range) at cylinder x					
TD_FAC_MAX_TMP	-	1... FFH	1... 255	1/128	-
Maximal dwell time control					
TD_FAC_MIN_TMP	-	1... FFH	1... 255	1/128	-
Minimal dwell time control					
TD_IGC [NC_CYL_NR]	O/V	0... FFFFH	0... 262.14	0,004	ms
Dwell time duration					
TD_IGC_ACT_MAX	-	0... FFFFH	0... 262.14	0,004	ms
Maximal Dwell time duration					
TD_IGC_ACT_MIN	-	0... FFFFH	0... 262.14	0,004	ms
Minimal Dwell time duration					
TD_LIM_MAX	O/V	0... FFFFH	0... 262.14	0,004	ms
Maximum dwell time allowed					

Input data:

IGA_AV_H_RNG [NC_CYL_NR] {p. 1828}	IGA_IGC_H_RNG_ACT [NC_CYL_NR] {p. 2037}	IGC_EXT_ADJ [NC_CYL_NR]	INJ_MOD [NC_CYL_NR] {p. 2037}
INJ_MOD_SP [NC_CYL_NR] {p. 3328}	LV_ES {p. 1720}	LV_FIRST_VLD_TOOTH {p. 1505}	LV_IGC_EXT_ADJ [NC_CYL_NR]
LV_IGK {p. 906}	LV_IGN_INJ_SYN_DEAC {p. 8269}	LV_INH_IGC [NC_CYL_NR] {p. 4773}	LV_ST_END {p. 1720}
NC_CYL_NR {p. 1526}	NC_INJ_MOD_HOM {p. 2045}	NC_INJ_MOD_MASK_1 {p. 2045}	NC_TD_LIM_MAX_H {p. 1876}
NC_TD_LIM_MAX_L {p. 1876}	NC_TD_LIM_MIN {p. 1877}	TD {p. 1873}	TD_AD [NC_CYL_NR] {p. 932}
TD_FAC_MAX {p. 917}	TD_FAC_MIN {p. 917}	TD_IGC_ACT [NC_CYL_NR] {p. 2040}	TD_S {p. 1875}
VB {p. 1185}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VB_TD_MAX_LIM_H	-	0... FFH	0... 26	0.102	V
High battery voltage threshold above which we apply NC_TD_LIM_MAX_H for maximum dwell time					
C_VB_TD_MAX_LIM_L	-	0... FFH	0... 26	0.102	V
Low battery voltage threshold below which we apply NC_TD_LIM_MAX_L for maximum dwell time					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_TD_LIM_MAX_H	-	0... FFFFH	0... 262.14	0.004	ms
NC_TD_LIM_MAX_H - Typical value 20 ms					
NC_TD_LIM_MAX_L	-	0... FFFFH	0... 262.14	0.004	ms
NC_TD_LIM_MAX_L - Typical value 10 ms					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_TD_LIM_MIN	-	0... FFFFH	0... 262.14	0.004	ms
NC_TD_LIM_MIN (Typical value 1 ms)					

ACTION_INFR_SetIgnDwell (IN <>, IN <>, IN <>, IN <>)
ACTION_INFR_SetIgnAngle (IN <>, IN <>)
ACTION_INFR_SetIgcDwellTest (IN <>, IN <>)
ACTION_INJR_IgnUpdate (IN <>, IN <>)

Exported action:

ACTION_IGRE_SendTrigForIgnUpd (IN <PRM_STATE_IGN_UPD_ENA>)
This action allows INJR to trig IGRE for updating its ignition parameter to its driver according to the designating cylinders specified by action parameter.

Description for action:

ACTION_IGRE_SendTrigForIgnUpd (IN <PRM_STATE_IGN_UPD_ENA>)					
This action allows INJR to trig IGRE for updating its ignition parameter to its driver according to the designating cylinders specified by action parameter.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_STATE_IGN_UPD_ENA	IN	0...FF	0...255	1	-
Bitmap to enable/disable ignition update calculations.					

Formula section For ACTION_IGRE_SendTrigForIgnUpd:

TD_IGC_ACT_MAX = 0 ms
TD_IGC_ACT_MIN = 262.14 ms

For x = 0 **to** NC_CYL_NR - 1
    TD_IGC_ACT_MAX = max (TD_IGC_ACT[x], TD_IGC_ACT_MAX)
    TD_IGC_ACT_MIN = min (TD_IGC_ACT[x], TD_IGC_ACT_MIN)
Endfor

TD_ FAC_MAX_TMP = min (TD_LIM_MAX /TD_IGC_ACT_MAX, TD_FAC_MAX)
TD_ FAC_MIN_TMP = max (NC_TD_LIM_MIN /TD_IGC_ACT_MIN, TD_FAC_MIN)

TD_IGC[x] = TD_IGC_ACT[x]
IGA_IGC_H_RNG[x] = IGA_IGC_H_RNG_ACT[x]

For x = 0 **to** NC_CYL_NR - 1
    Set ignition parameters if newly calculated:
    If bit x of PRM_STATE_IGN_UPD_ENA == 1
    Then
        ACTION_INFR_SetIgnDwell (x, TD_FAC_MIN_TMP, TD_IGC[x], TD_
FAC_MAX_TMP)
        ACTION_INFR_SetIgnAngle (x, IGA_IGC_H_RNG[x]**)**
    EndIf
Endfor

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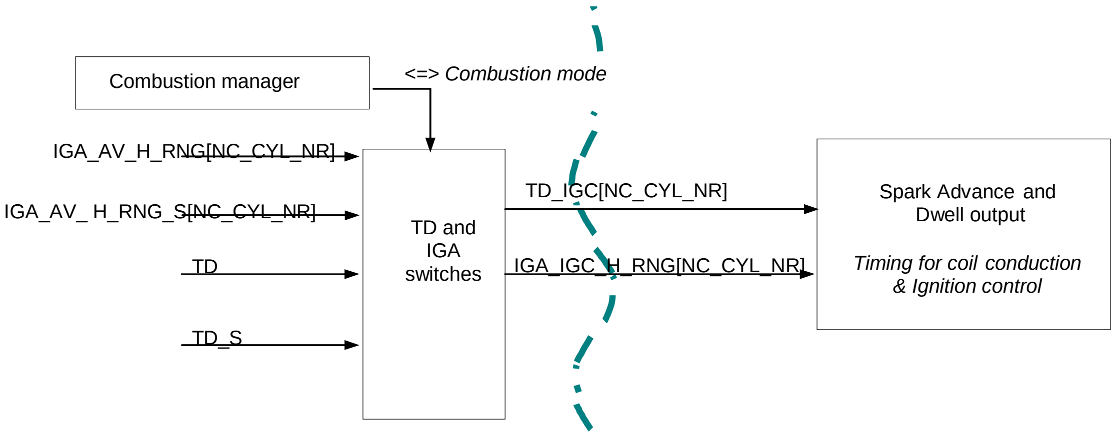
FUNCTION DESCRIPTION:

This module should cover all necessary switches between the different dwell times and ignition angles to ensure two outputs, TD_IGC[NC_CYL_NR] and IGA_IGC_H_RNG[NC_CYL_NR].

Initialisation: at reset
TD_IGC[NC_CYL_NR] = TD + TD_AD[NC_CYL_NR]
IGA_IGC_H_RNG[NC_CYL_NR] = IGA_AV_H_RNG[NC_CYL_NR]

For x = 0 **to** NC_CYL_NR - 1
ACTION_INFR_SetIgnDwell(x,TD_FAC_MIN,TD_IGC[x],TD_FAC_MAX)
ACTION_INFR_SetIgnAngle(x,IGA_IGC_H_RNG[x])
Endfor

Signal flow diagram:



Choice between homogeneous inputs and stratified inputs

The switch between homogeneous and stratified combustion mode could not be realised between TD_ON[NC_CYL_NR] and TD_OFF[NC_CYL_NR].
Switching is only possible if there's no action on the cylinder.
The switch has to be synchronised with the injection switch. The combustion manager managed by INJR does this synchronisation. The switch has to work per cylinder. Some inputs on this signal flow diagram are in fact use by the synchronization module of INJR.

6.6.1 Update of Ignition angle if homogeneous mode is selected

Application conditions

Activation: *LV_ST_END = 1: Engine synchronized*

Recurrence: 10ms

Formula section:

For x = 0 **to** NC_CYL_NR - 1
If INJ_MOD[x] == 'SNGH' **And** INJ_MOD_SP[x] == 'SNGH'
Or **[** INJ_MOD[x] == 'MPLH' **And** INJ_MOD_SP[x] == 'MPLH' **And** LV_IGN_INJ_SYN_DEAC = 1 **]**

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Or **[** INJ_MOD[x] == 'MPLH+PLS3' **And** INJ_MOD_SP[x] == 'MPLH+PLS3' **And** LV_IGN_INJ_SYN_DEAC = 1 **]**
Then IGA_IGC_H_RNG[x] = IGA_AV_H_RNG[x]
ACTION_INJR_IgnUpdate (x, IGA_IGC_H_RNG[x]**)**
ACTION_INFR_SetIgnAngle (x, IGA_IGC_H_RNG_ACT[x]**)**
Endif
Endfor

6.6.2 TD_LIM_MAX calculation

Application conditions

Activation: `Engine synchronized`

Recurrence: `10ms`

Initialisation: `at reset`

Formula section:

If VB < C_VB_TD_MAX_LIM_L
Then TD_LIM_MAX = NC_TD_LIM_MAX_H
Endif

If VB > C_VB_TD_MAX_LIM_H
Then TD_LIM_MAX = NC_TD_LIM_MAX_L
Endif

In every case: TD_IGC[x] * TD_FAC_MAX <= TD_LIM_MAX
TD_IGC[x] * TD_FAC_MIN >= NC_TD_LIM_MIN

NC_TD_LIM_MIN is defined for dwell time protection in case of advance ignition changes during the dwell time application. If the dwell time is equal to this minimal limit value, the advance ignition could be not guaranteed

NC_TD_LIM_MAX is defined for the maximum dwell time in case of advance ignition changes during the dwell time application. If the dwell time is equal to this maximal limit value, the advance ignition could be not guaranteed

Note: In any case, TD_FAC_MIN has to be smaller than 1 and TD_FAC_MAX greater than one to be sure to respect the requested dwell and avoid inconsistencies

care has to be taken with the setting of NC_TD_LIM_MAX_L and NC_TD_LIM_MAX_H in order to avoid Dwell Time /coil charging recovery:
Dwell time can start at the earliest at 288°CRK before the TDC.
NC_TD_LIM_MAX_L and NC_TD_LIM_MAX_H should be tuned in consequence to respect coil charging time no recovery and coil capacity

*TD MAX = min(TD_IGC[x] * TD_FAC_MAX , TD_LIM_MAX)*
*TD MIN = max(TD_IGC[x] * TD_FAC_MIN, NC_TD_LIM_MIN)*

6.6.3 Dwell time switch Ignition Actuator Tests Diagnosis

Application conditions

Activation:

```
[ LV_ES = 1              // Actuator tests activation
  and   LV_IGK        = 1
  and   LV_FIRST_VLD_TOOTH = 0
  and   LV_INH_IGC[x] = 0
```

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```
and      at least one LV_IGC _EXT_ADJ[x] = 1]
```

Deactivation:

```
[ LV_ES  = 0          // Actuator tests deactivation
  or        LV_IGK        = 0
  or      LV_FIRST_VLD_TOOTH = 1
or     LV_INH_IGC[x]  = 1
  or        at least one LV_IGC_EXT_ADJ[x] = 0]
```

Recurrence: `On transition of IGC_EXT_ADJ[x] from 0 to 1`

System description:

For ignition coil actuator tests purpose, the Dwell Time has to be applied and transmitted to BSW via action. A specific service is used for those tests purposes.

Formula section:

If (INJ_MOD[x] & NC_INJ_MOD_MASK_1) != NC_INJ_MOD_HOM *// Stratified mode for cyl. _x*
Then TD_IGC[x] = TD_S
Else TD_IGC[x] = TD
Endif

For x = 0 **to** NC_CYL_NR - 1
If LV_IGC _EXT_ADJ[x] = 1
Then On transition of IGC _EXT_ADJ[x] from 0 to 1
And LV_FIRST_VLD_TOOTH = 0
ACTION_INFR_SetIgcDwellTest(x,TD_IGC[x])
ElseIf LV_FIRST_VLD_TOOTH = 1
ACTION_INFR_SetIgcDwellTest(x,0) *// immediate cut of tests on engine running*
EndIf
EndFor

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6.7 Ignition with multiple spark

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGN_MPL_NR [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Number of ignition sparks					
T_CTR_TD_MPL	V	0... FFFFH	0... 6553.5	0,1	s
Maintenance Time of Multiple Spark activation before Out Case					
TD_MPL	O/V	0... FFFFH	0... 262.14	0,004	ms
Dwell time for multiple spark (for 2ˆnd and others MPL sparks)					
TD_MPL_1	O/V	0... FFFFH	0... 262.14	0,004	ms
Dwell time for 1ˆst multiple spark (e.g. 1ˆst spark after main spark)					
TD_MPL_1_DLY	O/V	0... FFFFH	0... 262.14	0,004	ms
Dwell time interruption between main spark and 1ˆst MPL spark					
TD_MPL_DLY	O/V	0... FFFFH	0... 262.14	0,004	ms
Dwell time interruption between MPL sparks (except between main and 1ˆst MPL spark)					

Input data:

INJ_MOD [NC_CYL_NR] {p. 2037}	INJ_MOD_MPL {p. 1896}	LDPM_N_32_1_IGRE	LDPM_VB_1_IGRE
LV_ES {p. 1720}	LV_FL {p. 1759}	LV_INH_TD_MPL {p. 1896}	LV_IS {p. 1720}
LV_PL {p. 1720}	LV_PU {p. 1720}	LV_PUC {p. 1720}	LV_ST {p. 1720}
LV_TD_MPL_SPC_IGN_ ACT {p. 1896}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}	NC_INJ_MOD_HOM {p. 2045}
NC_INJ_MOD_MASK_1 {p. 2045}	NR_MPL_CYL_IGN [NC_CYL_NR] {p. 1896}	TCO {p. 1100}	TEMP_MDL_IGC {p. 1896}
VB {p. 1185}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_MAX_MPL_IS	-	0... FFH	0... 8160	32	rpm
Engine speed max for ignition with multiple spark at idle					
C_N_MAX_MPL_PL_PU_FL	-	0... FFH	0... 8160	32	rpm
Engine speed max for ignition with multiple spark at Run					
C_N_MAX_MPL_PUC	-	0... FFH	0... 8160	32	rpm
Engine speed max for ignition with multiple spark at Fuel cut off					
C_N_MAX_MPL_ST	-	0... FFH	0... 8160	32	rpm
Engine speed max for ignition with multiple spark at Start					
C_N_MIN_MPL_IS	-	0... FFH	0... 8160	32	rpm
Engine speed min for ignition with multiple spark at Idle					
C_N_MIN_MPL_PL_PU_FL	-	0... FFH	0... 8160	32	rpm
Engine speed min for ignition with multiple spark at Run					
C_N_MIN_MPL_PUC	-	0... FFH	0... 8160	32	rpm
Engine speed min for ignition with multiple spark at fuel cut off					
C_N_MIN_MPL_ST	-	0... FFH	0... 8160	32	rpm
Engine speed min for ignition with multiple spark at Start					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_CTR_TD_MPL	-	0... FFFFH	0... 655.35	0,01	s
Maintenance Time of Multiple Spark activation before Out Case					
C_T_CTR_TD_MPL_AST	-	0... FFFFH	0... 655.35	0,01	s
Maintenance Time of Multiple Spark activation before Out Case and for the After Start phase					
C_TCO_MAX_MPL_IS	-	0... FEH	-48... 142.5	0.75	°C
Max. Coolant Temp. to have multiple spark at Idle speed					
C_TCO_MAX_MPL_PL_PU_FL	-	0... FEH	-48... 142.5	0.75	°C
Max. Coolant Temp. to have multiple spark at Run					
C_TCO_MAX_MPL_PUC	-	0... FEH	-48... 142.5	0.75	°C
Max. Coolant Temp. To have multiple spark at fuel cut off					
C_TCO_MAX_MPL_ST	-	0... FEH	-48... 142.5	0.75	°C
Max. Coolant Temp. to have multiple spark at start					
C_TD_MPL_MAN	-	0... 1H	0 ...1	1	-
Manual activation of the MPL					
C_TEMP_MDL_IGC_HYS	-	0... FFH	-40 ...215	1	°C
Estimated coil temperature minimum threshold					
C_TEMP_MDL_IGC_MAX	-	0... FFH	-40 ...215	1	°C
estimated coil temperature maximum threshold					
C_VB_MAX_MPL_IS	-	0... FFH	0... 26	0.102	V
Max. Battery voltage to have multiple spark (requested value 16V) at idle speed					
C_VB_MAX_MPL_PL_PU_FL	-	0... FFH	0... 26	0.102	V
Max. Battery voltage to have multiple spark (requested value 16V) at Run					
C_VB_MAX_MPL_PUC	-	0... FFH	0... 26	0.102	V
Max. Battery voltage to have multiple spark (requested value 16V) at fuel cut off					
C_VB_MAX_MPL_ST	-	0... FFH	0... 26	0.102	V
Max. Battery voltage to have multiple spark (requested value 16V) at start					
IP_FAC_TCO_NR_MPL	-	0... 50H	0 ...8	0.1	-
LDPM_TCO_1_IGRE	8	0... FEH	-48... 142.5	0.75	°C
TCO factor used to calculate multiple spark number in homogeneous mode					
IP_FAC_TCO_NR_MPL_S	-	0... 50H	0 ...8	0.1	-
LDPM_TCO_1_IGRE	8	0... FEH	-48... 142.5	0.75	°C
TCO factor used to calculate multiple spark number in stratified mode					
IP_FAC_TEMP_MDL_IGC_NR_MPL	-	0... 50H	0 ...8	0.1	-
LDPM_TEMP_MDL_IGC_1_IGRE	8	0... FFH	-40 ...215	1	°C
estimated coil temperature factor used to calculate multiple spark number in homogeneous mode					
IP_FAC_TEMP_MDL_IGC_NR_MPL_S	-	0... 50H	0 ...8	0.1	-
LDPM_TEMP_MDL_IGC_1_IGRE	8	0... FFH	-40 ...215	1	°C
estimated coil temperature factor used to calculate multiple spark number in stratified mode					
IP_NR_MPL	V	0... FFH	0... 255	1	-
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_MV_1_IGRE	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Number of successive ignition sparks depending on engine speed and mass fuel in homogeneous mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_NR_MPL_S	V	0... FFH	0... 255	1	-
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	Rpm
LDPM_MFF_SP_MV_1_IGRE	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Number of successive ignition sparks depending on engine speed and mass fuel in stratified mode					
IP_TD_MPL	-	0... FFFFH	0... 262.14	0,004	ms
LDPM_VB_1_IGRE	8	0... FFH	0... 26	0.102	V
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Dwell time for multiple spark in homogeneous mode confirmed					
IP_TD_MPL_1	V	0... FFFFH	0... 262.14	0,004	ms
LDPM_VB_1_IGRE	8	0... FFH	0... 26	0.102	V
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Dwell time for 1ˆst multiple spark in homogeneous mode confirmed					
IP_TD_MPL_1_S	V	0... FFFFH	0... 262.14	0,004	ms
LDPM_VB_1_IGRE	8	0... FFH	0... 26	0.102	V
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Dwell time for 1ˆst multiple spark in stratified mode confirmed					
IP_TD_MPL_S	-	0... FFFFH	0... 262.14	0,004	ms
LDPM_VB_1_IGRE	8	0... FFH	0... 26	0.102	V
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Dwell time for multiple spark in stratified mode confirmed					
IP_TD_T_MPL	-	0... FFFFH	0... 262.14	0,004	ms
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Minimum time between two ignition (normal value 150µs) in homogeneous mode					
IP_TD_T_MPL_1	V	0... FFFFH	0... 262.14	0,004	ms
LDPM_VB_1_IGRE	8	0... FFH	0... 26	0.102	V
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Time delay between mains spark and start of ign coil drive for 1ˆst MPL spark (homogeneous mode confirmed)					
IP_TD_T_MPL_1_S	V	0... FFFFH	0... 262.14	0,004	ms
LDPM_VB_1_IGRE	8	0... FFH	0... 26	0.102	V
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Time delay between main spark and start of ign coil drive for 1ˆst MPL spark (stratified mode confirmed)					
IP_TD_T_MPL_S	-	0... FFFFH	0... 262.14	0,004	ms
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Minimum time between two ignition (normal value 150µs) in stratified mode					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_MAX_IGN_MPL_NR	-	0... FFH	0... 255	1	-
Maximum multiple spark - Typical value for debug:7					
NC_MPL_IGN_H_RNG_CRK_MAX	-	0... 12C0H	0... 300	0.0625	°CRK
Maximum ignition angle after TDC to start TD_MPL (normal value 12 to 18 °CRK)					
NC_MPL_T_MAX	-	0... FFFFH	0... 262.14	0.004	ms
Maximum time duration of Multiple Spark (Normal value 60 ms)					

Import actions:

Continued on next page

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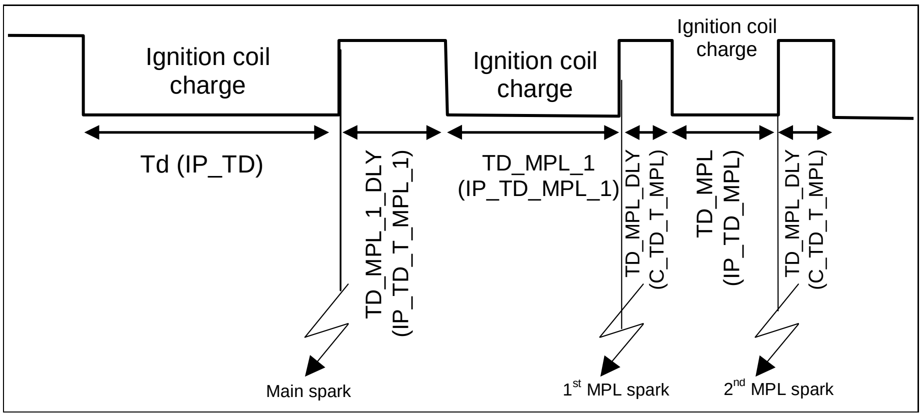
ACTION_ INFR_SetIgnMpl (**IN**<No Name available>,**IN**<No Name available>,**IN**<No Name available>,**IN**<No Name available>,**IN**<No Name available>,**IN**<No Name available>)

6.7.1 Calculation of parameters for multiple spark

FUNCTION DESCRIPTION:

With this function several subsequent sparks could be created. The delay time to create a spark and the time to reload the coil are defined in tables depending on battery voltage and on engine speed.
At start and for the following application conditions, the ignition is controlled by means of multiple sparks.
After an adjustable combustion period, the ignition coil is loaded with a specific dwell time to create successive sparks. The number of successive sparks is defined as IGN_MPL_NR.
The multiple sparks ignition can also be activated by the input flag LV_TD_MPL_SPC_IGN_ACT. In this case, the 1^{st} MPL spark (e.g. the first spark after the main spark) is controlled by specific calibration data IP_TD_MPL_1 and IP_TD_T_MPL_1 (see the picture below for more explanation).
If LV_TD_MPL_SPC_IGN_ACT is inactive, the 1^{st} MPL spark takes the same parameters than the other MPL sparks.



The MPL Sparks are maintained during a time (C_T_CTR_TD_MPL_AST or C_T_CTR_TD_MPL) after the end of the activation condition, before exiting this MPL procedure (*Application Multiple Spark Maintenance for a time before Exit Case*)
We use an estimated coil temperature to limit the number of multiple sparks and then protect ignition coil.
We also increase the number of multiple sparks in case of misfiring.
Priority is given to the protection of ignition coil, according to the estimated temperature coil compared to a maximum value: C_TEMP_MDL_IGC_MAX.

Application conditions

Initialisation:

```
IGN_MPL_NR = 0
    TD_MPL          = 0
TD_MPL_1        = 0
    TD_MPL_DLY     = 0
    TD_MPL_1_DLY  = 0
T_CTR_TD_MPL       = 0          At reset and in deactivation
condition
```

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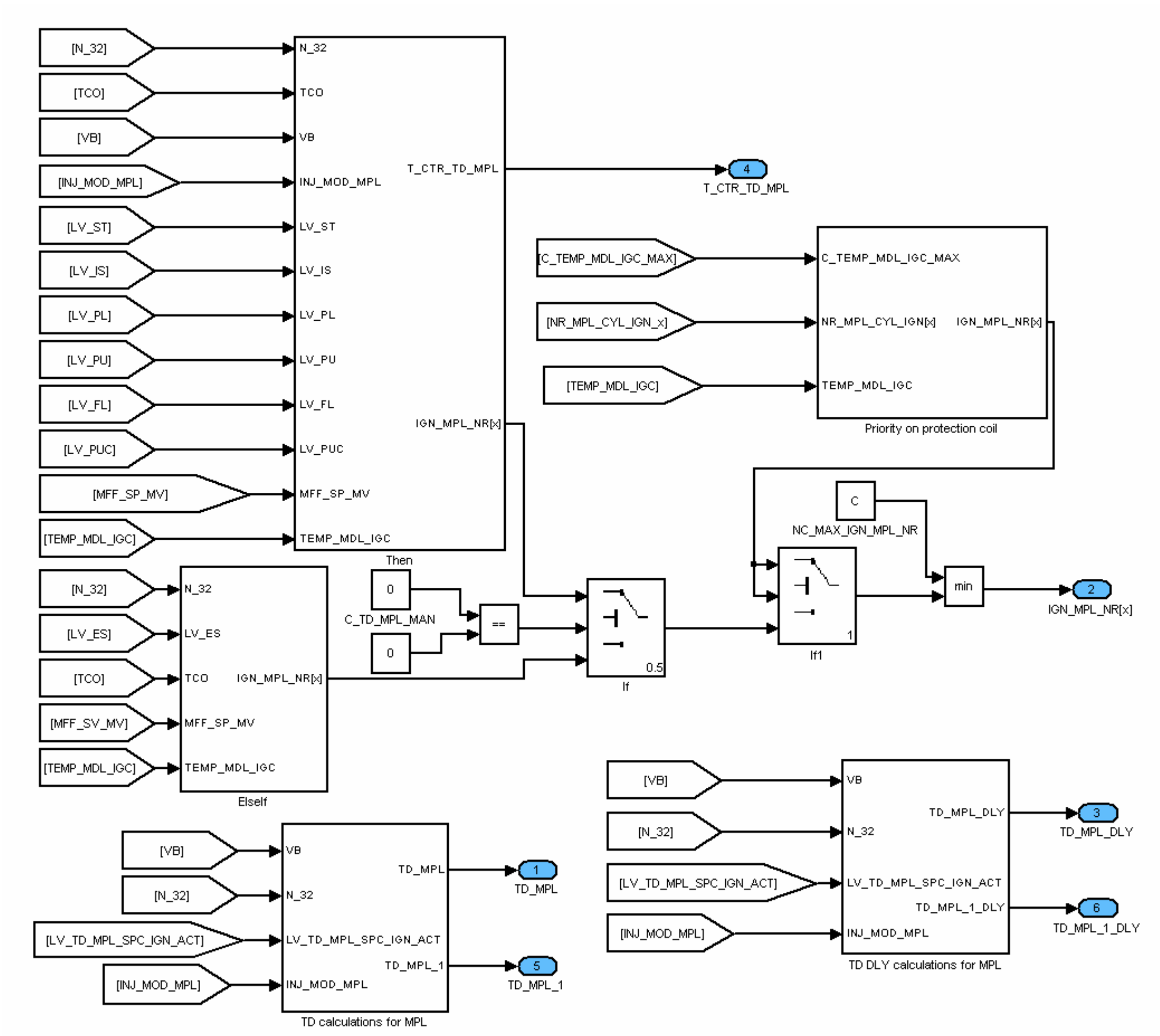
Recurrence: 10 ms
Activation: LV_INH_TD_MPL = 0

Deactivation: LV_INH_TD_MPL = 1

Formula section:



IGRE_TD_MPL

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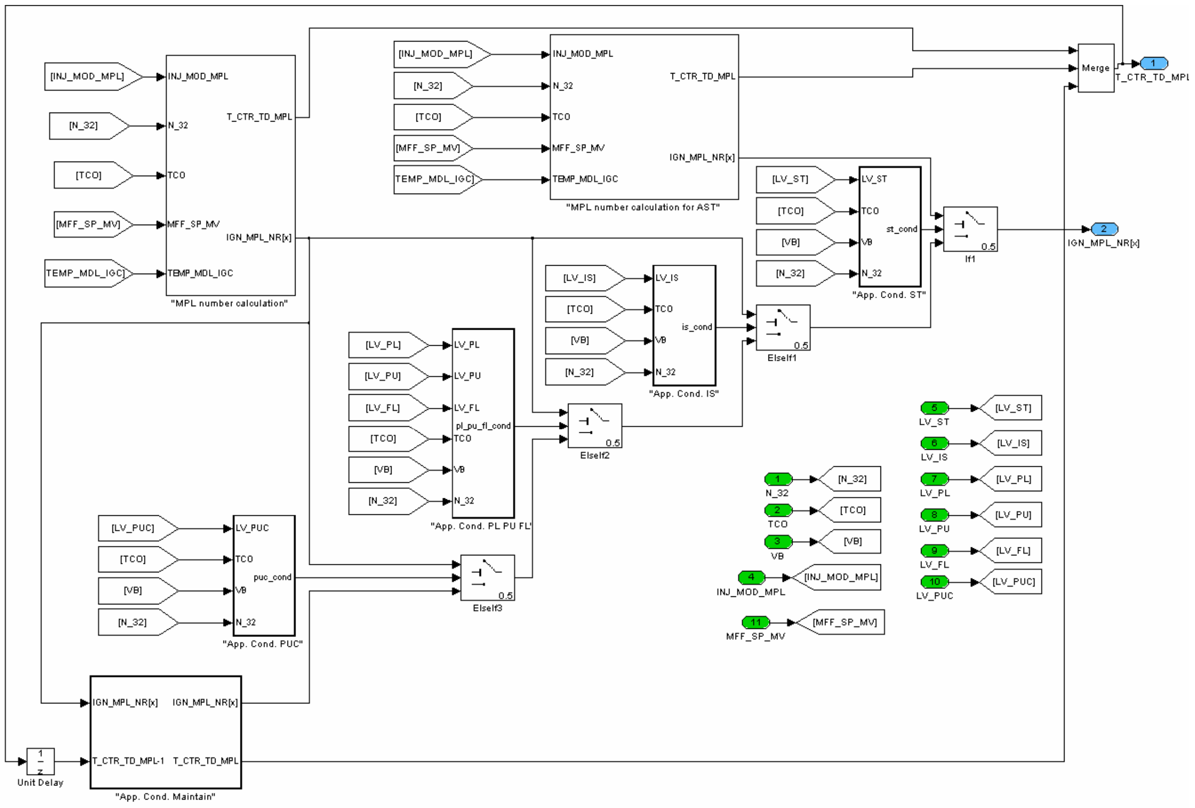

iGRE_TD_MPL / Then

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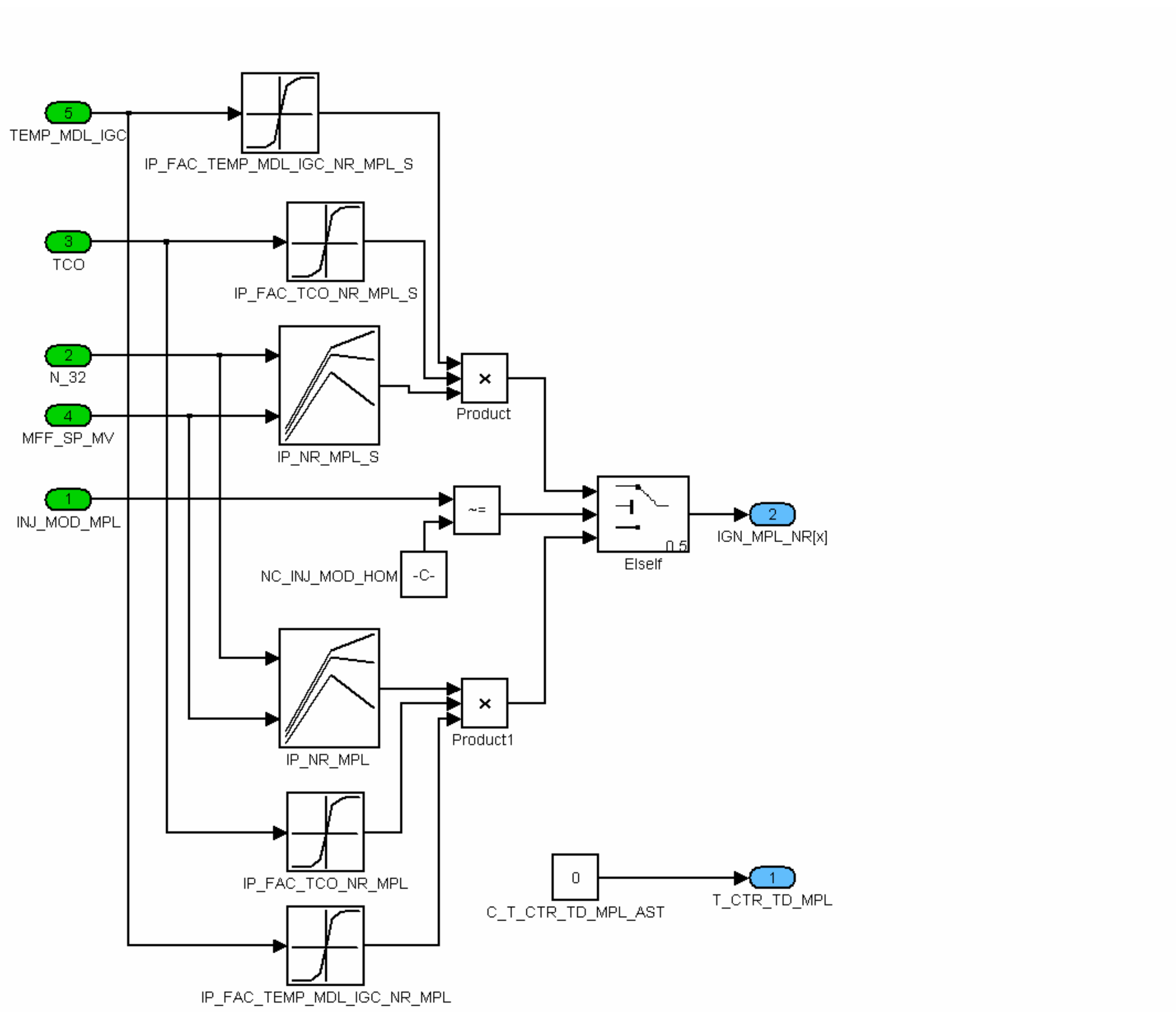

IGRE_TD_MPL / Then / MPL number calculation for AST

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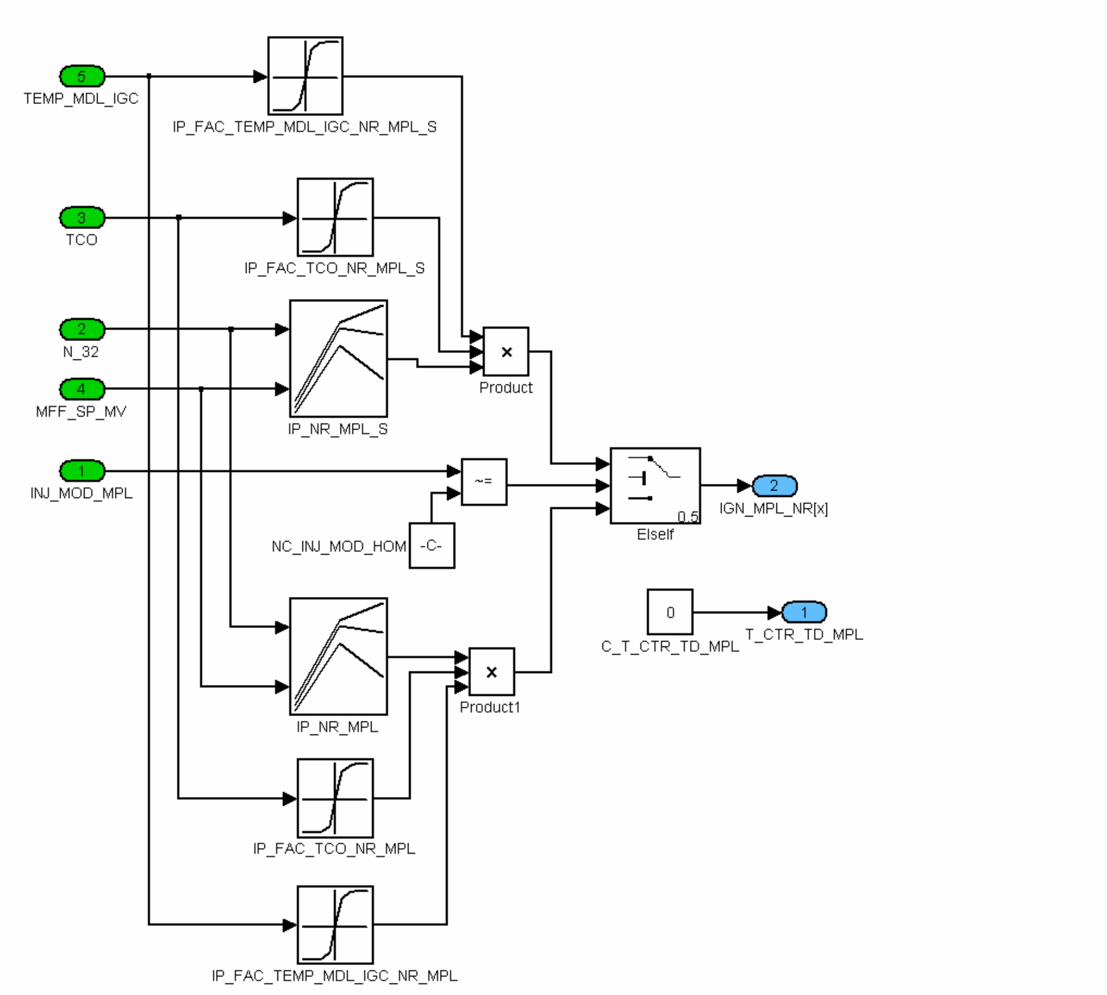

Figure 6.7.1: IGRE_TD_MPL /Then /MPL number calculation

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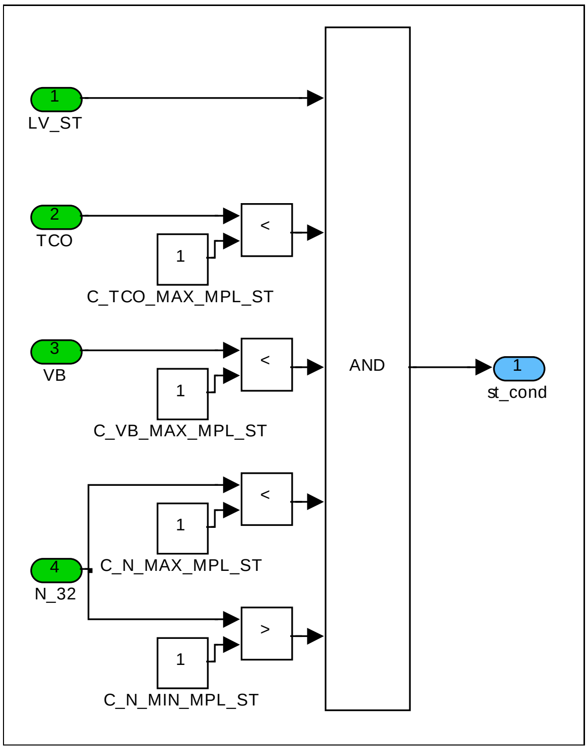

Figure 6.7.2: IGRE_TD_MPL /Then /App. Cond. ST

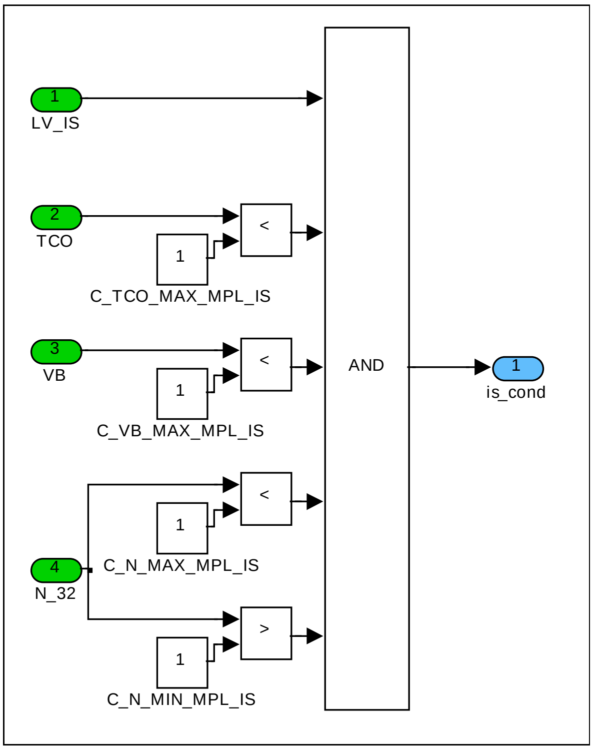

Figure 6.7.3: IGRE_TD_MPL /Then /App. Cond. IS

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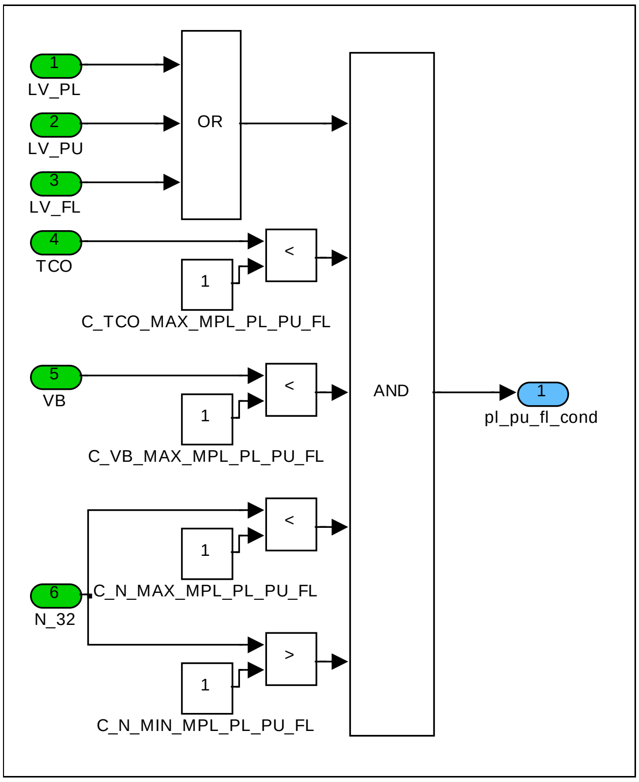

Figure 6.7.4: IGRE_TD_MPL /Then /App. Cond. PL PU FL

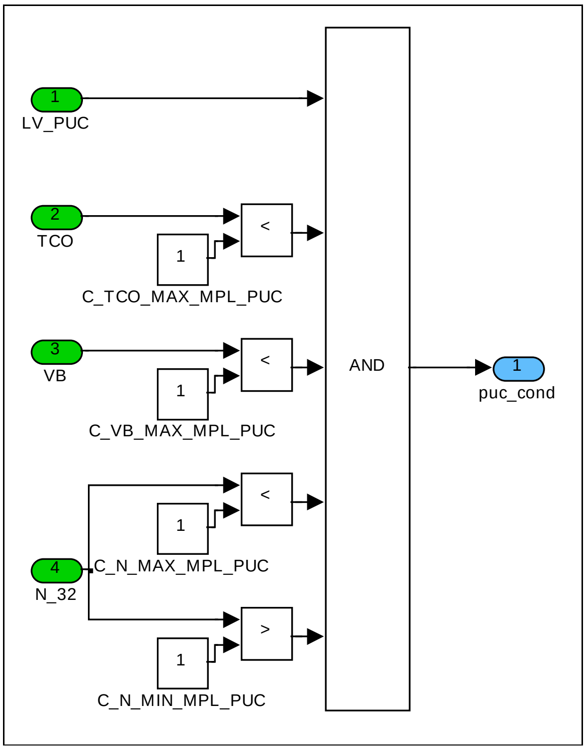

Figure 6.7.5: IGRE_TD_MPL /Then /App. Cond. PUC

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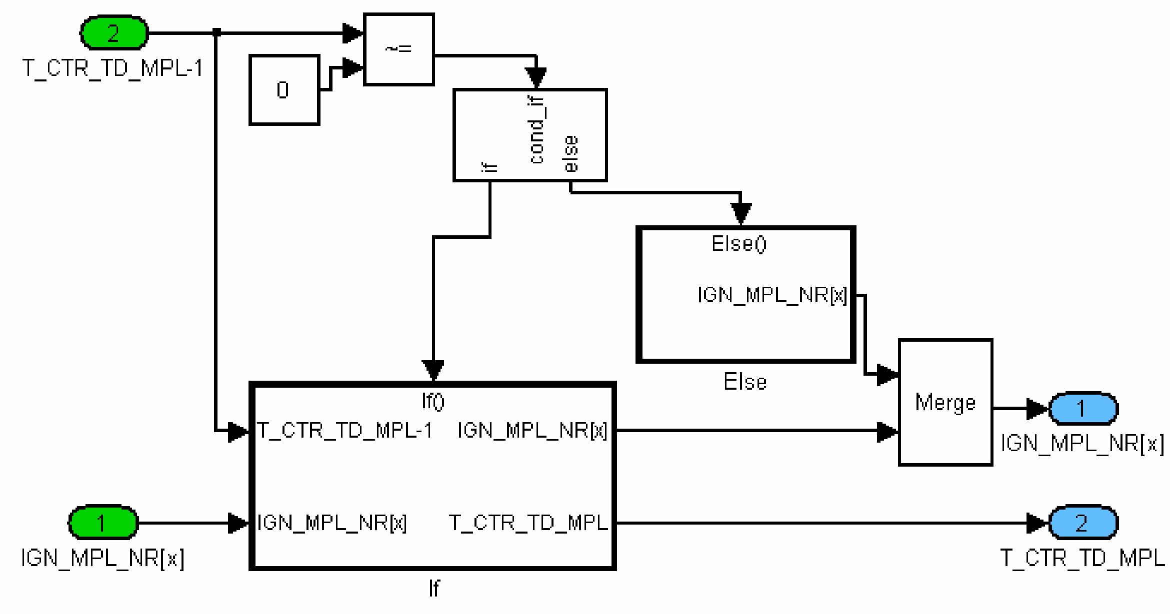

Figure 6.7.6: IGRE_TD_MPL /Then /App. Cond. Maintain

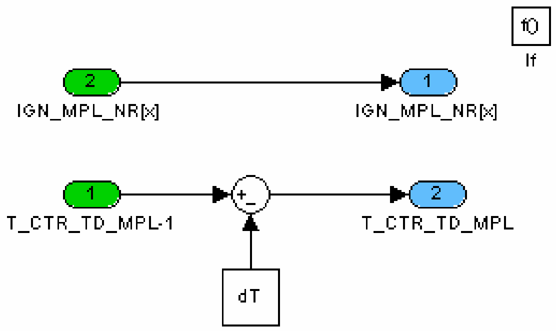

Figure 6.7.7: IGRE_TD_MPL /Then /App. Cond. Maintain /If

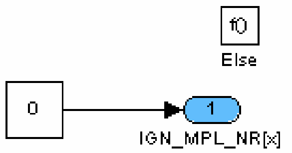

Figure 6.7.8: IGRE_TD_MPL /Then /App. Cond. Maintain /Else

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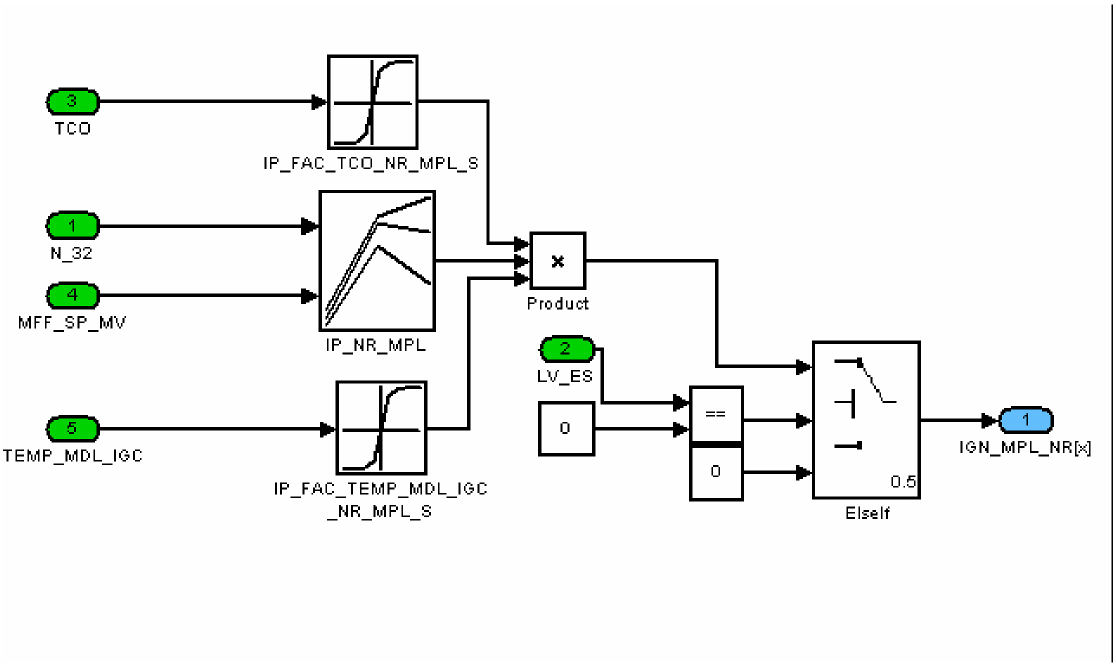

Figure 6.7.9: IGRE_TD_MPL /ElseIf

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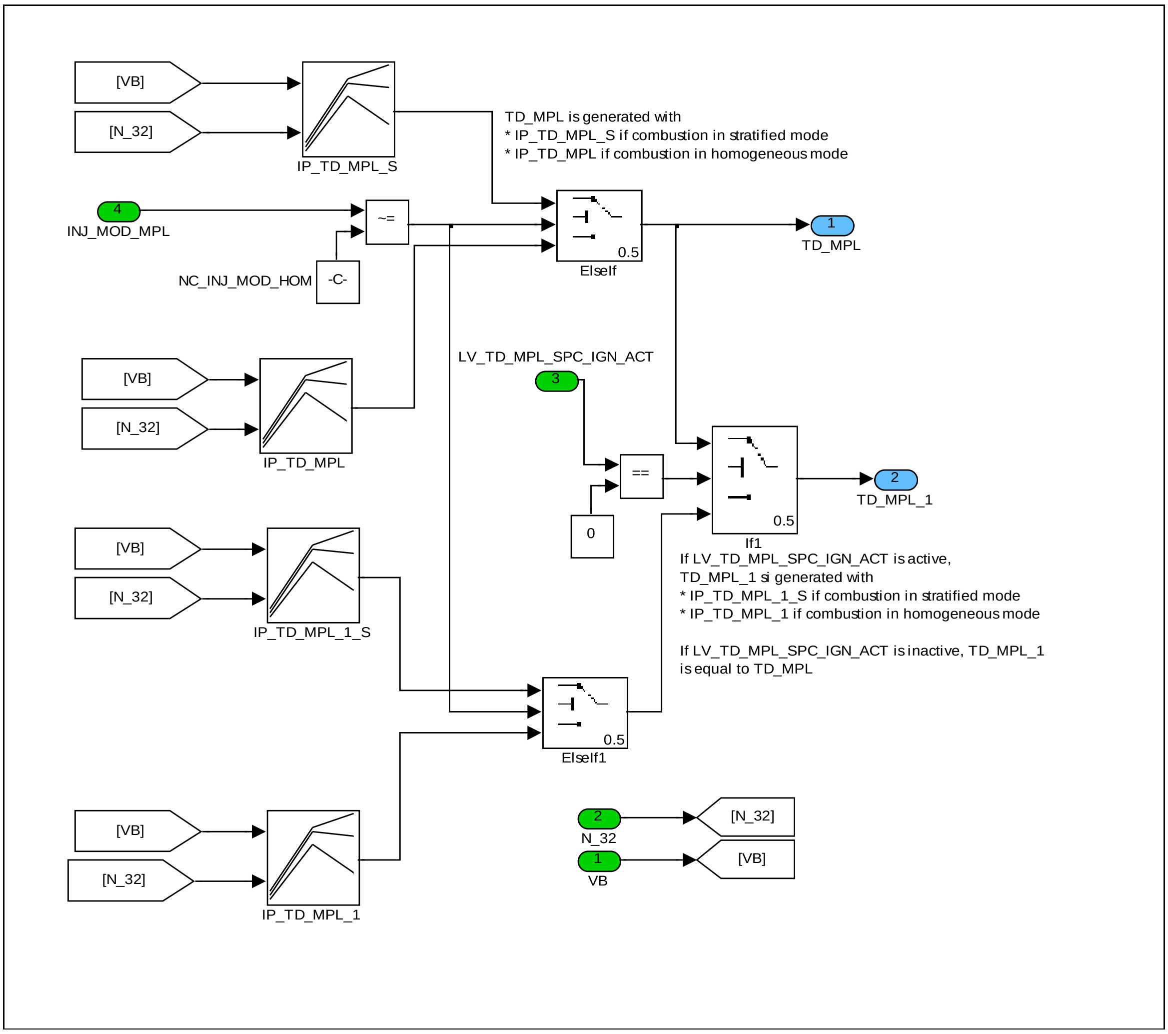

Figure 6.7.10: IGRE_TD_MPL /TD calculations for MPL

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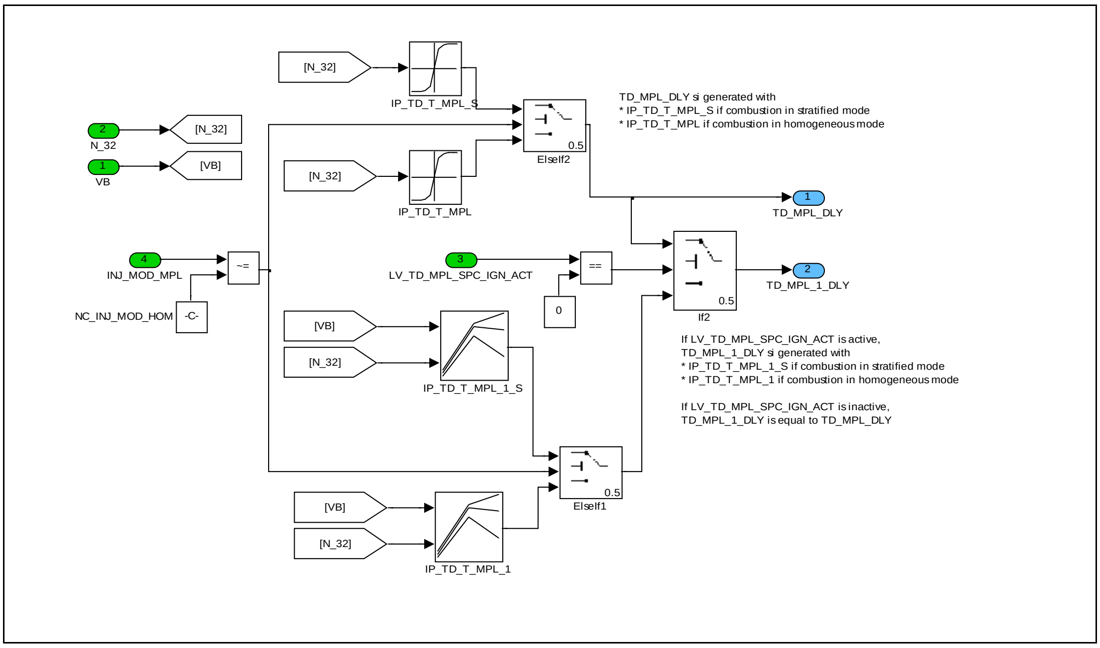

Figure 6.7.11: IGRE_TD_MPL /TD DLY calculations for MPL

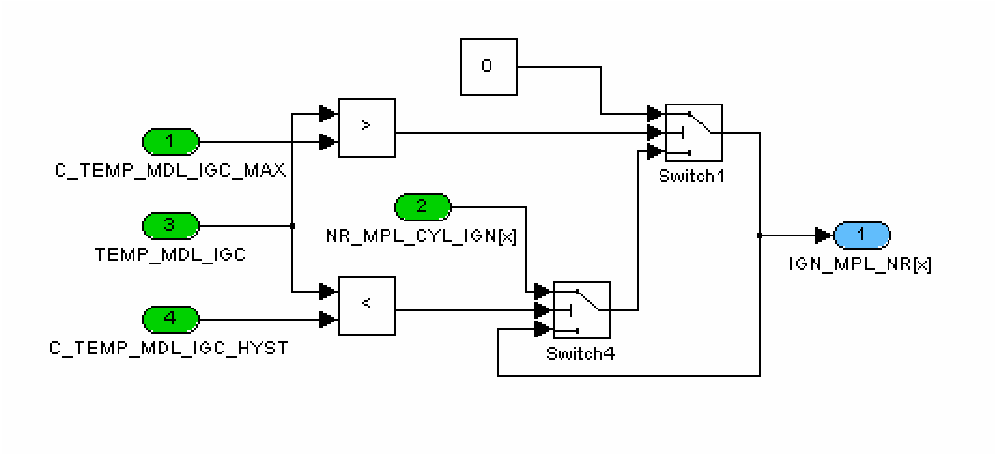

Figure 6.7.12: Priority on protection coil

6.7.2 Settings of multiple spark parameters

Application conditions

Initialisation: *At reset*
ACTION_INFR_SetIgnMpl (x, TD_MPL_1, TD_MPL, TD_MPL_1_DLY, TD_MPL_DLY, IGN_MPL_NR[x])

Recurrence: 10 ms

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Formula section:

For x = 0 **to** NC_CYL_NR - 1
ACTION_INFR_SetIgnMpl (x, TD_MPL_1, TD_MPL, TD_MPL_1_DLY, TD_MPL_DLY, IGN_MPL_NR[x])
EndFor

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6.8 Ignition with multiple spark (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EGY_COLD_IGC	O/V	0... FFFFH	0... 6553.5	0.1	W
Lost energy in the ignition coils because of cooling					
EGY_HEAT_IGC	O/V	0... FFFFH	0... 6553.5	0.1	W
Ignition energy of the ignition coils					
EGY_HEAT_IGC_HOM	O/V	0... FFFFH	0... 6553.5	0.1	W
Ignition energy of the ignition coils in homogeneous mode					
EGY_HEAT_IGC_S	O/V	0... FFFFH	0... 6553.5	0.1	W
Ignition energy of the ignition coils in stratified mode					
INJ_MOD_MPL	O/V	0... FFH	0... 255	1	-
Variable indicating if combustion mode is considered as homogeneous or stratified					
LV_INH_TD_MPL	O/V	0... 1H	0 ...1	1	-
Inhibition for multiple spark					
LV_TD_MPL_SPC_IGN_ACT	O/V	0... 1H	0 ...1	1	-
Activation of the 2° ignition event using modified extended MPL					
NR_MPL_CYL_IGN [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Number of MPL for selected cylinder by BMW layer word label in homogeneous mode					
TEMP_COOL	V	0... FFH	-40 ...215	1	°C
Cooling temperature of ignition coils					
TEMP_MDL_IGC	O/V/S	0... FFH	-40 ...215	1	°C
Estimated coil temperature					

Input data:

IGN_MPL_NR [NC_CYL_NR] {p. 1881}	INJ_MOD [NC_CYL_NR] {p. 2037}	LV_TD_AD_H {p. 937}	N_32 {p. 1525}
NC_CYL_NR {p. 1526}	STATE_MPL_CYL_IGN {p. 8264}	TAM {p. 1579}	TCO {p. 1100}
TECU {p. 1256}	TOIL {p. 8204}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ALFA_A_IGC	-	0... 3E8H	0 ...1	1e-3	W/K
Product of heat-transfer-coefficient and area of the ignition coils					
C_CP_M_IGC	-	0... 2710H	0... 1000	0.1	J/K
Product of heat-capacity and mass of ignition coils					
C_N_MAX_MPL_SPC_IGN_ACT	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for 2° ignition event activation					
C_TCO_STE	-	0... FEH	-48... 142.5	0.75	°C
Minimum threshold for calculation of temperature model					
C_TECU_MAX_IGN_MPL	-	0... FEH	-48... 142.5	0.75	°C
TECU threshold to disable multiple spark activation					
C_TEMP_COOL_INI	-	0... FFH	-40 ...215	1	°C
Initialisation of ignition coils cooling temperature					
C_TEMP_GRD	-	0... 320H	0 ...8	0.01	-
Temperature gradient in integrator-block					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TEMP_MDL_IGC_HYS_MAX	-	0... FFH	-40 ...215	1	°C
Estimated coil temperature maximum threshold					
C_TEMP_MDL_IGC_HYS_MIN	-	0... FFH	-40 ...215	1	°C
Estimated coil temperature minimum threshold					
C_TEMP_MDL_IGC_INI	-	0... FFH	-40 ...215	1	°C
initialization-value for temperature model					
C_TEMP_MDL_IGC_INT_MAX	-	0... FFH	-40 ...215	1	°C
Integrator maximum limit of coil model-temperature					
C_TEMP_MDL_IGC_INT_MIN	-	0... FFH	-40 ...215	1	°C
Integrator minimum limit of coil model-temperature					
C_TOIL_IGC_MAX	-	0... C8H	-40 ...160	1	°C
Maximum threshold for oil temperature					
C_TOIL_IGC_MIN	-	0... C8H	-40 ...160	1	°C
Threshold for TOIL					
ID_NR_IGN_MPL	-	0... FFH	0... 255	1	-
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Number of successive ignition sparks in homogeneous mode if misfiring is detected					
ID_NR_IGN_MPL_S	-	0... FFH	0... 255	1	-
LDPM_N_32_1_IGRE	8	0... FFH	0... 8160	32	rpm
Number of successive ignition sparks in stratified mode if misfiring is detected					
IP_EFF_IGC	-	0... 7FH	0... 1.984375	0.015625	-
LDP_TEMP_MDL_IGC_IP_EFF_IGC	6	0... FFH	-40 ...215	1	°C
Efficiency of ignition coils depending on model temperature					
IP_EGY_IGC_HOM	V	0... FFFFH	0... 6553.5	0.1	W
LDPM_IGN_MPL_NR_IP_EGY_IGC	8	0... FFH	0... 255	1	-
LDPM_N_32	8	0... FFH	0... 8160	32	rpm
ignition energy in homogeneous mode					
IP_EGY_IGC_S	V	0... FFFFH	0... 6553.5	0.1	W
LDPM_IGN_MPL_NR_IP_EGY_IGC	8	0... FFH	0... 255	1	-
LDPM_N_32	8	0... FFH	0... 8160	32	rpm
ignition energy in stratified mode					
IP_TAM_COR	-	0... FE00H	-48... 142.5	2.92969e-3	°C
LDP_TAM_IP_TAM_COR	6	0... FEH	-48... 142.5	0.75	°C
Temperature correction due to ambient temperature influence					
LC_TD_MPL_SPC_IGN_ACT	-	0... 1H	0 ...1	1	-
Calibration for activation control of 2° ignition event using modified extended MPL to switch off					
LC_TEMP_IGC_VAR	-	0... 1H	0 ...1	1	-
Switch between TOIL and TCO for TEMP_COOL					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_INJ_MOD_HOM	-	0... FFH	0... 255	1	-
NC_INJ_MOD_HOM					
NC_INJ_MOD_MASK_1	-	0... FFH	0... 255	1	-
Mask					
NC_INJ_MOD_S	-	0... FFH	0... 255	1	-
Constant defined to indicate stratified mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

General Information

Application Conditions

Initialization: RST, NVMINI, NVMSTO, NVMRES
Recurrence: 100MS if alwayselse 10MS
Activation: 100MS: always
10MS: always
Deactivation: never
Additionally Activation of one event deactivates others

Function description

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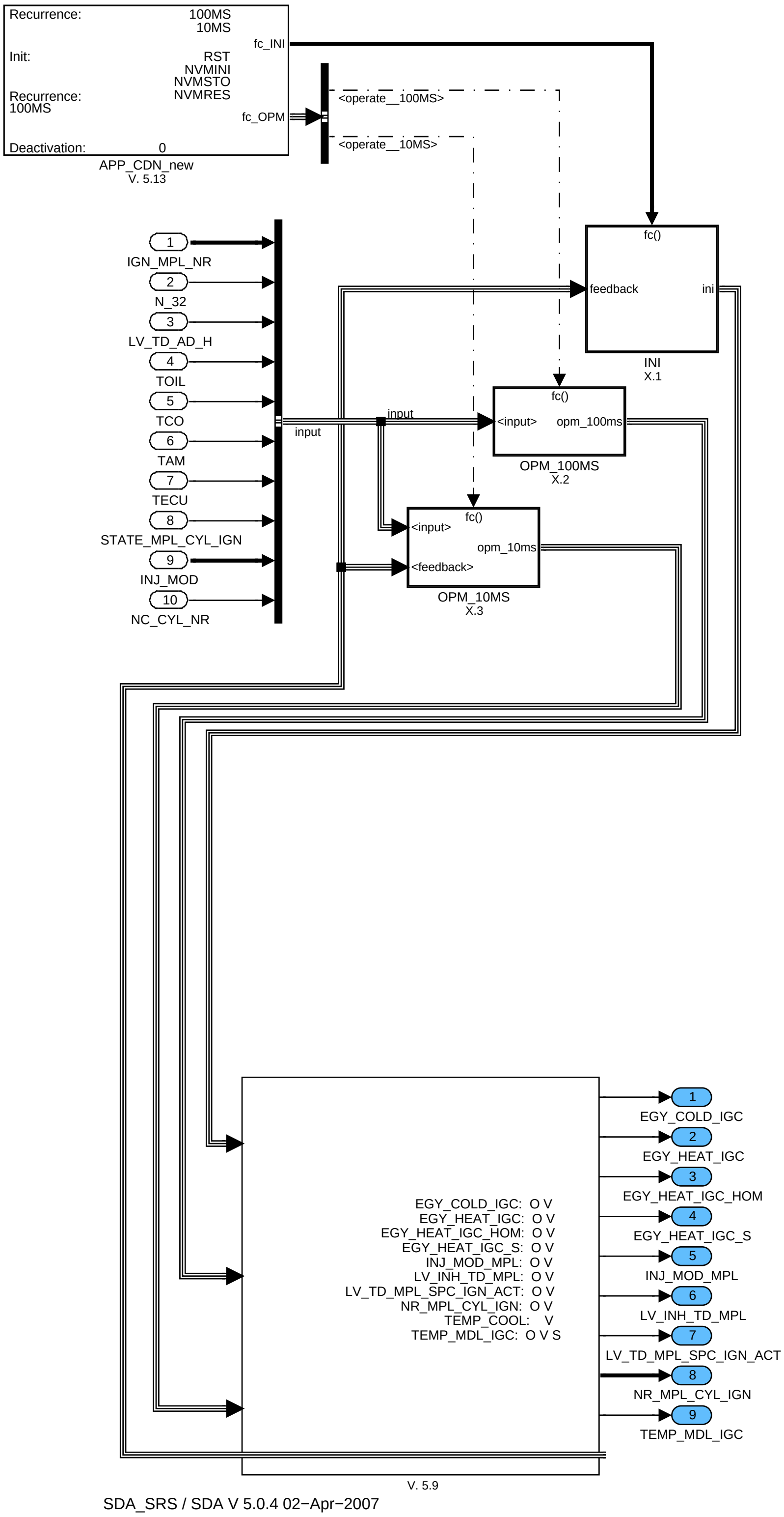

x

Figure 6.8.1: : Path: IGRE_M602J

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6.8.1 Initialization

6.8.1.1 Initialization of TEMP_MDL_IGC in non-volatile-memory

The last calculated value of TEMP_MDL_IGC shall be stored.

6.8.1.1.1 Initialization of TEMP_MDL_IGC

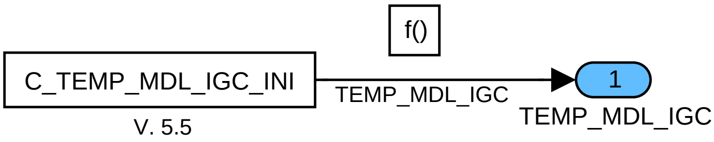

Figure 6.8.2: : Path: IGRE_M602J/INI/NVMY/INI_NVMY

6.8.1.1.2 Initialization of TEMP_MDL_IGC out of NVMY

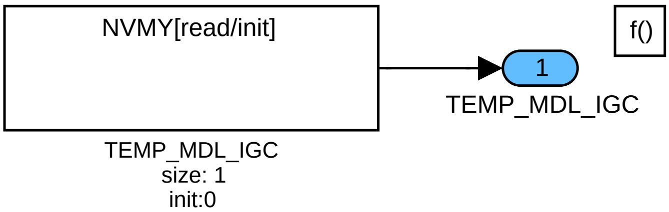

Figure 6.8.3: : Path: IGRE_M602J/INI/NVMY/RD_NVMY

6.8.1.1.3 Storing of TEMP_MDL_IGC in NVMY

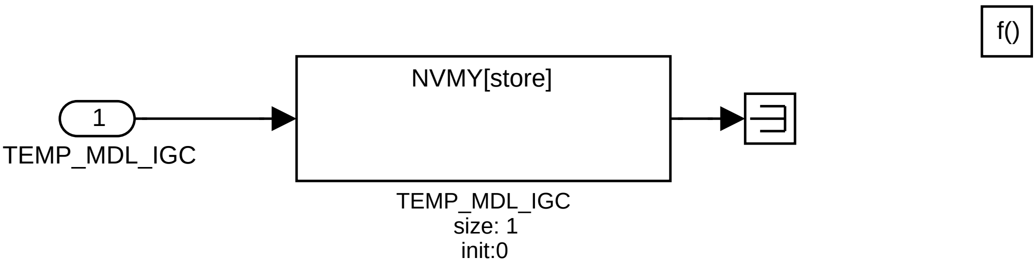

Figure 6.8.4: : Path: IGRE_M602J/INI/NVMY/SAVE_NVMY

6.8.1.2 Initialization values

Initialization

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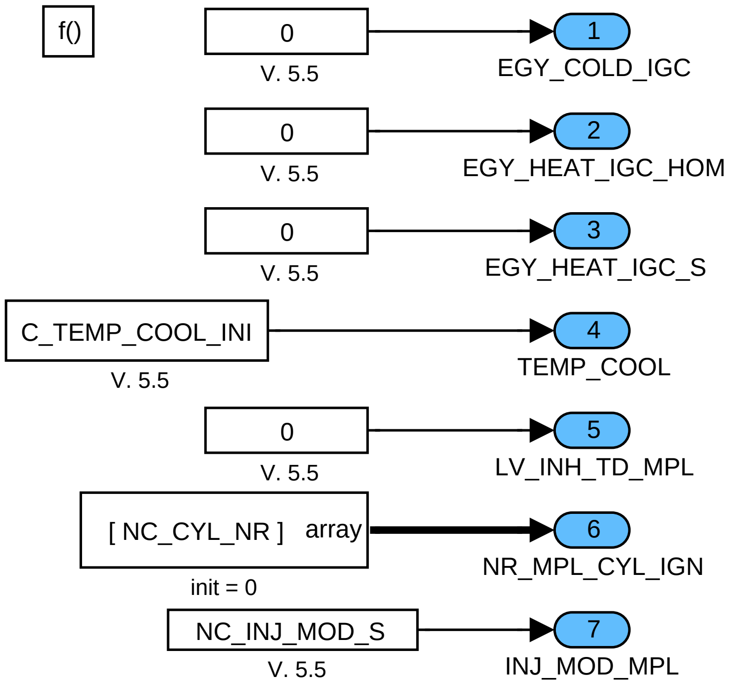

Figure 6.8.5: : Path: IGRE_M602J/INI/RST

6.8.2 Recurrence 100ms

6.8.2.1 Calculation of cooling temperature for temperature model (recurrence 100ms)

The cooling temperature is calculated as the sum of the influence of the ambient temperature and TOIL or TCO. The customer wants the LC to choose between TOIL and TCO because he is not sure which one is correct. In a future version the selection will be removed.

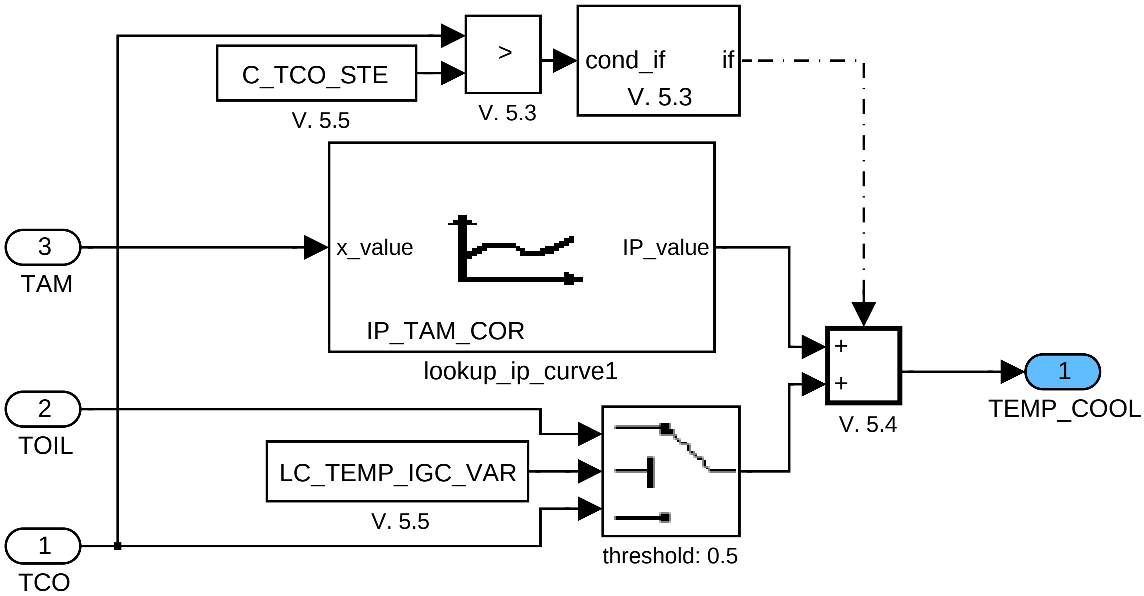

Figure 6.8.6: : Path: IGRE_M602J/OPM_100MS/TEMP

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6.8.3 Recurrence 10ms

6.8.3.1 Temperature Model for Ignition Coils (recurrence 10ms)

The function shall only be calculated when the activation-condition TCO>C_TCO_STE is fulfilled.

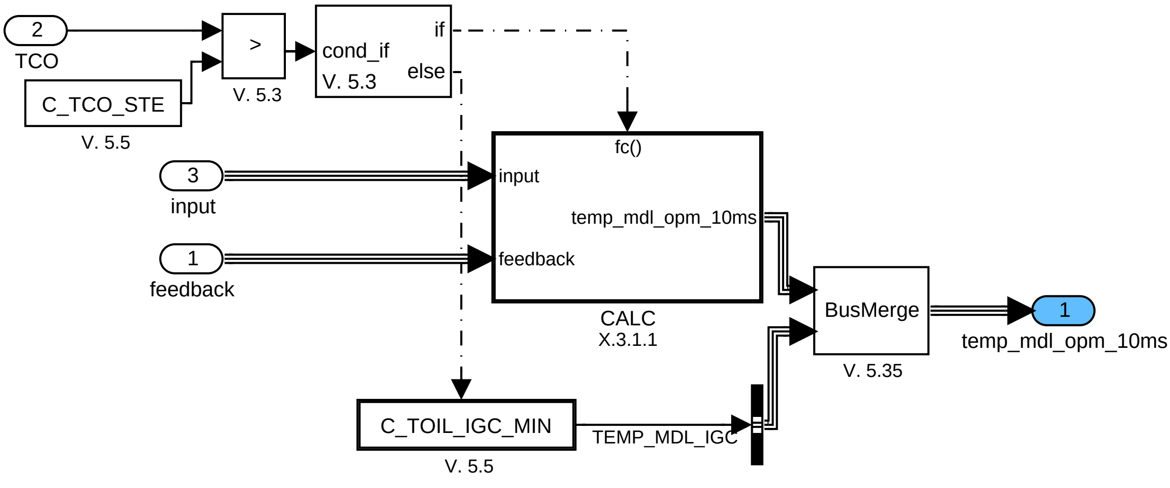

Figure 6.8.7: : Path: IGRE_M602J/OPM_10MS/CALC_TEMP_MDL

6.8.3.1.1 Calculation overview for Temperature-Model of Ignition-Coils

No Calculation

6.8.3.1.1.1 Energy of ignition-coils in homogeneous and stratified mode

As a fundamental of the ignition-coil model the heat-energy of the ignition-coils is calculated. It can differentiate between the homogenous and stratified mode.

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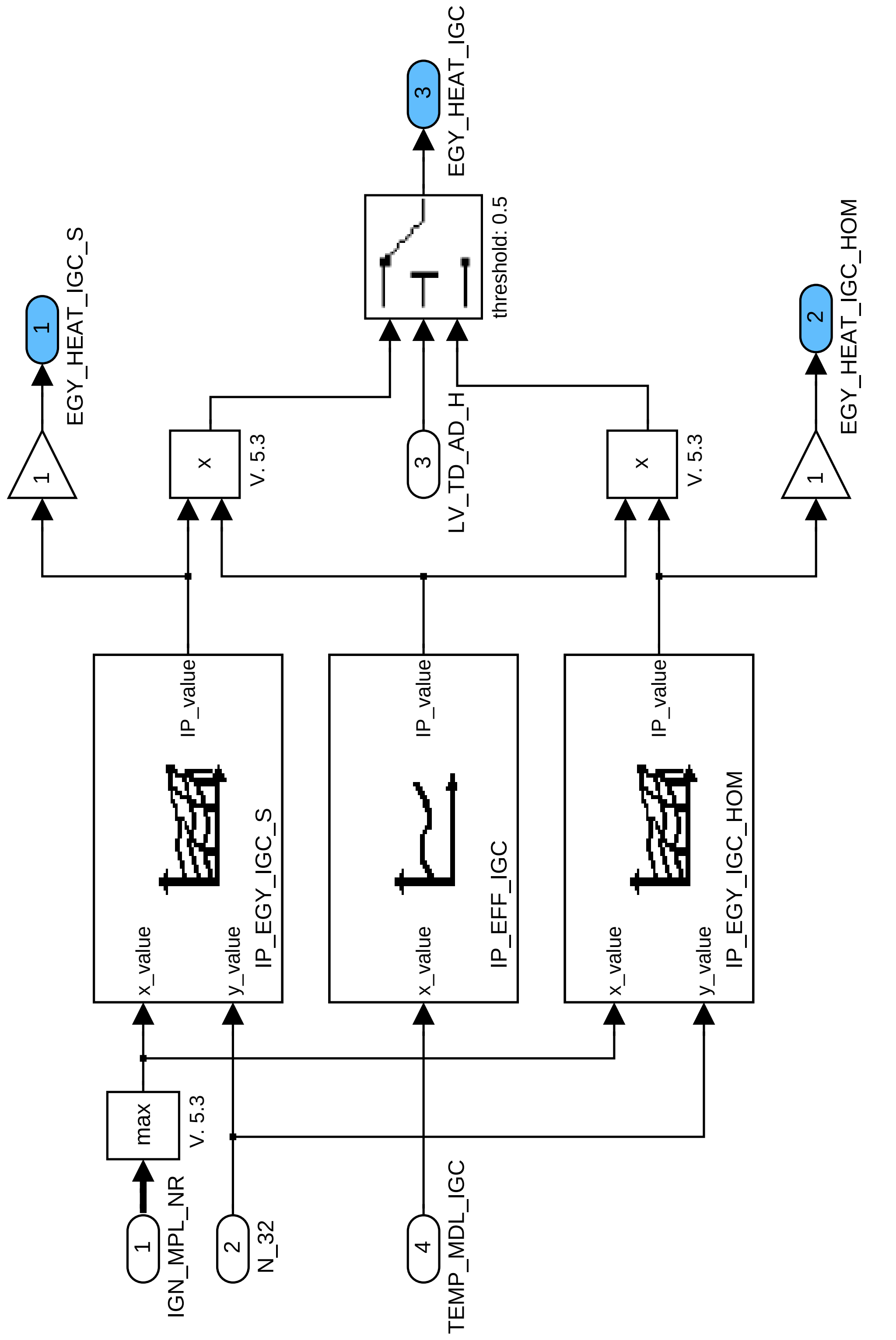

Figure 6.8.8: : Path: IGRE_M602J/OPM_10MS/CALC_TEMP_MDL/CALC/EGY_HEAT

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6.8.3.1.1.2 Calculation of model-temperature

The model temperature of the ignition coils gets calculated in this function. Based on the heat-energy, the cooling temperature, and the last calculated model temperature the cooling-energy and the new model temperature get calculated. C_ALFA_A_IGC is the product of the heat-transfer-c fficient and the area of the coils and C_CP_M_IGC the product of the heat-capacity and the mass of the coils. The integrator-block generates the temperature.

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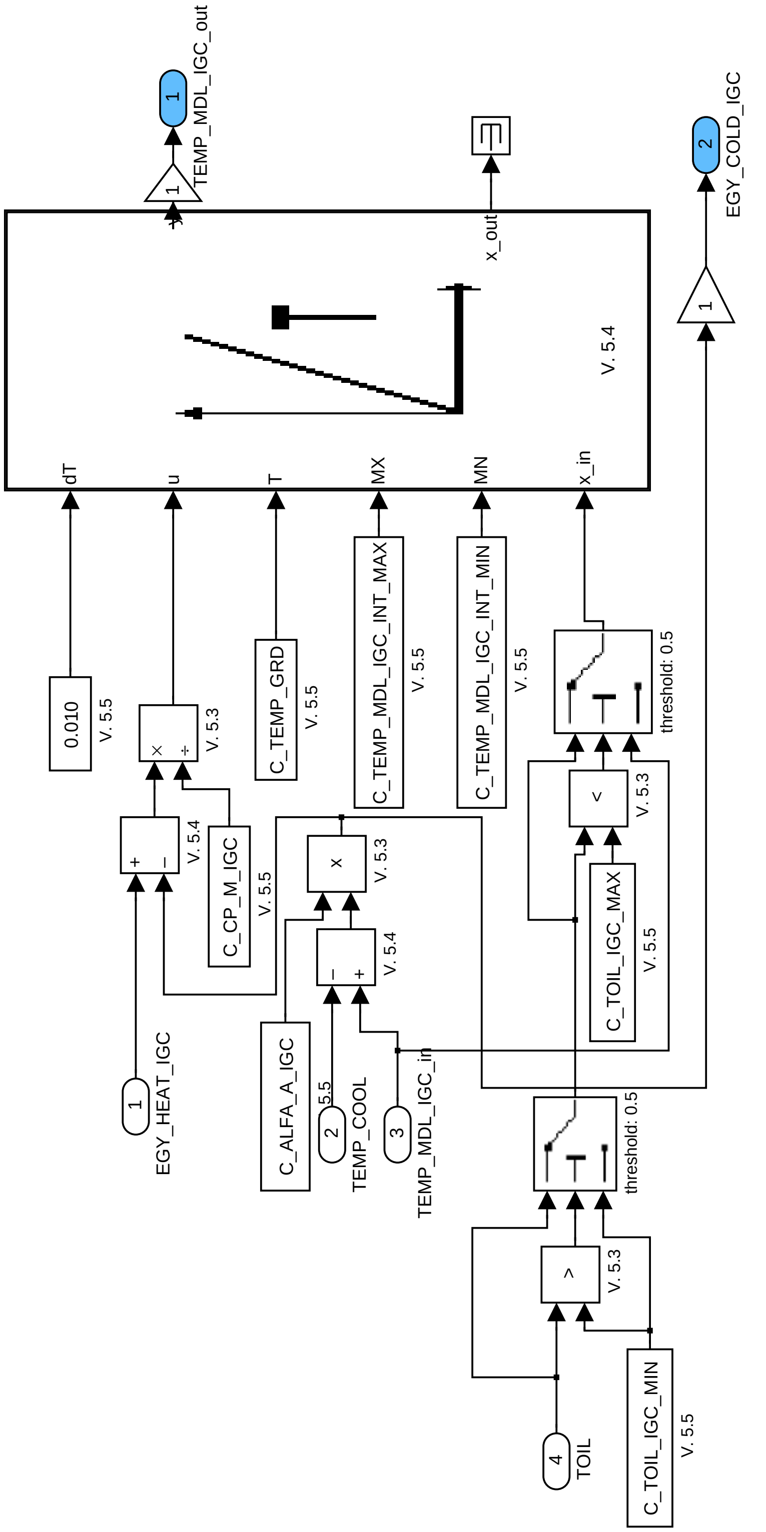

Figure 6.8.9: :   Path: IGRE_M602J/OPM_10MS/CALC_TEMP_MDL/CALC/TEMP_IGC

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6.8.3.2 Deactivation of multiple spark on ECU temperature threshold

The purpose of this function is to deactivate the multiple sparks above an ECU temperature threshold in order to decrease heat dissipation due to multiple sparks.

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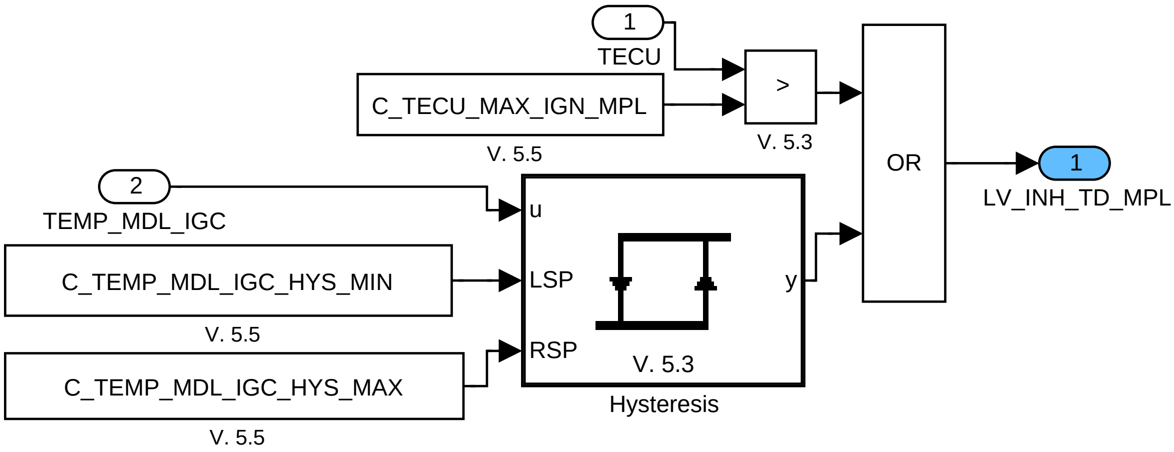

Figure 6.8.10: : Path: IGRE_M602J/OPM_10MS/TEMP_MPL_DEAC

6.8.3.3 Extended Multiple Spark function Activation

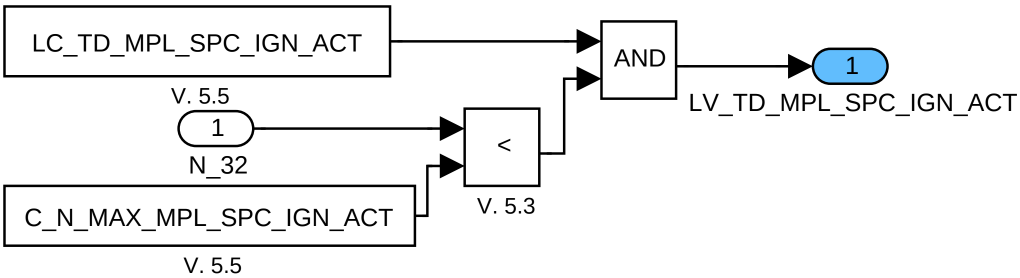

Figure 6.8.11: : Path: IGRE_M602J/OPM_10MS/MPL_SPC_IGN_ACT

6.8.3.4 Individual raise of Multiple Spark in case of misfiring

The purpose of this function is to set a calibrated number of multiple spark on a specific cylinder in case of misfiring.
The selection of cylinder is done by a word: STATE_MPL_CYL_IGN. Each bit codes a cylinder, the first cylinder is code by the lowest bit. If the bit is set to 1, there is misfiring and we set the number of MPL for this cylinder to a calibrated value. If it's set to 0, the number of MPL in this specifications will be set to 0 and will be replace in the generic specifications by an appropriate value based on a interpolation table depending on engine speed and battery voltage.

6.8.3.4.1 Set INJ_MOD_MPL to NC_INJ_MOD_S

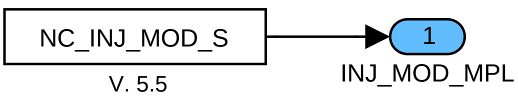

Figure 6.8.12: : Path: IGRE_M602J/OPM_10MS/INJ_MOD_MPL/SET_NC_INJ_MOD_S

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6.8.3.4.2 FOR-Loop for calculation for every cylinder

The calculation shall be done for every cylinder.

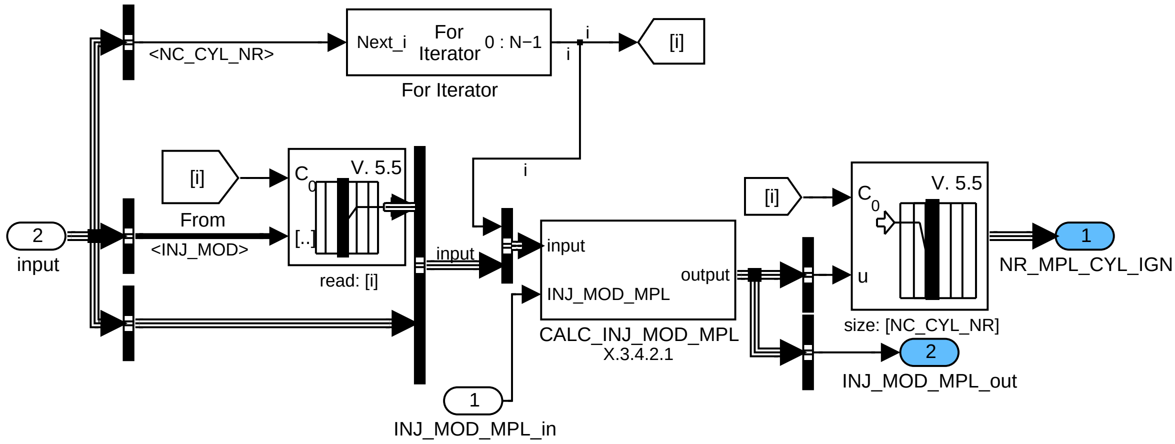

Figure 6.8.13: : Path: IGRE_M602J/OPM_10MS/INJ_MOD_MPL/FOR_INJ_MOD_MPL

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6.8.3.4.2.1 Calculation-Subsystem in FOR-Loop

6.8.3.4.2.1.1 Calculation of Injection-Mode and Number of Multiple sparks

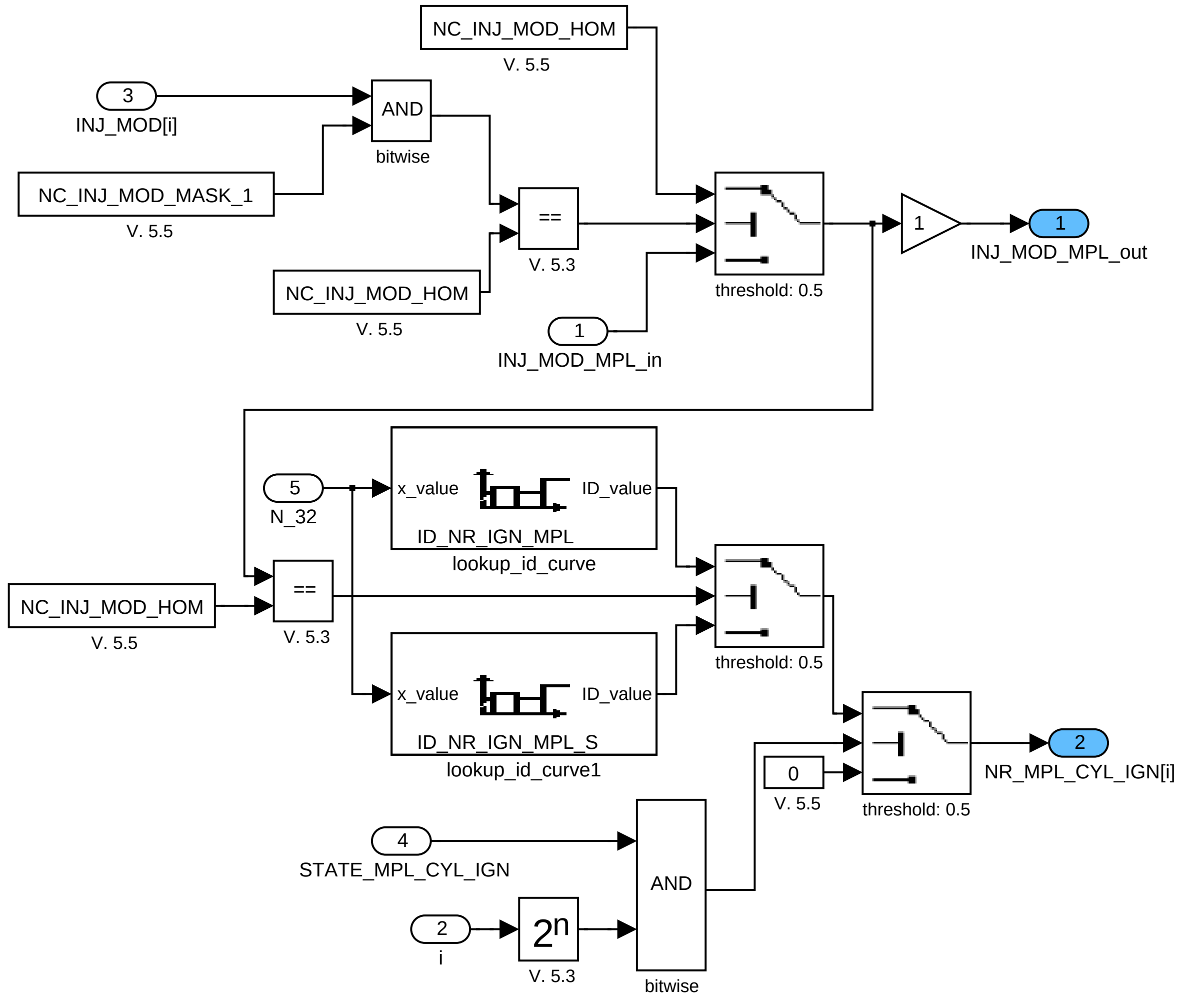

Figure 6.8.14: : Path:
IGRE_M602J/OPM_10MS/INJ_MOD_MPL/FOR_INJ_MOD_MPL/CALC_INJ_MOD_MPL/CALC

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6.9 Ignition activation control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CYCNR_IGA_ES	V	0... FH	0... 15	1	-
Counter for number of cycles for which ignition is maintained after detection of LV_IGK= 0 or LV_STST_STOP_REQ= 1					
INH_IGC	V	0... FFH	0... 255	1	-
Inhibition of selected cylinder					

Input data:

INH_IGC_MIS_GEN {p. 7194}	LV_FIRST_VLD_TOOTH {p. 1505}	LV_IGK {p. 906}	LV_IGN_INJ_LOCK_REQ {p. 4455}
LV_INH_IGC [NC_CYL_NR] {p. 4773}	LV_LOCK_IMOB	LV_ST_END {p. 1720}	LV_STST_STOP_REQ {p. 805}
LV_SYN_ENG {p. 1506}	NC_CYL_NR {p. 1526}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CYCNR_IGA_ES	-	0... FH	0... 15	1	-
Number of cycles for which ignition is maintained after detection of LV_IGK = 0					

Import actions:

ACTION_INFR_SetIgnEnable (**IN**<No Name available>,**IN**<No Name available>)

6.9.1 Normal Mode Activation

FUNCTION DESCRIPTION:

As there could be different possibilities to deactivate the ignition system an **OR-Junction** is done in this chapter. The output of this or-junction has to be INH_IGC.
The Inputs can come from the ignition diagnosis, from the injection chapter, from the Misfire Generator or from any other function requesting ignition cut-off.

Application conditions

Initialisation: `at reset`

Recurrence:
```
if LV_ST_END = 1and LV_IGN_INJ_LOCK_REQ = 0:
                     segment synchronous (every TDC)
 if LV_ST_END = 0 or LV_IGN_INJ_LOCK_REQ = 1:
       10 ms
```

Activation: `LV_SYN_ENG = 1`

Deactivation: `LV_SYN_ENG = 0`

Formula section:

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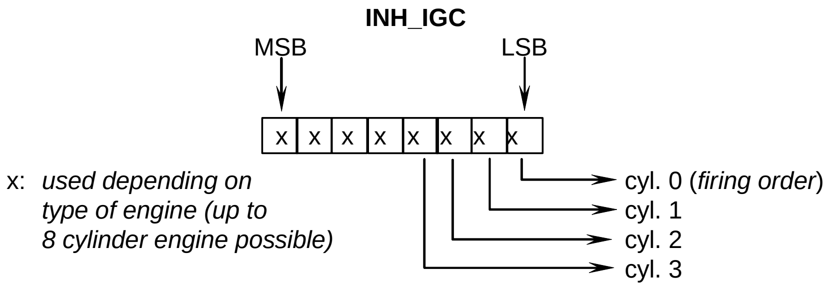
Output driver deactivation

The decision to inhibit an ignition stage is taken for each output before the turn on at TD_ON[x]. This means that no Disable /cut-off can be set on a coil while charging
INH_IGC is the bit wise OR of all inputs requesting an ignition cut-off.
LV_INH_IGC[x] sets the INH_IGC for the corresponding cylinder to 1.
When one bit within INH_IGC is set to 1, the corresponding ignition output is performed as soon as possible. The ignition output remains inhibited while the INH_IGC is unchanged.



- *Calculation of CTR_CYCNR_IGA_ES*

IF (LV_IGK$_n$= 0 **and** LV_IGK$_{n-1}$ = 1)
or (LV_STST_STOP_REQ$_n$ = 1 **and** LV_STST_STOP_REQ$_{n-1}$ = 0)

THEN CTR_CYCNR_IGA_ES$_n$ = C_CYCNR_IGA_ES

ELSE **IF** (LV_IGK$_n$ = 0 **and** LV_IGK$_{n-1}$ = 0)
or (LV_STST_STOP_REQ$_n$ = 1 **and** LV_STST_STOP_REQ$_{n-1}$ = 1)

THEN CTR_CYCNR_IGA_ES$_n$ = CTR_CYCNR_IGA_ES$_{n-1}$ -1

ELSE CTR_CYCNR_IGA_ES$_n$ = CTR_CYCNR_IGA_ES$_{n-1}$

ENDIF

ENDIF

- *Inhibition for ignition system of cylinder x*

IF LV_LOCK_IMOB = 1
or LV_IGN_INJ_LOCK_REQ = 1
or LV_FIRST_VLD_TOOTH = 0
or (CTR_CYCNR_IGA_ES = 0 **and** LV_IGK = 0)
or (CTR_CYCNR_IGA_ES = 0 **and** LV_STST_STOP_REQ = 1)

THEN INH_IGC = $2^{NC\_CYL\_NR}$- 1 (ignitions on all the cylinders are inhibited)
ELSE

FOR x = 0 to NC_CYL_NR-1
IF LV_INH_IGC[x] = 1
or bit x of INH_IGC_MIS_GEN = 1
THEN the corresponding bit /Cylinder x of INH_IGC is set to 1
ELSE the corresponding bit /Cylinder x of INH_IGC is set to 0
ENDIF
ENDFOR

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ENDIF

FOR x = 0 to NC_CYL_NR-1
ACTION_INFR_SetIgnEnable(x, not(corresponding bit x of INH_IGC))
ENDFOR

Note:

1. For DI engine it is strongly recommended to enable Ignition only after Validated synchronisation, *ie.* activation of this function on LV_SYN_VLD = 1 only instead of LV_SYN_ENG
2. No deactivation is possible on a charging coil, *ie.* after TD_ON[x] event: if Dwell Time has started on a stage, this charging will be elapsed to its end
   Refer to module 200X for more details

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6.10 Basic ignition angle at start

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_ST	O/V	0... FFH	0... 60	0.375	°CRK
Basic ignition angle at start					
LV_ANG_PSN_ENG_REL_TMP	V	0... 1H	0 ...1	1	-
The first ITDC is reached in case of MSA start					
LV_IGA_ST_PSN_ENG_COR_STST	V	0... 1H	0 ...1	1	-
IGA_ST correction for MSA start is active					

Input data:

AMP {p. 982}	CYC_ST {p. 797}	LV_ES {p. 1720}	LV_IGA_ST_OPM_SEL {p. 8266}
LV_ST {p. 1720}	LV_STST_ST_REQ {p. 804}	LV_SYN_ENG {p. 1506}	N {p. 1525}
PSN_ENG_REL {p. 807}	PSN_ENG_REL_ST {p. 807}	TCO {p. 1100}	TIA {p. 1226}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ANG_PSN_ENG_REL_STST	-	0... 780H	0... 720	0.375	°CRK
Relative engine position threshold for deactivation of additive ignition angle correction (default 120 °CRK) [Attention: PSN_ENG_REL = 180...0,375°CRK]					
IP_IGA_ST_AMP_COR_OPM_1	-	0... FFH	0... 47.625	0.375	°CRK
LDPM_AMP_1_IGA_ST	6	0... FFFFH	0... 5434	0.08291752	hPa
Ambient pressure correction of the basic ignition angle at start at operation mode 1					
IP_IGA_ST_AMP_COR_OPM_2	-	0... FFH	0... 47.625	0.375	°CRK
LDPM_AMP_1_IGA_ST	6	0... FFFFH	0... 5434	0.08291752	hPa
Ambient pressure correction of the basic ignition angle at start at operation mode 2					
IP_IGA_ST_BAS_OPM_1	-	0... FFH	0... 60	0.375	°CRK
LDPM_N_1_IGA_ST	6	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_1_IGSP	8	0... FEH	0... 142.5	0.75	°C
Basic ignition angle at start at operation mode 1					
IP_IGA_ST_BAS_OPM_2	-	0... FFH	0... 60	0.375	°CRK
LDPM_N_1_IGA_ST	6	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_1_IGSP	8	0... FEH	0... 142.5	0.75	°C
Basic ignition angle at start at operation mode 2					
IP_IGA_ST_CYC_ST_COR_OPM_1	-	0... FFH	0... 47.625	0.375	°CRK
LDPM_CYC_1_IGA_ST	6	0... FFH	0... 255	1	-
LDPM_TCO_1_IGSP	8	0... FEH	0... 142.5	0.75	°C
Correction of the basic ignition angle at start dependen on the start cycle counter at operation mode 1					
IP_IGA_ST_CYC_ST_COR_OPM_2	-	0... FFH	0... 47.625	0.375	°CRK
LDPM_CYC_1_IGA_ST	6	0... FFH	0... 255	1	-
LDPM_TCO_1_IGSP	8	0... FEH	0... 142.5	0.75	°C
Correction of the basic ignition angle at start dependen on the start cycle counter at operation mode 2					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_IGA_ST_PSN_ENG_COR_STST	-	0... FFH	0... 47.625	0.375	°CRK
LDP_ANG_PSN_ENG_REL_ST	6	0... 780H	0... 720	0.375	°CRK
Relative engine stop position correction additive to IGA_ST for the first ignition at MSA start					
IP_IGA_ST_TIA_COR_OPM_1	-	0... FFH	0... 47.625	0.375	°CRK
LDPM_TIA_1_IGA_ST	6	0... FEH	0... 142.5	0.75	°C
Ambient pressure correction of the basic ignition angle at start at operation mode 1					
IP_IGA_ST_TIA_COR_OPM_2	-	0... FFH	0... 47.625	0.375	°CRK
LDPM_TIA_1_IGA_ST	6	0... FEH	0... 142.5	0.75	°C
Ambient pressure correction of the basic ignition angle at start at operation mode 2					

6.10.1 IGSP_M6004

FUNCTION DESCRIPTION:
General information:
The ignition angle at start is basically dependent on the engine speed N and coolant temperature TCO determined by the map IP_IGA_ST_BAS. Additionally a map dependent on the ambient pressure AMP corrects this basic ignition angle. To avoid backfiring due to the fast increase of the combustion chamber temperature a second correction dependent on the cycle counter CYC_ST and the coolant temperature is added. A further map consideres influences of the inrake air temperature TIA.
The switch LV_IGA_ST_OPM_SEL is used to determine if either the basic ignition angle at start for operation mode 1 or the basic ignition angle at start for operation mode 2 is calculated.
In case of MSA start (engine start stop automatic) there is an additive correction dependent on the relative engine position PSN_ENG_REL_ST for the first ignition.

Application conditions :
Activation : LV_ST = 1 or (LV_ES = 1 and LV_SYN_ENG = 1)
Deactivation : LV_ST = 0 and (LV_ES = 0 or LV_SYN_ENG = 0)
Update rate : every 10 ms and every TDC
Initialisation: at reset : *IGA_ST = 0*
LV_IGA_ST_PSN_ENG_COR_STST = 0
LV_PSN_ENG_REL_TMP = 0

Remark: if LV_IGA_ST_OPM_SEL = 1 only the upper part has to be executed (IP....OPM_2), else only the lower part has to be executed (IP....OPM_1).

Application Condition

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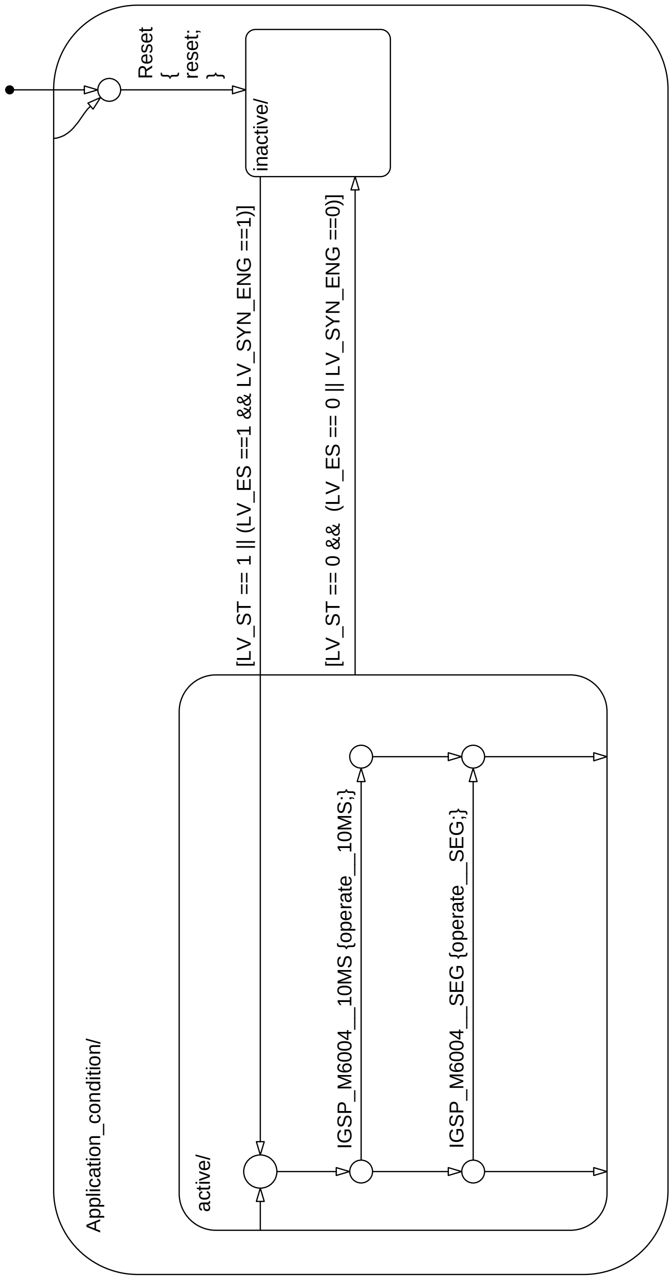

Figure 6.10.1: IGSP_M6004/APP_CDN/Chart

Function Description

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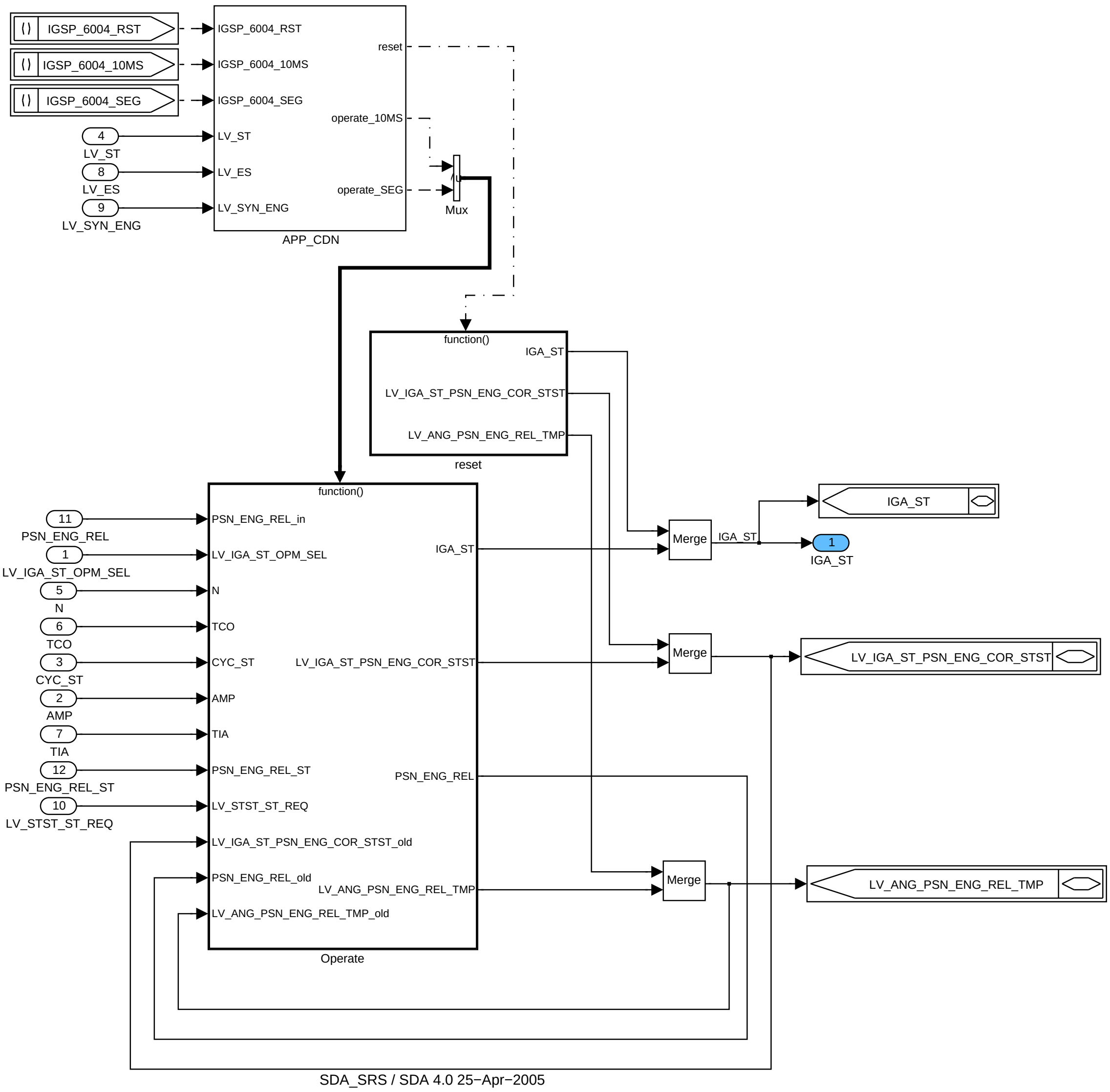

Figure 6.10.2: IGSP_M6004

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6.10.1.1 Reset

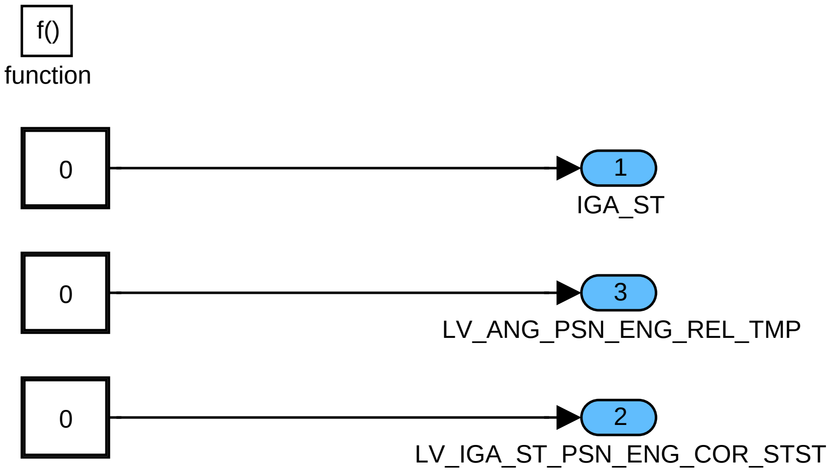

Figure 6.10.3: IGSP_M6004/reset

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6.10.1.2 Overview of IGA_ST calculation

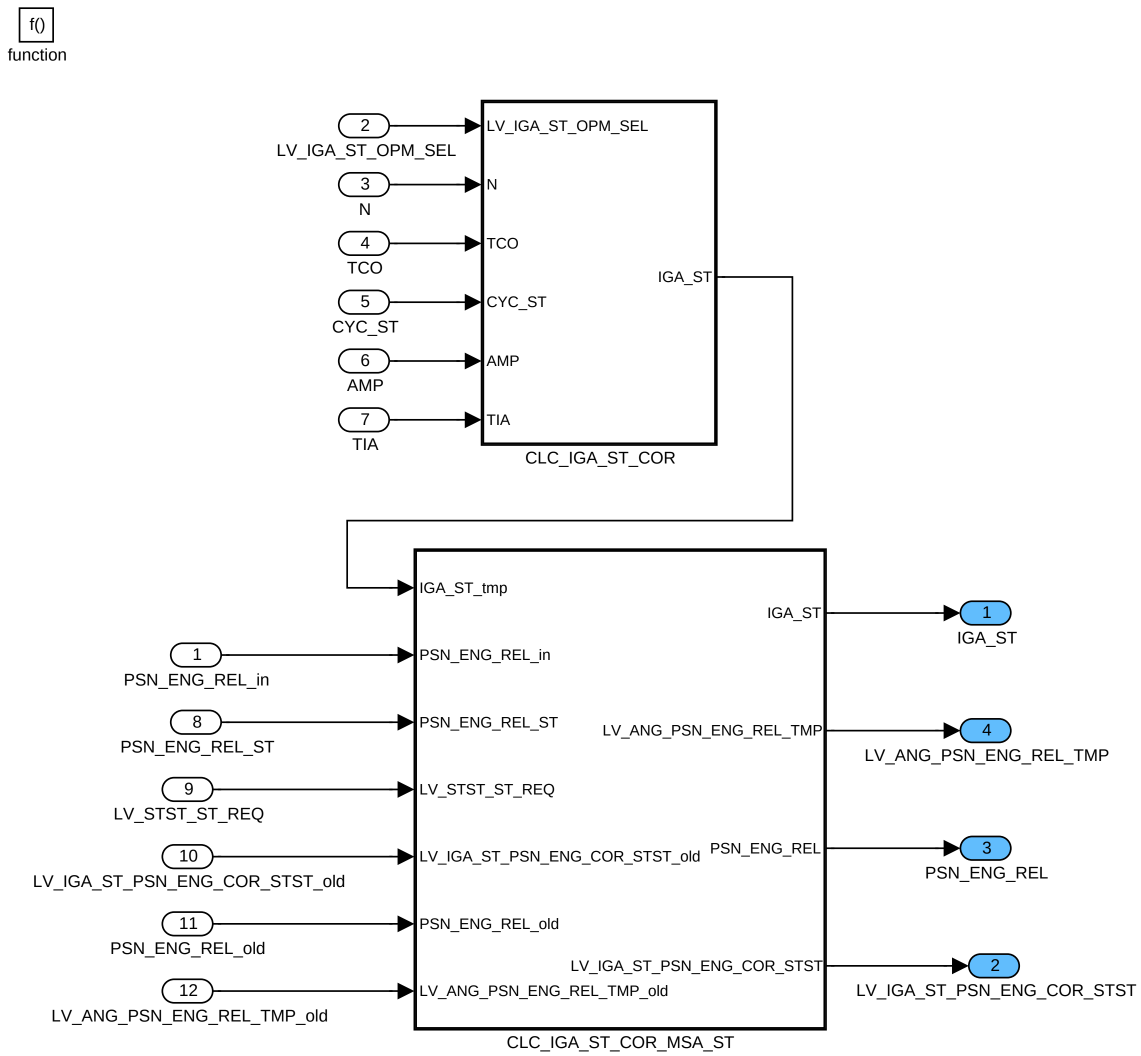

Figure 6.10.4: IGSP_M6004/Operate

Calculation of standard IGA_ST correction

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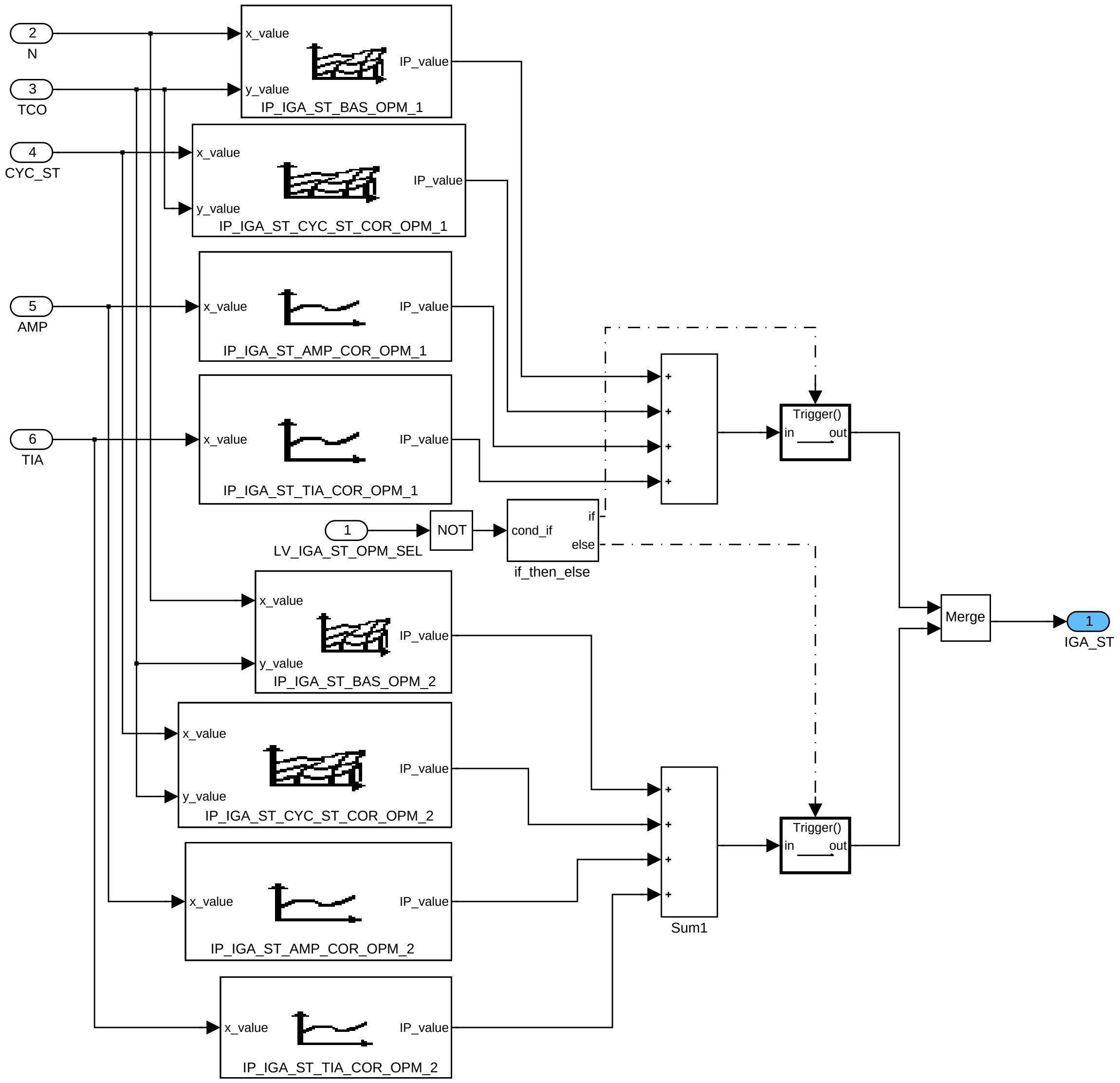

Figure 6.10.5: IGSP_M6004/Operate/CLC_IGA_ST_COR

Calculation of IGA_ST correction in case of MSA start (engine start stop automatic)

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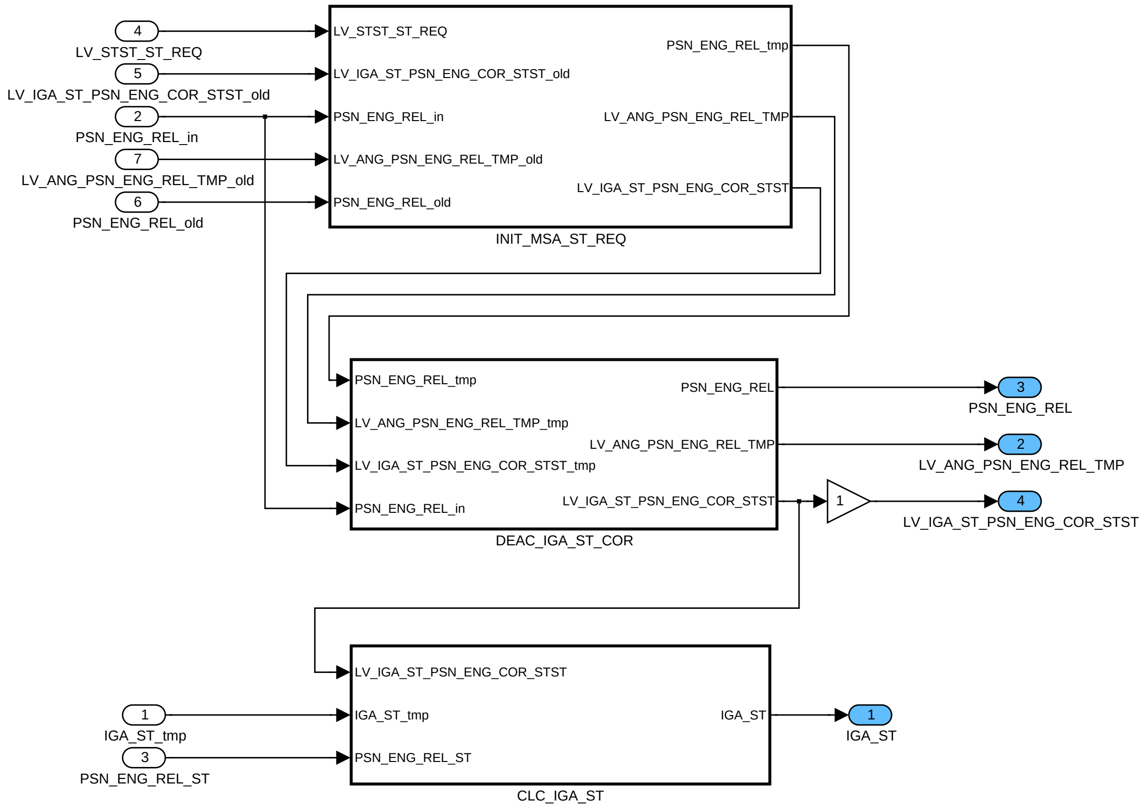

Figure 6.10.6: IGSP_M6004/Operate/CLC_IGA_ST_COR_MSA_ST

Initialisation at MSA start request

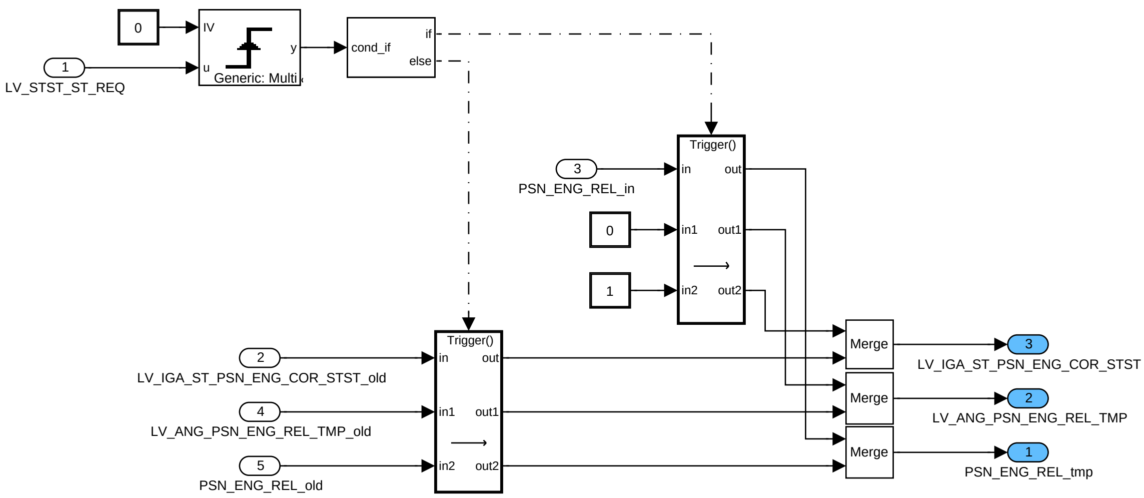

Figure 6.10.7: IGSP_M6004/Operate/CLC_IGA_ST_COR_MSA_ST/INIT_MSA_ST_REQ

Deactivation of IGA_ST correction

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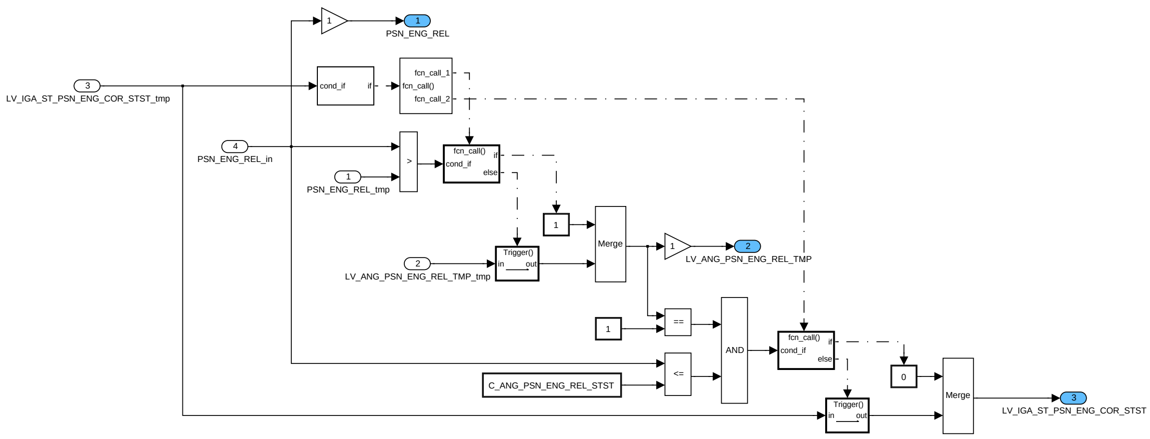

Figure 6.10.8: IGSP_M6004/Operate/CLC_IGA_ST_COR_MSA_ST/DEAC_IGA_ST_COR

Calculation of corrected IGA_ST

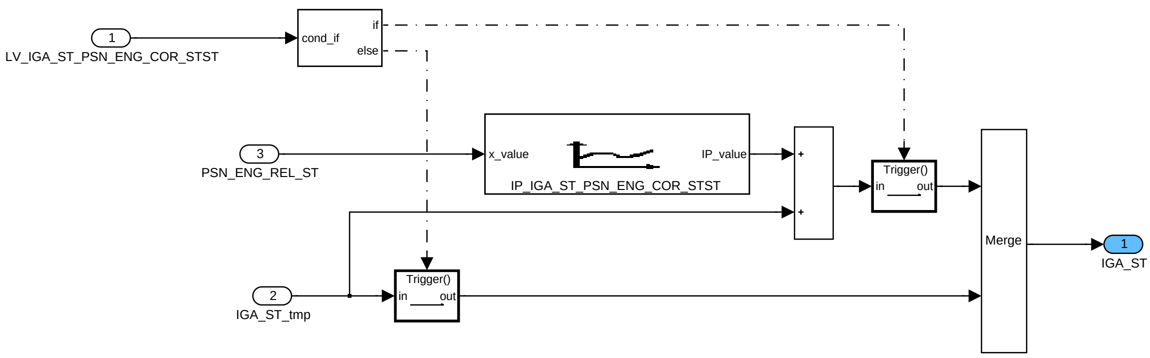

Figure 6.10.9: IGSP_M6004/Operate/CLC_IGA_ST_COR_MSA_ST/CLC_IGA_ST

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6.11 Exhaust gas recirculation correction

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EGR_RATIO_COR_2	V	0... FFFFH	0... 99.99847	1.5259e-3	%
corrected EGR_RATIO for LDP of IP_IGA_BAS_EGR					
IGA_BAS_EGR_COR	O/V	80... 7FH	-48... 47.625	0.375	°CRK
additive basic ignition angle correction due to EGR influence					
IGA_BAS_EGR_COR_HOM	V	80... 7FH	-48... 47.625	0.375	°CRK
additive basic ignition angle correction due to EGR influence in homogenous mode					
IGA_BAS_EGR_COR_S	V	80... 7FH	-48... 47.625	0.375	°CRK
additive basic ignition angle correction due to EGR influence in stratified mode					

Input data:

EGR_RATIO_SP {p. 8197}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_EGR_ACT {p. 987}	LV_SP_RATE_CYL_EGR_SWI {p. 8137}
MAF {p. 8277}	MFF_SP_S {p. 8243}	N_32 {p. 1525}	TCO {p. 1100}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_IGA_BAS_EGR_LAMB	-	0... FFH	0... 0.996	0.0039063	-
LDPM_N_32_IP_EGR_RATIO	12	0... FFH	0... 8160	32	rpm
LDPM_MAF_IP_EGR_RATIO	12	0... FFFFH	0... 1389	0.0212	mg/stk
factor for EGR_RATIO list of datapoints					
IP_FAC_RATE_EGR_AFL	-	0... FFH	0... 1.992	0.007813	-
LDPM_TCO__IGA_EGR	5	0... FEH	-48... 142.5	0.75	°C
temperature corrective factor					
IP_IGA_BAS_EGR	-	0... FFH	-48... 47.625	0.375	°CRK
LDP_EGR_RATIO_COR_2__IGA_BAS	6	0... FFFFH	0... 99.998	1.525e-3	%
basis for EGR correction IGA_BAS					
IP_IGA_BAS_EGR_FAC__N__MAF	-	0... FFH	0... 1.992	0.007813	-
LDPM_N_32_IP_EGR_RATIO	12	0... FFH	0... 8160	32	rpm
LDPM_MAF_IP_EGR_RATIO	12	0... FFFFH	0... 1389	0.0212	mg/stk
No description given					
IP_IGA_EGR_S	-	0... FFH	-48... 47.625	0.375	°CRK
LDPM_TCO__IGA_EGR	5	0... FEH	-48... 142.5	0.75	°C
Temperature based correction (stratified mode)					

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FUNCTION DESCRIPTION:

General information:

Homogeneous mode:
In homogeneous mode, if EGR function is active, the basic ignition angle IGA_BAS_IVVT is improved by the additive EGR correction value IGA_BAS_EGR_COR. This value depends from N_32, MAF, TCO, EGR_RATIO_SP and LAMB_SP.

Stratified mode:

In stratified mode, if EGR function is active, the basic ignition angle IGA_BAS_S is improved by the additive EGR correction value IGA_BAS_EGR_COR. IGA_BAS_EGR_COR is calculated from the coolant temperature TCO (IP_IGA_EGR_S).

Application conditions

Activation: LV_EGR_ACT = 1

Deactivation: LV_EGR_ACT = 0

Update Rate: 10 ms

Initialization: IGA_BAS_EGR_COR = 0

Signal flow diagram:

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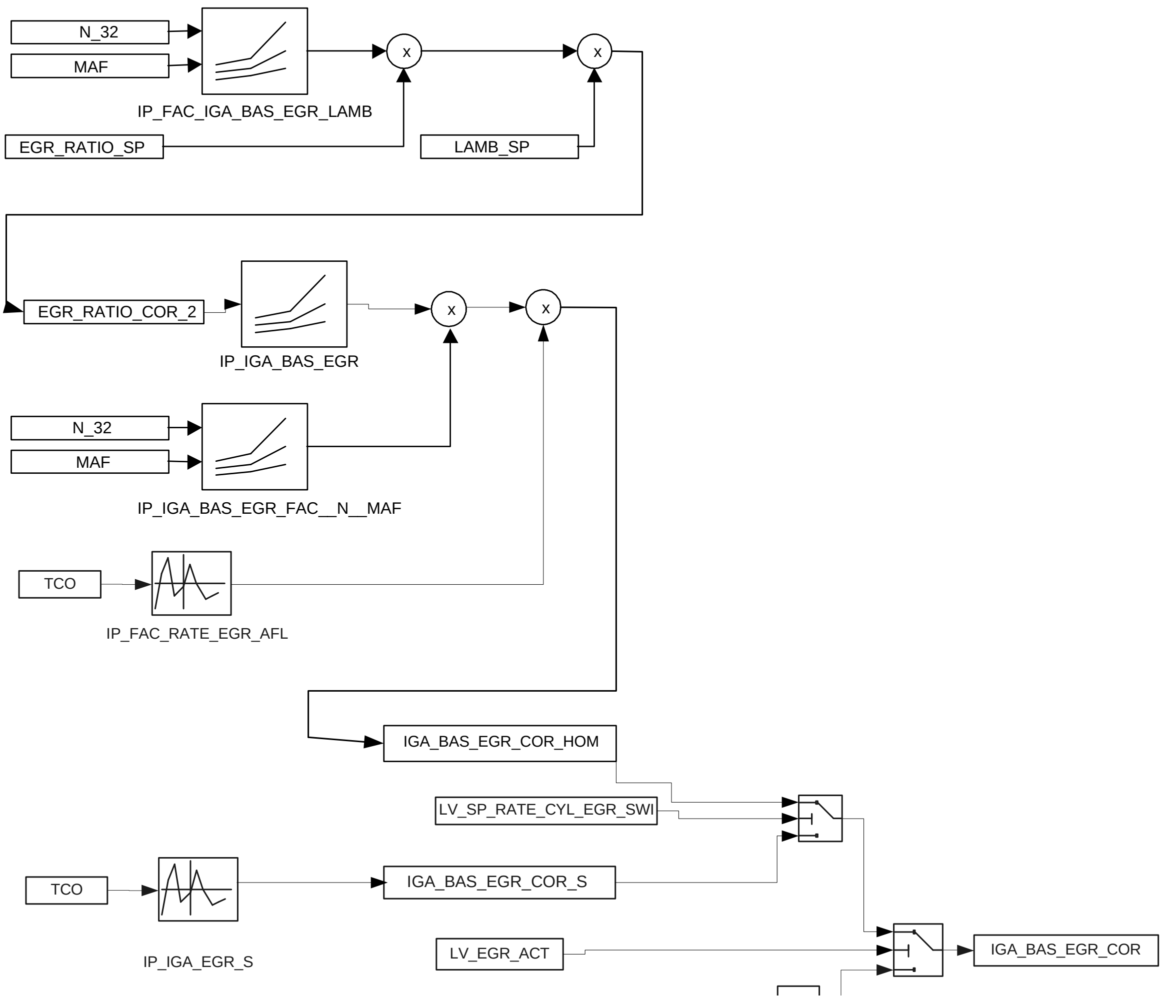

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Formula section:

EGR_RATIO_COR_2 = EGR_RATIO_SP * IP_FAC_IGA_BAS_EGR_LAMB * LAMB_SP
IGA_BAS_EGR_COR_HOM = IP_IGA_BAS_EGR *

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```
                              IP_IGA_BAS_EGR_FAC__N__MAF   *
                              IP_FAC_RATE_EGR_AFL
IGA_BAS_EGR_COR_S      =        IP_IGA_EGR_S
```

if LV_EGR_ACT = 0
  then IGA_BAS_EGR_COR = 0
  elseif LV_SP_RATE_CYL_EGR_SWI = 1
    then IGA_BAS_EGR_COR = IGA_BAS_EGR_COR_HOM
    else IGA_BAS_EGR_COR = IGA_BAS_EGR_COR_S
  endif
endif

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6.12 TQM - Minimum ignition angle

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_DIF_MIN_AST_H_RNG	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Intermediate variable: correction on IGA_DIF_MIN for combustion cycles after start management in wide range					
IGA_DIF_MIN_DELTA_H_RNG	V	0... B40H	0... -180	-0.0625	°CRK
Extra retard on IGA_DIF_MIN in case of torque intervention in wide range					
IGA_DIF_MIN_H_RNG	O/V	0... B40H	0... -180	-0.0625	°CRK
Difference of minimum ignition angle to reference ignition angle in wide range					
IGA_MIN_BAS_1_H_RNG	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Intermediate variable: basic minimum ignition angle in wide range					
IGA_MIN_BAS_2_H_RNG	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
basic minimum ignition angle including cat heating in wide range					
IGA_MIN_BAS_2_OPM_1_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
basic minimum ignition angle high range regarding cat heating and OPM 1					
IGA_MIN_BAS_2_OPM_2_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
basic minimum ignition angle high range regarding cat heating and OPM 2					
IGA_MIN_BAS_EXT_H_RNG	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Intermediate variable: basic minimum ignition angle in wide range					
IGA_MIN_BAS_H_RNG	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
basic minimum ignition angle in wide range					
IGA_MIN_BAS_INT_H_RNG	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Intermediate variable: basic minimum ignition angle in wide range					
IGA_MIN_BAS_OPM_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
basic minimum ignition angle depening on engine operation mode					
IGA_MIN_BAS_PU_H_RNG	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Intermediate variable: PU minimum ignition angle in wide range					
IGA_MIN_BAS_PUC_H_RNG	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Intermediate variable: basic minimum ignition angle in wide range					
LV_IGA_DIF_MIN_DELTA_ACT	V	0... 1H	0 ...1	1	-
Flag to enable and declare the acting of the extra retard on IGA_DIF_MIN					

Input data:

AMP {p. 982}	CYC_CAST {p. 1766}	FAC_IGA_OPM_SEL {p. 8266}	IGA_DIF_SP_H_RNG {p. 1948}
IGA_REF_COR {p. 8266}	LV_AST_END {p. 2100}	LV_AT {p. 654}	LV_CH_TQ_ADD {p. 799}
LV_CH_TQ_ADD_IS {p. 799}	LV_HOM_ACT {p. 8136}	LV_HOM_RUN {p. 8136}	LV_IGA_MIN_EXT {p. 8266}
LV_IGA_MIN_PUC {p. 1720}	LV_TQ_IGA_ACT {p. 1948}	MAF_HB {p. 805}	N_32 {p. 1525}
N_DIF {p. 1122}	OPM_AV {p. 8137}	OPM_REQ {p. 8137}	TCO {p. 1100}
TQ_ADD_CH {p. 6582}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DELTA_TEMP_DIS	-	0... FFH	0... 2.55	0.01	s
Disable time of extra spark retard on IGA_DIF_MIN after end of gradient return					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_IGA_DIF_MIN_BAS_LGRD_H_RNG	-	0... B40H	0... 180	0.0625	°CRK
Step gradient limitation					
C_IGA_DIF_MIN_DELTA_LGRD_H_RNG	-	0... B40H	0... -180	-0.0625	°CRK
Step gradient limitation after extra spark retard on IGA_DIF_MIN					
C_IGA_DIF_MIN_DELTA_TEMP_DIS	-	0... FFH	0... 2.55	0.01	s
Disable time of extra spark retard on IGA_DIF_MIN after end of gradient return					
C_IGA_DIF_MIN_DELTA_TEMP_ENA	-	0... FFH	0... 2.55	0.01	s
Maintaining time of extra retard on IGA_DIF_MIN					
C_IGA_MIN_PUC_LGRD_H_RNG	-	0... B40H	0... 180	0.0625	°CRK
Step gradient limitation					
IP_FAC_IGA_DIF_AST	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_N_DIF_IGSP	8	8000... 7FFFH	-32768 ...32767	1	rpm
scaling N_DIF correction for minimum ignition angle ast					
IP_FAC_IGA_DIF_MIN_AMP	-	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_CYC_CAST_IP_IGA_DIF_MIN	8	0... FFFFH	0... 65535	1	-
scaling AMPcorrection for minimum ignition angle AST					
IP_FAC_IGA_MIN_TCO	V	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
scaling TCO correction for minimum ignition angle					
IP_FAC_IGA_MIN_TCO_EXT	V	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
scaling TCO correction for minimum ignition angle					
IP_FAC_IGA_MIN_TCO_PU	V	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
scaling TCO correction for minimum ignition angle					
IP_IGA_DIF_MIN_CYC_AMP_AT_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
LDP_AMP_IP_IGA_DIF_MIN_CYC_AMP	6	0... FFFFH	0... 5434	0.0829175	hPa
LDPM_TCO_1_IGSP	8	0... FEH	-48... 142.5	0.75	°C
Altitude correction on minimum ignition angle for after start for automatic transmission					
IP_IGA_DIF_MIN_CYC_AMP_MT_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
LDP_AMP_IP_IGA_DIF_MIN_CYC_AMP	6	0... FFFFH	0... 5434	0.0829175	hPa
LDPM_TCO_1_IGSP	8	0... FEH	-48... 142.5	0.75	°C
Altitude correction on minimum ignition angle for after start for manual transmission					
IP_IGA_DIF_MIN_CYC_AT	V	0... FFH	-48... 47.625	0.375	°CRK
LDPM_CYC_CAST_IP_IGA_DIF_MIN	8	0... FFFFH	0... 65535	1	-
LDPM_TCO_1_IGSP	8	0... FEH	-48... 142.5	0.75	°C
Correction on minimum ignition angle for combustion cycles after start for automatic transmission					
IP_IGA_DIF_MIN_CYC_MT	V	0... FFH	-48... 47.625	0.375	°CRK
LDPM_CYC_CAST_IP_IGA_DIF_MIN	8	0... FFFFH	0... 65535	1	-

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_TCO_1_IGSP	8	0... FEH	-48... 142.5	0.75	°C
Correction on minimum ignition angle for combustion cycles after start for manual tranmission					
IP_IGA_DIF_MIN_DELTA_H_RNG	V	0... B40H	0... -180	-0.0625	°CRK
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
Extra spark retard on minimum ignition angle in case of torque intervention					
IP_IGA_DIF_MIN_TCO	-	0... FFH	-48... 47.625	0.375	°CRK
LDPM_TCO_1_IGSP	8	0... FEH	-48... 142.5	0.75	°C
TCO correction for minimum ignition angle					
IP_IGA_DIF_MIN_TCO_EXT_H_RNG	-	0... B40H	-90 ...90	0.0625	°CRK
LDPM_TCO_1_IGSP	8	0... FEH	-48... 142.5	0.75	°C
TCO correction for minimum ignition angle					
IP_IGA_DIF_MIN_TCO_H_RNG	-	0... B40H	-90 ...90	0.0625	°CRK
LDPM_TCO_1_IGSP	8	0... FEH	-48... 142.5	0.75	°C
TCO correction for minimum ignition angle					
IP_IGA_DIF_MIN_TCO_PU_H_RNG	-	0... B40H	-90 ...90	0.0625	°CRK
LDPM_TCO_1_IGSP	8	0... FEH	-48... 142.5	0.75	°C
TCO correction for minimum ignition angle					
IP_IGA_MIN_CH_COR_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
Offset on basic minimum ignition angle caused by cat heating					
IP_IGA_MIN_N_MAF_EXT_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
Basic minimum ignition angle difference value					
IP_IGA_MIN_N_MAF_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
Basic minimum ignition angle difference value					
IP_IGA_MIN_N_MAF_PU_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
Basic minimum ignition angle difference value					
IP_IGA_MIN_OPM_COR_H_RNG	V	0... B40H	-90 ...90	0.0625	°CRK
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_2_IGSP	6	0... FFH	0... 1389	5.4470588	mg/stk
Offset on basic minimum ignition angle caused by engine throttled mode					
IP_T_IGA_MIN_PUC	-	0... FFH	0... 2.55	0.01	s
LDPM_N_32_2_IGSP	8	0... FFH	0... 8160	32	rpm
timer inside puc					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_INH_IGA_MIN_PUC	-	0... 1H	0 ...1	1	-
Logical constant for inhibiting ramping of IGA_MIN_BAS_PUC_H_RNG to IGA_BAS_COR in case of LV_PUC=1					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_USE_IGA_MIN_AST	-	0... 1H	0 ...1	1	-
Compiler switch for specific minimum IGA after start phase enabled					

FUNCTION DESCRIPTION:

The minimum ignition angle is the minimum allowable ignition angle which is possible to apply to the engine. The basic minimum ignition angle determined through a calibration map is corrected by a temperature dependent additive term. Furthermore there are additive influences by cat heating and engine operating mode like throttled or unthrottled.In some special engine running states, the minimal ignition angle calibrated in this function can be limited by external request to avoid too strong spark retards during those states.Hence, in all practical cases IGA_DIF_MIN_H_RNG is a negative value which is the maximum allowable spark retard determined by a calibration map. It includes the coolant temperature correction (*for engine protection, pollution condition, etc...*).

6.12.1 IGA_DIF_MIN_H_RNG calculation with extra spark retard for torque intervention and after start management

General information:

In case of a strong fast torque intervention requested (*ie. if IGA_DIF_SP_H_RNG hence requested by torque intervention becomes lower than IGA_DIF_MIN_0_H_RNG*) then a specific over-retard (*IGA_DIF_MIN_DELTA_H_RNG*) is authorised on minimum ignition angle for a while. It permits to manage a strongest response from the engine to a torque reduction request. IGA_DIF_MIN_0_*H_RNG* is just an intermediate variable introduced here for clarification of explanations. IGA_DIF_MIN_0_*H_RNG* is just the result of the interpolation map without other affects. This over-retard is only allowed for a given time (*C_IGA_DIF_MIN_DELTA_TEMP_ENA*). In case of a rising edge of the flag for enabling extra-retard (LV_IGA_DIF_MIN_DELTA_ACT= 0->1) the active counter is reseted to C_IGA_DIF_MIN_DELTA_TEMP_ENA. If torque intervention by spark retard is active as well as homogeneous ignition angle and injection parameters are applied to the engine (LV_TQ_IGA_ACT=1 and LV_HOM_ACT=1) the active counter is decremented to 0, otherwise it is incremented back to C_IGA_DIF_MIN_DELTA_TEMP_ENA. The counter for extra-retard is set to avoid exhaust gas over-heating and thus protect the exhaust branch. At the end of this counter, this over-retard on IGA_DIF_MIN_H_RNG goes back up to 0 with a limited gradient (*C_IGA_DIF_MIN_DELTA_LGRD*_H_RNG) for its come-back law. This limited gradient for come-back is necessary to avoid the changes on ignition angle applied can be felt on-board the car. At the end of this gradient limited come-back, such an other kind of extra retard is inhibited during a while (*C_IGA_DIF_MIN_DELTA_TEMP_ENA*) just to be sure to avoid any problems of exhaust gas over-heating. This functionality aims to deal with thermal exchange effects. So, the timer are in time units (*sec.*) and the calibration map here defined for extra retard is related to LDP of temperature.

Application conditions

Activation: LV_HOM_RUN = 1

Deactivation: LV_HOM_RUN = 0

Initialisation: IGA_DIF_MIN_H_RNG = 0° CRK at reset
IGA_DIF_MIN_0_H_RNG = 0 °CRK
IGA_DIF_MIN_AST_H_RNG = 0 °CRK

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```
IGA_DIF_MIN_DELTA_H_RNG          = 0 °CRK
IGA_MIN_BAS_x_H_RNG               = -35.625°CRK
```

Update Rate:
```
whole functionality          =>     10 ms
IP_IGA_DIF_MIN_TCO_H_RNG      =>     1000 ms
```

Formula section:

Condition to enable the extra-spark retard:

If LV_IGA_DIF_MIN_DELTA_ACT = 0
And When IGA_DIF_SP_H_RNG becomes lower than IGA_DIF_MIN_0_*H_RNG* $_{n-1}$
Then LV_IGA_DIF_MIN_DELTA_ACT = 1
And IGA_DIF_MIN_DELTA_H_RNG = IGA_DIF_MIN_DELTA_1_*H_RNG*
ElseIf LV_IGA_DIF_MIN_DELTA_ACT = 1
And When IGA_DIF_SP_H_RNG becomes lower than IGA_DIF_MIN_0_*H_RNG* $_{n-1}$
Then IGA_DIF_MIN_DELTA_H_RNG = IGA_DIF_MIN_DELTA_1_*H_RNG*
Else **if** IGA_DIF_SP_H_RNG is greater than IGA_DIF_MIN_0_*H_RNG* $_{n-1}$
And LV_IGA_DIF_MIN_DELTA_ACT = 0 **or** 1
(***Whatever*** *should be the state of LV_IGA_DIF_MIN_DELTA_ACT*)

Then LV_IGA_DIF_MIN_DELTA_ACT remains in its previous state
And IGA_DIF_MIN_DELTA_H_RNG = 0
EndIf

IGA_DIF_MIN_DELTA_1_H_RNG and IGA_DIF_MIN_0_H_RNG are only an intermediate variable just used for calculation and clarification

Management of extra spark retard:

IF (LV_IGA_DIF_MIN_DELTA_ACT$_n$ = 1 **and**
LV_IGA_DIF_MIN_DELTA_ACT$_{n-1}$ = 0)
THEN CTR_IGA_DIF_MIN_DELTA_TEMP_ENA$_n$ =
C_IGA_DIF_MIN_DELTA_TEMP_ENA
the timer for extra-retard authorised is reseted
ENDIF

IF (LV_HOM_ACT = 1 **and** LV_TQ_IGA_ACT = 1)
THEN CTR_IGA_DIF_MIN_DELTA_TEMP_ENA$_n$ =
CTR_IGA_DIF_MIN_DELTA_TEMP_ENA$_{n-1}$ - 1
the timer for extra-retard authorised is decremented
IGA_DIF_MIN_DELTA_1_H_RNG=
IP_IGA_DIF_MIN_DELTA_H_RNG(N_32,MAF_HB)
ELSE CTR_IGA_DIF_MIN_DELTA_TEMP_ENA$_n$ =
CTR_IGA_DIF_MIN_DELTA_TEMP_ENA$_{n-1}$ + 1
the timer for extra-retard authorised is incremented
IGA_DIF_MIN_DELTA_1_H_RNG=
IP_IGA_DIF_MIN_DELTA_H_RNG(N_32,MAF_HB)
ENDIF
IF CTR_IGA_DIF_MIN_DELTA_TEMP_ENA$_n$ = 0
at the end of timer for extra-retard authorized
THEN IGA_DIF_MIN_DELTA_2_H_RNG$_n$ =
Min[(IGA_DIF_MIN_DELTA_H_RNG$_{n-1}$ -

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C_IGA_DIF_MIN_DELTA_LGRD_H_RNG), 0]
IGA_DIF_MIN_DELTA_1_H_RNG$_n$ = IGA_DIF_MIN_DELTA_2_H_RNG$_n$
Gradient limited come-back of the over-retard bordered to 0
ENDIF

IF IGA_DIF_MIN_DELTA_2_H_RNG = 0
at the end of the gradient limited come-back to 0
THEN CTR_IGA_DIF_MIN_DELTA_TEMP_DIS$_n$ = C_IGA_DIF_MIN_DELTA_TEMP_DIS

IF CTR_IGA_DIF_MIN_DELTA_TEMP_DIS$_n$ $>$ 0
THEN IGA_DIF_MIN_DELTA_1_H_RNG$_n$ = 0
CTR_IGA_DIF_MIN_DELTA_TEMP_DIS$_n$ = CTR_IGA_DIF_MIN_DELTA_TEMP_DIS$_{n-1}$ -1
Inhibition of another over-retard at the end of a first one during the lasting of the timer C_IGA_DIF_MIN_DELTA_TEMP_DIS
ELSE
IF (CTR_IGA_DIF_MIN_DELTA_TEMP_DIS$_n$= 0 **and** (CTR_IGA_DIF_MIN_DELTA_TEMP_DIS$_{n-1}$ = 1)
THEN LV_IGA_DIF_MIN_DELTA_ACT = 0
At the end of the inhibition time, another extra retard is allowed again
ENDIF
ENDIF
ENDIF

Note: CTR_IGA_DIF_MIN_DELTA_TEMP_ENA, IGA_DIF_MIN_DELTA_2_H_RNG and CTR_IGA_DIF_MIN_DELTA_TEMP_DIS are only intermediate variables just used for calculation and clarification

Management of extra spark retard

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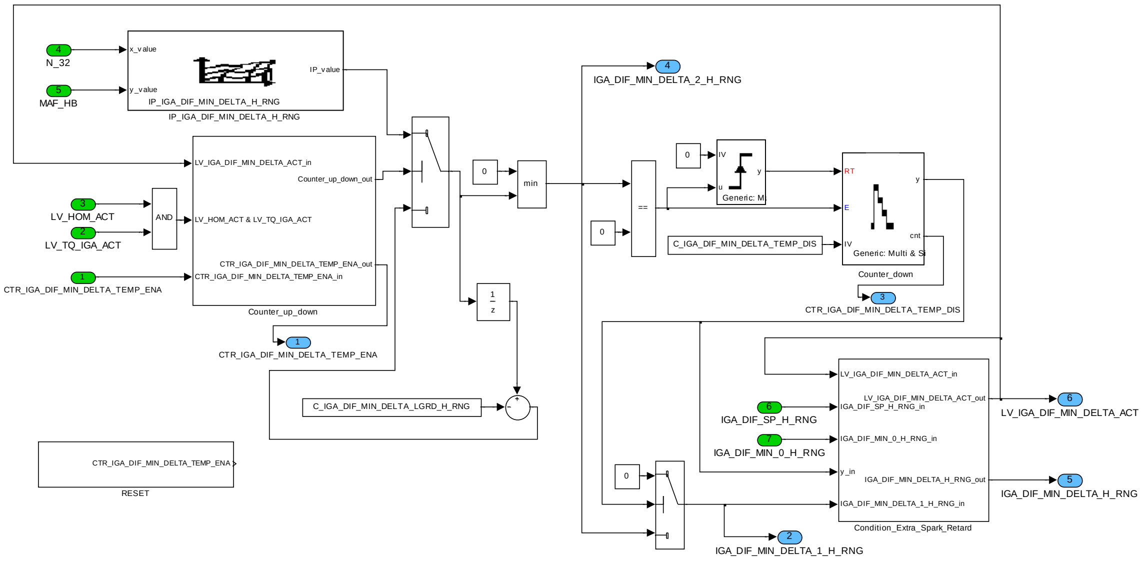
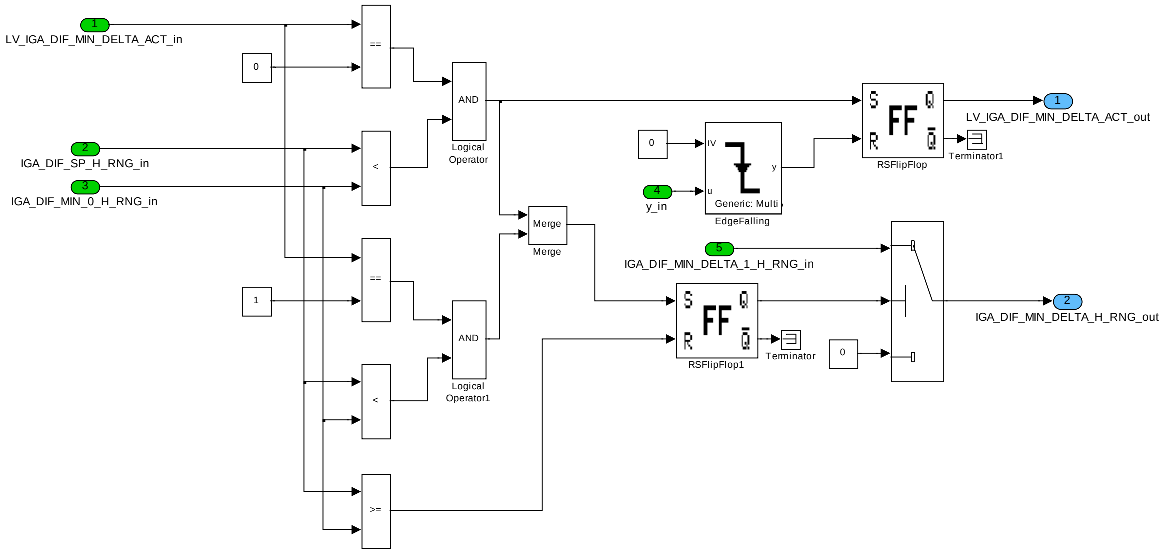


Condition_Extra_Spark_Retard



Counter_up_down

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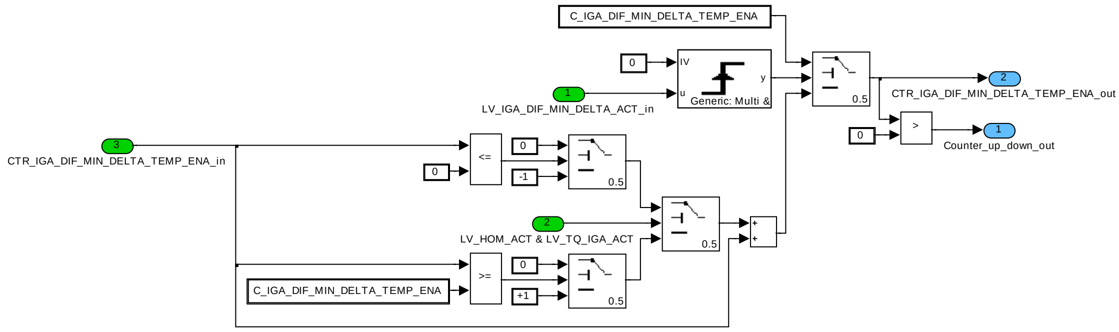

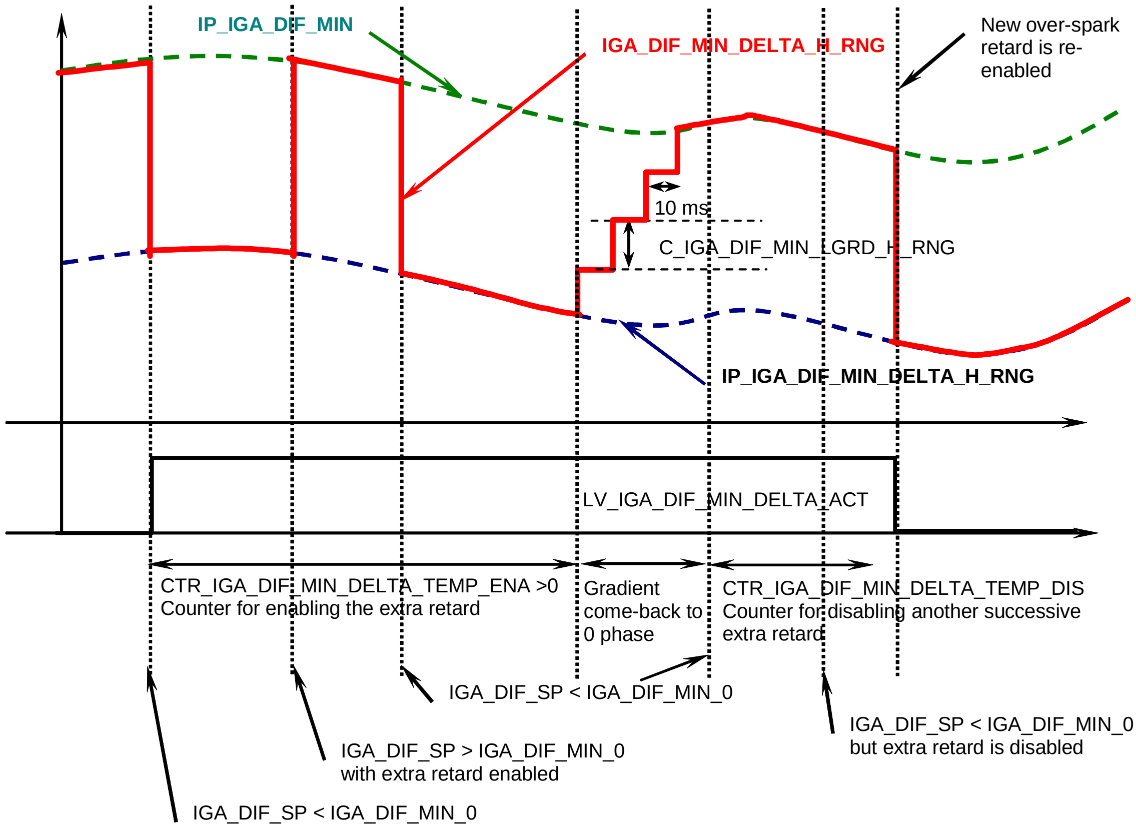

After start correction on IGA_DIF_MIN_H_RNG:

ery 10ms ***if NLC_USE_IGA_MIN_AST = 1***

The following calculations are only performed in homogenous mode during the after start phase (LV_AST_END = 0) and only if considered by project management choice (if NLC_USE_IGA_MIN_AST = 1). In other case, they can be switched off. The update rate is 10ms.

If LV_AT = 1 **and** LV_AST_END = 0 **and** NLC_USE_IGA_MIN_AST = 1

Then IGA_DIF_MIN_AST_H_RNG = (IP_IGA_DIF_MIN_CYC_AT + IP_IGA_DIF_MIN_CYC_AMP_AT_H_RNG * IP_FAC_IGA_DIF_MIN_AMP) * IP_FAC_IGA_DIF_AST

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elseif LV_AT = 0 **and** LV_AST_END = 0 **and** NLC_USE_IGA_MIN_AST = 1
then IGA_DIF_MIN_AST_H_RNG = (IP_IGA_DIF_MIN_CYC_MT + IP_IGA_DIF_MIN_CYC_AMP_MT_H_RNG * IP_FAC_IGA_DIF_MIN_AMP) * IP_FAC_IGA_DIF_AST

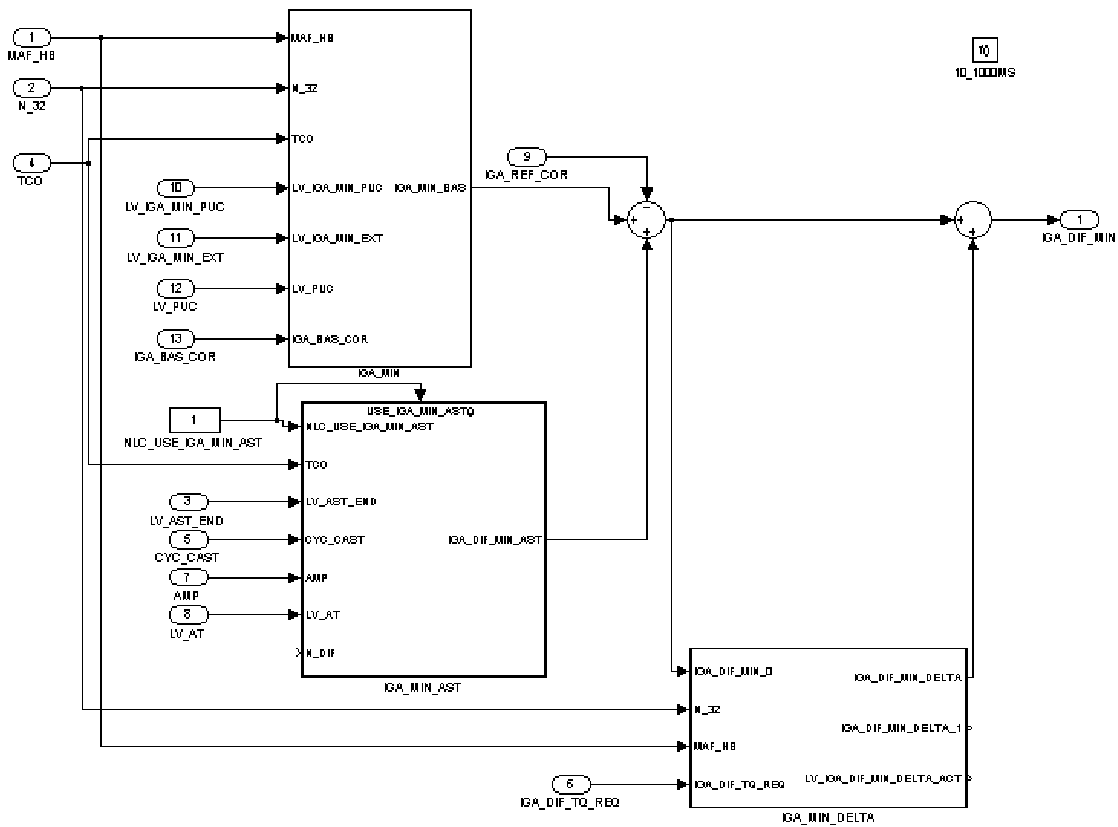
ElseIf IGA_DIF_MIN_AST_H_RNG = 0 *the computation can be switched off*
EndIf

6.12.2 Limitation of IGA_DIF_MIN_H_RNG for after start management

General information:

After start phase it is possible to include a specific correction depending on engine cycles after start and engine coolant temperature to the minimum ignition angle calculated from basic maps to improve the efficiency of catalyst heating.
Note: *All this following part is only computed - and integrated in the SW -*
if NLC_USE_IGA_MIN_AST = 1

Signal flow diagram:



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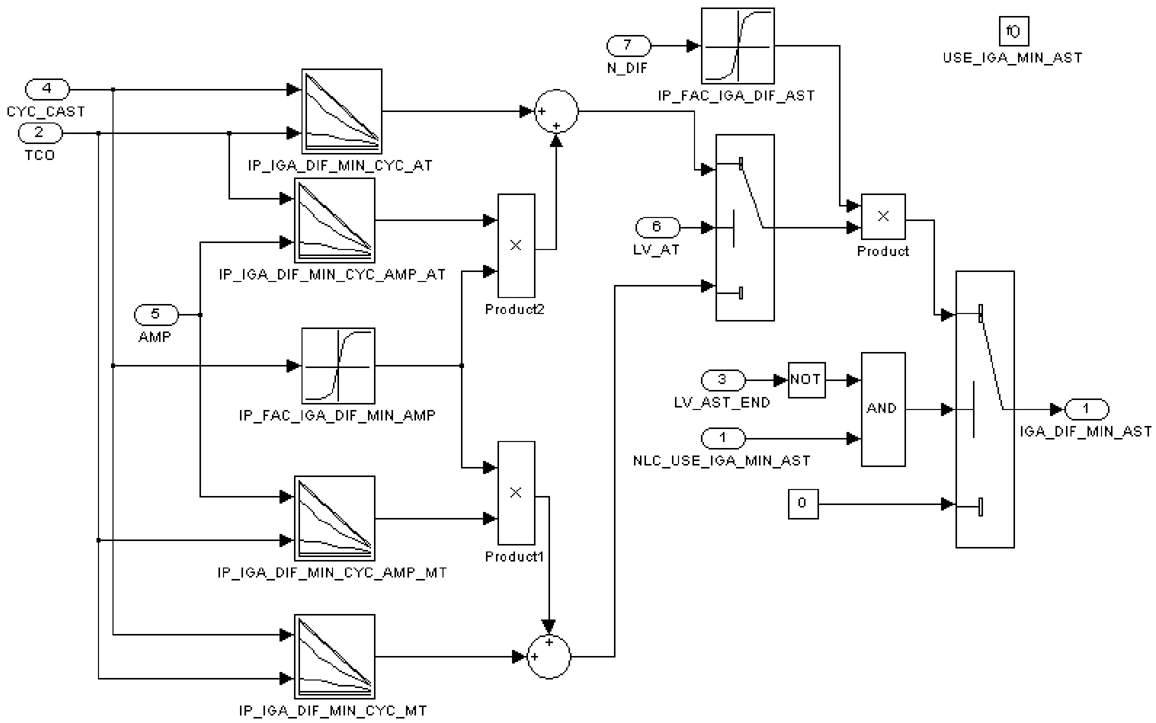

6.12.3 IGA_MIN switch conditions

Signal flow diagram:

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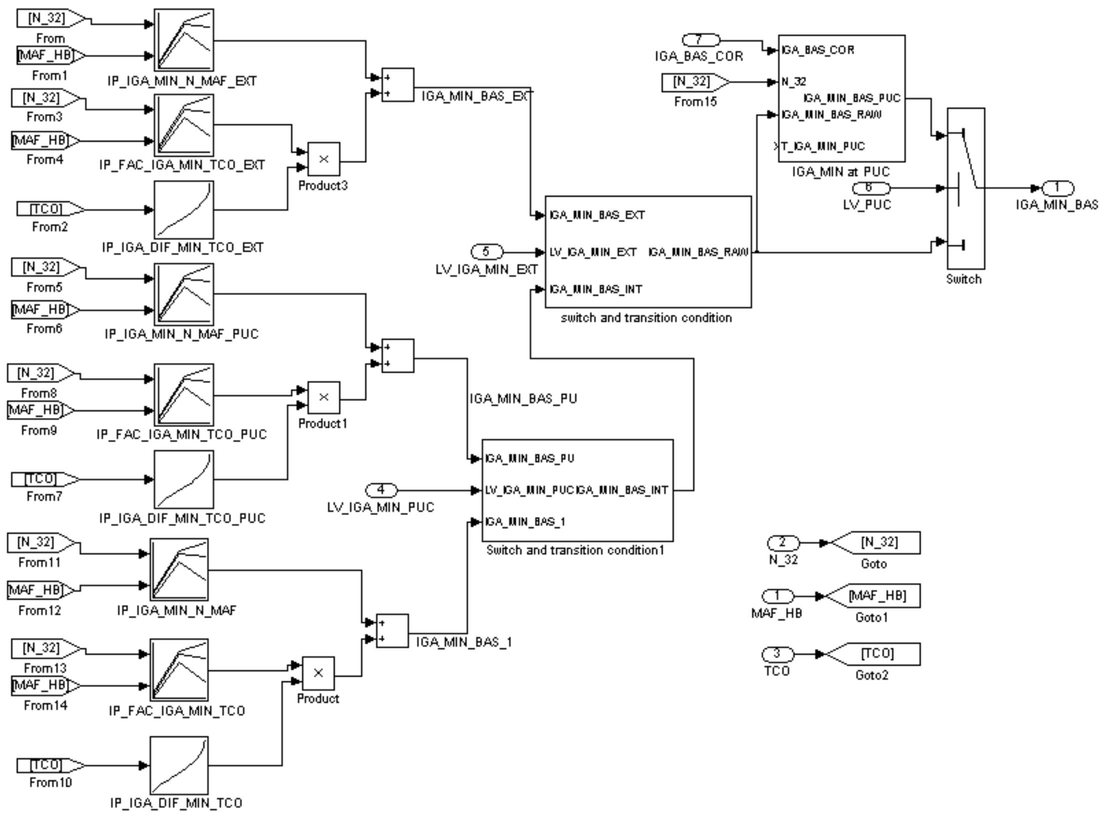

Additional maps are introduced to consider the influence of cat heating and throttled engine mode. IP_IGA_MIN_CH_COR and IP_IGA_MIN_OPM_COR are additive corrections on IGA_MIN_BAS_H_RNG. Each one is depending on N_32 and MAF_HB. The combined sum results in IGA_MIN_BAS_OPM.

The fading of IP_IGA_MIN_CH_COR in depence of operation mode is managed by function function OPM_SWI.

Formula description:

IF OPM_REQ_CUS = 66 **or** OPM_REQ_CUS = 82
THEN
IGA_MIN_BAS_2_H_RNG = IGA_MIN_BAS_H_RNG + IP_IGA_MIN_CH_COR_H_RNG
ELSE
IGA_MIN_BAS_2_H_RNG = IGA_MIN_BAS_H_RNG
ENDIF
IGA_MIN_BAS_2_OPM_1_H_RNG = IGA_MIN_BAS_2_H_RNG
IGA_MIN_BAS_2_OPM_2_H_RNG = IGA_MIN_BAS_2_H_RNG + IP_IGA_MIN_OPM_COR_H_RNG
IGA_MIN_BAS_OPM_H_RNG = Function call OPM_SWI (described in chapter 1.5)

6.12.4 Operation mode manager (function OPM_SWI)

There are two input values IGA_MIN_BAS_2_OPM_1_H_RNG, IGA_MIN_BAS_2_OPM_2_H_RNG. Each input value belongs to a special operation mode OPM_1, OPM_2. Moreover the value OPM_SEL_AV indicates the active and OPM_SEL_REQ indicates the requested operation mode. The aim of the operation manager is to create an output value depending on the active operation mode. If there is

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a switch from one mode to another a smooth changeover from one input value to the other in possible by using the interpolation factor FAC_IGA_OPM_SEL .

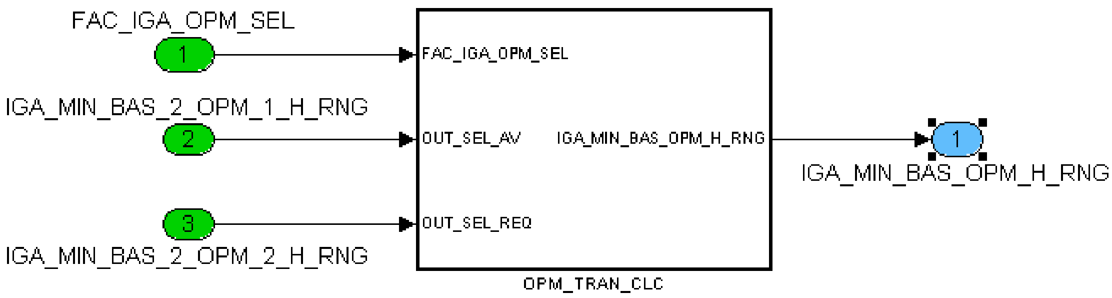

Figure 6.12.1: Operation mode manager

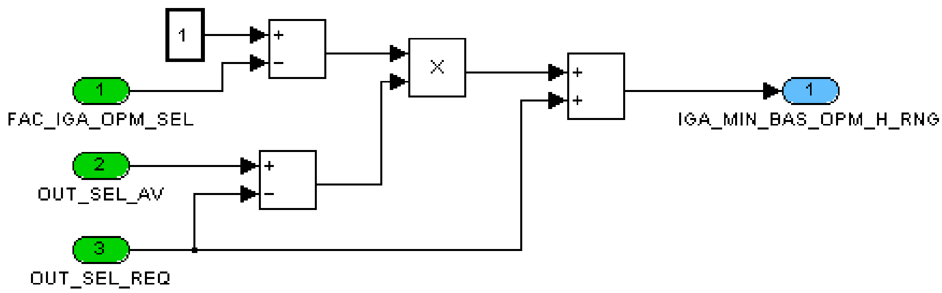

Figure 6.12.2: OPM_TRAN_CLC

To prevent a jump in the IGA_MIN a transition is necessary at switching to an other IGA_MIN_BAS_x_ H_RNG with the change limitation of C_IGA_DIF_MIN_BAS_LGRD_H_RNG.

LV_IGA_MIN_PUC == from 0 to 1 **and** LV_IGA_MIN_EXT == 0:
IF IGA_MIN_BAS_INT_H_RNG$_{n-1}$ - IGA_MIN_BAS_PU_H_RNG$_{n}$ > 0
Then IGA_MIN_BAS_INT_H_RNG$_{n-1}$ - C_IGA_DIF_MIN_BAS_LGRD_H_RNG
until IGA_MIN_BAS_INT_H_RNG$_{n-1}$ - IGA_MIN_BAS_PU_H_RNG$_{n}$ $<=$ C_IGA_DIF_MIN_ BAS_LGRD_H_RNG
Then IGA_MIN_BAS_INT_H_RNG$_{n}$ = IGA_MIN_BAS_PU_H_RNG
else
IF IGA_MIN_BAS_INT_H_RNG$_{n-1}$ - IGA_MIN_BAS_PU_H_RNG$_{n}$ < 0
Then IGA_MIN_BAS_INT_H_RNG$_{n-1}$ + C_IGA_DIF_MIN_BAS_LGRD_H_RNG
until IGA_MIN_BAS_INT_H_RNG$_{n-1}$ - IGA_MIN_BAS_PU_H_RNG$_{n}$ $<=$ C_IGA_ DIF_MIN_BAS_LGRD_H_RNG
Then IGA_MIN_BAS_INT_H_RNG$_{n}$ = IGA_MIN_BAS_PU_H_RNG

LV_IGA_MIN_PUC == from 1 to 0 **and** LV_IGA_MIN_EXT == 0:
IF IGA_MIN_BAS_INT_H_RNG$_{n-1}$ - IGA_MIN_BAS_1_H_RNG$_{n}$ > 0
Then IGA_MIN_BAS_INT_H_RNG$_{n-1}$ - C_IGA_DIF_MIN_BAS_LGRD_H_RNG
until IGA_MIN_BAS_INT_H_RNG$_{n-1}$ - IGA_MIN_BAS_1_H_RNG$_{n}$ $<=$ C_IGA_DIF_MIN_ BAS_LGRD_H_RNG

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Then IGA_MIN_BAS_INT_H_RNG$_{n}$ = IGA_MIN_BAS_1_H_RNG
else
IF IGA_MIN_BAS_INT_H_RNG$_{n-1}$ - IGA_MIN_BAS_1_H_RNG$_{n}$ < 0
Then IGA_MIN_BAS_INT_H_RNG$_{n-1}$ + C_IGA_DIF_MIN_BAS_LGRD_H_RNG
until IGA_MIN_BAS_INT_H_RNG$_{n-1}$ - IGA_MIN_BAS_1_H_RNG$_{n}$<= C_IGA_DIF_MIN_BAS_LGRD_H_RNG
Then IGA_MIN_BAS_INT_H_RNG$_{n}$ = IGA_MIN_BAS_1_H_RNG

LV_IGA_MIN_EXT == from 0 to 1:
IF IGA_MIN_BAS_RAW_H_RNG$_{n-1}$ - IGA_MIN_BAS_EXT_H_RNG$_{n}$ > 0
Then IGA_MIN_BAS_RAW_H_RNG$_{n-1}$ - C_IGA_DIF_MIN_BAS_LGRD_H_RNG
untilIGA_MIN_BAS_RAW_H_RNG$_{n-1}$ - IGA_MIN_BAS_EXT_H_RNG$_{n}$ C_IGA_DIF_MIN_BAS_LGRD_H_RNG
Then IGA_MIN_BAS_RAW_H_RNG$_{n}$ = IGA_MIN_BAS_EXT_H_RNG
else
IF IGA_MIN_BAS_RAW_H_RNG$_{n-1}$ - IGA_MIN_BAS_EXT_H_RNG$_{n}$ < 0
Then IGA_MIN_BAS_RAW_H_RNG$_{n-1}$ + C_IGA_DIF_MIN_BAS_LGRD_H_RNG
until IGA_MIN_BAS_RAW_H_RNG$_{n-1}$ - IGA_MIN_BAS_EXT_H_RNG$_{n}$ C_IGA_DIF_MIN_BAS_LGRD_H_RNG
Then IGA_MIN_BAS_RAW_H_RNG$_{n}$ = IGA_MIN_BAS_EXT_H_RNG

LV_IGA_MIN_EXT == from 1 to 0:
IF IGA_MIN_BAS_RAW_H_RNG$_{n-1}$ - IGA_MIN_BAS_INT_H_RNG$_{n}$ > 0
Then IGA_MIN_BAS_RAW_H_RNG$_{n-1}$ - C_IGA_DIF_MIN_BAS_LGRD_H_RNG
until IGA_MIN_BAS_RAW_H_RNG$_{n-1}$ - IGA_MIN_BAS_INT_H_RNG$_{n}$ C_IGA_DIF_MIN_BAS_LGRD_H_RNG
Then IGA_MIN_BAS_RAW_H_RNG$_{n}$ = IGA_MIN_BAS_INT_H_RNG
else
IF IGA_MIN_BAS_RAW_H_RNG$_{n-1}$ - IGA_MIN_BAS_INT_H_RNG$_{n}$ < 0
Then IGA_MIN_BAS_RAW_H_RNG$_{n-1}$ + C_IGA_DIF_MIN_BAS_LGRD_H_RNG
untilIGA_MIN_BAS_RAW_H_RNG$_{n-1}$ - IGA_MIN_BAS_INT_H_RNG$_{n}$ C_IGA_DIF_MIN_BAS_LGRD_H_RNG
Then IGA_MIN_BAS_RAW_H_RNG$_{n}$ = IGA_MIN_BAS_INT_H_RNG

LV_IGA_MIN_EXT = = 1:
IF LV_IGA_MIN_PUC = = 0
Then IGA_MIN_BAS_INT_H_RNG = IGA_MIN_BAS_1_H_RNG
else IGA_MIN_BAS_INT_H_RNG = IGA_MIN_BAS_PU_H_RNG
endif

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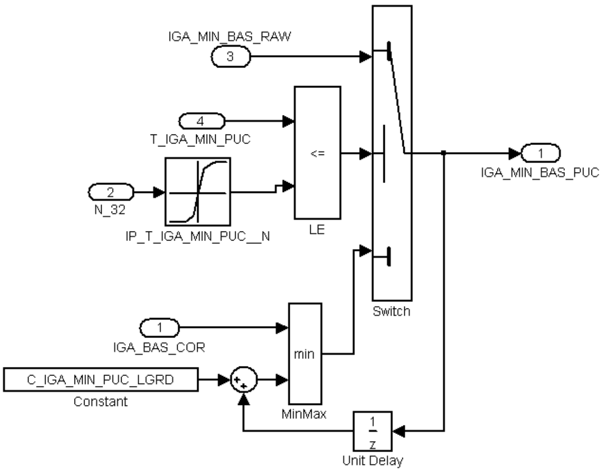

IF LV_PUC$_n$ = 1 **AND** LV_PUC$_{n-1}$ = 0 **AND** LC_INH_IGA_MIN_PUC = 0

Thenstart timerT_IGA_MIN_PUC incrementation

IF T_IGA_MIN_PUC $<$ = IP_T_IGA_MIN_PUC

then IGA_MIN_BAS_PUC_H_RNG = IGA_MIN_BAS_RAW_H_RNG

else IGA_MIN_BAS_PUC_H_RNG$_n$ = min((IGA_MIN_BAS_PUC_H_RNG$_{n-1}$ + C_IGA_MIN_PUC_LGRD_H_RNG; IGA_BAS_COR)

endif

IF LV_PUC == 0

Then IGA_MIN_BAS_H_RNG = IGA_MIN_BAS_RAW_H_RNG

else IGA_MIN_BAS_H_RNG = IGA_MIN_BAS_PUC_H_RNG

endif

Maximum possible spark retard: every 10ms

The two following calculations are always performed (in homogenous mode) at an update rate of 10ms.

IGA_DIF_MIN_0_*H_RNG* = -1* IGA_REF_COR + IGA_MIN_BAS_OPM_H_RNG+ IGA_DIF_MIN_AST_H_RNG *after start correction*

IGA_DIF_MIN_0_H_RNG is just the standard result of the interpolation maps

IGA_DIF_MIN_H_RNG = (IGA_DIF_MIN_0_*H_RNG* + IGA_DIF_MIN_DELTA_H_RNG)

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6.13 Exhaust gas temperature protection - Minimun ignition angle limitation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_DIF_MIN_TEG_1_H_RNG	-	0... B40H	0... -180	0.0625	°CRK
Difference of minimum ignition angle with reference one according to TEG value - Intermediate variable					
IGA_DIF_MIN_TEG_H_RNG	O/V	0... B40H	0... -180	0.0625	°CRK
Difference of minimum ignition angle with reference one - TEG correction included					
IGA_MIN_TEG_H_RNG	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
minimum ignition angle					
TEG_CAT_UP_MDL_MAX	O/V	0... 7FF0H	0... 2047	0.0625	°C
Maximal Temperature of exhaust gas between all cylinder bank					
TEG_DYN_HYS	V	0... 7FF0H	0... 2047	0.0625	°C
Temperature of exhaust gas with hysterisis for IGA_MIN limitation					

Input data:

IGA_DIF_MIN_H_RNG {p. 1925}	IGA_REF_COR {p. 8266}	LV_ES {p. 1720}	LV_HOM_RUN {p. 8136}
LV_ST {p. 1720}	TEG_CAT_UP_MDL [_i] {p. 8236}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TEG_MAX_IGA	-	0... 7FF0H	0... 2047	0.0625	°C
Maximum allowable exhaust gas temperature for spark retard control					
C_TEG_MAX_IGA_HYS	-	0... 7FF0H	0... 2047	0.0625	°C
Hysterisis on exhaust gas temperature for spark retard control					
IP_IGA_DIF_MIN_TEG_H_RNG__TEG	-	0... B40H	0... -180	0.0625	°CRK
LDP_TEG_DYN_HYS	16	0... 7FF0H	0... 2047	0.0625	°C
Minimum ignition angle versus exhaust gas temperature					

FUNCTION DESCRIPTION:

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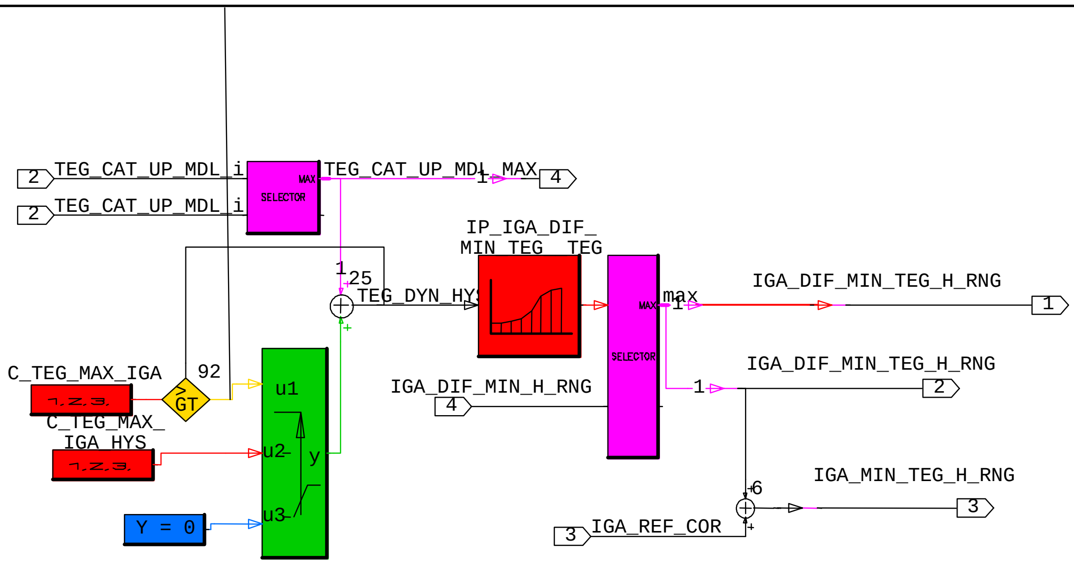
Discrete SuperBlock	Sample Period	Sample Skew	Inputs	Outputs	Enable Signal
IGA_MIN_for_TEG	1.	0.	4	4	Parent



General information:

The minimum ignition angle IGA_MIN is the minimum allowable ignition angle that is possible to apply to the engine. Hencce, it only includes the combustion stability concern. It does not take into account any thermal effect. It should be used during the torque intervention phases in order to produce a fast reduction of the torque.

Applying IGA_MIN as actual ignition angle results in efficiency losses that should lead to an exhaust gas overheating and/or engine damages.

In order to avoid overheating of the components in the exhaust-system branch, minimum spark retard has to be limited in accordance with the actual exhaust gas temperature TEG_CAT_UP_MDL[NC_CBK_EX_NR].

Moreover to determine the maximum possible torque reserve for catalyst heating, the torque reserve co-ordination module needs the minimum ignition angle efficiency and the minimum ignition angle with exhaust branch protection efficiency in order to limit and choose the different torque reserve requests.

Hence another minimum spark retard difference have to be calculated IGA_DIF_MIN_TEG_H_RNG which takes into account the exhaust gas system protection. It is the maximum between the one calculated versus the maximal exhaust gases temperature (TEG_CAT_UP_MDL_MAX) and the basic one IGA_DIF_MIN_H_RNG.

Classically IGA_DIF_MIN is calculated from a basic value of the minimum ignition angle corrected with a temperature dependent additive term. The basic minimum spark advance is here extracted from a calibration map.

To calculate the minimum spark retard limitation according to the exhaust gas temperature the map IP_IGA_DIF_MIN_TEG_H_RNG__TEG is used. TEG_DYN_HYS is used as input for this map. This intermediate variable TEG_DYN_HYS represents the exhaust gas temperature TEG_CAT_UP_MDL[NC_CBK_EX_NR] increased by an hysterisis in order to anticipate the exhaust-system branch overheat.

The influence of the ignition angle on the exhaust gas temperature results from the ignition angle efficiency. Thus - in order to calibrate easily the map IP_IGA_DIF_MIN_TEG_H_RNG__TEG - one should use the efficiencies resulting from IGA_DIF_MIN_H_RNG values with the map IP_EFF_IGA__IGA_DIF and limit these efficiencies according to the actual exhaust gas temperature to avoid exhaust-system branch overheat. Then, thanks to the reverse map IP_IGA_DIF__EFF or thanks to the torque model for ignition angle efficiency, it is possible to calculate the value of the map IP_IGA_DIF_MIN_TEG_H_RNG__TEG.

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So, in all practical cases IGA_DIF_MIN_H_RNG is a negative value that is the maximum allowable spark retard for engine stable running and pollutant conditions. It includes the coolant temperature correction. The exhaust gas temperature limitation is then taken into account in IGA_DIF_MIN_TEG_H_RNG:

The actual exhaust gas temperature TEG_CAT_UP_MDL[NC_CBK_EX_NR] can be either measured by a sensor on the exhaust-system branch or calculated from an exhaust gas temperature model.

For engines with multiple cylinder bamks, this temperature TEG_CAT_UP_MDL[NC_CBK_EX_NR] of exhaust gas before catalyst is defined and dedicated for each cylinder banks individualy. Since here the limitation of IGA_MIN is just a protective function versus the catalyst overheating, only the maximal value from all those cylinder bank related TEG_CAT_UP_MDL[NC_CBK_EX_NR] temperature will be taken into account.

Note: Two different update rates are used in the following calculations: for everything related to TEG only 1000ms rate is used to update calculation in synchronisation with TEG updates; for calculations related to ignition angle a 10 time faster update rate of 100ms.

These calculations are only performed when engine is running (*not stalled*) in homogenous mode after the end of start phase.

Application conditions

Activation: LV_HOM_RUN = 1 **and** LV_ST = 0 **and** LV_ES = 0

active only in homogenous mode after the end of start phase before engine stall

Deactivation: LV_HOM_RUN = 0 **or** LV_ST = 1 **or** LV_ES = 1

Initialisation:
IGA_MIN_TEG_H_RNG = -90 °CRK
IGA_DIF_MIN_TEG_H_RNG = -180 °CRK
IGA_DIF_MIN_TEG_1_H_RNG = -180 °CRK
TEG_DYN_HYS = 0 at reset

Update Rate:
TEG_DYN_HYS => 1000ms
and synchronised with TEG_CAT_UP_MDL[NC_CBK_EX_NR] updates.
IGA_DIF_MIN_TEG_H_RNG => 100ms
IGA_MIN_TEG_H_RNG => 100ms
EFF_IGA_MIN_TEG => 100ms

Formula section:

Maximal cylinder bank exhaust gas temperature determination:

every 1000ms

in synchronisation with TEG_CAT_UP_MDL[NC_CBK_EX_NR] updates

$$TEG\_CAT\_UP\_MDL\_MAX = \underset{0}{\overset{NC\_CBK\_NR-1}{Max}}\left(TEG\_CAT\_UP\_MDL\_i\right)$$

Hysteris function on exhaust gas temperature for ignition effects anticipation:

every 1000ms

in synchronisation with TEG_CAT_UP_MDL[NC_CBK_EX_NR] updates

If $TEG\_DYN\_HYS_{n-1} > C\_TEG\_MAX\_IGA$
Then $TEG\_DYN\_HYS_{n} = TEG\_CAT\_UP\_MDL\_MAX_{n} + C\_TEG\_MAX\_IGA\_HYS$
Else $TEG\_DYN\_HYS_{n} = TEG\_CAT\_UP\_MDL\_MAX_{n}$
Endif

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IGA_DIF_MIN_TEG_1_H_RNG = IP_IGA_DIF_MIN_TEG_H_RNG__TEG (TEG_DYN_HYS)

IGA_DIF_MIN_TEG_1_H_RNG is just an intermediate variable for calculation to name the result of the interpolation

Limitation of Maximum possible spark retard according to exhaust temperature TEG_DYN_HYS:

every 100ms

IGA_DIF_MIN_TEG_H_RNG = Max (IGA_DIF_MIN_H_RNG . IGA_DIF_MIN_TEG_1_H_RNG)

Minimum ignition angle limited for exhaust temperature protection:

ery 100ms

IGA_MIN_TEG_H_RNG = IGA_REF_COR + IGA_DIF_MIN_TEG_H_RNG

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6.14 Ignition angle difference for catalyst heating with post injection

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_DIF_S_CH	O/V	0... FFH	-35.625 ...60	0.375	°CRK
Ignition angle difference for stratified catalyst heating with post injection					

Input data:

MFF_SP_MV {p. 2151}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}	STATE_CH_MOD_REQ {p. 1796}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_IGA_DIF_ADD_MFF_POST_CH_L	-	0... FFH	-35.625 ...60	0.375	°CRK
Mass of post injection depending correction for ignition angle difference for low load catalyst heating					
C_IGA_DIF_S_CH_AST_BAS	-	0... F00H	-720 ...720	0.375	°CRK
Ignition angle difference for stratified catalyst hating with post injection					
C_IGA_DIF_S_CH_L_BAS	-	0... F00H	-720 ...720	0.375	°CRK
Ignition angle difference for stratified low load catalyst heating with post injection					
C_IGA_DIF_S_CH_MAN	-	0... FFH	-35.625 ...60	0.375	°CRK
Manual setting of ignition angle difference for stratified catalyst heating with post injection					
LC_IGA_DIF_S_CH_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of ignition angle difference for stratified catalyst heating with post injection					

Overview

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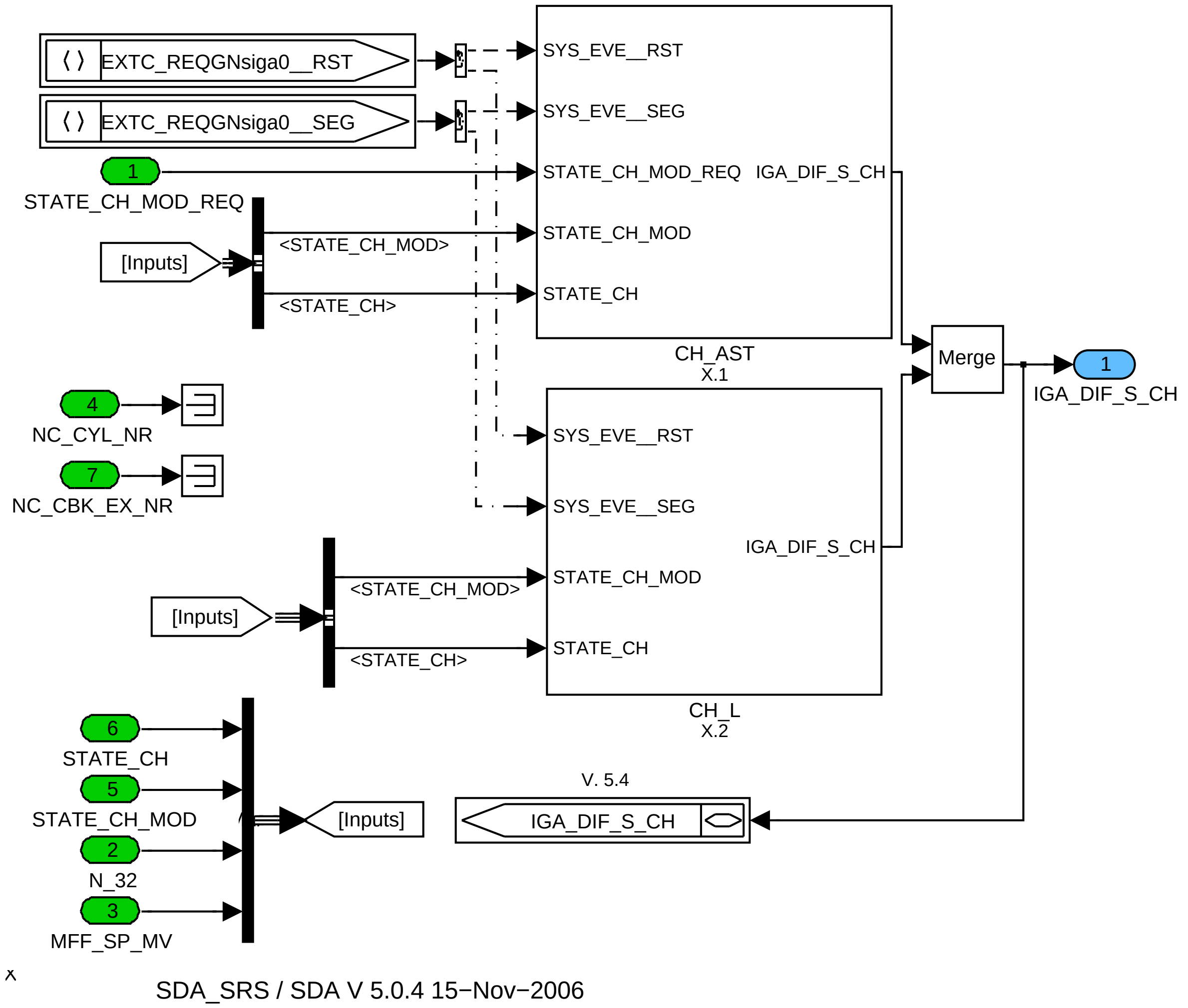

Figure 6.14.1: : Path: EXTC_REQGNsiga0

General Information

For catalyst heating in stratified mode possibly with post injection there is an increase of exhaust gas temperature due to retarding the ignition angle. In this module a difference of the ignition angle is generated.
The function is divided into two parts: After start and low load catalyst heating.

6.14.1 Catalyst heating after start

Application Conditions

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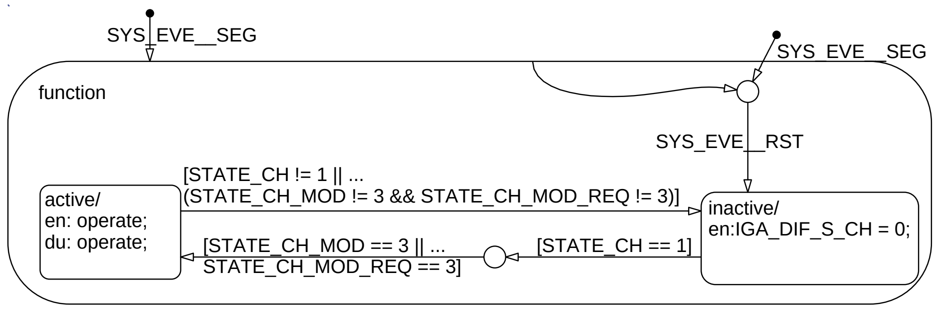

Figure 6.14.2: : Path: EXTC_REQGNsiga0/CH_AST/APP_CDN/Chart

Function description

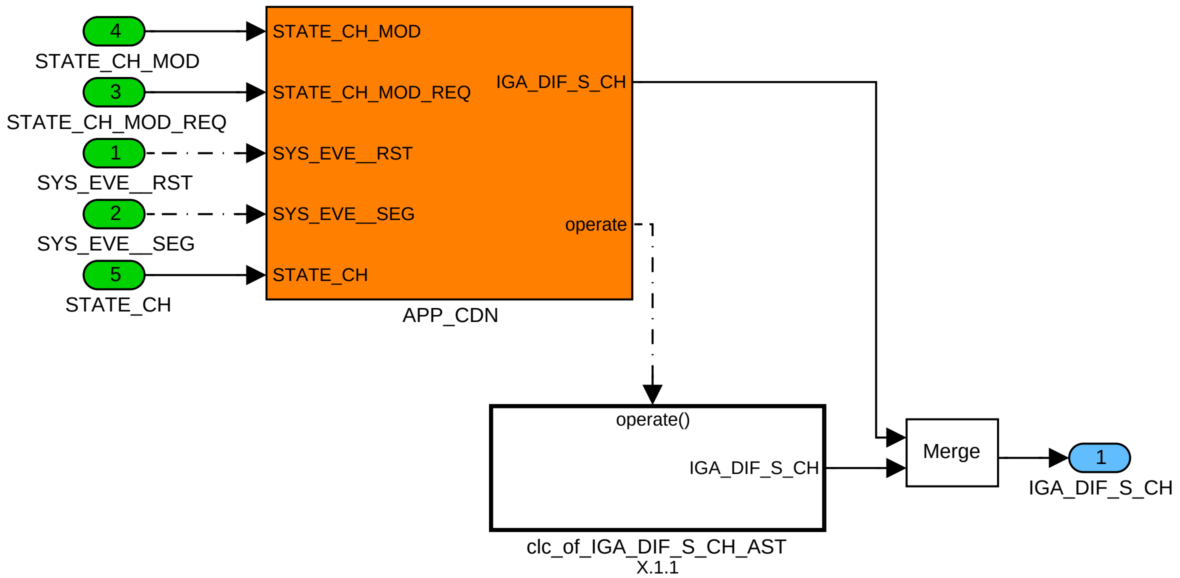

Figure 6.14.3: : Path: EXTC_REQGNsiga0/CH_AST

6.14.1.1 Function: Catalyst heating after start

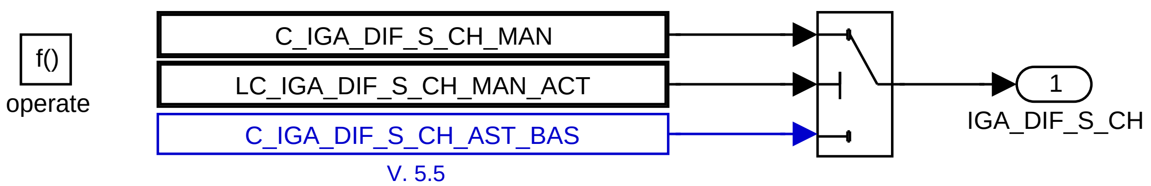

Figure 6.14.4: : Path: EXTC_REQGNsiga0/CH_AST/clc_of_IGA_DIF_S_CH_AST

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6.14.2 Low load catalyst heating

Application Conditions

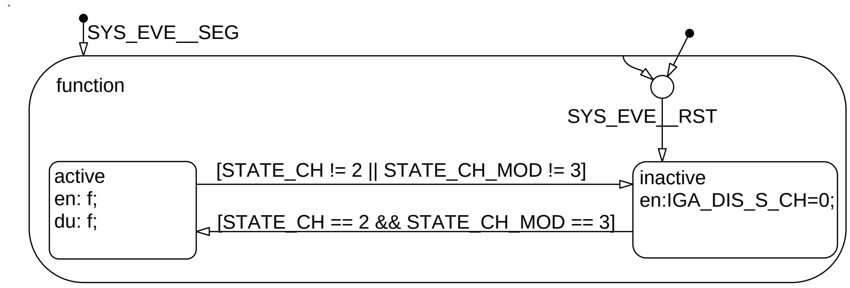

Figure 6.14.5: :   Path: EXTC_REQGNsiga0/CH_L/APP_CDN/Chart

Function description

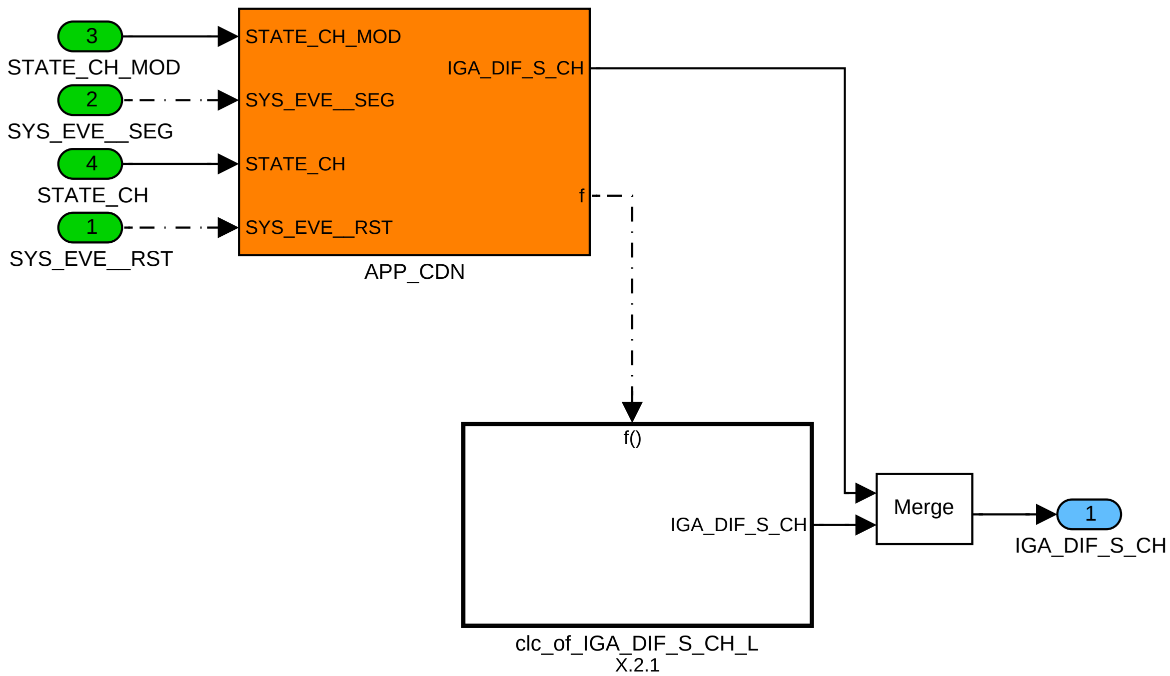

Figure 6.14.6: :   Path: EXTC_REQGNsiga0/CH_L

6.14.2.1 Function: Low load catalyst heating

For low load CH there is a second correction depending on the actual fuel mass of post injection beside the CH_ASTfunctionality. The read_vector block picks out one element (here the 1st) of the cylinder individual MFF_POSTvector.

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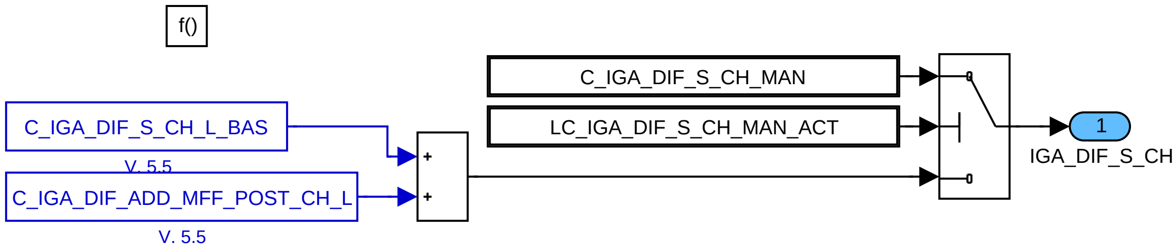

Figure 6.14.7: : Path: EXTC_REQGNsiga0/CH_L/clc_of_IGA_DIF_S_CH_L

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6.15 TQM - Setpoint ignition angle

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_IGA_INV_COR_CBK	V	0... 4E20H	0... 100	0.005	%
Setpoint ignition efficiency; inverted and corrected depending on engine state bank selective					
EFF_IGA_INV_COR_CBK_CAN	V	0... 4E20H	0... 100	0.005	%
Setpoint ignition efficiency CAN; inverted and corrected depending on engine state bank selective					
EFF_IGA_SP_CBK [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	-
Setpoint ignition efficiency bank selective					
EFF_IGA_SP_CBK_1 [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	-
Setpoint ignition efficiency bank selective					
EFF_IGA_SP_CBK_1_CAN [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	-
Setpoint ignition efficiency for CAN bank selective					
EFF_IGA_SP_CBK_CAN [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	-
Setpoint ignition efficiency for CAN bank selective					
IGA_DIF_SP_CBK_CAN_H_RNG [NC_CBK_EX_NR]	O/V	0... B40H	0... -180	-0.0625	°CRK
Setpoint subtrahend ignition angle in wide range for CAN bank selective					
IGA_DIF_SP_CBK_H_RNG	O/V	0... B40H	0... -180	-0.0625	°CRK
Setpoint subtrahend ignition angle in wide range bank selective					
IGA_DIF_SP_H_RNG	O/V	0... B40H	0... -180	-0.0625	°CRK
Setpoint subtrahend ignition angle in wide range					
IGA_SP_CAN_H_RNG	O/V	0... B40H	0... -180	-0.0625	°CRK
Setpoint ignition angle from torque management for CAN					
IGA_SP_CBK_CAN_H_RNG [NC_CBK_EX_NR]	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Setpoint ignition angle from torque management for CAN bank selective					
IGA_SP_CBK_H_RNG [NC_CBK_EX_NR]	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Setpoint ignition angle from torque management bank selective					
IGA_SP_H_RNG	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Setpoint ignition angle from torque management					
LV_TQ_IGA_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable torque intervention by spark retard is active					
LV_TQ_IGA_REQ	V	0... 1H	0 ...1	1	-
Logical variable torque intervention by spark retard is request					

Input data:

EFF_IGA_BAS_COR_CBK [NC_CBK_EX_NR] {p. 1845}	EFF_LAMB_AV_CBK [NC_CBK_EX_NR] {p. 8379}	EFF_SCC_AV {p. 6665}	FAC_EFF_IGA {p. 1845}
IGA_REF_COR_CBK [NC_CBK_EX_NR] {p. 8266}	LV_ACT_AJ {p. 8192}	LV_HOM_RUN {p. 8136}	LV_REQ_ISC {p. 3501}
LV_TQ_IGA_ENA {p. 8379}	TQI_REF {p. 8380}	TQI_SP_CAN {p. 8391}	TQI_SP_CBK [NC_CBK_EX_NR] {p. 8391}

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EFF_IGA_THD_1	-	0... FFFFH	0... 1.99996	30.5e-6	-
Threshold ignition efficiency for deactivation spark retard					
C_EFF_IGA_THD_AJ	-	0... FFFFH	0... 1.99996	30.5e-6	-
Threshold on ignition efficiency for deactivation of spark retard in anti-jerk intervention					
C_EFF_IGA_THD_IS	-	0... FFFFH	0... 1.99996	30.5e-6	-
Threshold on ignition efficiency for deactivation of spark retard in idle speed					
C_TQ_IGA_INH	-	0... 2H	0 ...2	1	-
Constant inhibition TQ-intervention by spark retard (0..no inh, 1..Inh, 2..calculated old way)					
IP_IGA_DIF_SP_H_RNG	-	0... B40H	0... -180	-0.0625	°CRK
LDP_EFF_IGA_INV_COR_IP_IGA_DIF	16	0... 4E20H	0... 100	0.005	%
Setpoint spark retard for torque intervention					

FUNCTION DESCRIPTION:

General information:

For homogeneous (*LV_HOM_RUN = 1*) the module ignition angle setpoint delivers IGA_DIF_SP_H_RNG as an output which depends on the torque setpoint TQI_SP_CBK[NC_CBK_EX_NR]. For the calculation of the setpoint of ignition efficiency EFF_IGA_SP the actual cylinder fuel cut-off efficiency EFF_SCC_AV, the Exhaust Gas Re-circulation efficiency and the actual lambda efficiency EFF_LAMB_AV are considered which are multiplied with the reference torque value TQI_REF.
By evaluation of the standardised ignition characteristic the spark retard value IGA_DIF_SP_H_RNG is calculated (*a negative value*) and will be applied on the reference ignition angle to define the ignition angle setpoint for torque interventions. In a system with variable valve lift the standardised ignition characteristic depends on the actual engine mode. Two modes are distinguished: load control via inlet valve lift and load control via the main throttle. To pay this different load controls attention the basic standardised ignition characteristic given by IP_IGA_DIF_SP_H_RNG is corrected with engine mode depending factor FAC_IGA_DIF.
Hereafter, it is determined if a fast torque intervention request implies a spark retard for its application through the logical flag LV_TQ_IGA_REQ.
If EFF_IGA_SP >= EFF_IGA_BAS_COR then no torque intervention is necessary and LV_TQ_IGA_ACT is set to 0 since there is no spark retard requested by torque. In this case IGA_DIF_SP_H_RNG is set to the passive value which is the maximum value for difference ignition angle *(=0 °CRK*). Then IGA_DIF_SP_H_RNG is not a limitation for the basic ignition angle in any case.
If EFF_IGA_SP < (EFF_IGA_BAS_COR - Threshold) then a significant spark retard resulting from a torque request has to be applied. For this LV_TQ_IGA_REQ is set to 1.
The value of the Threshold used here depends on both if an anti-jerk intervention is activated and if the engine is in idle speed phase. In normal condition (*no anti-jerk nor idle speed*) the threshold is Threshold = C_EFF_IGA_THD_1. In case of Anti-Jerk intervention a specific threshold will be used (*Threshold_1 = C_EFF_IGA_THD_AJ*) ; in idle speed also another specific threshold (*Threshold_2 = C_EFF_IGA_THD_IS*) instead of the normal one. Finally, the minimal threshold between both preceding is retained to be *applied (Threshold = Min(Threshold_1,Threshold_2)*).
IGA_DIF_SP_H_RNG is deduced from EFF_IGA_SP and is added (*negative value*) to the reference ignition angle to get the ignition angle setpoint for torque intervention.
The main reason for the existence of these two cases is to reduce ignition angle jitters if torque values are jittering (TQI_SP_CBK[NC_CBK_EX_NR] *and TQI_REF*). If no significant torque intervention is recognised then IGA_DIF_SP_H_RNG is set to the passive value 0°CRK. In this case the torque

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controlled ignition angle setpoint has definitely no impact any more to the applied ignition angle which is then only determined from the basic ignition angle and knock control.
This functionality allows choosing what parameter (*Ignition, Injection, ETC, etc...*) will be impacted first by a fast torque intervention and how this torque reduction request will be handled.
IGA_SP_CAN_H_RNG is calculated like IGA_SP_H_RNG only with calculations depending on TQI_SP_CAN.

Application conditions:

Activation: LV_HOM_RUN = 1
Deactivation: LV_HOM_RUN = 0
Initialisation: IGA_SP_CBK_H_RNG[NC_CBK_EX_NR] = IGA_SP_H_RNG = 60°CRK **and** IGA_SP_CBK_CAN_H_RNG[NC_CBK_EX_NR] = IGA_SP_CAN_H_RNG = 60°CRK **and** LV_TQ_IGA_ACT = 0 at reset
Update Rate: 10 ms

Formula section:

IF EFF_SCC_AV > 0
then EFF_IGA_SP_CBK_1[NC_CBK_EX_NR] = TQI_SP_CBK[NC_CBK_EX_NR] /(TQI_REF * EFF_SCC_AV * EFF_LAMB_AV_CBK[NC_CBK_EX_NR])
else EFF_IGA_SP_CBK_1[NC_CBK_EX_NR] =TQI_SP_CBK[NC_CBK_EX_NR]/(TQI_REF* EFF_LAMB_AV_CBK[NC_CBK_EX_NR])
endif
EFF_IGA_SP_CBK_1_CAN[NC_CBK_EX_NR] = TQI_SP_CAN /(TQI_REF * EFF_SCC_AV * EFF_LAMB_AV_CBK[NC_CBK_EX_NR])
note: if division by 0 then set EFF_IGA_SP_CBK_1 to maximum Hexa value.

EFF_IGA_SP_CBK[NC_CBK_EX_NR]=Min(EFF_IGA_SP_CBK_1[NC_CBK_EX_NR] , 1.0)
EFF_IGA_SP_CBK_CAN[NC_CBK_EX_NR]=Min(EFF_IGA_SP_CBK_1_CAN[NC_CBK_EX_NR] , 1.0)
Those preliminary calculations have to be done all the time whatever should be the value of LV_TQ_IGA_ACT.

Fast torque intervention request determination
Preliminary calculations for threshold:
If LV_ACT_AJ = 1
Then Threshold_1 = C_EFF_IGA_THD_AJ
Else Threshold_1 = C_EFF_IGA_THD_1
Endif
If LV_REQ_ISC = 1
Then Threshold_2 = C_EFF_IGA_THD_IS
Else Threshold_2 = C_EFF_IGA_THD_1
Endif
And Threshold = Min(Threshold_1,Threshold_2)
Threshold, Threshold_1, Threshold_2 here are only an intermediate variable to clarify those choices on the Torque intervention.
Fast Torque Intervention request determination upon Threshold
(Reduction to a global variable instead of cylinder bank selective approach):
If (EFF_IGA_SP_CBK[CBK_1]<(EFF_IGA_BAS_COR_CBK[CBK_1] - Threshold) **Or** (EFF_IGA_SP_CBK[CBK_2]<(EFF_IGA_BAS_COR_CBK[CBK_2] - Threshold))
Then LV_TQ_IGA_REQ = 1
Elseif EFF_IGA_SP_CBK[CBK_1] >= EFF_IGA_BAS_COR_CBK[CBK_1]
Or

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EFF_IGA_SP_CBK[CBK_2] >= EFF_IGA_BAS_COR_CBK[CBK_2]
then LV_TQ_IGA_REQ = 0
else $LV\_TQ\_IGA\_REQ_{n}$ = $LV\_TQ\_IGA\_ACT_{n-1}$
Endif

//LV_TQ_IGA_ACT determination:
If C_TQ_IGA_INH = 0
Then LV_TQ_IGA_ACT = LV_TQ_IGA_ENA
Else **If** C_TQ_IGA_INH = 1
Then LV_TQ_IGA_ACT = 0
Else **If** LV_TQ_IGA_ENA = 1 **and** LV_TQ_IGA_REQ = 1
Then LV_TQ_IGA_ACT = 1
Else LV_TQ_IGA_ACT = 0
Endif
Endif
Endif

Setpoint spark retard calculation (for visual purposes, [C] =[NC_EX_CBK_NR] in the following concerning _CBK_ variables):
If LV_TQ_IGA_ACT = 1
Then EFF_IGA_INV_COR_CBK*[C]* = **(**100 - EFF_IGA_SP_CBK*[C]**100**)** /FAC_EFF_IGA
EFF_IGA_INV_COR_CBK_CAN*[C]* = **(**100 - EFF_IGA_SP_CBK_CAN*[C]**100**)** /FAC_EFF_IGA

IGA_DIF_SP_CBK_H_RNG*[C]* = IP_IGA_DIF_SP_H_RNG(EFF_IGA_INV_COR_CBK*[C]*)

IGA_DIF_SP_CBK_CAN_H_RNG*[C]* = IP_IGA_DIF_SP_H_RNG (EFF_IGA_INV_COR_CBK_CAN*[C]*)

IGA_SP_CBK_H_RNG*[C]* = IGA_REF_COR_CBK*[C]* + IGA_DIF_SP_CBK_H_RNG*[C]*

IGA_SP_CBK_CAN_H_RNG*[C]* = IGA_REF_COR_CBK*[C]* + IGA_DIF_SP_CBK_CAN_H_RNG*[C]*
Else IGA_SP_CBK_H_RNG*[C]* = IGA_SP_CBK_CAN_H_RNG*[C]* = 60°CRK
Endif

Calculation of Arithmetic Mean Values:
IGA_SP_H_RNG = mean(IGA_SP_CBK_H_RNG*[C]*)
IGA_DIF_SP_H_RNG = mean(IGA_DIF_SP_CBK_H_RNG*[C]*)
IGA_SP_CAN_H_RNG = mean(IGA_SP_CBK_CAN_H_RNG*[C]*)
IGA_DIF_SP_CAN_H_RNG = mean(IGA_DIF_SP_CBK_CAN_H_RNG*[C]*)

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6.16 Knock control (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_0_KNK_PRE_DET [NC_NR_FRF_KNK_PRE]	V/S	0... FFH	0... 255	1	-
Freeze frame for number of pre window events when pre-ignition is detected					
CTR_1_KNK_PRE_DET [NC_NR_FRF_KNK_PRE]	V/S	0... FFH	0... 255	1	-
Freeze frame for number of main window events when pre-ignition is detected					
CTR_IGA_DIF_MAX_KNK [NC_CYL_NR]	V/S	0... FFH	0... 255	1	-
Counter for number of occured excursion limit events (cylinder individual)					
CTR_TOT_KNK_PRE_DET [NC_CYL_NR]	V/S	0... FFH	0... 255	1	-
Counter for total number of occured pre-ignition detections (cylinder individual)					
CYL_ID_IGA_DIF_MAX_KNK [NC_NR_FRF_KNK_RTD]	V/S	0... FFH	0... 255	1	-
Freeze frame for knocking cylinder identification when excursion limit event occurs					
CYL_ID_KNK_PRE_DET [NC_NR_FRF_KNK_PRE]	V/S	0... FFH	0... 255	1	-
Freeze frame for cylinder identification where pre-ignition is detected					
KNK_CTL_DIS	O/V	0... 1H	0 ...1	1	-
knock control disabled due to malfunctions					
MAF_IGA_DIF_MAX_KNK [NC_NR_FRF_KNK_RTD]	V/S	0... FFH	0... 1389	5.4470588	mg/stk
Freeze frame for mass air flow when excursion limit event occurs					
MAF_KNK_PRE_DET [NC_NR_FRF_KNK_PRE]	V/S	0... FFH	0... 1389	5.4470588	mg/stk
Freeze frame for mass air flow when pre-ignition is detected					
N_IGA_DIF_MAX_KNK [NC_NR_FRF_KNK_RTD]	V/S	0... FFH	0... 8160	32	rpm
Freeze frame for engine speed when excursion limit event occurs					
N_KNK_PRE_DET [NC_NR_FRF_KNK_PRE]	V/S	0... FFH	0... 8160	32	rpm
Freeze frame for engine speed when pre-ignition is detected					
TCO_IGA_DIF_MAX_KNK [NC_NR_FRF_KNK_RTD]	V/S	0... FEH	-48... 142.5	0.75	°C
Freeze frame for coolant temperature when excursion limit event occurs					
TIA_IGA_DIF_MAX_KNK [NC_NR_FRF_KNK_RTD]	V/S	0... FEH	-48... 142.5	0.75	°C
Freeze frame for temperatur of injected air when excursion limit event occurs					

Input data:

CTR_KNK_PRE_DET_0 [NC_CYL_NR] {p. 1960}	CTR_KNK_PRE_DET_1 [NC_CYL_NR] {p. 1960}	CYL_ID_KNK {p. 1960}	IGA [NC_CYL_NR] {p. 1828}
IGA_ADJ_KNK [NC_CYL_NR] {p. 1960}	IGA_KNK [NC_CYL_NR] {p. 1960}	KNKS [NC_CYL_NR] {p. 849}	LC_AD_CLR_RON {p. 527}
LV_ERR_CRK {p. 4455}	LV_ERR_KNKS [NC_NR_SENS_KNK] {p. 4903}	LV_ERR_SPI_KNK {p. 4245}	LV_ES {p. 1720}

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LV_IGA_DIF_MAX_KNK {p. 1961}	LV_IGK {p. 906}	LV_KNK {p. 1961}	LV_KNK_PRE_DET {p. 1962}
MAF {p. 8277}	MAF_HB {p. 805}	N {p. 1525}	N_32 {p. 1525}
NC_CYL_NR {p. 1526}	NL [NC_CYL_NR] {p. 1962}	SEG_NR {p. 1525}	TCO {p. 1100}
TIA {p. 1226}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_IGA_LGRD_3	-	0... 7FFFH	0... 47.99853	1.46e-3	°CRK
gradient limitation when underspending knock load threshold					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_FRF_KNK_PRE	-	0... FFH	1... 256	1	-
Number of freeze frame datasets for storing operation point and cylinder number for pre-ignition analysis					
NC_NR_FRF_KNK_RTD	-	0... FFH	1... 256	1	-
Number of freeze frame datasets for storing operation point and cylinder number for excursion limit analysis					

6.16.1 Inhibition of knock control

General information:

To activate the knock control, a macro function (KNK_CTL_DIS) is executed which checks if knock control is disabled due to malfunctions. If KNK_CTL_DIS = 0 the conditions are fulfilled and the knock control is enabled.

Application conditions

Initialisation:
```
at reset or LV_ES 0->1:
If LV_ERR_CRK = 0 and LV_ERR_KNKS[NC_NR_SENS_KNK] =
0 and LV_ERR_SPI_KNK = 0
Then KNK_CTL_DIS = 0
```

Recurrence: *every segment*

Activation: *LV_ES = 0*

Formula section:

If LV_ERR_CRK = 1 **or**
LV_ERR_KNKS[NC_NR_SENS_KNK] = 1 **or**
LV_ERR_SPI_KNK = 1
Then KNK_CTL_DIS = 1
Endif

6.16.2 Excursion Limit Analysis

FUNCTION DESCRIPTION:

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General information:

'Control Excursion Limit' in the 'Knock Control' module is used to limit the difference of the ignition adjustment angle through knock control of the single cylinders to a certain value.
When a limitation on one cylinder is done, LV_IGA_DIF_MAX_KNK is set in order to give this information to the 'Excursion Limit Analysis' functionality.
Here the values for the concerning cylinder and actual operation point are stored.

Graphical interpretation:

- Cylinder individual counter CTR_IGA_DIF_MAX_KNK[NC_CYL_NR]

```
input   |_CTR_|
- -> |______|   (for CYL_ID_KNK = 0)
- -> |______|   (for CYL_ID_KNK = 1)
- -> |______|   (for CYL_ID_KNK = 2)
- -> |______|   (for CYL_ID_KNK = 3)
- -> |______|   (for CYL_ID_KNK = 4)
- -> |______|   (for CYL_ID_KNK = 5)
:
NC_CYL_NR rows for counting excursion limit events on each cylinder individually
```

- Frozen operation point data and id of concerning cylinder
  (shifting register with newest values on top position)
  N_IGA_DIF_MAX_KNK[NC_NR_FRF_KNK_RTD],
  MAF_IGA_DIF_MAX_KNK[NC_NR_FRF_KNK_RTD],
  TCO_IGA_DIF_MAX_KNK[NC_NR_FRF_KNK_RTD],
  TIA_IGA_DIF_MAX_KNK[NC_NR_FRF_KNK_RTD],
  CYL_ID_IGA_DIF_MAX_KNK[NC_NR_FRF_KNK_RTD]

```
input   |__N___|_MAF_|_TCO_|_TIA__|Cyl_ID_|

    --> |______|______|______|______|______| ---┐ (newest dataset)
        |______|______|______|______|______| <-┘ (2nd recent dataset)
        |______|______|______|______|______| <-┘ (3rd recent dataset)
        |______|______|______|______|______| <-┘ (4th recent dataset)
        |______|______|______|______|______| <-┘ (5th recent dataset)
        |______|______|______|______|______| <-┘ (6th recent dataset)
        :
        NC_NR_FRF_KNK_RTD rows for data freeze at events on all cylinders
```

Application conditions

Initialisation: *CTR_IGA_DIF_MAX_KNK[0 to NC_CYL_NR - 1],*
N_IGA_DIF_MAX_KNK[0 to NC_NR_FRF_KNK_RTD - 1],
MAF_IGA_DIF_MAX_KNK[0 to NC_NR_FRF_KNK_RTD - 1],
TCO_IGA_DIF_MAX_KNK[0 to NC_NR_FRF_KNK_RTD - 1],
TIA_IGA_DIF_MAX_KNK[0 to NC_NR_FRF_KNK_RTD - 1],
CYL_ID_IGA_DIF_MAX_KNK[0 to NC_NR_FRF_KNK_RTD - 1]
get values from E2PROM at reset

Recurrence: *every segment*

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Activation: *at every engine state except engine stop*

Deactivation: *at engine stop*

Formula section:

Module has to be executed
- after calculation of 'Control Excursion Limit' module
- within the same SEG_NR.

fix number of 'freeze frames' with respect to storage space:
NC_NR_FRF_KNK_RTD = 10

cylinder individual counter for recognition of reaching excursion limit:
If LV_IGA_DIF_MAX_KNK = 1 **And** CTR_IGA_DIF_MAX_KNK[CYL_ID_KNK]$_n$ < 255
Then CTR_IGA_DIF_MAX_KNK[CYL_ID_KNK]$_n$ = CTR_IGA_DIF_MAX_KNK[CYL_ID_KNK]$_{n-1}$ + 1
Endif

overwriting old values in 'freeze frames': data are shifted, latest values are stored
If LV_IGA_DIF_MAX_KNK = 1
Then **For** i = NC_NR_FRF_KNK_RTD - 1 **To** 1 **Step** -1
N_IGA_DIF_MAX_KNK[i] = N_IGA_DIF_MAX_KNK[i-1]
MAF_IGA_DIF_MAX_KNK[i] = MAF_IGA_DIF_MAX_KNK[i-1]
TCO_IGA_DIF_MAX_KNK[i] = TCO_IGA_DIF_MAX_KNK[i-1]
TIA_IGA_DIF_MAX_KNK[i] = TIA_IGA_DIF_MAX_KNK[i-1]
CYL_ID_IGA_DIF_MAX_KNK[i] = CYL_ID_IGA_DIF_MAX_KNK[i-1]
Next i
N_IGA_DIF_MAX_KNK[0] = N_32
MAF_IGA_DIF_MAX_KNK[0] = MAF_HB
TCO_IGA_DIF_MAX_KNK[0] = TCO
TIA_IGA_DIF_MAX_KNK[0] = TIA
CYL_ID_IGA_DIF_MAX_KNK[0] = CYL_ID_KNK
Endif
N.B.: i represents identification index of stored info data set
(shifting in 'For' loop has not to be executed, if NC_NR_FRF_KNK_RTD = 1)
(efficiency of CPU load could be optimized, if only 'filled' freeze frames are shifted)

6.16.3 Pre-Ignition Analysis

FUNCTION DESCRIPTION:

General information:

'Normal Operation Pre-Ignition' in the 'Knock Control' module is used to cut off injection of a single cylinder in case of pre-ignition detection. LV_KNK_PRE_DET is set and gives this information to the 'Pre-Ignition Analysis' functionality. Here the values for the concerning cylinder and actual operation point are stored. Also the number of pre window (CTR_0_...) and main window (CTR_1...) events when pre-ignition is detected is monitored.

Graphical interpretation:

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- Cylinder individual counter CTR_TOT_KNK_PRE_DET[NC_CYL_NR]

```
input   |_CTR_|
- -> |_______|   (for CYL_ID_KNK = 0)
- -> |_______|   (for CYL_ID_KNK = 1)
- -> |_______|   (for CYL_ID_KNK = 2)
- -> |_______|   (for CYL_ID_KNK = 3)
- -> |_______|   (for CYL_ID_KNK = 4)
- -> |_______|   (for CYL_ID_KNK = 5)
:
NC_CYL_NR rows for counting total number of occured pre-ignition detections
              on each cylinder individually
```

- Frozen operation point data and id of concerning cylinder
  (shifting register with newest values on top position)
  N_KNK_PRE_DET[NC_NR_FRF_KNK_PRE],
  MAF_KNK_PRE_DET[NC_NR_FRF_KNK_PRE],
  CTR_0_KNK_PRE_DET[NC_NR_FRF_KNK_PRE],
  CTR_1_KNK_PRE_DET[NC_NR_FRF_KNK_PRE],
  CYL_ID_KNK_PRE_DET[NC_NR_FRF_KNK_PRE]

```
input   |__N___|_MAF_|CTR 0 |CTR 1 | Cyl_ID|

    --> |_______|_______|_______|_______|_______| ---┐ (newest dataset)
        |_______|_______|_______|_______|_______| <-┘ (2nd recent dataset)
        |_______|_______|_______|_______|_______| <-┘ (3rd recent dataset)
        |_______|_______|_______|_______|_______| <-┘ (4th recent dataset)
        |_______|_______|_______|_______|_______| <-┘ (5th recent dataset)
        |_______|_______|_______|_______|_______| <-┘ (6th recent dataset)
        :
        NC_NR_FRF_KNK_PRE rows for data freeze at events on all cylinders
```

Application conditions

Initialisation: *CTR_TOT_KNK_PRE_DET[0 to NC_CYL_NR - 1],*
N_KNK_PRE_DET[0 to NC_NR_FRF_KNK_PRE - 1],
MAF_KNK_PRE_DET[0 to NC_NR_FRF_KNK_PRE - 1],
CTR_0_KNK_PRE_DET[0 to NC_NR_FRF_KNK_PRE - 1],
CTR_1_KNK_PRE_DET[0 to NC_NR_FRF_KNK_PRE - 1],
CYL_ID_KNK_PRE_DET[0 to NC_NR_FRF_KNK_PRE - 1]
get values from E2PROM at reset

Recurrence: *every segment*

Activation: *at every engine state except engine stop*

Deactivation: *at engine stop*

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Formula section:

Module has to be executed
- after calculation of 'Normal Operation Pre-Ignition' module

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- within the same SEG_NR.

fix number of 'freeze frames' with respect to storage space:
NC_NR_FRF_KNK_PRE = 50

cylinder individual counter for total number of occured pre-ignition detections:
If LV_KNK_PRE_DET = 1 **And** CTR_TOT_KNK_PRE_DET[CYL_ID_KNK]$_n$ < 255
Then CTR_TOT_KNK_PRE_DET[CYL_ID_KNK]$_n$ = CTR_TOT_KNK_PRE_DET[CYL_ID_KNK]$_{n-1}$ + 1
Endif

overwriting old values in 'freeze frames': data are shifted, latest values are stored
If LV_KNK_PRE_DET = 1
Then **For** i = NC_NR_FRF_KNK_PRE - 1 **To** 1 **Step** -1
N_KNK_PRE_DET[i] = N_KNK_PRE_DET[i-1]
MAF_KNK_PRE_DET[i] = MAF_KNK_PRE_DET[i-1]
CTR_0_KNK_PRE_DET[i] = CTR_0_KNK_PRE_DET[i-1]
CTR_1_KNK_PRE_DET[i] = CTR_1_KNK_PRE_DET[i-1]
CYL_ID_KNK_PRE_DET[i] = CYL_ID_KNK_PRE_DET[i-1]
Next i
N_KNK_PRE_DET[0] = N_32
MAF_KNK_PRE_DET[0] = MAF_HB
CTR_0_KNK_PRE_DET[0] = CTR_KNK_PRE_DET_0[CYL_ID_KNK]
CTR_1_KNK_PRE_DET[0] = CTR_KNK_PRE_DET_1[CYL_ID_KNK]
CYL_ID_KNK_PRE_DET[0] = CYL_ID_KNK
Endif
N.B.: i represents identification index of stored info data set
(shifting in 'For' loop has not to be executed, if NC_NR_FRF_KNK_PRE = 1)
(efficiency of CPU load could be optimized, if only 'filled' freeze frames are shifted)

6.16.4 Knock Control Measurement CAN-Interface

General information:

This chapter is used as interface between the variables on the local CAN bus of the knock control measurement with CAN-interface and the system variables.
The process is as followed:
a.) start the output of systemvalues
b.) output of the systemvalue
c.) stop the output of systemvalues

6.16.4.1 CAN Protocol

Description:

The following control units participate to CAN-communication:
DME: Engine management system
IAV: Measurement equipment from BMW

Baudrate: 500 kBaud

The IAV sends for starting its measurement values on CAN Messages the ID = **700H.**

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The DME sends its measurement concerning the IAV interface on CAN Messages with the ID = **701H and 702H.**
The IAV sends for stopping its measurement values on CAN Messages   the ID = **70AH.**

6.16.4.2 Send messages by DME ID 701H and ID702H

ID 701H

Byte No.	Signal Name supplier	Byte Name Of Customer	Bit No.	Bit Name of Customer	Function Description
0	SEG_NR		0 - 7		segment number
1	CYL_ID_KNK		0 - 7		cylinder identification number
2	KNKS[NC_CYL_NR] (low Byte)		0 - 7		knock value
3	KNKS[NC_CYL_NR] (high Byte)		0 - 7		knock value
4	NL[NC_CYL_NR] (low Byte)		0 - 7		noise level
5	NL[NC_CYL_NR] (high Byte)		0 - 7		noise level
6	IGA[NC_CYL_NR]		0 - 7		ignition of cylinder x
7	IGA_KNK[NC_CYL_NR]		0 - 7		knock ignition value

ID 702H

Byte No.	Signal Name supplier	Byte Name Of Customer	Bit No.	Bit Name of Customer	Function Description
0	SEG_NR		0 - 7		segment number
1	LV_KNK		0 - 7		state of knock control
2	IGA_ADJ_KNK[NC_CYL_NR]		0 - 7		jerk ignition of knock control
3	FF		0 - 7		dummy value fix
4	N (low Byte)		0 - 7		engine speed
5	N (high Byte)		0 - 7		engine speed
6	MAF (low Byte)		0 - 7		mass air flow
7	MAF (high Byte)		0 - 7		mass air flow

Application conditions

Initialisation:
Recurrence: *segment synchronous*
Activation: *LV_IGK = 1*

The resolution and the Hex-limits for the values within the message is equal to the defined system quantity.

6.16.4.3 Received messages by the DME ID 700H and ID70AH

General information:

This message starts or stops the data transfer from the ECU to the IAV.

Application conditions

Recurrence: *10 ms*

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Activation: `LV_IGK = 1`

ID 700H

Byte No.	Signal Name supplier	Byte Name Of Customer	Bit No.	Bit Name of Customer	Function Description

ID 70AH

Byte No.	Signal Name supplier	Byte Name Of Customer	Bit No.	Bit Name of Customer	Function Description

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6.17 Knock control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_KNK_CMB	V	0... FFH	0... 255	1	-
Counter to disable KNK control after combustion mode switch					
CTR_KNK_PRE_DET [NC_CYL_NR]	V	0... FFFFH	0... 65535	1	-
Detection counter for evaluated knock and pre-ignition events					
CTR_KNK_PRE_DET_0 [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Number of pre window events for pre-ignition detection					
CTR_KNK_PRE_DET_1 [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Number of main window events for pre-ignition detection					
CTR_KNK_PRE_DET_NR [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Counter for number of occured pre-ignition detections in actual driving cycle					
CYCNR_INH_IV_KNK_PRE_DET [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Cycle counter for duration of injection shut off by pre-ignition detection					
CYCNR_KNK_PRE_DET	V	0... FFFFH	0... 65535	1	-
Cycle counter for observation period pre-ignition					
CYL_ID_KNK	O/V	0... FFH	0... 255	1	-
Cylinder number for knock control					
FAC_IGA_MAX_KNK	V	0... FFH	0... 0.99609	3.9063e-3	-
Weighting factor for the max. spark retard against coolant					
IGA_ADJ_KNK [NC_CYL_NR]	O/V	0... 80H	-48 ...0	0.375	°CRK
Total spark retard through knock control with adaptation (cylinder individual)					
IGA_ADJ_MAX_KNK	V	0... FFH	-35.625 ...60	0.375	°CRK
Total spark retard through knock control including adaptation (cylinder individual)					
IGA_DEC_KNK	-	1... 7FH	0.375... 47.625	0.375	°CRK/cyc
Spark retard at recognised knocking					
IGA_KNK [NC_CYL_NR]	O/V	0... 80H	-48 ...0	0.375	°CRK
Spark retard due to knocking combustion					
IGA_KNK_BAS [NC_CYL_NR]	-	0... 80H	-48 ...0	0.375	°CRK
Spark retard through knock control prior adaptation (cylinder individual)					
IGA_MV_ADJ_KNK	O/V	0... 80H	-48 ...0	0.375	°CRK
Meanvalue of actual retard adjustment with adaptation values					
IGA_MV_CBK_ADJ_KNK [NC_CBK_EX_NR]	O/V	0... 80H	-48 ...0	0.375	°CRK
Meanvalue of actual retard adjustment with adaptation values bank selective					
IGA_MV_KNK	V	0... 80H	-48 ...0	0.375	°CRK
Mean value of actual retard adjustment without adaptation values					
INH_IV_KNK	O/V	0... FFH	0... 255	1	-
Ignition shut off pattern from knock control pre-ignition					
KNK_AD_SF [NC_CYL_NR]	-	0... 1H	0 ...1	1	-
Flag for transition from passive to active					
KNK_THD [NC_CYL_NR]	V	0... FFH	0... 4.98046	0.0195313	V
Knock Threshold cylinder x					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
KNK_THD_MAX	V	0... FFH	0... 4.998	0.0195313	V
Maximum knock threshold in main window					
KNK_THD_PRE	V	0... FFH	0... 4.998	0.0195313	V
Knock Threshold cylinder x in pre-window					
KNKS_1_DIAG	O	0... FFH	0... 255	1	-
Assignment of cylinder number to knock sensor 1 (diagnosis only)					
KNKS_2_DIAG	O	0... FFH	0... 255	1	-
Assignment of cylinder number to knock sensor 2 (diagnosis only)					
KNKS_CMD_CONF [NC_CYL_NR]	O	0... FFH	0... 255	1	-
Configuration value for the analogue channel of knock sensor					
KNKS_CMD_FIL [NC_CYL_NR]	O/V	0... 3FH	0... 63	1	-
Knock Filter Frequency and Reference Filter Frequency Cyl.x					
KNKS_CMD_FIL_PRE [NC_CYL_NR]	O/V	0... 3FH	0... 63	1	-
Knock Filter Frequency and Reference Filter Frequency Cyl.x					
KNKS_CMD_GAIN [NC_CYL_NR]	O/V	0... 3FH	0... 63	1	-
Amplification precontrol Cyl.x					
KNKS_CMD_GAIN_PRE [NC_CYL_NR]	O/V	0... 3FH	0... 63	1	-
Amplification precontrol Cyl.x					
KNKS_CMD_INT [NC_CYL_NR]	O/V	0... 1FH	0... 31	1	-
Integration Time Constant Cyl.x					
KNKS_CMD_INT_PRE [NC_CYL_NR]	O/V	0... 1FH	0... 31	1	-
Integration Time Constant Cyl.x					
KNKWB [NC_CYL_NR]	O/V	0... FFH	0... 95.625	0.375	°CRK
Beginning of Measurement Window Cyl.x					
KNKWB_PRE [NC_CYL_NR]	O/V	0... FFH	0... 95.625	0.375	°CRK
Beginning of Measurement Window Cyl.x first window					
KNKWE [NC_CYL_NR]	O/V	0... FFH	0... 95.625	0.375	°CRK
End of Measurement Window Cyl.x					
KNKWE_PRE [NC_CYL_NR]	O/V	0... FFH	0... 95.625	0.375	°CRK
End of Measurement Window Cyl.x first window					
LV_CTR_KNK_CMB	V	0... 1H	0 ...1	1	-
Logical variable to enable counter after combustion mode change					
LV_IGA_DIF_MAX_KNK	O/V	0... 1H	0 ...1	1	-
Indicator for excursion limit analysis (knock ignition angle of one cylinder is at maximum deviation limit from mean value)					
LV_KNK	O/V	0... 1H	0 ...1	1	-
Logical variable for recognition of knock					
LV_KNK_CTL_ENA	O/V	0... 1H	0 ...1	1	-
Boolean for knock control enabled					
LV_KNK_CTL_PRE_ENA	O/V	0... 1H	0 ...1	1	-
Boolean for knock control pre-ignition enabled					
LV_KNK_CTL_PRE_INH	V	0... 1H	0 ...1	1	-
Logical variable for complete inhibition of knock control pre-ignition					
LV_KNK_MAX	V	0... 1H	0 ...1	1	-
Logical variable for recognition of knock above maximum threshold					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_KNK_PAS_TRAN_ACT	-	0... 1H	0 ...1	1	-
Transition for knock control passive to active					
LV_KNK_PRE	V	0... 1H	0 ...1	1	-
Logical variable for recognition of knock in first window					
LV_KNK_PRE_DET	O/V	0... 1H	0 ...1	1	-
Logical variable for pre-ignition recognition by algorithm					
LV_KNK_TRA_MAF	V	0... 1H	0 ...1	1	-
Logical variable for Load Dynamic Function active or passive					
LV_KNK_TRA_N	V	0... 1H	0 ...1	1	-
Logical variable for Engine Speed Dynamic Function active or passive					
LV_KNKWE_PRE_GAP	V	0... 1H	0 ...1	1	-
Boolean for indication of pre-window restriction, caused by hardware required gap for save operation					
MAF_KNK	O/V	0... FFH	0... 1389	5.4470588	mg/stk
Mass air flow with hysteresis					
N_KNK	V	0... FFH	0... 8160	32	rpm
Engine speed with hysteresis					
NL [NC_CYL_NR]	O/V	0... FFFFH	0... 4.99992	76.3e-6	V
Floating mean value of the noise signal					
STATE_CMB_CTL_KNK	V	0... 8H	0 ...8	1	-
States of the combustion management to be saved for further use					
STATE_CMB_CTL_TMP	V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H	HOM_AFS AFS_TO_AFL HOM_AFL AFL_TO_AFS HOM_TO_ HOMS HOMS BACKS S S_TO_HOMS BACKHOM	-	-
States of the combustion management					

Input data:

C_IGA_LGRD_3 {p. 1953}	IGA_CH {p. 798}	IGA_WOUT_KNK [NC_CYL_NR] {p. 1828}	KNK_CTL_DIS {p. 1952}
KNKS [NC_CYL_NR] {p. 849}	KNKS_PRE [NC_CYL_NR] {p. 849}	LV_CH {p. 8232}	LV_ERR_KNKS [NC_NR_SENS_KNK] {p. 4903}
LV_ES {p. 1720}	LV_FL {p. 1759}	LV_HOM_ACT {p. 8136}	LV_IGA_TRA_KNK {p. 8304}
LV_IGK {p. 906}	LV_ST {p. 1720}	MAF {p. 8277}	MFF_SP_MV {p. 2151}
N_32 {p. 1525}	N_GRD {p. 1525}	NC_KNKS_CONF {p. 1967}	OPM_AV {p. 8137}
SEG_NR {p. 1525}	TCO {p. 1100}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CYCNR_KNK_PRE_DET_RST	-	0... FFFFH	0... 65535	1	-
Reset threshold for observation period pre-ignition cycle counter					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_KNK_TRA	-	0... FFH	0... 1.99218	0.0078125	-
Factor for weighted KNKS consideration at knocking in transient condition					
C_FAC_TRA_KNK	-	0... FFH	0... 7.96875	0.03125	-
correction factor for load dynamic active					
C_FIL_FRQ_KNK_AFL [NC_CYL_NR]	-	0... 3FH	0... 63	1	-
Knock Filter Frequency and Reference Filter Frequency Cyl.x in AFL or S					
C_IGA_DIF_MIN_MAX_KNK	-	0... 80H	-48 ...0	0.375	°CRK
Control excursion limit valid for spark advance and spark retard					
C_INC_CTR_KNK_PRE_DET_0_1	-	0... FFH	0... 255	1	-
Increment for knock detection in normal knock window					
C_INC_CTR_KNK_PRE_DET_1_0	-	0... FFH	0... 255	1	-
Increment for knock detection in knock pre-window					
C_INC_CTR_KNK_PRE_DET_1_1	-	0... FFH	0... 255	1	-
Increment for knock detection in normal and knock pre-window					
C_ITC_KNK_AFL [NC_CYL_NR]	-	0... 1FH	0... 31	1	-
Integration Time Constant Cyl.x in AFL or S					
C_KNK_THD_MAX	-	0... FFH	0... 4.998	0.0195313	V
Maximum knock threshold					
C_KNKS_1_DIAG	-	0... FFH	0... 255	1	-
Assignment of cylinder number to knock sensor 1 (diagnosis only)					
C_KNKS_2_DIAG	-	0... FFH	0... 255	1	-
Assignment of cylinder number to knock sensor 2 (diagnosis only)					
C_MAF_IGA_HYS_KNK	-	0... FFH	0... 1389	5.45	mg/stk
Air-Mass Hysteresis for Knock Control					
C_N_IGA_HYS_KNK	-	0... FFH	0... 8160	32	rpm
Speed Hysteresis for Knock Control					
C_N_KNK_CTL_PRE_INH	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for complete inhibition of knock control pre-ignition					
C_NL_CRLC_CMB	-	0... FFH	0... 0.99609	3.9063e-3	-
Averaging Constant for Noise Value Calculation at HOM_AFS combustion					
C_NL_CRLC_TRA	-	0... FFH	0... 0.99609	3.9063e-3	-
Averaging Constant for Noise Value Calculation for Transient Case					
C_NL_CRLC_TRA_AFL	-	0... FFH	0... 0.99609	3.9063e-3	-
Averaging Constant for Noise Value Calculation for Transient Case at AFL or S combustion					
C_NL_MIN	-	0... FFH	0... 4.998	19.5e-3	V
Minimum noise value					
ID_CTR_KNK_CMB	-	0... FFH	0... 255	1	-

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_STATE_CMB_CTL_KNK	0	0H 1H 2H 3H 4H 5H 6H 7H 8H	HOM_AFS AFS_TO_AFL HOM_AFL AFL_TO_AFS HOM_TO_S BACKS S S_TO_HOM BACKHOM	-	-
Counter to disable KNK control after combustion mode switch					
ID_CYCNR_FAC_TRA_KNK__N	-	0... FFH	0... 255	1	seg
LDPM_N_6_4	4	0... FFH	0... 8160	32	rpm
Cycle counter during which the Load Dynamic Function stays active after triggering					
ID_FIL_FRQ_KNK [NC_CYL_NR]	-	0... 3FH	0... 63	1	-
LDPM_N_FIL_FRQ_KNK	4	0... FFH	0... 8160	32	rpm
Knock Filter Frequency and Reference Filter Frequency Cyl.x					
ID_FIL_FRQ_KNK_PRE [NC_CYL_NR]	-	0... 3FH	0... 63	1	-
LDPM_N_FIL_FRQ_KNK	4	0... FFH	0... 8160	32	rpm
Knock Filter Frequency and Reference Filter Frequency Cyl.x previous					
ID_IGA_DEC_KNK_1__N	-	1... 7FH	0.375... 47.625	0.375	°CRK/cyc
LDPM_N_4_9	3	0... FFH	0... 8160	32	rpm
Spark retard at recognised knocking, Intensity 1					
ID_IGA_DEC_KNK_2__N	-	1... 7FH	0.375... 47.625	0.375	°CRK/cyc
LDPM_N_4_9	3	0... FFH	0... 8160	32	rpm
Spark retard at recognised knocking, Intensity 2					
ID_IGA_DEC_KNK_AFL_1__N	-	1... 7FH	0.375... 47.625	0.375	-
LDPM_N_4_9	3	0... FFH	0... 8160	32	rpm
Spark retard at recognised knocking, Intensity 1 in AFL or S					
ID_IGA_DEC_KNK_AFL_2__N	-	1... 7FH	0.375... 47.625	0.375	-
LDPM_N_4_9	3	0... FFH	0... 8160	32	rpm
Spark retard at recognised knocking, Intensity 2 in AFL or S					
ID_ITC_KNK [NC_CYL_NR]	V	0... 1FH	0... 31	1	-
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_9	4	0... FFH	0... 1389	5.45	mg/stk
Integration Time Constant Cyl.x					
ID_ITC_KNK_PRE [NC_CYL_NR]	V	0... 1FH	0... 31	1	-
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_9	4	0... FFH	0... 1389	5.45	mg/stk
Integration Time Constant Cyl.x previous					
ID_KNK_THD_MAX_PRE	-	0... FFH	0... 4.998	0.0195313	V
LDPM_N_KNK_THD_MAX	6	0... FFH	0... 8160	32	rpm
Maximum knock threshold pre-window					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_N_GRD_MAX_KNK__N	-	0... 7FH	0... 4064	32	rpm/s
LDPM_N_IGA_AD	8	0... FFH	0... 8160	32	rpm
Speed Gradient for dynamic identification					
ID_NL_CRLC	-	0... FFH	0... 0.99609	3.9063e-3	-
LDP_N_KNK_NL_CRLC	4	0... FFH	0... 8160	32	rpm
Averaging Constant for Noise Value Calculation					
IP_CTR_KNK_PRE_DET_THD	-	0... FFFFH	0... 65535	1	-
LDP_N_CTR_KNK_PRE_DET	6	0... FFH	0... 8160	32	rpm
Threshold for evaluated pre-ignition detection counter					
IP_CYCNR_INH_IV_KNK_PRE_DET	V	0... FFH	0... 255	1	-
LDP_N_CTR_KNK_PRE_DET_NR	4	0... FFH	0... 8160	32	rpm
LDP_CTR_KNK_PRE_DET_NR	4	0... FFH	0... 255	1	-
Cycle number of injection shut off duration by pre-ignition detection					
IP_FAC_IGA_MAX_KNK__TCO__TIA	V	0... FFH	0... 0.99609	3.9063e-3	-
LDP_TCO__FAC_IGA_TCO_KNK	4	0... FEH	-48... 142.5	0.75	°C
LDP_TIA__FAC_IGA_TIA_KNK	4	0... FEH	-48... 142.5	0.75	°C
Weighting factor for the max. spark retard against coolant					
IP_FAC_NL_UPD_DEAC	-	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
Factor on KNK_THD for comparison with KNKS to deactivate an update of NL values					
IP_FAC_THD_KNK [NC_CYL_NR]	V	0... FFH	0... 7.96875	0.03125	-
LDPM_N_2_9c	16	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_9	4	0... FFH	0... 1389	5.45	mg/stk
Knock Factor Table Cyl. X					
IP_FAC_THD_KNK_AFL [NC_CYL_NR]	V	0... FFH	0... 7.96875	0.03125	-
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
LDPM_MFF_1_9	4	0... FFFFH	0... 1389	0.0211948	mg/stk
Knock Factor Table Cyl. X in AFL or S					
IP_GAIN_KNK [NC_CYL_NR]	V	0... 3FH	0... 63	1	-
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
LDPM_MAF_GAIN_KNK	12	0... FFH	0... 1389	5.4470588	mg/stk
Amplification precontrol Cyl.x					
IP_GAIN_KNK_AFL [NC_CYL_NR]	V	0... 3FH	0... 63	1	-
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
LDPM_MFF_1_9	4	0... FFFFH	0... 1389	0.0211948	mg/stk
Amplification precontrol Cyl.x in AFL or S					
IP_GAIN_KNK_PRE [NC_CYL_NR]	V	0... 3FH	0... 63	1	-
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
LDPM_MAF_GAIN_KNK	12	0... FFH	0... 1389	5.4470588	mg/stk
Amplification precontrol Cyl.x previous					
IP_IGA_BAS_MAX_KNK__N__MAF	V	0... FFH	-35.625 ...60	0.375	°CRK
LDPM_N_IGA_MAX_KNK	8	0... FFH	0... 8160	32	rpm

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_MAF_IGA_MAX_KNK	8	0... FFH	0... 1389	5.4470588	mg/stk
Maximum value for spark retard					
IP_IGA_BAS_MAX_KNK_ERR__N__MAF	V	0... FFH	-35.625 ...60	0.375	°CRK
LDPM_N_IGA_MAX_KNK	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_IGA_MAX_KNK	8	0... FFH	0... 1389	5.4470588	mg/stk
Maximum value for spark retard in case of KNK sensor error					
IP_IGA_INC_KNK__N	-	1... 7FFFH	0.00146... 47.99853	1.4648e-3	°CRK/cyc
LDPM_N_6_4	4	0... FFH	0... 8160	32	rpm
Re-set Increment KNK					
IP_IGA_OFS_MAX_KNK__N__MAF	V	0... FFH	-48... 47.625	0.375	°CRK
LDPM_N_IGA_MAX_KNK	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_IGA_MAX_KNK	8	0... FFH	0... 1389	5.4470588	mg/stk
Maximum value for spark retard					
IP_KNK_THD_ADD_N	-	0... FFH	-2.56 ...2.54	0.02	V
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
Knock summand					
IP_KNK_THD_ADD_N_AFL	-	0... FFH	-2.56 ...2.54	0.02	V
LDPM_N_2_9	16	0... FFH	0... 8160	32	rpm
Knock summand in AFL or S					
IP_KNK_THD_MAX	V	0... FFH	0... 4.998	0.0195313	V
LDPM_N_KNK_THD_MAX	6	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_9	4	0... FFH	0... 1389	5.4470588	mg/stk
Maximum knock threshold					
IP_KNKWB [NC_CYL_NR]	V	0... FFH	0... 95.625	0.375	°CRK
LDPM_N_KNKWB	10	0... FFH	0... 8160	32	rpm
LDPM_MAF_KNKWB	4	0... FFH	0... 1389	5.4470588	mg/stk
Beginning of Measurement Window Cyl.x					
IP_KNKWB_AFL	V	0... FFH	0... 95.625	0.375	°CRK
LDPM_N_KNKWB	10	0... FFH	0... 8160	32	rpm
LDPM_MFF_1_9	4	0... FFFFH	0... 1389	0.0211948	mg/stk
Beginning of Measurement Window for all Cyl. in AFL or S					
IP_KNKWB_PRE [NC_CYL_NR]	V	0... FFH	0... 95.625	0.375	°CRK
LDPM_N_KNKWB	10	0... FFH	0... 8160	32	rpm
LDPM_MAF_KNKWB	4	0... FFH	0... 1389	5.4470588	mg/stk
Beginning of Measurement Window Cyl.x previous					
IP_KNKWE [NC_CYL_NR]	V	0... FFH	0... 95.625	0.375	°CRK
LDPM_N_KNKWB	10	0... FFH	0... 8160	32	rpm
LDPM_MAF_KNKWB	4	0... FFH	0... 1389	5.4470588	mg/stk
End of Measurement Window Cyl.x					
IP_KNKWE_AFL	V	0... FFH	0... 95.625	0.375	°CRK
LDPM_N_KNKWB	10	0... FFH	0... 8160	32	rpm

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_MFF_1_9	4	0... FFFFH	0... 1389	0.0211948	mg/stk
End of Measurement Window for all Cyl. in AFL or S					
IP_KNKWE_PRE [NC_CYL_NR]	V	0... FFH	0... 95.625	0.375	°CRK
LDPM_N_KNKWB	10	0... FFH	0... 8160	32	rpm
LDPM_MAF_KNKWB	4	0... FFH	0... 1389	5.4470588	mg/stk
End of Measurement Window Cyl.x previous					
IP_KNKWE_PRE_GAP	-	0... FFH	0... 95.625	0.375	°CRK
LDP_N_KNKWE_PRE_GAP	4	0... FFH	0... 8160	32	rpm
Gap restricting Knock Pre-Window for save IC operation					
IP_MAF_MIN_KNK__N__TCO	V	0... FFH	0... 1389	5.45	mg/stk
LDPM_N_3_9	8	0... FFH	0... 8160	32	rpm
LDP_TCO__MAF_MIN_KNK	4	0... FEH	-48... 142.5	0.75	°C
Air-mass Threshold Release KNK					
IP_MAF_MIN_KNK_PRE	-	0... FFH	0... 1389	5.4470588	mg/stk
LDPM_N_3_9	8	0... FFH	0... 8160	32	rpm
Air-mass Threshold Release KNK Pre-Ignition					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_KNKS_CONF	-	0... FFH	0... 255	1	-
Configuration value of analogue channel of knock sensor for all cylinders (eg. 6 cylinder: 00101010b)					
NC_KNKWB_INI	-	0... FFH	0... 95.625	0.375	°CRK
Beginning of Measurement Window Cyl.x					
NC_KNKWB_PRE_INI	-	0... FFH	0... 95.625	0.375	°CRK
Beginning of Measurement Pre-Window Cyl.x					
NC_KNKWE_INI	-	0... FFH	0... 95.625	0.375	°CRK
End of Measurement Window Cyl.x					
NC_KNKWE_PRE_INI	-	0... FFH	0... 95.625	0.375	°CRK
End of Measurement Pre-Window Cyl.x					

Overview

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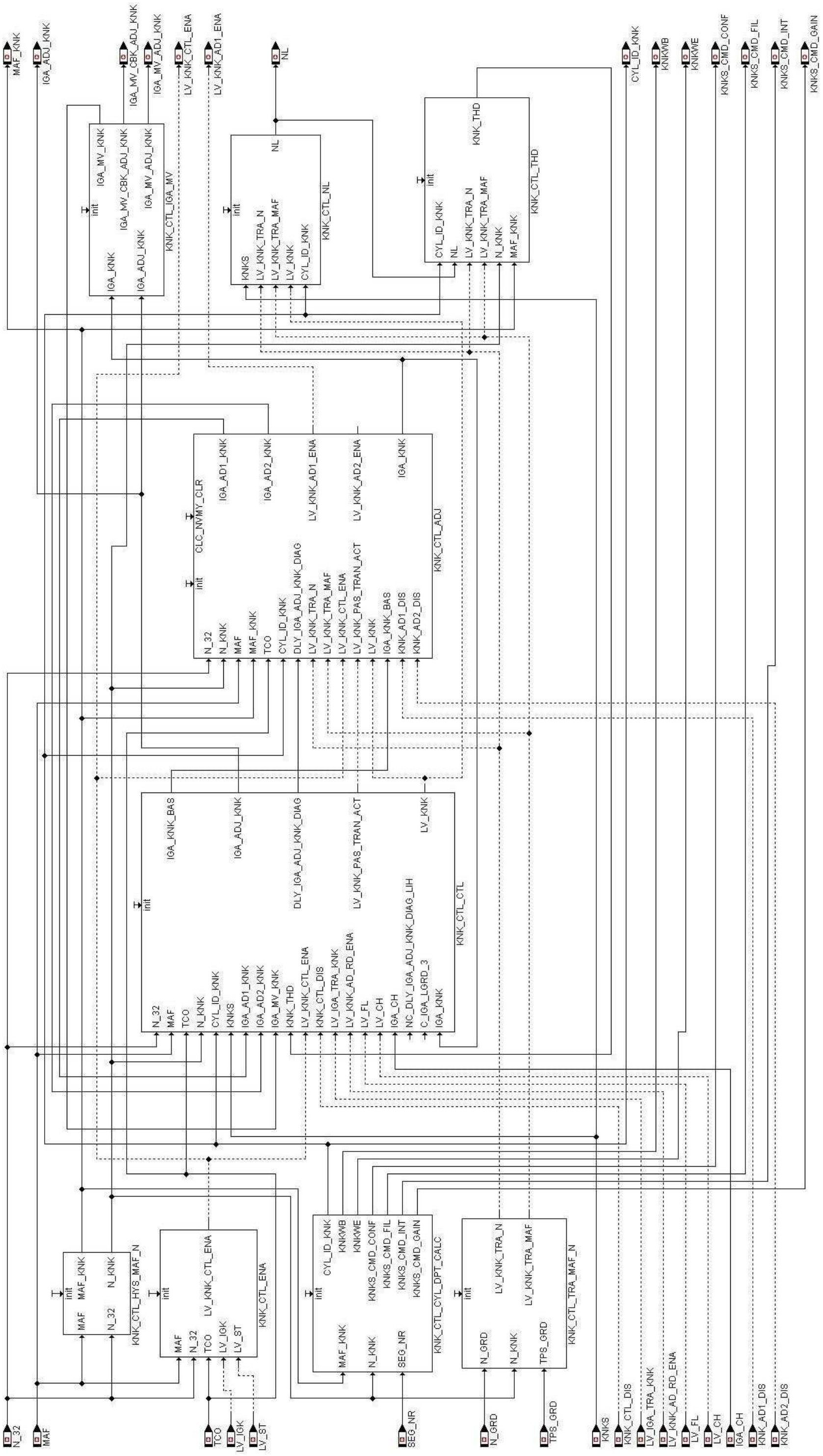

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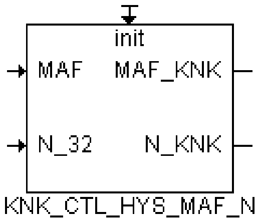
6.17.1 Pre-processing

6.17.1.1 Hysteresis Function for MAF and N_32



General information:

Hysteresis functions for engine speed and air-mass changes are defined for the tables relevant for the knock control in order to avoid steps recognisable for the driver due to small changes of the operation point.

Application conditions

Activation: *at every engine state except engine stop*

Deactivation: *at engine stop*

Initialization: *MAF_KNK = N_KNK = 0 at reset and engine running to engine stop*

Update Rate: *every segment*

Formula section:

if **|(N_32 - N_KNK)| >= C_N_IGA_HYS_KNK**
N_KNK = N_32
else
N_KNK remains unchanged
end if

if **|(MAF - MAF_KNK)| >= C_MAF_IGA_HYS_KNK**
MAF_KNK = MAF
else
MAF_KNK remains unchanged
end if

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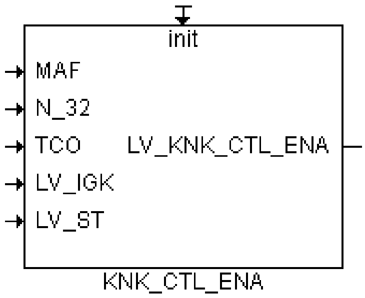
6.17.1.2 Knock Control Enable



Application conditions

Activation: *at every engine state except engine stop*

Deactivation: *at engine stop*

Initialization:
LV_KNK_CTL_ENA = 0 at reset and engine running to engine stop
LV_KNK_CTL_PRE_ENA = 0 at reset and engine running to engine stop
LV_CTR_KNK_CMB = 0 reset and engine running to engine stop
CTR_KNK_CMB = 0 reset and engine running to engine stop

Update Rate: *every segment*

Formula section:

knock control enable:
if (LV_ST = 1 or LV_IGK = 0)
then LV_KNK_CTL_ENA = 0
else
if (MAF_KNK >= IP_MAF_MIN_KNK__N__TCO)
LV_KNK_CTL_ENA = 1
else
LV_KNK_CTL_ENA = 0
end if
end if

knock control pre-ignition enable:
if LV_KNK_CTL_ENA = 1 **and** MAF_KNK >= IP_MAF_MIN_KNK_PRE
then LV_KNK_CTL_PRE_ENA = 1
else LV_KNK_CTL_PRE_ENA = 0
end if

inhibit knock control pre-ignition:
if N_32 > C_N_KNK_CTL_PRE_INH
then LV_KNK_CTL_PRE_INH = 1
else LV_KNK_CTL_PRE_INH = 0
end if

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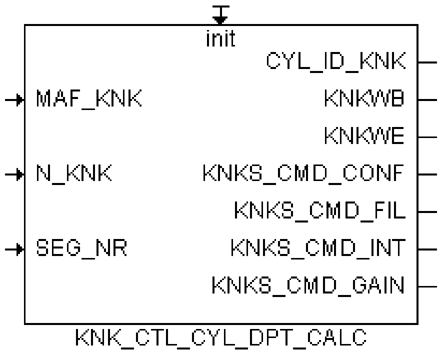
If the relevant air-mass is below the air-mass threshold (LV_KNK_CTL_ENA = 0), only the noise value calculation is executed.
An additional air-mass threshold exists for enabling cylinder cut off algorithm (LV_KNK_CTL_PRE_ENA).
A complete inhibition of pre-window calculation and consideration is forced (LV_KNK_CTL_PRE_INH = 1), when pre-window is initialized with 0 (see IRS); especially when engine speed is above a calibratable threshold.

6.17.1.3 Cylinder Dependent Calculations



6.17.1.3.1 Cylinder Number for Knock Control

Application conditions

Activation: *at every engine state except engine stop*

Deactivation: *at engine stop*

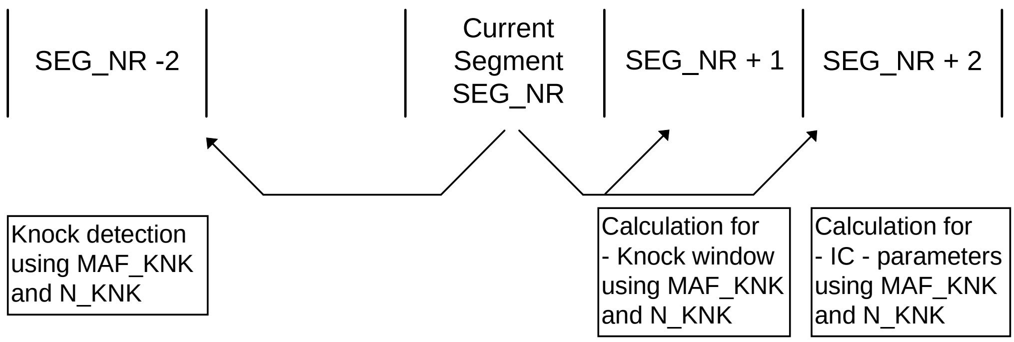
Initialization: *CYL_ID_KNK = 0 at reset and engine running to engine stop*

Update Rate: *every segment*

Formula section:

CYL_ID_KNK = SEG_NR - 2

Description:



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6.17.1.3.2 Knock Measurement Window

General information:

The knock detection is performed for cylinder-individually defined measurement windows since knock-typical oscillations only occur for certain crankshaft angles. The measurement windows (crank angle of beginning and end) are specified as function of the engine speed and load.
If the estimated 'End of the Knock Measurement Window' is lower or equal compared to the 'Beginning of the Knock measurement Window', both values are initialized.

The crank angle for the beginning of the knock measurement window is taken for each cylinder from the respective table IP_KNKWB[x] according to the firing order.
The crank angle for the end of the knock measurement window is taken for each cylinder from the respective table IP_KNKWE[x] according to the firing order.

Apart from window settings for AFS (stoichiometric) separate windows are existing in operation mode AFL (lean) and S (stratified).

Application conditions

Activation: *at every engine state except engine stop*

Deactivation: *at engine stop*

Initialization:
```
at reset and engine running to engine stop
 KNKWB[0 to NC_CYL_NR] = NC_KNKWB_INI
 KNKWE[0 to NC_CYL_NR] = NC_KNKWE_INI
 KNKWB_PRE[0 to NC_CYL_NR] = NC_KNKWB_PRE_INI
 KNKWE_PRE[0 to NC_CYL_NR] = NC_KNKWE_PRE_INI
```

Update Rate: *every segment*

Formula section:

Definition of cylinder dependent knock window ranges:
RNG_WB = (720° /NC_CYL_NR) - 12°
RNG_WB_HEX = HEX(RNG_WB /0.375°)
RNG_WE = (720° /NC_CYL_NR) - 6°
RNG_WE_HEX = HEX(RNG_WE /0.375°)

if **OPM_AV = "AFS"**
then **KNKWB[x] = IP_KNKWB[x]**
KNKWE[x] = IP_KNKWE[x]
else **KNKWB[x] = IP_KNKWB_ AFL**
KNKWE[x] = IP_KNKWE_AFL
end if

if **(KNKWE[x] ≤ KNKWB[x])**
then **KNKWB[x] = NC_KNKWB_INI**
KNKWE[x] = NC_KNKWE_INI
end if

if **LV_KNK_CTL_PRE_INH = 0**
then **KNKWB_PRE[x] = IP_KNKWB_PRE[x]**
KNKWE_PRE[x] = IP_KNKWE_PRE[x]

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if KNKWE_PRE[x] + IP_KNKWE_PRE_GAP >= KNKWB[x]
then KNKWE_PRE[x] = KNKWB[x] - IP_KNKWE_PRE_GAP
LV_KNKWE_PRE_GAP = 1
else LV_KNKWE_PRE_GAP = 0
end if

if (KNKWE_PRE[x] ≤ KNKWB_PRE[x])
then LV_KNK_CTL_PRE_INH = 1
end if
endif

if LV_KNK_CTL_PRE_INH = 1
then KNKWB_PRE[x] = NC_KNKWB_PRE_INI
KNKWE_PRE[x] = NC_KNKWE_PRE_INI
endif

call action interface for pre and normal window

ACTION_INFR_*SetKnkWindow*(IN <Knkwb>, IN <Knkwd>, IN <Cyl>, IN <Win>)
Sets knock window for cylinder *cyl*

N.B.: x represents current SEG_NR + 1

Important information for calibration:
In order to have the possibility of two windows (pre- and main) in one segment, BSW is calculating with double number of segments with half of the original length. Every window begin (pre- or main) must lie within one of such doubled segments. The beginning of a segment for the main window is fixed in BSW to 2°CRK after TDC. Due to that the main knock window KNKWB[x] must be calibrated not before 2°CRK.
IP_KNKWE_PRE_GAP calibration must be done before KNKS_PRE signal parameter calibration (window, gain, filter frequency, integration time constant), in order to assure right calculated and transferred values from the knock IC and not to have different values because of new window length after changing this restriction. The duration of the gap between KNKWE_PRE and KNKWB is determined by the SPI bus communication. During the gap the integrator value of the pre-window has to be read and the ATIC62 device has to be programmed with the main window parameters (window, gain, filter frequency, integration time constant). The required duration has to be determined system individually by the BSW SW department.
Special restrictions must be considered, if distance between 0°CRK (minimum possible value for pre-window begin and end; also when set inactive a activation peak is remaining) and main window begin should be smaller than this determined gap or a smaller gap in general should be used. Then especially the same parametrisation for pre- and main window is required and no inhibition for pre-window calculation is allowed. Thus in BSW right parameters for main window are already set during pre-window parametrisation.
To have low CPU load, the knock pre-ignition window can be set to 0 by LV_KNK_CTL_PRE_INH = 1. This is done either above a calibratable engine speed threshold or at implausibility, when pre-window end is earlier than pre-window begin. KNKWB_PRE and KNKWE_PRE values are initialized with the NC values 0. Then no parametrisation and knock IC processing is executed (see IRS). Also the detection algorithm and KNK_THR_PRE aren't executed any longer.

Description:
(example for NC_CYL_NR=6; TDC offset = 0°CRK)

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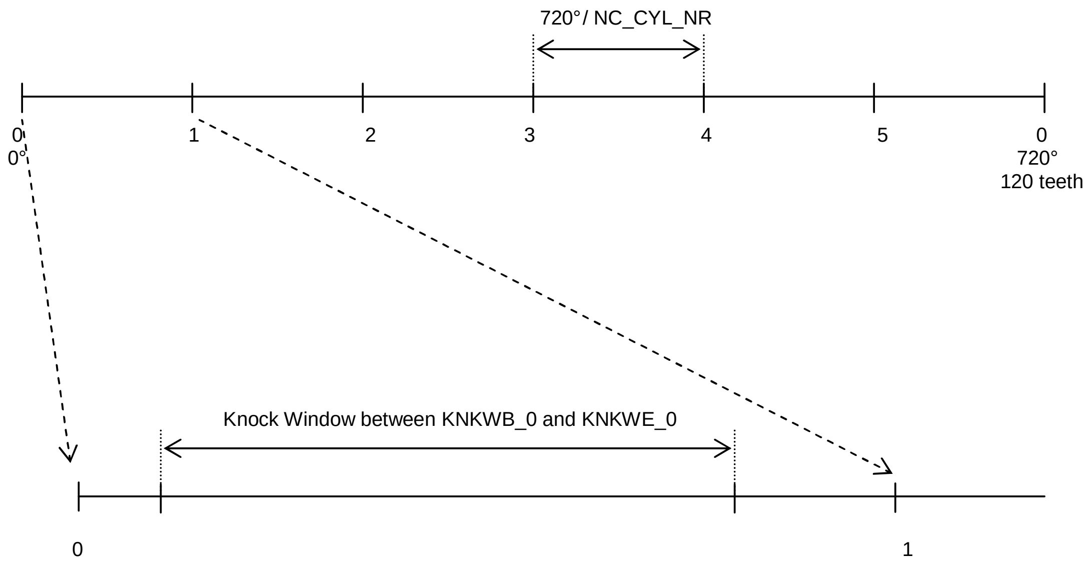

6.17.1.3.3 Assignment of cylinder number to Knock sensor diagnosis

FUNCTION DESCRIPTION:

The physically defined cylinder number is defined in firing oder 1 5 3 6 2 4 for a in-line 6 cyl. engine. There is the possibility to define especially for the knock sensor diagnosis which cylinder should be used for the knock sensor diagnosis via the help of the calibration constants C_KNKS_1/_2_DIAG. Only 'loud' cylinders should be used to detect a malfunktion of the Knock sensor signal.
The maximum possible number of cylinders is defined with NC_KNKS_CONF. Only cylinders can be used which are assigned for the knock detection of the individual knock sensor.
e.g. in-line 6 cyl. engine:

logically:	0	1	2	3	4	5	
physically:	1	5	3	6	2	4	
assignment KR	0	1	0	1	0	1	NC_KNKS_CONF = 2A hex
assignment KNKS1	1	0	1	0	1	0	C_KNK_1_DIAG = 15 hex
assignment KNKS2	0	1	0	1	0	1	C_KNK_2_DIAG = 2A hex

Application conditions

Initialisation: `all = 0 at reset and engine running to engine stop`

Recurrence: `segment synchronous`

Activation: `all engine states except LV_ES`

6.17.1.3.4 Calibration of ATIC62 device

FUNCTION DESCRIPTION:

General information:
The knock control in the engine management works with the ATIC62 device. The output value of the integrator after the end of the measurement window is fed as Knock Value KNKS through an analogue channel to the control algorithm.
(Further information may be obtained in "Applications Guide to ATIC62 ".)

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Apart from parameters for AFS (stoichiometric) separate sets of parameters are existing in operation mode AFL (lean) and S (stratified).

Application conditions

Activation: *at every engine state except engine stop*

Deactivation: *at engine stop*

Initialization:
```
KNKS_CMD_INT[0 to NC_CYL_NR]      =   0
 KNKS_CMD_FIL[0 to NC_CYL_NR]          =      0
 KNKS_CMD_GAIN[0 to NC_CYL_NR]        =      0
 KNKS_CMD_INT_PRE[0 to NC_CYL_NR]     =     0
 KNKS_CMD_FIL_PRE[0 to NC_CYL_NR]     =     0
 KNKS_CMD_GAIN_PRE[0 to NC_CYL_NR] =     0
 KNKS_CMD_CONF[0 to NC_CYL_NR]      =      value of configuration
bit at position x
                  in NC_KNKS_CONF
   at reset and engine running to engine stop
```

Update Rate: *every segment*

Formula section:

If OPM_AV = "AFS"

Then KNKS_CMD_INT[x] = ID_ITC_KNK[x]
KNKS_CMD_FIL[x] = ID_FIL_FRQ_KNK[x]
KNKS_CMD_GAIN[x] = IP_GAIN_KNK[x]

KNKS_CMD_INT_PRE[x] = ID_ITC_KNK_PRE[x]
KNKS_CMD_FIL_PRE[x] = ID_FIL_FRQ_KNK_PRE[x]
KNKS_CMD_GAIN_PRE[x] = IP_GAIN_KNK_PRE[x]

Else KNKS_CMD_INT[x] = C_ITC_KNK_AFL[x]
KNKS_CMD_FIL[x] = C_FIL_FRQ_KNK_AFL[x]
KNKS_CMD_GAIN[x] = IP_GAIN_KNK_AFL[x]

KNKS_CMD_INT_PRE[x] = C_ITC_KNK_AFL[x]
KNKS_CMD_FIL_PRE[x] = C_FIL_FRQ_KNK_AFL[x]
KNKS_CMD_GAIN_PRE[x] = IP_GAIN_KNK_AFL[x]

Endif

call action interface for pre and normal window parameters

ACTION_INFR_*SetKnkCfg*(IN <Cmd_fil>, IN <Cmd_gain>, IN <Cmd_int>, IN <Cyl>, IN <Win>)
Sets knock pre-processor window, filter, gain and integrator factors for cylinder *cyl*

N.B.: x represents current SEG_NR + 2
Description (example for 4 cylinder engine):

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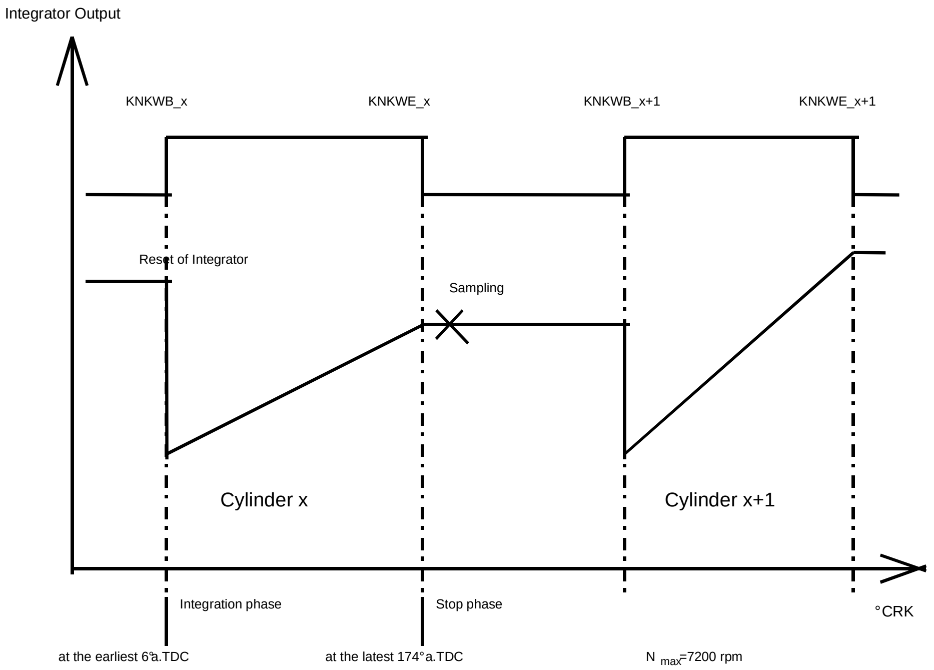
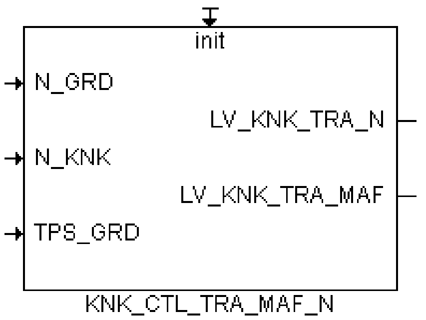


Note: These calibration data have to be adjusted if the processor sampling rate is changed.

6.17.1.4 Load and Speed Dynamics



6.17.1.4.1 Speed Dynamics Function

FUNCTION DESCRIPTION:

General information:
In order to keep track with the noise values for large engine speed gradients (LV_KNK_TRA_N = 1), the standard filtering constant is exchanged by a faster averaging constant C_NL_CRLC_TRA.
Care needs to be given to the absolute function evaluation, so that there is no difference in the treatment of positive and negative speed gradients.
Furthermore the values of Knock -Adaptation-circuits 1 + 2 are only read at active speed dynamics.

Application conditions

Activation: *at every engine state except engine stop*

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Deactivation: *at engine stop*

Initialization: *LV_KNK_TRA_N = 0 at reset and engine running to engine stop*

Update Rate: *every segment*

Formula section:

if **(|N_GRD| >= ID_N_GRD_MAX_KNK__N)**

LV_KNK_TRA_N = 1

else

LV_KNK_TRA_N = 0

end if

6.17.1.4.2 Load Dynamics Function

FUNCTION DESCRIPTION:

General information:

In order to keep track with the noise values for large (positive) load gradients (LV_KNK_TRA_MAF = 1), the standard filtering constant is exchanged by a faster averaging constant C_NL_CRLC_TRA. After the triggering of the load dynamics the special filtering constant C_NL_CRLC_TRA is applied for the number of ID_CYCNR_FAC_TRA_KNK__N cycles. In addition, at active load dynamics function, the knock detection (KNK_THD[x]) is made less sensitive with the help of the factor C_FAC_TRA_KNK.
The values from the knock adaptation-circuits 1 + 2 are only read.

Application conditions

Activation: *at every engine state except engine stop*

Deactivation: *at engine stop*

Initialization: *LV_KNK_TRA_MAF = 0 at reset and engine running to engine stop*

Update Rate: *every segment*

Formula section:

if **LV_IGA_TRA_KNK 0 -> 1**

LV_KNK_TRA_MAF = 1 for ID_CYCNR_FAC_TRA_KNK__N cycles

else

if **(ID_CYCNR_FAC_TRA_KNK__N has elapsed)**

LV_KNK_TRA_MAF = 0

end if

end if

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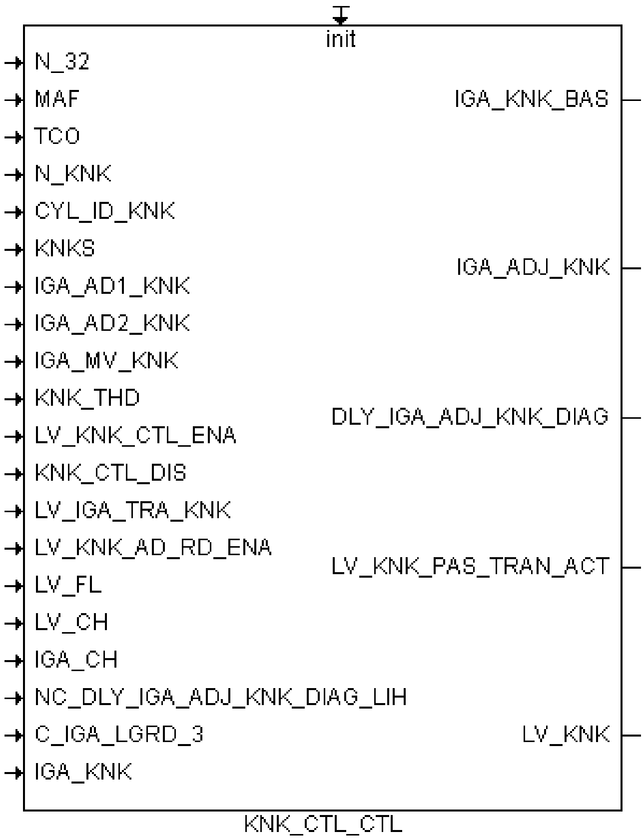
6.17.2 Knock Control



Overview:

→ Knock Control at change of operation mode
→ Knock Detection in separate window
→ Knock Detection
if (LV_KNK_CTL_ENA = 1)
→ Knock Control active
if Combustion mode = 'stratified'
→ Calculation 'knock control in stratified mode'
else
if
→ Calculation of Maximum Retard Adjustment
if (KNK_CTL_DIS = 1)
→ Limp Home operation
else
if (LV_KNK_CTL_PRE_ENA = 1)
→ Normal Operation Pre-Ignition
end if
→ Normal operation
→ Control excursion limit
end if
→ Limitation of total ignition retard

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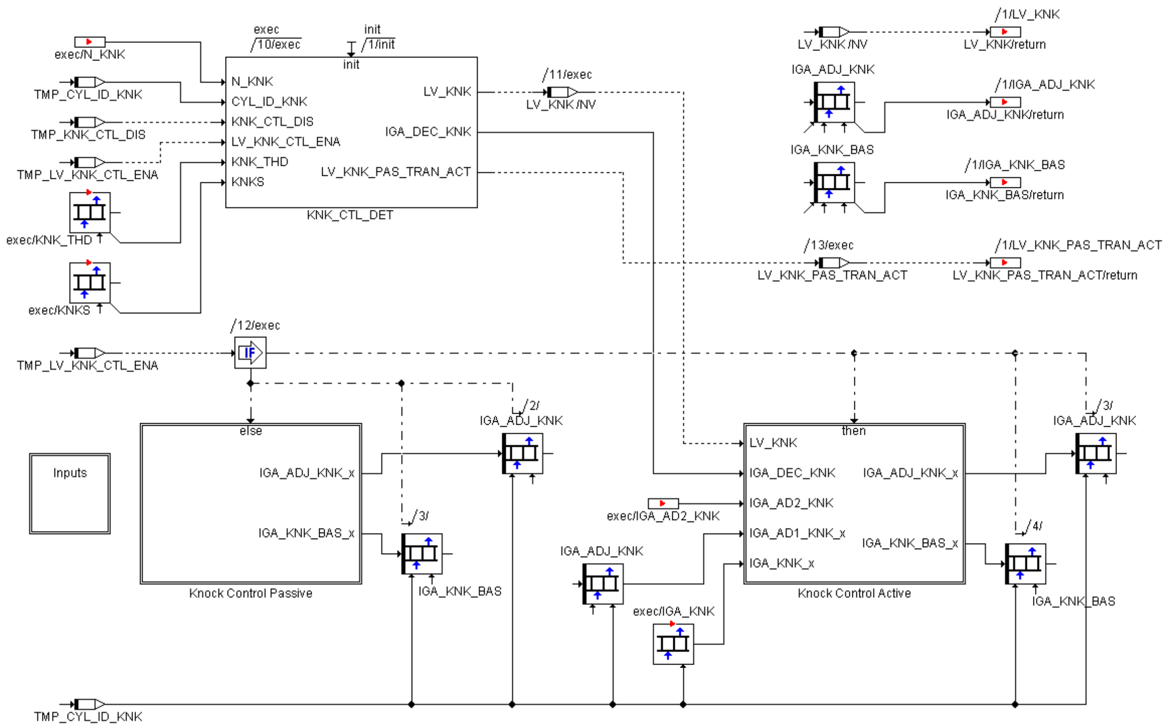
else
→ **Reset of Knock control**
end if
endif
else
→ **Knock control passive (Reset after abandoning the Knock-Operating-Limit)**
end if



Application conditions

Activation: *at every engine state except engine stop*

Deactivation: *at engine stop*

Initialisation: at reset and engine running to engine stop
IGA_ADJ_KNK[NC_CYL_NR] = 0
STATE_CMB_CTL_KNK = 0

Update Rate: *every segment*

6.17.2.1 Knock Control at change of operation mode

Changing the operation mode causes some additional noise. To avoid faulty detection of knock, the knock control is cut off for a calibratable time. The noise level has to be shifted with a own correlation constant. This calculation has to be done before IGA_DEC_KNK is calculated.
Definition of temp variable for change between combustion states:

if OPM_AV(n) != OPM_AV(n-1) // operation mode has changed
then
if OPM_AV = "AFS" to "AFL"
then STATE_CMB_CTL _TMP = "AFS_TO_AFL" (1H)

elseif OPM_AV = "AFS" to "S"

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```
          then      STATE_CMB_CTL _TMP = " HOM_TO_S "      (4H)

          elseif    OPM_AV = "S" to "AFL"
          then      STATE_CMB_CTL _TMP = "BACKHOM"          (8H)

          elseif    OPM_AV = "S" to "AFS"
          then      STATE_CMB_CTL _TMP = " S_TO_HOM "      (7H)

          elseif    OPM_AV = "AFL" to "AFS"
          then      STATE_CMB_CTL _TMP = "AFL_TO_AFS"      (3H)

          elseif    OPM_AV = "'AFL"   to "S"
          then      STATE_CMB_CTL _TMP = "BACKS"            (5H)
else
          if          OPM_AV = "AFS"
          then      STATE_CMB_CTL _TMP = "HOM_AFS"          (0H)

          elseif    OPM_AV = "AFL"
          then      STATE_CMB_CTL _TMP = "HOM_AFL"          (2H)

          elseif    OPM_AV = "S"
          then      STATE_CMB_CTL _TMP = "S"                    (6H)
endif


if             OPM_AV(n) != OPM_AV(n-1) // operation mode has changed
  then
               LV_CTR_KNK_CMB = 1
               CTR_KNK_CMB = 0
               STATE_CMB_CTL_KNK = STATE_CMB_CTL_TMP
endif

if     LV_CTR_KNK_CMB = 1 and CTR_KNK_CMB < ID_CTR_KNK_CMB
  then
               CTR_KNK_CMB ++
  else
              CTR_KNK_CMB = 0
              LV_CTR_KNK_CMB = 0
endif
```

ID_CTR_KNK_CMB is to be used in dividers of six (six segments equal one working cycle)

6.17.2.2 Knock Detection in separate window

FUNCTION DESCRIPTION:

General information:

Application conditions

Activation: *at every engine state except engine stop*

Deactivation: *at engine stop*

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Initialisation:
```
at reset and engine running to engine stop
   LV_KNK_PRE = 0
   CYCNR_KNK_PRE_DET = 0
   CTR_KNK_PRE_DET[0 to NC_CYL_NR] = 0
   CTR_KNK_PRE_DET_0[0 to NC_CYL_NR] = 0
   CTR_KNK_PRE_DET_1[0 to NC_CYL_NR] = 0
   LV_KNK_PRE_DET = 0
   CTR_KNK_PRE_DET_NR[0 to NC_CYL_NR] = 0
   CYCNR_INH_IV_KNK_PRE_DET[0 to NC_CYL_NR] = 0
   set all bits in INH_IV_KNK = 0
```

Update Rate: *every segment*

Formula section:

if **(LV_KNK_CTL_PRE_ENA = 1)**
Knock Control Pre-Ignition Active:
if **(KNK_CTL_DIS = 0)**
if **(NC_CYL_NR cycles has elapsed after Passive or Limp-Home)**
LV_KNK_PAS_TRAN_ACT = 1

call action interface for acquisition of knks signal for pre-window

ACTION_INFR_*GetVKnks*(OUT <V_knks>, IN <Cyl>, IN <Win>)
Gets the formatted knock noise raw signal

if **LV_KNK_CTL_PRE_INH = 0 and**
(KNKS_PRE[x] >= KNK_THD_PRE) and
LV_CTR_KNK_CMB=0 and
OPM_AV = "AFS" (no pre-window used in AFL or S)
then
LV_KNK_PRE = 1
else
LV_KNK_PRE = 0
end if
else
LV_KNK_PAS_TRAN_ACT = 0
LV_KNK_PRE = 0
CYCNR_KNK_PRE_DET = 0 (reset of counter for observation period)
CTR_KNK_PRE_DET[x] = 0 (reset of detection counter)
CTR_KNK_PRE_DET_0[x] = 0 (reset of pre window counter)
CTR_KNK_PRE_DET_1[x] = 0 (reset of main window counter)
LV_KNK_PRE_DET = 0 (reset of bit for detected pre-ignition)
CYCNR_INH_IV_KNK_PRE_DET[x] = 0 (reset of injection shut off counter)
set all bits in INH_IV_KNK = 0 (reset of pre-ignition inhibit bits)
end if
else
LV_KNK_PAS_TRAN_ACT = 0
LV_KNK_PRE = 0
CYCNR_KNK_PRE_DET = 0 (reset of counter for observation period)
CTR_KNK_PRE_DET[x] = 0 (reset of detection counter)
CTR_KNK_PRE_DET_0[x] = 0 (reset of pre window counter)
CTR_KNK_PRE_DET_1[x] = 0 (reset of main window counter)
LV_KNK_PRE_DET = 0 (reset of bit for detected pre-ignition)

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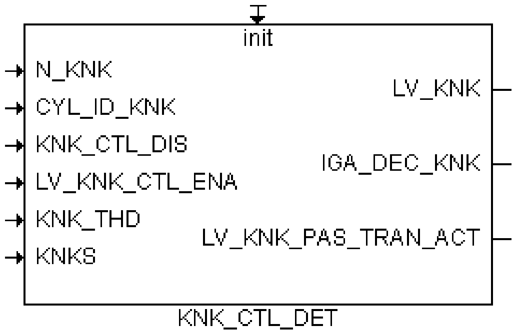
CYCNR_INH_IV_KNK_PRE_DET[x] = 0 (reset of injection shut off counter)
set all bits in INH_IV_KNK = 0 (reset of pre-ignition inhibit bits)
end if
else
LV_KNK_PAS_TRAN_ACT = 0
LV_KNK_PRE = 0
CYCNR_KNK_PRE_DET = 0 (reset of counter for observation period)
CTR_KNK_PRE_DET[x] = 0 (reset of detection counter)
CTR_KNK_PRE_DET_0[x] = 0 (reset of pre window counter)
CTR_KNK_PRE_DET_1[x] = 0 (reset of main window counter)
LV_KNK_PRE_DET = 0 (reset of bit for detected pre-ignition)
CYCNR_INH_IV_KNK_PRE_DET[x] = 0 (reset of injection shut off counter)
set all bits in INH_IV_KNK = 0 (reset of pre-ignition inhibit bits)
end if

N.B.: x represents current CYL_ID_KNK

6.17.2.3 Knock Detection



FUNCTION DESCRIPTION:

General information:

Application conditions

Activation: *at every engine state except engine stop*
Deactivation: *at engine stop*
Initialisation: –
Update Rate: *every segment*

Formula section:

if **(LV_KNK_CTL_ENA = 1)**
Knock Control Active:
if **(KNK_CTL_DIS = 0)**
if **(NC_CYL_NR cycles has elapsed after Passive or Limp-Home)**
LV_KNK_PAS_TRAN_ACT = 1

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call action interface for acquisition of knks signal for normal window

ACTION_INFR_*GetVKnks*(OUT <V_knks>, IN <Cyl>, IN <Win>)
Gets the formatted knock noise raw signal

```
if      (KNKS[x] >= KNK_THD[x]) and LV_CTR_KNK_CMB = 0
        LV_KNK = 1
           if      OPM_AV = "AFS"
                   if      (KNKS[x] ≥ 2 * KNK_THD[x])
                           Intensity 2:
                           IGA_DEC_KNK = ID_IGA_DEC_KNK_2
              else
                           Intensity 1:
                           IGA_DEC_KNK = ID_IGA_DEC_KNK_1
                   end if
           else
                   if      (KNKS[x] ≥ 2 * KNK_THD[x])
                           Intensity 2:
                          IGA_DEC_KNK = ID_IGA_DEC_KNK_AFL_2
                           Intensity 1:
                           IGA_DEC_KNK = ID_IGA_DEC_KNK_AFL_1
                   end if
           end if
else
           LV_KNK = 0
   end if
if      (KNKS[x] >= KNK_THD_MAX) and LV_CTR_KNK_CMB = 0
        LV_KNK_MAX = 1
else
           LV_KNK_MAX = 0
   end if
```

```
                    else
                            LV_KNK_PAS_TRAN_ACT = 0
                            LV_KNK = 0
                    end if
            else
                    Limp-Home Intensity 1:
                    IGA_DEC_KNK = ID_IGA_DEC_KNK_1
                    LV_KNK_PAS_TRAN_ACT = 0
                 LV_KNK = 0
            end if
    else
            Knock Control Passive:
            LV_KNK_PAS_TRAN_ACT = 0
            LV_KNK = 0
    end if
```

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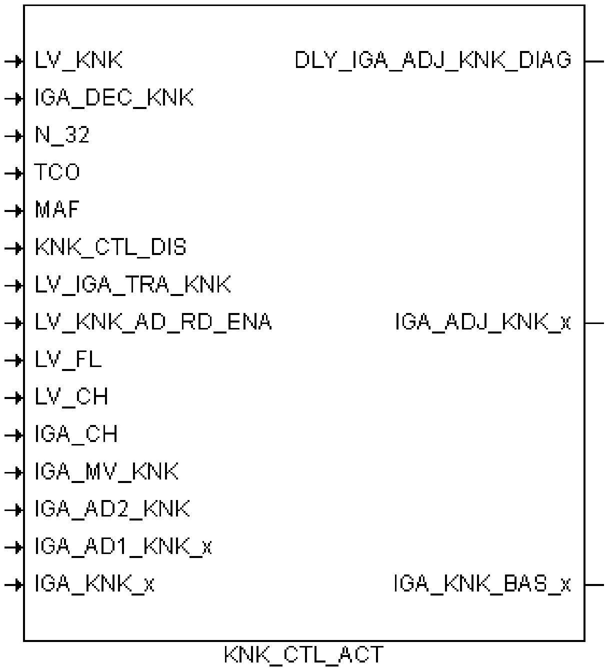
N.B.: x represents current CYL_ID_KNK
Different adjustment decrements are also produced due to the different knock intensities.
Then it is possible to react to hard knock-strikes with a greater ignition - timing retardation.

6.17.2.4 Knock control active



General information:
The spark retard is calculated cylinder-individual at every firing event. The spark retard due to the knock control system is determined by the spark retard due to knocking combustion (IGA_KNK[x]). The sum of these retard components is limited to a maximum spark retard.

Application conditions

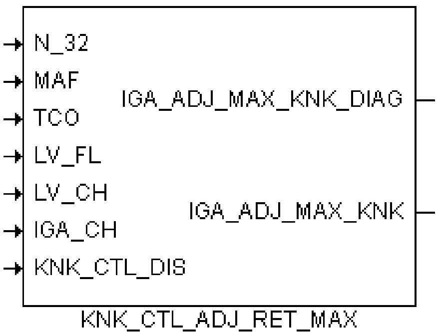
Activation: *at every engine state except engine stop*

Deactivation: *LV_ES = 1*

Initialisation: –

Update Rate: *every segment*

6.17.2.4.1 Calculation of Maximum Retard Adjustment



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FUNCTION DESCRIPTION:

General information:
This ignition angle is also executed if a knock control related malfunction is detected (KNK_CTL_DIS = 1).

Please note that this maximum spark retard is an absolute ignition angle referring to TDC.

Application conditions

Activation: *at every engine state except engine stop*

Deactivation: –

Initialisation: –

Update Rate: *every segment*

Formula section:

IGA_OFS_MAX_KNK = IP_IGA_OFS_MAX_KNK(N_32, MAF)
FAC_IGA_MAX_KNK = IP_FAC_IGA_MAX_KNK(TCO, TIA)
IF LV_ERR_KNKS[NC_NR_SENS_KNK] = 1 (or condition)
Then
IGA_BAS_MAX_KNK = IP_IGA_BAS_MAX_KNK_ERR(N_32, MAF)
Else
IGA_BAS_MAX_KNK = IP_IGA_BAS_MAX_KNK(N_32, MAF)
EndIf
IGA_ADJ_MAX_KNK = IGA_BAS_MAX_KNK + (IGA_OFS_MAX_KNK * FAC_IGA_MAX_KNK)

6.17.2.4.2 Normal Operation Pre-Ignition

FUNCTION DESCRIPTION:

General information:
Surface ignition, before the regular ignition is triggered, is called pre-ignition. This kind of autoignition is caused by a hot spot, generated by prolonged, heavy spark knock. It is known as knock-induced pre-ignition. This is the most damaging side effect of spark knock.
Knock-induced pre-ignition is detected by following algorithm, that is observing normal knocking (normal knock window) and pre-ignition (pre-knock window). Both windows are evaluated to detect occuring pre-ignition events. If either many knock events are detected in the normal knock window or in the pre-knock window or in the normal knock window plus the pre-knock window during a certain number of firing events, autoignition is detected and the protection function of the engine is activated. Then the injection of the concerned cylinder is shut off for a calibratable number of firing events, which can be increased in case of multiple detection events during one driving cycle, in order to prevent engine damage.
(No execution, if not (LV_KNK_CTL_PRE_ENA = 1))

Detection algorithm:

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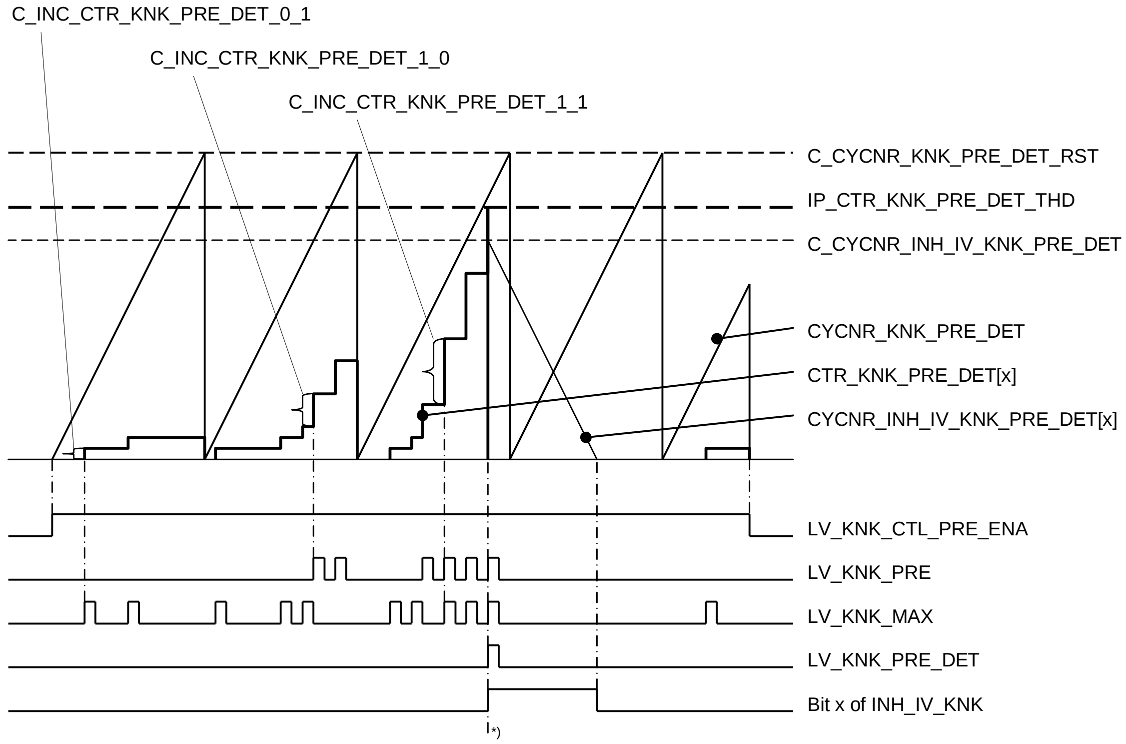

*) counter exceeds threshold within observation period --> cycle counter for injection inhibition starts

LV_KNK_PRE refers to ID_KNK_THD_MAX_PRE threshold,
LV_KNK_MAX refers to IP_KNK_THD_MAX threshold!

Formula section:

cycle counter for observation period
(update rate: every 720°)
CYCNR_KNK_PRE_DET = CYCNR_KNK_PRE_DET$_{n-1}$ + 1

cycle counter and detection counter reset when reaching cycle counter threshold
(update rate: every 720°)
If CYCNR_KNK_PRE_DET $>$ C_CYCNR_KNK_PRE_DET_RST
Then CYCNR_KNK_PRE_DET = 0
CTR_KNK_PRE_DET[0 to NC_CYL_NR] = 0
Endif

detection counter
(cylinder individually)
If CTR_KNK_PRE_DET[x] = 0
Then CTR_KNK_PRE_DET_0[x] = 0
CTR_KNK_PRE_DET_1[x] = 0
Endif
If LV_KNK_PRE = 0 **and** LV_KNK_MAX = 1
Then CTR_KNK_PRE_DET[x] = CTR_KNK_PRE_DET[x]$_{n-1}$ + INC_CTR_KNK_PRE_DET_0_1
CTR_KNK_PRE_DET_1[x] ++
Elseif LV_KNK_PRE = 1 **and** LV_KNK_MAX = 0

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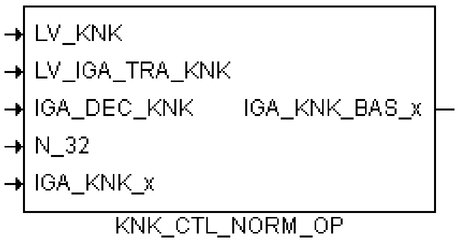
Then CTR_KNK_PRE_DET[x] = CTR_KNK_PRE_DET[x]$_{n-1}$ + INC_CTR_KNK_PRE_DET_1_0
CTR_KNK_PRE_DET_0[x] ++
Elseif LV_KNK_PRE = 1 **and** LV_KNK_MAX = 1
Then CTR_KNK_PRE_DET[x] = CTR_KNK_PRE_DET[x]$_{n-1}$ + INC_CTR_KNK_PRE_DET_1_1
CTR_KNK_PRE_DET_0[x] ++
CTR_KNK_PRE_DET_1[x] ++
Endif

knock pre-ignition detection and detection counter reset when reaching detection threshold (cylinder individually)
If CTR_KNK_PRE_DET[x] $>$ IP_CTR_KNK_PRE_DET_THD
Then LV_KNK_PRE_DET = 1
CTR_KNK_PRE_DET[x] = 0
Else LV_KNK_PRE_DET = 0
Endif

injection shut off for adjustable number of cycles
(cylinder individually)
If LV_KNK_PRE_DET = 1
Then CTR_KNK_PRE_DET_NR[x] ++
CYCNR_INH_IV_KNK_PRE_DET[x] = IP_CYCNR_INH_IV_KNK_PRE_DET (N_KNK, CTR_KNK_PRE_DET_NR[x])
Endif
If CYCNR_INH_IV_KNK_PRE_DET[x] $>$ 0
Then CYCNR_INH_IV_KNK_PRE_DET[x] = CYCNR_INH_IV_KNK_PRE_DET[x]$_{n-1}$ - 1
set bit x for corresponding cylinder in INH_IV_KNK = 1
Else set bit x for corresponding cylinder in INH_IV_KNK = 0
Endif
this calculation has to be done before 'Cylinder Shut Off (Application Incidences)'

N.B.: x represents current CYL_ID_KNK

6.17.2.4.3 Normal Operation



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FUNCTION DESCRIPTION:

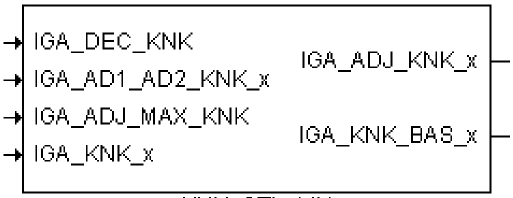
General information:

The spark retard is calculated cylinder-individual at every firing event. The spark retard due to the knock control system is determined by the spark retard due to knocking combustion (IGA_KNK[NC_CYL_NR]). The sum of these retard components is limited to a maximum spark retard.
In case of knock free operation (LV_KNK=0) and LV_KNK_CTL_ENA = 1 the Ignition retard due to knock control is re-set to zero (Controlled reset at Knock-free operation).
The controlled ignition-timing reset remains active until either the map ignition timing (IGA_KNK_BAS[x] = 0) is reached or until knocking occurs.

Formula section:

if (LV_KNK = 1)
then IGA_KNK_BAS[x] = IGA_KNK[x] - IGA_DEC_KNK
else Controlled reset at Knock-free operation
  if (LV_IGA_TRA_KNK = 0)
  then IGA_KNK_BAS[x] = IGA_KNK[x] + IP_IGA_INC_KNK__N
  else IGA_KNK_BAS[x] = IGA_KNK[x]
  end if
end if
N.B.: x represents current CYL_ID_KNK

6.17.2.4.4 Limp Home Operation



KNK_CTL_LIH

FUNCTION DESCRIPTION:

General information:
After an diagnosis error on the knock control system is detected (KNK_CTL_DIS = 1) the limp home spark retard level is achieved via spark retard Intensity 1 (IGA_DEC_KNK).

Formula section:

Check if limphome spark retard level is already reached
if IGA_KNK[x] - IGA_DEC_KNK < IGA_ADJ_MAX_KNK - IGA_WOUT_KNK
limphome spark retard level reached: Limitation to max. absolute (refering to TDC) possible ignition retard
then
  IGA_KNK_BAS[x] = IGA_ADJ_MAX_KNK - IGA_WOUT_KNK
Limphome spark retard level not yet reached
else
  IGA_KNK_BAS[x] = IGA_KNK[x] - IGA_DEC_KNK
end if

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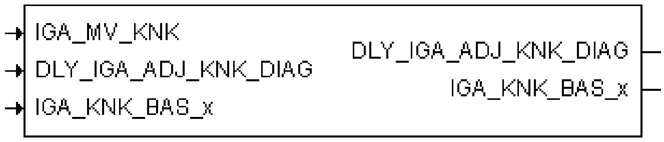
6.17.2.4.5 Control Exursion limit



KNK_CTL_CTL_EX_LIM

FUNCTION DESCRIPTION:

General information:

The control excursion limit is used to limit the difference of the ignition adjustment angle through knock-control of the single cylinders to a certain value. All 720 °CRK the arithmetic mean value of the cylinder ignition adjustment angles IGA_KNK_BAS[NC_CYL_NR] is calculated:

All 720/Cyl. °CRK a test will be done, to see whether the ignition adjustment angle of the just calculated cylinder is more retarded or advanced than

IGA_MV_KNK - C_IGA_ DIF_MIN_MAX_KNK. In this case the knock control adjustment angle is limited to the control excursion limit.

In case that ignition angle retard reaches the maximum limit, LV_IGA_DIF_MAX_KNK is set in order to give this information to the 'Excursion Limit Analysis' functionality, where the values for concerning cylinder and actual operation point are stored.

Formula section:

Case Differentiation:

Analysis trigger reset:

LV_IGA_DIF_MAX_KNK = 0

if IGA_KNK_BAS[x] IGA_MV_KNK + C_IGA_DIF_MIN_MAX_KNK

advance limitation:

then IGA_KNK_BAS[x] = IGA_MV_KNK + C_IGA_DIF_MIN_MAX_KNK

else

if IGA_KNK_BAS[x] IGA_MV_KNK - C_IGA_DIF_MIN_MAX_KNK

retard limitation:

then IGA_KNK_BAS[x] = IGA_MV_KNK - C_IGA_DIF_MIN_MAX_KNK

Analysis trigger for cylinder individual counter, freeze of Cyl_ID_KNK and operation point:

LV_IGA_DIF_MAX_KNK = 1

endif

end if

N.B.: x represents current CYL_ID_KNK

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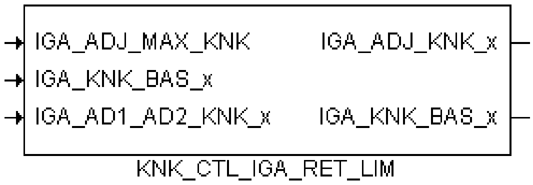
6.17.2.4.6 Limitation of total ignition retard

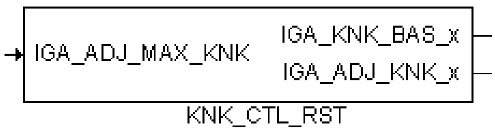


Formula section:

if LV_HOM_ACT = 1
then
check if limphome spark retard level is already reached
if IGA_KNK_BAS[x] < IGA_ADJ_MAX_KNK - IGA_WOUT_KNK
limphome spark retard level reached: Limitation to max. absolute (refering to TDC) possible ignition retard
then
IGA_KNK_BAS[x] = IGA_ADJ_MAX_KNK - IGA_WOUT_KNK
endif
endif
IGA_KNK[x] = IGA_KNK_BAS[x]
IGA_ADJ_KNK[x] = IGA_KNK_BAS[x]

N.B.: x represents current CYL_ID_KNK

6.17.2.4.7 Reset of Knock control



Formula section:

IGA_KNK_BAS[x] = 0°CRK
IGA_ADJ_KNK[x] = IGA_ADJ_MAX_KNK - IGA_WOUT_KNK

N.B.: x represents current CYL_ID_KNK

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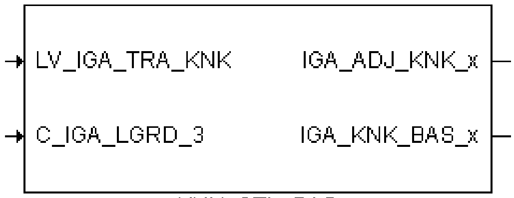
6.17.2.5 Knock control passiv (Reset after abandoning the Knock-Operating-Limit)



KNK_CTL_PAS

FUNCTION DESCRIPTION:

General information:
If the operating limit falls below (LV_KNK_CTL_ENA = 0;), then the ignition adjustment angle IGA_KNK_BAS[x] is re-set to 0, with the change limitation C_IGA_LGRD_3 - however referring to 720° CRK -, in order to reach the map ignition timing.

Formula section:

if (LV_IGA_TRA_KNK = 0)
then
IGA_ADJ_KNK[x] = IGA_ADJ_KNK[x]$_{(N-1)}$ + C_IGA_LGRD_3
IGA_KNK_BAS[x] = 0
else
IGA_ADJ_KNK[x] = IGA_ADJ_KNK[x]$_{N-1)}$ (remains unchanged)
IGA_KNK_BAS[x] = 0
end if

6.17.2.6 Knock Control in Stratified Mode

FUNCTION DESCRIPTION:

General information:
Knock detection and knock control is also active in stratified combustion mode. As ignition retard is not usable in stratified mode and may lead to problems at combustion mode changes, the spark retard variables IGA_ADJ_KNK and IGA_KNK_BAS are set to zero during stratifed. If stratified mode is left, the spark retard has to start at 0 °CRK when knock is recognized.

Formula section:

if OPM_AV = ’S’ (stratified combustion, 1H)
then
call action interface for acquisition of knks signal for pre and normal window

ACTION_INFR_*GetVKnks*(OUT <V_knks>, IN <Cyl>, IN <Win>)
Gets the formatted knock noise raw signal

IGA_ADJ_KNK[x] = 0 °CRK
IGA_KNK_BAS[x] = 0 °CRK

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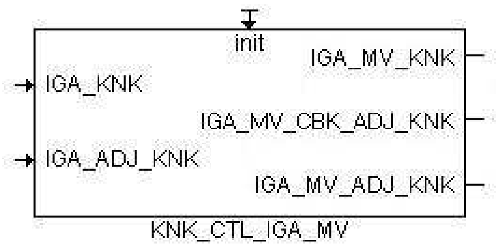
if (KNKSx >= KNK_THD[x])
then LV_KNK = 1
else LV_KNK = 0
endif
if (KNKS_PRE[x] ≥ KNK_THD_PRE)
then LV_KNK_PRE = 1
else LV_KNK_PRE = 0
end if
CYCNR_KNK_PRE_DET = 0 (reset of counter for observation period)
CTR_KNK_PRE_DET[x] = 0 (reset of detection counter)
CTR_KNK_PRE_DET_0[x] = 0 (reset of pre window counter)
CTR_KNK_PRE_DET_1[x] = 0 (reset of main window counter)
LV_KNK_PRE_DET = 0 (reset of bit for detected pre-ignition)
CYCNR_INH_IV_KNK_PRE_DET[x] = 0 (reset of injection shut off counter)
set all bits in INH_IV_KNK = 0 (reset of pre-ignition inhibit bits)
else
IGA_ADJ_KNK[x] is calculated as described in the previous chapters
IGA_KNK_BAS[x] is calculated as described in the previous chapters
end if

Hints:
Due to former changes IGA_KNK[x] is now identical to IGA_KNK_BAS[x].
At transition from stratified combustion mode to normal operation mode of knock control, NC_CYL_NR cycles have to be elapsed for spark retard.

6.17.3 Post-processing

6.17.3.1 Meanvalues of knock-control ignition adjustment



<u>**Application conditions**</u>

Activation: *at every engine state except engine stop*

Deactivation: –

Initialisation: at reset and engine running to engine stop
IGA_MV_KNK = IGA_MV_ADJ_KNK = 0
IGA_MV_CBK_ADJ_KNK[NC_CBK_EX_NR] = 0

Update Rate: every 720° CRK: IGA_MV_KNK, IGA_MV_ADJ_KNK
every segment: IGA_MV_CBK_ADJ_KNK[NC_CBK_EX_NR]

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Formula section:

$$IGA\_MV\_KNK = \frac{\sum_{i=1}^{NC\_CYL\_NR} (IGA\_KNK\_x)}{NC\_CYL\_NR}$$

$$IGA\_MV\_ADJ\_KNK = \frac{\sum_{i=1}^{NC\_CYL\_NR} (IGA\_ADJ\_KNK\_x)}{NC\_CYL\_NR}$$

Calculation of IGA_MV_CBK_ADJ_KNK[NC_CBK_EX_NR]:

IF NC_CBK_EX_NR $>$ 1 *(please note physical meaning)*
THEN
FOR i = 1 **TO** NC_CBK_EX_NR *(please note physical meaning)*
IGA_MV_CBK_ADJ_KNK[i] = 0
ENDFOR
FOR x = 0 **TO** (NC_CYL_NR - 1)
IF (NC_LAMB_REF **AND** 2^x) 0 *(bitwise)*
THEN
Bank 2:
IGA_MV_CBK_ADJ_KNK[2] += IGA_ADJ_KNK[x]
ELSE
Bank 1:
IGA_MV_CBK_ADJ_KNK[1] += IGA_ADJ_KNK[x]
ENDIF
ENDFOR
FOR i = 1 **TO** NC_CBK_EX_NR
IGA_MV_CBK_ADJ_KNK[i] = IGA_MV_CBK_ADJ_KNK[i] /
(NC_CYL_NR /NC_CBK_EX_NR)
ENDFOR
ELSE
IGA_MV_CBK_ADJ_KNK[1] = 0
FOR x = 0 **TO** (NC_CYL_NR - 1)
IGA_MV_CBK_ADJ_KNK[1] += IGA_ADJ_KNK[x]
ENDFOR
IGA_MV_CBK_ADJ_KNK[1] = IGA_MV_CBK_ADJ_KNK[1] /NC_CYL_NR
ENDIF

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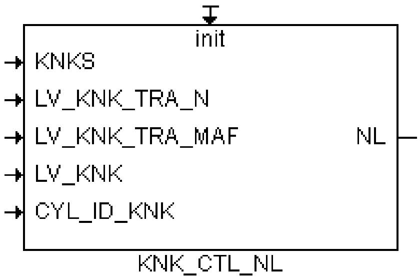
6.17.3.2 Noise Value



FUNCTION DESCRIPTION:

The noise value is cylinder-individually calculated as sliding average from the knock values. The averaging constant is either taken from ID_NL_CRLC, if no knock control transient function is active (LV_KNK_TRA_N = 0 and LV_KNK_TRA_MAF = 0) or C_NL_CRLC_TRA, when a knock control transient function is active (LV_KNK_TRA_N = 1 or LV_KNK_TRA_MAF = 1).

Application conditions

Activation: *at every engine state except engine stop*

Deactivation: *at engine stop*

Initialization: NL[0 to NC_CYL_NR] = C_KNK_THD_MAX
at reset or engine running to engine stop

Update Rate: *every segment*

Formula section:

if **(LV_KNK_TRA_N or LV_KNK_TRA_MAF)**
then if **OPM_AV = "AFS"**
then **NL[x] = NL[x] + (KNKS[x] - NL[x]) * C_NL_CRLC_TRA**
else **NL[x] = NL[x] + (KNKS[x] - NL[x]) * C_NL_CRLC_TRA_AFL**
end if

elseif **LV_CTR_KNK_CMB = 1**
then **NL[x] = NL[x] + (KNKS[x] - NL[x]) * C_NL_CRLC_CMB**

else **NL[x] = NL[x] + (KNKS[x] - NL[x]) * ID_NL_CRLC**
end if

NL[NC_CYL_NR] shows always the measured noise value from the ATIC62 device. The noise value is calculated always (independant from detection of knocking combustion).

In transient condition, if knocking combustions are detected (LV_KNK = 1) after knock-free operation, the first noise value is used weighted ((KNKS[x] / IP_FAC_THD_KNK) * C_FAC_KNK_TRA instead of simply use of KNKS[x]) to calculate the noise level, the second and the following are taken into consideration for normal transient calculation of noise level again.

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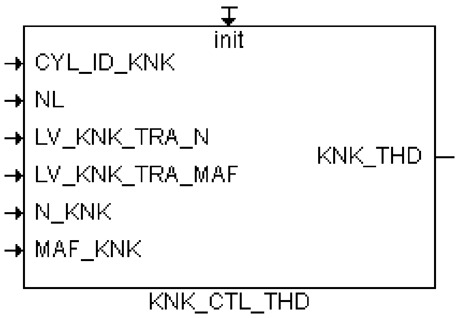
Else, if KNKS[x] $\geq$ IP_FAC_NL_UPD_DEAC * KNK_THD[x] (signal near threshold)
AND LV_KNK_PAS_TRAN_ACT = 1 (**delay cycles elapsed after passive or limp-home)**
AND LV_CTR_KNK_CMB = 0 (**delay counter elapsed after combustion mode switch), the first and the second noise value isn‘t used to calculate the noise level (NL[NC_CYL_NR] remains unchanged), the third and the following are taken into consideration for calculation of noise level. NL[NC_CYL_NR] remains unchanged for this time.**

N.B.: x represents current CYL_ID_KNK

6.17.3.3 Relative and Absolute Knock Threshold



FUNCTION DESCRIPTION:

General information:
The knock threshold (KNK_THD[NC_CYL_NR]) is the limit for the knock values (KNKSx), which are used for knock decision. If the knock values are greater or equal to the knock threshold, then knocking is recognised (LV_KNK = 1) and an ignition timing retardation follows. If the knock values are smaller, knocking is not detected (LV_KNK = 0) and the relevant KNK-ignition-angle is reset ($\rightarrow$ Knock-free Operation after Knocking).

The knock threshold is calculated for each cylinder separately and depends on the cylinder-individual noise value. Calculation of the knock threshold occurs with help from the cylinder-individual knock factors IP_FAC_THD_KNK[NC_CYL_NR] and knock summand IP_ADD_KNK__N.

If the noise value is above the minimum threshold C_NL_MIN, the knock threshold is calculated on the basis of the cylinder-individually noise value NL[NC_CYL_NR]. If the noise value is below C_NL_MIN this value is used as noise value for calculation of the knock threshold. If the knock threshold is above ID_THD_MAX_KNK this value is used as knock threshold (Limitation).
C_THD_MAX_KNK stays preserved as initialisation value for NL and NL_0_5 (in multiplexer specification).

N.B.: The actual knock value KNKS[x]$_n$ is not used in the calculation of the actual knock threshold KNK_THD[x]$_n$ but in the calculation of the next threshold KNK_THD[x]$_{n+1}$. So the decision knocking combustion yes/no is done with using the knock threshold KNKS[x]$_{n-1}$.

Application conditions

Activation: *at every engine state except engine stop*

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Deactivation: *at engine stop*

Initialization: KNK_THD[0 to NC_CYL_NR] = KNK_THD_PRE = 5V
at reset and engine running to engine stop

Update Rate: *every segment*

Formula section:

The lower absolute threshold is one value for all cylinders and is represented by the constant C_NL_MIN.

```
If      NL[x] < C_NL_MIN
        NL_LIM = C_NL_MIN
else
        NL_LIM = NL[x]
end if

if      OPM_AV = "AFS"
        if      (LV_KNK_TRA_N = 0 and LV_KNK_TRA_MAF = 0)
                KNK_THD[x] = ( NL_LIM + IP_KNK_THD_ADD_N ) * IP_FAC_THD_KNK[x]
        else
                KNK_THD[x] = ( NL_LIM + IP_KNK_THD_ADD_N ) * IP_FAC_THD_KNK[x] *
                                C_FAC_TRA_KNK
        end if
else
        if      (LV_KNK_TRA_N = 0 and LV_KNK_TRA_MAF = 0)
                KNK_THD)[x] = ( NL_LIM + IP_KNK_THD_ADD_N_AFL ) *
                                IP_FAC_THD_KNK_AFL[x]
        else
                KNK_THD)[x] = ( NL_LIM + IP_KNK_THD_ADD_N_AFL ) *
                                IP_FAC_THD_KNK_AFL[x] * C_FAC_TRA_KNK
        end if
end if
```

The knock threshold is generally limited to KNK_THD_MAX

```
KNK_THD_MAX = IP_KNK_THD_MAX
If  (KNK_THD[x] > KNK_THD_MAX)
     KNK_THD[x] = KNK_THD_MAX
end if

If  LV_KNK_CTL_PRE_INH = 0
     KNK_THD_PRE = ID_KNK_THD_MAX_PRE
end if
```

N.B.: x represents current CYL_ID_KNK

(*) The correction factor **C_FAC_TRA_KNK** is part of the KNK-load dynamics function and is effective after recognised load dynamics **ID_CYCNR_FAC_TRA_KNK__N** cycles.

The knock factor is the multiplicative part used for calculation of the knock threshold from the noise value.
The knock summand is an additive correction of the knock noise value. Thereby the knock threshold can be moved, dependent on the speed, in a positive or negative direction.

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KNK_THD_MAX with respect to **IP_KNK_THD_MAX** is used as absolute threshold for detection algorithm in main window.
KNK_THD_PRE with respect to **ID_KNK_THD_MAX_PRE** is used as absolute threshold for detection algorithm in pre-window.

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7 - Injection

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7.1 Final injection timing

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_DIF_SOI_IGN	O	0... F00H	0... 1440	0.375	°CRK
Output variable for LACO					
FAC_PRS_COR_DAMP_1_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to delay time and fuel pressure; first pulse homogeneous mode					
FAC_PRS_COR_DAMP_2_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to delay time and fuel pressure; second pulse homogeneous mode					
FAC_PRS_COR_DAMP_3_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to delay time and fuel pressure; third pulse homogeneous mode					
FAC_PRS_COR_MFF_1_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to previous injected fuel mass; first pulse homogeneous mode					
FAC_PRS_COR_MFF_2_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to previous injected fuel mass; second pulse homogeneous mode					
FAC_PRS_COR_MFF_3_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to previous injected fuel mass; third pulse homogeneous mode					
FAC_PRS_COR_OSC_1_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to delay time and injection time; first pulse homogeneous mode					
FAC_PRS_COR_OSC_2_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to delay time and injection time; second pulse homogeneous mode					
FAC_PRS_COR_OSC_3_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
Pressure pulsation correction factor due to delay time and injection time; third pulse homogeneous mode					
FAC_TI_2_S_COR [NC_CBK_HPP_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	-
Correction factor for mass flow difference at double injection, caused by duration of the second pulse.					
FAC_TI_2_S_DLY_COR [NC_CBK_HPP_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	-
Correction factor for mass flow difference at double injection					
FAC_TI_3_S_COR [NC_CBK_HPP_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	-
Correction factor for mass flow difference at multiple injection, caused by duration of the third pulse.					
FAC_TI_3_S_DLY_COR [NC_CBK_HPP_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	-
Correction factor for mass flow difference at multiple injection; 3. pulse strat. mode					
FAC_TI_PRS_COR_1	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Pressure pulsation correction factor for first pulse					
FAC_TI_PRS_COR_1_HOM [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Pressure pulsation correction factor for first pulse homogeneous mode					
FAC_TI_PRS_COR_2	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Pressure pulsation correction factor for the second pulse					
FAC_TI_PRS_COR_2_HOM [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Pressure pulsation correction factor for second pulse homogeneous mode					
FAC_TI_PRS_COR_2_S [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Pressure pulsation correction factor for second pulse stratified mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TI_PRS_COR_3	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Pressure pulsation correction factor for the third pulse					
FAC_TI_PRS_COR_3_HOM [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Pressure pulsation correction factor for third pulse homogeneous mode					
FAC_TI_PRS_COR_3_S [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Pressure pulsation correction factor for third pulse stratified mode					
IDX_TI_1_HOM_CLC [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Couting factor index for first pulse HOM					
IDX_TI_1_S_CLC [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Couting factor index for first pulse S					
IDX_TI_1_STND_HOM [NC_CYL_NR]	V	0... FFFFH	0... 65535	1	-
Couting factor index for first pulse HOM intermediate value					
IDX_TI_2_HOM_CLC [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Couting factor index for second pulse HOM					
IDX_TI_2_S_CLC [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Couting factor index for second pulse S					
IDX_TI_2_STND_HOM [NC_CYL_NR]	V	0... FFFFH	0... 65535	1	-
Couting factor index for second pulse HOM intermediate value					
IDX_TI_3_HOM_CLC [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Couting factor index for third pulse HOM					
IDX_TI_3_S_CLC [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Couting factor index for third pulse S					
IDX_TI_3_STND_HOM [NC_CYL_NR]	V	0... FFFFH	0... 65535	1	-
Couting factor index for third pulse HOM intermediate value					
LV_AUTH_TI_MIN_AFL	O/V	0... 1H	0 ...1	1	-
Logical variable to authorize homogeneous lean mode if injection time is not to less					
LV_AUTH_TI_MIN_S	O/V	0... 1H	0 ...1	1	-
Logical variable to authorize stratified mode if injection time is not to less					
LV_TI_1_HOM_MIN	O/V	0... 1H	0 ...1	1	-
Flag to indicate that minimum injection time is reached for homogeneous mode, first pulse					
LV_TI_1_S_MIN	O/V	0... 1H	0 ...1	1	-
Flag to indicate that minimum injection time is reached for stratified mode, first pulse					
LV_TI_2_HOM_MIN	O/V	0... 1H	0 ...1	1	-
Flag to indicate that minimum injection time is reached for homogeneous mode, second pulse					
LV_TI_2_S_MIN	O/V	0... 1H	0 ...1	1	-
Flag to indicate that minimum injection time is reached for stratified mode, second pulse					
LV_TI_3_HOM_MIN	O/V	0... 1H	0 ...1	1	-
Flag to indicate that minimum injection time is reached for homogeneous mode, third pulse					
LV_TI_3_S_MIN	O/V	0... 1H	0 ...1	1	-
Flag to indicate that minimum injection time is reached for stratified mode, third pulse					
MFF_SP_1_HOM_COR_INJ [NC_CYL_NR]	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual mass fuel flow set-point for homogeneous mode corrected by piezo energy carryover, first pulse					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MFF_SP_1_S_COR_INJ [NC_CYL_NR]	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual mass fuel flow set-point for stratified mode corrected by piezo energy carryover, first pulse					
MFF_SP_2_HOM_COR_INJ [NC_CYL_NR]	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual mass fuel flow set-point for homogeneous mode corrected by piezo energy carryover, second pulse					
MFF_SP_2_S_COR_INJ [NC_CYL_NR]	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual mass fuel flow set-point for stratified mode corrected by piezo energy carryover, second pulse					
MFF_SP_3_HOM_COR_INJ [NC_CYL_NR]	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual mass fuel flow set-point for homogeneous mode corrected by piezo energy carryover, third pulse					
MFF_SP_3_S_COR_INJ [NC_CYL_NR]	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual mass fuel flow set-point for stratified mode corrected by piezo energy carryover, third pulse					
RATIO_T_PER_PRS_COR_1_HOM	V	0... FFFFH	0... 0.99998	15.3e-6	-
Ratio of offset time to periode time of fuel rail pressure pulsation; homogeneous first pulse					
RATIO_T_PER_PRS_COR_2_HOM	V	0... FFFFH	0... 0.99998	15.3e-6	-
Ratio of offset time to periode time of fuel rail pressure pulsation; homogeneous second pulse					
RATIO_T_PER_PRS_COR_3_HOM	V	0... FFFFH	0... 0.99998	15.3e-6	-
Ratio of offset time to periode time of fuel rail pressure pulsation; homogeneous third pulse					
RATIO_TI_1_HOM	V	0... FFFFH	0... 15.99975	244.1e-6	-
Ratio of injection time to periode time of fuel rail pressure pulsation; homogeneous first pulse					
RATIO_TI_2_HOM	V	0... FFFFH	0... 15.99975	244.1e-6	-
Ratio of injection time to periode time of fuel rail pressure pulsation; homogeneous second pulse					
RATIO_TI_3_HOM	V	0... FFFFH	0... 15.99975	244.1e-6	-
Ratio of injection time to periode time of fuel rail pressure pulsation; homogeneous third pulse					
T_AUTH_TI_MIN_AFL	-	0... FFFFH	0.01... 655.36	0.01	s
Delay time after AFL mode was inhibited due to injection time limitation					
T_CHA_PER_HOM [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV charge period for homogeneous mode					
T_CHA_PER_HOM_2 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV charge period for homogeneous mode second pulse					
T_CHA_PER_HOM_3 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV charge period for homogeneous mode third pulse					
T_CHA_PER_POST	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV charge period for post injection pulse					
T_CHA_PER_S_1 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV charge period for stratified mode first pulse					
T_CHA_PER_S_2 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV charge period for stratified mode second pulse					
T_CHA_PER_S_3 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV charge period for stratified mode third pulse					
T_DCHA_PER_HOM [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV discharge period for homogeneous mode first pulse					
T_DCHA_PER_HOM_2 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV discharge period for homogeneous mode second pulse					
T_DCHA_PER_HOM_3 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV discharge period for homogeneous mode third pulse					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_DCHA_PER_POST	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV discharge period for post injection pulse					
T_DCHA_PER_S_1 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV discharge period for stratified mode first pulse					
T_DCHA_PER_S_2 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV discharge period for stratified mode second pulse					
T_DCHA_PER_S_3 [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Piezo IV discharge period for stratified mode; third pulse					
T_DLY_1_1_HOM	V	0... FFFFH	0... 65.535	0.001	ms
Delay time between the first pulses of two consecutive cylinders at homogeneous single injection					
T_DLY_1_2_HOM	V	0... FFFFH	0... 65.535	0.001	ms
Delay time between the first and second pulse at homogeneous multi injection					
T_DLY_2_3_HOM	V	0... FFFFH	0... 65.535	0.001	ms
Delay time between the second and third pulse at homogeneous multi injection					
T_PER_PRS_COR_1_HOM	V	0... FFFFH	0... 65.535	0.001	ms
Periode time of fuel rail pressure pulsation; homogeneous first pulse					
T_PER_PRS_COR_2_HOM	V	0... FFFFH	0... 65.535	0.001	ms
Periode time of fuel rail pressure pulsation; homogeneous second pulse					
T_PER_PRS_COR_3_HOM	V	0... FFFFH	0... 65.535	0.001	ms
Periode time of fuel rail pressure pulsation; homogeneous third pulse					
T_RLS_DLY_DCHA_1_HOM [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Release delay time for first pulse in homogeneous mode.					
T_RLS_DLY_DCHA_1_S [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Release delay time for first pulse in stratified mode.					
T_RLS_DLY_DCHA_2_HOM [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Release delay time for second pulse in homogeneous mode.					
T_RLS_DLY_DCHA_2_S [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Release delay time for second pulse in stratified mode.					
T_RLS_DLY_DCHA_3_HOM [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Release delay time for third pulse in homogeneous mode.					
T_RLS_DLY_DCHA_3_S [NC_CYL_NR]	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Release delay time for third pulse in stratified mode.					
T_RLS_DLY_DCHA_POST	O/V	0... 7FFFH	0... 3276.7	0.1	µs
Release delay time for post injection.					
TEMP_PRS_COR_1_HOM	V	0... FEH	-48... 142.5	0.75	°C
Fuel temperature for pressure pulsations correction; first pulse homogeneous mode					
TEMP_PRS_COR_2_HOM	V	0... FEH	-48... 142.5	0.75	°C
Fuel temperature for pressure pulsations correction; second pulse homogeneous mode					
TI_1_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, homogeneous mode, first pulse (intermediate value)					
TI_1_HOM_CLC [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, homogeneous mode, first pulse (intermediate value)					
TI_1_HOM_CLC_MAX	O/V	0... FFFFH	0... 65.535	0.001	ms
Maximum injection time of first pulse, homogeneous mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TI_1_HOM_CLC_MIN	V	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time of first pulse, homogeneous mode					
TI_1_S [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, stratified mode, fist pulse (intermediate value)					
TI_1_S_CLC [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, stratified mode, fist pulse (intermediate value)					
TI_1_S_CLC_MIN	V	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time of first pulse, stratified mode					
TI_1_STND_HOM [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Mapped Injection time, homogeneous mode, 1. pulse					
TI_2_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, homogeneous mode, second pulse (intermediate value)					
TI_2_HOM_CLC [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, homogeneous mode, second pulse (intermediate value)					
TI_2_HOM_CLC_MAX	O/V	0... FFFFH	0... 65.535	0.001	ms
Maximum injection time of second pulse, homogeneous mode					
TI_2_HOM_CLC_MIN	V	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time of second pulse, homogeneous mode					
TI_2_S [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, stratified mode, second pulse (intermediate value)					
TI_2_S_CLC [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, stratified mode, second pulse (intermediate value)					
TI_2_S_CLC_MIN	V	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time of second pulse, stratified mode					
TI_2_STND_HOM [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Mapped Injection time, homogeneous mode, 2. pulse					
TI_3_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, homogeneous mode, third pulse					
TI_3_HOM_CLC [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, homogeneous mode, third pulse (intermediate value)					
TI_3_HOM_CLC_MAX	O/V	0... FFFFH	0... 65.535	0.001	ms
Maximum injection time of third pulse, homogeneous mode					
TI_3_HOM_CLC_MIN	V	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time of third pulse, homogeneous mode					
TI_3_S [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, stratified mode, third pulse					
TI_3_S_CLC [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time, stratified mode, third pulse (intermediate value)					
TI_3_S_CLC_MIN	V	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time of third pulse, stratified mode					
TI_3_STND_HOM [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Mapped Injection time, homogeneous mode, 3. pulse					
TI_MIN_HOM	O/V	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time limitation for homogeneous mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Input data:

CRK_DIF_SOI_IGN_HOM {p. 2122}	CRK_DIF_SOI_IGN_S {p. 2140}	CTR_CYL_NR_ST_CLC_INJR {p. 3327}	EOI_2_HOM_EXT [NC_CYL_NR] {p. 2146}
EOI_3_HOM_EXT [NC_CYL_NR] {p. 2146}	FAC_MFF_DIF_HOM [NC_CYL_NR] {p. 2260}	FAC_MFF_DIF_S [NC_CYL_NR] {p. 2260}	FAC_MFF_TFU {p. 2224}
FAC_N {p. 3327}	FAC_TI_1_PRS_CYL_HOM [NC_CYL_NR] {p. 2200}	FAC_TI_1_PRS_CYL_S [NC_CYL_NR] {p. 2212}	FAC_TI_2_PRS_CYL_HOM [NC_CYL_NR] {p. 2204}
FAC_TI_2_PRS_CYL_S [NC_CYL_NR] {p. 2216}	FAC_TI_3_PRS_CYL_HOM [NC_CYL_NR] {p. 2208}	FAC_TI_3_PRS_CYL_S [NC_CYL_NR] {p. 2220}	FAC_TI_COR_IV_EGY_RNG_L [NC_CBK_HPP_NR] {p. 2260}
FAC_TI_L_PRS {p. 3327}	FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	IDX_PRS_COR_CYL_CLC_MPLH [NC_CBK_HPP_NR] {p. 3327}	IDX_PRS_COR_CYL_CLC_S [NC_CBK_HPP_NR] {p. 3327}
INJ_MOD_SP_HOM [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_HOMS [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}	LF_PRS_COR_HPP_ENA {p. 3330}
LV_AFL_CLC {p. 1822}	LV_EGY_RNG_IV_PLS_1_HOM [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_1_S [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_2_HOM [NC_CYL_NR] {p. 2261}
LV_EGY_RNG_IV_PLS_2_S [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_3_HOM [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_3_S [NC_CYL_NR] {p. 2261}	LV_IV_POST_EGY_RNG {p. 2179}
LV_PRS_COR_MPLH_ENA {p. 3331}	LV_PRS_COR_SNGH_ENA {p. 3331}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}
MFF_ADD_REAC [NC_CYL_NR] {p. 3331}	MFF_SP_1_HOM [NC_CYL_NR] {p. 8242}	MFF_SP_1_S [NC_CYL_NR] {p. 8242}	MFF_SP_2_HOM [NC_CYL_NR] {p. 8242}
MFF_SP_2_S [NC_CYL_NR] {p. 8242}	MFF_SP_3_HOM [NC_CYL_NR] {p. 8243}	MFF_SP_3_S [NC_CYL_NR] {p. 8243}	NC_CBK_HPP_NR [1] {p. 812}
NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}	NC_INJ_MOD_HOM {p. 2045}	NC_INJ_MOD_MASK_1 {p. 2045}	NC_NR_IDX_MFF_1_INJ {p. 627}
NC_NR_IDX_MFF_2_INJ {p. 627}	NC_NR_IDX_MFF_SP_2 {p. 627}	NC_NR_IDX_MFF_SP_3 {p. 627}	NC_NR_IDX_PRS_DEC_INJ {p. 627}
NC_NR_IDX_PRS_DEC_INJ_2 {p. 627}	NC_NR_IDX_T_DLY_1_2_S_COR {p. 627}	NC_NR_IDX_T_DLY_1_2_S_DLY_COR {p. 627}	NC_NR_IDX_T_DLY_2_3_S_COR {p. 627}
NC_NR_IDX_T_DLY_2_3_S_DLY_COR {p. 627}	NC_NR_IDX_TI_1_INJ {p. 627}	NC_NR_IDX_TI_2_INJ {p. 627}	NC_NR_IDX_TI_2_S {p. 627}

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NC_NR_IDX_TI_3_S {p. 627}	NR_CYL_CLC_RED_INJ {p. 3331}	PRS_DEC_INJ_1_HOM [NC_CYL_NR] {p. 2200}	PRS_DEC_INJ_1_S [NC_CYL_NR] {p. 2212}
PRS_DEC_INJ_2_HOM [NC_CYL_NR] {p. 2204}	PRS_DEC_INJ_2_S [NC_CYL_NR] {p. 2216}	PRS_DEC_INJ_3_HOM [NC_CYL_NR] {p. 2208}	PRS_DEC_INJ_3_S [NC_CYL_NR] {p. 2220}
SOI_1_HOM_EXT [NC_CYL_NR] {p. 2146}	STATE_CMB_CTL {p. 8137}	STATE_INJ_MOD_HOMS_REQ {p. 3331}	STATE_INJ_MOD_REQ {p. 3332}
STATE_INJ_MOD_S_REQ {p. 3332}	T_DLY_1_2_S_EXT [NC_CYL_NR] {p. 2146}	T_DLY_2_3_S_EXT [NC_CYL_NR] {p. 2146}	TCO {p. 1100}
TEMP_CAPA_IV_MV {p. 2241}	TFU_INJ {p. 3332}	TI_2_PRS_HOM_SP [NC_CYL_NR] {p. 2204}	TI_2_STND_S [NC_CYL_NR] {p. 2216}
TI_3_PRS_HOM_SP [NC_CYL_NR] {p. 2208}	TI_3_STND_S [NC_CYL_NR] {p. 2220}	TI_ADD [NC_CYL_NR] {p. 999}	TI_FAC [NC_CYL_NR] {p. 999}
TI_TUN_ADD_IV [NC_CYL_NR] {p. 2233}	TI_TUN_IV [NC_CYL_NR] {p. 2233}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_PRS_COR_TEMP_SEL	-	0... 8H	0 ...8	1	-
Constant to select temperature for pressure pulsation correction (0=TFU_INJ; 1=TEMP_CAPA_IV_MV; 2=TCO)					
C_T_AUTH_TI_MIN_AFL	-	0... FFFFH	0.01... 655.36	0.01	s
Delay time after AFL mode was inhibited due to injection time limitation					
C_T_CHA_PER_H	-	0... 7FFFH	0... 3276.7	0.1	µs
Piezo injector charging time for high injector needle lift					
C_T_CHA_PER_L	-	0... 7FFFH	0... 3276.7	0.1	µs
Piezo injector charging time for low injector needle lift					
C_T_MIN_DIF_CHA_DCHA	-	8000... 7FFFH	-3276.8 ...3276.7	0.1	µs
Minimum time between end of charging procedure and begin of discharging procedure for injection valve					
C_TI_1_HOM_MAN	-	0... FFFFH	0... 65.535	0.001	ms
Manual setpoint for injection time in homogeneous mode, 1. pulse					
C_TI_1_S_MAN	-	0... FFFFH	0... 65.535	0.001	ms
Manual setpoint for injection time in stratified mode, 1. pulse					
C_TI_2_HOM_MAN	-	0... FFFFH	0... 65.535	0.001	ms
Manual setpoint for injection time in homogeneous mode, 2. pulse					
C_TI_2_S_MAN	-	0... FFFFH	0... 65.535	0.001	ms
Manual setpoint for injection time in stratified mode, 2. pulse					
C_TI_3_HOM_MAN	-	0... FFFFH	0... 65.535	0.001	ms
Manual setpoint for injection time in homogeneous mode, 3. pulse					
C_TI_3_S_MAN	-	0... FFFFH	0... 65.535	0.001	ms
Manual setpoint for injection time in stratified mode, 3. pulse					
C_TI_MIN_HYS_S	-	0... FFH	0... 1.02	0.004	ms
Hysteresis to TI_MIN, (injection time limitation at stratified mode)					
C_TI_MIN_OFS	-	0... FFH	0... 1.02	0.004	ms
Offset to TI_MIN, (injection time limitation at AFL mode and stratified mode)					
ID_T_PER_PRS_COR_1_HOM	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_NR_OSC_1_INJR	5	0... 9H	0 ...9	1	-
Pressure pulsation correction factor due increasing delay time; homogeneous first pulse					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_T_PER_PRS_COR_2_HOM	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_NR_OSC_1_INJR	5	0... 9H	0 ...9	1	-
Pressure pulsation correction factor due increasing delay time; homogeneous second pulse					
ID_T_PER_PRS_COR_3_HOM	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_NR_OSC_1_INJR	5	0... 9H	0 ...9	1	-
Pressure pulsation correction factor due increasing delay time; homogeneous third pulse					
IP_FAC_PRS_COR_DAMP_1_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_T_DLY_1_INJR	8	0... FFFFH	0... 65.535	0.001	ms
LDPM_FUP_H_2_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Pressure pulsation correction factor due to delay time and fuel pressure; homogeneous first pulse					
IP_FAC_PRS_COR_DAMP_2_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_T_DLY_1_INJR	8	0... FFFFH	0... 65.535	0.001	ms
LDPM_FUP_H_2_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Pressure pulsation correction factor due to delay time and fuel pressure; homogeneous second pulse					
IP_FAC_PRS_COR_DAMP_3_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_T_DLY_1_INJR	8	0... FFFFH	0... 65.535	0.001	ms
LDPM_FUP_H_2_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Pressure pulsation correction factor due to delay time and fuel pressure; homogeneous third pulse					
IP_FAC_PRS_COR_MFF_1_HOM	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_MFF_1_INJR	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Pressure pulsation correction factor due to previous injected fuel mass; homogeneous first pulse					
IP_FAC_PRS_COR_MFF_2_HOM	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_MFF_1_INJR	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Pressure pulsation correction factor due to previous injected fuel mass; homogeneous second pulse					
IP_FAC_PRS_COR_MFF_3_HOM	-	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_MFF_1_INJR	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Pressure pulsation correction factor due to previous injected fuel mass; homogeneous third pulse					
IP_FAC_PRS_COR_OSC_1_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_RATIO_T_PER_1_INJR	12	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_RATIO_TI_1_INJR	12	0... FFFFH	0... 15.99975	244.1e-6	-
Pressure pulsation correction factor due to delay time and injection time; homogeneous first pulse					
IP_FAC_PRS_COR_OSC_2_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_RATIO_T_PER_1_INJR	12	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_RATIO_TI_1_INJR	12	0... FFFFH	0... 15.99975	244.1e-6	-
Pressure pulsation correction factor due to delay time and injection time; homogeneous second pulse					
IP_FAC_PRS_COR_OSC_3_HOM	V	0... FFFFH	-1... 0.99996	30.5e-6	-
LDPM_RATIO_T_PER_1_INJR	12	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_RATIO_TI_1_INJR	12	0... FFFFH	0... 15.99975	244.1e-6	-
Pressure pulsation correction factor due to delay time and injection time; homogeneous third pulse					
IP_FAC_TI_2_S_COR	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_TI_2_S_IP_FAC_TI_2_S_COR	NC_ NR_ IDX_ TI_2_ S	0... FFFFH	0... 65.535	0.001	ms

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_T_DLY_1_2_S_IP_FAC_COR_2_S	NC_NR_IDX_T_DLY_1_2_S_COR	0... FFFFH	0... 65.535	0.001	ms
This calibration data is for correction of the mass flow difference between the mass flow sum of two pulses in comparison with the same requested mass for one pulse. This correction compensate different second injection duration.					
IP_FAC_TI_2_S_DLY_COR	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_T_DLY_1_2_S_IP_FAC_TI_2_S	NC_NR_IDX_T_DLY_1_2_S_DLY_COR	0... FFFFH	0... 65.535	0.001	ms
LDP_MFF_SP_IP_FAC_TI_2_S	NC_NR_IDX_MFF_SP_2	0... FFFFH	0... 1389	0.0211948	mg/stk
This calibration data is for correction of the mass flow difference between the mass flow sum of two pulses in comparison with the same requested mass for one pulse. The difference is caused by physical effects of the piezo injector.					
IP_FAC_TI_3_S_COR	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_TI_3_S_IP_FAC_TI_3_S_COR	NC_NR_IDX_TI_3_S	0... FFFFH	0... 65.535	0.001	ms
LDP_T_DLY_2_3_S_IP_FAC_COR_3_S	NC_NR_IDX_T_DLY_2_3_S_COR	0... FFFFH	0... 65.535	0.001	ms
This calibration data is for correction of the mass flow difference between the mass flow sum of two pulses in comparison with the same requested mass for one pulse. This correction compensate different third injection duration.					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_TI_3_S_DLY_COR	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_T_DLY_2_3_S_IP_FAC_TI_3_S	NC_ NR_ IDX_ T_ DLY_ 2_3_ S_ DLY_ COR	0... FFFFH	0... 65.535	0.001	ms
LDP_MFF_SP_IP_FAC_TI_3_S	NC_ NR_ IDX_ MFF_ SP_3	0... FFFFH	0... 1389	0.0211948	mg/stk
This calibration data is for correction of the mass flow difference between the mass flow sum of two pulses in comparison with the same requested mass for one pulse. The difference is caused by physical effects of the piezo injector.					
IP_MFF_IDX_TI_EGY_H	V	0... FFFFH	0... 65535	1	-
LDPM_MFF_SP_1_INJR	NC_ NR_ IDX_ MFF_ 1_INJ	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_PRS_DEC_INJ_2_INJR	NC_ NR_ IDX_ PRS_ DEC_ INJ_2	0... FFFFH	0... 347776	5.3067216	hPa
Injector characteristic at different injector pressure differences, for high energy range					
IP_MFF_IDX_TI_EGY_L	V	0... FFFFH	0... 65535	1	-
LDPM_MFF_SP_1_INJR	NC_ NR_ IDX_ MFF_ 1_INJ	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_PRS_DEC_INJ_2_INJR	NC_ NR_ IDX_ PRS_ DEC_ INJ_2	0... FFFFH	0... 347776	5.3067216	hPa
Injector characteristic at different injector pressure differences, for low energy range					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_MFF_TI_EGY_H	V	0... FFFFH	0... 65.535	0.001	ms
LDPM_MFF_SP_2_INJR	NC_ NR_ IDX_ MFF_ 2_INJ	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_PRS_DEC_INJ_3_INJR	NC_ NR_ IDX_ PRS_ DEC_ INJ	0... FFFFH	0... 347776	5.3067216	hPa
Injector characteristic at different injector pressure differences, for high energy range					
IP_MFF_TI_EGY_L	V	0... FFFFH	0... 65.535	0.001	ms
LDPM_MFF_SP_2_INJR	NC_ NR_ IDX_ MFF_ 2_INJ	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_PRS_DEC_INJ_3_INJR	NC_ NR_ IDX_ PRS_ DEC_ INJ	0... FFFFH	0... 347776	5.3067216	hPa
Injector characteristic at different injector pressure differences, for low energy range					
IP_T_CHA_PER_H	-	0... 7FFFH	0... 3276.7	0.1	µs
LDPM_IDX_TI_1_INJR	NC_ NR_ IDX_ TI_1_ INJ	0... FFFFH	0... 65535	1	-
Injector charging time for high injector needle lift.					
IP_T_CHA_PER_L	-	0... 7FFFH	0... 3276.7	0.1	µs
LDPM_IDX_TI_2_INJR	NC_ NR_ IDX_ TI_2_ INJ	0... FFFFH	0... 65535	1	-
Injector charging time for low injector needle lift.					
IP_T_PER_PRS_COR_1_HOM	V	0... FFFFH	0... 65.535	0.001	ms
LDPM_TEMP_PRS_COR_1_INJR	5	0... FEH	-48... 142.5	0.75	°C
LDPM_FUP_H_2_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Periode time of fuel rail pressure pulsation; homogeneous first pulse					
IP_T_PER_PRS_COR_2_HOM	V	0... FFFFH	0... 65.535	0.001	ms

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_TEMP_PRS_COR_1_INJR	5	0... FEH	-48... 142.5	0.75	°C
LDPM_FUP_H_2_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Periode time of fuel rail pressure pulsation; homogeneous second pulse					
IP_T_PER_PRS_COR_3_HOM	V	0... FFFFH	0... 65.535	0.001	ms
LDPM_TEMP_PRS_COR_1_INJR	5	0... FEH	-48... 142.5	0.75	°C
LDPM_FUP_H_2_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Periode time of fuel rail pressure pulsation; homogeneous third pulse					
IP_T_RLS_DLY_T_DCHA	-	0... 7FFFH	0... 3276.7	0.1	µs
LDP_T_DCHA_IP_T_RLS_DLY	6	0... 7FFFH	0... 3276.7	0.1	µs
Release Delay time depending on the discharge time					
IP_TI_H	-	0... FFFFH	0... 65.535	0.001	ms
LDPM_IDX_TI_1_INJR	NC_ NR_ IDX_ TI_1_ INJ	0... FFFFH	0... 65535	1	-
Injection time for high injector needle lift.					
IP_TI_L	-	0... FFFFH	0... 65.535	0.001	ms
LDPM_IDX_TI_2_INJR	NC_ NR_ IDX_ TI_2_ INJ	0... FFFFH	0... 65535	1	-
Injection time for low injector needle lift.					
IP_TI_MIN_HOM	-	0... FFFFH	0... 65.535	0.001	ms
LDPM_PRS_DEC_INJ_1_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Minimum injection time limitation for homogeneous mode					
LC_CUR_SHP_INJ_ENA	-	0... 1H	0 ...1	1	-
Switch to enable injection current shaping via IDX_TI calculation.					
LC_PRS_COR_MPLH_ENA	-	0... 1H	0 ...1	1	-
Switch to enable correction of rail pressure pulsations in homogeneous multi injection mode					
LC_PRS_COR_MPLS_ENA	-	0... 1H	0 ...1	1	-
Switch to enable correction of rail pressure pulsations in multiple stratified mode					
LC_PRS_COR_SNGH_ENA	-	0... 1H	0 ...1	1	-
Switch to enable correction of rail pressure pulsations in homogeneous single injection mode					
LC_PRS_COR_SOI_DLY_ENA	-	0... 1H	0 ...1	1	-
Switch to enable delaytime calculation from start of injection in homogeneous mode					
LC_TI_1_HOM_MAN_ACT	-	0... 1H	0 ...1	1	-
Manual switch for manual setpoint for injection time in homogeneous mode					
LC_TI_1_S_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual setpoint for injection time in startified mode, 1. pulse					
LC_TI_2_HOM_MAN_ACT	-	0... 1H	0 ...1	1	-
Manual switch for manual setpoint for injection time in homogeneous mode, 2. pulse					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_TI_2_S_MAN_ACT	-	0... 1H	0 ...1	1	-
switch for manual setpoint for injection time in stratified mode, 2. pulse					
LC_TI_3_HOM_MAN_ACT	-	0... 1H	0 ...1	1	-
Manual switch for manual setpoint for injection time in homogeneous mode, 3. pulse					
LC_TI_3_S_MAN_ACT	-	0... 1H	0 ...1	1	-
switch for manual setpoint for injection time in stratified mode, 3. pulse					

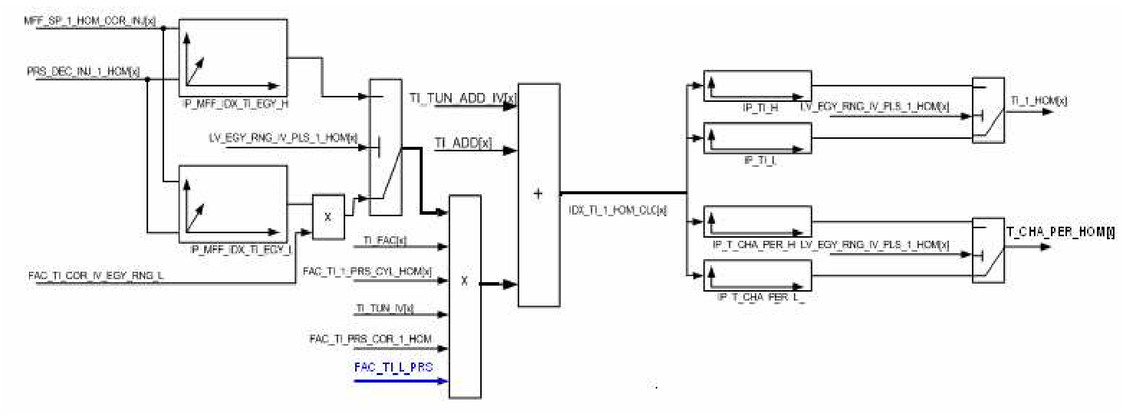
Overview:

Calculation of the cylinder individual injection times for homogeneous mode:

First pulse:
This module calculates the cylinder individual injection times TI_1_HOM[x], which are applied at the injectors.
The injection time can be set manually. If the switch LC_TI_1_HOM_MAN_ACT is set to one, the constant C_TI_1_HOM_MAN is applied.

If homogeneous lean mode is active (STATE_CMB_CTL = HOM_AFL) and TI_1_HOM[x] is smaller than (TI_MIN + C_TI_MIN_OFS), the combustion mode changes to homogeneous mode. This is indicated if the flag LV_AUTH_TI_MIN_AFL is set to zero. Switching back to homogeneous lean mode is allowed at the earliest if the delay time C_T_AUTH_TI_MIN_AFL has elapsed. Then the flag LV_AUTH_TI_MIN_AFL is set back to zero.

Overview for calculation of the first pulse in homogenous mode with active current shaping (LC_CUR_SHP_INJ_ENA = 1):



Overview for calculation of the first pulse in homogenous mode with inactive current shaping (LC_CUR_SHP_INJ_ENA = 0):

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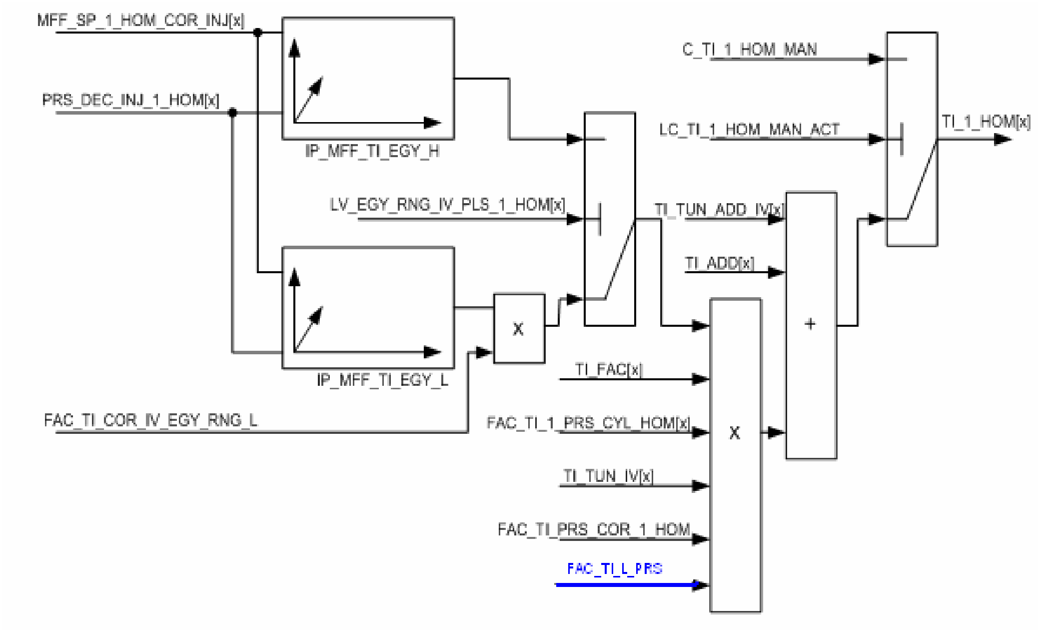


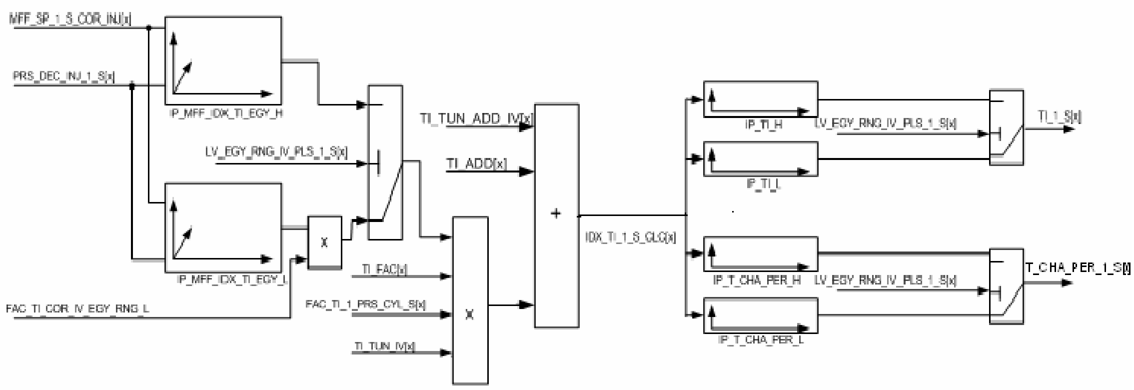
Second pulse:
If double injection is active (STATE_INJ_MOD_HOM_REQ = MPLH), then TI_2_HOM[x] is calculated.

Third pulse:
If triple injection is active (STATE_INJ_MOD_HOM_REQ = MPLH+PLS3), then TI_3_HOM[x] is calculated.

Calculation of the cylinder individual injection times for stratified mode:

First pulse:
The injection time TI_1_S[x] can be set manually. If the switch LC_TI_1_S_MAN_ACT is set to one, the constant C_TI_1_S_MAN is applied.

Overview for calculation of the first pulse in stratified mode with active current shaping (LC_CUR_SHP_INJ_ENA = 1):



Overview for calculation of the first pulse in stratified mode with inactive current shaping (LC_CUR_SHP_INJ_ENA = 0):

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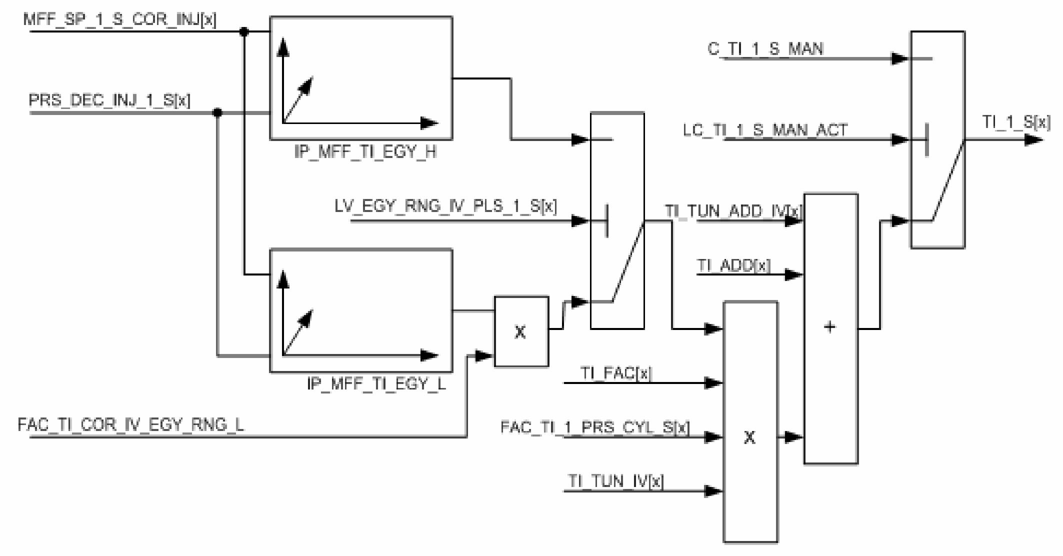

Second pulse:
If double injection is active (STATE_INJ_MOD_S_REQ = MPLS), then TI_2_S[x] is calculated.

The injection time TI_2_S[x] can be set manually. If the switch LC_TI_2_S_MAN_ACT is set to one, the constant C_TI_2_S_MAN is applied.

Third pulse:
If triple injection is active (STATE_INJ_MOD_S_REQ = MPLS+PLS3), then TI_3_S[x] is calculated.

The injection time TI_3_S[x] can be set manually. If the switch LC_TI_3_S_MAN_ACT is set to one, the constant C_TI_3_S_MAN is applied.

FUNCTION DESCRIPTION:

7.1.1 Segment synchronous tasks

Application conditions

Activation: every engine state

Deactivation: –

Initialization:

```
at reset:  TI_3_HOM_CLC_MIN   = 65.535 ms
                    TI_2_HOM_CLC_MIN   = 65.535 ms
                    TI_1_HOM_CLC_MIN   = 65.535 ms
T_CHA_PER_HOM[ ]  = C_T_CHA_PER_H  // all NC_CYL_NR elements
T_DCHA_PER_HOM[ ] = C_T_CHA_PER_H // all NC_CYL_NR elements
T_CHA_PER_HOM_2[ ]  = C_T_CHA_PER_H  // all NC_CYL_NR elements
T_DCHA_PER_HOM_2[ ]  = C_T_CHA_PER_H // all NC_CYL_NR elements
T_CHA_PER_HOM_3[ ]  = C_T_CHA_PER_H // all NC_CYL_NR elements
T_DCHA_PER_HOM_3[ ]  = C_T_CHA_PER_H // all NC_CYL_NR elements
T_CHA_PER_S_1[ ]  = C_T_CHA_PER_H // all NC_CYL_NR elements
T_DCHA_PER_S_1[ ]  = C_T_CHA_PER_H // all NC_CYL_NR elements
```

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```
T_CHA_PER_S_2[ ]  = C_T_CHA_PER_H // all NC_CYL_NR elements
T_DCHA_PER_S_2[ ]  = C_T_CHA_PER_H // all NC_CYL_NR elements
T_CHA_PER_S_3[ ]  = C_T_CHA_PER_H // all NC_CYL_NR elements
T_DCHA_PER_S_3[ ]  = C_T_CHA_PER_H // all NC_CYL_NR elements
T_CHA_PER_POST  = C_T_CHA_PER_H
T_DCHA_PER_POST  = C_T_CHA_PER_H
T_RLS_DLY_DCHA_1_HOM[ ] = 200µs   // all NC_CYL_NR elements
T_RLS_DLY_DCHA_2_HOM[ ] = 200µs   // all NC_CYL_NR elements
T_RLS_DLY_DCHA_3_HOM[ ] = 200µs   // all NC_CYL_NR elements
T_RLS_DLY_DCHA_1_S[ ]   = 200µs    // all NC_CYL_NR elements
T_RLS_DLY_DCHA_2_S[ ]   = 200µs    // all NC_CYL_NR elements
T_RLS_DLY_DCHA_3_S[ ]   = 200µs    // all NC_CYL_NR elements
T_RLS_DLY_DCHA_POST  = 200µs
```

Recurrence:
```
 LV_ST_END = 0:  10 ms
LV_ST_END = 1:     segment synchronous
```

Formula section:

For loop for runtime optimization:
In this specification the for loop
FOR i = 0, i < NR_CYL_CLC_RED_INJ **DO**
x = CTR_CYL_NR_ST_CLC_INJR + i
(1a)**IF** x >= NC_CYL_NR
(1a)**THEN**
x = x - NC_CYL_NR
(1a)**ENDIF**
<**loop content**>
ENDFOR
is substituted by
FOR cylinder_start to cylinder_stop **DO**
<**loop content**>
ENDFOR
Note: In the for loops, x will be used as loop variable to indicate the cylinder x!

7.1.1.1 Calculation of the cylinder individual injection times for homogeneous mode

7.1.1.1.1 Calculation of the minimal applied injection time

TI_MIN_HOM is used to for deactivation of air fuel lean mode.
(1)IF LV_AFL_CLC = 1
(1)THEN
TI_MIN_HOM = IP_TI_MIN_HOM
... (Input data for IP_TI_MIN_HOM is
PRS_DEC_INJ_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[0]])
(1)ENDIF

7.1.1.1.2 First pulse (main pulse)

Correction of fuel pressure pulsations for homogeneous single injection mode:
(1)IF STATE_INJ_MOD_HOM_REQ = "SNGH"
AND LC_PRS_COR_SNGH_ENA = 1
AND LV_PRS_COR_SNGH_ENA = 1
(1)THEN

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(1a)FOR m = 0 **TO** NC_CBK_HPP_NR - 1 **DO**
(1a)IF Bit m of LF_PRS_COR_HPP_ENA = 1
(1a)THEN
Correction due to MFF_SP_1_HOM:
FAC_PRS_COR_MFF_1_HOM = IP_FAC_PRS_COR_MFF_1_HOM(
Input: (MFF_SP_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] + MFF_ADD_REAC[IDX_PRS_COR_CYL_CLC_MPLH[m]]) * (1+ FAC_MFF_DIF_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]]) * FAC_MFF_TFU)
Correction of damping depending on FUP and delay time between pulses:
(2)IF LC_PRS_COR_SOI_DLY_ENA = 1
(2)THEN
T_DLY_1_1_HOM = (720°/(NC_CYL_NR/NC_CBK_HPP_NR)) /FAC_N
(2)ELSE
T_DLY_1_1_HOM = (720°/(NC_CYL_NR/NC_CBK_HPP_NR)) /FAC_N
- TI_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]]
Note: Previous calculated TI_1_HOM is used to calculate delay time between pulses
(2)ENDIF
FAC_PRS_COR_DAMP_1_HOM = IP_FAC_PRS_COR_DAMP_1_HOM(
Inputs: T_DLY_1_1_HOM; FUP_H_INJ[m])
Calculate period time of pressure waves:
(3)IF C_PRS_COR_TEMP_SEL = 0
(3)THEN
TEMP_PRS_COR_1_HOM = TFU_INJ
(3)ELSE
(4) IF C_PRS_COR_TEMP_SEL = 1
(4)THEN
TEMP_PRS_COR_1_HOM =
TEMP_CAPA_IV_MV
(4)ELSE
TEMP_PRS_COR_1_HOM = TCO
(4)ENDIF
(3)ENDIF
T_PER_PRS_COR_1_HOM = IP_T_PER_PRS_COR_1_HOM(
Inputs: TEMP_PRS_COR_1_HOM; FUP_H_INJ[m])
Calculate Time offset within one wave:
i = 0 // i indicates the number of while loops
(1)WHILE T_DLY_1_1_HOM > T_PER_PRS_COR_1_HOM **DO**
T_DLY_1_1_HOM = T_DLY_1_1_HOM
- (T_PER_PRS_COR_1_HOM * ID_T_PER_PRS_COR_1_HOM(Input: i))
Note: In case of i > 4 use 4 as input for ID map to prevent overflow
i = i + 1
Note: To prevent an endless loop, break the while-loop if i reaches 50. In that case, set T_DLY_1_1_HOM to 0!
(1)ENDWHILE
Calculate normalized Time offset within one wave:
RATIO_T_PER_PRS_COR_1_HOM =
T_DLY_1_1_HOM/(T_PER_PRS_COR_1_HOM
* ID_T_PER_PRS_COR_1_HOM(Input: i))
RATIO_TI_1_HOM = TI_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]]/
(T_PER_PRS_COR_1_HOM * ID_T_PER_PRS_COR_1_HOM(Input: i))
Calculate correction due to wave position and injection time:

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FAC_PRS_COR_OSC_1_HOM = IP_FAC_PRS_COR_OSC_1_HOM(
Inputs: RATIO_T_PER_PRS_COR_1_HOM; RATIO_TI_1_HOM)
Note: Previous calculated TI_1_HOM is used to calculate factor
Calculate final correction factor:
FAC_TI_PRS_COR_1_HOM[m] = 1 + (FAC_PRS_COR_MFF_1_HOM
* FAC_PRS_COR_DAMP_1_HOM * FAC_PRS_COR_OSC_1_HOM)
(1a)ENDIF
(1a)ENDFOR
(1)ELSE
(1b)FOR m = 0 **TO** NC_CBK_HPP_NR - 1 **DO**
FAC_TI_PRS_COR_1_HOM[m] = 1
(1b)ENDFOR
(1)ENDIF

Calculation of injection time for homogeneous first pulse:
(1)FOR cylinder_start to cylinder_stop **DO**
MFF_SP_1_HOM_COR_INJ[x] = (MFF_SP_1_HOM[x] + MFF_ADD_REAC[x]) * (1+ FAC_MFF_DIF_HOM[x]) * FAC_MFF_TFU

(2a)IF LC_CUR_SHP_INJ_ENA = 1
(2a)THEN // current shaping via IDX_TI calculation is active
(2)IF LV_EGY_RNG_IV_PLS_1_HOM[x] = 1
(2)THEN
IDX_TI_1_STND_HOM[x] = IP_MFF_IDX_TI_EGY_H(MFF_SP_1_HOM_COR_INJ[x];
PRS_DEC_INJ_1_HOM[x])
(2)ELSE
IDX_TI_1_STND_HOM[x] = IP_MFF_IDX_TI_EGY_L(MFF_SP_1_HOM_COR_INJ[x];
PRS_DEC_INJ_1_HOM[x])
* FAC_TI_COR_IV_EGY_RNG_L[NC_IDX_CYL_HPP_REF[x]]
(2)ENDIF
IDX_TI_1_HOM_CLC[x] = IDX_TI_1_STND_HOM[x]

* FAC_TI_1_PRS_CYL_HOM[x]
* TI_FAC[x]
* TI_TUN_IV[x]
* FAC_TI_PRS_COR_1_HOM[NC_IDX_CYL_HPP_REF[x]]
* FAC_TI_L_PRS
+ (TI_TUN_ADD_IV[x] /0.001ms)
+ (TI_ADD[x] /0.001ms)

Calculate section 1.1.3.1:
Calculate_Pulse_timing_parameters(IN <LV_EGY_RNG_IV_PLS_1_HOM[x]>,
IN <IDX_TI_1_HOM_CLC[x]>, OUT <T_CHA_PER_HOM[x]>,
OUT <TI_1_HOM_CLC[x]>)

(2a)ELSE // current shaping is inactive; classic TI calculation applied
(2b)IF LV_EGY_RNG_IV_PLS_1_HOM[x] = 1
(2b)THEN
TI_1_STND_HOM[x] = IP_MFF_TI_ EGY_H(MFF_SP_1_HOM_COR_INJ[x];
PRS_DEC_INJ_1_HOM[x])
T_CHA_PER_HOM[x] = C_T_CHA_PER_H
(2b)ELSE

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```
        TI_1_STND_HOM[x] = IP_MFF_TI_ EGY_L(MFF_SP_1_HOM_COR_INJ[x];
                     PRS_DEC_INJ_1_HOM[x])
                     * FAC_TI_COR_IV_EGY_RNG_L[NC_IDX_CYL_HPP_REF[x]]
        T_CHA_PER_HOM[x] = C_T_CHA_PER_L
      (2b)ENDIF
      TI_1_HOM_CLC[x] =     TI_1_STND_HOM[x]

* FAC_TI_1_PRS_CYL_HOM[x]

* TI_FAC[x]

* TI_TUN_IV[x]

* FAC_TI_PRS_COR_1_HOM[NC_IDX_CYL_HPP_REF[x]]

* FAC_TI_L_PRS

+ TI_TUN_ADD_IV[x]

+ TI_ADD[x]
(2a)ENDIF
(1) ENDFOR

TI_1_HOM_CLC_MIN   = MIN(TI_1_HOM_CLC[ ]) // Minimum of all NC_CYL_NR cylinders
TI_1_HOM_CLC_MAX   = MAX(TI_1_HOM_CLC[ ]) // Maximum of all NC_CYL_NR cylinders

(4) IF LC_TI_1_HOM_MAN_ACT = 1
(4) THEN
      (4)FOR cylinder_start to cylinder_stop DO
            TI_1_HOM[x]   = C_TI_1_HOM_MAN
            (4a)IF LV_EGY_RNG_IV_PLS_1_HOM[x] = 1
            (4a)THEN
                  T_CHA_PER_HOM[x] = C_T_CHA_PER_H
            (4a)ELSE
                  T_CHA_PER_HOM[x] = C_T_CHA_PER_L
            (4a)ENDIF
      (4)ENDFOR
   LV_TI_1_HOM_MIN = 0
(4) ELSE
   (5)FOR cylinder_start to cylinder_stop DO
            TI_1_HOM[x] = TI_1_HOM_CLC[x]
      (5)ENDFOR
   LV_TI_1_HOM_MIN = 0
(4) ENDIF

(6)FOR cylinder_start to cylinder_stop DO
     T_CHA_PER_HOM[x] = MIN(T_CHA_PER_HOM[x];
                                  TI_1_HOM[x] - C_T_MIN_DIF_CHA_DCHA)
     T_DCHA_PER_HOM[x] = T_CHA_PER_HOM[x]
```

Note: In case of TI_1_HOM[x] < C_T_MIN_DIF_CHA_DCHA, set T_CHA/DCHA_PER_HOM[x] to 0!

Note: For calibration purposes the injection time TI_1_HOM[x] can be set manually to the value C_TI_1_HOM_MAN

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Calculate release delay:
T_RLS_DLY_DCHA_1_HOM[x] = IP_T_RLS_DLY_T_DCHA(T_DCHA_PER_HOM[x])
(6)ENDFOR

7.1.1.1.3 Second pulse

Correction of fuel pressure pulsations for homogeneous multi injection mode:

```
(1)IF (STATE_INJ_MOD_HOM_REQ = "MPLH"
        OR STATE_INJ_MOD_HOM_REQ = "MPLH+PLS3")
     AND LC_PRS_COR_MPLH_ENA = 1
     AND LV_PRS_COR_MPLH_ENA = 1
(1)THEN
     (2a)FOR m = 0 TO NC_CBK_HPP_NR - 1 DO
        (2a)IF Bit m of LF_PRS_COR_HPP_ENA = 1
        (2a)THEN
              Correction due to MFF_SP_1_HOM:
              FAC_PRS_COR_MFF_2_HOM = IP_FAC_PRS_COR_MFF_2_HOM(
                   Input: MFF_SP_1_HOM_COR_INJ[IDX_PRS_COR_CYL_CLC_MPLH[m]])
              Correction of damping depending on FUP and delay time between pulses:
              (2)IF LC_PRS_COR_SOI_DLY_ENA = 1
              (2)THEN
               T_DLY_1_2_HOM =
                   (SOI_1_HOM_EXT[IDX_PRS_COR_CYL_CLC_MPLH[m]]
                                 - (EOI_2_HOM_EXT[IDX_PRS_COR_CYL_CLC_MPLH[m]]
                               + TI_2_PRS_HOM_SP[IDX_PRS_COR_CYL_CLC_MPLH[m]]
                                                   * FAC_N)) /FAC_N
              (2)ELSE
                   T_DLY_1_2_HOM =
                       (SOI_1_HOM_EXT[IDX_PRS_COR_CYL_CLC_MPLH[m]]
                       - TI_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] * FAC_N
                                 - (EOI_2_HOM_EXT[IDX_PRS_COR_CYL_CLC_MPLH[m]]
                                + TI_2_PRS_HOM_SP[IDX_PRS_COR_CYL_CLC_MPLH[m]]
                                                   * FAC_N)) /FAC_N
              (2)ENDIF
          FAC_PRS_COR_DAMP_2_HOM = IP_FAC_PRS_COR_DAMP_2_HOM(
                       Inputs: T_DLY_1_2_HOM; FUP_H_INJ[m])
          Calculate period time of pressure waves:
          (3)IF C_PRS_COR_TEMP_SEL = 0
          (3)THEN
                       TEMP_PRS_COR_2_HOM = TFU_INJ
          (3)ELSE
                       (4) IF C_PRS_COR_TEMP_SEL = 1
                       (4)THEN
                                 TEMP_PRS_COR_2_HOM =
                                           TEMP_CAPA_IV_MV
                       (4)ELSE
                                 TEMP_PRS_COR_2_HOM = TCO
                       (4)ENDIF
              (3)ENDIF
               T_PER_PRS_COR_2_HOM = IP_T_PER_PRS_COR_2_HOM(
                         Inputs: TEMP_PRS_COR_2_HOM; FUP_H_INJ[m])
               Calculate Time offset within one wave:
```

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```
i = 0 // i indicates the number of while loops
    (1)WHILE T_DLY_1_2_HOM > T_PER_PRS_COR_2_HOM DO
            T_DLY_1_2_HOM = T_DLY_1_2_HOM
                - (T_PER_PRS_COR_2_HOM
                            * ID_T_PER_PRS_COR_2_HOM(Input: i))
            Note: In case of i > 4 use 4 as input for ID map to prevent overflow
            i = i + 1
            Note: To prevent an endless loop, break the while-loop if i reaches 50.
            In that case, set T_DLY_1_2_HOM to 0!
    (1)ENDWHILE
    Calculate normalized Time offset within one wave:
    RATIO_T_PER_PRS_COR_2_HOM =
            T_DLY_1_2_HOM/
            (T_PER_PRS_COR_2_HOM * ID_T_PER_PRS_COR_2_HOM(Input: i))
    RATIO_TI_2_HOM =
         TI_2_PRS_HOM_SP[IDX_PRS_COR_CYL_CLC_MPLH[m]]/
        (T_PER_PRS_COR_2_HOM * ID_T_PER_PRS_COR_2_HOM(Input: i))
    Calculate correction due to wave position and injection time:
    FAC_PRS_COR_OSC_2_HOM = IP_FAC_PRS_COR_OSC_2_HOM(
        Inputs: RATIO_T_PER_PRS_COR_2_HOM; RATIO_TI_2_HOM)
    Calculate final correction factor:
    FAC_TI_PRS_COR_2_HOM[m] = 1 + (FAC_PRS_COR_MFF_2_HOM
            * FAC_PRS_COR_DAMP_2_HOM * FAC_PRS_COR_OSC_2_HOM)
   (2a)ENDIF
  (2a)ENDFOR
(1)ELSE
    (2b)FOR m = 0 TO NC_CBK_HPP_NR - 1 DO
            FAC_TI_PRS_COR_2_HOM[m] = 1
    (2b)ENDFOR
(1)ENDIF
```

Calculation of injection time for homogeneous second pulse:

```
(3)FOR cylinder_start to cylinder_stop DO
(1)IF INJ_MOD_SP_HOM[x] = "SNGH"    (if single injection is requested)
(1) THEN
        TI_2_HOM[x] = 0
        IDX_TI_2_HOM_CLC[x] = 0
(1) ELSE (if multiple injection is requested)
MFF_SP_2_HOM_COR_INJ[x] = MFF_SP_2_HOM[x] *(1+ FAC_MFF_DIF_HOM[x])
                                                    * FAC_MFF_TFU
(2a)IF LC_CUR_SHP_INJ_ENA = 1
(2a)THEN // current shaping via IDX_TI calculation is active
   (4) IF     LV_EGY_RNG_IV_PLS_2_HOM[x] = 1
   (4) THEN
    IDX_TI_2_STND_HOM[x] = IP_MFF_IDX_TI_EGY_H(MFF_SP_2_HOM_COR_INJ[x];
                                      PRS_DEC_INJ_2_HOM[x])
   (4) ELSE
  IDX_TI_2_STND_HOM[x] = IP_MFF_IDX_TI_EGY_L(MFF_SP_2_HOM_COR_INJ[x];
                                      PRS_DEC_INJ_2_HOM[x])
                          * FAC_TI_COR_IV_EGY_RNG_L[NC_IDX_CYL_HPP_REF[x]]
   (4) ENDIF
```

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IDX_TI_2_HOM_CLC[x] = IDX_TI_2_STND_HOM[x]
* FAC_TI_2_PRS_CYL_HOM[x]
* FAC_TI_PRS_COR_2_HOM[NC_IDX_CYL_HPP_REF[x]]

* TI_FAC[x]
* TI_TUN_IV[x]

* FAC_TI_L_PRS
Calculate section 1.1.3.1:
Calculate_Pulse_timing_parameters(IN <LV_EGY_RNG_IV_PLS_2_HOM[x]>,
IN <IDX_TI_2_HOM_CLC[x]>, OUT <T_CHA_PER_HOM_2[x]>,
OUT <TI_2_HOM_CLC[x]>)
(2a)ELSE // current shaping is inactive; classic TI calculation applied
(4a) IF LV_EGY_RNG_IV_PLS_2_HOM[x] = 1
(4a) THEN
TI_2_STND_HOM[x] = IP_MFF_TI_ EGY_H(MFF_SP_2_HOM_COR_INJ[x];
PRS_DEC_INJ_2_HOM[x])
T_CHA_PER_HOM_2[x] = C_T_CHA_PER_H
(4a) ELSE
TI_2_STND_HOM[x] = IP_MFF_TI_ EGY_L(MFF_SP_2_HOM_COR_INJ[x];
PRS_DEC_INJ_2_HOM[x])
* FAC_TI_COR_IV_EGY_RNG_L[NC_IDX_CYL_HPP_REF[x]]
T_CHA_PER_HOM_2[x] = C_T_CHA_PER_L
(4a) ENDIF
TI_2_HOM_CLC[x] = TI_2_STND_HOM[x]
* FAC_TI_2_PRS_CYL_HOM[x]
* FAC_TI_PRS_COR_2_HOM[NC_IDX_CYL_HPP_REF[x]]
* TI_FAC[x]

* TI_TUN_IV[x]

* FAC_TI_L_PRS
(2a)ENDIF

(7) IF LC_TI_2_HOM_MAN_ACT = 1
(7) THEN
TI_2_HOM[x] = C_TI_2_HOM_MAN
(7a)IF LV_EGY_RNG_IV_PLS_2_HOM[x] = 1
(7a)THEN
T_CHA_PER_HOM_2[x] = C_T_CHA_PER_H
(7a)ELSE
T_CHA_PER_HOM_2[x] = C_T_CHA_PER_L
(7a)ENDIF
(7) ELSE
TI_2_HOM[x] = TI_2_HOM_CLC[x]
(7) ENDIF
T_CHA_PER_HOM_2[x] = **MIN**(T_CHA_PER_HOM_2[x];
TI_2_HOM[x] - C_T_MIN_DIF_CHA_DCHA)
T_DCHA_PER_HOM_2[x] = T_CHA_PER_HOM_2[x]
Note: In case of TI_2_HOM[x] < C_T_MIN_DIF_CHA_DCHA, set
T_CHA/DCHA_PER_HOM_2[x] to 0!
Note: For calibration purposes the injection time TI_2_HOM[x] can be set manually to the value C_TI_2_HOM_MAN

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Calculate release delay:
T_RLS_DLY_DCHA_2_HOM[x] = IP_T_RLS_DLY_T_DCHA(T_DCHA_PER_HOM_2[x])

(1) ENDIF
(3)ENDFOR
LV_TI_2_HOM_MIN = 0
TI_2_HOM_CLC_MIN **= MIN(**TI_2_HOM_CLC[ ]**)** // Minimum of all NC_CYL_NR cylinders
TI_2_HOM_CLC_MAX **= MAX(**TI_2_HOM_CLC[ ]**)** // Maximum of all NC_CYL_NR cylinders

7.1.1.1.4 Third pulse

Correction of fuel pressure pulsations for homogeneous multi injection mode:
(1)IF STATE_INJ_MOD_HOM_REQ = "MPLH+PLS3"
AND LC_PRS_COR_MPLH_ENA = 1
AND LV_PRS_COR_MPLH_ENA = 1
(1)THEN
(3a)FOR m = 0 **TO** NC_CBK_HPP_NR - 1 **DO**
(3a)IF Bit m of LF_PRS_COR_HPP_ENA = 1
(3a)THEN
Correction due to MFF_SP_2_HOM:
FAC_PRS_COR_MFF_3_HOM = IP_FAC_PRS_COR_MFF_3_HOM(
Input: MFF_SP_2_HOM_COR_INJ[IDX_PRS_COR_CYL_CLC_MPLH[m]])
Correction of damping depending on FUP and delay time between pulses:
(2)IF LC_PRS_COR_SOI_DLY_ENA = 1
(2)THEN
T_DLY_2_3_HOM =
(EOI_2_HOM_EXT[IDX_PRS_COR_CYL_CLC_MPLH[m]]
+ TI_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] * FAC_N
- (EOI_3_HOM_EXT[IDX_PRS_COR_CYL_CLC_MPLH[m]]
+ TI_3_PRS_HOM_SP[IDX_PRS_COR_CYL_CLC_MPLH[m]]
* FAC_N)) /FAC_N
(2)ELSE
T_DLY_2_3_HOM =
(EOI_2_HOM_EXT[IDX_PRS_COR_CYL_CLC_MPLH[m]]
- (EOI_3_HOM_EXT[IDX_PRS_COR_CYL_CLC_MPLH[m]]
+ TI_3_PRS_HOM_SP[IDX_PRS_COR_CYL_CLC_MPLH[m]]
* FAC_N)) /FAC_N
(2)ENDIF
FAC_PRS_COR_DAMP_3_HOM = IP_FAC_PRS_COR_DAMP_3_HOM(
Inputs: T_DLY_2_3_HOM; FUP_H_INJ[m])
Calculate period time of pressure waves:
T_PER_PRS_COR_3_HOM = IP_T_PER_PRS_COR_3_HOM(
Inputs: TEMP_PRS_COR_2_HOM; FUP_H_INJ[m])
Calculate Time offset within one wave:
i = 0 // i indicates the number of while loops
(1)WHILE T_DLY_2_3_HOM > T_PER_PRS_COR_3_HOM **DO**
T_DLY_2_3_HOM = T_DLY_2_3_HOM
- (T_PER_PRS_COR_3_HOM * ID_T_PER_PRS_COR_3_HOM(Input: i))
Note: In case of i > 4 use 4 as input for ID map to prevent overflow
i = i + 1
Note: To prevent an endless loop, break the while-loop if i reaches 50.
In that case, set T_DLY_2_3_HOM to 0!

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```
            (1)ENDWHILE
            Calculate normalized Time offset within one wave:
            RATIO_T_PER_PRS_COR_3_HOM =
                T_DLY_2_3_HOM/(T_PER_PRS_COR_3_HOM
                                              * ID_T_PER_PRS_COR_3_HOM(Input: i))
            RATIO_TI_3_HOM = TI_3_PRS_HOM_SP[IDX_PRS_COR_CYL_CLC_MPLH[m]]/
                (T_PER_PRS_COR_3_HOM * ID_T_PER_PRS_COR_3_HOM(Input: i))
            Calculate correction due to wave position and injection time:
            FAC_PRS_COR_OSC_3_HOM = IP_FAC_PRS_COR_OSC_3_HOM(
                     Inputs: RATIO_T_PER_PRS_COR_3_HOM; RATIO_TI_3_HOM)
            Calculate final correction factor:
            FAC_TI_PRS_COR_3_HOM[m] = 1 + (FAC_PRS_COR_MFF_3_HOM
                        * FAC_PRS_COR_DAMP_3_HOM * FAC_PRS_COR_OSC_3_HOM)
        (3a)ENDIF
      (3a)ENDFOR
(1)ELSE
      (3b)FOR m = 0 TO NC_CBK_HPP_NR - 1 DO
                FAC_TI_PRS_COR_3_HOM[m] = 1
      (3b)ENDFOR
(1)ENDIF

(3)FOR cylinder_start to cylinder_stop DO
(1)IF INJ_MOD_SP_HOM[x] ≠ "MPLH+PLS3"     (if third injection is not requested)
(1) THEN
            TI_3_HOM[x] = 0
            IDX_TI_3_HOM_CLC[x] = 0
(1) ELSE (if third injection is requested)
MFF_SP_3_HOM_COR_INJ[x] = MFF_SP_3_HOM[x] *(1+ FAC_MFF_DIF_HOM[x])
                                                  * FAC_MFF_TFU
(2a)IF LC_CUR_SHP_INJ_ENA = 1
(2a)THEN // current shaping via IDX_TI calculation is active
    (4) IF    LV_EGY_RNG_IV_PLS_3_HOM[x] = 1
    (4) THEN
      IDX_TI_3_STND_HOM[x] = IP_MFF_IDX_TI_EGY_H(MFF_SP_3_HOM_COR_INJ[x];
                                          PRS_DEC_INJ_3_HOM[x])
     (4) ELSE
      IDX_TI_3_STND_HOM[x] = IP_MFF_IDX_TI_EGY_L(MFF_SP_3_HOM_COR_INJ[x];
                                          PRS_DEC_INJ_3_HOM[x])
                              * FAC_TI_COR_IV_EGY_RNG_L[NC_IDX_CYL_HPP_REF[x]]
     (4) ENDIF
     IDX_TI_3_HOM_CLC[x] =      IDX_TI_3_STND_HOM[x]
                                   * FAC_TI_3_PRS_CYL_HOM[x]
                                   * FAC_TI_PRS_COR_3_HOM[NC_IDX_CYL_HPP_REF[x]]
                                   * TI_FAC[x]
                                   * TI_TUN_IV[x]
                                   * FAC_TI_L_PRS
     Calculate section 1.1.3.1:
     Calculate_Pulse_timing_parameters(IN <LV_EGY_RNG_IV_PLS_3_HOM[x]>,
   IN <IDX_TI_3_HOM_CLC[x]>, OUT <T_CHA_PER_HOM_3[x]>,
      OUT <TI_3_HOM_CLC[x]>)
(2a)ELSE // current shaping is inactive; classic TI calculation applied
    (4a) IF  LV_EGY_RNG_IV_PLS_3_HOM[x] = 1
```

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(4a) THEN
TI_3_STND_HOM[x] = IP_MFF_TI_ EGY_H(MFF_SP_3_HOM_COR_INJ[x];
PRS_DEC_INJ_3_HOM[x])
T_CHA_PER_HOM_3[x] = C_T_CHA_PER_H
(4a) ELSE
TI_3_STND_HOM[x] = IP_MFF_TI _EGY_L(MFF_SP_3_HOM_COR_INJ[x];
PRS_DEC_INJ_3_HOM[x])
* FAC_TI_COR_IV_EGY_RNG_L[NC_IDX_CYL_HPP_REF[x]]
T_CHA_PER_HOM_3[x] = C_T_CHA_PER_L
(4a) ENDIF
TI_3_HOM_CLC[x] = TI_3_STND_HOM[x]
* FAC_TI_3_PRS_CYL_HOM[x]
* FAC_TI_PRS_COR_3_HOM[NC_IDX_CYL_HPP_REF[x]]
* TI_FAC[x]

* TI_TUN_IV[x]

* FAC_TI_L_PRS
(2a)ENDIF
(7) IF LC_TI_3_HOM_MAN_ACT = 1
(7) THEN
TI_3_HOM[x] = C_TI_3_HOM_MAN
(7a)IF LV_EGY_RNG_IV_PLS_3_HOM[x] = 1
(7a)THEN
T_CHA_PER_HOM_3[x] = C_T_CHA_PER_H
(7a)ELSE
T_CHA_PER_HOM_3[x] = C_T_CHA_PER_L
(7a)ENDIF
(7) ELSE
TI_3_HOM[x] = TI_3_HOM_CLC[x]
(7) ENDIF
T_CHA_PER_HOM_3[x] = **MIN**(T_CHA_PER_HOM_3[x];
TI_3_HOM[x] - C_T_MIN_DIF_CHA_DCHA)
T_DCHA_PER_HOM_3[x] = T_CHA_PER_HOM_3[x]
Note: In case of TI_3_HOM[x] < C_T_MIN_DIF_CHA_DCHA, set
T_CHA/DCHA_PER_HOM_3[x] to 0!
Note: For calibration purposes the injection time TI_3_HOM[x] can be set manually to the value C_ TI_3_HOM_MAN

Calculate release delay:
T_RLS_DLY_DCHA_3_HOM[x] = IP_T_RLS_DLY_T_DCHA(T_DCHA_PER_HOM_3[x])

(1) ENDIF
(3)ENDFOR
LV_TI_3_HOM_MIN = 0
TI_3_HOM_CLC_MIN = **MIN(**TI_3_HOM_CLC[ ]**)** // Minimum of all NC_CYL_NR cylinders
TI_3_HOM_CLC_MAX = **MAX(**TI_3_HOM_CLC[ ]**)** // Maximum of all NC_CYL_NR cylinders

7.1.1.2 Calculation of the cylinder individual injection times for stratified mode and homogeneous-stratified mode

(1) IF LV_S_CLC = 1 (Note: this part is only calculated, if stratified mode or homogeneous-stratified mode is enabled)

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1. **THEN**

7.1.1.2.1 First pulse

(1)FOR cylinder_start to cylinder_stop **DO**
MFF_SP_1_S_COR_INJ[x] = MFF_SP_1_S[x]*(1 + FAC_MFF_DIF_S[x]) * FAC_MFF_TFU
(0)IF LC_CUR_SHP_INJ_ENA = 1
(0)THEN // current shaping via IDX_TI calculation is active
(1a) IF LV_EGY_RNG_IV_PLS_1_S[x] = 1
(1a) THEN (high injector needle lift is selected for the first pulse)
IDX_TI_1_S_CLC[x] = IP_MFF_IDX_TI_EGY_H(MFF_SP_1_S_COR_INJ[x];

PRS_DEC_INJ_1_S[x])

* TI_FAC[x]

* TI_TUN_IV[x]

* FAC_TI_1_PRS_CYL_S[x]

+ (TI_TUN_ADD_IV[x] /0.001ms)

+ (TI_ADD[x] /0.001ms)
(1a) ELSE (low injector needle lift is selected for the first pulse)
IDX_TI_1_S_CLC[x] = IP_MFF_IDX_TI_EGY_L(MFF_SP_1_S_COR_INJ[x];

PRS_DEC_INJ_1_S[x])

* FAC_TI_COR_IV_EGY_RNG_L

[NC_IDX_CYL_HPP_REF[x]]

* TI_FAC[x]

* TI_TUN_IV[x]

* FAC_TI_1_PRS_CYL_S[x]

+ (TI_TUN_ADD_IV[x] /0.001ms)

+ (TI_ADD[x] /0.001ms)
(1a) ENDIF
Calculate section 1.1.3.1:
Calculate_Pulse_timing_parameters(IN <LV_EGY_RNG_IV_PLS_1_S[x]>,
IN <IDX_TI_1_S_CLC[x]>, OUT <T_CHA_PER_S_1[x]>,
OUT <TI_1_S_CLC[x]>)
(0)ELSE // current shaping is inactive; classic TI calculation applied
(1b) IF LV_EGY_RNG_IV_PLS_1_S[x] = 1
(1b) THEN (high injector needle lift is selected for the first pulse)
TI_1_S_CLC[x] = IP_MFF_TI_EGY_H (MFF_SP_1_S_COR_INJ[x];

PRS_DEC_INJ_1_S[x])

* TI_FAC[x]

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* TI_TUN_IV[x]

* FAC_TI_1_PRS_CYL_S[x]

+ TI_TUN_ADD_IV[x]

+ TI_ADD[x]
T_CHA_PER_S_1[x] = C_T_CHA_PER_H
(1b) ELSE (low injector needle lift is selected for the first pulse)
TI_1_S_CLC[x] = IP_MFF_TI_EGY_L (MFF_SP_1_S_COR_INJ[x];

PRS_DEC_INJ_1_S[x])

* FAC_TI_COR_IV_EGY_RNG_L

[NC_IDX_CYL_HPP_REF[x]]

* TI_FAC[x]

* TI_TUN_IV[x]

* FAC_TI_1_PRS_CYL_S[x]

+ TI_TUN_ADD_IV[x]

+ TI_ADD[x]
T_CHA_PER_S_1[x] = C_T_CHA_PER_L
(1b) ENDIF
(0)ENDIF
(1)ENDFOR
TI_1_S_CLC_MIN = MIN(TI_1_S_CLC[ ]) // Minimum of all NC_CYL_NR cylinders

(2) IF
LC_TI_1_S_MAN_ACT = 1
(2) THEN
(2)FOR cylinder_start to cylinder_stop **DO**
TI_1_S[x] = C_TI_1_S_MAN
(2a)IF LV_EGY_RNG_IV_PLS_1_S[x] = 1
(2a)THEN
T_CHA_PER_S_1[x] = C_T_CHA_PER_H
(2a)ELSE
T_CHA_PER_S_1[x] = C_T_CHA_PER_L
(2a)ENDIF
T_CHA_PER_S_1[x] = **MIN**(T_CHA_PER_S_1[x];
TI_1_S[x] - C_T_MIN_DIF_CHA_DCHA)
T_DCHA_PER_S_1[x] = T_CHA_PER_S_1[x]
Note: In case of TI_1_S[x] < C_T_MIN_DIF_CHA_DCHA, set
T_CHA/DCHA_PER_S_1[x] to 0!
Calculate release delay:
T_RLS_DLY_DCHA_1_S[x] =
IP_T_RLS_DLY_T_DCHA(T_DCHA_PER_S_1[x])
(2)ENDFOR

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```
  LV_AUTH_TI_MIN_S = 1
  LV_TI_1_S_MIN = 0
(2) ELSE
     (3)FOR cylinder_start to cylinder_stop DO
            TI_1_S[x] = TI_1_S_CLC[x]
            T_CHA_PER_S_1[x] = MIN(T_CHA_PER_S_1[x];
                                  TI_1_S[x] - C_T_MIN_DIF_CHA_DCHA)
            T_DCHA_PER_S_1[x] = T_CHA_PER_S_1[x]
            Note: In case of TI_1_S[x] < C_T_MIN_DIF_CHA_DCHA, set
                    T_CHA/DCHA_PER_S_1[x] to 0!
            Calculate release delay:
            T_RLS_DLY_DCHA_1_S[x] =
                              IP_T_RLS_DLY_T_DCHA(T_DCHA_PER_S_1[x])
     (3)ENDFOR
  LV_AUTH_TI_MIN_S = 1
  LV_TI_1_S_MIN = 0
(2) ENDIF
```

Note: For calibration purposes the injection time TI_1_S[x] can be set manually to the value C_TI_1_S_MAN

7.1.1.2.2 Second pulse

```
(6) IF (STATE_INJ_MOD_REQ = 'HOMS' OR STATE_INJ_MOD_REQ = 'HOMS+PLS3')
      OR LC_PRS_COR_MPLS_ENA = 0
(6) THEN
     (4)FOR m = 0 TO NC_CBK_HPP_NR - 1 DO
            FAC_TI_2_S_DLY_COR[m] = 1
            FAC_TI_2_S_COR[m] = 1
            FAC_TI_PRS_COR_2_S[m] = 1
     (4)ENDFOR
(6) ELSE
     (4a)FOR m = 0 TO NC_CBK_HPP_NR - 1 DO
            FAC_TI_2_S_DLY_COR[m] = IP_FAC_TI_2_S_DLY_COR (
              Input: T_DLY_1_2_S_EXT[IDX_PRS_COR_CYL_CLC_S[m]],          MFF_
            SP_1_S[IDX_PRS_COR_CYL_CLC_S[m]])

            FAC_TI_2_S_COR[m] = IP_FAC_TI_2_S_COR (
              Input: TI_2_STND_S[IDX_PRS_COR_CYL_CLC_S[m]];
                          T_DLY_1_2_S_EXT[IDX_PRS_COR_CYL_CLC_S[m]])
            FAC_TI_PRS_COR_2_S[m] = FAC_TI_2_S_DLY_COR[m]
                                       * FAC_TI_2_S_COR[m]
```

This correction factor is for correction of the mass flow difference between the mass flow sum of two pulses in comparison with the same requested mass for one pulse. The difference is caused by physical effects of the piezo injector.

```
     (4a)ENDFOR
(6) ENDIF

(5)FOR cylinder_start to cylinder_stop DO
(5)IF INJ_MOD_SP_S[x] = "SNGS"
     AND INJ_MOD_SP_HOMS[x] = "HOMS-SNG"
(5)THEN
     TI_2_S[x] = 0
```

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IDX_TI_2_S_CLC[x] = 0
(5)ELSE
MFF_SP_2_S_COR_INJ[x] = MFF_SP_2_S[x]*(1 + FAC_MFF_DIF_S[x]) * FAC_MFF_TFU
(0)IF LC_CUR_SHP_INJ_ENA = 1
(0)THEN // current shaping via IDX_TI calculation is active
(2a) IF LV_EGY_RNG_IV_PLS_2_S[x] = 1
(2a) THEN (high injector needle lift is selected for the second pulse)
IDX_TI_2_S_CLC[x] = IP_MFF_IDX_TI_EGY_H(MFF_SP_2_S_COR_INJ[x];

PRS_DEC_INJ_2_S[x])

* TI_FAC[x]

* TI_TUN_IV[x]

* FAC_TI_2_PRS_CYL_S[x]

* FAC_TI_PRS_COR_2_S[NC_IDX_CYL_HPP_REF[x]]
(2a) ELSE (low injector needle lift is selected for the second pulse)
IDX_TI_2_S_CLC[x] = IP_MFF_IDX_TI_EGY_L(MFF_SP_2_S_COR_INJ[x];

PRS_DEC_INJ_2_S[x])

* FAC_TI_COR_IV_EGY_RNG_L

[NC_IDX_CYL_HPP_REF[x]]

* TI_FAC[x]

* TI_TUN_IV[x]

* FAC_TI_2_PRS_CYL_S[x]

* FAC_TI_PRS_COR_2_S[NC_IDX_CYL_HPP_REF[x]]
(2a) ENDIF
Calculate section 1.1.3.1:
Calculate_Pulse_timing_parameters(IN <LV_EGY_RNG_IV_PLS_2_S[x]>,
IN <IDX_TI_2_S_CLC[x]>, OUT <T_CHA_PER_S_2[x]>,
OUT <TI_2_S_CLC[x]>)
(0)ELSE // current shaping is inactive; classic TI calculation applied
(2b) IF LV_EGY_RNG_IV_PLS_2_S[x] = 1
(2b) THEN (high injector needle lift is selected for the second pulse)
TI_2_S_CLC[x] = IP_MFF_TI_EGY_H (MFF_SP_2_S_COR_INJ[x];

PRS_DEC_INJ_2_S[x])

* TI_FAC[x]

* TI_TUN_IV[x]

* FAC_TI_2_PRS_CYL_S[x]

* FAC_TI_PRS_COR_2_S[NC_IDX_CYL_HPP_REF[x]]
T_CHA_PER_S_2[x] = C_T_CHA_PER_H

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(2b) ELSE (low injector needle lift is selected for the second pulse)
TI_2_S_CLC[x] = IP_MFF_TI_EGY_L (MFF_SP_2_S_COR_INJ[x];
PRS_DEC_INJ_2_S[x])

* FAC_TI_COR_IV_EGY_RNG_L

[NC_IDX_CYL_HPP_REF[x]]

* TI_FAC[x]

* TI_TUN_IV[x]

* FAC_TI_2_PRS_CYL_S[x]

* FAC_TI_PRS_COR_2_S[NC_IDX_CYL_HPP_REF[x]]
T_CHA_PER_S_2[x] = C_T_CHA_PER_L
(2b) ENDIF
(0)ENDIF
(7) IF
LC_TI_2_S_MAN_ACT = 1
(7) THEN
TI_2_S[x] = C_TI_2_S_MAN
(7a)IF LV_EGY_RNG_IV_PLS_2_S[x] = 1
(7a)THEN
T_CHA_PER_S_2[x] = C_T_CHA_PER_H
(7a)ELSE
T_CHA_PER_S_2[x] = C_T_CHA_PER_L
(7a)ENDIF
(7) ELSE
TI_2_S[x] = TI_2_S_CLC[x]
(7) ENDIF
T_CHA_PER_S_2[x] = **MIN**(T_CHA_PER_S_2[x];
TI_2_S[x] - C_T_MIN_DIF_CHA_DCHA)
T_DCHA_PER_S_2[x] = T_CHA_PER_S_2[x]
Note: In case of TI_2_S[x] < C_T_MIN_DIF_CHA_DCHA, set T_CHA/DCHA_PER_S_2[x] to 0!
Note: For calibration purposes the injection time TI_2_S[x] can be set manually to the value C_TI_2_S_MAN

Calculate release delay:
T_RLS_DLY_DCHA_2_S[x] = IP_T_RLS_DLY_T_DCHA(T_DCHA_PER_S_2[x])

(5) ENDIF
(5)ENDFOR
LV_TI_2_S_MIN = 0
TI_2_S_CLC_MIN = MIN (TI_2_S_CLC[x]) // Minimum of all NC_CYL_NR cylinders

7.1.1.2.3 Third pulse

(10) IF STATE_INJ_MOD_REQ = 'HOMS+PLS3'
OR LC_PRS_COR_MPLS_ENA = 0
(10) THEN
(6)FOR m = 0 **TO** NC_CBK_HPP_NR - 1 **DO**

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FAC_TI_3_S_DLY_COR[m] = 1
FAC_TI_3_S_COR[m] = 1
FAC_TI_PRS_COR_3_S[m] = 1
(6)ENDFOR
(10) ELSE
(6a)FOR m = 0 **TO** NC_CBK_HPP_NR - 1 **DO**
FAC_TI_3_S_DLY_COR[m] = IP_FAC_TI_3_S_DLY_COR
(Input: T_DLY_2_3_S_EXT[IDX_PRS_COR_CYL_CLC_S[m]],
MFF_SP_2_S[IDX_PRS_COR_CYL_CLC_S[m]])

FAC_TI_3_S_COR[m] = IP_FAC_TI_3_S_COR
(Input: TI_3_STND_S[IDX_PRS_COR_CYL_CLC_S[m]];
T_DLY_2_3_S_EXT[IDX_PRS_COR_CYL_CLC_S[m]])
FAC_TI_PRS_COR_3_S[m] = FAC_TI_3_S_DLY_COR[m]
* FAC_TI_3_S_COR[m]
This correction factor is for correction of the mass flow difference be-
tween the
mass flow sum of two pulses in comparison with the same requested mass
for
one pulse. The difference is caused by physical effects of the piezo injector.
(6a)ENDFOR
(10) ENDIF

(8)FOR cylinder_start to cylinder_stop **DO**
(9)IF INJ_MOD_SP_S[x] = "MPLS+PLS3"
OR INJ_MOD_SP_HOMS[x] = "HOMS+PLS3"
(9)THEN
MFF_SP_3_S_COR_INJ[x] = MFF_SP_3_S[x]*(1 + FAC_MFF_DIF_S[x])
* FAC_MFF_TFU
(0)IF LC_CUR_SHP_INJ_ENA = 1
(0)THEN // current shaping via IDX_TI calculation is active
(3a) IF LV_EGY_RNG_IV_PLS_3_S[x] = 1
(3a) THEN (high injector needle lift is selected for the third pulse)
IDX_TI_3_S_CLC[x] = IP_MFF_IDX_TI_EGY_H(MFF_SP_3_S_COR_INJ[x];

PRS_DEC_INJ_3_S[x])

* TI_FAC[x]

* TI_TUN_IV[x]

* FAC_TI_3_PRS_CYL_S[x]

* FAC_TI_PRS_COR_3_S[NC_IDX_CYL_HPP_REF[x]]
(3a) ELSE (low injector needle lift is selected for the third pulse)
IDX_TI_3_S_CLC[x] = IP_MFF_IDX_TI_EGY_L(MFF_SP_3_S_COR_INJ[x];

PRS_DEC_INJ_3_S[x])

* FAC_TI_COR_IV_EGY_RNG_L

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[NC_IDX_CYL_HPP_REF[x]]

* TI_FAC[x]

* TI_TUN_IV[x]

* FAC_TI_3_PRS_CYL_S[x]

* FAC_TI_PRS_COR_3_S[NC_IDX_CYL_HPP_REF[x]]
(3a) ENDIF
Calculate section 1.1.3.1:
Calculate_Pulse_timing_parameters(IN <LV_EGY_RNG_IV_PLS_3_S[x]>, IN <IDX_TI_3_S_CLC[x]>, OUT <T_CHA_PER_S_3[x]>, OUT <TI_3_S_CLC[x]>)
(0)ELSE // current shaping is inactive; classic TI calculation applied
(3b) IF LV_EGY_RNG_IV_PLS_3_S[x] = 1
(3b) THEN (high injector needle lift is selected for the third pulse)
TI_3_S_CLC[x] = IP_MFF_TI_EGY_H (MFF_SP_3_S_COR_INJ[x];

PRS_DEC_INJ_3_S[x])

* TI_FAC[x]

* TI_TUN_IV[x]

* FAC_TI_3_PRS_CYL_S[x]

* FAC_TI_PRS_COR_3_S[NC_IDX_CYL_HPP_REF[x]]
T_CHA_PER_S_3[x] = C_T_CHA_PER_H
(3b) ELSE (low injector needle lift is selected for the third pulse)
TI_3_S_CLC[x] = IP_MFF_TI_EGY_L (MFF_SP_3_S_COR_INJ[x];

PRS_DEC_INJ_3_S[x])

* FAC_TI_COR_IV_EGY_RNG_L

[NC_IDX_CYL_HPP_REF[x]]

* TI_FAC[x]

* TI_TUN_IV[x]

* FAC_TI_3_PRS_CYL_S[x]

* FAC_TI_PRS_COR_3_S[NC_IDX_CYL_HPP_REF[x]]
T_CHA_PER_S_3[x] = C_T_CHA_PER_L
(3b) ENDIF
(0)ENDIF
(11) IF LC_TI_3_S_MAN_ACT = 1
(11) THEN
TI_3_S[x] = C_TI_3_S_MAN
(11a)IF LV_EGY_RNG_IV_PLS_3_S[x] = 1

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(11a)THEN
T_CHA_PER_S_3[x] = C_T_CHA_PER_H
(11a)ELSE
T_CHA_PER_S_3[x] = C_T_CHA_PER_L
(11a)ENDIF
(11) ELSE
TI_3_S[x] = TI_3_S_CLC[x]
(11) ENDIF
T_CHA_PER_S_3[x] = **MIN**(T_CHA_PER_S_3[x];
TI_3_S[x] - C_T_MIN_DIF_CHA_DCHA)
T_DCHA_PER_S_3[x] = T_CHA_PER_S_3[x]
Note: In case of TI_3_S[x] $<$ C_T_MIN_DIF_CHA_DCHA, set
T_CHA/DCHA_PER_S_3[x] to 0!
Note: For calibration purposes the injection time TI_3_S[x] can be set manually to the value C_TI_3_S_MAN

Calculate release delay:
T_RLS_DLY_DCHA_3_S[x] = IP_T_RLS_DLY_T_DCHA(T_DCHA_PER_S_3[x])

(9) ELSE (**No** third pulse in stratified mode or homogeneous-stratified mode is required)
TI_3_S[x] = 0
IDX_TI_3_S_CLC[x] = 0
(9) ENDIF
(8)ENDFOR
LV_TI_3_S_MIN = 0
TI_3_S_CLC_MIN = MIN (TI_3_S_CLC[x]) // Minimum of all NC_CYL_NR cylinders

(1) ELSE - LV_S_CLC
(12)FOR cylinder_start to cylinder_stop **DO**
TI_1_S[x] = 0, TI_2_S[x] = 0, TI_3_S[x] = 0
IDX_TI_1_S_CLC[x] = 0, IDX_TI_2_S_CLC[x] = 0, IDX_TI_3_S_CLC[x] = 0
(12)ENDFOR
LV_AUTH_TI_MIN_S = 0
LV_TI_1_S_MIN = 0, LV_TI_2_S_MIN = 0, LV_TI_3_S_MIN = 0
(1) ENDIF

7.1.1.3 Calculate charge and discharge period of post pulse:

This section calculates the charging and discharging time for the post injection pulse.

if$^{(1)}$ LV_IV_POST_EGY_RNG = 1
then
T_CHA_PER_POST = C_T_CHA_PER_H
else$^{(1)}$
T_CHA_PER_POST = C_T_CHA_PER_L
endif$^{(1)}$
T_DCHA_PER_POST = T_CHA_PER_POST

Calculate release delay:
T_RLS_DLY_DCHA_POST = IP_T_RLS_DLY_T_DCHA(T_DCHA_PER_POST)

7.1.2 Calculate interface to monitoring unit:

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7.1.3 (1)IF STATE_INJ_MOD_REQ BitwiseAND NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOM

7.1.4 (1)THEN

7.1.5 FAC_TI_PRS_COR_1 = MEAN(FAC_TI_PRS_COR_1_HOM[ ])

// mean value of all elements

FAC_TI_PRS_COR_2 = **MEAN**(FAC_TI_PRS_COR_2_HOM[ ])

// mean value of all elements

FAC_TI_PRS_COR_3 = **MEAN**(FAC_TI_PRS_COR_3_HOM[ ])

// mean value of all elements

(1)ELSE

7.1.6 FAC_TI_PRS_COR_1 = 1

FAC_TI_PRS_COR_2 = **MEAN**(FAC_TI_PRS_COR_2_S[ ])

// mean value of all elements

FAC_TI_PRS_COR_3 = **MEAN**(FAC_TI_PRS_COR_3_S[ ])

// mean value of all elements

7.1.6.1 (1)ENDIF

7.1.6.2 Subroutines

This chapter describes the sub functions which are called from the main sections.

7.1.6.2.1 Calculate Pulse timing parameters

This section calculates the pulse timing parameters (Charge Time, TI) for the given counting factor index and needle lift.
Input parameters: PRM_LV_EGY_RNG_IV, PRM_IDX_TI_CLC
Output parameters: PRM_T_CHA_PER, PRM_TI
Parameter description:

PRM_LV_EGY_RNG_IV	IN	0...1H	0...1	1	[-]
Injector needle lift.					
PRM_IDX_TI_CLC	IN	0...FFFFH	0...65535	1	[-]
Counting factor index					
PRM_T_CHA_PER	OUT	0...7FFFH	0...3276.7	0.1	[µs]
Injector charge periode					
PRM_TI	OUT	0...FFFFH	0...65.535	0.001	[ms]
Injection time					

Calculate_Pulse_timing_parameters(IN <PRM_LV_EGY_RNG_IV>,
IN <PRM_IDX_TI_CLC>, OUT <PRM_T_CHA_PER>, OUT <PRM_TI>)
(1)IF PRM_LV_EGY_RNG_IV = 1
(1)THEN - high injector needle lift
PRM_TI = IP_TI_H(PRM_IDX_TI_CLC)
PRM_T_CHA_PER = IP_T_CHA_PER_H(PRM_IDX_TI_CLC)
(1)ELSE - low injector needle lift
PRM_TI = IP_TI_L(PRM_IDX_TI_CLC)
PRM_T_CHA_PER = IP_T_CHA_PER_L(PRM_IDX_TI_CLC)

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(1)ENDIF
End of Calculate_Pulse_timing_parameters

7.1.7 Time synchronous tasks

Application conditions

Activation: every engine state

Deactivation: –

Initialization: at reset: LV_AUTH_TI_MIN_AFL = 1

Recurrence: 10 ms

Calculation of LV_AUTH_TI_MIN_AFL:

If homogeneous lean mode is active (STATE_CMB_CTL = HOM_AFL) and the electrical injection time is smaller than (TI_MIN_HOM + C_TI_MIN_OFS), the combustion mode changes to homogeneous stochiometric mode. Switching back to homogeneous lean mode is allowed at the earliest if the delay time C_ T_AUTH_TI_MIN_AFL has elapsed.

1. **IF**

LV_AFL_CLC = 0

1. **THEN**

LV_AUTH_TI_MIN_AFL = 1
T_AUTH_TI_MIN_AFL = 0
(1) ELSE
(2) IF
LV_AUTH_TI_MIN_AFL = 1
AND
STATE_CMB_CTL = 'HOM_AFL' (homogeneous lean mode)
AND
TI_1_HOM_CLC_MIN < (TI_MIN_HOM + C_TI_MIN_OFS)
(2) THEN
LV_AUTH_TI_MIN_AFL = 0
T_AUTH_TI_MIN_AFL = C_ T_AUTH_TI_MIN_AFL
(2) ELSE
(3) IF
T_AUTH_TI_MIN_AFL (n) > 0.01s (0H)
(3) THEN
T_AUTH_TI_MIN_AFL (n+1) = T_AUTH_TI_MIN_AFL (n) - 0.01 [s]
(3) ELSE
LV_AUTH_TI_MIN_AFL = 1
(3) ENDIF
(2) ENDIF
(1) ENDIF

Output variable for LACO:
(4) IF (STATE_INJ_MOD_REQ = 'SNGH') **OR** (STATE_INJ_MOD_REQ = 'MPLH')
OR (STATE_INJ_MOD_REQ = 'MPLH+PLS3')
(4) THEN
CRK_DIF_SOI_IGN = CRK_DIF_SOI_IGN_HOM
(4) ELSE
CRK_DIF_SOI_IGN = CRK_DIF_SOI_IGN_S

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(4) ENDIF

Application hint:

The input value TI_FAC[x] and TI_ADD[x] are the output value of the module "Coordination of Injection Time Correction Factors for Cylinder Balancing ". If the Cylinder Balancing Function is not used than TI_FAC[x] and TI_ADD[x] have to be initialized in an "Initialization Module" as follows:
TI_FAC[x] =1
TI_ADD [x] = 0

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7.2 Transfer to basic software for injection

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAPA_IV_1_CLC [NC_CYL_NR]	V	0... FFFFH	0... 27.96	426.642e-6	µF
Capacity of the piezo injector for the first pulse, calculated from measurement data					
CAPA_IV_2_CLC [NC_CYL_NR]	V	0... FFFFH	0... 27.96	426.642e-6	µF
Capacity of the piezo injector for the second pulse, calculated from measurement data					
CAPA_IV_POST_CLC [NC_CYL_NR]	V	0... FFFFH	0... 27.96	426.642e-6	µF
Capacity of the piezo injector for the post injection pulse, calculated from measurement data					
CDN_DIAG_IV_RAW [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Detailed error condition information of injection valve, cylinder individual I/O-SW returned raw value					
CDN_DIAG_PBK_IV_RAW [NC_PBK_IV_NR]	O/V	0... FFH	0... 255	1	-
Detailed error condition information of injection valve power stages, ATIC bank individual I/O-SW returned raw value					
CHA_IV_1_MES [NC_CYL_NR]	O/V	0... 3FFH	0... 2272.6968	2.2216	µAs
Actual measured charge value of a carried out first pulse on the piezo injector, cylinder individual					
CHA_IV_2_MES [NC_CYL_NR]	O/V	0... 3FFH	0... 2272.6968	2.2216	µAs
Actual measured charge value of a carried out second pulse on the piezo injector, cylinder individual					
CHA_IV_POST_MES [NC_CYL_NR]	O/V	0... 3FFH	0... 2272.6968	2.2216	µAs
Actual measured charge value of a carried out post injection pulse on the piezo injector, cylinder individual					
CHR_INJ_TRIM_0 [NC_PBK_IV_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	µAs
Measured charge at begin offset cancellation trim pulse					
CHR_INJ_TRIM_1 [NC_PBK_IV_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	µAs
Measured charge at end offset cancellation trim pulse					
CHR_INJ_TRIM_2 [NC_PBK_IV_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	µAs
Measured charge at begin gain cancellation trim pulse					
CHR_INJ_TRIM_3 [NC_PBK_IV_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	µAs
Measured charge at end gain cancellation trim pulse					
CHR_IV_MES_BEG_CHA	-	0... 3FFH	0... 2272.6968	2.2216	µAs
Reference charge value before start of charge phase of injection valve.					
CHR_IV_MES_END_CHA	-	0... 3FFH	0... 2272.6968	2.2216	µAs
Remaining charge value after charge phase of injection valve.					
CRK_PSN_ENG_IGN_INJ_UPD [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
Expected engine update position at start of transmitting ignition and injection parameter to I/O-SW					
CRK_PSN_INJ_BAS [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
Engine position relative to INJ_BAS angle					
CRK_WIN_SEL_IGN_INJ [NC_CYL_NR]	V	0H 1H 2H 3H 4H	NO_CLC NO_WIN ADC_WIN RTD_WIN UPD_OLD_STATE	-	-
Selected injection window for update/mode switch					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_WIN_SEL_PREV	-	0H 1H 2H 3H 4H	NO_CLC NO_WIN ADC_WIN RTD_WIN UPD_OLD_ STATE	-	-
Previous selected injection window for update/mode switch; temporary value					
CRK_WIN_SEL_TMP	-	0H 1H 2H 3H 4H	NO_CLC NO_WIN ADC_WIN RTD_WIN UPD_OLD_ STATE	-	-
Selected injection window for update/mode switch; temporary value					
CTR_INH_IV_MIS_GEN [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Counter of number of cycles where shut off caused by misfire generator was active					
CTR_INJ_SWI_ACK_ERR	V	0... FFFFH	0... 65535	1	-
Counter for injection update errors					
CTR_PBK_IV_INI	V	0... FFH	0... 255	1	-
Counter of consecutive injection power stage initializations.					
CTR_PBK_IV_INI_MPL	O/V/S	0... FFH	0... 255	1	-
Counter of injection power stage initializations which produced at least one error.					
CTR_PSN_INH_IV_DYN	-	0... FH	0... 15	1	-
Position counter for dynamic cylinder shut off sequence calculation					
CTR_STATE_PREV_PBK_IV [NC_PBK_IV_NR]	V	0... FFH	0... 255	1	-
Number of activated IV on the selected power stage bank during last engine cycle (720°CRK)					
CTR_TEST_MOD_IV [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Counter of number of injection valve actuator test cycles, cylinder individual					
CUR_CHA_OFS_CNL [NC_PBK_IV_NR]	O/V	8000... 7FFFH	-8.388608 ...8.388352	0.000256	A
Current applied at the initialization for offset cancellation purposes					
EGY_IV_1_CLC [NC_CYL_NR]	O/V	0... FFFFH	0... 255	0.00389105	mJ
Energy inside injector calculated from measurement data for the first pulse					
EGY_IV_2_CLC [NC_CYL_NR]	V	0... FFFFH	0... 255	0.00389105	mJ
Energy inside injector calculated from measurement data for the second pulse					
EGY_IV_POST_CLC [NC_CYL_NR]	V	0... FFFFH	0... 255	0.00389105	mJ
Energy inside injector calculated from measurement data for the post injection pulse					
EOI_1_MES [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Actual performed EOI of the first injection pulse, estimated					
EOI_2_HOM_CSERS_TEST [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
End of injection for homogeneous mode for CSERS_INJ demo mode, 2.pulse					
EOI_2_MES [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Actual performed EOI of the second injection pulse, estimated					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EOI_3_HOM_CSERS_TEST [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
End of injection for homogeneous mode for CSERS_INJ demo mode, 3.pulse					
EOI_INJ_UPD_PSN	-	0... 780H	0... 720	0.375	°CRK
End of injection position for autonomous generated update pulses					
EOI_POST_MES [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Actual performed EOI of the post injection pulse, estimated					
FAC_ADC_REF_INJ	V	0... FFFFH	0... 1.9999694824218	30.5175e-6	-
Correction factor for ADC measurement values due to ADC reference voltage calibration.					
FAC_ADD_PULSE	O/V	0... FFH	0... 1.9921875	0.0078125	-
Weighting factor for injection time update at transient conditions (additive pulse)					
IGA_IGC_H_RNG_ACT [NC_CYL_NR]	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Ignition angle (high range) currently applied by I/O-SW, cylinder individual					
IGA_TMP_SYN	-	FA60... 5A0H	-90 ...90	0.0625	°CRK
Temporary ignition angle for ignition/injection synchronization calculations					
INH_IV_DYN	O/V	0... FFH	0... 255	1	-
Shut off pattern for dynamic shut off (fixed cylinder allocation)					
INH_IV_MIS_GEN_ACK	V	0... FFH	0... 255	1	-
Shut off pattern for shut off caused by misfire generator					
INJ_MOD [NC_CYL_NR]	O/V	1H 2H 3H 4H 6H 7H 21H 22H 41H 42H 43H 62H 80H 81H 82H 83H	SNGS MPLS MPLS+PLS3 PRE_INJ CRASH TEST_PULSE SNGS+MPLP MPLS+MPLP HOMS-SNG HOMS HOMS+PLS3 HOMS+MPLP DISABLE SNGH MPLH MPLH+PLS3	-	-
Cylinder individual injection mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INJ_UPD_ACK [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Actual applied update mode; returned by I/O software					
LV_CTR_PBK_IV_INI_INC	V	0... 1H	0 ...1	1	-
Flag to trigger another injection power stage initialization after init failed.					
LV_CUR_CHA_OFS_INI	V	0... 1H	0 ...1	1	-
Flag to indicate that offset cancellation current is initialized for all power banks.					
LV_EGY_RNG_IV_PLS_1_ACK [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Cylinder individual flag to indicate that the first injection pulse was executed with high injector needle lift (1 = high).					
LV_EGY_RNG_IV_PLS_1_ACT [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the first pulse (0 = low range, 1 = high range); for injection update calculations					
LV_IGN_INJ_COPL_HOM_ACT [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Flag to indicate that ignition injection coupling is active during HOM mode.					
LV_IGN_INJ_UPD_WIN	V	0... 1H	0 ...1	1	-
Flag to indicate that an injection mode switch or update is possible					
LV_INH_INJ [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Flag that indicates if cylinder shut off is active or not					
LV_INH_INJ_OLD	-	0... 1H	0 ...1	1	-
Flag that indicates if cylinder shut off was active or not. It contains the information from previous calculation run.					
LV_INH_INJ_UPD_MOD_UPD [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Flag to indicate an inhibitation of update mode update					
LV_INJ_DEAC_BACK_ENG	V	0... 1H	0 ...1	1	-
Flag to indicate deactivated injection due to backward rotation of engine					
LV_INJ_MOD_UPD	V	0... 1H	0 ...1	1	-
Flag to indicate that the possibility of an injection mode data update (1) or mode switch (0) has to be checked					
LV_INJ_MPLP_CYL [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Logical variable for enabling post injection, cylinder individual					
LV_INJ_REST_ENA	V	0... 1H	0 ...1	1	-
Flag to indicate a possible restart of injection during running engine					
LV_INJ_UPD_CLC_ENA	V	0... 1H	0 ...1	1	-
Flag to enable injection update calculations					
LV_IV_MES_VLD	O/V	0... 1H	0 ...1	1	-
The flag indicates if the measurements for charge and voltage of the piezo injector is valid					
LV_IV_PLS_MES_VLD [NC_NR_IV_PLS]	V	0... 1H	0 ...1	1	-
Flag to indicate valid measurement of charge and voltage of each injection pulse.					
LV_SOI_ACT_SWI [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Flag to indicate the use of start of injection angle for injection mode switch calculations					
LV_SOI_ACT_UPD [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Flag to indicate the use of start of injection angle for injection mode update calculations					
LV_ST_INJ	O/V	0... 1H	0 ...1	1	-
Flag which indicates that the injection has started after engine synchronization					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_STATE_PBK_IV_INI_ACT	V	0... 1H	0 ...1	1	-
Flag to indicate an active injection driver initialization phase					
LV_STATE_PREV_IV [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Cylinder individuel flag which indicates whether last injection was activated or deactivated					
LV_STATE_PREV_PBK_IV [NC_PBK_IV_NR]	V	0... 1H	0 ...1	1	-
Injection valve power stage bank individual flag which indicates if the power stage bank was activated (=1) or deactivated during the last injection cycles					
LV_TI_3_HOM_ACT	-	0... 1H	0 ...1	1	-
Logical value indicating active homogeneous injection for third pulse					
NR_CYL_INH_IV_DYN	-	0... 7H	0 ...7	1	-
Destination logical cylinder number for dynamic fuel shut off					
NR_CYL_INJ_BAS	O/V	0... 7H	0 ...7	1	-
Number of the current cylinder, which has reached its CRK_INJ_BAS[x]-Event					
NR_CYL_INJ_BAS_PREV	O/V	0... 7H	0 ...7	1	-
Number of the previous cylinder, which had reached its CRK_INJ_BAS[x]-Event					
NR_CYL_OFS_INH_IV_DYN	V	0... 7H	0 ...7	1	-
Cylinder offset for destination of current cylinder number for dynamic fuel shut off					
NR_PBK_IV_INI	V	0... 8H	0 ...8	1	-
Number of initialized injection valve power banks					
PREV_STATE_IV	O/V	0... FFH	0... 255	1	-
Bit coded byte which indicates whether a cylinder was deactivated or not					
PWM_DCDC_SP	V	0... FFFFH	0... 99.998474121093	0.00152587	%
Pulse width modulated signal to adjust DCDC converter setpoint.					
SOI_1_HOM_CSERS_TEST [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
Start of injection for homogeneous mode for CSERS_INJ demo mode, 1.pulse					
SOI_1_MES [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Actual performed SOI of the first injection pulse, estimated					
SOI_2_MES [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Actual performed SOI of the second injection pulse, estimated					
SOI_EOI_ACT_SWI [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
Start or end of injection angle for injection mode switch calculations					
SOI_EOI_ACT_UPD [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
Start or end of injection angle for injection mode data update calculations					
SOI_POST_MES [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Actual performed SOI of the post injection pulse, estimated					
SOI_TMP_SYN	-	0... 780H	0... 720	0.375	°CRK
Temporary start of injection angle for ignition/injection synchronization calculations					
SOI_TMP_SYN_PREV	-	0... 780H	0... 720	0.375	°CRK
Temporary start of injection angle for ignition/injection synchronization calculations (previous value)					
STATE_ERR_IV_CYL_RAW [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Detailed error information of injection valve, cylinder individual I/O-SW raw value					
STATE_ERR_PBK_IV_RAW [NC_PBK_IV_NR]	O/V	0... FFH	0... 255	1	-
Detailed error information of injection valve power stages, ATIC bank individual I/O-SW raw value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_ERR_PBK_IV_ST_RAW [NC_PBK_IV_NR]	O/V	0... FFH	0... 255	1	-
Detailed error information of injection valve power stages during startup phase, ATIC bank individual I/O-SW raw value					
STATE_IGN_UPD_ENA	V	0... FFH	0... 255	1	-
Bitmask to enable/disable ignition update calculations					
STATE_INJ_CRASH_ACT	V	0... FFH	0... 255	1	-
Injection driver state during vehicle crash request					
STATE_INJ_DR	V	0H 1H 2H 3H 4H 5H	DISABLED INI CONF WAIT WAIT2RUN RUN	-	-
Actual state of injection driver					
STATE_INJ_UPD_TRM	O/V	0... FFH	0... 255	1	-
State, which indicates that at least one data set per cylinder was sent to I/O-SW (bit x of assigned cylinder =1)					
STATE_PBK_IV_INI	O/V	0H 1H 2H 3H	INIT_PENDING REINIT_ PENDING INIT_ACTIVE INIT_FINISHED	-	-
State variable indicating the current status of initialization of injection valve power stage banks					
STATE_UPD_IGN [NC_CYL_NR]	V	0H 1H 2H	NONE TRIG_IT TRIG_EXT	-	-
State of ignition update for ignition/injection synchronization calculations					
T_INJ_CRASH_ACT	V	0... FFFFH	0... 655350	10	ms
Injection valve opening time during vehicle crash					
TD_IGC_ACT [NC_CYL_NR]	O/V	0... FFFFH	0... 262.14	0.004	ms
Dwell time currently applied by I/O-SW, cylinder individual					
TD_TMP_SYN	-	0... FFFFH	0... 262.14	0.004	ms
Temporary ignition dwell time for ignition/injection synchronization calculations					
TI_1_ADD_DLY_HOM	V	8000... 7FFFH	-32768 ...32767	1	µs
Injector dead time correction first pulse, homogeneous mode					
TI_1_HOM_CSERS_TEST [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time for CSERS_INJ demo mode, first pulse (intermediate value)					
TI_1_MES [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Actual performed cylinder individual injection time, first pulse					
TI_2_HOM_CSERS_TEST [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time for CSERS_INJ demo mode, second pulse (intermediate value)					
TI_2_MES [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Actual performed cylinder individual injection time, second pulse or additional pulse					
TI_3_HOM_CSERS_TEST [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Cylinder individual injection time for CSERS_INJ demo mode, third pulse (intermediate value)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TI_ACT_SWI [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Injection time for injection mode switch calculations					
TI_ACT_UPD [NC_CYL_NR]	V	0... FFFFH	0... 65.535	0.001	ms
Injection time for injection mode data update calculations					
TI_ADD_PULSE_MIN	O/V	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time for additive injection pulse					
TI_POST_MES [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Actual performed cylinder individual injection time, post injection pulse					
V_ADC_REF_MES_INJ	V	0... FFFFH	0... 9.9998474121093	152.587e-6	V
Filtered ADC reference calibration voltage.					
V_ADC_REF_MES_INJ_RAW	V	0... FFFFH	0... 9.9998474121093	152.587e-6	V
Raw ADC reference calibration voltage.					
V_IV_1_MES [NC_CYL_NR]	O/V	0... 7FFFH	0... 639.98046875	0.01953125	V
Actual measured voltage of a carried out first pulse on the piezo injector, cylinder individual					
V_IV_2_MES [NC_CYL_NR]	O/V	0... 7FFFH	0... 639.98046875	0.01953125	V
Actual measured voltage of a carried out second pulse on the piezo injector, cylinder individual					
V_IV_POST_MES [NC_CYL_NR]	O/V	0... 7FFFH	0... 639.98046875	0.01953125	V
Actual measured voltage of a carried out post pulse on the piezo injector, cylinder individual					
VBOOST_PBK_IV_MES [NC_NR_DCDC_INJ]	V	0... 7FFFH	0... 639.98046875	0.01953125	V
Actual measured voltage of the DCDC converter for the injection valve power stage banks					

Input data:

C_T_CHA_PER_H {p. 2005}	CRK_INJ_BAS [NC_CYL_NR] {p. 2122}	CRK_PSN_STAT_IGN_UPD_END {p. 3327}	CRK_PSN_STAT_IGN_UPD_ST {p. 3327}
CRK_PSN_STAT_WIN_END {p. 3327}	CRK_PSN_STAT_WIN_ST {p. 3327}	CUR_CHA_OFS_CNL_OUT [NC_PBK_IV_NR] {p. 3432}	EGY_STEP_INJ_CHA_GRD [NC_CYL_NR] {p. 2277}
EGY_STEP_INJ_CHA_GRD_L [NC_CYL_NR] {p. 2277}	EGY_STEP_INJ_DCHA_GRD [NC_CYL_NR] {p. 2277}	EGY_STEP_INJ_DCHA_GRD_L [NC_CYL_NR] {p. 2277}	EOI_1_S [NC_CYL_NR] {p. 2140}
EOI_2_HOM [NC_CYL_NR] {p. 2130}	EOI_2_HOMS [NC_CYL_NR] {p. 2136}	EOI_3_HOM [NC_CYL_NR] {p. 2133}	EOI_3_HOMS [NC_CYL_NR] {p. 2136}
EOI_LIM_HOM {p. 2122}	EOI_LIM_POST {p. 2188}	FAC_CHA_IV_MES_PBK [NC_PBK_IV_NR] {p. 2090}	FAC_COR_SLOP_CHA_CAL [NC_PBK_IV_NR] {p. 3432}
FAC_N {p. 3327}	FAC_V_IV_MES_PBK [NC_PBK_IV_NR] {p. 2090}	IDX_PRS_COR_CYL_CLC_MPLH [NC_CBK_HPP_NR] {p. 3327}	IGA_AV_H_RNG [NC_CYL_NR] {p. 1828}

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IGA_AV_H_RNG_HOMS [NC_CYL_NR] {p. 1828}	IGA_AV_H_RNG_S [NC_CYL_NR] {p. 1828}	INH_INJ {p. 2295}	INH_IV {p. 2295}
INH_IV_MIS_GEN {p. 7194}	INJ_MOD_SP [NC_CYL_NR] {p. 3328}	INJ_MOD_SP_HOM [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_HOMS [NC_CYL_NR] {p. 3329}
INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}	LV_ADD_PULSE_ENA {p. 8242}	LV_CSERS_INJ_PLS_ TEST_MOD_ENA {p. 6117}	LV_DIAG_END_RLY_ MAIN_DLY {p. 4933}
LV_EGY_RNG_IV_PLS_1_ HOM [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_1_ S [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_2_ HOM [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_2_ S [NC_CYL_NR] {p. 2261}
LV_EGY_RNG_IV_PLS_3_ HOM [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_3_ S [NC_CYL_NR] {p. 2261}	LV_EOI_2_DELTA_HOM_ CUS {p. 8269}	LV_ERR_TMP_MU_MC {p. 7072}
LV_ES {p. 1720}	LV_IGA_AND_INJ_SWI_ HOMS {p. 8136}	LV_IGK {p. 906}	LV_INJ_CRASH_ACT {p. 3330}
LV_INJ_DI_PLS_UPD_ MPLH {p. 2146}	LV_INJ_OFF_TMR_INJ_ ENA {p. 7158}	LV_IV_POST_EGY_RNG {p. 2179}	LV_IV_TEST_MOD_AUTH {p. 3330}
LV_MC_SOPC_INH_DI {p. 7186}	LV_POST_INJ_ACT {p. 2179}	LV_RLY_MAIN_DLY_ERR {p. 4933}	LV_ST_END {p. 1720}
LV_ST_INJ_REQ {p. 3331}	LV_SYN_ENG {p. 1506}	LV_TI_EXT_ADJ [NC_CYL_NR] {p. 3331}	N_32 {p. 1525}
NC_CBK_HPP_NR [1] {p. 812}	NC_CRK_INJ_BAS_REF {p. 626}	NC_CSERS_INJ_PLS_ TEST_ANG_ADD [NC_NR_IV_PLS] {p. 626}	NC_CSERS_INJ_PLS_ TEST_TI_FAC [NC_NR_IV_PLS] {p. 626}
NC_CTR_MAX_IV_TEST_ MOD {p. 626}	NC_CYL_NR {p. 1526}	NC_IDX_CYL_PBK_IV_ REF [NC_CYL_NR] {p. 626}	NC_INJ_INH_SWI_IV_ SHIFT_NR {p. 626}
NC_IV_CRASH {p. 626}	NC_N_MAX_IV_TEST_ MOD {p. 627}	NC_NR_DCDC_INJ {p. 627}	NC_NR_IV_PLS {p. 627}
NC_PBK_IV_NR {p. 628}	NC_PWM_DCDC_SP_MAX {p. 628}	NC_PWM_DCDC_SP_MIN {p. 628}	NC_STATE_PBK_IV_ST_ TRIM_ERR {p. 4798}
NC_STATE_STST_ENA {p. 628}	NC_TD_LIM_MIN {p. 1877}	NC_TI_CRASH {p. 629}	NC_TI_TEST_PLS_PER {p. 629}
NC_V_ADC_REF_INJ {p. 629}	NLC_CSERS_INJ_PLS_ TEST_CONF {p. 629}	NR_CYL_IV_TEST_MOD {p. 3331}	PRS_DEC_INJ_1_HOM [NC_CYL_NR] {p. 2200}
PSN_ENG {p. 1525}	SEG_NR {p. 1525}	SOI_1_HOM [NC_CYL_NR] {p. 2122}	SOI_1_HOMS [NC_CYL_NR] {p. 2136}
SOI_LIM {p. 2122}	SOI_LIM_POST {p. 2188}	SOI_POST_INJ [NC_CYL_NR] {p. 2188}	STATE_INH_IV_DYN {p. 2295}
STATE_INJ_UPD_ENA {p. 3332}	SUM_INH_INJ {p. 2295}	T_CHA_PER_HOM [NC_CYL_NR] {p. 2001}	T_CHA_PER_HOM_2 [NC_CYL_NR] {p. 2001}

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T_CHA_PER_HOM_3 [NC_CYL_NR] {p. 2001}	T_CHA_PER_POST {p. 2001}	T_CHA_PER_S_1 [NC_CYL_NR] {p. 2001}	T_CHA_PER_S_2 [NC_CYL_NR] {p. 2001}
T_CHA_PER_S_3 [NC_CYL_NR] {p. 2001}	T_DCHA_PER_HOM [NC_CYL_NR] {p. 2001}	T_DCHA_PER_HOM_2 [NC_CYL_NR] {p. 2001}	T_DCHA_PER_HOM_3 [NC_CYL_NR] {p. 2001}
T_DCHA_PER_POST {p. 2002}	T_DCHA_PER_S_1 [NC_CYL_NR] {p. 2002}	T_DCHA_PER_S_2 [NC_CYL_NR] {p. 2002}	T_DCHA_PER_S_3 [NC_CYL_NR] {p. 2002}
T_DLY_1_2_S_EXT [NC_CYL_NR] {p. 2146}	T_DLY_2_3_S_EXT [NC_CYL_NR] {p. 2146}	T_RLS_DLY_DCHA_1_ HOM [NC_CYL_NR] {p. 2002}	T_RLS_DLY_DCHA_1_S [NC_CYL_NR] {p. 2002}
T_RLS_DLY_DCHA_2_ HOM [NC_CYL_NR] {p. 2002}	T_RLS_DLY_DCHA_2_S [NC_CYL_NR] {p. 2002}	T_RLS_DLY_DCHA_3_ HOM [NC_CYL_NR] {p. 2002}	T_RLS_DLY_DCHA_3_S [NC_CYL_NR] {p. 2002}
T_RLS_DLY_DCHA_POST {p. 2002}	TCO {p. 1100}	TD {p. 1873}	TD_AD [NC_CYL_NR] {p. 932}
TD_LIM_MAX {p. 1876}	TD_S {p. 1875}	TECU {p. 1256}	TI_1_HOM [NC_CYL_NR] {p. 2002}
TI_1_S [NC_CYL_NR] {p. 2003}	TI_2_HOM [NC_CYL_NR] {p. 2003}	TI_2_S [NC_CYL_NR] {p. 2003}	TI_3_HOM [NC_CYL_NR] {p. 2003}
TI_3_S [NC_CYL_NR] {p. 2003}	TI_EXT_ADJ [NC_CYL_NR] {p. 3332}	TI_POST_INJ [NC_CYL_NR] {p. 2179}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CSERS_INJ_PLS_TEST_ANG_ADD [NC_NR_IV_PLS]	V	FF01... FFH	-95.625 ...95.625	0.375	°CRK
Calibrated offset to change injection phase for CSERS_INJ demo mode					
C_CSERS_INJ_PLS_TEST_TI_FAC [NC_NR_IV_PLS]	V	0... FFH	0 ...1	0.00392156	-
Calibrated factor to change injection time for CSERS_INJ demo mode					
C_CTR_PBK_IV_INI_MAX	V	0... FFH	0... 255	1	-
Maximum number of injection power stage initializations before an error is detected.					
C_FAC_FIL_V_ADC_REF	V	0... FFFFH	0... 0.9999847412109	15.2587e-6	-
Filter constant of PT1-filter for measured ADC reference calibration voltage.					
C_NR_CYL_OFS_INH_IV_DYN	V	0... 7H	0 ...7	1	-
Cylinder offset for destination of current cylinder number for dynamic fuel shut off					
C_SOI_EXT_ADJ	V	0... 780H	0... 720	0.375	°CRK
Start of injection for external adjustment (service tool intervention)					
C_SOI_MIN_UPD_PLS_SNGH	V	0... 780H	0... 720	0.375	°CRK
Minimum start (limit) of injection for makeup pulse at homogeneous single injection mode					
C_T_CHA_FALL_H	V	0... 7FFFH	0... 3276.7	0.1	µs
Charge fall time for injector charge current at high needle lift.					
C_T_CHA_FALL_L	V	0... 7FFFH	0... 3276.7	0.1	µs
Charge fall time for injector charge current at low needle lift.					
C_T_CHA_RISE_H	V	0... 7FFFH	0... 3276.7	0.1	µs
Charge rise time for injector charge current at high needle lift.					
C_T_CHA_RISE_L	V	0... 7FFFH	0... 3276.7	0.1	µs
Charge rise time for injector charge current at low needle lift.					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DCHA_FALL_H	V	0... 7FFFH	0... 3276.7	0.1	µs
Discharge fall time for injector discharge current at high needle lift.					
C_T_DCHA_FALL_L	V	0... 7FFFH	0... 3276.7	0.1	µs
Discharge fall time for injector discharge current at low needle lift.					
C_T_DCHA_RISE_H	V	0... 7FFFH	0... 3276.7	0.1	µs
Discharge rise time for injector discharge current at high needle lift.					
C_T_DCHA_RISE_L	V	0... 7FFFH	0... 3276.7	0.1	µs
Discharge rise time for injector discharge current at low needle lift.					
C_T_OFS_UPD_IGN_INJ_SYN	V	0... FFFFH	0... 65.535	0.001	ms
Task run time offset for a synchronized update of ignition and injection parameters to I/O-SW					
C_V_ADC_REF_INJ	V	0... FFFFH	0... 9.9998474121093	152.587e-6	V
ADC reference calibration voltage.					
C_V_ADC_REF_MES_INJ_MAX_PLAUS	V	0... FFFFH	0... 9.9998474121093	152.587e-6	V
Maximum plausible value of measured ADC reference calibration voltage.					
C_V_ADC_REF_MES_INJ_MIN_PLAUS	V	0... FFFFH	0... 9.9998474121093	152.587e-6	V
Minimum plausible value of measured ADC reference calibration voltage.					
CLF_CSERS_INJ_PLS_TEST_CYL_ON [NC_NR_IV_PLS]	V	0... FFFFH	0... 65535	1	-
Calibrated bitfield enabling CSERS_INJ demo mode test pulse on chosen cylinder, bit 0 enabling cylinder 0, bit 1 enabling cylinder 1, ...					
IP_EOI_INJ_UPD_PSN	V	0... 780H	0... 720	0.375	°CRK
LDP_N_32_IP_EOI_INJ_UPD_PSN	6	0... FFH	0... 8160	32	rpm
End of injection position for autonomous generated update pulses					
IP_FAC_ADD_PULSE	V	0... FFH	0... 1.9921875	0.0078125	-
LDP_N_32_IP_FAC_ADD_PULSE	7	0... FFH	0... 8160	32	rpm
LDP_TCO_IP_FAC_ADD_PULSE	7	0... FEH	-48... 142.5	0.75	°C
Weighting factor for additive pulses in case of injection time update at transient conditions					
IP_PWM_DCDC_PCTL	V	0... FFFFH	0... 99.998474121093	0.00152587	%
LDPM_TECU_DCDC_PCTL	6	0... FEH	-48... 142.5	0.75	°C
Pulse wide modulated pre control for DCDC converter					
IP_TI_ADD_DLY_HPDI_EGY_H	V	0... FFFFH	-32768 ...32767	1	µs
LDPM_PRS_DEC_INJ_1_INJR	6	0... FFFFH	0... 347776	5.30672159	hPa
Injector dead time correction for high energy range of the injector					
IP_TI_ADD_DLY_HPDI_EGY_L	V	0... FFFFH	-32768 ...32767	1	µs
LDPM_PRS_DEC_INJ_1_INJR	6	0... FFFFH	0... 347776	5.30672159	hPa
Injector dead time correction for low energy range of the injector					
IP_TI_ADD_PULSE_MIN	V	0... FFFFH	0... 65.535	0.001	ms
LDPM_PRS_DEC_INJ_1_INJR	6	0... FFFFH	0... 347776	5.30672159	hPa
Minimum injection time for additive injection pulse, pressure dependent					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_CSERS_INJ_PLS_TEST_TYP	V	0... 1H	0 ...1	1	-
Switch to choose type of injection pulse change for CSERS_INJ demo mode; 0 = phase shift is active, 1 = timing change is active					
LC_CUR_CHA_INJ_H_L_SEL_ENA	V	0... 1H	0 ...1	1	-
Flag to enable page selection for high and low injector needle lift.					
LC_IGN_INJ_COPL_MOD_SWI_ENA	V	0... 1H	0 ...1	1	-
Switch to enable mode switch strategy at change of ignition injection coupling during HOM mode.					
LC_IGN_UPD_STAT_ENA	V	0... 1H	0 ...1	1	-
Flag to enable static update calculation of ignition angle (at ignition/injection synchronization)					
LC_INJ_PLS_UPD_MOD	V	0H 1H	IMMEDIATE AUTONOMOUS	-	-
Logical constant for selection of injection pulse update mode					
LC_INJ_UPD_OLD_MOD_ENA	V	0... 1H	0 ...1	1	-
Flag to enable injection data update of old injection mode in case of mode switch failed					
LC_IV_ADD_PLS_MPLH_ENA	V	0... 1H	0 ...1	1	-
Switch to enable pulse update functionality at homogeneous multiple injection					
LC_IV_ADD_PLS_SNGH_ENA	V	0... 1H	0 ...1	1	-
Switch to enable makeup pulse functionality at homogeneous single injection					
LC_V_ADC_REF_CAL_INJ	V	0... 1H	0 ...1	1	-
Switch ADC calibration voltage reference between calibratable voltage (= 1) and configurable voltage (= 0).					
LC_V_ADC_REF_ENA	V	0... 1H	0 ...1	1	-
Flag to enable ADC reference voltage calibration.					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_INJ_MOD_DI	-	0... FFH	0... 255	1	-
Constant defined to indicate that injection is disabled					
NC_INJ_MOD_HOM	-	0... FFH	0... 255	1	-
Constant defined to indicate homogeneous mode					
NC_INJ_MOD_HOMS	-	0... FFH	0... 255	1	-
Constant defined to indicate homogeneous stratified mode					
NC_INJ_MOD_MASK_1	-	0... FFH	0... 255	1	-
Mask for injection mode determination					
NC_INJ_MOD_MASK_2	-	0... FFH	0... 255	1	-
Mask for injection pulse type determination					
NC_INJ_MOD_MULTI	-	0... FFH	0... 255	1	-
Constant defined to indicate multi injection mode					
NC_INJ_MOD_MULTI_PLS3	-	0... FFH	0... 255	1	-
Constant defined to indicate multi injection mode with three pulses					
NC_INJ_MOD_S	-	0... FFH	0... 255	1	-
Constant defined to indicate stratified mode					
NC_INJ_MOD_SINGLE	-	0... FFH	0... 255	1	-
Constant defined to indicate single injection mode					
NC_INJ_MOD_TEST_PLS	-	0... FFH	0... 255	1	-
Constant defined to indicate injection mode for actuator tests by diagnostic tester					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Action definition

ACTION_INJR_IgnUpdate (**IN**<PRM_IGA_IGC_H_RNG>,**IN**<PRM_CYL>)	Mode: O
This action sets the cylinder individual ignition angle for mode switch and data update of <Cyl> to <Iga_Igc_H_Rng>..	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_IGA_IGC_H_RNG	in	FA60... 5A0H	-90 ...90	0.0625	°CRK
This parameter defines the new ignition angle for homogeneous single injection mode.					
PRM_CYL	in	0... 7H	0 ...7	1	-
This action affects the injection mode of cylinder Cyl.					

Import actions:

ACTION_IGRE_SendTrigForIgnUpd (**IN**<PRM_STATE_IGN_UPD_ENA>)
ACTION_INFR_GetInjDiagElectric (**IN**<PRM_CYL>,**OUT**<PRM_ERR_DIAG>,**OUT**<PRM_DIAG_VALID>)
ACTION_INFR_GetInjDiagIni (**IN**<PRM_BANK_NR>,**OUT**<PRM_ERR_INI>,**OUT**<PRM_INI_VALID>)
ACTION_INFR_GetInjMesEoi (**IN**<PRM_CYL>,**IN**<PRM_PLS_NR>,**OUT**<PRM_PLS_POSITION>)
ACTION_INFR_GetInjMesPulsePer (**IN**<PRM_CYL>,**IN**<PRM_PLS_NR>,**OUT**<PRM_PERIOD>)
ACTION_INFR_GetInjMesSoi (**IN**<PRM_CYL>,**IN**<PRM_PLS_NR>,**OUT**<PRM_PLS_POSITION>)
ACTION_INFR_IniInjDriver ()
ACTION_INFR_ReqInjPulse (**IN**<PRM_CYL>,**IN**<PRM_PULSE_PER>)
ACTION_INFR_ReqInjUpdate (**IN**<PRM_CYL>,**IN**<PRM_MODE>,**OUT**<PRM_ACKNOWLEDGE>)
ACTION_INFR_SetInjChaCur (**IN**<PRM_CYL>,**IN**<PRM_PAGE_NR>,**IN**<PRM_CHA_CUR>)
ACTION_INFR_SetInjDchaCur (**IN**<PRM_CYL>,**IN**<PRM_PAGE_NR>,**IN**<PRM_DCHA_CUR>)
ACTION_INFR_SetInjEoiLim (**IN**<PRM_CYL>,**IN**<PRM_PACKET_NR>,**IN**<PRM_EOI_LIM>)
ACTION_INFR_SetInjInhibit (**IN**<PRM_CYL>,**IN**<PRM_LV_INH_INJ>)
ACTION_INFR_SetInjPlsUpdFactor (**IN**<PRM_PLSUPD_FACTOR>)
ACTION_INFR_SetInjPlsUpdOffset (**IN**<PRM_CYL>,**IN**<PRM_UPD_OFFSET>)
ACTION_INFR_SetInjPulseType (**IN**<PRM_CYL>,**IN**<PRM_PLS_NR>,**IN**<PRM_PLS_TYPE>)
ACTION_INFR_SetInjSoiLim (**IN**<PRM_CYL>,**IN**<PRM_PACKET_NR>,**IN**<PRM_SOI_LIM>)
ACTION_INJR_SetOfsCurIni (**IN**<PRM_OFSCURLNI>,**IN**<PRM_BANK>)
ACTION_INJR_SetStateInjUpdEna (**IN**<PRM_CYL>,**IN**<PRM_STATE_INJ_UPD_ENA>)

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General information

More import actions:

ACTION_INFR_GetInjDiagPower(IN<Bank_nr>,**OUT**<Err_power>,**OUT**<Power_valid>)
ACTION_INFR_GetInjMesQ(IN<Cyl>,**IN**<Pulse>,**IN**<Event>,**OUT**<Charge>)
ACTION_INFR_GetInjMesQTrim(IN<Bank>,**IN**<Event>,**OUT**<Charge>)
ACTION_INFR_GetInjMesU(IN<Cyl>,**IN**<Pulse>,**IN**<Event>,**OUT**<Voltage>)
ACTION_INFR_GetInjMesUDcdc(IN<Dcdc>,**OUT**<Voltage_dcdc>)

Continued on next page

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ACTION_INFR_GetInjMesURef(OUT<Voltage>)
ACTION_INFR_GetInjMesVld(IN<Cyl>,**IN**<Pulse>,**OUT**<Mes_Vld>)
ACTION_INFR_GetInjOfsCur(IN<Bank>,**OUT**<Ofs_cur>)
ACTION_INFR_ReqInjMode(IN<Mode>)
ACTION_INFR_SetInjChaFallPer(IN<Page_nr>,**IN**<Cha_fall_per>)
ACTION_INFR_SetInjChaPer(IN<Cyl>,**IN**<Pulse>,**IN**< Cha_per >)
ACTION_INFR_SetInjChaRisePer(IN<Page_nr>,**IN**<Cha_rise_per>)
ACTION_INFR_SetInjDcdc(IN<Dcdc_nr>,**IN**<Dcdc_ducy>)
ACTION_INFR_SetInjDchaFallPer(IN<Page_nr>,**IN**<Dcha_fall_per>)
ACTION_INFR_SetInjDchaPer(IN<Cyl>,**IN**<Pulse>,**IN**< Dis_cha_per >)
ACTION_INFR_SetInjDchaRisePer(IN<Page_nr>,**IN**<Dcha_rise_per>)
ACTION_INFR_SetInjOfsCur(IN<Bank>,**IN**< Ofs_cur >)
ACTION_INFR_SetInjPlsUpdMinPer(IN<Plsupd_min_per>)
ACTION_INFR_SetInjPlsUpdMode(IN<Cyl>,**IN**<Pulse>,**IN**<Plsupd_mode>)
ACTION_INFR_SetInjPulseDurPer(IN<Cyl>,**IN**<Pulse>,**IN**<Pls_duration>)
ACTION_INFR_SetInjPulseEna(IN<Cyl>,**IN**<Pulse>,**IN**< Pulse_ena >)
ACTION_INFR_SetInjPulsePage(IN<Cyl>,**IN**<Pls_nr>,**IN**<Page_nr>)
ACTION_INFR_SetInjPulsePosAng(IN<Cyl>,**IN**<Pulse>,**IN**< Position_ang>)
ACTION_INFR_SetInjPulsePosPer(IN<Cyl>,**IN**<Pulse>,**IN**< Position_per>)
ACTION_INFR_SetInjSeqEndDly(IN<Cyl>,**IN**<Pulse>,**IN**< Seq_end_delay >)
ACTION_INFR_SetInjTdcToBaseAng(IN<Tdc_to_base_ang >)

The purpose of this module is the transfer of injection related data to IO-Software under real time conditions. The most important thing is to maintain the data consistency. The figure 1 shows the general flow of data:

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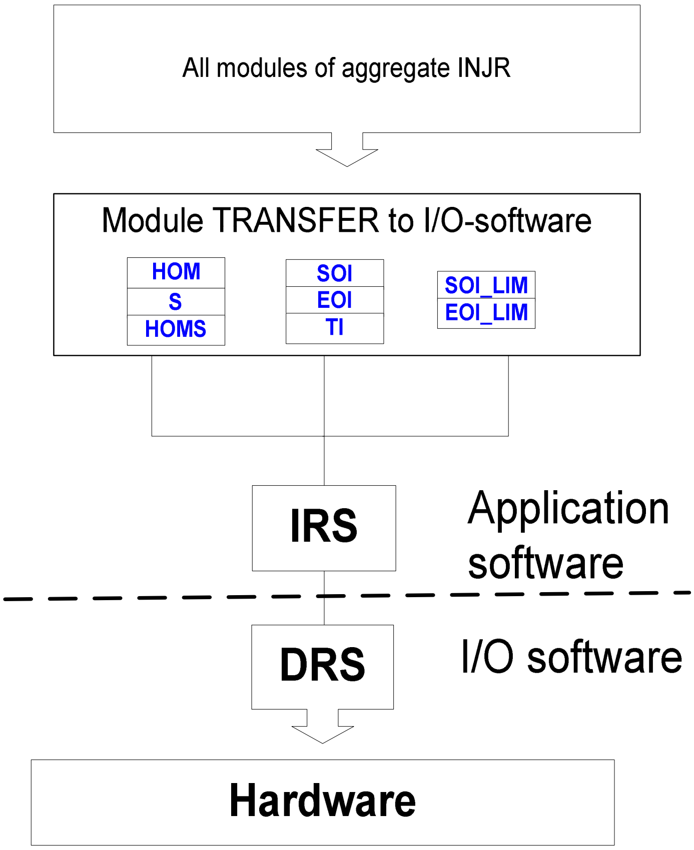

Figure 7.2.1: overview Interface to I/O-software

Control of piezo injector needle lift

To control the needle lift of the piezo injector the energy loaded into the actuator is set by the number of energy packets. In the actual version are two possible setting: High lift and low lift. The data is an input data from module needle lift. The variables are T_CHA_PER_xxx and T_DCHA_PER_xxx, which describe the charge and discharge time.

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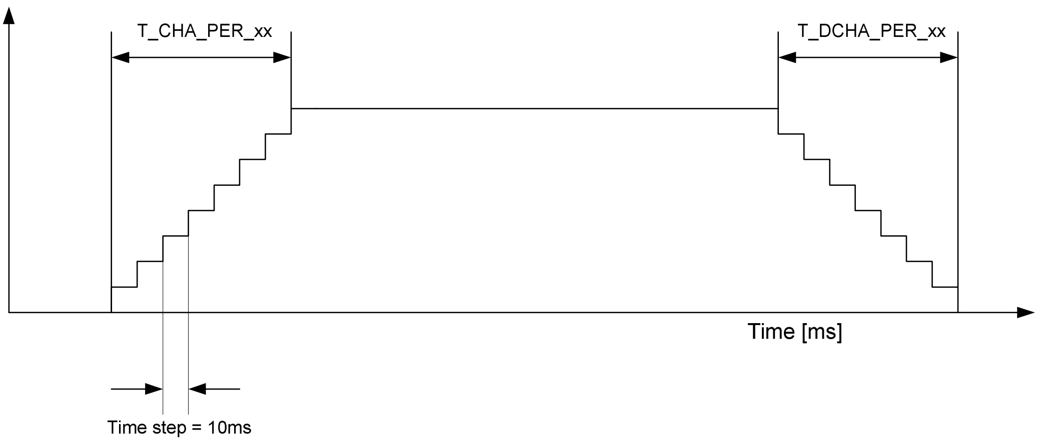

Figure 7.2.2: setting of energy packets for piezo injector

For different injection modes, the energy packets can be different. The following picture shows the overview of the different setting and the update timing conditions.

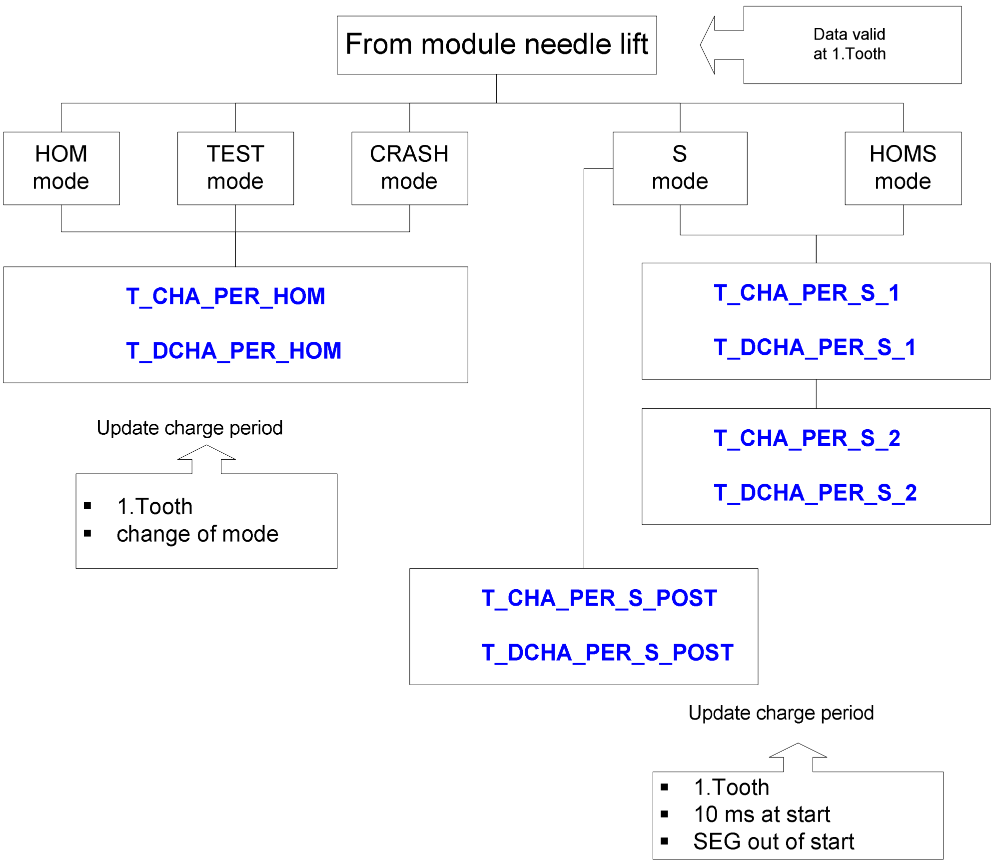

Figure 7.2.3: overview

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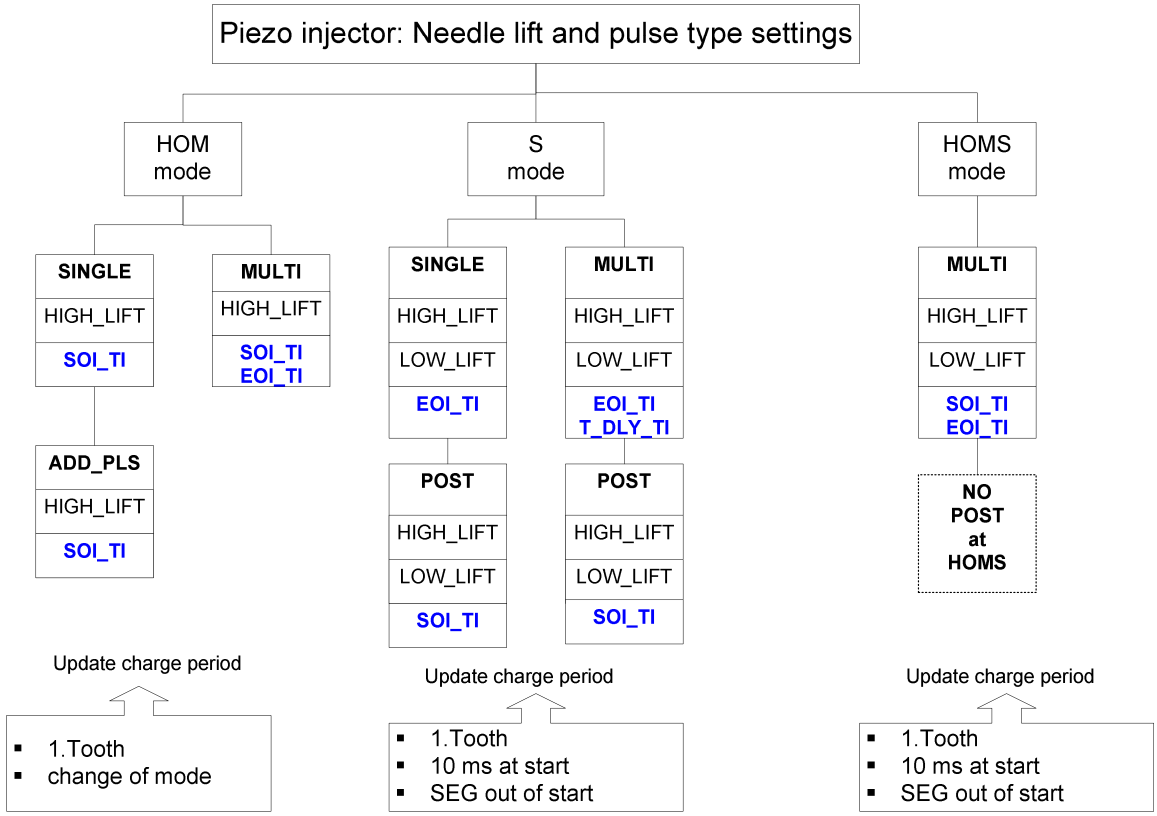
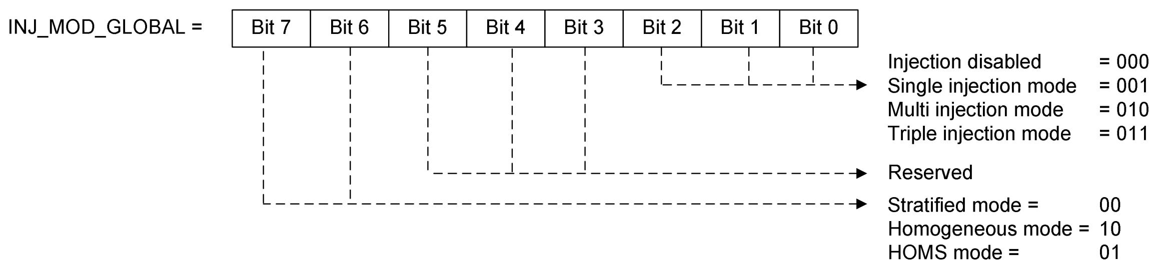


Figure 7.2.4: settings of needle lift and pulse type

Definitions bit masks for injection mode

Byte definition

INJ_MOD[x], INJ_MOD_SP[x]



Example: homogenous multi injection mode (MPLH)

INJ_MOD_GLOBAL =								
	1	0	0	0	0	0	1	0

Figure 7.2.5: Byte definition injection mode

Definition of NC constants

NC_INJ_MOD_DI = 0x00H
NC_INJ_MOD_S = 0x00H
NC_INJ_MOD_HOM = 0x80H

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NC_INJ_MOD_HOMS = 0x40H
NC_INJ_MOD_SINGLE = 0x01H
NC_INJ_MOD_MULTI = 0x02H
NC_INJ_MOD_MULTI_PLS3 = 0x03H
NC_INJ_MOD_TEST_PLS = 0x07H
NC_INJ_MOD_MASK_1 = 0xC0H
NC_INJ_MOD_MASK_2 = 0x07H

7.2.1 Reset tasks

General information:

This chapter describes the procedures required at reset for an accurate engine start.

Application conditions:

Initialisation: –

Activation: at reset
Note! This task has to be called first in calculation order of reset tasks.

Deactivation: –

Recurrence: once at reset

Function description:

Formula section:

Set the crankshaft position where the infrastructure generates the trigger INJBAS at the end of the injection of each cylinder:

```
ACTION_INFR_SetInjTdcToBaseAng(IN Tdc_to_base_ang= NC_CRK_INJ_BAS_REF)

PWM_DCDC_SP = IP_PWM_DCDC_PCTL(TECU)
```

Limit DCDC converter setpoint to maximum and minimum value to prevent power stage destruction:

```
PWM_DCDC_SP = MAX(PWM_DCDC_SP, NC_PWM_DCDC_SP_MIN)
PWM_DCDC_SP = MIN(PWM_DCDC_SP, NC_PWM_DCDC_SP_MAX)

FOR  d = 0 TO  (NC_NR_DCDC_INJ - 1) DO:
ACTION_INFR_SetInjDcdc(IN Dcdc_nr= d, IN Dcdc_ducy= PWM_DCDC_SP)
ENDFOR

CTR_INJ_SWI_ACK_ERR = 0
STATE_INJ_UPD_TRM   = 0
LV_INJ_UPD_CLC_ENA  = 0

FOR  x = 0 TO  (NC_CYL_NR -1) DO:
INJ_MOD[x]          = "DISABLE"
SOI_1_MES[x]        = 720° CRK
SOI_2_MES[x]        = 720° CRK
SOI_POST_MES[x]     = 720° CRK
ENDFOR
```

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```
Do not start injection before first valid tooth event was reached.  Injection
driver is locked.
LV_ST_INJ                = 1
STATE_INJ_DR             = "DISABLED"
STATE_PBK_IV_INI         = "INIT_PENDING"
LV_INJ_REST_ENA          = 0
LV_STATE_PBK_IV_INI_ACT = 0
LV_CUR_CHA_OFS_INI       = 0
LV_CTR_PBK_IV_INI_INC    = 0

Initialize ADC voltage reference calibration:
FAC_ADC_REF_INJ = 1

Set filter output to expected reference voltage:
IF  LC_V_ADC_REF_CAL_INJ = 1
THEN    V_ADC_REF_MES_INJ = C_V_ADC_REF_INJ
ELSE    V_ADC_REF_MES_INJ = NC_V_ADC_REF_INJ
ENDIF

#IF  NC_PBK_IV_TYP = 1
#THEN    //Set page data t_cha_rise, t_cha_fall, t_dcha_rise and t_dcha_fall
(only supported by specific injection hardware):
Note:  Page 0 is used for high injector needle lift, page 1 for low injector
needle lift!
ACTION_INFR_SetInjChaRisePer(IN Page_nr= 0, Cha_rise_per= C_T_CHA_RISE_H)
ACTION_INFR_SetInjChaRisePer(IN Page_nr= 1, Cha_rise_per= C_T_CHA_RISE_L)
ACTION_INFR_SetInjChaFallPer(IN Page_nr= 0, Cha_fall_per= C_T_CHA_FALL_H)
ACTION_INFR_SetInjChaFallPer(IN Page_nr= 1, Cha_fall_per= C_T_CHA_FALL_L)
ACTION_INFR_SetInjDchaRisePer(IN Page_nr= 0, Dcha_rise_per= C_T_DCHA_RISE_H)
ACTION_INFR_SetInjDchaRisePer(IN Page_nr= 1, Dcha_rise_per= C_T_DCHA_RISE_L)
ACTION_INFR_SetInjDchaFallPer(IN Page_nr= 0, Dcha_fall_per= C_T_DCHA_FALL_H)
ACTION_INFR_SetInjDchaFallPer(IN Page_nr= 1, Dcha_fall_per= C_T_DCHA_FALL_L)
#ENDIF
```

7.2.2 Power stage initialization

General information:

This chapter describes the procedures to initialize the power stage driver.

Application conditions:

Initialisation: at NVMY initialization: CTR_PBK_IV_INI_MPL = 0

Activation: at every engine state

Deactivation: –

Recurrence: 10 ms

Function description:

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Formula section:

```
//Initialization of injection IO-driver
IF   STATE_PBK_IV_INI = "INIT_PENDING"    AND
     LV_MC_SOPC_INH_DI = 0                AND
     LV_ERR_TMP_MU_MC = 0                 AND
     LV_DIAG_END_RLY_MAIN_DLY = 1         AND
     LV_RLY_MAIN_DLY_ERR = 0              AND
     LV_INJ_OFF_TMR_INJ_ENA = 1           AND
     LV_STATE_PBK_IV_INI_ACT = 0
THEN    STATE_PBK_IV_INI          = "INIT_ACTIVE"
        NR_PBK_IV_INI             = 0
        CTR_PBK_IV_INI            = 0
        LV_STATE_PBK_IV_INI_ACT = 1
        ACTION_INFR_IniInjDriver()
ENDIF

//Re-initialization of injection IO-driver
IF   STATE_PBK_IV_INI = "REINIT_PENDING" AND
     LV_IGK = 1                           AND
     LV_INJ_OFF_TMR_INJ_ENA= 1            AND
     LV_STATE_PBK_IV_INI_ACT = 0
THEN    STATE_PBK_IV_INI          = "INIT_ACTIVE"
        NR_PBK_IV_INI             = 0
         CTR_PBK_IV_INI            = 0
        LV_STATE_PBK_IV_INI_ACT = 1
        ACTION_INFR_IniInjDriver()
ENDIF

//Repeat injection power stage initialization if finished with errors
IF   LV_CTR_PBK_IV_INI_INC = 1
THEN    LV_CTR_PBK_IV_INI_INC = 0
        NR_PBK_IV_INI = 0
        ACTION_INFR_IniInjDriver()
ENDIF

//Set flag to indicate that a proper start was performed
IF   LV_ST_END = 1
THEN    LV_INJ_REST_ENA = 1
ENDIF
```

7.2.3 End of injection driver initialization

General information:

Application conditions:

Initialisation: –

Activation: every INJEOD-event (EndOfDriverInitialization)

Deactivation: –

Recurrence: INJEOD-event (EndOfDriverInitialization)

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Function description:

Formula section:

```
//Note!  p represents the power-stage bank which reached the INJEOD-event.
NR_PBK_IV_INI = NR_PBK_IV_INI + 1

ACTION_INFR_GetInjDiagIni(IN p, OUT STATE_ERR_PBK_IV_ST_RAW[p]= Err_ini,
                          OUT Ini_valid not used)
#IF NC_PBK_IV_TYP = 1
#THEN    //Get Initial value for offset cancellation of bank p and initialize
offset cancellation controller:
ACTION_INFR_GetInjOfsCur(IN Bank=  p, OUT CUR_CHA_OFS_CNL[p]= Ofs_cur)
ACTION_INJR_SetOfsCurIni(IN Bank= p, IN OfsCurIni= CUR_CHA_OFS_CNL[p])
#ENDIF

(1)IF  NR_PBK_IV_INI ≥ NC_PBK_IV_NR
(1)THEN                  //every injection valve powerbank was initialized
     CTR_PBK_IV_INI++                         //increment counter by 1
 (2)IF  STATE_ERR_PBK_IV_ST_RAW[] = 0         //all NC_PBK_IV_NR elements
    OR  CTR_PBK_IV_INI ≥ C_CTR_PBK_IV_INI_MAX
 (2)THEN    LV_CUR_CHA_OFS_INI       = 1
            LV_STATE_PBK_IV_INI_ACT = 0
  (3)IF  STATE_PBK_IV_INI  = "INIT_ACTIVE"
  (3)THEN    STATE_PBK_IV_INI  = "INIT_FINISHED"
   (4)IF  STATE_INJ_DR = "DISABLED" AND  LV_INJ_REST_ENA = 1
   (4)THEN     Calculate subroutine "Start initialization"
   (4)ENDIF
  (3)ENDIF
  (5)IF CTR_PBK_IV_INI > 1
  (5)THEN    CTR_PBK_IV_INI_MPL++                    //increment counter by 1
     //Note:    CTR_PBK_IV_INI_MPL shall be stored in the non volatile memory!
  (5)ENDIF
 (2)ELSE                                      //initialization with errors
    LV_CTR_PBK_IV_INI_INC = 1
 (2)ENDIF
(1)ENDIF
```

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7.2.4 First valid tooth tasks

General information:

This chapter describes the procedures required at first valid tooth for an accurate engine start.

Application conditions:

Initialisation: –

Activation: at first valid tooth

Deactivation: –

Recurrence: once at first valid tooth

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Function description:

Formula section:

```
Calculate subroutine "Start initialization"

LV_ST_INJ = 0
```

7.2.5 Crank synchronous tasks

General information:

Note: In this specification the LSB of a bit field (e. g. STATE_INJ_UPD_ENA) is revered to as Bit 0! That means that the first loop of the for loop (x = 0) reveres to the LSBs, the next (x = 1) to the next and so on.

Application conditions:

Initialisation:	–
Activation:	every engine state
Deactivation:	–
Recurrence:	LV_ST_END = 0: 10 ms LV_ST_END = 1: segment synchronous

Function description:

Formula section:

```
(1)IF  LV_INJ_UPD_CLC_ENA = 1
(1)THEN    STATE_IGN_UPD_ENA = 0                              //all bits

//Minimum injection time for additional pulse:
In case of single injection and homogeneous mode, a second injection pulse can
be applied by the I/ O-software at transient engine operation (as a result of
an injection update).  For this pulse, a minimum injection time TI_ADD_PULSE_
MIN is defined.  Each of the applied IP_TI_ADD_PULSE_MIN data should be greater
than the smallest calculated TI_MIN.

   TI_ADD_PULSE_MIN = 0
   FOR  m = 0 TO  NC_CBK_HPP_NR - 1 DO:
   TI_ADD_PULSE_MIN = MAX(TI_ADD_PULSE_MIN; IP_TI_ADD_PULSE_MIN(Input:
                           PRS_DEC_INJ_1_HOM[IDX_PRS_COR_CLY_CLC_MPLH[m]))
   ENDFOR
   FAC_ADD_PULSE = IP_FAC_ADD_PULSE(N_32, TCO)

(1)FOR  x = 0 TO  (NC_CYL_NR-1) DO:

Cylinder shut off transfer data:
Disable_task_interruption
LV_INH_INJ[x] = (Bit x of INH_INJ             OR
```

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```
               Bit x of INH_IV_MIS_GEN_ACK)              //logical
ACTION_INFR_SetInjInhibit(IN Cyl= x, IN Lv_inhibit= LV_INH_INJ[x])
Enable_task_interruption

Set injection mode set-point:
  (2)IF  Bit x of STATE_INJ_UPD_TRM = 0
  (2)THEN    //no valid data set within I/ O software

    (3)IF  Bit x of STATE_INJ_UPD_ENA = 1
    (3)THEN    INJ_MOD[x] = INJ_MOD_SP[x]
               Calculate subroutine "Configure injection"
               Calculate subroutine "Update injection data"
               ACTION_INJR_SetStateInjUpdEna(IN Cyl= x, State_Inj_Upd_Ena= 0)
               ACTION_INFR_ReqInjUpdate(IN Cyl= x, IN Mode= Immediate,
                                         OUT INJ_UPD_ACK[x]= Acknowledge)
               Calculate subroutine "Update ignition data"
               Bit x of STATE_IGN_UPD_ENA = 1
               CRK_WIN_SEL_IGN_INJ[x]     = "NO_CLC"
               Bit x of STATE_INJ_UPD_TRM = 1
    (3)ENDIF

  (2)ELSE    //valid data set within I/ O software
               Calculate subroutine "Check engine position"

    (4)IF  INJ_MOD[x] = INJ_MOD_SP[x]
    (4)THEN    //no mode switch requested

      (5)IF  CRK_WIN_SEL_IGN_INJ[x] = "ADC_WIN"  OR  "RTD_WIN"
      (5)THEN    //update possible

        (6)IF  Bit x of STATE_INJ_UPD_ENA = 1
        (6)THEN    Calculate subroutine "Update injection data"
                   ACTION_INJR_SetStateInjUpdEna(IN Cyl= x,
                                                 IN State_Inj_Upd_Ena= 0)
                   ACTION_INFR_ReqInjUpdate(IN Cyl= x, IN Mode= Immediate,
                                            OUT INJ_UPD_ACK[x]= Acknowledge)
        (6)ENDIF
      (5)ENDIF

    (4)ELSE   //mode switch requested

      (7)IF  CRK_WIN_SEL_IGN_INJ[x] = "ADC_WIN"  OR  "RTD_WIN"
      (7)THEN   //mode switch possible
            INJ_MOD[x] = INJ_MOD_SP[x]
            Calculate subroutine "Configure injection"
            Calculate subroutine "Update injection data"
            ACTION_INJR_SetStateInjUpdEna(IN Cyl= x, IN State_Inj_Upd_Ena= 0)
            ACTION_INFR_ReqInjUpdate(IN Cyl= x, IN Mode= Cycle,
                                     OUT INJ_UPD_ACK[x]= Acknowledge)

        (8)IF  INJ_UPD_ACK[x] ≠ "Cycle"
        (8)THEN  CTR_INJ_SWI_ACK_ERR++          //increment counter by 1
        (8)ENDIF

      (7)ELSE   //mode switching failed
            Check if old injection mode can be updated
            LV_INJ_MOD_UPD = 1
            Calculate subroutine "Check variable window"(input:  LV_INJ_MOD_UPD;
                                                         output:  LV_IGN_INJ_UPD_WIN)
        (9)IF  LC_INJ_UPD_OLD_MOD_ENA = 1                AND
             LV_IGN_INJ_UPD_WIN = 1                      AND
```

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```
                LV_INH_INJ_UPD_MOD_UPD[x] = 0             AND
               ( INJ_MOD[x] = INJ_MOD_SP_HOM[x]                    OR
               INJ_MOD[x] = INJ_MOD_SP_S[x] AND LV_IGA_AND_INJ_SWI_HOMS = 0  OR
               INJ_MOD[x] = INJ_MOD_SP_HOMS[x] AND  LV_IGA_AND_INJ_SWI_HOMS = 1
)
                                                          AND NOT
               ( INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_1 = NC_INJ_MOD_S  AND
               INJ_MOD_SP[x] BitwiseAND  NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOMS )
                                                          AND NOT
               (  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOMS AND
               INJ_MOD_SP[x] BitwiseAND  NC_INJ_MOD_MASK_1 = NC_INJ_MOD_S )
          (9)THEN
             Calculate subroutine "Update injection data"
             ACTION_INFR_ReqInjUpdate(IN Cyl= x, IN Mode= Immediate,
                                      OUT INJ_UPD_ACK[x]= Acknowledge)
             CRK_WIN_SEL_IGN_INJ[x] = "UPD_OLD_STATE"
             STATE_UPD_IGN[x]       = "TRIG_IT"
          (9)ENDIF
        (7)ENDIF
      (4)ENDIF

        (10)IF  STATE_UPD_IGN[x] = "TRIG_IT"
        (10)THEN
            Bit x of STATE_IGN_UPD_ENA = 1
            Calculate subroutine "Update ignition data"
        (10)ENDIF
    (2)ENDIF
(1)ENDFOR

ACTION_IGRE_SendTrigForIgnUpd(IN PRM_STATE_IGN_UPD_ENA= STATE_IGN_UPD_ENA)
(1)ENDIF

//get actual measured voltage of the DCDC converter:
FOR  d = 0 TO  (NC_NR_DCDC_INJ - 1) DO:
ACTION_INFR_GetInjMesUDcdc(IN Dcdc= d,
                           OUT VBOOST_PBK_IV_MES[d]= Voltage_dcdc)
ENDFOR
```

7.2.6 INJBAS triggered tasks

General information:

Note!   x represents the current assigned active cylinder cyl_av, which is used for subsequent data calculations.

Application conditions:

Initialisation: –

Activation: every INJBAS event

Deactivation: –

Recurrence: INJBAS synchronous

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Function description:

Formula section:

7.2.6.1 Get actual and previous cylinder number of CRK_INJ_BAS

```
//The Parameter Cyl_av is delivered from the I/ O SW and indicates the logical
cylinder number for the actual INJBAS event.
The cylinder index x is provided as parameter by the INJBAS Trigger

NR_CYL_INJ_BAS_PREV = NR_CYL_INJ_BAS
NR_CYL_INJ_BAS      = x
```

7.2.6.2 Transfer data

```
CTR_PSN_INH_IV_DYN = (STATE_INH_IV_DYN /  2^16) AND  0x0F        //...bitwise
NR_CYL_INH_IV_DYN = (NC_CYL_NR + x - NR_CYL_OFS_INH_IV_DYN) MODULO  NC_CYL_NR
IF  (STATE_INH_IV_DYN AND  2^CTR_PSN_INH_IV_DYN) ≠ 0                  //...bitwise
THEN    //cylinder will be switched off
INH_IV_DYN = INH_IV_DYN OR  2^NR_CYL_INH_IV_DYN                      //...bitwise
ELSE    //cylinder will be switched on
INH_IV_DYN = INH_IV_DYN AND  NOT(2^NR_CYL_INH_IV_DYN)                //...bitwise
ENDIF

CTR_PSN_INH_IV_DYN++                                  //increment counter by 1

IF  CTR_PSN_INH_IV_DYN ≥ NC_INJ_INH_SWI_IV_SHIFT_NR
THEN    CTR_PSN_INH_IV_DYN = 0
ENDIF

STATE_INH_IV_DYN                 = (STATE_INH_IV_DYN AND  0x0000FFFF)   OR
                                   (CTR_PSN_INH_IV_DYN * 2^16)      //...bitwise
INH_INJ                          = INH_IV OR  INH_IV_DYN            //...bitwise
LV_INH_INJ_OLD                   = LV_INH_INJ[NR_CYL_INH_IV_DYN]
LV_INH_INJ[NR_CYL_INH_IV_DYN] = Bit NR_CYL_INH_IV_DYN of INH_INJ     OR
                                 Bit NR_CYL_INH_IV_DYN of INH_IV_MIS_GEN
//Note!  Pay attention on data consistency of INH_INJ, INH_IV_DYN and LV_INH_
INJ[x].

SUM_INH_INJ                      = the sum of the digits of INH_INJ
IF  Bit NR_CYL_INH_IV_DYN of INH_IV_MIS_GEN = 0
THEN
INH_IV_MIS_GEN_ACK = INH_IV_MIS_GEN_ACK AND NOT 2^NR_CYL_INH_IV_DYN //...bitwise
CTR_INH_IV_MIS_GEN[NR_CYL_INH_IV_DYN] = 0
ELSE
INH_IV_MIS_GEN_ACK = INH_IV_MIS_GEN_ACK OR 2^NR_CYL_INH_IV_DYN      //...bitwise
CTR_INH_IV_MIS_GEN[NR_CYL_INH_IV_DYN]++              //increment counter by 1
ENDIF
//Please Note!  STATE_INH_IV_DYN is an output data of cylinder shut off specification.
The content of the data will be changed in this interrupt procedure.  Pay attention
on data consistency, even at cylinder shut off module

IF  LV_INH_INJ[NR_CYL_INH_IV_DYN] ≠ LV_INH_INJ_OLD
THEN    ACTION_INFR_SetInjInhibit(IN Cyl= NR_CYL_INH_IV_DYN,
                                   IN Lv_inhibit= LV_INH_INJ[NR_CYL_INH_IV_DYN])
ENDIF
```

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7.2.6.3 Post injection

```
IF  LV_INJ_MPLP_CYL[x] ≠ LV_POST_INJ_ACT                                      AND
    INJ_MOD[x] AND  NC_INJ_MOD_MASK_1 = NC_INJ_MOD_S  //...  bitwise          AND
    INJ_MOD[x] AND  NC_INJ_MOD_MASK_2 ≠ NC_INJ_MOD_MULTI_PLS3  //...  bitwise

THEN   //stratified mode
  LV_INJ_MPLP_CYL[x] = LV_POST_INJ_ACT
  IF  LV_INJ_MPLP_CYL[x] = 1
  THEN    //activate post injection:
   ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 3,
                               IN Pulse_type= SOI_TI)
   ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 3,
                                IN Plsupd_mode= NONE)
   ACTION_INFR_SetInjSoiLim(IN Cyl= x, IN Packet_nr= 1,
                            IN Soi_lim= - SOI_LIM_POST)
   ACTION_INFR_SetInjEoiLim(IN Cyl= x, IN Packet_nr= 1,
                            IN Eoi_lim= - EOI_LIM_POST)
   ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse= 3,
                                 IN Position_ang= - SOI_POST_INJ[x])
   ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse= 3,
                                 IN Pls_duration= TI_POST_INJ[x])
   ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 3, IN Pulse_ena= 1)
  ELSE   //deactivate post injection:
   SOI_POST_MES[x] = 720° CRK
   EOI_POST_MES[x] = 0° CRK
   TI_POST_MES[x]  = 0 ms
   ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 3, IN Pulse_ena= 0)
  ENDIF

ELSE   //not stratified
  IF  LV_INJ_MPLP_CYL[x] = 1             AND
      INJ_MOD[x] AND  NC_INJ_MOD_MASK_1 ¹ NC_INJ_MOD_S       //...  bitwise
  THEN   //deactivate post injection:
   LV_INJ_MPLP_CYL[x] = 0
   SOI_POST_MES[x] = 720° CRK
   EOI_POST_MES[x] = 0° CRK
   TI_POST_MES[x]  = 0 ms
   ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 3, IN Pulse_ena= 0)
  ENDIF
ENDIF
```

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7.2.6.4 Transfer of measured injection related data from I/O-SW

After an injection was performed, the (cylinder individual) SOI, EOI and TI of that injection are indicated at the output interface as (x = current assigned active cylinder cyl_av):

```
SOI_1_MES[x]      //actual performed SOI of the first injection pulse
SOI_2_MES[x]      //actual performed SOI of the second injection pulse or
                    the additional pulse
SOI_POST_MES[x]   //actual performed SOI of the third injection pulse
EOI_1_MES[x]      //actual performed EOI of the first injection pulse
EOI_2_MES[x]      //actual performed EOI of the second injection pulse or
                    the additional pulse
EOI_POST_MES[x]   //actual performed EOI of the third injection pulse
TI_1_MES[x]       //actual performed injection time of the first injection
                    pulse
TI_2_MES[x]       //actual performed injection time of the second injection
                    pulse or the additional pulse
TI_POST_MES[x]    //actual performed injection time of the third injection
                    pulse

ACTION_INFR_GetInjMesPulsePer(IN Cyl= x, IN Pulse= 0,
                              OUT TI_1_MES[x]= Pls_Period)
ACTION_INFR_GetInjMesPulsePer(IN Cyl= x, IN Pulse= 1,
                              OUT TI_2_MES[x]= Pls_Period)
ACTION_INFR_GetInjMesPulsePer(IN Cyl= x, IN Pulse= 2,
                              OUT TI_POST_MES[x]= Pls_Period)

Get measured values:
IF   TI_1_MES[x] > 0ms
THEN    ACTION_INFR_GetInjMesSoi(IN Cyl= x, IN Pulse= 0,
                                 OUT SOI_1_MES[x]= - Pls_position)
        ACTION_INFR_GetInjMesEoi(IN Cyl= x, IN Pulse= 0,
                                 OUT EOI_1_MES[x]= - Pls_position)
ELSE    SOI_1_MES[x]  = 720°CRK
        EOI_1_MES[x]  = 0°CRK
ENDIF

IF   TI_2_MES[x] > 0ms
THEN    ACTION_INFR_GetInjMesSoi(IN Cyl= x, IN Pulse= 1,
                                 OUT SOI_2_MES[x]= - Pls_position)
        ACTION_INFR_GetInjMesEoi(IN Cyl= x, IN Pulse= 1,
                                 OUT EOI_2_MES[x]= - Pls_position)
ELSE    SOI_2_MES[x]  = 720°CRK
        EOI_2_MES[x]  = 0°CRK
ENDIF

IF   TI_POST_MES[x] > 0ms
THEN    LV_TI_3_HOM_ACT   = 1
        ACTION_INFR_GetInjMesSoi(IN Cyl= x, IN Pulse= 2,
                                 OUT SOI_POST_MES[x]= - Pls_position)
        ACTION_INFR_GetInjMesEoi(IN Cyl= x, IN Pulse= 2,
                                 OUT EOI_POST_MES[x]= - Pls_position)
ELSE    ACTION_INFR_GetInjMesPulsePer(IN Cyl=x, IN Pulse= 3,
                                      OUT TI_POST_MES[x]= Pls_Period)
  IF   TI_POST_MES[x] > 0ms
  THEN    LV_TI_3_HOM_ACT = 0
          ACTION_INFR_GetInjMesSoi(IN Cyl= x, IN Pulse= 3,
                                   OUT SOI_POST_MES[x]= - Pls_position)
          ACTION_INFR_GetInjMesEoi(IN Cyl= x, IN Pulse= 3,
                                   OUT EOI_POST_MES[x]= - Pls_position)
  ELSE    SOI_POST_MES[x] = 720°CRK
```

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```
          EOI_POST_MES[x] = 0°CRK
   ENDIF
ENDIF

Get previous injection state:
//Note:  Due to current injection concept, pulse number one is always executed
expect during cylinder shut off!
IF  TI_1_MES[x] = 0
THEN    LV_STATE_PREV_IV[x] = 0      //no injection during previous cycle
ELSE    LV_STATE_PREV_IV[x] = 1      //injection during previous cycle
ENDIF

IF  LV_STATE_PREV_IV[x] = 1
THEN   set bit x of PREV_STATE_IV
       CTR_STATE_PREV_PBK_IV[NC_IDX_CYL_PBK_IV_REF[x]]++   //increment
                                                           counter by 1
ELSE   clear bit x of PREV_STATE_IV
ENDIF
Note!  Pay attention to data consistency of PREV_STATE_IV and LV_STATE_PREV_
IV[x]
Lv_prev_state_iv = 1 ....  logical cylinder x was injected
Lv_prev_state_iv = 0 ....  logical cylinder x was not injected
```

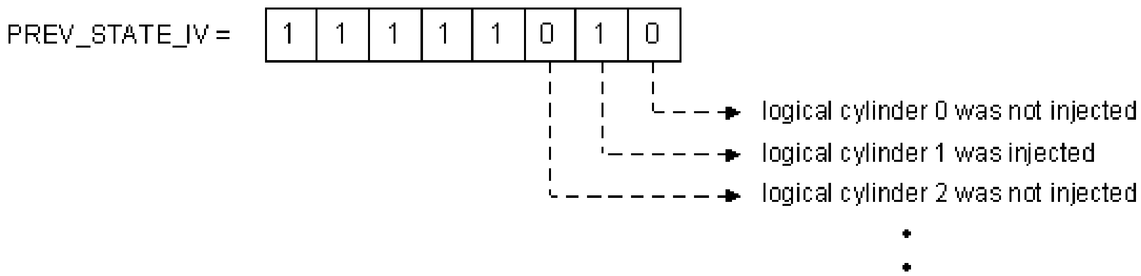

Figure 7.2.6:

```
IF  STATE_ERR_PBK_IV_ST_RAW[NC_IDX_CYL_PBK_IV_REF[x]]    AND
    NC_STATE_PBK_IV_ST_TRIM_ERR) ≠ 0                          //...bitwise
THEN   LV_IV_MES_VLD         = 0
       LV_IV_PLS_MES_VLD[ ] = 0                    //all NC_NR_IV_PLS elements
ELSE   ACTION_INFR_GetInjMesVld(IN Cyl= x, Pulse= 0,
                                OUT LV_IV_PLS_MES_VLD[0]= Mes_Vld)
       ACTION_INFR_GetInjMesVld(IN Cyl= x, Pulse= 1,
                                OUT LV_IV_PLS_MES_VLD[1]= Mes_Vld)
       IF  LV_TI_3_HOM_ACT = 1
       THEN   ACTION_INFR_GetInjMesVld(IN Cyl= x, Pulse= 2,
                                       OUT LV_IV_PLS_MES_VLD[2]= Mes_Vld)
       ELSE   ACTION_INFR_GetInjMesVld(IN Cyl= x, Pulse= 3,
                                       OUT LV_IV_PLS_MES_VLD[2]= Mes_Vld)
       ENDIF

//Calculate global measurement valid flag:
In case of a measured injection time which is greater than zero, the corresponding
measurement valid flag of the same pulse must be set to indicate a valid measurement.
In case of TI_x_MES = 0, the corresponding valid flag has "don't care" status.
       IF  LV_IV_PLS_MES_VLD[0] = 1 OR  TI_1_MES[x] = 0     AND
           LV_IV_PLS_MES_VLD[1] = 1 OR  TI_2_MES[x] = 0     AND
           LV_IV_PLS_MES_VLD[2] = 1 OR  TI_POST_MES[x] = 0
       THEN   LV_IV_MES_VLD = 1
```

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```
        ELSE    LV_IV_MES_VLD = 0
        ENDIF
ENDIF

IF   TI_1_MES[x] > 0 AND  LV_IV_PLS_MES_VLD[0] = 1
THEN    ACTION_INFR_GetInjMesQ(IN Cyl= x, IN Pulse= 0, IN Event= BEG_CHA,
                               OUT Charge= CHR_IV_MES_BEG_CHA)
        ACTION_INFR_GetInjMesQ(IN Cyl= x, IN Pulse= 0, IN Event= END_CHA,
                               OUT Charge= CHR_IV_MES_END_CHA)
        CHA_IV_1_MES[x] = (CHR_IV_MES_END_CHA - CHR_IV_MES_BEG_CHA)
                          * FAC_CHA_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
                          * FAC_COR_SLOP_CHA_CAL[NC_IDX_CYL_PBK_IV_REF[x]]
                          * FAC_ADC_REF_INJ
        ACTION_INFR_GetInjMesU(IN Cyl= x, IN Pulse= 0, IN Event= END_CHA,
                               OUT V_IV_1_MES [x]= Voltage)
        V_IV_1_MES[x] = V_IV_1_MES[x]
                        * FAC_V_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
                        * FAC_ADC_REF_INJ
        //calculate energy and capacity out of measured data:
        EGY_IV_1_CLC[x]  = 0.5 * CHA_IV_1_MES[x] * V_IV_1_MES[x]
        CAPA_IV_1_CLC[x] = CHA_IV_1_MES[x] /  V_IV_1_MES[x]

ELSE    CHA_IV_1_MES[x]  = 0
        V_IV_1_MES[x]    = 0
        EGY_IV_1_CLC[x]  = 0
        CAPA_IV_1_CLC[x] = 0
ENDIF

IF   TI_2_MES[x] > 0 AND  LV_IV_PLS_MES_VLD[1] = 1
THEN    ACTION_INFR_GetInjMesQ(IN Cyl= x, IN Pulse= 1, IN Event= BEG_CHA,
                               OUT Charge= CHR_IV_MES_BEG_CHA)
        ACTION_INFR_GetInjMesQ(IN Cyl= x, IN Pulse= 1, IN Event= END_CHA,
                               OUT Charge= CHR_IV_MES_END_CHA)
        CHA_IV_2_MES[x] = (CHR_IV_MES_END_CHA - CHR_IV_MES_BEG_CHA)
                          * FAC_CHA_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
                          * FAC_COR_SLOP_CHA_CAL[NC_IDX_CYL_PBK_IV_REF[x]]
                          * FAC_ADC_REF_INJ
        ACTION_INFR_GetInjMesU(IN Cyl= x, IN Pulse= 1, IN Pulse = END_CHA,
                               OUT V_IV_2_MES[x]= Voltage)
        V_IV_2_MES[x] = V_IV_2_MES[x]
                        * FAC_V_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
                        * FAC_ADC_REF_INJ
        //calculate energy and capacity out of measured data:
        EGY_IV_2_CLC[x]  = 0.5 * CHA_IV_2_MES[x] * V_IV_2_MES[x]
        CAPA_IV_2_CLC[x] = CHA_IV_2_MES[x] /  V_IV_2_MES[x]

ELSE    CHA_IV_2_MES[x]  = 0
        V_IV_2_MES[x]    = 0
        EGY_IV_2_CLC[x]  = 0
        CAPA_IV_2_CLC[x] = 0
ENDIF

IF   TI_POST_MES[x] > 0 AND  LV_IV_PLS_MES_VLD[2] = 1
THEN
  IF   LV_TI_3_HOM_ACT = 1
  THEN    ACTION_INFR_GetInjMesQ(IN Cyl= x, IN Pulse= 2, IN Event= BEG_CHA,
                                 OUT Charge= CHR_IV_MES_BEG_CHA)
          ACTION_INFR_GetInjMesQ(IN Cyl= x, IN Pulse= 2, IN Event= END_CHA,
                                 OUT Charge= CHR_IV_MES_END_CHA)
          CHA_IV_POST_MES[x] = (CHR_IV_MES_END_CHA - CHR_IV_MES_BEG_CHA)
                               * FAC_CHA_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
```

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```
                                    * FAC_COR_SLOP_CHA_CAL[NC_IDX_CYL_PBK_IV_REF[x]]
                                   * FAC_ADC_REF_INJ
         ACTION_INFR_GetInjMesU(IN Cyl= x, IN Pulse= 2, IN Event= END_CHA,
                                       OUT V_IV_POST_MES[x]= Voltage)
         V_IV_POST_MES[x] = V_IV_POST_MES[x]
                                    * FAC_V_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
                                   * FAC_ADC_REF_INJ

  ELSE   ACTION_INFR_GetInjMesQ(IN Cyl= x, IN Pulse= 3, IN Event= BEG_CHA,
                                       OUT Charge= CHR_IV_MES_BEG_CHA)
         ACTION_INFR_GetInjMesQ(IN Cyl= x, IN Pulse= 3, IN Event= END_CHA,
                                       OUT Charge= CHR_IV_MES_END_CHA)
         CHA_IV_POST_MES[x] = (CHR_IV_MES_END_CHA - CHR_IV_MES_BEG_CHA)
                                      * FAC_CHA_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
                                    * FAC_COR_SLOP_CHA_CAL[NC_IDX_CYL_PBK_IV_REF[x]]
                                  * FAC_ADC_REF_INJ
         ACTION_INFR_GetInjMesU(IN Cyl= x, IN Pulse= 3, IN Event= END_CHA,
                                       OUT V_IV_POST_MES[x]= Voltage)
         V_IV_POST_MES[x] = V_IV_POST_MES[x]
                                    * FAC_V_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
                                   * FAC_ADC_REF_INJ
  ENDIF
  //calculate energy and capacity out of measured data:
  EGY_IV_POST_CLC[x]  = 0.5 * CHA_IV_POST_MES[x] * V_IV_POST_MES[x]
  CAPA_IV_POST_CLC[x] = CHA_IV_POST_MES[x] /  V_IV_POST_MES[x]

ELSE   CHA_IV_POST_MES[x]  = 0
       V_IV_POST_MES[x]    = 0
       EGY_IV_POST_CLC[x]  = 0
       CAPA_IV_POST_CLC[x] = 0
ENDIF


#IF  NC_PBK_IV_TYP = 1
#THEN    //Get measured charge values of trim pulses for integrator offset cancellation
and gain calibration:
ACTION_INFR_GetInjMesQTrim(IN Bank=  NC_IDX_CYL_PBK_IV_REF[x],
    IN Event= BEG_OFS, OUT CHR_INJ_TRIM_0[NC_IDX_CYL_PBK_IV_REF[x]]= Charge)
CHR_INJ_TRIM_0[NC_IDX_CYL_PBK_IV_REF[x]] =
                             CHR_INJ_TRIM_0[NC_IDX_CYL_PBK_IV_REF[x]]
                             * FAC_CHA_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
                             * FAC_ADC_REF_INJ
//Note:    Trim measurement has to be corrected by end of line trim and voltage
reference calibration.
ACTION_INFR_GetInjMesQTrim(IN Bank=  NC_IDX_CYL_PBK_IV_REF[x],
                         IN Event= END_OFS,
                      OUT CHR_INJ_TRIM_1[NC_IDX_CYL_PBK_IV_REF[x]]= Charge)
CHR_INJ_TRIM_1[NC_IDX_CYL_PBK_IV_REF[x]] =
                             CHR_INJ_TRIM_1[NC_IDX_CYL_PBK_IV_REF[x]]
                             * FAC_CHA_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
                             * FAC_ADC_REF_INJ
ACTION_INFR_GetInjMesQTrim(IN Bank=  NC_IDX_CYL_PBK_IV_REF[x],
                         IN Event = BEG_GAIN,
                      OUT CHR_INJ_TRIM_2[NC_IDX_CYL_PBK_IV_REF[x]]= Charge)
CHR_INJ_TRIM_2[NC_IDX_CYL_PBK_IV_REF[x]] =
                             CHR_INJ_TRIM_2[NC_IDX_CYL_PBK_IV_REF[x]]
                             * FAC_CHA_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
                             * FAC_ADC_REF_INJ
ACTION_INFR_GetInjMesQTrim(IN Bank=  NC_IDX_CYL_PBK_IV_REF[x],
                        IN Event= END_GAIN,
                     OUT CHR_INJ_TRIM_3[NC_IDX_CYL_PBK_IV_REF[x]] = Charge)
```

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```
CHR_INJ_TRIM_3[NC_IDX_CYL_PBK_IV_REF[x]] =
                             CHR_INJ_TRIM_3[NC_IDX_CYL_PBK_IV_REF[x]]
                             * FAC_CHA_IV_MES_PBK[NC_IDX_CYL_PBK_IV_REF[x]]
                             * FAC_ADC_REF_INJ
ACTION_INFR_GetInjOfsCur(IN Bank=  NC_IDX_CYL_PBK_IV_REF[x],
                    OUT CUR_CHA_OFS_CNL[NC_IDX_CYL_PBK_IV_REF[x]]= Ofs_cur)

//Send new value for integrator offset cancellation current:
Note:    new values are only sent after offset current initialization during
power stage initialization!
  IF  LV_CUR_CHA_OFS_INI = 1
  THEN   ACTION_INFR_SetInjOfsCur(IN Bank=  NC_IDX_CYL_PBK_IV_REF[x],
                 IN Ofs_cur= CUR_CHA_OFS_CNL_OUT[NC_IDX_CYL_PBK_IV_REF[x]])
  ENDIF
#ENDIF
```

7.2.6.5 Transfer of injection valve diagnosis I/O-SW raw values

```
ACTION_INFR_GetInjDiagElectric(IN Cyl= x,
                               OUT STATE_ERR_IV_CYL_RAW[x]= Err_diag,
                               OUT CDN_DIAG_IV_RAW[x]= Diag_valid)
```

7.2.7 Synchronized start

General information:

Application conditions:

Initialisation: –

Activation: at every engine state

Deactivation: –

Recurrence: 10 ms
Note! This task has to be called separately in calculation order after IGRE.

Function description:

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Formula section:

```
IF   (LV_ST_INJ = 0 AND  LV_ST_INJ_REQ = 1)                    OR
     (STATE_INJ_DR = "DISABLED" AND  LV_INJ_REST_ENA = 1 AND
      LV_INJ_DEAC_BACK_ENG = 0)
THEN    //check if at least one data set was sent to I/ O-SW before starting
          the injection.
  IF   STATE_INJ_UPD_TRM = 2^(NC_CYL_NR)  -1  AND
       STATE_INJ_CRASH_ACT = 00H          AND
       LV_SYN_ENG = 1                     AND
       STATE_PBK_IV_INI = "INIT_FINISHED"
  THEN     ACTION_INFR_ReqInjMode(IN Mode= DISABLE)
           ACTION_INFR_ReqInjMode(IN Mode= SEQUENTIAL)
           STATE_INJ_DR = "RUN"
           //Please note, that this step was necessary to prevent a mode
           switch from IV test mode to sequential injection mode directly.
           LV_ST_INJ = 1
  ENDIF
ENDIF
```

7.2.8 ECU-state-transition from synchronous to asynchronous state

General information:

Relevant only for start stop projects. Comply with the compiler switch NC_STATE_STST_ENA = 1.

Application conditions:

Initialisation: –

Activation: at ECU-state-transition from SYN_ENG_IGK_ON to ENG_RUN (SYN_ON to ASYN_ON)

Deactivation: –

Recurrence: every ECU-state-transition from SYN_ENG_IGK_ON to ENG_RUN (SYN_ON to ASYN_ON)

Function description:

Formula section:

```
#IF   NC_STATE_STST_ENA = 1
#THEN     LV_INJ_DEAC_BACK_ENG = 1
          ACTION_INFR_ReqInjMode(IN Mode= DISABLE)
          STATE_INJ_DR          = "DISABLED"
#ENDIF
```

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7.2.9 ECU-state-transition from asynchronous to synchronous state

General information:

Relevant only for start stop projects. Comply with the compiler switch NC_STATE_STST_ENA = 1.

Application conditions:

Initialisation: –

Activation: at ECU-state-transition from ENG_RUN to SYN_ENG_IGK_ON (ASYN_ON to SYN_ON)

Deactivation: –

Recurrence: every ECU-state-transition from ENG_RUN to SYN_ENG_IGK_ON (ASYN_ON to SYN_ON)

Function description:

Formula section:

```
#IF  NC_STATE_STST_ENA = 1
#THEN
 IF  LV_INJ_DEAC_BACK_ENG = 1
 THEN    Calculate subroutine "Start initialization"
         LV_ST_INJ            = 0
         LV_INJ_DEAC_BACK_ENG = 0
 ENDIF
#ENDIF
```

7.2.10 Ignition key OFF

General information:

Application conditions:

Initialisation: –

Activation: at transition of LV_IGK from 1==>0

Deactivation: –

Recurrence: every transition of LV_IGK from 1==>0

Function description:

Formula section:

```
STATE_PBK_IV_INI     = "REINIT_PENDING"
LV_INJ_DEAC_BACK_ENG = 0
```

7.2.11 Ignition key on

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General information:

This chapter describes the procedures required at ignition key on to ensure an accurate engine restart at running engine.

Application conditions:

Initialisation: -

Activation: at ignition key on event (LV_IGK = 0==>1)

Deactivation: -

Recurrence: once at every ignition key on event
Note: This section has to be calculated before all other time and segment synchronous sections which are dependent on LV_IGK!

Function description:

Formula section:

```
IF   STATE_PBK_IV_INI = "REINIT_PENDING"
THEN     Calculate subroutine "Disable injection driver functionality"
ENDIF
```

7.2.12 Engine stop

General information:

Application conditions:

Initialisation: -

Activation: at transition of LV_ES from 0==>1

Deactivation: -

Recurrence: every transition of LV_ES from 0==>1

Function description:

Formula section:

```
Calculate subroutine "Disable injection driver functionality"
LV_INJ_REST_ENA      = 0
LV_INJ_DEAC_BACK_ENG = 0
```

7.2.13 Injection valve power stage diagnosis

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General information:

This chapter describes the procedure to get injection power stage diagnosis information from I/O-SW.

Application conditions:

Initialisation: –

Activation: every engine state

Deactivation: –

Recurrence: segment synchronous

Function description:

Formula section:

```
IF   STATE_PBK_IV_INI = "INIT_FINISHED"    AND
     LV_ST_INJ = 1                          AND
     LV_INJ_UPD_CLC_ENA = 1                 AND
     STATE_INJ_UPD_TRM = 2^(NC_CYL_NR) -1
THEN
   IF   SEG_NR = 0
   THEN
   FOR  p = 0 TO  (NC_PBK_IV_NR -1) DO:
   Disable_task_interruption
   ACTION_INFR_GetInjDiagPower(IN Bank_nr= p,
                            OUT STATE_ERR_PBK_IV_RAW[p]= Err_power,
                            OUT CDN_DIAG_PBK_IV_RAW[p]= Power_valid)
      IF   CTR_STATE_PREV_PBK_IV[p] > 0
      THEN
      CTR_STATE_PREV_PBK_IV[p]  = 0
      LV_STATE_PREV_PBK_IV[p]   = 1
      CDN_DIAG_PBK_IV_RAW[p]    = CDN_DIAG_PBK_IV_RAW[p] OR  0x08 //...bitwise
      ELSE
      LV_STATE_PREV_PBK_IV[p]   = 0
      ENDIF
   Enable_task_interruption
   ENDFOR
   ENDIF
ELSE
FOR  p = 0 TO  (NC_PBK_IV_NR -1) DO:
STATE_ERR_PBK_IV_RAW[p]         = 0
CDN_DIAG_PBK_IV_RAW[p]          = 0
CTR_STATE_PREV_PBK_IV[p]        = 0
LV_STATE_PREV_PBK_IV[p]         = 0
ENDFOR
ENDIF
```

7.2.14 Injector test mode

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General information:

This chapter describes the procedure for actuator tests by diagnostic tester.

Application conditions:

Initialisation: at EXIT_ST event: CTR_TEST_MOD_IV[NC_CYL_NR] = 0

Activation: LV_ES = 1

Deactivation: -

Recurrence: 1 s

Function description:

Formula section:

```
IF  LV_IV_TEST_MOD_AUTH =1                                          AND
    N_32 <=  NC_N_MAX_IV_TEST_MOD                                    AND
    CTR_TEST_MOD_IV[NR_CYL_IV_TEST_MOD] <  NC_CTR_MAX_IV_TEST_MOD    AND
    INJ_MOD[NR_CYL_IV_TEST_MOD] AND  NC_INJ_MOD_MASK_2 =  NC_INJ_MOD_DI
                                                          //...  bitwise
THEN
CTR_TEST_MOD_IV[NR_CYL_IV_TEST_MOD]++            //increment counter by 1
ACTION_INFR_ReqInjMode(IN Mode= STATIC)
STATE_INJ_DR = "RUN"
ACTION_INFR_SetInjChaPer(IN Cyl= NR_CYL_IV_TEST_MOD, IN Pulse= 0,
                         IN Cha_per= C_T_CHA_PER_H)
ACTION_INFR_SetInjDchaPer(IN Cyl= NR_CYL_IV_TEST_MOD, IN Pulse= 0,
                          IN Dis_cha_per= C_T_CHA_PER_H)
 #IF  NC_PBK_IV_TYP = 1
 #THEN
 ACTION_INFR_SetInjSeqEndDly(IN Cyl= NR_CYL_IV_TEST_MOD, IN Pulse= 0,
               IN Seq_end_delay= T_RLS_DLY_DCHA_1_HOM[NR_CYL_IV_TEST_MOD])
   IF  LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
   THEN    //set Page:  High needle lift - page 0
   ACTION_INFR_SetInjPulsePage(IN Cyl= NR_CYL_IV_TEST_MOD, IN Pulse= 0,
                               IN Page= 0))
   ENDIF
 #ENDIF
ACTION_INFR_ReqInjUpdate(IN Cyl= NR_CYL_IV_TEST_MOD, IN Mode= IMMEDIATE)
ACTION_INFR_ReqInjPulse(IN Cyl=NR_CYL_IV_TEST_MOD,
                        IN Duration= NC_TI_TEST_PLS_PER)
ENDIF
```

7.2.15 Crash signal reaction of injection driver

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General information:

This chapter describes the behavior of the injection driver during vehicle crash. Under crash conditions, all selected injectors (NC_IV_CRASH) are open for a predefined period, to drain off the fuel from the rail into the cylinder. This will reduce the danger of fire or explosion, if the rail will be damaged.
Definition of STATE_INJ_CRASH_ACT:
00H = no request received;
    The injection driver works under normal conditions.
01H = vehicle crash reaction request received by LV_INJ_CRASH_ACT = 1;
    The injection driver will be shut down.
02H = injection driver crash reaction acknowledged;
    The selected injectors are opened for NC_TI_CRASH period.
03H = injection driver crash reaction finished;
    All working injectors are closed. The driver is under hold conditions.

Application conditions:

Initialisation: at reset: T_INJ_CRASH_ACT = 0
STATE_INJ_CRASH_ACT = 00H

Activation: every engine state

Deactivation: –

Recurrence: 10 ms

Function description:

Formula section:

```
IF   STATE_INJ_CRASH_ACT = 01H                AND
     STATE_PBK_IV_INI = "INIT_FINISHED"
THEN
   ACTION_INFR_ReqInjMode(IN Mode = STATIC)
   STATE_INJ_DR = "RUN"
   FOR   x = 0 TO   (NC_CYL_NR -1) DO:
   ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 0,
                            IN Cha_per= C_T_CHA_PER_H)
   ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 0,
                             IN Dis_cha_per= C_T_CHA_PER_H)
    #IF  NC_PBK_IV_TYP = 1
    #THEN
    ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 0,
                                IN Seq_end_delay= C_T_CHA_PER_H)
      IF  LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
      THEN   //set Page:  High needle lift - page 0
      ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 0, IN Page= 0))
      ENDIF
    #ENDIF
      IF  bit x of NC_IV_CRASH = 1
      THEN
      ACTION_INFR_ReqInjUpdate(IN Cyl= x, IN Mode= IMMEDIATE)
      ACTION_INFR_ReqInjPulse(IN Cyl= x,
                              IN Duration= MIN(470 ms, NC_TI_CRASH))
      ENDIF
   ENDFOR
   STATE_INJ_CRASH_ACT = 02H
```

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```
ENDIF

IF  LV_INJ_CRASH_ACT = 1  AND  STATE_INJ_CRASH_ACT = 00H
THEN
 Disable_task_interruption
 STATE_INJ_CRASH_ACT = 01H
 FOR  x = 0 TO  (NC_CYL_NR -1) DO:
 INJ_MOD[x]     = "DISABLE"
 ENDFOR
 LV_ST_INJ      = 1
 Enable_task_interruption
 ACTION_INFR_ReqInjMode(IN Mode= DISABLE)
 STATE_INJ_DR   = "DISABLED"
ENDIF

IF  STATE_INJ_CRASH_ACT = 02H  AND  T_INJ_CRASH_ACT ≥ NC_TI_CRASH
THEN
 STATE_INJ_CRASH_ACT  = 03H
 ACTION_INFR_ReqInjMode(IN Mode= DISABLE)
 STATE_INJ_DR         = "DISABLED"
ENDIF

IF  STATE_INJ_CRASH_ACT = 02H
THEN
T_INJ_CRASH_ACT = T_INJ_CRASH_ACT + 10 ms
  IF  (T_INJ_CRASH_ACT MODULO  500ms) = 0
  THEN
  FOR  x = 0 TO  (NC_CYL_NR -1) DO:
    IF bit x of NC_IV_CRASH = 1
    THEN    ACTION_INFR_ReqInjPulse(IN Cyl= x,
                                    IN Duration= MIN( 480 ms, (NC_TI_CRASH
                                    - (T_INJ_CRASH_ACT - 10 ms))))

    ENDIF
  ENDFOR
  ENDIF
ENDIF
```

7.2.16 Time synchronous tasks (1s)

General information:

This chapter describes time synchronous tasks with the recurrence of 1 second.
Here, the voltage setpoint for the DCDC converter is set depending on the temperature of the ECU. The DCDC voltage is transferred via PWM value.

Application conditions:

Initialisation: –

Activation: at every engine state

Deactivation: –

Recurrence: 1 s

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Function description:

Formula section:

```
Calculate DCDC converter setpoint and send it to basic software:
PWM_DCDC_SP = IP_PWM_DCDC_PCTL(TECU)

Limit DCDC converter setpoint to maximum and minimum value to prevent power stage
destruction:
PWM_DCDC_SP = MAX(PWM_DCDC_SP, NC_PWM_DCDC_SP_MIN)
PWM_DCDC_SP = MIN(PWM_DCDC_SP, NC_PWM_DCDC_SP_MAX)
FOR  d = 0 TO  (NC_NR_DCDC_INJ - 1) DO:
ACTION_INFR_SetInjDcdc(IN Dcdc_nr= d, IN Dcdc_ducy= PWM_DCDC_SP)
ENDFOR

Get measured reference calibration voltage and calculate ADC voltage reference
calibration:
The measured voltage NC_V_ADC_REF_INJ is more accurate then the ADC reference
voltage.  By calculating a correction factor for all ADC measurement values,
this accuracy can be transferred to all ADC measurements.  This feature exists
only for certain injection hardware drivers.
#IF  NC_PBK_IV_TYP = 1
#THEN
ACTION_INFR_GetInjMesURef(OUT V_ADC_REF_MES_INJ_RAW= Voltage)
#ENDIF

Voltage reference calibration is activated by LC switch and a positive plausibility
check of the raw value.
IF  NC_PBK_IV_TYP = 1                                             AND
    LC_V_ADC_REF_ENA = 1                                          AND
    V_ADC_REF_MES_INJ_RAW > C_V_ADC_REF_MES_INJ_MIN_PLAUS          AND
    V_ADC_REF_MES_INJ_RAW < C_V_ADC_REF_MES_INJ_MAX_PLAUS
THEN    //filter analogue signal V_ADC_REF_MES_INJ_RAW with PT1-filter:
  V_ADC_REF_MES_INJ = (C_FAC_FIL_V_ADC_REF *
                      (V_ADC_REF_MES_INJ_RAW - V_ADC_REF_MES_INJ))
                      + V_ADC_REF_MES_INJ
  IF  LC_V_ADC_REF_CAL_INJ = 1
  THEN    FAC_ADC_REF_INJ = C_V_ADC_REF_INJ /  V_ADC_REF_MES_INJ
  ELSE    FAC_ADC_REF_INJ = NC_V_ADC_REF_INJ /  V_ADC_REF_MES_INJ
  ENDIF
ENDIF
```

7.2.17 Subroutines

General information:

This section defines the subroutines. The following chapters are only calculated if called by another section like a function call. The input parameters are mentioned at the function calls.

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Application conditions:

Initialisation: -

Activation: if called by another section

Deactivation: -

Recurrence: once if called by another section

Function description:

Formula section:

7.2.17.1 Start initialization

```
PWM_DCDC_SP = IP_PWM_DCDC_PCTL(TECU)       //Mode independent

Limit DCDC converter setpoint to maximum and minimum value to prevent power stage
destruction:
PWM_DCDC_SP = MAX(PWM_DCDC_SP, NC_PWM_DCDC_SP_MIN)
PWM_DCDC_SP = MIN(PWM_DCDC_SP, NC_PWM_DCDC_SP_MAX)

FOR  d = 0 TO  (NC_NR_DCDC_INJ - 1) DO:
    ACTION_INFR_SetInjDcdc(IN Dcdc_nr= d, IN Dcdc_ducy= PWM_DCDC_SP)
ENDFOR

INH_IV_DYN              = 0
NR_CYL_OFS_INH_IV_DYN = C_NR_CYL_OFS_INH_IV_DYN
STATE_INJ_UPD_TRM       = 0 (all bits)
LV_INJ_UPD_CLC_ENA      = 1
INH_IV_MIS_GEN_ACK      = 0

FOR  x = 0 TO  (NC_CYL_NR -1) DO:
ACTION_INJR_SetStateInjUpdEna(IN Cyl= x, State_Inj_Upd_Ena= 0)
CTR_INH_IV_MIS_GEN[x] = 0
ENDFOR

NR_CYL_INJ_BAS          = 0
NR_CYL_INJ_BAS_PREV     = NC_CYL_NR -1
```

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7.2.17.2 Disable injection driver functionality

```
//This chapter describes the engine stop procedure as required for this specification.
It is called either at engine run to engine stop event or at ignition key off
event
FOR  x = 0 TO  (NC_CYL_NR -1) DO:
INJ_MOD[x] = "DISABLE"
ENDFOR

LV_ST_INJ          = 1
LV_INJ_UPD_CLC_ENA = 0

IF  STATE_INJ_CRASH_ACT = 00H
THEN
ACTION_INFR_ReqInjMode(IN Mode= DISABLE)
STATE_INJ_DR        = "DISABLED"
ENDIF

PREV_STATE_IV = 0    //no injection is performed by I/ O-SW from this time

Do the following calculations for all cylinders:
FOR  x = 0 TO  (NC_CYL_NR -1) DO:
ACTION_INJR_SetStateInjUpdEna(IN Cyl= x, State_Inj_Upd_Ena= 0)
LV_STATE_PREV_IV[x]  = 0
LV_INJ_MPLP_CYL[x]   = 0
SOI_1_MES[x]         = 720° CRK
SOI_2_MES[x]         = 720° CRK
SOI_POST_MES[x]      = 720° CRK
EOI_1_MES[x]         = 0° CRK
EOI_2_MES[x]         = 0° CRK
EOI_POST_MES[x]      = 0° CRK
TI_1_MES[x]          = 0 ms
TI_2_MES[x]          = 0 ms
TI_POST_MES[x]       = 0 ms

CHA_IV_1_MES [x]     = 0
V_IV_1_MES [x]       = 0
EGY_IV_1_CLC [x]     = 0
CAPA_IV_1_CLC [x]    = 0

CHA_IV_2_MES [x]     = 0
V_IV_2_MES [x]       = 0
EGY_IV_2_CLC [x]     = 0
CAPA_IV_2_CLC [x]    = 0

CHA_IV_POST_MES [x]  = 0
V_IV_POST_MES [x]    = 0
EGY_IV_POST_CLC [x]  = 0
CAPA_IV_POST_CLC [x] = 0
ENDFOR

Do the following calculations for all power stage banks:
FOR  p = 0 TO  (NC_PBK_IV_NR -1) DO:
STATE_ERR_PBK_IV_RAW[p]  = 0
CDN_DIAG_PBK_IV_RAW[p]   = 0
CTR_STATE_PREV_PBK_IV[p] = 0
LV_STATE_PREV_PBK_IV[p]  = 0
ENDFOR
```

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7.2.17.3 Configure Injection

~~The CSERS_TEST variables show the injection set points which will be activated if CSERS_~~
~~Be aware that bad calibration of injection pulses, e.g. injection pulse during /~~
~~after ignition may harm components of the test vehicle.~~

~~Calculation of CSERS_INIJ_DIAG test timing and phasing outputs for visibility~~

~~**#IF**   NLC_CSERS_INJ_PLS_TEST_CONF == 0~~
~~**#THEN**~~
~~TI_1_HOM_CSERS_TEST[x] = TI_1_HOM[x] * NC_CSERS_INJ_PLS_TEST_TI_FAC[0]~~
~~SOI_1_HOM_CSERS_TEST[x] =~~
~~SOI_1_HOM[x] + NC_CSERS_INJ_PLS_TEST_ANG_ADD[0]~~

~~TI_2_HOM_CSERS_TEST[x] = TI_2_HOM[x] * NC_CSERS_INJ_PLS_TEST_TI_FAC[1]~~
~~EOI_2_HOM_CSERS_TEST[x] =~~
~~EOI_2_HOM[x] + NC_CSERS_INJ_PLS_TEST_ANG_ADD[1]~~

~~TI_3_HOM_CSERS_TEST[x] = TI_3_HOM[x] * NC_CSERS_INJ_PLS_TEST_TI_FAC[2]~~
~~EOI_3_HOM_CSERS_TEST[x] =~~
~~EOI_3_HOM[x] + NC_CSERS_INJ_PLS_TEST_ANG_ADD[2]~~

~~**#ELSE**~~
~~TI_1_HOM_CSERS_TEST[x] = TI_1_HOM[x] * C_CSERS_INJ_PLS_TEST_TI_FAC[0]~~
~~SOI_1_HOM_CSERS_TEST[x] =~~
~~SOI_1_HOM[x] + C_CSERS_INJ_PLS_TEST_ANG_ADD[0]~~

~~TI_2_HOM_CSERS_TEST[x] = TI_2_HOM[x] * C_CSERS_INJ_PLS_TEST_TI_FAC[1]~~
~~EOI_2_HOM_CSERS_TEST[x] =~~
~~EOI_2_HOM[x] + C_CSERS_INJ_PLS_TEST_ANG_ADD[1]~~

~~TI_3_HOM_CSERS_TEST[x] = TI_3_HOM[x] * C_CSERS_INJ_PLS_TEST_TI_FAC[2]~~
~~EOI_3_HOM_CSERS_TEST[x] =~~
~~EOI_3_HOM[x] + C_CSERS_INJ_PLS_TEST_ANG_ADD[2]~~
~~**#ENDIF**~~

TI_ACT_SWI[x] = 0
TI_ACT_UPD[x] = 0

//Disable post pulse:
LV_INJ_MPLP_CYL[x] = 0 (post injection disabled)
ACTION_INFR_**SetInjPulseEna**(IN Cyl= x, IN Pulse= 3, IN Pulse_ena= 0)

//Homogeneous combustion mode:
(1)**IF** INJ_MOD[x] **BitwiseAND** NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOM
(1)**THEN** *//homogeneous combustion mode*
(2)**IF** INJ_MOD[x] **BitwiseAND** NC_INJ_MOD_MASK_2 ≠ NC_INJ_MOD_SINGLE
(2)**THEN** *//homogeneous mode multi injection*
Settings for first pulse
ACTION_INFR_**SetInjPulseType**(IN Cyl= x, IN Pulse= 0, IN Pulse_type= SOI_TI)
ACTION_INFR_**SetInjPlsUpdMode**(IN Cyl = x, IN Pulse= 0, IN Plsupd_mode= NONE)
ACTION_INFR_**SetInjPulseEna**(IN Cyl= x, IN Pulse= 0, IN Pulse_ena= 1)
Settings for second pulse
ACTION_INFR_**SetInjPulseType**(IN Cyl= x, IN Pulse= 1, IN Pulse_type= EOI_TI)
(3)**IF** LC_IV_ADD_PLS_MPLH_ENA = 1
(3)**THEN** ACTION_INFR_**SetInjPlsUpdMode**(IN Cyl= x, IN Pulse= 1,
IN Plsupd_mode= UPDATE)
(3)**ELSE** ACTION_INFR_**SetInjPlsUpdMode**(IN Cyl= x, IN Pulse= 1,
IN Plsupd_mode= NONE)
(3)**ENDIF**

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```
ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 1, IN Pulse_ena= 1)
Settings for third pulse
 (4)IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_2 = NC_INJ_MOD_MULTI_PLS3
 (4)THEN    ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 2,
                                        IN Pulse_type= EOI_TI)
            ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 2,
                                         IN Plsupd_mode= NONE)
            ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 2,
                                       IN Pulse_ena= 1)
 (4)ELSE    ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 2,
                                       IN Pulse_ena= 0)
 (4)ENDIF
(2)ELSE    //homogeneous mode single injection
Settings for first pulse
ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 0, IN Pulse_type= SOI_TI)
ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 0, IN Plsupd_mode= NONE)
Enable first pulse
ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 0, IN Pulse_ena= 1)
Disable third pulse
ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 2, IN Pulse_ena= 0)
 (5)IF  LC_IV_ADD_PLS_SNGH_ENA = 1
 (5)THEN
 Settings makeup pulse
 ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 1, IN Pulse_type= EOI_TI)
  (6)IF  LC_INJ_PLS_UPD_MOD = AUTONOMOUS
  (6)THEN    ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 1,
                                          IN Plsupd_mode= AUTONOMOUS)
  (6)ELSE    ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 1,
                                          IN Plsupd_mode= IMMEDIATE)
  (6)ENDIF
 Enable second (makeup) pulse
 ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 1, IN Pulse_ena= 1)
 (5)ELSE
 Disable second (makeup) pulse
 ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 1, IN Pulse_ena= 0)
 (5)ENDIF
(2)ENDIF
(1)ENDIF

//Stratified combustion mode:
(1)IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_1 = NC_INJ_MOD_S
(1)THEN    //stratified combustion mode
 (2)IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_2 ≠ NC_INJ_MOD_SINGLE
 (2)THEN    //stratified multi injection
Settings for first pulse
ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 0, IN Pulse_type= EOI_TI)
ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 0, IN Plsupd_mode= NONE)
Settings for second pulse
ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 1, IN Pulse_type= T_TI)
ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 1, IN Plsupd_mode= NONE)
Enable first pulse
ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 0, IN Pulse_ena= 1)
Enable second pulse
ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 1, IN Pulse_ena= 1)
 (3)IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_2 = NC_INJ_MOD_MULTI_PLS3
 (3)THEN    //stratified triple injection
 Settings for third pulse
 ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 2, IN Pulse_type= T_TI)
 ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 2,
                              IN Plsupd_mode= NONE)
 Enable third pulse
```

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```
  ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 2, IN Pulse_ena= 1)
  (3)ELSE
  Disable third pulse
  ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 2, IN Pulse_ena= 0)
  (3)ENDIF
 (2)ELSE     //Stratified mode single injection
  Settings for first pulse
  ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 0, IN Pulse_type= EOI_TI)
  ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 0, IN Plsupd_mode= NONE)
  Enable first pulse
  ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 0, IN Pulse_ena= 1)
  Disable second pulse
  ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 1, IN Pulse_ena= 0)
  Disable third pulse
  ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 2, IN Pulse_ena= 0)
 (2)ENDIF
(1)ENDIF

//Homogeneous-stratified combustion mode:
(1)IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOMS
(1)THEN    //homs mode
 (2)IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_2 ≠ NC_INJ_MOD_SINGLE
 (2)THEN    //homs multi injection
 Settings for first pulse
 ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 0, IN Pulse_type= SOI_TI)
 ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 0, IN Plsupd_mode= NONE)
 Settings for second pulse
 ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 1, IN Pulse_type= EOI_TI)
 ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 1, IN Plsupd_mode= NONE)
 Enable first pulse
 ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 0, IN Pulse_ena= 1)
 Enable second pulse
 ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 1, IN Pulse_ena= 1)
  (3)IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_2 = NC_INJ_MOD_MULTI_PLS3
  (3)THEN    //homs triple injection
  Settings for third pulse
  ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 2, IN Pulse_type= EOI_TI)
  ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 2, IN Plsupd_mode= NONE)
  Enable third pulse
  ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 2, IN Pulse_ena= 1)
  (3)ELSE
  Disable third pulse
  ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 2, IN Pulse_ena= 0)
  (3)ENDIF
 (2)ELSE    //homs single injection
  Settings for first pulse
  ACTION_INFR_SetInjPulseType(IN Cyl= x, IN Pulse= 0, IN Pulse_type= SOI_TI)
  ACTION_INFR_SetInjPlsUpdMode(IN Cyl= x, IN Pulse= 0, IN Plsupd_mode= NONE)
  Enable first pulse
  ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 0, IN Pulse_ena= 1)
  Disable second pulse
  ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 1, IN Pulse_ena= 0)
  Disable third pulse
  ACTION_INFR_SetInjPulseEna(IN Cyl= x, IN Pulse= 2, IN Pulse_ena= 0)
 (2)ENDIF
(1)ENDIF
```

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7.2.17.4 Update injection data

The CSERS_TEST variables show the injection set points which will be activated if CSERS multiple injection diagnosis demo mode is activated and catalyst heating is active. They are also calculated out of demo mode in order to enable a control of the demo mode set points before activating the demo mode.
Be aware that bad calibration of injection pulses, e.g. injection pulse during / after ignition may harm components of the test vehicle.

Calculation of CSERS_INIJ_DIAG test timing and phasing outputs for visibility

```
#IF     NLC_CSERS_INJ_PLS_TEST_CONF == 0
#THEN
  TI_1_HOM_CSERS_TEST[x] = TI_1_HOM[x] * NC_CSERS_INJ_PLS_TEST_TI_FAC[0]
  SOI_1_HOM_CSERS_TEST[x] =
                          SOI_1_HOM[x] + NC_CSERS_INJ_PLS_TEST_ANG_ADD[0]

  TI_2_HOM_CSERS_TEST[x] = TI_2_HOM[x] * NC_CSERS_INJ_PLS_TEST_TI_FAC[1]
  EOI_2_HOM_CSERS_TEST[x] =
                          EOI_2_HOM[x] + NC_CSERS_INJ_PLS_TEST_ANG_ADD[1]

  TI_3_HOM_CSERS_TEST[x] = TI_3_HOM[x] * NC_CSERS_INJ_PLS_TEST_TI_FAC[2]
  EOI_3_HOM_CSERS_TEST[x] =
                          EOI_3_HOM[x] + NC_CSERS_INJ_PLS_TEST_ANG_ADD[2]

#ELSE
  TI_1_HOM_CSERS_TEST[x] = TI_1_HOM[x] * C_CSERS_INJ_PLS_TEST_TI_FAC[0]
  SOI_1_HOM_CSERS_TEST[x] =
                          SOI_1_HOM[x] + C_CSERS_INJ_PLS_TEST_ANG_ADD[0]

  TI_2_HOM_CSERS_TEST[x] = TI_2_HOM[x] * C_CSERS_INJ_PLS_TEST_TI_FAC[1]
  EOI_2_HOM_CSERS_TEST[x] =
                          EOI_2_HOM[x] + C_CSERS_INJ_PLS_TEST_ANG_ADD[1]


  TI_3_HOM_CSERS_TEST[x] = TI_3_HOM[x] * C_CSERS_INJ_PLS_TEST_TI_FAC[2]
  EOI_3_HOM_CSERS_TEST[x] =
                          EOI_3_HOM[x] + C_CSERS_INJ_PLS_TEST_ANG_ADD[2]
#ENDIF

//Transfer data for charge and discharge current.
Note:    In case of active page selection, the data on page 0 refers to high
injector needle lift, the data on page 1 to low injector needle lift.
ACTION_INFR_SetInjChaCur(IN Cyl= x, IN Page= 0,
                         IN Cha_cur= EGY_STEP_INJ_CHA_GRD[x])
ACTION_INFR_SetInjDchaCur(IN Cyl= x, IN Page= 0,
                          IN Dis_cha_cur= EGY_STEP_INJ_DCHA_GRD[x])
#IF  NC_PBK_IV_TYP = 1
#THEN    ACTION_INFR_SetInjChaCur(IN Cyl= x, IN Page= 1,
                                IN Cha_cur= EGY_STEP_INJ_CHA_GRD_L[x])
         ACTION_INFR_SetInjDchaCur(IN Cyl= x, IN Page= 1,
                                IN Dis_cha_cur= EGY_STEP_INJ_DCHA_GRD_L[x])
#ENDIF

IF  LV_INJ_MPLP_CYL[x] = 1         //post injection enabled
THEN    ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 3,
                                 IN Cha_per= T_CHA_PER_POST)
        ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 3,
                                  IN Dis_cha_per= T_DCHA_PER_POST)
  #IF NC_PBK_IV_TYP = 1
  #THEN
```

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```
    IF  LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
    THEN    //Set Page:  high needle lift - page 0; low needle lift - page 1
    ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 3,
                                IN Page= NOT(LV_IV_POST_EGY_RNG))
    ENDIF
  ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 3,
                              IN Seq_end_delay= T_RLS_DLY_DCHA_POST)
  #ENDIF
ACTION_INFR_SetInjSoiLim(IN Cyl= x, IN Packet_nr= 1,
                         IN Soi_lim= - SOI_LIM_POST)
ACTION_INFR_SetInjEoiLim(IN Cyl= x, IN Packet_nr= 1,
                         IN Eoi_lim= - EOI_LIM_POST)
ACTION_INFR_SetInjPulsePosAng(IN Cyl=x, IN Pulse= 3,
                              IN Position_ang= - SOI_POST_INJ[x])
ACTION_INFR_SetInjPulseDurPer(IN Cyl=x, IN Pulse= 3,
                              IN Pls_duration= TI_POST_INJ[x])
ENDIF

//Homogeneous combustion mode:
(1)IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOM
(1)THEN    //Homogeneous mode
 (2)IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_2 ≠ NC_INJ_MOD_SINGLE
 (2)THEN    //homogeneous mode multi injection
  (3)IF  LC_IV_ADD_PLS_MPLH_ENA
  (3)THEN
  ACTION_INFR_SetInjPlsUpdFactor(IN Plsupd_factor= FAC_ADD_PULSE)
  ACTION_INFR_SetInjPlsUpdMinPer(IN Plsupd_min_per= TI_ADD_PULSE_MIN)
  (3)ENDIF
 ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 1,
                          IN Cha_per= T_CHA_PER_HOM_2[x])
 ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 1,
                           IN Dis_cha_per= T_DCHA_PER_HOM_2[x])
 #IF  NC_PBK_IV_TYP = 1
 #THEN
  (4)IF  LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
  (4)THEN   //Set Page:  High needle lift - page 0; low needle lift - page 1
  ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 1,
                              IN Page= NOT(LV_EGY_RNG_IV_PLS_2_HOM[x]))
  (4)ENDIF
 ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 1,
                             IN Seq_end_delay= T_RLS_DLY_DCHA_2_HOM[x])
 #ENDIF
  (21)IF  LV_CSERS_INJ_PLS_TEST_MOD_ENA == 1
  (21)THEN         / * CSERS_INJ demo mode on */
    (22)IF    CLF_CSERS_INJ_PLS_TEST_CYL_ON[1][bit x] == 1
    (22)THEN       / * CSERS_INJ demo mode change for this pulse */
      (23)IF    LC_CSERS_INJ_PLS_TEST_TYP == 0
      (23)THEN    / * move injection phase for CSERS_INJ demo test */
        ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 1,
                                      IN Pls_duration = TI_2_HOM[x])
        ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 1,
                                      IN Position_ang = - EOI_2_HOM_CSERS_TEST[x])

       (23)ELSE     / * change injection time for CSERS_INJ demo test */
       ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 1,
                                     IN Position_ang = - EOI_2_HOM[x])
       ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 1,
                                     IN Pls_duration = TI_2_HOM_CSERS_TEST[x])
      (23)ENDIF
    (22)ELSE     / * test mode active, no pulse change */
     ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 1,
```

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```
                                      IN Position_ang = - EOI_2_HOM[x])
      ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 1,
                                      IN Pls_duration = TI_2_HOM[x])
    (22)ENDIF
  (21)ELSE / *normal mode - CSERS_INJ demo mode not active,no pulse change*/


    ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse= 1,
                                  IN Position_ang= - EOI_2_HOM[x])
    ACTION_INFR_SetInjPulseDurPer(IN Cyl=x, IN Pulse= 1,
                                  IN Pls_duration= TI_2_HOM[x])
  (21)ENDIF

  (5)IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_2 = NC_INJ_MOD_MULTI_PLS3
  (5)THEN     //homogeneous mode triple injection
  ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 2,
                           IN Cha_per= T_CHA_PER_HOM_3[x])
  ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 2,
                            IN Dis_cha_per= T_DCHA_PER_HOM_3[x])
   #IF  NC_PBK_IV_TYP = 1
   #THEN
   (6)IF  LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
   (6)THEN  //Set Page:  High needle lift - page 0; low needle lift - page 1
   ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 2,
                               IN Page= NOT(LV_EGY_RNG_IV_PLS_3_HOM[x]))
   (6)ENDIF
  ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 2,
                              IN Seq_end_delay= T_RLS_DLY_DCHA_3_HOM[x])
   #ENDIF
   (51)IF  LV_CSERS_INJ_PLS_TEST_MOD_ENA == 1
     (51)THEN          / * CSERS_INJ demo mode on */
       (52)IF    CLF_CSERS_INJ_PLS_TEST_CYL_ON[2][bit x] == 1
       (52)THEN        / * CSERS_INJ demo mode change for this pulse */
         (53)IF    LC_CSERS_INJ_PLS_TEST_TYP == 0
         (53)THEN    / * move injection phase for CSERS_INJ demo test */
           ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 2,
                                        IN Pls_duration = TI_3_HOM[x])
           ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 2,
                                  IN Position_ang = - EOI_3_HOM_CSERS_TEST[x])
         (53)ELSE    / * change injection time for CSERS_INJ demo test */
           ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 2,
                                        IN Position_ang = - EOI_3_HOM[x])
           ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 2,
                                  IN Pls_duration = TI_3_HOM_CSERS_TEST[x])
        (53)ENDIF
      (52)ELSE     / * test mode active, no pulse change */
        ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 2,
                                      IN Position_ang = - EOI_3_HOM[x])
        ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 2,
                                      IN Pls_duration = TI_3_HOM[x])
      (52)ENDIF
   (51)ELSE / *normal mode - CSERS_INJ demo mode not active,no pulse change*/

     ACTION_INFR_SetInjPulsePosAng(IN Cyl=x, IN Pulse= 2,
                                   IN Position_ang= - EOI_3_HOM[x])
     ACTION_INFR_SetInjPulseDurPer(IN Cyl=x, IN Pulse= 2,
                                   IN Pls_duration= TI_3_HOM[x])
   (51)ENDIF

  (5)ENDIF
```

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```
SOI_EOI_ACT_UPD[x] = EOI_2_HOM[x]
LV_SOI_ACT_UPD[x]  = 0
TI_ACT_UPD[x]      = TI_2_HOM[x]

(2)ELSE    //homogeneous mode single injection
 Handling of makeup pulse
 (3)IF  LC_IV_ADD_PLS_SNGH_ENA = 1
 (3)THEN    ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 1,
                                     IN Cha_per= T_CHA_PER_HOM[x])
            ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 1,
                                      IN Dis_cha_per= T_DCHA_PER_HOM[x])
  #IF  NC_PBK_IV_TYP = 1
  #THEN
   (4)IF  LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
   (4)THEN    //Set Page:  high needle lift - page 0;
                           low needle lift - page 1
   ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 1,
                               IN Page= NOT(LV_EGY_RNG_IV_PLS_1_HOM[x]))
   (4)ENDIF
  ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 1,
                              IN Seq_end_delay= T_RLS_DLY_DCHA_1_HOM[x])
  #ENDIF
  (5)IF  (LC_INJ_PLS_UPD_MOD = AUTONOMOUS)
  (5)THEN
  EOI_INJ_UPD_PSN = IP_EOI_INJ_UPD_PSN(N_32)
  ACTION_INFR_SetInjPulsePosAng(IN Cyl=x, IN Pulse= 1,
                                IN Position_ang= - EOI_INJ_UPD_PSN)
  (5)ELSE
  ACTION_INFR_SetInjPulsePosAng(IN Cyl=x, IN Pulse= 1,
            IN Position_ang= - MAX(C_SOI_MIN_UPD_PLS_SNGH; EOI_LIM_HOM))
  (5)ENDIF
 ACTION_INFR_SetInjPlsUpdFactor(IN Plsupd_factor= FAC_ADD_PULSE)
 ACTION_INFR_SetInjPlsUpdMinPer(IN Plsupd_min_per= TI_ADD_PULSE_MIN)
  (6)IF  LV_EGY_RNG_IV_PLS_1_HOM[x] = 1
  (6)THEN
  TI_1_ADD_DLY_HOM = IP_TI_ADD_DLY_HPDI_EGY_H(PRS_DEC_INJ_1_HOM[x])
  (6)ELSE
  TI_1_ADD_DLY_HOM = IP_TI_ADD_DLY_HPDI_EGY_L(PRS_DEC_INJ_1_HOM[x])
  (6)ENDIF
 ACTION_INFR_SetInjPlsUpdOffset(IN Cyl= x,
                                IN Plsupd_offset= TI_1_ADD_DLY_HOM)
 SOI_EOI_ACT_UPD[x]  = MAX(C_SOI_MIN_UPD_PLS_SNGH; EOI_LIM_HOM)
 LV_SOI_ACT_UPD[x]   = 1
 (3)ELSE
 SOI_EOI_ACT_UPD[x]  = SOI_1_HOM[x]
 LV_SOI_ACT_UPD[x]   = 1
 (3)ENDIF
(2)ENDIF
Calculations for all homogeneous modes
ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 0,
                         IN Cha_per= T_CHA_PER_HOM[x])
ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 0,
                          IN Dis_cha_per= T_DCHA_PER_HOM[x])
 #IF  NC_PBK_IV_TYP = 1
 #THEN
  (7)IF  LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
  (7)THEN   //Set Page:  high needle lift - page 0; low needle lift - page 1
  ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 0,
                              IN Page= NOT(LV_EGY_RNG_IV_PLS_1_HOM[x]))
  (7)ENDIF
 ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 0,
```

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```
                              IN Seq_end_delay= T_RLS_DLY_DCHA_1_HOM[x])
 #ENDIF
LV_EGY_RNG_IV_PLS_1_ACT[x] = LV_EGY_RNG_IV_PLS_1_HOM[x]
LV_IGN_INJ_COPL_HOM_ACT[x] = LV_EOI_2_DELTA_HOM_CUS
 (8)IF  CRK_WIN_SEL_IGN_INJ[x] ≠ "RTD_WIN"
 (8)THEN    LV_EGY_RNG_IV_PLS_1_ACK[x] = LV_EGY_RNG_IV_PLS_1_ACT[x]
 (8)ENDIF
//Service tool intervention:
 (9)IF  LV_TI_EXT_ADJ[x] = 0
 (9)THEN    //no  service tool intervention
  (91)IF  LV_CSERS_INJ_PLS_TEST_MOD_ENA == 1
  (91)THEN         / * CSERS_INJ demo mode on */
    (92)IF    CLF_CSERS_INJ_PLS_TEST_CYL_ON[1][bit x] == 1
    (92)THEN       / * CSERS_INJ demo mode change for this pulse */
      (93)IF    LC_CSERS_INJ_PLS_TEST_TYP == 0
      (93)THEN    / * move injection phase for CSERS_INJ demo test */
       ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 0,
                               IN Pls_duration = TI_1_HOM[x])
       ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 0,
                        IN Position_ang = - SOI_1_HOM_CSERS_TEST[x])

      (93)ELSE    / * change injection time for CSERS_INJ demo test */
       ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 0,
                               IN Position_ang = - SOI_1_HOM[x])
       ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 0,
                          IN Pls_duration = TI_1_HOM_CSERS_TEST[x])
      (93)ENDIF
    (92)ELSE     / * test mode active, no pulse change */
     ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse = 0,
                               IN Position_ang = - SOI_1_HOM[x])
     ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse = 0,
                               IN Pls_duration = TI_1_HOM[x])
     (92)ENDIF
   (91)ELSE / *normal mode - CSERS_INJ demo mode not active,no pulse change*/

     ACTION_INFR_SetInjPulsePosAng(IN Cyl=x, IN Pulse= 0,
                              IN Position_ang= - SOI_1_HOM[x])
     ACTION_INFR_SetInjPulseDurPer(IN Cyl=x, IN Pulse= 0,
                              IN Pls_duration= TI_1_HOM[x])
   (91)ENDIF

 SOI_EOI_ACT_SWI[x] = SOI_1_HOM[x]
 LV_SOI_ACT_SWI[x]  = 1
 (9)ELSE    //service tool intervention
 ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse= 0,
                          IN Position_ang= - C_SOI_EXT_ADJ)
 ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse= 0,
                          IN Pls_duration= TI_EXT_ADJ[x])
 SOI_EOI_ACT_SWI[x] = C_SOI_EXT_ADJ
 LV_SOI_ACT_SWI[x]  = 1
 (9)ENDIF
ACTION_INFR_SetInjSoiLim  (IN Cyl= x, IN Packet_nr= 0, IN Soi_lim= - SOI_LIM)
ACTION_INFR_SetInjEoiLim  (IN Cyl= x, IN Packet_nr= 0,
                          IN Eoi_lim= - EOI_LIM_HOM)
(1)ENDIF

//Stratified combustion mode:
(1)IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_1 = NC_INJ_MOD_S
(1)THEN
Set limits
ACTION_INFR_SetInjSoiLim(IN Cyl= x, IN Packet_nr= 0,IN Soi_lim= - SOI_LIM)
```

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```
ACTION_INFR_SetInjEoiLim(IN Cyl= x, IN Packet_nr= 0, IN Eoi_lim= 0° CRK)
 (2)IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_2 ≠ NC_INJ_MOD_SINGLE
 (2)THEN    //stratified multi injeciton
 Settings for second pulse:
 Set injector needle lift by charge and discharge time
 ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 1,
                          IN Cha_per= T_CHA_PER_S_2[x])
 ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 1,
                           IN Dis_cha_per= T_DCHA_PER_S_2[x])
  #IF  NC_PBK_IV_TYP = 1
  #THEN
   (3)IF  LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
   (3)THEN  //Set Page:  high needle lift - page 0; low needle lift - page 1
   ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 1,
                               IN Page= NOT(LV_EGY_RNG_IV_PLS_2_S[x]))
   (3)ENDIF
  ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 1,
                              IN Seq_end_delay= T_RLS_DLY_DCHA_2_S[x])
  #ENDIF
 Set time and phasing
 ACTION_INFR_SetInjPulsePosPer(IN Cyl= x, IN Pulse= 1,
                               IN Position_per= T_DLY_1_2_S_EXT[x])
 ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse= 1,
                               IN Pls_duration= TI_2_S[x])
  (4)IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_2 = NC_INJ_MOD_MULTI_PLS3
  (4)THEN    //stratified triple injection
  ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 2,
                           IN Cha_per= T_CHA_PER_S_3[x])
  ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 2,
                            IN Dis_cha_per= T_DCHA_PER_S_3[x])
   #IF  NC_PBK_IV_TYP = 1
   #THEN
    (5)IF  LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
    (5)THEN    //Set Page:  high needle lift - page 0;
                           low needle lift - page 1
    ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 2,
                                IN Page= NOT(LV_EGY_RNG_IV_PLS_3_S[x]))
    (5)ENDIF
   ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 2,
                               IN Seq_end_delay= T_RLS_DLY_DCHA_3_S[x])
   #ENDIF
  ACTION_INFR_SetInjPulsePosPer(IN Cyl=x, IN Pulse= 2,
                                IN Position_per= T_DLY_2_3_S_EXT[x])
  ACTION_INFR_SetInjPulseDurPer(IN Cyl=x, IN Pulse = 2,
                                IN Pls_duration= TI_3_S[x])
  (4)ENDIF
 (2)ENDIF
Stratified mode single injection
Settings for first pulse; Set injector needle lift by charge and discharge time
ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 0,
                         IN Cha_per= T_CHA_PER_S_1[x])
ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 0,
                          IN Dis_cha_per= (T_DCHA_PER_S_1[x])
 #IF  NC_PBK_IV_TYP = 1
 #THEN
  (6)IF  LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
  (6)THEN  //Set Page:  high needle lift - page 0; low needle lift - page 1
  ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 0,
                              IN Page= NOT(LV_EGY_RNG_IV_PLS_1_S[x]))
  (6)ENDIF
 ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 0,
```

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```
                              IN Seq_end_delay= T_RLS_DLY_DCHA_1_S[x])
 #ENDIF
LV_EGY_RNG_IV_PLS_1_ACT[x] = LV_EGY_RNG_IV_PLS_1_S[x]
 (7)IF   CRK_WIN_SEL_IGN_INJ[x] ≠ "RTD_WIN"
 (7)THEN    LV_EGY_RNG_IV_PLS_1_ACK[x] = LV_EGY_RNG_IV_PLS_1_ACT[x]
 (7)ENDIF
Set time and phasing
ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse= 0,
                              IN Position_ang= - EOI_1_S[x])
ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse= 0,
                              IN Pls_duration= TI_1_S[x])
SOI_EOI_ACT_SWI[x] = EOI_1_S[x]
LV_SOI_ACT_SWI[x]  = 0
TI_ACT_SWI[x]      = TI_1_S[x]
SOI_EOI_ACT_UPD[x] = EOI_1_S[x]
LV_SOI_ACT_UPD[x]  = 0
TI_ACT_UPD[x]      = TI_1_S[x]
(1)ENDIF

//Homogeneous Stratified mode:
(1)IF   INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOMS
(1)THEN
Set limits
ACTION_INFR_SetInjSoiLim(IN Cyl= x, IN Packet_nr= 0, IN Soi_lim= - SOI_LIM)
ACTION_INFR_SetInjEoiLim(IN Cyl= x, IN Packet_nr= 0, IN Eoi_lim= 0° CRK)
 (2)IF (INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_2) ≠ NC_INJ_MOD_SINGLE
 (2)THEN    //Homogeneous stratified mode multi injection
 Settings for second pulse:
 Set injector needle lift by charge and discharge time
 ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 1,
                          IN Cha_per= T_CHA_PER_S_2[x])
 ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 1,
                           IN Dis_cha_per= T_DCHA_PER_S_2[x])
  #IF  NC_PBK_IV_TYP = 1
  #THEN
   (3)IF  LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
   (3)THEN  //Set Page:  high needle lift - page 0; low needle lift - page 1
   ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 1,
                               IN Page= NOT(LV_EGY_RNG_IV_PLS_2_S[x]))
   (3)ENDIF
  ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 1,
                              IN Seq_end_delay= T_RLS_DLY_DCHA_2_S[x])
  #ENDIF
 Set time and phasing
 ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse= 1,
                               IN Position_ang= - EOI_2_HOMS[x])
 ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse= 1,
                               IN Pls_duration= TI_2_S[x])
  (4)IF  INJ_MOD[x] BiswiseAND  NC_INJ_MOD_MASK_2 = NC_INJ_MOD_MULTI_PLS3
  (4)THEN    //Homogeneous Stratified mode triple injection
  ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 2,
                           IN Cha_per= T_CHA_PER_S_3[x])
  ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 2,
                            IN Dis_cha_per= T_DCHA_PER_S_3[x])
   #IF  NC_PBK_IV_TYP = 1
   #THEN
    (5)IF  LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
    (5)THEN    //Set Page:  high needle lift - page 0;
                            low needle lift - page 1
    ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 2,
                                IN Page= NOT(LV_EGY_RNG_IV_PLS_3_S[x]))
```

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```
    (5)ENDIF
   ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 2,
                               IN Seq_end_delay= T_RLS_DLY_DCHA_3_S[x])
   #ENDIF
  ACTION_INFR_SetInjPulsePosAng(IN Cyl=x, IN Pulse= 2,
                                IN Position_ang= - EOI_3_HOMS[x])
  ACTION_INFR_SetInjPulseDurPer(IN Cyl=x, IN Pulse= 2,
                                IN Pls_duration= TI_3_S[x])
  (4)ENDIF
 SOI_EOI_ACT_UPD[x] = EOI_2_HOMS[x]
 LV_SOI_ACT_UPD[x]  = 0
 TI_ACT_UPD[x]      = TI_2_S[x]
 (2)ELSE    //homogeneous stratified mode single injection
 SOI_EOI_ACT_UPD[x] = SOI_1_HOMS[x]
 LV_SOI_ACT_UPD[x]  = 1
 (2)ENDIF
Homogeneous Stratified mode single injection and multi injection
Settings for first pulse Set injector needle lift by charge and discharge time
ACTION_INFR_SetInjChaPer(IN Cyl= x, IN Pulse= 0,
                         IN Cha_per= T_CHA_PER_S_1[x])
ACTION_INFR_SetInjDchaPer(IN Cyl= x, IN Pulse= 0,
                          IN Dis_cha_per= T_DCHA_PER_S_1[x])
 #IF  NC_PBK_IV_TYP = 1
 #THEN
  (6)IF  LC_CUR_CHA_INJ_H_L_SEL_ENA = 1
  (6)THEN   //Set Page:  High needle lift - page 0; low needle lift - page 1
  ACTION_INFR_SetInjPulsePage(IN Cyl= x, IN Pulse= 0,
                              IN Page= NOT(LV_EGY_RNG_IV_PLS_1_S[x]))
  (6)ENDIF
 ACTION_INFR_SetInjSeqEndDly(IN Cyl= x, IN Pulse= 0,
                             IN Seq_end_delay= T_RLS_DLY_DCHA_1_S[x])
 #ENDIF
LV_EGY_RNG_IV_PLS_1_ACT[x] = LV_EGY_RNG_IV_PLS_1_S[x]
 (7)IF  CRK_WIN_SEL_IGN_INJ[x] ≠ "RTD_WIN"
 (7)THEN    LV_EGY_RNG_IV_PLS_1_ACK[x] = LV_EGY_RNG_IV_PLS_1_ACT[x]
 (7)ENDIF
Set time and phasing
ACTION_INFR_SetInjPulsePosAng(IN Cyl= x, IN Pulse= 0,
                              IN Position_ang= - SOI_1_HOMS[x])
ACTION_INFR_SetInjPulseDurPer(IN Cyl= x, IN Pulse= 0,
                              IN Pls_duration= TI_1_S[x])
SOI_EOI_ACT_SWI[x] = SOI_1_HOMS[x]
LV_SOI_ACT_SWI[x]  = 1
(1)ENDIF
```

7.2.17.5 Update ignition data

```
IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_1 = NC_INJ_MOD_S
THEN     //stratified combustion mode
IGA_IGC_H_RNG_ACT[x]     = IGA_AV_H_RNG_S[x]
TD_TMP_SYN               = TD_S
ELSE
   IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOMS
   THEN    //homogeneous-stratified combustion mode
   IGA_IGC_H_RNG_ACT[x] = IGA_AV_H_RNG_HOMS[x]
   TD_TMP_SYN           = TD_S
   ELSE    //homogeneous combustion mode
   IGA_IGC_H_RNG_ACT[x] = IGA_AV_H_RNG[x]
   TD_TMP_SYN           = TD
   ENDIF
ENDIF
TD_IGC_ACT[x] = MIN(TD_LIM_MAX; MAX(NC_TD_LIM_MIN; TD_TMP_SYN + TD_AD[x]))
```

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7.2.17.6 Check engine position

```
//This section calculates the actual engine position of the given cylinder x
and the possibility of injection mode switch or data update.

LV_INH_INJ_UPD_MOD_UPD[x] = 0
//Set acknowledged injector needle lift of first injection pulse to value transmitted
to BSW:
LV_EGY_RNG_IV_PLS_1_ACK[x] = LV_EGY_RNG_IV_PLS_1_ACT[x]
CRK_PSN_INJ_BAS[x] = ((720° - PSN_ENG - CRK_INJ_BAS[0]) + (x*720°/ NC_CYL_NR)
                     +720°) MODULO  720°

(1)IF  LC_IGN_UPD_STAT_ENA = 0            OR
       Bit x of STATE_INJ_UPD_ENA = 1
(1)THEN    CRK_PSN_ENG_IGN_INJ_UPD[x] = CRK_PSN_INJ_BAS[x] -
                                        C_T_OFS_UPD_IGN_INJ_SYN * FAC_N
//Note:    In case of C_T_OFS_UPD_IGN_INJ_SYN * FAC_N > CRK_PSN_INJ_BAS[x], limit
CRK_PSN_ENG_IGN_INJ_UPD[x] to zero!

CRK_WIN_SEL_TMP  = "NO_WIN"
CRK_WIN_SEL_PREV = CRK_WIN_SEL_IGN_INJ[x]
 (2)IF  CRK_PSN_INJ_BAS[x] < CRK_PSN_STAT_WIN_ST
 (2)THEN    CRK_WIN_SEL_TMP = "RTD_WIN"
 (2)ELSE
  (3)IF  CRK_PSN_INJ_BAS[x] > CRK_PSN_STAT_WIN_END
  (3)THEN   CRK_WIN_SEL_TMP = "ADC_WIN"
  (3)ELSE
   (4)IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOM
   (4)THEN
    (5)IF  INJ_MOD[x] = "SNGH"
    (5)THEN
     (6)IF  LV_ADD_PULSE_ENA = 0                                        OR
            LV_EGY_RNG_IV_PLS_1_HOM[x] ≠ LV_EGY_RNG_IV_PLS_1_ACT[x]   OR
            LC_IV_ADD_PLS_SNGH_ENA = 0                                  OR
            (LV_IGN_INJ_COPL_HOM_ACT[x] ≠ LV_EOI_2_DELTA_HOM_CUS
            AND  LC_IGN_INJ_COPL_MOD_SWI_ENA = 1)
     (6)THEN    LV_INH_INJ_UPD_MOD_UPD[x] = 1
     (6)ENDIF
    (5)ELSE
     (7)IF  LV_EGY_RNG_IV_PLS_1_HOM[x] ≠ LV_EGY_RNG_IV_PLS_1_ACT[x]    OR
           (LV_EGY_RNG_IV_PLS_1_HOM[x] = 0
           AND  LV_EGY_RNG_IV_PLS_2_HOM[x] = 1)                         OR
           LC_IV_ADD_PLS_MPLH_ENA = 0                                   OR
           LV_INJ_DI_PLS_UPD_MPLH = 1                                   OR
           (LV_IGN_INJ_COPL_HOM_ACT[x] ≠ LV_EOI_2_DELTA_HOM_CUS
           AND  LC_IGN_INJ_COPL_MOD_SWI_ENA = 1)
     (7)THEN    LV_INH_INJ_UPD_MOD_UPD[x] = 1
     (7)ENDIF
    (5)ENDIF
   (4)ENDIF
   (8)IF  (INJ_MOD[x] = "HOMS" OR  INJ_MOD[x] = "HOMS+PLS3")    AND
          LV_EGY_RNG_IV_PLS_1_S[x] ≠ LV_EGY_RNG_IV_PLS_1_ACT[x]
   (8)THEN    LV_INH_INJ_UPD_MOD_UPD[x] = 1
   (8)ENDIF
   (9)IF  INJ_MOD[x] ≠ INJ_MOD_SP[x]    OR
          LV_INH_INJ_UPD_MOD_UPD[x] = 1
   (9)THEN    //check window for switching to INJ_MOD_SP[x]
      LV_INJ_MOD_UPD = 0
   (9)ELSE    //check window for update of INJ_MOD[x]
      LV_INJ_MOD_UPD = 1
   (9)ENDIF
```

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```
   Calculate subroutine  "check variable window"(input:  LV_INJ_MOD_UPD;
                                              output:  LV_IGN_INJ_UPD_WIN)
   (10)IF  LV_IGN_INJ_UPD_WIN = 1
   (10)THEN     CRK_WIN_SEL_TMP   = "ADC_WIN"
   (10)ENDIF
  (3)ENDIF
 (2)ENDIF
CRK_WIN_SEL_IGN_INJ[x] = CRK_WIN_SEL_TMP
 (11)IF  LC_IGN_UPD_STAT_ENA = 0
 (11)THEN
  (12)IF  CRK_WIN_SEL_TMP = "ADC_WIN"    OR
          CRK_WIN_SEL_TMP = "NO_WIN" AND  CRK_WIN_SEL_PREV = "RTD_WIN"
  (12)THEN    STATE_UPD_IGN[x]   = "TRIG_IT"
  (12)ELSE    STATE_UPD_IGN[x]   = "NONE"
  (12)ENDIF
 (11)ELSE
  (13)IF  INJ_MOD[x] ≠ INJ_MOD_SP[x]
  (13)THEN
   (14)IF  CRK_WIN_SEL_TMP = "ADC_WIN"   OR
           (CRK_WIN_SEL_TMP ≠ "RTD_WIN"
           AND  CRK_PSN_INJ_BAS[x] < CRK_PSN_STAT_IGN_UPD_ST
           AND  CRK_PSN_INJ_BAS[x] > CRK_PSN_STAT_IGN_UPD_END)
   (14)THEN    STATE_UPD_IGN[x]  = "TRIG_IT"
   (14)ELSE    STATE_UPD_IGN[x]  = "NONE"
   (14)ENDIF
  (13)ELSE
   (15)IF  CRK_PSN_INJ_BAS[x] < CRK_PSN_STAT_IGN_UPD_ST   AND
           CRK_PSN_INJ_BAS[x] > CRK_PSN_STAT_IGN_UPD_END
   (15)THEN    STATE_UPD_IGN[x]  = "TRIG_IT"
   (15)ELSE    STATE_UPD_IGN[x]  = "NONE"
   (15)ENDIF
  (13)ENDIF
 (11)ENDIF
(1)ELSE
CRK_WIN_SEL_IGN_INJ[x] = "NO_CLC"
  IF  CRK_PSN_INJ_BAS[x] < CRK_PSN_STAT_IGN_UPD_ST   AND
      CRK_PSN_INJ_BAS[x] > CRK_PSN_STAT_IGN_UPD_END
  THEN    STATE_UPD_IGN[x]       = "TRIG_IT"
  ELSE    STATE_UPD_IGN[x]       = "NONE"
  ENDIF
(1)ENDIF
```

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7.2.17.7 Check variable window

//This section calculates, if an injection mode switch (LV_INJ_MOD_UPD = 0) or an injection data update at no mode switch (LV_INJ_MOD_UPD = 1) is possible. Therefore, the engine position must be within the "variable window". This is indicated by LV_IGN_INJ_UPD_WIN = 1.
Note: *This section works like a function with LV_INJ_MOD_UPD as input and LV_IGN_INJ_UPD_WIN as output.*

```
LV_IGN_INJ_UPD_WIN = 0
IF  CRK_PSN_ENG_IGN_INJ_UPD[x] > (IGA_IGC_H_RNG_ACT[x] - CRK_INJ_BAS[0]
                                 + TD_IGC_ACT[x] * FAC_N)
THEN
  IF  LV_INJ_MOD_UPD = 1
  THEN    //calculate temporary values of previous SOI for data update
    IF  LV_SOI_ACT_UPD[x] = 1
    THEN    SOI_TMP_SYN_PREV = SOI_EOI_ACT_UPD[x]
    ELSE    SOI_TMP_SYN_PREV = SOI_EOI_ACT_UPD[x] + TI_ACT_UPD[x] * FAC_N
    ENDIF
  ELSE    //calculate temporary values of previous SOI for injection mode
            switch
    IF   LV_SOI_ACT_SWI[x] = 1
    THEN    SOI_TMP_SYN_PREV = SOI_EOI_ACT_SWI[x]
    ELSE    SOI_TMP_SYN_PREV = SOI_EOI_ACT_SWI[x] + TI_ACT_SWI[x] * FAC_N
    ENDIF
  ENDIF
    IF  CRK_PSN_ENG_IGN_INJ_UPD[x] > SOI_TMP_SYN_PREV
    THEN    Calculate subroutine "Determine new ignition and injection
                                  values for variable window"
      IF  CRK_PSN_ENG_IGN_INJ_UPD[x] > MAX(IGA_TMP_SYN - CRK_INJ_BAS[0] +
           (TD_TMP_SYN + TD_AD[x]) * FAC_N; SOI_TMP_SYN)
      THEN    //switch or update to new ignition and injection data also
                possible
              LV_IGN_INJ_UPD_WIN = 1
      ENDIF
    ENDIF
ENDIF
```

7.2.17.8 Determine new ignition and injection values for variable window

//This section calculates the temporary values of ignition angle, dwell time and start of injection for either mode switch (LV_INJ_MOD_UPD = 0) or data update in case of no mode switch (LV_INJ_MOD_UPD = 1).

```
(1)IF  LV_INJ_MOD_UPD = 1
(1)THEN    //calculate temporary values for data update
 (2)IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_1 = NC_INJ_MOD_S
 (2)THEN    //stratified combustion mode
 IGA_TMP_SYN  = IGA_AV_H_RNG_S[x]
 TD_TMP_SYN   = TD_S
 SOI_TMP_SYN  = EOI_1_S[x] + TI_1_S[x] * FAC_N
 (2)ELSE
  (3)IF  INJ_MOD[x] BitwiseAND  NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOMS
  (3)THEN    //homogeneous-stratified combustion mode
  IGA_TMP_SYN = IGA_AV_H_RNG_HOMS[x]
  TD_TMP_SYN  = TD_S
   (4)IF  INJ_MOD[x] = "HOMS_SNG"
   (4)THEN    SOI_TMP_SYN = SOI_1_HOMS[x]
   (4)ELSE    SOI_TMP_SYN = EOI_2_HOMS[x] + TI_2_S[x] * FAC_N
```

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```
    (4)ENDIF
   (3)ELSE     //homogeneous combustion mode
   IGA_TMP_SYN = IGA_AV_H_RNG[x]
   TD_TMP_SYN  = TD
    (5)IF  INJ_MOD[x] = "SNGH"
    (5)THEN
     (6)IF  LC_IV_ADD_PLS_SNGH_ENA = 1
     (6)THEN    SOI_TMP_SYN = MAX(C_SOI_MIN_UPD_PLS_SNGH; EOI_LIM_HOM)
     (6)ELSE    SOI_TMP_SYN = SOI_1_HOM[x]
     (6)ENDIF
    (5)ELSE
    SOI_TMP_SYN = EOI_2_HOM[x] + TI_2_HOM[x] * FAC_N
    (5)ENDIF
   (3)ENDIF
  (2)ENDIF
 (1)ELSE     //calculate temporary values for mode switch
  (7)IF  INJ_MOD_SP[x] BitwiseAND  NC_INJ_MOD_MASK_1 = NC_INJ_MOD_S
  (7)THEN    //stratified combustion mode
  IGA_TMP_SYN  = IGA_AV_H_RNG_S[x]
  TD_TMP_SYN   = TD_S
  SOI_TMP_SYN  = EOI_1_S[x] + TI_1_S[x] * FAC_N
  (7)ELSE
   (8)IF  INJ_MOD_SP[x] BitwiseAND  NC_INJ_MOD_MASK_1 = NC_INJ_MOD_HOMS
   (8)THEN    //homogeneous-stratified combustion mode
   IGA_TMP_SYN = IGA_AV_H_RNG_HOMS[x]
   TD_TMP_SYN  = TD_S
   SOI_TMP_SYN = SOI_1_HOMS[x]
   (8)ELSE    //homogeneous combustion mode
   IGA_TMP_SYN = IGA_AV_H_RNG[x]
   TD_TMP_SYN  = TD
   SOI_TMP_SYN = SOI_1_HOM[x]
   (8)ENDIF
  (7)ENDIF
 (1)ENDIF
```

7.2.18 ACTION_INJR_IgnUpdate

```
IGA_IGC_H_RNG_ACT[Cyl] = Iga_Igc_H_Rng
STATE_UPD_IGN[Cyl]     = "TRIG_EXT"
```

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7.3 Transfer to basic software for injection (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_CHA_IV_MES_PBK [NC_PBK_IV_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Factor to correct the measured injector charge due to end of line trimming					
FAC_V_IV_MES_PBK [NC_PBK_IV_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Factor to correct the measured injector voltage due to end of line trimming					

Input data:

C_FAC_CHA_IV_MES_ PBK_0_0	C_FAC_CHA_IV_MES_ PBK_0_1	C_FAC_CHA_IV_MES_ PBK_0_CPL	C_FAC_CHA_IV_MES_ PBK_1_0
C_FAC_CHA_IV_MES_ PBK_1_1	C_FAC_CHA_IV_MES_ PBK_1_CPL	C_FAC_V_IV_MES_PBK_ 0_0	C_FAC_V_IV_MES_PBK_ 0_1
C_FAC_V_IV_MES_PBK_ 0_CPL	C_FAC_V_IV_MES_PBK_ 1_0	C_FAC_V_IV_MES_PBK_ 1_1	C_FAC_V_IV_MES_PBK_ 1_CPL
NC_PBK_IV_NR {p. 628}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_CHA_IV_MES_PBK_MAX_PLAUS	-	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum value for injector charge correction plausibility check due to end of line trimming					
C_FAC_CHA_IV_MES_PBK_MIN_PLAUS	-	0... FFFFH	0... 1.99996	30.5e-6	-
Minimum value for injector charge correction plausibility check due to end of line trimming					
C_FAC_V_IV_MES_PBK_MAX_PLAUS	-	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum value for injector voltage correction plausibility check due to end of line trimming					
C_FAC_V_IV_MES_PBK_MIN_PLAUS	-	0... FFFFH	0... 1.99996	30.5e-6	-
Minimum value for injector voltage correction plausibility check due to end of line trimming					
LC_FAC_IV_MES_PBK_ENA	-	0... 1H	0 ...1	1	-
Switch to enable the use of ECU end of line trimming values for injector voltage and charge measurement					

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FUNCTION DESCRIPTION:

This function reads the ECU end of line trimming values for piezo injector energy measurement. A check against the complementary values is done as well as a plausibility check.

General information:

The pizo injector energy measurement consists of a voltage measurement and a charge measurement. Both kinds of measurement have to be calibrated at the end of production line (EOL trimming) to improve measurement accuracy. The results of the EOL trimming are one correction factor for voltage measurement and one correciton factor for charge measurement for each injection driver ATIC.

Signal flow diagram:

-

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Description:

If the functionality is activated by LC, each values are checked against their complementary values which are also stored within the ECU at end of produciton line. After that, a plausibility check is done by using an upper and a lower threshold. If the complementary check or the plausibility check fails or if the functionality is deactivated by LC, the trimming factors are set to 1.

Application conditions

Initialisation: –

Recurrence: *only once at reset*

Activation: *every engine state*

Deactivation: –

Formula section:

(1) IF LC_FAC_IV_MES_PBK_ENA = 1
(1) THEN

Injector voltage correction of first power bank:
Check the ECU end of line trimming values against their binary complement and select a valid value or set the correction factor to one in case of invalid trimming values.
(2) IF (C_FAC_V_IV_MES_PBK_0_0 **BitwiseXOR** C_FAC_V_IV_MES_PBK_0_CPL = FFFFH)
(2) THEN
FAC_V_IV_MES_PBK[0] = C_FAC_V_IV_MES_PBK_0_0
(2) ELSE
(3) IF (C_FAC_V_IV_MES_PBK_0_1 **BitwiseXOR** C_FAC_V_IV_MES_PBK_0_CPL = FFFFH)
(3) THEN
FAC_V_IV_MES_PBK[0] = C_FAC_V_IV_MES_PBK_0_1
(3) ELSE
FAC_V_IV_MES_PBK[0] = 1
(3) ENDIF
(2) ENDIF

Check the calculated correction factor for plausibility
(4) IF (FAC_V_IV_MES_PBK[0] > C_FAC_V_IV_MES_PBK_MAX_PLAUS **OR** (FAC_V_IV_MES_PBK[0] < C_FAC_V_IV_MES_PBK_MIN_PLAUS)
(4) THEN
FAC_V_IV_MES_PBK[0] = 1
(4) ENDIF

Injector charge correction of first power bank:
Check the ECU end of line trimming values against their binary complement and select a valid value or set the correction factor to one in case of invalid trimming values.
(5) IF (C_FAC_CHA_IV_MES_PBK_0_0 **BitwiseXOR** C_FAC_CHA_IV_MES_PBK_0_CPL = FFFFH)
(5) THEN
FAC_CHA_IV_MES_PBK[0] = C_FAC_CHA_IV_MES_PBK_0_0
(5) ELSE

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(6) IF (C_FAC_CHA_IV_MES_PBK_0_1 **BitwiseXOR** C_FAC_CHA_IV_MES_PBK_0_CPL = FFFFH)
(6) THEN
FAC_CHA_IV_MES_PBK[0] = C_FAC_CHA_IV_MES_PBK_0_1
(6) ELSE
FAC_CHA_IV_MES_PBK[0] = 1
(6) ENDIF
(5) ENDIF

Check the calculated correction factor for plausibility
(7) IF (FAC_CHA_IV_MES_PBK[0] > C_FAC_CHA_IV_MES_PBK_MAX_PLAUS **OR** (FAC_CHA_IV_MES_PBK[0] < C_FAC_CHA_IV_MES_PBK_MIN_PLAUS)
(7) THEN
FAC_CHA_IV_MES_PBK[0] = 1
(7) ENDIF

Injector voltage correction of second power bank:
Check the ECU end of line trimming values against their binary complement and select a valid value or set the correction factor to one in case of invalid trimming values.
(8) IF (C_FAC_V_IV_MES_PBK_1_0 **BitwiseXOR** C_FAC_V_IV_MES_PBK_1_CPL = FFFFH)
(8) THEN
FAC_V_IV_MES_PBK[1] = C_FAC_V_IV_MES_PBK_1_0
(8) ELSE
(9) IF (C_FAC_V_IV_MES_PBK_1_1 **BitwiseXOR** C_FAC_V_IV_MES_PBK_1_CPL = FFFFH)
(9) THEN
FAC_V_IV_MES_PBK[1] = C_FAC_V_IV_MES_PBK_1_1
(9) ELSE
FAC_V_IV_MES_PBK[1] = 1
(9) ENDIF
(8) ENDIF

Check the calculated correction factor for plausibility
(10) IF (FAC_V_IV_MES_PBK[1] > C_FAC_V_IV_MES_PBK_MAX_PLAUS **OR** (FAC_V_IV_MES_PBK[1] < C_FAC_V_IV_MES_PBK_MIN_PLAUS)
(10) THEN
FAC_V_IV_MES_PBK[1] = 1
(10) ENDIF

Injector charge correction of second power bank:
Check the ECU end of line trimming values against their binary complement and select a valid value or set the correction factor to one in case of invalid trimming values.
(11) IF (C_FAC_CHA_IV_MES_PBK_1_0 **BitwiseXOR** C_FAC_CHA_IV_MES_PBK_1_CPL = FFFFH)
(11) THEN
FAC_CHA_IV_MES_PBK[1] = C_FAC_CHA_IV_MES_PBK_1_0
(11) ELSE
(12) IF (C_FAC_CHA_IV_MES_PBK_1_1 **BitwiseXOR** C_FAC_CHA_IV_MES_PBK_1_CPL = FFFFH)
(12) THEN
FAC_CHA_IV_MES_PBK[1] = C_FAC_CHA_IV_MES_PBK_1_1

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```
            (12) ELSE
                        FAC_CHA_IV_MES_PBK[1] = 1
            (12) ENDIF
    (11) ENDIF

    Check the calculated correction factor for plausibility
    (13) IF  (FAC_CHA_IV_MES_PBK[1] > C_FAC_CHA_IV_MES_PBK_MAX_PLAUS   OR
             (FAC_CHA_IV_MES_PBK[1] < C_FAC_CHA_IV_MES_PBK_MIN_PLAUS)
    (13) THEN
             FAC_CHA_IV_MES_PBK[1] = 1
    (13) ENDIF

(1) ELSE
        (1) FOR   i = 0   TO   NC_PBK_IV_NR - 1
                FAC_V_IV_MES_PBK[i] = 1
             FAC_CHA_IV_MES_PBK[i] = 1
        (1) ENDFOR
(1) ENDIF
```

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7.4 Restart function

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_ST_REST	O/V	0... FFH	0... 1.9921875	0.0078125	-
Restart factor for the correction of mass fuel flow at start					

Input data:

LV_REST {p. 1766}	LV_STALL {p. 1766}	LV_T_REL_CAN_REG {p. 1567}	T_AST_REST {p. 1766}
T_ES_2 {p. 1444}	TCO {p. 1100}	TCO_STOP {p. 1100}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_REST	-	0... FFH	0... 0.99609307	0.00390625	-
LDP_T_AST_REST	8	0... FFFFH	0... 6553.5	0.1	s
LDP_TCO_STOP__FAC_REST	8	0... FEH	0... 142.5	0.75	°C
Considering coolant stop temperature and after start time for re start calculation					
IP_FAC_STALL	-	0... FFH	0... 0.99609307	0.00390625	-
LDPM_TCO__FAC_STALL	8	0... FEH	0... 142.5	0.75	°C
Special cold start reduction factor in case of re start after engine stall out					
IP_FAC_STND_REST	-	0... FFH	0... 0.99609307	0.00390625	-
LDPM_TCO__TI_ST_REST	8	0... FEH	0... 142.5	0.75	°C
Cold start reduction factor in case of re start with no engine stop time T_ES available					
IP_REST	-	0... FFH	0... 0.99609307	0.00390625	-
LDP_T_ES_2_REST	10	0... FFFFH	0... 1092.25	0.01666667	min
Considering the shut off time for re start calculation					

7.4.1 FMSP_M7003

FUNCTION DESCRIPTION:
General information:
In order to improve restarts, a correction factor of mass fuel flow during preinjection and start injection is calculated. This factor is multiplicative and decreases the mass fuel flow. In order to prevent, that no calculation of T_ES was done, the T_ES calculation task is called.

Application Condition

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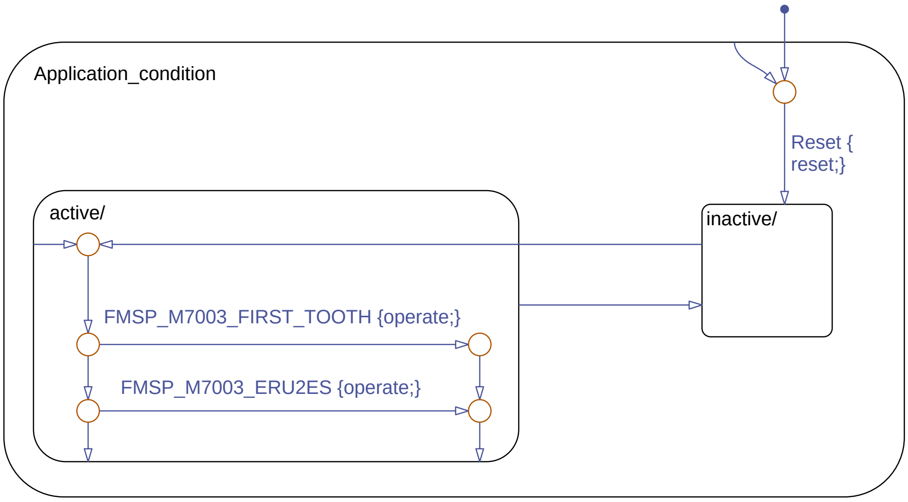

Figure 7.4.1: FMSP_M7003/APP_CDN/Chart

Function Description

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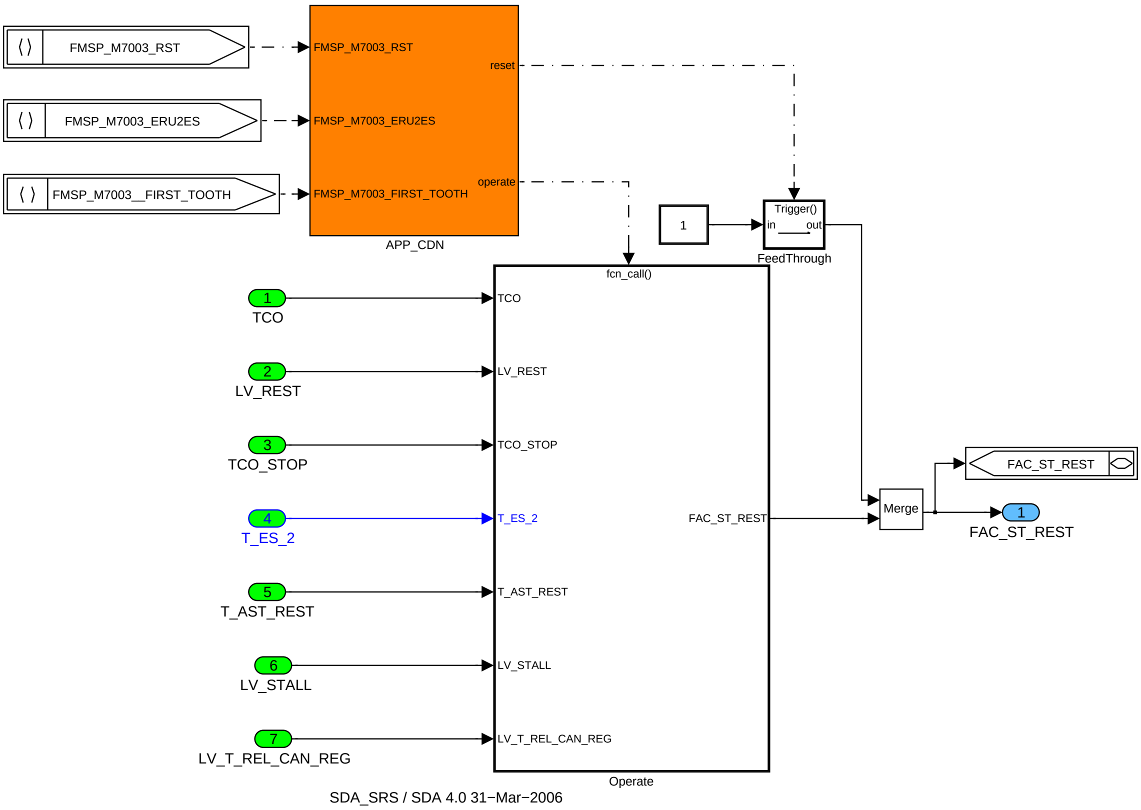

Figure 7.4.2: FMSP_M7003

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7.4.1.1 SUBFUNCTION: Operate

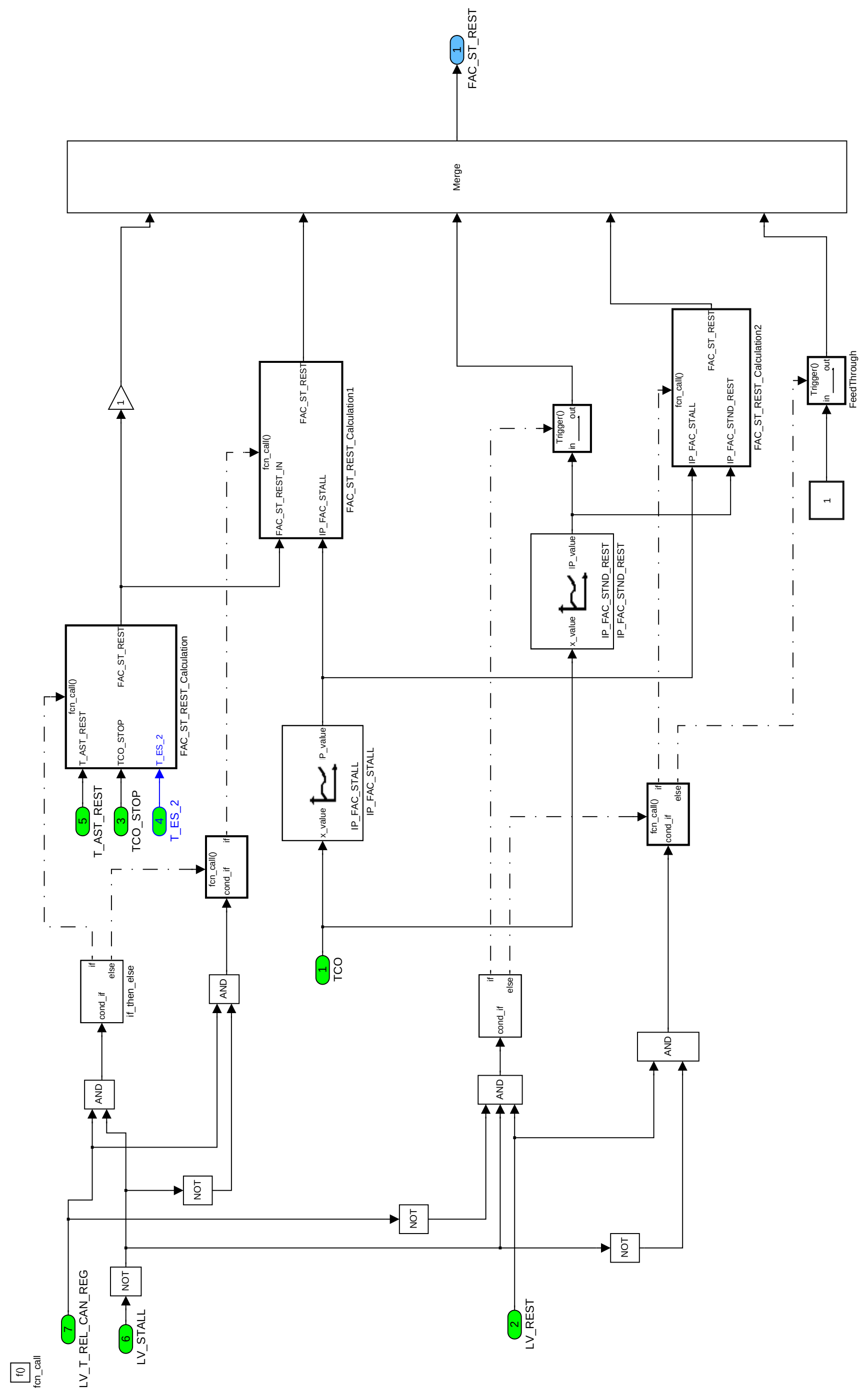

Figure 7.4.3: FMSP_M7003/Operate

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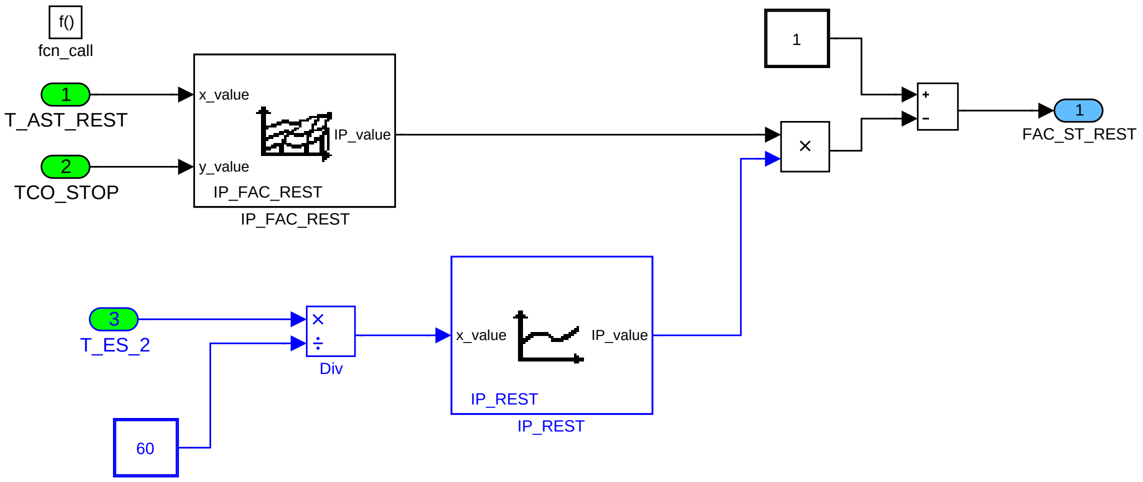

Figure 7.4.4: FMSP_M7003/Operate/FAC_ST_REST_Calculation

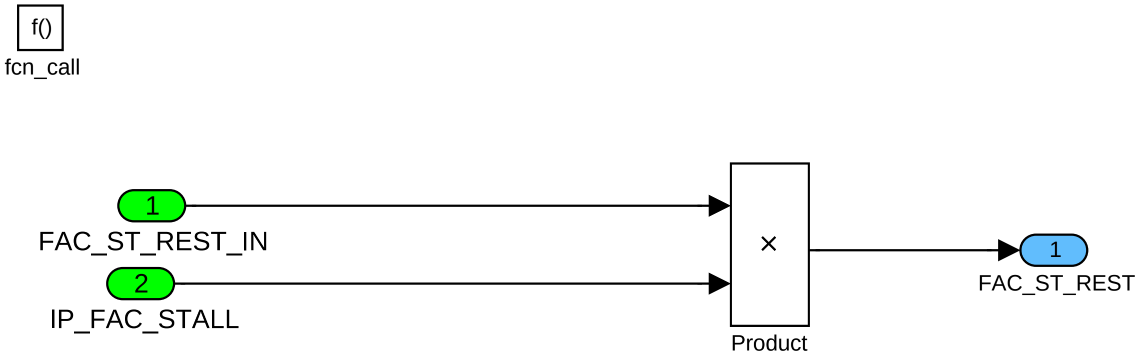

Figure 7.4.5: FMSP_M7003/Operate/FAC_ST_REST_Calculation1

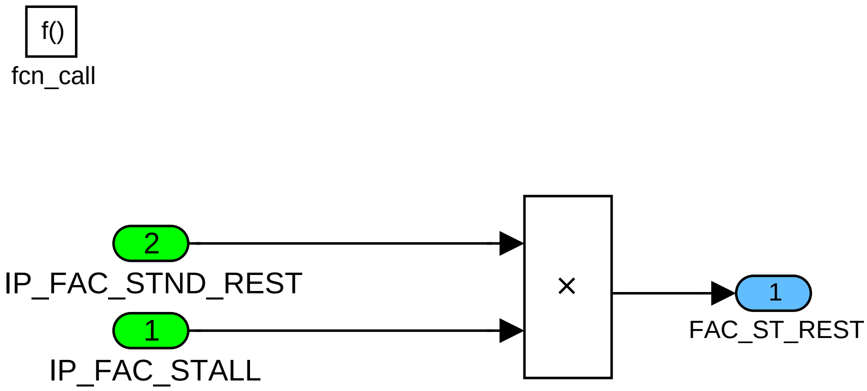

Figure 7.4.6: FMSP_M7003/Operate/FAC_ST_REST_Calculation2

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7.5 Ambient pressure correction at start

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_ST_AMP	O/V	0... FFH	0... 1.9922	0.0078	-
Injection correction at start upon AMP					

Input data:

AMP {p. 982}	LV_ST_END {p. 1720}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_ST_AMP	-	0... FFH	0... 1.9922	0.0078	-
LDP_AMP_IP_FAC_ST_AMP	6	0... FFFFH	0... 5434	0.083	hPa
Cranking injection time correction upon ambient pressure					

Overview:

The purpose of this strategy is to correct the injection time depending on the ambient pressure before the MAF (manifold air pressure) variable is available.

Application conditions

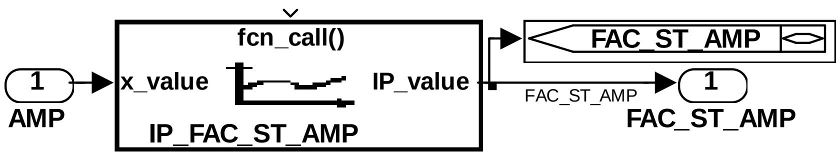
Activation: LV_ST_END =0

Deactivation: –

Initialization: –

Recurrence: 10 ms

FUNCTION DESCRIPTION:



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7.6 Cold post start correction

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TI_CAST_FUP	V	0... FFH	0... 1.9921875	0.0078125	-
Factor for weighting the influence of fuel pressure on cold post start injection					
LV_AST_END	O/V	0... 1H	0 ...1	1	-
logical bit for after start end					
TI_CAST	O/V	0... FFFFH	0... 3.99993896	610.352e3	-
cold post start injection time correction					
TI_CAST_H_PRS	V	0... FFFFH	0... 3.99993896	610.352e3	-
cold start fuel mass flow at high fuel pressure					
TI_CAST_LIH_L_PRS	V	0... FFFFH	0... 3.99993896	610.352e3	-
cold start fuel mass flow at limb home low fuel pressure					

Input data:

CYC_CAST {p. 1766}	FAC_ST_REST {p. 2094}	FUP {p. 1283}	LV_AST {p. 1766}
LV_CLC_2SEG {p. 1825}	LV_CLC_2SEG_ENA {p. 1825}	LV_ST_END {p. 1720}	MAF_HB {p. 805}
N_32 {p. 1525}	TCO {p. 1100}	TIA {p. 1226}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_TI_CAST_FUP	-	0... FFH	0... 0.99609375	0.00390625	-
Low pass filter correlation constant for the weighting factor of fuel pressure					
IP_FAC_REST_TI_CAST_H_PRS	-	0... FFH	0... 0.99609375	0.00390625	-
LDPM_CYC_CAST_1	8	0... FFFFH	0... 65535	1	-
LDPM_FAC_ST_REST	6	0... FFH	0... 1.9921875	0.0078125	-
Correction of TI_CAST at restart high fuel pressure					
IP_FAC_REST_TI_CAST_LIH_L_PRS	-	0... FFH	0... 0.99609375	0.00390625	-
LDPM_CYC_CAST_1	8	0... FFFFH	0... 65535	1	-
LDPM_FAC_ST_REST	6	0... FFH	0... 1.9921875	0.0078125	-
Correction of TI_CAST at restart low fuel pressure					
IP_FAC_TI_CAST_FUP	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_FUP_FAC_TI_CAST	6	0... FFFFH	0... 347776	5.3067216	hPa
Factor for weighting the influence of fuel pressure on cold post start injection					
IP_FAC_TI_CAST_H_PRS	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_MAF_6	8	0... FFH	0... 1389	5.44705882	mg/stk
LDPM_N_3_9	8	0... FFH	0... 8160	32	rpm
Cold after start injection correction at high fuel pressure (engine operating point)					
IP_FAC_TI_CAST_LIH_L_PRS	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_MAF_6	8	0... FFH	0... 1389	5.44705882	mg/stk
LDPM_N_3_9	8	0... FFH	0... 8160	32	rpm
Cold after start injection correction at limp home low fuel pressure (engine operating point)					
IP_TI_CAST_H_PRS	-	0... FFH	0... 3.984375	0.015625	-
LDPM_TIA_IP_TI_CAST	2	0... FEH	0... 142.5	0.75	°C

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_TCO__MFF_DEAC_CST	10	0... FEH	0... 142.5	0.75	°C
Initialization value of post start enrichment factor at high fuel pressure					
IP_TI_CAST_LIH_L_PRS	-	0... FFH	0... 3.984375	0.015625	-
LDPM_TIA_IP_TI_CAST	2	0... FEH	0... 142.5	0.75	°C
LDPM_TCO__MFF_DEAC_CST	10	0... FEH	0... 142.5	0.75	°C
Initialization value of post start enrichment factor at low fuel pressure					
IP_TI_DEAC_CAST_H_PRS	-	0... FFH	0... 0.99609307	0.00390625	-
LDPM_CYC_CAST_2	16	0... FFFFH	0... 65535	1	-
LDPM_TCO__MFF_DEAC_CST	10	0... FEH	0... 142.5	0.75	°C
Deactivation factor of post start enrichment at high fuel pressure					
IP_TI_DEAC_CAST_LIH_L_PRS	-	0... FFH	0... 0.99609307	0.00390625	-
LDPM_CYC_CAST_2	16	0... FFFFH	0... 65535	1	-
LDPM_TCO__MFF_DEAC_CST	10	0... FEH	0... 142.5	0.75	°C
Deactivation factor of post start enrichment at low fuel pressure					

7.6.1 FMSP_M7009

FUNCTION DESCRIPTION:
General information:
This enrichment takes place just after start in order to ensure the first combustions in cold conditions.
CYC_CAST is first the number of cycles (segments) at start. At the transition to after start, the counter is reset and represents then the number of afterstart cycles during LV_AST=1.
Depending on fuel pressure FUP the functionality weighs up 2 cold post start injection times. Both injection times are calculated continuously and depending on a factor based on fuel pressure a interpolation between high and low pressure path estimates the executed after start injection TI_CAST.

Application conditions:
Initialisation: all outputs = 0 at ECU reset
Recurrence: segmentsynchronous
Activation: Post start auxiliary function (LV_AST) activated (exit from LV_ST to LV_IS or LV_PL) and (LV_CLC_2SEG = 1 or LV_CLC_2SEG_ENA = 0)
Deactivation: not Activation

Application Condition

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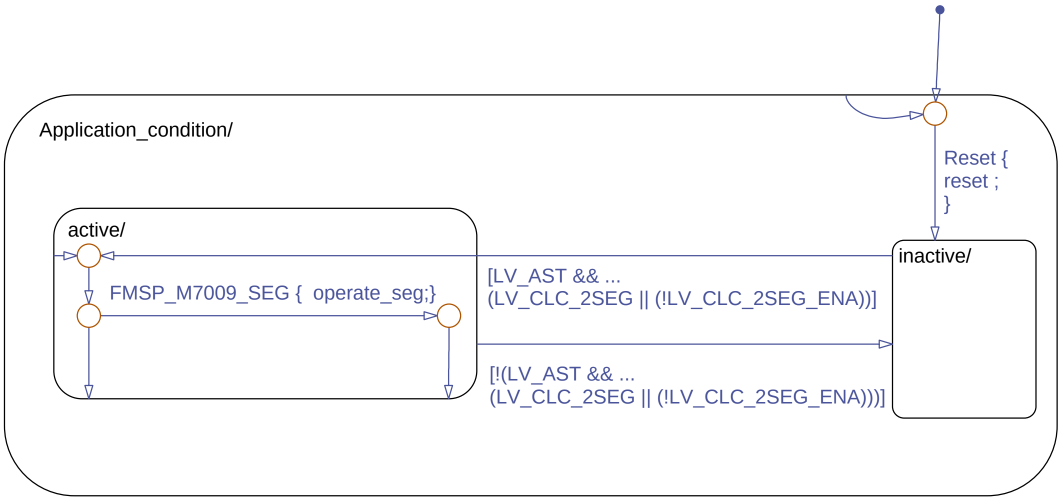

Function Description

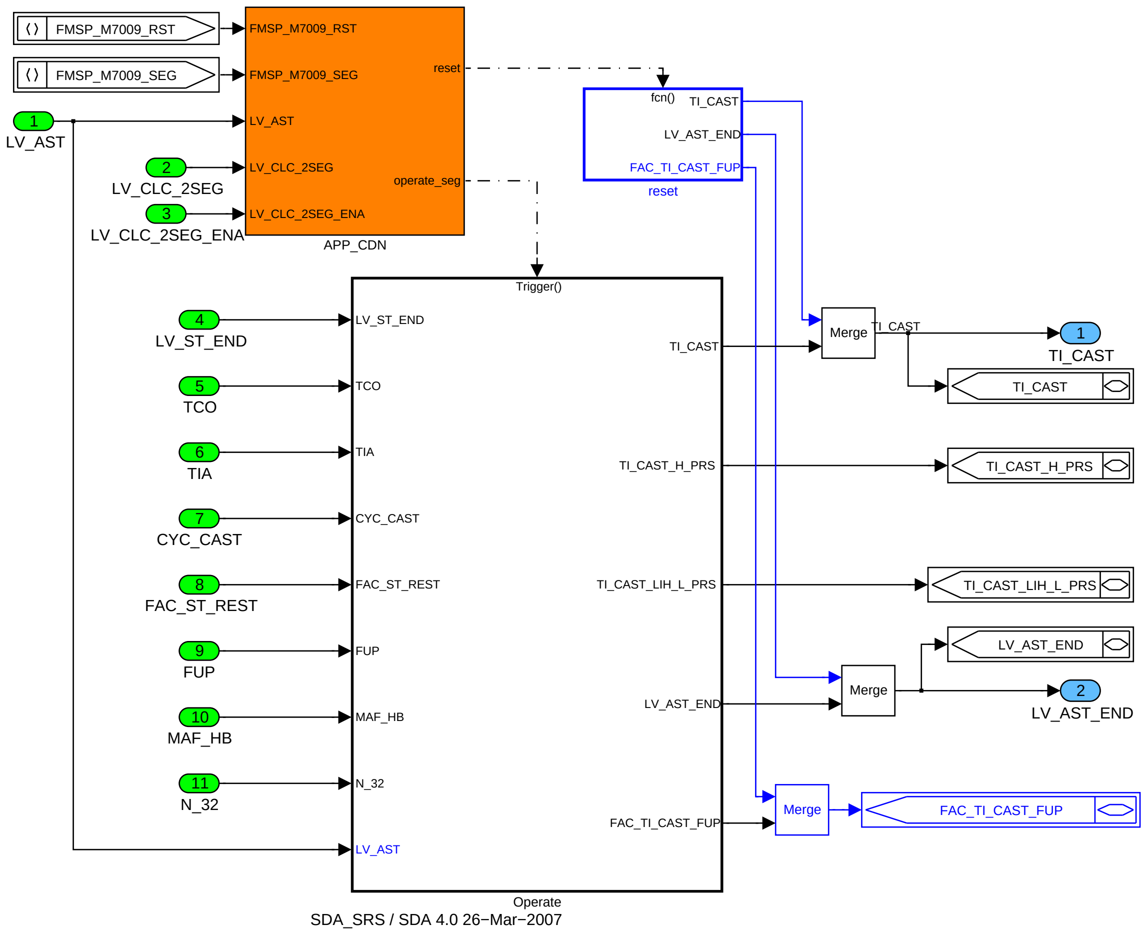

Figure 7.6.1: FMSP_M7009

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7.6.1.1 SUBFUNCTION: Operate

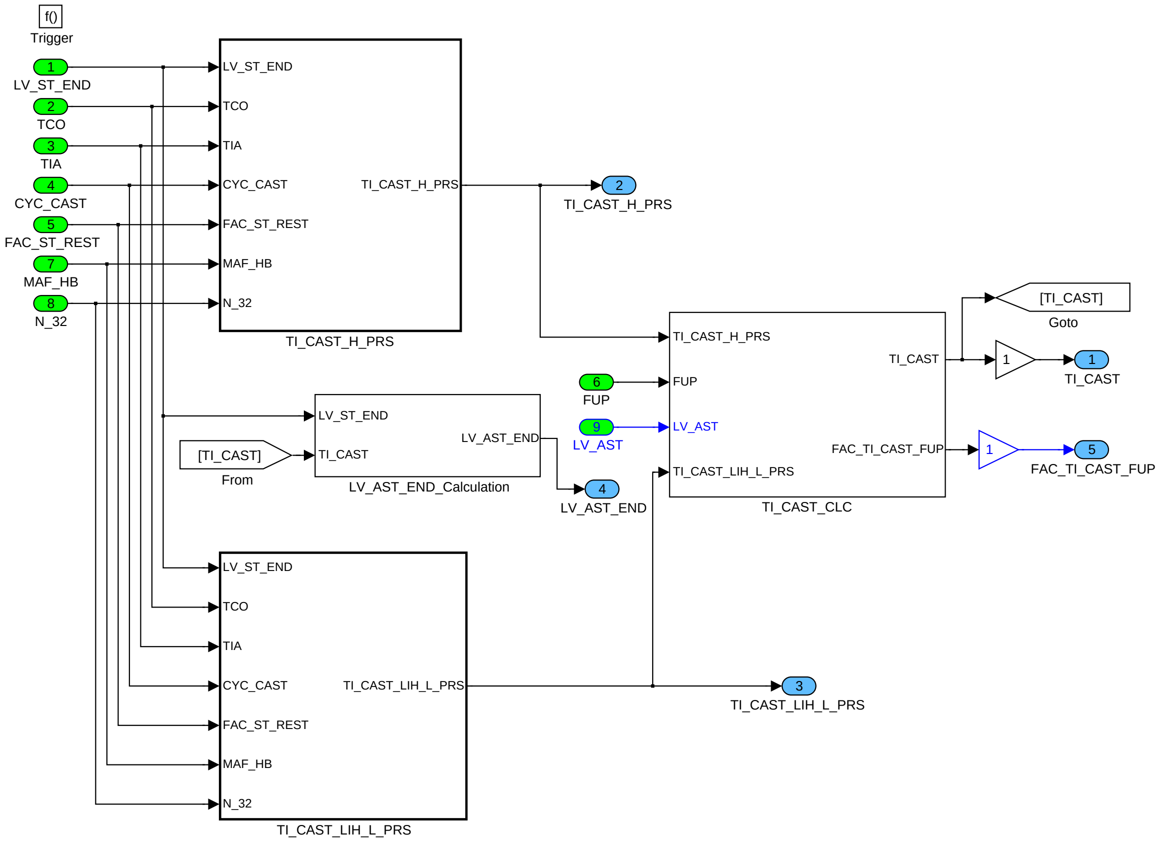

Figure 7.6.2: FMSP_M7009/Operate

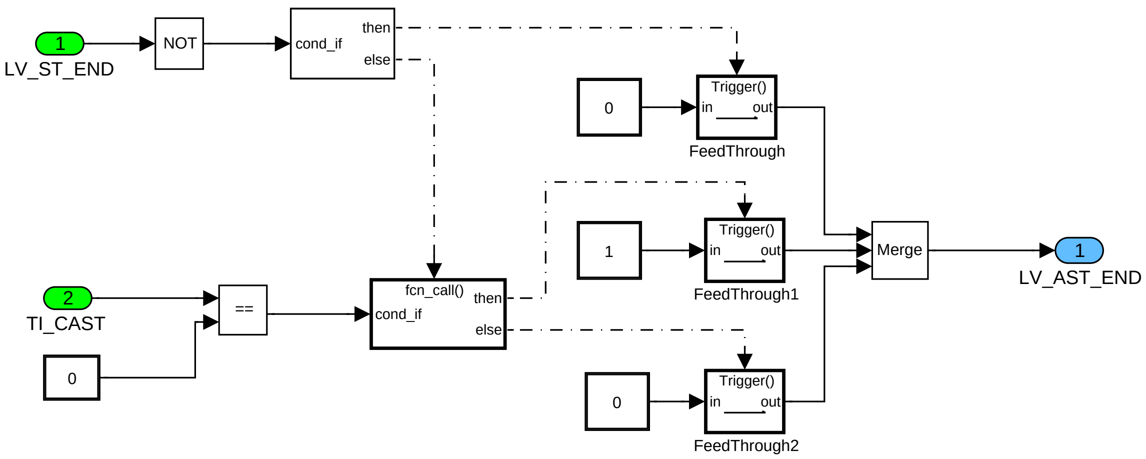

Figure 7.6.3: FMSP_M7009/Operate/LV_AST_END_Calculation

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TI_CAST_SWI

There are two input values TI_CAST_H_PRS and TI_CAST_LIH_L_PRS. Each input value belongs to the fuel pressure. Moreover FUP indicates which path is more weighted. It is ensured that a continuous

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crossfading in the range TI_CAST_H_PRS and TI_CAST_LIH_L_PRS is active in the after start time interval. The algorithms are calculated until LV_AST drops.

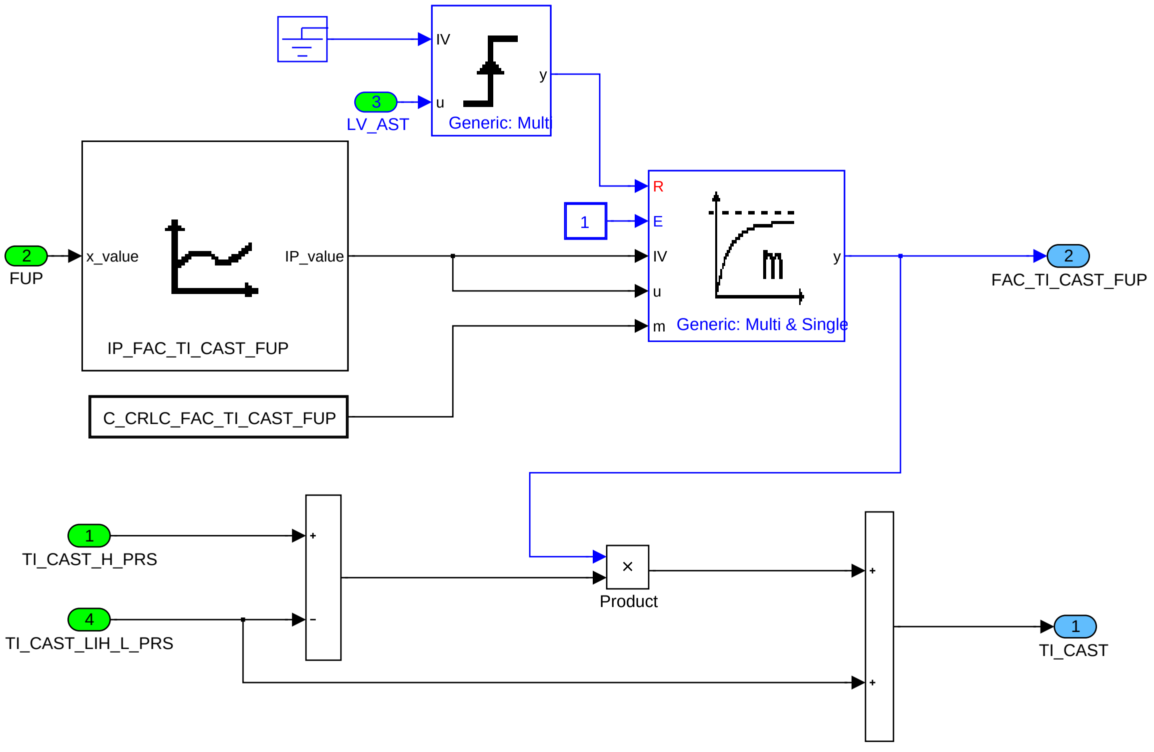

Figure 7.6.4: FMSP_M7009/Operate/TI_CAST_CLC

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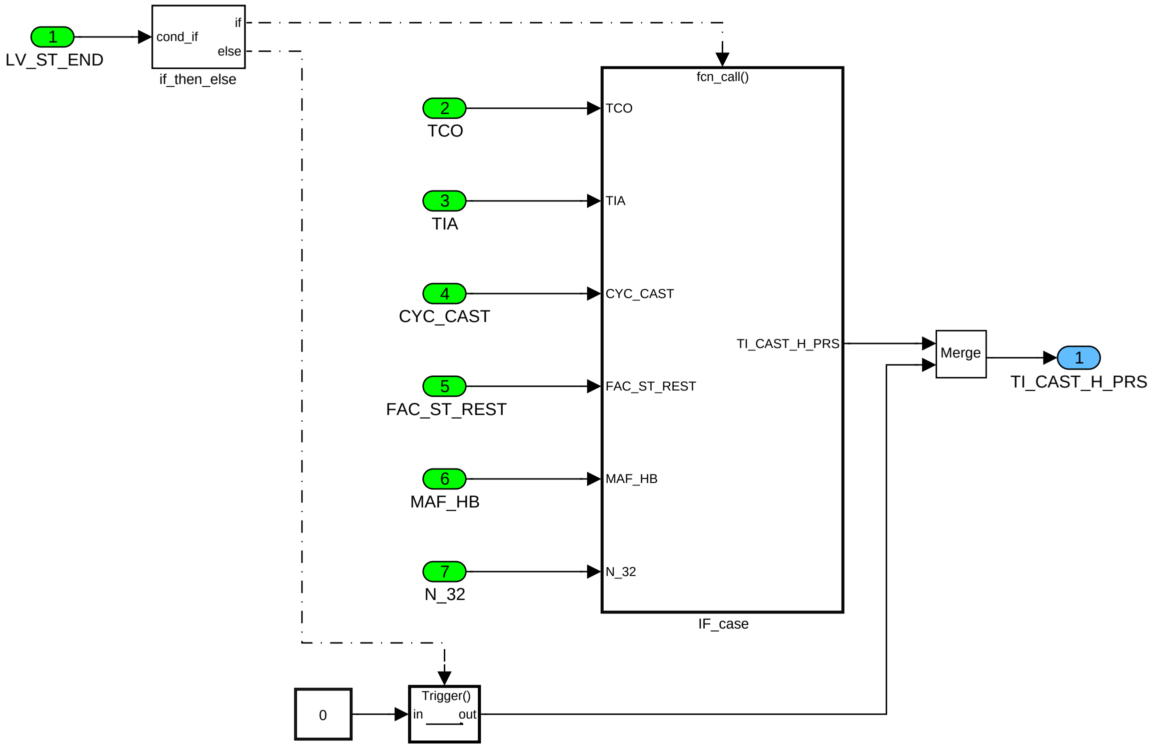

Figure 7.6.5: FMSP_M7009/Operate/TI_CAST_H_PRS

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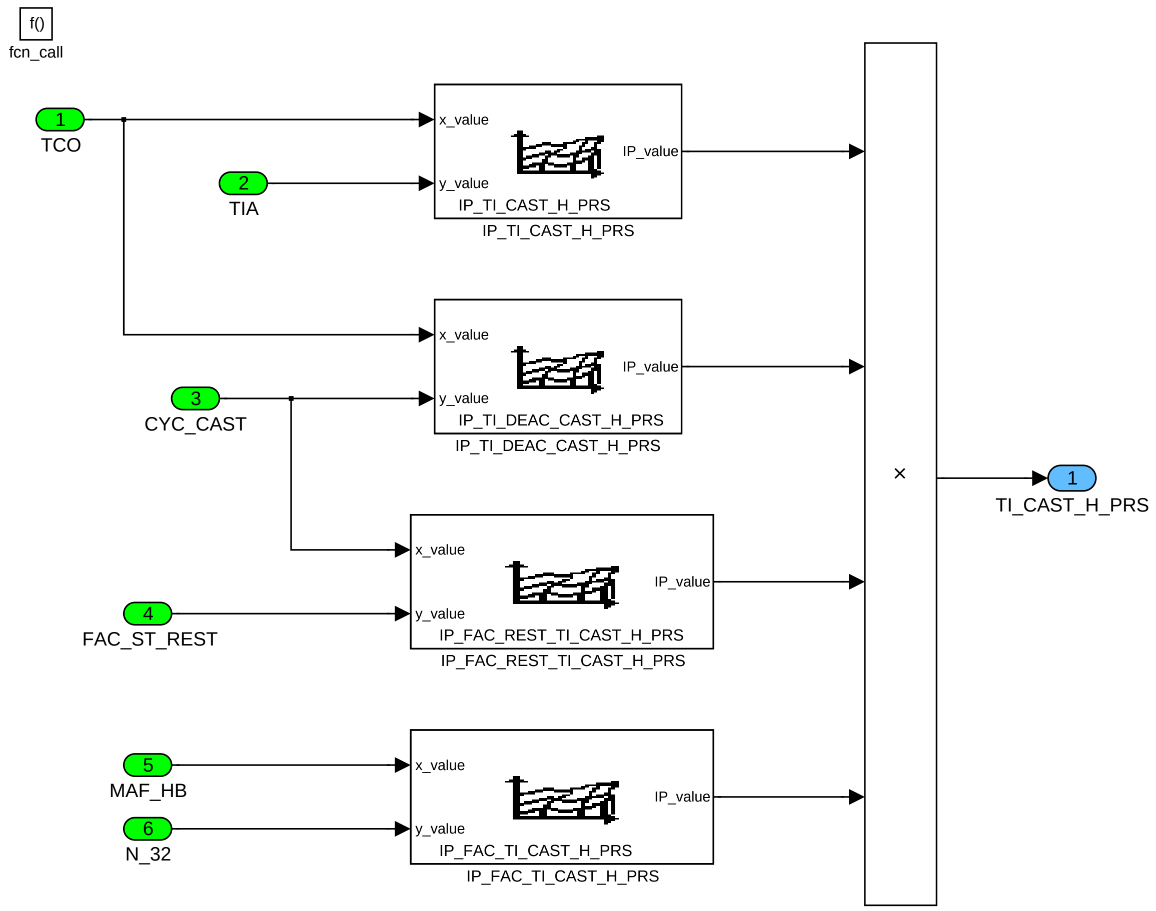

Figure 7.6.6: FMSP_M7009/Operate/TI_CAST_H_PRS/IF_case

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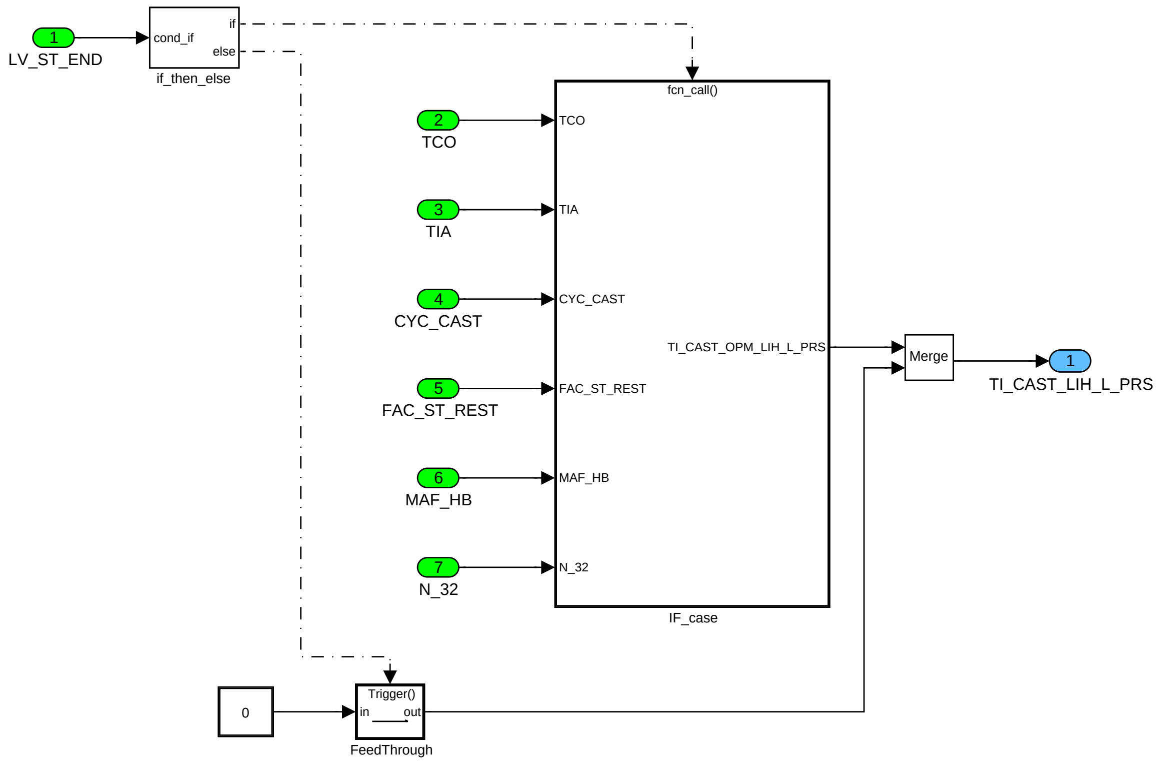

Figure 7.6.7: FMSP_M7009/Operate/TI_CAST_LIH_L_PRS

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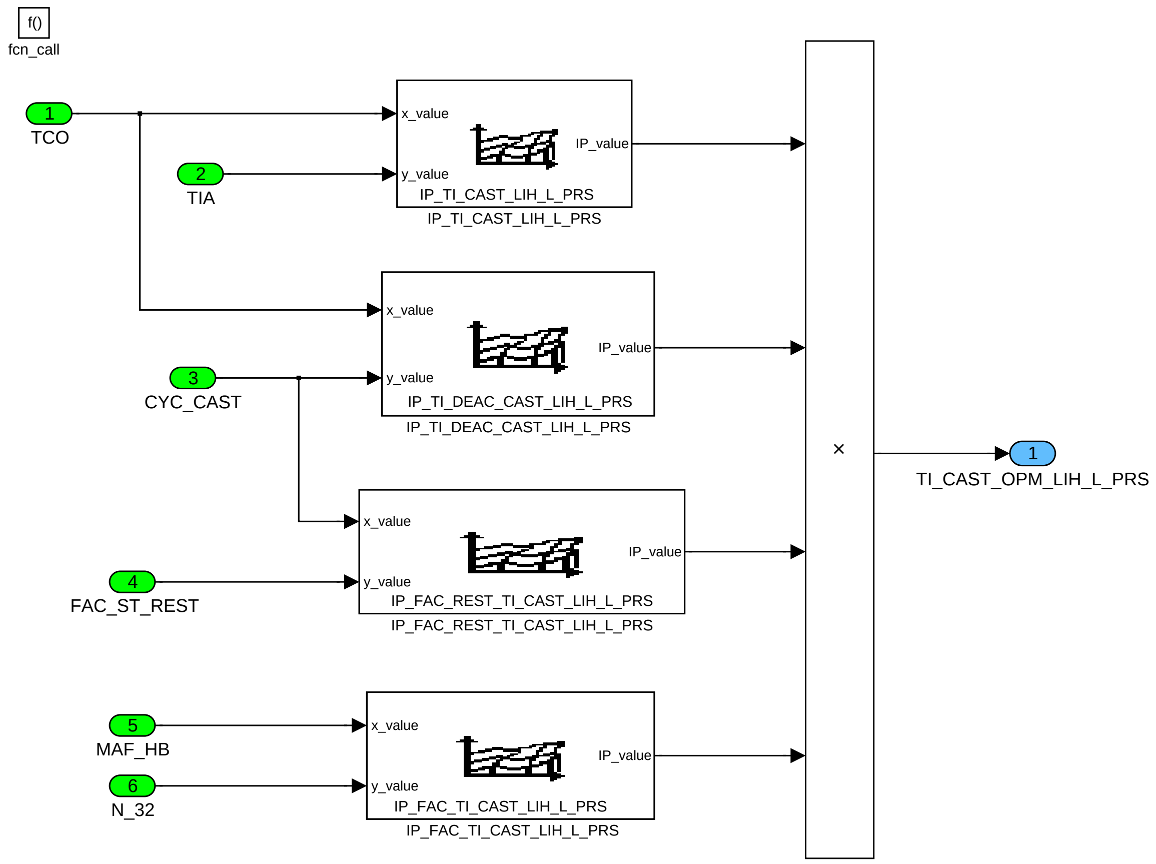

Figure 7.6.8: FMSP_M7009/Operate/TI_CAST_LIH_L_PRS/IF_case

7.6.1.2 SUBFUNCTION: reset

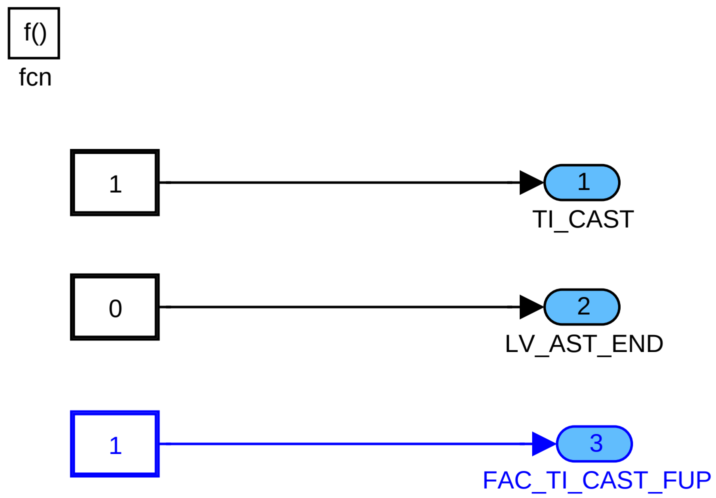

Figure 7.6.9: FMSP_M7009/reset

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7.7 Warm up correction

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TI_WUP_FUP	V	0... FFH	0... 1.9921875	0.0078125	-
Factor for weighting the influence of fuel pressure on warm up injection					
TI_TEMP	V	0... FFFFH	0... 3.99993896	610.352e3	-
Warm up enrichment part, intermediate, permanent part					
TI_WUP	O/V	0... FFFFH	0... 3.99993896	610.352e3	-
Warm up enrichment, total value					
TI_WUP_1	V	0... FFFFH	0... 3.99993896	610.352e3	-
Warm up enrichment part after operation mode manager, intermediate value					
TI_WUP_1_ADD	O/V	0... FFFFH	0... 3.99993896	610.352e3	-
Warm up enrichment, additive part of intermediate value					
TI_WUP_1_ADD_H_PRS	V	0... FFFFH	0... 3.99993896	610.352e3	-
Warm up enrichment, additive part of intermediate value at high fuel pressure					
TI_WUP_1_ADD_LIH_L_PRS	V	0... FFFFH	0... 3.99993896	610.352e3	-
Warm up enrichment, additive part of intermediate value at low fuel pressure					
TI_WUP_1_H_PRS	V	0... FFFFH	0... 3.99993896	610.352e3	-
Warm up enrichment part at high fuel pressure					
TI_WUP_1_LIH_L_PRS	V	0... FFFFH	0... 3.99993896	610.352e3	-
Warm up enrichment part at low fuel pressure					

Input data:

AMP {p. 982}	FUP {p. 1283}	INJ_MOD_HOM_REQ {p. 8241}	LV_CLC_2SEG {p. 1825}
LV_CLC_2SEG_ENA {p. 1825}	LV_ES {p. 1720}	LV_WUP {p. 1775}	MAF_HB {p. 805}
MAP {p. 8278}	N_32 {p. 1525}	TCO {p. 1100}	TCO_ST {p. 1100}
TIA {p. 1226}	TOIL {p. 8204}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_TI_WUP_FUP	-	0... FFH	0... 0.99609375	0.00390625	-
Low pass filter correlation constant for the weighting factor of fuel pressure					
IP_FAC_TI_TCO_WUP_H_PRS	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_TCO__TI_WUP_H_PRS	8	0... FEH	0... 142.5	0.75	°C
warm up basic factor at high fuel pressure					
IP_FAC_TI_TCO_WUP_LIH_L_PRS	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_TCO__TI_WUP_LIH_L_PRS	8	0... FEH	0... 142.5	0.75	°C
warm up basic factor at low fuel pressure					
IP_FAC_TI_VO_WUP	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_MAP_DIF__FAC_TI_VO_WUP	8	0... FFFFH	0... 5434	0.08291752	hPa
LDPM_N_32__TI_WUP	8	0... FFH	0... 8160	32	rpm
Factor map for TCO/VO dependent warm up correction					
IP_FAC_TI_WUP_FUP	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_FUP_FAC_TI_WUP	6	0... FFFFH	0... 347776	5.3067216	hPa
Factor for weighting the influence of fuel pressure on warm up injection					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TI_FAC_N_MAP	-	0... FFH	0... 0.99609375	0.00390625	-
LDP_MAP__TI_FAC_N_MAP	8	0... FFFFH	0... 5434	0.08291752	hPa
LDP_N_32__TI_FAC_N_MAP	8	0... FFH	0... 8160	32	rpm
Injection time weighting for temperature influence f(operating point)					
IP_TI_FAC_TCO	-	0... FFH	0... 0.99609375	0.00390625	-
LDP_TCO__TI_FAC_TCO	3	0... FEH	0... 142.5	0.75	°C
Injection time weighting for temperature influence f(coolant temperature)					
IP_TI_FAC_TIA_TOIL	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_TIA_TI_FAC_TIA_TOIL	6	0... FEH	0... 142.5	0.75	°C
LDP_TOIL_TI_FAC_TIA_TOIL	6	0... C8H	0... 160	1	°C
Injection time weighting for temperature influence f(TIA, TOIL)					
IP_TI_TCO_WUP_H_PRS	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_TCO_ST_TI_TCO_WUP_H_PRS	6	0... FEH	0... 142.5	0.75	°C
LDPM_TCO__TI_WUP_H_PRS	8	0... FEH	0... 142.5	0.75	°C
TCO/TCO_ST dependent warm up correction at high fuel pressure					
IP_TI_TCO_WUP_LIH_L_PRS	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_TCO_ST_TI_TCO_WUP_LIH_L_PRS	6	0... FEH	0... 142.5	0.75	°C
LDPM_TCO__TI_WUP_LIH_L_PRS	8	0... FEH	0... 142.5	0.75	°C
TCO/TCO_ST dependent warm up correction at low fuel pressure					
IP_TI_WUP_H_PRS	-	0... FFH	0... 0.99609375	0.00390625	-
LDPM_MAF_HB__TI_WUP	8	0... FFH	0... 1389	5.44705882	mg/stk
LDPM_N_32__TI_WUP	8	0... FFH	0... 8160	32	rpm
TI warm up correction at high fuel pressure					
IP_TI_WUP_H_PRS_SNGH	-	0... FFH	0... 0.99609375	0.00390625	-
LDPM_MAF_HB__TI_WUP	8	0... FFH	0... 1389	5.44705882	mg/stk
LDPM_N_32__TI_WUP	8	0... FFH	0... 8160	32	rpm
TI warm up correction at high fuel pressure for SNGH					
IP_TI_WUP_LIH_L_PRS	-	0... FFH	0... 0.99609375	0.00390625	-
LDPM_MAF_HB__TI_WUP	8	0... FFH	0... 1389	5.44705882	mg/stk
LDPM_N_32__TI_WUP	8	0... FFH	0... 8160	32	rpm
TI warm up correction at low fuel pressure					

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7.7.1 FMSP_M700A

FUNCTION DESCRIPTION:
General information:
To cover the increased fuel requirement while the engine is cold, injection is corrected via the warm up enrichment.
The function splits up 2 warmup enrichment parts intermediate value (applied for 2 different fuel pressure modes). In accordance with the received fuel pressure FUP the warm up injection represents the weighted enrichment parts.
Application conditions:
Activation : at every engine operating state, when
(LV_CLC_2SEG = 1 **or** LV_CLC_2SEG_ENA = 0)
Deactivation : **not** Activation
Initialization : at ECUInitialisation, LV_ES = 0 >1, LV_ST = 0 > 1:
TI_WUP, TI_TEMP and FAC_TI_WUP_FUP = 1,0
TI_WUP_1 = 1,000061, TI_WUP_1_ADD = 0,000061
Update rate : 1/segment

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Application Condition

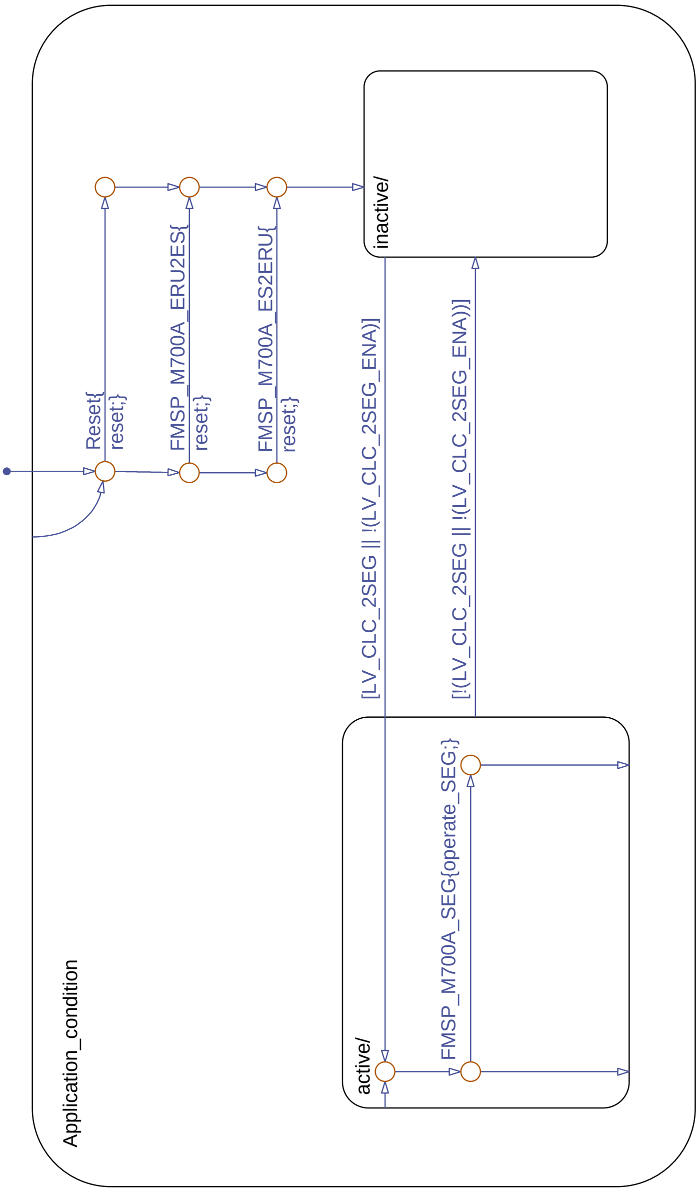

Figure 7.7.1: FMSP_M700A/APP_CDN/Chart

Function Description

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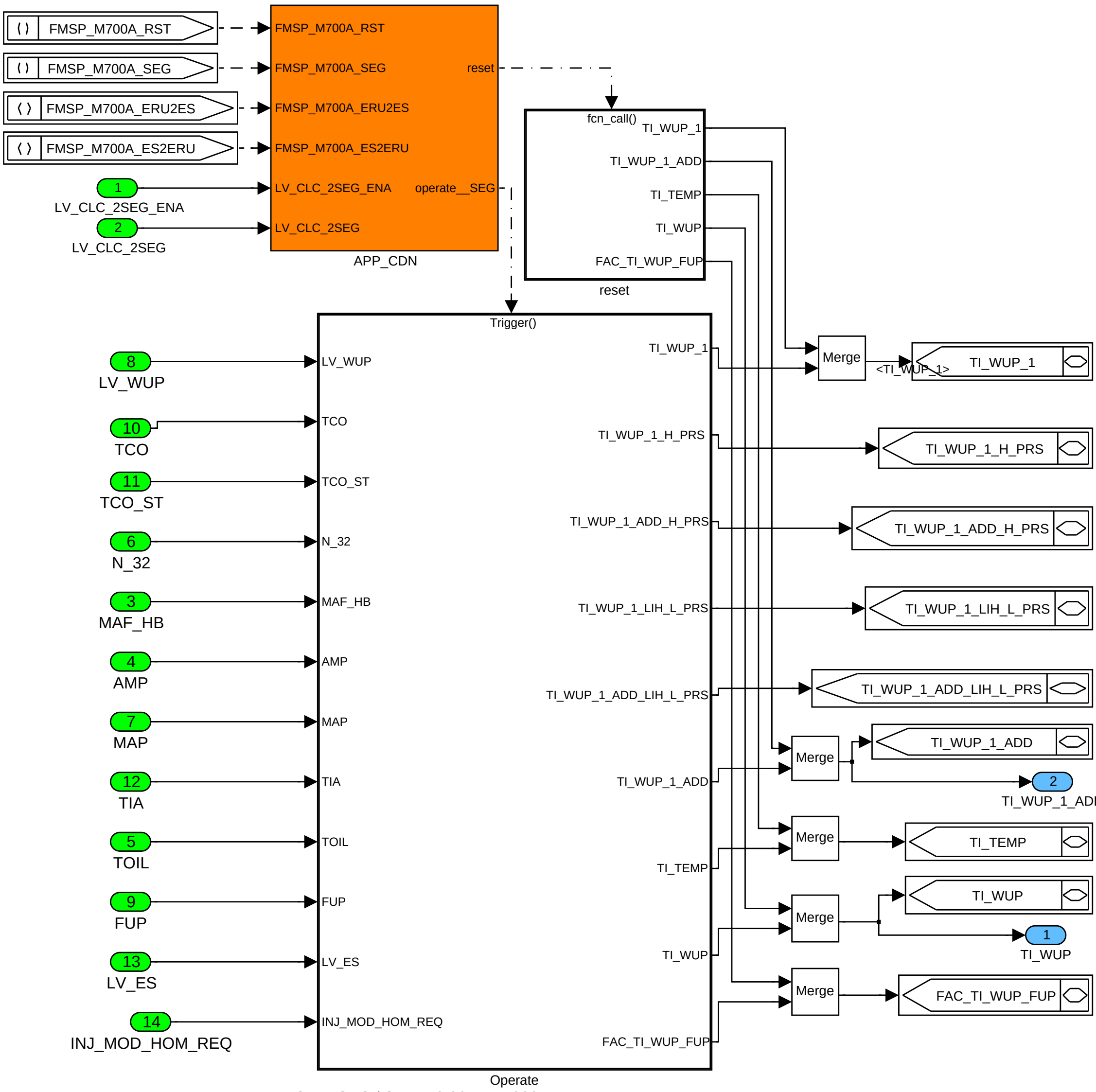

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Figure 7.7.2: FMSP_M700A

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7.7.1.1 SUBFUNCTION: Operate

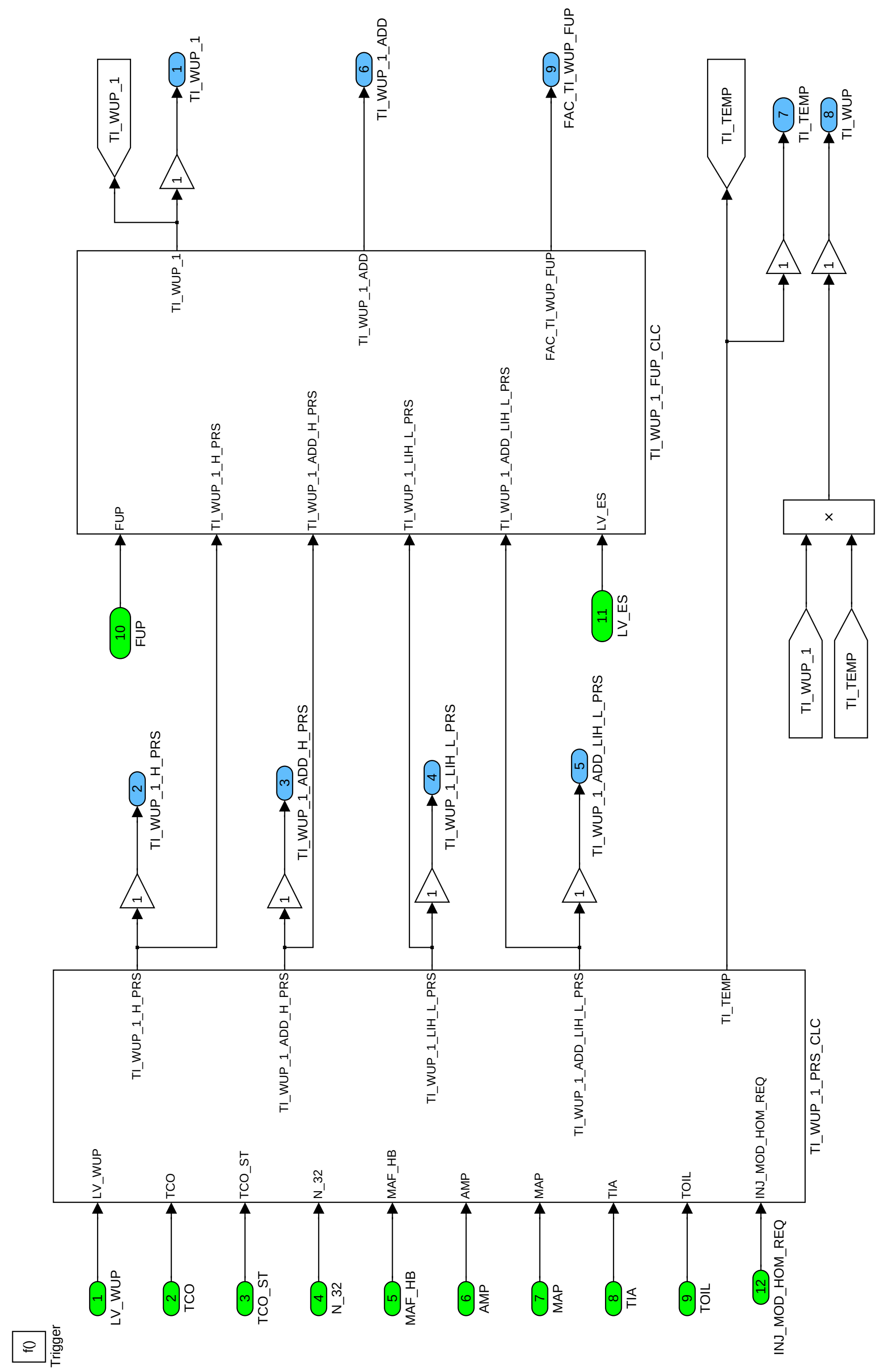

Figure 7.7.3: FMSP_M700A/Operate

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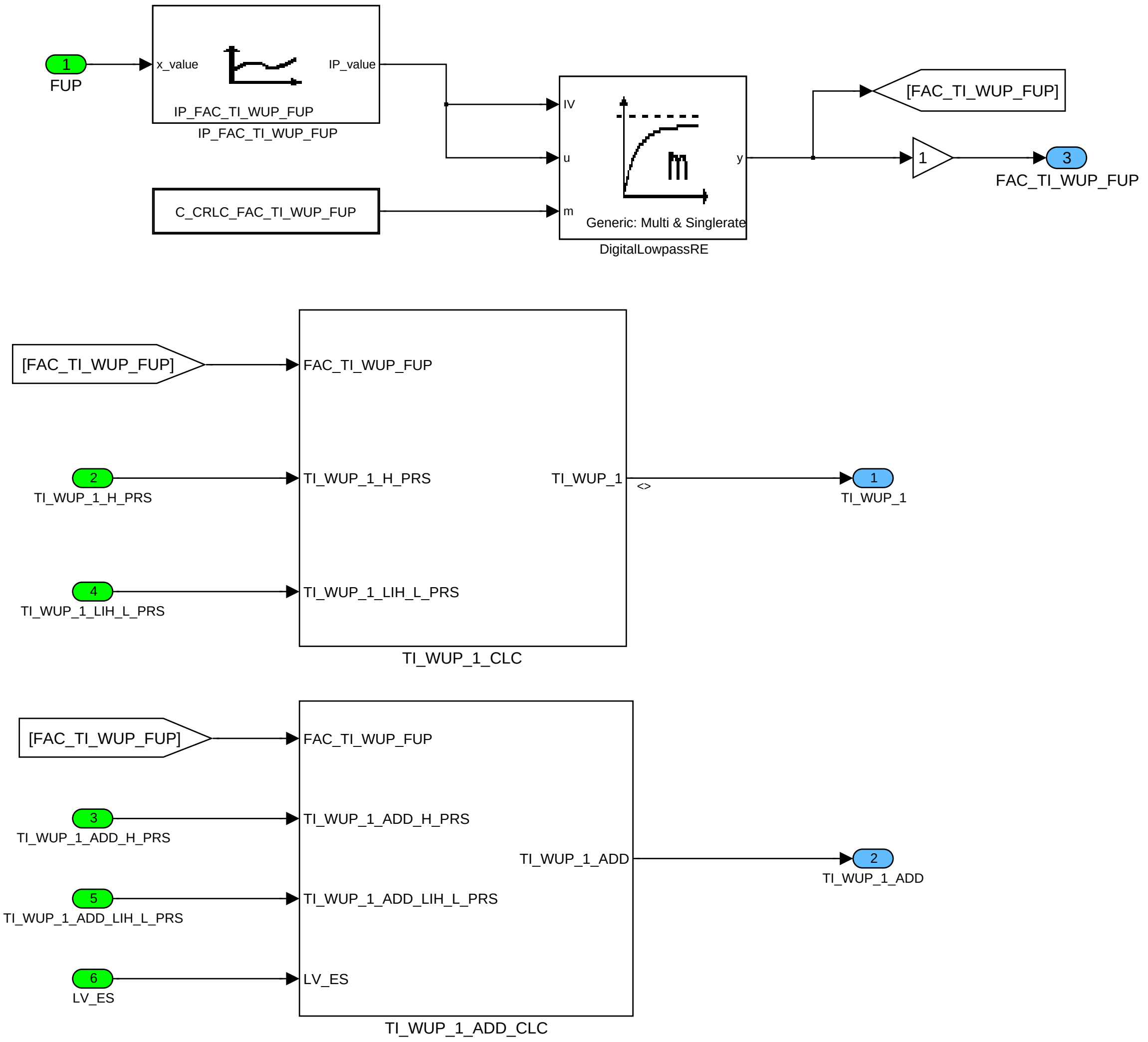

Figure 7.7.4: FMSP_M700A/Operate/TI_WUP_1_FUP_CLC

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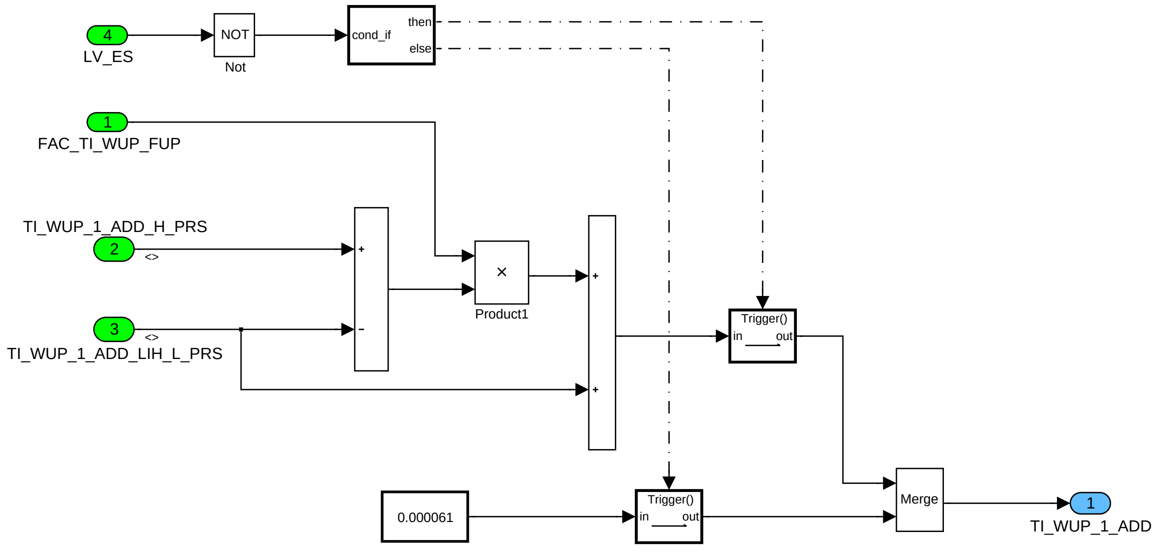

Figure 7.7.5: FMSP_M700A/Operate/TI_WUP_1_FUP_CLC/TI_WUP_1_ADD_CLC

FMSP_M700A/OPERATE/TI_WUP_1_FUP_CLC/TI_WUP_1_CLC

The input values TI_WUP_1_H_PRS and TI_WUP_1_LIH_L_PRS are calculated for the fuel high pressure and the fuel limp home low pressure mode. Each input value belongs to a fuel pressure mode. Depending on FUP a factor indicates which path is executed as a result of the interpolation.

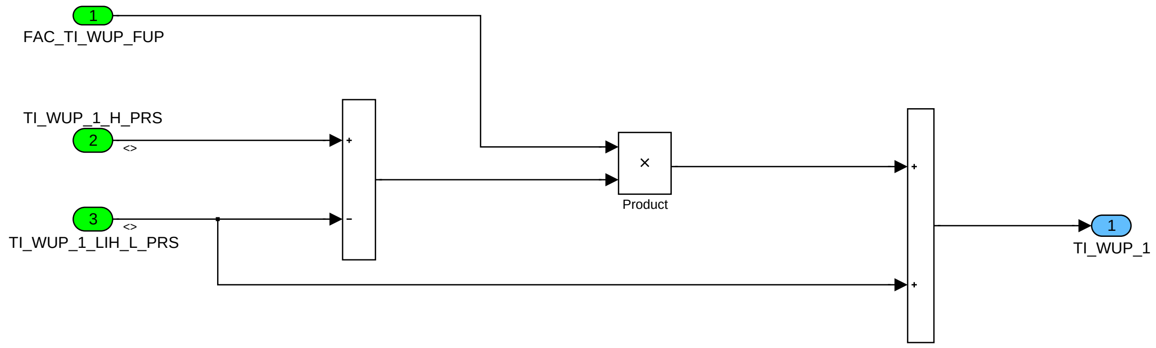

Figure 7.7.6: FMSP_M700A/Operate/TI_WUP_1_FUP_CLC/TI_WUP_1_CLC

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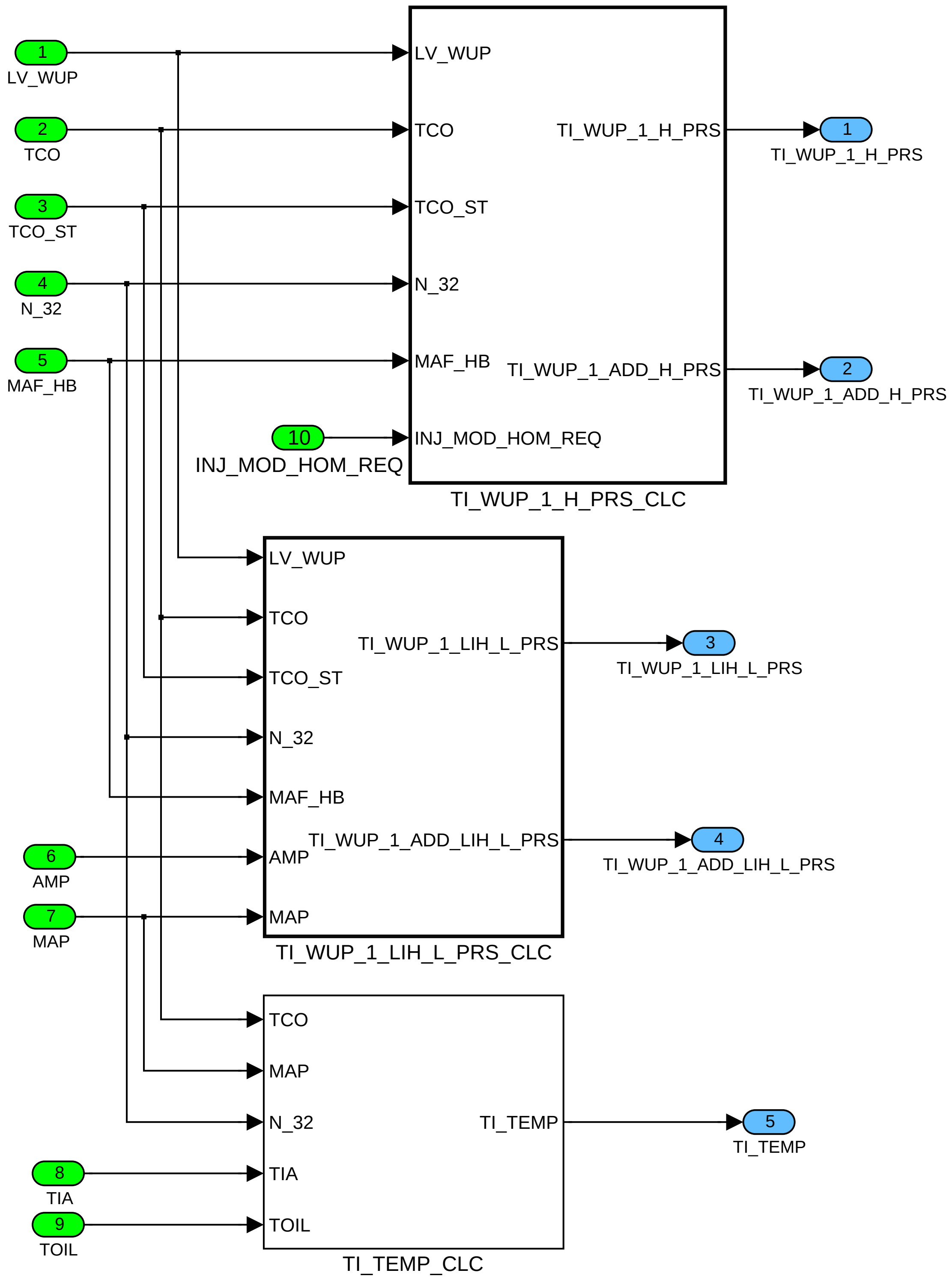

Figure 7.7.7: FMSP_M700A/Operate/TI_WUP_1_PRS_CLC

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FMSP_M700A/OPERATE/TI_WUP_1_PRS_CLC/TI_TEMP_CLC

content

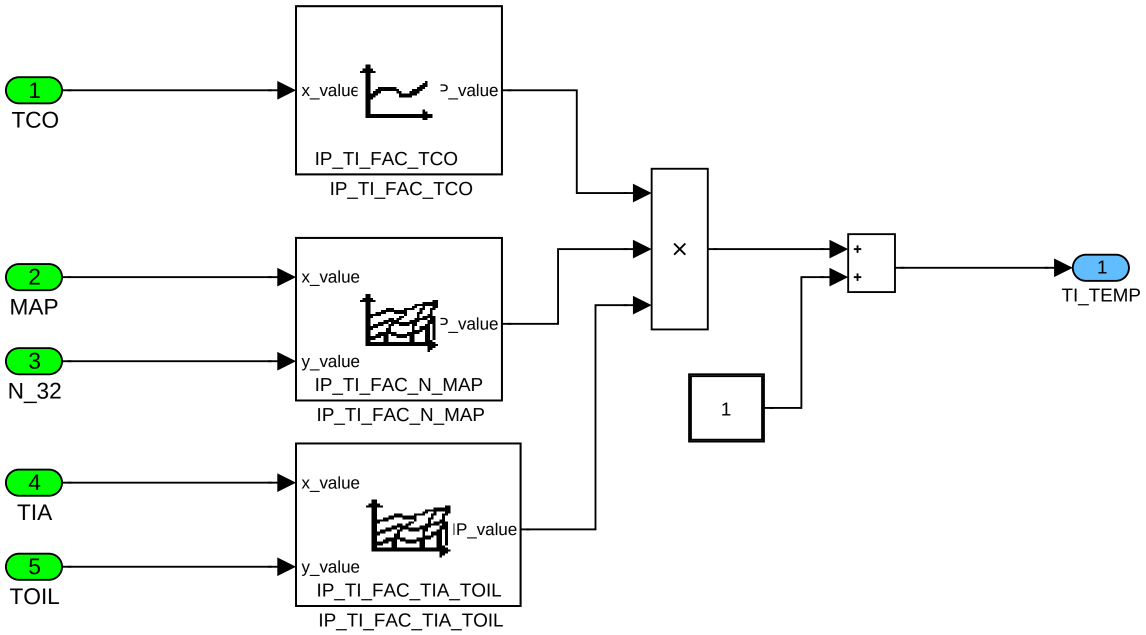

Figure 7.7.8: FMSP_M700A/Operate/TI_WUP_1_PRS_CLC/TI_TEMP_CLC

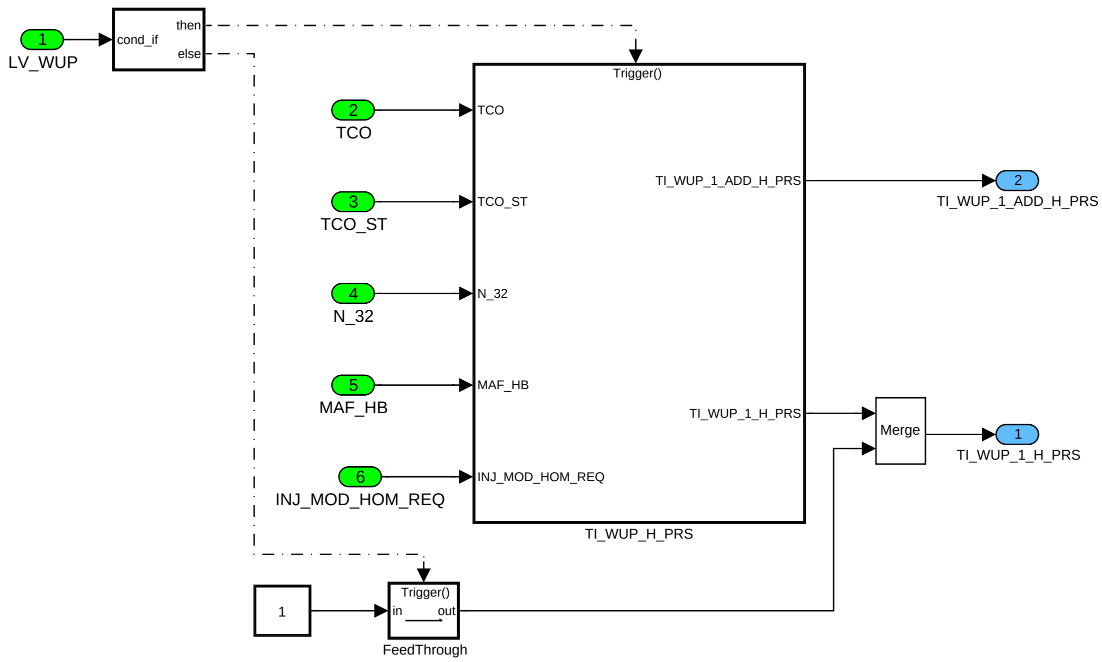

Figure 7.7.9: FMSP_M700A/Operate/TI_WUP_1_PRS_CLC/TI_WUP_1_H_PRS_CLC

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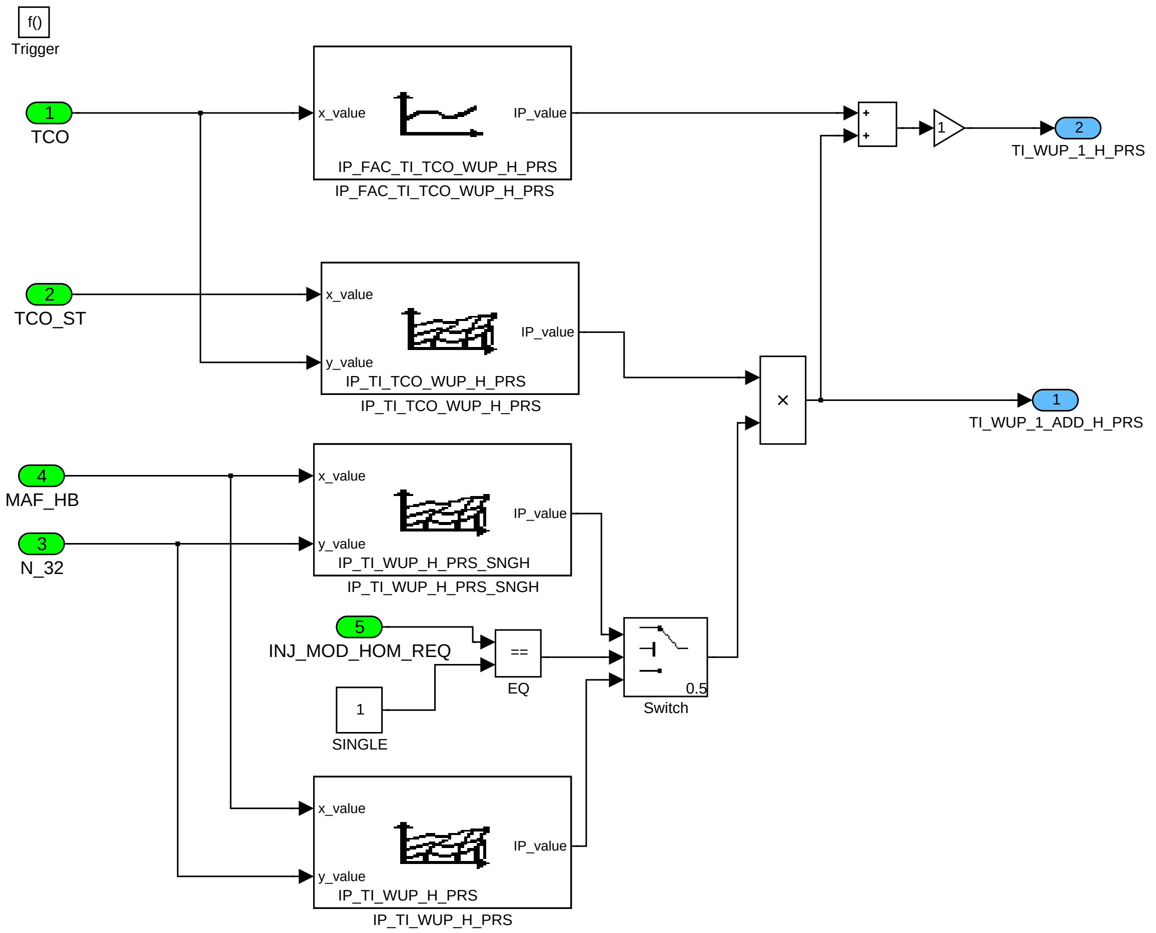

Figure 7.7.10:
FMSP_M700A/Operate/TI_WUP_1_PRS_CLC/TI_WUP_1_H_PRS_CLC/TI_WUP_H_PRS

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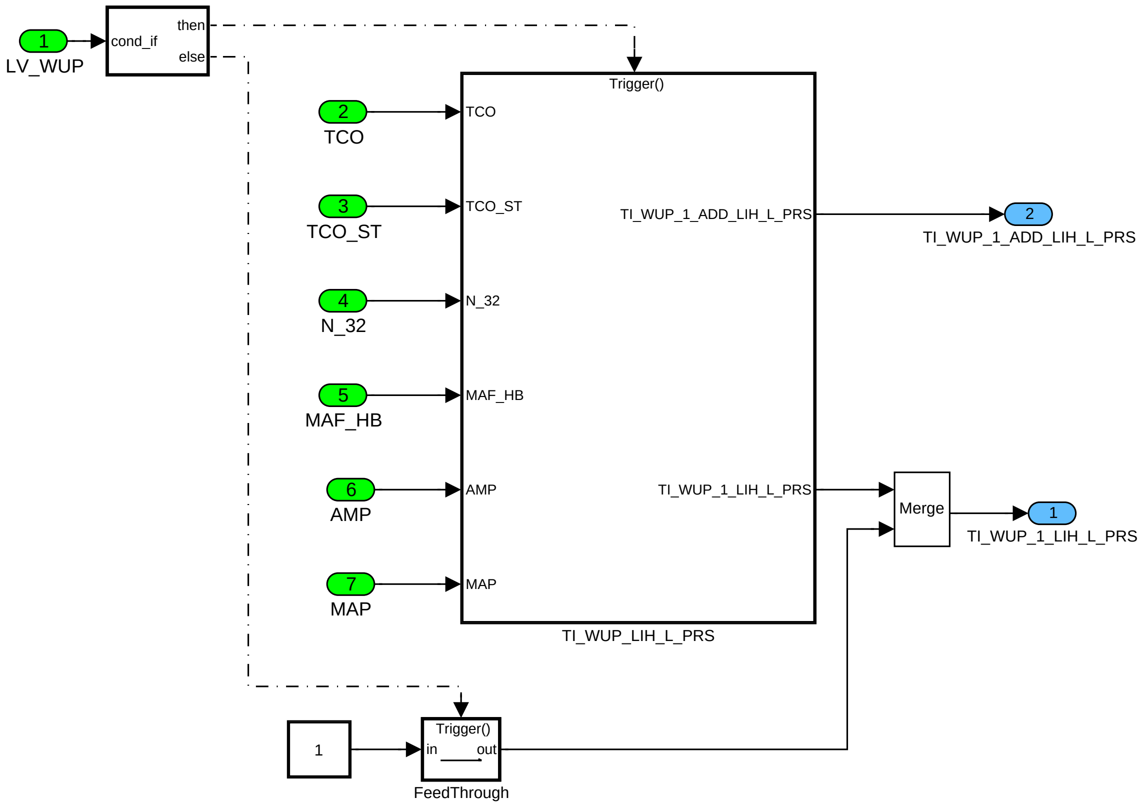

Figure 7.7.11: FMSP_M700A/Operate/TI_WUP_1_PRS_CLC/TI_WUP_1_LIH_L_PRS_CLC

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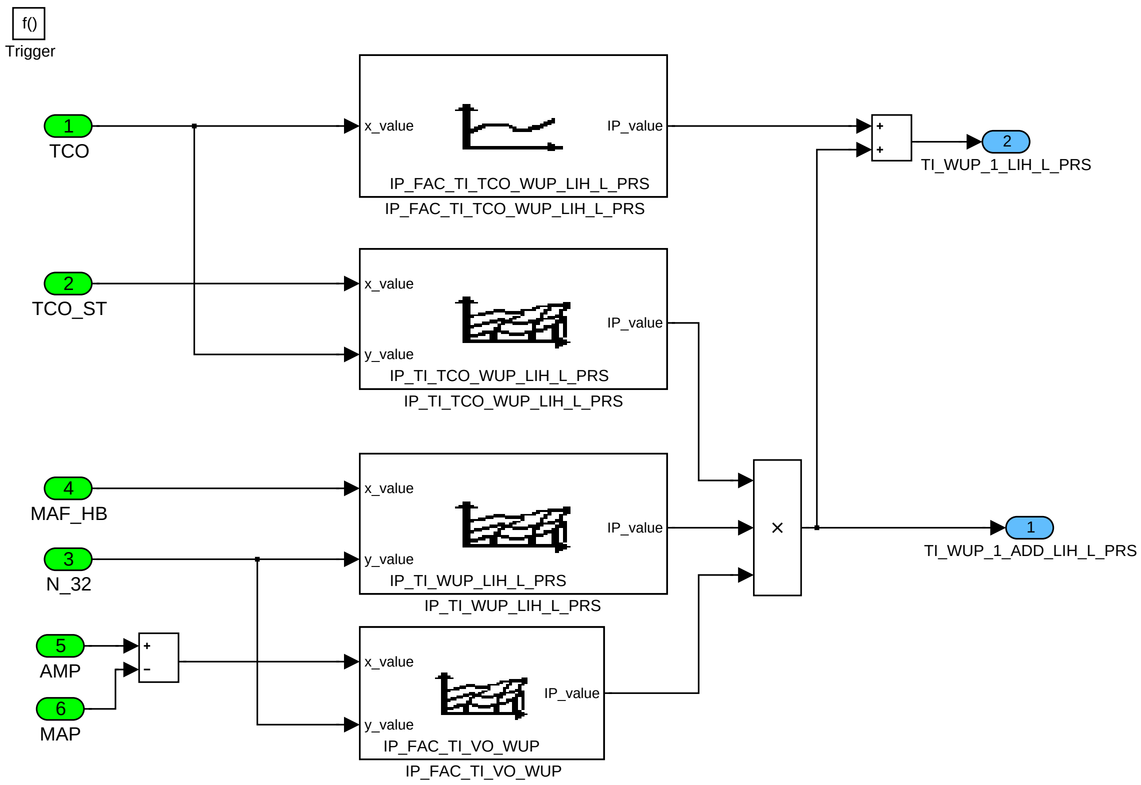

Figure 7.7.12:
FMSP_M700A/Operate/TI_WUP_1_PRS_CLC/TI_WUP_1_LIH_L_PRS_CLC/TI_WUP_LIH_L_PRS

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7.7.1.2 SUBFUNCTION: reset

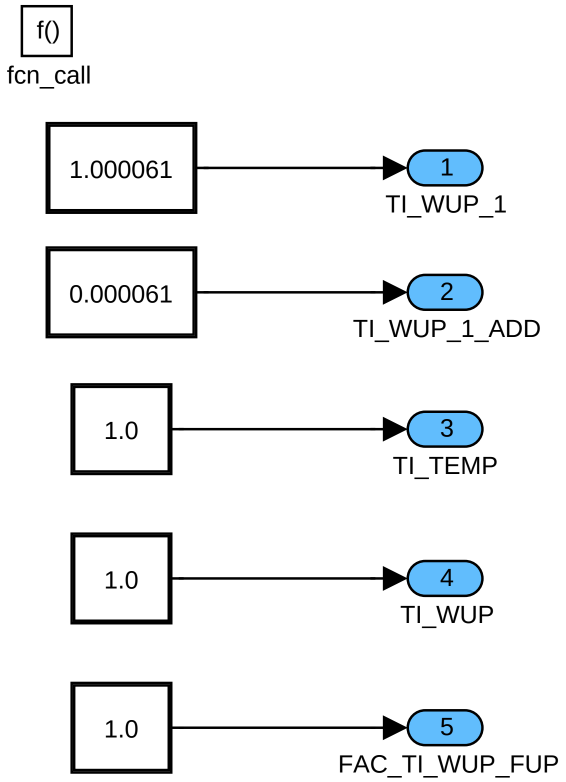

Figure 7.7.13: FMSP_M700A/reset

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7.8 Injection phase for homogeneous mode - 1. pulse

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_DIF_SOI_IGN_HOM	O/V	0... F00H	0... 1440	0.375	°CRK
Current start of injection phase related to ignition TDC					
CRK_INJ_BAS [NC_CYL_NR]	O/V	F100... F00H	-1440 ...1440	0.375	°CRK
Cylinder individual zero position for phasing related to ignition TDC					
EOI_1_HOM	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for homogeneous mode, 1.pulse - non cylinder individual HPDI-Version					
EOI_LIM_HOM	O/V	0... 780H	0... 720	0.375	°CRK
Latest possible EOI at homogeneous mode					
LV_CRK_DIF_SOI_EOI_LIM	O/V	0... 1H	0 ...1	1	-
Difference between SOI and EOI is beyond the maximum, the pulse will be limited					
LV_EOI_LIM_HOM	V	0... 1H	0 ...1	1	-
At least one injection was repositioned to EOI_LIM_HOM					
SOI_1_HOM [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of injection for homogeneous mode, 1.pulse - cylinder individual HPDI-Version					
SOI_1_HOM_CLC [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
Calculated start of injection for homogeneous mode, 1.pulse - cylinder individual HPDI-Version					
SOI_1_HOM_MAX	-	0... 780H	0... 720	0.375	°CRK
Maximum start of injection angle for homogeneous mode, 1.pulse					
SOI_LIM	O/V	0... 780H	0... 720	0.375	°CRK
Earliest possible SOI					

Input data:

CAM_SHIFT_EX {p. 2146}	CTR_CYL_NR_ST_CLC_INJR {p. 3327}	EOI_2_HOM_EXT [NC_CYL_NR] {p. 2146}	FAC_N {p. 3327}
FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	INJ_MOD_HOM_REQ {p. 8241}	LV_EOI_2_DELTA_HOM_CUS {p. 8269}	LV_EOI_LIM_EOLP_OFS {p. 800}
LV_EOI_ST_ENA {p. 8242}	LV_ST_END {p. 1720}	NC_CBK_HPP_NR [1] {p. 812}	NC_CRK_INJ_BAS_REF {p. 626}
NC_CRK_INJ_REF_TDC {p. 626}	NC_CRK_INJ_RNG {p. 626}	NC_CYL_NR {p. 1526}	NC_INJ_MOD_SINGLE {p. 2045}
NC_T_MIN_OFS_INJ_CYL {p. 628}	NR_CYL_CLC_RED_INJ {p. 3331}	SOI_1_HOM_EXT [NC_CYL_NR] {p. 2146}	TI_1_HOM [NC_CYL_NR] {p. 2002}
TI_1_HOM_CLC_MAX {p. 2002}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_LIM_EOL_OFS	-	FC40... 3C0H	-360 ...360	0.375	°CRK
Constant to add offset to EOI_LIM_HOM when engine first starts at end of line (EOL)					
C_EOI_LIM_HOM	-	0... 780H	0... 720	0.375	°CRK
Latest possible EOI at homogeneous mode					
C_EOI_LIM_HOM_CH_COR	-	FC40... 3C0H	-360 ...360	0.375	°CRK
Additive correction on EOI_LIM_HOM duing catalyst heating					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_LIM_HOM_MULTI_COR	-	FC40... 3C0H	-360 ...360	0.375	°CRK
Correction value for calculation of the latest possible EOI, if homogeneous multi injection mode is active					
C_EOI_LIM_HOM_ST	-	0... 780H	0... 720	0.375	°CRK
Latest possible EOI at homogeneous mode at start					
C_SOI_1_HOM_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setpoint for homogeneous SOI					
C_SOI_1_HOM_ST_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setpoint for homogeneous SOI during start					
C_SOI_LIM	-	0... 780H	0... 720	0.375	°CRK
Earliest possible SOI					
IP_EOI_LIM_HOM_FUP_COR	-	0... 780H	-360 ...360	0.375	°CRK
LDPM_FUP_H_1_INJR	8	0... FFFFH	0... 347776	5.3067216	hPa
FUP correction of EOI_LIM_HOM					
LC_SOI_1_HOM_MAN	-	0... 1H	0 ...1	1	-
Switch to activate the manual setpoint for homogeneous SOI					
LC_SOI_1_HOM_ST_MAN	-	0... 1H	0 ...1	1	-
Switch to activate the manual setpoint for homogeneous SOI during start					

FUNCTION DESCRIPTION:

7.8.1 Definition of the injection range

Application conditions

Activation: `at reset`

Deactivation: –

Initialization: –

Recurrence: `once at reset`

The fuel can be injected over a range of 720 °CRK. The cylinder individual zero position of this range is defined via the constants NC_CRK_INJ_REF_TDC and NC_CRK_INJ_BAS_REF with reference to the ignition TDC of cylinder 0, see figure below.

Formula section:

Related to tdc cylinder 0:
FOR x = 0 **TO** (NC_CYL_NR-1) **DO**:
CRK_INJ_BAS[x] = NC_CRK_INJ_REF_TDC + NC_CRK_INJ_BAS_REF - x * (720 /NC_CYL_NR)
ENDFOR

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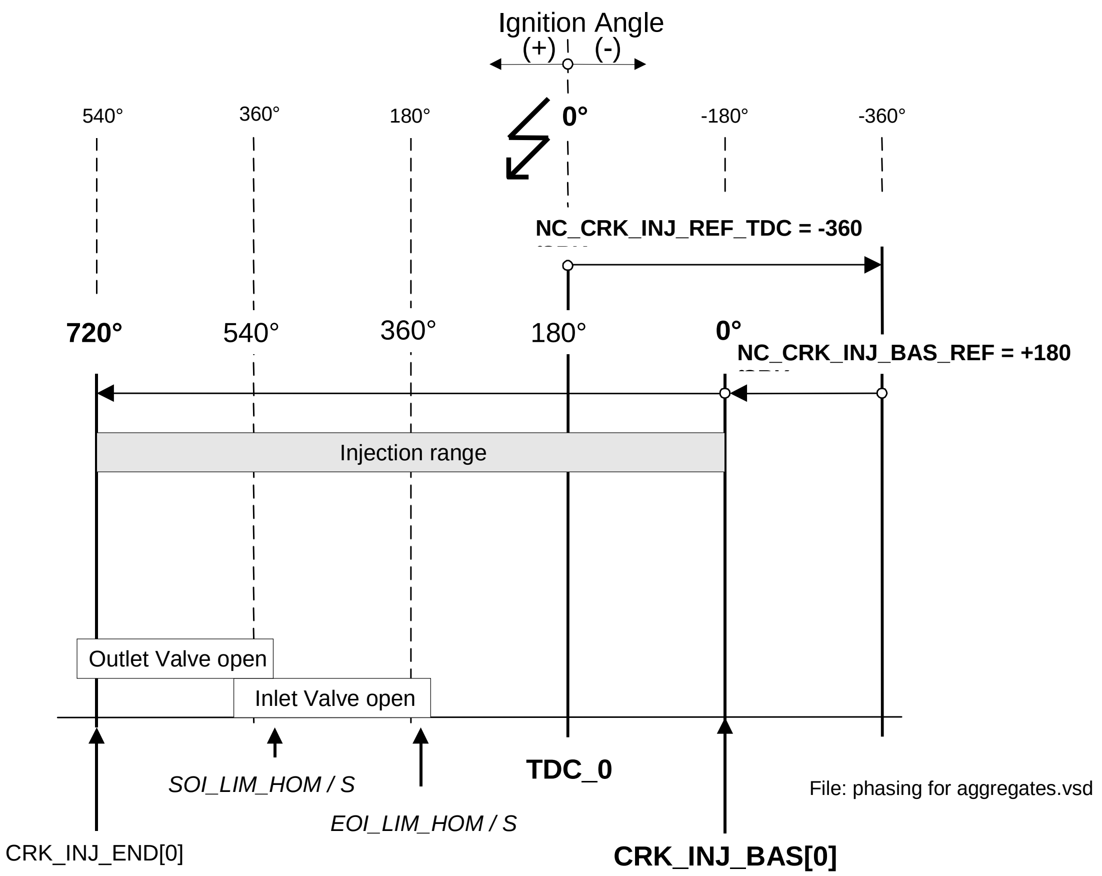

Definition of the non calibrateable constants:

NC_CRK_INJ_REF_TDC = -360°CRK
NC_CRK_INJ_BAS = 180 °CRK

For loop for runtime optimization:
In this specification the for loop
FOR i = 0, i < NR_CYL_CLC_RED_INJ **DO**
  x = CTR_CYL_NR_ST_CLC_INJR + i
  (1a)**IF** x >= NC_CYL_NR
  (1a)**THEN**
    x = x - NC_CYL_NR
  (1a)**ENDIF**
  <**loop content**>
ENDFOR
is substituted by
FOR cylinder_start to cylinder_stop **DO**
  <**loop content**>
ENDFOR
Note: In the for loops, x will be used as loop variable to indicate the cylinder x!

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7.8.2 Injection phasing at start

Application conditions

Activation: LV_ST_END = 0
Deactivation: –
Initialization: –
Recurrence: 10ms

Formula section:

All calculations are related to CRK_INJ_BAS[NC_CYL_NR].

EOI_LIM_HOM = 0
(1) IF (single injection)
INJ_MOD_HOM_REQ = NC_INJ_MOD_SINGLE (if single injection is requested)
(1) THEN
    FOR m = 0 **TO** NC_CBK_HPP_NR - 1 **DO**
        EOI_LIM_HOM = **MAX**(EOI_LIM_HOM;
            C_EOI_LIM_HOM_ST + IP_EOI_LIM_HOM_FUP_COR (Input: FUP_H_INJ[m])
)
    ENDFOR
(1) ELSE (multiple injection)
    For double injection the minimum injection angle will be limited by the following calculation:
    FOR m = 0 **TO** NC_CBK_HPP_NR - 1 **DO**
        EOI_LIM_HOM = **MAX**(EOI_LIM_HOM;
            C_EOI_LIM_HOM_ST + IP_EOI_LIM_HOM_FUP_COR (Input: FUP_H_INJ[m])
            + C_EOI_LIM_HOM_MULTI_COR)
    ENDFOR
(1) ENDIF

IF LV_EOI_LIM_EOLP_OFS = 1
THEN
    EOI_LIM_HOM = EOI_LIM_HOM + C_EOI_LIM_EOL_OFS
    // limit EOI_LIM_HOM to its physical limits
END

SOI_LIM = C_SOI_LIM + CAM_SHIFT_EX

Check if the difference between SOI and EOI is beyond the maximum.
(2) IF
  (TI_1_HOM_CLC_MAX * FAC_N + EOI_LIM_HOM) > SOI_LIM
(2) THEN
    LV_CRK_DIF_SOI_EOI_LIM = 1 (TI is beyond the maximum)
(2) ELSE
    LV_CRK_DIF_SOI_EOI_LIM = 0 (TI is below the maximum)
(2) ENDIF

Calculation of SOI:
(3) IF
LC_SOI_1_HOM_ST_MAN = 1

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(3) THEN
(1) FOR x = 0 **TO** (NC_CYL_NR -1) **DO**:
SOI_1_HOM_CLC[x] = C_SOI_1_HOM_ST_MAN
(1) ENDFOR
(3) ELSE
(4) IF LV_EOI_ST_ENA = 1
(4) THEN
(2) FOR x = 0 **TO** (NC_CYL_NR -1) **DO**:
SOI_1_HOM_CLC[x] = TI_1_HOM[x] * FAC_N + EOI_2_HOM_EXT[x]
(2) ENDFOR
(4) ELSE
(3) FOR x = 0 **TO** (NC_CYL_NR -1) **DO**:
SOI_1_HOM_CLC[x] = SOI_1_HOM_EXT[x]
(3) ENDFOR
(4) ENDIF
(3) ENDIF

Limitation to the end of injection:
SOI_1_HOM_MAX = 0
(4) FOR x = 0 **TO** (NC_CYL_NR -1) **DO**:
(5) IF
SOI_1_HOM_CLC[x] - TI_1_HOM[x] * FAC_N < EOI_LIM_HOM
(5) THEN
SOI_1_HOM[x] = EOI_LIM_HOM + TI_1_HOM[x] * FAC_N
LV_ EOI_LIM_HOM = 1 At least one injection was repositioned to EOI_LIM_HOM
(5) ELSE
SOI_1_HOM[x] = SOI_1_HOM_CLC[x]
LV_ EOI_LIM_HOM = 0
(5) ENDIF
Limit SOI_1_HOM to SOI_LIM:
SOI_1_HOM[x] = **MIN**(SOI_1_HOM[x]; SOI_LIM)
SOI_1_HOM_MAX = MAX(SOI_1_HOM_MAX, SOI_1_HOM[x])
(4) ENDFOR

(6) IF (single injection)
INJ_MOD_HOM_REQ = NC_INJ_MOD_SINGLE (if single injection is requested)
(6) THEN
EOI_LIM_HOM = MAX(EOI_LIM_HOM, (SOI_1_HOM_MAX
- (NC_CRK_INJ_RNG - NC_T_MIN_OFS_INJ_CYL *FAC_N)))
(6) ENDIF

EOI_1_HOM = 720°CRK
(5) FOR x = 0 **TO** (NC_CYL_NR -1) **DO**:
EOI_1_HOM = MIN(EOI_1_HOM, (SOI_1_HOM[x] - TI_1_HOM[x] * FAC_N))
(5) ENDFOR

Output variable for LACO:
CRK_DIF_SOI_IGN_HOM = SOI_1_HOM[0] + CRK_INJ_BAS [0]

7.8.3 Injection phasing out of start

Application conditions

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Activation: LV_ST_END = 1

Deactivation: –

Initialization: –

Recurrence: segment synchronous

Formula section:

Out of start injection phasing is defined via SOI.
All calculations are related to CRK_INJ_BAS[NC_CYL_NR].

EOI_LIM_HOM = 0
(1) IF (single injection)
INJ_MOD_HOM_REQ = NC_INJ_MOD_SINGLE (if single injection is requested)
(1) THEN
FOR m = 0 **TO** NC_CBK_HPP_NR - 1 **DO**
EOI_LIM_HOM = **MAX**(EOI_LIM_HOM;
C_EOI_LIM_HOM + IP_EOI_LIM_HOM_FUP_COR (Input: FUP_H_INJ[m]))
ENDFOR

1. **ELSE** (multiple injection)

(1a) IF LV_EOI_2_DELTA_HOM_CUS = 1
(1a)THEN
FOR m = 0 **TO** NC_CBK_HPP_NR - 1 **DO**
Minimum injection angle during catalyst heating:
EOI_LIM_HOM = **MAX**(EOI_LIM_HOM;
C_EOI_LIM_HOM
+ IP_EOI_LIM_HOM_FUP_COR (Input: FUP_H)
+ C_EOI_LIM_HOM_CH_COR)
ENDFOR
(1a) ELSE

For double injection the minimum injection angle will be limited by the following calculation:
FOR m = 0 **TO** NC_CBK_HPP_NR - 1 **DO**
EOI_LIM_HOM = **MAX**(EOI_LIM_HOM;
C_EOI_LIM_HOM + IP_EOI_LIM_HOM_FUP_COR (Input: FUP_H_INJ[m])
+ C_EOI_LIM_HOM_MULTI_COR)

ENDFOR
(1a) ENDIF

(1) ENDIF

IF LV_EOI_LIM_EOLP_OFS = 1
THEN
EOI_LIM_HOM = EOI_LIM_HOM + C_EOI_LIM_EOL_OFS
// limit EOI_LIM_HOM to its physical limits
END
SOI_LIM = C_SOI_LIM + CAM_SHIFT_EX
Check it the difference between SOI and EOI is beyond the maximum.

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(2) IF
(TI_1_HOM_CLC_MAX * FAC_N + EOI_LIM_HOM) > SOI_LIM
(2) THEN
LV_CRK_DIF_SOI_EOI_LIM = 1 (TI is beyond the maximum)
(2) ELSE
LV_CRK_DIF_SOI_EOI_LIM = 0 (TI is below the maximum)
(2) ENDIF

Calculation of SOI:
(3) IF
LC_SOI_1_HOM_MAN = 1
(3) THEN
(1)FOR cylinder_start to cylinder_stop **DO**
SOI_1_HOM_CLC[x] = C_SOI_1_HOM_MAN
(1) ENDFOR
(3) ELSE
(2)FOR cylinder_start to cylinder_stop **DO**
Dynamical limitation of SOI under consideration of NC_CRK_INJ_RNG:
(4) IF SOI_1_HOM_EXT[x] < (EOI_1_HOM + (NC_CRK_INJ_RNG - NC_T_MIN_OFS_INJ_CYL *FAC_N))
(4) THEN
SOI_1_HOM_CLC[x] = SOI_1_HOM_EXT[x]
(4) ELSE
SOI_1_HOM_CLC[x] = EOI_1_HOM + (NC_CRK_INJ_RNG - NC_T_MIN_OFS_INJ_CYL *FAC_N)
(4) ENDIF
(2) ENDFOR
(3) ENDIF

Limitation to the end of injection:
SOI_1_HOM_MAX = 0
(3)FOR cylinder_start to cylinder_stop **DO**
(5) IF
SOI_1_HOM_CLC[x] - TI_1_HOM[x] * FAC_N < EOI_LIM_HOM
(5) THEN
SOI_1_HOM[x] = EOI_LIM_HOM + TI_1_HOM[x] * FAC_N
LV_ EOI_LIM_HOM = 1 At least one injection was repositioned to EOI_LIM_HOM
(5) ELSE
SOI_1_HOM[x] = SOI_1_HOM_CLC[x]
LV_ EOI_LIM_HOM = 0
(5) ENDIF
Limit SOI_1_HOM to SOI_LIM:
SOI_1_HOM[x] = **MIN**(SOI_1_HOM[x]; SOI_LIM)
SOI_1_HOM_MAX = MAX(SOI_1_HOM_MAX, SOI_1_HOM[x])
(3) ENDFOR
(6) IF (single injection)
INJ_MOD_HOM_REQ = NC_INJ_MOD_SINGLE (if single injection is requested)
(6) THEN
EOI_LIM_HOM = MAX(EOI_LIM_HOM, (SOI_1_HOM_MAX
- (NC_CRK_INJ_RNG - NC_T_MIN_OFS_INJ_CYL *FAC_N)))
(6) ENDIF

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EOI_1_HOM = 720°CRK
(4)FOR cylinder_start to cylinder_stop **DO**
    EOI_1_HOM = MIN(EOI_1_HOM, (SOI_1_HOM[x] - TI_1_HOM[x] * FAC_N))
(4) ENDFOR

Output variable for LACO (10 ms synchronous):
CRK_DIF_SOI_IGN_HOM = SOI_1_HOM[0] + CRK_INJ_BAS[0]

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7.9 Injection phase for homogeneous mode - 2. pulse

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EOI_1_SOI_2_GAP_HOM	V	0... 780H	0... 720	0.375	°CRK
Gap between the two injections at cylinder 0					
EOI_2_HOM [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection of the second injection for hom. combustion mode (intermediate value)					
EOI_2_HOM_INTER [NC_CYL_NR]	-	0... 780H	0... 720	0.375	°CRK
end of injection of the second injection for hom. combustion mode (intermediate value)					
SOI_2_HOM	V	0... 780H	0... 720	0.375	°CRK
Start of injection of the second injection for homogeneous combustion					
SOI_2_HOM_INTER [NC_CYL_NR]	-	0... 780H	0... 720	0.375	°CRK
Calibrated start of injection of the second injection for homogeneous combustion mode					
SOI_2_HOM_TOL	-	0... 780H	0... 720	0.375	°CRK
Top limit for the start of the second injection					

Input data:

CTR_CYL_NR_ST_CLC_INJR {p. 3327}	EOI_1_HOM {p. 2122}	EOI_2_HOM_EXT [NC_CYL_NR] {p. 2146}	FAC_N {p. 3327}
INJ_MOD_SP_HOM [NC_CYL_NR] {p. 3329}	LV_ST_END {p. 1720}	NC_CYL_NR {p. 1526}	NR_CYL_CLC_RED_INJ {p. 3331}
SOI_2_MAX_HOM_EXT {p. 2146}	TI_2_HOM [NC_CYL_NR] {p. 2003}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DELTA_T_MIN_DUI	-	0... FFFFH	0... 65.535	0.001	ms
Least time between two injections					
C_EOI_2_HOM_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setpoint for EOI					
LC_EOI_2_HOM_MAN	-	0... 1H	0 ...1	1	-
switch for using the manual setpoit for EOI					

FUNCTION DESCRIPTION:

For the definition of the injection range see module “Injection phase for homogeneous mode, 1. pulse”.
The injection phase for the second pulse is defined via EOI.
All calculations are related to CRK_INJ_BAS[NC_CYL_NR].

Application conditions

Activation: every engine state

Deactivation: –

Initialization: –

Recurrence:
LV_ST_END = 0: 10 ms
LV_ST_END = 1: segment synchronous

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Formula section:

For loop for runtime optimization:
In this specification the for loop
FOR i = 0, i $<$ NR_CYL_CLC_RED_INJ **DO**
x = CTR_CYL_NR_ST_CLC_INJR + i
(1a)**IF** x $>=$ NC_CYL_NR
(1a)**THEN**
x = x - NC_CYL_NR
(1a)**ENDIF**
<**loop content**>
ENDFOR
is substituted by
FOR cylinder_start to cylinder_stop **DO**
<**loop content**>
ENDFOR
Note: In the for loops, x will be used as loop variable to indicate the cylinder x!

Start of the 2^{nd} injection has to be earliest at SOI_2_MAX_HOM_EXT and after the end of the 1^{st} pulse plus a defined delay time C_DELTA_T_MIN_DUI.
SOI_2_HOM_TOL = **MIN**(EOI_1_HOM - C_DELTA_T_MIN_DUI * FAC_N;SOI_2_MAX_HOM_EXT)
SOI_2_HOM = 0

FOR cylinder_start to cylinder_stop **DO**
(1)IF INJ_MOD_SP_HOM[x] $\neq$ "SNGH"
(1)THEN
(2) IF
LC_EOI_2_HOM_MAN = 1
(2) THEN
EOI_2_HOM_INTER[x] = C_EOI_2_HOM_MAN
(2) ELSE
EOI_2_HOM_INTER[x] = EOI_2_HOM_EXT[x]
(2) ENDIF
SOI_2_HOM_INTER[x] = EOI_2_HOM_INTER[x] + TI_2_HOM[x] * FAC_N
(3) IF
SOI_2_HOM_INTER[x] SOI_2_HOM_TOL
(3) THEN
EOI_2_HOM[x] = EOI_2_HOM_INTER[x] - (SOI_2_HOM_INTER[x] -SOI_2_HOM_TOL)

SOI_2_HOM = MAX(SOI_2_HOM; SOI_2_HOM_TOL)
(3) ELSE
EOI_2_HOM[x] = EOI_2_HOM_INTER[x]
SOI_2_HOM = MAX(SOI_2_HOM; SOI_2_HOM_INTER[x])
(3) ENDIF

(1) ELSE
EOI_2_HOM[x] = 0
(1) ENDIF
ENDFOR

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Gap between the two injections:

(4)IF SOI_2_HOM $\neq$ 0

(4)THEN

EOI_1_SOI_2_GAP_HOM = EOI_1_HOM - SOI_2_HOM

(4)ELSE

EOI_1_SOI_2_GAP_HOM = 0

(4)ENDIF

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7.10 Injection phase for homogeneous mode - 3. pulse

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EOI_2_SOI_3_GAP_HOM	V	0... 780H	0... 720	0.375	°CRK
Gap between the second and the third injection at cylinder 0					
EOI_3_HOM [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection of the third injection for hom. combustion mode					
EOI_3_HOM_INTER [NC_CYL_NR]	-	0... 780H	0... 720	0.375	°CRK
End of injection of the third injection for hom. combustion mode (intermediate value)					
SOI_3_HOM_INTER [NC_CYL_NR]	-	0... 780H	0... 720	0.375	°CRK
Calibrated start of injection of the third injection for homogeneous combustion mode					
SOI_3_HOM_MAX	V	0... 780H	0... 720	0.375	°CRK
Maximum start of injection angle of the third injection for homogeneous combustion mode					
SOI_3_HOM_TOL	-	0... 780H	0... 720	0.375	°CRK
Top limit for the start of the third injection					

Input data:

C_DELTA_T_MIN_DUI {p. 2130}	CTR_CYL_NR_ST_CLC_INJR {p. 3327}	EOI_2_HOM [NC_CYL_NR] {p. 2130}	EOI_3_HOM_EXT [NC_CYL_NR] {p. 2146}
FAC_N {p. 3327}	IDX_PRS_COR_CYL_CLC_MPLH [NC_CBK_HPP_NR] {p. 3327}	INJ_MOD_SP_HOM [NC_CYL_NR] {p. 3329}	LV_ST_END {p. 1720}
NC_CBK_HPP_NR [1] {p. 812}	NC_CYL_NR {p. 1526}	NR_CYL_CLC_RED_INJ {p. 3331}	TI_3_HOM [NC_CYL_NR] {p. 2003}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_3_HOM_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setpoint for EOI of third pulse, homogeneous combustion mode					
LC_EOI_3_HOM_MAN	-	0... 1H	0 ...1	1	-
Switch for enabling the manual setpoint for EOI of third pulse, homogeneous combustion mode					

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FUNCTION DESCRIPTION:

For the definition of the injection range see module “Injection phase for homogeneous mode, 1. pulse”.
The injection phase for the second pulse is defined via EOI.
All calculations are related to CRK_INJ_BAS[NC_CYL_NR].

For loop for runtime optimization:
In this specification the for loop
FOR i = 0, i < NR_CYL_CLC_RED_INJ **DO**
x = CTR_CYL_NR_ST_CLC_INJR + i
(1a)**IF** x >= NC_CYL_NR
(1a)**THEN**
x = x - NC_CYL_NR
(1a)**ENDIF**
<**loop content**>

ENDFOR
is substituted by
FOR cylinder_start to cylinder_stop **DO**
<**loop content**>
ENDFOR
Note: In the for loops, x will be used as loop variable to indicate the cylinder x!

Application conditions

Activation: every engine state
Deactivation: –
Initialization: –
Recurrence: LV_ST_END = 0: 10 ms
LV_ST_END = 1: segment synchronous

Formula section:

```
SOI_3_HOM_MAX = 0°CRK
FOR cylinder_start to cylinder_stop DO
   (1)IF INJ_MOD_SP_HOM[x] = "MPLH+PLS3"
   (1)THEN
     SOI_3_HOM_TOL = EOI_2_HOM[x] - C_DELTA_T_MIN_DUI * FAC_N
     (2) IF LC_EOI_3_HOM_MAN = 1
     (2) THEN
          EOI_3_HOM_INTER[x] = C_EOI_3_HOM_MAN
     (2) ELSE
          EOI_3_HOM_INTER[x] = EOI_3_HOM_EXT[x]
     (2) ENDIF
     SOI_3_HOM_INTER[x] = EOI_3_HOM_INTER[x] + TI_3_HOM[x] * FAC_N
     (3) IF SOI_3_HOM_INTER[x] > SOI_3_HOM_TOL
     (3) THEN
          EOI_3_HOM[x] = EOI_3_HOM_INTER[x] - (SOI_3_HOM_INTER[x] - SOI_3_HOM_TOL)
          SOI_3_HOM_MAX = MAX(SOI_3_HOM_MAX, SOI_3_HOM_TOL)
     (3) ELSE
          EOI_3_HOM[x] = EOI_3_HOM_INTER[x]
          SOI_3_HOM_MAX = MAX(SOI_3_HOM_MAX, SOI_3_HOM_INTER[x])
     (3) ENDIF
(1)ELSE
  EOI_3_HOM[x] = 0
(1)ENDIF
ENDFOR
```

Gap between the second and the third injection:

```
(4)IF SOI_3_HOM_MAX ≠ 0
(4)THEN
      FOR m = 0 TO NC_CBK_HPP_NR - 1 DO
              (5)IF INJ_MOD_SP_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m] =
                                                          "MPLH+PLS3"
              (5)THEN
                EOI_2_SOI_3_GAP_HOM = EOI_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]]
                      - (EOI_3_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]]
```

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```
                    + TI_3_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] *FAC_N)
              Break the for-loop after condition is fulfilled one time
          (5)ENDIF
    ENDFOR
(4)ELSE
    EOI_2_SOI_3_GAP_HOM = 0
(4)ENDIF
```

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7.11 Injection phase for homogeneous /stratified mode

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EOI_2_HOMS [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of the second injection for homogeneous stratified mode					
EOI_3_HOMS [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of the third injection for homogeneous stratified mode					
SOI_1_HOMS [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of the first injection for homogeneous stratified mode					

Input data:

CTR_CYL_NR_ST_CLC_INJR {p. 3327}	EOI_1_HOMS_EXT [NC_CYL_NR] {p. 2146}	EOI_2_HOMS_EXT [NC_CYL_NR] {p. 2146}	EOI_3_HOMS_EXT [NC_CYL_NR] {p. 2146}
FAC_N {p. 3327}	INJ_MOD_SP_HOMS [NC_CYL_NR] {p. 3329}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}
NC_CYL_NR {p. 1526}	NC_T_MIN_OFS_INJ_PLS {p. 628}	NR_CYL_CLC_RED_INJ {p. 3331}	SOI_1_HOMS_EXT [NC_CYL_NR] {p. 2146}
T_DLY_2_3_MIN_HOMS [NC_CYL_NR] {p. 2146}	TI_1_S [NC_CYL_NR] {p. 2003}	TI_2_S [NC_CYL_NR] {p. 2003}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_2_HOMS_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setpoint for EOI of the second pulse during homogeneous stratified mode					
C_EOI_3_HOMS_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setpoint for EOI of the third pulse during homogeneous stratified mode					
C_SOI_1_HOMS_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setpoint for SOI of the first pulse during homogeneous stratified mode					
LC_EOI_2_HOMS_MAN	-	0... 1H	0 ...1	1	-
Switch to activate the manual setpoint for EOI_2, homogeneous stratified mode					
LC_EOI_3_HOMS_MAN	-	0... 1H	0 ...1	1	-
Switch to activate the manual setpoint for EOI_3, homogeneous stratified mode					
LC_SOI_1_HOMS_MAN	-	0... 1H	0 ...1	1	-
Switch to activate the manual setpoint for SOI_1, homogeneous stratified mode					

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FUNCTION DESCRIPTION:

Calculation of injection phasing for homogeneous-stratified mode.

Application conditions

Activation: *LV_S_CLC = 1*

Deactivation: *LV_S_CLC = 0*

Initialization at Reset: -

Recurrence: LV_ST_END = 0: 10 ms
LV_ST_END = 1: segment synchronous

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Formula section:

For loop for runtime optimization:
In this specification the for loop
FOR i = 0, i < NR_CYL_CLC_RED_INJ **DO**
x = CTR_CYL_NR_ST_CLC_INJR + i
(1a)**IF** x >= NC_CYL_NR
(1a)**THEN**
x = x - NC_CYL_NR
(1a)**ENDIF**
<**loop content**>
ENDFOR
is substituted by
FOR cylinder_start to cylinder_stop **DO**
<**loop content**>
ENDFOR
Note: In the for loops, x will be used as loop variable to indicate the cylinder x!

(0)FOR cylinder_start to cylinder_stop **DO**

Single injection

(0)IF INJ_MOD_SP_HOMS[x] = "HOMS-SNG"
(0)THEN
(1) IF LC_SOI_1_HOMS_MAN = 1
(1) THEN
SOI_1_HOMS[x] = C_SOI_1_HOMS_MAN
(1) ELSE
SOI_1_HOMS[x] = EOI_1_HOMS_EXT[x] + TI_1_S[x]*FAC_N
(1) ENDIF
EOI_2_HOMS[x] = 0
EOI_3_HOMS[x] = 0
(0) ENDIF

Double injection

(0)IF INJ_MOD_SP_HOMS[x] = "HOMS"
(0)THEN
(1) IF LC_SOI_1_HOMS_MAN = 1
(1) THEN
SOI_1_HOMS[x] = C_SOI_1_HOMS_MAN
(1) ELSE
SOI_1_HOMS[x] = SOI_1_HOMS_EXT[x]
(1) ENDIF
(2) IF LC_EOI_2_HOMS_MAN = 1
(2) THEN
EOI_2_HOMS[x] = C_EOI_2_HOMS_MAN
(2) ELSE
EOI_2_HOMS[x] = EOI_2_HOMS_EXT[x]
(2) ENDIF
EOI_3_HOMS[x] = 0

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(0) ENDIF

Triple injection

```
(0)IF INJ_MOD_SP_HOMS[x] = "HOMS+PLS3"
(0)THEN
    (1) IF LC_SOI_1_HOMS_MAN = 1
    (1) THEN
            SOI_1_HOMS[x] = C_SOI_1_HOMS_MAN
    (1) ELSE
            SOI_1_HOMS[x] = SOI_1_HOMS_EXT[x]
    (1) ENDIF
    (2) IF LC_EOI_2_HOMS_MAN = 1
    (2) THEN
            EOI_2_HOMS[x] = C_EOI_2_HOMS_MAN
    (2) ELSE
            EOI_2_HOMS[x] = EOI_2_HOMS_EXT[x]
    (2) ENDIF
    (1) IF LC_EOI_3_HOMS_MAN = 1
    (1) THEN
            EOI_3_HOMS[x] = C_EOI_3_HOMS_MAN
    (1) ELSE
            EOI_3_HOMS[x] = EOI_3_HOMS_EXT[x]
    (1) ENDIF
(0) ENDIF
(0)ENDFOR
```

Check plausibility of calculated injection angles. If necessary, move the first pulse:

```
(5)FOR cylinder_start to cylinder_stop DO
   (6)IF INJ_MOD_SP_HOMS[x] = "HOMS+PLS3"
   (6) THEN
       (7) IF (EOI_3_HOMS[x] + TI_3_S[x] *FAC_N + T_DYL_2_3_MIN_HOMS[x]*FAC_N)
                 >  EOI_2_HOMS[x]
       (7) THEN
        EOI_2_HOMS[x] = EOI_3_HOMS[x] + TI_3_S[x] *FAC_N
                               + T_DYL_2_3_MIN_HOMS[x]*FAC_N
       (7) ENDIF
       (7) IF (EOI_2_HOMS[x] + TI_2_S[x] *FAC_N + NC_T_MIN_OFS_INJ_PLS *FAC_N)
               >
               (SOI_1_HOMS[x] - TI_1_S[x] *FAC_N)
       (7) THEN
        SOI_1_HOMS[x] = EOI_2_HOMS[x] + TI_2_S[x] *FAC_N + TI_1_S[x] *FAC_N
                              + NC_T_MIN_OFS_INJ_PLS *FAC_N
       (7) ENDIF
   (6) ENDIF
   (6)IF INJ_MOD_SP_HOMS[x] = "HOMS"
   (6) THEN
       (7) IF (EOI_2_HOMS[x] + TI_2_S[x] *FAC_N + T_DYL_2_3_MIN_HOMS[x]*FAC_N)
                 >  (SOI_1_HOMS[x] - TI_1_S[x] *FAC_N)
       (7) THEN
        SOI_1_HOMS[x] = EOI_2_HOMS[x] + TI_2_S[x] *FAC_N + TI_1_S[x] *FAC_N
                              + T_DYL_2_3_MIN_HOMS[x]*FAC_N
       (7) ENDIF
```

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(6) ENDIF
(5) ENDFOR

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7.12 Injection phase for stratified mode - 1. pulse

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_DIF_SOI_IGN_S	O	0... F00H	0... 1440	0.375	°CRK
Output variable for LACO					
EOI_1_S [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of the first injection for stratified mode					
SOI_1_S [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of the first injection phase for stratified mode					

Input data:

CRK_INJ_BAS [NC_CYL_NR] {p. 2122}	CTR_CYL_NR_ST_CLC_INJR {p. 3327}	EOI_1_S_EXT [NC_CYL_NR] {p. 2146}	FAC_N {p. 3327}
INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}	NC_CYL_NR {p. 1526}
NR_CYL_CLC_RED_INJ {p. 3331}	SOI_2_S [NC_CYL_NR] {p. 2142}	T_DLY_1_2_S_EXT [NC_CYL_NR] {p. 2146}	TI_1_S [NC_CYL_NR] {p. 2003}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_1_S_MAN	-	0... 780H	0... 720	0.375	°CRK
Global application assistance for the second injection					
LC_EOI_1_S_MAN	-	0... 1H	0 ...1	1	-
Global application assistance switch passive/active for the second injection					

FUNCTION DESCRIPTION:

Application conditions

Activation: *LV_S_CLC = 1*

Deactivation: –

Initialization at Reset: –

Recurrence: LV_ST_END = 0: 10 ms
LV_ST_END = 1: segment sychronous

Formula section:

For loop for runtime optimization:
In this specification the for loop
FOR i = 0, i < NR_CYL_CLC_RED_INJ **DO**
x = CTR_CYL_NR_ST_CLC_INJR + i
(1a)**IF** x >= NC_CYL_NR
(1a)**THEN**
x = x - NC_CYL_NR
(1a)**ENDIF**
<**loop content**>

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ENDFOR
is substituted by
FOR cylinder_start to cylinder_stop **DO**
<**loop content**>
ENDFOR
Note: In the for loops, x will be used as loop variable to indicate the cylinder x!

FOR cylinder_start to cylinder_stop **DO**
(1) IF INJ_MOD_SP_S[x] $\neq$ "SNGS"
(1) THEN
EOI_1_S[x] = SOI_2_S[x] + T_DLY_1_2_S_EXT[x] * FAC_N
(1) ELSE
(2) IF LC_EOI_1_S_MAN = 1
(2) THEN
EOI_1_S[x] = C_EOI_1_S_MAN
(2) ELSE
EOI_1_S[x] = EOI_1_S_EXT[x]
(2) ENDIF
(1) ENDIF
SOI_1_S[x] = EOI_1_S[x] + TI_1_S[x] * FAC_N
ENDFOR

Output variable for LACO (10 ms synchronous):
CRK_DIF_SOI_IGN_S = SOI_1_S[CTR_CYL_NR_ST_CLC_INJR] + CRK_INJ_BAS[0]

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7.13 Injection phase for stratified mode - 2. pulse

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EOI_2_S [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of the second injection for stratified mode					
SOI_2_S [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of the second injection for stratified mode					

Input data:

CTR_CYL_NR_ST_CLC_INJR {p. 3327}	EOI_2_S_EXT [NC_CYL_NR] {p. 2146}	FAC_N {p. 3327}	INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}
LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}	NC_CYL_NR {p. 1526}	NR_CYL_CLC_RED_INJ {p. 3331}
SOI_3_S [NC_CYL_NR] {p. 2144}	T_DLY_2_3_S_EXT [NC_CYL_NR] {p. 2146}	TI_2_S [NC_CYL_NR] {p. 2003}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_2_S_MAN	-	0... 780H	0... 720	0.375	°CRK
Global application assistance for the second injection					
LC_EOI_2_S_MAN	-	0... 1H	0 ...1	1	-
Global application assistance switch passive/active for the second injection					

FUNCTION DESCRIPTION:

Application conditions

Activation: *LV_S_CLC = 1*

Deactivation: *LV_S_CLC = 0*

Initialization at Reset: -

Recurrence: LV_ST_END = 0: 10 ms
LV_ST_END = 1: segment sychronous

Formula section:

For loop for runtime optimization:
In this specification the for loop
FOR i = 0, i < NR_CYL_CLC_RED_INJ **DO**
x = CTR_CYL_NR_ST_CLC_INJR + i
(1a)**IF** x >= NC_CYL_NR
(1a)**THEN**
x = x - NC_CYL_NR
(1a)**ENDIF**
<**loop content**>
ENDFOR
is substituted by

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```
FOR cylinder_start to cylinder_stop DO
        <loop content>
ENDFOR
```

Note: In the for loops, x will be used as loop variable to indicate the cylinder x!

```
FOR cylinder_start to cylinder_stop DO
(1)IF INJ_MOD_SP_S[x] = "MPLS+PLS3"
(1)THEN
        EOI_2_S[x] = SOI_3_S[x] + T_DLY_2_3_S_EXT[x]* FAC_N
    SOI_2_S[x] = EOI_2_S[x] + TI_2_S[x]*FAC_N
(1)ELSE
        (2) IF INJ_MOD_SP_S[x] = "MPLS"
        (2) THEN
                (3) IF LC_EOI_2_S_MAN = 1
                (3) THEN
                        EOI_2_S[x] = C_EOI_2_S_MAN
                (3) ELSE
                        EOI_2_S[x] = EOI_2_S_EXT[x]
                (3) ENDIF
               SOI_2_S[x] = EOI_2_S[x] + TI_2_S[x]*FAC_N
        (2) ELSE
                SOI_2_S[x] = 0
                EOI_2_S[x] = 0
        (2) ENDIF
(1) ENDIF
ENDFOR
```

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7.14 Injection phase for stratified mode - 3. pulse

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EOI_3_S [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of the third injection for stratified mode					
SOI_3_S [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of the third injection for stratified mode					

Input data:

CTR_CYL_NR_ST_CLC_INJR {p. 3327}	EOI_3_S_EXT [NC_CYL_NR] {p. 2146}	FAC_N {p. 3327}	INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}
LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}	NC_CYL_NR {p. 1526}	NR_CYL_CLC_RED_INJ {p. 3331}
TI_3_S [NC_CYL_NR] {p. 2003}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_3_S_MAN	-	0... 780H	0... 720	0.375	°CRK
Global application assistance for the third injection					
LC_EOI_3_S_MAN	-	0... 1H	0 ...1	1	-
Global application assistance switch passive/active for the third injection					

FUNCTION DESCRIPTION:

Application conditions

Activation: *LV_S_CLC = 1*

Deactivation: *LV_S_CLC = 0*

Initialization at Reset: -

Recurrence: LV_ST_END = 0: 10 ms
LV_ST_END = 1: segment sychronous

Formula section:

For loop for runtime optimization:
In this specification the for loop
FOR i = 0, i < NR_CYL_CLC_RED_INJ **DO**
x = CTR_CYL_NR_ST_CLC_INJR + i
(1a)**IF** x >= NC_CYL_NR
(1a)**THEN**
x = x - NC_CYL_NR
(1a)**ENDIF**
<**loop content**>
ENDFOR
is substituted by

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```
FOR cylinder_start to cylinder_stop DO
        <loop content>
ENDFOR
```

Note: In the for loops, x will be used as loop variable to indicate the cylinder x!

```
FOR cylinder_start to cylinder_stop DO
   (1)IF INJ_MOD_SP_S[x] = "MPLS+PLS3"
   (1)THEN
         (2) IF
         LC_EOI_3_S_MAN = 1
         (2) THEN
         EOI_3_S[x] = C_EOI_3_S_MAN
         (2)     ELSE
         EOI_3_S[x] = EOI_3_S_EXT[x]
         (2)     ENDIF
         SOI_3_S[x] = EOI_3_S[x] + TI_3_S[x] * FAC_N
   (1)ELSE
         EOI_3_S[x] = 0
         SOI_3_S[x] = 0
   (1)ENDIF
ENDFOR
```

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7.15 Injection phase (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAM_SHIFT_EX	O/V	FC40... 3C0H	-360 ...360	0.375	°CRK
Shift of the exhaust camshaft relative to passiv position					
CAM_SHIFT_IN	O/V	FC40... 3C0H	-360 ...360	0.375	°CRK
Shift of the inlet camshaft relative to passiv position					
EOI_1_HOMS_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for homogeneous stratified mode, 1. pulse - base value from customer layer					
EOI_1_S_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for stratified mode, 1.pulse - base value from customer layer					
EOI_2_HOM_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for homogeneous mode, 2.pulse - base value from customer layer					
EOI_2_HOMS_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for homogeneous stratified mode, 2.pulse - base value from customer layer					
EOI_2_S_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for stratified mode, 2.pulse - base value from customer layer					
EOI_3_HOM_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for homogeneous mode, 3.pulse - base value from customer layer					
EOI_3_HOMS_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for homogeneous stratified mode, 3.pulse - base value from customer layer					
EOI_3_S_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of injection for stratified mode, 3.pulse - base value from customer layer					
LV_INJ_DI_PLS_UPD_MPLH	O/V	0... 1H	0 ...1	1	-
Flag to disable pulse updates in multiple homogeneous mode.					
LV_INJ_PLS_UPD_MPLH_DEAC	O/V	0... 1H	0 ...1	1	-
Flag to deactivate pulse updates in multiple homogeneous mode					
SOI_1_HOM_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of injection for homogeneous mode, 1.pulse - base value from customer layer					
SOI_1_HOMS_EXT [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of injection for homogeneous stratified mode, 1.pulse - base value from customer layer					
SOI_2_MAX_HOM_EXT	O/V	0... 780H	0... 720	0.375	°CRK
Earliest start of injection for the second pulse in homogeneous injection mode					
T_DLY_1_2_S_EXT [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Interval between first and second pulse of stratified injection base value from MSD70 layer					
T_DLY_2_3_MIN_HOMS [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Minimum time delay between second and third pulse for homogeneous-stratified mode					
T_DLY_2_3_S_EXT [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Interval between second and third pulse of stratified injection; base value from MSD70 layer					

Input data:

CRK_INJ_BAS [NC_CYL_NR] {p. 2122}	CTR_CYL_NR_ST_CLC_ INJR {p. 3327}	EOI_2_HOM_CUS [NC_CYL_NR] {p. 8269}	EOI_2_HOMS_CUS [NC_CYL_NR]
EOI_3_HOM_CUS [NC_CYL_NR]	EOI_3_HOMS_CUS [NC_CYL_NR] {p. 8269}	EOI_3_S_CUS [NC_CYL_NR] {p. 8269}	FAC_N {p. 3327}
IGA_AV_H_RNG [NC_CYL_NR] {p. 1828}	INJ_MOD_SP_HOM [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_HOMS [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}

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LF_SOI_S_ENA {p. 8269}	LV_EOI_2_DELTA_HOM_CUS {p. 8269}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}
NC_CYL_NR {p. 1526}	NR_CYL_CLC_RED_INJ {p. 3331}	SOI_1_HOM_CUS [NC_CYL_NR] {p. 8270}	SOI_1_HOMS_CUS [NC_CYL_NR] {p. 8270}
SOI_2_MAX_CUS {p. 8270}	SOI_S_CUS [NC_CYL_NR] {p. 8270}	STATE_INJ_MOD_HOM_REQ {p. 3331}	T_DLY_1_2_S_CUS [NC_CYL_NR] {p. 8270}
T_DLY_2_3_MIN_HOMS_CUS [NC_CYL_NR] {p. 8270}	T_DLY_2_3_S_CUS [NC_CYL_NR] {p. 8270}	TI_1_S [NC_CYL_NR] {p. 2003}	TI_2_S [NC_CYL_NR] {p. 2003}
TI_3_S [NC_CYL_NR] {p. 2003}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_1_2_S_EXT_MAN	-	0... FFFFH	0... 65.535	0.001	ms
Manual setpoint for time interval between first and second pulse of stratified injection					
C_T_DLY_2_3_S_EXT_MAN	-	0... FFFFH	0... 65.535	0.001	ms
Manual setpoint for time interval between second and third pulse of stratified injection					
LC_T_DLY_1_2_S_EXT_MAN_ENA	-	0... 1H	0 ...1	1	-
Switch to enable manual setpoint for time interval between first and second pulse of stratified injection					
LC_T_DLY_2_3_S_EXT_MAN_ENA	-	0... 1H	0 ...1	1	-
Switch to enable manual setpoint for time interval between second and third pulse of stratified injection					

FUNCTION DESCRIPTION:

In this part, the conversion of injection phasing from customer nomenclature to supplier nomenclature is done.
For calculation order purposes, the specification is divided in two parts. The part that calculates the delay times for stratified combustion mode must be calculated before the task "Final injection timing", the part that calculates the rest of the phasing must be calculated after.

For loop for runtime optimization:
In this specification the for loop
FOR i = 0, i < NR_CYL_CLC_RED_INJ **DO**
x = CTR_CYL_NR_ST_CLC_INJR + i
(1a)**IF** x >= NC_CYL_NR
(1a)**THEN**
x = x - NC_CYL_NR
(1a)**ENDIF**
<**loop content**>
ENDFOR
is substituted by
FOR cylinder_start to cylinder_stop **DO**
<**loop content**>
ENDFOR
Note: In the for loops, x will be used as loop variable to indicate the cylinder x!

7.15.1 Calculation of pulse delay times for stratified combustion mode

Note: This task must be calculated **before** the task "Final injection timing"!

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Application conditions

Activation: every engine state

Deactivation: –

Initialization: –

Recurrence: LV_ST_END = 0: 10ms
LV_ST_END = 1: segment synchronous

Formula section:

Deactivate pulse update during double injection in HOM mode with ignition related injection:

IF LV_EOI_2_DELTA_HOM_CUS = 1
AND STATE_INJ_MOD_HOM_REQ ≠ MPLH+PLS3
THEN
LV_INJ_PLS_UPD_MPLH_DEAC = 1

ELSE
LV_INJ_PLS_UPD_MPLH_DEAC = 0

ENDIF

LV_INJ_DI_PLS_UPD_MPLH = LV_INJ_PLS_UPD_MPLH_DEAC

(1)FOR cylinder_start to cylinder_stop **DO**
SOI_1_HOM_EXT[x] = SOI_1_HOM_CUS[x] - CRK_INJ_BAS[0]
(1) IF LV_EOI_2_DELTA_HOM_CUS = 1
AND INJ_MOD_SP_HOM[x] ≠ MPLH+PLS3
(1) THEN
EOI_2_HOM_EXT[x] = EOI_2_HOM_CUS[x] + (IGA_AV_H_RNG[x] - CRK_INJ_BAS[0])

(1) ELSE
EOI_2_HOM_EXT[x] = EOI_2_HOM_CUS[x] - CRK_INJ_BAS[0]
(1) ENDIF
(1a) IF LV_EOI_2_DELTA_HOM_CUS = 1
AND INJ_MOD_SP_HOM[x] = MPLH+PLS3
(1a) THEN
EOI_3_HOM_EXT[x] = EOI_3_HOM_CUS[x] + (IGA_AV_H_RNG[x] - CRK_INJ_BAS[0])

(1a) ELSE
EOI_3_HOM_EXT[x] = EOI_3_HOM_CUS[x] - CRK_INJ_BAS[0]
(1a) ENDIF

(1)IF LV_S_CLC = 1
(1)THEN
Calculation of pulse delay times:
(2)IF INJ_MOD_SP_S[x] ="MPLS+PLS3" (triple injection)
(2)THEN
T_DLY_1_2_S_EXT[x] = T_DLY_1_2_S_CUS[x]
T_DLY_2_3_S_EXT[x] = T_DLY_2_3_S_CUS[x]
(2)ENDIF
(3)IF INJ_MOD_SP_S[x] ="MPLS" (double injection)

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(3)THEN
T_DLY_1_2_S_EXT[x] = T_DLY_2_3_S_CUS[x]
(3)ENDIF
Manual setting of pulse delay times:
(4)IF LC_T_DLY_1_2_S_EXT_MAN_ENA = 1
(4)THEN
T_DLY_1_2_S_EXT[x] = C_T_DLY_1_2_S_EXT_MAN
(4)ENDIF
(5)IF LC_T_DLY_2_3_S_EXT_MAN_ENA = 1
(5)THEN
T_DLY_2_3_S_EXT[x] = C_T_DLY_2_3_S_EXT_MAN
(5)ENDIF
(1)ENDIF
(1)ENDFOR

7.15.2 Calculation of injection phasing

Note: This task must be calculated **after** the task "Final injection timing"!

Application conditions

Activation: every engine state

Deactivation: –

Initialization: –

Recurrence: LV_ST_END = 0: 10ms
LV_ST_END = 1: segment synchronous

Formula section:

CAM_SHIFT_EX = 0
CAM_SHIFT_IN = 0
SOI_2_MAX_HOM_EXT = SOI_2_MAX_CUS - CRK_INJ_BAS[0]

(1)FOR cylinder_start to cylinder_stop **DO**

(0)IF LV_S_CLC = 1
(0)THEN

Mapping for stratified combustion mode
(1)IF INJ_MOD_SP_S[x] ="MPLS+PLS3" (triple injection)
(1) THEN
(1a)IF Bit x of LF_SOI_S_ENA = 0
(1a)THEN
EOI_3_S_EXT[x] = EOI_3_S_CUS[x] - CRK_INJ_BAS[0]
(1a)ELSE
EOI_3_S_EXT[x] = SOI_S_CUS[x] - CRK_INJ_BAS[0]
- (TI_3_S[x] * FAC_N)
(1a)ENDIF
(1) ENDIF

(2)IF INJ_MOD_SP_S[x] ="MPLS" (double injection)
(2) THEN

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(2a)IF Bit x of LF_SOI_S_ENA = 0
(2a)THEN
EOI_2_S_EXT[x] = EOI_3_S_CUS[x] - CRK_INJ_BAS[0]
(2a)ELSE
EOI_2_S_EXT[x] = SOI_S_CUS[x] - CRK_INJ_BAS[0]
- (TI_2_S[x] * FAC_N)
(2a)ENDIF

1. **ENDIF**

(3)IF INJ_MOD_SP_S[x] ="SNGS" (single injection)
(3) THEN
(2a)IF Bit x of LF_SOI_S_ENA = 0
(2a)THEN
EOI_1_S_EXT[x] = EOI_3_S_CUS[x] - CRK_INJ_BAS[0]
(2a)ELSE
EOI_1_S_EXT[x] = SOI_S_CUS[x] - CRK_INJ_BAS[0]
- (TI_1_S[x] * FAC_N)
(2a)ENDIF

1. **ENDIF**

Mapping for homogeneous stratified combustion mode
(1)IF INJ_MOD_SP_HOMS[x] ="HOMS+PLS3" (triple injection)
EOI_3_HOMS_EXT[x] = EOI_3_HOMS_CUS[x] - CRK_INJ_BAS[0]
EOI_2_HOMS_EXT[x] = EOI_2_HOMS_CUS[x] - CRK_INJ_BAS[0]
SOI_1_HOMS_EXT[x] = SOI_1_HOMS_CUS[x] - CRK_INJ_BAS[0]
(1) ENDIF

(2)IF INJ_MOD_SP_HOMS[x] ="HOMS" (double injection)
EOI_2_HOMS_EXT[x] = EOI_3_HOMS_CUS[x] - CRK_INJ_BAS[0]
SOI_1_HOMS_EXT[x] = SOI_1_HOMS_CUS[x] - CRK_INJ_BAS[0]
(2) ENDIF

(3)IF INJ_MOD_SP_HOMS[x] ="HOMS-SNG" (single injection)
EOI_1_HOMS_EXT[x] = EOI_3_HOMS_CUS[x] - CRK_INJ_BAS[0]
(3) ENDIF
T_DLY_2_3_MIN_HOMS[x] = T_DLY_2_3_MIN_HOMS_CUS[x]
(0)ENDIF - LV_S_CLC
(1) ENDFOR

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7.16 Calculation of mass fuel flow setpoint

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MFF_SP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint after combustion selection, bank selective					
MFF_SP_FUP_CTL	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint for fuel pressure control					
MFF_SP_HOM [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint for homogeneous mode, bank selective					
MFF_SP_HOM_BAS_MV	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Arithmetic Mean of mass fuel flow setpoint for homogeneous mode					
MFF_SP_HOM_ENG [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint after combustion selection					
MFF_SP_MV	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint after combustion selection					

Input data:

LV_IGA_AND_INJ_SWI {p. 8136}	LV_ST_END {p. 1720}	MFF_SP_1_HOM [NC_CYL_NR] {p. 8242}	MFF_SP_1_S [NC_CYL_NR] {p. 8242}
MFF_SP_2_HOM [NC_CYL_NR] {p. 8242}	MFF_SP_2_S [NC_CYL_NR] {p. 8242}	MFF_SP_3_HOM [NC_CYL_NR] {p. 8243}	MFF_SP_3_S [NC_CYL_NR] {p. 8243}
MFF_SP_HOM_BAS [NC_CBK_EX_NR] {p. 8243}	SUM_INH_INJ {p. 2295}		

FUNCTION DESCRIPTION:

General information:

MFF_SP_MV is set to MFF_SP_HOM or MFF_SP_S depending on LV_IGA_AND_INJ_SWI.
MFF_SP serves as input, e.g. for the function „Fuel Pressure Control".

Application conditions

Initialisation: at reset

Recurrence: If LV_ST_END = 0: 10 ms
If LV_ST_END = 1: every TDC

Activation: every engine state

Deactivation: -

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Formula section:

Calculation of MFF_SP_MV and MFF_SP_FUP_CTL:

IF LV_IGA_AND_INJ_SWI = 1 (homogeneous mode)
THEN MFF_SP_MV = (MFF_SP_1_HOM[x] + MFF_SP_2_HOM[x] + MFF_SP_3_HOM[x]) /NC_CYL_NR

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```
        MFF_SP_FUP_CTL   =   MFF_SP_MV * (1-(SUM_INH_INJ /NC_CYL_NR))
ELSE  (stratified mode)
        MFF_SP_MV          =   (MFF_SP_1_S[x] + MFF_SP_2_S[x] + MFF_SP_3_S[x]) /NC_CYL_
NR
        MFF_SP_FUP_CTL   =   MFF_SP_MV * (1-(SUM_INH_INJ /NC_CYL_NR))
ENDIF
```

Calculation of MFF_SP[NC_CBK_EX_NR]:

```
IF      NC_CBK_EX_NR > 1                  (please note physical meaning)
THEN
        FOR i = 1 TO NC_CBK_EX_NR             (please note physical meaning)
              MFF_SP[i] = 0
        ENDFOR
        FOR x = 0 TO (NC_CYL_NR - 1)
          IF (NC_LAMB_REF AND 2^x) ≠ 0                (bitwise)
          THEN
               Bank 2:
                 IF          LV_IGA_AND_INJ_SWI = 1  (homogeneous mode)
                 THEN     MFF_SP[2] += MFF_SP_1_HOM[x] + MFF_SP_2_HOM[x]
                                      + MFF_SP_3_HOM[x]
                 ELSE     (stratified mode)
                          MFF_SP[2] += MFF_SP_1_S[x] + MFF_SP_2_S[x] +
                                            MFF_SP_3_S[x]
                 ENDIF
               ELSE
                 Bank 1:
                 IF          LV_IGA_AND_INJ_SWI = 1  (homogeneous mode)
                 THEN     MFF_SP[1] += MFF_SP_1_HOM[x] + MFF_SP_2_HOM[x]
                                       + MFF_SP_3_HOM[x]
                 ELSE     (stratified mode)
                          MFF_SP[1] += MFF_SP_1_S[x] + MFF_SP_2_S[x] +
                                            MFF_SP_3_S[x]
                 ENDIF
               ENDIF
        ENDFOR
        FOR i = 1 TO NC_CBK_EX_NR
               MFF_SP[i] = MFF_SP[i] /(NC_CYL_NR /NC_CBK_EX_NR)
        ENDFOR
ELSE
        MFF_SP[1] = 0
        FOR x = 0 TO (NC_CYL_NR - 1)
               IF            LV_IGA_AND_INJ_SWI = 1        (homogeneous mode)
          THEN       MFF_SP[1] += MFF_SP_1_HOM[x] + MFF_SP_2_HOM[x]
                                      + MFF_SP_3_HOM[x]
               ELSE        (stratified mode)
                       MFF_SP[1] += MFF_SP_1_S[x] + MFF_SP_2_S[x] +
                                       MFF_SP_3_S[x]
               ENDIF
        ENDFOR
        MFF_SP[1] = MFF_SP[1] /NC_CYL_NR
ENDIF
```

Calculation of MFF_SP_HOM[NC_CBK_EX_NR]:

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```
IF      NC_CBK_EX_NR > 1                  (please note physical meaning)
THEN
        FOR i = 1 TO NC_CBK_EX_NR             (please note physical meaning)
              MFF_SP_HOM[i] = 0
        ENDFOR

        FOR x = 0 TO (NC_CYL_NR - 1)
          IF (NC_LAMB_REF AND 2^x) ≠ 0                 (bitwise)
          THEN
              Bank 2:
                MFF_SP_HOM[2] += MFF_SP_1_HOM[x] + MFF_SP_2_HOM[x]
                                  + MFF_SP_3_HOM[x]
               ELSE
                Bank 1:
                MFF_SP_HOM[1] += MFF_SP_1_HOM[x] + MFF_SP_2_HOM[x]
                                  + MFF_SP_3_HOM[x]
               ENDIF
        ENDFOR

        FOR i = 1 TO NC_CBK_EX_NR
               MFF_SP_HOM[i] = MFF_SP_HOM[i] /(NC_CYL_NR /NC_CBK_EX_NR)
               MFF_SP_HOM_ENG[i] = MFF_SP_HOM[i]
        ENDFOR

ELSE
        MFF_SP_HOM[1] = 0
        FOR x = 0 TO (NC_CYL_NR - 1)
               MFF_SP_HOM[1] += MFF_SP_1_HOM[x] + MFF_SP_2_HOM[x]
                                  + MFF_SP_3_HOM[x]
        ENDFOR
        MFF_SP_HOM[1] = MFF_SP_HOM[1] /NC_CYL_NR
        MFF_SP_HOM_ENG[1] = MFF_SP_HOM[1]
ENDIF
```

Calculation of MFF_SP_HOM_BAS_MV:

MFF_SP_HOM_BAS_MV = **SUM(** MFF_SP_HOM_BAS[NC_CBK_EX_NR] **)**
/NC_CBK_EX_NR

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7.17 Homogeneous catalyst heating with multiple injection 1. pulse

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
SOI_1_MPLH_CH [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of 1st injection for catalyst heating with multiple injection in homogeneous					

Input data:

LV_IS {p. 1720}	LV_MPLH_ACT {p. 8269}	MAF {p. 8277}	N_32 {p. 1525}
NC_CYL_NR {p. 1526}	STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}	STATE_CH_MOD_REQ {p. 1796}
TCO {p. 1100}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_SOI_1_MPLH_CH_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setting of start of injection for catalyst heating					
IP_SOI_1_CH_ADD_TCO	-	0... F00H	-720 ...720	0.375	°CRK
LDP_TCO_IP_SOI_1_CH_ADD_TCO	6	0... FEH	-48... 142.5	0.75	°C
Additive value for end of 1st injection related to ignition angle depending on coolant temperature					
IP_SOI_1_MPLH_CH_AST	V	0... 780H	0... 720	0.375	°CRK
LDPM_N_32_7_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_EXTC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic start of injection for CH					
IP_SOI_1_MPLH_CH_AST_IS	V	0... 780H	0... 720	0.375	°CRK
LDPM_N_32_5_EXTC	6	0... FFH	0... 8160	32	rpm
LDP_MAF_IP_SOI_1_MPLH_CH_AST_IS	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic start of injection for CH in idle					
IP_SOI_1_MPLH_CH_SO2P	V	0... 780H	0... 720	0.375	°CRK
LDPM_N_32_8_EXTC	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_EXTC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic start of injection for MPLH during catalyst heating for desulfation					
LC_SOI_1_MPLH_CH_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of start of injection for catalyst heating					

Overview

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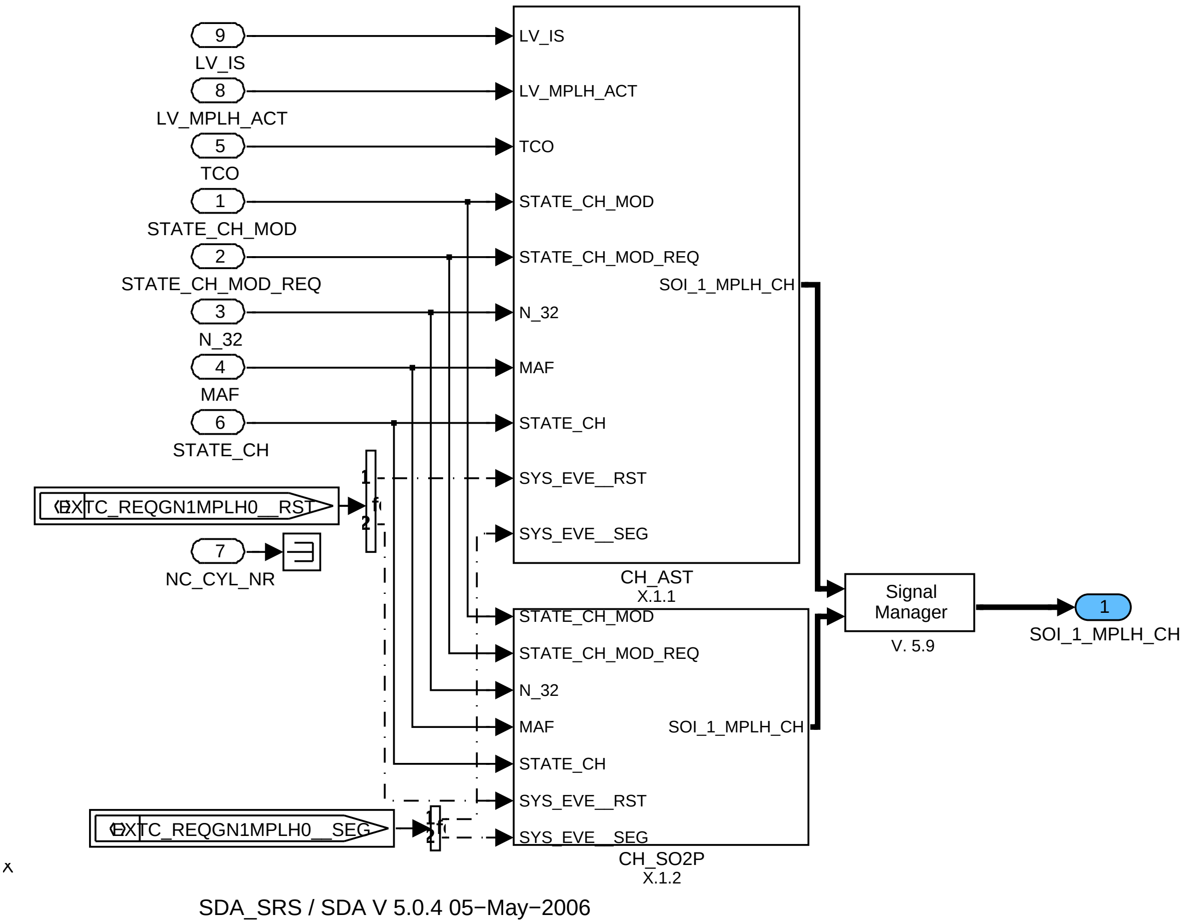

Figure 7.17.1: : Path: EXTC_REQGN1MPLH0

General Information

In this module a special phasing of the 1st pulse in homogeneous split injection in case of catalyst heating is generated.

7.17.1 Catalyst heating after start

Application Conditions

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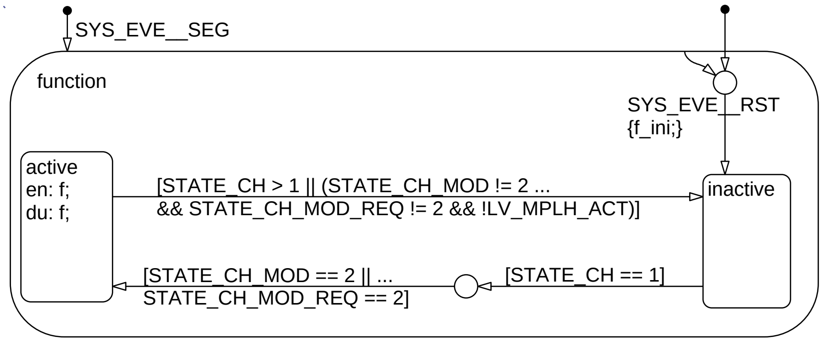

Figure 7.17.2: : Path: EXTC_REQGN1MPLH0/CH_AST/APP_CDN/Chart

Function description

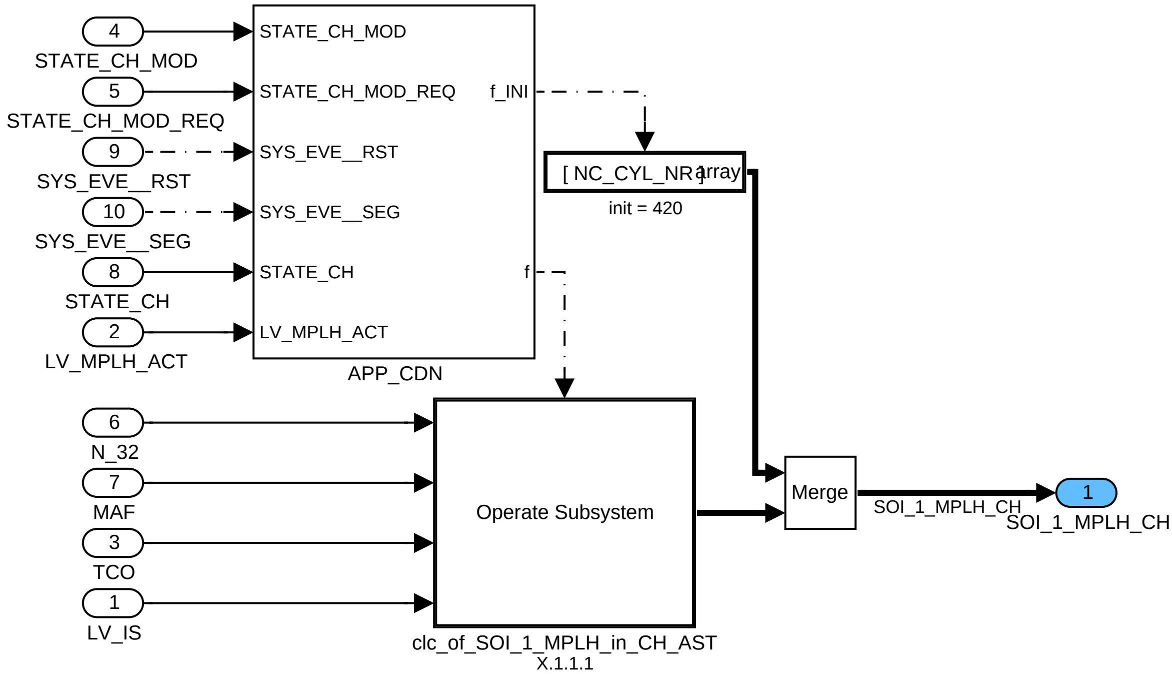

Figure 7.17.3: : Path: EXTC_REQGN1MPLH0/CH_AST

7.17.1.1 Catalyst heating after start - Subsystem

In the For-system the scalar value is written to each row of the NC_CYL_NR-dimensional vector.

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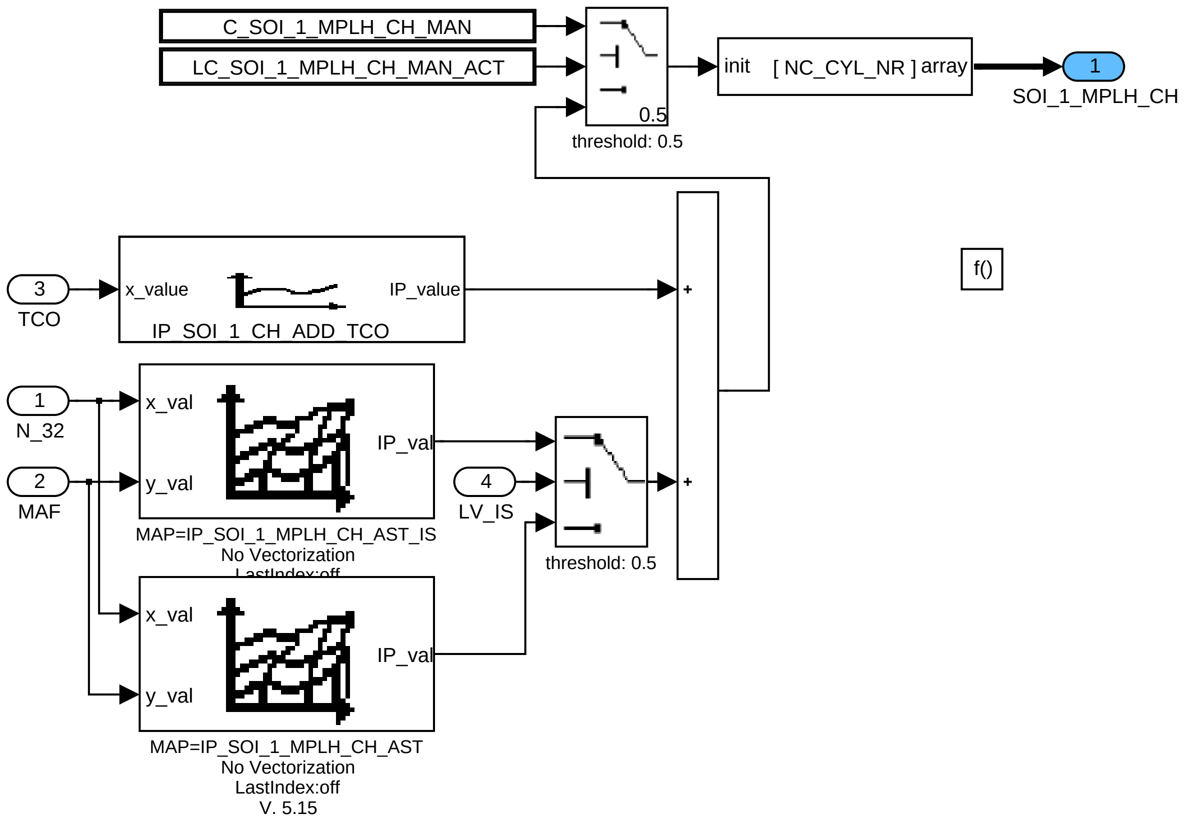

Figure 7.17.4: : Path: EXTC_REQGN1MPLH0/CH_AST/clc_of_SOI_1_MPLH_in_CH_AST

7.17.2 Catalyst heating for desulfation

Application Conditions

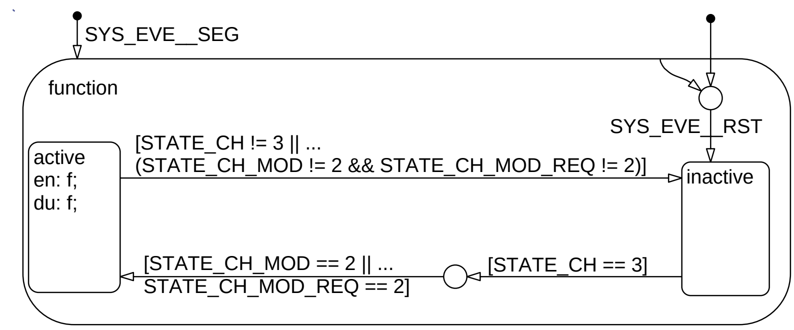

Figure 7.17.5: : Path: EXTC_REQGN1MPLH0/CH_SO2P/APP_CDN/Chart

Function description

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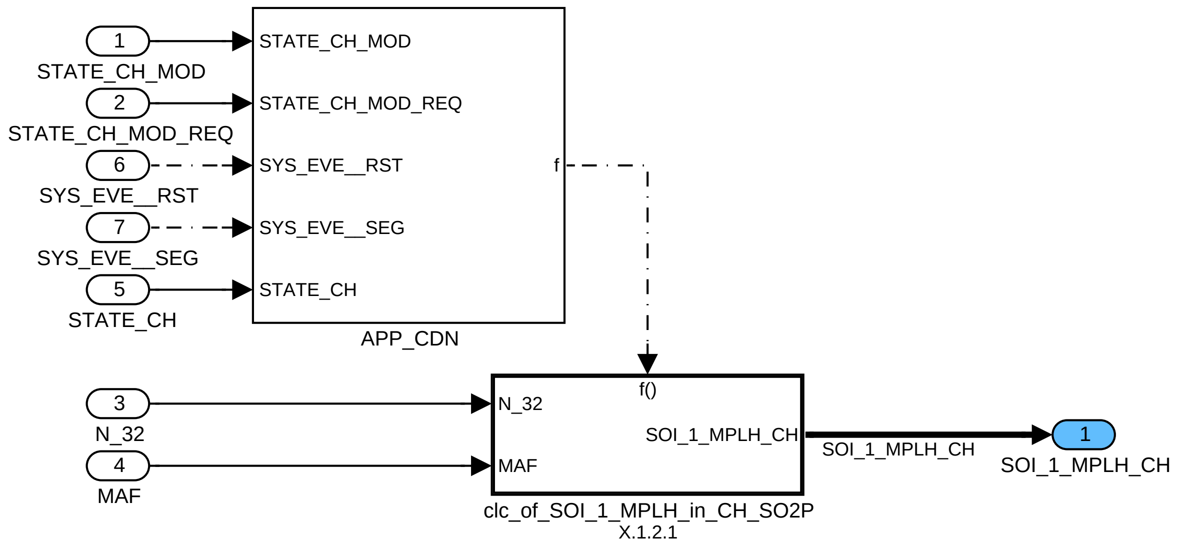

Figure 7.17.6: : Path: EXTC_REQGN1MPLH0/CH_SO2P

7.17.2.1 Catalyst heating for desulfation - Subsystem

In the For-system the scalar value is written to each row of the NC_CYL_NR-dimensional vector.

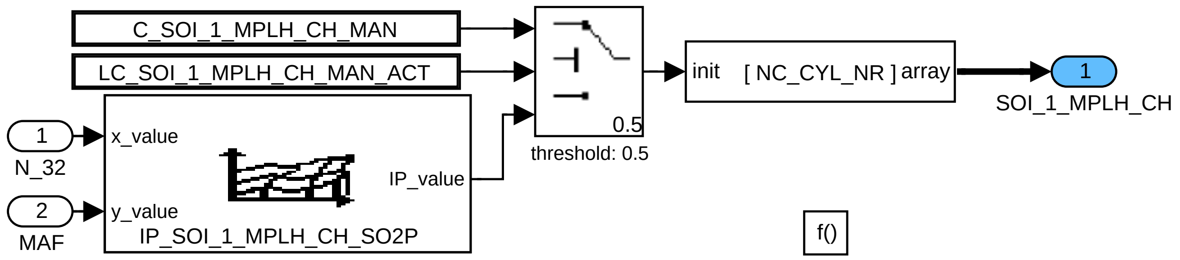

Figure 7.17.7: : Path: EXTC_REQGN1MPLH0/CH_SO2P/clc_of_SOI_1_MPLH_in_CH_SO2P

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7.18 Homogeneous catalyst heating with multiple injection 2. pulse

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EOI_2_DELTA_MPLH_CH	O/V	0... 780H	0... 720	0.375	°CRK
End of injection of the second injection for catalyst heating - related to ignition angle					

Input data:

LV_MPLH_ACT {p. 8269}	MAF {p. 8277}	MFF_SP_2_MPLH_CH {p. 2164}	N_32 {p. 1525}
STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}	STATE_CH_MOD_REQ {p. 1796}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_2_DELTA_MPLH_CH_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual setting of end of injection of the second injection for catalyst heating					
IP_EOI_2_DELTA_MPLH_CH_AST	-	0... 780H	0... 720	0.375	°CRK
LDPM_N_32_7_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_EXTC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
End of 2nd injection in after start catalyst heating in homogeneous with split injection- related to ignition angle					
IP_EOI_2_DELTA_MPLH_CH_SO2P	-	0... 780H	0... 720	0.375	°CRK
LDPM_N_32_8_EXTC	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_EXTC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
End of 2nd injection in desulfation catalyst heating in homogeneous with split injection- related to ignition angle					
IP_EOI_2_MPLH_CH_ADD_MFF_2	-	0... F00H	-720 ...720	0.375	°CRK
LDP_MFF_2_IP_EOI_2_MPLH_CH_ADD	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Additive value for end of 2nd injection					
LC_EOI_2_DELTA_MPLH_CH_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of end of injection of the second injection for catalyst heating					

Overview

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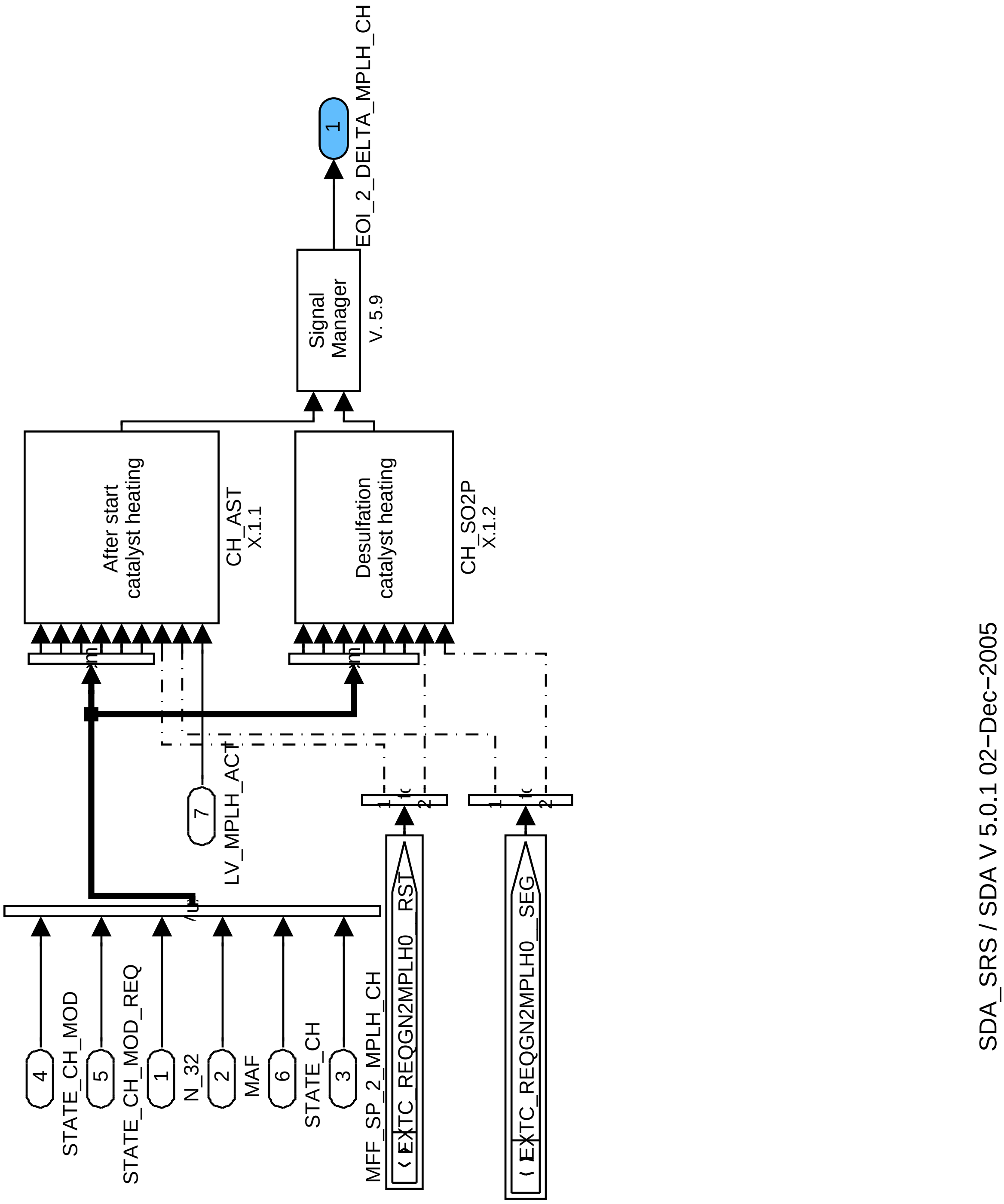

Figure 7.18.1: : Path: EXTC_REQGN2MPLH0

General Information

For catalyst heating in homogeneous split mode an additional injection pulse is generated. This module contains the phasing of this pulse.
EOI_2_DELTA_MPLH_CH therefore is defined as crankshaft angle difference between end of injection of 2nd pulse and ignition angle.

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7.18.1 After start catalyst heating

Application Conditions

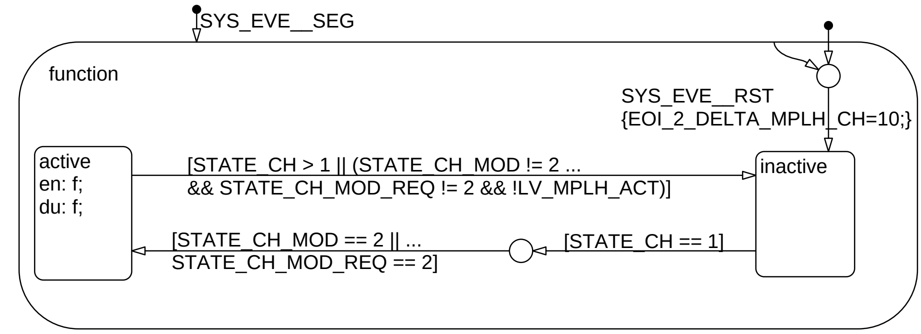

Figure 7.18.2: : Path: EXTC_REQGN2MPLH0/CH_AST/APP_CDN/Chart

Function description

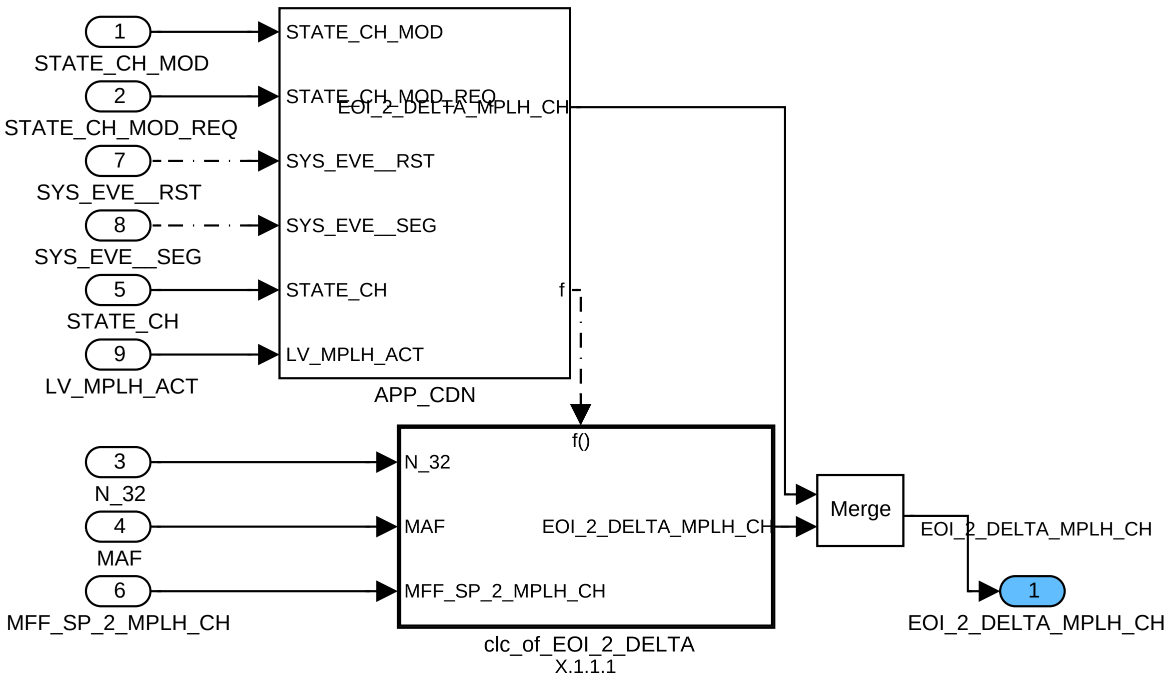

Figure 7.18.3: : Path: EXTC_REQGN2MPLH0/CH_AST

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7.18.1.1 Calculation of phasing for 2nd pulse

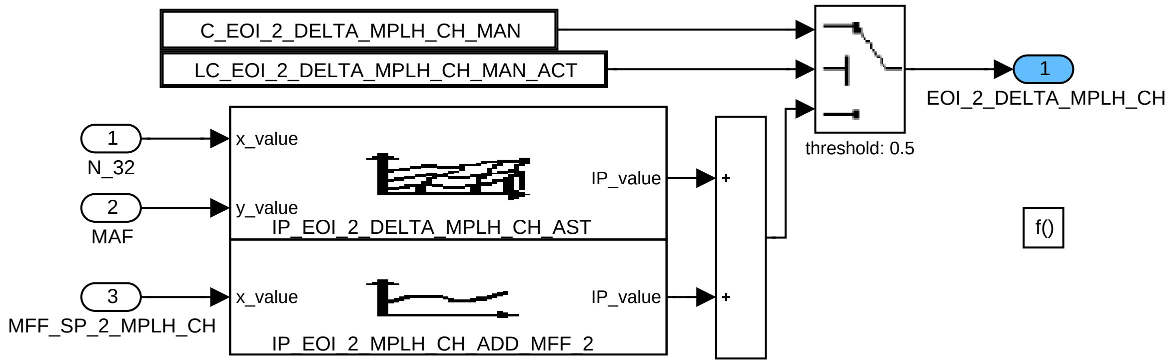

Figure 7.18.4: : Path: EXTC_REQGN2MPLH0/CH_AST/clc_of_EOI_2_DELTA

7.18.2 Desulfation catalyst heating

Application Conditions

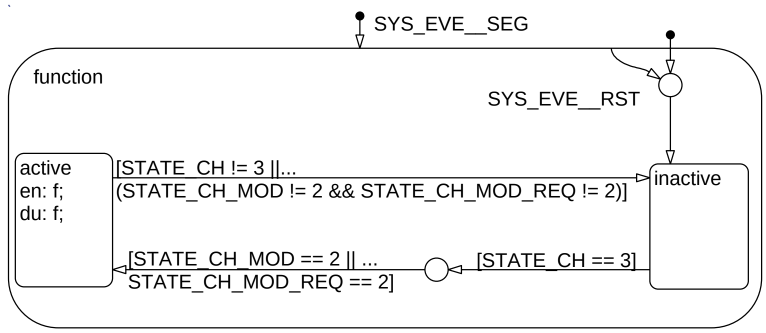

Figure 7.18.5: : Path: EXTC_REQGN2MPLH0/CH_SO2P/APP_CDN/Chart

Function description

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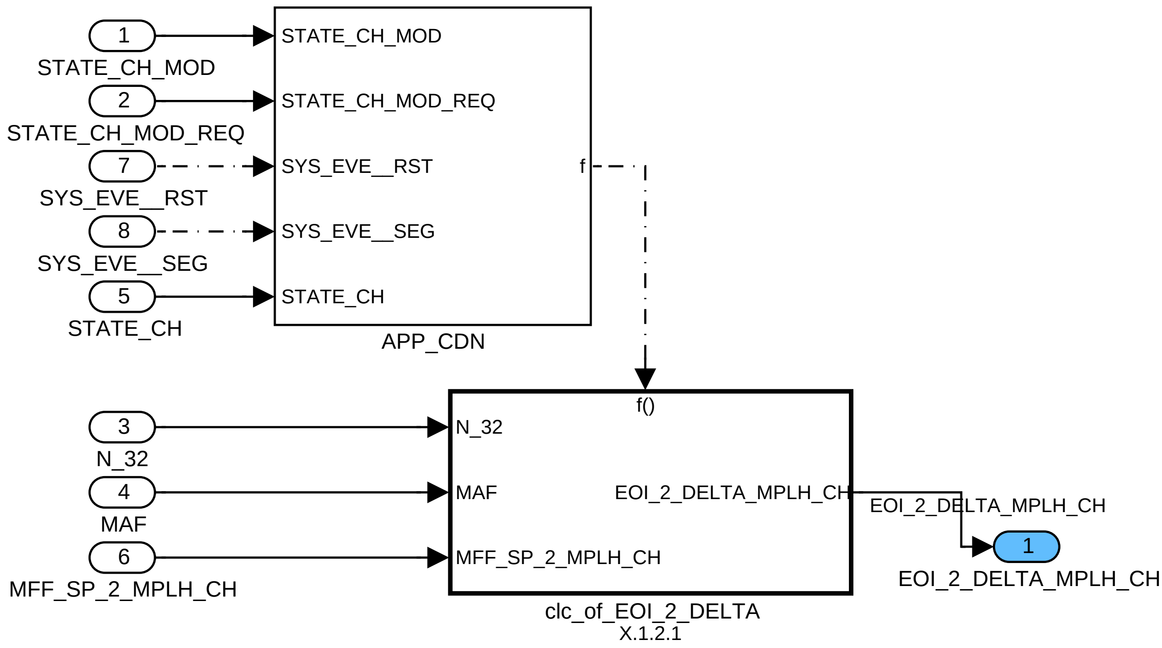

Figure 7.18.6: : Path: EXTC_REQGN2MPLH0/CH_SO2P

7.18.2.1 Calculation of phasing for 2nd pulse

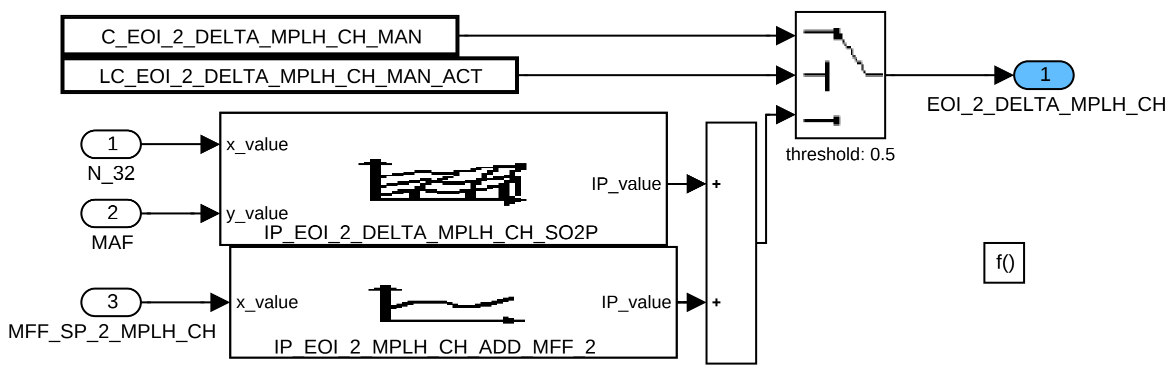

Figure 7.18.7: : Path: EXTC_REQGN2MPLH0/CH_SO2P/clc_of_EOI_2_DELTA

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7.19 Fuel mass split up for catalyst heating

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MFF_SP_2_MPLH_CH	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass for second injection pulse					

Input data:

IGA_AV_MV_H_RNG {p. 1828}	LV_MPLH_ACT {p. 8269}	MAF {p. 8277}	N_32 {p. 1525}
STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}	STATE_CH_MOD_REQ {p. 1796}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MFF_SP_2_MPLH_CH_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Manual setting of fuel mass for second injection pulse					
IP_MFF_SP_2_ADD_IGA_CH	-	0... FFFFH	-694.5... 694.4788	0.02119-	mg/stk
LDP_IGA_H_RNG_IP_MFF_2_MPLH_CH	4	0... B40H	-90 ...90	0.0625	°CRK
Ignition angle depending correction of fuel mass for second injection pulse					
IP_MFF_SP_2_MPLH_CH_AST	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_7_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_EXTC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic fuel mass for second injection pulse in after start catalyst heating					
IP_MFF_SP_2_MPLH_CH_SO2P	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_8_EXTC	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_EXTC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass for second injection pulse in desulfation catalyst heating					
LC_MFF_SP_2_MPLH_CH_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of fuel mass for second injection pulse					

Overview

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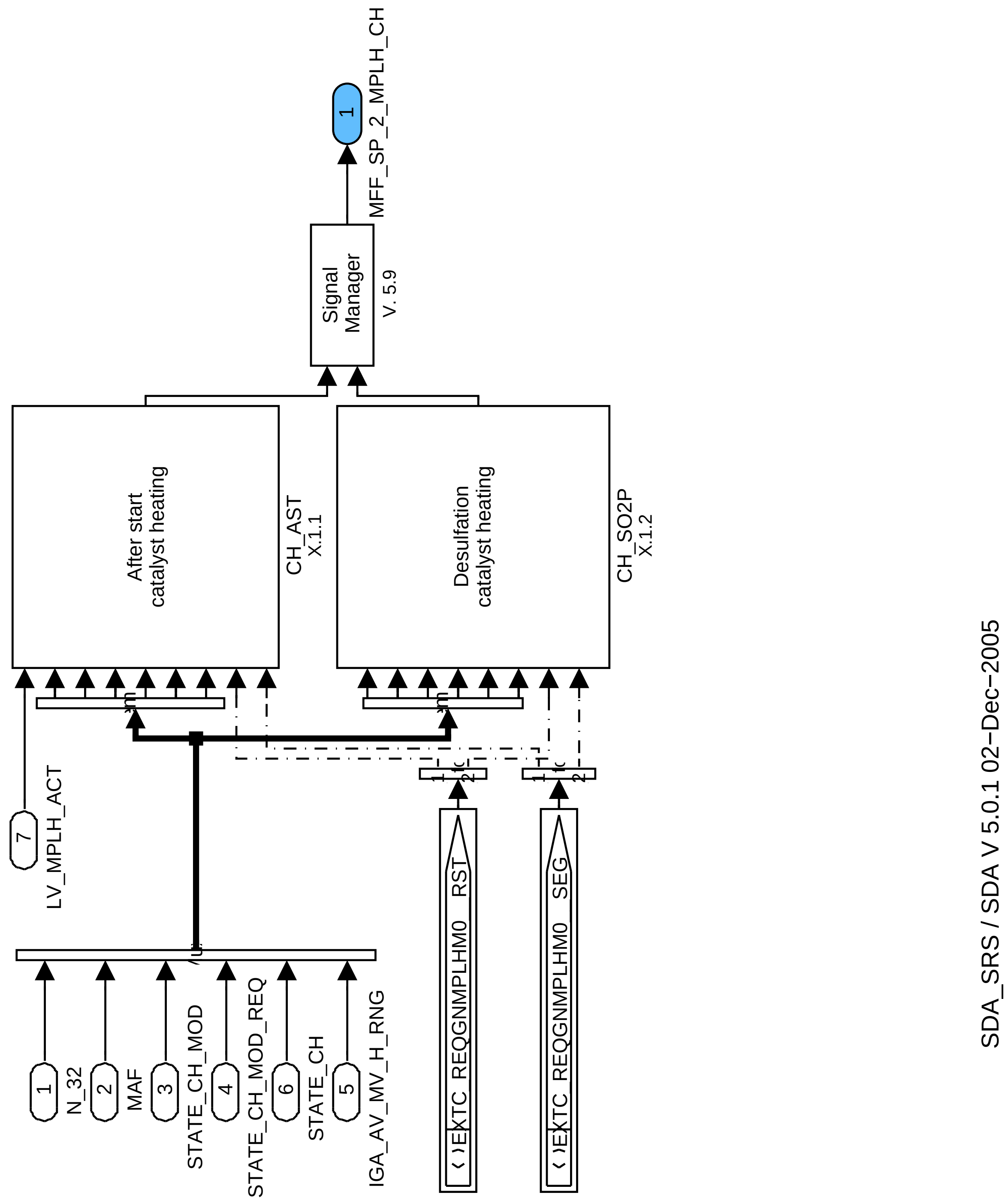

Figure 7.19.1: : Path: EXTC_REQGNMPLHM0

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General Information

To heat up the catalyst a 2nd fuel mass pulse is injected in homogeneous mode short time before ignition. In this module the mass of this pulse is generated.

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The ignition angle is being retarded to increase the exhaust temperature. The 2nd injection mass MFF_SP_2_MPLH_CH should be calculated depending on ignition angle. That is done through IGA_AV_MV_H_RNG.

7.19.1 After start catalyst heating

Application Conditions

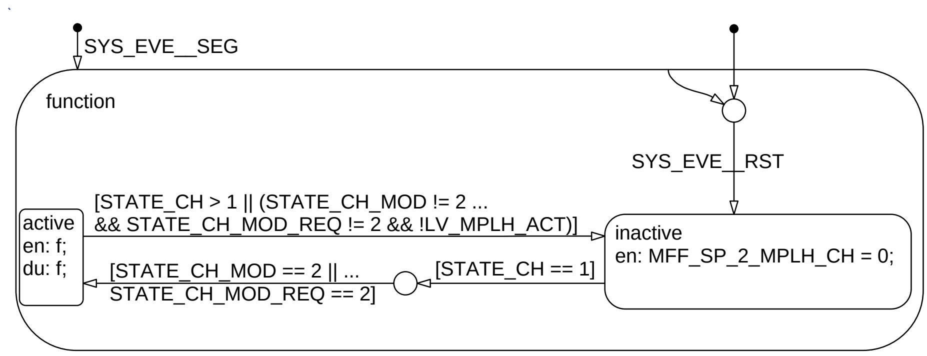

Figure 7.19.2: : Path: EXTC_REQGNMPLHM0/CH_AST/APP_CDN/Chart

Function description

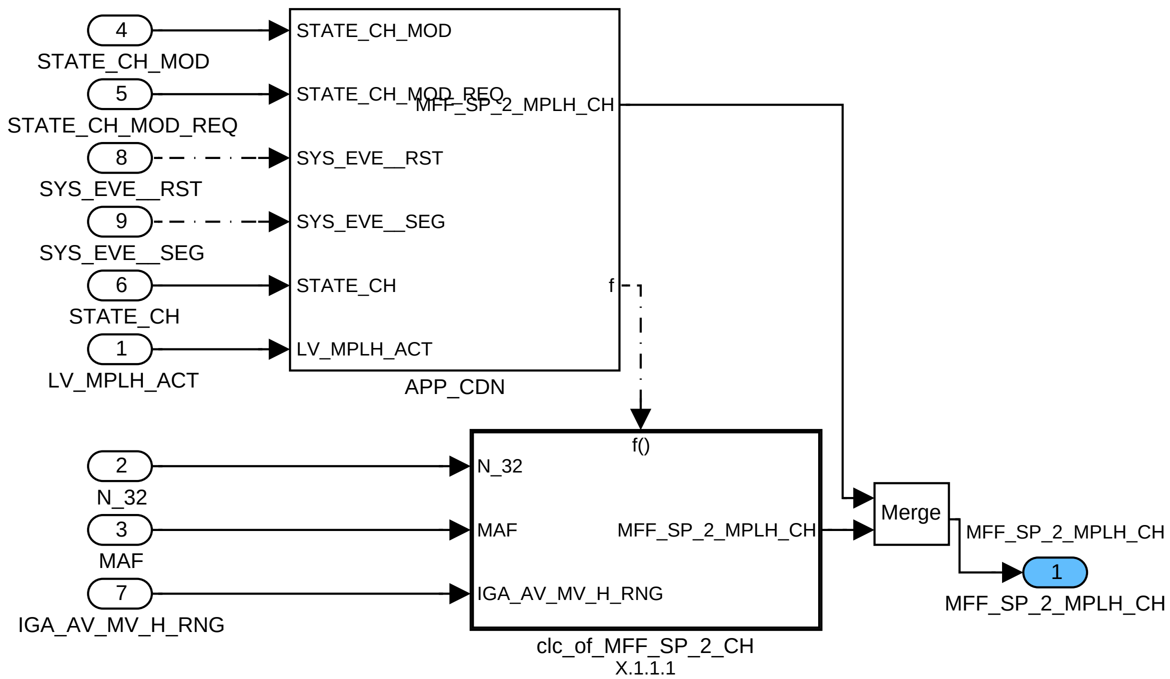

Figure 7.19.3: : Path: EXTC_REQGNMPLHM0/CH_AST

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7.19.1.1 Function: After start catalyst heating

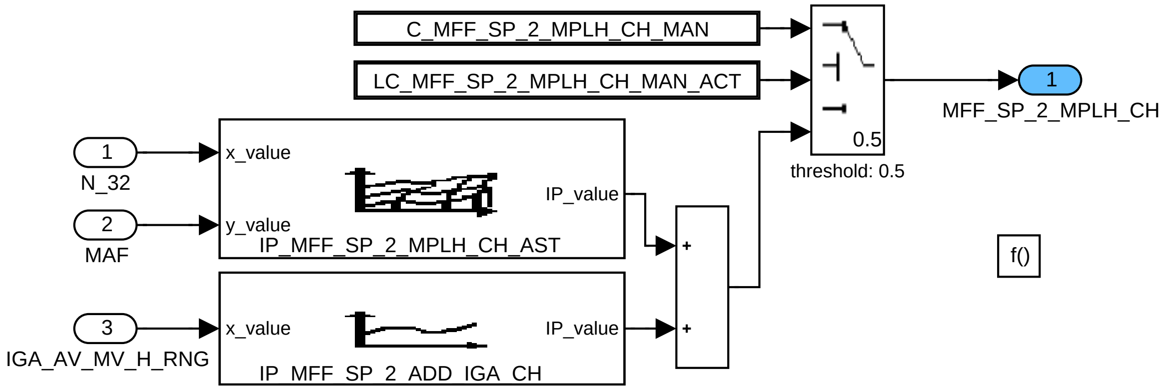

Figure 7.19.4: : Path: EXTC_REQGNMPLHM0/CH_AST/clc_of_MFF_SP_2_CH

7.19.2 Desulfation catalyst heating

Application Conditions

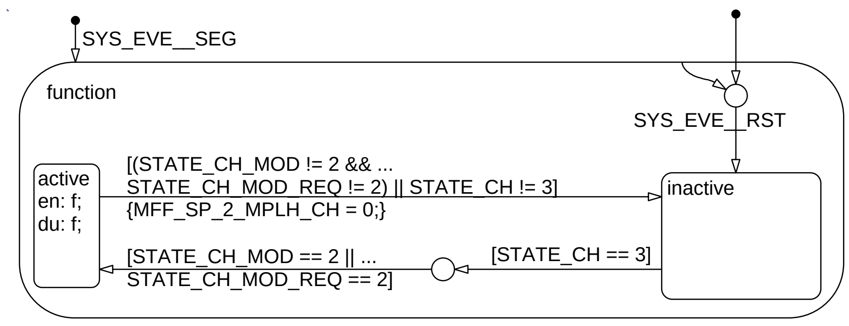

Figure 7.19.5: : Path: EXTC_REQGNMPLHM0/CH_SO2P/APP_CDN/Chart

Function description

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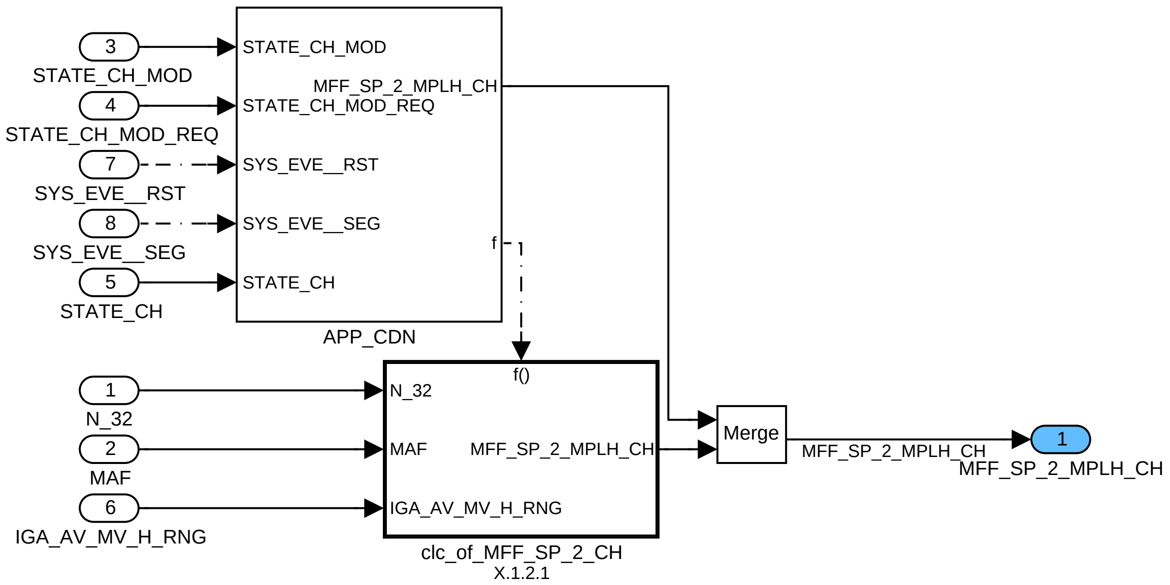

Figure 7.19.6: : Path: EXTC_REQGNMPLHM0/CH_SO2P

7.19.2.1 Function: Desulfation catalyst heating

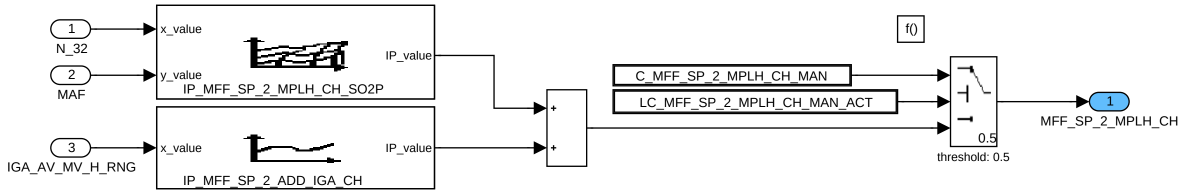

Figure 7.19.7: : Path: EXTC_REQGNMPLHM0/CH_SO2P/clc_of_MFF_SP_2_CH

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7.20 Lambda setpoint for catalyst heating

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_CH [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda setpoint for catalyst heating - bankselective					
LAMB_SP_CH_SO2P [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda setpoint for catalyst heating - bankselective, during desulfation					

Input data:

LAMB_PULS_SO2P [NC_CBK_EX_NR] {p. 3150}	LAMB_SO2P [NC_CBK_EX_NR] {p. 3129}	LV_DLY_CH_MOD_REQ_SO2P_HOM {p. 1813}	LV_IS {p. 1720}
LV_SO2P_FAST_REQ {p. 3129}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	STATE_CH {p. 1777}
STATE_CH_MOD {p. 1796}	STATE_CH_MOD_REQ {p. 1796}	T_AST {p. 1766}	TCO {p. 1100}
TQI_REQ_SLOW {p. 8391}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_MV_CH_L_RGN	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Mean lambda value during catalyst heating with lambda split					
C_LAMB_SP_CH_MAN [NC_CBK_EX_NR]	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Manual setting of lambda setpoint for catalyst heating - bankselective					
IP_LAMB_ADD_CH_AST_HOM	V	0... 7FFFH	-16... 15.9990234375	976.563e-6	-
LDPM_T_AST_4_EXTC	6	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_5_EXTC	8	0... FEH	-48... 142.5	0.75	°C
T_AST and TCO depending additional correction for lambda setpoint for catalyst heating					
IP_LAMB_ADD_CH_AST_MPLH	V	0... 7FFFH	-16... 15.9990234375	976.563e-6	-
LDPM_T_AST_4_EXTC	6	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_5_EXTC	8	0... FEH	-48... 142.5	0.75	°C
T_AST and TCO depending additional correction for lambda setpoint for catalyst heating with dual injection					
IP_LAMB_CH_AST_HOM	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDPM_N_32_10_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_SLOW_3_EXTC	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Lambda setpoint for homogeneous after start catalyst heating in idle speed					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_LAMB_CH_AST_HOM_IS	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDPM_N_32_9_EXTC	4	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_SLOW_4_EXTC	4	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Lambda setpoint for homogeneous after start catalyst heating in idle speed					
IP_LAMB_CH_AST_MPLH	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDPM_N_32_10_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_SLOW_3_EXTC	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Lambda setpoint for homogeneous after start catalyst heating with dual injection					
IP_LAMB_CH_AST_MPLH_IS	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDPM_N_32_9_EXTC	4	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_SLOW_4_EXTC	4	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Lambda setpoint for homogeneous catalyst heating with dual injection in idle speed					
IP_LAMB_CH_L_RGN	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDP_N_32_IP_LAMB_CH_L_RGN	6	0... FFH	0... 8160	32	rpm
LDP_TQI_REQ_SLOW_IP_LAMB_CH_RGN	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Lambda split value for enriched bank.					
LC_LAMB_SO2P_FAST_ENA	-	0... 1H	0 ...1	1	-
Enables using of LAMB_SO2P in case of LV_SO2P_FAST_REQ (fast desulfation without wobble)					
LC_LAMB_SP_CH_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of LAMB_SP_CH					
LC_LAMB_SP_CH_SO2P_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of LAMB_SP_CH_SO2P					

Overview

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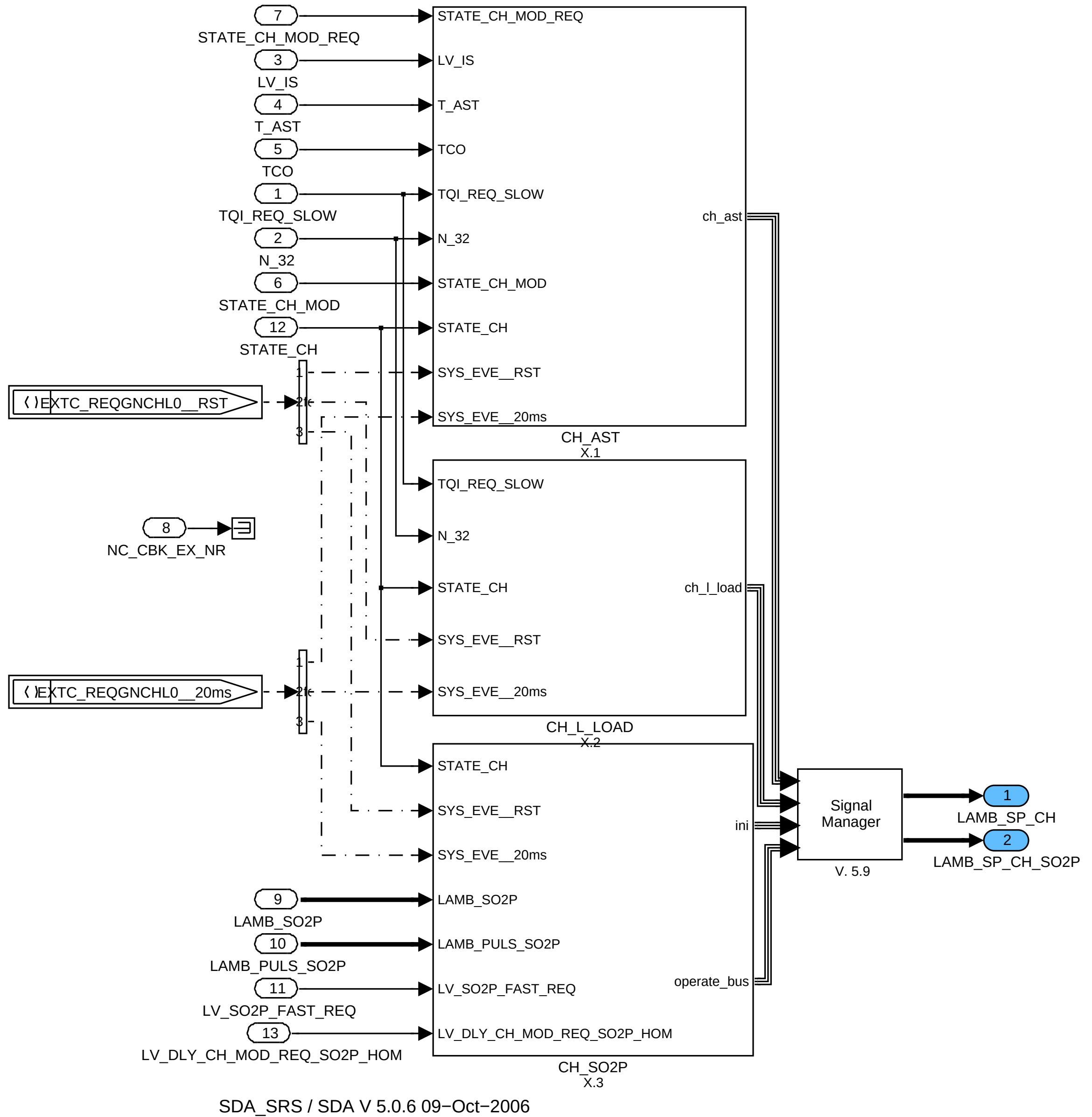

Figure 7.20.1: : Path: EXTC_REQGNCHL0

General Information

In this module a lambda-setpoint for homogeneous catalyst heating is generated.

7.20.1 After start catalyst heating

In stratified mode the lambda setpoint is also calculated if homogenous (split) mode is requested by STATE_CH_MOD_REQ.

Application Conditions

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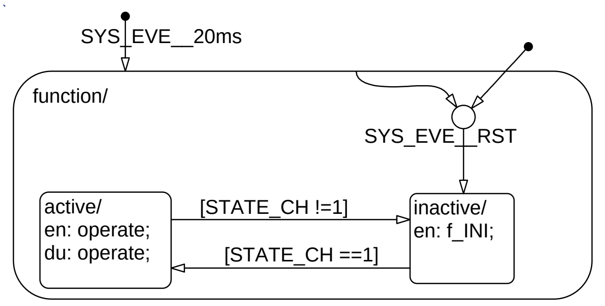

Figure 7.20.2: : Path: EXTC_REQGNCHL0/CH_AST/APP_CDN/Chart

Function description

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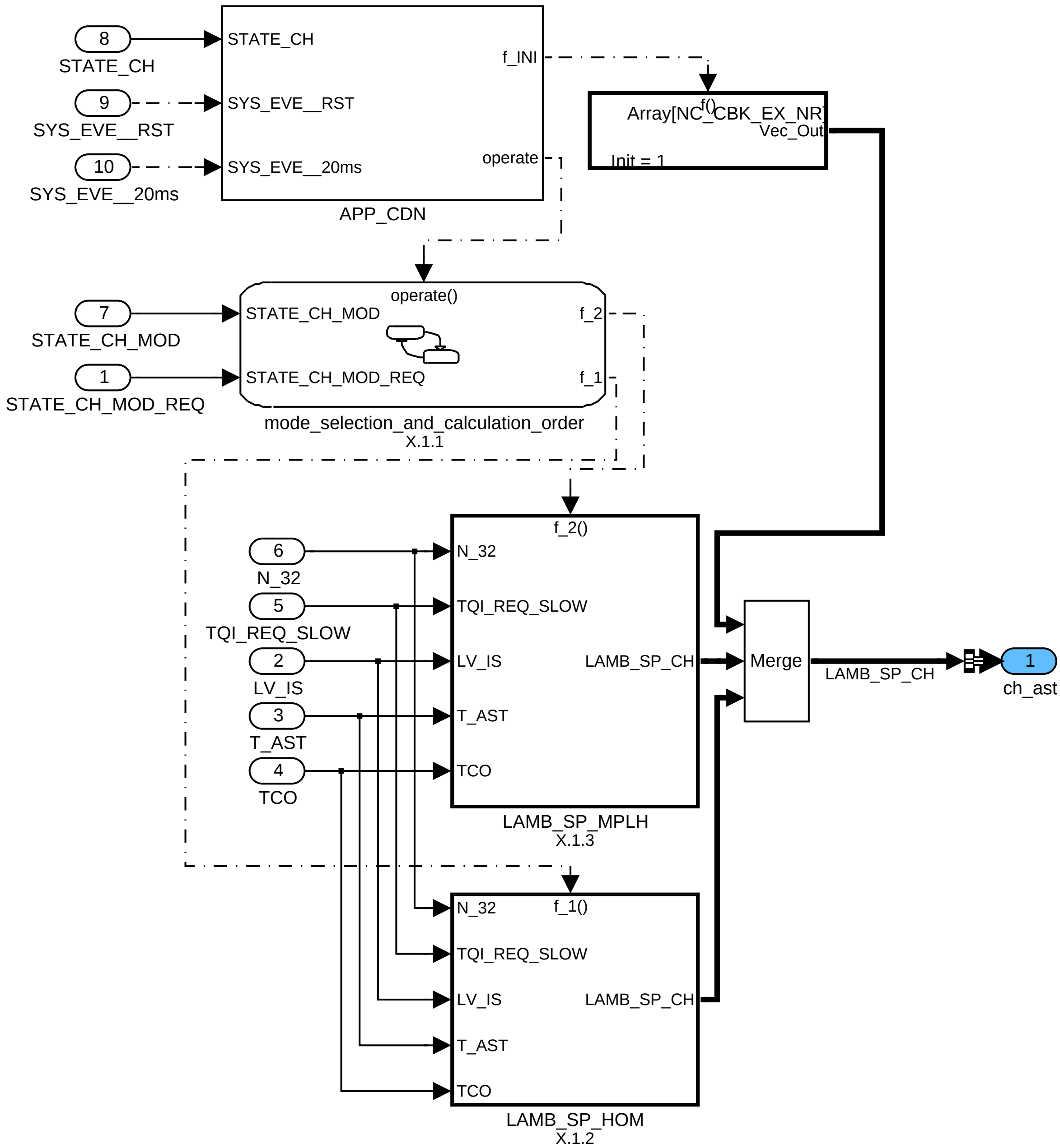

Figure 7.20.3: : Path: EXTC_REQGNCHL0/CH_AST

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7.20.1.1 No title given

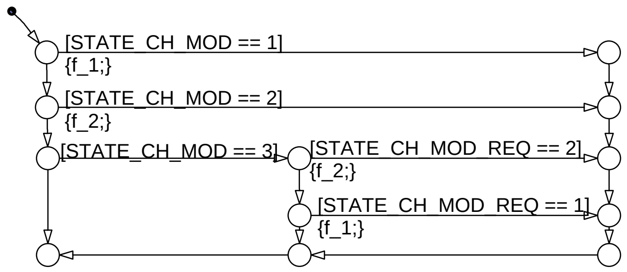

Figure 7.20.4: : Path: EXTC_REQGNCHL0/CH_AST/mode_selection_and_calculation_order

7.20.1.2 After start catalyst heating, single injection

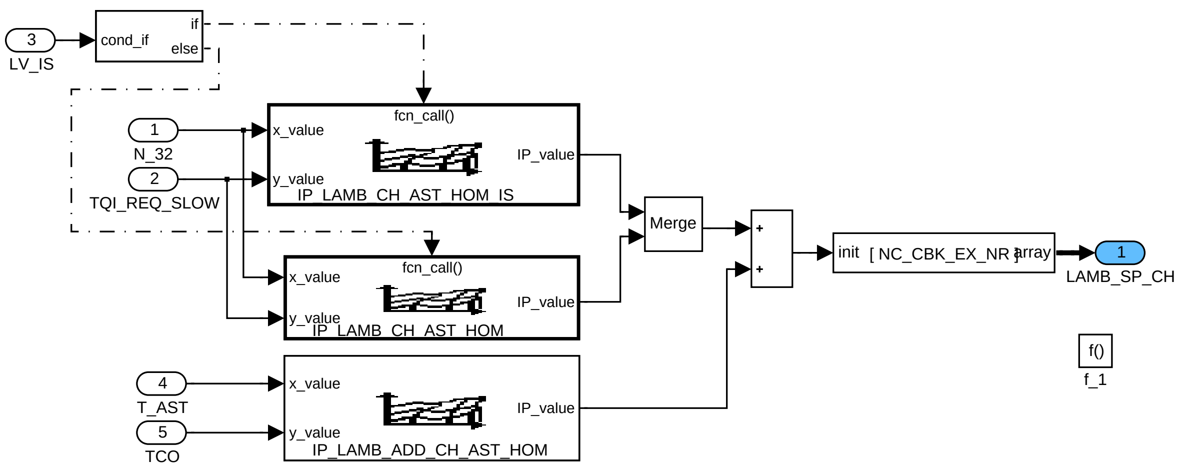

Figure 7.20.5: : Path: EXTC_REQGNCHL0/CH_AST/LAMB_SP_HOM

7.20.1.3 After start catalyst heating, multiple injection

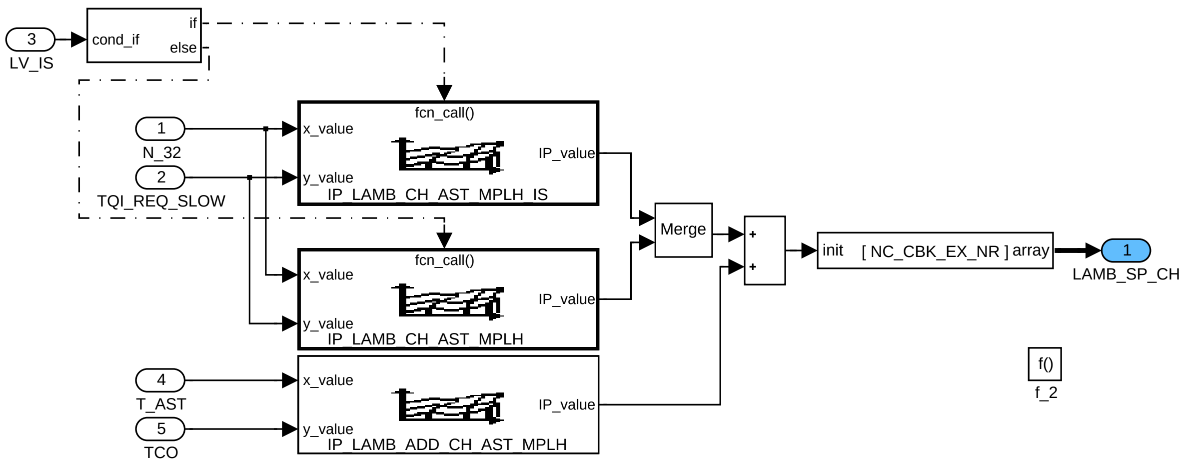

Figure 7.20.6: : Path: EXTC_REQGNCHL0/CH_AST/LAMB_SP_MPLH

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7.20.2 Low load catalyst heating

Low load catalyst heating is activated after regeneration. With this function it is possilble to apply different lambda-setpoints for each bank. The function can only be used with Y exhaust-systems because the exhaust gases of the lean and the rich cylinder banks are mixed upstream the NOx-trap and cause exothermic reaction.

Application Conditions

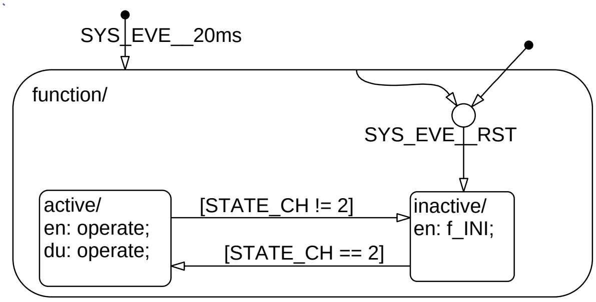

Figure 7.20.7: : Path: EXTC_REQGNCHL0/CH_L_LOAD/APP_CDN/Chart

Function description

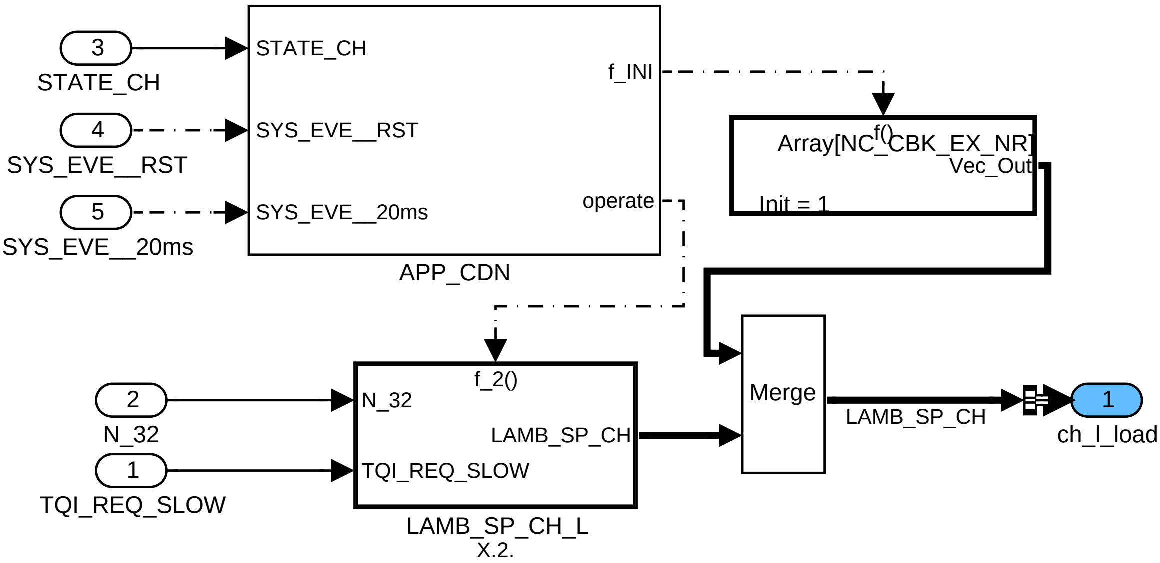

Figure 7.20.8: : Path: EXTC_REQGNCHL0/CH_L_LOAD

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7.20.2.1 Function: Low load catalyst heating

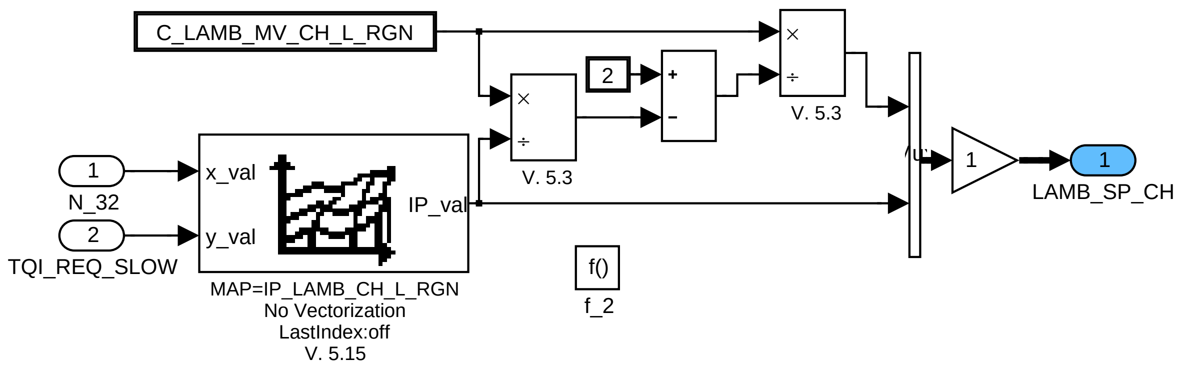

Figure 7.20.9: : Path: EXTC_REQGNCHL0/CH_L_LOAD/LAMB_SP_CH_L

7.20.3 Desulfation catalyst heating

Application Conditions

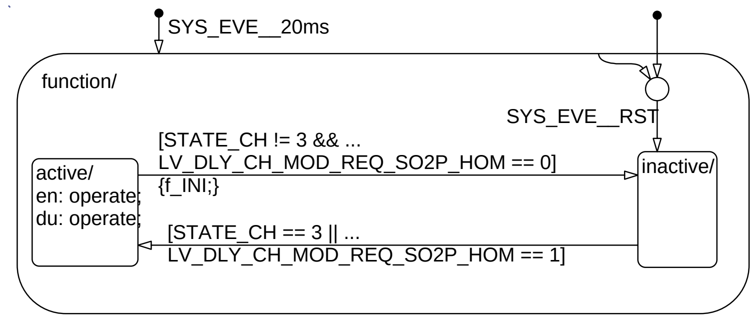

Figure 7.20.10: : Path: EXTC_REQGNCHL0/CH_SO2P/APP_CDN/Chart

Function description

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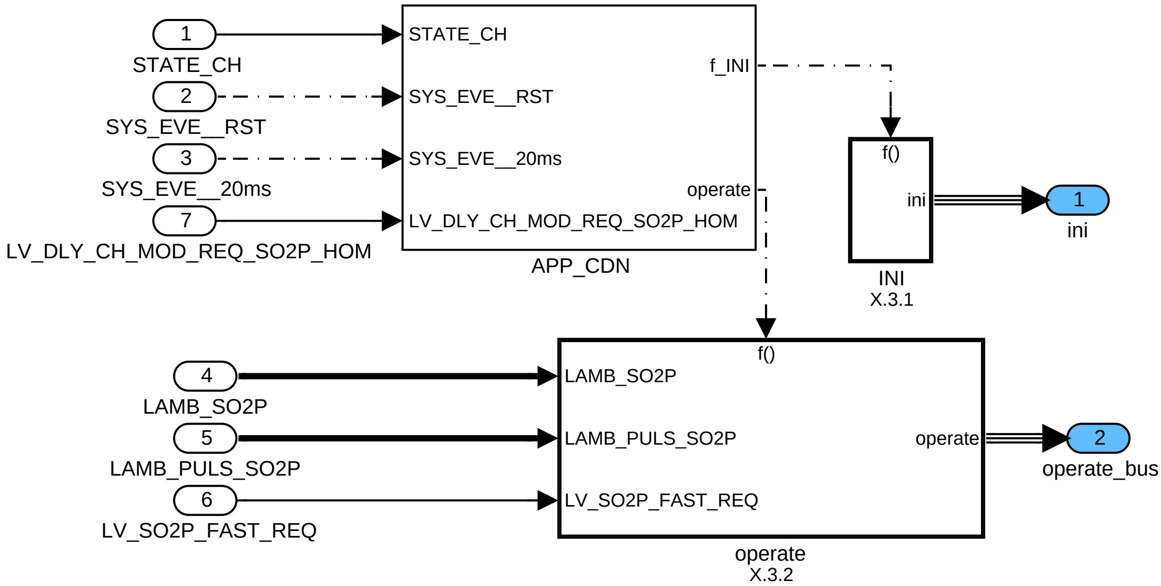

Figure 7.20.11: : Path: EXTC_REQGNCHL0/CH_SO2P

7.20.3.1 Initialisation

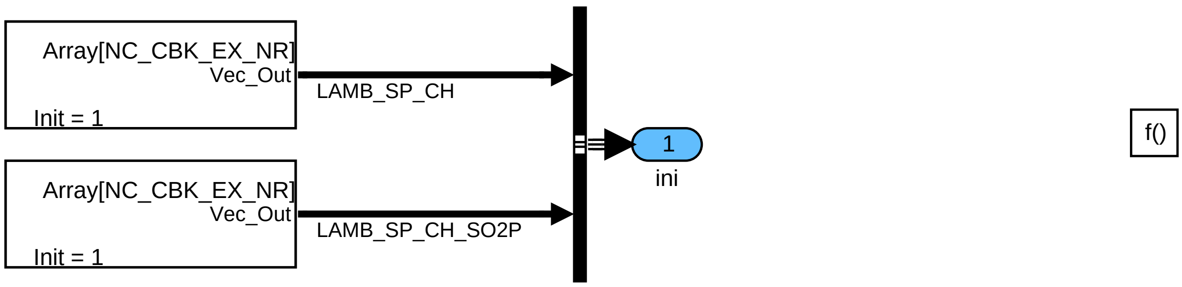

Figure 7.20.12: : Path: EXTC_REQGNCHL0/CH_SO2P/INI

7.20.3.2 Function: Desulfation catalyst heating

The basic lambda value for catalyst desulfation catalyst heating is applicatable for single or splitted injection. A temperature-depending factor weighs the difference between this basic-value and lambda=1. The resulting lambda setpoint is used for both cylinder banks. LAMB_SP_CH is used during catalyst heating phase, LAMB_SP_CH_SO2P is used during desulfation if there was catalyst heating active before. Due to C_LAMB_SP_CH_MAN it is possible to set the lambda setpoint cylinder individual.

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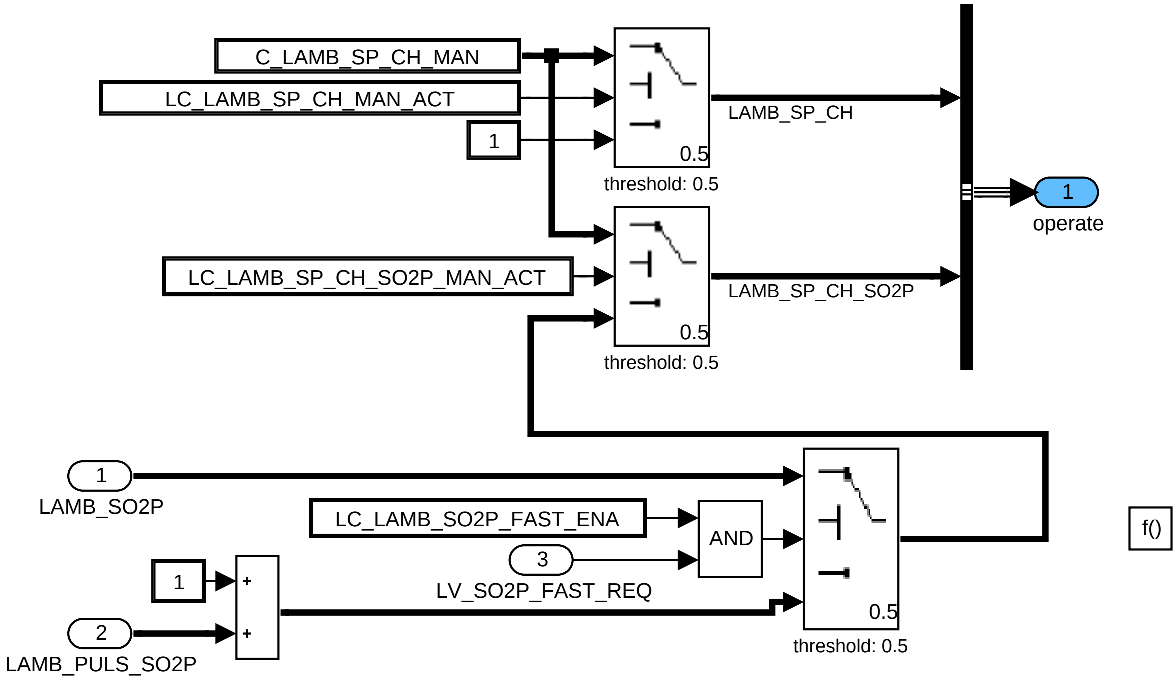

Figure 7.20.13: : Path: EXTC_REQGNCHL0/CH_SO2P/operate

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7.21 Fuel mass setpoint of post injection for catalyst heating

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_CMB_S	V	0... FFFFH	0... 31.9995117188	488.281e-6	-
Lambda of stratified combustion - without post pulse					
LV_IV_POST_EGY_RNG	O/V	0... 1H	0 ...1	1	-
Boolean variable indicating used piezo IV energy range for post injection					
LV_POST_INJ_ACT	O/V	0... 1H	0 ...1	1	-
Boolean variable indicating the post injection is active					
MFF_MPLP_CH	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass for post injection					
MFF_POST_INJ [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow of the post injection					
TI_POST_INJ [NC_CYL_NR]	O	0... FFFFH	0... 65.535	1e-3	ms
Injection time of the post injection					

Input data:

CYC_CAST {p. 1766}	FAC_MFF_TFU {p. 2224}	FUP_H {p. 1283}	IP_MFF_TI_EGY_H {p. 2009}
IP_MFF_TI_EGY_L {p. 2009}	MAF {p. 8277}	MFF_SP_MPLP [NC_CYL_NR] {p. 8243}	MFF_SP_MV {p. 2151}
N_32 {p. 1525}	NC_CYL_NR {p. 1526}	STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}
STATE_CH_MOD_REQ {p. 1796}	STATE_INJ_MOD_SWI_ ACT {p. 3332}	TCO {p. 1100}	TEMP_CAT_DIF_CH_L {p. 1777}
TI_FAC [NC_CYL_NR] {p. 999}	TNT_DIF_CH_L {p. 1777}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_MFF_MPLP_CH_AST	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Correction factor depending on TCO and CYC_CAST for the mass fuel flow of the post injection					
C_FAC_MFF_MPLP_CH_AST_N_32	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Engine speed correction factor for the mass fuel flow of the post injection					
C_FAC_MFF_MPLP_CH_L	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Difference between cat. temperatures and target temp. depending correction for TQ_ADD_CH_L					
C_FAC_TI_POST_PRS_CYL	-	0... FFFFH	0... 15.9997558594	244.141e-6	-
Correction factor to compensate the influence of the cylinder counter pressure					
C_FUP_COR_POST_INJ	-	0... FFFFH	0... 347776	5.3067216	hPa
Manual additive correction factor for injector pressure difference at post injection					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_FAC_POST_INJ	-	0... FFFFH	0... 31.9995117188	488.281e-6	-
Constant for stoichiometric air/fuel ratio (=14.7)					
C_MFF_MPLP_CH_AST	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic map for the mass fuel flow of the post injection for after start catalyst heating					
C_MFF_MPLP_CH_L	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic map for the mass fuel flow of the post injection for low load CH					
C_MFF_MPLP_CH_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Manual mass fuel flow for the post injection for catalyst heating					
IP_FAC_COR_POST_INJ	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDP_N_32_IP_FAC_COR_POST_INJ	6	0... FFH	0... 8160	32	rpm
Engine speed correction factor for the mass fuel flow of the post injection					
LC_IV_POST_EGY_RNG	-	0... 1H	0 ...1	1	-
Switch to select energy range					
LC_MFF_MPLP_CH_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual mass fuel flow for the post injection for catalyst heating					

Overview

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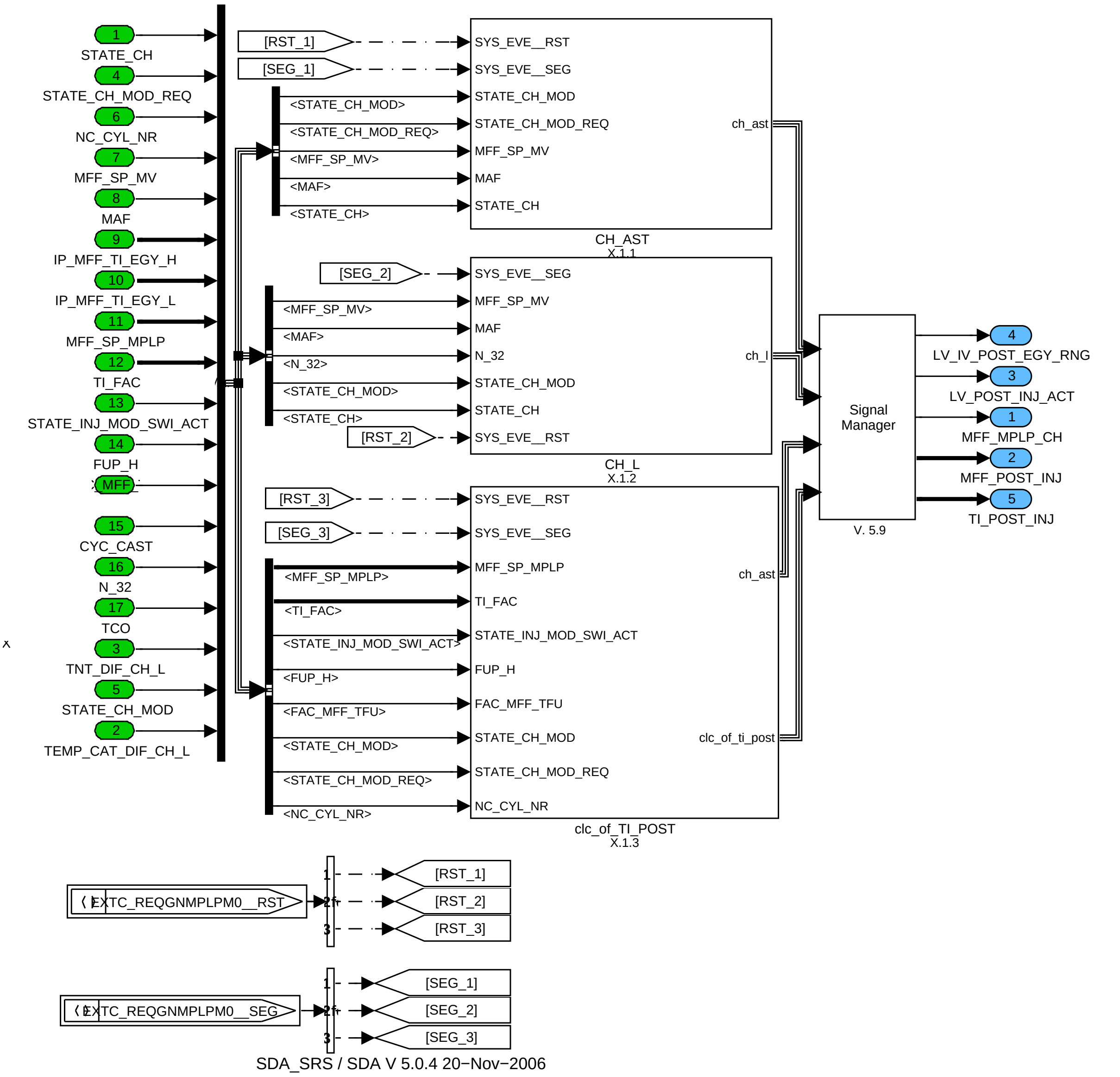

Figure 7.21.1: : Path: EXTC_REQGNMPLPM0

General Information

For catalyst heating an additional fuel mass pulse is injected after the stratified injected main combustion has occurred. In this module the mass of this so called post injection is generated.
The module has to be calculated before Injection phase of post injection for catalyst heating , MAF correction for catalyst heating in stratified mode and Ignition angle difference for catalyst heating with post injection .

7.21.1 After start catalyst heating

Application Conditions

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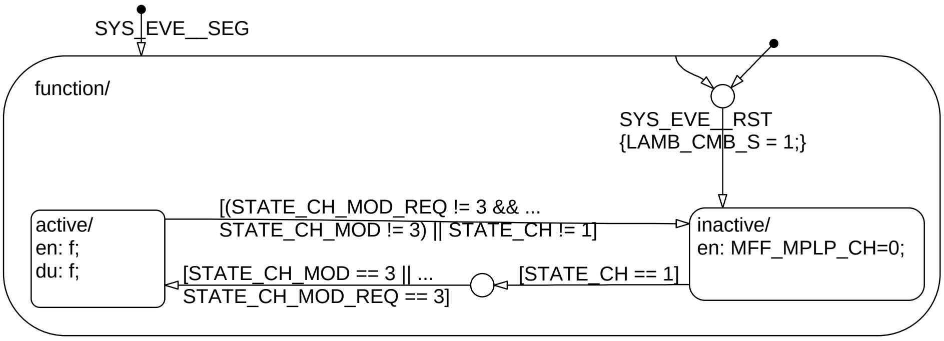

Figure 7.21.2: : Path: EXTC_REQGNMPLPM0/CH_AST/APP_CDN/Chart

Function description

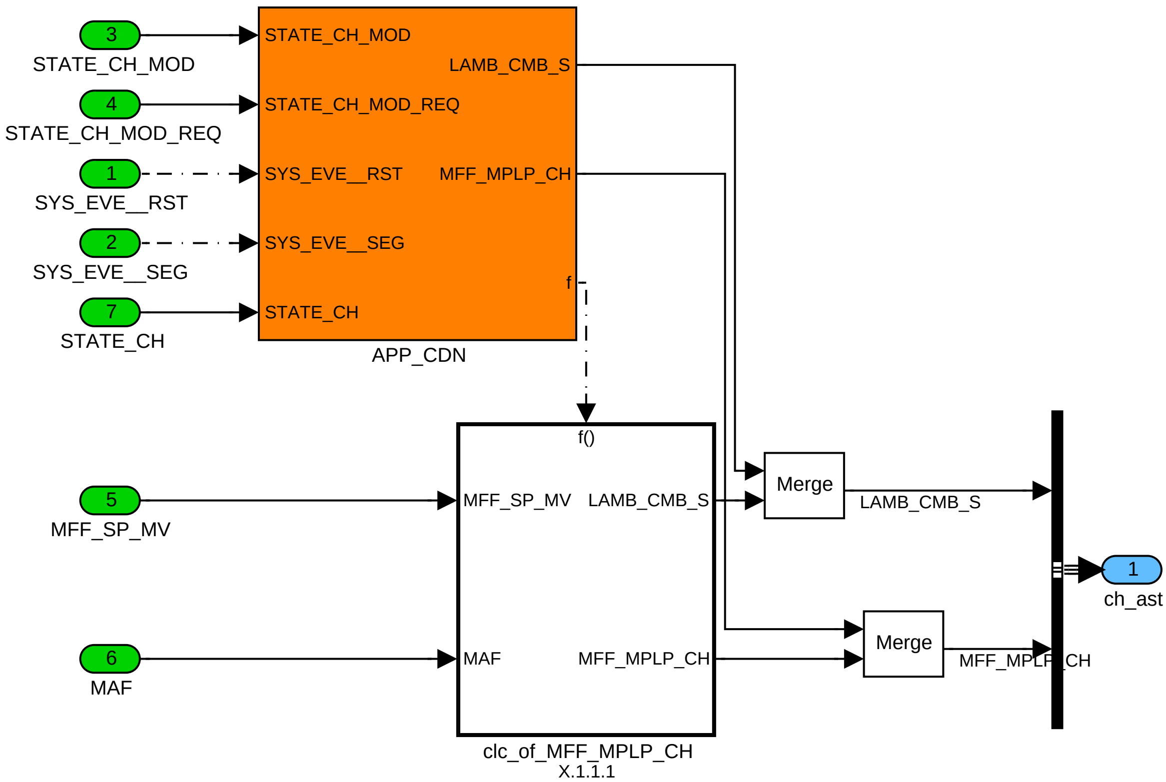

Figure 7.21.3: : Path: EXTC_REQGNMPLPM0/CH_AST

7.21.1.1 Calculation of MFF_MPLP_CH in after start catalyst heating

LAMB_CMB_S is the global lambda of the stratified main combustion without post injection. If MFF_SP is 0, LAMB_CMB_S should be set to its maximum limit. C_MAF_FAC_POST_INJ shell be 14.7 .

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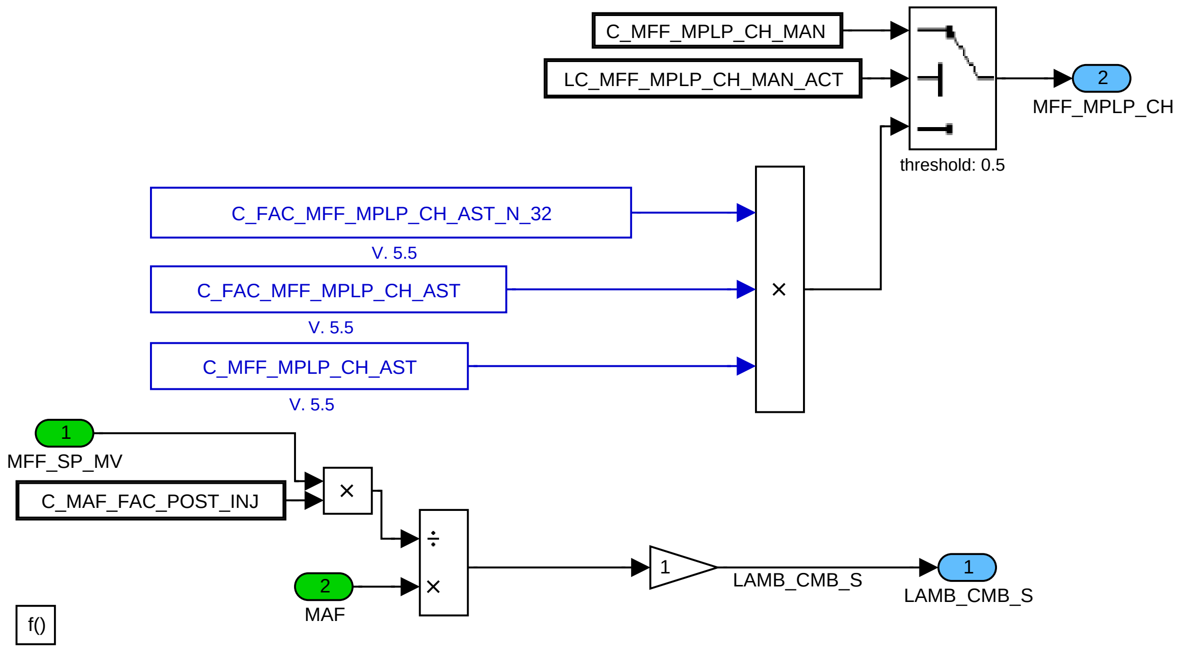

Figure 7.21.4: :   Path: EXTC_REQGNMPLPM0/CH_AST/clc_of_MFF_MPLP_CH

7.21.2 Low load catalyst heating

Application Conditions

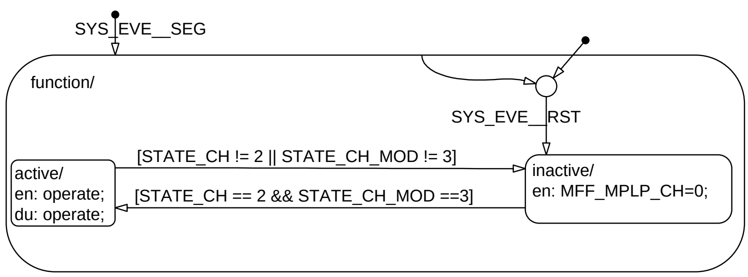

Figure 7.21.5: :   Path: EXTC_REQGNMPLPM0/CH_L/APP_CDN/Chart

Function description

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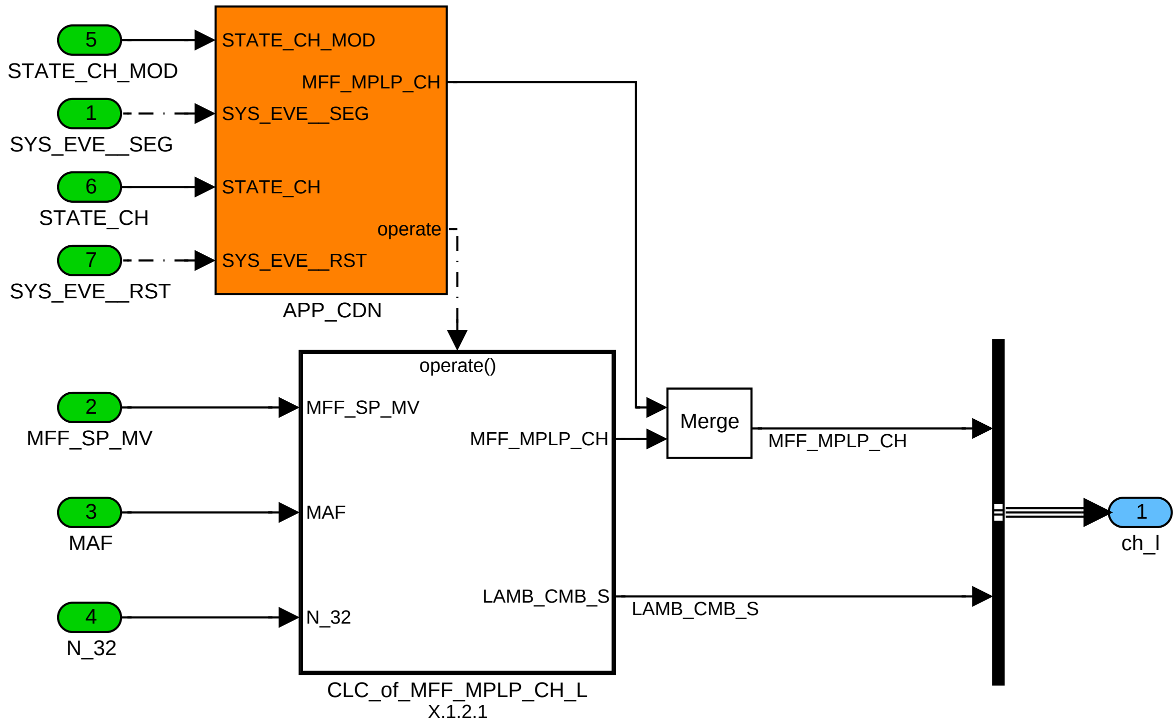

Figure 7.21.6: : Path: EXTC_REQGNMPLPM0/CH_L

7.21.2.1 Calculation of MFF_MPLP_CH in low load catalyst heating

LAMB_CMB_S is the global lambda of the stratified main combustion without post injection.

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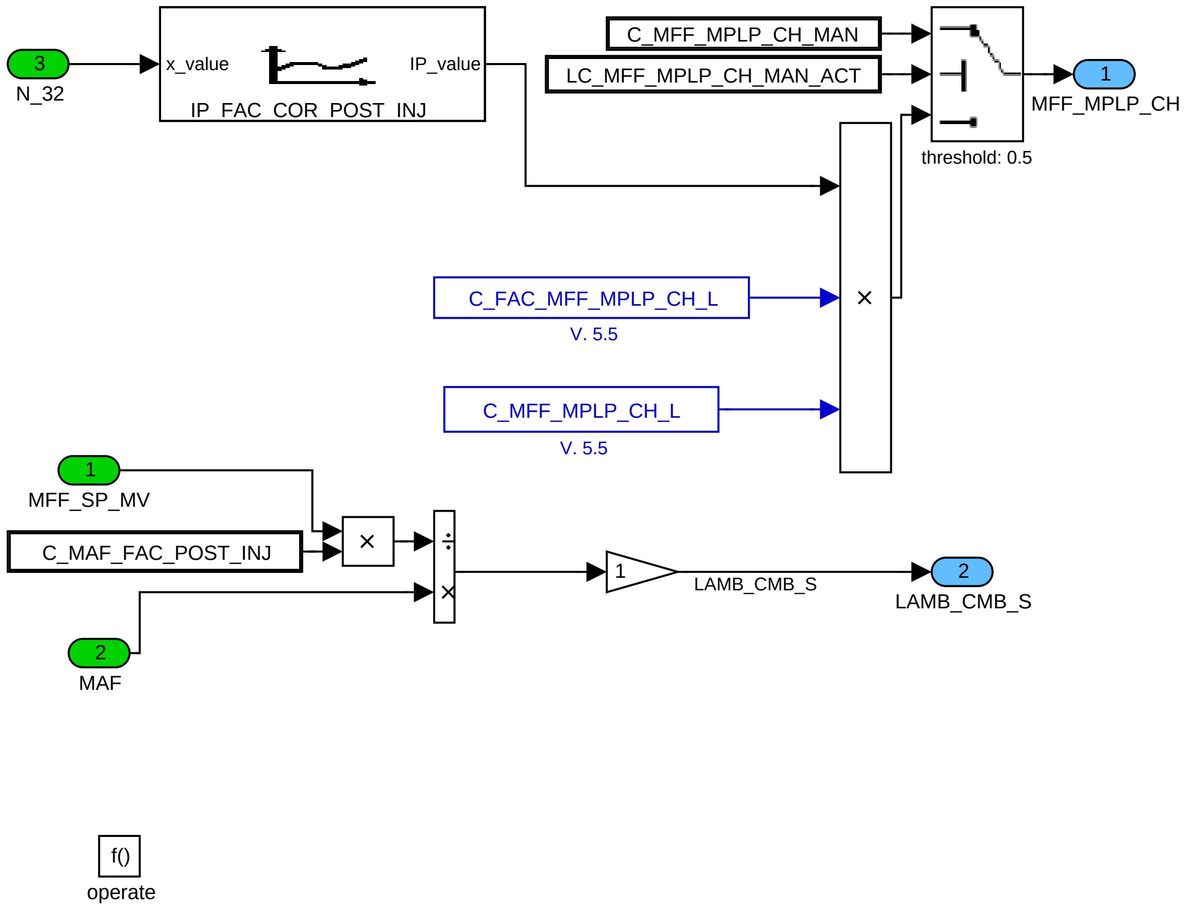

Figure 7.21.7: : Path: EXTC_REQGNMPLPM0/CH_L/CLC_of_MFF_MPLP_CH_L

7.21.3 Injection time of post injection

Application Conditions

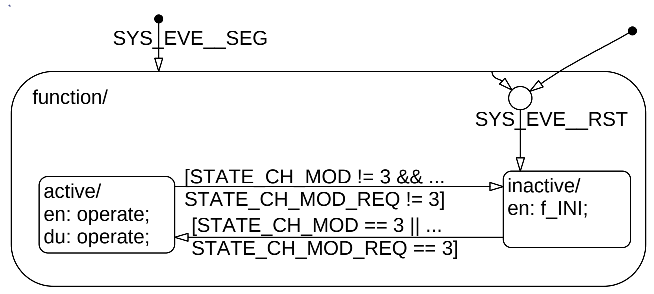

Figure 7.21.8: : Path: EXTC_REQGNMPLPM0/clc_of_TI_POST/APP_CDN/Chart

Function description

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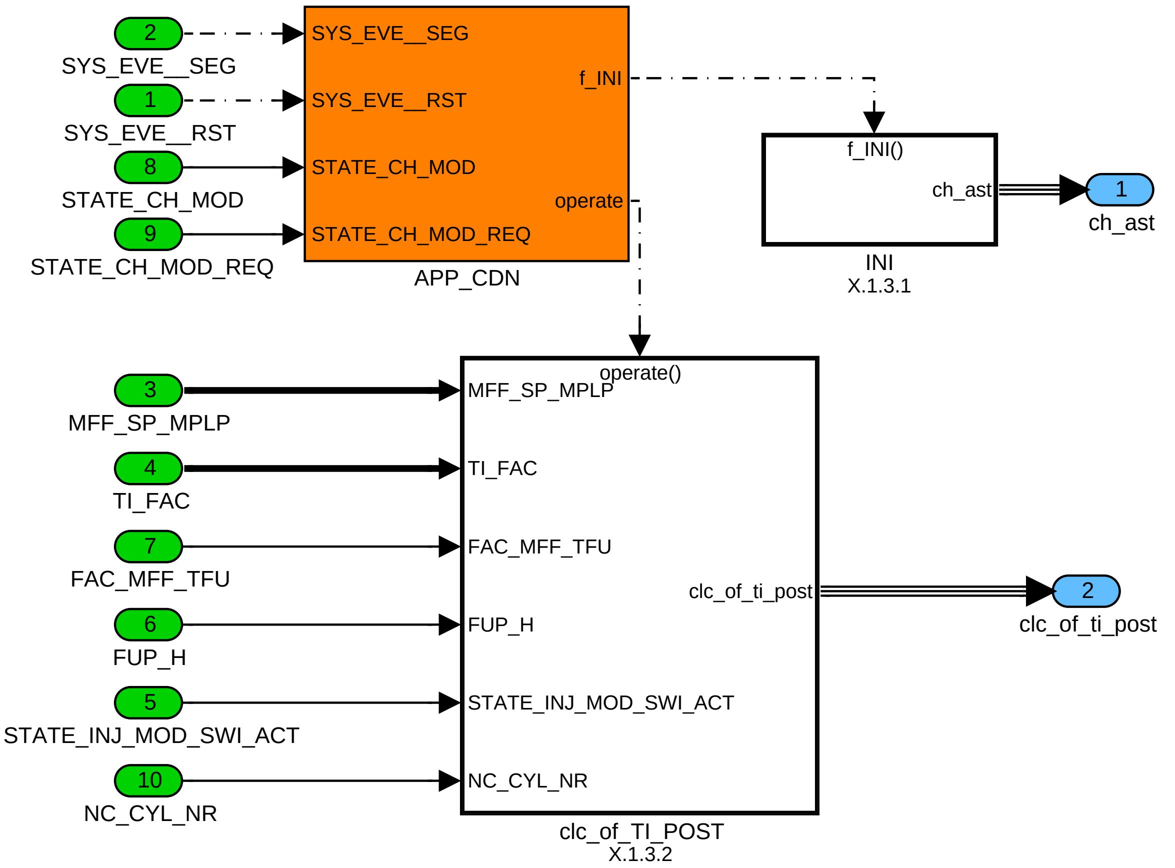

Figure 7.21.9: : Path: EXTC_REQGNMPLPM0/clc_of_TI_POST

7.21.3.1 Initialization

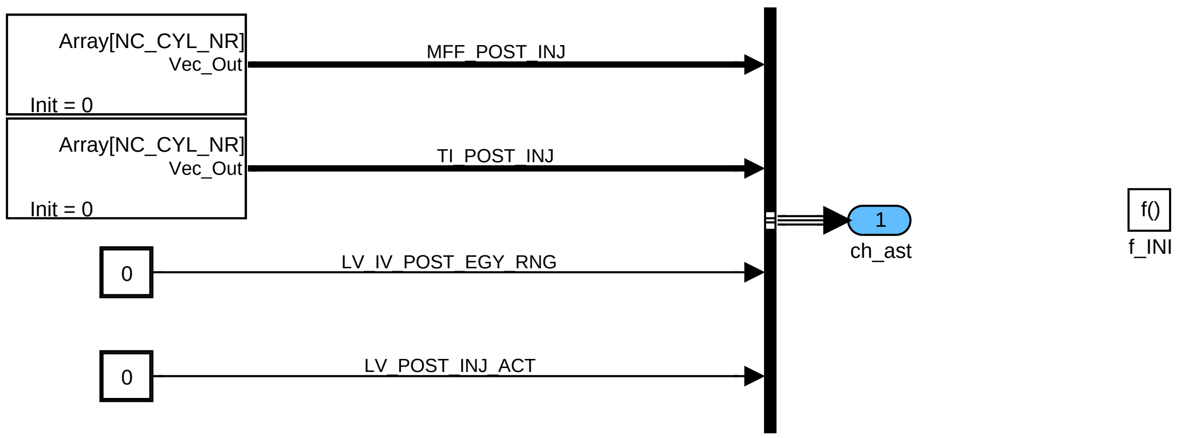

Figure 7.21.10: : Path: EXTC_REQGNMPLPM0/clc_of_TI_POST/INI

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7.21.3.2 Calculation of post injection

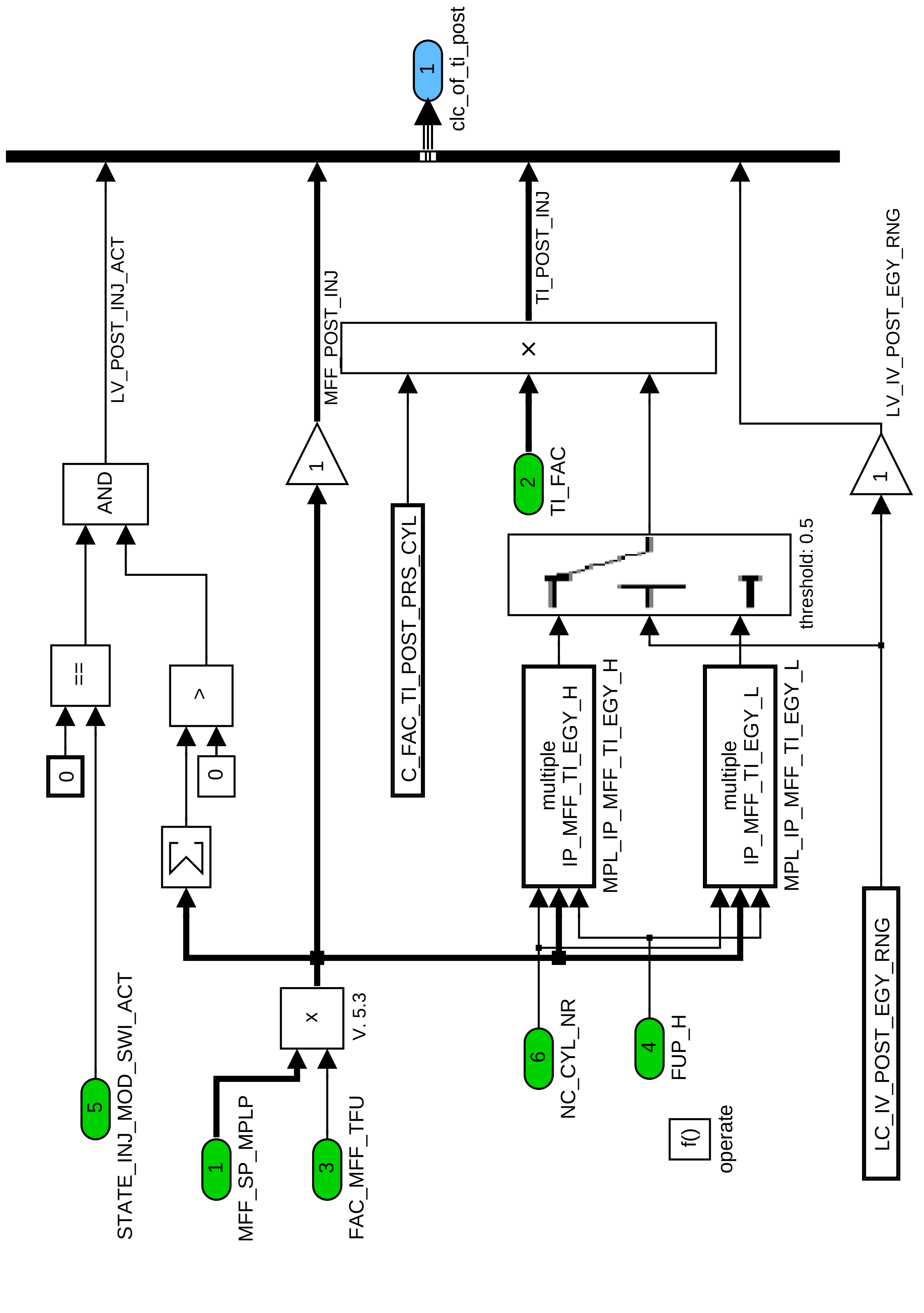

Figure 7.21.11: : Path: EXTC_REQGNMPLPM0/clc_of_TI_POST/clc_of_TI_POST

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7.22 Injection phase of post injection for catalyst heating

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EOI_LIM_POST	O/V	0... 780H	0... 720	0.375	°CRK
Latest possible EOI for post injection					
EOI_POST_INJ [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
End of the post injection					
SOI_LIM_POST	O/V	0... 780H	0... 720	0.375	°CRK
Earliest possible SOI for post injection					
SOI_MPLP_DIF_CH	O/V	0... 780H	0... 720	0.375	°CRK
Start of injection of the second injection for catalyst heating					
SOI_POST_INJ [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Start of the post injection to EOI_LIM					

Input data:

CRK_INJ_BAS [NC_CYL_NR] {p. 2122}	FAC_N {p. 3327}	MFF_POST_INJ [NC_CYL_NR] {p. 2179}	MFF_SP_MV {p. 2151}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	SOI_MPLP_CUS [NC_CYL_NR] {p. 8270}
STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}	STATE_CH_MOD_REQ {p. 1796}	TI_POST_INJ [NC_CYL_NR] {p. 2179}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EOI_LIM_POST	-	0... 780H	0... 720	0.375	°CRK
Latest possible EOI for post injection relatet to EOI_LIM					
C_SOI_LIM_POST	-	0... 780H	0... 720	0.375	°CRK
Earliest possible SOI for post injection related to EOI_LIM					
C_SOI_MPLP_ADD_MFF_POST_CH_L	-	0... 780H	0... 720	0.375	°CRK
Mass of post injection depending correction of start of injection of post injection for low load strat. CH					
C_SOI_MPLP_DIF_CH_AST	-	0... 780H	0... 720	0.375	°CRK
Start of injection of the post injection for catalyst heating related to ignition angle					
C_SOI_MPLP_DIF_CH_L	-	0... 780H	0... 720	0.375	°CRK
Start of injection of post injection for low load stratified catalyst heating					
C_SOI_MPLP_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual start of injection for the post injection					
C_SOI_POST_INJ_MAN	-	0... 780H	0... 720	0.375	°CRK
Manual start of injection for the post injection					
LC_SOI_MPLP_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual start of injection for the post injection					
LC_SOI_POST_INJ_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual start of injection for the post injection					

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Overview

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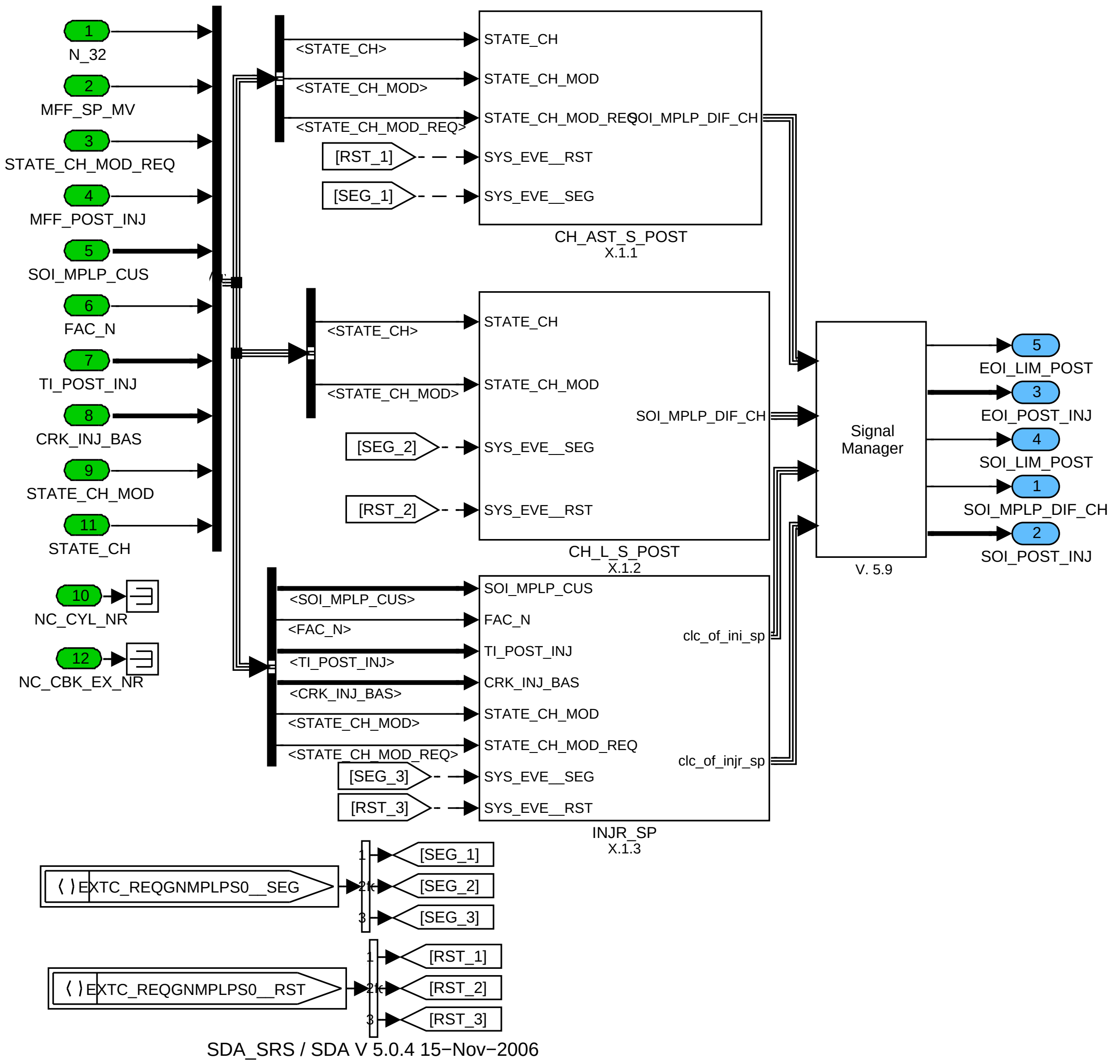

Figure 7.22.1: : Path: EXTC_REQGNMPLPS0

General Information

For catalyst heating an additional fuel mass pulse is injected after the stratified injected main combustion has occurred. This will increase the temperature in the exhaust system, especially in the catalyst. In this module the injection phase of this so called post injection is generated.
The function is splitted into 3 parts: the phasing for after start catalyst heating, the phasing for low load heating and the calculation of further setpoints for the INJR aggregate.
SOI_MPLP_DIF_CH is an input for BMWfunctions where SOI_3_S_CUS is the (eventually changed) output. SOI_POST_INJ and EOI_POST_INJ are the actually phasings.

SOI_MPLP_DIF_CH means the difference crankshaft angle between the ignition angle and the start of the post injection.

7.22.1 Post injection for after start catalyst heating

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Application Conditions

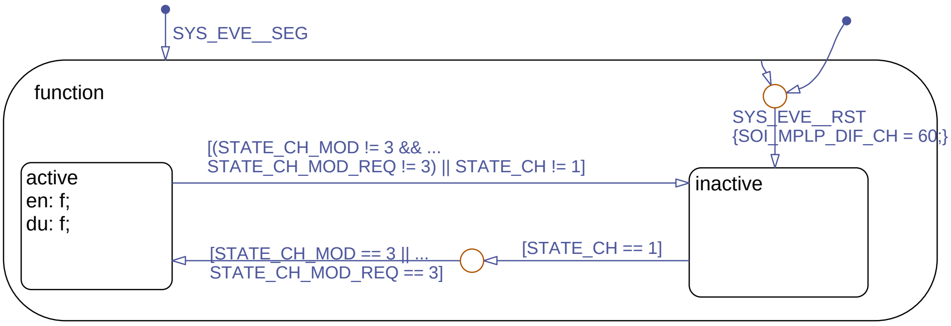

Figure 7.22.2: : Path: EXTC_REQGNMPLPS0/CH_AST_S_POST/APP_CDN/Chart

Function description

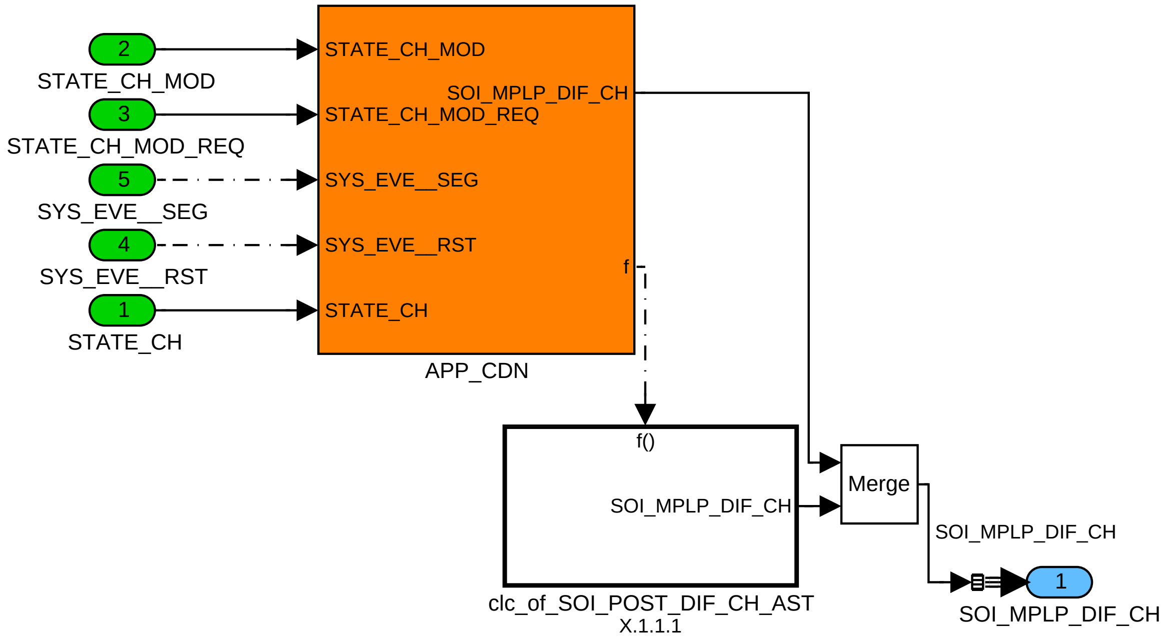

Figure 7.22.3: : Path: EXTC_REQGNMPLPS0/CH_AST_S_POST

7.22.1.1 Function: Post injection for after start catalyst heating

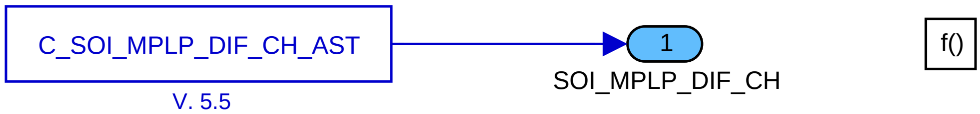

Figure 7.22.4: : Path: EXTC_REQGNMPLPS0/CH_AST_S_POST/clc_of_SOI_POST_DIF_CH_AST

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7.22.2 Post injection for low load catalyst heating

Application Conditions

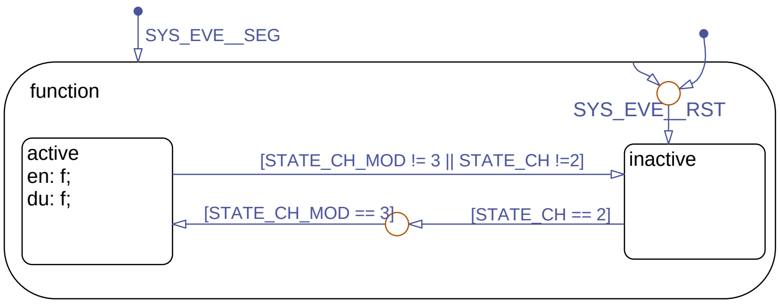

Figure 7.22.5: : Path: EXTC_REQGNMPLPS0/CH_L_S_POST/APP_CDN/Chart

Function description

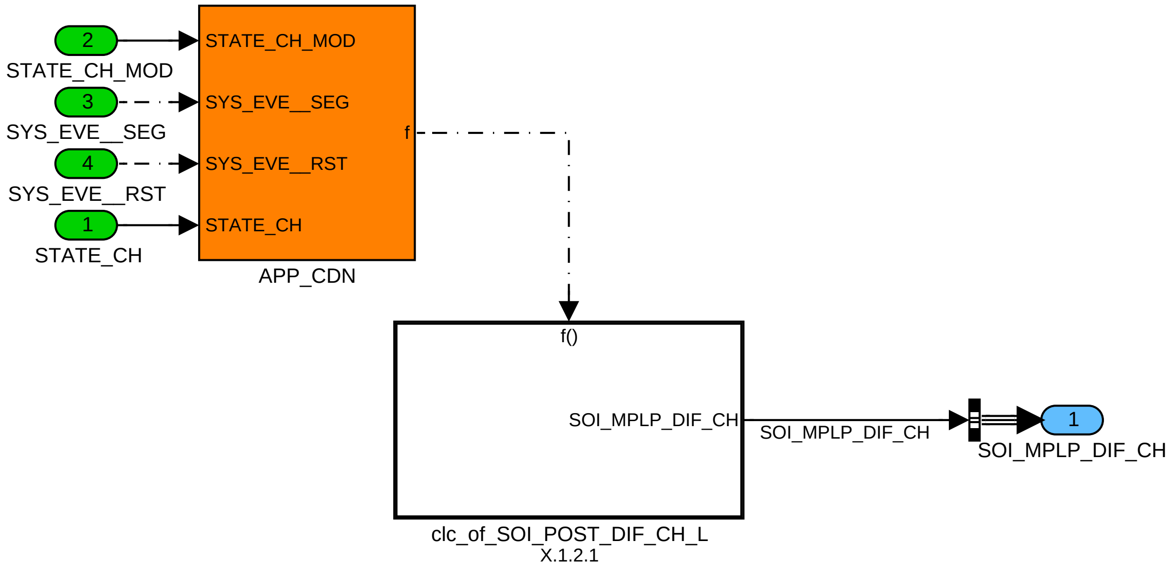

Figure 7.22.6: : Path: EXTC_REQGNMPLPS0/CH_L_S_POST

7.22.2.1 Function: Post injection for low load heating

For low load CH there is a second correction dependend on the actual fuel mass of post injection beside the CH_AST-functionality. The read_vector block picks out one element (here the 1st)of the cylinder indiviuell MFF_POST-vector.

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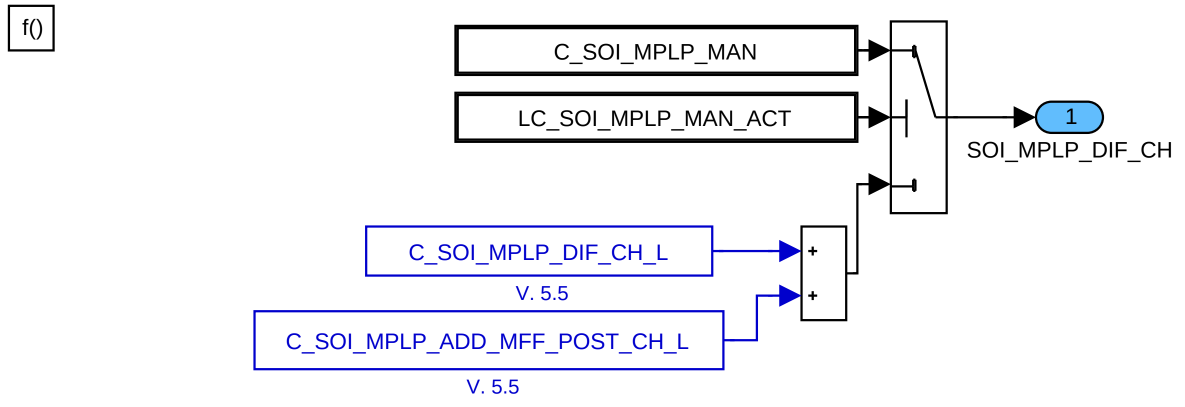

Figure 7.22.7: : Path: EXTC_REQGNMPLPS0/CH_L_S_POST/clc_of_SOI_POST_DIF_CH_L

7.22.3 Setpoint calculation for the INJR aggregate

Up to now the calculation of EOI_POST_INJ and the limitation values are not done in INJR (injection realization).

Application Conditions

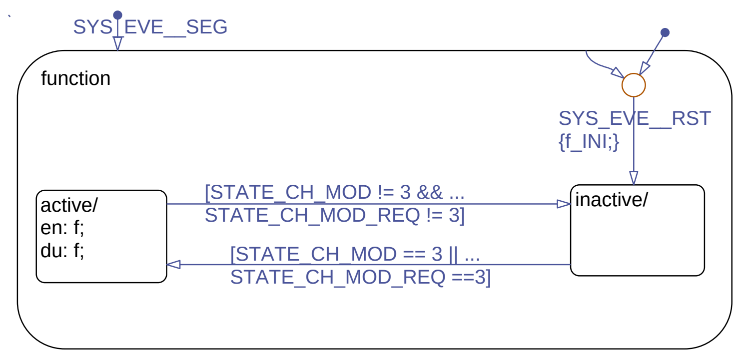

Figure 7.22.8: : Path: EXTC_REQGNMPLPS0/INJR_SP/APP_CDN/Chart

Function description

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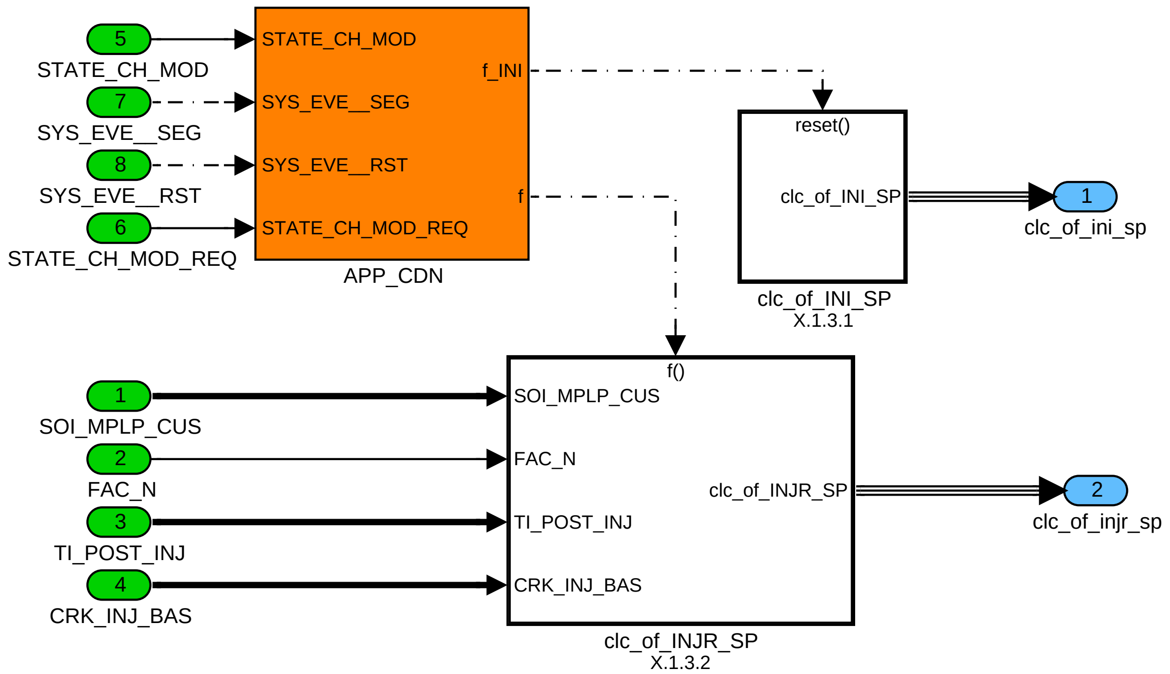

Figure 7.22.9: : Path: EXTC_REQGNMPLPS0/INJR_SP

7.22.3.1 Initialization

The limitations are initialized by the calibratable value. The set_vector block initializes the Vec_out with the value Init.

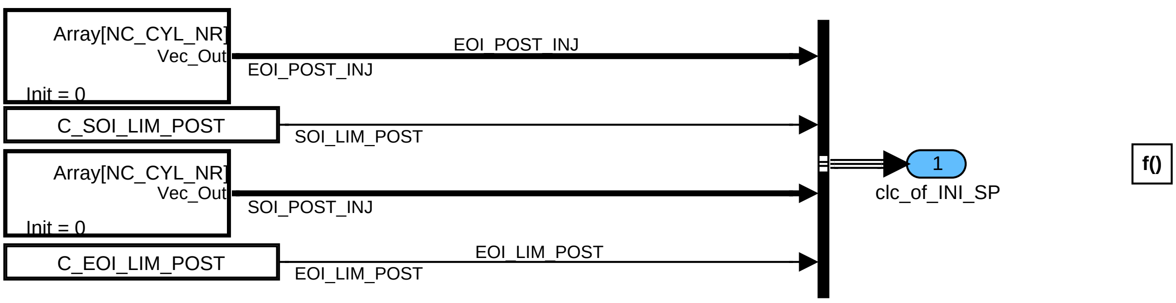

Figure 7.22.10: : Path: EXTC_REQGNMPLPS0/INJR_SP/clc_of_INI_SP

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7.22.3.2 Function: Setpoint calculation for the INJR aggregate

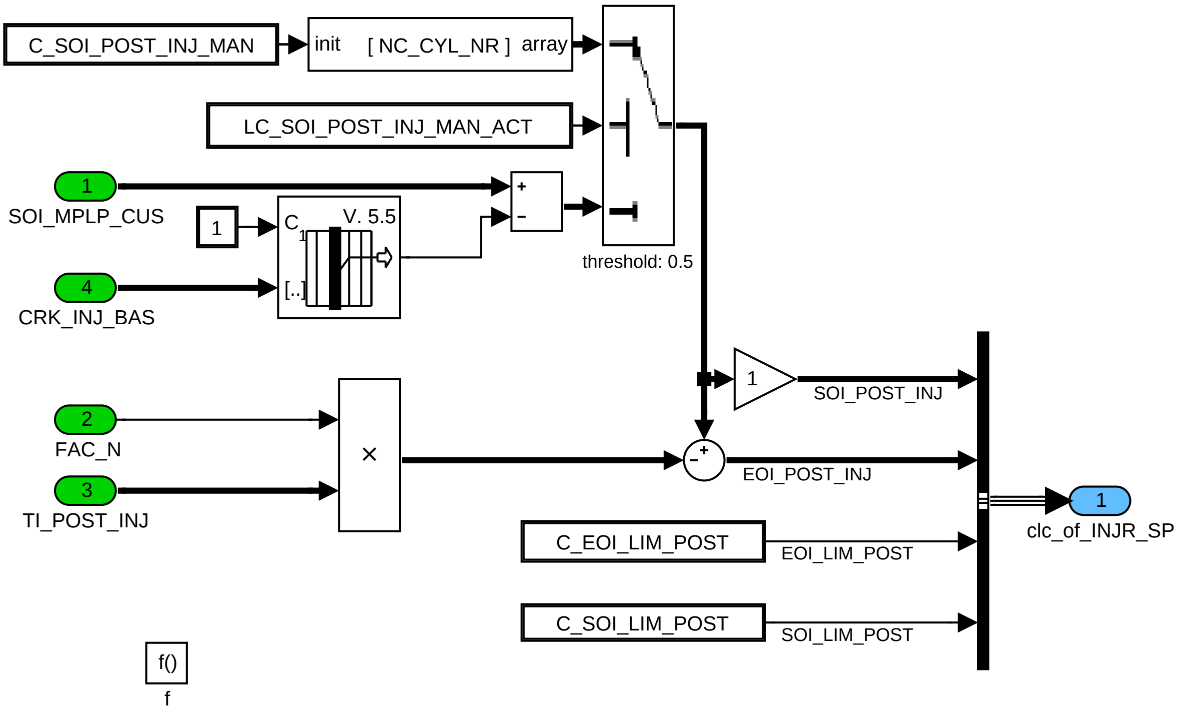

Figure 7.22.11: : Path: EXTC_REQGNMPLPS0/INJR_SP/clc_of_INJR_SP

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7.23 Catalyst overheating prevention

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_COP_CUS [_i]	O/V	0... 7FFFH	0... 31.9990234	980e-6	-
lambda for catalyst overheating prevention					
LAMB_TEG_CAT_DOWN_COP [_i]	V	0... 7FFFH	0... 31.9990234	980e-6	-
calculation value for catalyst overheating prevention downstream the precatalyst					
LAMB_TEG_CAT_UP_MDL_COP [_i]	V	0... 7FFFH	0... 31.9990234	980e-6	-
calculation value for catalyst overheating prevention upstream of the precatalyst					
LAMB_TNT_MDL_H_COP [_i]	V	0... 7FFFH	0... 31.9990234	980e-6	-
calculation value for catalyst overheating prevention in the NOx-trap catalyst					
LV_LAMB_COP_CUS [_i]	O/V	00... 01H	0 ...1	1	-
general flag for catalyst overheating prevention active and output					
LV_TEG_CAT_DOWN_COP [_i]	V	00... 01H	0 ...1	1	-
flag for catalyst overheating prevention active					
LV_TEG_CAT_UP_MDL_COP [_i]	V	00... 01H	0 ...1	1	-
flag for catalyst overheating prevention active					
LV_TNT_MDL_H_COP [_i]	V	00... 01H	0 ...1	1	-
flag for catalyst overheating prevention active					
TEG_CAT_DOWN [_i]	V	0... 7FF0H	0... 2047	0.0625	°C
Exhaust gas temperature downstream the catalyst					

Input data:

LAMB_BAS [NC_CBK_EX_NR] {p. 8340}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_AST {p. 1766}	LV_PUC {p. 1720}
LV_SCC [NC_CBK_EX_NR] {p. 2295}	LV_ST_END {p. 1720}	TEG_CAT_DOWN_MDL {p. 8236}	TEG_CAT_UP_MDL [_i] {p. 8236}
TEG_PCAT_DOWN [NC_CBK_EX_NR] {p. 1253}	TNT_MDL_H {p. 8237}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_COP_MIN	-	0... 7FFFH	0.31.9990234	-	-
minimum value for catalyst overheating protection					
C_LAMB_COP_PAS	-	0... 7FFFH	0.31.9990234	-	-
passive value for the lambda catalyst overheating prevention					
C_LAMB_TEG_CAT_DOWN_COP_I	-	0... FFFFH	0... 0.003922	59.8e-9	1/°C
I-part of controler					
C_LAMB_TEG_CAT_UP_MDL_COP_I	-	0... FFFFH	0... 0.003922	59.8e-9	1/°C
I-part of controler					
C_LAMB_TNT_MDL_H_COP_I	-	0... FFFFH	0... 0.003922	59.8e-9	1/°C
I-part of controler					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TEG_CAT_DOWN_THD_COP	-	0... 7FF0H	0... 2047	0.0625	°C
threshold for exhaust gas temperature downstream of the precatalyst - I-controller activation					
C_TEG_CAT_DOWN_THD_MAX_COP	-	0... 7FF0H	0... 2047	0.0625	°C
Maximum threshold for exhaust gas temperature downstream of the precatalyst					
C_TEG_CAT_DOWN_THD_MIN_COP	-	0... 7FF0H	0... 2047	0.0625	°C
bottom threshold for exhaust gas temperature downstream of the precatalyst					
C_TEG_CAT_UP_MDL_THD_COP	-	0... 7FF0H	0... 2047	0.0625	°C
threshold for exhaust gas temperature upstream of the precatalyst - I-controller activation					
C_TEG_CAT_UP_MDL_THD_MAX_COP	-	0... 7FF0H	0... 2047	0.0625	°C
Maximum threshold for exhaust gas temperature upstream of the precatalyst					
C_TEG_CAT_UP_MDL_THD_MIN_COP	-	0... 7FF0H	0... 2047	0.0625	°C
bottom threshold for exhaust gas temperature upstream of the precatalyst					
C_TNT_MDL_H_THD_COP	-	0... FFFFH	0... 1024	0.015625	°C
threshold for temperature in the NOx Trap catalyst - I-controller activation					
C_TNT_MDL_H_THD_MAX_COP	-	0... FFFFH	0... 1024	0.015625	°C
maximum threshold for temperature in the NOx Trap catalyst					
C_TNT_MDL_H_THD_MIN_COP	-	0... FFFFH	0... 1024	0.015625	°C
bottom threshold for temperature in the NOx Trap catalyst					

FUNCTION DESCRIPTION:

Application conditions:

Recurrence: every 1 s.
Initialisation: at reset LAMB_COP_CUS_i = C_LAMB_COP_PAS
Activation: If LV_ST_END = 1
Deactivation: -

General information:

If the temperature in the exhaust line exceeds a certain limit, the catalytic converter or even the exhaust line can be destroyed. To reduce the temperature the lambda is ramped down.
The exhaust line of a gasoline direct injection engine consists of a precatalyst and a NO_x-trap catalyst. The actual temperatures upstream (TEG_CAT_UP_MDL_i) and downstream of the precatalyst (TEG_CAT_DOWN_MDL_i or TEG_PCAT_DOWN_i, respectively) and the temperature in the NO_x-trap (TNT_MDL_H_i) are compaired to thresholds, separate for each temperature. The difference between an actual temperature and a threshold is input for an I-controller. Three different I-controllers are working in parallel.
Descriptions of LAMB_COP_i is the output LAMB_COP_CUS_i

In the following, **xx** serves as substitute for specification purposes. This is in detail:
xx = TEG_CAT_UP_MDL for I-controller 1 (temperature upstream of the precatalyst)
xx = TEG_CAT_DOWN for I-controller 2 (temperature downstream of the precat.)
xx = TNT_MDL_H for I-controller 3 (temperature in the NO_x-trap catalyst)

Formula section:

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7.23.1 Maximal selection between model or sensor based temperatur downstream the precatalyst

If a temperature sensor downstream the precatalyst is available the maximum value between the sensor based temperature TEG_PCAT_DOWN_i and the the model based temperature TEG_CAT_DOWN_MDL_i is choosen.

TEG_CAT_DOWN_i = MAX (TEG_PCAT_DOWN_i, TEG_CAT_DOWN_MDL_i)

Note:

If no temperature sensor downstream the precatalyst is available the variable has to be initialized as follows:
TEG_PCAT_DOWN_i = 0

7.23.2 Activation and Deactivation of the Controller

A single controller is activated (LV_xx_COP_i = 1) if the temperature xx_i exceeds its threshold C_xx_THD_COP. A singel controller is deactivated (LV_xx_COP_i = 0) if the temperature xx_i is below the threshold C_xx_THD_MIN_COP or if the temperature xx_i is below the threshold C_xx_THD_COP after the lambda was ramped up and has reached the the basic lambda setpoint LAMB_BAS_i.
All controllers are deactivated if one of the following logical variables is set to one:
LV_AST, LV_PUC, LV_SCC_i.
For that case the lambda for catalyst overheat protection LAMB_COP_i is set to the passive value C_LAMB_COP_PAS.

```
(1) If              LV_AST = 1 or LV_PUC = 1or LV_SCC_i = 1
(1) then              LV_xx_COP_i = 0
  1. else
          (2) if              xx_i >= C_xx_THD_MIN_COP
          (2) then
            (3) if               xx_i >= C_xx_THD_COP
            (3) then               LV_xx_COP_i = 1
            (3) else
                  (4) if               LAMB_xx_COP_i > LAMB_BAS_i
                  (4) then               LV_xx_COP_i = 0
                  (4) endif
            (3) endif
          (2) else              LV_xx_COP_i = 0
          (2) endif
  1. endif
```

At transition LV_xx_COP_i = 0 -> 1 the variable LAMB_xx_COP_i is initialized with LAMB_SP_i .

7.23.3 Controller Equations

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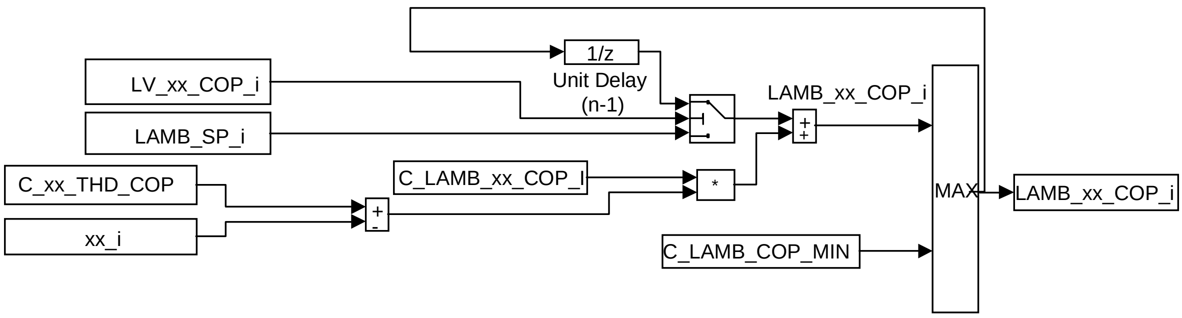


If LV_xx_COP_i = 1 ...... (controller active)
then
LAMB_xx_COP_i (n) = LAMB_xx_COP_i (n-1) + C_LAMB_xx_COP_I * (C_xx_THD_COP - xx_i)
else LAMB_xx_COP_i = C_LAMB_COP_PAS ...... (controller inactive)
endif

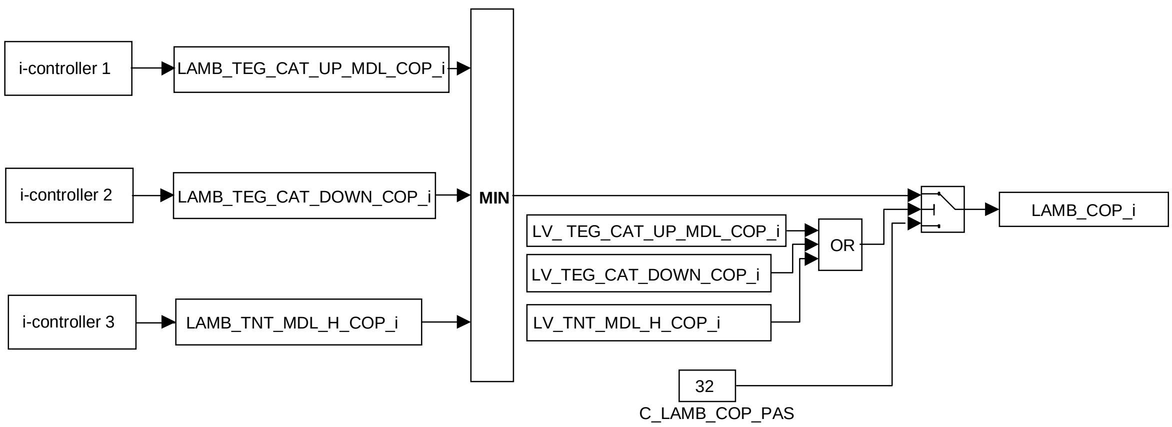
Application Hint: The passive value C_ LAMB_COP_PAS shoud be set to 32.

The value LAMB_xx_COP_i can not be smaller than the minimum allowed lambda value C_LAMB_ COP_MIN:

LAMB_xx_COP_i = MAX (LAMB_xx_COP_i, C_LAMB_COP_MIN)

7.23.4 Calculation of LAMB_COP (Resulting lambda request)

System flow diagramm:



If at least one controller is active (LV_xx_COP_i = 1) the minimum controller output is selected for LAMB_COP_i:

if LV_TEG_CAT_UP_MDL_COP_i = 1
or
LV_TEG_CAT_DOWN_COP_i = 1
or
LV_TNT_MDL_H_COP_i = 1
then LAMB_COP_i = MIN (LAMB_xx_COP_i)
LV_LAMB_COP_i = 1
else LAMB_COP_i = C_LAMB_COP_PAS

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LV_LAMB_COP_i = 0

endif

If one of the temperatures **xx_i** exceeds the maximum threshold C_xx_THD_MAX_COP, the lambda enrichment is set to the minimum allowed lambda value C_LAMB_COP_MIN immediately.

If

TEG_CAT_UP_MDL_i >= C_TEG_CAT_UP_MDL_THD_MAX_COP

or

TEG_CAT_DOWN_MDL_i >= C_TEG_CAT_DOWN_THD_MAX_COP

or

TNT_MDL_H_i >= C_TNT_MDL_H_THD_MAX_COP

then LAMB_COP_i = C_LAMB_COP_MIN

endif

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7.24 Injection pressure correction - HOM 1. pulse

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_INJ_1_HOM	V	0... 780H	0... 720	0.375	°CRK
Estimated value for injection angle (EOI-SOI), 1. pulse homogeneous mode					
FAC_TI_1_PRS_CYL_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
correction factor to compensate the influence of the cylinder counter pressure, 1. pulse homogeneous					
FAC_TI_1_PRS_CYL_HOM_TMP	-	0... FFFFH	0... 15.99975	244.1e-6	-
correction factor to compensate the influence of the cylinder counter pressure, 1. pulse homogeneous; temporary value					
IDX_TI_1_PRS_HOM_SP_TMP	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for pressure correction calculation; first pulse HOM.					
PRS_DEC_INJ_1_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Pressure difference at the injector, 1. pulse homogeneous mode					
PRS_DEC_INJ_1_HOM_TMP	-	0... FFFFH	0... 347776	5.3067216	hPa
Pressure difference at the injector, 1. pulse homogeneous mode; temporary value					
PRS_INJ_MV_1_HOM	V	0... FFFFH	0... 347776	5.3067216	hPa
Mean cylinder pressure during injection, 1. Pulse homogeneous mode					
TI_1_PRS_HOM_SP_TMP	-	0... FFFFH	0... 65.535	0.001	ms
Injection time setpoint for calculation of injection pressure correction at homogeneous mode, first pulse; temporary value					

Input data:

FAC_MFF_DIF_HOM [NC_CYL_NR] {p. 2260}	FAC_MFF_TFU {p. 2224}	FAC_N {p. 3327}	FAC_TI_COR_IV_EGY_RNG_L [NC_CBK_HPP_NR] {p. 2260}
FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	IDX_PRS_COR_CYL_CLC_MPLH [NC_CBK_HPP_NR] {p. 3327}	IP_MFF_IDX_TI_EGY_H {p. 2008}	IP_MFF_IDX_TI_EGY_L {p. 2008}
IP_MFF_TI_EGY_H {p. 2009}	IP_MFF_TI_EGY_L {p. 2009}	IP_PRS_INC_CMP {p. 2204}	IP_TI_H {p. 2010}
IP_TI_L {p. 2010}	LC_CUR_SHP_INJ_ENA {p. 2010}	LF_PRS_COR_HPP_ENA {p. 3330}	LV_EGY_RNG_IV_PLS_1_HOM [NC_CYL_NR] {p. 2261}
LV_ST_END {p. 1720}	MAP_INJ [NC_CBK_HPP_NR] {p. 3331}	MFF_ADD_REAC [NC_CYL_NR] {p. 3331}	MFF_SP_1_HOM [NC_CYL_NR] {p. 8242}
NC_CBK_HPP_NR [1] {p. 812}	NC_CYL_NR {p. 1526}	NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}	SOI_1_HOM [NC_CYL_NR] {p. 2122}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_TI_PRS_CYL	-	0... FFFFH	0... 15.99975	244.1e-6	-
LDP_PRS_INJ_IP_FAC_TI_PRS_CYL	12	0... FFFFH	0... 347776	5.3067216	hPa
correction factor to compesate the influence of the cylinder couter pressure					
IP_FAC_TI_PRS_CYL_L	-	0... FFFFH	0... 15.99975	244.1e-6	-
LDP_PRS_INJ_IP_FAC_TI_PRS_CYL	12	0... FFFFH	0... 347776	5.3067216	hPa
correction factor to compesate the influence of the cylinder couter pressure for low injector needle lift.					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_PRS_COR_1_HOM_CMP_ENA	-	0... 1H	0 ...1	1	-
Flag to enable fuel pressure correction with compression influence for 1st pulse homogeneous mode					

FUNCTION DESCRIPTION:

General information:

The module calculates a correction factor to compensate the influence of the cylinder counter pressure at the injector (here: MAP) and the influence of the fuel temperature on the injected fuel mass. Also, the pressure difference at the injector is calculated.

Application conditions

Activation: every engine state

Deactivation: –

Initialisation: at reset: FAC_TI_1_PRS_CYL_HOM[ ] = 1 // all NC_CYL_NR elements

Update rate: LV_ST_END = 0: 10 ms
LV_ST_END = 1: segment synchronous

Formula section:

FOR m = 0 **TO** NC_CBK_HPP_NR - 1 **DO**
Check, if fuel bank m has to be calculated:
(1)IF Bit m of LF_PRS_COR_HPP_ENA = 1
(1)THEN
(1a)IF LV_ST_END = 0 **OR** LC_PRS_COR_1_HOM_CMP_ENA = 0
(1a)THEN
PRS_DEC_INJ_1_HOM_TMP = FUP_H_INJ[m] - MAP_INJ[m]
(1b)IF LV_EGY_RNG_IV_PLS_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] = 1
(1b)THEN
FAC_TI_1_PRS_CYL_HOM_TMP = IP_FAC_TI_PRS_CYL(MAP_INJ[m])
(1b)ELSE
FAC_TI_1_PRS_CYL_HOM_TMP = IP_FAC_TI_PRS_CYL_L(MAP_INJ[m])
(1b)ENDIF
(1a)ELSE
Calculation of an injection time for pressure correction:
(2a)IF LC_CUR_SHP_INJ_ENA = 1
(2a)THEN // current shaping via IDX_TI calculation is active
(2)IF LV_EGY_RNG_IV_PLS_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] = 1
(2)THEN
IDX_TI_1_PRS_HOM_SP_TMP = IP_MFF_IDX_TI_EGY_H(
((MFF_SP_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] +
MFF_ADD_REAC[IDX_PRS_COR_CYL_CLC_MPLH[m]])*(1 +
FAC_MFF_DIF_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]])
*FAC_MFF_TFU);
PRS_DEC_INJ_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1))
* FAC_TI_1_PRS_CYL_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1)

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TI_1_PRS_HOM_SP_TMP = IP_TI_H(IDX_TI_1_PRS_HOM_SP_TMP)
(2)ELSE
IDX_TI_1_PRS_HOM_SP_TMP = IP_MFF_IDX_TI_EGY_L(
((MFF_SP_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] +
MFF_ADD_REAC[IDX_PRS_COR_CYL_CLC_MPLH[m]])*(1 +
FAC_MFF_DIF_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]])
*FAC_MFF_TFU);
PRS_DEC_INJ_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1))
* FAC_TI_COR_IV_EGY_RNG_L[m]
* FAC_TI_1_PRS_CYL_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1)
TI_1_PRS_HOM_SP_TMP = IP_TI_L(IDX_TI_1_PRS_HOM_SP_TMP)
(2)ENDIF
(2a)ELSE // current shaping is inactive; classic TI calculation applied
(2)IF LV_EGY_RNG_IV_PLS_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] = 1
(2)THEN
TI_1_PRS_HOM_SP_TMP = IP_MFF_TI_EGY_H(
((MFF_SP_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] +
MFF_ADD_REAC[IDX_PRS_COR_CYL_CLC_MPLH[m]])*(1 +
FAC_MFF_DIF_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]])*FAC_MFF_TFU);
PRS_DEC_INJ_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1))
* FAC_TI_1_PRS_CYL_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1)
(2)ELSE
TI_1_PRS_HOM_SP_TMP = IP_MFF_TI_EGY_L(
((MFF_SP_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] +
MFF_ADD_REAC[IDX_PRS_COR_CYL_CLC_MPLH[m]])*(1 +
FAC_MFF_DIF_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]])*FAC_MFF_TFU);
PRS_DEC_INJ_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1))
* FAC_TI_COR_IV_EGY_RNG_L[m]
* FAC_TI_1_PRS_CYL_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1)
(2)ENDIF
(2a)ENDIF

A rough injection duration angle CRK_INJ_1_HOM is estimated from TI_1_PRS_HOM_SP_TMP and engine speed (FAC_N):
From the manifold pressure MAP_INJ[m], the end of injection and the rough injection angle a mean counter pressure within the cylinder during the injection is calculated.
The pressure difference at the injector is calculated from fuel rail pressure and the manifold pressure.
The correction factor FAC_TI_1_PRS_CYL_HOM is used to compensate the influence of the cylinder counter pressure on the injector needle lift.

CRK_INJ_1_HOM = TI_1_PRS_HOM_SP_TMP * FAC_N

PRS_INJ_MV_1_HOM = MAP_INJ[m] * IP_PRS_INC_CMP
(Input data for IP_PRS_INC_CMP is
(SOI_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] -
TI_1_PRS_HOM_SP_TMP*FAC_N) and CRK_INJ_1_HOM)
PRS_DEC_INJ_1_HOM_TMP = FUP_H_INJ[m] - PRS_INJ_MV_1_HOM

(3)IF LV_EGY_RNG_IV_PLS_1_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] = 1
(3)THEN
FAC_TI_1_PRS_CYL_HOM_TMP = IP_FAC_TI_PRS_CYL(PRS_INJ_MV_1_HOM)
(3)ELSE
FAC_TI_1_PRS_CYL_HOM_TMP =

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```
                                   IP_FAC_TI_PRS_CYL_L(PRS_INJ_MV_1_HOM)
         (3)ENDIF
        (1a)ENDIF
        Calculate cylinder individual injection pressure correction values:
        FOR x = 0 TO NC_CYL_NR - 1 DO
            IF NC_IDX_CYL_HPP_REF[x] = m
            THEN
                PRS_DEC_INJ_1_HOM[x] = PRS_DEC_INJ_1_HOM_TMP
                FAC_TI_1_PRS_CYL_HOM[x] = FAC_TI_1_PRS_CYL_HOM_TMP
            ENDIF
        ENDFOR
       (1)ENDIF
   ENDFOR
```

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7.25 Injection pressure correction for multiple injection - HOM 2. pulse

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_INJ_2_HOM	V	0... 780H	0... 720	0.375	°CRK
rough value for injection angle (EOI-SOI), 2. pulse					
FAC_TI_2_PRS_CYL_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Correction factor to compensate the influence of the cylinder counter pressure, 2. Pulse homogeneous					
FAC_TI_2_PRS_CYL_HOM_TMP	-	0... FFFFH	0... 15.99975	244.1e-6	-
Correction factor to compensate the influence of the cylinder counter pressure, 2. Pulse homogeneous; temporary value					
IDX_TI_2_PRS_HOM_SP_TMP	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for pressure correction calculations; second pulse HOM.					
PRS_DEC_INJ_2_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Pressure difference at the injector, 2. pulse homogeneous mode					
PRS_DEC_INJ_2_HOM_TMP	-	0... FFFFH	0... 347776	5.3067216	hPa
Pressure difference at the injector, 2. pulse; temporary value					
PRS_INJ_MV_2_HOM	V	0... FFFFH	0... 347776	5.3067216	hPa
mean cylinder pressure during injection, 2. Pulse					
TI_2_PRS_HOM_SP [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Injection time setpoint for calculation of injection pressure correction at homogeneous mode, second pulse					
TI_2_PRS_HOM_SP_TMP	-	0... FFFFH	0... 65.535	0.001	ms
Injection time setpoint for calculation of injection pressure correction at homogeneous mode, second pulse; temporary value					

Input data:

EOI_2_HOM [NC_CYL_NR] {p. 2130}	FAC_MFF_DIF_HOM [NC_CYL_NR] {p. 2260}	FAC_MFF_TFU {p. 2224}	FAC_N {p. 3327}
FAC_TI_COR_IV_EGY_RNG_L [NC_CBK_HPP_NR] {p. 2260}	FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	IDX_PRS_COR_CYL_CLC_MPLH [NC_CBK_HPP_NR] {p. 3327}	INJ_MOD_SP_HOM [NC_CYL_NR] {p. 3329}
IP_FAC_TI_PRS_CYL {p. 2200}	IP_FAC_TI_PRS_CYL_L {p. 2200}	IP_MFF_IDX_TI_EGY_H {p. 2008}	IP_MFF_IDX_TI_EGY_L {p. 2008}
IP_MFF_TI_EGY_H {p. 2009}	IP_MFF_TI_EGY_L {p. 2009}	IP_TI_H {p. 2010}	IP_TI_L {p. 2010}
LC_CUR_SHP_INJ_ENA {p. 2010}	LF_PRS_COR_HPP_ENA {p. 3330}	LV_EGY_RNG_IV_PLS_2_HOM [NC_CYL_NR] {p. 2261}	LV_ST_END {p. 1720}
MAP_INJ [NC_CBK_HPP_NR] {p. 3331}	MFF_SP_2_HOM [NC_CYL_NR] {p. 8242}	NC_CBK_HPP_NR [1] {p. 812}	NC_CYL_NR {p. 1526}
NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_PRS_INC_CMP	V	0... FFFFH	0... 31.99951	488.299e-6	-
LDP_EOI_IP_PRS_INC_CMP	12	0... 780H	0... 720	0.375	°CRK
LDP_CRK_INJ_IP_PRS_INC_CMP	16	0... 780H	0... 720	0.375	°CRK
Mean pressure increase in cylinder due to compression					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Overview

The module calculates a correction factor to compensate the influence of the cylinder counter pressure and the influence of the fuel temperature on the injected fuel mass.

Application conditions

Activation: every engine state

Deactivation: -

Initialization: -

Update rate: LV_ST_END = 0: 10 ms
LV_ST_END = 1: every TDC

Function Description

(1)FOR m = 0 **TO** NC_CBK_HPP_NR - 1 **DO**

(1)IF INJ_MOD_SP_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] = "MPLH" **OR**
INJ_MOD_SP_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] = "MPLH+PLS3"
(1) THEN

Check, if fuel bank m has to be calculated:
(2)IF Bit m of LF_PRS_COR_HPP_ENA = 1
(2)THEN

Calculation of an injection time for pressure correction:
(2a)IF LC_CUR_SHP_INJ_ENA = 1
(2a)THEN // current shaping via IDX_TI calculation is active
(3)IF LV_EGY_RNG_IV_PLS_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] = 1
(3)THEN
IDX_TI_2_PRS_HOM_SP_TMP = IP_MFF_IDX_TI_EGY_H(
(MFF_SP_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]]*(1 +
FAC_MFF_DIF_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]])
*FAC_MFF_TFU);
PRS_DEC_INJ_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1))
* FAC_TI_2_PRS_CYL_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1)
TI_2_PRS_HOM_SP_TMP = IP_TI_H(IDX_TI_2_PRS_HOM_SP_TMP)
(3)ELSE
IDX_TI_2_PRS_HOM_SP_TMP = IP_MFF_IDX_TI_EGY_L(
(MFF_SP_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]]*(1 +
FAC_MFF_DIF_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]])
*FAC_MFF_TFU);
PRS_DEC_INJ_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1))
* FAC_TI_COR_IV_EGY_RNG_L[m]
* FAC_TI_2_PRS_CYL_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1)
TI_2_PRS_HOM_SP_TMP = IP_TI_L(IDX_TI_2_PRS_HOM_SP_TMP)
(3)ENDIF

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```
(2a)ELSE // current shaping is inactive; classic TI calculation applied
 (3a)IF LV_EGY_RNG_IV_PLS_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] = 1
 (3a)THEN
    TI_2_PRS_HOM_SP_TMP = IP_MFF_TI_EGY_H(
            (MFF_SP_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]]*(1 +
            FAC_MFF_DIF_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]])
            *FAC_MFF_TFU);
            PRS_DEC_INJ_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1))
            * FAC_TI_2_PRS_CYL_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1)
  (3a)ELSE
    TI_2_PRS_HOM_SP_TMP = IP_MFF_TI_EGY_L(
            (MFF_SP_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]]*(1 +
            FAC_MFF_DIF_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]])
            *FAC_MFF_TFU);
            PRS_DEC_INJ_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1))
           * FAC_TI_COR_IV_EGY_RNG_L[m]
           * FAC_TI_2_PRS_CYL_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1)
  (3a)ENDIF
(2a)ENDIF
```

Calculation of the counter pressure within the cylinder:

A rough injection duration angle CRK_INJ_2_HOM is estimated from TI_2_PRS_HOM_SP_TMP and engine speed (FAC_N):

From the manifold pressure MAP, the end of injection EOI_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] and the rough injection angle a mean counter pressure within the cylinder during the injection is calculated.

The pressure difference at the injector is calculated from fuel rail pressure and the mean counter pressure.

The total correction factor results from the map IP_FAC_TI_PRS_CYL.
For low injector needle lift, a separate map IP_FAC_TI_PRS_CYL_L is used.

```
CRK_INJ_2_HOM = TI_2_PRS_HOM_SP_TMP * FAC_N

PRS_INJ_MV_2_HOM = MAP_INJ[m] * IP_PRS_INC_CMP
(Input data for IP_PRS_INC_CMP is
EOI_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] and CRK_INJ_2_HOM)

PRS_DEC_INJ_2_HOM_TMP = FUP_H_INJ[m] - PRS_INJ_MV_2_HOM
(3a)IF LV_EGY_RNG_IV_PLS_2_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] = 1
(3a)THEN
    FAC_TI_2_PRS_CYL_HOM_TMP =
                        IP_FAC_TI_PRS_CYL(PRS_INJ_MV_2_HOM)
(3a)ELSE
    FAC_TI_2_PRS_CYL_HOM_TMP =
                        IP_FAC_TI_PRS_CYL_L(PRS_INJ_MV_2_HOM)
(3a)ENDIF

(2)FOR x = 0 TO NC_CYL_NR - 1 DO
    (4)IF NC_IDX_CYL_HPP_REF[x] = m
```

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```
            (4)THEN
                PRS_DEC_INJ_2_HOM[x] = PRS_DEC_INJ_2_HOM_TMP
                FAC_TI_2_PRS_CYL_HOM[x] = FAC_TI_2_PRS_CYL_HOM_TMP
                TI_2_PRS_HOM_SP[x] = TI_2_PRS_HOM_SP_TMP
            (4)ENDIF
          (2)ENDFOR
        (2)ENDIF

(1)ELSE
        (3)FOR x = 0 TO NC_CYL_NR - 1 DO
            (5)IF NC_IDX_CYL_HPP_REF[x] = m
          (5)THEN
                FAC_TI_2_PRS_CYL_HOM[x] = 1.0
                PRS_DEC_INJ_2_HOM[x] = FUP_H_INJ[m]
              (5)ENDIF
          (3)ENDFOR
(1)ENDIF
   (1)ENDFOR
```

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7.26 Injection pressure correction for multiple injection - HOM 3. pulse

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_INJ_3_HOM	V	0... 780H	0... 720	0.375	°CRK
rough value for injection angle (EOI-SOI), 3. pulse					
FAC_TI_3_PRS_CYL_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Correction factor to compensate the influence of the cylinder counter pressure, 3. Pulse homogeneous					
FAC_TI_3_PRS_CYL_HOM_TMP	-	0... FFFFH	0... 15.99975	244.1e-6	-
Correction factor to compensate the influence of the cylinder counter pressure, 3. Pulse homogeneous; temporary value					
IDX_TI_3_PRS_HOM_SP_TMP	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for pressure correction calculations; third pulse HOM.					
PRS_DEC_INJ_3_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Pressure difference at the injector, 3. pulse homogeneous mode					
PRS_DEC_INJ_3_HOM_TMP	-	0... FFFFH	0... 347776	5.3067216	hPa
Pressure difference at the injector, 3. pulse homogeneous mode; temporary value					
PRS_INJ_MV_3_HOM	V	0... FFFFH	0... 347776	5.3067216	hPa
mean cylinder pressure during injection, 3. Pulse					
TI_3_PRS_HOM_SP [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Injection time setpoint for calculation of injection pressure correction at homogeneous mode, third pulse					
TI_3_PRS_HOM_SP_TMP	-	0... FFFFH	0... 65.535	0.001	ms
Injection time setpoint for calculation of injection pressure correction at homogeneous mode, third pulse; temporary value					

Input data:

EOI_3_HOM [NC_CYL_NR] {p. 2133}	FAC_MFF_DIF_HOM [NC_CYL_NR] {p. 2260}	FAC_MFF_TFU {p. 2224}	FAC_N {p. 3327}
FAC_TI_COR_IV_EGY_RNG_L [NC_CBK_HPP_NR] {p. 2260}	FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	IDX_PRS_COR_CYL_CLC_MPLH [NC_CBK_HPP_NR] {p. 3327}	INJ_MOD_SP_HOM [NC_CYL_NR] {p. 3329}
IP_FAC_TI_PRS_CYL {p. 2200}	IP_FAC_TI_PRS_CYL_L {p. 2200}	IP_MFF_IDX_TI_EGY_H {p. 2008}	IP_MFF_IDX_TI_EGY_L {p. 2008}
IP_MFF_TI_EGY_H {p. 2009}	IP_MFF_TI_EGY_L {p. 2009}	IP_PRS_INC_CMP {p. 2204}	IP_TI_H {p. 2010}
IP_TI_L {p. 2010}	LC_CUR_SHP_INJ_ENA {p. 2010}	LF_PRS_COR_HPP_ENA {p. 3330}	LV_EGY_RNG_IV_PLS_3_HOM [NC_CYL_NR] {p. 2261}
LV_ST_END {p. 1720}	MAP_INJ [NC_CBK_HPP_NR] {p. 3331}	MFF_SP_3_HOM [NC_CYL_NR] {p. 8243}	NC_CBK_HPP_NR [1] {p. 812}
NC_CYL_NR {p. 1526}	NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}		

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Overview

The module calculates a correction factor to compensate the influence of the cylinder counter pressure and the influence of the fuel temperature on the injection time..

Application conditions

Activation: every engine state

Deactivation: –

Initialisation: –

Update rate: LV_ST_END = 0: 10 ms
LV_ST_END = 1: segment synchronous

Function Description

(1)FOR m = 0 **TO** NC_CBK_HPP_NR - 1 **DO**

(1) IF (INJ_MOD_SP_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] = "MPLH+PLS3")
(1) THEN

Check, if fuel bank m has to be calculated:
(2)IF Bit m of LF_PRS_COR_HPP_ENA = 1
(2)THEN

Calculation of an injection time for pressure correction:
(2a)IF LC_CUR_SHP_INJ_ENA = 1
(2a)THEN // current shaping via IDX_TI calculation is active
(3)IF LV_EGY_RNG_IV_PLS_3_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] = 1
(3)THEN
IDX_TI_3_PRS_HOM_SP_TMP = IP_MFF_IDX_TI_EGY_H(
(MFF_SP_3_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]]*(1 +
FAC_MFF_DIF_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]])*FAC_MFF_TFU);
PRS_DEC_INJ_3_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1))
* FAC_TI_3_PRS_CYL_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1)
TI_3_PRS_HOM_SP_TMP = IP_TI_H(IDX_TI_3_PRS_HOM_SP_TMP)
(3)ELSE
IDX_TI_3_PRS_HOM_SP_TMP = IP_MFF_IDX_TI_EGY_L(
(MFF_SP_3_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]]*(1 +
FAC_MFF_DIF_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]])*FAC_MFF_TFU);
PRS_DEC_INJ_3_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1))
* FAC_TI_COR_IV_EGY_RNG_L[m]
* FAC_TI_3_PRS_CYL_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1)
TI_3_PRS_HOM_SP_TMP = IP_TI_L(IDX_TI_3_PRS_HOM_SP_TMP)
(3)ENDIF
(2a)ELSE // current shaping is inactive; classic TI calculation applied
(3a)IF LV_EGY_RNG_IV_PLS_3_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] = 1
(3a)THEN
TI_3_PRS_HOM_SP_TMP = IP_MFF_TI_EGY_H(
(MFF_SP_3_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]]*(1 +
FAC_MFF_DIF_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]])*FAC_MFF_TFU);
PRS_DEC_INJ_3_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1))
* FAC_TI_3_PRS_CYL_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1)
(3a)ELSE
TI_3_PRS_HOM_SP_TMP = IP_MFF_TI_EGY_L(
(MFF_SP_3_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]]*(1 +
FAC_MFF_DIF_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]])*FAC_MFF_TFU);
PRS_DEC_INJ_3_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1))
* FAC_TI_COR_IV_EGY_RNG_L[m]

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```
        * FAC_TI_3_PRS_CYL_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]](n-1)
      (3a)ENDIF
    (2a)ENDIF
```

Calculation of the counter pressure within the cylinder:
A rough injection duration angle CRK_INJ_3_HOM is estimated from TI_3_PRS_HOM_SP_TMP and engine speed (FAC_N):

From the manifold pressure MAP, the end of injection EOI_3_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] and the rough injection angle a mean counter pressure within the cylinder during the injection is calculated.

The pressure difference at the injector is calculated from fuel rail pressure and the mean counter pressure.

The total correction factor results from the map IP_FAC_TI_PRS_CYL.
For low injector needle lift, a separate map IP_FAC_TI_PRS_CYL_L is used.

CRK_INJ_3_HOM = TI_3_PRS_HOM_SP_TMP * FAC_N

PRS_INJ_MV_3_HOM = MAP_INJ[m] * IP_PRS_INC_CMP
(Input data for IP_PRS_INC_CMP is
EOI_3_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] and CRK_INJ_3_HOM)

```
 PRS_DEC_INJ_3_HOM_TMP = FUP_H_INJ[m] - PRS_INJ_MV_3_HOM
 (3a)IF LV_EGY_RNG_IV_PLS_3_HOM[IDX_PRS_COR_CYL_CLC_MPLH[m]] = 1
(3a)THEN
      FAC_TI_3_PRS_CYL_HOM_TMP =
                          IP_FAC_TI_PRS_CYL(PRS_INJ_MV_3_HOM)
 (3a)ELSE
      FAC_TI_3_PRS_CYL_HOM_TMP =
                          IP_FAC_TI_PRS_CYL_L(PRS_INJ_MV_3_HOM)
 (3a)ENDIF

 (2)FOR x = 0 TO NC_CYL_NR - 1 DO
      (4)IF NC_IDX_CYL_HPP_REF[x] = m
      (4)THEN
            PRS_DEC_INJ_3_HOM[x] = PRS_DEC_INJ_3_HOM_TMP
            FAC_TI_3_PRS_CYL_HOM[x] = FAC_TI_3_PRS_CYL_HOM_TMP
            TI_3_PRS_HOM_SP[x] = TI_3_PRS_HOM_SP_TMP
      (4)ENDIF
 (2)ENDFOR
(2)ENDIF

  (1)ELSE
   (3)FOR x = 0 TO NC_CYL_NR - 1 DO
      (5)IF NC_IDX_CYL_HPP_REF[x] = m
         (5)THEN
            FAC_TI_3_PRS_CYL_HOM[x] = 1.0
            PRS_DEC_INJ_3_HOM[x] = FUP_H_INJ[m]
         (5)ENDIF
     (3)ENDFOR
  (1)ENDIF
```

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(1)ENDFOR

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7.27 Injection pressure correction for multiple injection - S 1. pulse

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_INJ_1_S	V	0... 780H	0... 720	0.375	°CRK
rough value for injection angle (EOI-SOI), stratified mode 1. pulse					
FAC_TI_1_PRS_CYL_S [NC_CYL_NR]	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
factor for correction of fuel injection time due to an influence of cylinder counter pressure, strat. mode 1. pulse					
FAC_TI_1_PRS_CYL_S_TMP	-	0... FFFFH	0... 15.99975	244.1e-6	-
factor for correction of fuel injection time due to an influence of cylinder counter pressure, strat. mode 1. pulse; temporary value					
FUP_PRS_COR [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure for calculation of the pressure correction at stratified mode					
IDX_TI_1_PRS_S_SP_TMP	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for pressure correction calculations; first pulse S.					
PRS_DEC_INJ_1_S [NC_CYL_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
pressure decrease at the injector, stratified mode 1. pulse					
PRS_DEC_INJ_1_S_TMP	-	0... FFFFH	0... 347776	5.3067216	hPa
pressure decrease at the injector, stratified mode 1. pulse; temporary value					
PRS_INJ_MV_1_S	V	0... FFFFH	0... 347776	5.3067216	hPa
mean cylinder pressure during injection, stratified mode 1. pulse					
TI_1_PRS_S_SP_TMP	-	0... FFFFH	0... 65.535	0.001	ms
Injection time setpoint for calculation of injection pressure correction, stratified mode, 1. pulse; temporary value					

Input data:

EOI_1_S [NC_CYL_NR] {p. 2140}	FAC_MFF_DIF_S [NC_CYL_NR] {p. 2260}	FAC_MFF_TFU {p. 2224}	FAC_N {p. 3327}
FAC_TI_COR_IV_EGY_RNG_L [NC_CBK_HPP_NR] {p. 2260}	FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	FUP_H_SP_S {p. 3868}	FUP_H_SP_S_INJ [NC_CBK_HPP_NR] {p. 3327}
IDX_PRS_COR_CYL_CLC_S [NC_CBK_HPP_NR] {p. 3327}	IP_FAC_TI_PRS_CYL {p. 2200}	IP_FAC_TI_PRS_CYL_L {p. 2200}	IP_MFF_IDX_TI_EGY_H {p. 2008}
IP_MFF_IDX_TI_EGY_L {p. 2008}	IP_MFF_TI_EGY_H {p. 2009}	IP_MFF_TI_EGY_L {p. 2009}	IP_TI_H {p. 2010}
IP_TI_L {p. 2010}	LC_CUR_SHP_INJ_ENA {p. 2010}	LF_PRS_COR_HPP_ENA {p. 3330}	LV_EGY_RNG_IV_PLS_1_S [NC_CYL_NR] {p. 2261}
LV_IGA_AND_INJ_SWI {p. 8136}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}	MAP_INJ [NC_CBK_HPP_NR] {p. 3331}
MFF_SP_1_S [NC_CYL_NR] {p. 8242}	NC_CBK_HPP_NR [1] {p. 812}	NC_CYL_NR {p. 1526}	NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_PRS_INC_CMP_S	V	0... FFFFH	0... 31.99951	488.299e-6	-

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_EOI_2_S_0_IP_PRS_INC_CMP_S	12	0... 780H	0... 720	0.375	°CRK
LDP_CRK_INJ_2_S_IP_PRS_INC_CMP	16	0... 780H	0... 720	0.375	°CRK
Mean pressure increase in cylinder due to compression					

FUNCTION DESCRIPTION:

General information:

The module calculates a correction factor to compensate the influence of the cylinder counter pressure and the influence of the fuel temperature on the injected fuel mass.

Application conditions

Activation: every engine state

Deactivation: –

Initialisation: –

Update rate:
```
LV_ST_END = 0:   10 ms
LV_ST_END = 1:    segment synchronous
```

Formula section:

(1)FOR m = 0 **TO** NC_CBK_HPP_NR - 1 **DO**

(1) IF
LV_S_CLC = 1
(1) THEN
Check, if fuel bank m has to be calculated:
(2)IF Bit m of LF_PRS_COR_HPP_ENA = 1
(2)THEN
The injection time TI_1_PRS_S_SP_TMP is necessary to calculate CRK_INJ_1_S.
Calculation of TI_1_PRS_S_SP_TMP:
(2a)IF LC_CUR_SHP_INJ_ENA = 1
(2a)THEN // current shaping via IDX_TI calculation is active
(3)IF LV_EGY_RNG_IV_PLS_1_S[IDX_PRS_COR_CYL_CLC_S[m]] = 1
(3)THEN
IDX_TI_1_PRS_S_SP_TMP = IP_MFF_IDX_TI_EGY_H(
(MFF_SP_1_S[IDX_PRS_COR_CYL_CLC_S[m]]*(1 +
FAC_MFF_DIF_S[IDX_PRS_COR_CYL_CLC_S[m]])*FAC_MFF_TFU);
PRS_DEC_INJ_1_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1))
* FAC_TI_1_PRS_CYL_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1)
TI_1_PRS_S_SP_TMP = IP_TI_H(IDX_TI_1_PRS_S_SP_TMP)
(3)ELSE
IDX_TI_1_PRS_S_SP_TMP = IP_MFF_IDX_TI_EGY_L(
(MFF_SP_1_S[IDX_PRS_COR_CYL_CLC_S[m]]*(1 +
FAC_MFF_DIF_S[IDX_PRS_COR_CYL_CLC_S[m]])*FAC_MFF_TFU);
PRS_DEC_INJ_1_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1))
* FAC_TI_COR_IV_EGY_RNG_L[m]
* FAC_TI_1_PRS_CYL_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1)

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TI_1_PRS_S_SP_TMP = IP_TI_L(IDX_TI_1_PRS_S_SP_TMP)
(3)ENDIF
(2a)ELSE // current shaping is inactive; classic TI calculation applied
(3a)IF LV_EGY_RNG_IV_PLS_1_S[IDX_PRS_COR_CYL_CLC_S[m]] = 1
(3a)THEN
TI_1_PRS_S_SP_TMP = IP_MFF_TI_EGY_H(
(MFF_SP_1_S[IDX_PRS_COR_CYL_CLC_S[m]]*(1 +
FAC_MFF_DIF_S[IDX_PRS_COR_CYL_CLC_S[m]])*FAC_MFF_TFU);
PRS_DEC_INJ_1_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1))
* FAC_TI_1_PRS_CYL_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1)
(3a)ELSE
TI_1_PRS_S_SP_TMP = IP_MFF_TI_EGY_L(
(MFF_SP_1_S[IDX_PRS_COR_CYL_CLC_S[m]]*(1 +
FAC_MFF_DIF_S[IDX_PRS_COR_CYL_CLC_S[m]])*FAC_MFF_TFU);
PRS_DEC_INJ_1_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1))
* FAC_TI_COR_IV_EGY_RNG_L[m]
* FAC_TI_1_PRS_CYL_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1)
(3a)ENDIF
(2a)ENDIF

A rough injection duration angle CRK_INJ_1_S is estimated from TI_1_PRS_S_SP_TMP and engine speed:

From the manifold pressure MAP_INJ[m], the end of injection EOI_1_S[IDX_PRS_COR_CYL_CLC_S[m]] and the rough injection angle a mean counter pressure within the cylinder during the injection is calculated.

CRK_INJ_1_S = TI_1_PRS_S_SP_TMP * FAC_N

PRS_INJ_MV_1_S = MAP_INJ[m] * IP_PRS_INC_CMP_S
(EOI_1_S[IDX_PRS_COR_CYL_CLC_S[m]]; CRK_INJ_1_S)

The pressure difference at the injector is calculated from fuel rail pressure and the mean counter pressure.
If the engine is not running in stratified mode (LV_IGA_AND_INJ_SWI = 1), for a correct calculation of the pressure correction the FUP_H_SP_S_INJ[m] has to be used instead of the actual FUP_H_INJ[m], because the actual FUP_H_INJ[m] is tuned for a different combustion mode than stratified.

(4)IF LV_IGA_AND_INJ_SWI = 1
(4)THEN
FUP_PRS_COR[m] = FUP_H_SP_S_INJ[m]
(4)ELSE
FUP_PRS_COR[m] = FUP_H_INJ[m]
(4)ENDIF
PRS_DEC_INJ_1_S_TMP = FUP_PRS_COR[m] - PRS_INJ_MV_1_S

The total correction factor results from the map IP_FAC_TI_PRS_CYL.
For low injector needle lift, a separate map IP_FAC_TI_PRS_CYL_L is used.
(4a)IF LV_EGY_RNG_IV_PLS_1_S[IDX_PRS_COR_CYL_CLC_S[m]] = 1
(4a)THEN
FAC_TI_1_PRS_CYL_S_TMP = IP_FAC_TI_PRS_CYL(PRS_INJ_MV_1_S)
(4a)ELSE

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```
            FAC_TI_1_PRS_CYL_S_TMP = IP_FAC_TI_PRS_CYL_L(PRS_INJ_MV_1_S)
        (4a)ENDIF

        (2)FOR x = 0 TO NC_CYL_NR - 1 DO
            (5)IF NC_IDX_CYL_HPP_REF[x] = m
            (5)THEN
                    PRS_DEC_INJ_1_S[x] = PRS_DEC_INJ_1_S_TMP
                    FAC_TI_1_PRS_CYL_S[x] = FAC_TI_1_PRS_CYL_S_TMP
            (5)ENDIF
        (2)ENDFOR
    (2)ENDIF

(1) ELSE
    (3)FOR x = 0 TO NC_CYL_NR - 1 DO
        (5)IF NC_IDX_CYL_HPP_REF[x] = m
        (5)THEN
            PRS_DEC_INJ_1_S[x] = FUP_H_SP_S_INJ[m]
        (5)ENDIF
    (3)ENDFOR
(1) ENDIF
(1)ENDFOR
```

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7.28 Injection pressure correction for multiple injection - S 2. pulse

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_INJ_2_S	V	0... 780H	0... 720	0.375	°CRK
rough value for injection angle (EOI-SOI), stratified mode 1. pulse					
FAC_TI_2_PRS_CYL_S [NC_CYL_NR]	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
factor for correction of fuel injection time due to an influence of cylinder counter pressure, strat. mode 2. pulse					
FAC_TI_2_PRS_CYL_S_TMP	-	0... FFFFH	0... 15.99975	244.1e-6	-
Factor for correction of fuel injection time due to an influence of cylinder counter pressure, strat. mode 2. pulse; temporary value					
IDX_TI_2_PRS_S_SP_TMP	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for pressure correction calculations; second pulse S.					
PRS_DEC_INJ_2_S [NC_CYL_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Pressure decrease at the injector, stratified mode 2. pulse					
PRS_DEC_INJ_2_S_TMP	-	0... FFFFH	0... 347776	5.3067216	hPa
Pressure decrease at the injector, stratified mode 2. pulse; temporary value					
PRS_INJ_MV_2_S	V	0... FFFFH	0... 347776	5.3067216	hPa
mean cylinder pressure during injection, stratified mode 2. pulse					
TI_2_PRS_S_SP_TMP	-	0... FFFFH	0... 65.535	0.001	ms
Injection time setpoint for calculation of injection pressure correction, stratified mode, 2. pulse; temporary value					
TI_2_STND_S [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Mapped Injection time, stratified mode, 2. pulse					

Input data:

EOI_2_S [NC_CYL_NR] {p. 2142}	FAC_MFF_DIF_S [NC_CYL_NR] {p. 2260}	FAC_MFF_TFU {p. 2224}	FAC_N {p. 3327}
FAC_TI_COR_IV_EGY_RNG_L [NC_CBK_HPP_NR] {p. 2260}	FUP_H_SP_S_INJ [NC_CBK_HPP_NR] {p. 3327}	FUP_PRS_COR [NC_CBK_HPP_NR] {p. 2212}	IDX_PRS_COR_CYL_CLC_S [NC_CBK_HPP_NR] {p. 3327}
INJ_MOD_SP_HOMS [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}	IP_FAC_TI_PRS_CYL {p. 2200}	IP_FAC_TI_PRS_CYL_L {p. 2200}
IP_MFF_IDX_TI_EGY_H {p. 2008}	IP_MFF_IDX_TI_EGY_L {p. 2008}	IP_MFF_TI_EGY_H {p. 2009}	IP_MFF_TI_EGY_L {p. 2009}
IP_PRS_INC_CMP_S {p. 2212}	IP_TI_H {p. 2010}	IP_TI_L {p. 2010}	LC_CUR_SHP_INJ_ENA {p. 2010}
LF_PRS_COR_HPP_ENA {p. 3330}	LV_EGY_RNG_IV_PLS_2_S [NC_CYL_NR] {p. 2261}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}
MAP_INJ [NC_CBK_HPP_NR] {p. 3331}	MFF_SP_2_S [NC_CYL_NR] {p. 8242}	NC_CBK_HPP_NR [1] {p. 812}	NC_CYL_NR {p. 1526}
NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}	NC_INJ_MOD_MULTI {p. 2045}		

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FUNCTION DESCRIPTION:

General information:

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The module calculates a correction factor to compensate the influence of the cylinder counter pressure and the influence of the fuel temperature on the injected fuel mass.

Application conditions

Activation: every engine state

Deactivation: –

Initialisation: –

Update rate: LV_ST_END = 0: 10 ms
LV_ST_END = 1: segment synchronous

Formula section:

```
(1)FOR m = 0 TO NC_CBK_HPP_NR - 1 DO
    (1)IF LV_S_CLC = 1 AND
            (INJ_MOD_SP_S[IDX_PRS_COR_CYL_CLC_S[m]] = "MPLS" OR
            INJ_MOD_SP_S[IDX_PRS_COR_CYL_CLC_S[m]] = "MPLS+PLS3" OR
            INJ_MOD_SP_HOMS[IDX_PRS_COR_CYL_CLC_S[m]] = "HOMS" OR
            INJ_MOD_SP_HOMS[IDX_PRS_COR_CYL_CLC_S[m]] = "HOMS+PLS3")
    (1)THEN
     Check, if fuel bank m has to be calculated:
     (2)IF Bit m of LF_PRS_COR_HPP_ENA = 1
  (2)THEN
            The injection time TI_2_PRS_S_SP_TMP is necessary to calculate CRK_INJ_2_S.
            Calculation of TI_2_PRS_S_SP_TMP:
             (2a)IF LC_CUR_SHP_INJ_ENA = 1
            (2a)THEN // current shaping via IDX_TI calculation is active
              (3)IF LV_EGY_RNG_IV_PLS_2_S[IDX_PRS_COR_CYL_CLC_S[m]] = 1
              (3)THEN
                IDX_TI_2_PRS_S_SP_TMP = IP_MFF_IDX_TI_EGY_H(
                    (MFF_SP_2_S[IDX_PRS_COR_CYL_CLC_S[m]]*(1 +
                    FAC_MFF_DIF_S[IDX_PRS_COR_CYL_CLC_S[m]])*FAC_MFF_TFU);
                                PRS_DEC_INJ_2_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1))
                  * FAC_TI_2_PRS_CYL_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1)
               TI_2_PRS_S_SP_TMP = IP_TI_H(IDX_TI_2_PRS_S_SP_TMP)
              (3)ELSE
                IDX_TI_2_PRS_S_SP_TMP = IP_MFF_IDX_TI_EGY_L(
                        (MFF_SP_2_S[IDX_PRS_COR_CYL_CLC_S[m]]*(1 +
                        FAC_MFF_DIF_S[IDX_PRS_COR_CYL_CLC_S[m]])*FAC_MFF_TFU);
                                PRS_DEC_INJ_2_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1))
                 * FAC_TI_COR_IV_EGY_RNG_L[m]
                 * FAC_TI_2_PRS_CYL_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1)
               TI_2_PRS_S_SP_TMP = IP_TI_L(IDX_TI_2_PRS_S_SP_TMP)
              (3)ENDIF
            (2a)ELSE // current shaping is inactive; classic TI calculation applied
              (3a)IF LV_EGY_RNG_IV_PLS_2_S[IDX_PRS_COR_CYL_CLC_S[m]] = 1
              (3a)THEN
                TI_2_PRS_S_SP_TMP = IP_MFF_TI_EGY_H(
                    (MFF_SP_2_S[IDX_PRS_COR_CYL_CLC_S[m]]*(1 +
                    FAC_MFF_DIF_S[IDX_PRS_COR_CYL_CLC_S[m]])*FAC_MFF_TFU);
                                PRS_DEC_INJ_2_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1))
```

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```
    * FAC_TI_2_PRS_CYL_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1)
  (3a)ELSE
    TI_2_PRS_S_SP_TMP = IP_MFF_TI_EGY_L(
            (MFF_SP_2_S[IDX_PRS_COR_CYL_CLC_S[m]]*(1 +
            FAC_MFF_DIF_S[IDX_PRS_COR_CYL_CLC_S[m]])*FAC_MFF_TFU);
                    PRS_DEC_INJ_2_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1))
            * FAC_TI_COR_IV_EGY_RNG_L[m]
            * FAC_TI_2_PRS_CYL_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1)
  (3a)ENDIF
 (2a)ENDIF
```

A rough injection duration angle CRK_INJ_2_S is estimated from TI_2_PRS_S_SP_TMP and engine speed:

From the manifold pressure MAP_INJ[m], the end of injection EOI_2_S[IDX_PRS_COR_CYL_CLC_S[m]] and the rough injection angle a mean counter pressure within the cylinder during the injection is calculated.

The pressure difference at the injector is calculated from fuel rail pressure and the mean counter pressure.

The total correction factor results from the map IP_FAC_TI_PRS_CYL.
For low injector needle lift, a separate map IP_FAC_TI_PRS_CYL_L is used.

CRK_INJ_2_S = TI_2_PRS_S_SP_TMP * FAC_N

PRS_INJ_MV_2_S = MAP_INJ[m] * IP_PRS_INC_CMP_S
(Input data for IP_PRS_INC_CMP_S is EOI_2_S[IDX_PRS_COR_CYL_CLC_S[m]] and CRK_INJ_2_S)

```
PRS_DEC_INJ_2_S_TMP = FUP_PRS_COR[m] - PRS_INJ_MV_2_S
 (3a)IF LV_EGY_RNG_IV_PLS_2_S[IDX_PRS_COR_CYL_CLC_S[m]] = 1
(3a)THEN
   FAC_TI_2_PRS_CYL_S_TMP = IP_FAC_TI_PRS_CYL(PRS_INJ_MV_2_S)
 (3a)ELSE
    FAC_TI_2_PRS_CYL_S_TMP = IP_FAC_TI_PRS_CYL_L(PRS_INJ_MV_2_S)
 (3a)ENDIF

 (2)FOR x = 0 TO NC_CYL_NR - 1 DO
    (4)IF NC_IDX_CYL_HPP_REF[x] = m
    (4)THEN
          PRS_DEC_INJ_2_S[x] = PRS_DEC_INJ_2_S_TMP
          FAC_TI_2_PRS_CYL_S[x] = FAC_TI_2_PRS_CYL_S_TMP
          TI_2_STND_S[x] = TI_2_PRS_S_SP_TMP
    (4)ENDIF
 (2)ENDFOR
(2)ENDIF
   (1)ELSE
  (3)FOR x = 0 TO NC_CYL_NR - 1 DO
     (5)IF NC_IDX_CYL_HPP_REF[x] = m
     (5)THEN
        PRS_DEC_INJ_2_S[x] = FUP_H_SP_S_INJ[m]
    (5)ENDIF
```

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(3)ENDFOR
(1)ENDIF
(1)ENDFOR

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7.29 Injection pressure correction for multiple injection - S 3. pulse

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_INJ_3_S	V	0... 780H	0... 720	0.375	°CRK
Rough value for injection angle (SOI-EOI), stratified mode 3. pulse					
FAC_TI_3_PRS_CYL_S [NC_CYL_NR]	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
factor for correction of fuel injection time due to an influence of cylinder counter pressure, strat. mode 3. pulse					
FAC_TI_3_PRS_CYL_S_TMP	-	0... FFFFH	0... 15.99975	244.1e-6	-
factor for correction of fuel injection time due to an influence of cylinder counter pressure, strat. mode 3. pulse; temporary value					
IDX_TI_3_PRS_S_SP_TMP	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for pressure correction calculations; third pulse S.					
PRS_DEC_INJ_3_S [NC_CYL_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Pressure decrease at the injector, stratified mode 3. pulse					
PRS_DEC_INJ_3_S_TMP	-	0... FFFFH	0... 347776	5.3067216	hPa
Pressure decrease at the injector, stratified mode 3. pulse; temporary value					
PRS_INJ_MV_3_S	V	0... FFFFH	0... 347776	5.3067216	hPa
Cylinder pressure (mean value) during injection, stratified mode 3. pulse					
TI_3_PRS_S_SP_TMP	-	0... FFFFH	0... 65.535	0.001	ms
Injection time setpoint for calculation of injection pressure correction, stratified mode, 3. pulse; temporary value					
TI_3_STND_S [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Mapped Injection time, stratified mode, 3. pulse					

Input data:

EOI_3_S [NC_CYL_NR] {p. 2144}	FAC_MFF_DIF_S [NC_CYL_NR] {p. 2260}	FAC_MFF_TFU {p. 2224}	FAC_N {p. 3327}
FAC_TI_COR_IV_EGY_RNG_L [NC_CBK_HPP_NR] {p. 2260}	FUP_H_SP_S_INJ [NC_CBK_HPP_NR] {p. 3327}	FUP_PRS_COR [NC_CBK_HPP_NR] {p. 2212}	IDX_PRS_COR_CYL_CLC_S [NC_CBK_HPP_NR] {p. 3327}
INJ_MOD_SP_HOMS [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}	IP_FAC_TI_PRS_CYL {p. 2200}	IP_FAC_TI_PRS_CYL_L {p. 2200}
IP_MFF_IDX_TI_EGY_H {p. 2008}	IP_MFF_IDX_TI_EGY_L {p. 2008}	IP_MFF_TI_EGY_H {p. 2009}	IP_MFF_TI_EGY_L {p. 2009}
IP_PRS_INC_CMP_S {p. 2212}	IP_TI_H {p. 2010}	IP_TI_L {p. 2010}	LC_CUR_SHP_INJ_ENA {p. 2010}
LF_PRS_COR_HPP_ENA {p. 3330}	LV_EGY_RNG_IV_PLS_3_S [NC_CYL_NR] {p. 2261}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}
MAP_INJ [NC_CBK_HPP_NR] {p. 3331}	MFF_SP_3_S [NC_CYL_NR] {p. 8243}	NC_CBK_HPP_NR [1] {p. 812}	NC_CYL_NR {p. 1526}
NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}			

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FUNCTION DESCRIPTION:

General information:

The module calculates a correction factor to compensate the influence of the cylinder counter pressure and the influence of the fuel temperature on the injected fuel mass.

Application conditions

Activation: every engine state

Deactivation: –

Initialisation: –

Update rate: LV_ST_END = 0: 10 ms
LV_ST_END = 1: segment synchronous

Formula section:

(1)FOR m = 0 **TO** NC_CBK_HPP_NR - 1 **DO**
(1)IF (LV_S_CLC = 1) **AND**
(INJ_MOD_SP_S[IDX_PRS_COR_CYL_CLC_S[m]] = "MPLS+PLS3" **OR**
INJ_MOD_SP_HOMS[IDX_PRS_COR_CYL_CLC_S[m]] = "HOMS+PLS3")
(1)THEN
Check, if fuel bank m has to be calculated:
(2)IF Bit m of LF_PRS_COR_HPP_ENA = 1
(2)THEN
The injection time TI_3_PRS_S_SP_TMP is necessary to calculate CRK_INJ_3_S.
Calculation of TI_3_PRS_S_SP_TMP:
(2a)IF LC_CUR_SHP_INJ_ENA = 1
(2a)THEN // current shaping via IDX_TI calculation is active
(3)IF LV_EGY_RNG_IV_PLS_3_S[IDX_PRS_COR_CYL_CLC_S[m]] = 1
(3)THEN
IDX_TI_3_PRS_S_SP_TMP = IP_MFF_IDX_TI_EGY_H(
(MFF_SP_3_S[IDX_PRS_COR_CYL_CLC_S[m]]*(1 +
FAC_MFF_DIF_S[IDX_PRS_COR_CYL_CLC_S[m]])*FAC_MFF_TFU);
PRS_DEC_INJ_3_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1))
* FAC_TI_3_PRS_CYL_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1)
TI_3_PRS_S_SP_TMP = IP_TI_H(IDX_TI_3_PRS_S_SP_TMP)
(3)ELSE
IDX_TI_3_PRS_S_SP_TMP = IP_MFF_IDX_TI_EGY_L(
(MFF_SP_3_S[IDX_PRS_COR_CYL_CLC_S[m]]*(1 +
FAC_MFF_DIF_S[IDX_PRS_COR_CYL_CLC_S[m]])*FAC_MFF_TFU);
PRS_DEC_INJ_3_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1))
* FAC_TI_COR_IV_EGY_RNG_L[m]
* FAC_TI_3_PRS_CYL_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1)
TI_3_PRS_S_SP_TMP = IP_TI_L(IDX_TI_3_PRS_S_SP_TMP)
(3)ENDIF
(2a)ELSE // current shaping is inactive; classic TI calculation applied
(3a)IF LV_EGY_RNG_IV_PLS_3_S[IDX_PRS_COR_CYL_CLC_S[m]] = 1
(3a)THEN
TI_3_PRS_S_SP_TMP = IP_MFF_TI_EGY_H(
(MFF_SP_3_S[IDX_PRS_COR_CYL_CLC_S[m]]*(1 +
FAC_MFF_DIF_S[IDX_PRS_COR_CYL_CLC_S[m]])*FAC_MFF_TFU);
PRS_DEC_INJ_3_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1))
* FAC_TI_3_PRS_CYL_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1)
(3a)ELSE

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```
TI_3_PRS_S_SP_TMP = IP_MFF_TI_EGY_L(
        (MFF_SP_3_S[IDX_PRS_COR_CYL_CLC_S[m]]*(1 +
        FAC_MFF_DIF_S[IDX_PRS_COR_CYL_CLC_S[m]])*FAC_MFF_TFU);
                PRS_DEC_INJ_3_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1))
        * FAC_TI_COR_IV_EGY_RNG_L[m]
        * FAC_TI_3_PRS_CYL_S[IDX_PRS_COR_CYL_CLC_S[m]](n-1)
(3a)ENDIF
(2a)ENDIF
```

A rough injection duration angle CRK_INJ_3_S is estimated from TI_3_PRS_S_SP_TMP and engine speed:
Note: TI_3_PRS_S_SP_TMP is calculated with the pressure correction information of the previous calculated injector pressure difference PRS_DEC_INJ_3_S[IDX_PRS_COR_CYL_CLC_S[m]].

From the manifold pressure MAP_INJ[m], the end of injection EOI_3_S[IDX_PRS_COR_CYL_CLC_S[m]] and the rough injection angle a mean counter pressure within the cylinder during the injection is calculated.

The pressure difference at the injector is calculated from fuel rail pressure and the mean counter pressure.

The total correction factor results from the map IP_FAC_TI_PRS_CYL.
For low injector needle lift, a separate map IP_FAC_TI_PRS_CYL_L is used.

CRK_INJ_3_S = TI_3_PRS_S_SP_TMP * FAC_N

PRS_INJ_MV_3_S = MAP_INJ[m] * IP_PRS_INC_CMP_S
(Input data for IP_PRS_INC_CMP_S is EOI_3_S[IDX_PRS_COR_CYL_CLC_S[m]] and CRK_INJ_3_S)

```
PRS_DEC_INJ_3_S_TMP = FUP_PRS_COR[m] - PRS_INJ_MV_3_S
(3a)IF LV_EGY_RNG_IV_PLS_3_S[IDX_PRS_COR_CYL_CLC_S[m]] = 1
(3a)THEN
    FAC_TI_3_PRS_CYL_S_TMP = IP_FAC_TI_PRS_CYL (PRS_INJ_MV_3_S)
(3a)ELSE
    FAC_TI_3_PRS_CYL_S_TMP = IP_FAC_TI_PRS_CYL_L(PRS_INJ_MV_3_S)
(3a)ENDIF

(2)FOR x = 0 TO NC_CYL_NR - 1 DO
    (4)IF NC_IDX_CYL_HPP_REF[x] = m
    (4)THEN
            PRS_DEC_INJ_3_S[x] = PRS_DEC_INJ_3_S_TMP
            FAC_TI_3_PRS_CYL_S[x] = FAC_TI_3_PRS_CYL_S_TMP
            TI_3_STND_S[x] = TI_3_PRS_S_SP_TMP
    (4)ENDIF
(2)ENDFOR
(2)ENDIF

(1)ELSE
(3)FOR x = 0 TO NC_CYL_NR - 1 DO
    (5)IF NC_IDX_CYL_HPP_REF[x] = m
    (5)THEN
```

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PRS_DEC_INJ_3_S[x] = FUP_H_SP_S_INJ[m]
(5)ENDIF
(3)ENDFOR
(1)ENDIF
(1)ENDFOR

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7.30 Fuel temperature correction

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_MFF_TFU	O/V	0... 1FFFH	0... 1.999755859375	244.14e-6	-
Factor to correct fuel mass due to the fuel temperature in rail.					

Input data:

TFU_INJ {p. 3332}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_MFF_TEMP_COR	V	0... 1FFFH	0... 1.999755859375	244.14e-6	-
LDP_TFU_IP_FAC_MFF_TEMP_COR	12	0... FEH	-48... 142.5	0.75	°C
factor for correction of fuel injection due to the fuel temperature					

General information

Density fluctuations of fuel due to temperature variation can be compensated with a correction factor on the fuel mass setpoint.

Application conditions:

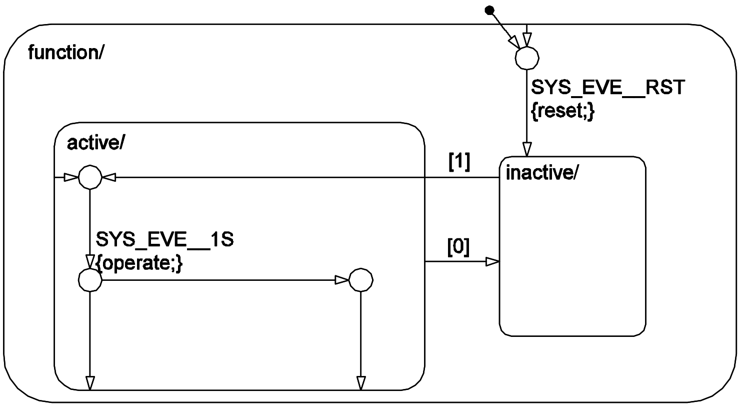

Figure 7.30.1: INJR_ISPCLTFU0/APP_CDN/Chart

Function description:

Signal flow diagram:

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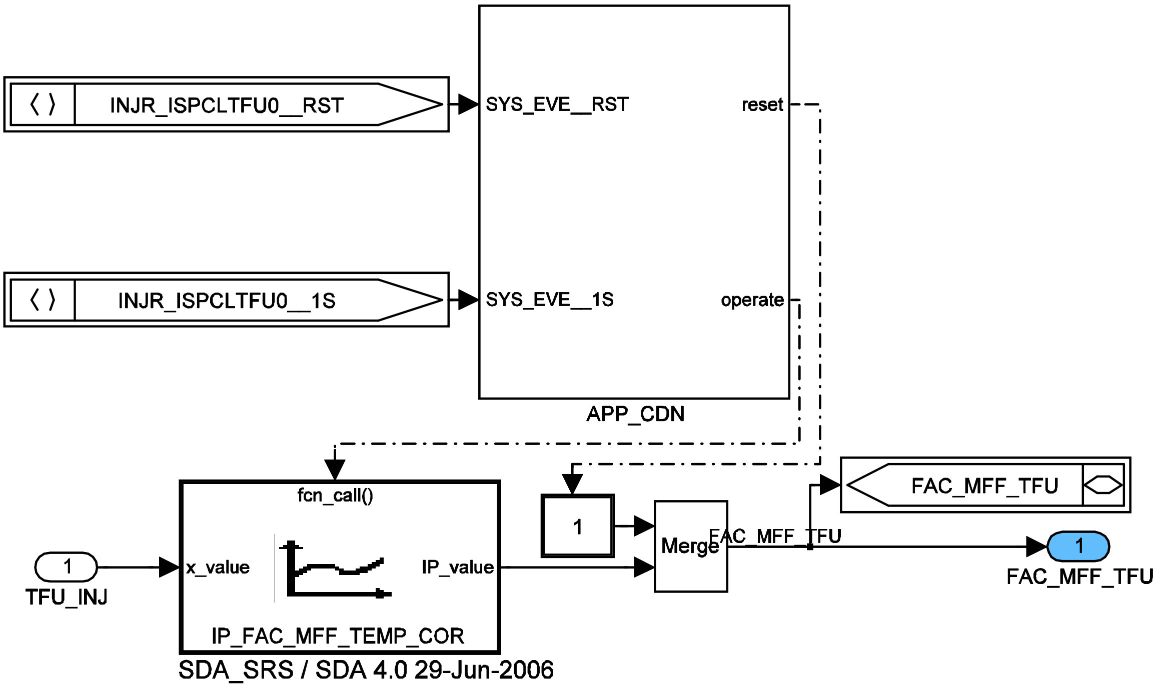

Figure 7.30.2: INJR_ISPCLTFU0

Formula section:

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7.31 Compensation of temperature influence on the injector needle lift

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EGY_ADD_TEMP	O/V	8000... 7FFFH	-127.50194 ...127.49805	3.8911e-3	mJ
Additive piezo energy correction depending on the injector temperature					
LV_EGY_ADD_ST_TMP	-	0... 1H	0 ...1	1	-
Ramping from Start Energy correction to Correction Value from Map is active					

Input data:

NC_CYL_NR {p. 1526}	TCO_ST {p. 1100}	TEMP_CAPA_IV_MV {p. 2241}	TFU_INJ {p. 3332}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EGY_ADD_TEMP_GRAD	-	0... 7FFFH	0... 127.99609	3.9062e-3	mJ/s
Gradient to ramp from Energy Temperature Offset during Start to normal Energy Temperature Offset					
C_EGY_ADD_TEMP_ST	-	8000... 7FFFH	-127.50194 ...127.49805	3.8911e-3	mJ
Energy Temperature Offset during Start					
IP_EGY_ADD_TEMP	V	0... FFFFH	-127.50194 ...127.49805	3.8911e-3	mJ
LDP_TFU_INJ_IP_EGY_ADD_TEMP	6	0... FEH	-48... 142.5	0.75	°C
LDP_TCO_ST_IP_EGY_ADD_TEMP	6	0... FEH	-48... 142.5	0.75	°C
Additive piezo energy correction depending on the injector temperature					
LC_EGY_ADD_TEMP_ST_ENA	-	0... 1H	0 ...1	1	-
Switch to enable new Engery Temperature correction					
LC_TEMP_CAPA_IV_ENA	-	0... 1H	0 ...1	1	-
Switch to enable useage of piezo stack temperature					

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Overview:

The needle lift of piezo actuators depends on the injector temperature. In order to compensate this effect and to keep the needle lift constant an additive correction of the piezo stack energy has to be applied.,

FUNCTION DESCRIPTION:

Application conditions

Activation: `every engine state`

Deactivation: -

Initialisation: `at reset:`
`EGY_ADD_TEMP=0`

EGY_ADD_TEMP_IP=0 // only local variable
LV_EGY_ADD_ST_TMP =0

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Recurrence: 1 s

Formula section:

When LC_EGY_ADD_TEMP_ST_ENA ist enabled during Start the Energy correction is made by a clibrateable constant C_EGY_ADD_TEMP_ST. When LV_ST_END is reached the correction Value is ramped withe the Gradient C_EGY_ADD_TEMP_GRAD to the resective Map Value depending on TCO_ST and TEMP_CAPA_IV or TFU_INJ.

(1)IF LV_ST_END=0 **AND** LC_EGY_ADD_TEMP_ST_ENA =1
(1)THEN
EGY_ADD_TEMP = C_EGY_ADD_TEMP_ST
LV_EGY_ADD_ST_TMP = 1
(1)ELSE
(2)IF LC_TEMP_CAPA_IV_ENA =1
(2)THEN
EGY_ADD_TEMP_IP = IP_ EGY_ADD_TEMP (TEMP_CAPA_IV_MV; TCO_ST)
(2) ELSE
EGY_ADD_TEMP_IP = IP_ EGY_ADD_TEMP (TFU_INJ;TCO_ST)
(2) ENDIF

//ramp up or down with calibrateable Gradient
(3) IF abs(EGY_ADD_TEMP_IP - EGY_ADD_TEMP**)** > C_EGY_ADD_TEMP_GRAD
AND LV_EGY_ADD_ST_TMP = 1
(3) THEN
(4) IF EGY_ADD_TEMP_IP - EGY_ADD_TEMP > 0
(4) THEN
increment EGY_ADD_TEMP **by** C_EGY_ADD_TEMP_GRAD
(4) ELSE
decrement EGY_ADD_TEMP **by** C_EGY_ADD_TEMP_GRAD
(4)ENDIF
(3) ELSE
EGY_ADD_TEMP = EGY_ADD_TEMP_IP
LV_EGY_ADD_ST_TMP=0 // Ramping only once at Start end
(3) ENDIF
(1)ENDIF

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7.32 Compensation of fuel pressure influence on the injector needle lift

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EGY_ADD_FUP [NC_CBK_HPP_NR]	O/V	8000... 7FFFH	0... 127.498054	0.00389105	mJ
Additive piezo energy correction depending on the fuel pressure					

Input data:

FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	LV_ST_END {p. 1720}	NC_CBK_HPP_NR [1] {p. 812}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_EGY_ADD_FUP	-	0... FFFFH	0... 127.498054	0.00389105	mJ
LDP_FUP_IP_EGY_ADD_FUP	12	0... FFFFH	0... 347776	5.3067216	hPa
Additive piezo energy correction depending on the fuel pressure					

General information

The needle lift of injection valves with piezo actuators depends on the fuel pressure. In order to compensate this effect and to keep the needle lift constant an additive correction of the piezo stack energy has to be applied.

Application Condition

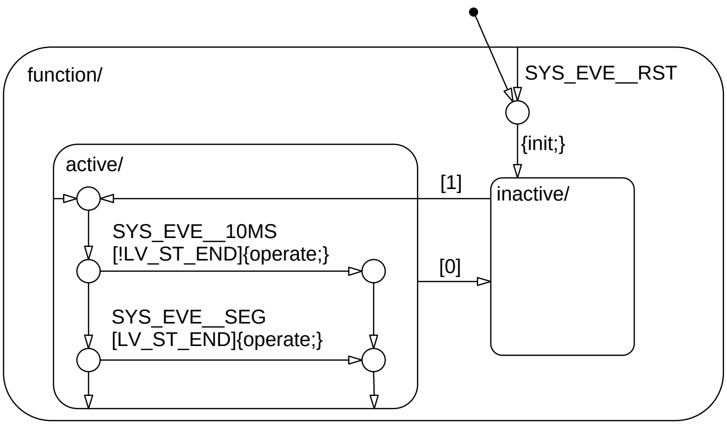

Figure 7.32.1: INJR_ISPCLFUCOR0/APP_CDN/Chart

Function Description

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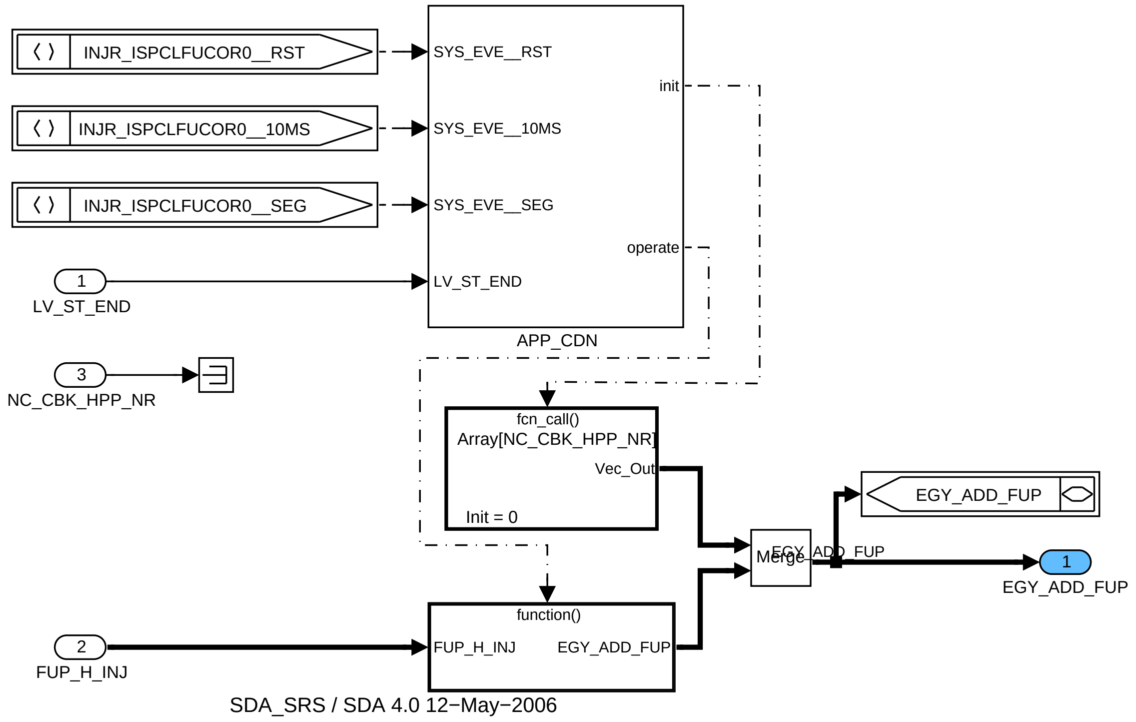

Figure 7.32.2: INJR_ISPCLFUCOR0

7.32.1 SUBFUNCTION: Subsystem

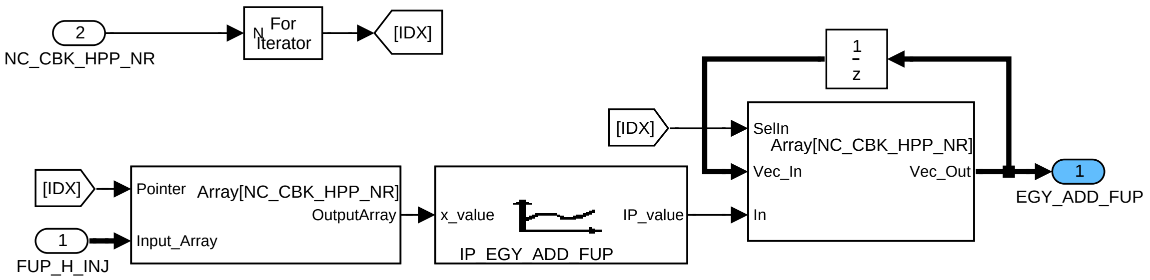

Figure 7.32.3: INJR_ISPCLFUCOR0/Subsystem/For_Iterator

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7.33 Compensation of the injection duty cycle on the injector needle lift

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DUCY_TI_N	V	0... 4000H	0... 100	0.00610352	%
Injection duty cycle					
EGY_ADD_DUCY	O/V	8000... 7FFFH	0... 127.498054	0.00389105	mJ
Additive piezo energy correction depending on the injection duty cycle					

Input data:

FAC_N {p. 3327}	LV_ST_END {p. 1720}	N_32 {p. 1525}	TI_1_MES [NC_CYL_NR] {p. 2040}
TI_2_MES [NC_CYL_NR] {p. 2040}	TI_POST_MES [NC_CYL_NR] {p. 2041}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_EGY_ADD_DUCY	-	0... FFFFH	0... 127.498054	0.00389105	mJ
LDP_DUCY_IP_EGY_ADD_DUCY	7	0... 4000H	0... 100	0.00610352	%
LDP_N_IP_EGY_ADD_DUCY	7	0... FFH	0... 8160	32	rpm
Additive piezo energy correction depending on the injection duty cycle					
LC_EGY_ADD_DUCY_ENA	-	0... 1H	0 ...1	1	-
Flag to activate energy correction accounting for injection duty cycle					

General information

The needle lift of injection valves with piezo actuators depends on the injection duty cycle. In order to compensate this effect and to keep the needle lift constant an additive correction of the piezo stack energy has to be applied.

Application Condition

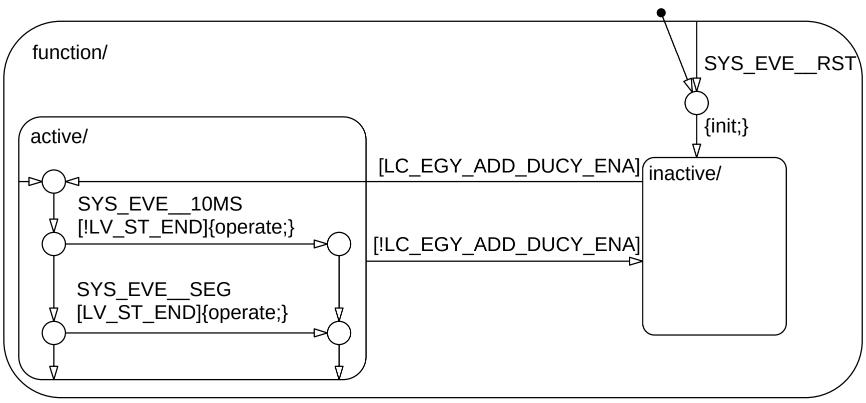

Figure 7.33.1: INJR_ISPCLDUCY0/APP_CDN/Chart

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Function Description

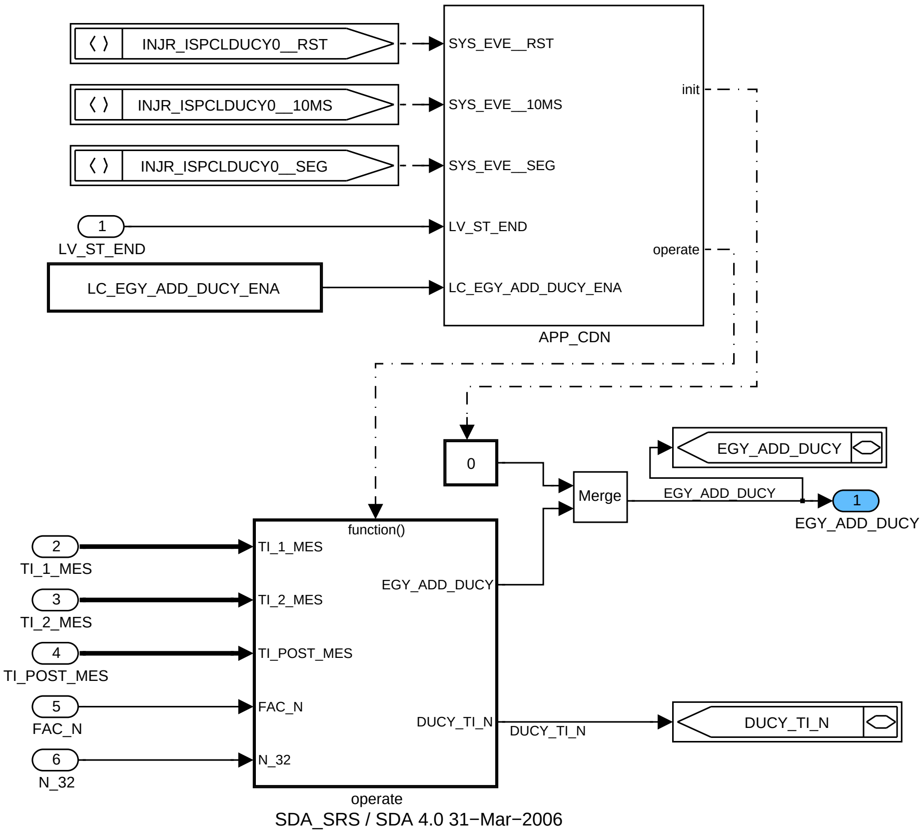

Figure 7.33.2: INJR_ISPCLDUCY0

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7.33.1 SUBFUNCTION: operate

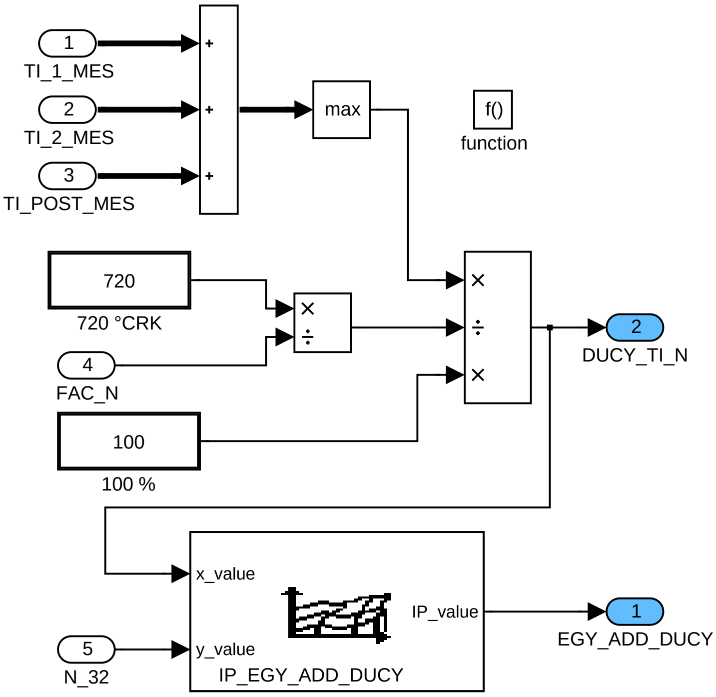

Figure 7.33.3: INJR_ISPCLDUCY0/operate

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7.34 Correction of injection via application system

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TI_ADD_AS_CBK_EX [NC_CBK_EX_NR]	V	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Exhaust bank selective injection time correction caused by service tool intervention - additive value					
TI_AS	O/V	0... FFFFH	0... 15.99975	244e-6	-
Global Injection Time Correction by the Application System - multiplicative					
TI_AS_CBK_EX [NC_CBK_EX_NR]	V	0... FFFFH	0... 15.99975	244e-6	-
Exhaust bank selective injection time correction caused by service tool intervention - multiplicative value					
TI_TUN_ADD_IV [NC_CYL_NR]	O/V	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Cylinder selective Injection Time Correction by the Application System - additive value					
TI_TUN_IV [NC_CYL_NR]	O/V	0... FFFFH	0... 15.99975	244e-6	-
Cylinder selective Injection Time Correction by the Application System - multiplicative value					

Input data:

FAC_TI_EXT_ADJ {p. 3327}	LV_FAC_TI_EXT_ADJ {p. 3330}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
NC_USE_TI_AS_CBK {p. 629}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TI_ADD_AS [NC_CYL_NR]	-	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Cylinder selective Injection Time Correction - additive value					
C_TI_ADD_AS_CBK_EX [NC_CBK_EX_NR]	-	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Exhaust bank selective Injection Time Correction - additive value					
C_TI_ADD_AS_GLOBAL	-	8000... 7FFFH	-131.072 ...131.068	0.004	ms
Global Injection Time Correction - additive value					
C_TI_AS [NC_CYL_NR]	-	0... FFFFH	0... 15.99975	244e-6	-
Injection time factor (cylinder selective) to correct cylinder injection value					
C_TI_AS_CBK_EX [NC_CBK_EX_NR]	-	0... FFFFH	0... 15.99975	244e-6	-
Injection time factor (exhaust bank selective) to correct cylinder injection value					
C_TI_AS_GLOBAL	-	0... FFFFH	0... 15.99975	244e-6	-
Global injection time correction					
LC_TI_AS_CBK_UPD_DIS	-	0... 1H	0 ...1	1	-
Switch to disable TI_AS_CBK_EX and TI_ADD_AS_CBK_EX data update, for customer delivery it has to be 0					

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Overview

For development, the application tool can perform a cylinder specific injection time correction. Additionally - for service tool tests - an exhaust bank dependent TI correction can be applied also.

FUNCTION DESCRIPTION:

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Application conditions

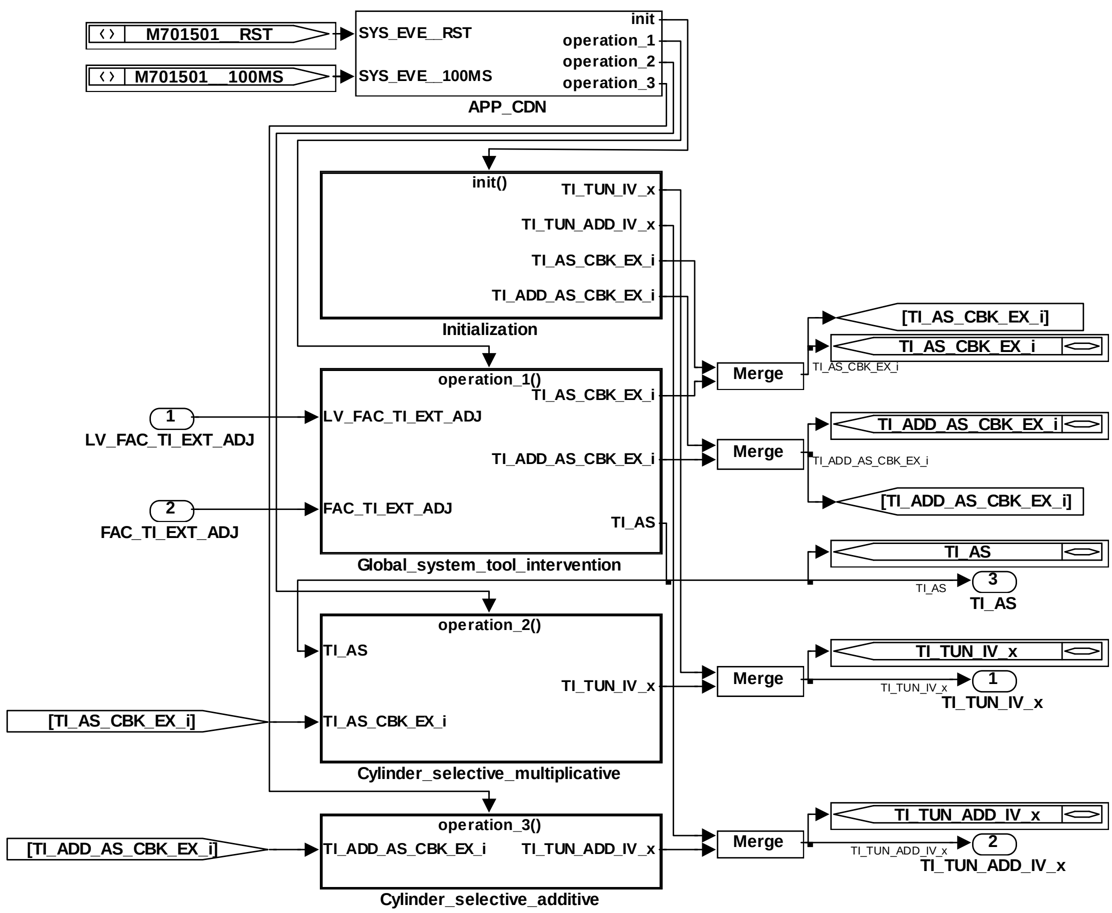
Activation: every engine state

Deactivation: –

Initialization:

```
at reset:
 (1) FOR  x =  0 TO  (NC_CYL_NR -1 ) DO:
     TI_TUN_IV[x] = 1
     TI_TUN_ADD_IV[x] = 0
 (1) ENDFOR
 #if (NC_USE_TI_EXT_ADJ = 1)
 (2) FOR  i =  1 TO  NC_CBK_EX_NR DO:
     TI_AS_CBK_EX[i] = C_TI_AS_CBK_EX[i]
     TI_ADD_AS_CBK_EX[i] = C_TI_ADD_AS_CBK_EX[i]
 (2) ENDFOR
 #endif
Recurrence:  100ms
```

Main System:



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Initialization:

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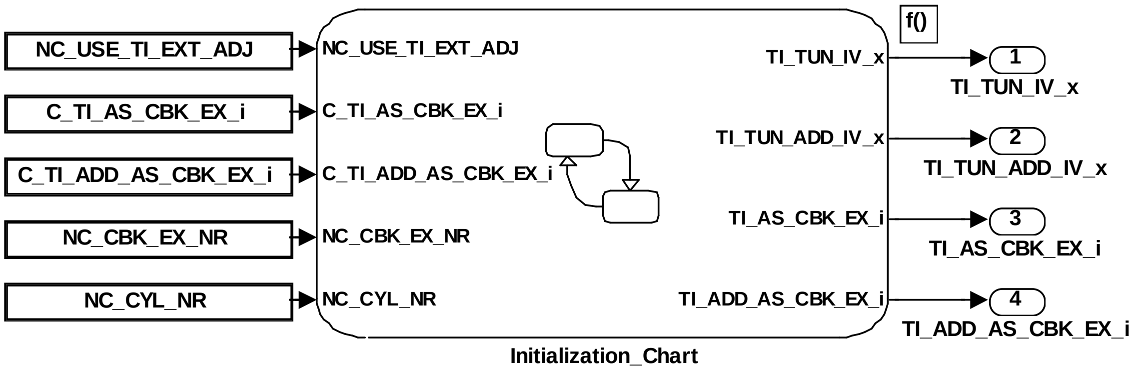
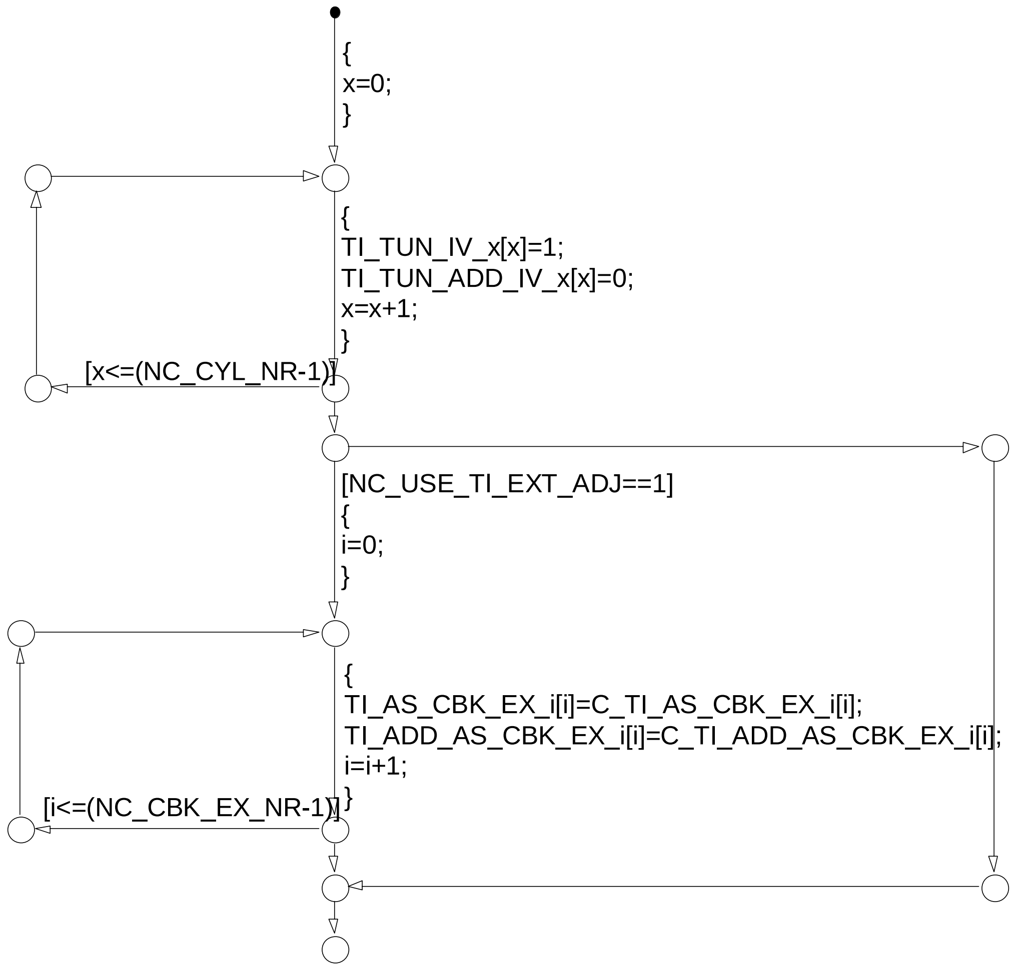


Initialization_Chart:



Global_system_tool_intervention:

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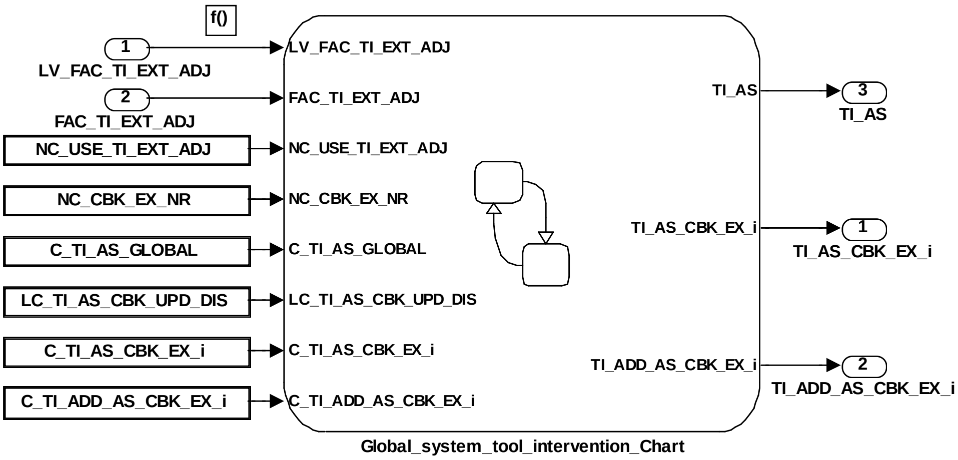
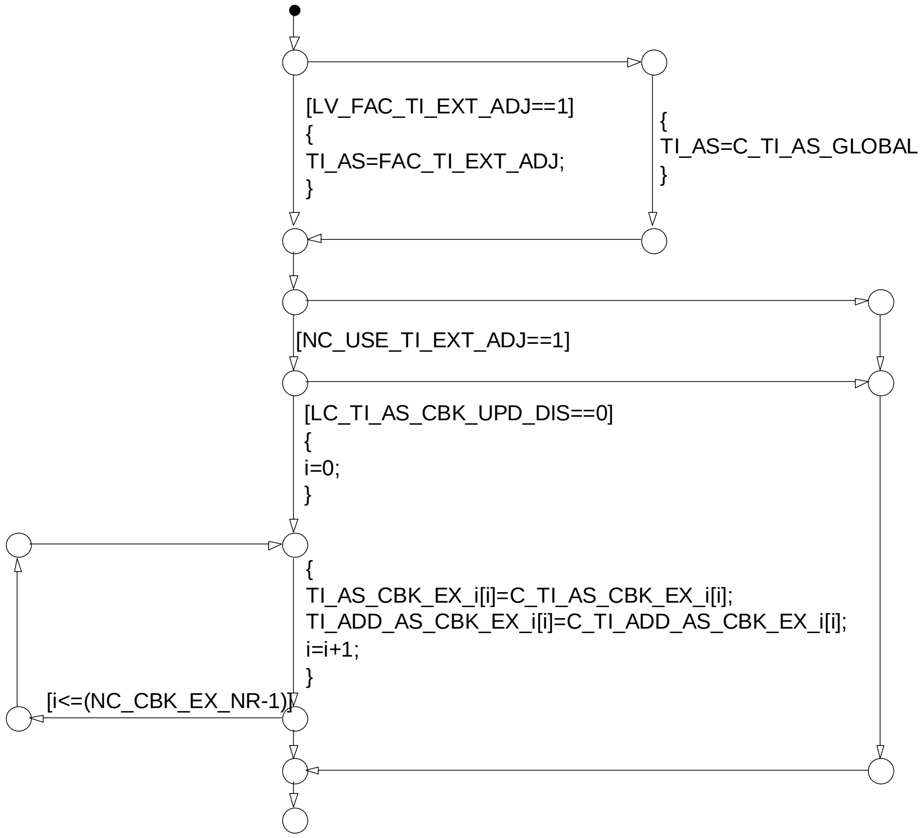


Global_system_tool_intervention_Chart:



Cylinder_selective_multiplative:

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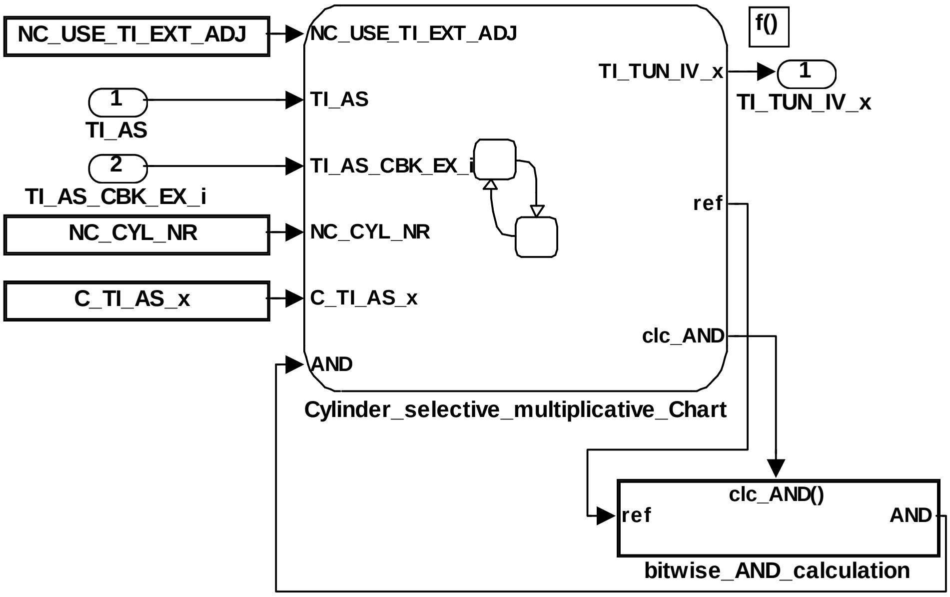
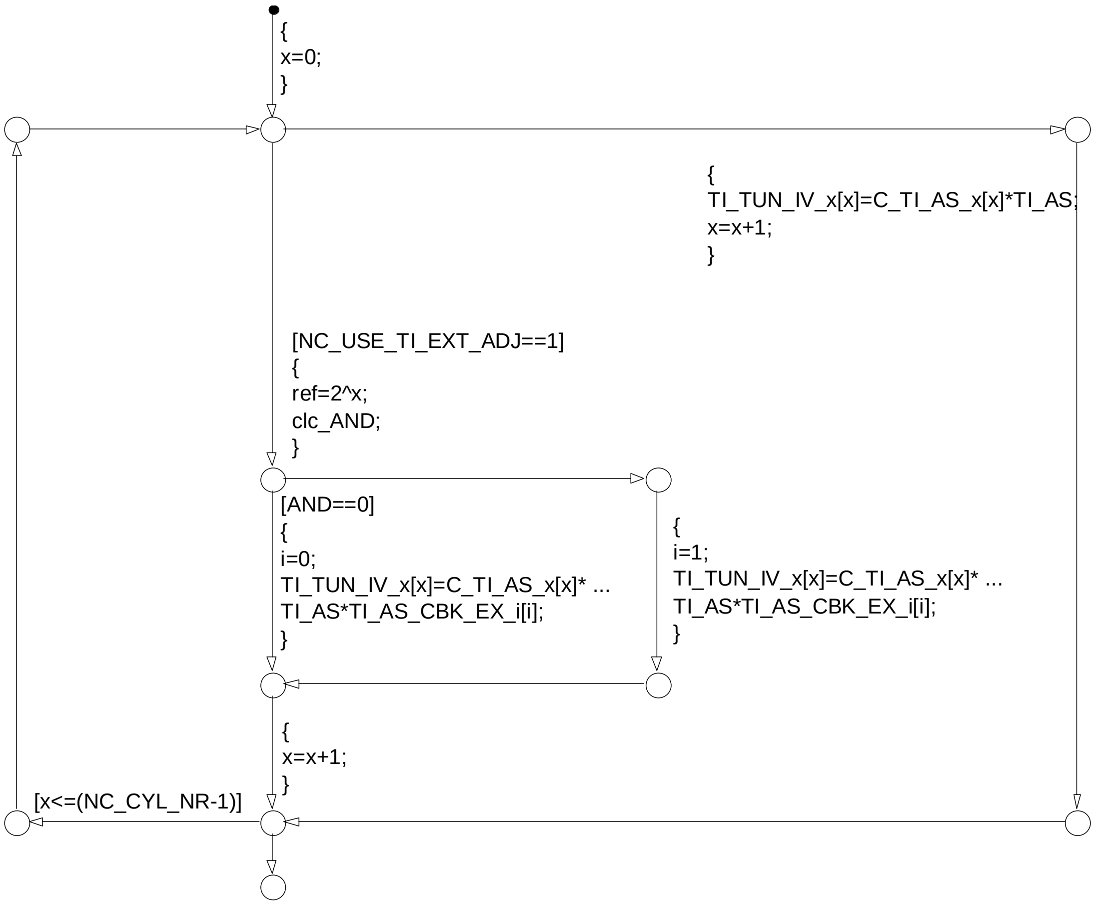


Cylinder_selective_multiplative_Chart:



bitwise_AND_calculation:

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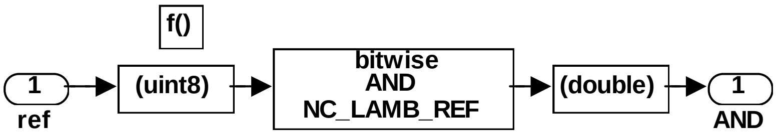
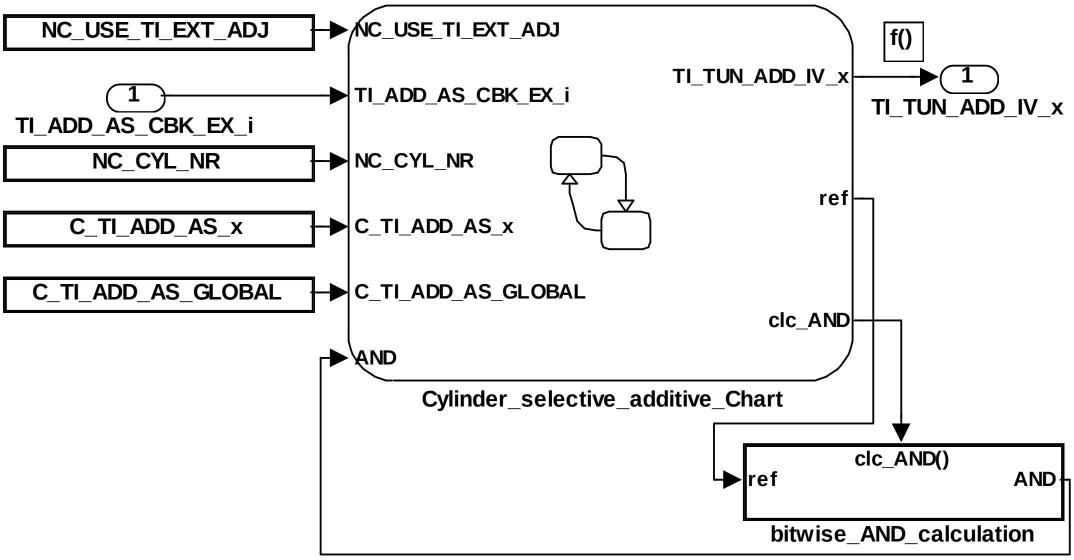
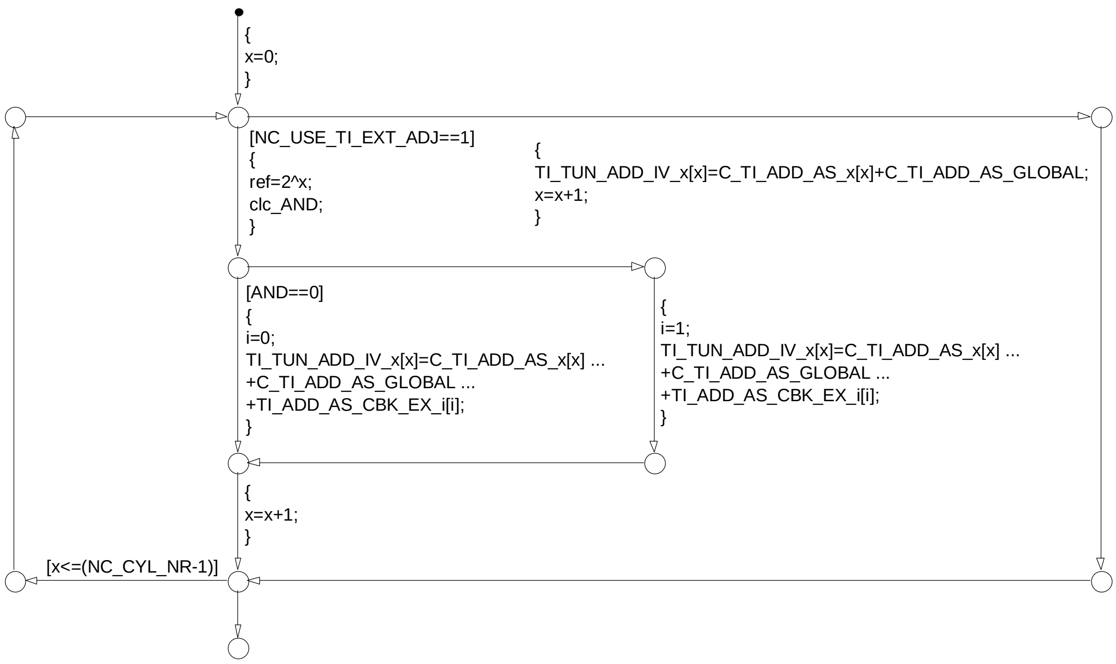


Cylinder_selective_additive:



Cylinder_selective_additive_Chart:



bitwise_AND_calculation:

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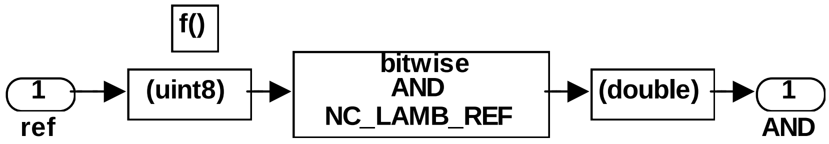

Formula section:

7.34.1 Global application system/service tool intervention

(1) IF LV_FAC_TI_EXT_ADJ = 1 ... Service tool intervention active
(1) THEN TI_AS = FAC_TI_EXT_ADJ
(1) ELSE TI_AS = C_TI_AS_GLOBAL ... Application system intervention active
(1) ENDIF
#if (NC_USE_TI_AS_CBK = 1)
(2) IF LC_TI_AS_CBK_UPD_DIS = 0 ... If switch is not set, update adaptation factors. If not, a data update from service tool is necessary
(2) THEN
(3) FOR i **=** 1 **TO** NC_CBK_EX_NR **DO:**
TI_AS_CBK_EX[i] = C_TI_AS_CBK_EX[i]
TI_ADD_AS_CBK_EX[i] = C_TI_ADD_AS_CBK_EX[i]
(3) ENDFOR
(2) ENDIF
#endif

7.34.2 Cylinder selective injection time correction - multiplicative

(4) FOR x **=** 0 **TO** (NC_CYL_NR-1) **DO:**
#if (NC_USE_TI_AS_CBK = 1)
i = {exhaust bank number which corresponds to cylinder x }
TI_TUN_IV[x] = C_TI_AS[x] ... Cylinder specific application system intervention
* TI_AS ... Global application system/service tool
* TI_AS_CBK_EX[i] ... Used and updated by service tool
#else
TI_TUN_IV[x] = C_TI_AS[x] ... Cylinder specific application system intervention
* TI_AS ... Global application system/service tool
#endif
(4) ENDFOR

7.34.3 Cylinder selective injection time correction - additive

(5) FOR x **=** 0 **TO** (NC_CYL_NR-1) **DO:**
#if (NC_USE_TI_AS_CBK = 1)
i = {exhaust bank number which corresponds to cylinder x }
TI_TUN_ADD_IV[x] = C_TI_ADD_AS[x] ... Cylinder specific application system intervention
+ C_TI_ADD_AS_GLOBAL ... Global application system
+ TI_ADD_AS_CBK_EX[i] ... Used and updated by service tool
#else

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TI_TUN_ADD_IV[x] = C_TI_ADD_AS[x] ... Cylinder specific application system intervention
+ C_TI_ADD_AS_GLOBAL ... Global application system

#endif

(5) ENDFOR

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7.35 Piezo capacity temperature determination

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAPA_IV_1_FIL [NC_CYL_NR]	O/V	0... FFFFH	0... 27.96	42.6642e3	µF
Capacity of the piezo injector for the first pulse, filtered value					
CAPA_IV_DIF_NOM [NC_CYL_NR]	O/V/S	8000... 7FFFH	0... 13.9797867	42.6642e3	µF
Capacity offset of the piezo injector to the nominal value					
LV_T_ES_CAPA_TEMP_VLD	O/V	0... 1H	0 ...1	1	-
Engine stop time is valid for calculation of capacity offset					
LV_TEMP_CAPA_IV_CLC_ENA [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Cylinder individual flag to enable calculation of piezo temperature out of its capacity value					
LV_TEMP_CAPA_IV_EOL	O/V/S	0... 1H	0 ...1	1	-
Flag indicating valid capacatiy temperature adaptation at end of line					
TEMP_CAPA_IV [NC_CYL_NR]	O/V	0... FEH	0... 142.5	0.75	°C
Temperature of the piezo stack derived from its capacity					
TEMP_CAPA_IV_MV	O/V/S	0... FEH	0... 142.5	0.75	°C
Temperature of the piezo stacks derived from their capacities, mean value					
TEMP_CAPA_IV_SUB	V	0... FEH	0... 142.5	0.75	°C
Temperature of the piezo stacks, substitutional value					

Input data:

CAPA_IV_1_CLC [NC_CYL_NR] {p. 2035}	EGY_IV_1_CLC [NC_CYL_NR] {p. 2036}	FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	LV_CH {p. 8232}
LV_EGY_RNG_IV_PLS_1_ACK [NC_CYL_NR] {p. 2038}	LV_IV_MES_VLD {p. 2038}	LV_ST_END {p. 1720}	LV_SYN_ENG {p. 1506}
LV_T_ES_NOT_PLAUS {p. 4467}	NC_CBK_HPP_NR [1] {p. 812}	NC_CYL_NR {p. 1526}	NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}
NR_CYL_INJ_BAS {p. 2039}	SEG_CTR {p. 1525}	T_ES {p. 1444}	TCO {p. 1100}
TI_1_MES [NC_CYL_NR] {p. 2040}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CAPA_IV_DIF_NOM_LIM	-	0... FFFFH	0... 27.96	42.6642e3	µF
Limit of the capacity offset of the piezo injector to the nominal value					
C_CRLC_TEMP_CAPA_IV	-	0... FFH	0... 0.99609375	0.00390625	-
constant for LowPass filtering for TEMP_CAPA_IV					
C_FAC_FIL_CAPA_IV	-	0... FFH	0... 0.99609375	0.00390625	-
PT1 Filter constant for piezo capacity					
C_SEG_CTR_CAPA_TEMP	-	0... FFFFH	0... 65535	1	-
Number of segments for capacity offset calculation					
C_T_ES_CAPA_TEMP	-	0... FFFFH	0... 65535	1	min
Minimum engine of duration for capacity offset calculation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TEMP_CAPA_INC	-	0... 2000H	0... 1.5	18.3105e3	°C
Temperature increment					
C_TEMP_CAPA_IV_EOL	-	0... 1H	0 ...1	1	-
Flag for capacatiy temperature adaptation at end of line, manual setting					
C_TI_MIN_CAPA_FIL	-	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time limit for calculation of filtered capacity					
IP_CAPA_COR_EGY_IV	-	0... FFFFH	0... 13.9797867	42.6642e3	µF
LDP_EGY_IP_CAPA_COR_EGY_IV	6	0... FFFFH	0... 255	0.00389105	mJ
Capacity correction depending on the piezo injector s energy					
IP_CAPA_IV_NOM	-	0... FFFFH	0... 27.96	42.6642e3	µF
LDP_TCO_IP_CAPA_IV_NOM	8	0... FEH	0... 142.5	0.75	°C
LDPM_FUP_2_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Nominal capacity of the piezo injector depending on temperature and fuel pressure					
IP_FAC_T_ES_TEMP_CAPA_IV_2	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_T_ES_1_INJR	8	0... FFFFH	0... 65535	1	min
2. factor for piezo stack temperature substitution accounting for engine off time					
IP_TEMP_CAPA_IV_NOM	-	0... FEH	0... 142.5	0.75	°C
LDP_CAPA_IP_TEMP_CAPA_IV_NOM	8	0... FFFFH	0... 27.96	42.6642e3	µF
LDPM_FUP_2_INJR	6	0... FFFFH	0... 347776	5.3067216	hPa
Nominal temperature capacity relationship of the piezo injector depending on fuel pressure					
LC_CAPA_IV_DIF_NOM_INH_CH_ENA	-	0... 1H	0 ...1	1	-
Logical constant to enable inhibition of capacatiy offset determination for catalyst heating					
LC_TEMP_CAPA_IV_CLC_ENA	-	0... 1H	0 ...1	1	-
Flag to enable calculation of piezo temperature					
LC_TEMP_CAPA_IV_EOL_MAN	-	0... 1H	0 ...1	1	-
Logical constant to enable manual setting of end of line bit for capacity temperature adaptation					

General information

The large signal capacity of the piezo stack rises with temperature. This dependency can be used to determine the piezo temperature out of its capacity. Since the capacity is also influenced by forces acting on the piezo stack the fuel pressure has to be taken into account. This dependency is described by the map IP_TEMP_CAPA_IV_NOM supplying a temperature for a certain nominal (mean) capacity and fuel pressure level. The map IP_CAPA_IV_NOM describes the inverse relationship supplying a capacity for a given temperature and fuel pressure. The lookup curve IP_CAPA_COR_EGY_IV accounts for the dependency of the capacity on the energy stored in the piezo stack and provides an additive correction for the capacity value.
The capacity value deviates from one stack to another due to manufacturing variations, aging effects etc.. Therefore the offset of each injector to the nominal capacity has to be determined at a reference temperature.(Fig. 1)

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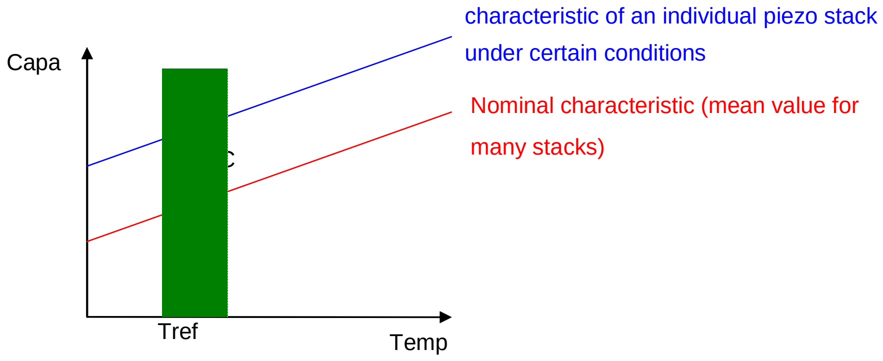

Figure 7.35.1: : capacity temperature relationship for piezo stacks

The capacity offset of each injector is stored in the nonvolatile memory (NVMY). Once the capacity offset is available the individual capacity can be shifted to the nominal characteristic allowing for a determination of the piezo temperature (Fig. 2).

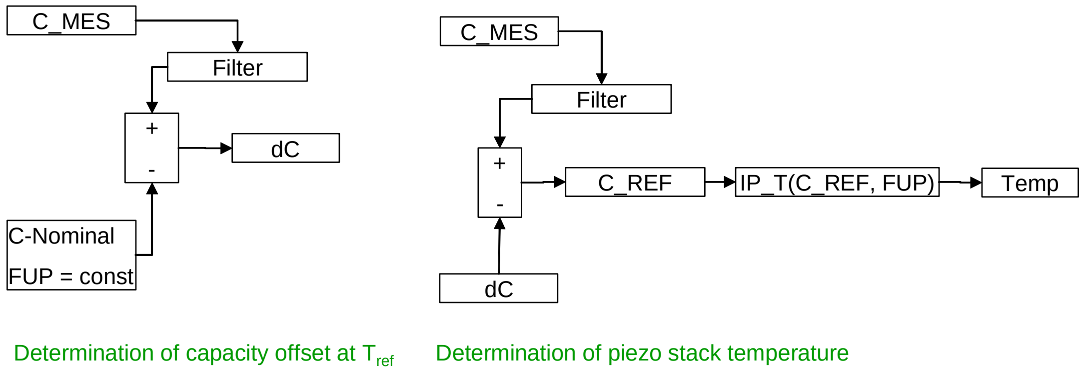

Figure 7.35.2: : Functional overview

Application Condition

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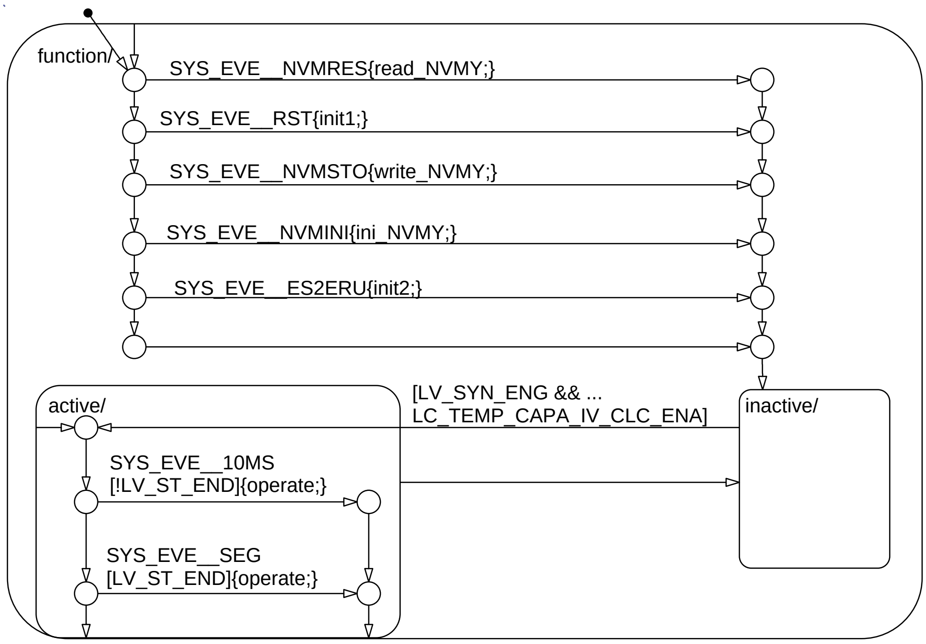

Figure 7.35.3: INJR_ISPCLCAPA0/APP_CDN/Chart

Function Description

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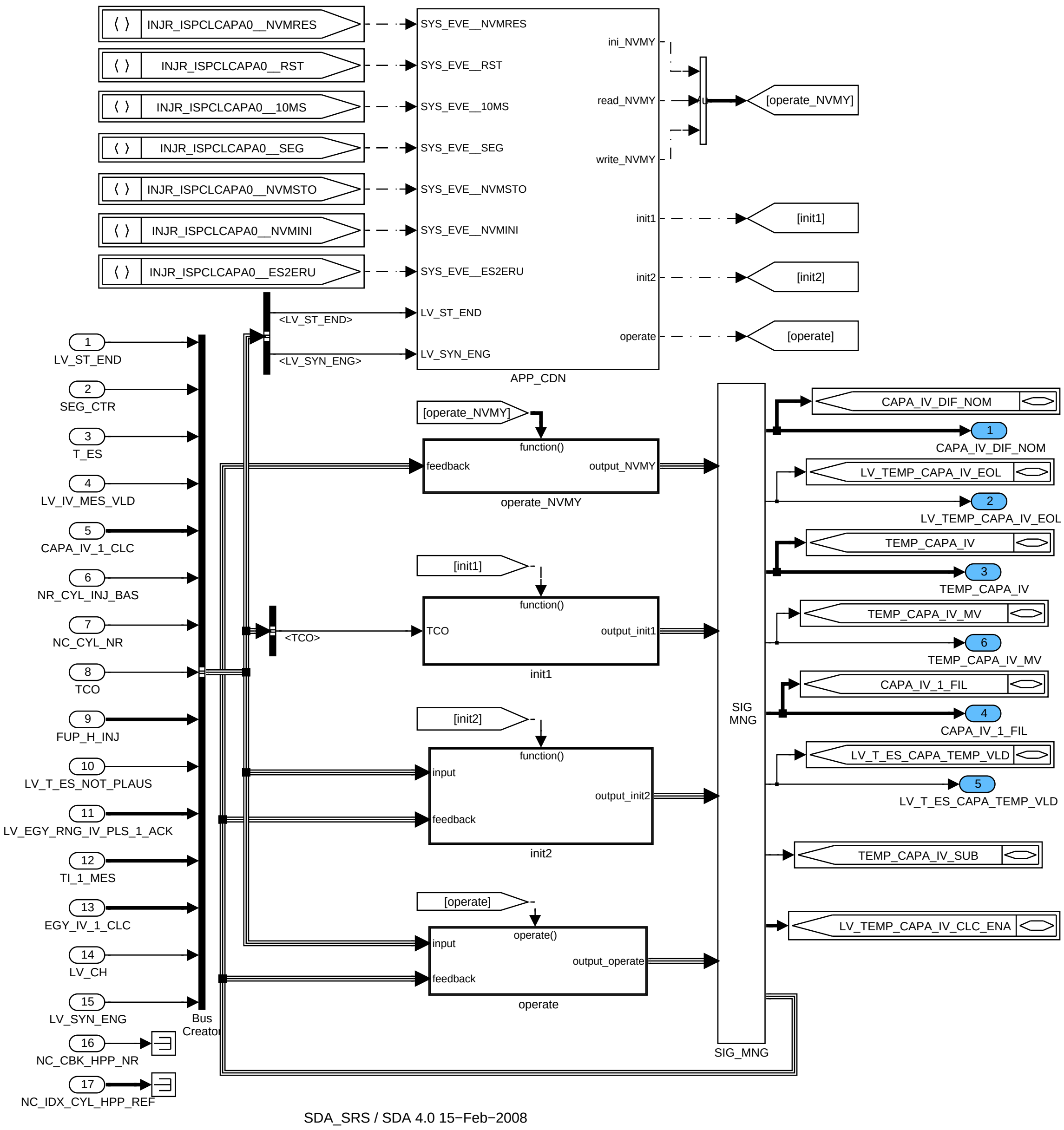

Figure 7.35.4: INJR_ISPCLCAPA0

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7.35.1 SUBFUNCTION: SIG_MNG

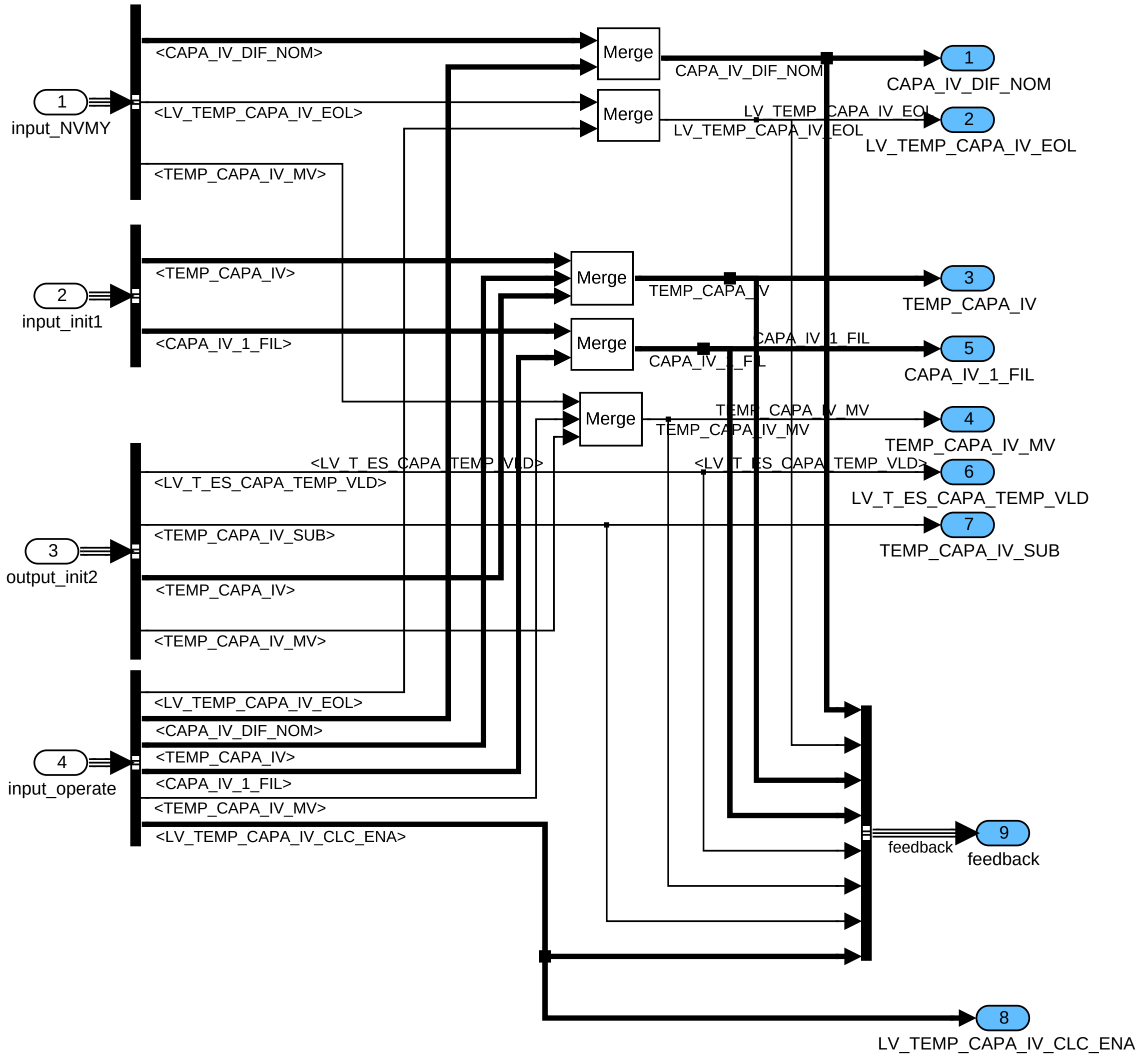

Figure 7.35.5: INJR_ISPCLCAPA0/SIG_MNG

7.35.2 Initialization

The piezo stack temperature is initialized with the coolant temperature at ECUreset.

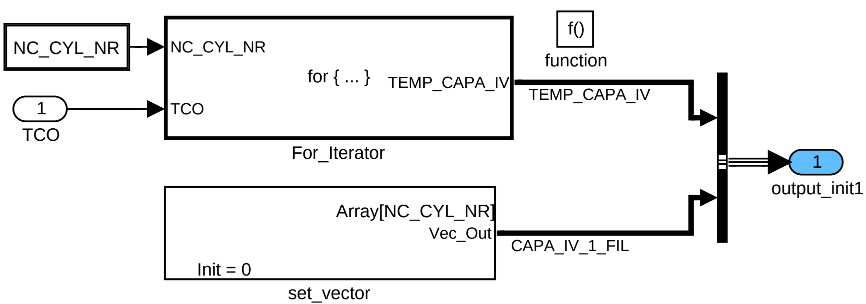

Figure 7.35.6: INJR_ISPCLCAPA0/init1

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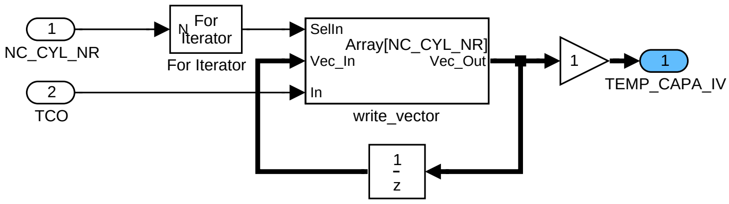

Figure 7.35.7: INJR_ISPCLCAPA0/init1/For_Iterator

7.35.3 Plausibility check of engine off time and calculation of substitute value for TEMP_CAPA_IV

A new adaptation value of the capacity offset is calculated if the engine offtime is plausible and greater than a calibratable constant. If both conditions are true the bit LV_T_ES_CAPA_TEMP_VLD is set. For the first engine start at end-of-line the capacity offset adaptation is always done. At the first engine start LV_TEMP_CAPA_IV_EOL is zero. It is set to one if the capacity offset is adapted and will be stored in the nonvolatile memory. Furthermore an substitute value for the piezo-capacity temperature is determined via engine off-time, coolant-temperature and the mean value of the piezo-temperatures of the last driving cycle.

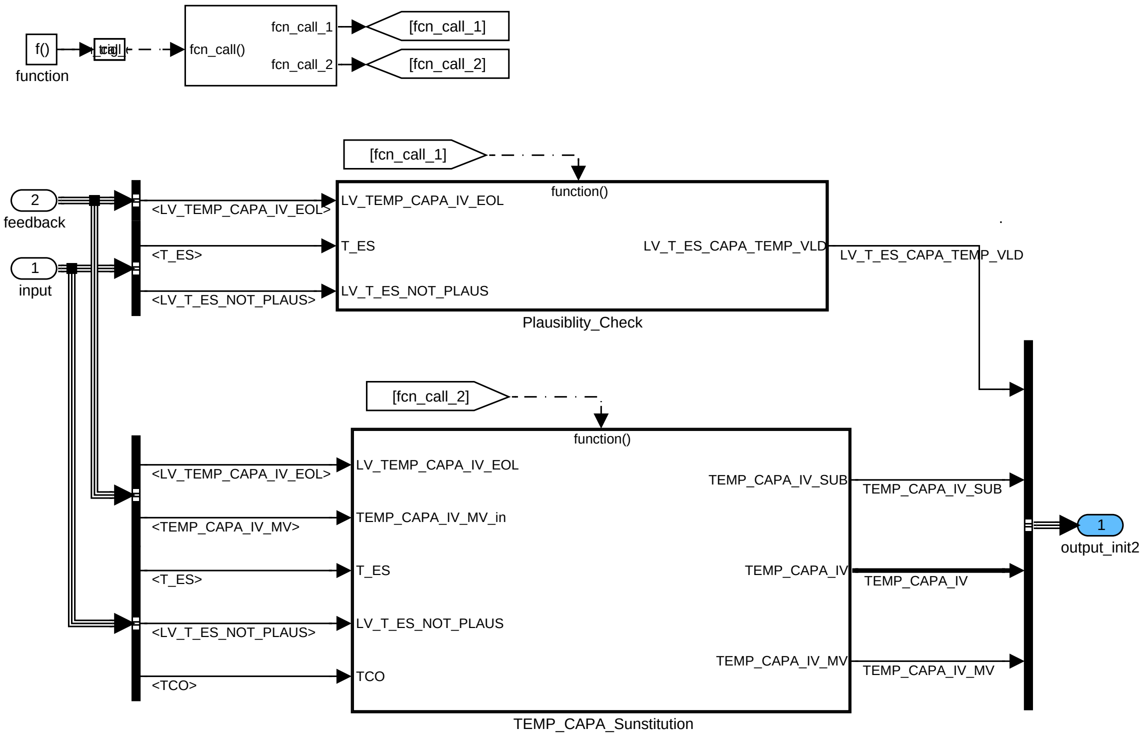

Figure 7.35.8: INJR_ISPCLCAPA0/init2

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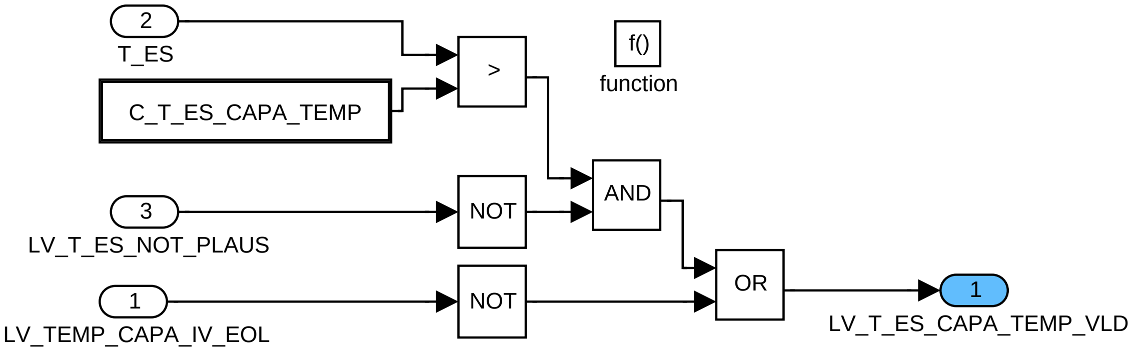

Figure 7.35.9: INJR_ISPCLCAPA0/init2/Plausiblity_Check

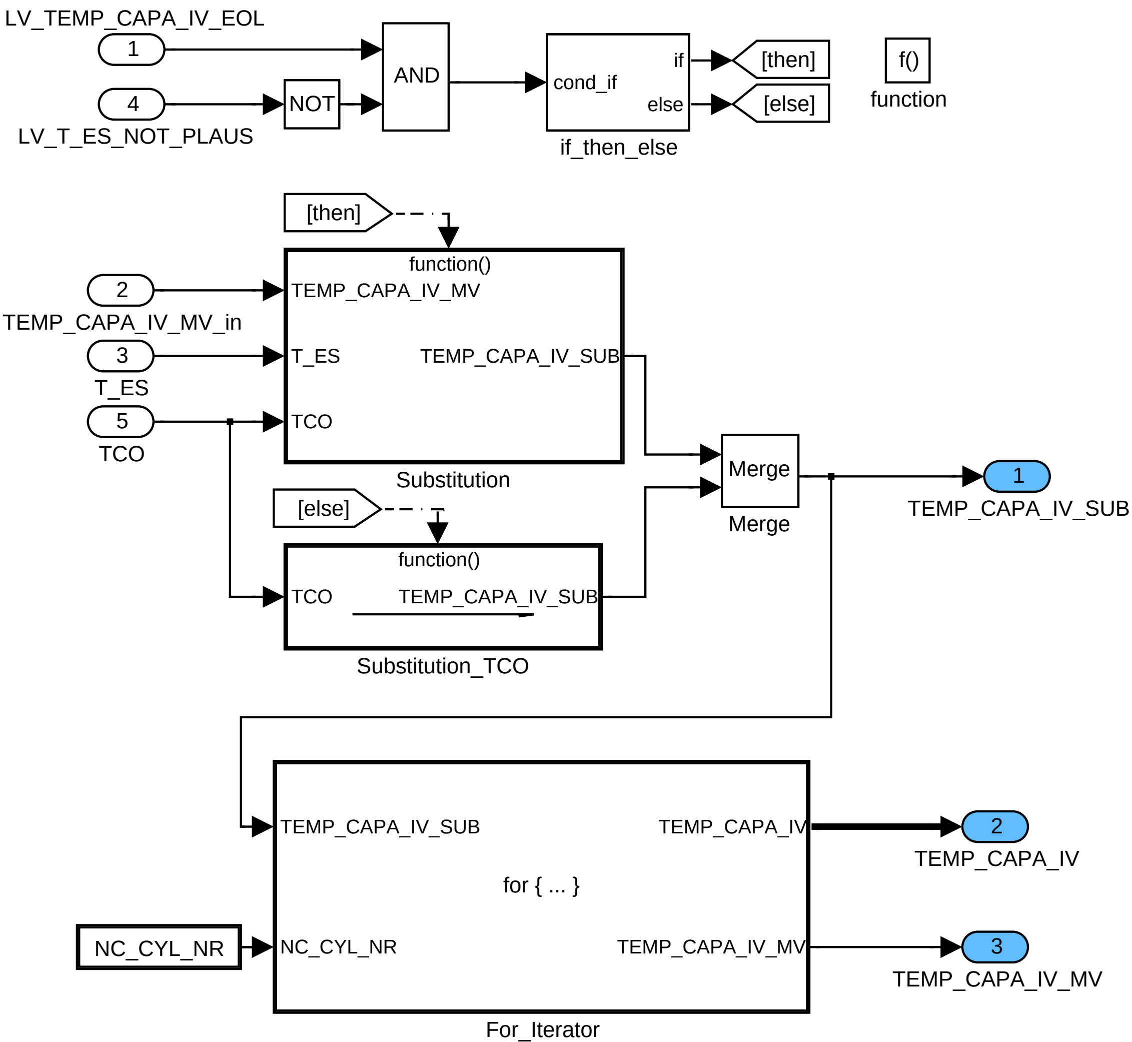

Figure 7.35.10: INJR_ISPCLCAPA0/init2/TEMP_CAPA_Sunstitution

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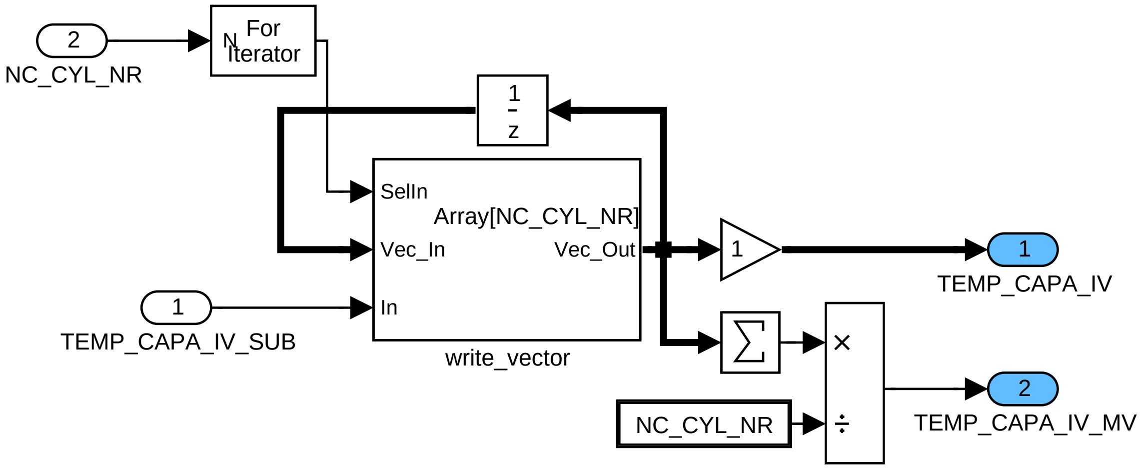

Figure 7.35.11: INJR_ISPCLCAPA0/init2/TEMP_CAPA_Sunstitution/For_Iterator

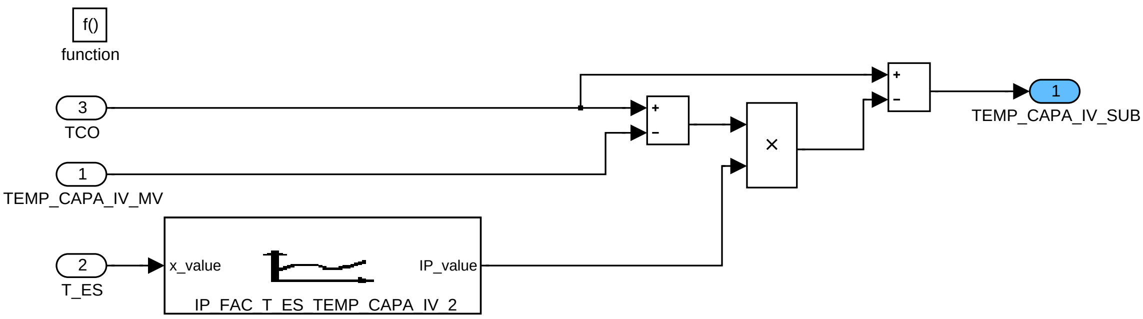

Figure 7.35.12: INJR_ISPCLCAPA0/init2/TEMP_CAPA_Sunstitution/Substitution

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7.35.4 Calculation of filtered capacity, capacity offset and stack temperature

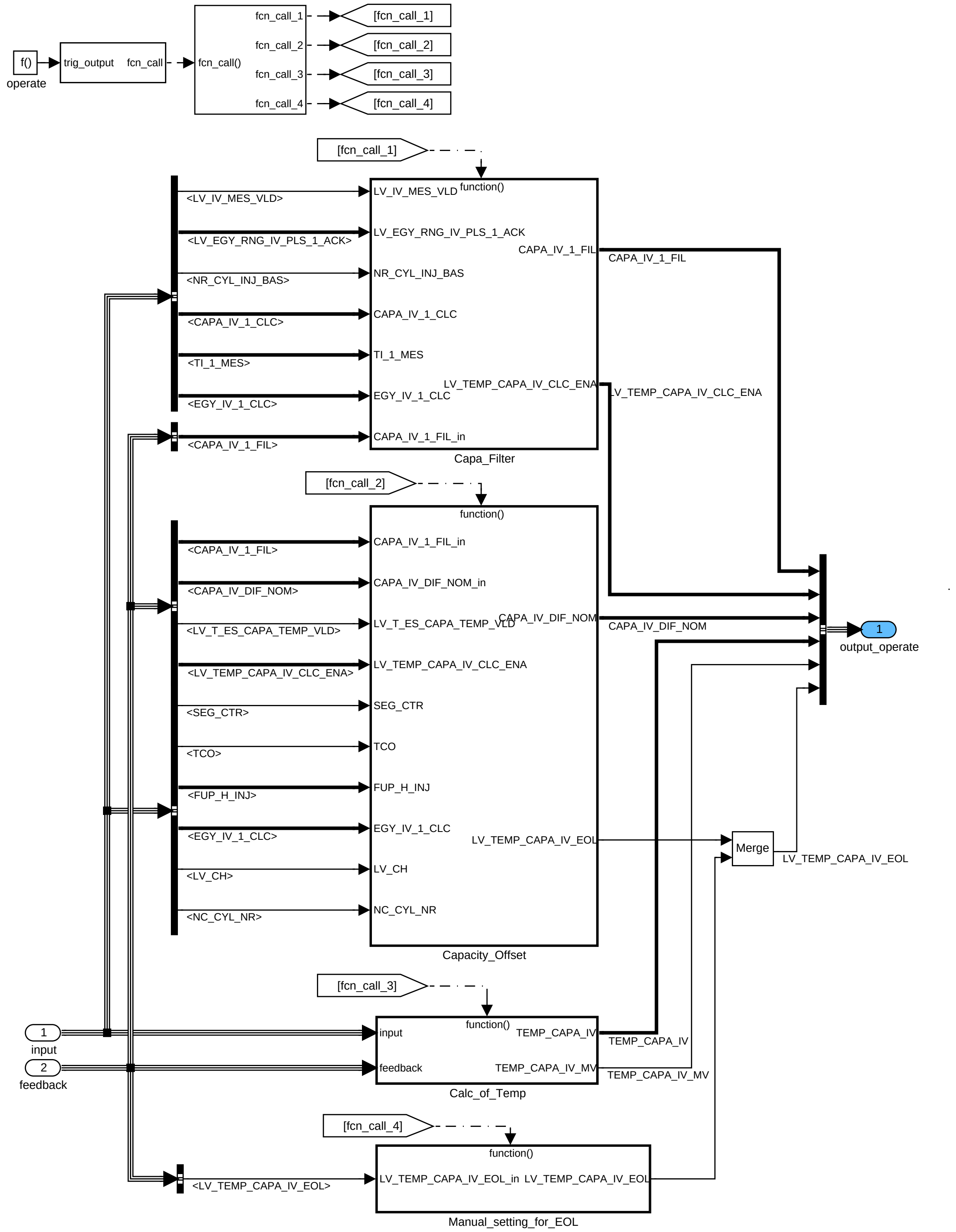

Figure 7.35.13: INJR_ISPCLCAPA0/operate

Calculation of piezo stack temperature

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While the segment counter is lower than a calibratable constant the temperature of the piezo stacks is set to the substitute value TEMP_CAPA_IV_SUB. When the SEG_CTR exceed this threshold the temperature is extracted from the map IP_TEMP_CAPA_IV_NOM accounting for each stack's individual capacity offset to the nominal value.

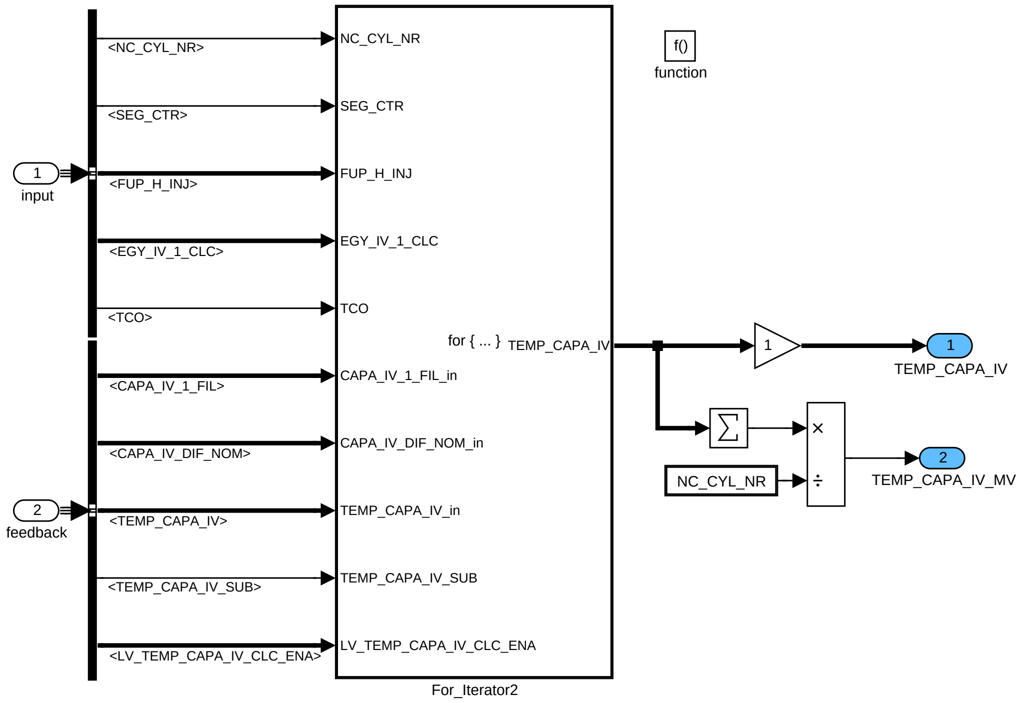

Figure 7.35.14: INJR_ISPCLCAPA0/operate/Calc_of_Temp

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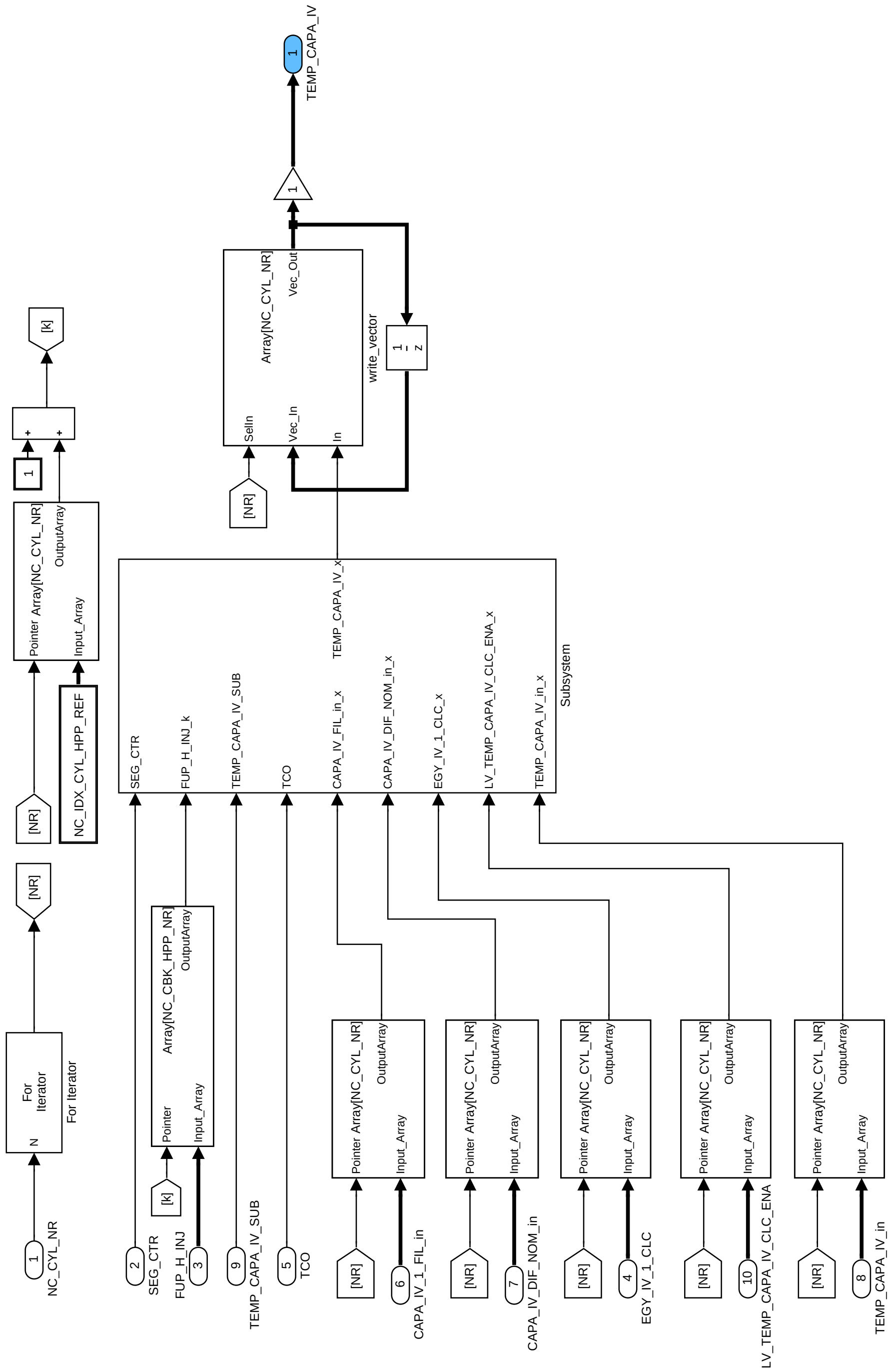

Figure 7.35.15: INJR_ISPCLCAPA0/operate/Calc_of_Temp/For_Iterator2

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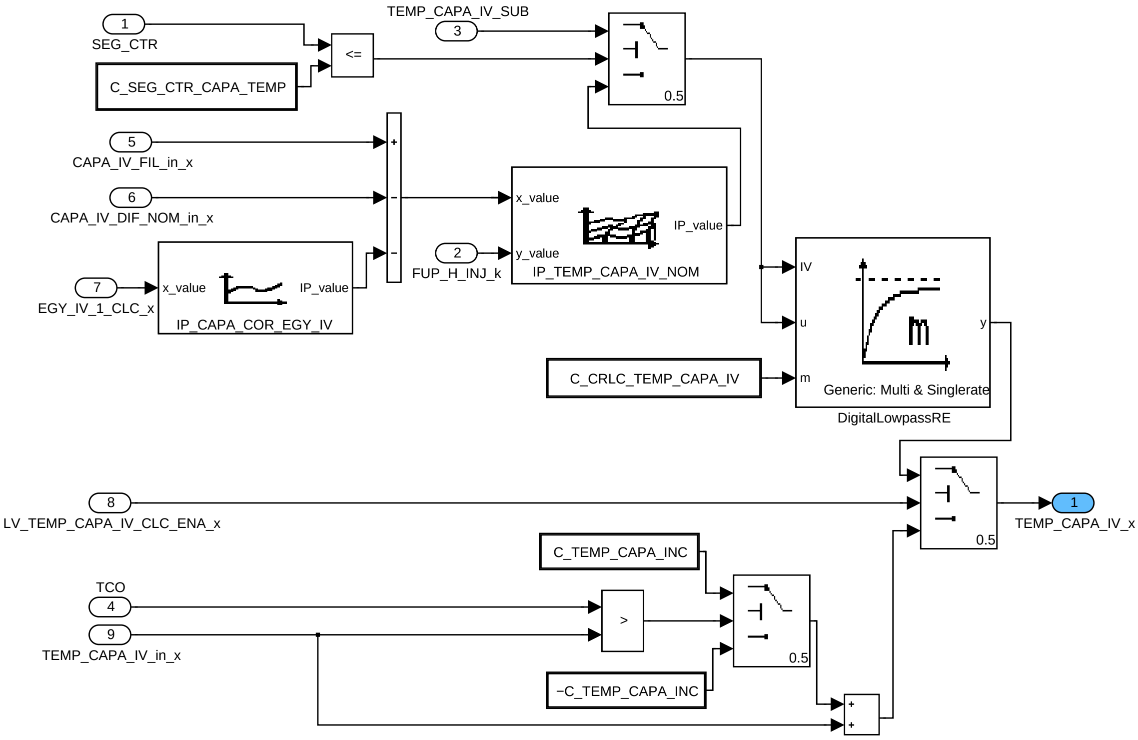

Figure 7.35.16: INJR_ISPCLCAPA0/operate/Calc_of_Temp/For_Iterator2/Subsystem

Filtering of piezo capacity

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The large signal capacity is calculated out of measured charge and voltage value. Since the signal is noisy it has to be low pass filtered. The filter constant can be applied via C_FAC_FIL_CAPA_IV. The filtered capacity is used for the further calculations. At first entry the filtered capacity is set to the measured capacity value via reset (R) and intial value (IV) input ports. The filter is enabled if the measured voltage and charge values are valid (LV_IV_MES_VLD), if the measured injection time is greater than a calibratable constant and if high energy range is used (LV_EGY_RNG_IV_PLS_1_ACT).

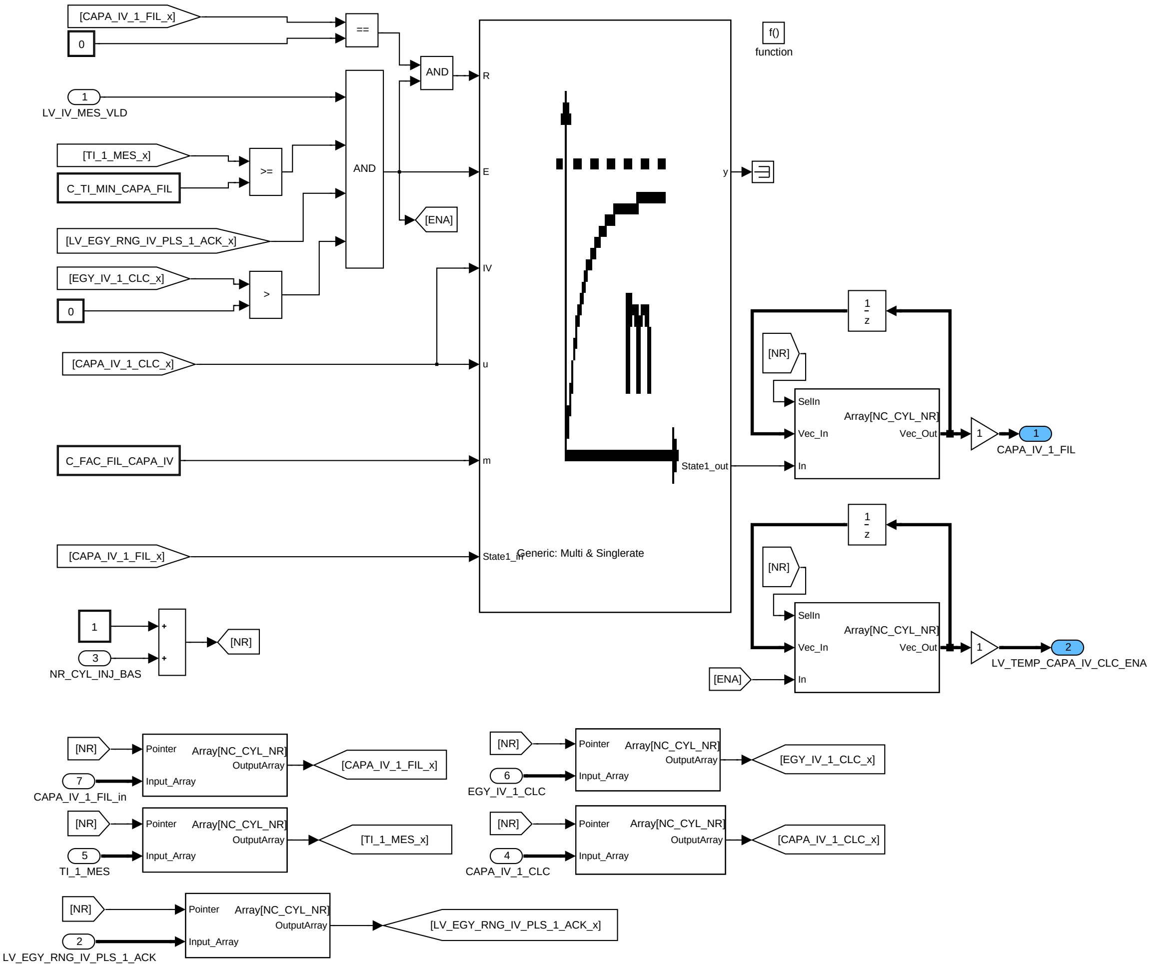

Figure 7.35.17: INJR_ISPCLCAPA0/operate/Capa_Filter

Calculation of capacity offset

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The capacity offset of each injector is stored in the nonvolatile memory. A new adaptation value is calculated if the engine offtime T_ES is plausible and greater than a calibratable constant (LV_T_ES_CAPA_TEMP_VLD = TRUE). Then the coolant temperature TCO is used as the reference temperature. The calculation of the offset value is triggered as soon as the segment counter exceeds a calibratable level. The capacity offset is limited to C_CAPA_IV_DIF_NOM_LIM. The calculation of capacity offset can be inhibited if catalyst heating is active. For the first engine start the end-of-line flag LV_TEMP_CAPA_IV_EOL is set if adaptation was done.

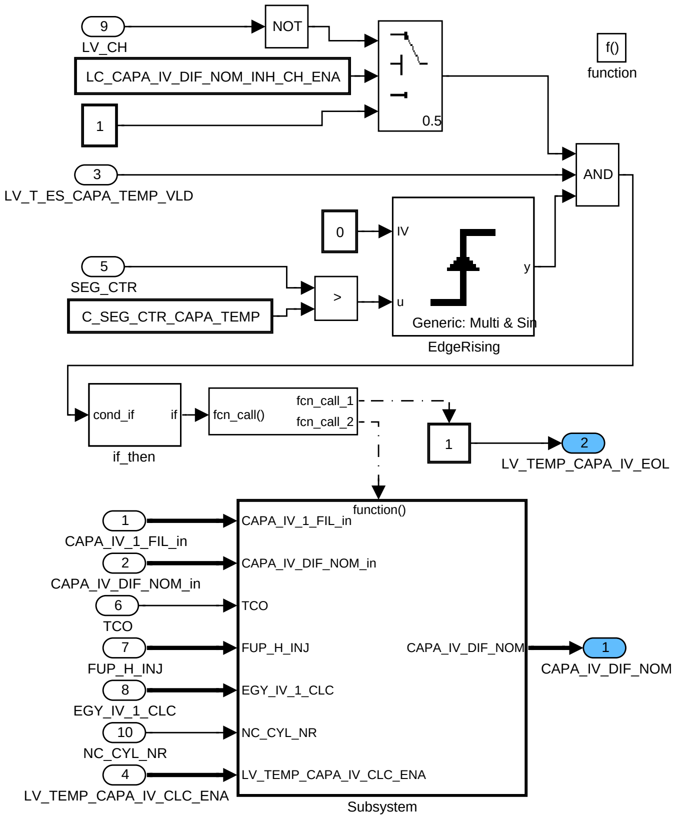

Figure 7.35.18: INJR_ISPCLCAPA0/operate/Capacity_Offset

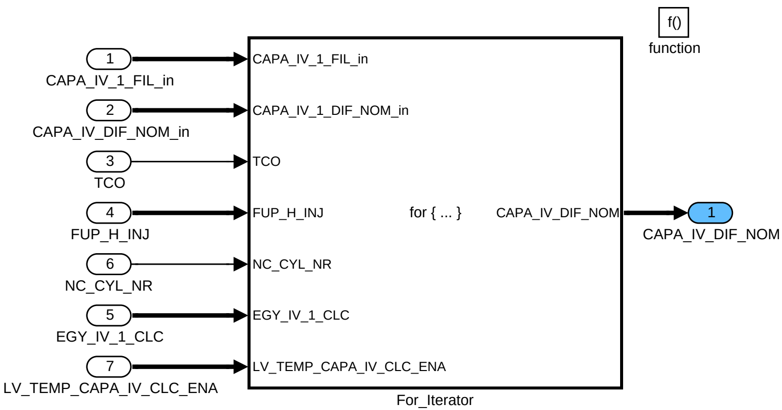

Figure 7.35.19: INJR_ISPCLCAPA0/operate/Capacity_Offset/Subsystem

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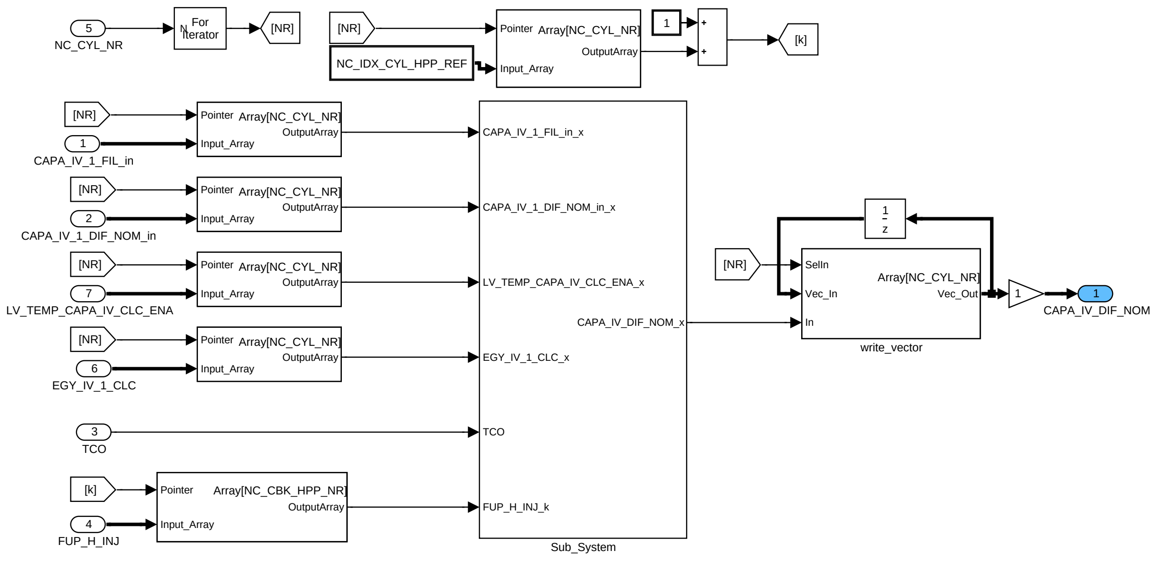

Figure 7.35.20: INJR_ISPCLCAPA0/operate/Capacity_Offset/Subsystem/For_Iterator

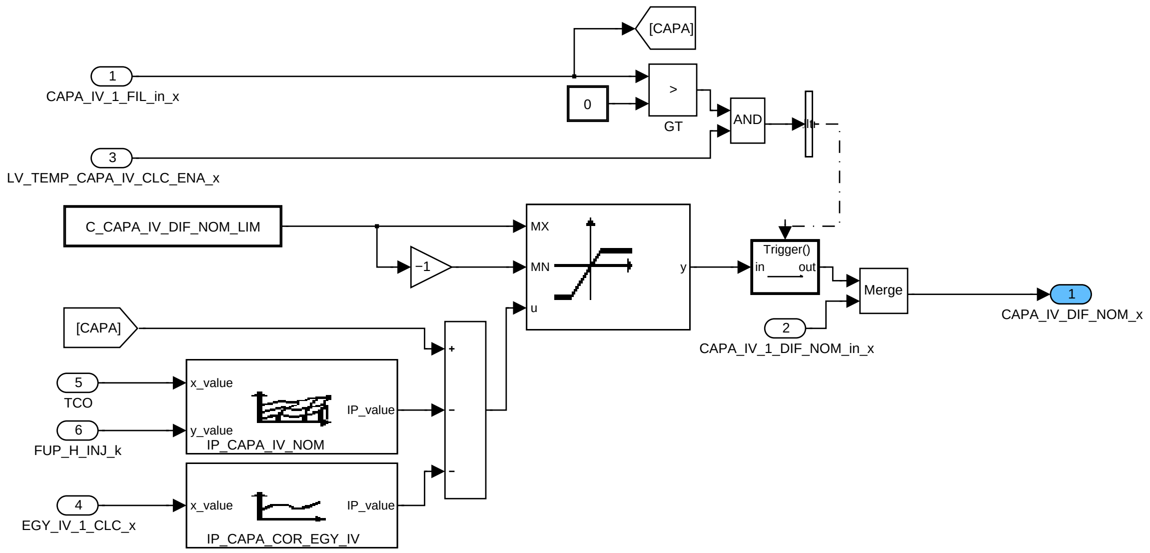

Figure 7.35.21: INJR_ISPCLCAPA0/operate/Capacity_Offset/Subsystem/For_Iterator/Sub_System

Manual setting for end of line flag

The endofline fag LV_TEMP_CAPA_IV_EOL can be set manually via LC_TEMP_CAPA_IV_EOL_MAN and C_TEMP_CAPA_IV_EOL.

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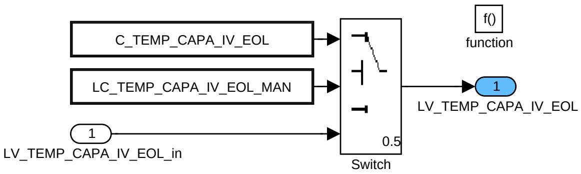

Figure 7.35.22: INJR_ISPCLCAPA0/operate/Manual_setting_for_EOL

7.35.5 Handling of nonvolatile memory

The capacity offset of each injector is stored. It is read and written to the NVMY before/after each complete driving cycle.

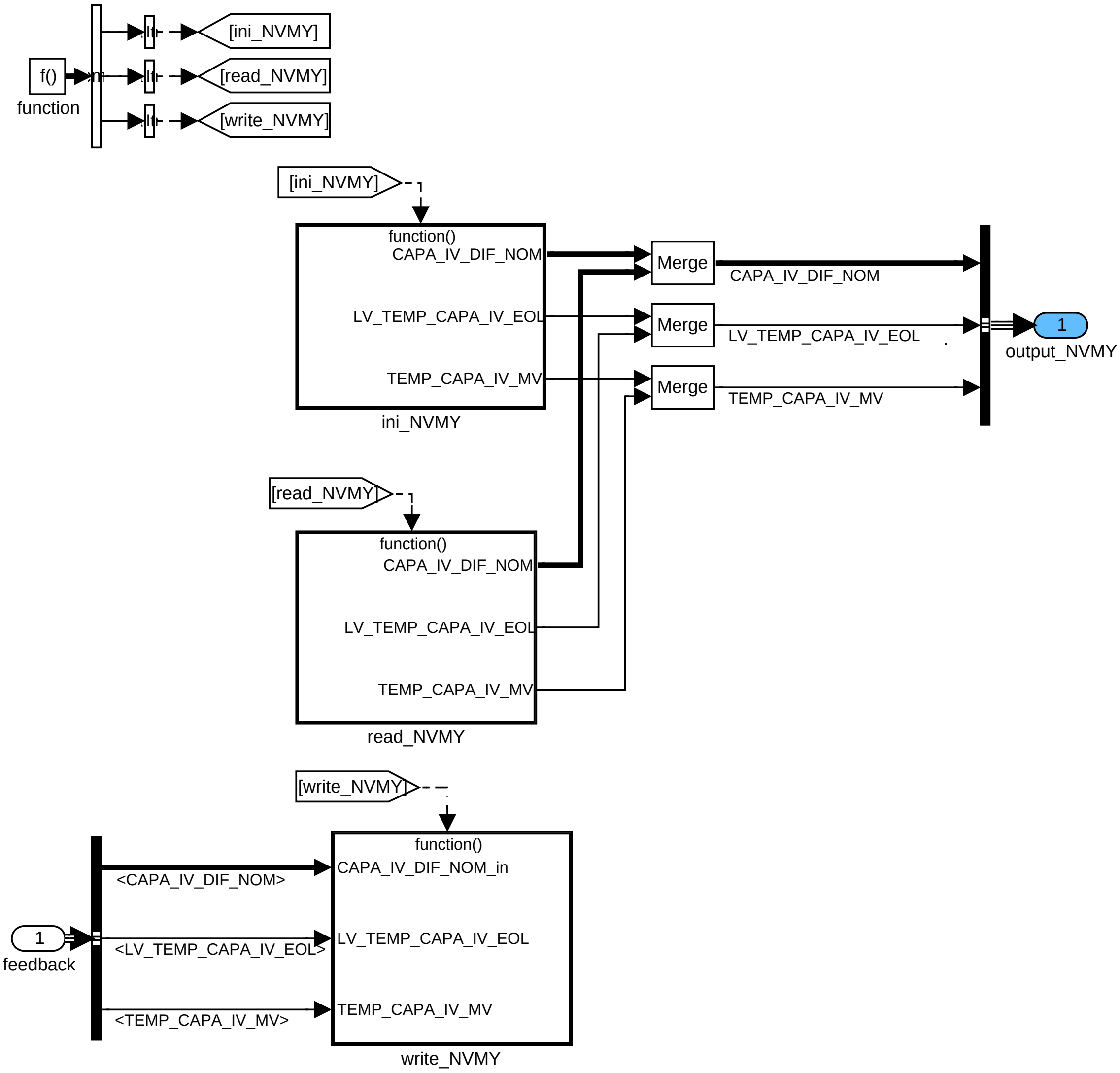

Figure 7.35.23: INJR_ISPCLCAPA0/operate_NVMY

Initialization of nonvolatile memory

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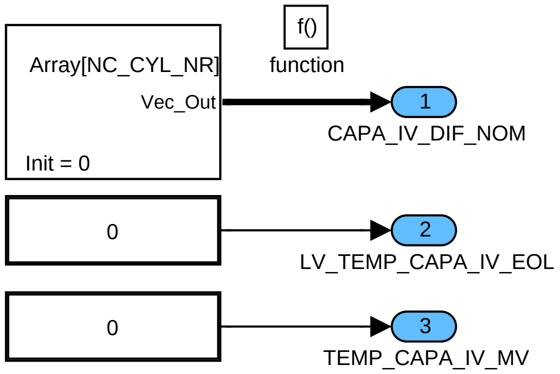

Figure 7.35.24: INJR_ISPCLCAPA0/operate_NVMY/ini_NVMY

Reading of nonvolatile memory

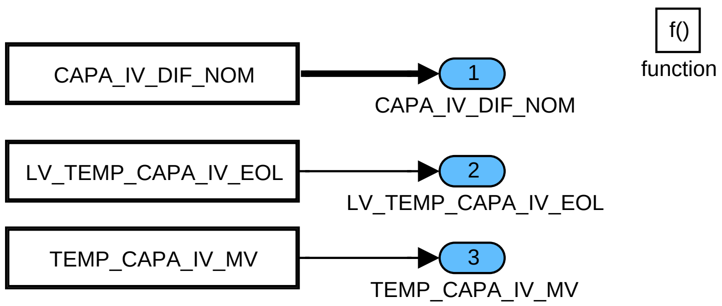

Figure 7.35.25: INJR_ISPCLCAPA0/operate_NVMY/read_NVMY

Writing of nonvolatile memory

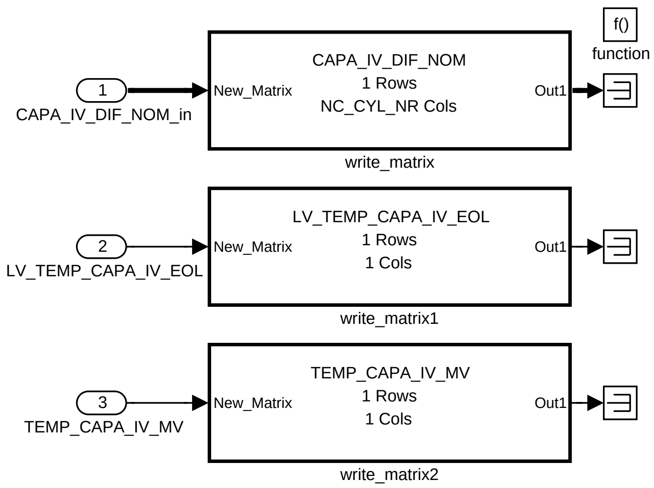

Figure 7.35.26: INJR_ISPCLCAPA0/operate_NVMY/write_NVMY

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7.36 Injector needle lift adjustment

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EGY_ADD_AD [NC_CYL_NR]	O/V	E000... 2000H	-50 ...50	6.1035e-3	%
Adaptive piezo energy correction depending on CYBL + CILC corrections					
EGY_STEP_INJ_CHA_GRD_DIF_HOM [NC_CYL_NR]	V	E000... 2000H	-50 ...50	6.1035e-3	%
Piezo injector energy charge gradient abundance for a single step - homogenous operation					
EGY_STEP_INJ_CHA_GRD_DIF_S [NC_CYL_NR]	V	E000... 2000H	-50 ...50	6.1035e-3	%
Piezo injector energy charge gradient abundance for a single step - stratified operation					
EGY_STEP_INJ_CHA_GRD_LIM_NOT [NC_CYL_NR]	V	0... 4000H	0... 100	6.1035e-3	%
Unlimited piezo injector energy charge gradient for a single step					
FAC_EGY_DIF_HOM [NC_CYL_NR]	V	0... 4000H	-50 ...50	6.1035e-3	%
Energy-level-difference factor - homogenous operation					
FAC_EGY_DIF_S [NC_CYL_NR]	V	0... 4000H	-50 ...50	6.1035e-3	%
Energy-level-difference factor - stratified operation					
FAC_MFF_DIF_HOM [NC_CYL_NR]	O/V	0... FFFFH	-1... 0.99996	30.5e-6	-
MFF-difference factor - homogenous operation					
FAC_MFF_DIF_MV	O/V	0... FFFFH	-1... 0.99996	30.5e-6	-
MFF-difference factor - mean value					
FAC_MFF_DIF_S [NC_CYL_NR]	O/V	0... FFFFH	-1... 0.99996	30.5e-6	-
MFF-difference factor - stratified operation					
FAC_TI_COR_IV_EGY_RNG_L [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Multiplicative injection time correction factor for corrections in case of injector low lift					
IDX_TI_1_STND_S_TMP [NC_CYL_NR]	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for first pulse S.					
IDX_TI_2_STND_S_TMP [NC_CYL_NR]	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for second pulse S.					
IDX_TI_3_STND_S_TMP [NC_CYL_NR]	-	0... FFFFH	0... 65535	1	-
Temporary counting factor index for third pulse S.					
IDX_TI_HYS_IV_EGY_RNG	V	0... FFFFH	0... 65535	1	-
Counting factor index hysteresis for selection of injector energy range					
IDX_TI_THD_IV_EGY_RNG	V	0... FFFFH	0... 65535	1	-
Counting factor index threshold for the selection of the injector energy range in stratified mode.					
LF_EGY_RNG_IV_1_HOM_REQ	V	0... FFH	0... 255	1	-
Bit coded injector needle lift request for each cylinder; first pulse homogeneous mode					
LF_EGY_RNG_IV_1_S_REQ	V	0... FFH	0... 255	1	-
Bit coded injector needle lift request for each cylinder; first pulse stratified mode					
LF_EGY_RNG_IV_2_HOM_REQ	V	0... FFH	0... 255	1	-
Bit coded injector needle lift request for each cylinder; second pulse homogeneous mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LF_EGY_RNG_IV_2_S_REQ	V	0... FFH	0... 255	1	-
Bit coded injector needle lift request for each cylinder; second pulse stratified mode					
LF_EGY_RNG_IV_3_HOM_REQ	V	0... FFH	0... 255	1	-
Bit coded injector needle lift request for each cylinder; third pulse homogeneous mode					
LF_EGY_RNG_IV_3_S_REQ	V	0... FFH	0... 255	1	-
Bit coded injector needle lift request for each cylinder; third pulse stratified mode					
LV_EGY_ADD_AD_LIM [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Adaptive piezo energy correction is at limit, cylinder individual					
LV_EGY_ADD_AD_LIM_TOL [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Adaptive piezo energy correction is at top limit, cylinder individual					
LV_EGY_RNG_IV_PLS_1_HOM [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the first pulse homogeneous mode (0 = low range, 1 = high range)					
LV_EGY_RNG_IV_PLS_1_S [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the first pulse stratified mode (0 = low range, 1 = high range)					
LV_EGY_RNG_IV_PLS_2_HOM [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the second pulse homogeneous mode (0 = low range, 1 = high range)					
LV_EGY_RNG_IV_PLS_2_S [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the second pulse stratified mode (0 = low range, 1 = high range)					
LV_EGY_RNG_IV_PLS_3_HOM [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the third pulse homogeneous mode (0 = low range, 1 = high range)					
LV_EGY_RNG_IV_PLS_3_S [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the third pulse stratified mode (0 = low range, 1 = high range)					
LV_IV_EGY_RNG_1	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the first pulse (0 = low range, 1 = high range)					
LV_IV_EGY_RNG_2	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the second pulse (0 = low range, 1 = high range)					
LV_IV_EGY_RNG_3	O/V	0... 1H	0 ...1	1	-
Flag for the injector energy range of the third pulse (0 = low range, 1 = high range)					
MFF_THD_EGY_RNG_IV	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass threshold for the selection of the injector energy range depending on fuel pressure. Pulse specific					

Input data:

CTR_CYL_NR_ST_CLC_INJR {p. 3327}	EGY_LEVEL_IV_BAL [NC_CYL_NR] {p. 3215}	EGY_LEVEL_IV_BAL_CONV [NC_CYL_NR] {p. 3215}	EGY_STEP_INJ_CHA_GRD_BAS [NC_CYL_NR] {p. 2277}
EGY_STEP_INJ_CHA_LIM_DIF [NC_CYL_NR] {p. 2277}	FAC_TI_1_PRS_CYL_S [NC_CYL_NR] {p. 2212}	FAC_TI_2_PRS_CYL_S [NC_CYL_NR] {p. 2216}	FAC_TI_3_PRS_CYL_S [NC_CYL_NR] {p. 2220}
FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}	INJ_MOD_SP_HOM [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_HOMS [NC_CYL_NR] {p. 3329}	INJ_MOD_SP_S [NC_CYL_NR] {p. 3330}
IP_EGY_LEVEL_IV_BAL_CONV {p. 3216}	IP_FAC_EGY_LEVEL_IV_BAL_COR {p. 3216}	IP_MFF_IDX_TI_EGY_H {p. 2008}	IP_MFF_TI_EGY_H {p. 2009}

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LC_CUR_SHP_INJ_ENA {p. 2010}	LF_EGY_RNG_HOM_EXT {p. 3330}	LFT_L_IV_HOM_REQ {p. 3330}	LFT_L_IV_S_REQ {p. 3330}
LV_EGY_RNG_HOM_EXT_ENA {p. 3330}	LV_EGY_STEP_INJ_CHA_LIM [NC_CYL_NR] {p. 2277}	LV_IV_POST_EGY_RNG {p. 2179}	LV_S_CLC {p. 1822}
LV_ST_END {p. 1720}	MFF_SP_1_S [NC_CYL_NR] {p. 8242}	MFF_SP_2_HOM [NC_CYL_NR] {p. 8242}	MFF_SP_2_S [NC_CYL_NR] {p. 8242}
MFF_SP_3_HOM [NC_CYL_NR] {p. 8243}	MFF_SP_3_S [NC_CYL_NR] {p. 8243}	MFF_SP_MV {p. 2151}	N_32 {p. 1525}
NC_CBK_HPP_NR [1] {p. 812}	NC_CYL_NR {p. 1526}	NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}	NC_INJ_MOD_HOM {p. 2045}
NC_INJ_MOD_MASK_1 {p. 2045}	NC_INJ_MOD_MULTI {p. 2045}	NR_CYL_CLC_RED_INJ {p. 3331}	PRS_DEC_INJ_1_S [NC_CYL_NR] {p. 2212}
PRS_DEC_INJ_2_S [NC_CYL_NR] {p. 2216}	PRS_DEC_INJ_3_S [NC_CYL_NR] {p. 2220}	STATE_INJ_MOD_HOM_REQ {p. 3331}	STATE_INJ_MOD_HOMS_REQ {p. 3331}
STATE_INJ_MOD_REQ {p. 3332}	STATE_INJ_MOD_S_REQ {p. 3332}	TFU_INJ {p. 3332}	TI_FAC [NC_CYL_NR] {p. 999}
TI_TUN_IV [NC_CYL_NR] {p. 2233}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EGY_STEP_INJ_CHA_GRD_MAX_HOM	-	0... 4000H	0... 100	6.1035e-3	%
Upper threshold of energy charge gradient for a single step - homogenous operation					
C_EGY_STEP_INJ_CHA_GRD_MAX_S	-	0... 4000H	0... 100	6.1035e-3	%
Upper threshold of energy charge gradient for a single step - stratified operation					
C_EGY_STEP_INJ_CHA_GRD_MIN_HOM	-	0... 4000H	0... 100	6.1035e-3	%
Lower threshold of energy charge gradient for a single step - homogenous operation					
C_EGY_STEP_INJ_CHA_GRD_MIN_S	-	0... 4000H	0... 100	6.1035e-3	%
Lower threshold of energy charge gradient for a single step - stratified operation					
C_IDX_TI_HYS_IV_EGY_RNG	-	0... FFFFH	0... 65535	1	-
Counting factor index hysteresis for the selection of the injector energy range.					
C_MFF_HYS_IV_EGY_RNG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass hysteresis for the selection of the injector energy range					
C_TI_HYS_IV_EGY_RNG	-	0... FFFFH	0... 65.535	0.001	ms
Injection time hysteresis for the selection of the injector energy range					
ID_IDX_TI_THD_IV_EGY_RNG	-	0... FFFFH	0... 65535	1	-
LDP_N_32_TI_THD_IV_EGY_RNG	3	0... FFH	0... 8160	32	rpm
Counting factor index threshold for the selection of the injector energy range depending on engine speed.					
ID_TI_THD_IV_EGY_RNG	-	0... FFFFH	0... 65.535	0.001	ms
LDP_N_32_TI_THD_IV_EGY_RNG	3	0... FFH	0... 8160	32	rpm
Injection time threshold for the selection of the injector energy range depending on engine speed					
IP_FAC_TI_COR_IV_EGY_RNG_L	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_FUP_FAC_TI_COR_IV_EGY_RNG_L	12	0... FFFFH	0... 347776	5.3067216	hPa
Multiplicative injection time correction factor for corrections in case of injector low lift depending on FUP					
IP_MFF_THD_IV_EGY_RNG	-	0... FFFFH	0... 1389	0.0211948	mg/stk

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_FUP_MFF_THD_IV_EGY_RNG	4	0... FFFFH	0... 347776	5.3067216	hPa
Fuel mass threshold for the selection of the injector energy range depending on Cyl PRS					
LC_EGY_RNG_IV_CYL_IND_DI	-	0... 1H	0 ...1	1	-
Switch to disable cylinder individual injector needle lift					

DESCRIPTION:

General information:

This functionality switches between two different base energy ranges for PIEZO injectors. Starting with these base ranges, specific energy levels are calculated for each cylinder depending on the cylinder balancing injection valve energy level.

Application conditions

Initialization: at reset and at first valid tooth:

LF_EGY_RNG_IV_1_HOM_REQ = (2^NC_CYL_NR) - 1
LF_EGY_RNG_IV_2_HOM_REQ = (2^NC_CYL_NR) - 1
LF_EGY_RNG_IV_3_HOM_REQ = (2^NC_CYL_NR) - 1
LF_EGY_RNG_IV_1_S_REQ = (2^NC_CYL_NR) - 1
LF_EGY_RNG_IV_2_S_REQ = (2^NC_CYL_NR) - 1
LF_EGY_RNG_IV_3_S_REQ = (2^NC_CYL_NR) - 1
LV_IV_EGY_RNG_1 = 1
LV_IV_EGY_RNG_2 = 1
LV_IV_EGY_RNG_3 = 1
LV_EGY_RNG_IV_PLS_1_S[ ] = 1 // all NC_CYL_NR elements
LV_EGY_RNG_IV_PLS_2_S[ ] = 1 // all NC_CYL_NR elements
LV_EGY_RNG_IV_PLS_3_S[ ] = 1 // all NC_CYL_NR elements
LV_EGY_RNG_IV_PLS_1_HOM[ ] = 1 // all NC_CYL_NR elements
LV_EGY_RNG_IV_PLS_2_HOM[ ] = 1 // all NC_CYL_NR elements
LV_EGY_RNG_IV_PLS_3_HOM[ ] = 1 // all NC_CYL_NR elements

EGY_ADD_AD[x] = EGY_LEVEL_IV_BAL[x]

EGY_STEP_INJ_CHA_GRD_DIF_HOM[x] = 0
FAC_EGY_DIF_HOM[x] = 0
FAC_MFF_DIF_HOM[x] = 0
EGY_STEP_INJ_CHA_GRD_DIF_S[x] = 0
FAC_EGY_DIF_S[x] = 0
FAC_MFF_DIF_S[x] = 0
FAC_MFF_DIF_MV = 0

FAC_TI_COR_IV_EGY_RNG_L = 1.0

Recurrence:

LV_ST_END = 0: 10ms
LV_ST_END = 1: segment synchronous

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Activation: every engine state

Deactivation: -

Formula section:

For loop for runtime optimization:
In this specification the for loop
FOR i = 0, i < NR_CYL_CLC_RED_INJ **DO**
x = CTR_CYL_NR_ST_CLC_INJR + i
(1a)**IF** x >= NC_CYL_NR
(1a)**THEN**
x = x - NC_CYL_NR
(1a)**ENDIF**
<**loop content**>
ENDFOR
is substituted by
FOR cylinder_start to cylinder_stop **DO**
<**loop content**>
ENDFOR
Note: In the for loops, x will be used as loop variable to indicate the cylinder x!

7.36.1 Cylinder individual adjustment of the energy level

This function calculates cylinder individual charge and discharge gradients depending on the cylinder balancing injection valve energy level. Should the unlimited gradient value run out of the lower/upper limits, the gradient variable shall be limited to the maximum or minimum threshold - dependently on engine operation mode (homogenous or stratified) - and the energy-level-difference factor shall be converted in the MFF-difference factor.

if(1) **{(**STATE_INJ_MOD_REQ **&** NC_INJ_MOD_MASK_1**)** = NC_INJ_MOD_HOM**}**
[*Bit-wise AND- operator*]
then
for(2) cylinder_start to cylinder_stop **DO**
EGY_STEP_INJ_CHA_GRD_LIM_NOT[x] =
EGY_STEP_INJ_CHA_GRD_BAS[x]
+ EGY_LEVEL_IV_BAL[x]
if(3) EGY_STEP_INJ_CHA_GRD_LIM_NOT[x] >
C_EGY_STEP_INJ_CHA_GRD_MAX_
HOM
then
LV_EGY_ADD_AD_LIM[x] = 1
LV_EGY_ADD_AD_LIM_TOL[x] = 1
EGY_STEP_INJ_CHA_GRD_DIF_HOM[x] =
EGY_STEP_INJ_CHA_GRD_LIM_
NOT[x] -
C_EGY_STEP_INJ_CHA_GRD_MAX_
HOM
if(4) LV_EGY_STEP_INJ_CHA_LIM[x] = 1
then
FAC_EGY_DIF_HOM[x] =
(100% + EGY_LEVEL_IV_BAL_
CONV[x])*

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(EGY_STEP_INJ_CHA_GRD_DIF_
HOM[x] +
EGY_STEP_INJ_CHA_LIM_DIF[x])/
(100% + EGY_LEVEL_IV_BAL[x])/
IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_
SP_MV)

else(4)
FAC_EGY_DIF_HOM[x] =
(100% + EGY_LEVEL_IV_BAL_
CONV[x])*
EGY_STEP_INJ_CHA_GRD_DIF_
HOM[x]/
(100% + EGY_LEVEL_IV_BAL[x])/
IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_
SP_MV)

endif(4)
FAC_MFF_DIF_HOM[x] = ***inverse***(IP_EGY_LEVEL_IV_BAL_CONV
(FAC_EGY_DIF_HOM[x]))

EGY_ADD_AD[x] = C_EGY_STEP_INJ_CHA_GRD_MAX_HOM -
EGY_STEP_INJ_CHA_GRD_BAS[x]

else(3)
if(4) EGY_STEP_INJ_CHA_GRD_LIM_NOT[x] $<$
C_EGY_STEP_INJ_CHA_GRD_MIN_
HOM

then
LV_EGY_ADD_AD_LIM[x] = 1
EGY_STEP_INJ_CHA_GRD_DIF_HOM[x] =
EGY_STEP_INJ_CHA_GRD_LIM_
NOT[x] -
C_EGY_STEP_INJ_CHA_GRD_MIN_
HOM

if(5) LV_EGY_STEP_INJ_CHA_LIM[x] = 1
then
FAC_EGY_DIF_HOM[x] =
(100% + EGY_LEVEL_IV_BAL_
CONV[x])*
(EGY_STEP_INJ_CHA_GRD_DIF_
HOM[x] +
EGY_STEP_INJ_CHA_LIM_DIF[x])/
(100% + EGY_LEVEL_IV_BAL[x])/
IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_
SP_MV)

else(5)
FAC_EGY_DIF_HOM[x] =
(100% + EGY_LEVEL_IV_BAL_
CONV[x])*
EGY_STEP_INJ_CHA_GRD_DIF_
HOM[x]/

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(100% + EGY_LEVEL_IV_BAL[x])/
IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_SP_MV)
endif(5)
FAC_MFF_DIF_HOM[x] =
inverse(IP_EGY_LEVEL_IV_BAL_CONV
(FAC_EGY_DIF_HOM[x]))
EGY_ADD_AD[x] = C_EGY_STEP_INJ_CHA_GRD_MIN_HOM -
EGY_STEP_INJ_CHA_GRD_BAS[x]
else(4)
if(5) LV_EGY_STEP_INJ_CHA_LIM[x] = 1
then
FAC_EGY_DIF_HOM[x] =
(100% + EGY_LEVEL_IV_BAL_CONV[x])*
EGY_STEP_INJ_CHA_LIM_DIF[x]/
(100% + EGY_LEVEL_IV_BAL[x])/
IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_SP_MV)
FAC_MFF_DIF_HOM[x] =
inverse(IP_EGY_LEVEL_IV_BAL_CONV
(FAC_EGY_DIF_HOM[x]))

else(5)
FAC_EGY_DIF_HOM[x] = 0
FAC_MFF_DIF_HOM[x] = 0
endif(5)
EGY_STEP_INJ_CHA_GRD_DIF_HOM[x] = 0
EGY_ADD_AD[x] = EGY_LEVEL_IV_BAL[x]
LV_EGY_ADD_AD_LIM[x] = 0
LV_EGY_ADD_AD_LIM_TOL[x] = 0
endif(4)
endif(3)
endfor(2)

calculation of mean value of FAC_MFF_DIF_HOM[ ] (mean value over all cylinders):
FAC_MFF_DIF_MV = mean(FAC_MFF_DIF_HOM[ ])

else(1)
for(2) cylinder_start to cylinder_stop **DO**
EGY_STEP_INJ_CHA_GRD_LIM_NOT[x] =
EGY_STEP_INJ_CHA_GRD_BAS[x] + EGY_LEVEL_IV_BAL[x]
if(3) EGY_STEP_INJ_CHA_GRD_LIM_NOT[x] >
C_EGY_STEP_INJ_CHA_GRD_MAX_S
then
LV_EGY_ADD_AD_LIM[x] = 1
LV_EGY_ADD_AD_LIM_TOL[x] = 1

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EGY_STEP_INJ_CHA_GRD_DIF_S[x] =
EGY_STEP_INJ_CHA_GRD_LIM_
NOT[x] -
C_EGY_STEP_INJ_CHA_GRD_MAX_
S
if(4) LV_EGY_STEP_INJ_CHA_LIM[x] = 1
then
FAC_EGY_DIF_S[x] = (100% + EGY_LEVEL_IV_BAL_CONV[x])*
(EGY_STEP_INJ_CHA_GRD_DIF_
S[x] +
EGY_STEP_INJ_CHA_LIM_DIF[x])/
(100% + EGY_LEVEL_IV_BAL[x])/
IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_
SP_MV)
else(4)
FAC_EGY_DIF_S[x] = (100% + EGY_LEVEL_IV_BAL_CONV[x])*
EGY_STEP_INJ_CHA_GRD_DIF_
S[x]/
(100% + EGY_LEVEL_IV_BAL[x])/
IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_
SP_MV)
endif(4)
FAC_MFF_DIF_S[x] = ***inverse***(IP_EGY_LEVEL_IV_BAL_CONV
(FAC_EGY_DIF_S[x]))
EGY_ADD_AD[x] = C_EGY_STEP_INJ_CHA_GRD_MAX_S -
EGY_STEP_INJ_CHA_GRD_BAS[x]
else(3)
if(4) EGY_STEP_INJ_CHA_GRD_LIM_NOT[x] $<$
C_EGY_STEP_INJ_CHA_GRD_MIN_
S
then
LV_EGY_ADD_AD_LIM[x] = 1
EGY_STEP_INJ_CHA_GRD_DIF_S[x] =
EGY_STEP_INJ_CHA_GRD_LIM_
NOT[x] -
C_EGY_STEP_INJ_CHA_GRD_MIN_
S
if(5) LV_EGY_STEP_INJ_CHA_LIM[x] = 1
then
FAC_EGY_DIF_S[x] =
(100% + EGY_LEVEL_IV_BAL_
CONV[x])*
(EGY_STEP_INJ_CHA_GRD_DIF_
S[x] +
EGY_STEP_INJ_CHA_LIM_DIF[x])/
(100% + EGY_LEVEL_IV_BAL[x])/
IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_
SP_MV)
else(5)

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FAC_EGY_DIF_S[x] =
(100% + EGY_LEVEL_IV_BAL_
CONV[x])*
EGY_STEP_INJ_CHA_GRD_DIF_
S[x]/
(100% + EGY_LEVEL_IV_BAL[x])/
IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_
SP_MV)
endif(5)
FAC_MFF_DIF_S[x] = ***inverse***(IP_EGY_LEVEL_IV_BAL_CONV
(FAC_EGY_DIF_S[x]))

EGY_ADD_AD[x] = C_EGY_STEP_INJ_CHA_GRD_MIN_S -
EGY_STEP_INJ_CHA_GRD_BAS[x]
else(4)
if(5) LV_EGY_STEP_INJ_CHA_LIM[x] = 1
then
FAC_EGY_DIF_S[x] =
(100% + EGY_LEVEL_IV_BAL_
CONV[x])*
EGY_STEP_INJ_CHA_LIM_DIF[x]/
(100% + EGY_LEVEL_IV_BAL[x])/
IP_FAC_EGY_LEVEL_IV_BAL_COR(MFF_
SP_MV)
FAC_MFF_DIF_S[x] =
inverse(IP_EGY_LEVEL_IV_BAL_
CONV
(FAC_EGY_DIF_S[x]))
else(5)
FAC_EGY_DIF_S[x] = 0
FAC_MFF_DIF_S[x] = 0
endif(5)
EGY_STEP_INJ_CHA_GRD_DIF_S[x] = 0
EGY_ADD_AD[x] = EGY_LEVEL_IV_BAL[x]
LV_EGY_ADD_AD_LIM[x] = 0
LV_EGY_ADD_AD_LIM_TOL[x] = 0
endif(4)
endif(3)

endfor(2)

calculation of mean value of FAC_MFF_DIF_S[ ] (mean value over all cylinders):
FAC_MFF_DIF_MV = mean(FAC_MFF_DIF_S[ ])

endif(1)

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7.36.2 Selection of injector energy range

7.36.2.1 Basis calculations

The minimum fuel mass setpoint for stratified mode is determined from the pulses with a fuel mass setpoint greater than zero. The corresponding minimum injection time is calculated and if the injection time is greater than a threshold or homogeneous mode is selected, high energy range will be selected for the injector, pulse individual.
The energy range can also be clipped to low range by dynamic injector needle lift selection (bit field LFT_L_IV_S_REQ).
Important note: For better readability of the specification, the LSB of the bit field LFT_L_IV_S_REQ, which corresponds to the physically first injection pulse, is referred to as bit 1 (**not** bit 0 as it would be in SW). The next bit would be bit 2 etc.

7.36.2.2 Main calculations for stratified combustion mode:

FOR m = 0 **TO** NC_CBK_HPP_NR - 1 **DO**
FAC_TI_COR_IV_EGY_RNG_L[m] =
IP_FAC_TI_COR_IV_EGY_RNG_L (Input: FUP_H_INJ[m])
ENDFOR
if$^{(1)}$ LV_S_CLC = 1 *Check if stratified mode has to be calculated*
then
if$^{(1a)}$ LC_CUR_SHP_INJ_ENA = 1
then$^{(1a)}$// current shaping via IDX_TI calculation is active
IDX_TI_THD_IV_EGY_RNG = ID_IDX_TI_THD_IV_EGY_RNG (Input: N_32)
IDX_TI_HYS_IV_EGY_RNG = C_IDX_TI_HYS_IV_EGY_RNG
else$^{(1a)}$ // current shaping is inactive; classic TI calculation applied
IDX_TI_THD_IV_EGY_RNG = ID_TI_THD_IV_EGY_RNG (Input: N_32) /0.001ms
IDX_TI_HYS_IV_EGY_RNG = C_TI_HYS_IV_EGY_RNG /0.001ms
endif$^{(1a)}$
(1)**FOR** cylinder_start to cylinder_stop **DO**
check, if third pulse stratified mode has to be calculated
if$^{(2)}$ INJ_MOD_SP_S[x] = "MPLS+PLS3" **OR**
INJ_MOD_SP_HOMS[x] = "HOMS+PLS3"
then [*Third pulse has to be calculated*]
calculate section 1.2.2 (third pulse stratified)
endif$^{(2)}$
check, if second pulse stratified mode has to be calculated
if$^{(3)}$ INJ_MOD_SP_S[x] = "MPLS" **OR**
INJ_MOD_SP_S[x] = "MPLS+PLS3" **OR**
INJ_MOD_SP_HOMS[x] = "HOMS" **OR**
INJ_MOD_SP_HOMS[x] = "HOMS+PLS3"
then
calculate section 1.2.3 (second pulse stratified)
endif$^{(3)}$
always calculate first pulse stratified mode, if LV_S_CLC = 1
calculate section 1.2.4 (first pulse stratified)
(1)**ENDFOR**
endif$^{(1)}$
end of section 1.2.1

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7.36.2.3 Calculate energy selection parameters for the third injection pulse stratified mode:

Note: Calculate this section only if called by another section

if(1) LC_CUR_SHP_INJ_ENA = 1
then
IDX_TI_3_STND_S_TMP[x] = IP_MFF_IDX_TI_EGY_H (
MFF_SP_3_S[x]*(1 + FAC_MFF_DIF_S[x]); PRS_DEC_INJ_3_S[x])
* TI_FAC[x] * TI_TUN_IV[x] * FAC_TI_3_PRS_CYL_S[x]
else(1)
IDX_TI_3_STND_S_TMP[x] = (IP_MFF_TI_EGY_H (
MFF_SP_3_S[x]*(1 + FAC_MFF_DIF_S[x]); PRS_DEC_INJ_3_S[x])
/0.001ms)
* TI_FAC[x] * TI_TUN_IV[x] * FAC_TI_3_PRS_CYL_S[x]
endif(1)

if(2) (IDX_TI_3_STND_S_TMP[x] < IDX_TI_THD_IV_EGY_RNG) **or**
Bit 3 of LFT_L_IV_S_REQ = 1
then
LV_EGY_RNG_IV_PLS_3_S[x] = 0
Bit x of LF_EGY_RNG_IV_3_S_REQ = 0
[*Select low energy range*]

else(2)
if(3) IDX_TI_3_STND_S_TMP[x] > (IDX_TI_THD_IV_EGY_RNG
+ IDX_TI_HYS_IV_EGY_RNG)
then
LV_EGY_RNG_IV_PLS_3_S[x] = 1
Bit x of LF_EGY_RNG_IV_3_S_REQ = 1
[*Select high energy range*]

else(3)
[*no operation: energy range unchanged*]
endif(3)
endif(2)

end of section 1.2.2

7.36.2.4 Calculate energy selection parameters for the second injection pulse stratified mode:

Note: Calculate this section only if called by another section

if(1) LC_CUR_SHP_INJ_ENA = 1
then
IDX_TI_2_STND_S_TMP[x] = IP_MFF_IDX_TI_EGY_H (
MFF_SP_2_S[x]*(1 + FAC_MFF_DIF_S[x]); PRS_DEC_INJ_2_S[x])
* TI_FAC[x] * TI_TUN_IV[x] * FAC_TI_2_PRS_CYL_S[x]
else(1)
IDX_TI_2_STND_S_TMP[x] = (IP_MFF_TI_EGY_H (
MFF_SP_2_S[x]*(1 + FAC_MFF_DIF_S[x]); PRS_DEC_INJ_2_S[x])
/0.001ms)
* TI_FAC[x] * TI_TUN_IV[x] * FAC_TI_2_PRS_CYL_S[x]
endif(1)

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if(2) (IDX_TI_2_STND_S_TMP[x] < IDX_TI_THD_IV_EGY_RNG) **or**
Bit 2 of LFT_L_IV_S_REQ = 1
then
LV_EGY_RNG_IV_PLS_2_S[x] = 0
Bit x of LF_EGY_RNG_IV_2_S_REQ = 0
[*Select low energy range*]

else(2)
if(3) IDX_TI_2_STND_S_TMP[x] > (IDX_TI_THD_IV_EGY_RNG
+ IDX_TI_HYS_IV_EGY_RNG)
then
LV_EGY_RNG_IV_PLS_2_S[x] = 1
Bit x of LF_EGY_RNG_IV_2_S_REQ = 1
[*Select high energy range*]

else(3)
[*no operation: energy range unchanged*]
endif(3)
endif(2)

end of section 1.2.3

7.36.2.5 Calculate energy selection parameters for the first injection pulse stratified mode:

Note: Calculate this section only if called by another section

if(1) LC_CUR_SHP_INJ_ENA = 1
then
IDX_TI_1_STND_S_TMP[x] = IP_MFF_IDX_TI_EGY_H (
MFF_SP_1_S[x]*(1 + FAC_MFF_DIF_S[x]); PRS_DEC_INJ_1_S[x])
* TI_FAC[x] * TI_TUN_IV[x] * FAC_TI_1_PRS_CYL_S[x]
else(1)
IDX_TI_1_STND_S_TMP[x] = (IP_MFF_TI_EGY_H (
MFF_SP_1_S[x]*(1 + FAC_MFF_DIF_S[x]); PRS_DEC_INJ_1_S[x])
/0.001ms)
* TI_FAC[x] * TI_TUN_IV[x] * FAC_TI_1_PRS_CYL_S[x]
endif(1)
if(2) (IDX_TI_1_STND_S_TMP[x] < IDX_TI_THD_IV_EGY_RNG) **or**
Bit 1 of LFT_L_IV_S_REQ = 1
then
LV_EGY_RNG_IV_PLS_1_S[x] = 0
Bit x of LF_EGY_RNG_IV_1_S_REQ = 0
[*Select low energy range*]

else(2)
if(3) IDX_TI_1_STND_S_TMP[x] > (IDX_TI_THD_IV_EGY_RNG
+ IDX_TI_HYS_IV_EGY_RNG)
then
LV_EGY_RNG_IV_PLS_1_S[x] = 1
Bit x of LF_EGY_RNG_IV_1_S_REQ = 1
[*Select high energy range*]

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else(3)
[*no operation: energy range unchanged*]
endif(3)
endif(2)

end of section 1.2.4

7.36.2.6 Energy range calculations for multiple homogeneous mode (Main calculations)

If multiple homogenous injection mode is selected, the second/third fuel mass setpoint will be checked against a threshold. If the fuel mass is below the threshold, the second/third injection pulse will be executed with low energy range.
The energy range can also be clipped to low range by dynamic injector needle lift selection (bit field LFT_L_IV_HOM_REQ).
Important note: For better readability of the specification, the LSB of the bit field LFT_L_IV_HOM_REQ, which corresponds to the physically first injection pulse, is referred to as bit 1 (**not** bit 0 as it would be in SW). The next bit would be bit 2 etc.
Note: For improvement of runtime, calculate the map IP_MFF_THD_IV_EGY_RNG only once per recurrence for every fuel pressure value!

ENDFOR
(1)**FOR** cylinder_start to cylinder_stop **DO**
check, if second or second and third pulse homogeneous mode has to be calculated
if(1) INJ_MOD_SP_HOM[x] = 'MPLH' **OR**
INJ_MOD_SP_HOM[x] = 'MPLH+PLS3'
[*Homogeneous multiple injection mode requested*]
then
calculate section 1.2.7 (second pulse homogeneous)

check, if third pulse homogeneous mode has to be calculated
if(2) INJ_MOD_SP_HOM[x] = 'MPLH+PLS3'
[*Homogeneous triple injection mode requested*]
then
calculate section 1.2.8 (third pulse homogeneous)
endif(2)

endif(1)

always calculate parameters for the first pulse homogeneous mode
calculate section 1.2.9 (first pulse homogeneous)
(1)**ENDFOR**
end of section 1.2.6

7.36.2.7 Calculate energy selection parameters for the second injection pulse at homogeneous mode based on fuel mass threshold:

Note: Calculate this section only if called by another section

if(1) LV_EGY_RNG_HOM_EXT_ENA = 1

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then // set injector needle lift to external value
LV_EGY_RNG_IV_PLS_2_HOM[x] = Bit 1 of LF_EGY_RNG_HOM_EXT
Bit x of LF_EGY_RNG_IV_2_HOM_REQ = Bit 1 of LF_EGY_RNG_HOM_EXT
else$^{(1)}$
MFF_THD_EGY_RNG_IV = IP_MFF_THD_IV_EGY_RNG(INPUT: PRS_DEC_INJ_2_HOM[x])

if$^{(2)}$ (MFF_SP_2_HOM[x] $<$ **MFF_THD_EGY_RNG_IV**)
or Bit 2 of LFT_L_IV_HOM_REQ = 1
then
LV_EGY_RNG_IV_PLS_2_HOM[x] = 0
Bit x of LF_EGY_RNG_IV_2_HOM_REQ = 0
[*Select low energy range*]

else$^{(2)}$
if$^{(3)}$ MFF_SP_2_HOM[x] $>$
(**MFF_THD_EGY_RNG_IV)**
+ C_MFF_HYS_IV_EGY_RNG)
then
LV_EGY_RNG_IV_PLS_2_HOM[x] = 1
Bit x of LF_EGY_RNG_IV_2_HOM_REQ = 1
[*Select high energy range*]

else$^{(3)}$
[*no operation: energy range unchanged*]
endif$^{(3)}$
endif$^{(2)}$
endif$^{(1)}$
end of section 1.2.7

7.36.2.8 Calculate energy selection parameters for the third injection pulse at homogeneous mode based on fuel mass threshold:

Note: Calculate this section only if called by another section

if$^{(1)}$ LV_EGY_RNG_HOM_EXT_ENA = 1
then // set injector needle lift to external value
LV_EGY_RNG_IV_PLS_3_HOM[x] = Bit 2 of LF_EGY_RNG_HOM_EXT
Bit x of LF_EGY_RNG_IV_3_HOM_REQ = Bit 2 of LF_EGY_RNG_HOM_EXT
else$^{(1)}$
MFF_THD_EGY_RNG_IV = IP_MFF_THD_IV_EGY_RNG(INPUT: PRS_DEC_INJ_3_HOM[x])

if$^{(2)}$ (MFF_SP_3_HOM[x] $<$ **MFF_THD_EGY_RNG_IV**)
or Bit 3 of LFT_L_IV_HOM_REQ = 1
then
LV_EGY_RNG_IV_PLS_3_HOM[x] = 0
Bit x of LF_EGY_RNG_IV_3_HOM_REQ = 0
[*Select low energy range*]

else$^{(2)}$
if$^{(3)}$ MFF_SP_3_HOM[x] $>$
(**MFF_THD_EGY_RNG_IV**
+ C_MFF_HYS_IV_EGY_RNG)
then

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LV_EGY_RNG_IV_PLS_3_HOM[x] = 1
Bit x of LF_EGY_RNG_IV_3_HOM_REQ = 1
[*Select high energy range*]

else$^{(3)}$
[*no operation: energy range unchanged*]
endif$^{(3)}$
endif$^{(2)}$
endif$^{(1)}$
end of section 1.2.8

7.36.2.9 Calculate energy selection parameters for the first injection pulse at homogeneous mode:

Note: Calculate this section only if called by another section

if$^{(1)}$ LV_EGY_RNG_HOM_EXT_ENA = 1
then // set injector needle lift to external value
LV_EGY_RNG_IV_PLS_1_HOM[x] = Bit 0 of LF_EGY_RNG_HOM_EXT
Bit x of LF_EGY_RNG_IV_1_HOM_REQ = Bit 0 of LF_EGY_RNG_HOM_EXT
else$^{(1)}$
MFF_THD_EGY_RNG_IV = IP_MFF_THD_IV_EGY_RNG(INPUT: PRS_DEC_INJ_1_HOM[x])

if$^{(2)}$ (MFF_SP_1_HOM[x] $<$ **MFF_THD_EGY_RNG_IV**)
or Bit 1 of LFT_L_IV_HOM_REQ = 1
then
LV_EGY_RNG_IV_PLS_1_HOM[x] = 0
Bit x of LF_EGY_RNG_IV_1_HOM_REQ = 0
[*Select low energy range*]

else$^{(2)}$
if$^{(3)}$ MFF_SP_1_HOM[x] $>$
(**MFF_THD_EGY_RNG_IV**
+ C_MFF_HYS_IV_EGY_RNG)
then
LV_EGY_RNG_IV_PLS_1_HOM[x] = 1
Bit x of LF_EGY_RNG_IV_1_HOM_REQ = 1
[*Select high energy range*]

else$^{(3)}$
[*no operation: energy range unchanged*]
endif$^{(3)}$
endif$^{(2)}$
endif$^{(1)}$
end of section 1.2.9

7.36.2.10 Calculate global energy selection parameters for monitoring unit:

(1)**IF** LC_EGY_RNG_IV_CYL_IND_DI = 1 **AND** LV_EGY_RNG_HOM_EXT_ENA = 0
(1)**THEN**
(2)**IF** LV_S_CLC = 1
(2)**THEN**
(3)**IF** LF_EGY_RNG_IV_1_S_REQ = (2ˆNC_CYL_NR) - 1
(3)**THEN**

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```
                    (1)FOR cylinder_start to cylinder_stop DO
                          LV_EGY_RNG_IV_PLS_1_S[x] = 1
                    (1)ENDFOR
            (3)ELSE
                    (2)FOR cylinder_start to cylinder_stop DO
                          LV_EGY_RNG_IV_PLS_1_S[x] = 0
                    (2)ENDFOR
            (3)ENDIF
            (4)IF (STATE_INJ_MOD_S_REQ = "MPLS" OR
                     STATE_INJ_MOD_S_REQ = "MPLS+PLS3" OR
                STATE_INJ_MOD_HOMS_REQ = "HOMS" OR
                    STATE_INJ_MOD_HOMS_REQ = "HOMS+PLS3")
            (4)THEN
                    (5)IF LF_EGY_RNG_IV_2_S_REQ = (2^NC_CYL_NR) - 1
                    (5)THEN
                          (3)FOR cylinder_start to cylinder_stop DO
                                LV_EGY_RNG_IV_PLS_2_S[x] = 1
                          (3)ENDFOR
                    (5)ELSE
                          (4)FOR cylinder_start to cylinder_stop DO
                                LV_EGY_RNG_IV_PLS_2_S[x] = 0
                          (4)ENDFOR
                    (5)ENDIF
            (4)ENDIF
            (6)IF (STATE_INJ_MOD_S_REQ = "MPLS+PLS3" OR
                    STATE_INJ_MOD_HOMS_REQ = "HOMS+PLS3")
            (6)THEN
                    (7)IF LF_EGY_RNG_IV_3_S_REQ = (2^NC_CYL_NR) - 1
                    (7)THEN
                          (5)FOR cylinder_start to cylinder_stop DO
                                LV_EGY_RNG_IV_PLS_3_S[x] = 1
                          (5)ENDFOR
                    (7)ELSE
                          (6)FOR cylinder_start to cylinder_stop DO
                                LV_EGY_RNG_IV_PLS_3_S[x] = 0
                          (6)ENDFOR
                    (7)ENDIF
            (6)ENDIF
    (2)ENDIF - LV_S_CLC
    (8)IF LF_EGY_RNG_IV_1_HOM_REQ = (2^NC_CYL_NR) - 1
    (8)THEN
            (7)FOR cylinder_start to cylinder_stop DO
                    LV_EGY_RNG_IV_PLS_1_HOM[x] = 1
            (7)ENDFOR
    (8)ELSE
            (8)FOR cylinder_start to cylinder_stop DO
                    LV_EGY_RNG_IV_PLS_1_HOM[x] = 0
            (8)ENDFOR
    (8)ENDIF
    (9)IF (STATE_INJ_MOD_HOM_REQ = "MPLH" OR
         STATE_INJ_MOD_HOM_REQ = "MPLH+PLS3")
    (9)THEN
```

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```
(10)IF LF_EGY_RNG_IV_2_HOM_REQ = (2^NC_CYL_NR) - 1
(10)THEN
        (9)FOR cylinder_start to cylinder_stop DO
                LV_EGY_RNG_IV_PLS_2_HOM[x] = 1
        (9)ENDFOR
(10)ELSE
        (10)FOR cylinder_start to cylinder_stop DO
                LV_EGY_RNG_IV_PLS_2_HOM[x] = 0
        (10)ENDFOR
(10)ENDIF
(9)ENDIF
(11)IF STATE_INJ_MOD_HOM_REQ = "MPLH+PLS3"
(11)THEN
    (12)IF LF_EGY_RNG_IV_3_HOM_REQ = (2^NC_CYL_NR) - 1
    (12)THEN
        (11)FOR cylinder_start to cylinder_stop DO
                LV_EGY_RNG_IV_PLS_3_HOM[x] = 1
        (11)ENDFOR
    (12)ELSE
        (12)FOR cylinder_start to cylinder_stop DO
                LV_EGY_RNG_IV_PLS_3_HOM[x] = 0
        (12)ENDFOR
    (12)ENDIF
(11)ENDIF
(1)ENDIF - LC_EGY_RNG_IV_CYL_IND_DI
```

To keep the interface to the monitoring unit stable, LV_IV_EGY_RNG_1, LV_IV_EGY_RNG_2 and LV_IV_EGY_RNG_3 have to be set to the values of the homogeneous path in case of requested homogeneous injection or to the values of the stratified path else.

```
if(1)   {(STATE_INJ_MOD_REQ & NC_INJ_MOD_MASK_1) = NC_INJ_MOD_HOM}
then
        global requested injection mode is homogeneous mode; use homogeneous
        values
        LV_IV_EGY_RNG_1 =
                LV_EGY_RNG_IV_PLS_1_HOM[CTR_CYL_NR_ST_CLC_INJR]
        LV_IV_EGY_RNG_2 =
                LV_EGY_RNG_IV_PLS_2_HOM[CTR_CYL_NR_ST_CLC_INJR]
        LV_IV_EGY_RNG_3 =
                LV_EGY_RNG_IV_PLS_3_HOM[CTR_CYL_NR_ST_CLC_INJR]
else
        global requested injection mode is homs or stratified mode; use stratified values
        LV_IV_EGY_RNG_1 =
                LV_EGY_RNG_IV_PLS_1_S[CTR_CYL_NR_ST_CLC_INJR]
        LV_IV_EGY_RNG_2 =
                LV_EGY_RNG_IV_PLS_2_S[CTR_CYL_NR_ST_CLC_INJR]
        LV_IV_EGY_RNG_3 =
                LV_EGY_RNG_IV_PLS_3_S[CTR_CYL_NR_ST_CLC_INJR]
endif(1)
```

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7.37 Injector needle lift control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EGY_MAX_V_LIM [NC_CYL_NR]	V	0... FFFFH	0... 255	0.00389105	mJ
Maximum limit of energy after voltage limiter					
EGY_SP [NC_CYL_NR]	V	0... FFFFH	0... 255	0.00389105	mJ
Energy setpoint for piezo injector energy controller after voltage limiter					
EGY_SP_NOT_LIM [NC_CYL_NR]	V	0... FFFFH	0... 255	0.00389105	mJ
Unlimited energy setpoint for piezo injector energy controller					
EGY_STEP_INJ_CHA_GRD [NC_CYL_NR]	O/V	0... 4000H	0... 100	0.00610352	%
Piezo injector energy charge gradient for a single step					
EGY_STEP_INJ_CHA_GRD_BAS [NC_CYL_NR]	O/V	0... 4000H	0... 100	0.00610352	%
Piezo injector base energy charge gradient for a single step, without adaptation corrections.					
EGY_STEP_INJ_CHA_GRD_L [NC_CYL_NR]	O/V	0... 4000H	0... 100	0.00610352	%
Piezo injector energy charge gradient for low injector needle lift.					
EGY_STEP_INJ_CHA_GRD_OFS	V	E000... 2000H	0... 50	0.00610352	%
Piezo injector energy charge and discharge gradient offset					
EGY_STEP_INJ_CHA_LIM_DIF [NC_CYL_NR]	O/V	0... 4000H	0... 100	0.00610352	%
Difference of piezo stack energy, which is over the voltage limit					
EGY_STEP_INJ_DCHA_GRD [NC_CYL_NR]	O/V	0... 4000H	0... 100	0.00610352	%
Piezo injector energy discharge gradient for a single step					
EGY_STEP_INJ_DCHA_GRD_L [NC_CYL_NR]	O/V	0... 4000H	0... 100	0.00610352	%
Piezo injector energy discharge gradient for low injector needle lift.					
FAC_EGY_COR_FIL_TMP [NC_CYL_NR]	-	8000... 7FFFH	0... 0.99996948	305.176e3	%/mJ
Temporary correction factor after PT1 filter, cylinder individual					
FAC_EGY_COR_I_TMP [NC_CYL_NR]	-	8000... 7FFFH	0... 0.99996948	305.176e3	%/mJ
Temporary correction factor before Integrator, cylinder individual					
FAC_EGY_PWM_AD [NC_CYL_NR]	O/V/S	0... FFFFH	0... 1.99996948	305.176e3	%/mJ
Conversion factor: EGY to % PWM for piezo injector					
FAC_EGY_PWM_AD_INI [NC_CYL_NR]	-	0... FFFFH	0... 1.99996948	305.176e3	%/mJ
Conversion factor: EGY to % PWM for piezo injector at RESET					
LV_EGY_AD_ENA	V	0... 1H	0 ...1	1	-
Piezo energy adaption is enabled and active, if set					
LV_EGY_PWM_LIM [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Piezo stack energy demand over 100% PWM					
LV_EGY_STEP_INJ_CHA_LIM [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Piezo stack energy is out of limit (over voltage protection)					
LV_V_LIM_ENA	V	0... 1H	0 ...1	1	-
Piezo voltage limitation is enabled and active, if set					
MAX_INJ_EGY_LEVEL	O/V	E000... 2000H	0... 50	0.00610352	%
Maximum correction value of injector energy level (calibrateable)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MIN_INJ_EGY_LEVEL	O/V	E000... 2000H	0... 50	0.00610352	%
Minimum correction value of injector energy level (calibrateable)					
NR_EGY_CTL_CYL_CLC	V	0... 7H	0 ...7	1	-
Cylinder for that the injector needle lift control is calculated					
TEMP_SEL_EGY_CTL	V	0... FEH	0... 142.5	0.75	°C
Selected temperature for engergy controller functions.					
V_INJ_IV_ERR	-	8000... 7FFFH	0... 639.980469	0.01953125	V
Control error of voltage dependent energy limiter					

Input data:

EGY_ADD_AD [NC_CYL_NR] {p. 2260}	EGY_ADD_COR_EXT [NC_CYL_NR] {p. 2289}	EGY_ADD_DUCY {p. 2230}	EGY_ADD_FUP [NC_CBK_HPP_NR] {p. 2228}
EGY_ADD_TEMP {p. 2226}	EGY_IV_1_CLC [NC_CYL_NR] {p. 2036}	EGY_SP_IV_EXT [NC_CYL_NR] {p. 2289}	FUP_H_INJ [NC_CBK_HPP_NR] {p. 3327}
LV_EGY_ADD_AD_LIM [NC_CYL_NR] {p. 2261}	LV_EGY_ADD_AD_LIM_TOL [NC_CYL_NR] {p. 2261}	LV_EGY_RNG_IV_PLS_1_ACK [NC_CYL_NR] {p. 2038}	LV_ES {p. 1720}
LV_IV_MES_VLD {p. 2038}	MFF_SP_MV {p. 2151}	N {p. 1525}	NC_CBK_HPP_NR [1] {p. 812}
NC_CYL_NR {p. 1526}	NC_IDX_CYL_HPP_REF [NC_CYL_NR] {p. 626}	NC_PWM_EGY_INJ_MAX {p. 628}	NC_PWM_EGY_INJ_MIN {p. 628}
NR_CYL_INJ_BAS {p. 2039}	SEG_CTR {p. 1525}	STATE_DIAG_IV {p. 4803}	TCO {p. 1100}
TECU {p. 1256}	TEMP_CAPA_IV_MV {p. 2241}	TFU_INJ {p. 3332}	TI_1_MES [NC_CYL_NR] {p. 2040}
V_IV_1_MES [NC_CYL_NR] {p. 2041}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EGY_BAS_INJ_SP_H	-	0... FFFFH	0... 255	0.00389105	mJ
Energy base value for piezo injector at high needle lift					
C_EGY_CTL_ENA_THD_MAX	-	0... FFFFH	0... 255	0.00389105	mJ
Upper energy threshold to activate controller					
C_EGY_CTL_ENA_THD_MIN	-	0... FFFFH	0... 255	0.00389105	mJ
Lower energy threshold to activate controller					
C_EGY_CTL_I_GAIN	-	0... FFFFH	0... 1.99996948	305.176e3	%/mJ
Integral gain for piezo energy controller					
C_EGY_CTL_P_GAIN	-	0... FFFFH	0... 1.99996948	305.176e3	%/mJ
proportional gain for energy controller					
C_EGY_INJ_MAX_LIM	-	0... FFFFH	0... 255	0.00389105	mJ
Maximum value for voltage dependent injector energy limiter					
C_EGY_STEP_INJ_CHA_GRD [NC_CYL_NR]	-	0... 4000H	0... 100	0.00610352	%
Piezo injector energy charge and discharge gradient for a single step					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_COR_EGY_STEP_INJ_DCHA_GRD	-	0... FFFFH	0... 1.99996948	305.176e3	-
Multiplicative correction factor for cylinder balancing influence on discharge gradient calculation					
C_FAC_EGY_PWM_AD_MAX	-	0... FFFFH	0... 1.99996948	305.176e3	%/mJ
Maximal value of conversion factot EGY to % PWM					
C_FAC_EGY_PWM_AD_MIN	-	0... FFFFH	0... 1.99996948	305.176e3	%/mJ
Minimal value of conversion factot EGY to % PWM					
C_FAC_EGY_PWM_MAN [NC_CYL_NR]	-	0... FFFFH	0... 1.99996948	305.176e3	%/mJ
Manually set conversion factor: EGY to % PWM for piezo injector					
C_FAC_LPF_EGY_PWM_AD	-	0... FFH	0... 0.99609375	0.00390625	-
Factor for PT1 Filter for calculation of FAC_EGY_PWM_AD					
C_MAX_INJ_EGY_LEVEL_COR	-	E000... 2000H	0... 50	0.00610352	%
Maximum correction value of injector energy level					
C_MIN_INJ_EGY_LEVEL_COR	-	E000... 2000H	0... 50	0.00610352	%
Minimum correction value of injector energy level					
C_PWM_FAC_COR_EGY_GRD_DCHA_L	-	0... FFFFH	0... 1.99996948	305.176e3	-
Factor to correct the energy discharge gradient for low needle lift.					
C_PWM_FAC_COR_EGY_GRD_H_L	-	0... FFFFH	0... 1.99996948	305.176e3	-
Factor to correct the energy gradient for low needle lift regarding the energy gradient for high needle lift.					
C_PWM_LIM_V_MAX_I_GAIN	-	0... FFFFH	0... 1.99996948	305.176e3	mJ/V
Integral gain for PWM limiting related to stack voltage					
C_PWM_OFS_COR_EGY_GRD_DCHA_L	-	E000... 2000H	0... 50	0.00610352	%
Offset to correct the energy discharge gradient for low needle lift.					
C_PWM_OFS_COR_EGY_GRD_H_L	-	E000... 2000H	0... 50	0.00610352	%
Offset to correct the energy gradient for low needle lift regarding the energy gradient for high needle lift.					
C_PWM_OFS_COR_STEP_INJ_DCHA_GRD	-	E000... 2000H	0... 50	0.00610352	%
Offset of injector discharge gradient					
C_SEG_CTR_EGY_AD_ENA	-	0... FFFFH	0... 65535	1	-
Number of segments for activation of piezo energy adaptation					
C_TECU_MIN_EGY_CTL_ENA	-	0... FEH	0... 142.5	0.75	°C
Minimum ECU temperature to activate piezo injector energy controller.					
C_TEMP_MIN_EGY_CTL_ENA	-	0... FEH	0... 142.5	0.75	°C
Minimum selected temperature to activate piezo injector energy controller.					
C_TEMP_SEL_EGY_CTL	-	0... FFH	0... 255	1	-
Switch to select temperature for energy controller functions; 0: TEMP_CAPA_IV_MV, 1: TFU_INJ, 2: TCO;					
C_TI_EGY_CTL_CLC_MIN	-	0... FFFFH	0... 65.535	0.001	ms
Minimum injection time limit for calculation of energy control					
IP_EGY_STEP_INJ_CHA_GRD_OFS	-	0... 4000H	0... 50	0.00610352	%
LDP_FUP_IP_EGY_STEP_INJ_CHA_GRD	6	0... FFFFH	0... 347776	5.3067216	hPa
LDP_TFU_INJ_IP_EGY_STEP_INJ_CHA	4	0... FEH	0... 142.5	0.75	°C
Piezo injector energy charge and discharge gradient offset for a single step					
IP_V_IV_MAX	-	0... 7FFFH	0... 639.980469	0.01953125	V
LDP_TFU_INJ_IP_V_IV_MAX	6	0... FEH	0... 142.5	0.75	°C
Maximum allowed voltage on piezo stack before limiting					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_EGY_ADD_AD_LIM_ENA	-	0... 1H	0 ...1	1	-
Enable blocking of adaption if additive corrections (EGY_ADD_AD) are limited					
LC_EGY_SP_IV_EXT_ENA	-	0... 1H	0 ...1	1	-
Logical constant to enable external energy setpoint for injector energy controller					
LC_EGY_STEP_CTL_DYN_ENA	-	0... 1H	0 ...1	1	-
Enable complete piezo energy controller					
LC_ENA_ADAP_EGY_CTL	-	0... 1H	0 ...1	1	-
Enable new adaptation of piezo energy controller values after engine start					

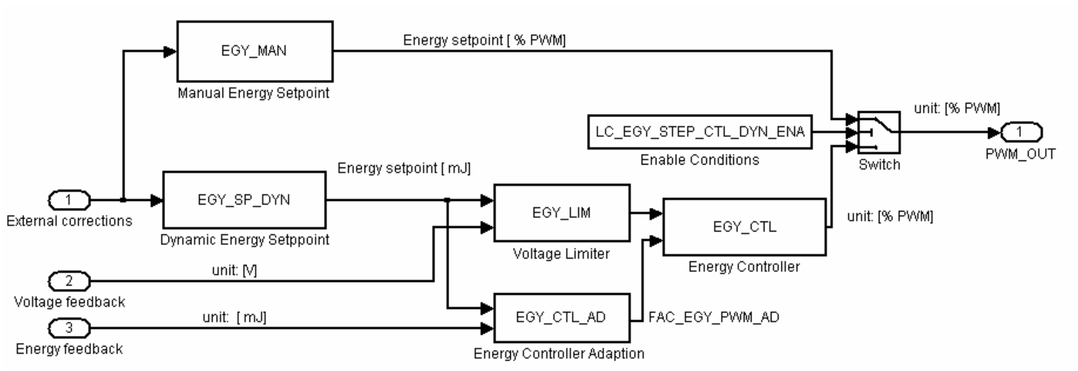
Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_EGY_RNG_H	-	0... 1H	0 ...1	1	-
Symbolic constant for usage of high energy range of PIEZO injection valve					

Exported actions:

ACTION_INJR_**SetFacEgyPwmAd** (IN <Cyl>, IN <Fac>)
Sets the cylinder individual conversion factor FAC_EGY_PWM_AD of cylinder <Cyl> to value <Fac>.

7.37.1 Controller concept overview



There are several modes to operate the piezo energy controller unit.
If **LC_EGY_STEP_CTL_DYN_ENA** is FALSE, the manual set point calculation with direct feed through to the PWM output is active.
Otherwise the dynamic set point calculation and voltage limiter are activated.
For the voltage limiter are proper feedback conditions necessary.
The adaption of the conversion factor FAC_EGY_PWM_AD is calculated, if switched ON only, and if proper feedback is granted.

Value of NC_EGY_RNG_H = 1.

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7.37.1.1 Description for ACTION_INJR_SetFacEgyPwmAd

ACTION_INJR_SetFacEgyPwmAd (IN <Cyl>, IN <Fac>)					
Sets the cylinder individual conversion factor FAC_EGY_PWM_AD of cylinder <Cyl> to value <Fac>.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
Cyl	IN	0...7 H	0...7	1	1
This action affects the conversion factor FAC_EGY_PWM_AD of cylinder Cyl.					
Fac	IN	0...FFFFH	0...1.99996948	3.05176 E-5	%/mJ
This parameter defines the new value of FAC_EGY_PWM_AD.					

Formula Section for ACTION_INJR_SetFacEgyPwmAd:

FAC_EGY_PWM_AD[Cyl] = Fac

Application Condition

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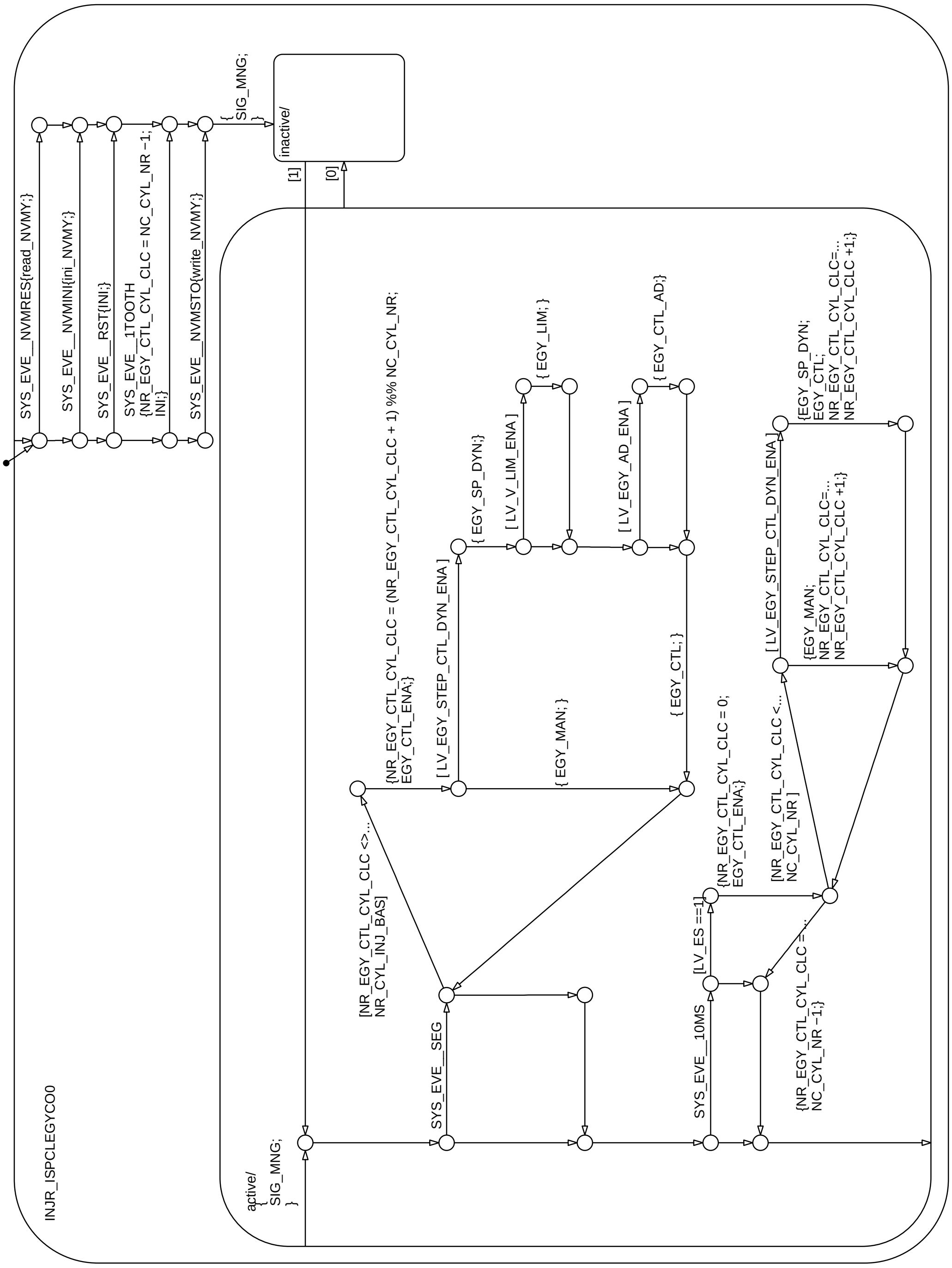

Figure 7.37.1: INJR_ISPCLEGYCO0/APP_CDN/Chart

Function Description

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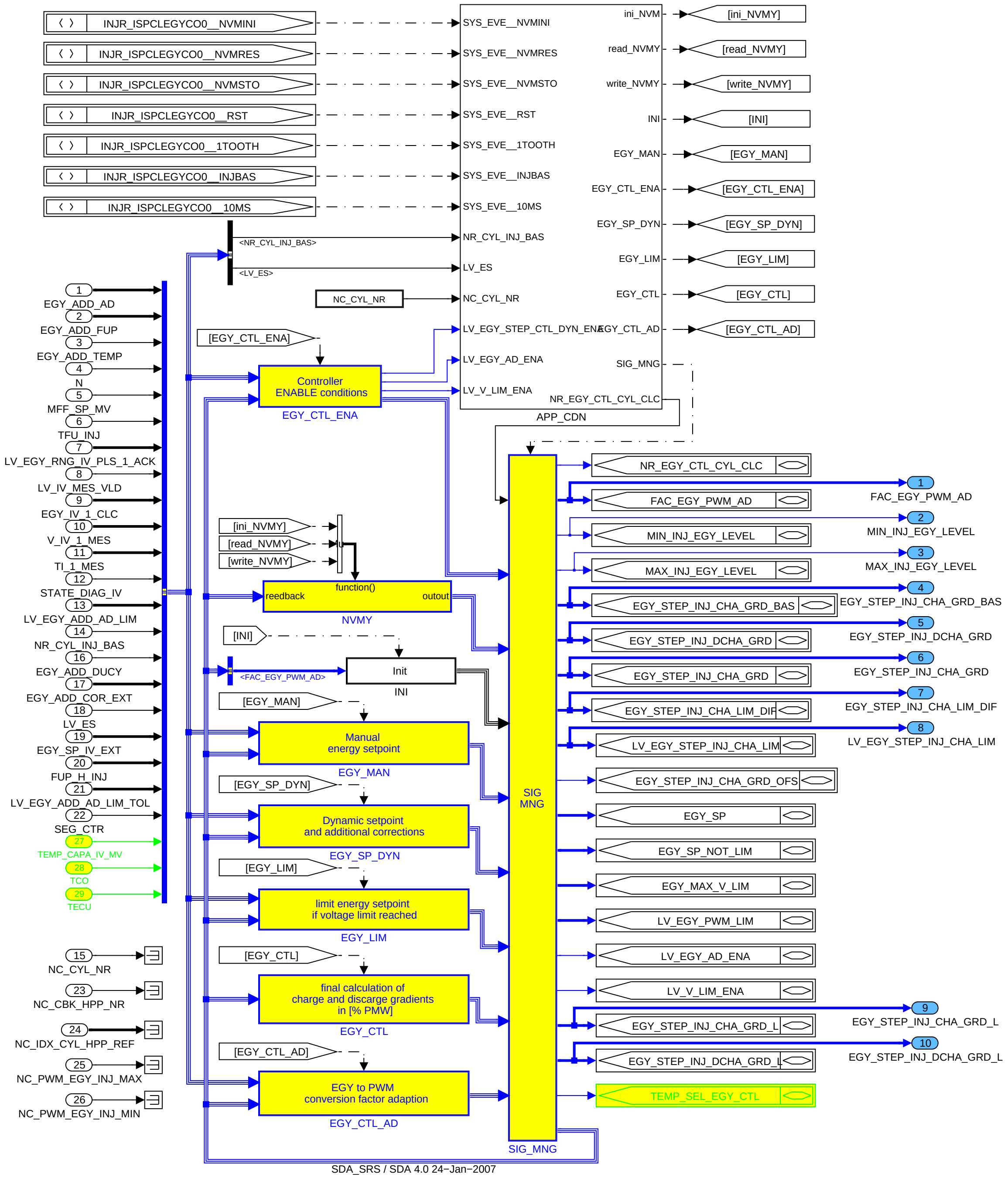

Figure 7.37.2: INJR_ISPCLEGYCO0

7.37.1.2 Handling of nonvolatile memory

The conversion factor FAC_EGY_PWM_AD is stored in the nonvolatile memory. It is read and written to the NVMY before/after each complete driving cycle. The NVMY is initialized with C_FAC_EGY_PWM_MAN.

7.37.1.3 Initialization

Do all initializations at RESET

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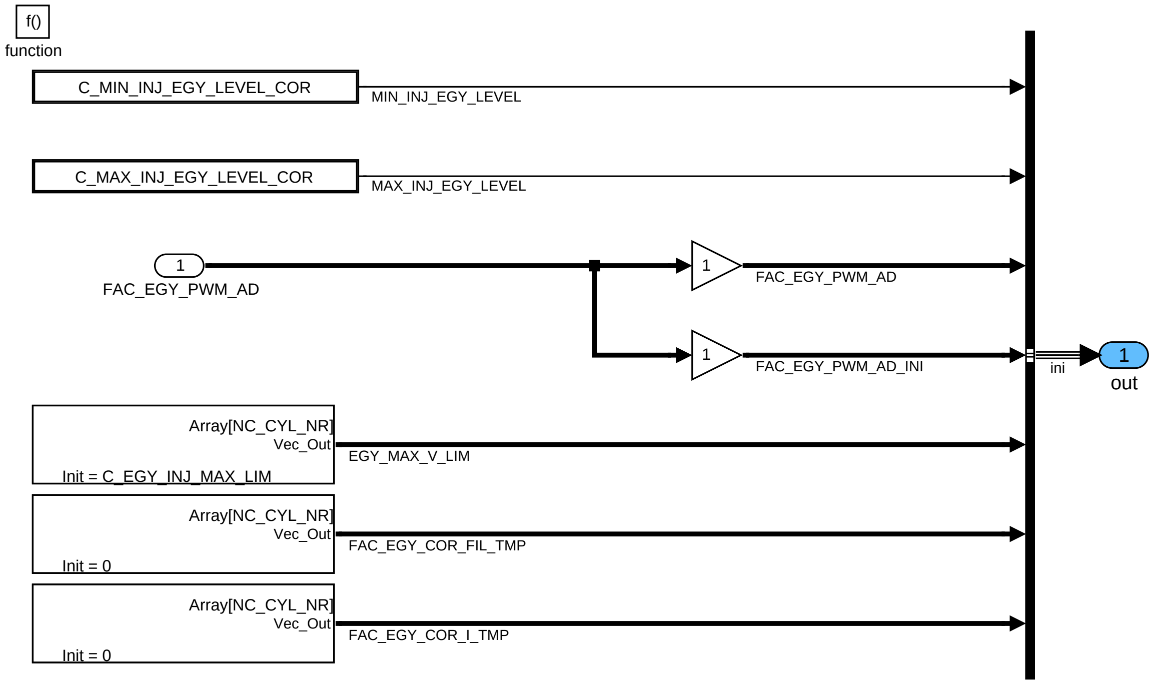

Figure 7.37.3: INJR_ISPCLEGYCO0/INI

7.37.1.4 SUBFUNCTION: EGY_MAN

Manual set point calculation and direct PWM signal output

If dynamic control is not enabled the manual set point is written directly to PWM outputs

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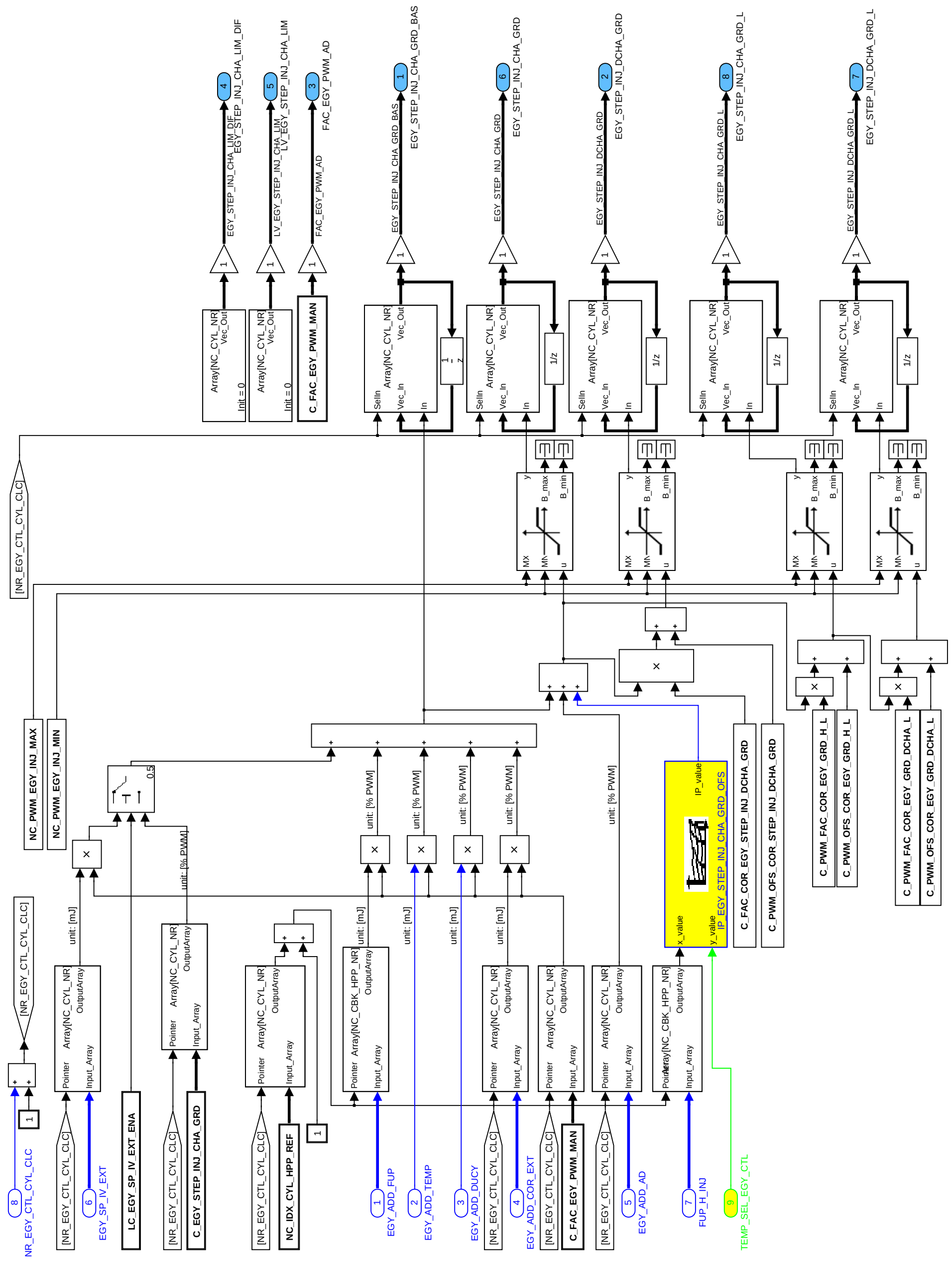

Figure 7.37.4: INJR_ISPCLEGYCO0/EGY_MAN/EGY_SP_MAN

7.37.1.5 SUBFUNCTION: EGY_CTL_ENA

ENABLE conditions for energy controller and controller gain adaption

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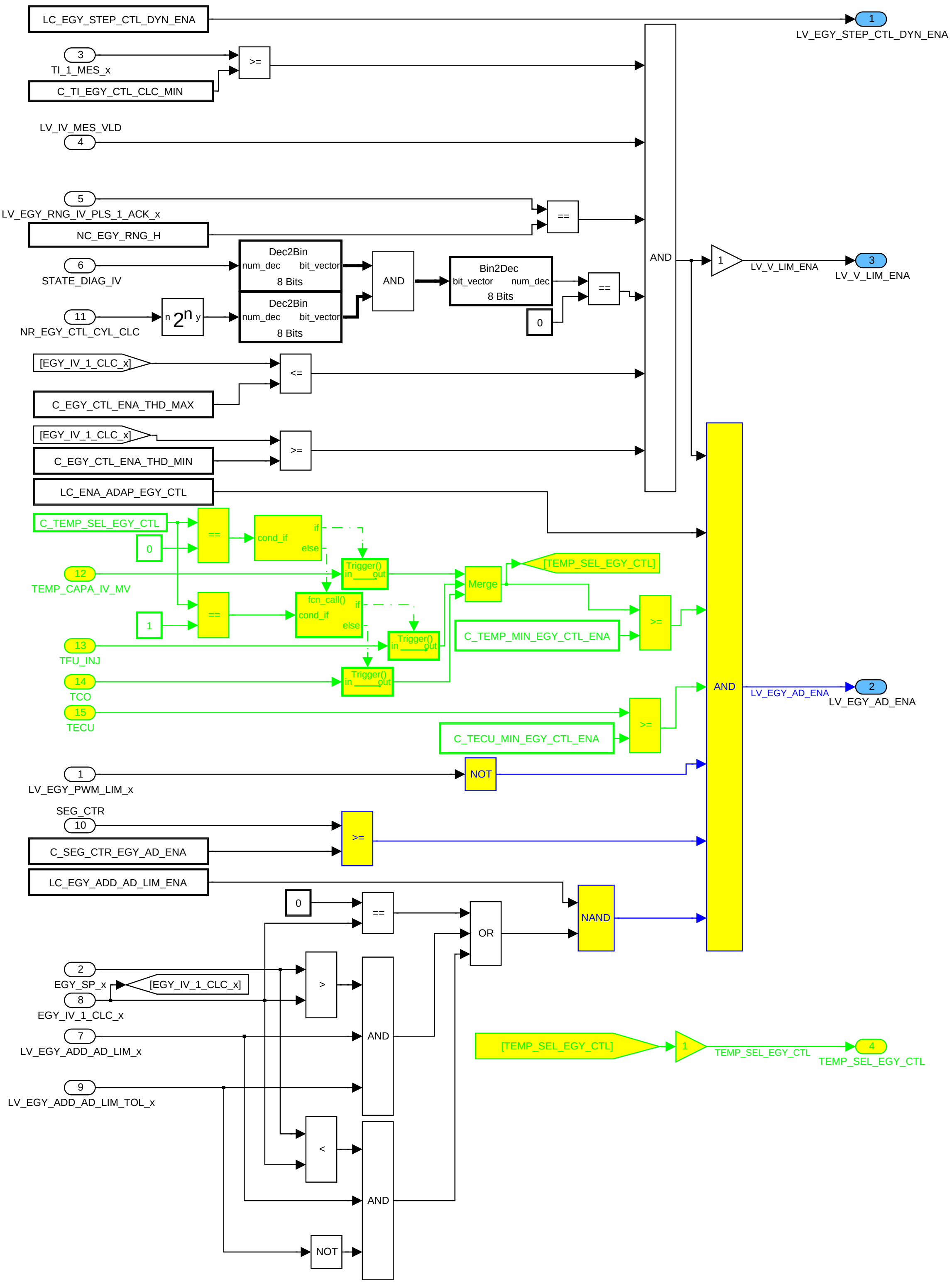

Figure 7.37.5: INJR_ISPCLEGYCO0/EGY_CTL_ENA/EGY_CTL_ENA_x

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7.37.1.6 SUBFUNCTION: EGY_SP_DYN

Dynamic Energy set point calculation with additional correction

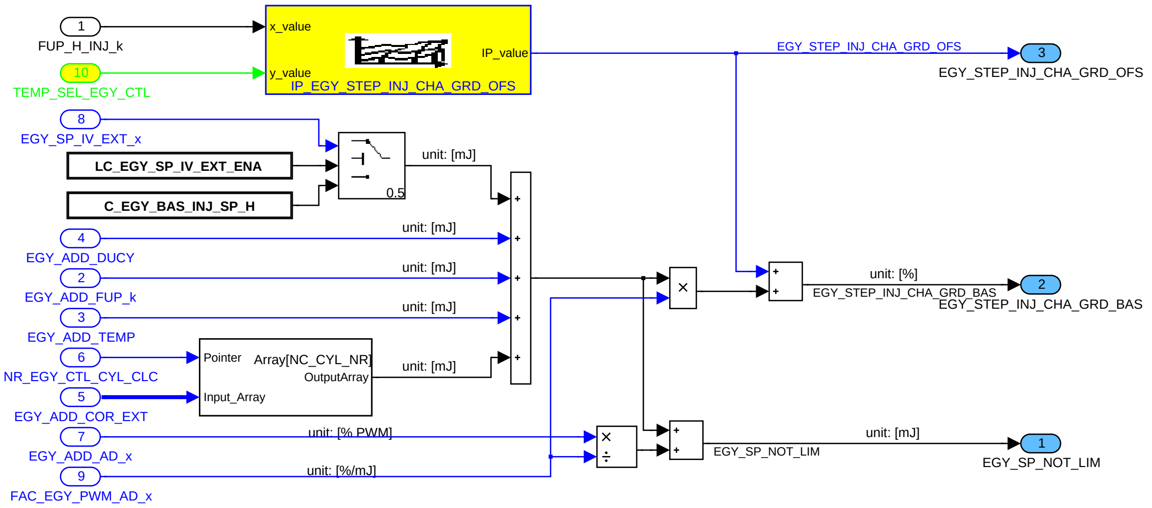

Figure 7.37.6: INJR_ISPCLEGYCO0/EGY_SP_DYN/EGY_SP_DYN_x

7.37.1.7 SUBFUNCTION: EGY_LIM

Limitation of energy set point if stack voltage limit is reached

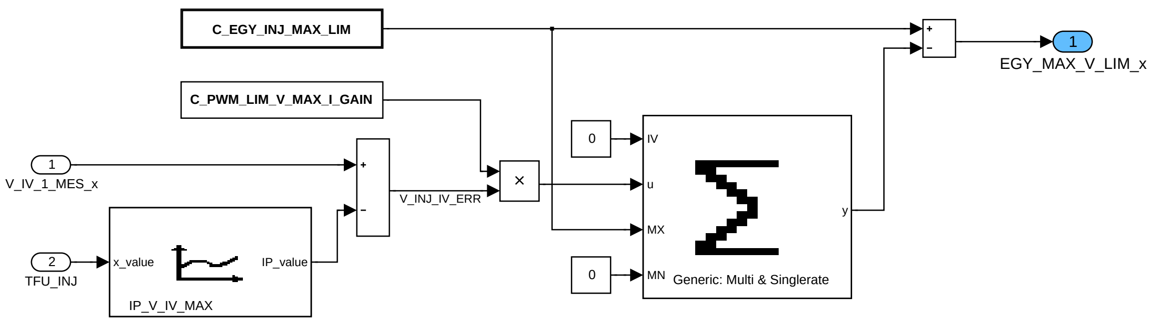

Figure 7.37.7: INJR_ISPCLEGYCO0/EGY_LIM/EGY_LIM_x

7.37.1.8 SUBFUNCTION: EGY_CTL

Energy controller for direct calculation of PWM signal out of energy set point

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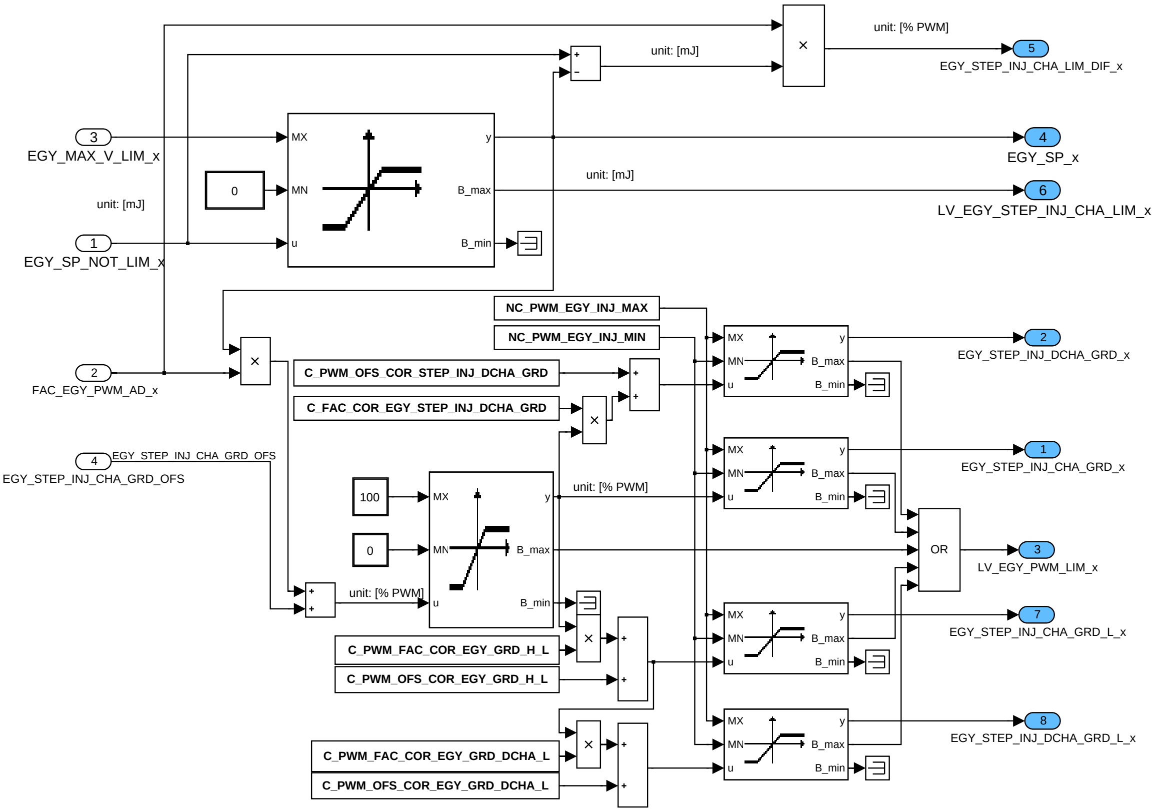

Figure 7.37.8: INJR_ISPCLEGYCO0/EGY_CTL/EGY_CTL_x

7.37.1.9 SUBFUNCTION: EGY_CTL_AD

Adaption of energy to PWM conversion factor FAC_EGY_PWM_AD

At RESET the factor is set to the stored value from the non volatile memory or to ’1’ if the stored value is not valid.
At Engine switch off the last learned value is stored to the NVMY.

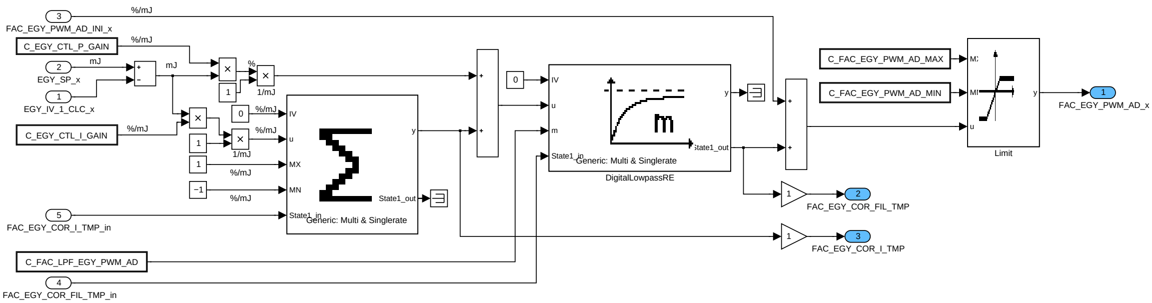

Figure 7.37.9: INJR_ISPCLEGYCO0/EGY_CTL_AD/EGY_CTL_AD_x

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7.38 Injector needle lift control (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DIST_IV_CHG [NC_CYL_NR]	O/V/S	0... FFFFH	0... 524280	8	km
Cylinder individual distance accumulation [8 km] at injector change					
EGY_ADD_COR_EXT [NC_CYL_NR]	O/V	8000... 7FFFH	0... 127.498054	0.00389105	mJ
External additive piezo energy correction					
EGY_SP_IV_EXT [NC_CYL_NR]	O/V	0... FFFFH	0... 255	0.00389105	mJ
External injection valve EGY setpoint value for energy controller					

Input data:

DIST_KWP {p. 1183}	EGY_LAM_ADJ_COR_ LAM_AD_CUS [NC_CYL_NR] {p. 8308}	EGY_SP_IV_EXT_ADJ [NC_CYL_NR] {p. 7679}	LF_ERR_PLAUS_IV_EGY_ CAL {p. 4790}
LV_ST_END {p. 1720}	MFF_SP_MV {p. 2151}	N {p. 1525}	NC_CYL_NR {p. 1526}
STATE_INJ_MOD_REQ {p. 3332}	STATE_IV_CHG {p. 7683}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EGY_SP_IV_EXT_ADJ [NC_CYL_NR]	-	0... FFFFH	0... 255	0.00389105	mJ
Default value for external energy setpoint for piezo injector energy controller calculation					
IP_EGY_ADD_COR_EXT_HOM	-	0... FFFFH	0... 127.498054	0.00389105	mJ
LDPM_N_IP_EGY_ADD_COR_EXT	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MFF_SP_IP_EGY_ADD_COR_EXT	8	0... FFFFH	0... 1389	0.02119478	mg/stk
Additive piezo injector energy correction depending on engine speed and load, HOM mode					
IP_EGY_ADD_COR_EXT_HOMS	-	0... FFFFH	0... 127.498054	0.00389105	mJ
LDPM_N_IP_EGY_ADD_COR_EXT	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MFF_SP_IP_EGY_ADD_COR_EXT	8	0... FFFFH	0... 1389	0.02119478	mg/stk
Additive piezo injector energy correction depending on engine speed and load, HOMS mode					
IP_EGY_ADD_COR_EXT_S	-	0... FFFFH	0... 127.498054	0.00389105	mJ
LDPM_N_IP_EGY_ADD_COR_EXT	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MFF_SP_IP_EGY_ADD_COR_EXT	8	0... FFFFH	0... 1389	0.02119478	mg/stk
Additive piezo injector energy correction depending on engine speed and load, S mode					
IP_EGY_ADD_IV_AGI_DIST	-	0... FFFFH	0... 127.498054	0.00389105	mJ
LDPM_DIST_IP_EGY_ADD_IV_AGI	16	0... FFFFH	0... 524280	8	km
Additive piezo energy depending on accumulated driving distance for compensation of aging effects					
LC_EGY_SP_IV_EXT_ADJ_ENA	-	0... 1H	0 ...1	1	-
Logical constant to enable external energy setpoint calculation for piezo injector energy controller					

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General information

This module generates an external cylinder individual set point for the piezo energy controller. EGY_ SP_IV_EXT. Furthermore an additive piezo energy correction is supplied. It is taken into account for the energy set point calculation.

Application Condition

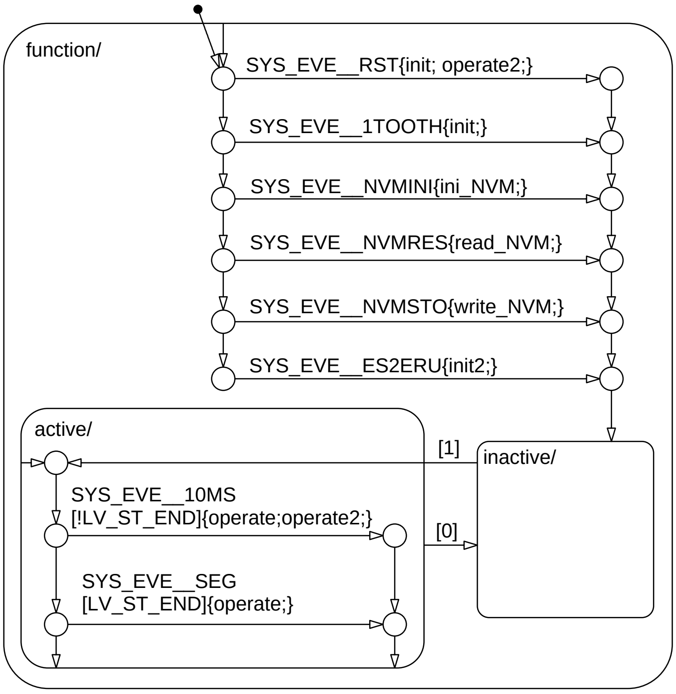

Figure 7.38.1: INJR_ISPCLEGYAI0/APP_CDN/Chart

Function Description

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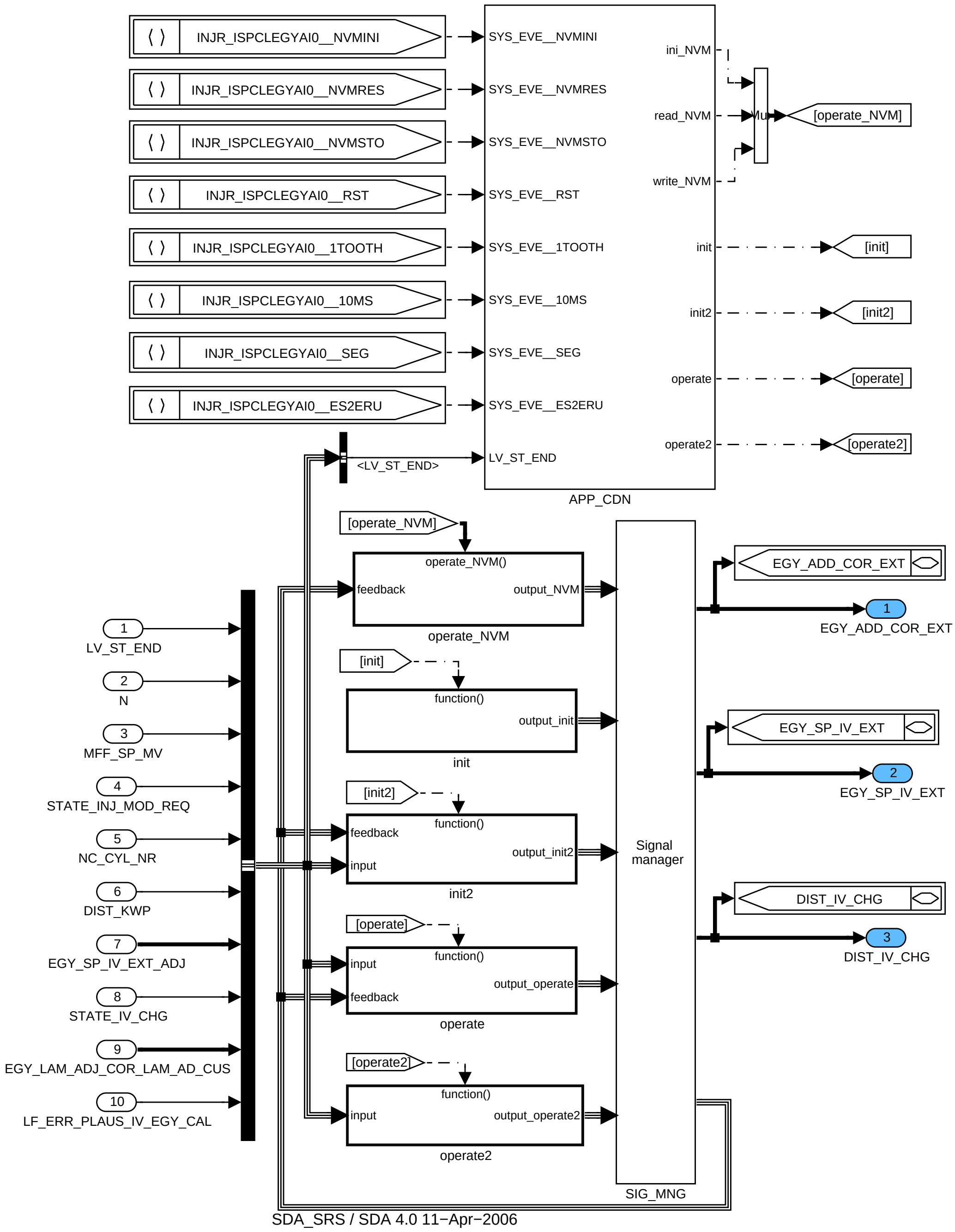

Figure 7.38.2: INJR_ISPCLEGYAI0

7.38.1 Nonvolatile memory operations

The accumulated driving distance at injector change DIST_IV_CHG is stored in the nonvolatile memory (NVM). It is read from and written to the NVM before/after each complete driving cycle.
Please note: DIST_IV_CHG has to be allocated in that part of the NVM-RAM which is not erased during reflashing of ECU.

7.38.2 Initialization at reset and first valid tooth

At reset and fist valid tooth the additive energy correction is set to 0.

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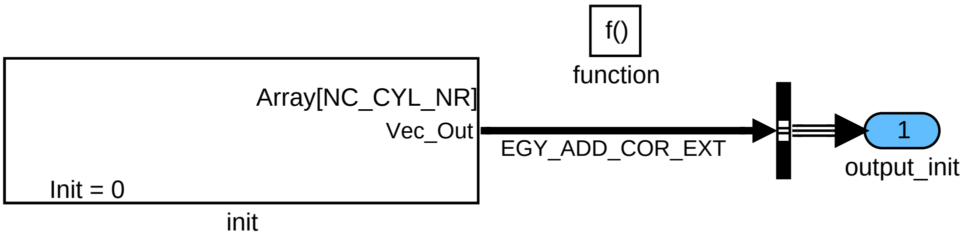

Figure 7.38.3: INJR_ISPCLEGYAI0/init

7.38.3 Calculation at engine stop to engine run

At ES2RUN it is determined whether an injection valve was changed: STATE_IV_CHG is provided by the keywordprotocol KWP and supplies a bit coded information: If the bit on position x is set the injector was changed. DIST_IV_CHG is the cylinder individual driving distance when the injector was changed. It is stored in the nonvolatile memory.

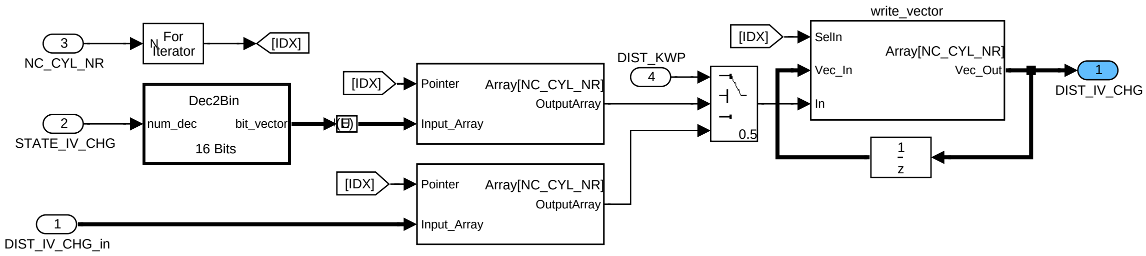

Figure 7.38.4: INJR_ISPCLEGYAI0/init2/ForIterator

7.38.4 Calculation of additive energy correction

An additive piezo energy correction depending on engine speed and load is supplied. Depending on the requested combustion modes (homogeneous, homogeneousstratified and stratified) different maps are used. Furthermore an additive correction accounting for aging effects of the piezo injection valve is supplied cylinder individually. The accumulated driving distance is used as an indicator for aging. It is given by the difference of the actual driving distance and the driving distance at the last injector change. EGY_LAM_ADJ_COR_LAM_AD_CUS accounts for the long term lambda adaptation.

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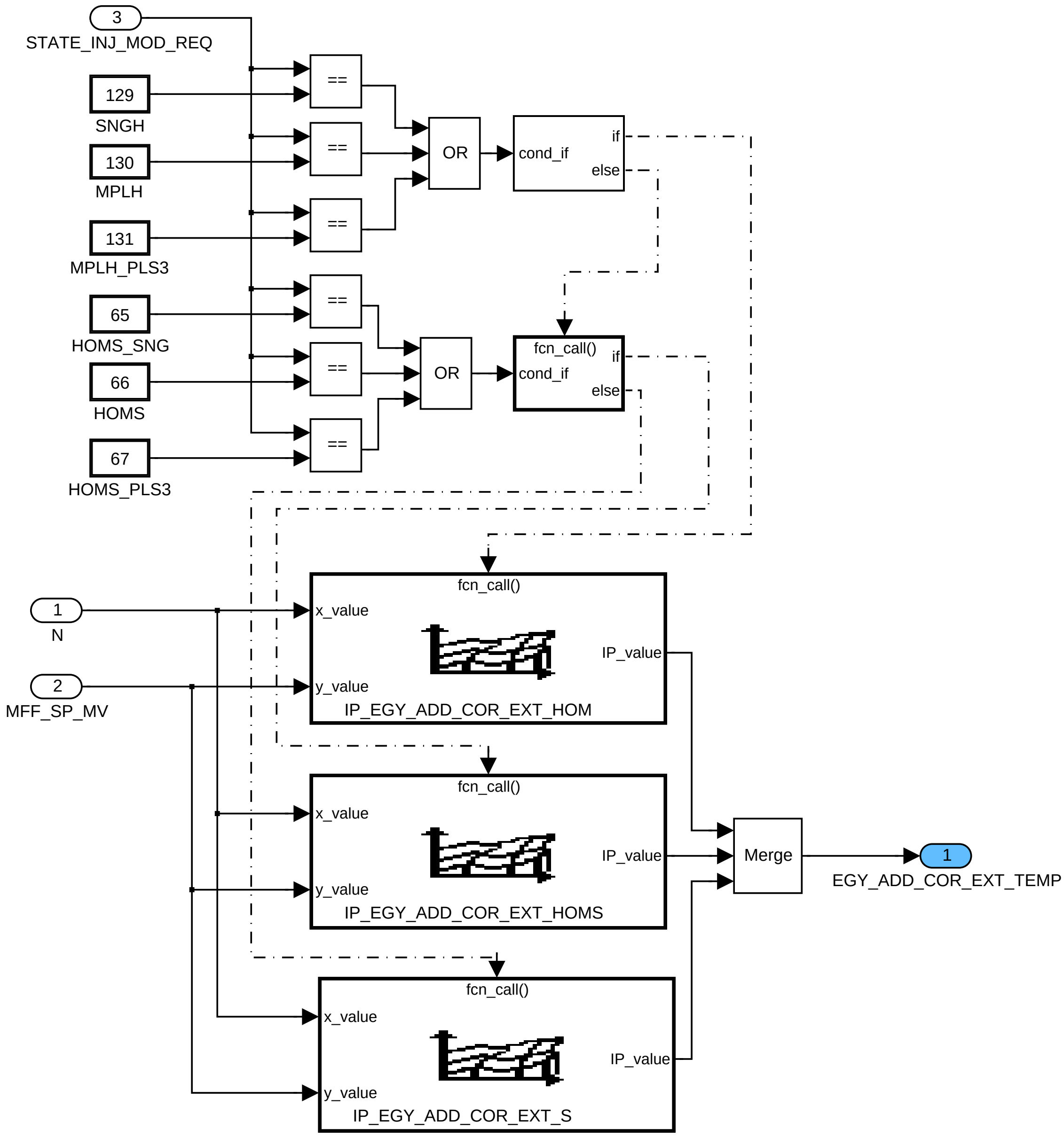

Figure 7.38.5: INJR_ISPCLEGYAI0/operate/CLC_EGY_ADD_COR_EXT

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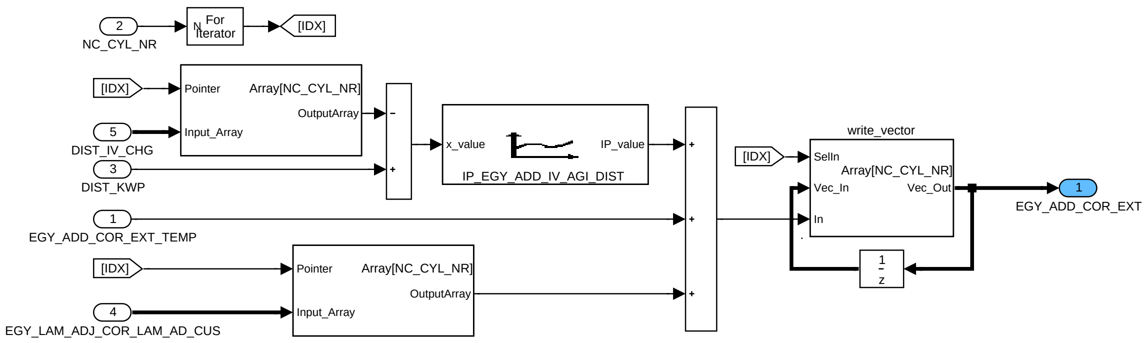

Figure 7.38.6: INJR_ISPCLEGYAI0/operate/ForIterator

7.38.5 External energy setpoint for energy controller

This functionality supplies a cylinder individual injection valve energy set point for the energy controller. It is set to EGY_SP_IV_EXT_ADJ given by the KWP if the cylinder individual values are plausible (bit x is zero in bit-mask LF_ERR_PLAUS_IV_EGY_CAL for logical cylinder x) and if LC_EGY_SP_IV_EXT_ADJ_ENA is set. Otherwise cylinder individual values can be supplied manually via the calibration constant C_EGY_SP_IV_EXT_ADJ.

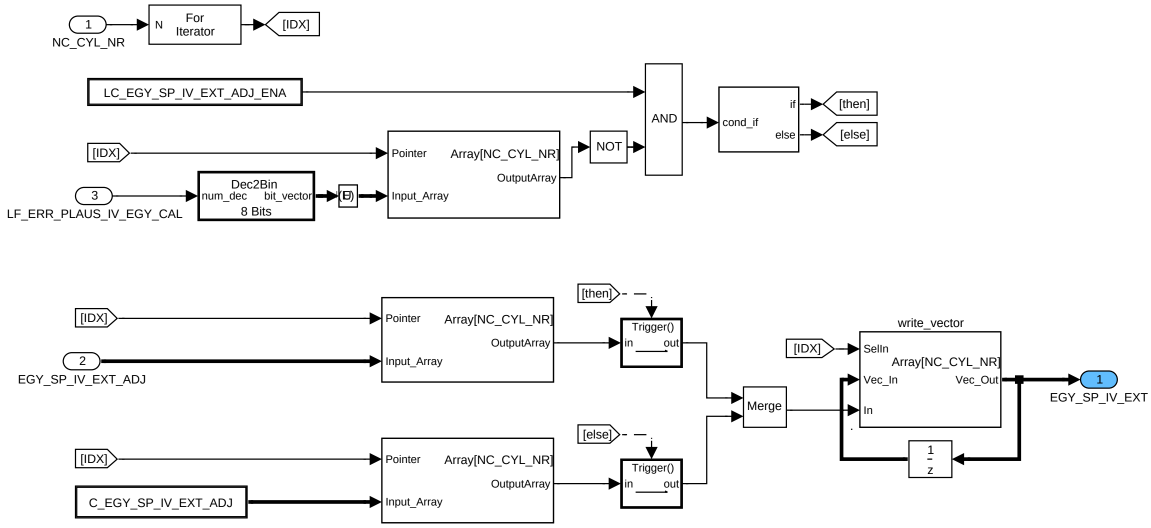

Figure 7.38.7: INJR_ISPCLEGYAI0/operate2/Calc_of_EGY_SP/For_Iterator

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7.39 Cylinder shut off

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INH_INJ	O/V	0... FFH	0... 255	1	-
Final cylinder shut off pattern (fixed cylinder allocation)					
INH_IV	O/V	0... FFH	0... 255	1	-
Shut off pattern for static cylinder shut off (fixed cylinder allocation)					
INH_IV_IGK	V	0... FFH	0... 255	1	-
Shut off pattern of IGK					
INH_IV_MON	V	0... FFH	0... 255	1	-
Shut off pattern of shut off request by monitoring concept					
INH_IV_N_MAX_REQ_FCUT	V	0... FFH	0... 255	1	-
Shut off pattern of LV_N_MAX_REQ_FCUT (engine speed limitation)					
INH_IV_PUC	V	0... FFH	0... 255	1	-
Shut off pattern of pull fuel shut off					
INH_SWI_IV	O/V	0... FFFFH	0... 65535	1	-
Shut off pattern for dynamic cylinder shut off					
LV_FCUT_IND	O/V	0... 1H	0 ...1	1	-
At least one cylinder is shut off					
LV_INJ_CUT	O/V	0... 1H	0 ...1	1	-
All cylinders shut-off					
LV_SCC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag that indicates static single cylinder shut off, exhaust cylinder bank individual					
NR_PAT	O/V	0... FFH	0... 255	1	-
Index corresponding to the highest shut off level (fuel shut off with pattern)					
NR_PAT_OLD	-	0... FFH	0... 255	1	-
Index corresponding to the highest shut off level (fuel shut off with pattern) from previous calculation run					
STATE_INH_IV_DYN	O/V	0... FFFFFFFFH	0... 4294967295	1	-
State of the dynamic cylinder shut off request					
SUM_INH_INJ	O/V	0... 8H	0 ...8	1	-
Sum of INH_INJ					
SUM_INH_IV	O/V	0... 8H	0 ...8	1	-
Sum of INH_IV					
SUM_INH_IV_CBK [NC_CBK_EX_NR]	O/V	0... 8H	0 ...8	1	-
Sum of those bits within INH_IV which are allocated to exhaust cylinder bank i					
SUM_INH_IV_DYN	O/V	0... 8H	0 ...8	1	-
Sum of INH_IV_DYN					

Input data:

INH_IV_DYN {p. 2037}	INH_IV_EXT {p. 2304}	INH_IV_IGC {p. 4780}	INH_IV_MIS {p. 6237}
LF_IV_INH_PUC_EXT {p. 3330}	LV_ERR_TMP_MU_MC {p. 7072}	LV_IGK {p. 906}	LV_INJ_PUC_ENA {p. 3330}
LV_N_MAX_REQ_FCUT {p. 3779}	LV_OFF_IV_MON {p. 6877}	LV_PUC {p. 1720}	LV_SEL_CYL {p. 2307}
LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_INJ_INH_SWI_IV_SHIFT_NR {p. 626}

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NC_LAMB_REF [NC_CYL_NR] {p. 812}	NR_PAT_SCC {p. 6665}	NR_PAT_SEL_CYL {p. 2307}	

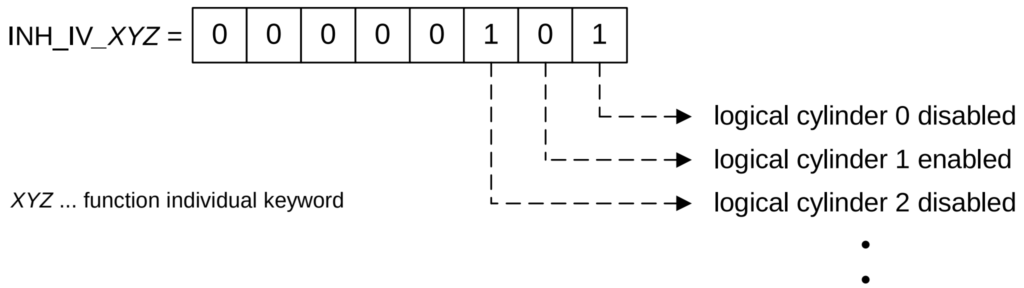
Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_INH_SWI_IV	-	0... FFFFH	0... 65535	1	-
LDP_NR_PAT_ID_INH_SWI_IV	17	0... FFH	0... 255	1	-
Cylinder shut off pattern for dynamic cylinder shut off					
LC_SWI_MOD_INH_IV_DYN	-	0... 1H	0 ...1	1	-
Mode switch between different dynamic fuel shut off algorithm					

General information

Static fuel shut off:

In several engine operating- and system states and in case of malfunctions of the injection or ignition system the fuel injection must be disabled at individual cylinders. All the shut off requirements are coordinated, hence these requirements have to have the same structure as described below:



Dynamic fuel shut off:

The information which cylinder has to be shut off static, is coded within a byte (with the length of 8 bit) at the cylinder corresponding position.

In some engine operating states, e. g. fast torque reduction, restart fuel feed or pull fuel cut off, the injection has to be disabled for a certain subsequent numbers of injections. The fuel cut off starts immediately at the next cylinder following an order defined in a pattern. That means, different to the cylinder individual static fuel shut off, there is no predefined and fixed association between cylinders and the shut off sequence.

Injections, which are already started, will not be stopped.

FUNCTION DESCRIPTION:

Application conditions

Activation: every engine state

Deactivation: –

Initialization: –

Reccurence: if LV_ST_END = 0: 10 ms
if LV_ST_END = 1: segment synchronous

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7.39.1 Static fuel shut off

7.39.1.1 Ignition Key

IF LV_IGK = 0

THEN all cylinders are shut off

INH_IV_IGK =

1	1	1	1	1	1	1	1

ELSE no cylinder is shut off

INH_IV_IGK =

0	0	0	0	0	0	0	0

ENDIF

7.39.1.2 Ignition System

INH_IV_IGC (Input pattern)

7.39.1.3 Monitoring Concept

IF (LV_OFF_IV_MON = 1) OR (LV_ERR_TMP_MU_MC = 1)

THEN all cylinders are shut off

INH_IV_MON =

1	1	1	1	1	1	1	1

ELSE no cylinder is shut off

INH_IV_MON =

0	0	0	0	0	0	0	0

ENDIF

7.39.1.4 Misfire Detection

INH_IV_MIS (Input pattern)

7.39.1.5 Pull Fuel Cut Off

To guarantee a moderate transition from trailing throttle PU to trailing throttle fuel cut off, the transition is handled by the module “Sequential fuel cut off and restart fuel feed”, see chapter Cylinder Individual Fuel Shut Off with Pattern. After the transition is finished (indicated by the flag LV_SEL_CYL) all cylinders are shut off by INH_IV_PUC.

IF LV_PUC = 1
AND
LV_SEL_CYL = 0

THEN
IF LV_INJ_PUC_ENA = 1
THEN

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INH_IV_PUC = LF_IV_INH_PUC_EXT

ELSE

all cylinders are shut off

INH_IV_PUC =

1	1	1	1	1	1	1	1

ENDIF

ELSE no cylinder is shut off

INH_IV_PUC =

0	0	0	0	0	0	0	0

ENDIF

7.39.1.6 Engine speed limitation

IF LV_N_MAX_REQ_FCUT = 1

THEN all cylinders are shut off

INH_IV_N_MAX_REQ_FCUT =

1	1	1	1	1	1	1	1

ELSE no cylinder is shut off

INH_IV_N_MAX_REQ_FCUT =

0	0	0	0	0	0	0	0

ENDIF

7.39.1.7 Shut Off Pattern from Application Incidences

INH_IV_EXT (Input pattern)

Additional shut off requirements are coordinated within the module “Cylinder Shut Off (Application Incidences)”.

7.39.1.8 Coordination of the Static Fuel Shut Off Requirements

The output pattern INH_IV is the bitwise OR of all pattern, linked with a mask ((2 $^{NC\_CYL\_NR}$)-1).
As an example see below:

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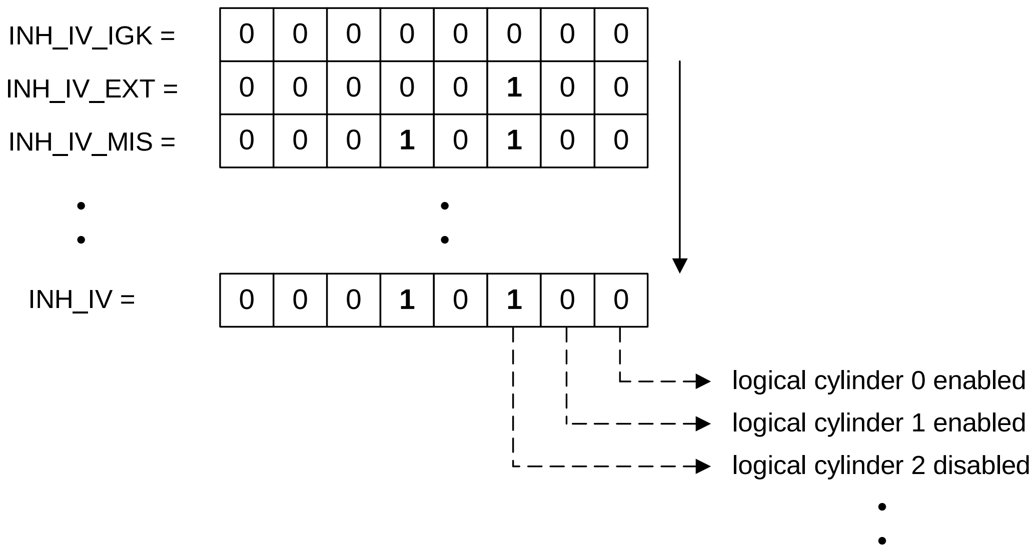

7.39.2 Dynamic fuel shut off

In some engine operating states, e. g. fast torque reduction, restart fuel feed or pull fuel cut off, the injection has to be disabled for a certain subsequent numbers of injections. The fuel cut off starts immediately at the next cylinder following an order defined in a pattern. That means, different to the cylinder individual static fuel shut off, there is no predefined and fixed association between cylinders and the shut off sequence.

Injections, which are already started, are not stopped.

The map ID_INH_SWI_IV contains (2 * NC_CYL_NR + 1) different pattern with calibrate able shut off sequences. Every pattern is allocated to an index NR_PAT (mapping points).
There are two requirements for “Dynamic fuel shut off” to this module:
NR_PAT_SEL_CYL is an index defined by the module “Sequential fuel cut off and restart fuel feed”.
NR_PAT_SCC is an index defined by the module “Torque based pattern calculation”.
NR_PAT is the index corresponding to the highest shut off level (number of cylinders disabled) of these both requirements. A certain pattern is repeated until this index changes.
NR_PAT_OLD = NR_PAT
NR_PAT = MAX (NR_PAT_SEL_CYL, NR_PAT_SCC)
INH_SWI_IV = ID_INH_SWI_IV
For example a map ID_INH_SWI_IV for an 8-cylinder engine with different shut off sequences (8 next injections):

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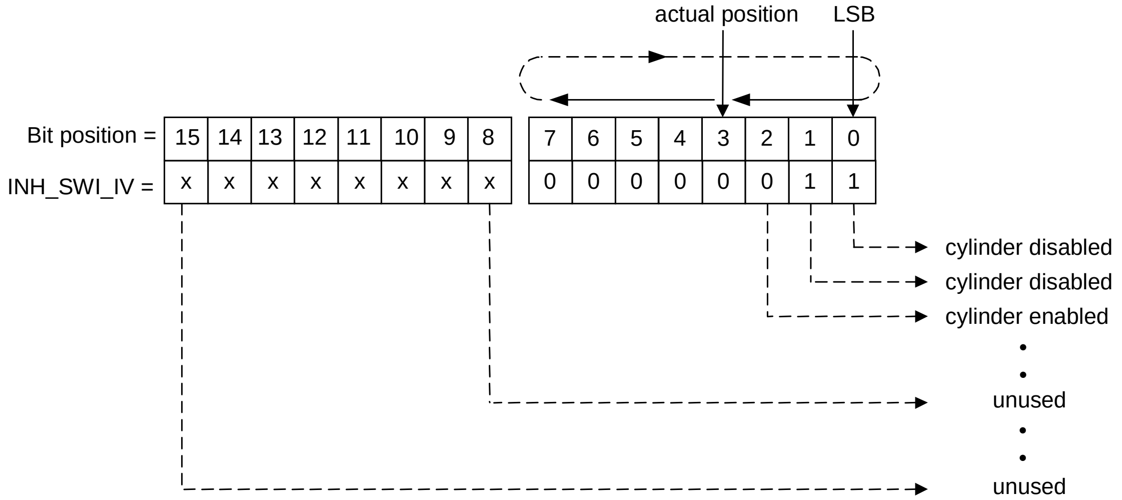
NR_PAT (Index)	Shut off sequence
0	xxxxxxxx 00000000
1	xxxxxxxx 00000001
2	xxxxxxxx 00000011
3	xxxxxxxx 00000111
4	xxxxxxxx 00001111
5	xxxxxxxx 00011111
6	xxxxxxxx 00111111
7	xxxxxxxx 01111111
8	xxxxxxxx 11111111
The following sequences can be used for reactivation of cylinders	
9	xxxxxxxx 11111111
10	xxxxxxxx 01111111
11	xxxxxxxx 00111111
12	xxxxxxxx 00011111
13	xxxxxxxx 00001111
14	Xxxxxxxx 00000111
15	xxxxxxxx 00000011
16	xxxxxxxx 00000001

Note:

To guarantee that the algorithm works correct, the table ID_INH_SWI_IV has to be applied as follows: The higher the index NR_PAT, the higher the number of cylinders deactivated.

INH_SWI_IV is defined as follows:



(e.g. NC_INJ_INH_SWI_IV_SHIFT_NR = 8, actual bit position = 4):

If the bit at a bit position = 1 → cylinder disabled
If the bit at a bit position = 0 → cylinder enabled

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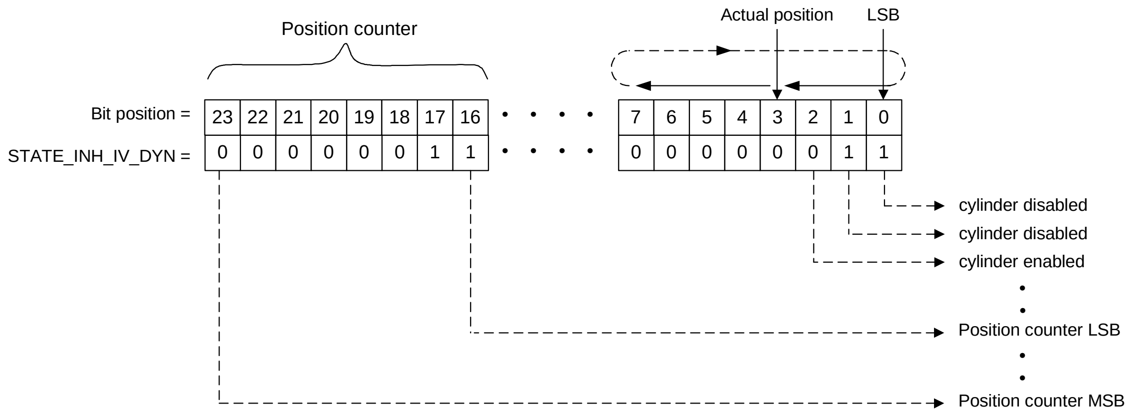
The length of the pattern is 16 bit. NC_INJ_INH_SWI_IV_SHIFT_NR defines how many bits are used for the shut off sequence.

NC_CYL_NR < = NC_INJ_INH_SWI_IV_SHIFT_NR < = 16

Calculation of STATE_INH_IV_DYN:

Definition of STATE_INH_IV_DYN:



Note! The position counter data field inside STATE_INH_IV_DYN will be updated at TRIG_EOI_LIM[x].
It contains the 'Actual position' inside the shut off pattern sequence.
Select between two different algorithm for STATE_INH_IV_DYN calculation:
(1) IF LC_SWI_MOD_INH_IV_DYN = 0
(1) THEN Classic mode: If NR_PAT increases, then STATE_INH_IV_DYN starts always with a new fuel cut off sequence and 'Actual position' will be set to zero. Otherwise the 'Actual position' stays unchanged and a new shut off pattern - or the old one - is used based on INH_SWI_IV - see picture above.

(2) IF NR_PAT > NR_PAT_OLD
(2) THEN
Start with a new fuel cut off sequence at the first bit position (LSB). Use as sequence the current content of INH_SWI_IV.
STATE_INH_IV_DYN = INH_SWI_IV

(2) ELSE
Continue with the fuel cut off sequence at 'Actual position' and change the shut off pattern depending on INH_SWI_IV:
STATE_INH_IV_DYN = STATE_INH_IV_DYN **AND** 0xFFFF0000 ...bitwise
OR ...bitwise
INH_SWI_IV **AND** 0x0000FFFF ...bitwise
Note! Pay attention of data consistency of STATE_INH_IV_DYN.
(2) ENDIF

(1) ELSE Modern mode: Only if NR_PAT was zero and increases, then STATE_INH_IV_DYN starts with a new fuel cut off sequence and 'Actual position' will be set to zero. Otherwise the 'Actual position' stays unchanged and a new shut off pattern - or the old one - is used based on INH_SWI_IV - see picture above.

(3) IF (NR_PAT_OLD = 0) **AND** (NR_PAT > NR_PAT_OLD)
(3) THEN

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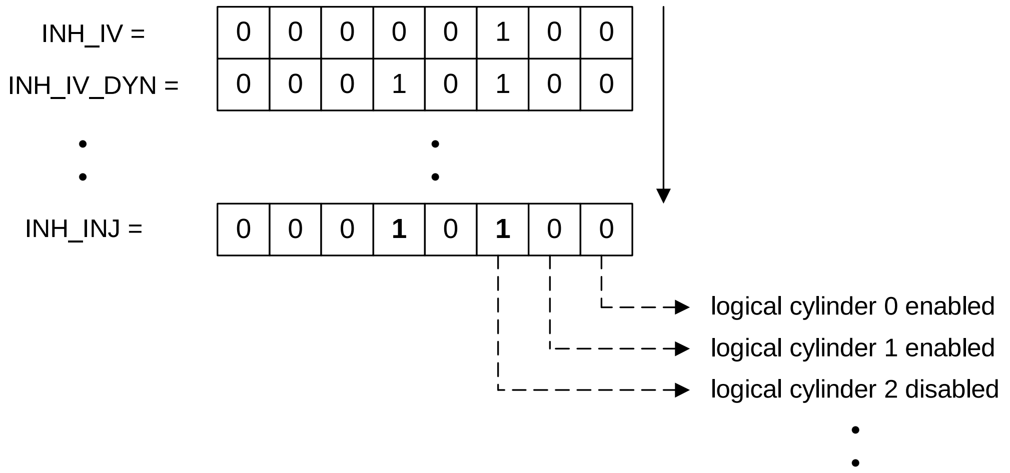
Start with a new fuel cut off sequence at the first bit position (LSB). Use as sequence the current content of INH_SWI_IV.
STATE_INH_IV_DYN = INH_SWI_IV

(3) ELSE
Continue with the fuel cut off sequence at 'Actual position' and change the shut off pattern depending on INH_SWI_IV:
STATE_INH_IV_DYN = STATE_INH_IV_DYN **AND** 0xFFFF0000 ...bitwise
OR ...bitwise
INH_SWI_IV **AND** 0x0000FFFF ...bitwise
Note! Pay attention of data consistency of STATE_INH_IV_DYN.
(3) ENDIF
(1) ENDIF

7.39.3 Coordination of shut off information for basic software (INH_INJ)

The output pattern INH_INJ is the bitwise OR of the pattern INH_IV and INH_IV_DYN, linked with a mask ((2 $^{NC\_CYL\_NR}$) -1).
As an example see below:



Note! Pay attention of data consistency of INH_IV.

7.39.4 Shut Off Status Information

SUM_INH_IV .... sum of INH_IV
SUM_INH_IV_CBK_i .... sum of those bits within INH_IV which are allocated to exhaust cylinderbank i, with i = 1 for exhaust cylinderbank 1 and i = 2 for exhaust cylinderbank 2.
SUM_INH_IV_DYN ..... sum of INH_IV_DYN
SUM_INH_INJ ..... sum of INH_INJ
Note! Pay attention on data consistency of SUM_INH_INJ and SUM_INH_IV_DYN

Note:

The allocation between physical cylinders and exhaust cylinderbank 1 and 2 is defined by the pattern NC_LAMB_REF. For example an 8 cylinder engine:

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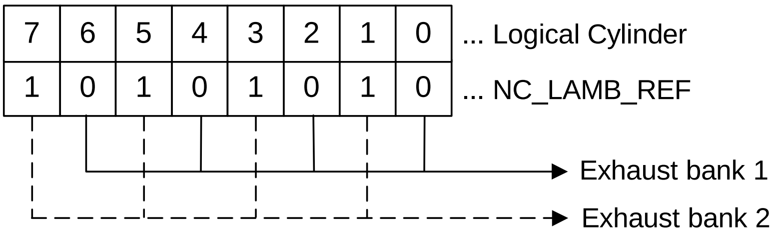

(1) IF SUM_INH_INJ ≠ 0
(1) THEN
LV_FCUT_IND = 1 (at least one cylinder is shut off)
1. **(2) IF** SUM_INH_INJ NC_CYL_NR
(2) THEN (all cylinders are shut off)
LV_INJ_CUT = 1
(3) FOR i = 1 **TO** NC_CBK_EX_NR **DO:**
LV_SCC[i] = 1 (i = 1 and 2, for exhaust cylinder bank 1 and 2)
(3) ENDFOR
(2) ELSE
LV_INJ_CUT = 0
(4) FOR i = 1 **TO** NC_CBK_EX_NR **DO:**
(5) IF SUM_INH_IV_CBK[i] ≠ 0
(5) THEN
LV_SCC[i] = 1
(5) ELSE
LV_SCC[i] = 0
(5) ENDIF
(4) ENDFOR
(2) ENDIF
(1) ELSE
LV_FCUT_IND = 0
LV_INJ_CUT = 0
(6) FOR i = 1 **TO** NC_CBK_EX_NR **DO:**
LV_SCC[i] = 0
(6) ENDFOR
1. **ENDIF**

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7.40 Cylinder shut off (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INH_IV_EXT	O/V	0... FFH	0... 255	1	-
Shut off pattern for cylinder shut off (cylinder allocated)					
INH_IV_IGN_INJ_LOCK_REQ	V	0... FFH	0... 255	1	-
Shut off request from ENSD due to backwards rotation detection					
INH_IV_SWI_MAN	V	0... FFH	0... 255	1	-
Manual shut off request					

Input data:

INH_IV_CUS {p. 8269}	INH_IV_DIAG_ERR {p. 4810}	INH_IV_FTL_MIN {p. 4762}	INH_IV_IMOB
INH_IV_KNK {p. 1960}	INH_IV_KWP {p. 7482}	INH_IV_MIS {p. 6237}	INH_IV_STST {p. 798}
INH_PBK_IV_DIAG_ERR {p. 4794}	LV_IGN_INJ_LOCK_REQ {p. 4455}	LV_ST_END {p. 1720}	NC_STATE_STST_ENA {p. 628}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_INJ_LOCK_REQ_TMP	-	0... 1H	0 ...1	1	-
Switch for lock of injection until complete engine stop					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_INH_IV_SWI_MAN	-	0... FFH	0... 255	1	-
Application constant for manual shut off request					
LC_INH_IV_DIAG_ERR_IMDT_ENA	-	0... 1H	0 ...1	1	-
Manual switch to activate cylinder shut off immediate after debouncing of an IV error without accordance to MISF					

7.40.1 Cylinder Individual Static Fuel Shut Off

Application conditions

Activation: every engine state

Deactivation: –

Initialization:

```
at reset all 0
   # IF NC_STATE_STST_ENA = 1
   # THEN
   at ECU_STATE transition SYN_ENG_IGK_ON to RUN_ENG
   LV_INJ_LOCK_REQ_TMP = 1
   at ECU_STATE transition RUN_ENG to ENG_STOP
   LV_INJ_LOCK_REQ_TMP = 0
   # ENDIF
Reccurence:      if LV_ST_END = 0:  10 ms
    if LV_ST_END = 1:  segment synchronous
```

Note: The module has to be calculated before the module "Cylinder Shut Off".

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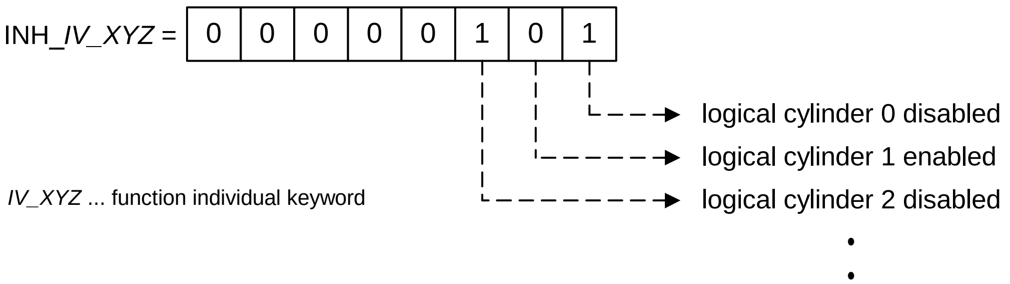
Formula section:

7.40.1.1 General



In several engine operating- and system states and in case of malfunctions the fuel injection must be disabled at individual cylinders. All the shut off requirements are coordinated, hence these requirements have to have the same structure as described below:

The information which cylinder has to be shut off static, is coded within a byte (with the length of 8 bit) at the cylinder corresponding position.

7.40.1.2 Static Fuel Shut Off Requirements

7.40.1.2.1 Inhibit by manual switch

INH_IV_SWI_MAN (Input pattern) = C_INH_IV_SWI_MAN

7.40.1.2.2 INH_IV_IMOB

7.40.1.2.3 Shut off request from immobilizer (cylinder allocated):

7.40.1.2.4 INH_IV_IMOB (Input pattern)

7.40.1.2.5 Inhibition of the injection by ENSD

IF LV_IGN_INJ_LOCK_REQ = 1 **or**
(LC_INJ_LOCK_REQ_TMP = 1 **and**
LV_INJ_LOCK_REQ_TMP = 1)

THEN
INH_IV_IGN_INJ_LOCK_REQ = $2^{NC\_CYL\_NR}$ -1 (Input pattern)
ELSE
INH_IV_IGN_INJ_LOCK_REQ = 0x00 (Input pattern)
ENDIF

7.40.1.2.6 Inhibition of the injection by injection valve diagnosis error

IF (LC_INH_IV_DIAG_ERR_IMDT_ENA = 1)
OR ... logical

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((INH_IV_DIAG_ERR **AND** INH_IV_MIS) $\neq$ 0) ... bitwise
THEN
INH_IV_DIAG_ERR (Input pattern)
ELSE
0x00 (Input pattern)
ENDIF

7.40.1.2.7 Inhibition of the injection by pre-ignition knock control

Cylinder individual shut off in case of knock pre-ignition INH_IV_KNK (Input pattern)

7.40.1.2.8 FTL_MIN diagnosis

Cylinder individual shut off in case of less fuel INH_IV_FTL_MIN

7.40.1.2.9 Inhibition of the injection by customer

Cylinder individual shut off by customer request INH_IV_CUS

7.40.1.2.10 Workshop tester

Cylinder individual shut off by KWP-job, sent from tester: INH_IV_KWP

7.40.1.2.11 Inhibition of the injection for engine shut down due to stop request

INH_IV_STST (Input pattern)

7.40.1.2.12 Inhibition of the injection due to injector power bank errors

Cylinder individual shut off in case of injector power bank errors

INH_PBK_IV_DIAG_ERR

7.40.1.3 Coordination of the Static Fuel Shut Off Requirements

The output pattern INH_IV_EXT is the bitwise OR of all patterns INH_IV_XYZ (and INH_PBK_IV_DIAG_ERR). As an example see below:

INH_IV_XYZ =	0	0	0	0	0	0	0	0
INH_IV_XYZ =	0	0	0	0	0	**1**	0	0
INH_IV_XYZ =	0	0	0	**1**	0	**1**	0	0
:					:			
INH_IV_EXT =	0	0	0	**1**	0	**1**	0	0

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7.41 Sequential fuel cutoff and restart fuel feed

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CASE_SEL_CYL	V	0... 3 H	0 ...3	1	-
Case selector					
LV_FCUT_CDN_PUC_PL	V	0... 1H	0 ...1	1	-
External authorization of sequential or 2-step-method at transition from PUC to PL					
LV_FCUT_CDN_PUC_PU_IS	V	0... 1H	0 ...1	1	-
External authorization of sequential or 2-step-method at transition from PUC to PU or IS					
LV_SEL_CYL	O/V	0... 1H	0 ...1	1	-
Boolean for Cylinder specific transition PU-PUC, PUC-IS or PUC-PL ongoing					
NR_PAT_SEL_CYL	O/V	0... FFH	0... 255	1	-
Selected index of Fuel cut off pattern for transition PU-PUC, PUC-IS, PUC-PL					
NR_SEL_CYL	V	1... 8 H	1 ...8	1	-
Index number of the selective cylinder pattern					
T_FCUT_AJ	V	0... FF H	0... 2.55	0.01	s
Timer value during jerk minimal sequential fuel cut-off					
T_OSC_DT	V	0... FF H	0... 2.55	0.01	s
Period of time of the oscillation of the drive-train					
TQI_SP_SLOW_DIF	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Difference in requested torque for slow path from actual to last segment					

Input data:

GEAR {p. 1302}	LV_AT {p. 654}	LV_DT {p. 1310}	LV_ES {p. 1720}
LV_IGK {p. 906}	LV_IS {p. 1720}	LV_PL {p. 1720}	LV_PU {p. 1720}
LV_PUC {p. 1720}	LV_ST {p. 1720}	N_DIF_COR {p. 1122}	N_GRD {p. 1525}
STATE_ENG {p. 1720}	T_SEG_AV {p. 1525}	TQI_SP_SLOW {p. 811}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_DIF_MAX_SEL_RIS	-	8000... 7FFFH	-32768 ...32767	1	rpm
N_DIF_COR threshold for deactivation of cylinder individual cut-off for restart IS					
C_N_GRD_MIN_SEL_RIS	-	80... 7FH	-4096 ...4064	32	1/min/s
N_GRD threshold for cancelling cylinder individual cut-off for restart IS					
C_NR_SEL_CYL_1	-	1... 8 H	1 ...8	1	-
Start pattern index for transition from PU -> PUC (case 1)					
C_NR_SEL_CYL_2	-	1... 8 H	1 ...8	1	-
Start pattern index for transition from PUC -> IS, PU (case 2)					
C_NR_SEL_CYL_3	-	1... 8 H	1 ...8	1	-
Start pattern index for transition from PUC -> PL (case 3)					
C_TQI_SP_SLOW_DIF_MAX	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
TQI_SP_SLOW_DIF threshold for cancelling cylinder individual cut-off for restart in PL					
ID_PAT_SEL_CYL	V	0... FFH	0... 255	1	-
LDP_CASE_SEL_CYL_ID_PAT_SEL_CYL	3	1... 3H	1 ...3	1	-
LDP_NR_SEL_CYL_ID_PAT_SEL_CYL	8	1... 8H	1 ...8	1	-
Table for cylinder specific restart and trailing throttle fuel cut off					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_T_OSC_DT	-	0... FF H	0... 2.55	0.01	s
LDP_GEAR_1_DRVB	8	0... FF H	0... 255	1	-
Characteristic period of time of the eigenfrequency of the powertrain					
LC_ENA_FCUT_AJ	-	0 , 1 H	0 , 1	-	-
Logical variable to enable jerk minimal sequential fuel cut-off					
LC_INH_DT_PU	-	0 , 1 H	0 , 1	-	-
Logical variable to inhibit LV_DT impact on jerk minimal sequential fuel cut-off activation					

FUNCTION DESCRIPTION:

General information:
At transition from trailing throttle to trailing throttle fuel cut off, torque jumps generally occur at trailing throttle fuel cut off which are noticeable as jerks in the vehicle. To reduce the torque at this transition, the ignition timing is retarded and the combustion air is adjusted to small values.
These procedures however do not always achieve the required torque reduction, because ignition timing and combustion air can only be reduced that far, that jerk free engine operation is still possible.
To support the above mentioned torque reduction measurement, it is possible that the injection is switched on and/or switched off for individual cylinders within a defined number of engine cycles (on and/or deactivation) incase of PUC and reentry into Idle.
The engine speed gradient is monitored in order to cancel the selective reentry idle at rapid engine speed drops. If the engine speed gradient is below the threshold C_N_GRD_MIN_SEL_RIS or N_DIF_COR is greater than or equal to C_N_DIF_MAX_SEL_RIS then all cylinders are immediately activated (-> CASE 2). The same happens if during selective reentry there is a significant increase of torque request, e.g. TQI_SP_SLOW_DIF is higher than C_TQI_SP_SLOW_DIF_MAX (-> CASE 2 and 3).

7.41.1 Calculation of TQI_SP_SLOW dynamic

Description:

This value is needed for fast restart of fuel feed.

Application conditions

Initialisation: *TQI_SP_SLOW_DIF = 0*
Recurrence: *20ms*
Activation: *at every engine state*
Deactivation: –

Formula section:

TQI_SP_SLOW_DIF = TQI_SP_SLOW(n) - TQI_SP_SLOW(n-1)

7.41.2 NR_PAT_SEL_CYL calculation

Recurrence: Segment-synchronous

7.41.2.1 Calculation of T_OSC_DT:

if LV_AT = 0

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then T_OSC_DT = ID_T_OSC_DT(GEAR)
else T_OSC_DT = 0
endif

Description (Example for 4-cylinder engines)

At a transition LV_PU → LV_PUC,. LV_PUC → LV_IS and LV_PUC → LV_PL , 32 cycles (8 x 720°CRK) in case of a 4-cylinder can be influenced. To realize this, a table ID_PAT_SEL_CYL contains the sequences of injection patterns (0...7), predefined in the table ID_PAT_IND. “ NR_SEL_CYL “ means the logical number in the shut off sequence (1...8).

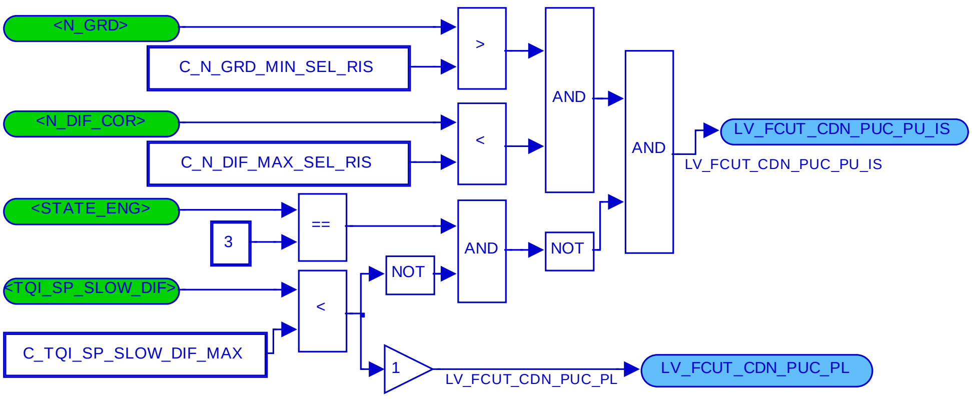
Application conditions:

Activation:

At active cylinder specific transitions LV_SEL_CYL =1

7.41.2.2 Calculation of exit conditions for running sequences (CASE 2 and CASE 3)

These bits are needed to terminate running sequences.



7.41.2.3 Transition from PU ? PUC (CASE 1)

The entrance in the transition pattern for PUC follows, when all conditions for PUC are fulfilled.

```
if LC_ENA_FCUT_AJ = 0 or LV_AT = 1
        then if (LV_DT = 0 and LC_INH_DT_PU = 0)
                then    NR_SEL_CYL = 8
                        NR_PAT_SEL_CYL = ID_PAT_SEL_CYL(NR_SEL_CYL)
                else    NR_SEL_CYL starts from 1 and is incremented every 720 °KW
                        until its maximum value. In case of deactivation NR_SEL_CYL
                        is reset to 1.
        else
        if (LV_DT = 0 and LC_INH_DT_PU = 0)
        then    NR_SEL_CYL = 8
                NR_PAT_SEL_CYL = ID_PAT_SEL_CYL(NR_SEL_CYL)
                T_FCUT_AJ is initialized with T_OSC_DT /2
        else    NR_SEL_CYL = C_NR_SEL_CYL_1
                NR_PAT_SEL_CYL = ID_PAT_SEL_CYL(NR_SEL_CYL)
                LV_SEL_CYL = 1
                if T_FCUT_AJ - T_SEG_AV = 0
                then    NR_SEL_CYL = 8
                        NR_PAT_SEL_CYL = ID_PAT_SEL_CYL(NR_SEL_CYL)
```

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```
                    T_FCUT_AJ is initialized with T_OSC_DT /2
                    LV_SEL_CYL = 0
            else    NR_SEL_CYL_n = NR_SEL_CYL_n-1
                    T_FCUT_AJ is decremented
                    end
      end
end
```

The transition is completed, when the last of the 32 transition cycles has run out. The pattern index applied as last one has to be the highest used for the cut-off strategy , that means all cylinders are cut off. NR_SEL_CYL is reset to 1.

If in the course of the transition pattern or while the time sequence an engine operating state change to PU, PL or IS happens, all cylinders are switched on immediatedly (pattern index : “0”), NR_SEL_CYL is reset to 1.

7.41.2.4 Transition from PUC ? IS or PUC ? PU (CASE 2)

The entrance in the transition pattern for RIS (reactivation idle speed) follows, when all conditions for IS resp. PU are fulfilled.

```
 if LC_ENA_FCUT_AJ = 0 or LV_AT = 1
then    if (LV_DT = 0 and LC_INH_DT_PU = 0) or LV_FCUT_CDN_PUC_PU_IS = 0
        then    NR_SEL_CYL = 8
                NR_PAT_SEL_CYL = ID_PAT_SEL_CYL(NR_SEL_CYL)
        else    NR_SEL_CYL starts from 1 and is incremented every 720 °KW
                until its maximum value.

else
        if (LV_DT = 0 and LC_INH_DT_PU = 0) or LV_FCUT_CDN_PUC_PU_IS = 0
        then    NR_SEL_CYL = 8
                NR_PAT_SEL_CYL = ID_PAT_SEL_CYL(NR_SEL_CYL)
                T_FCUT_AJ is initialized with T_OSC_DT /2
        else    NR_SEL_CYL = C_NR_SEL_CYL_2
                NR_PAT_SEL_CYL = ID_PAT_SEL_CYL(NR_SEL_CYL)
                LV_SEL_CYL = 1
                if T_FCUT_AJ - T_SEG_AV = 0
                then    NR_SEL_CYL = 8
                        NR_PAT_SEL_CYL = ID_PAT_SEL_CYL(NR_SEL_CYL)
                        T_FCUT_AJ is initialized with T_OSC_DT /2
                        LV_SEL_CYL = 0
                else    NR_SEL_CYL_n = NR_SEL_CYL_n-1
                        T_FCUT_AJ is decremented
                end
        end
end
```

The transition pattern is completed, when the last cycle of the 32 transition cycles has run out. The pattern number applied as last one has to be „0” , that means all cylinders are switched on. NR_SEL_CYL is reset to 1.

If in the course of the transition pattern or while time sequence a engine operating state change to PUC happens, the transition pattern or time sequence for RIS runs out to its end and after that the transition pattern for PUC starts, if required.

If the function is deactivated (see deactivation conditions), all cylinders are switched on immediatedly. In case of deactivation NR_SEL_CYL is reset to 1.

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7.41.2.5 Transition from PUC ? PL (CASE 3)

The entrance in the transition pattern for RPL (reactivation part load) follows, when all conditions for PL are fulfilled.

```
 if LC_ENA_FCUT_AJ = 0 or LV_AT = 1
then    if (LV_DT = 0 and LC_INH_DT_PU = 0) or LV_FCUT_CDN_PUC_PL = 0
        then    NR_SEL_CYL = 8
                NR_PAT_SEL_CYL = ID_PAT_SEL_CYL(NR_SEL_CYL)
        else    NR_SEL_CYL starts from 1 and is incremented every 720 °KW
                until its maximum value. In case of deactivation NR_SEL_CYL
                is reset to 1.

else
        if (LV_DT = 0 and LC_INH_DT_PU = 0) or LV_FCUT_CDN_PUC_PL = 0
        then    NR_SEL_CYL = 8
                NR_PAT_SEL_CYL = ID_PAT_SEL_CYL(NR_SEL_CYL)
                T_FCUT_AJ is initialized with T_OSC_DT /2
        else    NR_SEL_CYL = C_NR_SEL_CYL_3
                NR_PAT_SEL_CYL = ID_PAT_SEL_CYL(NR_SEL_CYL)
                LV_SEL_CYL = 1
                if T_FCUT_AJ - T_SEG_AV = 0
                then    NR_SEL_CYL = 8
                        NR_PAT_SEL_CYL = ID_PAT_SEL_CYL(NR_SEL_CYL)
                        T_FCUT_AJ is initialized with T_OSC_DT /2
                        LV_SEL_CYL = 0
                else    NR_SEL_CYL_n = NR_SEL_CYL_n-1
                        T_FCUT_AJ is decremented
                end
        end
end
```

The transition pattern is completed, when the last cycle of the 32 transition cycles has run out. The pattern number applied as last one has to be „0" , that means all cylinders are switched on. NR_SEL_CYL is reset to 1.

If in the course of the transition pattern a engine operating state change to PUC happens, the transition pattern for reentry PL runs out to its end and after that the transition pattern for PUC starts, if required. If the function is deactivated, all cylinders are switched on immediatedly.

Deactivation:
- LV_ES = 1 **or**
- LV_ST = 1 **or**
- LV_IGK = 0 **or**
- Pattern completed

At passive cylinder specific transitions:
LV_SEL_CYL = 0 and NR_SEL_CYL = 1
T_FCUT_AJ is initialized with T_OSC_DT /2

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Transition tables

The transition pattern indexes are adjustable in the table ID_PAT_SEL_CYL. There are 8 fade out patterns which are applicable per transition table (definition of patterns see chapter 7, "Cylinder shut off with pattern").

The following cases are distinguished in ID_PAT_SEL_CYL:

CASE 1: Trailing throttle fuel cut off (PUC)
CASE 2: Restart IS (RIS)
CASE 3: Restart PL (RPL)

Example for shut-off sequences with 8 levels and a shut off pattern for the 4 next injections (4-cylinder)

CASE_SEL_CYL■ NR_SEL_CYL →

	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***
1	1	1	2	2	3	3	4	4
2	5	5	5	6	6	7	7	0
3	5	6	6	7	0	0	0	0

According shut off sequences: (0 : Injection, 1: no injection)

Case 1	1 0 0 0	1 0 0 0	1 0 1 0	1 0 1 0	1 0 1 1	1 0 1 1	1 1 1 1	1 1 1 1
Case 2	0 1 1 1	0 1 1 1	0 1 1 1	0 1 0 1	0 1 0 1	0 0 0 1	0 0 0 1	0 0 0 0
Case 3	0 1 1 1	0 1 0 1	0 1 0 1	0 0 0 1	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0

Formula section:

NR_PAT_SEL_CYL = ID_PAT_SEL_CYL

Application assistances

Handling of reactivation functions (out of PUC):
Injection (Reactivation fuel feed) : To ensure, that all cylinders get at least once the same amount of TI_ADD_REAC, TI_ADD_REAC is not decremented as long as sequential transition PUC → IS resp. PUC → PL is ongoing.
Ignition: The according reactivation functions are not concerned by sequential transition functions.
Handling of engine states:
The detection of PU, PUC, PL and IS is not concerned by sequential transition functions.

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7.42 O2 sensor (lin, up) signal compensation and conversion

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CYC_T_WAIT_OFS_ADJ_RED [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter of cycles for application of reduced repetition rate for offset adjustment during engine warm-up					
CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Storage variable for SPI communication error counter value of WRAF controller					
CTR_VLS_MV_LSL_NR_SAMPLE [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Sample counter for mean value calculation					
IPLSL_COR [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-12.596... 12.59561	384e-6	mA
Compensated nominal pumping current (after sensor /sensor dispersion compensation for new /aged sensor)					
LAMB_LS_UP [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda signal value of the WRAF sensor					
LAMB_LS_UP_MIN	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Minimum lambda in multiple-branched exhaust gas lines					
LAMB_LS_UP_MV	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Mean value of lambda in multiple-branched exhaust gas lines					
LAMB_LS_UP_MV_TMP	-	0... FFFFFFFFH	0... 4194303.99902	976.599e-6	-
Temporary storage for calculation of mean value of lambda in multiple-branched exhaust gas lines					
LV_LAMB_PLS_SWI_OFF [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Indicator for need to switch off forced lambda stimulation					
LV_LAMB_STI_OFF_LSL_OFS_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request for disabling of forced lambda stimulation, or keeping it disabled, resp.					
LV_LSL_OFS_ACT_AST [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Switch to chose activation conditions directly after engine start					
LV_LSL_OFS_ADJ_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
State of the offset measurement (active /not active)					
LV_LSL_OFS_ADJ_IS [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Offset measurement carried out during current idle phase					
LV_LSL_OFS_GAIN_SWI_CYC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating active Ip gain range for alternating offset adjustment					
LV_LSL_UP_SHO_PER_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Trigger the short period stop mode of Lambda controller during offset adjustment and gain switching					
LV_SWI_CLC_LSL_OFS_ADJ [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable for switching of lambda calculation routines					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SWI_GAIN_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag configuring the WRAF sensor interface gain-selection for Ip measurement (0 = g8, 1 = g16)					
LV_VLS_OFS_ADJ_CMPL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating successful completion of offset adjustment cycle					
LV_VLS_OFS_ADJ_ENA_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag requesting enabling of offset adjustment mode of WRAF sensor interface for lambda signal output voltage					
LV_VLS_OFS_LIM_LSL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating limitation of output voltage offset adjustment value for Ip gain16					
LV_VLS_OFS_LIM_LSL_L_GAIN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating limitation of output voltage offset adjustment value for Ip gain8					
STATE_LSL_OFS_ADJ [NC_CBK_EX_NR]	V	0H 1H 2H 3H 4H	WAIT PREPARE ADJUST_H ADJUST_L RETURN	-	-
State of WRAF controller lambda output voltage offset adjustment					
T_DLY_LAMB_STI_OFF_OFS_ADJ [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Wait timer to allow for lambda signal settling upon deactivation of forced stimulation					
T_DLY_LSL_OFS_ADJ [NC_CBK_EX_NR]	V	0... FFH	0... 2.55	0.01	s
Wait timer to delay acquisition of measurement values upon activation of adjustment					
T_DLY_LSL_OFS_ADJ_IS [NC_CBK_EX_NR]	V	0... FFH	0... 2.55	0.01	s
Wait timer to delay activation of offset adjustment upon entering engine state idle speed					
T_DLY_LSL_OFS_ADJ_PUC_END [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Wait timer to delay activation of offset adjustment after leaving fuel cut-off phase					
T_INI_DLY_LSL_SIG_ACQ [NC_CBK_EX_NR]	V	0... FFH	0... 2.55	0.01	s
Delay of aquisition after freeze of signal. Assures that segment synchronous meanvalue calc has reached final value.					
T_WAIT_LSL_OFS_ADJ [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Wait timer to define minimum interval between two subsequent offset adjustment cycles					
VLS_COR_H_RES_LSL [NC_CBK_EX_NR]	V	0... FFFFH	0... 9.99984	152.6e-6	V
Compensated output signal of lambda sensor with extended resolution					
VLS_COR_MV_LSL [NC_CBK_EX_NR]	V	0... FFFFH	0... 9.99984	152.6e-6	V
Optional average over two samples of compensated output signal of lambda sensor					
VLS_COR_TMP_LSL [NC_CBK_EX_NR]	V	0... FFFFH	0... 9.99984	152.6e-6	V
Temporary storage value of compensated output signal of lambda sensor					
VLS_DELTA_TMP_LSL [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-327680... 327679.99984	153e-6	V
Controller setpoint free, gain and exhaust pressure corrected output signal					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VLS_MMV_LSL [NC_CBK_EX_NR]	V	0... 7FFFH	0... 4.99984	153e-6	V
Moving mean value of output signal of linear lambda sensor for Ip gain16					
VLS_MMV_LSL_L_GAIN [NC_CBK_EX_NR]	V	0... 7FFFH	0... 4.99984	153e-6	V
Moving mean value of output signal of linear lambda sensor for Ip gain8					
VLS_MV_LSL [NC_CBK_EX_NR]	V	0... 7FFFH	0... 4.99984	153e-6	V
Mean value of output signal of linear lambda sensor					
VLS_MV_LSL_BUF [NC_CBK_EX_NR]	V	0... FFFFH	0... 319.99511	4.88e-3	V
Buffer for mean value calculation					
VLS_OFS_LSL [NC_CBK_EX_NR]	V	8000... 7FFFH	-5... 4.99984	153e-6	V
Output signal offset of linear lambda sensor for Ip gain16					
VLS_OFS_LSL_L_GAIN [NC_CBK_EX_NR]	V	8000... 7FFFH	-5... 4.99984	153e-6	V
Output signal offset of linear lambda sensor for Ip gain8					
VLS_OFS_TMP_LSL [NC_CBK_EX_NR]	V	8000... 7FFFH	-5... 4.99984	153e-6	V
Intermediate storage variable for calculated offset value for Ip gain16					
VLS_OFS_TMP_OLD_LSL [NC_CBK_EX_NR]	V	8000... 7FFFH	-5... 4.99984	153e-6	V
Storage variable for calculated offset value for Ip gain16					
VLS_OFS_TMP_OLD_LSL_L_GAIN [NC_CBK_EX_NR]	V	8000... 7FFFH	-5... 4.99984	152.6e-6	V
Storage variable for calculated offset value for Ip gain8					
VLS_UP_COR [NC_CBK_EX_NR]	O/V	0... 7FFH	0... 9.99511	4.8828e-3	V
Compensated output signal of lambda sensor					
VLS_UP_COR_H_GAIN [NC_CBK_EX_NR]	O/V	0... 7FFH	0... 9.99511	4.8828e-3	V
Ip gain16 equivalent of compensated output signal of lambda sensor					
VLS_UP_DIAG [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-160... 159.99511	4.88e-3	V
Offset and exhaust pressure compensated VLS_UP[i] which is used for sensor diagnoses					

Input data:

CTR_ERR_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 955}	FAC_LSL_GAIN_AD [NC_CBK_EX_NR] {p. 2371}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_INH_LSL_OFS_ADJ [NC_CBK_EX_NR] {p. 2333}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	LV_IS {p. 1720}	LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}
LV_LS_UP_READY [NC_CBK_EX_NR] {p. 2335}	LV_LS_UP_READY_CDN [NC_CBK_EX_NR] {p. 2335}	LV_LSH_UP_MAN_ACT [NC_CBK_EX_NR] {p. 2385}	LV_LSL_IF_SPI_RST_END [NC_CBK_EX_NR] {p. 1313}
LV_PU {p. 1720}	LV_PUC {p. 1720}	LV_ST_END {p. 1720}	LV_TTIP_MES_VLD_LS_UP [NC_CBK_EX_NR] {p. 1320}
LV_VLS_UP_INIT [NC_CBK_EX_NR] {p. 1341}	LV_VLS_UP_VLD [NC_CBK_EX_NR] {p. 1341}	NC_CBK_EX_NR {p. 1829}	PRS_EX_PCAT_UP {p. 807}
STATE_CAT_DIAG [NC_CBK_EX_NR] {p. 5474}	STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}	TTIP_MES_LS_UP [NC_CBK_EX_NR] {p. 1321}

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VB {p. 1185}	VLS_UP [NC_CBK_EX_NR] {p. 1341}	VLS_UP_10_RAW [NC_CBK_EX_NR] {p. 1342}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_VLS_UP_OFS_ADJ	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for filtering of mean value of WRAF sensor lambda signal for Ip gain16					
C_CRLC_VLS_UP_OFS_ADJ_L_GAIN	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for filtering of mean value of WRAF sensor lambda signal for Ip gain8					
C_FAC_LPF_VLS_COR_LSL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Low pass filter constant for filtering of corrected output signal of WRAF sensor					
C_ICPLSL_COR_ADD	-	8000... 7FFFH	-12.596... 12.59561	384.4e-6	mA
Additive correction of pump current due to adjusted value of pumped reference current					
C_IPLSL_GAIN	-	0... FFFFH	0... 5.0384	76.9e-6	mA/V
Total gain of WRAF sensor interface circuit (Ip /(V_LMBD_IP - C_VLS_OFS_SP_LSL)) for Ip gain16Ip: for NTK UEGO = pumping current through sensor, for BOSCH LSU = current through measurement resistor					
C_LAMB_LS_UP_GAIN_SWI_MAX	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Lean lambda threshold for switching of Ip gain16 -> gain8					
C_LAMB_LS_UP_GAIN_SWI_MIN	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Rich lambda threshold for switching of Ip gain16 -> gain8					
C_LAMB_LS_UP_MAX_OFS_ADJ	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Maximum lambda threshold for the offset calculation					
C_LAMB_LS_UP_MIN_OFS_ADJ	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Minimum lambda threshold for the offset calculation					
C_LAMB_LS_UP_VLS_UP_H_GAIN_MAX	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Upper limit of Ip gain16 band in terms of lambda					
C_LAMB_LS_UP_VLS_UP_H_GAIN_MIN	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Bottom limit of Ip gain16 band in terms of lambda					
C_NR_CYC_T_WAIT_LSL_OFS_ADJ_RED	-	0... FFH	0... 255	1	-
Number of cycles for application of reduced repetition rate for offset adjustment during engine warm-up					
C_T_DLY_LAMB_STI_OFF_OFS_ADJ	-	0... FFFFH	0... 655.35	0.01	s
Delay time for the offset calculation after switching-off forced lambda stimulation					
C_T_DLY_LSL_OFS_ADJ	-	0... FFH	0... 2.55	0.01	s
Delay time for the offset calculation after activating offset adjustment					
C_T_DLY_LSL_OFS_ADJ_CYC	-	0... FFH	0... 2.55	0.01	s
Delay time for second offset determination after switching Ip ranges					
C_T_DLY_LSL_OFS_ADJ_IS	-	0... FFH	0... 2.55	0.01	s
Delay time for activation of offset adjustment upon entering engine state idle speed					
C_T_DLY_LSL_OFS_ADJ_PUC_END	-	0... FFFFH	0... 655.35	0.01	s
Delay time for activation of offset adjustment after leaving fuel cut-off phase					
C_T_INI_DLY_LSL_SIG_ACQ	-	0... FFH	0... 2.55	0.01	s
Delay of acquisition after freeze of signal. Assures that segment synchronous mean value calc has reached final value.					
C_T_WAIT_LSL_OFS_ADJ	-	0... FFFFH	0... 655.35	0.01	s
Lock time after an offset calculation prior to the next calculation for warm engine					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_WAIT_LSL_OFS_ADJ_RED	-	0... FFFFH	0... 655.35	0.01	s
Lock time after an offset calculation prior to the next calculation during engine warm-up					
C_VB_MIN_OFS_ADJ	-	0... FFH	0... 25.89843	0.1015625	V
Minimum battery voltage for accurate offset adjustment based on related reference voltages					
C_VLS_OFS_DELTA_ADD	-	8000... 7FFFH	-5... 4.99984	152.6e-6	V
Additive share of correlation between offset value in Ip gain16, and Ip gain8					
C_VLS_OFS_DELTA_CBK_EX_MAN	-	8000... 7FFFH	-5... 4.99984	152.6e-6	V
Diametrical shift of offset values for different exhaust banks for diagnostic test purpose					
C_VLS_OFS_DIF_OK_LSL	-	0... 7FFFH	0... 4.99984	153e-6	V
Maximum permitted deviation of two successive offset values for Ip gain16					
C_VLS_OFS_DIF_OK_LSL_L_GAIN	-	0... 7FFFH	0... 4.99984	153e-6	V
Maximum permitted deviation of two successive offset values for Ip gain8					
C_VLS_OFS_MAX_ABSV_LSL	-	0... 7FFFH	0... 4.99984	153e-6	V
Limit value for the offset as a maximum value (absolute value) for Ip gain16					
C_VLS_OFS_MAX_ABSV_LSL_L_GAIN	-	0... 7FFFH	0... 4.99984	153e-6	V
Limit value for the offset as a maximum value (absolute value) for Ip gain8					
C_VLS_OFS_SP_LSL	-	0... 7FFFH	0... 4.99984	153e-6	V
Nominal WRAF controller output offset voltage (valid for Ip = 0 or lambda = 1)					
IP_FAC_COR_IPLSL_AFR_PRS_EX	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_PRS_EX_IP_FAC_COR_IPLSL	8	0... FFFFH	0... 5434	0.0829175	hPa
Factor for exhaust gas pressure correction at rich conditions					
IP_FAC_COR_IPLSL_PRS_EX	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_PRS_EX_IP_FAC_COR_IPLSL	8	0... FFFFH	0... 5434	0.0829175	hPa
Factor for exhaust gas pressure correction at lean conditions					
IP_FAC_COR_IPLSL_TTIP_LS_UP	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_TTIP_LS_UP_IP_FAC_COR_IPLSL	8	0... FFFFH	-2048... 2047.9375	0.0625	°C
Factor for correction of tip temperature influence					
IP_LAMB_LS_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
LDP_VLS_COR_MV_IP_LAMB_LS_UP	32	0... FFFFH	0... 9.99984	152.6e-6	V
Characteristic curve of the lambda sensor (LAMB_LS_UP[i] vs. compensated VLS_COR_MV_LSL[i])					
LC_CAT_DIAG_ACT_WAIT	-	0... 1H	0 ...1	1	-
Switch to grant catalyst diagnosis priority to be completed without interruption by OA					
LC_CTR_ERR_LSL_IF_SAVE_MAN_INC	-	0... 1H	0 ...1	1	-
Switch enabling simulation of SPI communication error with WRAF controller					
LC_IPLSL_GAIN_SWI_ACT	-	0... 1H	0 ...1	1	-
Switch to enable gain switching for measurement of pumping current					
LC_LAMB_PLS_ACT_NEUT	-	0... 1H	0 ...1	1	-
Switch to perform OA regardless of current status of forced lambda stimulation					
LC_LSL_OFS_ADJ_ENA	-	0... 1H	0 ...1	1	-
Switch to enable offset adjustment in every engine state					
LC_LSL_OFS_ADJ_GAIN_SEL	-	0... 1H	0 ...1	1	-
Switch to choose Ip measurement range in which singular offset adjustment shall be performed (0 = gain8, 1 = gain16)					

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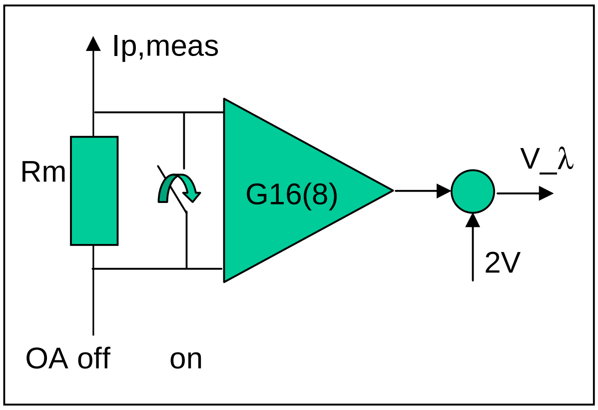
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LSL_OFS_ADJ_H_L_GAIN	-	0... 1H	0 ...1	1	-
Switch to enable offset adjustment in both Ip measurement ranges					
LC_LSL_OFS_GAIN_SWI_CYC	-	0... 1H	0 ...1	1	-
Switch to choose alternating offset adjustment in Ip gain16 /gain8 mode					
LC_SWI_GAIN_LSL_IF_PUC_ACT	-	0... 1H	0 ...1	1	-
Switch to activate Ip gain switching gain16 -> gain8 during PUC					
LC_VLS_COR_MV_LSL_ACT	-	0... 1H	0 ...1	1	-
Switch for (de)activation of averaging of VLS_COR_H_RES_LSL[i] prior to conversion					
LC_VLS_UP_THD_SWI_GAIN_AFL_ACT	-	0... 1H	0 ...1	1	-
Boolean flag for activation of Ip gain switching due to possible VLS_UP_RAW[i] lean side signal saturation					
LC_VLS_UP_THD_SWI_GAIN_AFR_ACT	-	0... 1H	0 ...1	1	-
Boolean flag for activation of Ip gain switching due to possible VSL_UP_RAW[i] rich side signal saturation					

FUNCTION DESCRIPTION:

OA = Offset adjustment.
Based on short circuiting of Ip measurement amplifier input.



Ip measurement gain16 = High Gain ('1')
Ip measurement gain8 = Low Gain ('0')

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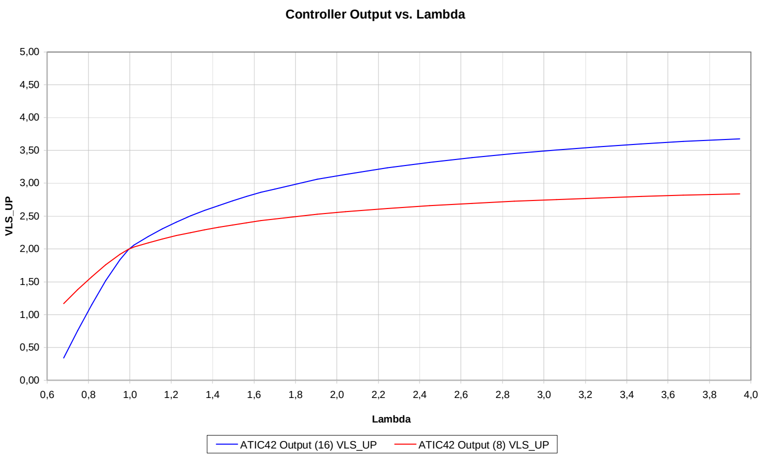
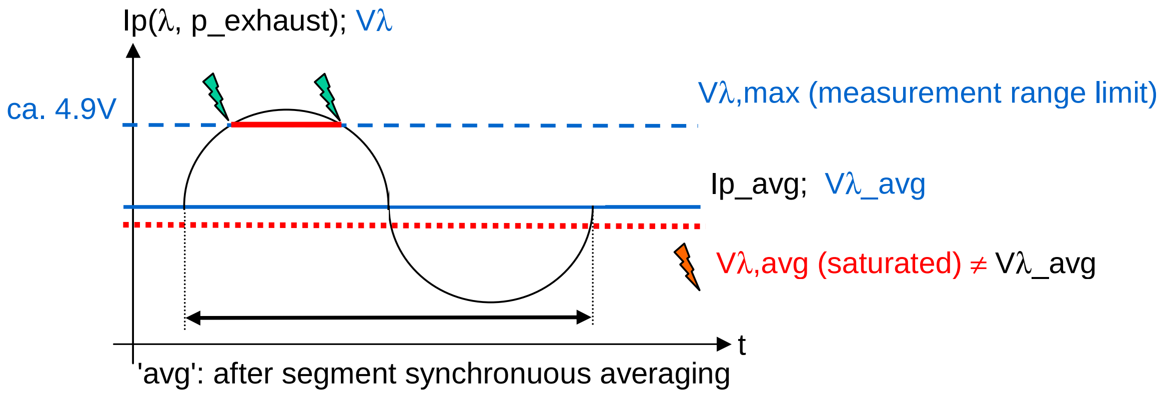
Use cases				
LOGICAL CONSTANT Effect ('0' / '1')	gain16 only	gain8 only	gain16&8 simultane ously	gain16/8 alternating
LC_LSL_OFS_ADJ_GAIN_SEL Defines default Ip measurmement gain	1	0	1	1
LC_LSL_OFS_ADJ_H_L_GAIN OA in default gain only (second range is approximated) / for both gains	0	0	1	1
LC_LSL_OFS_GAIN_SWI_CYC Simultaneous / alternating OA for both gains	0	0	0	1
LC_IPLSL_GAIN_SWI_ACT Gain switching during Ip measurement active	0 / 1	0 / 1	0 / 1	0 / 1



Ip measurement range vs. resolution (exemplary).



Range switching triggered by /V thresholds to avoid saturation effects of Ip measurement.

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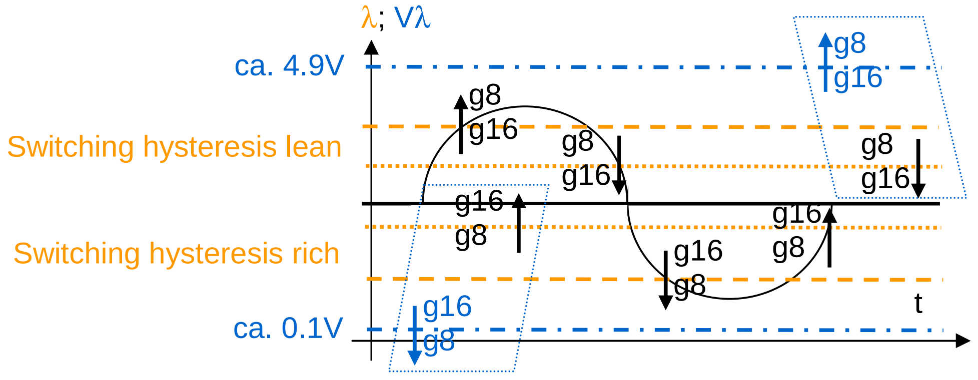

Switching thresholds/hysteresis

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned
(NC_CBK_EX_NR = 2), then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Application conditions

Initialisation: The following variable initialisation shall take place at **LV_IGK 0->1, afterRESET**, or **upon erase of error management:**

VLS_UP_COR[i] = 0
VLS_COR_H_RES_LSL[i] = 0
VLS_UP_COR_H_GAIN[i] = 0
VLS_DELTA_TMP_LSL[i] = 0
VLS_OFS_LSL[i] = 0
VLS_OFS_TMP_LSL[i] = 0
VLS_OFS_TMP_OLD_LSL[i] = 0
VLS_OFS_LSL_L_GAIN[i] = 0
VLS_OFS_TMP_OLD_LSL_L_GAIN[i] = 0
IPLSL_COR[i] = 0
LV_VLS_OFS_LIM_LSL[i] = 0
LV_VLS_OFS_LIM_LSL_L_GAIN[i] = 0
VLS_MV_LSL[i] = 0
LAMB_LS_UP[i] = 1
LAMB_LS_UP_MV = 1
LAMB_LS_UP_MIN = 1
VLS_COR_TMP_LSL[i] = C_VLS_OFS_SP_LSL
VLS_COR_MV_LSL[i] = C_VLS_OFS_SP_LSL
LV_SWI_CLC_LSL_OFS_ADJ[i] = 0
VLS_MMV_LSL[i]$_{i-1}$ = C_VLS_OFS_SP_LSL
VLS_MMV_LSL_L_GAIN[i]$_{i-1}$ = C_VLS_OFS_SP_LSL
CTR_ CYC_T_WAIT_OFS_ADJ_RED[i] = 0
LV_LSL_UP_SHO_PER_REQ[i] = 0
LV_LSL_OFS_ACT_AST[i] = 1
LV_LSL_OFS_ADJ_ACT[i] = 0
LV_LSL_OFS_ADJ_IS[i] = 0
LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] = 0

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```
 LV_LAMB_PLS_SWI_OFF[i] = 0
T_WAIT_LSL_OFS_ADJ[i] = 0
 CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE[i]
 = CTR_ERR_LSL_IF_SPI_WR[i]
 STATE_LSL_OFS_ADJ[i] =   WAIT
 T_DLY_LSL_OFS_ADJ_IS[i] = C_T_DLY_LSL_OFS_ADJ_IS
 LV_SWI_GAIN_LSL_IF[i] = LC_LSL_OFS_ADJ_GAIN_SEL
 LV_VLS_OFS_ADJ_CMPL[i] = 0
 LV_LSL_OFS_GAIN_SWI_CYC[i] = LC_LSL_OFS_ADJ_GAIN_SEL
 T_DLY_LSL_OFS_ADJ_PUC_END[i] = 0
 T_INI_DLY_SIG_ACQ[i] = 0
The following variable initialisation shall take place according
to below condition:
If        (  LV_LSH_UP_MAN_ACT[i] == 0 ->1 and  LV_ST_END ==
0 )
or        ( LV_LSH_UP_MAN_ACT[i] == 0 and  LV_ST_END == 0 ->1
)
then
  LV_LSL_OFS_ACT_AST[i] = 1
 LV_LSL_OFS_ADJ_ACT[i] = 0
 LV_LSL_OFS_ADJ_IS[i] = 0
 LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] = 0
 LV_LAMB_PLS_SWI_OFF[i] = 0
 T_WAIT_LSL_OFS_ADJ[i] = 0
 CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE[i]
      = CTR_ERR_LSL_IF_SPI_WR[i]
 STATE_LSL_OFS_ADJ[i] =   WAIT
 T_DLY_LSL_OFS_ADJ_IS[i] = C_T_DLY_LSL_OFS_ADJ_IS
 LV_SWI_GAIN_LSL_IF[i] = LC_LSL_OFS_ADJ_GAIN_SEL
 LV_VLS_OFS_ADJ_CMPL[i] = 0
 LV_LSL_OFS_GAIN_SWI_CYC[i] = LC_LSL_OFS_ADJ_GAIN_SEL
 T_DLY_LSL_OFS_ADJ_PUC_END[i] = 0
 endif
```

Recurrence: *T_SAMPLE = 10ms*

7.42.1 Compensation of WRAF controller electrical offset voltage and system gain error

Activation:

To avoid disturbances to the WRAF interface due to EMC interference of the starter, the function shall be activated after engine start.

If **(** LV_ST_END == 1
or LV_LSH_UP_MAN_ACT[i] == 1 **)**
and LV_LSL_IF_SPI_RST_END[i] == 1
(Initialisation of WRAF controller ASIC completed successfully)
and LV_ERR_OFS_LSL_UP[i] == 0
then *" function enabled "*
else *" function disabled "*
The following variable initialisation shall take place after function deactivation:
LV_VLS_OFS_ADJ_ENA_LSL_IF[i] = 0
LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] = 0
LV_LAMB_PLS_SWI_OFF[i] = 0
LV_LSL_OFS_ADJ_ACT[i] = 0
LV_LSL_OFS_ADJ_IS[i] = 0
endif

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If LV_LSL_OFS_ACT_AST[i] == 1
then " **1.1.1 Conditions for offset adjustment directly after engine start** "
else " **1.1.2 Conditions for offset adjustment during normal engine operation** "
endif

Deactivation: - -

7.42.1.1 Conditions for offset adjustment directly after engine start

Description:

Formula section:

```
If      ( LV_LS_UP_READY[i] == 0
or        LV_LSH_UP_MAN_ACT[i] == 1 )
and       LV_INH_LSL_OFS_ADJ[i] == 0
and       VB > C_VB_MIN_OFS_ADJ
and       STATE_LSL_IF_SPI_RD[i] ( bit LSL_ENA ) == 1
and       CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE[i] == CTR_ERR_LSL_IF_SPI_WR[i]
then    LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] = 1
          If      LC_LSL_OFS_ADJ_H_L_GAIN == 1
          and       LV_LSL_OFS_ADJ_ACT[i] == 0
          then      LV_SWI_GAIN_LSL_IF[i] = 1
          endif
else    CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE[i] = CTR_ERR_LSL_IF_SPI_WR[i]
        LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] = 0
        LV_SWI_GAIN_LSL_IF[i] = LC_LSL_OFS_ADJ_GAIN_SEL
          If      LV_VLS_OFS_ADJ_ENA_LSL_IF[i] == 1 ( first measurement aborted )
          or        LV_LS_UP_READY[i] == 1 ( regular engine operation reached )
          then      LV_LSL_OFS_ACT_AST[i] = 0   ( leave after start phase )
                STATE_LSL_OFS_ADJ[i] =    WAIT
          endif
          LV_VLS_OFS_ADJ_ENA_LSL_IF[i] = 0
endif
```

7.42.1.2 Conditions for offset adjustment during normal engine operation

Description:

Formula section:

T_WAIT_LSL_OFS_ADJ[i] = T_WAIT_LSL_OFS_ADJ[i] - T_SAMPLE

If LV_IS == 0
then T_DLY_LSL_OFS_ADJ_IS[i] = C_T_DLY_LSL_OFS_ADJ_IS
else T_DLY_LSL_OFS_ADJ_IS[i] = T_DLY_LSL_OFS_ADJ_IS[i] - T_SAMPLE
endif

If LV_PUC == 1

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```
then        T_DLY_LSL_OFS_ADJ_PUC_END[i] = C_T_DLY_LSL_OFS_ADJ_PUC_END
else        T_DLY_LSL_OFS_ADJ_PUC_END[i]
                = T_DLY_LSL_OFS_ADJ_PUC_END[i] - T_SAMPLE
endif

If              T_WAIT_LSL_OFS_ADJ[i] == 0
and                 LV_INH_LSL_OFS_ADJ[i] == 0
and                 LV_LS_UP_READY[i] == 1
and                 LV_LSH_UP_MAN_ACT[i] == 0
and                 VB > C_VB_MIN_OFS_ADJ
and                 LV_PUC == 0
and                 T_DLY_LSL_OFS_ADJ_PUC_END[i] == 0
and                 LV_PU == 0
and                 ( LC_LSL_OFS_ADJ_ENA == 1
            or          ( LV_IS == 1
            and T_DLY_LSL_OFS_ADJ_IS[i] == 0 ) )
and                 LV_LSL_OFS_ADJ_IS[i] == 0
and                 ( C_LAMB_LS_UP_MIN_OFS_ADJ < LAMB_SP[i]
               <C_LAMB_LS_UP_MAX_OFS_ADJ
or                 LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] == 1 )
and                 ( LC_CAT_DIAG_ACT_WAIT == 0
            or          STATE_CAT_DIAG[i] ==   PASSIVE
            or          STATE_CAT_DIAG[i] ==   END   )
and                 STATE_LSL_IF_SPI_RD[i] ( bit LSL_ENA ) == 1
and                 CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE[i] == CTR_ERR_LSL_IF_SPI_WR[i]
then        If          ( LC_LSL_OFS_ADJ_H_L_GAIN == 1
                            and         LV_SWI_GAIN_LSL_IF[i] == 1
                    and         STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN ) == 1 )
                    ( OA for both ranges active: starts once gain16   is selected in
                    measurement mode, is performed for gain16 and gain8
                    simultaneously /alternating, return to gain16 -> measurement mode )
                or          ( LC_LSL_OFS_ADJ_H_L_GAIN == 0
                            and         LV_SWI_GAIN_LSL_IF[i] == LC_LSL_OFS_ADJ_GAIN_SEL
                            and         STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN )
                                    == LC_LSL_OFS_ADJ_GAIN_SEL )
                    ( OA is performed for default range only )
            then            If          LV_LAMB_PLS_ACT[i] == 1
                    and         LC_LAMB_PLS_ACT_NEUT == 0
                        then        LV_LAMB_PLS_SWI_OFF[i] = 1
                    endif
                        LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] = 1
            endif
else        CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE[i] = CTR_ERR_LSL_IF_SPI_WR[i]
                LV_LAMB_PLS_SWI_OFF[i] = 0
            LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] = 0
            If          LV_IS == 0
            then            LV_LSL_OFS_ADJ_IS[i] = 0
            endif
            STATE_LSL_OFS_ADJ[i] =     WAIT
            LV_VLS_OFS_ADJ_ENA_LSL_IF[i] = 0
endif
```

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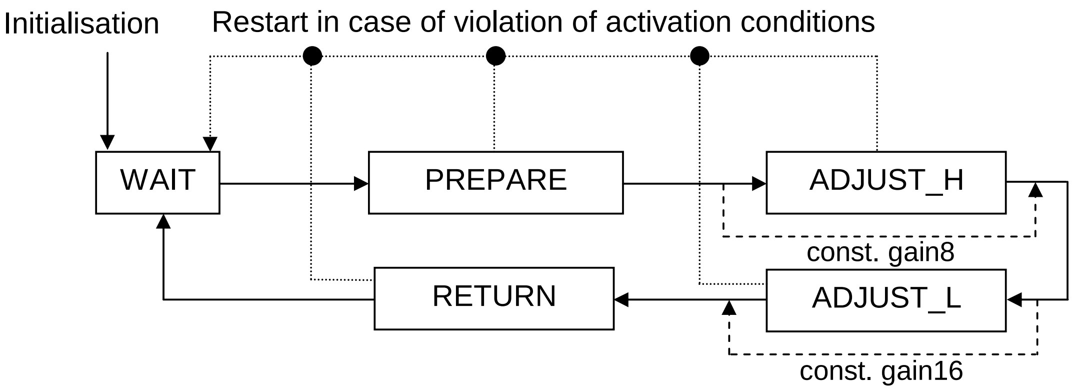
7.42.1.3 Offset calculation

Description:



Formula section:

Initial state upon (re)start of state machine

STATE WAIT :

LV_VLS_OFS_ADJ_CMPL[i] = 0

If STATE_LSL_IF_SPI_RD[i] (*bit* VLS_OFS_ENA) == 0
then LV_LSL_OFS_ADJ_ACT[i] = 0
  If LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] == 1
  and **(** LV_LAMB_PLS_ACT[i] == 0
    or LC_LAMB_PLS_ACT_NEUT == 1 **)**
  then **If** LV_LAMB_PLS_SWI_OFF[i] == 1
      and LC_LAMB_PLS_ACT_NEUT == 0
    then T_DLY_LAMB_STI_OFF_OFS_ADJ[i]
      = C_T_DLY_LAMB_STI_OFF_OFS_ADJ
    else T_DLY_LAMB_STI_OFF_OFS_ADJ[i] = 0
      endif
    STATE_LSL_OFS_ADJ[i] = PREPARE
  endif
endif

STATE PREPARE :

If T_DLY_LAMB_STI_OFF_OFS_ADJ[i] == 0
then LV_LSL_OFS_ADJ_ACT[i] = 1
  LV_VLS_OFS_ADJ_ENA_LSL_IF[i] = 1
  If LC_LSL_OFS_GAIN_SWI_CYC[i] == 1
  and LV_LSL_OFS_GAIN_SWI_CYC[i] == 0
  (alternating OA, gain8 recurrence)
  then LV_SWI_GAIN_LSL_IF[i] = 0
  endif
  If LC_CTR_ERR_LSL_IF_SAVE_MAN_INC == 1
  then CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE[i]
    = CTR_ERR_LSL_IF_SPI_OFS_ADJ_SAVE[i] + 1

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```
            endif
            If      STATE_LSL_IF_SPI_RD[i] ( bit  VLS_OFS_ENA ) == 1
            ( ATIC42 OA mode enabled )
            then      T_DLY_LSL_OFS_ADJ[i] = C_T_DLY_LSL_OFS_ADJ
           CTR_VLS_MV_LSL_NR_SAMPLE[i] = 0
           VLS_MV_LSL_BUF[i] = 0
           If     ( LC_LSL_OFS_ADJ_H_L_GAIN == 0
           and      LC_LSL_OFS_ADJ_GAIN_SEL == 0 )
                    ( OA for gain8 only )
                    or          LV_LSL_OFS_GAIN_SWI_CYC[i] == 0
                         ( Alternating OA gain16/8 )
                    then           STATE_LSL_OFS_ADJ[i]   =     ADJUST_L
           else     STATE_LSL_OFS_ADJ[i]   =     ADJUST_H
           endif
            endif
else        T_DLY_LAMB_STI_OFF_OFS_ADJ[i]
                = T_DLY_LAMB_STI_OFF_OFS_ADJ[i] - T_SAMPLE
endif
```

STATE   ADJUST_H   :

```
If               STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN ) == 1           ( gain16 )
then        If          T_DLY_LSL_OFS_ADJ[i] == 0
            then            1.1.3.1 Measurement acquisition
                    If          CTR_VLS_MV_LSL_NR_SAMPLE[i] >= 4
                    then           VLS_MV_LSL[i] = VLS_MV_LSL_BUF[i] /4
                                1.1.3.2 Offset adjustment High Gain
                               If          LC_LSL_OFS_ADJ_H_L_GAIN == 1
                              ( OA for both ranges active )
                               then          If          LC_LSL_OFS_GAIN_SWI_CYC == 0
                                      ( Simultaneous OA gain16& 8 )
                                      or          LV_LSL_OFS_ACT_AST[i] == 1
                                      ( Initial OA in both gain16& 8 )
                                       then            T_DLY_LSL_OFS_ADJ[i]
                                                          = C_T_DLY_LSL_OFS_ADJ_CYC
                                               CTR_VLS_MV_LSL_NR_SAMPLE[i] = 0
                                            VLS_MV_LSL_BUF[i] = 0
                                            LV_SWI_GAIN_LSL_IF[i] = 0
                                            STATE_LSL_OFS_ADJ[i] =    ADJUST_L
                                       else            ( Alternating OA gain16/8 )
                                               LV_LSL_OFS_GAIN_SWI_CYC = 0
                                                STATE_LSL_OFS_ADJ[i] =     RETURN
                                       endif
                              else          ( OA for gain16 only )
                                      VLS_OFS_TMP_LSL[i]
                                      = ( ( VLS_OFS_TMP_LSL[i] - C_VLS_OFS_DELTA_ADD )
                                               /2 ) + C_VLS_OFS_DELTA_ADD
                                        1.1.3.3. Offset adjustment Low Gain
                                       ( calculation of corresponding offset for gain8 )
                                       STATE_LSL_OFS_ADJ[i] =     RETURN
                               endif
                   endif
            else          T_DLY_LSL_OFS_ADJ[i] = T_DLY_LSL_OFS_ADJ[i] - T_SAMPLE
```

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```
            endif
endif

STATE   ADJUST_L  :
If              STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN ) == 0          ( gain8 )
then        If        T_DLY_LSL_OFS_ADJ[i] == 0
            then          1.1.3.1 Measurement acquisition
                   If          CTR_VLS_MV_LSL_NR_SAMPLE[i] >= 4
                   then          VLS_MV_LSL[i] = VLS_MV_LSL_BUF[i] /4
                              1.1.3.3 Offset adjustment Low Gain
                          If          LC_LSL_OFS_ADJ_H_L_GAIN == 1
                                ( OA for both ranges active )
                          then          LV_SWI_GAIN_LSL_IF[i] = 1
                          else          ( OA for gain8 only )
                                VLS_OFS_TMP_LSL[i] = ( ( VLS_OFS_TMP_LSL[i]
                                        - C_VLS_OFS_DELTA_ADD ) * 2 )
                                        + C_VLS_OFS_DELTA_ADD
                                   1.1.3.2 Offset adjustment High Gain
                                ( calculation of corresponding offset for gain16 )
                           endif
                           If          LC_LSL_OFS_GAIN_SWI_CYC == 1
                           then          LV_LSL_OFS_GAIN_SWI_CYC[i] = 1
                           endif
                         STATE_LSL_OFS_ADJ[i] =     RETURN
                     endif
               else          T_DLY_LSL_OFS_ADJ[i] = T_DLY_LSL_OFS_ADJ[i] - T_SAMPLE
            endif
endif

STATE   RETURN  :
LV_VLS_OFS_ADJ_ENA_LSL_IF[i] = 0
If              LC_LSL_OFS_ADJ_H_L_GAIN == 0
( OA in default range only: no gain switching has taken place during calibration)
or              STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN ) == 1
( OA in both ranges: wait for return to gain16 prior to exiting to measurement mode )
then        If        LV_LSL_OFS_ACT_AST[i] == 0
            then          If          CTR_ CYC_T_WAIT_OFS_ADJ_RED[i]
                                        < C_NR_CYC_T_WAIT_LSL_OFS_ADJ_RED
                   then          T_WAIT_LSL_OFS_ADJ[i]
                                        = C_T_WAIT_LSL_OFS_ADJ_RED
                          CTR_ CYC_T_WAIT_OFS_ADJ_RED[i]
                                        = CTR_ CYC_T_WAIT_OFS_ADJ_RED[i] + 1
                   else          T_WAIT_LSL_OFS_ADJ[i] = C_T_WAIT_LSL_OFS_ADJ
                   endif
                   If          LV_IS == 1
                   then          LV_LSL_OFS_ADJ_IS[i] = 1
                   endif
            else          LV_LSL_OFS_ACT_AST[i] = 0
            endif
            STATE_LSL_OFS_ADJ[i]   =    WAIT
            LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] = 0
            LV_VLS_OFS_ADJ_CMPL[i] = 1
```

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endif

7.42.1.3.1 Measurement acquisition

Description:

Formula section:

If CTR_VLS_MV_LSL_NR_SAMPLE[i] $<$ 4
then VLS_MV_LSL_BUF[i] = VLS_MV_LSL_BUF[i] + VLS_UP_10_RAW[i]
CTR_VLS_MV_LSL_NR_SAMPLE[i] =
CTR_VLS_MV_LSL_NR_SAMPLE[i] + 1
endif

7.42.1.3.2 Offset adjustment High Gain

Description:

Formula section:

If LC_LSL_OFS_ADJ_H_L_GAIN == 1
(skip gain16 measurement acquisition for OA in gain8 only
-> calculation of corresponding offset for gain16)
or LC_LSL_OFS_ADJ_GAIN_SEL == 1
then **If** LV_LSL_OFS_ACT_AST[i] == 1
then VLS_MMV_LSL[i] = VLS_MV_LSL[i]
else VLS_MMV_LSL[i]$_i$ = VLS_MMV_LSL[i]$_{i-1}$ + C_CRLC_VLS_UP_OFS_ADJ
* (VLS_MV_LSL[i] - VLS_MMV_LSL[i]$_{i-1}$)
endif
VLS_OFS_TMP_LSL[i] = C_VLS_OFS_SP_LSL - VLS_MMV_LSL[i]
endif
If I VLS_OFS_TMP_LSL[i] - VLS_OFS_TMP_OLD_LSL[i] I
$<$ C_VLS_OFS_DIF_OK_LSL
or LV_LSL_OFS_ACT_AST[i] == 1
then **If** | VLS_OFS_TMP_LSL[i] | $<$ C_VLS_OFS_MAX_ABSV_LSL
then LV_VLS_OFS_LIM_LSL[i] = 0
VLS_OFS_LSL[i] = VLS_OFS_TMP_LSL[i]
(offset adjustment valid; VLS_OFS_LSL[i] is changed)
else LV_VLS_OFS_LIM_LSL[i] = 1
If VLS_OFS_TMP_LSL[i] $>$ 0
then VLS_OFS_LSL[i] = + C_VLS_OFS_MAX_ABSV_LSL
else VLS_OFS_LSL[i] = C_VLS_OFS_MAX_ABSV_LSL
(set offset voltage to threshold value which has been reached,
taking into account the correct sign)
endif
endif
endif
VLS_OFS_TMP_OLD_LSL[i] = VLS_OFS_TMP_LSL[i]

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7.42.1.3.3 Offset adjustment Low Gain

Description:

Formula section:

If LC_LSL_OFS_ADJ_H_L_GAIN == 1
(skip gain8 measurement acquisition for OA in gain16 only
-> calculation of corresponding offset for gain8)
or LC_LSL_OFS_ADJ_GAIN_SEL == 0
then **If** LV_LSL_OFS_ACT_AST[i] == 1
then VLS_MMV_LSL_L_GAIN[i] = VLS_MV_LSL[i]
else VLS_MMV_LSL_L_GAIN[i]$_i$ = VLS_MMV_LSL_L_GAIN[i]$_{i-1}$
+ C_CRLC_VLS_UP_OFS_ADJ_L_GAIN
* (VLS_MV_LSL[i] - VLS_MMV_LSL_L_GAIN[i]$_{i-1}$)
endif
VLS_OFS_TMP_LSL[i] = C_VLS_OFS_SP_LSL - VLS_MMV_LSL_L_GAIN[i]
endif
If I VLS_OFS_TMP_LSL[i] - VLS_OFS_TMP_OLD_LSL_L_GAIN[i] I
$<$ C_VLS_OFS_DIF_OK_LSL_L_GAIN
or LV_LSL_OFS_ACT_AST[i] == 1
then **If** | VLS_OFS_TMP_LSL[i] | $<$ C_VLS_OFS_MAX_ABSV_LSL_L_GAIN
then LV_VLS_OFS_LIM_LSL_L_GAIN[i] = 0
VLS_OFS_LSL_L_GAIN[i] = VLS_OFS_TMP_LSL[i]
(offset adjustment valid; VLS_OFS_LSL_L_GAIN[i] is changed)
else LV_VLS_OFS_LIM_LSL_L_GAIN[i] = 1
If VLS_OFS_TMP_LSL[i] $>$ 0
then VLS_OFS_LSL_L_GAIN[i] =
+ C_VLS_OFS_MAX_ABSV_LSL_L_GAIN
else VLS_OFS_LSL_L_GAIN[i] =
C_VLS_OFS_MAX_ABSV_LSL_L_GAIN
(set offset voltage to threshold value which has been reached,
taking into account the correct sign)
endif
endif
endif
VLS_OFS_TMP_OLD_LSL_L_GAIN[i] = VLS_OFS_TMP_LSL[i]

7.42.2 Signal acquisition and conversion for WRAF sensor

FUNCTION DESCRIPTION:

Description:

Activation:

If STATE_LSH_UP[i] $<>$ OFF
and LV_LSL_IF_SPI_RST_END[i] == 1
(Initialisation of WRAF controller ASIC completed successfully)

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```
then        " function enabled "
else        " function disabled "
```

7.42.2.1 WRAF sensor interface gain-switching for Ip measurement

Description:

NOTE: The logical variable LV_SWI_GAIN_LSL_IF[i] is mapped in the interface byte STATE_LSL_ IF_SPI_WR[i].
Its initialization at ECU RESET shall be done according to the corresponding bit value of C_ STATE_LSL_IF_SP_WR_INI in ASW-BSW Interface , 4033.

Formula section:

```
If              LC_IPLSL_GAIN_SWI_ACT == 1          (Ip gain switching active)
and               LV_IPLSL_VLD[i] == 1
and               LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] == 0
then      If        STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN          ) == 1          (gain16)
          and         LV_SWI_GAIN_LSL_IF[i] == 1
          then          If          LV_VLS_UP_VLD[i] == ( 1 -> 0 )
                 and          (( LAMB_LS_UP[i] > 1
                 and          LC_VLS_UP_THD_SWI_GAIN_AFL_ACT == 1 )
                 or          ( LAMB_LS_UP[i] < 1
                 and          LC_VLS_UP_THD_SWI_GAIN_AFR_ACT == 1 ) )
                 or          ( LC_SWI_GAIN_LSL_IF_PUC_ACT == 1
                 and          LV_PUC == 1 )
                or          LAMB_LS_UP[i] > C_LAMB_LS_UP_GAIN_SWI_MAX
                     or          LAMB_LS_UP[i] < C_LAMB_LS_UP_GAIN_SWI _MIN
                then          LV_SWI_GAIN_LSL_IF[i] = 0 ( gain16 -> gain8 )
                endif
          else        ( gain8 )
                If          STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN ) == 0
                and          LV_SWI_GAIN_LSL_IF[i] == 0
                and          ( C_LAMB_LS_UP_VLS_UP_H_GAIN_MIN
                                  < LAMB_LS_UP[i]
                                  < C_LAMB_LS_UP_VLS_UP_H_GAIN_MAX )
                 or          ( LC_SWI_GAIN_LSL_IF_PUC_ACT == 1
                 and          LV_PUC == 1 )
                then          LV_SWI_GAIN_LSL_IF[i] = 1
                        ( gain8 -> gain16, including hysteresis )
                endif
          endif
else      If        LV_LAMB_STI_OFF_LSL_OFS_ADJ[i] == 0
          then        LV_SWI_GAIN_LSL_IF[i] = LC_LSL_OFS_ADJ_GAIN_SEL
                ( stay in default gain mode )
          endif
endif
```

7.42.2.2 Calculation of compensated WRAF controller output voltage and WRAF sensor pumping current

Description:

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Formula section:

If LV_VLS_UP_INIT[i] == 0 *(no gain switching currently ongoing)*
and LV_SWI_GAIN_LSL_IF[i] == STATE_LSL_IF_SPI_RD[i] (*bit* SWI_GAIN)
and LV_LSL_OFS_ADJ_ACT[i] == 0
(OA mode of WRAF controller not active)
then **If** STATE_LSL_IF_SPI_RD[i] (*bit* SWI_GAIN) == 1 *(gain16)*
then VLS_DELTA_TMP_LSL[i]
= (VLS_UP[i] + VLS_OFS_LSL[i] - C_VLS_OFS_SP_LSL)
If C_VLS_OFS_DELTA_CBK_EX_MAN $<>$ 0
(request for simulated diametrical misalignment of cylinder banks for diagnostic test purpose)
then **If** i == 1
then VLS_DELTA_TMP_LSL[i] = VLS_DELTA_TMP_LSL[i]
+ C_VLS_OFS_DELTA_CBK_EX_MAN
else VLS_DELTA_TMP_LSL[i] = VLS_DELTA_TMP_LSL[i]
- C_VLS_OFS_DELTA_CBK_EX_MAN
endif
endif
else *(gain8)*
VLS_DELTA_TMP_LSL[i] = (VLS_UP[i] + VLS_OFS_LSL_L_GAIN[i]
- C_VLS_OFS_SP_LSL) * 2
endif
If VLS_DELTA_TMP_LSL[i] $>=$ 0
then VLS_DELTA_TMP_LSL[i] = VLS_DELTA_TMP_LSL[i]
* IP_FAC_COR_IPLSL_PRS_EX
else VLS_DELTA_TMP_LSL[i] = VLS_DELTA_TMP_LSL[i]
* IP_FAC_COR_IPLSL_AFR_PRS_EX
endif
VLS_UP_DIAG[i] = VLS_DELTA_TMP_LSL[i] + C_VLS_OFS_SP_LSL
If LV_LS_UP_READY[i] == 1
and LV_LS_UP_READY_CDN[i] == 0
then VLS_DELTA_TMP_LSL[i] = VLS_DELTA_TMP_LSL[i]
* IP_FAC_COR_IPLSL_TTIP_LS_UP
endif
VLS_DELTA_TMP_LSL[i] = VLS_DELTA_TMP_LSL[i] * FAC_LSL_GAIN_AD[i]
+ (C_ICPLSL_COR_ADD /C_IPLSL_GAIN **)**
IPLSL_COR[i] = VLS_DELTA_TMP_LSL[i] * C_IPLSL_GAIN
else VLS_DELTA_TMP_LSL[i]$_{n}$ = VLS_DELTA_TMP_LSL[i]$_{n-1}$
VLS_UP_DIAG[i]$_{n}$ = VLS_UP_DIAG[i]$_{n-1}$
IPLSL_COR[i]$_{n}$ = IPLSL_COR[i]$_{n-1}$
endif

% Low pass filtering of compensated signal.
If C_FAC_LPF_VLS_COR_LSL $>$ 0
and LV_VLS_UP_INIT = 0
then
VLS_COR_H_RES_LSL[i]$_{n}$ = VLS_COR_H_RES_LSL[i]$_{n-1}$
+ (VLS_DELTA_TMP_LSL[i] + C_VLS_OFS_SP_LSL
- VLS_COR_H_RES_LSL[i]$_{n-1}$) * C_FAC_LPF_VLS_COR_LSL
else
VLS_COR_H_RES_LSL[i]$_{n}$ = VLS_DELTA_TMP_LSL[i] + C_VLS_OFS_SP_LSL

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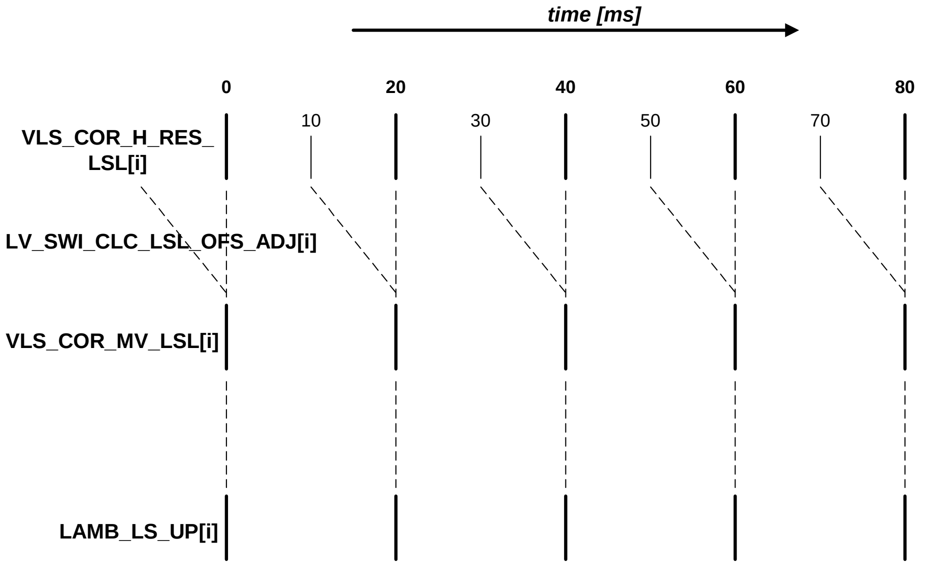
endif

VLS_UP_COR[i] = VLS_COR_H_RES_LSL[i]
VLS_UP_COR_H_GAIN[i] = VLS_COR_H_RES_LSL[i]

7.42.2.3 Conversion into lambda signal

Description:

Signal flow diagram for activated averaging (LC_VLS_COR_MV_LSL_ACT == 1):



Formula section:

Calculation in case of LC_VLS_COR_MV_LSL_ACT = 1

If LV_VLS_UP_INIT[i] = (1 -> 0) *(initialization of current Ip range complete)*
and LV_LSL_OFS_ADJ_ACT[i] == 0
(OA mode of WRAF controller not active)
then VLS_COR_TMP_LSL[i] = VLS_COR_H_RES_LSL[i]
VLS_COR_MV_LSL[i] = VLS_COR_H_RES_LSL[i]
LV_LSL_UP_SHO_PER_REQ[i] = 0
LAMB_LS_UP[i] = IP_LAMB_LS_UP
else **If** LV_VLS_UP_INIT[i] == 1 *(gain switching is currently taking place)*
or LV_SWI_GAIN_LSL_IF[i] STATE_LSL_IF_SPI_RD[i] (*bit* SWI_GAIN)
or LV_LSL_OFS_ADJ_ACT[i] == 1
(OA mode of WRAF controller active)
then VLS_COR_TMP_LSL[i]$_n$ = VLS_COR_TMP_LSL[i]$_{n-1}$
VLS_COR_MV_LSL[i]$_n$ = VLS_COR_MV_LSL[i]$_{n-1}$
LV_LSL_UP_SHO_PER_REQ[i] = 1
LAMB_LS_UP[i]$_n$ = LAMB_LS_UP[i]$_{n-1}$
LV_SWI_CLC_LSL_OFS_ADJ[i] = 0
else **If** LV_SWI_CLC_LSL_OFS_ADJ[i] == 0
then LV_SWI_CLC_LSL_OFS_ADJ[i] = 1

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VLS_COR_TMP_LSL[i] = VLS_COR_H_RES_LSL[i]
else LV_SWI_CLC_LSL_OFS_ADJ[i] = 0
VLS_COR_MV_LSL[i] = (VLS_COR_H_RES_LSL[i]
+ VLS_COR_TMP_LSL[i]) /2
LV_LSL_UP_SHO_PER_REQ[i] = 0
LAMB_LS_UP[i] = IP_LAMB_LS_UP
endif
endif
endif

(end of calculations in case of LC_VLS_COR_MV_LSL_ACT = 1)

<u>Calculation in case of LC_VLS_COR_MV_LSL_ACT = 0</u>

If LV_VLS_UP_INIT[i] == 1 *(gain switching is currently taking place)*
or LV_SWI_GAIN_LSL_IF[i] STATE_LSL_IF_SPI_RD[i] (*bit* SWI_GAIN)
or LV_LSL_OFS_ADJ_ACT[i] == 1 *(OA mode of WRAF controller active)*
then VLS_COR_TMP_LSL[i]$_n$ = VLS_COR_TMP_LSL[i]$_{n-1}$
VLS_COR_MV_LSL[i]$_n$ = VLS_COR_MV_LSL[i]$_{n-1}$
LV_LSL_UP_SHO_PER_REQ[i] = 1
LAMB_LS_UP[i]$_n$ = LAMB_LS_UP[i]$_{n-1}$
T_INI_DLY_LSL_SIG_ACQ[i] = C_T_INI_DLY_LSL_SIG_ACQ
else
if T_INI_DLY_LSL_SIG_ACQ[i] $>$ 0
then decrement T_INI_DLY_LSL_SIG_ACQ[i]
VLS_COR_TMP_LSL[i]$_n$ = VLS_COR_TMP_LSL[i]$_{n-1}$
VLS_COR_MV_LSL[i]$_n$ = VLS_COR_MV_LSL[i]$_{n-1}$
LV_LSL_UP_SHO_PER_REQ[i] = 1
LAMB_LS_UP[i]$_n$ = LAMB_LS_UP[i]$_{n-1}$
else VLS_COR_TMP_LSL[i] = VLS_COR_H_RES_LSL[i]
VLS_COR_MV_LSL[i] = VLS_COR_H_RES_LSL[i]
LV_LSL_UP_SHO_PER_REQ[i] = 0
LAMB_LS_UP[i] = IP_LAMB_LS_UP
endif

(end of calculations in case of LC_VLS_COR_MV_LSL_ACT = 1)

*Set*LAMB_LS_UP_MIN_TMP = 32, and LAMB_LS_UP_MV_TMP = 0, i_ctr_tmp = 0, prior to execution of FOR loop depending on [i].

LAMB_LS_UP_MIN_TMP = **MIN** (LAMB_LS_UP[i], LAMB_LS_UP_MIN_TMP)
LAMB_LS_UP_MIN = LAMB_LS_UP_MIN_TMP
LAMB_LS_UP_MV_TMP = LAMB_LS_UP_MV_TMP + LAMB_LS_UP[i]
increment i_ctr_tmp
LAMB_LS_UP_MV = LAMB_LS_UP_MV_TMP /i_ctr_tmp

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7.43 O2 sensor (lin, up) signal compensation and conversion (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_LSL_OFS_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that upstream oxygen sensor Ip offset adjustment shall be inhibited					
T_HOM_ACT_OFS_ADJ	O/V	0... FFFFH	0... 655.35	0.01	s
Time in homogenous mode for enabling offset adjustment					

Input data:

C_T_DLY_TTIP_MES_ OBD_LSH_UP {p. 5440}	C_T_DLY_TTIP_RES_ OBD_LSH_UP {p. 5440}	LV_HOM_ACT {p. 8136}	LV_LAM_AD_INJ_ACT {p. 3348}
STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}			

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned
(NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

The Boolean flag LV_INH_LSL_OFS_ADJ[i] shall indicate whether the upstream oxygen sensor Ip offset adjustment shall be permitted to take place.
When set, Ip offset adjustment shall be inhibited.

Description:

Application conditions:

Initialisation:
The following initialisation shall be carried out **after RESET**, **after engine start**, or **upon erase of error management**.
LV_INH_LSL_OFS_ADJ [i] = 0
T_HOM_ACT_OFS_ADJ = max phys. value

Recurrence:
T_SAMPLE = 10ms

Activation:
LV_ST_END == 1

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Deactivation:
- -

Formula section:

IF LV_HOM_ACT = 0
THEN T_HOM_ACT_OFS_ADJ = 0
ELSE increment T_HOM_ACT_OFS_ADJ (timer shall saturate at max phys. limit)
ENDIF

If STATE_LSL_IF_SPI_RD[i] *bit* LSL_ENA == 0
or LV_LAM_AD_INJ_ACT = 1
or (T_HOM_ACT_OFS_ADJ <= (C_T_DLY_TTIP_MES_OBD_LSH_UP + C_T_DLY_TTIP_RES_OBD_LSH_UP))
then LV_INH_LSL_OFS_ADJ[i] = 1
else LV_INH_LSL_OFS_ADJ[i] = 0
endif

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7.44 O2 sensor (up) operability detection

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_DE_INT_LS_UP_READY [NC_CBK_EX_NR]	V	0... FFFFH	0... 63.9990234	97.6563e3	-
Value as a measure of the sensor signal variation vs. time					
LAMB_MV_LS_UP_READY [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234	97.6563e3	-
Mean value of the converted upstream oxygen sensor signal in terms of A/F ratio					
LV_LS_UP_READY [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable for operative readiness of upstream oxygen sensor					
LV_LS_UP_READY_CDN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable for forced operative readiness of upstream oxygen sensor					
LV_LS_UP_READY_RAW [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable for raw operative readiness of upstream oxygen sensor					
LV_LSL_UP_ERR_SUSP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
error suspicion of upstream oxygen sensor signal, set reduced limitation of Lambda controller					
LV_LSL_UP_SUSP_ENA [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Enable setting of LV_LSL_UP_ERR_SUSP once the WRAF sensor is ready					
LV_TEG_MIN_DLY [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable indicating sufficient delay after dew point detection prior to forced sensor activation					
T_DLY_CHK_LS_UP_READY [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Delay timer for start of readiness detection after engine start					
T_DLY_LS_UP_READY_TEG_MIN [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Delay time after dew point detection prior to forced sensor activation					
T_LAMB_DE_INT_RST [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer for duration of summation of sensor signal dispersion up to reset thereof					
T_TOUT_LS_UP_READY [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer for forced activation of linear lambda sensor					

Input data:

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}
LV_LSL_DEAC [NC_CBK_EX_NR] {p. 955}	LV_PUC {p. 1720}	LV_ST_END {p. 1720}	LV_TEMP_DEW_LS_UP [NC_CBK_EX_NR] {p. 1007}
LV_TTIP_MES_VLD_LS_UP [NC_CBK_EX_NR] {p. 1320}	LV_V_REF_VLD_R_IT_LS_UP [NC_CBK_EX_NR] {p. 1320}	MAF_INT_PUC_ACT {p. 2942}	NC_CBK_EX_NR {p. 1829}
STATE_ERR_IPLSL [NC_CBK_EX_NR] {p. 955}	STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}	TCO_ST {p. 1100}
TTIP_MES_LS_UP [NC_CBK_EX_NR] {p. 1321}			

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LAMB_LS_UP_READY	-	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant for mean value calculation of lambda sensor output signal					
C_LAMB_DE_INT_THD_LS_UP_READY	-	0... FFFFH	0... 63.9990234	97.6563e3	-
Sensor signal dispersion threshold for readiness detection					
C_LAMB_THD_MAX_LS_UP_READY	-	0... 7FFH	0... 1.99902344	97.6563e3	-
Upper threshold of sensor signal for readiness detection					
C_LAMB_THD_MIN_LS_UP_READY	-	0... 7FFH	0... 1.99902344	97.6563e3	-
Lower threshold of sensor signal for readiness detection					
C_MAF_INT_PUC_MAX_LS_UP_READY	-	0... FFFFH	0... 2912.67	0.04444444	g
Maximum MAF integral value during PUC used for reset of operability					
C_T_DLY_LS_UP_READY_TEG_MIN	-	0... FFFFH	0... 1310.7	0.02	s
Threshold of delay time after dew point detection prior to forced sensor activation					
C_T_LAMB_DE_INT_RST	-	0... FFFFH	0... 1310.7	0.02	s
Time for sensor dispersion calculation up to reset					
C_TTIP_MIN_LS_UP_READY	-	8000... 7FFFH	0... 2047.94	0.0625	°C
Minimum oxygen sensor ceramic temperature for save operation					
ID_T_DLY_CHK_LS_UP_READY	-	0... FFFFH	0... 1310.7	0.02	s
LDP_TCO_ST_ID_T_DLY_CHK_LS_UP	8	0... FEH	0... 142.5	0.75	°C
Delay time for begin of readiness detection after engine start					
ID_T_TOUT_LS_UP_READY	-	0... FFFFH	0... 1310.7	0.02	s
LDP_TCO_ST_ID_T_TOUT_LS_UP	4	0... FEH	0... 142.5	0.75	°C
Time out constant for readiness detection > forced readiness detection					
LC_TEG_MIN_DEAC	-	0... 1H	0 ...1	1	-
Test switch to disable dependance of readiness detection on dew point detection					
LC_TEG_MIN_THD_DEAC_TEST	-	0... 1H	0 ...1	1	-
Test switch to check function behaviour at revocation of dew point					

FUNCTION DESCRIPTION

General information:

This is a particular **version for linear oxygen sensors to be used if the oxygen sensor ceramic temperature is determined by internal resistance measurement of the Nernst cell**. It requires that the oscillator can be switched on and off depending on LV_LS_UP_READY_RAW[i] which is determined in this function.

The operability check for the lambda sensor shall detect the moment at which the sensor reaches principal ability to generate plausible output signals (once pump current control loop has successfully been activated!). It shall analyse the sensor signal and distinguish between two stages of operative readiness. The criterion for raw sensor operability may be the variation of the sensor signal as well as the crossing of a maximum or minimum threshold by the sensor signal or simply when a delay has been exceeded. When the raw operative readiness has been sensed, the full operative readiness shall be determined by waiting until the minimum oxygen sensor ceramic temperature for safe sensor operation has been reached.

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC_CBK_EX_NR = 1)

i = 1, for single exhaust cylinder bank.

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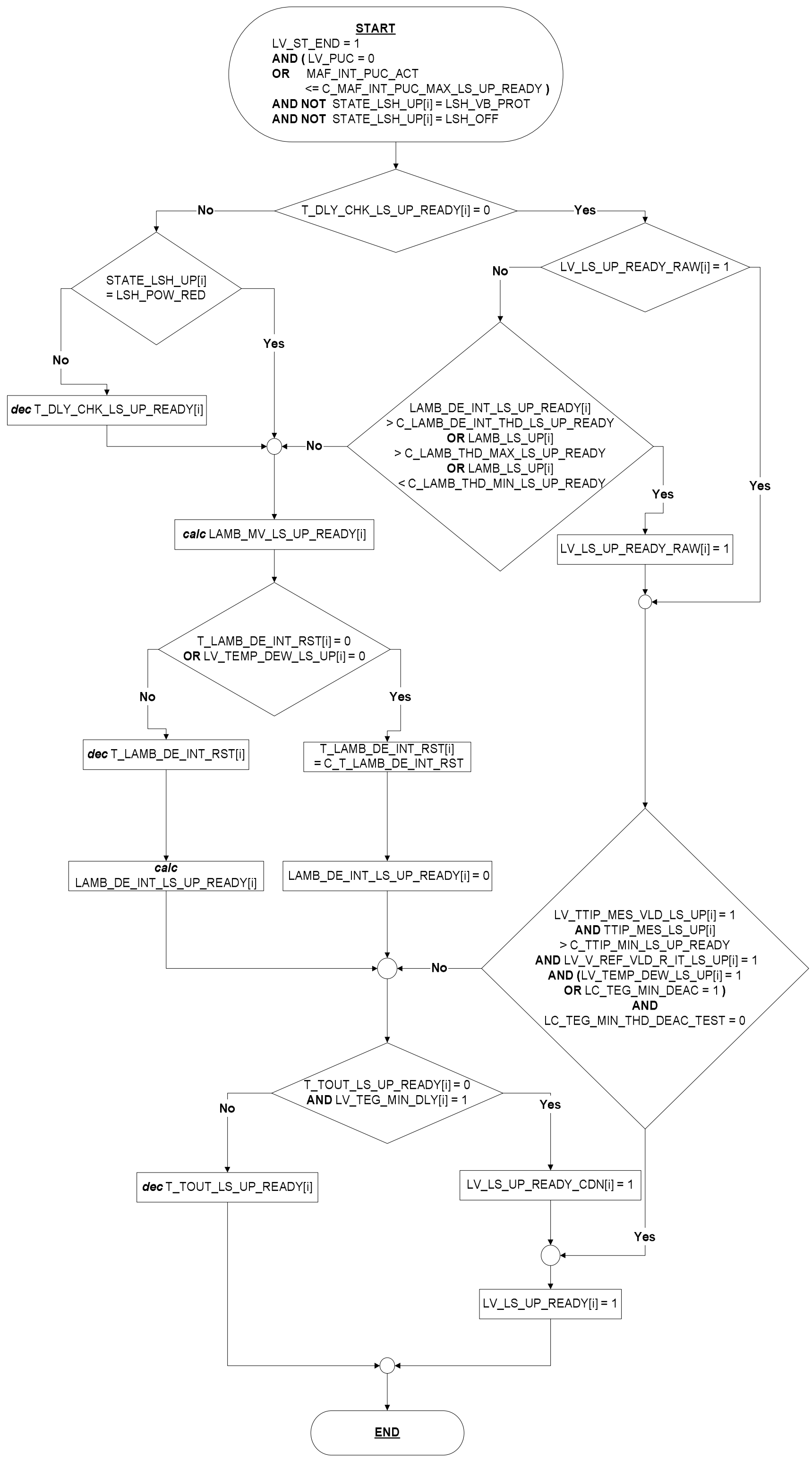
Signal flow diagram:



Description:

The function shall be activated with the following conditions being fulfilled:

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Engine start is left, i.e. "exit START" (LV_ST_END = 1) *and*
Upstream heater has left the batteryvoltage protection mode (STATE_LSH_UP[i]   LSH_VB_PROT) *and*
Upstream heater is <u>not</u> in off mode (STATE_LSH_UP[i]   LSH_OFF) *and*
Threshold value of MAF integral is <u>not</u> exceeded during PUC.
The function shall be deactived once any one of these conditions is not fulfilled anymore.
Function restart shall also take place upon erase of error management.
Precondition for starting the operability check is that the delay time ID_T_DLY_CHK_LS_UP_READY has expired.

The sensor is subsequently recognized as being <u>fully</u> operable (LV_LS_UP_READY[i] = 1) if

(

the value LAMB_DE_INT_LS_UP_READY[i] exceeds the threshold C_LAMB_DE_INT_THD_LS_UP_READY once
OR if the sensor output signal LAMB_LS_UP[i] exceeds the window defined by the limiting values C_LAMB_THD_MIN_LS_UP_READY and C_LAMB_THD_MAX_LS_UP_READY

< This state is called <u>raw</u> sensor operability (LV_LS_UP_READY_RAW[i] = 1) >

AND

the value for ceramic temperature is valid (LV_TTIP_MES_VLD_LS_UP[i] = 1)
AND the value of the reference voltage is valid (LV_V_REF_VLD_R_IT_LS_UP[i] = 1)
AND the temperature of the sensor is higher than a threshold (TTIP_MES_LS_UP[i] > C_TTIP_MIN_LS_UP_READY)

AND

the dew point was exceeded (LV_TEMP_DEW_LS_UP[i] = 1)
OR LC_TEG_MIN_DEAC = 1 (only for test purpose in conjunction with forced sensor heating prior to engine start!)

AND

LC_TEG_MIN_THD_DEAC_TEST = 0

)

OR

the timer for forced activation has expired (T_TOUT_LS_UP_READY[i] = 0)
AND dew point was exceeded (LV_TEMP_DEW_LS_UP[i] = 1) for certain time delay (LV_TEG_MIN_DLY[i] = 1)
< This state is called <u>forced</u> sensor operability (LV_LS_UP_READY_CDN[i] = 1) >

The logical value LV_LS_UP_READY_RAW[i] detects changes in sensor signal as basis for recognition of the raw sensor operability.

<u>REMARK:</u> The CARB has defined that the sensor must be recognized as being operable after a certain time upon engine start. This requirement is realized using the timer T_TOUT_LS_UP_READY[i].

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If the timer has expired the sensor will be set operable (LV_LS_UP_READY[i] = 1) and in addition the conditional readiness bit (LV_LS_UP_READY_CDN[i]) will be set to 1 , initializing the forced activation of sensor.

The flag LV_LSL_UP_ERR_SUSP[i] indicates that a fault may be present in the sensor, which is not yet debounced but may lead to wrong lambda measurement. It may be used to restrict the usage of the sensor signal by functions like lambda control or adaptation or diagnosis functions. The detection of these conditions is effectively masked with LV_LSL_UP_SUSP_ENA[i], which ensures that LV_LSL_UP_ERR_SUSP[i] is not set during sensor warmup.
.

Application Condition

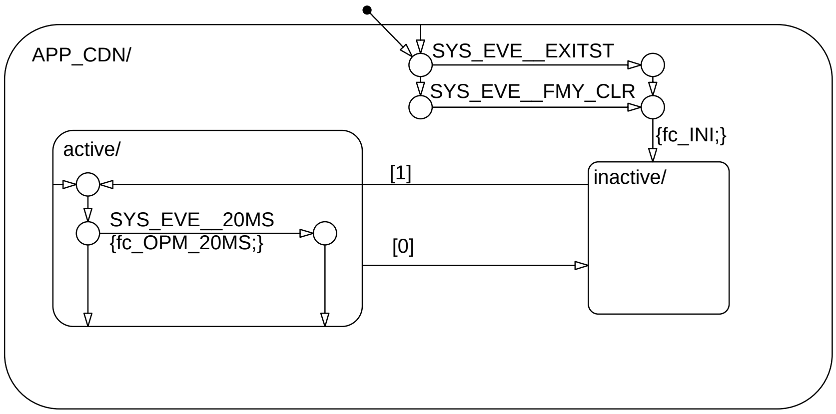

Figure 7.44.1: EGCP_DTSYSLSL0/APP_CDN/Chart

Function Description

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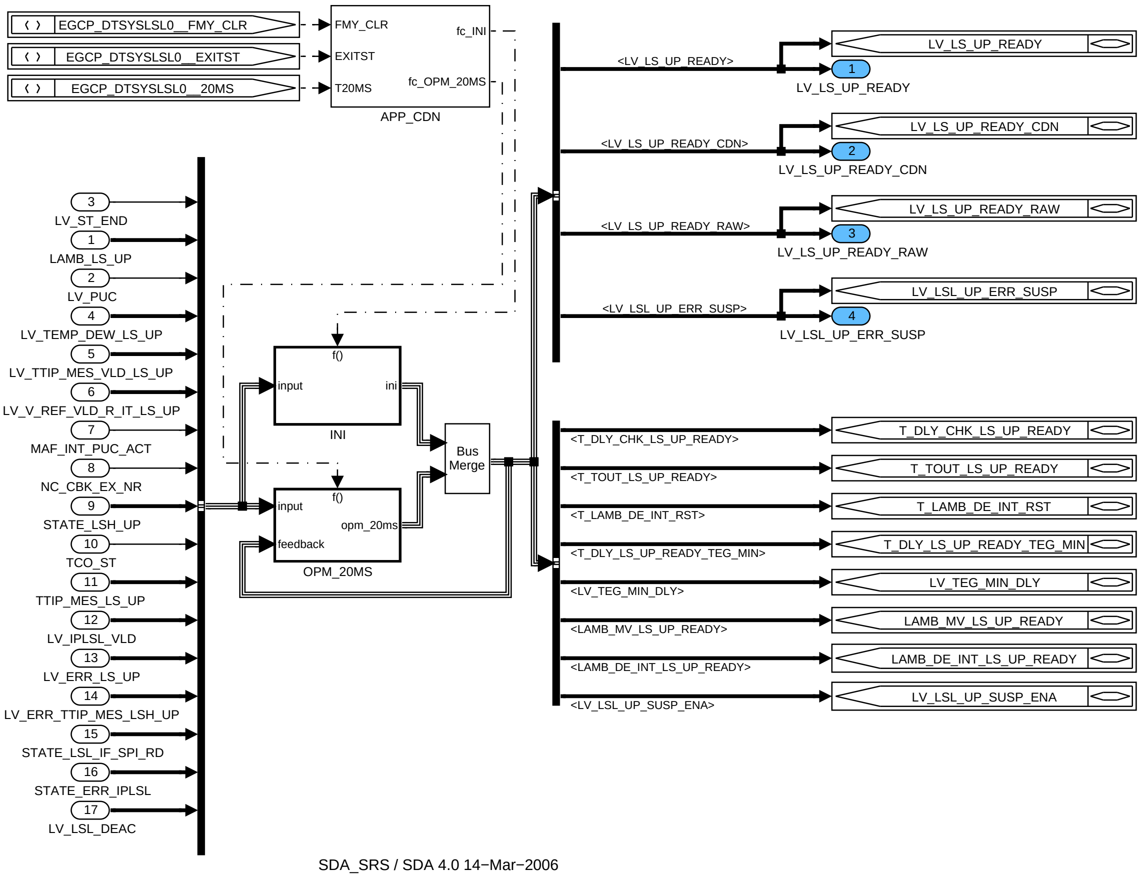

Figure 7.44.2: EGCP_DTSYSLSL0

7.44.1 INITIALIZATION

Initialization at reset and cleaning of fault memory

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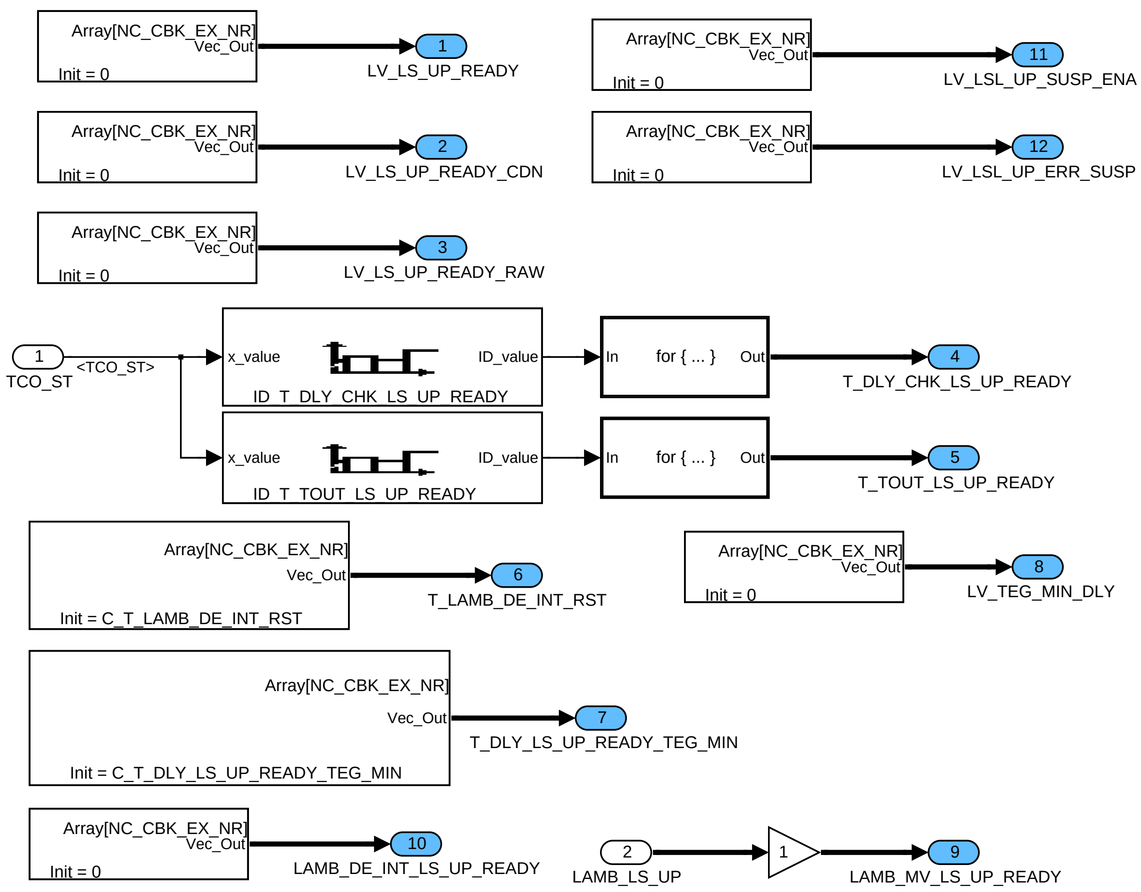

Figure 7.44.3: EGCP_DTSYSLSL0/INI/INI

7.44.2 FORMULA SECTION

Content of the formula section:
SECTION 1: Check of the general condition for initialization or activation
SECTION 2: Calculation active (FCN_ACT)
SECTION 2.1: Check of full operative readiness
SECTION 2.2: Check of sensor readiness
SECTION 2.2.1: Readiness detection (READ_DET)
SECTION 2.2.1.1: Check of the delay time for start of readiness
SECTION 2.2.1.2: Calculation of mean value and sensor signal variation
SECTION 2.2.1.3: Calculation of the delay time after dew point detection
SECTION 2.2.1.4: Forced operative readiness
SECTION 2.3: Generation of signal quality flags
SECTION 3: Initialization due to MAF integral exceeding during PUC (INI_MAF_INT_EXC)
SECTION 4: Initialization in case calculation not active (INI_VL_PROT)

SECTION 1: Check of the general condition for initialization or activation

fc_FCN_ACT triggers the calculation of whole Section 2
fc_INI_MAF_INT_EXC triggers the calculation of Section 3
fc_INI_VL_PROT triggers the calculation of Section 4

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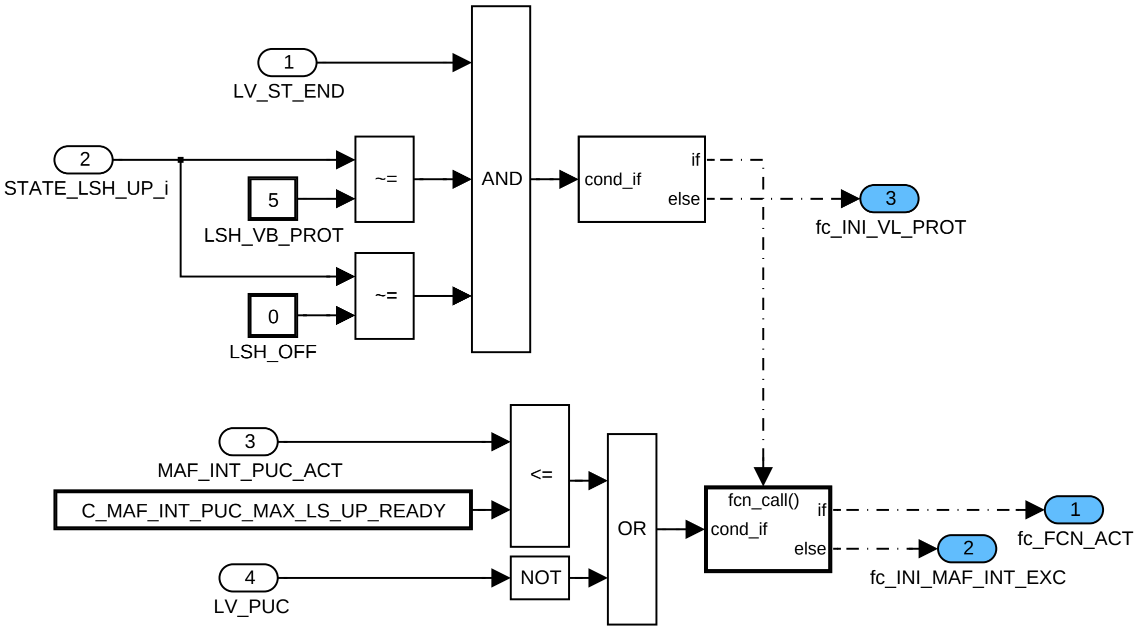

Figure 7.44.4: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CHK_ACT_CDN

SECTION 2: Calculation active (fc_FCN_ACT)

SECTION 2.1: Check of full operative readiness

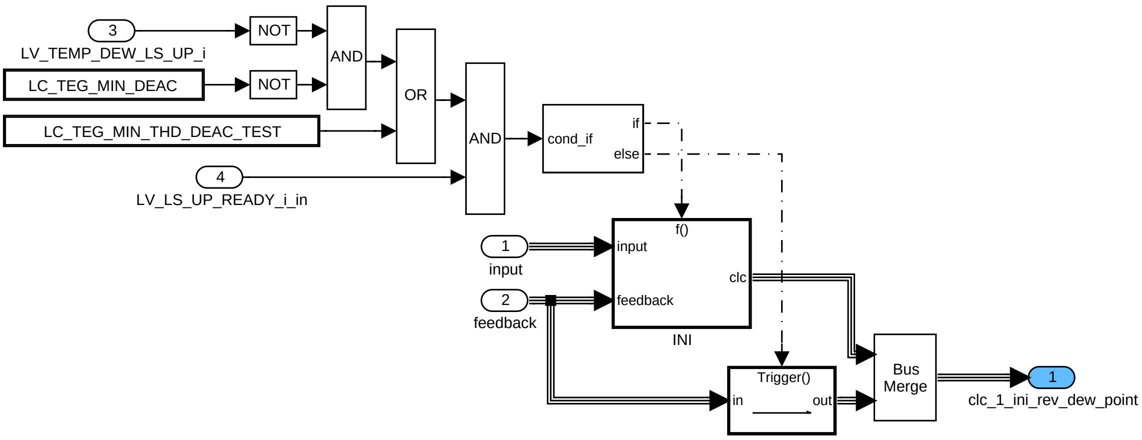

Figure 7.44.5: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CLC_OPER_DET_FOR_LLS/FCN_ACT/CLC_1_INI_REV_DEW_POINT

Initialization due to revocation of dew point upon successful initial detection of full operative readiness

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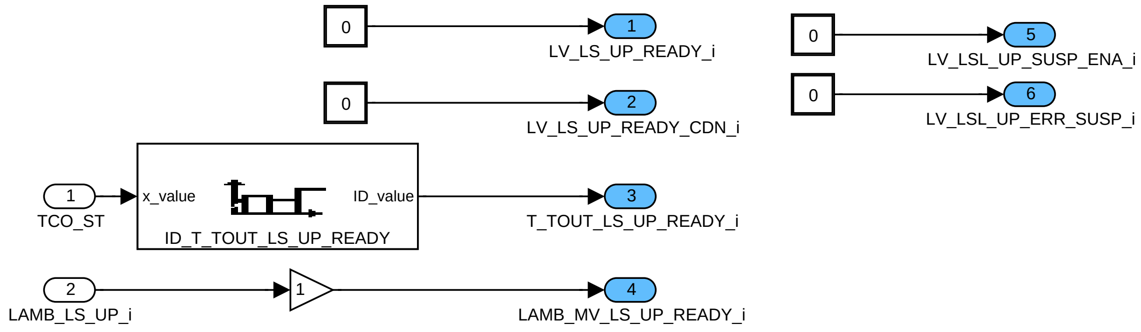

Figure 7.44.6: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CLC_OPER_DET_FOR_LLS/FCN_ACT/CLC_1_INI_REV_DEW_POINT/INI/INI

SECTION 2.2: Check of sensor readiness

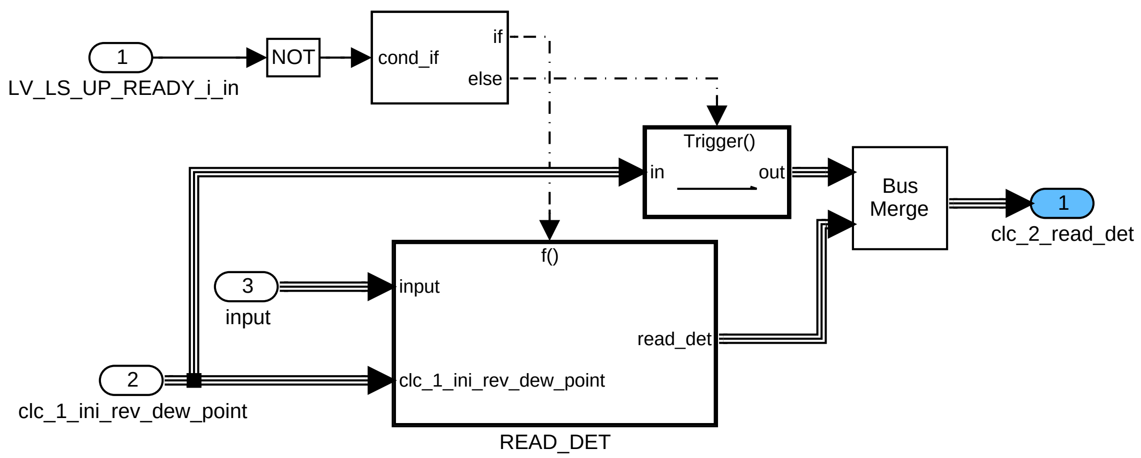

Figure 7.44.7: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CLC_OPER_DET_FOR_LLS/FCN_ACT/CLC_2_READ_DET

SECTION 2.2.1: Readiness detection (READ_DET)

SECTION 2.2.1.1: Check of the delay time for start of readiness

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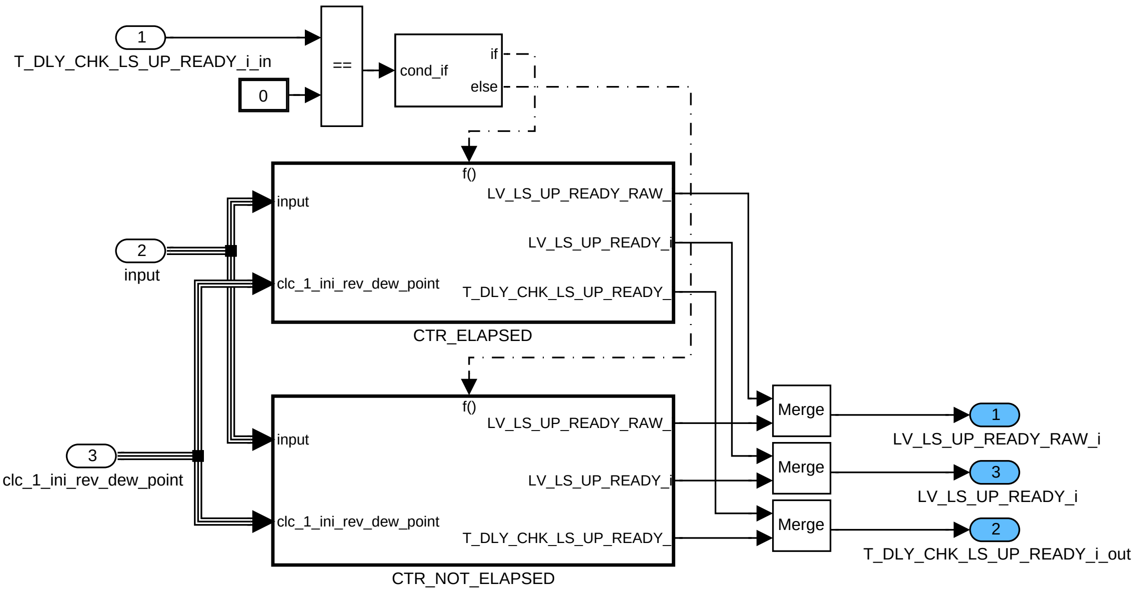

Figure 7.44.8: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CLC_OPER_DET_FOR_LLS/FCN_ACT/CLC_2_READ_DET/READ_DET/CLC_1_T_DLY_CHK

Delay time elapsed (CTR_ELAPSED) - recognition of sensor operability

The detection of sensor operability is done in two calculations:
Calculation 1: RAW sensor operability detection
Calculation 2: Full sensor operability detection

Calculation 1: RAW sensor operability detection

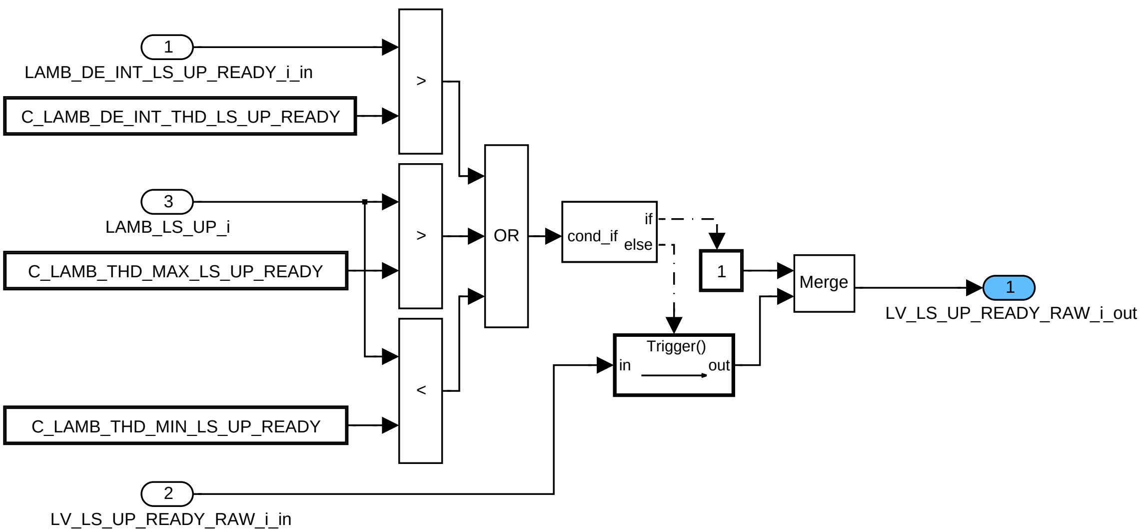

Figure 7.44.9: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CLC_OPER_DET_FOR_LLS/FCN_ACT/CLC_2_READ_DET/READ_DET/CLC_1_T_DLY_CHK/CTR_ELAPSED/CTR_ELAPSED_1

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Calculation 2: Full sensor operability detection

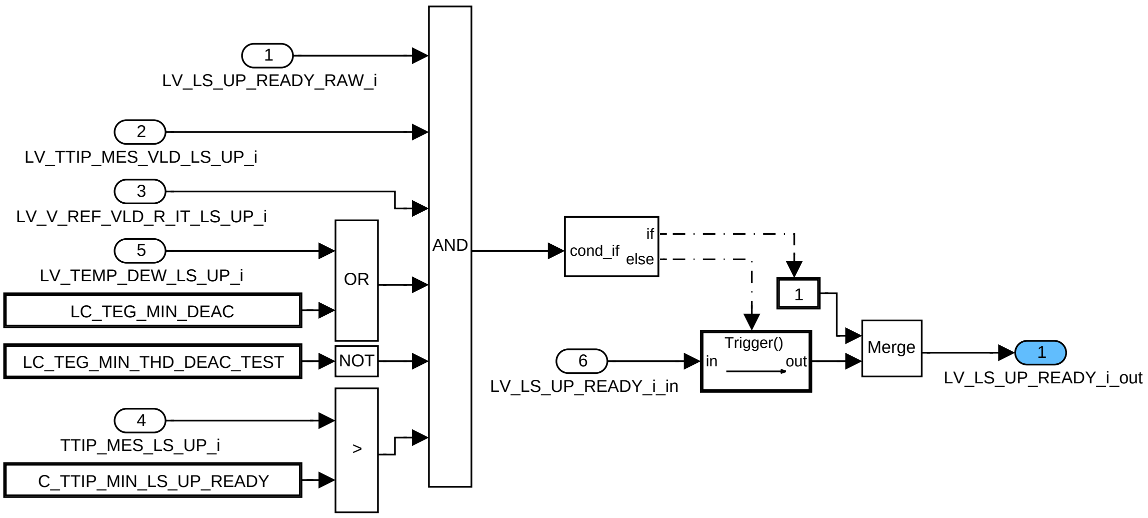

Figure 7.44.10: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CLC_OPER_DET_FOR_LLS/FCN_ACT/CLC_2_READ_DET/READ_DET/CLC_1_T_DLY_CHK/CTR_ELAPSED/CTR_ELAPSED_2

Delay time not elapsed (CTR_NOT_ELAPSED)

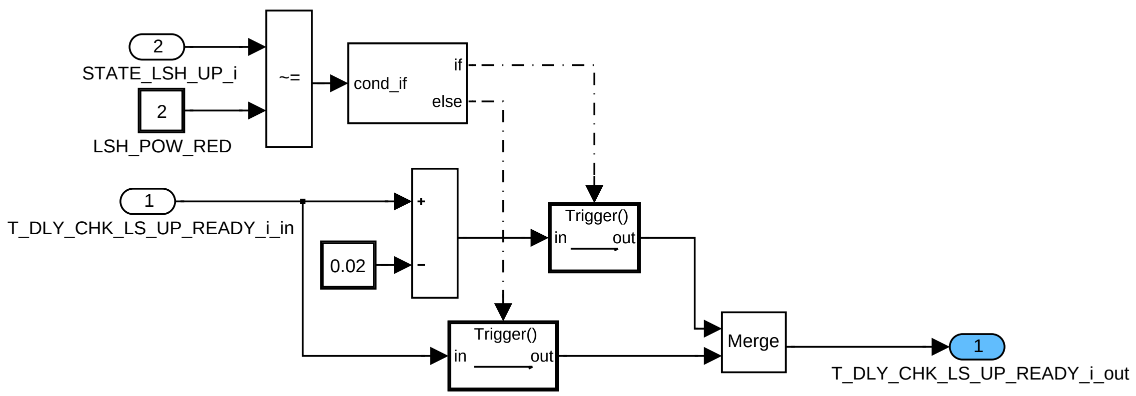

Figure 7.44.11: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CLC_OPER_DET_FOR_LLS/FCN_ACT/CLC_2_READ_DET/READ_DET/CLC_1_T_DLY_CHK/CTR_NOT_ELAPSED/CTR_NOT_ELAPSED

SECTION 2.2.1.2: Calculation of mean value and sensor signal variation

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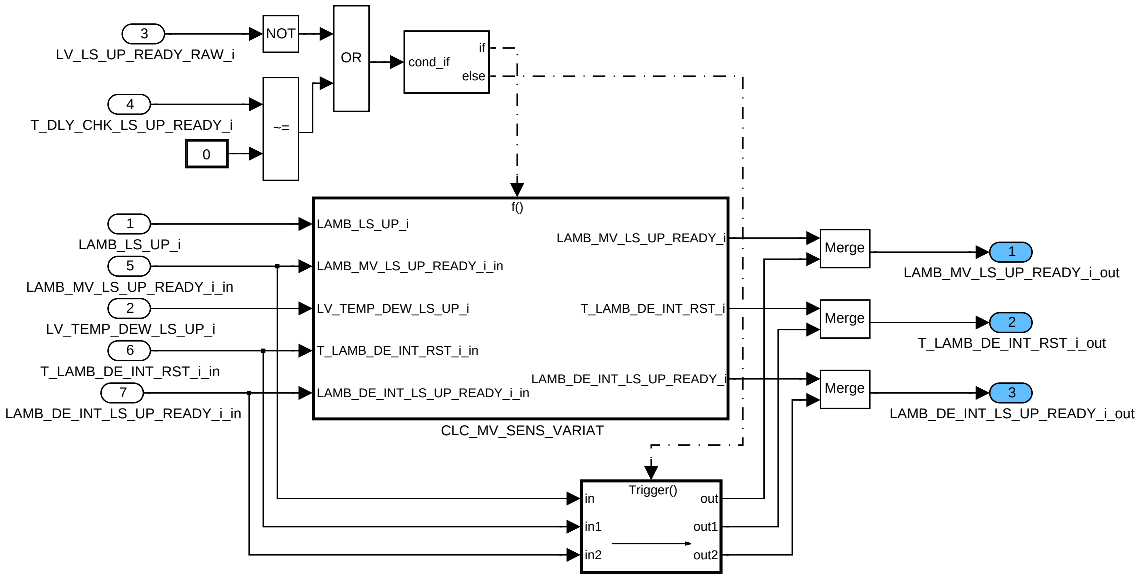

Figure 7.44.12: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CLC_OPER_DET_FOR_LLS/FCN_ACT/CLC_2_READ_DET/READ_DET/CLC_2_MV_SENS_SIG

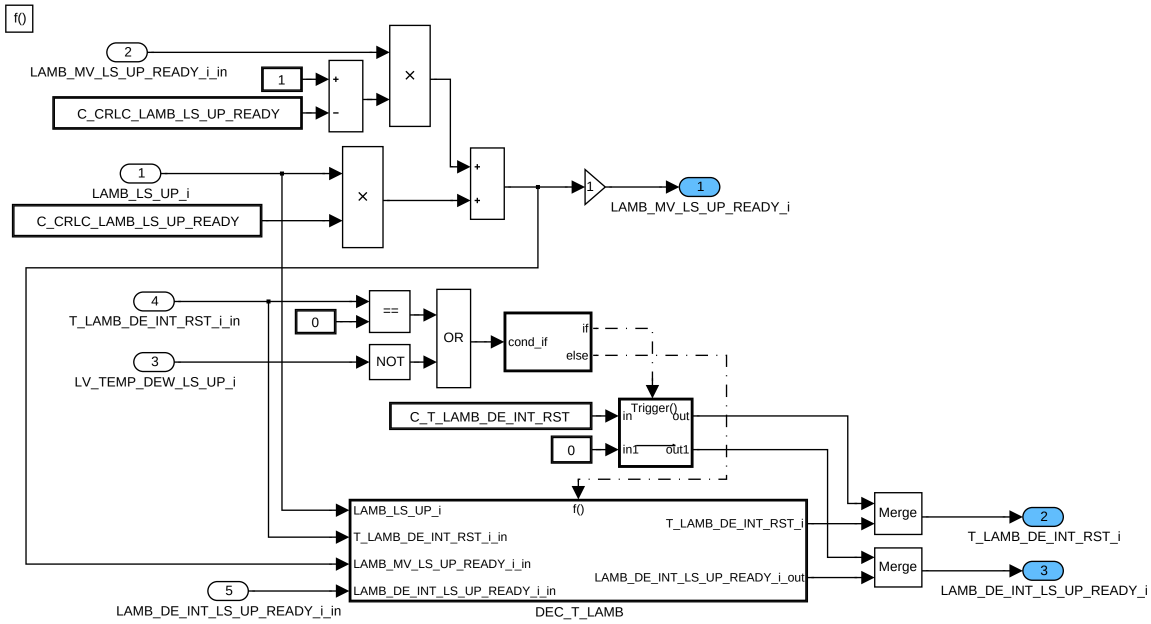

Figure 7.44.13: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CLC_OPER_DET_FOR_LLS/FCN_ACT/CLC_2_READ_DET/READ_DET/CLC_2_MV_SENS_SIG/CLC_MV_SENS_VARIAT

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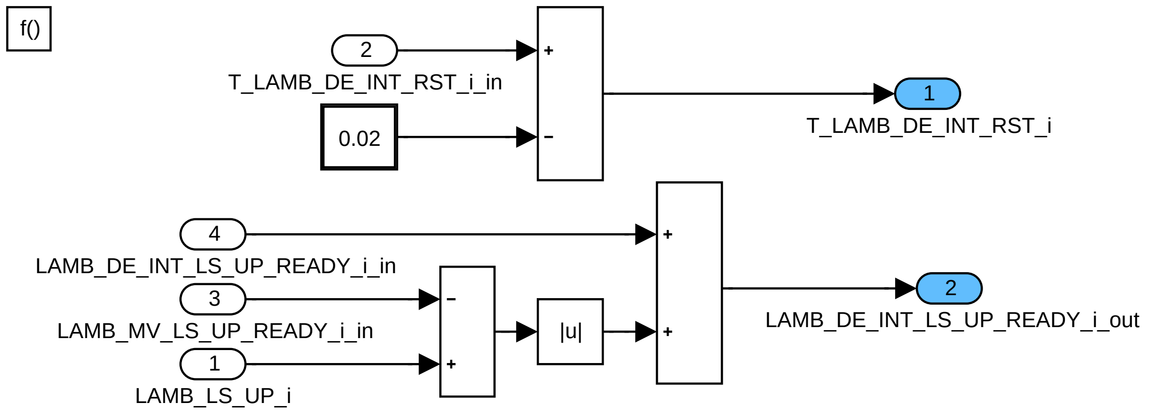

Figure 7.44.14: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CLC_OPER_DET_FOR_LLS/FCN_ACT/CLC_2_READ_DET/READ_DET/CLC_2_MV_SENS_SIG/CLC_MV_SENS_VARIAT/DEC_T_LAMB

SECTION 2.2.1.3: Calculation of the delay time after dew point detection

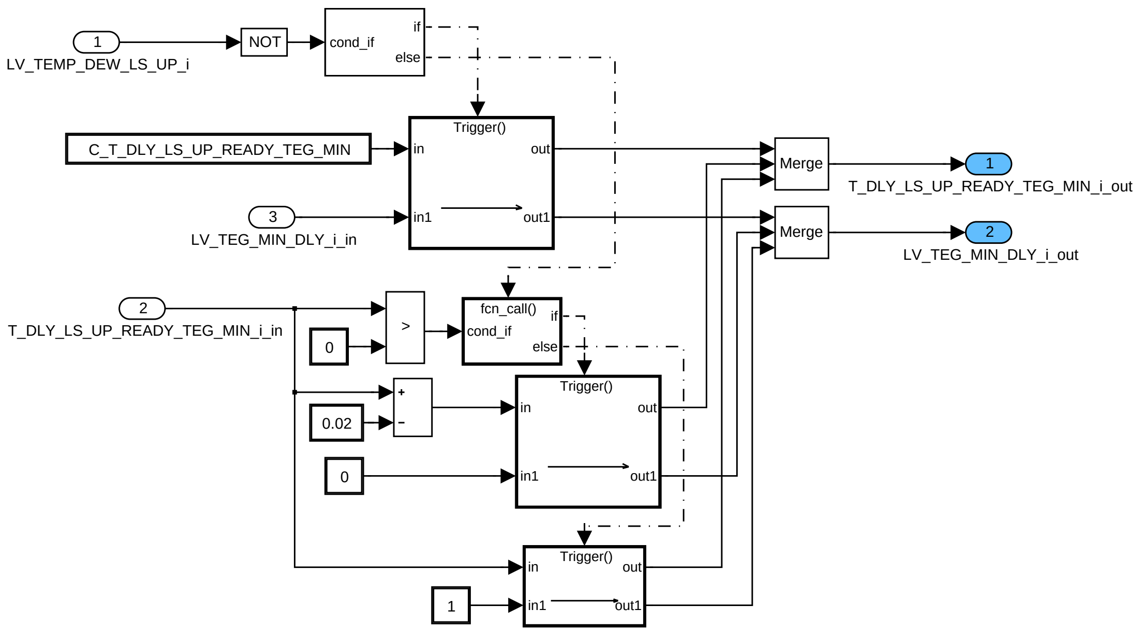

Figure 7.44.15: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CLC_OPER_DET_FOR_LLS/FCN_ACT/CLC_2_READ_DET/READ_DET/CLC_3_DLY_TIME

SECTION 2.2.1.4: Forced operative readiness

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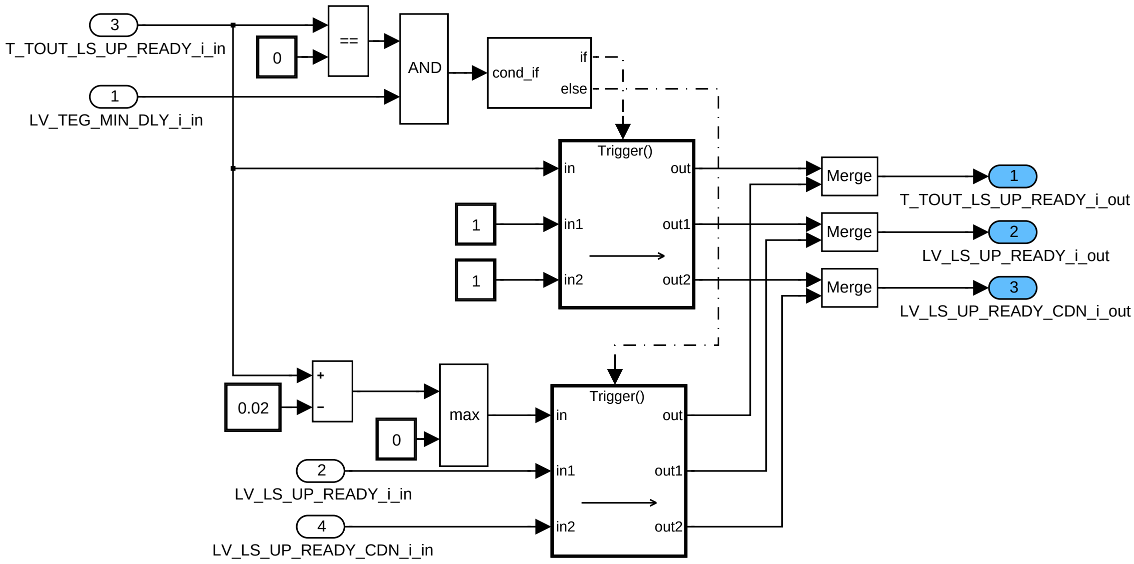

Figure 7.44.16: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CLC_OPER_DET_FOR_LLS/FCN_ACT/CLC_2_READ_DET/READ_DET/CLC_4_CHK_FORCE_ACT_SENS

SECTION 2.3: Generation of signal quality flags

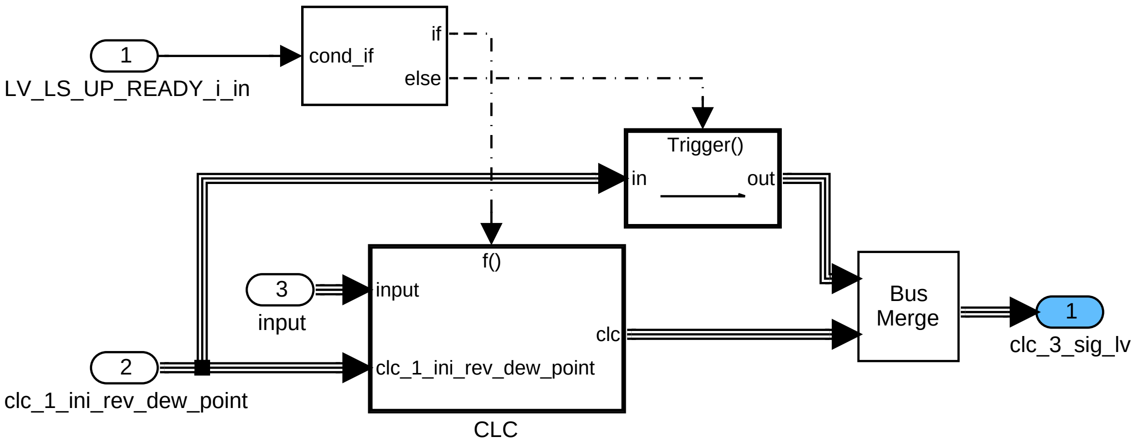

Figure 7.44.17: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CLC_OPER_DET_FOR_LLS/FCN_ACT/CLC_3_SIG_LV

Calculation active (CLC)

Unlock the error suspicion flag

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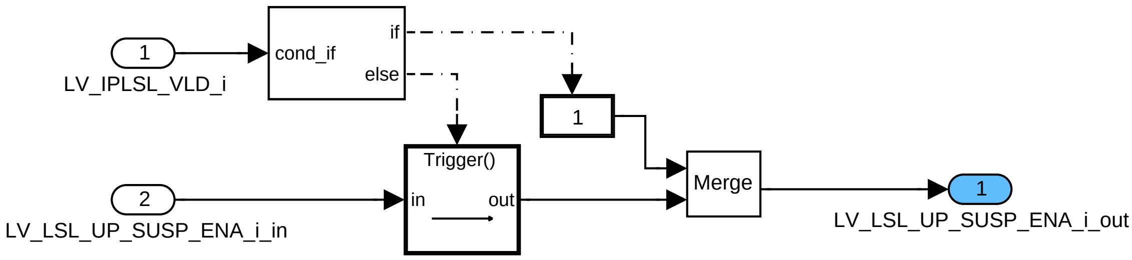

Figure 7.44.18: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CLC_OPER_DET_FOR_LLS/FCN_ACT/CLC_3_SIG_LV/CLC/CLC_1_IPLSL_VLD

Error suspicion present

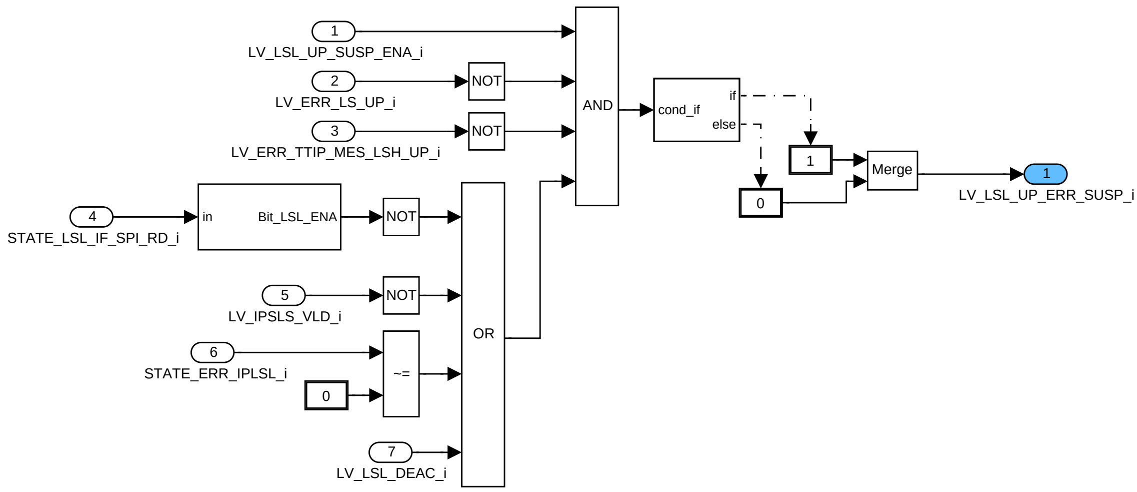

Figure 7.44.19: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CLC_OPER_DET_FOR_LLS/FCN_ACT/CLC_3_SIG_LV/CLC/CLC_2_ERR_SUSP

SECTION 3: Initialization due to MAF integral exceeding during PUC (fc_INI_MAF_INT_EXC)

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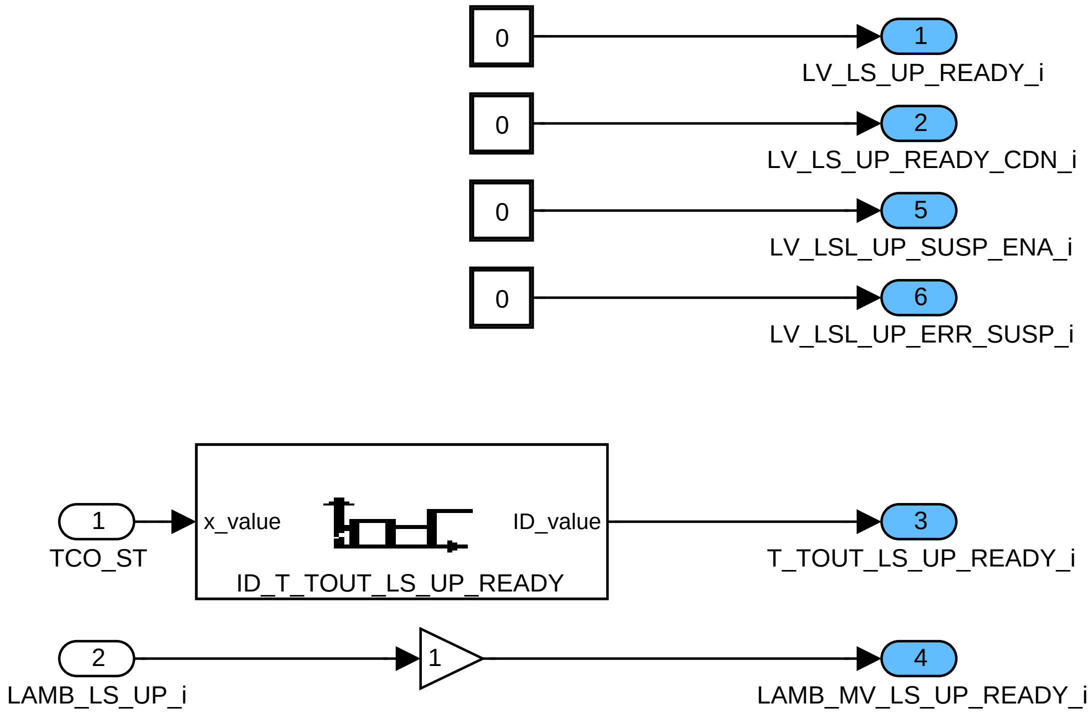

Figure 7.44.20: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CLC_OPER_DET_FOR_LLS/INI_MAF_INT_EXC/INI_MAF_INT_EXC

SECTION 4: Initialization in case calculation not active (fc_ INI_VL_PROT)

Initialization due to "Voltage protection" or "off" mode or "not yet left engine start"

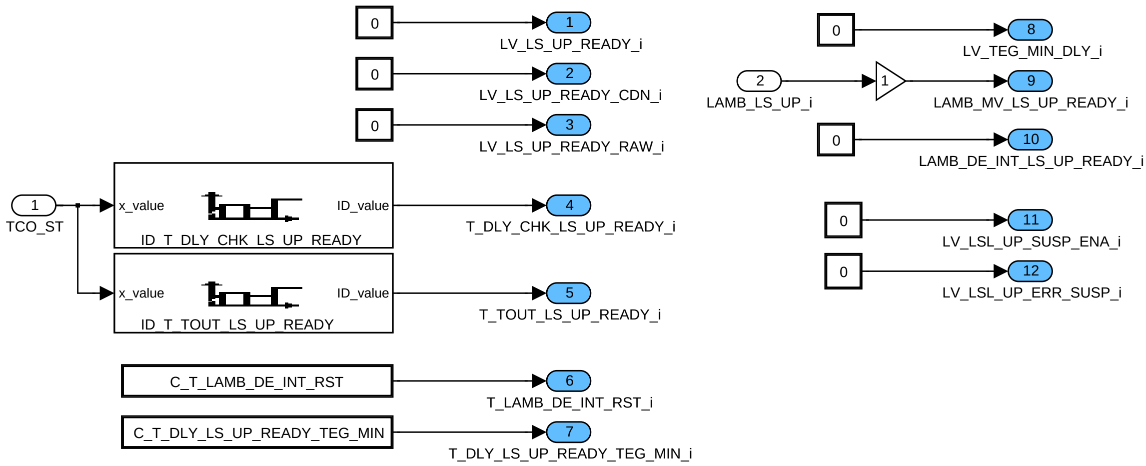

Figure 7.44.21: EGCP_DTSYSLSL0/OPM_20MS/FLP/OPM/CLC_OPER_DET_FOR_LLS/INI_VL_PROT/INI_VL_PROT

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7.45 O2 sensor (lin, up) operating strategy

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ICPLSL [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter used to approximate filling & emptying of WRAF sensor pumped reference area					
CTR_ICPLSL_MAX [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Delay for filling & emptying of WRAF sensor pumped reference area					
CTR_IPLSL_CTL_ENA_NR_CYC [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Cycle counter for pulsed activation of pump current					
CTR_IPLSL_CTL_ENA_PWM_OFF [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for duration of Ip off phase during pulsed activation of pump current					
CTR_IPLSL_CTL_ENA_PWM_ON [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for duration of Ip on phase during pulsed activation of pump current					
ICPLSL_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1FH	0... 31	1	-
Value of the pumping current applied for filling of WRAF sensor oxygen reference area (Icp)					
LAMB_THD_TMP_VPLSL_LIM [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.99902	976.999e-6	-
Intermediate storage variable of threshold for Vp limitation in terms of lambda					
LAMB_THD_VPLSL_LIM [NC_CBK_EX_NR]	O/V/S	0... 7FFFH	0... 31.99902	976.999e-6	-
Threshold for Vp limitation in terms of lambda					
LV_ICPLSL_ENA_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag requesting activation /deactivation of reference pumping current (Icp)					
LV_ICPLSL_VLD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating that WRAF sensor pumped reference area is completely filled					
LV_IPLSL_CTL_ENA_LSL_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag requesting activation /deactivation of pumping current (Ip) controller					
LV_IPLSL_CTL_ENA_PLS_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that pulsed activation of pump current is active					
LV_IPLSL_CTL_INH_VNLSL_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that pump current control is inhibited by active Icp cut-off /Vn overvoltage conditions					
LV_IPLSL_CTL_INH_VPLSL_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that pump current control is inhibited by active active pumping voltage (Vp) limitation conditions					
LV_IPLSL_NOT_VLD_VB_L [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that increased heater-coupling due to permanent battery undervoltage might be present					
LV_IPLSL_VLD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that WRAF sensor pump current is valid					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAMB_LS_UP_ESTIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable indicating limited accuracy of measured lambda signal					
LV_LAMB_LS_UP_VLD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that lambda signal from WRAF system is reliable and up-to-date					
LV_VPLSL_LIM_ACT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating active pumping voltage (Vp) limitation conditions					
R_IT_IPLSL [NC_CBK_EX_NR]	V	0... FFFFH	0... 16383.75	0.25	ohm
Calculated value of internal DC resistance of WRAF sensor pump cell					
T_DLY_IPLSL_CTL_ENA [NC_CBK_EX_NR]	V	0... FFH	0... 2.55	0.01	s
Delay timer for validation of Ip after enabling of Ip control loop, used to allow for signal settling					
T_DLY_VNLSL_LIM_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Timer for limitation of duration of Ip control loop inhibition due to Icp cut-off /Vn overvoltage conditions					
T_ICPLSL_DLY_PWL [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Delay timer for limited Icp supply during ECU power latch					
T_IPLSL_CTL_LSH_UP_MAN_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Timer for delay in activation of pump current control upon engine start in case of forced sensor pre-heating					
T_IPLSL_NOT_VLD_VB_L [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Delay timer for possible occurence of increased heater coupling due to permanent battery undervoltage					
T_IPLSL_NOT_VLD_VB_L_THD [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Upper limit of delay timer for possible occurence of increased heater coupling					
VPLSL [NC_CBK_EX_NR]	V	80... 7FH	-3.224... 3.19881	0.0251875	V
Calculated voltage across WRAF sensor pump cell (Vp = VIP-VG)					

Input data:

CTR_ERR_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 955}	IPLSL_COR [NC_CBK_EX_NR] {p. 2313}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}
LV_DIAG_OBD_SYM_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_IGK {p. 906}	LV_LAMB_STI_OFF_LSL_OFS_ADJ [NC_CBK_EX_NR] {p. 2313}
LV_LS_UP_READY [NC_CBK_EX_NR] {p. 2335}	LV_LS_UP_READY_CDN [NC_CBK_EX_NR] {p. 2335}	LV_LSH_UP_MAN_ACT [NC_CBK_EX_NR] {p. 2385}	LV_LSL_DEAC [NC_CBK_EX_NR] {p. 955}
LV_LSL_IF_SPI_RST_END [NC_CBK_EX_NR] {p. 1313}	LV_LSL_OFS_ADJ_ACT [NC_CBK_EX_NR] {p. 2313}	LV_SAP {p. 804}	LV_SAV {p. 804}
LV_ST_END {p. 1720}	LV_SWI_GAIN_LSL_IF [NC_CBK_EX_NR] {p. 2314}	LV_VLS_OFS_ADJ_ENA_LSL_IF [NC_CBK_EX_NR] {p. 2314}	LV_VLS_UP_INIT [NC_CBK_EX_NR] {p. 1341}
LV_VLS_UP_VLD [NC_CBK_EX_NR] {p. 1341}	LV_VNLSL_LIM [NC_CBK_EX_NR] {p. 955}	LV_VPLSL_LIM [NC_CBK_EX_NR] {p. 955}	MAF_KGH {p. 1195}

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N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	R_IT_LS_UP [NC_CBK_EX_NR] {p. 1320}	SAF_KGH {p. 807}
STATE_ERR_IPLSL [NC_CBK_EX_NR] {p. 955}	STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	STATE_LSL_IF_CONF_SPI_RD [NC_CBK_EX_NR] {p. 956}	STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}
TTIP_MES_LS_UP [NC_CBK_EX_NR] {p. 1321}	VB {p. 1185}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_ICPLSL_DEC	-	0... FFH	0... 255	1	-
Decrement of counter used to approximate emptying of WRAF sensor oxygen reference area					
C_CTR_ICPLSL_INC	-	0... FFH	0... 255	1	-
Increment of counter used to approximate filling of WRAF sensor oxygen reference area					
C_CTR_ICPLSL_THD	-	0... FFFFH	0... 65535	1	-
Threshold of counter used to approximate filling state of WRAF sensor oxygen reference area during discharge					
C_CTR_IPLSL_CTL_ENA_NR_CYC	-	0... FFH	0... 255	1	-
Number of cycles for pulsed activation of pump current					
C_CTR_IPLSL_CTL_ENA_PWM_OFF	-	0... FFH	0... 255	1	-
Threshold for duration of Ip off phase during pulsed activation of pump current					
C_CTR_IPLSL_CTL_ENA_PWM_ON	-	0... FFH	0... 255	1	-
Threshold for duration of Ip on phase during pulsed activation of pump current					
C_ICPLSL_PWL_LSL_IF	-	0... 1FH	0... 31	1	-
Configuration of current to pump reference air (Icp) during power latch phase, or forced sensor pre-heating, resp.					
C_LAMB_SP_MAX_IPLSL_CTL_ENA	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Maximum value of lambda setpoint for activation of Ip control loop					
C_LAMB_SP_MIN_IPLSL_CTL_ENA	-	0... 7FFFH	0... 31.99902	976.999e-6	-
MInimum value of lambda setpoint for activation of Ip control loop					
C_LAMB_THD_MAX_VNLSL_LIM	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Maximum value of lambda threshold for Vn overvoltage /reverse Icp cut-off monitoring					
C_LAMB_THD_MAX_VPLSL_LIM	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Maximum value of lambda threshold for Vp limitation					
C_MAF_KGH_MIN_LAMB_LS_UP_ESTIM	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Minimum MAF_KGH to guarantee sufficient sensor signal dynamics lambda-wise					
C_N_32_MAX_LAMB_LS_UP_ESTIM	-	0... FFH	0... 8160	32	rpm
N threshold above which limited accuracy of measured lambda signal is expected					
C_R_IT_IPLSL_AGI_ADD	-	0... FFFFH	0... 16383.75	0.25	ohm
Additive ageing constant for WRAF sensor internal pump cell DC resistance					
C_R_IT_IPLSL_AGI_FAC	-	0... FFH	0... 7.96875	0.03125	-
Multiplicative ageing factor for WRAF sensor internal pump cell DC resistance					
C_T_DLY_IPLSL_CTL_ENA	-	0... FFH	0... 2.55	0.01	s
Delay to be exceeded from switching on of pump current control to setting validity flag					
C_T_DLY_MAX_VNLSL_LIM_ACT	-	0... FFFFH	0... 655.35	0.01	s
Delay from determining Icp cut-off /Vn overvoltage to forced revokation of Ip control loop disable flag					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_ICPLSL_DLY_PWL	-	0... FFFFH	0... 655.35	0.01	s
Delay time for limited Icp supply during ECU power latch					
C_T_IPLSL_CTL_LSH_UP_MAN_ACT	-	0... FFFFH	0... 655.35	0.01	s
Delay time for activation of pump current control after engine start in case of forced sensor pre-heating					
C_T_IPLSL_NOT_VLD_VB_L_DEC	-	0... FFFFH	0... 655.35	0.01	s
Delay time for revocation of indicated increased heater coupling					
C_T_IPLSL_NOT_VLD_VB_L_INC	-	0... FFFFH	0... 655.35	0.01	s
Delay time for possible occurence of increased heater coupling due to permanent battery undervoltage					
C_TTIP_MIN_LAMB_LS_UP_ESTIM	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Minimum elememt temperature for accurate compensation of measured lambda signal					
C_TTIP_THD_ICPLSL_INC_LS_UP	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Ceramic temperature above which Icp can be switched to elevated values (warm sensor)					
C_TTIP_THD_IPLSL_ACT_LS_UP	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Ceramic temperature above which Ip control loop may be activated					
C_VB_L_THD_IPLSL_NOT_VLD	-	0... FFH	0... 25.89843	0.1015625	V
Battery undervoltage threshold for possible increase of heater-coupling					
C_VB_MIN_IPLSL_CTL_ENA	-	0... FFH	0... 25.89843	0.1015625	V
Threshold value of battery voltage for accurate operation of ATIC42					
C_VPLSL_THD_VNLSL_LIM	-	80... 7FH	-3.224... 3.19881	0.0251875	V
Pumping voltage (Vp) threshold below which Icp cut-off /Vn overvoltage conditions are detected					
ID_CTR_ICPLSL_THD	V	0... FFFFH	0... 65535	1	-
LDP_TTIP_LS_IP_CTR_ICPLSL_THD	3	0... FFFFH	-2048... 2047.9375	0.0625	°C
LDP_ICPLSL_IP_CTR_ICPLSL_THD	3	0... 1FH	0... 31	1	-
Variable threshold of counter used to approximate filling & emptying of WRAF sensor pumped reference area					
ID_LSL_IF_ICPLSL_IPLSL_CTL_DI	V	0... 1FH	0... 31	1	-
LDP_LAMB_SP_IP_ICPLSL_IPLSL_DI	3	0... 7FFFH	0... 31.99902	976.999e-6	-
LDP_SAF_KGH_IP_ICPLSL_IPLSL_DI	3	0... FFFFH	0... 1023.98437	0.015625	kg/h
Configuration of current to pump reference air (Icp) with Ip control disabled and warm WRAF sensor					
ID_LSL_IF_ICPLSL_WUP	V	0... 1FH	0... 31	1	-
LDP_LAMB_SP_IP_ICPLSL_WUP	3	0... 7FFFH	0... 31.99902	976.999e-6	-
LDP_SAF_KGH_IP_ICPLSL_WUP	3	0... FFFFH	0... 1023.98437	0.015625	kg/h
Configuration of current to pump reference air (Icp) with Ip control disabled and cold WRAF sensor					
IP_LSL_IF_ICPLSL_IPLSL_CTL_ENA	-	0... 1FH	0... 31	1	-
LDP_LAMB_IP_ICPLSL_IPLSL_ENA	3	0... 7FFFH	0... 31.99902	976.999e-6	-
Configuration of current to pump reference air (Icp) with Ip control enabled					
IP_R_IT_IPLSL	V	0... FFFFH	0... 16383.75	0.25	ohm
LDP_R_IT_LS_UP_IP_R_IT_IPLSL	8	0... FFFFH	0... 16383.75	0.25	ohm
LDP_LAMB_SP_IP_R_IT_IPLSL	8	0... 7FFFH	0... 31.99902	976.999e-6	-
Internal DC resistance of WRAF sensor pump cell					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_ICPLSL_ACT	-	0... 1H	0 ...1	1	-
Boolean flag indicating whether upstream WRAF sensors are of type pumped-reference or not					
LC_ICPLSL_ENA_LSL_IF	-	0... 1H	0 ...1	1	-
Boolean flag permitting manual activation /deactivation of pumped-reference current (Icp)					
LC_IPLSL_CTL_ENA_MAN_LSL_IF	-	0... 1H	0 ...1	1	-
Boolean flag requesting activation /deactivation of pump current control during manual control					
LC_IPLSL_CTL_ENA_MAN_SWI_LSL_IF	-	0... 1H	0 ...1	1	-
Boolean flag permitting manual activation /deactivation of pump current control					
LC_VB_L_SIM_MAN	-	0... 1H	0 ...1	1	-
Switch for simulation of battery undervoltage which can be used for function testing					

FUNCTION DESCRIPTION:

General information:

The purpose of this function is the management of supply of pumped reference current (Icp), and pump current (Ip) control for ATIC42 WRAF sensor interface.
The Icp current is required by certain WRAF sensor types to provide a pumped oxygen reference for the Nernst cell sensing portion, as this is not provided by venting air into a chamber within the sensor. The value of the Icp current is programmed according to certain operating states of the WRAF system, and the Icp current is enabled or disabled.
Ip current is a measure of lambda. The Ip controller shall be required to meet stringent sensor protection requirements. For certain critical operating states of WRAF sensor, it may be undesirable to have the Ip control active and hence the function shall enable /disable the Ip control as required.
Both danger of implausible lambda measurement, e.g. due to signal saturation effects, and physical sensor destruction have to be detected and appropriate measures are taken.
Ip control is activated with a repeated pulse routine to avoid excessive pumping voltage (Vp) supply at point of activation. During activation, some of the provided sensor protection mechanisms are inhibited because they would produce inappropriate results due to transient behaviour.
Validity of pumping current signal is jugded depending on current state of WRAF system. Certain operating conditions lead to temporary revocation of validity flag, e.g. danger of increased heater-coupling on Ip signal circuit due to longer term battery undervoltage.
In case of pumping voltage (Vp) across sensor pump cell violating certain bounds or of reverse Icp cut-off, Ip control also has to be inhibited to avoid physical destruction of sensor element, i.e. by blackening effect of zirconia dioxyde ceramic.
Two logical variables stating short term profound reliability of measured lambda signal, and signal accuracy level (regular /limited), resp., shall be provided.

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Description:

The function shall be activated once the transition from engine start to engine run has taken place and once the initialisation of the WRAF sensor 'ASW<=>BSW' interface has successfully been carried out. It shall stay active up to the end of ECU power latch.

Alternative activation of certain chapters shall take place in case of forced sensor pre-heating prior to engine start.

The function is split into ten main sections:

1. Activation of pumped reference current (Icp)
2. Value of pumped reference current (Set Icp programming value)

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3. Determination of Icp cut-off conditions (Overvoltage at sensor Vn pin)
4. Determination of required status of pump current (Ip) control loop
5. Activation of pump current (Ip) control loop
6. Possibility of increased heater-coupling due to permanent battery undervoltage
7. Validity of pump current (Ip)
8. Pumping voltage (Vp) limitation strategy
9. Provision of a cumulative logical variable LV_LAMB_LS_UP_VLD_i for judgement of short term reliability of WRAF system lambda output signal.
10. Indication of regular /limited accuracy of measurement signal.

Remark: Below description of functional units within WRAF sensor control module aims to provide a general survey on physical backgrounds of sensor behaviour and derived actions for operational strategy. For related **variable names** please respect corresponding diagrams provided within **formula section**.

1. Activation of pumped reference current

This section shall provide the Icp enable and appropriate programming value information to the WRAF sensor interface and indicate whether the pumped reference has been filled via corresponding validity flag.

Should the sensor type being used not have a pumped oxygen reference or a general WRAF sensor error has occured, then this section shall be disabled, i.e. status flag for Icp validity is revoked, Icp is programmed to its minimum value, and Icp supply is deactived.

If none of these two conditions is present, this section behaves as follows:

During pulsed Ip control activation only programming value of Icp is evaluated and no other change in Icp supply conditions is performed.

In case of permanent operation of Ip loop with no SPI fault present, sufficiently high battery voltage for accurate operation of ATIC42, and no Vn overvoltage in conjuction with under-run of rich lambda setpoint threshold present (occurence is limited to rich atmosphere, forced Icp cut-off is automatically performed by ATIC42 HW), routine waits for successful mirroring of latest Icp status and programming value commands sent via SPI bus.

Once command transfer has been successful, Icp flow is requested, sensor element temperature has exceeded calibratible threshold, counter limit for filling time of pumped reference is determined. Latter condition can be replaced by OBD2 heater fault present in conjunction with operative sensor readiness (-> tip temperature not reliable), or in case of conditional operative readiness (-> forced sensor activation).

If repeated evaluation of corresponding index table (which depends on sensed element temperature and Icp programming value) leads to a higher value than adjusted before and pumped reference has not been filled completely yet, counter limit is increased. To force initial determination of counter limit this action is also performed when entering the condition with a filling counter value of zero.

Once Icp counter limit is reached the Icp valid flag is set, otherwise counter for Icp filling status is incremented.

General Icp activation is treated depending on engine condition (Icp active with engine running), status of forced sensor heating, and value of power latch delay timer. Latter provides for extended Icp supply after engine stop.

Next Subroutine Value of pumped reference current is executed to determine appropriate Icp programming value.

Should any of the following conditions hold true, filling status of pumped reference has to be verified: SPI command transfer fault, low battery voltage, Vn overvoltage in conjunction with under-run of rich lambda setpoint threshold, revocation of Icp activation, tip temperature drop below threshold.

If pumped reference area has been judged to be completely filled before, Icp counter limit is set to calibratable threshold which represents delay for emptying prior to revocation of 'Icp valid' status bit - to take into account for transient disturbances without immedate reset. Revocation takes place once counter has been decremented to zero.

In case of forced sensor pre-heating prior to engine start, simplified filling procedure of pumped reference is applied which bypasses certain conditions.

1. Value of pumped reference current

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Icp value to be programmed is determined for four different operating states taking into account dependency of provided reference pumping current on (estimated) exhaust lambda and on sensor element temperature:

- Power Latch phase (engine stalled and forced sensor pre-heating inactive): Exhaust system filled with air; Ip control loop disabled. Icp supply is limited to calibratable delay time.
- Ip control active or pulsed activation thereof: Exhaust lambda provided by WRAF sensor.
- Ip control inactive, cold sensor: Exhaust lambda derived from combustion lambda setpoint (LAMB_SP[i]) and additional secondary air flow (SAF_KGH). For calibration it has to be taken into account that LAMB_SP[i] does not represent composition of exhaust atmosphere present at linear oxygen sensor during activation of secondary air; under these conditions lean conditions prevail at sensor mounting location regardless of LAMB_SP[i]!
- Ip control inactive, warm sensor, or OBD2 heater fault present in conjunction with operative sensor readiness (-> tip temperature not reliable), or in case of conditional operative readiness (-> forced sensor activation): same as above.

The influence of secondary air on exhaust lambda at sensor mounting position is taken into account for disabled Ip control loop.
Current status of Ip control loop is judged by evaluation of corresponding ATIC42 interface bit.
Distinction between cold and warm sensor is made by evaluation of calibratable ceramic temperature threshold.
As long as Ip control is in disabled state, Electromagnetic force (EMF) across sensor nernst cell adjusts itself in a range between 0 ... 1V depending on surrounding exhaust gas atmosphere - comparable to the behaviour of a binary type oxygen sensor. With enabled loop, EMF is controlled to be approx. -0mV constantly.
As a rule of thumb for conversion of Icp programming value to actual value of Icp current provided by ATIC42 (which is split between sensor nernst cell and shunt resistance within ATIC42 module which serves as voltage limitation for cold sensor) the following formula can be applied:
Icp = (k + 1) * 5uA with k: Icp programming value.

1. Determination of Icp cut-off conditions

Under worst case tolerances and rich conditions, the potential at sensor pin VN may exceed the threshold up to which Icp generation can be guaranteed for sensors of pumped reference type. Under such circumstances the Icp may temporarily be reduced or even cut-off by ATIC42 protection mechanism. This may lead to lean Ip misindication and also to sensor damage.
ATIC42 2^{nd} silicon provides for automatic Icp cut-off in case of Vn overvoltage and signals the presence of such a condition through its interface.
Hence when Icp cut-off is signaled to occur by ATIC42, Ip control shall be disabled reducing the potential Vp across the pump cell and thereby also reducing the potential at pin Vn.
The voltage Vp across the pump cell shall be modelled by multiplying the measured pump current Ip with the pump cell internal DC resistance obtained from the relationship between the internal resistance of the Nernst cell and the pump cell.
The pump cell DC internal resistance (Rip) shall be obtained from a mapping dependent on value of nernst cell inner resistance (Ri, representing sensor temperature), and lambda setpoint. Both internal resistances are linked by sensor temperature and design. Additionally the pump cell resistance is dependent on the sensor lambda environment, hence the lambda setpoint dependence. Preliminary Rip value is then multiplied by a factor and a constant is added. Both parameters permit the dependency of the resistances to be modified to take worst case ageing into account.
The pump cell voltage Vp shall be calculated by multiplying modelled Rip by corrected value of pump current Ip.
Providing that WRAF sensor is of pumped reference type, the function shall determine whether Icp cut-off conditions are already active. If true, then the condition shall only be deemed to no longer persist when Rip is less than the value stored once Icp cut-off conditions were determined (i.e. sensor elememt got hotter), or lambda setpoint is greater than (i.e. leaner) than the value stored once Icp cut-off conditions were determined. Or, if maximum duration of active Vp limitation is calibrated to be non-zero, when the internal timer TIMER_2 has expired. In addition, for all three cases, VN overvoltage shall no longer be indicated by ATIC42. If all this holds true, then TIMER_2 shall be stopped, the stored Rip and

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lambda setpoint values shall be reset and the Ip control inhibition flag revoked. Otherwise TIMER_2 is decremented.

If the Icp cut-off conditions are inactive, and pulsed Ip control activation has been completed, calculated Vp voltage shall be compared to a minimum threshold. If this rich threshold is exceeded or Vn overvoltage is sensed by ATIC42 and rich environment is present at sensor (i.e. rich lambda setpoint threshold is under-run), Icp cut-off conditions may occur. Should they be present for longer than estimated emptying delay of pumped reference, TIMER_2 shall be initialized, the current Rip and lambda setpoint values shall be stored, and Ip control inhibition flag shall be set.

1. Determination of required status of pump current (Ip) control loop

This section shall collect the various requests for activation /deactivation of the Ip control loop and provide the information to the WRAF sensor interface.

The function shall provide for manual switching of the Ip control loop by means of logical constants. If manual activation is requested, subroutine Activation of pump current control loop is executed.

In case of automatic switching, no general WRAF sensor error present and running engine (or with activated forced sensor pre-heating), the function checks if pumped reference of a sensor requiring Icp is not completely filled yet, or if Icp cut-off or Vp limitation sensor protection routine is active (and forced sensor pre-heating is inactive). Either one of these conditions leads to Ip passivation by resetting corresponding ATIC42 interface bit. At the same time all variables needed for next Activation of pump current control loop are initialized.

Next the function shall determine whether the conditional operative readiness is set or pulsed Ip control activation is running. If so then the evaluation of further conditions related to sensor readiness and tolerated lambda setpoint range for Ip activation shall be skipped and Activation of pump current control loop shall be executed.

If former condtions are not present, then the function shall determine whether operative readiness is set (or forced sensor pre-heating is activated). If not, then the Ip control loop shall be deactivated.

Once oxygen sensor ceramic temperature is greater or equal to a calibratable threshold, Ip loop shall be enabled once lambda setopint is located within calibratable bounds, or secondary air is active (providing for lean exhaust gas atmosphere), and Ip offset adjustment is not pending. The same action is taken once OBD2 heater fault ist present (-> tip temperature not reliable). Otherwise Ip loop shall stay disabled.

Thus pumping voltage saturation because of high pumping current requirements for << >> 1 can be avoided at point of Ip control loop activation. During secondary air phase, output signal of WRAF sensor is used for monitoring purposes. Thus Ip loop has to be activated even at very lean surrounding atmosphere which is present at that time. In general pumping voltage saturation in lean direction is not critical for WRAF sensor operation in conjunction with ATIC42 as it is for rich atmosphere.

1. Activation of pump current (Ip) control

In order to avoid excessive supply of pumping voltage Vp to WRAF sensor during switch-on of Ip control loop (which might lead to sensor destruction due to blackening effect for applied rich voltages Vp < 2V), a pulsed activation with PWM-behaviour is provided.

For a calibratable number of cycles, ON- and OFF- phases of variable length are applied to WRAF sensor interface. Calibration can also be used to skip sensor protection mechanisms during one-time Ip switch-on for a certain time. In this case OFF-phase is of zero length.

1. Indication of possibility for increased heater-coupling due to permanent battery undervoltage

For the linear oxygen sensor BOSCH LSU4.9, up to and including Äp3.1, there is a danger that for longer term battery undervoltage in combination with maximum heater PWM, increased heater-coupling to the pumping current signal circuit of the sensor might appear.

This effect is related to ion migration within the sensor element due to long term application of a certain ion activation potential to negative sensor heater electrode which is of active low type.

Once regular battery voltage conditions are restored the exaggerated heater coupling vanishes within several seconds and returns to regular values.

A timer based detection strategy for possibility of increased heater coupling has been developed and is depticted in below figure.

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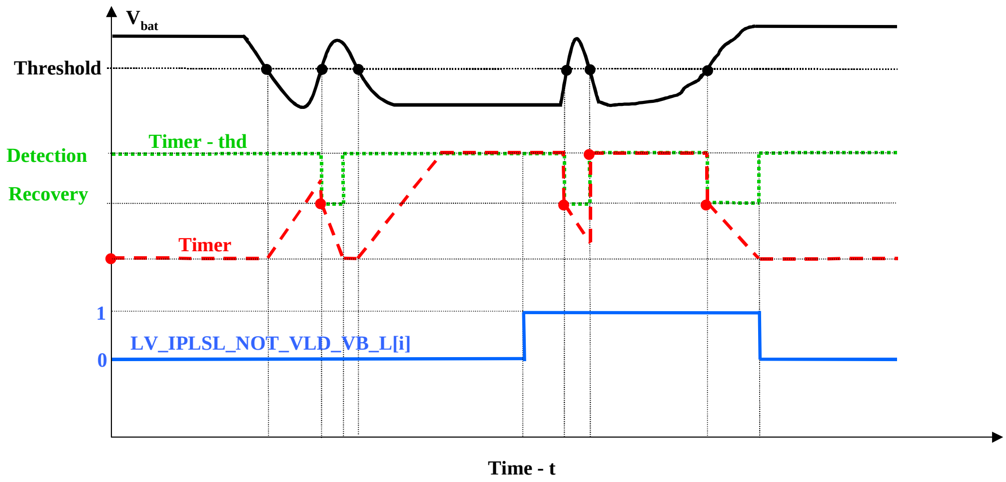

Once the critical battery undervoltage condition is met for a certain delay time after leaving engine start - usually also leading to high PWM values - pumping current validity shall be revoked.
Since detection and recovery might be linked to different delay times, timer threshold is switched depending on presence of battery undervoltage condition.
If recovery delay time is interrupted by repeated undervoltage condition the delay timer is set to and kept at detection threshold value.
Should time based thresholds for detection and recovery be calibrated identically, latter ist incremented for one step to avoid ambiguities within algorithm execution.

1. Validity of pump current (Ip)

This section shall model the basic validity of the Ip current. For short term reliability of ATIC42 lambda output signal a special indicator bit is introduced in chapter 9.
The function shall check if a general WRAF sensor error is present or if a SPI error has occurred since the last function recurrence. Latter information is retrieved by comparison of corresponding error counter with its previously stored value. If the values differ from each other then current value shall be stored for next comparison, the internal timer TIMER_1 and the Ip validity flag shall be reset.
If sufficient battery voltage for power supply of ATIC42 is available, function shall wait for the sent Ip control enable /disable information to be mirrored by comparing to ATIC42 SPI response byte.
In case of forced sensor pre-heating additional delay time **after engine start** can be calibrated. If corresponding timer threshold is calibrated to be zero, validity of pump current shall also be detectable prior to engine start.
Next the function checks if pulsed activation of pump current control loop is active. If so, Ip validity is revoked.
If not, the function shall determine whether the Ip control loop has been requested to be active. In addition the danger of increased heater coupling due to permanent battery undervoltage has to be excluded.
If all validation conditions hold true, a delay shall be exceeded prior to setting the Ip validity flag. If false, then the internal timer TIMER_1 and the Ip validity flag shall be reset.

1. Pumping voltage (Vp) limitation strategy

Since it is crucial for pumping voltage (Vp) across WRAF sensor pump cell not to exceed certain bounds depending on sensor temperature and ehxaust lambda (roughly $|Vp| \leq 2V$ for sensor at operating temperature, less during sensor warm-up), compliance with these limits has to be ensured under all operating conditions. Exceeding these limits may lead to physical sensor destruction by blackening of zirconia sensor element especially under rich conditions.
Sensor ageing (increase in pump cell inner resistance), insufficient sensor operating temperature, or high pressure conditions, resp., may lead to restriction of measurable lambda range within permitted pumping voltage range.

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Since physical Vp threshold for WRAF sensors can be extended to Vp > 2V in lean area, HW based analog Vp limitation provided by ATIC42 offers sufficient protection. For rich area, evaluation of digital limitation threshold LV_LSL_VP_LIM_i enables strict limitation of Vp to fixed threshold of Vp = -2V also under dynamic conditions by means of SW intervention on status of Ip control loop.
Gradual increase in limitation of operational lambda range in rich environment due to long term effects shall lead to adaptation of corresponding threshold which is stored in non-volatile ECU memory.
Once digital Vp limitation is indicated by ATIC42, and rich lambda setpoint limitation threshold is under-run, and secondary air /pulsed Ip control activation both are not active, current measured lambda value is temporarily stored as new threshold for reactivation of Ip control. Since digital limitation might already limit pumping current, measured lambda value is equal or greater actual lambda which provides additional security margin for reactivation of Ip control loop.
Should Lambda signal be indicated not to be reliable at that time, current lambda setpoint value is adopted as new temporary threshold.
To guarantee minimum operational range in rich direction, e.g. for Ip activation during sensor warm-up, a calibratable maximum value for Vp limitation lambda threshold has to be respected in addition.
Vp limitation threshold is assigned with either latter value or previously determined temporary threshold.
Upon storage of Vp limitation threshold, Ip control is inhibited by setting corresponding flag and Vp limitation status bit is set thus preventing second evaluation of limitation threshold during current Vp limitation phase.
Should Vp limitation not be indicated any longer, but Vp limitation still be active, lambda setpoint is crosschecked with actual Vp limitation threshold. Once setpoint value exceeds latter, Vp limitation status is reset and inhibition of Ip control loop is revoked.
With Vp limitation inactive and reliable lambda value exceeding limitation threshold in rich direction an improvement in WRAF sensor behaviour is detected (due to sensor change or vanishing of temporary effects which led to an increase in Vp requirements, like e.g. elevated exhaust pressure or decreased sensor temperature) and Vp limitation threshold is relaxed.

1. Logical variable for judgement of WRAF sensor lambda signal reliability

Various conditions for operative readiness of WRAF system, consisting of WRAF sensor (including heater) & WRAF controller, have to be fullfilled and no diagnostic contraindications are allowed to be present to judge WRAF lambda signal as being *completely* reliable (for details see formula section). Evaluation of this variable has to take place at start of Vp limitation check.

1. Logical variable for judgement of lambda sensor signal accuracy level

Certain environmental conditions or functional limitations might lead to decrease in signal accuracy level (regular -> limited) due to need for additional compensative measures which are subject to tolerances, or limited functional performance.
Presence of any of these conditions is indicated by cumulative flag.

Application conditions

Initialisation:

The following initialisation shall take place for each newly-flashed ECU or upon detection of EEPROM error:
LAMB_THD_VPLSL_LIM[i] = 0

The following initialisation shall take place directly after RESET:
ICPLSL_LSL_IF[i] = 0
T_IPLSL_NOT_VLD_VB_L_THD[i] = C_T_IPLSL_NOT_VLD_VB_L_INC
T_IPLSL_NOT_VLD_VB_L[i] = 0

The following initialisation shall take place after ECU RESET, at LV_IGK = 0->1, or upon erase of error management:
R_IT_IPLSL[i] = 16383.75 (i.e. FFFFH)

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VPLSL[i] = 0
CTR_ICPLSL[i] = 0
CTR_ICPLSL_MAX[i] = 0
T_ICPLSL_DLY_PWL[i] = 0
LV_ICPLSL_VLD[i] = 0
LV_IPLSL_VLD[i] = 0
LV_IPLSL_CTL_ENA_PLS_ACT[i] = 0
CTR_IPLSL_CTL_ENA_NR_CYC[i] = 0
CTR_IPLSL_CTL_ENA_PWM_ON[i] = 0
CTR_IPLSL_CTL_ENA_PWM_OFF[i] = 0
LV_IPLSL_CTL_INH_VNLSL_LIM[i] = 0
LV_VPLSL_LIM_ACT[i] = 0
LAMB_THD_TMP_VPLSL_LIM[i] = 0
LV_IPLSL_CTL_INH_VPLSL_LIM[i] = 0
LV_LAMB_LS_UP_VLD[i] = 0
LV_IPLSL_NOT_VLD_VB_L[i] = 0
T_IPLSL_CTL_LSH_UP_MAN_ACT[i] = C_T_IPLSL_CTL_LSH_UP_MAN_ACT
LV_LAMB_LS_UP_ESTIM[i] = 1

R_IT_IPLSL[i] ***Store*** = 16383.75 (i.e. FFFFH)
LAMB_SP[i] ***Store*** = 0
Reset internal timers T_DLY_IPLSL_CTL_ENA[i] & T_DLY_VPLSL_LIM_ACT [i]

Recurrence:
T_SAMPLE = 10ms.

Activation:
For chapters 3. /6. /8. /9.: Transition from engine start to run and SPI initialisation complete.
LV_LSL_IF_SPI_RST_END[i] == 1
and LV_ST_END == 1

For chapters 1. /2. /4. /5. /7. **/10.**: Extended supply of pumped reference current and activation of Ip control loop prior to engine start in case of forced sensor pre-heating.

LV_LSL_IF_SPI_RST_END[i] == 1
and **(** LV_ST_END == 1
or LV_LSH_UP_MAN_ACT[i] == 1 **)**

Deactivation:
At the end of ECU power latch.

Formula section:

1. Activation of pumped reference current

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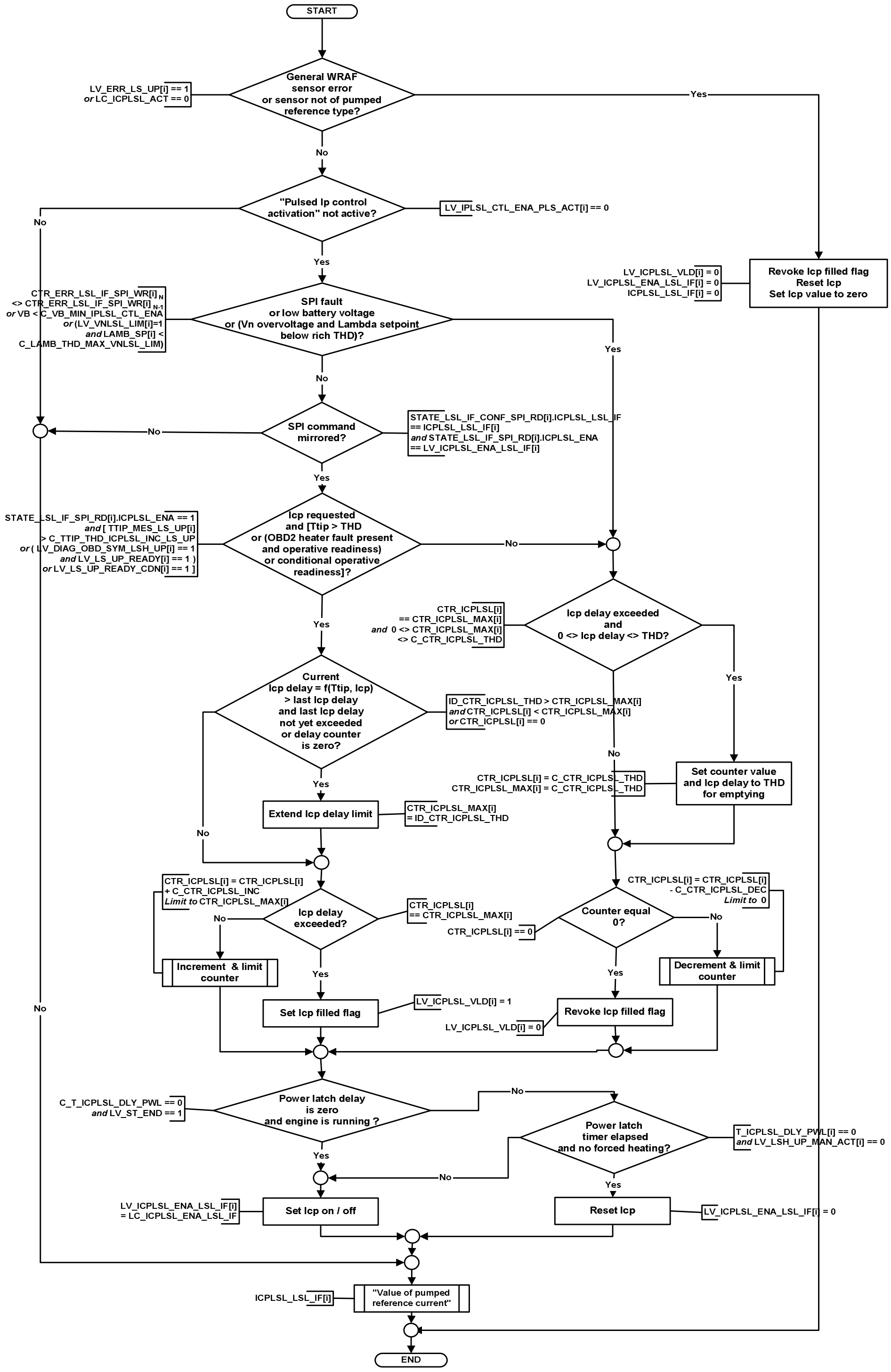

1. Value of pumped reference current

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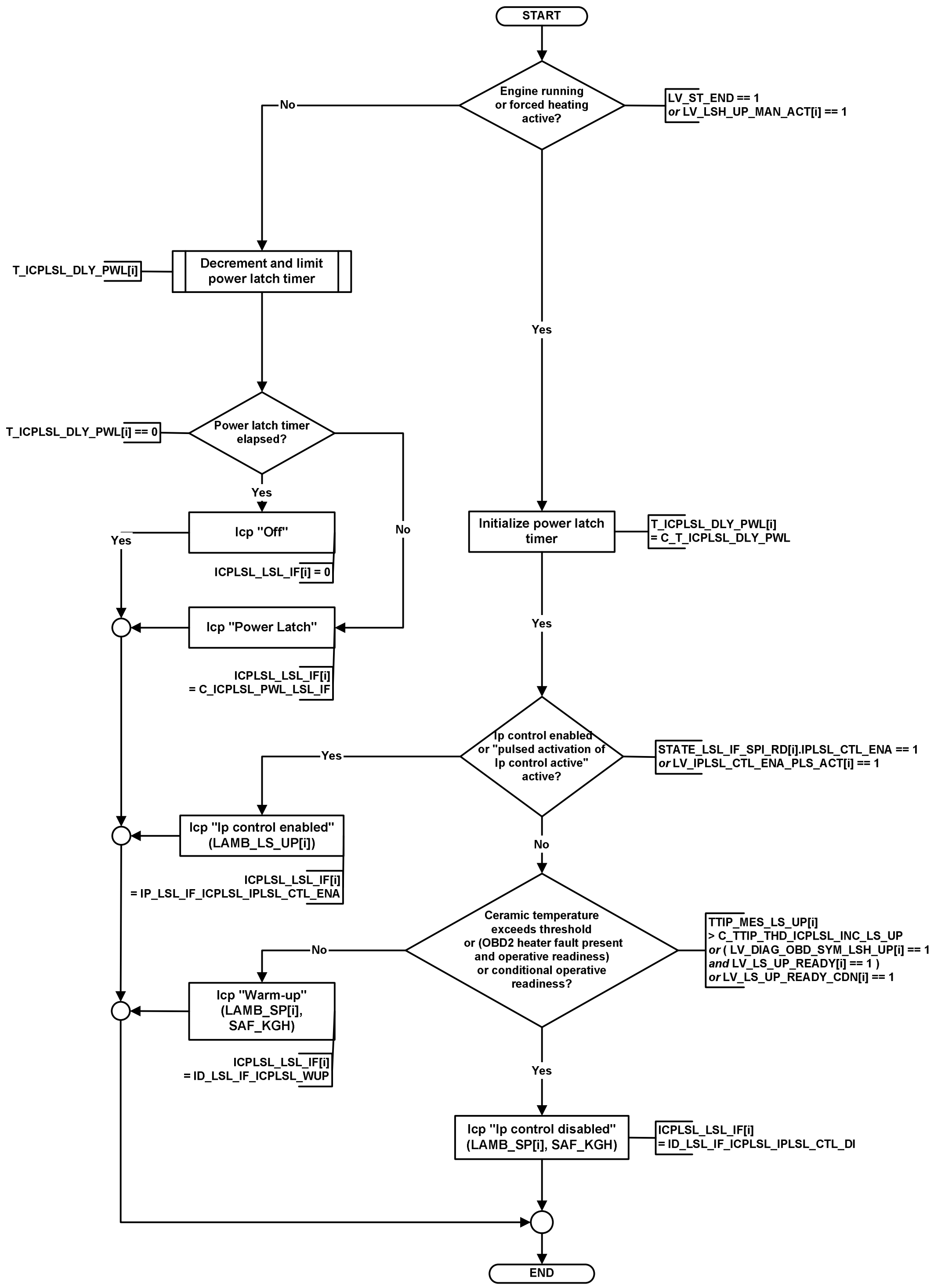

1. Determination of Icp cut-off conditions

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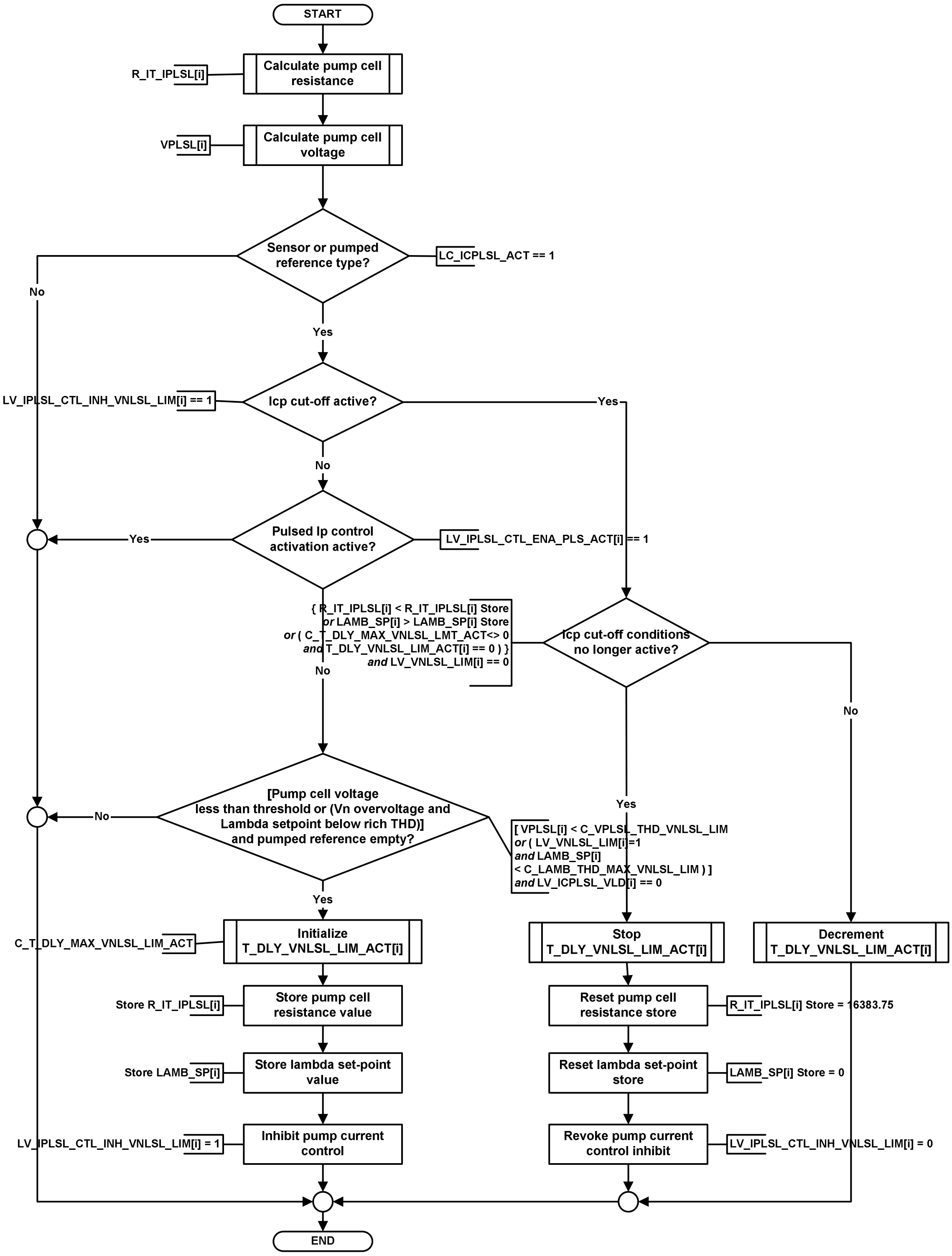

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Calculation of modelled WRAF sensor pump cell DC resistance

See determination of Icp cut-off conditions above for use.

R_IT_IPLSL[i] = (IP_R_IT_IPLSL (R_IT_LS_UP[i], LAMB_SP[i]) * C_R_IT_IPLSL_AGI_FAC) + C_R_IT_IPLSL_AGI_ADD

Calculation of modelled voltage across WRAF sensor pump cell

See determination of Icp cut-off conditions above for use.

VPLSL[i] = R_IT_IPLSL[i] * IPLSL_COR[i]

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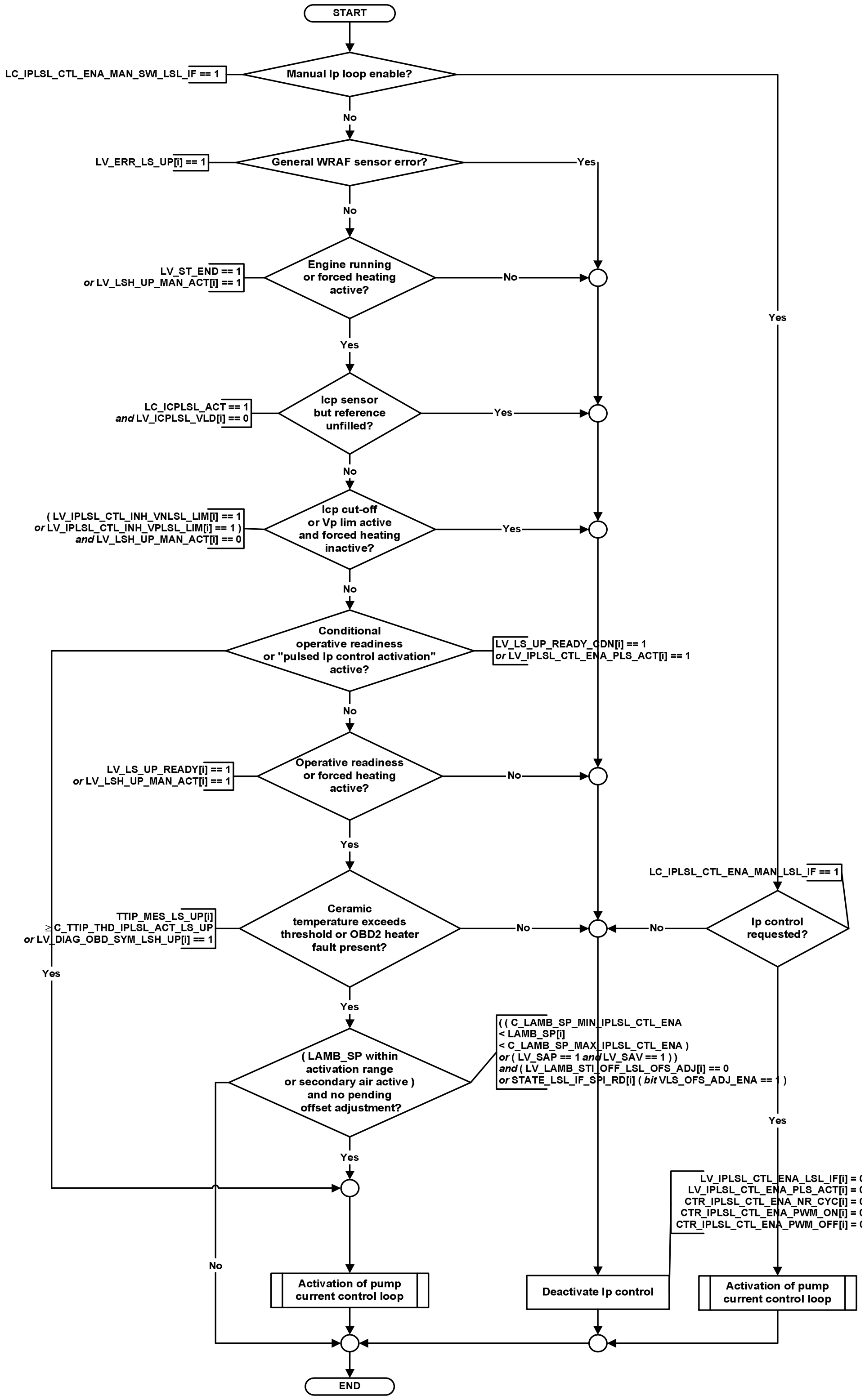
1. Determine required status of pump current (Ip) control loop



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1. Activation of pump current (Ip) control loop

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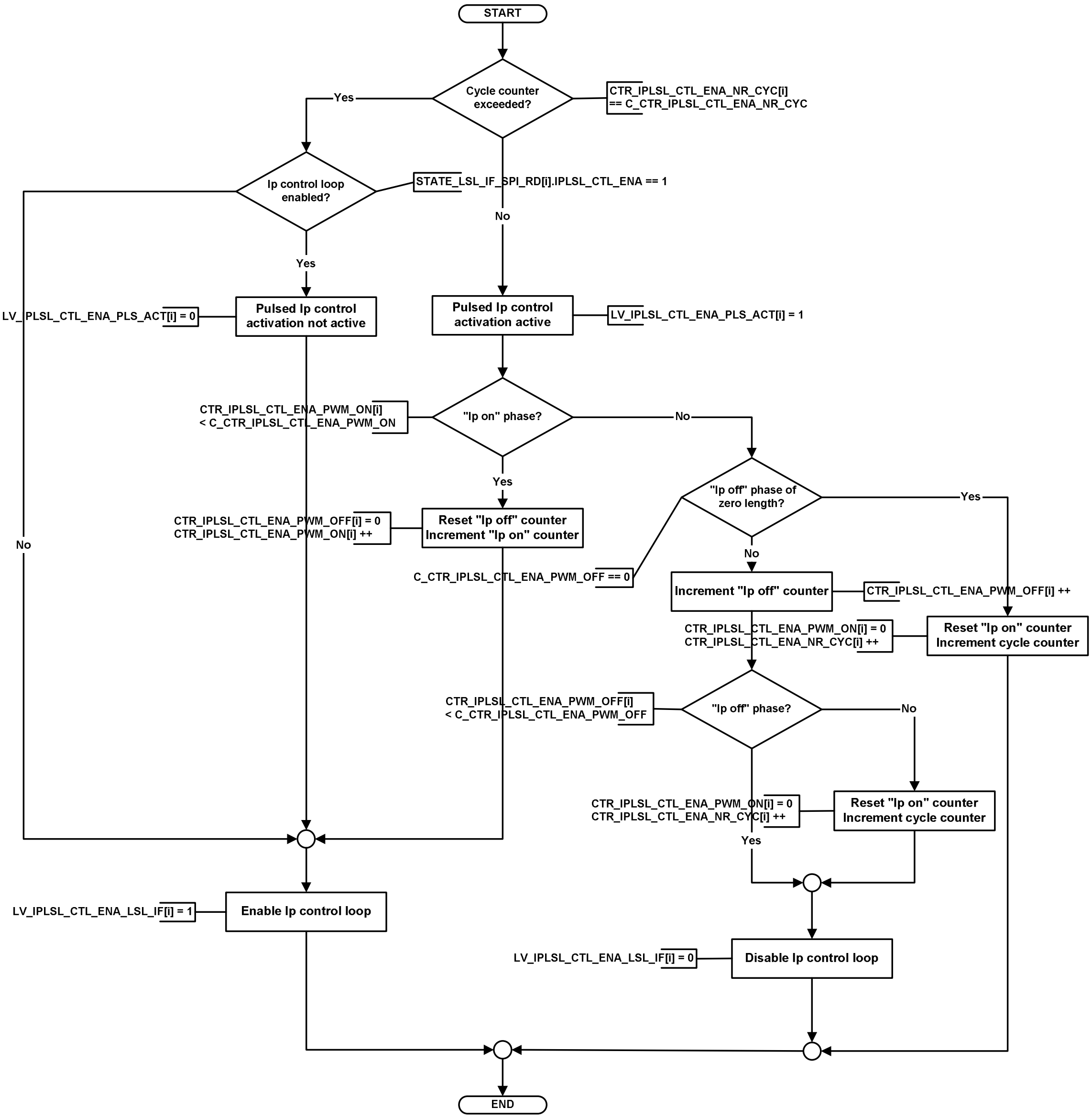

1. Indication of possibility for increased heater-coupling due to permanent battery undervoltage

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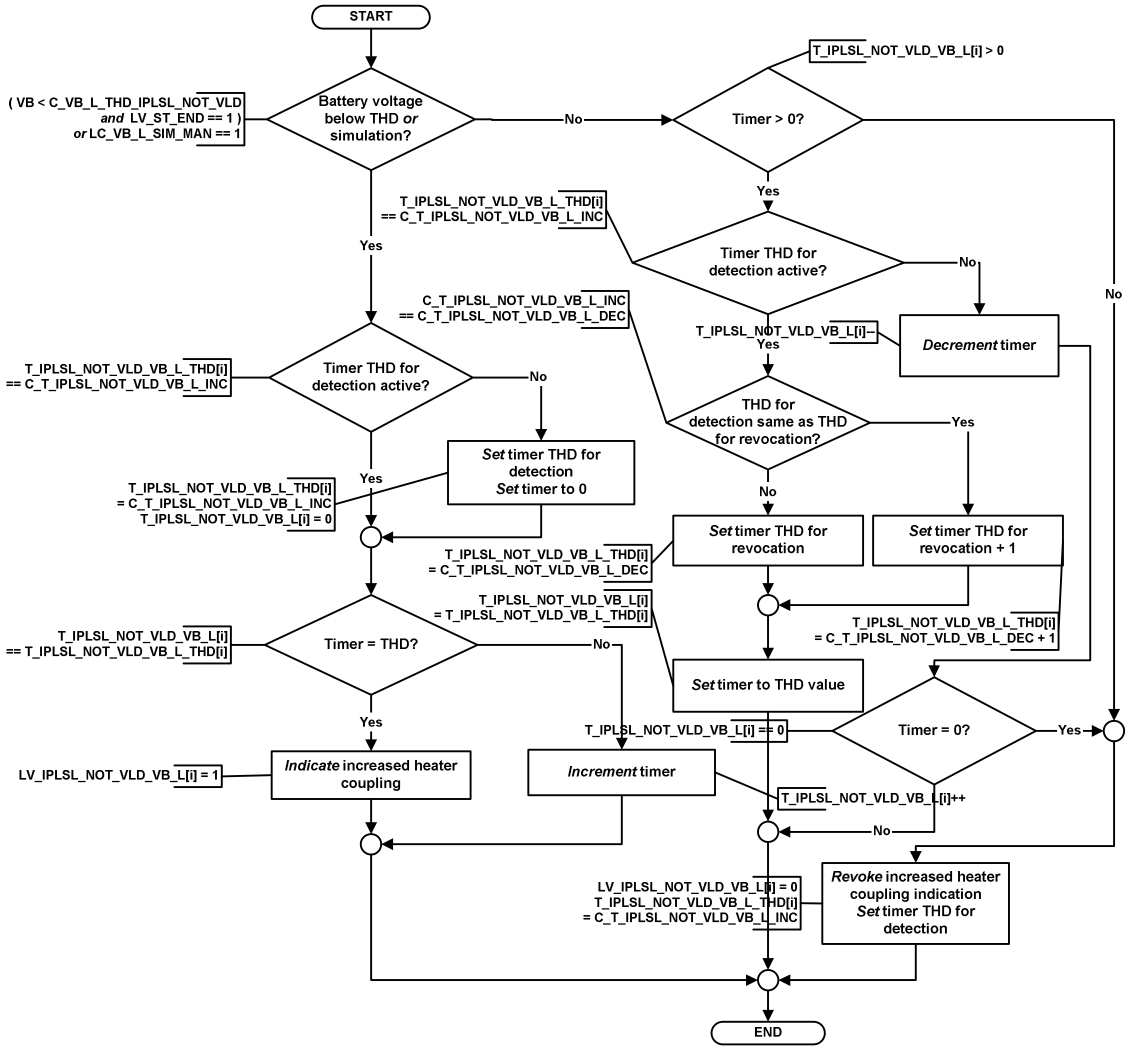

1. Validity of pump current (Ip)

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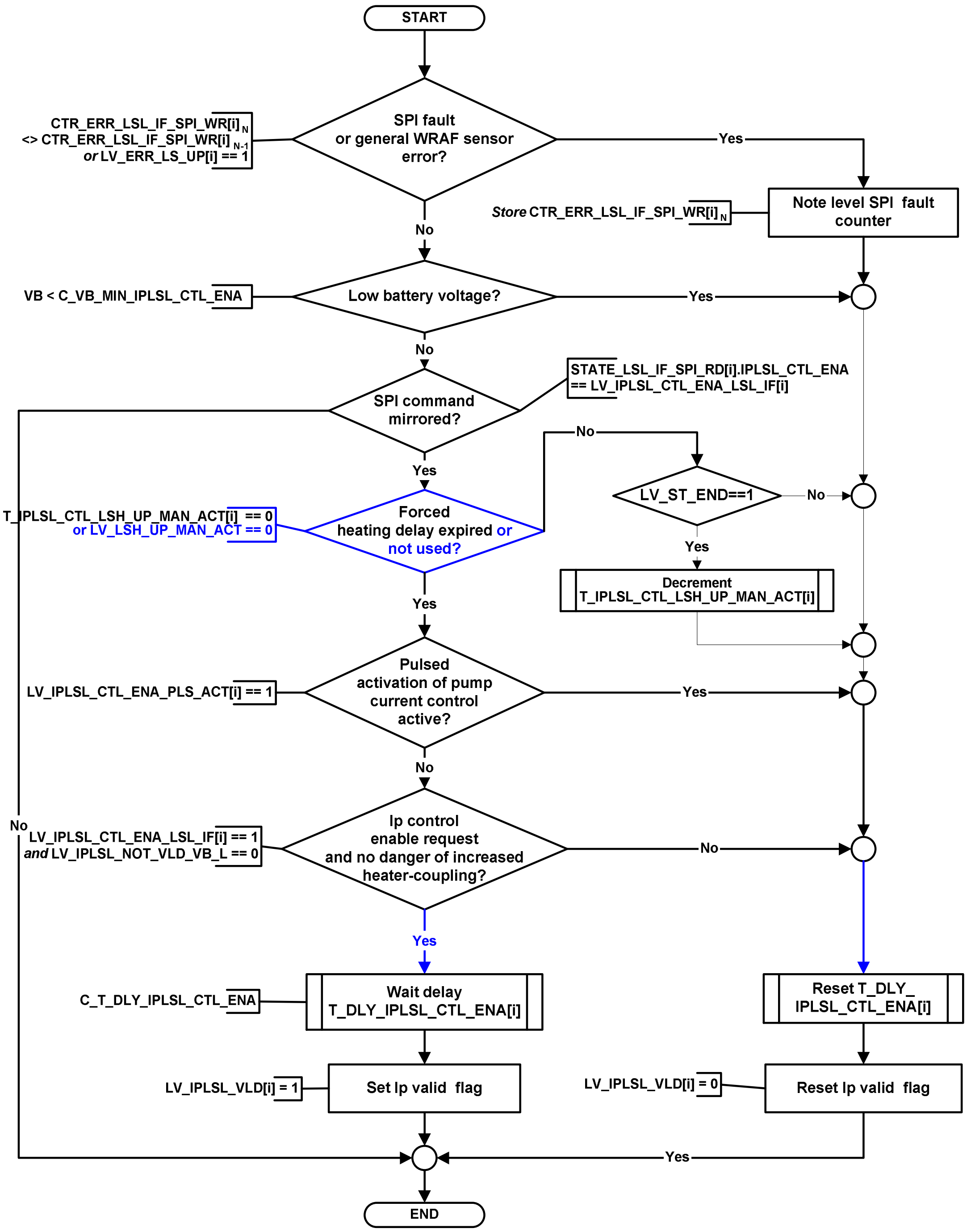

1. Pumping voltage (Vp) limitation strategy

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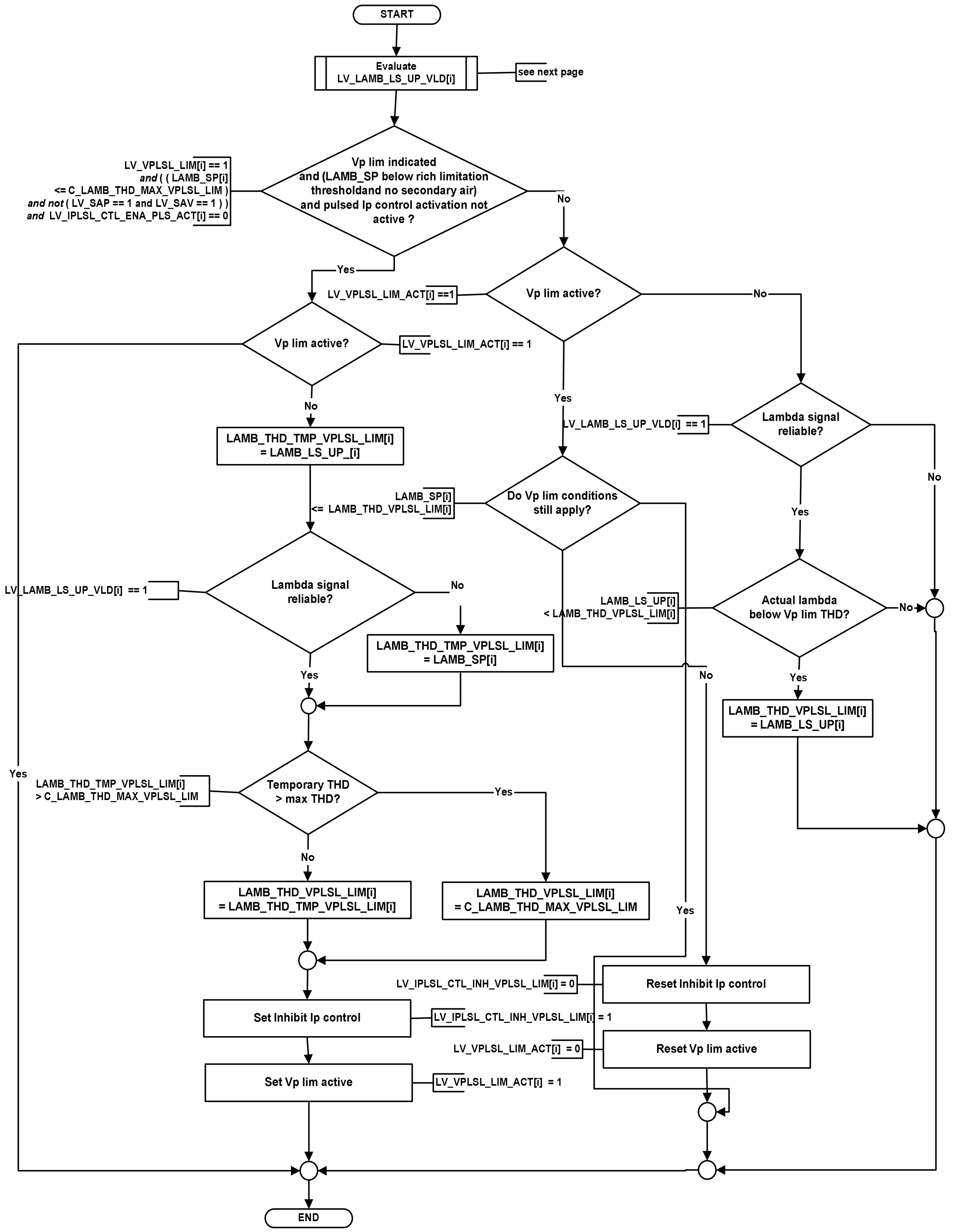

1. Logical variable for judgement of short term WRAF sensor lambda signal reliability

If LV_LS_UP_READY[i] == 1
/* WRAF sensor full operative readiness detected */
and LV_LSL_OFS_ADJ_ACT[i] == 0
and LV_VLS_OFS_ADJ_ENA_LSL_IF[i] == 0
/* WRAF controller electrical offset adjustment not active */
and STATE_LSL_IF_SPI_RD[i] (*bit* LSL_ENA) == 1

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```
                    /* WRAF sensor coupled */
and                      ( LV_ICPLSL_VLD[i] == 1 or LC_ICPLSL_ACT == 0 )
                    /* Reference pumping current valid or sensor not of pumped reference type */
and                      LV_IPLSL_VLD[i] == 1
                    /* WRAF sensor pumping current valid */
and                      LV_VLS_UP_VLD[i] == 1
                    /* No clipping of ATIC42 output voltage present */
and                      LV_VLS_UP_INIT[i] == 0
and                      LV_SWI_GAIN_LSL_IF[i] == STATE_LSL_IF_SPI_RD[i] ( bit SWI_GAIN )
                    /* Initialisation of VLS_UP[i] has successfully been performed
               upon Ip gain-switching */
and                      STATE_ERR_IPLSL[i] == 0
                    /* Pumping current within allowed bounds */
and            LV_LSL_DEAC[i] == 0
                    /* No OBD1 signal fault pending */
and                      LV_ERR_LS_UP[i] == 0
               /* No WRAF system error present */
then           LV_LAMB_LS_UP_VLD[i] = 1
                    /* WRAF system lambda signal reliable */
else           LV_LAMB_LS_UP_VLD[i] = 0
               /* WRAF system lambda signal NOT reliable */
endif
```

1. Logical variable for judgement of lambda sensor signal accuracy level

```
If                      LV_IPLSL_VLD[i] == 0
                    /* WRAF sensor pump current is valid in general */
or                      TTIP_MES_LS_UP[i] < C_TTIP_MIN_LAMB_LS_UP_ESTIM
or                      MAF_KGH < C_MAF_KGH_MIN_LAMB_LS_UP_ESTIM
or                      N_32 > C_N_32_MAX_LAMB_LS_UP_ESTIM
then           LV_LAMB_LS_UP_ESTIM[i] = 1
                    /* Reduced accuracy of linear lambda signal */
else           LV_LAMB_LS_UP_ESTIM[i] = 0
               /* No constraint on general pump current validity */
endif
```

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7.46 O2 sensor (lin, up) IP gain adaptation in PUC

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LSL_GAIN_AD [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 1.99996	30.5e-6	-
Adaptive factor for WRAF sensor gain					
IPLSL_COR_BEG_PURGE [NC_CBK_EX_NR]	V	8000... 7FFFH	-12.596... 12.59561	384.4e-6	mA
Corrected pumping current during fuel cut at begin of purged condition					
IPLSL_COR_CHG_PURGE [NC_CBK_EX_NR]	V	8000... 7FFFH	-12.596... 12.59561	384.4e-6	mA
Change of corrected pumping current during acquisition at purged condition					
IPLSL_COR_MMV_FCUT [NC_CBK_EX_NR]	V	8000... 7FFFH	-12.596... 12.59561	384.4e-6	mA
Moving mean value of corrected pumping current during fuel cut					
IPLSL_MMV_VLD_FCUT [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-12.596... 12.59561	384.4e-6	mA
Moving mean of valid samples of pumping current during fuel cut					
IPLSL_MV_PURGE [NC_CBK_EX_NR]	V	8000... 7FFFH	-12.596... 12.59561	384.4e-6	mA
Arithmetic mean of compensated pumping current during fuel cut at purged condition					
IPLSL_PURGE [NC_CBK_EX_NR]	V	8000... 7FFFH	-12.596... 12.59561	384.4e-6	mA
Compensated (excluding factor for gain adaptation) pumping current during fuel cut at purged condition					
IPLSL_VARI_PURGE [NC_CBK_EX_NR]	V	0... FFFFFFFFH	0... 634.63686	147.799e-9	(mA)**2
Variance of corrected pumping current during fuel cut at purged condition					
IPLSL_VARI_VLD_FCUT [NC_CBK_EX_NR]	O/V/S	0... FFFFFFFFH	0... 634.63686	147.799e-9	(mA)**2
Moving variance of valid samples of pumping current during fuel cut					
LV_FAC_LSL_GAIN_AD_LIM_MAX [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status flag for limitation of WRAF gain adaptation factor to maximum					
LV_FAC_LSL_GAIN_AD_LIM_MIN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status flag for limitation of WRAF gain adaptation factor to minimum					
LV_IPLSL_COR_MMV_FCUT_VLD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag stating validity of latest moving mean value of corrected pumping current during PUC					
LV_IPLSL_VLD_FCUT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Valid Ip sample has been acquired during current fuel cut					
LV_LSL_FCUT_MES_NOT_PLAUS [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Actual fuel cut Ip measurement not plausible					
LV_LSL_FCUT_MES_REP_INH [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status flag indicating successful fuel cut Ip measurement during current PUC phase					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LSL_FIRST_GAIN_AD [NC_CBK_EX_NR]	V/S	0... 1H	0 ...1	1	-
Bit indicating that Gainadaptation is calculated for the first time					
LV_LSL_GAIN_AD_FCUT_NOT_OK [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Factor for gain adaptation out of valid range					
LV_LSL_GAIN_AD_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request for fuel cut Ip measurement					
LV_LSL_GAIN_AD_REQ_VLD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Validation of request for fuel cut Ip measurement					
LV_MAP_PUC_LIM_REQ_LSL_GAIN_AD	O/V	0... 1H	0 ...1	1	-
Status flag for request of limitation of MAP during next PUC phase from torque management					
MAF_INT_PUC_MIN_LSL_GAIN_AD [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.66666	0.0444444	g
treshold for MAF-integral as transition condition from PURGE to ACQ					
STATE_IPLSL_AD_FCUT [NC_CBK_EX_NR]	V	0H 1H 2H 3H 4H	INIT WAIT PURGE ACQ ADAPT	-	-
State of fuel cut gain adaptation procedure					
STATE_IPLSL_GAIN_AD [NC_CBK_EX_NR]	V	0H 1H 2H 3H	IN_RANGE LOW_LIMIT HIGH_LIMIT IMPOSSIBLE	-	-
State of WRAF sensor gain adaptation factor					
T_ACQ_IPLSL_PURGE [NC_CBK_EX_NR]	V	0... FFH	0... 25.5	0.1	s
Timer for acquisition interval of compensated pumping current during fuel cut at purged condition					
T_DLY_IPLSL_COR_MMV_FCUT_VLD [NC_CBK_EX_NR]	V	0... FFH	0... 25.5	0.1	s
Delay timer for retry of gain adaptation upon detection of possible saturation effects on Ip measurement					

Input data:

AMP {p. 982}	CTR_STOP_FSD {p. 6133}	GEAR {p. 1302}	IPLSL_COR [NC_CBK_EX_NR] {p. 2313}
LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_CP_CLOSE_ACT {p. 3749}	LV_IGK {p. 906}	LV_INH_LSL_GAIN_AD [NC_CBK_EX_NR] {p. 2383}
LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	LV_LAMB_LS_UP_VLD [NC_CBK_EX_NR] {p. 2352}	LV_LS_UP_READY [NC_CBK_EX_NR] {p. 2335}	LV_MAP_PUC_LIM_ACT_ LSL_GAIN_AD {p. 981}
LV_PUC {p. 1720}	LV_SWI_GAIN_LSL_IF [NC_CBK_EX_NR] {p. 2314}	LV_V_REF_VLD_R_IT_LS_ UP [NC_CBK_EX_NR] {p. 1320}	LV_VLS_UP_INIT [NC_CBK_EX_NR] {p. 1341}
LV_VLS_UP_VLD [NC_CBK_EX_NR] {p. 1341}	LV_VPLSL_LIM [NC_CBK_EX_NR] {p. 955}	MAF_INT_PUC_ACT {p. 2942}	MAF_KGH {p. 1195}

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N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}	TAM {p. 1579}
TCO {p. 1100}	TTIP_MES_LS_UP [NC_CBK_EX_NR] {p. 1321}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_MIN_LSL_GAIN_AD	-	0... FFFFH	0... 5434	82.8999e-3	hPa
Minimum ambient pressure to allow fuel cut Ip determination					
C_CRLC_IPLSL_COR_FCUT	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for filtering of corrected pumping current					
C_CRLC_IPLSL_MV_VLD	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for filtering of valid Ip samples (is also time constant for adaptation)					
C_CTR_STOP_FSD_THD	-	0... FFH	0... 255	1	-
threshold for CTR_STOP_FSD to allow gain adaptation					
C_FAC_IPLSL_COR_THD_FCUT	-	0... FFH	0... 0.99609	3.91e-3	-
Factor for minimum threshold of the low pass filtered pumping current to detect stable conditions (end of PURGE)					
C_FAC_LSL_GAIN_AD_LIM_MAX	-	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum threshold for WRAF sensor gain adaptation					
C_FAC_LSL_GAIN_AD_LIM_MIN	-	0... FFFFH	0... 1.99996	30.5e-6	-
Minimum threshold for WRAF sensor gain adaptation					
C_FAC_LSL_GAIN_AD_MAN_ADJ	-	0... FFFFH	0... 1.99996	30.5e-6	-
Value for manual adjustment of WRAF sensor gain adaptation factor					
C_IPLSL_COR_GRD_THD_FCUT	-	8000... 7FFFH	-12.596... 12.59561	384e-6	mA/ 100ms
Maximum gradient of low pass filtered pumping current to detect stable conditions (end of PURGE)					
C_IPLSL_MV_VLD_VARI_MAX	-	0... FFFFFFFFH	0... 634.63686	148e-9	mA**2
Maximum permitted variance of valid Ip sample to allow adaptation					
C_IPLSL_NOM_PURGE	-	8000... 7FFFH	-12.596... 12.59561	384e-6	mA
Nominal pumping current at fuel cut					
C_IPLSL_VARI_THD_MAX_PURGE	-	0... FFFFFFFFH	0... 634.63686	148e-9	mA**2
Maximum variance of the low pass filtered pumping current to confirm stable conditions					
C_IPLSL_VARI_THD_MIN_PURGE	-	0... FFFFFFFFH	0... 634.63686	148e-9	mA**2
Minimum variance of the low pass filtered pumping current to confirm that sensor is operable					
C_N_32_BOL_LSL_GAIN_AD	-	0... FFH	0... 8160	32	rpm
Additional bottom limit above which fuel cut Ip determination is allowed to take place					
C_N_32_MAX_LSL_GAIN_AD	-	0... FFH	0... 8160	32	rpm
Maximum engine speed to allow fuel cut Ip determination					
C_N_32_MIN_LSL_GAIN_AD	-	0... FFH	0... 8160	32	rpm
Minimum engine speed to allow fuel cut Ip determination					
C_N_32_TOL_LSL_GAIN_AD	-	0... FFH	0... 8160	32	rpm
Additional top limit below which fuel cut Ip determination is allowed to take place					
C_NR_GEAR_MIN_LSL_GAIN_AD	-	0... FFH	0... 255	1	-
Minimum gear to allow fuel cut Ip determination					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_ACQ_IPLSL_PURGE	-	1... FFH	0.1... 25.5	0.1	s
Duration of Ip acquisition and averaging					
C_T_DLY_IPLSL_COR_MMV_FCUT_VLD	-	1... FFH	0.1... 25.5	0.1	s
Delay time for retry of gain adaptation upon detection of possible saturation effects on Ip measurement					
C_TAM_MAX_LSL_GAIN_AD	-	0... FEH	-48... 142.5	0.75	°C
Maximum ambient temperature to allow fuel cut Ip determination					
C_TCO_MIN_LSL_GAIN_AD	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature to allow fuel cut Ip determination					
C_TTIP_MAX_LSL_GAIN_AD	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Maximum tip temperature to allow fuel cut Ip determination					
C_TTIP_MIN_LSL_GAIN_AD	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Minimum tip temperature to allow fuel cut Ip determination					
IP_FAC_COR_IPLSL_CHG_PURGE	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_IPLSL_CHG_PURGE_IP_IPLSL	4	0... FFFFH	-12.596... 12.59561	384e-6	mA
Factor for residual gas after purging correction					
IP_FAC_COR_IPLSL_MAF_KGH	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_MAF_KGH_IP_FAC_COR_IPLSL	12	0... FFFFH	0... 2047.96875	0.03125	kg/h
Factor for MAF correction					
IP_FAC_COR_IPLSL_N_32	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_N_32_IP_FAC_COR_IPLSL	16	0... FFH	0... 8160	32	rpm
Factor for engine speed correction					
IP_MAF_INT_PUC_MIN_LSL_GAIN_AD	-	0... FFFFH	0... 2912.66666	0.0444444	g
LDP_LAMB_LS_UP_IP_MAF_INT	6	0... 7FFFH	0... 31.99902	976.599e-6	-
Treshold for MAF-integral as transition condition from PURGE to ACQ					
LC_FAC_LSL_GAIN_AD_ENA	-	0... 1H	0 ...1	1	-
Enable adoption of WRAF sensor gain adaptation factor					
LC_FAC_LSL_GAIN_AD_LIM_RST	-	0... 1H	0 ...1	1	-
Switch for reset of adaptation factor to one when exceeding thresholds, or for adoption of threshold value, resp.					
LC_FAC_LSL_GAIN_AD_MAN_ADJ_ENA	-	0... 1H	0 ...1	1	-
Enable manual adjustment of WRAF sensor gain adaptation factor					
LC_IPLSL_GAIN_SEL_LSL_GAIN_AD	-	0... 1H	0 ...1	1	-
Determines which Ip gain has to be active during execution of gain adaptation (0 = gain8, 1 = gain16)					
LC_LSL_FIRST_GAIN_AD	-	0... 1H	0 ...1	1	-
1: no filtering for first calculation of correction value after exchange of ECU or sensor					
LC_LSL_GAIN_AD_ENA	-	0... 1H	0 ...1	1	-
Enable WRAF sensor gain adaptation					
LC_LSL_GAIN_AD_TEST	-	0... 1H	0 ...1	1	-
Manual enable of LV_LSL_GAIN_AD_REQ_i for test purposes					
LC_MAP_PUC_LIM_ACT_NOT_VLD	-	0... 1H	0 ...1	1	-
Flag to ignore activation of limitation of MAP during PUC by torque management					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_MAP_PUC_LIM_REQ_LSL_GAIN_AD	-	0... 1H	0 ...1	1	-
Enable request to torque management for limitation of MAP during PUC					

FUNCTION DESCRIPTION:

During fuel cut-off the engine purges the exhaust line with air. This condition is the best suitable engine operating condition to check the WRAF sensor's static gain.
The function comprises:

1. the recognition of a condition to be stable enough for a significant pumping current measurement.
2. pumping current correction due to interfering impacts as: exhaust pressure etc.
3. current acquisition and averaging during fuel cut.
4. evaluation of adaptation conditions
5. WRAF sensor gain adaptation

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Application conditions

Activation: at LV_IGK = 1
Deactivation: at LV_IGK = 0

Initialization **at first ECU run** :
FAC_LSL_GAIN_AD[i] = 1
IPLSL_MMV_VLD_FCUT[i] = C_IPLSL_NOM_PURGE
IPLSL_VARI_VLD_FCUT[i] = 0
LV_LSL_FIRST_GAIN_AD[i] = 1

Initialization at every transition **LV_IGK = 0 ->** 1, **ECU Reset, or upon erase of error management**:
STATE_IPLSL_AD_FCUT[i] = INIT

7.46.1 Conditions for WRAF Sensor fuel cut-off Ip determination

FUNCTION:

These conditions must be verified the whole time during the fuel cut-off Ip determination.
Request of MAP limitation during next PUC phase by any arbitrary exhaust cylinder bank shall lead to corresponding request to torque management.

Recurrence: T_SAMPLE = 100ms.

Perform prior to execution of FOR loop depending on [i].
If LV_PUC == 0
then LV_MAP_PUC_LIM_REQ_LSL_GAIN_AD = 0
endif
Fuel cut-off Ip determination is requested only:
If (LV_LS_UP_READY [i] == 1

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```
and       LV_IPLSL_VLD[i] == 1
and       LV_CP_CLOSE_ACT == 1
and       CTR_STOP_FSD <= C_CTR_STOP_FSD_THD
and       TCO > C_TCO_MIN_LSL_GAIN_AD
and       TAM < C_TAM_MAX_LSL_GAIN_AD
and       ( C_N_32_MIN_LSL_GAIN_AD < N_32 < C_N_32_MAX_LSL_GAIN_AD
or        C_N_32_BOL_LSL_GAIN_AD < N_32   < C_N_32_TOL_LSL_GAIN_AD )
and       C_TTIP_MIN_LSL_GAIN_AD < TTIP_MES_LS_UP[i]
                < C_TTIP_MAX_LSL_GAIN_AD
and       AMP > C_AMP_MIN_LSL_GAIN_AD
and       LV_V_REF_VLD_R_IT_LS_UP[i] == 1
          ( tip temperature of upstream sensor is valid )
and       LC_LSL_GAIN_AD_ENA == 1
and       GEAR  C_NR_GEAR_MIN_LSL_GAIN_AD
and       LV_INH_LSL_GAIN_AD[i] == 0
and       LC_FAC_LSL_GAIN_AD_MAN_ADJ_ENA == 0 )
or        LC_LSL_GAIN_AD_TEST == 1
then      ( general conditions fulfilled )
          If      LV_PUC == 0
          then    If      LC_MAP_PUC_LIM_REQ_LSL_GAIN_AD == 1
                  then    LV_MAP_PUC_LIM_REQ_LSL_GAIN_AD = 1
                  endif
                  ( MAP limitation during next PUC is requested )
                  LV_LSL_GAIN_AD_REQ_VLD[i] = 1
                   ( request of gain adaptation will be seen valid )
                   LV_LSL_GAIN_AD_REQ[i] = 0
          else    If      LV_LSL_GAIN_AD_REQ_VLD[i] == 1
                  then    LV_LSL_GAIN_AD_REQ[i] = 1
                          ( gain adaptation is requested )
                          If      LV_LAMB_LS_UP_VLD[i] == 1
                          and     LV_VPLSL_LIM[i] == 0
                          and     LV_VLS_UP_VLD[i] == 1
                          and     T_DLY_IPLSL_COR_MMV_FCUT_VLD[i] == 0
                          then    LV_IPLSL_COR_MMV_FCUT_VLD[i] = 1
                          else    decrement T_DLY_IPLSL_COR_MMV_FCUT_VLD[i]
                          endif
                   endif
          endif
else      If      LC_FAC_LSL_GAIN_AD_MAN_ADJ_ENA == 1
          then    FAC_LSL_GAIN_AD[i] = C_FAC_LSL_GAIN_AD_MAN_ADJ
                   LV_LSL_GAIN_AD_FCUT_NOT_OK[i] = 0
                   LV_FAC_LSL_GAIN_AD_LIM_MAX[i] = 0
                   LV_FAC_LSL_GAIN_AD_LIM_MIN[i] = 0
          endif
          LV_LSL_GAIN_AD_REQ[i] = 0
           LV_LSL_GAIN_AD_REQ_VLD[i] = 0
endif
```

7.46.2 Low Pass Filtering of Pumping Current during fuel cut

FUNCTION:

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Recurrence: T_SAMPLE = 10 ms.

Remark: Index ‘k’ is linked to T_SAMPLE = 10ms.

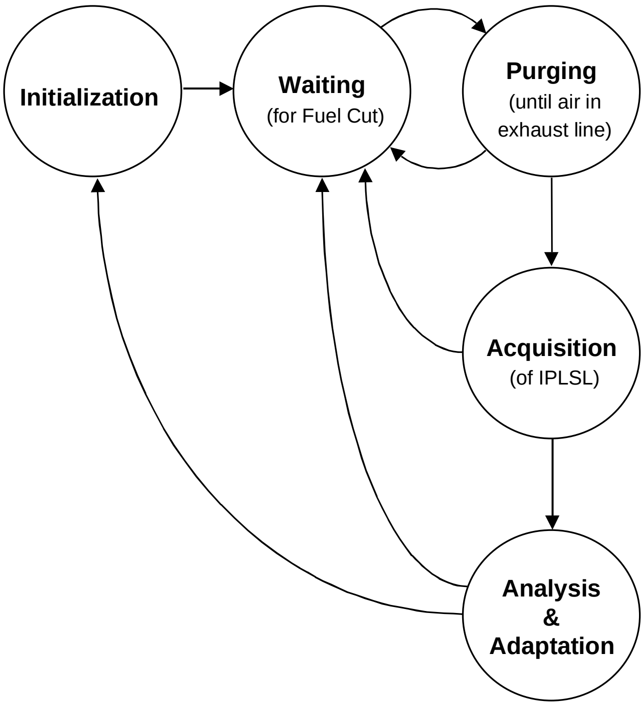
If LV_LSL_GAIN_AD_REQ[i] == 1
then **If** LV_LAMB_LS_UP_VLD[i] = 1
and LV_VPLSL_LIM[i] = 0
and LV_VLS_UP_VLD[i] = 1
then IPLSL_COR_MMV_FCUT[i]$_{k}$ = IPLSL_COR_MMV_FCUT[i]$_{k-1}$
+ C_CRLC_IPLSL_COR_FCUT
* (IPLSL_COR[i] - IPLSL_COR_MMV_FCUT[i]$_{k-1}$)
else LV_IPLSL_COR_MMV_FCUT_VLD[i] = 0
T_DLY_IPLSL_COR_MMV_FCUT_VLD[i]
= C_T_DLY_IPLSL_COR_MMV_FCUT_VLD
IPLSL_COR_MMV_FCUT[i] = IPLSL_COR[i]
endif
else IPLSL_COR_MMV_FCUT[i] = IPLSL_COR [i]
endif

7.46.3 Sequence for fuel cut-off Ip determination:

FUNCTION:

Recurrence: T_SAMPLE = 100 ms.

Remark: Index ‘n’ is linked to T_SAMPLE = 100ms.



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7.46.3.1 State INIT :

Actions:

LV_LSL_GAIN_AD_REQ[i] = 0
LV_LSL_FCUT_MES_REP_INH[i] = 0
LV_LSL_FCUT_MES_NOT_PLAUS[i] = 0
LV_LSL_GAIN_AD_FCUT_NOT_OK[i] = 0
LV_IPLSL_COR_MMV_FCUT_VLD[i] = 1
T_DLY_IPLSL_COR_MMV_FCUT_VLD[i] = 0

Transition to state “WAIT”:

Conditions:
none
Actions during transition:
STATE_IPLSL_AD_FCUT[i] = WAIT

7.46.3.2 State WAIT :

STATE_IPLSL_AD_FCUT[i] remains in this wait state as long as the conditions for fuel cut Off Ip determination are not fulfilled or not fulfilled anymore. Furthermore it is taken care that only one measurement per fuel cut is done.

Actions:

If LV_PUC == 0
then LV_LSL_FCUT_MES_REP_INH[i] = 0
endif

Transition to state “PURGE":

Conditions:

If LV_LSL_GAIN_AD_REQ[i] == 1
and LV_LSL_FCUT_MES_REP_INH[i] == 0
(LV_LSL_FCUT_MES_REP_INH[i] == 1 prevents a second measurement during the same fuel cut)
and **(** LV_MAP_PUC_LIM_ACT_LSL_GAIN_AD == 1
or LC_MAP_PUC_LIM_ACT_NOT_VLD == 1 **)**
and LV_SWI_GAIN_LSL_IF[i] == LC_IPLSL_GAIN_SEL_LSL_GAIN_AD
and STATE_LSL_IF_SPI_RD[i] (*bit* SWI_GAIN)
== LC_IPLSL_GAIN_SEL_LSL_GAIN_AD
and LV_VLS_UP_INIT[i] == 0
(Confirmation that required gain for pump current measurement is active)
then *" transition to PURGE "*
endif

Actions during transition:
STATE_IPLSL_AD_FCUT[i] = PURGE
IPLSL_COR_MMV_FCUT[i] = IPLSL_COR[i]
IPLSL_COR_MMV_FCUT[i]$_{n-1}$ = IPLSL_COR_MMV_FCUT[i]$_{n}$
LV_IPLSL_VLD_FCUT[i] = 0
MAF_INT_PUC_MIN_LSL_GAIN_AD[i]
= IP_MAF_INT_PUC_MIN_LSL_GAIN_AD(LAMB_LS_UP[i])

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7.46.3.3 State: PURGE :

During fuel cut STATE_IPLSL_AD_FCUT[i] waits until the exhaust system is purged and the pumping current is stable. The stability is reached if:

1. the gradient of the averaged pumping current is below a threshold
2. and the absolute pumping current is higher than a given threshold.

Actions:

none

Transition to state "WAIT":

Conditions:

If LV_LSL_GAIN_AD_REQ[i] == 0
then *" transition to WAIT "*
endif

Actions during transition:

STATE_IPLSL_AD_FCUT[i] = WAIT

Transition to state "Acquisition":

Conditions:

If LV_LSL_GAIN_AD_REQ[i] == 1
and (IPLSL_COR_MMV_FCUT[i]$_n$ - IPLSL_COR_MMV_FCUT[i]$_{n-1}$)
$<$ C_IPLSL_COR_GRD_THD_FCUT
and IPLSL_COR_MMV_FCUT[i]$_n$
$>$ C_FAC_IPLSL_COR_THD_FCUT * C_IPLSL_NOM_PURGE
and MAF_INT_PUC_ACT $>$ MAF_INT_PUC_MIN_LSL_GAIN_AD[i]
then *" transition to ACQUISITION "*
else IPLSL_COR_MMV_FCUT[i]$_{n-1}$ = IPLSL_COR_MMV_FCUT[i]$_n$
" stay in PURGE "
endif

Actions during transition:

STATE_IPLSL_AD_FCUT[i] = ACQUISITION
IPLSL_VARI_PURGE[i] = 0
T_ACQ_IPLSL_PURGE[i] = 0
IPLSL_COR_BEG_PURGE[i] = IPLSL_COR_MMV_FCUT[i]

7.46.3.4 State Acquisition :

As input the pumping current (IPLSL_COR_MMV_FCUT[i]) is compensated for actual impacts of:

1. ambient pressure
2. engine speed
3. MAF_KGH
4. (and WRAF sensor TTIP_MES_LS_UP[i])

Afterwards the real current (IPLSL_PURGE[i]) is calculated by division with the actual compensation factor (FAC_LSL_GAIN_AD[i]).

During the acquisition time (C_T_ACQ_IPLSL_PURGE) the actual real current (at fuel cut and at purged exhaust line) is averaged (IPLSL_MV_PURGE[i]) and its variance (IPLSL_VARI_PURGE[i]) is calculated. At the end of the acquisition a final compensation of residual gas purging is done by multiplying with IP_FAC_COR_IPLSL_CHG_PURGE with the latter depending on the Ip change from start to end of acquisition.

Actions:

If LV_IPLSL_COR_MMV_FCUT_VLD[i] = 1
then **If** T_ACQ_IPLSL_PURGE[i] $<$ C_T_ACQ_IPLSL_PURGE
then IPLSL_PURGE[i] = IPLSL_COR_MMV_FCUT[i]
* IP_FAC_COR_IPLSL_MAF_KGH * IP_FAC_COR_IPLSL_N_32 /
FAC_LSL_GAIN_AD[i]

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IPLSL_MV_PURGE[i]$_n$ = (T_ACQ_IPLSL_PURGE[i]
* IPLSL_MV_PURGE[i]$_{n-1}$ + T_SAMPLE * IPLSL_PURGE[i])
/(T_ACQ_IPLSL_PURGE[i] + T_SAMPLE)
IPLSL_VARI_PURGE[i]$_n$ =
(T_ACQ_IPLSL_PURGE[i] * IPLSL_VARI_PURGE[i]$_{n-1}$
+ T_SAMPLE * (IPLSL_MV_PURGE[i] - IPLSL_PURGE[i]) ˆ2)
/(T_ACQ_IPLSL_PURGE[i] + T_SAMPLE)
T_ACQ_IPLSL_PURGE[i]$_n$ = T_ACQ_IPLSL_PURGE[i]$_{n-1}$+ T_SAMPLE
endif
else IPLSL_COR_BEG_PURGE[i] = IPLSL_COR_MMV_FCUT[i]
T_ACQ_IPLSL_PURGE[i] = 0
IPLSL_VARI_PURGE[i] = 0
endif
If T_ACQ_IPLSL_PURGE[i] == C_T_ACQ_IPLSL_PURGE
and LV_LSL_FCUT_MES_REP_INH[i] == 0
then LV_LSL_FCUT_MES_REP_INH[i] = 1
IPLSL_COR_CHG_PURGE[i] =
IPLSL_COR_MMV_FCUT[i] - IPLSL_COR_BEG_PURGE[i]
IPLSL_MV_PURGE[i] =
IPLSL_MV_PURGE[i] * IP_FAC_COR_IPLSL_CHG_PURGE
endif

Transition to state “WAIT":
Conditions:

If LV_LSL_GAIN_AD_REQ[i] == 0
then *" transition to WAIT "*
endif
Actions during transition:
STATE_IPLSL_AD_FCUT[i] = WAIT

Transition to state “ADAPT":
Conditions:
If LV_LSL_GAIN_AD_REQ[i] == 1
and LV_LSL_FCUT_MES_REP_INH[i] == 1
then *" transition to ADAPT "*
endif
Actions during transition:
STATE_IPLSL_AD_FCUT[i] = ADAPT

7.46.3.5 State ADAPT :

The fuel cut pumping current sample is checked for sensor operability and stability during the previous acquisition phase. Therefore the variance of the output must be between allowed limits. If this condition or the conditions for “fuel cut-off Ip determination” are not fulfilled anymore the STATE_IPLSL_AD_FCUT[i] switches back to “WAIT”.
If the conditions are fulfilled it will be declared as “valid sample”. Next a MMV value and the variance of the valid Ip samples are calculated.
If the gain adaptation takes place for the first time (in case of a new sensor or new ECU) the MMV value is initialized with the mean-value of the first measurement. The variance stays on the initial value (zero) in this case. The calculation of MMV and variance is started as soon as one successful gain adaptation was carried out (by setting LV_FIRST_GAIN_AD = 0).
A new adaptive factor (FAC_LSL_GAIN_AD[i]) for the WRAF sensor’s gain is calculated if the following conditions for adaptation are fulfilled:

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1. Variance of previous valid samples in permitted range.
2. Adaptive factor (FAC_LSL_GAIN_AD[i]) in permitted range

Since the new adaptive factor is calculated based on the MMV value of the valid samples it follows the average of the last measurements and not direct every particular fuel cut sample. The response time of the adaptation is defined by the correlation constant (C_CRLC_IPLSL_MV_VLD).

Actions:

If LV_IPLSL_VLD_FCUT[i] == 0
(LV_IPLSL_VLD_FCUT[i] == 1 prevents a second evaluation and updating of IPLSL_MMV_VLD_FCUT[i] during the same fuel cut)
and C_IPLSL_VARI_THD_MIN_PURGE $<=$ IPLSL_VARI_PURGE[i]
$<$ C_IPLSL_VARI_THD_MAX_PURGE
then LV_LSL_FCUT_MES_NOT_PLAUS[i] = 0
LV_IPLSL_VLD_FCUT[i] = 1

Average of recent valid fuel cuts & Variance of recent valid fuel cuts:
If (LV_LSL_FIRST_GAIN_AD[i] == 1 **and** LC_LSL_FIRST_GAIN_AD == 1)
then IPLSL_MMV_VLD_FCUT[i]$_i$ = IPLSL_MV_PURGE[i]$_i$
IPLSL_VARI_VLD_FCUT[i]$_i$ = IPLSL_VARI_VLD_FCUT[i]$_{i-1}$

else IPLSL_MMV_VLD_FCUT[i]$_i$ = IPLSL_MMV_VLD_FCUT[i]$_{i-1}$
+ C_CRLC_IPLSL_MV_VLD * (IPLSL_MV_PURGE[i]

- IPLSL_MMV_VLD_FCUT[i]$_{i-1}$)

IPLSL_VARI_VLD_FCUT[i]$_i$ = IPLSL_VARI_VLD_FCUT[i]$_{i-1}$
+ C_CRLC_IPLSL_MV_VLD * ((IPLSL_MV_PURGE[i]
- IPLSL_MMV_VLD_FCUT[i]$_i$) ^2 - IPLSL_VARI_VLD_FCUT[i]$_{i-1}$)

end

Adaptation conditions
If IPLSL_VARI_VLD_FCUT[i] $>$ C_IPLSL_MV_VLD_VARI_MAX
then STATE_IPLSL_GAIN_AD[i] = 3 *(impossible)*
(adaptation impossible due variance limit of valid fuel cut measurements exceeded)
else **If** (C_IPLSL_NOM_PURGE /IPLSL_MMV_VLD_FCUT[i])
$>$ C_FAC_LSL_GAIN_AD_LIM_MAX
then STATE_IPLSL_GAIN_AD[i] = 1 *(low Ip limit)*
If LC_FAC_LSL_GAIN_AD_LIM_RST == 1
then FAC_LSL_GAIN_AD[i] = 1
else FAC_LSL_GAIN_AD[i]
= C_FAC_LSL_GAIN_AD_LIM_MAX
endif
LV_FAC_LSL_GAIN_AD_LIM_MIN[i] = 0
LV_FAC_LSL_GAIN_AD_LIM_MAX[i] = 1
(upper adapt. factor limit exceeded since pumping current lower than allowed limit)
else LV_FAC_LSL_GAIN_AD_LIM_MAX[i] = 0
If (C_IPLSL_NOM_PURGE /IPLSL_MMV_VLD_FCUT[i])
$<$ C_FAC_LSL_GAIN_AD_LIM_MIN
then STATE_IPLSL_GAIN_AD[i] = 2 *(high Ip limit)*
If LC_FAC_LSL_GAIN_AD_LIM_RST = 1

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```
                                    then    FAC_LSL_GAIN_AD[i] = 1
                                    else    FAC_LSL_GAIN_AD[i]
                                                    = C_FAC_LSL_GAIN_AD_LIM_MIN
                                    endif
                                  LV_FAC_LSL_GAIN_AD_LIM_MIN[i] = 1
                                    ( lower adaptation factor limit exceeded,
                                  since pumping current higher than allowed limit )
                            else    STATE_IPLSL_GAIN_AD[i] = 0          ( in range )
                                  LV_FAC_LSL_GAIN_AD_LIM_MIN[i] = 0
                            endif
                      endif
                endif

                Adaptation
                If      STATE_IPLSL_GAIN_AD[i] == 0        ( in range )
                then    LV_LSL_GAIN_AD_FCUT_NOT_OK[i] = 0
                         If       LC_FAC_LSL_GAIN_AD_ENA == 1
                        then    FAC_LSL_GAIN_AD[i] =
                                        C_IPLSL_NOM_PURGE /IPLSL_MMV_VLD_FCUT[i]
                                ( New adaptation factor = nominal current divided by MMV
                                of uncompensated current )
                                LV_LSL_FIRST_GAIN_AD[i] = 0
                         else    FAC_LSL_GAIN_AD[i] = 1
                         endif
                else    LV_LSL_GAIN_AD_FCUT_NOT_OK[i] = 1
                endif
  else    LV_LSL_FCUT_MES_NOT_PLAUS[i] = 1
  endif
```

Transition to state “WAIT":

Conditions:

```
    If       LV_LSL_FCUT_MES_NOT_PLAUS[i] == 1
    or       LV_LSL_GAIN_AD_FCUT_NOT_OK[i] == 1
    then    " transition to WAIT “
    endif
```

Actions during transition:

STATE_IPLSL_AD_FCUT[i] = WAIT

Transition to state “INIT":

Conditions:

```
    If       LV_IPLSL_VLD_FCUT[i] == 1
    and      LV_PUC == 0
  then    " transition to INIT "
  endif
```

Actions during transition:

STATE_IPLSL_AD_FCUT[i] = INIT

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7.47 Activation conditions for WRAF sensor gain adaptation at fuel cutoff

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_LSL_GAIN_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
WRAF sensor Gain Adaptation: application incidences for inhibition					

Input data:

LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CUS {p. 1042}	LV_ERR_CHG_LS_UP {p. 5416}
LV_ERR_CRK {p. 4455}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}
LV_ERR_EL_CPS {p. 4708}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_IGC {p. 4772}
LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_MAF {p. 4815}
LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_SA_SAV {p. 801}	LV_ERR_SA_SAV_LSL {p. 801}
LV_ERR_SAP {p. 802}	LV_ERR_SAV {p. 802}	LV_ERR_TAM_CAN {p. 5076}	LV_ERR_TAM_PLAUS {p. 5076}
LV_ERR_TCO {p. 4496}	LV_ERR_TPS {p. 4982}	LV_ERR_TTIP_MES_LSH_ UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}
LV_IGK {p. 906}	LV_MIS_STATE_A {p. 6238}	LV_MIS_STATE_B {p. 6238}	LV_ST_END {p. 1720}
NC_CBK_EX_NR {p. 1829}	OPM_AV {p. 8137}	STATE_ERR_IV {p. 4803}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LSL_GAIN_AD_ENA_ALL_OPM	-	0... 1H	0 ...1	1	-
Logical constant to enable gain adaption in all engine operation modes					

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FUNCTION DESCRIPTION:

General information:

If one of the below mentioned conditions is not fulfilled, the inhibit bit interrupts the WRAF sensor gain adaptation at fuel cut-off.

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
  i = 1, for exhaust cylinder bank 1
  i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)

i = 1, for single exhaust cylinder bank.

Application conditions

Initialisation: *at every LV_IGK = 0 ⇒ 1 and reset all output variables are initialized with 0*

Recurrence: *T_SAMPLE = 100 ms.*

Activation: *at LV_IGK = 1*

Deactivation: *at LV_IGK = 0*

Formula section:

IF LV_ERR_MAF = 1 *mass air flow sensor* **OR**

- STATE_ERR_IV <> 0 *injection valve* **OR**
- LV_ERR_TPS = 1 *Throttle position sensor* **OR**
- LV_ERR_IGC = 1 **OR**
- LV_ERR_FSD_LAM_LIM [i] = 1 **OR**
- LV_ERR_TTIP_MES_LSH_UP[i] = 1 **OR**
- LV_ERR_LOAD_TPS_PLAUS = 1 *(MAF, ISA, AMP) PlausiCheck* **OR**
- LV_ERR_IVVT = 1 *infinitaly valve timing* **OR**
- LV_ERR_LS_UP[NC_CBK_EX_NR] = 1 *WRAF sensor* **OR**
- LV_ERR_DELTA_I_LAM[NC_CBK_EX_NR] = 1 *trimm controller diag.* **OR**
- LV_ERR_VLS_DOWN_DIF[NC_CBK_EX_NR] = 1 **OR**
- LV_ERR_CHG_LS_UP = 1 *swapped WRAF sensor* **OR**
- LV_ERR_EL_CPS = 1 *Canister purge valve* **OR**
- LV_ERR_DIAGCPS = 1 *Canister purge valve mechanical blocked* **OR**
- LV_ERR_FSD[NC_CBK_EX_NR] = 1 *fuel system diagnosis* **OR**
- LV_ERR_SA_SAV = 1 *Secondary air valve error detected* **OR**
- LV_ERR_SA_SAV_LSL = 1 **OR**
- LV_ERR_SAV = 1 *Secondary air valve* **OR**
- LV_ERR_SAP = 1 *Secondary air pumpe* **OR**
- LV_MIS_STATE_B = 1 *Misfire State B detected* **OR**
- LV_MIS_STATE_A = 1 *Misfire State A detected* **OR**
- LV_ERR_CRK = 1 *crankshaft sensor* **OR**
- LV_ERR_CAM_CUS = 1 **OR**
- LV_ERR_TCO = 1 *Coolant temperature sensor* **OR**
- LV_ERR_TAM_CAN = 1 **OR**
- LV_ERR_TAM_PLAUS = 1 **OR**
- LV_ERR_AMP = 1 **OR**
- LV_ERR_AMP_PLAUS = 1 **OR**
- LV_ERR_OFS_LSL_UP[i] = 1 **OR**
- LV_ERR_CTL_LSL_UP[i] = 1 **OR**
- LV_ERR_MAP_TPS_PLAUS = 1 **OR**
- (LC_LSL_GAIN_AD_ENA_ALL_OPM = 0 **and** OPM_AV <> 1)

THEN
LV_INH_LSL_GAIN_AD[NC_CBK_EX_NR] = 1
ELSE
LV_INH_LSL_GAIN_AD[NC_CBK_EX_NR] = 0
ENDIF

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7.48 O2 sensor (up) heater management

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LSHPWM_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 99.60937	0.390625	%
Heater driver PWM duty cycle, acquired also by BSW					
LV_LSH_CTL_CLL_LSH_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean variable indicating closed loop control mode active					
LV_LSH_UP_MAN_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean variable indicating that forced lambda probe heating before engine start is active					
LV_V_EFC_LIM_BOL_LSH_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating effective heater voltage limited due to sum of voltage components falling below zero.					
LV_V_EFC_LIM_MAX_LSH_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating effective heater voltage limited due to exceeding absolute maximum voltage spec.					
LV_V_EFC_LIM_PROT_VB_LSH_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean variable indicating effective heater voltage limited due to excessive battery voltage level					
LV_V_EFC_LIM_TOL_LSH_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating effective heater voltage limited due to exceeding threshold for period of time.					
STATE_LSH_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H 4H 5H 6H	LSH_OFF LSH_POW_RISE LSH_POW_RED LSH_POW_FALL LSH_POW_CTL LSH_VB_PROT LSH_TEMP_PROT	-	-
Present heater state					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_POW_RISE_LSH_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 6553.5	0.1	s
Timer indicating the duration of the pre-heating and post dew point heating phases					
T_V_EFC_LIM_LSH_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer indicating the duration of the effective heater voltage limitation preventing overvoltage					
T_V_EFC_TOL_LSH_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer indicating permitted effective heater voltage overvoltage duration					
TTIP_MES_DIF_LS_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Difference between actual and set oxygen sensor tip temperature					
V_EFC_CLC_LSH_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 25.9996	397e-6	V
Effective calculated heater voltage value prior to overvoltage protection					
V_EFC_CTL_ADD_LSH_UP [NC_CBK_EX_NR]	V	80... 7FH	-13... 12.89843	0.1015625	V
Additive effective heater voltage from closed loop controller					
V_EFC_CTL_I_LSH_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	-13... 12.9996	397e-6	V
Additive effective heater voltage from closed loop controller, I term					
V_EFC_CTL_I_LSH_UP_TMP [NC_CBK_EX_NR]	-	8000... 7FFFH	-13... 12.9996	396.7e-6	V
Intermediate additive effective heater voltage from closed loop controller, I term					
V_EFC_CTL_P_LSH_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	-13... 12.9996	397e-6	V
Additive effective heater voltage from closed loop controller, P term					
V_EFC_CTL_P_LSH_UP_TMP [NC_CBK_EX_NR]	-	8000... 7FFFH	-13... 12.9996	396.7e-6	V
Intermediate additive effective heater voltage from closed loop controller, P term					
V_EFC_LSH_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 25.89843	0.1015625	V
Effective final output value of heater voltage					

Input data:

LSHPWM_EXT_LS_UP [NC_CBK_EX_NR] {p. 2406}	LV_ES {p. 1720}	LV_INH_LSH_CTL_CLL_LSH_UP [NC_CBK_EX_NR] {p. 2406}	LV_INH_LSH_UP [NC_CBK_EX_NR] {p. 2406}
LV_LS_UP_READY_CDN [NC_CBK_EX_NR] {p. 2335}	LV_ST_END {p. 1720}	LV_STST_STOP_CYC {p. 805}	LV_TEMP_DEW_LS_UP [NC_CBK_EX_NR] {p. 1007}
LV_TTIP_MES_VLD_LS_UP [NC_CBK_EX_NR] {p. 1320}	LV_V_REF_VLD_R_IT_LS_UP [NC_CBK_EX_NR] {p. 1320}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}
T_AST {p. 1766}	TEG_DYN_LS_UP [NC_CBK_EX_NR] {p. 1008}	TEMP_INI_LS_UP [NC_CBK_EX_NR] {p. 2406}	TTIP_MES_LS_UP [NC_CBK_EX_NR] {p. 1321}
VB {p. 1185}	VS {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_CTL_I_LSH_UP	-	0... FFH	0... 6.348	24.9e-3	-
Multiplicative scaling factor for closed loop I-term					
C_FAC_CTL_P_LSH_UP	-	0... FFH	0... 6.348	24.9e-3	-
Multiplicative scaling factor for closed loop P-term					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_V_EFC_AS_LSH_UP	-	0... FFH	0... 1.99218	0.0078125	-
Multiplicative correction factor to effective heater voltage					
C_FAC_V_EFC_LSH_UP_MAN_ACT	-	0... FFH	0... 1.99218	0.0078125	-
Multiplicative correction factor to effective heater voltage with activated forced heating before engine start for state LSH_POW_CTL					
C_T_AST_MAX_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time after start at which step in max. effective heater voltage applied, if LSH_POW_CTL active (T_POW_RISE_LSH_UP[NC_CBK_EX_NR] stopped)					
C_T_MAX_CDN_LSH_UP_MAN_ACT	-	0... FFFFH	0... 6553.5	0.1	s
Time threshold for transition from state POW_RISE to POW_CTL with activated forced heating before engine start					
C_T_MAX_POW_RISE_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Duration of open loop pre-heating in LSH_POW_RISE from dew-point to set-point temperature					
C_T_MAX_V_EFC_LIM_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Maximum duration of effective heater voltage limiting					
C_T_MAX_V_EFC_MAX_ST_LSH_UP	-	0... FFH	0... 25.5	0.1	s
Time after start at which step in max. effective heater voltage applied					
C_T_MAX_V_EFC_TOL_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Maximum permitted duration where excessive effective heater voltage tolerated					
C_TEG_DYN_MAX_LSH_UP	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Maximum permitted exhaust gas temperature above which LSH switched off					
C_TTIP_DIF_MIN_CTL_P_LS_UP	-	0... 7FFFH	0... 2047.9375	0.0625	°C
Minimum required temperature difference in order to calculate P term of controller					
C_TTIP_SP_LS_UP [NC_CBK_EX_NR]	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Oxygen sensor set temperature for closed loop control					
C_V_EFC_AS_LSH_UP	-	80... 7FH	-13... 12.89843	0.1015625	V
Effective heater voltage calibration system additive factor					
C_V_EFC_DEC_LSH_UP	-	0... FFH	0... 1.625	6.37e-3	V/100ms
Effective heater voltage decrement to lower temperature					
C_V_EFC_INC_LSH_UP	-	0... FFH	0... 1.625	6.37e-3	V/100ms
Effective heater voltage increment to raise temperature					
C_V_EFC_INI_LSH_UP_MAN_ACT	-	0... FFFFH	0... 25.9996	396.7e-6	V
Initial effective heater voltage when forced heating before engine start activated					
C_V_EFC_LIM_LSH_UP	-	0... FFH	0... 25.89843	0.1015625	V
Effective heater voltage limit under persistent excessive heater voltage condition					
C_V_EFC_MAX_LSH_UP	-	0... FFH	0... 25.89843	0.1015625	V
Absolute maximum permitted effective heater voltage after initial phase; threshold & limit					
C_V_EFC_MAX_LSH_UP_MAN_ACT	-	0... FFFFH	0... 25.9996	396.7e-6	V
Absolute maximum permitted effective heater voltage during forced heating phase before engine start					
C_V_EFC_MAX_ST_LSH_UP	-	0... FFH	0... 25.89843	0.1015625	V
Absolute maximum permitted effective heater voltage during initial phase; threshold & limit					
C_V_EFC_PROT_VB_LSH_UP	-	0... FFH	0... 25.89843	0.1015625	V
Effective heater voltage in the case of battery voltage overvoltage condition					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_EFC_RED_LSH_UP	-	0... FFH	0... 25.89843	0.1015625	V
Reduced effective heater voltage during danger of water splash damage					
C_V_EFC_STEP_LSH_UP	-	80... 7FH	-13... 12.89843	0.1015625	V
Additional effective heater voltage step on transition from LSH_POW_RED to LSH_POW_RISE					
C_V_EFC_TOL_LSH_UP	-	0... FFH	0... 25.89843	0.1015625	V
Effective heater voltage threshold above which voltage limiting may occur if threshold persistently exceeded					
C_VB_MAX_PROT_LSH_UP	-	0... FFH	0... 25.89843	0.1015625	V
Maximum permitted battery voltage threshold, over which overvoltage detected					
ID_TTIP_SP_DIF_LSH_UP	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
LDP_T_POW_RISE_LSH_UP_ID_TTIP	4	0... FFFFH	0... 6553.5	0.1	s
Reducing value for TTIP threshold of transition conditions LSH_POW_RISE to LSH_POW_CTL					
IP_FAC_NEG_CTL_I_LSH_UP	V	0... FFH	0... 0.255	0.001	V/K
LDPM_N_32_1_EGCP	6	0... FFH	0... 8160	32	rpm
LDPM_TEG_DYN_LS_UP_1_EGCP	6	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Closed loop controller I-term factor for temperature too high; decrease heater voltage					
IP_FAC_NEG_CTL_P_LSH_UP	V	0... FFH	0... 0.255	0.001	V/K
LDPM_N_32_1_EGCP	6	0... FFH	0... 8160	32	rpm
LDPM_TEG_DYN_LS_UP_1_EGCP	6	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Closed loop controller P-term factor for temperature too high; decrease heater voltage					
IP_FAC_POS_CTL_I_LSH_UP	V	0... FFH	0... 0.255	0.001	V/K
LDPM_N_32_1_EGCP	6	0... FFH	0... 8160	32	rpm
LDPM_TEG_DYN_LS_UP_1_EGCP	6	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Closed loop controller I-term factor for temperature too low; increase heater voltage					
IP_FAC_POS_CTL_P_LSH_UP	V	0... FFH	0... 0.255	0.001	V/K
LDPM_N_32_1_EGCP	6	0... FFH	0... 8160	32	rpm
LDPM_TEG_DYN_LS_UP_1_EGCP	6	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Closed loop controller P-term factor for temperature too low; increase heater voltage					
IP_FAC_V_EFC_TEG_LSH_UP	-	0... FFH	0... 3.98437	0.015625	-
LDP_VS_IP_FAC_V_EFC_TEG_LSH_UP	6	0... FFH	0... 255	1	km/h
Factor for the heat transfer rate, bank 2 only					
IP_T_TEMP_THD_LSH_UP	-	0... FFH	0... 25.5	0.1	s
LDPM_TEMP_INI_LS_UP_1_EGCP	6	0... FFFFH	-2048... 2047.9375	0.0625	°C
Duration until critical water splash sensor temperature reached					
IP_V_EFC_CTL_LSH_UP	V	0... FFH	0... 25.89843	0.1015625	V
LDPM_N_32_1_EGCP	6	0... FFH	0... 8160	32	rpm
LDPM_TEG_DYN_LS_UP_1_EGCP	6	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Open loop control effective heater voltage					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_V_EFC_INI_LSH_UP	-	0... FFH	0... 25.89843	0.1015625	V
LDPM_TEMP_INI_LS_UP_1_EGCP	6	0... FFFFH	-2048... 2047.9375	0.0625	°C
Initial effective heater voltage					
LC_LSH_CTL_CLL_INH_LSH_UP [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Boolean constant to permit suspension of closed loop heater control					
LC_LSH_UP_MAN_ACT [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Boolean constant to permit forced lambda sensor heating before engine start					
LC_TEMP_DEW_LSH_UP	-	0... 1H	0 ...1	1	-
Logical calibration data to force LSH_OFF to LSH_POW_RED transition if no dew point recognized					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_LSHPWM_BOL_LSH_UP	-	0... FFH	0... 99.60937	0.390625	%
Heater driver PWM duty cycle lower limit					
NC_LSHPWM_TOL_LSH_UP	-	0... FFH	0... 99.60937	0.390625	%
Heater driver PWM duty cycle upper limit					

Import actions:

ACTION_INFR_SetPwmLshUp (**IN**<i>,**IN**<ducy>)

FUNCTION DESCRIPTION:

General information:

If two separate cylinder banks are concerned, then
i = 1, for cylinder bank 1
i = 2, for cylinder bank 2
The heater control shall be realised by use of a state machine. Each upstream oxygen sensor shall have its own state machine and each state machine shall run independently of the other.

Lambda probe heating after engine start (normal case)

The goal of the heater control shall be to control the oxygen sensor heating such that the optimal operating temperature is reached in the shortest time possible. At the same time, the maximum permissible temperature gradient (possible damage to ceramic due to thermal stress), the possible occurrence of water splash under the dew point (possible damage to ceramic due to thermal shock) and the absolute maximum ratings specified for the sensor shall be taken into account.
The function shall permit oxygen sensor heating under open and closed loop control.
Signal flow:

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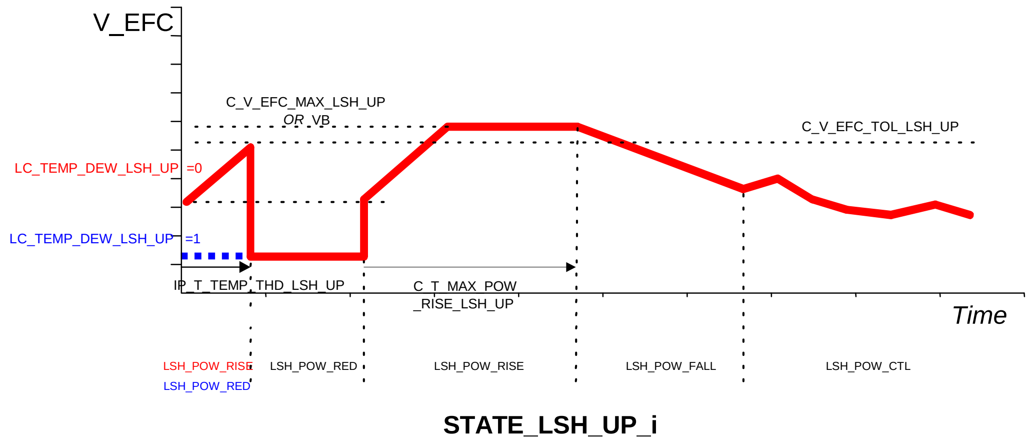

Figure 7.48.1: : Course of effective heater voltage over time /state

The heater control shall be initialised to the LSH_OFF state at the start of a new driving cycle. Hence the oxygen sensor will not initially be electrically heated if not otherwise required (see sub chapter "forced lambda probe heating before engine start").

In the normal case (no forced heating before engine start) heating shall be started when the engine has transitioned from the start state (LV_ST_END = 1) and the heater management inhibit bit for the correspopnding bank is not set (LV_INH_LSH_UP[i] = 0). Depending on the lambda sensor requirement specification following two methods of initial lambda sensor heating are possible as judged by calibration of LC_TEMP_DEW_LSH_UP (see figure 1). This is due to the fact that for lambda sensors until dew point recognition either a certain temperature limit or a defined voltage limit must not be exceeded as the lambda sensor may be damaged by water splash or excessive temperature gradient otherwise. Depending on the setting of LC_TEMP_DEW_LSH_UP the heater management state machine shall thus switch from LSH_OFF to LSH_POW_RISE (LC_TEMP_DEW_LSH_UP = 0) or to LSH_POW_RED (LC_TEMP_DEW_LSH_UP = 1). In case of direct dew point recognition after hot restart the state machine shall switch to LSH_POW_RISE.

1.) Transition from LSH_OFF to LSH_POW_RED before dew point recognition

In case of transition from LSH_OFF to LSH_POW_RED the initial heater power is set by setting the effective heater voltage to C_V_EFC_RED_LSH_UP. The reduced heating state where water splash may occur shall persist until the dew point in the exhaust gas system has been recognized, i.e. until LV_TEMP_DEW_LS_UP[i] = 1, at which point the heater state shall switch to LSH_POW_RISE.

The effective heater voltage shall be set to the effective heater voltage as determined by IP_V_EFC_INI_LSH_UP, which may be modified by the calibration data C_V_EFC_STEP_LSH_UP, and may further be incremented with a gradient of C_V_EFC_INC_LSH_UP without danger of damaging the oxygen sensor. Additionally the timer T_POW_RISE_LSH_UP[i] shall be reinitialised with the IP_T_TEMP_THD_LSH_UP determined at function start.

2.) Transition from LSH_OFF to LSH_POW_RISE before dew point recognition

In case of transition from heater state LSH_OFF to LSH_POW_RISE the initial value for the effective heater voltage shall be determined by obtaining the oxygen sensor temperature at start (TEMP_INI_LS_UP[i]) from input data. This shall then be used to obtain the appropriate effective heater starting voltage from map IP_V_EFC_INI_ LSH_UP. In the state LSH_POW_RISE, the effective heater voltage shall be incremented with the gradient of C_V_EFC_INC_LSH_UP. The continuation of the heating gradient shall depend on whether the dew point at sensor location has been recognized.

Should the dew point not have been exceeded (LV_TEMP_DEW_LS_UP[i] = 0) but timer T_POW_RISE_LSH_UP[i] has equalled or exceeded IP_T_TEMP_THD_LSH_UP, it shall be assumed that condensed water splash at the oxygen sensor location may occur. In order to protect the oxygen sensor by keeping the temperature of the ceramic lower than the specified critical temperature, the

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heater power shall be reduced immediately by setting the effective heater voltage to C_V_EFC_RED_LSH_UP. In this case, the heater state shall be set to LSH_POW_RED (see above).

The reduced heating state shall persist until the dew point in the exhaust gas system has been recognized, i.e. until LV_TEMP_DEW_LS_UP[i] = 1, at which point the heater state shall return to LSH_POW_RISE. For further operation please refer to case 1.)

Should the initial exhaust gas temperature at start have been determined to exceed the dew point (LV_TEMP_DEW_LS_UP[i] = 1), the heater control shall not enter the reduced heater power state but continue to incrementally increase the heater power within the LSH_POW_RISE state.

Dependent on whether closed loop control is permitted, the heater management shall enter either LSH_POW_CTL or LSH_POW_FALL. Should closed loop be permitted (LV_INH_LSH_CTL_CLL_LSH_UP[i] = 0) and the ceramic temperature reference be valid (LV_V_REF_VLD_R_IT_LS_UP[i] = 1) and ceramic temperature exceed the set temperature (TTIP_MES_LS_UP[i]   C_TTIP_SP_LS_UP[i]) then the state machine shall change to LSH_POW_CTL and the timer shall be frozen. This state change shall permit the controller to take over heating when the operative readiness has been detected in order to prevent under- & overshoot of the ceramic temperature. Should the conditional operative readiness be set (LV_LS_UP_READY_CDN[i] = 1) then the state machine shall also enter state LSH_POW_CTL and stop the timer. This shall permit the heater stability diagnosis to be carried out even when the heater is sufficiently defective to prevent the set temperature from being reached. Should the closed loop controller be inhibited or the ceramic temperature calibration be faulty, and T_POW_RISE_LSH_UP[i] be determined to have equalled or exceeded the value C_T_MAX_POW_RISE_LSH_UP (irrespective of the dew point having been exceeded or not), the heater state shall change to LSH_POW_FALL and the timer shall be frozen.

In the LSH_POW_FALL state, the effective heater voltage shall be reduced with a gradient of C_V_EFC_DEC_LSH_UP until such time that it falls below or equals the value set for the open loop control at the current engine operating point. For cylinder bank 1, this value is determined by map IP_V_EFC_CTL_LSH_UP alone. For cylinder bank 2, this value is determined by IP_V_EFC_CTL_LSH_UP * IP_FAC_V_EFC_TEG_LSH_UP. The latter factor shall be necessary to accommodate differences in heat transfer rates between cylinder banks at the oxygen sensor location, particularly for transversal mounted V6-engines. At such time the effective heater voltage falls below or equals the respective threshold, the heater state shall change to LSH_POW_CTL.

Should, however, the Boolean flag LV_TEMP_DEW_LS_UP[i] be reset whilst in the state LSH_POW_FALL, then the closed loop controller terms shall be reset, the Boolean flags to indicate closed loop control and effective heater voltage limitation shall be reset and the heater control shall resume at state LSH_POW_RED following the procedures outlined above.

The control of the effective heater voltage may be carried out in open loop or closed loop mode. Unless either the closed loop control inhibit bit (LV_INH_LSH_CTL_CLL_LSH_UP[i]) is set or the reference voltage validity bit (LV_V_REF_VLD_R_IT_LS_UP[i]) is reset, the effective heater voltage shall be controlled in closed loop mode. Closed loop control conditions met shall be indicated by setting LV_LSH_CTL_CLL_LSH_UP[i]. Should at any time one of the above conditions no longer be met, the heater controller shall revert to open loop control, reset the closed loop variables and reset LV_LSH_CTL_CLL_LSH_UP[i].

In the open loop heater control mode, the effective heater voltage shall be obtained from map IP_V_EFC_CTL_LSH_UP and is dependent upon the engine speed and the modelled exhaust gas temperature. For cylinder bank 2, an additional multiplicative factor (IP_FAC_V_EFC_TEG_LSH_UP) may be required for the reasons outlined above.

In the closed loop heater control mode, a PI controller, that affects the open loop effective heater voltage in an additive manner, shall regulate the effective heater voltage such that the temperature specified by C_TTIP_SP_LS_UP[i] is maintained. The closed loop control may be further described as follows:

The current temperature of the oxygen sensor (TTIP_MES_LS_UP[i]) shall be obtained and the difference between this temperature and the set temperature computed to obtain the input variable to the controller (TTIP_MES_DIF_LS_UP[i]). Note that this variable shall be computed in both open and closed loop control modes but shall only be used in the closed loop control mode.

The controller shall then determine the appropriate additive voltage (V_EFC_CTL_ADD_LSH_UP[i]) by computing the P and I terms separately and then adding the two terms.

The P term (V_EFC_CTL_P_LSH_UP[i]) shall calculate a voltage proportional to the temperature difference and thus converting a temperature delta into voltage. The P term shall only be calculated when the

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absolute temperature difference (TTIP_MES_DIF_LS_UP[i]) equals or exceeds a constant (C_TTIP_DIF_MIN_CTL_P_LS_UP). This shall be achieved via the map IP_FAC_xxx_P_LSH_UP_CTL, where xxx stands for either POS or NEG dependent on the sign of the temperature difference. The map values are dependent on engine speed and exhaust gas temperature. A further dimensionless constant C_FAC_CTL_P_LSH_UP shall permit global parameter changes to be made.

The I term (V_EFC_CTL_I_LSH_UP[i]) shall calculate an integral of a voltage that shall be proportional to the temperature difference and thus converting a temperature delta into voltage. This shall be achieved via the map IP_FAC_xxx_I_LSH_UP_CTL, where xxx stands for either POS or NEG dependent on the sign of the temperature difference. The map values are dependent on engine speed and exhaust gas temperature. A further dimensionless constant C_FAC_CTL_I_LSH_UP shall permit global parameter changes to be made.

Once the additive voltage has been determined, this shall then be added to the open loop control voltage along with a calibration system constant (C_V_EFC_AS_LSH_UP) to permit a global change in the total effective heater voltage to be made. Thus the calculated effective heater voltage (V_EFC_CLC_LSH_UP[i]) shall be computed from the open loop value, the closed loop additive term and the global correction value.

The closed loop control computations shall be suspended should either the Boolean flag LC_LSH_CTL_CLL_INH_LSH_UP[i] be set or the ceramic temperature no longer be valid, for example due to an active reference voltage measurement, as indicated by LV_TTIP_MES_VLD_LS_UP[i] being reset. This shall freeze the P and I terms at their last calculated value. Upon revoking the suspension, the controller shall continue to compute from where the point immediately prior to the suspension, i.e. shall not start anew. Furthermore should the sum of the components used to calculate the effective heater voltage be negative, LV_V_EFC_LIM_BOL_LSH_UP[i] shall be set. This shall prevent the controller from decreasing the effective heater voltage further but not prevent it from increasing the voltage. When the sum of the components is no longer negative, LV_V_EFC_LIM_BOL_LSH_UP[i] shall be reset. Similarly, should either of the overvoltage limitation Boolean flags LV_V_EFC_LIM_TOL_LSH_UP[i] & LV_V_EFC_LIM_MAX_LSH_UP[i] be set, as described later, the controller shall be prevented from increasing the effective heater voltage further but not prevent it from decreasing the voltage. When the overvoltage flags are no longer set and the other applicable conditions are met, the controller shall resume normal operation.

Should, however, the Boolean flag LV_TEMP_DEW_LS_UP[i] be reset whilst in the state LSH_POW_CTL, then the closed loop controller terms shall be reset, the Boolean flags to indicate closed loop control and effective heater voltage limitation shall be reset and the heater control shall resume at state LSH_POW_RED following the procedures outlined above.

Should at any time the battery voltage VB exceed the threshold C_VB_MAX_PROT_LSH_UP, as determined by the state of logical variable LV_V_EFC_LIM_PROT_VB_LSH_UP[i], the oxygen sensor heater power shall be reduced by reducing the effective heater voltage used to calculate the driver duty cycle to C_V_EFC_PROT_VB_LSH_UP. The heater state shall change to LSH_VB_PROT on the next recurrence of the state machine and the effective heater voltage set to the aforementioned limit. This shall prevent damage to the sensor due to excessive heater voltages e.g. due to jump start from 24 V.

Should the battery voltage recover when in the state LSH_VB_PROT, as indicated by LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 0, T_POW_RISE_LSH_UP[i] shall be reset, V_EFC_LSH_UP[i] shall be initialised to IP_V_EFC_INI_LSH_UP calculated after the start, the closed loop controller terms shall be reset, the Boolean flags to indicate closed loop control and effective heater voltage limitation shall be reset and the heater control shall resume at state LSH_POW_RISE following the procedures outlined above.

Short term voltage excursions shall cause the heater power to be limited but will only cause the state machine to change state should the voltage excursion persist until the next recurrence of the state machine. The state machine shall not be able to enter the LSH_VB_PROT state directly from LSH_OFF but shall be required to pass through LSH_POW_RISE.

The sensor shall also be protected from over-temperature. This shall be achieved by evaluating the value of the modelled exhaust gas temperature TEG_DYN_LS_UP[i] in all states other than LSH_OFF. Should the exhaust gas temperature exceed the threshold C_TEG_DYN_MAX_LSH_UP, the calculated effective heater voltage shall be reduced to 0, the state shall change to LSH_TEMP_PROT thus suspending closed loop control, if active.

Should the exhaust gas temperature fall below the threshold, the state shall change dependent on the state active immediately prior to the over-temperature protection. If the state was LSH_POW_CTL,

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the state machine shall return to this state and the effective heater voltage shall take the new value as computed by the open /closed loop control. The closed loop controller shall not be started anew. If the state was any other than LSH_POW_CTL, the state shall change to LSH_POW_RISE. In this case T_POW_RISE_LSH_UP[i] shall be reset, V_EFC_LSH_UP[i] shall be initialised to IP_V_EFC_INI_LSH_UP calculated after the start, the closed loop controller terms shall be reset, the Boolean flags to indicate closed loop control and effective heater voltage limitation shall be reset and the heater control shall resume at state LSH_POW_RISE following the procedures outlined above.

Furthermore, in order to protect the sensor heater against long term high voltage stress it shall be necessary to limit the effective heater voltage should the value of V_EFC_CLC_LSH_UP[i] equal or exceed the threshold C_V_EFC_TOL_LSH_UP.

In this instance, the timer T_V_EFC_TOL_LSH_UP[i] shall be started. Should the overvoltage condition persist, such that this timer equals or exceeds the threshold C_T_MAX_V_EFC_TOL_LSH_UP, timer T_V_EFC_LIM_LSH_UP[i] shall be started and the Boolean flag LV_V_EFC_LIM_TOL_LSH_UP[i] shall be set. This flag shall prevent the controller from increasing effective the voltage further. If however the value of V_EFC_CLC_LSH_UP[i] should fall below the threshold C_V_EFC_TOL_LSH_UP at any time, LV_V_EFC_LIM_TOL_LSH_UP[i] shall be reset.

Once timer T_V_EFC_LIM_LSH_UP[i] has been started, Boolean flag LV_V_EFC_LIM_TOL_LSH_UP[i] shall be set or reset depending on the value of V_EFC_CLC_LSH_UP[i]. Once the timer T_V_EFC_LIM_LSH_UP[i] equals or exceeds threshold C_T_MAX_V_EFC_LIM_LSH_UP, both timers shall be reset and timer T_V_EFC_TOL_LSH_UP[i] must exceed the threshold C_T_MAX_V_EFC_TOL_LSH_UP again in order to permit further limiting to take place.

To prevent damage to the sensor, V_EFC_CLC_LSH_UP[i] shall not be permitted to exceed the lower of the values C_V_EFC_MAX_LSH_UP, C_V_EFC_MAX_ST_LSH_UP or VB dependent on the value of T_POW_RISE_LSH_UP[i].

If T_POW_RISE_LSH_UP[i] equals or exceeds the constant C_T_MAX_V_EFC_MAX_ST_LSH_UP STEP or conditions regarding T_AST and STATE_LSH_UP[i] then V_EFC_CLC_LSH_UP[i] shall be checked against VB & C_V_EFC_MAX_LSH_UP. If either of the values is exceeded then Boolean flag LV_V_EFC_LIM_MAX_LSH_UP[i] shall be set and V_EFC_CLC_LSH_UP[i] limited to the lower of VB & C_V_EFC_MAX_LSH_UP otherwise LV_V_EFC_LIM_MAX_LSH_UP[i] shall be reset.

If T_POW_RISE_LSH_UP[i] is lower then constant C_T_MAX_V_EFC_MAX_ST_LSH_UP then V_EFC_CLC_LSH_UP[i] shall be checked against VB & C_V_EFC_MAX_ST_LSH_UP. If either of the values is exceeded then Boolean flag LV_V_EFC_LIM_MAX_LSH_UP[i] shall be set and V_EFC_CLC_LSH_UP[i] limited to the lower of VB & C_V_EFC_MAX_ST_LSH_UP otherwise LV_V_EFC_LIM_MAX_LSH_UP[i] shall be reset.

The flag LV_V_EFC_LIM_MAX_LSH_UP[i] shall prevent the controller from increasing effective the voltage further and permit the final effective heater voltage to be limited, as described later.

Should timer T_V_EFC_LIM_LSH_UP[i] be unequal to zero, i.e. overvoltage no longer tolerated as it has been present for certain time, V_EFC_LSH_UP[i] shall be the lower of the values V_EFC_CLC_LSH_UP[i] & C_V_EFC_LIM_LSH_UP otherwise V_EFC_LSH_UP[i] shall be set to V_EFC_CLC_LSH_UP[i].

Once the effective heater voltage has been determined throughout the various heater states other than LSH_OFF, it shall be used to compute the PWM duty cycle (LSHPWM_UP[i]) that shall control the appropriate heater driver. The heater power shall be corrected to take into account deviations in the measured battery voltage and limited to the range bounded by NC_LSHPWM_TOL_LSH_UP & NC_LSHPWM_BOL_LSH_UP. The evaluation of excess battery voltage shall be determined at the same recurrence as the computation of the duty cycle as described above. The PWM value may also be modified by use of constant C_FAC_V_EFC_AS_LSH_UP.

Should at any time an inhibit flag be set (LV_INH_LSH_UP[i] = 1), the corresponding oxygen sensor heater shall be switched off and the STATE_LSH_UP[i] set to LSH_OFF. This shall allow project specific application conditions to turn off oxygen sensor heating according to project philosophy. Should the heater function be inhibited, then the PWM duty cycle shall be set to input LSHPWM_EXT_LS_UP[i]. On a transition of the inhibit bit LV_INH_LSH_UP[i] from 1 0, the heater function shall start from anew.

Forced lambda probe heating before engine start (for application purpose)

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Additionally to normal sensor heating after engine start setting LC_LSH_UP_MAN_ACT[i] = 1 allows forced pre-heating of the lambda sensor before engine start. The aim is to ramp up the sensor element to operating temperature in order to achieve a reliable lambda sensor signal already at the time when the engine is started. It has to be emphasized that this method covers a high risk for sensor damage by water splash as operating temperature is already reached before dew-point recognition. Therefore this feature shall only be used for application purpose.

If forced heating is activated, i.e. condition 15 being fulfilled, the state machine shall enter the state LSH_POW_RISE and a heater voltage C_V_EFC_INI_LSH_UP_MAN_ACT shall be applied. Before engine start no forced convection and consequently no lambda sensor cooling by the exhaust gas is present. Therefore the initial heater voltage may be reduced to C_V_EFC_INI_LSH_UP_MAN_ACT in order to prevent excessive temperature gradients and overheating. Additionally the STATE_LSH_UP[i] shall be set to LSH_POW_RISE, the timer T_POW_RISE_LSH_UP[i] shall be incremented and the status flag LV_LSH_UP_MAN_ACT[i] indicating activated forced heating shall be set. Forced pre-heating activation by evaluating the transition of LC_LSH_UP_MAN_ACT[i] from 0 to 1 ensures that forced heating may not become active in field application even if LC_LSH_UP_MAN_ACT[i] remains 1 for the final series data.

In the state LSH_POW_RISE the lambda sensor heater voltage shall further be increased with the same voltage ramp as for inactive forced heating. It should be considered that too high ramp values may lead to excessive temperature gradients. The heater voltage during this initial phase is limited to C_V_EFC_MAX_LSH_UP_MAN_ACT. Resetting LC_LSH_UP_MAN_ACT[i] shall also reset LV_LSH_UP_MAN_ACT[i]. If T_POW_RISE_ LSH_UP[i] exceeds the threshold C_T_MAX_CDN_LSH_UP_MAN_ACT the state machine shall change to state LSH_POW_CTL.

In the state LSH_POW_CTL while forced heating is active the element temperature shall be controlled in open loop. The corresponding effective heater voltage is derived from the same map IP_V_EFC_CTL_LSH_UP as for inactive forced heating, reduced by the factor C_FAC_V_EFC_LSH_UP_MAN_ACT. If forced heating is activated the lambda sensor protection states LSH_VB_PROT and LSH_TEMP_PROT may be reached. Should the corresponding conditions no longer be met, the state LSH_POW_RISE shall be re-entered.

Application conditions:

Activation:

At any engine operating state.

Deactivation:

-

Time recurrence:

The state machine, sensor protection and effective heater voltage definition shall be carried out once every 100 ms.

The determination of the oxygen sensor heater driver duty cycle and associated excessive battery voltage protection shall be carried out once every 10 ms.

Initialisation:

The following variable initialisation shall take place at LV_IGK = 0→1:

STATE_LSH_UP[i] = LSH_OFF
T_POW_RISE_LSH_UP[i] = 0
T_V_EFC_TOL_LSH_UP[i] = 0
T_V_EFC_LIM_LSH_UP[i] = 0
LSHPWM_UP[i] = 0
V_EFC_CTL_P_LSH_UP[i] = 0
V_EFC_CTL_I_LSH_UP[i] = 0
V_EFC_CTL_ADD_LSH_UP[i] = 0
V_EFC_LSH_UP[i] = 0
V_EFC_CLC_LSH_UP[i] = 0
LV_LSH_CTL_CLL_LSH_UP[i] = 0
LV_LSH_UP_MAN_ACT[i] = 0

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LV_V_EFC_LIM_BOL_LSH_UP[i] = 0
LV_V_EFC_LIM_TOL_LSH_UP[i] = 0
LV_V_EFC_LIM_MAX_LSH_UP[i] = 0
LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 0
TTIP_MES_DIF_LS_UP[i] = 0

At reset:
ACTION_INFR_SetPwmLshUp(
IN i
IN LSHPWM_UP[i])

NOTE: Projects not making use of the inhibit flags LV_INH_LSH_UP[i] & LV_INH_LSH_CTL_CLL_LSH_UP[i] shall ensure that they are initialised with and remain 0, thus never disabling the oxygen sensor heater function or thus never disabling the oxygen sensor heater closed loop control function respectively

Formula section:

The following formula shall be evaluated before the state machine is calculated:
If LC_LSH_UP_MAN_ACT[i] = 1→0
then LV_LSH_UP_MAN_ACT[i] = 0
endif

7.48.1 Heater management state machine

The state machine shall remain in its current state and carry out the actions specified to occur within that state once per recurrence unless otherwise specified. The state machine shall only move to another state when one of the conditions has been determined to be met.
Note: The priorities of the conditions to change between states shall be defined by the order in which these conditions are listed within the appropriate state as described below.

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HEATER STATE DIAGRAM

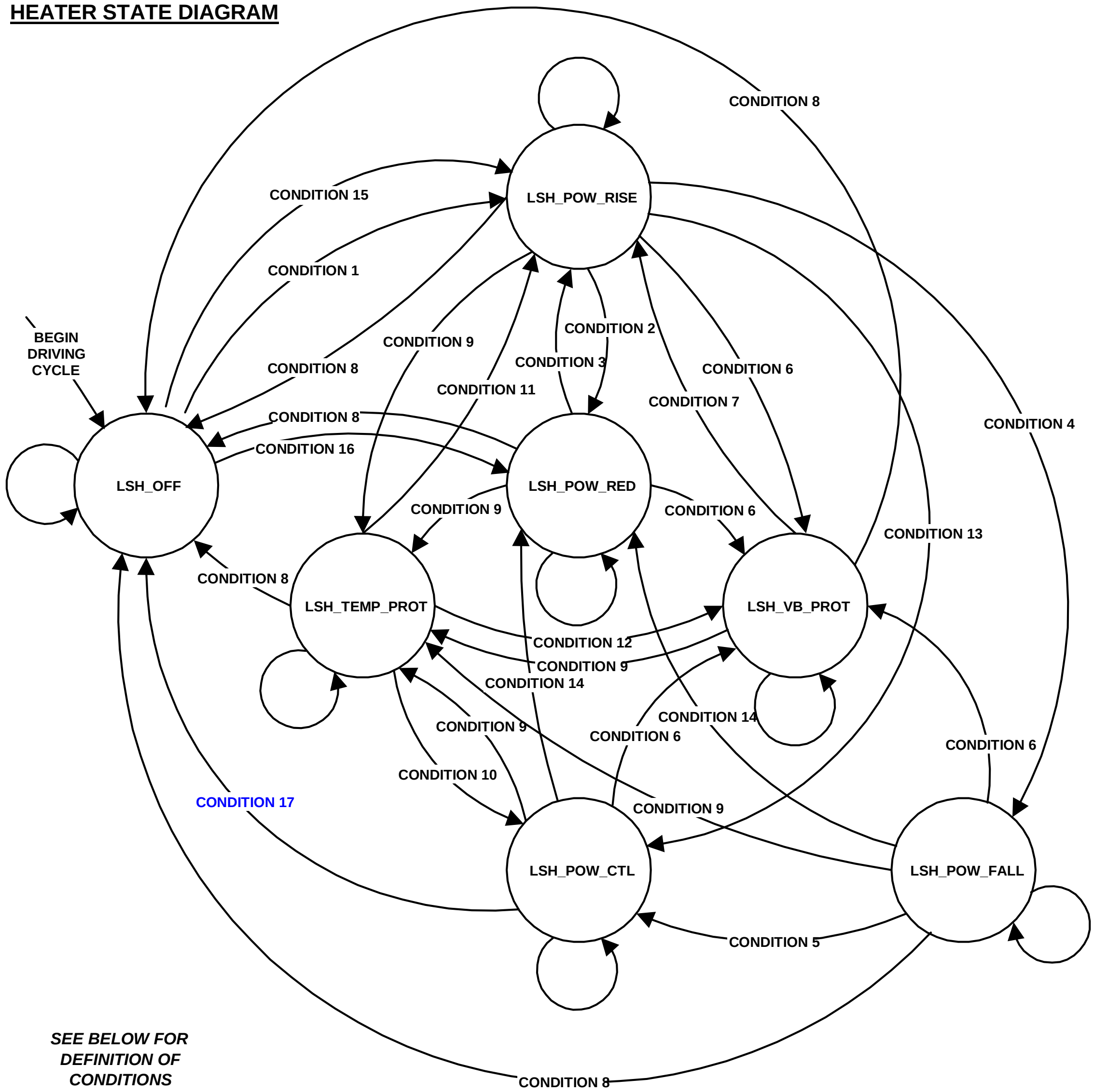

Figure 2: Heater management state diagram

STATE_LSH_UP[i] LSH_OFF

Actions:

T_POW_RISE_LSH_UP[i] = 0
T_V_EFC_TOL_LSH_UP[i] = 0
T_V_EFC_LIM_LSH_UP[i] = 0
V_EFC_CTL_P_LSH_UP[i] = 0
V_EFC_CTL_I_LSH_UP[i] = 0
V_EFC_CTL_ADD_LSH_UP[i] = 0
V_EFC_LSH_UP[i] = 0
V_EFC_CLC_LSH_UP[i] = 0
LV_LSH_CTL_CLL_LSH_UP[i] = 0
LV_LSH_UP_MAN_ACT[i] = 0
LV_V_EFC_LIM_BOL_LSH_UP[i] = 0
LV_V_EFC_LIM_TOL_LSH_UP[i] = 0
LV_V_EFC_LIM_MAX_LSH_UP[i] = 0
LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 0
TTIP_MES_DIF_LS_UP[i] = 0

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Note: The above listed actions must be carried out at least once when the state has been entered for the first time or from any other state!

Condition 1: LSH_OFF to LSH_POW_RISE
LV_ST_END = 1 **&**
LV_INH_LSH_UP[i] = 0 **&**
(LV_TEMP_DEW_LS_UP[i] = 1 **or**
LC_TEMP_DEW_LSH_UP = 0)
Transition actions:
V_EFC_CLC_LSH_UP[i] = IP_V_EFC_INI_LSH_UP (TEMP_INI_LS_UP[i])
Timer T_POW_RISE_LSH_UP[i] shall be started
STATE_LSH_UP[i] = LSH_POW_RISE
Condition 16: LSH_OFF to LSH_POW_RED
LV_ST_END = 1 **&**
LV_INH_LSH_UP[i] = 0 **&**
LV_TEMP_DEW_LS_UP[i] = 0 **&**
LC_TEMP_DEW_LSH_UP = 1
Transition actions:
V_EFC_CLC_LSH_UP[i] = C_V_EFC_RED_LSH_UP

Condition 15: Forced transition LSH_OFF to LSH_POW_RISE before engine start.
LV_ES = 1 **&** LC_LSH_UP_MAN_ACT[i] = 0→1
Transition actions:
V_EFC_CLC_LSH_UP[i] = C_V_EFC_INI_LSH_UP_MAN_ACT
Timer T_POW_RISE_LSH_UP[i] shall be started
STATE_LSH_UP[i] = LSH_POW_RISE
LV_LSH_UP_MAN_ACT[i] = 1

STATE_LSH_UP[i] LSH_POW_RISE

Actions:

If LV_LSH_UP_MAN_ACT[i] = 1 **&** LV_ST_END = 0
then V_EFC_CLC_LSH_UP[i]$_N$ = MIN(V_EFC_CLC_LSH_UP[i]$_{N-1}$ + C_V_EFC_INC_LSH_UP * 100 ms, C_V_EFC_MAX_LSH_UP_MAN_ACT)
else V_EFC_CLC_LSH_UP[i]$_N$ = V_EFC_CLC_LSH_UP[i]$_{N-1}$ + C_V_EFC_INC_LSH_UP * 100 ms
endif

Note: See section General oxygen sensor voltage protection for notes on limiting the applied heater voltage.

Condition 8: LSH_POW_RISE to LSH_OFF
(LV_ST_END = 0 **&** LV_LSH_UP_MAN_ACT[i] = 0) **or** LV_INH_LSH_UP[i] = 1
Transition actions:
STATE_LSH_UP[i] = LSH_OFF
V_EFC_LSH_UP[i] = 0
Condition 9: LSH_POW_RISE to LSH_TEMP_PROT
TEG_DYN_LS_UP[i] $>$ C_TEG_DYN_MAX_LSH_UP **&**
LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 0
Transition actions:
STATE_LSH_UP[i] = LSH_TEMP_PROT
Condition 6: LSH_POW_RISE to LSH_VB_PROT
LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 1
Transition actions:

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STATE_LSH_UP[i] = LSH_VB_PROT

Condition 2: LSH_POW_RISE to LSH_POW_RED

(T_POW_RISE_LSH_UP[i]   IP_T_TEMP_THD_LSH_UP (TEMP_INI_LS_UP[i]) **&**
LV_TEMP_DEW_LS_UP[i] = 0) **&** LV_LSH_UP_MAN_ACT[i] = 0

Transition actions:

STATE_LSH_UP[i] = LSH_POW_RED

Condition 13: LSH_POW_RISE to LSH_POW_CTL

(LV_INH_LSH_CTL_CLL_LSH_UP[i] = 0 **&**
LV_V_REF_VLD_R_IT_LS_UP[i] = 1 **&**
TTIP_MES_LS_UP[i]   C_TTIP_SP_LS_UP[i] - ID_TTIP_SP_DIF_LSH_UP **&**
LV_TTIP_MES_VLD_LS_UP[i] = 1) **or**
LV_LS_UP_READY_CDN[i] = 1 **or**
(LV_LSH_UP_MAN_ACT[i] = 1 **&**
T_POW_RISE_LSH_UP[i]   C_T_MAX_CDN_LSH_UP_MAN_ACT)

Transition actions:

Stop timer T_POW_RISE_LSH_UP[i] and freeze value
STATE_LSH_UP[i] = LSH_POW_CTL

Condition 4: LSH_POW_RISE to LSH_POW_FALL

((LV_INH_LSH_CTL_CLL_LSH_UP[i] = 1 **or**
LV_V_REF_VLD_R_IT_LS_UP[i] = 0) **&**
T_POW_RISE_LSH_UP[i]   C_T_MAX_POW_RISE_LSH_UP + IP_T_TEMP_THD_LSH_UP (TEMP_INI_LS_UP[i])) **&** LV_LSH_UP_MAN_ACT[i] = 0

Transition actions:

Stop timer T_POW_RISE_LSH_UP[i] and freeze value
STATE_LSH_UP[i] = LSH_POW_FALL

STATE_LSH_UP[i]   LSH_POW_RED

Actions:

V_EFC_CLC_LSH_UP[i] = C_V_EFC_RED_LSH_UP

Condition 8: LSH_POW_RED to LSH_OFF

(LV_ST_END = 0 **&** LV_LSH_UP_MAN_ACT[i] = 0) **or** LV_INH_LSH_UP[i] = 1

Transition actions:

STATE_LSH_UP[i] = LSH_OFF
V_EFC_LSH_UP[i] = 0

Condition 9: LSH_POW_RED to LSH_TEMP_PROT

TEG_DYN_LS_UP[i] > C_TEG_DYN_MAX_LSH_UP **&**
LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 0

Transition actions:

STATE_LSH_UP[i] = LSH_TEMP_PROT

Condition 6: LSH_POW_RED to LSH_VB_PROT

LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 1

Transition actions:

STATE_LSH_UP[i] = LSH_VB_PROT

Condition 3: LSH_POW_RED to LSH_POW_RISE

LV_TEMP_DEW_LS_UP[i] = 1

Transition actions:

V_EFC_CLC_LSH_UP[i] = IP_V_EFC_INI_LSH_UP (TEMP_INI_LS_UP[i]) *(same value as at start)* + C_V_EFC_STEP_LSH_UP
Re-initialise timer T_POW_RISE_LSH_UP[i] with IP_T_TEMP_THD_LSH_UP (TEMP_INI_LS_UP[i]) *(same value as at start)*
STATE_LSH_UP[i] = LSH_POW_RISE

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Note: See section General oxygen sensor voltage protection for notes on limiting the applied heater voltage. The function shall prevent the effective heater voltage from becoming negative by limiting to 0 where necessary.

STATE_LSH_UP[i] LSH_POW_FALL

Actions:

V_EFC_CLC_LSH_UP[i]$_N$ = V_EFC_CLC_LSH_UP[i]$_{N-1}$ - C_V_EFC_DEC_LSH_UP * 100 ms

Note: See section General oxygen sensor voltage protection for notes on limiting the applied heater voltage. The function shall prevent the effective heater voltage from becoming negative by limiting to 0 where necessary.

Condition 8: LSH_POW_FALL to LSH_OFF

(LV_ST_END = 0 **&** LV_LSH_UP_MAN_ACT[i] = 0) **or** LV_INH_LSH_UP[i] = 1

Transition actions:

STATE_LSH_UP[i] = LSH_OFF

V_EFC_LSH_UP[i] = 0

Condition 9: LSH_POW_FALL to LSH_TEMP_PROT

TEG_DYN_LS_UP[i] $>$ C_TEG_DYN_MAX_LSH_UP **&**

LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 0

Transition actions:

STATE_LSH_UP[i] = LSH_TEMP_PROT

Condition 6: LSH_POW_FALL to LSH_VB_PROT

LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 1

Transition actions:

STATE_LSH_UP[i] = LSH_VB_PROT

Condition 14: LSH_POW_FALL to LSH_POW_RED

LV_TEMP_DEW_LS_UP[i] = 0

Transition actions:

T_V_EFC_TOL_LSH_UP[i] = 0

T_V_EFC_LIM_LSH_UP[i] = 0

V_EFC_CTL_P_LSH_UP[i] = 0

V_EFC_CTL_I_LSH_UP[i] = 0

V_EFC_CTL_ADD_LSH_UP[i] = 0

LV_LSH_CTL_CLL_LSH_UP[i] = 0

LV_V_EFC_LIM_BOL_LSH_UP[i] = 0

LV_V_EFC_LIM_TOL_LSH_UP[i] = 0

LV_V_EFC_LIM_MAX_LSH_UP[i] = 0

TTIP_MES_DIF_LS_UP[i] = 0

STATE_LSH_UP[i] = LSH_POW_RED

Condition 5: LSH_POW_FALL to LSH_POW_CTL

For Bank 1; i = 1

V_EFC_LSH_UP[i] IP_V_EFC_CTL_LSH_UP (N_32, TEG_DYN_LS_UP[i])

For Bank 2; i = 2

V_EFC_LSH_UP[i] IP_V_EFC_CTL_LSH_UP (N_32, TEG_DYN_LS_UP[i]) * IP_FAC_V_EFC_TEG_LSH_UP

Transition actions:

STATE_LSH_UP[i] = LSH_POW_CTL

STATE_LSH_UP[i] LSH_POW_CTL

Actions:

Determine deviation between desired operating temperature and measured temperature:

TTIP_MES_DIF_LS_UP[i] = C_TTIP_SP_LS_UP[i] - TTIP_MES_LS_UP[i]

Note: TTIP_MES_DIF_LS_UP[i] shall be computed in both open loop and closed loop control modes.

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Determine whether closed loop control permitted, if not revert to open loop control:
If (LV_INH_LSH_CTL_CLL_LSH_UP[i] = 0) **&**
(LV_V_REF_VLD_R_IT_LS_UP[i] = 1)
then ***Closed loop control:***
LV_LSH_CTL_CLL_LSH_UP[i] = 1
Case A*: Closed loop control*
else ***Open loop control:***
LV_LSH_CTL_CLL_LSH_UP[i] = 0
PI controller shall be re-initialised, i.e.:
V_EFC_CTL_P_LSH_UP[i] = 0
V_EFC_CTL_I_LSH_UP[i] = 0
V_EFC_CTL_ADD_LSH_UP[i] = 0
endif.
Case A*: Closed loop control:*
Determine conditions for computation of closed loop control variables:
If (LC_LSH_CTL_CLL_INH_LSH_UP[i] = 1) **or**
(LV_TTIP_MES_VLD_LS_UP[i] = 0)
then ***General suspension and re-initialisation of closed loop control computation, i.e.:***
V_EFC_CTL_ADD_LSH_UP[i] = 0
V_EFC_CTL_P_LSH_UP[i] = 0
V_EFC_CTL_I_LSH_UP[i] = 0
else ***Normal closed loop control computation:***
Case B*: Closed loop control & Not generally suspended:*
endif.
End Case A*: Closed loop control:*
Case B*: Closed loop control & Not generally suspended:*

If (TTIP_MES_LS_UP[i] $>$ C_TTIP_SP_LS_UP[i]) *i.e. Temperature difference negative*
then *Compute I terms of controller:*
V_EFC_CTL_I_LSH_UP_TMP[i]$_{N}$ = V_EFC_CTL_I_LSH_UP[i]$_{N-1}$ +
TTIP_MES_DIF_LS_UP[i] *
IP_FAC_NEG_CTL_I_LSH_UP (N_32, TEG_DYN_LS_UP[i])*
C_FAC_CTL_I_LSH_UP
If (| TTIP_MES_DIF_LS_UP[i] | C_TTIP_DIF_MIN_CTL_P_LS_UP)
then *Compute P term of controller:*
V_EFC_CTL_P_LSH_UP_TMP[i] = TTIP_MES_DIF_LS_UP[i] *
IP_FAC_NEG_CTL_P_LSH_UP (N_32, TEG_DYN_LS_UP[i])*
C_FAC_CTL_P_LSH_UP
else V_EFC_CTL_P_LSH_UP_TMP[i] = 0
endif
if (LV_V_EFC_LIM_BOL_LSH_UP[i] = 0) *i.e. no lower limiting active*
then V_EFC_CTL_I_LSH_UP[i]$_{N}$ = V_EFC_CTL_I_LSH_UP_TMP[i]
V_EFC_CTL_P_LSH_UP[i]$_{N}$ = V_EFC_CTL_P_LSH_UP_TMP[i]
else V_EFC_CTL_I_LSH_UP[i]$_{N}$ = MAX(V_EFC_CTL_I_LSH_UP[i]$_{N-1}$,
V_EFC_CTL_I_LSH_UP_TMP[i])
V_EFC_CTL_P_LSH_UP[i]$_{N}$ = MAX(V_EFC_CTL_P_LSH_UP[i]$_{N-1}$,
V_EFC_CTL_P_LSH_UP_TMP[i])
endif
else *Temperature difference positive or zero; compute I term of controller:*
V_EFC_CTL_I_LSH_UP_TMP[i]$_{N}$ = V_EFC_CTL_I_LSH_UP[i]$_{N-1}$ +
TTIP_MES_DIF_LS_UP[i] *

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IP_FAC_POS_CTL_I_LSH_UP (N_32, TEG_DYN_LS_UP[i])*
C_FAC_CTL_I_LSH_UP

If (| TTIP_MES_DIF_LS_UP[i] | C_TTIP_DIF_MIN_CTL_P_LS_UP)

then *Compute P term of controller:*

V_EFC_CTL_P_LSH_UP_TMP[i] = TTIP_MES_DIF_LS_UP[i] *
IP_FAC_POS_CTL_P_LSH_UP (N_32, TEG_DYN_LS_UP[i])*
C_FAC_CTL_P_LSH_UP

else V_EFC_CTL_P_LSH_UP_TMP[i] = 0

endif

if LV_V_EFC_LIM_MAX_LSH_UP[i] = 0 **&**
LV_V_EFC_LIM_TOL_LSH_UP[i] = 0 *i.e. no upper limiting active*

then V_EFC_CTL_I_LSH_UP[i]$_N$ = V_EFC_CTL_I_LSH_UP_TMP[i]
V_EFC_CTL_P_LSH_UP[i]$_N$ = V_EFC_CTL_P_LSH_UP_TMP[i]

else V_EFC_CTL_I_LSH_UP[i]$_N$ = MIN(V_EFC_CTL_I_LSH_UP[i]$_{N-1}$,
V_EFC_CTL_I_LSH_UP_TMP[i])
V_EFC_CTL_P_LSH_UP[i]$_N$ = MIN(V_EFC_CTL_P_LSH_UP[i]$_{N-1}$,
V_EFC_CTL_P_LSH_UP_TMP[i])

endif

endif

Note: In cases where the effective heater voltage has been limited as shown by the state of the Boolean flag LV_V_EFC_LIM_BOL_LSH_UP[i], the controller shall only be permitted to increase the effective voltage. In the case of limiting via Boolean flags LV_V_EFC_LIM_TOL_LSH_UP[i] & LV_V_EFC_LIM_MAX_LSH_UP[i] the closed loop control shall only be permitted to decrease the effective heater voltage. In all other cases, the controller shall effectively be suspended, i.e. P & I terms shall remain unchanged but applied, until the applicable limitation is revoked. Upon revoking the limitation, the function shall resume to compute the P & I terms according to the conditions specified above.

Combine P and I terms:
V_EFC_CTL_ADD_LSH_UP[i] =
V_EFC_CTL_P_LSH_UP[i] + V_EFC_CTL_I_LSH_UP[i]

Note: Although variables V_EFC_CTL_P_LSH_UP[i] and V_EFC_CTL_I_LSH_UP[i] are defined as words, the summation shall be carried out as a 16 bit addition and the resultant 16 bit value converted to an 8 bit value, by taking the high byte, and placed in V_EFC_CTL_ADD_LSH_UP[i]. This shall prevent controller from stopping short of the target temperature.

End Case B: *Closed loop control; Not suspended:*

Compute effective heater voltage from open loop control and closed loop delta voltages:

If LV_LSH_UP_MAN_ACT[i] = 1 **&** LV_ST_END = 0

then V_EFC_CLC_LSH_UP[i] = IP_V_EFC_CTL_LSH_UP (N_32, TEG_DYN_LS_UP[i]) *
C_FAC_V_EFC_LSH_UP_MAN_ACT

else

For Bank 1; i = 1

V_EFC_CLC_LSH_UP[i] = IP_V_EFC_CTL_LSH_UP (N_32, TEG_DYN_LS_UP[i]) + V_EFC_CTL_ADD_LSH_UP[i] + C_V_EFC_AS_LSH_UP

Note: If (IP_V_EFC_CTL_LSH_UP + V_EFC_CTL_ADD_LSH_UP[i] + C_V_EFC_AS_LSH_UP) $<$ ***0 , i.e. would cause the effective heater voltage to be negative, V_EFC_CLC_LSH_UP[i] shall be limited to 0 and further reduction of the effective heater voltage via by the closed loop controller P & I terms shall be prevented by setting LV_V_EFC_LSH_UP_LIM_BOL[i], until the sum less than zero condition is no longer met at which point LV_V_EFC_LSH_UP_LIM_BOL[i] shall be reset.***

For Bank 2; i = 2

V_EFC_CLC_LSH_UP[i] = IP_V_EFC_CTL_LSH_UP (N_32, TEG_DYN_LS_UP[i])* IP_FAC_V_EFC_TEG_LSH_UP + V_EFC_CTL_ADD_LSH_UP[i] + C_V_EFC_AS_LSH_UP

Note: If (IP_V_EFC_CTL_LSH_UP* IP_FAC_V_EFC_TEG_LSH_UP + V_EFC_CTL_ADD_LSH_UP[i] + C_V_EFC_AS_LSH_UP) $<$ ***0 , i.e. would cause the effective heater voltage to be negative, V_***

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EFC_CLC_LSH_UP[i] shall be limited to 0 and further reduction of the effective heater voltage via by the closed loop controller P & I terms shall be prevented by setting LV_V_EFC_LSH_UP_LIM_BOL[i], until the sum less than zero condition is no longer met at which point LV_V_EFC_LSH_UP_LIM_BOL[i] shall be reset.

endif

Condition 17: LSH_POW_CTL to LSH_OFF

(LV_ST_END = 0 **&** LV_LSH_UP_MAN_ACT[i] = 0 **&** LV_STST_STOP_CYC = 0) **or** LV_INH_LSH_UP[i] = 1

Transition actions:

STATE_LSH_UP[i] = LSH_OFF

V_EFC_LSH_UP[i] = 0

Condition 9: LSH_POW_CTL to LSH_TEMP_PROT

TEG_DYN_LS_UP[i] > C_TEG_DYN_MAX_LSH_UP **&**

LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 0

Transition actions:

STATE_LSH_UP[i] = LSH_TEMP_PROT

Condition 6: LSH_POW_CTL to LSH_VB_PROT

LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 1

Transition actions:

STATE_LSH_UP[i] = LSH_VB_PROT

Condition 14: LSH_POW_CTL to LSH_POW_RED

LV_TEMP_DEW_LS_UP[i] = 0 **&** LV_LSH_UP_MAN_ACT[i] = 0

Transition actions:

T_V_EFC_TOL_LSH_UP[i] = 0

T_V_EFC_LIM_LSH_UP[i] = 0

V_EFC_CTL_P_LSH_UP[i] = 0

V_EFC_CTL_I_LSH_UP[i] = 0

V_EFC_CTL_ADD_LSH_UP[i] = 0

LV_LSH_CTL_CLL_LSH_UP[i] = 0

LV_V_EFC_LIM_BOL_LSH_UP[i] = 0

LV_V_EFC_LIM_TOL_LSH_UP[i] = 0

LV_V_EFC_LIM_MAX_LSH_UP[i] = 0

TTIP_MES_DIF_LS_UP[i] = 0

STATE_LSH_UP[i] = LSH_POW_RED

STATE_LSH_UP[i] LSH_VB_PROT

Actions:

V_EFC_CLC_LSH_UP[i] = C_V_EFC_PROT_VB_LSH_UP

Condition 8: LSH_VB_PROT to LSH_OFF

(LV_ST_END = 0 **&** LV_LSH_UP_MAN_ACT[i] = 0) **or** LV_INH_LSH_UP[i] = 1

Transition actions:

STATE_LSH_UP[i] = LSH_OFF

V_EFC_LSH_UP[i] = 0

Condition 9: LSH_VB_PROT to LSH_TEMP_PROT

TEG_DYN_LS_UP[i] > C_TEG_DYN_MAX_LSH_UP **&**

LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 0

Transition actions:

STATE_LSH_UP[i] = LSH_TEMP_PROT

Condition 7: LSH_VB_PROT to LSH_POW_RISE

LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 0

Transition actions:

T_POW_RISE_LSH_UP[i] = 0

If LV_LSH_UP_MAN_ACT[i] = 0

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then V_EFC_CLC_LSH_UP[i] = IP_V_EFC_INI_LSH_UP (TEMP_INI_LS_UP[i])
else V_EFC_CLC_LSH_UP[i] = C_V_EFC_INI_LSH_UP_MAN_ACT
endif
T_V_EFC_TOL_LSH_UP[i] = 0
T_V_EFC_LIM_LSH_UP[i] = 0
V_EFC_CTL_P_LSH_UP[i] = 0
V_EFC_CTL_I_LSH_UP[i] = 0
V_EFC_CTL_ADD_LSH_UP[i] = 0
LV_LSH_CTL_CLL_LSH_UP[i] = 0
LV_V_EFC_LIM_BOL_LSH_UP[i] = 0
LV_V_EFC_LIM_TOL_LSH_UP[i] = 0
LV_V_EFC_LIM_MAX_LSH_UP[i] = 0
TTIP_MES_DIF_LS_UP[i] = 0
STATE_LSH_UP[i] = LSH_POW_RISE

STATE_LSH_UP[i]   LSH_TEMP_PROT

Actions:
V_EFC_CLC_LSH_UP[i] = 0
Condition 8: LSH_TEMP_PROT to LSH_OFF
(LV_ST_END = 0 **&** LV_LSH_UP_MAN_ACT[i] = 0) **or** LV_INH_LSH_UP[i] = 1
Transition actions:
STATE_LSH_UP[i] = LSH_OFF
V_EFC_LSH_UP[i] = 0
Condition 12: LSH_TEMP_PROT to LSH_VB_PROT
LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 1
Transition actions:
STATE_LSH_UP[i] = LSH_VB_PROT
Condition 10: LSH_TEMP_PROT to LSH_POW_CTL
TEG_DYN_LS_UP[i]   C_TEG_DYN_MAX_LSH_UP **&**
Previous state of STATE_LSH_UP[i] = LSH_POW_CTL
Transition actions:
STATE_LSH_UP[i] = LSH_POW_CTL
Condition 11: LSH_TEMP_PROT to LSH_POW_RISE
TEG_DYN_LS_UP[i]   C_TEG_DYN_MAX_LSH_UP **&**
Previous state of STATE_LSH_UP[i]   LSH_POW_CTL
Transition actions:
T_POW_RISE_LSH_UP[i] = 0
If LV_LSH_UP_MAN_ACT[i] = 0
then V_EFC_CLC_LSH_UP[i] = IP_V_EFC_INI_LSH_UP (TEMP_INI_LS_UP[i])
else V_EFC_CLC_LSH_UP[i] = C_V_EFC_INI_LSH_UP_MAN_ACT
endif
T_V_EFC_TOL_LSH_UP[i] = 0
T_V_EFC_LIM_LSH_UP[i] = 0
V_EFC_CTL_P_LSH_UP[i] = 0
V_EFC_CTL_I_LSH_UP[i] = 0
V_EFC_CTL_ADD_LSH_UP[i] = 0
LV_LSH_CTL_CLL_LSH_UP[i] = 0
LV_V_EFC_LIM_BOL_LSH_UP[i] = 0
LV_V_EFC_LIM_TOL_LSH_UP[i] = 0
LV_V_EFC_LIM_MAX_LSH_UP[i] = 0
TTIP_MES_DIF_LS_UP[i] = 0
STATE_LSH_UP[i] = LSH_POW_RISE

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Note: Should none of the conditions have been determined to be met, the state machine shall remain in the same state.

7.48.2 Oxygen sensor heater voltage protection

Prolonged exposure to heater voltages that exceed the absolute maximum ratings specified shall be prevented. The preventative measures shall be applicable to all heater states other than LSH_OFF.

```
If                  STATE_LSH_UP[i]   LSH_OFF
then        If          (V_EFC_CLC_LSH_UP[i]   C_V_EFC_TOL_LSH_UP)
                then            If          (T_V_EFC_TOL_LSH_UP[i]   C_T_MAX_V_EFC_TOL_LSH_
UP)
                        then            If          T_V_EFC_LIM_LSH_UP[i]
                                                C_T_MAX_V_EFC_LIM_LSH_UP
                              then          LV_V_EFC_LIM_TOL_LSH_UP[i] = 0
                              Reset timer T_V_EFC_LIM_LSH_UP[i]
                              Reset timer T_V_EFC_TOL_LSH_UP[i]
                              else          LV_V_EFC_LIM_TOL_LSH_UP[i] = 1
                              Increment timer T_V_EFC_LIM_LSH_UP[i]
                              endif
                        else            LV_V_EFC_LIM_TOL_LSH_UP[i] = 0
                              Reset timer T_V_EFC_LIM_LSH_UP[i]
                        Increment timer T_V_EFC_TOL_LSH_UP[i]
                        endif
            else     LV_V_EFC_LIM_TOL_LSH_UP[i] = 0

                If     T_V_EFC_LIM_LSH_UP[i] = 0
                    or          T_V_EFC_LIM_LSH_UP[i]
                                     C_T_MAX_V_EFC_LIM_LSH_UP
                        then            Reset timer T_V_EFC_LIM_LSH_UP[i]
                        Reset timer T_V_EFC_TOL_LSH_UP[i]
                        else            Increment timer T_V_EFC_LIM_LSH_UP[i]
                        endif
            endif
            If          T_POW_RISE_LSH_UP[i]   C_T_MAX_V_EFC_MAX_ST_LSH_UP
            or           (T_AST   C_T_AST_MAX_LSH_UP
            and            STATE_LSH_UP[i] = "LSH_POW_CTL")
            then     If     V_EFC_CLC_LSH_UP[i] > VB
                    or          V_EFC_CLC_LSH_UP[i] > C_V_EFC_MAX_LSH_UP
                then     LV_V_EFC_LIM_MAX_LSH_UP[i] = 1
                    V_EFC_CLC_LSH_UP[i] = MIN (VB, C_V_EFC_MAX_LSH_UP)
                        else            LV_V_EFC_LIM_MAX_LSH_UP[i] = 0
                        endif
            else     If     V_EFC_CLC_LSH_UP[i] > VB
                    or          V_EFC_CLC_LSH_UP[i] > C_V_EFC_MAX_ST_LSH_UP
                        then            LV_V_EFC_LIM_MAX_LSH_UP[i] = 1
                              V_EFC_CLC_LSH_UP[i] =
                                                MIN (VB, C_V_EFC_MAX_ST_LSH_UP)
                        else            LV_V_EFC_LIM_MAX_LSH_UP[i] = 0
                        endif
            endif
            If          T_V_EFC_LIM_LSH_UP[i] <> 0
        then            V_EFC_LSH_UP[i] =
                                     MIN (V_EFC_CLC_LSH_UP[i], C_V_EFC_LIM_LSH_UP)
```

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else V_EFC_LSH_UP[i] = V_EFC_CLC_LSH_UP[i]
endif
endif

7.48.3 Oxygen sensor heater driver duty cycle computation

The PWM duty cycle for the appropriate heater driver shall continually be calculated in all heater states at the specified recurrence.

If (STATE_LSH_UP[i] = LSH_OFF **&** LC_LSH_UP_MAN_ACT[i] = 0)
then LSHPWM_UP[i] = LSHPWM_EXT_LS_UP[i]
else **If** (VB C_VB_MAX_PROT_LSH_UP)
then LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 1
LSHPWM_UP[i] = C_V_EFC_PROT_VB_LSH_UP^2 *100 /VB$_N{}^2$
else LV_V_EFC_LIM_PROT_VB_LSH_UP[i] = 0
LSHPWM_UP[i] = V_EFC_LSH_UP[i]$_N{}^2$ *
C_FAC_V_EFC_AS_LSH_UP *100 /VB$_N{}^2$
If LSHPWM_UP[i] NC_LSHPWM_TOL_LSH_UP
then LSHPWM_UP[i] = NC_LSHPWM_TOL_LSH_UP
else **If** LSHPWM_UP[i] NC_LSHPWM_BOL_LSH_UP
then LSHPWM_UP[i] = NC_LSHPWM_BOL_LSH_UP
else LSHPWM_UP[i] = LSHPWM_UP[i]
endif
endif
endif
endif.
ACTION_INFR_SetPwmLshUp(
IN i
IN LSHPWM_UP[i])

The value C_FAC_V_EFC_AS_LSH_UP is a correction signal generated in the application system.

NOTE: The recurrence of the heater driving duty cycle shall occur at the same recurrence as the Vbatt acquisition. This shall prevent short duration voltage drop-outs during engine start from causing long duration Vbatt corrections being made where the Vbatt has since recovered. This may otherwise cause excessive current to flow in the heater driver.

The computation of the duty cycle shall be checked to ensure that the result remains positive (i.e. 0) at all times and that now under- or overflows are caused by the values of the calibration system constants.

The multiplication of the corrected voltage ratio by 100 to obtain a unit of percent (%) may not necessarily be implemented in the SW but in the data bank definition of the variables.

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7.49 O2 sensor (up) heater management (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LSHPWM_EXT_LS_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 99.60937	0.390625	%
Heater driver PWM duty cycle - external adjustment					
LSHPWM_UP_MAN	V	0... FFH	0... 99.60937	0.390625	%
Heater driver PWM duty cycle - manual adjustment via application system					
LV_INH_LSH_CTL_CLL_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions closed loop heater control not met					
LV_INH_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for heating not met					
TEMP_INI_LS_UP [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Oxygen sensor temperature at engine start					
V_EFC_LSH_UP_MAN	V	0... FFH	0... 25.89843	0.1015625	V
Effective output value of heater voltage via application system					

Input data:

LSHPWM_UP_EXT_ADJ [NC_CBK_EX_NR] {p. 7431}	LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}
LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_IGK {p. 906}	LV_LSHPWM_UP_EXT_ADJ [NC_CBK_EX_NR] {p. 7434}
LV_ST_END {p. 1720}	LV_VAR_LSH_UP {p. 656}	NC_CBK_EX_NR {p. 1829}	TEG_WALL_CAT_UP_MDL [NC_CBK_EX_NR] {p. 8237}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_INC_V_EFC_MAN	-	0... FFH	0... 1.625	6.37e-3	V/100ms
Effective heater voltage increment to raise temperature via application system					
C_V_EFC_MAN	-	0... FFH	0... 25.89843	0.1015625	V
Maximum permitted effective heater voltage via application system					
LC_LSH_UP [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Boolean variable to enable oxygen sensor heating					
LC_LSH_UP_CLL_CTL [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Boolean variable to enable closed loop oxygen sensor heater control					
LC_LSHPWM_UP_MAN_ADJ [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Boolean variable to enable oxygen sensor heating via application system					

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FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinderbanks.

i = 1 ... NC_CBK_EX_NR

Description:

The Boolean constant LC_LSH_UP[i] shall permit the appropriate oxygen sensor to be heated. When set, the Boolean inhibit flag LV_INH_LSH_UP[i] shall be reset. When reset, LV_INH_LSH_UP[i] shall be set.
The Boolean flag LV_INH_LSH_CTL_CLL_LSH_UP[i] shall indicate whether closed loop heating shall be inhibited or not. Should either the Boolean constant LC_LSH_UP_CLL_CTL[i] be reset or one of several upstream
sensor error bits be set then the Boolean inhibit flag LV_INH_LSH_CTL_CLL_LSH_UP[i] shall be set (open loop heater control), otherwise LV_INH_LSH_CTL_CLL_LSH_UP[i] shall be reset (closed loop heater control permitted).

Application conditions

Activation: *LV_IGK = 1*

Deactivation: *LV_IGK = 0*

Recurrence: *100 ms*

Initialisation:
```
LV_INH_LSH_UP[i] = 0
LV_INH_LSH_CTL_CLL_LSH_UP[i] = 0
LSHPWM_EXT_LS_UP[i] = 0%
V_EFC_LSH_UP_MAN = C_V_EFC_MAN
TEMP_INI_LS_UP[i] = TEG_WALL_CAT_UP_MDL[i]
```

Formula section:

Calculation of LSHPWM during external adjustment, manual adjustment via application system or not learnt variant

If(1) LV_LSHPWM_UP_EXT_ADJ[i]= 0 // no adjustment by tester
Then(1)
If(2) (LC_LSHPWM_UP_MAN_ADJ[i] = 1 **and**
'not serial software') // adjustment by application system
Then(2) LV_INH_LSH_UP[i] = 1
If(3) V_EFC_LSH_UP_MAN < C_V_EFC_MAN
Then(3)
$V\_EFC\_LSH\_UP\_MAN_N$ = $V\_EFC\_LSH\_UP\_MAN_{N-1}$ + C_INC_V_EFC_MAN
LSHPWM_UP_MAN = $V\_EFC\_LSH\_UP\_MAN_N{}^2$ * $100/VB_N{}^2$ // in %
Else(3) $V\_EFC\_LSH\_UP\_MAN_N$ = C_V_EFC_MAN
LSHPWM_UP_MAN = $C\_ V\_EFC\_MAN^2$ * $100/VB_N{}^2$ // in %
Endif(3)
LSHPWM_EXT_LS_UP[i] = LSHPWM_UP_MAN
Else(2)
If(3) LV_VAR_LSH_UP = 0
Then(3) LV_INH_LSH_UP[i] = 1
LSHPWM_EXT_LS_UP[i] = 5%
Else(3) LV_INH_LSH_UP[i] = **!** LC_LSH_UP[i]
LSHPWM_EXT_LS_UP[i] = 0
LSHPWM_UP_MAN = 0
Endif(2)
Else(1) LV_INH_LSH_UP[i] = 1

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LSHPWM_EXT_LS_UP[i] = LSHPWM_UP_EXT_ADJ[i]
Endif(1)

Calculation of Oxygen sensor temperature at engine start
One time determination after finishing engine state start
If LV_ST_END = 1 for first time after LV_ST_END = 0
Then TEMP_INI_LS_UP[i] = TEG_WALL_CAT_UP_MDL[i]
Endif

Inhibition of closed loop heater control
If LC_LSH_UP_CLL_CTL[i] = 0 **or**
LV_ERR_OC_LSL_UP[i] = 1 **or**
LV_ERR_LSL_UP_IF[i] = 1 **or**
LV_ERR_EL_LSL_UP[i] = 1 **or**
LV_ERR_OBD_VLD_LSH_UP[i] = 1 **or**
LV_VAR_LSH_UP = 0 **or**
LV_ERR_LSH_UP[i] = 1
Then LV_INH_LSH_CTL_CLL_LSH_UP[i] = 1
Else LV_INH_LSH_CTL_CLL_LSH_UP[i] = 0
Endif

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7.50 O2 sensor (bin, down) signal evaluation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VLS_DOWN_MMV_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating calibrateable delay since PUC deactivation passed					
LV_VLS_DOWN_MMV_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating VLS_DOWN_MMV_xxx[i] signals being limited when set					
VLS_DOWN_BOL [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Variable switching threshold for calculation of VLS_DOWN_MMV_MIN[i]					
VLS_DOWN_DRV1_ABS_MAX [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 4.99992	76.3e-6	V/10ms
Absolute maximum value within buffer containing 1st derivative of VLS_DOWN[i] signal					
VLS_DOWN_DRV1_MMV [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-2.5... 2.4999	76.3e-6	V/10ms
Mean of buffer containing 1st derivative of VLS_DOWN[i] signal					
VLS_DOWN_DRV1_MMV_MIN [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-2.5... 2.4999	76.3e-6	V/10ms
Minimum value of mean of buffer containing 1st derivative of VLS_DOWN[i] signal in lean phase					
VLS_DOWN_MMV_HYS [NC_CBK_EX_NR]	V	0... 3333H	0... 0.99998	76.3e-6	V
Variable hysteresis used to determine switching thresholds					
VLS_DOWN_MMV_MAX [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 4.99992	76.3e-6	V
Mean oxygen sensor rich voltage					
VLS_DOWN_MMV_MIN [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 4.99992	76.3e-6	V
Mean oxygen sensor lean voltage					
VLS_DOWN_TOL [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Variable switching threshold for calculation of VLS_DOWN_MMV_MAX[i]					

Input data:

LV_ES {p. 1720}	LV_PUC {p. 1720}	NC_CBK_EX_NR {p. 1829}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}
VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_DOWN_H_RES [NC_CBK_EX_NR] {p. 967}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_VLS_DOWN	-	0... FFFFH	0... 0.99998	15.3e-6	-
Filter constant for determination of VLS_DOWN_MMV_xxx[i] values when respective threshold passed					
C_CRLC_VLS_DOWN_OFF	-	0... FFFFH	0... 0.99998	15.3e-6	-
Filter constant for determination of VLS_DOWN_MMV_xxx[i] values when respective threshold not passed					
C_CTR_VLS_DOWN_BUF	-	1... AH	1... 10	1	-
Constant to change the time range for the calculation of the moving mean value					
C_FAC_VLS_DOWN_MMV_HYS	-	0... FFH	0... 0.99609	3.9063e-3	-
Multiplicative factor governing amplitude of hysteresis					
C_T_DLY_PUC_END_VLS_DOWN	-	0... FFFFH	0... 655.35	0.01	s
Delay between completion of engine state PUC and computation of VLS_DOWN_MMV_xxx[i]					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_DOWN_INI_MAX	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upper initialisation value for VLS_DOWN_BOL[i]. VLS_DOWN_MMV_MAX[i]					
C_VLS_DOWN_INI_MIN	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lower initialisation value for VLS_DOWN_TOL[i]. VLS_DOWN_MMV_MIN[i]					
C_VLS_DOWN_MMV_HYS_MIN	-	0... 3333H	0... 0.99998	76.3e-6	V
Minimum hysteresis for the computation of the thresholds VLS_DOWN_TOL[i] and VLS_DOWN_BOL[i]					

7.50.1 Signal evaluation

FUNCTION DESCRIPTION:

General information:

The function shall evaluate the oxygen sensor signal voltage and compute a number of resultant values that may be used by other functions. These values shall include:

1. Moving mean of sensor voltage first derivative, i.e. average signal gradient
2. Minimum value of moving mean of sensor voltage first derivative in lean phase
3. Absolute maximum of sensor voltage first derivative over defined number of previous samples, i.e. measure of sensor voltage stability
4. Moving mean value of lean sensor voltage
5. Moving mean value of rich sensor voltage.

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank

Signal flow diagram:

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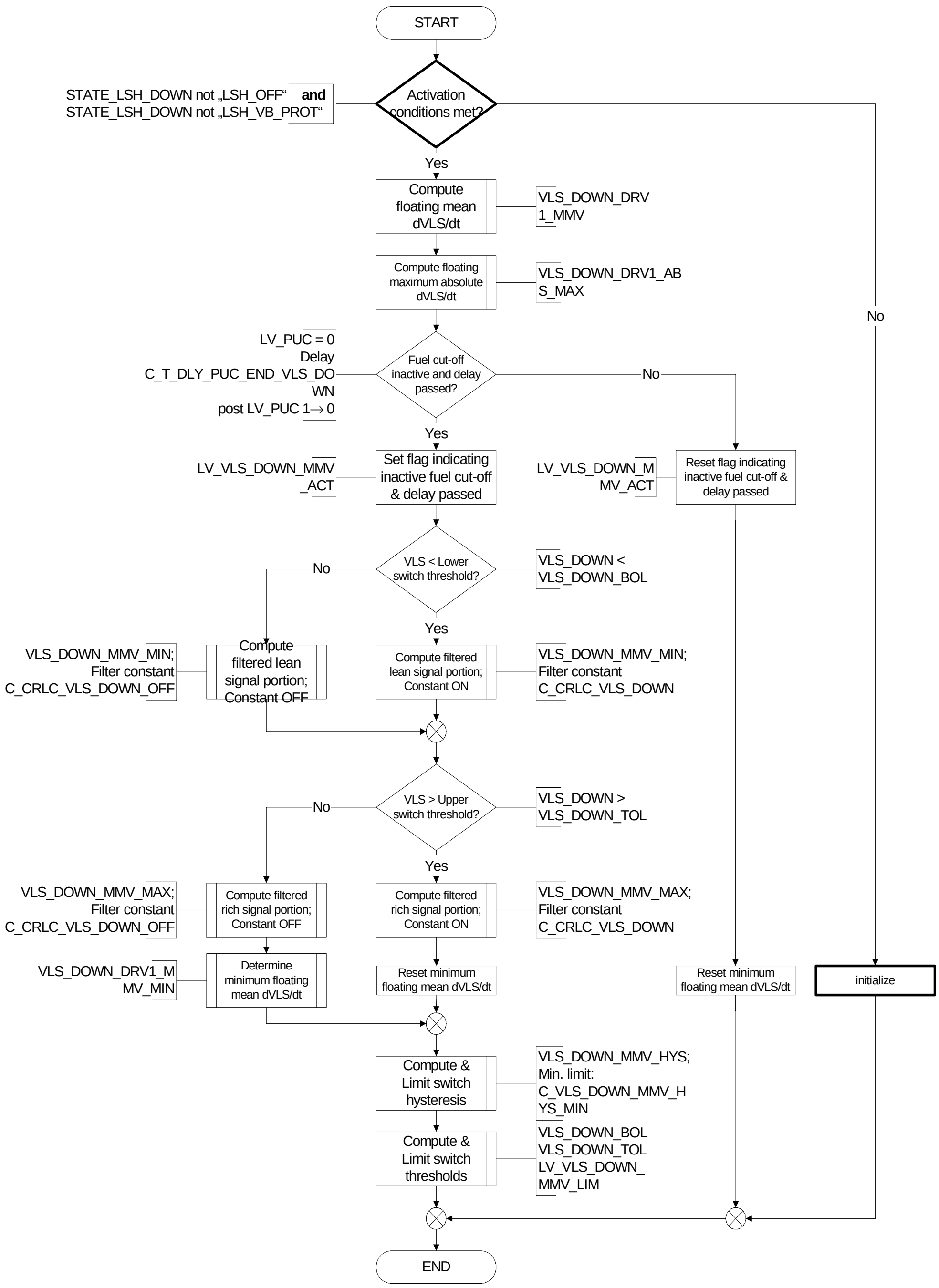

Figure 1 Function flow chart, Signal evaluation

Description:

The function shall evaluate the downstream oxygen sensor signal VLS_DOWN and VLS_DOWN_H_RES[i] and provide variables quantifying the signal characteristics: Floating mean gradient, Floating maximum signal deviation between samples, Filtered mean rich signal voltage & Filtered mean lean signal voltage (voltage will deviate from stable level signal with ageing of the catalyst). This shall be carried out as follows:

The function shall be active when the heater state is not "off" or "overvoltage protection".

Once the activation conditions have been met the function may be described in the following blocks:

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1. Computation of moving mean of first derivative VLS_DOWN_DRV1_MMV[i]: The moving mean value of oxygen sensor signal voltage first derivative VLS_DOWN_DRV1_MMV[i] shall be computed by averaging the last differences between consecutive VLS_DOWN_H_RES[i] samples, i.e. the most current difference (VLS_DOWN_H_RES[i]$_N$ - VLS_DOWN_H_RES[i]$_{N-1}$) and the previous C_CTR_VLS_DOWN_BUF differences. This shall indicate a measure for the signal gradient.
2. Computation of absolute maximum of first derivative VLS_DOWN_DRV1_ABS_MAX[i]: The absolute maximum of the oxygen sensor voltage first derivative VLS_DOWN_DRV1_ABS_MAX[i] shall be computed by taking the maximum of the absolute values of the last differences between consecutive VLS_DOWN_H_RES[i] samples, i.e. the most current difference (VLS_DOWN_H_RES[i]$_N$ - VLS_DOWN_H_RES[i]$_{N-1}$) and the previous 5 differences. This shall indicate a measure for the signal stability.
3. Computation of moving mean value of lean and rich sensor voltages, VLS_DOWN_MMV_xxx[i]: The computation of the moving mean value of lean and rich sensor voltages, associated switch thresholds and switch hysteresis shall only be carried out when the overrun fuel cut-off flag is reset (LV_PUC = 0) and the time C_T_DLY_PUC_END_VLS_DOWN has passed since the deactivation of the last occurring engine state PUC (i.e. LV_PUC 1 0). The lean and rich mean signal voltages shall be implemented by use of first order low pass filtering and floating switching thresholds. For example:

Should the VLS_DOWN[i] signal exceeds the threshold VLS_DOWN_TOL[i], the rich mean signal voltage VLS_DOWN_MMV_MAX[i] shall be computed by filtering the VLS_DOWN [i] signal with filter constant C_CRLC_VLS_DOWN. This shall continue until threshold VLS_DOWN_TOL[i] is no longer exceeded, after which VLS_DOWN_MMV_MAX[i] shall be computed by filtering with filter constant C_CRLC_VLS_DOWN_OFF. This constant is much smaller than C_CRLC_VLS_DOWN and the effect is to cause the VLS_DOWN_MMV_MAX[i] to follow the rich peaks. The OFF constant shall permit the VLS_DOWN_MMV_MAX[i] signal to follow the VLS_DOWN[i] signal for sudden decreases in signal amplitude, i.e. maximum VLS_DOWN[i] lower than VLS_DOWN_TOL[i].

The same procedure shall be carried out for the computation of VLS_DOWN_MMV_MIN[i], i.e. where VLS_DOWN[i] falls below VLS_DOWN_BOL[i], VLS_DOWN_MMV_MIN[i] shall be computed with filter constant C_CRLC_VLS_DOWN and where VLS_DOWN[i] no longer falls below VLS_DOWN_BOL[i], the filter constant C_CRLC_VLS_DOWN_OFF shall be used.

4. Determination of the minimum value of the moving mean of first derivative VLS_DOWN_DRV1_MMV_MIN[i]: The same conditions as for the computation of VLS_DOWN_MMV_xxx[i] shall apply. Should VLS_DOWN[i] fall below or equal VLS_DOWN_TOL[i], VLS_DOWN_DRV1_MMV_MIN[i]$_N$ shall be equal to the lower of VLS_DOWN_DRV1_MMV_MIN[i]$_{N-1}$ & VLS_DOWN_DRV1_MMV[i]. When VLS_DOWN[i] exceeds VLS_DOWN_TOL[i], the LV_PUC condition in conjunction with delay C_T_DLY_PUC_END_VLS_DOWN is not met or the function is deactivated, VLS_DOWN_DRV1_MMV_MIN[i] shall be reset to 0.
5. Compute & limit switch hysteresis: The value of the hysteresis, VLS_DOWN_MMV_HYS[i], used to determine the switching thresholds VLS_DOWN_BOL[i] & VLS_DOWN_TOL[i] shall be made proportional using factor C_FAC_VLS_DOWN_MMV_HYS to the oxygen sensor signal amplitude, as determined by taking the absolute difference of the moving mean lean /rich variables. The hysteresis shall also be limited so that it may not fall below the calibrateable threshold C_VLS_DOWN_MMV_HYS_MIN.
6. Compute & limit switch thresholds: The function shall limit the minimum amplitude of the difference between the moving mean lean /rich variables (VLS_DOWN_MMV_MAX[i] - VLS_DOWN_MMV_MIN[i]) to twice that of the switch hysteresis, VLS_DOWN_MMV_HYS[i].

Should the amplitude of the aforementioned difference fall below the said threshold, both the switch thresholds VLS_DOWN_BOL[i] & VLS_DOWN_TOL[i] shall be set to the average of the moving mean lean /rich variables, the moving mean lean /rich variables are recalculated based on the limited switching thresholds and hysteresis and the flag LV_VLS_DOWN_MMV_LIM[i] shall be set to indicate that switch threshold limiting is active.

Should no limiting be required, the switch thresholds VLS_DOWN_BOL[i] & VLS_DOWN_TOL[i] shall be calculated based on the switch hysteresis, moving mean lean variable and moving mean rich variable respectively. The flag LV_VLS_DOWN_MMV_LIM[i] shall be reset to indicate that no switch threshold limiting is being carried out.

The above blocks shall be cycled through once every function recurrence.

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Application conditions:

Recurrence:
The function shall be carried out once every oxygen sensor acquisition, i.e. every 10 ms.
Initialisation:
The following initialisation shall be carried out at RESET and when the function is inactive (or at least once when the function becomes inactive).

VLS_DOWN_MMV_MIN[i] = C_VLS_DOWN_INI_MIN
VLS_DOWN_MMV_MAX[i] = C_VLS_DOWN_INI_MAX
VLS_DOWN_BOL[i] = C_VLS_DOWN_INI_MAX
VLS_DOWN_TOL[i] = C_VLS_DOWN_INI_MIN
VLS_DOWN_MMV_HYS[i] = C_VLS_DOWN_MMV_HYS_MIN
LV_VLS_DOWN_MMV_LIM[i] = 0
LV_VLS_DOWN_MMV_ACT[i] = 0
VLS_DOWN_DRV1_MMV[i] = 0
VLS_DOWN_DRV1_MMV_MIN[i] = 0
VLS_DOWN_DRV1_ABS_MAX[i] = 0
Buffer contents from which VLS_DOWN_DRV1_MMV[i] & VLS_DOWN_DRV1_ABS_MAX[i] computed = 0.
Activation:
STATE_LSH_DOWN[i] **not** LSH_OFF **and**
STATE_LSH_DOWN[i] **not** LSH_VB_PROT
Deactivation:
STATE_LSH_DOWN[i] = LSH_OFF **or**
STATE_LSH_DOWN[i] = LSH_VB_PROT

Formula section:

The following function shall be carried out in the order listed and as indicated by the function flow chart:
Computation of moving mean of first derivative VLS_DOWN_DRV1_MMV[i]

$$\mathrm{VLS\_DOWN\_DRV1\_MMV[i]} = \frac{\sum_{x=0}^{\mathrm{C\_CTR\_VLS\_DOWN\_BUF-1}} \left(\mathrm{VLS\_DOWN\_H\_RES[i]}_{N-x} - \mathrm{VLS\_DOWN\_H\_RES[i]}_{N-(x+1)}\right)}{\mathrm{C\_CTR\_VLS\_DOWN\_BUF} * 10\mathrm{ms}}$$

The above may be facilitated for example by use of a C_CTR_VLS_DOWN_BUF value ring buffer. The most current difference, (VLS_DOWN_H_RES[i]$_{N}$ - VLS_DOWN_H_RES[i]$_{N-1}$), would overwrite the oldest difference in the buffer, (VLS_DOWN_H_RES[i]$_{N-5}$ - VLS_DOWN_H_RES[i]$_{N-6}$), and the average of the buffer contents recalculated.
Computation of absolute maximum of first derivative number of previous samples VLS_DOWN_DRV1_ ABS_MAX[i]

$$\mathrm{VLS\_DOWN\_DRV1\_ABS\_MAX[i]} =$$

$$\mathrm{MAXIMUM}\left|_{x=0}^{\mathrm{C\_CTR\_VLS\_DOWN\_BUF-1}} \left(\mathrm{VLS\_DOWN\_H\_RES[i]}_{N-x} - \mathrm{VLS\_DOWN\_H\_RES[i]}_{N-(x+1)}\right)\right|$$

The above may be facilitated for example by use of the same C_CTR_VLS_DOWN_BUF value ring buffer, as proposed above for the computation of VLS_DOWN_DRV1_MMV[i]. The function would calculate the absolute values of the buffer contents and take the maximum of these values.

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Computation of moving mean value of lean and rich sensor voltages, VLS_DOWN_MMV_xxx[i]

If (LV_PUC = 0) **&**
(delay since last LV_PUC 1 0 transition C_T_DLY_PUC_END_VLS_DOWN)
then LV_VLS_DOWN_MMV_ACT[i] = 1
If (VLS_DOWN[i] $<$ VLS_DOWN_BOL[i])
then *Compute moving mean lean signal, filter constant ON*
else *Compute moving mean lean signal, filter constant OFF*
endif
If (VLS_DOWN[i] $>$ VLS_DOWN_TOL[i])
then *Compute moving mean rich signal, filter constant ON*
VLS_DOWN_DRV1_MMV_MIN[i] = 0
else *Compute moving mean rich signal, filter constant OFF*
Determine minimum of moving mean of first derivative
endif
Compute & limit switch hysteresis
Compute & limit switch thresholds
else LV_VLS_DOWN_MMV_ACT[i] = 0
Reset timer used for delay C_T_DLY_PUC_END_VLS_DOWN
VLS_DOWN_DRV1_MMV_MIN[i] = 0
endif.

Compute moving mean lean signal, filter constant ON

The moving mean of the lean signal voltage shall be realised by use of a 1st order low pass digital filter with the filter constant C_CRLC_VLS_DOWN.

VLS_DOWN_MMV_MIN[i]$_N$ = VLS_DOWN_MMV_MIN[i]$_{N-1}$ * (1-C_CRLC_VLS_DOWN) + VLS_DOWN[i]$_N$ * C_CRLC_VLS_DOWN

Compute moving mean lean signal, filter constant OFF

The moving mean of the lean signal voltage shall be realised by use of a 1st order low pass digital filter with the filter constant C_CRLC_VLS_DOWN_OFF.

VLS_DOWN_MMV_MIN[i]$_N$ = VLS_DOWN_MMV_MIN[i]$_{N-1}$ * (1-C_CRLC_VLS_DOWN_OFF) + VLS_DOWN[i]$_N$ * C_CRLC_VLS_DOWN_OFF

Compute moving mean rich signal, filter constant ON

The moving mean of the rich signal voltage shall be realised by use of a 1st order low pass digital filter with the filter constant C_CRLC_VLS_DOWN.

VLS_DOWN_MMV_MAX[i]$_N$ = VLS_DOWN_MMV_MAX[i]$_{N-1}$ * (1-C_CRLC_VLS_DOWN) + VLS_DOWN[i]$_N$ * C_CRLC_VLS_DOWN

Compute moving mean rich signal, filter constant OFF

The moving mean of the rich signal voltage shall be realised by use of a 1st order low pass digital filter with the filter constant C_CRLC_VLS_DOWN_OFF.

VLS_DOWN_MMV_MAX[i]$_N$ = VLS_DOWN_MMV_MAX[i]$_{N-1}$ * (1-C_CRLC_VLS_DOWN_OFF) + VLS_DOWN[i]$_N$ * C_CRLC_VLS_DOWN_OFF

Determine minimum of moving mean of first derivative VLS_DOWN_DRV1_MMV_MIN[i]

The determination of the minimum of VLS_DOWN_DRV1_MMV[i] shall take place when the condition VLS_DOWN[i] VLS_DOWN_TOL[i] has been met. In this case:

VLS_DOWN_DRV1_MMV_MIN[i] = MIN(VLS_DOWN_DRV1_MMV_MIN[i], VLS_DOWN_DRV1_MMV[i])

Should the above condition no longer met, the LV_PUC with delay condition not be met or the initial activation conditions not be met then VLS_DOWN_DRV1_MMV_MIN[i] shall be reset to 0.

Compute & limit switch hysteresis

VLS_DOWN_MMV_HYS[i] = | (VLS_DOWN_MMV_MAX[i] - VLS_DOWN_MMV_MIN[i]) | *

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C_FAC_VLS_DOWN_MMV_HYS
If (VLS_DOWN_MMV_HYS[i] < C_VLS_DOWN_MMV_HYS_MIN)
then VLS_DOWN_MMV_HYS[i] = C_VLS_DOWN_MMV_HYS_MIN
endif.

Compute & limit switch thresholds

If ((VLS_DOWN_MMV_MAX[i] - VLS_DOWN_MMV_MIN[i])
2 * VLS_DOWN_MMV_HYS[i])
then VLS_DOWN_BOL[i] = (VLS_DOWN_MMV_MAX[i] + VLS_DOWN_MMV_MIN[i]) /2
VLS_DOWN_TOL[i] = (VLS_DOWN_MMV_MAX[i] + VLS_DOWN_MMV_MIN[i]) /2
VLS_DOWN_MMV_MIN[i] = VLS_DOWN_BOL[i] - VLS_DOWN_MMV_HYS[i]
VLS_DOWN_MMV_MAX[i] = VLS_DOWN_TOL[i] + VLS_DOWN_MMV_HYS[i]
LV_VLS_DOWN_MMV_LIM[i] = 1
else VLS_DOWN_BOL[i] = VLS_DOWN_MMV_MIN[i] + VLS_DOWN_MMV_HYS[i]
VLS_DOWN_TOL[i] = VLS_DOWN_MMV_MAX[i] - VLS_DOWN_MMV_HYS[i]
LV_VLS_DOWN_MMV_LIM[i] = 0
endif.

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7.51 O2 sensor (bin, down) operability detection

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LS_DOWN_READY [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable for operative readiness of downstream oxygen sensor(s)					
LV_LS_DOWN_READY_DEAC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable indicating that operative readiness of downstream oxygen sensor(s) has been reset					
LV_VLS_DOWN_NOT_STAT	V	0... 1H	0 ...1	1	-
Logical variable to indicate non stationary conditions at downstream sensor (for Y configuration with NOx trap)					
MAF_INT_DLY_EG_NOX_EQU_DOWN	V	0... FFFFH	0... 2912.66666	0.0444444	g
MAF integral to consider gas flow delay between downstream sensor and NOx sensor (for Y configuration)					
MAF_INT_NOT_STAT	V	0... FFFFH	0... 2912.66666	0.0444444	g
MAF integral during non stationary condition at downstream sensor (for Y configuration with NOx trap)					
NR_CBK_EX_LS_DOWN	-	0... 4H	0 ...4	1	-
exhaust gas bank with downstream sensor (for Y configuration with NOx trap)					
NR_CBK_EX_NOT_LS_DOWN	-	0... 4H	0 ...4	1	-
exhaust gas bank without downstream sensor (for Y configuration with NOx trap)					
T_TEMP_DEW_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time after dew point detection for downstream lambda probe					

Input data:

LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_ES {p. 1720}	LV_PUC {p. 1720}	LV_TEMP_DEW_LS_DOWN [NC_CBK_EX_NR] {p. 1007}
LV_VLS_NS_VLD [NC_NOX_SENS_CONF] {p. 992}	MAF_CYL {p. 8277}	MAF_INT_PUC_ACT {p. 2942}	MAF_INT_PUC_NOT_ACT {p. 2942}
NC_CBK_EX_NR {p. 1829}	NR_CONF_CBK_EX {p. 944}	NT_AGI {p. 3073}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}
TEG_DYN_LS_DOWN [NC_CBK_EX_NR] {p. 1007}	VLS_DIF_LAM_ADJ [NC_CBK_EX_NR] {p. 2590}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_INT_PUC_MAX_DOWN_LS_READY	-	0... FFFFH	0... 2912.66666	0.0444444	g
Maximum MAF integral during PUC for operability reset					
C_MAF_INT_PUC_NOT_LS_DOWN_READY	-	0... FFFFH	0... 2912.66666	0.0444444	g
Minimum MAF integral after operability reset for restart of readiness detection					
C_MAF_MAX_INT_NOT_STAT	-	0... FFFFH	0... 2912.66666	0.0444444	g
MAF integral threshold above which non stationary condition at downstream sensor apply					
C_T_MIN_TEMP_DEW_LS_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time threshold after dew point recognition for lambda probe readiness detection					
C_TEG_DYN_MIN_LS_DOWN_READY	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Temperature threshold above which O2 sensor recognised as operatively ready					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_DIF_MAX_LAM_ADJ	-	FC00... 3FFH	-5... 4.99511	4.8828e-3	V
maximum positive setpoint deviation tolerable to use NOx sensor signal instead of downstream sensor					
C_VLS_DIF_MIN_LAM_ADJ	-	FC00... 3FFH	-5... 4.99511	4.8828e-3	V
maximum negative setpoint deviation tolerable to use NOx sensor signal instead of downstream sensor					
C_VLS_DOWN_AFL_THD_READY	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lean VLS_DOWN[i] threshold for operative readiness detection					
C_VLS_DOWN_AFR_THD_READY	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Rich VLS_DOWN[i] threshold for operative readiness detection					
IP_MAF_MAX_DLY_EG_FAC_NT_AGI	-	0... FFFFH	0... 2912.66666	0.0444444	g
LDP_NT_AGI_IP_MAF_MAX_DLY_EG	6	0... FFFFH	0... 0.99998	15.3e-6	-
MAF integral threshold for consideration of gas delay flow (dependent on NOx trap ageing)					

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

The operative readiness of the downstream oxygen sensor(s) shall be determined by this function to allow other functions to act accordingly dependent upon the readiness.

Description:

The operative readiness shall only be determined for a downstream oxygen sensor which is not operatively ready. The oxygen sensor shall be set as inoperable after a ECU reset, in the state *Engine Stop*, when during PUC the MAF integral exceeds a calibrated threshold or when the dew point LV_TEMP_DEW_LS_DOWN[i] switches back to 0.
The operative readiness shall be determined by analysing the downstream oxygen sensor voltage (VLS_DOWN[i]) and determining whether the voltage has left a pre-determined voltage band after the lambda probe heater state machine has reached LSH_POW_CTL.
A second condition shall permit the forced operative readiness state, should the voltage level condition not be met, by assuming that when the modelled exhaust gas temperature at lambda probe position has reached a pre-determined threshold, that the downstream oxygen sensor is also at operating temperature and functioning. The forced readiness detection may additionally be delayed until dew point detection or even longer until the calibratable threshold C_T_MIN_TEMP_DEW_LS_DOWN has been reached, depending on its calibration.
Should the sensor's operative readiness be reset due to a sufficiently long fuel cut-off phase or reset of dew-point recognition a certain mass air flow integral threshold after leaving fuel cut-off shall be awaited until operability detection is started again. This shall ensure that the sensor heater has sufficient time to raise the temperature up to normal operating conditions prior to start of readiness detection in order to increase its reliability.
The operative readiness of the downstream oxygen sensor(s) shall be recorded in the variable LV_LS_DOWN_READY[i].

Application conditions:

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Initialisation:
At reset: reset all variables to 0
Recurrence: T_SAMPLE = 100 ms
Activation: In all engine states

Formula section:

% only relevant for Y configurations with one downstream sensor and 1 NOx sensor
%SW-hint: The following if-then-else calculation can be done outside the for-loop, since calculation is independent of exhaust bank.

```
#if   NC_CBK_EX_NR = 2
#then
    if        NR_CONF_CBK_EX = 3           % downstream sensor on bank 1 is missing
    then          NR_CBK_EX_LS_DOWN = 2
                  NR_CBK_EX_NOT_LS_DOWN = 1
    elseif        NR_CONF_CBK_EX = 4       % downstream sensor on bank 2 is missing
              NR_CBK_EX_LS_DOWN = 1
              NR_CBK_EX_NOT_LS_DOWN = 2
    else                                   % no downstream sensor is missing
              NR_CBK_EX_LS_DOWN = 0
              NR_CBK_EX_NOT_LS_DOWN = 0
    endif
#else                                      % NC_CBK_EX_NR = 1
          NR_CBK_EX_LS_DOWN = 0
          NR_CBK_EX_NOT_LS_DOWN = 0
#endif

If     LV_ES = 1
then
          LV_LS_DOWN_READY[i] = 0
          T_TEMP_DEW_LS_DOWN[i] = 0
          LV_LS_DOWN_READY_DEAC[i] = 0
else
          if         i = NR_CBK_EX_NOT_LS_DOWN
    % only relevant for Y configurations with one downstream sensor and 1 NOx sensor
    then          % calculation for the exhaust bank without any downstream sensor
       if         VLS_DIF_LAM_ADJ[NR_CBK_EX_LS_DOWN] >= C_VLS_DIF_ MAX_LAM_ADJ
       or         VLS_DIF_LAM_ADJ[NR_CBK_EX_LS_DOWN] <= C_VLS_DIF_MIN_LAM_ADJ
       then
                 if       MAF_INT_NOT_STAT < C_MAF_MAX_INT_NOT_STAT
          then           MAF_INT_NOT_STAT_n = MAF_INT_NOT_STAT_n-1 + MAF_CYL * T_SAMPLE[ms] * 1/3600 [g*h/(kg*ms)]
                         % increment MAF_INT_NOT_STAT
          endif
       else           MAF_INT_NOT_STAT_n = MAF_INT_NOT_STAT_n-1 - MAF_CYL * T_SAMPLE[ms] * 1/3600 [g*h/(kg*ms)]
                         % decrement MAF_INT_NOT_STAT
       endif
       if                MAF_INT_NOT_STAT >= C_MAF_MAX_INT_NOT_STAT
       then          % deviation on bank with downstream of untolerable magnitude
```


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LV_VLS_DOWN_NOT_STAT = 1
else LV_VLS_DOWN_NOT_STAT = 0
endif
if LV_LS_DOWN_READY[NR_CBK_EX_LS_DOWN] = 1
and LV_ERR_LS_DOWN[NR_CBK_EX_LS_DOWN] = 0
and LV_VLS_DOWN_NOT_STAT = 0
then *% wait for gas flow delay from downstream sensor to NOx sensor*
MAF_INT_DLY_EG_NOX_EQU_DOWN$_n$ = MAF_INT_DLY_EG_NOX_EQU_DOWN$_{n-1}$ + MAF_CYL * T_SAMPLE[ms] * 1/3600 [g*h/(kg*ms)]
% increment MAF_INT_DLY_EG_NOX_EQU_DOWN
else MAF_INT_DLY_EG_NOX_EQU_DOWN = 0
endif
if MAF_INT_DLY_EG_NOX_EQU_DOWN $>$ MAF_MAX_DLY_EG_FAC_NT_AGI
% maximum gas flow delay is dependent on NOx trap ageing
and LV_VLS_NS_VLD[1] = 1
then *% deviation on bank with downstream sensor is low enough to neglect influence*
LV_LS_DOWN_READY[i] = 1
else LV_LS_DOWN_READY[i] = 0
endif
else ***% all other configurations***
if (LV_PUC = 1
and MAF_INT_PUC_ACT $>$ C_MAF_INT_PUC_MAX_DOWN_LS_READY
and MAF_INT_PUC_ACT$_n$ $>$ MAF_INT_PUC_ACT$_{n-1}$)
or LV_TEMP_DEW_LS_DOWN[i] = 1 -> 0
then LV_LS_DOWN_READY[i] = 0
LV_LS_DOWN_READY_DEAC[i] = 1
endif
If LV_LS_DOWN_READY[i] = 0
and LV_LS_DOWN_READY_DEAC[i] = 0
then *execute section* ***"Readiness detection"***
else
if MAF_INT_PUC_NOT_ACT >= C_MAF_INT_PUC_NOT_LS_DOWN_READY
and MAF_INT_PUC_NOT_ACT$_n$ $>$ MAF_INT_PUC_NOT_ACT$_{n-1}$
then LV_LS_DOWN_READY_DEAC[i] = 0
T_TEMP_DEW_LS_DOWN[i] = 0
endif
endif
endif
endif

Readiness detection

% all other configurations
if LV_TEMP_DEW_LS_DOWN[i] = 1
then T_TEMP_DEW_LS_DOWN[i] = T_TEMP_DEW_LS_DOWN[i] + T_SAMPLE
else T_TEMP_DEW_LS_DOWN[i] = 0
endif
if **(** (C_VLS_DOWN_AFR_THD_READY $<$ VLS_DOWN[i] **or** VLS_DOWN[i] $<$ C_VLS_DOWN_AFL_THD_READY) **and** STATE_LSH_DOWN[i] = LSH_POW_CTL **)**

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```
or( TEG_DYN_LS_DOWN[i] > C_TEG_DYN_MIN_LS_DOWN_READY     and
        T_TEMP_DEW_LS_DOWN[i] >= C_T_MIN_TEMP_DEW_LS_DOWN )
then     LV_LS_DOWN_READY[i] = 1
endif
```

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7.52 O2 sensor (bin, down) heater management

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LSHPWM_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 99.60937	0.390625	%
Heater driver PWM duty cycle; acquired also by BSW					
LV_V_EFC_LIM_BOL_LSH_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating effective heater voltage limited due to sum of voltage components falling below zero.					
LV_V_EFC_LIM_MAX_LSH_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating effective heater voltage limited due to exceeding absolute maximum voltage spec.					
LV_V_EFC_LIM_PROT_VB_LSH_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean variable indicating effective heater voltage limited due to excessive battery voltage level					
LV_V_EFC_LIM_TOL_LSH_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating effective heater voltage limited due to exceeding threshold for period of time.					
STATE_LSH_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H 4H 5H 6H	LSH_OFF LSH_POW_RISE LSH_POW_RED LSH_POW_FALL LSH_POW_CTL LSH_VB_PROT LSH_TEMP_PROT	-	-
Present heater state					
T_POW_RISE_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 6553.5	0.1	s
Timer indicating the duration of the pre-heating and post dew point heating phases					
T_V_EFC_LIM_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 25.5	0.1	s
Timer indicating the duration of the effective heater voltage limitation preventing overvoltage					
T_V_EFC_TOL_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 25.5	0.1	s
Timer indicating permitted effective heater voltage overvoltage duration					
V_EFC_CLC_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 25.9996	397e-6	V
Effective calculated heater voltage value prior to overvoltage protection					
V_EFC_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 25.89843	0.1015625	V
Effective final output value of heater voltage					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Input data:

LSHPWM_EXT_LS_DOWN [NC_CBK_EX_NR] {p. 2435}	LV_INH_LSH_DOWN [NC_CBK_EX_NR] {p. 2435}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_ST_END {p. 1720}
LV_TEMP_DEW_LS_DOWN [NC_CBK_EX_NR] {p. 1007}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	T_AST {p. 1766}
TEG_DYN_LS_DOWN [NC_CBK_EX_NR] {p. 1007}	TEMP_INI_LS_DOWN [NC_CBK_EX_NR] {p. 2435}	VB {p. 1185}	VS {p. 1176}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_V_EFC_AS_LSH_DOWN	-	0... FFH	0... 1.99218	0.0078125	-
Multiplicative correction factor to effective heater voltage					
C_T_AST_MAX_LSH_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Time after start at which step in max. effective heater voltage applied, if LSH_POW_CTL active (T_POW_RISE_LSH_DOWN[i] stopped)					
C_T_MAX_POW_RISE_LSH_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Duration of open loop pre-heating in LSH_POW_RISE from dew-point to set-point temperature					
C_T_MAX_V_EFC_LIM_LSH_DOWN	-	0... FFH	0... 25.5	0.1	s
Maximum duration of effective heater voltage limiting					
C_T_MAX_V_EFC_MAX_ST_LSH_DOWN	-	0... FFH	0... 25.5	0.1	s
Time after start at which step in max. effective heater voltage applied					
C_T_MAX_V_EFC_TOL_LSH_DOWN	-	0... FFH	0... 25.5	0.1	s
Maximum permitted duration where excessive effective heater voltage tolerated					
C_TEG_DYN_MAX_LSH_DOWN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Maximum permitted exhaust gas temperature above which LSH switched off					
C_V_EFC_AS_LSH_DOWN	-	80... 7FH	-13... 12.89843	0.1015625	V
Effective heater voltage calibration system additive factor					
C_V_EFC_DEC_LSH_DOWN	-	0... FFH	0... 1.625	6.37e-3	V/100ms
Effective heater voltage decrement to lower temperature					
C_V_EFC_INC_LSH_DOWN	-	0... FFH	0... 1.625	6.37e-3	V/100ms
Effective heater voltage increment to raise temperature					
C_V_EFC_LIM_LSH_DOWN	-	0... FFH	0... 25.89843	0.1015625	V
Effective heater voltage limit under persistent excessive heater voltage condition					
C_V_EFC_MAX_LSH_DOWN	-	0... FFH	0... 25.89843	0.1015625	V
Absolute maximum permitted effective heater voltage after initial phase; threshold & limit					
C_V_EFC_MAX_ST_LSH_DOWN	-	0... FFH	0... 25.89843	0.1015625	V
Absolute maximum permitted effective heater voltage during initial phase; threshold & limit					
C_V_EFC_PROT_VB_LSH_DOWN	-	0... FFH	0... 25.89843	0.1015625	V
Effective heater voltage in the case of battery voltage overvoltage condition					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_EFC_RED_LSH_DOWN	-	0... FFH	0... 25.89843	0.1015625	V
Reduced effective heater voltage during danger of water splash damage					
C_V_EFC_STEP_LSH_DOWN	-	80... 7FH	-13... 12.89843	0.1015625	V
Additional effective heater voltage step on transition from LSH_POW_RED to LSH_POW_RISE					
C_V_EFC_TOL_LSH_DOWN	-	0... FFH	0... 25.89843	0.1015625	V
Effective heater voltage threshold above which voltage limiting may occur if threshold persistently exceeded					
C_VB_MAX_PROT_LSH_DOWN	-	0... FFH	0... 25.89843	0.1015625	V
Maximum permitted battery voltage threshold, over which overvoltage detected					
IP_FAC_V_EFC_TEG_LSH_DOWN	-	0... FFH	0... 3.98437	0.015625	-
LDPM_VS_1_EGCP	6	0... FFH	0... 255	1	km/h
Factor for the heat transfer rate, bank 2 only					
IP_T_TEMP_THD_LSH_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
LDPM_TEMP_INI_LS_DOWN_1_EGCP	6	0... FFFFH	-2048... 2047.9375	0.0625	°C
Duration until critical water splash sensor temperature reached					
IP_V_EFC_CTL_LSH_DOWN	V	0... FFH	0... 25.89843	0.1015625	V
LDPM_N_32_3_EGCP	6	0... FFH	0... 8160	32	rpm
LDPM_TEG_DYN_LS_DOWN_1_EGCP	6	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Open loop control effective heater voltage					
IP_V_EFC_INI_LSH_DOWN	-	0... FFH	0... 25.89843	0.1015625	V
LDPM_TEMP_INI_LS_DOWN_1_EGCP	6	0... FFFFH	-2048... 2047.9375	0.0625	°C
Initial effective heater voltage					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_LSHPWM_BOL_LSH_DOWN	-	0... FFH	0... 99.60937	0.390625	%
Heater driver PWM duty cycle lower limit					
NC_LSHPWM_TOL_LSH_DOWN	-	0... FFH	0... 99.60937	0.390625	%
Heater driver PWM duty cycle upper limit					

Import actions:

ACTION_INFR_SetPwmLshDown (**IN**<i>,**IN**<ducy>)

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

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The goal of the heater control shall be to control the oxygen sensor heating such that the optimal operating temperature is reached in the shortest time possible. At the same time, the maximum permissible temperature gradient (possible damage to ceramic due to thermal stress), the possible occurrence of water splash under the dew point (possible damage to ceramic due to thermal shock) and the absolute maximum ratings specified for the sensor shall be taken into account. The function shall permit oxygen sensor heating under open loop control.

Signal flow:

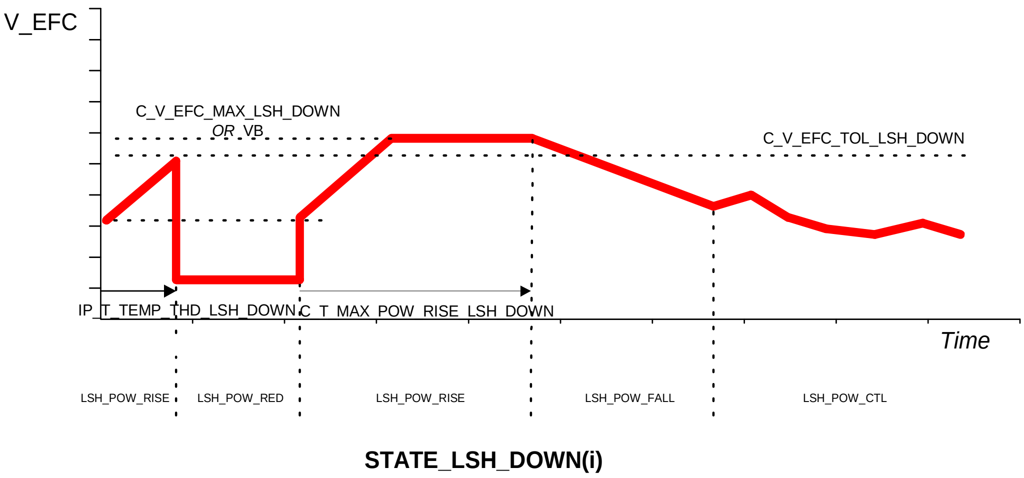

Figure 7.52.1: : Course of effective heater voltage over time /state

Description:

The heater control shall be realised by use of a state machine. Each downstream oxygen sensor shall have its own state machine and each state machine shall run independently of the other.

The heater control shall be initialised to the LSH_OFF state at the start of a new driving cycle. Hence the oxygen sensor will not initially be electrically heated.

Heating shall commence should the activation conditions listed below be met. i.e. when the engine has transitioned from the start state (LV_ST_END = 1) and the heater management inhibit bit for the corresponding bank is not set (LV_INH_LSH_DOWN[i] = 0). The appropriate heater state shall change to LSH_POW_RISE and the initial value for the effective heater voltage shall be determined by obtaining the oxygen sensor temperature at start (TEMP_INI_LS_DOWN[i]) from input data. This shall then be used to obtain the appropriate effective heater starting voltage from map IP_V_EFC_INI_LSH_DOWN.

In the state LSH_POW_RISE, the effective heater voltage shall be incremented with the gradient of C_V_EFC_INC_LSH_DOWN.

The continuation of the heating gradient shall depend on whether the dew point at the sensor location has been determined to have been exceeded, i.e. the temperature of the inner manifold wall at the sensor location has exceeded the temperature threshold where water in the exhaust gas may condense, as determined by LV_TEMP_DEW_LS_DOWN[i].

Should the dew point not have been exceeded (LV_TEMP_DEW_LS_DOWN[i] = 0) but timer T_POW_RISE_LSH_DOWN[i] has equalled or exceeded IP_T_TEMP_THD_LSH_DOWN, it shall be assumed that condensed water splash at the oxygen sensor location may occur. In order to protect the oxygen sensor by keeping the temperature of the ceramic lower than the specified critical temperature, the heater power shall be reduced immediately by setting the effective heater voltage to C_V_EFC_RED_LSH_DOWN. In this case, the heater state shall be set to LSH_POW_RED.

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The reduced heating state shall persist until the dew point in the exhaust gas system has been determined to have been exceeded, i.e. until LV_TEMP_DEW_LS_DOWN[i] = 1, at which point the heater state shall return to LSH_POW_RISE. The effective heater voltage shall be set to the same effective heater voltage as determined at start (IP_V_EFC_INI_LSH_DOWN), which may be modified by the calibration data C_V_EFC_STEP_LSH_DOWN, may be further incremented with a gradient of C_V_EFC_INC_LSH_DOWN without danger of damaging the oxygen sensor and the timer T_POW_RISE_LSH_DOWN[i] shall be reinitialised with the IP_T_TEMP_THD_LSH_DOWN determined at function start.

Should the initial exhaust gas temperature at start have been determined to exceed the dew point (LV_TEMP_DEW_LS_DOWN[i] = 1), the heater control shall not enter the reduced heater power state but continue to incrementally increase the heater power within the LSH_POW_RISE state.

Should T_POW_RISE_LSH_DOWN[i] be determined to have equalled or exceeded the value C_T_MAX_POW_RISE_LSH_DOWN (irrespective of the dew point having been exceeded or not), the heater state shall change to LSH_POW_FALL and the timer shall be frozen.

In the LSH_POW_FALL state, the effective heater voltage shall be reduced with a gradient of C_V_EFC_DEC_LSH_DOWN until such time that it falls below or equals the value set for the open loop control at the current engine operating point. For cylinder bank 1, this value is determined by map IP_V_EFC_CTL_LSH_DOWN alone. For cylinder bank 2, this value is determined by IP_V_EFC_CTL_LSH_DOWN * IP_FAC_V_EFC_TEG_LSH_DOWN. The latter factor shall be necessary to accommodate differences in heat transfer rates between cylinder banks at the oxygen sensor location, particularly for transversal mounted V6-engines. At such time the effective heater voltage falls below or equals the respective threshold, the heater state shall change to LSH_POW_CTL.

Should, however, the Boolean flag LV_TEMP_DEW_LS_DOWN[i] be reset whilst in the state LSH_POW_FALL, the heater control shall resume at state LSH_POW_RED following the procedures outlined above.

The control of the effective heater voltage is carried out in open loop mode.

In the open loop heater control mode, the effective heater voltage shall be obtained from map IP_V_EFC_CTL_LSH_DOWN and is dependent upon the engine speed and the modelled exhaust gas temperature. For cylinder bank 2, an additional multiplicative factor (IP_FAC_V_EFC_TEG_LSH_DOWN) may be required for the reasons outlined above.

To the open loop control voltage a calibration system constant (C_V_EFC_AS_LSH_DOWN) can be added to permit a global change in the total effective heater voltage to be made. Thus the calculated effective heater voltage (V_EFC_CLC_LSH_DOWN[i]) shall be computed from the open loop value and the global correction value.

Furthermore should the sum of the components used to calculate the effective heater voltage be negative, LV_V_EFC_LIM_BOL_LSH_DOWN[i] shall be set. This shall prevent the controller from decreasing the effective heater voltage further but not prevent it from increasing the voltage. When the sum of the components is no longer negative, LV_V_EFC_LIM_BOL_LSH_DOWN[i] shall be reset. Similarly, should either of the overvoltage limitation Boolean flags LV_V_EFC_LIM_TOL_LSH_DOWN[i] & LV_V_EFC_LIM_MAX_LSH_DOWN[i] be set, as described later, the controller shall be prevented from increasing the effective heater voltage further but not prevent it from decreasing the voltage. When the overvoltage flags are no longer set and the other applicable conditions are met, the controller shall resume normal operation.

Should, however, the Boolean flag LV_TEMP_DEW_LS_DOWN[i] be reset whilst in the state LSH_POW_CTL, then the open loop controller terms shall be reset, the Boolean flags to indicate open loop control and effective heater voltage limitation shall be reset and the heater control shall resume at state LSH_POW_RED following the procedures outlined above.

Should at any time the battery voltage VB exceed the threshold C_VB_MAX_PROT_LSH_DOWN, as determined by the state of logical variable LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i], the oxygen sensor heater power shall be reduced by reducing the effective heater voltage used to calculate the driver duty cycle to C_V_EFC_PROT_VB_LSH_DOWN. The heater state shall change to LSH_VB_PROT on the next recurrence of the state machine and the effective heater voltage set to the aforementioned limit. This shall prevent damage to the sensor due to excessive heater voltages e.g. due to jump start from 24 V.

Should the battery voltage recover when in the state LSH_VB_PROT, as indicated by LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 0, T_POW_RISE_LSH_DOWN[i] shall be reset, V_EFC_LSH_DOWN[i]

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shall be initialised to IP_V_EFC_INI_LSH_DOWN calculated after the start, the heater control shall resume at state LSH_POW_RISE following the procedures outlined above.

Short term voltage excursions shall cause the heater power to be limited but will only cause the state machine to change state should the voltage excursion persist until the next recurrence of the state machine. The state machine shall not be able to enter the LSH_VB_PROT state directly from LSH_OFF but shall be required to pass through LSH_POW_RISE.

The sensor shall also be protected from over-temperature. This shall be achieved by evaluating the value of the modelled exhaust gas temperature TEG_DYN_LS_DOWN[i] in all states other than LSH_OFF. Should the exhaust gas temperature exceed the threshold C_TEG_DYN_MAX_LSH_DOWN, the calculated effective heater voltage shall be reduced to 0, the state shall change to LSH_TEMP_PROT thus suspending open loop control, if active.

Should the exhaust gas temperature fall below the threshold, the state shall change dependent on the state active immediately prior to the over-temperature protection. If the state was LSH_POW_CTL, the state machine shall return to this state and the effective heater voltage shall take the new value as computed by the open loop control. If the state was any other than LSH_POW_CTL, the state shall change to LSH_POW_RISE. In this case T_POW_RISE_LSH_DOWN[i] shall be reset, V_EFC_LSH_DOWN[i] shall be initialised to IP_V_EFC_INI_LSH_DOWN calculated after the start, effective heater voltage limitation shall be reset and the heater control shall resume at state LSH_POW_RISE following the procedures outlined above.

Furthermore, in order to protect the sensor heater against long term high voltage stress it shall be necessary to limit the effective heater voltage should the value of V_EFC_CLC_LSH_DOWN[i] equal or exceed the threshold C_V_EFC_TOL_LSH_DOWN.

In this instance, the timer T_V_EFC_TOL_LSH_DOWN[i] shall be started. Should the overvoltage condition persist, such that this timer equals or exceeds the threshold C_T_MAX_V_EFC_TOL_LSH_DOWN, timer T_V_EFC_LIM_LSH_DOWN[i] shall be started and the Boolean flag LV_V_EFC_LIM_TOL_LSH_DOWN[i] shall be set. This flag shall prevent the controller from increasing effective the voltage further. If however the value of V_EFC_CLC_LSH_DOWN[i] should fall below the threshold C_V_EFC_TOL_LSH_DOWN at any time, LV_V_EFC_LIM_TOL_LSH_DOWN[i] shall be reset.

Once timer T_V_EFC_LIM_LSH_DOWN[i] has been started, Boolean flag LV_V_EFC_LIM_TOL_LSH_DOWN[i] shall be set or reset depending on the value of V_EFC_CLC_LSH_DOWN[i]. Once the timer T_V_EFC_LIM_LSH_DOWN[i] equals or exceeds threshold C_T_MAX_V_EFC_LIM_LSH_DOWN, both timers shall be reset and timer T_V_EFC_TOL_LSH_DOWN[i] must exceed the threshold C_T_MAX_V_EFC_TOL_LSH_DOWN again in order to permit further limiting to take place.

To prevent damage to the sensor, V_EFC_CLC_LSH_DOWN[i] shall not be permitted to exceed the lower of the values C_V_EFC_MAX_LSH_DOWN, C_V_EFC_MAX_ST_LSH_DOWN or VB dependent on the value of T_POW_RISE_LSH_DOWN[i].

If T_POW_RISE_LSH_DOWN[i] equals or exceeds the constant C_T_MAX_V_EFC_MAX_ST_LSH_DOWN or conditions regarding T_AST and STATE_LSH_DOWN[i] then V_EFC_CLC_LSH_DOWN[i] shall be checked against VB & C_V_EFC_MAX_LSH_DOWN. If either of the values is exceeded then Boolean flag LV_V_EFC_LIM_MAX_LSH_DOWN[i] shall be set and V_EFC_CLC_LSH_DOWN[i] limited to the lower of VB & C_V_EFC_MAX_LSH_DOWN otherwise LV_V_EFC_LIM_MAX_LSH_DOWN[i] shall be reset.

If T_POW_RISE_LSH_DOWN[i] is lower then constant C_T_MAX_V_EFC_MAX_ST_LSH_DOWN then V_EFC_CLC_LSH_DOWN[i] shall be checked against VB & C_V_EFC_MAX_ST_LSH_DOWN. If either of the values is exceeded then Boolean flag LV_V_EFC_LIM_MAX_LSH_DOWN[i] shall be set and V_EFC_CLC_LSH_DOWN[i] limited to the lower of VB & C_V_EFC_MAX_ST_LSH_DOWN otherwise LV_V_EFC_LIM_MAX_LSH_DOWN[i] shall be reset.

The flag LV_V_EFC_LIM_MAX_LSH_DOWN[i] shall prevent the controller from increasing effective the voltage further and permit the final effective heater voltage to be limited, as described later.

Should timer T_V_EFC_LIM_LSH_DOWN[i] be unequal to zero, i.e. overvoltage no longer tolerated as it has been present for certain time, V_EFC_LSH_DOWN[i] shall be the lower of the values V_EFC_CLC_LSH_DOWN[i] & C_V_EFC_LIM_LSH_DOWN otherwise V_EFC_LSH_DOWN[i] shall be set to V_EFC_CLC_LSH_DOWN[i].

Once the effective heater voltage has been determined throughout the various heater states other than LSH_OFF, it shall be used to compute the PWM duty cycle (LSHPWM_DOWN[i]) that shall control the appropriate heater driver. The heater power shall be corrected to take into account deviations in the

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measured battery voltage and limited to the range bounded by NC_LSHPWM_TOL_LSH_DOWN & NC_LSHPWM_BOL_LSH_DOWN. The evaluation of excess battery voltage shall be determined at the same recurrence as the computation of the duty cycle as described above. The PWM value may also be modified by use of constant C_FAC_V_EFC_AS_LSH_DOWN.
Should at any time an inhibit flag be set (LV_INH_LSH_DOWN[i] = 1), the corresponding oxygen sensor heater shall be switched off and the STATE_LSH_DOWN[i] set to LSH_OFF. This shall allow project specific application conditions to turn off oxygen sensor heating according to project philosophy. Should the heater function be inhibited, then the PWM duty cycle shall be set to input LSHPWM_EXT_LS_DOWN[i]. On a transition of the inhibit bit LV_INH_LSH_DOWN[i] from 1 0, the heater function shall start from anew.

Application conditions:

Activation:
At any engine operting state.
Deactivation:
-
Time recurrence:
The state machine, sensor protection and effective heater voltage definition shall be carried out once every 100 ms. T_SAMPLE_1 = 100ms
The determination of the oxygen sensor heater driver duty cycle and associated excessive battery voltage protection shall be carried out once every 10 ms. T_SAMPLE_2 = 10ms
Initialisation:
The following variable initialisation shall take place at the beginning of a new driving cycle:
STATE_LSH_DOWN[i] = LSH_OFF
T_POW_RISE_LSH_DOWN[i] = 0
T_V_EFC_TOL_LSH_DOWN[i] = 0
T_V_EFC_LIM_LSH_DOWN[i] = 0
LSHPWM_DOWN[i] = 0
V_EFC_LSH_DOWN[i] = 0
V_EFC_CLC_LSH_DOWN[i] = 0
LV_V_EFC_LIM_BOL_LSH_DOWN[i] = 0
LV_V_EFC_LIM_TOL_LSH_DOWN[i] = 0
LV_V_EFC_LIM_MAX_LSH_DOWN[i] = 0
LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 0

At reset:

ACTION_INFR_SetPwmLshDown(
IN i
IN LSHPWM_DOWN[i])

NOTE: Projects not making use of the inhibit flags LV_INH_LSH_DOWN[i] shall ensure that they are initialised with and remain 0, thus never disabling the oxygen sensor heater function or thus never disabling the oxygen sensor heater open loop control function respectively

Formula section:

7.52.1 Heater management state machine

The state machine shall remain in its current state and carry out the actions specified to occur within that state once per recurrence unless otherwise specified. The state machine shall only move to another state when one of the conditions has been determined to be met.

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Note: The priorities of the conditions to change between states shall be defined by the order in which these conditions are listed within the appropriate state as described below.

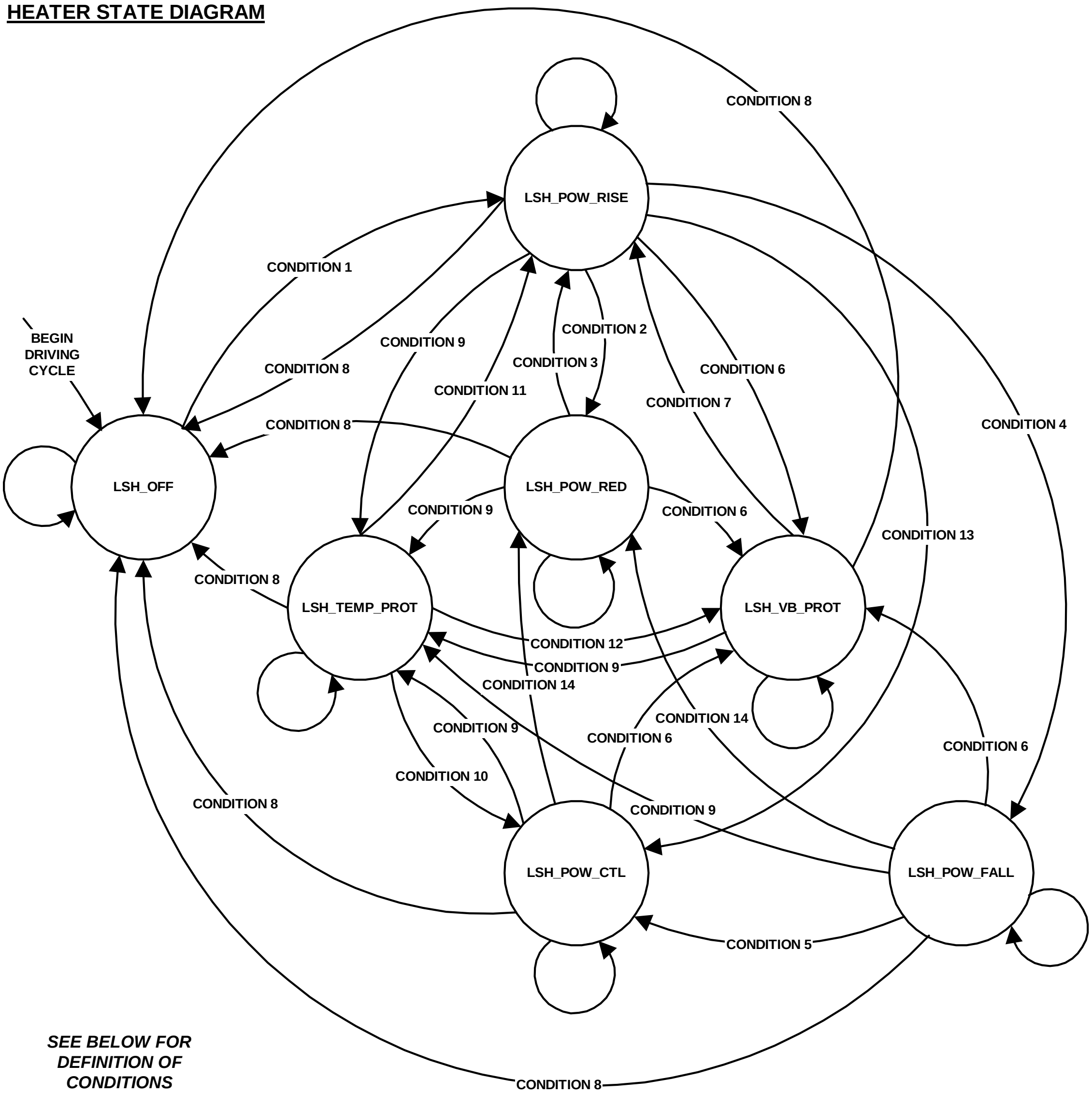

Figure 2: Heater management state diagram

STATE_LSH_DOWN[i] LSH_OFF

Actions:

T_POW_RISE_LSH_DOWN[i] = 0
T_V_EFC_TOL_LSH_DOWN[i] = 0
T_V_EFC_LIM_LSH_DOWN[i] = 0
V_EFC_LSH_DOWN[i] = 0
V_EFC_CLC_LSH_DOWN[i] = 0
LV_V_EFC_LIM_BOL_LSH_DOWN[i] = 0
LV_V_EFC_LIM_TOL_LSH_DOWN[i] = 0
LV_V_EFC_LIM_MAX_LSH_DOWN[i] = 0
LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 0

Note: The above listed actions must be carried out at least once when the state has been entered for the first time or from any other state!

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Condition 1: LSH_OFF to LSH_POW_RISE
LV_ST_END = 1 **&**
LV_INH_LSH_DOWN[i] = 0
Transition actions:
V_EFC_CLC_LSH_DOWN[i] = IP_V_EFC_INI_LSH_DOWN (TEMP_INI_LS_DOWN[i])
Timer T_POW_RISE_LSH_DOWN[i] shall be started
STATE_LSH_DOWN[i] = LSH_POW_RISE
STATE_LSH_DOWN[i]   LSH_POW_RISE
Actions:
V_EFC_CLC_LSH_DOWN[i]$_N$ = V_EFC_CLC_LSH_DOWN[i]$_{N-1}$ + C_V_EFC_INC_LSH_DOWN
T_SAMPLE_1
Increment timer T_POW_RISE_LSH_DOWN[i]
Note: See section Oxygen sensor heater voltage protection for notes on limiting the applied heater voltage.
Condition 8: LSH_POW_RISE to LSH_OFF
LV_ST_END = 0 **or** LV_INH_LSH_DOWN[i] = 1
Transition actions:
STATE_LSH_DOWN[i] = LSH_OFF
Condition 9: LSH_POW_RISE to LSH_TEMP_PROT
TEG_DYN_LS_DOWN[i] $>$ C_TEG_DYN_MAX_LSH_DOWN **&**
LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 0
Transition actions:
STATE_LSH_DOWN[i] = LSH_TEMP_PROT
Condition 6: LSH_POW_RISE to LSH_VB_PROT
LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 1
Transition actions:
STATE_LSH_DOWN[i] = LSH_VB_PROT
Condition 2: LSH_POW_RISE to LSH_POW_RED
T_POW_RISE_LSH_DOWN[i]   IP_T_TEMP_THD_LSH_DOWN (TEMP_INI_LS_DOWN[i]) **&**
LV_TEMP_DEW_LS_DOWN[i] = 0
Transition actions:
STATE_LSH_DOWN[i] = LSH_POW_RED
Condition 13: LSH_POW_RISE to LSH_POW_CTL
LV_LS_DOWN_READY[i] = 1
Transition actions:
Stop timer T_POW_RISE_LSH_DOWN[i] and freeze value
STATE_LSH_DOWN[i] = LSH_POW_CTL
Condition 4: LSH_POW_RISE to LSH_POW_FALL
T_POW_RISE_LSH_DOWN[i]   C_T_MAX_POW_RISE_LSH_DOWN + IP_T_TEMP_THD_LSH_DOWN
% IP_ ... (TEMP_INI_LS_DOWN[i])
Transition actions:
Stop timer T_POW_RISE_LSH_DOWN[i] and freeze value
STATE_LSH_DOWN[i] = LSH_POW_FALL
STATE_LSH_DOWN[i]   LSH_POW_RED
Actions:
V_EFC_CLC_LSH_DOWN[i] = C_V_EFC_RED_LSH_DOWN
Condition 8: LSH_POW_RED to LSH_OFF
LV_ST_END = 0 **or** LV_INH_LSH_DOWN[i] = 1
Transition actions:
STATE_LSH_DOWN[i] = LSH_OFF
Condition 9: LSH_POW_RED to LSH_TEMP_PROT
TEG_DYN_LS_DOWN[i] $>$ C_TEG_DYN_MAX_LSH_DOWN **&**

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LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 0
Transition actions:
STATE_LSH_DOWN[i] = LSH_TEMP_PROT
Condition 6: LSH_POW_RED to LSH_VB_PROT
LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 1
Transition actions:
STATE_LSH_DOWN[i] = LSH_VB_PROT
Condition 3: LSH_POW_RED to LSH_POW_RISE
LV_TEMP_DEW_LS_DOWN[i] = 1
Transition actions:
V_EFC_CLC_LSH_DOWN[i] = IP_V_EFC_INI_LSH_DOWN
+ C_V_EFC_STEP_LSH_DOWN
% IP_ ... (TEMP_INI_LS_DOWN[i]) *same value as at start*
T_POW_RISE_LSH_DOWN[i] = IP_T_TEMP_THD_LSH_DOWN
% TEMP_INI_LS_DOWN[i] *same value as at start*
STATE_LSH_DOWN[i] = LSH_POW_RISE
Note: See section Oxygen sensor heater voltage protection for notes on limiting the applied heater voltage. The function shall prevent the effective heater voltage from becoming negative by limiting to 0 where necessary.
STATE_LSH_DOWN[i] LSH_POW_FALL
Actions:
V_EFC_CLC_LSH_DOWN[i]$_N$ = V_EFC_CLC_LSH_DOWN[i]$_{N-1}$ - C_V_EFC_DEC_LSH_DOWN *
T_SAMPLE_1
Note: See section Oxygen sensor heater voltage protection for notes on limiting the applied heater voltage. The function shall prevent the effective heater voltage from becoming negative by limiting to 0 where necessary.
Condition 8: LSH_POW_FALL to LSH_OFF
LV_ST_END = 0 **or** LV_INH_LSH_DOWN[i] = 1
Transition actions:
STATE_LSH_DOWN[i] = LSH_OFF
Condition 9: LSH_POW_FALL to LSH_TEMP_PROT
TEG_DYN_LS_DOWN[i] $>$ C_TEG_DYN_MAX_LSH_DOWN **&**
LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 0
Transition actions:
STATE_LSH_DOWN[i] = LSH_TEMP_PROT
Condition 6: LSH_POW_FALL to LSH_VB_PROT
LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 1
Transition actions:
STATE_LSH_DOWN[i] = LSH_VB_PROT
Condition 14: LSH_POW_FALL to LSH_POW_RED
LV_TEMP_DEW_LS_DOWN[i] = 0
Transition actions:
T_V_EFC_TOL_LSH_DOWN[i] = 0
T_V_EFC_LIM_LSH_DOWN[i] = 0
LV_V_EFC_LIM_BOL_LSH_DOWN[i] = 0
LV_V_EFC_LIM_TOL_LSH_DOWN[i] = 0
LV_V_EFC_LIM_MAX_LSH_DOWN[i] = 0
STATE_LSH_DOWN[i] = LSH_POW_RED
Condition 5: LSH_POW_FALL to LSH_POW_CTL
For bank 1; i = 1
V_EFC_LSH_DOWN[i]IP_V_EFC_CTL_LSH_DOWN(N_32,TEG_DYN_LS_DOWN[i])
For bank 2; i = 2
V_EFC_LSH_DOWN[i]IP_V_EFC_CTL_LSH_DOWN(N_32,TEG_DYN_LS_DOWN[i])

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* IP_FAC_V_EFC_TEG_LSH_DOWN

Transition actions:

STATE_LSH_DOWN[i] = LSH_POW_CTL

STATE_LSH_DOWN[i] LSH_POW_CTL

Actions:

Compute effective heater voltage from open loop control and closed loop delta voltages:

For Bank 1; i = 1

V_EFC_CLC_LSH_DOWN[i] = IP_V_EFC_CTL_LSH_DOWN + C_V_EFC_AS_LSH_DOWN
% IP_ ... (N_32, TEG_DYN_LS_DOWN[i])

Note: If (IP_V_EFC_CTL_LSH_DOWN + C_V_EFC_AS_LSH_DOWN) < 0 , i.e. would cause the effective heater voltage to be negative, V_EFC_CLC_LSH_DOWN[i] shall be limited to 0 and LV_V_EFC_LIM_BOL_LSH_DOWN[i] shall be set, until the sum less than zero condition is no longer met at which point LV_V_EFC_LIM_BOL_LSH_DOWN[i] shall be reset.

For Bank 2; i = 2

V_EFC_CLC_LSH_DOWN[i] = IP_V_EFC_CTL_LSH_DOWN * IP_FAC_V_EFC_TEG_LSH_DOWN
+ C_V_EFC_AS_LSH_DOWN
% IP_ ... (N_32, TEG_DYN_LS_DOWN[i])

Note: If (IP_V_EFC_CTL_LSH_DOWN * IP_FAC_V_EFC_TEG_LSH_DOWN + C_V_EFC_AS_LSH_DOWN) < 0 , i.e. would cause the effective heater voltage to be negative, V_EFC_CLC_LSH_DOWN[i] shall be limited to 0 and LV_V_EFC_LIM_BOL_LSH_DOWN[i] shall be set, until the sum less than zero condition is no longer met at which point LV_V_EFC_LIM_BOL_LSH_DOWN[i] shall be reset.

Condition 8: LSH_POW_CTL to LSH_OFF

LV_ST_END = 0 **or** LV_INH_LSH_DOWN[i] = 1

Transition actions:

STATE_LSH_DOWN[i] = LSH_OFF

Condition 9: LSH_POW_CTL to LSH_TEMP_PROT

TEG_DYN_LS_DOWN[i] > C_TEG_DYN_MAX_LSH_DOWN **&**
LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 0

Transition actions:

STATE_LSH_DOWN[i] = LSH_TEMP_PROT

Condition 6: LSH_POW_CTL to LSH_VB_PROT

LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 1

Transition actions:

STATE_LSH_DOWN[i] = LSH_VB_PROT

Condition 14: LSH_POW_CTL to LSH_POW_RED

LV_TEMP_DEW_LS_DOWN[i] = 0

Transition actions:

T_V_EFC_TOL_LSH_DOWN[i] = 0
T_V_EFC_LIM_LSH_DOWN[i] = 0
LV_V_EFC_LIM_BOL_LSH_DOWN[i] = 0
LV_V_EFC_LIM_TOL_LSH_DOWN[i] = 0
LV_V_EFC_LIM_MAX_LSH_DOWN[i] = 0
STATE_LSH_DOWN[i] = LSH_POW_RED

STATE_LSH_DOWN[i] LSH_VB_PROT

Actions:

V_EFC_CLC_LSH_DOWN[i] = C_V_EFC_PROT_VB_LSH_DOWN

Condition 8: LSH_VB_PROT to LSH_OFF

LV_ST_END = 0 **or** LV_INH_LSH_DOWN[i] = 1

Transition actions:

STATE_LSH_DOWN[i] = LSH_OFF

Condition 9: LSH_VB_PROT to LSH_TEMP_PROT

TEG_DYN_LS_DOWN[i] > C_TEG_DYN_MAX_LSH_DOWN **&**

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LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 0
Transition actions:
STATE_LSH_DOWN[i] = LSH_TEMP_PROT
Condition 7: LSH_VB_PROT to LSH_POW_RISE
LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 0
Transition actions:
T_POW_RISE_LSH_DOWN[i] = 0
V_EFC_CLC_LSH_DOWN[i] = IP_V_EFC_INI_LSH_DOWN
% IP_ ... (TEMP_INI_LS_DOWN[i]) *same value as at start*
T_V_EFC_TOL_LSH_DOWN[i] = 0
T_V_EFC_LIM_LSH_DOWN[i] = 0
LV_V_EFC_LIM_BOL_LSH_DOWN[i] = 0
LV_V_EFC_LIM_TOL_LSH_DOWN[i] = 0
LV_V_EFC_LIM_MAX_LSH_DOWN[i] = 0
STATE_LSH_DOWN[i] = LSH_POW_RISE
STATE_LSH_DOWN[i]   LSH_TEMP_PROT
Actions:
V_EFC_CLC_LSH_DOWN[i] = 0
Condition 8: LSH_TEMP_PROT to LSH_OFF
LV_ST_END = 0 **or** LV_INH_LSH_DOWN[i] = 1
Transition actions:
STATE_LSH_DOWN[i] = LSH_OFF
Condition 12: LSH_TEMP_PROT to LSH_VB_PROT
LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 1
Transition actions:
STATE_LSH_DOWN[i] = LSH_VB_PROT
Condition 10: LSH_TEMP_PROT to LSH_POW_CTL
TEG_DYN_LS_DOWN[i]   C_TEG_DYN_MAX_LSH_DOWN **&**
Previous state of STATE_LSH_DOWN[i] = LSH_POW_CTL
Transition actions:
STATE_LSH_DOWN[i] = LSH_POW_CTL
Condition 11: LSH_TEMP_PROT to LSH_POW_RISE
TEG_DYN_LS_DOWN[i]   C_TEG_DYN_MAX_LSH_DOWN **&**
Previous state of STATE_LSH_DOWN[i]   LSH_POW_CTL
Transition actions:
T_POW_RISE_LSH_DOWN[i] = 0
V_EFC_CLC_LSH_DOWN[i] = IP_V_EFC_INI_LSH_DOWN (TEMP_INI_LS_DOWN[i])
% IP_ ... (TEMP_INI_LS_DOWN[i]) *same value as at start*
T_V_EFC_TOL_LSH_DOWN[i] = 0
T_V_EFC_LIM_LSH_DOWN[i] = 0
LV_V_EFC_LIM_BOL_LSH_DOWN[i] = 0
LV_V_EFC_LIM_TOL_LSH_DOWN[i] = 0
LV_V_EFC_LIM_MAX_LSH_DOWN[i] = 0
STATE_LSH_DOWN[i] = LSH_POW_RISE
Note: Should none of the conditions have been determined to be met, the state machine shall remain in the same state.

7.52.2 Oxygen sensor heater voltage protection

Prolonged exposure to heater voltages that exceed the absolute maximum ratings specified shall be prevented. The preventative measures shall be applicable to all heater states other than LSH_OFF.
If STATE_LSH_DOWN[i]   LSH_OFF
then **If** V_EFC_CLC_LSH_DOWN[i]   C_V_EFC_TOL_LSH_DOWN

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```
then        If        T_V_EFC_TOL_LSH_DOWN[i]
                      C_T_MAX_V_EFC_TOL_LSH_DOWN
            then        If        T_V_EFC_LIM_LSH_DOWN[i]
                      C_T_MAX_V_EFC_LIM_LSH_DOWN
                  then        LV_V_EFC_LIM_TOL_LSH_DOWN[i] = 0
                        Reset timer T_V_EFC_LIM_LSH_DOWN[i]
                        Reset timer T_V_EFC_TOL_LSH_DOWN[i]
                  else        LV_V_EFC_LIM_TOL_LSH_DOWN[i] = 1
                        Increment timer T_V_EFC_LIM_LSH_DOWN[i]
                  endif
            else        LV_V_EFC_LIM_TOL_LSH_DOWN[i] = 0
                  Reset timer T_V_EFC_LIM_LSH_DOWN[i]
                  Increment timer T_V_EFC_TOL_LSH_DOWN[i]
            endif
else        LV_V_EFC_LIM_TOL_LSH_DOWN[i] = 0
            If        T_V_EFC_LIM_LSH_DOWN[i] = 0
        or        T_V_EFC_LIM_LSH_DOWN[i]
                      C_T_MAX_V_EFC_LIM_LSH_DOWN
            then        Reset timer T_V_EFC_LIM_LSH_DOWN[i]
                  Reset timer T_V_EFC_TOL_LSH_DOWN[i]
            else        Increment timer T_V_EFC_LIM_LSH_DOWN[i]
            endif
endif
If    T_POW_RISE_LSH_DOWN[i]
                C_T_MAX_V_EFC_MAX_ST_LSH_DOWN
or          (T_AST   C_T_AST_MAX_LSH_DOWN
and          STATE_LSH_DOWN[i] = "LSH_POW_CTL")
then        If        V_EFC_CLC_LSH_DOWN[i] > VB
        or        V_EFC_CLC_LSH_DOWN[i] > C_V_EFC_MAX_LSH_DOWN
            then        LV_V_EFC_LIM_MAX_LSH_DOWN[i] = 1
                  V_EFC_CLC_LSH_DOWN[i] =
                              MIN (VB; C_V_EFC_MAX_LSH_DOWN)
            else        LV_V_EFC_LIM_MAX_LSH_DOWN[i] = 0
            endif
else        If        V_EFC_CLC_LSH_DOWN[i] > VB
        or        V_EFC_CLC_LSH_DOWN[i] > C_V_EFC_MAX_ST_LSH_DOWN
            then        LV_V_EFC_LIM_MAX_LSH_DOWN[i] = 1
                  V_EFC_CLC_LSH_DOWN[i] =
                              MIN (VB, C_V_EFC_MAX_ST_LSH_DOWN)
            else        LV_V_EFC_LIM_MAX_LSH_DOWN[i] = 0
            endif
endif
If          T_V_EFC_LIM_LSH_DOWN[i] <> 0
then        V_EFC_LSH_DOWN[i] =
                MIN (V_EFC_CLC_LSH_DOWN[i], C_V_EFC_LIM_LSH_DOWN)
else        V_EFC_LSH_DOWN[i] = V_EFC_CLC_LSH_DOWN[i]
endif
endif
```

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7.52.3 Oxygen sensor heater driver duty cycle computation

The PWM duty cycle for the appropriate heater driver shall continually be calculated in all heater states at the specified recurrence.

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If STATE_LSH_DOWN[i] = LSH_OFF
then LSHPWM_DOWN[i] = LSHPWM_EXT_LS_DOWN[i]
else **If** VB C_VB_MAX_PROT_LSH_DOWN
then LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 1
LSHPWM_DOWN[i] = C_V_EFC_PROT_VB_LSH_DOWN^2 * 100 /VB$_N$^{2}
else LV_V_EFC_LIM_PROT_VB_LSH_DOWN[i] = 0
LSHPWM_DOWN[i] = V_EFC_LSH_DOWN[i]$_N$^{2} *
C_FAC_V_EFC_AS_LSH_DOWN *100 /VB$_N$^{2}
If LSHPWM_DOWN[i] NC_LSHPWM_TOL_LSH_DOWN
then LSHPWM_DOWN[i] = NC_LSHPWM_TOL_LSH_DOWN
else **If** LSHPWM_DOWN[i] NC_LSHPWM_BOL_LSH_DOWN
then LSHPWM_DOWN[i] = NC_LSHPWM_BOL_LSH_DOWN
else LSHPWM_DOWN[i] = LSHPWM_DOWN[i]
endif
endif
endif
endif.
ACTION_INFR_SetPwmLshDown(
IN **i**
IN **LSHPWM_DOWN[i])**

The value C_FAC_V_EFC_AS_LSH_DOWN is a correction signal generated in the application system.

NOTE: The recurrence of the heater driving duty cycle shall occur at the same recurrence as the Vbatt acquisition. This shall prevent short duration voltage drop-outs during engine start from causing long duration Vbatt corrections being made where the Vbatt has since recovered. This may otherwise cause excessive current to flow in the heater driver.

The computation of the duty cycle shall be checked to ensure that the result remains positive (i.e. 0) at all times and that now under- or overflows are caused by the values of the calibration system constants.

The multiplication of the corrected voltage ratio by 100 to obtain a unit of percent (%) may not necessarily be implemented in the SW but in the data bank definition of the variables.

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7.53 O2 sensor (bin, down) heater management (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LSHPWM_EXT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 99.60937	0.390625	%
Downstream heater PWM duty cycle preset from external tester					
LV_INH_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for heating not met					
TEMP_INI_LS_DOWN [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Oxygen sensor temperature at start					

Input data:

LSHPWM_DOWN_EXT_ADJ [NC_CBK_EX_NR] {p. 7431}	LV_IGK {p. 906}	LV_LSHPWM_DOWN_EXT_ADJ [NC_CBK_EX_NR] {p. 7434}	LV_VAR_LSH_DOWN {p. 656}
NC_CBK_EX_NR {p. 1829}	NC_LSHPWM_BOL_LSH_DOWN {p. 2423}	TEG_WALL_CAT_DOWN_MDL [NC_CBK_EX_NR] {p. 8236}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LSH_DOWN [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Boolean variable to enable oxygen sensor heating					

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Description:

The Boolean constant LC_LSH_DOWN[i] shall permit the appropriate oxygen sensor to be heated. When set, the Boolean inhibit flag LV_INH_LSH_DOWN[i] shall be reset. When reset, LV_INH_LSH_DOWN[i] shall be set.
The oxygen sensor temperature at start TEMP_INI_LS_DOWN[i] shall be obtained from the input variable TEG_WALL_CAT_DOWN_MDL[i] (this is the exhaust duct temperature downstream) every time an engine start is finished.
All actions beside the initialisation routine are done only, if the variant with monitor lambda sensors is on the table.

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Application conditions

Activation: *LV_IGK = 1*

Deactivation: *LV_IGK = 0*

Recurrence: *1 s*

Initialisation:

The following variable initialisation shall take place at the beginning of a new driving cycle:

LV_INH_LSH_DOWN[i] = 0
LSHPWM_EXT_LS_DOWN[i] = 0
TEMP_INI_LS_DOWN[i] = 0 °C

Formula section:

```
IF          LV_LSHPWM_DOWN_EXT_ADJ[i] = 0
THEN
     if      LV_VAR_LSH_DOWN = 0
     then       LV_INH_LSH_DOWN[i]   =   1
            LSHPWM_EXT_LS_DOWN[i]   = NC_LSHPWM_BOL_LSH_DOWN
     else       LV_INH_LSH_DOWN[i]   =  ! LC_LSH_DOWN[i]
            LSHPWM_EXT_LS_DOWN[i]   =   0
ELSE        LV_INH_LSH_DOWN[i]   =   1
            LSHPWM_EXT_LS_DOWN[i]   = LSHPWM_DOWN_EXT_ADJ[i]
ENDIF
```

Once at every function activation:

TEMP_INI_LS_DOWN[i] = TEG_WALL_CAT_DOWN_MDL[i]

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7.54 O2 sensor lambda setpoint intervention

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_DIAG_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda set point for active plausibility test					
LV_LAMB_SP_REQ_DIAG_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Lambda coordination request to change set point for active plausibility test					

Input data:

LAMB_SP_DIAG_OC_ LSL_UP [NC_CBK_EX_NR] {p. 4300}	LAMB_SP_DIAG_OPL_ LS_UP_DOWN [NC_CBK_EX_NR] {p. 5387}	LAMB_SP_OSC_CHK [NC_CBK_EX_NR] {p. 5214}	LV_ST_END {p. 1720}

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

This function provides an internal coordination of lambda setpoint requests from functions within EGCP.

Description:

The function shall perform a priority ranking for several lambda setpoint requests established inside the EGCP aggregate and forward one request to functions outside EGCP. The flag LV_LAMB_SP_REQ_DIAG_ACT[i] shall indicate that at least one setpoint request is active. No check should be performed whether the setpoint is reached, nor should a request for open or closed loop lambda control be output. The possible sources of lambda setpoint requests are:

- plausibility check of upstream and downstream O2 sensor,
- monitor for downstream O2 sensor during oscillation check,
- monitor for upstream O2 sensor during open circuit check.

Application conditions

Initialisation:

At LV_IGK = 0 to 1, reset or at clearing error memory initialize all variables and bits with 0, with the expection of:
LAMB_SP_DIAG_LS_UP_DOWN[i] which is initialized with 1.

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Recurrence:
This function shall be carried out every 100 ms.

Activation:
LV_ST_END = 1

Formula section:

% priority is open loop check > oscillation check > open circuit check
If LAMB_SP_DIAG_OPL_LS_UP_DOWN[i] > 0
then
LAMB_SP_DIAG_LS_UP_DOWN[i] = LAMB_SP_DIAG_OPL_LS_UP_DOWN[i]
LV_LAMB_SP_REQ_DIAG_ACT[i] = 1

elseif LAMB_SP_OSC_CHK[i] > 0
then
LAMB_SP_DIAG_LS_UP_DOWN[i] = LAMB_SP_OSC_CHK[i]
LV_LAMB_SP_REQ_DIAG_ACT[i] = 1

elseif LAMB_SP_DIAG_OC_LSL_UP[i] > 0
and LAMB_SP_DIAG_OPL_LS_UP_DOWN[i] = 0 for all i
then
LAMB_SP_DIAG_LS_UP_DOWN[i] = LAMB_SP_DIAG_OC_LSL_UP[i]
LV_LAMB_SP_REQ_DIAG_ACT[i] = 1

else
LAMB_SP_DIAG_LS_UP_DOWN[i] = 1
LV_LAMB_SP_REQ_DIAG_ACT[i] = 0
endif

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7.55 O2 sensor air fuel cycle evaluation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_AFL_CYC [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Counter indicating number of air fuel cycles					
LV_AFL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating detection of lean Air-Fuel mixture when set					
LV_AFL_OLD_1_EGCP [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Auxiliary flag indicating lean Air-Fuel mixture status of previous sample step					
T_AFL_CYC [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 655.35	0.01	s
Lean mixture cycle time					
T_AFL_CYC_HLD [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 655.35	0.01	s
Lean mixture cycle time, held until next new value available					
T_AFR_CYC [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 655.35	0.01	s
Rich mixture cycle time					
T_SUM_AFL_AFR_CYC [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 655.35	0.01	s
Lean plus rich mixture cycle time; time of last forced lambda stimulation period					

Input data:

LAMB_PLS [NC_CBK_EX_NR] {p. 2558}	LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2,

otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Signal flow diagram:

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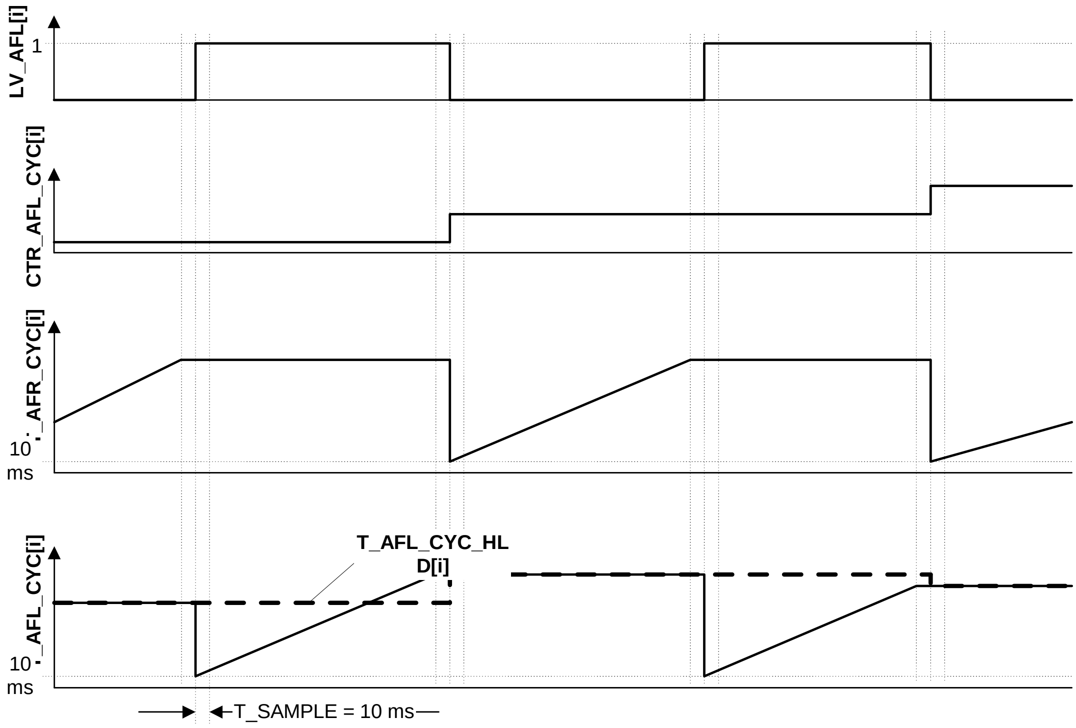

Figure 7.55.1: : Definition of   dwell times

Description:

The logical variable LV_AFL_i that indicates a lean air fuel ratio (lambda set point is lean) is calculated based on the output of the forced lambda stimulation. In case of a positive LAMB_PLS[i] the flag is set to one. The lean dwell time T_AFL_CYC[i] is calculated in that case. If LAMB_PLS[i] is negative or zero LV_AFL[i] is 0. In that case the rich dwell time T_AFL_CYC[i] is calculated.
When LV_AFL[i] switches from 0 to 1 T_AFL_CYC[i] is reset. When LV_AFL[i] switches from 1 to 0 T_AFR_CYC[i] is reset and the current value of T_AFL_CYC[i] is stored in the variable T_AFL_CYC_HLD[i]
The function is only active when the forced lambda stimulation is active (LV_LAMB_PLS_ACT[i] = 1). For further explanation see Figure 1.
T_SUM_AFL_AFR_CYC[i] is the period time of the forced lambda stimulation. It is updates each rising edge of LV_AFL[i].

Application conditions

Initialisation: at engine start (LV_ST_END = 0 -> 1) and at each function activation:

```
LV_AFL[i] = 0
        LV_AFL_OLD_1_EGCP[i] = 0
        CTR_AFL_CYC[i] = 0
        T_AFR_CYC[i] = T_SAMPLE
        T_AFL_CYC[i] = T_SAMPLE
        T_AFL_CYC_HLD[i] = T_SAMPLE
        T_SUM_AFL_AFR_CYC[i] = T_SAMPLE
```

Recurrence: *T_SAMPLE = 10 ms*

Activation: *LV_LAMB_PLS_ACT[i] = 1*

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Deactivation: –

Formula section:

```
IF LAMB_PLS[i] > 0       /* lean */
THEN
LV_AFL[i] = 1
IF LV_AFL_OLD_1_EGCP[i] = 0       /* rising edge LV_AFL[i] = 0 -> 1 */
THEN
T_SUM_AFL_AFR_CYC[i] = T_AFL_CYC_HLD[i] + T_AFR_CYC[i]
T_AFL_CYC[i] = T_SAMPLE
ELSE
T_AFL_CYC[i] = T_AFL_CYC[i] + T_SAMPLE
ENDIF
ELSE/* rich */
LV_AFL[i] = 0
IF LV_AFL_OLD_1_EGCP[i] = 1       /* falling edge LV_AFL[i] = 1 -> 0 */
THEN
T_AFR_CYC[i] = T_SAMPLE
T_AFL_CYC_HLD[i] = T_AFL_CYC[i]
CTR_AFL_CYC[i] = CTR_AFL_CYC[i] + 1
ELSE
T_AFR_CYC[i] = T_AFR_CYC[i] + T_SAMPLE
    ENDIF
ENDIF
LV_AFL_OLD_1_EGCP[i] = LV_AFL[i]
```

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7.56 Exhaust gas temperature model

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_COLD_ST_DOWN	O/V/S	0... FFH	0... 255	1	-
Number of cold starts at downstream-catalyst					
CTR_COLD_ST_UP	O/V/S	0... FFH	0... 255	1	-
Number of cold starts at upstream-catalyst					
FAC_DEW_CTR_COLD_ST_DOWN	O/V	0... FFFFH	0... 255.99609	3.9062e-3	-
Factor for dew point recognition downstream					
FAC_DEW_CTR_COLD_ST_UP	O/V	0... FFFFH	0... 255.99609	3.9062e-3	-
Factor for dew point recognition upstream					
INT_TEG_MAF	V	0... FFFFH	0... 9102.08	0.1388888	g
sum of the weighted air mass flow values used for the dew point recognition					
LV_TEG_CAT_DOWN_MIN_THD	O/V	0... 1H	0 ...1	1	-
dew point has been reached pre/post cat. specific bank selective downstream					
LV_TEG_MIN_THD	O/V	0... 1H	0 ...1	1	-
Dew-point recognition					
MAF_DEW_ADD_DOWN	O/V	0... FFFFH	0... 9102.08	0.1388888	g
Additional amount of air mas flow until reaching dew point downstream					
MAF_DEW_ADD_UP	O/V	0... FFFFH	0... 9102.08	0.1388888	g
Additional amount of air mas flow until reaching dew point upstream					
MAF_INT_DEW_END_DOWN_SP	O/V	0... FFFFH	0... 9102.08	0.1388888	g
Total air mass flow wich is converted in the exhaust gas until reaching the dew point downstream					
MAF_INT_DEW_END_UP_SP	O/V	0... FFFFH	0... 9102.08	0.1388888	g
Total air mass flow wich is converted in the exhaust gas until reaching the dew point upstream					
MAF_INT_TEG_CAT_DOWN_THD	O/V	0... FFFFH	0... 9102.08	0.1388888	g
Air mass flow wich is converted in the exhaust gas until reaching the dew point downstream					
MAF_INT_TEG_THD	O/V	0... FFFFH	0... 9102.08	0.1388888	g
Air mass flow wich is converted in the exhaust gas until reaching the dew point upstream					
T_ES_DEW	O/V	0... FFFFH	0... 65535	1	min
Engine shut-off duration					

Input data:

LV_ES {p. 1720}	LV_HOM_ACT {p. 8136}	LV_IGK {p. 906}	LV_PUC {p. 1720}
LV_ST {p. 1720}	MAF_KGH {p. 1195}	T_ES_CUS {p. 1444}	TAM {p. 1579}
TCO_ST {p. 1100}	TIA {p. 1226}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_COLD_ST_DOWN	-	0... FFH	0... 3.98437	0.015625	-
weighting factor for the consideration of the number of cold starts downstream of the catalyst					
C_CTR_COLD_ST_UP	-	0... FFH	0... 3.98437	0.015625	-
weighting factor for the consideration of the number of cold starts upstream of the catalyst					
IP_INT_TEG_CAT_DOWN_THD	V	0... FFFFH	0... 9102.08	0.1388888	g
LDPM_TCO_ST_1_EXTD	8	0... FEH	-48... 142.5	0.75	°C
LDPM_TIA_1_EXTD	6	0... FEH	-48... 142.5	0.75	°C
threshold air mass flow integral for detection of dew point downstream of catalyst					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_INT_TEG_THD	V	0... FFFFH	0... 9102.08	0.1388888	g
LDPM_TCO_ST_1_EXTD	8	0... FEH	-48... 142.5	0.75	°C
LDPM_TIA_1_EXTD	6	0... FEH	-48... 142.5	0.75	°C
threshold air mass flow integral for detection of dew point upstream of catalyst					
IP_MAF_ADD_DEW_DOWN	V	0... FFFFH	0... 9102.08	0.1388888	g
LDPM_T_ES_DEW	8	0... FFFFH	0... 65535	1	min
LDPM_TAM	6	0... FEH	-48... 142.5	0.75	°C
Additional air mass flow for consideration of cooling down effect to the exhaust wall-temperature downstream					
IP_MAF_ADD_DEW_UP	V	0... FFFFH	0... 9102.08	0.1388888	g
LDPM_T_ES_DEW	8	0... FFFFH	0... 65535	1	min
LDPM_TAM	6	0... FEH	-48... 142.5	0.75	°C
Additional air mass flow for consideration of cooling down effect to the exhaust wall-temperature upstream					

7.56.1 Detection of dew point

FUNCTION DESCRIPTION:

General information:

The exhaust gas temperature model has been removed from supplier side and is now modelled in the BMW objects. This module does satisfy the open interfaces of the dew point recognition between supplier and BMW.

Application conditions

Initialisation:

```
IF  (there are no adaptation values stored OR  the EEPROM
does not work)
            THEN
      CTR_COLD_ST_UP = 0 (default value is set)
      CTR_COLD_ST_DOWN = 0 (default value is set)

ELSE        CTR_COLD_ST_UP = CTR_COLD_ST_UP
      CTR_COLD_ST_DOWN = CTR_COLD_ST_DOWN
      (previously stored values are assigned)

          END
          At transition LV_ES = 1 -> 0
          INT_TEG_MAF = 0         (Mass flow integral for dew
point detection)
          LV_TEG_MIN_THD = 0         (State:  dew point not
passed)
          LV_TEG_CAT_DOWN_MIN_THD = 0 (State:  dew point downstream
of cat.  not passed)
```

Recurrence: 1000ms

Activation: LV_ES and LV_ST = 0 (after leaving the engine state ST)

Deactivation: LV_ES = 1 (engine state ES is active)

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Formula section:

Calculation of the number of cold starts up-/downstream:

After leaving the engine state ST the value of CTR_COLD_ST_UP/DOWN is incremented by the increment one.
The value CTR_COLD_ST_UP/DOWN is a measure of the number of cold-start tests and has to be stored in the flash-memory when the engine is switched off (LV_IGK = 0). After a new start of the engine CTR_COLD_ST_UP/DOWN is initialized with the stored value.

IF LV_ST_END= 0 -> 1
THEN CTR_COLD_ST_UP = CTR_COLD_ST_UP + 1
CTR_COLD_ST_DOWN = CTR_COLD_ST_DOWN +1
ENDIF

Calculation of INT_TEG_MAF

IF LV_PUC = 0 **AND** (LV_TEG_MIN_THD = 0 **OR** LV_TEG_CAT_DOWN_MIN_THD = 0)
% For PUC active no increment of INT_TEG_MAF$_N$
THEN
INT_TEG_MAF$_N$ = INT_TEG_MAF$_{N-1}$ + MAF_KGH$_N$ * 1000ms

END

Dew point upstream of catalyst:
T_ES_DEW = T_ES_CUS

MAF_INT_TEG_THD = IP_INT_TEG_THD(TCO_ST, TIA)
MAF_DEW_ADD_UP = IP_MAF_ADD_DEW_UP(T_ES_DEW, TAM)
FAC_DEW_CTR_COLD_ST_UP = (1 + (CTR_COLD_ST_UP - 1) * C_CTR_COLD_ST_UP)

MAF__INT_DEW_END_UP_SP = **(**MAF_INT_TEG_THD + MAF_DEW_ADD_UP) * FAC_DEW_CTR_COLD_ST_UP

IF INT_TEG_MAFN >**=**MAF_INT_DEW_END_UP_SP
THEN
LV_TEG_MIN_THD = 1 % dew point passed
ENDIF

Reset of cold start counter CTR_COLD_ST_UP:

IF LV_TEG_MIN_THD = 1
THEN
CTR_COLD_ST_UP = 0 % reset of cold start counter upstream
ENDIF

Dew point downstream of catalyst:

MAF_INT_TEG_CAT_DOWN_THD = IP_INT_TEG_CAT_DOWN_THD(TCO_ST, TIA)

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MAF_DEW_ADD_DOWN = IP_MAF_ADD_DEW_DOWN(T_ES_DEW, TAM)
FAC_DEW_CTR_COLD_ST_DOWN = (1 + (CTR_COLD_ST_DOWN - 1) * C_CTR_COLD_ST_DOWN)

MAF_INT_DEW_END_DOWN_SP = (MAF_INT_TEG_CAT_DOWN_THD + MAF_DEW_ADD_DOWN) *
FAC_DEW_CTR_COLD_ST_DOWN

IF INT_TEG_MAFN >=MAF_INT_DEW_END_DOWN_SP
THEN
LV_TEG_CAT_DOWN_MIN_THD = 1 % dew point passed
ENDIF

Reset of cold start counter CTR_COLD_ST_DOWN:

IF LV_TEG_CAT_DOWN_MIN_THD = 1
THEN
CTR_COLD_ST_DOWN = 0 % reset of cold start counter downstream
ENDIF

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7.57 Exhaust gas temperature model (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_TEG_CAT_DOWN_MIN_THD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
dew point has been reached pre/post cat. specific bank selective downstream					
LV_TEG_MIN_THD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Dew-point recognition					
NR_CYL_SCC_TEG [NC_CBK_EX_NR]	O/V	0... 1AH	0... 13	0.5	-
Number of shut off cylinders for TEG calculation					

Input data:

INH_CYC_IV {p. 798}	INH_SWI_IV {p. 2295}	LV_IGK {p. 906}	LV_TEG_CAT_DOWN_MIN_THD [NC_CBK_EX_NR] {p. 2446}
LV_TEG_MIN_THD [NC_CBK_EX_NR] {p. 2446}			

7.57.1 Mean value calculations for the TEG model

General information:

The TEG model is calculated at the recurrence of 500 ms. For this it is nessesary to calculate mean values by high frequency influency variables. The sampling of the input datas are 10 ms.

Application conditions

Initialisation: –

Recurrence: 10ms

Activation: LV_IGK = 1

Deactivation: –

FUNCTION DESCRIPTION:

Cylinder shut off regionisation:
This function shows bank selective the mean value of shut off cylinders about 500 ms. After this time the sampling is starting again.

N53 /N54:

⇐ Logic Cylinder Number

INH_CYC_IV = XXXXXXXXX
Bank 1 (log): 0; 2; 4 Log: 0 1 2 3 4 5
Bank 2 (log): 1; 3; 5 Pys.: R6 Cyl: 1 5 3 6 2 4

INH_SWI_IV = XXXXXXXXX

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Bank 1 (log): 0; 2; 4 Log: 0 1 2 3 4 5
Bank 2 (log): 1; 3; 5 Pys.: R6 Cyl: 1 5 3 6 2 4

N43:

⇐ Logic Cylinder Number

INH_CYC_IV = XXXXXXXXX
Bank 1 (log): 0; 2 Log: 0 1 2 3
Bank 2 (log): 1; 3; Pys.: R4 Cyl: 1 3 4 2

INH_SWI_IV = XXXXXXXXX
Bank 1 (log): 0; 2; Log: 0 1 2 3
Bank 2 (log): 1; 3; Pys.: R4 Cyl: 1 3 4 2

NR_CYL_SCC_TEG_RAW[i]: Number of shut off cylinder bank i
MAX (INH_SWI_IV ; INH_CYC_IV)

Formula section:

IF counter $<$ 50 (Sampling 10ms)
Then NR_CYL_SCC_TEG_RAW[i] =
(NR_CYL_SCC_TEG_RAW[i]$_{=n-1}$+ Number of shut off cylinder bank i)
counter + 1
Else counter = 50
NR_CYL_SCC_TEG[i] = NR_CYL_SCC_TEG_RAW[i] /50 NR_
CYL_SCC_TEG_RAW[i] and counter reset to 0
Endif

7.57.2 Conversion of temperature outputs for interfaces

7.57.2.1 Exhaust temperature for interfaces

Description:

A conversion is necessary to support the different resolutions in other modules.

Application conditions

Initialisation: –
Recurrence: 500ms
Activation: at all engine operating states
Deactivation: –

Formula section:

LV_TEG_MIN_THD_1 = LV_TEG_MIN_THD
LV_TEG_MIN_THD_2 = LV_TEG_MIN_THD
LV_TEG_CAT_DOWN_MIN_THD_1 = LV_TEG_CAT_DOWN_MIN_THD
LV_TEG_CAT_DOWN_MIN_THD_2 = LV_TEG_CAT_DOWN_MIN_THD

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7.58 Lambda control conditions

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_DIF_SOI_LSL_POS [NC_CBK_EX_NR]	O/V	0... 10EH	0... 1620	6	°CRK
crank shaft angle difference between the start of injection and the end of the exhaust cycle					
LV_LAM_ACT_DC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
closed loop had been enabled for at least one time					
LV_LAM_NOT_STAT_CDN	O/V	0... 1H	0 ...1	1	-
flag for stop mode activation of lambda controller by wall film					
LV_LAM_STOP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation signal for the lambda controller stop mode					
LV_LAM_STOP_SHO_PER [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation signal for the controller stop mode while active offset adjustment					
MAF_INT_LAM_REAC [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.42	0.0277778	g
air mass flow for lambda controller reactivation after stop mode					
STATE_LS [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H 10H	INI OL_CDN CL OL_INTR OL_ERR CL_ERR	-	-
Fuel system status					
STATE_LS_SAE [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H 10H	INI OL_CDN CL OL_INTR OL_ERR CL_ERR	-	-
PID03 Fuel system status bank 1 or 1/2					
T_LAM_NOT_STAT_CDN	V	0... FFFFH	0... 1310.7	0.02	s
time counter for lambda controller reactivation after wall film					
T_LAM_REAC [NC_CBK_EX_NR]	V	0... FFH	0... 5.1	0.02	s
time counter for lambda controller reactivation after stop mode					
T_TOUT_FAC_LAM_IN_CHK [NC_CBK_EX_NR]	O/V	0... FFH	0... 5.1	0.02	s
Timer for controller difference consideration to reactivate the lambda controller after stop mode					

Input data:

C_CAM_OP_EX {p. 812}	CAM_EX [NC_NR_CBK_IVVT] {p. 8399}	CRK_DIF_SOI_IGN {p. 1999}	FAC_DIF_LAM_IN [NC_CBK_EX_NR] {p. 2460}
FAC_NEUT_NOT_STAT_CDN {p. 2544}	LV_ES {p. 1720}	LV_FCUT_IND {p. 2295}	LV_IGK {p. 906}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAM_STOP_REQ [NC_CBK_EX_NR] {p. 2545}	LV_LAM_STOP_SHO_PER_REQ [NC_CBK_EX_NR] {p. 2545}	LV_LSL_UP_SHO_PER_REQ [NC_CBK_EX_NR] {p. 2313}

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LV_MAF_INT_MIN_LAM_REAC_SWI {p. 2545}	LV_PUC {p. 1720}	LV_STATE_LS_OPL_ERR [NC_CBK_EX_NR] {p. 2545}	MAF_CYL {p. 8277}
NC_CBK_EX_NR {p. 1829}	NC_NR_CBK_IVVT {p. 604}	TCO {p. 1100}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_DIF_LAM_IN_MIN_LAM_REAC	-	0... 7FFFH	0... 0.99996948242	30.5176e-6	-
Threshold for controller difference to reactivate lambda controller after stop mode					
C_MAF_INT_MIN_LAM_REAC	-	0... FFFFH	0... 1820.42	0.0277778	g
threshold for the air mass flow integral for reactivation of the lambda controller					
C_MAF_INT_MIN_LAM_REAC_OPT	-	0... FFFFH	0... 1820.42	0.0277778	g
optional threshold for the air mass flow integral for reactivation of the lambda controller					
C_T_MIN_LAM_REAC	-	0... FFH	0... 5.1	0.02	s
time delay for lambda controller reactivation after stop mode					
C_T_MIN_TOUT_FAC_LAM_IN_CHK	-	0... FFH	0... 5.1	0.02	s
Time-out threshold for controller difference consideration to reactivate the lambda controller after stop mode					
IP_FAC_NEUT_MAX_NOT_STAT_CDN	-	0... FFFFH	-1... 0.99996948	30.5176e-6	-
LDPM_TCO_1_LACO	6	0... FEH	-48... 142.5	0.75	°C
maximum threshold for detection of non-stationary conditions for lambda controller					
IP_FAC_NEUT_MIN_NOT_STAT_CDN	-	0... FFFFH	-1... 0.99996948	30.5176e-6	-
LDPM_TCO_1_LACO	6	0... FEH	-48... 142.5	0.75	°C
minimum threshold for detection of non-stationary conditions for lambda controller					
IP_T_LAM_NOT_STAT_CDN	-	0... FFFFH	0... 1310.7	0.02	s
LDPM_TCO_1_LACO	6	0... FEH	-48... 142.5	0.75	°C
time threshold to reactivate the lambda controller after wall film					

General information:

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

The recurrence time is defined by T_SAMPLE in [ms].
NC_CBK_EX_NR defines the number of exhaust banks.
For vector elements the variable extension _i is used in the model instead of [i] as found in the textual description.

Application conditions:

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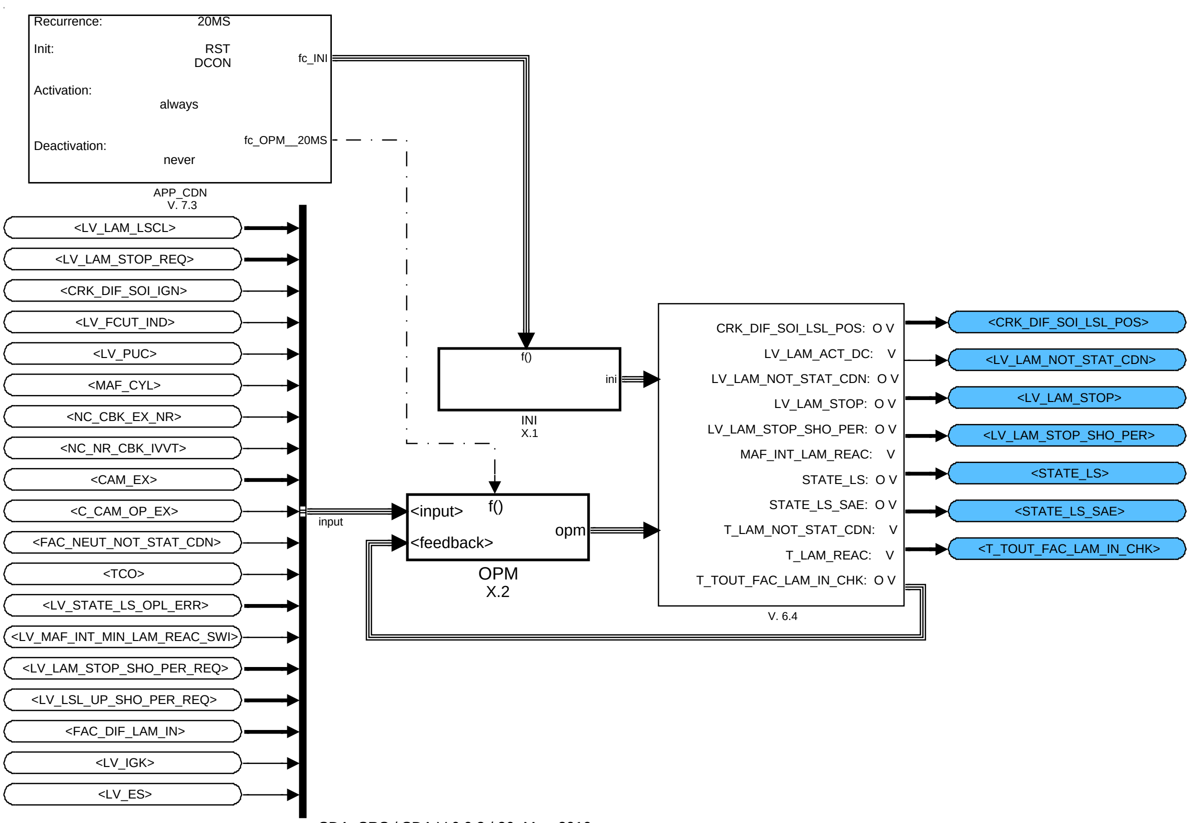
Initialisation: `RST, DCON`
Recurrence: `20MS`
Activation: `always`
Deactivation: `never`

Function description:

Formula section:



SDA_SRS / SDA V 6.0.3 / 26−Mar−2010

Figure 7.58.1: :

7.58.1 Initialization

STATE_LS[i] is set to "INI".
STATE_LS_SAE[i] is set to "INI"
T_LAM_REAC[i] is set to C_T_MIN_LAM_REAC.
MAF_INT_LAM_REAC[i] is set to C_MAF_INT_MIN_LAM_REAC.
T_TOUT_FAC_LAM_IN_CHK[i is set to C_T_MIN_TOUT_FAC_LAM_IN_CHK.]
All other output variables are set to 0.

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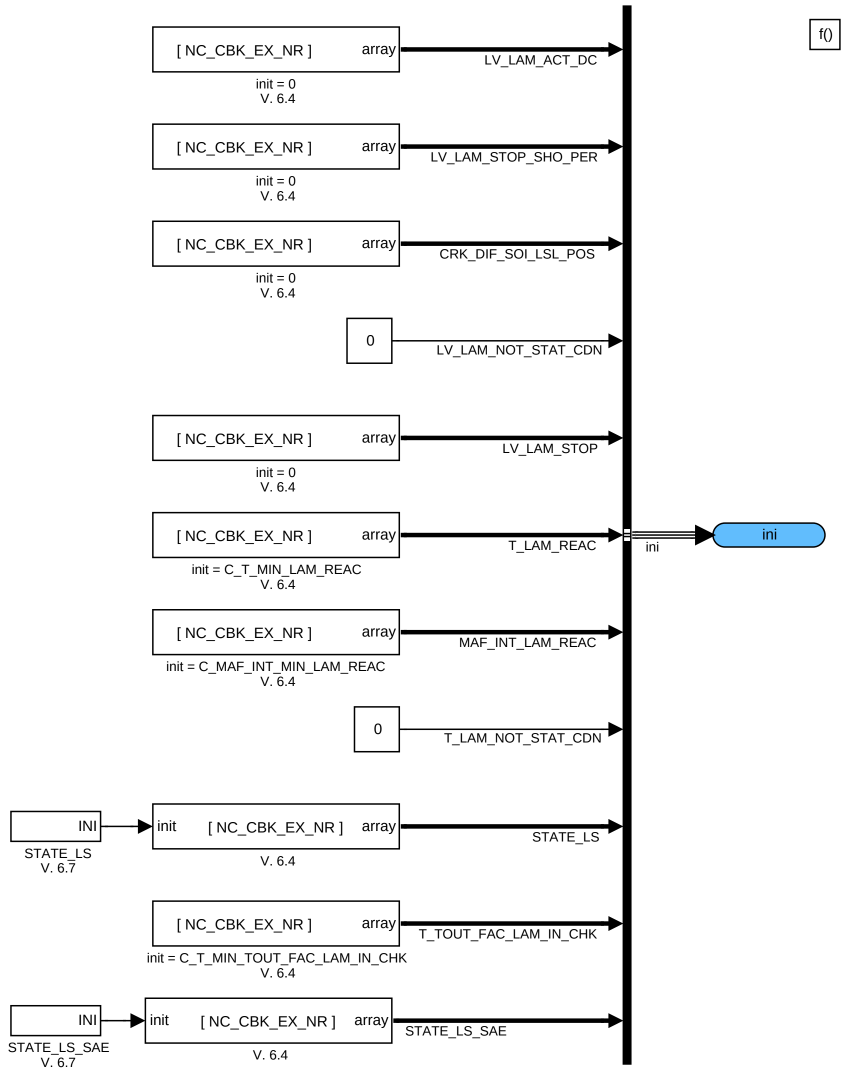

Figure 7.58.2: :

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7.58.2 Formula section

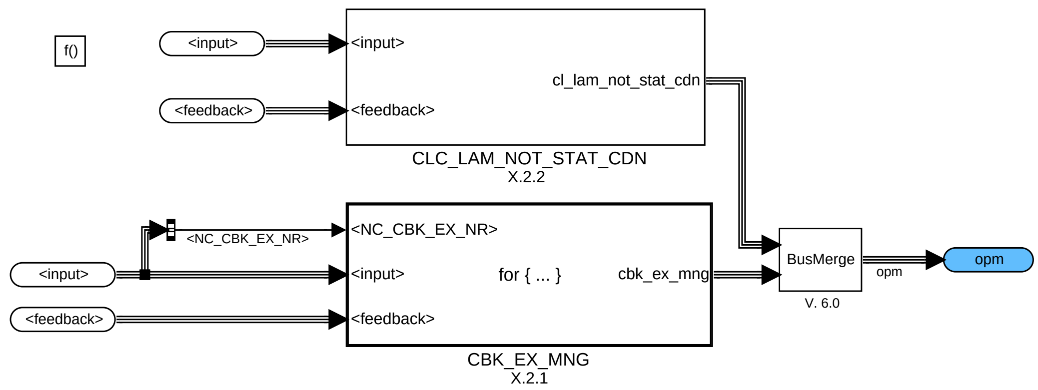

Figure 7.58.3: :

7.58.2.1 Exhaust bank specific functionality

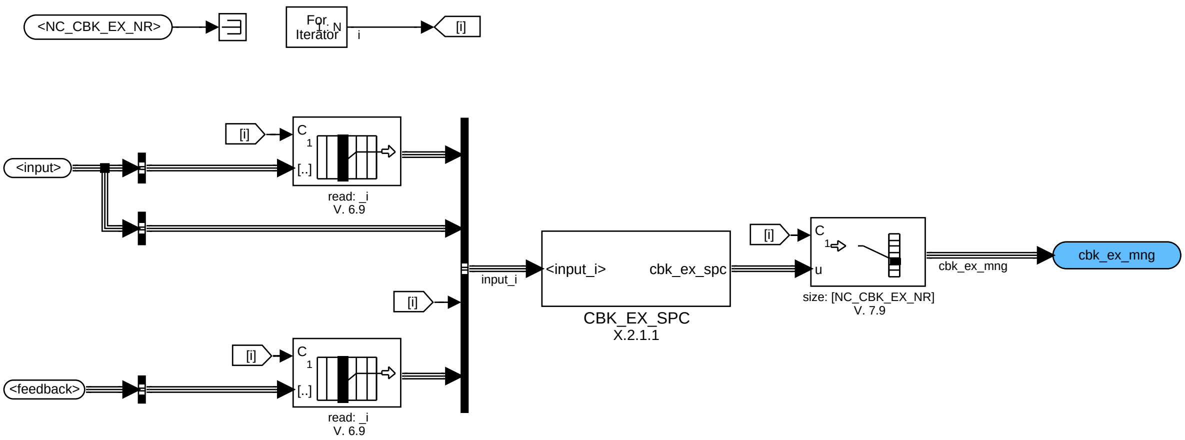

Figure 7.58.4: :

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7.58.2.1.1 Calculation of LV_LAM_STOP[i], LV_LAM_STOP_SHO_PER[i], CRK_DIF_SOI_LSL_POS[i], LV_LAM_LSCL[i], LV_LAM_ACT_DC[i], STATE_LS[i] and CTR_RAF_CHG[i]

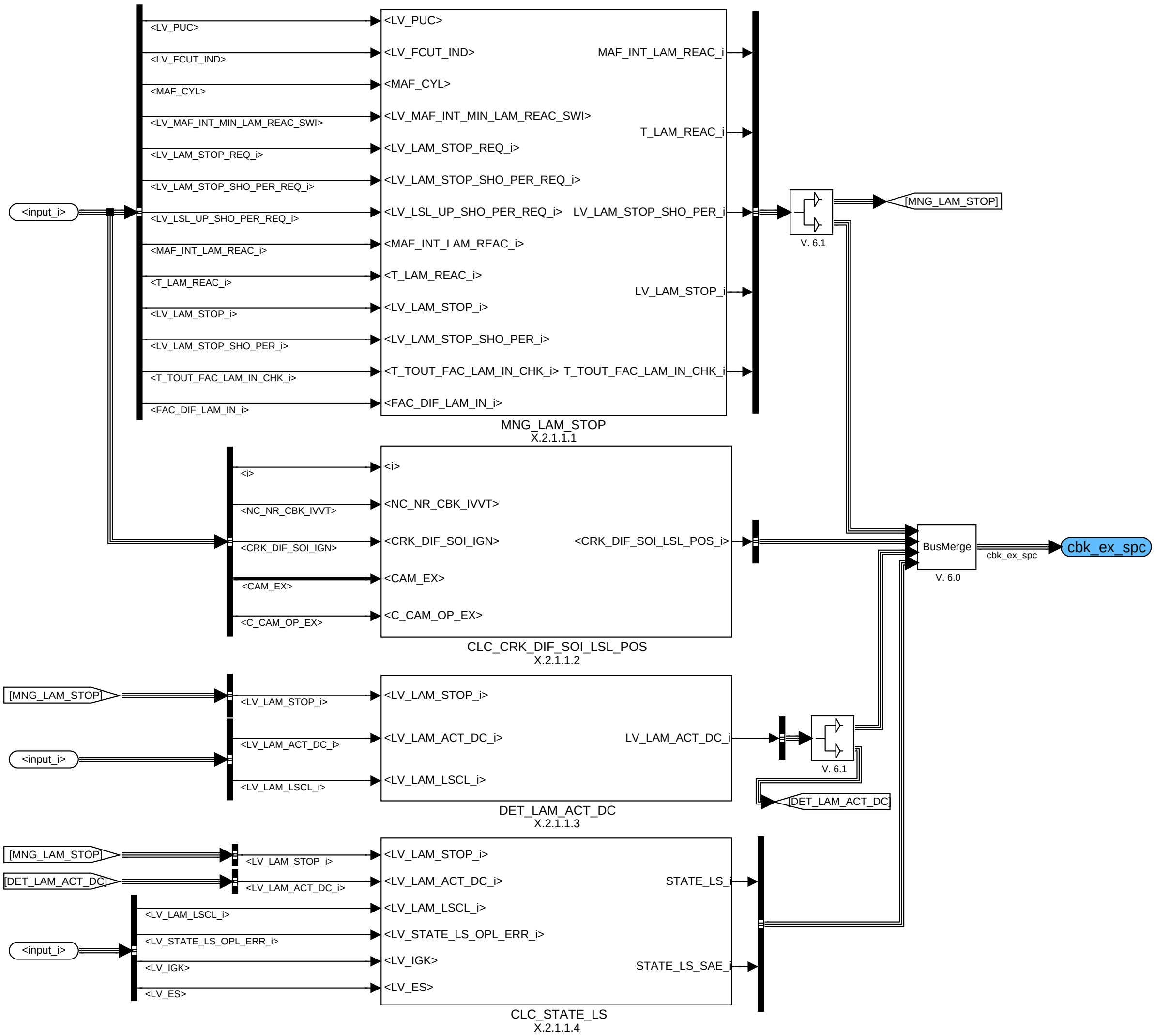

Figure 7.58.5: :

7.58.2.1.1.1 Calculation of LV_LAM_STOP[i] and LV_LAM_STOP_SHO_PER[i]

The lambda-controller is in the stop-mode (LV_LAM_STOP[i] = 1) if one of the conditions
a) the offset-adjustment of the lambda-sensor is active
(LV_LSL_OFS_ADJ_ACT[i] = 1)
b) Switching of the pump current measurement range (gain-switching) of the lambda-sensor is currently taking place (LV_VLS_UP_INIT[i] = 1)
c) Ip gain-switch of the lambda-sensor is not yet confirmed by the hardware (LV_SWI_GAIN_LSL_IF[i] STATE_LSL_IF_SPI_RD[i] (bit SWI_GAIN))
d) OBDI signal failed (LV_LSL_DEAC[i] = 1)
e) one cylinder at least is cut off (LV_FCUT_IND = 1)
f) the engine state LV_PUC is active
g) lambda controller stop mode request (LV_LAM_STOP_REQ[i] = 1)
is fulfilled.

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Additionally LV_LAM_STOP_SHO_PER[i] is set to 1 in case that condition a), b), c) or d) is true (short period stop mode).
LV_LAM_STOP_SHO_PER[i] is set to 0 if condition e), f) or g) is true (nominal stop mode). These latter conditions have the higher priority if a) or b) are fulfilled too.
If condition a) and b) are not fulfilled anymore the timer T_LAM_REAC[i] is to start. If this timer exceeds a calibration threshold, LV_LAM_STOP[i] and LV_LAM_STOP_SHO_PER[i] are set both to 0.
If condition e), f) and g) are not fulfilled anymore the integral MAF_INT_LAM_REAC[i] is calculated. If this integral exceeds a calibration threshold and the controller difference FAC_DIF_LAM_IN[i] is below a threshold while a time out threshold is not exceeded, LV_LAM_STOP[i] is set to 0.

For the calcuation of the air mass flow integral the unit conversion:
[g] = [kg/h] * [ms] * [(g*h) /(kg*ms)] /3600
has to be considered.

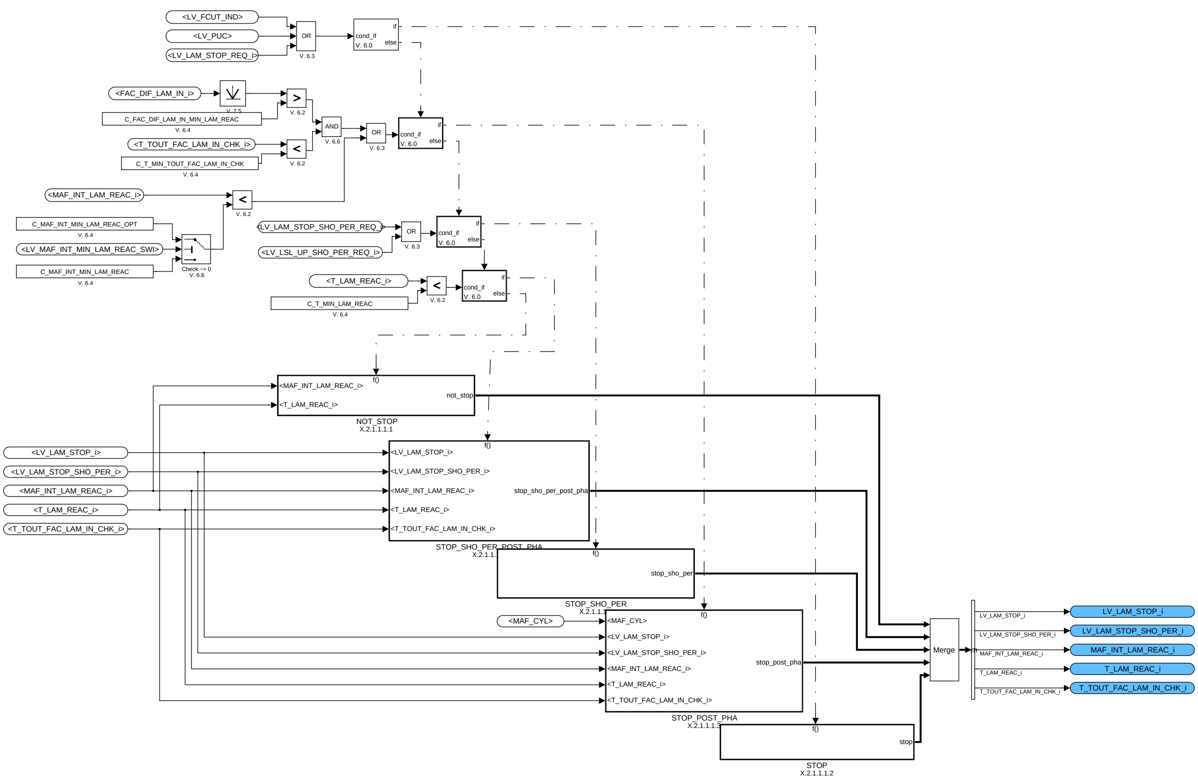

Figure 7.58.6: :

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7.58.2.1.1.1.1 No stop mode

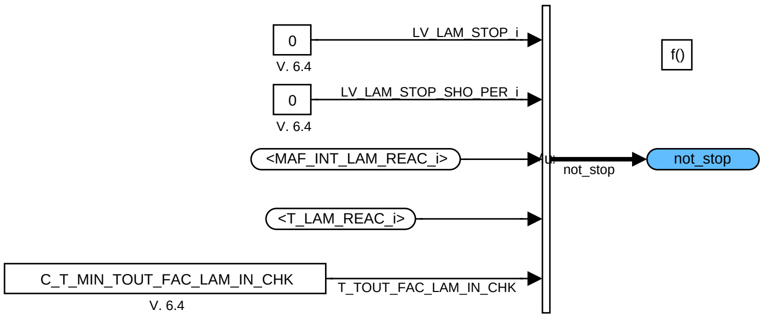

Figure 7.58.7: :

7.58.2.1.1.1.2 Nominal stop mode

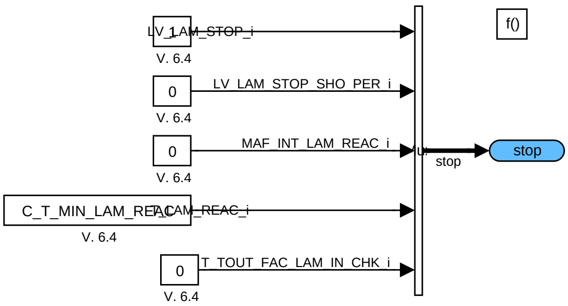

Figure 7.58.8: :

7.58.2.1.1.1.3 Post phase of nominal stop mode

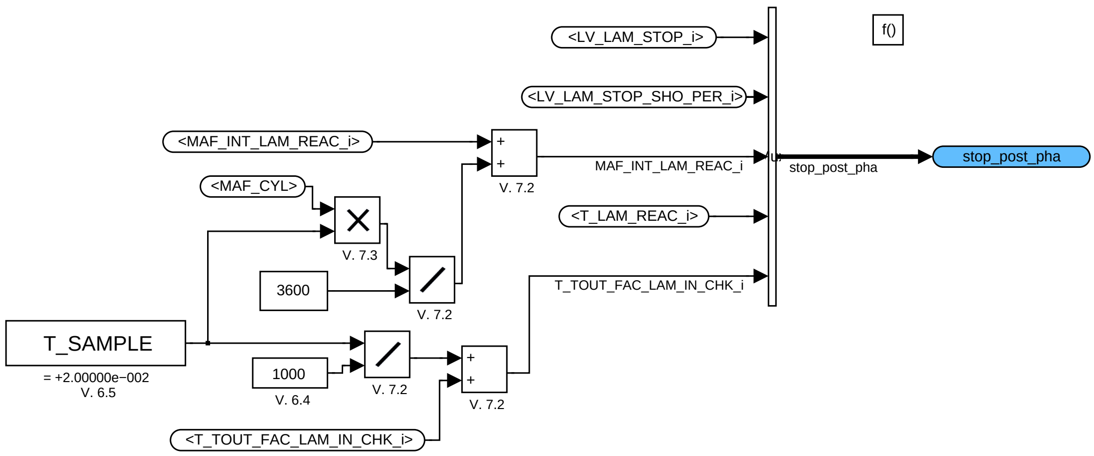

Figure 7.58.9: :

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7.58.2.1.1.1.4 Short period stop mode

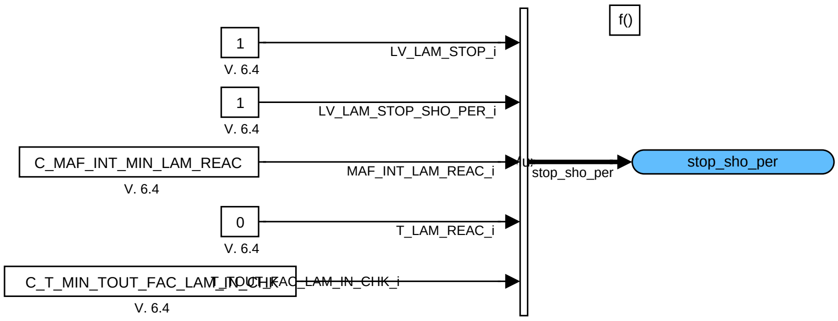

Figure 7.58.10: :

7.58.2.1.1.1.5 Post phase of short period stop mode

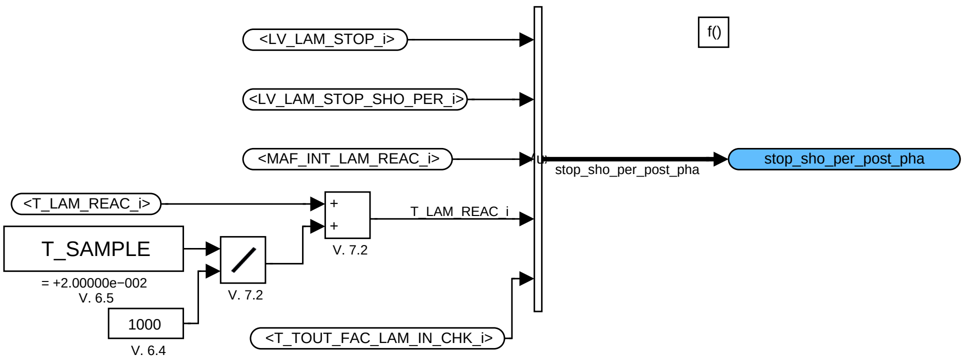

Figure 7.58.11: :

7.58.2.1.1.2 Calculation of CRK_DIF_SOI_LSL_POS[i]

The value of CRK_DIF_SOI_LSL_POS[i] corresponds to the crankshaft angle difference between the start of injection and the end of the exhaust cycle of the engine. This value is required for the calculation of the gas delay needed for the linear lambda controller. The distance between start of injection and top dead center where the injected fuel is ignited is defined by CRK_DIF_SOI_IGN (see injection phase for homogeneous and stratified mode). The distance from the mentioned top dead center to the point where the exhaust valves close is defined by 360°CRK plus current position of exhaust camshaft (CAM_EX[i]; is always negative) minus half of the opening period. So the opening timing edge of the exhaust valve is met.

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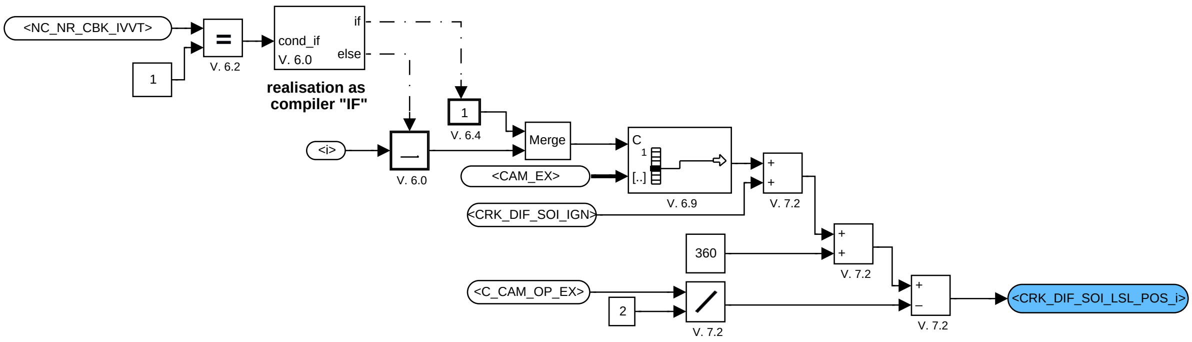

Figure 7.58.12: :

7.58.2.1.1.3 Calculation of LV_LAM_ACT_DC[i]

The flag LV_LAM_ACT_DC[i] shows that lambda closed loop control was active at least once during the actual driving cycle.

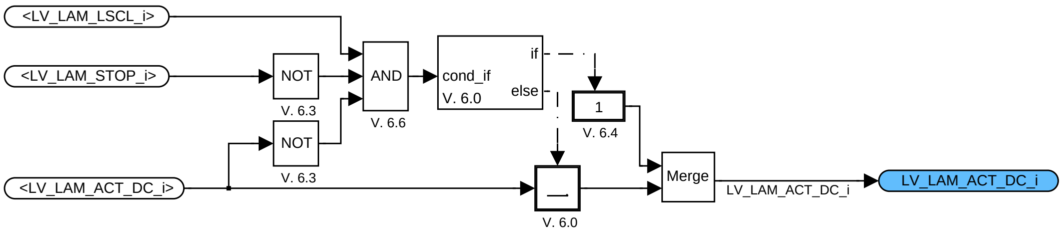

Figure 7.58.13: :

7.58.2.1.1.4 Evaluation of fuel system status STATE_LS[i]

The fuel system status byte indicated the status (open /closed loop) of the cylinder bank. It belongs to the freeze frame requested by law SAE J1979. State 16 is not supported.

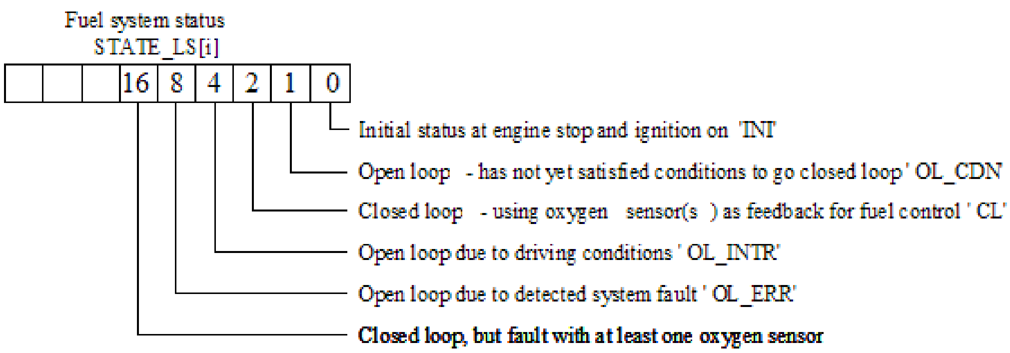

Figure 7.58.14: :

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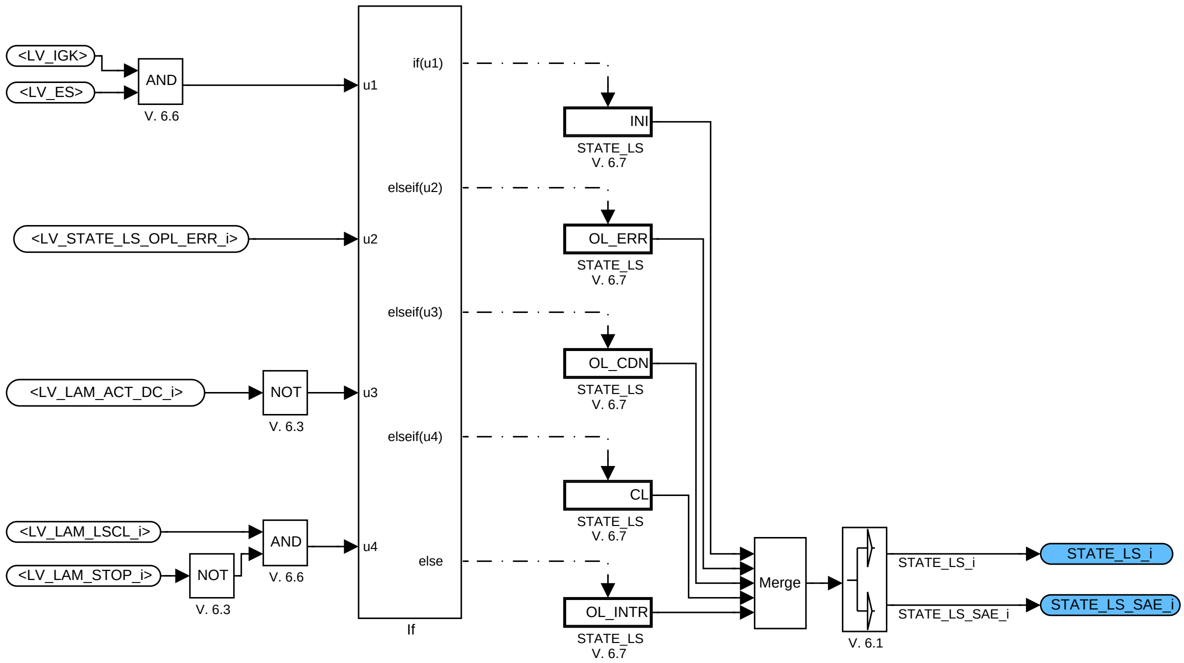

Figure 7.58.15: :

7.58.2.2 Definition of non stationary conditions

To avoid big controller excursion under non stationary conditions like wall film the output limitation of the lambda controller can be restricted. Therefore the flag LV_LAM_NOT_STAT_CDN is set if the neutral value FAC_NEUT_NOT_STAT_CDN exceeds the calibration minimum or maximum. The limitation itself (reaction on this flag) is executed in the module linear lambda control.
If the sum of the wall film is lower than this calibration threshold a counter is decreased. If the counter is 0 then the lambda-controller works without the limitation again.

7.58.2.2.1 Definition of non stationary conditions

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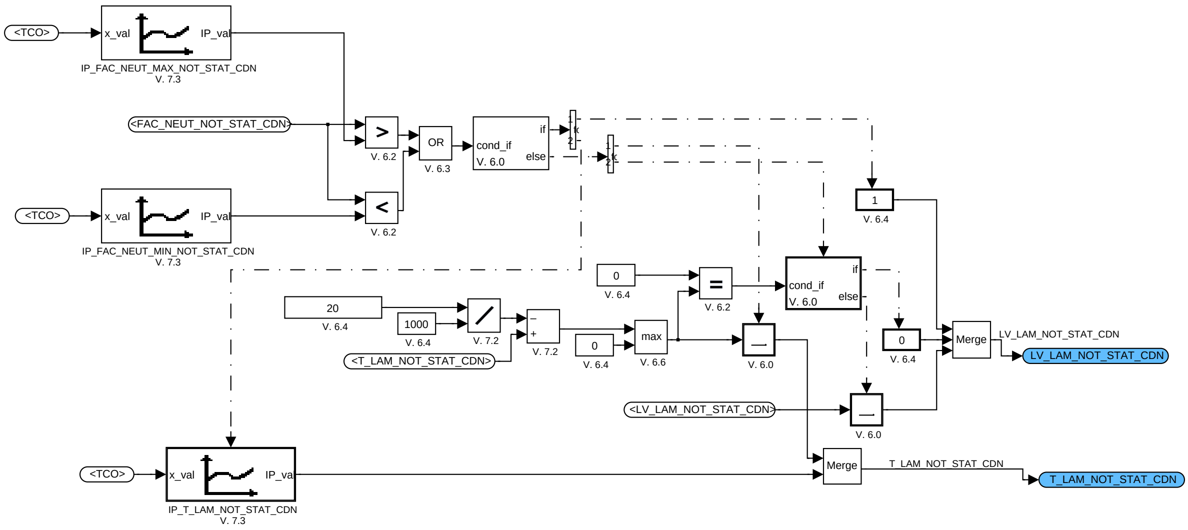

Figure 7.58.16: :

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7.59 Lambda control (fuel mass)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRLC_2_LSL_MDL [NC_CBK_EX_NR]	V	0... FFFFH	0... 0.999985	15.3186e-6	-
Correlation constant for aged lambda sensor model with PT2 behaviour					
CRLC_LSL_MDL [NC_CBK_EX_NR]	V	0... FFFFH	0... 0.999985	15.3186e-6	-
correlation constant for lambda sensor model					
CTR_RAF_CHG [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
counter of air fuel ratio changes					
FAC_DIF_LAM_IN [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-1... 0.999969	30.5176e-6	-
controller difference (richness)					
FAC_DIF_LAM_IN_MMV [NC_CBK_EX_NR]	O/V	80000000... 7FFFFFFFH	-1... 0.99999999953	465.66e-12	-
controller difference (richness) moving mean value					
FAC_DIF_SUM_LAM_IN [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-65536... 65535.9999695	30.5176e-6	-
unlimited summation of controller difference					
FAC_DIF_SUM_LAM_IN_SAVE [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-65536... 65535.9999695	30.5176e-6	-
stored value of controller difference summation					
FAC_DIF_SUM_LIM_LAM_IN [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-65536... 65535.9999695	30.5176e-6	-
limited summation of controller difference					
FAC_EG_DLY [NC_CBK_EX_NR]	V	0... FFH	0... 31.875	0.125	-
weighting factor for the calculation of the exhaust gas delay					
FAC_GAIN_D_LAM [NC_CBK_EX_NR]	V	0... 7FFFH	0... 0.0399987793	1.2207e-6	s
gain of lambda controller D share					
FAC_GAIN_D_LAM_EXT [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 0.0399987793	1.2207e-6	s
external gain of lambda controller D-share					
FAC_GAIN_I_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 49.9992370605	762.939e-6	1/s
gain of lambda controller I share					
FAC_GAIN_I_LAM_EXT [NC_CBK_EX_NR]	O/V	D... FFFFH	0.00991821... 49.9992370605	762.939e-6	1/s
external gain of lambda controller I-share					
FAC_GAIN_I2_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 24.9996185303	381.47e-6	1/s**2
gain of lambda controller I^2 share					
FAC_GAIN_P_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 15.999756	244.141e-6	-
gain of lambda controller P share					
FAC_GAIN_P_LAM_EXT [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 15.9997558594	244.141e-6	-
external gain of lambda controller P-share					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_AD_OUT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
fuel mass set point factor, output from lambda adaptation					
FAC_LAM_COR [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
limited lambda controller output plus pre control correction					
FAC_LAM_D_LIM [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
limited D share output signal					
FAC_LAM_DELTA_I_I2_SHIFT [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
I and I^2 share shift based on downstream signal evaluation					
FAC_LAM_I [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
unlimited I share output signal					
FAC_LAM_I_I2_SUM_LIM [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
limited I share + I^2 share output signal					
FAC_LAM_I_IT [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-50... 49.9999999767	23.2831e-9	%
unlimited internal I share used for PID control only					
FAC_LAM_I_IT_LIM [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-50... 49.9999999767	23.2831e-9	%
limited internal I share used for PID control only					
FAC_LAM_I_MAX [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
upper limitation for I share					
FAC_LAM_I_MIN [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
lower limitation for I share					
FAC_LAM_I2 [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
unlimited I^2 share output signal					
FAC_LAM_I2_LIM [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
limited I^2 share output signal					
FAC_LAM_LIM [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
limited value of lambda controller output					
FAC_LAM_MAX_NOT_LAM_LIM [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Factor for the maximum limitation of lamda controller					
FAC_LAM_MAX_NOT_STAT_CDN [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
upper limit in case of limitation under non stationary conditions					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_MIN_NOT_LAM_LIM [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Factor for the minimum limitation of lamda controller					
FAC_LAM_MIN_NOT_STAT_CDN [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
bottom limit in case of limitation under non stationary conditions					
FAC_LAM_MV [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
mean value of lambda controller output					
FAC_LAM_MV_MMV [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
FAC_LAM_MV[i] average value					
FAC_LAM_MV_MMV_CP [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
mean value of lambda controller output, used by canister purge					
FAC_LAM_MV_MMV_LDC [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
moving mean value of the controller output, used for limited dynamics calculation					
FAC_LAM_MV_MMV_LDC_DIAG [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Mean value of the controller output, used by limited dynamics for cat efficiency diagnosis					
FAC_LAM_OUT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
lambda controller output					
FAC_LAM_P_LIM [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
limited P share output signal					
FAC_LAM_PCTL [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
pre control path correction					
LAMB_COR_AV_LAM [NC_CBK_EX_NR]	V	0... 7FFFH	0... 1.999939	61.0352e-6	-
corrected signal of WRAF sensor; actual value for lambda controller					
LAMB_LS_UP_LAM_MMV [NC_CBK_EX_NR]	O/V	0... FFFFFFFFH	0... 31.9999999925	7.-058e-9	-
filtered lambda sensor signal upstream					
LAMB_LSL_MDL_OUT_TMP [NC_CBK_EX_NR]	V	0... FFFFFFFFH	0... 31.9999999925	7.-058e-9	-
temporary output variable for lambda sensor model (after 1st PT1)					
LAMB_SP_FIL_HOM [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 1.999939	61.0352e-6	-
output signal of the WRAF sensor model for homogeneous mode					
LAMB_SP_FIL_S [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902344	976.563e-6	-
output signal of the WRAF sensor model for stratified mode					
LAMB_SP_LSL_MDL_IN_HOM [NC_CBK_EX_NR]	V	0... FFFFH	0... 3.99993896484	61.0352e-6	-
lambda controller set point including forced stimulation and the influence of secondary air					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_LSL_MDL_OUT_HOM [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 3.99993896484	61.0352e-6	-
output signal of the WRAF sensor model in homogeneous mode					
LAMB_SP_LSL_MDL_OUT_S [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.99902344	976.563e-6	-
output signal of the WRAF sensor model in stratified mode					
LAMB_SP_PCTL [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 1.999939	61.0352e-6	-
pre control lambda set point					
LV_FAC_LAM_ADJ_LAM_AD_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
lambda shift required by lambda adaptation was carried out					
LV_FAC_LAM_DIAGCP_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
controller shift caused by EVAP diagnosis was carried out					
LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
upper limit of lambda controller output reached					
LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
lower limit of lambda controller output reached					
LV_FAC_LAM_LIM_NOT_STAT_CDN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
limitation under non stationary operating conditions (threshold exceeded)					
LV_FAC_LAM_MAX_NOT_LAM_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating maximum lambda controller limitation due to FAC_LAM_MAX_NOT_LAM_LIM limitation					
LV_FAC_LAM_MIN_NOT_LAM_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating minimum lambda controller limitation due to FAC_LAM_MIN_NOT_LAM_LIM limitation					
LV_FAC_LAM_SHIFT_CP_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Controller shift caused by canister purge was carried out					
LV_LAM_GAIN_EXT	O/V	0... 1H	0 ...1	1	-
lambda controller gain switch for activation of external parameters					
LV_LAM_GAIN_LS_DIAG	O/V	0... 1H	0 ...1	1	-
flag indicating that current lambda controller parameters result from EGCP request					
LV_LAM_I2_ACT	V	0... 1H	0 ...1	1	-
flag to switch between PII^2D and PID lambda controller					
LV_LAM_LSCL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation flag of lambda control					
LV_SENS_MDL_OFF_ACT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that lambda sensor model switch-off is active.					
LV_T_MAX_LSCL_ACT_TCO [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
lambda controller activation by timer condition instead of TCO condition					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VLS_DOWN_THD_AFL_LAM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that downstream sensor signal is below calibration threshold (used for lambda control)					
LV_VLS_DOWN_THD_AFR_LAM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that downstream sensor signal is above calibration threshold (used for lambda control)					
MFF_ADD_CP	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Canister Purge Fuel Mass correction corresponding to Lambda Factor Shift					
MFF_ADD_LAM_AD_OUT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
fuel mass set point offset, output from lambda adaptation					
STATE_FAC_GAIN_PID_EXT [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Status for the condition under which the external lambda control gain factors are determined					
STATE_LAM [NC_CBK_EX_NR]	V	0H 1H 2H 3H	OFF ON STOP_SHO_PER STOP	-	-
lambda controller state					
T_DLY_SENS_MDL_ACT [NC_CBK_EX_NR]	V	0... FFH	0... 5.1	0.02	s
Delay timer for reactivation of linear lamdba sensor model					
T_DLY_SOI_LSL_POS [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1.023984	15.625e-6	s
delay between start of injection and WRAF sensor signal location					
T_LSL_UP_AGI_OFS [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	s
current sensor rise-time offset of the lambda controller plant model due to sensor ageing					
T1_LSL_UP [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1.99996948242	30.5176e-6	s
first order time lag of the WRAF sensor model					
T1_LSL_UP_OPT [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1.99996948242	30.5176e-6	s
first order time lag of the WRAF sensor model (optional)					
TOUT_I_I2_SHIFT_VLD_AFL [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
time out for I and I^2 share shift based on lean downstream signal					
TOUT_I_I2_SHIFT_VLD_AFR [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
time out for I and I^2 share shift based on rich downstream signal					
VLS_DOWN_MMV_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 4.99992371	76.2939e-6	V
moving mean value of downstream sensor voltage					

Input data:

CRK_DIF_SOI_LSL_POS [NC_CBK_EX_NR] {p. 2448}	CRLC_FAC_LAM_MV_MMV_CP {p. 3698}	FAC_EG_DLY_AGI_L2R [NC_CBK_EX_NR] {p. 2544}	FAC_EG_DLY_AGI_R2L [NC_CBK_EX_NR] {p. 2544}
FAC_IPT_SENS_MDL [NC_CBK_EX_NR] {p. 2544}	FAC_IPT_SENS_MDL_OPT [NC_CBK_EX_NR] {p. 2544}	FAC_LAM_AD_LAM_OUT [NC_CBK_EX_NR] {p. 2641}	FAC_LAM_ADJ_LAM_AD [NC_CBK_EX_NR] {p. 2641}

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FAC_LAM_DIAGCP [NC_CBK_EX_NR] {p. 798}	FAC_LAM_SHIFT_CP {p. 3699}	FAC_LAMB_SP_SA {p. 798}	LAMB_AV_DELTA_LAM [NC_CBK_EX_NR] {p. 2544}
LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_PLS [NC_CBK_EX_NR] {p. 2558}	LAMB_SP_DELTA_LAM [NC_CBK_EX_NR] {p. 2544}	LAMB_SP_HOM [NC_CBK_EX_NR] {p. 8340}
LAMB_SP_S {p. 1820}	LV_AFL [NC_CBK_EX_NR] {p. 2439}	LV_CP_RAMP_OPEN_ACT {p. 3636}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}
LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_FAC_LAM_ADJ_LAM_AD [NC_CBK_EX_NR] {p. 2642}	LV_FAC_LAM_DIAGCP {p. 1001}	LV_FAC_LAM_SHIFT_CP {p. 3699}
LV_HOM_ACT {p. 8136}	LV_INH_LSCL [NC_CBK_EX_NR] {p. 2544}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	LV_IS {p. 1720}
LV_LAM_AD_EXT {p. 1016}	LV_LAM_DI_REQ [NC_CBK_EX_NR] {p. 5389}	LV_LAM_GAIN_SWI {p. 2544}	LV_LAM_NOT_STAT_CDN {p. 2448}
LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_LAM_STOP_SHO_PER [NC_CBK_EX_NR] {p. 2448}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_LSL_UP_ERR_SUSP [NC_CBK_EX_NR] {p. 2335}
LV_PUC {p. 1720}	LV_ST_END {p. 1720}	LV_TI_1_HOM_MIN {p. 2000}	MAF {p. 8277}
MAF_INT_PUC_ACT {p. 2942}	MAF_INT_S_ACT {p. 2545}	MFF_ADD_LAM_CP {p. 3692}	MFF_LAM_ADD_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2642}
N {p. 1525}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
NC_NR_FAC_GAIN_LAM {p. 826}	STATE_LAM_GAIN_REQ_LS_DIAG {p. 5349}	STATE_SENS_MDL [NC_CBK_EX_NR] {p. 2545}	T_AST {p. 1766}
T_LSL_UP_AGI_L2R [NC_CBK_EX_NR] {p. 2545}	T_LSL_UP_AGI_R2L [NC_CBK_EX_NR] {p. 2545}	T_SEG_AV {p. 1525}	TCO {p. 1100}
TCO_ST {p. 1100}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_DIF_LAM_IN_MMV	-	0... FFH	0... 0.99609375	3.90625e-3	-
correlation constant for the calculation of FAC_DIF_LAM_IN_MMV[i]					
C_CRLC_FAC_LAM_MV	-	0... FFH	0... 0.99609375	3.90625e-3	-
correlation constant for calculation of the controller output mean value FAC_LAM_MV[i]					
C_CRLC_FAC_LAM_MV_MMV	-	0... FFH	0... 0.99609375	3.90625e-3	-
correlation constant for the calculation of the filtered controller output mean value FAC_LAM_MV_MMV[i]					
C_CRLC_FAC_LAM_MV_MMV_LDC	-	0... FFH	0... 0.99609375	3.90625e-3	-
correlation constant for the calculation of moving mean value for limited dynamics detection					
C_CRLC_FAC_LAM_MV_MMV_LDC_DIAG	-	0... FFH	0... 0.99609375	3.90625e-3	-
correlation constant for mean value calculation of lambda controller output, used by limited dynamics for cat efficiency diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_VLS_DOWN_MMV_LAM	-	0... FFH	0... 0.99609375	3.90625e-3	-
correlation constant for the calculation of VLS_DOWN_MMV_LAM[i]					
C_FAC_GAIN_D_LAM_DLY_DIAG	-	0... 7FFFH	0... 0.0399987793	1.2207e-6	s
gain of lambda controller D share in case of delay diagnosis					
C_FAC_GAIN_D_LAM_DYN_DIAG	-	0... 7FFFH	0... 0.0399987793	1.2207e-6	s
gain of lambda controller D share in case of delay diagnosis					
C_FAC_LAM_D_MAX_LAM	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
upper limitation of the lambda controller D share					
C_FAC_LAM_D_MIN_LAM	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
bottom limitation of the lambda controller D share					
C_FAC_LAM_DELTA_LSCL_OFF	-	0... 7FFFH	0... 49.99847412	1.52588e-3	%
output signal delta to ramp the output signal to zero in case of deactivated lambda controller					
C_FAC_LAM_I_I2_SUM_MAX_LAM	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
upper limitation of lambda controller I share + I^2 share					
C_FAC_LAM_I_I2_SUM_MAX_LAM_CP	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
upper limitation of lambda controller I share + I^2 share during active canister purge					
C_FAC_LAM_I_I2_SUM_MIN_LAM	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
bottom limitation of lambda controller I share + I^2 share					
C_FAC_LAM_I_I2_SUM_MIN_LAM_CP	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
bottom limitation of lambda controller I share + I^2 share during active canister purge					
C_FAC_LAM_I_MAX_LAM_DLY_DIAG	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
upper limitation of lambda controller I share during delay diagnosis					
C_FAC_LAM_I_MAX_LAM_DYN_DIAG	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
upper limitation of lambda controller I share during dynamic diagnosis					
C_FAC_LAM_I_MAX_LAM_ERR_DYN	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
upper limitation of lambda controller I share when dynamic error detected					
C_FAC_LAM_I_MIN_LAM_DLY_DIAG	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
lower limitation of lambda controller I share during delay diagnosis					
C_FAC_LAM_I_MIN_LAM_DYN_DIAG	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
lower limitation of lambda controller I share during dynamic diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_LAM_I_MIN_LAM_ERR_DYN	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
lower limitation of lambda controller I share when dynamic error detected					
C_FAC_LAM_MAX_DLY_DIAG	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Maximum lambda controller limitation during delay diagnosis					
C_FAC_LAM_MAX_DYN_DIAG	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Maximum lambda controller limitation during dynamic diagnosis					
C_FAC_LAM_MAX_ERR_DYN	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Maximum lambda controller limitation when dynamic error detected					
C_FAC_LAM_MIN_DLY_DIAG	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Minimum lambda controller limitation during delay diagnosis					
C_FAC_LAM_MIN_DYN_DIAG	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Minimum lambda controller limitation during dynamic diagnosis					
C_FAC_LAM_MIN_ERR_DYN	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Minimum lambda controller limitation when dynamic error detected					
C_FAC_LAM_OUT_MAX	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
upper limitation of the lambda controller output					
C_FAC_LAM_OUT_MAX_CP	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
upper limitation of the lambda controller output during canister purge ramp open phase					
C_FAC_LAM_OUT_MAX_ERR_SUSP	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
upper limitation of the lambda controller output during oxygen sensor error suspicion					
C_FAC_LAM_OUT_MIN	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
bottom limitation of the lambda controller output					
C_FAC_LAM_OUT_MIN_CP	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
bottom limitation of the lambda controller output during canister purge ramp open phase					
C_FAC_LAM_OUT_MIN_ERR_SUSP	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
bottom limitation of the lambda controller output during oxygen sensor error suspicion					
C_FAC_LAM_P_MAX_LAM	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
upper limitation of lambda controller P share					
C_FAC_LAM_P_MAX_LAM_CP	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
upper limitation of lambda controller P share during active canister purge					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_LAM_P_MIN_LAM	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
bottom limitation of lambda controller P share					
C_FAC_LAM_P_MIN_LAM_CP	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
bottom limitation of lambda controller P share during active canister purge					
C_LAMB_SENS_MDL_OFF_PUC	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda signal threshold during PUC to switch-off lambda sensor model					
C_N_MIN_LAM_LSCL	-	0... FFH	0... 8160	32	rpm
minimum engine speed for lambda controller activation					
C_T_DLY_SENS_MDL_ACT	-	0... FFH	0... 5.1	0.02	s
Time delay for reactivation of linear lamdba sensor model					
C_TOUT_I_I2_SHIFT_VLD	-	0... FFFFH	0... 1310.7	0.02	s
time out for I and I^2 share shift based on downstream signal evaluation					
C_VLS_DOWN_THD_AFL_LAM	-	0... FFFFH	0... 4.99992371	76.2939e-6	V
lean threshold of downstream sensor signal for I and I^2 share correction					
C_VLS_DOWN_THD_AFR_LAM	-	0... FFFFH	0... 4.99992371	76.2939e-6	V
rich threshold of downstream sensor signal for I and I^2 share correction					
ID_T_AST_MIN_LSCL_ACT	-	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_1_LACO	6	0... FEH	-48... 142.5	0.75	°C
minimum time after start that must be elapsed before activating lambda controller					
ID_T_MAX_LSCL_ACT_TCO	-	1... FFFFH	1... 65535	1	s
LDPM_TCO_ST_1_LACO	6	0... FEH	-48... 142.5	0.75	°C
maximum time value up to that the controller can be activated by TCO condition					
ID_TCO_MIN_LAM_LSCL	-	0... FEH	-48... 142.5	0.75	°C
LDPM_TCO_ST_1_LACO	6	0... FEH	-48... 142.5	0.75	°C
minimum TCO for lambda controller activation					
ID_TCO_MIN_LAM_LSCL_IS	-	0... FEH	-48... 142.5	0.75	°C
LDPM_TCO_ST_1_LACO	6	0... FEH	-48... 142.5	0.75	°C
minimum TCO for lambda controller activation at idle speed					
IP_FAC_EG_DLY [NC_CBK_EX_NR]	V	0... FFH	0... 31.875	0.125	-
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
weighting factor for the calculation of the exhaust gas delay					
IP_FAC_EG_DLY_L2R [NC_CBK_EX_NR]	V	0... FFH	0... 31.875	0.125	-
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
weighting factor for the calculation of the exhaust gas delay - lean to rich					
IP_FAC_EG_DLY_L2R_IPT [NC_CBK_EX_NR]	V	0... FFH	0... 31.875	0.125	-
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
weighting factor for the calculation of the exhaust gas delay - lean to rich, Interpolated value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_EG_DLY_R2L [NC_CBK_EX_NR]	V	0... FFH	0... 31.875	0.125	-
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
weighting factor for the calculation of the exhaust gas delay - rich to lean					
IP_FAC_EG_DLY_R2L_IPT [NC_CBK_EX_NR]	V	0... FFH	0... 31.875	0.125	-
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
weighting factor for the calculation of the exhaust gas delay - rich to lean, Interpolated value					
IP_FAC_GAIN_D_LAM	V	0... 7FFFH	0... 0.0399987793	1.2207e-6	s
LDPM_T_DLY_SOI_LSL_POS_1_LACO	8	0... FFFFH	0... 1.023984	15.625e-6	s
LDPM_T1_LSL_UP_1_LACO	8	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller D share					
IP_FAC_GAIN_D_LAM_GAIN_SWI	V	0... 7FFFH	0... 0.0399987793	1.2207e-6	s
LDPM_T_DLY_SOI_LSL_POS_2_LACO	4	0... FFFFH	0... 1.023984	15.625e-6	s
LDPM_T1_LSL_UP_2_LACO	4	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller D share in case of LV_LAM_GAIN_SWI is set					
IP_FAC_GAIN_I_LAM	V	D... FFFFH	0.00991821... 49.9992370605	762.939e-6	1/s
LDPM_T_DLY_SOI_LSL_POS_1_LACO	8	0... FFFFH	0... 1.023984	15.625e-6	s
LDPM_T1_LSL_UP_1_LACO	8	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller I share					
IP_FAC_GAIN_I_LAM_DLY_DIAG	V	D... FFFFH	0.00991821... 49.9992370605	762.939e-6	1/s
LDPM_T_DLY_SOI_LSL_POS_3_LACO	NC_NR_FAC_GAIN_LAM	0... FFFFH	0... 1.023984375	15.625e-6	s
LDPM_T1_LSL_UP_3_LACO	NC_NR_FAC_GAIN_LAM	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller I share in case of delay diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_GAIN_I_LAM_DYN_DIAG	V	D... FFFFH	0.00991821... 49.9992370605	762.939e-6	1/s
LDPM_T_DLY_SOI_LSL_POS_3_LACO	NC_ NR_ FAC_ GAIN_ LAM	0... FFFFH	0... 1.023984375	15.625e-6	s
LDPM_T1_LSL_UP_3_LACO	NC_ NR_ FAC_ GAIN_ LAM	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller I share in case of DYN_DIAG					
IP_FAC_GAIN_I_LAM_GAIN_SWI	V	D... FFFFH	0.00991821... 49.9992370605	762.939e-6	1/s
LDPM_T_DLY_SOI_LSL_POS_2_LACO	4	0... FFFFH	0... 1.023984	15.625e-6	s
LDPM_T1_LSL_UP_2_LACO	4	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller I share in case of LV_LAM_GAIN_SWI is set					
IP_FAC_GAIN_P_LAM	V	0... FFFFH	0... 15.999756	244.141e-6	-
LDPM_T_DLY_SOI_LSL_POS_1_LACO	8	0... FFFFH	0... 1.023984	15.625e-6	s
LDPM_T1_LSL_UP_1_LACO	8	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller P share					
IP_FAC_GAIN_P_LAM_DLY_DIAG	V	0... FFFFH	0... 15.9997558594	244.141e-6	-
LDPM_T_DLY_SOI_LSL_POS_3_LACO	NC_ NR_ FAC_ GAIN_ LAM	0... FFFFH	0... 1.023984375	15.625e-6	s
LDPM_T1_LSL_UP_3_LACO	NC_ NR_ FAC_ GAIN_ LAM	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller P share in case of delay diagnosis					
IP_FAC_GAIN_P_LAM_DYN_DIAG	V	0... FFFFH	0... 15.9997558594	244.141e-6	-
LDPM_T_DLY_SOI_LSL_POS_3_LACO	NC_ NR_ FAC_ GAIN_ LAM	0... FFFFH	0... 1.023984375	15.625e-6	s

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_T1_LSL_UP_3_LACO	NC_NR_FAC_GAIN_LAM	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller P share in case of DYN_DIAG					
IP_FAC_GAIN_P_LAM_GAIN_SWI	V	0... FFFFH	0... 15.999756	244.141e-6	-
LDPM_T_DLY_SOI_LSL_POS_2_LACO	4	0... FFFFH	0... 1.023984	15.625e-6	s
LDPM_T1_LSL_UP_2_LACO	4	0... FFFFH	0... 1.99996948242	30.5176e-6	s
gain of lambda controller P share in case of LV_LAM_GAIN_SWI is set					
IP_FAC_LAM_MAX_NOT_STAT_CDN	-	0... FFFFH	-50... 49.99847412	1.52588e-3	%
LDPM_FAC_LAM_MV_1_LACO	8	0... FFFFH	-50... 49.99847412	1.52588e-3	%
upper limit of lambda controller output under non stationary operating conditions					
IP_FAC_LAM_MIN_NOT_STAT_CDN	-	0... FFFFH	-50... 49.99847412	1.52588e-3	%
LDPM_FAC_LAM_MV_1_LACO	8	0... FFFFH	-50... 49.99847412	1.52588e-3	%
bottom limit of lambda controller output under non stationary operating conditions					
IP_LAMB_SP_THE_PUC	-	0... FFFFH	0... 3.99993896484	61.0352e-6	-
LDP_MAF_INT_PUC_IP_LAMB_SP_THE	4	0... FFFFH	0... 2912.66666667	0.0444444	g
theoretical lambda set point during PUC					
IP_LAMB_SP_THE_S_HOM	-	0... FFFFH	0... 3.99993896484	61.0352e-6	-
LDP_MAF_INT_S_IP_LAMB_SP_THE	4	0... FFFFH	0... 2912.66666667	0.0444444	g
Theoretical lambda set point for switching from S to HOM					
IP_T1_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	s
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
first order time lag of the WRAF sensor model					
IP_T1_LSL_UP_L2R [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	s
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
first order time lag of the WRAF sensor model - lean to rich					
IP_T1_LSL_UP_L2R_IPT [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	s

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
first order time lag of the WRAF sensor model - lean to rich, Interpolated value					
IP_T1_LSL_UP_R2L [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	s
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
first order time lag of the WRAF sensor model - rich to lean					
IP_T1_LSL_UP_R2L_IPT [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	s
LDPM_N_1_LACO	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_LACO	8	0... FFFFH	0... 1389	0.0211948	mg/stk
first order time lag of the WRAF sensor model - rich to lean, Interpolated value					
LC_LAM_I2_ACT	-	0... 1H	0 ...1	1	-
calibration flag to switch between PII^2D and PID lambda controller					
LC_SENS_MDL_AGI_T1_ACT	-	0... 1H	0 ...1	1	-
switch to consider sensor ageing in lambda controller plant model by additional T1 (=1) or T2 (=0) time					

General information:

By means of a Pad approximation the delayed lambda set point LAMB_SP_FIL_HOM[i] (for homogeneous mode) and LAMB_SP_FIL_S[i] (for stratified mode) is calculated. All other variables which are output of these sub-systems are only necessary to realize the functionality with the desired accuracy. The behavior of the delay is described by an all-pass filter (Pad approximation of 2nd order). Its principle is shown here below.

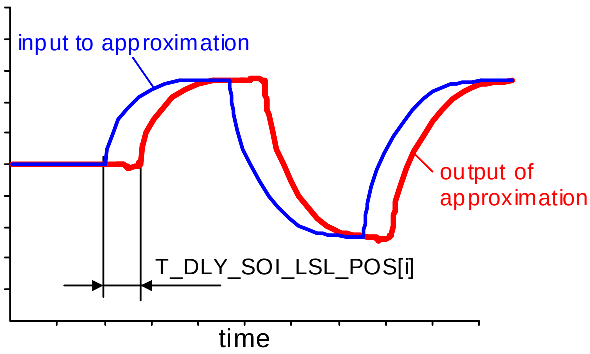

Figure 7.59.1: :

Gas delay approximation (2nd order Pad approximation)

The following formula describes the Pad approximation in its mathematical representation:

$$f_1 = \frac{T\_DLY\_SOI\_LSL\_POS[i]}{T\_SAMPLE},$$

Figure 7.59.2: :

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$$f_2 = \frac{f_1^2}{3},$$

Figure 7.59.3: :

Signal flow diagram:

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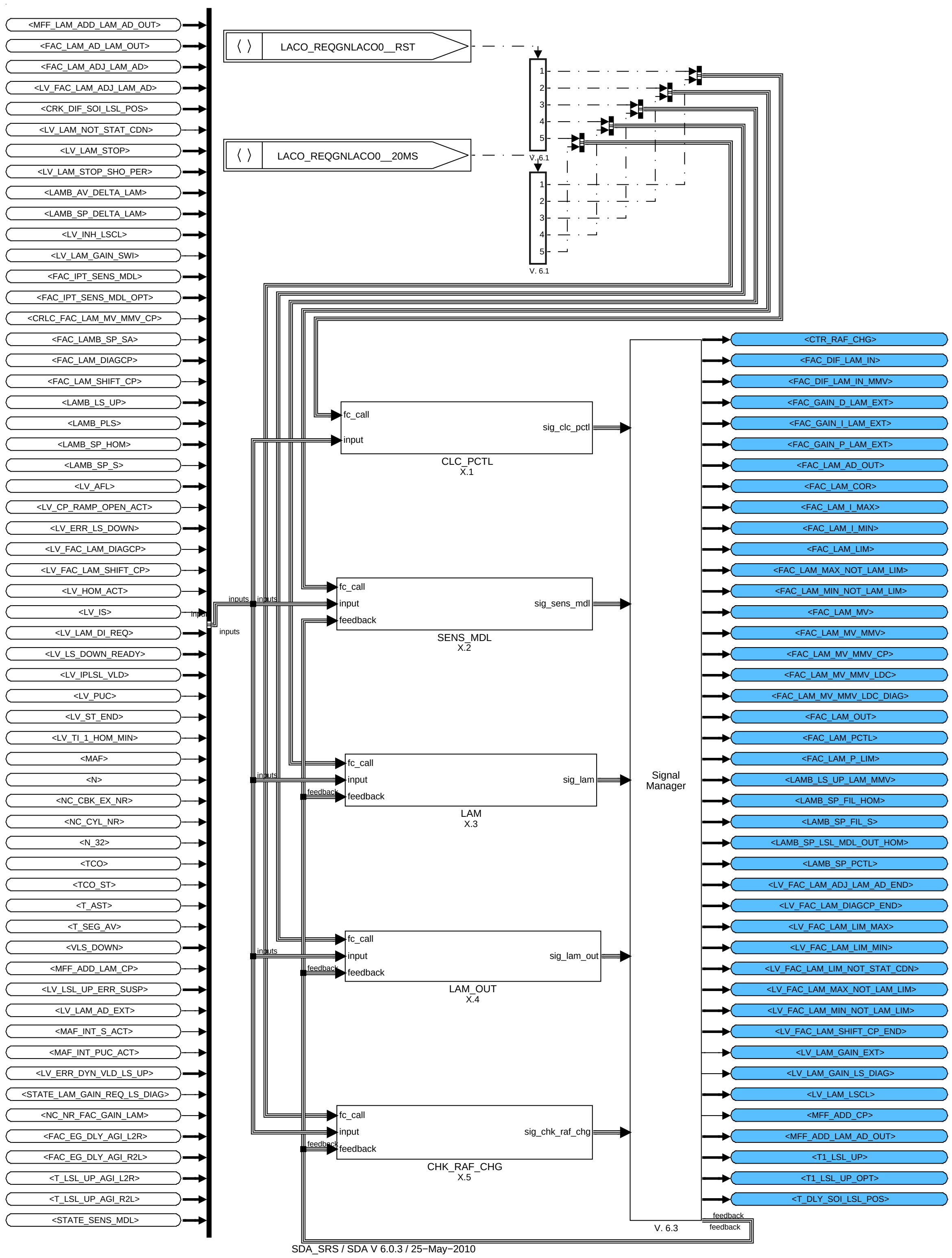

Figure 7.59.4: :

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7.59.1 LACO_REQGNLACO0/SENS_MDL/OPERATE/CBK_EX_MNG/CBK_EX_SPC/SUBSYSTEM

General information:

Application conditions:

Initialisation:	RST
Recurrence:	20MS
Activation:	LV_ST_END == 1
Deactivation:	LV_ST_END == 0

Function description:

Formula section:

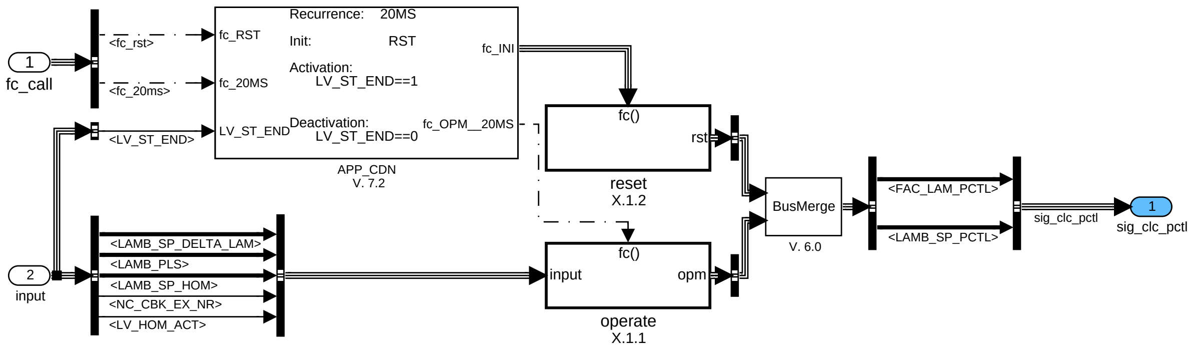

Figure 7.59.5: :

7.59.1.1 For loop

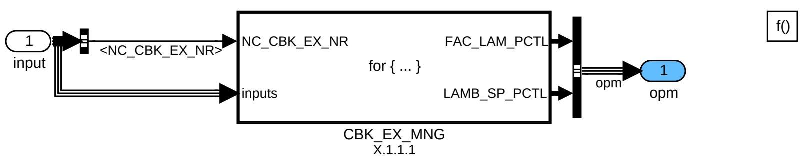

Figure 7.59.6: :

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7.59.1.1.1 for loop (i= 1 to NC_CBK_EX_NR)

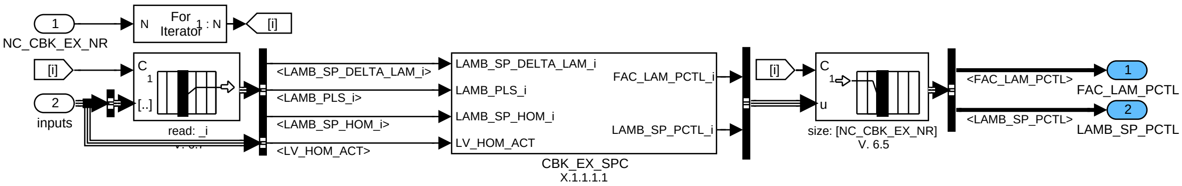

Figure 7.59.7: :

7.59.1.1.1.1 Calculation of pre control lambda set point

In case of homogeneous mode the pre control lambda set point is the static set point LAMB_SP_HOM[i] added with the forced stimulation output LAMB_PLS[i]. Furthermore LAMB_SP_DELTA_LAM[i] is subtracted to consider a trim control lambda shift. This latter variable is assigned in the application incidences.
The pre control correction FAC_LAM_PCTL[i] is then calculated by inverting LAMB_SP_PCTL[i].
In case of stratified mode (LV_HOM_ACT[i] = 0) both outputs are initialized

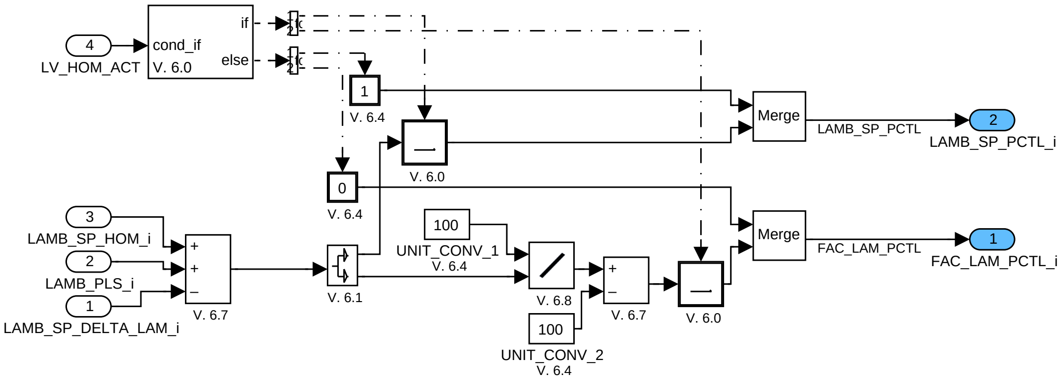

Figure 7.59.8: :

7.59.1.2 Initialisation

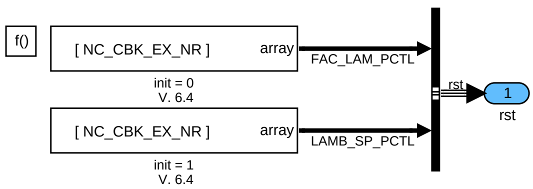

Figure 7.59.9: :

7.59.2 Moving mean value calculation

General information:

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Application conditions:

Initialisation:	RST
Recurrence:	20MS
Activation:	LV_ST_END == 1
Deactivation:	LV_ST_END == 0

Function description:

Formula section:

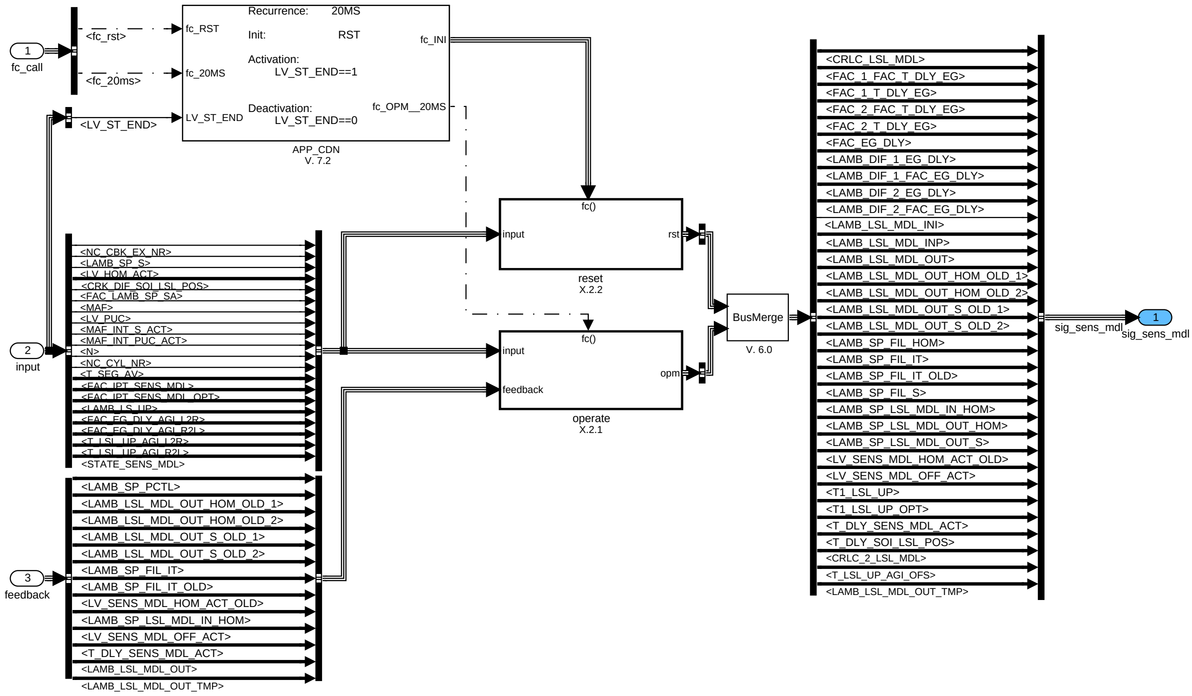

Figure 7.59.10: :

7.59.2.1 For loop

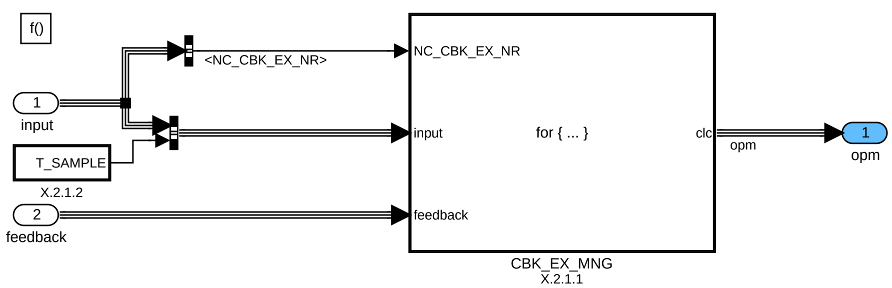

Figure 7.59.11: :

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7.59.2.1.1 for loop (i = 0 to NC_CBK_EX_NR)

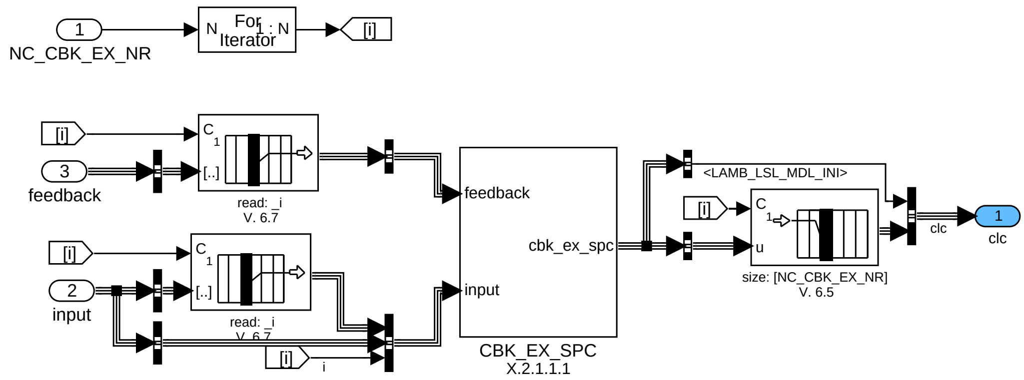

Figure 7.59.12: :

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7.59.2.1.1.1 Determination of Lambda set point

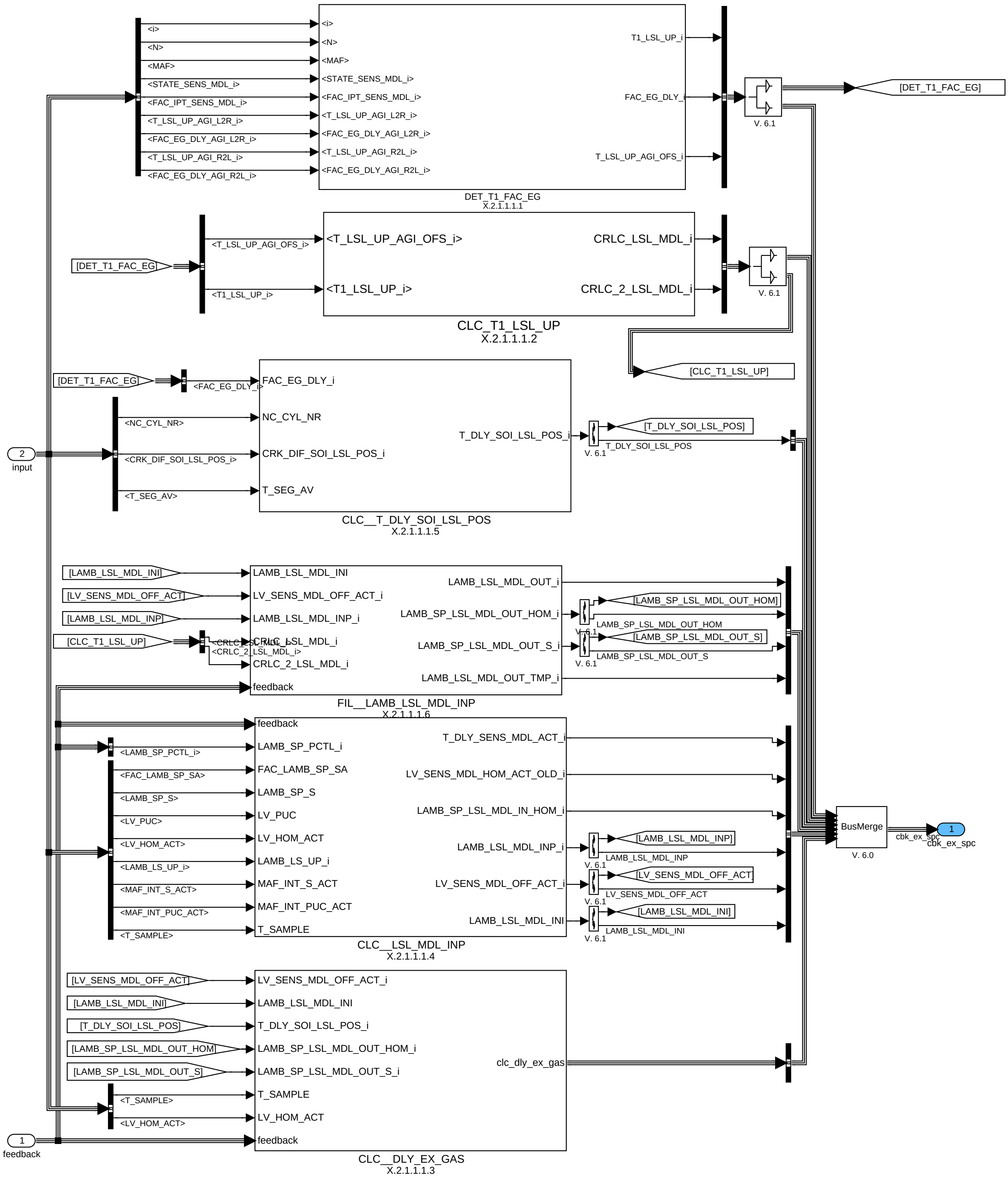

Figure 7.59.13: :

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7.59.2.1.1.1.1 Depending on STATE_SENS_MDL[i] different plant-models are selected

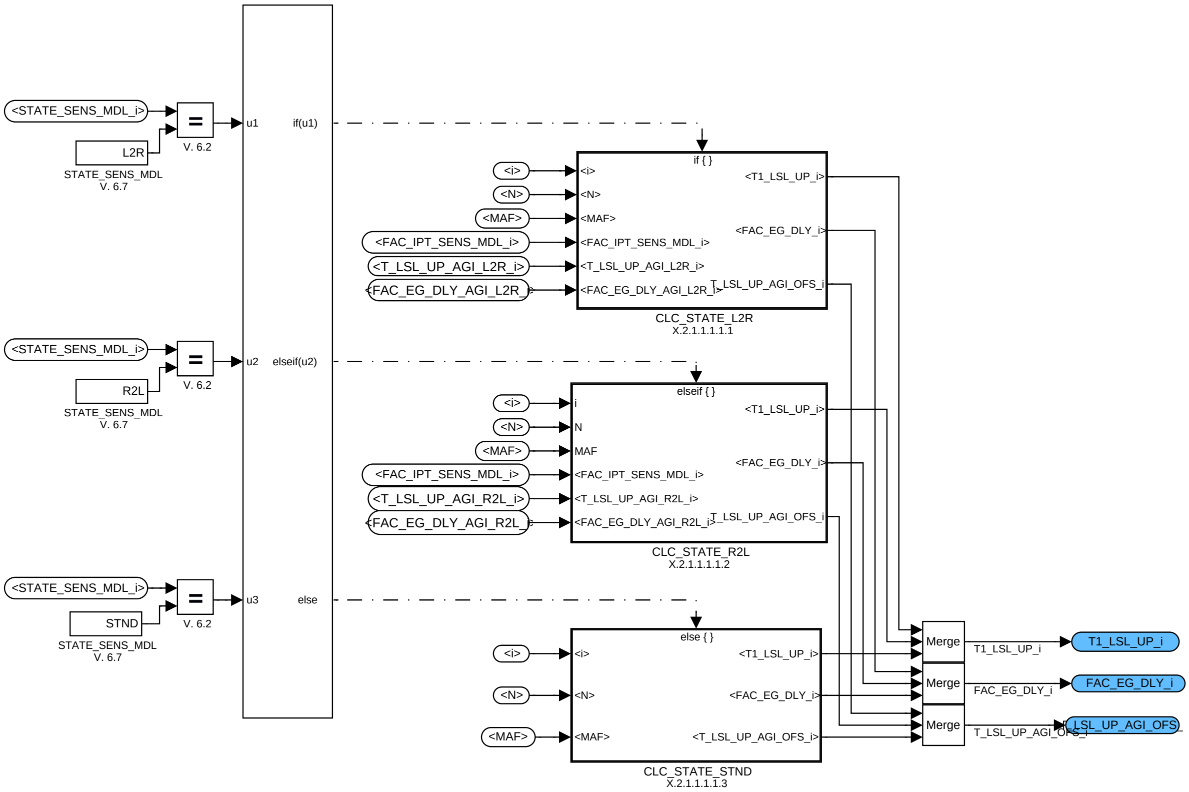

Figure 7.59.14: :

7.59.2.1.1.1.1.1 Calculation when STATE_SENS_MDL[i] = L2R

Lean to rich model is active

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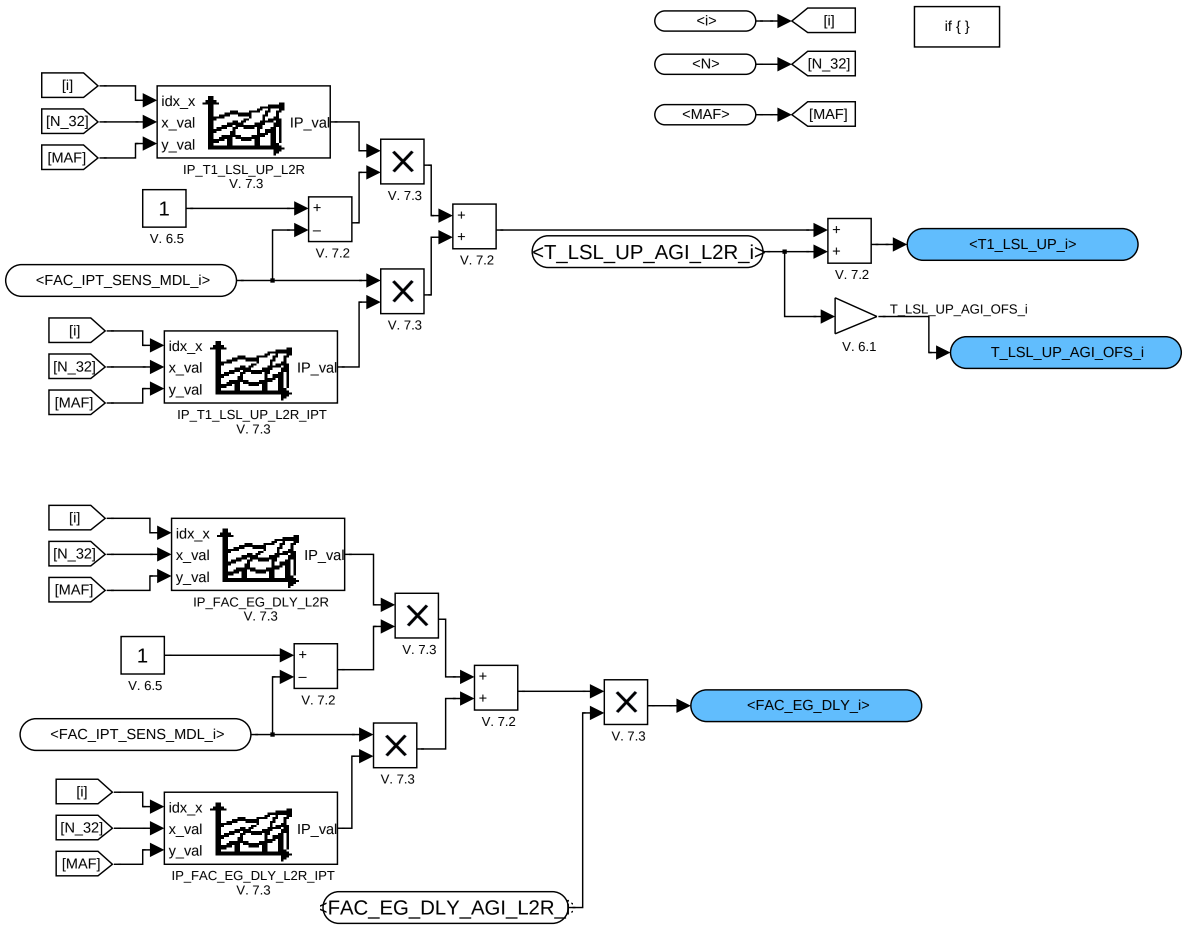

Figure 7.59.15: :

7.59.2.1.1.1.1.2 Calculation when STATE_SENS_MDL[i] = R2L

Rich to lean model is active

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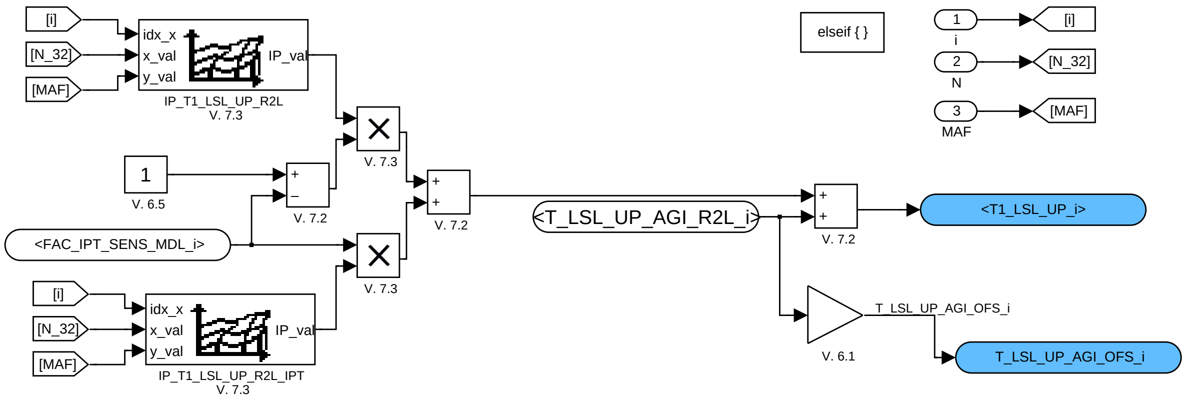

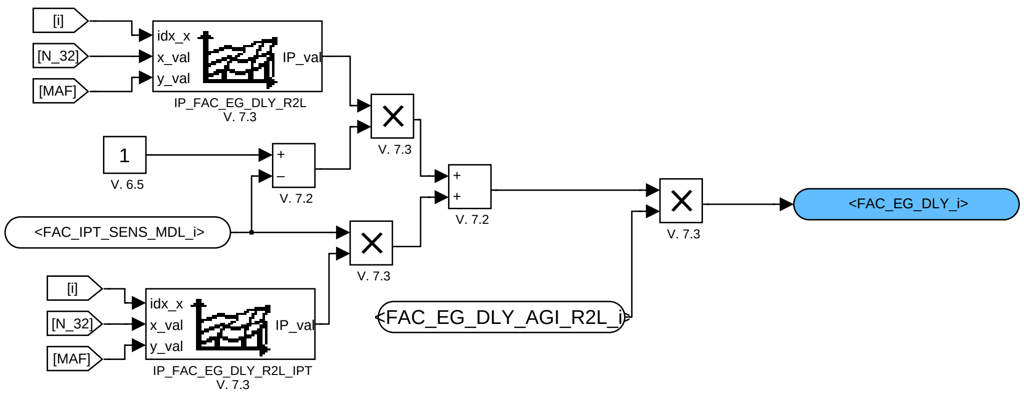

Figure 7.59.16: :

7.59.2.1.1.1.1.3 Calculation when STATE_SENS_MDL[i] = STND

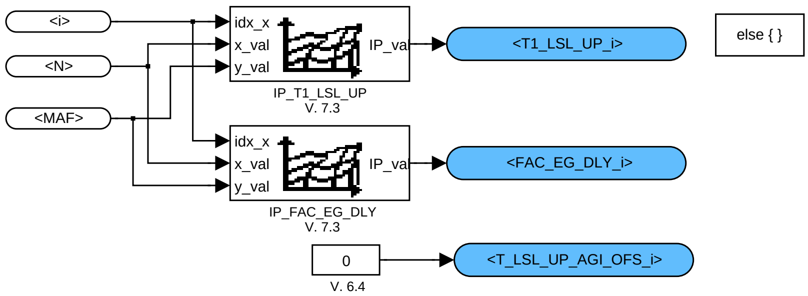

Figure 7.59.17: :

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7.59.2.1.1.1.2 Calculation of Correlation constant for aged lambda sensor model with PT2 behaviour

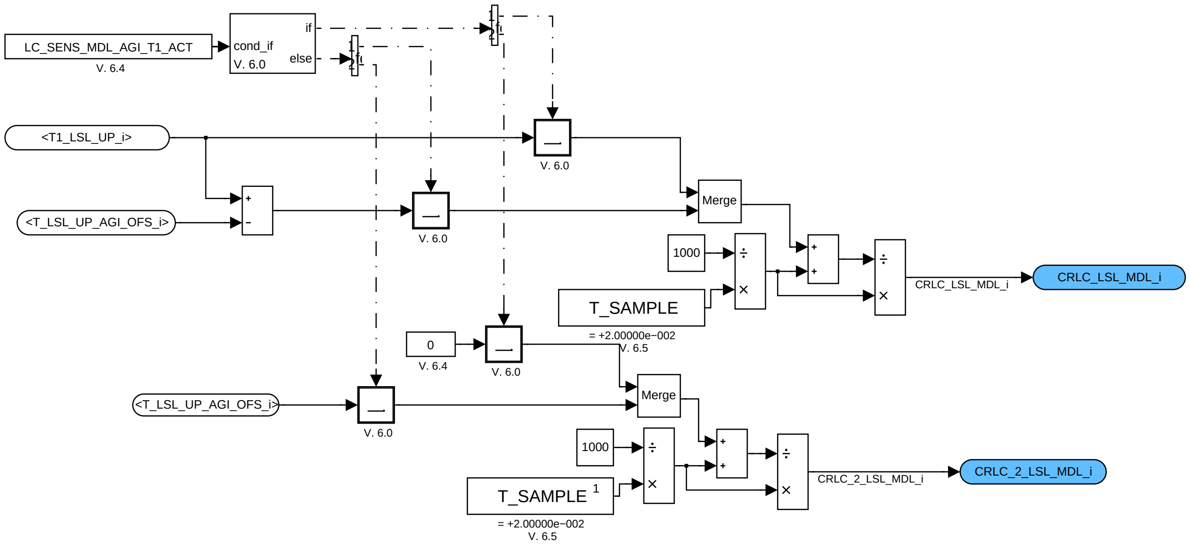

Figure 7.59.18: :

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7.59.2.1.1.1.3 internal factor of Pade filter calculation

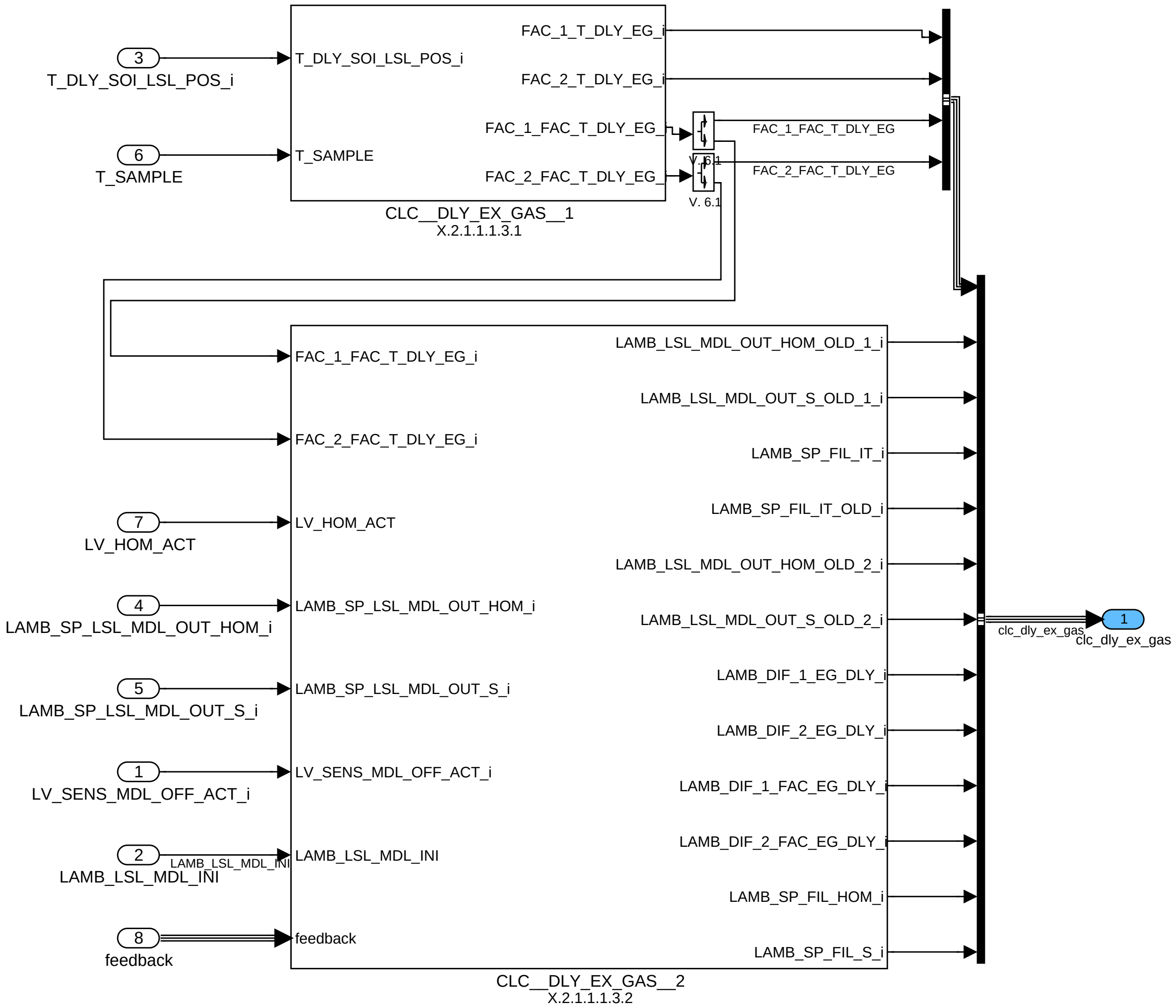

Figure 7.59.19: :

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7.59.2.1.1.1.3.1 internal factor of Pade filter calculation

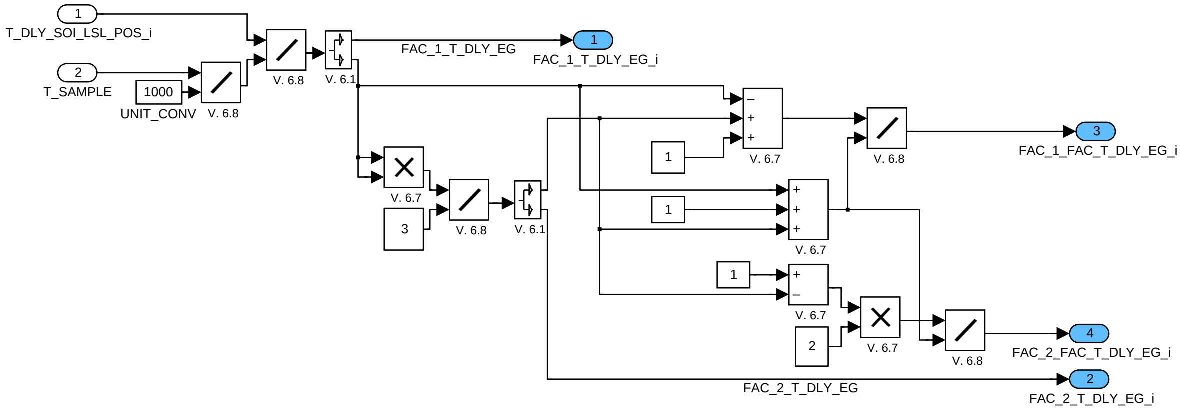

Figure 7.59.20: :

7.59.2.1.1.1.3.2 Pad approximation (part 2)

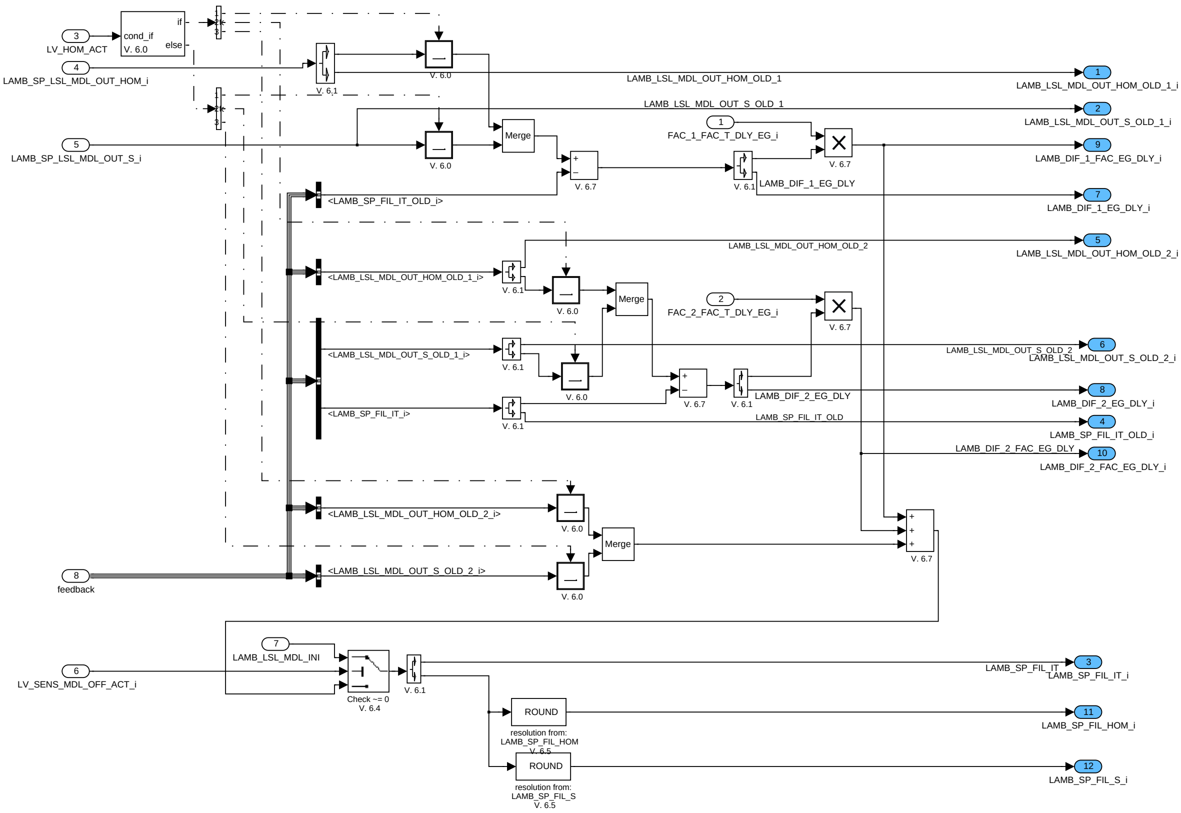

Figure 7.59.21: :

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7.59.2.1.1.1.4 Lambda set point as model input (LAMB_SP_LSL_MDL_IN_HOM[i])

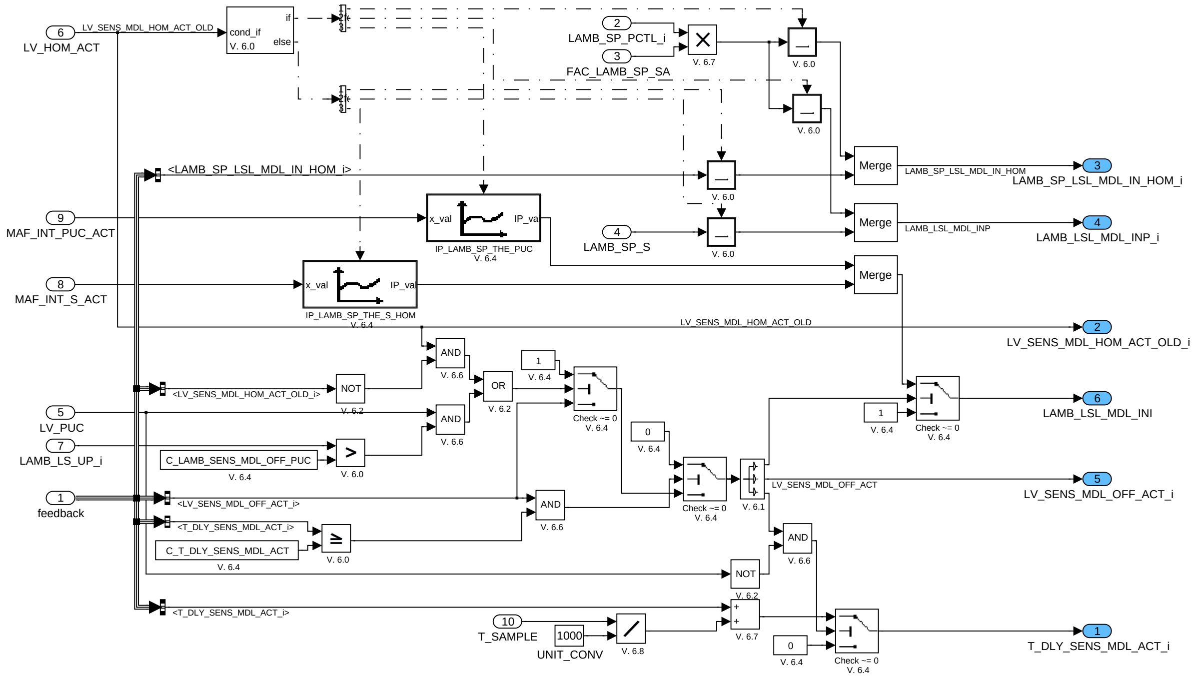

Figure 7.59.22: :

7.59.2.1.1.1.5 Calculation of gas delay time (T_DLY_SOI_LSL_POS[i])

The gas delay T_DLY_SOI_LSL_POS[i] corresponds to the time from fuel injection up to the measurement of the air fuel ratio by the WRAF sensor. FAC_EG_DLY[i] is a tuning factor for the sensor position and is determined together with the T1 maps by means of a system identification.
The gas delay is calculated with the following formula:

$$T\_DLY\_SOI\_LSL\_POS[i] = \left[\frac{CRK\_DIF\_SOI\_LSL\_POS[i]}{180^{\circ}CRK} \cdot \frac{NC\_CYL\_NR}{4} + FAC\_EG\_DLY[i]\right] \cdot T\_SEG\_AV.$$

Figure 7.59.23: :

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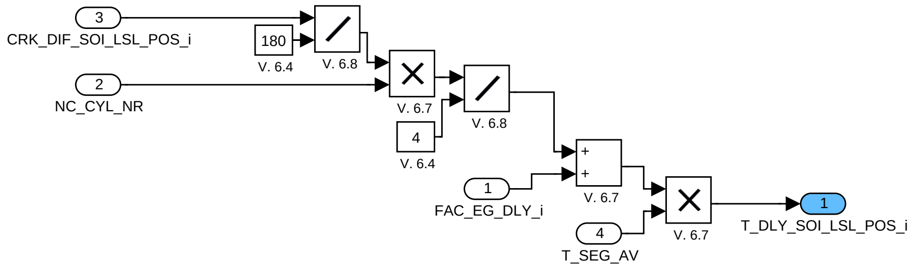

Figure 7.59.24: :

7.59.2.1.1.1.6 Filtering of lambda set point model input (LAMB_SP_LSL_MDL_OUT_HOM/S[i])

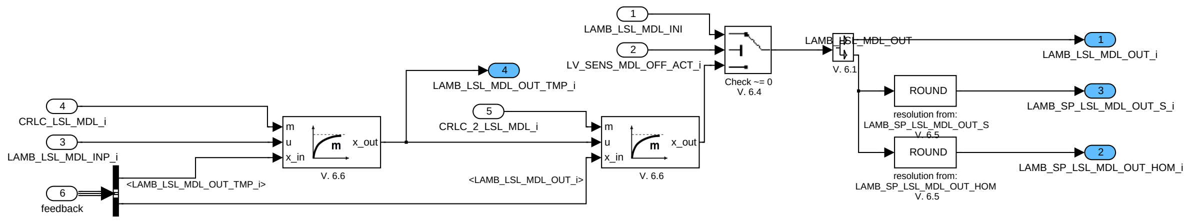

Figure 7.59.25: :

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7.59.2.1.2 No title given

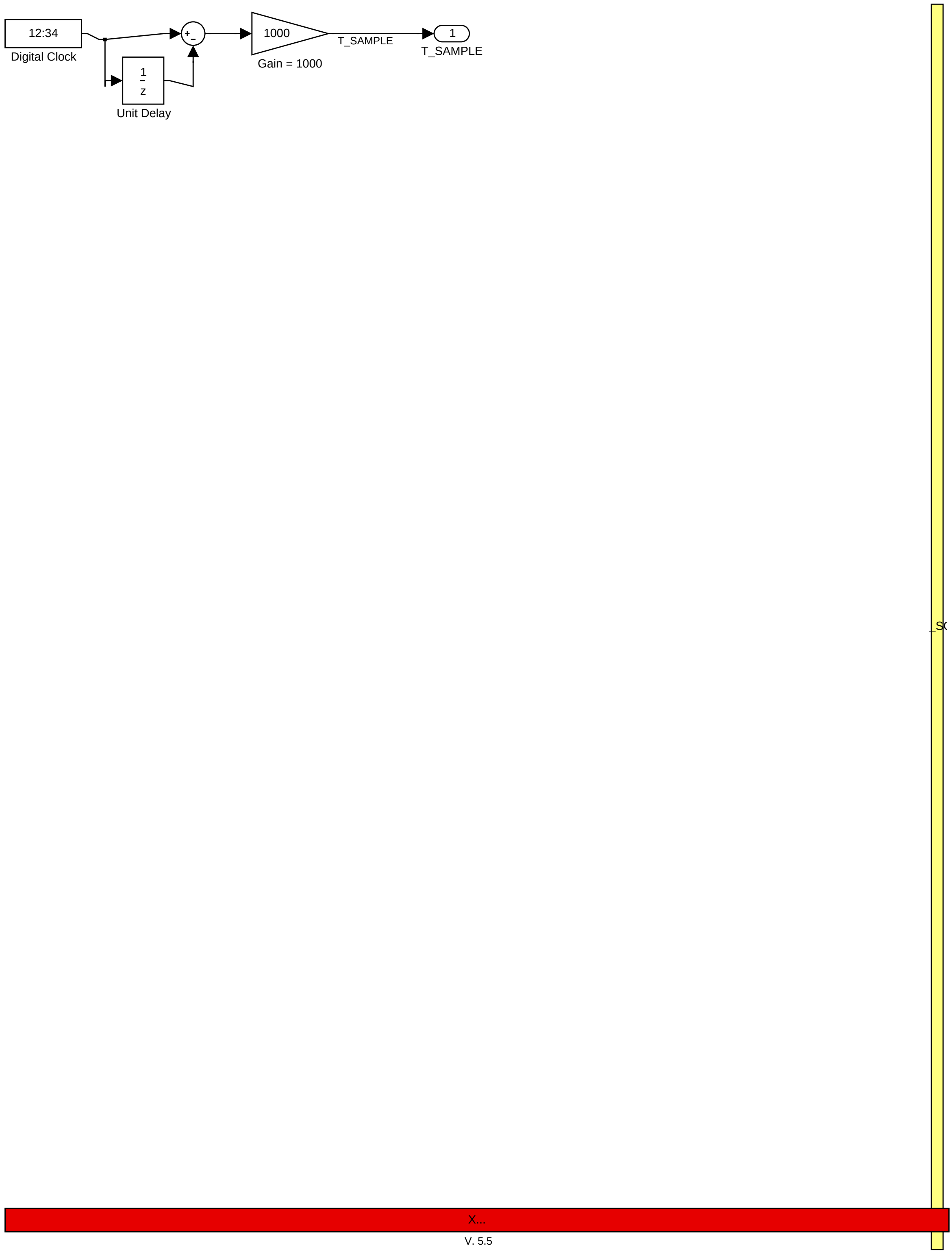

Figure 7.59.26: :

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7.59.2.2 Initialisation

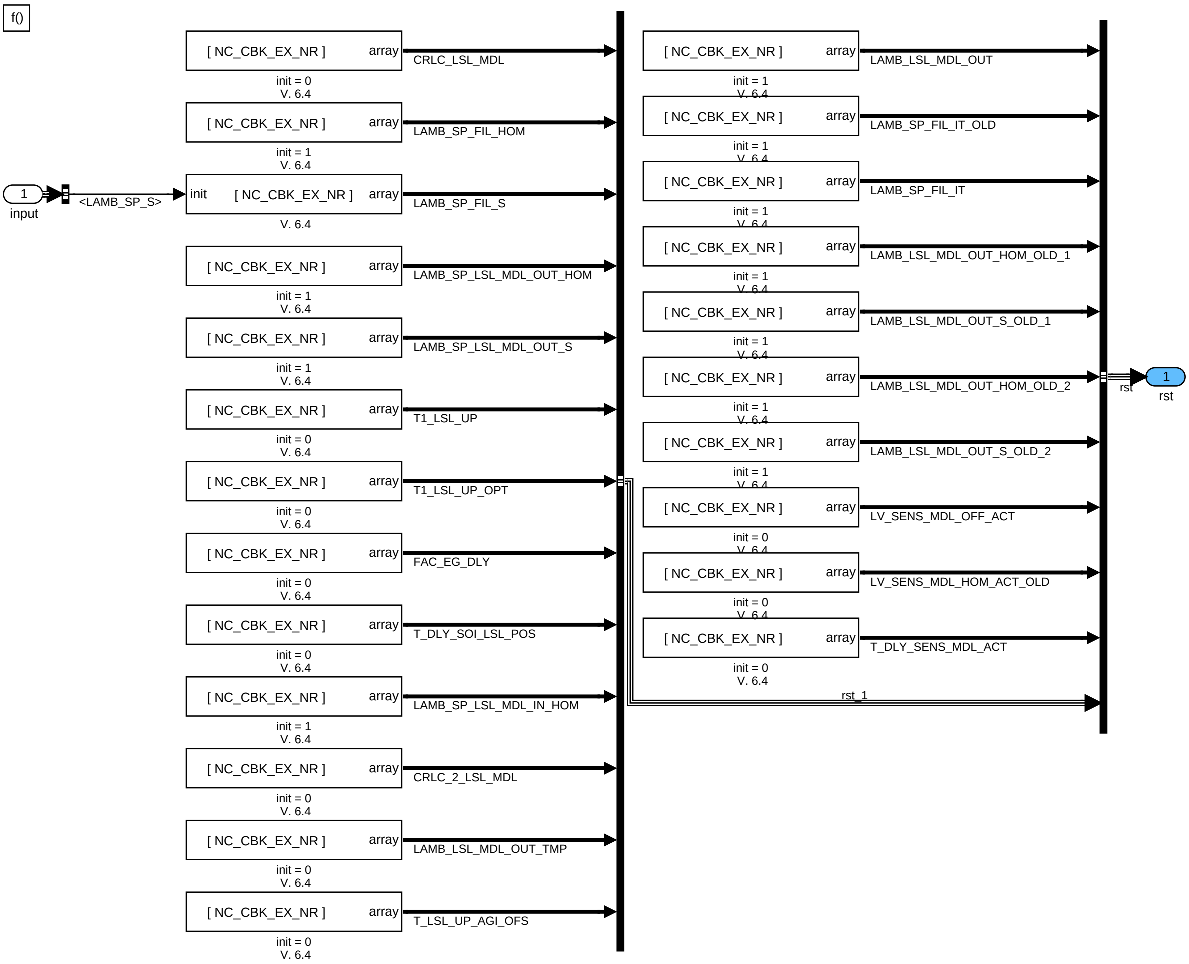

Figure 7.59.27: :

7.59.3 Linear lambda controller

General information:

Application conditions:

Initialisation:	RST
Recurrence:	20MS
Activation:	LV_ST_END == 1
Deactivation:	LV_ST_END == 0

Function description:

Formula section:

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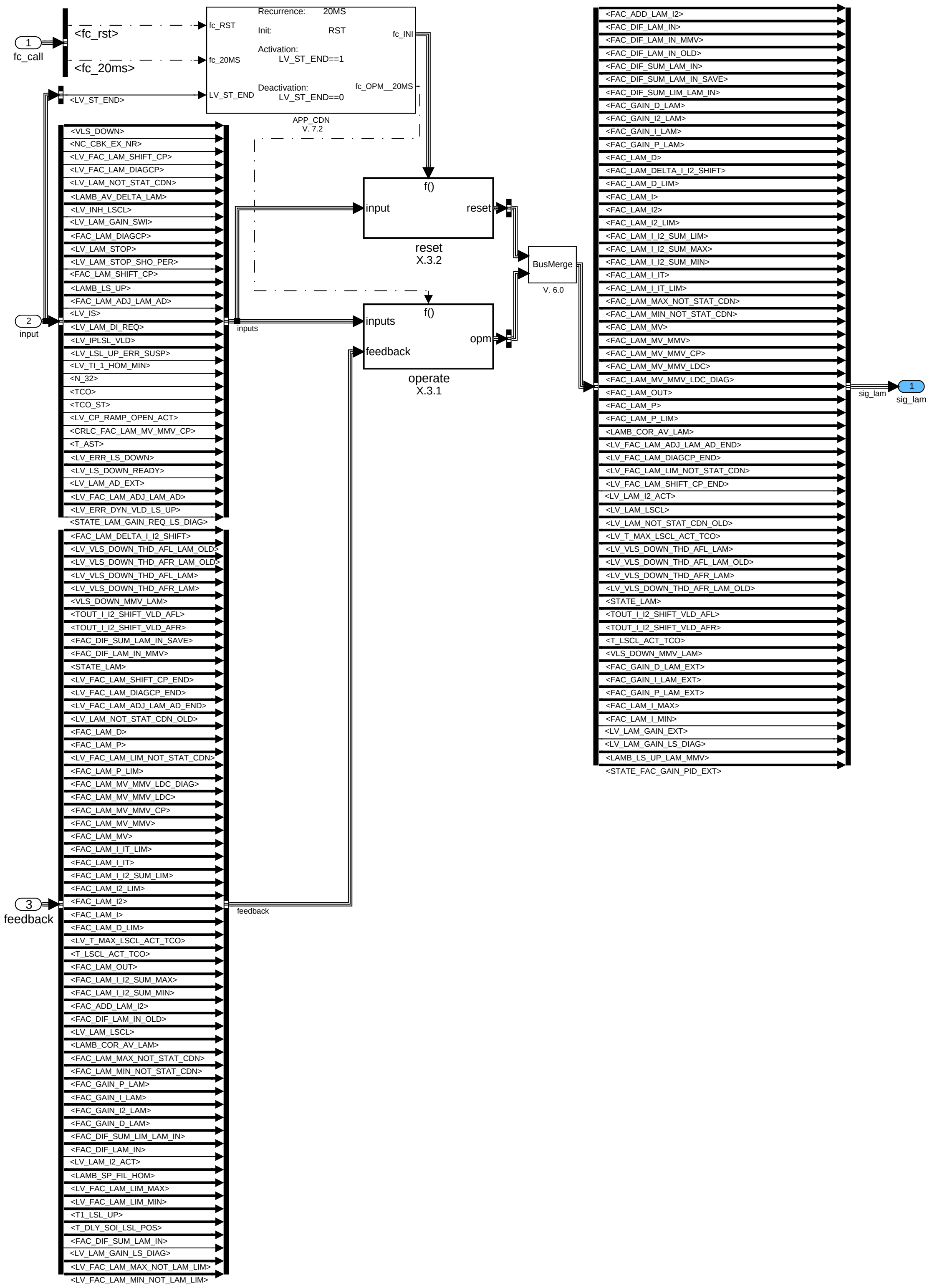

Figure 7.59.28: :

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7.59.3.1 Operation at 20ms

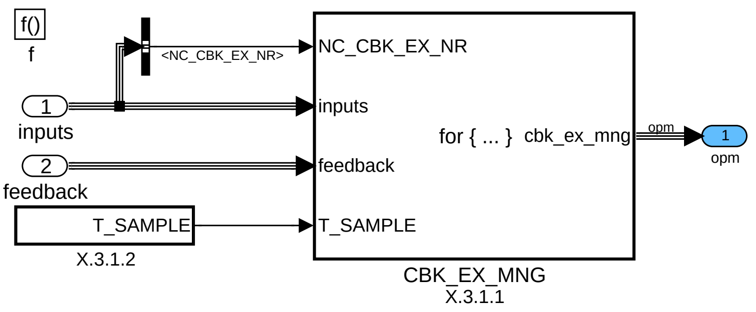

Figure 7.59.29: :

7.59.3.1.1 for loop (i= 1 to NC_CBK_EX_NR)

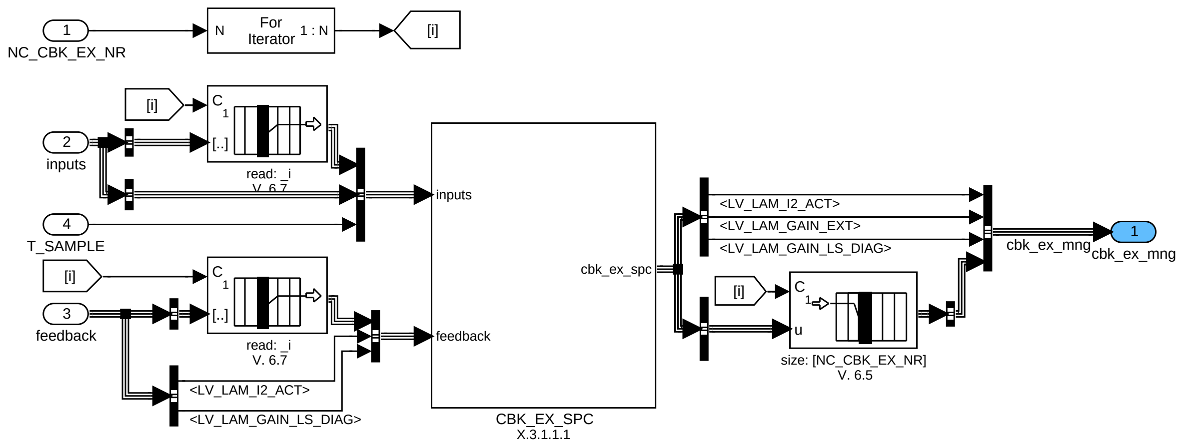

Figure 7.59.30: :

7.59.3.1.1.1 Activation and state machine

The sub-system ACT_LAM desribes the activation of the lambda sontroller.

State machine of lambda contoller:
If LV_LAM_LSCL[i] is 0 then state "0:OFF" is applied. Otherwise then three different states are to distinguish.
State "1:ON" is applied when the controller is not stopped by the flag LV_LAM_STOP[i]. In that case the controller is in normal operation mode.
If LV_LAM_STOP[i] is set to 1 either state "2:STOP_SHO_PER" or state "3:STOP" is applied depending on LV_LAM_STOP_SHO_PER[i].

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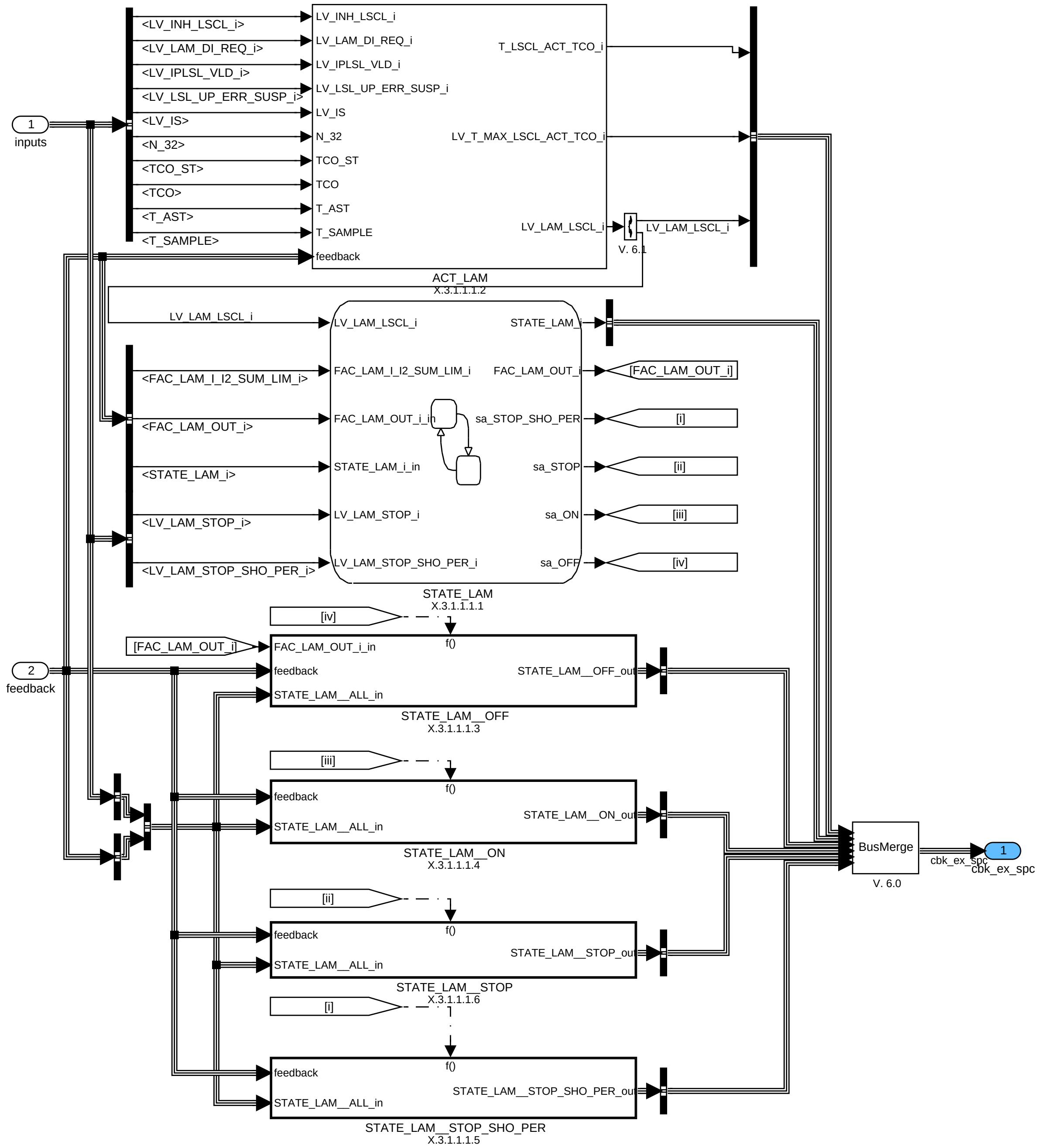

Figure 7.59.31: :

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7.59.3.1.1.1.1 STATE_LAM

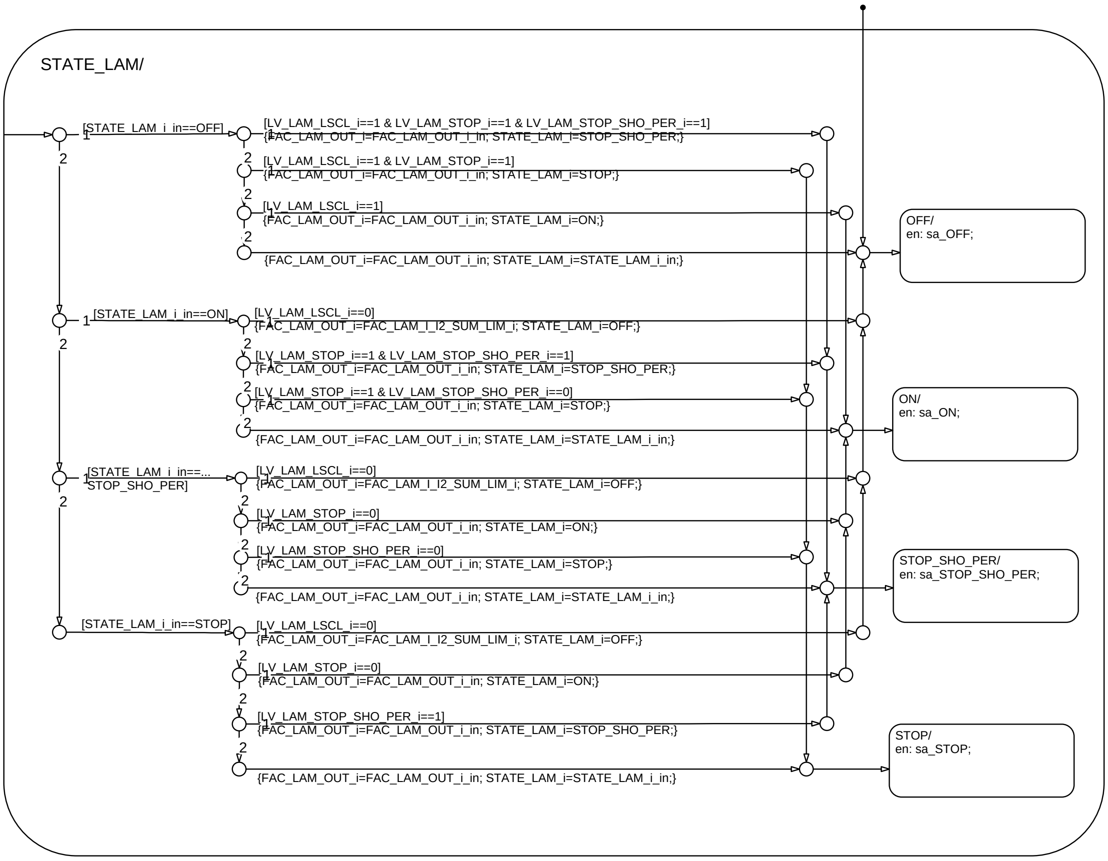

Figure 7.59.32: :

7.59.3.1.1.1.2 Controller activation /deactivation

Independent of the lambda controller state (STATE_LAM[i]) the evaluation of controller activation / deactivation is calculated.

The controller is activated by the flag LV_LAM_LSCL[i] = 1. This flag is set if the following conditions are fulfilled:

- inhibit flag not set (LV_INH_LSCL[i] = 0)
- no request from OBD function to inhibit lambda controller (LV_LAM_DI_REQ[i] = 0)
- WRAF sensor operability recognised (LV_LS_UP_READY[i] = 1)
- engine speed above threshold (N_32 > C_N_MIN_LAM_LSCL)
- time after start threshold expired (T_AST > ID_T_AST_MIN_LSCL_ACT)
- coolant temperature exceeds threshold

(in idle speed TCO > ID_TCO_MIN_LAM_LSCL_IS
otherwise TCO > ID_TCO_MIN_LAM_LSCL)
or the time ID_T_MAX_LSCL_ACT_TCO is expired

LV_T_MAX_LSCL_ACT_TCO[i] is permanently set to 1 if the controller was activated by the time condition instead of activation by the corresponding TCO condition. Otherwise LV_T_MAX_LSCL_ACT_TCO[i] is set to 0. If one of the conditions above is not fulfilled the flag LV_LAM_LSCL[i] is set to 0 and the controller is not activated.

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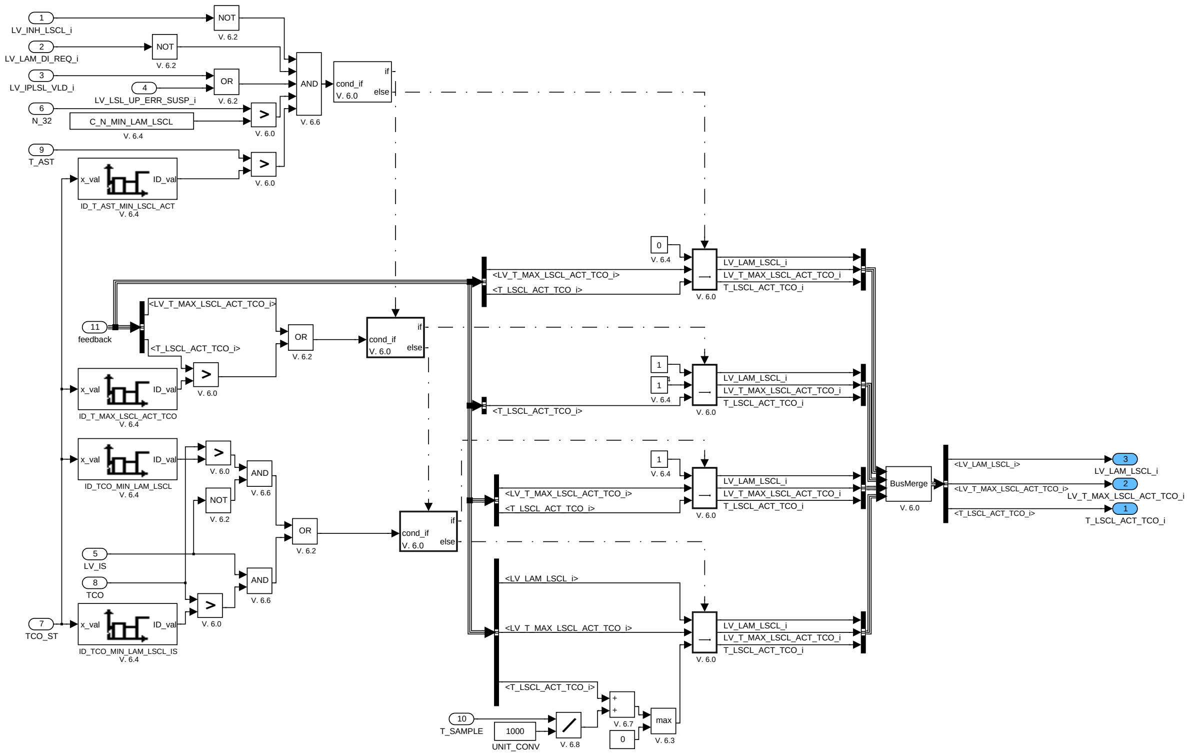

Figure 7.59.33: :

7.59.3.1.1.1.3 STATE_LAM: "0:OFF"

In state "0:OFF" this calibration flag LC_LAM_I2_ACT is copied in the variable LV_LAM_I2_ACT that means a switch between PID and PII2D controller can only be applied in this state.

The reset of internal state variables and output values (Sub-System: RST__IT_STATE_VALUE_OUT_VALUE_CBK_SPC) is carried out.

FAC_LAM_OUT[i] is set to the current offset (I + I2 share) when entering this state and then ramped down to zero (RAMP_DOWN__FAC_LAM_OUT).

The controller difference FAC_DIF_LAM_IN[i] is calculated (Sub-System: CLC__FAC_DIF_LAM) as difference of the inverted lambda set point (LAMB_SP_FIL_HOM[i])-1 and the inverted measured lambda signal corrected by the trim control influence (LAMB_LS_UP[i] + LAMB_AV_DELTA_LAM[i])-1. Therefore FAC_DIF_LAM_IN[i] represents a richness. LAMB_AV_DELTA_LAM[i] is assigned in the application incidences. A moving mean value of the controller difference (FAC_DIF_LAM_IN_MMV[i]) is calculated in order to realise a shift of I and I2 share based on downstream signal evaluation.

A moving mean value of the downstream sensor signal voltage (VLS_DOWN_LAM_MMV[i]) is calculated (Sub-System: DET__VLS_DOWN_AFL_AFR). Based on this moving mean value a too lean (100% O2 loading of the catalyst) or too rich (0% O2 loading of the catalyst) mixture is detected. The respective flags LV_VLS_DOWN_THD_AFL_LAM[i] or LV_VLS_DOWN_THD_AFR_LAM[i] is set to 1.

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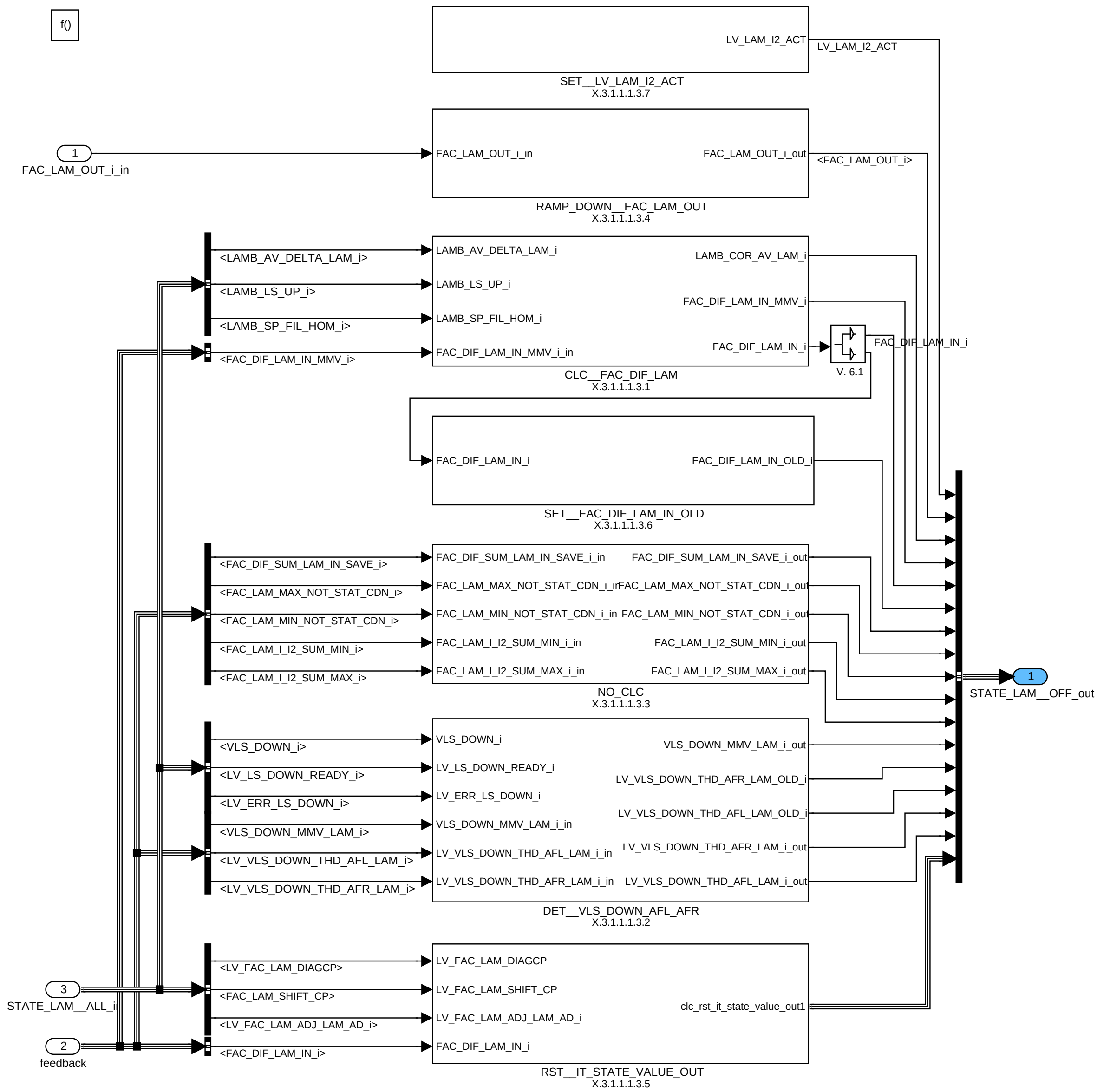

Figure 7.59.34: :

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7.59.3.1.1.1.3.1 Calculation of controller difference (as richness)

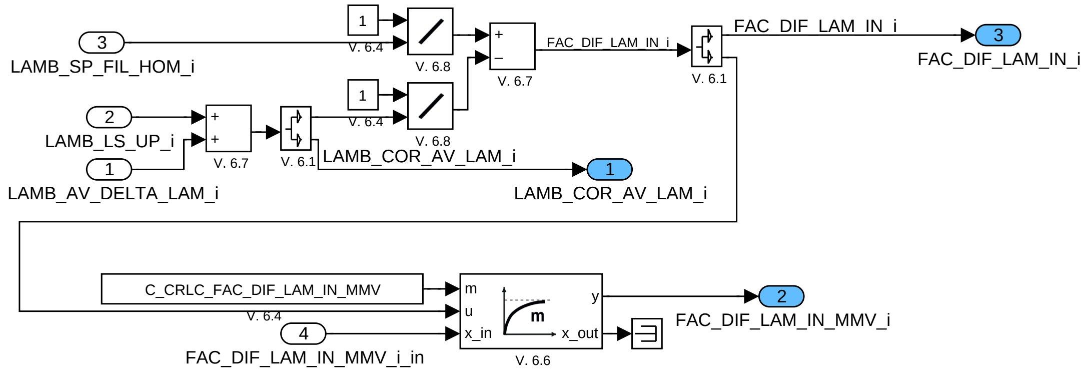

Figure 7.59.35: :

7.59.3.1.1.1.3.2 Evaluation of downstream sensor voltage

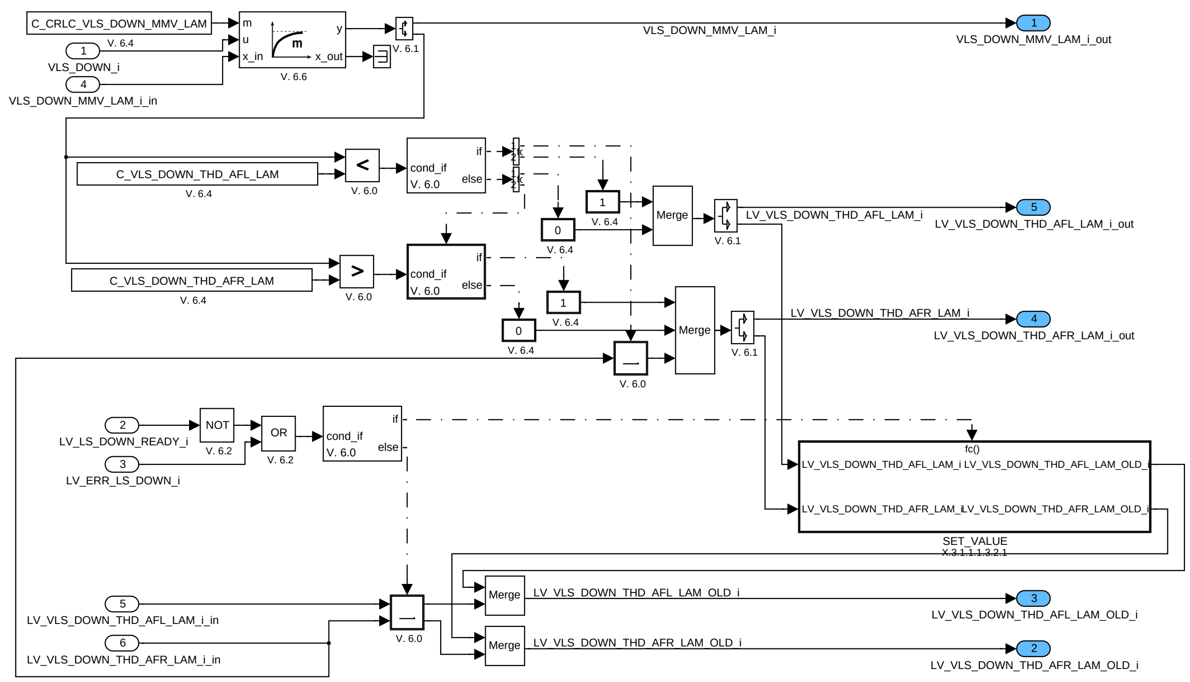

Figure 7.59.36: :

7.59.3.1.1.1.3.2.1 Calculation of old value

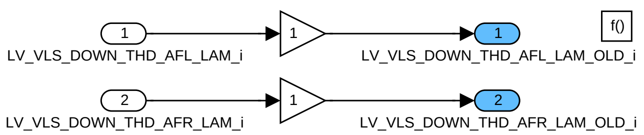

Figure 7.59.37: :

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7.59.3.1.1.1.3.3 feedthrough

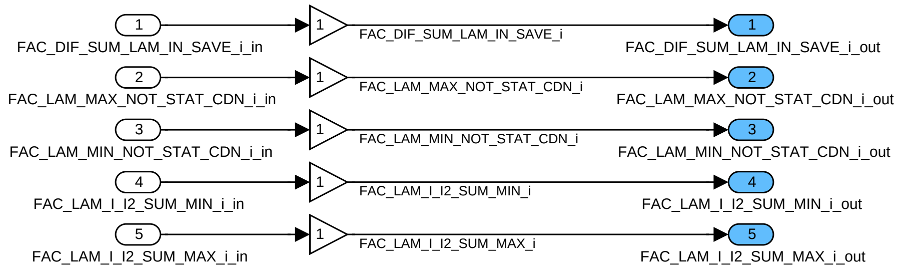

Figure 7.59.38: :

7.59.3.1.1.1.3.4 Ramping down of ouput signal

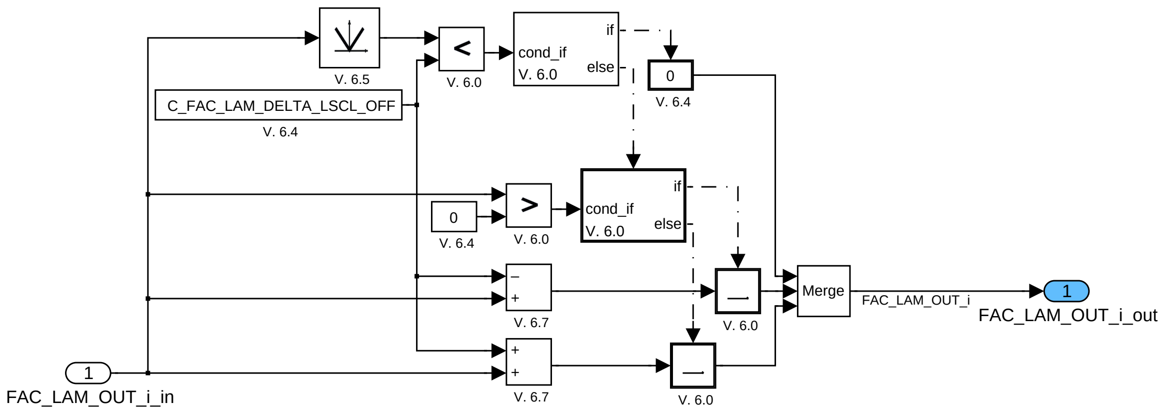

Figure 7.59.39: :

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7.59.3.1.1.1.3.5 Reset of internal state variables and output values

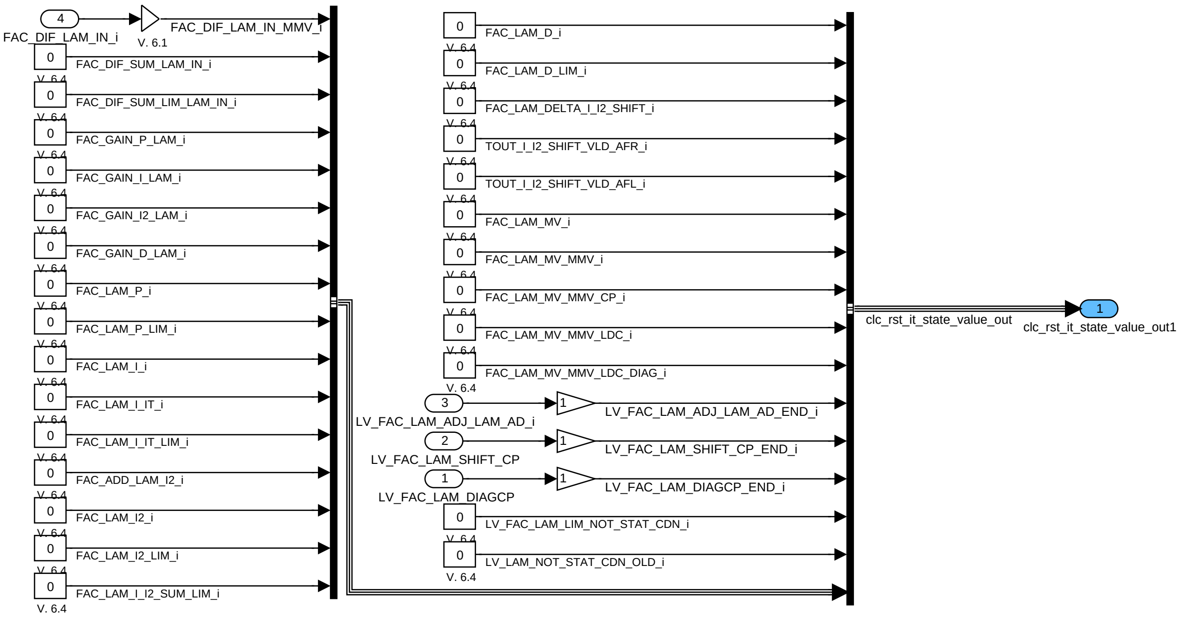

Figure 7.59.40: :

7.59.3.1.1.1.3.6 Calculation of old value

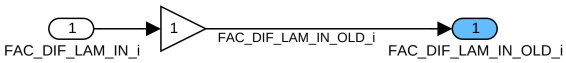

Figure 7.59.41: :

7.59.3.1.1.1.3.7 switch between PII^2D and PID lambda controller

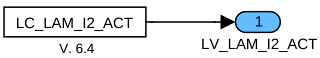

Figure 7.59.42: :

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7.59.3.1.1.1.4 Calculation of lambda controller output

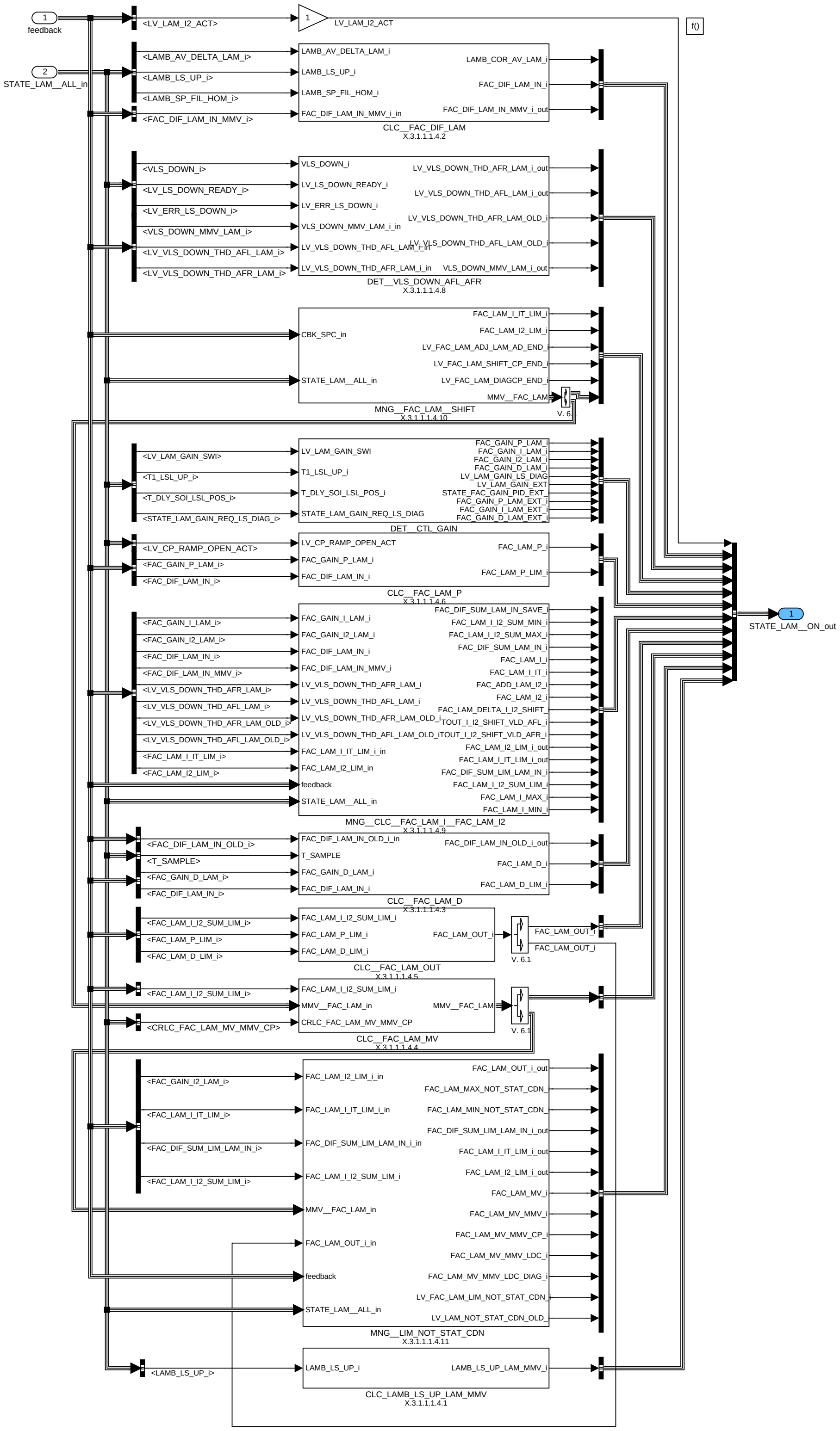

Figure 7.59.43: :

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7.59.3.1.1.1.4.1 Assignment of LAMB_LS_UP to LAMB_LS_UP_LAM_MMV

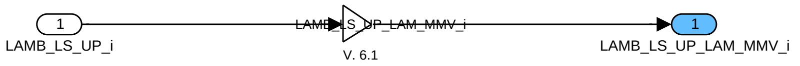

Figure 7.59.44: :

7.59.3.1.1.1.4.2 Calculation of controller difference (as richness)

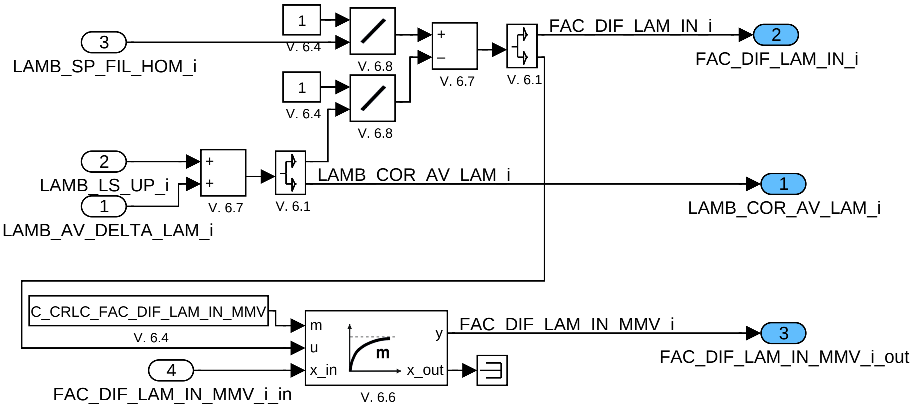

Figure 7.59.45: -:

7.59.3.1.1.1.4.3 D share calculation

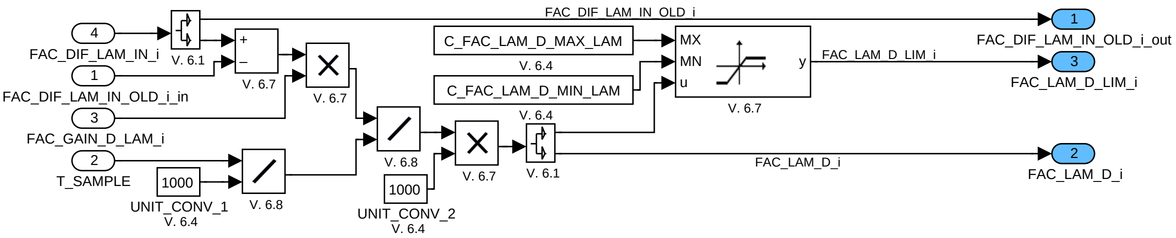

Figure 7.59.46: :

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7.59.3.1.1.1.4.4 mean value of lambda controller output

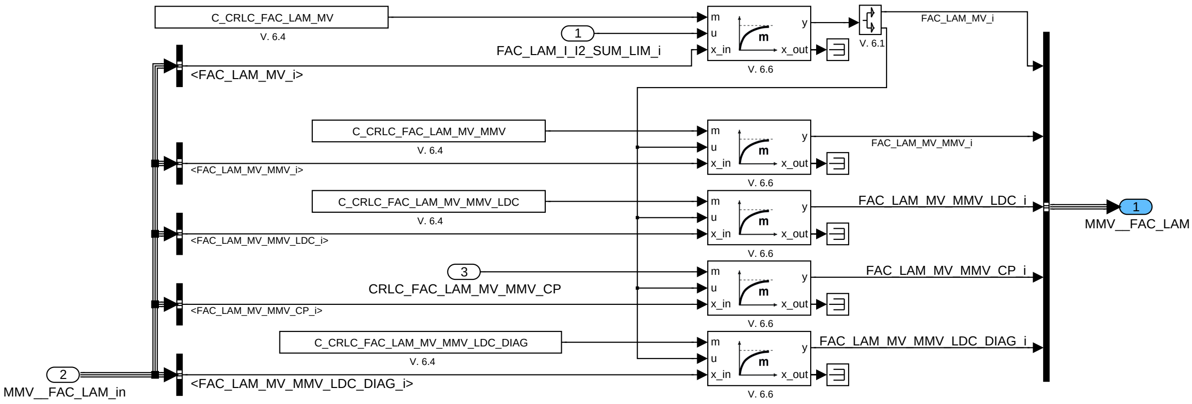

Figure 7.59.47: :

7.59.3.1.1.1.4.5 Calculation of controller output signal

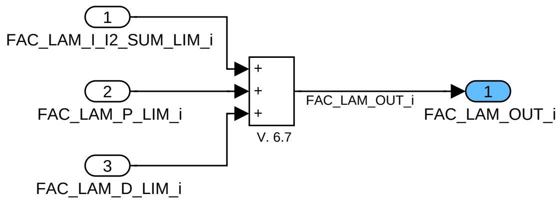

Figure 7.59.48: :

7.59.3.1.1.1.4.6 P share calculation

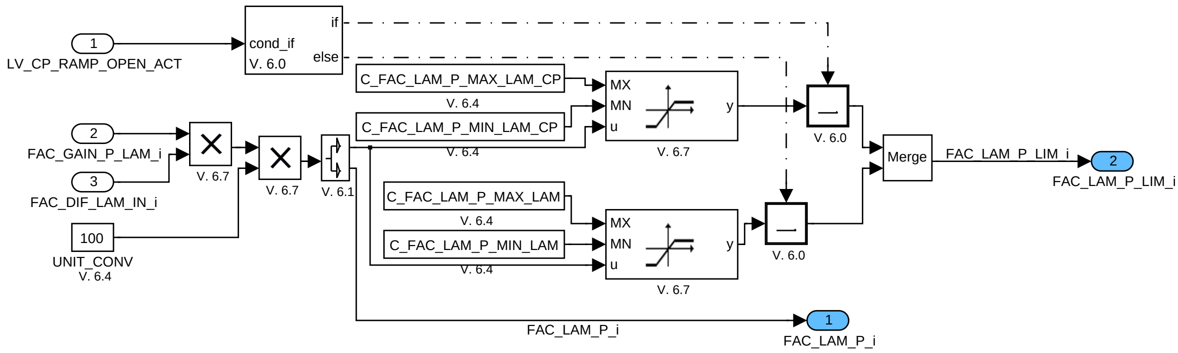

Figure 7.59.49: :

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7.59.3.1.1.1.4.7 calculation of LV_LAM_GAIN_LS_DIAG and LV_LAM_GAIN_EXT

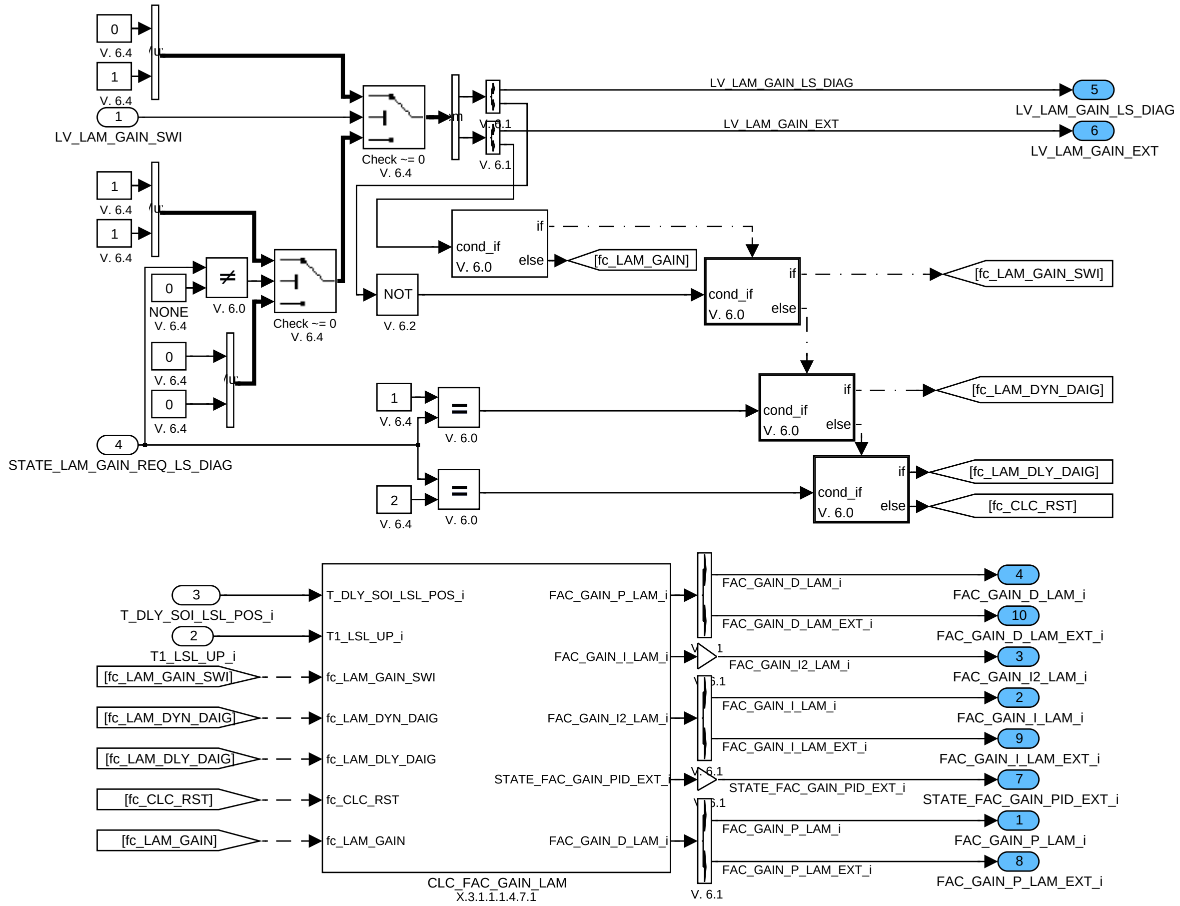

Figure 7.59.50: :

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7.59.3.1.1.1.4.7.1 Determination of controller parameters (FAC_GAIN_P/I/I2/D_LAM[i])

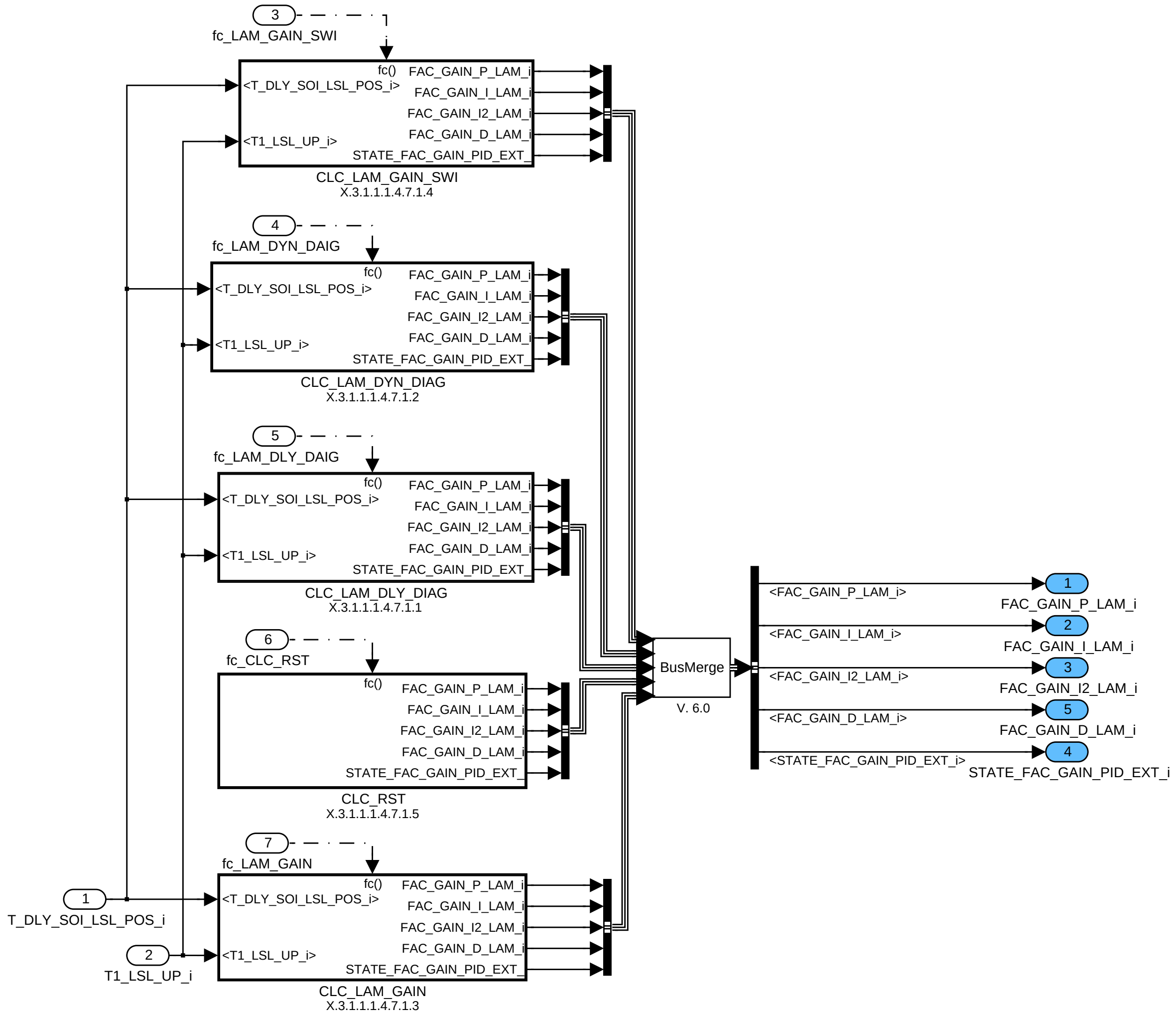

Figure 7.59.51: :

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7.59.3.1.1.1.4.7.1.1 Calculation of lambda controller gain factors in case of DLY_DIAG

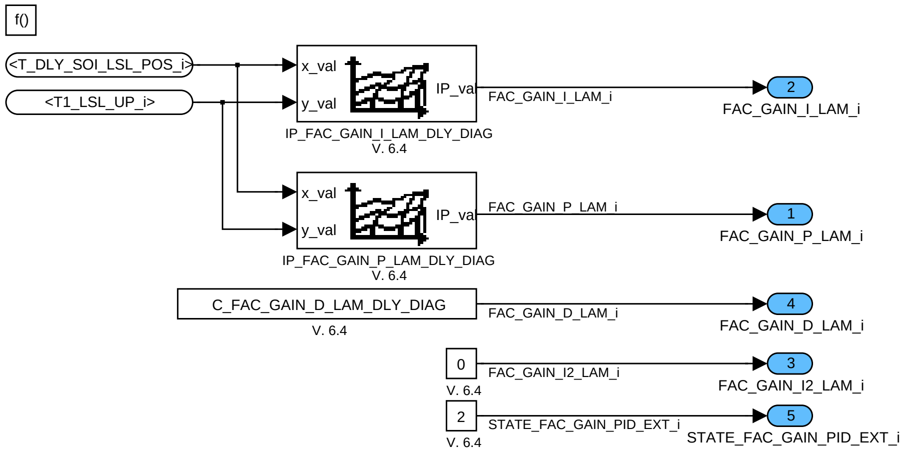

Figure 7.59.52: :

7.59.3.1.1.1.4.7.1.2 Calculation of lambda controller gain factors in case of DYN_DIAG

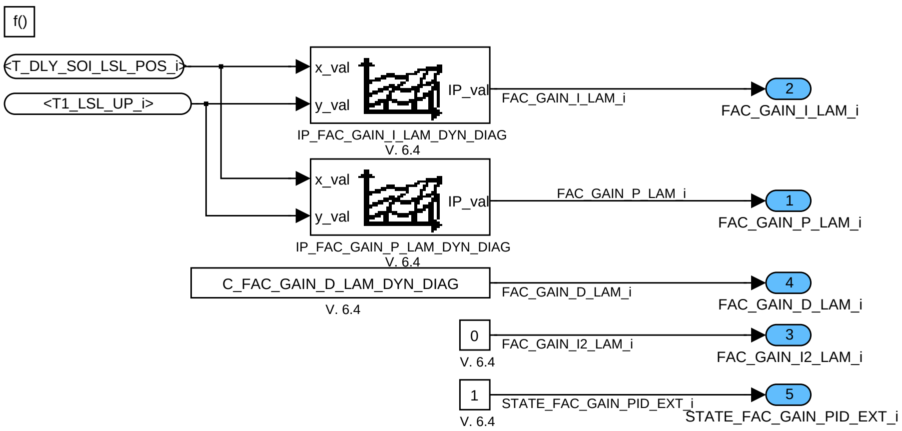

Figure 7.59.53: :

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7.59.3.1.1.1.4.7.1.3 regular gain factors

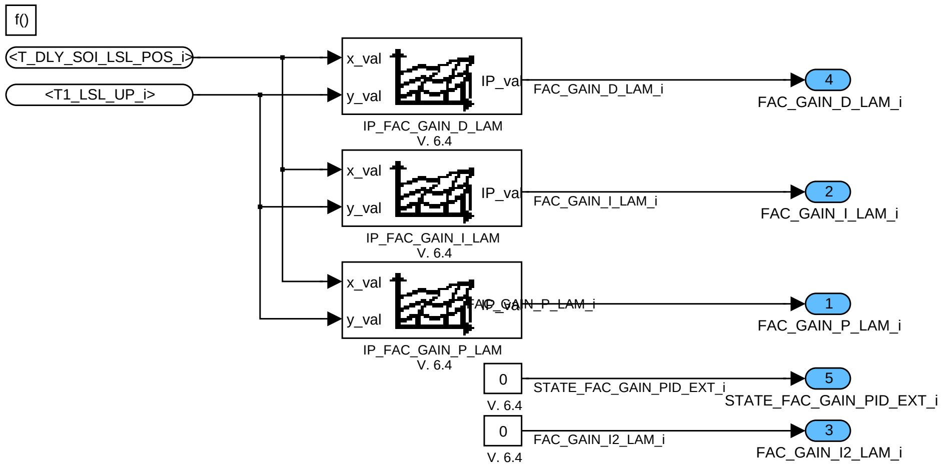

Figure 7.59.54: :

7.59.3.1.1.1.4.7.1.4 Calculation of lambda controller gain factors in case of LV_LAM_GAIN_SWI is set

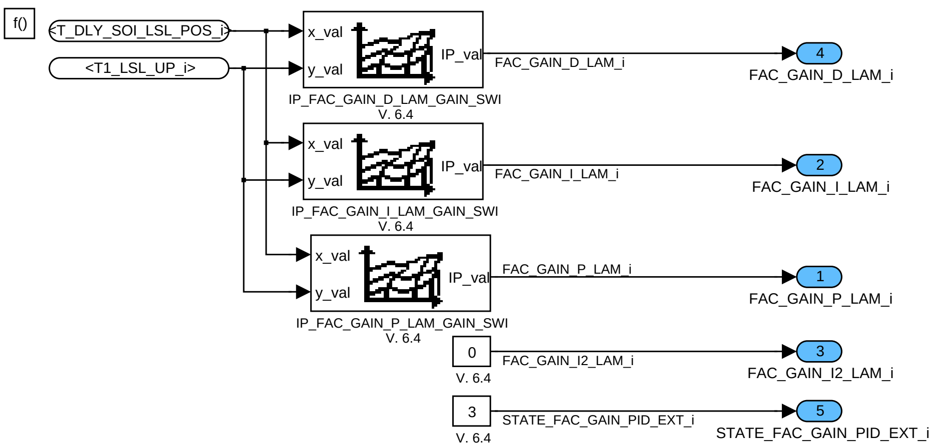

Figure 7.59.55: :

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7.59.3.1.1.1.4.7.1.5 All the external gain factors are set to zero

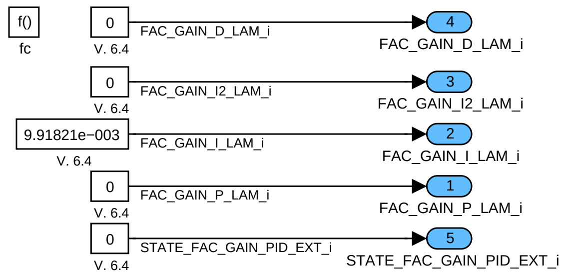

Figure 7.59.56: :

7.59.3.1.1.1.4.8 Evaluation of downstream sensor voltage

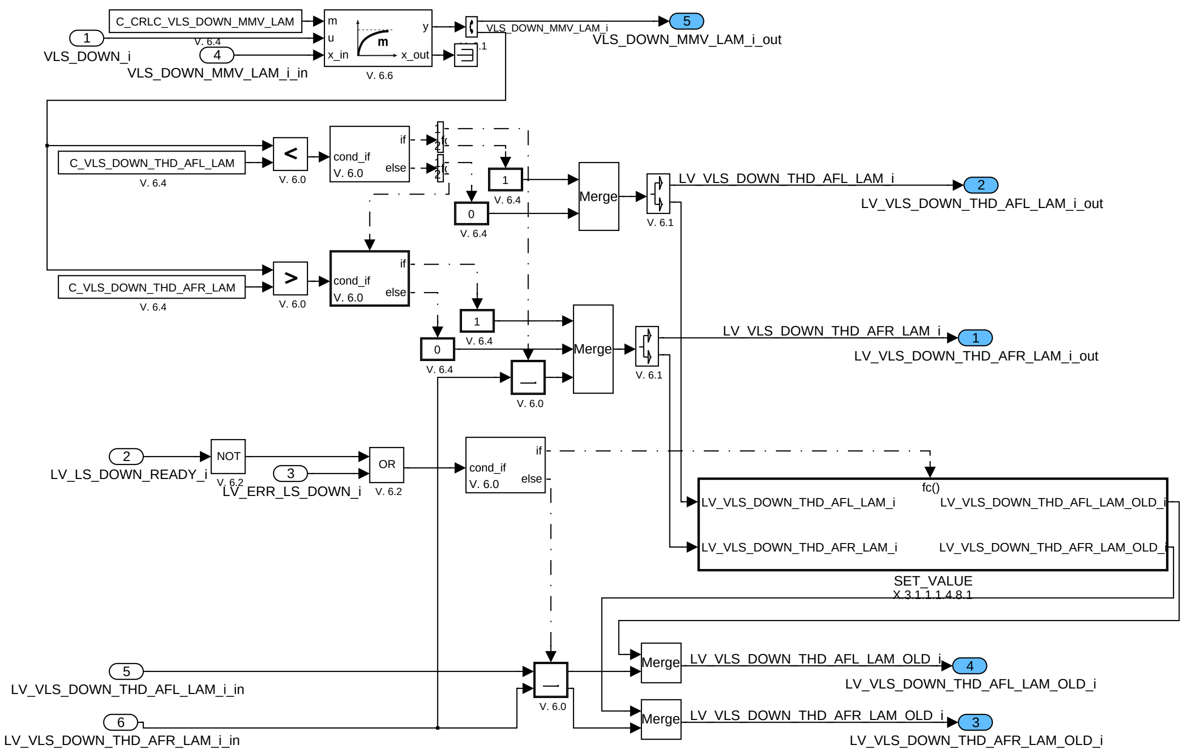

Figure 7.59.57: :

7.59.3.1.1.1.4.8.1 Calculation of old values

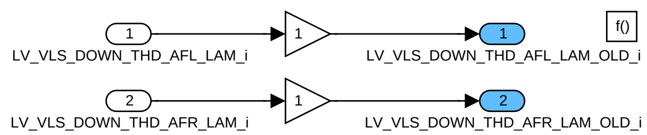

Figure 7.59.58: :

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7.59.3.1.1.1.4.9 Calculation of the I and I2 share

The calculation of the I and I^2 share depends on the flag LV_LAM_I2_ACT. If it is set to 1 then the lambda controller is calculated as an PII^2D controller. Otherwise a PID controller is applied.

PII^2D controller: The control differences are summed up in the variable FAC_DIF_SUM_LAM_IN[i]. A shift of the I and I2 share based on downstream signal evaluation is realised by shifting FAC_DIF_SUM_LAM_IN[i]. This variable is then multiplied with the I share gain FAC_GAIN_I_LAM[i] and the sample time. The result is stored in the variable FAC_LAM_I[i] which represents the unlimited I share. In case of anti wind up limitation of FAC_LAM_I[i] to its maximum or minimum possible range FAC_DIF_SUM_LAM_IN[i] has to be limited "backwards". FAC_DIF_SUM_LAM_IN[i] is input to the calculation of the I^2 share too. Therefore a multiplication with T_SAMPLE^2 and FAC_GAIN_I2_LAM[i] is necessary. If the product of FAC_DIF_SUM_LAM_IN[i], T_SAMPLE^2 and FAC_GAIN_I2_LAM[i] leads to zero result while FAC_DIF_SUM_LAM_IN[i] is not zero (FAC_GAIN_I2_LAM[i] is never 0 when using a PII^2D controller) then the I^2 share is increased or decreased by the resolution of FAC_LAM_I2[i]. By means of FAC_LAM_DELTA_I_I2_SHIFT[i] the shift of the I share is realised. If the shift should be applied if this variable is not equal to 0 for one sample step. With C_TOUT_I_I2_SHIFT_VLD an time out for the shift can be applied.

PID controller: The I^2 share FAC_LAM_I2[i] is always set to 0. The I share is calculated with an internal variable that has a higher resolution than FAC_LAM_I[i] (see formula section).

For both controllers the calculation of the I share is only executed if no limitation is applied (LV_FAC_LAM_LIM_MAX[i] = 0 and LV_FAC_LAM_LIM_MIN[i] = 0). If the injected fuel mass is not on its minimum value (indicated by LV_TI_1_HOM_MIN = 1) or LV_FAC_LAM_LIM_MIN[i] = 0 then the I share is only calculated if the controller difference is above 0. If LV_FAC_LAM_LIM_MAX[i] = 0 then the controller difference must be above 0. For the I^2 share calculation FAC_DIF_SUM_LAM_IN[i] must be above or below 0 in the same way in case of the mentioned limitations.

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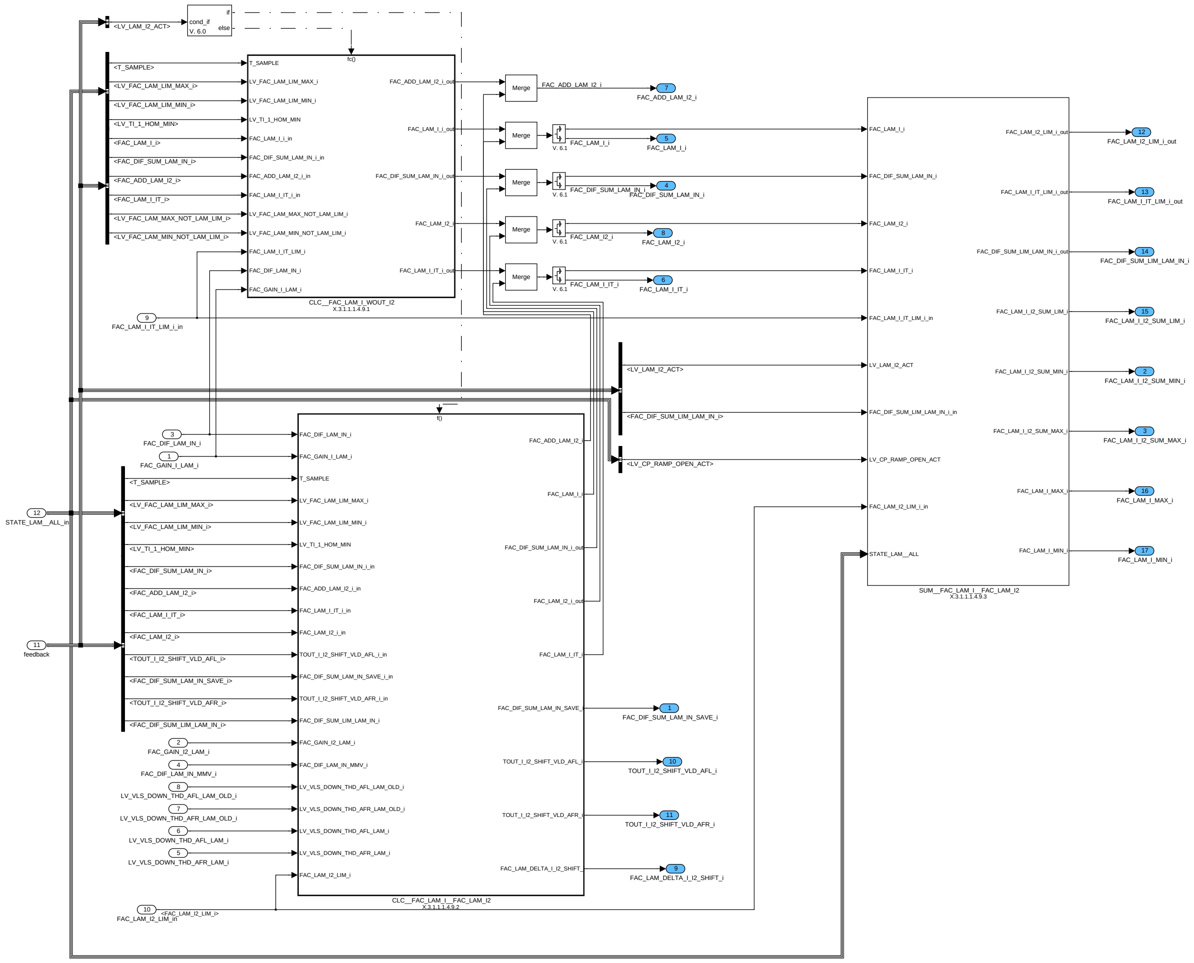

Figure 7.59.59: :

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7.59.3.1.1.1.4.9.1 I share calculation without active I2 share

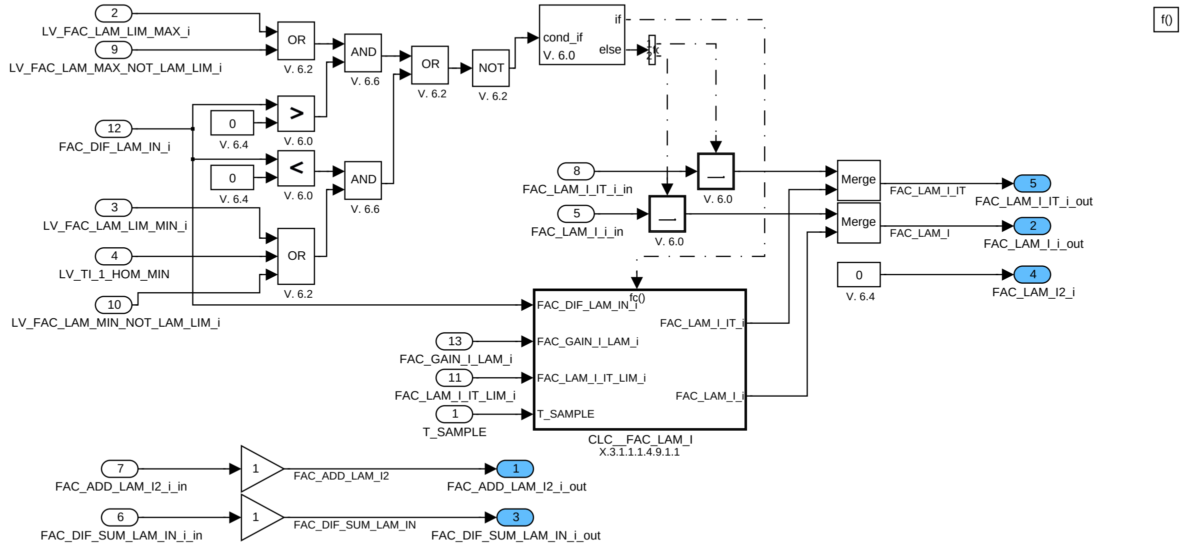

Figure 7.59.60: :

7.59.3.1.1.1.4.9.1.1 I share calculation with active I2 share

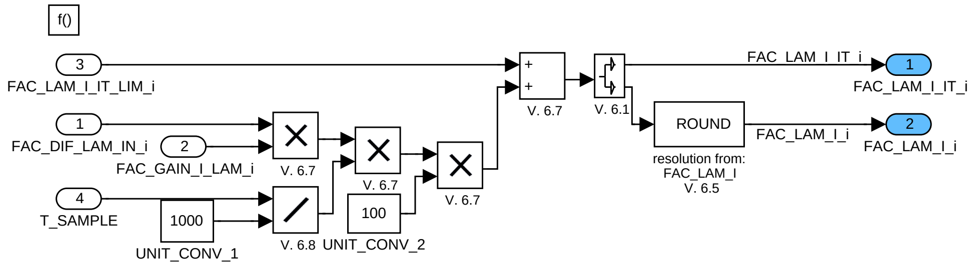

Figure 7.59.61: :

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7.59.3.1.1.1.4.9.2 Calculations of I2 share

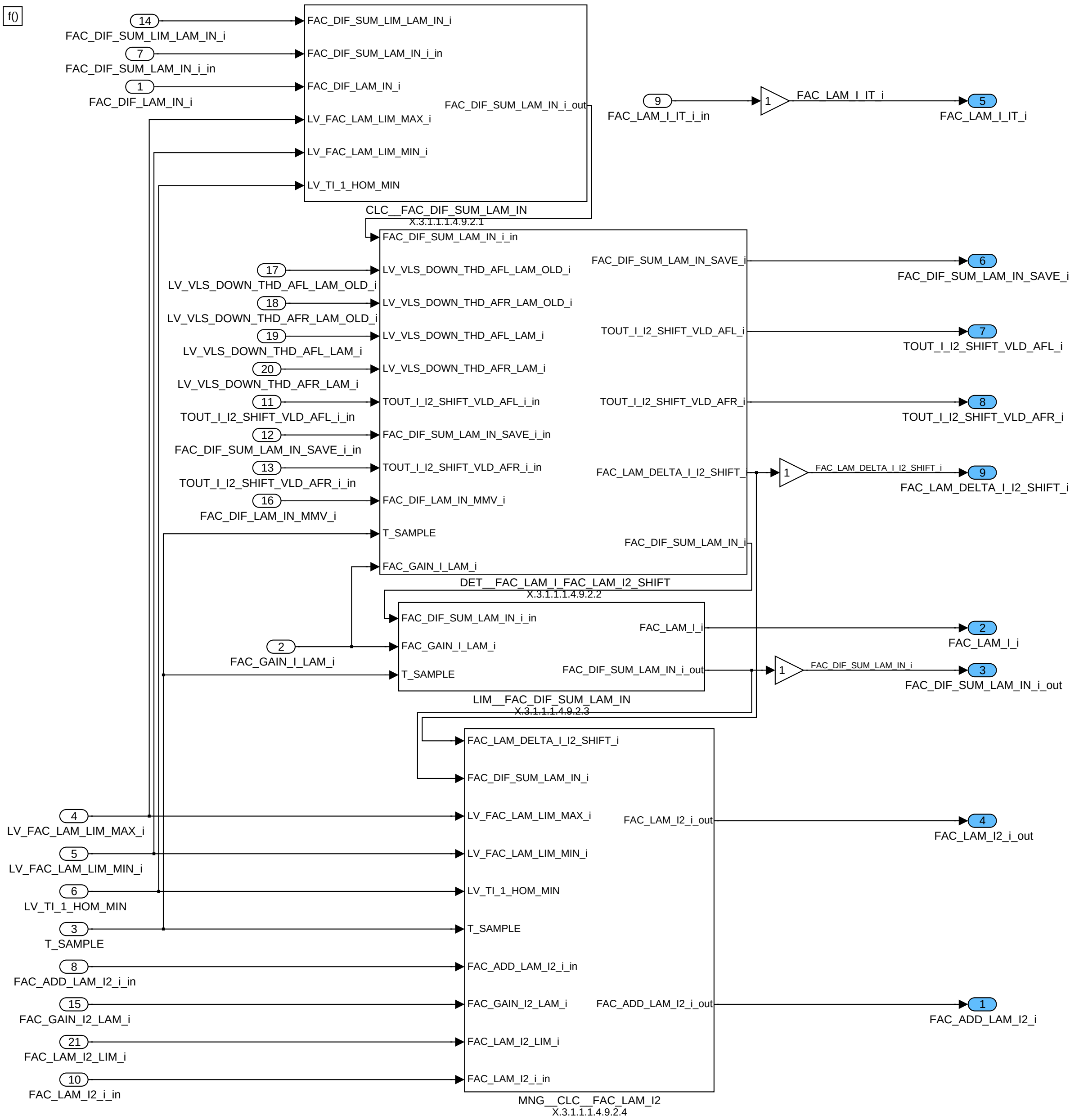

Figure 7.59.62: :

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7.59.3.1.1.1.4.9.2.1 Summation of controller difference (only with active I2 share calculation)

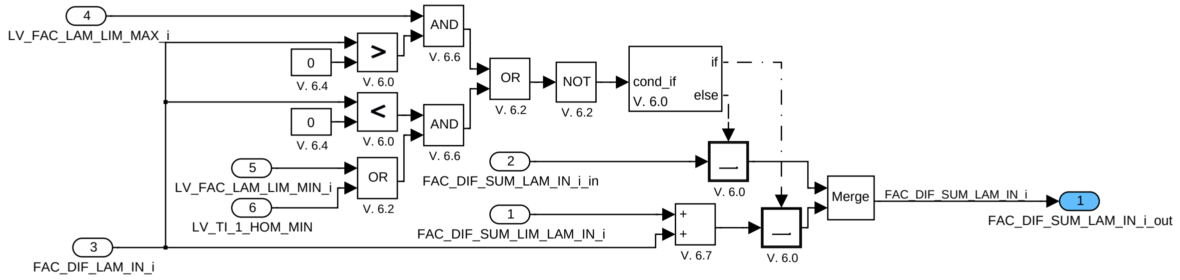

Figure 7.59.63: :

7.59.3.1.1.1.4.9.2.2 Determination of I and I2 share shift based on downstream signal evaluation (only with active I2 share calculation)

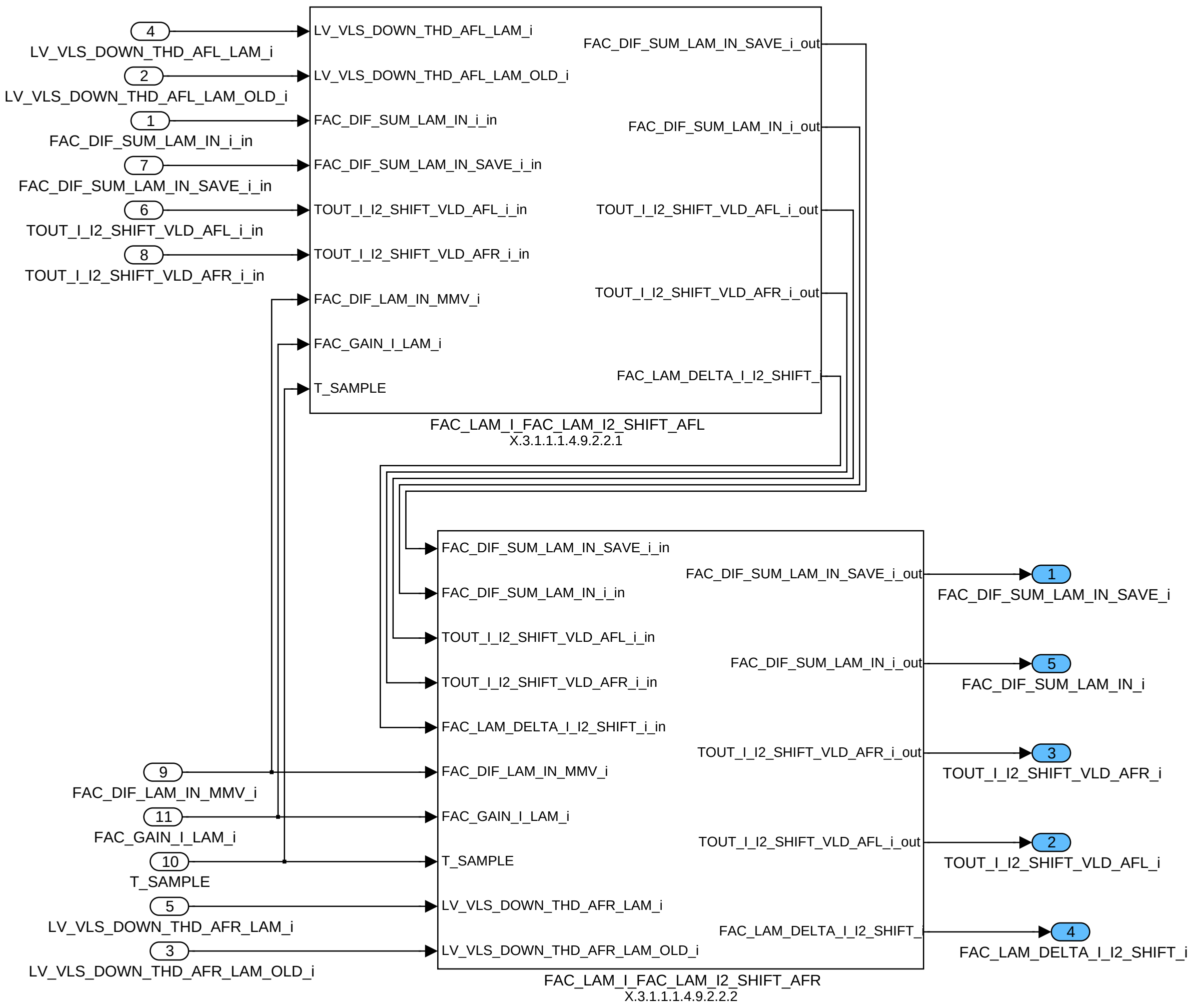

Figure 7.59.64: :

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7.59.3.1.1.1.4.9.2.2.1 Determination of I and I2 share shift for AFL

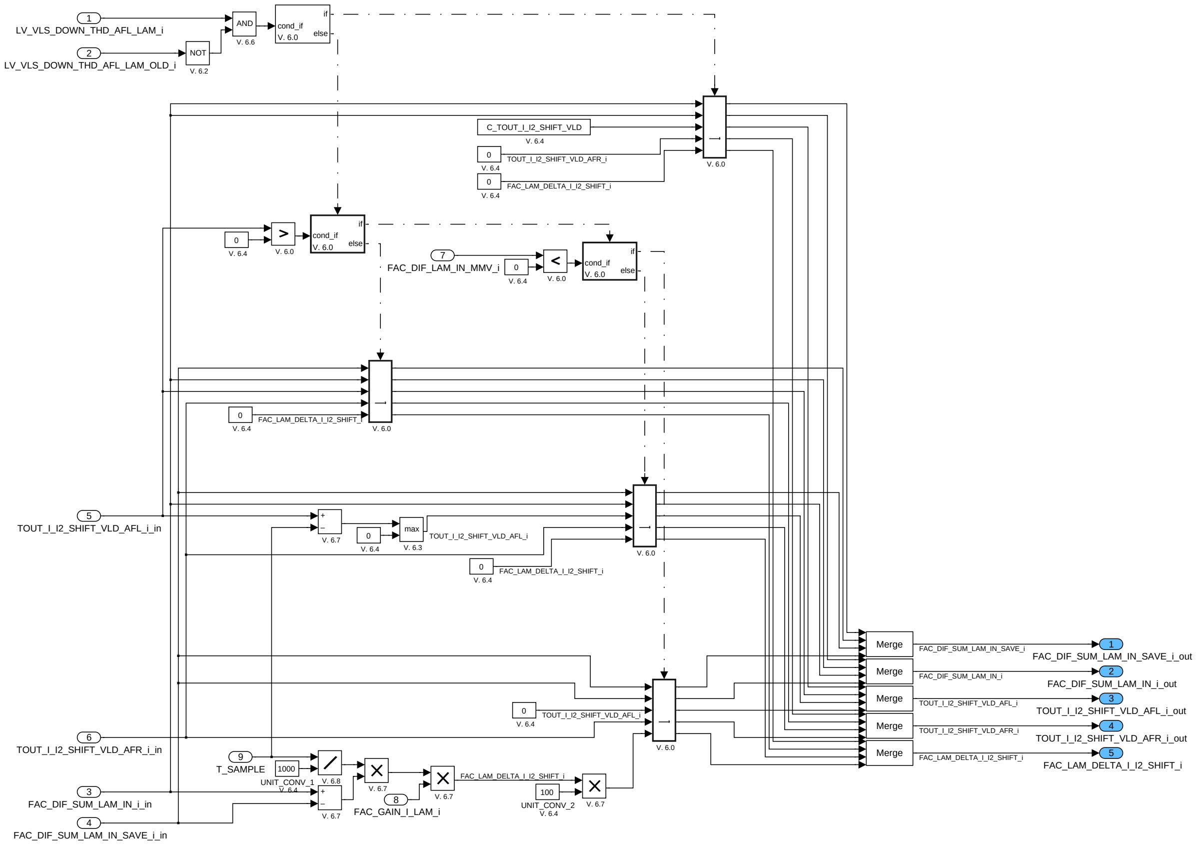

Figure 7.59.65: :

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7.59.3.1.1.1.4.9.2.2.2 Determination of I and I2 share shift for AFR

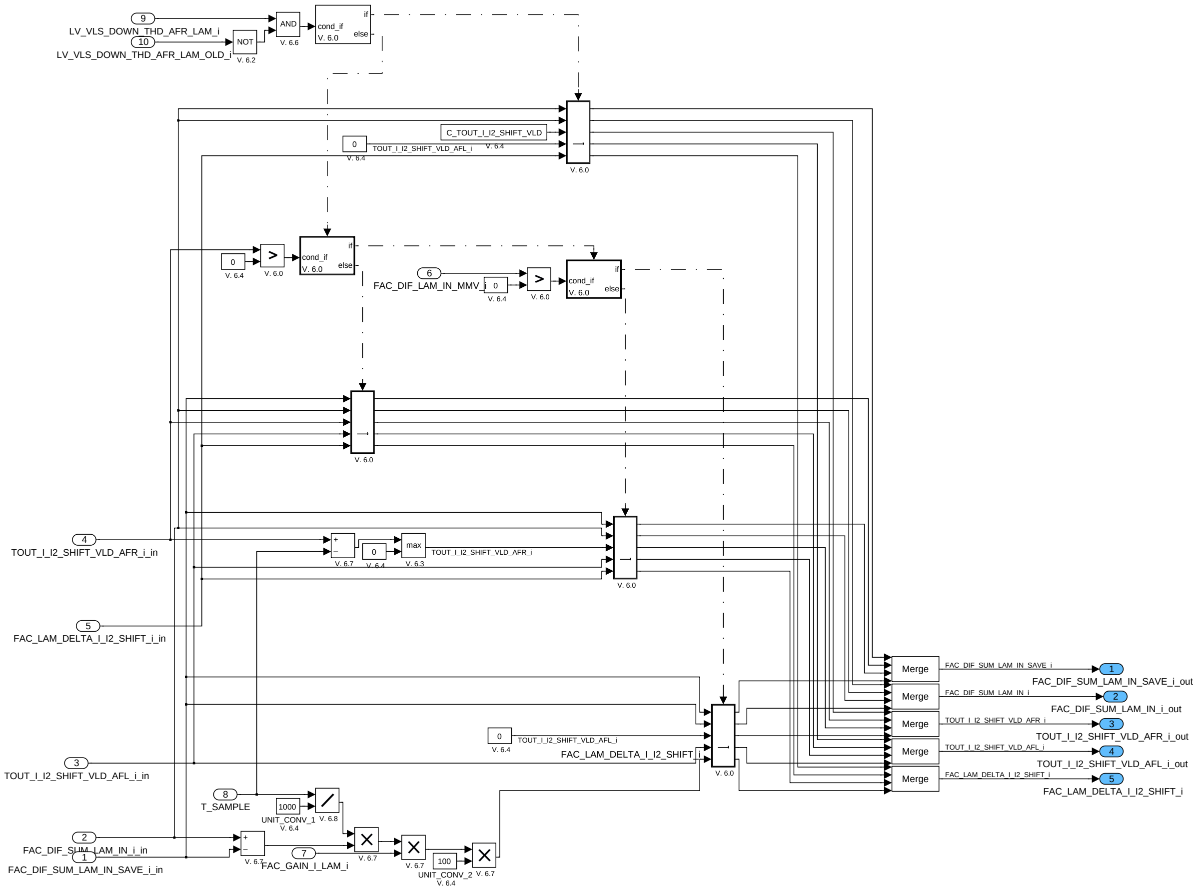

Figure 7.59.66: :

7.59.3.1.1.1.4.9.2.3 I share calculation (only with active I2 share calculation) /Anti wind up limitation of I share and controller difference summation (only with active I2 share calculation)

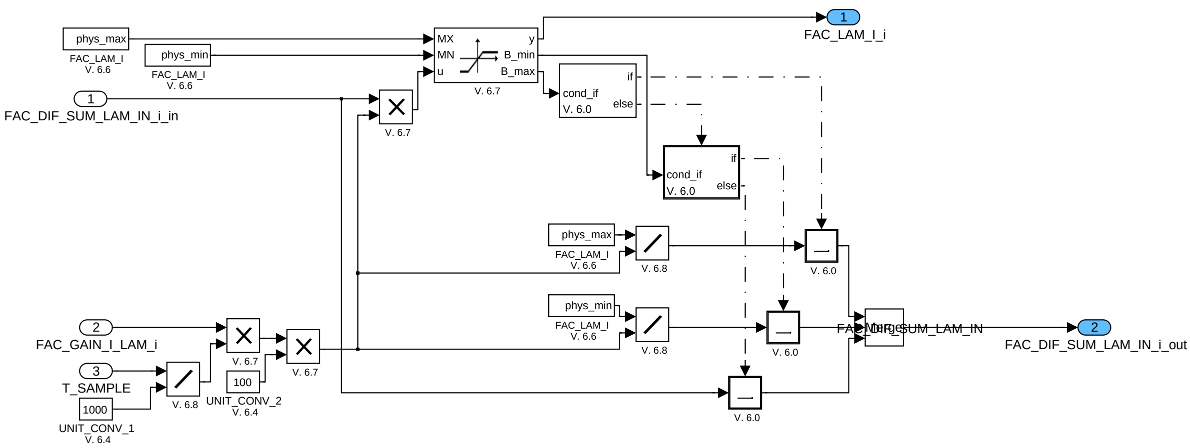

Figure 7.59.67: :

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7.59.3.1.1.1.4.9.2.4 limited Iˆ2 share output signal

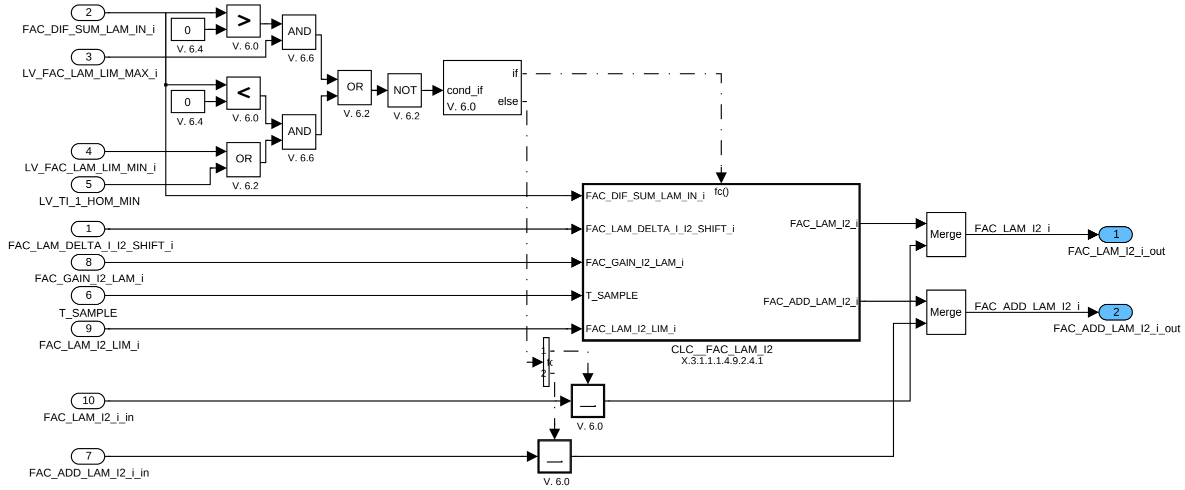

Figure 7.59.68: :

7.59.3.1.1.1.4.9.2.4.1 part that is added to the Iˆ2 share every sample step

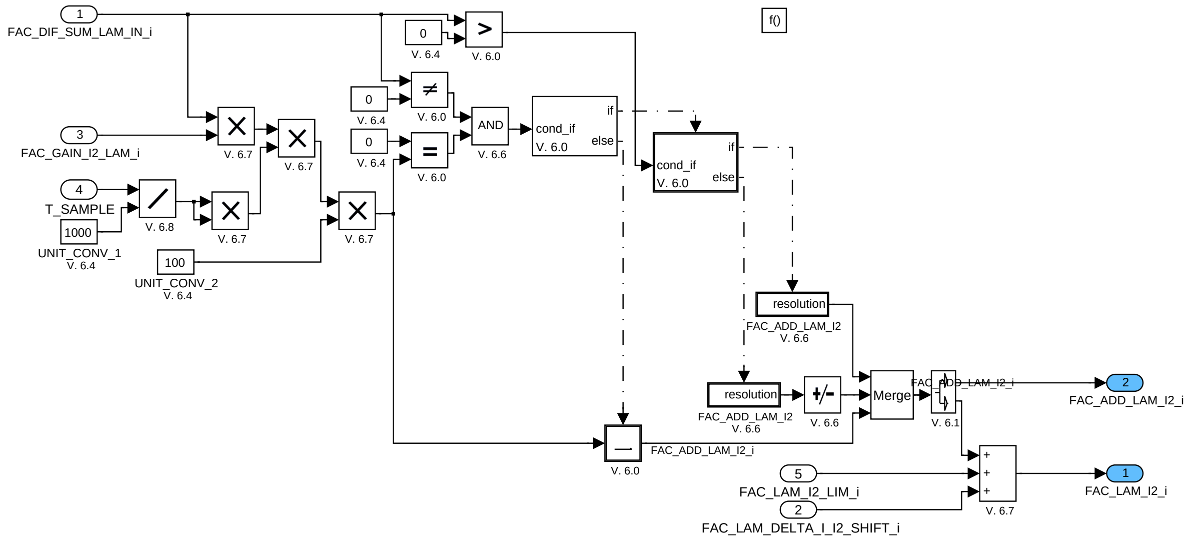

Figure 7.59.69: :

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7.59.3.1.1.1.4.9.3 Summation and limitation of I and I2 share

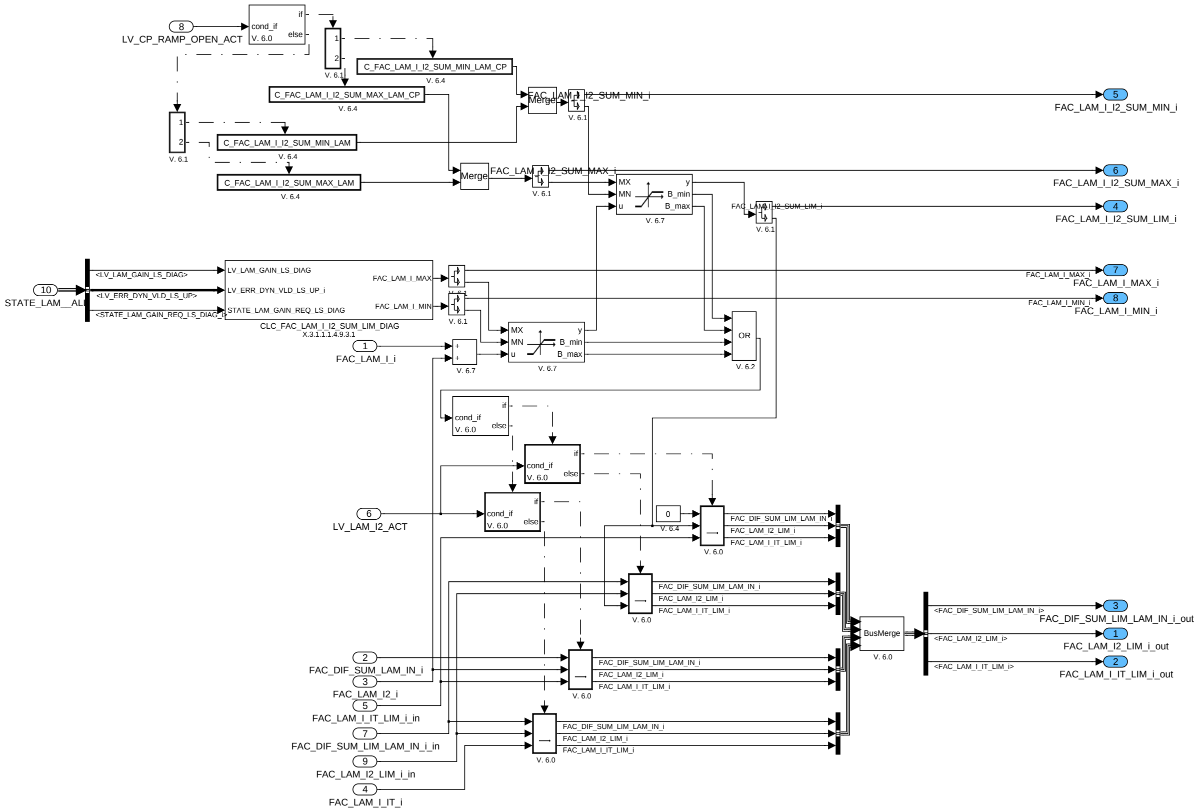

Figure 7.59.70: :

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7.59.3.1.1.1.4.9.3.1 Determination of I-share limitation

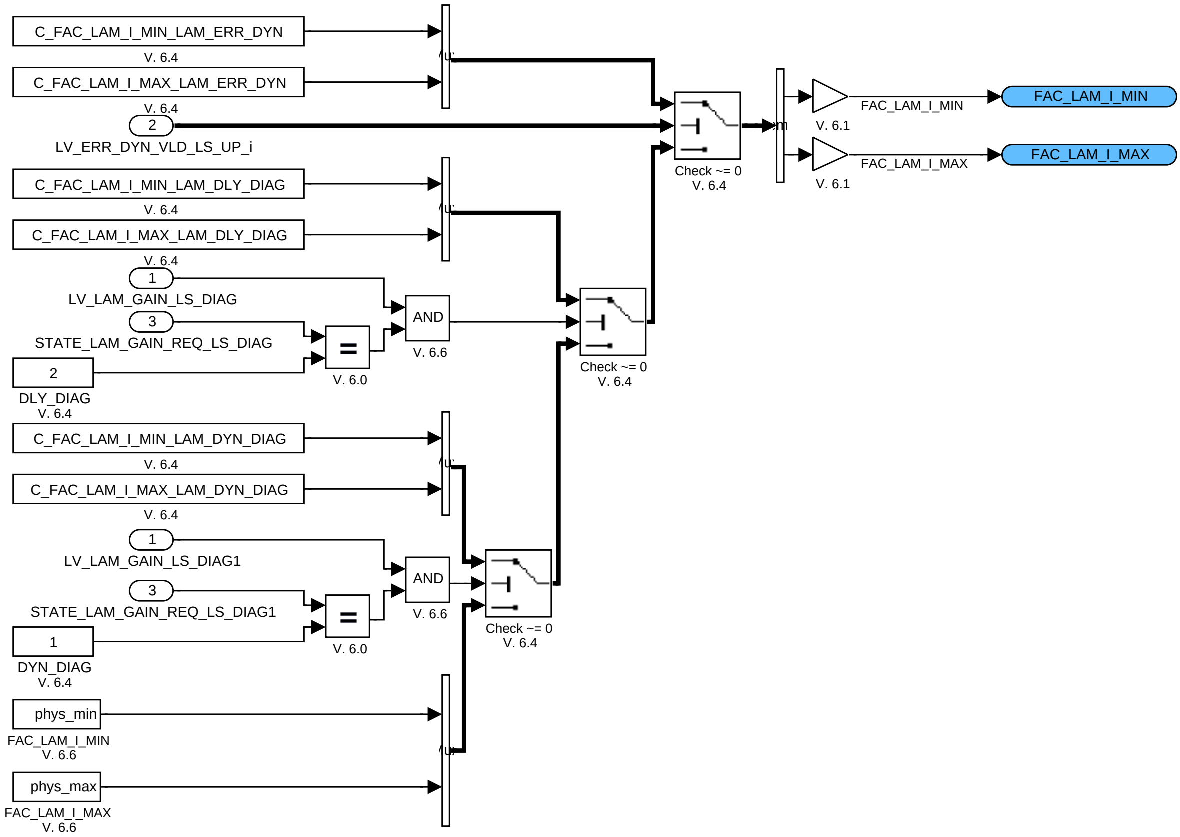

Figure 7.59.71: :

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7.59.3.1.1.1.4.10 Shift and initialization of lambda controller

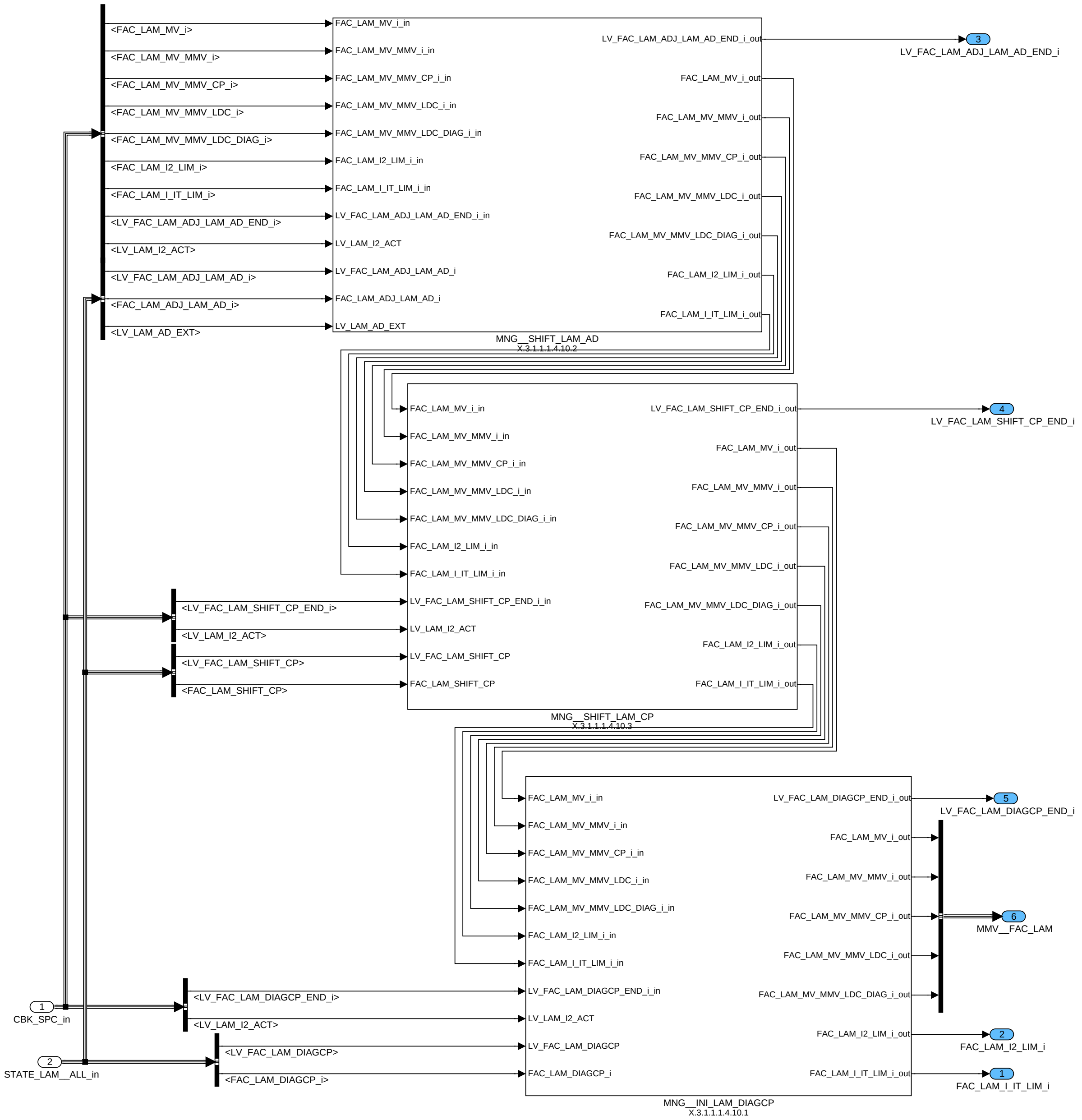

Figure 7.59.72: :

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7.59.3.1.1.1.4.10.1 Output initialisation of lambda controller by evaporative system monitoring function

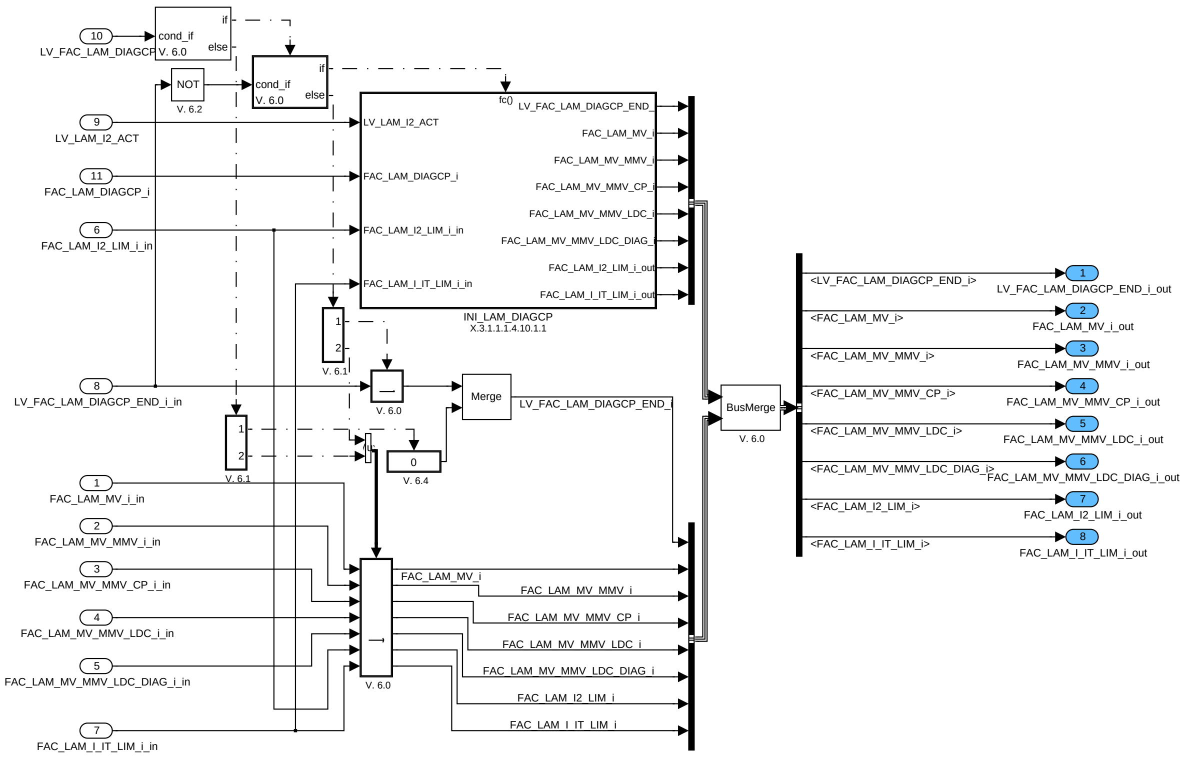

Figure 7.59.73: :

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7.59.3.1.1.1.4.10.1.1 Calculation of controller shift

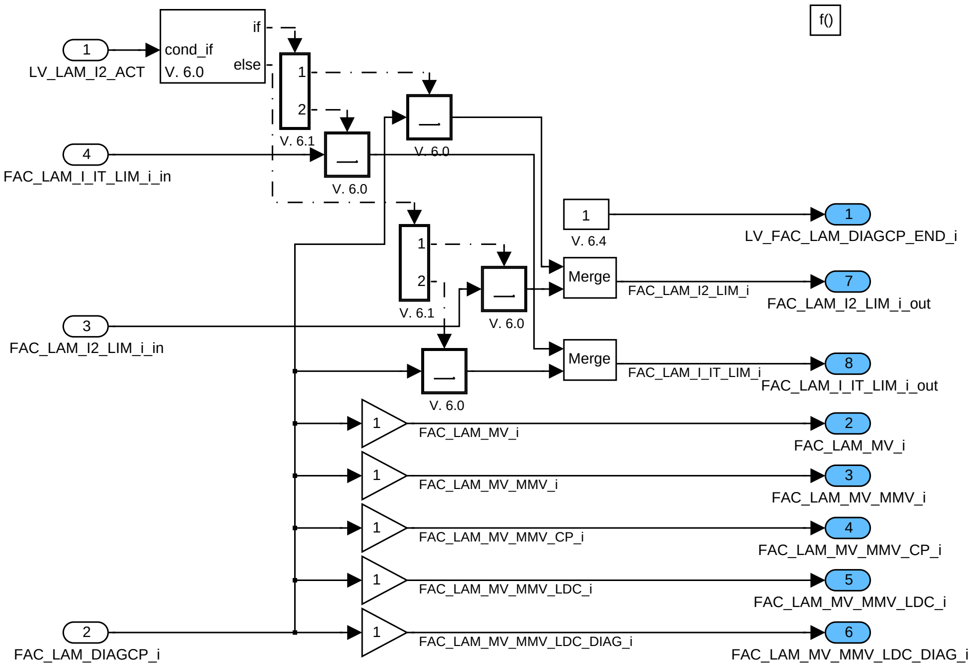

Figure 7.59.74: :

7.59.3.1.1.1.4.10.2 Output shift of the lambda controller by lambda adaptation

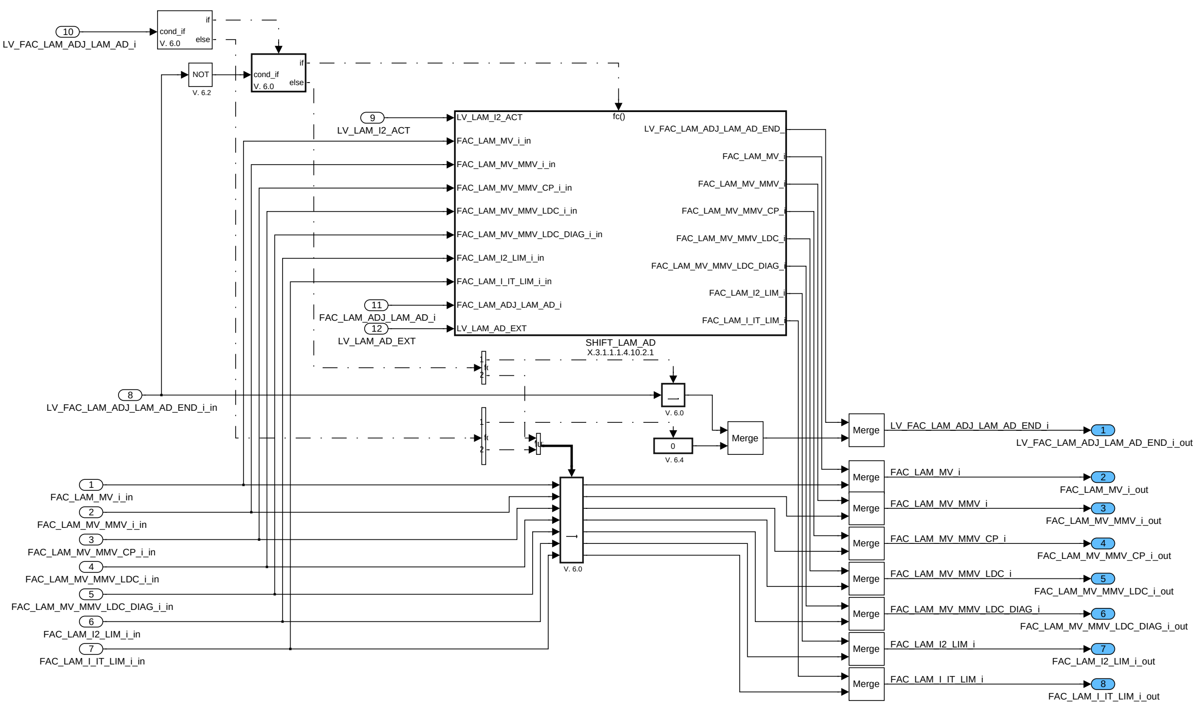

Figure 7.59.75: :

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7.59.3.1.1.1.4.10.2.1 Calculation of mean value of lambda controller output

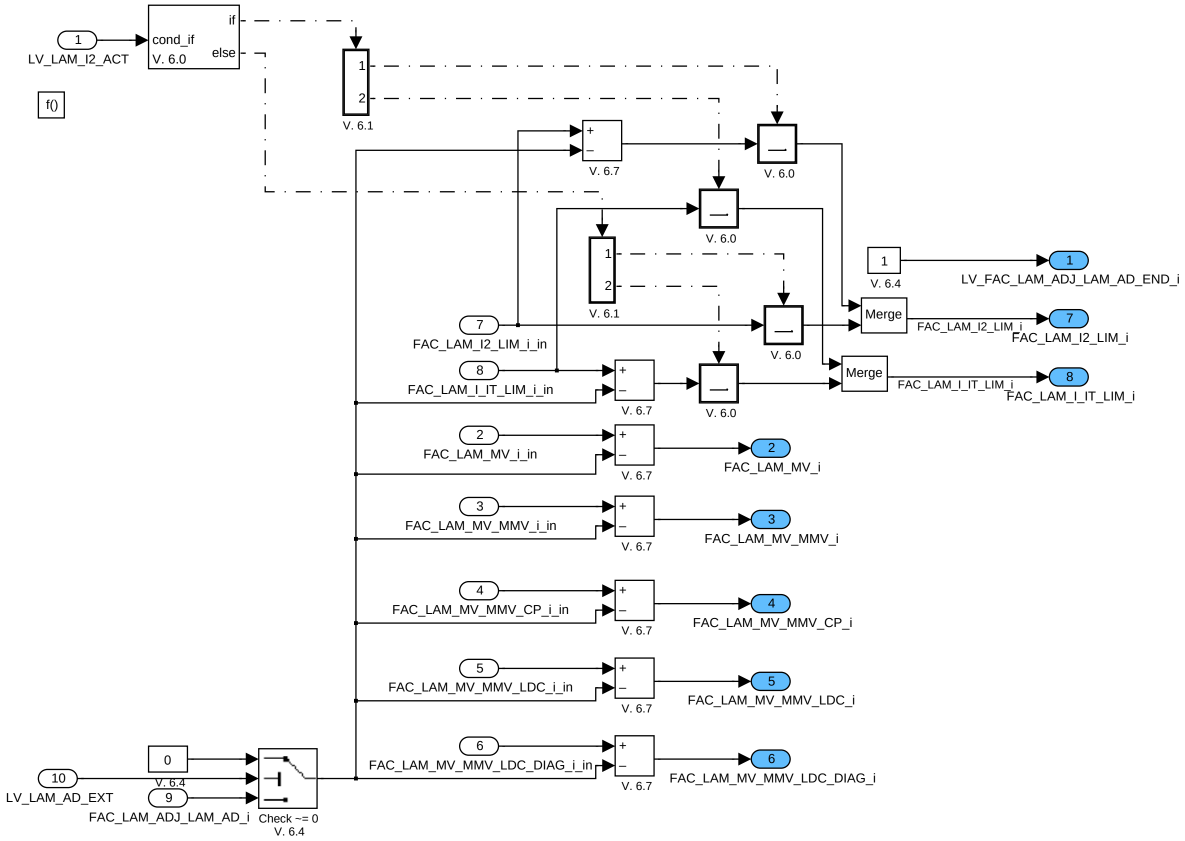

Figure 7.59.76: :

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7.59.3.1.1.1.4.10.3 Output shift of lambda controller by canister purge function

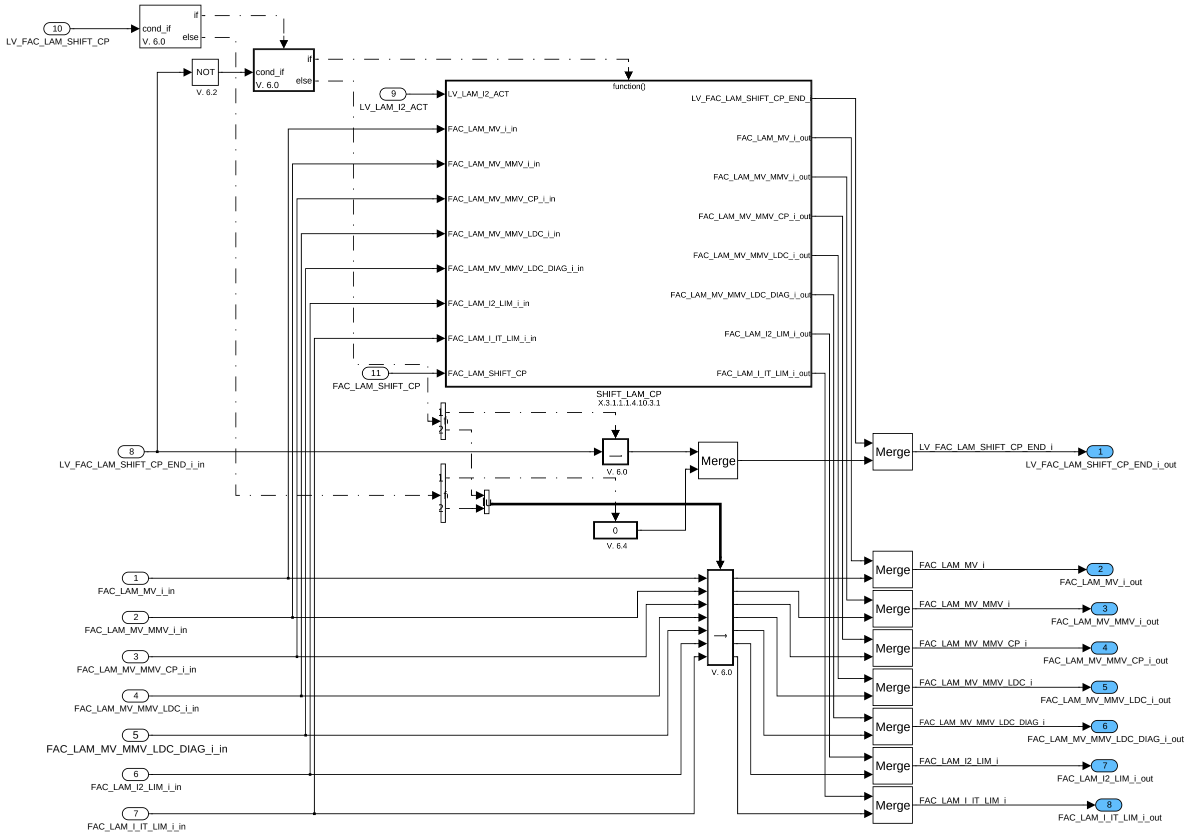

Figure 7.59.77: :

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7.59.3.1.1.1.4.10.3.1 Output shift of lambda controller

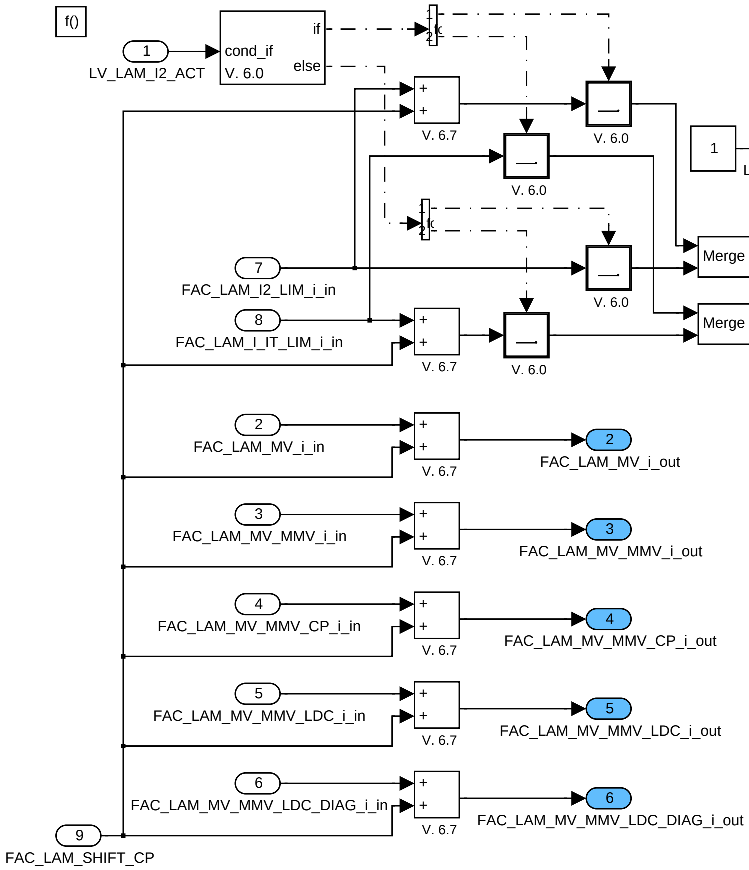

Figure 7.59.78: :

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7.59.3.1.1.1.4.11 Limitation under non stationary conditions

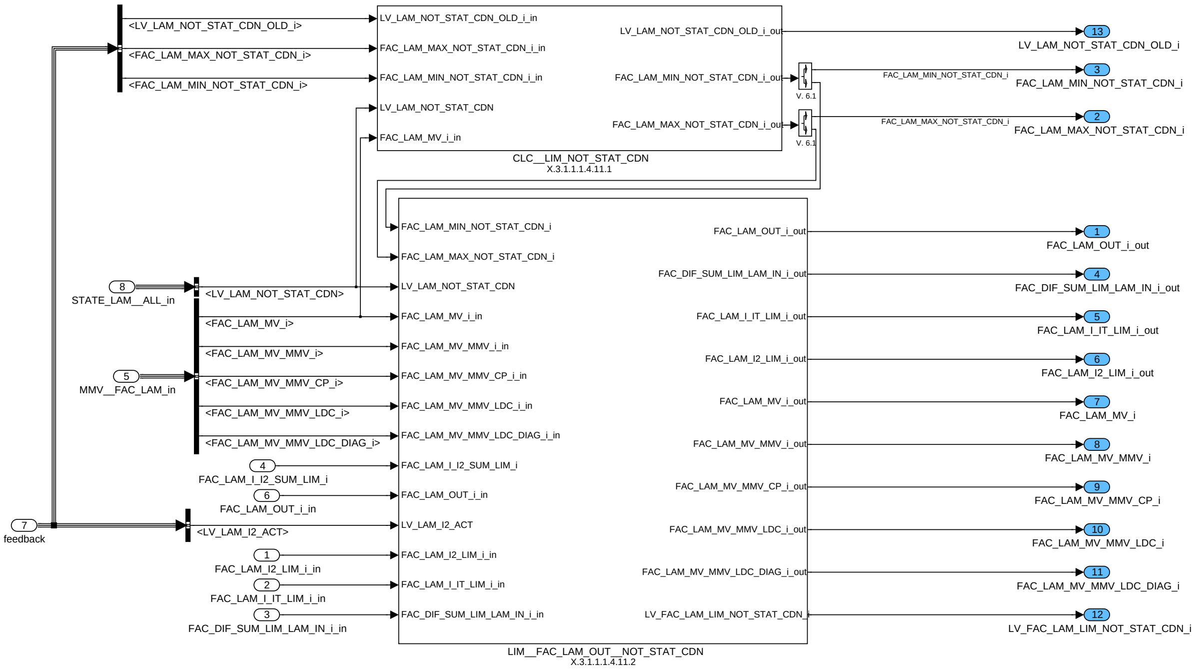

Figure 7.59.79: :

7.59.3.1.1.1.4.11.1 Limitation under non stationary conditions

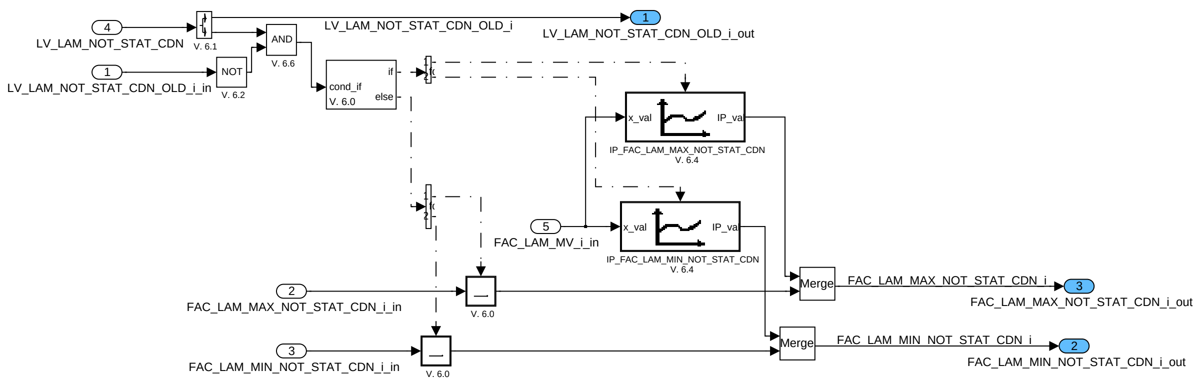

Figure 7.59.80: :

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7.59.3.1.1.1.4.11.2 Limitation under non stationary conditions

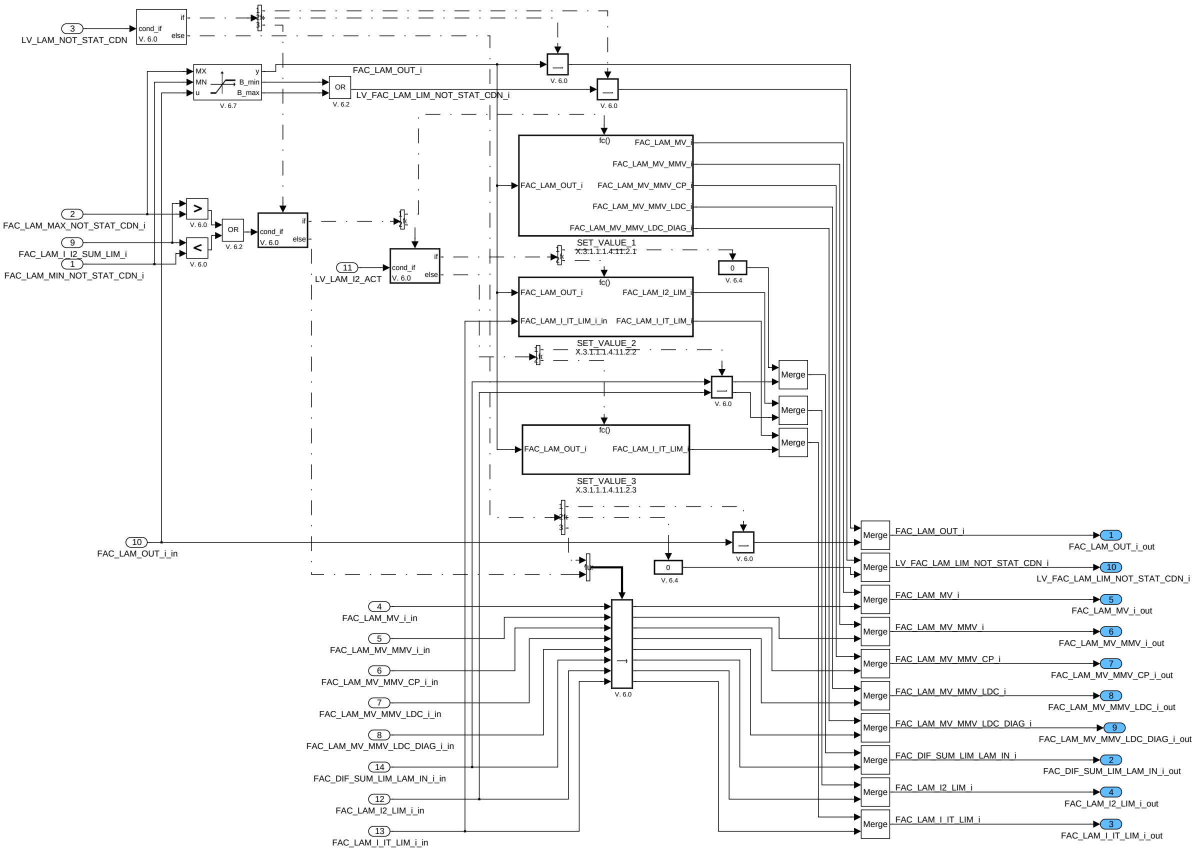

Figure 7.59.81: :

7.59.3.1.1.1.4.11.2.1 mean value

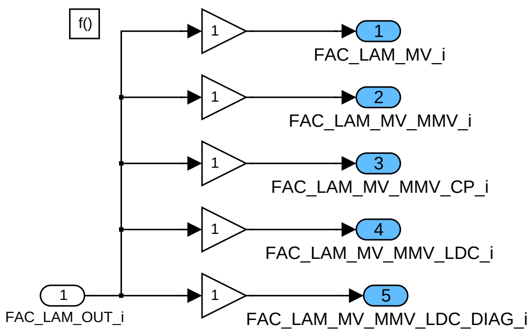

Figure 7.59.82: :

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7.59.3.1.1.1.4.11.2.2 unlimited Iˆ2 share output signal

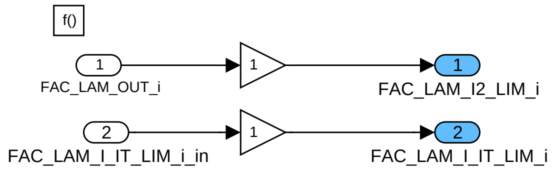

Figure 7.59.83: :

7.59.3.1.1.1.4.11.2.3 limited internal I share used for PID control only

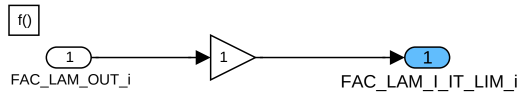

Figure 7.59.84: :

7.59.3.1.1.1.5 STATE_LAM: "2:STOP_SHO_PER"

In state "2:STOP_SHO_PER " the D share is set to 0 and P, I and I2 share are frozen. The confirmation of the hereafter described output shifts or initialisation are not carried out. This state is for very short term controller stops.

For the description of Sub-System CLC__FAC_DIF_LAM and Sub-System DET__VLS_DOWN_AFL_AFR see description of STATE_LAM: 0:OFF .
For the description of Sub-System CLC__FAC_LAM_OUT see description of STATE_LAM: 1:ON .

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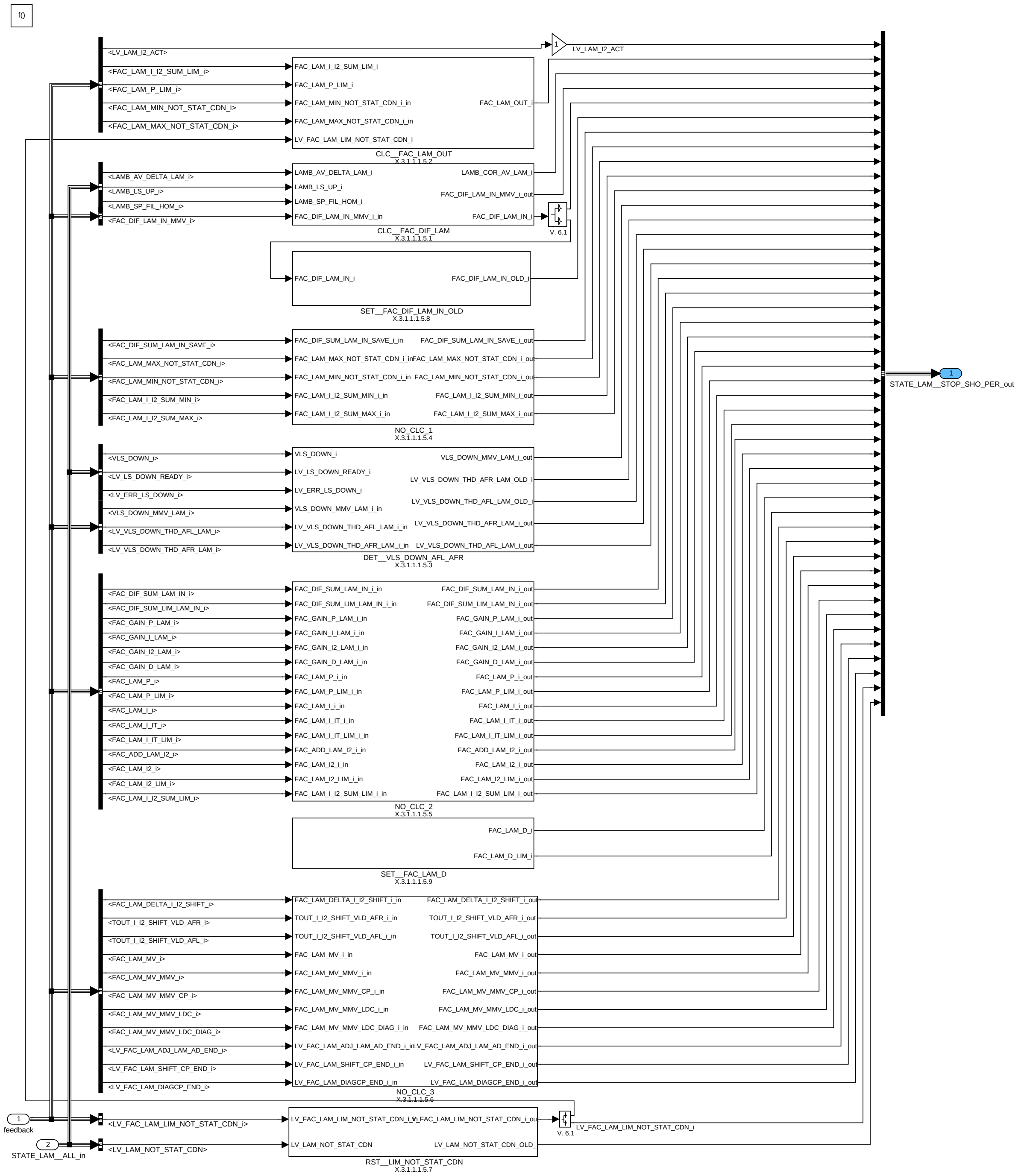

Figure 7.59.85: :

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7.59.3.1.1.1.5.1 Calculation of controller difference (as richness)

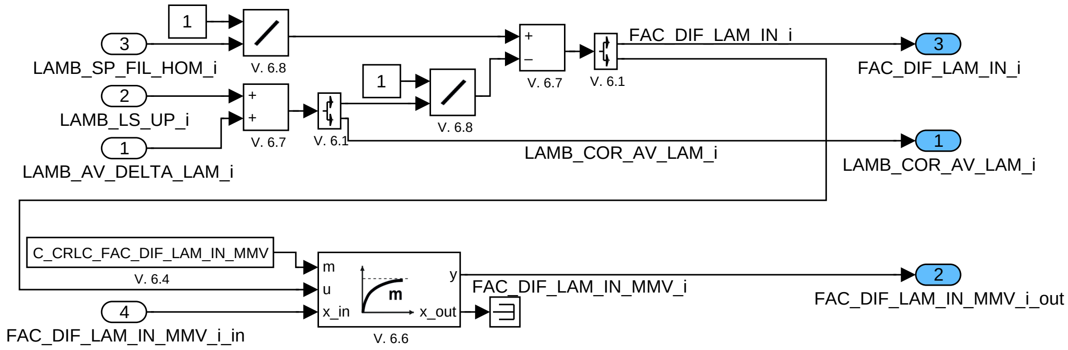

Figure 7.59.86: :

7.59.3.1.1.1.5.2 Calculation of controller output signal

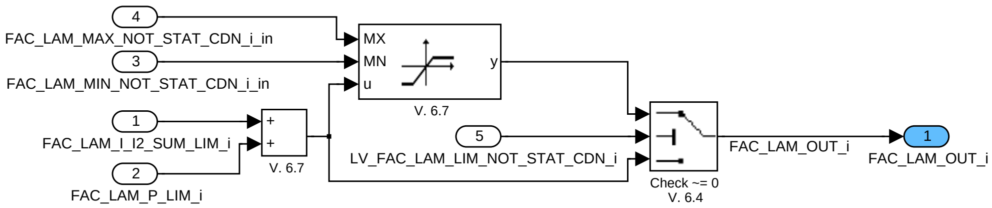

Figure 7.59.87: :

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7.59.3.1.1.1.5.3 Evaluation of downstream sensor voltage

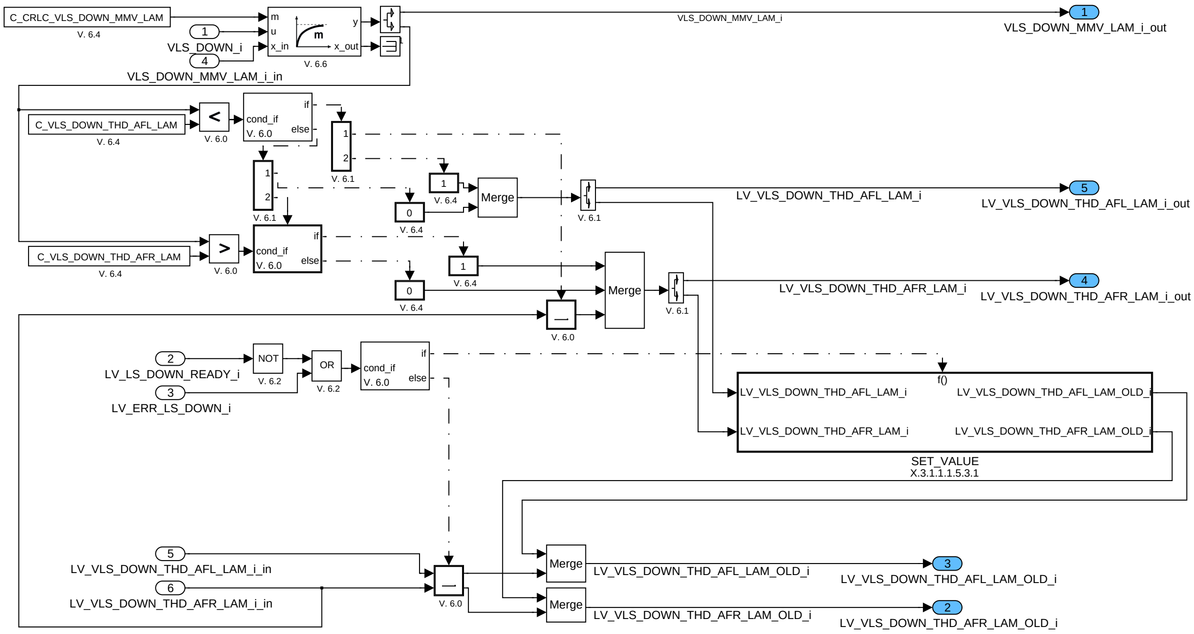

Figure 7.59.88: :

7.59.3.1.1.1.5.3.1 Calculation of old value

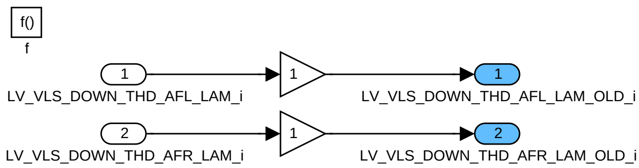

Figure 7.59.89: :

7.59.3.1.1.1.5.4 feedthrough

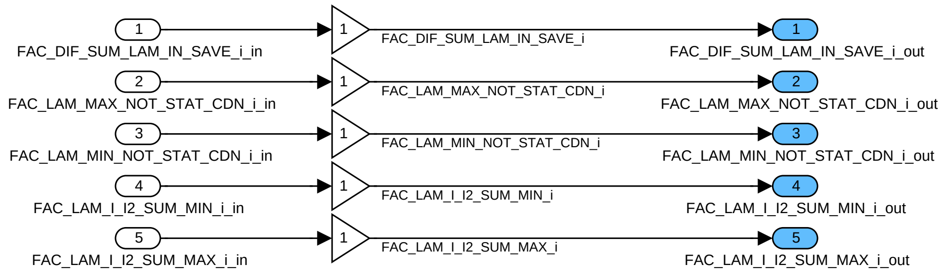

Figure 7.59.90: :

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7.59.3.1.1.1.5.5 feedthrough

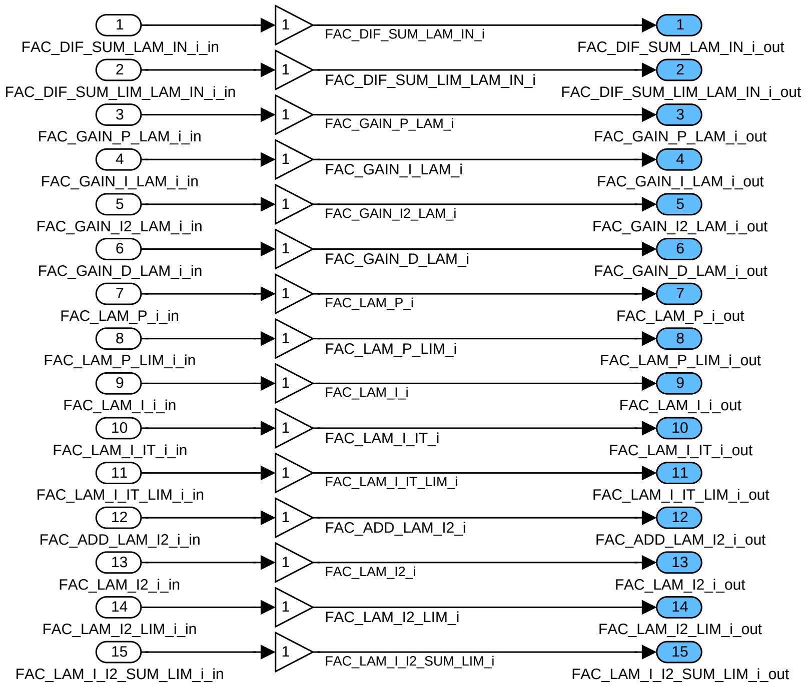

Figure 7.59.91: :

7.59.3.1.1.1.5.6 feedthrough

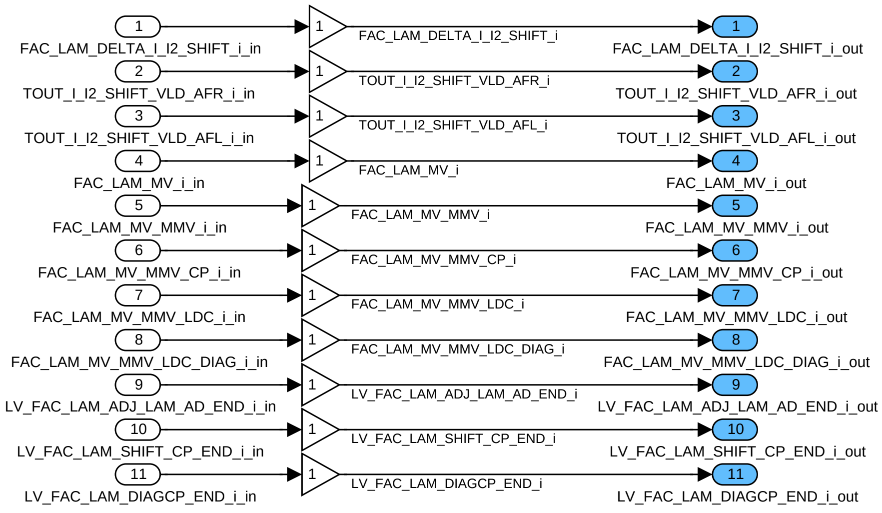

Figure 7.59.92: :

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7.59.3.1.1.1.5.7 limitation under non stationary operating conditions (threshold exceeded)

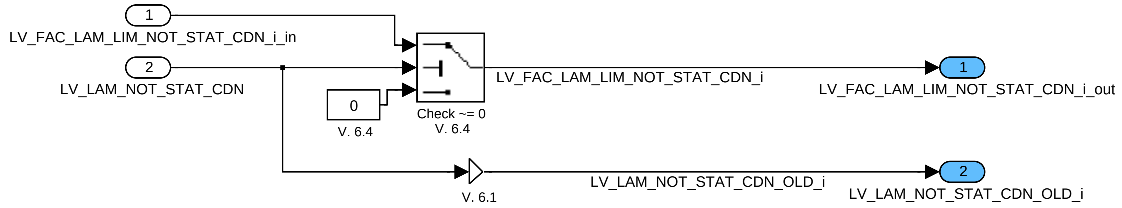

Figure 7.59.93: :

7.59.3.1.1.1.5.8 Calculation of old value

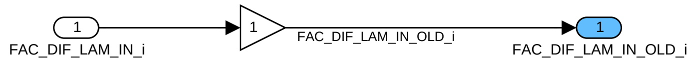

Figure 7.59.94: :

7.59.3.1.1.1.5.9 unlimited D share output signal

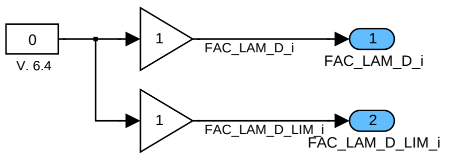

Figure 7.59.95: :

7.59.3.1.1.1.6 STATE_LAM: "3:_STOP"

In state "3:STOP" reset of internal state variables and output values (Sub-System: RST__IT_STATE_VALUE_OUT_VALUE_CBK_SPC) and reset of FAC_LAM_OUT[i] is carried out. The confirmation of the hereafter described output shifts or initialisation are carried out without applying the shifts or initialisation itself.

For the description of Sub-System CLC__FAC_DIF_LAM and Sub-System DET__VLS_DOWN_AFL_AFR see description of STATE_LAM: 0:OFF .

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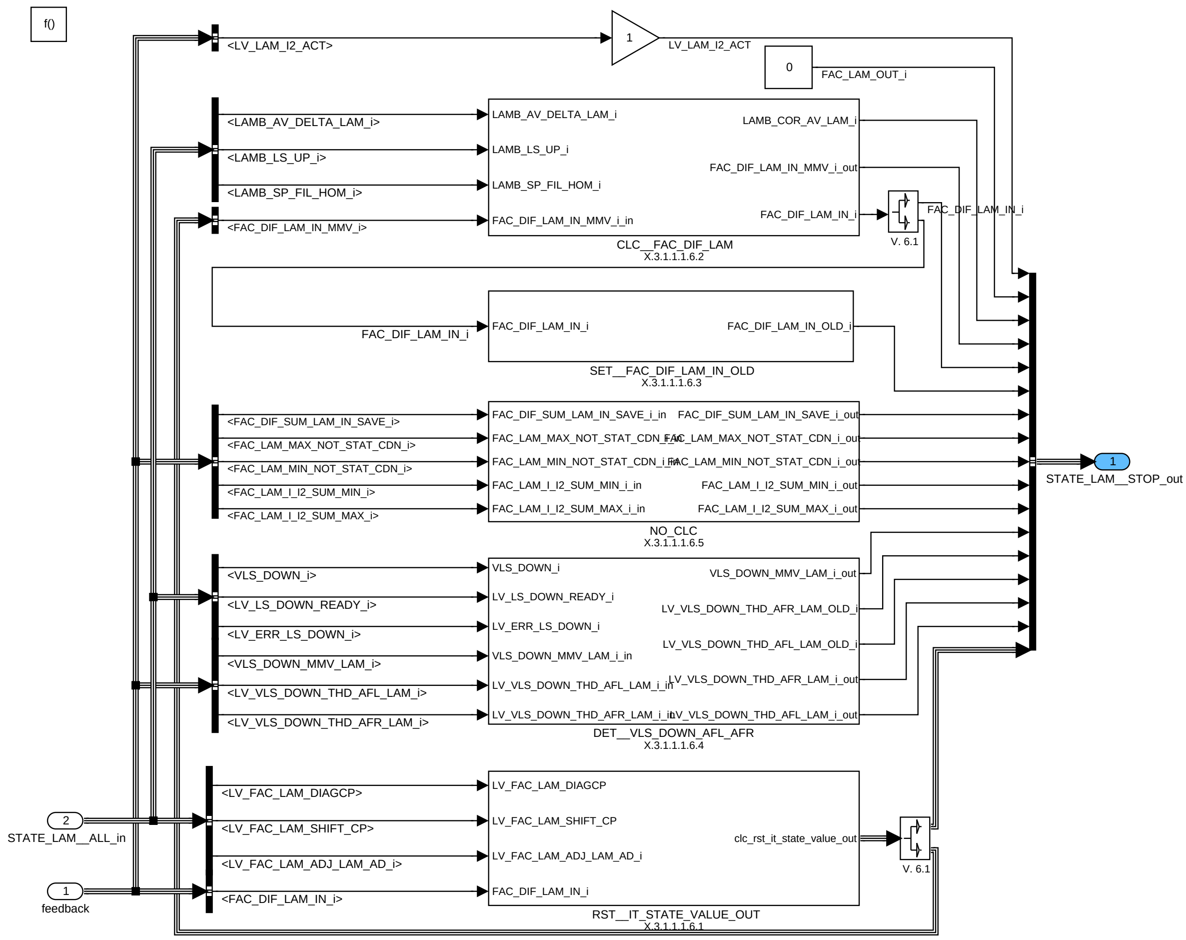

Figure 7.59.96: :

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7.59.3.1.1.1.6.1 Reset of internal state variables and output values

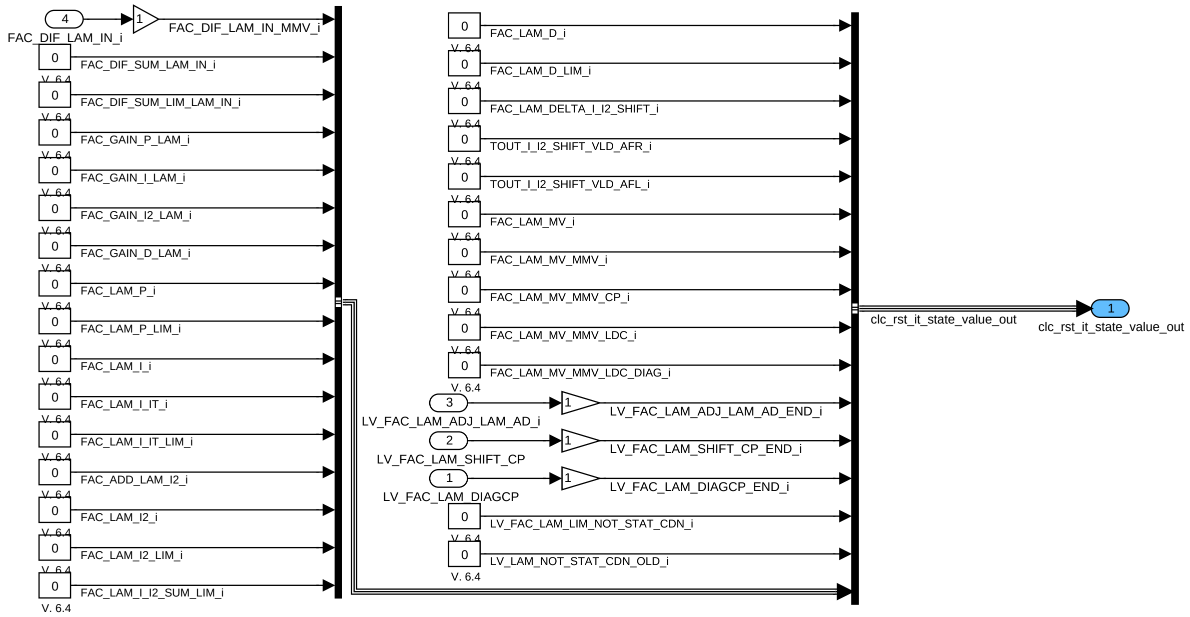

Figure 7.59.97: :

7.59.3.1.1.1.6.2 Calculation of controller difference (as richness)

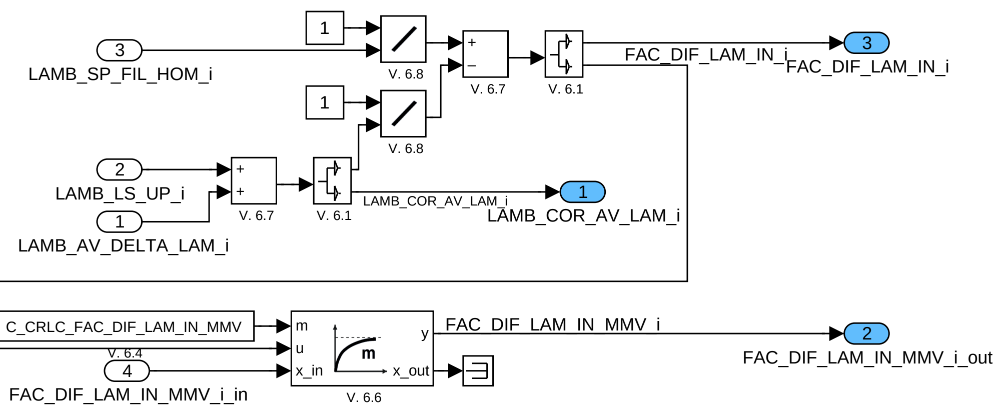

Figure 7.59.98: :

7.59.3.1.1.1.6.3 Calculation of old value

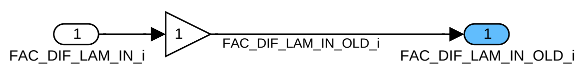

Figure 7.59.99: :

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7.59.3.1.1.1.6.4 Evaluation of downstream sensor voltage

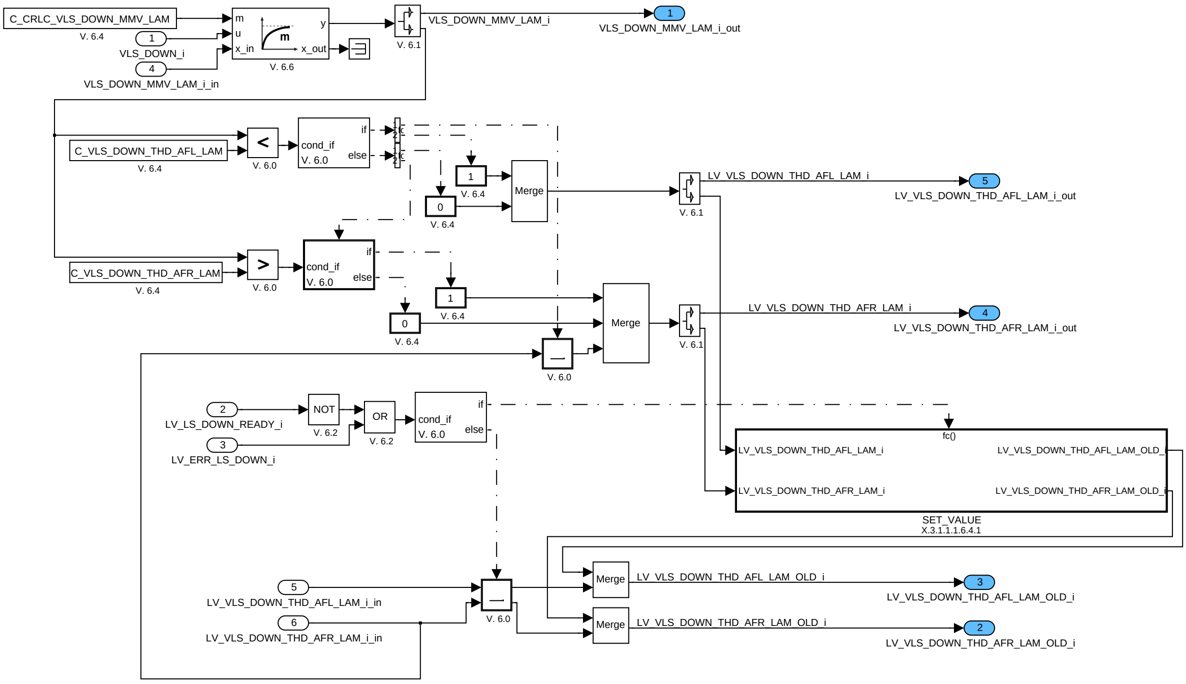

Figure 7.59.100: :

7.59.3.1.1.1.6.4.1 Calculation of old value

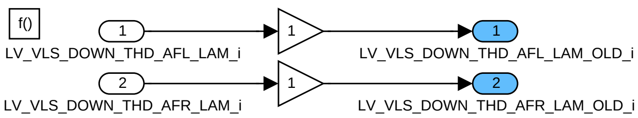

Figure 7.59.101: :

7.59.3.1.1.1.6.5 feedthrough

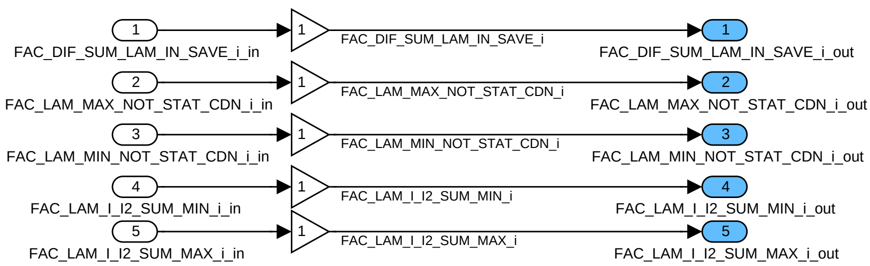

Figure 7.59.102: :

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7.59.3.1.2 No title given

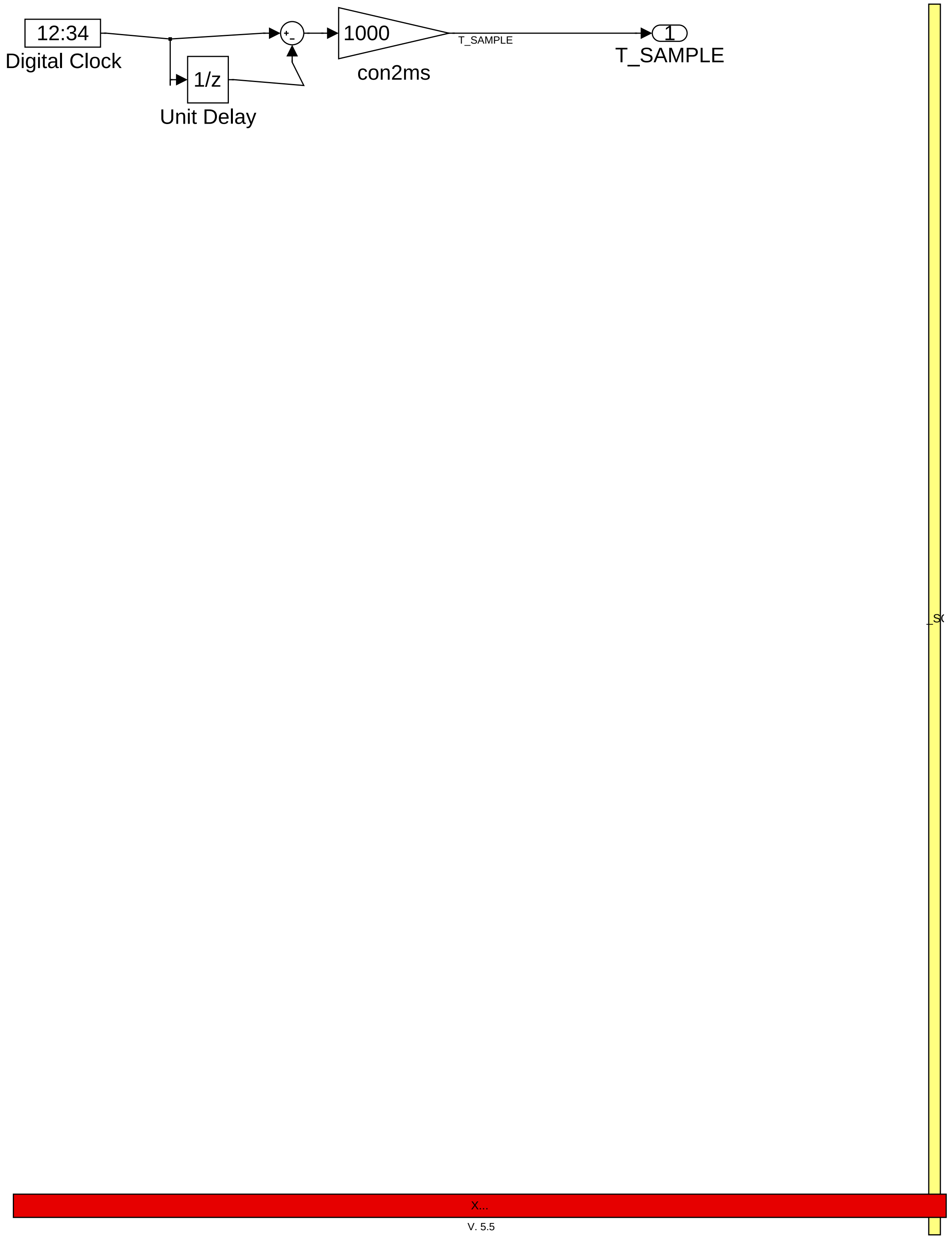

Figure 7.59.103: :

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7.59.3.2 Initialisation

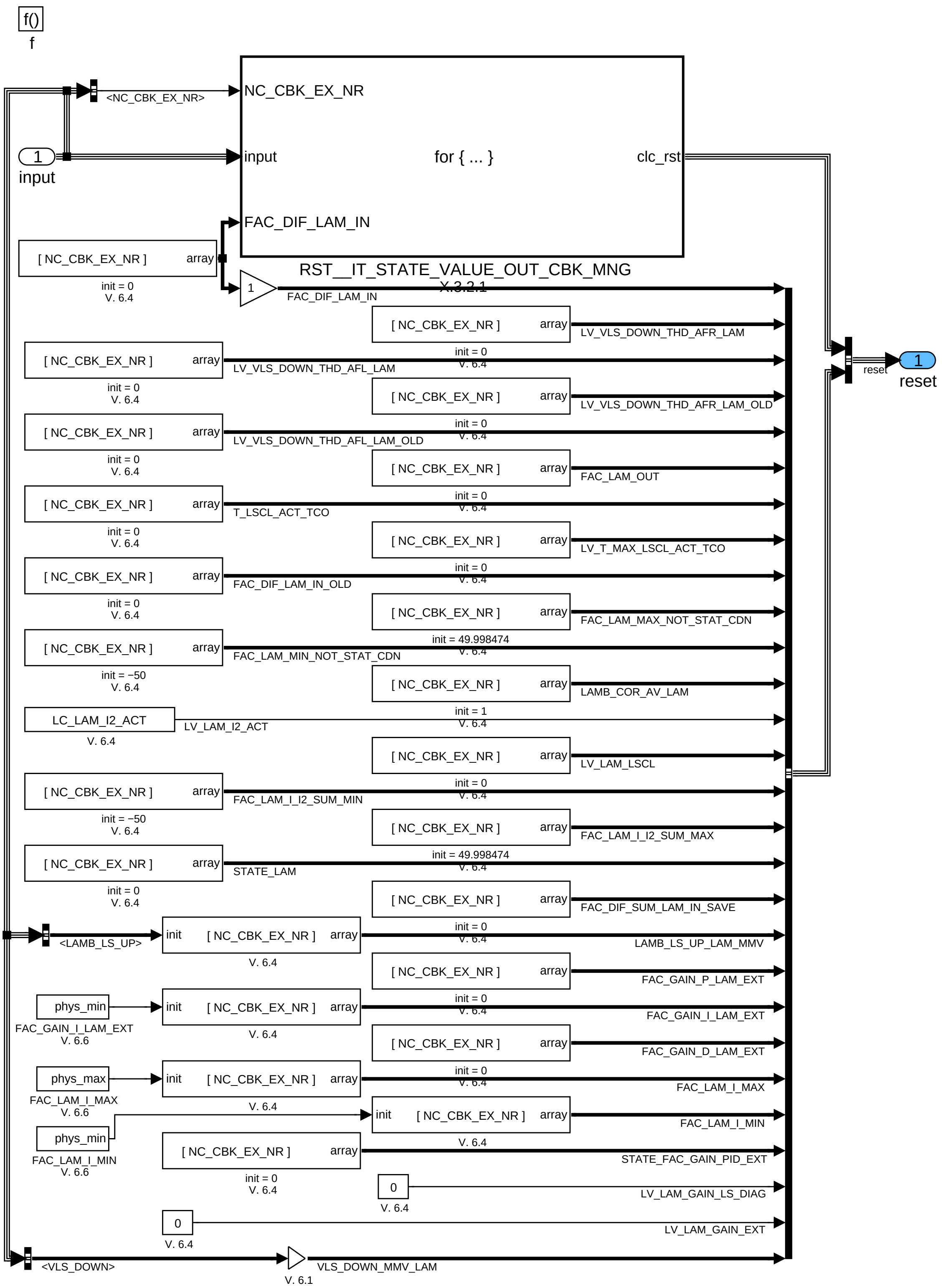

Figure 7.59.104: :

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7.59.3.2.1 for loop

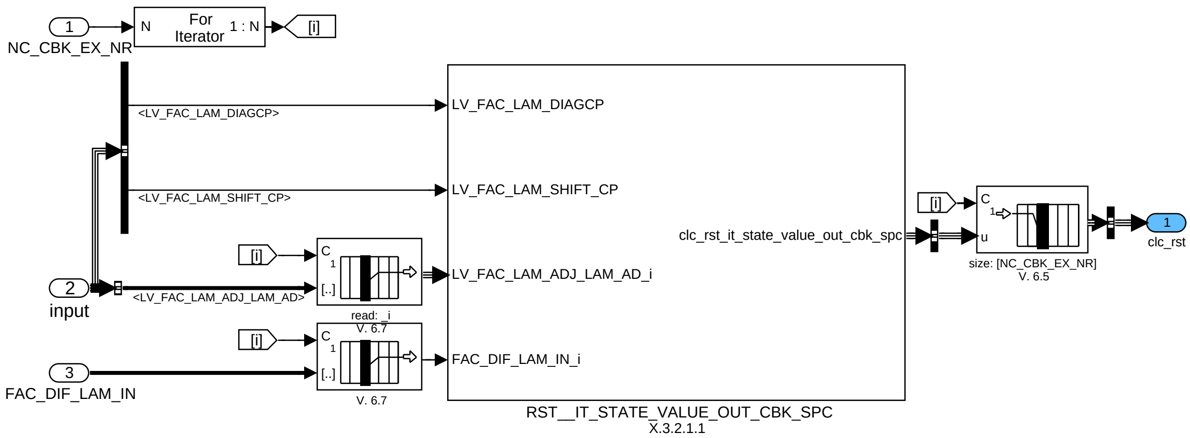

Figure 7.59.105: :

7.59.3.2.1.1 reset

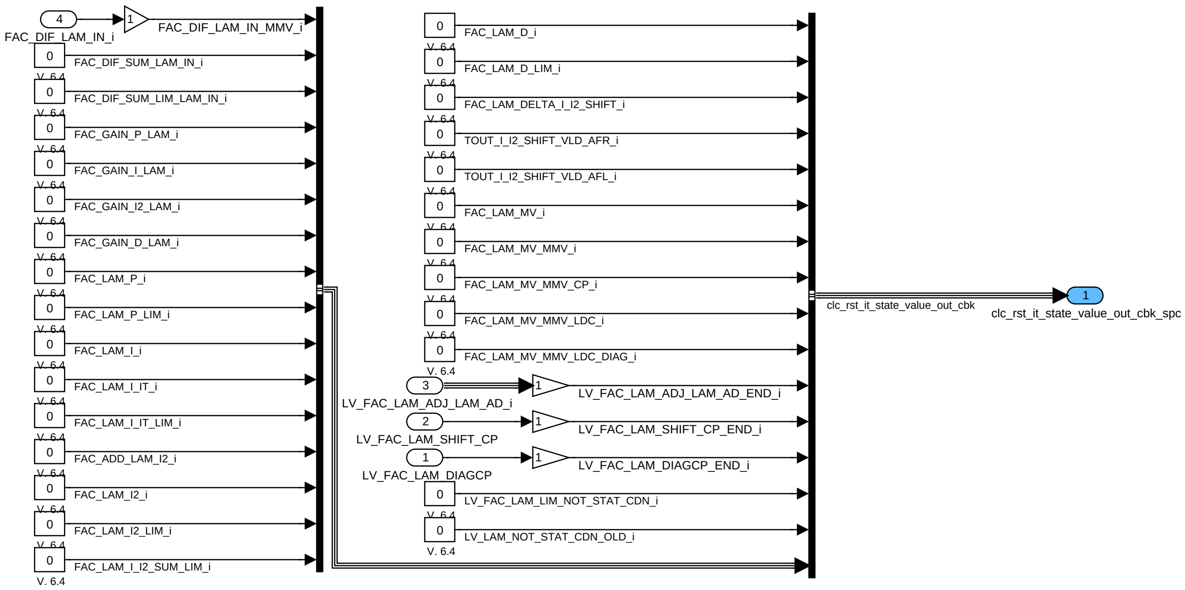

Figure 7.59.106: :

7.59.4 Controller output limitation and pre control path correction considera-tion

General information:

Application conditions:

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Initialisation: RST
Recurrence: 20MS
Activation: always
Deactivation: never

Function description:

Formula section:

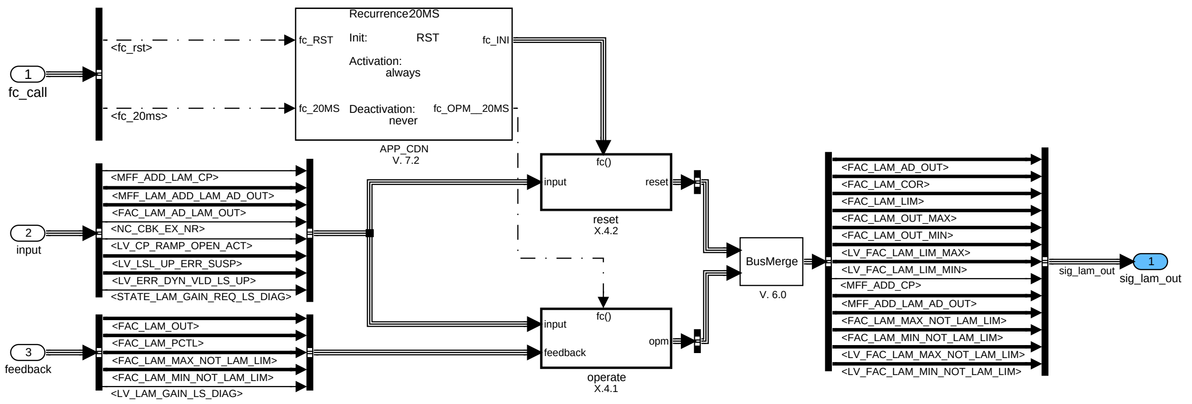

Figure 7.59.107: :

7.59.4.1 for loop

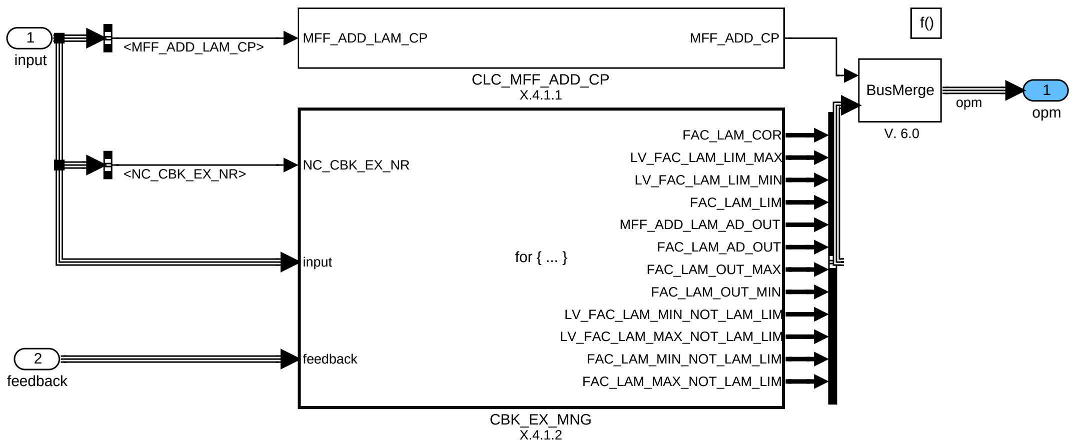

Figure 7.59.108: :

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7.59.4.1.1 Canister Purge Fuel Mass correction corresponding to Lambda Factor Shift

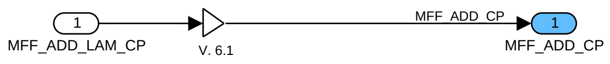

Figure 7.59.109: :

7.59.4.1.2 for loop (i= 0 to NC_CBK_EX_NR)

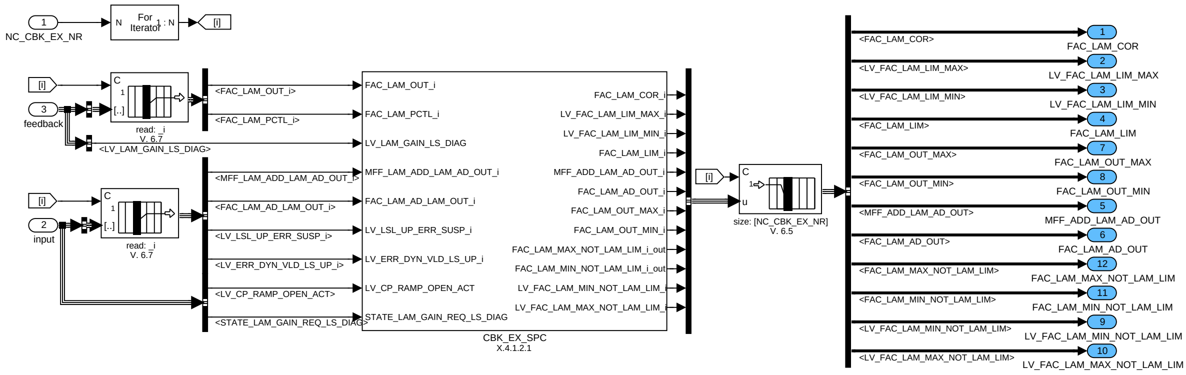

Figure 7.59.110: :

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7.59.4.1.2.1 limited lambda controller output plus pre control correction

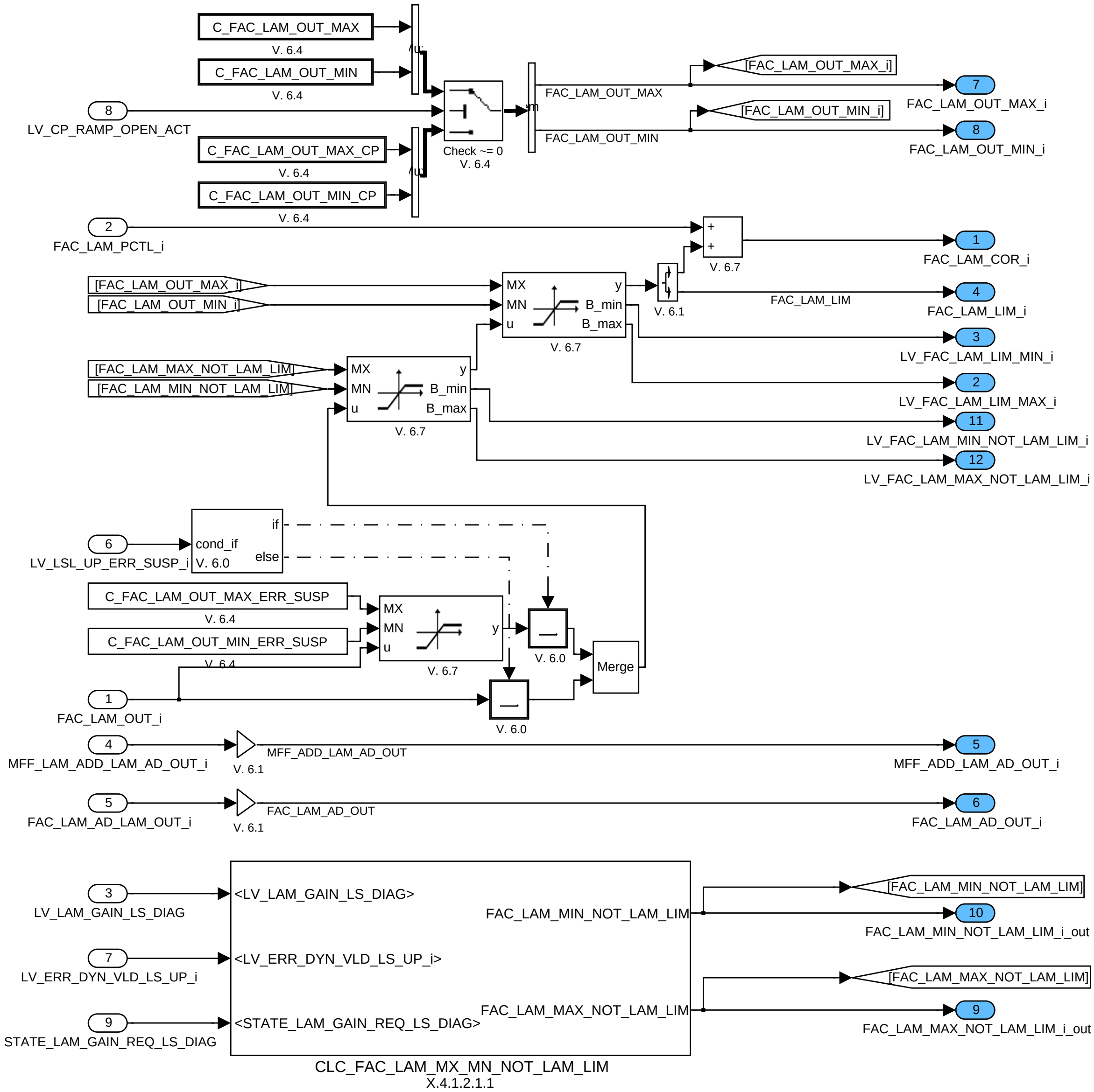

Figure 7.59.111: :

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7.59.4.1.2.1.1 Limitation of Total Lambda Controller Output

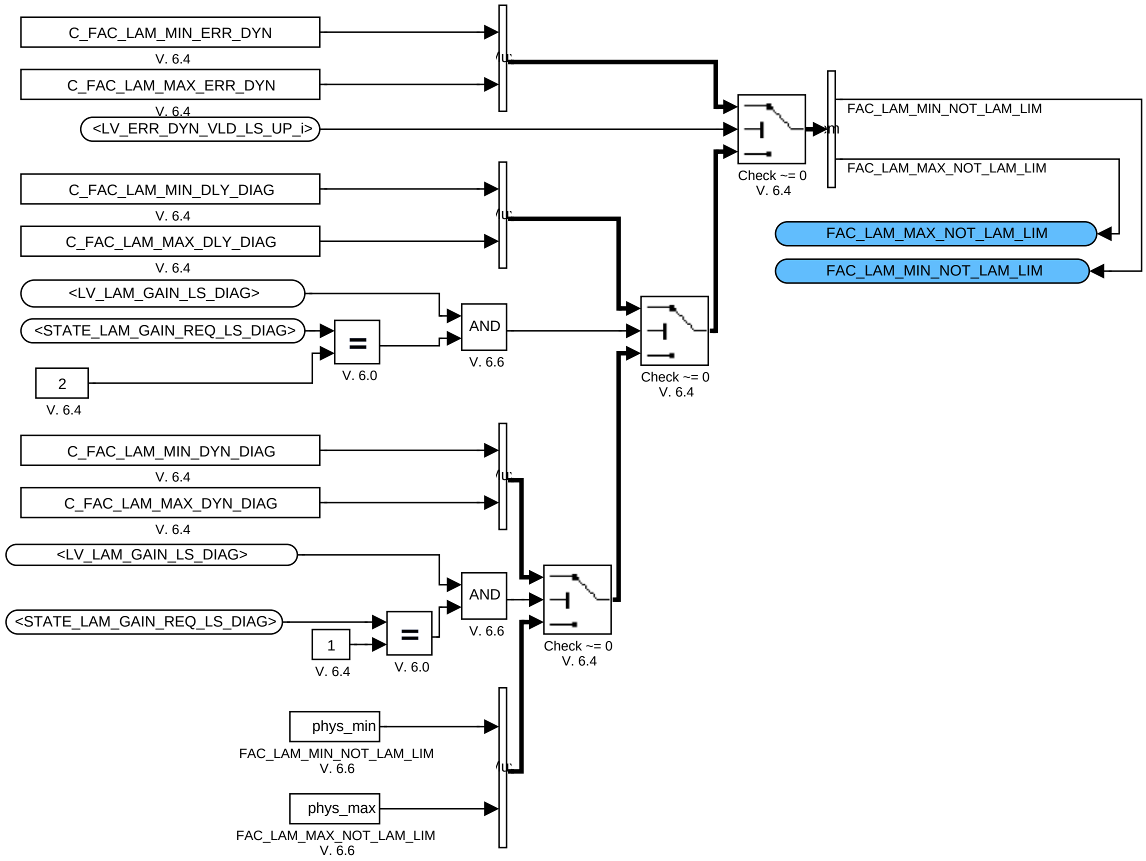

Figure 7.59.112: :

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7.59.4.2 reset

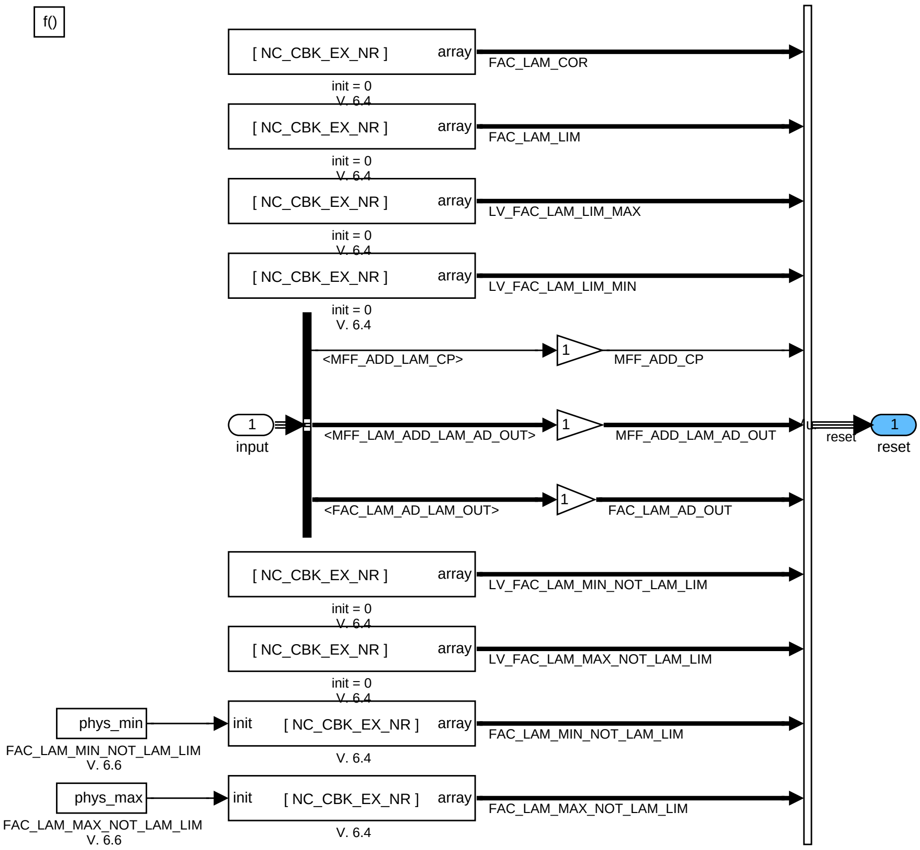

Figure 7.59.113: :

7.59.5 Calculation of air fuel ratio changes counter

General information:

At each change of LV_AFL[i] the counter of air fuel ratio changes CTR_RAF_CHG[i] has to be incremented.
The counter CTR_RAF_CHG[i] can overflow.

NC_CBK_EX_NR defines the number of exhaust banks.
For vector elements the variable extension "_i" is used in the model instead of "[i]" as found in the textual description.

Application conditions:

Initialisation:	`RST`
Recurrence:	`20MS`
Activation:	`LV_ST_END == 1`
Deactivation:	`LV_ST_END == 0`

Function description:

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Formula section:

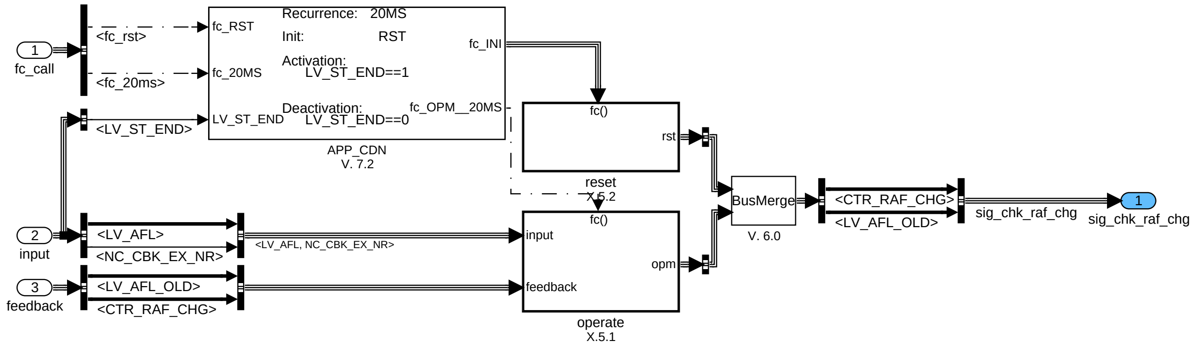

Figure 7.59.114: :

7.59.5.1 for loop

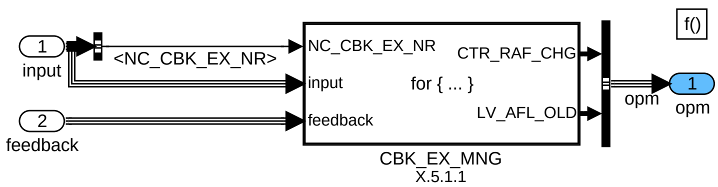

Figure 7.59.115: :

7.59.5.1.1 for loop (i= 0 to NC_CBK_EX_NR)

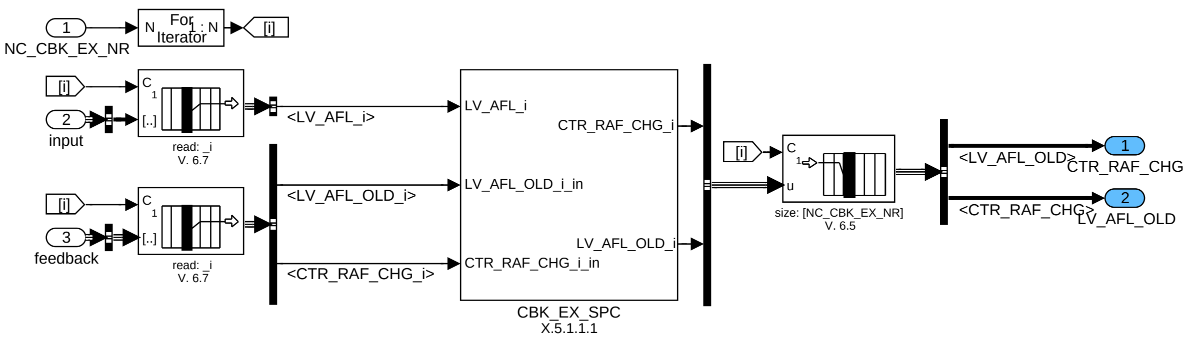

Figure 7.59.116: :

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7.59.5.1.1.1 counter of air fuel ratio changes

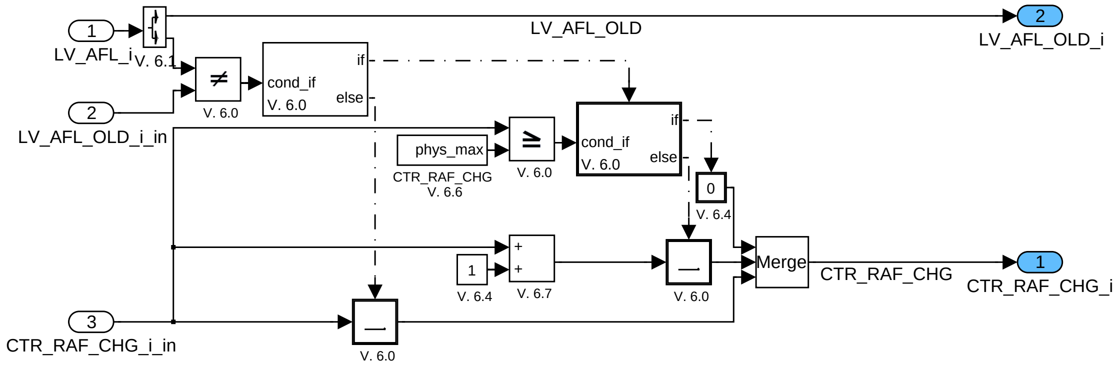

Figure 7.59.117: :

7.59.5.2 Initialisation

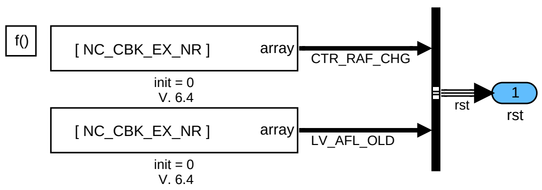

Figure 7.59.118: :

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7.60 Lambda control (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_EG_DLY_AGI_L2R [NC_CBK_EX_NR]	O/V	0... FFH	0... 31.875	0.125	-
Weighting factor for the calculation of the exhaust gas delay for aging in L2R-direction					
FAC_EG_DLY_AGI_R2L [NC_CBK_EX_NR]	O/V	0... FFH	0... 31.875	0.125	-
Weighting factor for the calculation of the exhaust gas delay for aging in R2L-direction					
FAC_IPT_SENS_MDL [NC_CBK_EX_NR]	O/V	0... 400H	0 ...1	976.599e-6	-
Interpolation factor for gas delay and sensor behavior model					
FAC_IPT_SENS_MDL_OPT [NC_CBK_EX_NR]	O/V	0... 400H	0 ...1	976.599e-6	-
Interpolation factor for sensor behavior model (optional)					
FAC_NEUT_NOT_STAT_CDN	O/V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
value for detection of non-stationary conditions for lambda controller limitation					
FAC_TQ_REQ_OFS_LAM_NOT_STAT	V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
actual torque value offset for detection of non-stationary condition					
LAMB_AV_DELTA_LAM [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61e-6	-
lambda shift applied on measured lambda signal					
LAMB_DELTA_DYN_DIAG [NC_CBK_EX_NR]	V	F800... 800H	-0.125 ...0.125	61e-6	-
lambda setpoint shift for lambda controller due to active dynamic diagnosis					
LAMB_DIF_AV_CTL_ST_IN [NC_CBK_EX_NR]	V	F800... 800H	-0.125 ...0.125	61e-6	-
start lambda difference for lambda ctl.					
LAMB_DIF_AV_CTL_ST_OUT [NC_CBK_EX_NR]	V	F800... 800H	-0.125 ...0.125	61e-6	-
Lambda offset in case of first lambda ctl start in DC					
LAMB_LS_UP_DRV1 [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-0.5... 0.49998	15.3e-6	1/10ms
first derivate of upstream lambda signal					
LAMB_LS_UP_DRV1_MMV [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-0.5... 0.49998	15.3e-6	1/10ms
first derivate of upstream lambda signal - moving mean value					
LAMB_LS_UP_OLD_DRV1 [NC_CBK_EX_NR]	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Previous value of LAMB_LS_UP					
LAMB_SP_DELTA_LAM [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61e-6	-
lambda shift applied on lambda set point					
LV_AFL_DRV1 [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating first derivate detection of lean Air-Fuel mixture when set					
LV_INH_LSCL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
inhibit signal for the controller deactivation					
LV_LAM_GAIN_SWI	O/V	0... 1H	0 ...1	1	-
lambda controller gain switch for idle speed					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_STOP_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request to stop the lambda controller					
LV_LAM_STOP_SHO_PER_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request to trigger the short period stop mode of the Lambda controller					
LV_LAMB_SP_AFL_THD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that lambda setpoint is too lean and therefore the lambda controller is inhibited.					
LV_LAMB_SP_AFR_THD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that lambda setpoint is too rich and therefore the lambda controller is inhibited.					
LV_MAF_INT_MIN_LAM_REAC_SWI	O/V	0... 1H	0 ...1	1	-
flag to switch limit of MAF_INT_MIN_LAM_REAC					
LV_STATE_LS_OPL_ERR [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag summarising errors that leads to open loop control					
MAF_INT_LAM_NOT_STAT	V	0... FFFFH	0... 1820.42	0.0277778	g
air mass flow integral for detection of non stationary condition					
MAF_INT_S_ACT	O/V	0... FFFFH	0... 2912.66666	0.0444444	g
air mass flow integral for during the S or HOMS operation modi					
MAF_OFS_LAM_NOT_STAT	V	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
air mass flow offset for detection of non stationary condition					
N_OFS_LAM_NOT_STAT	V	E020... 1FE0H	-8160 ...8160	1	rpm
engine speed offset for detection of non stationary condition					
STATE_SENS_MDL [NC_CBK_EX_NR]	O/V	0H 1H 2H	STND L2R R2L	-	-
State showing the active sensor plant-model					
T_LSL_UP_AGI_L2R [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	s
Time lag of the WRAF sensor model for aging in L2R-direction					
T_LSL_UP_AGI_R2L [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	s
Time lag of the WRAF sensor model for aging in R2L-direction					

Input data:

DELTA_LAMB_SP_O2L_ MDL [NC_CBK_EX_NR] {p. 1037}	ERR_INH_LSCL [NC_CBK_EX_NR] {p. 1014}	FAC_COMP_MV_DIAG_ DYN_SENS_MDL [NC_CBK_EX_NR] {p. 5345}	FAC_DIAG_DYN_LSL_UP [NC_CBK_EX_NR] {p. 5345}
FAC_TQ_REQ_DELTA_ LDC {p. 2585}	LAMB_DELTA_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LAMB_DELTA_SUM_LAM_ ADJ_AD [NC_CBK_EX_NR] {p. 2622}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}
LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LAMB_SP_HOM [NC_CBK_EX_NR] {p. 8340}	LV_ACT_SA_EOL {p. 7763}	LV_AFL [NC_CBK_EX_NR] {p. 2439}
LV_HOM_ACT {p. 8136}	LV_INH_LAM_KWP {p. 7483}	LV_INH_LSCL_CUS [NC_CBK_EX_NR] {p. 8310}	LV_IS {p. 1720}

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LV_LAM_AD_INJ_ACT {p. 3348}	LV_LAMB_COP [NC_CBK_EX_NR] {p. 8233}	LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_REQ_ISC {p. 3501}
LV_SA_END {p. 804}	LV_ST_END {p. 1720}	MAF {p. 8277}	MAF_CYL {p. 8277}
MAF_DELTA_LDC {p. 2585}	N {p. 1525}	N_DELTA_LDC {p. 2585}	NC_CBK_EX_NR {p. 1829}
STATE_LAM_GAIN_REQ_LS_DIAG {p. 5349}	STATE_LS [NC_CBK_EX_NR] {p. 2448}	WGPWM [NC_CBK_EX_NR] {p. 8140}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LAMB_LS_UP_DRV1	-	0... FFFFH	0... 0.99998	15.3e-6	-
Filtering constant for LAMB_LS_UP_DRV1_MMV					
C_FAC_DIAG_DYN_MIN_SENS_MDL_AGI	-	0... 400H	0 ...1	976.599e-6	-
Minimum FAC_DIAG_DYN-value to activate lambda controller plant model for sensor ageing					
C_FAC_TQ_REQ_DYW_LAM_NOT_STAT	-	0... FFFFH	0... 1.99996	30.5e-6	-
torque scaling factor window for detection for non stationary condition					
C_LAM_MAF_MIN_HYS	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Hysteresis for minimum MAF - threshold for lambda control					
C_LAMB_DIF_AV_CTL_ST_MAX	-	F800... 800H	-0.125 ...0.125	61e-6	-
max. allowable lambda deviation at initialisation of lambda difference for the lambda controller					
C_LAMB_DIF_AV_CTL_ST_MAX_IS	-	F800... 800H	-0.125 ...0.125	61e-6	-
max. allowable lambda deviation at initialisation of lambda difference for the lambda controller in IS					
C_LAMB_DIF_AV_CTL_ST_MIN	-	F800... 800H	-0.125 ...0.125	61e-6	-
min. allowable lambda deviation at initialisation of lambda difference for the lambda controller					
C_LAMB_DIF_AV_CTL_ST_MIN_IS	-	F800... 800H	-0.125 ...0.125	61e-6	-
min. allowable lambda deviation at initialisation of lambda difference for the lambda controller in IS					
C_LAMB_LS_UP_DRV1_THD_L2R	-	8000... 7FFFH	-0.5... 0.49998	15.3e-6	1/10ms
lambda gradient threshold below which lean2rich-model is activated					
C_LAMB_LS_UP_DRV1_THD_R2L	-	8000... 7FFFH	-0.5... 0.49998	15.3e-6	1/10ms
lambda gradient threshold above which rich2lean-model is activated					
C_LAMB_SP_AFL_THD	-	400... 1000H	1 ...4	976.599e-6	-
lean air-fuel mixture setpoint threshold					
C_LAMB_SP_AFL_THD_HYS	-	0... 400H	0 ...1	976.599e-6	-
lean air-fuel mixture setpoint threshold hysteresis					
C_LAMB_SP_AFR_THD	-	0... 400H	0 ...1	976.599e-6	-
rich air-fuel mixture setpoint threshold					
C_LAMB_SP_AFR_THD_HYS	-	0... 400H	0 ...1	976.599e-6	-
rich air-fuel mixture setpoint threshold hysteresis					
C_LGRD_LAMB_DIF_AV_CTL_ST	-	F800... 800H	-0.125 ...0.125	61e-6	-
limitation gradient of lambda deviation at initialisation of lambda difference for the lambda controller					
C_MAF_DYW_LAM_NOT_STAT	-	0... FFFFH	0... 1389	0.0211948	mg/stk
air mass flow window for detection of non stationary condition					
C_MAF_INT_LAM_NOT_STAT	-	0... FFFFH	0... 1820.41666	0.0277778	g
air mass flow integral for detection of non stationary condition					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_DYW_LAM_NOT_STAT	-	0... 1FE0H	0... 8160	1	rpm
engine speed window for detection of non stationary condition					
ID_FAC_IPT_SENS_MDL	-	0... 400H	0 ...1	976.599e-6	-
LDP_WGPWM_ID_FAC_IPT_SENS_MDL	6	0... FFFFH	0... 99.99847	1.5259e-3	%
Interpolation factor for waste gate position					
IP_FAC_EG_DLY_AGI_ASYM	-	0... FFH	0... 31.875	0.125	-
LDPM_FAC_COMP_MV_1_LACO	6	0... FFFFH	-32... 31.99902	976.599e-6	-
Additional delay time for lambda controller plant model - non symmetrical sensor ageing					
IP_FAC_IPT_SENS_MDL_OPT	-	0... 400H	0 ...1	976.599e-6	-
LDP_FAC_DYN_IP_FAC_IPT_SENS_MDL	4	0... 400H	0 ...1	976.599e-6	-
Interpolation factor for WRAF sensor dynamic					
IP_LAM_MAF_MIN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_LAM_MAF_MIN	6	0... 1FE0H	0... 8160	1	rpm
Minimum MAF - threshold for lambda control					
IP_LAMB_DELTA_DYN_DIAG	-	0... 1000H	-0.125 ...0.125	61e-6	-
LDPM_FAC_COMP_MV_1_LACO	6	0... FFFFH	-32... 31.99902	976.599e-6	-
lambda setpoint shift for lambda controller incase of active dynamic diagnosis					
IP_T_LSL_UP_AGI_ASYM	-	0... FFFFH	0... 1.99996	30.5e-6	s
LDPM_FAC_COMP_MV_1_LACO	6	0... FFFFH	-32... 31.99902	976.599e-6	-
Additional rise time for lambda controller plant model - non symmetrical sensor aging					
LC_FAC_IPT_SENS_MDL_OPT_ACT	-	0... 1H	0 ...1	1	-
switch to enable calculation of aged lin. O2 sensor signal correction (for monitoring only					
LC_HOM_ACT_COMP	-	0... 1H	0 ...1	1	-
switching variable for the open loop/closed loop operation in stratified mode					
LC_LAM_GAIN_SWI	-	0... 1H	0 ...1	1	-
flag indicating whether lambda controller parameter switch is allowed					
LC_LAM_GAIN_SWI_LAM_AD_INJ	-	0... 1H	0 ...1	1	-
Flag indicating whether lambda controller parameter switch is allowed for minimum fuel mass adaptation					
LC_LAM_OFF_SAWUP	-	0... 1H	0 ...1	1	-
switching variable for the open loop/closed loop operation at secondary air					
LC_LAMB_COP_OFF	-	0... 1H	0 ...1	1	-
switch to disable the cat-heating-"lambda control deactivation condition"					
LC_SENS_MDL_SWI_DRV1_ACT	-	0... 1H	0 ...1	1	-
switch to activate the calculation of Lambda gradient for lambda controller plant model					

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FUNCTION DESCRIPTION:

General information:

This module defines the project specific activation conditions and necessary output variables for the linear lambda controller.
The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2,

otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Application conditions

Initialisation:

```
at ECU reset:
          LV_INH_LSCL[i]                    =    1
          LV_LAM_GAIN_SWI                    =    LC_LAM_GAIN_
SWI
          LAMB_SP_DELTA_LAM[i]                    =    0
          LAMB_AV_DELTA_LAM[i]                    =    0
          LV_LAM_STOP_REQ[i]                    =    0
          LV_STATE_LS_OPL_ERR[i]                    =    0
          LV_LAMB_SP_AFR_THD[i]                    =    0
          LV_LAMB_SP_AFL_THD[i]                    =    0
          LV_LAM_MAF_MIN                    =    0
MFF_ADD_WF                 = 0
N_OFS_LAM_NOT_STAT   = 0
MAF_OFS_LAM_NOT_STAT    = 0
MAF_INT_LAM_NOT_STAT    = 0
LAMB_DIF_AV_CTL_ST_OUT[i] = 0
LV_CLC_LAMB_DIF_AV_ST    = 1
 LV_LAM_STOP_SHO_PER_REQ[i] = 0
FAC_TQ_REQ_OFS_LAM_NOT_STAT = 0
MAF_INT_S_ACT = 0
LAMB_DELTA_DYN_DIAG[i]   = 0
 At LV_IGK = 0 -> 1
LAMB_DIF_AV_CTL_ST_OUT[i] = 0
LV_CLC_LAMB_DIF_AV_ST    = 1
LV_MAF_INT_MIN_LAM_REAC_SWI = 0
```

Recurrence: *T_SAMPLE = 20 ms*

Activation: *LV_ST_END = 1*

Deactivation: -

Formula section:

7.60.1 Calculation of LV_INH_LSCL[i]

7.60.1.1 Inhibition of the lambda feedback control circuit

If(1) LAMB_SP[i] < C_LAMB_SP_AFR_THD
% lambda setpoint value is less than the rich air-fuel mixture threshold
Then(1) LV_LAMB_SP_AFR_THD[i] = 1
Else(1)
If(2) LAMB_SP[i] C_LAMB_SP_AFR_THD + C_LAMB_SP_AFR_THD_HYS
Then(2) LV_LAMB_SP_AFR_THD[i]= 0
Endif(2)
Endif(1)
If(1) LAMB_SP[i] > C_LAMB_SP_AFL_THD lambda setpoint value is greater than the lean air-fuel mixture threshold
Then(1) LV_LAMB_SP_AFL_THD[i] = 1
Else(1)
If(2) LAMB_SP[i] ≤ C_LAMB_SP_AFL_THD - C_LAMB_SP_AFL_THD_HYS
Then(2) LV_LAMB_SP_AFL_THD[i] = 0
Endif(2)
Endif(1)
(signal flow is analogous LV_LAMB_SP_AFR_THD[i] , see above)

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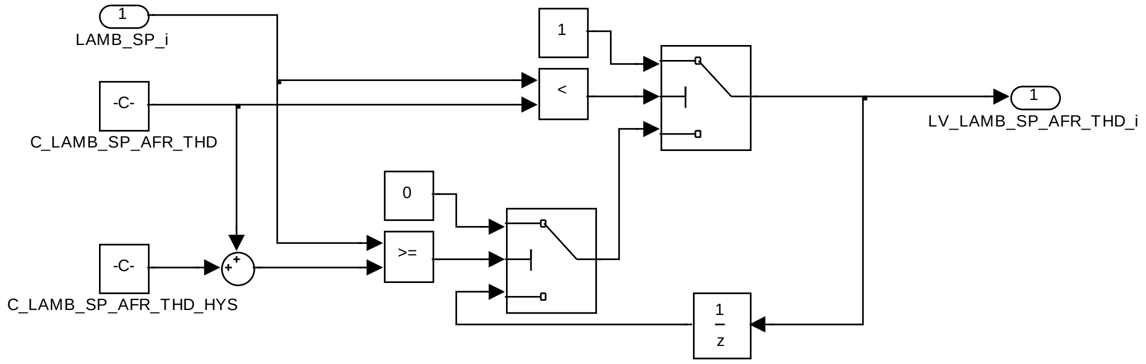

If(1) MAF $<$ IP_LAM_MAF_MIN
Then(1) LV_LAM_MAF_MIN = 1
Else(1)
If(2) MAF IP_LAM_MAF_MIN + C_LAM_MAF_MIN_HYS
Then(2) LV_LAM_MAF_MIN = 0
Endif(2)
Endif(1)

7.60.1.2 Inhibition due to present error

If ERR_INH_LSCL[i] $>$ 0
Then LV_STATE_LS_OPL_ERR[i] = 1
Else LV_STATE_LS_OPL_ERR[i] = 0
Endif

7.60.1.3 Summary of all inhibition conditions for activation of lambda controller

If LV_STATE_LS_OPL_ERR[i] = 1 **or** (present error)
LV_LAMB_SP_AFR_THD[i] = 1 **or** (lambda setpoint to rich)
LV_LAMB_SP_AFL_THD[i] = 1 **or** (lambda setpoint to lean)
LV_LAM_MAF_MIN = 1 **or** (minimum maf not fulfilled)
(LC_LAMB_COP_OFF = 1 **and**
LV_LAMB_COP[i] = 1**) or** (catalyst overheat prevention)
LV_ACT_SA_EOL = 1 **or** (EOL test SA is active)
(LC_LAM_OFF_SAWUP=1**and**
LV_SA_END = 0**) or** (secondary air is active)
LV_INH_LAM_KWP = 1 (disable Controller via Tester)
Then LV_INH_LSCL[i] = 1
Else LV_INH_LSCL[i] = 0
Endif

7.60.1.4 Calculation of LV_LAM_STOP_REQ[i]

The request to stop the lambda-controller (LV_LAM_STOP_REQ[i] = 1), if one of the conditions

1. stratified charge mode (LV_HOM_ACT=0) **and** LC_HOM_ACT_COMP = 0 **or**
2. secondary air is active (LV_SA_END = 0) **and** LC_LAM_OFF_SAWUP = 1

is fulfilled.

If (LV_HOM_ACT = 0 **and**
LC_HOM_ACT_COMP = 0) **or**
LV_INH_LSCL_CUS[i] = 1 **or**

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(LV_SA_END = 0 **and**
LC_LAM_OFF_SAWUP = 1**)**
Then LV_LAM_STOP_REQ[i] = 1
Else LV_LAM_STOP_REQ[i]= 0
Endif

7.60.1.5 Setting of LV_LAM_GAIN_SWI

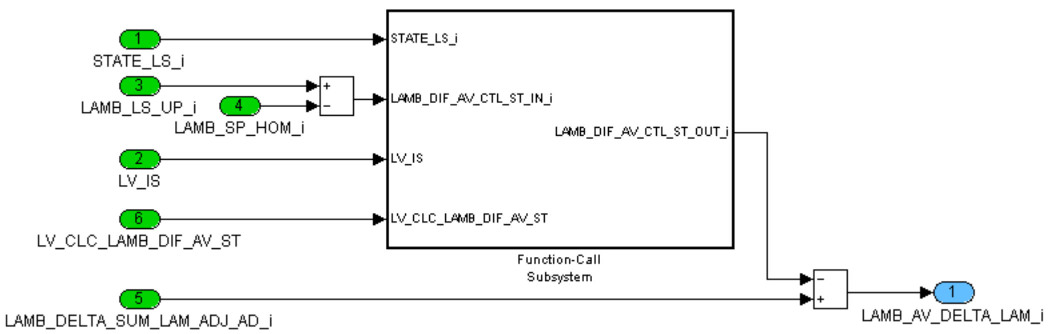
The gain of the lambda controller is different between idle speed and part load. Therefore, the gain is switched in case of active idle speed controller.
If (LV_REQ_ISC = 1 **and** LC_LAM_GAIN_SWI = 1)
or (LV_LAM_AD_INJ_ACT = 1 **and** LC_LAM_GAIN_SWI_LAM_AD_INJ = 1)
Then LV_LAM_GAIN_SWI = 1
Else LV_LAM_GAIN_SWI = 0
Endif

7.60.1.6 Assignment of LAMB_SP_DELTA_LAM[i]

The output of the trim controller (P and I share) is distributed as follows as corrective intervention on the lambda set point and on the measured lambda signal:

If STATE_LAM_GAIN_REQ_LS_DIAG = DYN_DIAG
Then LAMB_DELTA_DYN_DIAG[i] = IP_LAMB_DELTA_DYN_DIAG (FAC_
COMP_MV_DIAG_DYN_SENS_MDL [i])
Else LAMB_DELTA_DYN_DIAG[i] = 0
Endif
LAMB_SP_DELTA_LAM[i] = LAMB_DELTA_LAM_ADJ[i]
+ DELTA_LAMB_SP_O2L_MDL[i]
+ LAMB_DELTA_DYN_DIAG[i]

7.60.1.7 Assignement of LAMB_AV_DELTA_LAM[i]



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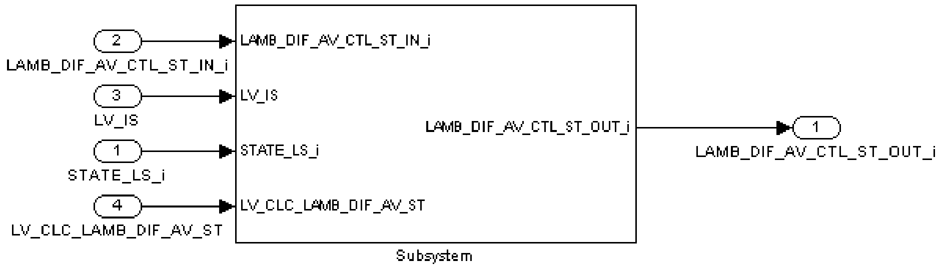

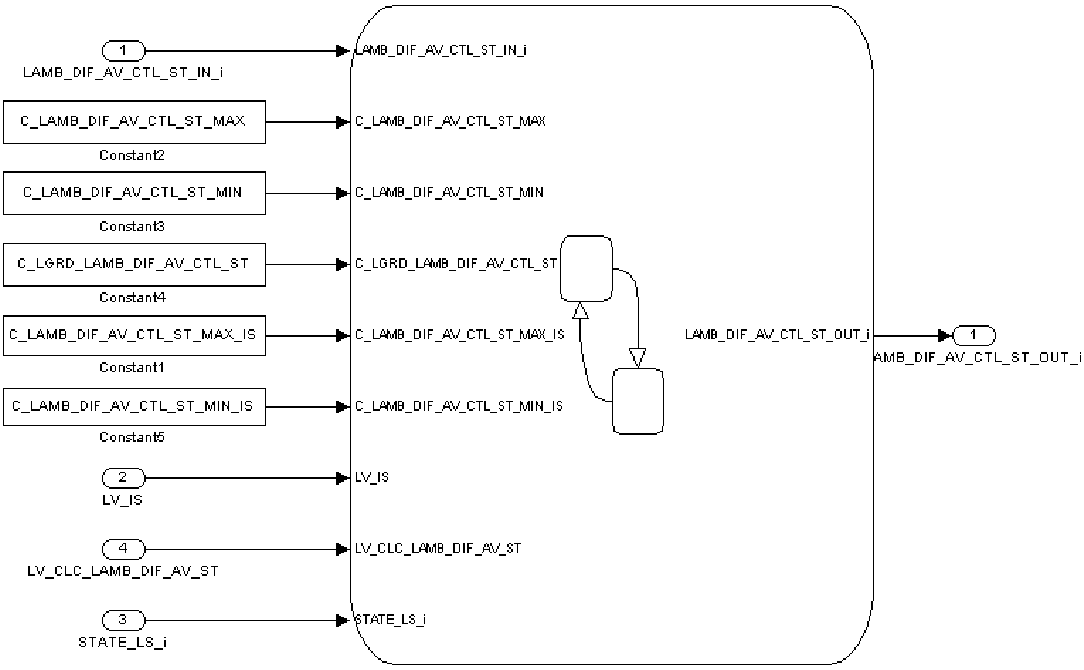

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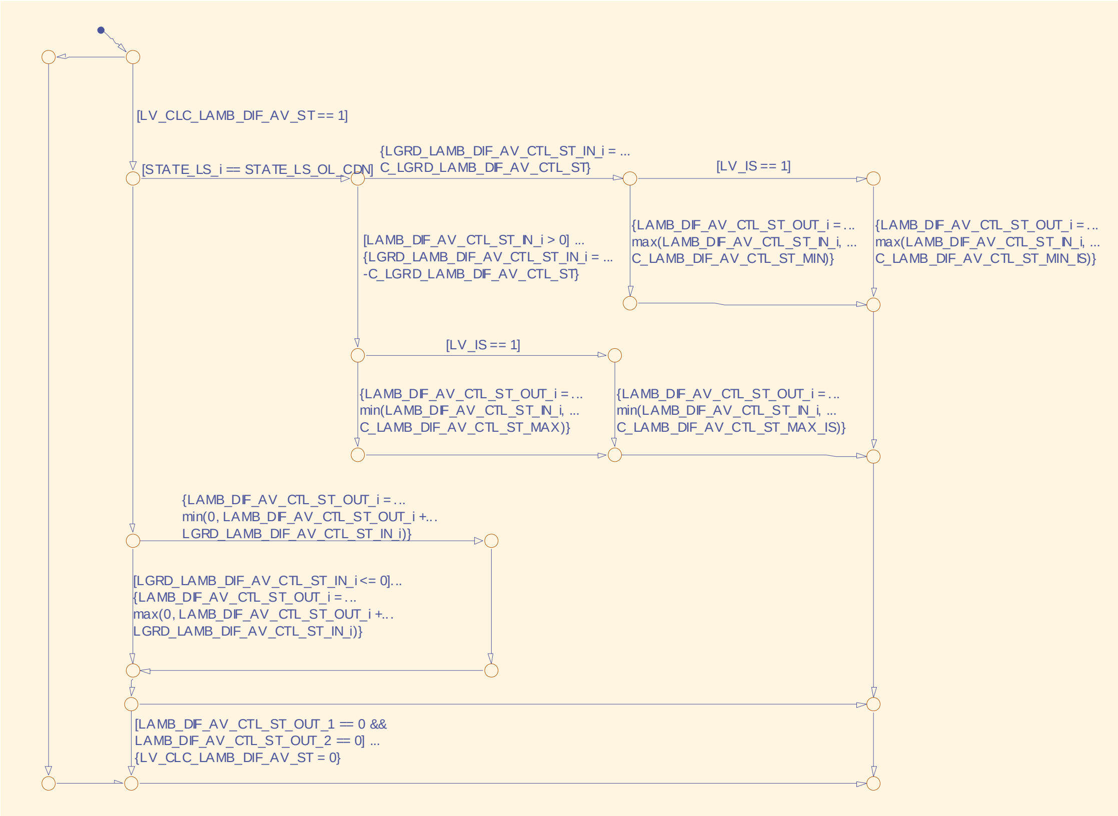

7.60.1.8 1.1.7 tection of non-stationary condition

A limited dynamic condition based on N, MAF and PV_AV is detected when the variation of those variables exceed the calibrateable threshold.

IF (**ABS**(N_DELTA_LDC) > C_N_DYW_LAM_NOT_STAT)
THEN
    IF (**ABS**(N_DELTA_LDC - N_OFS_LAM_NOT_STAT) > C_N_DYW_LAM_NOT_STAT)
THEN
        N_OFS_LAM_NOT_STAT = N_DELTA_LDC
        MAF_INT_LAM_NOT_STAT = 0
ENDIF
ELSE
N_OFS_LAM_NOT_STAT = 0
ENDIF
IF (**ABS**(MAF_DELTA_LDC) > C_MAF_DYW_LAM_NOT_STAT)
THEN
    IF (**ABS**(MAF_DELTA_LDC - MAF_OFS_LAM_NOT_STAT) >
        C_MAF_DYW_LAM_NOT_STAT)
THEN
        MAF_OFS_LAM_NOT_STAT = MAF_DELTA_LDC
        MAF_INT_LAM_NOT_STAT = 0
ENDIF
ELSE
MAF_OFS_LAM_NOT_STAT = 0
ENDIF

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IF (**ABS**(FAC_TQ_REQ_DELTA_LDC) > C_FAC_TQ_REQ_DYW_LAM_NOT_STAT)
THEN
IF (**ABS**(FAC_TQ_REQ_DELTA_LDC - FAC_TQ_REQ_OFS_LAM_NOT_STAT) >
C_FAC_TQ_REQ_DYW_LAM_NOT_STAT)
THEN
FAC_TQ_REQ_OFS_LAM_NOT_STAT = FAC_TQ_REQ_DELTA_LDC
MAF_INT_LAM_NOT_STAT = 0
ENDIF
ELSE
FAC_TQ_REQ_OFS_LAM_NOT_STAT = 0
ENDIF
IF (MAF_INT_LAM_NOT_STAT < C_MAF_INT_LAM_NOT_STAT)
THEN % non stationary condition detected
MAF_INT_LAM_NOT_STAT [g] = MAF_INT_LAM_NOT_STAT [g] +

MAF_CYL [kg/h] * T_SAMPLE [ms] * 1/3600 [(g*h) /(kg*ms)]
FAC_NEUT_NOT_STAT_CDN= 7FFFh
ELSE % stationary condition
FAC_NEUT_NOT_STAT_CDN= 0h
ENDIF

7.60.1.9 Assignment of interpolation factor

If LC_FAC_IPT_SENS_MDL_OPT_ACT = 1
then
FAC_IPT_SENS_MDL[i] = 0
FAC_IPT_SENS_MDL_OPT[i] = IP_FAC_IPT_SENS_MDL_OPT(FAC_DIAG_DYN_LSL_UP[i])
else
FAC_IPT_SENS_MDL[i] = ID_FAC_IPT_SENS_MDL(WGPWM[i])
FAC_IPT_SENS_MDL_OPT[i] = 0
endif

7.60.1.10 Calculation of air massflow integral during S/HOMS operation mode

If LV_HOM_ACT = 1 -> 0
Then MAF_INT_S_ACT = 0
Elseif LV_HOM_ACT = 0
Then MAF_INT_S_ACT = MAF_INT_S_ACT + MAF_CYL [kg/h] * T_SAMPLE [ms] * 1/3600 [(g*h) /(kg*ms)]
Elseif LV_HOM_ACT = 1
Then hold MAF_INT_S_ACT
Endif

7.60.2 Calculations in 10ms

General information:

The lambda controller plant model is determined depending on STATE_SENS_MDL. It can be chosen between a lean2rich, a rich2lean and a default model.
The default sensor plant model is used e.g. if forced adaptation is off and gradient based switching is off or during the dynamic diagnosis to have a defined reference.

Application conditions:

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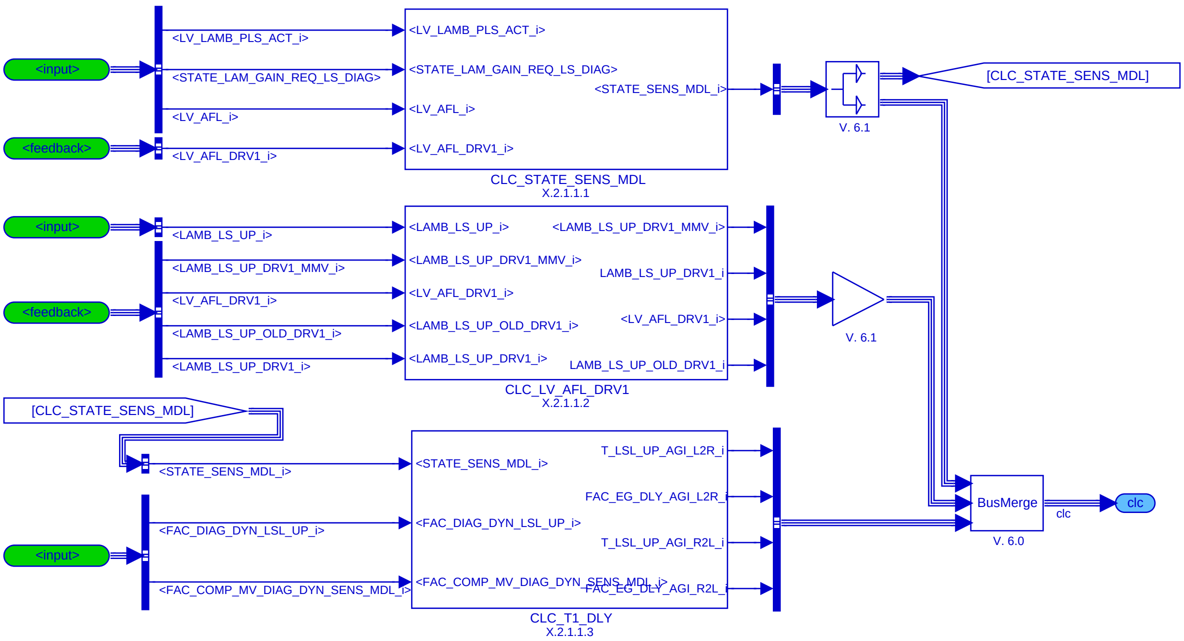
Initialisation:
```
at ECU reset:
STATE_SENS_MDL[i]    = STND
LAMB_LS_UP_DRV1[i]      = 0
LAMB_LS_UP_DRV1_MMV[i] = 0
FAC_IPT_SENS_MDL[i]     = 0
FAC_EG_DLY_AGI_L2R[i]  = 0
FAC_EG_DLY_AGI_R2L[1]  = 0
LAMB_DELTA_DYN_DIAG[i] = 0
LV_AFL_DRV1[i]          = 0
T_LSL_UP_AGI_L2R[i]     = 0
T_LSL_UP_AGI_R2L[i]     = 0
```
Recurrence: 10 ms
Activation: LV_ST_END = 1
Deactivation: LV_ST_END = 0

Function description:

Formula section:

7.60.2.1 Calculation of lambda controller plant model status



1.2.2State showing the active sensor plant-model

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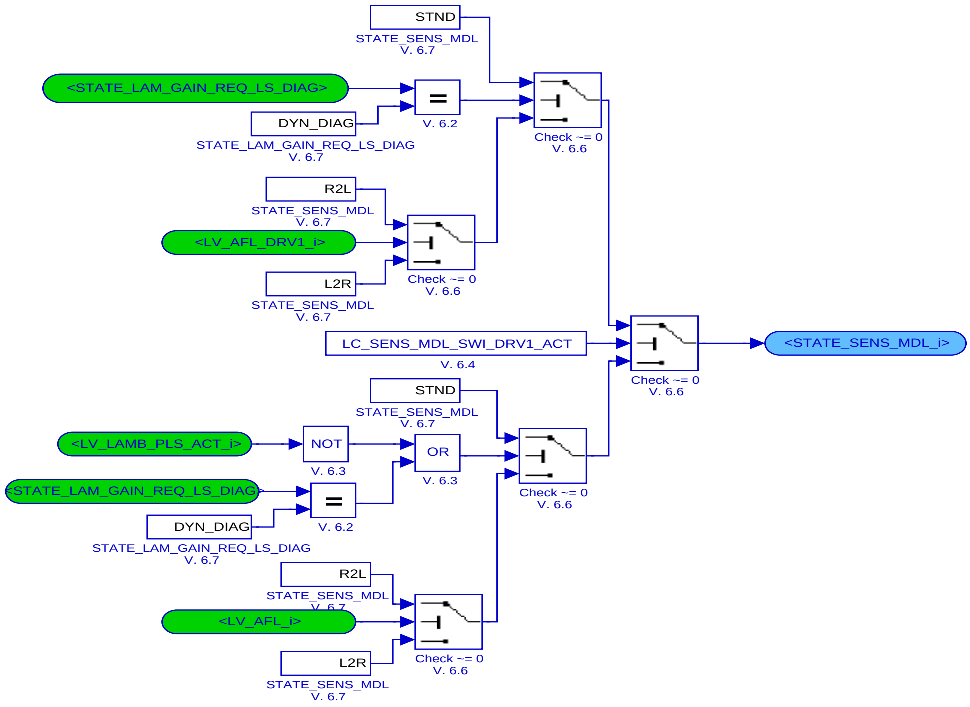

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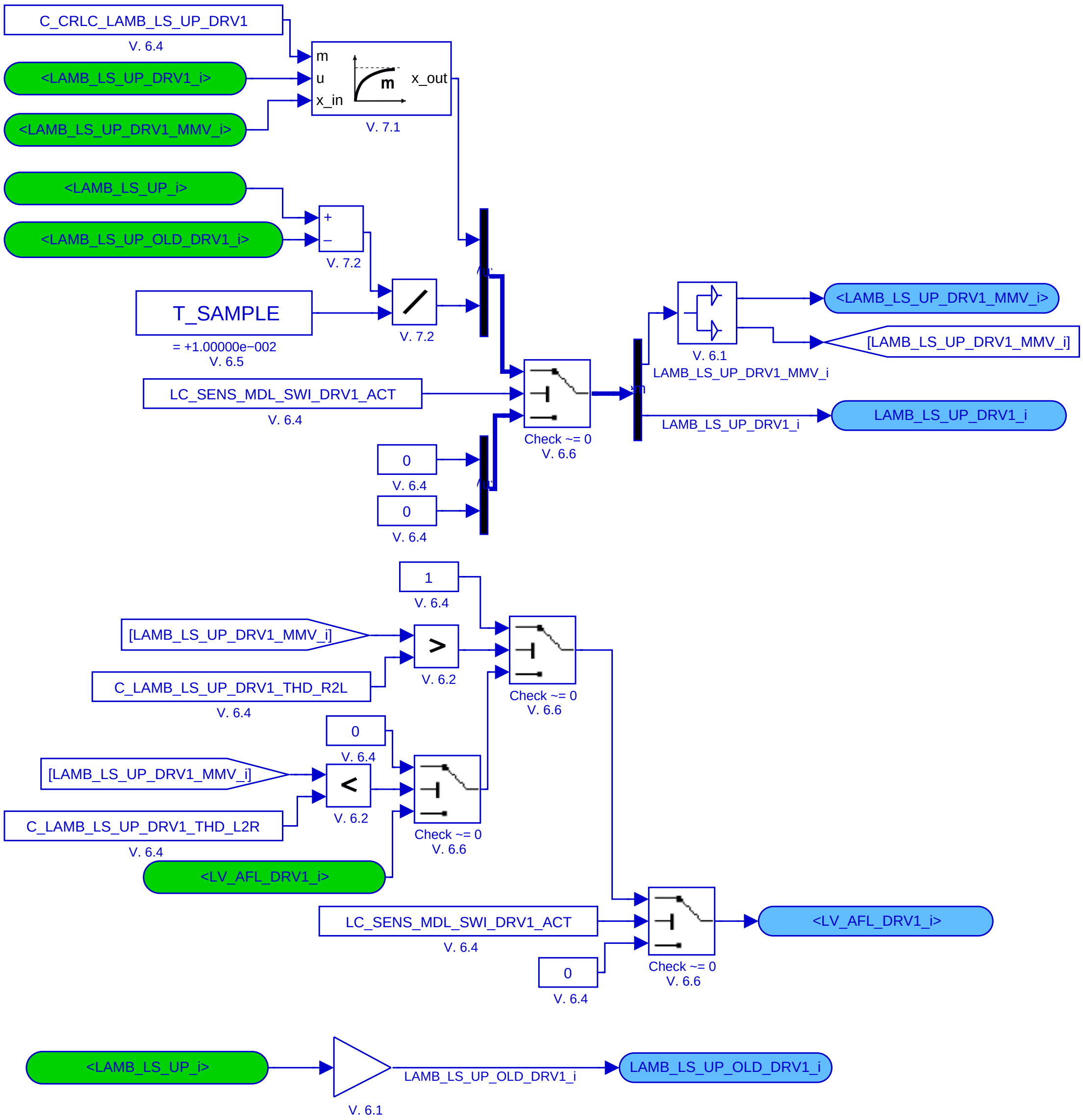
7.60.2.2 1.2.3 Calculation of first derivate detection of lean Air-Fuel mixture when set



7.60.2.3 1.2.4 Determination T1 and T-delay times for lambda controller plant model in-case of ageing

FAC_COMP_MV_DIAG_DYN_SENS_MDL[i] is given by EGCP to indicate the assymetric aged sensor behaviour. (e.g. -1.5=L2Rslow, 1.5=R2Lslow and 0=nominal).Depending on this value additional T1- and T-delay-times (separate ones for R2L & L2R) can be determined. These times are taken into account in the lambda controller plant model while the R2L or L2R model is active

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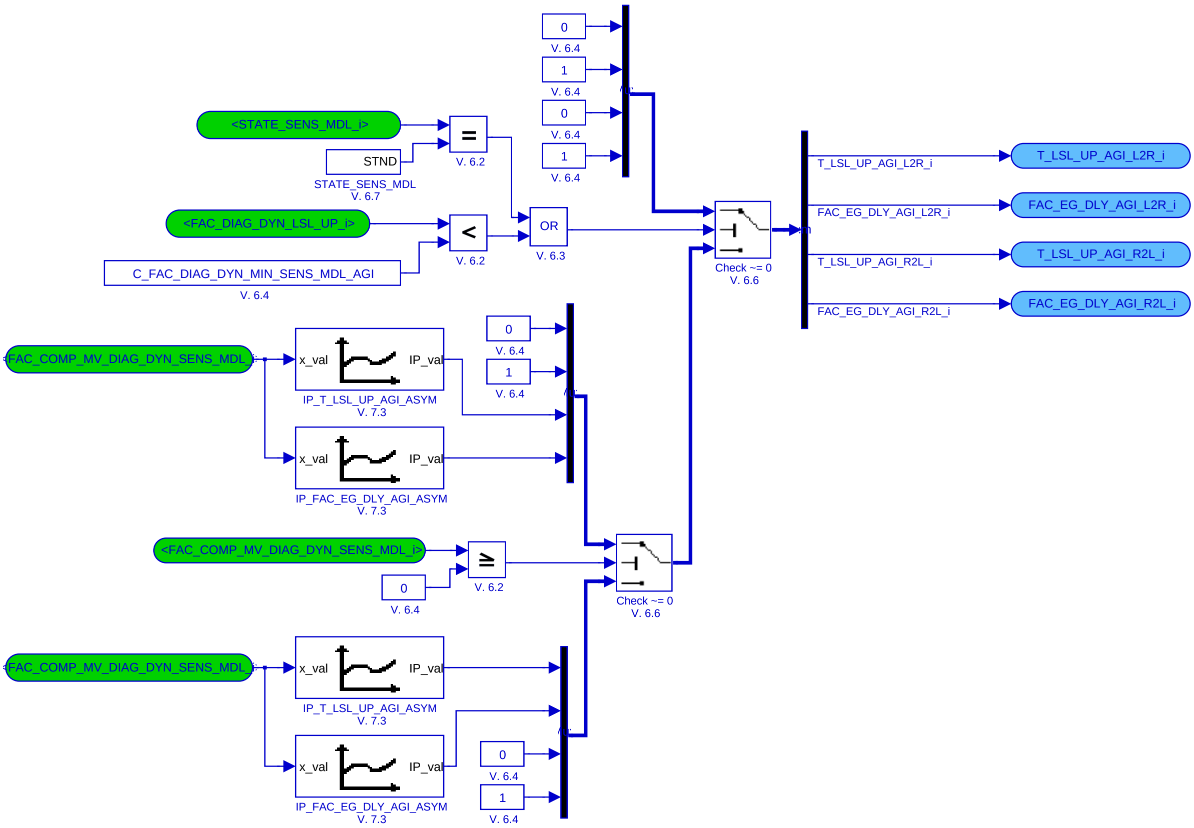

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7.61 Forced lambda stimulation coordination

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_PLS [NC_CBK_EX_NR]	O/V	F800... 7FFH	0... 0.12493896	610.352e3	-
Lambda deviation for the Lambda Controller					
LV_LAMB_PLS_AFL_COR_ACT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that corrective action for lean half wave of lambda stimulation is active					
LV_LAMB_PLS_AFR_COR_ACT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that corrective action for rich half wave of lambda stimulation is active					

Input data:

FAC_DIF_LAM_IN_MMV [NC_CBK_EX_NR] {p. 2460}	LAMB_PLS_EXT [NC_CBK_EX_NR] {p. 2579}	LAMB_PLS_O2L_OSC [NC_CBK_EX_NR] {p. 2563}	LV_ST_END {p. 1720}
NC_CBK_EX_NR {p. 1829}	STATE_LAMB_PLS_DET_ VALUE {p. 2958}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_DIF_THD_AFL_PLS_OFF	-	0... 7FFFH	0... 0.99996948	305.176e3	-
lambda control difference threshold for deactivating lean stimulation half wave					
C_FAC_DIF_THD_AFL_PLS_ON	-	8000... 7FFFH	0... 0.99996948	305.176e3	-
lambda control difference threshold for re activating lean stimulation half wave					
C_FAC_DIF_THD_AFR_PLS_OFF	-	8000... 0H	0 ...0	305.176e3	-
lambda control difference threshold for deactivating rich stimulation half wave					
C_FAC_DIF_THD_AFR_PLS_ON	-	8000... 7FFFH	0... 0.99996948	305.176e3	-
lambda control difference threshold for re activating rich stimulation half wave					
LC_LAMB_PLS_COR_ACT_IS	-	0... 1H	0 ...1	1	-
calibration flag indicating that corrective action for lambda stimulation is allowed in idle speed					
LC_LAMB_PLS_EXT	-	0... 1H	0 ...1	1	-
flag indicating that external LAMP_PLS is used					

7.61.1 EGTR_DEFSPFSTIC0

NC_CBK_EX_NR defines the number of exhaust banks.
For vector elements, the variable extension _i is used in the model instead of [i] as found in the textual description.

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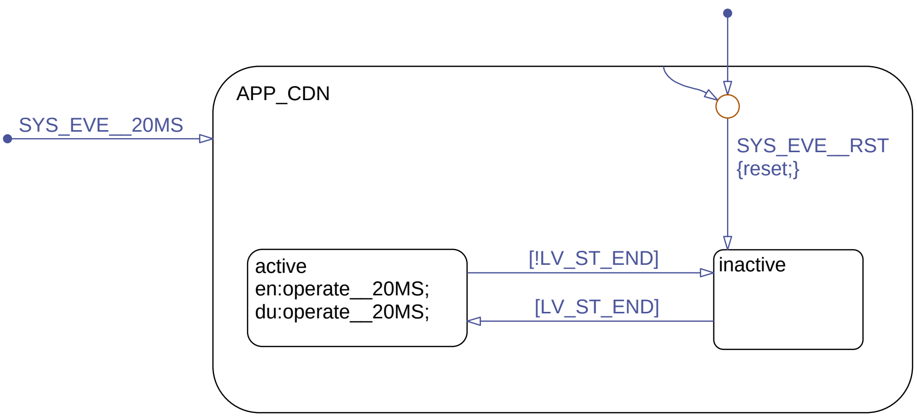

Figure 7.61.1: EGTR_DEFSPFSTIC0/APP_CDN/Chart

Function Description

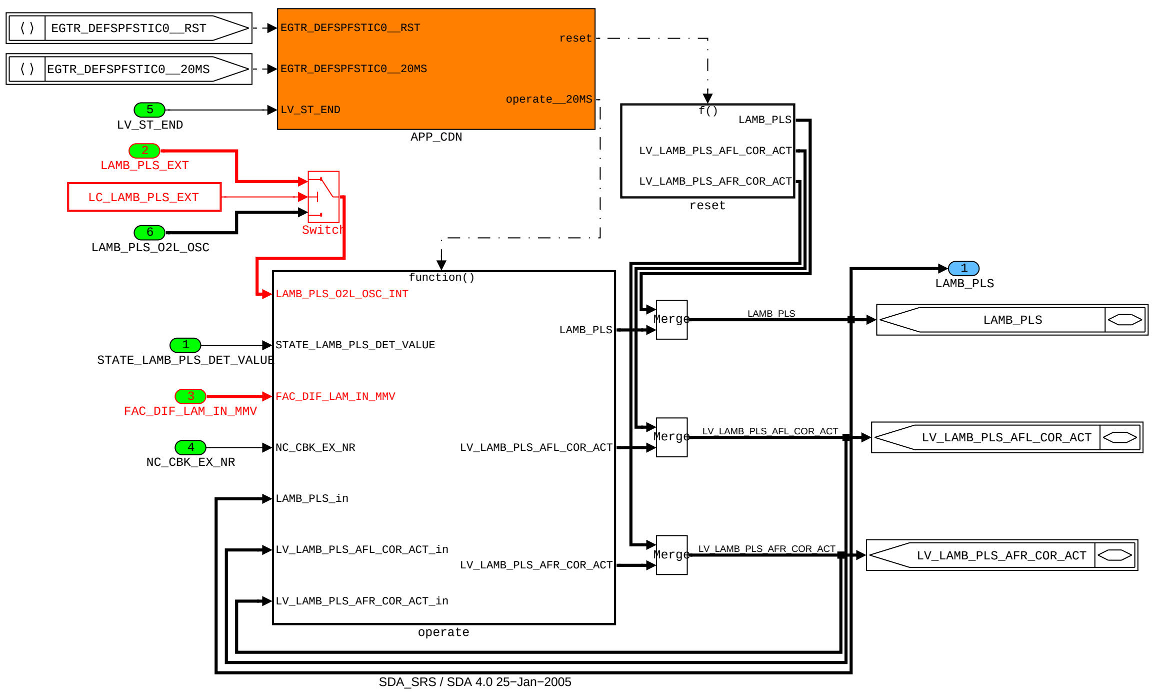

Figure 7.61.2: EGTR_DEFSPFSTIC0

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7.61.1.1 SUBFUNCTION: operate

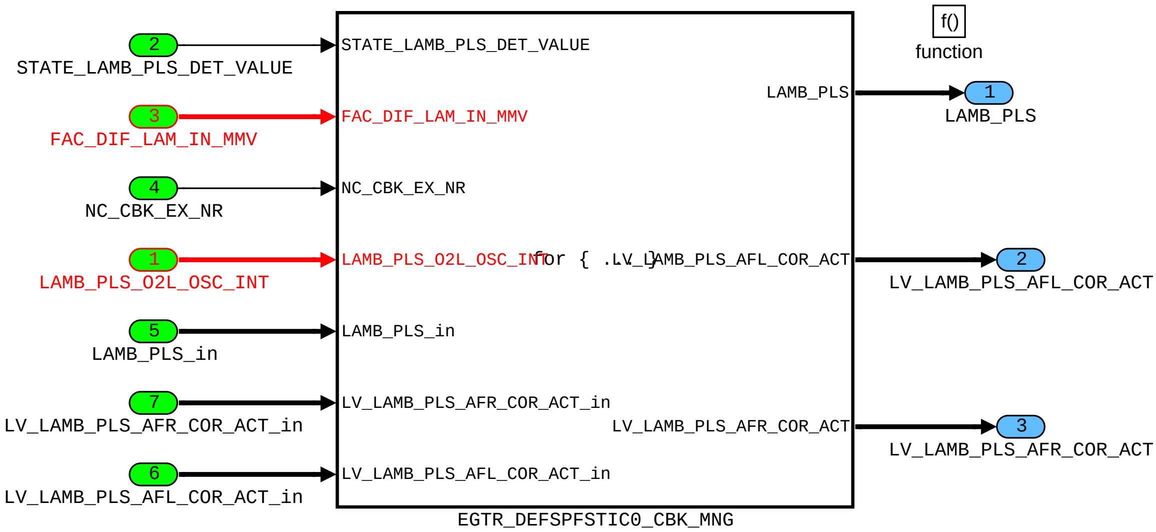

Figure 7.61.3: EGTR_DEFSPFSTIC0/operate

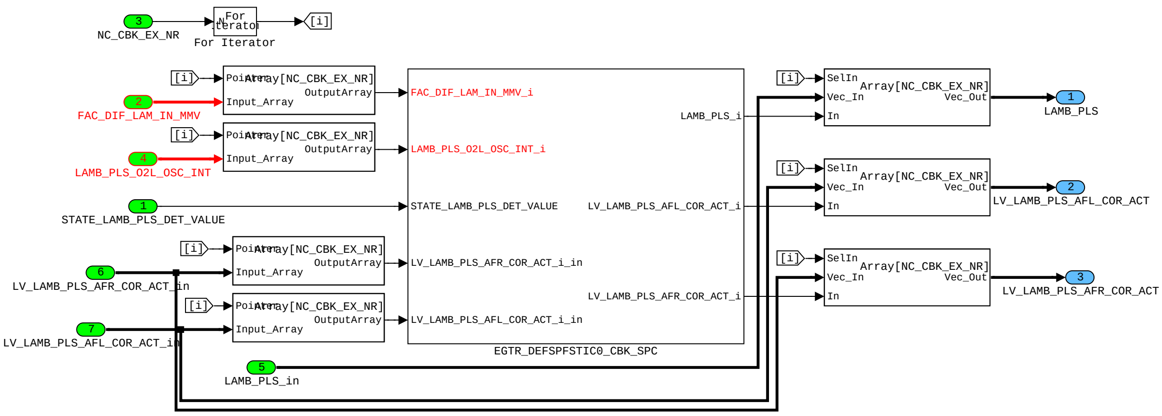

Figure 7.61.4: EGTR_DEFSPFSTIC0/operate/EGTR_DEFSPFSTIC0_CBK_MNG

Corrective action depending on lambda cotnroller difference

Depending on the lambda control difference FAC_LAM_DIF_IN[i] a corrective intervention on the lambda pulse can be applied. In case of too lean mixture the lean deviation can be suppressed and in case of too rich mixture the rich deviation can be suppressed. Activation and deactivation of the corrective intervention is realised with different thresholds in order to apply a hysteresis.
With LC_LAMB_PLS_COR_ACT_IS this corective action can also be applied in idle speed.

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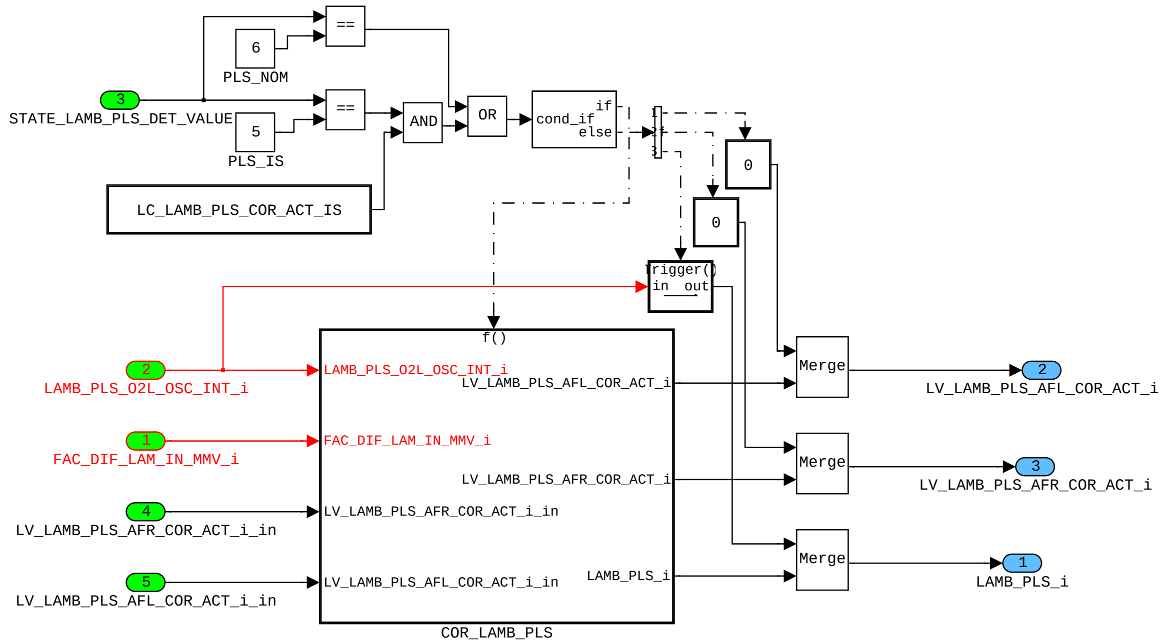

Figure 7.61.5:
EGTR_DEFSPFSTIC0/operate/EGTR_DEFSPFSTIC0_CBK_MNG/EGTR_DEFSPFSTIC0_CBK_SPC

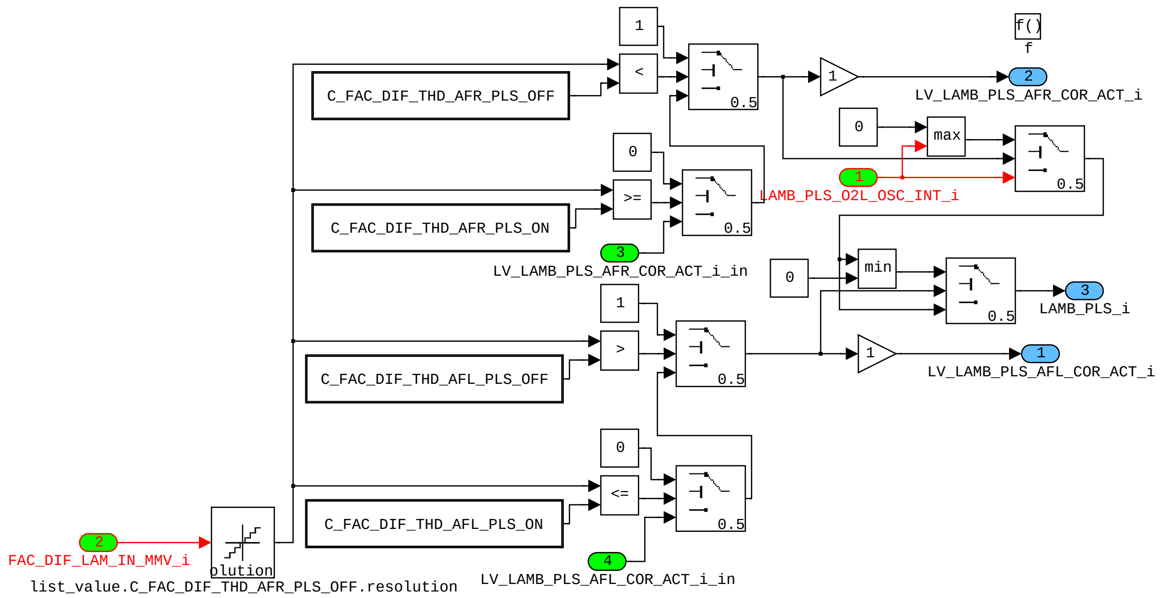

Figure 7.61.6: EGTR_DEFSPFSTIC0/operate/EGTR_DEFSPFSTIC0_CBK_MNG/
EGTR_DEFSPFSTIC0_CBK_SPC/COR_LAMB_PLS

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7.61.1.2 SUBFUNCTION: reset

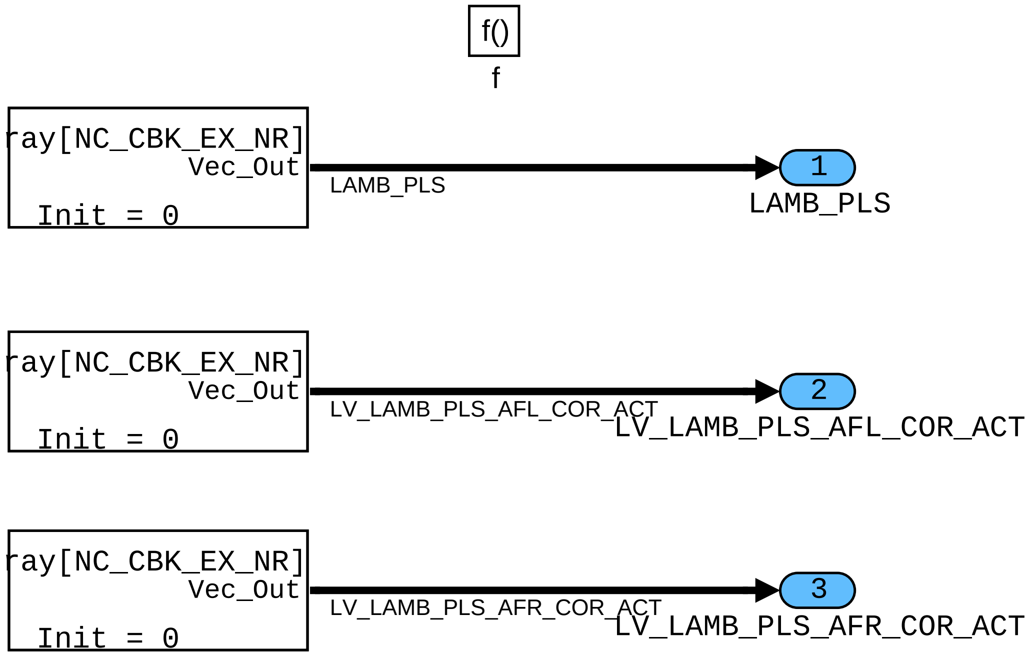

Figure 7.61.7: EGTR_DEFSPFSTIC0/reset

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7.62 Forced lambda stimulation (linear control)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_O2L_LAMB_PLS [NC_CBK_EX_NR]	V	8000... 7FFFH	-0.25... 0.2499924	7.6294e-6	-
temporary factor for O2 loading calculation considering the lambda set point deviation					
LAMB_PLS_O2L_OSC [NC_CBK_EX_NR]	O/V	F800... 7FFH	-0.125... 0.124939	61.352e-6	-
lambda set point deviation based on forced stimulation O2 balancing					
LV_LAMB_PLS_MST_CBK [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
auxiliary flag indicating that this bank is master bank for forced stimulation					
LV_LAMB_PLS_O2L_OSC_POS [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
auxiliary flag indicating positive lambda stimulation half wave					
LV_LAMB_PLS_SYN_CBK	O/V	0... 1H	0 ...1	1	-
flag used for exhaust gas bank synchronization					
O2L_ADD_LAMB_PLS [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-669.9236 ...669.9236	311.96e-9	g
O2 load to be added to the O2 load integral each sample step					
O2L_LAMB_PLS [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-669.9236 ...669.9236	311.96e-9	g
current O2 loading or release for forced lambda stimulation					
O2L_SP_HALF_LAMB_PLS [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.616849	39.306e-6	g
auxiliary value; half O2 loading set point of forced lambda stimulation					
O2L_SP_NEW_LAMB_PLS [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.616849	39.306e-6	g
O2 loading set point that is realized by forced lambda stimulation					
STATE_LAMB_PLS [NC_CBK_EX_NR]	O/V	0H 1H 2H	OFF AFL AFR	-	-
state of forced lambda stimulation					

Input data:

LAMB_DELTA_MAX_PLS {p. 2958}	LAMB_SP_DE_PLS {p. 2958}	LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_ST_END {p. 1720}
MAF_CYL {p. 8277}	NC_CBK_EX_NR {p. 1829}	O2L_SP_PLS {p. 2958}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_LAMB_PLS_O2L_OSC_COR	-	0... 2H	0 ...2	1	-
defines operation mode of forced stimulation: 0 - amplitude symmetric, 1 - timesync COR_AFL, 2 - timesync COR_AFR					
LC_O2L_PLS_CBK_SYN	-	0... 1H	0 ...1	1	-
0: asynchronous forced stimulation, 1: synchronous forced stimulation					

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The forced lambda stimulation generates an output signal that causes lean and rich deviations of the air fuel ratio from the lambda controller set point. By means of the stimulation parameters (set point deviation, period time and gradient) a well defined O2 load for the catalyst can be calibrated. So the catalyst efficiency can be increased.
Furthermore the forced lambda stimulation is used by diagnosis functions for the up stream lambda sensor and by the catalyst efficiency diagnosis.
The recurrence time is defined by T_SAMPLE in 20 ms.
NC_CBK_EX_NR defines the number of exhaust banks.
For vector elements, the variable extension _i is used in the model instead of [i] as found in the textual description.

Application Conditions

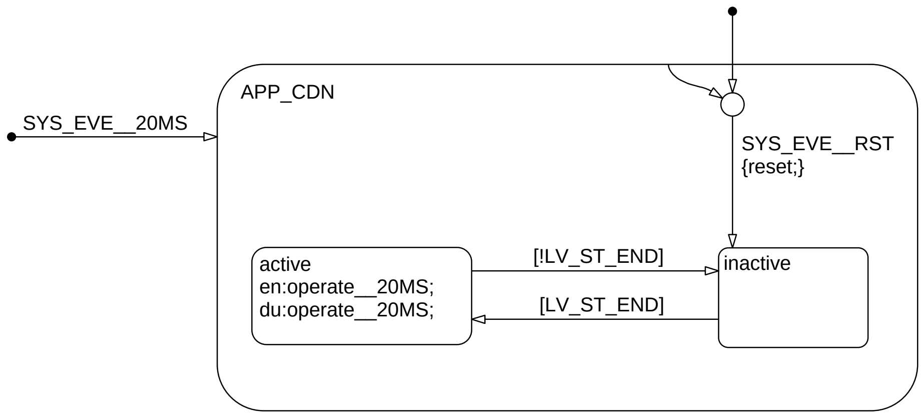

Figure 7.62.1: : Path: EGTR_DEFSPFSTI0/APP_CDN/Chart

Function description

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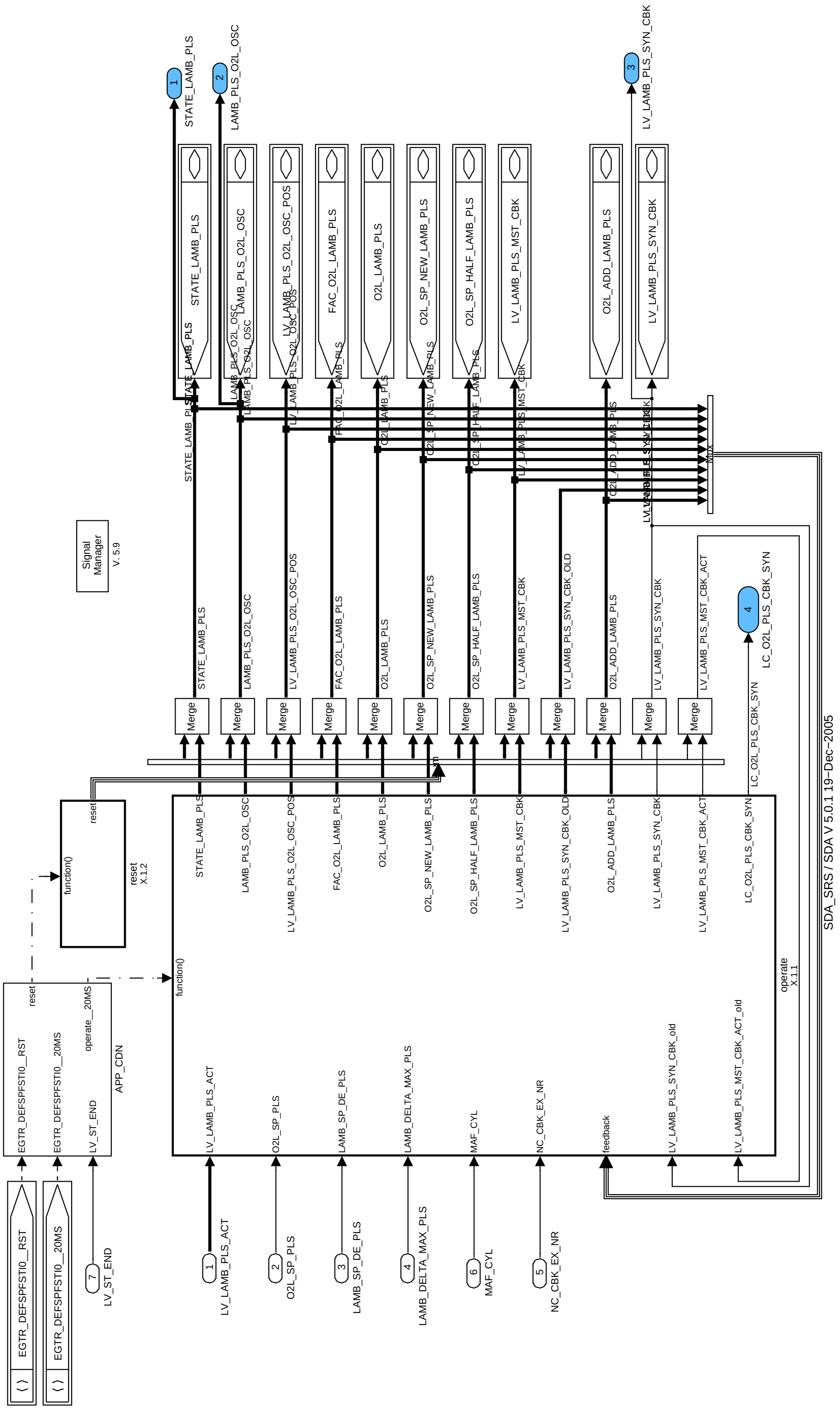

Figure 7.62.2: : Path: EGTR_DEFSPFSTI0

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7.62.1 Operate level 20ms:

This level is calculated in 20ms tasks.

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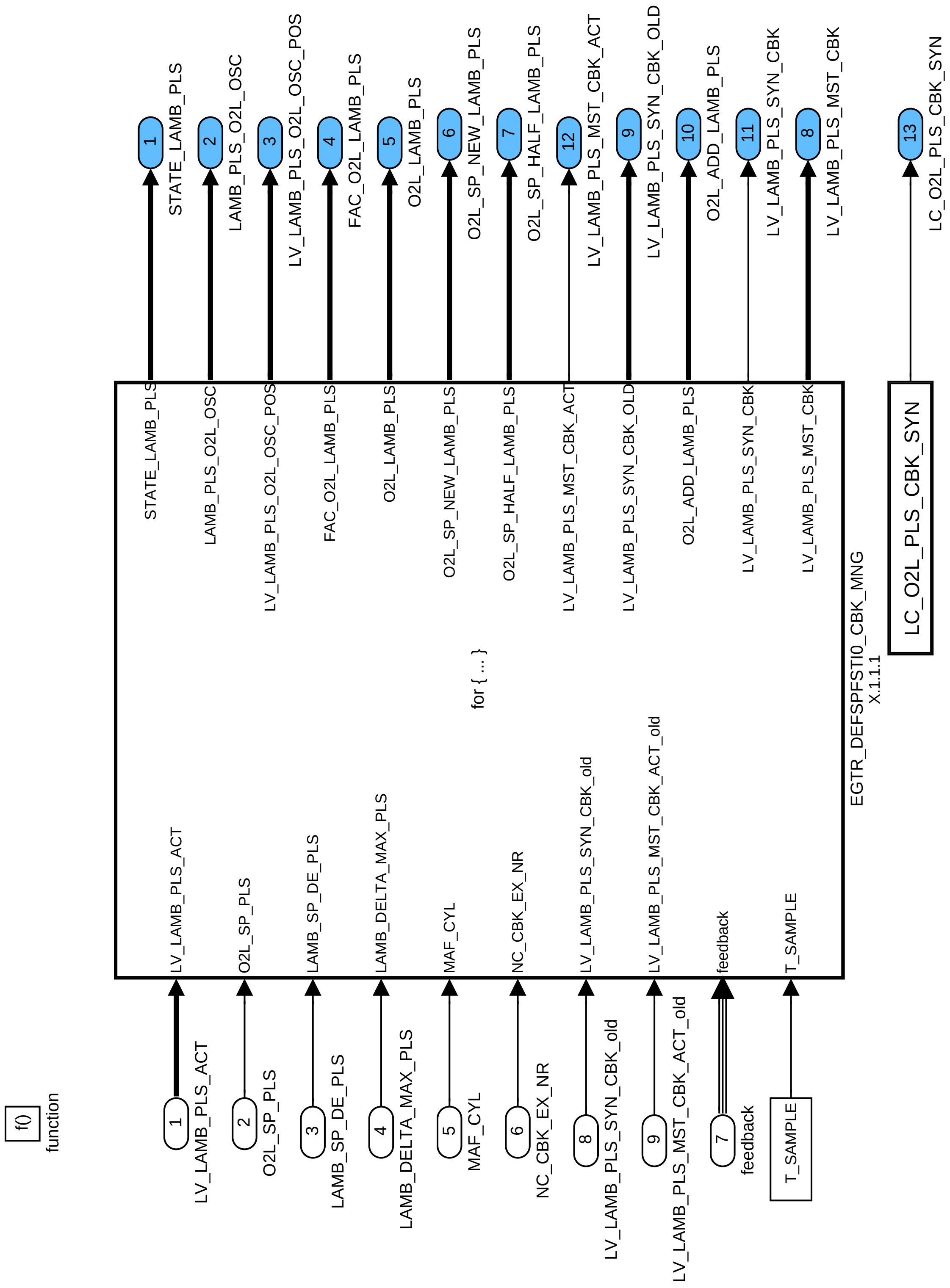

Figure 7.62.3: : Path: EGTR_DEFSPFSTI0/operate

7.62.1.1 Vectorization level for for-loop:

Here the vectors are split for the for-loop-calculation.

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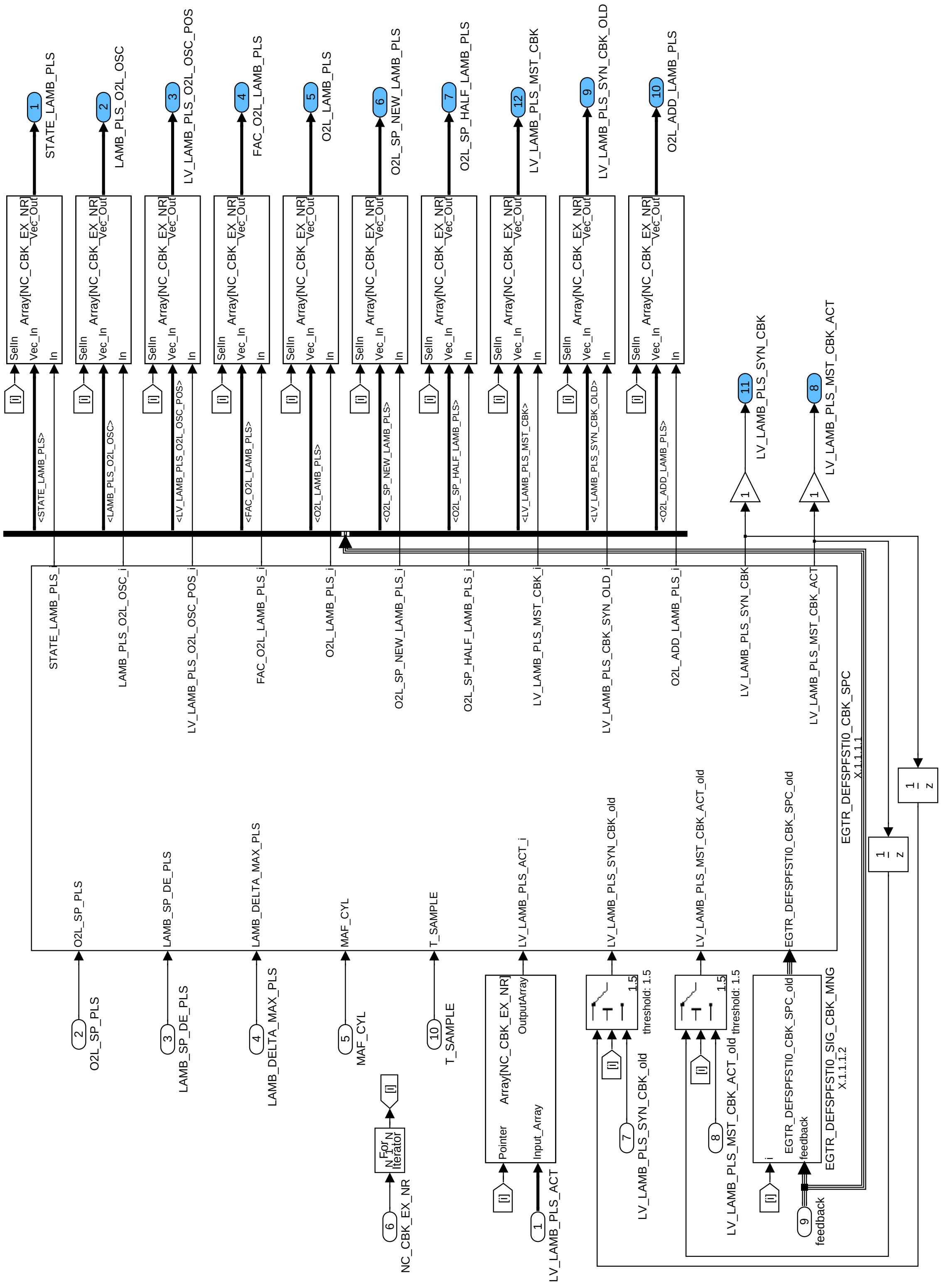

Figure 7.62.4: : Path: EGTR_DEFSPFSTI0/operate/EGTR_DEFSPFSTI0_CBK_MNG

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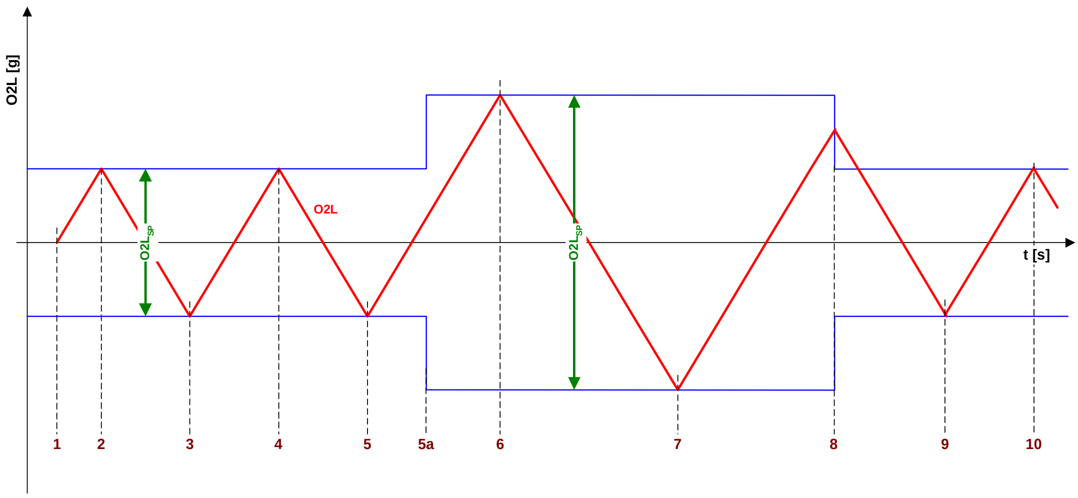
7.62.1.1.1 Execution of state machine:

In state OFF the output of the forced lambda stimulation is 0. This state is active if LV_LAMB_PLS_ACT[i] is not set.
In case of LV_LAMB_PLS_ACT[i] = 1 either state AFL or state AFR is active. In state AFL the set point deviation is increased stepwise to the calibrated set point deviation. In state AFR the set point deviation is decreased. The transition between both states depend on the O2 loading calculated in both states (CLC_O2L_LAMB_PLS). When the current O2 loading reaches the current set point (O2L_SP_NEW_LAMB_PLS[i]) then the transition to the opposite state takes place. The O2 loading is calculated with the formula:

$$m_{O_2} = 23\% \cdot \int \left(1 - \tfrac{1}{1+\Delta\lambda_{SP}}\right) \cdot \dot{m}_{air} \, dt$$

In order to realise synchronisation of both banks two flags are defined. LV_LAMB_PLS_MST_CBK_ACT is a common flag that defines whether forced stimulation is already active for one bank. Master bank is the bank that has set the flag LV_LAMB_PLS_MST_CBK_ACT; this is also indicated by the bank selective flag LV_LAMB_PLS_MST_CBK[i] which must be set to 1 for the master bank and to 0 for the slave bank.
The second flag to synchronise both banks is LV_LAMB_PLS_SYN_CBK. This flag is set by the master when the transition from state AFR to AFL occurs in order to inform the slave to execute the desired transition.



If the set point from Determination of forced lambda stimuation parameters (O2L_SP_PLS) changes the O2 loading set point that is adjusted switches for the next half wave to an intermedieate value and the next but one half wave will be the target value.
Asynchronous or synchronous operation:
The master bank changes from lean to rich or from rich to lean, if the O2 threshold O2L_SP_NEW_PLS is reached. The synchronization pulse LV_LAMB_PLS_SYN_CBK is set at the end of the rich phase.
In case of asynchronous forced stimulation (LC_O2L_PLS_CBK_SYN=0) the slave changes from lean to rich at synchronization pulse and from rich to lean, if the O2 threshold is reached.
In case of synchronous forced stimulation (LC_O2L_PLS_CBK_SYN=1) the slave changes from rich to lean at synchronization pulse and from lean to rich, if the O2 threshold is reached.
Timesynchronous operation:
Due to the formula for O2 load calculation the time duration of the lean part of the forced stimulation period is slightly longer than the rich part.

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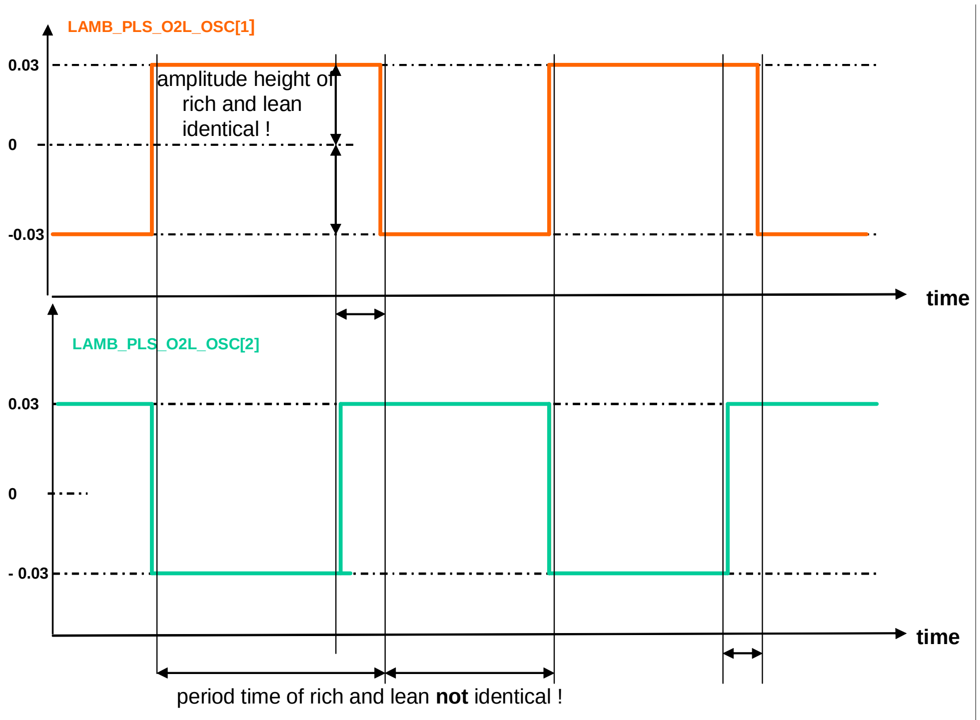
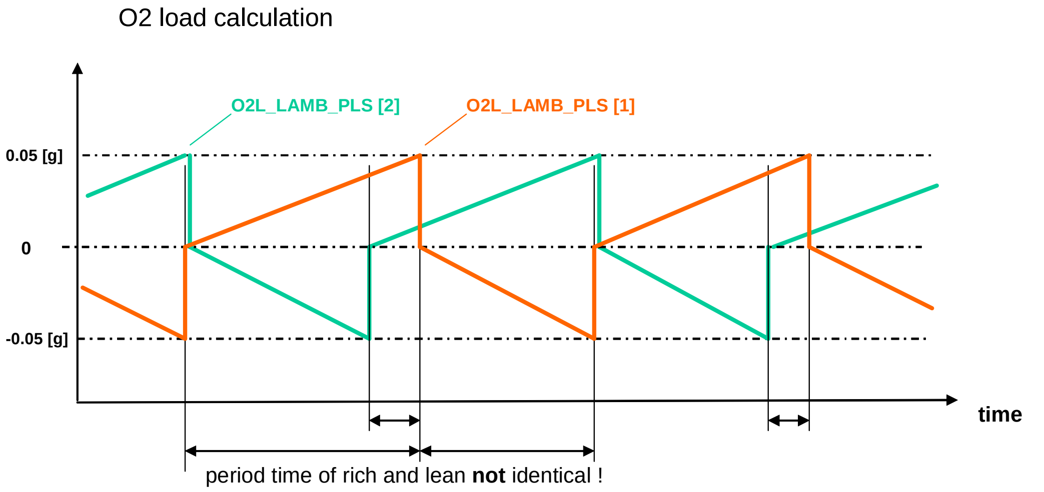
During the bankwise asynchronous operation mode (LC_O2L_PLS_CBK_SYN=0), this fact leads to small overlapping phases, where both banks are in the same STATE_LAMB_PLS = RICH or LEAN.





To prevent this behaviour and achieve a duration of the rich and lean phase of exact the same length, the amplitude of the forced stimulation LAMB_PLS_O2L_OSC can be corrected during the lean or during the rich phase (STATE_LAMB_PLS = AFL or AFR).

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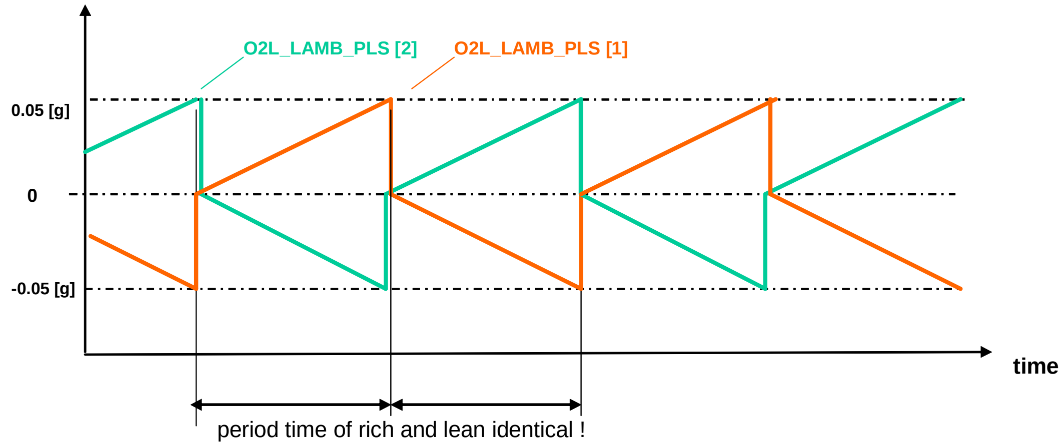
O2 load calculation



COR_AFL:
To switch on the timesynchronous operation with correction of the amplitude in STATE_LAMB_PLS=AFL set C_STATE_LAMB_PLS_O2L_OSC_COR = 1 (COR_AFL) .
As a consequence the amplitude LAMB_PLS_O2L_OSC is no more symmetric on the lean and rich side.
LAMB_PLS_O2L_OSC is limited to the calibrated value on the rich side and will be corrected to a slightly higher value on the lean side.
The correction factor on the lean side is calculated as follows:

$$m_{O_2}\_lean = -m_{O_2}\_rich$$

$$\frac{LAMB\_PLS\_O2L\_OSC(lean)}{1+LAMB\_PLS\_O2L\_OSC(lean)} = -\frac{LAMB\_PLS\_O2L\_OSC(rich)}{1+LAMB\_PLS\_O2L\_OSC(rich)}$$

$$LAMB\_PLS\_O2L\_OSC(lean) = -\frac{LAMB\_PLS\_O2L\_OSC(rich)}{1+2*LAMB\_PLS\_O2L\_OSC(rich)}$$

COR_AFR :
To switch on the timesynchronous operation with correction of the amplitude in STATE_LAMB_PLS=AFR set C_STATE_LAMB_PLS_O2L_OSC_COR = 2 (COR_AFR).
LAMB_PLS_O2L_OSC is then limited to the calibrated value on the lean side and will be corrected to a slighly lower value on the rich side.
The correction factor is on the rich side calculated as follows:

$$LAMB\_PLS\_O2L\_OSC(rich) = -\frac{LAMB\_PLS\_O2L\_OSC(lean)}{1+2*LAMB\_PLS\_O2L\_OSC(lean)}$$

COR_OFF:
If timesynchronous operation is not requested, it is possible to enable normal operation mode with symmetric amplitude hight by setting C_STATE_LAMB_PLS_O2L_OSC_COR = 0 (COR_OFF).

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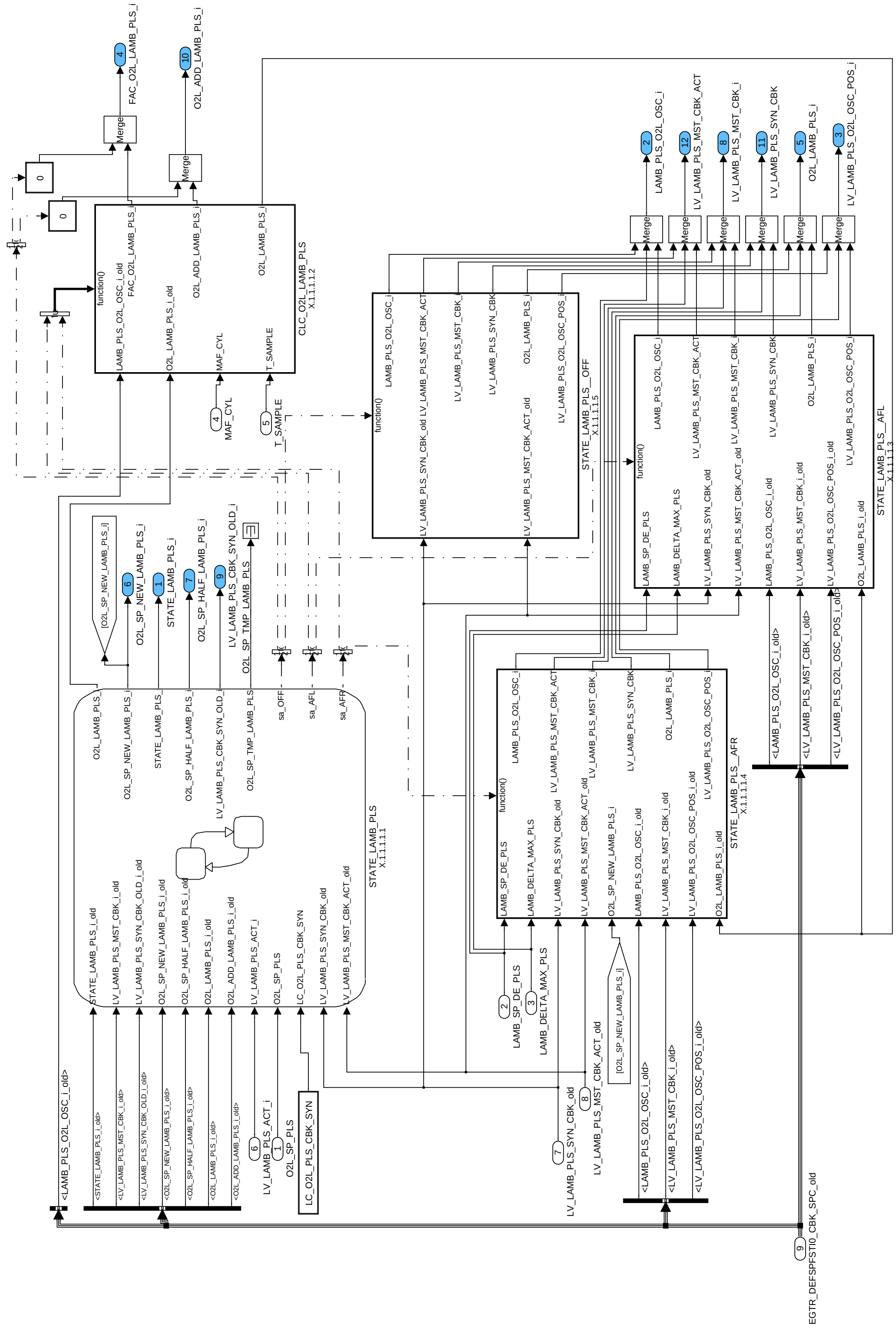

Figure 7.62.5: : Path: EGTR_DEFSPFSTI0/operate/EGTR_DEFSPFSTI0_CBK_MNG/EGTR_DEFSPFSTI0_CBK_SPC

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7.62.1.1.1.1 No title given

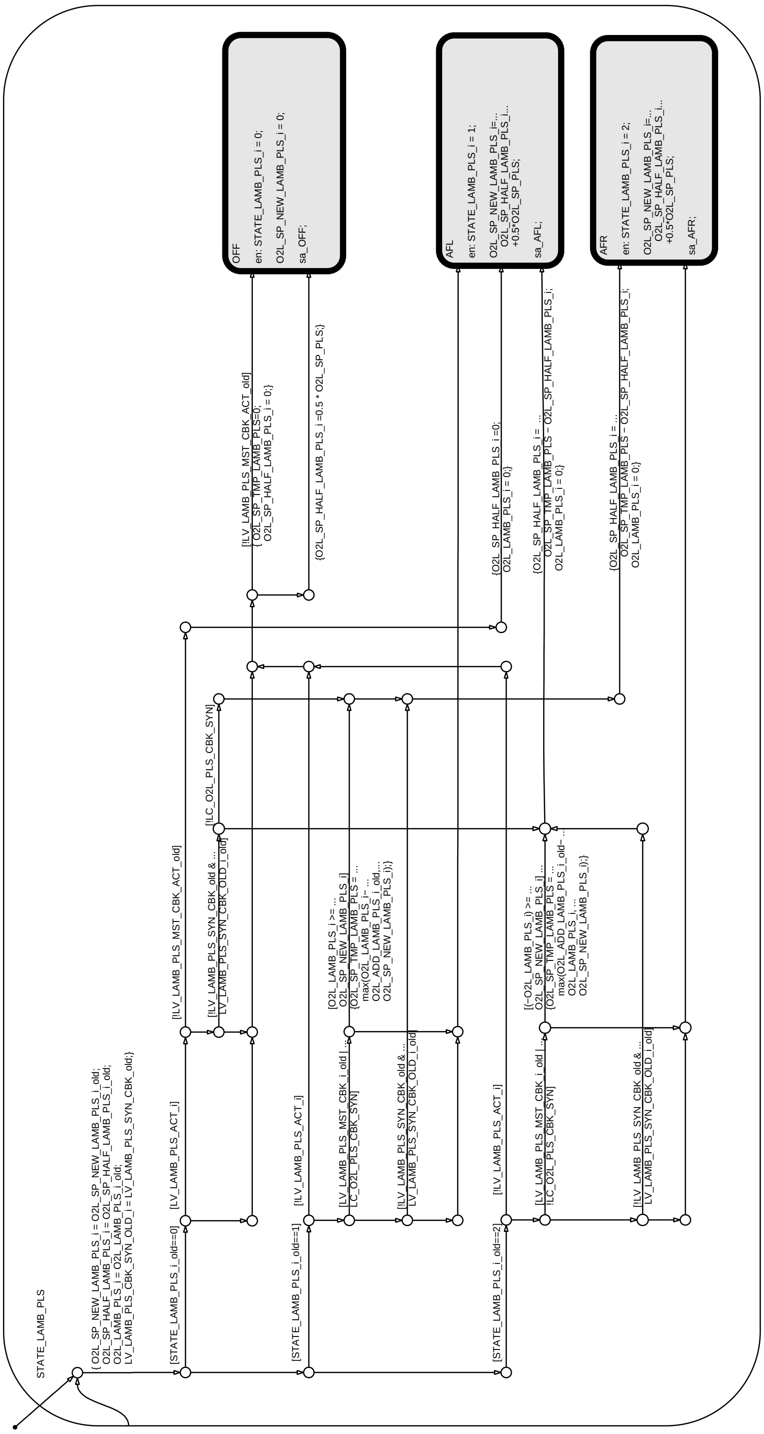

Figure 7.62.6: : Path: EGTR_DEFSPFSTI0/operate/EGTR_DEFSPFSTI0_CBK_MNG/ EGTR_DEFSPFSTI0_CBK_SPC/STATE_LAMB_PLS

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7.62.1.1.1.2 Calculation of O2 loading:

The O2 loading is calulated with the already mentioned formula. If the O2 loading that is to added each sample step is smaller than its resolution then the O2 loading is increased or decreased (depending on the sign) by the resolution value.

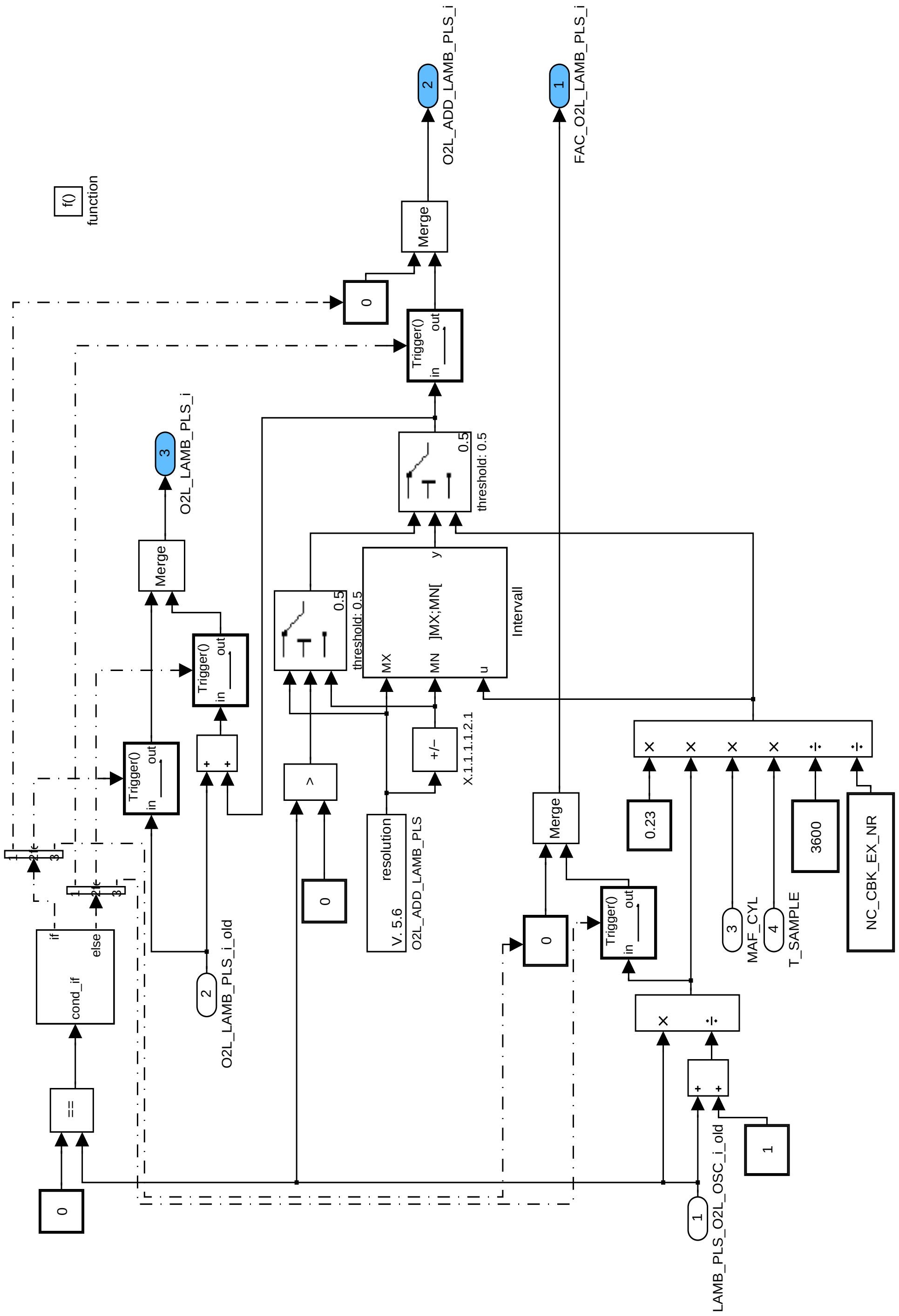

Figure 7.62.7: : Path: EGTR_DEFSPFSTI0/operate/EGTR_DEFSPFSTI0_CBK_MNG/ EGTR_DEFSPFSTI0_CBK_SPC/CLC_O2L_LAMB_PLS

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7.62.1.1.1.3 STATE "AFL":

In that state the lambda set point deviation LAMB_PLS_O2L_OSC[i] is increased step wise by LAMB_DELTA_MAX_PLS and limited to LAMB_SP_DE_PLS.
If timesynchronous operation mode is activated with C_STATE_LAMB_PLS_O2L_OSC_COR = 1, the lambda set point deviation is not symmetric. The rich half wave is limited to LAMB_SP_DE_PLS, but the lean half wave is corrected to a slightly higher value.
If the LAMB_PLS_O2L_OSC[i] becomes positive (indicated by rising edge of LV_LAMB_PLS_O2L_POS[i]) the sign of the current O2 loading changes in order adjust the right O2 loading (given by the set point).

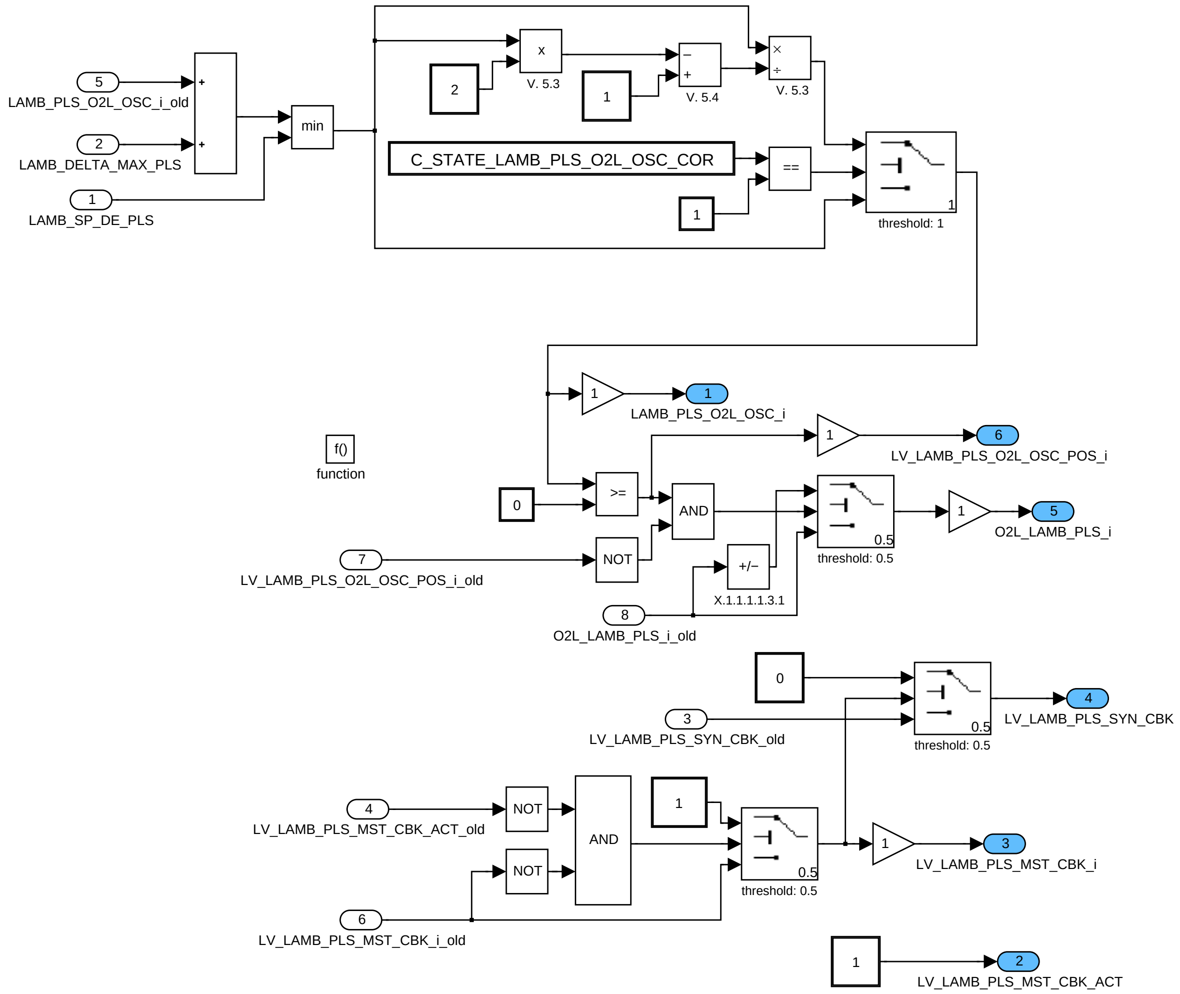

Figure 7.62.8: : Path: EGTR_DEFSPFSTI0/operate/EGTR_DEFSPFSTI0_CBK_MNG/EGTR_DEFSPFSTI0_CBK_SPC/STATE_LAMB_PLS__AFL

7.62.1.1.1.4 STATE "AFR":

In that state the lambda set point deviation LAMB_PLS_O2L_OSC[i] is decreased step wise by LAMB_DELTA_MAX_PLS and limited to minus LAMB_SP_DE_PLS.
If timesynchronous operation mode is activated with C_STATE_LAMB_PLS_O2L_OSC_COR = 2, the lambda set point deviation is not symmetric. The lean half wave is limited to LAMB_SP_DE_PLS, but the rich half wave is corrected to a slightly lower value.
If the LAMB_PLS_O2L_OSC[i] becomes negative (indicated by falling edge of LV_LAMB_PLS_O2L_POS[i]) the sign of the current O2 loading changes as in state AFL .

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When the O2 loading set point is reached the master bank sets the synchronization flag.

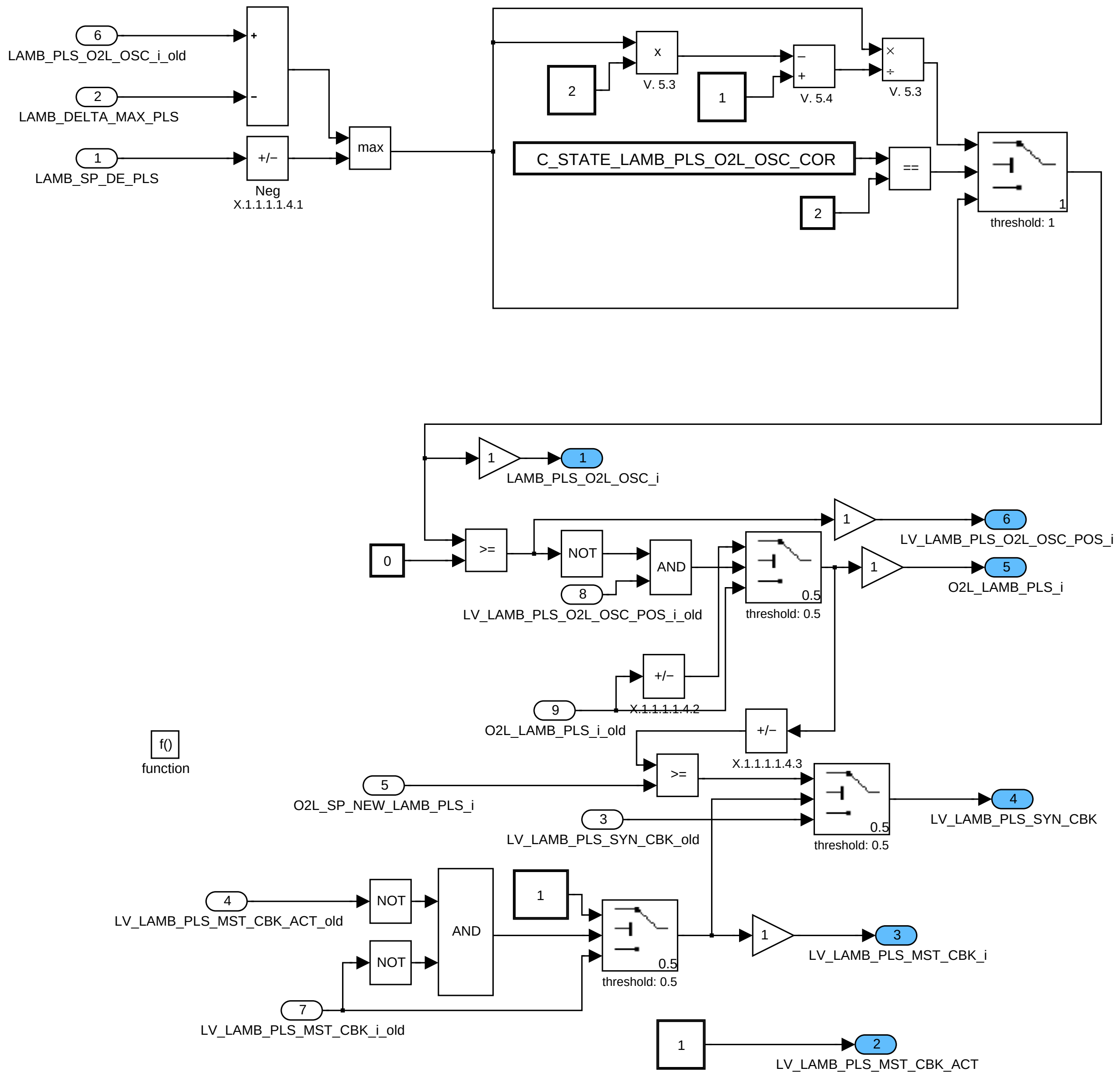

Figure 7.62.9: :   Path: EGTR_DEFSPFSTI0/operate/EGTR_DEFSPFSTI0_CBK_MNG/ EGTR_DEFSPFSTI0_CBK_SPC/STATE_LAMB_PLS__AFR

7.62.1.1.1.5 STATE "OFF":

In that state all flags and the current O2 loading are set to 0.

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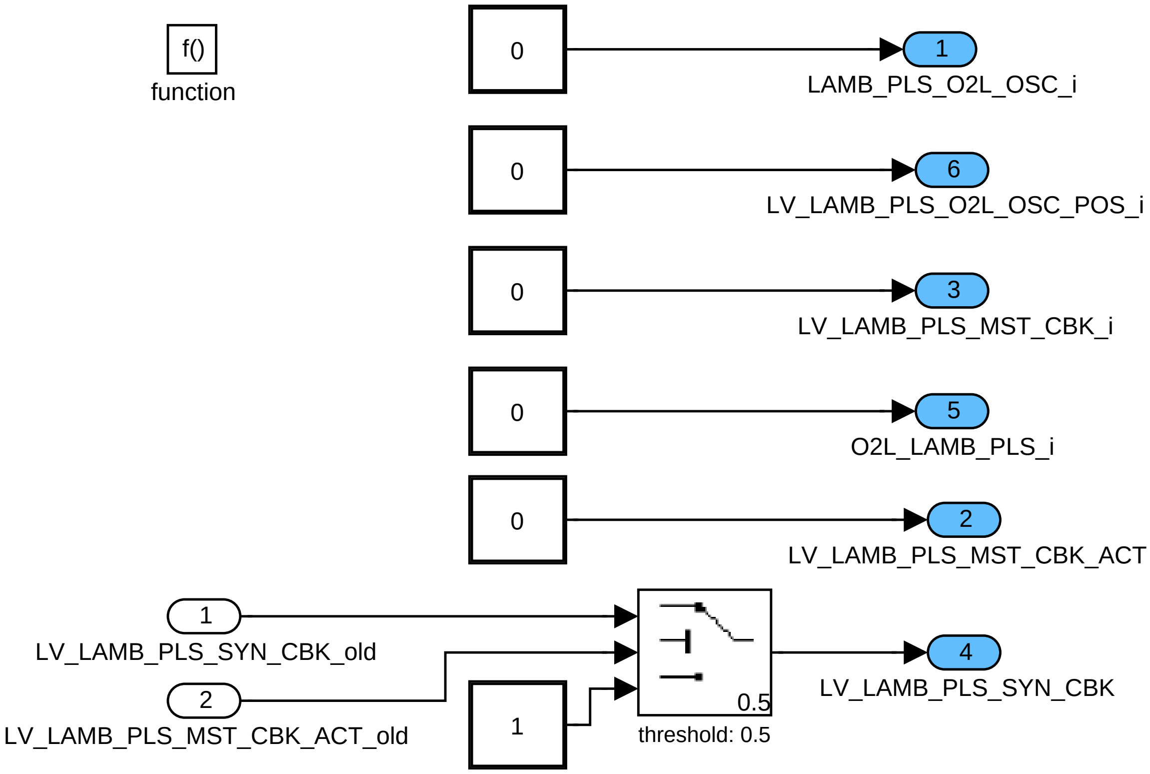

Figure 7.62.10: : Path: EGTR_DEFSPFSTI0/operate/EGTR_DEFSPFSTI0_CBK_MNG/
EGTR_DEFSPFSTI0_CBK_SPC/STATE_LAMB_PLS__OFF

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7.62.1.1.2 For-loop signal manager:

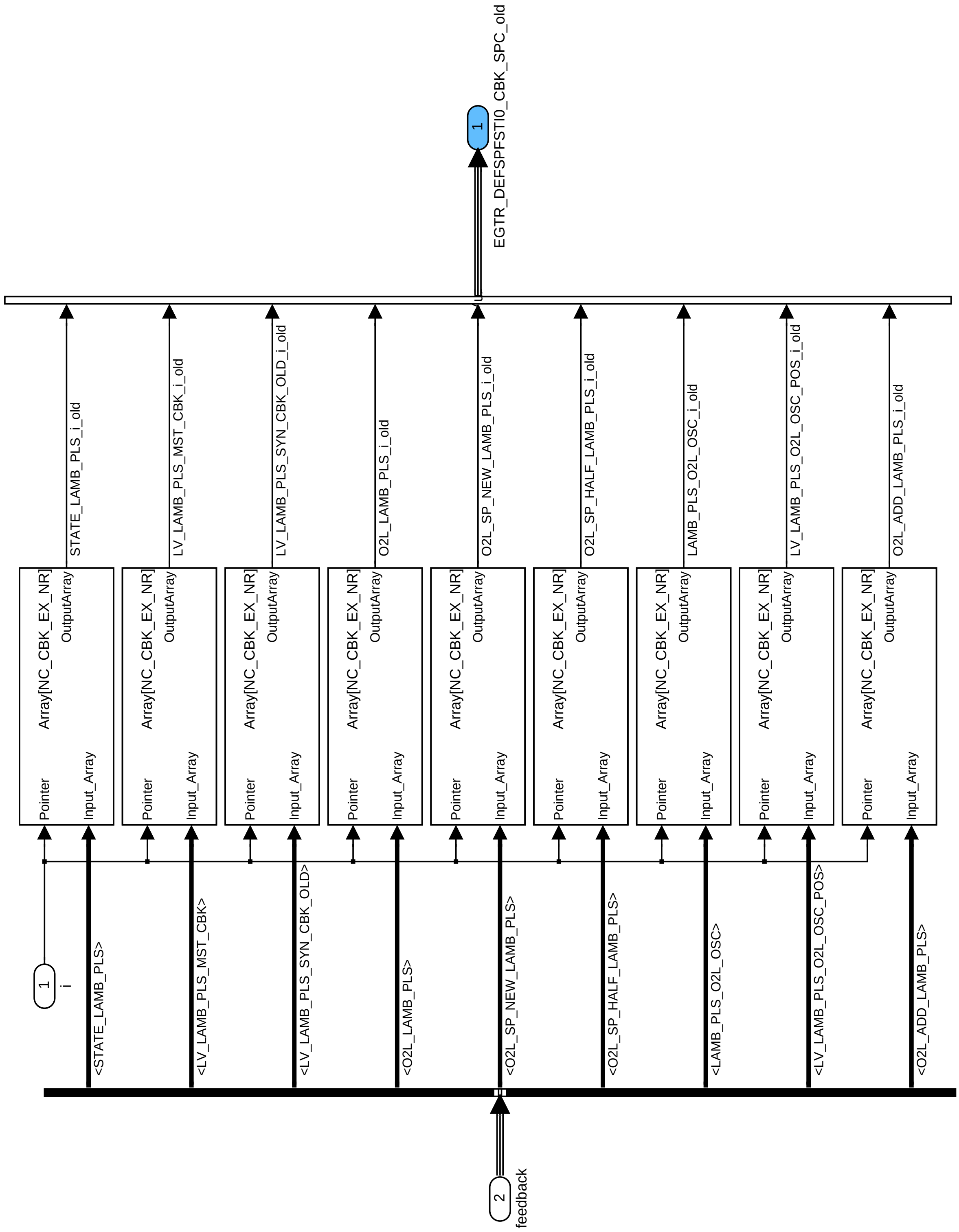

Figure 7.62.11: : Path: EGTR_DEFSPFSTI0/operate/EGTR_DEFSPFSTI0_CBK_MNG/ EGTR_DEFSPFSTI0_SIG_CBK_MNG

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7.62.2 Initialization:

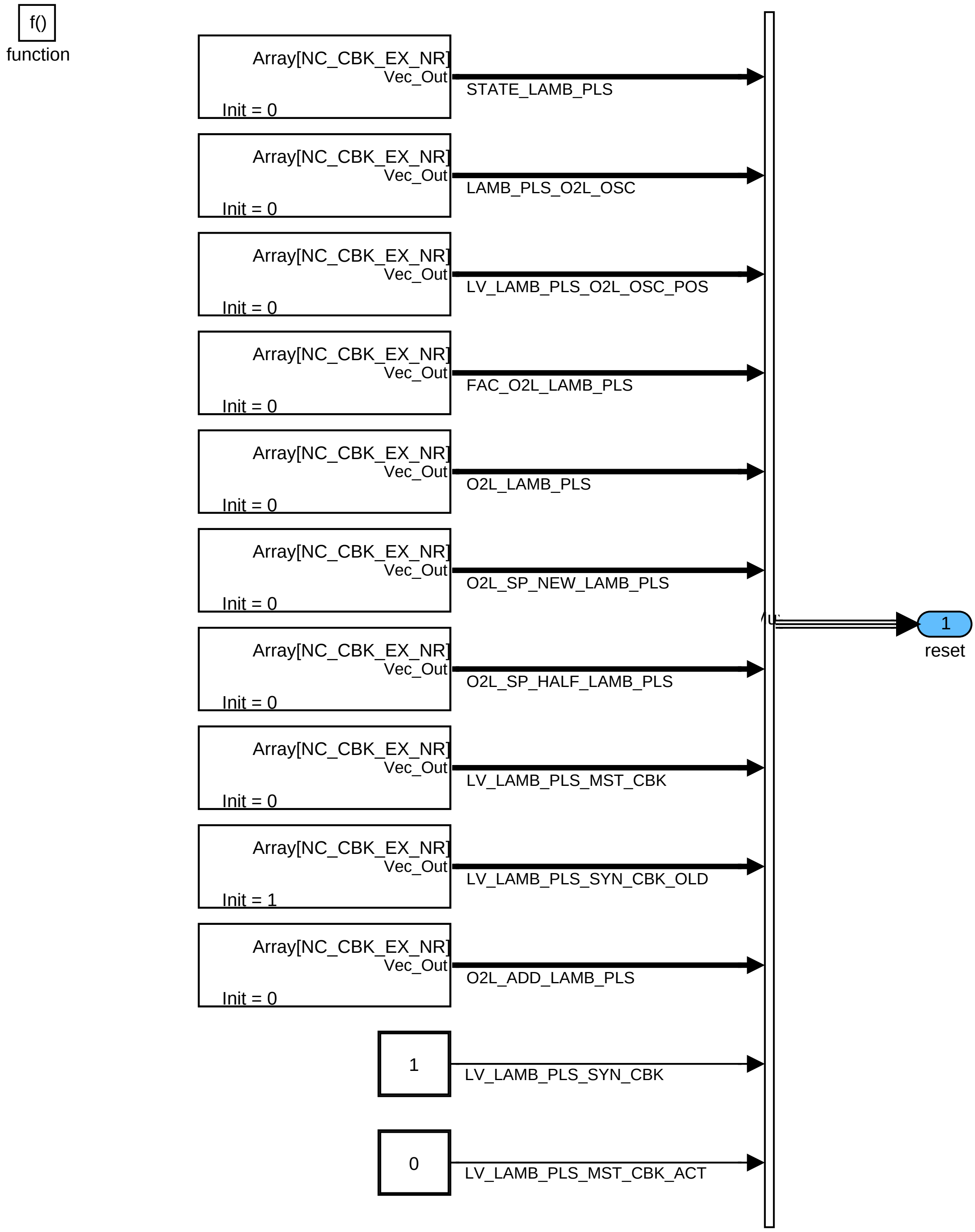

Figure 7.62.12: : Path: EGTR_DEFSPFSTI0/reset

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7.63 Forced lambda stimulation (linear control) (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_DELTA_MAX_PLS_EXT	O/V	0... FFFH	0... 0.249939	61.0352e-6	-
lambda set point deviation step height per sample step during external mode					
LAMB_PLS_EXT [NC_CBK_EX_NR]	O/V	F800... 7FFH	-0.125... 0.12493896484	61.0352e-6	-
lambda set point deviation from external source					
LAMB_SP_DE_PLS_EXT	O/V	0... 7FFH	0... 0.12493896484	61.0352e-6	-
amplitude of the forced lambda stimulation during external mode					
LV_INH_LAMB_PLS [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
inhibition flag for forced lambda stimulation					
LV_LAMB_PLS_LS_DIAG	O/V	0... 1H	0 ...1	1	-
active forced lambda stimulation for WRAF sensor diagnosis					
LV_LAMB_PLS_REQ_EXT	O/V	0... 1H	0 ...1	1	-
active forced lambda stimulation for external mode					
O2L_SP_PLS_EXT	O/V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
oxygen loading set point for forced lambda stimulation during external mode					

Input data:

LAMB_PLS_EXT_CUS [NC_CBK_EX_NR] {p. 8199}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_LAMB_STI_OFF_LSL_OFS_ADJ [NC_CBK_EX_NR] {p. 2313}	LV_ST_END {p. 1720}
MAF_HB {p. 805}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	STATE_LAMB_PLS_DET_VALUE {p. 2958}
STATE_LAMB_PLS_REQ_LS_DIAG {p. 5349}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_DELTA_MAX_DLY_DIAG_PLS	-	0... FFFH	0... 0.249939	61.0352e-6	-
lambda set point deviation step height per sample step for forced stimulation during active WRAF sensor delay diagnosis					
C_LAMB_DELTA_MAX_DYN_DIAG_PLS	-	0... FFFH	0... 0.249939	61.0352e-6	-
lambda set point deviation step height per sample step for forced stimulation during active WRAF sensor dynamic diagnosis					
C_LAMB_SP_DE_DLY_DIAG_PLS	-	0... 7FFH	0... 0.12493896484	61.0352e-6	-
amplitude of the forced lambda stimulation in case of active WRAF sensor delay diagnosis					
C_LAMB_SP_DE_DYN_DIAG_PLS	-	0... 7FFH	0... 0.12493896484	61.0352e-6	-
amplitude of the forced lambda stimulation in case of active WRAF sensor dynamic diagnosis					
IP_O2L_SP_DLY_DIAG_PLS	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
oxygen loading set point for forced lambda stimulation in case of active delay WRAF sensor diagnosis					
IP_O2L_SP_DYN_DIAG_PLS	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
oxygen loading set point for forced lambda stimulation in case of active dynamic WRAF sensor diagnosis					
LC_LAMB_PLS_INH [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
calibration flag to force lambda stimulation to be inhibited					
LC_LAMB_PLS_INH_DYN_LS_UP	-	0... 1H	0 ...1	1	-
calibration flag to forced lambda stimulation to be inhibited at active WRAF sensor dynamic or delay error					
LC_LAMB_STI_OFF_LSL_OFS_ADJ	-	0... 1H	0 ...1	1	-
calibration flag to allow inhibition of lambda stimulation during offset adjustment					

General Information

NC_CBK_EX_NR defines the number of exhaust banks.
For vector elements, the variable extension _i is used in the model instead of [i] as found in the textual description.

Application Conditions

Initialization: RST
Recurrence: 20MS
Activation: LV_ST_END==1
Deactivation: LV_ST_END==0

Function description

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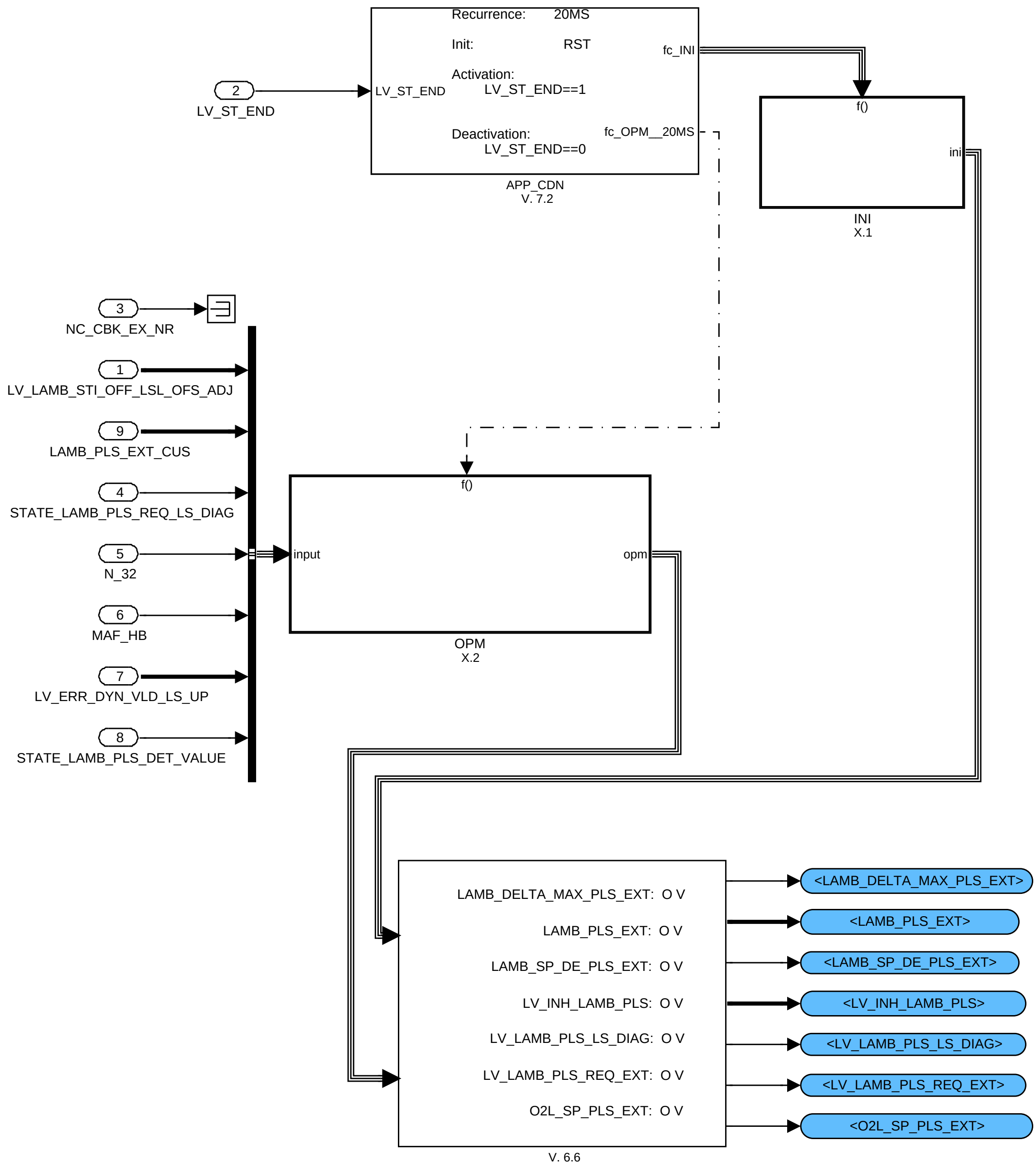

SDA_SRS / SDA V 5.3.2 / 09−Sep−2008

Figure 7.63.1: :

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7.63.1 Initialisation

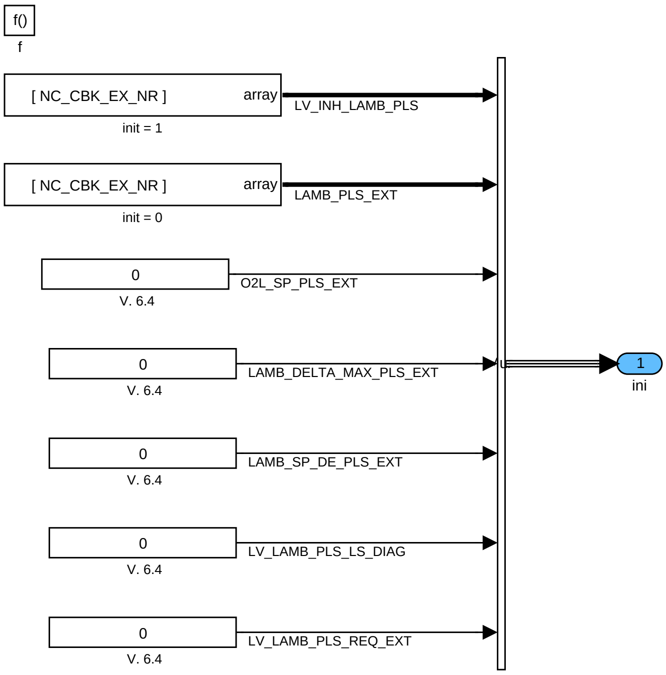

Figure 7.63.2: :

7.63.2 Operate

During WRAF sensor controller offset adjustment the forced lambda stimulation is switched off if the respective calibration flag allows this.
Furthermore the general calibration flag LC_LAMB_PLS_INH[i] inhibits the function if set.

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7.63.2.1 Set inhibition of forced lambda stimulation

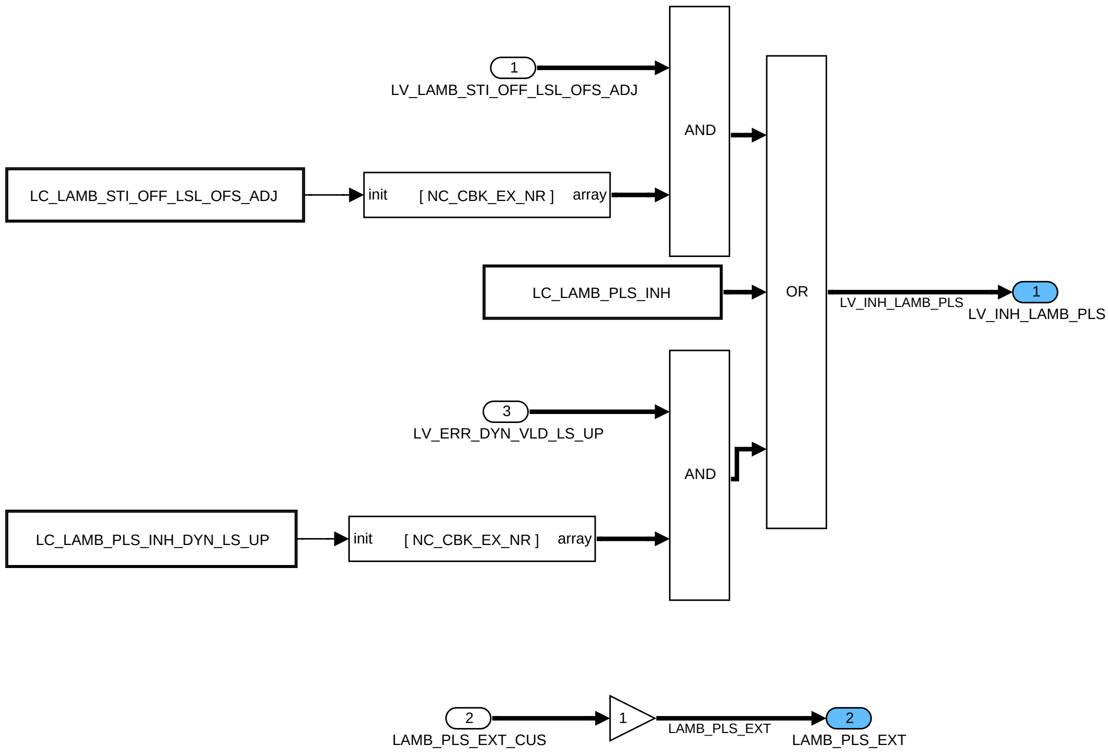

Figure 7.63.3: :

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7.63.2.2 Set forced lambda stimulation parameters for external mode

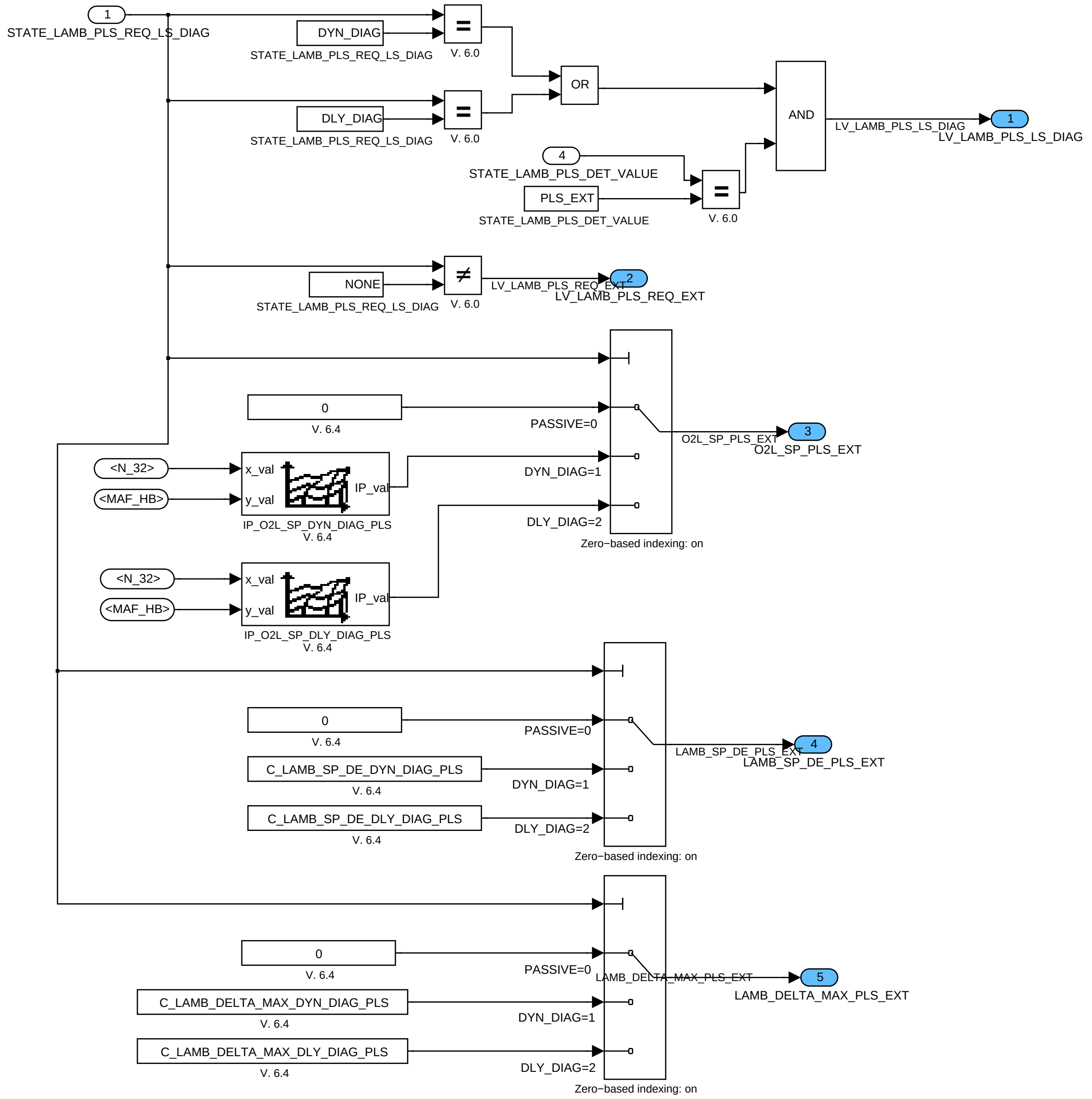

Figure 7.63.4: :

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7.64 Mean value calculation for limited dynamics

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_MV_DELTA_LDC [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.9984741	0.00152588	%
difference between FAC_LAM_MV[i] and moving mean value of FAC_LAM_MV[i] for limited dynamics detection					
FAC_TQ_REQ_DELTA_LDC	O/V	8000... 7FFFH	-1... 0.99996948	30.5175e-6	-
difference between torque scaling factor and moving mean value thereof for limited dynamics calculation					
FAC_TQ_REQ_MMV_LDC	V	0... FFFFH	0... 1.99996948	30.5175e-6	-
moving mean value of torque scaling factor for limited dynamics detection					
MAF_DELTA_LDC	O/V	8000... 7FFFH	-694.510597 ...694.489403	0.02119478	mg/stk
difference between MAF and moving mean value of MAF for limited dynamics detection					
MAF_MMV_LDC	V	0... FFFFH	0... 1389	0.02119478	mg/stk
moving mean value of MAF for limited dynamics detection					
N_DELTA_LDC	O/V	E020... 1FE0H	-8160 ...8160	1	rpm
difference between N and moving mean value of N for limited dynamics detection					
N_MMV_LDC	V	0... 1FE0H	0... 8160	1	rpm
moving mean value of N for limited dynamics detection					

Input data:

FAC_LAM_MV {p. 1014}	FAC_LAM_MV_MMV_LDC [NC_CBK_EX_NR] {p. 2462}	FAC_TQ_REQ {p. 6706}	LV_ST_END {p. 1720}
MAF {p. 8277}	N {p. 1525}	NC_CBK_EX_NR {p. 1829}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_TQ_REQ_MMV_LDC	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
correlation constant for moving mean value calculation of torque scaling factor for limited dynamics					
C_CRLC_MAF_MMV_LDC	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
correlation constant for moving mean value calculation of MAF for limited dynamics					
C_CRLC_N_MMV_LDC	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
correlation constant for moving mean value calculation of N for limited dynamics					

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7.64.1 LACO_ISPCLMVLDC0

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

NC_CBK_EX_NR defines the number of exhaust banks.
For vector elements the variable extension "_i" is used in the model instead of "[i]" as found in the textual description.

Application Condition

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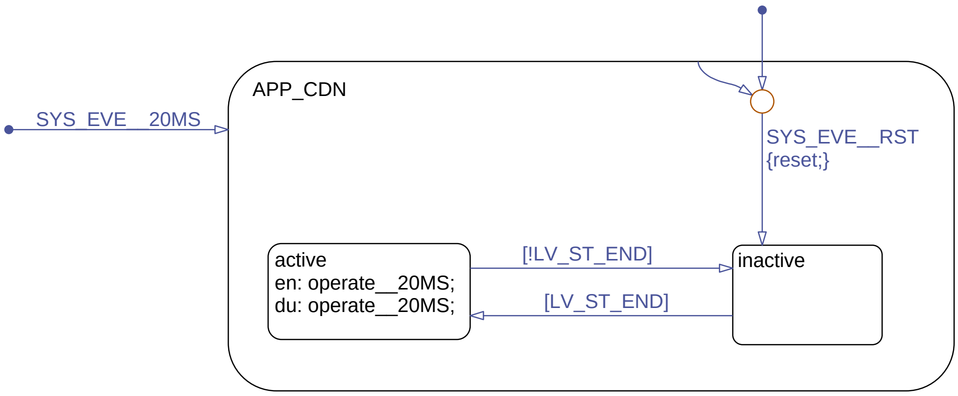

Figure 7.64.1: LACO_ISPCLMVLDC0/APP_CDN/Chart

Function Description

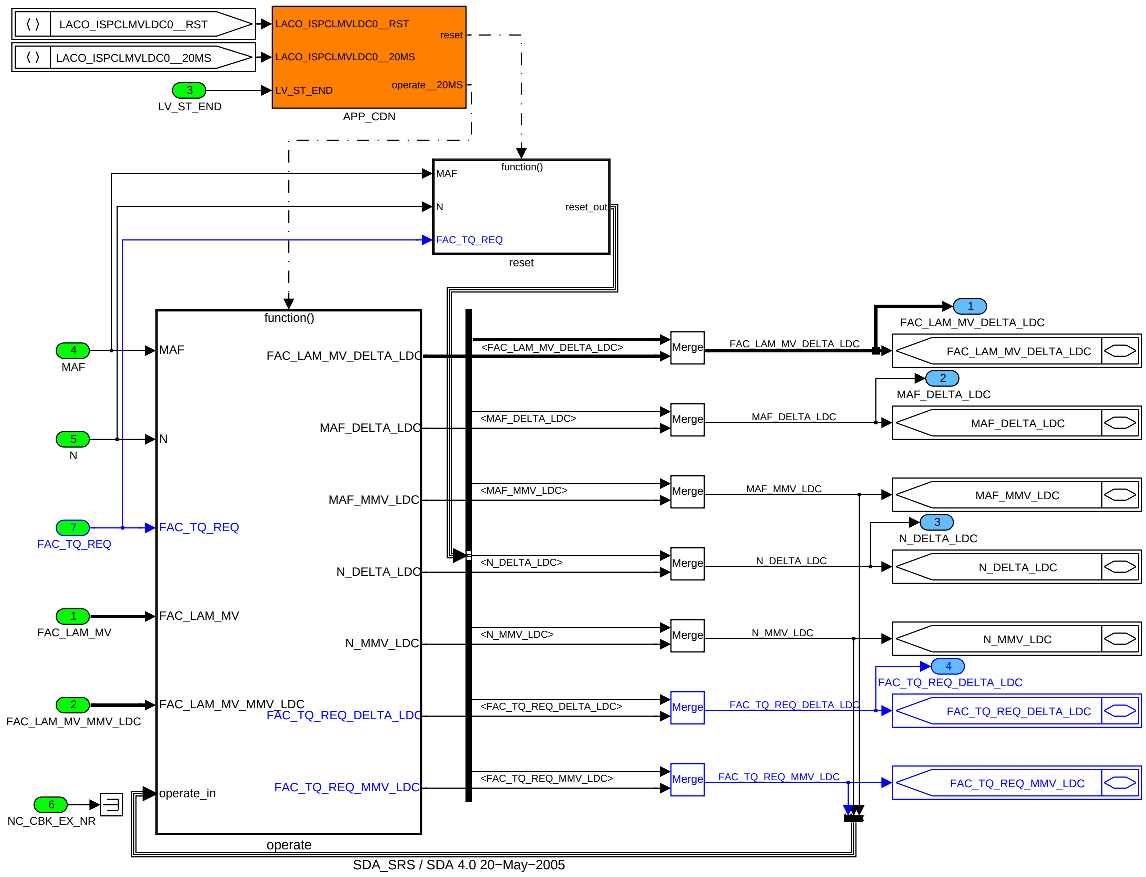

Figure 7.64.2: LACO_ISPCLMVLDC0

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7.64.1.1 SUBFUNCTION: reset

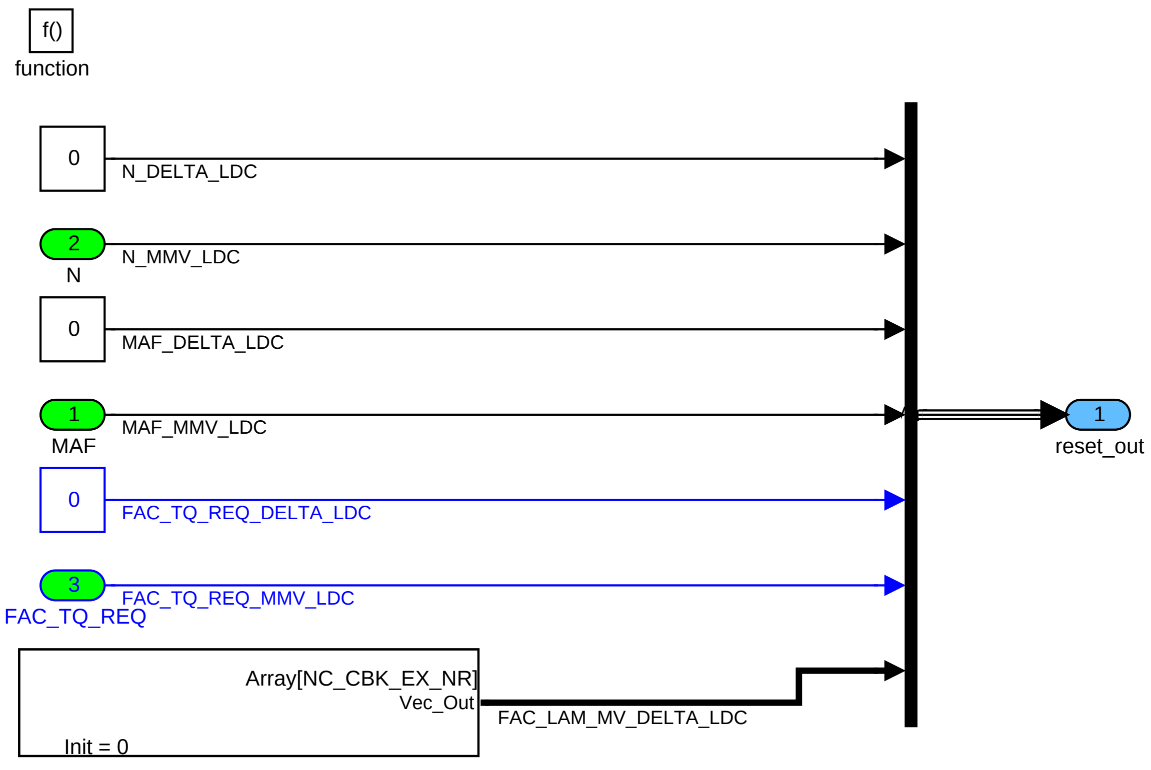

Figure 7.64.3: LACO_ISPCLMVLDC0/reset

7.64.1.2 operate

This function calculates for the detection of the limited dynamics the moving mean values of engine speed (N and N_MMV_LDC), air mass flow (MAF and MAF_MMV_LDC) and degree of activation of the accelerator pedal (PV and PV_AV_MMV_LDC). Furthermore the difference between these input values and the moving mean values is calculated.

For the lambda control output only the difference is evaluated because the moving mean value calculation is located in the lambda control module itself because of easier realisation of shift operations of the moving mean value (FAC_LAM_MV_MMV_LDC[i]).

Remark: The difference calculation of lambda control output is a vector operation.

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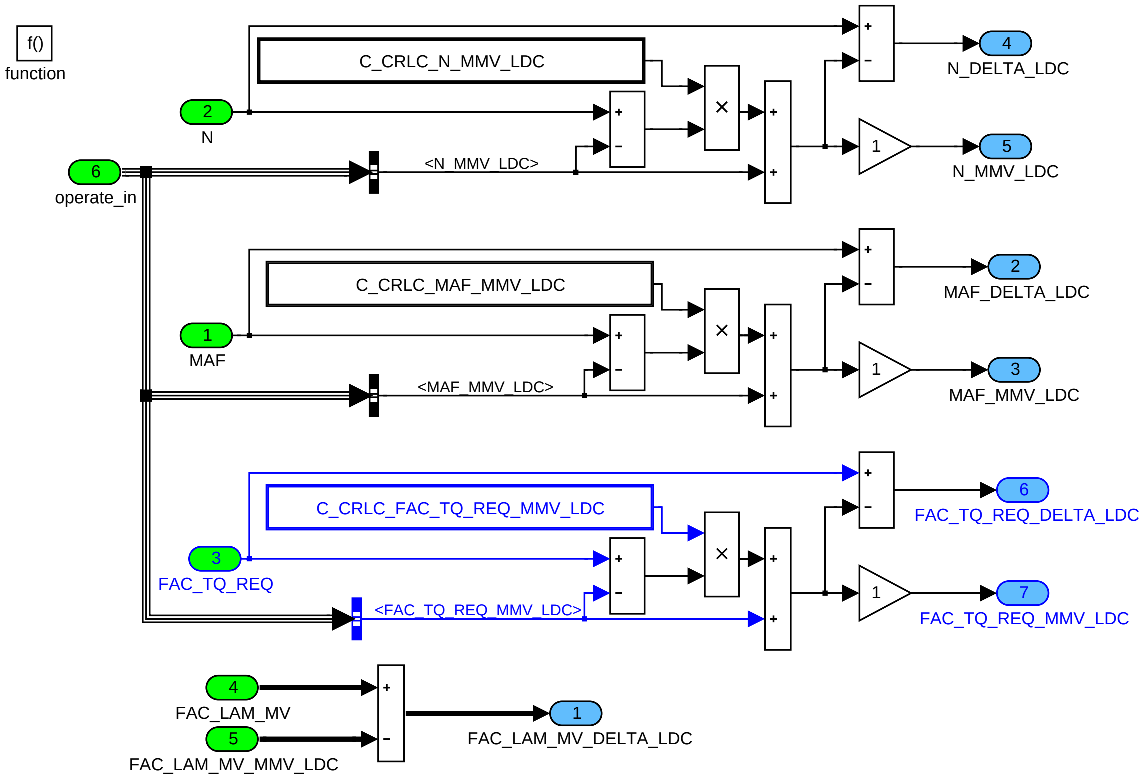

Figure 7.64.4: LACO_ISPCLMVLDC0/operate

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7.65 Dynamic fuel trim

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_DELTA_D_LAM_ADJ [NC_CBK_EX_NR]	V	F800... 800H	-0.125 ...0.125	61.0352e-6	-
D share from trim control					
LAMB_DELTA_I_LAM_ADJ [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61.0352e-6	-
I share from trim control					
LAMB_DELTA_I_MMV_LAM_ADJ [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-0.125... 0.1249961853	3.8147e-6	-
I share moving mean value from trim control					
LAMB_DELTA_I_SAVE_LAM_ADJ_H [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-0.125... 0.12499999994	58.208e-12	-
saved I share with high resolution from trim control					
LAMB_DELTA_LAM_ADJ [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61.0352e-6	-
total output (P share + I share) from trim control					
LAMB_DELTA_P_LAM_ADJ [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61.0352e-6	-
P share of from trim control					
LV_LAM_ADJ_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation flag of dynamic fuel trim					
LV_LAM_ADJ_AD_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that trim control I share shift was executed					
LV_LAM_ADJ_D_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation flag for calculation of trim controller D share					
LV_LAM_ADJ_I_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation flag for calculation of trim controller I share					
LV_LAM_ADJ_P_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation flag for calculation of trim controller P share					
MAF_INT_LAM_ADJ_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral for trim control activation					
MAF_INT_MIN_LAM_ADJ_D_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0 ...1	0.0222222	g
minimum air mass flow integral for trim control D share activation					
MAF_INT_MIN_LAM_ADJ_I_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0 ...1	0.0222222	g
minimum air mass flow integral for trim control I share activation					
MAF_INT_MIN_LAM_ADJ_P_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0 ...1	0.0222222	g
minimum air mass flow integral for trim control P share activation					
STATE_FAC_GAIN_TRIM_PID_EXT [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Status for the condition under which the external lambda control gain factors are determined					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VLS_DIF_DELTA_LAM_ADJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-5... 4.99984741211	152.588e-6	V
difference between downstream LS signal and moving mean value					
VLS_DIF_LAM_ADJ [NC_CBK_EX_NR]	O/V	FC00... 3FFH	-5... 4.9951171875	4.88281e-3	V
difference between set point and actual downstream LS signal					
VLS_DIF_MMV_LAM_ADJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-5... 4.99984741211	152.588e-6	V
moving mean value of difference between set point and actual downstream LS signal					
VLS_SP_LAM_ADJ [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
trim control set point					

Input data:

EFF_CAT_DIAG [NC_CBK_EX_NR] {p. 5535}	LAMB_DELTA_DIF_I_LAM_ADJ_AD [NC_CBK_EX_NR] {p. 2622}	LAMB_SP_HOM [NC_CBK_EX_NR] {p. 8340}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}
LV_ER_BAL_HOM_CDN {p. 800}	LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR] {p. 2463}	LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR] {p. 2463}	LV_INH_LAM_ADJ [NC_CBK_EX_NR] {p. 2613}
LV_LAM_ADJ_ACT_FAST_LAM_LSCL [NC_CBK_EX_NR] {p. 2613}	LV_LAM_ADJ_AD_REQ [NC_CBK_EX_NR] {p. 2622}	LV_LAM_ADJ_CAT_DIAG [NC_CBK_EX_NR] {p. 5473}	LV_LAM_ADJ_REQ_DYN_LSL_UP [NC_CBK_EX_NR] {p. 5348}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_LAM_STOP_SHO_PER [NC_CBK_EX_NR] {p. 2448}	LV_LAMB_DELTA_I_LAM_ADJ_DEAC [NC_CBK_EX_NR] {p. 2613}
LV_LAMB_OHP [NC_CBK_EX_NR] {p. 1016}	LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_LDC_LAM_ADJ [NC_CBK_EX_NR] {p. 2613}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}
LV_ST_END {p. 1720}	MAF_CYL {p. 8277}	MAF_HB {p. 805}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	STATE_LAM_GAIN_REQ_LS_DIAG {p. 5349}	T_AST {p. 1766}	TCO {p. 1100}
TEMP_CAT {p. 8237}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	VLS_AV_LAM_ADJ [NC_CBK_EX_NR] {p. 2613}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LAMB_DELTA_I_MMV_LAM_ADJ	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
correlation constant for trim control I share moving mean value calculation for adaptation value					
C_EFF_CAT_DIAG_MAX_LAM_ADJ_ACT	-	0... FFH	0... 1.9921875	7.8125e-3	-
catalyst diagnosis value threshold for trim control activation					
C_LAMB_DELTA_I_MAX_LAM_ADJ	-	F800... 800H	-0.125 ...0.125	61.0352e-6	-
upper limit of trim control I share					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_DELTA_I_MIN_LAM_ADJ	-	F800... 800H	-0.125 ...0.125	61.0352e-6	-
bottom limit of trim control I share					
C_LAMB_SP_MAX_LAM_ADJ_ACT	-	0... 7FFFH	0... 1.99993896484	61.0352e-6	-
maximum lambda set point for trim control activation					
C_LAMB_SP_MIN_LAM_ADJ_ACT	-	0... 7FFFH	0... 1.99993896484	61.0352e-6	-
minimum lambda set point for trim control activation					
C_MAF_INT_LAM_ADJ_D_ACT_FAST [NC_CBK_EX_NR]	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for fast trim control D share reactivation					
C_MAF_INT_LAM_ADJ_D_ACT_PURGE [NC_CBK_EX_NR]	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for trim control D share reactivation after cat purge					
C_MAF_INT_LAM_ADJ_D_ACT_SLOW	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for slow trim control D share reactivation					
C_MAF_INT_LAM_ADJ_I_ACT_FAST [NC_CBK_EX_NR]	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for fast trim control I share reactivation					
C_MAF_INT_LAM_ADJ_I_ACT_PURGE [NC_CBK_EX_NR]	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for trim control I share reactivation after cat purge					
C_MAF_INT_LAM_ADJ_I_ACT_SLOW	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for slow trim control I share reactivation					
C_MAF_INT_LAM_ADJ_P_ACT_FAST [NC_CBK_EX_NR]	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for fast trim control P share reactivation					
C_MAF_INT_LAM_ADJ_P_ACT_PURGE [NC_CBK_EX_NR]	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for trim control P share reactivation after cat purge					
C_MAF_INT_LAM_ADJ_P_ACT_SLOW	-	0... FFFFH	0 ...1	0.0222222	g
air mass flow integral threshold for slow trim control P share reactivation					
C_MAF_MAX_LAM_ADJ_D_ACT	-	0... FFH	0... 1389	5.4470588	mg/stk
maximum air mass flow threshold for trim control D share calculation					
C_MAF_MAX_LAM_ADJ_P_ACT	-	0... FFH	0... 1389	5.4470588	mg/stk
maximum air mass flow threshold for trim control P share calculation					
C_MAF_MIN_LAM_ADJ_D_ACT	-	0... FFH	0... 1389	5.4470588	mg/stk
minimum air mass flow threshold for trim control D share calculation					
C_MAF_MIN_LAM_ADJ_P_ACT	-	0... FFH	0... 1389	5.4470588	mg/stk
minimum air mass flow threshold for trim control P share calculation					
C_N_MAX_LAM_ADJ_D_ACT	-	0... FFH	0... 8160	32	rpm
maximum engine speed threshold for trim control D share calculation					
C_N_MAX_LAM_ADJ_P_ACT	-	0... FFH	0... 8160	32	rpm
maximum engine speed threshold for trim control P share calculation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_MIN_LAM_ADJ_D_ACT	-	0... FFH	0... 8160	32	rpm
minimum engine speed threshold for trim control D share calculation					
C_N_MIN_LAM_ADJ_P_ACT	-	0... FFH	0... 8160	32	rpm
minimum engine speed threshold for trim control P share calculation					
C_T_AST_LAM_ADJ_P_ACT_HST	-	0... FFFFH	0... 6553.5	0.1	s
T_AST threshold for hot start detection to immediately active trim control P share					
C_TCO_LAM_ADJ_P_ACT_HST	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold for hot start detection to immediately active trim control P share					
C_TEMP_CAT_MIN_LAM_ADJ_ACT	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
minimum cat temperature threshold for trim control activation					
IP_CRLC_LAMB_DELTA_I_LAM_ADJ [NC_CBK_EX_NR]	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
LDPM_MAF_CYL_1_LACO	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
air mass flow dependent weighting coefficient for trim control I share calculation					
IP_CRLC_VLS_DIF_MMV_LAM_ADJ	V	0... FFFFH	0... 0.99998474121	15.2588e-6	-
LDPM_MAF_CYL_1_LACO	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDPM_EFF_CAT_DIAG_1_LACO	8	0... FFH	0... 1.9921875	7.8125e-3	-
correlation constant to calculate moving mean value of trim controller difference					
IP_FAC_ADD_LAMB_DELTA_D	-	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_EFF_CAT_DIAG_1_LACO	8	0... FFH	0... 1.9921875	7.8125e-3	-
additional weighting coefficient for trim control D share calculation					
IP_FAC_ADD_LAMB_DELTA_P	-	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_EFF_CAT_DIAG_1_LACO	8	0... FFH	0... 1.9921875	7.8125e-3	-
additional weighting coefficient for trim control P share calculation					
IP_FAC_LAMB_DELTA_D_LAM_ADJ [NC_CBK_EX_NR]	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
LDPM_MAF_CYL_1_LACO	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
air mass flow dependent weighting coefficient for trim control D share calculation					
IP_FAC_LAMB_DELTA_P_LAM_ADJ [NC_CBK_EX_NR]	-	0... FFFFH	0... 0.999985	15.3186e-6	-
LDPM_MAF_CYL_1_LACO	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
air mass flow dependent weighting coefficient for trim control P share calculation					
IP_LAMB_DELTA_D_LAM_ADJ	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDP_VLS_DIF_DELTA_IP_LAMB_D	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control D share					
IP_LAMB_DELTA_D_LAM_ADJ_DLY_DIAG	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_VLS_DIF_LAM_ADJ_D_DIAG	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control D share in case of active delay diagnosis					
IP_LAMB_DELTA_D_LAM_ADJ_DYN_DIAG	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_VLS_DIF_LAM_ADJ_D_DIAG	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control D share in case of active dynamic diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_LAMB_DELTA_D_LAM_ADJ_ER_BAL_HOM	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_VLS_DIF_LAM_ADJ_2_LACO	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control D share in case cylinder balancing homogenous reached					
IP_LAMB_DELTA_I_LAM_ADJ	-	0... FFFFH	-0.125... 0.1249961853	3.8147e-6	-
LDPM_VLS_DIF_LAM_ADJ_1_LACO	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control I share					
IP_LAMB_DELTA_I_LAM_ADJ_DIAG	V	0... FFFFH	-0.125... 0.1249961853	3.8147e-6	-
LDPM_VLS_DIF_LAM_ADJ_2_LACO	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
LDPM_EFF_CAT_DIAG_1_LACO	8	0... FFH	0... 1.9921875	7.8125e-3	-
characteristic line of trim control I share in case of active diagnosis function					
IP_LAMB_DELTA_I_LAM_ADJ_DLY_DIAG	-	0... FFFFH	-0.125... 0.1249961853	3.8147e-6	-
LDPM_VLS_DIF_LAM_ADJ_DIAG_2	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control I share in case of active delay diagnosis					
IP_LAMB_DELTA_I_LAM_ADJ_DYN_DIAG	-	0... FFFFH	-0.125... 0.1249961853	3.8147e-6	-
LDPM_VLS_DIF_LAM_ADJ_DIAG_2	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control I share in case of active dynamic diagnosis					
IP_LAMB_DELTA_I_LAM_ADJ_ER_BAL_HOM	-	0... FFFFH	-0.125... 0.1249961853	3.8147e-6	-
LDPM_VLS_DIF_LAM_ADJ_2_LACO	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control P share in case cylinder balancing homogenous reached					
IP_LAMB_DELTA_P_LAM_ADJ	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_VLS_DIF_LAM_ADJ_1_LACO	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control P share					
IP_LAMB_DELTA_P_LAM_ADJ_DIAG	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_VLS_DIF_LAM_ADJ_2_LACO	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control P share in case of active cat diagnosis					
IP_LAMB_DELTA_P_LAM_ADJ_DLY_DIAG	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_VLS_DIF_LAM_ADJ_DIAG_2	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control P share in case of active delay diagnosis					
IP_LAMB_DELTA_P_LAM_ADJ_DYN_DIAG	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_VLS_DIF_LAM_ADJ_DIAG_2	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control P share in case of active dynamic diagnosis					
IP_LAMB_DELTA_P_LAM_ADJ_ER_BAL_HOM	-	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_VLS_DIF_LAM_ADJ_2_LACO	16	0... 7FFH	-5... 4.99511719	4.88281e-3	V
characteristic line of trim control P share in case cylinder balancing homogenous reached					
IP_MAF_MAX_LAM_ADJ_I_ACT	-	0... FFH	0... 1389	5.4470588	mg/stk
LDPM_N_32_2_LACO	6	0... FFH	0... 8160	32	rpm
maximum air mass flow threshold for trim control I share calculation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_MAF_MIN_LAM_ADJ_I_ACT	-	0... FFH	0... 1389	5.4470588	mg/stk
LDPM_N_32_2_LACO	6	0... FFH	0... 8160	32	rpm
minimum air mass flow threshold for trim control I share calculation					
IP_VLS_SP_DELTA_AFL_LAM_ADJ [NC_CBK_EX_NR]	V	0... 7FFH	-5... 4.99511719	4.88281e-3	V
LDPM_EFF_CAT_DIAG_1_LACO	8	0... FFH	0... 1.9921875	7.8125e-3	-
LDPM_TEMP_CAT_1_LACO	6	0... FFFFH	-33... 990.984375	0.015625	°C
Additional offset of setpoint for lambda sensor voltage air fuel lean lambda adjustment					
IP_VLS_SP_LAM_ADJ [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
LDP_MAF_HB_IP_VLS_SP_LAM_ADJ	8	0... FFH	0... 1389	5.4470588	mg/stk
LDP_N_32_IP_VLS_SP_LAM_ADJ	8	0... FFH	0... 8160	32	rpm
setpoint for downstream fuel trim controller					
LC_LAM_ADJ_I_SAVE_CAT_DIAG	-	0... 1H	0 ...1	1	-
flag indicating that I share after cat diagnosis is set to the value before cat diagnosis					
LC_LAM_ADJ_LDC_NOT_CHK	-	0... 1H	0 ...1	1	-
calibration flag to choose whether I share is calculated when limited dynamics are not fulfilled					
LC_LAMB_PLS_NOT_CHK_LAM_ADJ	-	0... 1H	0 ...1	1	-
calibration flag to choose whether I share is calculated when forced lambda stimulation is not active					

General information:

The trim controller causes a shift of the WRAF sensor signal (upstream of the catalyst) or/and a shift of the lambda set point (in opposite direction). The output components (P share, I share, the sum of both or the adaptation value) of the trim controller can be linked in the application incidence for the lambda controller to corresponding inputs of the lambda controller. A compensation of ageing effects of the WRAF sensor as well as a better observance of the catalyst window is reached because of these shifts.
The control value is composed of P, I and D shares. All are determined depending on the trim control sensor signal (binary signal). The difference of the sensor voltage from set point value is the basic characteristic. The set point value can be applied depending on the operating point, so that the dynamic lambda can be adjusted according to the operating range.

The recurrence time is defined by T_SAMPLE in [ms].
NC_CBK_EX_NR defines the number of exhaust banks.
For vector elements the variable extension "_i" is used in the model instead of "[i]" as found in the textual description.

Application conditions:

Initialisation:	`RST`
Recurrence:	`20MS`
Activation:	`LV_ST_END == 1`
Deactivation:	`if activation not true`

Function description:

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Formula section:

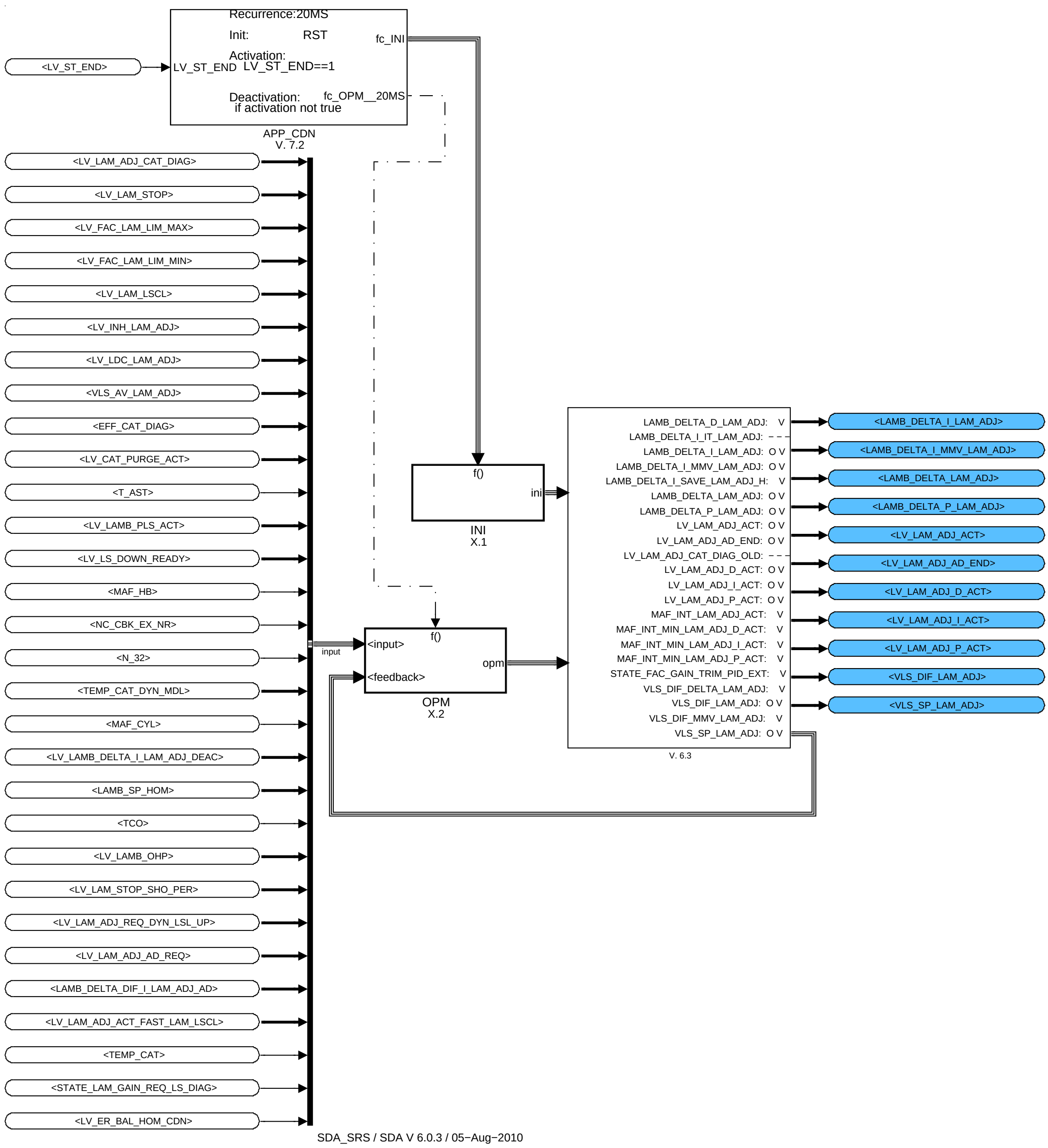

Figure 7.65.1: :

7.65.1 Initialisation

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7.65.2 Operation at 20ms

7.65.2.1 For loop (for i = 1 to NC_CBK_EX_NR)

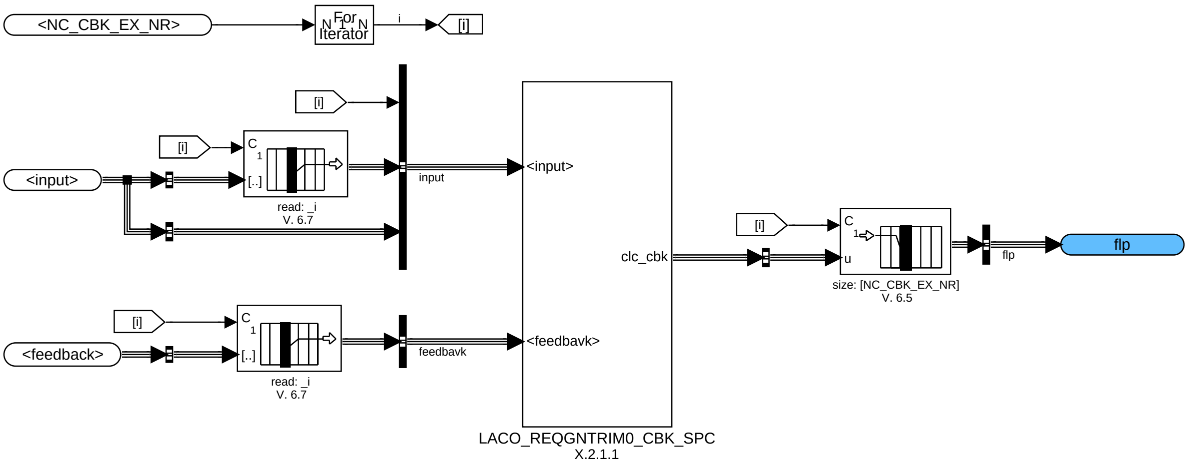

Figure 7.65.2: :

7.65.2.1.1 Calculation of for loop

7.65.2.1.1.1 Activation /deactivation of trim control (part I)

The trim controller is activated when the following conditions are fulfilled:
- no general inhibition
- the trim sensor is ready for operation
- the catalyst enrichment function is not active
- the lambda controller must be active
- the lambda controller must not be in short term in stop mode
- no output limitation of the lambda controller is active
- the catalyst is at operating temperature
- the catalyst efficiency is in the valid area
- the lambda set point must lie within calibration range
- no overheating protection with rich lambda is active

Before verifying the condition for P, I and/or D share activation, an air mass flow integral must exceed the threshold applied thresholds. These thresholds can be calibrated independently for P share, I share and D share activation. Depending on the deactivation reason different air mass flow integral thresholds can be applied. In case of hot start indicated by T_AST below limit and TCO above threshold the P share can be activated immediately if no other above mentioned activation condition is not fulfilled. The activation is realised by setting the MAF integral threshold for the P share to 0.

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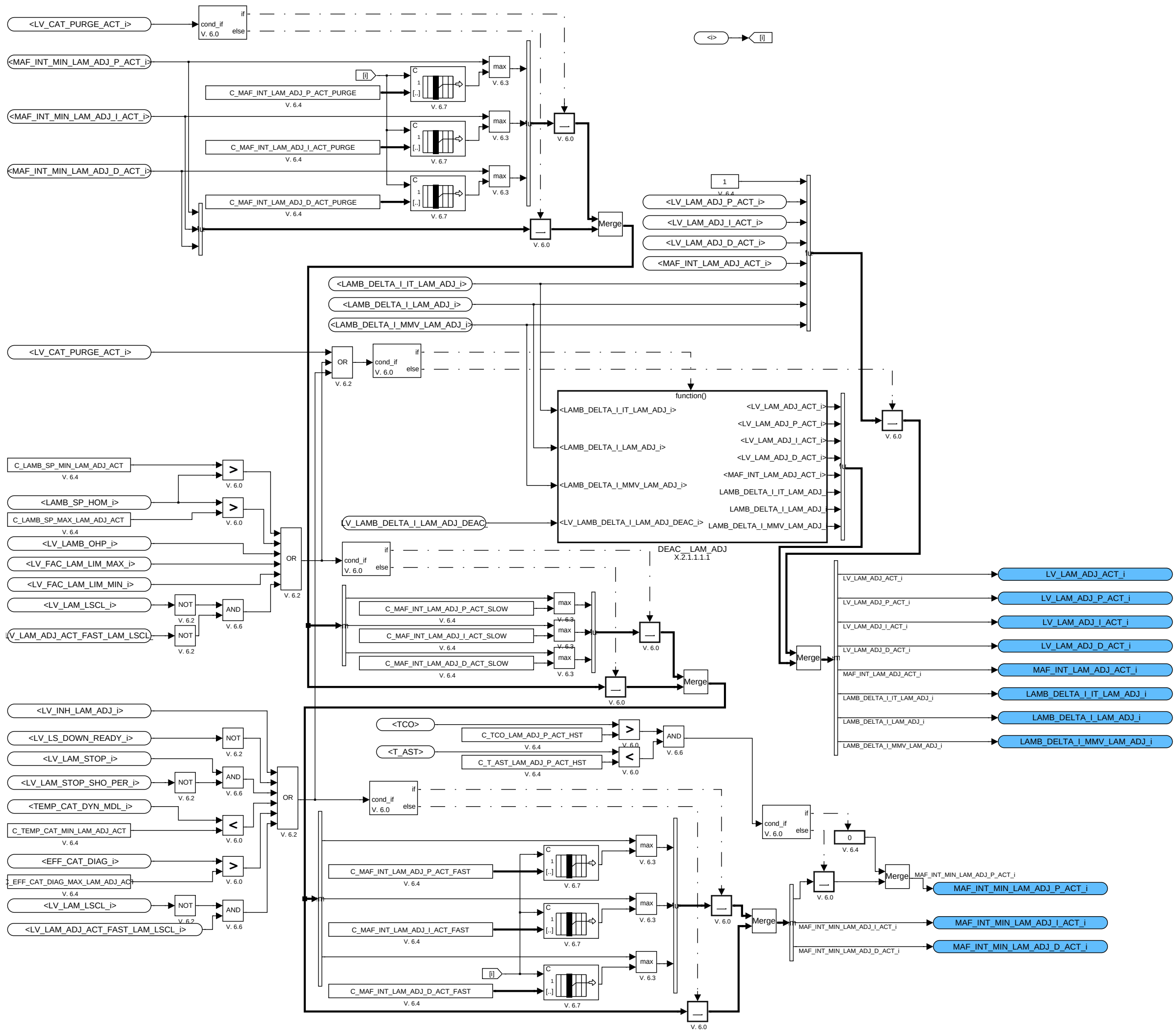

Figure 7.65.3: :

7.65.2.1.1.1.1 Deactivate trim controller

When deactivating the trim controller the P share and D share will get 0 and the I share remain fix (by deactivating the calualtion). If LV_LAMB_DELTA_I_LAM_ADJ_DEAC[i] was set to 0 (in the application incidences) then the I share is set to 0.

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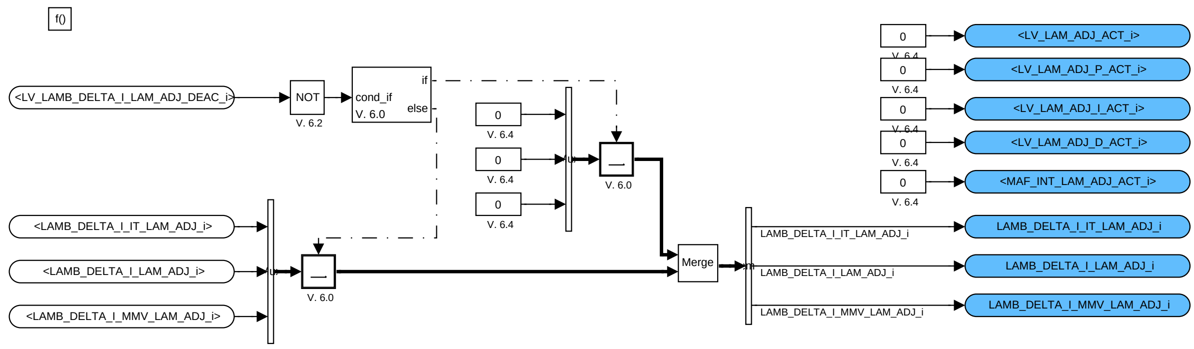

Figure 7.65.4: :

7.65.2.1.1.2 Activation /deactivation of trim control (part II)

When all conditions to activate the trim controller are fulfilled an air mass integral is started and the conditions for P, I and D share are checked separately.

For the calcuation of the air mass flow integral the unit conversion:
[g] = [kg/h] * [ms] * [(g*h) /(kg*ms)] /3600
has to be considered.

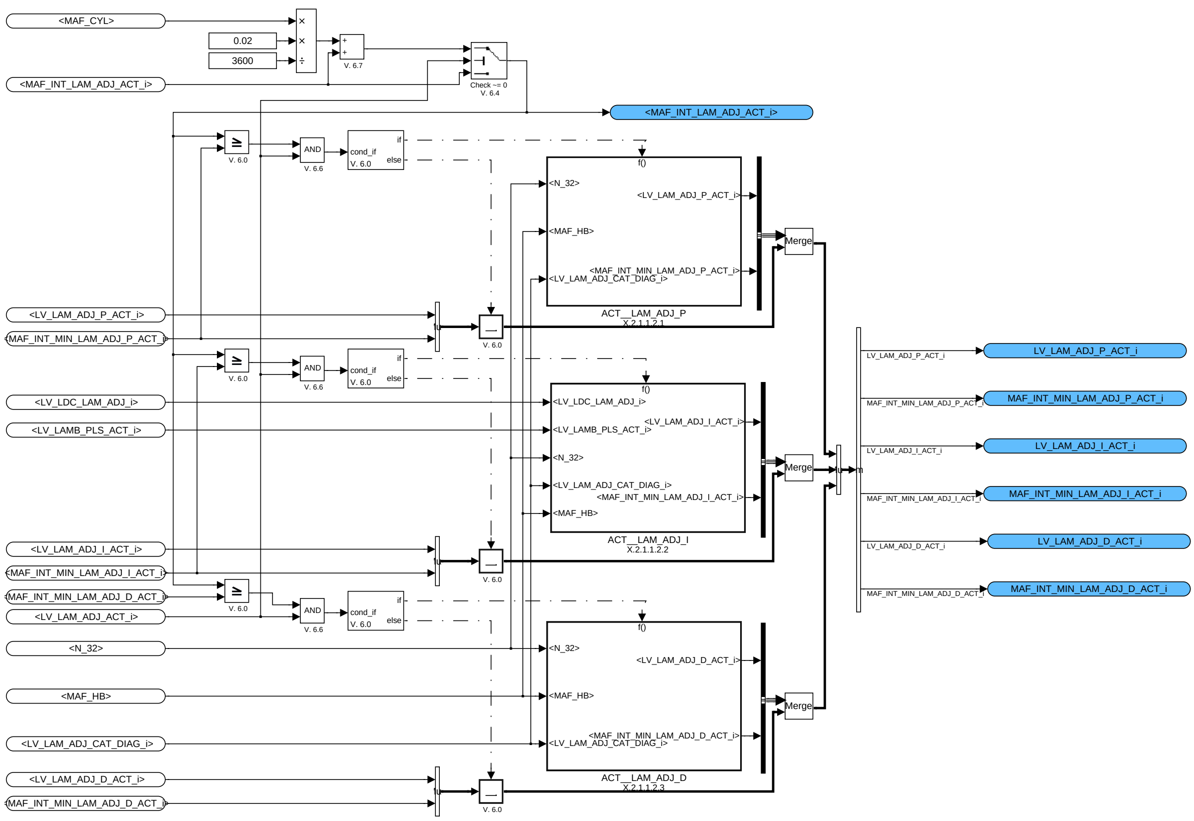

Figure 7.65.5: :

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7.65.2.1.1.2.1 Check P share activation conditions

The P share calculation gets active (indicated by LV_LAM_ADJ_P_ACT[i] after the P share MAF integral threshold is exceeded - only in applied N and MAF areas or when catalyst efficiency diagnosis or CYBL homogeneous activity is active.

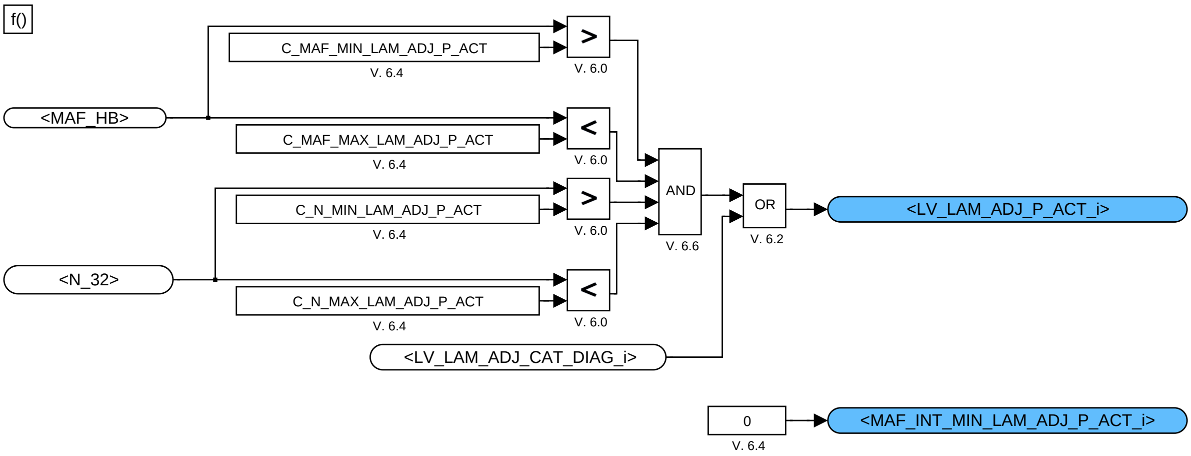

Figure 7.65.6: :

7.65.2.1.1.2.2 Check I share activation conditions

The I share calculation gets active (indicated by LV_LAM_ADJ_I_ACT[i]) after the I share MAF integral threshold is exceeded - in applied MAF areas when the limited dynamics conditions are fulfilled and when the forced lambda stimulation is active. Both latter conditions can be inhibited by means of calibration flags. During active cat efficiency diagnosis or CYBL homogeneous activity the I share is always active after exceeding the MAF integral threshold.

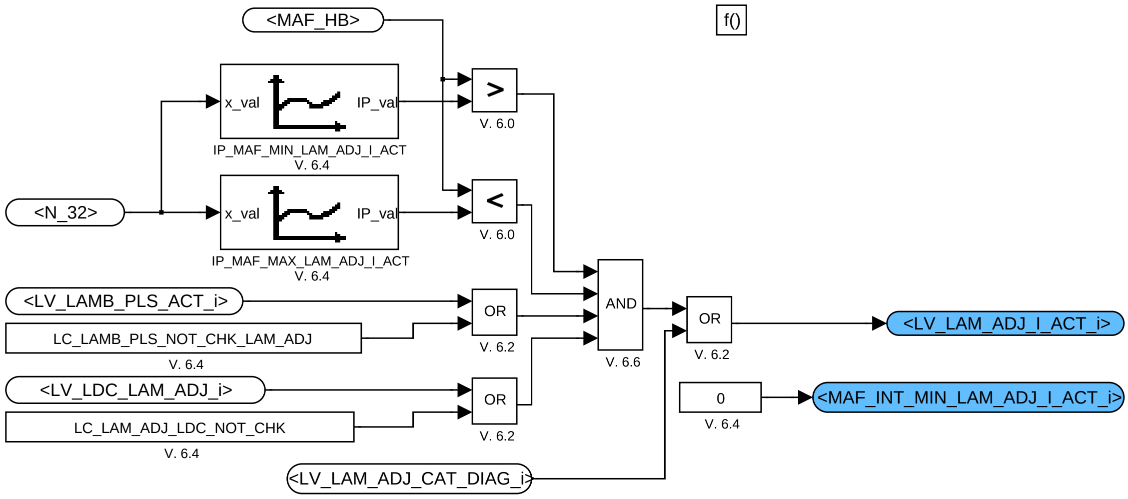

Figure 7.65.7: :

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7.65.2.1.1.2.3 Check D share activation conditions

The D share calculation gets active (indicated by LV_LAM_ADJ_D_ACT[i] after the D share MAF integral threshold is exceeded - only in applied N and MAF areas and when the catalyst efficiency diagnosis is not active or when CYBL homogeneous activity is active.

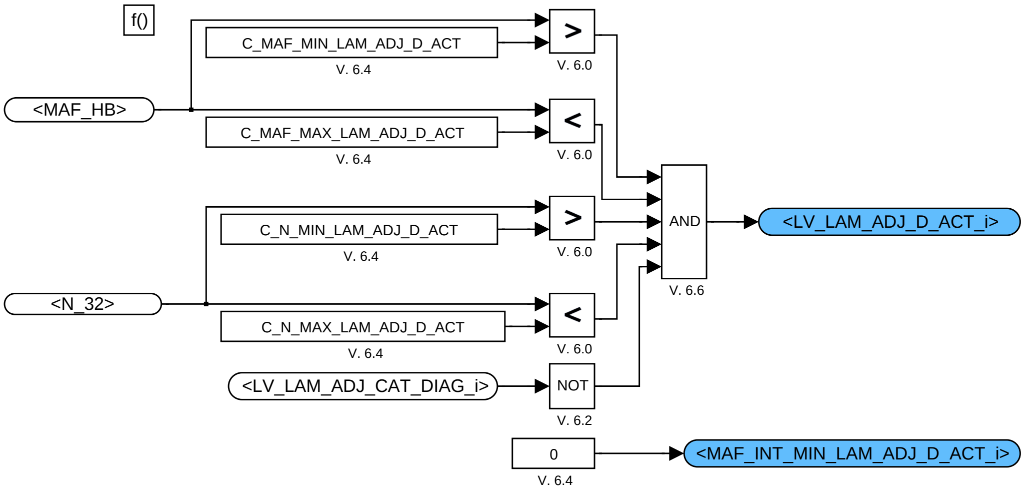

Figure 7.65.8: :

7.65.2.1.1.3 Calculation of controller difference

The controller deviation is defined by the difference of the set point of the sensor output voltage IP_VLS_SP_LAM_ADJ[i] and the actual value VLS_AV_LAM_ADJ[i]. The setpoint can be shifted by IP_VLS_SP_DELTA_LAM_ADJ depending on catalyst ageing to take into account stringent NOx increase with catalyst ageing.
VLS_AV_LAM_ADJ[i] is calculated in the application incidences and can be directly the measured trim sensor signal or the filtered and shifted signal in case of Catalyst diagnosis (depending on project requirements). The actual value can also inlude an external adjustment.

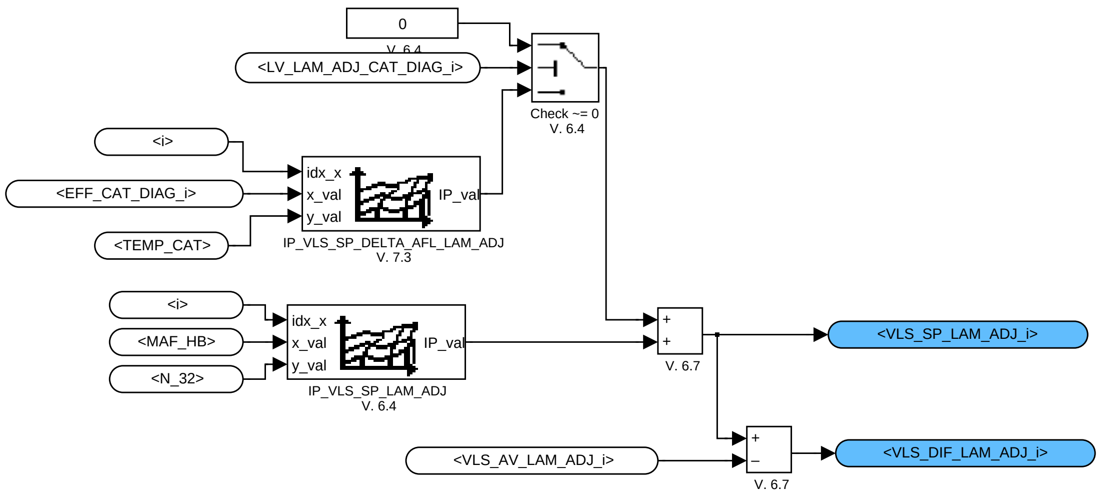

Figure 7.65.9: :

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7.65.2.1.1.4 P share calculation

The P share is calculated when LV_LAM_ADJ_P_ACT[i] is 1. Otherwise the P share is 0. In case of active catalyst diagnosis an own P share gain characteristic line is used.

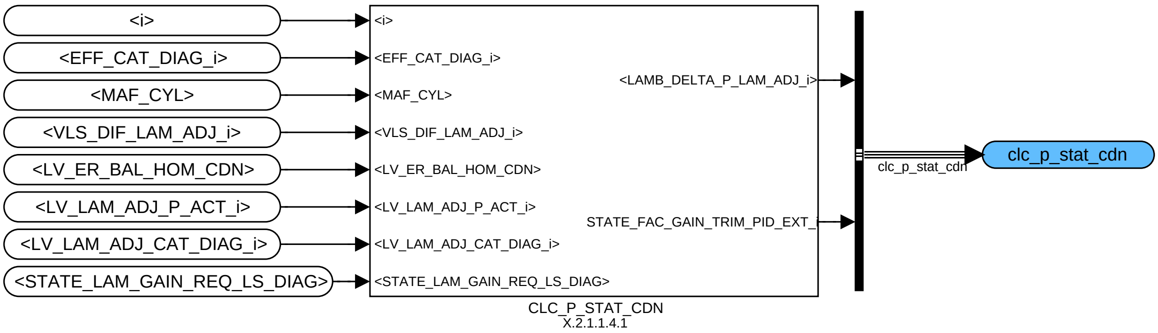

Figure 7.65.10: :

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7.65.2.1.1.4.1 Paramemter calculation of P share

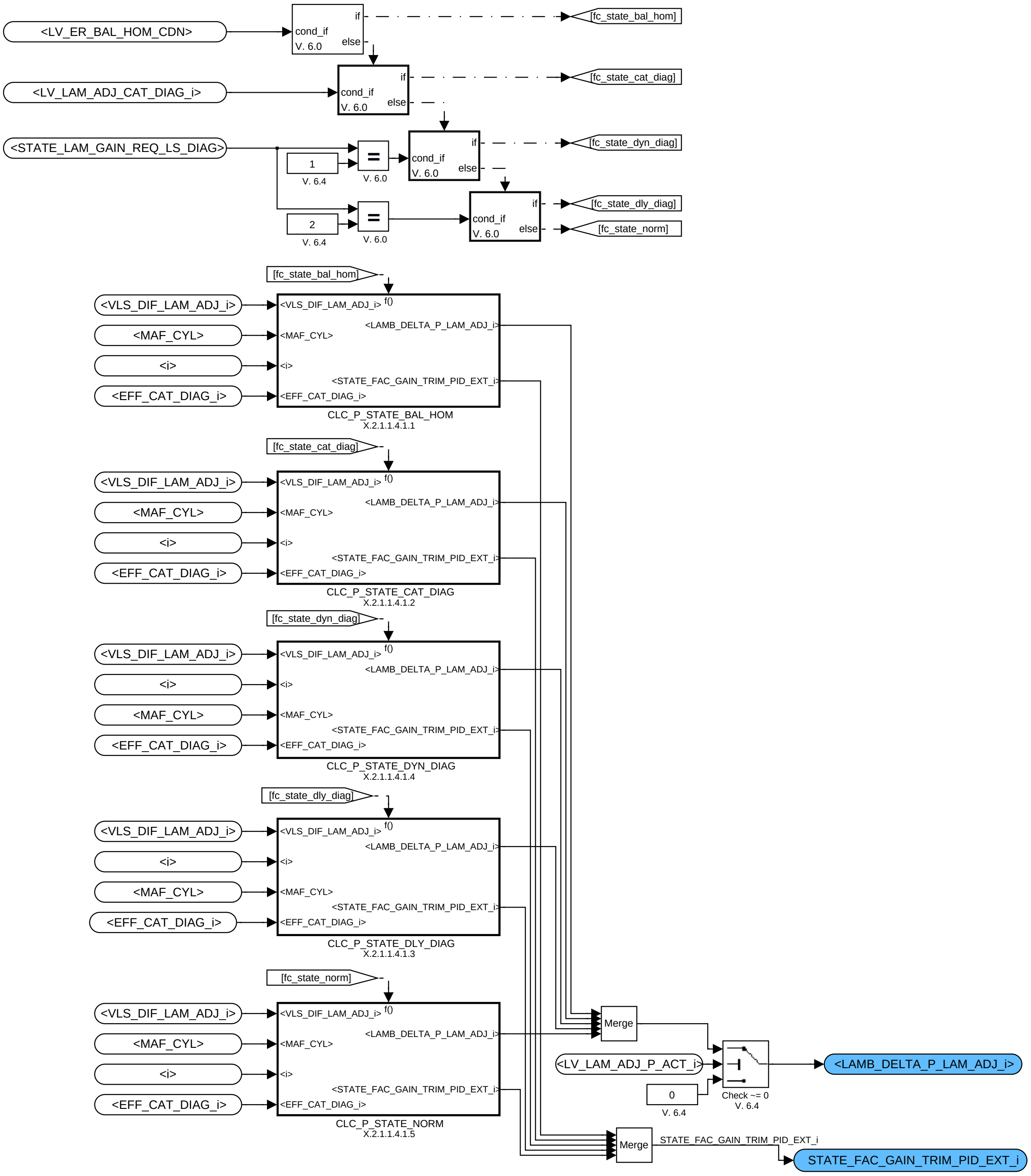

Figure 7.65.11: :

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7.65.2.1.1.4.1.1 P share calculation in case of cylinder balancing homogenous reached

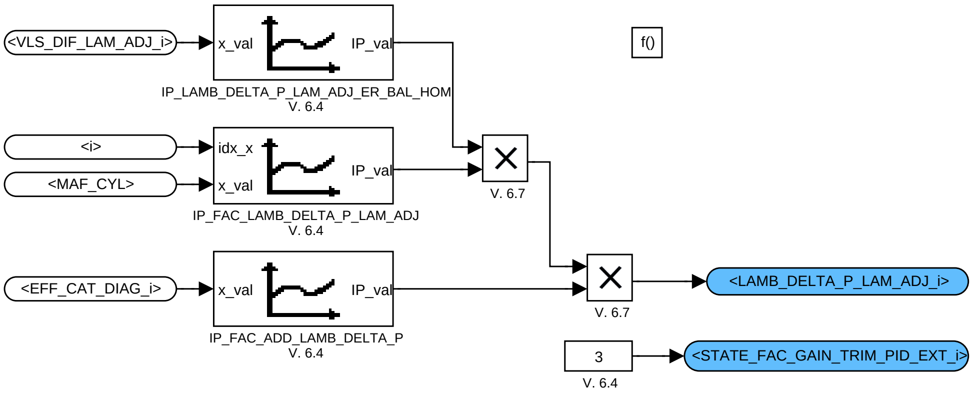

Figure 7.65.12: :

7.65.2.1.1.4.1.2 P share calculation in case of cat diagnosis

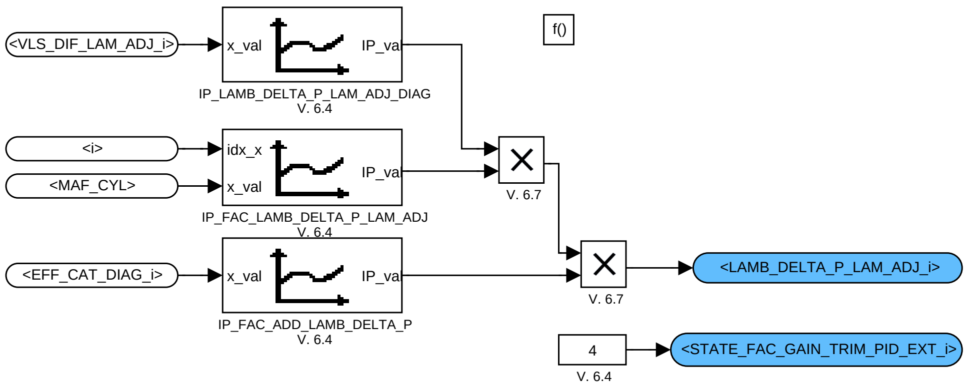

Figure 7.65.13: :

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7.65.2.1.1.4.1.3 P share calculation in case of delay diagnosis

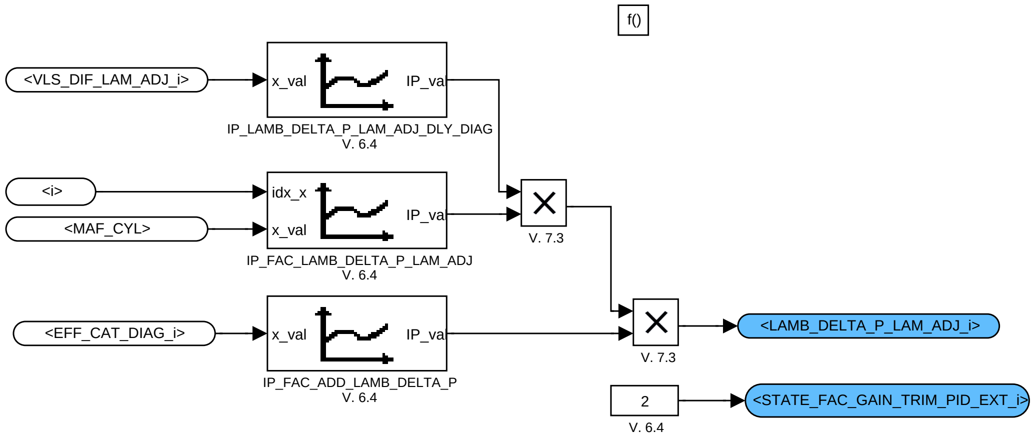

Figure 7.65.14: :

7.65.2.1.1.4.1.4 P share calculation in case of dynamic diagnosis

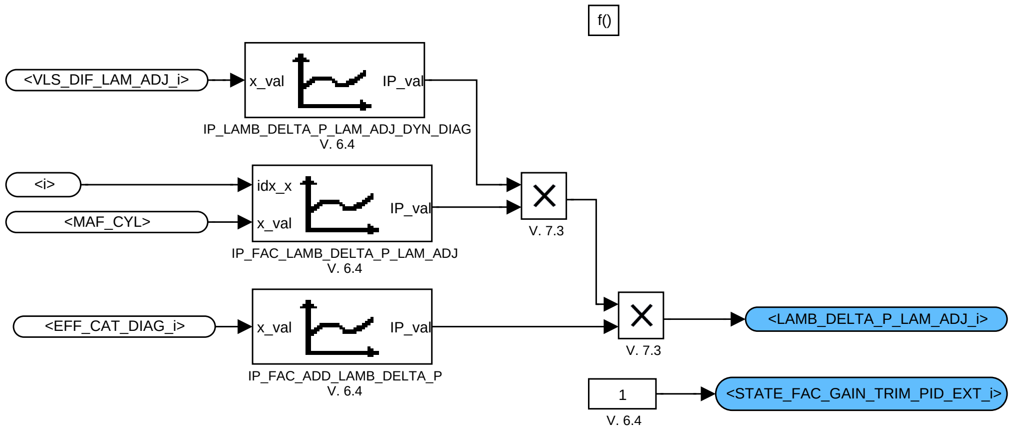

Figure 7.65.15: :

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7.65.2.1.1.4.1.5 P share calculation in case of normal state

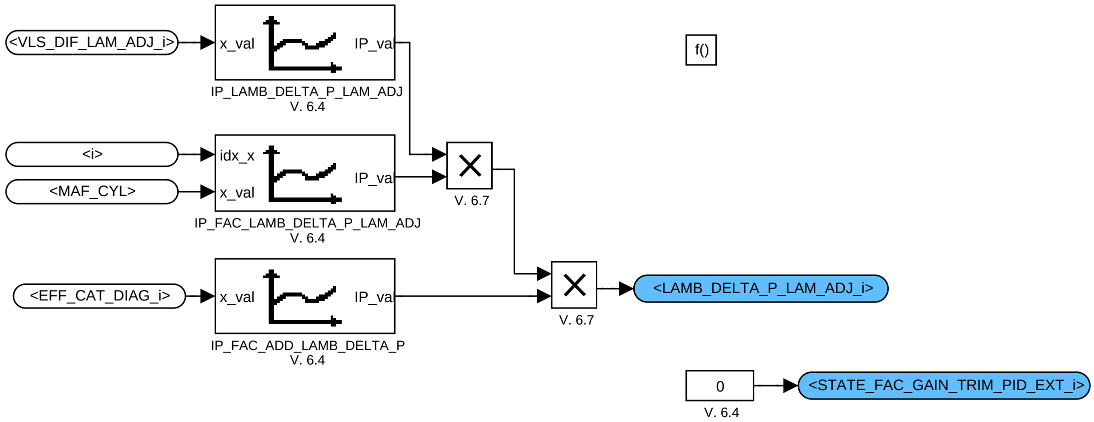

Figure 7.65.16: :

7.65.2.1.1.5 I share calculation management

The I share itself is calculated internally with a higher resolution than the output variable LAMB_DELTA_I_LAM_ADJ[i]. The variable LAMB_DELTA_I_IT_LAM_ADJ[i] is used. A limitation of calibration thresholds (C_LAMB_DELTA_I_MIN_LAM_ADJ and C_LAMB_DELTA_I_MAX_LAM_ADJ) is applied at the end of the calculation. Both variables are initialised with the adaptation value LAMB_DELTA_AD_LAM_ADJ[i].
The I share is only calculated when LV_LAM_ADJ_I_ACT[i] is 1. The calculation is the summation of IP_LAMB_DELTA_I_LAM_ADJ * IP_CRLC_LAMB_DELTA_I_LAM_ADJ. This latter map is for MAF_CYL weighting. If the I share is not calculated it remains fix.
A moving mean value of the I share LAMB_DELTA_I_MMV_LAM_ADJ[i] (needed for WRAF sensor characterisitc line adaptation) is calculated.
In case of active catalyst diagnosis and sensor dynamic diagnosis own parameters are applied (IP_LAMB_DELTA_I_LAM_ADJ_DIAG multiplied by IP_CRLC_LAMB_DELTA_I_LAM_ADJ) and the moving mean value of the I share is not calculated. When cat diagnosis gets active the I share is stored. It is written back to the corresponding variable at the end of the diagnosis only in case that LC_LAM_ADJ_I_SAVE_CAT_DIAG is set to 1.

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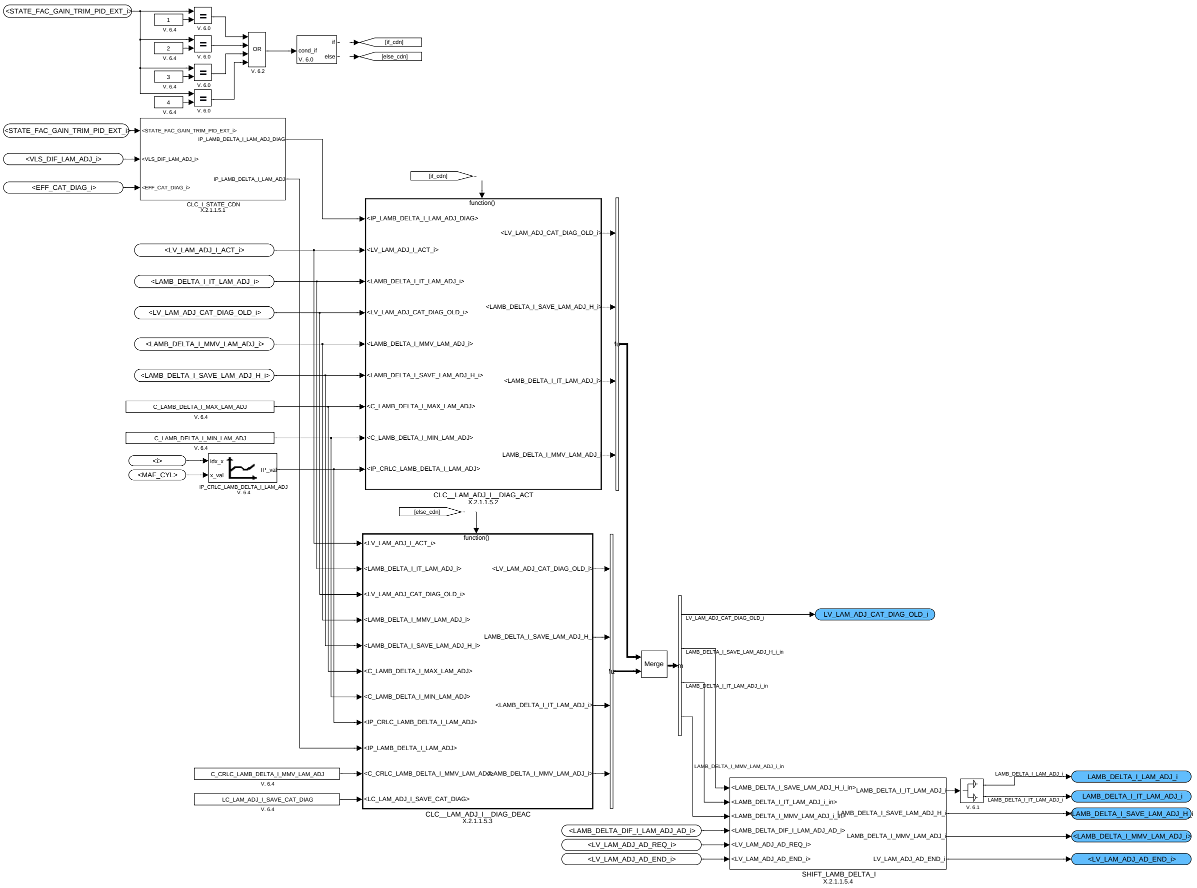

Figure 7.65.17: :

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7.65.2.1.1.5.1 Parameter calculation of I share

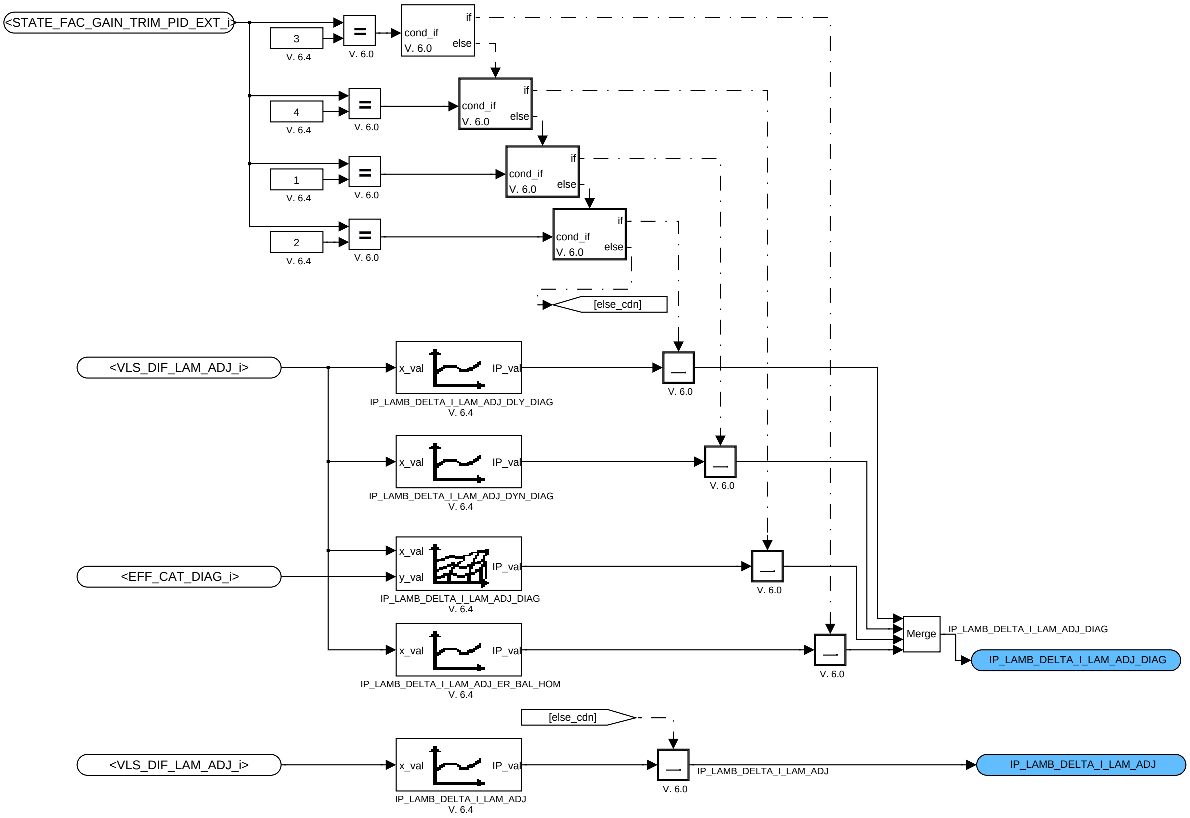

Figure 7.65.18: :

7.65.2.1.1.5.2 I-share during Diagnosis mode

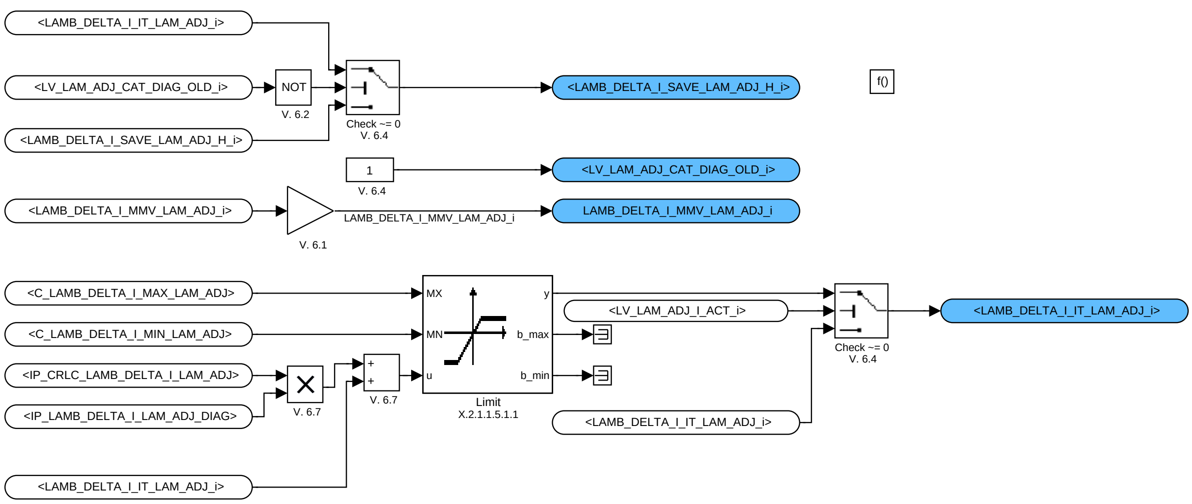

Figure 7.65.19: :

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7.65.2.1.1.5.3 I-share during nominal mode

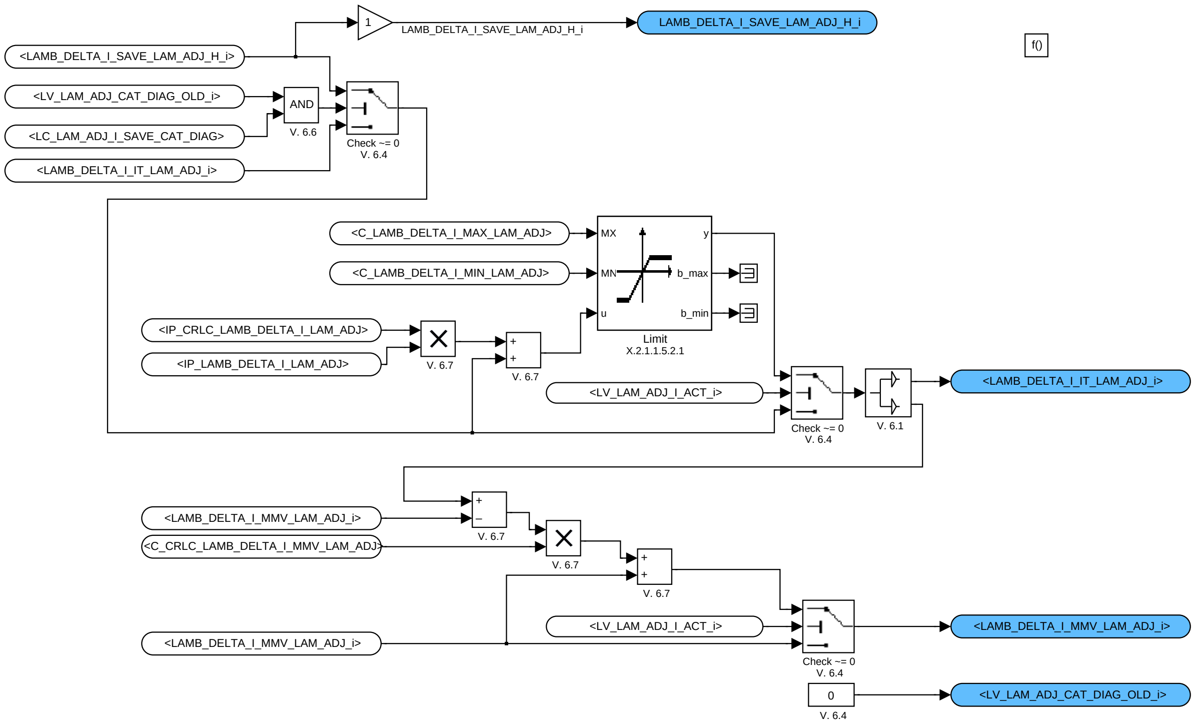

Figure 7.65.20: :

7.65.2.1.1.5.4 Shift of I share

When requested by the function WRAF sensor characterisitc line adaptation a shift of all I share components is applied. The adaptation value in the mentioned function executes an opposite shift.

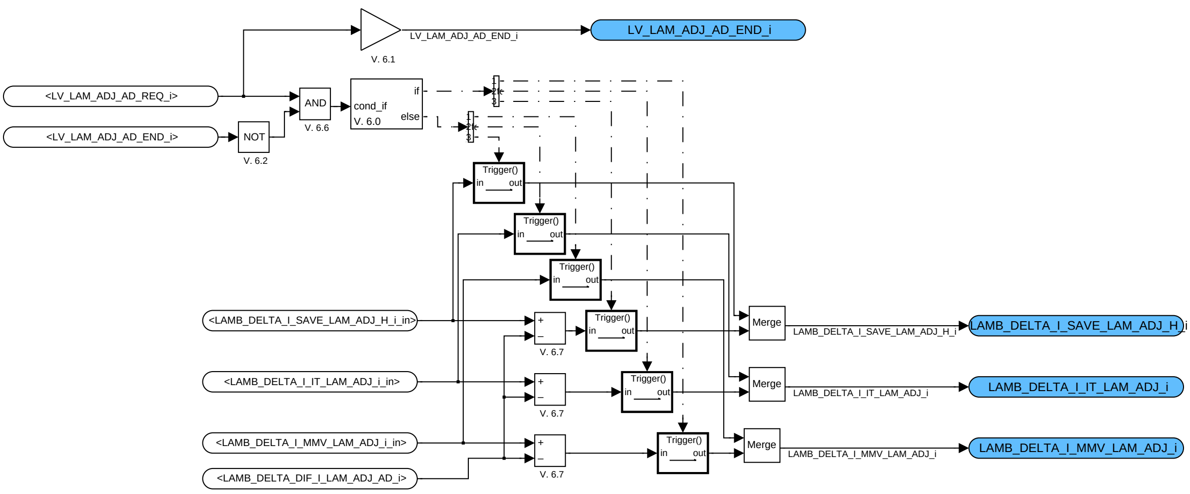

Figure 7.65.21: :

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7.65.2.1.1.6 D share calculation

The D share is calculated when LV_LAM_ADJ_D_ACT[i] is 1. The D share is calculated by evaluating the voltage difference between the control difference and its moving mean value. The filter parameter for moving mean value is MAF_CYL and EFF_CAT_DIAG depending to take into account longer needed duration of D-share at low MAF_CYL and shorter due to OSC deterioring due to catalyst ageing This voltage difference is then input to a characteristic line IP_LAMB_DELTA_D_LAM_ADJ that is weighted by MAF_CYL and EFF_CAT_DIAG[i].

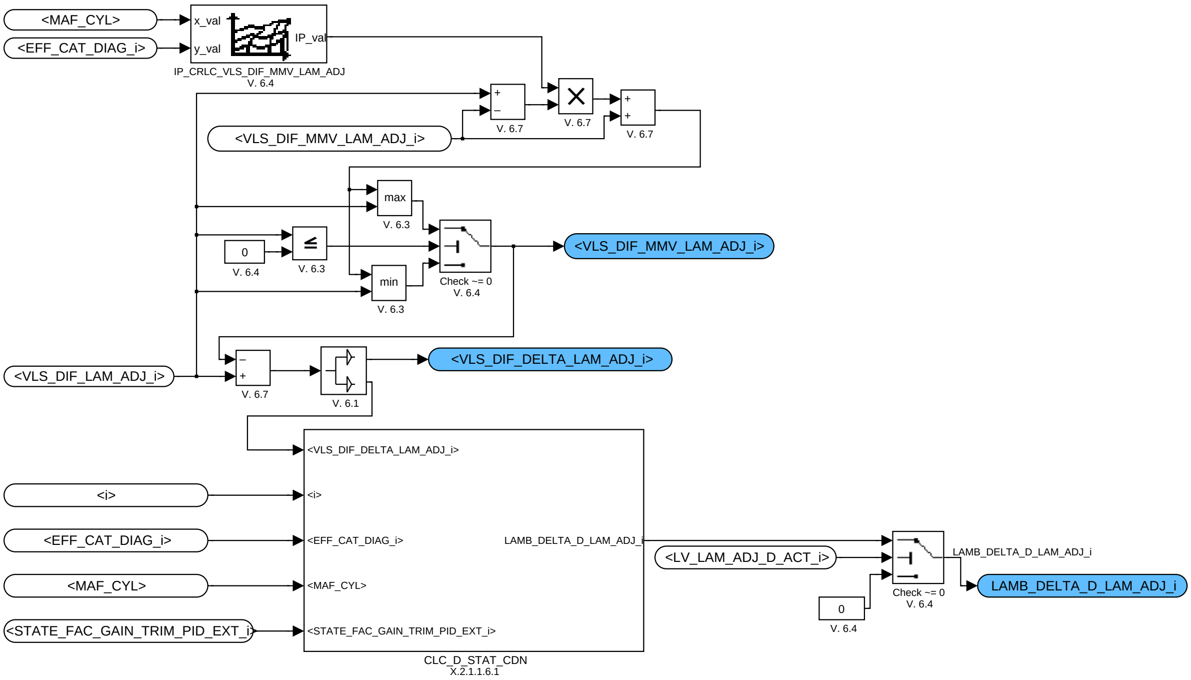

Figure 7.65.22: :

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7.65.2.1.1.6.1 Paramemter calculation of D share

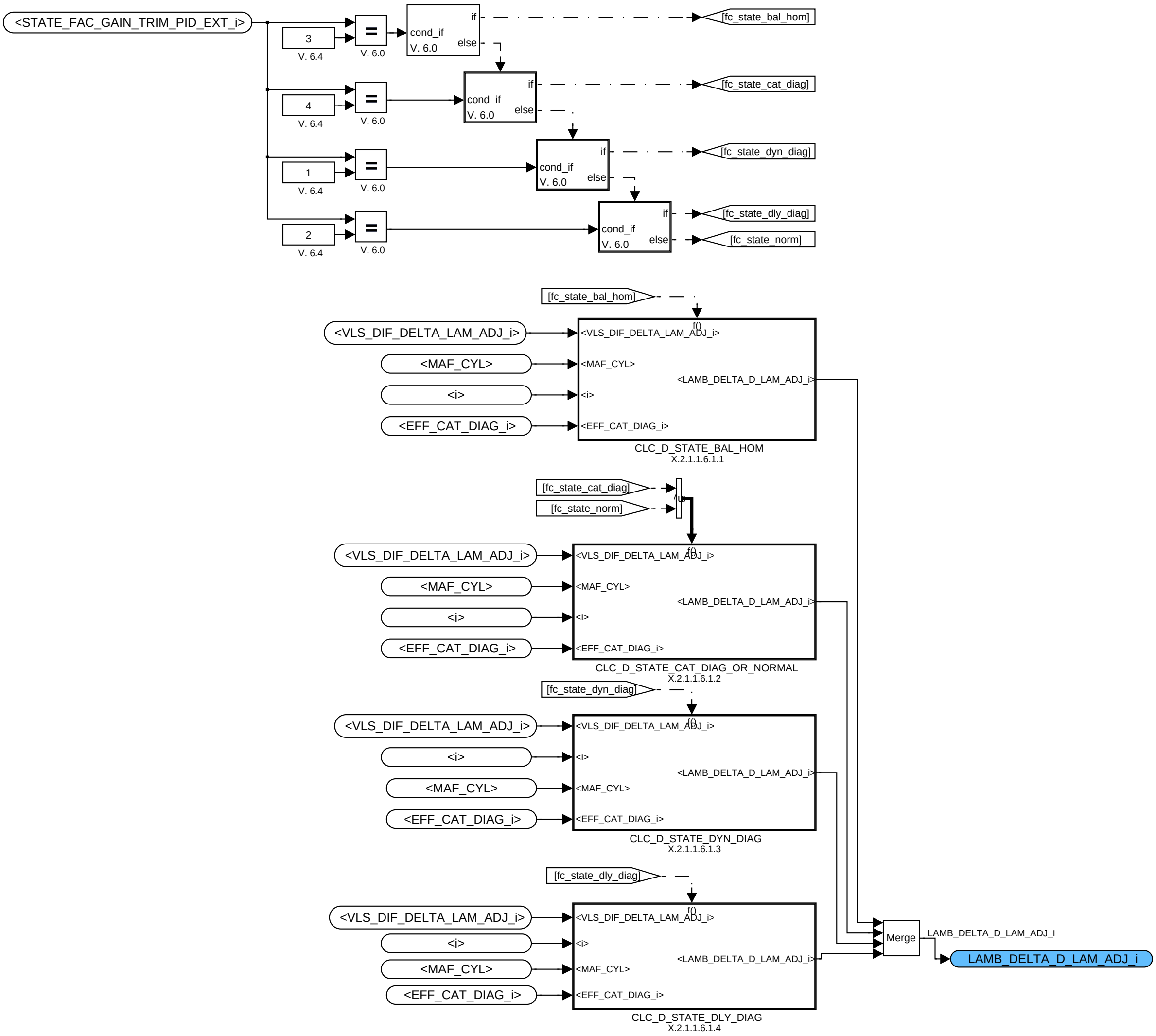

Figure 7.65.23: :

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7.65.2.1.1.6.1.1 D share calculation in case of cylinder balancing homogenous reached

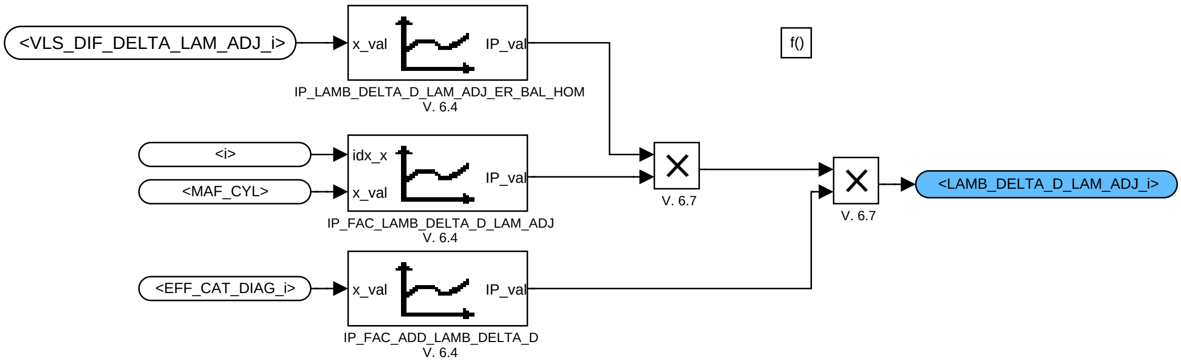

Figure 7.65.24: :

7.65.2.1.1.6.1.2 D share calculation in case of cat diagnosis

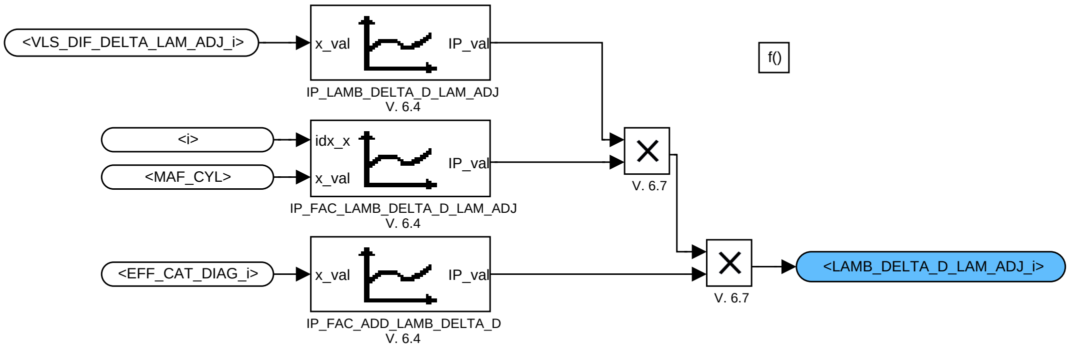

Figure 7.65.25: :

7.65.2.1.1.6.1.3 D share calculation in case of dynamic diagnosis

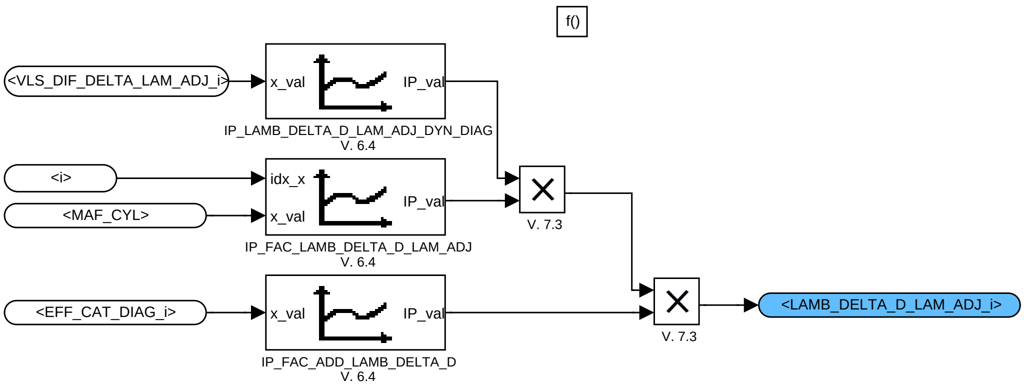

Figure 7.65.26: :

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7.65.2.1.1.6.1.4 D share calculation in case of delay diagnosis

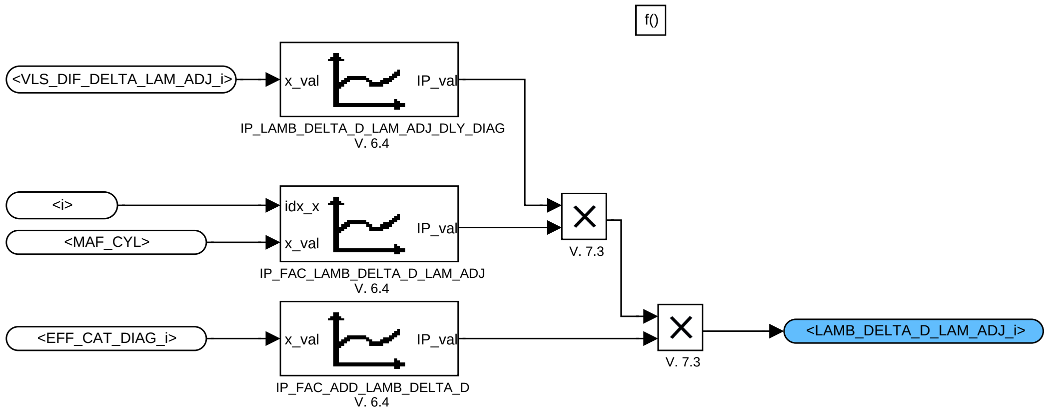

Figure 7.65.27: :

7.65.2.1.1.7 Calculation of total lambda shift

The total lambda shift LAMB_DELTA_LAM_ADJ[i] is calculated by adding P share, I share and D share.

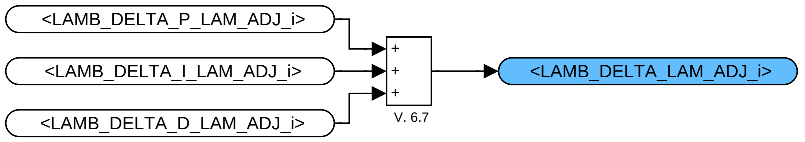

Figure 7.65.28: :

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7.66 Dynamic fuel trim (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DELTA_VLS_DOWN_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Set point shift for downstream fuel trim controller in case of active cat diagnosis					
LV_INH_LAM_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
inhibition flag for trim control					
LV_LAM_ADJ_ACT_FAST_LAM_LSCL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation flag for fast activation of dynamic fuel trim					
LV_LAMB_DELTA_AD_LAM_ADJ_CLC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that adaptation value is calculated at start of power latch phase					
LV_LAMB_DELTA_AD_LAM_ADJ_EXT	O/V	0... 1H	0 ...1	1	-
flag to set trim control adaptation value to calibration value (external adjustment)					
LV_LAMB_DELTA_I_LAM_ADJ_DEAC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that I share is fixed when deactivating lambda controller					
LV_LDC_LAM_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
limited dynamic conditions for trim control					
STATE_VLS_AV_LAM_ADJ [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Status flag for representation of different conditions under which VLS_AV_LAM_ADJ is calculated					
VLS_AV_LAM_ADJ [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
sensor voltage actual value for trim control					
VLS_DELTA_LAM_ADJ_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Sensor voltage set point shift in case of active cat efficiency diagnosis					
VLS_DELTA_LAM_ADJ_DYN_DIAG [NC_CBK_EX_NR]	V	FC00... 3FFH	-5... 4.9951171875	4.88281e-3	V
sensor voltage setpoint shift for trim controller incase of active dynamic diagnosis					

Input data:

EFF_CAT_DIAG [NC_CBK_EX_NR] {p. 5535}	ERR_INH_LAM_ADJ [NC_CBK_EX_NR] {p. 1014}	FAC_COMP_MV_DIAG_ DYN_SENS_MDL [NC_CBK_EX_NR] {p. 5345}	LV_LAM_AD_INJ_ACT {p. 3348}
LV_LAM_ADJ_ACT [NC_CBK_EX_NR] {p. 2589}	LV_LAM_ADJ_CAT_DIAG [NC_CBK_EX_NR] {p. 5473}	LV_LAM_ADJ_REQ_DYN_ LSL_UP [NC_CBK_EX_NR] {p. 5348}	LV_LDC_DLY [NC_CBK_EX_NR] {p. 2633}
LV_VAR_TCHA {p. 656}	MAF_KGH {p. 1195}	NC_CBK_EX_NR {p. 1829}	NC_NR_CAM_CBK {p. 1507}
T_AST {p. 1766}	T_SUM_AFL_AFR_CYC [NC_CBK_EX_NR] {p. 2439}	TCO_ST {p. 1100}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_CRLC_VLS_DOWN_DYN_DIAG	-	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_MAF_KGH__CRLC_VLS_DOWN	4	0... FFFFH	0... 2047.96875	0.03125	kg/h
correlation constant downstream signal during DYN_DIAG					
ID_CRLC_VLS_DOWN_T_DLY	-	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_MAF_KGH__CRLC_VLS_DOWN	4	0... FFFFH	0... 2047.96875	0.03125	kg/h
correlation constant downstream signal					
ID_T_DLY_LAM_AD [NC_CBK_EX_NR]	-	0... FFFFH	0... 6553.5	0.1	s
LDP_TCO_ST_1_EGCP	6	0... FEH	-48... 142.5	0.75	°C
activation of trim controller after calibratable time					
IP_CRLC_VLS_LAM_ADJ_CAT_DIAG	-	0... FFH	0... 0.99609375	3.90625e-3	-
LDP_T_SUM_AFL_AFR_IP_CRLC_VLS	6	0... FFFFH	0... 655.35	0.01	s
correlation constant for filtering downstream signal for catalyst efficiency diagnosis					
IP_VLS_DELTA_LAM_ADJ_CAT_DIAG	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
LDPM_EFF_CAT_DIAG_1_LACO	8	0... FFH	0... 1.9921875	7.8125e-3	-
sensor voltage set point shift in case of active cat efficiency diagnosis					
IP_VLS_DELTA_LAM_ADJ_DYN_DIAG	-	0... 7FFH	-5... 4.99511719	4.88281e-3	V
LDPM_FAC_COMP_MV_1_LACO	6	0... FFFFH	-32... 31.9990234375	976.563e-6	-
Sensor voltage setpoint shift for trim controller incase of active dynamic diagnosis					
LC_LAM_ADJ_ACT_FAST_LAM_LSCL	-	0... 1H	0 ...1	1	-
Switch to activate fast activation of dynamic fuel trim					
LC_LAM_ADJ_INH_ENA_LAM_AD_INJ	-	0... 1H	0 ...1	1	-
Switch to enable inhibtation of trim controller during MFMA operation					
LC_LAMB_DELTA_AD_LAM_ADJ_EXT	-	0... 1H	0 ...1	1	-
LC for external adjustment of adaptation value for the LAMBDA-shift					
LC_VAR_EX_CUS	-	0... 1H	0 ...1	1	-
Switch to an exhaust gas configuration with 2 linear and 1 binary O2 sensor (LC = 1)					

General information:

There are many errors which make it necessary to stop the trim control when they occure.
The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2,

otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank

Application conditions:

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Initialisation:	`RST`
Recurrence:	`20MS`
Activation:	`always`
Deactivation:	`never`

Function description:

Formula section:

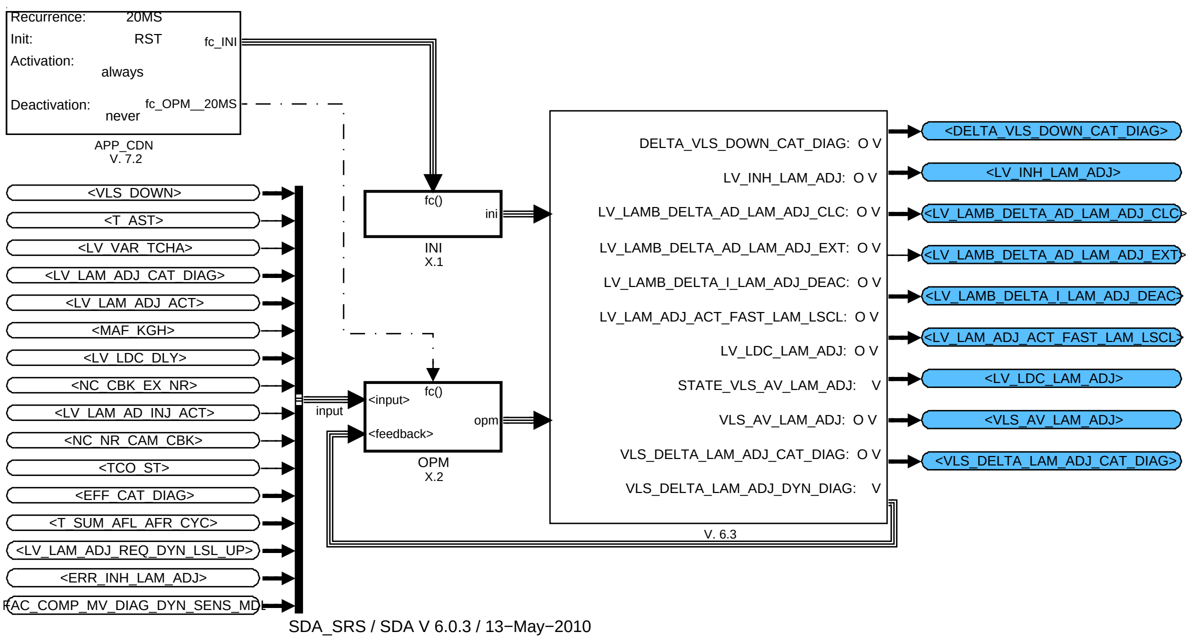

Figure 7.66.1: :

7.66.1 Initialization

The initialization is carried out at ECU reset

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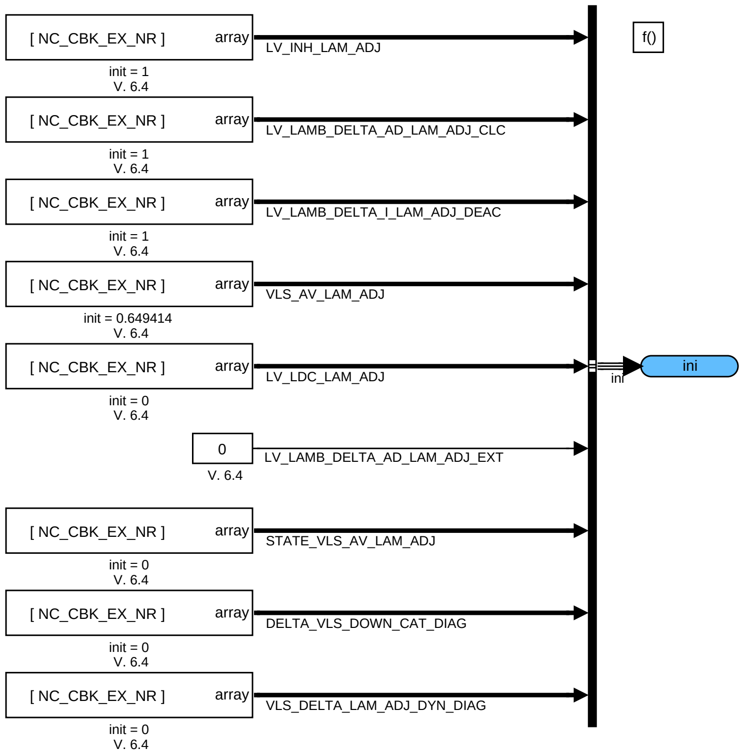

Figure 7.66.2: :

7.66.2 OPM

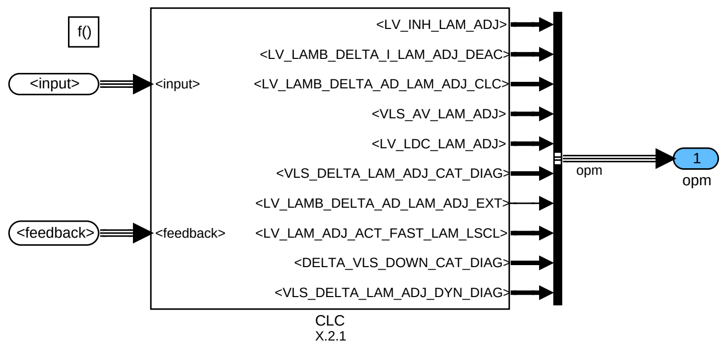

Figure 7.66.3: :

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7.66.2.1 Calculation

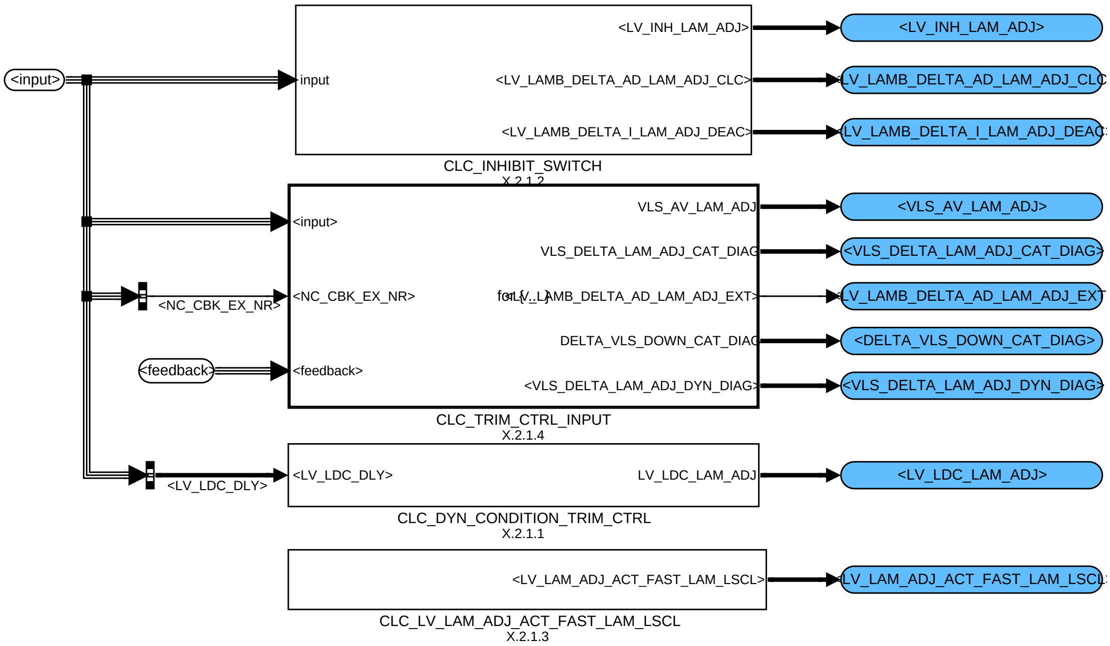

Figure 7.66.4: :

7.66.2.1.1 Determination of limited dynamic conditions for the trim controller

Figure 7.66.5: :

7.66.2.1.2 Calculation of inhibit switch LV_INH_LAM_ADJ[i]

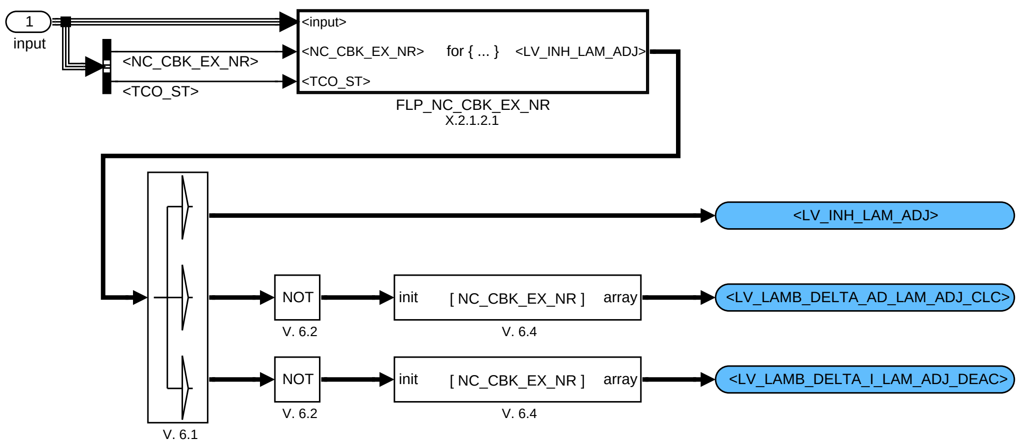

Figure 7.66.6: :

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7.66.2.1.2.1 FLP

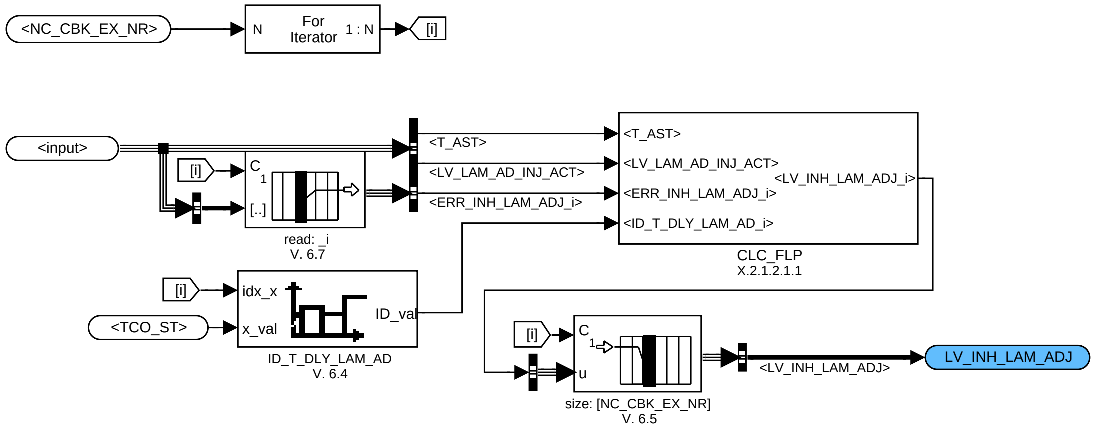

Figure 7.66.7: :

7.66.2.1.2.1.1 Bank specific calculation of LV_INH_LAM_ADJ[i]

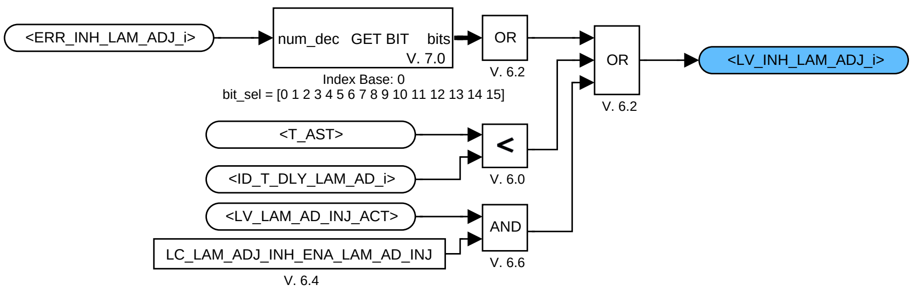

Figure 7.66.8: :

7.66.2.1.3 Assignment of LV_LAM_ADJ_ACT_FAST_LAM_LSCL[i]

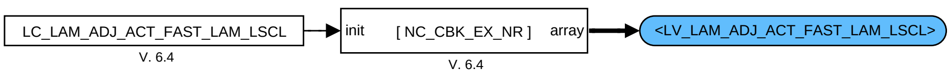

Figure 7.66.9: :

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7.66.2.1.4 Trim Control Input

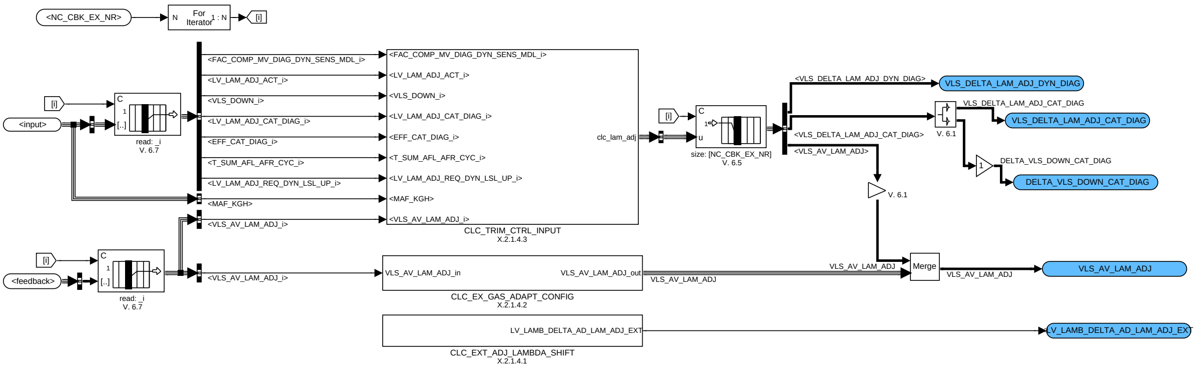

Figure 7.66.10: :

7.66.2.1.4.1 Interface for external adjustment of adaptation value for the (-shift

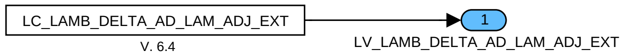

Figure 7.66.11: :

7.66.2.1.4.2 Adaptation for Exhaust Gas Configuration using 2 linear and 1 binary O2 sensors

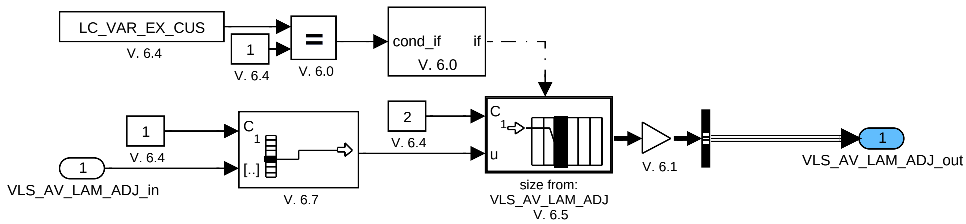

Figure 7.66.12: :

7.66.2.1.4.3 Calculation of VLS_AV_LAM_ADJ[i]

NOTE: VLS_AV_LAM_ADJ[i] must be calculated SW internally with high resolution (32 bit) and must convergate. VLS_AV_LAM_ADJ[i] must be initialised with VLS_DOWN[i] at function activation

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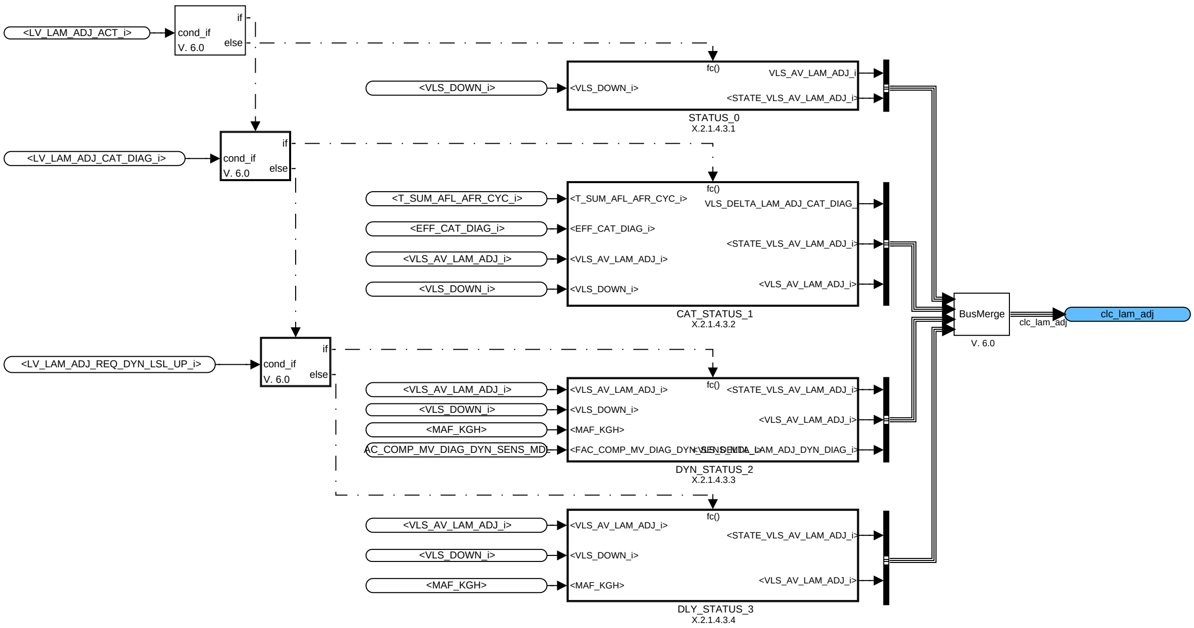

Figure 7.66.13: :

7.66.2.1.4.3.1 STATUS-0 of calculation of VLS_AV_LAM_ADJ

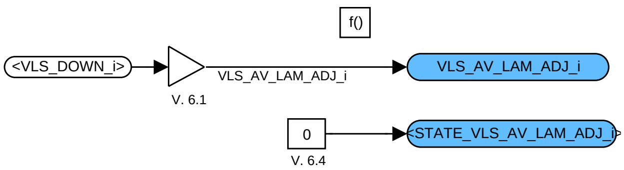

Figure 7.66.14: :

7.66.2.1.4.3.2 STATUS-1 of calculation of VLS_AV_LAM_ADJ

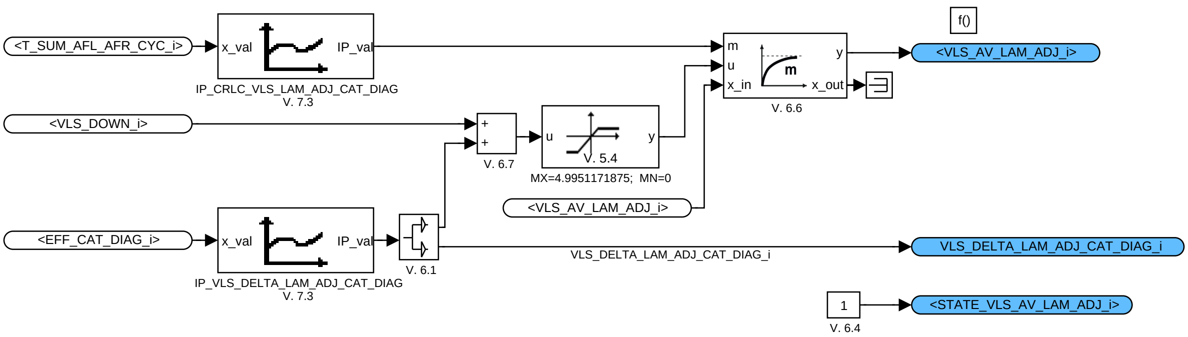

Figure 7.66.15: :

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7.66.2.1.4.3.3 STATUS-2 of calculation of VLS_AV_LAM_ADJ

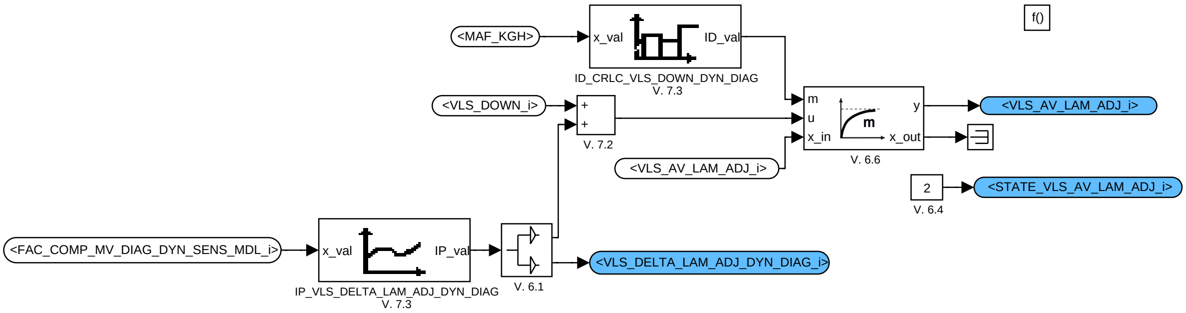

Figure 7.66.16: :

7.66.2.1.4.3.4 STATUS-3 of calculation of VLS_AV_LAM_ADJ

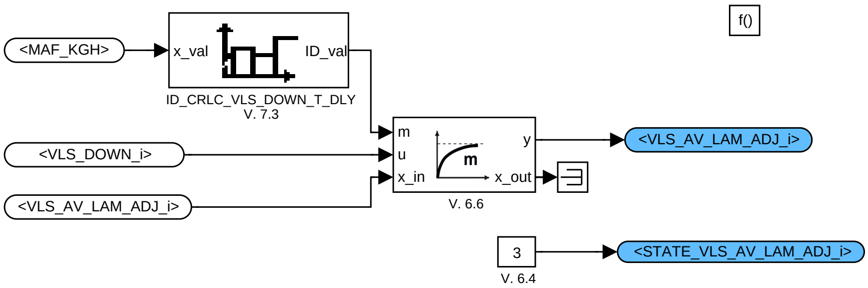

Figure 7.66.17: :

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7.67 WRAF sensor characteristic line adaptation with trim control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_RAF_CHG_LAM_ADJ [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
counter for lean <-> rich air fuel ratio changes					
CTR_RAF_CHG_OLD [NC_CBK_EX_NR]	-	0... FFH	0... 255	1	-
counter old of air fuel ratio changes					
LAMB_DELTA_AD_LAM_ADJ [NC_CBK_EX_NR]	O/V/S	F800... 800H	-0.125 ...0.125	61.0352e-6	-
adaptation value for WRAF sensor characteritic line shift					
LAMB_DELTA_BAS_LAM_ADJ_AD [NC_CBK_EX_NR]	V	F800... 800H	-0.125 ...0.125	61.0352e-6	-
basic characteristic line shift of WRAF sensor					
LAMB_DELTA_DIF_I_LAM_ADJ_AD [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61.0352e-6	-
trim control I share shift in case of new adaptation value for WRAF sensor characteristic line shift					
LAMB_DELTA_SUM_LAM_ADJ_AD [NC_CBK_EX_NR]	O/V	F800... 800H	-0.125 ...0.125	61.0352e-6	-
total characteristic line shift of WRAF sensor					
LV_LAM_ADJ_AD_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
request for trim control I share shift due to new adaptation value learning					

Input data:

CTR_RAF_CHG [NC_CBK_EX_NR] {p. 2460}	EFF_CAT_DIAG [NC_CBK_EX_NR] {p. 5535}	LAMB_DELTA_I_MMV_ LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LV_IS {p. 1720}
LV_LAM_ADJ_AD_CDN_ OK [NC_CBK_EX_NR] {p. 2627}	LV_LAM_ADJ_AD_END [NC_CBK_EX_NR] {p. 2589}	LV_LAMB_DELTA_AD_ LAM_ADJ_CLC [NC_CBK_EX_NR] {p. 2613}	LV_ST_END {p. 1720}
MAF {p. 8277}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	TEMP_CAT {p. 8237}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LAMB_DELTA_AD_LAM_ADJ	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
correlation constant of trim control adaptation value calculation					
C_LAMB_DELTA_BAS_LAM_ADJ_IS [NC_CBK_EX_NR]	-	F800... 800H	-0.125 ...0.125	61.0352e-6	-
basic characteristic line shift of WRAF sensor in case of idle speed					
C_LAMB_DELTA_MAX_LAM_ADJ_AD	-	F800... 800H	-0.125 ...0.125	61.0352e-6	-
maximum value for WRAF sensor characteristic line shift offset					
C_LAMB_DELTA_MIN_LAM_ADJ_AD	-	F800... 800H	-0.125 ...0.125	61.0352e-6	-
minimum value for WRAF sensor characteristic line shift offset					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NR_RAF_CHG_WAIT_LAM_ADJ	-	1... FFH	1... 255	1	-
number of lean <-> rich air fuel ratio changes between two adpatation cycles					
IP_LAMB_DELTA_AFL_LAM_ADJ [NC_CBK_EX_NR]	V	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDPM_EFF_CAT_DIAG_1_LACO	8	0... FFH	0... 1.9921875	7.8125e-3	-
LDPM_TEMP_CAT_1_LACO	6	0... FFFFH	-33... 990.984375	0.015625	°C
Additional offset for air fuel lean lambda adjustment					
IP_LAMB_DELTA_BAS_LAM_ADJ [NC_CBK_EX_NR]	V	0... 1000H	-0.125 ...0.125	61.0352e-6	-
LDP_MAF_IP_LAMB_DELTA_BAS	8	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_32_IP_LAMB_DELTA_BAS	8	0... FFH	0... 8160	32	rpm
basic characteric line shift of WRAF sensor					

General Information

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

The recurrence time is defined by T_SAMPLE in [ms].
NC_CBK_EX_NR defines the number of exhaust banks.
For vector elements the variable extension "_i" is used in the model instead of "[i]" as found in the textual description.

Application Conditions

Initialization: RST, NVMINI, NVMRES, NVMSTO
Recurrence: 100MS
Activation: LV_ST_END == 1
Deactivation: never

Function description

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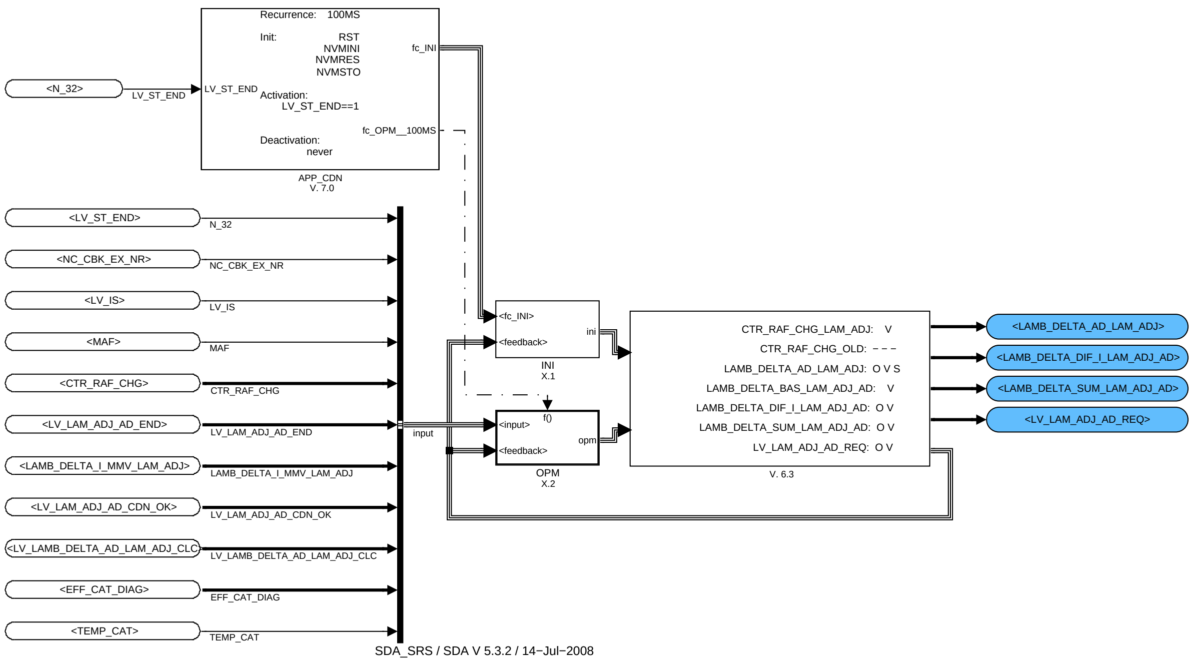

Figure 7.67.1: :

7.67.1 Initialization

7.67.1.1 All the variables are set to zero

7.67.1.2 Initialization of non volatile memory

7.67.1.3 Read non volatile memory

7.67.1.4 Store non volatile memory

7.67.2 Operation at 100ms

7.67.2.1 For loop

7.67.2.1.1 Basic WRAF sensor characteristic line shift

7.67.2.1.1.1 Conditions check for WRAF sensor characteristic line adaptation

By means of IP_LAMB_DELTA_BAS_LAM_ADJ[i] the basic sensor characteristic line shift is defined MAF and N dependent. In idle speed the calibration data C_LAMB_DELTA_BAS_LAM_ADJ_IS[i] is applied. Together with the adaptive correction LAMB_DELTA_AD_LAM_ADJ[i] (stored as non volatile data) the total shift LAMB_DELTA_SUM_LAM_ADJ_AD[i] is defined.

When the conditions for activating the adaptation are fulfilled the subsystem CLC_AD_CDN_OK is executed. Otherwise the subsystem CLC_AD_CDN_NOT_OK is called where no action is executed.

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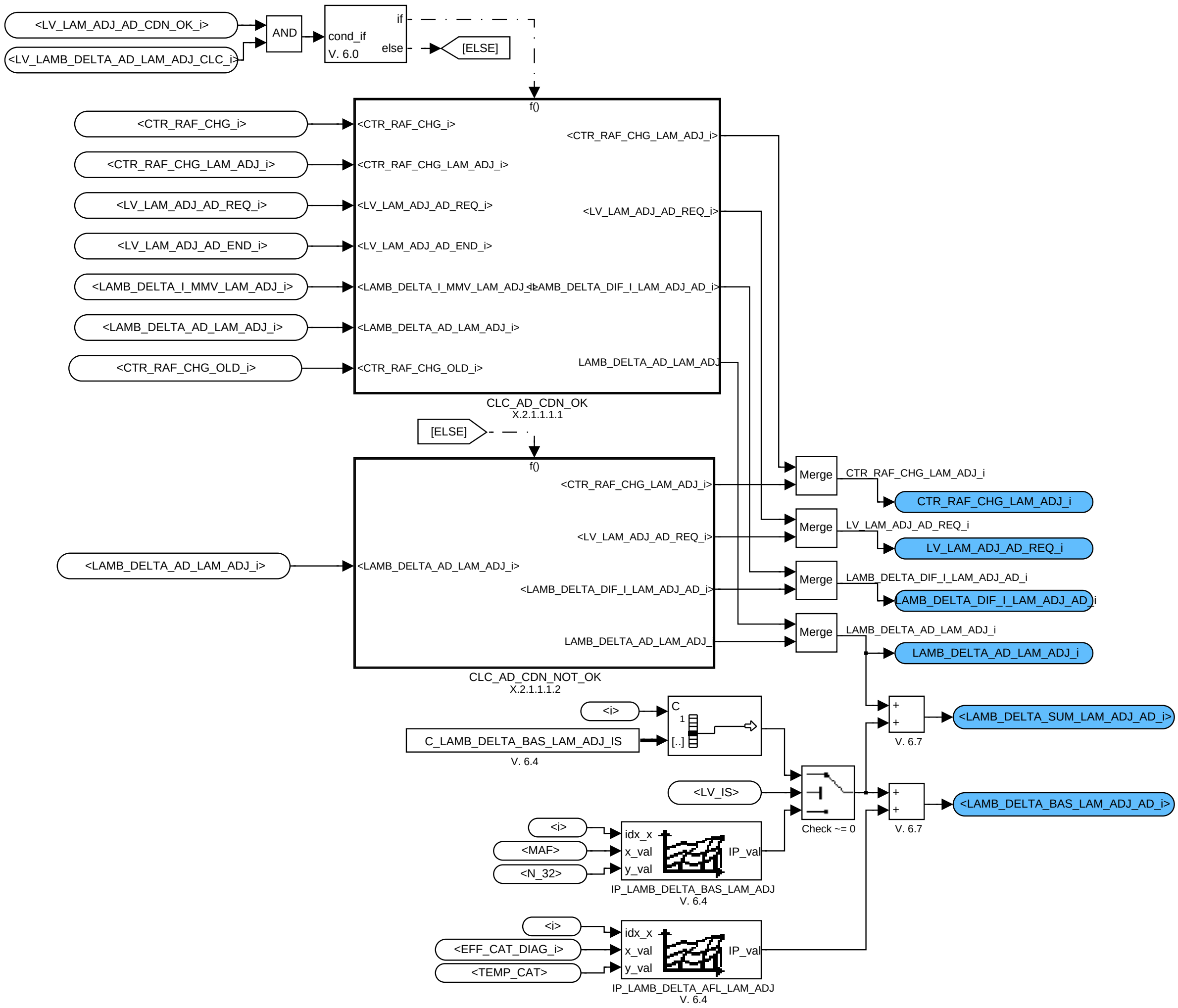

Figure 7.67.2: :

7.67.2.1.1.1.1 Adaptation of WRAF sensor characteristic line offset

The function waits a certain number of lean rich air fuel ratio changes (C_NR_RAF_CHG_WAIT_LAM_ADJ) between 2 adaptation cycles. Then the current I share of the trim controller is shifted step by step into the adaptation value. Furthermore this latter value is limited on a calibration maximum and minimum.

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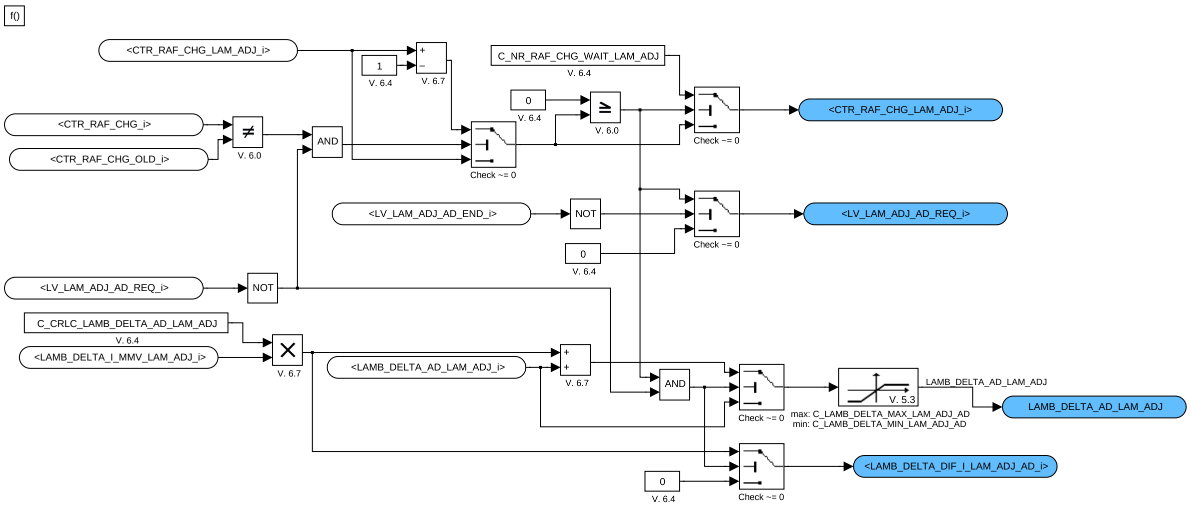

Figure 7.67.3: :

7.67.2.1.1.1.2 If the condition is not ok for WRAF sensor characteristic line adaptation.

Number of lean <> rich air fuel ratio changes between two adpatation cycles

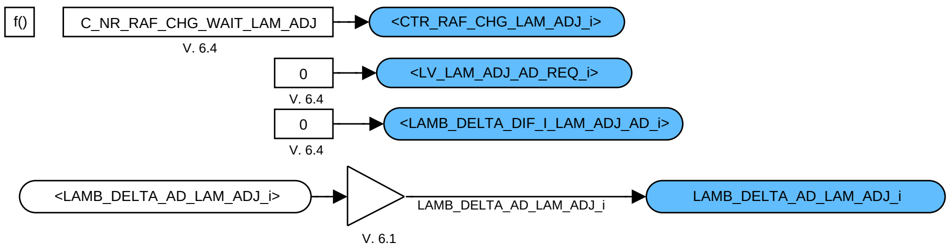

Figure 7.67.4: :

7.67.2.1.1.2 Calcualtion of old value

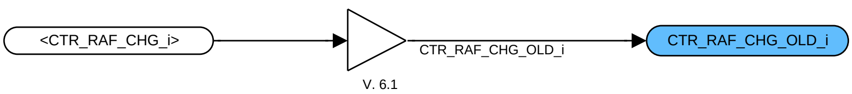

Figure 7.67.5: :

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7.68 Condition check for WRAF sensor adaptation with trim control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_ADJ_AD_CDN_OK [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating good conditions for WRAF sensor characteristic line adaptation					
MAF_INT_LAM_ADJ_CDN [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.42	0.0277778	g
air mass flow integral for condition detection of WRAF sensor characterisitc line adaptation					

Input data:

LAMB_DELTA_I_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LAMB_DELTA_I_MMV_ LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LAMB_DELTA_P_LAM_ ADJ [NC_CBK_EX_NR] {p. 2589}	LV_CP_CLOSE_ACT {p. 3749}
LV_LAM_ADJ_CAT_DIAG [NC_CBK_EX_NR] {p. 5473}	LV_LAM_ADJ_I_ACT [NC_CBK_EX_NR] {p. 2589}	LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_LDC_LAM_ADJ [NC_CBK_EX_NR] {p. 2613}
LV_ST_END {p. 1720}	MAF_CYL {p. 8277}	MAF_HB {p. 805}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_DELTA_DIF_I_MMV_LAM_ADJ	-	F800... 800H	0... 0.125	610.352e3	-
difference between I share and moving mean value to allow WRAF sensor characteristic line adaptation					
C_LAMB_DELTA_P_MAX_LAM_ADJ_CDN	-	F800... 800H	0... 0.125	610.352e3	-
maximum trim control P share for WRAF sensor characteristic line adaptation					
C_LAMB_DELTA_P_MIN_LAM_ADJ_CDN	-	F800... 800H	0... 0.125	610.352e3	-
minimum trim control P share for WRAF sensor characteristic line adaptation					
C_MAF_INT_THD_LAM_ADJ_CDN	-	0... FFFFH	0... 1820.42	0.0277778	g
air mass flow integral threshold for stationary condition definition for WRAF sensor characteristic line adaptation					
C_MAF_MAX_LAM_ADJ_CDN	-	0... FFH	0... 1389	5.44706	mg/stk
maximum air mass flow threshold for WRAF sensor characteristic line adaptation					
C_MAF_MIN_LAM_ADJ_CDN	-	0... FFH	0... 1389	5.44706	mg/stk
minimum air mass flow threshold for WRAF sensor characteristic line adaptation					
C_N_MAX_LAM_ADJ_CDN	-	0... FFH	0... 8160	32	rpm
maximum engine speed threshold for WRAF sensor characteristic line adaptation					
C_N_MIN_LAM_ADJ_CDN	-	0... FFH	0... 8160	32	rpm
minimum engine speed threshold for WRAF sensor characteristic line adaptation					

7.68.1 LACO_REQGNTRCDN0

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

The recurrence time is defined by T_SAMPLE in [ms].
NC_CBK_EX_NR defines the number of exhaust banks.

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For vector elements the variable extension "_i" is used in the model instead of "[i]" as found in the textual description.

Function Description

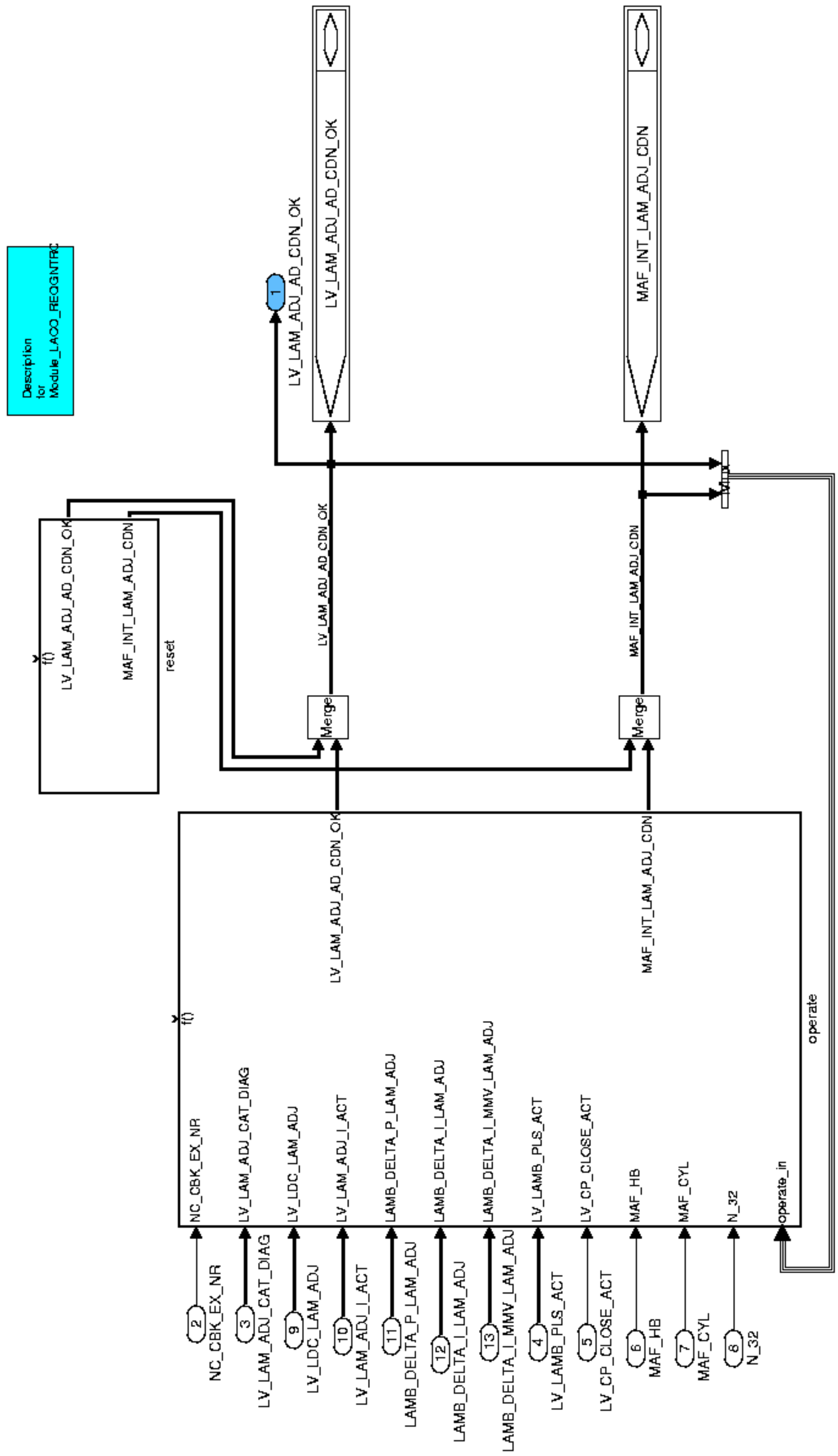

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Figure 7.68.1: LACO_REQGNTRCDN0

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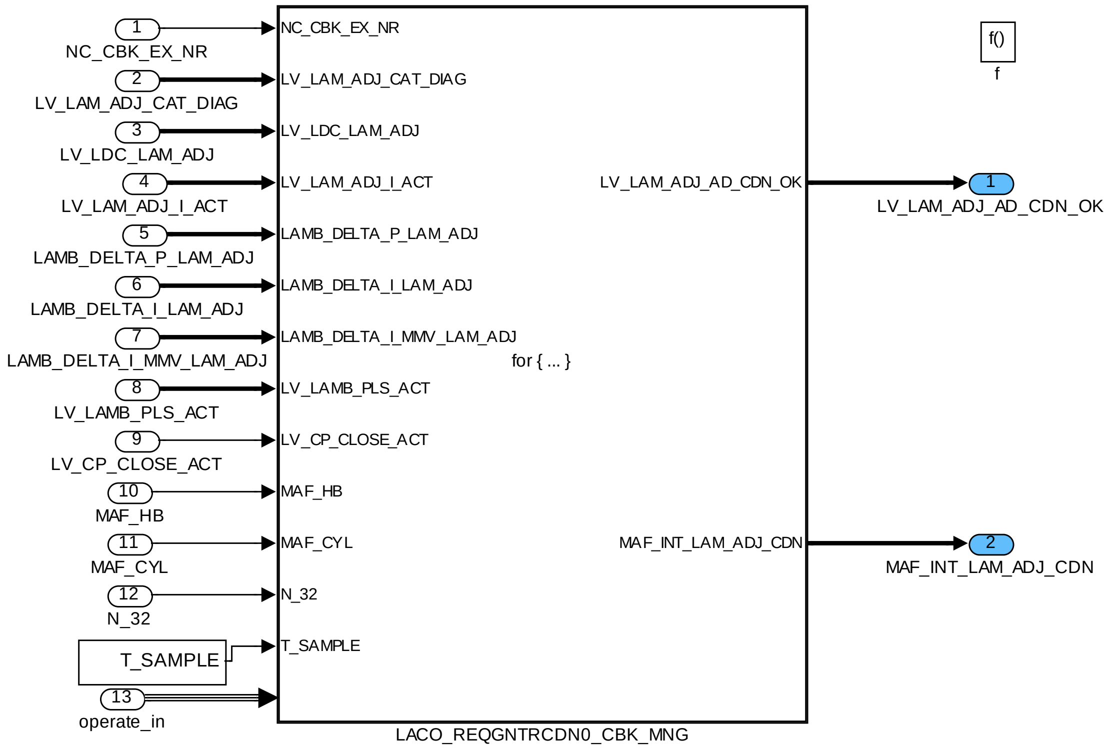

Figure 7.68.2: LACO_REQGNTRCDN0/operate

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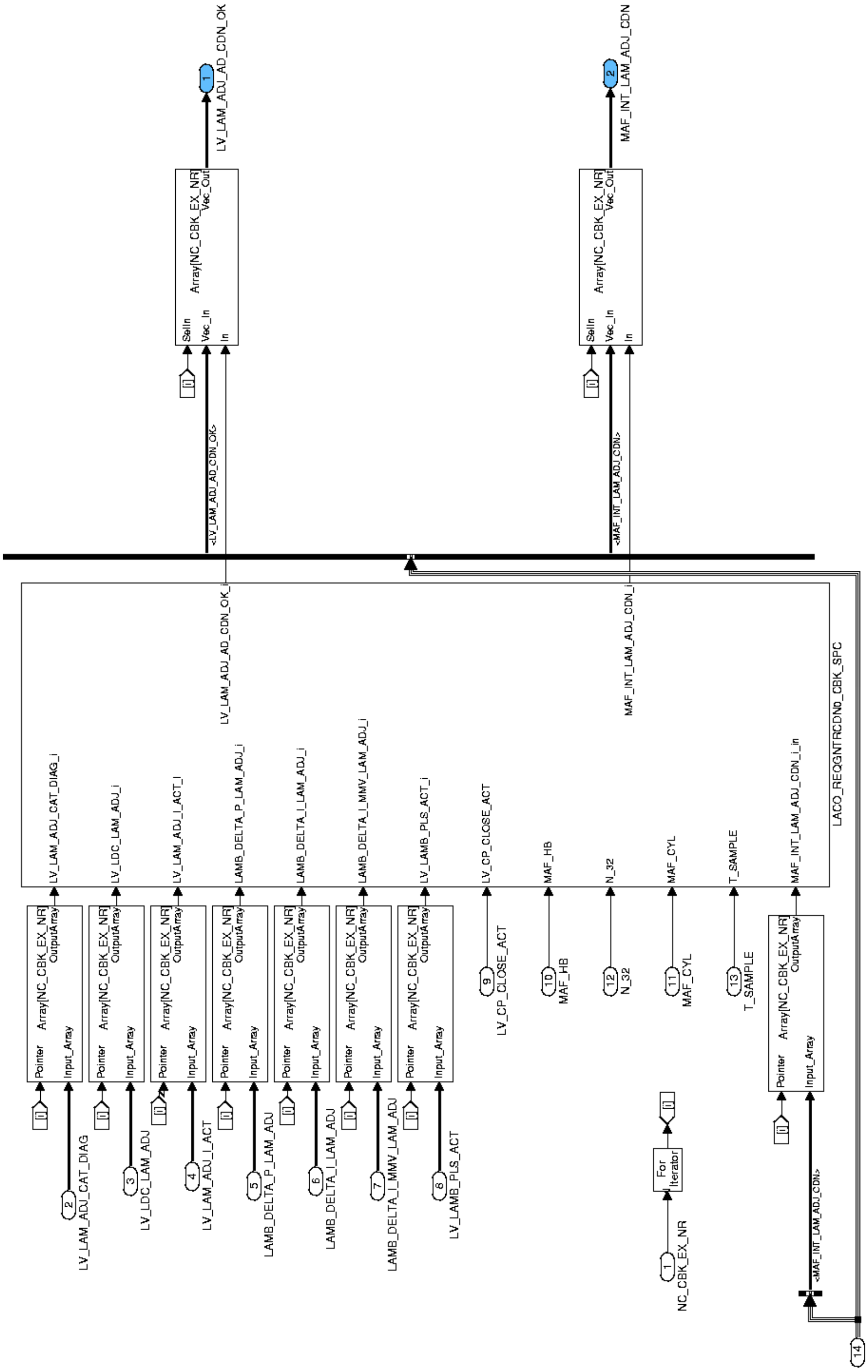

Figure 7.68.3: LACO_REQGNTRCDN0/operate/LACO_REQGNTRCDN0_CBK_MNG

Check conditions

If all the following conditions are fulfilled an air mass flow integral is calulated:

Catalyst efficiency diangnosis not active

limited dynamics (LV_LDC_LAM_ADJ[i]) are fulfilled

I share of trim control is active

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forced lambda stimulation is active
canister purge valve is closed
air mass flow is in a valid range
engine speed is in a valid range
P share of trim contol must be very low (absolute value)
I share of trim control must be stable
(difference between I share and moving mean value must be small)

When the air mass flow integral exceeds a calibration threshold the flag LV_LAM_ADJ_AD_CDN_OK[i] indicating that the adaptation can be started is set.

For the calcuation of the air mass flow integral the unit conversion:
[g] = [kg/h] * [ms] * [(g*h) /(kg*ms)] /3600
has to be considered.

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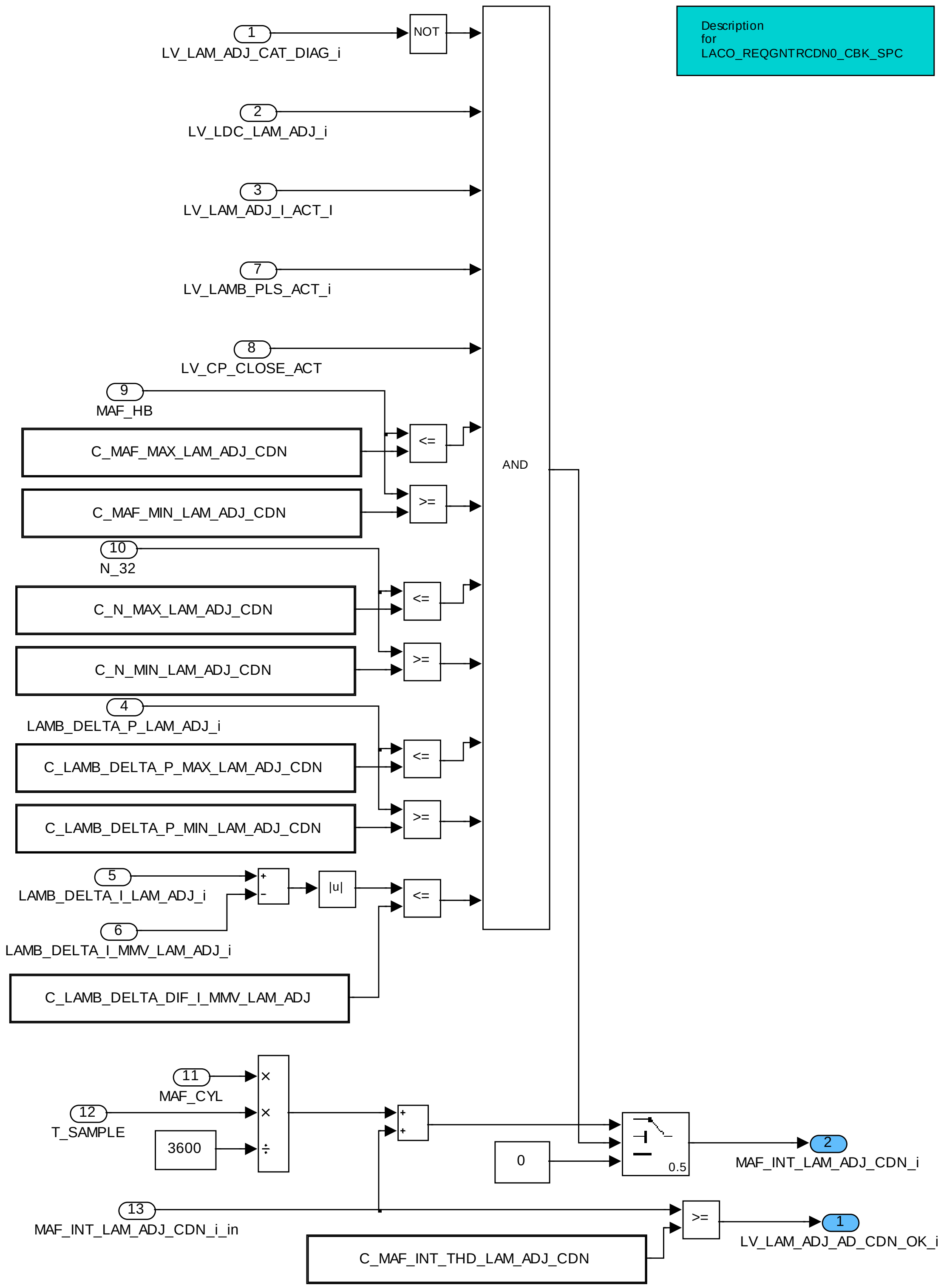

Figure 7.68.4: LACO_REQGNTRCDN0/operate/LACO_REQGNTRCDN0_CBK_MNG/
LACO_REQGNTRCDN0_CBK_SPC

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7.69 Limited dynamic for dynamic fuel trim

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_MV_MMV_DLY [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
floating mean value for limited lambda deviation					
FAC_TQ_REQ_GRD	V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Gradient of the requested factor torque					
FAC_TQ_REQ_GRD_SUM_DLY	V	0... FFFFH	0... 1.99996	30.5e-6	-
Summation of FAC_TQ_REQ_GRD to determine if a dynamic condition is present					
LV_FAC_TQ_REQ_LDC_DLY	V	0... 1H	0 ...1	1	-
Status limited dynamic of the requested torque factor					
LV_LAM_MV_LDC_DLY [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status limited dynamic FAC_LAM_MV[NC_CBK_EX_NR]					
LV_LDC_DLY [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
status flag indicated the limited dynamic conditions is fullfiled					
LV_MAF_LDC_DLY	V	0... 1H	0 ...1	1	-
Status limited dynamic MAF					
LV_N_LDC_DLY	V	0... 1H	0 ...1	1	-
Status limited dynamic N					
MAF_INT_LDC_DLY [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1820.42	0.0277778	g
integral of mass air flow since limited dynamic conditions fulfilled					
MAF_MMV_DLY	O/V	0... FFFFH	0... 1389	21.2e-3	mg/stk
floating mean value for limited MAF					
N_MMV_DLY	O/V	0... 1FE0H	0... 8160	1	rpm
floating mean value for limited engine speed					
T_FAC_TQ_REQ_GRD_SUM_DLY	V	0... FFH	0... 5.1	0.02	s
Timer to decrement FAC_TQ_REQ_GRD_SUM_DLY					

Input data:

FAC_LAM_MV {p. 1014}	FAC_TQ_REQ {p. 6706}	LV_IGK {p. 906}	LV_ST_END {p. 1720}
LV_VAR_LSH_UP {p. 656}	MAF {p. 8277}	MAF_KGH {p. 1195}	N {p. 1525}
NC_FAC_MAF_INT_20 {p. 651}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_REQ_GRD_DEC_DLY	-	0... FFFFH	0... 1.999969	30.5175e-6	-
decrement for calculation PV_AV gradient					
C_FAC_TQ_REQ_GRD_MIN_LDC_DLY	-	0... FFFFH	0... 1.99996	30.5e-6	-
minimum value of FAC_TQ_REQ_GRD to increment FAC_TQ_REQ_GRD_SUM_DLY					
C_FAC_TQ_REQ_GRD_SUM_MAX_DLY	-	0... FFFFH	0... 1.999969	30.5175e-6	-
threshold to reset the limited dynamic flag LV_LDC_DLY[i] due to present high FAC_TQ_REQ_GRD condition					
C_FAC_TQ_REQ_GRD_SUM_MIN_DLY	-	0... FFFFH	0... 1.999969	30.5175e-6	-
threshold to set the limited dynamic flag LV_LDC_DLY[i] when no high FAC_TQ_REQ_GRD condition is met					
C_LAM_MV_CRLC_DLY	-	0... FFFFH	0... 0.99998	15.3e-6	-
correlation constant floating mean value calculation lambda					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAM_MV_DYW_DLY	-	0... FFFFH	0... 99.99847	1.53e-3	%
threshold limited dynamic lambda					
C_MAF_CRLC_DLY	-	0... FFFFH	0... 0.99998	15.3e-6	-
correlation constant floating mean value calculation MAF					
C_MAF_DYW_DLY	-	0... FFFFH	0... 1389	21.2e-3	mg/stk
threshold limited dynamic engine MAF					
C_MAF_INT_MIN_LDC_DLY	-	0... FFFFH	0... 1820.42	27.7999e-3	g
MAF integral after setting limited dynamic conditions LV_LDC_DLYi before starting the monitoring cycle					
C_N_CRLC_DLY	-	0... FFFFH	0... 0.99998	15.3e-6	-
correlation constant floating mean value calculation engine speed					
C_N_DYW_DLY	-	0... 1FE0H	0... 8160	1	rpm
threshold limited dynamic engine speed					
C_T_FAC_TQ_REQ_GRD_SUM_DLY	-	0... FFH	0... 5.1	0.02	s
time periods for calculation limited dynamic FAC_TQ_REQ_GRD					

FUNCTION DESCRIPTION:

General information:

For a two bank exhaust gas configuration the calculation of the limited dynamic condition LV_LDC_DLY[i] is calculated for each bank separately. To differentiate variables and calibration data the index i is used.

i = 1, for cylinder bank 1
i = 2, for cylinder bank 2

The limited dynamic conditions LV_LDC_DLY[i] for dynamic fuel trim is detected if engine speed, mass air flow, FAC_LAM_MV[i] and the factor torque request gradient are within the correspondent dynamic window. Once this condition is met, an integral of the air flow is incremented until the calibrated threshold exceeds. After this point the flag LV_LDC_DLY[i] is set to indicate the trim controller, that the engine is running under limited dynamic conditions.

Application conditions

Initialisation:
```
at reset:
 LV_LDC_DLY[i] = 0
 MAF_INT_LDC_DLY[i] =  0
```

Recurrence: 20ms

Activation:
```
 LV_VAR_LSH_UP = 1  and  LV_ST_END = 1  and  LV_IGK = 1
```

Deactivation:
```
LV_VAR_LSH_UP = 0  or   LV_ST_END = 0  or  LV_IGK = 0
   Initialisation at deactivation:
 LV_LDC_DLY[i] = 0
 LV_N_LDC_DLY = 0
 LV_MAF_LDC_DLY = 0
 MAF_INT_LDC_DLY[i] =  0
   N_MMV_DLY          =    N
   MAF_MMV_DLY        =   MAF
 FAC_LAM_MV_MMV_DLY[i]  = FAC_LAM_MV[i]
 FAC_TQ_REQ_GRD_SUM_DLY   =  0
```

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All ring buffer registers shall be initialized with the same value, namely the value of FAC_TQ_REQ at the moment of activation.

Signal flow diagram:

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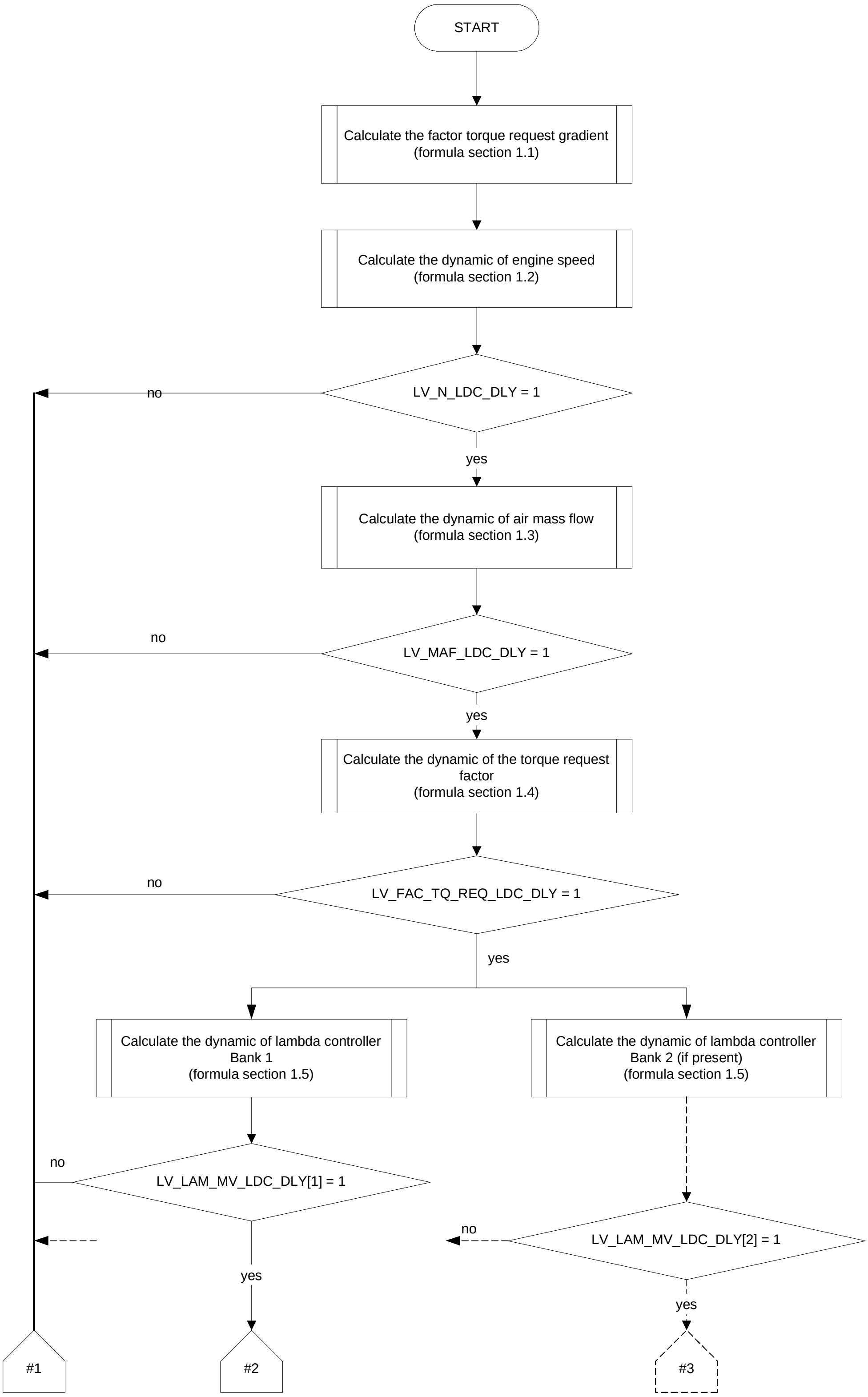

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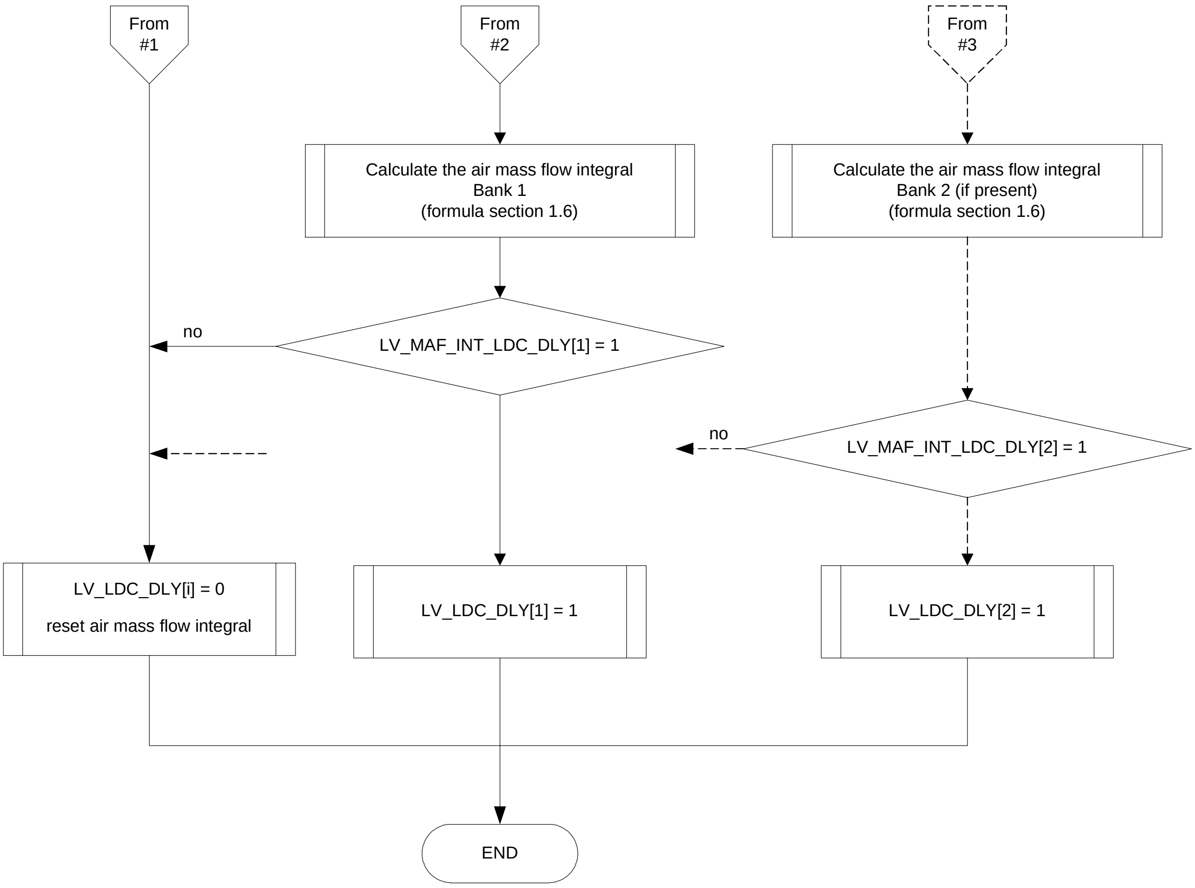

Formula section:

7.69.1 Calculation of the factor torque request gradient FAC_TQ_REQ_GRD

At every recurrence the variable FAC_TQ_REQ shall be written into a ring buffer containing the last four FAC_TQ_REQ values. The gradient of FAC_TQ_REQ (FAC_TQ_REQ_GRD) is calculated based on the FAC_TQ_REQ difference between the values contained in the first and last position of the ring buffer.

7.69.2 Limited engine speed (N) dynamics

The floating mean value N_MMV_DLY is computed using the averaging constant C_N_CRLC_DLY. The limited dynamics condition only exist while the engine speed N lies within the dynamics window around N_MMV_DLY.
If the above limited dynamics condition is violated, the floating mean value N_MMV_DLY is set to the current engine speed in order to reach the limited dynamics condition faster:

N_MMV_DLY = N_MMV_DLY * (1 - C_N_CRLC_DLY) + C_N_CRLC_DLY * N

IF | N - N_MMV_DLY | < C_N_DYW_DLY
  THEN LV_N_LDC_DLY = 1
  ELSE LV_N_LDC_DLY = 0
    N_MMV_DLY = N
ENDIF

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7.69.3 Limited mass air flow (MAF) dynamics

The floating mean value MAF_MMV_DLY is computed using the averaging constant C_MAF_CRLC_DLY. The limited dynamics condition only exist while the air mass MAF stays within the dynamics window around MAF_MMV_DLY.
If the above limited dynamics condition is violated, the floating mean value MAF_MMV_DLY is set to the current air-mass value in order to reach the limited dynamics condition faster:

IF LV_N_LDC_DLY = 1
THEN
MAF_MMV_DLY = MAF_MMV_DLY * (1 - C_MAF_CRLC_DLY) +
C_MAF_CRLC_DLY * MAF

IF | MAF - MAF_MMV_DLY | $<$ C_MAF_DYW_DLY
THEN LV_MAF_LDC_DLY = 1
ELSE LV_MAF_LDC_DLY = 0
MAF_MMV_DLY = MAF
ENDIF
ELSE
MAF_MMV_DLY = MAF
LV_MAF_LDC_DLY = 0
LV_LDC_DLY[i] = 0
MAF_INT_LDC_DLY[i] = 0
ENDIF

7.69.4 Limited requested torque factor gradient (FAC_TQ_REQ_GRD) dynamics

The FAC_TQ_REQ_GRD reflects the dynamic of the actual driver's demand prior to the corrections and is calculated with the recurence T_SAMPLE in [ms].
If C_FAC_TQ_REQ_GRD_SUM_MIN is larger than C_FAC_TQ_REQ_GRD_SUM_MAX the FAC_TQ_REQ gradient summation FAC_TQ_REQ_GRD_SUM_LDC_DLY will be no condition to determine the limited dynamic bit LV_LDC_DLY[i].

IF(3) LV_MAF_LDC_DLY = 1
THEN(3)
IF(3a) |FAC_TQ_REQ_GRD| C_FAC_TQ_REQ_GRD_MIN_LDC_DLY
THEN(3a) FAC_TQ_REQ_GRD_SUM_DLY$_{n+1}$ = FAC_TQ_REQ_GRD_SUM_DLY$_{n}$
\+ |FAC_TQ_REQ_GRD|
% Incrementation of FAC_TQ_REQ_GRD_SUM_DLY if FAC_TQ_REQ_GRD exceeds a threshold
ENDIF(3a)

T_FAC_TQ_REQ_GRD_SUM_DLY$_{n}$ =
T_FAC_TQ_REQ_GRD_SUM_DLY$_{n-1}$ + 1

IF(3b) T_FAC_TQ_REQ_GRD_SUM_DLY $\geq$
C_T_FAC_TQ_REQ_GRD_SUM_DLY
THEN(3b)
FAC_TQ_REQ_GRD_SUM_DLY$_{n}$ = FAC_TQ_REQ_GRD_SUM_DLY$_{n-1}$ -
C_FAC_TQ_REQ_GRD_DEC_DLY
% The decrementation by C_FAC_TQ_REQ_GRD_DEC_DLY is done every
% C_T_FAC_TQ_REQ_GRD_SUM_DLY intervalls

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```
            T_FAC_TQ_REQ_GRD_SUM_DLY  =  0
        ENDIF(3b)

        IF(3c)   C_FAC_TQ_REQ_GRD_SUM_MIN_DLY <
                                        C_FAC_TQ_REQ_GRD_SUM_MAX_DLY
        THEN(3c)        % FAC_TQ_REQ_GRD_SUM_DLY is condition for limited dynamic bit
            IF(4)     LV_FAC_TQ_REQ_LDC_DLY = 0
            THEN(4)              %  limited dynamic bit deactive, activation possible
                IF(5) FAC_TQ_REQ_GRD_SUM_DLY ≤
                                        C_FAC_TQ_REQ_GRD_SUM_MIN_DLY
                THEN(5)          % activation of limited dynamic bit
                    LV_FAC_TQ_REQ_LDC_DLY    =    1
                ENDIF(5)
            ELSE(4)              % limited dynamic bit active, deactivation possible

                IF(6) FAC_TQ_REQ_GRD_SUM_DLY >
                                         C_FAC_TQ_REQ_GRD_SUM_MAX_DLY
                THEN(6)         % deactivation of limited dynamic bit
                    LV_FAC_TQ_REQ_LDC_DLY   =    0
              ENDIF(6)
            ENDIF(4)
        ELSE(3c)
            LV_FAC_TQ_REQ_LDC_DLY  =    1
  ENDIF(3c)
ELSE(3)
  FAC_TQ_REQ_GRD_SUM_DLY     =  0
  T_FAC_TQ_REQ_GRD_SUM_DLY =  0
  LV_FAC_TQ_REQ_LDC_DLY   =    0
  LV_LDC_DLY[i] = 0
     MAF_INT_LDC_DLY[i] =   0
ENDIF(3)
```

7.69.5 Limited mean lambda controller output (FAC_LAM_MV[i]) dynamics

The floating mean value of the mean lambda controller output FAC_LAM_MV_MMV_DLY[i] is computed by using the averaging constant C_FAC_LAM_MV_CRLC_DLY. The limited dynamics condition is present while FAC_LAM_MV[i] stays within the dynamics window around FAC_LAM_MV_MMV_DLY[i]. If this condition violated, the correspondent flag is reset indicating a dynamic condition is present and the floating mean value FAC_LAM_MV_MMV_DLY[i] is set to the current value in order to reach the limited dynamics condition faster.

```
IF LV_FAC_TQ_REQ_LDC_DLY    =    1
THEN
  FAC_LAM_MV_MMV_DLY[i]   =
               FAC_LAM_MV_MMV_DLY[i] * (1 - C_LAM_MV_CRLC_DLY) +
                                           C_LAM_MV_CRLC_DLY * FAC_LAM_MV[i]

  IF | FAC_LAM_MV[i] - FAC_LAM_MV_MMV_DLY[i] | < C_LAM_MV_DYW_DLY
  THEN  LV_LAM_MV_LDC_DLY[i] = 1
  ELSE  LV_LAM_MV_LDC_DLY[i] = 0
              FAC_LAM_MV_MMV_DLY[i]   = FAC_LAM_MV[i]
```

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```
  ENDIF
ELSE
  FAC_LAM_MV_MMV_DLY[i]  = FAC_LAM_MV[i]
  LV_LAM_MV_LDC_DLY[i] = 0
  LV_LDC_DLY[i] = 0
    MAF_INT_LDC_DLY[i] =  0
ENDIF
```

7.69.6 Calculation of mass air flow integral

IF LV_LAM_MV_LDC_DLY[i] = 1
THEN
    IF MAF_INT_LDC_DLY[i] $\leq$ C_MAF_INT_MIN_LDC_DLY
    THEN
        LV_LDC_DLY[i] = 0
        MAF_INT_LDC_DLY[i]$_n$ = MAF_INT_LDC_DLY[i]$_{n-1}$ +
            MAF_KGH * NC_FAC_MAF_INT_20
    ELSE
        LV_LDC_DLY[i] = 1
    ENDIF
ELSE
  LV_LDC_DLY[i] = 0
  MAF_INT_LDC_DLY[i] = 0
ENDIF

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7.70 Lambda adaptation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_DELTA_H_RNG_LAM_AD [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 49.9984741	0.00152588	%
difference of lambda adaptation factor of high field to previous adaptation					
FAC_DELTA_L_RNG_LAM_AD [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 49.9984741	0.00152588	%
difference of lambda adaptation factor of low field to previous adaptation					
FAC_H_RNG_LAM_AD [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	0... 49.9984741	0.00152588	%
fuel mass set point factor of high field, stored value of lambda adaptation					
FAC_L_RNG_LAM_AD [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	0... 49.9984741	0.00152588	%
fuel mass set point factor of low field, stored value of lambda adaptation					
FAC_LAM_AD [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 49.9984741	0.00152588	%
fuel mass set point factor of lambda adaptation, interpolation of both factor areas (high and low field)					
FAC_LAM_AD_LAM_OUT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 49.9984741	0.00152588	%
fuel mass set point factor, output from lambda adaptation, input into lambda controller					
FAC_LAM_ADJ_LAM_AD [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 49.9984741	0.00152588	%
output value from lambda adaptation for the lambda controller shift					
FAC_MFF_ADD_FAC_LAM_AD [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	0... 99.996948	0.00305176	%
lambda adaptation correction for scan tool (factor and relative offset)					
FAC_MFF_ADD_LAM_AD_OUT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 99.996948	0.00305176	%
relative lambda adaptation offset quotient					
LV_FAC_H_RNG_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that lambda adaptation in factor learning upper field is active					
LV_FAC_H_RNG_LAM_AD_INI [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that high range Lambda adaptation is initialized with value of low range					
LV_FAC_H_RNG_LIM_MAX_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating top limitation of lambda adaptation factor of upper area					
LV_FAC_H_RNG_LIM_MIN_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating bottom limitation of lambda adaptation factor of upper area					
LV_FAC_L_RNG_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that lambda adaptation in factor learning lower field is active					
LV_FAC_L_RNG_LAM_AD_INI [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that low range Lambda adaptation is initialized with value of high range					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_FAC_L_RNG_LIM_MAX_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating top limitation of lambda adaptation factor of lower area					
LV_FAC_L_RNG_LIM_MIN_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating bottom limitation of lambda adaptation factor of lower area					
LV_FAC_LAM_AD_SHIFT_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Shift of Lambda adaptation was carried out					
LV_FAC_LAM_ADJ_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag to request lambda controller shift					
LV_LAM_AD_AFS_REQ	O/V	0... 1H	0 ...1	1	-
request flag for combustion manager to force lambda eq. 1 conditions for lambda adaptation					
LV_LAM_AD_CDN	O/V	0... 1H	0 ...1	1	-
flag for time scheduler indicating good conditions for lambda adaptation					
LV_LAM_AD_END	O/V	0... 1H	0 ...1	1	-
logical value indicating temporary end of lambda adaptation					
LV_LAM_AD_END_CBK [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
logical value indicating temporary end of lambda adaptation (bank specific flag)					
LV_LAM_AD_STOP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
logical variable indicating stop of the lambda adaptation cycle					
LV_LAM_AD_STOP_CBK_EX	V	0... 1H	0 ...1	1	-
logical variable indicating stop of at least one bank of the lambda adaptation cycle					
LV_MFF_ADD_LIM_MAX_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating top limitation of lambda adaptation offset					
LV_MFF_ADD_LIM_MIN_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating bottom limitation of lambda adaptation offset					
LV_MFF_ADD_RNG_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that lambda adaptation in offset learning field is active					
MFF_ADD_LAM_AD [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
fuel mass set point offset, stored value of lambda adaptation					
MFF_DELTA_ADD_LAM_AD [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
difference of lambda adaptation offset to previous adaptation					
MFF_DELTA_ADD_LAM_AD_H_RES [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 10.8496689	33.1116e3	mg/stk
difference integral with high resolution of lambda adaptation offset					
MFF_LAM_ADD_LAM_AD_OUT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
fuel mass set point offset, output from lambda adaptation, input into lambda controller					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_LAM_AD [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H 4H 5H 6H 7H	INIT WAIT CDN_FAC_L CDN_FAC_H CDN_ADD ADAPT_FAC_L ADAPT_FAC_H ADAPT_ADD	-	-
state of lambda adaptation					
T_PRI_LAM_AD [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
priority time for next requested lambda adaptation					
T_PRI_TOT_LAM_AD	O/V	0... FFFFH	0... 6553.5	0.1	s
minimum priority time of all exhaust cylinder banks for next requested lambda adaptation					
T_WAIT_LAM_AD [NC_CBK_EX_NR]	V	0... FFH	0... 5.1	0.02	s
waiting time between two adaptations					

Input data:

C_TCO_MIN_LAM_AD {p. 2724}	CRLC_LAM_AD [NC_CBK_EX_NR] {p. 2721}	FAC_LAM_AD_SHIFT [NC_CBK_EX_NR] {p. 2721}	FAC_LAM_AD_WUP [NC_CBK_EX_NR] {p. 2677}
FAC_LAM_ADJ_LAM_AD_WUP [NC_CBK_EX_NR] {p. 2677}	FAC_LAM_MV_MMV [NC_CBK_EX_NR] {p. 2462}	LV_FAC_LAM_AD_SHIFT [NC_CBK_EX_NR] {p. 2721}	LV_FAC_LAM_ADJ_LAM_AD_END [NC_CBK_EX_NR] {p. 2463}
LV_FAC_LAM_ADJ_LAM_AD_WUP [NC_CBK_EX_NR] {p. 2677}	LV_IGK {p. 906}	LV_LAM_AD_ACT [NC_CBK_EX_NR] {p. 2721}	LV_LAM_AD_CDN_ADD [NC_CBK_EX_NR] {p. 2721}
LV_LAM_AD_CDN_H_RNG [NC_CBK_EX_NR] {p. 2721}	LV_LAM_AD_CDN_L_RNG [NC_CBK_EX_NR] {p. 2721}	LV_LAM_AD_DEAC_ERR [NC_CBK_EX_NR] {p. 2721}	LV_LAM_AD_ENA {p. 3737}
LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_ST_END {p. 1720}	MFF_SP [NC_CBK_EX_NR] {p. 2151}	MFF_SP_AD [NC_CBK_EX_NR] {p. 2721}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	T_WAIT_MAX_LAM_AD [NC_CBK_EX_NR] {p. 2721}	TCO {p. 1100}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_MAX_H_RNG_LAM_AD	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
maximum value of upper area lambda adaptation factor					
C_FAC_MAX_L_RNG_LAM_AD	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
maximum value of lower area lambda adaptation factor					
C_FAC_MIN_H_RNG_LAM_AD	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
minimum value of upper area lambda adaptation factor					
C_FAC_MIN_L_RNG_LAM_AD	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
minimum value of lower area lambda adaptation factor					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MFF_MAX_ADD_RNG_LAM_AD	-	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
maximum value of lambda adaptation offset					
C_MFF_MIN_ADD_RNG_LAM_AD	-	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
minimum value of lambda adaptation offset					
C_MFF_SP_TOL_ADD_RNG_LAM_AD	-	0... FFFFH	0... 1389	0.02119478	mg/stk
maximum fuel mass set point for offset lambda adaptation					
C_N_BOL_FAC_H_RNG_LAM_AD	-	0... FFH	0... 8160	32	rpm
minimum engine speed for upper area factor lambda adaptation					
C_N_BOL_FAC_L_RNG_LAM_AD	-	0... FFH	0... 8160	32	rpm
minimum engine speed for lower area factor lambda adaptation					
C_N_TOL_ADD_RNG_LAM_AD	-	0... FFH	0... 8160	32	rpm
maximum engine speed for offset lambda adaptation					
C_N_TOL_FAC_H_RNG_LAM_AD	-	0... FFH	0... 8160	32	rpm
maximum engine speed for upper area factor lambda adaptation					
C_N_TOL_FAC_L_RNG_LAM_AD	-	0... FFH	0... 8160	32	rpm
maximum engine speed for lower area factor lambda adaptation					
C_T_PRI_MAX_LAM_AD	-	0... FFFFH	0... 6553.5	0.1	s
maximum priority time to set temporary end of adaptation flag					
ID_MFF_SP_BOL_FAC_H_RNG_LAM_AD	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDP_N_32_ID_MFF_SP_BOL_H_RNG	8	0... FFH	0... 8160	32	rpm
minimum fuel mass set point for upper area factor lambda adaptation					
ID_MFF_SP_BOL_FAC_L_RNG_LAM_AD	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDP_N_32_ID_MFF_SP_BOL_L_RNG	8	0... FFH	0... 8160	32	rpm
minimum fuel mass set point for lower area factor lambda adaptation					
ID_MFF_SP_TOL_FAC_H_RNG_LAM_AD	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDP_N_32_ID_MFF_SP_TOL_H_RNG	8	0... FFH	0... 8160	32	rpm
maximum fuel mass set point for upper area factor lambda adaptation					
ID_MFF_SP_TOL_FAC_L_RNG_LAM_AD	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDP_N_32_ID_MFF_SP_TOL_L_RNG	8	0... FFH	0... 8160	32	rpm
maximum fuel mass set point for lower area factor lambda adaptation					
ID_T_PRI_FAC_H_RNG_LAM_AD	-	0... FFFFH	0... 6553.5	0.1	s
LDP_FAC_DELTA_H_RNG_LAM_AD_PRI	8	0... FFFFH	0... 49.998474	0.0015259	%
priority time for next requested lambda adaptation according to factor difference or upper area					
ID_T_PRI_FAC_L_RNG_LAM_AD	-	0... FFFFH	0... 6553.5	0.1	s
LDP_FAC_DELTA_L_RNG_LAM_AD_PRI	8	0... FFFFH	0... 49.998474	0.0015259	%
priority time for next requested lambda adaptation according to factor difference or lower area					
ID_T_PRI_MFF_ADD_RNG_LAM_AD	-	0... FFFFH	0... 6553.5	0.1	s
LDP_MFF_DELTA_ADD_LAM_AD_T_PRI	8	0... FFFFH	0... 694.489403	0.021195	mg/stk
priority time for next requested lambda adaptation according to offset difference					
IP_FAC_N_FAC_LAM_AD	-	0... 80H	0 ...1	0.0078125	-
LDPM_N_32_4_LACO	6	0... FFH	0... 8160	32	rpm
factor on lambda adaptation factor depending on engine speed					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_N_MFF_ADD_LAM_AD	-	0... 80H	0 ...1	0.0078125	-
LDPM_N_32_4_LACO	6	0... FFH	0... 8160	32	rpm
factor on lambda adaptation offset depending on engine speed					
IP_MFF_SP_MAX_FAC_L_RNG_LAM_AD	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDPM_N_32_5_LACO	8	0... FFH	0... 8160	32	rpm
fuel mass set point threshold for consideration of only lower field lambda adaptation factor					
IP_MFF_SP_MIN_FAC_H_RNG_LAM_AD	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDPM_N_32_5_LACO	8	0... FFH	0... 8160	32	rpm
fuel mass set point threshold for consideration of only upper field lambda adaptation factor					
LC_FAC_H_RNG_AFS_REQ_LAM_AD	-	0... 1H	0 ...1	1	-
logical calibration to allow forced lambda eq. 1 conditions for factor adaptation at upper area					
LC_FAC_L_RNG_AFS_REQ_LAM_AD	-	0... 1H	0 ...1	1	-
logical calibration to allow forced lambda eq. 1 conditions for factor adaptation at upper area					
LC_FAC_LAM_AD_INI_ACT	-	0... 1H	0 ...1	1	-
logical calibration to allow initialization of adaptation factor from other range					
LC_MFF_ADD_RNG_AFS_REQ_LAM_AD	-	0... 1H	0 ...1	1	-
logical calibration to allow forced lambda eq. 1 conditions for offset adaptation					

General Information

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

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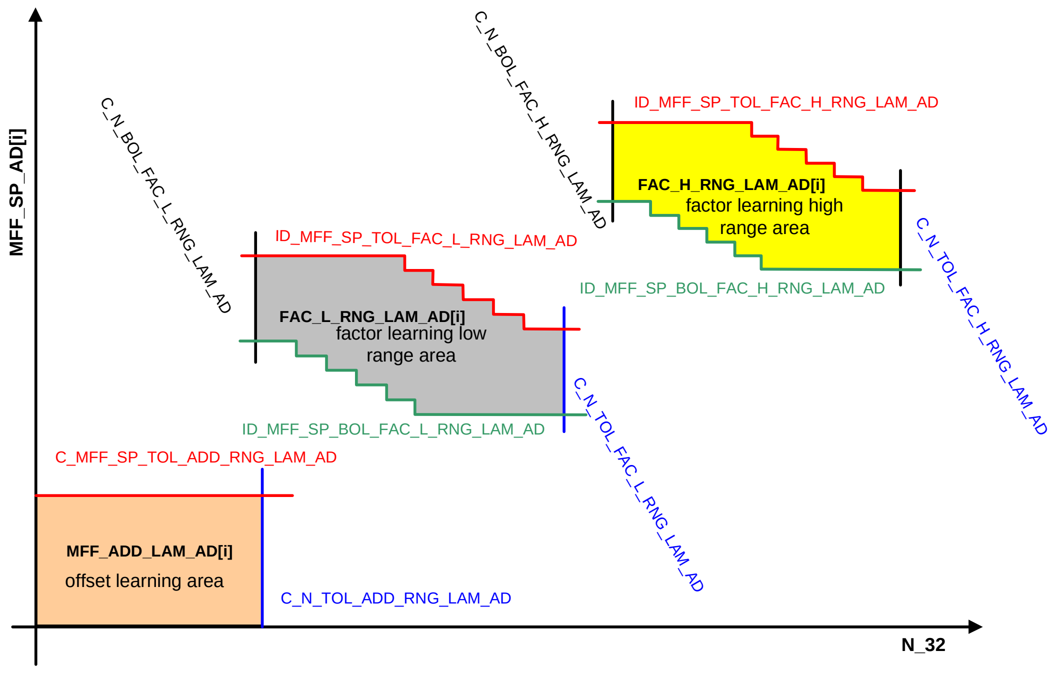

Adaptation field diagram

According to project philosophy homogeneous mode and suitable conditions can be forced by setting:
LC_MFF_ADD_RNG_AFS_REQ_LAM_AD,
LC_FAC_L_RNG_AFS_REQ_LAM_AD and /or
LC_FAC_H_RNG_AFS_REQ_LAM_AD.

Furthermore this function is used by the lambda adaptation in warmup phase to provide an unique interface to lambda controller and fuel mass set point calculation.

NC_CBK_EX_NR defines the number of exhaust banks.
For vector elements the variable extension "_i" is used in the model instead of "[i]" as found in the textual description.

Application Condition

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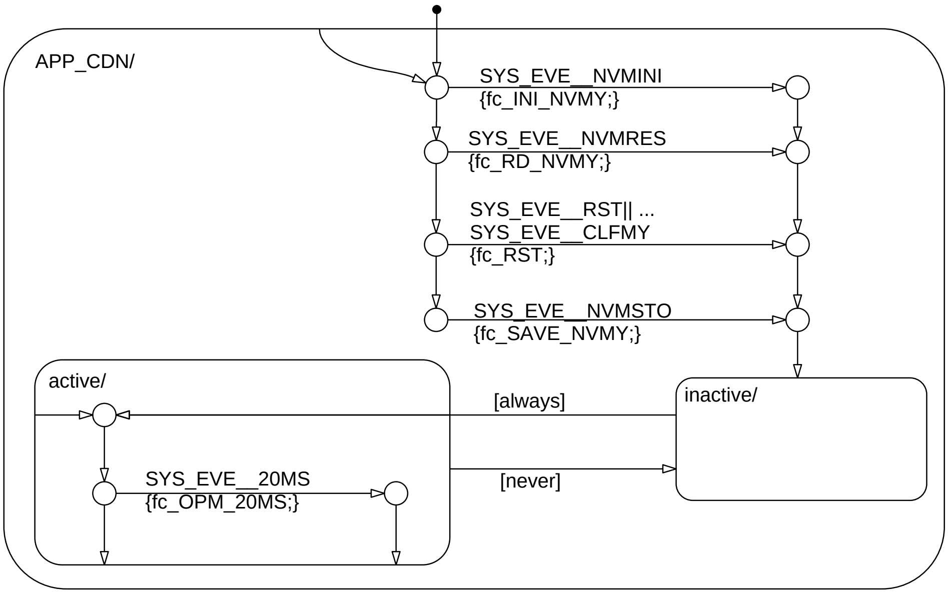

Figure 7.70.1: LACO_ISPCLADA0/APP_CDN/Chart

Function Description

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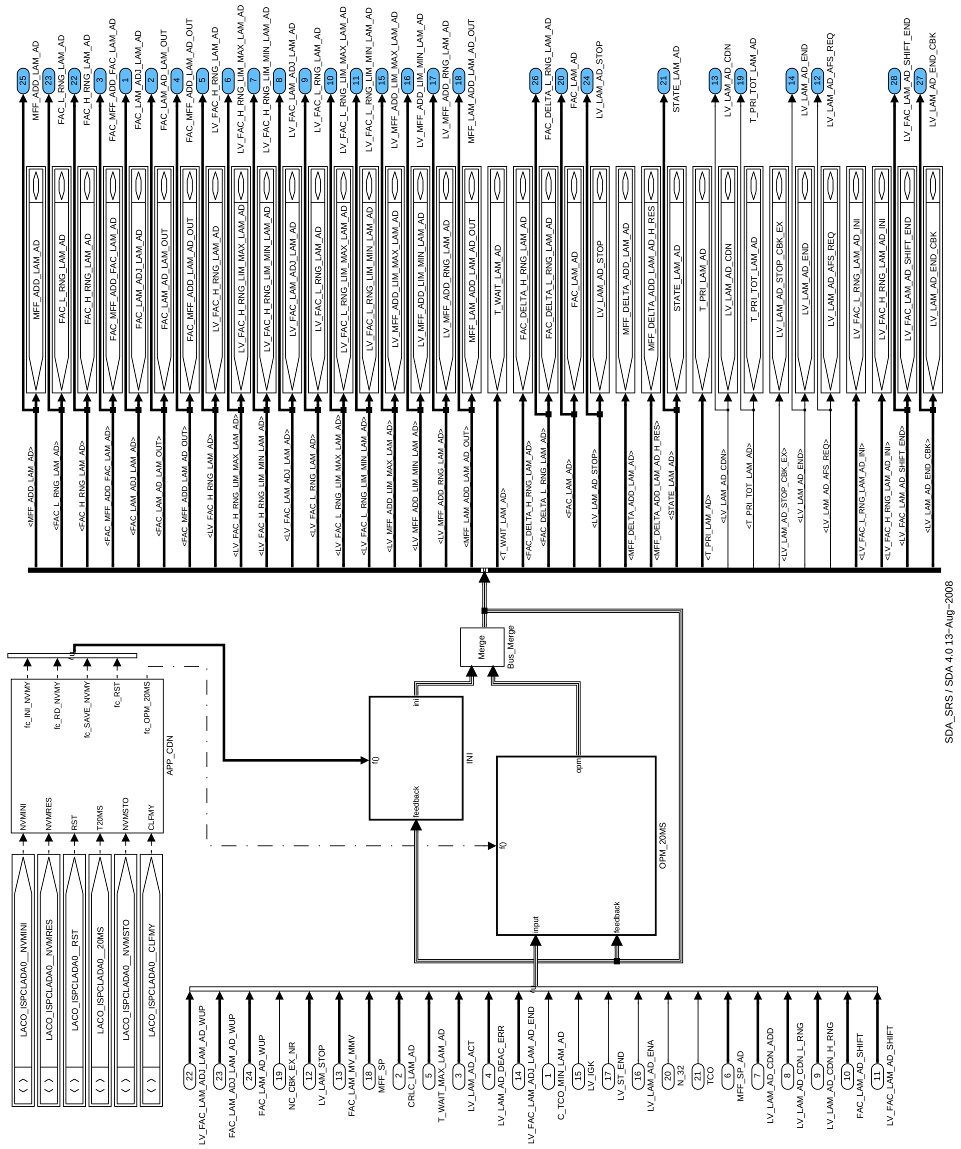

Figure 7.70.2: LACO_ISPCLADA0

7.70.1 Initialization and Non Volatile Memory Data Handling

ECU Reset

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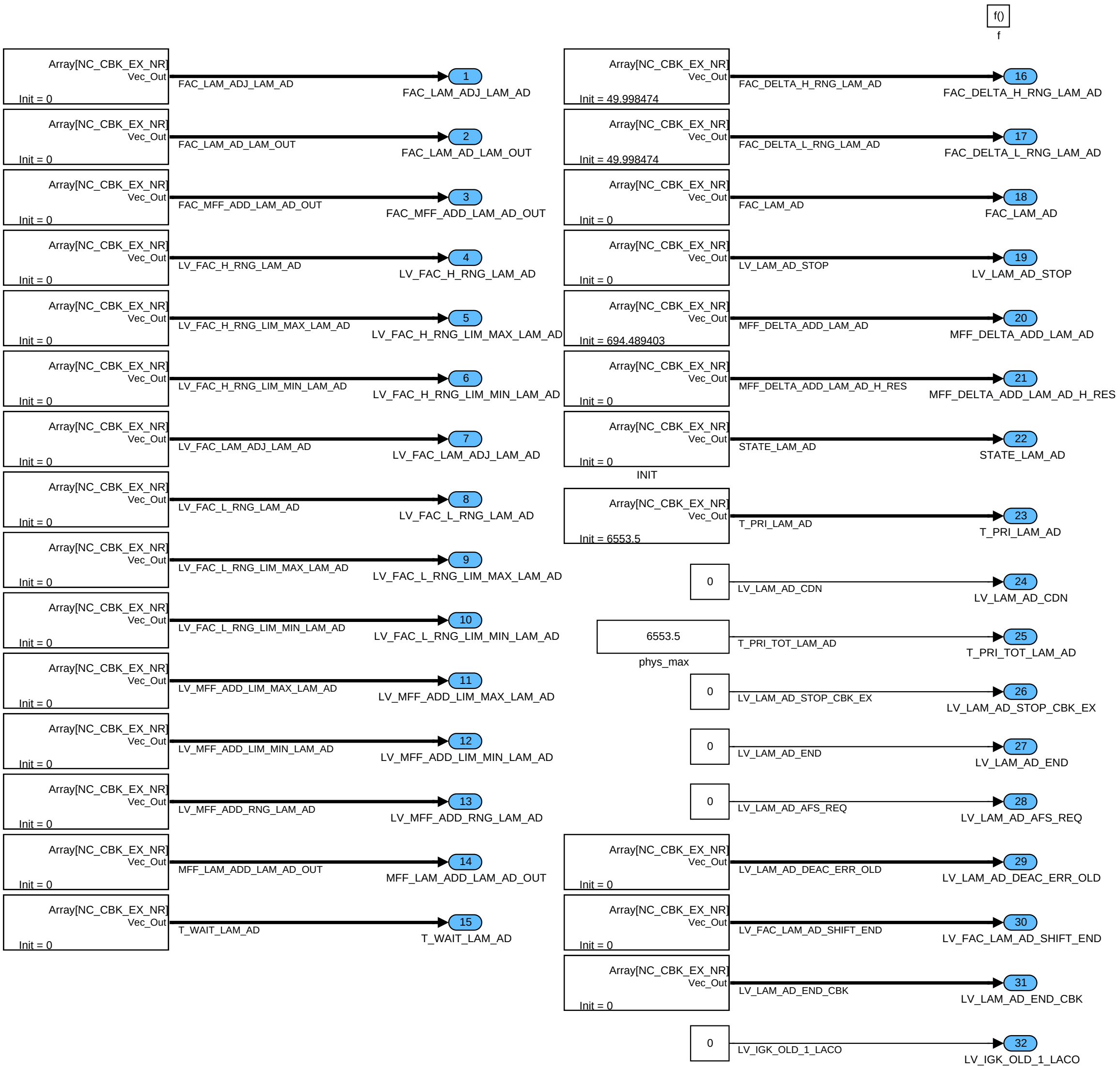

Figure 7.70.3: LACO_ISPCLADA0/INI/RST

Non Volatile Memory Data

MFF_ADD_LAM_AD[i], FAC_L_RNG_LAM_AD[i], FAC_H_RNG_LAM_AD[i] and FAC_MFF_ADD_FAC_LAM_AD[i] are stored in the NVMY (at the end of PWL phase) and read out at ECU reset.
If the ECU is brand new or in case of EEPROM error these data are set to the default value 0.
Furthermore the variables MFF_ADD_LAM_AD_TMP[i], FAC_L_RNG_LAM_AD_TMP[i] and FAC_H_RNG_LAM_AD_TMP[i] are used to store the initial values of MFF_ADD_LAM_AD[i], FAC_L_RNG_LAM_AD[i] and FAC_H_RNG_LAM_AD[i] during the whole driving cycle for potential use.
If the low range or the high adaptation value is zero indicating that the adaptation value was not yet learned since the last reset of the NVMY data, LV_FAC_L_RNG_LAM_AD_INI[i] respectively LV_FAC_H_RNG_LAM_AD_INI[i] are set to one.

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7.70.2 Formula Section

The main functionality is executed by means of a FOR loop over the number of exhaust banks. Only the determination of the priority information for the priority manager between canister purge and lambda adaptation is independent of the number of exhaust banks and executed after the FOR loop.

For Loop over Number of Exhaust Banks

Initialization of FOR Loop

Set Variables

Before executing the for loop variables are initialized.

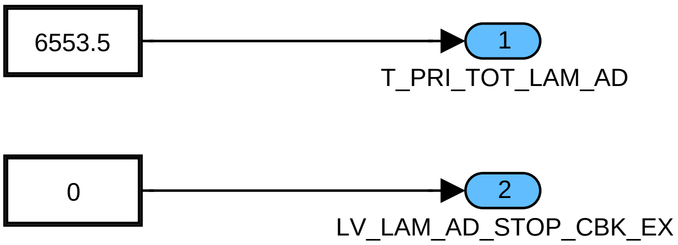

Figure 7.70.4: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/FB_INI_FLP/INI_FLP

State Machine Management and State Independent Calculations

Manage Lambda Adaptation State Machine

Determine Calibration Values Used inside State Machine

The calibration data used to determine the current adaptation field are evaluated.

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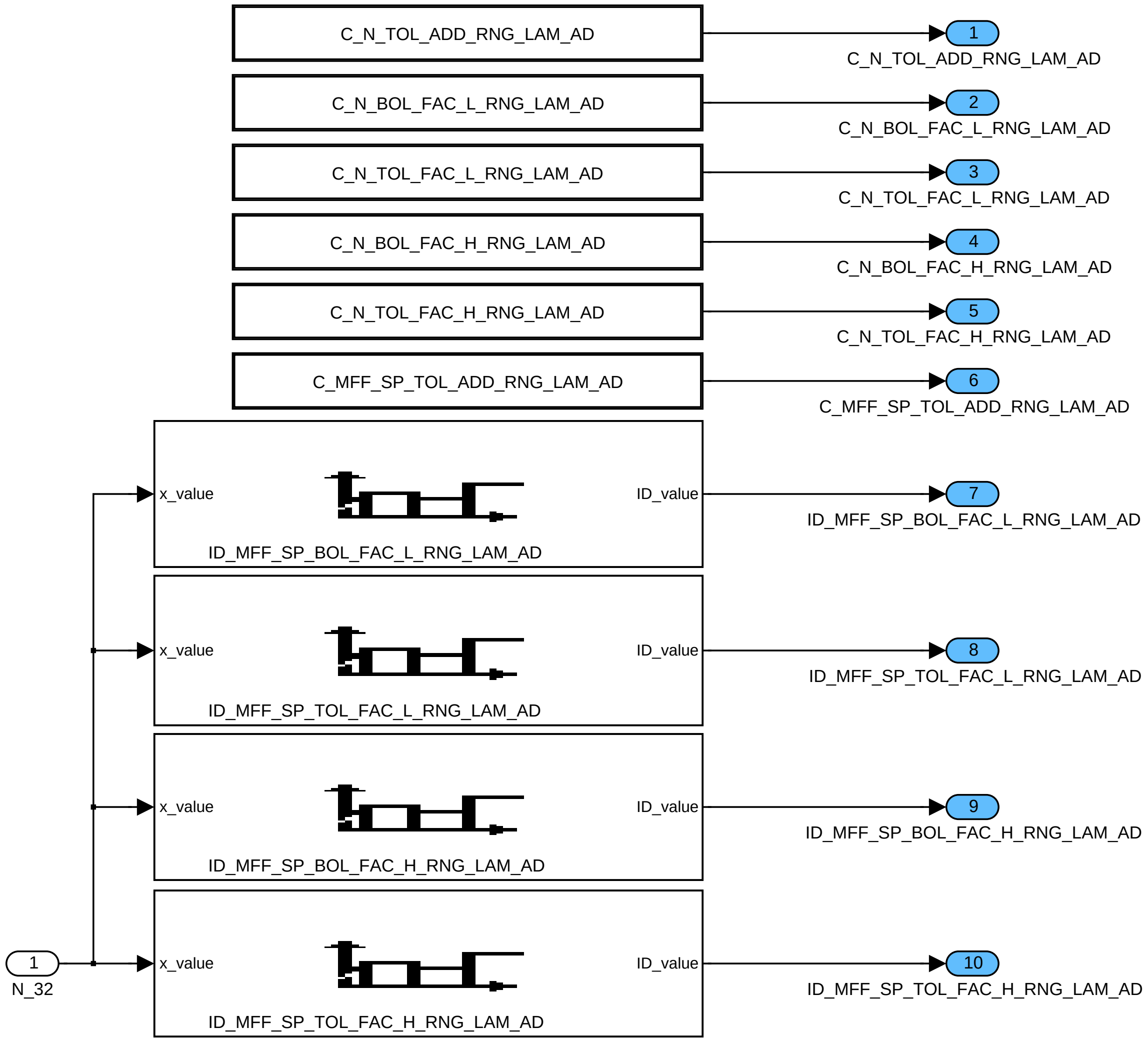

Figure 7.70.5:
LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/DET_STATE_LAM_AD/SET_CAL_VALUE

State Machine

If the lambda adaptation is not active the state INIT is applied.
If the engine is not running in one of the adaptation fields the state WAIT is applied.
Depending on fuel mass flow and engine speed limits the respective states are entered.
If the respective condition bit LV_LAM_AD_CDN_ADD; LV_LAM_AD_CDN_L_RNG or LV_LAM_AD_CDN_H_RNG is set, the adaptation state ADAPT_ADD, ADAPT_FAC_L or ADAPT_FAC_H is applied.
Otherwise one of the condition states is applied (CDN_ADD, CDN_FAC_L or CDN_FAC_H).
Furthermore at each transition to one of the adaptation sates the counter CTR_RAF_CHG_LAM_AD[i] is set to 0.

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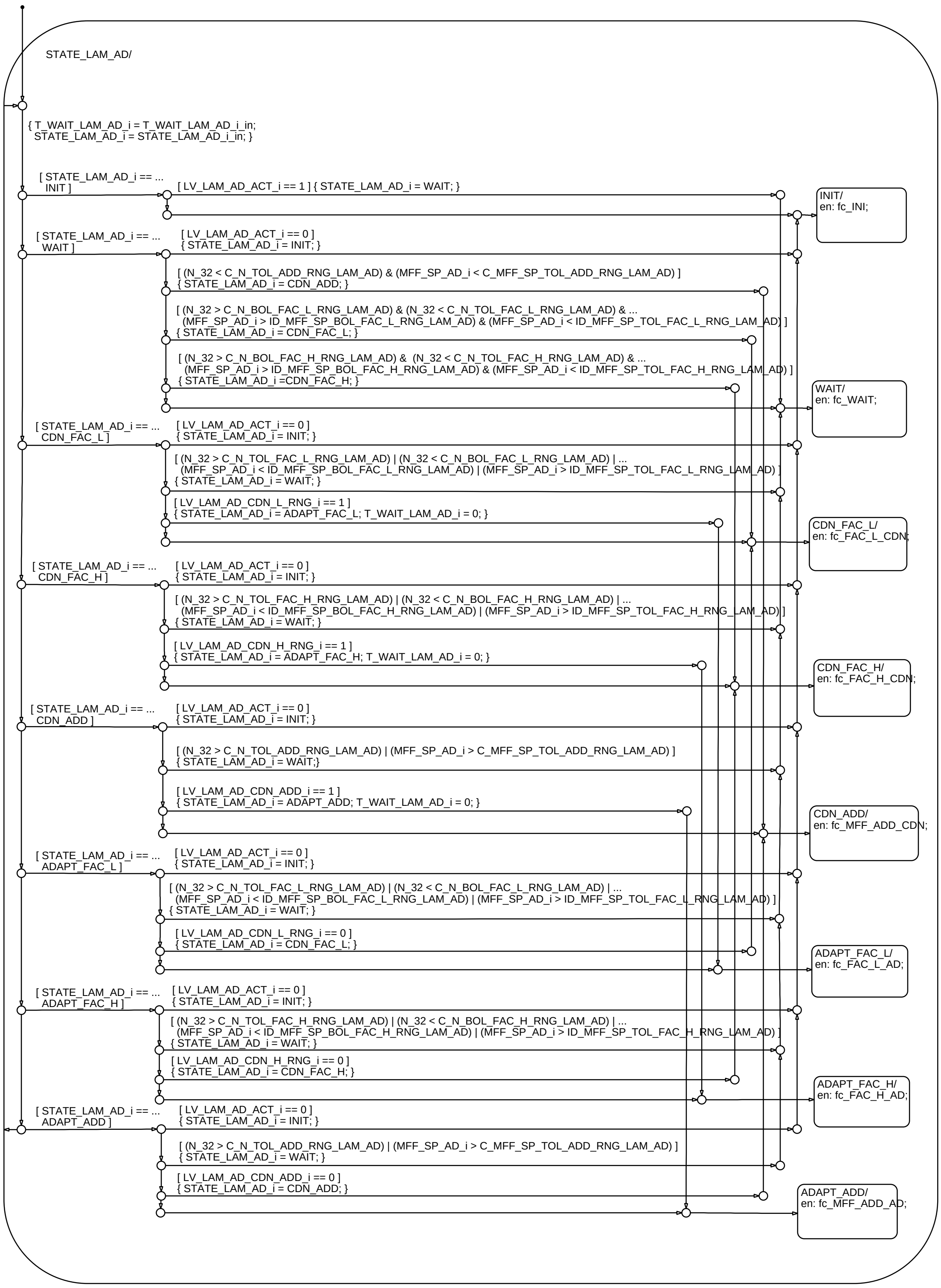

Figure 7.70.6: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/DET_STATE_LAM_AD/STATE_LAM_AD/STATE_LAM_AD

State Actions

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The following flags are set in any state.
LV_LAM_AD_CDN is indicating that the conditions for adaptation are fulfilled (used by priority manager between canister purge and lambda adaptation).
LV_LAM_AD_END sets the temporary end of lambda adaptation (to indicate to the priority manager that the priority for lambda adaptation is low).
LV_LAM_AD_AFS_REQ (if set to 1) requests stoichiometric mixture.
LV_MFF_ADD_RNG_LAM_AD[i], LV_FAC_L_RNG_LAM_AD[i] and LV_FAC_H_RNG_LAM_AD[i] are indicating that the lambda adaptation is active and running in the respective adaptation field.

State INIT

Set Variables

The general flags are set to 0. All other variables remain unchanged.

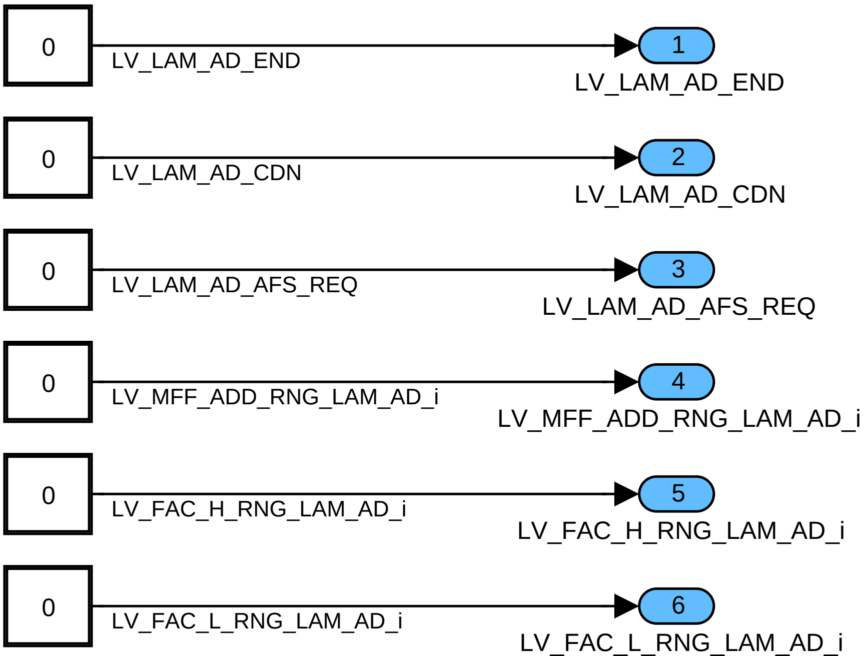

Figure 7.70.7:
LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/INI/SET_VALUE

State WAIT

Set Variables

The general flags are set to 0. The time T_PRI_LAM_AD[i] is set to the maximum value of the 3 adaptation fields. All other variables remain unchanged.

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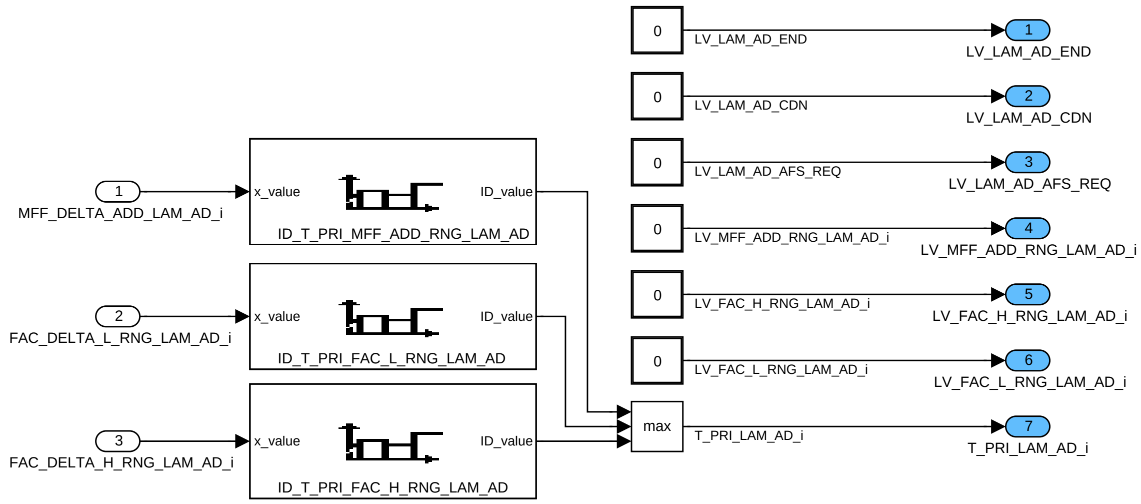

Figure 7.70.8:
LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/WAIT/SET_VALUE

State CDN_ADD

Set Variables

LV_LAM_AD_CDN is set to 1 as the load conditions for adaptation are fulfilled.
If LV_LAM_AD_ENA is set by the priority manager and stoichiometry request is allowed for offset adaptation by means of the respective calibration flag LV_LAM_AD_AFS_REQ is set to 1.
T_PRI_LAM_AD[i] is set depending on the last learned value in this adaptation field.
The other general flags are set to 0 and all other variables remain unchanged.

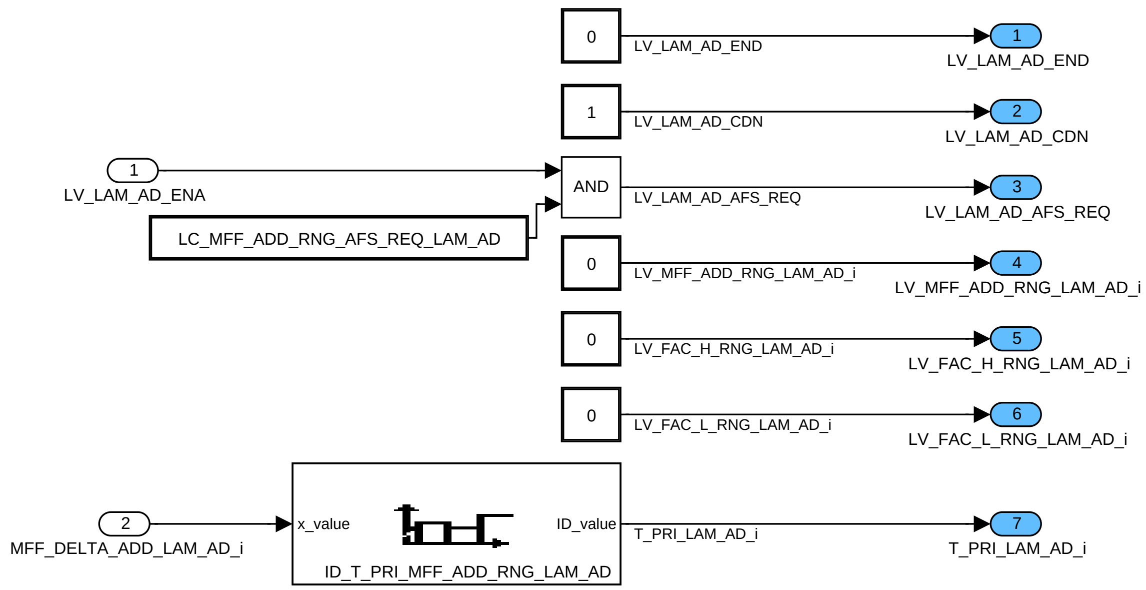

Figure 7.70.9: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/MFF_ADD_CDN/SET_VALUE

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State ADAPT_ADD

Set Variables

LV_MFF_ADD_RNG_LAM_AD[i] is set to 1 as adaptation is active in the respective adaptation field.

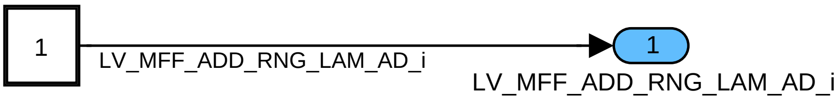

Figure 7.70.10:
LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/MFF_ADD_AD/SET_VALUE

Check Stopped Lambda Adaptation Cycle

Lambda adaptation cycle shall not be stopped (LV_LAM_AD_STOP[i] must be 0).

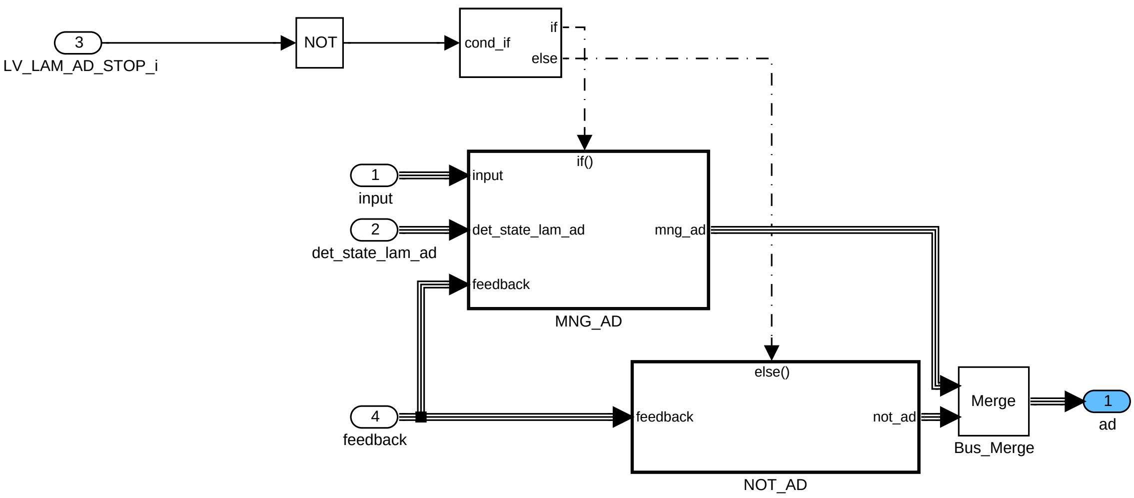

Figure 7.70.11:
LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/MFF_ADD_AD/AD

Wait for Timer Threshold Reached

Increment Counter

Wait timer is incremented by T_SAMPLE.

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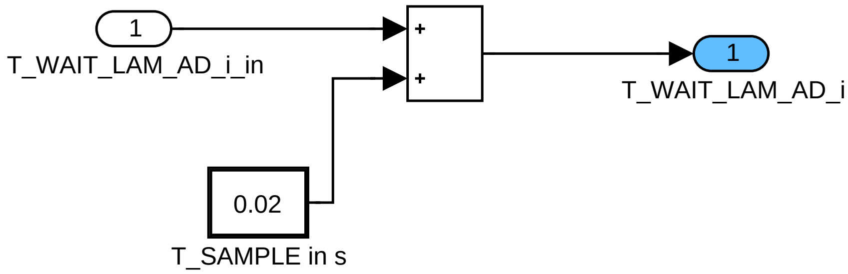

Figure 7.70.12: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/MFF_ADD_AD/AD/MNG_AD/INC_CTR

Check Wait Timer Threshold

New adaptation value is calculated if wait timer reaches threshold.

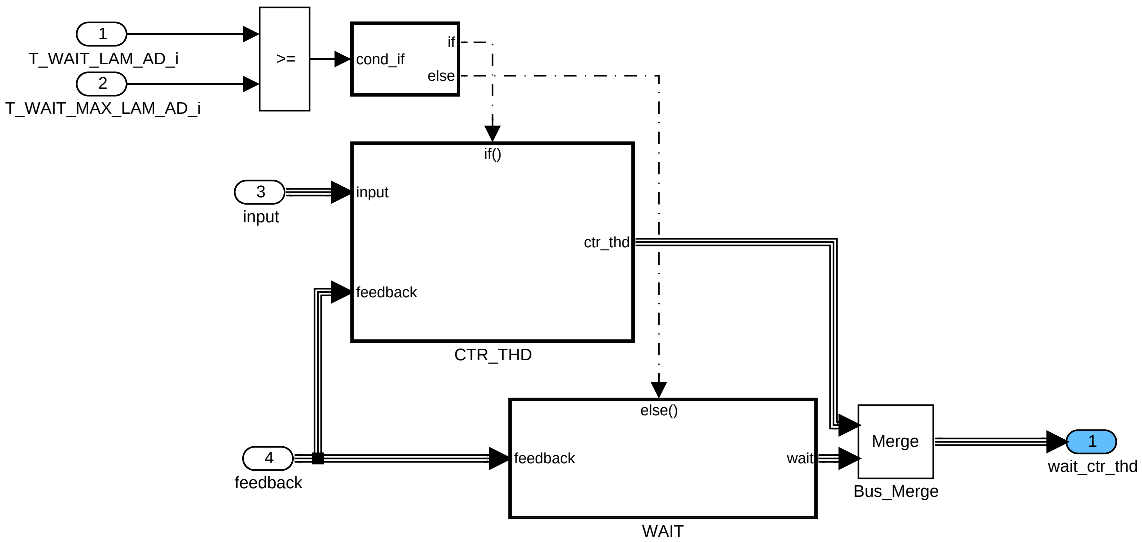

Figure 7.70.13: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/MFF_ADD_AD/AD/MNG_AD/WAIT_CTR_THD

Wait Timer threshold reached

Calculation of lambda controller shift

In order to apply the lambda controller shift with the same amount as the lambda adaptation shift FAC_LAM_ADJ_LAM_AD[i] is calculated based on the lambda controller output and a correlation constant (defined in application incidences) The respective lambda adaptation shift is calculated (with high resolution by the internal variable MFF_DELTA_ADD_LAM_AD_H_RES[i]) by multiplying FAC_LAM_ADJ_LAM_AD[i] with the fuel mass flow set point. The result is assigned to MFF_DELTA_ADD_LAM_AD[i] which is the lambda adaptation shift that is finally applied.
The variable MFF_DELTA_ADD_LAM_AD[i] will be 0 as long as the absolute value of MFF_DELTA_ADD_LAM_AD_H_RES[i] is below the resolution of MFF_DELTA_ADD_LAM_AD[i]

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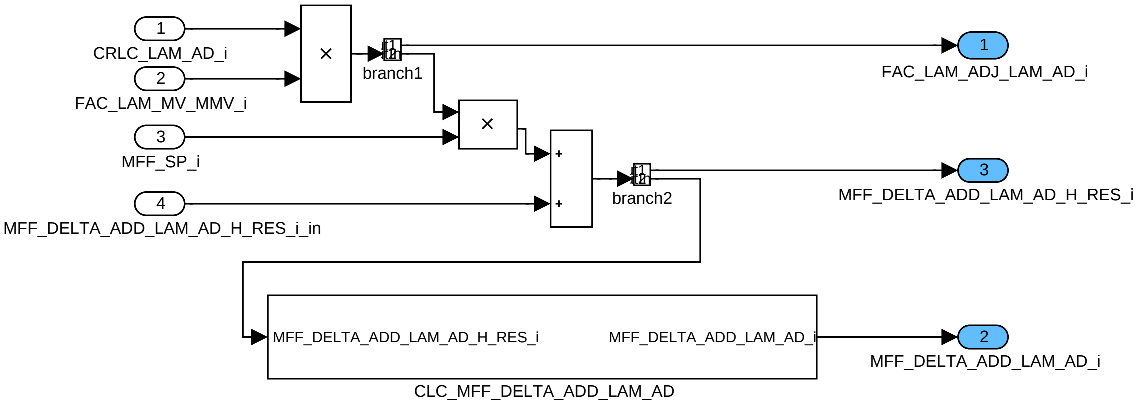

Figure 7.70.14: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/MFF_ADD_AD/AD/MNG_AD/WAIT_CTR_THD/CTR_THD/CLC_LAM_SHIFT

Wait for determination of new adaptation value

As long as MFF_DELTA_ADD_LAM_AD[i] is 0 no new adaptation value is taken into account.

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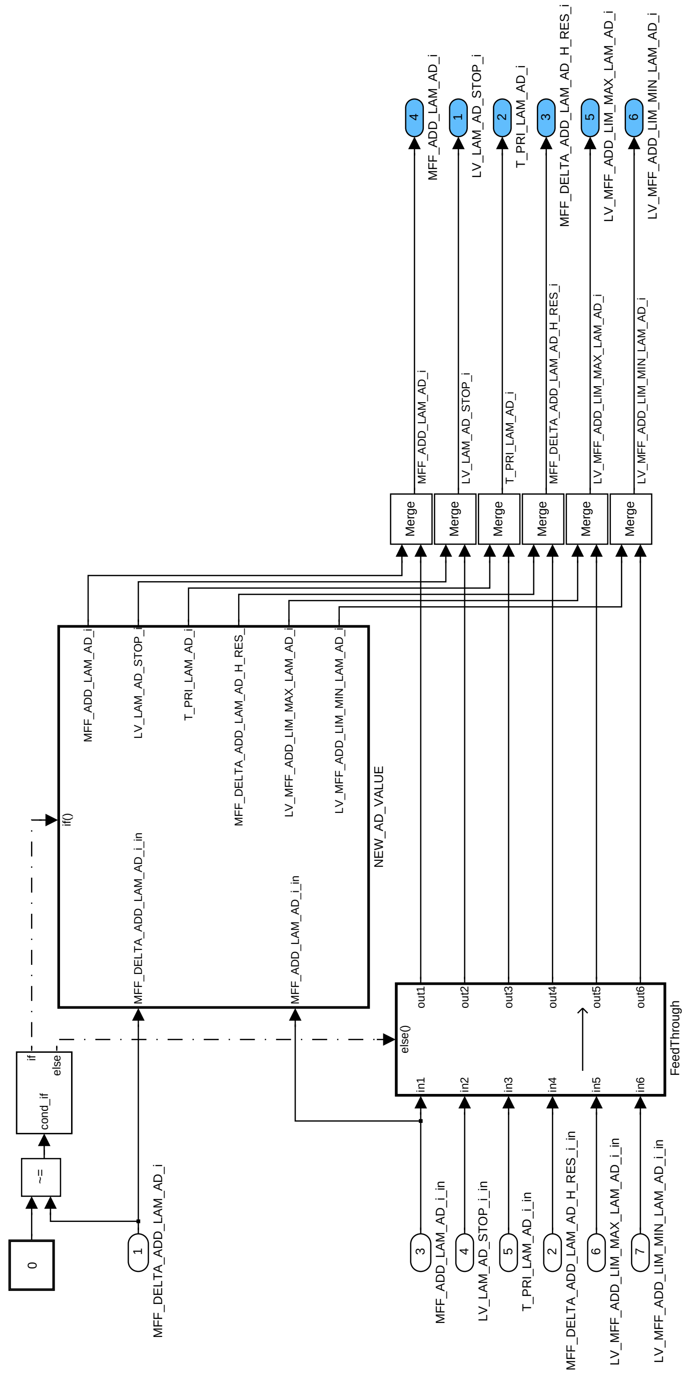

Figure 7.70.15: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/MFF_ADD_AD/AD/MNG_AD/WAIT_CTR_THD/CTR_THD/WAIT_NEW_AD_VALUE

Determine new adaptation value

The new delta is added to the adaptation value and limited on upper and lower thresholds. If these thresholds are exceeded the respective flags are set to 1.
A new priority time is evaluated based on the delta.
LV_LAM_AD_STOP[i] is set to 1 to indicate that a lambda controller shift can take place.

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MFF_DELTA_ADD_LAM_AD_H_RES[i] is set to 0 for next learning sequence.

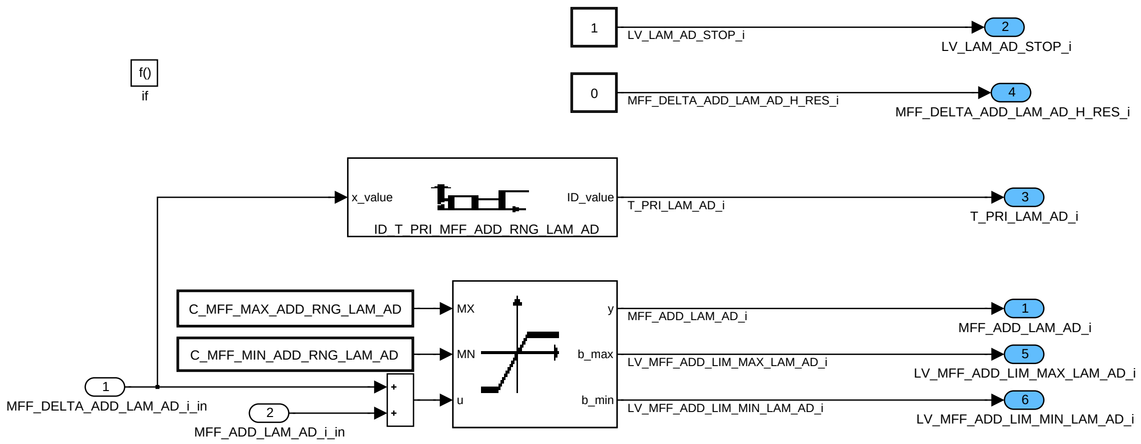

Figure 7.70.16: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/MFF_ADD_AD/AD/MNG_AD/WAIT_CTR_THD/CTR_THD/WAIT_NEW_AD_VALUE/NEW_AD_VALUE

State CDN_FAC_L

Set Variables

LV_LAM_AD_CDN is set to 1 as the load conditions for adaptation are fulfilled.
If LV_LAM_AD_ENA is set by the priority manager and stoichiometry request is allowed for lower factor field adaptation by means of the respective calibration flag LV_LAM_AD_AFS_REQ is set to 1.
T_PRI_LAM_AD[i] is set depending on the last learned value in this adaptation field.
The other general flags are set to 0 and all other variables remain unchanged.

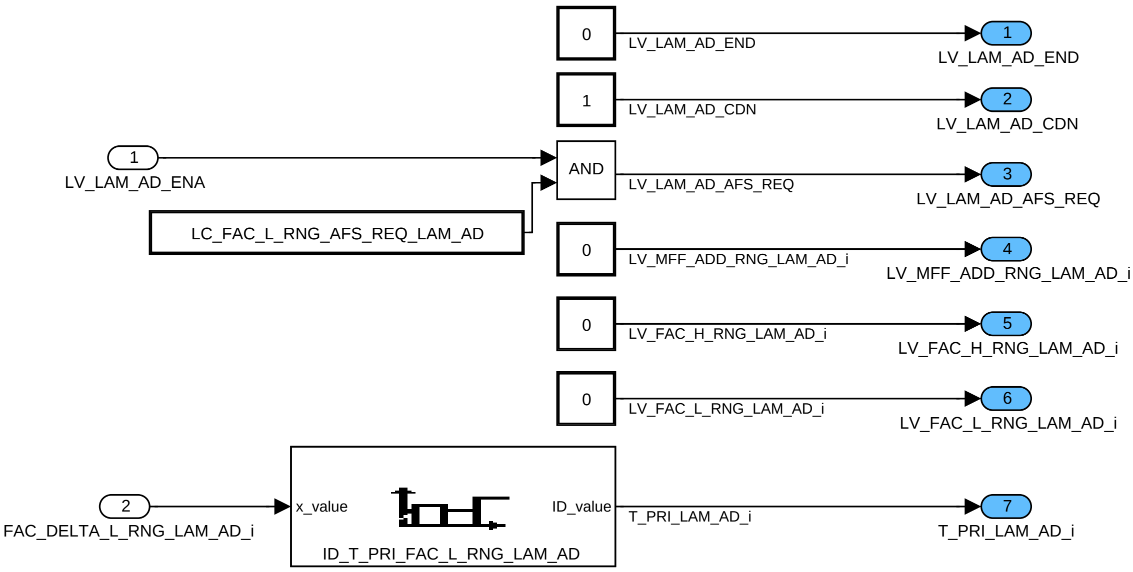

Figure 7.70.17:
LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/FAC_L_CDN/SET_VALUE

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State ADAPT_FAC_L

Set Variables

LV_FAC_L_RNG_LAM_AD[i] is set to 1 as adaptation is active in the respective adaptation field.

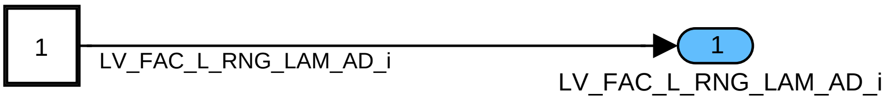

Figure 7.70.18:
LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/FAC_L_AD/SET_VALUE

Check Stopped Lambda Adaptation Cycle

Lambda adaptation cycle shall not be stopped (LV_LAM_AD_STOP[i] must be 0).

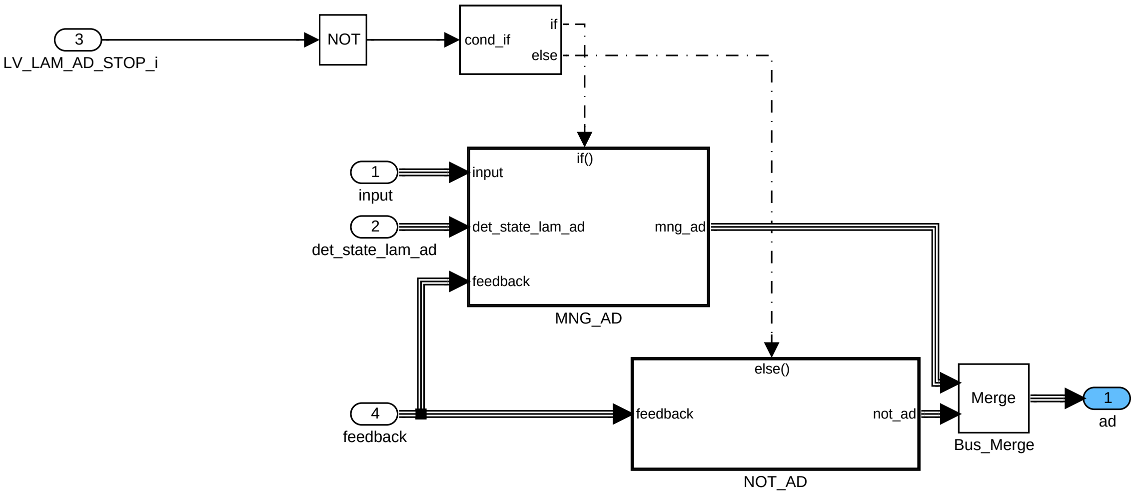

Figure 7.70.19:
LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/FAC_L_AD/AD

Wait for Timer Threshold Reached

Increment Counter

Wait timer is incremented by T_SAMPLE.

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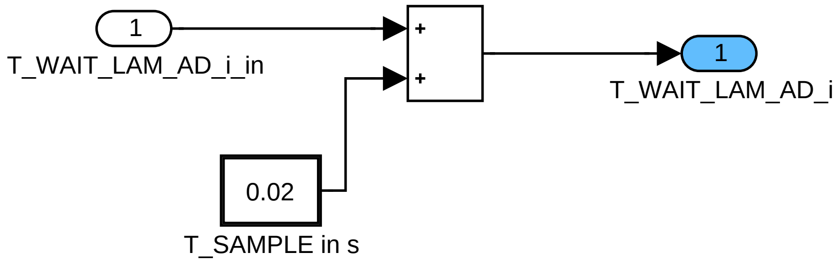

Figure 7.70.20: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/FAC_L_AD/AD/MNG_AD/INC_CTR

Check Wait Timer Threshold

New adaptation value is calculated if wait timer reaches threshold.

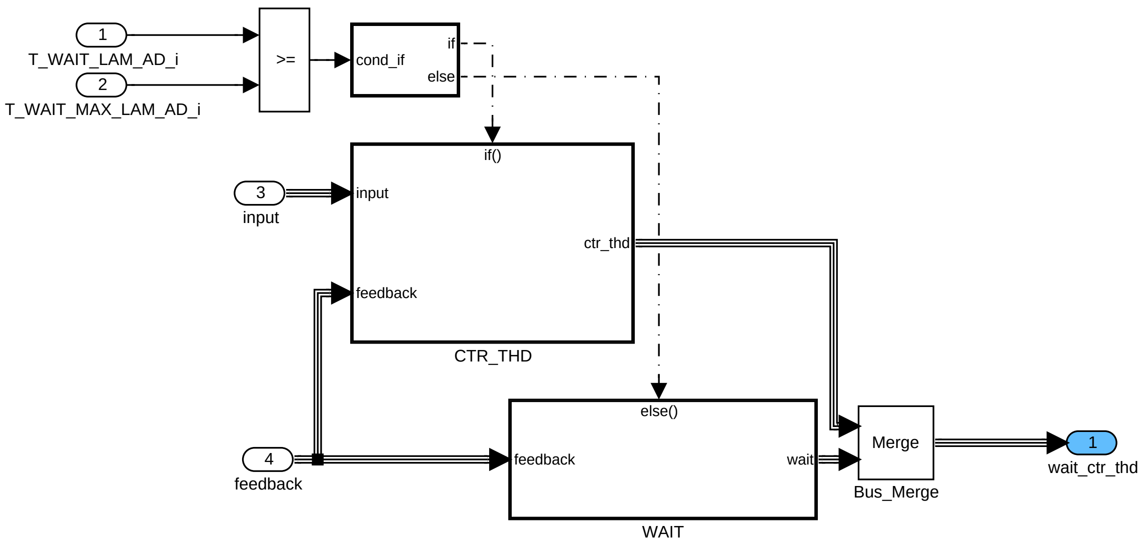

Figure 7.70.21: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/FAC_L_AD/AD/MNG_AD/WAIT_CTR_THD

Wait Timer Threshold Reached

Calculation of Lambda Controller Shift

The new delta for the adaptation value is calculated based on the lambda controller output and a correlation constant (defined in application incidences). This value is the same as for the shift applied to the lambda controller.

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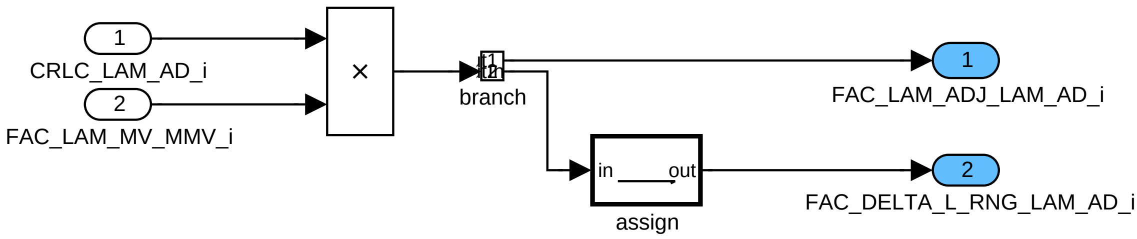

Figure 7.70.22: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/FAC_L_AD/AD/MNG_AD/WAIT_CTR_THD/CTR_THD/CLC_LAM_SHIFT

Determine New Adaptation Value

The new delta is added to the adaptation value and limited on upper and lower thresholds. If these thresholds are exceeded the respective flags are set to 1.
In case the high range adaptation value was not yet learned since the last reset of the NVMY data (indicated by LV_FAC_H_RNG_LAM_AD_INI[i] = 1), the low range value is written to the high range value.
A new priority time is evaluated based on the delta.
LV_LAM_AD_STOP[i] is set to 1 to indicate that a lambda controller shift can take place.

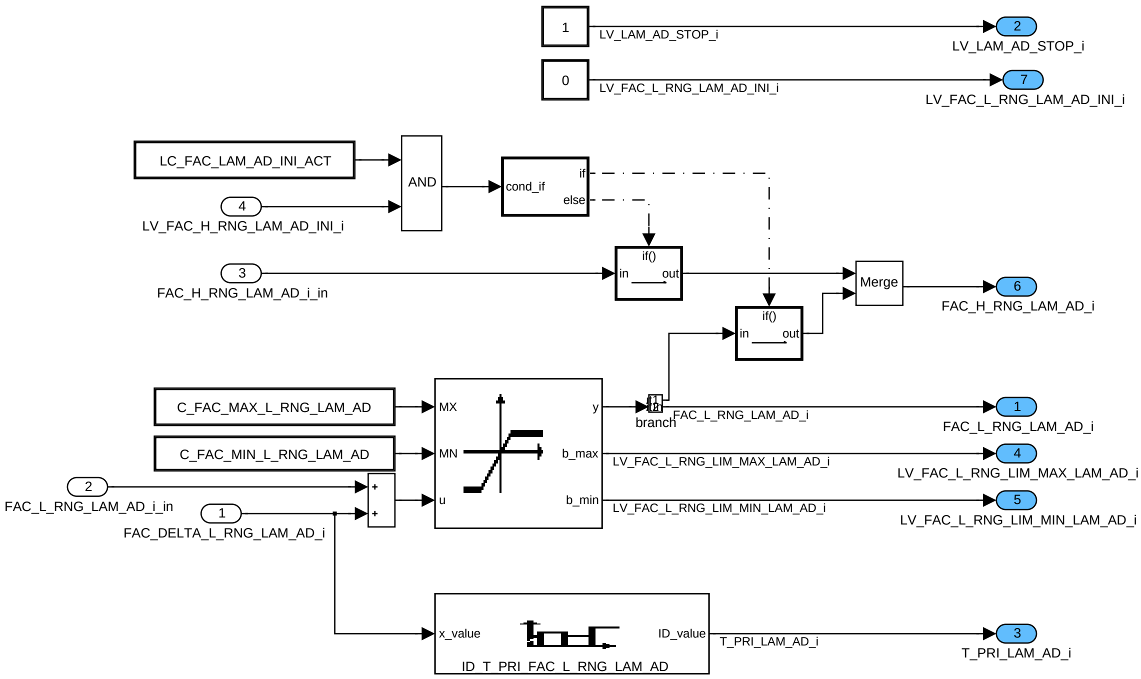

Figure 7.70.23: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/FAC_L_AD/AD/MNG_AD/WAIT_CTR_THD/CTR_THD/NEW_AD_VALUE

State CDN_FAC_H

Set Variables

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LV_LAM_AD_CDN is set to 1 as the load conditions for adaptation are fulfilled.
If LV_LAM_AD_ENA is set by the priority manager and stoichiometry request is allowed for higher factor field adaptation by means of the respective calibration flag LV_LAM_AD_AFS_REQ is set to 1.
T_PRI_LAM_AD[i] is set depending on the last learned value in this adaptation field.
The other general flags are set to 0 and all other variables remain unchanged.

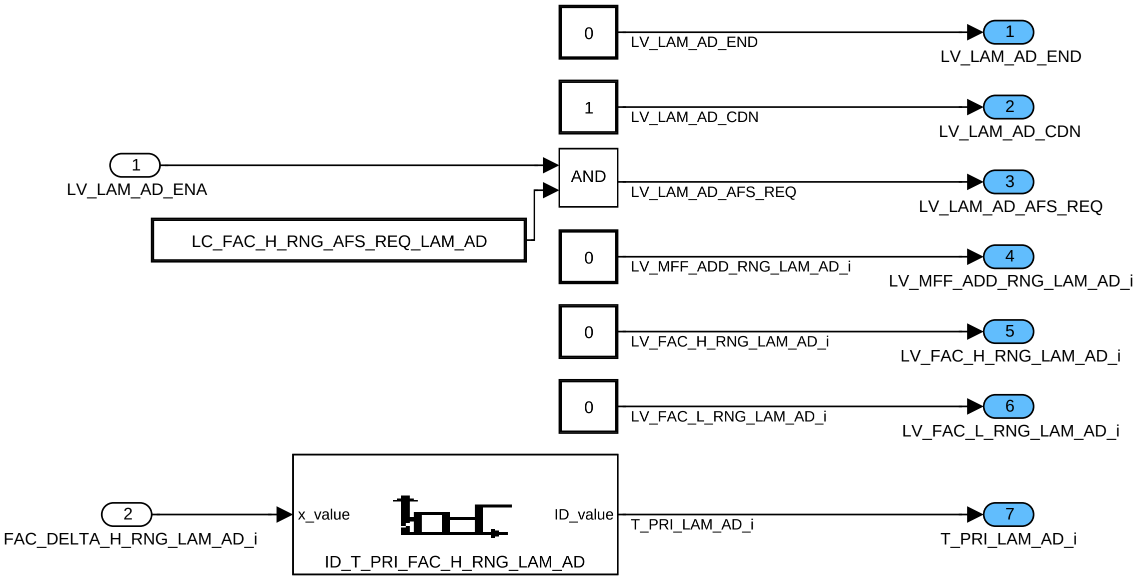

Figure 7.70.24:
LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/FAC_H_CDN/SET_VALUE

State ADAPT_FAC_H

Set Variables

LV_FAC_H_RNG_LAM_AD[i] is set to 1 as adaptation is active in the respective adaptation field.

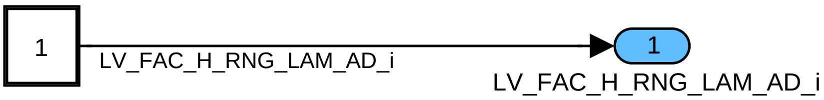

Figure 7.70.25:
LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/FAC_H_AD/SET_VALUE

Check Stopped Lambda Adaptation Cycle

Lambda adaptation cycle shall not be stopped (LV_LAM_AD_STOP[i] must be 0).

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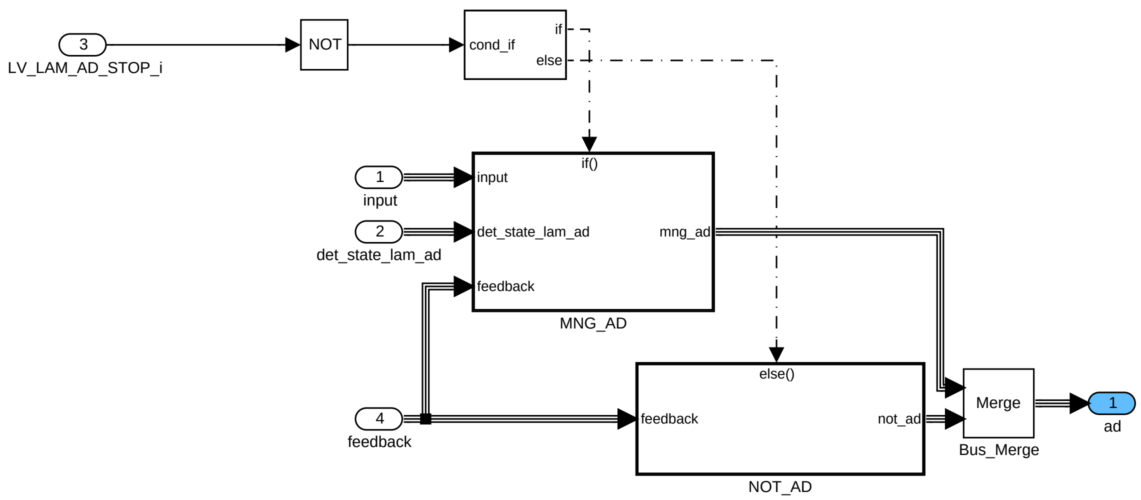

Figure 7.70.26:
LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/FAC_H_AD/AD

Wait for Timer Threshold Reached

Increment Counter

Wait timer is incremented by T_SAMPLE.

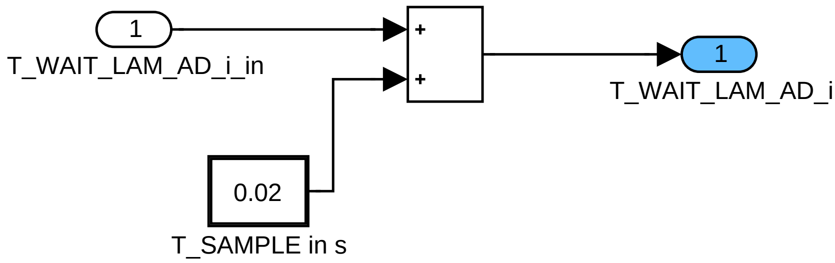

Figure 7.70.27: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/FAC_H_AD/AD/MNG_AD/INC_CTR

Check Wait Timer Threshold

New adaptation value is calculated if wait timer reaches threshold.

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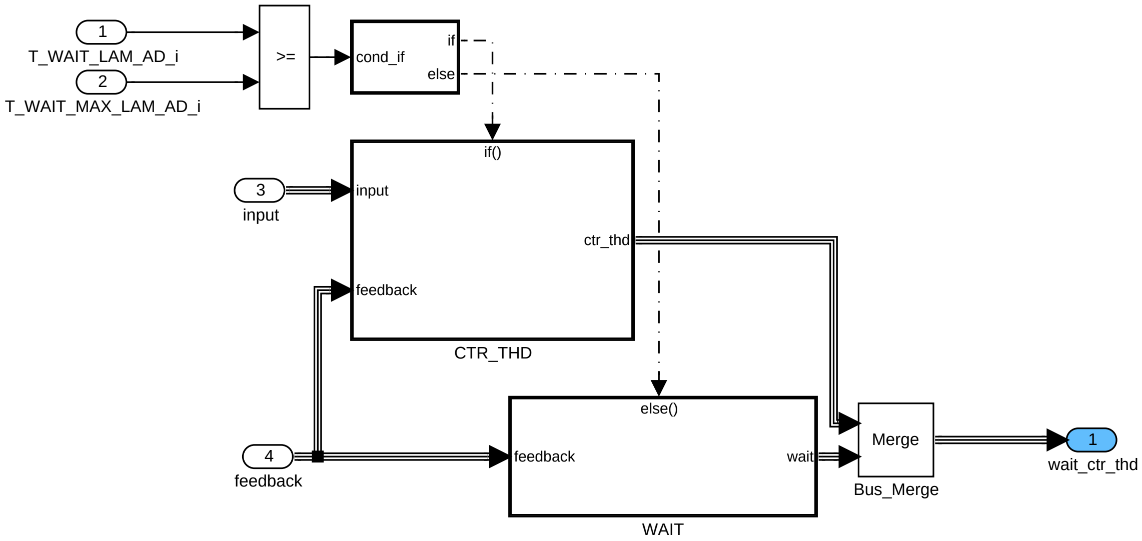

Figure 7.70.28: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/FAC_H_AD/AD/MNG_AD/WAIT_CTR_THD

Wait Timer Threshold Reached

Calculation of Lambda Controller Shift

The new delta for the adaptation value is calculated based on the lambda controller output and a correlation constant (defined in application incidences). This value is the same as for the shift applied to the lambda controller.

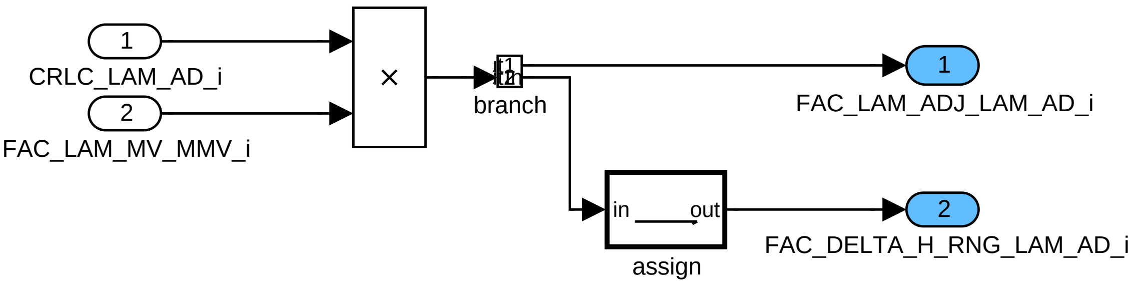

Figure 7.70.29: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/FAC_H_AD/AD/MNG_AD/WAIT_CTR_THD/CTR_THD/CLC_LAM_SHIFT

Determine New Adaptation Value

The new delta is added to the adaptation value and limited on upper and lower thresholds. If these thresholds are exceeded the respective flags are set to 1.
In case the low range adaptation value was not yet learned since the last reset of the NVMY data (indicated by LV_FAC_L_RNG_LAM_AD_INI[i] = 1), the high range value is written to the low range value.
A new priority time is evaluated based on the delta.

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LV_LAM_AD_STOP[i] is set to 1 to indicate that a lambda controller shift can take place.

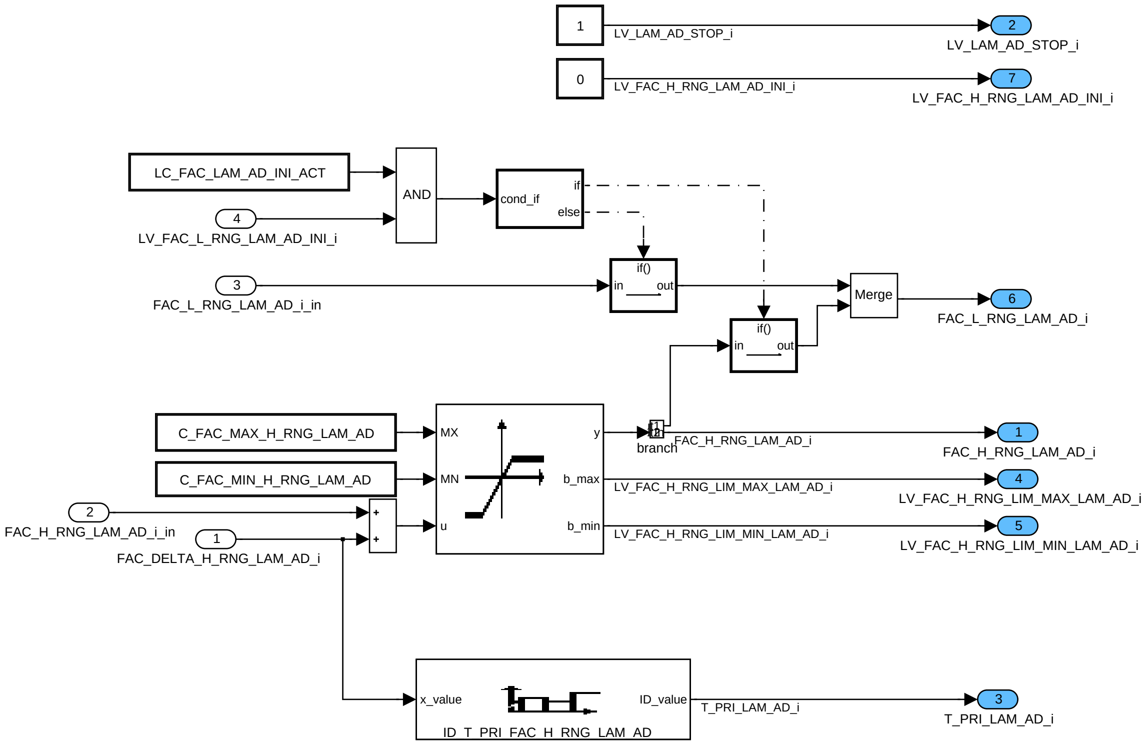

Figure 7.70.30: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/STATE_ACTION/FAC_H_AD/AD/MNG_AD/WAIT_CTR_THD/CTR_THD/NEW_AD_VALUE

State Machine Independent Calculations

Re Writing of Adaptation Correction at transition of ignition key

Rewriting of the adaptation values if required if not both adaptation factors were learned in the past.

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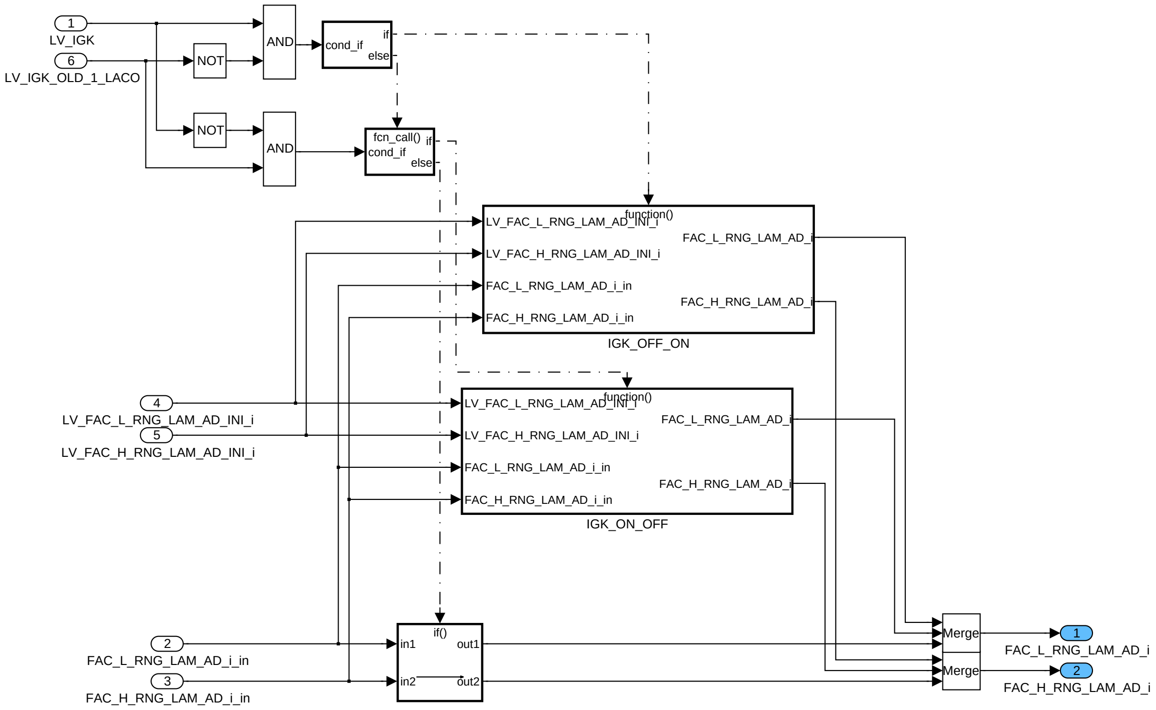

Figure 7.70.31: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/CLC_CMN/IGK_LAM_AD

Ignition key transition off to on

If only one of the initialization flags is set, then the respective adaptation value is reinitialized with the adaptation value of the other adaptation range.

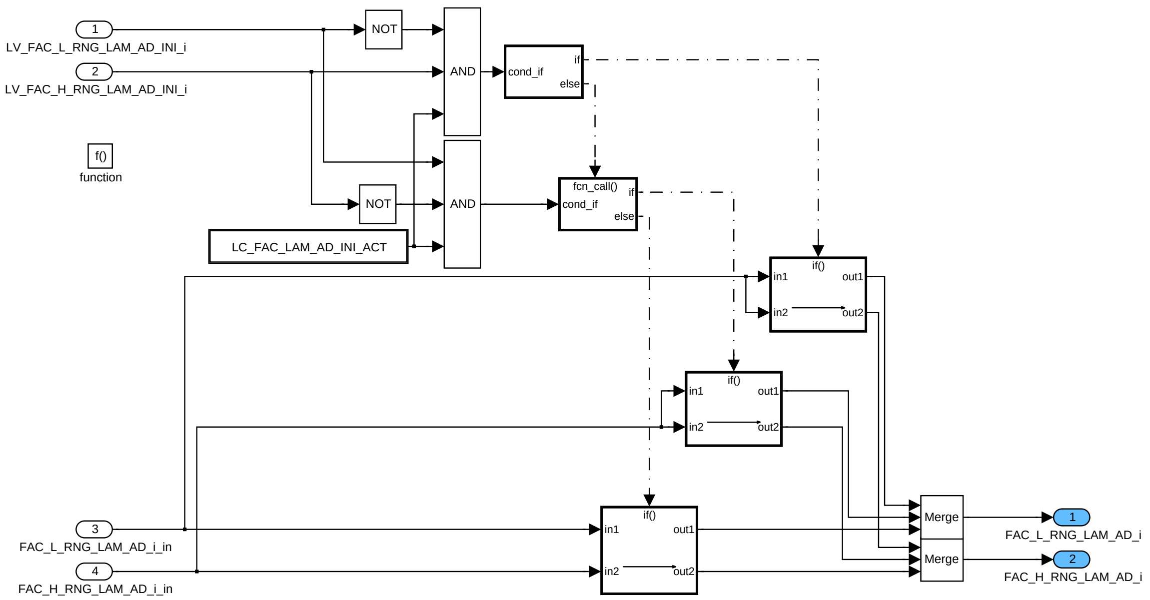

Figure 7.70.32: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/CLC_CMN/IGK_LAM_AD/IGK_OFF_ON

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Ignition key transition on to off

If the flag indicating that no adaptation was done in the relevant adaptation range, the adaptation values shall be reset to zero. This is required to set LV_FAC_L_RNG_LAM_AD_INI[i] respectively LV_FAC_H_RNG_LAM_AD_INI[i] in the next driving cycle.
If by any chance a adaptation of excately zero was learned, a adaptation value of 1 hex shall be written to the NVMY in order to avoid any false setting of LV_FAC_L_RNG_LAM_AD_INI[i] respectively LV_FAC_H_RNG_LAM_AD_INI[i] in the next driving cycle.

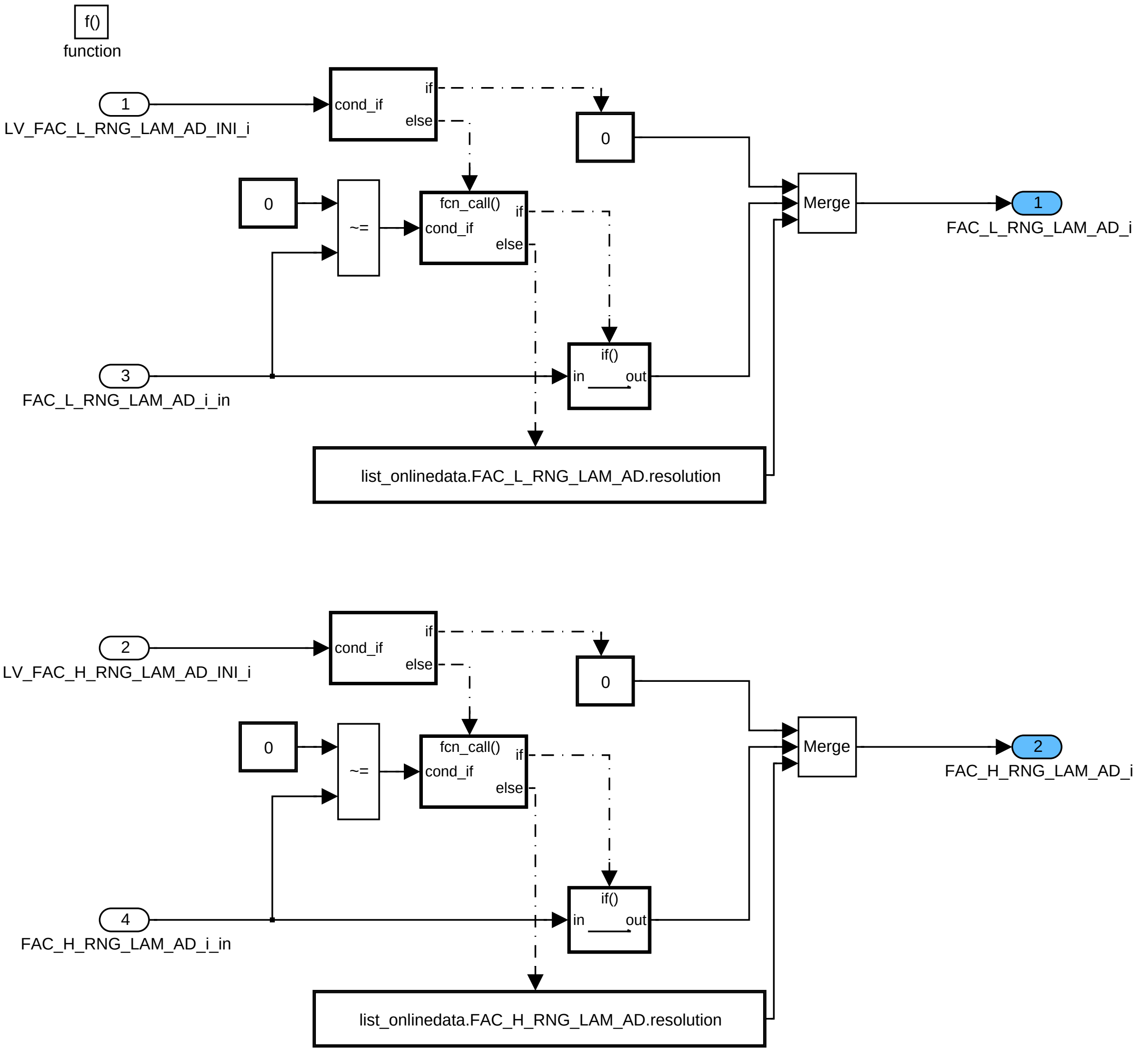

Figure 7.70.33:
LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/CLC_CMN/IGK_LAM_AD/IGK_ON_OFF

Re Writing of Adaptation Correction with Non Volatile Stored Values

In case of lambda adaptation relevant errors (see application incidences) the adaptation correction values MFF_ADD_LAM_AD[i], FAC_L_RNG_LAM_AD[i] and FAC_H_RNG_LAM_AD[i] must be rewritten with the values stored at the end of the last driving cycle. These values are available with the variables MFF_ADD_LAM_AD_TMP[i], FAC_L_RNG_LAM_AD_TMP[i] and FAC_H_RNG_LAM_AD_TMP[i] written to at the beginning of the driving cycle with the stored values of the last driving cycle.

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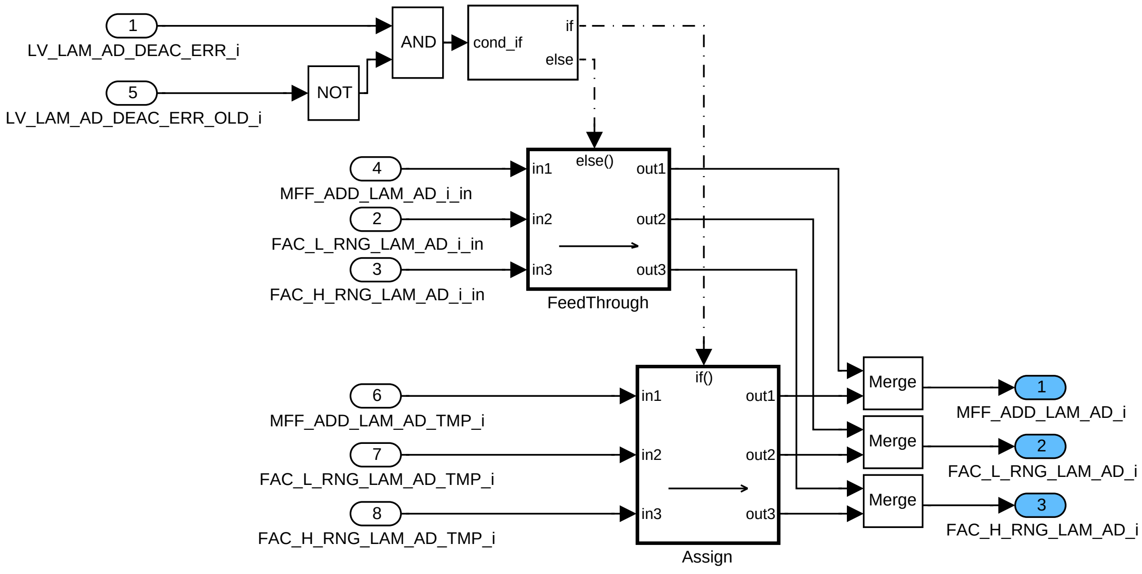

Figure 7.70.34: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/CLC_CMN/ERR_LAM_AD

Shift of adaptation values by external function

External functions might require an inverse step change in the Lambda adaptation value. The control of the value shift takes place in the external function and is indicated by the flags LV_FAC_LAM_AD_SHIFT[i].

The Lambda adaptation is shifted if the condition LV_FAC_LAM_AD_SHIFT[i] = 1 is valid. This variable is to be reset if the Lambda adaptation shift was carried out. That requires a confirmation of the executed controller shift. The confirmation is done by setting the variable LV_FAC_LAM_AD_SHIFT_END[i] to 1.

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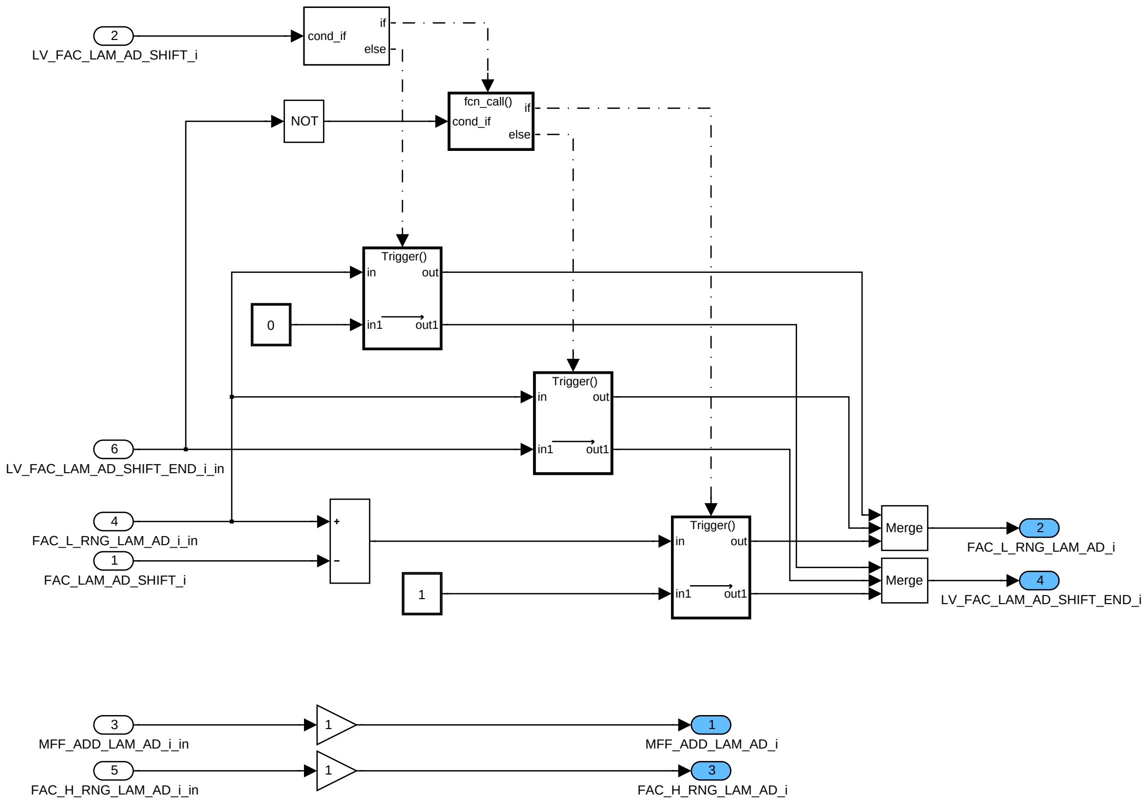

Figure 7.70.35: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/CLC_CMN/SHIFT_LAM_AD

Determination of Interpolated Lambda Adaptation Factor

In order to meet the physical behaviour of engine components (especially the air mass flow sensor), the actual multiplicative factor is calculated out of the two determined factors by interpolation at every state. Interpolation is applied between the borders
IP_MFF_SP_MAX_FAC_H_RNG_LAM_AD (lower border) and
IP_MFF_SP_MIN_FAC_H_RNG_LAM_AD (upper border)
as shown in the figure.

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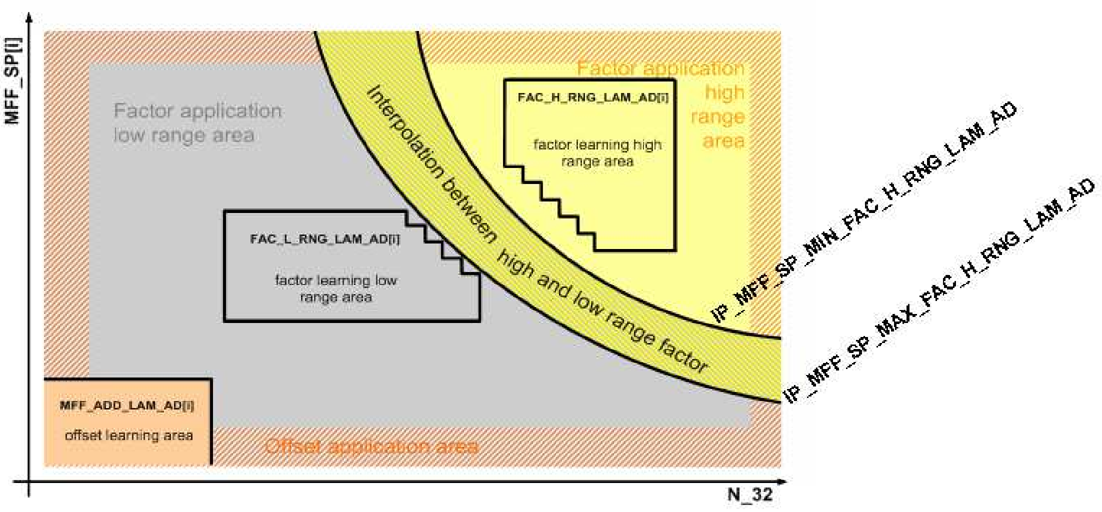

Interpolation of adaptation factors

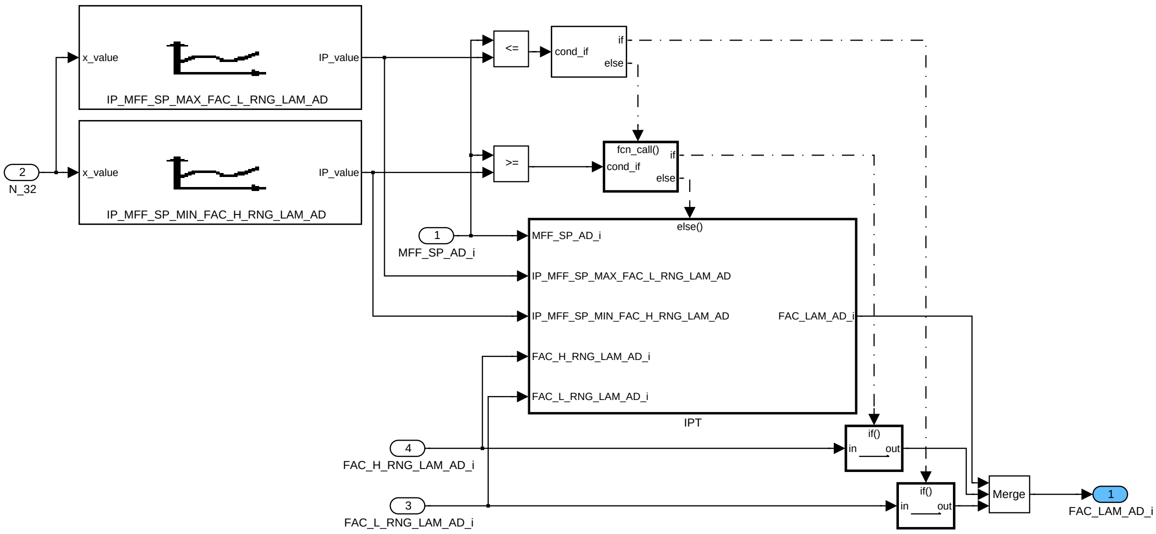

Figure 7.70.36:
LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/CLC_CMN/CLC_FAC_LAM_AD

Calculation of Output Signals for Fuel Mass Flow Set Point Correction

In order to avoid mixture problems when the engine has not reached its service temperature (warm up), lambda adaptation factors and their corresponding relative intermediate results can be decreased versus TCO and their own value (which is applied when the engine has its service temperature).
This is performed by weighting the adaptive factors as long as the lambda adaptation is disabled due to TCO C_TCO_MIN_LAM_AD (see: "application incidences").
The quotient of the additive relative factor is determined. The values MFF_LAM_ADD_LAM_AD_OUT[i] and MFF_SP[i] should be conditioned so, that FAC_MFF_ADD_LAM_AD_OUT[i] does not exceed the physical range of +/100 %!
The relative lambda adaptation FAC_MFF_ADD_FAC_LAM_AD[i] as long term adaptation is calculated out of both adaptation factors.

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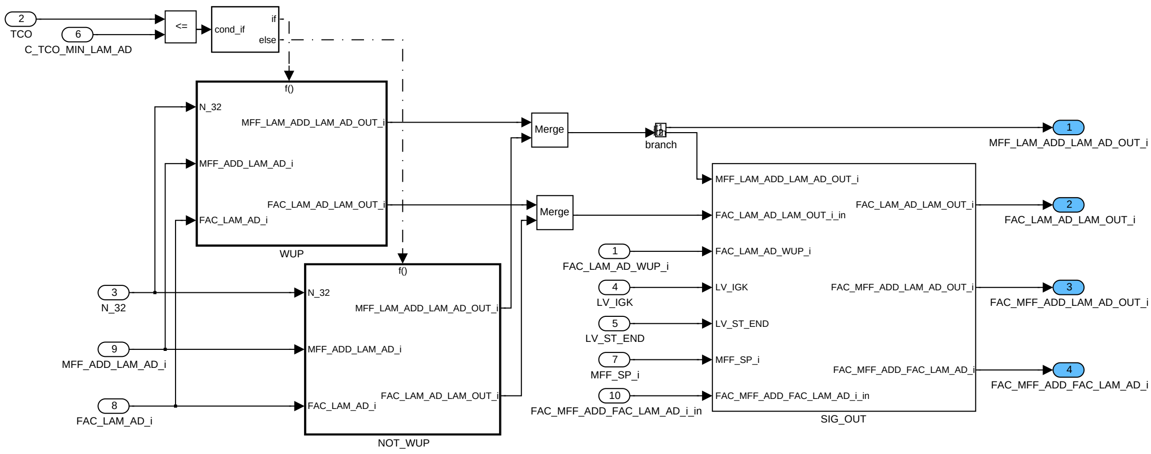

Figure 7.70.37: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/CLC_CMN/CLC_SIG_OUT

Apply Weighting Factors

A factor depending on engine speed can be applied if the lambda adaptation correction must not be applied by 100% in the whole engine speed range.

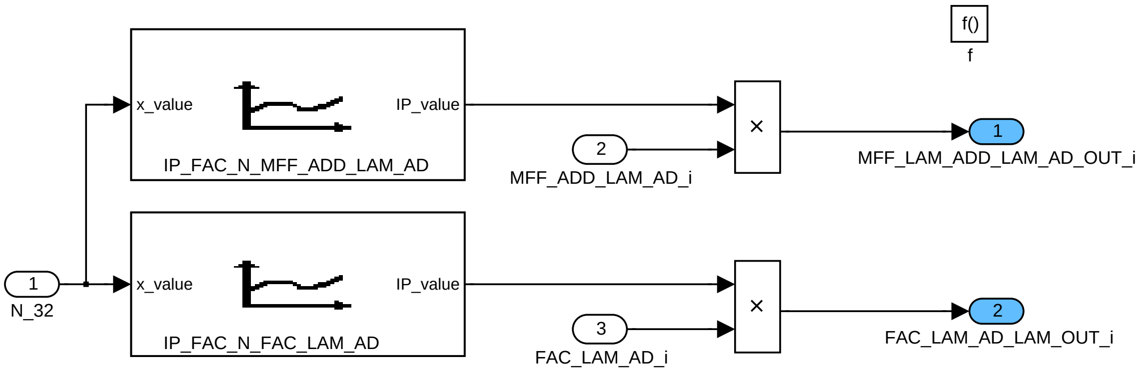

Figure 7.70.38:
LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/CLC_CMN/CLC_SIG_OUT/NOT_WUP

Apply Weighting Factors during Warm Up Phase

During warmup an additional factor depending on the lambda adaptation correction itself is applied.

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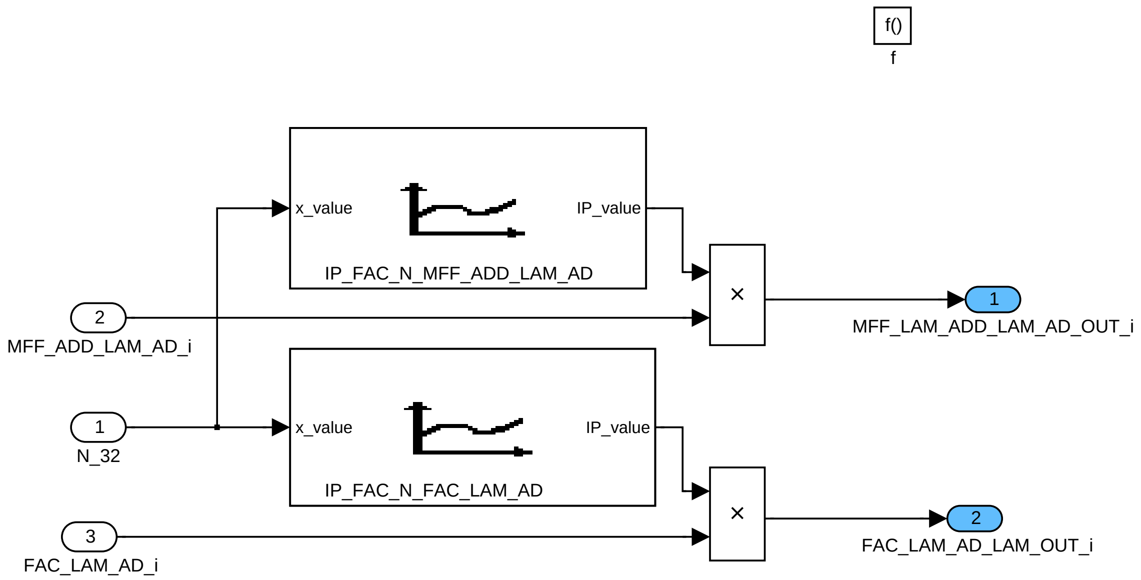

Figure 7.70.39:
LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/CLC_CMN/CLC_SIG_OUT/WUP

Final Output

FAC_MFF_ADD_LAM_AD_OUT[i] is the additive correction related to the fuel mass flow set point in order to have the same definition as for the multiplicative correction. When the engine is running this value is added to the multiplicative correction; so with the variable FAC_MFF_ADD_FAC_LAM_AD[i] the whole lambda adaptation correction is expressed.
If the lambda adaptation in warmup phase (external module) is active the respective output of this function FAC_LAM_AD_WUP[i] is not zero and added here to the over all lambda adaptation multiplicative correction.

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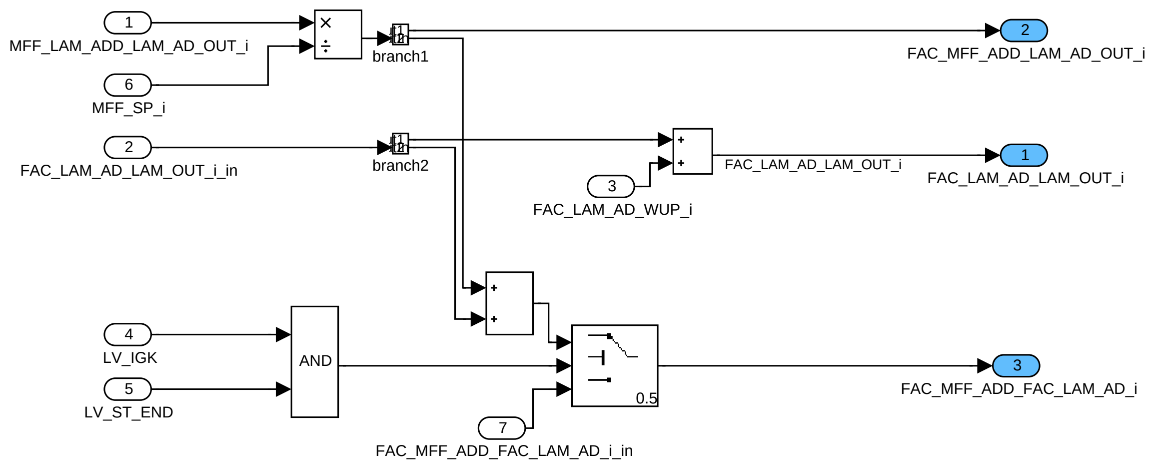

Figure 7.70.40:
LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/CLC_CMN/CLC_SIG_OUT/SIG_OUT

Interface to Lambda Controller

Interfacing Lambda Adaptation (this function)

A shift of the lambda controller output after the calculation of a valid adaptation value by FAC_LAM_ADJ_LAM_AD[i] is required in order to avoid rapid changes in the air fuel ratio caused by the lambda adaptation. FAC_LAM_ADJ_LAM_AD[i] is calculated in the states "ADAPT_ADD", "ADAPT_FAC_L" and "ADAPT_FAC_H".
The shift of the lambda controller output is not carried out, if the lambda controller is stopped. To avoid a loss of adaptation values in that case, the lambda controller shall confirm the successful lambda controller shift.
If the lambda controller does not confirm the controller shift by FAC_LAM_ADJ_LAM_AD[i] by setting LV_FAC_LAM_ADJ_LAM_AD_END[i] to 1, the lambda adaptation stops further calculations (LV_LAM_AD_STOP[i] is set to 1) until the controller shift is confirmed. FAC_LAM_ADJ_LAM_AD[i] shall be set to 0 and LV_FAC_LAM_ADJ_LAM_AD[i] and LV_LAM_AD_STOP[i] are reset, if at a stopped lambda adaptation the deactivating conditions are fulfilled.

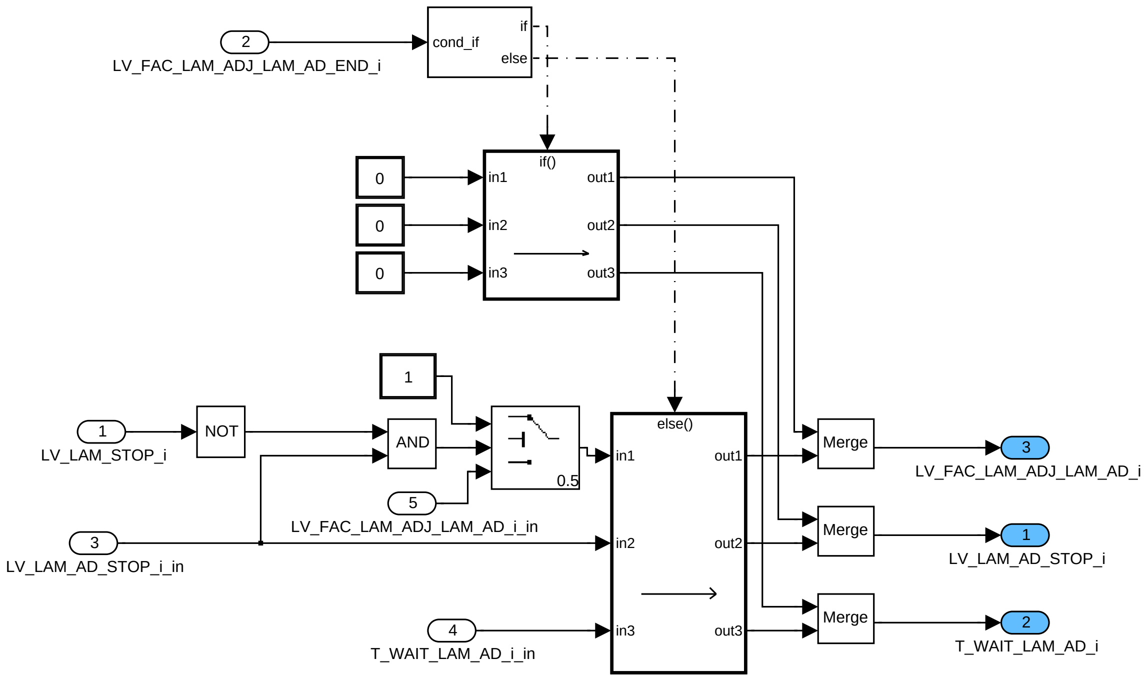

Figure 7.70.41: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/CLC_CMN/LAM_IF/LAM_AD

Interfacing Lambda Adaptation in Warm up phase (external module)

If TCO is below C_TCO_MIN_LAM_AD, any required shift by the warmup lambda adaptation is taken into account. Above this threshold lambda adaptation is active and any shift of this function is taken into account. As both adaptation function cannot be active at the same time the request flag LV_FAC_LAM_ADJ_LAM_AD[i] is used for both.

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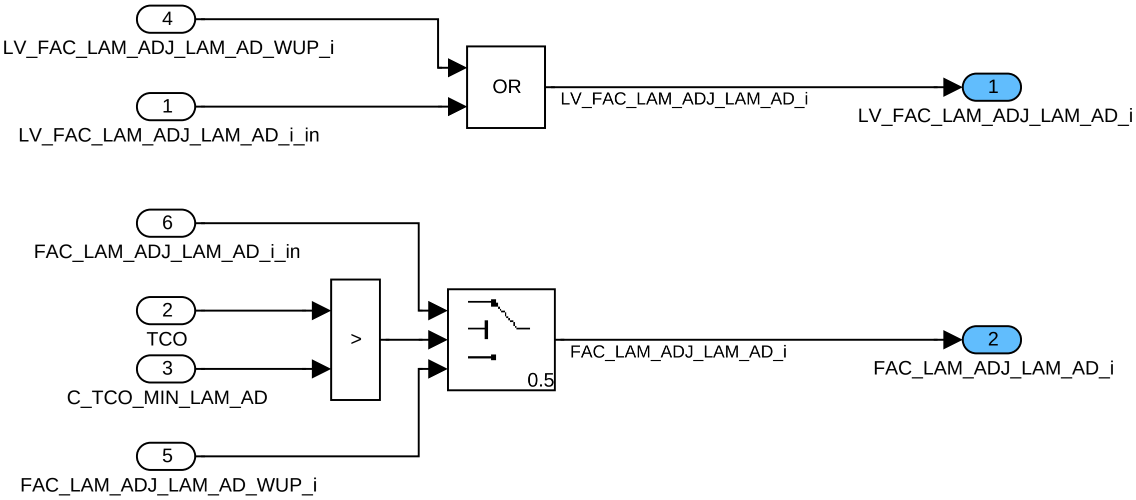

Figure 7.70.42:
LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/CLC_CMN/LAM_IF/LAM_AD_WUP

Check of Requirements for Time Scheduler

In order to observe the priority of further lambda adaptations, the differences between the old and the new adapted factors are observed. According to the observed deviations the new maximum time for next adaptation is calculated regarding the present conditions.
The output value for the time scheduler T_PRI_TOT_LAM_AD is not bank selective and represents the minimum time of all cylinder banks. In case of single exhaust cylinder bank T_PRI_TOT_LAM_AD is equal to T_PRI_LAM_AD[i] of this single bank.
If at least for one exhaust bank LV_LAM_AD_STOP[i] is set then the auxiliary flag LV_LAM_AD_STOP_CBK_EX is set to 1.
If the Lambda adaptation priority of any bank is below a limit (that means that the priority time is above a calibration threshold), the bank selective temporary Lambda adaptation end flag is set. When T_PRI_LAM_AD[i] exceeds C_T_PRI_MAX_LAM_AD the flag LV_LAM_AD_END_CBK[i] is set.

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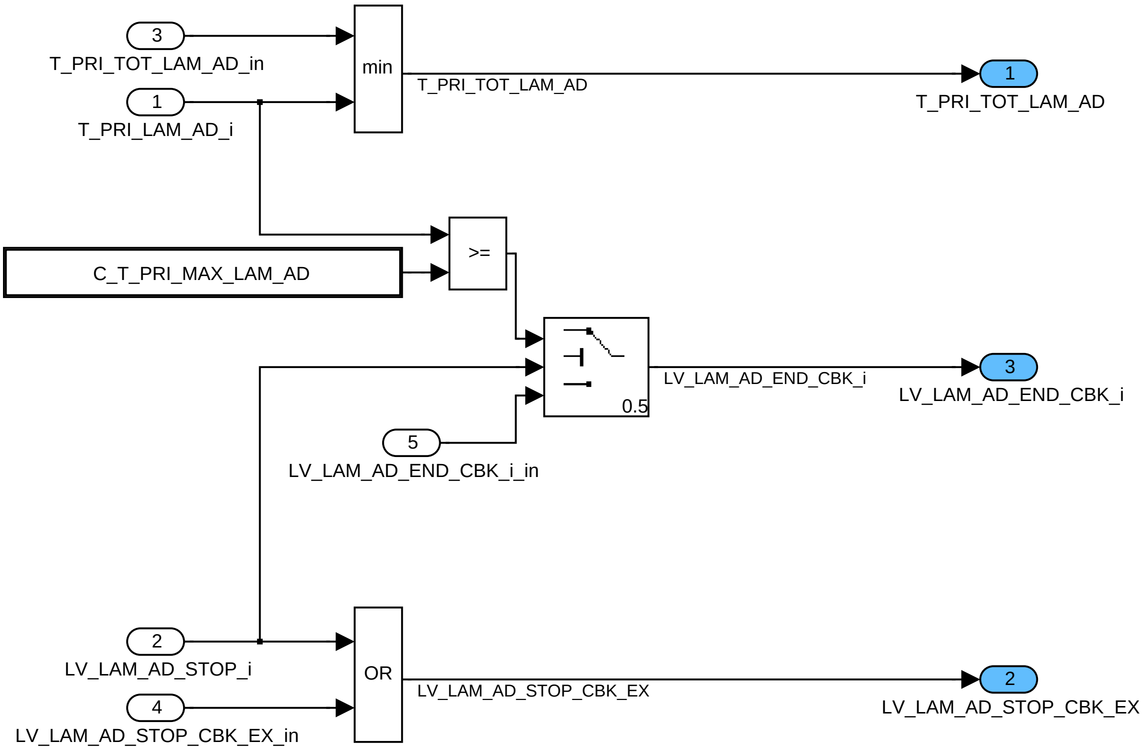

Figure 7.70.43: LACO_ISPCLADA0/OPM_20MS/CBK_MNG/CBK_FLP/CLC_CMN/T_PRI_MNG

Not exhaust bank specific calculations

Set Lambda Adaptation End Flag

If the total lambda adaptation priority of both exhaust banks is below a limit (that means that the priority time is above a calibration threshold), the temporary lambda adaptation end flag is set. When T_PRI_TOT_LAM_AD exceeds C_T_PRI_MAX_LAM_AD the flag LV_LAM_AD_END is set.

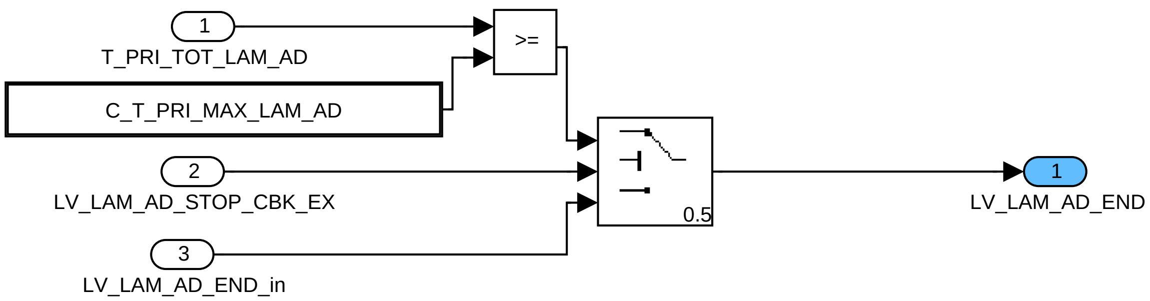

Figure 7.70.44: LACO_ISPCLADA0/OPM_20MS/NOT_CBK_SPC/SET_LAM_AD_END

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7.71 Lambda adaptation in warm up phase

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRLC_FAC_LAM_TCO_X [NC_CBK_EX_NR]	V	0... 80H	0 ...1	0.0078125	-
correlation factor for updating FAC_LAM_TCO_X					
CTR_TCO_MIN_INTER [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
counter for detection of TCO_MIN_INTER_LAM_AD_WUP					
FAC_BEG_L_RNG_LAM_AD [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 49.9984741	0.00152588	%
Lambda adaptation value in low range after reset and after auto shift					
FAC_LAM_AD_WUP [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 49.9984741	0.00152588	%
fuel mass set point factor of lambda adaptation in warm up phase					
FAC_LAM_AD_WUP_SHIFT [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 49.9984741	0.00152588	%
shift value of lambda adaptation in warm up phase after 1st learning					
FAC_LAM_ADD_CHG_FQ_DET [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 49.9984741	0.00152588	%
additive shift of adaptation values if change in fuel quality is detected					
FAC_LAM_ADJ_LAM_AD_WUP [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 49.9984741	0.00152588	%
output value from lambda adaptation in warm up phase for the lambda controller shift					
FAC_LAM_DIF_LAM_AD_WUP_MV [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 49.9984741	0.00152588	%
average value of Lambda controller output for Lambda adaptation in warm up phase					
FAC_LAM_TCO_A [NC_CBK_EX_NR]	V/S	8000... 7FFFH	0... 49.9984741	0.00152588	%
Lambda controller output at C_TCO_A_LAM_AD_WUP					
FAC_LAM_TCO_B [NC_CBK_EX_NR]	V/S	8000... 7FFFH	0... 49.9984741	0.00152588	%
Lambda controller output at C_TCO_B_LAM_AD_WUP					
FAC_LAM_TCO_C [NC_CBK_EX_NR]	V/S	8000... 7FFFH	0... 49.9984741	0.00152588	%
Lambda controller output at C_TCO_C_LAM_AD_WUP					
FAC_LAM_TCO_D [NC_CBK_EX_NR]	V/S	8000... 7FFFH	0... 49.9984741	0.00152588	%
Lambda controller output at C_TCO_D_LAM_AD_WUP					
FAC_LAM_TCO_E [NC_CBK_EX_NR]	V/S	8000... 7FFFH	0... 49.9984741	0.00152588	%
Lambda controller output at C_TCO_E_LAM_AD_WUP					
FAC_LAM_TCO_MIN [NC_CBK_EX_NR]	V/S	8000... 7FFFH	0... 49.9984741	0.00152588	%
Lambda controller output at TCO_MIN_LAM_AD_WUP					
LV_CTR_MAX_TCO_MIN_INTER [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that counter based criteria for transient phase has expired					
LV_FAC_LAM_ADJ_LAM_AD_WUP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag to request lambda controller shift from Lambda adaptation in warm up phase					
LV_LAM_AD_WUP_CHG_FQ_DET [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that change in fuel quality was detected in this driving cycle					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_AD_WUP_STOP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
logical variable indicating need of Lambda controller shift to mirror shift in Lambda adaptation in warm up phase					
LV_LOAD_VLD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that conditions for valid learning are fulfilled					
LV_T_MAX_LAM_AD_WUP_TRA_PHA [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that time dependent criteria for transient phase has expired					
LV_TCO_A_LAM_AD_WUP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that Lambda adaptation value in warm up phase at C_TCO_A_LAM_AD_WUP was updated					
LV_TCO_B_LAM_AD_WUP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that Lambda adaptation value in warm up phase at C_TCO_B_LAM_AD_WUP was updated					
LV_TCO_C_LAM_AD_WUP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that Lambda adaptation value in warm up phase at C_TCO_C_LAM_AD_WUP was updated					
LV_TCO_D_LAM_AD_WUP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that Lambda adaptation value in warm up phase at C_TCO_D_LAM_AD_WUP was updated					
LV_TCO_E_LAM_AD_WUP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that Lambda adaptation value in warm up phase at C_TCO_E_LAM_AD_WUP was updated					
LV_TCO_MIN_INTER_LAM_AD_WUP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that learning conditions for Lambda adaptation value in warm up phase are fulfilled					
LV_TCO_MIN_LAM_AD_WUP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that Lambda adaptation value in warm up phase at TCO_MIN_LAM_AD_WUP was updated					
T_LAM_AD_WUP_LDC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
timer to have valid limited dynamic phase for Lambda adaptation in warm up phase (partial load)					
T_LAM_AD_WUP_TRA_PHA [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
timer indicating transient phase of Lambda adaptation in warm up phase					
TCO_A_LAM_AD_WUP [NC_CBK_EX_NR]	V/S	0... FEH	0... 142.5	0.75	°C
actual coolant temperature in range around point A at which adaptation value was learnt					
TCO_B_LAM_AD_WUP [NC_CBK_EX_NR]	V/S	0... FEH	0... 142.5	0.75	°C
actual coolant temperature in range around point B at which adaptation value was learnt					
TCO_C_LAM_AD_WUP [NC_CBK_EX_NR]	V/S	0... FEH	0... 142.5	0.75	°C
actual coolant temperature in range around point C at which adaptation value was learnt					
TCO_D_LAM_AD_WUP [NC_CBK_EX_NR]	V/S	0... FEH	0... 142.5	0.75	°C
actual coolant temperature in range around point D at which adaptation value was learnt					
TCO_E_LAM_AD_WUP [NC_CBK_EX_NR]	V/S	0... FEH	0... 142.5	0.75	°C
actual coolant temperature in range around point E at which adaptation value was learnt					
TCO_MIN_INTER_LAM_AD_WUP [NC_CBK_EX_NR]	V	0... FEH	0... 142.5	0.75	°C
minimum TCO of current driving cycles where learning conditions for Lambda adaptation in warm up phase are fulfilled					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TCO_MIN_LAM_AD_WUP [NC_CBK_EX_NR]	V/S	0... FEH	0... 142.5	0.75	°C
minimum TCO of all driving cycles where learning conditions for Lambda adaptation in warm up phase (partial load) are fulfilled					

Input data:

FAC_DELTA_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_LAM_LIM [NC_CBK_EX_NR] {p. 2461}	LV_FAC_LAM_ADJ_LAM_AD_END [NC_CBK_EX_NR] {p. 2463}
LV_LAM_AD_DEAC_ERR [NC_CBK_EX_NR] {p. 2721}	LV_LAM_AD_WUP_ACT [NC_CBK_EX_NR] {p. 2721}	LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}
LV_LDC_LAM_AD [NC_CBK_EX_NR] {p. 2721}	MFF_ADD_LAM_AD [NC_CBK_EX_NR] {p. 2642}	MFF_SP [NC_CBK_EX_NR] {p. 2151}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	STATE_LS [NC_CBK_EX_NR] {p. 2448}	TCO {p. 1100}	TCO_ST {p. 1100}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_DIF_LAM_AD_WUP_MV	-	0... 80H	0 ...1	0.0078125	-
correlation constant for calculation of the controller deviation in warm up phase					
C_CRLC_FAC_LAM_TCO_X	-	0... 80H	0 ...1	0.0078125	-
correlation constant for updating FAC_LAM_TCO_X					
C_CRLC_FAC_LAM_TCO_X_FIRST_DC	-	0... 80H	0 ...1	0.0078125	-
correlation constant for updating FAC_LAM_TCO_X in first driving cycle					
C_CRLC_GLOBAL_FAC_LAM_AD_WUP	-	0... 80H	0 ...1	0.0078125	-
correlation constant for calculation of adaptation value in warm up phase					
C_CTR_TCO_MIN_INTER	-	0... 1FFFH	0... 8191	1	-
counter threshold for detecting minimum temperature for valid learning of adapatation value in warm up phase for current driving cycle					
C_FAC_LAM_AD_WUP_DELTA	-	0... 7FFFH	0... 49.9984741	0.00152588	%
delta of applied adaptation value in warm up phase to ramp the signal to new value					
C_FAC_LAM_AD_WUP_MAX_INTER	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
maximum value for adaptation value in warm up phase while in transient phase before valid learning is possible					
C_FAC_LAM_AD_WUP_MAX_LSCL_OFF	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
maximum value for adaptation value in warm up phase while Lambda controller is off					
C_FAC_LAM_AD_WUP_MIN_GAP	-	0... 7FFFH	0... 49.9984741	0.00152588	%
minimum (absolute) gap between old and new adaptation value in warm up phase necessary to update adaptation values					
C_FAC_LAM_AD_WUP_MIN_INTER	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
minimum value for adaptation value in warm up phase while in transient phase before valid learning is possible					
C_FAC_LAM_AD_WUP_MIN_LSCL_OFF	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
minimum value for adaptation value in warm up phase while Lambda controller is off					
C_MFF_SP_TOL_LAM_AD_WUP	-	0... FFFFH	0... 1389	0.02119478	mg/stk
maximum fuel mass set point for lambda adaptation in warm up phase (partial speed)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_BOL_LAM_AD_WUP	-	0... FFH	0... 8160	32	rpm
minimum engine speed for lambda adaptation in warm up phase (partial load)					
C_N_TOL_LAM_AD_WUP	-	0... FFH	0... 8160	32	rpm
maximum engine speed for lambda adaptation in warm up phase (partial load)					
C_T_MAX_LAM_AD_WUP_LDC	-	0... FFFFH	0... 6553.5	0.1	s
threshold for elasped time with limited dynamics for learning of adaptation value in warm up phase under load					
C_T_MAX_LAM_AD_WUP_TRA_PHA	-	0... FFFFH	0... 6553.5	0.1	s
threshold for timer indicating transient phase of Lambda adaptation in warm up phase					
C_TCO_A_LAM_AD_WUP	-	0... FEH	0... 142.5	0.75	°C
coolant temperature of point A for Lambda adaptation in warm up phase					
C_TCO_B_LAM_AD_WUP	-	0... FEH	0... 142.5	0.75	°C
coolant temperature of point B for Lambda adaptation in warm up phase					
C_TCO_C_LAM_AD_WUP	-	0... FEH	0... 142.5	0.75	°C
coolant temperature of point C for Lambda adaptation in warm up phase					
C_TCO_D_LAM_AD_WUP	-	0... FEH	0... 142.5	0.75	°C
coolant temperature of point D for Lambda adaptation in warm up phase					
C_TCO_E_LAM_AD_WUP	-	0... FEH	0... 142.5	0.75	°C
coolant temperature of point E for Lambda adaptation in warm up phase					
C_TCO_F_LAM_AD_WUP	-	0... FEH	0... 142.5	0.75	°C
coolant temperature of point F for Lambda adaptation in warm up phase					
C_TCO_LAM_AD_WUP_RNG	-	0... FE00H	0... 190.5	0.00292969	°C
temperature window for learning of adaptations value in warm up phase					
C_TCO_RNG_WR_DOWN_LAM_AD_WUP	-	0... FE00H	0... 190.5	0.00292969	°C
temperature window in which first learnt adaptation value can be written down to next lower point					
C_THD_DIF_L_RNG_LAM_AD	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
threshold value of change in low range adaptation factor to force auto shift					
C_THD_FAC_DELTA_L_RNG	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
threshold of lambda adaptation difference in low range to allow auto shift					
ID_FAC_THD_CHG_FQ_DET	-	0... FFFFH	0... 49.9984741	0.00152588	%
LDPM_TCO_3_LACO	6	0... FEH	0... 142.5	0.75	°C
threshold of difference in Lambda adaptation to detect change in fuel quality during warm up phase					
ID_MFF_SP_BOL_LAM_AD_WUP	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDP_N_32_ID_MFF_BOL_LAM_AD_WUP	4	0... FFH	0... 8160	32	rpm
minimum fuel mass set point for lambda adaptation in warm up phase (partial load)					
IP_FAC_CHG_FQ_DET_SCA	-	0... 80H	0 ...1	0.0078125	-
LDPM_TCO_3_LACO	6	0... FEH	0... 142.5	0.75	°C
scaling factor to shift adaptation values in warm up phase after detection of change in fuel quality					
IP_FAC_LAM_AD_WUP_MAX	-	0... FFFFH	0... 49.9984741	0.00152588	%
LDPM_TCO_3_LACO	6	0... FEH	0... 142.5	0.75	°C
maximum value for adaptation value in warm up phase					
IP_FAC_LAM_AD_WUP_MIN	-	0... FFFFH	0... 49.9984741	0.00152588	%
LDPM_TCO_3_LACO	6	0... FEH	0... 142.5	0.75	°C
minimum value for adaptation value in warm up phase					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_FAC_RAW_LAM_AD_WUP_LIM_ACT	-	0... 1H	0 ...1	1	-
logical calibration to force FAC_LAM_AD_WUP to FAC_LAM_TCO_MIN at temperature below TCO_MIN					
LC_FAC_WR_DOWN_LAM_AD_WUP	-	0... 1H	0 ...1	1	-
First learnt adaptation values shall be written down to next lower interpolation					
LC_LAM_AD_WUP_CLR_INH	-	0... 1H	0 ...1	1	-
Inhibit initialization of NVMY data (for application purposes only)					
LC_LAM_AD_WUP_SHIFT_ACT	-	0... 1H	0 ...1	1	-
logical calibration to enable auto shift in Lambda adaptation in warm up phase in all driving cycles					

7.71.1 LACO_ISPCLADAW0

The Lambda adaptation in warmup phase enhances the Lambda adaptation functionality to obtain a more precise correction at low temperatures ($<$ 50°C). The adaptive correction is applied to compensate serial production tolerances of components at low.
TCO dependent correction factors (%/°C) are learned in five temperature ranges. The correction factors are derived from the Lambda controller output. They are learned in an adaptation field specified by MFF_SP[i] and N_32. They are, however, to correct the injection time for all engine states. Learning of these factors requires that the Lambda controller is in the state 'ON'.

The recurrence time is defined by T_SAMPLE in [ms].

NC_CBK_EX_NR defines the number of exhaust banks. For vector elements the variable extension "_i" is used in the model instead of "[i]" as found in the textual description.

Application Condition

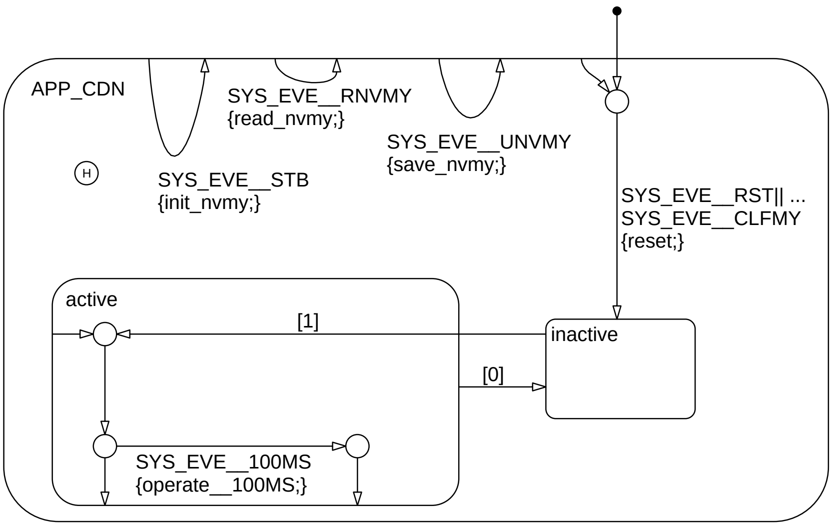

Figure 7.71.1: LACO_ISPCLADAW0/APP_CDN/Chart

Function Description

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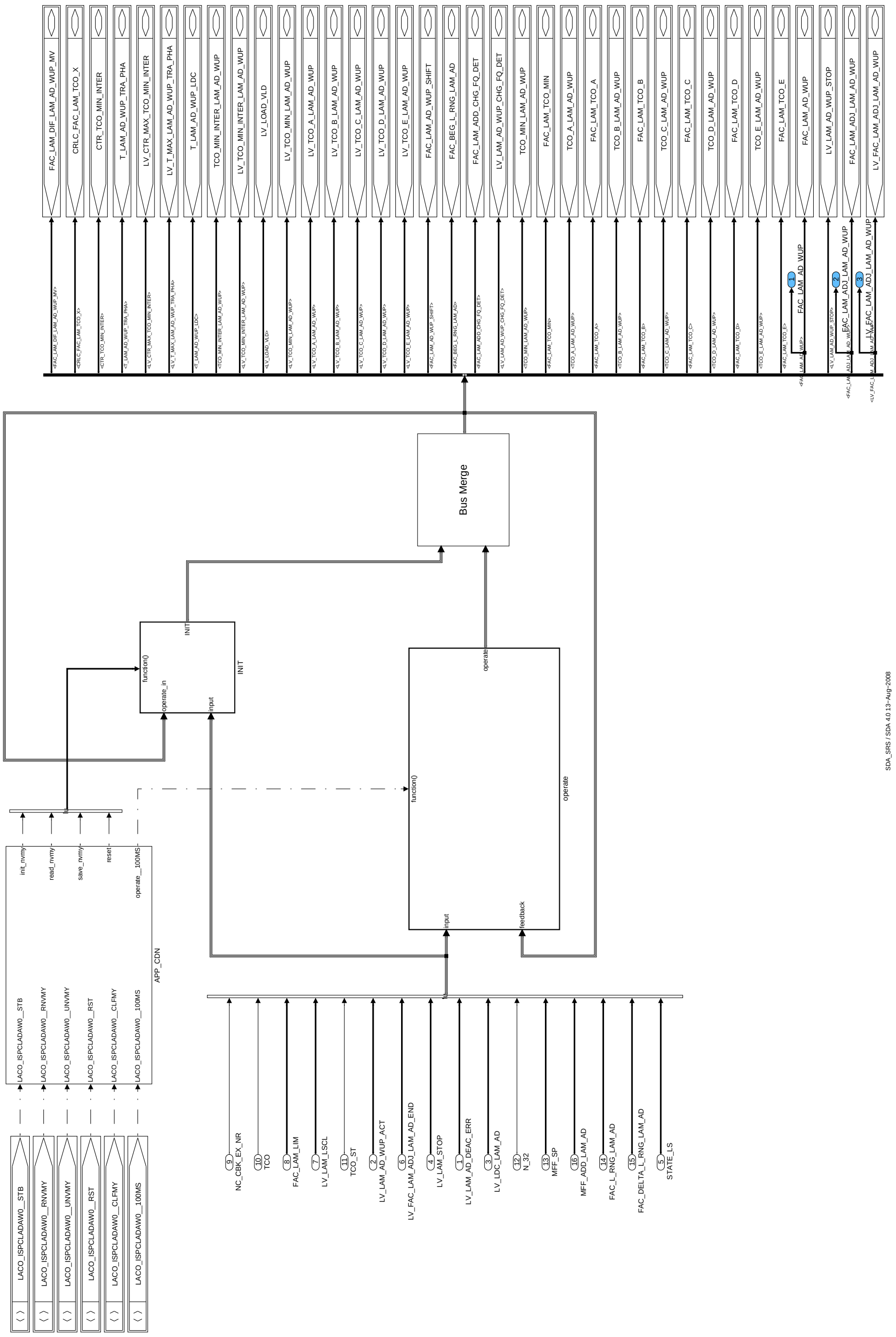

Figure 7.71.2: LACO_ISPCLADAW0

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7.71.1.1 SUBFUNCTION: operate

Calculation of the uncorrected Lambda controller output

To obtain the actual load on the Lambda controller, the controller output without adaptation is calculated. This is the sum of FAC_LAM_LIM[i] and applied adaptive correction in the warmup phase. The actual load is then filtered to have a smoother signal. In case of a not yet activated Lambda controller the value is set to zero. This is necessary in order to facilitate the detection of end of the transient phase after the start of the Lambda controller.

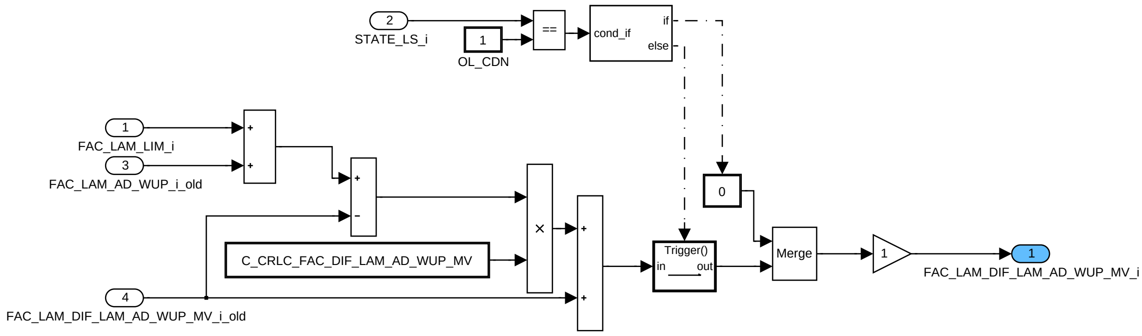

Figure 7.71.3: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/
FAC_LAM_AD_WUP_CBK_SPC/FAC_LAM_DIF_LAM_AD_WUP_MV

Correlation constant for updating of adaptation factors

In the update process of the adaptation factor a correlation constant is taken into account. Typically this value will be less then one to reduce the impact of outlier.
In case of a brand new ECU the cold adaptation values need to be shifted, if they are learned before the warm adaptation values are learned. The shift value amounts to the adaptation factor in the low range area. During this shift process no correlation constant is considered. Hence, in case of a brand new ECU the correlation constant is set to 1. Otherwise the auto shift value will not correspond to the corresponding value learned in the cold adaptation.

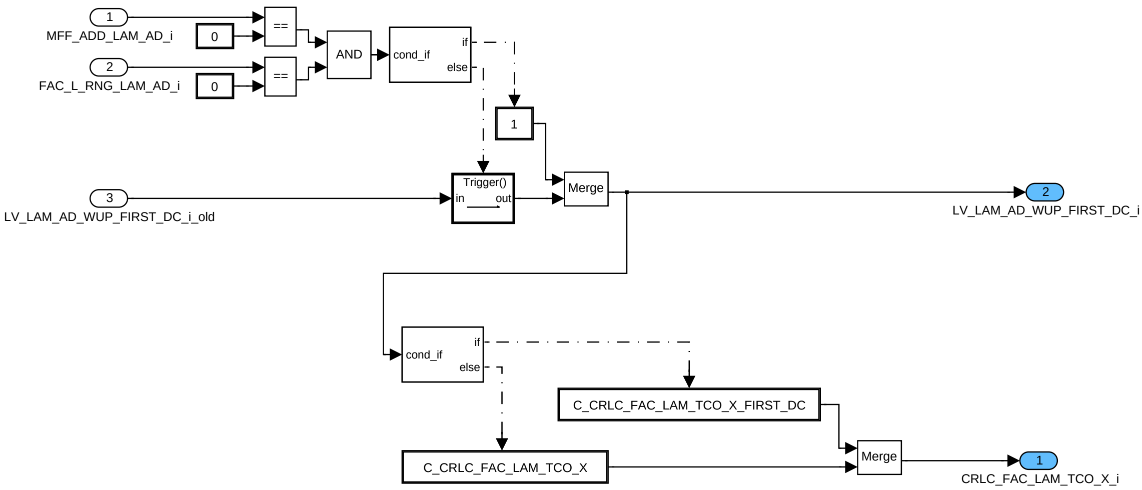

Figure 7.71.4: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/
FAC_LAM_AD_WUP_CBK_SPC/CLC_CRLC_LAM_TCO_X

Determination of valid partial load phase

To enable learning of the adaptation factor the conditions for valid learning have be fulfilled for at least the calibratable time C_T_MAX_LAM_AD_WUP_LDC.

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The conditions are:
Limited dynamics of the Lambda adaptation are fulfilled.
Lambda controller is active.
Lambda controller is not in the stop mode.
N_32 is below a threshold, but above another threshold.

- MFF_SP[i] is below a threshold, but above another threshold.

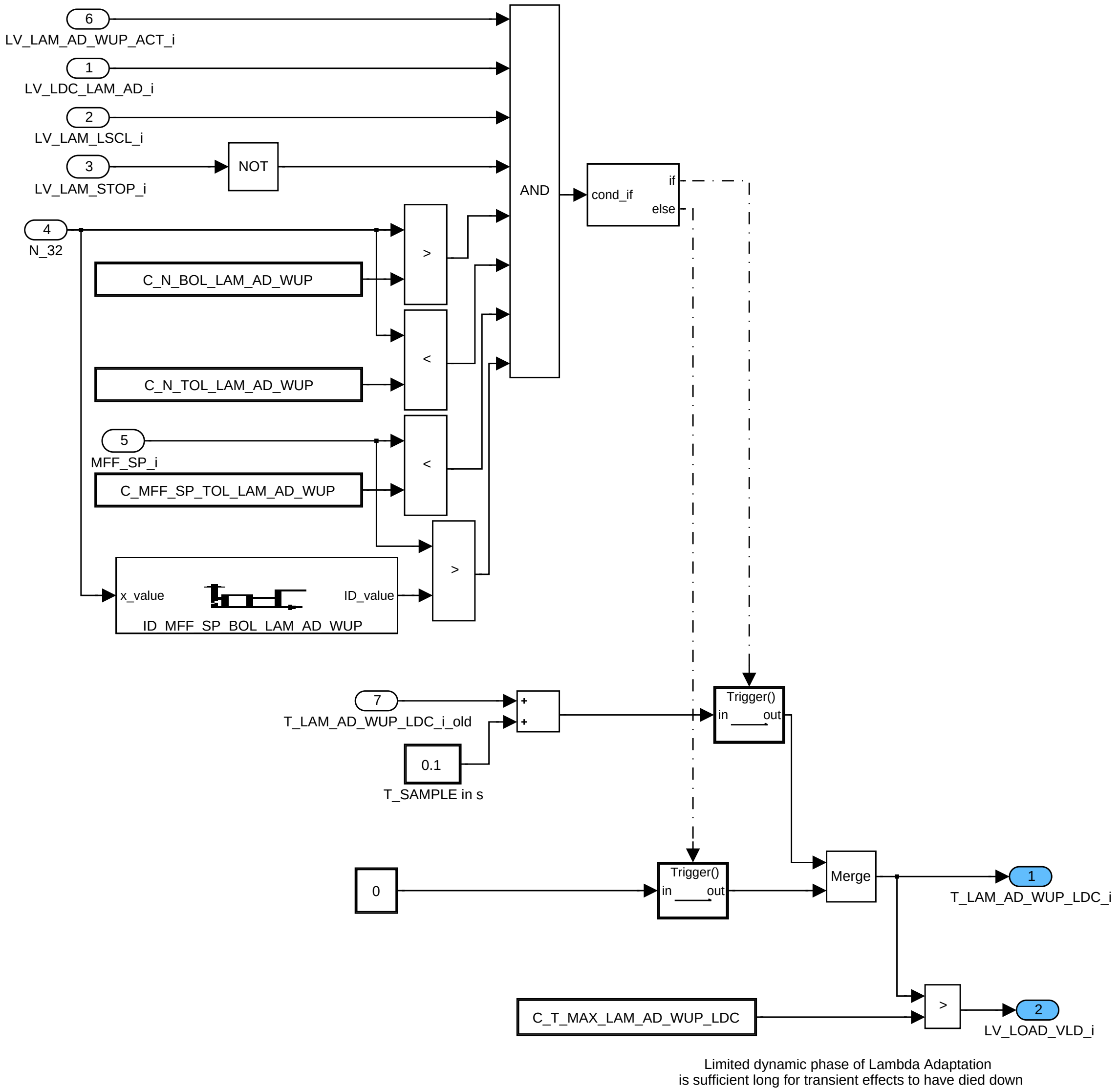

Figure 7.71.5: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/
FAC_LAM_AD_WUP_CBK_SPC/TCO_MIN_INTER_LAM_AD_WUP/CLC_T_LAM_AD_WUP_LDC

Determination of minimum temperature valid for learning in current driving cycle

To enable learning in the current driving cycle for the first time the following conditions must be satisfied:
The counter as well as the timer criteria are fulfilled, thus is transient phase is over.
The global activation conditions are fulfilled.
Limited dynamics are given, the Lambda controller is in state on and engine operating point is within the required mass air flow and speed range (see also definition of LV_LOAD_VLD[i]).

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The coolant temperature is within the temperature range of the lowest and highest interpolation points.

If above conditions are fulfilled, then the flag indicating the detection of TCO_MIN_INTER is set.

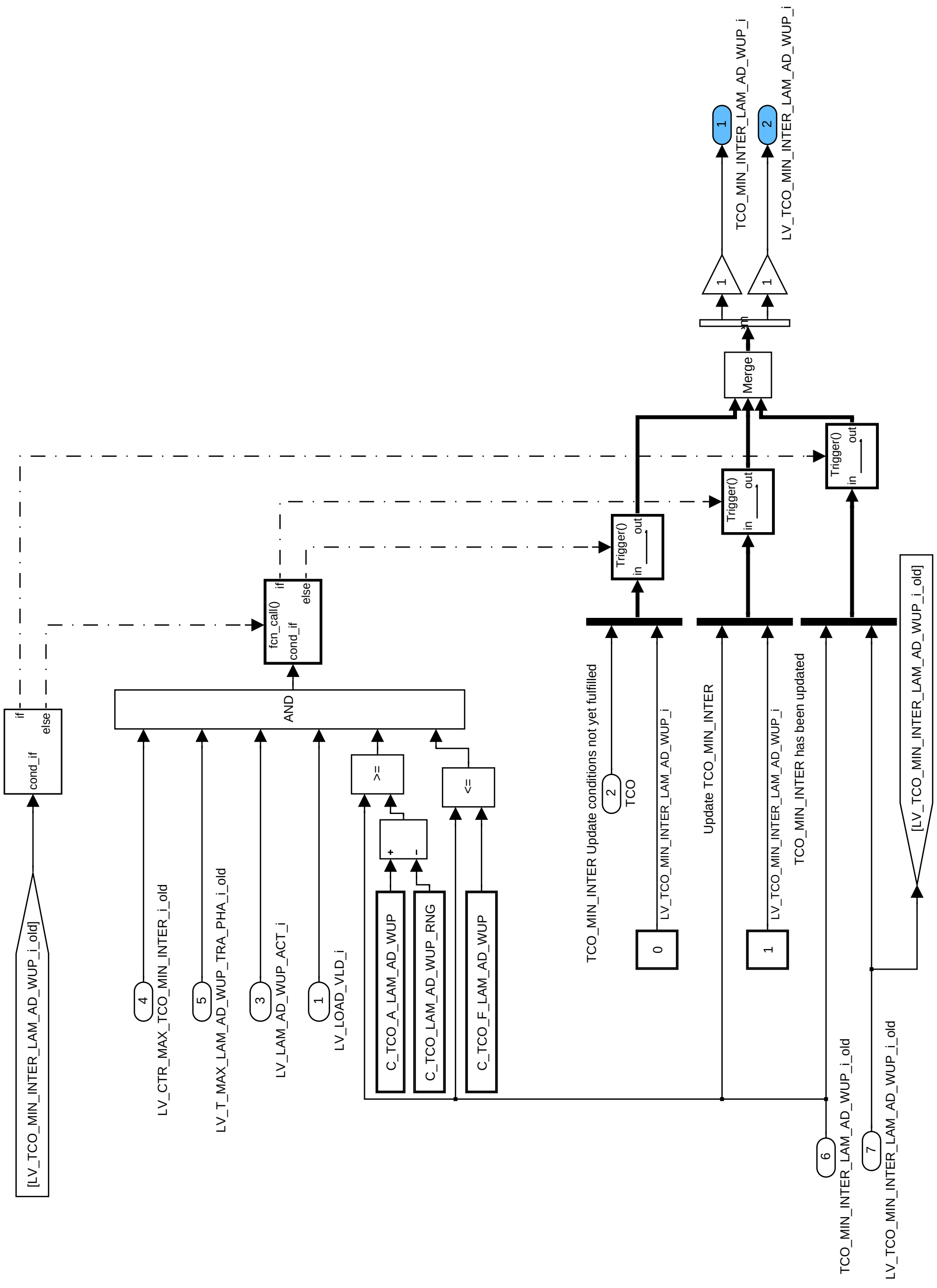

Figure 7.71.6:
LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/FAC_LAM_AD_WUP_CBK_SPC/
TCO_MIN_INTER_LAM_AD_WUP/CLC_TCO_MIN_INTER_LAM_AD_WUP

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Determination of end of transient phase

Two different criteria can be used to determine the end of the transient phase:
Timer criteria:

When the Lambda controller enters the state ON a timer is incremented. If this timer exceeds a threshold, it is assumed that the transient is over. This criterion is very simple, but not very accurate.

Counter criteria:

The counter is incremented when the uncorrected Lambda controller moves towards the zero percent line or stays unchanged. In case it moves away from the zero percent line, the counter is decremented. The counter cannot be decremented below zero. If the counter exceeds a certain threshold, the end of the transient phase is detected. This criterion was found to be very accurate.

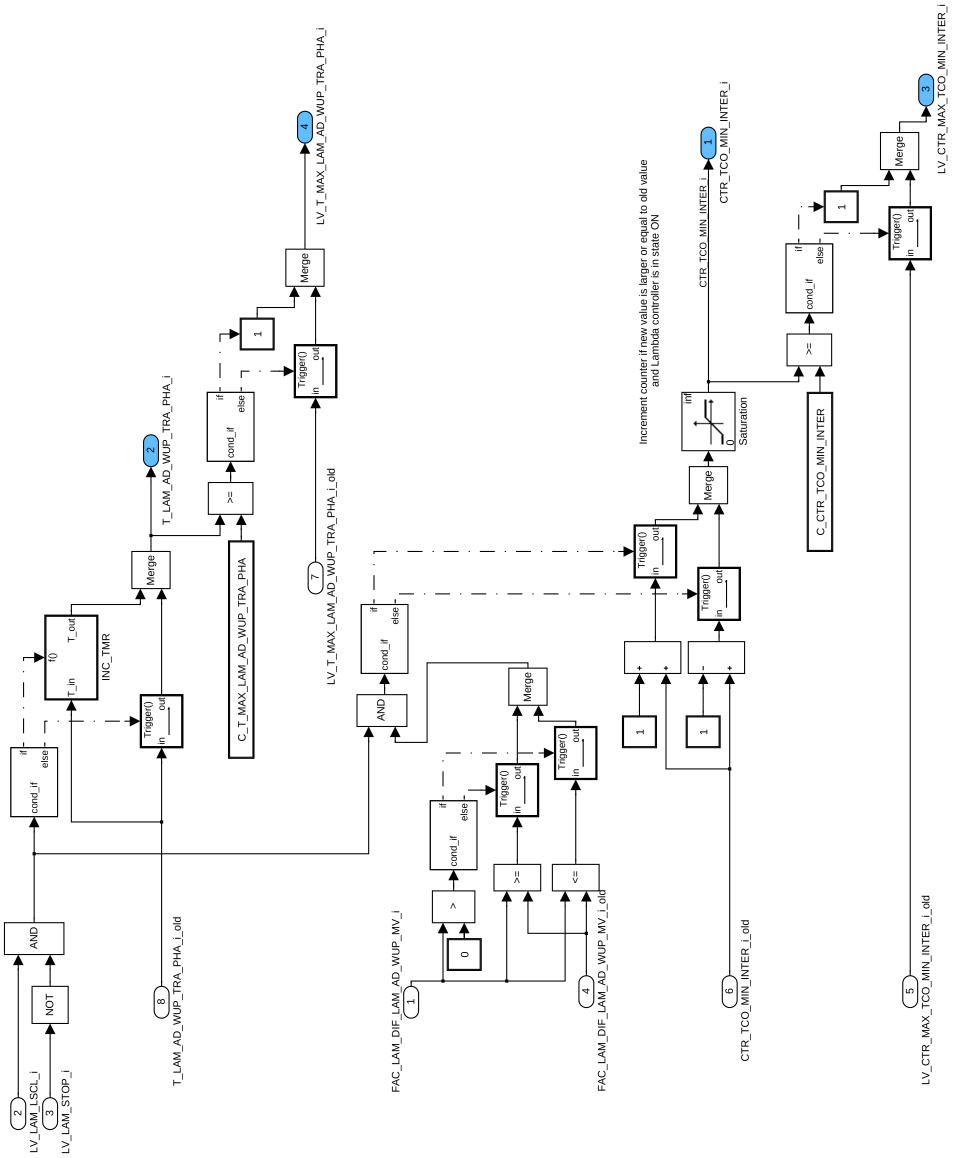

Figure 7.71.7: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/
FAC_LAM_AD_WUP_CBK_SPC/TCO_MIN_INTER_LAM_AD_WUP/CLC_CTR_TCO_MIN_INTER

Auto shift functionality - correction of adaptation value with warm adaptation value

In each driving cycle it is checked whether the fuel quality has changed to the worse. This check is done once per driving cycle at the time when the conditions for learning are fulfilled for the first time. A change of fuel quality is detected if the uncorrected Lambda controller output has shifted by at least

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a calibratable threshold towards lean. The threshold is specified in a map with TCO as an input. This allows taking into account the TCO dependent deterioration effect of poor fuel quality.
Once fuel of low quality is detected, a flag indicating that detection was done in the current driving cycle is set to one. Furthermore, the difference in the uncorrected Lambda controller output (which led to this detection) is normalized. The normalization is done using a TCO dependent map. The same map is used later on to shift all adaptation values. Therefore, the map has to represent the qualitative course of the additional enrichment demand caused by the poor fuel quality.

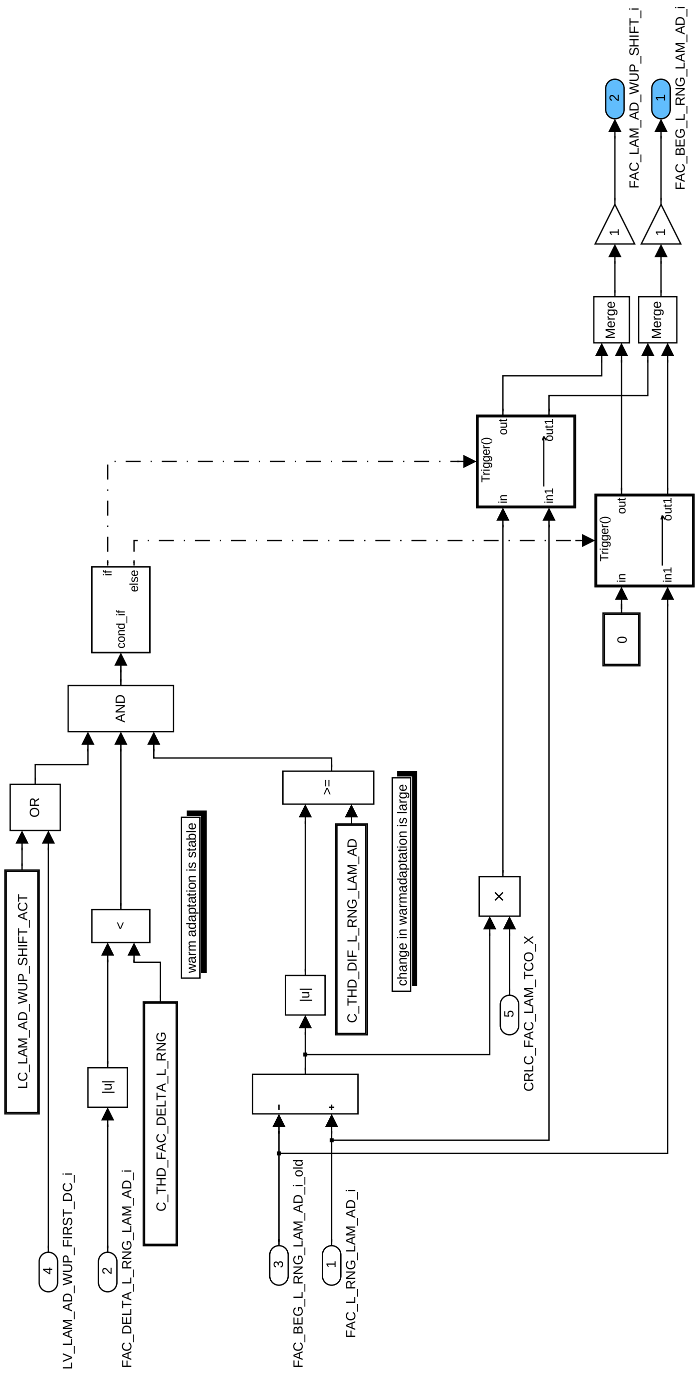

Figure 7.71.8: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/
FAC_LAM_AD_WUP_CBK_SPC/CLC_FAC_LAM_AD_WUP_SHIFT

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Detection of change in fuel quality

In each driving cycle it is checked whether the fuel quality has changed to the worse. This check is done once per driving cycle at the time when the conditions for learning are fulfilled for the first time. A change of fuel quality is detected if the uncorrected Lambda controller output has shifted by at least a calibratable threshold towards lean. The threshold is specified in a map with TCO as an input. This allows taking into account the TCO dependent deterioration effect of poor fuel quality.

Once fuel of low quality is detected, a flag indicating that detection was done in the current driving cycle is set to one. Furthermore, the difference in the uncorrected Lambda controller output (which led to this detection) is normalized. The normalization is done using a TCO dependent map. The same map is used later on to shift all adaptation values. Therefore, the map has to represent the qualitative course of the additional enrichment demand caused by the poor fuel quality.

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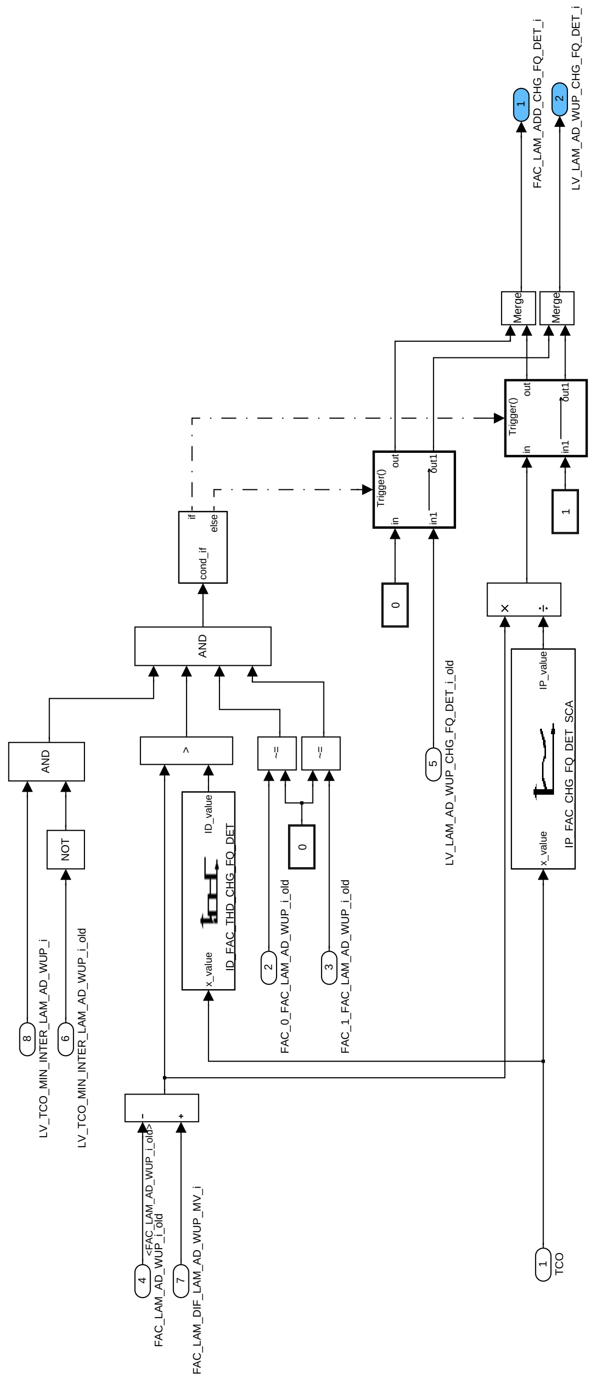

Figure 7.71.9: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/
FAC_LAM_AD_WUP_CBK_SPC/CLC_CHG_FQ_DET

Adaptive factor at lowest temperature over all driving cycles

Beside the interpolation points A to F with fixed temperature ranges, a moving interplation point is used. This interpolation point also represents the lowest temperature over all driving cycles at which the learning conditions were fulfilled.

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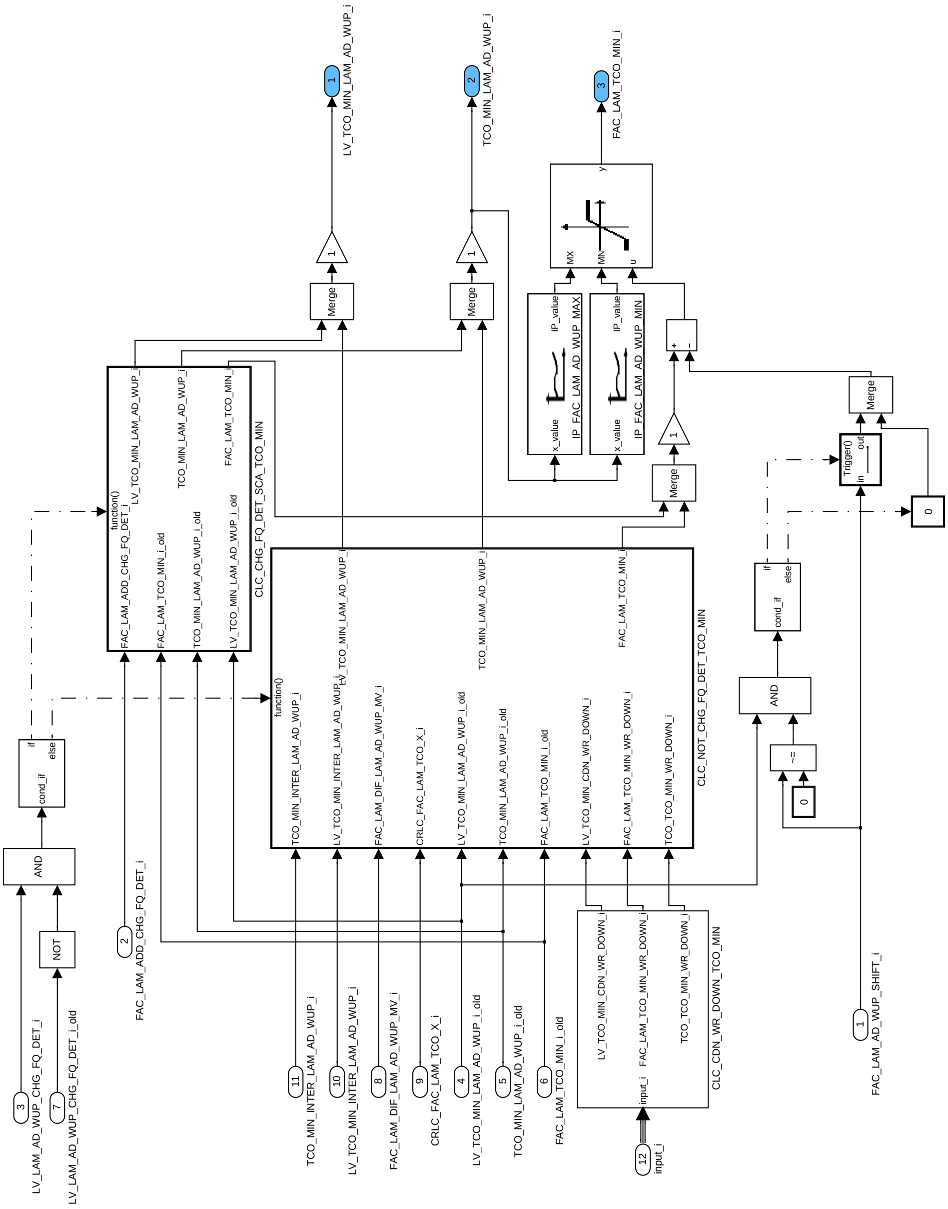

Figure 7.71.10: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/ FAC_LAM_AD_WUP_CBK_SPC/TCO_MIN_LAM_AD_WUP

Determination of adaptation value during detection of change in fuel quality

First it is checked whether the adaptation factor is different from zero to confirm, that it has been updated at some point in the past. If this is not the case no shift is realized at this particular interpolation point. For shifting the normalized shift value is multiplied by a TCO dependent weighting factor and then added to the old adaptation factor. The weighting factor takes into account that the negative effects of the low quality fuel disappear with rising temperature. Hence, the weighting factor should be around 1 for the lowest interpolation point and at around zero for the highest temperature.

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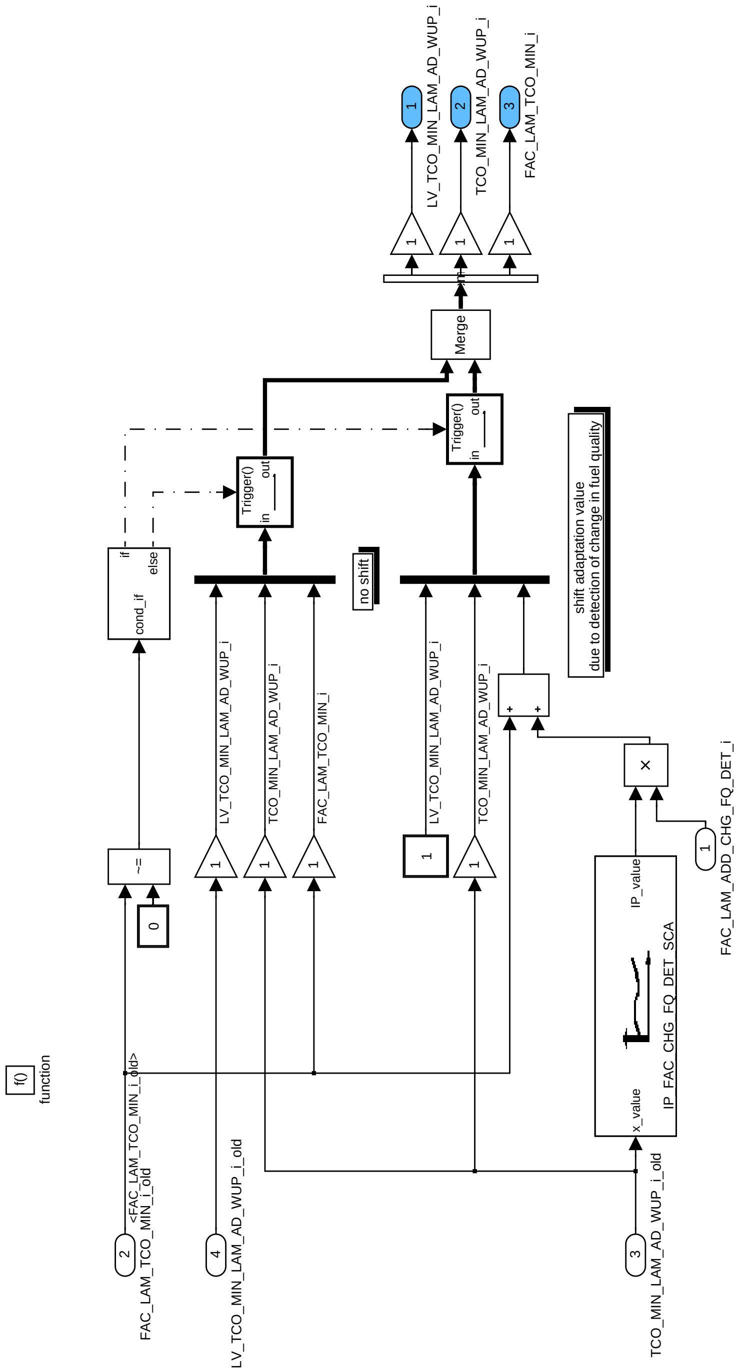

Figure 7.71.11: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/
FAC_LAM_AD_WUP_CBK_SPC/TCO_MIN_LAM_AD_WUP/CLC_CHG_FQ_DET_SCA_TCO_MIN

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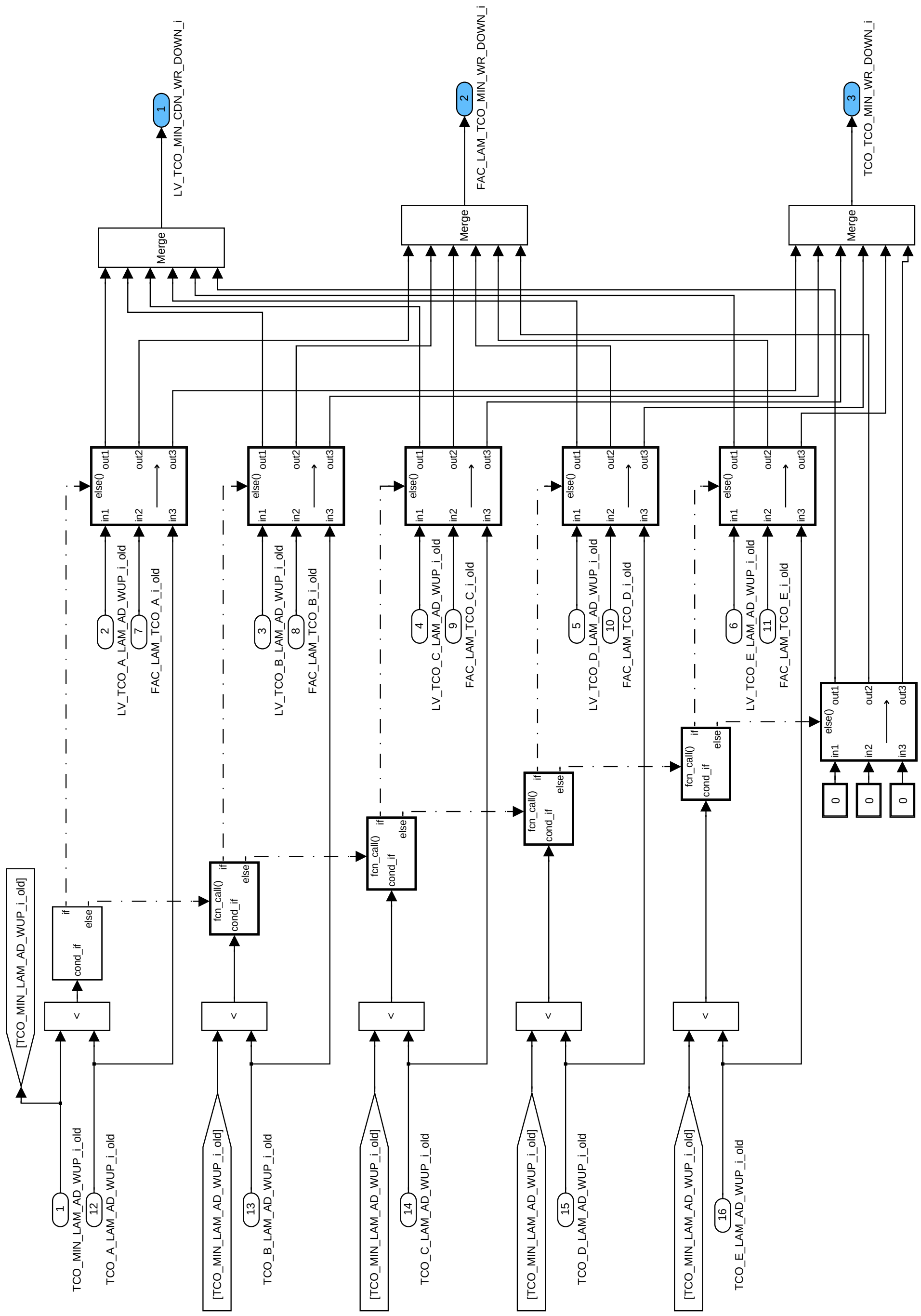

Figure 7.71.12: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/FAC_LAM_AD_WUP_CBK_SPC/TCO_MIN_LAM_AD_WUP/CLC_CDN_WR_DOWN_TCO_MIN/CLC

Determination of minimum temperature valid for learning of all driving cycles

TCO_MIN is updated with TCO_MIN_INTER if the value for the current driving cycle (TCO_MIN_INTER) is smaller than the previously stored value of TCO_MIN. During update the correlation constant is considered.

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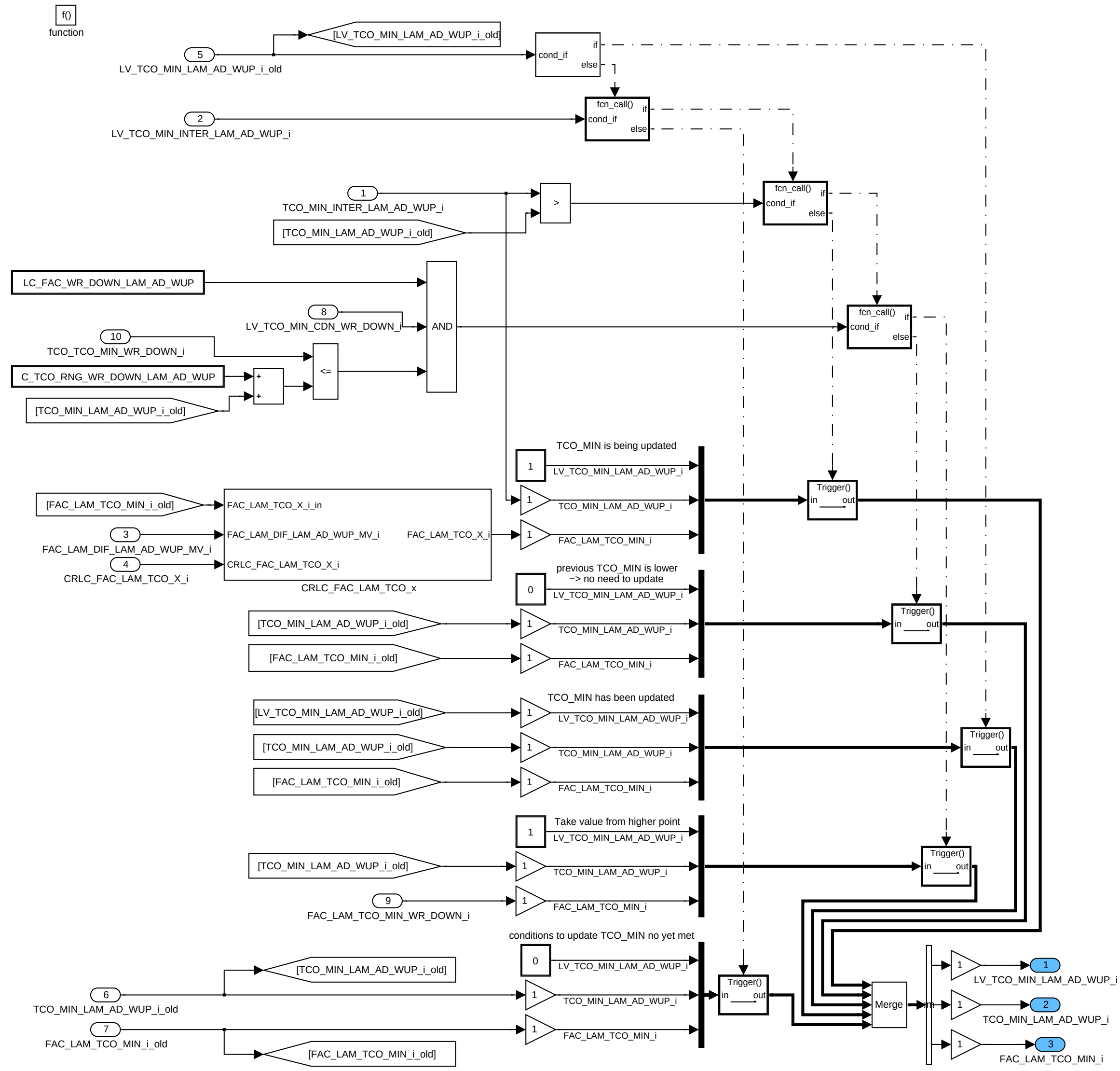

Figure 7.71.13: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/
FAC_LAM_AD_WUP_CBK_SPC/TCO_MIN_LAM_AD_WUP/CLC_NOT_CHG_FQ_DET_TCO_MIN

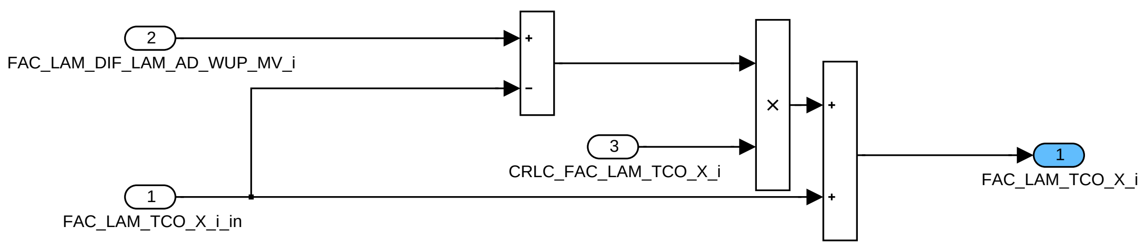

Figure 7.71.14:
LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/FAC_LAM_AD_WUP_CBK_SPC/
TCO_MIN_LAM_AD_WUP/CLC_NOT_CHG_FQ_DET_TCO_MIN/CRLC_FAC_LAM_TCO_x

Determination of new adaptation value at point A to E

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If a change in fuel quality is detected the normal update process of the adaptation factor is inhibited. The auto shift value is always zero with the exception of the calculation recurrence during which the shift is executed. Furthermore, if the adaptation factor was not updated in this driving cycle (LV_TCO_X_LAM_AD_WUP[i]), then the auto shift correction is not applied.

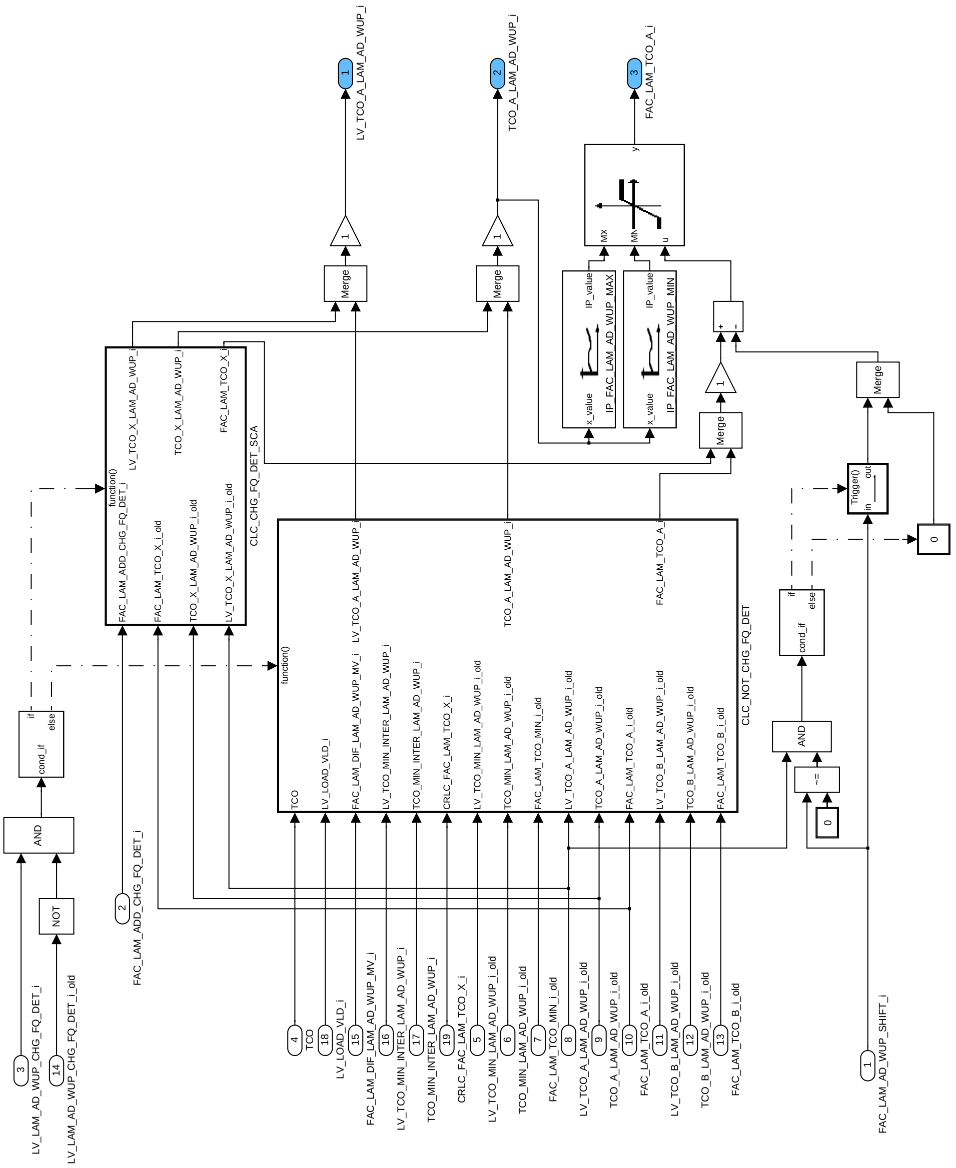

Figure 7.71.15: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/FAC_LAM_AD_WUP_CBK_SPC/TCO_LAM_AD_WUP/CLC_FAC_LAM_TCO_A

Determination of adaptation value during detection of change in fuel quality

First it is checked whether the adaptation factor is different from zero to confirm, that it has been updated at some point in the past. If this is not the case no shift is realized at this particular interpolation point.

For shifting the normalized shift value is multiplied by a TCO dependent weighting factor and then added to the old adaptation factor. The weighting factor takes into account that the negative effects of the low quality fuel disappear with rising temperature. Hence, the weighting factor should be around 1 for the lowest interpolation point and at around zero for the highest temperature.

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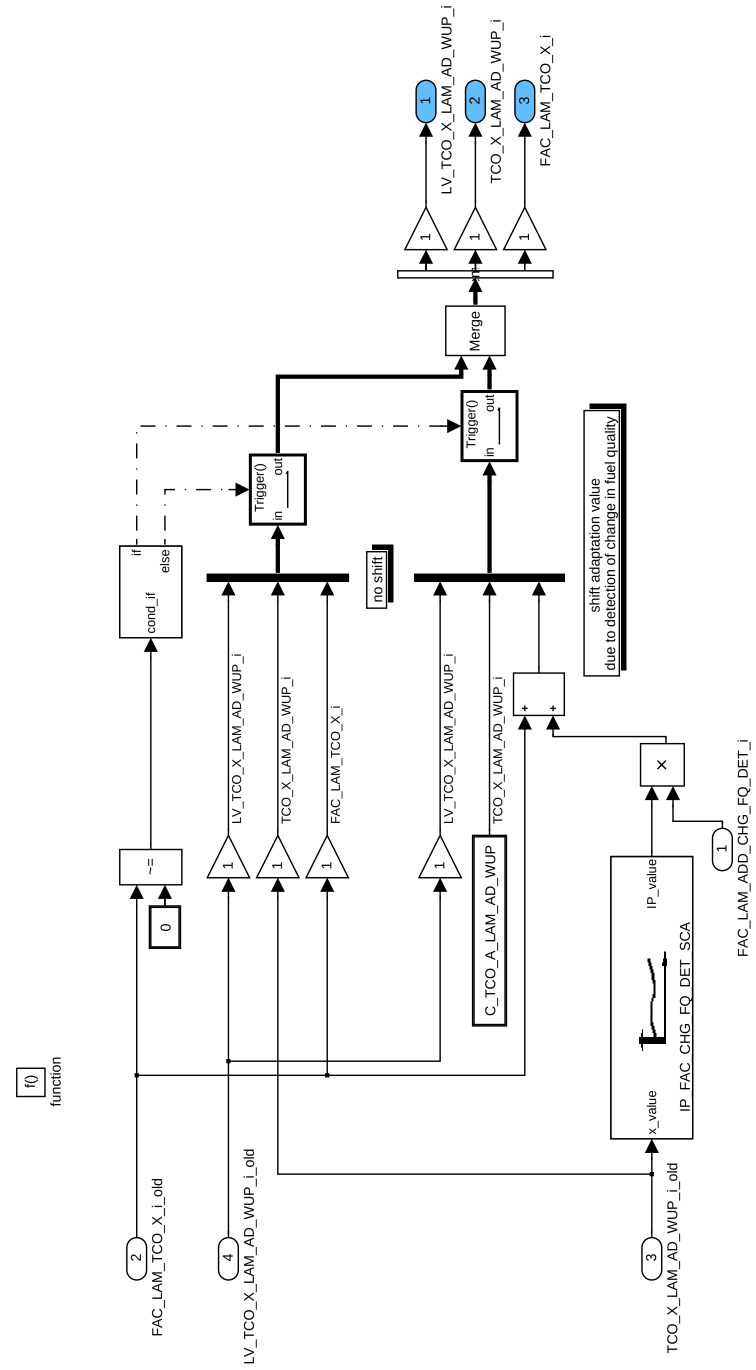

Figure 7.71.16:
LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/FAC_LAM_AD_WUP_CBK_SPC/
TCO_LAM_AD_WUP/CLC_FAC_LAM_TCO_A/CLC_CHG_FQ_DET_SCA

Determination of adaptation value during normal operation

Four different states shall be distinguished:

1.) Conditions to update are not yet fulfilled. Indicator flag remains zero and the factor and the temperature at the interpolation point are not updated.

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2.) The adaptation factor the corresponding temperature are updated once the following conditions are met:
 TCO is within the temperature window
 End of transient phase has been detected, thus TCO_MIN_INTER[i] is set
 The conditions for valid learning are fulfilled sufficiently long (LV_LOAD_VLD[i])
 The difference to the previously stored value is sufficiently large
If all above conditions are met, the adaptation factor is updated with the uncorrected Lambda controller output (in this process a correlation factor is considered) and the corresponding temperature is updated with the current TCO. Additionally the indicator flag is set to one.
3.) If TCO_MIN[i] is updated (the lowest ever learnt temperature is reduced) and it is larger than the temperature of the interpolation point, then the adaptation value is updated with factor belonging to TCO_MIN[i]. The corresponding temperature is not updated in this state. This update procedure can be restricted in such that TCO_MIN[i] needs to be within temperature of point of A and point B plus size of the temperature window.
4.) Update was already done in this driving cycle: No actions are undertaken.

The calculation at point B to E proceed analogous. At interpolation point F the correction factor is fixed at zero, in order to fade out the correction smoothly.

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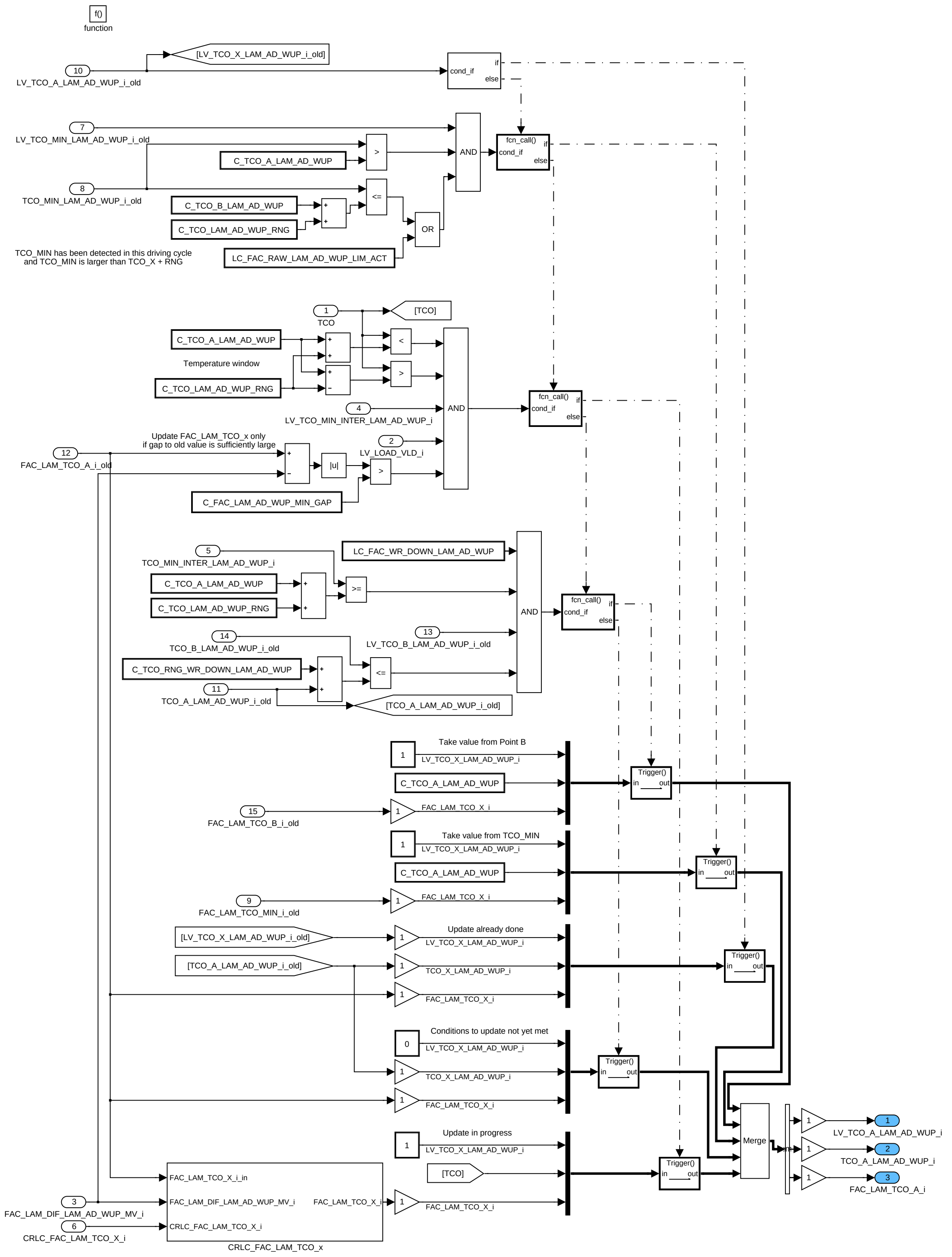

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Figure 7.71.17:
LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/FAC_LAM_AD_WUP_CBK_SPC/
TCO_LAM_AD_WUP/CLC_FAC_LAM_TCO_A/CLC_NOT_CHG_FQ_DET

Determination of new adaptation value at point B

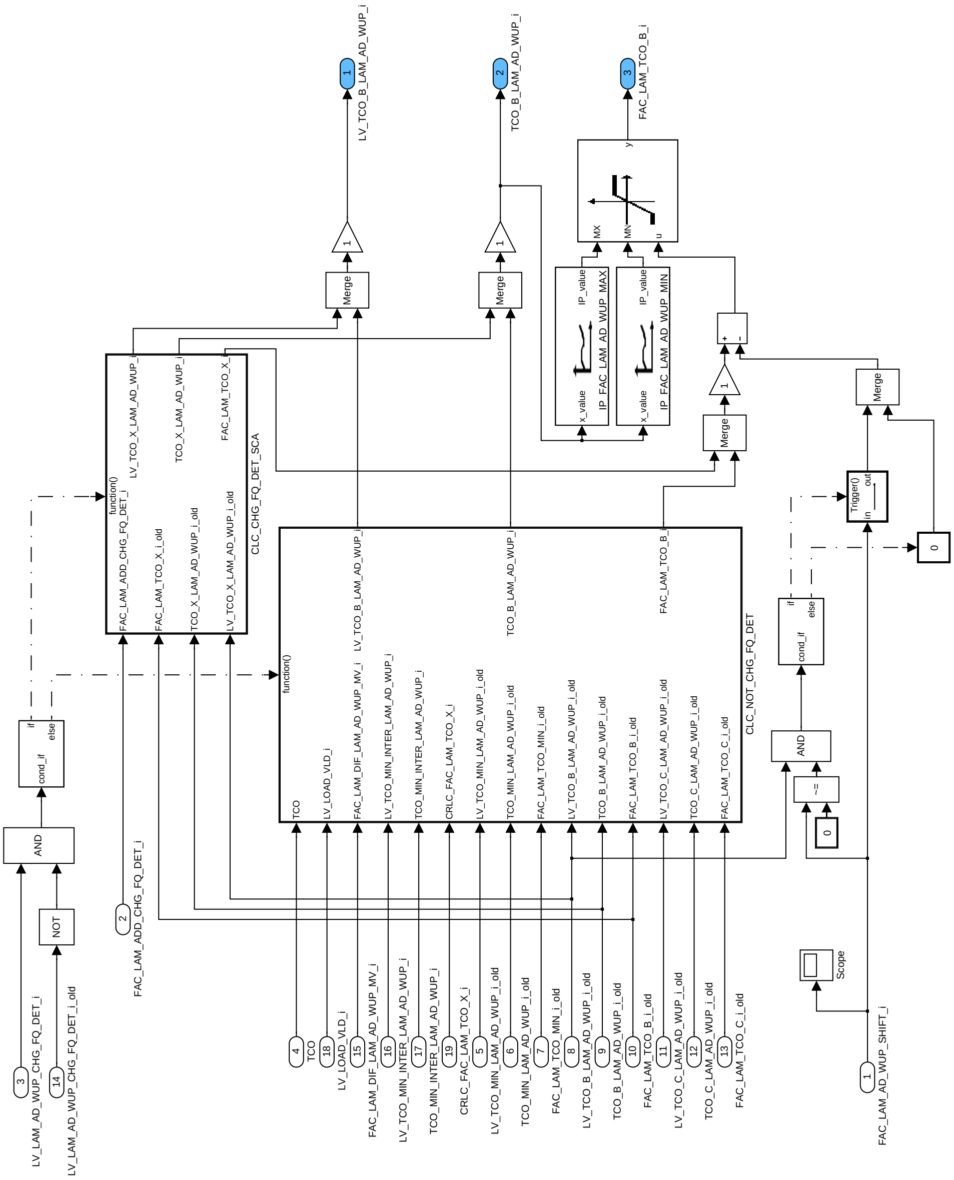

Figure 7.71.18: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/
FAC_LAM_AD_WUP_CBK_SPC/TCO_LAM_AD_WUP/CLC_FAC_LAM_TCO_B

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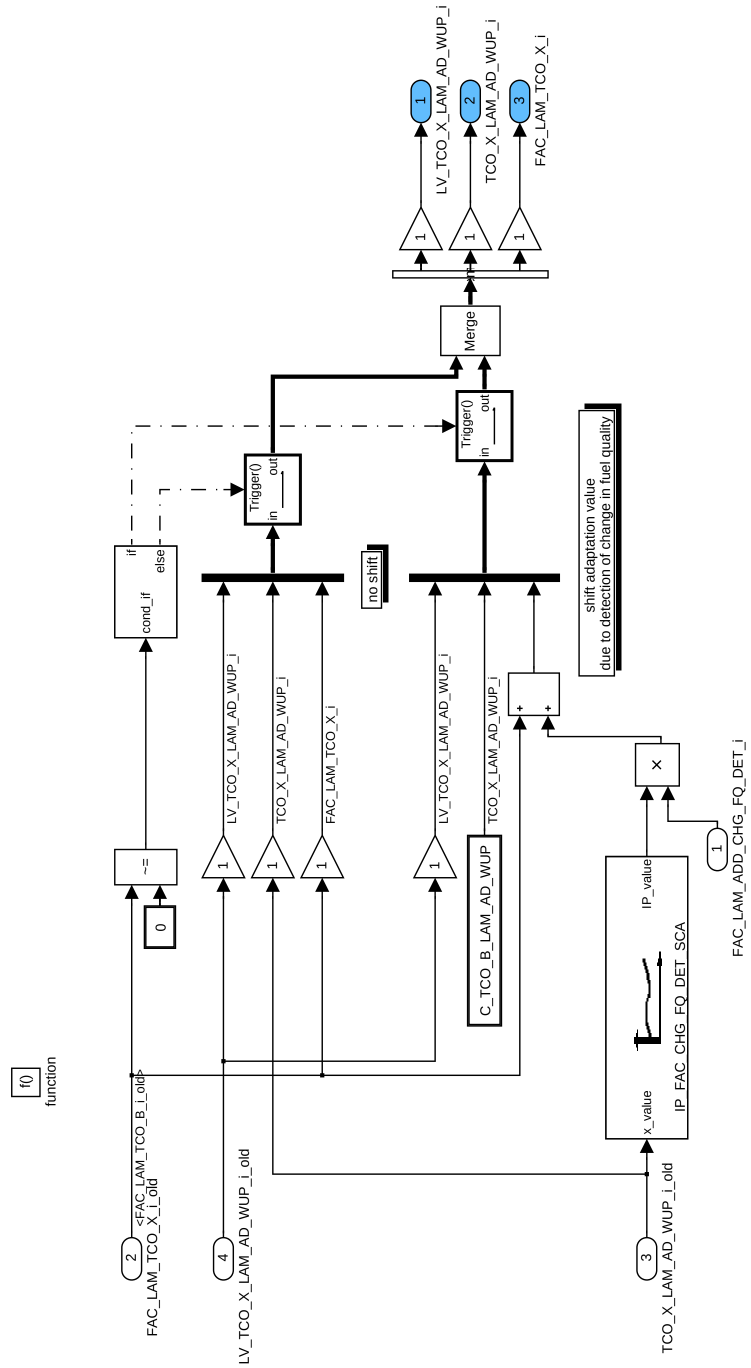

Figure 7.71.19:
LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/FAC_LAM_AD_WUP_CBK_SPC/
TCO_LAM_AD_WUP/CLC_FAC_LAM_TCO_B/CLC_CHG_FQ_DET_SCA

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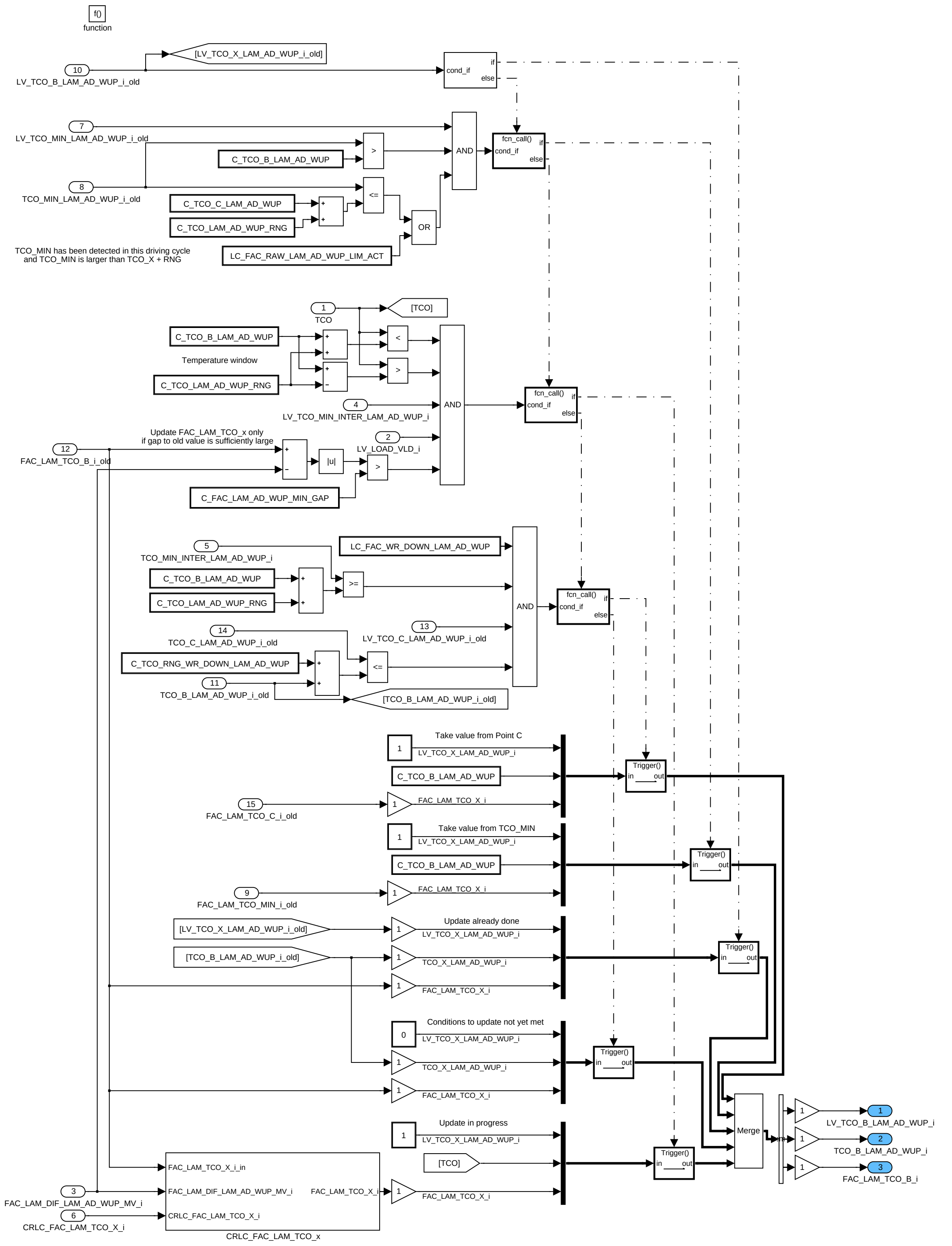

Figure 7.71.20:
LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/FAC_LAM_AD_WUP_CBK_SPC/TCO_LAM_AD_WUP/CLC_FAC_LAM_TCO_B/CLC_NOT_CHG_FQ_DET

Determination of new adaptation value at point C

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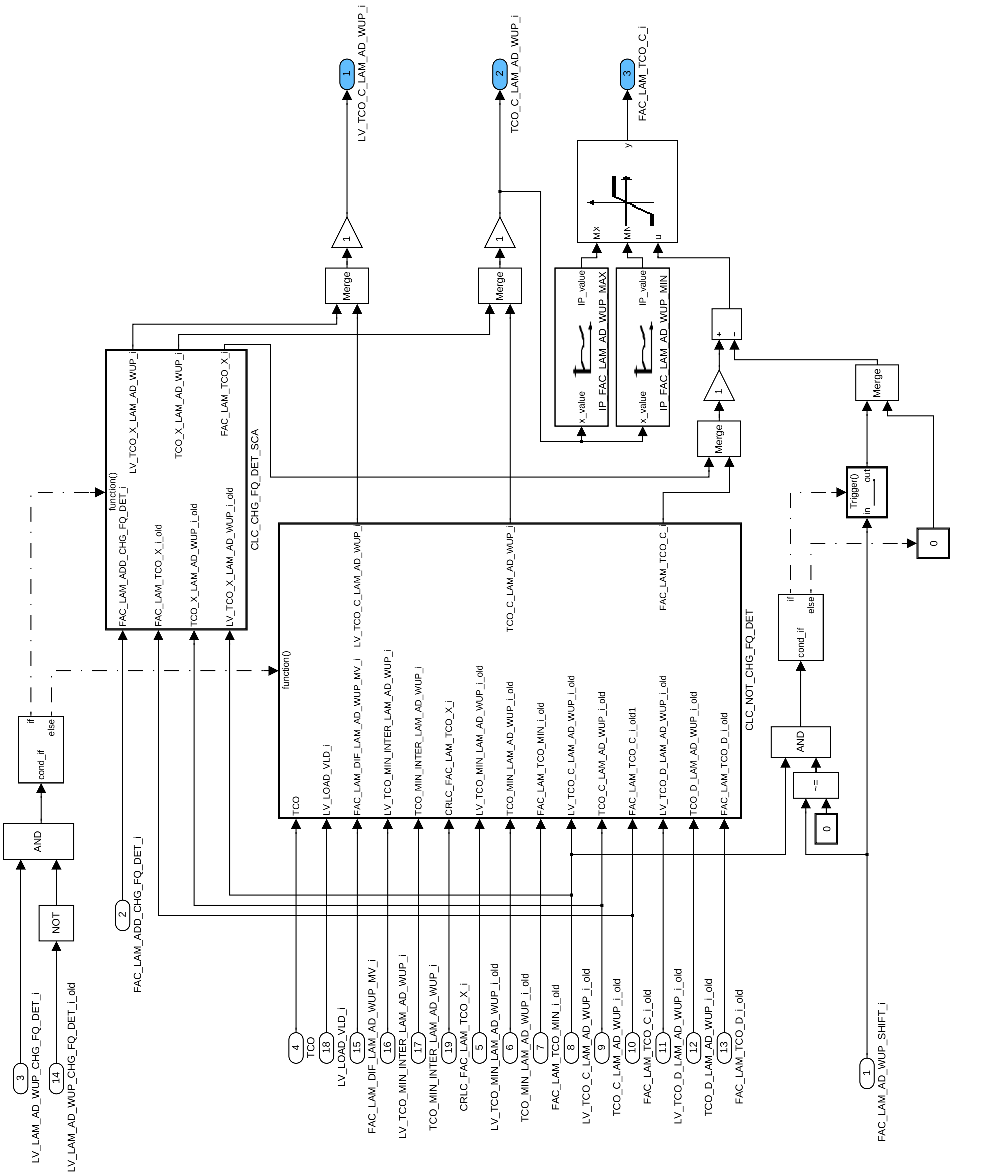

Figure 7.71.21: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/
FAC_LAM_AD_WUP_CBK_SPC/TCO_LAM_AD_WUP/CLC_FAC_LAM_TCO_C

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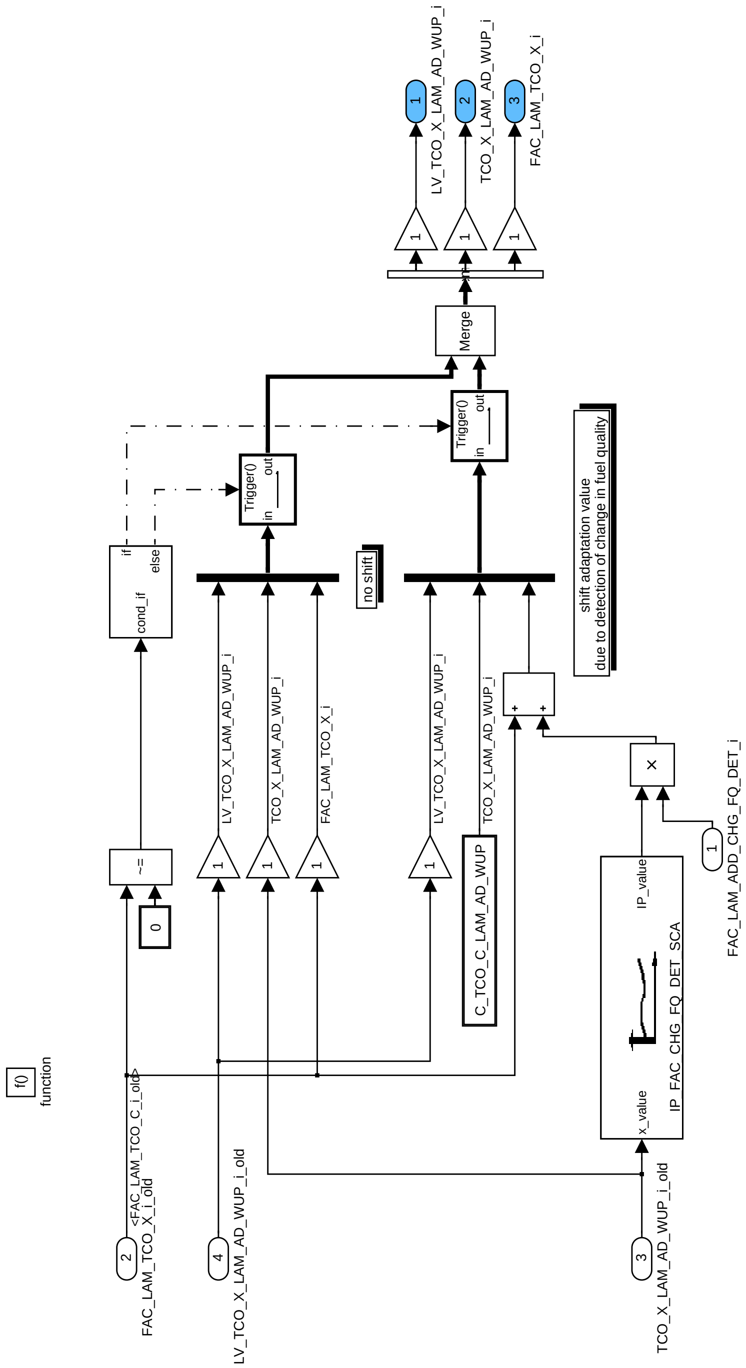

Figure 7.71.22:
LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/FAC_LAM_AD_WUP_CBK_SPC/
TCO_LAM_AD_WUP/CLC_FAC_LAM_TCO_C/CLC_CHG_FQ_DET_SCA

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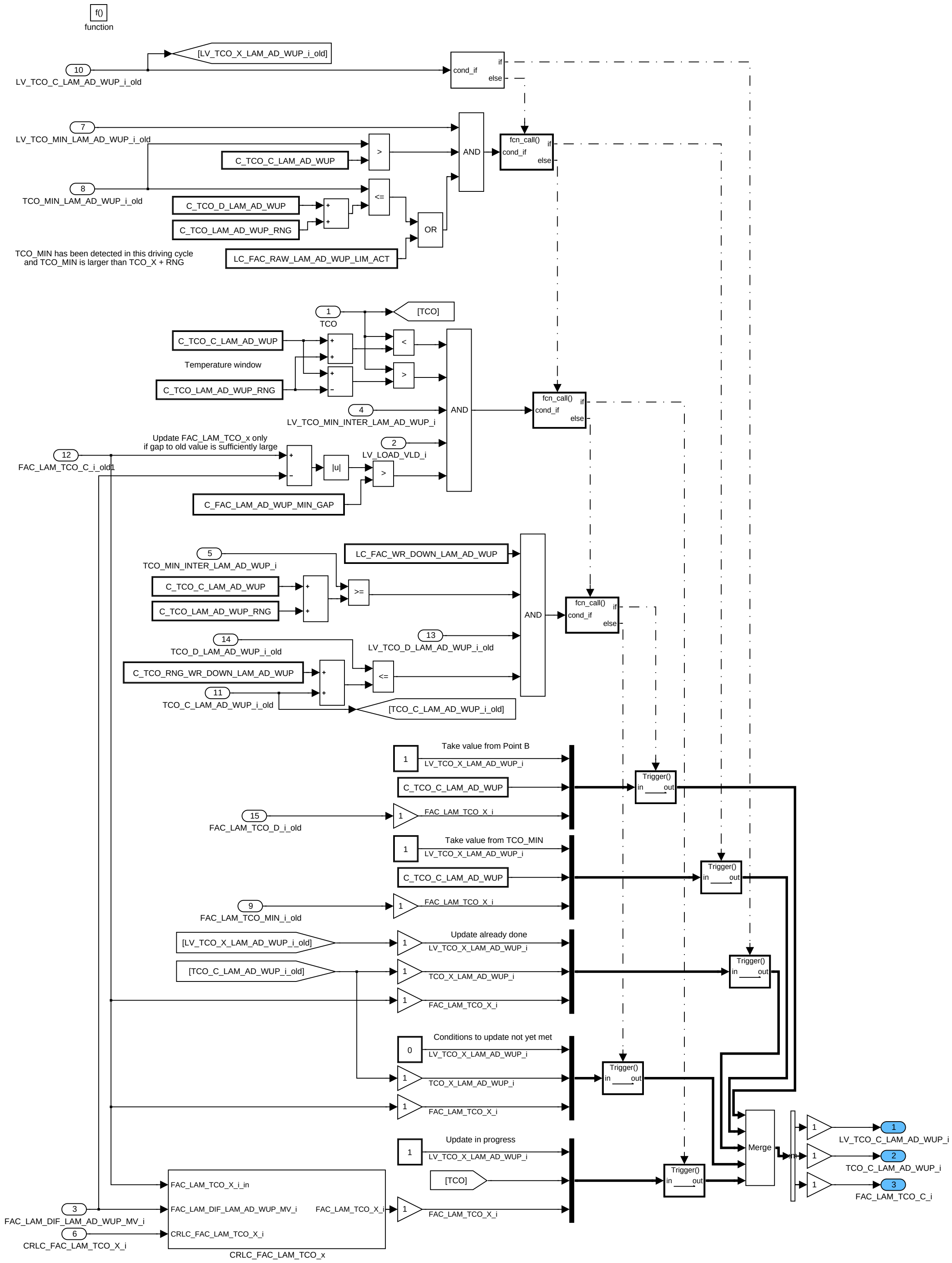

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Figure 7.71.23:
LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/FAC_LAM_AD_WUP_CBK_SPC/
TCO_LAM_AD_WUP/CLC_FAC_LAM_TCO_C/CLC_NOT_CHG_FQ_DET

Determination of new adaptation value at point D

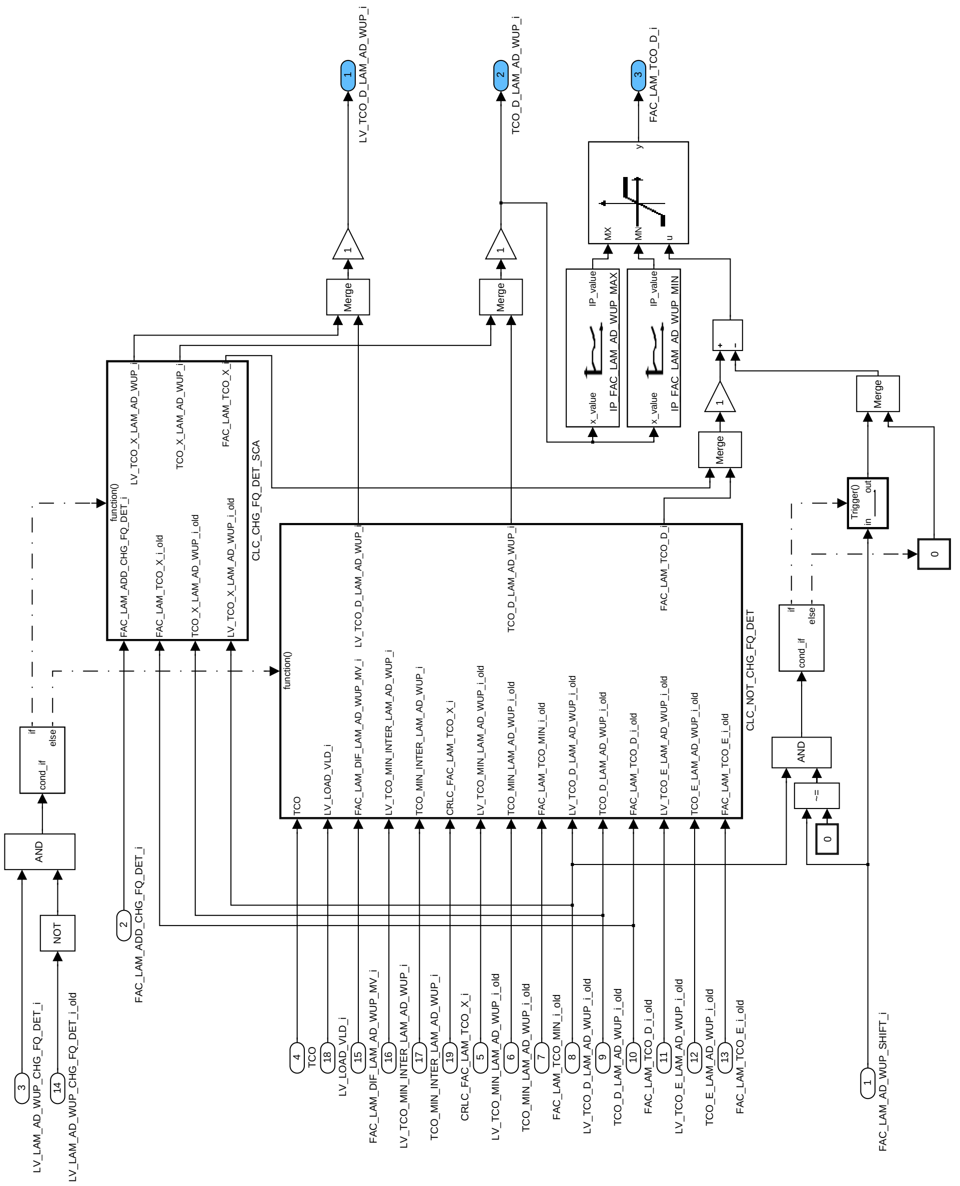

Figure 7.71.24: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/ FAC_LAM_AD_WUP_CBK_SPC/TCO_LAM_AD_WUP/CLC_FAC_LAM_TCO_D

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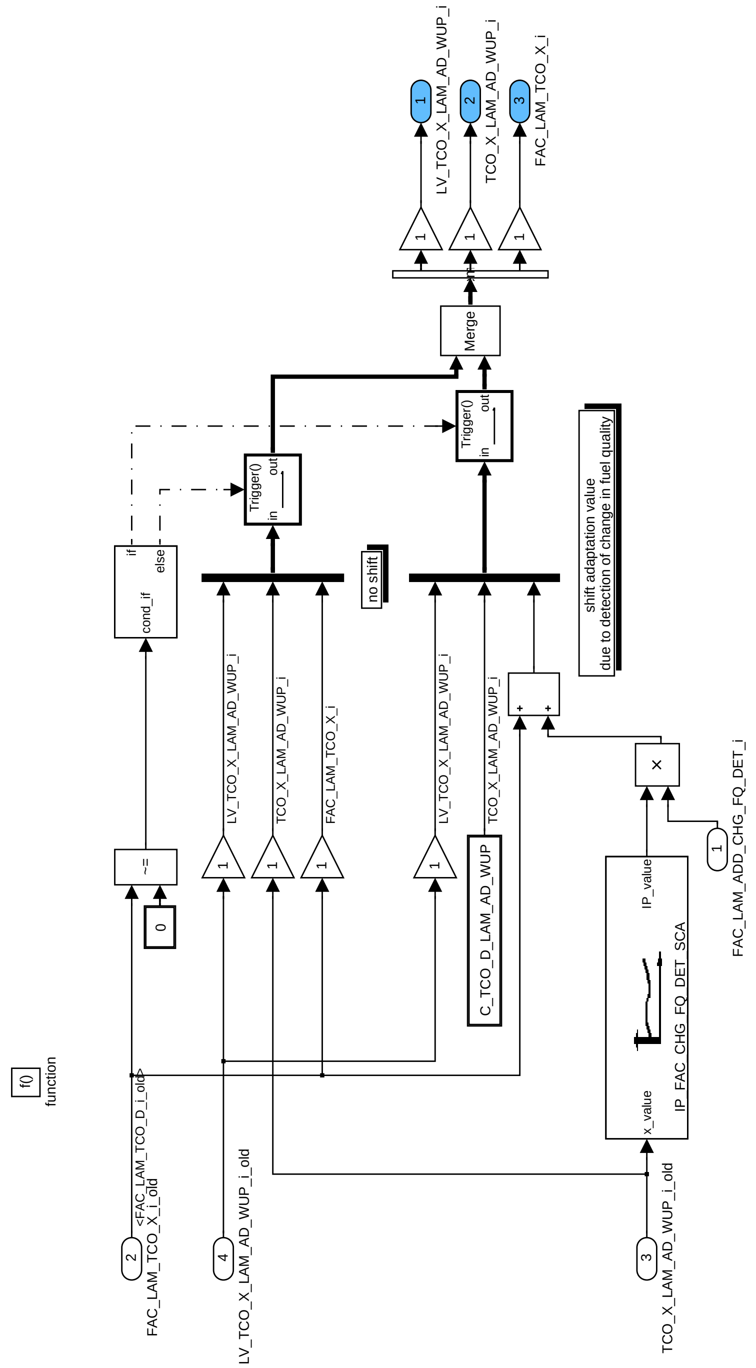

Figure 7.71.25:
LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/FAC_LAM_AD_WUP_CBK_SPC/
TCO_LAM_AD_WUP/CLC_FAC_LAM_TCO_D/CLC_CHG_FQ_DET_SCA

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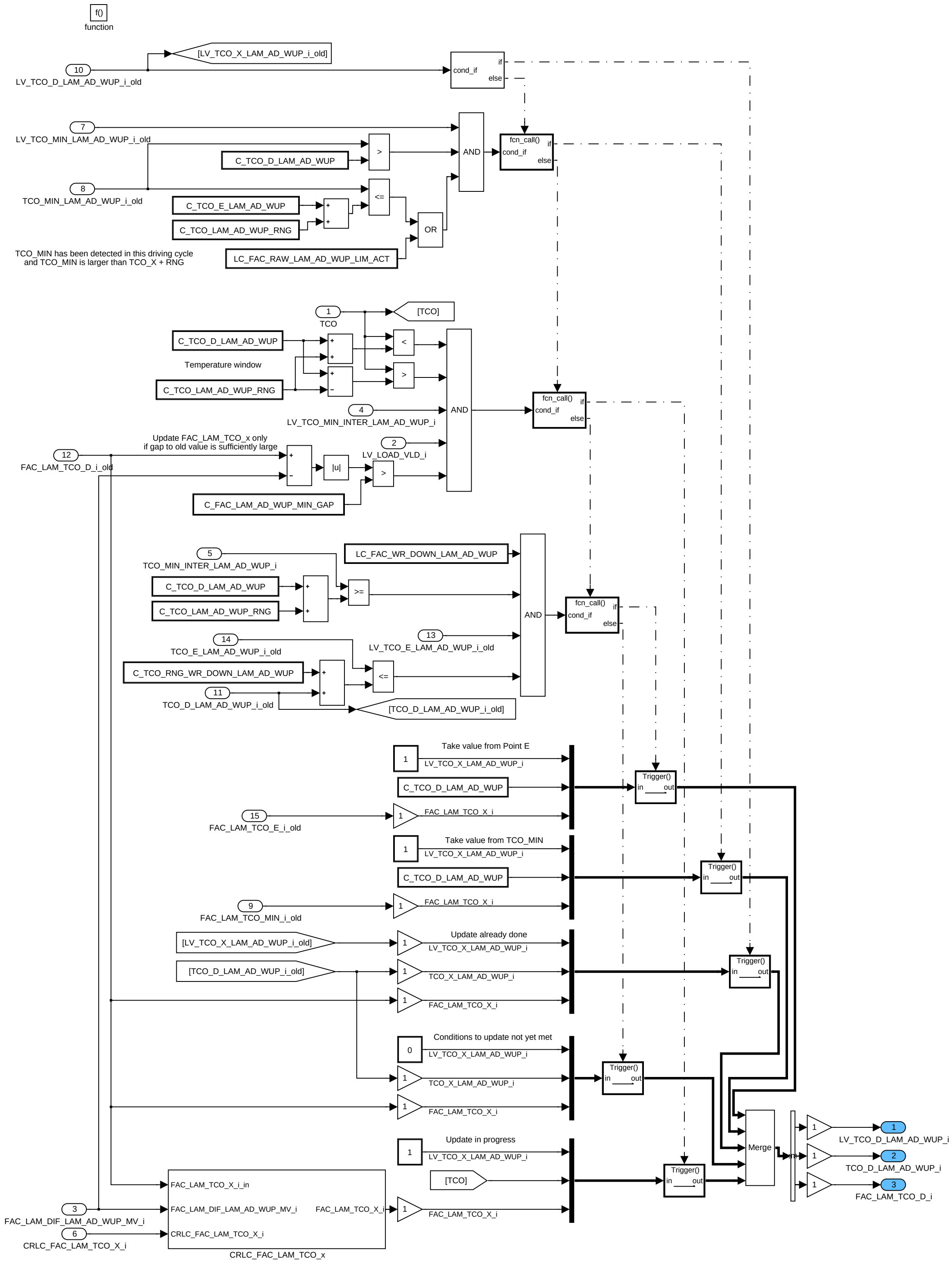

Figure 7.71.26:
LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/FAC_LAM_AD_WUP_CBK_SPC/
TCO_LAM_AD_WUP/CLC_FAC_LAM_TCO_D/CLC_NOT_CHG_FQ_DET

Determination of new adaptation value at point E

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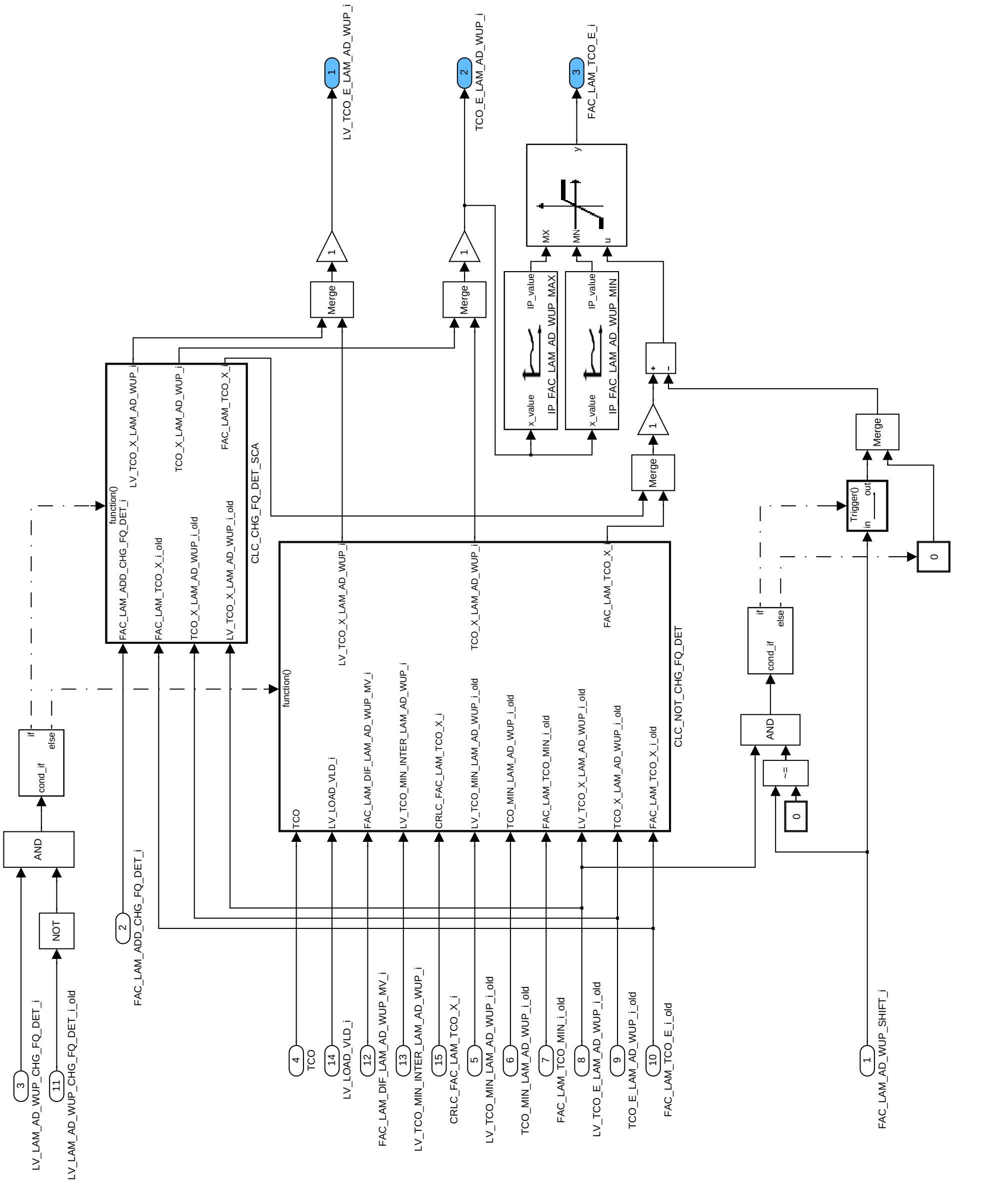

Figure 7.71.27: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/ FAC_LAM_AD_WUP_CBK_SPC/TCO_LAM_AD_WUP/CLC_FAC_LAM_TCO_E

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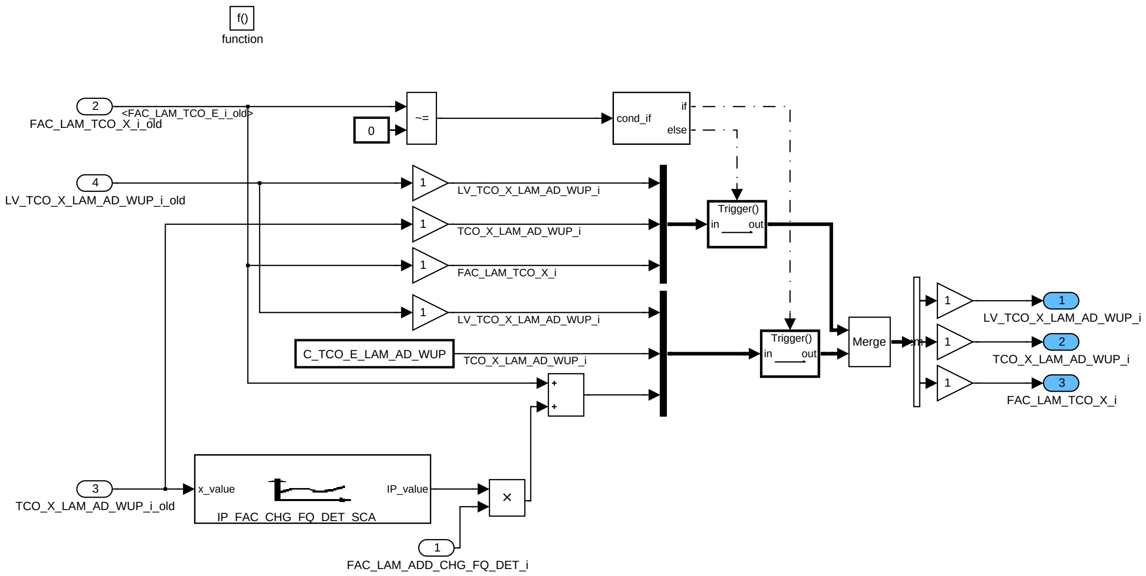

Figure 7.71.28:
LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/FAC_LAM_AD_WUP_CBK_SPC/
TCO_LAM_AD_WUP/CLC_FAC_LAM_TCO_E/CLC_CHG_FQ_DET_SCA

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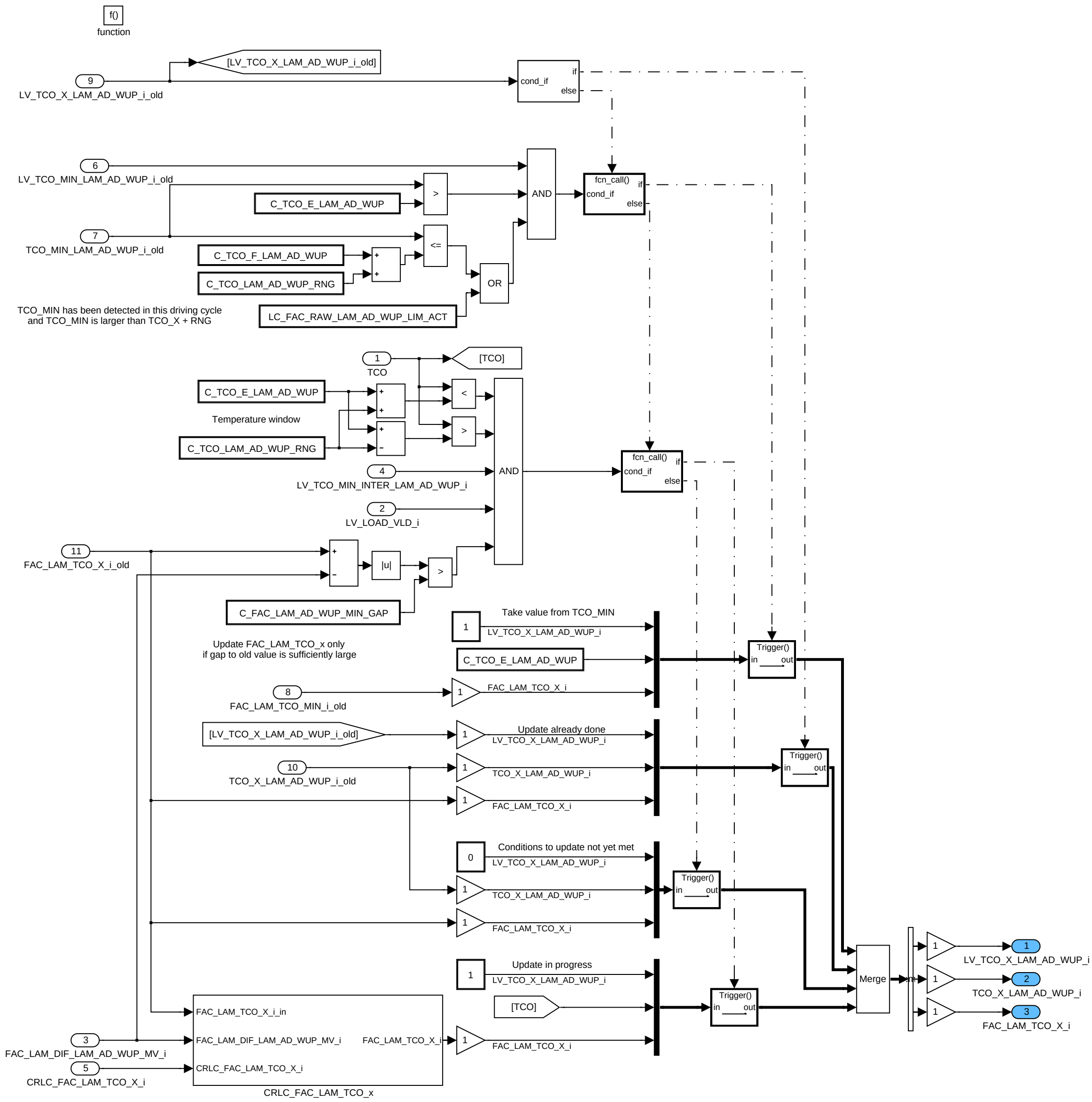

Figure 7.71.29:
LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/FAC_LAM_AD_WUP_CBK_SPC/
TCO_LAM_AD_WUP/CLC_FAC_LAM_TCO_E/CLC_NOT_CHG_FQ_DET

Set variables at point F

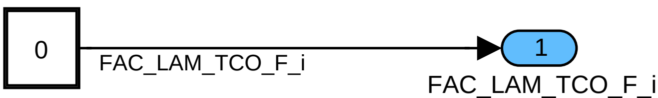

Figure 7.71.30: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/
FAC_LAM_AD_WUP_CBK_SPC/TCO_LAM_AD_WUP/CLC_FAC_LAM_TCO_F

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Parameters for slope equation

Here the parameters which are required to solve the slope equation are arranged.

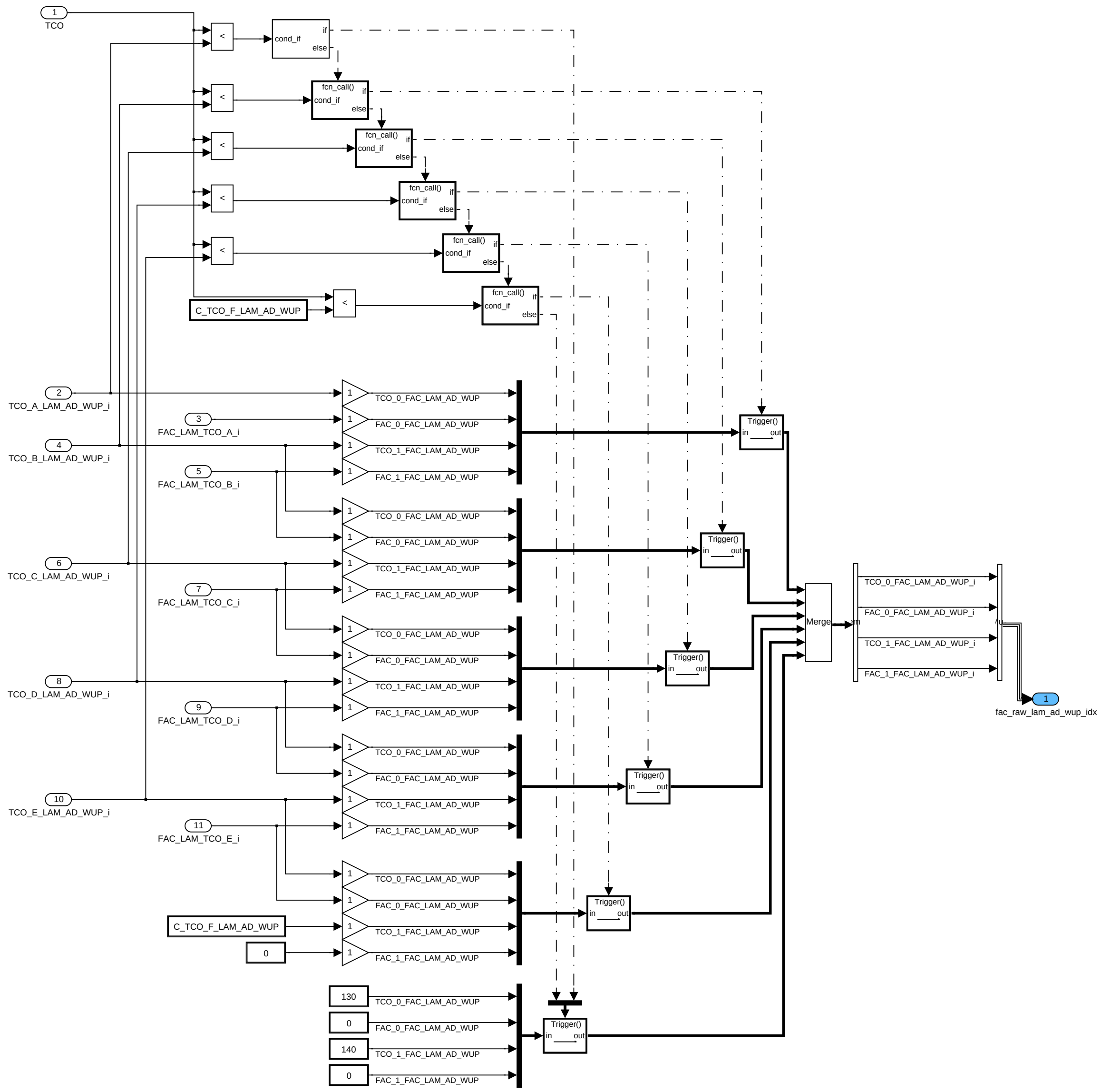

Figure 7.71.31: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/
FAC_LAM_AD_WUP_CBK_SPC/CLC_FAC_LAM_AD_WUP/FAC_RAW_LAM_AD_WUP_IDX

Calculation of the Lambda adaptation factor in the warm up phase

The respective adaptation factor in warmup phase is derived from slope equation with TCO as an input. Five different cases for the calculation of FAC_RAW_LAM_AD_WUP must be distinguished:

1.) The momentary TCO is between two interpolation points with TCO_MIN *smaller* than the lower interpolation point: Solving the slope equation with the two interpolation points and TCO as an input will yield FAC_RAW_LAM_AD_WUP.

2.) The momentary TCO is between two interpolation points with TCO_MIN *larger* than the lower interpolation point: Between the lower interpolation point and TCO_MIN, the output is fixed to FAC_LAM_TCO_MIN. Between TCO_MIN and the upper interpolation point, the slope equation made up from TCO_MIN and the upper interpolation point shall be used to calculate FAC_RAW_LAM_AD_WUP.

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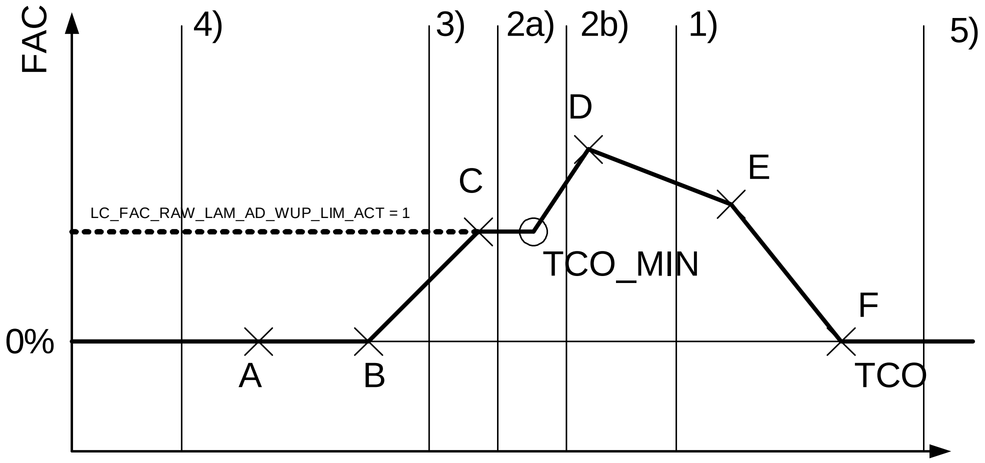
3.) TCO is smaller than TCO_MIN and TCO_MIN is larger than the next higher interpolation point. If LC_FAC_RAW_LAM_AD_WUP_LIM_ACT is set to one, the output value is fixed to FAC_LAM_TCO_MIN; otherwise it shall be obtained by solving the slope equation.
4.) TCO is smaller than temperature at point A:
If LC_FAC_RAW_LAM_AD_WUP_LIM_ACT is set to one, the output value is fixed to FAC_LAM_TCO_MIN, otherwise it is zero.
5.) TCO is larger than temperature of point F: the output is zero.



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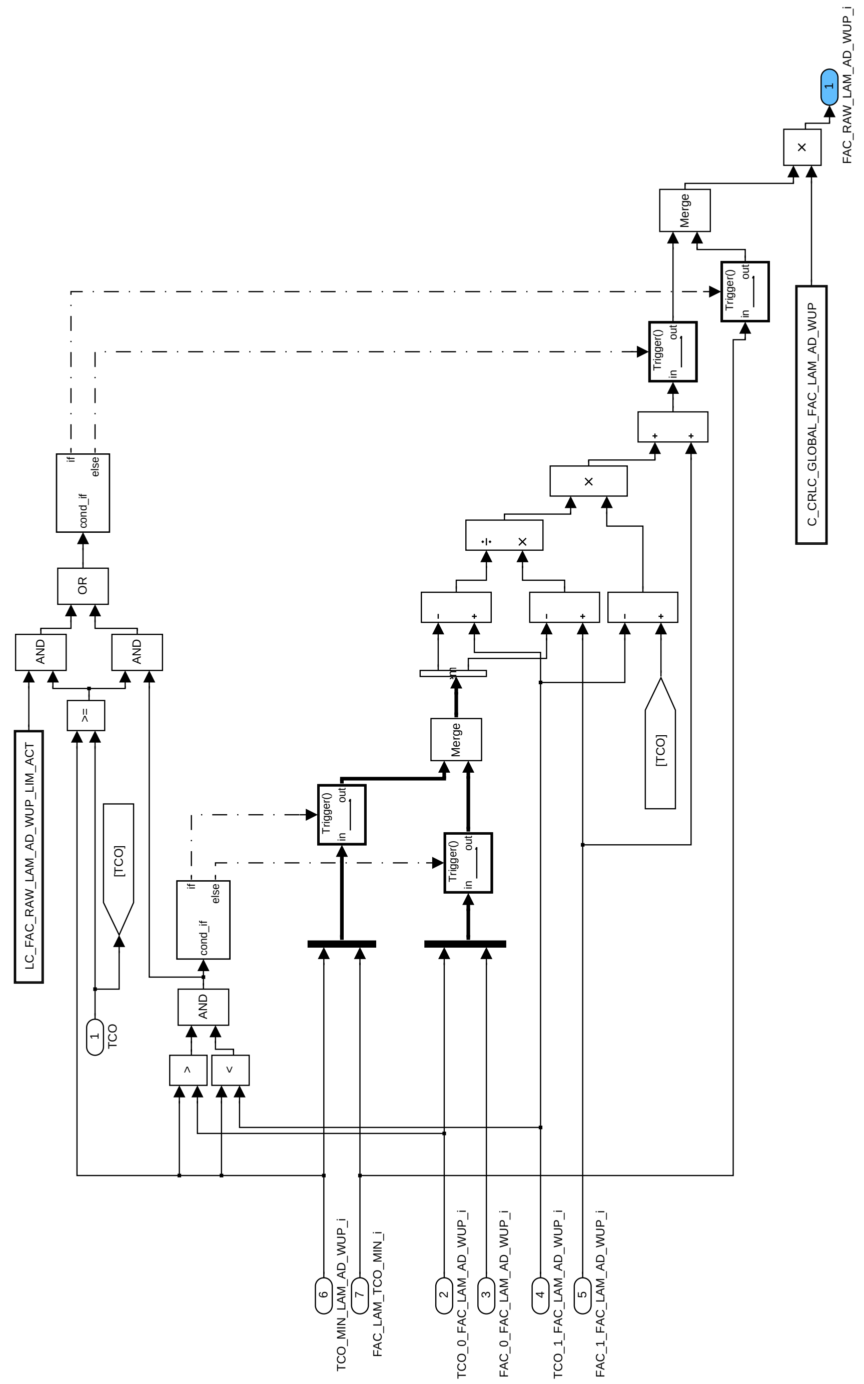

Figure 7.71.32: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/
FAC_LAM_AD_WUP_CBK_SPC/CLC_FAC_LAM_AD_WUP/FAC_RAW_LAM_AD_WUP

Limitation of adaptation factor

Three different limitations of the Lambda adaptation factor in warmup phase can be applied. If the conditions to go closed loop Lambda control are not yet fulfilled (STATE_LS == 0) C_FAC_LAM_AD_WUP_MAX/MIN_LSCL_OFF is applied. In the transient phase until TCO_MIN_INTER is detected C_

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FAC_LAM_AD_WUP_MAX/MIN_INTER is the relevant limitation. After detection of TCO_MIN_INTER the limitation are specified by IP_FAC_LAM_AD_WUP_MAX/MIN.
With C_FAC_LAM_AD_WUP_DELTA the shifts in the Lambda adaptation factor in warmup phase can be smoothed by specifying the maximum step value. It has been observed that for large changes in the adaptation value that Lambda controller output is not reduced as fast as the adaptation value increases (due to transient effects). This causes unwanted deviation of the Lambda value, which can be avoided by specifying a smooth transition between different values of the adaptation factor.

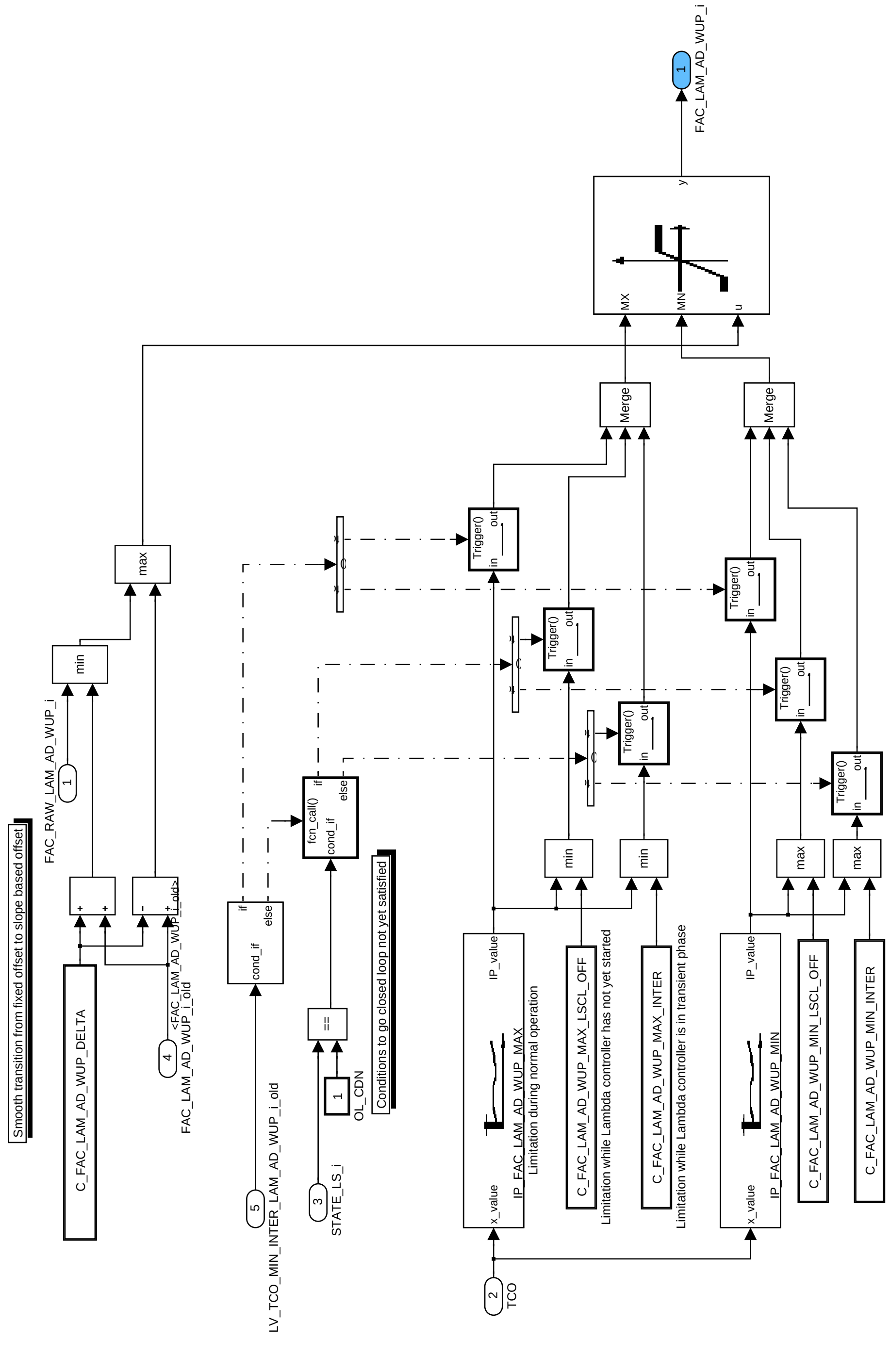

Figure 7.71.33: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/
FAC_LAM_AD_WUP_CBK_SPC/CLC_FAC_LAM_AD_WUP/FAC_LAM_AD_WUP_LIM

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Shift of the Lambda controller

A shift of the Lambda controller output is required if the value of FAC_LAM_AD_WUP[i] has changed since the last calculation recurrence in order to avoid large Lambda controller excursions.

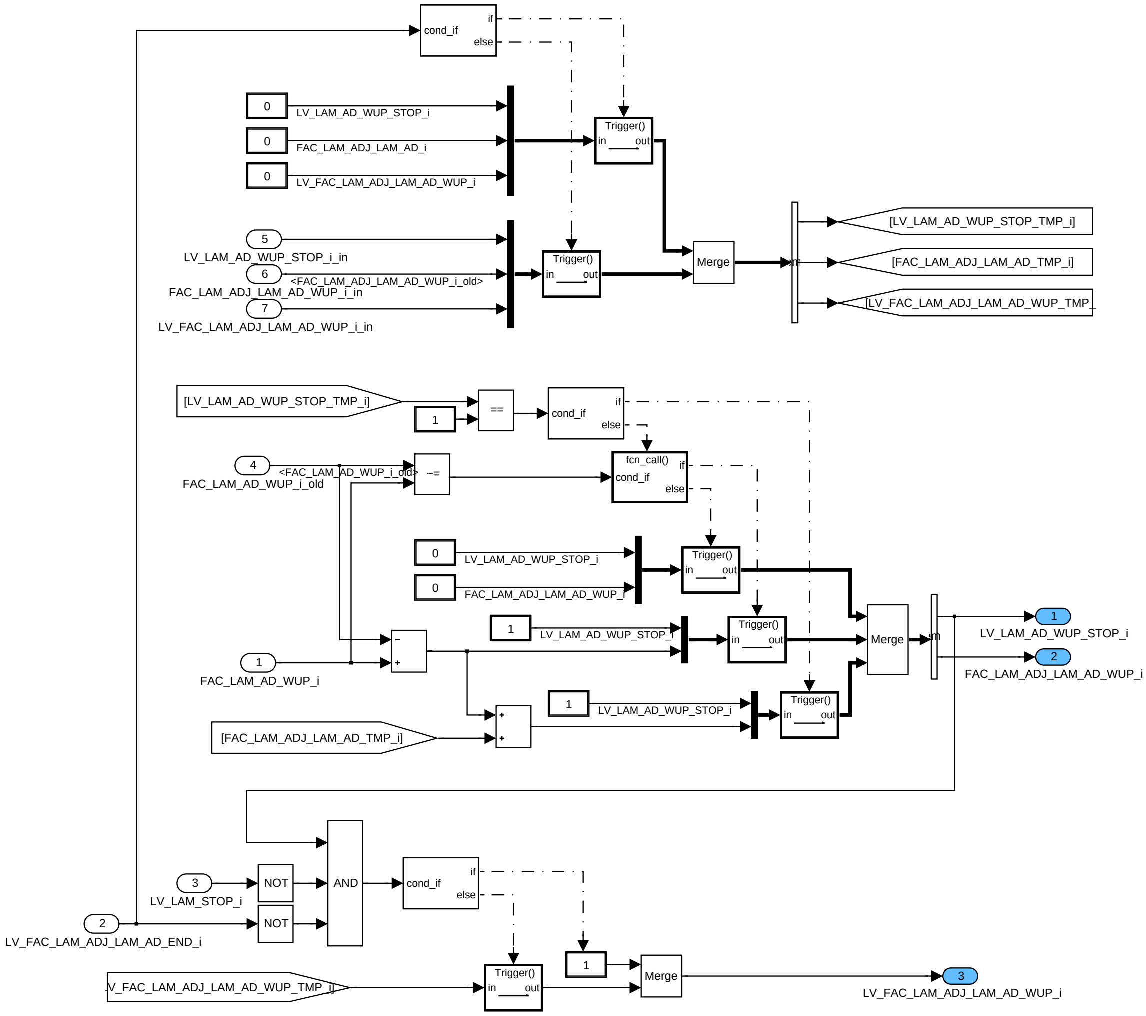

Figure 7.71.34: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/
FAC_LAM_AD_WUP_CBK_SPC/CLC_FAC_LAM_AD_WUP/CLC_FAC_LAM_ADJ_LAM_AD_WUP

Rewriting of adaptation correction in warm up phase with non volatile stored values

In case of Lambda adaptation relevant errors (see application incidences) the values of the data to be stored in the nonvolatile memory must be rewritten with the values stored at the end of the last driving cycle.

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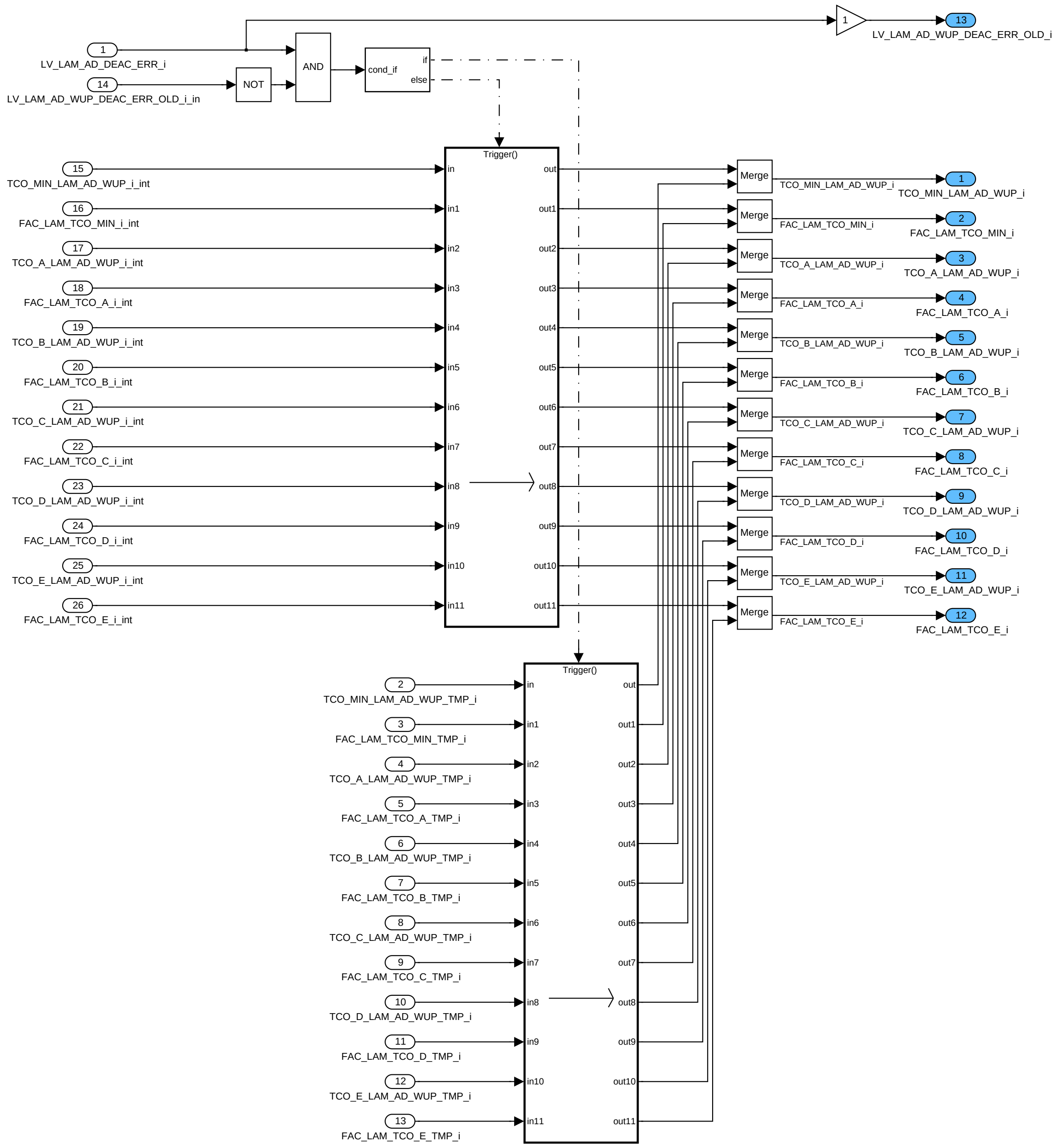

Figure 7.71.35: LACO_ISPCLADAW0/operate/FAC_LAM_AD_WUP_CBK_MNG/
FAC_LAM_AD_WUP_CBK_SPC/ERR_LAM_AD_WUP

7.71.1.2 Initialization and Non Volatile Memory Data Handling

Non Volatile Memory Data

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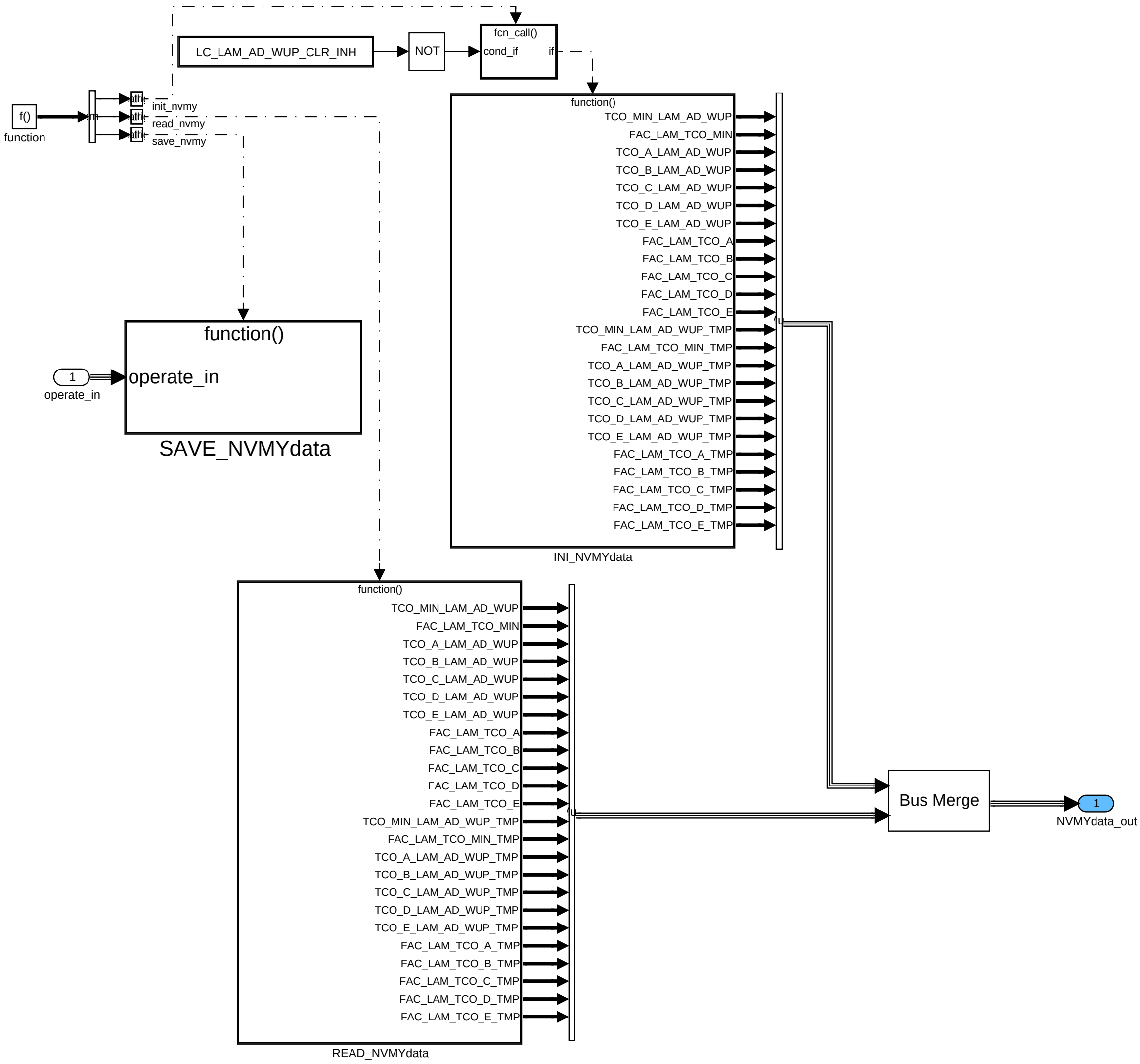

Figure 7.71.36: LACO_ISPCLADAW0/INIT/NVMYdata

Initialization of NVMY Data

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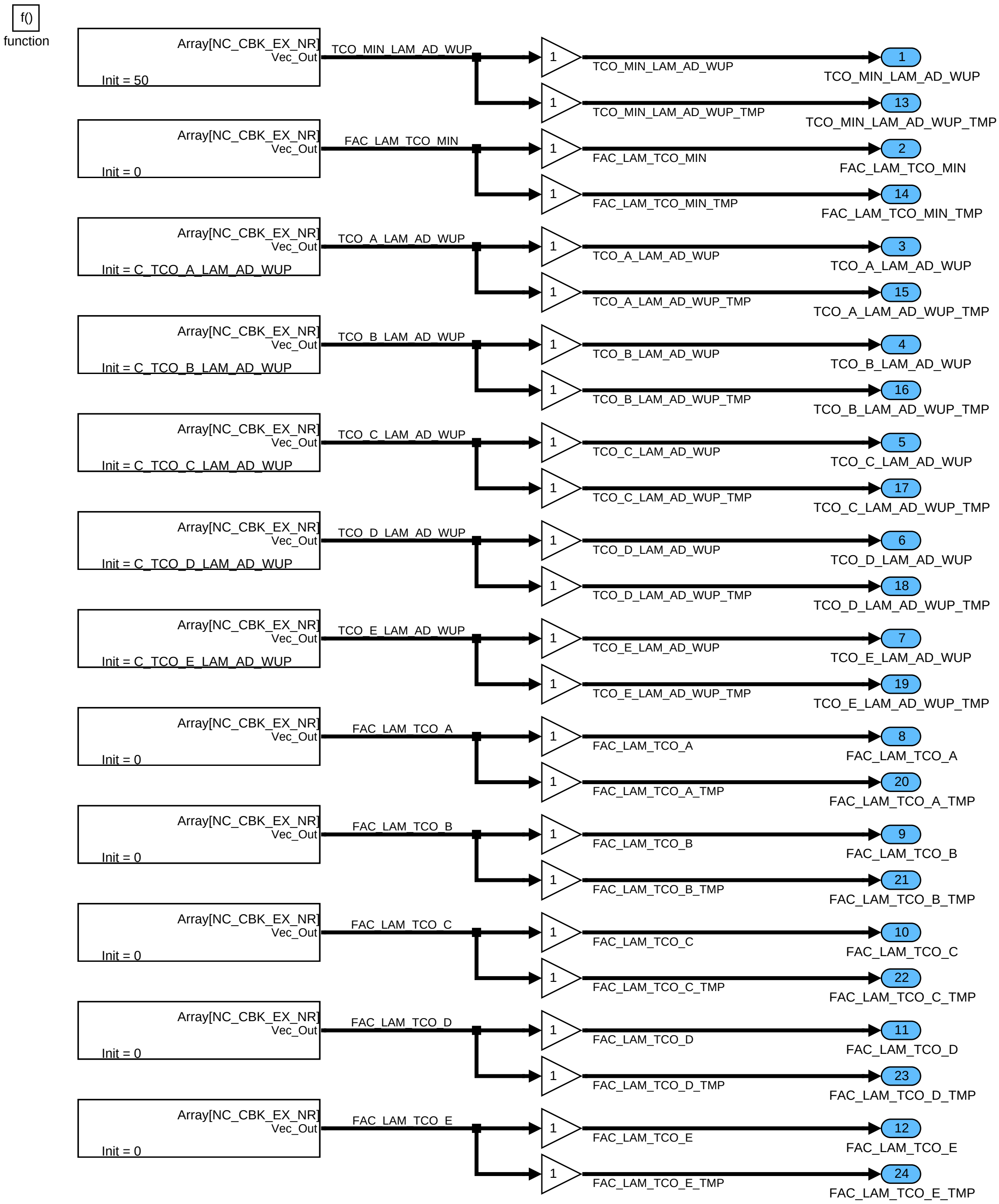

Figure 7.71.37: LACO_ISPCLADAW0/INIT/NVMYdata/INI_NVMYdata

Read NVMY Data

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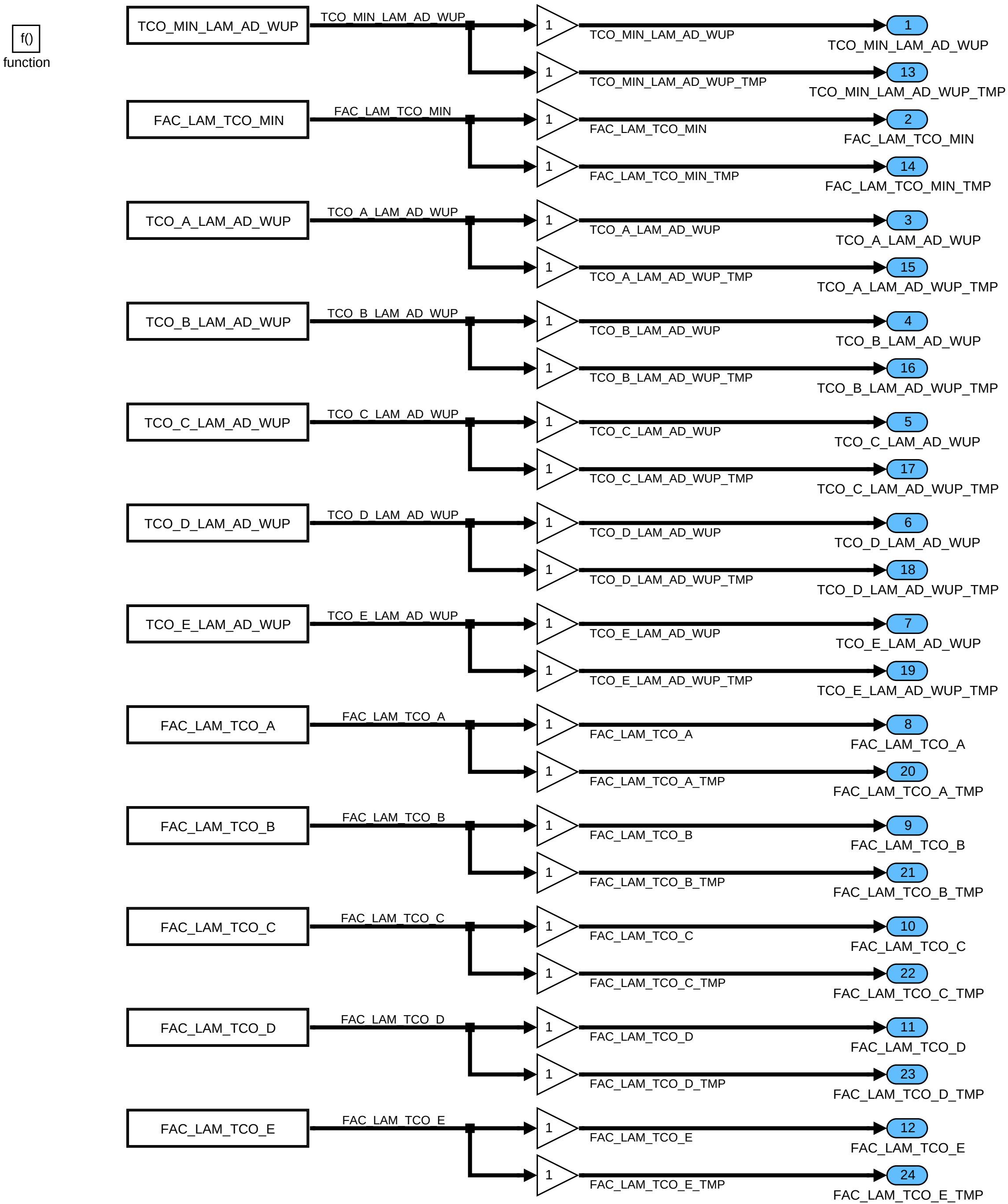

Figure 7.71.38: LACO_ISPCLADAW0/INIT/NVMYdata/READ_NVMYdata

Store NVMY

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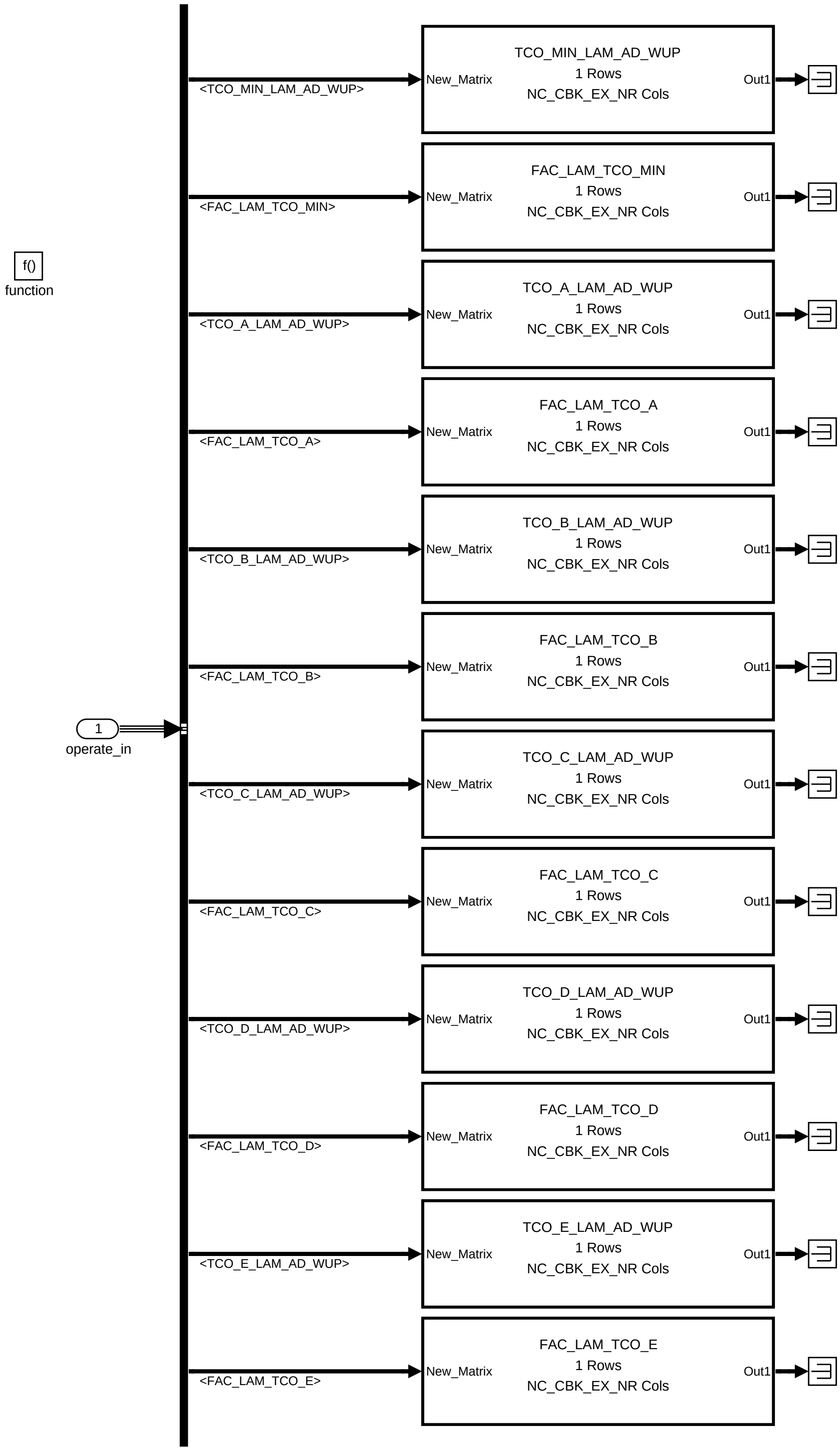

Figure 7.71.39: LACO_ISPCLADAW0/INIT/NVMYdata/SAVE_NVMYdata

ECU Reset

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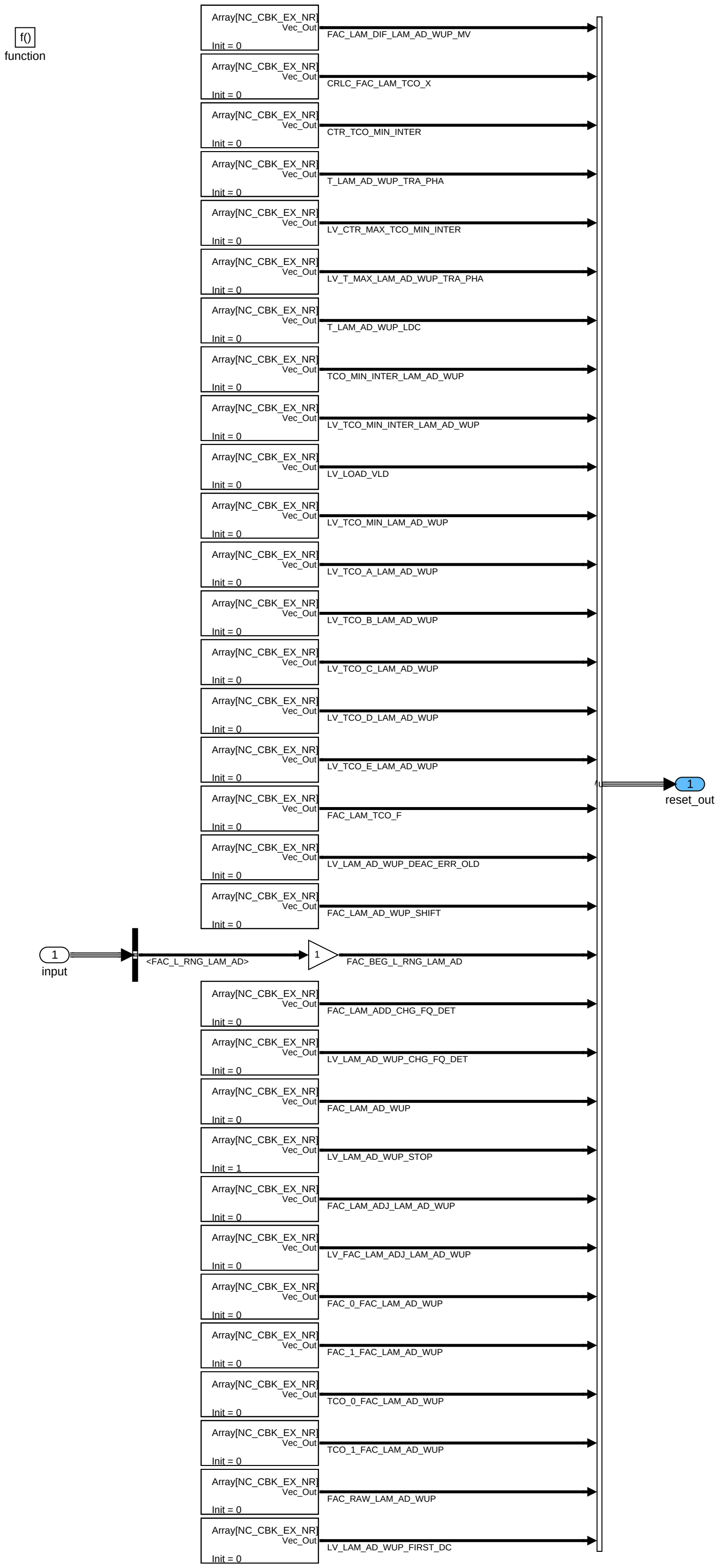

Figure 7.71.40: LACO_ISPCLADAW0/INIT/reset

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7.72 Lambda adaptation (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRLC_LAM_AD [NC_CBK_EX_NR]	O/V	0... FFH	0... 0.99609	3.9062e-3	-
correlation constant for calculation of adaptive values					
FAC_LAM_AD_SHIFT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Output value for shift of Lambda adaptation					
FAC_LAM_MV_OFS_LDC_LAM_AD [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
filtered lambda controller output offset for limited dynamics calculation					
LV_FAC_LAM_AD_SHIFT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to request shift of Lambda adaptation					
LV_LAM_AD_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that lambda adaptation can be activated					
LV_LAM_AD_ACT_ERR [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that lambda adaptation can be activated because of no error detected					
LV_LAM_AD_CDN_ADD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
condition bit for activation of lambda adaptation ADAPT_ADD					
LV_LAM_AD_CDN_H_RNG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
condition bit for activation of lambda adaptation ADAPT_FAC_H					
LV_LAM_AD_CDN_L_RNG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
condition bit for activation of lambda adaptation ADAPT_FAC_L					
LV_LAM_AD_DEAC_ERR [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that lambda adaptation is deactivated due to an error					
LV_LAM_AD_WUP_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that lambda adaptation in warm-up phase can be activated					
LV_LDC_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
limited dynamic conditions for lambda adaptation					
MAF_INT_LDC_LAM_AD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.42	0.0277778	g
air mass flow integral during limited dynamics not fulfilled					
MAF_OFS_LDC_LAM_AD [NC_CBK_EX_NR]	V	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
air mass flow offset for limited dynamics calculation					
MFF_SP_AD [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint for lambda adaptation - bank selective					
N_OFS_LDC_LAM_AD [NC_CBK_EX_NR]	V	E020... 1FE0H	-8160 ...8160	1	rpm
engine speed offset for limited dynamics calculation					
T_WAIT_MAX_LAM_AD [NC_CBK_EX_NR]	-	0... FFH	0... 5.1	0.02	s
threshold of waiting time between two adaptations					

Input data:

AMP {p. 982}	ERR_INH_LAM_AD_ACT [NC_CBK_EX_NR] {p. 1014}	FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_LAM_AD_CUS_ SHIFT [NC_CBK_EX_NR] {p. 8308}
FAC_LAM_MV_DELTA_ LDC [NC_CBK_EX_NR] {p. 2585}	FUP {p. 1283}	LAMB_SP_HOM [NC_CBK_EX_NR] {p. 8340}	LV_CP_RAMP_OPEN_ACT {p. 3636}

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LV_FAC_H_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	LV_FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	LV_FAC_LAM_AD_CUS_SHIFT [NC_CBK_EX_NR] {p. 8309}	LV_HOM_ACT {p. 8136}
LV_INH_FSD_STOP_OIL {p. 6133}	LV_LAM_AD_ENA {p. 3737}	LV_LAM_AD_EXT {p. 1016}	LV_LAM_AD_INJ_ACT {p. 3348}
LV_LAM_LIM_LAM_AD [NC_CBK_EX_NR] {p. 6141}	LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_MFF_ADD_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2642}
MAF_CYL {p. 8277}	MAF_DELTA_LDC {p. 2585}	MAF_KGH {p. 1195}	MFF_ADD_LAM_AD [NC_CBK_EX_NR] {p. 2642}
MFF_SP_HOM_BAS_MV {p. 2151}	MFF_SP_S_SWI_HOM {p. 8243}	N_DELTA_LDC {p. 2585}	NC_CBK_EX_NR {p. 1829}
NC_CYL_NR {p. 1526}	STATE_LAM_AD [NC_CBK_EX_NR] {p. 2643}	TAM {p. 1579}	TCO {p. 1100}
TIA {p. 1226}	WGPWM [NC_CBK_EX_NR] {p. 8140}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_MIN_LAM_AD	-	0... FFFFH	0... 5434	0.0829175	hPa
Minimun ambient pressure to activate lambda adaptation					
C_CRLC_LAM_AD_ADD	-	0... FFH	0... 0.99609	3.9062e-3	-
correlation constant for lambda adaptation at offset learning area					
C_CRLC_LAM_AD_ADD_LAM_LIM	-	0... FFH	0... 0.99609	3.9062e-3	-
correlation constant for lambda adaptation at offset learning area when forced modus is required					
C_CRLC_LAM_AD_H	-	0... FFH	0... 0.99609	3.9062e-3	-
correlation constant for lambda adaptation at high area					
C_CRLC_LAM_AD_H_LAM_LIM	-	0... FFH	0... 0.99609	3.9062e-3	-
correlation constant for lambda adaptation at high area when forced modus is required					
C_CRLC_LAM_AD_L	-	0... FFH	0... 0.99609	3.9062e-3	-
correlation constant for lambda adaptation at low area					
C_CRLC_LAM_AD_L_LAM_LIM	-	0... FFH	0... 0.99609	3.9062e-3	-
correlation constant for lambda adaptation at low area when forced modus is required					
C_FAC_LAM_MV_DYW_LDC_LAM_AD	-	0... 7FFFH	0... 49.99847	1.5259e-3	%
lambda control output window for limited dynamic conditions lambda adaptation					
C_FUP_MAX_LAM_AD	-	0... FFFFH	0... 347776	5.3067216	hPa
Minimun fuel pressure mean value to activate lambda adaptation					
C_FUP_MIN_LAM_AD	-	0... FFFFH	0... 347776	5.3067216	hPa
Minimun fuel pressure mean value to activate lambda adaptation					
C_LAMB_SP_AD_MAX_ADD	-	0... 7FFFH	0... 1.99993	61e-6	-
maximum lambda setpoint to allow lambda adaptation at offset learning area					
C_LAMB_SP_AD_MAX_H	-	0... 7FFFH	0... 1.99993	61e-6	-
maximum lambda setpoint to allow lambda adaptation at high range operating point					
C_LAMB_SP_AD_MAX_L	-	0... 7FFFH	0... 1.99993	61e-6	-
maximum lambda setpoint to allow lambda adaptation at low range operating point					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_SP_AD_MAX_WUP_ADD	-	0... 7FFFH	0... 1.99993	61e-6	-
maximum lambda setpoint to allow lambda adaptation at offset learning area during warm-up phase					
C_LAMB_SP_AD_MAX_WUP_H	-	0... 7FFFH	0... 1.99993	61e-6	-
maximum lambda setpoint to allow lambda adaptation at high range operating point during warm-up phase					
C_LAMB_SP_AD_MAX_WUP_L	-	0... 7FFFH	0... 1.99993	61e-6	-
maximum lambda setpoint to allow lambda adaptation at low range operating point during warm-up phase					
C_LAMB_SP_AD_MIN_ADD	-	0... 7FFFH	0... 1.99993	61e-6	-
minimum lambda setpoint to allow lambda adaptation at offset learning area					
C_LAMB_SP_AD_MIN_H	-	0... 7FFFH	0... 1.99993	61e-6	-
minimum lambda setpoint to allow lambda adaptation at high range operating point					
C_LAMB_SP_AD_MIN_L	-	0... 7FFFH	0... 1.99993	61e-6	-
minimum lambda setpoint to allow lambda adaptation at low range operating point					
C_LAMB_SP_AD_MIN_WUP_ADD	-	0... 7FFFH	0... 1.99993	61e-6	-
minimum lambda setpoint to allow lambda adaptation at offset learning area during warm-up phase					
C_LAMB_SP_AD_MIN_WUP_H	-	0... 7FFFH	0... 1.99993	61e-6	-
minimum lambda setpoint to allow lambda adaptation at high range operating point during warm-up phase					
C_LAMB_SP_AD_MIN_WUP_L	-	0... 7FFFH	0... 1.99993	61e-6	-
minimum lambda setpoint to allow lambda adaptation at low range operating point during warm-up phase					
C_MAF_DYW_LDC_LAM_AD	-	0... FFFFH	0... 1389	0.0211948	mg/stk
air mass flow window for limited dynamic conditions lambda adaptation					
C_MAF_INT_LDC_LAM_AD	-	0... FFFFH	0... 1820.42	0.0277778	g
air mass flow integral for duration of violation of limited dynamic conditions lambda adaptation					
C_MAF_KGH_MAX_LAM_AD	-	0... FFFFH	0... 1023.98437	0.015625	kg/h
maximum mass air flow for adaptive learning					
C_MAF_KGH_MAX_LAM_AD_WUP	-	0... FFFFH	0... 1023.98437	0.015625	kg/h
maximum mass air flow for adaptive learning during warm-up phase					
C_MAF_KGH_MIN_LAM_AD_WUP	-	0... FFFFH	0... 1023.98437	0.015625	kg/h
minimum mass air flow for adaptive learning during warm-up phase					
C_N_DYW_LDC_LAM_AD	-	0... 1FE0H	0... 8160	1	rpm
engine speed window for limited dynamic conditions trim control					
C_T_AST_BOL_INH_LAM_AD	-	0... FFFFH	0... 6553.5	0.1	s
Bottom of boundary of time window to inhibit lambda adaption					
C_T_AST_TOL_INH_LAM_AD	-	0... FFFFH	0... 6553.5	0.1	s
Top of boundary of time window to inhibit lambda adaption					
C_T_WAIT_MAX_LAM_AD	-	0... FFH	0... 5.1	0.02	s
threshold of waiting time between two adaptations					
C_T_WAIT_MAX_LAM_AD_ADD	-	0... FFH	0... 5.1	0.02	s
threshold of waiting time between two adaptations at offset learning area					
C_T_WAIT_MAX_LAM_AD_H_RNG	-	0... FFH	0... 5.1	0.02	s
threshold of waiting time between two adaptations in high adaptation range					
C_T_WAIT_MAX_LAM_AD_L_RNG	-	0... FFH	0... 5.1	0.02	s
threshold of waiting time between two adaptations in low adaptation range					
C_TAM_MIN_LAM_AD	-	0... FEH	-48... 142.5	0.75	°C
Minimum ambient temperature for activation of lambda adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_MAX_LAM_AD_WUP	-	0... FEH	-48... 142.5	0.75	°C
maximum coolant temperature for Lambda adaptation in warm-up phase					
C_TCO_MAX_T_AST_INH_LAM_AD	-	0... FEH	-48... 142.5	0.75	°C
Max. TCO to allow time window to inhibit lambda adaption					
C_TCO_MIN_LAM_AD	-	0... FEH	-48... 142.5	0.75	°C
minimum coolant temperature for adaptive learning					
C_TCO_MIN_LAM_AD_WUP	-	0... FEH	-48... 142.5	0.75	°C
minimum coolant temperature for Lambda adaptation in warm-up phase					
C_TIA_MAX_LAM_AD	-	0... FEH	-48... 142.5	0.75	°C
maximum air temperature for adaptive learning					
C_WGPWM_MIN_LAM_AD	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Minimum waste gate signal for lambda adaptation at active driving cycle					
LC_LAM_AD_INH_STOP_OIL	-	0... 1H	0 ...1	1	-
Logical constant to inibit the lambda adaptation when LV_INH_FSD_STOP_OIL is set.					
LC_LAM_AD_WUP_ADD_RNG_CDN	-	0... 1H	0 ...1	1	-
Logical switch to require previous adaptation in ADD Range					
LC_LAM_AD_WUP_DEAC [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
logical calibration to disable Lambda adaptation in warm-up pahse					
LC_LAM_AD_WUP_INH_STOP_OIL	-	0... 1H	0 ...1	1	-
Logical constant to inibit the lambda adaptation WUP when LV_INH_FSD_STOP_OIL is set.					
LC_LAM_AD_WUP_L_RNG_CDN	-	0... 1H	0 ...1	1	-
Logical switch to require previous adaptation in FAC_L Range					
LC_WGPWM_INH_LAM_AD_ENA	-	0... 1H	0 ...1	1	-
Logical constant to enable inhibition of the lambda adaptation below a wastegate PWM value					

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks. For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2,
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Description:

The activation conditions of the lambda adaptation depends on:

- coolant temperature thresholds,
- temperature of intake air into manifold threshold,
- air mass flow threshold,
- secondary air function including diagnosis finished
- lambda setpoint thresholds
- and several error flags that must be zero

If all activation conditions are fulfilled, during the warm-up phase LV_LAM_AD_WUP_ACT[i] is set and during normal warm conditions LV_LAM_AD_ACT[i] is set to 1. That means that the lambda adaptation can get active if no other inhibition defined in the lambda adaptation module is set.

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The detection of the limited dynamics is calculated based on the current engine speed, air mass flow and filtered lambda control output. The input to this function is the difference between each of the mentioned base values and its moving mean values. If one of those differences exceeds a calibrated threshold, an air mass flow integral is started to be calculated until a calibrated MAF threshold is reached. During the calculation the limited dynamics are defined to be not fulfilled (LV_LDC_LAM_AD[i] = 0). In order to reset the difference between base value and moving mean value after each threshold exceeding, an offset variable is introduced (see formula section).
Furthermore the correlation constant for calculation of adaptive values and the distance between two adaptations are determined dependent on the different adaptation ranges.

Application conditions

Initialisation: *at ECU reset:*

LV_LAM_AD_ACT[i] = 0
LV_LAM_AD_WUP_ACT[i] = 0
LV_LAM_AD_ACT_ERR[i] = 0
CRLC_LAM_AD[i] = 0
T_WAIT_MAX_LAM_AD[i] = 0
LV_LDC_LAM_AD[i] = 0
N_OFS_LDC_LAM_AD[i] = 0 rpm
MAF_OFS_LDC_LAM_AD[i] = 0 mg/ stk
FAC_LAM_MV_OFS_LDC_LAM_AD[i] = 0 %
MAF_INT_LDC_LAM_AD[i] = 0 g
LV_LAM_AD_DEAC_ERR[i] = 0
LV_LAM_AD_CDN_H_RNG[i] = 0
LV_LAM_AD_CDN_L_RNG[i] = 0
LV_LAM_AD_CDN_ADD[i] = 0
MFF_SP_AD[i] = MFF_SP_HOM_BAS_MV

At transition LV_IGK = 1 -> 0:

LV_LAM_AD_ACT[i] = 0
LV_LAM_AD_WUP_ACT[i] = 0

Recurrence: *T_SAMPLE = 20 ms*

Activation: *LV_IGK = 1*

Deactivation: *LV_IGK = 0*

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Formula section:

Determination of activation conditions for lambda adaptation:

If

Bit 0 of ERR_INH_LAM_AD_ACT[i] = 0 **and**
Bit 1 of ERR_INH_LAM_AD_ACT[i] = 0 **and**
Bit 2 of ERR_INH_LAM_AD_ACT[i] = 0 **and**

Bit 4 of ERR_INH_LAM_AD_ACT[i] = 0 **and**
Bit 5 of ERR_INH_LAM_AD_ACT[i] = 0 **and**
Bit 6 of ERR_INH_LAM_AD_ACT[i] = 0 **and**
Bit 7 of ERR_INH_LAM_AD_ACT[i] = 0 **and**
Bit 8 of ERR_INH_LAM_AD_ACT[i] = 0 **and**
Bit 9 of ERR_INH_LAM_AD_ACT[i] = 0 **and**
Bit 10 of ERR_INH_LAM_AD_ACT[i] = 0 **and**
Bit 11 of ERR_INH_LAM_AD_ACT[i] = 0 **and**
Bit 12 of ERR_INH_LAM_AD_ACT[i] = 0 **and**

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Bit 13 of ERR_INH_LAM_AD_ACT[i] = 0 **and**
Bit 14 of ERR_INH_LAM_AD_ACT[i] = 0 **and**
Bit 15 of ERR_INH_LAM_AD_ACT[i] = 0 **and**

then LV_LAM_AD_ACT_ERR[i] = 0
else LV_LAM_AD_ACT_ERR[i] = 1
endif

% reset of adaption values in case of error:
LV_LAM_AD_DEAC_ERR[i] =
(LV_LAM_AD_ACT_ERR[i] **OR** Bit 3 of ERR_INH_LAM_AD_ACT[i] = **1**)

If LC_LAM_AD_WUP_DEAC = 1 or
LV_LAM_AD_INJ_ACT = 1 or
LV_LAM_AD_ACT[i] = 1 or
LV_CP_RAMP_OPEN_ACT = 1 or
LV_LAM_AD_ACT_ERR[i] = 1 or
TCO < C_TCO_MIN_LAM_AD_WUP or
TCO > C_TCO_MAX_LAM_AD_WUP or
TIA > C_TIA_MAX_LAM_AD or
MAF_KGH < C_MAF_KGH_MIN_LAM_AD_WUP or
MAF_KGH > C_MAF_KGH_MAX_LAM_AD_WUP or
TAM < C_TAM_MIN_LAM_AD or
AMP < C_AMP_MIN_LAM_AD or
FUP < C_FUP_MIN_LAM_AD or
FUP > C_FUP_MAX_LAM_AD or
(MFF_ADD_LAM_AD[i] = 0 &
LC_LAM_AD_WUP_ADD_RNG_CDN = 1) or
(FAC_L_RNG_LAM_AD[i] = 0 &
LC_LAM_AD_WUP_L_RNG_CDN = 1) or
(LV_INH_FSD_STOP_OIL=1 & LC_LAM_AD_WUP_INH_STOP_OIL = 1)

then LV_LAM_AD_WUP_ACT[i] = 0
else LV_LAM_AD_WUP_ACT[i] = 1
endif

If LV_LAM_AD_ACT_ERR[i] = 1 **or**
LV_LAM_AD_WUP_ACT[i] = 1 **or**
LV_LAM_AD_INJ_ACT = 1 **or**
TCO < C_TCO_MIN_LAM_AD **or**
TIA > C_TIA_MAX_LAM_AD **or**
MAF_KGH > C_MAF_KGH_MAX_LAM_AD **or**
TAM < C_TAM_MIN_LAM_AD **or**
AMP < C_AMP_MIN_LAM_AD **or**
FUP < C_FUP_MIN_LAM_AD **or**
FUP > C_FUP_MAX_LAM_AD **or**
(LV_FAC_H_RNG_LAM_AD[i] = 1 **and**
C_LAMB_SP_AD_MIN_H > LAMB_SP_HOM[i] > C_LAMB_SP_AD_MAX_H **)** **or**
(LV_FAC_L_RNG_LAM_AD[i] = 1 **and**
C_LAMB_SP_AD_MIN_L > LAMB_SP_HOM[i] > C_LAMB_SP_AD_MAX_L **)** **or**
(LV_MFF_ADD_RNG_LAM_AD[i] = 1 **and**

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```
        C_LAMB_SP_AD_MIN_ADD > LAMB_SP_HOM[i] > C_LAMB_SP_AD_MAX_ADD ) or
  (WGPWM[i] ≤ C_WGPWM_MIN_LAM_AD and  LV_LAM_CYL_ACT = 1 and LC_WPPWM_INH_
LAM_AD_ENA = 1)                                        or
        (LV_INH_FSD_STOP_OIL=1 & LC_LAM_AD_INH_STOP_OIL = 1)            or
  ((C_T_AST_BOL_INH_LAM_AD < T_AST < C_T_AST_TOL_INH_LAM_AD)
  & TCO < C_TCO_MAX_T_AST_INH_LAM_AD)
then        LV_LAM_AD_ACT[i]  =  0
else        LV_LAM_AD_ACT[i]  =  1
endif

if       LV_LAM_AD_ENA = 1          and
        LV_LAM_LSCL[i] = 1                    and
        LV_LAM_STOP[i] = 0          and
        LV_LDC_LAM_AD[i] = 1
then
  LV_LAM_AD_CDN_L_RNG[i] =1
        if         LV_LAM_AD_EXT = 0
        then          LV_LAM_AD_CDN_H_RNG[i] = 1
              LV_LAM_AD_CDN_ADD[i] = 1
        else          LV_LAM_AD_CDN_H_RNG[i] = 0
              LV_LAM_AD_CDN_ADD[i] = 0
        end
else
        LV_LAM_AD_CDN_H_RNG[i] = 0
  LV_LAM_AD_CDN_L_RNG[i] = 0
        LV_LAM_AD_CDN_ADD[i] = 0
endif
```

Determination of mass fuel flow setpoint for lambda adaptation:

```
If         LV_HOM_ACT = 1
Then          MFF_SP_AD[i] = MFF_SP_HOM_BAS_MV
              % set value of MFF_SP_HOM_BAS_MV to both banks.
Else         MFF_SP_AD[i] = MFF_SP_S_SWI_HOM
              % set value of MFF_SP_S_SWI_HOM to both banks.
Endif
```

Detection of limited dynamic conditions for lambda adaptation:

```
If         (ABS(N_DELTA_LDC) > C_N_DYW_LDC_LAM_AD)
  then
        If          (ABS(N_DELTA_LDC - N_OFS_LDC_LAM_AD[i]) > C_N_DYW_LDC_LAM_AD)
          then          N_OFS_LDC_LAM_AD[i]  =  N_DELTA_LDC
          MAF_INT_LDC_LAM_AD[i]  =  0
        endif
  else              N_OFS_LDC_LAM_AD[i]  =  0
endif

If         (ABS(MAF_DELTA_LDC) > C_MAF_DYW_LDC_LAM_AD)
  then
        If           (ABS(MAF_DELTA_LDC - MAF_OFS_LDC_LAM_AD[i]) >
                          C_MAF_DYW_LDC_LAM_AD)
          then            MAF_OFS_LDC_LAM_AD[i]  =  MAF_DELTA_LDC
          MAF_INT_LDC_LAM_AD[i]  =  0
        endif
```

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```
  else              MAF_OFS_LDC_LAM_AD[i]  =  0
endif

If        (ABS(FAC_LAM_MV_DELTA_LDC[i]) > C_FAC_LAM_MV_DYW_LDC_LAM_AD)
  then
          If        (ABS(FAC_LAM_MV_DELTA_LDC[i] - FAC_LAM_MV_OFS_LDC_LAM_AD[i]) >
                                        C_FAC_LAM_MV_DYW_LDC_LAM_AD)
            then        FAC_LAM_MV_OFS_LDC_LAM_AD[i]  =  FAC_LAM_MV_DELTA_LDC[i]
           MAF_INT_LDC_LAM_AD[i]  =  0
          endif
  else              FAC_LAM_MV_OFS_LDC_LAM_AD[i]  =  0
endif

If        (MAF_INT_LDC_LAM_AD[i] < C_MAF_INT_LDC_LAM_AD)
  then         MAF_INT_LDC_LAM_AD[i] [g] = MAF_INT_LDC_LAM_AD[i] [g] +

MAF_CYL [kg/h] * T_SAMPLE [ms] * 1/3600 [(g*h) /(kg*ms)]
                  LV_LDC_LAM_AD[i]  =  0
else          LV_LDC_LAM_AD[i]  =  1
endif
```

Determination of correlation constant for lambda adaptation and of distance between two adaptation calculations:

Note: Waiting time between two adaptations and correlation constant are solely dependent on the different adaptation ranges.

```
If                   STATE_LAM_AD[i] = "ADAPT_ADD"
Then          T_WAIT_MAX_LAM_AD[i]  =  C_T_WAIT_MAX_LAM_AD_ADD
                           If LV_LAM_LIM_LAM_AD[i] = 0
                           Then CRLC_LAM_AD[i]  =  C_CRLC_LAM_AD_ADD
                           Else  CRLC_LAM_AD[i]  =  C_CRLC_LAM_AD_ADD_LAM_LIM
                           Endif
Else          If        STATE_LAM_AD[i] = "ADAPT_FAC_L"
                  Then         T_WAIT_MAX_LAM_AD[i]  =  C_T_WAIT_MAX_LAM_AD_L_RNG
                           If LV_LAM_LIM_LAM_AD[i] = 0
                           Then CRLC_LAM_AD[i]  =  C_CRLC_LAM_AD_L
                           Else  CRLC_LAM_AD[i]  =  C_CRLC_LAM_AD_L_LAM_LIM
                           Endif
              Else     If    STATE_LAM_AD[i] = "ADAPT_FAC_H"
                            Then         T_WAIT_MAX_LAM_AD[i]  = C_T_WAIT_MAX_LAM_AD_H_
RNG
                  If LV_LAM_LIM_LAM_AD[i] = 0
                  Then CRLC_LAM_AD[i]  =  C_CRLC_LAM_AD_H
                  Else  CRLC_LAM_AD[i]  =  C_CRLC_LAM_AD_H_LAM_LIM
                  Endif
                       Else         T_WAIT_MAX_LAM_AD[i]  =  C_T_WAIT_MAX_LAM_AD
                  If LV_LAM_LIM_LAM_AD[i] = 0
                  Then CRLC_LAM_AD[i]  =  C_CRLC_LAM_AD_H
                  Else  CRLC_LAM_AD[i]  =  C_CRLC_LAM_AD_H_LAM_LIM
                  Endif
                       Endif
              Endif
Endif
```

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Assignment of Lambda adaptation shift values

FAC_LAM_AD_SHIFT[i] = FAC_LAM_AD_CUS_SHIFT[i]

LV_FAC_LAM_AD_SHIFT[i] = LV_FAC_LAM_AD_CUS_SHIFT[i]

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7.73 Cylinder balancing via lambda sensor

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_CYL_LAM [NC_CYL_NR]	O/V	0... F0H	0... 1440	6	°CRK
Value of phase displacement					
CTR_LAM_CYL_SEL_REF_CLL [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Segment based reference counter to close the control loop					
CTR_LAMB_CYL_SEL_CQ_DRIFT_THD [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
CILC- drift-away counter based on CQ value					
CTR_LAMB_CYL_SEL_CQ_STAB [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
CILC- stability counter based on CQ value					
CTR_T_LAM_CYL_ADJ [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	s
Timer of cylinder individual lambda control adaptation					
DELTA_LAMB_AV [NC_CBK_EX_NR]	V	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Signal value of the WRAF Sensor, sampled with an appropriate resolution and shifted by its mean value					
DELTA_LAMB_CYL [NC_CYL_NR]	V	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Individual adjusted signal					
DELTA_LAMB_CYL_SEL [NC_CBK_EX_NR]	V	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Reassembled signal, made of individual adjusted signals					
DELTA_LAMB_CYL_SEL_CQ [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 7.99987	122.1e-6	-
Characteristic value of the estimated values					
DELTA_LAMB_CYL_SEL_CQ_FIL [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Filter value of characteristic quantity of estimated cylinder individual lambda deviation					
DELTA_LAMB_DIF_CYL [NC_CYL_NR]	V	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Control error for each cylinder					
DELTA_LAMB_ERR [NC_CBK_EX_NR]	V	8000... 7FFFH	-8... 7.99975	244.1e-6	1/s
Weighted estimation-error					
DELTA_LAMB_ERR_CYL_SEL [NC_CYL_NR]	V	8000... 7FFFH	-8... 7.99975	244.1e-6	1/s
Weighted estimation-error (split)					
DELTA_LAMB_ERR_RAW [NC_CBK_EX_NR]	V	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Difference between the measured and the estimated value of the WRAF sensor					
DELTA_LAMB_MDL [NC_CBK_EX_NR]	V	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Estimated value of the WRAF Sensor					
FAC_CYL_LAM [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Output of the cylinder individual controller					
FAC_CYL_LAM_ABSV_SUM [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 49.99847	1.5259e-3	%
Sum of the absolute cylinder individual controller outputs					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_CYL_LAM_COR [NC_CYL_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Factor for the injection time correction of cylinder x					
FAC_CYL_LAM_I_MV_SHIFT [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual controller output - I component, shifted by its mean value					
FAC_CYL_LAM_INT [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual controller output - I component					
FAC_CYL_LAM_P [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual controller output - P component					
FAC_CYL_LAM_P_MV_SHIFT [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual controller output - P component, shifted by its mean value					
FAC_LAM_CYL_SEL_ADJ [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual adaptation correction factor					
FAC_LAM_CYL_SEL_ADJ_CST [NC_CYL_NR]	O/V/S	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual adaptation correction factor under engine-cold condition					
FAC_LAM_CYL_SEL_ADJ_CST_FIL [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual adaptation filter output under engine cold condition					
FAC_LAM_CYL_SEL_ADJ_CST_MV [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Mean value of cold-range adaptation - calculated out of the cylinder individual correction values					
FAC_LAM_CYL_SEL_ADJ_FIL [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual adaptation filter output					
FAC_LAM_CYL_SEL_ADJ_H_RNG [NC_CYL_NR]	O/V/S	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual adaptation correction factor (high-range)					
FAC_LAM_CYL_SEL_ADJ_H_RNG_MV [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Mean value of high-range adaptation - calculated out of the cylinder individual correction values					
FAC_LAM_CYL_SEL_ADJ_INTER [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual adaptation correction factor (cold-nominal-interpolation)					
FAC_LAM_CYL_SEL_ADJ_L_RNG [NC_CYL_NR]	O/V/S	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Cylinder individual adaptation correction factor (low-range)					
FAC_LAM_CYL_SEL_ADJ_L_RNG_MV [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Mean value of low-range adaptation - calculated out of the cylinder individual correction values					
FAC_T [NC_CBK_EX_NR]	V	0... FFFFH	0... 63.99902	976.599e-6	-
Time factor of the exponential function for the sensor model					
FAC_VAL_LAM_CYL_SEL_REAC	V	0... FFFFH	0... 0.99998	15.3e-6	-
Valuated factor for internal states at reactivation moment					
LAMB_CYL_SEL [NC_CYL_NR]	V	0... 7FFFH	0... 7.99975	244.1e-6	-
Cylinder individual lambda value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_CYL_SEL_CQ_DIF_REF [NC_CBK_EX_NR]	V	8000... 7FFFH	-0.5... 0.49998	15.3e-6	-
Deviation of CILC - Characteristic Quantity from the stored reference value					
LAMB_CYL_SEL_CQ_REF [NC_CBK_EX_NR]	V	0... FFFFH	0... 0.99998	15.3e-6	-
Reference CILC - Characteristic Quantity stored at virtual limit transition					
LV_FAC_CYL_LAM_LIM_MAX [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that the cylinder individual lambda controller output is out of upper limit					
LV_FAC_CYL_LAM_LIM_MIN [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that the cylinder individual lambda controller output is out of lower limit					
LV_FAC_CYL_LAM_VIRT_LIM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that the cylinder individual lambda control is out of virtual limit					
LV_FAC_LAM_CYL_ADJ_CST_LIM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that at least one of the cold-adaptation values is out of range					
LV_FAC_LAM_CYL_SEL_ADJ_LIM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that at least one of the nominal-adaptation values is out of range					
LV_LAM_CYL_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Cylinder individual lambda control is active					
LV_LAM_CYL_SEL_ADJ_H_RNG_VLD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that the value of cylinder individual lambda adaptation in high-range is valid					
LV_LAM_CYL_SEL_ADJ_L_RNG_VLD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that the value of cylinder individual lambda adaptation in low-range is valid					
LV_LAM_CYL_SEL_ADJ_VLD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that the value of cylinder individual lambda adaptation is valid for the current adaptation state					
LV_LAM_CYL_SEL_CTL_DRIFT_PRED [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Drift-away behaviour of cylinder individual lambda control predicted					
LV_LAM_CYL_SEL_SEG_REF_CLL [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Segment based reference flag to close the control loop					
LV_LAMB_CYL_SEL_CQ_DRIFT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Drift-away behaviour of cylinder individual lambda control detected - based on CQ value					
LV_MFF_ADD_CYL_LAM_COR_LIM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating that at least one of the fuel mass offset correction values is out of range					
MFF_ADD_CYL_LAM_COR [NC_CYL_NR]	O/V/S	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
Cylinder individual fuel mass offset correction					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MFF_ADD_CYL_LAM_COR_MV [NC_CBK_EX_NR]	V	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
Mean value of the fuel mass offset correction - calculated out of the cylinder individual correction values					
MFF_ADD_CYL_LAM_COR_OUT [NC_CYL_NR]	O/V	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
Cylinder individual fuel mass offset correction - weighted output					
MFF_DELTA_LAM_CYL_SEL_REAC	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Absolute fuel mass difference at deactivation and reactivation interval					
MFF_SP_SAVE_LAM_CYL_SEL	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Stored fuel mass setpoint at CILC deactivation moment					
STATE_LAM_CYL_SEL [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H	PAS OPL WAIT CLL	-	-
State of cylinder individual lambda control					
STATE_LAM_CYL_SEL_ADJ [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H 4H 5H 6HH	PAS WAIT_ ENG_ COLD ADJ_ENG_ COLD WAIT_ENG_ NOM ADJ_NOM_L_ RNG ADJ_NOM_H_ RNG ADJ_NOM_ OFS	-	-
State of cylinder individual lambda control adaptation					
STATE_LAMB_CYL_SEL_CQ_SLOP [NC_CBK_EX_NR]	O/V/S	0H 1H 2H	NEUT RISE RISE_CYC	-	-
Slope state of CILC - Characteristic Quantity					
VLS_CYL_SEL [NC_CYL_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Upstream oxygen sensor acquisition (cylinder Individual)					

Input data:

AMP {p. 982}	DELTA_CRK_CYL_LAM [NC_CBK_EX_NR] {p. 2838}	LF_LS_CBK_EX_LAM_ CYL_SEL_CONF {p. 2864}	LV_DC {p. 5746}
LV_FAC_CYL_LAM_COR_ OSC [NC_CBK_EX_NR] {p. 2839}	LV_INH_OBD_DIAG_CYL_ BAL_LAM [NC_CBK_EX_NR] {p. 5113}	LV_LAM_CYL_ENA [NC_CBK_EX_NR] {p. 2864}	LV_LAM_CYL_SEL_ADJ_ OFS_REQ [NC_CBK_EX_NR] {p. 2864}
LV_LAM_CYL_SEL_ADJ_ RST_IV_EXT [NC_CBK_EX_NR] {p. 7483}	LV_LAM_CYL_SEL_CTL_ FAST_REQ {p. 2864}	LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	MAF {p. 8277}

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MFF_SP [NC_CBK_EX_NR] {p. 2151}	MFF_SP_LAM_CYL_SEL {p. 2864}	N {p. 1525}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	PHA_SHIFT_CAM_EX [NC_CBK_EX_NR] {p. 2864}	SEG_NR {p. 1525}
STATE_DELTA_CRK_CYL_LAM [NC_CBK_EX_NR] {p. 2839}	TCO {p. 1100}	TEMP_LAM_CYL_SEL {p. 2864}	VLS_CYL [NC_CYL_NR] {p. 1017}
VLS_CYL_TRIG [NC_CYL_NR] {p. 1017}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRK_CYL_LAM [NC_CYL_NR]	-	88... 78H	-720 ...720	6	°CRK
Factor for different distance between lambda sensor and cylinder individual exhaust-valves					
C_CRLC_CYL_FIL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for the filter output					
C_CRLC_DELTA_LAMB_CYL_CQ_FIL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Filter correlation constant - characteristic quantity of estimated cylinder individual lambda deviation					
C_CRLC_EXV_FAC [NC_CYL_NR]	-	0... FFFFH	0... 1.99996	30.5e-6	-
Exhaust-valve manifold-port correlation factor					
C_CRLC_LAM_CYL_CST_FIL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for the filter output under engine cold condition					
C_CTR_LAM_CYL_SEL_REF_CLL_THD	-	0... FFFFH	0... 65535	1	-
Threshold for segment based reference counter to close the control loop					
C_CTR_LAMB_CYL_SEL_CQ_DRIFT_THD	-	0... FFFFH	0... 65535	1	-
CQ- drift counter threshold for inhibition of cylinder individual lambda adaptation					
C_CTR_LAMB_CYL_SEL_CQ_STAB_THD	-	0... FFFFH	0... 65535	1	-
CQ- stability counter threshold to release the cylinder individual lambda adaptation					
C_DELTA_LAMB_CYL_SP	-	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Setpoint value					
C_FAC_CYL_LAM_ABSV_DEC	-	0... 7FFFH	0... 49.99847	1.5259e-3	%
Absolute decrement constant to increase or decrease the cylinder individual injection time correction					
C_FAC_CYL_LAM_MAX	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Upper limit of the cylinder individual controller output					
C_FAC_CYL_LAM_MIN	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lower limit of the cylinder individual controller output					
C_FAC_CYL_LAM_VIRT_MAX	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Upper virtual limit of the cylinder individual controller output					
C_FAC_CYL_LAM_VIRT_MIN	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lower virtual limit of the cylinder individual controller output					
C_FAC_LAM_CYL_SEL_ADJ_CST_MAX	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Upper limit of the cylinder individual cold-adaptation correction factor					
C_FAC_LAM_CYL_SEL_ADJ_CST_MIN	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lower limit of the cylinder individual cold-adaptation correction factor					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_LAM_CYL_SEL_ADJ_MAX	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Upper limit of the cylinder individual nominal-adaptation correction factor					
C_FAC_LAM_CYL_SEL_ADJ_MIN	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lower limit of the cylinder individual nominal-adaptation correction factor					
C_FAC_LAM_CYL_SEL_ADJ_VLD_THD	-	0... 7FFFH	0... 49.99847	1.5259e-3	%
Absolute-Controller-Sum-Threshold for evaluation of adaptation result					
C_LAMB_CYL_SEL_CQ_DIF_REF_THD	-	8000... 7FFFH	-0.5... 0.49998	15.3e-6	-
CQ- slope threshold for inhibition of cylinder individual lambda adaptation					
C_LAMB_CYL_SEL_CQ_DRIFT_THD	-	0... FFFFH	0... 0.99998	15.3e-6	-
CQ- drift threshold for inhibition of cylinder individual lambda adaptation					
C_MFF_LAM_CYL_ADJ_CST_MAX	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Upper fuel mass threshold for calculation of cylinder individual lambda adaptation (engine cold)					
C_MFF_LAM_CYL_ADJ_CST_MIN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower fuel mass threshold for calculation of cylinder individual lambda adaptation (engine cold)					
C_MFF_MAX_ADD_LAM_CYL_SEL_ADJ	-	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
Maximum value of cylinder individual fuel mass offset					
C_MFF_MAX_FAC_CYL_SEL_ADJ_H_RNG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Upper fuel mass threshold for calculation of cylinder individual lambda adaptation (high-range)					
C_MFF_MAX_FAC_CYL_SEL_ADJ_L_RNG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Upper fuel mass threshold for calculation of cylinder individual lambda adaptation (low-range)					
C_MFF_MIN_ADD_LAM_CYL_SEL_ADJ	-	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
Minimum value of cylinder individual fuel mass offset					
C_MFF_MIN_FAC_CYL_SEL_ADJ_H_RNG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower fuel mass threshold for calculation of cylinder individual lambda adaptation (high-range)					
C_MFF_MIN_FAC_CYL_SEL_ADJ_L_RNG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower fuel mass threshold for calculation of cylinder individual lambda adaptation (low-range)					
C_MFF_SP_THD_CYL_SEL_ADJ_H_RNG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Minimum fuel mass threshold for consideration of the high range adaptation value in the injection correction					
C_MFF_SP_THD_CYL_SEL_ADJ_L_RNG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Maximum fuel mass threshold for consideration of the low range adaptation value in the injection correction					
C_N_LAM_CYL_ADJ_CST_MAX	-	0... FFH	0... 8160	32	rpm
Upper engine speed threshold for calculation of cylinder individual lambda adaptation (cold condition)					
C_N_LAM_CYL_ADJ_CST_MIN	-	0... FFH	0... 8160	32	rpm
Lower engine speed threshold for calculation of cylinder individual lambda adaptation (cold condition)					
C_N_MAX_FAC_CYL_SEL_ADJ_H_RNG	-	0... FFH	0... 8160	32	rpm
Upper engine speed threshold for calculation of cylinder individual lambda adaptation (high-range)					
C_N_MAX_FAC_CYL_SEL_ADJ_L_RNG	-	0... FFH	0... 8160	32	rpm
Upper engine speed threshold for calculation of cylinder individual lambda adaptation (low-range)					
C_N_MIN_FAC_CYL_SEL_ADJ_H_RNG	-	0... FFH	0... 8160	32	rpm
Lower engine speed threshold for calculation of cylinder individual lambda adaptation (high-range)					
C_N_MIN_FAC_CYL_SEL_ADJ_L_RNG	-	0... FFH	0... 8160	32	rpm
Lower engine speed threshold for calculation of cylinder individual lambda adaptation (low-range)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_LAM_CYL_ADJ	-	0... FFH	0... 255	1	s
Time recurrence for adaptation update					
C_T_LAM_CYL_ADJ_CST	-	0... FFH	0... 255	1	s
Time recurrence for adaptation update under engine cold condition					
C_TEMP_LAM_CYL_CST_MAX	-	0... FEH	-48... 142.5	0.75	°C
Maximum coolant temperature for the activation of CILC under cold condition					
C_TEMP_LAM_CYL_CST_MIN	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature for the activation of CILC under cold condition					
C_TEMP_LAM_CYL_MIN	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature for the activation - nominal condition					
C_TEMP_THD_CYL_SEL_ADJ_COLD_RNG	-	0... FEH	-48... 142.5	0.75	°C
Maximum coolant temperature threshold for consideration of the cold-range adaptation value					
C_TEMP_THD_CYL_SEL_ADJ_NOM_RNG	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature threshold for consideration of the nominal-range adaptation value					
IP_CRK_DELTA_AMP_CYL_LAM	-	88... 78H	-720 ...720	6	°CRK
LDP_AMP_IP_CRK_DELTA_AMP	6	0... FFFFH	0... 5434	0.0829175	hPa
Phase shift deviation caused by elevation					
IP_CRK_SYN [NC_CBK_EX_NR]	V	0... F0H	0... 1440	6	°CRK
LDPM_N_1_CYBL	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_CYBL	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Phase displacement					
IP_CRLC_CYL_LAM	V	0... FFFFH	0... 7.99987	122.1e-6	%
LDPM_N_1_CILC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_CILC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Correlation characteristic for AFR equalisation - nominal controller parameter					
IP_CRLC_I_NEUT_RNG	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_DELTA_LAMB_DIF_CYL_I	8	0... FFFFH	-8... 7.99975	244.1e-6	-
Dead zone for calculation of I-component					
IP_CRLC_INT_FAST_CYL_LAM	V	0... FFFFH	0... 7.99987	122.1e-6	%
LDPM_N_1_CILC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_CILC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Correlation characteristic for AFR equalisation - fast controller parameter					
IP_CRLC_P_NEUT_RNG	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_DELTA_LAMB_DIF_CYL_P	8	0... FFFFH	-8... 7.99975	244.1e-6	-
Dead zone for calculation of P-component					
IP_EXP_LAMB_MDL [NC_CBK_EX_NR]	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_FAC_T_1_CYBL	16	0... FFFFH	0... 63.99902	976.599e-6	-
Exponential function for the sensor model					
IP_FAC_ERR_LAM_SEL	-	0... FFFFH	0... 255.99609	3.9063e-3	1/s
LDP_T1_LAMB_CYL_IP_FAC_ERR	6	0... FFFFH	0... 1.99996	30.5e-6	s
Weight coefficient					
IP_FAC_GAIN_P_LAM_CYL_SEL	V	0... FFFFH	0... 63.99902	976.599e-6	%
LDPM_N_1_CILC	8	0... 1FE0H	0... 8160	1	rpm

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_MAF_1_CILC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Gain of cylinder individual controller (P-component)					
IP_FAC_N_MFF_ADD_CYL_LAM_COR	-	0... FFH	0... 0.99609	3.9063e-3	-
LDP_N_32_IP_FAC_MFF_ADD_CYL	6	0... FFH	0... 8160	32	rpm
Engine speed dependent factor for realization of cylinder individual fuel mass offset correction					
IP_FAC_OPP_LAM_CYL_SEL_ADJ	V	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_N_1_CYBL	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_CYBL	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual lambda adaptation factor depending on operating point					
IP_FAC_OPP_LAM_CYL_SEL_ADJ_FAST	V	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_N_1_CILC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_CILC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual lambda adaptation factor depending on operating point (fast adaptation)					
IP_FAC_VAL_LAM_CYL_SEL_REAC	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_MFF_DELTA_LAM_CYL_IP_FAC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
MFF-difference- dependent factor for internal states at reactivation moment					
IP_FAC_WUP_MFF_ADD_CYL_LAM	-	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_TCO_1_CYBL	6	0... FEH	-48... 142.5	0.75	°C
Temperature dependent factor for realization of cylinder individual fuel mass offset correction during warm-up					
IP_LAMB_CYL [NC_CBK_EX_NR]	-	0... 7FFFH	0... 7.99975	244.1e-6	-
LDP_VLS_CYL_SEL_IP_LAMB	16	0... 3FFH	0... 4.99511	4.8828e-3	V
Characteristic curve of the WRAF sensor					
IP_N1_FAC_LAMB_MDL [NC_CBK_EX_NR]	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_FAC_T_1_CYBL	16	0... FFFFH	0... 63.99902	976.599e-6	-
N1 coefficient of the sensor model					
IP_N2_FAC_LAMB_MDL [NC_CBK_EX_NR]	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_FAC_T_1_CYBL	16	0... FFFFH	0... 63.99902	976.599e-6	-
N2 coefficient of the sensor model					
IP_T1_LAMB_CYL_SEL [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996	30.5e-6	s
LDPM_N_1_CYBL	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_CYBL	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Time lag of the lambda-sensor model specified for cylinder individual lambda control					
LC_ADAPT_COR_OUT	-	0... 1H	0 ...1	1	-
Adaptation switch (=1)					
LC_FAC_CYL_LAM_P_SWI	-	0... 1H	0 ...1	1	-
Calculation switch for the choice of the control structure (= 0 'I - controller'; = 1 'PI controller')					
LC_FAC_LAM_CYL_SEL_ADJ_CST_ENA	-	0... 1H	0 ...1	1	-
Switch enabling the adaptation under engine cold condition (=1)					
LC_FAC_LAM_CYL_SEL_ADJ_P_I_ENA	-	0... 1H	0 ...1	1	-
Calculation switch for the choice of the adaptation method (= 0 'I - component concerned'; = 1 'PI concerned')					
LC_LAM_CYL_SEL_ERR_RST	-	0... 1H	0 ...1	1	-
Switch enabling the reset of adaptation values in case of error (=1)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LAM_CYL_SEL_OPL	-	0... 1H	0 ...1	1	-
Switch for open loop operation (=1)					
LC_LAMB_DELTA_MDL_HLD	-	0... 1H	0 ...1	1	-
Calculation switch for the choice of the discretization method of the sensor model (= 0 'zoh'; = 1 'foh')					

DESCRIPTION:

General information:

if$^{(1)}$ two separate cylinder banks are concerned
then
i = 1, for cylinder bank 1 (x = 0, 2, 4, ...)
i = 2, for cylinder bank 2 (x = 1, 3, 5, ...)
else$^{(1)}$
i = 1 (x = 0 ... 3 or 4)
endif$^{(1)}$

Description of index "[i]" and "[x]":

x: logical cylinder
*use **NC_CYL_NR** : number of engine cylinders - index "[x]"*
*use **LF_LS_CBK_EX_LAM_CYL_SEL_CONF**: pattern for allocation of physical cylinders to exhaust bank - index "[i]"*

The purpose of this function is detection and control the cylinder to cylinder air-fuel ratio deviation in an internal combustion engine using an observer to estimate the deviation of each cylinder that is not measurable and a controller for each cylinder separately. In this connection the periodic signal of the WRAF sensor is reconstructed using a sensor model and adapted to the measured value. The estimated state describes the deviation in percentage for each cylinder. The mentioned value is an input to a control system that balances the air- /fuel ratio in each cylinder separately (Figure 1).

Figure 1: Structure of the cylinder individual lambda control for a 3-cylinder-exhaust-bank

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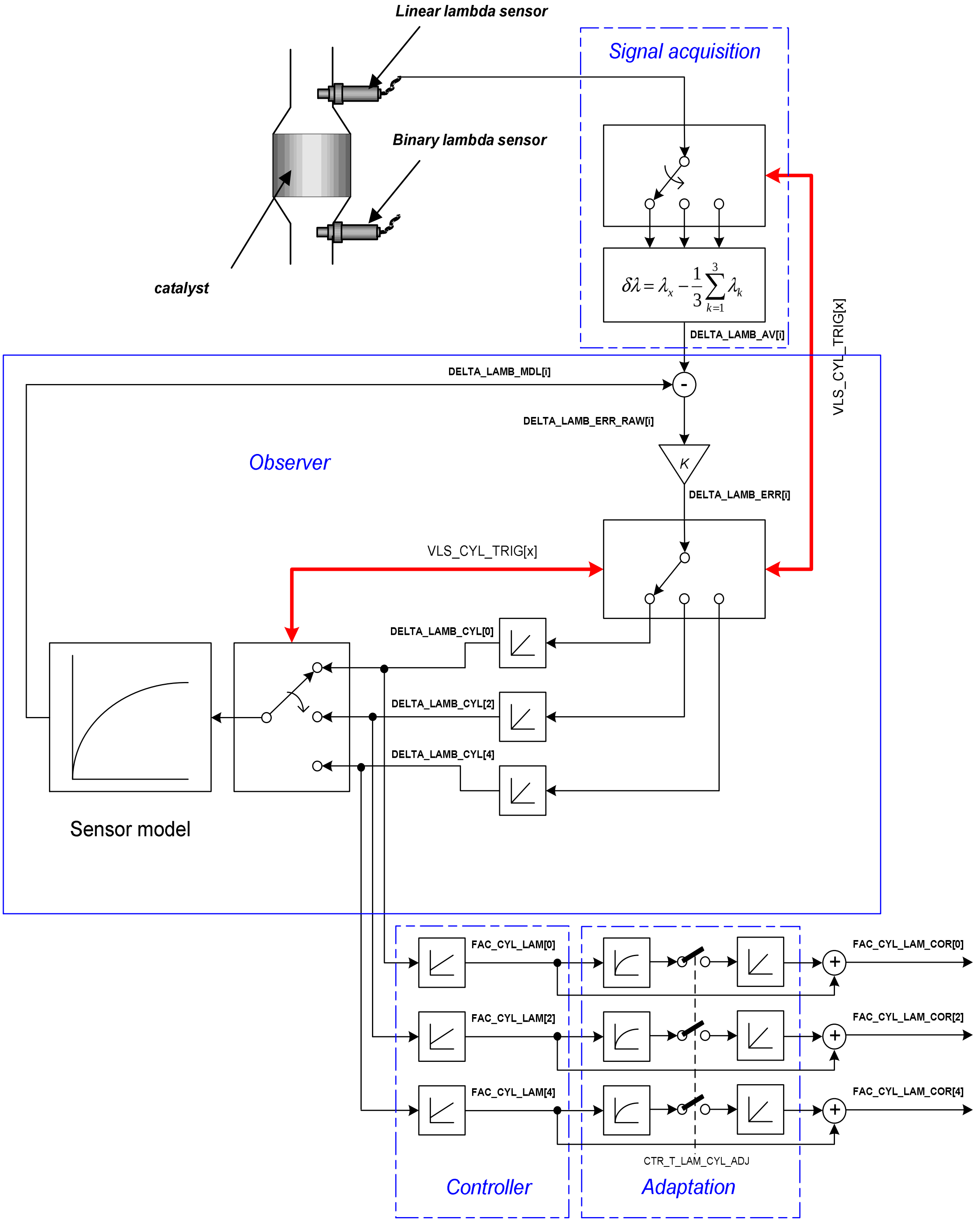

Application conditions:

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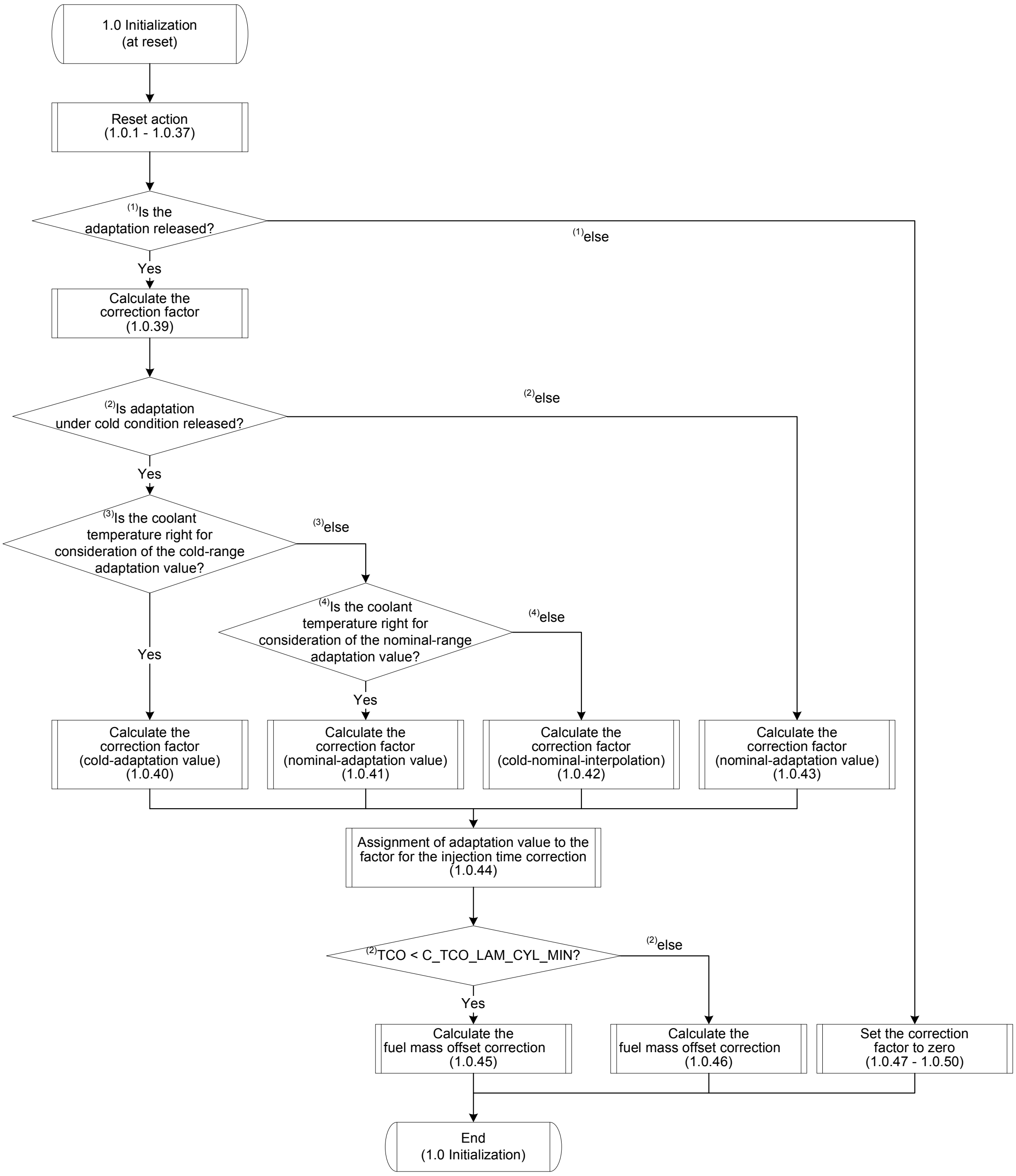
7.73.1 Initialization (at reset):



DELTA_LAMB_CYL_SEL_CQ[i] = 0 **(1.0.1)**

DELTA_LAMB_CYL_SEL_CQ_FIL[i] = 0 **(1.0.2)**

LAMB_CYL_SEL_CQ_REF[i] = 0 **(1.0.3)**

LAMB_CYL_SEL_CQ_DIF_REF[i] = 0 **(1.0.4)**

DELTA_LAMB_AV[i] = 0 **(1.0.5)**

DELTA_LAMB_ERR_RAW[i] = 0

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DELTA_LAMB_ERR[i] = 0 **(1.0.6)**

DELTA_LAMB_ERR_CYL_SEL[x] = 0 **(1.0.7)**

DELTA_LAMB_CYL[x] = 0 **(1.0.8)**

DELTA_LAMB_CYL_SEL[i] = 0 **(1.0.9)**

DELTA_LAMB_MDL[i] = 0 **(1.0.10)**

DELTA_LAMB_DIF_CYL[x] = 0 **(1.0.11)**

FAC_CYL_LAM_INT[x] = 0 **(1.0.12)**

FAC_CYL_LAM_P[x] = 0 **(1.0.13)**

FAC_CYL_LAM_I_MV_SHIFT[x] = 0 **(1.0.14)**

FAC_CYL_LAM_P_MV_SHIFT[x] = 0 **(1.0.15)**

FAC_CYL_LAM[x] = 0 **(1.0.16)**

FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0 **(1.0.17)**

FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0 **(1.0.18)**

LV_FAC_CYL_LAM_LIM_MIN[x] = 0 **(1.0.19)**

LV_FAC_CYL_LAM_LIM_MAX[x] = 0 **(1.0.20)**

LV_LAM_CYL_SEL_SEG_REF_CLL[i] = 0 **(1.0.21)**

LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0 **(1.0.22)**

STATE_LAM_CYL_SEL[i] = 0 [PAS] **(1.0.23)**

STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS] **(1.0.24)**

CTR_T_LAM_CYL_ADJ[i] = 0 **(1.0.25)**

MFF_ADD_CYL_LAM_COR_MV[i] = 0 **(1.0.26)**

MFF_DELTA_LAM_CYL_SEL_REAC = 0 **(1.0.27)**

FAC_VAL_LAM_CYL_SEL_REAC = 0 **(1.0.28)**

FAC_CYL_LAM_ABSV_SUM[i] = 0 **(1.0.29)**

MFF_SP_SAVE_LAM_CYL_SEL = 0 **(1.0.30)**

CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] = 0 **(1.0.31)**

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(1.0.32)

LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 0

(1.0.33)

CTR_LAM_CYL_SEL_REF_CLL[i] = 0

(1.0.34)

LV_LAM_CYL_SEL_ADJ_VLD[i] = 0

(1.0.35)

LV_MFF_ADD_CYL_LAM_COR_LIM[i] = 0

(1.0.36)

LV_FAC_CYL_LAM_VIRT_LIM[i] = 0

(1.0.37)

CTR_LAMB_CYL_SEL_CQ_STAB[i] = 0

(1.0.38)

if$^{(1)}$ LC_ADAPT_COR_OUT = 1
then
FAC_LAM_CYL_SEL_ADJ[x] = FAC_LAM_CYL_SEL_ADJ_L_RNG[x]
(1.0.39)
if$^{(2)}$ LC_FAC_LAM_CYL_SEL_ADJ_CST_ENA = 1
[adaptation under cold condition released]
then
if$^{(3)}$ TEMP_LAM_CYL_SEL C_TEMP_THD_CYL_SEL_ADJ_COLD_RNG
then
FAC_LAM_CYL_SEL_ADJ_INTER[x] =
FAC_LAM_CYL_SEL_ADJ_CST[x]
(1.0.40)
else$^{(3)}$
if$^{(4)}$ TEMP_LAM_CYL_SEL
C_TEMP_THD_CYL_SEL_ADJ_NOM_
RNG
then
FAC_LAM_CYL_SEL_ADJ_INTER[x] =
FAC_LAM_CYL_SEL_ADJ[x] **(1.0.41)**
else$^{(4)}$
FAC_LAM_CYL_SEL_ADJ_INTER[x] =
FAC_LAM_CYL_SEL_ADJ_CST[x]
+
(TEMP_LAM_CYL_SEL -
C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG)*
(FAC_LAM_CYL_SEL_ADJ[x] -
FAC_LAM_CYL_SEL_ADJ_CST[x])/
(C_TEMP_THD_CYL_SEL_ADJ_
NOM_RNG -
C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG) **(1.0.42)**
endif$^{(4)}$
endif$^{(3)}$
else$^{(2)}$
FAC_LAM_CYL_SEL_ADJ_INTER[x] = FAC_LAM_CYL_SEL_ADJ[x]
(1.0.43)
endif$^{(2)}$

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FAC_CYL_LAM_COR[x] = FAC_LAM_CYL_SEL_ADJ_INTER[x]
(1.0.44)

if$^{(2)}$ TEMP_LAM_CYL_SEL $<$ C_TEMP_LAM_CYL_MIN
then
MFF_ADD_CYL_LAM_COR_OUT[x] = MFF_ADD_CYL_LAM_COR[x]*
IP_FAC_WUP_MFF_ADD_CYL_LAM
(1.0.-)
else$^{(2)}$
MFF_ADD_CYL_LAM_COR_OUT[x] = MFF_ADD_CYL_LAM_COR[x]
(1.0.46)
endif$^{(2)}$
else$^{(1)}$
FAC_LAM_CYL_SEL_ADJ[x] = 0
(1.0.47)
FAC_LAM_CYL_SEL_ADJ_INTER[x] = 0
(1.0.48)
FAC_CYL_LAM_COR[x] = 0
(1.0.49)
MFF_ADD_CYL_LAM_COR_OUT[x] = 0
(1.0.50)
endif$^{(1)}$

7.73.2 Storage of the adaptation value:

The value of FAC_LAM_CYL_SEL_ADJ_L_RNG[x], FAC_LAM_CYL_SEL_ADJ_H_RNG[x] , FAC_LAM_CYL_SEL_ADJ_CST[x] and MFF_ADD_CYL_LAM_COR[x] shall be stored in the non-volatile memory at DC- transition (LV_DC 1 0). Should the value of cylinder individual injection time fall into the lower/ upper limit, the adaptation value shall not be stored in the non-volatile memory. I.e., if one of the exhaust-bank-related cylinders is out of range, the adaptation values for all cylinders of the concerned exhaust bank shall be taken from the last driving cycle (LDC).

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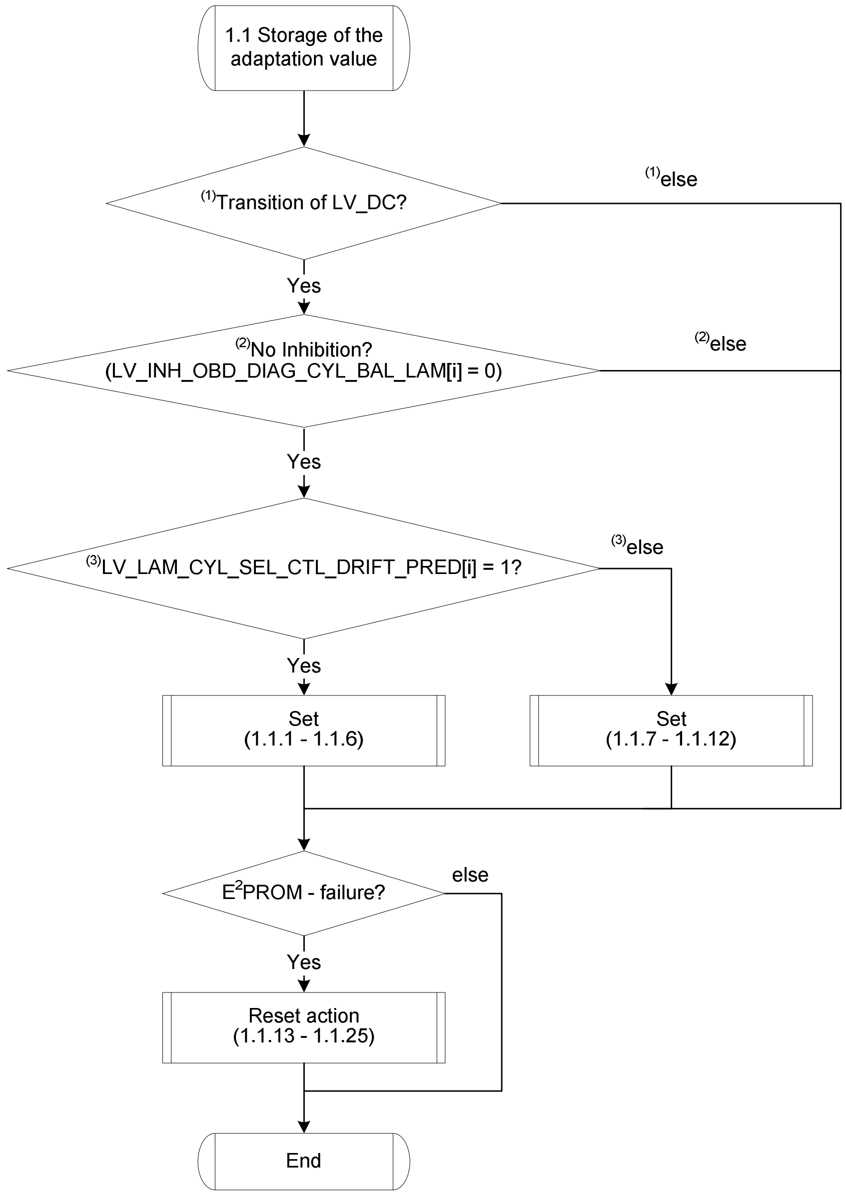

if$^{(1)}$ LV_DC 1 0

then

if$^{(2)}$ LV_INH_OBD_DIAG_CYL_BAL_LAM[i] = 0

then

if$^{(3)}$ LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 1

then

FAC_LAM_CYL_SEL_ADJ_L_RNG[x] = FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{LDC}$ **(1.1.1)**

FAC_LAM_CYL_SEL_ADJ_H_RNG[x] = FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{LDC}$ **(1.1.2)**

FAC_LAM_CYL_SEL_ADJ_CST[x] = FAC_LAM_CYL_SEL_ADJ_CST[x]$_{LDC}$ **(1.1.3)**

MFF_ADD_CYL_LAM_COR[x] = MFF_ADD_CYL_LAM_COR[x]$_{LDC}$ **(1.1.4)**

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LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i] = LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i]$_{LDC}$ **(1.1.5)**

LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] = LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i]$_{LDC}$ **(1.1.6)**

else(3)

FAC_LAM_CYL_SEL_ADJ_L_RNG[x] = FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{CDC}$ **(1.1.7)**

FAC_LAM_CYL_SEL_ADJ_H_RNG[x] = FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{CDC}$ **(1.1.8)**

FAC_LAM_CYL_SEL_ADJ_CST[x] = FAC_LAM_CYL_SEL_ADJ_CST[x]$_{CDC}$ **(1.1.9)**

MFF_ADD_CYL_LAM_COR[x] = MFF_ADD_CYL_LAM_COR[x]$_{CDC}$ **(1.1.10)**

LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i] = LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i]$_{CDC}$ **(1.1.11)**

LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] = LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i]$_{CDC}$ **(1.1.12)**

endif(3)

endif(2)

[*Remark: the cylinder based limitation (index x) shall be assigned to the corresponding exhaust bank (index i)*]

endif(1)

At E2PROM - failure:**

FAC_LAM_CYL_SEL_ADJ_L_RNG[x] = 0 **(1.1.13)**

FAC_LAM_CYL_SEL_ADJ_H_RNG[x] = 0 **(1.1.14)**

FAC_LAM_CYL_SEL_ADJ_CST[x] = 0 **(1.1.15)**

MFF_ADD_CYL_LAM_COR[x] = 0 **(1.1.16)**

LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i] = 0 **(1.1.17)**

LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] = 0 **(1.1.18)**

FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{LDC}$ = 0 **(1.1.19)**

FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{LDC}$ = 0 **(1.1.20)**

FAC_LAM_CYL_SEL_ADJ_CST[x]$_{LDC}$ = 0 **(1.1.21)**

MFF_ADD_CYL_LAM_COR[x]$_{LDC}$ = 0 **(1.1.22)**

LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i]$_{LDC}$ = 0 **(1.1.23)**

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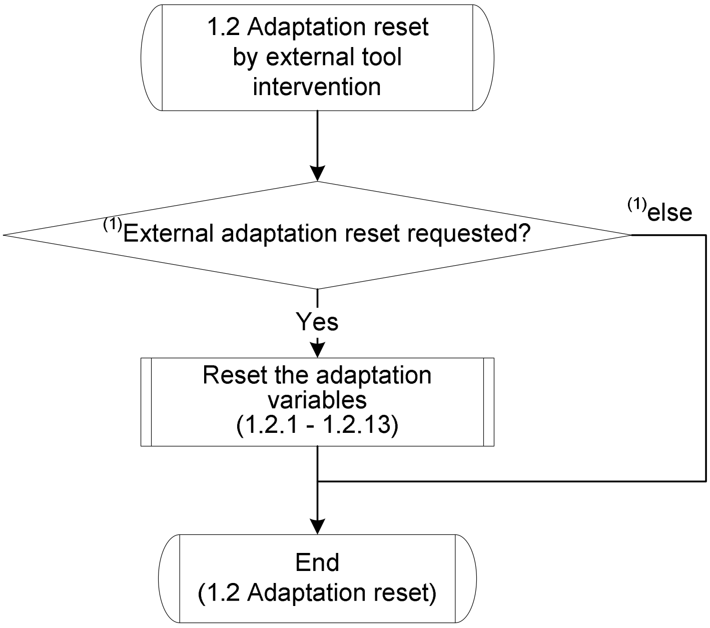
LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i]$_{LDC}$ = 0 **(1.1.24)**

STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 0 **(1.1.25)**

7.73.3 Adaptation reset by external tool intervention

Following calculation shall be carried out independently of the activation condition (time recurrence: 100 ms):



if(1) LV_LAM_CYL_SEL_ADJ_RST_IV_EXT[i] = 1

then

[*Remark: the exhaust bank based calculation shall be executed for all of the exhaust-bank-related cylinders (index "[i]" -> index "[x]")*]

FAC_LAM_CYL_SEL_ADJ_L_RNG[x] = 0 **(1.2.1)**

FAC_LAM_CYL_SEL_ADJ_H_RNG[x] = 0 **(1.2.2)**

FAC_LAM_CYL_SEL_ADJ_CST[x] = 0 **(1.2.3)**

MFF_ADD_CYL_LAM_COR[x] = 0 **(1.2.4)**

LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i] = 0 **(1.2.5)**

LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] = 0 **(1.2.6)**

FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{LDC}$ = 0 **(1.2.7)**

FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{LDC}$ = 0 **(1.2.8)**

FAC_LAM_CYL_SEL_ADJ_CST[x]$_{LDC}$ = 0 **(1.2.9)**

MFF_ADD_CYL_LAM_COR[x]$_{LDC}$ = 0 **(1.2.10)**

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LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i]$_{LDC}$ = 0

(1.2.11)

LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i]$_{LDC}$ = 0

(1.2.12)

STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 0

(1.2.13)

endif$^{(1)}$

Time recurrence:

every TDC; 100 ms **(1.2)**;every C_T_LAM_CYL_ADJ_CST **(1.12.9)**;
every C_T_LAM_CYL_ADJ **(1.12.9)**;

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7.73.4 Activation (exhaust bank selective):

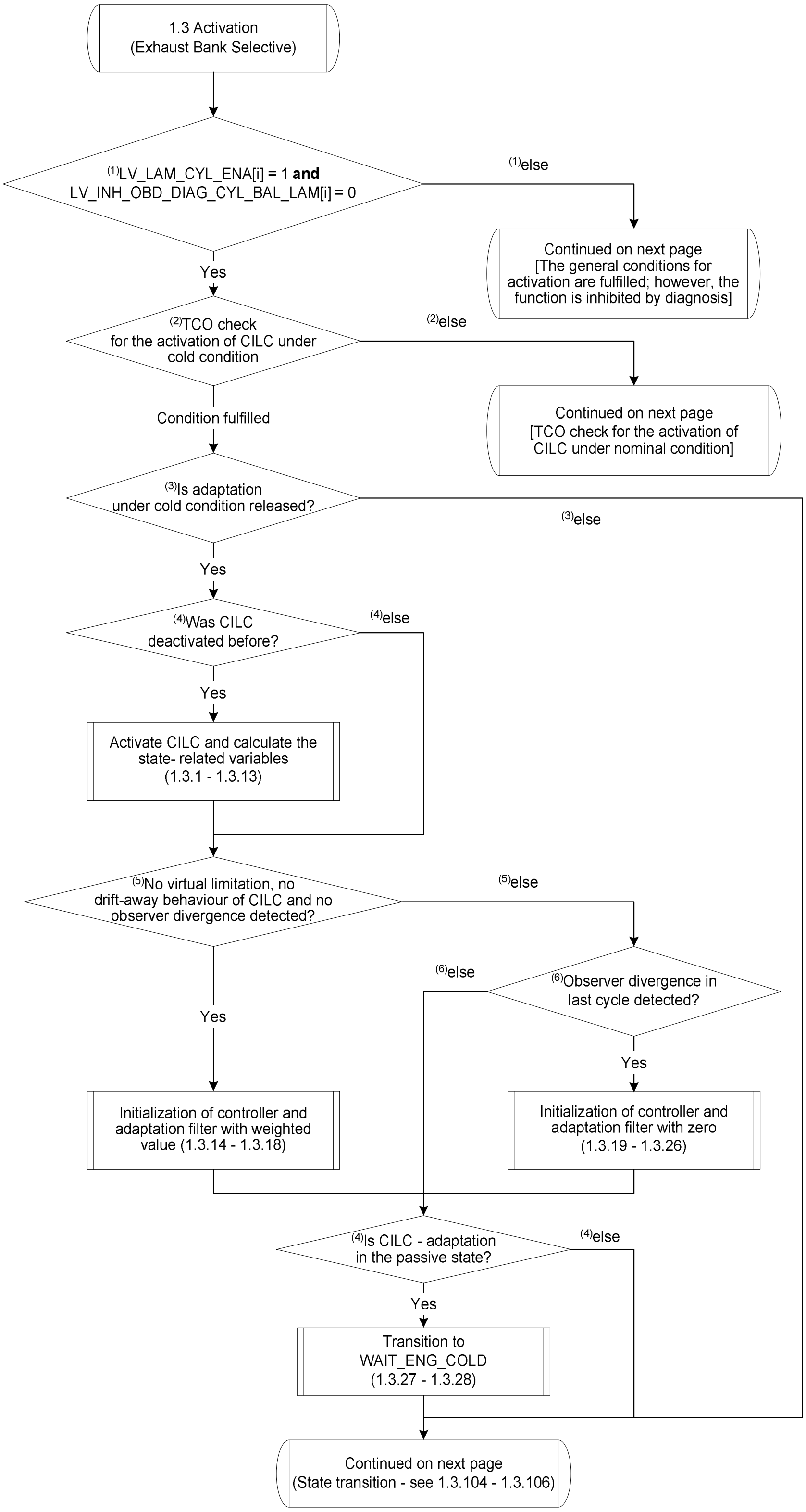

Figure 7.73.1: TOLOMEOGRAPHIC 269252-7.ps

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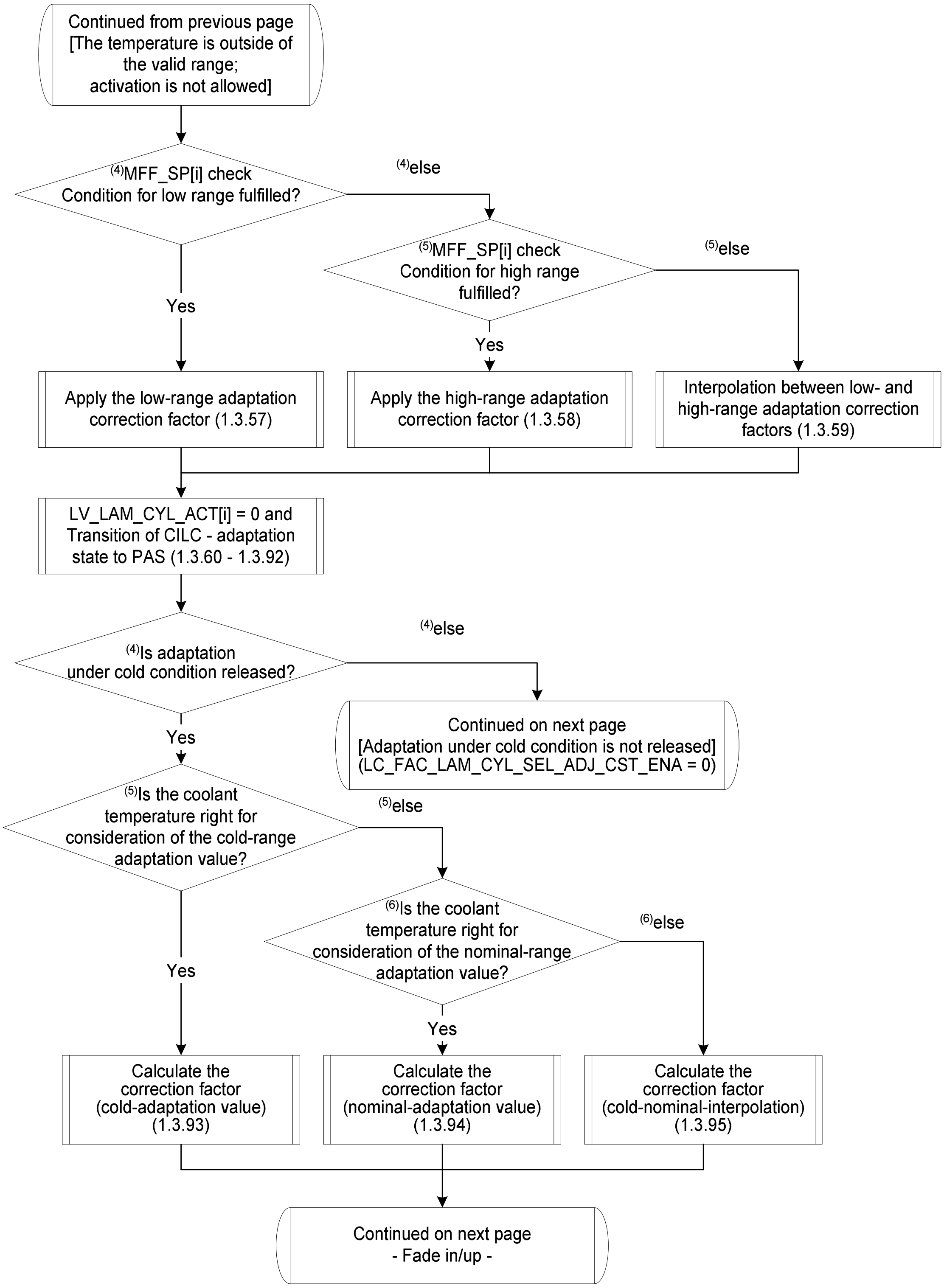

Figure 7.73.2: TOLOMEOGRAPHIC 269252-9.ps

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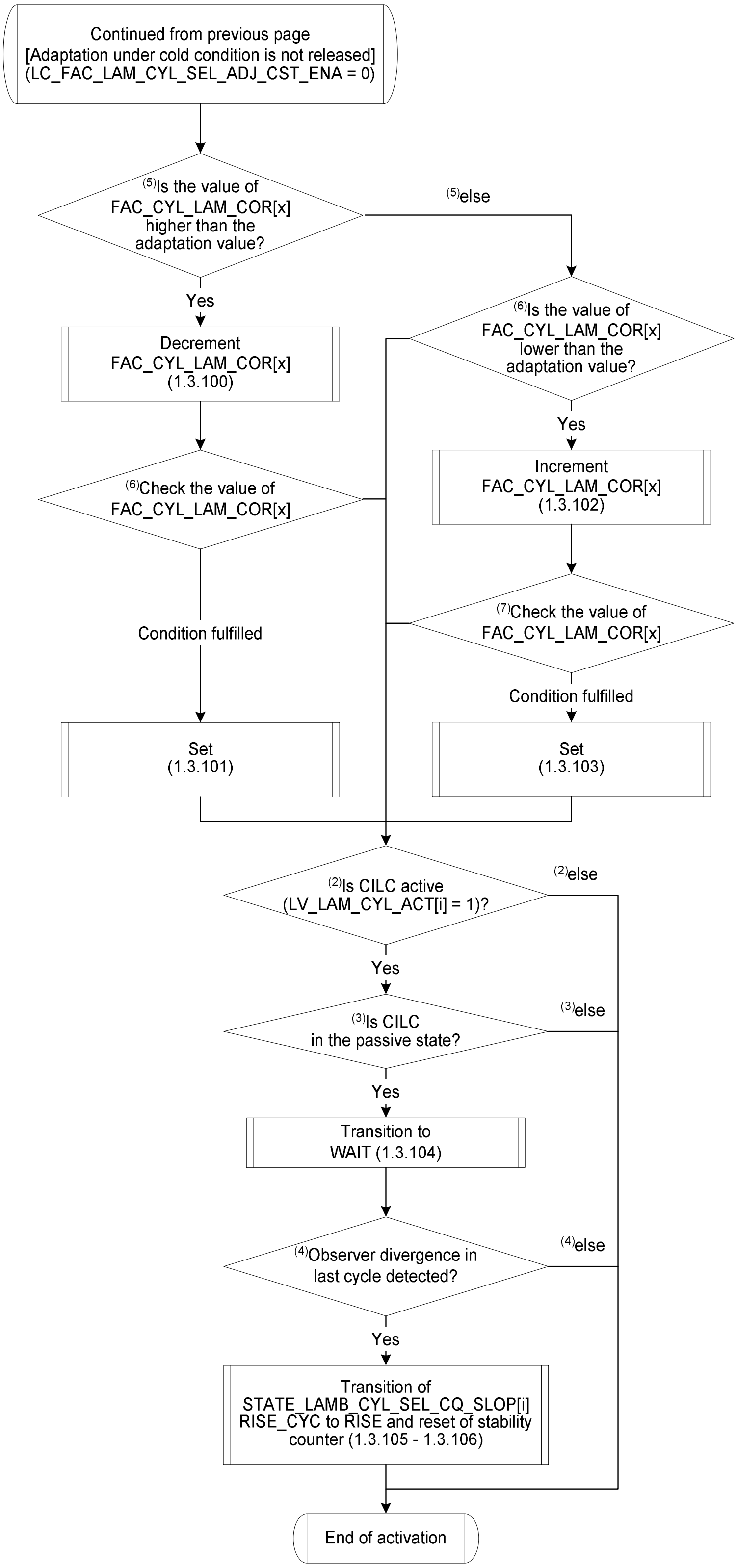

Figure 7.73.3: TOLOMEOGRAPHIC 269252-11.ps

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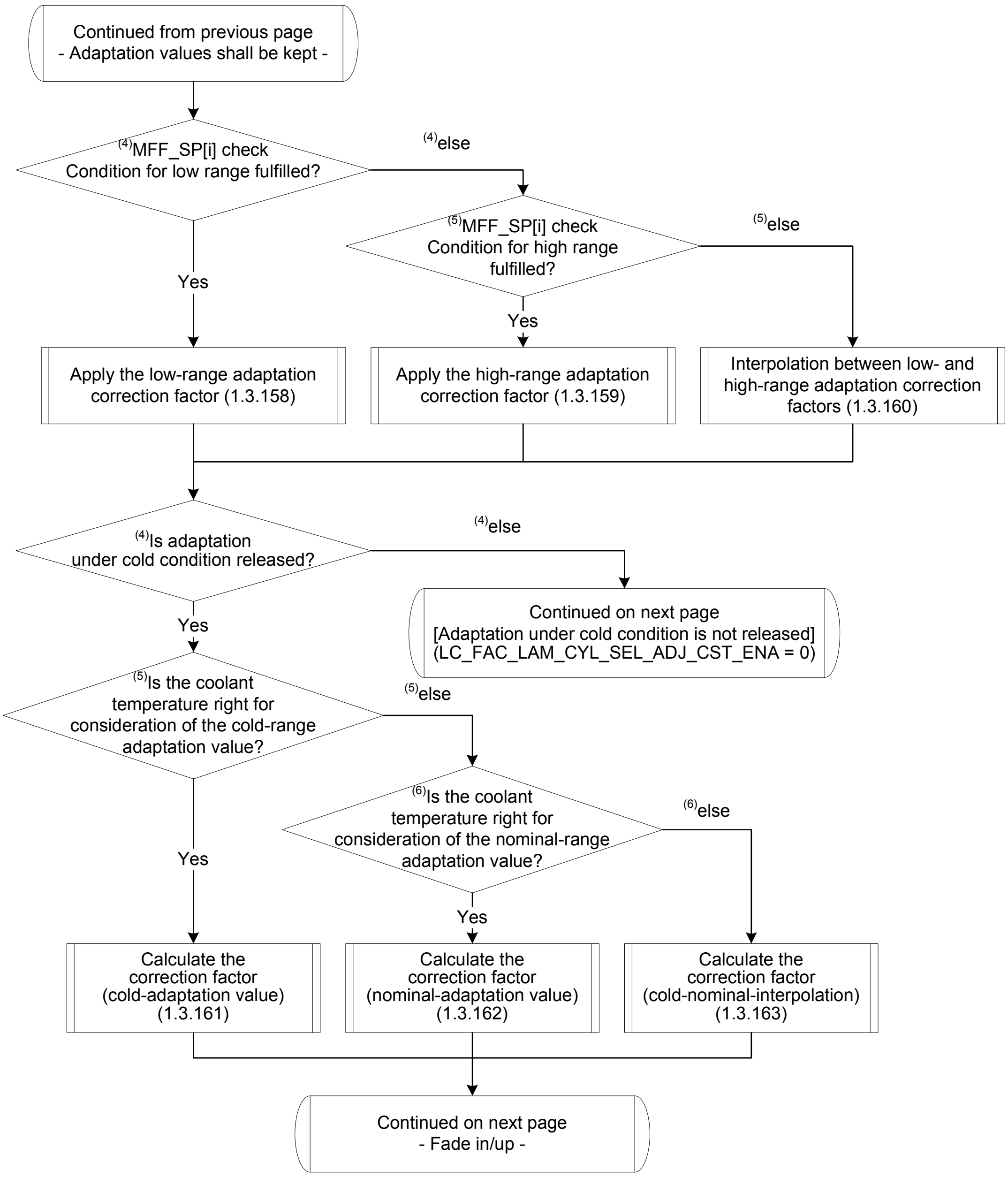

Figure 7.73.4: TOLOMEOGRAPHIC 269252-13.ps

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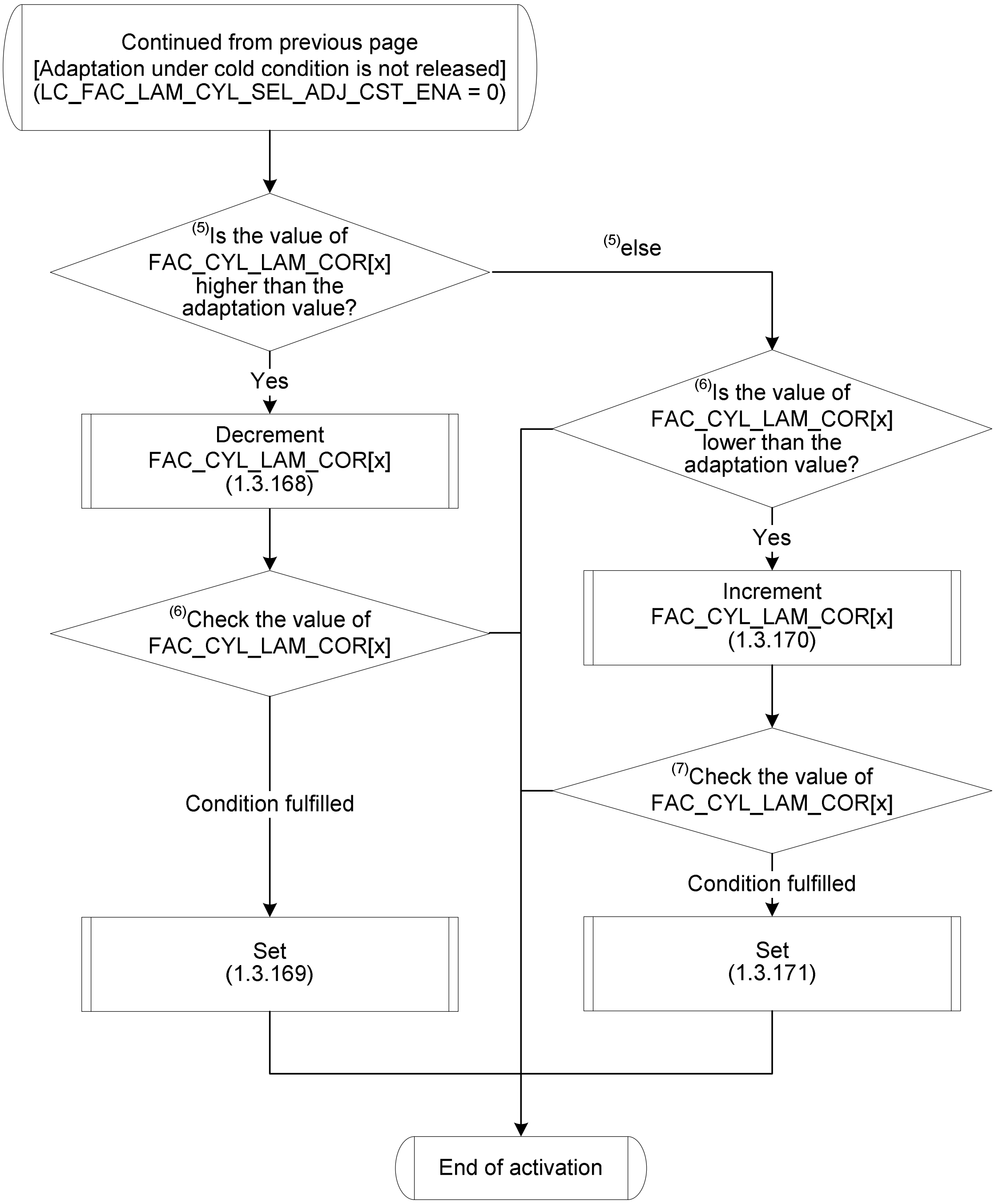

if$^{(1)}$ (LV_LAM_CYL_ENA[i] = 1 **and** LV_INH_OBD_DIAG_CYL_BAL_LAM[i] = 0)
then
if$^{(2)}$ (C_TEMP_LAM_CYL_CST_MIN $<$ TEMP_LAM_CYL_SEL $<$ C_TEMP_LAM_CYL_CST_MAX **and** TEMP_LAM_CYL_SEL $<$ C_TEMP_LAM_CYL_MIN **and** LV_LAM_LSCL[i] = 1)
[the temperature is inside of the valid range for activation under engine-cold condition]
then
if$^{(3)}$ LC_FAC_LAM_CYL_SEL_ADJ_CST_ENA = 1

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[adaptation under cold condition released]

then

if(4) LV_LAM_CYL_ACT[i] = 0

then

LV_LAM_CYL_ACT[i] = 1

(1.3.1)

MFF_DELTA_LAM_CYL_SEL_REAC =

abs(MFF_SP_SAVE_LAM_CYL_
SEL -

MFF_SP_LAM_CYL_SEL) **(1.3.2)**

FAC_VAL_LAM_CYL_SEL_REAC =

IP_FAC_VAL_LAM_CYL_SEL_REAC
(MFF_DELTA_LAM_CYL_SEL_REAC)
(1.3.3)

DELTA_LAMB_CYL_SEL_CQ[i] =

DELTA_LAMB_CYL_SEL_CQ[i]* FAC_
VAL_LAM_CYL_SEL_REAC **(1.3.4)**

DELTA_LAMB_CYL_SEL_CQ_FIL[i] =

DELTA_LAMB_CYL_SEL_CQ_FIL[i]*
FAC_VAL_LAM_CYL_SEL_REAC **(1.3.5)**

DELTA_LAMB_AV[i] = DELTA_LAMB_AV[i]*

FAC_VAL_LAM_CYL_SEL_REAC
(1.3.6)

DELTA_LAMB_ERR_RAW[i] = DELTA_LAMB_ERR_RAW[i]*

FAC_VAL_LAM_CYL_SEL_REAC
(1.3.7)

DELTA_LAMB_ERR[i] = DELTA_LAMB_ERR[i]*

FAC_VAL_LAM_CYL_SEL_REAC
(1.3.8)

DELTA_LAMB_ERR_CYL_SEL[x] =

DELTA_LAMB_ERR_CYL_SEL[x]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.9)

DELTA_LAMB_CYL[x] = DELTA_LAMB_CYL[x]*

FAC_VAL_LAM_CYL_SEL_REAC
(1.3.10)

DELTA_LAMB_CYL_SEL[i] = DELTA_LAMB_CYL_SEL[i]*

FAC_VAL_LAM_CYL_SEL_REAC
(1.3.11)

DELTA_LAMB_MDL[i] = DELTA_LAMB_MDL[i]*

FAC_VAL_LAM_CYL_SEL_REAC
(1.3.12)

DELTA_LAMB_DIF_CYL[x] = DELTA_LAMB_DIF_CYL[x]*

FAC_VAL_LAM_CYL_SEL_REAC
(1.3.13)

if(5) (LV_FAC_CYL_LAM_VIRT_LIM[i] = 0 **and**

LV_LAM_CYL_SEL_CTL_DRIFT_
PRED[i] = 0 **and**

STATE_LAMB_CYL_SEL_CQ_SLOP[i]
= 0)

then

FAC_CYL_LAM_INT[x] = FAC_CYL_LAM_INT[x]*

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FAC_VAL_LAM_CYL_SEL_REAC
(1.3.14)
FAC_CYL_LAM_I_MV_SHIFT[x] =
FAC_CYL_LAM_I_MV_SHIFT[x]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.15)
FAC_CYL_LAM[x] = FAC_CYL_LAM[x]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.16)
FAC_CYL_LAM_ABSV_SUM[i] =
FAC_CYL_LAM_ABSV_SUM[i]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.17)
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] =
FAC_LAM_CYL_SEL_ADJ_CST_
FIL[x]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.18)

else$^{(5)}$
if$^{(6)}$ STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 2
then
FAC_CYL_LAM_INT[x] = 0
(1.3.19)
FAC_CYL_LAM_I_MV_SHIFT[x] = 0
(1.3.20)
FAC_CYL_LAM[x] = 0
(1.3.21)
FAC_CYL_LAM_ABSV_SUM[i] = 0
(1.3.22)
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0
(1.3.23)
LV_FAC_CYL_LAM_LIM_MIN[x] = 0
(1.3.24)
LV_FAC_CYL_LAM_LIM_MAX[x] = 0
(1.3.25)
LV_FAC_CYL_LAM_VIRT_LIM[i] = 0
(1.3.26)
endif$^{(5)}$
endif$^{(4)}$
if$^{(4)}$ STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
then
STATE_LAM_CYL_SEL_ADJ[i] = 1 [WAIT_ENG_COLD]
(1.3.27)
CTR_T_LAM_CYL_ADJ[i] = C_T_LAM_CYL_ADJ_CST
(1.3.28)
endif$^{(4)}$
endif$^{(3)}$
else$^{(2)}$ *[the temperature is outside of the valid range for activation under engine-cold condition]*
if$^{(3)}$ TEMP_LAM_CYL_SEL C_TEMP_LAM_CYL_MIN
then
if$^{(4)}$ LV_LAM_CYL_ACT[i] = 0
then

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LV_LAM_CYL_ACT[i] = 1
(1.3.29)
MFF_DELTA_LAM_CYL_SEL_REAC =
abs(MFF_SP_SAVE_LAM_CYL_
SEL -
MFF_SP_LAM_CYL_SEL) **(1.3.30)**
FAC_VAL_LAM_CYL_SEL_REAC =
IP_FAC_VAL_LAM_CYL_SEL_REAC
(MFF_DELTA_LAM_CYL_SEL_REAC)
(1.3.31)
DELTA_LAMB_CYL_SEL_CQ[i] =
DELTA_LAMB_CYL_SEL_CQ[i]* FAC_
VAL_LAM_CYL_SEL_REAC **(1.3.32)**
DELTA_LAMB_CYL_SEL_CQ_FIL[i] =
DELTA_LAMB_CYL_SEL_CQ_FIL[i]*
FAC_VAL_LAM_CYL_SEL_REAC **(1.3.33)**
DELTA_LAMB_AV[i] = DELTA_LAMB_AV[i]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.34)
DELTA_LAMB_ERR_RAW[i] = DELTA_LAMB_ERR_RAW[i]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.35)
DELTA_LAMB_ERR[i] = DELTA_LAMB_ERR[i]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.36)
DELTA_LAMB_ERR_CYL_SEL[x] =
DELTA_LAMB_ERR_CYL_SEL[x]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.37)
DELTA_LAMB_CYL[x] = DELTA_LAMB_CYL[x]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.38)
DELTA_LAMB_CYL_SEL[i] = DELTA_LAMB_CYL_SEL[i]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.39)
DELTA_LAMB_MDL[i] = DELTA_LAMB_MDL[i]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.40)
DELTA_LAMB_DIF_CYL[x] = DELTA_LAMB_DIF_CYL[x]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.41)
if$^{(5)}$ (LV_FAC_CYL_LAM_VIRT_LIM[i] = 0 **and**
LV_LAM_CYL_SEL_CTL_DRIFT_
PRED[i] = 0 **and**
STATE_LAMB_CYL_SEL_CQ_SLOP[i]
= 0)
then
FAC_CYL_LAM_INT[x] = FAC_CYL_LAM_INT[x]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.42)
FAC_CYL_LAM_I_MV_SHIFT[x] =
FAC_CYL_LAM_I_MV_SHIFT[x]*
FAC_VAL_LAM_CYL_SEL_REAC
(1.3.43)

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FAC_CYL_LAM[x] = FAC_CYL_LAM[x]*
FAC_VAL_LAM_CYL_SEL_REAC

(1.3.44)

FAC_CYL_LAM_ABSV_SUM[i] =
FAC_CYL_LAM_ABSV_SUM[i]*
FAC_VAL_LAM_CYL_SEL_REAC

(1.3.-)

FAC_LAM_CYL_SEL_ADJ_FIL[x] =
FAC_LAM_CYL_SEL_ADJ_FIL[x]*
FAC_VAL_LAM_CYL_SEL_REAC

(1.3.46)

else$^{(5)}$
if$^{(6)}$ STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 2
then
FAC_CYL_LAM_INT[x] = 0
(1.3.47)
FAC_CYL_LAM_I_MV_SHIFT[x] = 0
(1.3.48)
FAC_CYL_LAM[x] = 0
(1.3.49)
FAC_CYL_LAM_ABSV_SUM[i] = 0
(1.3.50)
FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0
(1.3.51)
LV_FAC_CYL_LAM_LIM_MIN[x] = 0
(1.3.52)
LV_FAC_CYL_LAM_LIM_MAX[x] = 0
(1.3.53)
LV_FAC_CYL_LAM_VIRT_LIM[i] = 0
(1.3.54)
endif$^{(6)}$
endif$^{(5)}$
endif$^{(4)}$
if$^{(4)}$ STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
then
STATE_LAM_CYL_SEL_ADJ[i] = 3 [WAIT_ENG_NOM]
(1.3.55)
CTR_T_LAM_CYL_ADJ[i] = C_T_LAM_CYL_ADJ
(1.3.56)
endif$^{(4)}$
else$^{(3)}$ *[the temperature is outside of the valid range; activation is not allowed]*
if$^{(4)}$ MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_L_RNG
then
FAC_LAM_CYL_SEL_ADJ[x] =
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]

(1.3.57)

else$^{(4)}$
if$^{(5)}$ MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_H_RNG
then
FAC_LAM_CYL_SEL_ADJ[x] =
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]

(1.3.58)

else$^{(5)}$

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FAC_LAM_CYL_SEL_ADJ[x] =
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]
+
(MFF_SP[i] - C_MFF_SP_THD_
CYL_SEL_ADJ_L_RNG)*
(FAC_LAM_CYL_SEL_ADJ_H_RNG[x]
-
FAC_LAM_CYL_SEL_ADJ_L_RNG[x])/
(C_MFF_SP_THD_CYL_SEL_ADJ_
H_RNG -
C_MFF_SP_THD_CYL_SEL_ADJ_
L_RNG) **(1.3.59)**

endif$^{(5)}$

endif$^{(4)}$

LV_LAM_CYL_ACT[i] = 0 **(1.3.60)**

MFF_DELTA_LAM_CYL_SEL_REAC = 0 **(1.3.61)**

MFF_SP_SAVE_LAM_CYL_SEL = 0 **(1.3.62)**

FAC_VAL_LAM_CYL_SEL_REAC = 0 **(1.3.63)**

DELTA_LAMB_CYL_SEL_CQ[i] = 0 **(1.3.64)**

DELTA_LAMB_CYL_SEL_CQ_FIL[i] = 0 **(1.3.65)**

LAMB_CYL_SEL_CQ_REF[i] = 0 **(1.3.66)**

LAMB_CYL_SEL_CQ_DIF_REF[i] = 0 **(1.3.67)**

CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] = 0 **(1.3.68)**

CTR_LAMB_CYL_SEL_CQ_STAB[i] = 0 **(1.3.69)**

LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 0 **(1.3.70)**

LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0 **(1.3.71)**

DELTA_LAMB_AV[i] = 0 **(1.3.72)**

DELTA_LAMB_ERR_RAW[i] = 0 **(1.3.73)**

DELTA_LAMB_ERR[i] = 0 **(1.3.74)**

DELTA_LAMB_ERR_CYL_SEL[x] = 0 **(1.3.75)**

DELTA_LAMB_CYL[x] = 0 **(1.3.76)**

DELTA_LAMB_CYL_SEL[i] = 0 **(1.3.77)**

DELTA_LAMB_MDL[i] = 0 **(1.3.78)**

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DELTA_LAMB_DIF_CYL[x] = 0
(1.3.79)

FAC_CYL_LAM_INT[x] = 0
(1.3.80)

FAC_CYL_LAM_I_MV_SHIFT[x] = 0
(1.3.81)

FAC_CYL_LAM[x] = 0
(1.3.82)

FAC_CYL_LAM_ABSV_SUM[i] = 0
(1.3.83)

FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0
(1.3.84)

FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0
(1.3.85)

STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
(1.3.86)

STATE_LAM_CYL_SEL[i] = 0 [PAS]
(1.3.87)

CTR_LAM_CYL_SEL_REF_CLL[i] = 0
(1.3.88)

LV_LAM_CYL_SEL_ADJ_VLD[i] = 0
(1.3.89)

LV_FAC_CYL_LAM_LIM_MIN[x] = 0
(1.3.90)

LV_FAC_CYL_LAM_LIM_MAX[x] = 0
(1.3.91)

LV_FAC_CYL_LAM_VIRT_LIM[i] = 0
(1.3.92)

if$^{(4)}$ LC_FAC_LAM_CYL_SEL_ADJ_CST_ENA = 1
[adaptation under cold condition released]
then
if$^{(5)}$ TEMP_LAM_CYL_SEL C_TEMP_THD_CYL_SEL_ADJ_COLD_RNG
then
FAC_LAM_CYL_SEL_ADJ_INTER[x] = FAC_LAM_CYL_SEL_ADJ_CST[x]
(1.3.93)
else$^{(5)}$
if$^{(6)}$ TEMP_LAM_CYL_SEL C_TEMP_THD_CYL_SEL_ADJ_NOM_RNG
then
FAC_LAM_CYL_SEL_ADJ_INTER[x] = FAC_LAM_CYL_SEL_ADJ[x]
(1.3.94)
else$^{(6)}$
FAC_LAM_CYL_SEL_ADJ_INTER[x] = FAC_LAM_CYL_SEL_ADJ_CST[x] + (TEMP_LAM_CYL_SEL - C_TEMP_THD_CYL_SEL_ADJ_COLD_RNG)*

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(FAC_LAM_CYL_SEL_ADJ[x] - FAC_LAM_CYL_SEL_ADJ_CST[x])/

(C_TEMP_THD_CYL_SEL_ADJ_NOM_RNG - C_TEMP_THD_CYL_SEL_ADJ_COLD_RNG) **(1.3.95)**

endif$^{(6)}$

endif$^{(5)}$

if$^{(5)}$ FAC_CYL_LAM_COR[x]$_k$ $>$ FAC_LAM_CYL_SEL_ADJ_INTER[x]

then

FAC_CYL_LAM_COR[x]$_k$ = FAC_CYL_LAM_COR[x]$_{k-1}$ - C_FAC_CYL_LAM_ABSV_DEC **(1.3.96)**

if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $<$ FAC_LAM_CYL_SEL_ADJ_INTER[x]

then

FAC_CYL_LAM_COR[x]$_k$ = FAC_LAM_CYL_SEL_ADJ_INTER[x] **(1.3.97)**

endif$^{(6)}$

else$^{(5)}$

if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $<$ FAC_LAM_CYL_SEL_ADJ_INTER[x]

then

FAC_CYL_LAM_COR[x]$_k$ = FAC_CYL_LAM_COR[x]$_{k-1}$ + C_FAC_CYL_LAM_ABSV_DEC **(1.3.98)**

if$^{(7)}$ FAC_CYL_LAM_COR[x]$_k$ $>$ FAC_LAM_CYL_SEL_ADJ_INTER[x]

then

FAC_CYL_LAM_COR[x]$_k$ = FAC_LAM_CYL_SEL_ADJ_INTER[x] **(1.3.99)**

endif$^{(7)}$

endif$^{(6)}$

endif$^{(5)}$

else$^{(4)}$ *[adaptation under cold condition not released]*

if$^{(5)}$ FAC_CYL_LAM_COR[x]$_k$ $>$ FAC_LAM_CYL_SEL_ADJ[x]

then

FAC_CYL_LAM_COR[x]$_k$ = FAC_CYL_LAM_COR[x]$_{k-1}$ - C_FAC_CYL_LAM_ABSV_DEC **(1.3.100)**

if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $<$ FAC_LAM_CYL_SEL_ADJ[x]

then

FAC_CYL_LAM_COR[x]$_k$ = FAC_LAM_CYL_SEL_ADJ[x] **(1.3.101)**

endif$^{(6)}$

else$^{(5)}$

if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $<$ FAC_LAM_CYL_SEL_ADJ[x]

then

FAC_CYL_LAM_COR[x]$_k$ =

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FAC_CYL_LAM_COR[x]$_{k-1}$ +
C_FAC_CYL_LAM_ABSV_DEC **(1.3.102)**

if$^{(7)}$ FAC_CYL_LAM_COR[x]$_k$ $>$ FAC_LAM_CYL_SEL_ADJ[x]

then

FAC_CYL_LAM_COR[x]$_k$ = FAC_LAM_CYL_SEL_ADJ[x] **(1.3.103)**

endif$^{(7)}$

endif$^{(6)}$

endif$^{(5)}$

endif$^{(4)}$

endif$^{(3)}$

endif$^{(2)}$

if$^{(2)}$ LV_LAM_CYL_ACT[i] = 1

then

if$^{(3)}$ STATE_LAM_CYL_SEL[i] = 0 [PAS]

then

STATE_LAM_CYL_SEL[i] = 2 [WAIT] **(1.3.104)**

if$^{(4)}$ STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 2

then

STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 1 **(1.3.105)**

CTR_LAMB_CYL_SEL_CQ_STAB[i] = 0 **(1.3.106)**

endif$^{(4)}$

endif$^{(3)}$

endif$^{(2)}$

else$^{(1)}$ *[the general conditions for activation are fulfilled; however, the function is inhibited by diagnosis]*

if$^{(2)}$ (LV_LAM_CYL_ENA[i] = 1 **and** LV_INH_OBD_DIAG_CYL_BAL_LAM[i] = 1)

then

LV_LAM_CYL_ACT[i] = 0 **(1.3.107)**

LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0 **(1.3.108)**

DELTA_LAMB_CYL_SEL_CQ[i] = 0 **(1.3.109)**

DELTA_LAMB_CYL_SEL_CQ_FIL[i] = 0 **(1.3.110)**

LAMB_CYL_SEL_CQ_REF[i] = 0 **(1.3.111)**

LAMB_CYL_SEL_CQ_DIF_REF[i] = 0 **(1.3.112)**

CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] = 0 **(1.3.113)**

CTR_LAMB_CYL_SEL_CQ_STAB[i] = 0 **(1.3.114)**

LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 0 **(1.3.115)**

DELTA_LAMB_AV[i] = 0 **(1.3.116)**

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DELTA_LAMB_ERR_RAW[i] = 0 **(1.3.117)**

DELTA_LAMB_ERR[i] = 0 **(1.3.118)**

DELTA_LAMB_ERR_CYL_SEL[x] = 0 **(1.3.119)**

DELTA_LAMB_CYL[x] = 0 **(1.3.120)**

DELTA_LAMB_CYL_SEL[i] = 0 **(1.3.121)**

DELTA_LAMB_MDL[i] = 0 **(1.3.122)**

DELTA_LAMB_DIF_CYL[x] = 0 **(1.3.123)**

FAC_CYL_LAM_INT[x] = 0 **(1.3.124)**

FAC_CYL_LAM_P[x] = 0 **(1.3.125)**

FAC_CYL_LAM_I_MV_SHIFT[x] = 0 **(1.3.126)**

FAC_CYL_LAM_P_MV_SHIFT[x] = 0 **(1.3.127)**

FAC_CYL_LAM[x] = 0 **(1.3.128)**

FAC_CYL_LAM_ABSV_SUM[i] = 0 **(1.3.129)**

FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0 **(1.3.130)**

FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0 **(1.3.131)**

LV_LAM_CYL_SEL_SEG_REF_CLL[i] = 0 **(1.3.132)**

STATE_LAM_CYL_SEL[i] = 0 [PAS] **(1.3.133)**

STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS] **(1.3.134)**

CTR_T_LAM_CYL_ADJ[i] = 0 **(1.3.135)**

CTR_LAM_CYL_SEL_REF_CLL[i] = 0 **(1.3.136)**

LV_LAM_CYL_SEL_ADJ_VLD[i] = 0 **(1.3.& %■)**

LV_FAC_CYL_LAM_LIM_MIN[x] = 0 **(1.3.138)**

LV_FAC_CYL_LAM_LIM_MAX[x] = 0 **(1.3.139)**

LV_FAC_CYL_LAM_VIRT_LIM[i] = 0 **(1.3.140)**

if[3] LC_LAM_CYL_SEL_ERR_RST = 1
[adaptation values shall be reset]

then

if[4] FAC_CYL_LAM_COR[x]$_k$ > 0

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then

FAC_CYL_LAM_COR[x]$_k$ = FAC_CYL_LAM_COR[x]$_{k-1}$ - C_FAC_CYL_LAM_ABSV_DEC **(1.3.141)**

if$^{(5)}$ FAC_CYL_LAM_COR[x]$_k$ $<$ 0

then

FAC_CYL_LAM_COR[x]$_k$ = 0 **(1.3.142)**

endif$^{(5)}$

else$^{(4)}$

if$^{(5)}$ FAC_CYL_LAM_COR[x]$_k$ $<$ 0

then

FAC_CYL_LAM_COR[x]$_k$ = FAC_CYL_LAM_COR[x]$_{k-1}$ + C_FAC_CYL_LAM_ABSV_DEC **(1.3.143)**

if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $>$ 0

then

FAC_CYL_LAM_COR[x]$_k$ = 0 **(1.3.144)**

endif$^{(6)}$

endif$^{(5)}$

endif$^{(4)}$

FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{LDC}$ = 0 **(1.3.1-)**

FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{LDC}$ = 0 **(1.3.146)**

FAC_LAM_CYL_SEL_ADJ_CST[x]$_{LDC}$ = 0 **(1.3.147)**

MFF_ADD_CYL_LAM_COR[x]$_{LDC}$ = 0 **(1.3.148)**

LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i]$_{LDC}$ = 0 **(1.3.149)**

LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i]$_{LDC}$ = 0 **(1.3.150)**

FAC_LAM_CYL_SEL_ADJ[x] = 0 **(1.3.151)**

FAC_LAM_CYL_SEL_ADJ_L_RNG[x] = 0 **(1.3.152)**

FAC_LAM_CYL_SEL_ADJ_H_RNG[x] = 0 **(1.3.153)**

FAC_LAM_CYL_SEL_ADJ_CST[x] = 0 **(1.3.154)**

MFF_ADD_CYL_LAM_COR[x] = 0 **(1.3.155)**

LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i] = 0 **(1.3.156)**

LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] = 0 **(1.3.157)**

else$^{(3)}$ *[adaptation values shall be kept]*

if$^{(4)}$ MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_L_RNG

then

FAC_LAM_CYL_SEL_ADJ[x] = FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{LDC}$**(1.3.158**

else$^{(4)}$

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if$^{(5)}$ MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_H_RNG
then
FAC_LAM_CYL_SEL_ADJ[x] =
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{LDC}$**(1.3.15**
else$^{(5)}$
FAC_LAM_CYL_SEL_ADJ[x] =
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{LDC}$
+
(MFF_SP[i] - C_MFF_SP_THD_
CYL_SEL_ADJ_L_RNG)*
(FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{LDC}$
-
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{LDC}$)/
(C_MFF_SP_THD_CYL_SEL_ADJ_
H_RNG -
C_MFF_SP_THD_CYL_SEL_ADJ_
L_RNG) **(1.3.160)**
endif$^{(5)}$
endif$^{(4)}$
if$^{(4)}$ LC_FAC_LAM_CYL_SEL_ADJ_CST_ENA = 1
[adaptation under cold condition released]
then
if$^{(5)}$ TEMP_LAM_CYL_SEL
C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG
then
FAC_LAM_CYL_SEL_ADJ_INTER[x] =
FAC_LAM_CYL_SEL_ADJ_CST[x]$_{LDC}$
(1.3.161)
else$^{(5)}$
if$^{(6)}$ TEMP_LAM_CYL_SEL
C_TEMP_THD_CYL_SEL_ADJ_NOM_
RNG
then
FAC_LAM_CYL_SEL_ADJ_INTER[x] =
FAC_LAM_CYL_SEL_ADJ[x]
(1.3.162)
else$^{(6)}$
FAC_LAM_CYL_SEL_ADJ_INTER[x] =
FAC_LAM_CYL_SEL_ADJ_CST[x]$_{LDC}$
+
(TEMP_LAM_CYL_SEL -
C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG)*
(FAC_LAM_CYL_SEL_ADJ[x] -
FAC_LAM_CYL_SEL_ADJ_CST[x]$_{LDC}$)/
(C_TEMP_THD_CYL_SEL_ADJ_
NOM_RNG -
C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG) **(1.3.163)**
endif$^{(6)}$

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endif$^{(5)}$
if$^{(5)}$ FAC_CYL_LAM_COR[x]$_k$ $>$
FAC_LAM_CYL_SEL_ADJ_INTER[x]
then
FAC_CYL_LAM_COR[x]$_k$ = FAC_CYL_LAM_COR[x]$_{k-1}$
- C_FAC_CYL_LAM_ABSV_DEC
(1.3.164)
if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $<$
FAC_LAM_CYL_SEL_ADJ_INTER[x]
then
FAC_CYL_LAM_COR[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_INTER[x]
(1.3.165)
endif$^{(6)}$
else$^{(5)}$
if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $<$
FAC_LAM_CYL_SEL_ADJ_INTER[x]
then
FAC_CYL_LAM_COR[x]$_k$ =
FAC_CYL_LAM_COR[x]$_{k-1}$ +
C_FAC_CYL_LAM_ABSV_DEC **(1.3.166)**
if$^{(7)}$ FAC_CYL_LAM_COR[x]$_k$ $>$
FAC_LAM_CYL_SEL_ADJ_INTER[x]
then
FAC_CYL_LAM_COR[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_INTER[x]
(1.3.167)
endif$^{(7)}$
endif$^{(6)}$
endif$^{(5)}$
else$^{(4)}$ *[adaptation under cold condition not released]*
if$^{(5)}$ FAC_CYL_LAM_COR[x]$_k$ $>$ FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]$_k$ = FAC_CYL_LAM_COR[x]$_{k-1}$ -
C_FAC_CYL_LAM_ABSV_DEC **(1.3.168)**
if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $<$
FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ[x]**(1.3.169)**
endif$^{(6)}$
else$^{(5)}$
if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $<$
FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]$_k$ =
FAC_CYL_LAM_COR[x]$_{k-1}$ +
C_FAC_CYL_LAM_ABSV_DEC **(1.3.170)**
if$^{(7)}$ FAC_CYL_LAM_COR[x]$_k$ $>$
FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]$_k$ =

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FAC_LAM_CYL_SEL_ADJ[x]**(1.3.171)**

endif(7)
endif(6)
endif(5)
endif(4)
endif(3)
endif(2)
endif(1)

7.73.5 Deactivation (exhaust bank selective):

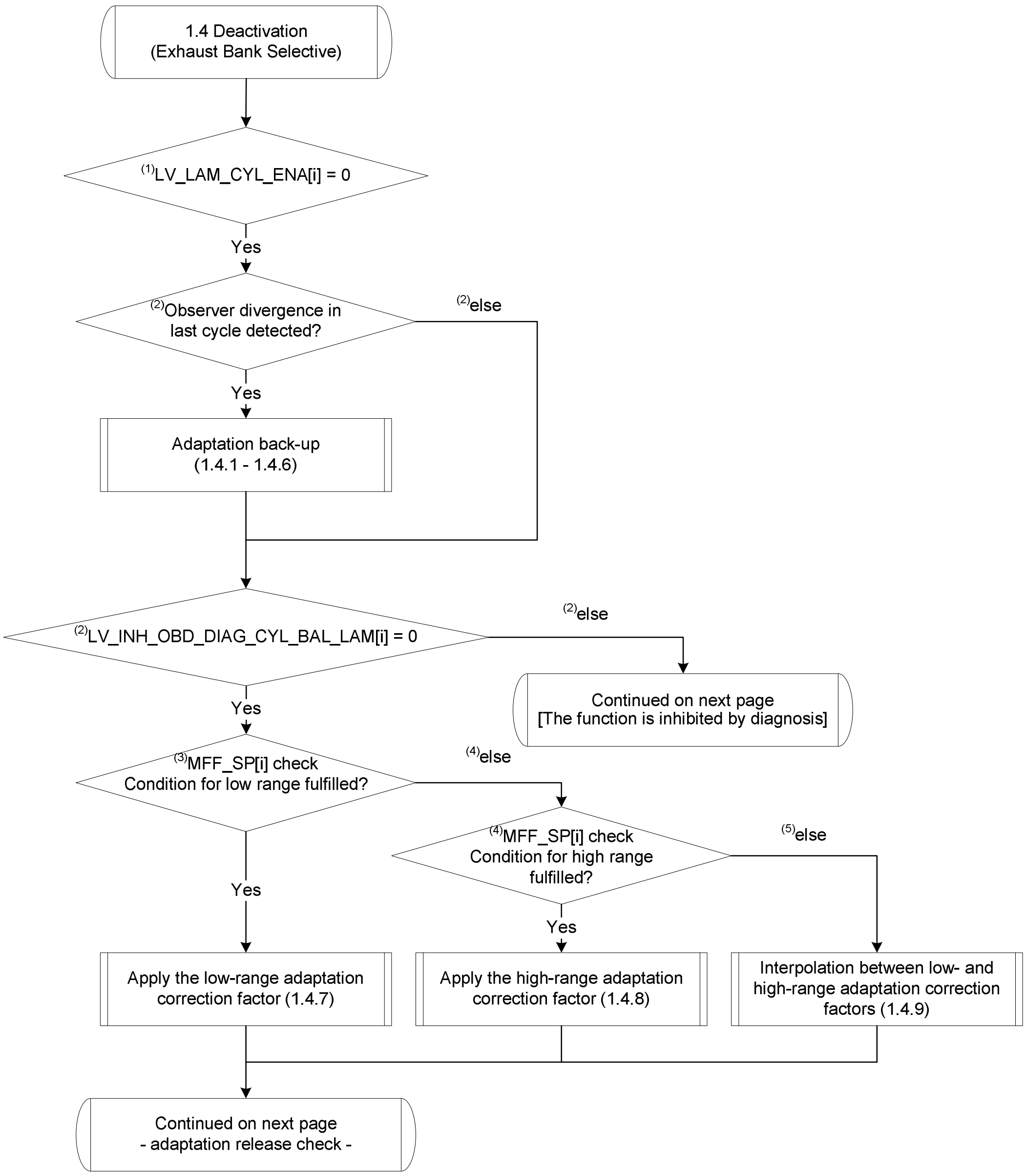

Figure 7.73.5: TOLOMEOGRAPHIC 269252-16.ps

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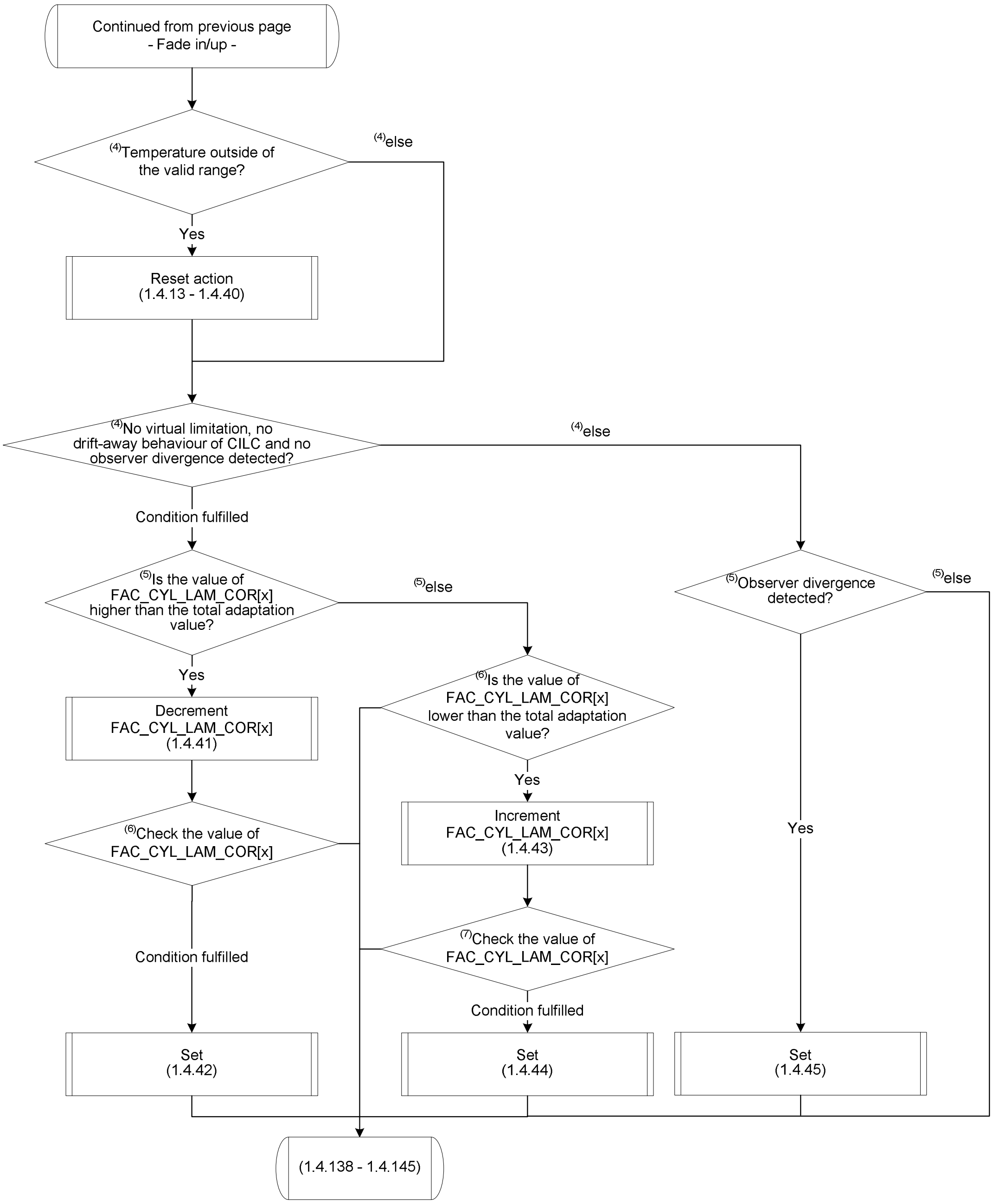

Figure 7.73.6: TOLOMEOGRAPHIC 269252-18.ps

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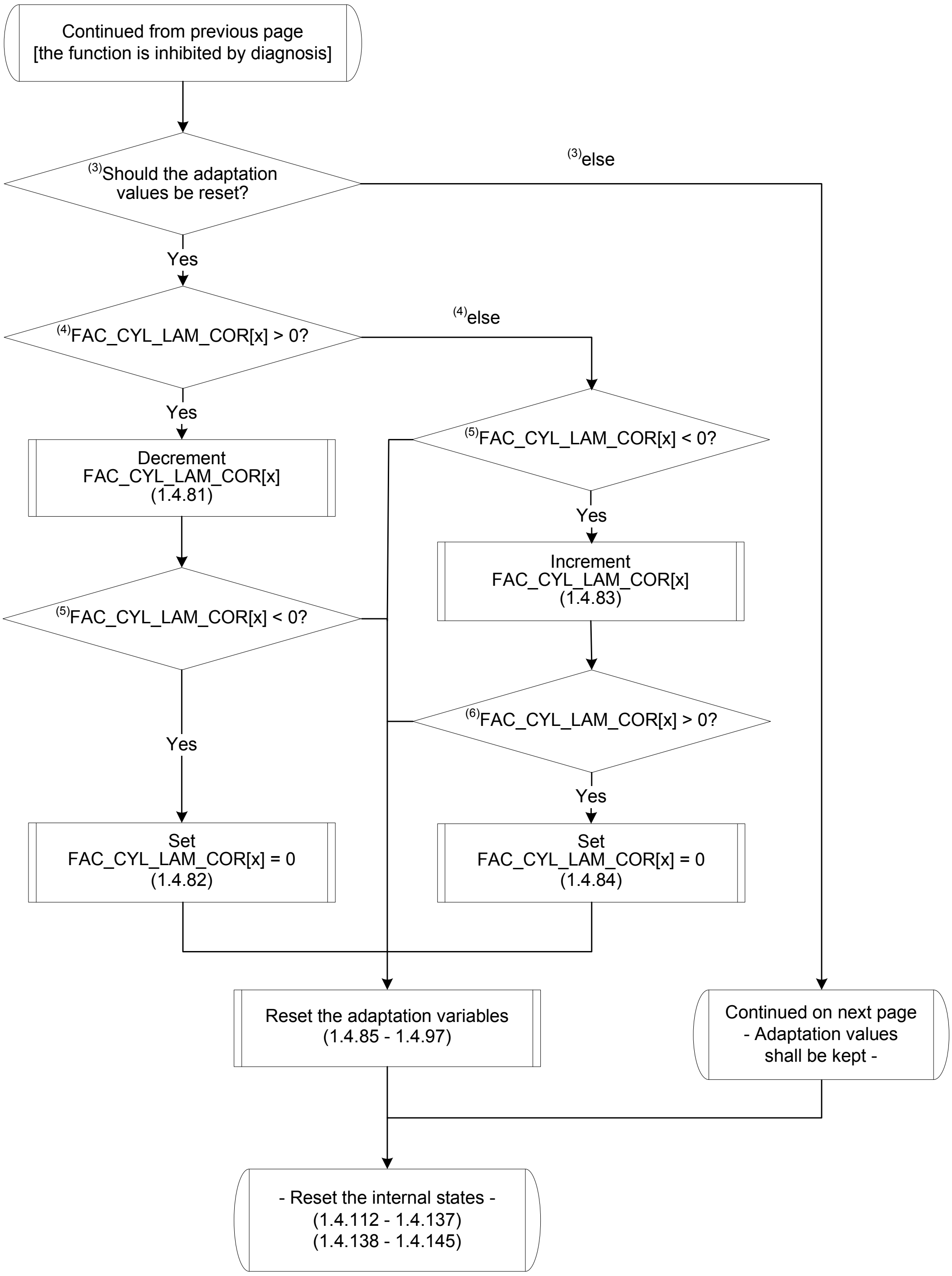

Figure 7.73.7: TOLOMEOGRAPHIC 269252-20.ps

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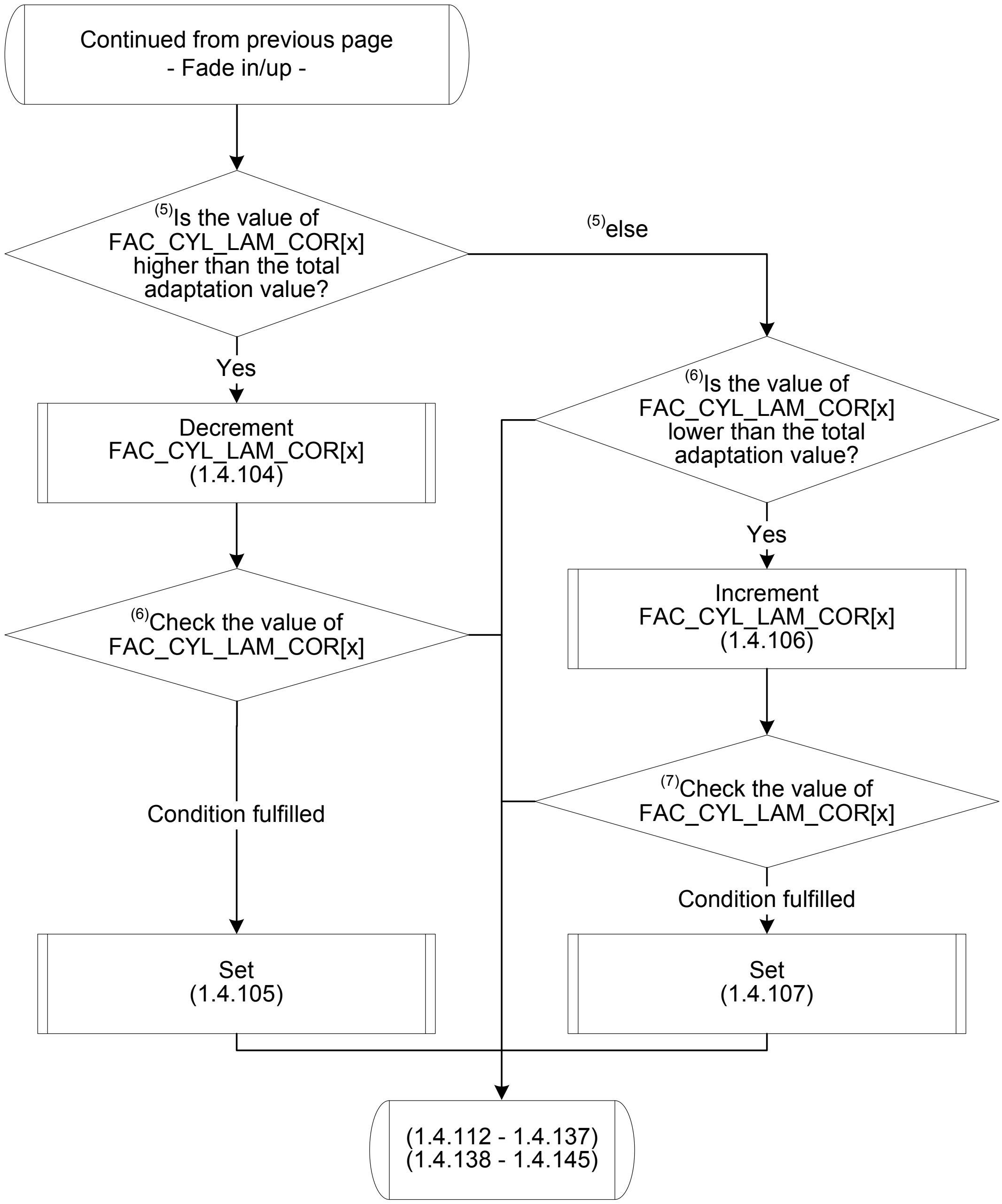

Figure 7.73.8: TOLOMEOGRAPHIC 269252-22.ps

if$^{(1)}$ LV_LAM_CYL_ENA[i] = 0

then

if$^{(2)}$ STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 2

then

for$^{(3)}$ j(x) = 1 : Number of cylinders per exhaust bank

FAC_LAM_CYL_SEL_ADJ_L_RNG[x] =

FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{LDC}$

(1.4.1)

FAC_LAM_CYL_SEL_ADJ_H_RNG[x] =

FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{LDC}$

(1.4.2)

FAC_LAM_CYL_SEL_ADJ_CST[x] =

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FAC_LAM_CYL_SEL_ADJ_CST[x]$_{LDC}$**(1.4.3)**
MFF_ADD_CYL_LAM_COR[x] =
MFF_ADD_CYL_LAM_COR[x]$_{LDC}$**(1.4.4)**
LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i] =
LV_LAM_CYL_SEL_ADJ_H_RNG_
VLD[i]$_{LDC}$**(1.4.5)**
LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] =
LV_LAM_CYL_SEL_ADJ_L_RNG_
VLD[i]$_{LDC}$**(1.4.6)**
endfor(3)
endif(2)
if(2) LV_INH_OBD_DIAG_CYL_BAL_LAM[i] = 0
then
if(3) MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_L_RNG
then
FAC_LAM_CYL_SEL_ADJ[x] = FAC_LAM_CYL_SEL_ADJ_L_RNG[x]
(1.4.7)
else(3)
if(4) MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_H_RNG
then
FAC_LAM_CYL_SEL_ADJ[x] =
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]
(1.4.8)
else(4)
FAC_LAM_CYL_SEL_ADJ[x] =
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]
+
(MFF_SP[i] - C_MFF_SP_THD_
CYL_SEL_ADJ_L_RNG)*
(FAC_LAM_CYL_SEL_ADJ_H_RNG[x]
-
FAC_LAM_CYL_SEL_ADJ_L_RNG[x])/
(C_MFF_SP_THD_CYL_SEL_ADJ_
H_RNG -
C_MFF_SP_THD_CYL_SEL_ADJ_
L_RNG) **(1.4.9)**
endif(4)
endif(3)
if(3) LC_FAC_LAM_CYL_SEL_ADJ_CST_ENA = 1
[adaptation under cold condition released]
then
if(4) TEMP_LAM_CYL_SEL
C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG
then
FAC_LAM_CYL_SEL_ADJ_INTER[x] =
FAC_LAM_CYL_SEL_ADJ_CST[x]
(1.4.10)
else(4)
if(5) TEMP_LAM_CYL_SEL
C_TEMP_THD_CYL_SEL_ADJ_NOM_
RNG

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then
FAC_LAM_CYL_SEL_ADJ_INTER[x] =
FAC_LAM_CYL_SEL_ADJ[x] **(1.4.11)**
else(5)
FAC_LAM_CYL_SEL_ADJ_INTER[x] =
FAC_LAM_CYL_SEL_ADJ_CST[x]
+
(TEMP_LAM_CYL_SEL -
C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG)*
(FAC_LAM_CYL_SEL_ADJ[x] -
FAC_LAM_CYL_SEL_ADJ_CST[x])/
(C_TEMP_THD_CYL_SEL_ADJ_
NOM_RNG -
C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG) **(1.4.12)**
endif(5)
endif(4)
if(4) **[**(TEMP_LAM_CYL_SEL $<$ C_TEMP_LAM_CYL_CST_MIN) **or**
(C_TEMP_LAM_CYL_CST_MAX
$<$
TEMP_LAM_CYL_SEL $<$ C_TEMP_
LAM_CYL_MIN)**]**
then
MFF_DELTA_LAM_CYL_SEL_REAC = 0
(1.4.13)
MFF_SP_SAVE_LAM_CYL_SEL = 0
(1.4.14)
FAC_VAL_LAM_CYL_SEL_REAC = 0
(1.4.15)
DELTA_LAMB_CYL_SEL_CQ[i] = 0
(1.4.16)
DELTA_LAMB_CYL_SEL_CQ_FIL[i] = 0
(1.4.17)
LAMB_CYL_SEL_CQ_REF[i] = 0
(1.4.18)
LAMB_CYL_SEL_CQ_DIF_REF[i] = 0
(1.4.19)
CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] = 0
(1.4.20)
CTR_LAMB_CYL_SEL_CQ_STAB[i] = 0
(1.4.21)
LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 0
(1.4.22)
LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0
(1.4.23)
DELTA_LAMB_AV[i] = 0
(1.4.24)
DELTA_LAMB_ERR_RAW[i] = 0
(1.4.25)
DELTA_LAMB_ERR[i] = 0
(1.4.26)

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DELTA_LAMB_ERR_CYL_SEL[x] = 0 **(1.4.27)**

DELTA_LAMB_CYL[x] = 0 **(1.4.28)**

DELTA_LAMB_CYL_SEL[i] = 0 **(1.4.29)**

DELTA_LAMB_MDL[i] = 0 **(1.4.30)**

DELTA_LAMB_DIF_CYL[x] = 0 **(1.4.31)**

FAC_CYL_LAM_INT[x] = 0 **(1.4.32)**

FAC_CYL_LAM_I_MV_SHIFT[x] = 0 **(1.4.33)**

FAC_CYL_LAM[x] = 0 **(1.4.34)**

FAC_CYL_LAM_ABSV_SUM[i] = 0 **(1.4.35)**

FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0 **(1.4.36)**

FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0 **(1.4.37)**

LV_FAC_CYL_LAM_LIM_MIN[x] = 0 **(1.4.38)**

LV_FAC_CYL_LAM_LIM_MAX[x] = 0 **(1.4.39)**

LV_FAC_CYL_LAM_VIRT_LIM[i] = 0 **(1.4.40)**

endif$^{(4)}$

if$^{(4)}$ (LV_FAC_CYL_LAM_VIRT_LIM[i] = 0 **and** LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0 **and** STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 0)

then

if$^{(5)}$ FAC_CYL_LAM_COR[x]$_k$ $>$ FAC_LAM_CYL_SEL_ADJ_INTER[x]

then

FAC_CYL_LAM_COR[x]$_k$ = FAC_CYL_LAM_COR[x]$_{k-1}$ - C_FAC_CYL_LAM_ABSV_DEC **(1.4.41)**

if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $<$ FAC_LAM_CYL_SEL_ADJ_INTER[x]

then

FAC_CYL_LAM_COR[x]$_k$ = FAC_LAM_CYL_SEL_ADJ_INTER[x] **(1.4.42)**

endif$^{(6)}$

else$^{(5)}$

if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $<$ FAC_LAM_CYL_SEL_ADJ_INTER[x]

then

FAC_CYL_LAM_COR[x]$_k$ =

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FAC_CYL_LAM_COR[x]$_{k-1}$
+ C_FAC_CYL_LAM_ABSV_DEC

(1.4.43)

if$^{(7)}$ FAC_CYL_LAM_COR[x]$_k$ $>$
FAC_LAM_CYL_SEL_ADJ_INTER[x]

then

FAC_CYL_LAM_COR[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_INTER[x]

(1.4.44)

endif$^{(7)}$

endif$^{(6)}$

endif$^{(5)}$

else$^{(4)}$

if$^{(5)}$ STATE_LAMB_CYL_SEL_CQ_SLOP[i] 0

then

FAC_CYL_LAM_COR[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_INTER[x]

(1.4.-)

endif$^{(5)}$

endif$^{(4)}$

else$^{(3)}$ *[adaptation under cold condition not released]*

if$^{(4)}$ TEMP_LAM_CYL_SEL $<$ C_TEMP_LAM_CYL_MIN

then

MFF_DELTA_LAM_CYL_SEL_REAC = 0
(1.4.46)

MFF_SP_SAVE_LAM_CYL_SEL = 0
(1.4.47)

FAC_VAL_LAM_CYL_SEL_REAC = 0
(1.4.48)

DELTA_LAMB_CYL_SEL_CQ[i] = 0
(1.4.49)

DELTA_LAMB_CYL_SEL_CQ_FIL[i] = 0
(1.4.50)

LAMB_CYL_SEL_CQ_REF[i] = 0
(1.4.51)

LAMB_CYL_SEL_CQ_DIF_REF[i] = 0
(1.4.52)

CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] = 0
(1.4.53)

CTR_LAMB_CYL_SEL_CQ_STAB[i] = 0
(1.4.54)

LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 0
(1.4.55)

LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0
(1.4.56)

DELTA_LAMB_AV[i] = 0
(1.4.57)

DELTA_LAMB_ERR_RAW[i] = 0
(1.4.58)

DELTA_LAMB_ERR[i] = 0
(1.4.59)

DELTA_LAMB_ERR_CYL_SEL[x] = 0

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(1.4.60)
DELTA_LAMB_CYL[x] = 0
(1.4.61)
DELTA_LAMB_CYL_SEL[i] = 0
(1.4.62)
DELTA_LAMB_MDL[i] = 0
(1.4.63)
DELTA_LAMB_DIF_CYL[x] = 0
(1.4.64)
FAC_CYL_LAM_INT[x] = 0
(1.4.65)
FAC_CYL_LAM_I_MV_SHIFT[x] = 0
(1.4.66)
FAC_CYL_LAM[x] = 0
(1.4.67)
FAC_CYL_LAM_ABSV_SUM[i] = 0
(1.4.68)
FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0
(1.4.69)
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0
(1.4.70)
LV_FAC_CYL_LAM_LIM_MIN[x] = 0
(1.4.71)
LV_FAC_CYL_LAM_LIM_MAX[x] = 0
(1.4.72)
LV_FAC_CYL_LAM_VIRT_LIM[i] = 0
(1.4.73)

endif$^{(4)}$
if$^{(4)}$ (LV_FAC_CYL_LAM_VIRT_LIM[i] = 0 **and** LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0 **and** STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 0)
then
if$^{(5)}$ FAC_CYL_LAM_COR[x]$_k$ $>$ FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]$_k$ = FAC_CYL_LAM_COR[x]$_{k-1}$ - C_FAC_CYL_LAM_ABSV_DEC **(1.4.74)**
if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $<$ FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]$_k$ = FAC_LAM_CYL_SEL_ADJ[x]
(1.4.75)
endif$^{(6)}$
else$^{(5)}$
if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $<$ FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]$_k$ = FAC_CYL_LAM_COR[x]$_{k-1}$ + C_FAC_CYL_LAM_ABSV_DEC **(1.4.76)**

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if$^{(7)}$ FAC_CYL_LAM_COR[x]$_k$ $>$ FAC_LAM_CYL_SEL_ADJ[x]
then
FAC_CYL_LAM_COR[x]$_k$ = FAC_LAM_CYL_SEL_ADJ[x] **(1.4.77)**
endif$^{(7)}$
endif$^{(6)}$
endif$^{(5)}$
else$^{(4)}$
if$^{(5)}$ STATE_LAMB_CYL_SEL_CQ_SLOP[i]   0
then
FAC_CYL_LAM_COR[x]$_k$ = FAC_LAM_CYL_SEL_ADJ[x] **(1.4.78)**
endif$^{(5)}$
endif$^{(4)}$
endif$^{(3)}$
if$^{(3)}$ LV_LAM_CYL_ACT[i] = 1
then
MFF_SP_SAVE_LAM_CYL_SEL = MFF_SP_LAM_CYL_SEL **(1.4.79)**
LV_LAM_CYL_ACT[i] = 0 **(1.4.80)**
endif$^{(3)}$
else$^{(2)}$ *[the function is inhibited by diagnosis]*
if$^{(3)}$ LC_LAM_CYL_SEL_ERR_RST = 1
[adaptation values shall be reset]
then
if$^{(4)}$ FAC_CYL_LAM_COR[x]$_k$ $>$ 0
then
FAC_CYL_LAM_COR[x]$_k$ = FAC_CYL_LAM_COR[x]$_{k-1}$ - C_FAC_CYL_LAM_ABSV_DEC **(1.4.81)**
if$^{(5)}$ FAC_CYL_LAM_COR[x]$_k$ $<$ 0
then
FAC_CYL_LAM_COR[x]$_k$ = 0 **(1.4.82)**
endif$^{(5)}$
else$^{(4)}$
if$^{(5)}$ FAC_CYL_LAM_COR[x]$_k$ $<$ 0
then
FAC_CYL_LAM_COR[x]$_k$ = FAC_CYL_LAM_COR[x]$_{k-1}$ + C_FAC_CYL_LAM_ABSV_DEC **(1.4.83)**
if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $>$ 0
then
FAC_CYL_LAM_COR[x]$_k$ = 0 **(1.4.84)**
endif$^{(6)}$
endif$^{(5)}$
endif$^{(4)}$
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{LDC}$ = 0 **(1.4.85)**
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{LDC}$ = 0 **(1.4.86)**

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FAC_LAM_CYL_SEL_ADJ_CST[x]$_{LDC}$ = 0 **(1.4.87)**

MFF_ADD_CYL_LAM_COR[x]$_{LDC}$ = 0 **(1.4.88)**

LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i]$_{LDC}$ = 0 **(1.4.89)**

LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i]$_{LDC}$ = 0 **(1.4.90)**

FAC_LAM_CYL_SEL_ADJ[x] = 0 **(1.4.91)**

FAC_LAM_CYL_SEL_ADJ_L_RNG[x] = 0 **(1.4.92)**

FAC_LAM_CYL_SEL_ADJ_H_RNG[x] = 0 **(1.4.93)**

FAC_LAM_CYL_SEL_ADJ_CST[x] = 0 **(1.4.94)**

MFF_ADD_CYL_LAM_COR[x] = 0 **(1.4.95)**

LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i] = 0 **(1.4.96)**

LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] = 0 **(1.4.97)**

else$^{(3)}$ *[adaptation values shall be kept]*

if$^{(4)}$ MFF_SP[i]   C_MFF_SP_THD_CYL_SEL_ADJ_L_RNG

then

FAC_LAM_CYL_SEL_ADJ[x] =

FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{LDC}$**(1.4.98)**

else$^{(4)}$

if$^{(5)}$ MFF_SP[i]   C_MFF_SP_THD_CYL_SEL_ADJ_H_RNG

then

FAC_LAM_CYL_SEL_ADJ[x] =

FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{LDC}$**(1.4.99**

else$^{(5)}$

FAC_LAM_CYL_SEL_ADJ[x] =

FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{LDC}$

+

(MFF_SP[i] - C_MFF_SP_THD_

CYL_SEL_ADJ_L_RNG)*

(FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{LDC}$

-

FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{LDC}$)/

(C_MFF_SP_THD_CYL_SEL_ADJ_

H_RNG -

C_MFF_SP_THD_CYL_SEL_ADJ_

L_RNG) **(1.4.100)**

endif$^{(5)}$

endif$^{(4)}$

if$^{(4)}$ LC_FAC_LAM_CYL_SEL_ADJ_CST_ENA = 1

[adaptation under cold condition released]

then

if$^{(5)}$ TEMP_LAM_CYL_SEL

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C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG
then
FAC_LAM_CYL_SEL_ADJ_INTER[x] =
FAC_LAM_CYL_SEL_ADJ_CST[x]$_{LDC}$
(1.4.101)
else$^{(5)}$
if$^{(6)}$ TEMP_LAM_CYL_SEL
C_TEMP_THD_CYL_SEL_ADJ_NOM_
RNG
then
FAC_LAM_CYL_SEL_ADJ_INTER[x] =
FAC_LAM_CYL_SEL_ADJ[x]
(1.4.102)
else$^{(6)}$
FAC_LAM_CYL_SEL_ADJ_INTER[x] =
FAC_LAM_CYL_SEL_ADJ_CST[x]$_{LDC}$
+
(TEMP_LAM_CYL_SEL -
C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG)*
(FAC_LAM_CYL_SEL_ADJ[x] -
FAC_LAM_CYL_SEL_ADJ_CST[x]$_{LDC}$)/
(C_TEMP_THD_CYL_SEL_ADJ_
NOM_RNG -
C_TEMP_THD_CYL_SEL_ADJ_COLD_
RNG) **(1.4.103)**
endif$^{(6)}$
endif$^{(5)}$
if$^{(5)}$ FAC_CYL_LAM_COR[x]$_k$ $>$
FAC_LAM_CYL_SEL_ADJ_INTER[x]
then
FAC_CYL_LAM_COR[x]$_k$ = FAC_CYL_LAM_COR[x]$_{k-1}$
- C_FAC_CYL_LAM_ABSV_DEC
(1.4.104)
if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $<$
FAC_LAM_CYL_SEL_ADJ_INTER[x]
then
FAC_CYL_LAM_COR[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_INTER[x]
(1.4.105)
endif$^{(6)}$
else$^{(5)}$
if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $<$
FAC_LAM_CYL_SEL_ADJ_INTER[x]
then
FAC_CYL_LAM_COR[x]$_k$ =
FAC_CYL_LAM_COR[x]$_{k-1}$ +
C_FAC_CYL_LAM_ABSV_DEC **(1.4.106)**
if$^{(7)}$ FAC_CYL_LAM_COR[x]$_k$ $>$
FAC_LAM_CYL_SEL_ADJ_INTER[x]
then

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FAC_CYL_LAM_COR[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_INTER[x]
(1.4.107)

endif$^{(7)}$

endif$^{(6)}$

endif$^{(5)}$

else$^{(4)}$ *[adaptation under cold condition not released]*

if$^{(5)}$ FAC_CYL_LAM_COR[x]$_k$ $>$ FAC_LAM_CYL_SEL_ADJ[x]

then

FAC_CYL_LAM_COR[x]$_k$ = FAC_CYL_LAM_COR[x]$_{k-1}$ -
C_FAC_CYL_LAM_ABSV_DEC **(1.4.108)**

if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $<$
FAC_LAM_CYL_SEL_ADJ[x]

then

FAC_CYL_LAM_COR[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ[x]**(1.4.109)**

endif$^{(6)}$

else$^{(5)}$

if$^{(6)}$ FAC_CYL_LAM_COR[x]$_k$ $<$
FAC_LAM_CYL_SEL_ADJ[x]

then

FAC_CYL_LAM_COR[x]$_k$ =
FAC_CYL_LAM_COR[x]$_{k-1}$ +
C_FAC_CYL_LAM_ABSV_DEC **(1.4.110)**

if$^{(7)}$ FAC_CYL_LAM_COR[x]$_k$ $>$
FAC_LAM_CYL_SEL_ADJ[x]

then

FAC_CYL_LAM_COR[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ[x]**(1.4.111)**

endif$^{(7)}$

endif$^{(6)}$

endif$^{(5)}$

endif$^{(4)}$

endif$^{(3)}$

LV_LAM_CYL_ACT[i] = 0 **(1.4.112)**

DELTA_LAMB_CYL_SEL_CQ[i] = 0 **(1.4.113)**

DELTA_LAMB_CYL_SEL_CQ_FIL[i] = 0 **(1.4.114)**

LAMB_CYL_SEL_CQ_REF[i] = 0 **(1.4.115)**

LAMB_CYL_SEL_CQ_DIF_REF[i] = 0 **(1.4.116)**

CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] = 0 **(1.4.117)**

CTR_LAMB_CYL_SEL_CQ_STAB[i] = 0 **(1.4.118)**

LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 0 **(1.4.119)**

LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0 **(1.4.120)**

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DELTA_LAMB_AV[i] = 0 (1.4.121)

DELTA_LAMB_ERR_RAW[i] = 0 (1.4.122)

DELTA_LAMB_ERR[i] = 0 (1.4.123)

DELTA_LAMB_ERR_CYL_SEL[x] = 0 (1.4.124)

DELTA_LAMB_CYL[x] = 0 (1.4.125)

DELTA_LAMB_CYL_SEL[i] = 0 (1.4.126)

DELTA_LAMB_MDL[i] = 0 (1.4.127)

DELTA_LAMB_DIF_CYL[x] = 0 (1.4.128)

FAC_CYL_LAM_INT[x] = 0 (1.4.129)

FAC_CYL_LAM_I_MV_SHIFT[x] = 0 (1.4.130)

FAC_CYL_LAM[x] = 0 (1.4.131)

FAC_CYL_LAM_ABSV_SUM[i] = 0 (1.4.132)

FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0 (1.4.133)

FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0 (1.4.134)

LV_FAC_CYL_LAM_LIM_MIN[x] = 0 (1.4.135)

LV_FAC_CYL_LAM_LIM_MAX[x] = 0 (1.4.136)

LV_FAC_CYL_LAM_VIRT_LIM[i] = 0 (1.4.& %■)

endif$^{(2)}$

STATE_LAM_CYL_SEL[i] = 0 [PAS] (1.4.138)

STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS] (1.4.139)

LV_LAM_CYL_SEL_SEG_REF_CLL[i] = 0 (1.4.140)

FAC_CYL_LAM_P[x] = 0 (1.4.141)

FAC_CYL_LAM_P_MV_SHIFT[x] = 0 (1.4.142)

CTR_T_LAM_CYL_ADJ[i] = 0 (1.4.143)

CTR_LAM_CYL_SEL_REF_CLL[i] = 0 (1.4.144)

LV_LAM_CYL_SEL_ADJ_VLD[i] = 0 (1.4.1-)

endif$^{(1)}$

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Formula section:

7.73.6 Signal evaluation (segment synchronous)

The aim of signal evaluation with a low sampling rate is the precise dividing of the lambda sensor output signal into the identified cylinder. Therefore, the sampling moment shall be computed, depending on the engine operating state, precisely. The Sampling moment is influenced by phase displacement predetermined by IP_CRK_SYN[i]. The value of the phase shift is given in CRK.

7.73.6.1 Calculation of the segment period

Depending on the engine speed the segment period is simply computed by

if$^{(1)}$ two separate exhaust banks are concerned, **then**

$$TA = 2 * \frac{2 * 60}{N * NC\_CYL\_NR}$$

(1.5.1.1)

else$^{(1)}$

$$TA = \frac{2 * 60}{N * NC\_CYL\_NR}$$

(1.5.1.2)

endif$^{(1)}$

7.73.6.2 Calculation of the phase displacement

The phase shift - caused by system delayed response - is computed once per combustion cycle using the map IP_CRK_SYN[i], adjusted by C_CRK_CYL_LAM[x], PHA_SHIFT_CAM_EX[i] and DELTA_CRK_CYL_LAM[i]. It shall be determined at the beginning of the combustion cycle (SEG_NR = 0). That applies to the first and ensuing segments.

if$^{(1)}$ SEG_NR = 0
then
CRK_CYL_LAM[x] = IP_CRK_SYN[i] + C_CRK_CYL_LAM[x] +
PHA_SHIFT_CAM_EX[i] + DELTA_
CRK_CYL_LAM[i] +
IP_CRK_DELTA_AMP_CYL_LAM
(1.5.2.1)

if$^{(2)}$ CRK_CYL_LAM[x] > *720 °CRK
then
CRK_CYL_LAM[x] = CRK_CYL_LAM[x] - *720 °CRK
(1.5.2.2)
endif$^{(2)}$
endif$^{(1)}$
Remark:
= 1, 2, ...

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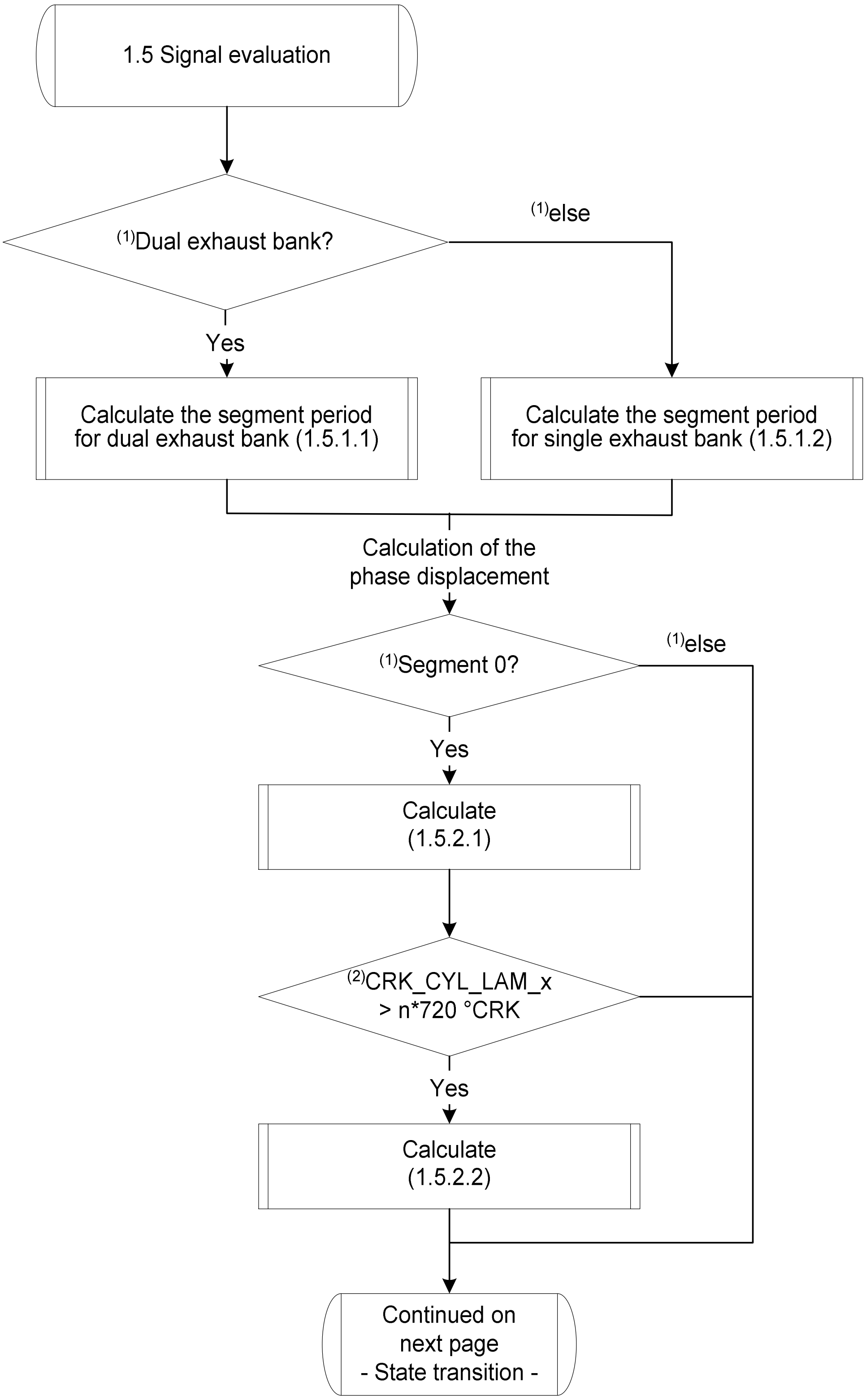

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7.73.6.3 State - Transition

In case of first activation or even reactivation the calculations in chapter 1.9 may be carried out on condition that at least one combustion cycle has been completed and the function is not in open loop mode.

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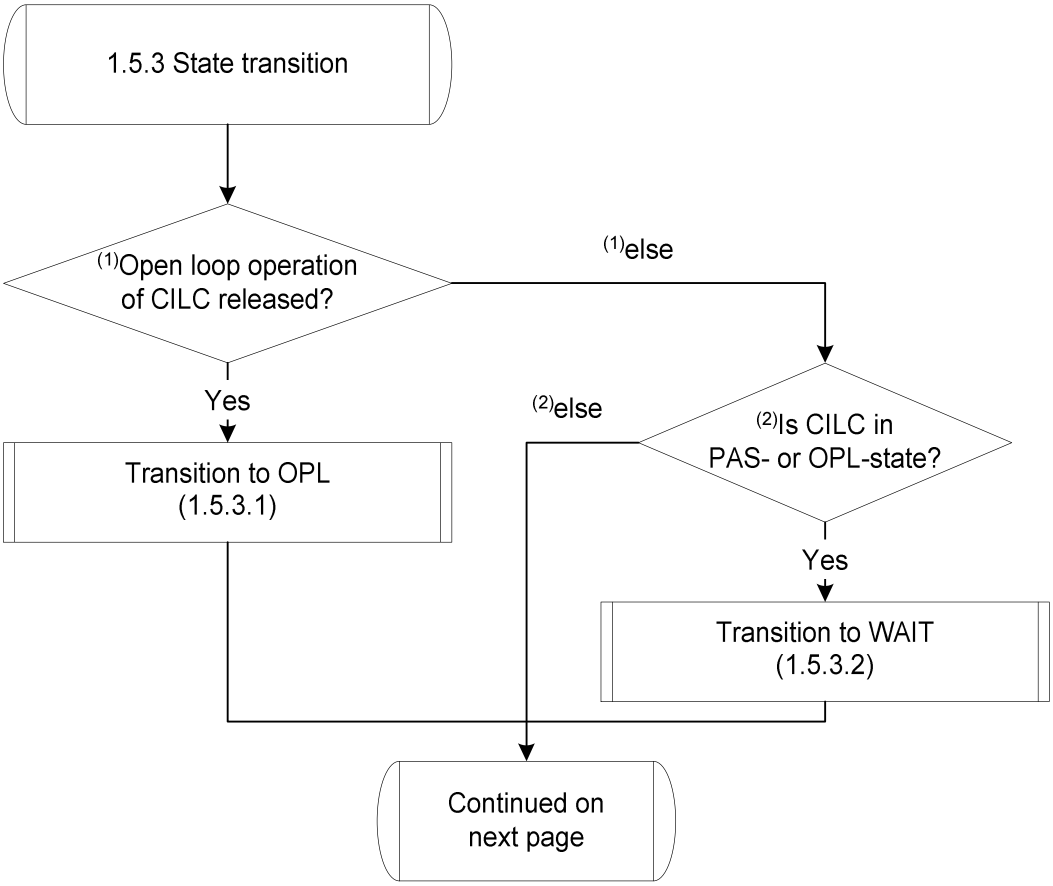

if[1] LC_LAM_CYL_SEL_OPL = 1
then
STATE_LAM_CYL_SEL[i] = 1 [OPL]
(1.5.3.1)
else[1]
if[2] (STATE_LAM_CYL_SEL[i] = 0 [PAS] **or** STATE_LAM_CYL_SEL[i] = 1 [OPL])
then
STATE_LAM_CYL_SEL[i] = 2 [WAIT]
(1.5.3.2)
endif[2]
endif[1]

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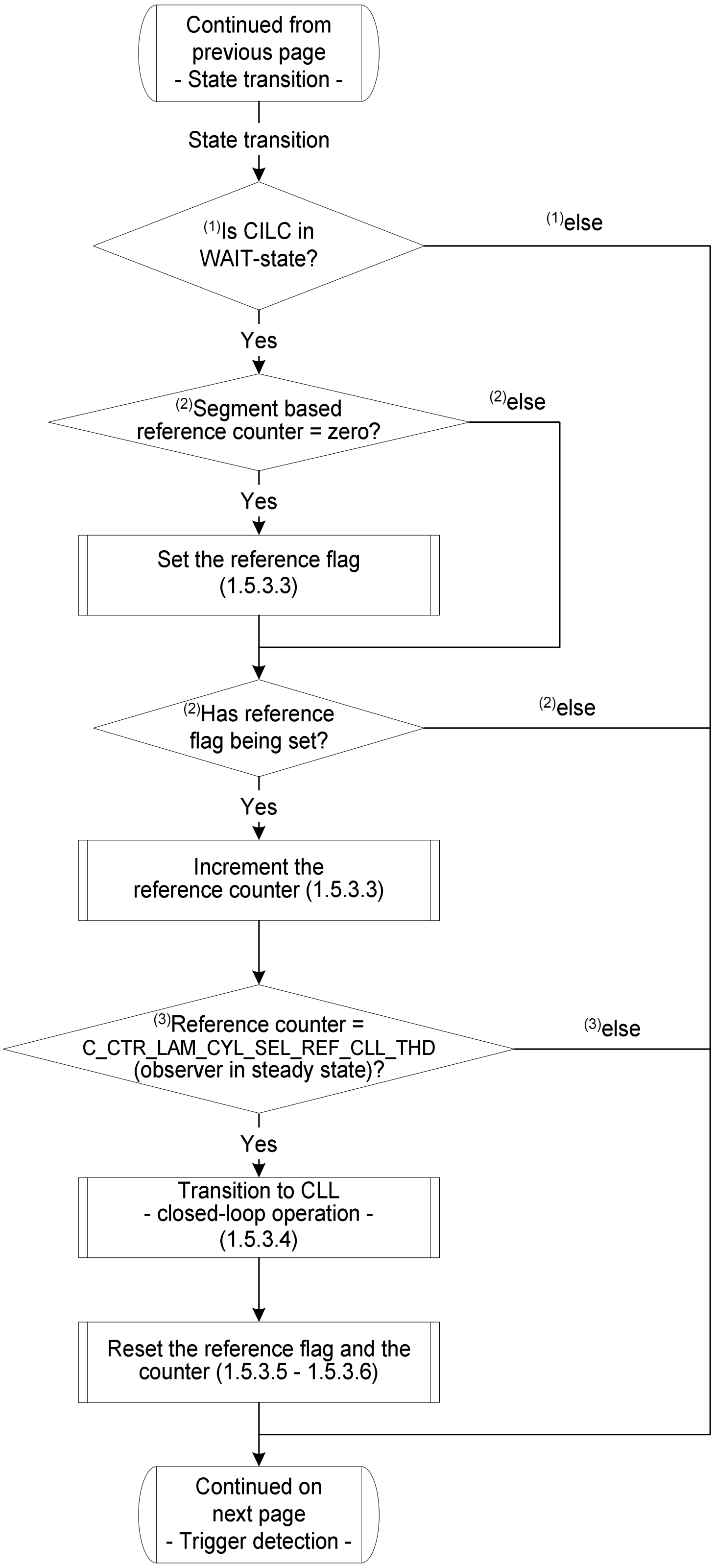

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if(1) STATE_LAM_CYL_SEL[i] = 2 [WAIT]

then

if(2) CTR_LAM_CYL_SEL_REF_CLL[i] = 0

then

LV_LAM_CYL_SEL_SEG_REF_CLL[i] = 1

(1.5.3.3)

endif$^{(2)}$
if$^{(2)}$ LV_LAM_CYL_SEL_SEG_REF_CLL[i] = 1
then
increment(CTR_LAM_CYL_SEL_REF_CLL[i])
if$^{(3)}$ CTR_LAM_CYL_SEL_REF_CLL[i] = C_CTR_LAM_CYL_SEL_REF_CLL_THD
then
STATE_LAM_CYL_SEL[i] = 3 [CLL]

(1.5.3.4)

LV_LAM_CYL_SEL_SEG_REF_CLL[i] = 0

(1.5.3.5)

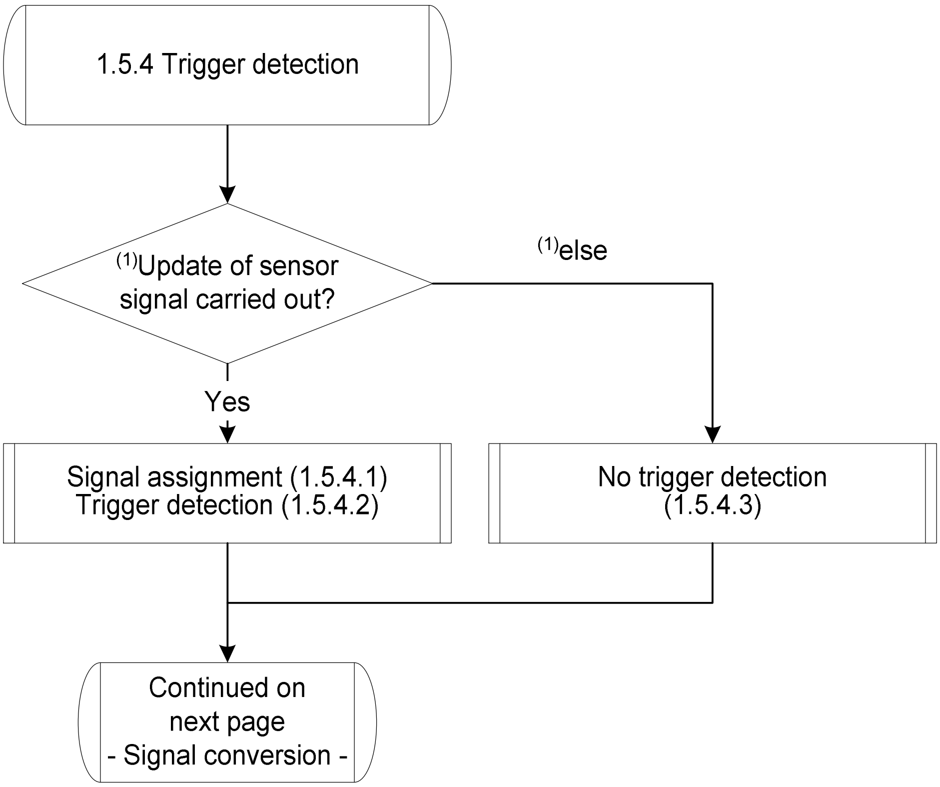
CTR_LAM_CYL_SEL_REF_CLL[i] = 0

(1.5.3.6)

endif$^{(3)}$
endif$^{(2)}$
endif$^{(1)}$

7.73.6.4 Trigger detection

The trigger for the corresponding segment is created if the state of the variable VLS_CYL_TRIG[x] changes. At the same time the value of VLS_CYL[x] shall be transferred to VLS_CYL_SEL[x].



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if$^{(1)}$ VLS_CYL_TRIG[x] VLS_CYL_TRIG[x]$_{k-1}$
then
VLS_CYL_SEL[x] = VLS_CYL[x]

(1.5.4.1)

LV_TRIG[x] = 1

(1.5.4.2)

else(1)

LV_TRIG[x] = 0

(1.5.4.3)

endif(1)

7.73.7 Signal conversion

The voltage value of VLS_CYL_SEL[x] shall be converted to Lambda using the characteristic curve IP_LAMB_CYL$_x$ and has to be shifted by its mean value. The resulting value represents the global AFR deviation. Calculation and shifting the mean value shall be carried out in segment step.

if(1) LV_TRIG[x] =1

then

LAMB_CYL_SEL[x]= IP_LAMB_CYL (VLS_CYL_SEL[x])

(1.6.1)

$$\text{DELTA\_LAMB\_AV[i]} = \text{LAMB\_CYL\_SEL[x]} - \frac{1}{\alpha}\sum_{k=1}^{\alpha}\text{LAMB\_CYL\_SEL[x]};$$

α :number of cylinders per bank

(1.6.2)

7.73.8 Calculation of time lag of the lambda-sensor model

T1_LAMB_CYL_SEL[i] = IP_T1_LAMB_CYL_SEL[i]

(1.7.1)

7.73.9 Calculation of the estimation-error

Estimation error represents the difference between the measured value, DELTA_LAMB_AV[i], and the estimated value, DELTA_LAMB_MDL[i].

DELTA_LAMB_ERR_RAW[i] = DELTA_LAMB_AV[i] -
DELTA_LAMB_MDL[i][x(n-1)] **(1.8.1)**

Remark: Software shall guarantee a segment synchronous comparison, i.e. the value of DELTA_LAMB_AV[i] at the segment-time x shall be compared with that DELTA_LAMB_MDL[i] which was calculated in segment x during the last combustion cycle [x(n-1)].

7.73.10 Weighting the estimation-error

Depending on T1_LAMB_CYL_SEL[i], the error shall be weighted. This is carried out by means of a characteristic curve. A non-linear dependent weighting function might be considered for late come out.

DELTA_LAMB_ERR[i] = DELTA_LAMB_ERR_RAW[i] * IP_FAC_ERR_LAM_SEL

(1.9.1)

7.73.11 Signal splitting /Calculation of the cylinder selective AFR /Signal merge

Splitting procedure shall be implemented in order the weighted error signal to be allocated to an internal state, which describes the current estimated value of air -/fuel ratio in each cylinder respectively (Figure 2).

DELTA_LAMB_ERR_CYL_SEL[x] = DELTA_LAMB_ERR[i]

(1.10.1)

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An adaptation mechanism, including an integral-action element for each cylinder - corrected by exhaust-manifold-port factor C_CRLC_EXV_FAC[x], adjusts the estimated value to the actual one. The adjusted value of the cylinder individual deviation is calculated by the equation

DELTA_LAMB_CYL[x]$_k$ = (DELTA_LAMB_CYL[x]$_{k-1}$ + DELTA_LAMB_ERR_CYL_SEL[x]$_k$*TA)* C_CRLC_EXV_FAC[x] **(1.10.2)**

In order to avoid rounding error that leads to zero-readout of the gradient term in aforementioned equation, following scan shall be made:

if$^{(2)}$ (DELTA_LAMB_ERR_CYL_SEL[x]$_k$*TA = 0 **and** DELTA_LAMB_ERR_CYL_SEL[x]$_k$ $>$ 0)

then

increment(DELTA_LAMB_ERR_CYL_SEL[x]$_k$*TA) **(1.10.3)**

else$^{(2)}$

if$^{(3)}$(DELTA_LAMB_ERR_CYL_SEL[x]$_k$*TA = 0 **and** DELTA_LAMB_ERR_CYL_SEL[x]$_k$$<$ 0)

then

decrement (DELTA_LAMB_ERR_CYL_SEL[x]$_k$*TA) **(1.10.4)**

endif$^{(3)}$

endif$^{(2)}$

In accordance with the ignition sequence signal-reassembling procedure shall be carried out in order to get the divided signals together. DELTA_LAMB_CYL_SEL[i] is input of the sensor model for the current segment.

DELTA_LAMB_CYL_SEL[i]$_k$ = DELTA_LAMB_CYL[x]$_k$ **(1.10.5)**

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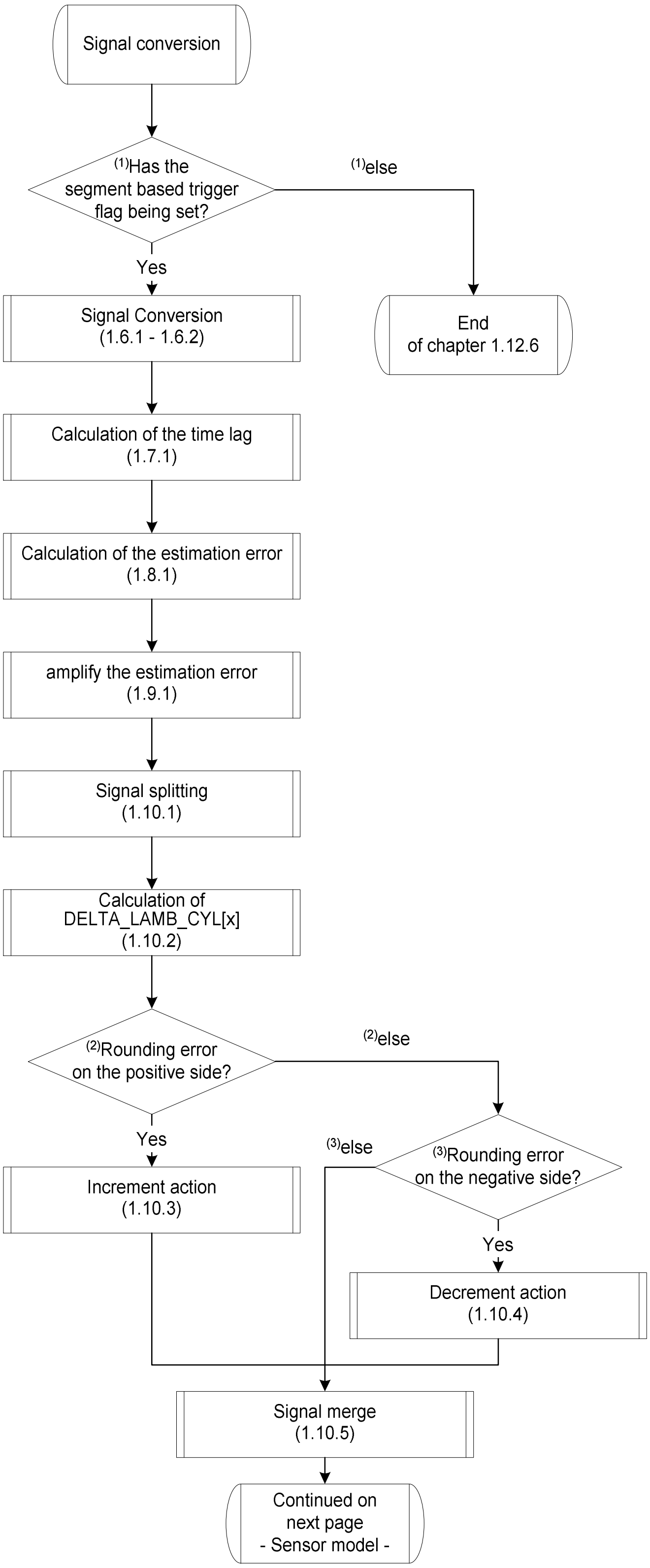

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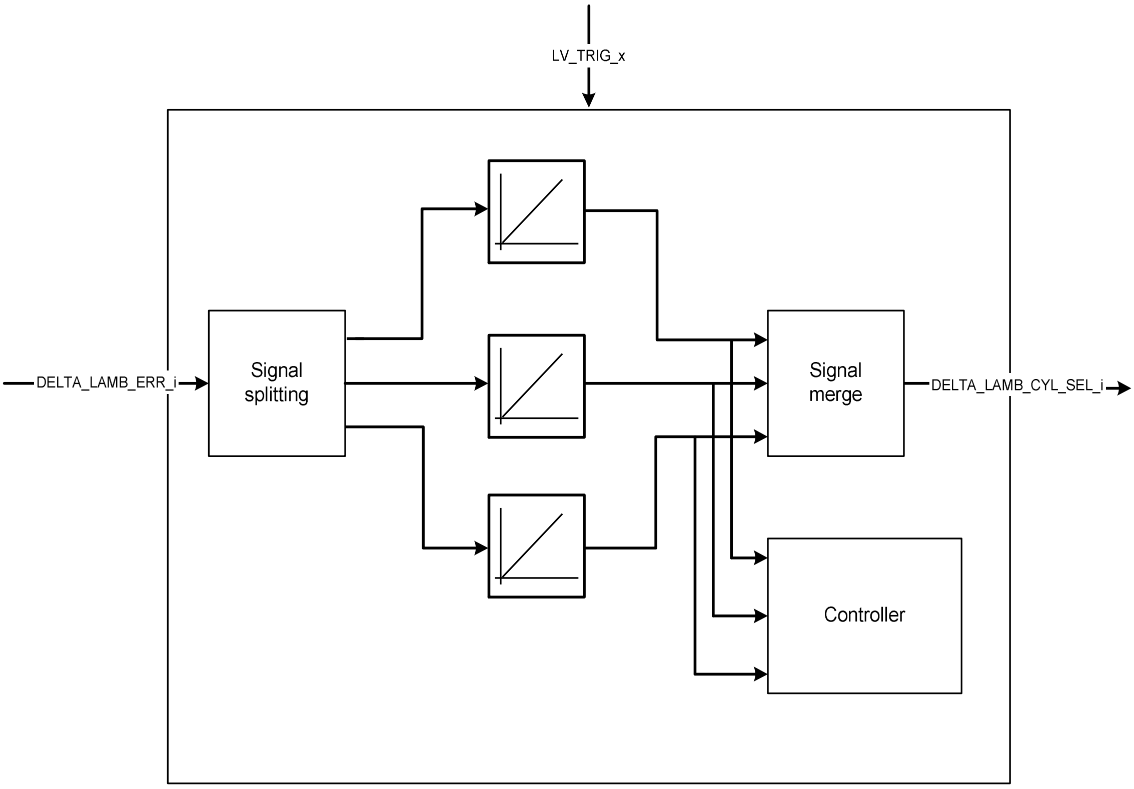

Figure 7.73.9: : Signal splitting, adjustment and signal merge

7.73.12 Sensor model

The dynamic behaviour of WRAF sensor is described by a sensor model, first order low-pass-filter. This is characterised by a time lag, T1_LAMB_CYL_SEL[i]. Furthermore, the effect of the delay is considered by choice of an adequate sampling time relevant to crankshaft angle. This is depicted in 0 ... 720 CRK range.
The approximated model is theoretically defined in time range as

$$y(t) = 1 - e^{-t/T}$$

and described in frequency range as continuous-time model

$$G(s) = \frac{1}{1 + sT}$$

with T = T1_LAMB_CYL_SEL[i]

Conversion of continuous-time model to discrete-time model with sample time TA can be made using either ’zoh’- or ’foh’-method.

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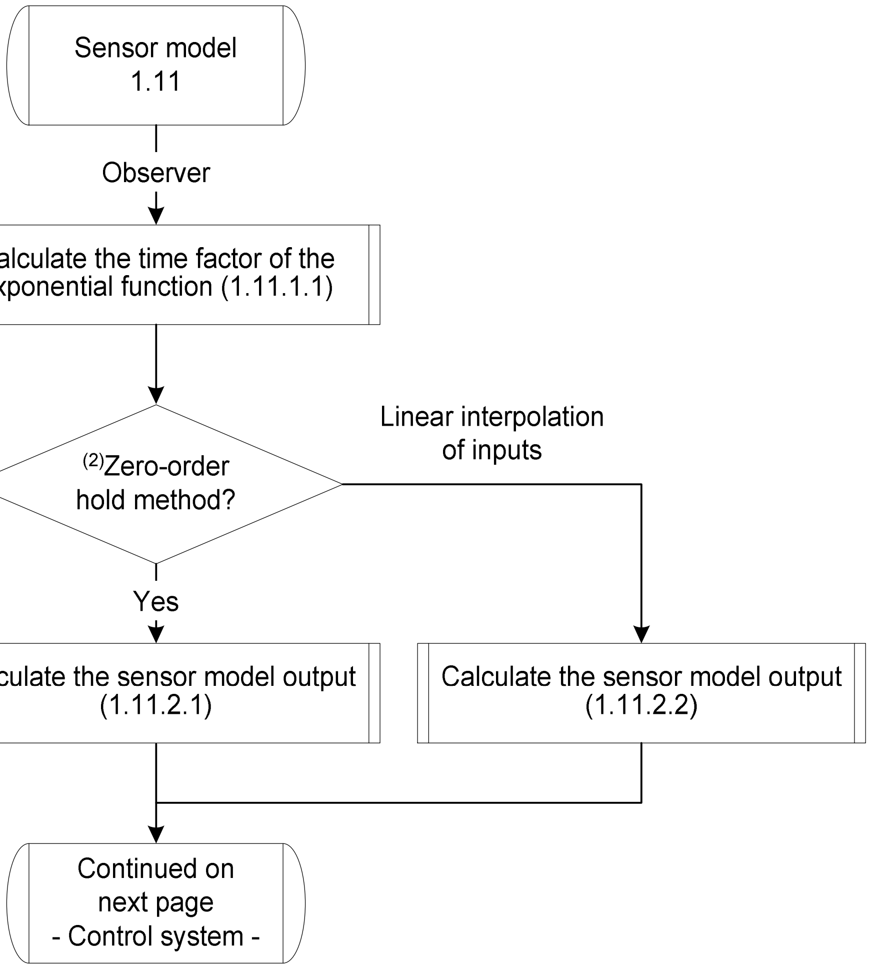

7.73.12.1 Calculation of model parameters

$$FAC\_T[i] = \frac{T1\_LAMB\_CYL\_SEL[i]}{TA}$$

(1.11.1.1)

- Zero-order hold on the inputs ’zoh’ - recommended method

(LC_LAMB_DELTA_MDL_HLD = 0)

calibration maps are

$$IP\_EXP\_LAMB\_MDL[i] = e^{-\frac{1}{FAC\_T[i]}},$$

IP_N1_FAC_LAMB_MDL[i] = 1 - IP_EXP_LAMB_MDL[i] and
IP_N2_FAC_LAMB_MDL[i] = 0

- Linear interpolation of inputs ’foh’ (LC_LAMB_DELTA_MDL_HLD = 1)

calibration maps are

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$$IP\_EXP\_LAMB\_MDL[i] = e^{-\frac{1}{FAC\_T[i]}},$$

IP_N1_FAC_LAMB_MDL[i] = 1 - FAC_T[i]$_*$ (1 - IP_EXP_LAMB_MDL[i]) and
IP_N2_FAC_LAMB_MDL[i] = FAC_T[i] - (1 + FAC_T[i])$_*$ IP_EXP_LAMB_MDL[i]

7.73.12.2 Calculation of the sensor model output

The output of sensor model is governed by DELTA_LAMB_MDL[i].

if$^{(2)}$LC_LAMB_DELTA_MDL_HLD = 0
then
DELTA_LAMB_MDL[i]$_k$ = IP_EXP_LAMB_MDL[i]*DELTA_LAMB_MDL[i]$_{k-1}$ + IP_N1_FAC_LAMB_MDL[i]*DELTA_LAMB_CYL_SEL[i]$_k$
(1.11.2.1)
else$^{(2)}$
DELTA_LAMB_MDL[i]$_k$ = IP_EXP_LAMB_MDL[i]*DELTA_LAMB_MDL[i]$_{k-1}$ + IP_N1_FAC_LAMB_MDL[i]*DELTA_LAMB_CYL_SEL[i]$_k$ + IP_N2_FAC_LAMB_MDL[i]*DELTA_LAMB_CYL_SEL[i]$_{k-1}$
(1.11.2.2)
endif$^{(2)}$

Attention:

Precise allocation required. For segment x, DELTA_LAMB_MDL[i]$_{k-1}$ and DELTA_LAMB_CYL_SEL[i]$_{k-1}$ are buffered variables that were calculated in the segment x -1 for one bank system and x - 2 for two bank system.

7.73.13 Control system

A cylinder individual AFR regulation is carried out (Figure 3).

7.73.13.1 Control deviation

The tracking error for corresponding cylinder is defined as DELTA_LAMB_DIF_CYL[x].

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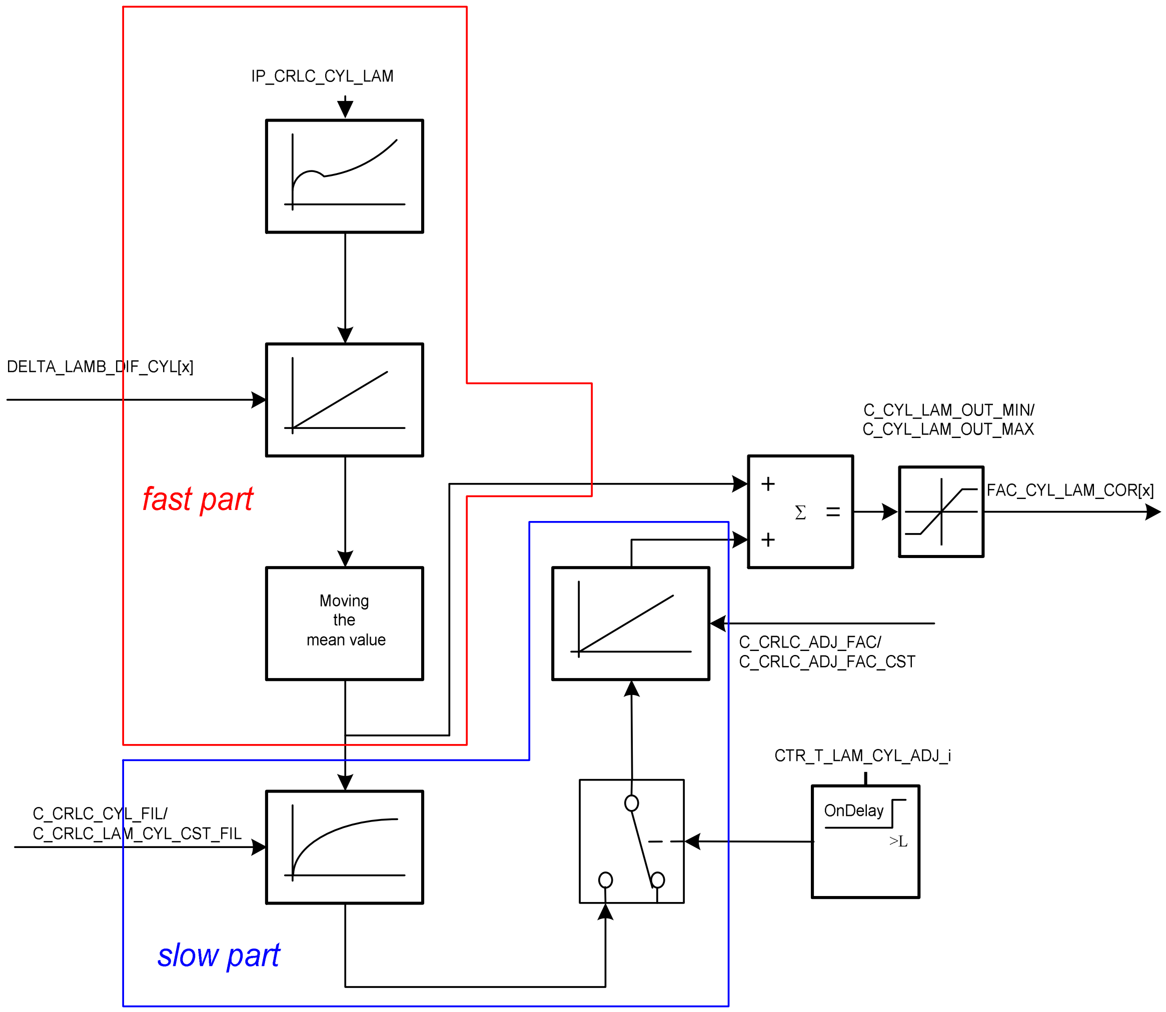

Figure 7.73.10: : Control system including the adaptation mechanism

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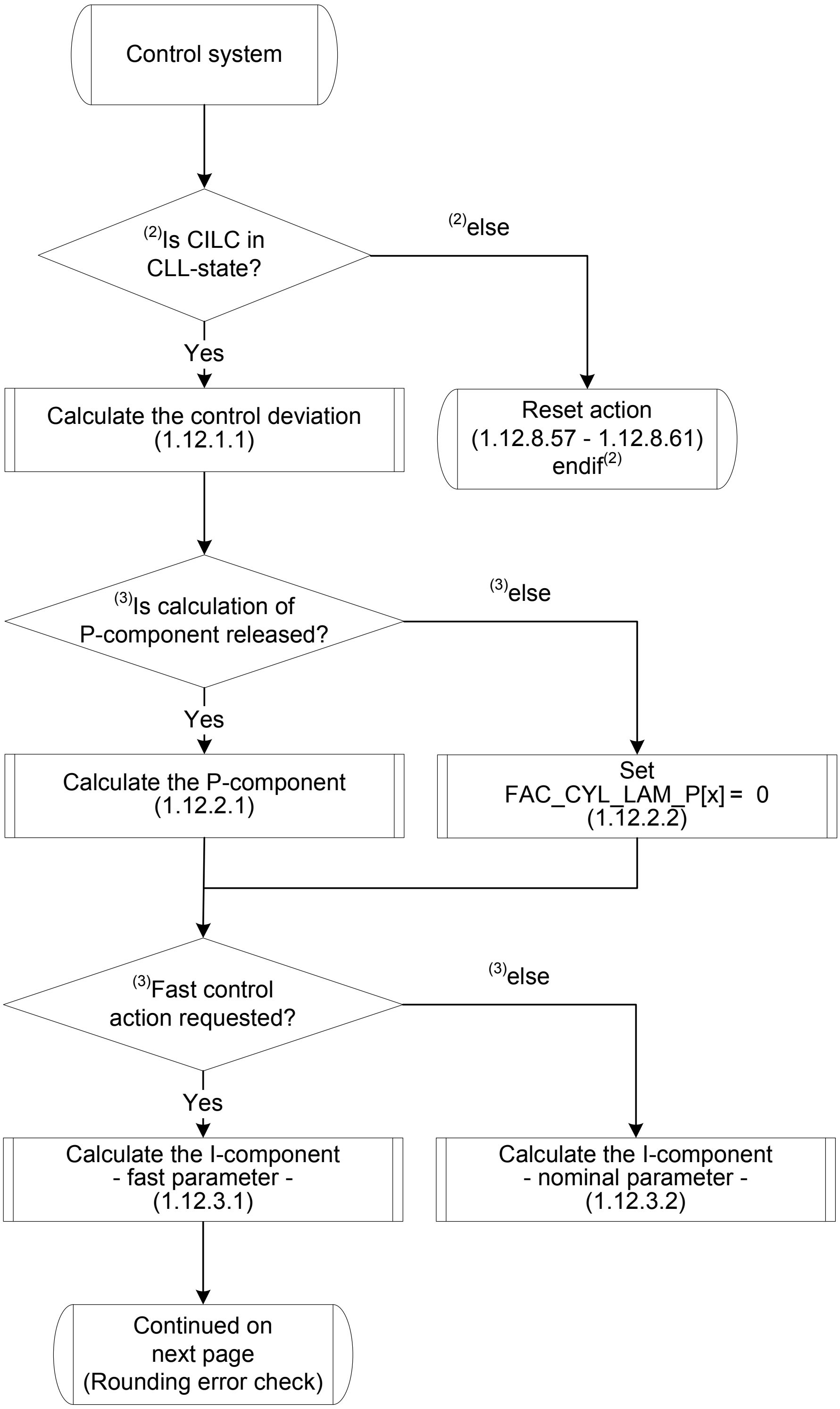

if[2] STATE_LAM_CYL_SEL[i] = 3 [CLL]

then

DELTA_LAMB_DIF_CYL[x] = DELTA_LAMB_CYL[x]
- C_DELTA_LAMB_CYL_SP **(1.12.1.1)**

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7.73.13.2 Calculation of proportional-action controller (P-Component)

The P-Component can be switched off using an on-off switch

if$^{(3)}$ LC_FAC_CYL_LAM_P_SWI = 1
then
FAC_CYL_LAM_P[x]= IP_FAC_GAIN_P_LAM_CYL_SEL* DELTA_LAMB_DIF_CYL[x]*IP_CRLC_P_NEUT_RNG **(1.12.2.1)**
else$^{(3)}$
FAC_CYL_LAM_P[x]= 0 **(1.12.2.2)**
endif$^{(3)}$

7.73.13.3 Calculation of integral-action controller (I-Component)

Tracking step disturbances with zero steady state error requires integration of the tracking error. Integral action can be incorporated by defining an internal state FAC_CYL_LAM_INT[x] that represents the integrated tracking error. This state is governed by FAC_CYL_LAM_INT[x]. For the injection systems being not adapted the integral action can be switched to the fast control parameter. The action is then triggered by LV_LAM_CYL_SEL_CTL_FAST_REQ.

if$^{(3)}$ LV_LAM_CYL_SEL_CTL_FAST_REQ = 1
then
FAC_CYL_LAM_INT[x]$_k$= FAC_CYL_LAM_INT[x]$_{k-1}$ + IP_CRLC_INT_FAST_CYL_LAM*DELTA_LAMB_DIF_CYL[x]$_k$* IP_CRLC_I_NEUT_RNG **(1.12.3.1)**
else$^{(3)}$
FAC_CYL_LAM_INT[x]$_k$= FAC_CYL_LAM_INT[x]$_{k-1}$ + IP_CRLC_CYL_LAM*DELTA_LAMB_DIF_CYL[x]$_k$* IP_CRLC_I_NEUT_RNG **(1.12.3.2)**
endif$^{(3)}$

In order to avoid rounding error that leads to zero-readout of the gradient term in aforementioned equation, following scan shall be made:

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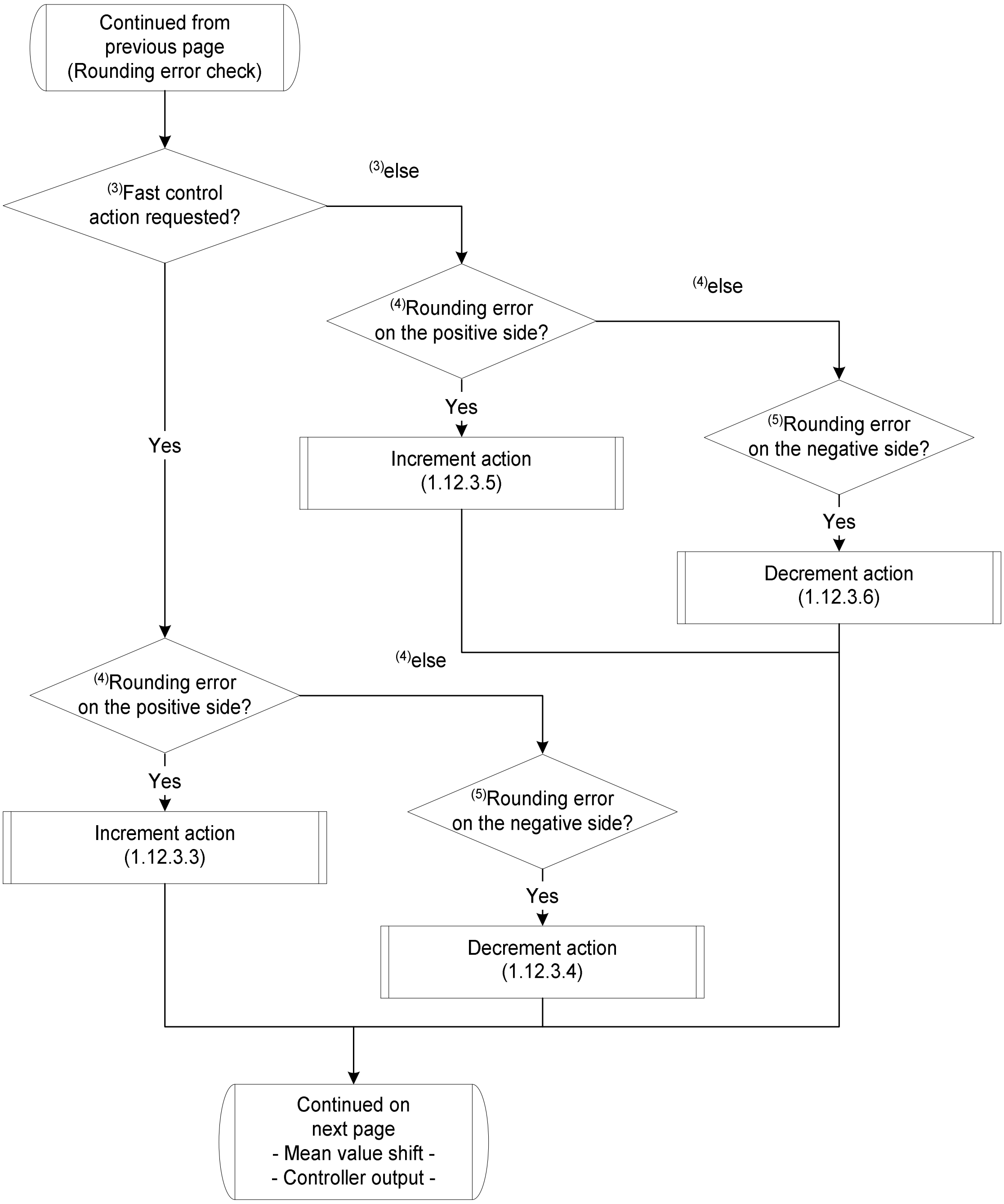

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if$^{(3)}$ LV_LAM_CYL_SEL_CTL_FAST_REQ = 1

then

if$^{(4)}$ (IP_CRLC_INT_FAST_CYL_LAM*DELTA_LAMB_DIF_CYL[x]$_k$*
IP_CRLC_I_NEUT_RNG = 0 **and**
IP_CRLC_INT_FAST_CYL_LAM $>$
0 **and**
IP_CRLC_I_NEUT_RNG $>$ 0 **and**
DELTA_LAMB_DIF_CYL[x]$_k$ $>$ 0)

then

increment (IP_CRLC_INT_FAST_CYL_LAM*
DELTA_LAMB_DIF_CYL[x]$_k$*
IP_CRLC_I_NEUT_RNG) **(1.12.3.3)**

else$^{(4)}$
if$^{(5)}$ (IP_CRLC_INT_FAST_CYL_LAM*
DELTA_LAMB_DIF_CYL[x]$_k$*
IP_CRLC_I_NEUT_RNG = 0 **and**
IP_CRLC_INT_FAST_CYL_LAM $>$ 0 **and**
IP_CRLC_I_NEUT_RNG $>$ 0 **and**
DELTA_LAMB_DIF_CYL[x]$_k$ $<$ 0)
then
decrement (IP_CRLC_INT_FAST_CYL_LAM*
DELTA_LAMB_DIF_CYL[x]$_k$*
IP_CRLC_I_NEUT_RNG) **(1.12.3.4)**
endif$^{(5)}$
endif$^{(4)}$
else$^{(3)}$
if$^{(4)}$ (IP_CRLC_CYL_LAM*DELTA_LAMB_DIF_CYL[x]$_k$*
IP_CRLC_I_NEUT_RNG = 0 **and**
IP_CRLC_CYL_LAM $>$ 0 **and**
IP_CRLC_I_NEUT_RNG $>$ 0 **and**
DELTA_LAMB_DIF_CYL[x]$_k$ $>$ 0)
then
increment (IP_CRLC_CYL_LAM*DELTA_LAMB_DIF_CYL[x]$_k$*
IP_CRLC_I_NEUT_RNG) **(1.12.3.5)**
else$^{(4)}$
if$^{(5)}$ (IP_CRLC_CYL_LAM*DELTA_LAMB_DIF_CYL[x]$_k$*
IP_CRLC_I_NEUT_RNG = 0 **and**
IP_CRLC_CYL_LAM $>$ 0 **and**
IP_CRLC_I_NEUT_RNG $>$ 0 **and**
DELTA_LAMB_DIF_CYL[x]$_k$ $<$ 0)
then
decrement (IP_CRLC_CYL_LAM*
DELTA_LAMB_DIF_CYL[x]$_k$*
IP_CRLC_I_NEUT_RNG) **(1.12.3.6)**
endif$^{(5)}$
endif$^{(4)}$
endif$^{(3)}$

7.73.13.4 Mean value shift

In order to avoid that the output of the cylinder individual control system affects the main controller for mean - control, it shall be shifted by its mean value.

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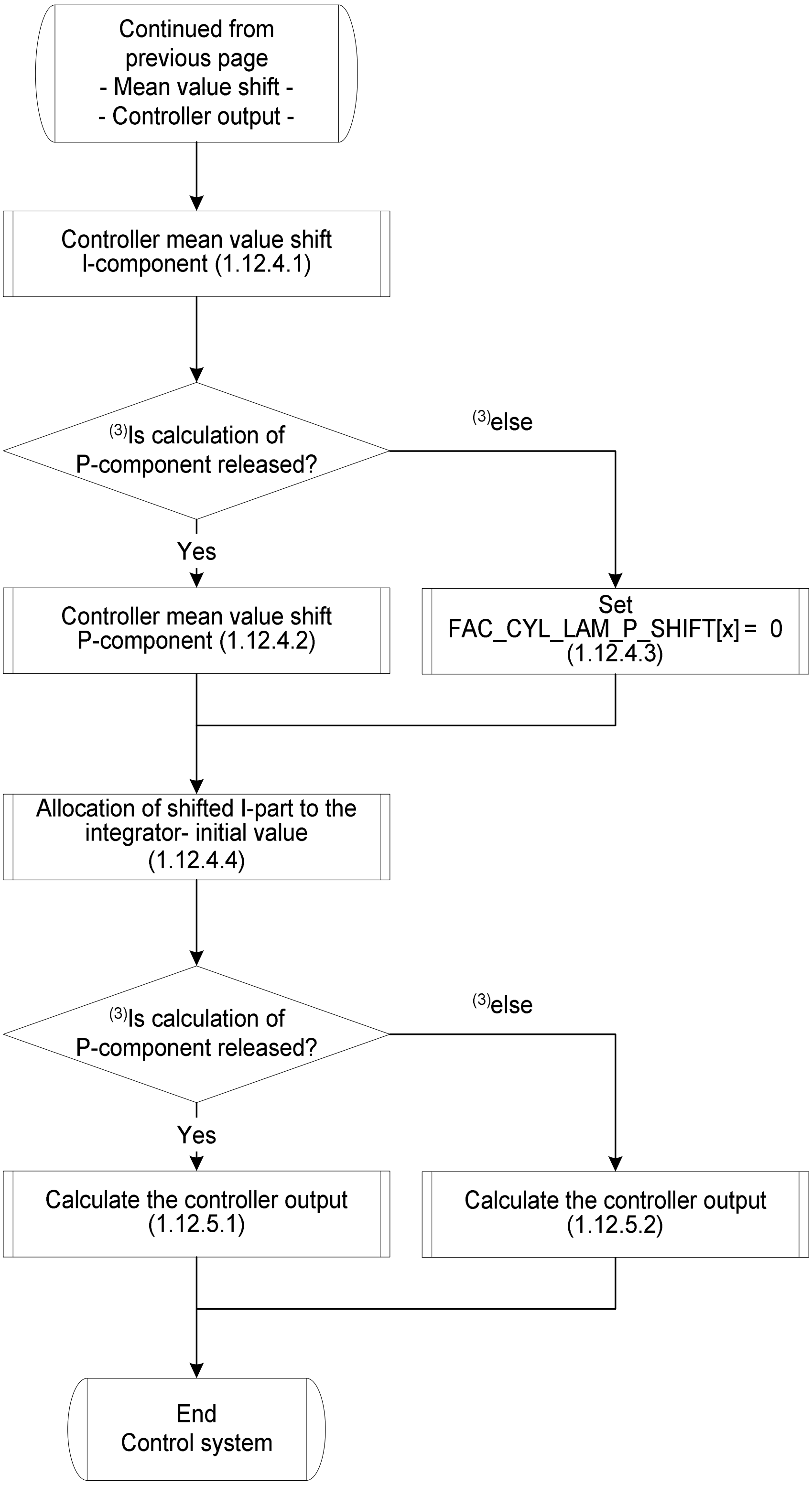

$$FAC\_CYL\_LAM\_I\_MV\_SHIFT[x]_k = FAC\_CYL\_LAM\_INT[x]_k - \frac{1}{\alpha} * \sum_{x=1}^{\alpha} FAC\_CYL\_LAM\_INT[x]$$

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(1.12.4.1)

if$^{(3)}$ LC_FAC_CYL_LAM_P_SWI = 1
then

$$FAC\_CYL\_LAM\_P\_MV\_SHIFT[x]_k = FAC\_CYL\_LAM\_P[x]_k - \frac{1}{\alpha} * \sum_{x=1}^{\alpha} FAC\_CYL\_LAM\_P[x]$$

α : number of cylinders per bank

(1.12.4.2)

else$^{(3)}$
FAC_CYL_LAM_P_MV_SHIFT[x]= 0
(1.12.4.3)

endif$^{(3)}$

The value of FAC_CYL_LAM_I_MV_SHIFT[x] shall be allocated to the initial value of the integrator:

$FAC\_CYL\_LAM\_INT[x]_k = FAC\_CYL\_LAM\_I\_MV\_SHIFT[x]_k$
(1.12.4.4)

7.73.13.5 Calculation of the controller output

if$^{(3)}$ LC_FAC_CYL_LAM_P_SWI = 1
then
$FAC\_CYL\_LAM[x]_k = FAC\_CYL\_LAM\_P\_MV\_SHIFT[x]_k + FAC\_CYL\_LAM\_I\_MV\_SHIFT[x]_k$ **(1.12.5.1)**
else$^{(3)}$
$FAC\_CYL\_LAM[x]_k = FAC\_CYL\_LAM\_I\_MV\_SHIFT[x]_k$
(1.12.5.2)
endif$^{(3)}$

7.73.13.6 Limitation of the controller output

If the cylinder individual controller output falls into the defined lower/upper limit, the corresponding flag has to be set and the involved controller output shall be limited to the minimum or maximum value.

if$^{(3)}$ $FAC\_CYL\_LAM[x]_k$ C_FAC_CYL_LAM_MIN
then
$FAC\_CYL\_LAM[x]_k = C\_FAC\_CYL\_LAM\_MIN$
(1.12.6.1)
LV_FAC_CYL_LAM_LIM_MIN[x] = 1
(1.12.6.2)
LV_FAC_CYL_LAM_LIM_MAX[x] = 0
(1.12.6.3)

else$^{(3)}$
if$^{(4)}$ $FAC\_CYL\_LAM[x]_k$ C_FAC_CYL_LAM_MAX
then
$FAC\_CYL\_LAM[x]_k = C\_FAC\_CYL\_LAM\_MAX$
(1.12.6.4)
LV_FAC_CYL_LAM_LIM_MAX[x] = 1
(1.12.6.5)
LV_FAC_CYL_LAM_LIM_MIN[x] = 0

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(1.12.6.6)

else$^{(4)}$

LV_FAC_CYL_LAM_LIM_MIN[x] = 0

(1.12.6.7)

LV_FAC_CYL_LAM_LIM_MAX[x] = 0

(1.12.6.8)

endif$^{(4)}$

endif$^{(4)}$

7.73.13.7 Anti-Wind-Up

As anti wind up measure for the integral-action element, FAC_CYL_LAM_INT[x], following calculations shall be carried out if the controller output is limited.

if$^{(3)}$ LV_FAC_CYL_LAM_LIM_MIN[x] = 1

then

$$\text{FAC\_CYL\_LAM\_INT[x]}_k = \frac{\alpha}{\alpha - 1} * \text{C\_FAC\_CYL\_LAM\_MIN} + \frac{1}{\alpha - 1} * \sum_{j=x+1}^{x-1} \text{FAC\_CYL\_LAM\_INT[j]}_k$$

(1.12.7.1)

endif$^{(3)}$

if$^{(3)}$ LV_FAC_CYL_LAM_LIM_MAX[x] = 1

then

$$\text{FAC\_CYL\_LAM\_INT[x]}_k = \frac{\alpha}{\alpha - 1} * \text{C\_FAC\_CYL\_LAM\_MAX} + \frac{1}{\alpha - 1} * \sum_{j=x+1}^{x-1} \text{FAC\_CYL\_LAM\_INT[j]}_k$$

(1.12.7.2)

endif$^{(3)}$

: number of cylinders per bank

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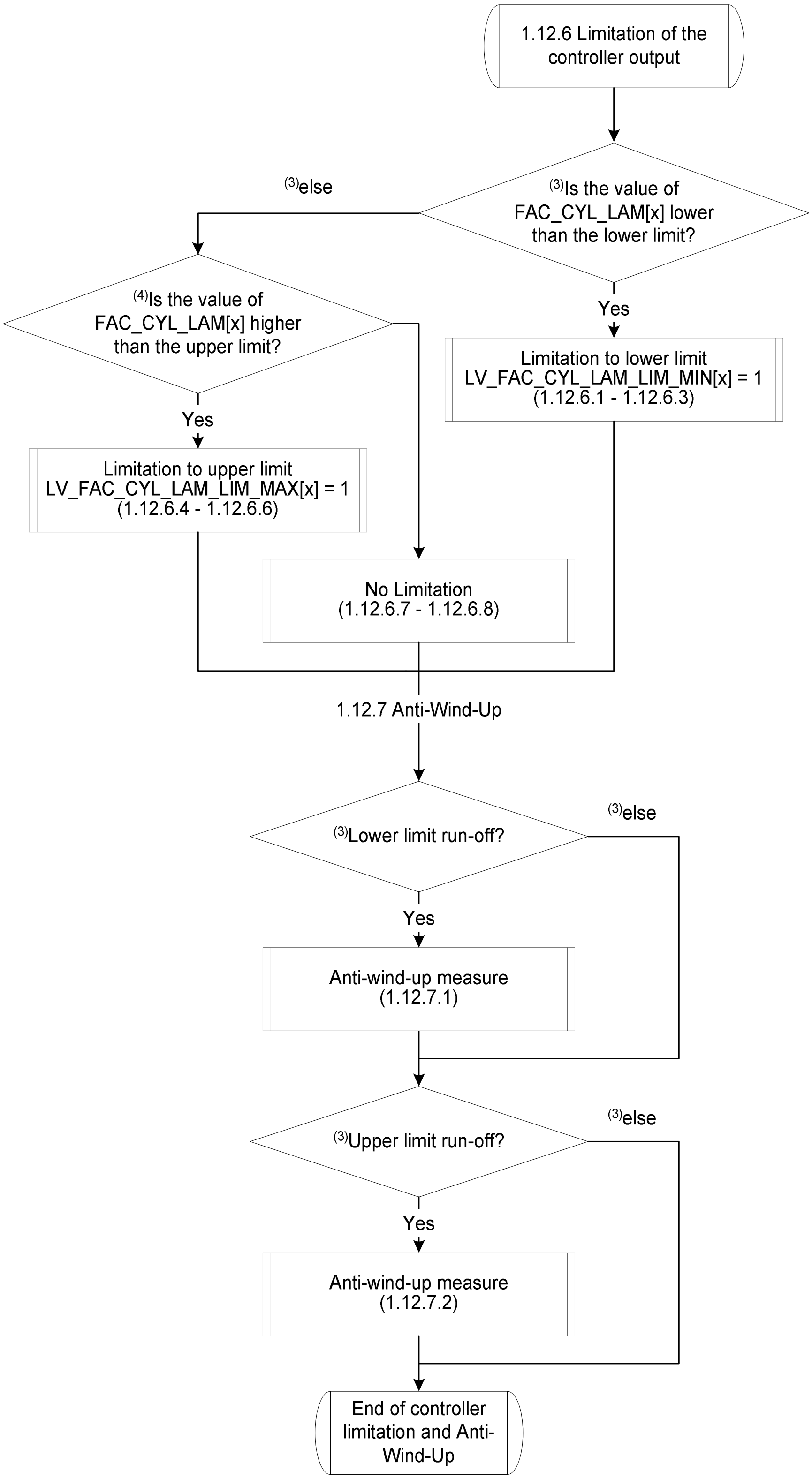

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7.73.13.8 Cylinder individual lambda adaptation

The cylinder individual lambda adaptation shall be carried out in an applied MAF- area. The mechanism consists of a first-order lag element. The output of this lowpass-filter is FAC_LAM_CYL_SEL_ADJ_

FIL[x] under nominal conditions (optimal operating temperature) and FAC_LAM_CYL_SEL_ADJ_FIL_CST[x] under engine-cold condition.

Remark:

For application purpose the mechanism can be switched off using LC_ADAPT_COR_OUT:
LC_ADAPT_COR_OUT = 1: Adaptation is switched on.
LC_ADAPT_COR_OUT = 0: Adaptation is switched off, and the adaptation output signal shall be set to zero.

if$^{(3)}$ LC_ADAPT_COR_OUT = 1
then
if$^{(4)}$ LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0
then
if$^{(5)}$ STATE_LAM_CYL_SEL_ADJ[i] = 1 [WAIT_ENG_COLD]
then
if$^{(6)}$ ((C_MFF_LAM_CYL_ADJ_CST_MIN <
MFF_SP_LAM_CYL_SEL <
C_MFF_LAM_CYL_ADJ_CST_MAX)
and
(C_N_LAM_CYL_ADJ_CST_MIN
N_32
C_N_LAM_CYL_ADJ_CST_MAX))
then
STATE_LAM_CYL_SEL_ADJ[i] = 2
[ADJ_ENG_COLD] **(1.12.8.1)**
endif$^{(6)}$
if$^{(6)}$ TEMP_LAM_CYL_SEL C_TEMP_LAM_CYL_MIN
then
STATE_LAM_CYL_SEL_ADJ[i] = 3
[WAIT_ENG_NOM] **(1.12.8.2)**
else$^{(6)}$
if$^{(7)}$ (TEMP_LAM_CYL_SEL <
C_TEMP_LAM_CYL_CST_MIN **or**
(TEMP_LAM_CYL_SEL >
C_TEMP_LAM_CYL_CST_MAX **and**
TEMP_LAM_CYL_SEL <
C_TEMP_LAM_CYL_MIN) **or**
LV_LAM_LSCL[i] = 0)
then
STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
(1.12.8.3)
endif$^{(7)}$
endif$^{(6)}$
endif$^{(5)}$

if$^{(5)}$ STATE_LAM_CYL_SEL_ADJ_i = 3 [WAIT_ENG_NOM]
then
if$^{(6)}$ LV_LAM_CYL_SEL_ADJ_OFS_REQ[i] = 0
then
if$^{(7)}$ ((N_32

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C_N_MIN_FAC_CYL_SEL_ADJ_
L_RNG **and**
N_32
C_N_MAX_FAC_CYL_SEL_ADJ_
L_RNG **and**
MFF_SP_LAM_CYL_SEL
C_MFF_MIN_FAC_CYL_SEL_ADJ_
L_RNG **and**
MFF_SP_LAM_CYL_SEL
C_MFF_MAX_FAC_CYL_SEL_ADJ_
L_RNG))

then
STATE_LAM_CYL_SEL_ADJ[i] = 4
[ADJ_NOM_L_RNG] **(1.12.8.4)**
else(7)
if(8) ((N_32
C_N_MIN_FAC_CYL_SEL_ADJ_
H_RNG
and N_32
C_N_MAX_FAC_CYL_SEL_ADJ_
H_RNG
and MFF_SP_LAM_CYL_SEL
C_MFF_MIN_FAC_CYL_SEL_ADJ_
H_RNG
and MFF_SP_LAM_CYL_SEL
C_MFF_MAX_FAC_CYL_SEL_ADJ_
H_RNG))
then
STATE_LAM_CYL_SEL_ADJ[i] = 5
[ADJ_NOM_H_RNG] **(1.12.8.5)**
endif(8)
endif(7)
else(6)
STATE_LAM_CYL_SEL_ADJ[i] = 6
[ADJ_NOM_OFS] **(1.12.8.6)**
endif(6)
if(6) (C_TEMP_LAM_CYL_CST_MIN <
TEMP_LAM_CYL_SEL <
C_TEMP_LAM_CYL_CST_MAX **and**
LV_LAM_LSCL[i] = 1)
then
STATE_LAM_CYL_SEL_ADJ[i] = 1
[WAIT_ENG_COLD] **(1.12.8.7)**
else(6)
if(7) (TEMP_LAM_CYL_SEL <
C_TEMP_LAM_CYL_CST_MIN **or**
(TEMP_LAM_CYL_SEL >
C_TEMP_LAM_CYL_CST_MAX **and**
TEMP_LAM_CYL_SEL <
C_TEMP_LAM_CYL_MIN))
then
STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
(1.12.8.8)

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endif(7)
endif(6)
endif(5)

if(5) STATE_LAM_CYL_SEL_ADJ[i] = 2 [ADJ_ENG_COLD]
then
if(6) (MFF_SP_LAM_CYL_SEL < C_MFF_LAM_CYL_ADJ_CST_MIN **or**
MFF_SP_LAM_CYL_SEL > C_MFF_LAM_CYL_ADJ_CST_MAX **or**
N_32 < C_N_LAM_CYL_ADJ_CST_MIN **or**
N_32 > C_N_LAM_CYL_ADJ_CST_MAX)
then
if(7) (C_TEMP_LAM_CYL_CST_MIN < TEMP_LAM_CYL_SEL < C_TEMP_LAM_CYL_CST_MAX **and** LV_LAM_LSCL[i] = 1)
then
STATE_LAM_CYL_SEL_ADJ[i] = 1 [WAIT_ENG_COLD] **(1.12.8.9)**
endif(7)
endif(6)
if(6) TEMP_LAM_CYL_SEL C_TEMP_LAM_CYL_MIN
then
STATE_LAM_CYL_SEL_ADJ[i] = 3 [WAIT_ENG_NOM] **(1.12.8.10)**
else(6)
if(7) (TEMP_LAM_CYL_SEL < C_TEMP_LAM_CYL_CST_MIN **or** (TEMP_LAM_CYL_SEL > C_TEMP_LAM_CYL_CST_MAX **and** TEMP_LAM_CYL_SEL < C_TEMP_LAM_CYL_MIN) **or** LV_LAM_LSCL[i] = 0)
then
STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS] **(1.12.8.11)**
endif(7)
endif(6)
endif(5)

if(5) STATE_LAM_CYL_SEL_ADJ[i] = 4 [ADJ_NOM_L_RNG]
then
if(6) (N_32 < C_N_MIN_FAC_CYL_SEL_ADJ_L_RNG **or**
N_32 > C_N_MAX_FAC_CYL_SEL_ADJ_L_RNG **or**
MFF_SP_LAM_CYL_SEL <

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C_MFF_MIN_FAC_CYL_SEL_ADJ_
L_RNG **or**
MFF_SP_LAM_CYL_SEL >
C_MFF_MAX_FAC_CYL_SEL_ADJ_
L_RNG **or**
LV_LAM_CYL_SEL_ADJ_OFS_REQ[i]
= 1)

then
if(7) TEMP_LAM_CYL_SEL
C_TEMP_LAM_CYL_MIN
then
STATE_LAM_CYL_SEL_ADJ[i] = 3
[WAIT_ENG_NOM] **(1.12.8.12)**
endif(7)
endif(6)
if(6) (C_TEMP_LAM_CYL_CST_MIN <
TEMP_LAM_CYL_SEL <
C_TEMP_LAM_CYL_CST_MAX **and**
LV_LAM_LSCL[i] = 1)
then
STATE_LAM_CYL_SEL_ADJ[i] = 1
[WAIT_ENG_COLD] **(1.12.8.13)**
else(6)
if(7) (TEMP_LAM_CYL_SEL <
C_TEMP_LAM_CYL_CST_MIN **or**
(TEMP_LAM_CYL_SEL >
C_TEMP_LAM_CYL_CST_MAX **and**
TEMP_LAM_CYL_SEL <
C_TEMP_LAM_CYL_MIN))
then
STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
(1.12.8.14)
endif(7)
endif(6)
endif(5)

if(5) STATE_LAM_CYL_SEL_ADJ[i] = 5 [ADJ_NOM_H_RNG]
then
if(6) (N_32 < C_N_MIN_FAC_CYL_SEL_ADJ_H_RNG **or**
N_32 > C_N_MAX_FAC_CYL_SEL_
ADJ_H_RNG **or**
MFF_SP_LAM_CYL_SEL <
C_MFF_MIN_FAC_CYL_SEL_ADJ_
H_RNG **or**
MFF_SP_LAM_CYL_SEL >
C_MFF_MAX_FAC_CYL_SEL_ADJ_
H_RNG **or**
LV_LAM_CYL_SEL_ADJ_OFS_REQ[i]
= 1)
then
if(7) TEMP_LAM_CYL_SEL
C_TEMP_LAM_CYL_MIN

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then
STATE_LAM_CYL_SEL_ADJ[i] = 3
[WAIT_ENG_NOM] **(1.12.8.15)**
endif(7)
endif(6)
if(6) (C_TEMP_LAM_CYL_CST_MIN <
TEMP_LAM_CYL_SEL <
C_TEMP_LAM_CYL_CST_MAX **and**
LV_LAM_LSCL[i] = 1)
then
STATE_LAM_CYL_SEL_ADJ[i] = 1
[WAIT_ENG_COLD] **(1.12.8.16)**
else(6)
if(7) (TEMP_LAM_CYL_SEL <
C_TEMP_LAM_CYL_CST_MIN **or**
(TEMP_LAM_CYL_SEL >
C_TEMP_LAM_CYL_CST_MAX **and**
TEMP_LAM_CYL_SEL <
C_TEMP_LAM_CYL_MIN))
then
STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
(1.12.8.17)
endif(7)
endif(6)
endif(5)
if(5) STATE_LAM_CYL_SEL_ADJ[i] = 6 [ADJ_NOM_OFS]
then
if(6) LV_LAM_CYL_SEL_ADJ_OFS_REQ[i] = 0
then
if(7) TEMP_LAM_CYL_SEL
C_TEMP_LAM_CYL_MIN
then
STATE_LAM_CYL_SEL_ADJ[i] = 3
[WAIT_ENG_NOM] **(1.12.8.18)**
endif(7)
endif(6)
if(6) (C_TEMP_LAM_CYL_CST_MIN <
TEMP_LAM_CYL_SEL <
C_TEMP_LAM_CYL_CST_MAX **and**
LV_LAM_LSCL[i] = 1)
then
STATE_LAM_CYL_SEL_ADJ[i] = 1
[WAIT_ENG_COLD] **(1.12.8.19)**
else(6)
if(7) (TEMP_LAM_CYL_SEL <
C_TEMP_LAM_CYL_CST_MIN **or**
(TEMP_LAM_CYL_SEL >
C_TEMP_LAM_CYL_CST_MAX **and**
TEMP_LAM_CYL_SEL <
C_TEMP_LAM_CYL_MIN))
then
STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]

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(1.12.8.20)

endif$^{(7)}$

endif$^{(6)}$

endif$^{(5)}$

[*Remark: the cylinder based limitation (index x) shall be assigned to the corresponding exhaust bank (index i)*]

if$^{(5)}$(STATE_LAM_CYL_SEL_ADJ[i] = 1 [WAIT_ENG_COLD] **or** STATE_LAM_CYL_SEL_ADJ[i] = 2 [ADJ_ENG_COLD])

then

FAC_LAM_CYL_SEL_ADJ_FIL[x]$_k$ = 0

(1.12.8.21)

if$^{(6)}$ LC_FAC_LAM_CYL_SEL_ADJ_P_I_ENA = 1

then

FAC_LAM_CYL_SEL_ADJ_CST_FIL[x]$_k$ = FAC_LAM_CYL_SEL_ADJ_CST_FIL[x]$_{k-1}$ + (FAC_CYL_LAM[x]$_k$ - FAC_LAM_CYL_SEL_ADJ_CST_FIL[x]$_{k-1}$) *C_CRLC_LAM_CYL_CST_FIL **(1.12.8.22)**

else$^{(6)}$

FAC_LAM_CYL_SEL_ADJ_CST_FIL[x]$_k$ = FAC_LAM_CYL_SEL_ADJ_CST_FIL[x]$_{k-1}$ + (FAC_CYL_LAM_I_MV_SHIFT[x]$_k$ - FAC_LAM_CYL_SEL_ADJ_CST_FIL[x]$_{k-1}$) *C_CRLC_LAM_CYL_CST_FIL **(1.12.8.23)**

endif$^{(6)}$

else$^{(5)}$

if$^{(6)}$ (STATE_LAM_CYL_SEL_ADJ[i] = 3 [WAIT_ENG_NOM] **or** STATE_LAM_CYL_SEL_ADJ[i] = 4 [ADJ_NOM_L_RNG] **or** STATE_LAM_CYL_SEL_ADJ[i] = 5 [ADJ_NOM_H_RNG] **or** STATE_LAM_CYL_SEL_ADJ[i] = 6 [ADJ_NOM_OFS])

then

FAC_LAM_CYL_SEL_ADJ_CST_FIL[x]$_k$ = 0

(1.12.8.24)

if$^{(7)}$LC_FAC_LAM_CYL_SEL_ADJ_P_I_ENA = 1

then

FAC_LAM_CYL_SEL_ADJ_FIL[x]$_k$ = FAC_LAM_CYL_SEL_ADJ_FIL[x]$_{k-1}$ + (FAC_CYL_LAM[x]$_k$ -

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FAC_LAM_CYL_SEL_ADJ_FIL[x]$_{k-1}$)*
C_CRLC_CYL_FIL **(1.12.8.25)**

else$^{(7)}$

FAC_LAM_CYL_SEL_ADJ_FIL[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_FIL[x]$_{k-1}$

+

(FAC_CYL_LAM_I_MV_SHIFT[x]$_k$

-

FAC_LAM_CYL_SEL_ADJ_FIL[x]$_{k-1}$)*
C_CRLC_CYL_FIL **(1.12.8.26)**

endif$^{(7)}$

else$^{(6)}$

FAC_LAM_CYL_SEL_ADJ_FIL[x]$_k$ = 0
(1.12.8.27)

FAC_LAM_CYL_SEL_ADJ_CST_FIL[x]$_k$ = 0
(1.12.8.28)

endif$^{(6)}$

endif$^{(5)}$

else$^{(4)}$

FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0
(1.12.8.29)

FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0
(1.12.8.30)

CTR_T_LAM_CYL_ADJ[i] = 0
(1.12.8.31)

if$^{(5)}$ (C_TEMP_LAM_CYL_CST_MIN $<$
TEMP_LAM_CYL_SEL $<$
C_TEMP_LAM_CYL_CST_MAX **and**
LV_LAM_LSCL[i] = 1)

then

STATE_LAM_CYL_SEL_ADJ[i] = 1
[WAIT_ENG_COLD] **(1.12.8.32)**

else$^{(5)}$

if$^{(6)}$ TEMP_LAM_CYL_SEL C_TEMP_LAM_CYL_MIN

then

STATE_LAM_CYL_SEL_ADJ[i] = 3
[WAIT_ENG_NOM] **(1.12.8.33)**

else$^{(6)}$

STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
(1.12.8.34)

endif$^{(6)}$

endif$^{(6)}$

LV_LAM_CYL_SEL_ADJ_VLD[i] = 0
(1.12.8.35)

endif$^{(4)}$

else$^{(3)}$

MFF_ADD_CYL_LAM_COR[x] = 0
(1.12.8.36)

MFF_ADD_CYL_LAM_COR[x]$_{LDC}$ = 0
(1.12.8.37)

FAC_LAM_CYL_SEL_ADJ[x] = 0
(1.12.8.38)

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FAC_LAM_CYL_SEL_ADJ_L_RNG[x] = 0
(1.12.8.39)
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{LDC}$ = 0
(1.12.8.40)
FAC_LAM_CYL_SEL_ADJ_H_RNG[x] = 0
(1.12.8.41)
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{LDC}$ = 0
(1.12.8.42)
FAC_LAM_CYL_SEL_ADJ_CST[x] = 0
(1.12.8.43)
FAC_LAM_CYL_SEL_ADJ_CST[x]$_{LDC}$ = 0
(1.12.8.44)
FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0
(1.12.8.-)
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0
(1.12.8.46)
CTR_T_LAM_CYL_ADJ[i] = 0
(1.12.8.47)
STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
(1.12.8.48)
LV_LAM_CYL_SEL_ADJ_VLD[i] = 0
(1.12.8.49)
LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i] = 0
(1.12.8.50)
LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] = 0
(1.12.8.51)
LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i]$_{LDC}$ = 0
(1.12.8.52)
LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i]$_{LDC}$ = 0
(1.12.8.53)
LV_FAC_LAM_CYL_ADJ_CST_LIM[i] = 0
(1.12.8.54)
LV_FAC_LAM_CYL_SEL_ADJ_LIM[i] = 0
(1.12.8.55)
LV_MFF_ADD_CYL_LAM_COR_LIM[i] = 0
(1.12.8.56)

endif$^{(3)}$
else$^{(2)}$
FAC_LAM_CYL_SEL_ADJ_FIL[x] = 0
(1.12.8.57)
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] = 0
(1.12.8.58)
CTR_T_LAM_CYL_ADJ[i] = 0
(1.12.8.59)
STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS]
(1.12.8.60)
LV_LAM_CYL_SEL_ADJ_VLD[i] = 0
(1.12.8.61)
endif$^{(2)}$
endif$^{(1)}$

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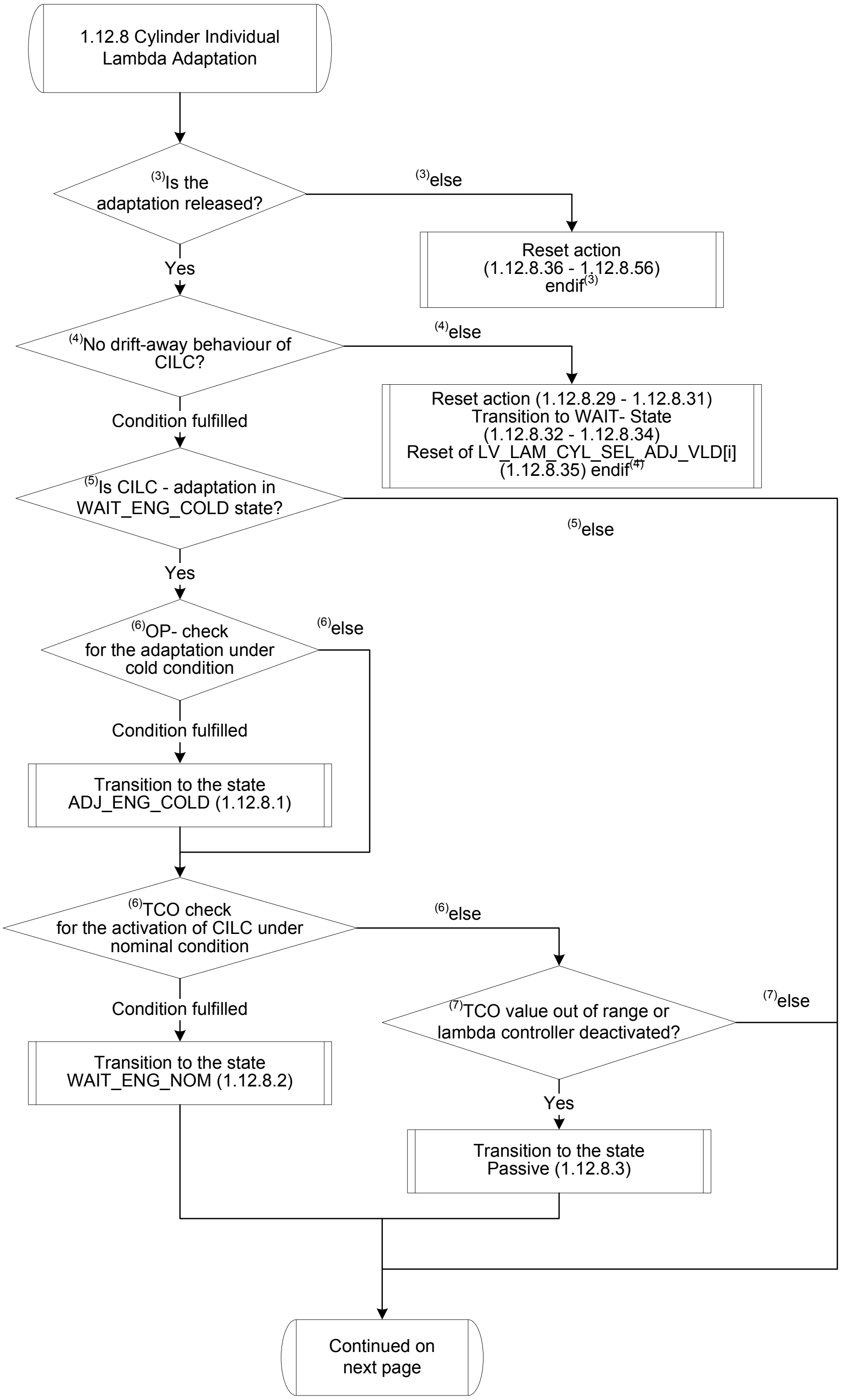

Figure 7.73.11: TOLOMEOGRAPHIC 269252-48.ps

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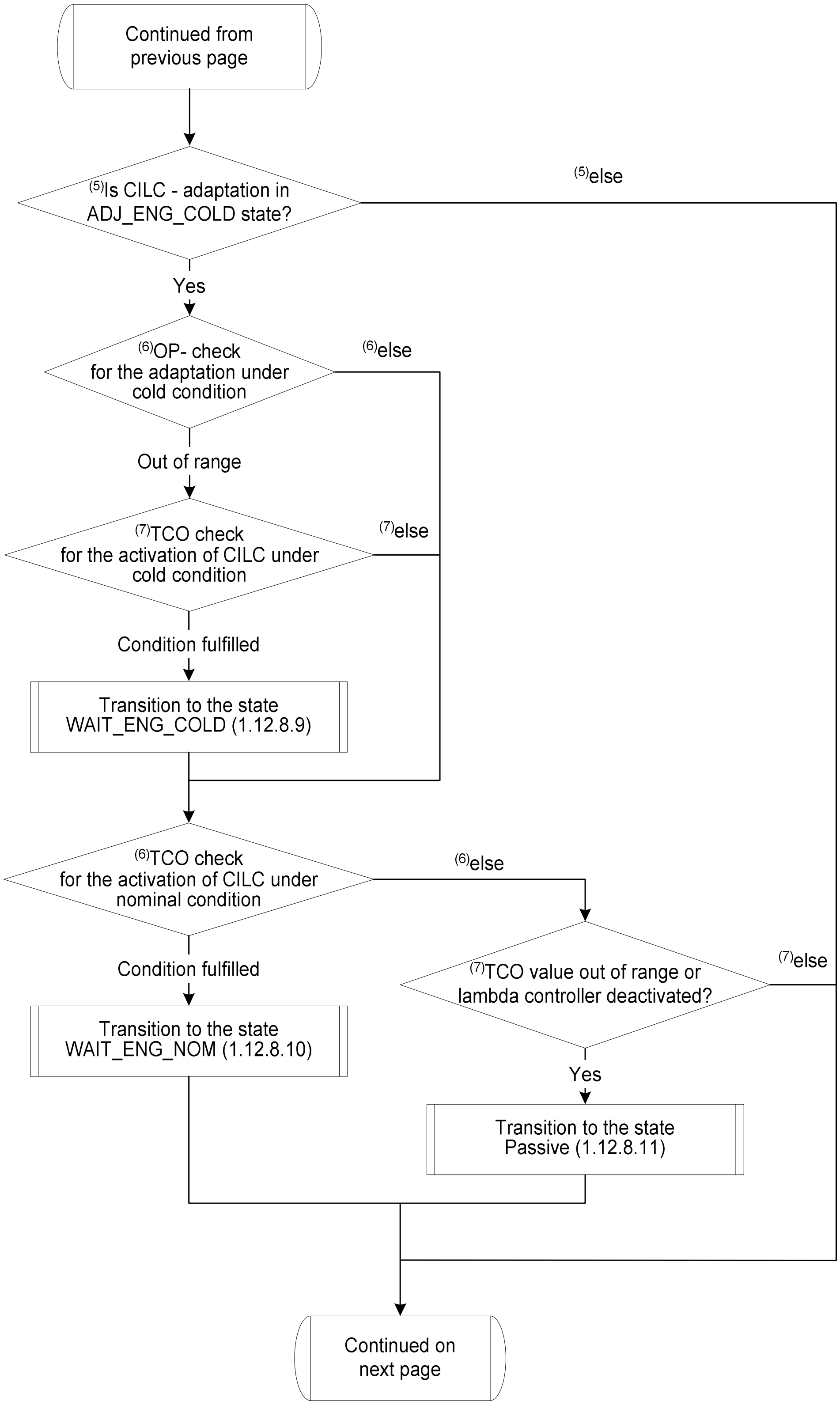

Figure 7.73.12: TOLOMEOGRAPHIC 269252-50.ps

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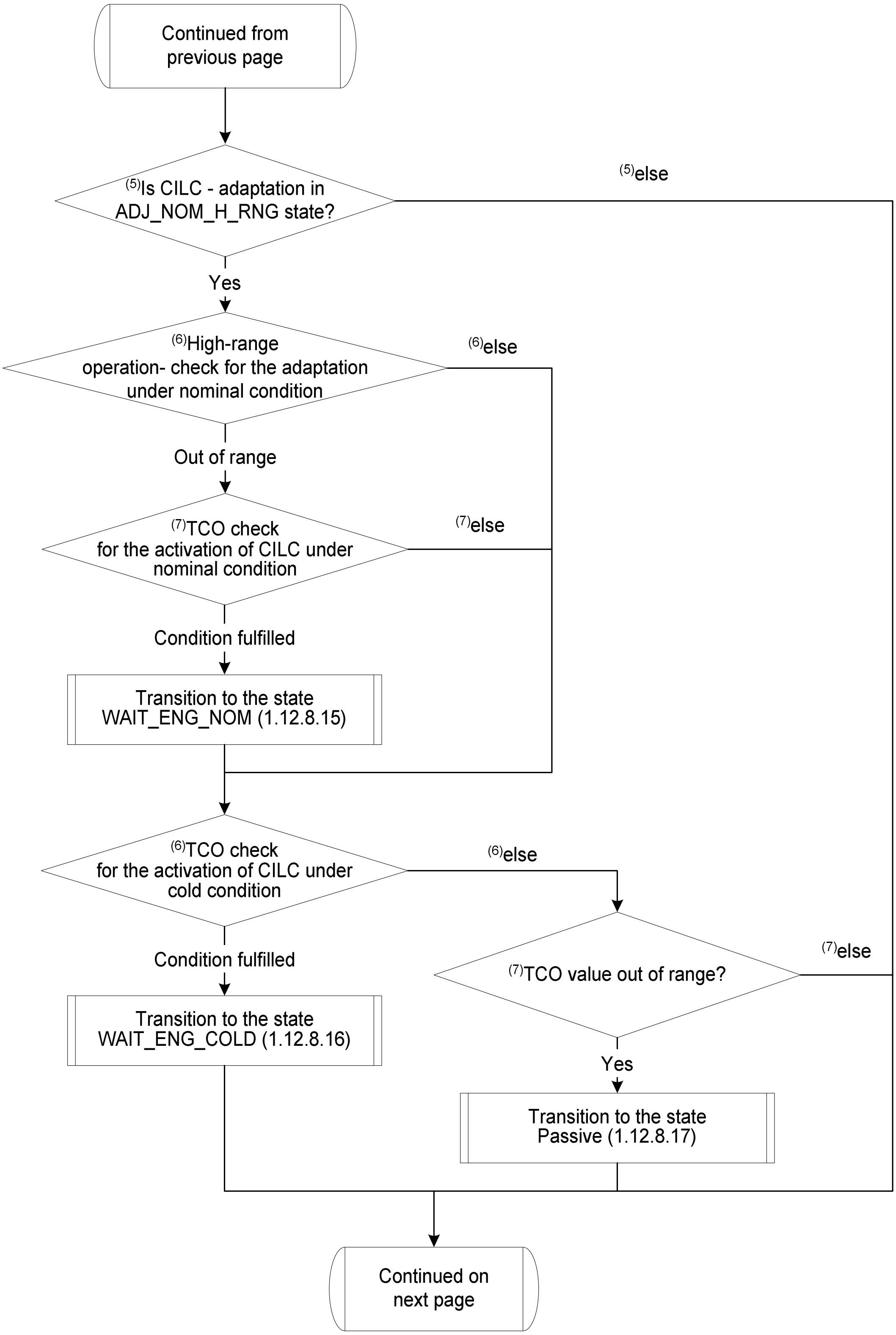

Figure 7.73.13: TOLOMEOGRAPHIC 269252-52.ps

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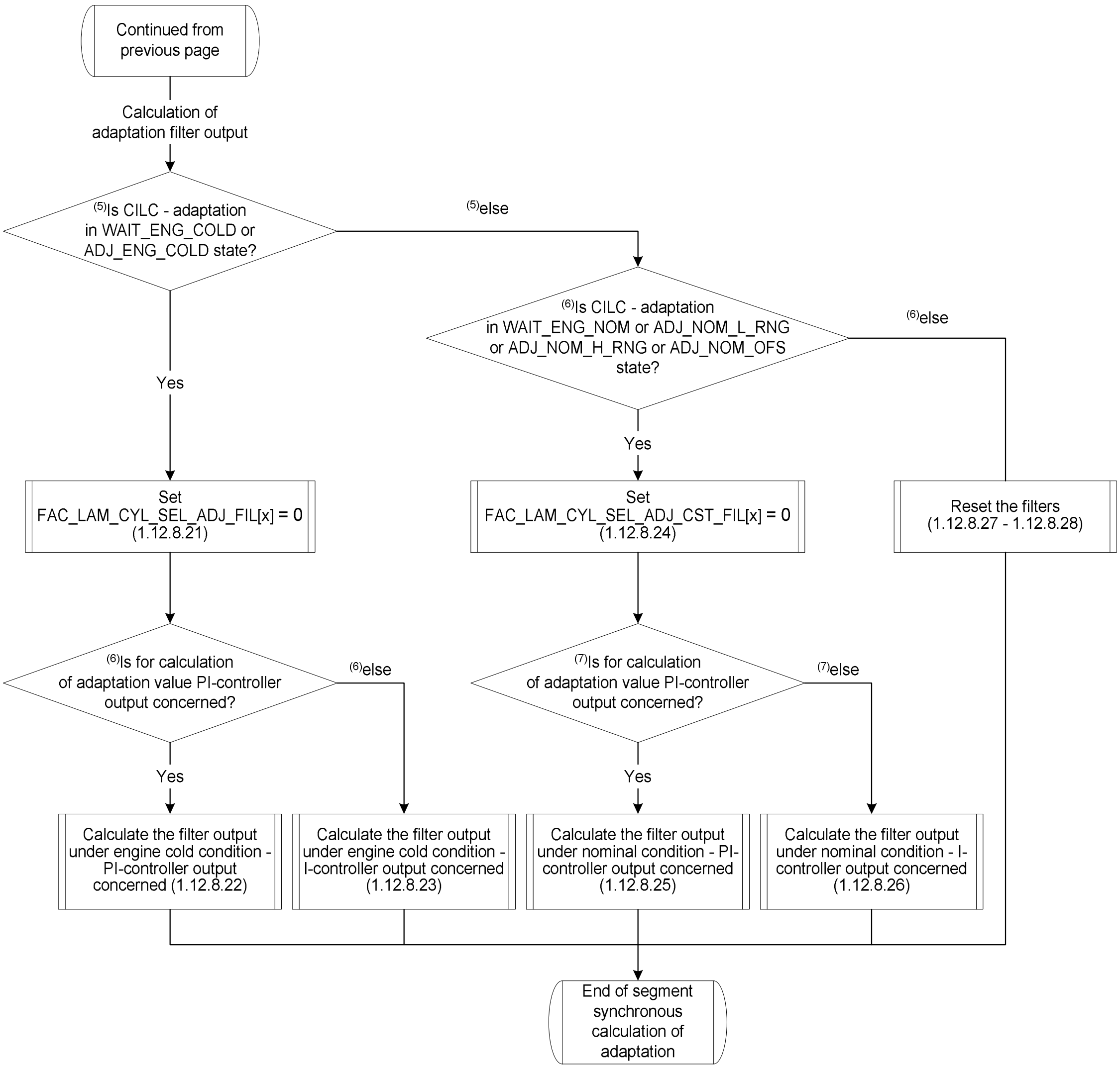

7.73.13.9 Update of cylinder individual lambda adaptation values

The computation of the cylinder individual lambda adaptation shall be updated in the time-cycle C_T_LAM_CYL_ADJ_CST/C_T_LAM_CYL_ADJ. When the computation was carried out, then the initial value of cylinder individual lambda-controller, FAC_CYL_LAM_INT[x], and low pass filter, FAC_LAM_CYL_SEL_ADJ_FIL[x]/FAC_LAM_CYL_SEL_ADJ_CST_FIL[x] shall be shifted. On the deactivation condition all cylinder individual filter outputs, FAC_LAM_CYL_SEL_ADJ_FIL[x] and the timer CTR_T_LAM_CYL_ADJ[i] shall be set to zero.

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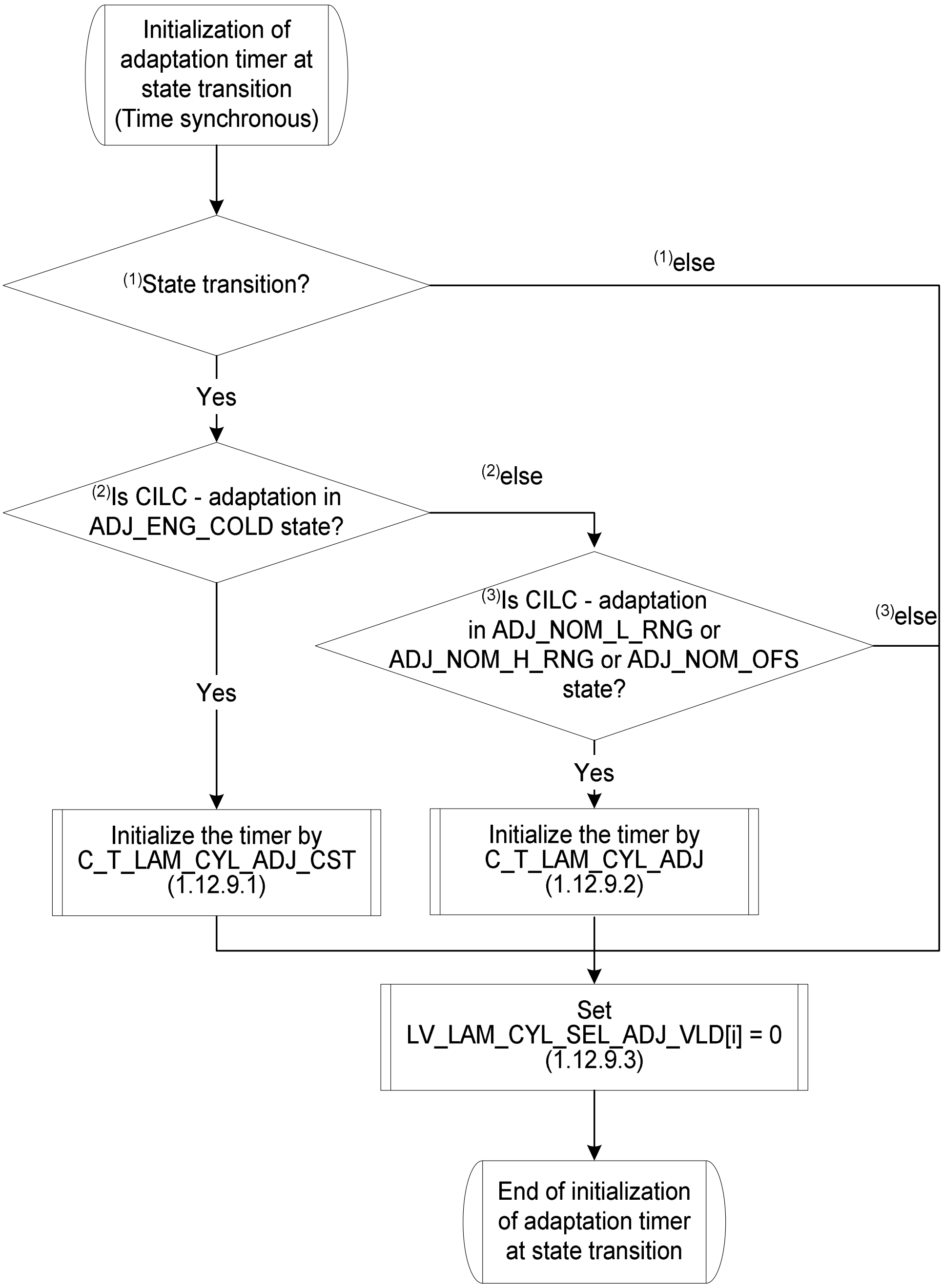

Figure 7.73.14: TOLOMEOGRAPHIC 269252-55.ps

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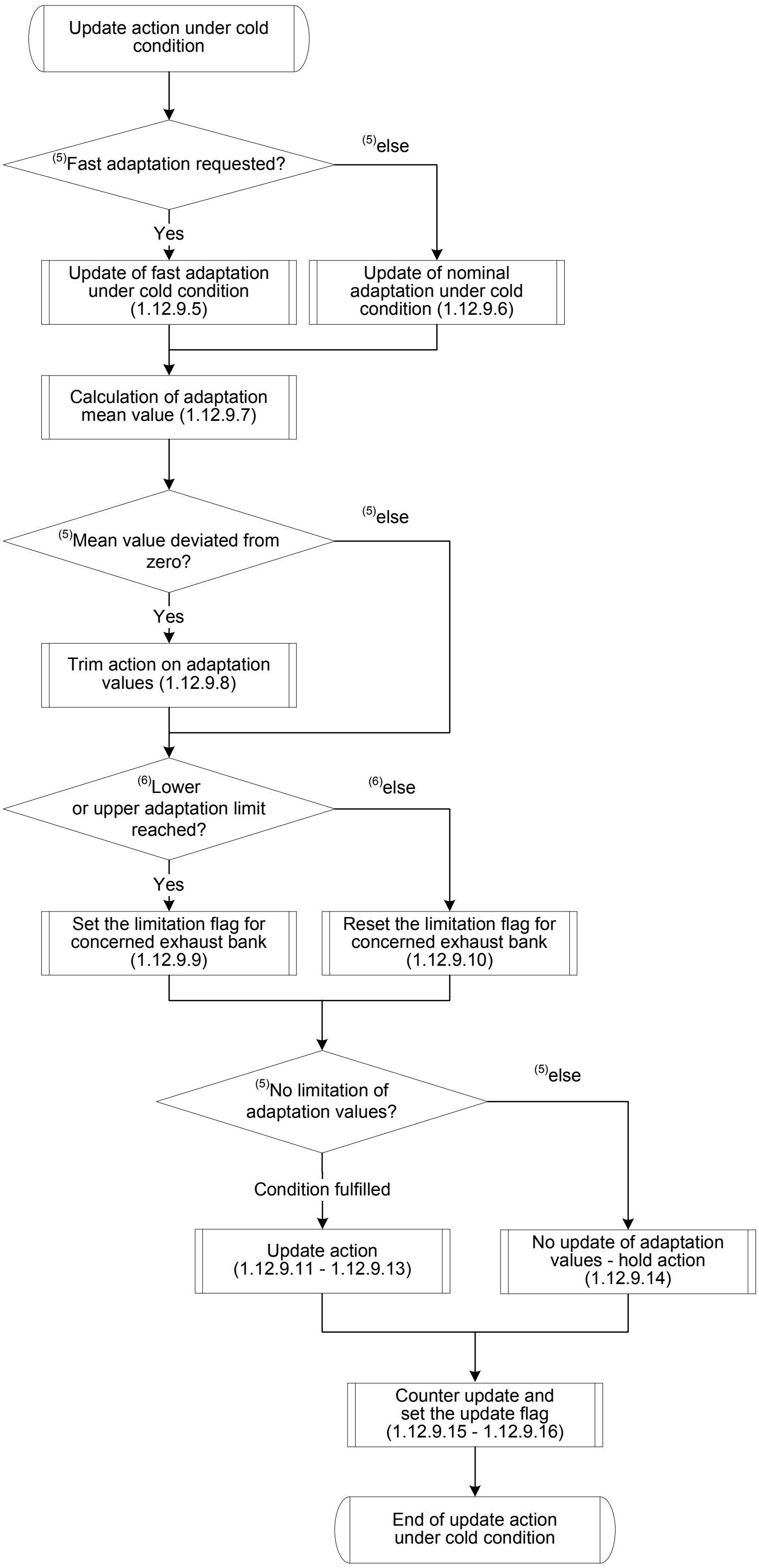

Figure 7.73.15: TOLOMEOGRAPHIC 269252-57.ps

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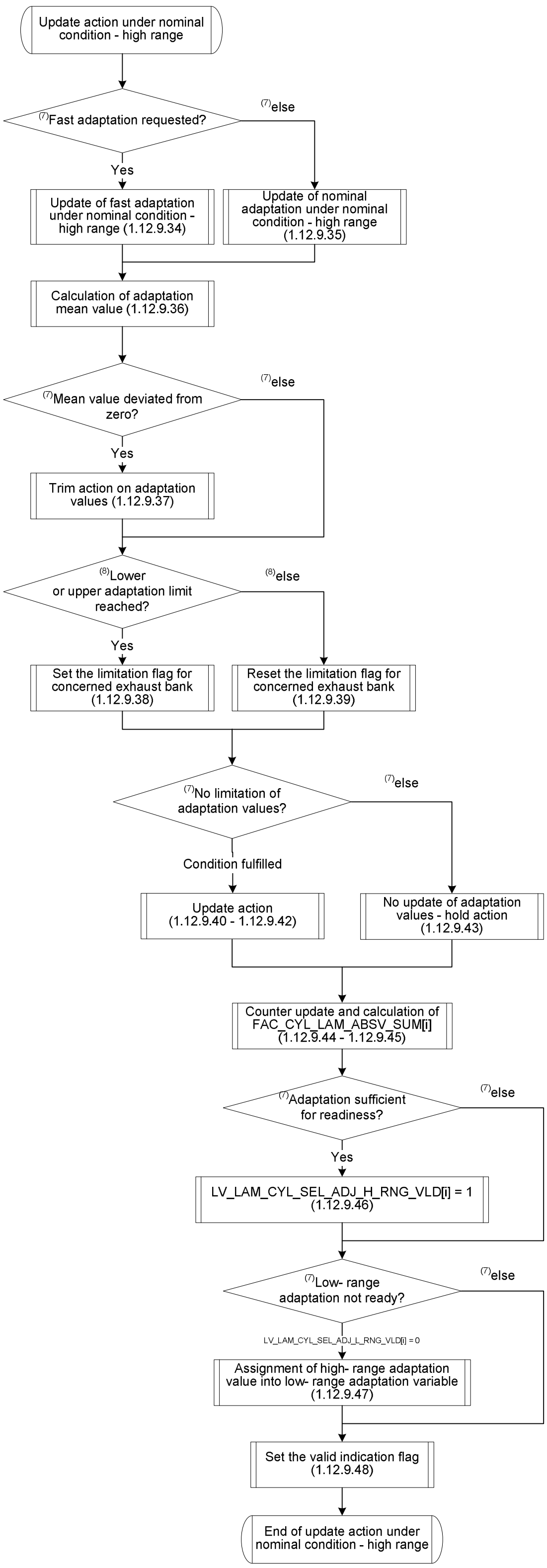

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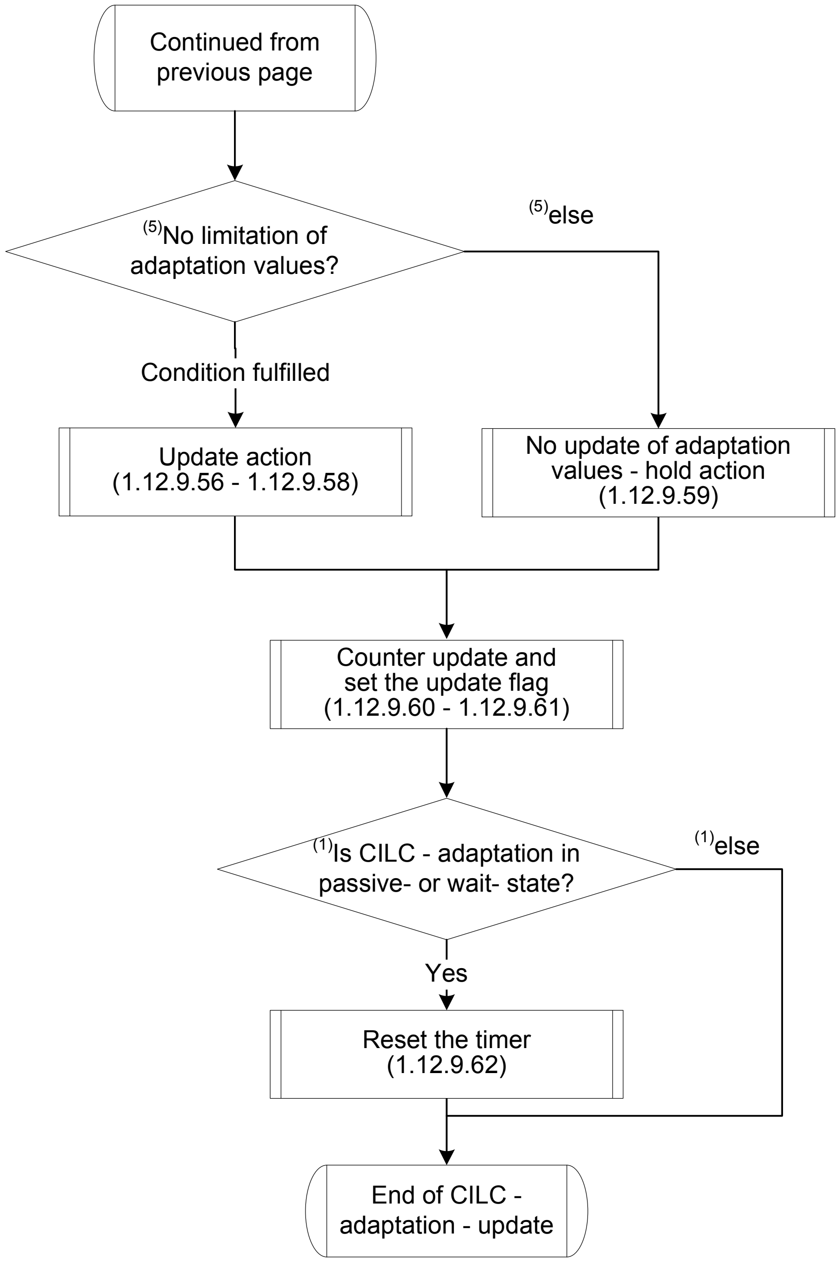
Figure 7.73.16: TOLOMEOGRAPHIC 269252-59.ps



if[1] STATE_LAM_CYL_SEL_ADJ[i]$_k$ STATE_LAM_CYL_SEL_ADJ[i]$_{k-1}$
then

if[2] STATE_LAM_CYL_SEL_ADJ[i] = 2 [ADJ_ENG_COLD]
then

CTR_T_LAM_CYL_ADJ[i] = C_T_LAM_CYL_ADJ_CST

(1.12.9.1)

else[2]

if[3] (STATE_LAM_CYL_SEL_ADJ[i] = 4 [ADJ_NOM_L_RNG] **or** STATE_LAM_CYL_SEL_ADJ[i] = 5 [ADJ_NOM_H_RNG] **or** STATE_LAM_CYL_SEL_ADJ[i] = 6 [ADJ_NOM_OFS])
then

CTR_T_LAM_CYL_ADJ[i] = C_T_LAM_CYL_ADJ

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(1.12.9.2)

endif(3)
endif(2)
LV_LAM_CYL_SEL_ADJ_VLD[i] = 0
(1.12.9.3)
endif(1)

if(1) LC_ADAPT_COR_OUT = 1
then
if(2) STATE_LAM_CYL_SEL[i] = 3 [CLL]
then
if(3) STATE_LAM_CYL_SEL_ADJ[i] = 2 [ADJ_ENG_COLD]
then
if(4) CTR_T_LAM_CYL_ADJ[i] 0
then
decrement CTR_T_LAM_CYL_ADJ[i]
(1.12.9.4)
endif(4)
if(4) CTR_T_LAM_CYL_ADJ[i] = 0
then
if(5) LV_LAM_CYL_SEL_CTL_FAST_REQ = 1
then
for(6) j(x) = 1 : Number of cylinders per exhaust bank
FAC_LAM_CYL_SEL_ADJ_CST[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_CST[x]$_{k-1}$
+
IP_FAC_OPP_LAM_CYL_SEL_ADJ_
FAST*
FAC_LAM_CYL_SEL_ADJ_CST_
FIL[x] **(1.12.9.5)**
endfor(6)
else(5)
for(6) j(x) = 1 : Number of cylinders per exhaust bank
FAC_LAM_CYL_SEL_ADJ_CST[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_CST[x]$_{k-1}$
+
IP_FAC_OPP_LAM_CYL_SEL_ADJ*
FAC_LAM_CYL_SEL_ADJ_CST_
FIL[x] **(1.12.9.6)**
endfor(6)
endif(5)

FAC_LAM_CYL_SEL_ADJ_CST_MV[i] =

$$\frac{1}{\alpha} * \sum_{x=1}^{\alpha} \text{FAC\_LAM\_CYL\_SEL\_ADJ\_CST[x]}$$

: number of cylinders per bank**(1.12.9.7)**

if(5) FAC_LAM_CYL_SEL_ADJ_CST_MV[i] 0
then
for(6) j(x) = 1 : Number of cylinders per exhaust bank
FAC_LAM_CYL_SEL_ADJ_CST[x]$_k$ =

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FAC_LAM_CYL_SEL_ADJ_CST[x]$_k$
-
FAC_LAM_CYL_SEL_ADJ_CST_
MV[i] **(1.12.9.8)**

endfor$^{(6)}$
endif$^{(5)}$

for$^{(5)}$ j(x) = 1 : Number of cylinders per exhaust bank
if$^{(6)}$ (FAC_LAM_CYL_SEL_ADJ_CST[x]$_k$ $>$
C_FAC_LAM_CYL_SEL_ADJ_CST_
MAX **or**
FAC_LAM_CYL_SEL_ADJ_CST[x]$_k$
$<$
C_FAC_LAM_CYL_SEL_ADJ_CST_
MIN)
then
LV_FAC_LAM_CYL_ADJ_CST_LIM[i] = 1
(1.12.9.9)
break$^{(5)}$
else$^{(6)}$
LV_FAC_LAM_CYL_ADJ_CST_LIM[i] = 0
(1.12.9.10)
endif$^{(6)}$
endfor$^{(5)}$

if$^{(5)}$ LV_FAC_LAM_CYL_ADJ_CST_LIM[i] = 0
then
for$^{(6)}$ j(x) = 1 : Number of cylinders per exhaust bank
FAC_CYL_LAM[x]$_k$ = FAC_CYL_LAM[x] -
(FAC_LAM_CYL_SEL_ADJ_CST[x]$_k$
-
FAC_LAM_CYL_SEL_ADJ_CST[x]$_{k-1}$)
(1.12.9.11)

FAC_CYL_LAM_INT[x]$_k$ = FAC_CYL_LAM[x]$_k$
(1.12.9.12)
FAC_LAM_CYL_SEL_ADJ_CST_FIL[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_CST_
FIL[x] -
(FAC_LAM_CYL_SEL_ADJ_CST[x]$_k$
-
FAC_LAM_CYL_SEL_ADJ_CST[x]$_{k-1}$)
(1.12.9.13)
endfor$^{(6)}$
else$^{(5)}$
for$^{(6)}$ j(x) = 1 : Number of cylinders per exhaust bank
FAC_LAM_CYL_SEL_ADJ_CST[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_CST[x]$_{k-1}$**(1.12.9.14)**
endfor$^{(6)}$
endif$^{(5)}$
CTR_T_LAM_CYL_ADJ[i] = C_T_LAM_CYL_ADJ_CST
(1.12.9.15)
LV_LAM_CYL_SEL_ADJ_VLD[i] = 1

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(1.12.9.16)

endif$^{(4)}$

else$^{(3)}$

if$^{(4)}$ STATE_LAM_CYL_SEL_ADJ[i] = 4 [ADJ_NOM_L_RNG]

then

if$^{(5)}$ CTR_T_LAM_CYL_ADJ[i] 0

then

decrement CTR_T_LAM_CYL_ADJ[i]

(1.12.9.17)

endif$^{(5)}$

if$^{(5)}$ CTR_T_LAM_CYL_ADJ[i] = 0

then

if$^{(6)}$ LV_LAM_CYL_SEL_CTL_FAST_REQ = 1

then

for$^{(7)}$ j(x) = 1 : Number of cylinders per exhaust bank

FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{k-1}$
+
IP_FAC_OPP_LAM_CYL_SEL_ADJ_
FAST*
FAC_LAM_CYL_SEL_ADJ_FIL[x]$_k$**(1.12.9.18)**

endfor$^{(7)}$

else$^{(6)}$

for$^{(7)}$ j(x) = 1 : Number of cylinders per exhaust bank

FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{k-1}$
+
IP_FAC_OPP_LAM_CYL_SEL_ADJ*
FAC_LAM_CYL_SEL_ADJ_FIL[x]$_k$**(1.12.9.19)**

endfor$^{(7)}$

endif$^{(6)}$

$$\text{FAC\_LAM\_CYL\_SEL\_ADJ\_L\_RNG\_MV[i]} = \frac{1}{\alpha} * \sum_{x=1}^{\alpha} \text{FAC\_LAM\_CYL\_SEL\_ADJ\_L\_RNG[x]}$$

: number of cylinders per bank**(1.12.9.20)**

if$^{(6)}$ FAC_LAM_CYL_SEL_ADJ_L_RNG_MV[i] 0

then

for$^{(7)}$ j(x) = 1 : Number of cylinders per exhaust bank

FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_k$
-
FAC_LAM_CYL_SEL_ADJ_L_RNG_
MV[i]

(1.12.9.21)

endfor$^{(7)}$

endif$^{(6)}$

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for$^{(6)}$ j(x) = 1 : Number of cylinders per exhaust bank
if$^{(7)}$ (FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_k$ $>$ C_FAC_LAM_CYL_SEL_ADJ_MAX
or
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_k$
$<$
C_FAC_LAM_CYL_SEL_ADJ_MIN)
then
LV_FAC_LAM_CYL_SEL_ADJ_LIM[i] = 1
(1.12.9.22)
break$^{(6)}$
else$^{(7)}$
LV_FAC_LAM_CYL_SEL_ADJ_LIM[i] = 0
(1.12.9.23)
endif$^{(7)}$
endfor$^{(6)}$

if$^{(6)}$ LV_FAC_LAM_CYL_SEL_ADJ_LIM[i] = 0
then
for$^{(7)}$ j(x) = 1 : Number of cylinders per exhaust bank
FAC_CYL_LAM[x]$_k$ = FAC_CYL_LAM[x] - (FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_k$
-
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{k-1}$)
(1.12.9.24)
FAC_CYL_LAM_INT[x]$_k$ = FAC_CYL_LAM[x]$_k$**(1.12.9.25)**
FAC_LAM_CYL_SEL_ADJ_FIL[x]$_k$ = FAC_LAM_CYL_SEL_ADJ_FIL[x]
-
(FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_k$
-
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{k-1}$)
(1.12.9.26)
endfor$^{(7)}$
else$^{(6)}$
for$^{(7)}$ j(x) = 1 : Number of cylinders per exhaust bank
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_k$ = FAC_LAM_CYL_SEL_ADJ_L_RNG[x]$_{k-1}$
(1.12.9.27)
endfor$^{(7)}$
endif$^{(6)}$
CTR_T_LAM_CYL_ADJ[i] = C_T_LAM_CYL_ADJ
(1.12.9.28)

$$\text{FAC\_CYL\_LAM\_ABSV\_SUM[i]} = \sum_{x=1}^{\alpha} \left|\text{FAC\_CYL\_LAM[x]}\right|$$

α: nr. of cylinders per bank

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(1.12.9.29)

if$^{(6)}$ FAC_CYL_LAM_ABSV_SUM[i] C_FAC_LAM_CYL_SEL_ADJ_VLD_
THD

then

LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] = 1

(1.12.9.30)

endif$^{(6)}$

if$^{(6)}$ LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[i] = 0

then

FAC_LAM_CYL_SEL_ADJ_H_RNG[x] = FAC_LAM_CYL_SEL_ADJ_L_RNG[x] **(1.12.9.31)**

endif$^{(6)}$

LV_LAM_CYL_SEL_ADJ_VLD[i] = 1

(1.12.9.32)

endif$^{(5)}$

else$^{(4)}$

if$^{(5)}$ STATE_LAM_CYL_SEL_ADJ[i] = 5 [ADJ_NOM_H_RNG]

then

if$^{(6)}$ CTR_T_LAM_CYL_ADJ[i] 0

then

decrement CTR_T_LAM_CYL_ADJ[i]

(1.12.9.33)

endif$^{(6)}$

if$^{(6)}$ CTR_T_LAM_CYL_ADJ[i] = 0

then

if$^{(7)}$ LV_LAM_CYL_SEL_CTL_FAST_REQ = 1

then

for$^{(8)}$ j(x) = 1 : Number of cylinders per exhaust bank

FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_k$ = FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{k-1}$
+
IP_FAC_OPP_LAM_CYL_SEL_ADJ_
FAST*
FAC_LAM_CYL_SEL_ADJ_FIL[x]$_k$

(1.12.9.34)

endfor$^{(8)}$

else$^{(7)}$

for$^{(8)}$ j(x) = 1 : Number of cylinders per exhaust bank

FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_k$ = FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{k-1}$
+
IP_FAC_OPP_LAM_CYL_SEL_ADJ*
FAC_LAM_CYL_SEL_ADJ_FIL[x]$_k$

(1.12.9.35)

endfor$^{(8)}$

endif$^{(7)}$

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FAC_LAM_CYL_SEL_ADJ_H_RNG_MV[i] =

$$\frac{1}{\alpha} * \sum_{x=1}^{\alpha} \text{FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG[x]}$$

α: number of cylinders per bank **(1.12.9.36)**

if(7) FAC_LAM_CYL_SEL_ADJ_H_RNG_MV[i] 0
then
for(8) j(x) = 1 : Number of cylinders per exhaust bank
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_k$
-
FAC_LAM_CYL_SEL_ADJ_H_RNG_
MV[i]
(1.12.9.37)
endfor(8)
endif(7)
for(7) j(x) = 1 : Number of cylinders per exhaust bank
if(8) (FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_k$
>
C_FAC_LAM_CYL_SEL_ADJ_MAX
or
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_k$
<
C_FAC_LAM_CYL_SEL_ADJ_MIN)
then
LV_FAC_LAM_CYL_SEL_ADJ_LIM[i] = 1
(1.12.9.38)
break(7)
else(8)
LV_FAC_LAM_CYL_SEL_ADJ_LIM[i] = 0
(1.12.9.39)
endif(8)
endfor(7)

if(7) LV_FAC_LAM_CYL_SEL_ADJ_LIM[i] = 0
then
for(8) j(x) = 1 : Number of cylinders per exhaust bank
FAC_CYL_LAM[x]$_k$ =
FAC_CYL_LAM[x] -
(FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_k$
-
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{k-1}$)
(1.12.9.40)
FAC_CYL_LAM_INT[x]$_k$ =
FAC_CYL_LAM[x]$_k$ **(1.12.9.41)**
FAC_LAM_CYL_SEL_ADJ_FIL[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_FIL[x]
-

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(FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{k}$

-

FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{k-1}$)
(1.12.9.42)

endfor$^{(8)}$
else$^{(7)}$
for$^{(8)}$ j(x) = 1 : Number of cylinders per exhaust bank
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{k}$ =
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]$_{k-1}$
(1.12.9.43)
endfor$^{(8)}$
endif$^{(7)}$
CTR_T_LAM_CYL_ADJ[i] = C_T_LAM_CYL_ADJ
(1.12.9.44)

$$\text{FAC\_CYL\_LAM\_ABSV\_SUM[i]} = \sum_{x=1}^{\alpha} \left|\text{FAC\_CYL\_LAM[x]}\right|$$

α : nr. of cylinders per bank

(1.12.9.-)
if$^{(7)}$ FAC_CYL_LAM_ABSV_SUM[i]
C_FAC_LAM_CYL_SEL_ADJ_VLD_
THD
then
LV_LAM_CYL_SEL_ADJ_H_RNG_
VLD[i] = 1
(1.12.9.46)
endif$^{(7)}$
if$^{(7)}$ LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[i] = 0
then
FAC_LAM_CYL_SEL_ADJ_L_RNG[x] =
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]**(1.12.9.47)**
endif$^{(7)}$
LV_LAM_CYL_SEL_ADJ_VLD[i] = 1
(1.12.9.48)
endif$^{(6)}$
endif$^{(5)}$
endif$^{(4)}$
endif$^{(3)}$
if$^{(3)}$ STATE_LAM_CYL_SEL_ADJ[i] = 6 [ADJ_NOM_OFS]
then
if$^{(4)}$ CTR_T_LAM_CYL_ADJ[i] 0
then
decrement CTR_T_LAM_CYL_ADJ[i]
(1.12.9.49)
endif$^{(4)}$
if$^{(4)}$ CTR_T_LAM_CYL_ADJ[i] = 0
then
if$^{(5)}$ LV_LAM_CYL_SEL_CTL_FAST_REQ = 1
then
for$^{(6)}$ j(x) = 1 : Number of cylinders per exhaust bank

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MFF_ADD_CYL_LAM_COR[x]$_k$ =
MFF_ADD_CYL_LAM_COR[x]$_{k-1}$
+ MFF_SP[i]*
IP_FAC_OPP_LAM_CYL_SEL_ADJ_
FAST*
FAC_LAM_CYL_SEL_ADJ_FIL[x]$_k$**(1.12.9.50)**

endfor(6)
else(5)
for(6) j(x) = 1 : Number of cylinders per exhaust bank
MFF_ADD_CYL_LAM_COR[x]$_k$ =
MFF_ADD_CYL_LAM_COR[x]$_{k-1}$
+ MFF_SP[i]*
IP_FAC_OPP_LAM_CYL_SEL_ADJ*
FAC_LAM_CYL_SEL_ADJ_FIL[x]$_k$**(1.12.9.51)**

endfor(6)
endif(5)

MFF_ADD_CYL_LAM_COR_MV[i] =

$$\frac{1}{\alpha} * \sum_{x=1}^{\alpha} \text{MFF\_ADD\_CYL\_LAM\_COR[x]}$$

: number of cylinders per bank
(1.12.9.52)

if(5) MFF_ADD_CYL_LAM_COR_MV[i] 0
then
for(6) j(x) = 1 : Number of cylinders per exhaust bank
MFF_ADD_CYL_LAM_COR[x]$_k$ =
MFF_ADD_CYL_LAM_COR[x]$_k$ -
MFF_ADD_CYL_LAM_COR_MV[i]
(1.12.9.53)

endfor(6)
endif(5)

for(5) j(x) = 1 : Number of cylinders per exhaust bank
if(6) (MFF_ADD_CYL_LAM_COR[x]$_k$ $>$
C_MFF_MAX_ADD_LAM_CYL_SEL_
ADJ **or**
MFF_ADD_CYL_LAM_COR[x]$_k$ $<$
C_MFF_MIN_ADD_LAM_CYL_SEL_
ADJ)
then
LV_MFF_ADD_CYL_LAM_COR_LIM[i] = 1
(1.12.9.54)
break(5)
else(6)
LV_MFF_ADD_CYL_LAM_COR_LIM[i] = 0
(1.12.9.55)
endif(6)
endfor(5)

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if$^{(5)}$ LV_MFF_ADD_CYL_LAM_COR_LIM[i] = 0
then
for$^{(6)}$ j(x) = 1 : Number of cylinders per exhaust bank
FAC_CYL_LAM[x]$_k$ = FAC_CYL_LAM[x]$_k$ -
(MFF_ADD_CYL_LAM_COR[x]$_k$ -
MFF_ADD_CYL_LAM_COR[x]$_{k-1}$)/
MFF_SP[i] **(1.12.9.56)**
FAC_CYL_LAM_INT[x]$_k$ = FAC_CYL_LAM[x]$_k$
(1.12.9.57)
FAC_LAM_CYL_SEL_ADJ_FIL[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_FIL[x]$_k$
-
(MFF_ADD_CYL_LAM_COR[x]$_k$ -
MFF_ADD_CYL_LAM_COR[x]$_{k-1}$)/
MFF_SP[i] **(1.12.9.58)**
endfor$^{(6)}$
else$^{(5)}$
for$^{(6)}$ j(x) = 1 : Number of cylinders per exhaust bank
MFF_ADD_CYL_LAM_COR[x]$_k$ =
MFF_ADD_CYL_LAM_COR[x]$_{k-1}$**(1.12.9.59)**
endfor$^{(6)}$
endif$^{(5)}$
CTR_T_LAM_CYL_ADJ[i] = C_T_LAM_CYL_ADJ
(1.12.9.60)
LV_LAM_CYL_SEL_ADJ_VLD[i] = 1
(1.12.9.61)
endif$^{(4)}$
endif$^{(3)}$
endif$^{(2)}$
endif$^{(1)}$

if$^{(1)}$ (STATE_LAM_CYL_SEL_ADJ[i] = 0 [PAS] **or**
STATE_LAM_CYL_SEL_ADJ[i] =
1 [WAIT_ENG_COLD] **or**
STATE_LAM_CYL_SEL_ADJ[i] =
3 [WAIT_ENG_NOM])
then
CTR_T_LAM_CYL_ADJ[i] = 0
(1.12.9.62)
endif$^{(1)}$

7.73.14 Calculation of the cylinder individual injection time correction

The value of the controller output FAC_CYL_LAM_COR[x] shall be calculated depending on adaptation state STATE_LAM_CYL_SEL_ADJ[i].

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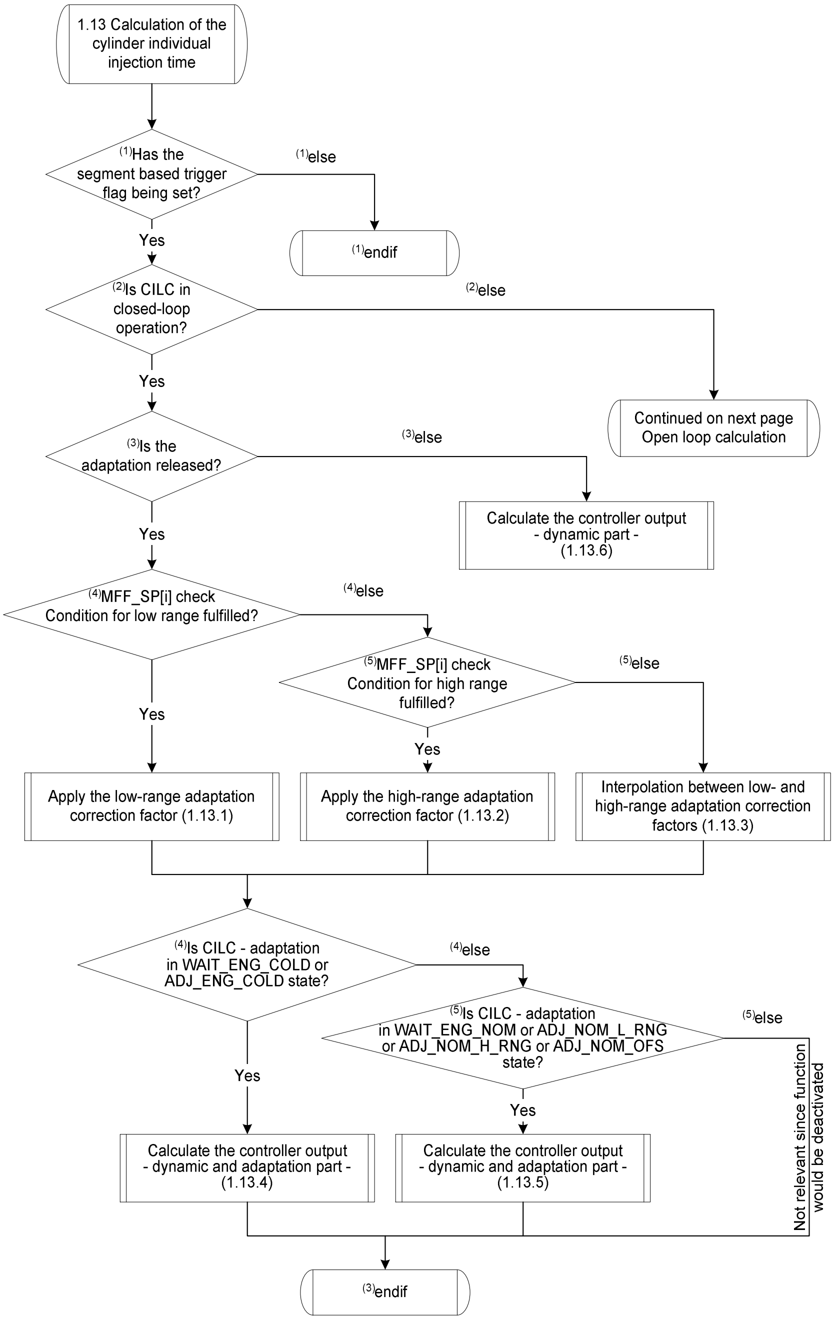

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Figure 7.73.17: TOLOMEOGRAPHIC 269252-68.ps

if$^{(1)}$ LV_TRIG[x] =1

then

if$^{(2)}$ STATE_LAM_CYL_SEL[i] = 3 [CLL]

then
if(3) LC_ADAPT_COR_OUT = 1
then
if(4) MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_L_RNG
then
FAC_LAM_CYL_SEL_ADJ[x] =
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]
(1.13.1)
else(4)
if(5) MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_H_RNG
then
FAC_LAM_CYL_SEL_ADJ[x] =
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]
(1.13.2)
else(5)
FAC_LAM_CYL_SEL_ADJ[x] =
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]
+
(MFF_SP[i] - C_MFF_SP_THD_
CYL_SEL_ADJ_L_RNG)*
(FAC_LAM_CYL_SEL_ADJ_H_RNG[x]
-
FAC_LAM_CYL_SEL_ADJ_L_RNG[x])/
(C_MFF_SP_THD_CYL_SEL_ADJ_
H_RNG -
C_MFF_SP_THD_CYL_SEL_ADJ_
L_RNG) **(1.13.3)**
endif(5)
endif(4)
if(4) (STATE_LAM_CYL_SEL_ADJ[i] = 1 [WAIT_ENG_COLD] **or**
STATE_LAM_CYL_SEL_ADJ[i] =
2 [ADJ_ENG_COLD])
then
FAC_CYL_LAM_COR[x]$_k$ = FAC_LAM_CYL_SEL_ADJ_CST[x]
+ FAC_CYL_LAM[x]$_k$ **(1.13.4)**
else(4)
if(5) (STATE_LAM_CYL_SEL_ADJ[i] = 3 [WAIT_ENG_NOM]
or STATE_LAM_CYL_SEL_ADJ[i]
= 4 [ADJ_NOM_L_RNG]
or STATE_LAM_CYL_SEL_ADJ[i]
= 5 [ADJ_NOM_H_RNG]
or STATE_LAM_CYL_SEL_ADJ[i]
= 6 [ADJ_NOM_OFS])
then
FAC_CYL_LAM_COR[x]$_k$ = FAC_LAM_CYL_SEL_ADJ[x]
+ FAC_CYL_LAM[x]$_k$ **(1.13.5)**
endif(5)
endif(4)
else(3)
FAC_CYL_LAM_COR[x]$_k$ = FAC_CYL_LAM[x]$_k$
(1.13.6)
endif(3)

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else$^{(2)}$

if$^{(3)}$ LC_ADAPT_COR_OUT = 1

then

if$^{(4)}$ MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_L_RNG

then

FAC_LAM_CYL_SEL_ADJ[x] =
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]
(1.13.7)

else$^{(4)}$

if$^{(5)}$ MFF_SP[i] C_MFF_SP_THD_CYL_SEL_ADJ_H_RNG

then

FAC_LAM_CYL_SEL_ADJ[x] =
FAC_LAM_CYL_SEL_ADJ_H_RNG[x]
(1.13.8)

else$^{(5)}$

FAC_LAM_CYL_SEL_ADJ[x] =
FAC_LAM_CYL_SEL_ADJ_L_RNG[x]
+
(MFF_SP[i] - C_MFF_SP_THD_
CYL_SEL_ADJ_L_RNG)*
(FAC_LAM_CYL_SEL_ADJ_H_RNG[x]
-
FAC_LAM_CYL_SEL_ADJ_L_RNG[x])/
(C_MFF_SP_THD_CYL_SEL_ADJ_
H_RNG -
C_MFF_SP_THD_CYL_SEL_ADJ_
L_RNG) **(1.13.9)**

endif$^{(5)}$

endif$^{(4)}$

if$^{(4)}$ (C_TEMP_LAM_CYL_CST_MIN $<$ TEMP_LAM_CYL_SEL $<$
C_TEMP_LAM_CYL_CST_MAX)

then

if$^{(5)}$ LC_LAM_CYL_SEL_OPL = 0

then

FAC_CYL_LAM_COR[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_CST[x]
+
FAC_CYL_LAM[x]$_k$**(1.13.10)**

else$^{(5)}$

FAC_CYL_LAM_COR[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ_CST[x]
(1.13.11)

endif$^{(5)}$

else$^{(4)}$

if$^{(5)}$ TEMP_LAM_CYL_SEL C_TEMP_LAM_CYL_MIN

then

if$^{(6)}$ LC_LAM_CYL_SEL_OPL = 0

then

FAC_CYL_LAM_COR[x]$_k$ =
FAC_LAM_CYL_SEL_ADJ[x]
+ FAC_CYL_LAM[x]$_k$**(1.13.12)**

else$^{(6)}$

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FAC_CYL_LAM_COR[x]$_k$ = FAC_LAM_CYL_SEL_ADJ[x] **(1.13.13)**

endif$^{(6)}$

endif$^{(5)}$

endif$^{(4)}$

else$^{(3)}$

FAC_CYL_LAM_COR[x]$_k$ = 0 **(1.13.14)**

endif$^{(3)}$

endif$^{(2)}$

[*Remark: the cylinder based calculation (index x) shall be assigned to the corresponding exhaust bank (index i)*]

endif$^{(1)}$

7.73.15 Calculation of the characteristic value of the state variables - control action result

In order to evaluate the control-action result the absolute value of mean value-deviation of the state variables shall be averaged over the whole combustion cycle.
In order to evaluate the adaptation result the sum of the absolute cylinder individual controller outputs is calculated (FAC_CYL_LAM_ABSV_SUM[i]).
Convergence of FAC_CYL_LAM_ABSV_SUM[i] is an indication of a well-running adaptation process.
In case of separate exhaust banks existing, the calculation shall be carried out for both exhaust banks at the beginning of the combustion cycle (SEG_NR = 0).

if$^{(1)}$ SEG_NR = 0
then

if$^{(2)}$ STATE_LAM_CYL_SEL[i] = 3 [*calculation is exhaust bank selective*]
then

$$\text{DELTA\_LAMB\_CYL\_SEL\_CQ[i]} = \frac{1}{\alpha}\sum_{x=1}^{\alpha}\left|\left[\frac{1}{\alpha}\sum_{x=1}^{\alpha}\text{DELTA\_LAMB\_CYL[x]}\right] - \text{DELTA\_LAMB\_CYL[x]}\right|$$

α : nr. of cylinders per bank

(1.14.1)

$$\text{FAC\_CYL\_LAM\_ABSV\_SUM[i]} = \sum_{x=1}^{\alpha}\left|\text{FAC\_CYL\_LAM[x]}\right|$$

α : nr. of cylinders per bank

(1.14.2)

[*Remark: the cylinder based variables (index x) shall be assigned to the corresponding exhaust bank (index i)*]

DELTA_LAMB_CYL_SEL_CQ_FIL[i]$_k$ = DELTA_LAMB_CYL_SEL_CQ_FIL[i]$_{k-1}$ + (DELTA_LAMB_CYL_SEL_CQ[i]$_k$ - DELTA_LAMB_CYL_SEL_CQ_FIL[i]$_{k-1}$) *C_CRLC_DELTA_LAMB_CYL_CQ_FIL **(1.14.3)**

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if$^{(3)}$ CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] $<$ C_CTR_LAMB_CYL_SEL_CQ_DRIFT_THD
then
if$^{(4)}$ DELTA_LAMB_CYL_SEL_CQ_FIL[i] C_LAMB_CYL_SEL_CQ_DRIFT_THD
then
increment (CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i])
(1.14.4)
if$^{(5)}$ CTR_LAMB_CYL_SEL_CQ_STAB[i] $>$ 0
then
decrement (CTR_LAMB_CYL_SEL_CQ_STAB[i])
(1.14.5)
endif$^{(5)}$
else$^{(4)}$
if$^{(5)}$ CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] $>$ 0
then
decrement (CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i])
(1.14.6)
endif$^{(5)}$
if$^{(5)}$ CTR_LAMB_CYL_SEL_CQ_STAB[i] $<$ C_CTR_LAMB_CYL_SEL_CQ_STAB_THD
then
increment (CTR_LAMB_CYL_SEL_CQ_STAB[i])
(1.14.7)
endif$^{(5)}$
endif$^{(4)}$
else$^{(3)}$
if$^{(4)}$ DELTA_LAMB_CYL_SEL_CQ_FIL[i] $<$ C_LAMB_CYL_SEL_CQ_DRIFT_THD
then
if$^{(5)}$ CTR_LAMB_CYL_SEL_CQ_STAB[i] $<$ C_CTR_LAMB_CYL_SEL_CQ_STAB_THD
then
increment (CTR_LAMB_CYL_SEL_CQ_STAB[i])
(1.14.8)
endif$^{(5)}$
if$^{(5)}$ CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] $>$ 0
then
decrement (CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i])
(1.14.9)
endif$^{(5)}$
else$^{(4)}$
if$^{(5)}$ CTR_LAMB_CYL_SEL_CQ_STAB[i] $>$ 0
then
decrement (CTR_LAMB_CYL_SEL_CQ_STAB[i])
(1.14.10)
endif$^{(5)}$
endif$^{(4)}$

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endif$^{(3)}$

if$^{(3)}$ CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] = C_CTR_LAMB_CYL_SEL_CQ_DRIFT_THD

then

LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 1 **(1.14.11)**

else$^{(3)}$

if$^{(4)}$ LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 1

then

if$^{(5)}$ CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] = 0

then

LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 0 **(1.14.12)**

endif$^{(5)}$

endif$^{(4)}$

endif$^{(3)}$

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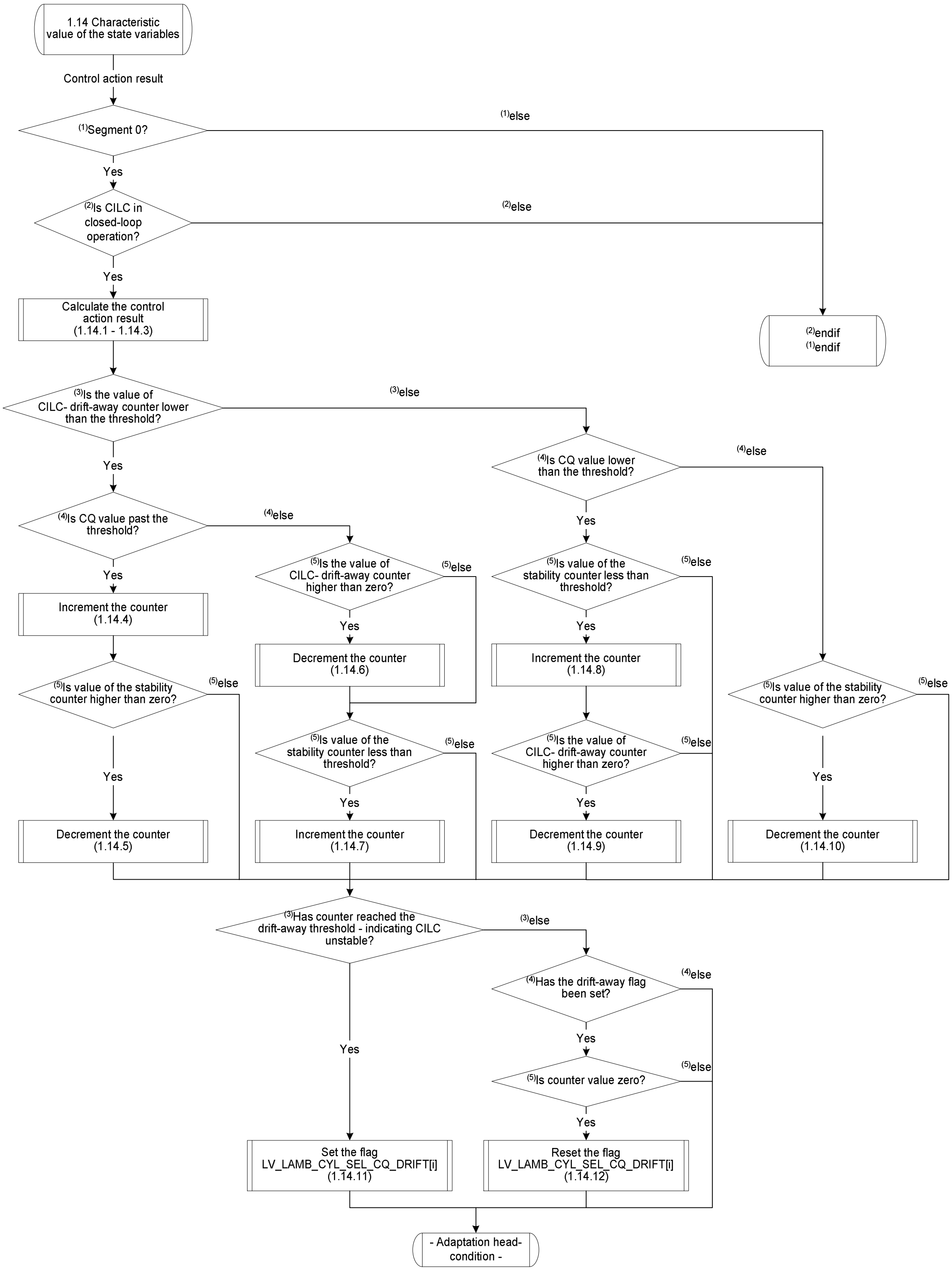

7.73.16 Detection of observer divergence

In order to detect the observer divergence in closed-loop operation and stop the adaptation process consequently, virtual limitation (C_FAC_CYL_LAM_VIRT_MIN/MAX) is defined. As soon as the single controller output (FAC_CYL_LAM[x]) passes the virtual limit over, the value of CILC- Characteristic Quantity (CQ- value as a measure for the observer behaviour) for the concerned exhaust bank is stored. Should one of the concerned exhaust-bank members (cylinders) reach the actual limit (LV_FAC_CYL_

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LAM_LIM_MIN/MAX[x] = 1) the current CQ- value has to be compared with the stored value at virtual limit transition. A positive ascent of characteristic value (CQ- value) in current activation cycle (STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 2) is interpreted as for unstable behaviour of CILC and shall involve inhibition of adaptation process.

if$^{(3)}$ (STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 0 **or** STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 1)
then
if$^{(4)}$ (FAC_CYL_LAM[x]$_k <$ C_FAC_CYL_LAM_VIRT_MIN **or** FAC_CYL_LAM[x]$_k >$ C_FAC_CYL_LAM_VIRT_MAX)
then
if$^{(5)}$ LV_FAC_CYL_LAM_VIRT_LIM[i] = 0
then
LAMB_CYL_SEL_CQ_REF[i] = DELTA_LAMB_CYL_SEL_CQ_FIL[i] **(1.15.1)**
LV_FAC_CYL_LAM_VIRT_LIM[i] = 1 **(1.15.2)**
else$^{(5)}$
if$^{(6)}$ (LV_FAC_CYL_LAM_LIM_MIN[x] = 1 **or** LV_FAC_CYL_LAM_LIM_MAX[x] = 1)
then
LAMB_CYL_SEL_CQ_DIF_REF[i] = DELTA_LAMB_CYL_SEL_CQ_FIL[i] - LAMB_CYL_SEL_CQ_REF[i] **(1.15.3)**
if$^{(7)}$ LAMB_CYL_SEL_CQ_DIF_REF[i] $>$ C_LAMB_CYL_SEL_CQ_DIF_REF_THD
then
STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 2 **(1.15.4)**
else$^{(7)}$
if$^{(8)}$ (STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 1 **and** CTR_LAMB_CYL_SEL_CQ_STAB[i] = C_CTR_LAMB_CYL_SEL_CQ_STAB_THD)
then
STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 0 **(1.15.5)**
endif$^{(8)}$
endif$^{(7)}$
else$^{(6)}$
if$^{(7)}$ (STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 1 **and** CTR_LAMB_CYL_SEL_CQ_STAB[i] = C_CTR_LAMB_CYL_SEL_CQ_STAB_THD)
then

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STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 0
(1.15.6)

endif$^{(7)}$

endif$^{(6)}$

endif$^{(5)}$

else$^{(4)}$

LV_FAC_CYL_LAM_VIRT_LIM[i] = 0
(1.15.7)

if$^{(5)}$ (STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 1 **and** CTR_LAMB_CYL_SEL_CQ_STAB[i]
=
C_CTR_LAMB_CYL_SEL_CQ_STAB_
THD)

then

STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 0
(1.15.8)

endif$^{(5)}$

endif$^{(4)}$

endif$^{(3)}$

endif$^{(2)}$

endif$^{(1)}$

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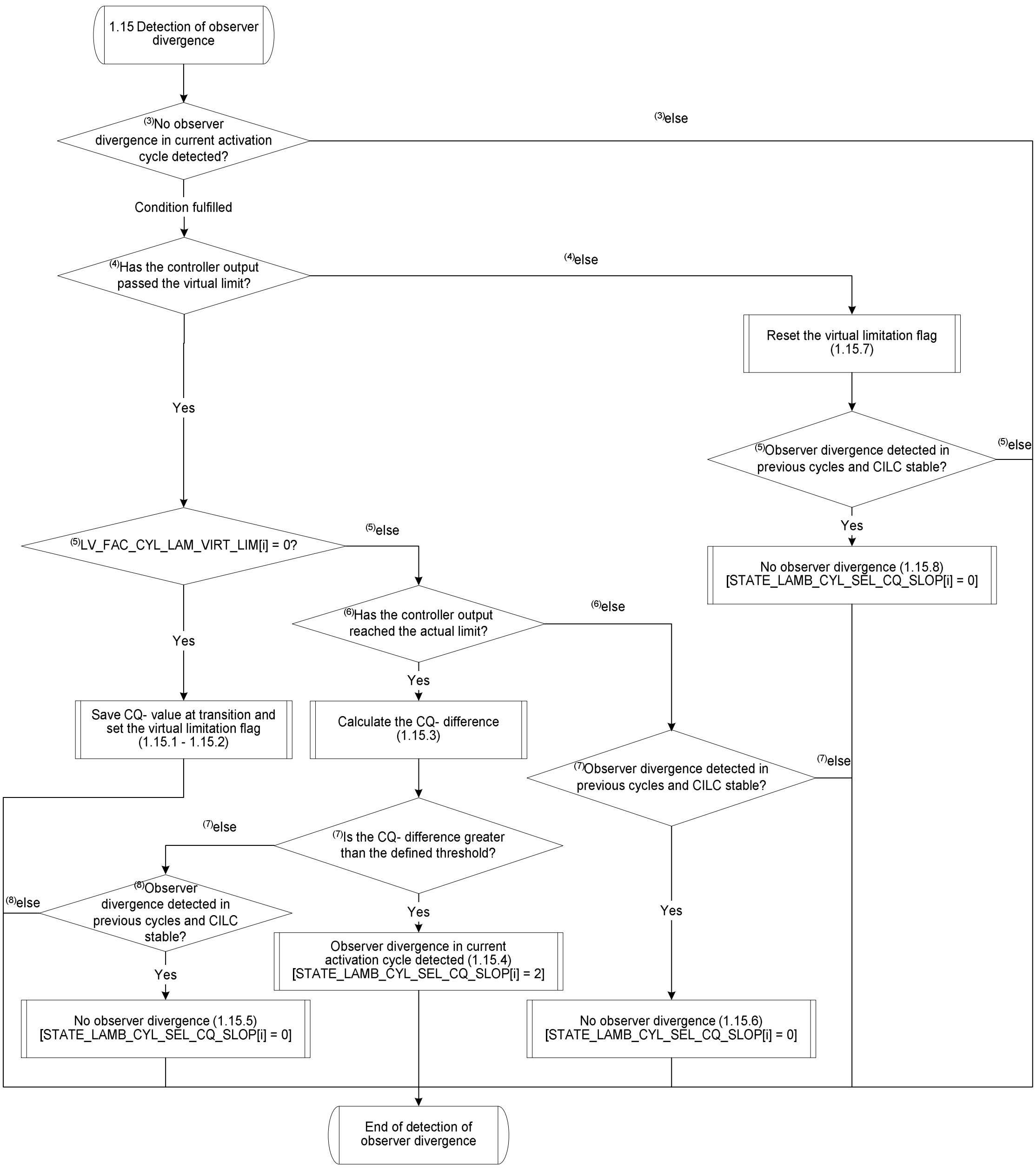

7.73.17 Adaptation head-condition

In order to stop the long-term adaptation in case of controller outputs drift away, controller behaviour shall be predicted using following auxiliary variables:

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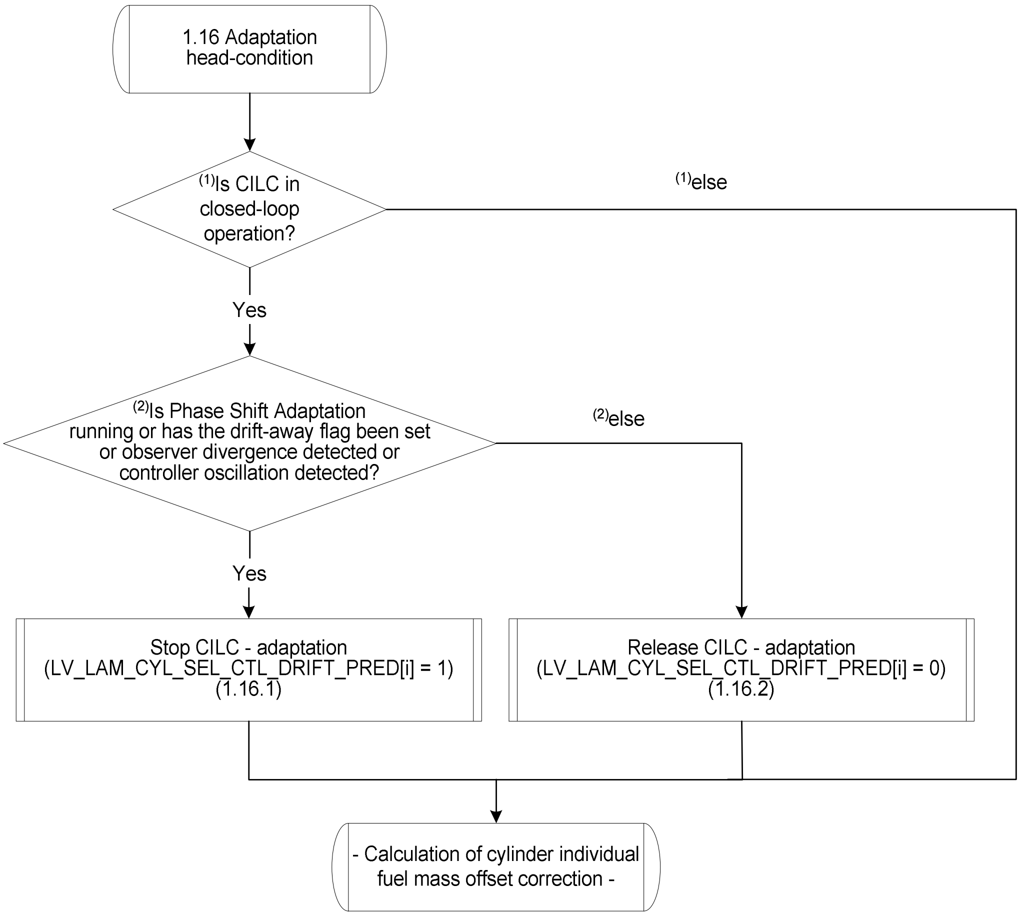

if$^{(1)}$ STATE_LAM_CYL_SEL[i] = 3 [*calculation is exhaust bank selective*]
then
    if$^{(2)}$ (STATE_DELTA_CRK_CYL_LAM[i] = 3 'AD_INI' **or**
STATE_DELTA_CRK_CYL_LAM[i] = 4 'AD_DEC' **or**
STATE_DELTA_CRK_CYL_LAM[i] = 5 'AD_INC' **or**
LV_LAMB_CYL_SEL_CQ_DRIFT[i] = 1 **or**
STATE_LAMB_CYL_SEL_CQ_SLOP[i] 0 **or**
LV_FAC_CYL_LAM_COR_OSC[i] = 1)
    then
        LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 1 **(1.16.1)**
    else$^{(2)}$
        LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 0 **(1.16.2)**
    endif$^{(2)}$
endif$^{(1)}$

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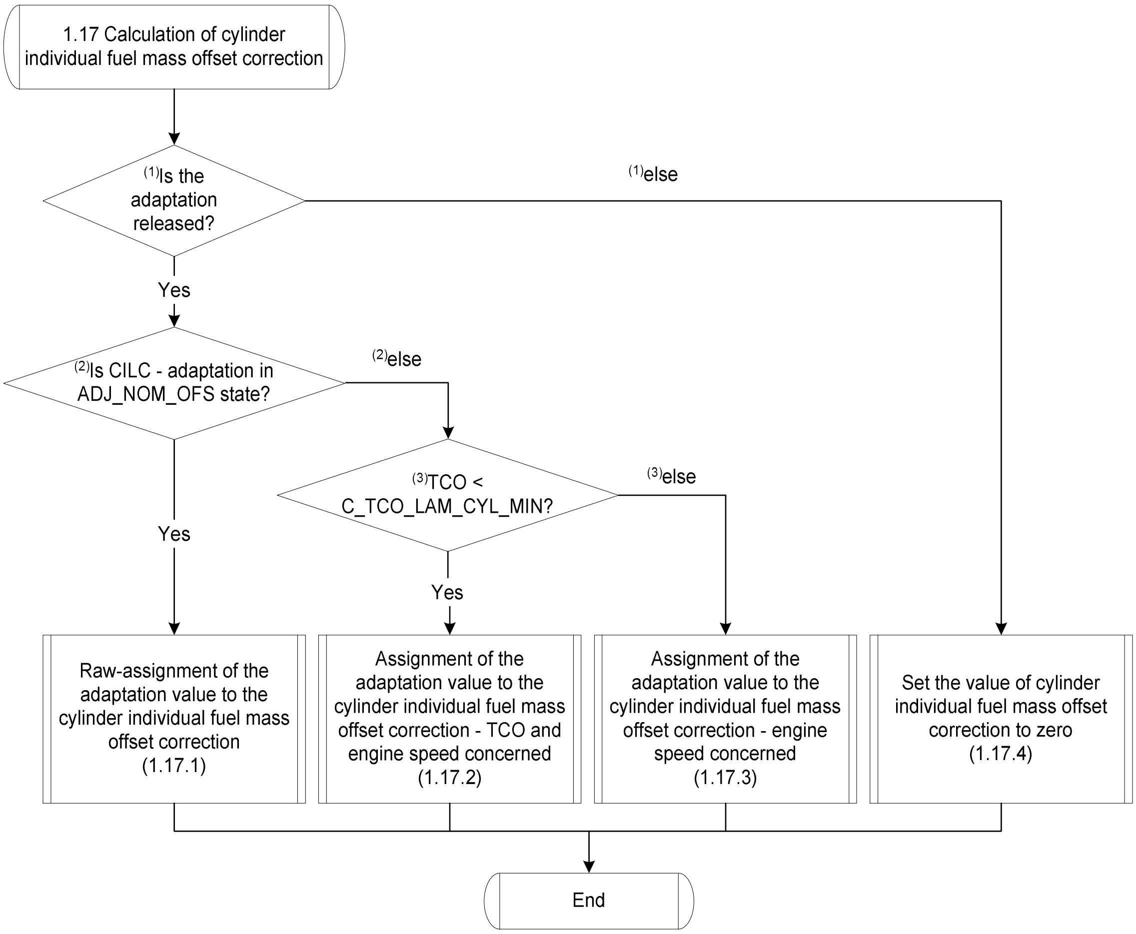
7.73.18 Calculation of cylinder individual fuel mass offset correction - weighted output

The value of cylinder individual fuel mass offset correction should be weighted versus engine speed, and temperature up to engine runs to the nominal temperature for activation of cylinder individual lambda control. The calculation shall be carried out independently of the activation condition for all of the cylinders.



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if$^{(1)}$ LC_ADAPT_COR_OUT = 1
then
if$^{(2)}$ STATE_LAM_CYL_SEL_ADJ[i] = 6 [ADJ_NOM_OFS]
then
MFF_ADD_CYL_LAM_COR_OUT[x] = MFF_ADD_CYL_LAM_COR[x]
(1.17.1)
else$^{(2)}$
if$^{(3)}$ TEMP_LAM_CYL_SEL $<$ C_TEMP_LAM_CYL_MIN
then
MFF_ADD_CYL_LAM_COR_OUT[x] = MFF_ADD_CYL_LAM_COR[x]*
IP_FAC_N_MFF_ADD_CYL_LAM_
COR*
IP_FAC_WUP_MFF_ADD_CYL_LAM
(1.17.2)
else$^{(3)}$
MFF_ADD_CYL_LAM_COR_OUT[x] = MFF_ADD_CYL_LAM_COR[x]*

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IP_FAC_N_MFF_ADD_CYL_LAM_COR **(1.17.3)**

endif(3)

endif(2)

else(1)

MFF_ADD_CYL_LAM_COR_OUT[x] = 0 **(1.17.4)**

endif(1)

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7.74 Phase shift adaptation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_CHG_FAC_PHA_SHIFT_AD [NC_CBK_EX_NR]	V	1... 78H	1... 120	1	-
Recursive change factor					
CRK_CYL_LAM_DELTA_INI [NC_CBK_EX_NR]	O/V/S	88... 78H	-720 ...720	6	°CRK
Initial CRK - adaptation value					
CRK_CYL_LAM_INT [NC_CBK_EX_NR]	V	88... 78H	-720 ...720	6	°CRK
Output of the integral-action					
CTR_CQ_FIL_FALL [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for improved cycles of cylinder individual lambda control response - CQ based					
CTR_CQ_MAX_OSC [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Duration of exceeded CQ limit					
CTR_CQ_MON_PHA_SHIFT_AD [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Period of CQ monitoring					
CTR_ER_MON_PHA_SHIFT_AD [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Period of engine roughness monitoring					
CTR_FAC_CYL_LAM_COR_DIF_ABSV [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for improved cycles of cylinder individual lambda control response - FAC_CYL_LAM_COR based					
CTR_PHA_SHIFT_AD_TRIG [NC_CBK_EX_NR]	O/V/S	0... FFH	0... 255	1	-
Counter for triggering the phase shift adaptation					
CTR_RESP_CYC_LAM_CYL_SEL [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for evaluation of cylinder individual lambda control response					
CTR_RESP_LAM_CYL_SEL [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Response time for adaptation result					
CTR_SUM_FAC_CYL_LAM_COR_OSC [NC_CYL_NR]	V	0... FFFFH	0... 65535	1	-
Duration of oscillation monitoring					
DELTA_CRK_CYL_LAM [NC_CBK_EX_NR]	O/V/S	88... 78H	-720 ...720	6	°CRK
Value of adapted phase displacement					
ER_STND_MMV_DIF_ABSV_SUM_GRD [NC_CBK_EX_NR]	V	8000... 7FFFH	-325.78 ...325.77	9.942e-3	1/s**2
Gradient of the absolute difference of filtered normalized and average engine roughness value					
ER_STND_MMV_DIF_ABSV_SUM_PRE [NC_CBK_EX_NR]	V	0... 7FFFH	0... 325.77	9.942e-3	1/s**2
Sum of the absolute difference of filtered normalized and average engine roughness value - previous sample					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ER_STND_MMV_DIF_BAL_ABSV_SUM [NC_CBK_EX_NR]	V	0... 7FFFH	0... 325.77	9.942e-3	1/s**2
Sum of the absolute difference of filtered normalized and average engine roughness value					
FAC_CYL_LAM_ABSV_SUM_GRD [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Gradient of the CILC outputs absolute sum					
FAC_CYL_LAM_ABSV_SUM_PRE [NC_CBK_EX_NR]	V	0... 7FFFH	0... 49.99847	1.5259e-3	%
Sum of the absolute cylinder individual controller outputs - previous sample					
FAC_CYL_LAM_SAVE [NC_CYL_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Value of the saved cylinder individual lambda controller output					
LV_DELTA_CRK_CYL_LAM_ERR [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Error flag indicating the adaptation value is not correct					
LV_ER_ABSV_SUM_GRD_RISE [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Unstable engine roughness detected					
LV_FAC_CYL_LAM_COR_LIM_OSC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Alternating limitation detected					
LV_FAC_CYL_LAM_COR_OSC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Oscillation detected					
LV_FAC_CYL_LAM_OSC_MAX_THD [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Flag indicating the upper limit of cylinder individual lambda control was reached - oscillation monitoring					
LV_FAC_CYL_LAM_OSC_MIN_THD [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Flag indicating the lower limit of cylinder individual lambda control was reached - oscillation monitoring					
LV_STATE_DELTA_CRK_WAIT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Waiting for adaptation response					
STATE_DELTA_CRK_CYL_LAM [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H 4H 5H 6H	AD_PAS AD_ACT AD_CDN AD_INI AD_DEC AD_INC AD_HOLD	-	-
Adaptation state					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Input data:

CTR_LAMB_CYL_SEL_CQ_DRIFT_THD [NC_CBK_EX_NR] {p. 2730}	DELTA_LAMB_CYL_SEL_CQ [NC_CBK_EX_NR] {p. 2730}	DELTA_LAMB_CYL_SEL_CQ_FIL [NC_CBK_EX_NR] {p. 2730}	ER_STND_MMV_DIF_BAL [NC_CYL_NR] {p. 1489}
FAC_CYL_LAM [NC_CYL_NR] {p. 2730}	FAC_CYL_LAM_ABSV_SUM [NC_CBK_EX_NR] {p. 2730}	LF_LS_CBK_EX_LAM_CYL_SEL_CONF {p. 2864}	LV_CRK_CYL_LAM_DELTA_RST_LS_EXT [NC_CBK_EX_NR]
LV_DC {p. 5746}	LV_ER_STND_ER_BAL_ACT {p. 4022}	LV_ES {p. 1720}	LV_FAC_CYL_LAM_LIM_MAX [NC_CYL_NR] {p. 2732}
LV_FAC_CYL_LAM_LIM_MIN [NC_CYL_NR] {p. 2732}	LV_LAM_CYL_SEL_CTL_DRIFT_PRED [NC_CBK_EX_NR] {p. 2732}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
SEG_NR {p. 1525}	STATE_LAM_CYL_SEL [NC_CBK_EX_NR] {p. 2733}	STATE_LAMB_CYL_SEL_CQ_SLOP [NC_CBK_EX_NR] {p. 2733}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRK_CHG_FAC_MAX	-	1... 78H	1... 120	1	-
Upper limit of the CRK change factor					
C_CRK_CHG_STEP	-	88... 78H	-720 ...720	6	°CRK
CRK change step					
C_CRK_CYL_LAM_DELTA_INI	-	88... 78H	-720 ...720	6	°CRK
CRK - initial constant					
C_CRK_CYL_LAM_INI_RED	-	0... 78H	0... 720	6	°CRK
CRK - initial reduction factor					
C_CTR_CQ_FIL_FALL_MIN	-	0... FFH	0... 255	1	-
Least number of improvement cycles to extend the waiting time for evaluation of adaptation result - CQ - based					
C_CTR_CQ_FIL_FALL_OK	-	0... FFH	0... 255	1	-
Minimum number of improved cycles to accept the adaptation value - CQ - based					
C_CTR_CQ_MIN_PHA_SHIFT_AD	-	0... FFFFH	0... 65535	1	-
Minimum time of exceeded CQ limit to request the adaptation					
C_CTR_CQ_MON_PHA_SHIFT_AD_MAX	-	0... FFFFH	0... 65535	1	-
Maximum time of oscillation monitoring - CQ - based					
C_CTR_ER_MON_PHA_SHIFT_AD_MAX	-	0... FFFFH	0... 65535	1	-
Maximum time for engine roughness monitoring					
C_CTR_ER_RESP_MIN_LAM_CYL_SEL	-	0... FFFFH	0... 65535	1	-
Minimum response time of engine roughness for evaluation of adaptation result					
C_CTR_FAC_CYL_LAM_DIF_ABSV_MIN	-	0... FFH	0... 255	1	-
Least number of improvement cycles to extend the waiting time for evaluation of adaptation result - FAC_CYL_LAM_COR - based					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_FAC_CYL_LAM_DIF_ABSV_OK	-	0... FFH	0... 255	1	-
Minimum number of improved cycles to accept the adaptation value - FAC_CYL_LAM_COR - based					
C_CTR_PHA_SHIFT_AD_TRIG_THD	-	0... FFH	0... 255	1	-
Trigger threshold for delayed phase shift adaptation					
C_CTR_RESP_CYC_MIN_LAM_CYL_SEL	-	0... FFH	0... 255	1	-
Minimum number of response cycles to evaluate the adaptation result					
C_CTR_RESP_MIN_LAM_CYL_SEL	-	0... FFFFH	0... 65535	1	-
Minimum response time for adaptation result					
C_CTR_SUM_FAC_CYL_LAM_OSC_MAX	-	0... FFFFH	0... 65535	1	-
Maximum time of oscillation monitoring - FAC_CYL_LAM_COR - based					
C_DELTA_CRK_OUT_MAX	-	88... 78H	-720 ...720	6	°CRK
Upper limit of the adapted phase displacement					
C_DELTA_CRK_OUT_MIN	-	88... 78H	-720 ...720	6	°CRK
Lower limit of the adapted phase displacement					
C_DELTA_LAMB_CYL_SEL_CQ_AD_THD	-	0... FFFFH	0... 0.99998	15.3e-6	-
Adaptation-release threshold					
C_ER_ABSV_GRD_FALL_THD_CRK_CHG	-	8000... 7FFFH	-325.78 ...325.77	9.942e-3	1/s**2
Threshold of engine roughness gradient drop for a safe adaptation result					
C_ER_ABSV_GRD_RISE_THD_CRK_CHG	-	0... 7FFFH	0... 325.77	9.942e-3	1/s**2
Maximum limit of engine roughness gradient rise					
C_FAC_CYL_LAM_ABSV_GRD_FALL_THD	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Threshold of CILC gradient drop for a safe adaptation result					
C_FAC_CYL_LAM_ABSV_GRD_RISE_THD	-	0... 7FFFH	0... 49.99847	1.5259e-3	%
Maximum limit of CILC gradient rise					
C_FAC_CYL_LAM_DIF_ABSV_MAX	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Maximum of allowed FAC_CYL_LAM_COR oscillation space					
C_FAC_CYL_LAM_MAX_PHA_SHIFT_AD	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Upper limit of FAC_CYL_LAM_COR value to detect the oscillation					
C_FAC_CYL_LAM_MIN_PHA_SHIFT_AD	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lower limit of FAC_CYL_LAM_COR value to detect the oscillation					
C_NR_SEG_REF_CBK_EX_2	-	0... 7H	0 ...7	1	-
Segment number for identification of the first fired cylinder of exhaust bank 2					
LC_CRK_CYL_LAM_DELTA_OUT	-	0... 1H	0 ...1	1	-
Adaptation switch					
LC_CRK_DELTA_CQ_SWI	-	0... 1H	0 ...1	1	-
Adaptation via characteristic quantity					

Phase Shift Adaptation

FUNCTION DESCRIPTION:

General information:

This module enables an adaptation of phase shift, which might be influenced by ageing effect of wide range A/F sensor or even calibration-error for instance.

if(1) two separate exhaust banks are concerned
then

i = 1, for cylinder bank 1 (x = 0, 2, 4, ...)
i = 2, for cylinder bank 2 (x = 1, 3, 5, ...)

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else(1)

i = 1 (x = 0 ... 3 or 4)

endif(1)

Description of index "[i]" and "[x]":

x: logical cylinder
*use **NC_CYL_NR** : number of engine cylinders - index "[x]"*
*use **LF_LS_CBK_EX_LAM_CYL_SEL_CONF**: pattern for allocation of physical cylinders to exhaust bank - index "[i]"*

Time recurrence: every TDC

7.74.1 Initialization (at reset)

The following initialization shall be carried out after a RESET and upon leaving the engine state Engine Stop (LV_ES).

STATE_DELTA_CRK_CYL_LAM[i] = 0 ’AD_PAS’ **(1.0.1)**

FAC_CYL_LAM_SAVE[x] = 0 **(1.0.2)**

LV_FAC_CYL_LAM_COR_OSC[i] = 0 **(1.0.3)**

LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 0 **(1.0.4)**

LV_FAC_CYL_LAM_OSC_MAX_THD[x] = 0 **(1.0.5)**

LV_FAC_CYL_LAM_OSC_MIN_THD[x] = 0 **(1.0.6)**

LV_STATE_DELTA_CRK_WAIT[i] = 0 **(1.0.7)**

CTR_SUM_FAC_CYL_LAM_COR_OSC[x] = 0 **(1.0.8)**

CTR_CQ_MON_PHA_SHIFT_AD[i] = 0 **(1.0.9)**

CTR_ER_MON_PHA_SHIFT_AD[i] = 0 **(1.0.10)**

CTR_CQ_MAX_OSC[i] = 0 **(1.0.11)**

CTR_RESP_LAM_CYL_SEL[i] = 0 **(1.0.12)**

CTR_RESP_CYC_LAM_CYL_SEL[i] = 0 **(1.0.13)**

CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] = 0 **(1.0.14)**

CTR_CQ_FIL_FALL[i] = 0 **(1.0.15)**

CRK_CHG_FAC_PHA_SHIFT_AD[i] = 1

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(1.0.16)

LV_DELTA_CRK_CYL_LAM_ERR[i] = 0

(1.0.17)

LV_ER_ABSV_SUM_GRD_RISE[i]= 0

(1.0.18)

ER_STND_MMV_DIF_BAL_ABSV_SUM[i]= 0

(1.0.19)

ER_STND_MMV_DIF_ABSV_SUM_PRE[i]= 0

(1.0.20)

ER_STND_MMV_DIF_ABSV_SUM_GRD[i]= 0

(1.0.21)

FAC_CYL_LAM_ABSV_SUM_PRE[i]= 0

(1.0.22)

FAC_CYL_LAM_ABSV_SUM_GRD[i]= 0

(1.0.23)

CRK_CYL_LAM_INT[i] = DELTA_CRK_CYL_LAM[i]

(1.0.24)

if(1) DELTA_CRK_CYL_LAM[i] = 0
then
CRK_CYL_LAM_DELTA_INI[i] = C_CRK_CYL_LAM_DELTA_INI

(1.0.25)

endif(1)

7.74.2 Reset at E**2PROM - failure

At E2PROM - failure:**
DELTA_CRK_CYL_LAM[i] = 0

(1.1.1)

CRK_CYL_LAM_DELTA_INI[i] = 0

(1.1.2)

CTR_PHA_SHIFT_AD_TRIG[i] = 0

(1.1.3)

7.74.3 Adaptation reset by external tool intervention

Following calculation shall be carried out independently of the activation condition (time recurrence: 100 ms):

if(1) LV_CRK_CYL_LAM_DELTA_RST_LS_EXT[i] = 1
then
DELTA_CRK_CYL_LAM[i] = 0

(1.2.1)

CRK_CYL_LAM_DELTA_INI[i] = C_CRK_CYL_LAM_DELTA_INI

(1.2.2)

FAC_CYL_LAM_SAVE[x] = 0

(1.2.3)

LV_FAC_CYL_LAM_COR_OSC[i] = 0

(1.2.4)

LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 0

(1.2.5)

LV_FAC_CYL_LAM_OSC_MAX_THD[x] = 0

(1.2.6)

LV_FAC_CYL_LAM_OSC_MIN_THD[x] = 0

(1.2.7)

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LV_STATE_DELTA_CRK_WAIT[i] = 0 (1.2.8)

CTR_SUM_FAC_CYL_LAM_COR_OSC[x] = 0 (1.2.9)

CTR_CQ_MON_PHA_SHIFT_AD[i] = 0 (1.2.10)

CTR_ER_MON_PHA_SHIFT_AD[i] = 0 (1.2.11)

CTR_CQ_MAX_OSC[i] = 0 (1.2.12)

CTR_RESP_LAM_CYL_SEL[i] = 0 (1.2.13)

CTR_RESP_CYC_LAM_CYL_SEL[i] = 0 (1.2.14)

CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] = 0 (1.2.15)

CTR_CQ_FIL_FALL[i] = 0 (1.2.16)

CRK_CHG_FAC_PHA_SHIFT_AD[i] = 1 (1.2.17)

LV_DELTA_CRK_CYL_LAM_ERR[i] = 0 (1.2.18)

LV_ER_ABSV_SUM_GRD_RISE[i]= 0 (1.2.19)

ER_STND_MMV_DIF_BAL_ABSV_SUM[i]= 0 (1.2.20)

ER_STND_MMV_DIF_ABSV_SUM_PRE[i]= 0 (1.2.21)

ER_STND_MMV_DIF_ABSV_SUM_GRD[i]= 0 (1.2.22)

FAC_CYL_LAM_ABSV_SUM_PRE[i]= 0 (1.2.23)

FAC_CYL_LAM_ABSV_SUM_GRD[i]= 0 (1.2.24)

CRK_CYL_LAM_INT[i] = 0 (1.2.25)

CTR_PHA_SHIFT_AD_TRIG[i] = 0 (1.2.26)

endif$^{(1)}$

7.74.4 Activation

if$^{(1)}$ LV_DELTA_CRK_CYL_LAM_ERR[i] = 0
then

if$^{(2)}$ STATE_DELTA_CRK_CYL_LAM[i] = 0 'AD_PAS'
then

STATE_DELTA_CRK_CYL_LAM[i] = 1 'AD_ACT' (1.3.1)

endif$^{(2)}$
end **if**$^{(1)}$

if$^{(1)}$ STATE_LAM_CYL_SEL[i] = 0 [*calculation is exhaust bank selective*]
then

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if$^{(2)}$ (LV_FAC_CYL_LAM_COR_OSC[i] = 1 **and** CTR_PHA_SHIFT_AD_TRIG[i] $<$ C_CTR_PHA_SHIFT_AD_TRIG_THD)
then
LV_FAC_CYL_LAM_COR_OSC[i] = 0 **(1.3.2)**
LV_FAC_CYL_LAM_OSC_MAX_THD[x] = 0 **(1.3.3)**
LV_FAC_CYL_LAM_OSC_MIN_THD[x] = 0 **(1.3.4)**
CTR_SUM_FAC_CYL_LAM_COR_OSC[x] = 0 **(1.3.5)**
CTR_CQ_MON_PHA_SHIFT_AD[i] = 0 **(1.3.6)**
CTR_CQ_MAX_OSC[i] = 0 **(1.3.7)**
endif$^{(2)}$
if$^{(2)}$ (LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 1 **and** CTR_PHA_SHIFT_AD_TRIG[i] $<$ C_CTR_PHA_SHIFT_AD_TRIG_THD)
then
LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 0 **(1.3.8)**
endif$^{(2)}$
if$^{(2)}$ (LV_ER_ABSV_SUM_GRD_RISE[i] = 1 **and** CTR_PHA_SHIFT_AD_TRIG[i] $<$ C_CTR_PHA_SHIFT_AD_TRIG_THD)
then
LV_ER_ABSV_SUM_GRD_RISE[i] = 0 **(1.3.9)**
endif$^{(2)}$
end if$^{(1)}$

7.74.5 Deactivation

if$^{(1)}$ LV_DELTA_CRK_CYL_LAM_ERR[i] = 1
then
STATE_DELTA_CRK_CYL_LAM[i] = 0 'AD_PAS' **(1.4.1)**
endif$^{(1)}$

Formula section:

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7.74.6 Monitoring the engine roughness

if(1) STATE_LAM_CYL_SEL[i] = 3 [*calculation is exhaust bank selective*]
then
if(2) (SEG_NR = 0 [*calculation for exhaust bank 1*] **or**
SEG_NR = C_NR_SEG_REF_CBK_EX_2 [*calculation for exhaust bank 2*]
then
if(3) LV_ER_STND_ER_BAL_ACT = 1
then
if(4) LV_STATE_DELTA_CRK_WAIT[i] = 0
then
if(5) CTR_ER_MON_PHA_SHIFT_AD[i] = 0
then
FAC_CYL_LAM_ABSV_SUM_PRE[i] =
FAC_CYL_LAM_ABSV_SUM[i] **(1.5.1)**
endif(5)
increment CTR_ER_MON_PHA_SHIFT_AD[i]
(1.5.2)
if(5) CTR_ER_MON_PHA_SHIFT_AD[i] =
C_CTR_ER_MON_PHA_SHIFT_AD_MAX
then
if(6) ER_STND_MMV_DIF_BAL_ABSV_SUM[i] ≠ 0
then
ER_STND_MMV_DIF_ABSV_SUM_PRE[i] =
ER_STND_MMV_DIF_BAL_ABSV_SUM[i] **(1.5.3)**
endif(6)

$$\text{ER\_STND\_MMV\_DIF\_BAL\_ABSV\_SUM[i]} = \sum_{x=1}^{\alpha} \left|\text{ER\_STND\_MMV\_DIF\_BAL[x]}\right|$$

α : nr. of cylinders per bank
(1.5.4)
[*Remark: the cylinder based variables (index x) shall be assigned to the corresponding exhaust bank (index i)*]

if(6) ER_STND_MMV_DIF_ABSV_SUM_PRE[i] ≠ 0
then
ER_STND_MMV_DIF_ABSV_SUM_GRD[i] =
ER_STND_MMV_DIF_BAL_ABSV_SUM[i] -
ER_STND_MMV_DIF_ABSV_SUM_PRE[i] **(1.5.5)**
endif(6)
FAC_CYL_LAM_ABSV_SUM_GRD[i] =
FAC_CYL_LAM_ABSV_SUM[i] -
FAC_CYL_LAM_ABSV_SUM_PRE[i] **(1.5.6)**

CTR_ER_MON_PHA_SHIFT_AD[i] = 0
(1.5.7)
endif(5)
endif(4)
endif(3)

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endif(2)
else(1)
CTR_ER_MON_PHA_SHIFT_AD[i] = 0
(1.5.8)
endif(1)

7.74.7 Detection of the cylinder individual lambda controller output oscillation:

The controller outputs of cylinder individual lambda control are monitored during the time the function is in closed loop mode (STATE_LAM_CYL_SEL[i] = CLL).

if(1) STATE_LAM_CYL_SEL[i] = 3 [*calculation is exhaust bank selective*]
then
if(2) (SEG_NR = 0 [*calculation for exhaust bank 1*] **or**
SEG_NR = C_NR_SEG_REF_CBK_
EX_2 [*calculation for exhaust bank 2*]
then
if(3) (LC_CRK_DELTA_CQ_SWI = 0 **and**
LV_ER_ABSV_SUM_GRD_RISE[i]
= 0)
then
if(4) **[**(FAC_CYL_LAM[x]
C_FAC_CYL_LAM_MAX_PHA_SHIFT_
AD) **and**
LV_FAC_CYL_LAM_OSC_MIN_THD[x]
= 0 **and**
LV_FAC_CYL_LAM_COR_LIM_OSC[i]
= 0**]**
then
LV_FAC_CYL_LAM_OSC_MAX_THD[x] = 1
(1.6.1)
endif(4)
if(4) LV_FAC_CYL_LAM_OSC_MAX_THD[x] = 1
then
if(5) LV_FAC_CYL_LAM_COR_OSC[i] = 0
then
increment CTR_SUM_FAC_CYL_LAM_COR_OSC[x]
(1.6.2)
endif(5)
if(5) **[**(FAC_CYL_LAM[x]
C_FAC_CYL_LAM_MIN_PHA_SHIFT_
AD) **and**
(CTR_SUM_FAC_CYL_LAM_COR_
OSC[x] <
C_CTR_SUM_FAC_CYL_LAM_OSC_
MAX)**]**
then
if(6) LV_FAC_CYL_LAM_COR_OSC[i] = 0
then
LV_FAC_CYL_LAM_COR_OSC[i] = 1
(1.6.3)

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[*Remark: the cylinder based Oscillation (index x) shall be assigned to the corresponding exhaust bank (index i)*]
if(7) CTR_PHA_SHIFT_AD_TRIG[i] < C_CTR_PHA_SHIFT_AD_TRIG_THD
then
increment(CTR_PHA_SHIFT_AD_TRIG[i])
(1.6.4)
endif(7)
endif(6)
endif(5)
endif(4)

if(4) **[**(FAC_CYL_LAM[x] < C_FAC_CYL_LAM_MIN_PHA_SHIFT_AD) **and** LV_FAC_CYL_LAM_OSC_MAX_THD[x] = 0 **and** LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 0**]**
then
LV_FAC_CYL_LAM_OSC_MIN_THD[x] = 1
(1.6.5)
endif(4)
if(4) LV_FAC_CYL_LAM_OSC_MIN_THD[x] = 1
then
if(5) LV_FAC_CYL_LAM_COR_OSC[i] = 0
then
increment CTR_SUM_FAC_CYL_LAM_COR_OSC[x]
(1.6.6)
endif(5)
if(5) **[**(FAC_CYL_LAM[x] > C_FAC_CYL_LAM_MAX_PHA_SHIFT_AD) **and** (CTR_SUM_FAC_CYL_LAM_COR_OSC[x] < C_CTR_SUM_FAC_CYL_LAM_OSC_MAX)**]**
then
if(6) LV_FAC_CYL_LAM_COR_OSC[i] = 0
then
LV_FAC_CYL_LAM_COR_OSC[i] = 1
(1.6.7)
[*Remark: the cylinder based Oscillation (index x) shall be assigned to the corresponding exhaust bank (index i)*]
if(7) CTR_PHA_SHIFT_AD_TRIG[i] < C_CTR_PHA_SHIFT_AD_TRIG_THD
then

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increment(CTR_PHA_SHIFT_AD_TRIG[i])
(1.6.8)

endif$^{(7)}$
endif$^{(6)}$
endif$^{(5)}$
endif$^{(4)}$

if$^{(4)}$ **[**(CTR_SUM_FAC_CYL_LAM_COR_OSC[x] = C_CTR_SUM_FAC_CYL_LAM_OSC_MAX) **and** LV_FAC_CYL_LAM_COR_OSC[i] = 0)**]**
then
CTR_SUM_FAC_CYL_LAM_COR_OSC[x] = 0
(1.6.9)
LV_FAC_CYL_LAM_OSC_MIN_THD[x] = 0
(1.6.10)
LV_FAC_CYL_LAM_OSC_MAX_THD[x] = 0
(1.6.11)
endif$^{(4)}$

7.74.8 Detection of Cylinder Individual lambda Control Instability - based on CILC- controller output:

For detection of unstable state of CILC the controller output of adjacent cylinders are considered. Should two of the cylinders be at the opposite limit and a drift-away behaviour of cylinder individual lambda control be detected, thus the unstable behaviour of CILC is assumed.

if$^{(4)}$ **[{**(LV_FAC_CYL_LAM_LIM_MIN[x] = 1 **and** LV_FAC_CYL_LAM_LIM_MAX[x+1] = 1) **or** (LV_FAC_CYL_LAM_LIM_MAX[x] = 1 **and** LV_FAC_CYL_LAM_LIM_MIN[x+1] = 1)**} and** LV_LAM_CYL_SEL_CTL_DRIFT_PRED[i] = 1**]** [*Remark: the index x and x+1 relate to the in succession firing cylinders on the same exhaust bank]*
then
if$^{(5)}$ LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 0
then
LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 1
(1.7.1)
[*Remark: the cylinder based Oscillation (index x) shall be assigned to the corresponding exhaust bank (index i)*]
if$^{(6)}$ CTR_PHA_SHIFT_AD_TRIG[i] $<$ C_CTR_PHA_SHIFT_AD_TRIG_THD
then
increment(CTR_PHA_SHIFT_AD_TRIG[i])
(1.7.2)

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endif(6)
endif(5)
else(4)
LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 0
(1.7.3)
endif(4)

7.74.9 Detection of Cylinder Individual lambda Control Instability - based on CILC - Characteristic Quantity:

For detection of unstable state of CILC the value of Characteristic Quantity (CQ) is considered (LC_CRK_DELTA_CQ_SWI = 1).

elseif(3) (LC_CRK_DELTA_CQ_SWI = 1 **and** LV_ER_ABSV_SUM_GRD_RISE[i] = 0)
then
increment CTR_CQ_MON_PHA_SHIFT_AD[i]
(1.8.1)
if(4) DELTA_LAMB_CYL_SEL_CQ_FIL[i] C_DELTA_LAMB_CYL_SEL_CQ_AD_THD
then
if(5) LV_FAC_CYL_LAM_COR_OSC[i] = 0
then
increment CTR_CQ_MAX_OSC[i]
(1.8.2)
endif(5)
if(5) **[**(CTR_CQ_MAX_OSC[i] = C_CTR_CQ_MIN_PHA_SHIFT_AD) **and** (CTR_CQ_MON_PHA_SHIFT_AD[i] $<$ C_CTR_CQ_MON_PHA_SHIFT_AD_MAX)**]**
then
if(6) LV_FAC_CYL_LAM_COR_OSC[i] = 0
then
LV_FAC_CYL_LAM_COR_OSC[i] = 1
(1.8.3)
if(7) CTR_PHA_SHIFT_AD_TRIG[i] $<$ C_CTR_PHA_SHIFT_AD_TRIG_THD
then
increment(CTR_PHA_SHIFT_AD_TRIG[i])
(1.8.4)
endif(7)
endif(6)
endif(5)
endif(4)
if(4) CTR_CQ_MON_PHA_SHIFT_AD[i] = C_CTR_CQ_MON_PHA_SHIFT_AD_MAX

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then
CTR_CQ_MON_PHA_SHIFT_AD[i] = 0
(1.8.5)
if(5) LV_FAC_CYL_LAM_COR_OSC[i] = 0
then
CTR_CQ_MAX_OSC[i] = 0
(1.8.6)
endif(5)
endif(4)

endif(3)

7.74.10 Detection of Cylinder Individual lambda Control Instability - based on engine roughness:

if(3) (LV_FAC_CYL_LAM_COR_OSC[i] = 0 **and** LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 0)
then
if(4) LV_ER_ABSV_SUM_GRD_RISE[i] = 0
then
if(5) (ER_STND_MMV_DIF_ABSV_SUM_GRD[i] $>$ C_ER_ABSV_GRD_RISE_THD_CRK_CHG **and** FAC_CYL_LAM_ABSV_SUM_GRD[i] $>$ C_FAC_CYL_LAM_ABSV_GRD_RISE_THD)
then
LV_ER_ABSV_SUM_GRD_RISE[i] = 1
(1.9.1)
FAC_CYL_LAM_ABSV_SUM_PRE[i] = FAC_CYL_LAM_ABSV_SUM[i]
(1.9.2)
if(6) CTR_PHA_SHIFT_AD_TRIG[i] $<$ C_CTR_PHA_SHIFT_AD_TRIG_THD
then
increment(CTR_PHA_SHIFT_AD_TRIG[i])
(1.9.3)
endif(6)
endif(5)
endif(4)
endif(3)
endif(2)
endif(1)

7.74.11 Adaptation start

if(1) (SEG_NR = 0 [*calculation for exhaust bank 1*] **or** SEG_NR = C_NR_SEG_REF_CBK_EX_2 [*calculation for exhaust bank 2*]
then

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if$^{(2)}$ **[**(STATE_DELTA_CRK_CYL_LAM[i] = 1 'AD_ACT' **or** STATE_DELTA_CRK_CYL_LAM[i] = 6 'AD_HOLD') **and** (LV_FAC_CYL_LAM_COR_OSC[i] = 1 **or** LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 1 **or** LV_ER_ABSV_SUM_GRD_RISE[i] = 1) **and** CTR_PHA_SHIFT_AD_TRIG[i] = C_CTR_PHA_SHIFT_AD_TRIG_THD**]**

then

STATE_DELTA_CRK_CYL_LAM[i] = 2 'AD_CDN' **(1.10.1)**

endif$^{(2)}$

if$^{(2)}$ (STATE_DELTA_CRK_CYL_LAM[i] = 2 'AD_CDN' **and** LV_STATE_DELTA_CRK_WAIT[i] = 0 **and** STATE_LAM_CYL_SEL[i] = 3) [*calculation is exhaust bank selective*]

then

STATE_DELTA_CRK_CYL_LAM[i] = 3 'AD_INI' **(1.10.2)**

CTR_RESP_CYC_LAM_CYL_SEL[i] = C_CTR_RESP_CYC_MIN_LAM_CYL_SEL **(1.10.3)**

FAC_CYL_LAM_SAVE[x] = FAC_CYL_LAM[x] **(1.10.4)**

if$^{(3)}$ LV_ER_ABSV_SUM_GRD_RISE[i] = 1

then

CTR_RESP_LAM_CYL_SEL[i] = C_CTR_ER_RESP_MIN_LAM_CYL_SEL **(1.10.5)**

else$^{(3)}$

CTR_RESP_LAM_CYL_SEL[i] = C_CTR_RESP_MIN_LAM_CYL_SEL **(1.10.6)**

endif$^{(3)}$

CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] = 0 **(1.10.7)**

CTR_CQ_FIL_FALL[i] = 0 **(1.10.8)**

endif$^{(2)}$

endif$^{(1)}$

7.74.12 Evaluation of adaptation result

if$^{(1)}$ STATE_LAM_CYL_SEL[i] = 3 [*calculation is exhaust bank selective*]

then

if$^{(2)}$ (SEG_NR = 0 [*calculation for exhaust bank 1*] **or** SEG_NR = C_NR_SEG_REF_CBK_EX_2 [*calculation for exhaust bank 2*]

then

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if$^{(3)}$ (LC_CRK_DELTA_CQ_SWI = 0 **and** LV_ER_ABSV_SUM_GRD_RISE[i] = 0)
then
if$^{(4)}$ (LV_STATE_DELTA_CRK_WAIT[i] = 1 **and** LV_FAC_CYL_LAM_COR_OSC[i] = 1)
then
decrement CTR_RESP_LAM_CYL_SEL[i] **(1.11.1)**
if$^{(5)}$ CTR_RESP_LAM_CYL_SEL[i] = 0
then
if$^{(6)}$ [[**abs**(FAC_CYL_LAM_SAVE[x] - FAC_CYL_LAM[x]) C_FAC_CYL_LAM_DIF_ABSV_MAX] **and** (LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 0)**]**
then
increment CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] **(1.11.2)**
endif$^{(6)}$
[*Remark: the counter CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] shall be incremented only once provided that the condition is fulfilled for all of the cylinders at the concerned exhaust bank (AND-logical operator)*]
CTR_RESP_LAM_CYL_SEL[i] = C_CTR_RESP_MIN_LAM_CYL_SEL **(1.11.3)**
FAC_CYL_LAM_SAVE[x] = FAC_CYL_LAM[x] **(1.11.4)**
Decrement CTR_RESP_CYC_LAM_CYL_SEL[i] **(1.11.5)**
endif$^{(5)}$
elseif$^{(4)}$ (LV_STATE_DELTA_CRK_WAIT[i] = 1 **and** LV_FAC_CYL_LAM_COR_OSC[i] = 0)
then
decrement CTR_RESP_LAM_CYL_SEL[i] **(1.11.6)**
if$^{(5)}$ CTR_RESP_LAM_CYL_SEL[i] = 0
then
if$^{(6)}$ LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 0
then
increment CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] **(1.11.7)**
endif$^{(6)}$
CTR_RESP_LAM_CYL_SEL[i] =

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C_CTR_RESP_MIN_LAM_CYL_SEL **(1.11.8)**

FAC_CYL_LAM_SAVE[x] = FAC_CYL_LAM[x] **(1.11.9)**

decrement CTR_RESP_CYC_LAM_CYL_SEL[i] **(1.11.10)**

endif$^{(5)}$

endif$^{(4)}$

if$^{(4)}$ (LV_STATE_DELTA_CRK_WAIT[i] = 1 **and** CTR_RESP_CYC_LAM_CYL_SEL[i] = 0)

then

CTR_RESP_CYC_LAM_CYL_SEL[i] = C_CTR_RESP_CYC_MIN_LAM_CYL_SEL **(1.11.11)**

if$^{(5)}$ CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] C_CTR_FAC_CYL_LAM_DIF_ABSV_OK

then

LV_FAC_CYL_LAM_COR_OSC[i] = 0 **(1.11.12)**

LV_FAC_CYL_LAM_OSC_MAX_THD[x] = 0 **(1.11.13)**

LV_FAC_CYL_LAM_OSC_MIN_THD[x] = 0 **(1.11.14)**

LV_STATE_DELTA_CRK_WAIT[i] = 0 **(1.11.15)**

CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] = 0 **(1.11.16)**

STATE_DELTA_CRK_CYL_LAM[i] = 6 'AD_HOLD' **(1.11.17)**

CRK_CHG_FAC_PHA_SHIFT_AD[i] = 1 **(1.11.18)**

if$^{(6)}$ C_CRK_CYL_LAM_DELTA_INI $>$ 0

then

CRK_CYL_LAM_DELTA_INI[i] = CRK_CYL_LAM_DELTA_INI[i] - C_CRK_CYL_LAM_INI_RED **(1.11.19)**

if$^{(7)}$ CRK_CYL_LAM_DELTA_INI[i] $<$ 0

then

CRK_CYL_LAM_DELTA_INI[i] = 0 **(1.11.20)**

endif$^{(7)}$

else$^{(6)}$

CRK_CYL_LAM_DELTA_INI[i] = CRK_CYL_LAM_DELTA_INI[i] + C_CRK_CYL_LAM_INI_RED **(1.11.21)**

if$^{(7)}$ CRK_CYL_LAM_DELTA_INI[i] $>$ 0

then

CRK_CYL_LAM_DELTA_INI[i] = 0 **(1.11.22)**

endif$^{(7)}$

endif$^{(6)}$

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elseif$^{(5)}$ **[**(CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] < C_CTR_FAC_CYL_LAM_DIF_ABSV_OK) **and** CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] C_CTR_FAC_CYL_LAM_DIF_ABSV_MIN**]**

then

LV_STATE_DELTA_CRK_WAIT[i] = 1 **(1.11.23)**

CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] = 0 **(1.11.24)**

elseif$^{(5)}$ (CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] < C_CTR_FAC_CYL_LAM_DIF_ABSV_MIN)

then

LV_STATE_DELTA_CRK_WAIT[i] = 0 **(1.11.25)**

CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] = 0 **(1.11.26)**

if$^{(6)}$ STATE_DELTA_CRK_CYL_LAM[i] = 3 'AD_INI'

then

STATE_DELTA_CRK_CYL_LAM[i] = 4 'AD_DEC' **(1.11.27)**

elseif$^{(6)}$ STATE_DELTA_CRK_CYL_LAM[i] = 4 'AD_DEC'

then

STATE_DELTA_CRK_CYL_LAM[i] = 5 'AD_INC' **(1.11.28)**

elseif$^{(6)}$ STATE_DELTA_CRK_CYL_LAM[i] = 5 'AD_INC'

then

STATE_DELTA_CRK_CYL_LAM[i] = 4 'AD_DEC' **(1.11.29)**

endif$^{(6)}$

endif$^{(5)}$

endif$^{(4)}$

elseif$^{(3)}$ (LC_CRK_DELTA_CQ_SWI = 1 **and** LV_ER_ABSV_SUM_GRD_RISE[i] = 0)

then

if$^{(4)}$ (LV_STATE_DELTA_CRK_WAIT[i] = 1 **and** LV_FAC_CYL_LAM_COR_OSC[i] = 1)

then

decrement CTR_RESP_LAM_CYL_SEL[i] **(1.11.30)**

if$^{(5)}$ CTR_RESP_LAM_CYL_SEL[i] = 0

then

if$^{(6)}$ DELTA_LAMB_CYL_SEL_CQ_FIL[i] <

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C_DELTA_LAMB_CYL_SEL_CQ_
AD_THD
then
increment CTR_CQ_FIL_FALL[i]
(1.11.31)
endif$^{(6)}$
CTR_RESP_LAM_CYL_SEL[i] =
C_CTR_RESP_MIN_LAM_CYL_
SEL **(1.11.32)**
FAC_CYL_LAM_SAVE[x] = FAC_CYL_LAM[x]
(1.11.33)
Decrement CTR_RESP_CYC_LAM_CYL_SEL[i]
(1.11.34)
endif$^{(5)}$
endif$^{(4)}$

if$^{(4)}$ (LV_STATE_DELTA_CRK_WAIT[i] = 1 **and**
CTR_RESP_CYC_LAM_CYL_SEL[i]
= 0)
then
CTR_RESP_CYC_LAM_CYL_SEL[i] =
C_CTR_RESP_CYC_MIN_LAM_
CYL_SEL **(1.11.35)**
if$^{(5)}$ CTR_CQ_FIL_FALL[i] C_CTR_CQ_FIL_FALL_OK
then
LV_FAC_CYL_LAM_COR_OSC[i] = 0
(1.11.36)
LV_STATE_DELTA_CRK_WAIT[i] = 0
(1.11.37)
CTR_CQ_FIL_FALL[i] = 0
(1.11.38)
STATE_DELTA_CRK_CYL_LAM[i] = 6 'AD_HOLD'
(1.11.39)
CRK_CHG_FAC_PHA_SHIFT_AD[i] = 1
(1.11.40)
if$^{(6)}$ C_CRK_CYL_LAM_DELTA_INI $>$ 0
then
CRK_CYL_LAM_DELTA_INI[i] =
CRK_CYL_LAM_DELTA_INI[i] -
C_CRK_CYL_LAM_INI_RED **(1.11.41)**
if$^{(7)}$ CRK_CYL_LAM_DELTA_INI[i] $<$ 0
then
CRK_CYL_LAM_DELTA_INI[i] = 0
(1.11.42)
endif$^{(7)}$
else$^{(6)}$
CRK_CYL_LAM_DELTA_INI[i] =
CRK_CYL_LAM_DELTA_INI[i] +
C_CRK_CYL_LAM_INI_RED **(1.11.43)**
if$^{(7)}$ CRK_CYL_LAM_DELTA_INI[i] $>$ 0
then
CRK_CYL_LAM_DELTA_INI[i] = 0
(1.11.44)

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endif$^{(7)}$
endif$^{(6)}$

elseif$^{(5)}$ **[**(CTR_CQ_FIL_FALL[i] $<$ C_CTR_CQ_FIL_FALL_OK) **and** CTR_CQ_FIL_FALL[i] C_CTR_CQ_FIL_FALL_MIN**]**
then
LV_STATE_DELTA_CRK_WAIT[i] = 1 **(1.11.-)**
CTR_CQ_FIL_FALL[i] = 0 **(1.11.46)**

elseif$^{(5)}$ (CTR_CQ_FIL_FALL[i] $<$ C_CTR_CQ_FIL_FALL_MIN)
then
LV_STATE_DELTA_CRK_WAIT[i] = 0 **(1.11.47)**
CTR_CQ_FIL_FALL[i] = 0 **(1.11.48)**
if$^{(6)}$ STATE_DELTA_CRK_CYL_LAM[i] = 3 ’AD_INI’
then
STATE_DELTA_CRK_CYL_LAM[i] = 4 ’AD_DEC’ **(1.11.49)**
elseif$^{(6)}$ STATE_DELTA_CRK_CYL_LAM[i] = 4 ’AD_DEC’
then
STATE_DELTA_CRK_CYL_LAM[i] = 5 ’AD_INC’ **(1.11.50)**
elseif$^{(6)}$ STATE_DELTA_CRK_CYL_LAM[i] = 5 ’AD_INC’
then
STATE_DELTA_CRK_CYL_LAM[i] = 4 ’AD_DEC’ **(1.11.51)**
endif$^{(6)}$

endif$^{(5)}$
endif$^{(4)}$
elseif$^{(3)}$ LV_ER_ABSV_SUM_GRD_RISE[i] = 1
then
if$^{(4)}$ LV_STATE_DELTA_CRK_WAIT[i] = 1
then
decrement CTR_RESP_LAM_CYL_SEL[i] **(1.11.52)**
if$^{(5)}$ CTR_RESP_LAM_CYL_SEL[i] = 0
then
ER_STND_MMV_DIF_ABSV_SUM_PRE[i] = ER_STND_MMV_DIF_BAL_ABSV_SUM[i] **(1.11.53)**

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ER_STND_MMV_DIF_BAL_ABSV_SUM[i] =

$$\sum_{x=1}^{\alpha} \left|ER\_STND\_MMV\_DIF\_BAL[x]\right|$$

α :nr. of cylinders per bank

(1.11.54)

[Remark: the cylinder based variables (index x) shall be assigned to the corresponding exhaust bank (index i)]

ER_STND_MMV_DIF_ABSV_SUM_GRD[i] =
ER_STND_MMV_DIF_BAL_ABSV_SUM[i] -
ER_STND_MMV_DIF_ABSV_SUM_PRE[i] **(1.11.55)**

FAC_CYL_LAM_ABSV_SUM_GRD[i] =
FAC_CYL_LAM_ABSV_SUM[i] -
FAC_CYL_LAM_ABSV_SUM_PRE[i]
(1.11.56)

FAC_CYL_LAM_ABSV_SUM_PRE[i] =
FAC_CYL_LAM_ABSV_SUM[i] **(1.11.57)**

if(6) (ER_STND_MMV_DIF_ABSV_SUM_GRD[i]
C_ER_ABSV_GRD_FALL_THD_CRK_CHG **and**
FAC_CYL_LAM_ABSV_SUM_GRD[i]
C_FAC_CYL_LAM_ABSV_GRD_FALL_THD)

then

LV_ER_ABSV_SUM_GRD_RISE[i] = 0
(1.11.58)

LV_STATE_DELTA_CRK_WAIT[i] = 0
(1.11.59)

STATE_DELTA_CRK_CYL_LAM[i] = 6 'AD_HOLD'
(1.11.60)

CRK_CHG_FAC_PHA_SHIFT_AD[i] = 1
(1.11.61)

if(7) C_CRK_CYL_LAM_DELTA_INI $>$ 0

then

CRK_CYL_LAM_DELTA_INI[i] =
CRK_CYL_LAM_DELTA_INI[i] -
C_CRK_CYL_LAM_INI_RED **(1.11.62)**

if(8) CRK_CYL_LAM_DELTA_INI[i] $<$ 0

then

CRK_CYL_LAM_DELTA_INI[i] = 0
(1.11.63)

endif(8)

else(7)

CRK_CYL_LAM_DELTA_INI[i] =
CRK_CYL_LAM_DELTA_INI[i] +

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C_CRK_CYL_LAM_INI_RED **(1.11.64)**

if$^{(8)}$ CRK_CYL_LAM_DELTA_INI[i] $>$ 0
then
CRK_CYL_LAM_DELTA_INI[i] = 0
(1.11.65)
endif$^{(8)}$
endif$^{(7)}$

else$^{(6)}$
LV_STATE_DELTA_CRK_WAIT[i] = 0
(1.11.66)
if$^{(7)}$ STATE_DELTA_CRK_CYL_LAM[i] = 3 'AD_INI'
then
STATE_DELTA_CRK_CYL_LAM[i] = 4 'AD_DEC' **(1.11.67)**
elseif$^{(7)}$ STATE_DELTA_CRK_CYL_LAM[i] = 4 'AD_DEC'
then
STATE_DELTA_CRK_CYL_LAM[i] = 5 'AD_INC' **(1.11.68)**
elseif$^{(7)}$ STATE_DELTA_CRK_CYL_LAM[i] = 5 'AD_INC'
then
STATE_DELTA_CRK_CYL_LAM[i] = 4 'AD_DEC' **(1.11.69)**
endif$^{(7)}$
CTR_RESP_LAM_CYL_SEL[i] = C_CTR_ER_RESP_MIN_LAM_CYL_SEL **(1.11.70)**
endif$^{(6)}$
endif$^{(5)}$
endif$^{(4)}$
endif$^{(3)}$
endif$^{(2)}$
endif$^{(1)}$

7.74.13 Control action

7.74.13.1 Initial-action

if$^{(1)}$ STATE_LAM_CYL_SEL[i] = 3 [*calculation is exhaust bank selective*]
then
if$^{(2)}$ (SEG_NR = 0 [*calculation for exhaust bank 1*] **or** SEG_NR = C_NR_SEG_REF_CBK_EX_2 [*calculation for exhaust bank 2*]
then
if$^{(3)}$ LV_STATE_DELTA_CRK_WAIT[i] = 0
then
if$^{(4)}$ STATE_DELTA_CRK_CYL_LAM[i] = 3 'AD_INI'
then
CRK_CYL_LAM_INT[i]$_k$ = CRK_CYL_LAM_INT[i]$_{k-1}$ + CRK_CYL_LAM_DELTA_INI[i] **(1.12.1.1)**
LV_STATE_DELTA_CRK_WAIT[i] = 1

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(1.12.1.2)

7.74.13.2 Recursive decrement-action

elseif$^{(4)}$ STATE_DELTA_CRK_CYL_LAM[i] = 4 ' AD_DEC'
then
if$^{(5)}$ CRK_CYL_LAM_DELTA_INI[i] $\geq$ 0
then
CRK_CYL_LAM_INT[i]$_k$ = CRK_CYL_LAM_INT[i]$_{k-1}$ -
(CRK_CHG_FAC_PHA_SHIFT_AD[i]*
C_CRK_CHG_STEP +
CRK_CYL_LAM_DELTA_INI[i]) **(1.12.2.1)**
else$^{(5)}$
CRK_CYL_LAM_INT[i]$_k$ = CRK_CYL_LAM_INT[i]$_{k-1}$ -
(CRK_CYL_LAM_DELTA_INI[i] -
CRK_CHG_FAC_PHA_SHIFT_AD[i]*
C_CRK_CHG_STEP) **(1.12.2.2)**
endif$^{(5)}$
CRK_CHG_FAC_PHA_SHIFT_AD[i] =
CRK_CHG_FAC_PHA_SHIFT_AD[i]
+ 1 **(1.12.2.3)**
LV_STATE_DELTA_CRK_WAIT[i] = 1
(1.12.2.4)

7.74.13.3 Recursive increment-action

elseif$^{(4)}$ STATE_DELTA_CRK_CYL_LAM[i] = 5 'AD_INC'
then
if$^{(5)}$ CRK_CYL_LAM_DELTA_INI[i] $\geq$ 0
then
CRK_CYL_LAM_INT[i]$_k$ = CRK_CYL_LAM_INT[i]$_{k-1}$ +
(CRK_CHG_FAC_PHA_SHIFT_AD[i]*
C_CRK_CHG_STEP +
CRK_CYL_LAM_DELTA_INI[i]) **(1.12.3.1)**
else$^{(5)}$
CRK_CYL_LAM_INT[i]$_k$ = CRK_CYL_LAM_INT[i]$_{k-1}$ +
(CRK_CYL_LAM_DELTA_INI[i] -
CRK_CHG_FAC_PHA_SHIFT_AD[i]*
C_CRK_CHG_STEP) **(1.12.3.2)**
endif$^{(5)}$
CRK_CHG_FAC_PHA_SHIFT_AD[i] =
CRK_CHG_FAC_PHA_SHIFT_AD[i]
+ 1 **(1.12.3.3)**
LV_STATE_DELTA_CRK_WAIT[i] = 1
(1.12.3.4)

7.74.13.4 Hold-action

elseif$^{(4)}$ STATE_DELTA_CRK_CYL_LAM[i] = 6 'AD_HOLD'
then
CRK_CYL_LAM_INT[i]$_k$ = CRK_CYL_LAM_INT[i]$_{k-1}$
(1.12.4.1)
endif$^{(4)}$
endif$^{(3)}$

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endif(2)
endif(1)

7.74.13.5 Calculation of the adaptation value

For application purpose the calculation of DELTA_CRK_CYL_LAM[i] can be switched off using LC_CRK_CYL_LAM_DELTA_OUT

if(1) LC_CRK_CYL_LAM_DELTA_OUT = 1
then
if(2) (SEG_NR = 0 [*calculation for exhaust bank 1*] **or**
SEG_NR = C_NR_SEG_REF_CBK_EX_2 [*calculation for exhaust bank 2*]
then
DELTA_CRK_CYL_LAM[i] = MINMAX (CRK_CYL_LAM_INT[i],
C_DELTA_CRK_OUT_MIN,
C_DELTA_CRK_OUT_MAX) **(1.12.5.1)**
endif(2)
if(2) CRK_CYL_LAM_DELTA_INI[i] = 0
then
CRK_CYL_LAM_DELTA_INI[i] = C_CRK_CYL_LAM_DELTA_INI
(1.12.5.2)
endif(2)
else(1)
DELTA_CRK_CYL_LAM[i] = 0
(1.12.5.3)
CRK_CYL_LAM_INT[i] = 0
(1.12.5.4)
CRK_CYL_LAM_DELTA_INI[i] = C_CRK_CYL_LAM_DELTA_INI
(1.12.5.5)
STATE_DELTA_CRK_CYL_LAM[i] = 0 'AD_PAS'
(1.12.5.6)
FAC_CYL_LAM_SAVE[x] = 0
(1.12.5.7)
LV_FAC_CYL_LAM_COR_OSC[i] = 0
(1.12.5.8)
LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 0
(1.12.5.9)
LV_FAC_CYL_LAM_OSC_MAX_THD[x] = 0
(1.12.5.10)
LV_FAC_CYL_LAM_OSC_MIN_THD[x] = 0
(1.12.5.11)
LV_STATE_DELTA_CRK_WAIT[i] = 0
(1.12.5.12)
CTR_SUM_FAC_CYL_LAM_COR_OSC[x] = 0
(1.12.5.13)
CTR_CQ_MON_PHA_SHIFT_AD[i] = 0
(1.12.5.14)
CTR_CQ_MAX_OSC[i] = 0
(1.12.5.15)
CTR_RESP_LAM_CYL_SEL[i] = 0
(1.12.5.16)
CTR_RESP_CYC_LAM_CYL_SEL[i] = 0

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CTR_FAC_CYL_LAM_COR_DIF_ABSV[i] = 0 **(1.12.5.17)**

CTR_CQ_FIL_FALL[i] = 0 **(1.12.5.18)**

CTR_ER_MON_PHA_SHIFT_AD[i] = 0 **(1.12.5.19)**

CRK_CHG_FAC_PHA_SHIFT_AD[i] = 1 **(1.12.5.20)**

LV_DELTA_CRK_CYL_LAM_ERR[i] = 0 **(1.12.5.21)**

LV_ER_ABSV_SUM_GRD_RISE[i]= 0 **(1.12.5.22)**

ER_STND_MMV_DIF_BAL_ABSV_SUM[i]= 0 **(1.12.5.23)**

ER_STND_MMV_DIF_ABSV_SUM_PRE[i]= 0 **(1.12.5.24)**

ER_STND_MMV_DIF_ABSV_SUM_GRD[i]= 0 **(1.12.5.25)**

FAC_CYL_LAM_ABSV_SUM_PRE[i]= 0 **(1.12.5.26)**

FAC_CYL_LAM_ABSV_SUM_GRD[i]= 0 **(1.12.5.27)**

CTR_PHA_SHIFT_AD_TRIG[i]= 0 **(1.12.5.28)**

(1.12.5.29)

endif$^{(1)}$

7.74.14 Error detection

if$^{(1)}$ (SEG_NR = 0 [*calculation for exhaust bank 1*] **or** SEG_NR = C_NR_SEG_REF_CBK_EX_2 [*calculation for exhaust bank 2*]
then

if$^{(2)}$ (DELTA_CRK_CYL_LAM[i] = C_DELTA_CRK_OUT_MIN **or** DELTA_CRK_CYL_LAM[i] = C_DELTA_CRK_OUT_MAX **or** CRK_CHG_FAC_PHA_SHIFT_AD[i] = C_CRK_CHG_FAC_MAX)
then

LV_DELTA_CRK_CYL_LAM_ERR[i] = 1 **(1.13.1)**

DELTA_CRK_CYL_LAM[i] = DELTA_CRK_CYL_LAM[i]$_{LDC}$ **(1.13.2)**

endif$^{(2)}$

endif$^{(1)}$

7.74.15 Storing the adaptation value after power latch

The value of DELTA_CRK_CYL_LAM[i] shall be stored in the non-volatile memory on following condition.

if$^{(1)}$ LV_DC 1 0
then

if$^{(2)}$ LC_CRK_CYL_LAM_DELTA_OUT = 1

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then

if$^{(3)}$ (LV_DELTA_CRK_CYL_LAM_ERR[i] = 0 **and** STATE_DELTA_CRK_CYL_LAM[i] = 6 'AD_HOLD')

then

DELTA_CRK_CYL_LAM[i] = DELTA_CRK_CYL_LAM[i]$_{CDC}$

(1.14.1)

else$^{(3)}$

DELTA_CRK_CYL_LAM[i] = DELTA_CRK_CYL_LAM[i]$_{LDC}$

(1.14.2)

endif$^{(3)}$

else$^{(2)}$

DELTA_CRK_CYL_LAM[i] = 0

(1.14.3)

endif$^{(2)}$

CDC: Current Driving Cycle
LDC: Last Driving Cycle

7.74.16 Counter update in case of CILC stable

if$^{(2)}$ (LV_FAC_CYL_LAM_COR_OSC[i] = 0 **and** LV_FAC_CYL_LAM_COR_LIM_OSC[i] = 0 **and** LV_ER_ABSV_SUM_GRD_RISE[i] = 0 **and** CTR_LAMB_CYL_SEL_CQ_DRIFT_THD[i] = 0 **and** STATE_LAMB_CYL_SEL_CQ_SLOP[i] = 0 **and** CTR_PHA_SHIFT_AD_TRIG[i] $>$ 0)

then

decrement(CTR_PHA_SHIFT_AD_TRIG[i])

(1.15.1)

endif$^{(2)}$

endif$^{(1)}$

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7.75 Cylinder balancing via lambda sensor (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_DIF_BAS_CRK_CYL_LAM	V	F4C0... B40H	-180 ...180	0.0625	°CRK
Difference between basic ignition angle stored during calibration of IP_CRK_SYN and actual value					
LF_LS_CBK_EX_LAM_CYL_SEL_CONF	O/V	0... FFH	0... 255	1	-
Logical variables data field for allocation of physical cylinders to exhaust bank					
LV_LAM_CYL_DEAC_VIM	O/V	0... 1H	0 ...1	1	-
Deactivating flag for cilc after VIM- activity					
LV_LAM_CYL_ENA [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation of the cylinder individual lambda control is open					
LV_LAM_CYL_ENA_CYL_BAL_DC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Specific activation conditions for cylinder individual lambda control are fulfilled in DC (CYBL coordination)					
LV_LAM_CYL_SEL_ADJ_OFS_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Cylinder individual fuel mass offset correction requested					
LV_LAM_CYL_SEL_CTL_FAST_REQ	O/V	0... 1H	0 ...1	1	-
Fast cylinder individual lambda control requested					
LV_LS_CBK_LAM_CYL_SEL_CONF_VLD	V	0... 1H	0 ...1	1	-
Configuration pattern for allocation of physical cylinders to exhaust bank is valid (=1)					
LV_MFF_N_CDN_LAM_CYL_ENA [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Fuel mass- and engine speed condition for the activation of the cylinder individual lambda control fulfilled					
MFF_SP_LAM_CYL_SEL	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint used by cylinder individual lambda control					
PHA_SHIFT_CAM_EX [NC_CBK_EX_NR]	O/V	88... 78H	-720 ...720	6	°CRK
Variable phase shift (variable valve timing)					
STATE_CDN_LAM_CYL_SEL_ADJ_RNG [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H	OUT_OF_RNG LOW_RNG HIGH_RNG COLD_RNG	-	-
Condition- state of cylinder individual lambda adaptation					
T_LAM_CYL_DEAC_VIM	O/V	0... FFH	0... 25.5	0.1	s
Deactivating time for cilc after VIM activity					
TEMP_LAM_CYL_SEL	O/V	0... FEH	-48... 142.5	0.75	°C
Temperature relevant for the operation of cylinder individual lambda control					

Input data:

AMP {p. 982}	C_CAM_OP_EX {p. 812}	C_MFF_LAM_CYL_ADJ_ CST_MAX {p. 2735}	C_MFF_LAM_CYL_ADJ_ CST_MIN {p. 2735}
C_MFF_MAX_FAC_CYL_ SEL_ADJ_H_RNG {p. 2735}	C_MFF_MAX_FAC_CYL_ SEL_ADJ_L_RNG {p. 2735}	C_MFF_MIN_FAC_CYL_ SEL_ADJ_H_RNG {p. 2735}	C_MFF_MIN_FAC_CYL_ SEL_ADJ_L_RNG {p. 2735}
C_N_LAM_CYL_ADJ_ CST_MAX {p. 2735}	C_N_LAM_CYL_ADJ_ CST_MIN {p. 2735}	C_N_MAX_FAC_CYL_ SEL_ADJ_H_RNG {p. 2735}	C_N_MAX_FAC_CYL_ SEL_ADJ_L_RNG {p. 2735}

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LV_ERR_TCHA_PRS_ LOW {p. 1063}	LV_ERR_TCO {p. 4496}	LV_ERR_TPS {p. 4982}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_ST_CHK_1 {p. 4951}	LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_TTIP_MES_LSH_ UP [NC_CBK_EX_NR] {p. 5438}
LV_ERR_VCV {p. 4729}	LV_ERR_VCV_PLAUS {p. 6062}	LV_ERR_WG_DR [NC_CBK_EX_NR]	LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR] {p. 2463}
LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR] {p. 2463}	LV_HOM_ACT {p. 8136}	LV_IND_FCUT {p. 803}	LV_INH_BAL_CUS {p. 8187}
LV_INH_OBD_DIAG_CYL_ BAL_LAM [NC_CBK_EX_NR] {p. 5113}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	LV_LAM_AD_INJ_ACT {p. 3348}	LV_LAM_CYL_SEL_ADJ_ OFS_EXT_REQ {p. 999}
LV_LAM_CYL_SEL_CTL_ DRIFT_PRED [NC_CBK_EX_NR] {p. 2732}	LV_LAM_CYL_SEL_LDC [NC_CBK_EX_NR] {p. 2882}	LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAMB_COP [NC_CBK_EX_NR] {p. 8233}
LV_MIS_STATE_A {p. 6238}	LV_MIS_STATE_B {p. 6238}	LV_TI_CYL_BAL_LAM_ ACT {p. 4022}	LV_VAR_LSH_UP {p. 656}
LV_VAR_TCHA {p. 656}	LV_VIM_1 {p. 3622}	LV_VPLSL_LIM [NC_CBK_EX_NR] {p. 955}	MAF {p. 8277}
MFF_SP_HOM_BAS_MV {p. 2151}	MFF_SP_S_SWI_HOM {p. 8243}	N {p. 1525}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_LAMB_REF [NC_CYL_NR] {p. 812}	NC_MAF_NR {p. 834}
NC_NR_CAM_CBK {p. 1507}	NC_NR_CBK_IVVT {p. 604}	STATE_CAT_DIAG [NC_CBK_EX_NR] {p. 5474}	STATE_DYN_DIAG [NC_CBK_EX_NR] {p. 5349}
TCO {p. 1100}	TEG_CAT_UP_MDL [_i] {p. 8236}	TEMP_CAPA_IV_MV {p. 2241}	TFU_IV {p. 1232}
WGPWM [NC_CBK_EX_NR] {p. 8140}			

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_LAM_CYL_MIN	-	0... FFFFH	0... 5434	0.0829175	hPa
Minimum ambient pressure for the activation					
C_CL_MMV_LAM_CYL_MAX	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Maximum canister load					
C_FAC_MV_LS_UP_DYN_LAM_CYL_THD	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
CILC-specific threshold of limit-sensor					
C_LAMB_SP_HOM_LAM_CYL_MIN_NOM	-	0... 7FFFH	0... 1.99993896484	61.0352e-6	-
Minimum Lambda SP for activation - nominal					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MFF_MAX_LAM_CYL_SEL_ADJ_ADD	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Upper fuel mass threshold for calculation of cylinder individual lambda adaptation in the additive area					
C_N_LAM_CYL_MAX_EOL	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed for the activation at EOL					
C_N_LAM_CYL_MAX_NOM	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed for the activation - nominal					
C_N_LAM_CYL_MIN_EOL	-	0... 1FE0H	0... 8160	1	rpm
Minimum engine speed for the activation at EOL					
C_N_LAM_CYL_MIN_NOM	-	0... 1FE0H	0... 8160	1	rpm
Minimum engine speed for the activation - nominal					
C_N_MAX_LAM_CYL_SEL_ADJ_ADD	-	0... 1FE0H	0... 8160	1	rpm
Upper engine speed threshold for calculation of cylinder individual lambda adaptation in the additive area					
C_T_LAM_CYL_DEAC_VIM	-	0... FFH	0... 25.5	0.1	s
Timer value for deactivating cilc after VIM activity					
C_TEG_CAT_UP_MDL_LAM_CYL_MAX	-	0... 7FF0H	0... 2047	0.0625	°C
Maximum exhaust gas temperature; engine out - alternative value for sensor hexagon temperature					
C_TEMP_IV_SWI_LAM_CYL_SEL	-	0... 2H	0 ...2	1	-
Manual switch for the injection-valve-temperature based cylinder individual lambda control					
C_WGPWM_MAX_LAM_CYL_SEL	-	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Maximum threshold of waste gate signal for activation of cylinder individual lambda control					
CLF_LS_CBK_EX_LAM_CYL_SEL_CONF	-	0... FFH	0... 255	1	-
Configuration pattern for allocation of physical cylinders to exhaust bank					
IP_CRK_DELTA_IGA_LAM_CYL_SEL	-	88... 78H	-720 ...720	6	°CRK
LDP_IGA_DIF_BAS_CYL_LAM_IP_CRK	8	0... 1680H	-180... 179.937	0.0624891	°CRK
Phase shift deviation caused by IGA difference					
IP_IGA_BAS_CRK_CYL_LAM	V	FA60... 5A0H	-90 ...90	0.0625	°CRK
LDPM_N_1_CYBL	8	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_1_CYBL	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic ignition angle stored during calibration of IP_CRK_SYN					
IP_MFF_LAM_CYL_MAX_EOL	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_3_CYBL	6	0... 1FE0H	0... 8160	1	rpm
Maximum fuel mass/engine speed threshold for the activation of cylinder individual lambda at EOL					
IP_MFF_LAM_CYL_MAX_NOM	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_4_CYBL	6	0... 1FE0H	0... 8160	1	rpm
Maximum fuel mass/engine speed threshold for the activation of cylinder individual lambda - nominal					
IP_MFF_LAM_CYL_MIN_EOL	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_3_CYBL	6	0... 1FE0H	0... 8160	1	rpm
Minimum fuel mass/engine speed threshold for the activation of cylinder individual lambda at EOL					
IP_MFF_LAM_CYL_MIN_NOM	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_4_CYBL	6	0... 1FE0H	0... 8160	1	rpm
Minimum fuel mass/engine speed threshold for the activation of cylinder individual lambda - nominal					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LAM_CYL_ENA_CDN_MAN	-	0... 1H	0 ...1	1	-
Manual switch to enable the cylinder individual lambda control ignoring the conditions are fulfilled					
LC_LAM_CYL_SEL_ADJ_OFS_RNG_REQ	-	0... 1H	0 ...1	1	-
Manual request for calculation of cylinder individual lambda adaptation in the additive area (=1)					
LC_LAM_CYL_SEL_CTL_FAST_REQ_MAN	-	0... 1H	0 ...1	1	-
Manual switch for a fast cylinder individual lambda control (=1)					

General Information

The module serves as a check box for application conditions of the function cylinder individual lambda control . If several conditions are fulfilled the flag LV_LAM_CYL_ENA is set to 1. This flag is an input to the cylinder individual lambda control.

Description of index "[i]" and "[x]":

x: logical cylinder
use NC_CYL_NR: number of engine cylinders index "[x]"
use LF_LS_CBK_EX_LAM_CYL_SEL_CONF: pattern for allocation of physical cylinders to exhaust bank index "[i]"

Application Conditions

Initialization: RST
Activation: SEG: always
100MS: always
Deactivation: never

Function description

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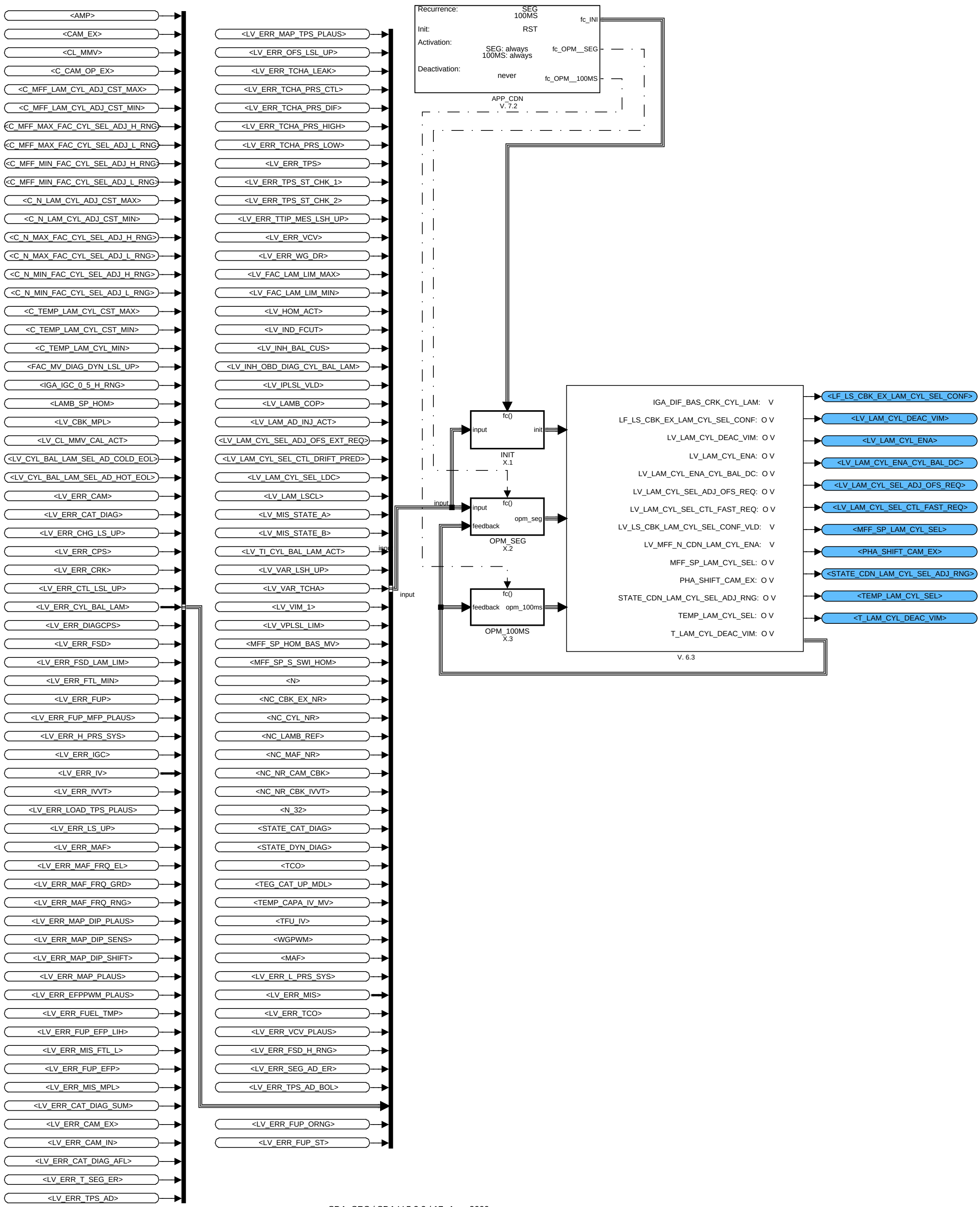

SDA_SRS / SDA V 5.3.2 / 17−Aug−2009

Figure 7.75.1: :

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7.75.1 Initialisation Overview

7.75.1.1 Initialisation at Reset

Check if CLF_LS_CBK_EX_LAM_CYL_SEL_CONF is calibrated in a valid way (0 or NC_LAMB_REF). If not, LV_LS_CBK_LAM_CYL_SEL_CONF_VLD indicates that the calibration is wrong and LV_LAM_CYL_ENA[NC_CBK_EX_NR] can not be set to 1.
So CILC is deactivated when calibration is wrong

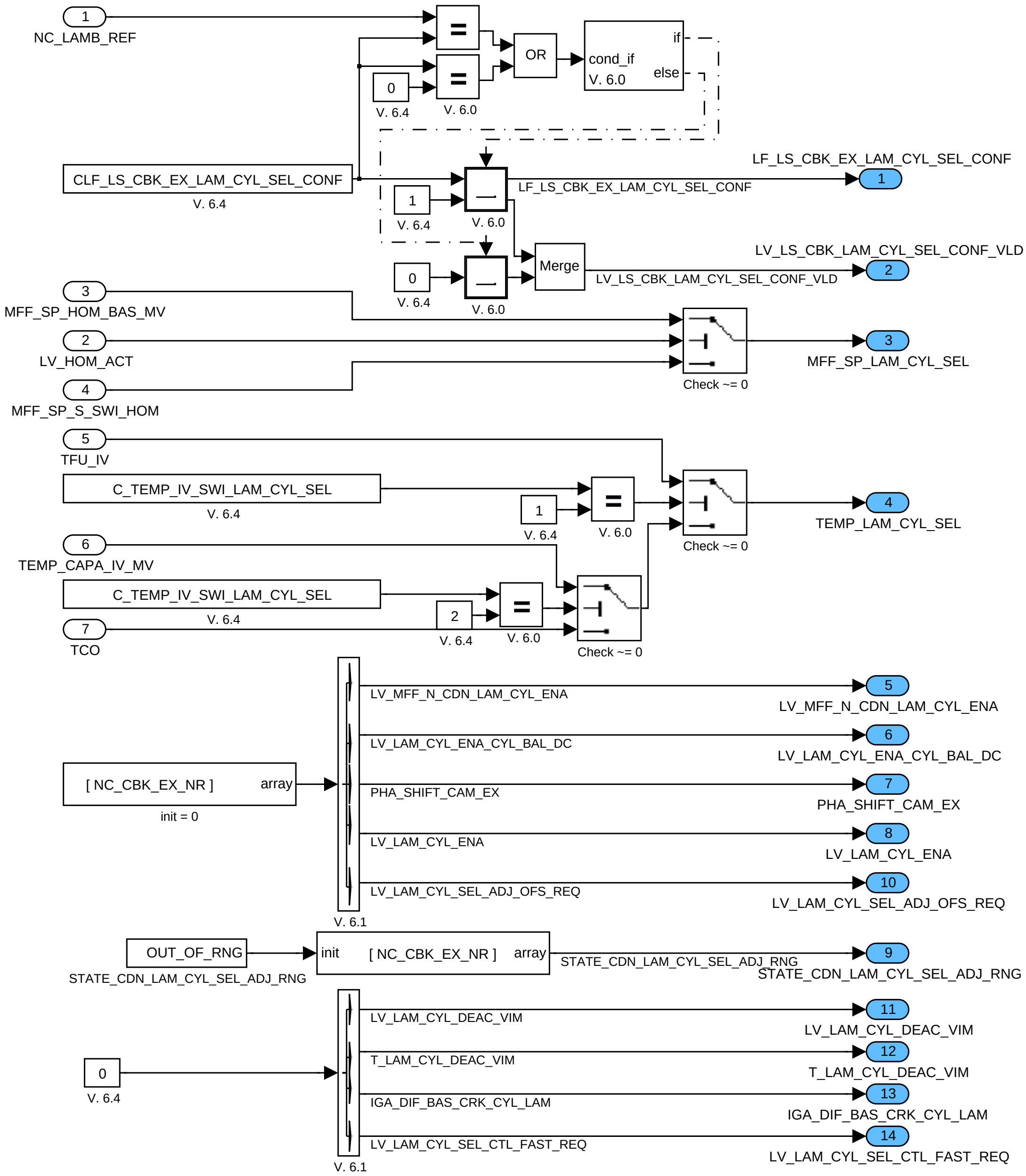

Figure 7.75.2: :

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7.75.2 Calculations at Segment recurrence

7.75.2.1 An Overview

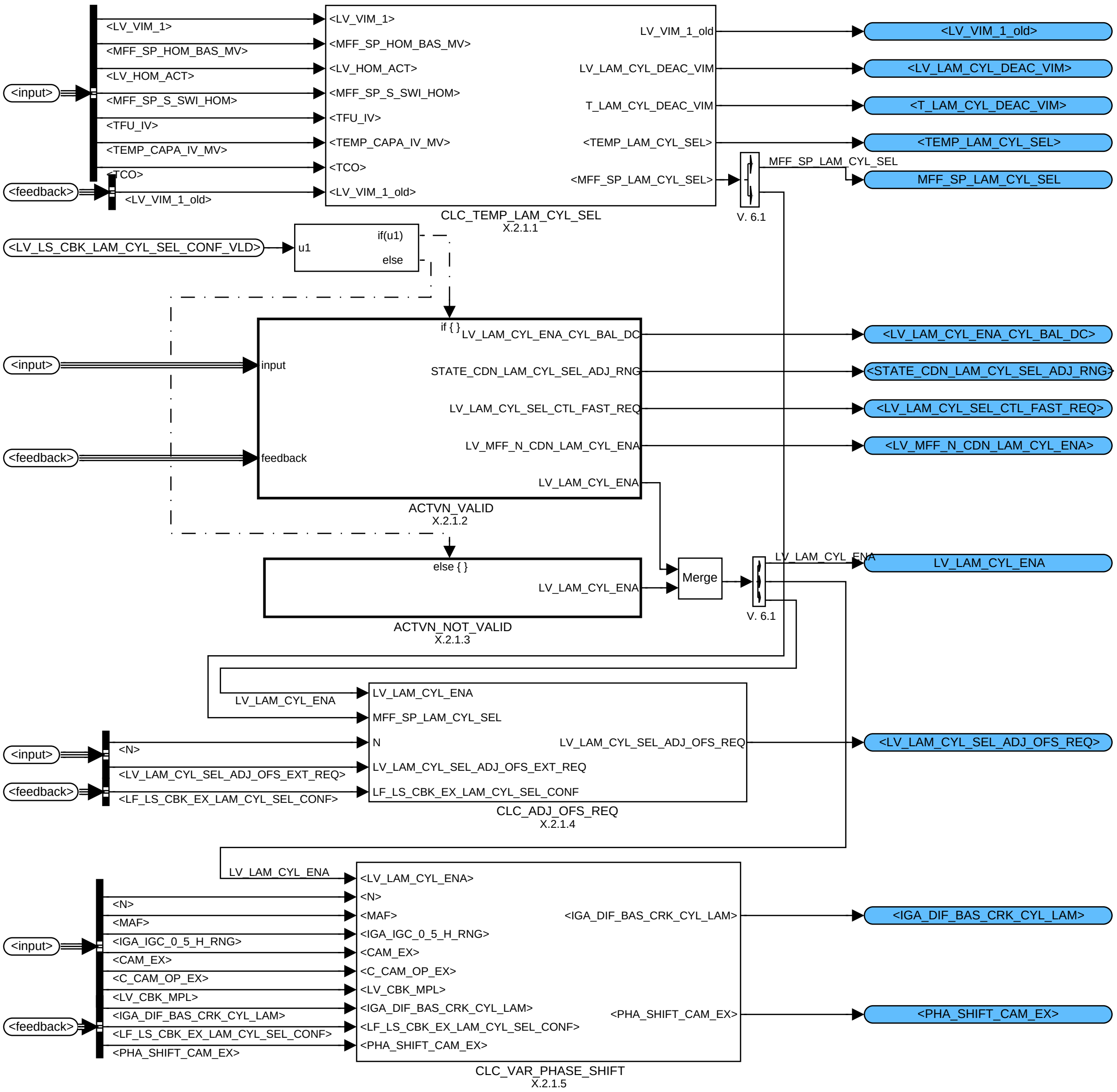

Figure 7.75.3: :

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7.75.2.1.1 Calculation of TEMP_LAM_CYL_SEL

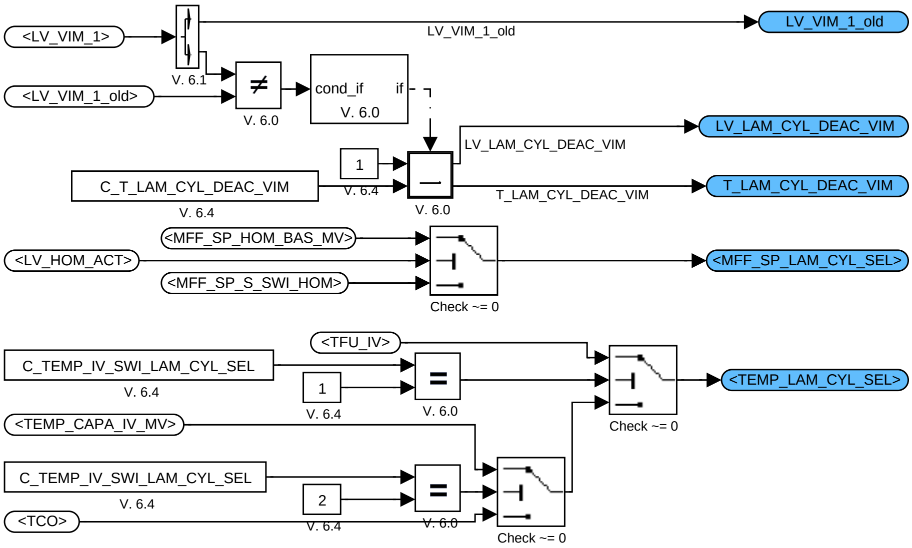

Figure 7.75.4: :

7.75.2.1.2 If Activation Valid

7.75.2.1.2.1 Calculation of LV_MFF_N_CDN_LAM_CYL_ENA

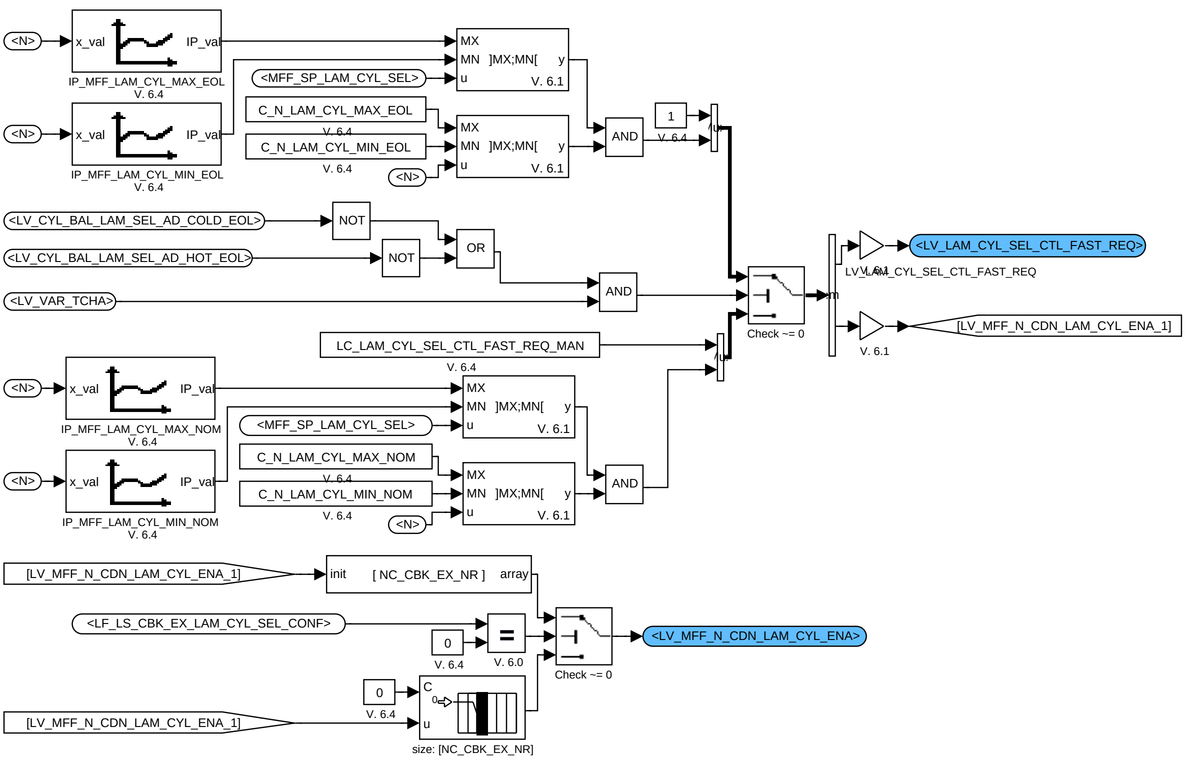

Figure 7.75.5: :

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7.75.2.1.2.2 Calculation of LV_LAM_CYL_ENA_CYL_BAL_DC

Remark:

1) Variables dependent on NC_CYL_NR shall be assigned to the corresponding exhaust bank (index i).
2) Every variable elements dependent on NC_NR_CAM_CBK or NC_MAF_NR shall be assigned to all exhaust bank.

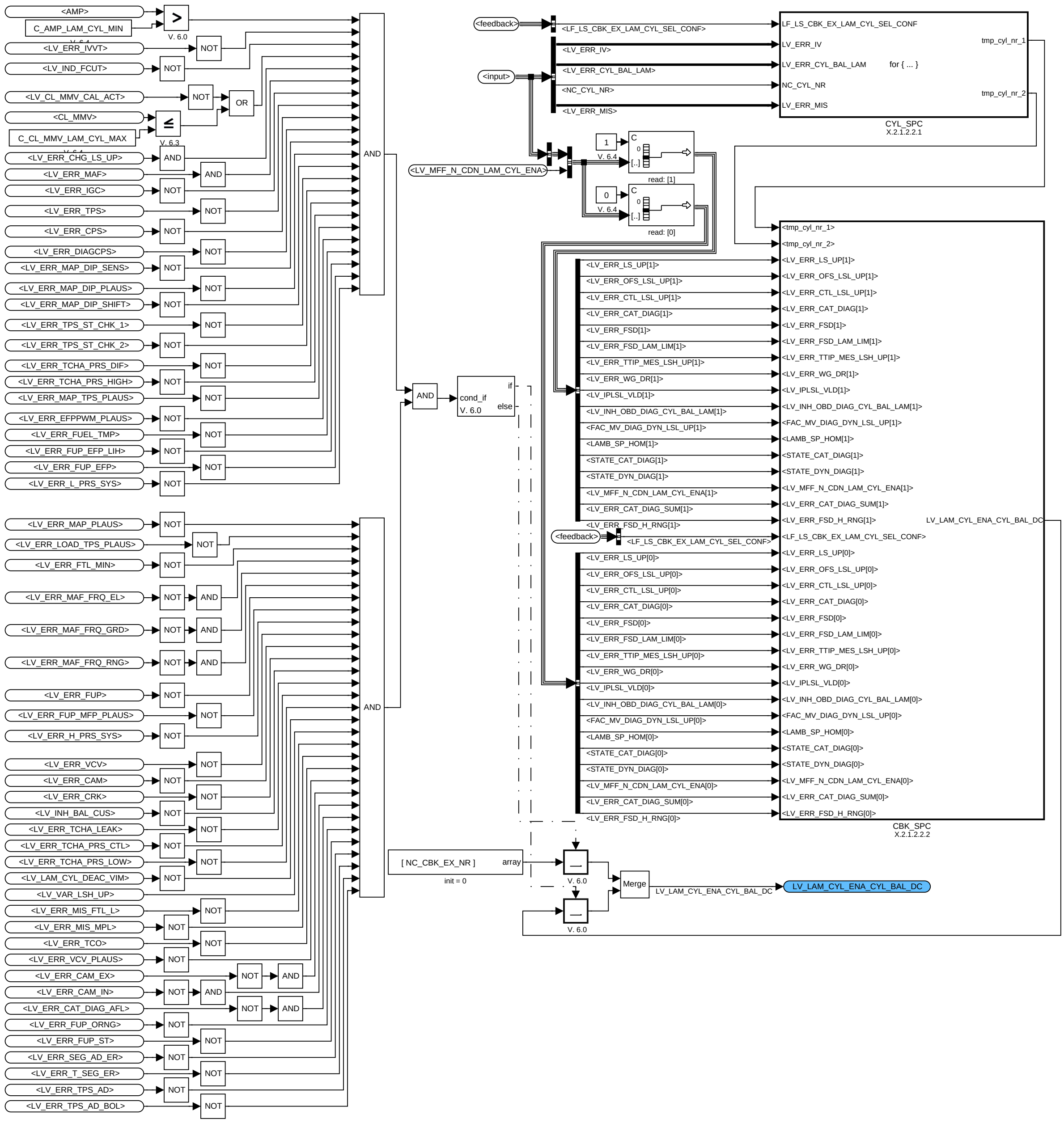

Figure 7.75.6: :

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7.75.2.1.2.2.1 Cylinder specific variables

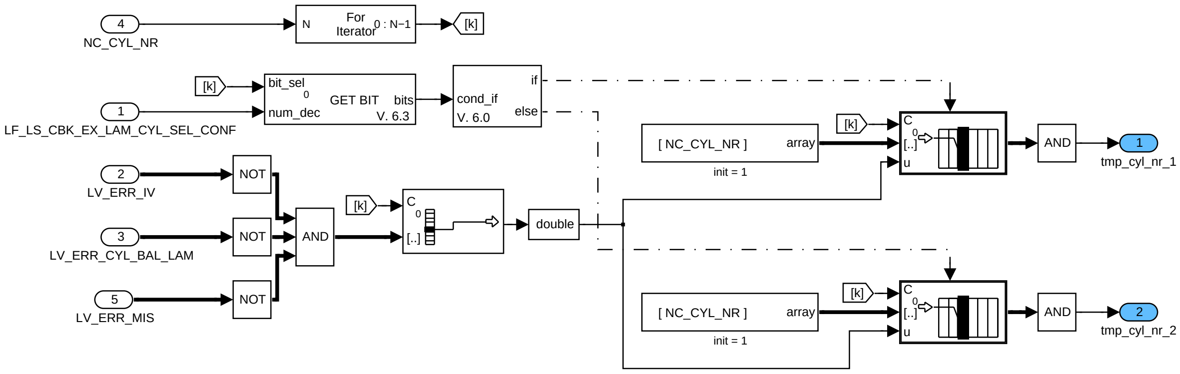

Figure 7.75.7: :

7.75.2.1.2.2.2 Bank specific variables

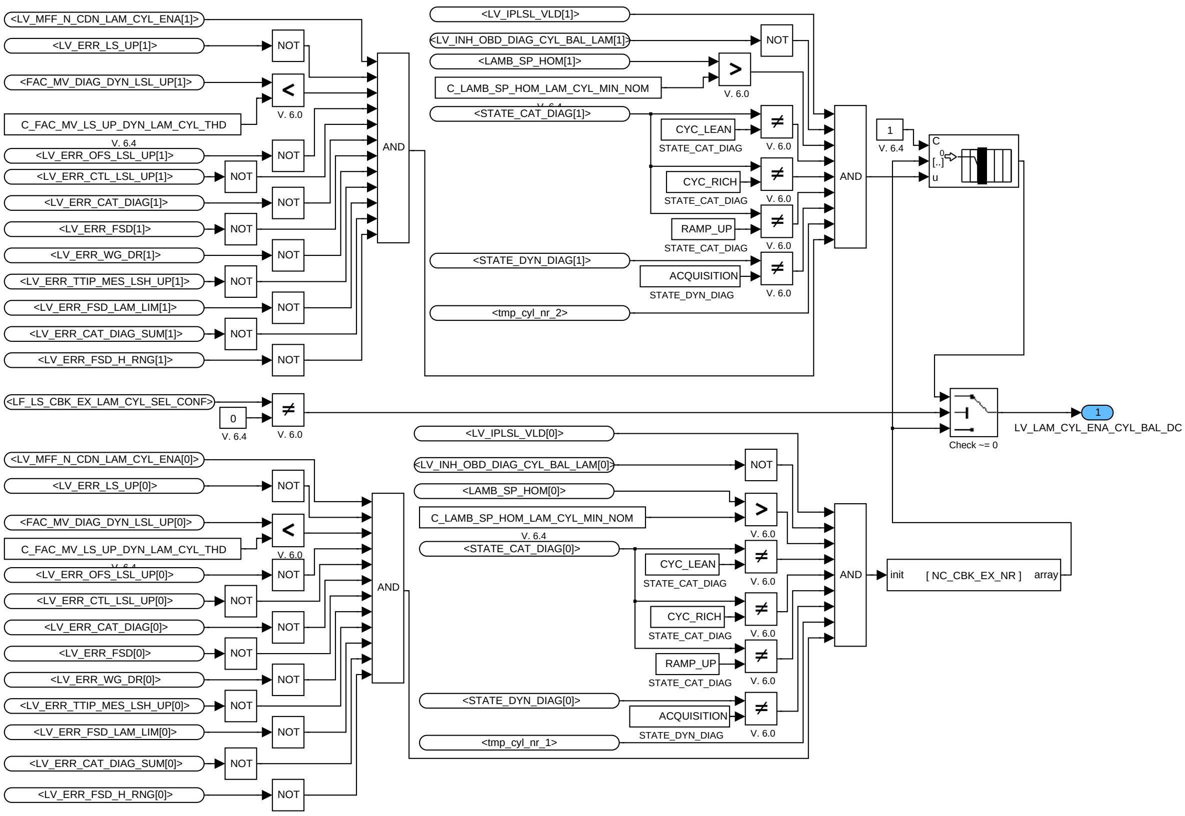

Figure 7.75.8: :

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7.75.2.1.2.3 Calculation of LV_LAM_CYL_ENA

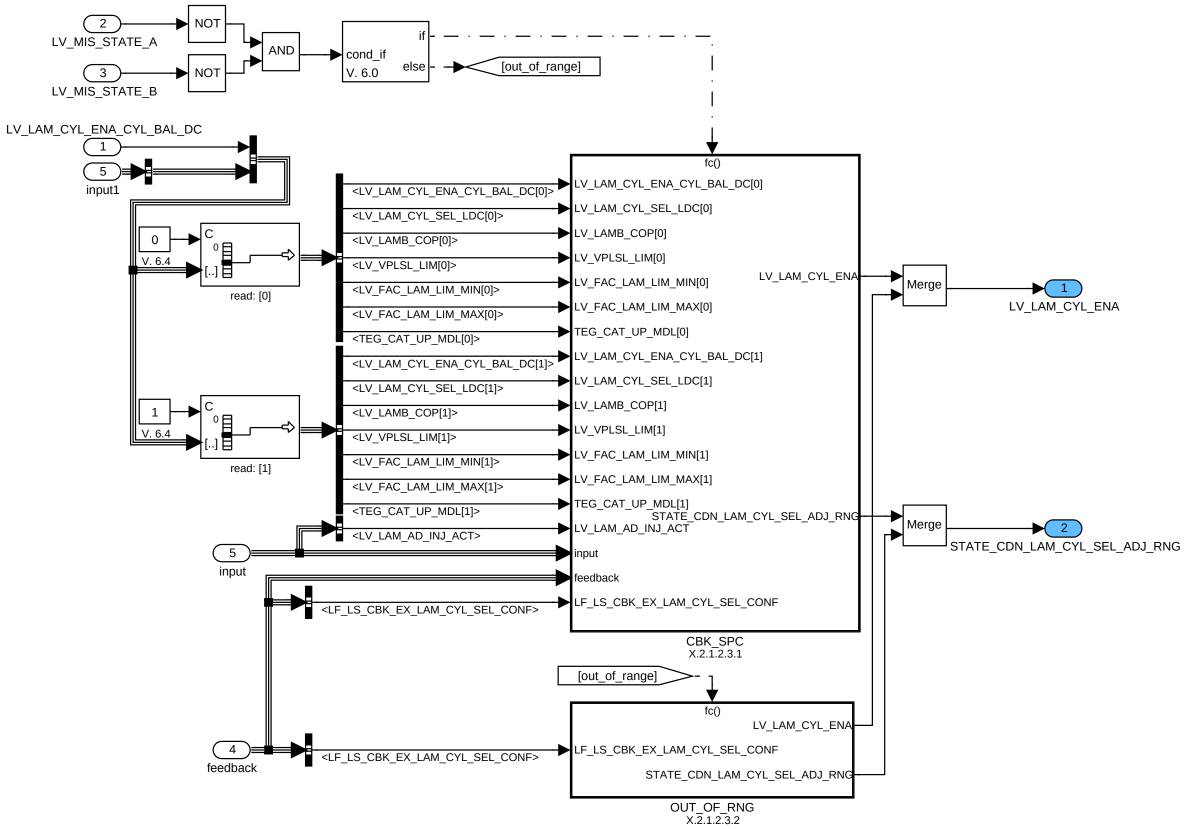

Figure 7.75.9: :

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7.75.2.1.2.3.1 Bank specific calculations

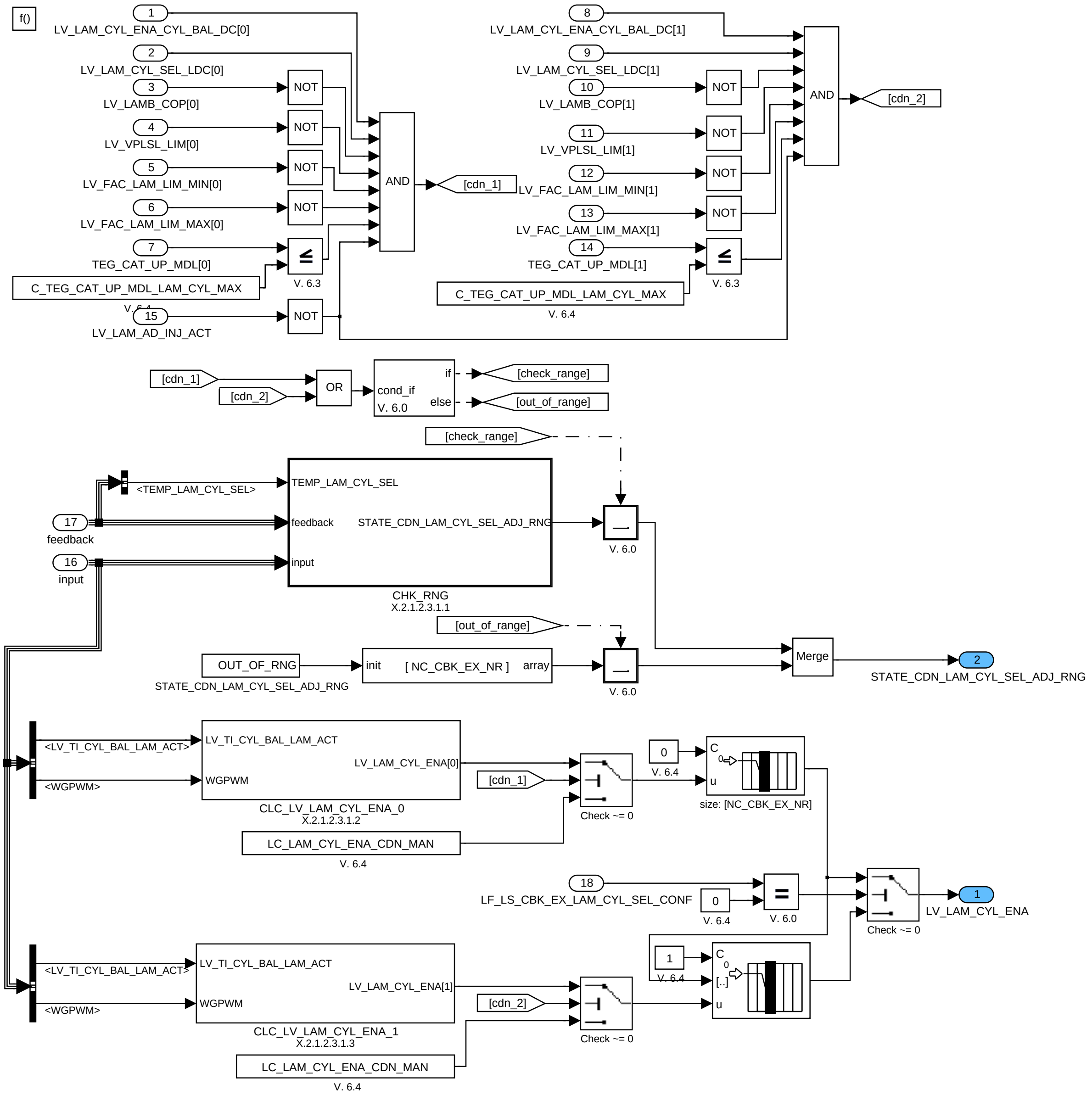

Figure 7.75.10: :

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7.75.2.1.2.3.1.1 Check range

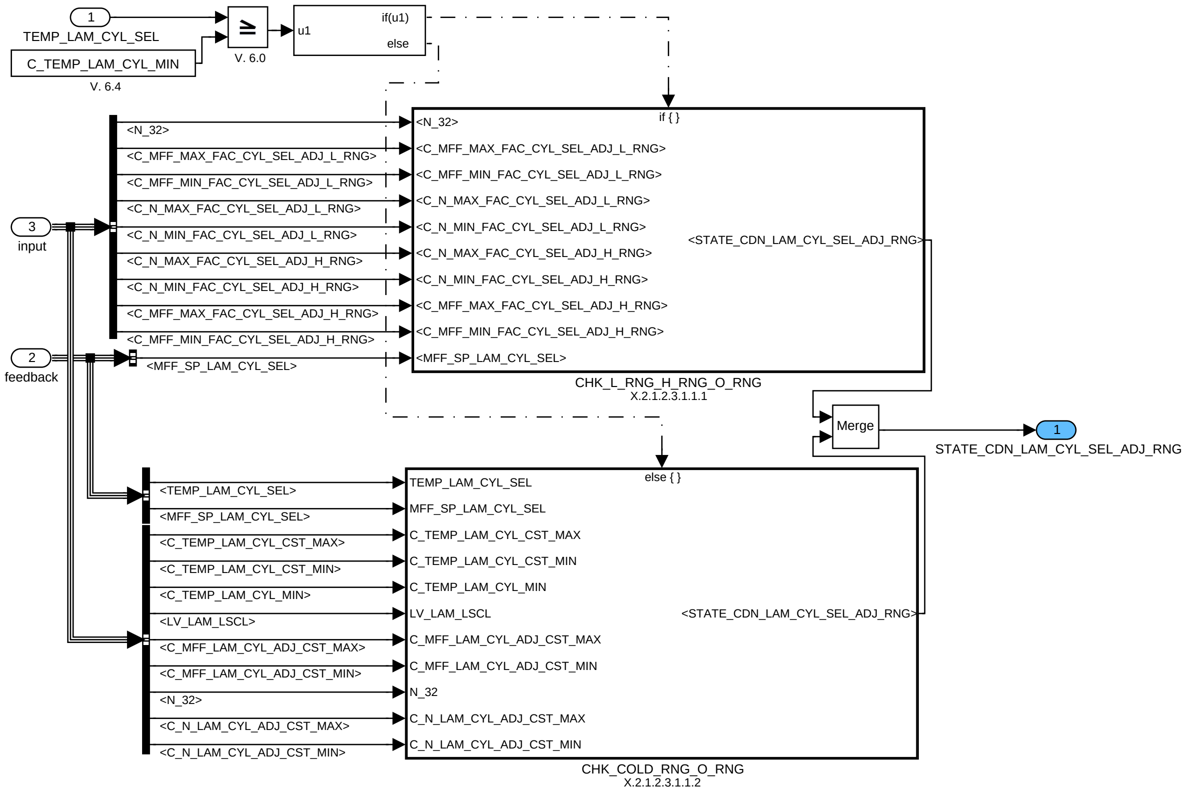

Figure 7.75.11: :

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7.75.2.1.2.3.1.1.1 Check for Low or High or Out of Range

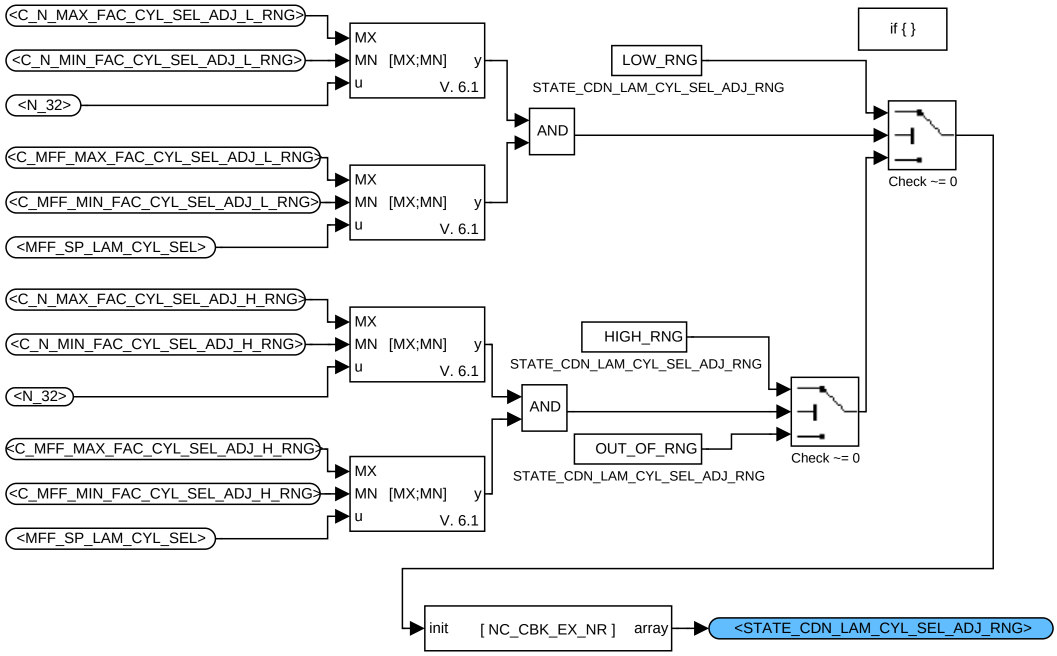

Figure 7.75.12: :

7.75.2.1.2.3.1.1.2 Check for Cold or Out of Range

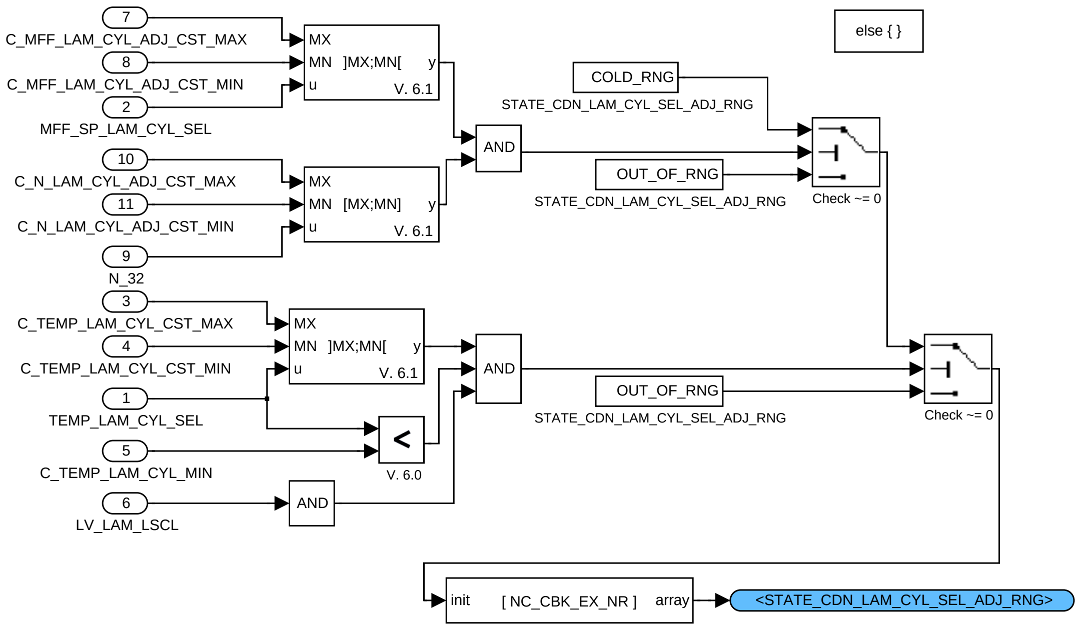

Figure 7.75.13: :

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7.75.2.1.2.3.1.2 Calculation of LV_LAM_CYL_ENA[0]

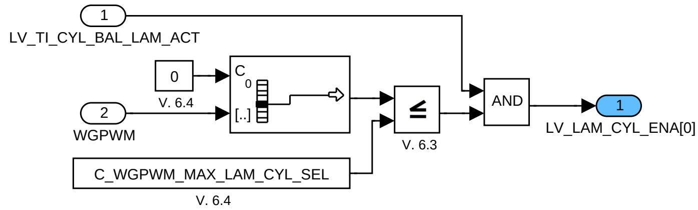

Figure 7.75.14: :

7.75.2.1.2.3.1.3 Calculation of LV_LAM_CYL_ENA[1]

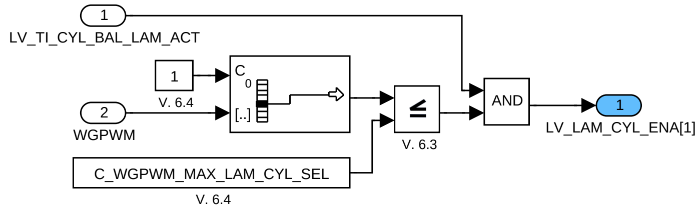

Figure 7.75.15: :

7.75.2.1.2.3.2 Out of Range

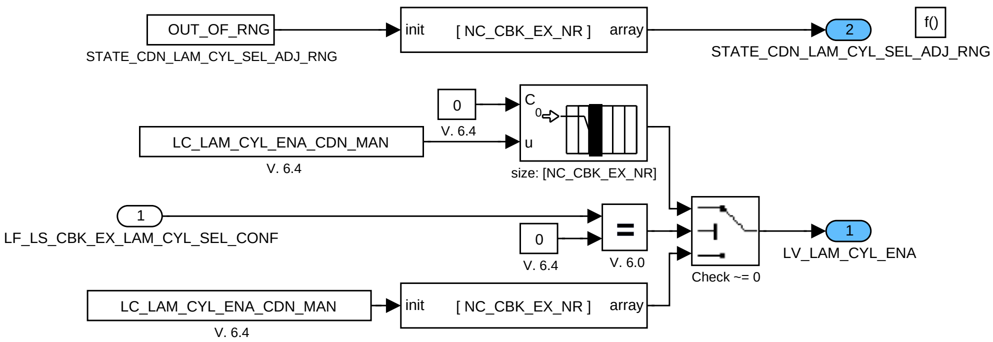

Figure 7.75.16: :

7.75.2.1.3 If Activation not valid

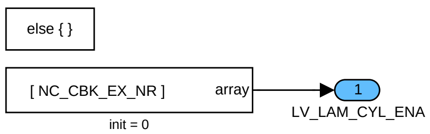

Figure 7.75.17: :

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7.75.2.1.4 Calculation of Offset requirement

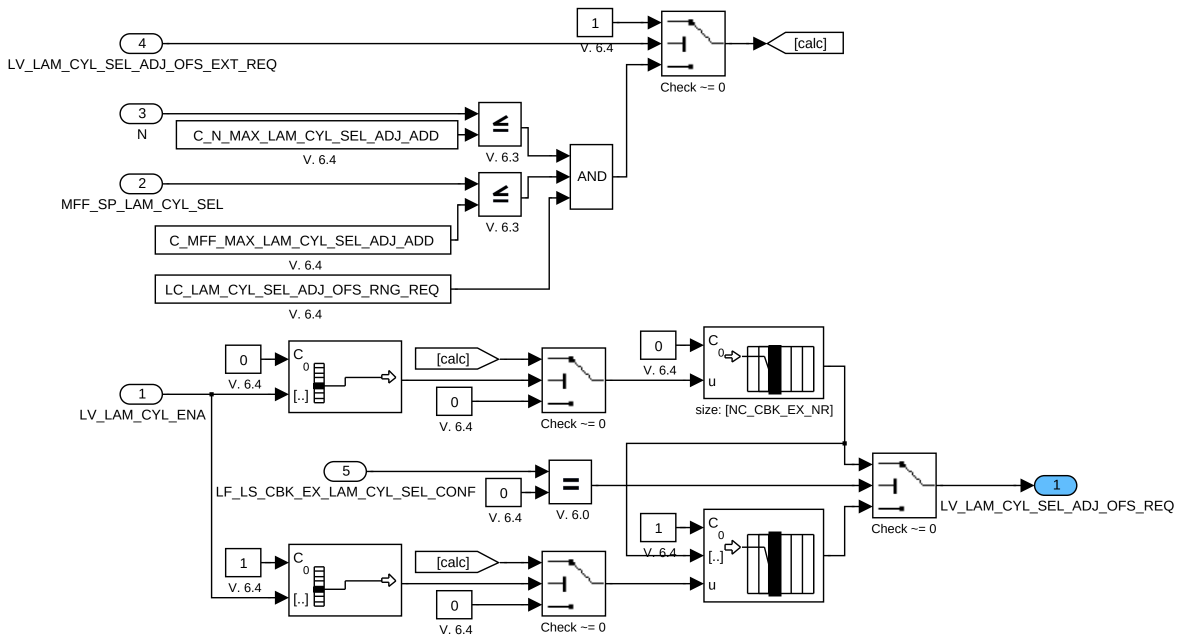

Figure 7.75.18: :

7.75.2.1.5 Calculation of Variable Phase shift

Regarding the influence of variable position of exhaust camshaft on phase shift, a variable phase shift, PHA_SHIFT_CAM_EX[i] is defined.
For a six-cylinder engine with a variable valve timing for instance, the variable phase shift is governed by the following calculation.

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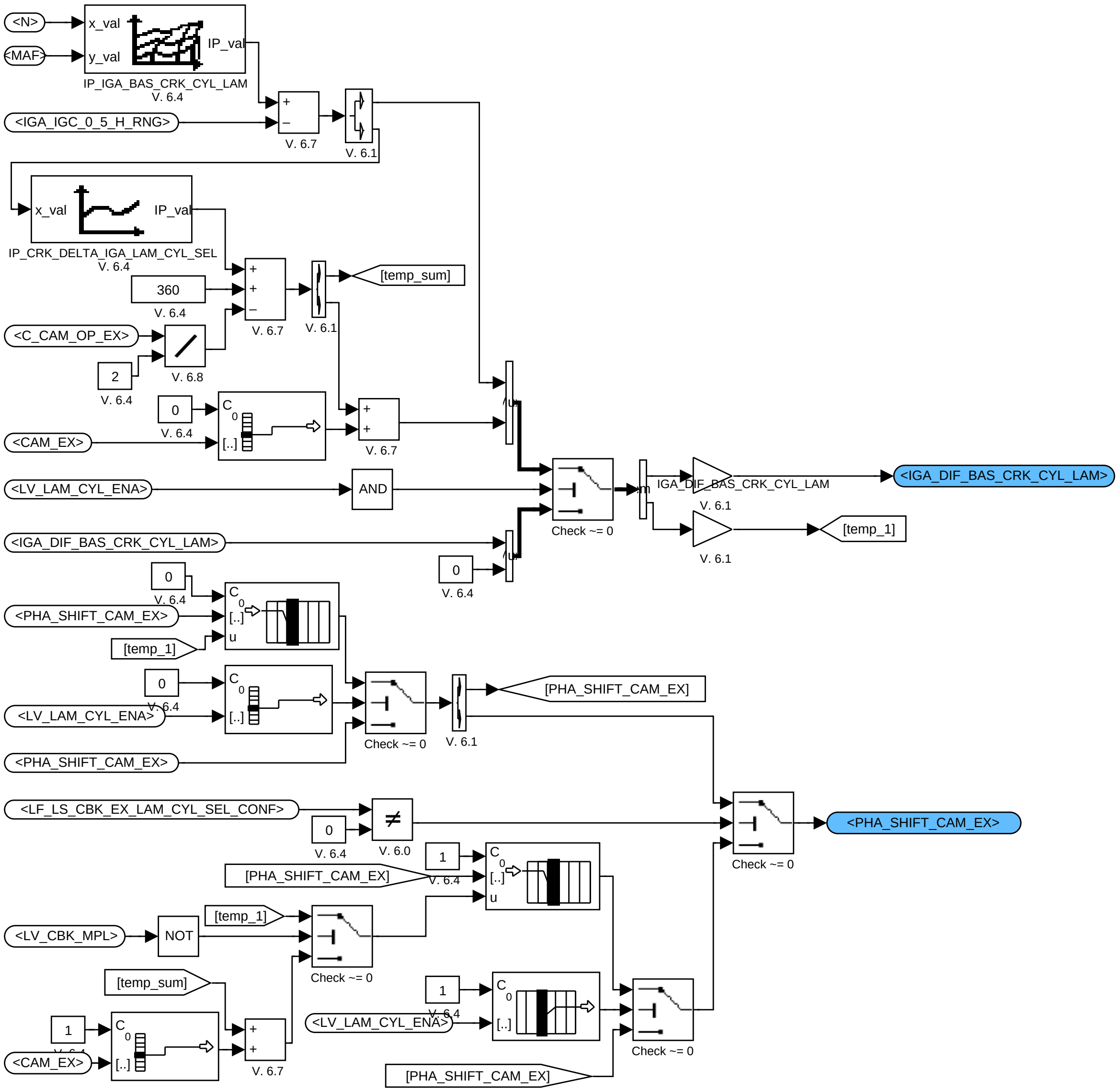

Figure 7.75.19: :

7.75.3 Calculations at 100ms recurrence

7.75.3.1 Decrement timer value T_LAM_CYL_DEAC_VIM and reactivation of CILC timer task

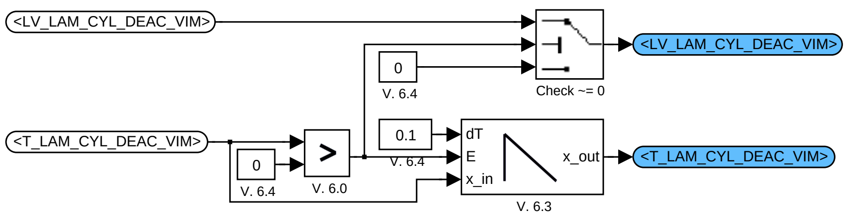

Figure 7.75.20: :

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7.76 Limited dynamics for cylinder individual lambda control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_MV_OFS_LDC_LAM_CYL_SEL [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.998474121093	0.00152587	%
Offset of lambda controller output mean value for detection of limited dynamics (cylinder individual lambda control)					
LV_LAM_CYL_SEL_LDC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Detection flag of limited dynamics for cylinder individual lambda control					
MAF_INT_LDC_LAM_CYL_SEL [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.45633333333e3	0.02222222	g
Air mass flow integral during the time after limited dynamics was interrupted					
MAF_OFS_LDC_LAM_CYL_SEL	V	8000... 7FFFH	-694.5105973907 ...694.48940260929	0.02119478	mg/stk
Offset of air mass flow for detection of limited dynamics for cylinder individual lambda control					
N_OFS_LDC_LAM_CYL_SEL	V	E020... 1FE0H	-8160 ...8160	1	rpm
Offset of engine speed for detection of limited dynamics for cylinder individual lambda control					

Input data:

FAC_LAM_MV_DELTA_LDC [NC_CBK_EX_NR] {p. 2585}	LF_LS_CBK_EX_LAM_CYL_SEL_CONF {p. 2864}	LV_ES {p. 1720}	LV_ST_END {p. 1720}
MAF_CYL {p. 8277}	MAF_DELTA_LDC {p. 2585}	N_DELTA_LDC {p. 2585}	NC_CBK_EX_NR {p. 1829}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_LAM_DYW_LDC_LAM_CYL_SEL	V	0... 7FFFH	0... 49.99847412	0.00152587	%
Dynamic window of lambda controller output for detection of limited dynamics (cylinder individual lambda control)					
C_MAF_DYW_LDC_LAM_CYL_SEL	V	0... FFFFH	0... 1389	0.02119478	mg/stk
Dynamic window of MAF for detection of limited dynamics (cylinder individual lambda control)					
C_MAF_INT_LDC_LAM_CYL_SEL	V	0... FFFFH	0... 1.45633333333e3	0.02222222	g
Threshold of air mass flow integral for detection of limited dynamics for cylinder individual lambda control					
C_N_DYW_LDC_LAM_CYL_SEL	V	0... 1FE0H	0... 8160	1	rpm
Dynamic window of engine speed for detection of limited dynamics (cylinder individual lambda control)					

General information

The condition limited dynamics LV_LAM_CYL_SEL_LDC[i] for cylinder individual lambda control is detected if the engine speed, mass air flow and the mean value of lambda controller output are within the corresponding dynamic window. Once all of the conditions are fulfilled, the integral of the mass air flow is calculated. The limited dynamics is then detected (LV_LAM_CYL_SEL_LDC[i] = 1) if the value of mass air flow integral reaches the calibrated threshold.

Application conditions:

Initialisation: **at reset, LV_IGK = 0 →1 and clear error memory:**

```
LV_LAM_CYL_SEL_LDC[i] = 0
MAF_INT_LDC_LAM_CYL_SEL[i] = 0
```

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```
FAC_LAM_MV_OFS_LDC_LAM_CYL_SEL[i] = 0
MAF_OFS_LDC_LAM_CYL_SEL = 0
N_OFS_LDC_LAM_CYL_SEL = 0
```

Activation: LV_ST_END = 1

Deactivation: LV_ES = 1

Recurrence: T_SAMPLE = 20 ms

Function description:

Formula section:

```
if(1)  two separate exhaust banks are concerned (NC_CBK_EX_NR = 2)
then
       i = 1, for exhaust bank 1
       i = 2, for exhaust bank 2
else(1)
       i = 1 (NC_CBK_EX_NR = 1)
endif(1)
```

*use **LF_LS_CBK_EX_LAM_CYL_SEL_CONF** to distinguish between single and 2-exhaust-bank configuration - index "[i]"*

7.76.1 Evaluation of the dynamic window for the engine speed

```
if(1) abs(N_DELTA_LDC) > C_N_DYW_LDC_LAM_CYL_SEL
then
    if(2)  abs(N_DELTA_LDC - N_OFS_LDC_LAM_CYL_SEL) >
                                              C_N_DYW_LDC_LAM_CYL_SEL
    then
             N_OFS_LDC_LAM_CYL_SEL = N_DELTA_LDC
                                                                (1.1.1)
             MAF_INT_LDC_LAM_CYL_SEL[i] = 0
                                                                (1.1.2)
    endif(2)
else(1)
    N_OFS_LDC_LAM_CYL_SEL = 0
                                                                (1.1.3)
endif(1)
```

7.76.2 Evaluation of the dynamic window for the air mass flow

```
if(1) abs(MAF_DELTA_LDC) > C_MAF_DYW_LDC_LAM_CYL_SEL
then
     if(2)  abs(MAF_DELTA_LDC - MAF_OFS_LDC_LAM_CYL_SEL) >
                                              C_MAF_DYW_LDC_LAM_CYL_SEL
     then
             MAF_OFS_LDC_LAM_CYL_SEL = MAF_DELTA_LDC
                                                                (1.2.1)
             MAF_INT_LDC_LAM_CYL_SEL[i] = 0
                                                                (1.2.2)
     endif(2)
else(1)
     MAF_OFS_LDC_LAM_CYL_SEL = 0
                                                                (1.2.3)
endif(1)
```

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7.76.3 Evaluation of the dynamic window for the lambda controller output mean value

```
if(1) abs(FAC_LAM_MV_DELTA_LDC[i]) > C_FAC_LAM_DYW_LDC_LAM_CYL_SEL
then
     if(2)  abs(FAC_LAM_MV_DELTA_LDC[i] -
                                        FAC_LAM_MV_OFS_LDC_LAM_CYL_SEL[i]) >
                                            C_FAC_LAM_DYW_LDC_LAM_CYL_SEL
     then
              FAC_LAM_MV_OFS_LDC_LAM_CYL_SEL[i] = FAC_LAM_MV_DELTA_LDC[i]
                                                                     (1.3.1)
              MAF_INT_LDC_LAM_CYL_SEL[i] = 0
                                                                     (1.3.2)
     endif(2)
else(1)
     FAC_LAM_MV_OFS_LDC_LAM_CYL_SEL[i] = 0
                                                                     (1.3.3)
endif(1)
```

7.76.4 Calculation of the air mass flow integral – detection of limited dynamics

```
if(1)  MAF_INT_LDC_LAM_CYL_SEL[i] < C_MAF_INT_LDC_LAM_CYL_SEL
then
     MAF_INT_LDC_LAM_CYL_SEL[i][g]  = MAF_INT_LDC_LAM_CYL_SEL[i][g]  +
                        MAF_CYL[kg/h]*T_SAMPLE[ms]*1/ 3600[(g*h)/(kg*ms)]
                                                                     (1.4.1)
     LV_LAM_CYL_SEL_LDC[i] = 0
                                                                     (1.4.2)
else(1)
     LV_LAM_CYL_SEL_LDC[i] = 1
                                                                     (1.4.3)
endif(1)
```

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7.77 Lambda setpoint for catalyst regeneration

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_RGN_CYC_LAMB_RGN	O/V	0... FFH	0... 255	1	-
Regenerations counter for calculating of alternate flag					
FAC_NT_AGI_RGN	V	0... FFFFH	0... 0.99998474121	15.2588e-6	-
NOx catalyst aging factor for Lambda setpoint correction factor determination					
LAMB_RGN [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda setpoint for catalyst regeneration					
LAMB_RGN_FAC [NC_CBK_EX_NR]	V	0... FFH	0... 1.9921875	7.8125e-3	-
factor for the correction of the regeneration lambda					
LV_LAMB_PARK_AFL_DEAC	V	0... 1H	0 ...1	1	-
Deactivation flag for regeneration depending on T_RGN_2					
LV_LAMB_SP_SWI	O/V	0... 1H	0 ...1	1	-
Flag of alternate					
LV_RGN_NT_REQ_OLD	-	0... 1H	0 ...1	1	-
Old logical value for regeneration phase request					
LV_SENS_RGN_1_READY_OLD	-	0... 1H	0 ...1	1	-
Old value for end of first regeneration flag					
MAF_KGH_HOM	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Calculated MAF_KGH for homogeneous operation					
STATE_RGN [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H 4H	H_AMPL PARK L_AMPL PASSIVE EQUAL	-	-
NOx regeneration state					
T_RGN	O/V	0... FFFFH	0... 655.35	0.01	s
Time counter for regeneration active					
T_RGN_2	O/V	0... FFFFH	0... 655.35	0.01	s
Time counter for second regeneration					
VLS_NS_OLD [NC_NOX_SENS_CONF]	-	0... 578H	-200 ...1200	1	mV
Old binary O2 signal voltage, raw value, measured by NOx-Sensor					

Input data:

FAC_NT_AGI_LIM {p. 3072}	LC_SENS_AFR_MOD {p. 3000}	LV_ES {p. 1720}	LV_NT_ACT {p. 2982}
LV_RGN_NT_REQ {p. 2983}	LV_SENS_AFR [NC_NT_NR] {p. 2983}	LV_SENS_RGN_1_READY {p. 2983}	LV_ST {p. 1720}
LV_VLS_GRD_NEG {p. 2983}	LV_VLS_NS_VLD [NC_NOX_SENS_CONF] {p. 992}	MAF {p. 8277}	MAF_SP_TQI {p. 8390}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}	NC_NT_NR {p. 644}
NT_AGI {p. 3073}	NT_AGI_SUL {p. 3073}	NT_AGI_THERMO {p. 3073}	STATE_NOX {p. 2986}

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TNT_MDL_MV_SNG [NC_NT_NR] {p. 8237}	VLS_NS [NC_NOX_SENS_CONF] {p. 992}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_RGN_SWI_ACT	-	1... FFH	1... 255	1	-
Number of regenerations with initialization of STATE_RGN when the alternate flag is 1					
C_CTR_RGN_SWI_DEAC	-	1... FFH	1... 255	1	-
Number of regenerations with initialization of STATE_RGN when the alternate flag is 0					
C_FAC_NT_AGI_RGN_MAN	-	0... FFH	0... 1.99218	0.0078125	-
Manual set value for FAC_NT_AGI_RGN					
C_LAMB_FAC_L_AMPL_NOT_GRD	-	0... FFH	0... 1.99218	0.0078125	-
factor for the correction of the regeneration after waiting time without negative gradient of VLS_NS					
C_LAMB_PARK_BAS	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Basis lambda setpoint for park					
C_LAMB_PAS_BAS	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Basis lambda setpoint for passive state					
C_LAMB_RGN_MAX_EQU	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Maximum Lambda value for equal regeneration mode					
C_LAMB_RGN_MAX_H_AMPL	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Maximum value for high amplitude regeneration lambda					
C_LAMB_RGN_MAX_L_AMPL	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Maximum value for low amplitude regeneration lambda					
C_STATE_FAC_NT_AGI_RGN	-	0H 1H 2H 3H 4H	ALL THERMO SUL MAN LIM	-	-
Mode switch for FAC_NT_AGI_RGN					
C_STATE_LAMB_RGN_1_H_AMPL	-	0H 1H 2H 3H	NONE VLS T_RGN T_RGN_2	-	-
Lambda setpoint correction strategy for first high amplitude regeneration					
C_STATE_LAMB_RGN_2_H_AMPL	-	0H 1H 2H 3H	NONE VLS T_RGN T_RGN_2	-	-
Lambda setpoint correction strategy for second high amplitude regeneration					
C_STATE_LAMB_RGN_EQU	-	0H 1H 2H 3H	NONE VLS T_RGN T_RGN_2	-	-
Lambda setpoint correction strategy for equal mode regeneration					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_LAMB_RGN_L_AMPL	-	0H 1H 2H 3H	NONE VLS_MAF T_RGN T_RGN_2	-	-
Strategy for low amplitude regeneration					
C_STATE_RGN_1_PARK	-	0H 1H 2H 3H	NONE VLS T_RGN T_RGN_2	-	-
Park strategy for first regeneration					
C_STATE_RGN_2_PARK	-	0H 1H 2H 3H	NONE VLS T_RGN T_RGN_2	-	-
Park strategy for second regeneration					
C_STATE_RGN_INI_1	-	0H 1H 2H 3H 4H	H_AMPL PARK L_AMPL PASSIVE EQUAL	-	-
Initialisation state for first bank					
C_STATE_RGN_INI_2	-	0H 1H 2H 3H 4H	H_AMPL PARK L_AMPL PASSIVE EQUAL	-	-
Initialisation state for second bank					
C_STATE_RGN_INI_VLS_NOT_VLD_1	-	0H 1H 2H 3H 4H	H_AMPL PARK L_AMPL PASSIVE EQUAL	-	-
Initialisation state for first bank as long as NOx sensor VLS signal is not valid					
C_STATE_RGN_INI_VLS_NOT_VLD_2	-	0H 1H 2H 3H 4H	H_AMPL PARK L_AMPL PASSIVE EQUAL	-	-
Initialisation state for second bank as long as NOx sensor VLS signal is not valid					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_PURGE_H_AMPL	-	0... FFFFH	0... 655.35	0.01	s
Purge time for high amplitude regeneration					
C_T_PURGE_L_AMPL	-	0... FFFFH	0... 655.35	0.01	s
Purge time for low amplitude regeneration					
C_T_RGN_2_NOT_GRD	-	0... FFFFH	0... 655.35	0.01	s
After this time the second bank will be regenerated without waiting for negative gradient of VLS_NS					
IP_LAMB_FAC_EQU_NT_AGI	-	0... FFH	0... 1.99218	0.0078125	-
LDP_FAC_NT_AGI_RGN_IP_EQU	6	0... FFFFH	0... 0.99998	15.3e-6	-
Lambda setpoint correction factor for equal regeneration mode depending on NOx catalyst aging factor					
IP_LAMB_FAC_EQU_T_RGN	-	0... FFH	0... 1.99218	0.0078125	-
LDP_T_RGN_EQU_IP_LAMB_FAC	8	0... FFFFH	0... 655.35	0.01	s
Lambda setpoint correction factor for equal mode regeneration depending on T_RGN					
IP_LAMB_FAC_H_AMPL_1_VLS	-	0... FFH	0... 1.99218	0.0078125	-
LDP_VLS_H_AMPL_1_IP_LAMB_FAC	8	0... 578H	-200 ...1200	1	mV
Lambda setpoint correction factor for first high amplitude regeneration depending on binary NS lambda signal					
IP_LAMB_FAC_H_AMPL_2_VLS	-	0... FFH	0... 1.99218	0.0078125	-
LDP_VLS_H_AMPL_2_IP_LAMB_FAC	8	0... 578H	-200 ...1200	1	mV
Lambda setpoint correction factor for second high amplitude regeneration depending on binary NS lambda signal					
IP_LAMB_FAC_H_AMPL_NT_AGI	-	0... FFH	0... 1.99218	0.0078125	-
LDP_FAC_NT_AGI_RGN_IP_H_AMPL	6	0... FFFFH	0... 0.99998	15.3e-6	-
Lambda setpoint correction factor for high amplitude regeneration mode depending on NOx catalyst aging factor					
IP_LAMB_FAC_L_AMPL_2_VLS	-	0... FFH	0... 1.99218	0.0078125	-
LDP_VLS_L_AMPL_2_IP_LAMB_FAC	8	0... 578H	-200 ...1200	1	mV
Lambda setpoint correction factor for second low amplitude regeneration depending on binary NS lambda signal					
IP_LAMB_FAC_L_AMPL_NT_AGI	-	0... FFH	0... 1.99218	0.0078125	-
LDP_FAC_NT_AGI_RGN_IP_L_AMPL	6	0... FFFFH	0... 0.99998	15.3e-6	-
Lambda setpoint correction factor for low amplitude regeneration mode depending on NOx catalyst aging factor					
IP_LAMB_FAC_L_AMPL_T_RGN_1	-	0... FFH	0... 1.99218	0.0078125	-
LDP_T_RGN_1_L_AMPL_IP_LAMB_FAC	8	0... FFFFH	0... 655.35	0.01	s
Lambda setpoint correction factor for low amplitude regeneration depending on T_RGN					
IP_LAMB_FAC_L_AMPL_T_RGN_2	-	0... FFH	0... 1.99218	0.0078125	-
LDP_T_RGN_2_L_AMPL_IP_LAMB_FAC	8	0... FFFFH	0... 655.35	0.01	s
Lambda setpoint correction factor for low amplitude regeneration depending on T_RGN_2					
IP_LAMB_FAC_L_AMPL_VLS_MAF_KGH	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MAF_KGH_L_AMPL_IP_LAMB_FAC	2	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_VLS_L_AMPL_1_IP_LAMB_FAC	2	0... 578H	-200 ...1200	1	mV
Lambda setpoint correction factor for first low amplitude regeneration depending on MAF and VLS_NS					
IP_LAMB_FAC_PARK_1_T_RGN	-	0... FFH	0... 1.99218	0.0078125	-
LDP_T_RGN_1_PARK_IP_LAMB_FAC	8	0... FFFFH	0... 655.35	0.01	s
Lambda setpoint correction factor for park for first regeneration depending on T_RGN					
IP_LAMB_FAC_PARK_1_VLS	-	0... FFH	0... 1.99218	0.0078125	-
LDP_VLS_PARK_1_IP_LAMB_FAC	8	0... 578H	-200 ...1200	1	mV
Lambda setpoint correction factor for park depending on binary NS lambda signal					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_LAMB_FAC_PARK_2_T_RGN_2	-	0... FFH	0... 1.99218	0.0078125	-
LDP_T_RGN_2_PARK_IP_LAMB_FAC	8	0... FFFFH	0... 655.35	0.01	s
Lambda setpoint correction factor for park depending on T_RGN_2					
IP_LAMB_PURGE_H_AMPL	V	0... 7FFFH	0... 31.99902	976.599e-6	-
LDPM_TNT_MDL_MV_SNG_1_NOXM	2	0... FFFFH	0... 1023.98437	0.015625	°C
LDPM_MAF_KGH_HOM_1_NOXM	2	0... FFFFH	0... 2047.96875	0.03125	kg/h
Basis lambda purge for high amplitude regeneration					
IP_LAMB_PURGE_L_AMPL	V	0... 7FFFH	0... 31.99902	976.599e-6	-
LDPM_TNT_MDL_MV_SNG_1_NOXM	2	0... FFFFH	0... 1023.98437	0.015625	°C
LDPM_MAF_KGH_HOM_1_NOXM	2	0... FFFFH	0... 2047.96875	0.03125	kg/h
Basis lambda purge for low amplitude regeneration					
IP_LAMB_RGN_EQU_BAS	V	0... 7FFFH	0... 31.99902	976.599e-6	-
LDPM_TNT_MDL_MV_SNG_1_NOXM	2	0... FFFFH	0... 1023.98437	0.015625	°C
LDPM_MAF_KGH_HOM_1_NOXM	2	0... FFFFH	0... 2047.96875	0.03125	kg/h
Basis lambda for equal mode regeneration					
IP_LAMB_RGN_H_AMPL_BAS	V	0... 7FFFH	0... 31.99902	976.599e-6	-
LDPM_TNT_MDL_MV_SNG_1_NOXM	2	0... FFFFH	0... 1023.98437	0.015625	°C
LDPM_MAF_KGH_HOM_1_NOXM	2	0... FFFFH	0... 2047.96875	0.03125	kg/h
Basis lambda for high amplitude regeneration					
IP_LAMB_RGN_L_AMPL_BAS	V	0... 7FFFH	0... 31.99902	976.599e-6	-
LDPM_TNT_MDL_MV_SNG_1_NOXM	2	0... FFFFH	0... 1023.98437	0.015625	°C
LDPM_MAF_KGH_HOM_1_NOXM	2	0... FFFFH	0... 2047.96875	0.03125	kg/h
Basis lambda for low amplitude regeneration					
IP_LAMB_RGN_MAX_PARK	V	0... 7FFFH	0... 31.99902	976.599e-6	-
LDP_N_32_IP_LAMB_RGN_MAX_PARK	2	0... FFH	0... 8160	32	rpm
LDP_MAF_IP_LAMB_RGN_MAX_PARK	2	0... FFFFH	0... 1389	0.0211948	mg/stk
Maximum lambda during park phase of regeneration					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_MAF_FAC_CYL	-	0... FFFFH	0... 11111.1111111	0.1695447	-
conversion factor between MAF					

General Information

The requirement of NOxstorage catalyst regeneration is the engine is operated with a rich mixture. This is the lambda setpoint for catalyst regeneration edition for single- and twin-branched exhaust lines, also for the Y configuration with two NOx-Traps (NT) and one NOx-Sensor (Conf 2). In this case the lambda setpoint of the already regenerated NT is set to the park value C_LAMB_PARK_BAS. The covered exhaust gas configurations are shown in the picture below:

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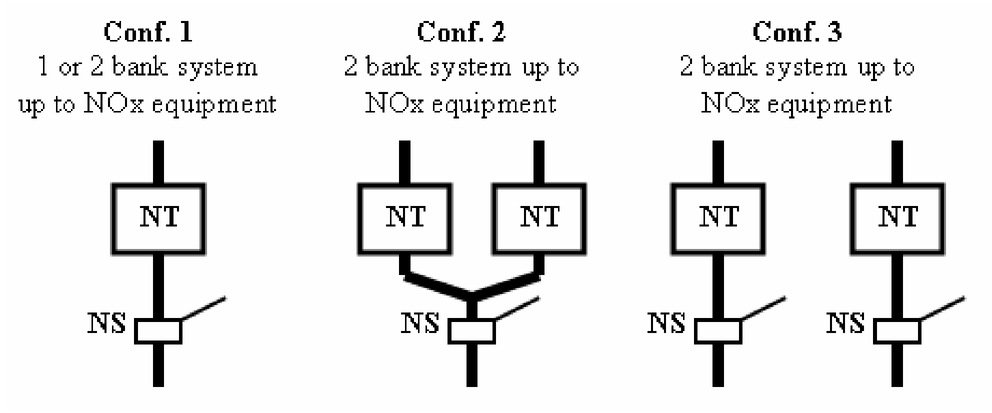
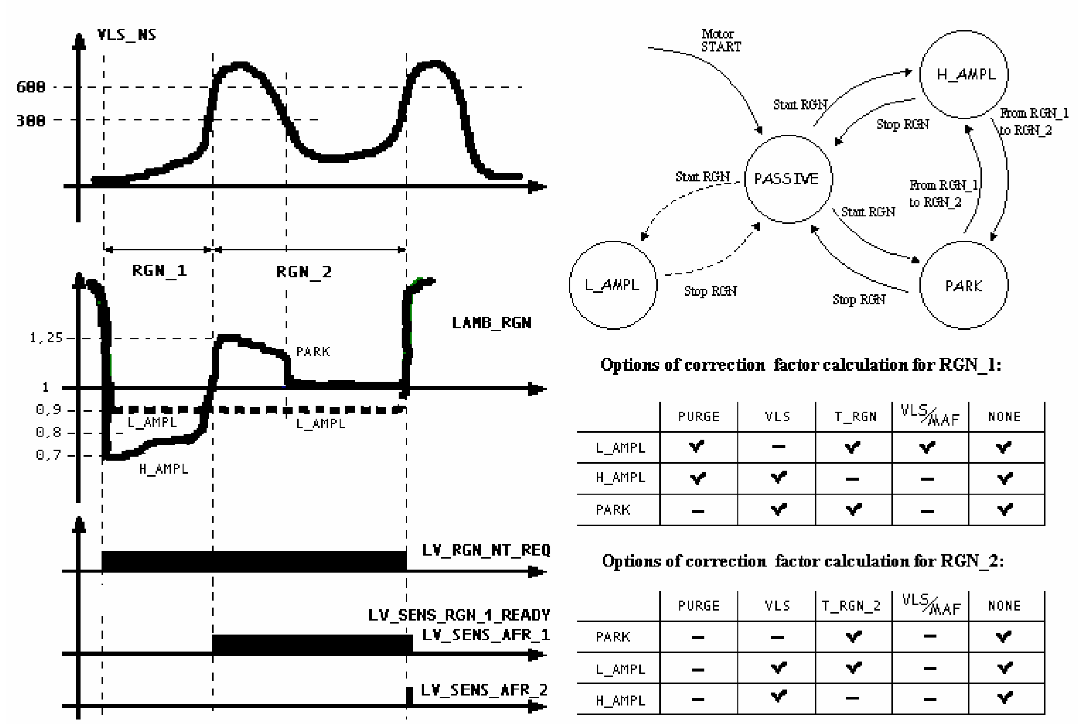


The regeneration curves, state flow and correction options for example configuration shows the picture:



Options of correction factor calculation for RGN_1:

	PURGE	VLS	T_RGN	VLS/MAF	NONE
L_AMPL	✓	–	✓	✓	✓
H_AMPL	✓	✓	–	–	✓
PARK	–	✓	✓	–	✓

Options of correction factor calculation for RGN_2:

	PURGE	VLS	T_RGN_2	VLS/MAF	NONE
PARK	–	–	✓	–	✓
L_AMPL	–	✓	✓	–	✓
H_AMPL	–	✓	–	–	✓

NC_CBK_EX_NR is the number of exhaust gas lines. Therefore
i = 1, for cylinder bank 1
i = 2, for cylinder bank 2.
NC_NOX_SENS_CONF is the number of NOx-Sensors. Therefore
NC_NOX_SENS_CONF = 0, for no NOx-Sensor
NC_NOX_SENS_CONF = 1 (n = 1), for one NOx-Sensor
NC_NOX_SENS_CONF = 2 (n = i), for two NOx-Sensors
NC_NT_NR is the number of NOx Catalysts. Therefore
NC_NT_NR = 1 (k = 1), for one NOx Catalyst
NC_NT_NR = 2 (k = i), for two NOx Catalysts

Application Conditions

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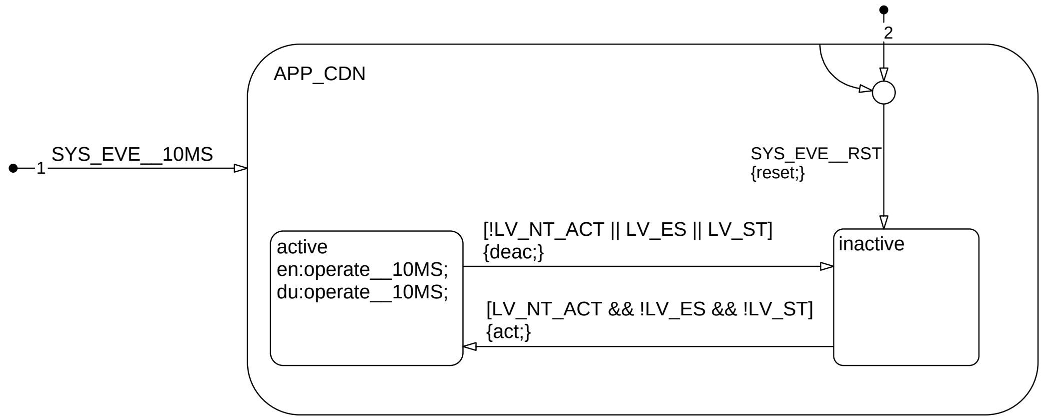

Figure 7.77.1: :

Function description

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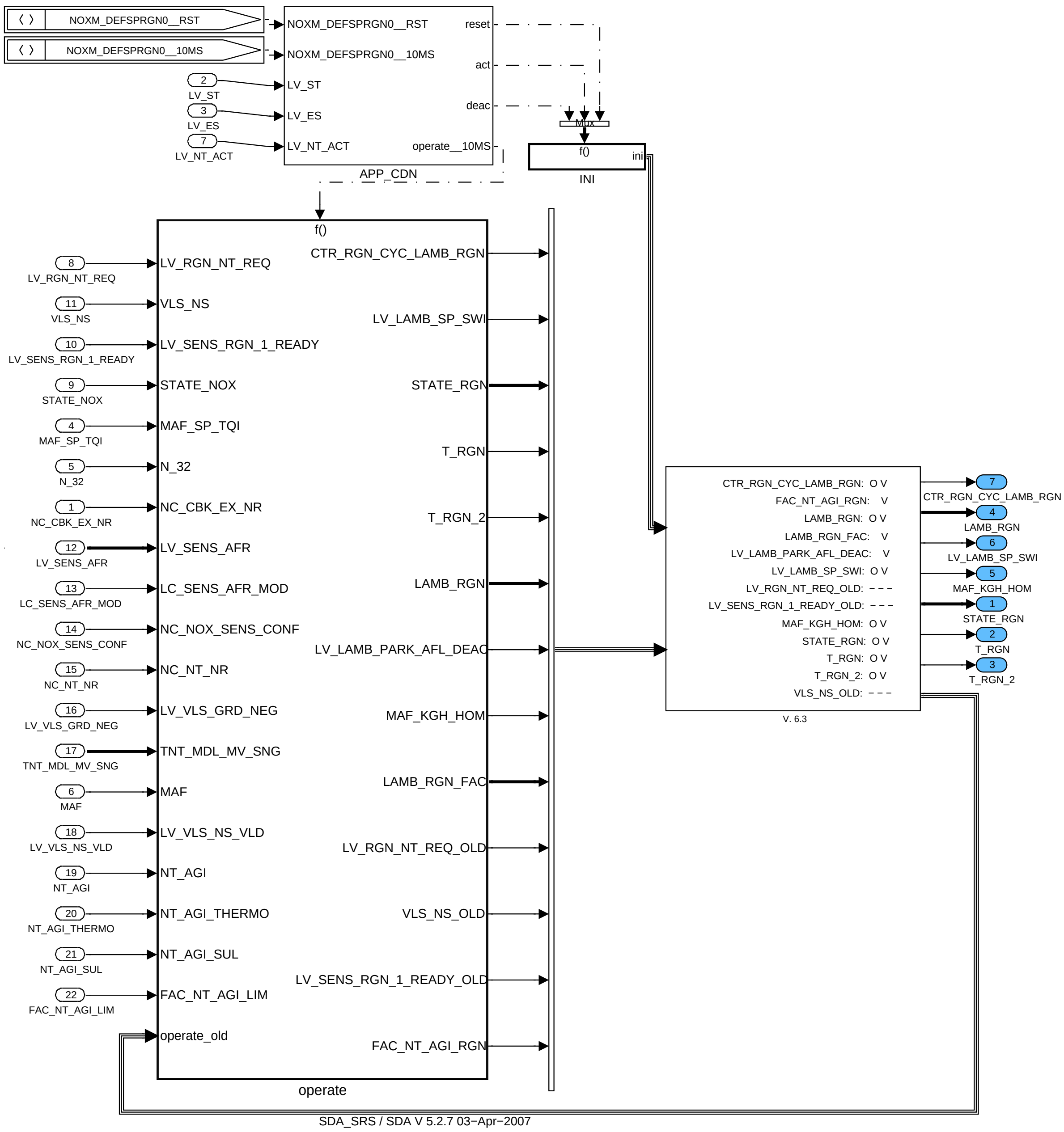

Figure 7.77.2: :

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7.77.1 INITIALIZATION AT RESET, ACTIVATION AND DEACTIVATION

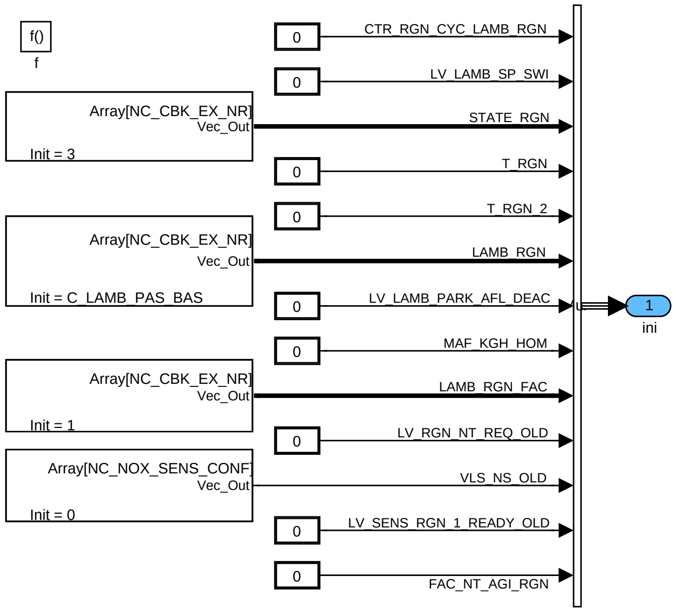

Figure 7.77.3: :

7.77.2 FORMULA SECTION

The function consists of two main sections:

SECTION 1: Initialization of the Regeneration State at start of the regeneration, calculation of the regeneration time and of the lambda basis for the low amplitude regeneration

SECTION 2: Calculation of the Regeneration State and the Regeneration Lambda Setpoint

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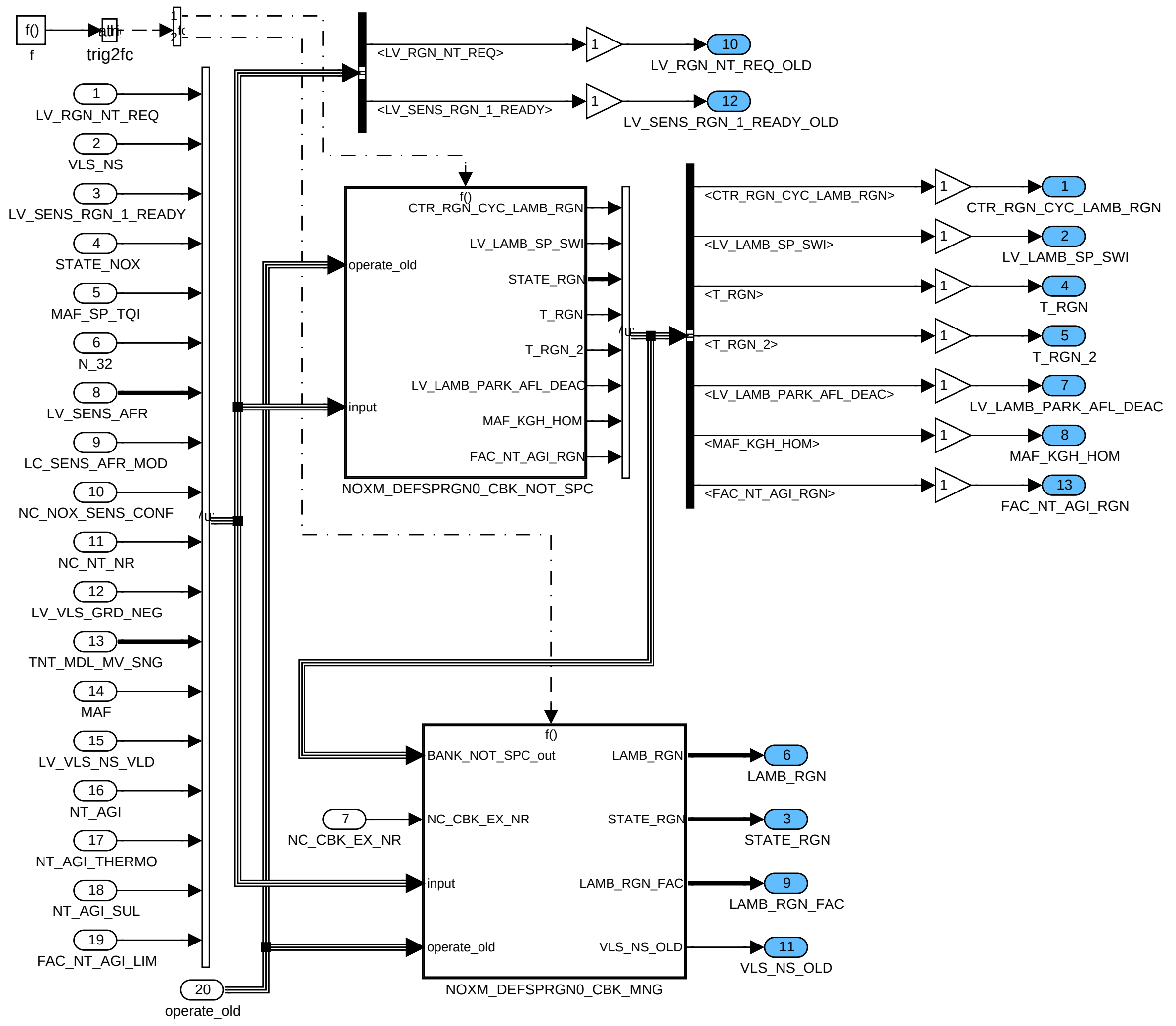

Figure 7.77.4: :

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7.77.2.1 SECTION 1: Initialization of Regeneration State at start of the regeneration, calculation of regeneration time and lambda basis for the low amplitude regeneration

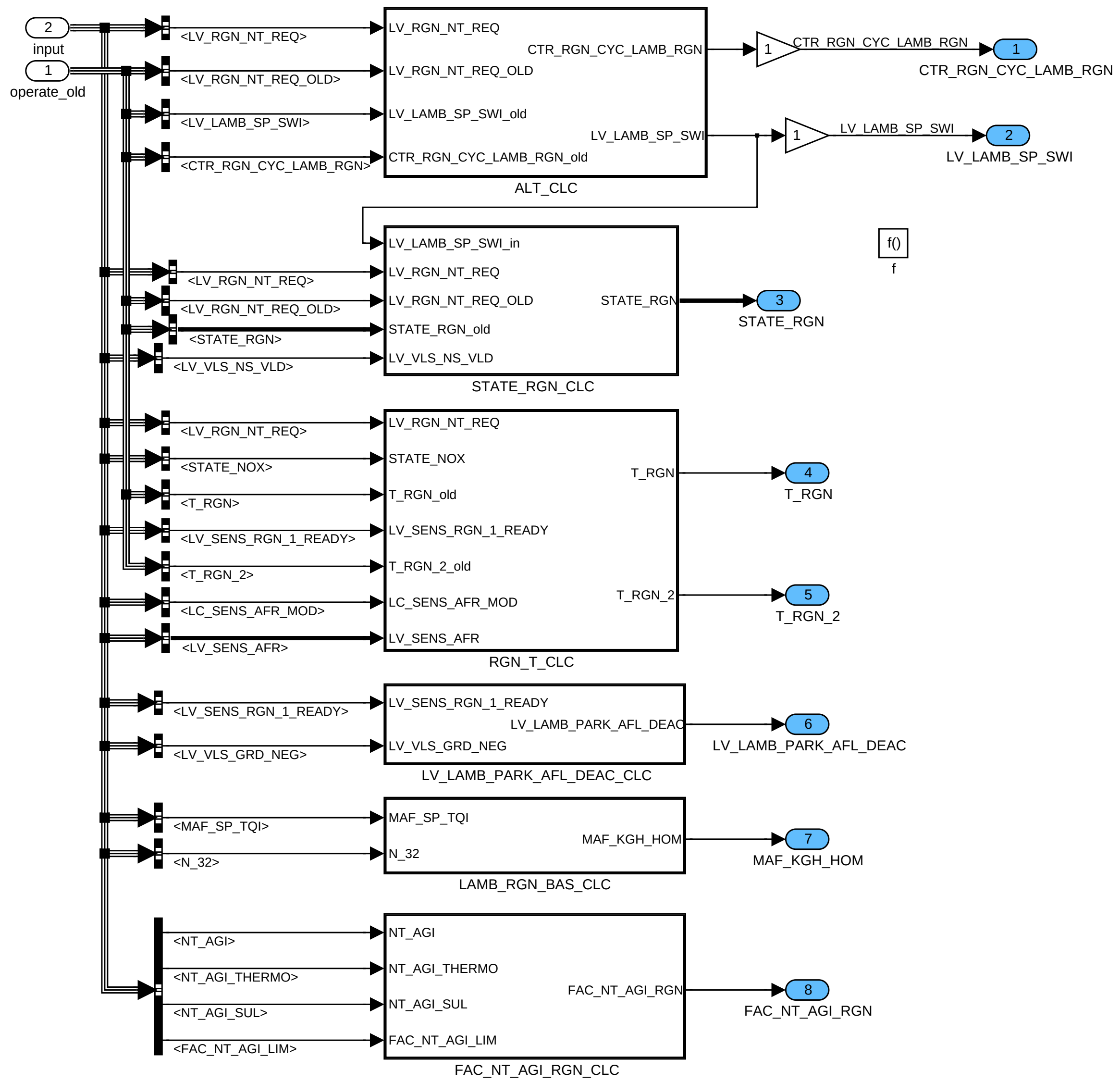

Figure 7.77.5: :

7.77.2.1.1 Calculation of regeneration counter and alternate flag

The regeneration counter is incremented at entering in regeneration. The alternate flag is used for switching of initialization values for the STATE_RGN between both banks. The interval between switching is set by the C_CTR_RGN_SWI_DEAC (alternate flag is not active) and by the C_CTR_RGN_SWI_ACT (alternate flag is active).

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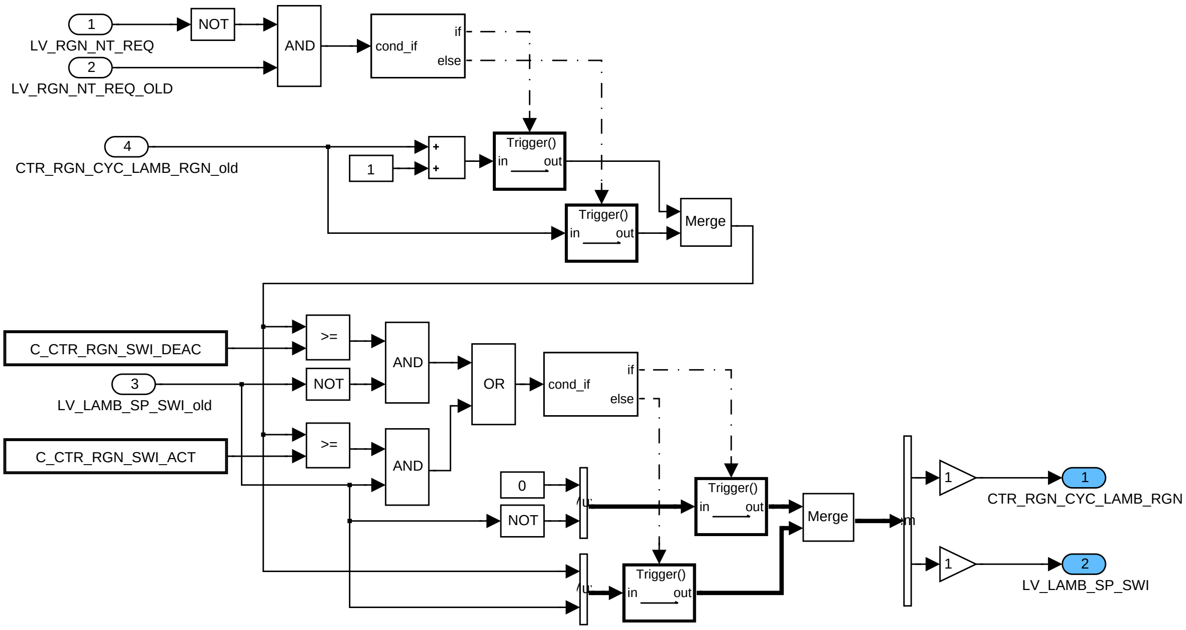

Figure 7.77.6: :

7.77.2.1.2 Initialization of regeneration state

The regeneration strategy for all banks is set at start of regeneration. The regeneration state is initialized depending on alternate flag.

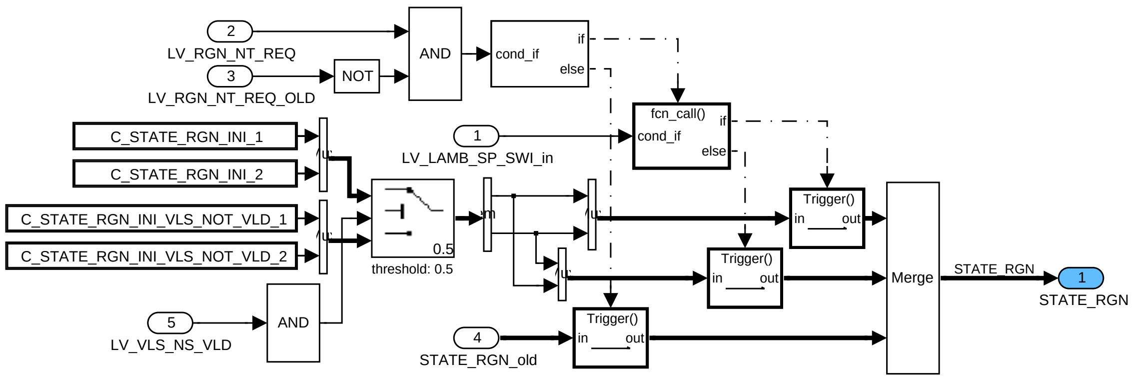

Figure 7.77.7: :

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7.77.2.1.3 Calculation of time for the first and the second regeneration

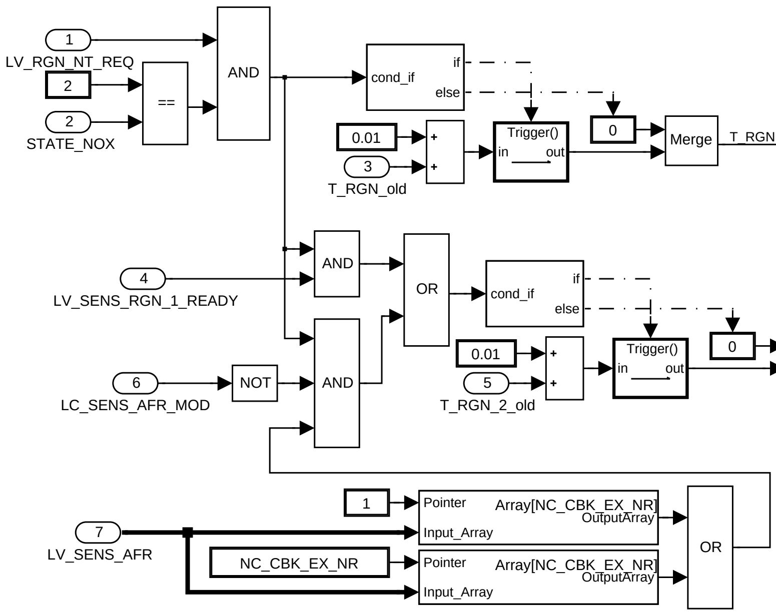

Figure 7.77.8: :

7.77.2.1.4 Deactivation of lean lambda setpoint after switch to the state "PARK".

To ensure the binary signal of the NOx Sensor can fall down after first regeneration, the deactivation of the lean lambda setpoint take place only when defined negative gradient has been reached.

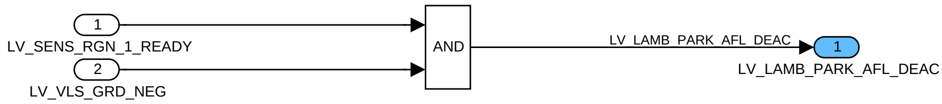

Figure 7.77.9: :

7.77.2.1.5 Calculation of MAF_KGH for homogeneous operation

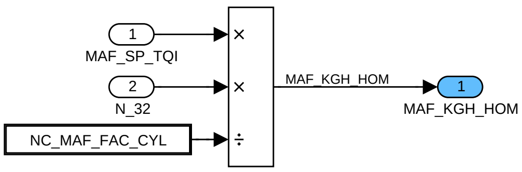

Figure 7.77.10: :

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7.77.2.1.6 Calculation of NOx catalyst aging factor for correction of basic Lambda setpoint for NOx regeneration

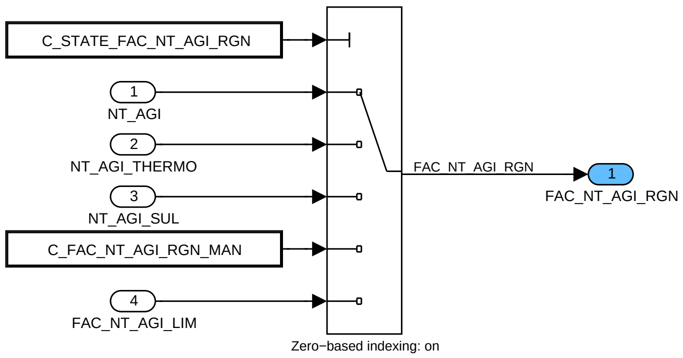

Figure 7.77.11: :

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7.77.2.2 FOR Loop

7.77.2.2.1 FOR Loop structure

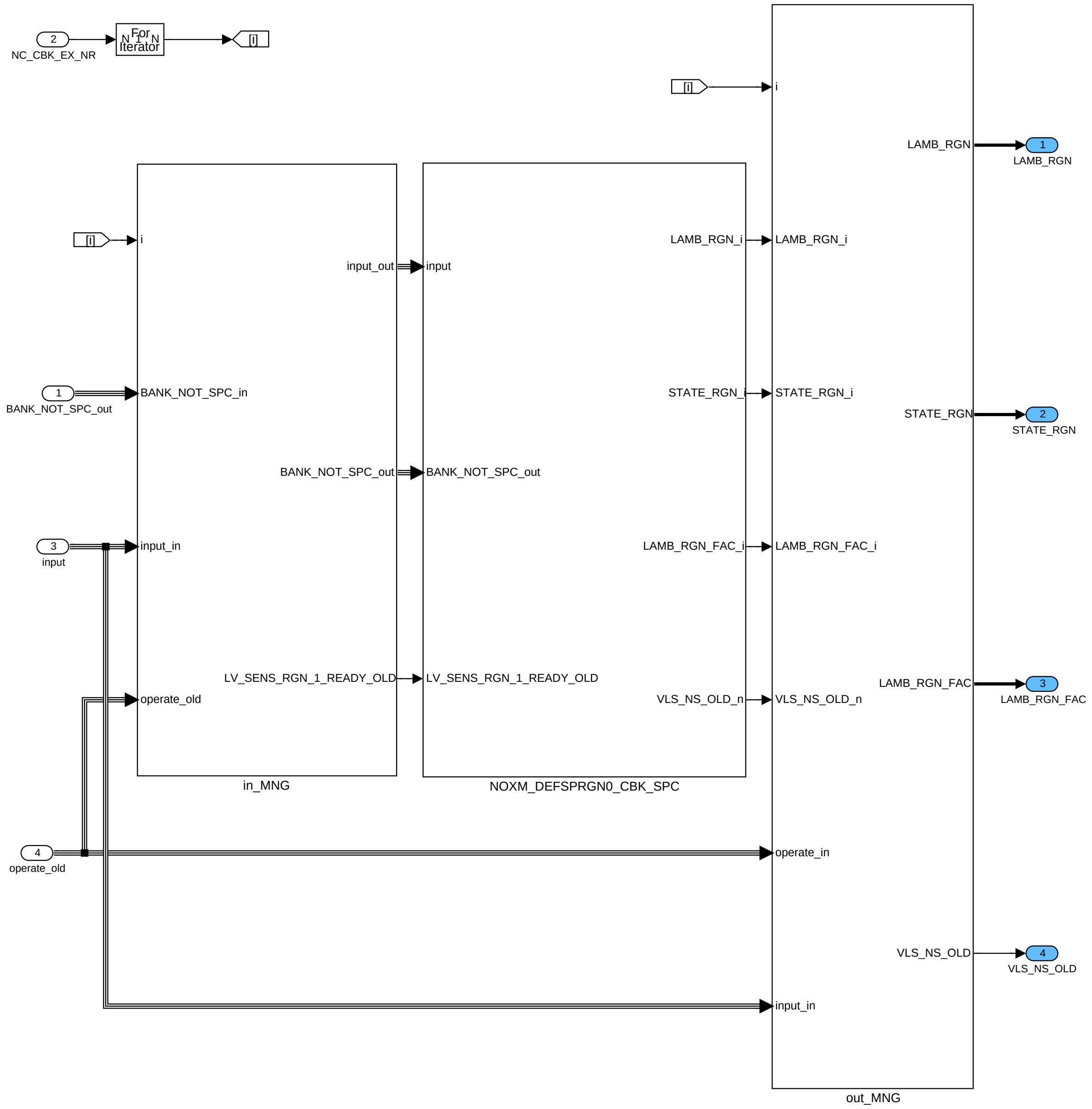

Figure 7.77.12: :

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7.77.2.2.1.1 Signal selection out of signal vectors

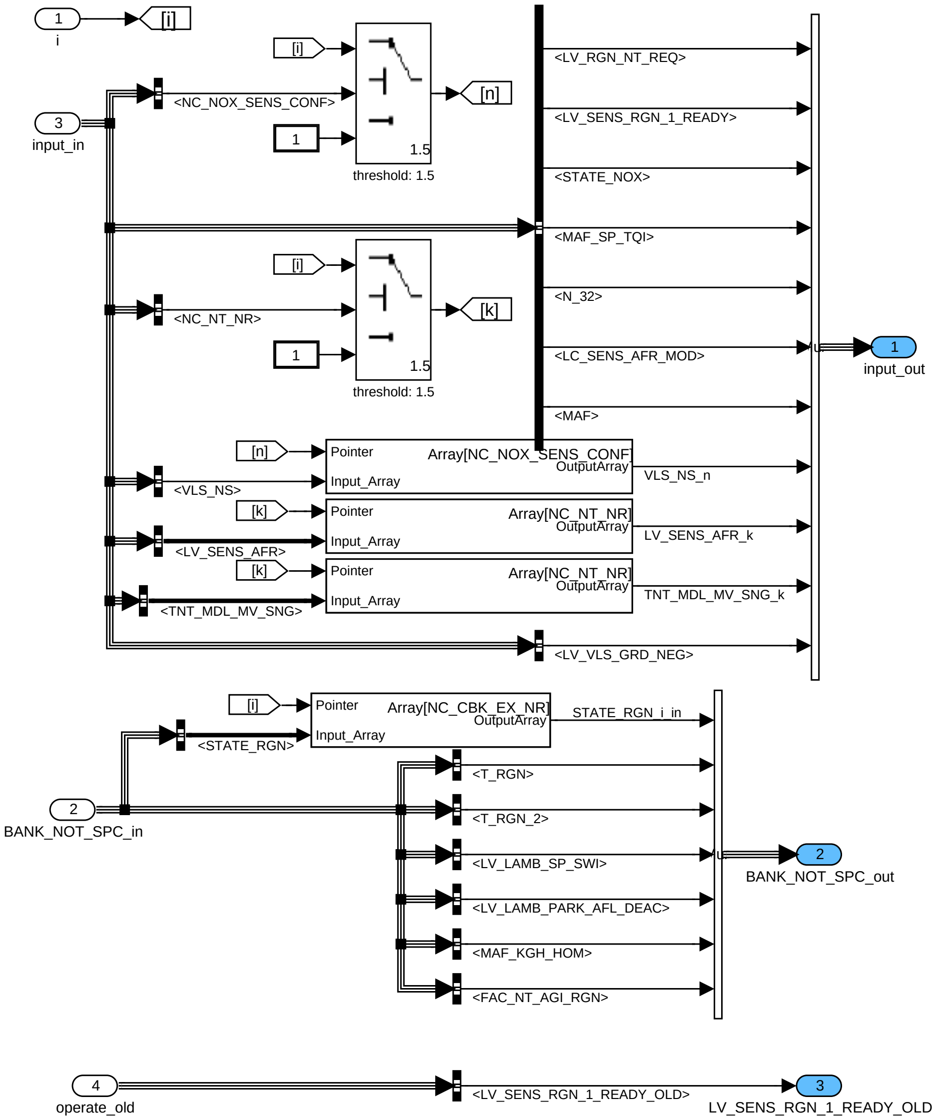

Figure 7.77.13: :

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7.77.2.2.1.2 SECTION 2: Calculation of the Regeneration State and the Regeneration Lambda Setpoint

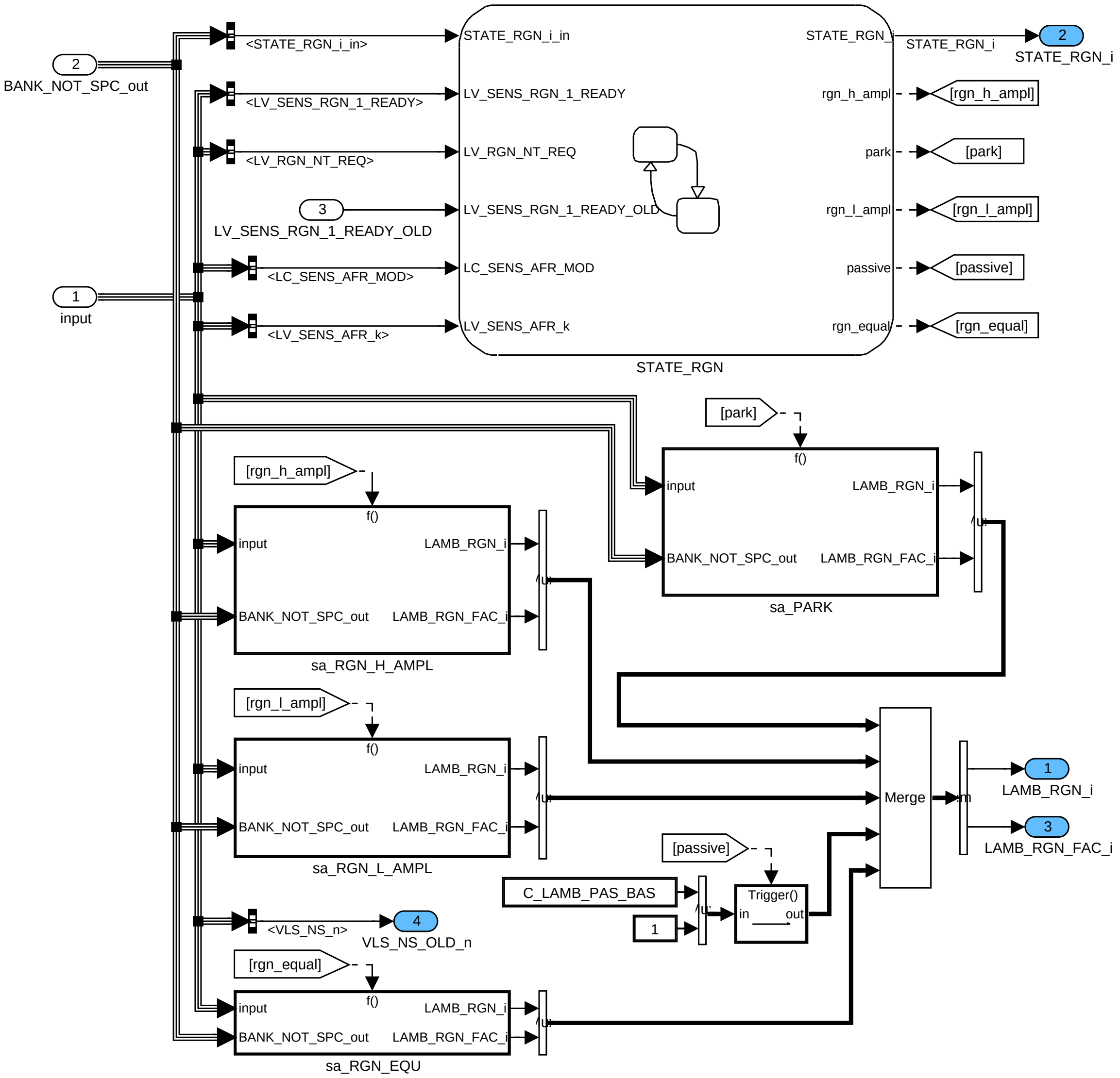

Figure 7.77.14: :

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7.77.2.2.1.2.1 STATE_RGN

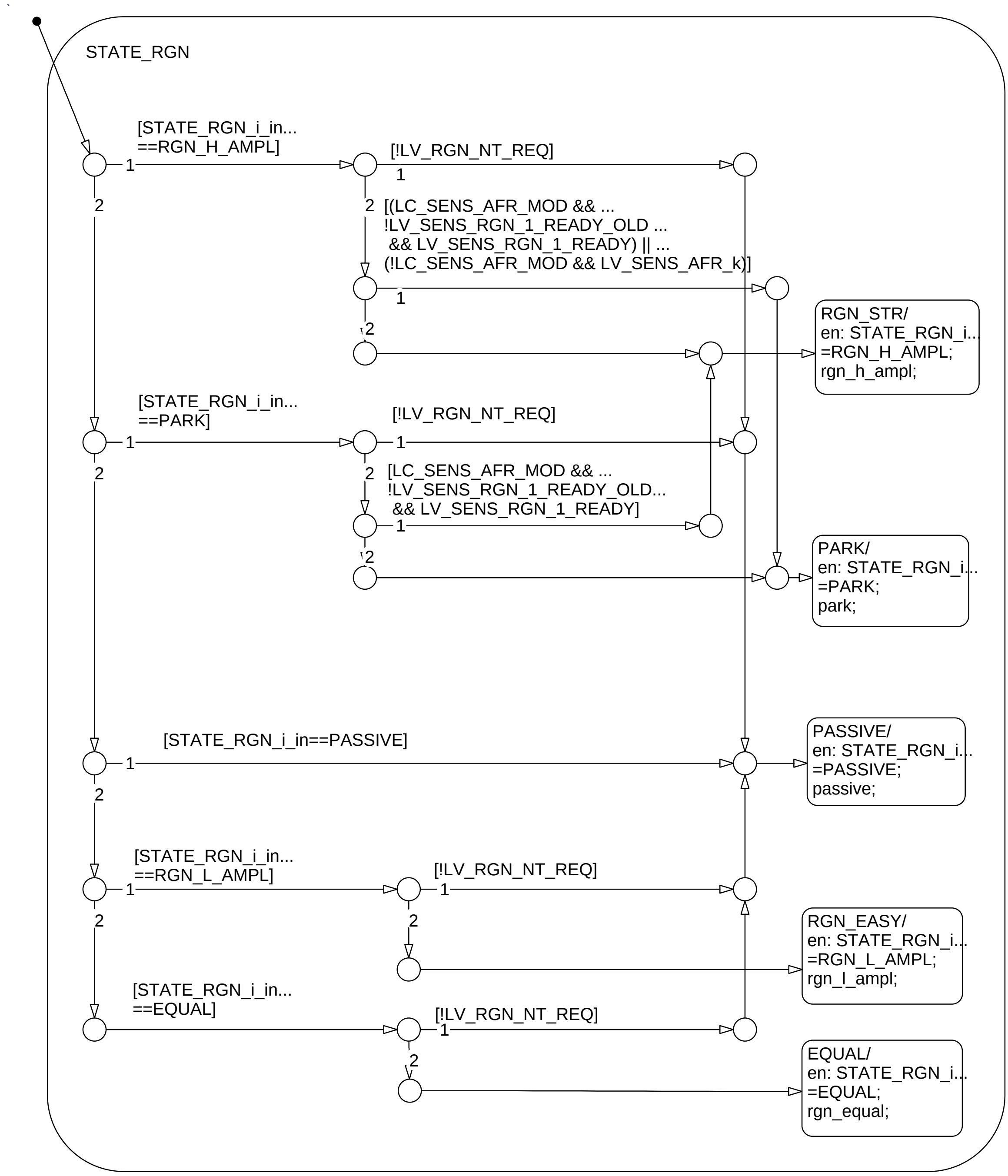

Figure 7.77.15: :

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7.77.2.2.1.2.2 Regeneration with High Amplitude

The high amplitude is set for bank which should be regenerated faster. This state is also entered when the bank was initialized with the state "PARK" and the first regeneration is finished. The lambda value is limited to the maximal value to avoid a jump to lean condition.

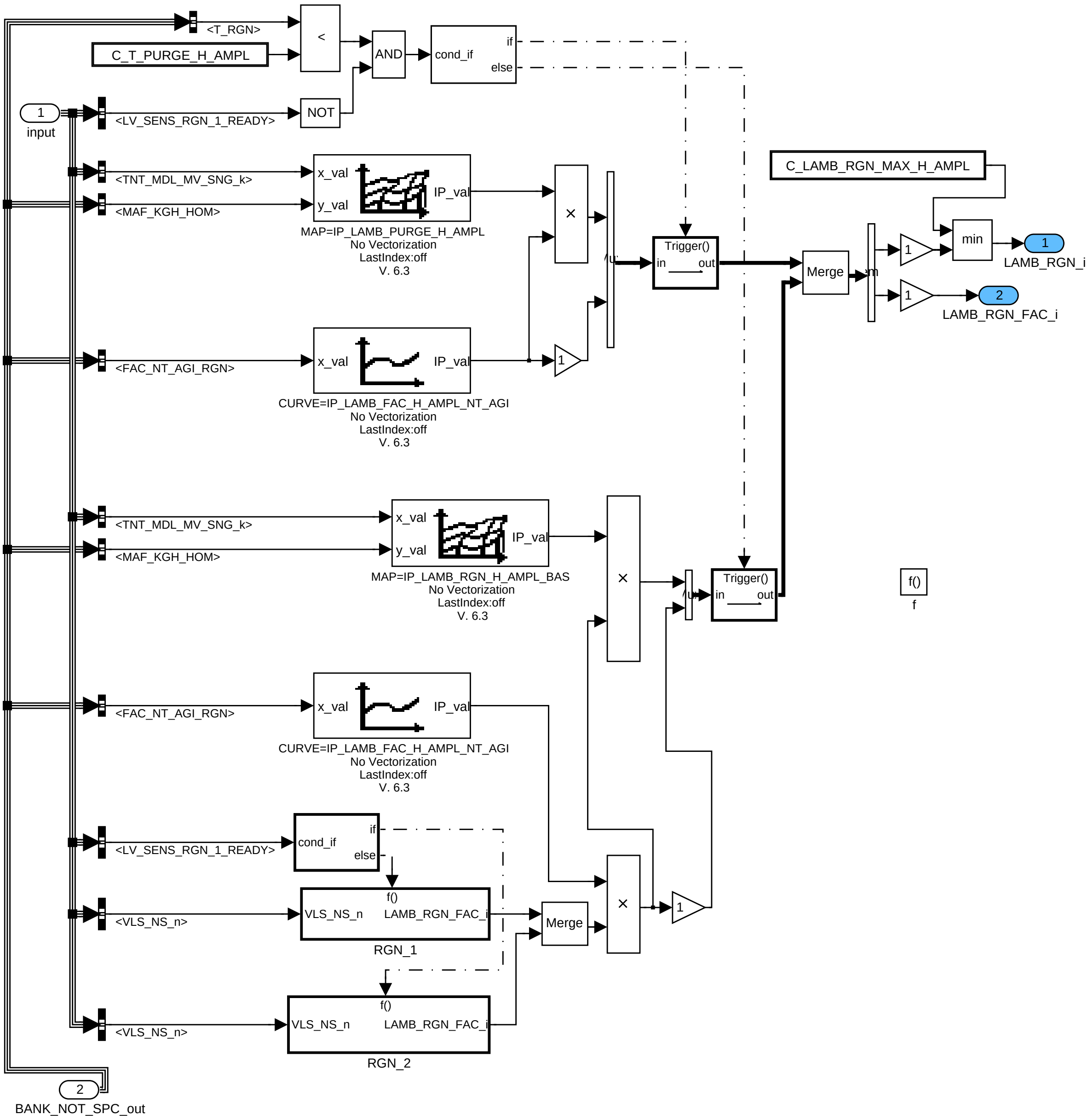

Figure 7.77.16: :

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7.77.2.2.1.2.2.1 Regeneration with High Amplitude - calculation of the Correction Factor at the first regeneration

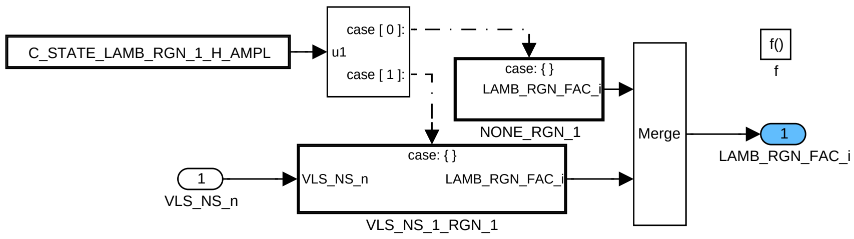

Figure 7.77.17: :

7.77.2.2.1.2.2.1.1 Regeneration with High Amplitude - 1st regeneration - no Lambda correction

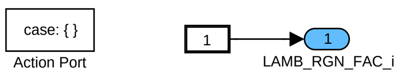

Figure 7.77.18: :

7.77.2.2.1.2.2.1.2 Regeneration with High Amplitude - 1st regeneration - Lambda correction by binary O2 signal of NOx sensor

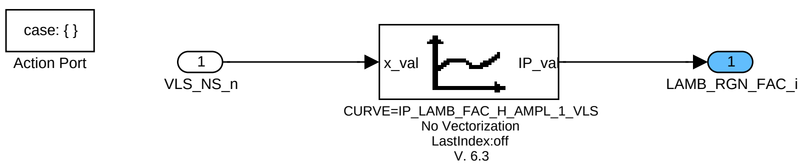

Figure 7.77.19: :

7.77.2.2.1.2.2.2 Regeneration with High Amplitude - calculation of the Correction Factor at the second regeneration

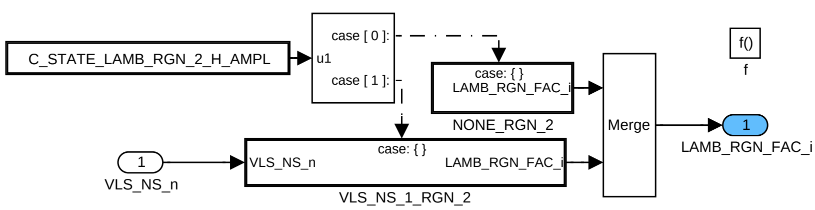

Figure 7.77.20: :

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7.77.2.2.1.2.2.2.1 Regeneration with High Amplitude - 2nd regeneration - no Lambda correction

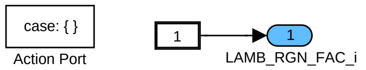

Figure 7.77.21: :

7.77.2.2.1.2.2.2.2 Regeneration with High Amplitude - 2nd regeneration - Lambda correction by binary O2 signal of NOx sensor

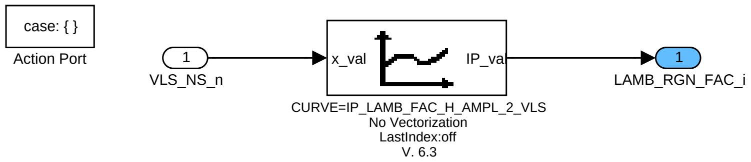

Figure 7.77.22: :

7.77.2.2.1.2.3 Park phase for lambda setpoint

When the bank regenerated with high amplitude is finished, the lambda value is set to neutral or to lean combustion condition. The bank can be also at entering in regeneration initialized with the state "PARK".

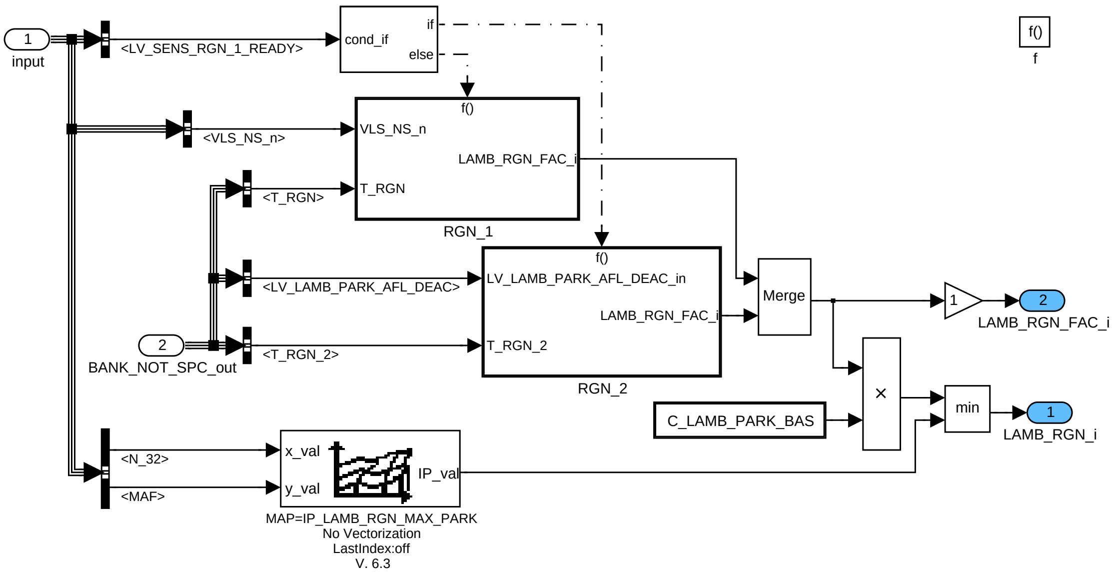

Figure 7.77.23: :

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7.77.2.2.1.2.3.1 Park phase for lambda setpoint - calculation of the Correction Factor at the first part of regeneration

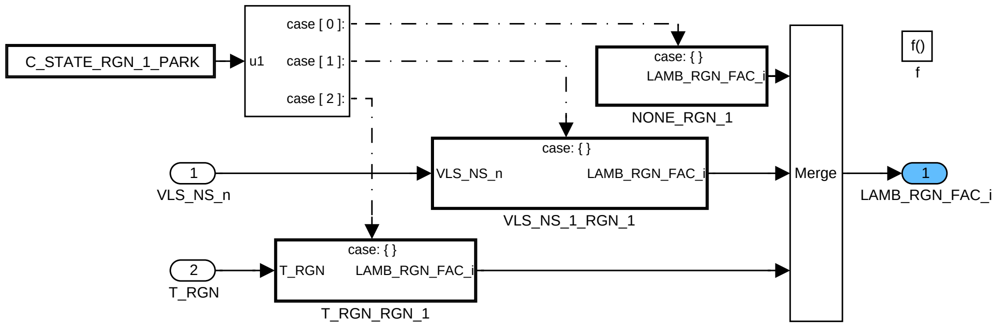

Figure 7.77.24: :

7.77.2.2.1.2.3.1.1 Park phase - 1st regeneration - no Lambda correction

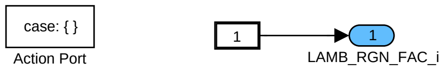

Figure 7.77.25: :

7.77.2.2.1.2.3.1.2 Park phase - 1st regeneration - Lambda correction by binary O2 signal of NOx sensor

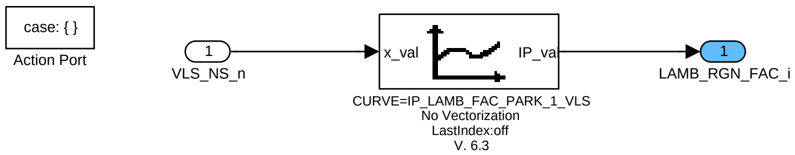

Figure 7.77.26: :

7.77.2.2.1.2.3.1.3 Park phase - 1st regeneration - Lambda correction by regeneration time

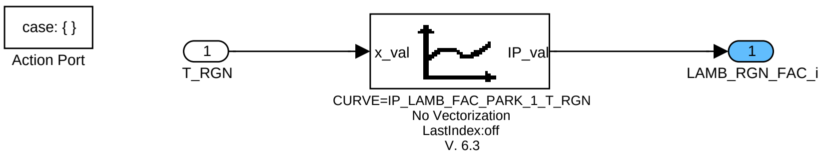

Figure 7.77.27: :

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7.77.2.2.1.2.3.2 Park phase for lambda setpoint - calculation of the Correction Factor at the part of second regeneration

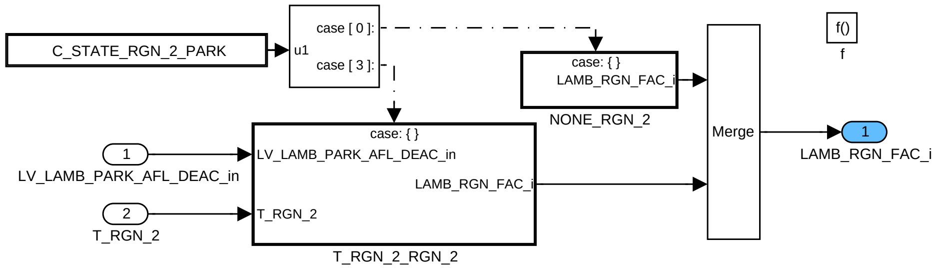

Figure 7.77.28: :

7.77.2.2.1.2.3.2.1 Park phase - 2nd regeneration - no Lambda correction

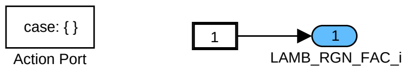

Figure 7.77.29: :

7.77.2.2.1.2.3.2.2 Park phase - 2nd regeneration - Lambda correction by regeneration time of 2nd regeneration

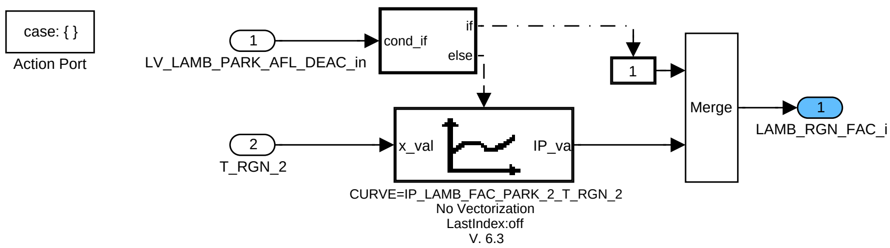

Figure 7.77.30: :

7.77.2.2.1.2.4 Regeneration with Low Amplitude

The low amplitude is set for bank which should be regenerated longer. The lambda value is limited to the maximal value to avoid a jump to lean condition.

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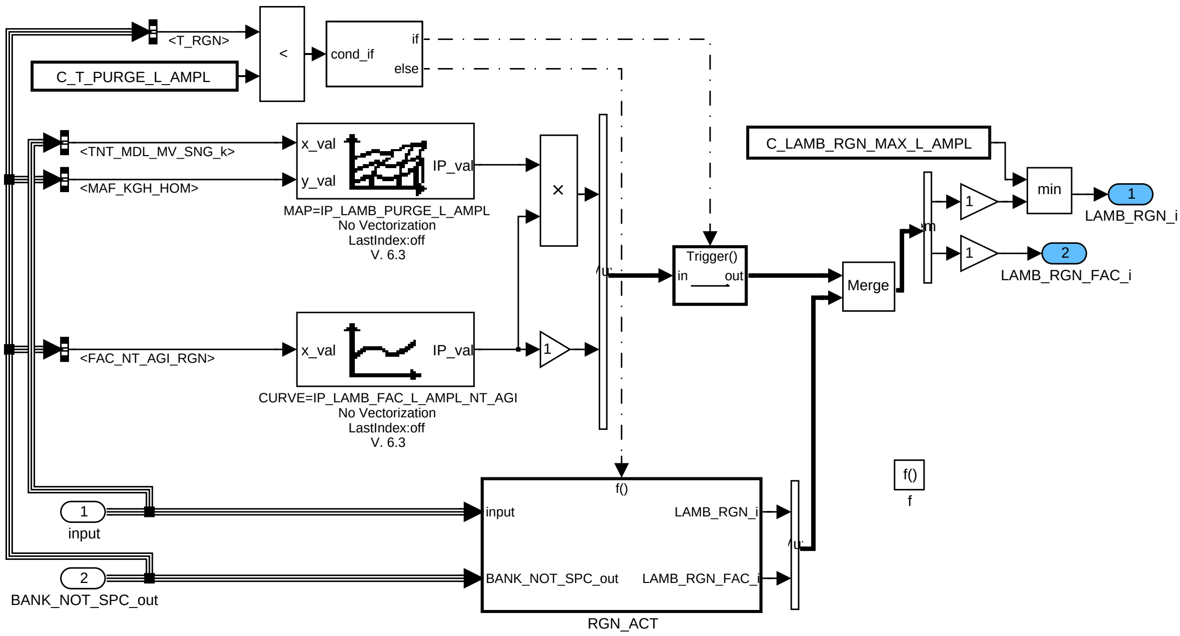

Figure 7.77.31: :

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7.77.2.2.1.2.4.1 Regeneration with Low Amplitude - calculation of the Correction Factor

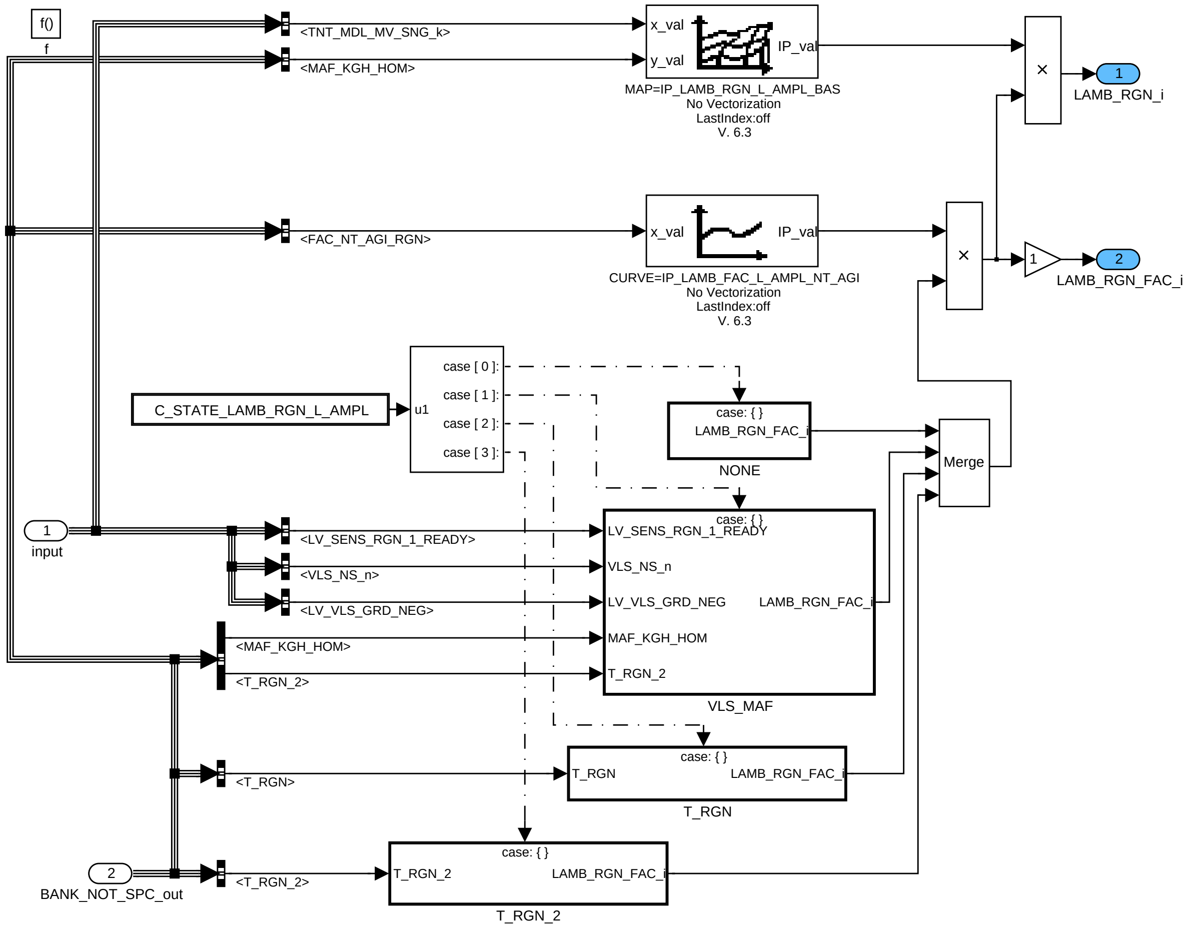

Figure 7.77.32: :

7.77.2.2.1.2.4.1.1 Regeneration with Low Amplitude - no Lambda correction

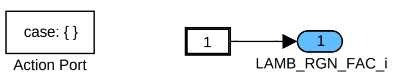

Figure 7.77.33: :

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7.77.2.2.1.2.4.1.2 Regeneration with Low Amplitude - Lambda correction by binary O2 signal of NOx sensor and air mass flow

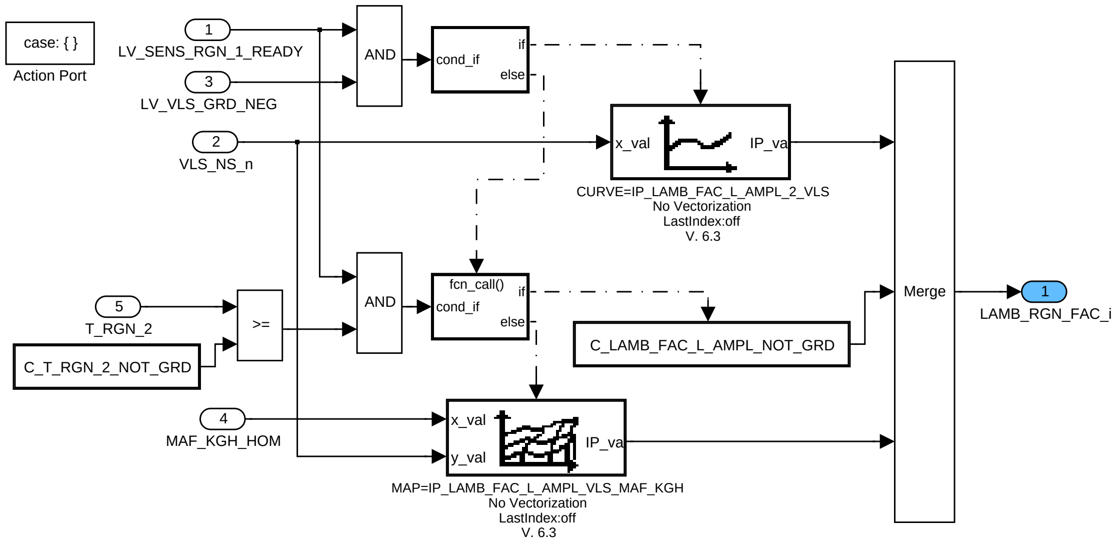

Figure 7.77.34: :

7.77.2.2.1.2.4.1.3 Regeneration with Low Amplitude - Lambda correction by regeneration time

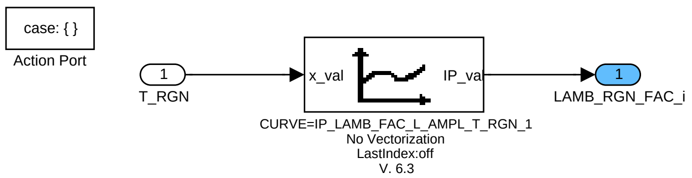

Figure 7.77.35: :

7.77.2.2.1.2.4.1.4 Regeneration with Low Amplitude - Lambda correction by regeneration time of 2nd regeneration

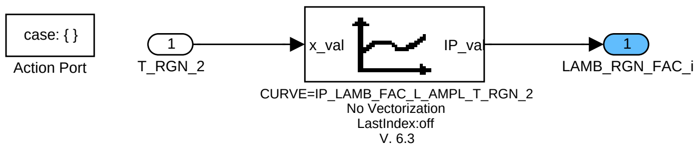

Figure 7.77.36: :

7.77.2.2.1.2.5 Regeneration with equal amplitude

The equal amplitude is set for both banks as long as the NOx sensor VLS signal is not valid.

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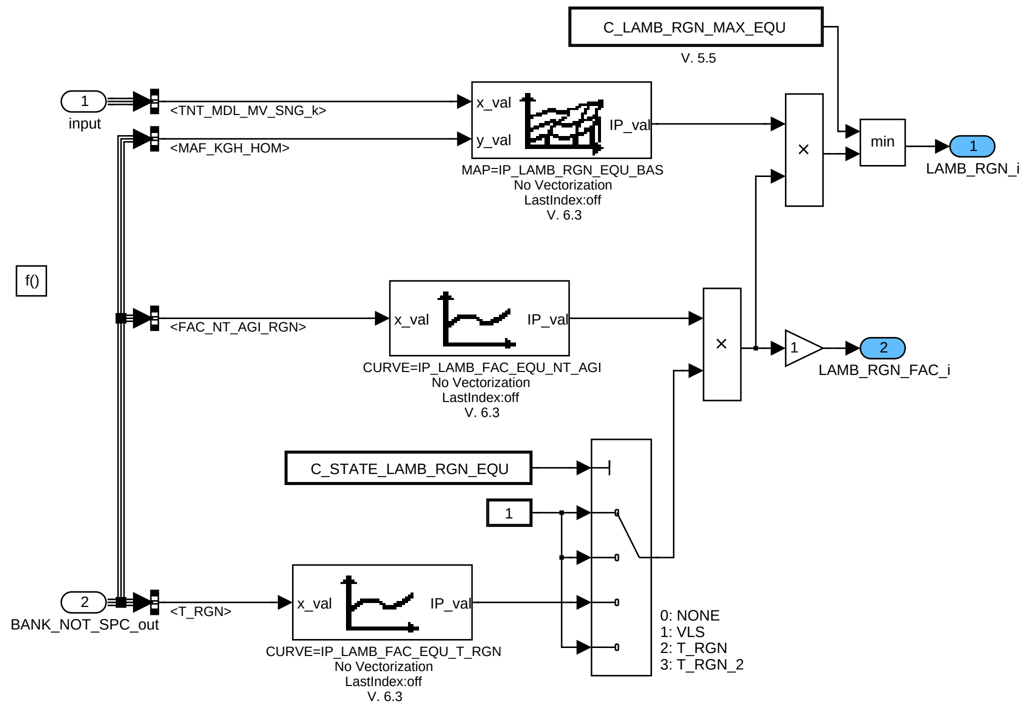

Figure 7.77.37: :

7.77.2.2.1.3 Signal combination to signal vectors

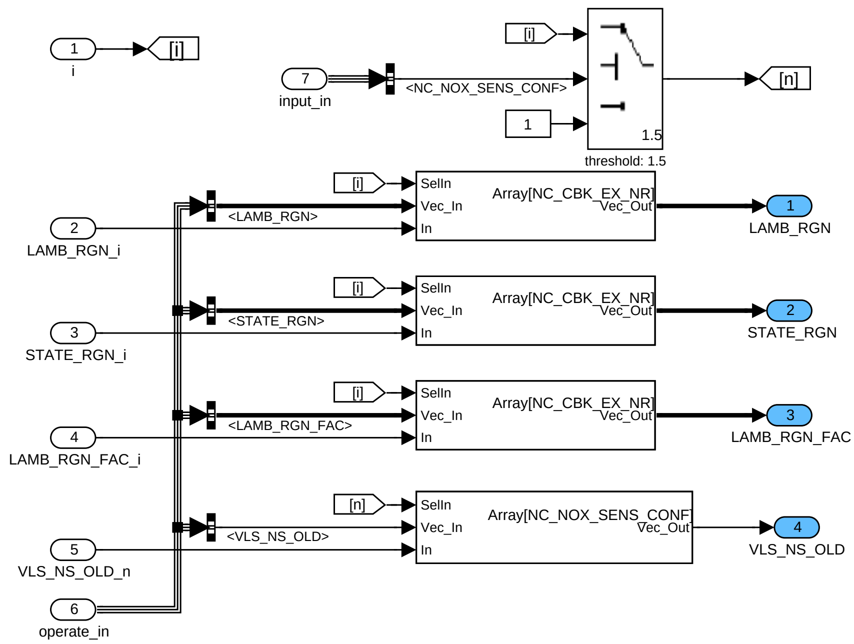

Figure 7.77.38: :

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7.78 Loading determination for catalyst purge function

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_ADD_MAIN_CAT_PURGE [NC_CBK_EX_NR]	O/V	0... FFH	0... 1.9921875	0.0078125	-
additional weighting factor for pre and main cat differences					
LV_CAT_PURGE_POST_PUC_TRIG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
auxiliary flag indicating that cat purge after PUC was triggered					
LV_CAT_PURGE_ST [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating that cat purge can be started (set for one sample step)					
LV_GS_SCC_OLD	-	0... 1H	0 ...1	1	-
old value for cylinder cut of during gear shift					
LV_LAMB_SP_CH_ACT_CAT_PURGE [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicates that LAMB_SP_CH was under threshold					
LV_PUC_OLD [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
auxiliary flag for edge detection of LV_PUC					
LV_SAWUP_OLD [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
auxiliary flag for edge detection of LV_SAWUP					
LV_ST_END_OLD [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
auxiliary flag for edge detection of LV_ST_END					
O2L_RLS_SP_PCAT_PURGE [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 2.61684896	399.306e3	g
oxygen loading to be purged (released) during pre cat purge					
STATE_CAT_PURGE [NC_CBK_EX_NR]	V	0H 1H 2H 3H 4H 5H	CAT_PURGE_OFF CAT_PURGE_PUC CAT_PURGE_SA CAT_PURGE_HST CAT_PURGE_CH CAT_PURGE_GS_SCC	-	-
state indicating the activation reason of cat purge					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Input data:

EFF_CAT_DIAG [NC_CBK_EX_NR] {p. 5535}	LAMB_SP_CH [NC_CBK_EX_NR] {p. 2169}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_FCUT_IND {p. 2295}
LV_GS_SCC {p. 2942}	LV_INH_CAT_PURGE [NC_CBK_EX_NR] {p. 2942}	LV_PUC {p. 1720}	LV_SAWUP {p. 804}
LV_ST_END {p. 1720}	MAF_INT_GS_SCC {p. 2942}	MAF_INT_PUC_ACT {p. 2942}	NC_CBK_EX_NR {p. 1829}
O2L_RLS_PCAT_PURGE [NC_CBK_EX_NR] {p. 2927}	TCO_ST {p. 1100}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_ADD_MAIN_CAT_PURGE_CH [NC_CBK_EX_NR]	-	0... FFH	0... 1.9921875	0.0078125	-
additional weighting factor to define oxygen loading for main cat purge after catalyst heating phase					
C_FAC_ADD_MAIN_CAT_PURGE_GS_SCC [NC_CBK_EX_NR]	-	0... FFH	0... 1.9921875	0.0078125	-
additional weighting factor for pre and main cat differences in case of gear shift with cylinder cut off					
C_FAC_ADD_MAIN_CAT_PURGE_HST [NC_CBK_EX_NR]	-	0... FFH	0... 1.9921875	0.0078125	-
additional weighting factor to define oxygen loading for main cat purge after hot start					
C_FAC_ADD_MAIN_CAT_PURGE_SA [NC_CBK_EX_NR]	-	0... FFH	0... 1.9921875	0.0078125	-
additional weighting factor to define oxygen loading for main cat purge after secondary air injection					
C_LAMB_SP_CH_THD_CAT_PURGE	-	0... 7FFFH	0... 31.9990234	97.6563e3	-
Threshold for lambda setpoint out of catalyst heating to activate catalyst purge					
C_MAF_INT_GS_SCC_MIN_CAT_PURGE	-	0... FFFFH	0... 2912.67	0.04444444	g
minimum air mass flow integral during cylinder cut off at gear shift to activate cat purge function					
C_MAF_INT_PUC_ACT_MIN_CAT_PURGE	-	0... FFFFH	0... 2912.67	0.04444444	g
minimum air mass flow integral during PUC to activate cat purge function					
C_O2L_RLS_MAX_PCAT_PURGE [NC_CBK_EX_NR]	-	0... FFFFH	0... 2.61684896	399.306e3	g
upper limit of oxygen loading set point for pre cat purge					
C_O2L_RLS_SP_PCAT_PURGE_CH [NC_CBK_EX_NR]	-	0... FFFFH	0... 2.61684896	399.306e3	g
oxygen loading to be purged after catalyst heating lean phase					
C_O2L_RLS_SP_PCAT_PURGE_HST [NC_CBK_EX_NR]	-	0... FFFFH	0... 2.61684896	399.306e3	g
oxygen loading to be purged after hot start					
C_O2L_RLS_SP_PCAT_PURGE_SA [NC_CBK_EX_NR]	-	0... FFFFH	0... 2.61684896	399.306e3	g
oxygen loading to be purged after secondary air injection					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_THD_CAT_PURGE_HST	-	0... FEH	0... 142.5	0.75	°C
temperature threshold for hot start detection of cat purge function					
IP_FAC_O2L_RLS_SP_PCAT_PURGE [NC_CBK_EX_NR]	-	0... FFH	0... 0.99609375	0.00390625	-
LDP_TEMP_CAT_IP_FAC_PCAT_PURGE	6	0... 7FFFH	0... 1774.79	0.0625	°C
LDPM_EFF_CAT_DIAG_1_EGTR	6	0... FFH	0... 1.9921875	0.0078125	-
weighting factor for oxygen loading to be released during pre cat purge					
IP_O2L_RLS_SP_PCAT_PURGE_PUC [NC_CBK_EX_NR]	-	0... FFFFH	0... 2.61684896	399.306e3	g
LDP_MAF_INT_PUC_ACT_IP_O2L_RLS	6	0... FFFFH	0... 2912.67	0.04444444	g
oxygen loading to be purged after pull cut off phase					

7.78.1 EGTR_DEFSPCENRD0

This function determines the oxygen loading for different catalyst enrichment (purge) cases that is to be relased during pre cat purge. The oxygen loading to be released during main cat purge is defined in the main function based on the oxygen loading for the pre catayst. Furthermore a priorization of the different cases is included.

The different enrichment cases after lean air fuel mixture condition, that are described within this function, are catalyst purge

after trailing throttle fuel cutoff phase (PUC),

after secondary air injection (SA),

after hot start (HST) and

after catalyst heating (CH) with lean air fuel mixture condition.

after cylinder cutoff at gear shifting (GS_SCC).

NC_CBK_EX_NR defines the number of exhaust banks.

For vector elements, the variable extension _i is used in the model instead of [i] as found in the textual description.

Application Condition

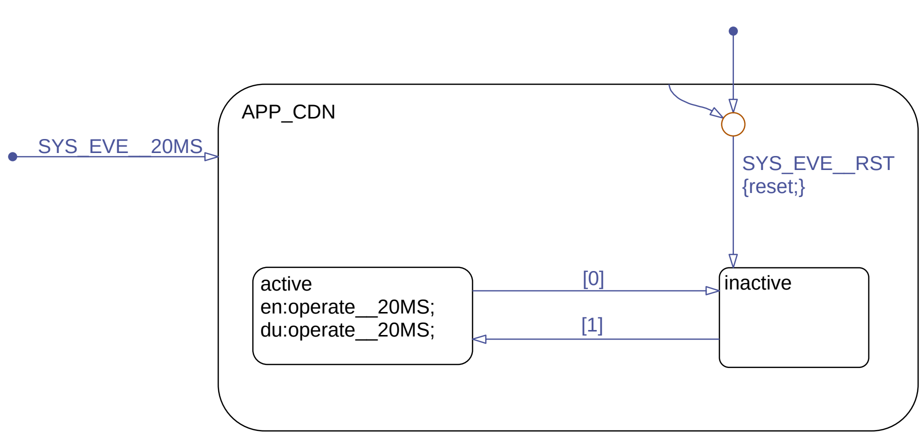

Figure 7.78.1: EGTR_DEFSPCENRD0/APP_CDN/Chart

Function Description

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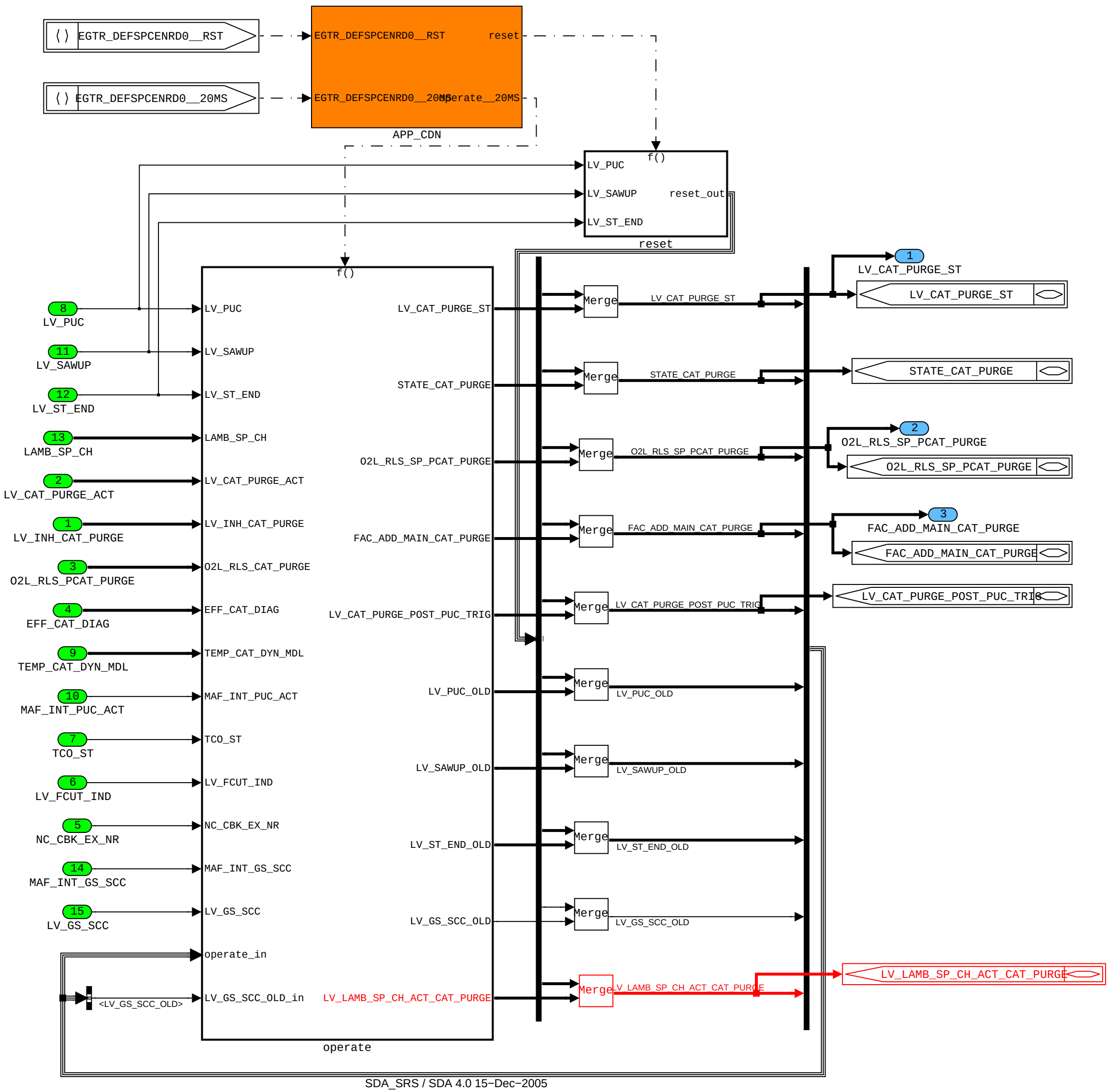

Figure 7.78.2: EGTR_DEFSPCENRD0

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7.78.1.1 SUBFUNCTION: operate

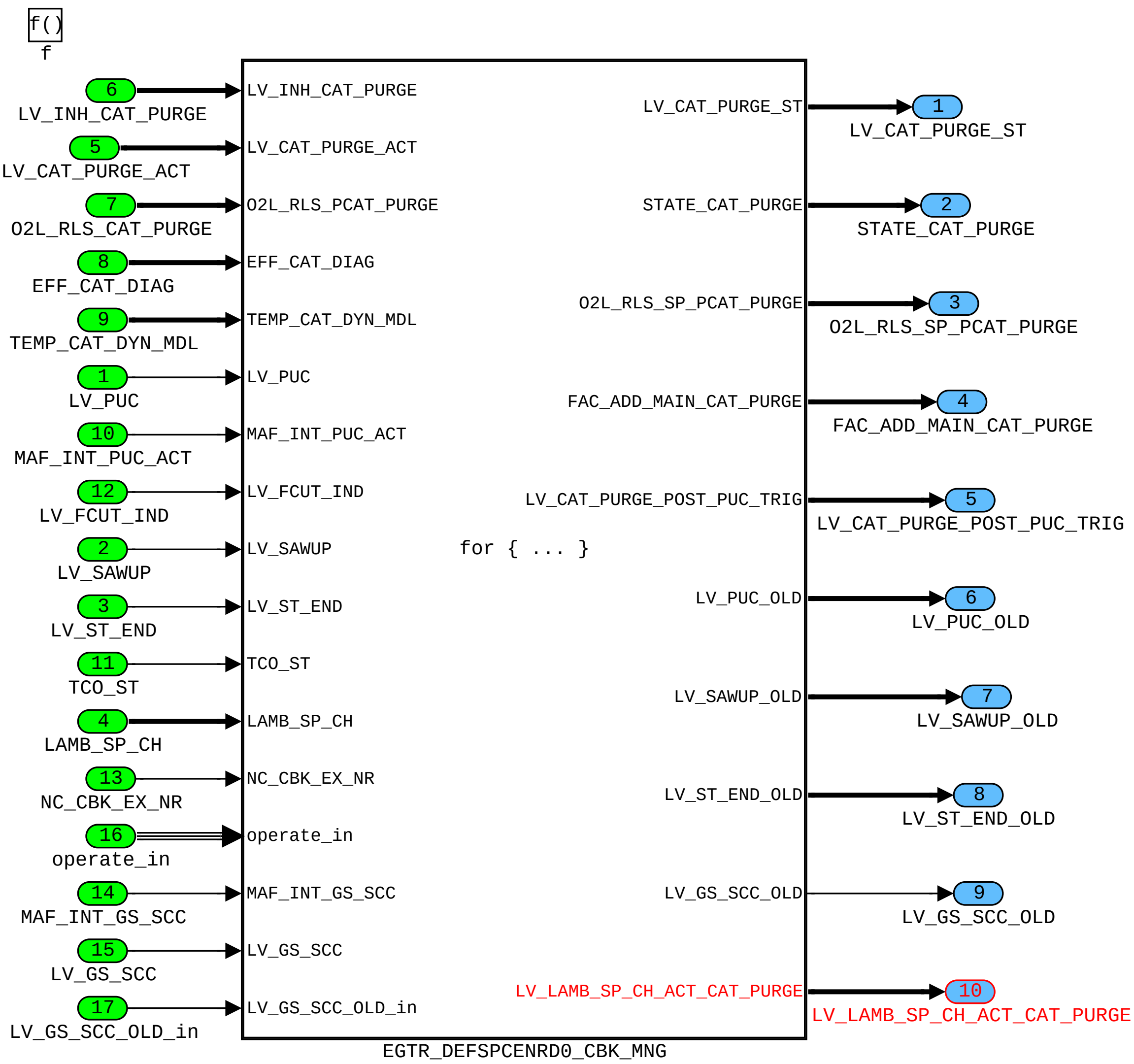

Figure 7.78.3: EGTR_DEFSPCENRD0/operate

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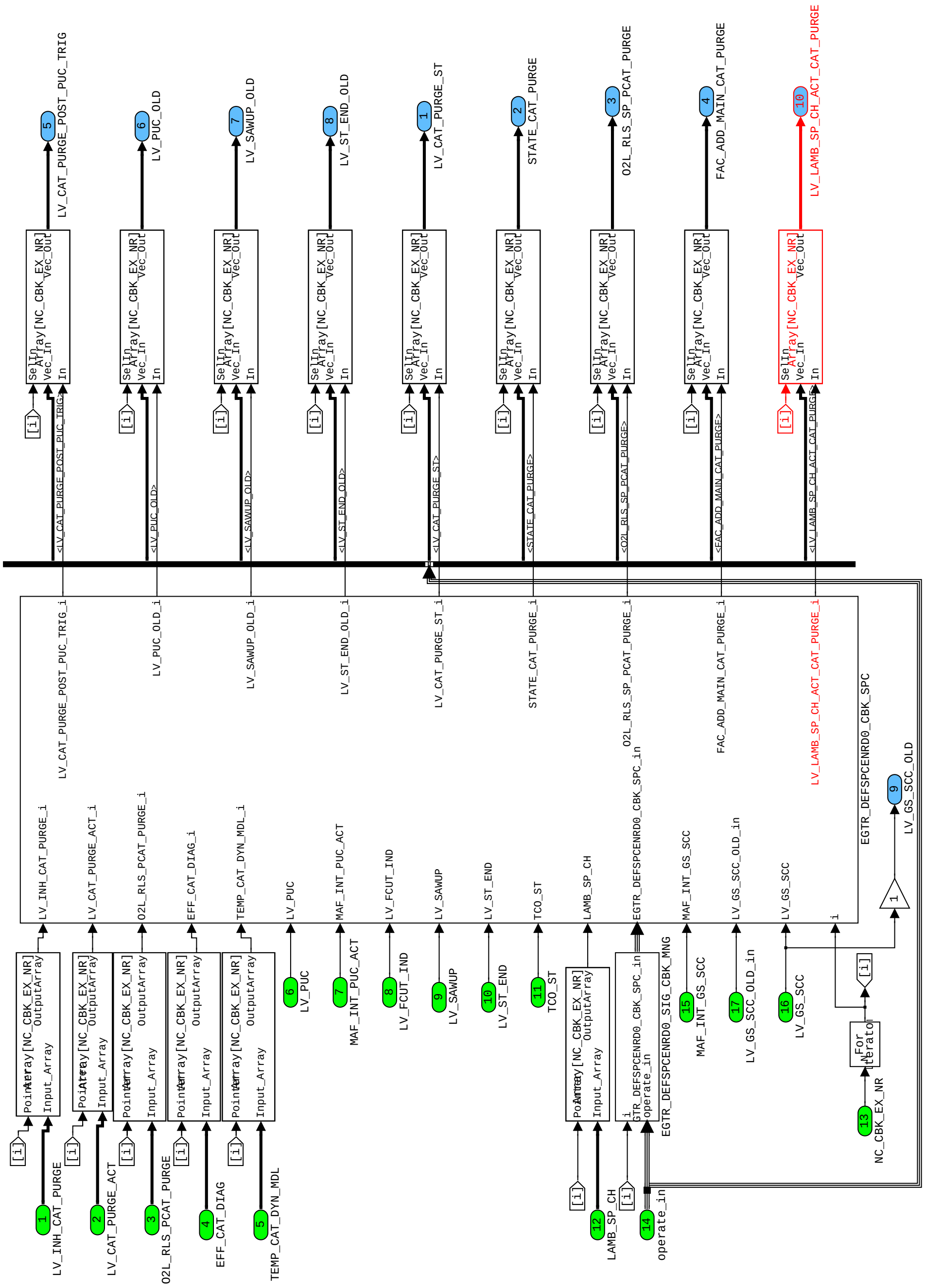

Figure 7.78.4: EGTR_DEFSPCENRD0/operate/EGTR_DEFSPCENRD0_CBK_MNG

Different catalyst purge cases

If LV_CAT_PURGE_ACT[i] is or gets 0 and STATE_CAT_PURGE[i] is not changing (compared to one sample step before) then the state is set to CAT_PURGE_OFF .
When one of the different cat purge cases gets active the flag LV_CAT_PURGE_ST[i] is set for one sample step to inform the main function.

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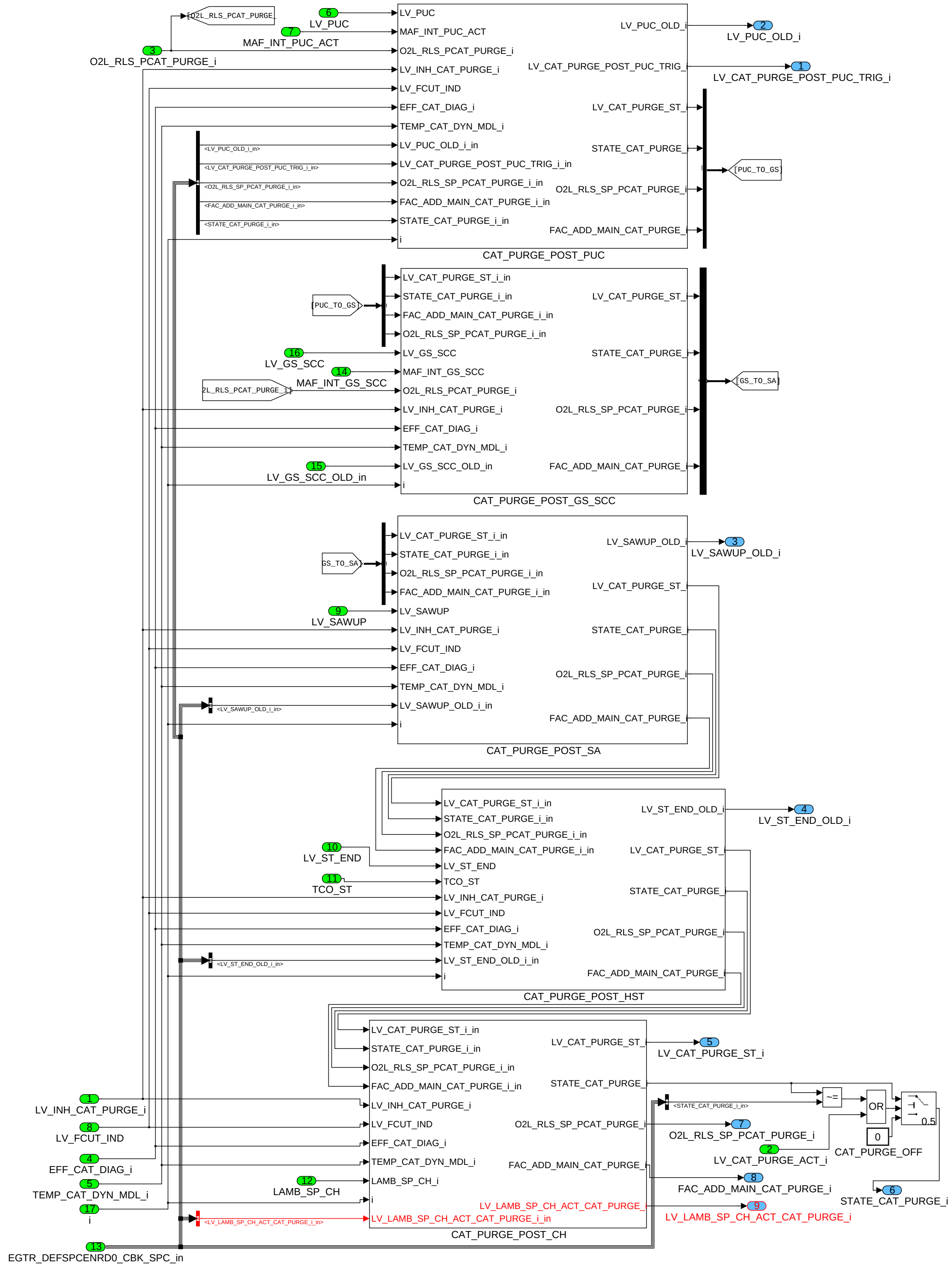

Figure 7.78.5: EGTR_DEFSPCENRD0/operate/EGTR_DEFSPCENRD0_CBK_MNG/ EGTR_DEFSPCENRD0_CBK_SPC

Catalyst purge after catalyst heating with lean air fuel mixture condition

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Cat purge after catayst heating is activated at falling edge of LV_LAMB_CH. Cat purge after trailing throttle fuel cutoff phase must not be active, no cylinder must be shut off and the inhibition flag must not be set.
The cat purge state is set to CAT_PURGE_CH .
The oxygen loading to be relased during pre catalyst purge is defined by C_O2L_RLS_SP_PCAT_PURGE_CH multiplied by a catayst temperature and efficiency depending factor. An additional factor to calculate the main catayst loading is set by C_FAC_ADD_MAIN_CAT_PURGE_CH.

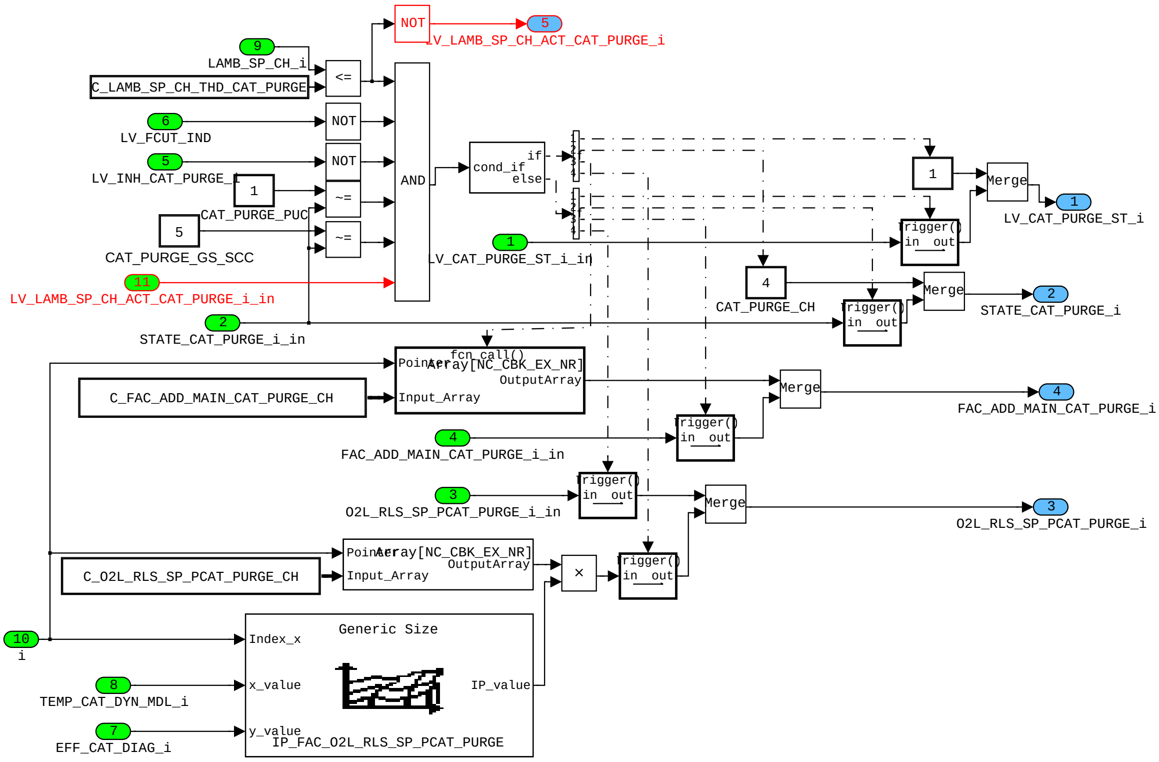

Figure 7.78.6: EGTR_DEFSPCENRD0/operate/EGTR_DEFSPCENRD0_CBK_MNG/
EGTR_DEFSPCENRD0_CBK_SPC/CAT_PURGE_POST_CH

Catalyst purge after cylinder cut off at gear shifting

Cat purge after cylinder cutoff at gear shifting is activated by a falling edge of LV_GS_SCC. It is similar to purge after PUC and has the same priority.

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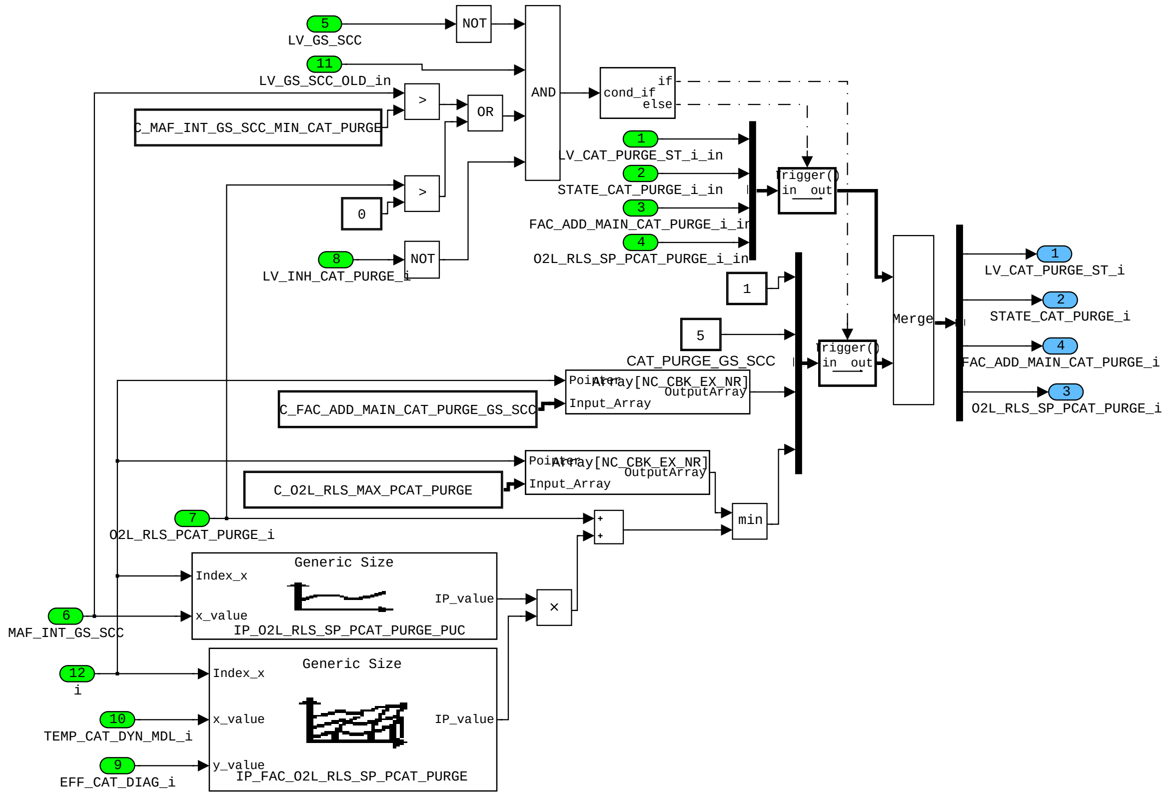

Figure 7.78.7: EGTR_DEFSPCENRD0/operate/EGTR_DEFSPCENRD0_CBK_MNG/
EGTR_DEFSPCENRD0_CBK_SPC/CAT_PURGE_POST_GS_SCC

Catalyst purge after hot start

Cat purge after hot start is activated at rising edge of LV_ST_END when the cooling temperature at start (TCO_ST) is above a calibration threshold. No other cat purge case must be active, no cylinder must be shut off and the inhibition flag must not be set.

The cat purge state is set to CAT_PURGE_HST .

The oxygen loading to be relased during pre catalyst purge is defined by C_O2L_RLS_SP_PCAT_PURGE_HST multiplied by a catayst temperature and efficiency depending factor. An additional factor to calculate the main catayst loading is set by C_FAC_ADD_MAIN_CAT_PURGE_HST.

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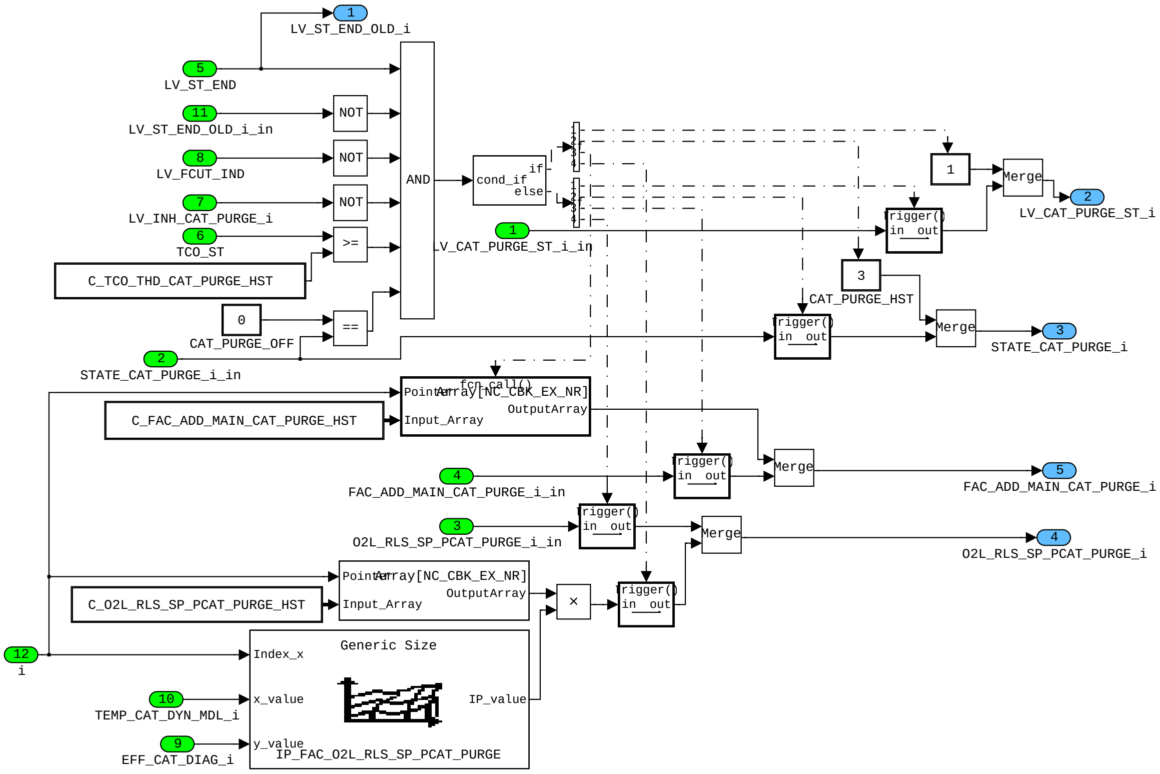

Figure 7.78.8: EGTR_DEFSPCENRD0/operate/EGTR_DEFSPCENRD0_CBK_MNG/
EGTR_DEFSPCENRD0_CBK_SPC/CAT_PURGE_POST_HST

Catalyst purge after trailing throttle fuel cut off phase

Cat purge after trailing throttle fuel cutoff (PUC) is activated at falling edge of LV_PUC. The inhibition flag must not be set and the air mass that was integrated during PUC must be above a minimum threshold or during last cat purge the pre cat purge was not finished (O2L_RLS_PCAT_PURGE[i] $>$ 0).

If at least one cylinder is shut off (LV_FCUT_IND = 1) when the conditions above are fulfilled then the start of cat purge is delayed till no cylinder is shut off any more. This is realized by means of the auxiliary flag LV_CAT_PURGE_POST_PUC_TRIG[i].

The cat purge state is set to CAT_PURGE_PUC .

The oxygen loading to be relased during pre catalyst purge is defined by IP_O2L_RLS_SP_PCAT_PURGE_PUC multiplied by a catayst temperature and efficiency depending factor. The result is limited to the maximum oxygen loading of the pre catalyst defined by C_O2L_RLS_MAX_PCAT_PURGE. The additional factor to calculate the main catayst loading is set to 1.

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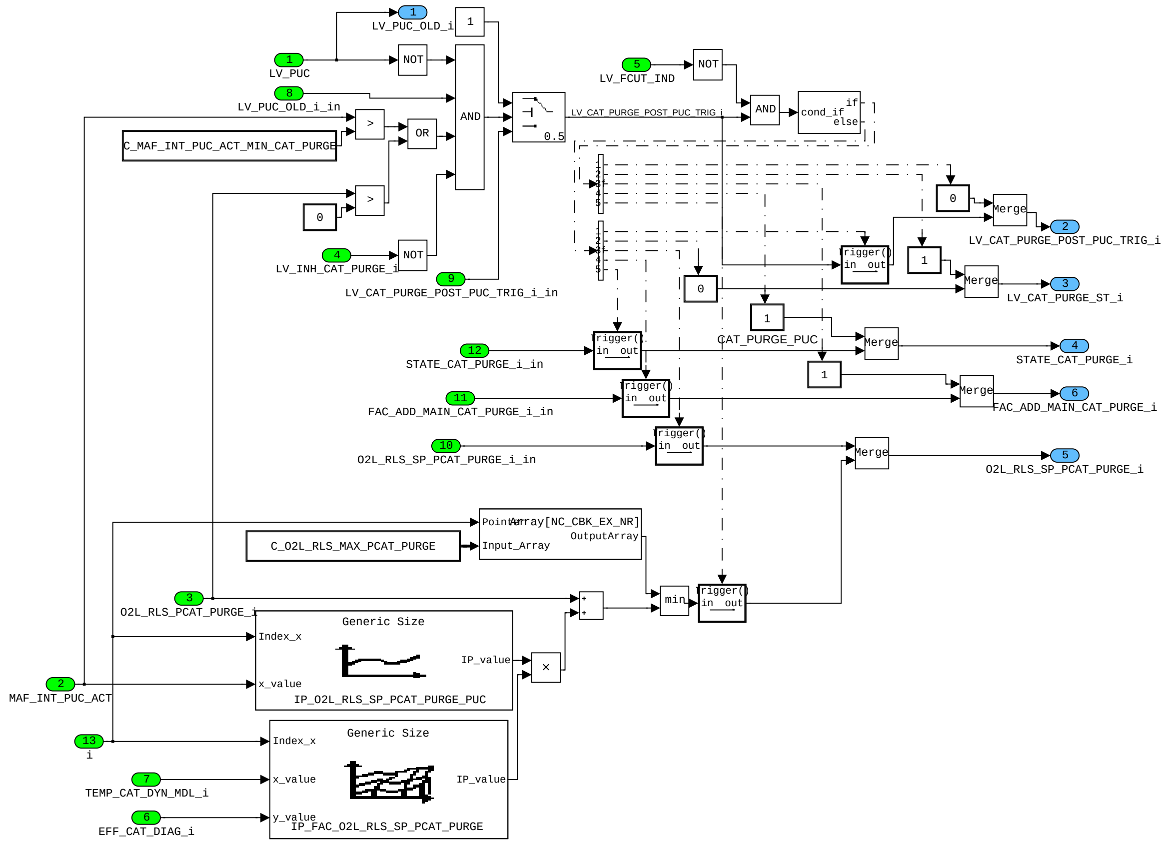

Figure 7.78.9: EGTR_DEFSPCENRD0/operate/EGTR_DEFSPCENRD0_CBK_MNG/
EGTR_DEFSPCENRD0_CBK_SPC/CAT_PURGE_POST_PUC

Catalyst purge after secondary air injection

Cat purge after secondary air is activated at falling edge of LV_SAWUP. Cat purge after trailing throttle fuel cutoff phase must not be active, no cylinder must be shut off and the inhibition flag must not be set.

The cat purge state is set to CAT_PURGE_SA .

The oxygen loading to be relased during pre catalyst purge is defined by C_O2L_RLS_SP_PCAT_PURGE_SA multiplied by a catayst temperature and efficiency depending factor. An additional factor to calculate the main catayst loading is set by C_FAC_ADD_MAIN_CAT_PURGE_SA.

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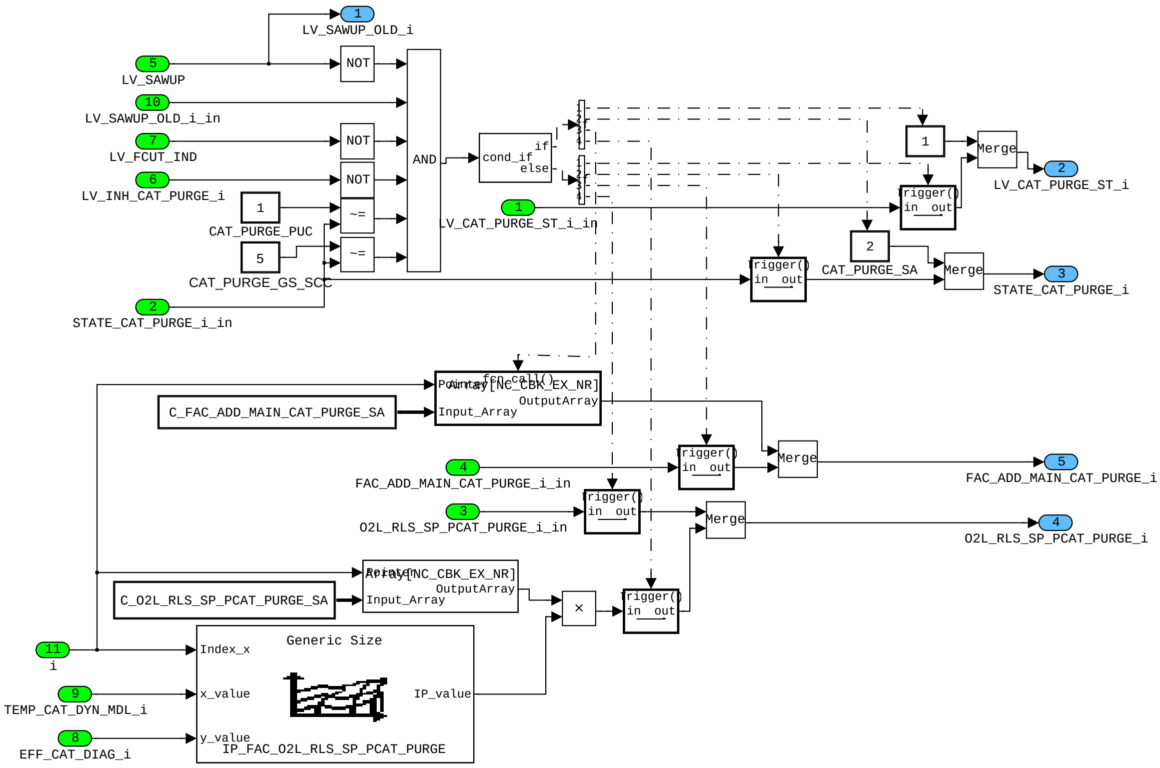

Figure 7.78.10: EGTR_DEFSPCENRD0/operate/EGTR_DEFSPCENRD0_CBK_MNG/
EGTR_DEFSPCENRD0_CBK_SPC/CAT_PURGE_POST_SA

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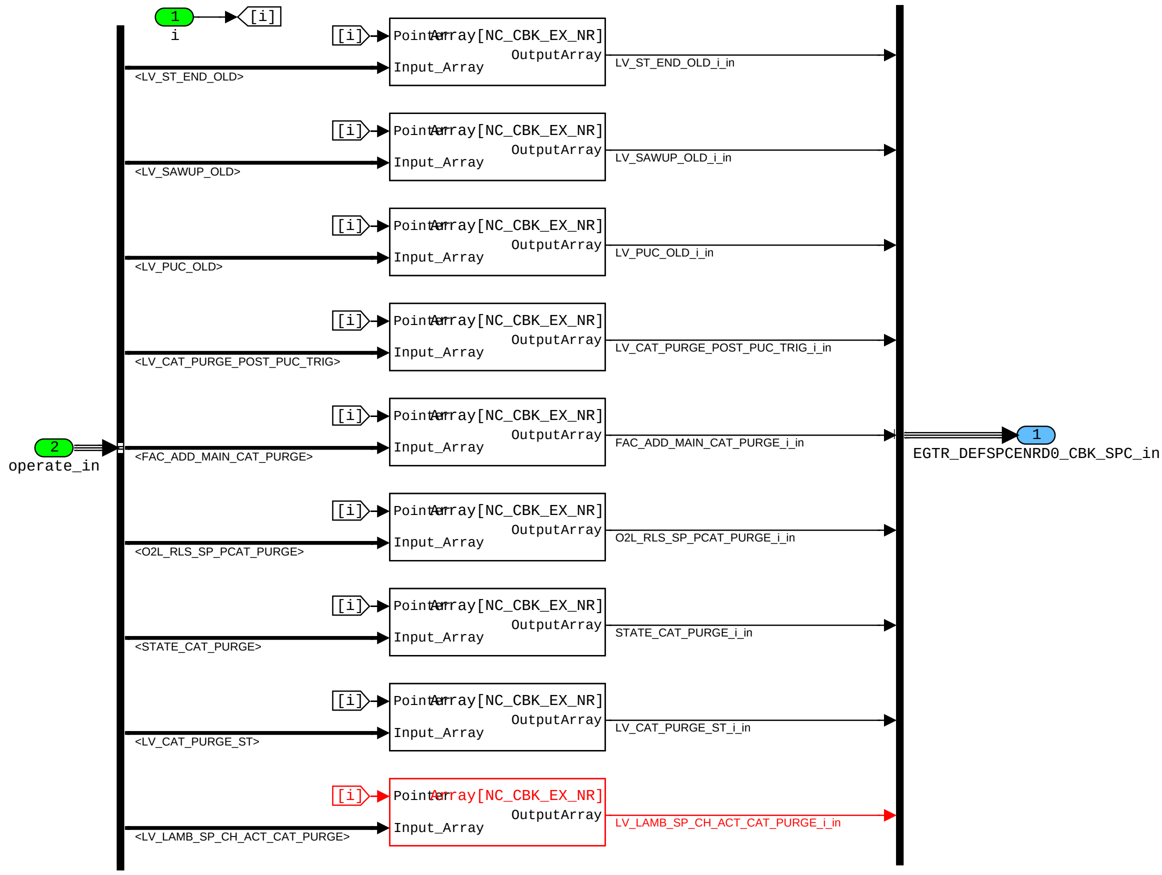

Figure 7.78.11: EGTR_DEFSPCENRD0/operate/EGTR_DEFSPCENRD0_CBK_MNG/
EGTR_DEFSPCENRD0_SIG_CBK_MNG

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7.78.1.2 SUBFUNCTION: reset

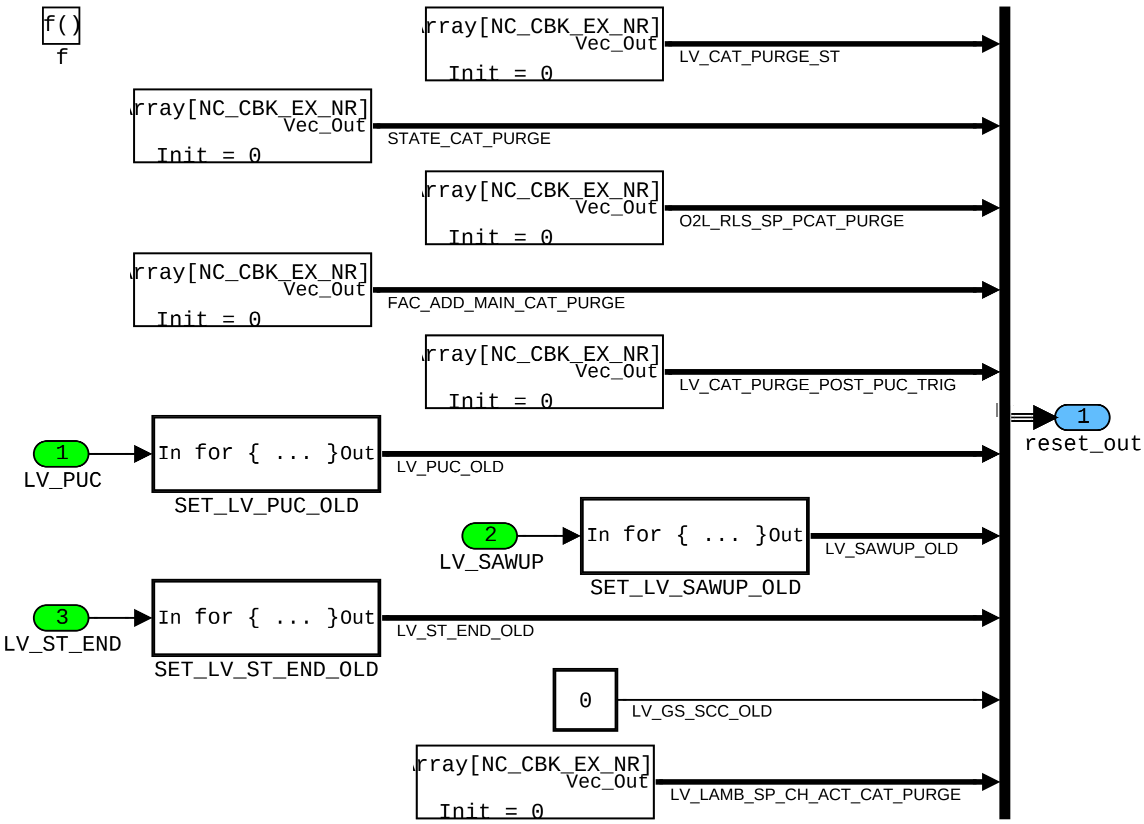

Figure 7.78.12: EGTR_DEFSPCENRD0/reset

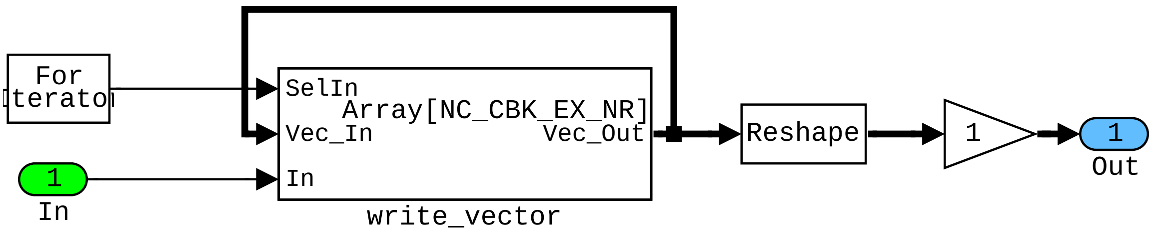

Figure 7.78.13: EGTR_DEFSPCENRD0/reset/SET_LV_PUC_OLD

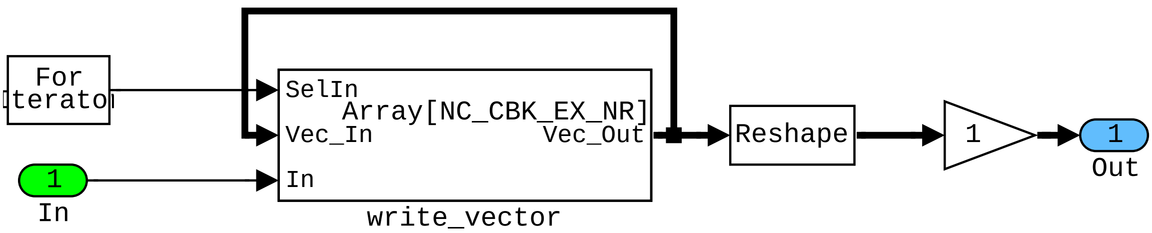

Figure 7.78.14: EGTR_DEFSPCENRD0/reset/SET_LV_SAWUP_OLD

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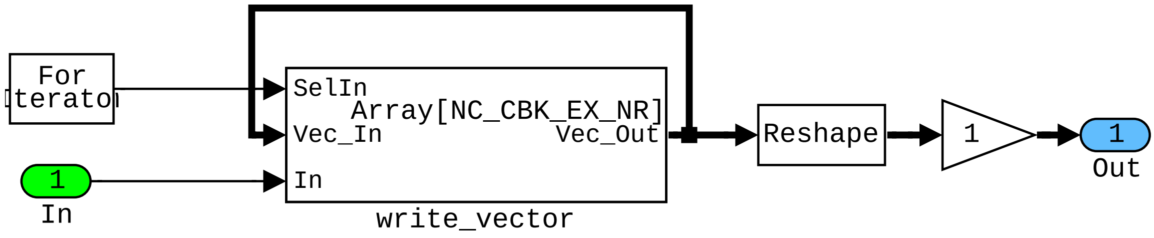

Figure 7.78.15: EGTR_DEFSPCENRD0/reset/SET_LV_ST_END_OLD

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7.79 Catalyst purge function

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_O2L_RLS_CAT_PURGE [NC_CBK_EX_NR]	V	8000... 7FFFH	-0.25... 0.24999237061	7.62939e-6	-
temporary factor for O2 loading release calculation considering the lambda set point deviation					
LAMB_SP_DELTA_IT_CAT_PURGE [NC_CBK_EX_NR]	O/V	0... FFFH	0... 0.249939	61.0352e-6	-
lambda set point shift of cat purge function (internal value)					
LV_CAT_PURGE_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status of catalyst purge activation					
LV_CAT_PURGE_MAIN_CAT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that cat purge for main cat is active					
LV_CAT_PURGE_PCAT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that cat purge for pre cat is active					
LV_VLS_DOWN_ACT_CAT_PURGE [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that downstream signal is/was below calibration threshold					
LV_VLS_MAIN_CAT_PRE_PURGE_ACT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that sensor signal after main cat is/was below calibration threshold for pre cat purge					
LV_VLS_MAIN_CAT_PURGE_ACT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag indicating that sensor signal after main cat is/was below calibration threshold					
O2L_RLS_ADD_CAT_PURGE [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-669.923556 ...669.923555	311.957e-9	g
oxygen loading to be added each sample step for cat purge air mass flow integral					
O2L_RLS_MAIN_CAT_PURGE [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-669.923556 ...669.923555	311.957e-9	g
oxygen loading to be released for main cat purge					
O2L_RLS_PCAT_PURGE [NC_CBK_EX_NR]	O/V	80000000... 7FFFFFFFH	-669.923556 ...669.923555	311.957e-9	g
oxygen loading to be released for pre cat purge					
O2L_RLS_REST_CAT_PURGE [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-669.923556 ...669.923555	311.957e-9	g
estimated rest oxygen loading to be released for pre and main cat purge					
O2L_RLS_TOT_CAT_PURGE [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-669.923556 ...669.923555	311.957e-9	g
total oxygen loading to be released for pre and main cat purge					
RATIO_O2L_RLS_CAT_PURGE [NC_CBK_EX_NR]	V	0... FFH	0... 0.99609375	3.90625e-3	-
quotient used by cat purge: current rest oxygen loading /total oxygen loading					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Input data:

EFF_CAT_DIAG [NC_CBK_EX_NR] {p. 5535}	FAC_ADD_MAIN_CAT_PURGE [NC_CBK_EX_NR] {p. 2912}	LV_CAT_PURGE_ST [NC_CBK_EX_NR] {p. 2912}	LV_DIAG_PUE_LS_DOWN_ADD_ACT [NC_CBK_EX_NR] {p. 2942}
LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_ERR_VLS_MAIN_CAT_PURGE [NC_CBK_EX_NR] {p. 2942}	LV_INH_CAT_PURGE [NC_CBK_EX_NR] {p. 2942}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}
LV_PUC {p. 1720}	LV_VLS_MAIN_CAT_PURGE_READY [NC_CBK_EX_NR] {p. 2942}	MAF_CYL {p. 8277}	NC_CBK_EX_NR {p. 1829}
O2L_RLS_SP_PCAT_PURGE [NC_CBK_EX_NR] {p. 2912}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	TEMP_MAIN_CAT_PURGE [NC_CBK_EX_NR] {p. 2942}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}
VLS_MAIN_CAT_PURGE [NC_CBK_EX_NR] {p. 2942}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_DOWN_THD_CAT_PURGE [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
downstream voltage signal threshold for end of pre cat purge detection					
C_VLS_MAIN_CAT_PURGE_THD	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
voltage signal threshold from sensor after main cat for end of main cat purge detection					
IP_FAC_MAIN_CAT_PURGE	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_TEMP_MAIN_CAT_PURGE_IP_FAC	6	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
LDPM_EFF_CAT_DIAG_1_EGTR	6	0... FFH	0... 1.9921875	7.8125e-3	-
weighting factor considering volume ratio (pre /main cat) and cat temperature (for main cat purge)					
IP_LAMB_SP_DELTA_CAT_PURGE	V	0... FFFH	0... 0.249939	61.0352e-6	-
LDP_MAF_CYL_IP_LAMB_SP	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_RATIO_O2L_RLS_IP_LAMB_SP	8	0... FFH	0... 0.99609375	3.90625e-3	-
lambda set point shift of catalyst purge function					
LC_VLS_MAIN_CAT_PURGE [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
calibration flag to use sensor signal after main cat to abort cat purge					

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General Information

The catalyst purge function realizes fast adjustment of optimized conditions for a high catalyst efficiency after a transition from trailing throttle fuel cut-off phase or other lean air fuel mixture conditions to stoichiometric conditions. That requires a fuel enrichment in order to reduce the oxygen content inside the catalyst. The degree of the fuel enrichment depends on the oxygen and the NOx content in the catalyst.
The recurrence time is defined by T_SAMPLE in [ms].
NC_CBK_EX_NR defines the number of exhaust banks.

For vector elements, the variable extension _i is used in the model instead of [i] as found in the textual description.

Application Conditions

Initialization: RST
Recurrence: 20MS
Activation: always
Deactivation: never

Function description

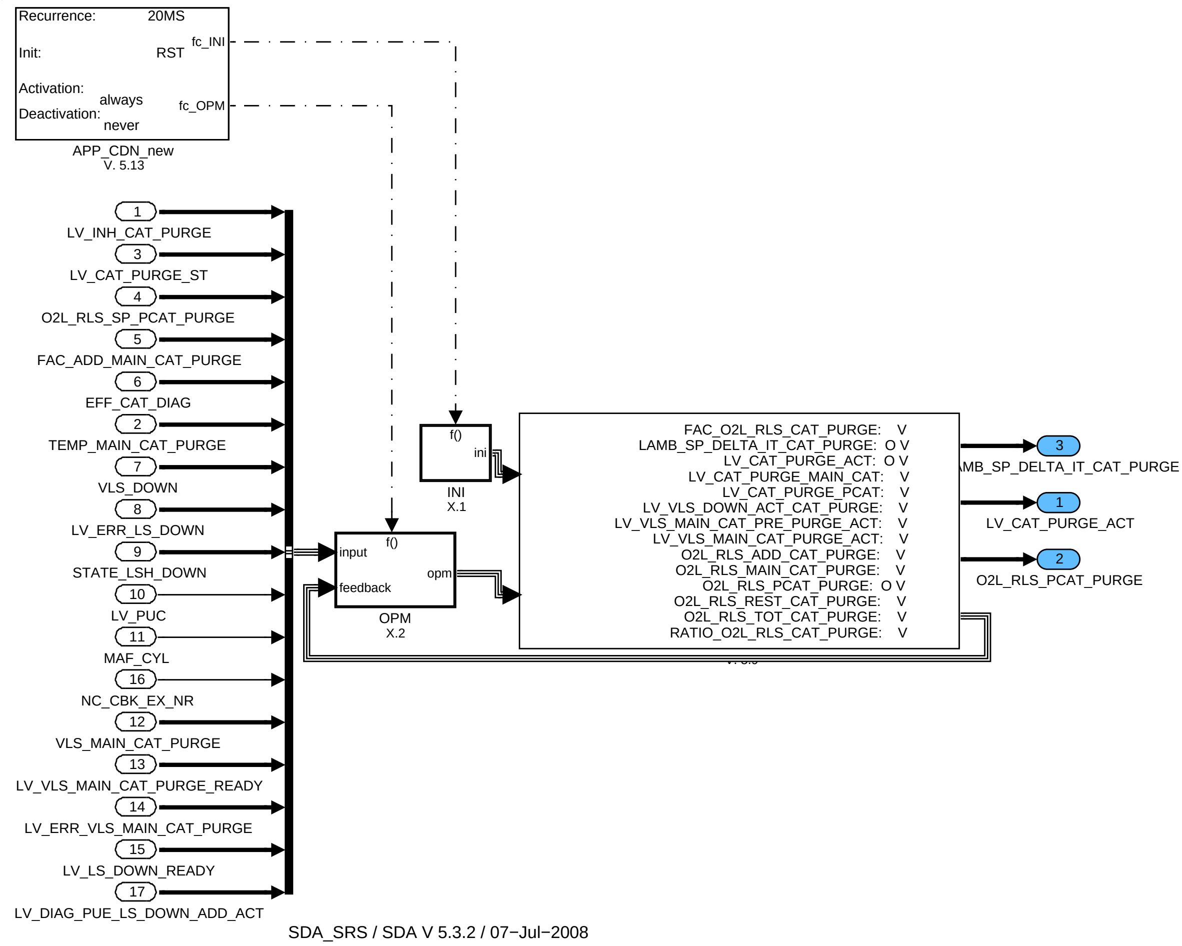

Figure 7.79.1: :

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7.79.1 Initialisation

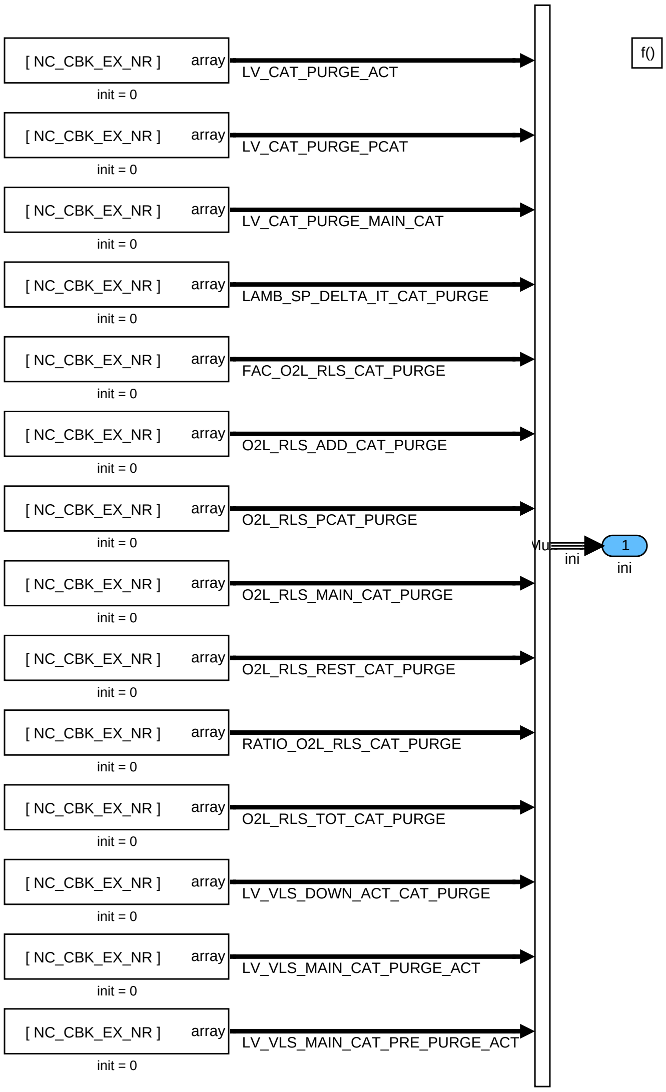

Figure 7.79.2: :

7.79.2 Calculation at every 20ms

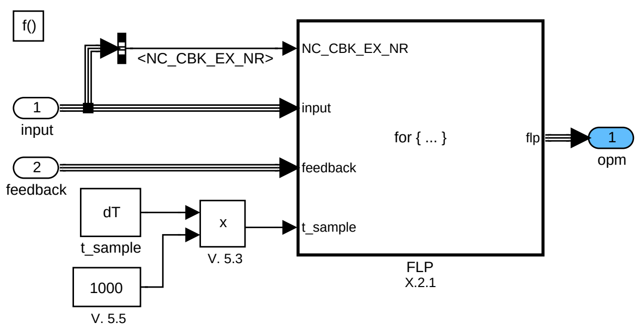

Figure 7.79.3: :

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7.79.2.1 Introduction of multiple bank system

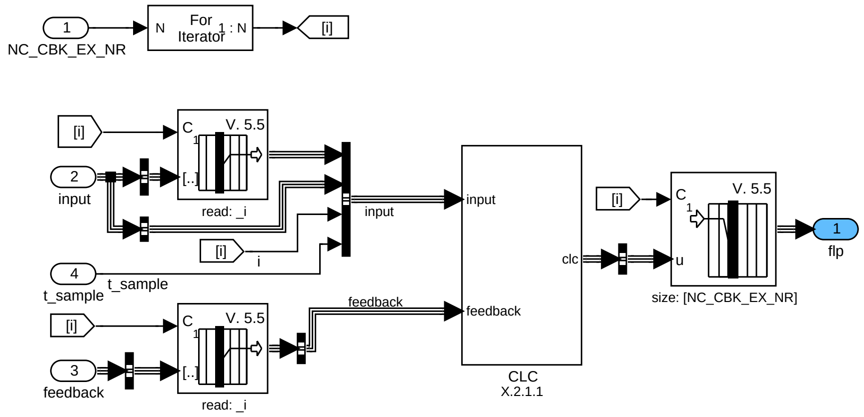

Figure 7.79.4: :

7.79.2.1.1 Formula section

7.79.2.1.1.1 Management of catalyst purge initialization and pre and main catalyst purge

If LV_CAT_PRUGE_ST[i] is set by the function Oxygen loading determination for catalyst enrichment function the initialization sub-system (INI_CAT_PURGE) is called. The flag is set only for one sample step.
Depending on LV_CAT_PURGE_PCAT[i] and LV_CAT_PURGE_MAIN_CAT[i] one of the sub-systems PRE_CAT_PURGE or MAIN_CAT_PURGE is called.
If LV_PUC or the inhibition flag is set no cat purge is executed or an active cat purge is interrupted (sub-system NOT_CAT_PURGE is called).
The cat purge activity flag LV_CAT_PURGE[i] is set to 1 if pre or main cat purge is active.

7.79.2.1.1.1.1 Condition checking

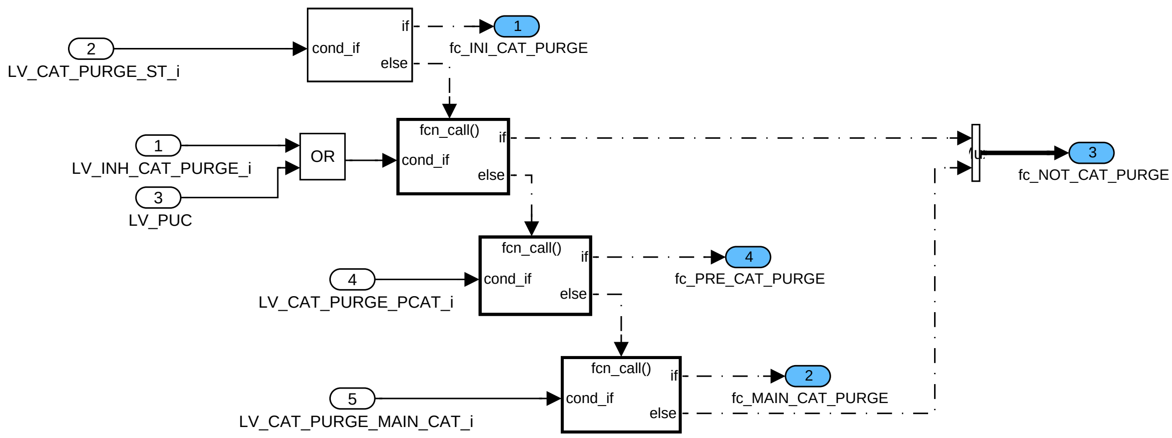

Figure 7.79.5: :

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7.79.2.1.1.1.2 Calculation of CAT_PURGE

7.79.2.1.1.1.2.1 Initialization of catalyst purge (fc_INI_CAT_PURGE)

Pre cat purge is activated by setting the respective flag. Main cat purge is deactivated.
The oxygen loading release integral for pre cat purge O2L_RLS_PCAT_PURGE[i] is initialised by O2L_RLS_SP_PCAT_PURGE[i]. The oxygen loading release integral for main cat purge is calculated by multiplying the one for pre cat purge with a factor map and with the additional factor defined in the function Oxygen loading determination for catalyst enrichment function . The rest oxygen loading release and the total oxygen loading release is the sum of the one for pre cat purge and main cat purge.

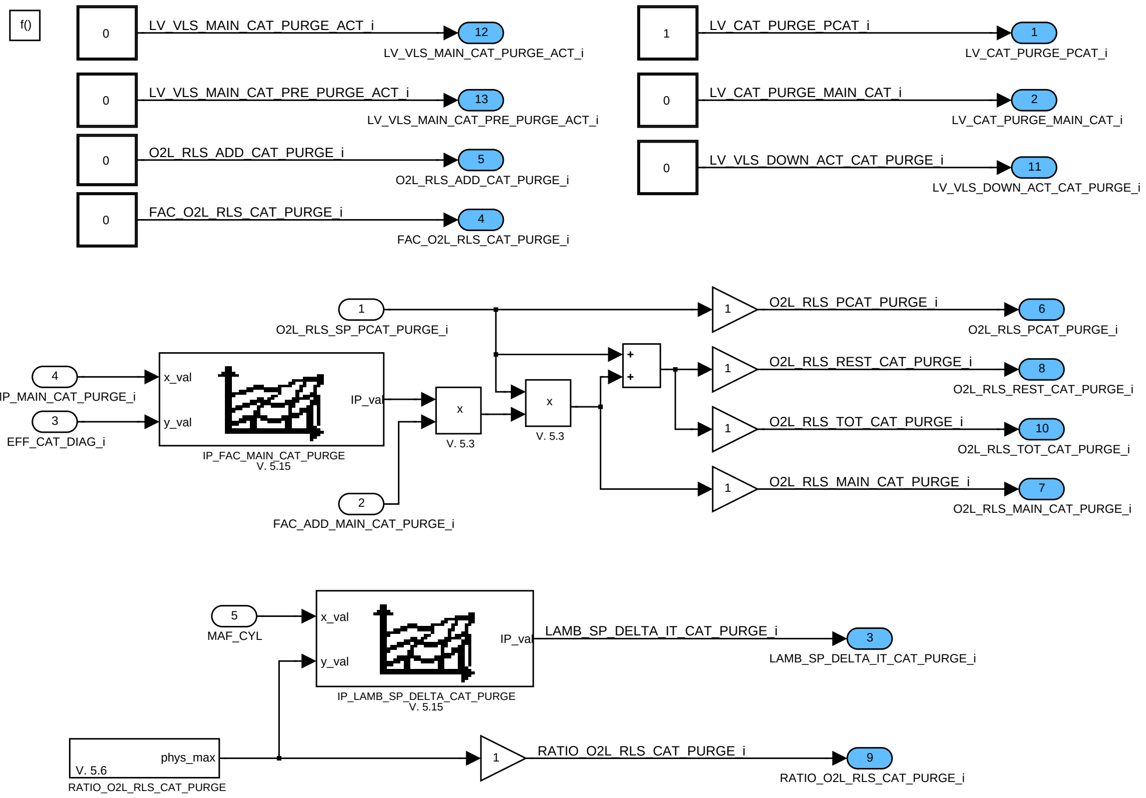

Figure 7.79.6: :

7.79.2.1.1.1.2.2 Main catalyst purge (fc_MAIN_CAT_PURGE)

If the oxygen loading for the main catalyst is released (O2L_RLS_MAIN_CAT_PURGE[i] <= 0) the end of main cat purge is detected and the respective sub-system MAIN_CAT_PURGE_END is triggered. Otherwise the sub-system MAIN_CAT_PURGE_CLC is called.

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7.79.2.1.1.1.2.2.1 Calculation of LV_VLS_DOWN_ACT_CAT_PURGE

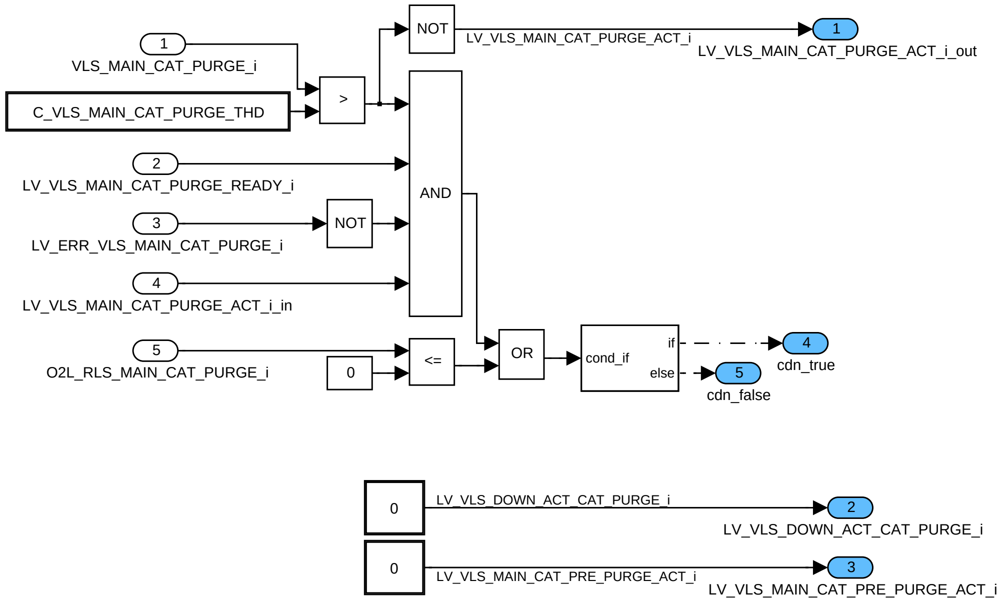

Figure 7.79.7: :

7.79.2.1.1.1.2.2.2 End of main catalyst purge (cdn_true)

Pre cat purge and main cat purge is deactivated by setting the respective flags. The rich shift of the lambda set point is set to 0

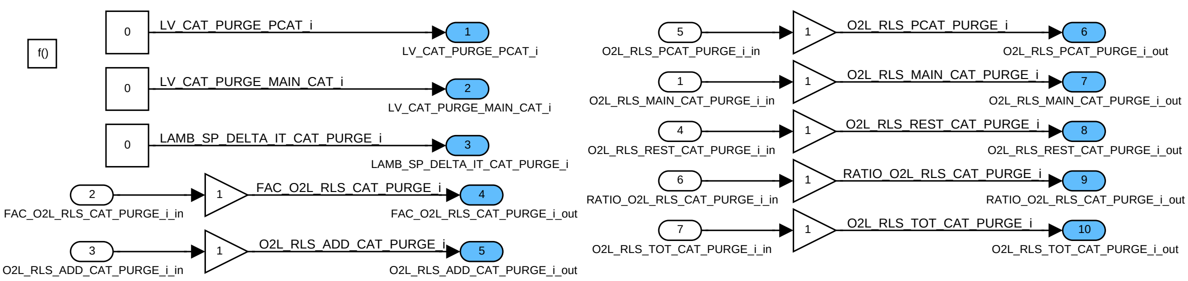

Figure 7.79.8: :

7.79.2.1.1.1.2.2.3 Calculation of main catalyst purge oxygen loading release (cdn_false)

See textual description for Calculation of pre catalyst purge oxygen loading release .

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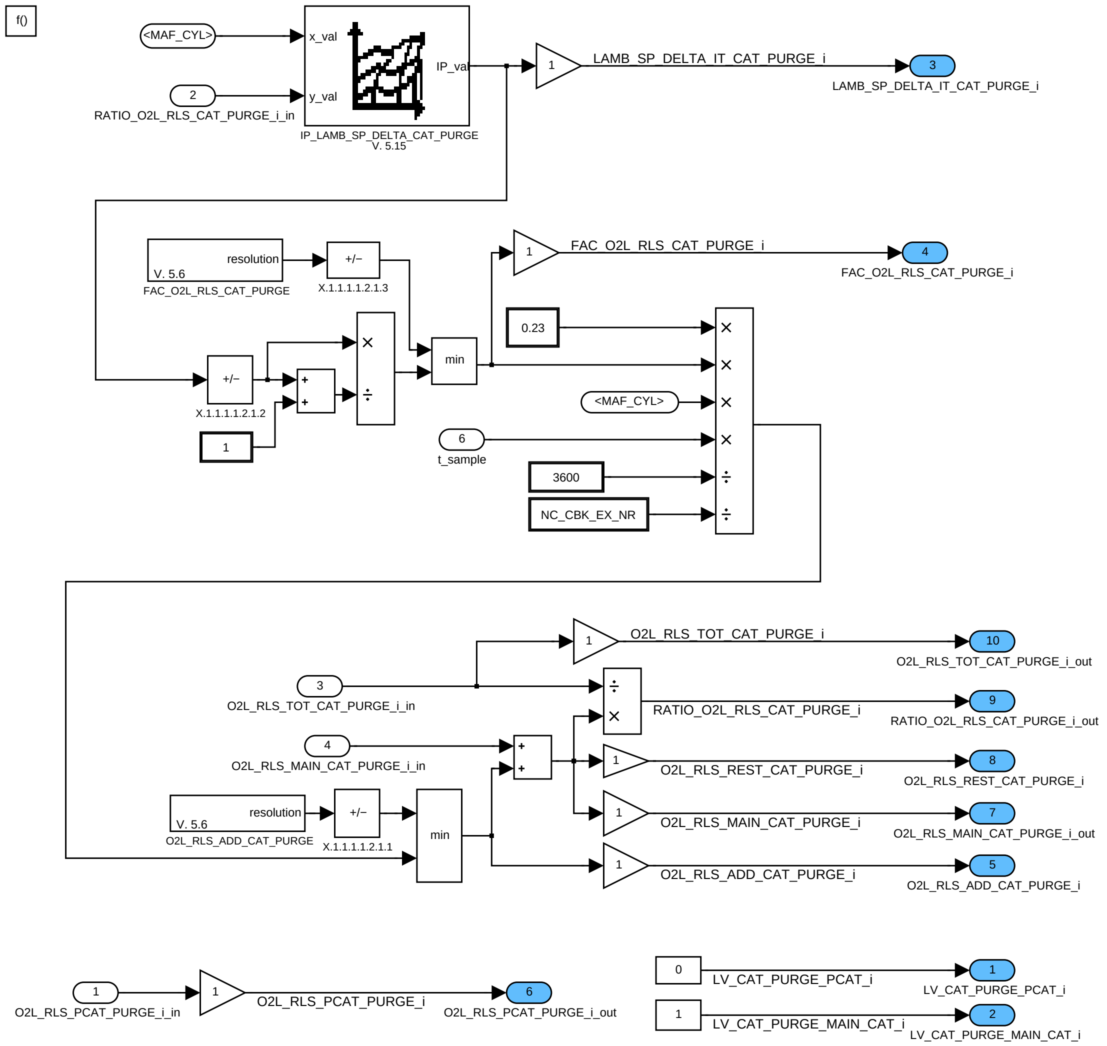

Figure 7.79.9: :

7.79.2.1.1.1.3 Deactivation of CAT_PURGE

7.79.2.1.1.1.3.1 Catalyst purge not active (fc_NOT_CAT_PURGE)

Pre cat purge and main cat purge is deactivated by setting the respective flags to 0. The rich shift of the lambda set point is also set to 0.

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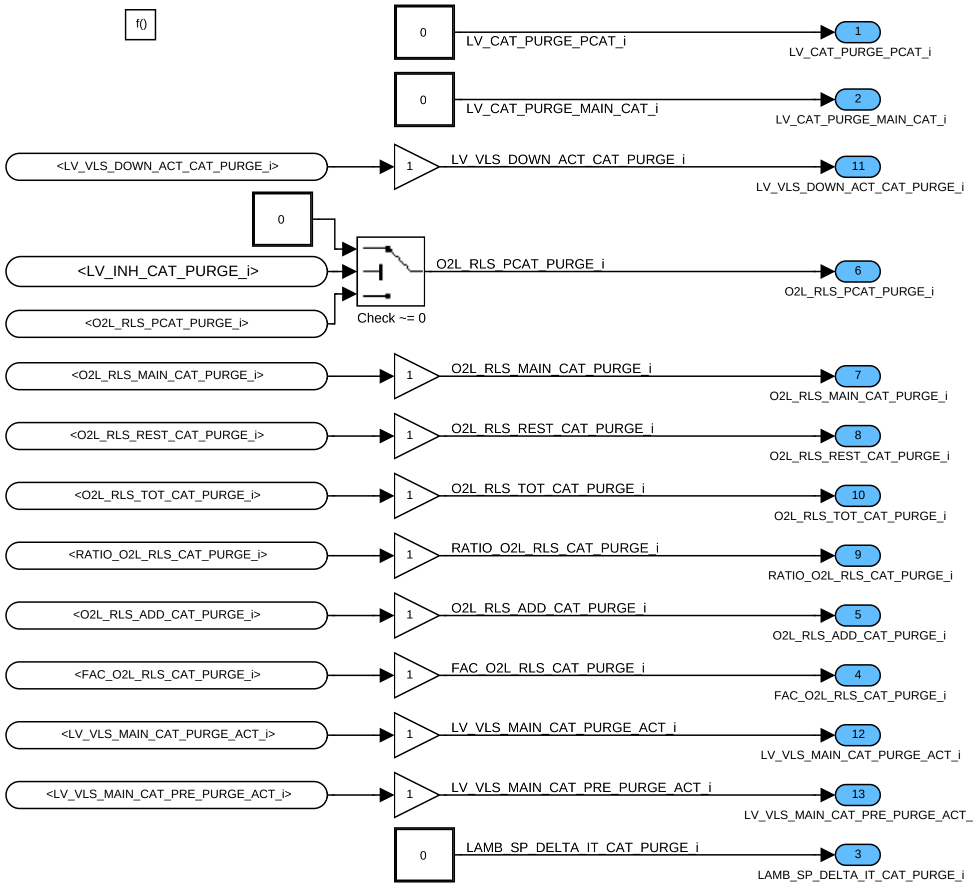

Figure 7.79.10: :

7.79.2.1.1.1.3.2 Pre catalyst purge (fc_PRE_CAT_PURGE)

If the oxygen loading for the pre catalyst is released (O2L_RLS_PCAT_PURGE[i] <= 0) and the lean to rich diagnosis isn t active (LV_DIAG_PUE_LS_DOWN_ADD_ACT = 0) or the downstream sensor signal exceeds a calibration threshold the end of pre cat purge is detected and the respective sub-system is triggered. The downstream signal is only evaluated if no error at the downstream sensor is present and the heater state is in LSH_POW_CTL . Furthermore the downstream signal must have been below the calibration threshold.
If the above mentioned conditions are not fulfilled the sub-system PRE_CAT_PRUGE_CLC is called.

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7.79.2.1.1.1.3.2.1 Calculation of LV_VLS_MAIN_CAT_PURGE_ACT

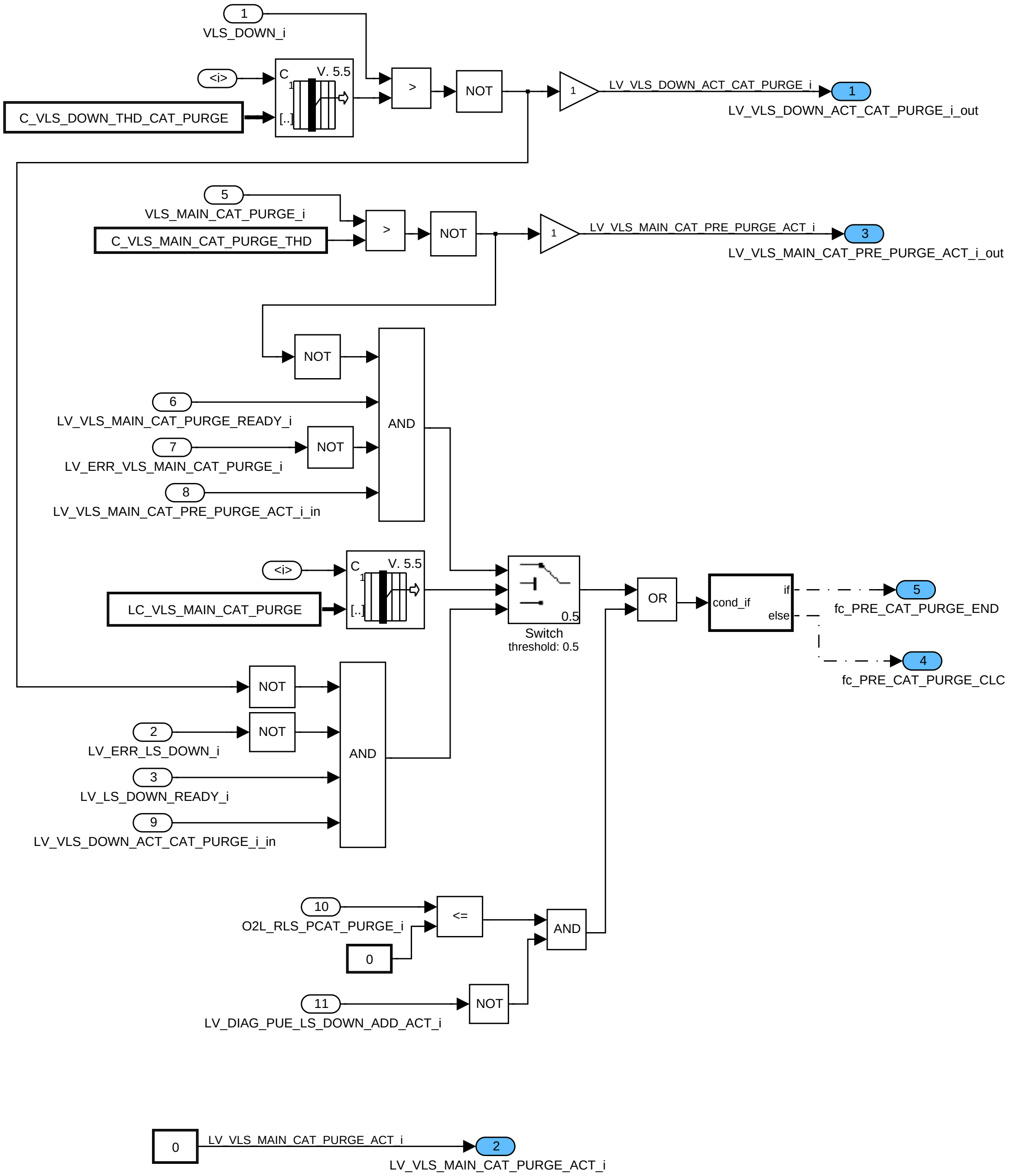

Figure 7.79.11: :

7.79.2.1.1.1.3.2.2 End of pre catalyst purge (cdn_true)

Main cat purge is activated by setting the respective flag. Pre cat purge is deactivated.
By newly evaluating the map IP_FAC_MAIN_CAT_PURGE the oxygen loading to be released during main cat purge is updated. The rest and total oxygen loading release is renewed and the quotient: rest /total oxygen loading release is also updated.

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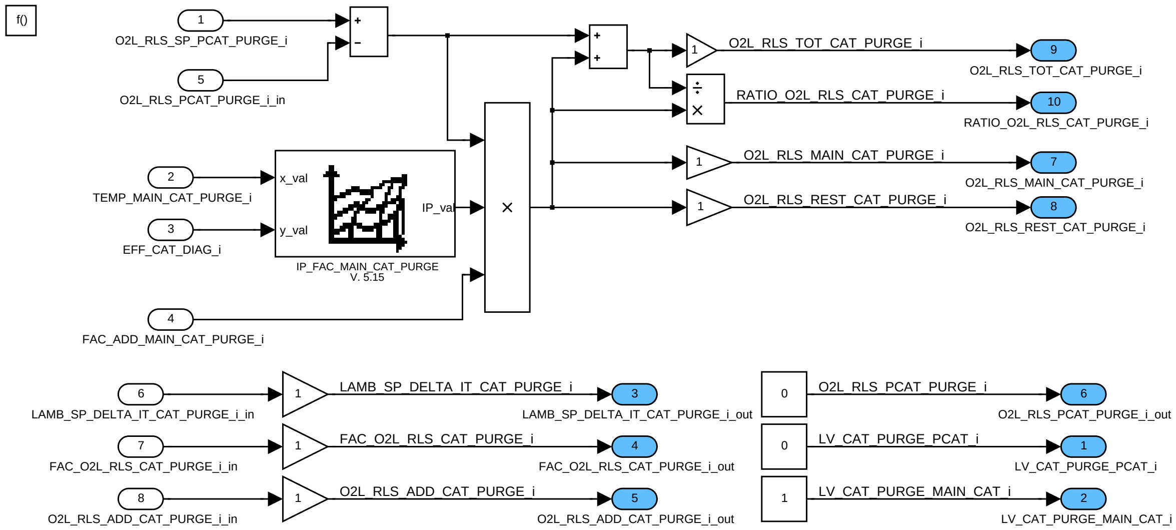

Figure 7.79.12: :

7.79.2.1.1.1.3.2.3 Calculation of pre catalyst purge oxygen loading release (cdn_false)

The rich shift of the lambda set point is taken from the respective map. The oxygen loading release is calculated by the following formula:

$$m_{O_2} = 0.23 \cdot \int \frac{-\Delta\lambda_{SP}}{1-\Delta\lambda_{SP}} \cdot \dot{m}_{air}\, dt$$

The remaining oxygen loading release (O2L_RLS_REST_CAT_PURGE[i]) is renewed and the quotient (RATIO_O2L_RLS_CAT_PURGE[i]): rest /total oxygen loading release is calculated.
For the calculation of the oxygen loading the unit conversion:
[g] = [kg/h] * [ms] * [(g*h) /(kg*ms)] /3600
has to be considered.
The fraction of the formula above is minimized to the resolution of its variable (FAC_O2L_RLS_CAT_PURGE[i]). The oxygen loading that is added each sample step is also minimized to the resolution of its variable (O2L_RLS_ADD_CAT_PURGE[i]).

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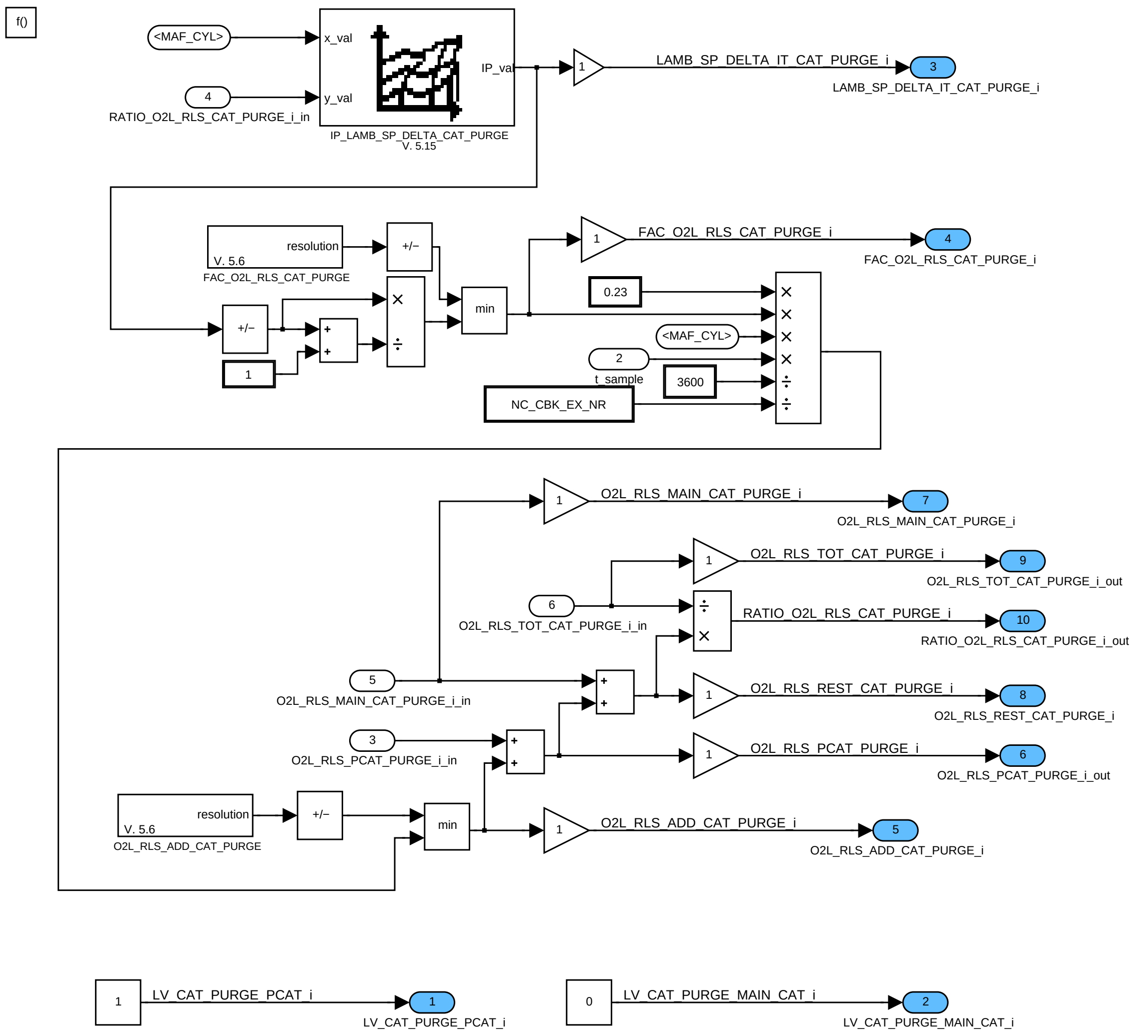

Figure 7.79.13: :

7.79.2.1.1.2 Calculation of LV_CAT_PURGE_ACT

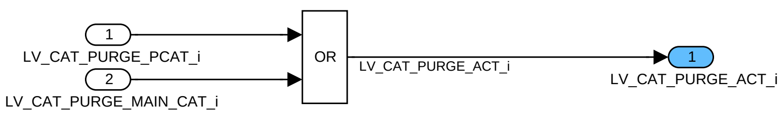

Figure 7.79.14: :

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7.80 Catalyst enrichment function coordination

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_DELTA_CAT_PURGE [NC_CBK_EX_NR]	O/V	0... FFFH	0... 0.249939	61.0352e-6	-
Lambda set point shift of cat purge function					

Input data:

LAMB_SP_CAT_PURGE_ ADD_PUE {p. 2942}	LAMB_SP_DELTA_ADD_ CAT_PURGE [NC_CBK_EX_NR] {p. 2942}	LAMB_SP_DELTA_IT_ CAT_PURGE [NC_CBK_EX_NR] {p. 2927}	NC_CBK_EX_NR {p. 1829}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_CAT_PURGE_PUE_ACT	-	0... 1H	0 ...1	1	-
Flag to activate amplitude for L2R diagnosis					

General Information

This function coordinates the lambda set point rich shift of different functions. Up to now only the output of the catalyst enrichment function is considered.
NC_CBK_EX_NR defines the number of exhaust banks.

Application Conditions

Initialization: RST
Recurrence: 20MS
Activation: always
Deactivation: never

Function description

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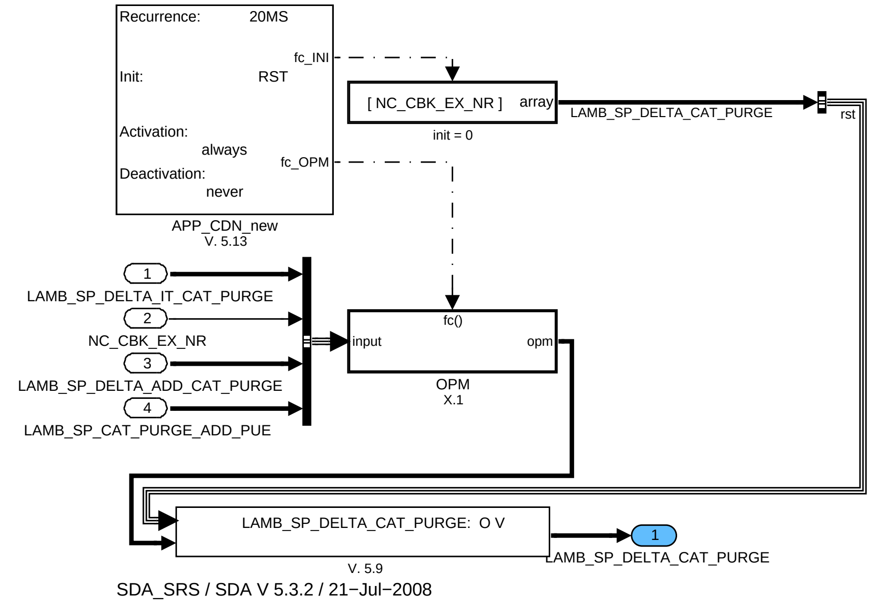

Figure 7.80.1: :

7.80.1 Calculation at every 20MS

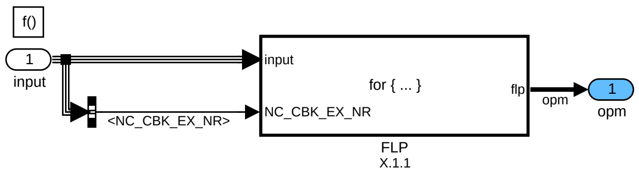

Figure 7.80.2: :

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7.80.1.1 Introduction of multiple bank system

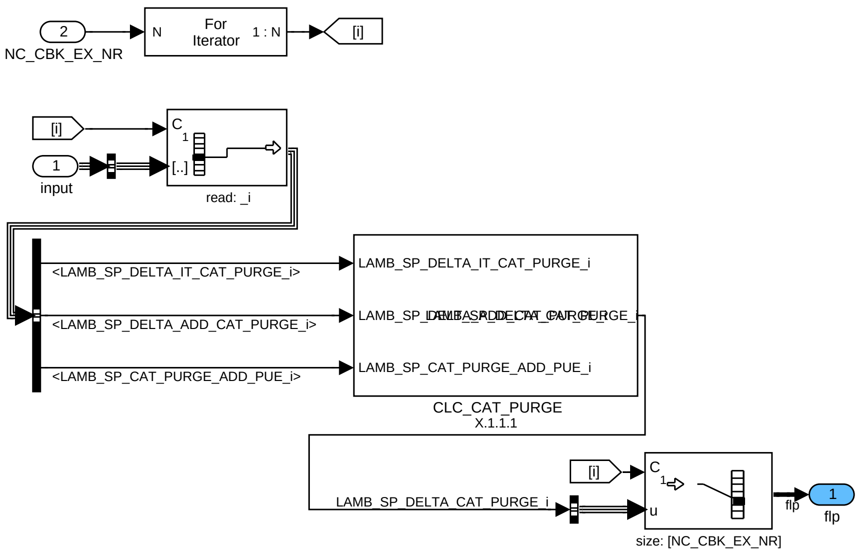

Figure 7.80.3: :

7.80.1.1.1 Calculation of LAMB_SP_DELTA_CAT_PURGE

The assignment of LAMB_SP_DELTA_CAT_PURGE[i] is a vector operation.

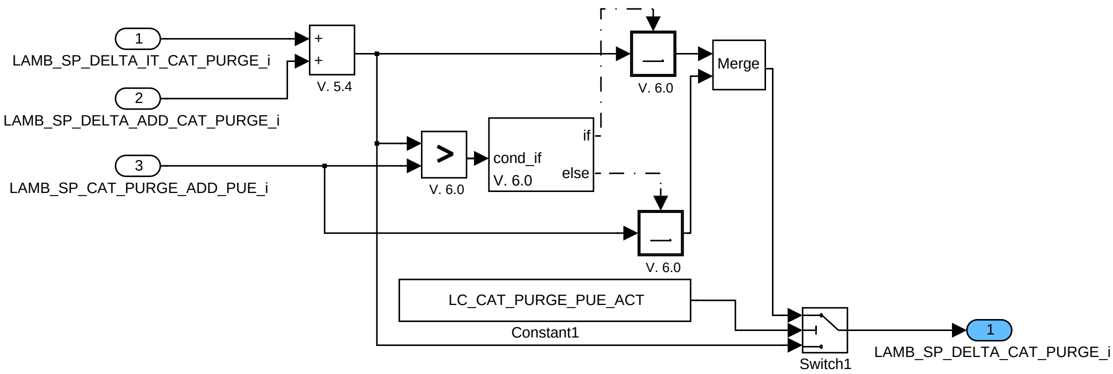

Figure 7.80.4: :

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7.81 Catalyst purge function (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_CAT_PURGE_ADD_PUE	O/V	0... FFFH	0... 0.249939	61.0352e-6	-
Lambda setpoint shift for L2R diagnosis					
LAMB_SP_DELTA_ADD_CAT_PURGE [NC_CBK_EX_NR]	O/V	0... FFFH	0... 0.249939	61.0352e-6	-
additional lambda set point shift for cat purge output					
LV_DIAG_PUE_LS_DOWN_ADD_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag that indicates, that L2R Diagnosis is active and uses CatPurge interface					
LV_ERR_VLS_MAIN_CAT_PURGE [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Final diagnostic of the sensor after main cat					
LV_GS_SCC	O/V	0... 1H	0 ...1	1	-
cylinder cut of during gear shift					
LV_INH_CAT_PURGE [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
inhibition flag for cat purge function					
LV_PUC_CHG_H_L	-	0... 1H	0 ...1	1	-
Bit for changing LV_PUC from high to low					
LV_PUC_CHG_L_H	-	0... 1H	0 ...1	1	-
Bit for changing LV_PUC from low to high					
LV_PUC_MAF_INT_OLD	-	0... 1H	0 ...1	1	-
auxiliary flag for edge detection of LV_PUC for MAF integrals					
LV_VLS_MAIN_CAT_PURGE_READY [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable for operative readiness of sensor(s) after main cat					
MAF_INT_GS_SCC	O/V	0... FFFFH	0... 2912.66666667	0.0444444	g
air mass flow integral at cylinder cut of during gear shift phase					
MAF_INT_PUC_ACT	O/V	0... FFFFH	0... 2912.66666667	0.0444444	g
air mass flow integral during pull cut off phase					
MAF_INT_PUC_NOT_ACT	O/V	0... FFFFH	0... 2912.66666667	0.0444444	g
air mass flow integral out of pull cut off phase					
RATIO_NTL_DEC_INT [NC_CBK_EX_NR]	-	0... FFFFH	0... 7.99987792969	122.07e-6	-
Ratio of NTL_DEC_INT of both NOx traps					
TEMP_MAIN_CAT_PURGE [NC_CBK_EX_NR]	O/V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
catalyst temperature of main cat for cat purge function					
VLS_MAIN_CAT_PURGE [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Sensor voltage measured after Main Catalyst (eg NOx sensor after NOx trap)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Input data:

EFF_SCC_AV {p. 6665}	LAMB_SP_ADD_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5168}	LV_CAT_PURGE_REQ_POST_AFL [NC_NT_NR] {p. 2982}	LV_DIAG_ACT_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5168}
LV_ERR_NS_CAN_BOFF {p. 991}	LV_ERR_NS_CAN_MSG_LOST [NC_NOX_SENS_CONF] {p. 991}	LV_ERR_NS_OBD_1_HTP [NC_NOX_SENS_CONF] {p. 4916}	LV_ERR_NS_OBD_1_VLS [NC_NOX_SENS_CONF] {p. 4916}
LV_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	LV_GS {p. 1565}	LV_PUC {p. 1720}	LV_VLS_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}
MAF_CYL {p. 8277}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}
NC_NT_NR {p. 644}	NTL_DEC_INT [NC_NT_NR] {p. 2985}	TCO {p. 1100}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}
VLS_NS [NC_NOX_SENS_CONF] {p. 992}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_CYL_MAX_CAT_PURGE	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
maximum air mass flow threshold for cat purge activation					
C_N_MAX_CAT_PURGE	-	0... FFH	0... 8160	32	rpm
maximum engine speed for cat purge					
C_TCO_MIN_CAT_PURGE	-	0... FEH	-48... 142.5	0.75	°C
minimum TCO threshold for cat purge activation					
C_TEMP_DIF_PCAT_MAIN_CAT_PURGE [NC_CBK_EX_NR]	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
temperature difference between pre and main cat					
IP_FAC_PURGE_RATIO_NTL	-	0... FFH	0... 7.96875	0.03125	-
LDP_RATIO_NTL_DEC_INT_IP_FAC	8	0... FFFFH	0... 7.99987792969	122.07e-6	-
Correction of different regenerated NOx traps depending on ratio of NTL_DEC_INT					
IP_LAMB_ADD_PURGE	V	0... FFFH	0... 0.249939	61.0352e-6	-
LDP_MAF_CYL_IP_LAMB_ADD_PURGE	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_VLS_NOX_SENS_IP_LAMB_ADD	8	0... 578H	-200 ...1200	1	mV
delta lambda map for cat purge after lean mode					
LC_CAT_PURGE_INH [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
calibration flag to force cat purge function to be inhibited					
LC_DIAG_ACT_PUE_LS_DOWN	-	0... 1H	0 ...1	1	-
Switch to deactivate the influence of gradient monitoring diagnosis					
LC_NS_2_DEAC	-	0... 1H	0 ...1	1	-
force usage of first NOx sensor for cat purge of both banks					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

General Information

This function defines the general inhibition of catalyst purge and the temperature of the main catalyst by means of a temperature gradient.
NC_CBK_EX_NR defines the number of exhaust banks.

Additionally, MAFintegrals from INSY (MAF_INT_PUC_ACT and MAF_INT_PUC_NOT_ACT) and an MAFintegral for gear shifting with cylinder cutoff (MAF_INT_GS_SCC) are included.
An additionally interface to NOXM for cat purge after lean operation is included.

Application Conditions

Initialization: RST
Activation: 20MS: always
SEG: always
Deactivation: never

Function description

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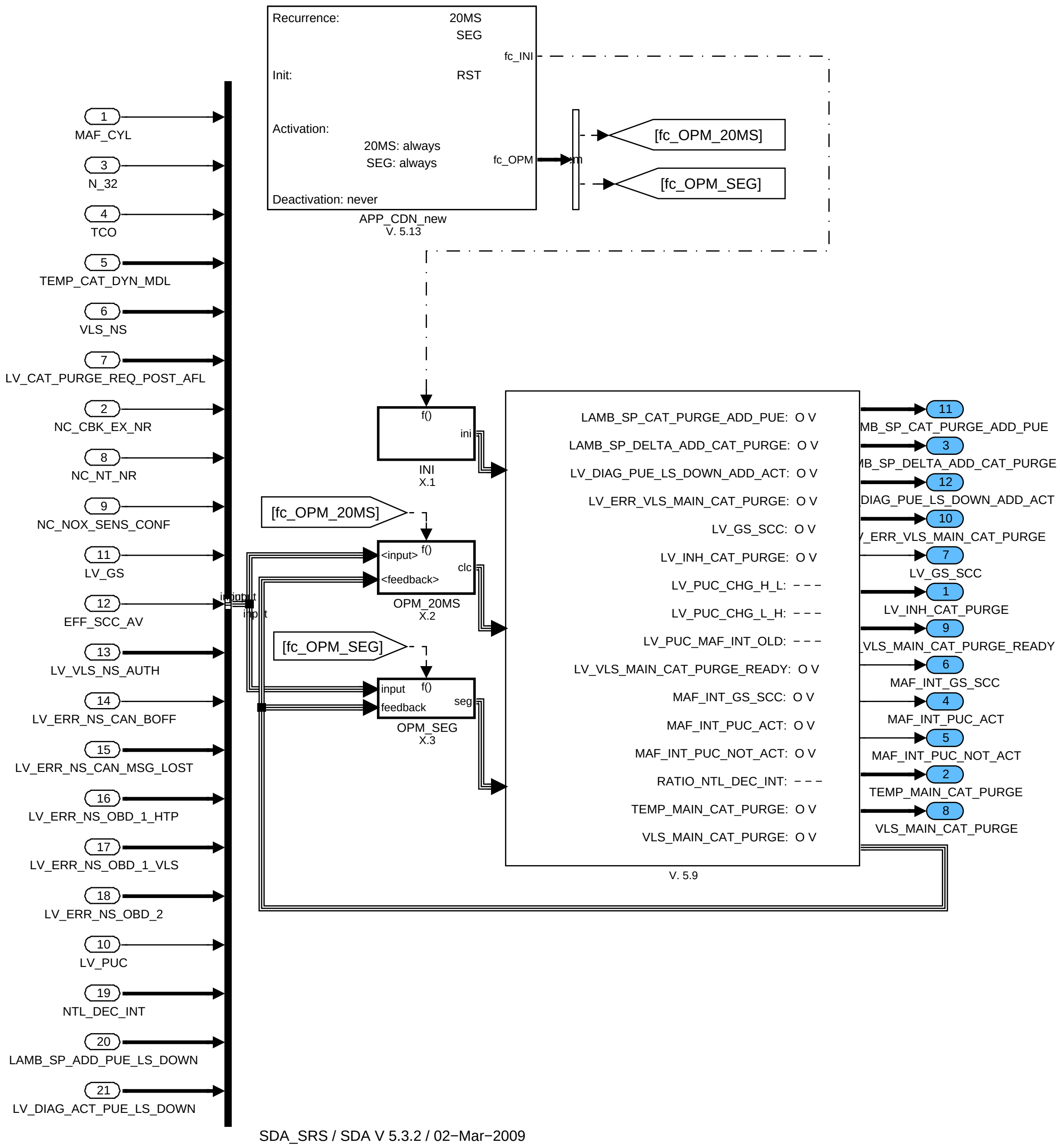

Figure 7.81.1: : Path: EGTR_DEFSPCENRI0

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7.81.1 Initialisation

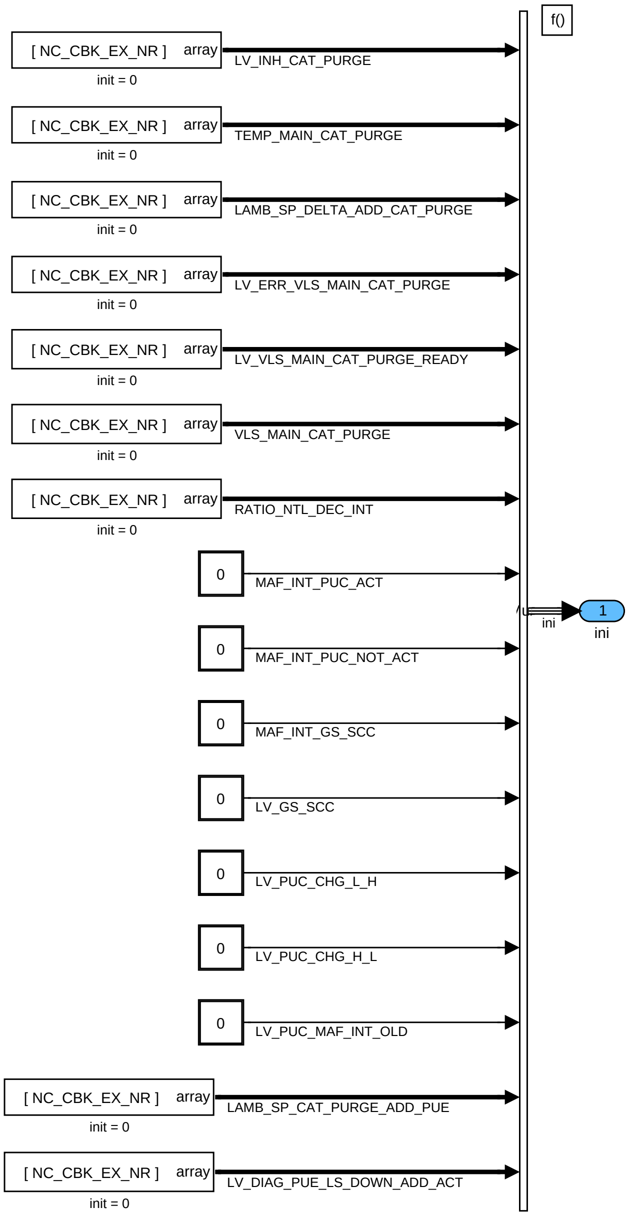

Figure 7.81.2: : Path: EGTR_DEFSPCENRI0/INI

7.81.2 Formula section:Calculation at every 20ms

7.81.2.1 LV_INH_CAT_PURGE and TEMP_MAIN_CAT_PURGE

LC_CAT_PURGE_INH[i] can inhibit each exhaust bank separately, while the threshold conditions of MAF_CYL, N_32 and TCO is valid for both banks in the same way. A vector operation must be applied. The temperatur gradient calculation for the main catalyst is a vector operation too.

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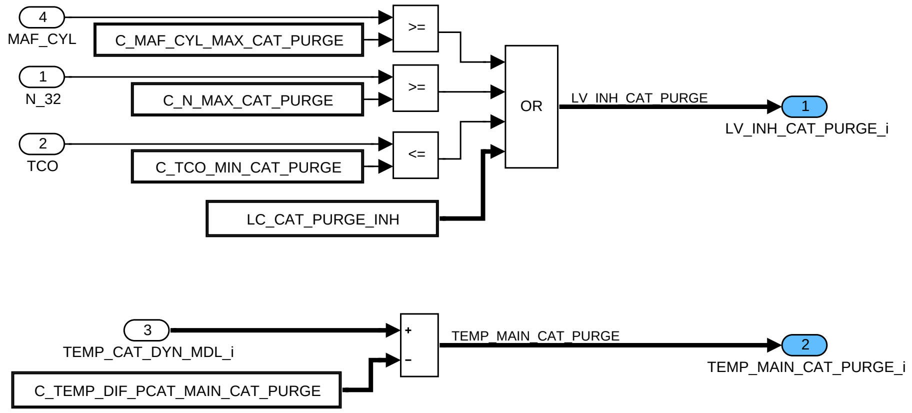

Figure 7.81.3: : Path: EGTR_DEFSPCENRI0/OPM_20MS/INH_CAT_PURGE

7.81.2.2 Introduction of multiple bank system

7.81.2.2.1 Calculation of LAMB_SP

7.81.2.2.1.1 LAMB_SP_DELTA_ADD_CAT_PURGE

This cat purge interface to NOXM is used after lean operation.
Vector size of input signals depend from NC_NT_NR and NC_NOX_SENS_CONF. Vector size of output signal depends from NC_CBK_EX_NR. Therefore the input signals have to be used dependend on different exhaust gas configurations. Especially, if NC_CBK_EX_NR is greater than the number of NOx sensors or NOx traps only the signal of the first bank have to be used for calculation of both banks.

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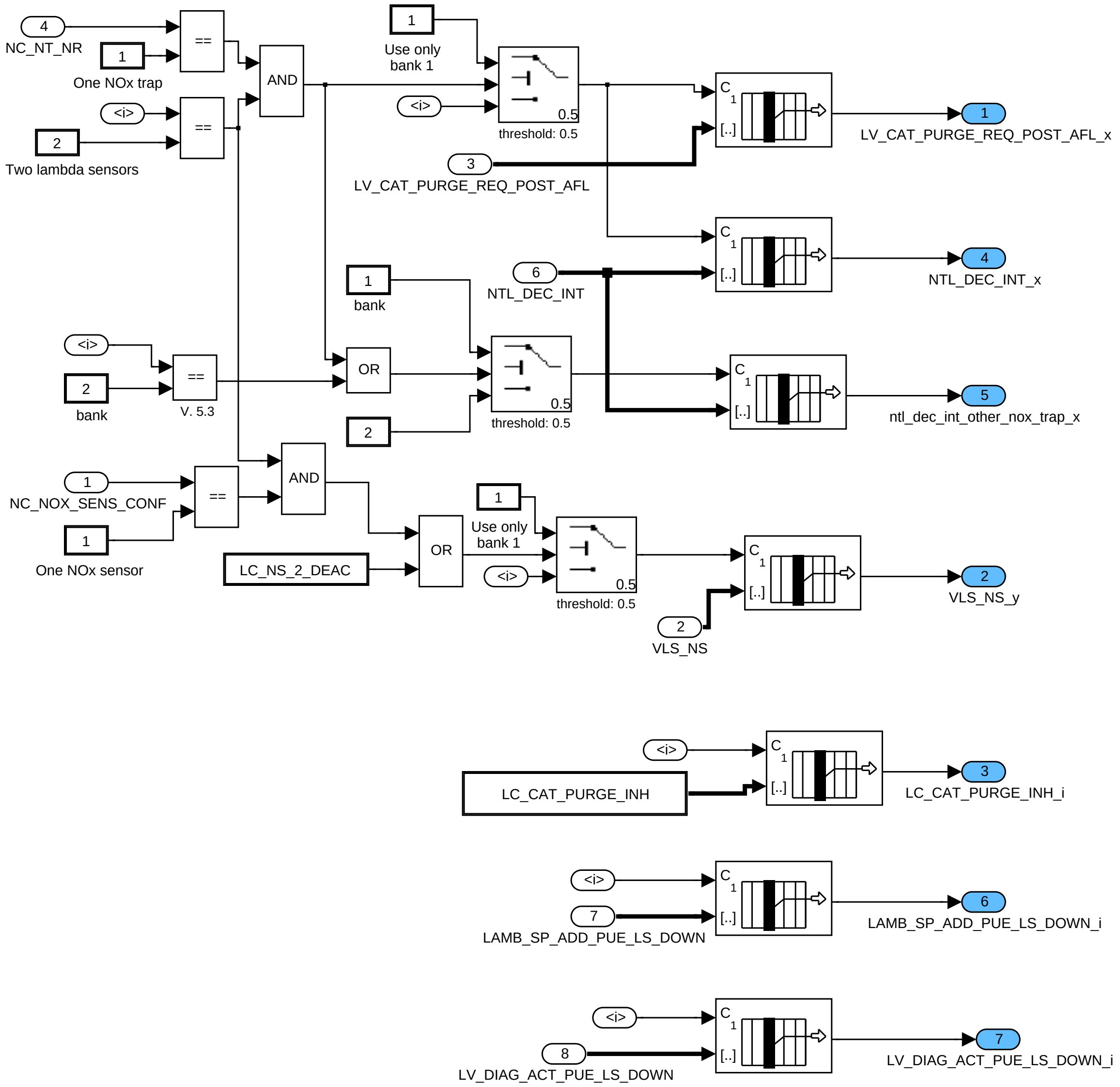

Figure 7.81.4: : Path: EGTR_DEFSPCENRI0/OPM_20MS/ADD_CAT_PURGE/CLC_LAMB_SP/CLC_LAMB_SP

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7.81.2.2.1.2 Calculation of LAMB_SP_DELTA_ADD_CAT_PURGE

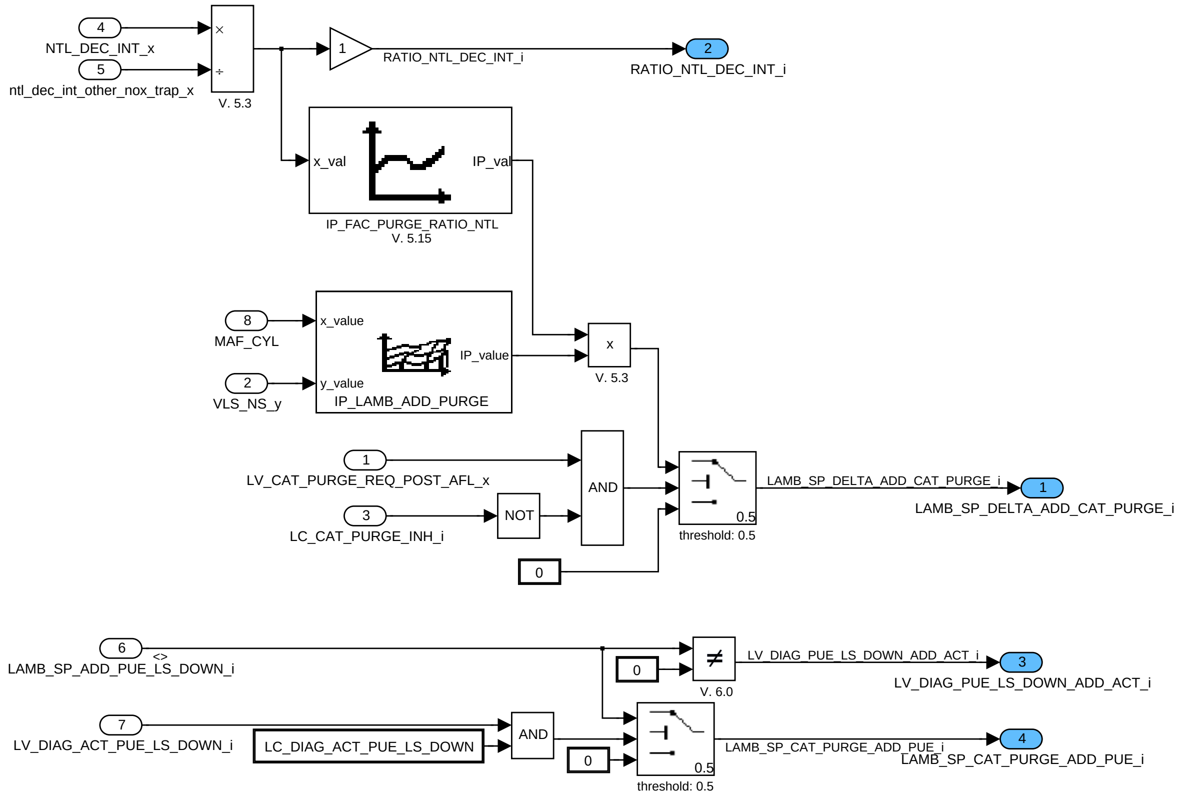

Figure 7.81.5: : Path: EGTR_DEFSPCENRI0/OPM_20MS/ADD_CAT_PURGE/CLC_LAMB_SP/CLC

7.81.2.3 MAF_INT_PUC_ACT and MAF_INT_PUC_NOT_ACT

Calculation of MAF integrals is done depending on LV_PUC, the reset of the integrals is done depending on edges of LV_PUC.

These edges will be detected in the synchronous segment loop and stored in LV_PUC_CHG_L_H or _H_L, to avoid loosing edges at high speed. After reset of an integral the edge memory flag will be cleared.

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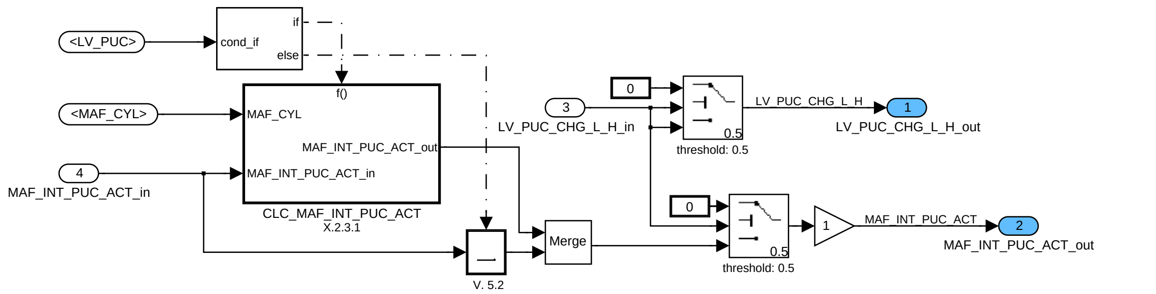

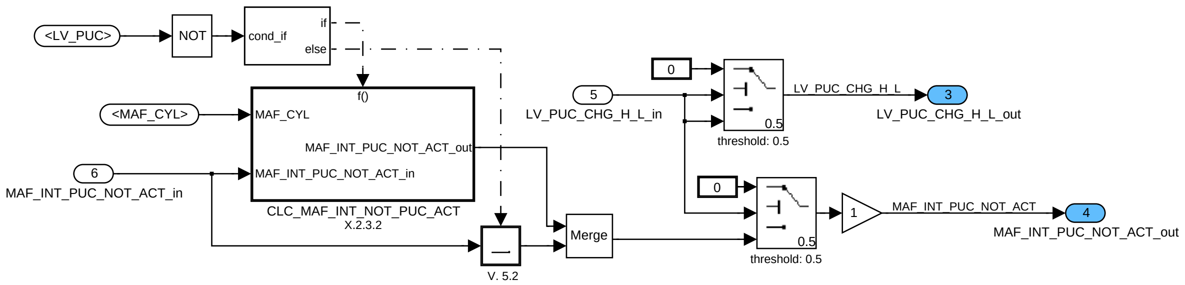

Figure 7.81.6: :   Path: EGTR_DEFSPCENRI0/OPM_20MS/MAF_INT_PUC

7.81.2.3.1 Calculation of MAF_INT_PUC_ACT

remark: MAF_INT_PUC_ACT have to be calculated internally on 32 bit

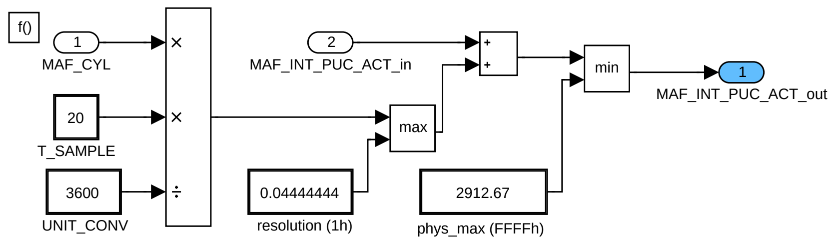

Figure 7.81.7: :   Path:
EGTR_DEFSPCENRI0/OPM_20MS/MAF_INT_PUC/CLC_MAF_INT_PUC_ACT

7.81.2.3.2 Calculation of MAF_INT_PUC_NOT_ACT

remark: MAF_INT_NOT_PUC_ACT have to be calculated internally on 32 bit

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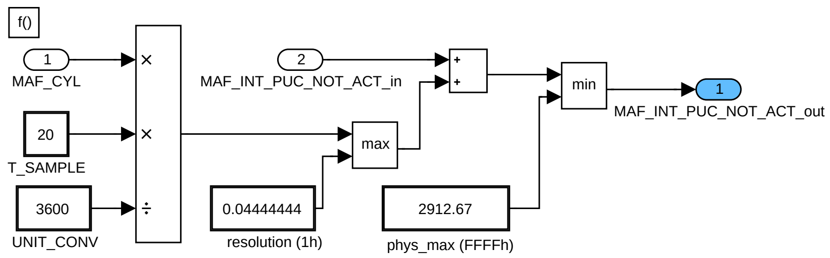

Figure 7.81.8: : Path: EGTR_DEFSPCENRI0/OPM_20MS/MAF_INT_PUC/CLC_MAF_INT_NOT_PUC_ACT

7.81.2.4 LV_GS_SCC and MAF_INT_GS_SCC

A MAF integral is calculated as long as cylinder cutoff at gear shifting is active.

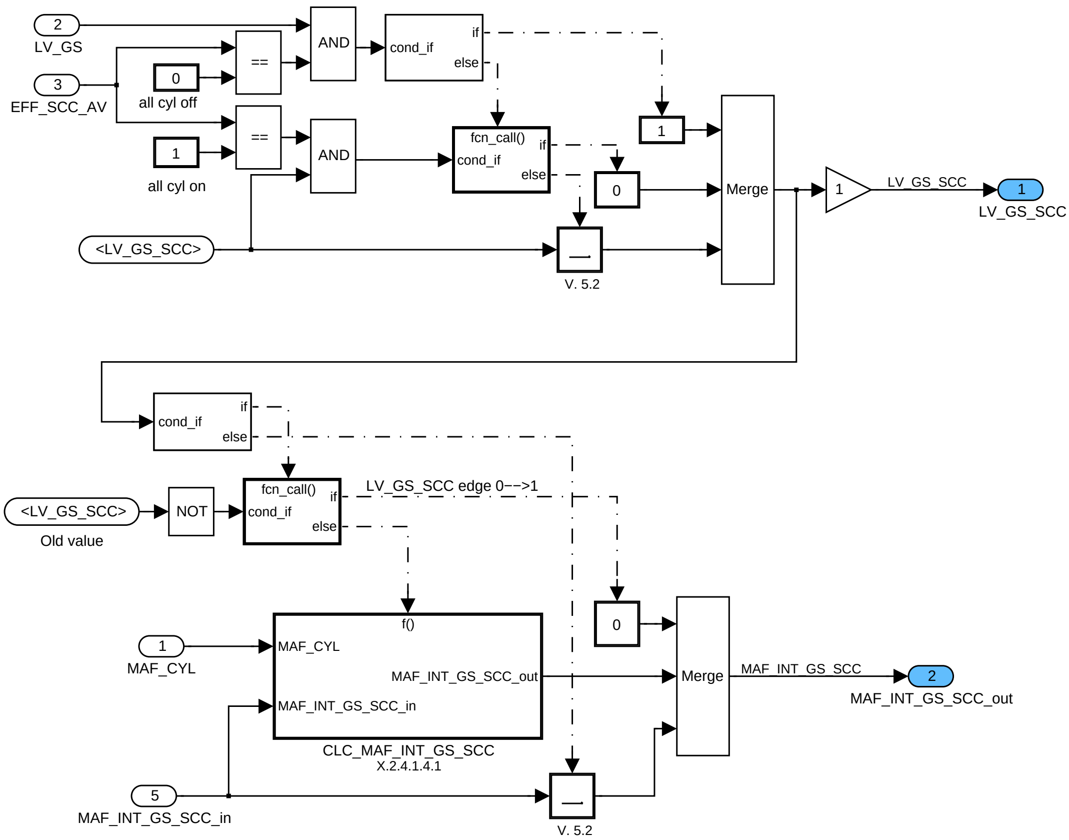

Figure 7.81.9: : Path: EGTR_DEFSPCENRI0/OPM_20MS/MAF_INT_GS

7.81.2.4.1 Calculation of MAF_INT_GS_SCC

remark: MAF_INT_GS_SCC have to be calculated internally on 32 bit

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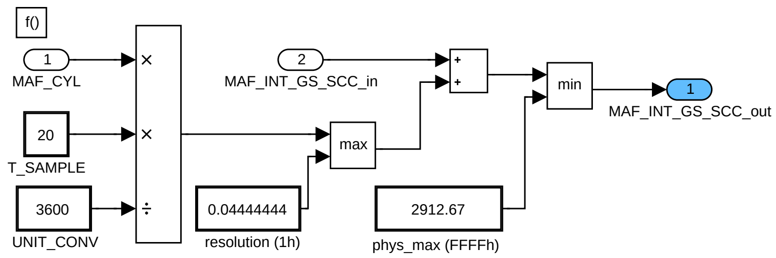

Figure 7.81.10: : Path: EGTR_DEFSPCENRI0/OPM_20MS/MAF_INT_GS/CLC_MAF_INT_GS_SCC

7.81.2.5 Introduction of multiple bank system

7.81.2.5.1 Calculation of Main catalyst purge

7.81.2.5.1.1 Detection of cancelation of main catalyst purge

The binary lambda signal of the single NOx sensor will be used to cancel the purging of both main catalysts.

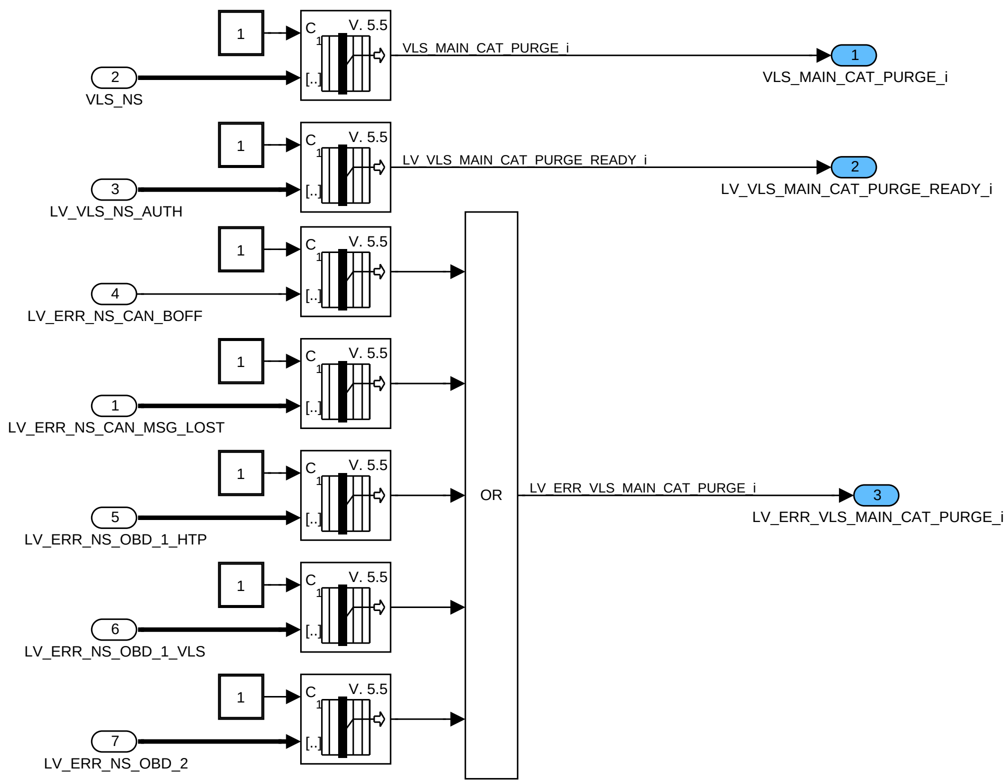

Figure 7.81.11: : Path: EGTR_DEFSPCENRI0/OPM_20MS/VLS_MAIN_CAT/CLC/CLC_MAIN_CAT_PURGE

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7.81.3 Formula section for segment task

7.81.3.1 Calculation of LV_PUC_CHG

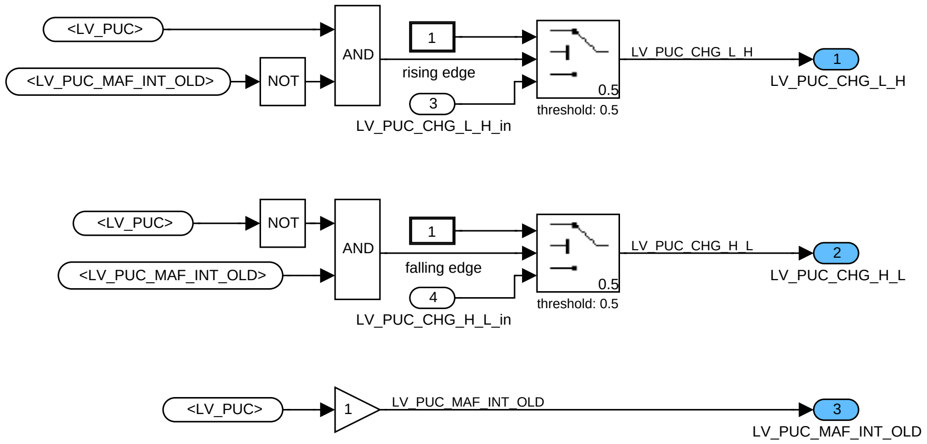

Figure 7.81.12: : Path: EGTR_DEFSPCENRI0/OPM_SEG/CLC_SEG

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7.82 Activation of forced lambda stimulation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAMB_PLS_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation state variable for the forced stimulation (only in case of NC_USE_EGTR = 0)					
LV_LAMB_PLS_ACT_CAT_PURGE [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
flag that indicates that the forced stimulation can be activated due to cat purge					
MAF_INT_LAMB_PLS_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0... 1456.33333333	0.0222222	g
air mass flow integral for forced lambda stimulation activation					

Input data:

LAMB_SP_DELTA_CAT_PURGE [NC_CBK_EX_NR] {p. 2939}	LAMB_SP_HOM [NC_CBK_EX_NR] {p. 8340}	LV_FAC_LAM_LIM_NOT_STAT_CDN [NC_CBK_EX_NR] {p. 2463}	LV_INH_LAMB_PLS [NC_CBK_EX_NR] {p. 2579}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_PUC {p. 1720}	LV_ST_END {p. 1720}
MAF_CYL {p. 8277}	NC_CBK_EX_NR {p. 1829}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_SP_DE_THD_LAMB_PLS_OFF	-	0... FFFH	0... 0.249939	61.0352e-6	-
upper threshold of cat purge deviation for de-activating the forced stimulation					
C_LAMB_SP_DE_THD_LAMB_PLS_ON	-	0... FFFH	0... 0.249939	61.0352e-6	-
lower threshold of cat purge deviation for activating the forced stimulation					
C_LAMB_SP_MAX_LAMB_PLS_ACT	-	0... 7FFFH	0... 1.99993896484	61.0352e-6	-
maximum lambda set point for forced lambda stimulation activation					
C_LAMB_SP_MIN_LAMB_PLS_ACT	-	0... 7FFFH	0... 1.99993896484	61.0352e-6	-
minimum lambda set point for forced lambda stimulation activation					
C_MAF_INT_MIN_LAMB_PLS_ACT	-	0... FFFFH	0... 1456.33333333	0.0222222	g
threshold for the air mass flow integral for the activation of the forced stimulation					
C_TEMP_CAT_MIN_LAMB_PLS_ACT	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
minimum value of the catalyst temperature for the activation of the forced stimulation					

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General Information

The recurrence time is defined by T_SAMPLE in [ms].
NC_CBK_EX_NR defines the number of exhaust banks.
For vector elements, the variable extension _i is used in the model instead of [i] as found in the textual description.

Application Conditions

Initialization: RST
Recurrence: 20MS
Activation: LV_ST_END==1
Deactivation: LV_ST_END==0

Function description

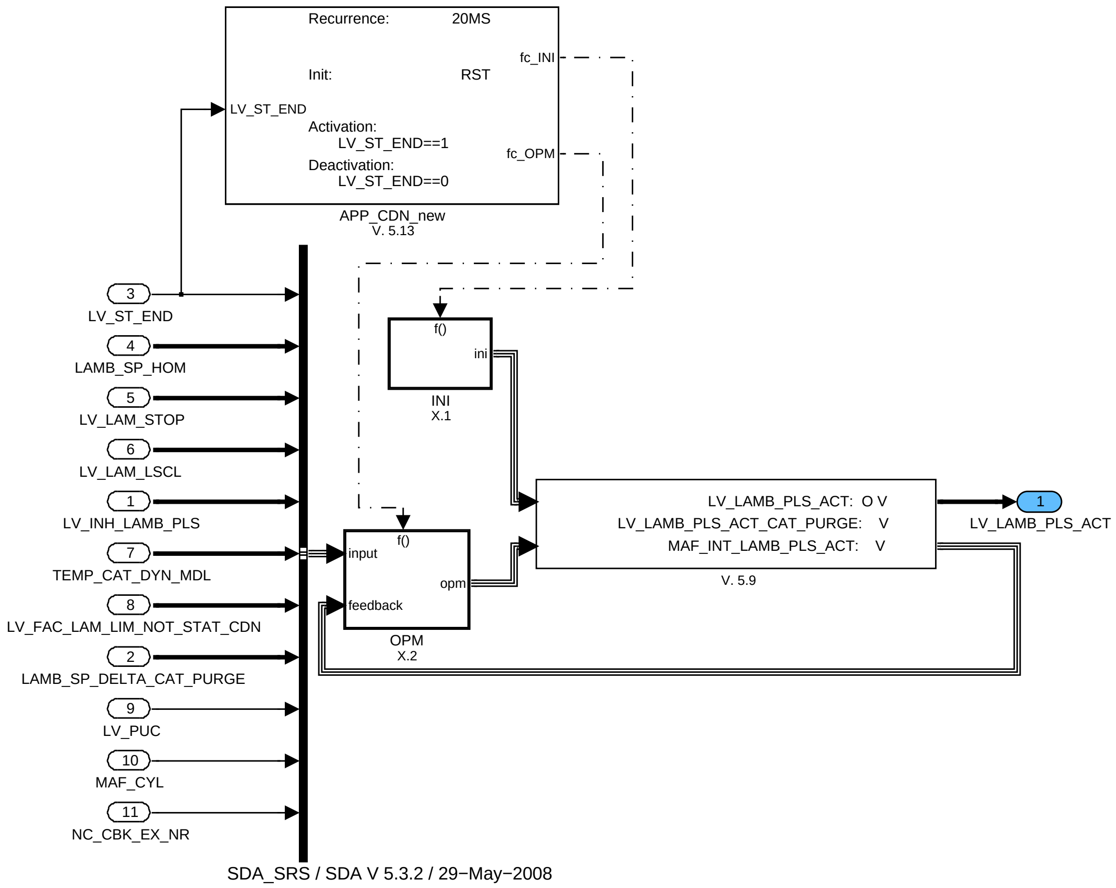

Figure 7.82.1: :

7.82.1 Initialisation

All variables are initialized with "0"

Function description

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7.82.2 Introduction multiple bank system

7.82.2.1 Bank specific calculations

7.82.2.1.1 Check lambda set point delta and request for heater diagnosis

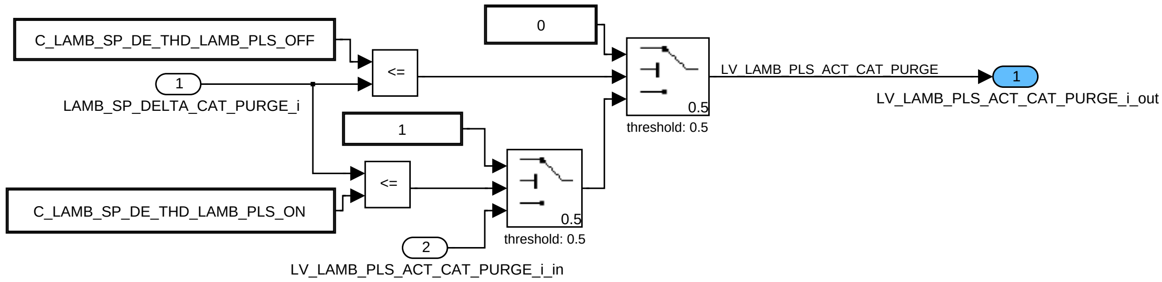

Figure 7.82.2: :

7.82.2.1.2 Check lambda and lambda controller conditions

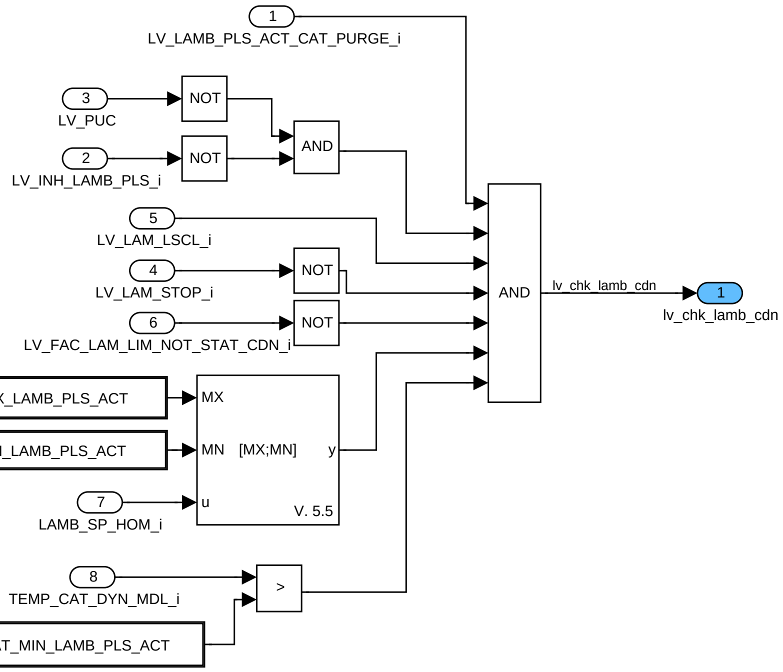

Figure 7.82.3: :

7.82.2.1.3 Calculation request for cat forced stimulation

For the activation the following conditions must be fulfilled:
- engine state pull fuel cut off is inactive
- no inhibition from application incidences
- lambda controller is activated and not in stop mode
- no lambda controller limitation under non stationary operating conditions

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- lambda set point deviation from catalyst purge is below calibration limit including hysteresis consideration (LV_LAMB_PLS_ACT_CAT_PURGE[i]); this flag is evaluated each time when the activation conditions are checked
- the lambda set point is in a valid range
- the catalyst temperature value exceeds a calibration threshold

If these conditions above are all fulfilled a mass air flow integral is calculated. The forced stimulation will be finally activated when the integral exceeds a calibration limit.

For the calculation of the air mass flow integral the unit conversion:

[g] = [kg/h] * [ms] * [(g*h) /(kg*ms)] /3600

has to be considered.

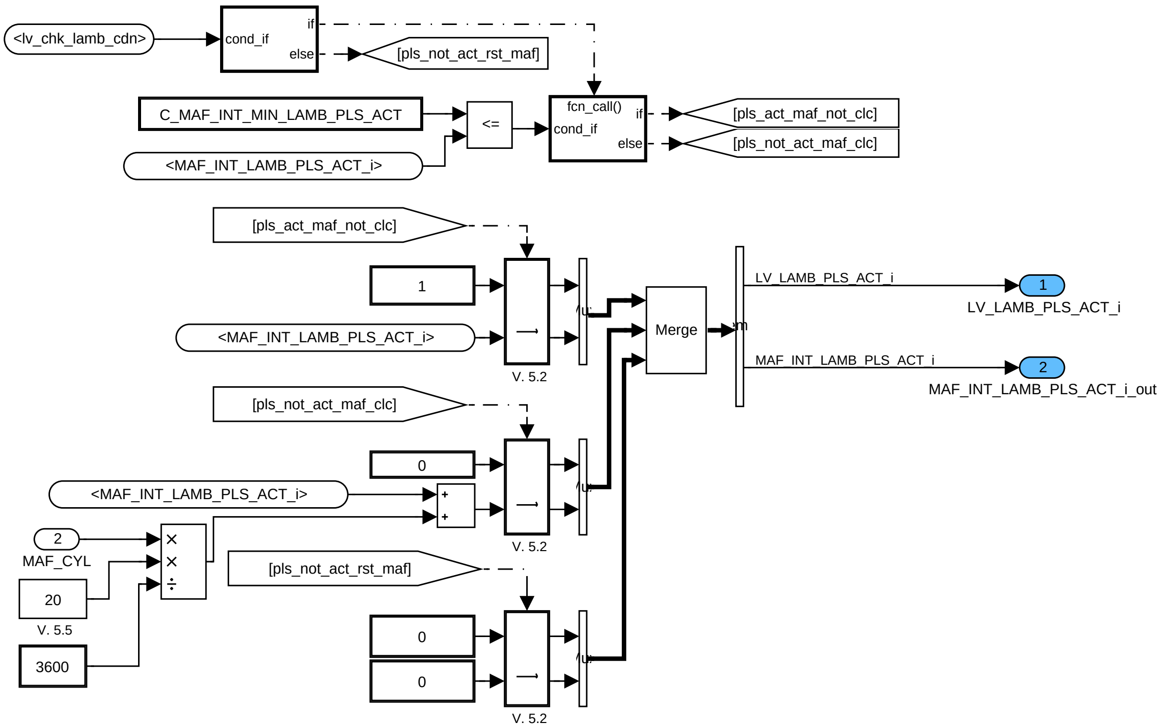

Figure 7.82.4: :

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7.83 Determination of forced lambda stimulation parameters

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_STEP_PLS_NOM_CAT_DIAG	O/V	0... 7H	0 ...7	1	-
step counter to switch between nominal and cat diagnosis forced stimulation					
LAMB_DELTA_MAX_PLS	O/V	0... FFFH	0... 0.249939	61.0352e-6	-
lambda set point deviation step height per sample step					
LAMB_SP_DE_PLS	O/V	0... 7FFH	0... 0.12493896484	61.0352e-6	-
Amplitude of the forced lambda stimulation					
LV_STATE_LAMB_PLS_CBK_EQU	-	0... 1H	0 ...1	1	-
auxiliary flag indicating that STATE_LAMB_PLS[i] is equal at both banks					
O2L_SP_PLS	O/V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
oxygen loading set point for forced lambda stimulation					
STATE_LAMB_PLS_DET_VALUE	O/V	0H 1H 2H 3H 4H 5H 6H	PLS_OFF PLS_LSH_DIAG PLS_CAT_DIAG PLS_CAT_DIAG_TRAN PLS_EXT PLS_IS PLS_NOM	-	-
State variable of forced lambda stimulation parameter determination					

Input data:

EFF_CAT_DIAG [NC_CBK_EX_NR] {p. 5535}	LAMB_DELTA_MAX_PLS_EXT {p. 2579}	LAMB_PLS_O2L_OSC [NC_CBK_EX_NR] {p. 2563}	LAMB_SP_DE_PLS_EXT {p. 2579}
LC_O2L_PLS_CBK_SYN {p. 2563}	LV_IS {p. 1720}	LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_LAMB_PLS_REQ_CAT_DIAG [NC_CBK_EX_NR] {p. 5473}
LV_LAMB_PLS_REQ_EXT {p. 2579}	LV_LAMB_PLS_SYN_CBK {p. 2563}	LV_ST_END {p. 1720}	MAF_HB {p. 805}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	O2L_SP_PLS_EXT {p. 2579}	STATE_LAMB_PLS [NC_CBK_EX_NR] {p. 2563}
T_AST {p. 1766}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	TNT_MDL_H {p. 8237}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_DELTA_MAX_IS_PLS	-	0... FFFH	0... 0.249939	61.0352e-6	-
lambda set point deviation step height per sample step for forced stimulation in case of idle speed					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_SP_DE_IS_PLS	-	0... 7FFH	0... 0.12493896484	61.0352e-6	-
amplitude of forced stimulation in case of idle speed					
C_NR_STEP_PLS_NOM_CAT_DIAG	-	0... 7H	0 ...7	1	-
Number of lean - rich steps to switch between nominal and cat diagnosis forced stimulation					
C_O2L_SP_IS_PLS	-	0... FFFFH	0... 2.61684895833	39.9306e-6	g
oxygen loading set point for forced lambda stimulation in case of idle speed					
IP_FAC_1_LAMB_SP_DE_PLS	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_EFF_CAT_DIAG_IP_FAC_1_PLS	4	0... FFH	0... 1.9921875	7.8125e-3	-
first factor for forced stimulation amplitude (depending on maximal value of EFF_CAT_DIAG[i])					
IP_FAC_2_LAMB_SP_DE_PLS	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_T_AST_IP_FAC_2_PLS	4	0... FFFFH	0... 6553.5	0.1	s
LDP_TEMP_CAT_IP_FAC_2_PLS	4	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
second factor for forced stimulation amplitude(depending on time after start and cat temperature)					
IP_FAC_O2L_SP_PLS_TNT_MDL_H	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDPM_TNT_MDL_H	8	0... FFFFH	0... 1023.984375	0.015625	°C
oxygen loading set point for forced lambda stimulation dependent on NOX trap temperature					
IP_LAMB_DELTA_MAX_CAT_DIAG_PLS	V	0... FFFFH	0... 0.249939	61.0352e-6	-
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
lambda set point deviation step height per sample step for forced stimulation in case of active catalyst diagnosis					
IP_LAMB_DELTA_MAX_NOM_PLS	V	0... FFFFH	0... 0.249939	61.0352e-6	-
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
lambda set point deviation step height per sample step for nominal forced stimulation					
IP_LAMB_SP_DE_CAT_DIAG_PLS	V	0... 7FFH	0... 0.12493896484	61.0352e-6	-
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
amplitude of forced stimulation in case of active catalyst diagnosis					
IP_LAMB_SP_DE_NOM_PLS	V	0... 7FFH	0... 0.12493896484	61.0352e-6	-
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
amplitude of nominal forced stimulation					
IP_O2L_SP_CAT_DIAG_PLS	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
oxygen loading set point for forced lambda stimulation in case of active catalyst diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_O2L_SP_NOM_PLS	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
oxygen loading set point for nominal forced lambda stimulation					

General Information

NC_CBK_EX_NR defines the number of exhaust banks.
For vector elements, the variable extension _i is used in the model instead of [i] as found in the textual description.

Application Conditions

Initialization: RST
Recurrence: 20MS
Activation: LV_ST_END ==1
Deactivation: LV_ST_END ==0

Function description

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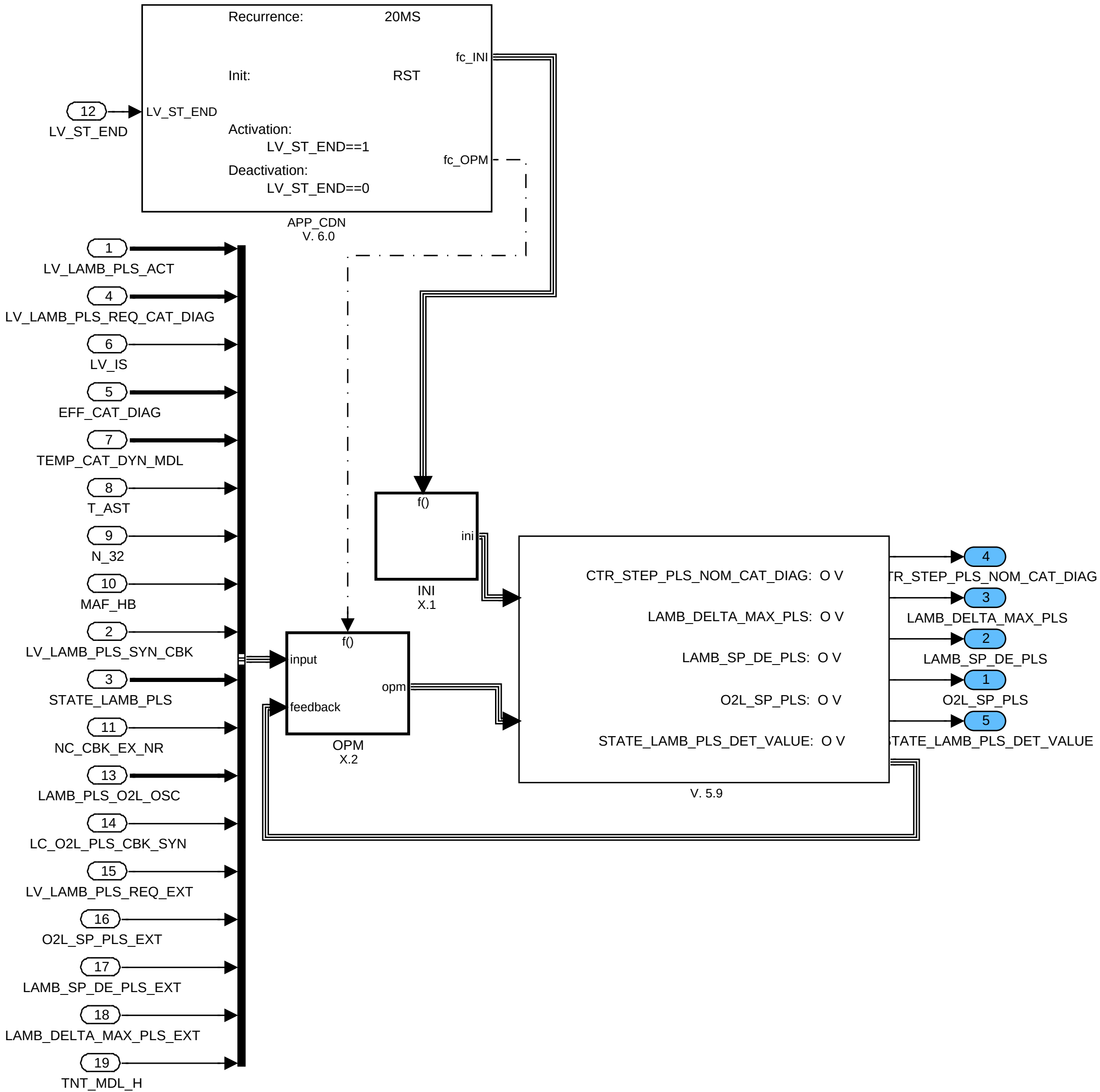

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Figure 7.83.1: :

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7.83.1 Initialisation

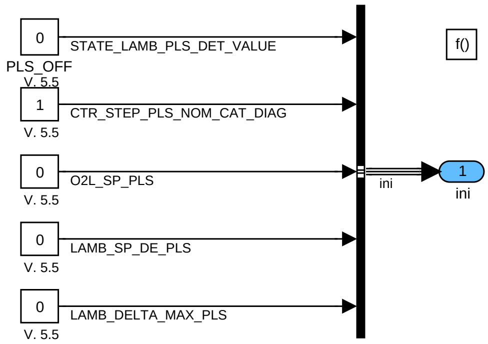

Figure 7.83.2: :

7.83.2 Formula section

7.83.2.1 Calculations

The forced lambda stimulation distinguishes between 5 different parameters which are listed hereafter with its priority:
a) Priority 1: forced stimulation parameters for catalyst effiency diagnosis
b) Priority 2: forced stimulation parameters for catalyst effiency diagnosis ramp up
c) Priority 3: forced stimulation parameters for requested external mode
d) Priority 4: forced stimulation parameters for idle speed
e) Priority 5: forced stimulation parameters for normal operation

7.83.2.1.1 Check STATE_LAMB_PLS[i] is equal for both banks

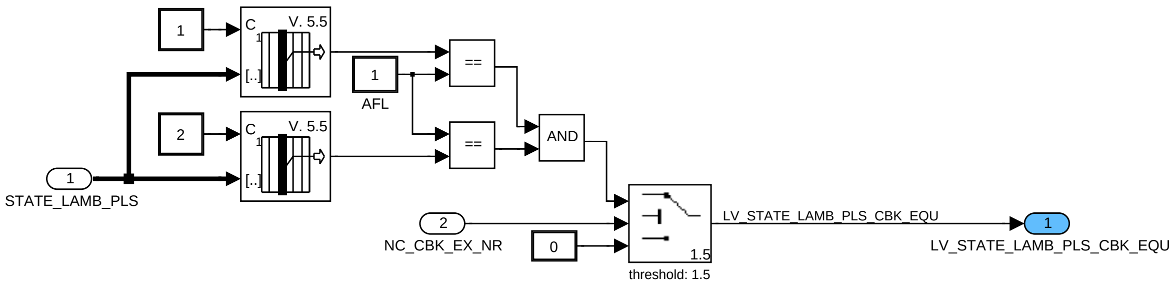

Figure 7.83.3: :

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7.83.2.1.2 Calculation of state contents

7.83.2.1.2.1 Parameters for catalyst efficiency diagnosis

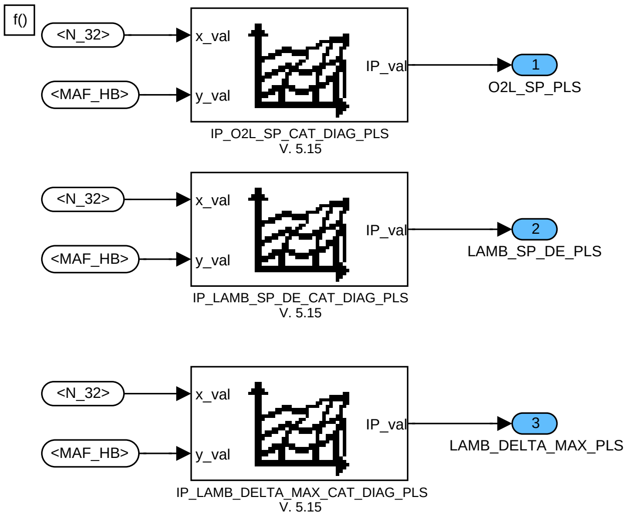

Figure 7.83.4: :

7.83.2.1.2.2 Parameters for transition phase to catalyst efficiency diagnosis

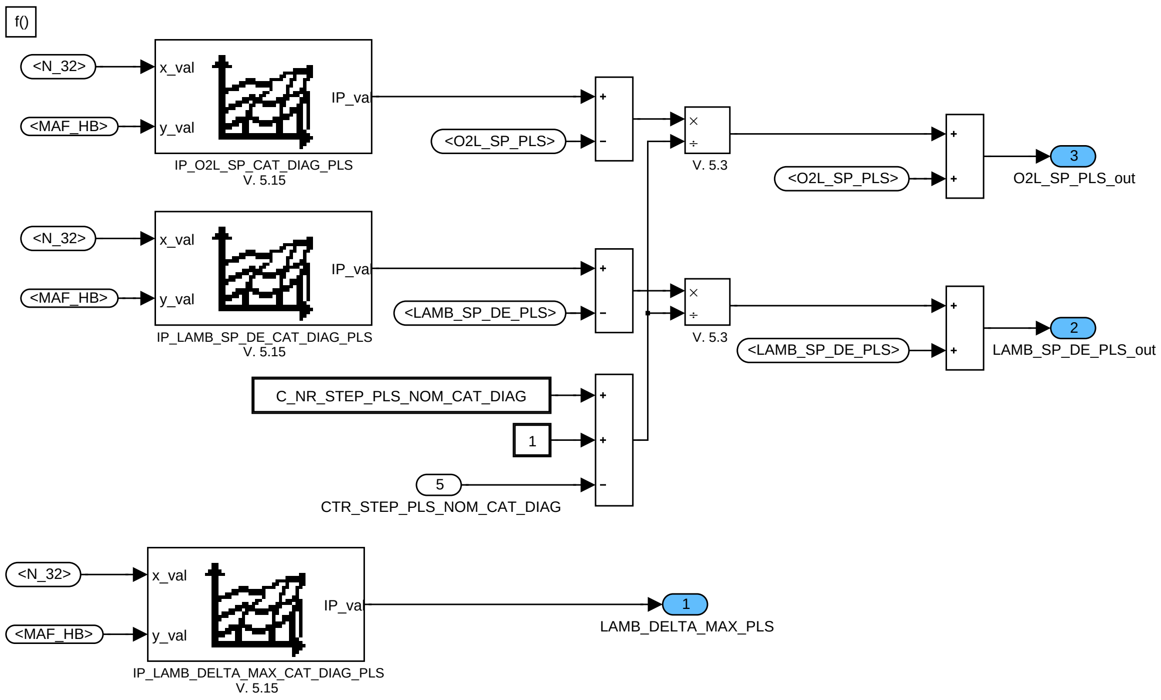

Figure 7.83.5: :

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7.83.2.1.2.3 Parameters for requested external mode

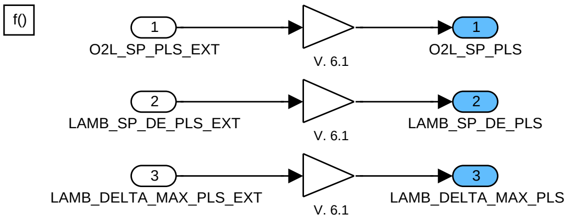

Figure 7.83.6: :

7.83.2.1.2.4 Parameters for IDLE speed

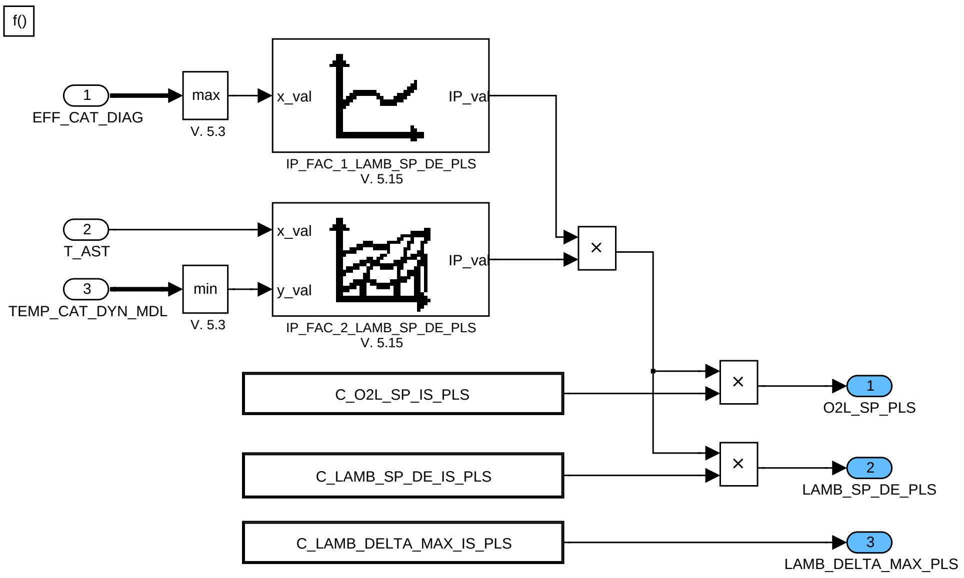

Figure 7.83.7: :

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7.83.2.1.2.5 Parameters for nominal stimulation

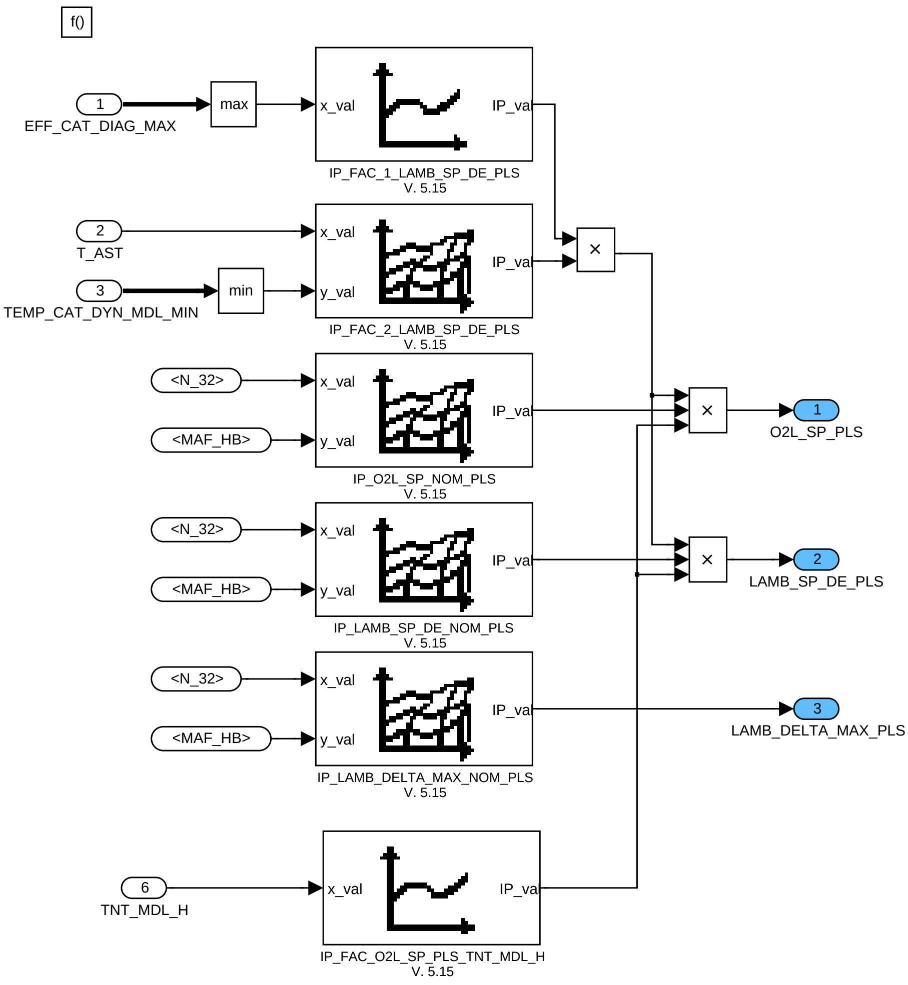

Figure 7.83.8: :

7.83.2.1.2.6 No parameters

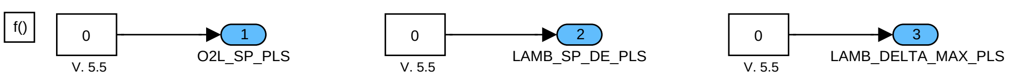

Figure 7.83.9: :

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7.83.2.1.3 Calculation bank crosses variables (CMN variables)

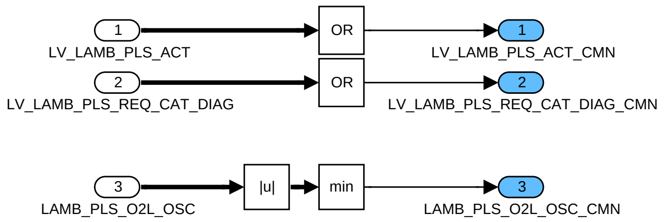

Figure 7.83.10: :

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7.83.2.1.4 SET__STATE_LAMB_PLS_DET_VALUE

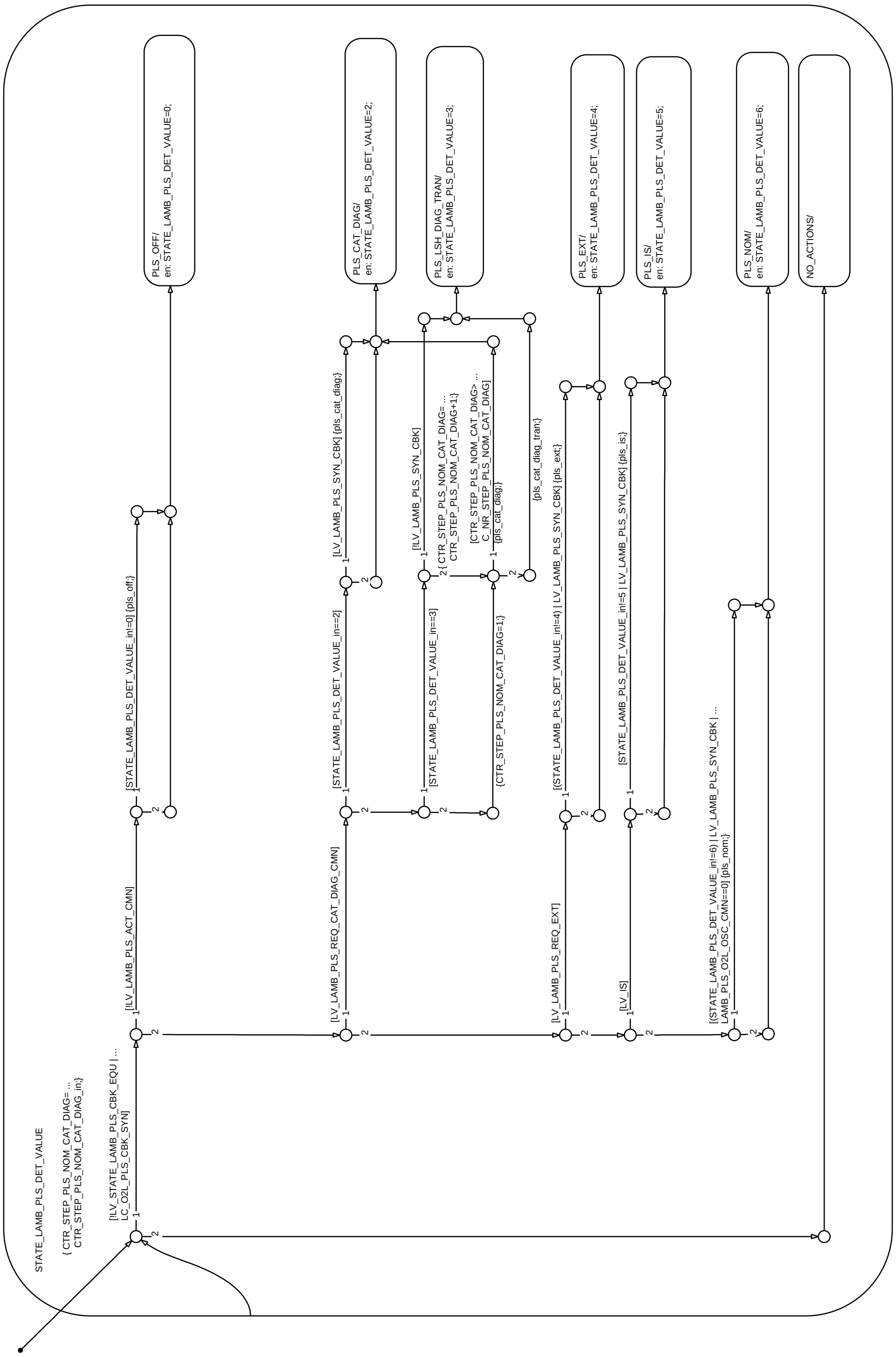

Figure 7.83.11: :

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7.84 NOx engine out emission homogeneous mode

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_NOX_PRED_CLC_INH	O/V	0... 1H	0 ...1	1	-
Inhibition of calculation of predicted NOx emissions					
MAP_DIF_NOX_HOMS	V	8000... 7FFFH	-2717.041... 2716.95854124	0.0829175	hPa
Pressure difference to basis ambient pressure of the model (homogeneous-stratified combustion mode)					
NOX_COR_HOMS	O/V	0... FFFFH	0... 1023.984375	0.015625	mg/s
Corrected engine out NOx emission in homogeneous-stratified combustion mode					
NOX_COR_HOMS_PRED	O/V	0... FFFFH	0... 1023.984375	0.015625	mg/s
Predicted engine out NOx emission for homogeneous-stratified combustion mode					
NOX_COR_HOMS_PRED_TMP	V	0... FFFFH	0... 2047.96875	0.03125	mg/s
Predicted engine out NOx emission if homogeneous-stratified combustion mode would be active (intermediate)					
NOX_COR_HOMS_TMP	V	0... FFFFH	0... 2047.96875	0.03125	mg/s
Corrected engine out NOx emission in homogeneous-stratified combustion mode (intermediate)					
RATIO_EGR_DIF_NOX_HOMS	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Exhaust gas recirculation ratio difference to basis calibration (homogeneous-stratified combustion mode)					
TCO_DIF_NOX_HOMS	V	80... 7FH	-96... 95.25	0.75	°C
Cooling water temperature difference to basis cooling temperature of the model (homogeneous-stratified combustion mode)					

Input data:

EGR_RATIO {p. 8277}	FAC_MAF_MAX {p. 1212}	GEAR {p. 1302}	LV_AT {p. 654}
LV_CLU_SWI {p. 996}	LV_GS {p. 1565}	LV_NOX_COR_NS_AD {p. 2976}	LV_ST_END {p. 1720}
LV_VAR_TCT {p. 656}	MAP_MES {p. 1198}	MFF_SP_HOMS {p. 8243}	MFF_SP_HOMS_PRED {p. 8243}
N_32 {p. 1525}	PQ_EGR {p. 1212}	PQ_EGR_SP {p. 8278}	TCO {p. 1100}
TIA_IM {p. 984}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_BAS_NOX_HOMS	-	0... FFFFH	0... 5434	0.0829175	hPa
Basis ambient pressure for NOx engine out emission model (homogeneous-stratified combustion mode)					
C_CRLC_HOMS_PRED_FALL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for predicted value of falling NOx emissions at HOMS					
C_CRLC_HOMS_PRED_RISE	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for predicted value of rising NOx emissions at HOMS					
C_TCO_BAS_NOX_HOMS	-	0... FEH	-48... 142.5	0.75	°C
Basis cooling water temperature for NOx engine out emission model (homogeneous-stratified combustion mode)					
IP_FAC_MAF_MAX_NOX_HOMS	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_FAC_MAF_MAX_IP_FAC_HOMS	4	0... FFFFH	0... 1.99996	30.5e-6	-
Engine out NOx emission correction due to the throttle factor (homogeneous-stratified combustion mode)					
IP_NOX_EGR_RATIO_BAS_HOMS	V	0... FFFFH	-50... 49.99847	1.5259e-3	%
LDPM_MFF_SP_1_NOXM	2	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_1_NOXM	2	0... FFH	0... 8160	32	rpm
EGR reference value at NOx emission basis calibration (homogeneous-stratified combustion mode)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_NOX_EGR_RATIO_DIF_HOMS	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_PQ_EGR_1_NOXM	2	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_RATIO_EGR_DIF_IP_NOX_HOMS	8	0... FFFFH	-50... 49.99847	1.5259e-3	%
Engine out NOx emission correction due to EGR deviation (homogeneous-stratified combustion mode)					
IP_NOX_HOMS	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDPM_MFF_SP_1_NOXM	2	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_1_NOXM	2	0... FFH	0... 8160	32	rpm
NOx engine out base emission in homogeneous-stratified combustion mode					
IP_NOX_HOMS_NS_AD	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDP_MFF_SP_IP_NOX_HOMS_NS_AD	2	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_32_IP_NOX_HOMS_NS_AD	2	0... FFH	0... 8160	32	rpm
NOx engine out base emission in homogeneous operation for NOx signal gain adaptation					
IP_NOX_MAP_DIF_HOMS	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_PQ_EGR_1_NOXM	2	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_MAP_DIF_NOX_1_NOXM	2	0... FFFFH	-2717.041... 2716.95854	0.0829175	hPa
Engine out NOx emission correction due to ambient pressure deviation (homogeneous-stratified combustion mode)					
IP_NOX_TCO_HOMS	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_MAP_DIF_NOX_1_NOXM	2	0... FFFFH	-2717.041... 2716.95854	0.0829175	hPa
LDPM_TCO_DIF_NOX_1_NOXM	2	0... FFH	-96... 95.25	0.75	°C
Engine out NOx emission correction due to cooling water temperature (homogeneous-stratified combustion mode)					
IP_NOX_TCO_HOMS_PRED	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_TCO_DIF_NOX_1_NOXM	2	0... FFH	-96... 95.25	0.75	°C
Prediction of engine out NOx emission correction due to cooling water temperature (homogeneous-stratified combustion mode)					
IP_NOX_TIA_HOMS	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_N_32_IP_NOX_TIA_HOMS	8	0... FFH	0... 8160	32	rpm
LDP_TIA_IM_IP_NOX_TIA_HOMS	4	0... FEH	-48... 142.5	0.75	°C
Engine out NOx emission correction due to intake air temperature (homogeneous-stratified combustion mode)					
LC_GS_PRED_ENA	-	0... 1H	0 ...1	1	-
Selection if NOx emission prediction calculation will be disabled during LV_GS=1					
LC_MFF_HOMS_PRED_ENA	-	0... 1H	0 ...1	1	-
Selection for predicted emissions (0: MFF_SP_HOMS, 1: MFF_SP_HOMS_PRED)					
LC_MT_PRED_ENA	-	0... 1H	0 ...1	1	-
Selection if NOx emission prediction calculation will be disabled during manual gear shift					

General Information

This module calculates the NOx engine out emission mass flow at homogeneous-stratified mode. This module guesses also a predicted value, if the homogeneous-stratified mode would become active at the actual conditions.
The calculations consist of an basis calibration, depending on fuel mass, motor speed and ambient temperature. This value will be corrected by several factors, which depend from the deviation of state variables compared to the basis calibration.

Application Conditions

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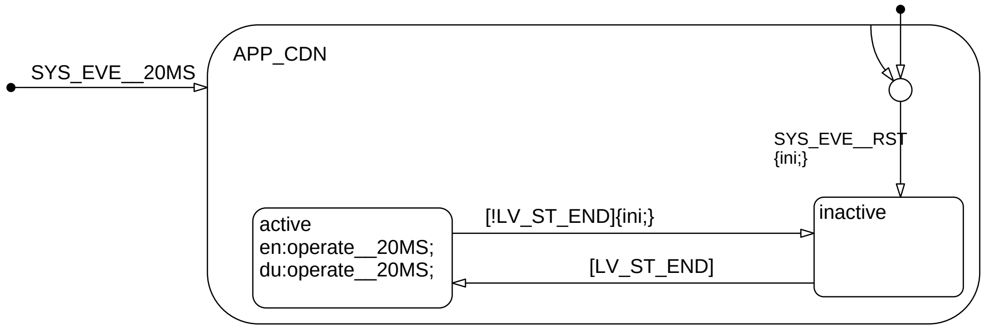

Figure 7.84.1: : Path: NOXM_MODUL7038/APP_CDN/Chart

Function description

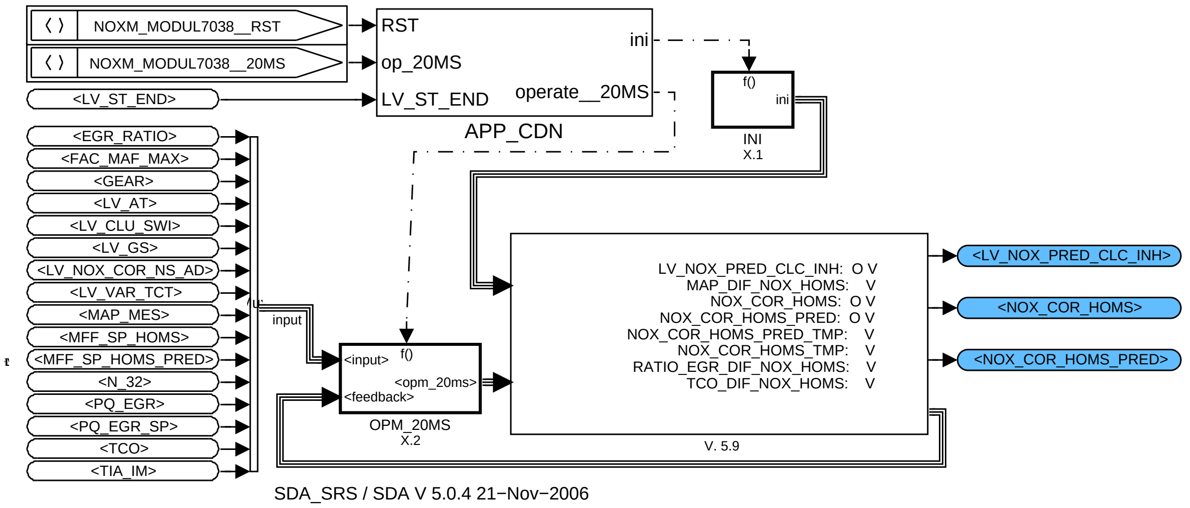

Figure 7.84.2: : Path: NOXM_MODUL7038

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7.84.1 Initialization at reset and deactivation

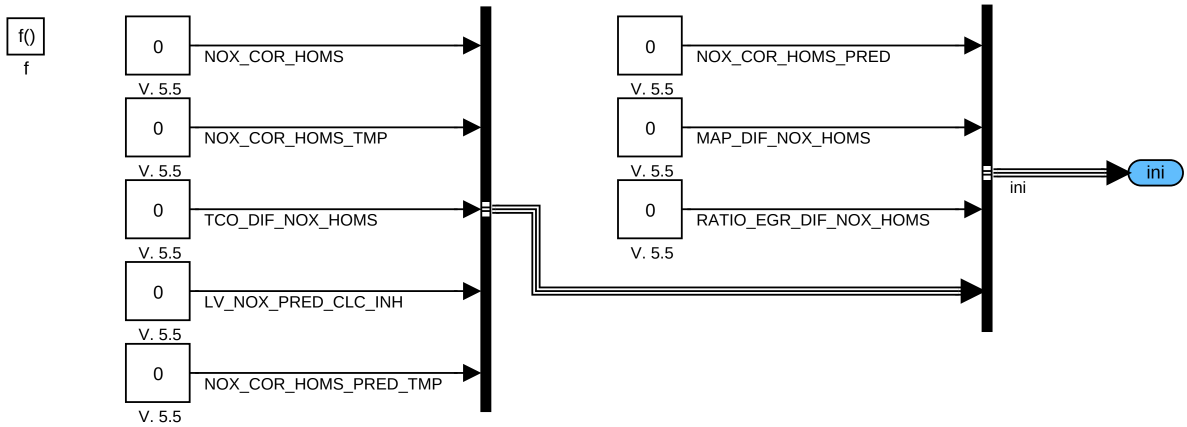

Figure 7.84.3: : Path: NOXM_MODUL7038/INI

7.84.2 Calculation at 20 ms

7.84.2.1 Deviation of air pressure

Figure 7.84.4: : Path: NOXM_MODUL7038/OPM_20MS/CLC1

7.84.2.2 Deviation of cooling water temperature

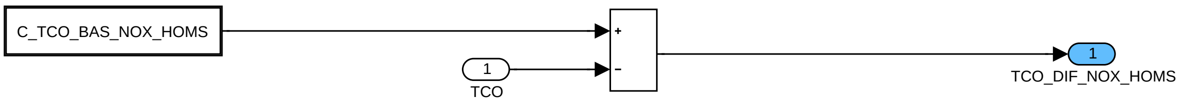

Figure 7.84.5: : Path: NOXM_MODUL7038/OPM_20MS/CLC2

7.84.2.3 Deviation of exhaust gas recirculation

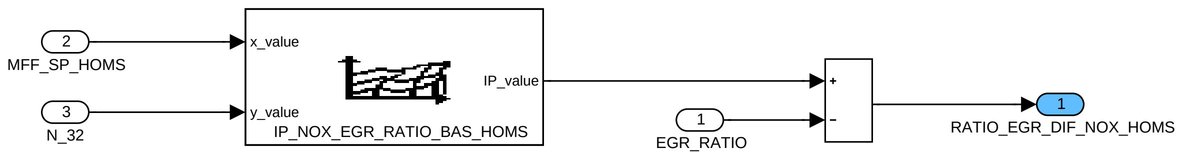

Figure 7.84.6: : Path: NOXM_MODUL7038/OPM_20MS/CLC3

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7.84.2.4 Basis calibration of NOx engine out emissions

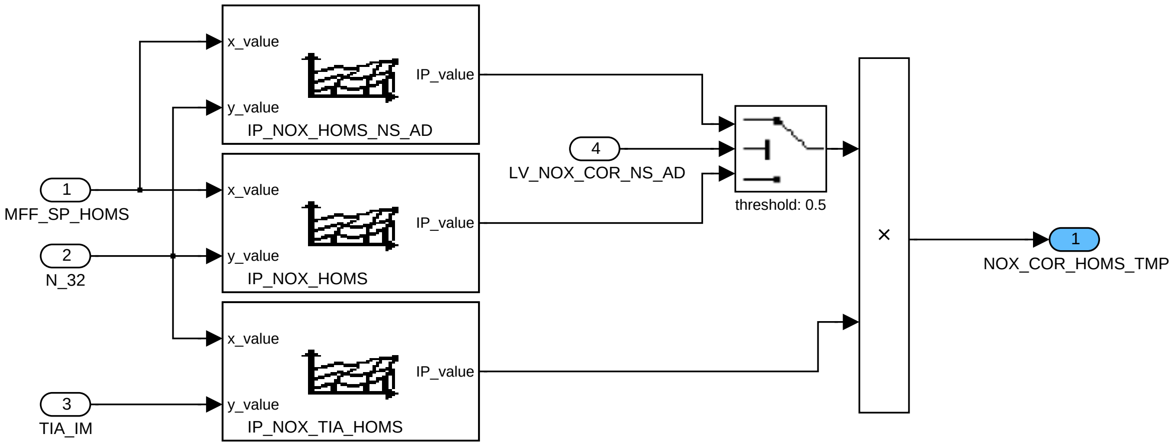

Figure 7.84.7: : Path: NOXM_MODUL7038/OPM_20MS/CLC4

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7.84.2.5 Corrected engine out NOx emissions

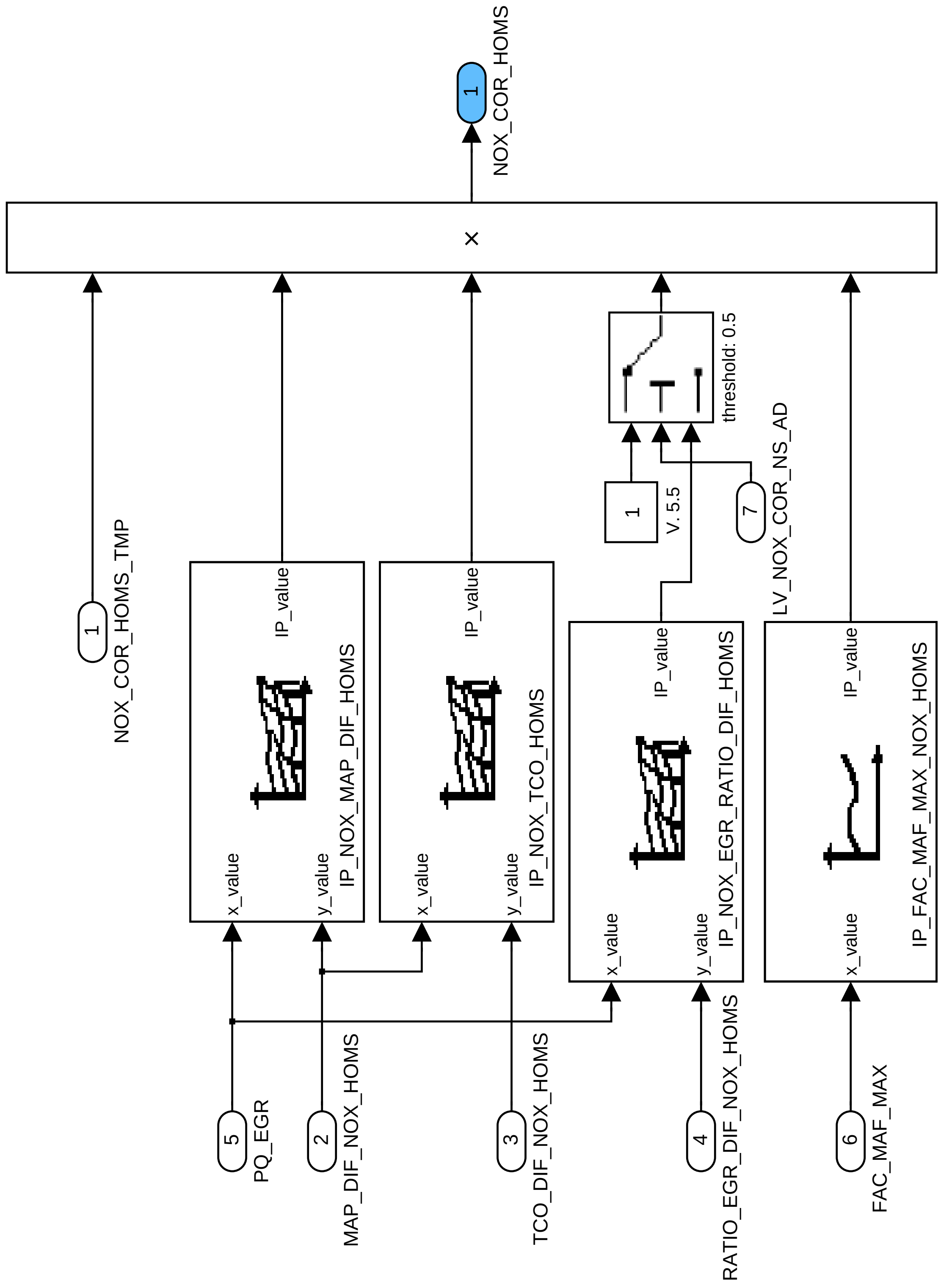

Figure 7.84.8: :   Path: NOXM_MODUL7038/OPM_20MS/CLC5

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7.84.2.6 Condition to stop calculation of predicted NOx emissions

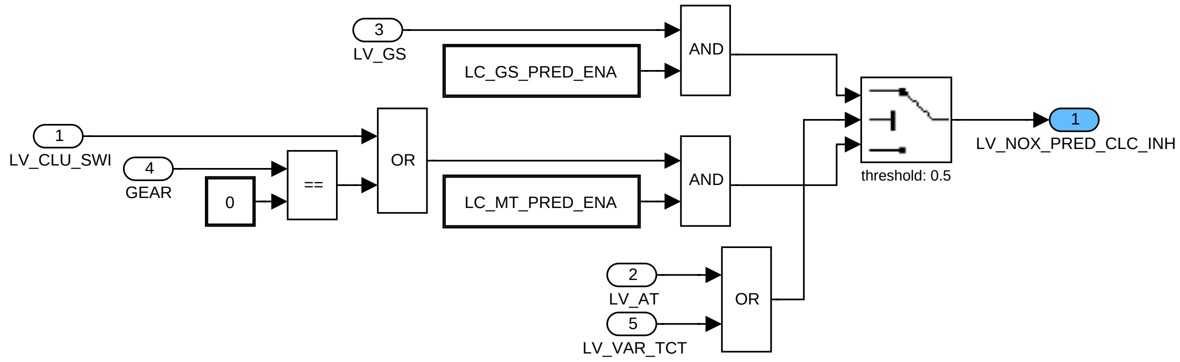

Figure 7.84.9: : Path: NOXM_MODUL7038/OPM_20MS/CLC7

7.84.2.7 Basis for predicted NOx emissions

The calibration maps are the same as for actual emissions. They deliver the predicted emissions, because the predicted fuel mass MFF_SP_HOMS_PRED may be used here.

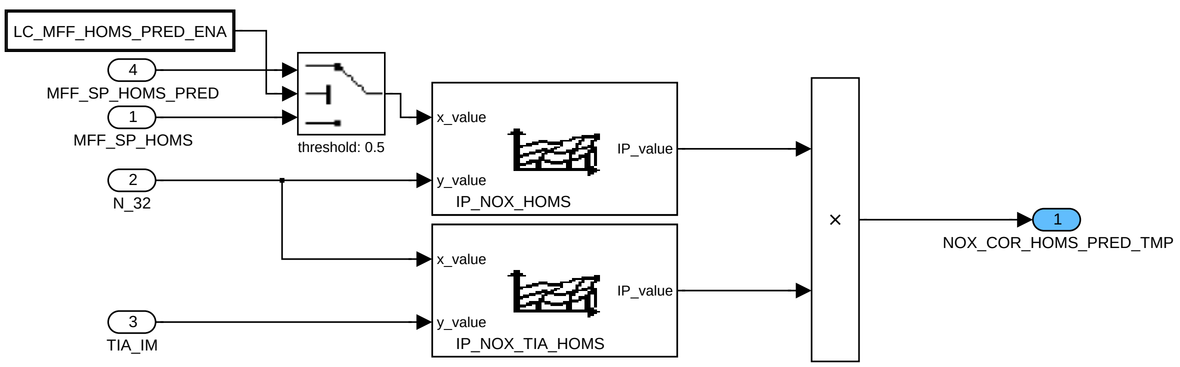

Figure 7.84.10: : Path: NOXM_MODUL7038/OPM_20MS/CLC8

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7.84.2.8 Predicted engine out NOx emissions

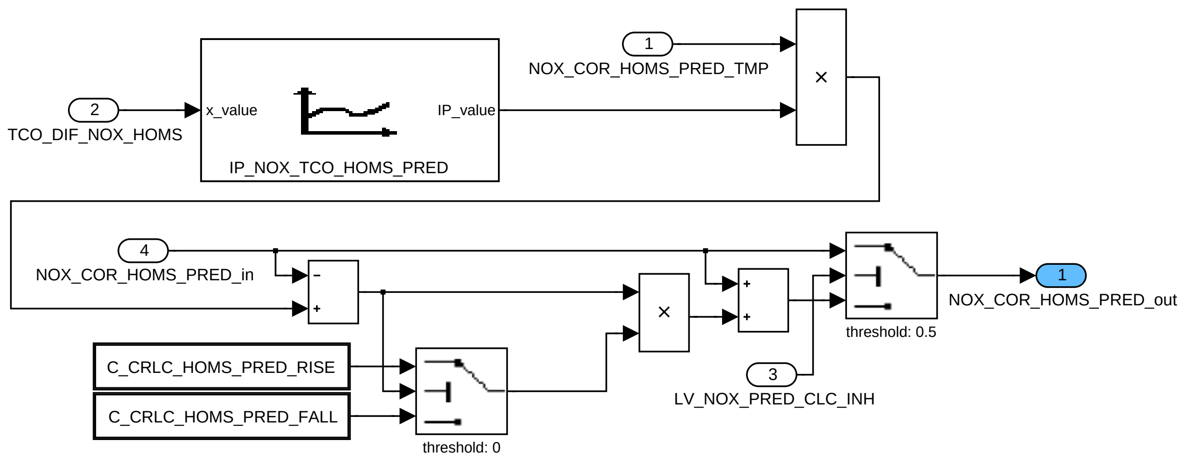

Figure 7.84.11: : Path: NOXM_MODUL7038/OPM_20MS/CLC9

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7.85 NOx engine out emission stratified mode

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_NOX_COR_NS_AD	O/V	0... 1H	0 ...1	1	-
NOx emission calculation for NOx signal gain adaptation					
MAP_DIF_NOX_S	V	8000... 7FFFH	-2717.041... 2716.95854124	0.0829175	hPa
Pressure difference to basis ambient pressure of the model					
NOX_COR_S	O/V	0... FFFFH	0... 1023.984375	0.015625	mg/s
Corrected engine out NOx emission in stratified operation mode					
NOX_COR_S_PRED	O/V	0... FFFFH	0... 1023.984375	0.015625	mg/s
Predicted engine out NOx emission for stratified operation mode					
NOX_COR_S_PRED_TMP	V	0... FFFFH	0... 2047.96875	0.03125	mg/s
Predicted engine out NOx emission for stratified operation mode (intermediate)					
NOX_COR_S_TMP	V	0... FFFFH	0... 2047.96875	0.03125	mg/s
Corrected engine out NOx emission in stratified operation mode (intermediate)					
RATIO_EGR_DIF_NOX_S	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Exhaust gas recirculation ratio difference to basis calibration					
TCO_DIF_NOX_S	V	80... 7FH	-96... 95.25	0.75	°C
Cooling water temperature difference to basis cooling temperature of the model					

Input data:

EGR_RATIO {p. 8277}	FAC_MAF_MAX {p. 1212}	LV_NOX_PRED_CLC_INH {p. 2968}	LV_ST_END {p. 1720}
MAP_MES {p. 1198}	MFF_SP_S {p. 8243}	MFF_SP_S_PRED {p. 8243}	N_32 {p. 1525}
NC_NOX_SENS_CONF {p. 643}	OPM_REQ_CUS {p. 8137}	PQ_EGR {p. 1212}	PQ_EGR_SP {p. 8278}
TCO {p. 1100}	TIA_IM {p. 984}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_BAS_NOX_S	-	0... FFFFH	0... 5434	0.0829175	hPa
Basis ambient pressure for NOx engine out emission model					
C_CRLC_S_PRED_FALL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for predicted value of falling NOx emissions at S					
C_CRLC_S_PRED_RISE	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for predicted value of rising NOx emissions at S					
C_STATE_OPM_NOX_S_NS_AD	-	0... FFFFH	0... 65535	1	-
State of combustion mode for switch to correction factor valid at NOx signal gain adaptation					
C_TCO_BAS_NOX_S	-	0... FEH	-48... 142.5	0.75	°C
Basis cooling water temperature for NOx engine out emission model					
IP_FAC_MAF_MAX_NOX_S	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_FAC_MAF_MAX_IP_FAC_S	4	0... FFFFH	0... 1.99996	30.5e-6	-
Engine out NOx emission correction due to the throttle factor					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_NOX_EGR_RATIO_BAS_S	V	0... FFFFH	-50... 49.99847	1.5259e-3	%
LDPM_MFF_SP_2_NOXM	2	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_3_NOXM	2	0... FFH	0... 8160	32	rpm
EGR reference value at NOx emission basis calibration					
IP_NOX_EGR_RATIO_DIF_S	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_PQ_EGR_2_NOXM	2	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_RATIO_EGR_DIF_IP_NOX_S	8	0... FFFFH	-50... 49.99847	1.5259e-3	%
Engine out NOx emission correction due to EGR deviation					
IP_NOX_MAP_DIF_S	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_PQ_EGR_2_NOXM	2	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_MAP_DIF_NOX_2_NOXM	2	0... FFFFH	-2717.041... 2716.95854	0.0829175	hPa
Engine out NOx emission correction due to ambient pressure deviation					
IP_NOX_S	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDPM_MFF_SP_2_NOXM	2	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_3_NOXM	2	0... FFH	0... 8160	32	rpm
NOx engine out base emission in stratified operation					
IP_NOX_S_NS_AD	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDP_MFF_SP_IP_NOX_S_NS_AD	2	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_32_IP_NOX_S_NS_AD	2	0... FFH	0... 8160	32	rpm
NOx engine out base emission in stratified operation for NOx signal gain adaptation					
IP_NOX_TCO_S	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_MAP_DIF_NOX_2_NOXM	2	0... FFFFH	-2717.041... 2716.95854	0.0829175	hPa
LDPM_TCO_DIF_NOX_2_NOXM	2	0... FFH	-96... 95.25	0.75	°C
Engine out NOx emission correction due to cooling water temperature					
IP_NOX_TCO_S_PRED	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_TCO_DIF_NOX_2_NOXM	2	0... FFH	-96... 95.25	0.75	°C
Prediction of engine out NOx emission correction due to cooling water temperature					
IP_NOX_TIA_S	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_N_32_IP_NOX_TIA_S	8	0... FFH	0... 8160	32	rpm
LDP_TIA_IM_IP_NOX_TIA_S	4	0... FEH	-48... 142.5	0.75	°C
Engine out NOx emission correction due to intake air temperature					
LC_MFF_S_PRED_ENA	-	0... 1H	0 ...1	1	-
Selection for predicted emissions (0: MFF_SP_S, 1: MFF_SP_S_PRED)					

General Information

This module calculates the NOx engine out emission mass flow at stratified mode. This module guesses also a predicted value, if the stratified mode would become active at the actual conditions.
The calculations consist of an basis calibration, depending on fuel mass, motor speed and ambient temperature. This value will be corrected by several factors, which depend from the deviation of state variables compared to the basis calibration.

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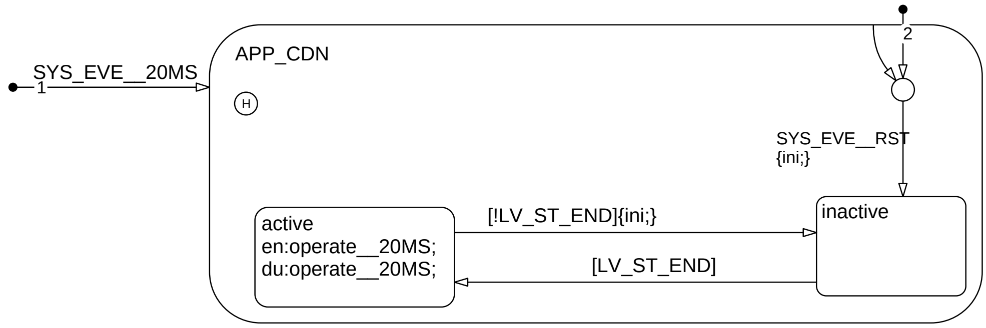

Figure 7.85.1: :

Function description

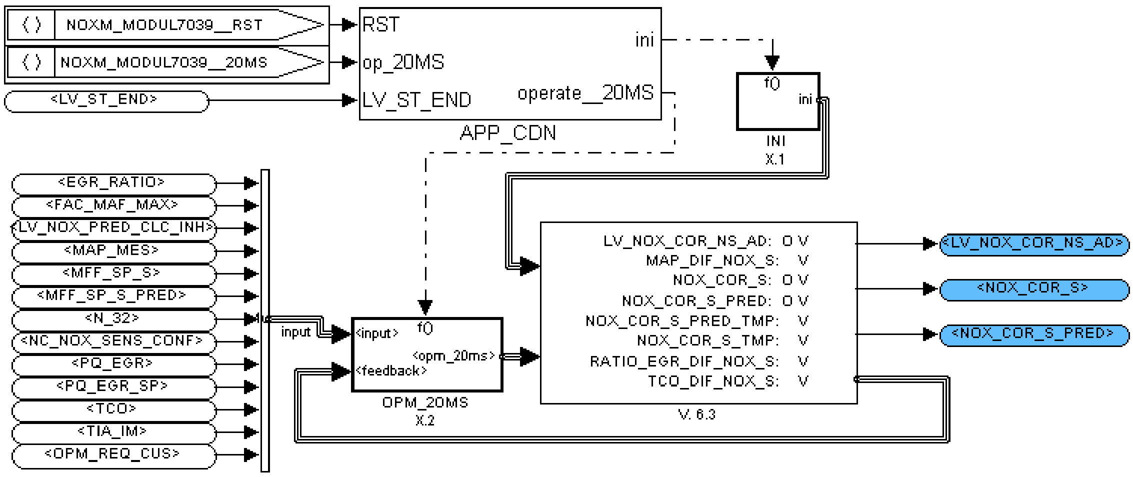

Figure 7.85.2: :

7.85.1 Initialization at reset and deactivation

7.85.2 Calculation at 20 ms

7.85.2.1 Deviation of air pressure

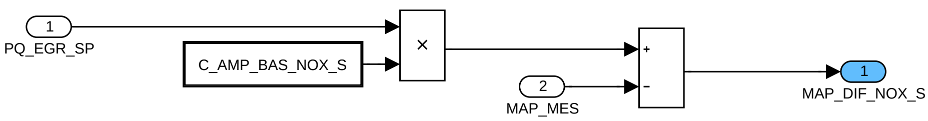

Figure 7.85.3: :

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7.85.2.2 Deviation of cooling water temperature

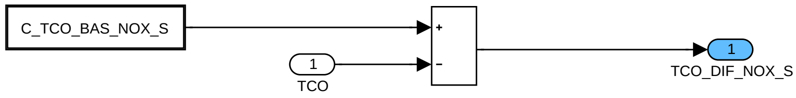

Figure 7.85.4: :

7.85.2.3 Deviation of exhaust gas recirculation

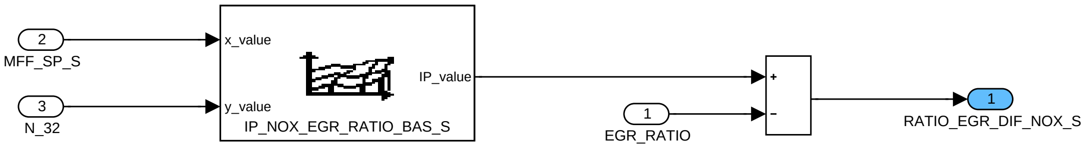

Figure 7.85.5: :

7.85.2.4 Detection of NOx signal gain adaptation

If the NOx signal gain adaptation for any NOx sensor is in required combustion mode, then a special basis calibration matrix is used.

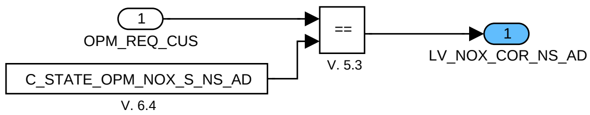

Figure 7.85.6: :

7.85.2.5 Basis calibration of NOx engine out emissions

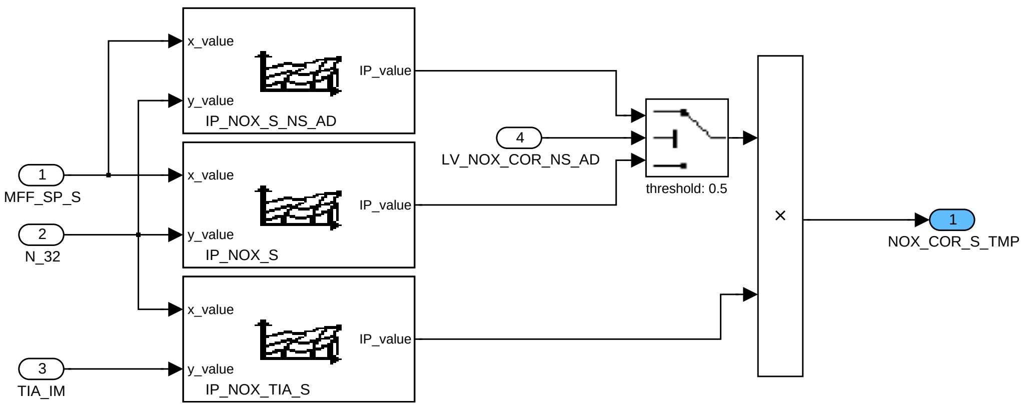

Figure 7.85.7: :

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7.85.2.6 Corrected engine out NOx emissions

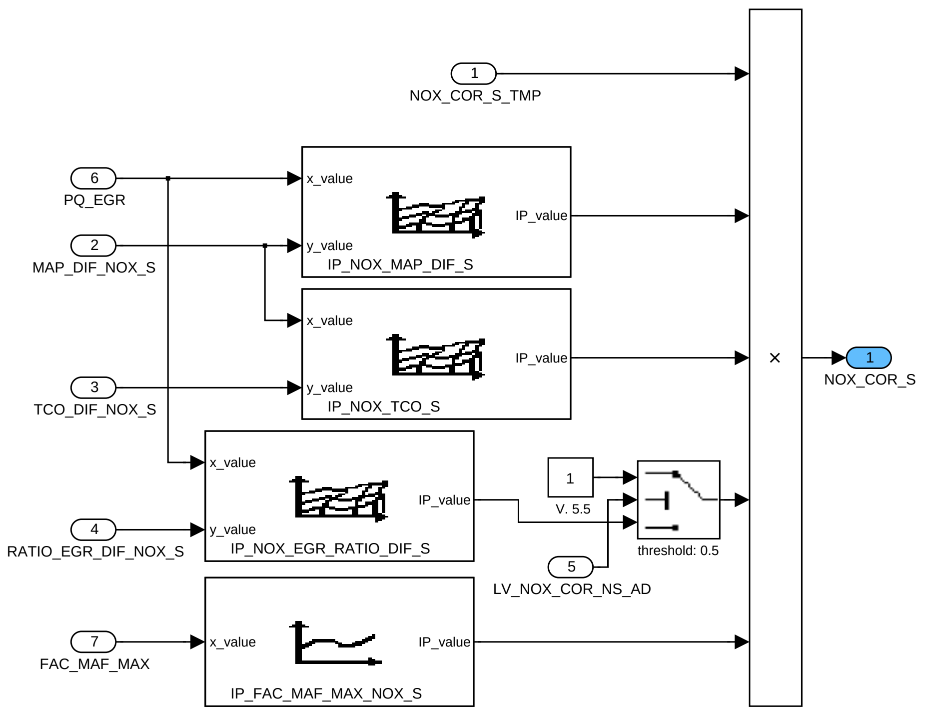

Figure 7.85.8: :

7.85.2.7 Basis for predicted NOx emissions

The calibration maps are the same as for actual emissions. They deliver the predicted emissions, because the predicted fuel mass MFF_SP_S_PRED may be used here.

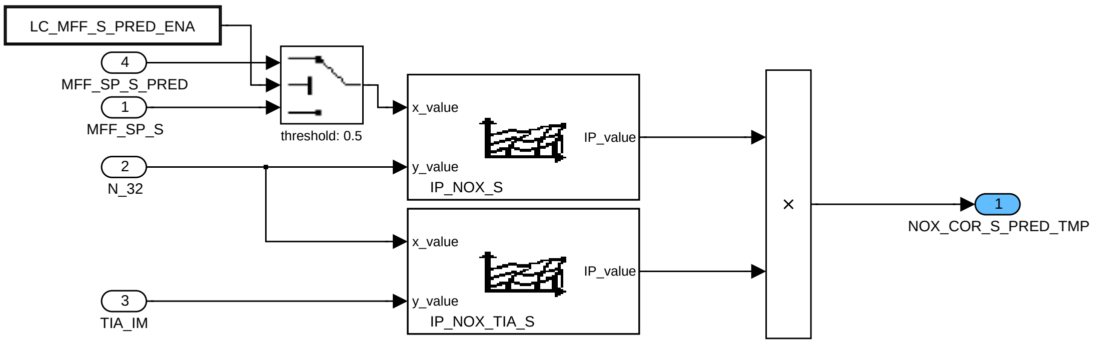

Figure 7.85.9: :

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7.85.2.8 Predicted engine out NOx emissions

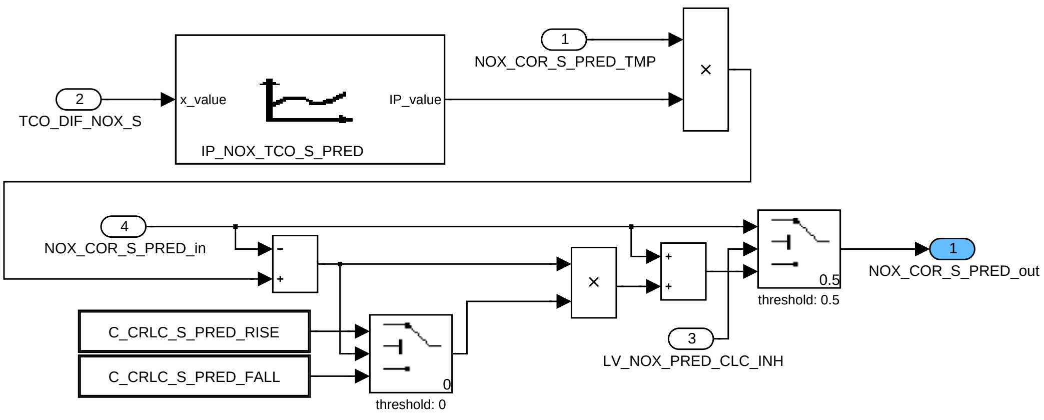

Figure 7.85.10: :

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7.86 NOx catalyst management

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_AFL_PURGE [NC_NT_NR]	V	0... FFH	0... 255	1	-
Activation counter for catalyst purge after lean operation					
DIST_AFL	V	0... FFFFH	0... 6553.5	0.1	km
Mileage during current lean operation phase (STATE_NOX = LOAD)					
DIST_AFL_ST	V	0... FFFFFFFFH	0... 429496729500	100	m
Mileage counter value at start of lean operation phase (STATE_NOX = LOAD)					
FAC_RGN_DEC_SHAR	V	0... 80H	0 ...1	0.0078125	-
Share factor for the reducing agent for the decrementation of NTL and O2L					
FLOW_NT_MMV	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
filtered exhaust gas flow through NOx trap					
LV_ACT_INT_PUC_AFL [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
Request for catalyst purge activation when leaving lean burn condition					
LV_AFL_NOT	O/V	0... 1H	0 ...1	1	-
Logical value: lambda1 or richer operation is requested or active					
LV_CAT_PURGE_REQ_POST_AFL [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
request for cat purge from NOx management					
LV_MDL_AFR	O/V	0... 1H	0 ...1	1	-
Model rich exhaust gas (stop of regeneration)					
LV_NOX_SENS	O/V	0... 1H	0 ...1	1	-
Logical Variable for the existence of a NOx-Sensor					
LV_NOX_SENS_NOX_VLD_RGN_ST [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
flag: NOx sensor NOx signal validity at the moment the NOx sensor rgn request is set					
LV_NOX_SENS_RGN	O/V	0... 1H	0 ...1	1	-
Regeneration request only due to NOx sensor (loading model blocked)					
LV_NT_ACT	O/V	0... 1H	0 ...1	1	-
Flag for NOx catalyst function activation					
LV_NT_AFS_REQ	O/V	0... 1H	0 ...1	1	-
Request of lambda = 1 operation mode					
LV_NT_AFS_REQ_PRED	V	0... 1H	0 ...1	1	-
Prediction result for request of homogeneous stoichiometric operation					
LV_NT_HOM_INI	O/V	0... 1H	0 ...1	1	-
flag: NOx trap initialised due to sufficient hom. stoic. operation (accumulation effects eliminated)					
LV_NT_RGN_2_NOT_VLD	V	0... 1H	0 ...1	1	-
Regeneration of second bank not successful					
LV_NT_RGN_2_NOT_VLD_SET	V	0... 1H	0 ...1	1	-
Set condition for Regeneration of second bank not successful					
LV_NT_RGN_STOP_PUC	O/V	0... 1H	0 ...1	1	-
Indicator, that a NOx regeneration was broken by engine state PUC					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_NTL_DEC_INT_AFR	V	0... 1H	0 ...1	1	-
Rich detection by NTL_DEC_INT ratio at the end of the regeneration of the second bank					
LV_NTL_DEC_INT_STOP_RGN	V	0... 1H	0 ...1	1	-
Ratio of NTL_DEC_INT reached to cancel the regeneration of the second bank					
LV_RGN_AGI [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
Flag used for communication with aging function					
LV_RGN_AGI_VLD [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
Flag used for communication with aging function					
LV_RGN_CDN	O/V	0... 1H	0 ...1	1	-
Flag for testing whether or not regeneration conditions are given					
LV_RGN_NT_REQ	O/V	0... 1H	0 ...1	1	-
Logical Variable for NOx trap regeneration phase request					
LV_RGN_REQ_NOX_SENS	O/V	0... 1H	0 ...1	1	-
Regeneration request caused by the NOx-Sensor signal					
LV_RGN_REQ_NOX_SENS_TMP [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
Bench-selective regeneration request caused by the NOx-Sensor signal					
LV_RGN_REQ_NTLD	O/V	0... 1H	0 ...1	1	-
Logical value for regeneration phase request because of the NOx trap loading degree					
LV_RGN_REQ_NTLD_AFS	O/V	0... 1H	0 ...1	1	-
Logical value for regeneration phase request before switching to stoichiometric operation or rich operation					
LV_RGN_STOP_MDL	O/V	0... 1H	0 ...1	1	-
Flag indicating: Stop of Rgn out of model enabled					
LV_RGN_STOP_SENS	O/V	0... 1H	0 ...1	1	-
Flag indicating: Stop of Rgn by sensor enabled					
LV_RGN_STOP_TOUT	O/V	0... 1H	0 ...1	1	-
Flag indicating: Stop of Rgn by time counter enabled					
LV_SENS_AFR [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
downstream sensor measures rich exhaust gas (stop of regeneration)					
LV_SENS_AFR_TRIM	O/V	0... 1H	0 ...1	1	-
downstream sensor sees rich exhaust gas (homogeneous detection threshold)					
LV_SENS_AFR_TRIM_TMP [NC_NT_NR]	O/V	0... 1H	0 ...1	1	-
downstream sensor measures rich exhaust gas (homogeneous detection threshold) (bench-selective value)					
LV_SENS_RGN_1_READY	O/V	0... 1H	0 ...1	1	-
End of first regeneration					
LV_T_AFL_MIN	O/V	0... 1H	0 ...1	1	-
flag: minimum lean time for setting a request elapsed					
LV_TOUT_AFR	O/V	0... 1H	0 ...1	1	-
rich exhaust gas after timeout (stop of regeneration)					
LV_TRIG_AFR_AFL	O/V	0... 1H	0 ...1	1	-
Logical value for triggering a transition of rich to lean operation					
LV_VLS_GRD_NEG	O/V	0... 1H	0 ...1	1	-
Negative gradient of VLS_NOX_SENS_1 between first and second regeneration					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VLS_GRD_NEG_SET_VLS	-	0... 1H	0 ...1	1	-
Flag for indicate of reaching of negative gradient for set of LV_SENS_AFR_2 with VLS signal					
MAF_INT_STOP	O/V	0... FFFFH	0 ...1	0.0222222	g
Air mass integral since start of STATE_NOX = STOP is active					
MAF_INT_STOP_NTL	O/V	0... FFFFH	0... 5825.33333	0.0888889	g
Air mass integral since start of actual STATE_NOX = STOP phase					
NOX_CONC	O/V	0... FFFFH	0... 65535	1	ppm
NOx concentration engine out (after raw emission adaptation correction)					
NOX_CONC_MMV	V	0... FFFFH	0... 65535	1	ppm
filtered NOx engine out concentration					
NOX_CONC_OUT_MDL	O/V	0... FFFFH	0... 65535	1	ppm
corrected NOx concentration after catalyst					
NOX_CONC_OUT_MDL_MMV	V	0... FFFFH	0... 65535	1	ppm
Filtered corrected NOx concentration after catalyst					
NOX_CONC_RAW	O/V	0... FFFFH	0... 65535	1	ppm
NOx concentration engine out					
NOX_CONC_RED	O/V	0... FFFFH	0... 65535	1	ppm
corrected NOx concentration in catalyst (incl. SSR)					
NOX_CONC_RED_MMV	O/V	0... FFFFH	0... 65535	1	ppm
filtered corrected NOx concentration in catalyst (incl. SSR)					
NOX_CONC_RED_MMV_RGN_ST	O/V	0... FFFFH	0... 65535	1	ppm
filtered corrected NOx concentration in catalyst (incl. SSR) at NOx regeneration start					
NOX_COR	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
raw engine out NOx emission					
NOX_COR_INT	V	0... FFFFH	0... 10485.6	0.16	mg
Integral of modelled NOx raw emissions (pre NOx catalyst) at current lean operation phase					
NOX_COR_RED	O/V	0... FFFFH	0... 1023.98437	0.015625	mg/s
corrected engine out NOx emission (incl. SSR)					
NOX_COR_RED_MMV	O/V	0... FFFFH	0... 1023.98437	0.015625	mg/s
Moving mean value of corrected engine out NOx emission (incl. SSR)					
NOX_FLOW	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
NOx emission flow which is stored in the catalyst					
NOX_HOMS_PRED_HYS	V	0... FFFFH	-1024... 1023.96875	0.03125	mg/s
NOx hysteresis for reset of Lambda = 1.0 operation request - homogeneous lean prediction					
NOX_HOMS_PRED_THD	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
NOx threshold for set of Lambda = 1.0 operation request - homogeneous lean prediction					
NOX_NS_AD_RGN_ST [NC_NT_NR]	O/V	0... 05DCH	0... 1500	1	ppm
downstream NOx concentration, measured by NOx sensor at start of regeneration					
NOX_NS_AD_TMP [NC_NOX_SENS_CONF]	V	0... 05DCH	0... 1500	1	ppm
temporary internal NOx sensor NOx value for regeneration request calculation					
NOX_OUT_INT_TMP [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 10485.6	0.16	mg
temporary internal NOx out integral value for NOx sensor regeneration request calculation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NOX_OUT_MDL	O/V	0... FFFFH	0... 1023.98437	0.015625	mg/s
modelled downstream NOx emission					
NOX_OUT_MDL_INT	O/V	0... FFFFH	0... 10485.6	0.16	mg
Integral of modelled downstream NOx emission for one lean /rich cycle					
NOX_S_PRED_HYS	V	0... FFFFH	-1024... 1023.96875	0.03125	mg/s
NOx hysteresis for reset of Lambda = 1.0 operation request - stratified prediction					
NOX_S_PRED_THD	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
NOx threshold for set of Lambda = 1.0 operation request - stratified prediction					
NOX_SENS_MAX	O/V	0... 05DCH	0... 1500	1	ppm
NOx sensor signal threshold for requesting a regeneration					
NOX_SENS_MAX_BAS	V	0... 05DCH	0... 1500	1	ppm
Not corrected NOx sensor signal threshold for requesting a regeneration					
NT_AGI_AV	O/V	0... FFH	0... 0.99609	3.9063e-3	-
actual aging factor (ratio of actual storage capacity vs. base storage capacity)					
NT_EFF	O/V	0... 8000H	0 ...1	30.5e-6	-
NOx trap efficiency					
NT_EFF_BAS	V	0... FFFFH	0... 0.99998	15.3e-6	-
Basis NOx trap efficiency					
NT_EFF_COR	V	0... FFH	0... 3.98437	0.015625	-
NOx trap efficiency correction factor					
NT_EFF_COR_RGN_ST	O/V	0... FFH	0... 3.98437	0.015625	-
NOx trap efficiency correction factor at regeneration start					
NT_O2_STC	O/V	0... FFFFH	0... 10485.6	0.16	mg
NOx trap oxygen storage capacity					
NT_O2_STC_BAS	O/V	0... FFFFH	0... 10485.6	0.16	mg
NOx trap base oxygen storage capacity					
NT_STC_BAS_RNG_H	O/V	0... FFFFH	0... 20971.2	0.32	mg
NOx trap base storage capacity					
NT_STC_RNG_H	V	0... FFFFH	0... 20971.2	0.32	mg
NOx trap storage capacity					
NTL	O/V/S	0... FFFFH	0... 10485.6	0.16	mg
NOx catalyst absolute loading					
NTL_DEC [NC_NT_NR]	V	0... FFFFFFFFH	0... 10485.6	2.4414e-6	mg
Decrement of NOx trap absolute NOx loading during regeneration (lack of oxygen)					
NTL_DEC_INT [NC_NT_NR]	O/V	0... FFFFH	0... 10485.6	0.16	mg
Integral of the lack of oxygen during regeneration phase					
NTL_DEC_INT_SWI [NC_NT_NR]	O/V	0... FFFFH	0... 10485.6	0.16	mg
NTL_DEC_INT until the downstream sensor switches to reach exhaust gas					
NTL_H	O/V	0... FFFFH	0... 20971.2	0.32	mg
NOx catalyst absolute loading, expanded/higher value range					
NTL_MIN	O/V	0... FFFFH	0... 10485.6	0.16	mg
Minimum NOx trap loading					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NTL_RGN_ST	O/V	0... FFFFH	0... 10485.6	0.16	mg
NOx trap absolute loading (O2+NOx) when regeneration starts					
NTL_RGN_ST_NOX	O/V	0... FFFFH	0... 10485.6	0.16	mg
NOx trap absolute loading (only NOx) when regeneration starts					
NTLD	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap loading degree					
NTLD_MAX	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
loading degree threshold for starting a regeneration					
NTLD_MAX_AFS	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
maximum NOx trap loading degree for requesting a regeneration before lambda1 operation					
NTLD_MAX_AFS_BAS	V	0... FFFFH	0... 0.99998	15.3e-6	-
Basis maximum NOx trap loading degree for requesting a regeneration before lambda=1.0 operation					
NTLD_MAX_VS	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
loading degree threshold for starting a regeneration depending on vehicle speed					
NTLD_MDL	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap loading degree out of model					
NTLD_RGN_ST	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap loading degree at starting regeneration					
O2_FLOW	V	0... FFFFH	0... 16383.75	0.25	mg/s
Corrected engine out O2 flow					
O2L	O/V	0... FFFFH	0... 10485.6	0.16	mg
O2 absolute loading of the NOx trap					
RATIO_NOX [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 99.99847	1.5259e-3	%
Ratio of NOx out integral to NOx raw emission integral					
RATIO_NOX_OUT_INT_DIST [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 6.5535	0.0001	g/km
Ratio of NOx out emissions related to mileage of current lean operation phase					
STATE_AFL_PURGE [NC_NT_NR]	V	0H 1H 2H	DISABLE OFF ON	-	-
State of catalyst purge after lean operation					
STATE_NOX	O/V	0H 1H 2H 3H 4H 5H	PASSIV LOAD REGENERATION WAIT STOP WARMUP	-	-
NOx catalyst state					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
SUM_NTL_CYC	O/V/S	0... FFFFH	0... 65535	1	-
Amount of regeneration cycles carried out					
T_AFL	O/V	0... FFFFH	0... 1310.7	0.02	s
elapsed time since lean phase was started					
T_AFL_PUC	O/V	0... FFFFH	0... 1310.7	0.02	s
elapsed time since last PUC phase					
T_AFL_SUM	O/V/S	0... FFFFFFFFH	0... 858993	0.02	s
sum of lean time					
T_NT_AFS_REQ_PRED	V	0... FFFFH	0... 6553.5	0.1	s
Duration of active homogeneous stoichiometric operation request due to high predicted NOx row emissions					
T_NT_HOM	V	0... FFFFH	0... 655.35	0.01	s
counting back the minimum homogeneous time for detecting initialised catalyst state					
T_NT_HOM_DELTA	V	80... 7FH	-1.28 ...1.27	0.01	s
decrement for T_NT_HOM counter					
T_NT_STST_ACT	V	0... FFFFH	0... 655.35	0.01	s
Activation time of NOx catalyst state management since end of last STST cycle					
T_STOP	O/V	0... FFFFH	0... 1310.7	0.02	s
Time counter since start of STATE_NOX = STOP is active					
TNT_MDL_MAX	V	0... FFH	0... 1020	4	°C
Maximum NOx trap temperature for lean operation					
TNT_MDL_MIN	V	0... FFH	0... 1020	4	°C
Minimum NOx trap temperature for lean operation					
TQI_MMV_NOX	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Filtered actual indicated engine torque for NOx emission aftertreatment					
VLS_MAX_TMP	V	0... 578H	-200 ...1200	1	mV
Temporary local maximum of VLS_NOX_SENS_1					
VLS_MIN_TMP	V	0... 578H	-200 ...1200	1	mV
Temporary local minimum of VLS_NOX_SENS_1					
VLS_NOX_SENS_1_OLD	-	0... 578H	-200 ...1200	1	mV
Old binary O2 signal voltage, raw value, measured by NOx-Sensor					
VLS_NOX_SENS_MMV	V	0... 578H	-200 ...1200	1	mV
filtered VLS_NOX_SENS for detection of regeneration state					
VS_DIF_HYS	V	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Vehicle speed difference hysteresis for reset of Lambda=1.0 operation request					
VS_DIF_NOX	V	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Vehicle speed difference for detection of transient driving conditions					
VS_DIF_THD	V	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Vehicle speed difference threshold for set of Lambda=1.0 operation request					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VS_MMV_NOX	V	0... 7FFFH	0... 255.99218	0.0078125	km/h
Filtered vehicle speed for detection of transient driving conditions					

Input data:

DIST {p. 1183}	LAMB_AV_COR {p. 798}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_LS_UP_MIN {p. 2313}
LAMB_LS_UP_MV {p. 2313}	LAMB_NOX_SENS [NC_NOX_SENS_CONF] {p. 1380}	LC_NOX_MDL_CTRL_ACT {p. 997}	LV_ADJ_NOX_SENS_RGN {p. 3053}
LV_AST {p. 1766}	LV_AT {p. 654}	LV_CLU_SWI {p. 996}	LV_EF {p. 3614}
LV_ERR_EGR_2 {p. 987}	LV_ES {p. 1720}	LV_FL {p. 1759}	LV_HOM_ACT {p. 8136}
LV_HOM_AFL_ACT {p. 8136}	LV_HOM_AFS_ACT {p. 8136}	LV_HOM_AFS_REQ {p. 8136}	LV_IGK {p. 906}
LV_INH_AFL {p. 1822}	LV_INH_NOX_MDL_ CTRL_RGN {p. 996}	LV_INH_NOX_SENS_RGN {p. 3053}	LV_INH_NT_ACT {p. 3053}
LV_INH_NT_AFL {p. 3053}	LV_INH_NT_RGN_STOP_ MDL_DIAG [NC_NOX_SENS_CONF] {p. 6347}	LV_INH_RGN_AD {p. 996}	LV_INH_RGN_REQ {p. 3053}
LV_INH_RGN_REQ_NOX_ SENS {p. 3053}	LV_INH_RGN_REQ_NTLD {p. 3053}	LV_INH_S {p. 1822}	LV_IS {p. 1720}
LV_LOAD_H {p. 3053}	LV_NOX_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_SENS_LAMB_ VLD [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_MAX_ADJ {p. 3107}
LV_NOX_SENS_NOX_VLD [NC_NOX_SENS_CONF] {p. 1380}	LV_NOX_SENS_VLS_VLD [NC_NOX_SENS_CONF] {p. 1381}	LV_NS_AD_REQ {p. 3189}	LV_NS_SHIFT_CMB_INT_ REQ {p. 6426}
LV_NT_AFS_REQ_AGI {p. 3072}	LV_NT_STC_MAX_AFL_ ACT {p. 996}	LV_NT_STST {p. 3053}	LV_NTLD_ADJ {p. 3053}
LV_PU {p. 1720}	LV_PUC {p. 1720}	LV_PUC_REQ {p. 1720}	LV_RGN_REQ_AD {p. 996}
LV_S_ACT {p. 8137}	LV_SCC [NC_CBK_EX_NR] {p. 2295}	LV_SO2P_REQ {p. 3129}	LV_ST {p. 1720}
LV_T_NS_VLD {p. 3193}	LV_TNT_MDL_MAX_OFS {p. 3053}	LV_VLS_NS_VLD [NC_NOX_SENS_CONF] {p. 992}	MAF_FG_CYL {p. 1212}
MAF_INT_FL_ACT {p. 3053}	MAF_INT_PUC_ACT {p. 2942}	MAF_KGH {p. 1195}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}	NC_NT_NR {p. 644}	NOX_AD_FAC {p. 996}

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NOX_COR_HOMS {p. 2968}	NOX_COR_HOMS_PRED {p. 2968}	NOX_COR_S {p. 2976}	NOX_COR_S_PRED {p. 2976}
NOX_NS_AD [NC_NOX_SENS_CONF] {p. 3193}	NOX_OUT_MES_INT [NC_NOX_SENS_CONF] {p. 3066}	NT_AGI {p. 3073}	NT_AGI_NTLD {p. 3073}
NT_AGI_S_RED {p. 3073}	NT_O2_STC_AD {p. 3177}	NTLD_MDL_DIF {p. 996}	OPM_AV {p. 8137}
STATE_RGN [NC_CBK_EX_NR] {p. 2885}	T_IS {p. 1720}	T_RGN {p. 2885}	T_RGN_2 {p. 2885}
TNT_MDL_H {p. 8237}	TNT_MDL_L {p. 8237}	TNT_MDL_MAX_OFS {p. 3054}	TNT_MDL_MV {p. 8237}
TQI_AV {p. 981}	TQI_REQ_FAST {p. 8391}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_NOX_SENS [NC_NOX_SENS_CONF] {p. 1382}
VLS_NT_DOWN [NC_NOX_SENS_CONF] {p. 811}	VS {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FLOW_NT	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for calculation of filtered exhaust gas flow					
C_CRLC_NOX_CONC_OUT_MDL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correction factor for filtering of NOX_CONC_OUT_MDL					
C_CRLC_NOX_CONC_RED	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correction factor for filtering of NOX_CONC_RED					
C_CRLC_NOX_COR_RED	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correction factor for filtering of NOX_COR_RED					
C_CRLC_TQI_MMV_NOX	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for calculation of filtered actual indicated engine torque					
C_CRLC_VLS_NOX_SENS	-	0... FFFFH	0... 0.99998	15.3e-6	-
filter constant for VLS_NOX_SENS					
C_CRLC_VS_MMV_NOX	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for calculation of filtered vehicle speed					
C_CTR_AFL_PURGE_MAX	-	0... FFH	0... 255	1	-
Maximum number of activation cycles for catalyst purge after lean operation at STATE_NOX = STOP					
C_DIST_AFL_MIN	-	0... FFFFH	0... 6553.5	0.1	km
Minimum mileage for calculation of RATIO_NOX_OUT_INT_DIST					
C_FAC_COR_O2L	-	0... FFH	0... 1.99218	0.0078125	-
Correction factor for the O2L decrementation					
C_FAC_NTL_DEC_INT_RGN_NOT_VLD [NC_NT_NR]	-	0... FFH	0... 1.99218	0.0078125	-
Factor for forcing a regeneration of second bank in relation to first bank					
C_FAC_NTL_DEC_INT_STOP_RGN [NC_NT_NR]	-	0... FFH	0... 1.99218	0.0078125	-
Factor for end of regeneration of second bank in relation to first bank					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_NTL_INI_ST	-	0... FFFFH	0... 65.535	0.001	-
Weighting factor for initialisation of NTL after reset					
C_FAC_NTLD_MAX_AFS_ERR_EGR	-	0... FFH	0... 1.99218	0.0078125	-
Factor to correct homogen request in case of EGR_ERR					
C_FAC_O2_EQU	-	0... FFH	0... 1.99218	0.0078125	-
Factor for the balance of stored NO O2					
C_LAMB_NOX_SENS_AFL_PURGE_OFF	-	0... 7FFFH	0... 31.99902	976.599e-6	-
LAMB_NOX_SENS deactivation threshold for catalyst purge after lean operation at STATE_NOX = STOP					
C_LAMB_NOX_SENS_AFL_PURGE_ON	-	0... 7FFFH	0... 31.99902	976.599e-6	-
LAMB_NOX_SENS activation threshold for catalyst purge after lean operation at STATE_NOX = STOP					
C_LAMB_NOX_SENS_AFR_TRIM	-	0... 7FFFH	0... 31.99902	976.599e-6	-
linear NOx sensor signal threshold for determining rich trim conditions					
C_LAMB_NOX_SENS_RGN_STOP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
linear NOx sensor signal threshold for determining rich exhaust gas					
C_LAMB_O2_STC	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda threshold for O2 storage in lean operation					
C_LAMB_RGN	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda threshold for rich operation					
C_LAMB_STC	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda threshold for lean operation					
C_MAF_INT_FL_RGN_STOP_MIN	-	0... FFFFH	0... 6553.5	0.1	g
Minimum air mass flow at full load after which a NOx regeneration break is allowed					
C_MAF_INT_PUC_NTL_H_RST	-	0... FFFFH	0... 2912.66666	0.0444444	g
Minimum mass air flow integral for reset of NTL_H at STATE_NOX = "WAIT"					
C_MAF_INT_PUC_RGN_STOP_MIN	-	0... FFFFH	0... 2912.66666	0.0444444	g
Minimum air mass flow at PUC after which a NOx regeneration break off is allowed					
C_MAF_INT_PUC_RST_RGN_REQ	-	0... FFFFH	0... 2912.66666	0.0444444	g
Minimum air mass flow at STATE_NOX = WAIT after that the reset of LV_RGN_NT_REQ is allowed					
C_MAF_INT_PUC_WAIT_MIN	-	0... FFFFH	0... 2912.66666	0.0444444	g
Minimum air mass flow at PUC after which the switch of STATE_NOX = LOAD -> WAIT is allowed					
C_MAF_INT_STOP_AFL_PURGE_MAX	-	0... FFFFH	0 ...1	0.0222222	g
Air mass integral limit for activation of catalyst purge after lean operation at STATE_NOX = STOP					
C_MAF_INT_STOP_NTL_H_RST	-	0... FFFFH	0... 5825.33333	0.0888889	g
Minimum mass air flow integral for reset of NTL_H at STATE_NOX = "STOP"					
C_NOX_CONC_COR	-	0... FFFFH	0... 8192	0.1250019	-
Correction factor of the NOx concentration regarding the mol mass					
C_NOX_COR_INT_MIN	-	0... FFFFH	0... 10485.6	0.16	mg
Minimum NOx raw emission integral value for calculation of RATIO_NOX					
C_NOX_NS_AD_DIF_MON	-	0... 05DCH	0... 1500	1	ppm
Maximum deviation between model and NOx-Sensor					
C_NOX_NS_AD_RGN_STOP	-	0... 05DCH	0... 1500	1	ppm
linear NOx sensor signal threshold for determining rich trim conditions					
C_NOX_OUT_MES_INT_MAX	-	0... FFFFH	0... 10485.6	0.16	mg
Threshold for integrated downstream emission (meas. by NOx sensor) for requesting a regeneration					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NOX_SENS_MAX_OFS	-	0... 05DCH	0... 1500	1	ppm
Threshold offset of the NOx sensor signal for requesting a regeneration					
C_NT_RGN_STOP_FL_SEL	-	0... 3H	0 ...3	1	-
Selection of NOx regeneration handling in kind of full load					
C_NT_RGN_STOP_PUC_SEL	-	0... 2H	0 ...2	1	-
Method selection for break off a running NOx regeneration if PUC has higher priority					
C_NT_STC_BAS_MAX_RNG_H	-	0... FFFFH	0... 20971.2	0.32	mg
maximum value of base NOx trap storage capacity map					
C_NT_STC_INI_RNG_H	-	0... FFFFH	0... 20971.2	0.32	mg
initialisation value of actual and base NOx trap storagecapacity					
C_NTL_INI_ST	-	0... FFFFH	0... 10485.6	0.16	mg
Initialisation value of the NOx trap absolute loading after engine start					
C_NTL_TRIG_AFR_AFL	-	0... FFFFH	0... 10485.6	0.16	mg
minimum NOx trap NOx loading for triggering the transition from rich to lean operation					
C_NTLD_LGRD	-	0... FFFFH	0... 0.99998	15.3e-6	-
limitating gradient of loading degree					
C_NTLD_NT_HOM_RST	-	0... FFFFH	0... 0.99998	15.3e-6	-
loading degree threshold for resetting the homogeneous time counter T_NT_HOM					
C_NTLD_RGN_ST_INI	-	0... FFFFH	0... 0.99998	15.3e-6	-
Initialisation value for NOx trap loading degree at starting regeneration					
C_O2_FLOW_COR_FAC	-	0... FFFFH	0... 127.99804	1.9531e-3	-
Correction factor for the O2 engine out flow					
C_O2L_MIN	-	0... FFFFH	0... 10485.6	0.16	mg
minimum NOx trap oxygen loading for stopping a regeneration					
C_RATIO_NOX_MAX	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Maximum ratio of NOx out integral to NOx raw emission integral; threshold for start of a NOx regenration					
C_RATIO_NOX_OUT_INT_DIST_MAX	-	0... FFFFH	0... 6.5535	0.0001	g/km
Maximum ratio of NOx out integral to mileage at current lean phase; threshold for start of a NOx regeneration					
C_STATE_RGN_CTL	-	0H 1H 2H 3HH	SENSOR MODEL SENSOR_ MODEL TIME	-	-
regeneration stop mode					
C_STATE_SENS_AFL_PURGE [NC_NT_NR]	-	0H 1H 2H 3H 4H	VLS_DOWN VLS_NOX_ SENS LAMB_NOX_ SENS VLS_NT_ DOWN NONE	-	-
Determination of signal for catalyst purge function after lean operation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_SENS_AFR [NC_NT_NR]	-	0H 1H 2H 3H 4H	VLS_DOWN VLS_NOX_SENS LAMB_NOX_SENS VLS_NT_DOWN NONE	-	-
bench-selective mode to determine rich exhaust gas downstream NOx trap					
C_STATE_SENS_AFR_TRIM [NC_NT_NR]	-	0H 1H 2H 3H 4H	VLS_DOWN VLS_NOX_SENS LAMB_NOX_SENS VLS_NT_DOWN NONE	-	-
bench-selective mode to determine trim threshold reached by downstream sensor					
C_SUM_NTL_CYC_SP	-	0... FFFFH	0... 65535	1	-
NOx trap regeneration cycle counter initialisation value					
C_SUM_O2L_NTL_MAX	-	0... FFFFH	0... 10485.6	0.16	mg
threshold of oxygen and NOx loading for requesting a NOx catalyst purge					
C_T_AFL_NT_HOM_RST	-	0... FFFFH	0... 1310.7	0.02	s
lean time after which the homogeneous time counter is re-initialised					
C_T_AFL_RGN_REQ_NTLD	-	0... FFFFH	0... 1310.7	0.02	s
Minimum duration of lean operation before permitting a regeneration request from the model					
C_T_AFL_RST	-	0... FFFFH	0... 655.35	0.01	s
Time limit for reset of T_AFL after an engine STST phase					
C_T_IS_RGN_STOP_MIN	-	0... FFFFH	0... 655.35	0.01	s
Minimum idle speed duration after which a NOx regeneration break off is allowed					
C_T_NT_AFS_REQ_PRED_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Maximum duration of of active AFS request due to high predicted NOx row emissions					
C_T_NT_HOM	-	0... FFFFH	0... 655.35	0.01	s
Lean time threshold for resetting the homogeneous time counter T_NT_HOM					
C_T_NT_HOM_MAX_VLD	-	0... FFFFH	0... 655.35	0.01	s
Lean time threshold for resetting the homogeneous time counter T_NT_HOM					
C_T_RGN_MAX_DIAG	-	0... FFFFH	0... 655.35	0.01	s
Maximum regeneration duration if sensor test is activated					
C_T_STOP_AFL_PURGE_MAX	-	0... FFFFH	0... 1310.7	0.02	s
Time limit for activation of catalyst purge after lean operation at STATE_NOX = STOP					
C_TNT_MDL_INH_PURGE	-	0... FFH	0... 1020	4	°C
NOx trap temperature threshold for inhibiting a catalyst purge					
C_TNT_MDL_MAX_HYS	-	0... FFH	0... 1020	4	°C
Temperature hysteresis for lambda=1-mode deactivation due to high temperature					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TNT_MDL_MIN_HYS	-	0... FFH	0... 1020	4	°C
Temperature hysteresis for lambda=1-mode deactivation due to low temperature					
C_TNT_MDL_MV_NTL_H_RST_HYS	-	0... FFH	0... 1020	4	°C
NOx catalyst temperature hysteresis for NTL_H calculation					
C_TNT_MDL_MV_NTL_H_RST_MAX	-	0... FFH	0... 1020	4	°C
Upper NOx catalyst temperature threshold for reset of NTL_H calculation					
C_TNT_MDL_MV_NTL_H_RST_MIN	-	0... FFH	0... 1020	4	°C
Lower NOx catalyst temperature threshold for reset of NTL_H calculation					
C_TNT_MDL_PURGE_DEAC	-	0... FFH	0... 1020	4	°C
NOx catalyst temperature for deactivation of NOx catalyst purge at STATE_NOX = STOP					
C_TNT_MDL_PURGE_MAX	-	0... FFH	0... 1020	4	°C
Maximum NOx catalyst temperature for enabling of NOx catalyst purge at STATE_NOX = STOP					
C_TNT_MDL_PURGE_MIN	-	0... FFH	0... 1020	4	°C
Minimum NOx catalyst temperature for enabling of NOx catalyst purge at STATE_NOX = STOP					
C_TNT_MDL_PURGE_REQ_MAX	-	0... FFH	0... 1020	4	°C
Maximum NOx catalyst temperature threshold for set of catalyst purge request					
C_VLS_DIST_GRD_POS	-	0... 578H	-200 ...1200	1	mV
Difference between local minimum and current value for calculation of positive gradient					
C_VLS_DOWN_AFL_PURGE_OFF	-	0... 3FFH	0... 4.99511	4.8828e-3	V
VLS_DOWN deactivation threshold for catalyst purge after lean operation at STATE_NOX = STOP					
C_VLS_DOWN_AFL_PURGE_ON	-	0... 3FFH	0... 4.99511	4.8828e-3	V
VLS_DOWN activation threshold for catalyst purge after lean operation at STATE_NOX = STOP					
C_VLS_DOWN_AFR_TRIM	-	0... 3FFH	0... 4.99511	4.8828e-3	V
binary lambda sensor signal threshold for determining rich trim conditions					
C_VLS_DOWN_MIN_NTL_DEC [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Minimum VLS_DOWN voltage for calculation of NTL_DEC_INT					
C_VLS_DOWN_RGN_2_MIN	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Limit for detection of a not successful regeneration of second bank					
C_VLS_GRD_NEG_VLS_SET	-	0... 578H	-200 ...1200	1	mV
Negative gradient for set of LV_SENS_AFR_2 with VLS signal					
C_VLS_MAX_RGN_1_STOP	-	0... 578H	-200 ...1200	1	mV
Threshold value for end of first regeneration					
C_VLS_MAX_RGN_2_STOP	-	0... 578H	-200 ...1200	1	mV
Threshold value for end of second regeneration					
C_VLS_NOX_SENS_AFL_PURGE_OFF	-	0... 578H	-200 ...1200	1	mV
VLS_NOX_SENS deactivation threshold for catalyst purge after lean operation at STATE_NOX = STOP					
C_VLS_NOX_SENS_AFL_PURGE_ON	-	0... 578H	-200 ...1200	1	mV
VLS_NOX_SENS activation threshold for catalyst purge after lean operation at STATE_NOX = STOP					
C_VLS_NOX_SENS_AFR_TRIM	-	0... 578H	-200 ...1200	1	mV
binary NOx sensor signal threshold for determining rich trim conditions					
C_VLS_NOX_SENS_RGN_STOP	-	0... 578H	-200 ...1200	1	mV
binary NOx sensor signal threshold for determining rich exhaust gas					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_NS_RGN_2_VLD	-	0... 578H	-200 ...1200	1	mV
Limit to enable again detection of end of regeneration of second bank by sensor					
C_VS_INH_PURGE	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for inhibiting a catalyst purge					
C_VS_PURGE_MAX	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for enabling of NOx catalyst purge at STATE_NOX = STOP					
C_VS_PURGE_REQ_MAX	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed threshold for set of catalyst purge request					
ID_VLS_DOWN_RGN_STOP	-	0... 3FFH	0... 4.99511	4.8828e-3	V
LDP_NTLD_RGN_ST_ID_VLS_DOWN	4	0... FFFFH	0... 0.99998	15.3e-6	-
downstream binary lambda sensor signal threshold for determining rich exhaust gas					
IP_FAC_NOX_SENS_MAX	V	0... FFH	0... 1.99218	0.0078125	-
LDPM_NT_AGI_S_RED	4	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_TNT_MDL_MV_IP_FAC_NOX_SENS	6	0... FFFFH	0... 1023.98437	0.015625	°C
Factor to correct threshold of the NOx sensor signal for requesting a regeneration					
IP_NOX_HOMS_AFS_REQ_AT	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDP_TNT_MDL_L_IP_NOX_HOMS_AT	8	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_NOX_HOMS_AT	6	0... FFFFH	0... 0.99998	15.3e-6	-
NOx threshold for set of Lambda = 1.0 operation request - homogeneous lean prediction - AT vehicle					
IP_NOX_HOMS_AFS_REQ_HYS_AT	V	0... FFFFH	-1024... 1023.96875	0.03125	mg/s
LDP_N_32_IP_NOX_HOMS_AT	6	0... FFH	0... 8160	32	rpm
LDP_TQI_MMV_NOX_IP_NOX_HOMS_AT	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
NOx hysteresis for reset of Lambda = 1.0 operation request - homogeneous lean prediction - AT vehicle					
IP_NOX_HOMS_AFS_REQ_HYS_MT	V	0... FFFFH	-1024... 1023.96875	0.03125	mg/s
LDP_N_32_IP_NOX_HOMS_MT	6	0... FFH	0... 8160	32	rpm
LDP_TQI_MMV_NOX_IP_NOX_HOMS_MT	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
NOx hysteresis for reset of Lambda = 1.0 operation request - homogeneous lean prediction - MT vehicle					
IP_NOX_HOMS_AFS_REQ_MT	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDP_TNT_MDL_L_IP_NOX_HOMS_MT	8	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_NOX_HOMS_MT	6	0... FFFFH	0... 0.99998	15.3e-6	-
NOx threshold for set of Lambda = 1.0 operation request - homogeneous lean prediction - MT vehicle					
IP_NOX_RED_FAC	-	0... FFH	0... 0.99609	3.9063e-3	-
LDP_TNT_MDL_MV_IP_NOX_RED_FAC	4	0... FFH	0... 1020	4	°C
Reduction factor taking into account the chemical NOx conversion					
IP_NOX_S_AFS_REQ_AT	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDP_TNT_MDL_L_IP_NOX_S_AT	8	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_NOX_S_AT	6	0... FFFFH	0... 0.99998	15.3e-6	-
NOx threshold for set of Lambda = 1.0 operation request - stratified prediction - AT vehicle					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_NOX_S_AFS_REQ_HYS_AT	V	0... FFFFH	-1024... 1023.96875	0.03125	mg/s
LDP_N_32_IP_NOX_S_AT	6	0... FFH	0... 8160	32	rpm
LDP_TQI_MMV_NOX_IP_NOX_S_AT	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
NOx hysteresis for reset of Lambda = 1.0 operation request - stratified prediction - AT vehicle					
IP_NOX_S_AFS_REQ_HYS_MT	V	0... FFFFH	-1024... 1023.96875	0.03125	mg/s
LDP_N_32_IP_NOX_S_MT	6	0... FFH	0... 8160	32	rpm
LDP_TQI_MMV_NOX_IP_NOX_S_MT	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
NOx hysteresis for reset of Lambda = 1.0 operation request - stratified prediction - MT vehicle					
IP_NOX_S_AFS_REQ_MT	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDP_TNT_MDL_L_IP_NOX_S_MT	8	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_NOX_S_MT	6	0... FFFFH	0... 0.99998	15.3e-6	-
NOx threshold for set of Lambda = 1.0 operation request - stratified prediction - MT vehicle					
IP_NOX_SENS_MAX_AT	V	0... 05DCH	0... 1500	1	ppm
LDP_FLOW_NT_MMV_IP_NOX_SENS_AT	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_N_32_IP_NOX_SENS_MAX_AT	8	0... FFH	0... 8160	32	rpm
threshold of the NOx sensor signal for requesting a regeneration for AT					
IP_NOX_SENS_MAX_MT	V	0... 05DCH	0... 1500	1	ppm
LDP_FLOW_NT_MMV_IP_NOX_SENS_MT	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_N_32_IP_NOX_SENS_MAX_MT	8	0... FFH	0... 8160	32	rpm
threshold of the NOx sensor signal for requesting a regeneration for MT					
IP_NT_AGI_RGN_FRQ	V	0... FFH	0... 0.99609	3.9063e-3	-
LDP_NT_AGI_NTLD_IP_NT_AGI_RGN	8	0... FFH	0... 0.99609	3.9063e-3	-
LDP_TNT_MDL_MV_IP_NT_AGI_RGN	8	0... FFH	0... 1020	4	°C
modification of the actual storage capacity due to aging factor NT_AGI_NTLD					
IP_NT_EFF_BAS	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_NTLD	2	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_TNT_MDL_NOX	2	0... FFH	0... 1020	4	°C
Basic NOx trap efficiency for open exhaust flap					
IP_NT_EFF_BAS_EF_CLOSE	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_NTLD	2	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_TNT_MDL_NOX	2	0... FFH	0... 1020	4	°C
Basic NOx trap efficiency for closed exhaust flap					
IP_NT_EFF_COR	V	0... FFH	0... 3.98437	0.015625	-
LDP_NOX_COR_IP_NT_EFF_COR	8	0... FFFFH	0... 1023.98437	0.015625	mg/s
LDPM_TNT_MDL_NOX	2	0... FFH	0... 1020	4	°C
NOx trap efficiency correction					
IP_NT_STC_BAS_RNG_H	V	0... FFFFH	0... 20971.2	0.32	mg
LDP_NOX_CONC_MMV_IP_NT_STC_BAS	8	0... FFFFH	0... 65535	1	ppm

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_TNT_MDL_NOX	2	0... FFH	0... 1020	4	°C
NOx trap storage capacity					
IP_NTL_DEC_INT_MAX	-	0... FFFFH	0... 10485.6	0.16	mg
LDP_NTL_RGN_ST_IP_NTL_DEC_INT	6	0... FFFFH	0... 10485.6	0.16	mg
Maximum amount of regeneration agent					
IP_NTL_MIN	-	0... FFFFH	0... 10485.6	0.16	mg
LDPM_TNT_MDL_NOX	2	0... FFH	0... 1020	4	°C
minimum NOx trap NOx loading for stopping a regeneration					
IP_NTL_MIN_AFL_PURGE	-	0... FFFFH	0... 10485.6	0.16	mg
LDP_VS_IP_NTL_MIN_AFL_PURGE	6	0... FFH	0... 255	1	km/h
NTL reset threshold for AFL_PURGE control variables					
IP_NTL_MIN_RGN_STOP	-	0... FFFFH	0... 10485.6	0.16	mg
LDP_TNT_MDL_MV_IP_NTL_MIN_RGN	6	0... FFFFH	0... 1023.98437	0.015625	°C
minimum NOx catalyst NOx loading for regeneration stop					
IP_NTLD_MAX_ADJ_AT	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_TQI_REQ_FAST_IP_NTLD_ADJ_AT	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_NTLD_ADJ_AT	8	0... FFH	0... 8160	32	rpm
Maximum NOx catalyst loading for requesting a regeneration (adjusted for special purposes) - AT vehicle					
IP_NTLD_MAX_ADJ_MT	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_TQI_REQ_FAST_IP_NTLD_ADJ_MT	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_NTLD_ADJ_MT	8	0... FFH	0... 8160	32	rpm
Maximum NOx catalyst loading for requesting a regeneration (adjusted for special purposes) - MT vehicle					
IP_NTLD_MAX_AFS_AT	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_TQI_REQ_FAST_IP_NTLD_AFS_AT	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_NTLD_MAX_AFS_AT	4	0... FFH	0... 8160	32	rpm
Maximum NOx trap loading degree for requesting a regeneration before lambda=1.0 operation (for automatic transmission)					
IP_NTLD_MAX_AFS_MT	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_TQI_REQ_FAST_IP_NTLD_AFS_MT	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_NTLD_MAX_AFS_MT	4	0... FFH	0... 8160	32	rpm
Maximum NOx trap loading degree for requesting a regeneration before lambda=1.0 operation (for manual transmission)					
IP_NTLD_MAX_AT	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_TQI_REQ_FAST_IP_NTLD_AT	12	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_NTLD_AT	8	0... FFH	0... 8160	32	rpm
Maximum NOx catalyst loading for requesting a regeneration - AT vehicle					
IP_NTLD_MAX_MT	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_TQI_REQ_FAST_IP_NTLD_MT	12	0... FFFFH	-1024... 1023.96875	0.03125	Nm

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_N_32_IP_NTLD_MT	8	0... FFH	0... 8160	32	rpm
Maximum NOx catalyst loading for requesting a regeneration - MT vehicle					
IP_NTLD_MAX_VS_AT	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_VS_IP_NTLD_MAX_VS_AT	6	0... FFH	0... 255	1	km/h
LDP_NT_AGI_S_RED_IP_NTLD_VS_AT	6	0... FFFFH	0... 0.99998	15.3e-6	-
NOx catalyst loading for requesting a NOx regeneration depending on vehicle speed - AT vehicle					
IP_NTLD_MAX_VS_MT	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_VS_IP_NTLD_MAX_VS_MT	6	0... FFH	0... 255	1	km/h
LDP_NT_AGI_S_RED_IP_NTLD_VS_MT	6	0... FFFFH	0... 0.99998	15.3e-6	-
NOx catalyst loading for requesting a NOx regeneration depending on vehicle speed - MT vehicle					
IP_NTLD_MIN_AFL_PURGE	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_VS_IP_NTLD_MIN_AFL_PURGE	6	0... FFH	0... 255	1	km/h
NTLD reset threshold for AFL_PURGE control variables					
IP_O2_STC_MAX	V	0... FFFFH	0... 10485.6	0.16	mg
LDP_LAMB_LS_UP_MV_IP_O2_STC_MAX	8	0... 7FFFH	0... 31.99902	976.599e-6	-
LDPM_TNT_MDL_NOX	2	0... FFH	0... 1020	4	°C
max. storage capacity of O2 in the NOx-trap					
IP_T_AFL_MIN	-	0... FFFFH	0... 1310.7	0.02	s
LDPM_VS_1_NOXM	8	0... FFH	0... 255	1	km/h
minimum duration of lean operation before permitting a regeneration					
IP_T_AFL_MIN_AFS	-	0... FFFFH	0... 1310.7	0.02	s
LDP_VS_IP_T_AFL_MIN_AFS	8	0... FFH	0... 255	1	km/h
Minimum duration of lean operation before permitting a regeneration at a switch to Lambda=1.0 operation					
IP_T_AFL_MIN_NT_RGN_STOP	-	0... FFFFH	0... 1310.7	0.02	s
LDPM_VS_1_NOXM	8	0... FFH	0... 255	1	km/h
minimum duration of lean operation before permitting a NOx regeneration after a broken NOx regeneration					
IP_T_MAX_RGN_2_STOP	V	0... FFFFH	0... 655.35	0.01	s
LDP_NTL_RGN_ST_IP_T_MAX_RGN	6	0... FFFFH	0... 10485.6	0.16	mg
LDP_NTL_DEC_INT_IP_T_MAX_RGN	6	0... FFFFH	0... 10485.6	0.16	mg
Maximum time duration of second regeneration					
IP_T_NT_HOM_DEC	V	0... 7FH	0... 1.27	0.01	s
LDPM_MAF_KGH_IP_T_NT_HOM	4	0... FFH	0... 2040	8	kg/h
LDPM_LAMB_AV_COR_IP_T_NT_HOM	4	0... 7FFFH	0... 31.99902	976.599e-6	-
Weighted decrement for the homogeneous time counter					
IP_T_NT_HOM_INC	V	0... 7FH	0... 1.27	0.01	s
LDPM_MAF_KGH_IP_T_NT_HOM	4	0... FFH	0... 2040	8	kg/h
LDPM_LAMB_AV_COR_IP_T_NT_HOM	4	0... 7FFFH	0... 31.99902	976.599e-6	-
Weighted increment for the homogeneous time counter					
IP_T_RGN_MAX	V	0... FFFFH	0... 655.35	0.01	s
LDP_FLOW_NT_MMV_IP_T_RGN_MAX	4	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDPM_NT_AGI_S_RED	4	0... FFFFH	0... 0.99998	15.3e-6	-
regeneration time for manual regeneration duration selection					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TNT_MDL_MAX_AT	V	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_TNT_MAX_AT	6	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_VS_IP_TNT_MAX_AT	6	0... FFH	0... 255	1	km/h
Maximum NOx catalyst temperature for lean operation - AT vehicle					
IP_TNT_MDL_MAX_MT	V	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_TNT_MAX_MT	6	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_VS_IP_TNT_MAX_MT	6	0... FFH	0... 255	1	km/h
Maximum NOx catalyst temperature for lean operation - MT vehicle					
IP_TNT_MDL_MIN_AT	-	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_TNT_MIN_AT	4	0... FFFFH	0... 0.99998	15.3e-6	-
Minimum NOx catalyst temperature for lean operation - AT vehicle					
IP_TNT_MDL_MIN_IS_AT	-	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_TNT_IS_AT	4	0... FFFFH	0... 0.99998	15.3e-6	-
Minimum NOx catalyst temperature for lean operation at idle speed - AT vehicle					
IP_TNT_MDL_MIN_IS_MT	-	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_TNT_IS_MT	4	0... FFFFH	0... 0.99998	15.3e-6	-
Minimum NOx catalyst temperature for lean operation at idle speed - MT vehicle					
IP_TNT_MDL_MIN_MT	-	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_TNT_MIN_MT	4	0... FFFFH	0... 0.99998	15.3e-6	-
Minimum NOx catalyst temperature for lean operation - MT vehicle					
IP_VLS_DIST_GRD_NEG	-	0... 578H	-200 ...1200	1	mV
LDP_VLS_MAX_TMP_IP_VLS_DIST	6	0... 578H	-200 ...1200	1	mV
Difference between local maximum and current value for calculation of negative gradient					
IP_VS_DIF_HYS_AT	-	0... FFFFH	-256... 255.99218	0.0078125	km/h
LDP_VS_MMV_NOX_IP_VS_HYS_AT	8	0... 7FFFH	0... 255.99218	0.0078125	km/h
Vehicle speed difference hysteresis for reset of Lambda=1.0 operation request - AT vehicle					
IP_VS_DIF_HYS_MT	-	0... FFFFH	-256... 255.99218	0.0078125	km/h
LDP_VS_MMV_NOX_IP_VS_HYS_MT	8	0... 7FFFH	0... 255.99218	0.0078125	km/h
Vehicle speed difference hysteresis for reset of Lambda=1.0 operation request - MT vehicle					
IP_VS_DIF_THD_BAS_AT	V	0... FFFFH	-256... 255.99218	0.0078125	km/h
LDP_TNT_MDL_L_IP_VS_THD_AT	8	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_VS_THD_AT	8	0... FFFFH	0... 0.99998	15.3e-6	-
Vehicle speed difference threshold for set of Lambda=1.0 operation request - AT vehicle					
IP_VS_DIF_THD_BAS_MT	V	0... FFFFH	-256... 255.99218	0.0078125	km/h
LDP_TNT_MDL_L_IP_VS_THD_MT	8	0... FFH	0... 1020	4	°C
LDP_NT_AGI_S_RED_IP_VS_THD_MT	8	0... FFFFH	0... 0.99998	15.3e-6	-
Vehicle speed difference threshold for set of Lambda=1.0 operation request - MT vehicle					
IP_VS_DIF_THD_COR_AT	-	0... FFFFH	-256... 255.99218	0.0078125	km/h

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_VS_MMV_NOX_IP_VS_COR_AT	8	0... 7FFFH	0... 255.99218	0.0078125	km/h
Vehicle speed difference threshold correction for set of Lambda=1.0 operation request - AT vehicle					
IP_VS_DIF_THD_COR_MT	-	0... FFFFH	-256... 255.99218	0.0078125	km/h
LDP_VS_MMV_NOX_IP_VS_COR_MT	8	0... 7FFFH	0... 255.99218	0.0078125	km/h
Vehicle speed difference threshold correction for set of Lambda=1.0 operation request - MT vehicle					
LC_AFL_PURGE_RST	-	0... 1H	0 ...1	1	-
Activation of NTL and NTLD threshold for reset of NT purge control variables					
LC_INH_AFL_PURGE_TOUT	-	0... 1H	0 ...1	1	-
Inhibition of catalyst purge break if a time out condition fulfilled					
LC_INH_NT_RGN_ST	-	0... 1H	0 ...1	1	-
Inhibition of NOx regeneration request at transition STATE_NOX = 'WARMUP' -> 'REGENERATION'					
LC_INH_RGN_PU	-	0... 1H	0 ...1	1	-
Switch to forbid regeneration during PU					
LC_INH_RGN_REQ_ST	-	0... 1H	0 ...1	1	-
Check of LV_INH_RGN_REQ at transition STATE_NOX = 'WARMUP' -> 'REGENERATION'					
LC_NOX_SENS	-	0... 1H	0 ...1	1	-
Logical constant for the existence of a NOx-Sensor					
LC_NOX_SENS_RGN	-	0... 1H	0 ...1	1	-
switch to exclusively use the NOx sensor for requesting a regeneration					
LC_NS_SHIFT_INH_AFL_PURGE	-	0... 1H	0 ...1	1	-
Deactivation of catalyst purge after lean operation at NOx sensor shift diagnosis					
LC_NT_ACT	-	0... 1H	0 ...1	1	-
Logical constant for NOx catalyst function activation					
LC_NT_AFS_REQ	-	0... 1H	0 ...1	1	-
switch to force hom.mode in Passive or enable lean operation					
LC_NT_AFS_REQ_NS_SHIFT	-	0... 1H	0 ...1	1	-
Activation of Lambda=1.0 operation request by for NOx sensor shift diagnosis by LV_NT_AFS_REQ					
LC_NT_RGN_STOP_INI_NTL_O2L	-	0... 1H	0 ...1	1	-
Method selection for handling of NTL and O2L at break off of a NOx regeneration by PUC or idle speed					
LC_NT_RGN_STOP_IS	-	0... 1H	0 ...1	1	-
Method selection for break off a running NOx regeneration if idle speed has higher priority					
LC_NT_STST_ACT	-	0... 1H	0 ...1	1	-
Activation of special engine start-stop functionality into NOx catalyst functionalities					
LC_NTL_DEC_INT_AFR_ENA	-	0... 1H	0 ...1	1	-
Enabling of rich detection by NTL_DEC_INT ratio at the end of the regeneration of the second bank					
LC_NTL_DEC_INT_AFR_SENS_AFR_2	-	0... 1H	0 ...1	1	-
Enables the set of LV_SENS_AFR_2 by LV_NTL_DEC_INT_AFR					
LC_NTL_H_RST_LOAD_TNT	-	0... 1H	0 ...1	1	-
Activation of NTL_H reset at out of bounds NOx catalyst temperatures at STATE_NOX = "LOAD"					
LC_NTL_INI_ST	-	0... 1H	0 ...1	1	-
Selection of NTL initialisation method (0...by NVMY value, 1...by C_NTL_INI_ST)					
LC_NTLD_MAX_AFS	-	0... 1H	0 ...1	1	-
Switch between NTLD and NTLD_MDL for LV_RGN_REQ_NTLD_AFS					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_SENS_AFR_MOD	-	0... 1H	0 ...1	1	-
Selection of calculation method for LV_SENS_AFR_i					
LC_STATE_NOX_AFL_ACT	-	0... 1H	0 ...1	1	-
Activation of NOx state management (STATE_NOX) at LV_INH_AFL=1 or LV_INH_S=1					
LC_STATE_NOX_INH_NT_AFS_REQ	-	0... 1H	0 ...1	1	-
Enabling of STATE_NOX = "STOP" to "LOAD" transition at LV_NT_AFS_REQ = 1					
LC_STATE_NOX_OPM_AV_ACT	-	0... 1H	0 ...1	1	-
Activation of NOx state management (STATE_NOX) at OPM_AV <> "AFS"					
LC_SUM_NTL_CYC_NEW	-	0... 1H	0 ...1	1	-
Initialisation of regeneration cycle counter					
LC_VLS_NS_VLD_AFL_PURGE	-	0... 1H	0 ...1	1	-
Deactivation of catalyst purge after lean operation at not valid binary Lambda signal of NOx sensor					
LC_VLS_NS_VLD_RGN_STOP_MDL	-	0... 1H	0 ...1	1	-
NOx regeneration stop by model at invalid binary Lambda signal of NOx sensor					

FUNCTION DESCRIPTION:

General information:

The NOx catalyst management can handle single branch and twin branch exhaust gas lines with the configuration data NC_NT_NR.
If NC_NT_NR = 1, just one NOx catalyst is taken into account, if NC_NT_NR = 2, the software calculates the twin branch version concerning NOx catalysts.
with i = 1 ... NC_NT_NR
typical values of NC_NT_NR = 1; 2

If two or more separate cylinder banks are concerned, then
m = 1, for cylinder bank 1
m = 2, for cylinder bank 2
with m = 1 ... NC_CBK_EX_NR
typical values of NC_CBK_EX_NR = 1;2

NC_NOX_SENS_CONF considers the number of NOx sensors in the system
with k = 1 ... NC_NOX_SENS_CONF
typical values of NC_NOX_SENS_CONF = 1;2

In some passages logical expressions are calculated using information of different branches (example: A_1 and A_2). If this module is compiled for single branched exhaust lines, only the first expression (here: A_1) should be taken into consideration.

In case of LV_NT_STST = 1 all calculations of this module shall be inhibited. That's valid for all used recurrences (10ms, 20ms, 100ms, 1000ms).

Application conditions

Initialisation: *- -*

Recurrence: *defined at each subchapter of this module, basic recurrence of this module is 10 ms*

Activation: *LV_NT_STST = 0*

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Deactivation: LV_NT_STST = 1

7.86.1 NOx catalyst management - catalyst states

FUNCTION DESCRIPTION:

Application conditions

Initialisation: – –

Recurrence: *10 ms*

Activation: – –

Deactivation: – –

7.86.1.1 State transition manager

FUNCTION DESCRIPTION:

General information:

The NOx catalyst state manager should be initialized with the STATE_NOX = PASSIVE.
In order to keep the state manager as simple as possible without loss of functionality, the state STOP contains all engine states based on stoichiometric operation except the regeneration. Such possible states are besides the ordinary lambda=1 operation the desulfation, the catalyst heating (see lambda=1-request chapter). Due to lambda oscillations in lambda=1 operation, the consideration of LV_NT_AFS_REQ is necessary in order to prevent an undesired leave of STOP.
The flag LV_RGN_AGI_i is set to 1 when the regeneration just starts (STATE_NOX switches from LOAD to REGENERATION) and the starting regeneration was requested by the modelled loading degree (LV_RGN_REQ_NTLD=1). It is reset, when the regeneration is stopped by a downstream sensor signal (see Sub-chapter: STATE_NOX = STOP).
STATE_NOX has to be initialised with PASSIVE
The states of the NOx Trap function are:

- ***PASSIVE*** : Initialisation of NOx catalyst management
- ***WARMUP***: Sensors ready, waiting for suitable catalyst temperature
- ***LOAD*** : storage of NOx (and oxygen) during lean burn phases
- ***REGENERATION*** : NOx-regeneration of the catalyst during a rich burn phase
- ***STOP*** : Lambda=1 operation
- ***WAIT***: During Fuel Cut Off, only oxygen crosses the catalyst

Signal flow diagram:

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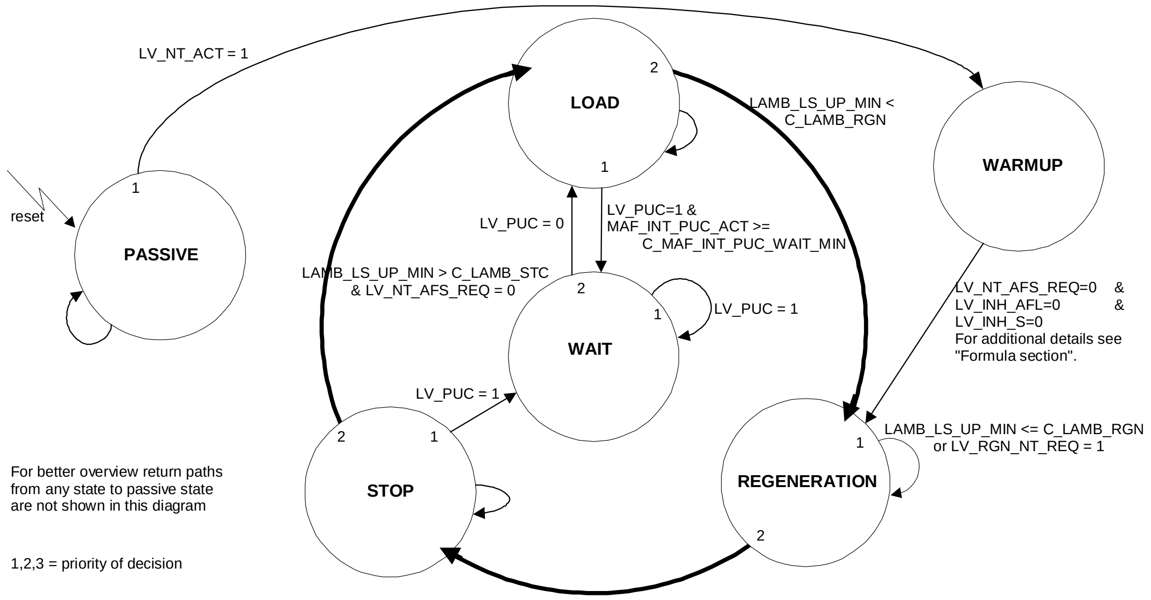

Figure 7.86.1: : State transition diagram

Application conditions

Initialisation: *LV_NT_ACT= 0 at reset*
at deactivation:
T_NT_STST_ACT = 0

Recurrence: *10ms*

Activation: – –

Deactivation: – –

Formula section

if(135) LC_NT_STST_ACT = 0
then(135)
LV_NT_ACT =
LC_NT_ACT = 1 **and**
LV_INH_NT_ACT = 0 **and** % sensor readiness
LV_ES = 0 **and**
LV_AST = 0 **and**
LV_ST = 0
else(135)
LV_NT_ACT =
LC_NT_ACT = 1 **and**
LV_INH_NT_ACT = 0 **and** % sensor readiness
LV_IGK = 1
endif(135)

if (1-) T_NT_STST_ACT < maximum value (FFFFH)
then (1-) increment T_NT_STST_ACT

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else (1-) % timer remains unchanged on its maximum value
T_NT_STST_ACT(n) = T_NT_STST_ACT(n-1)
endif (1-)

7.86.1.1.1 State management

% calculation of NTL_MIN was moved to here in order to insure the right calculation order
NTL_MIN = IP_NTL_MIN (TNT_MDL_MV)

Case STATE_NOX = PASSIVE
if (2) LV_NT_ACT = 1
then (2) STATE_NOX = WARMUP % Exit to WARMUP
else(2) stay in PASSIVE
endif (2)

Case STATE_NOX = WARMUP
if (3) LV_NT_ACT = 0
then (3) STATE_NOX = PASSIVE %
Exit to PASSIVE
else (3)
if (3+) LV_NT_AFS_REQ = 0
((OPM_AV <> "AFS" **AND** LC_STATE_NOX_OPM_AV_ACT = 1)
((LV_INH_AFL = 0 **OR** LC_STATE_NOX_AFL_ACT = 1)
(LV_INH_S = 0 **OR** LC_STATE_NOX_AFL_ACT = 1)
)
)
then (3+)
if (136) LV_INH_RGN_REQ = 0 **OR** LC_INH_RGN_REQ_ST = 0
then (136) STATE_NOX = REGENERATION
Exit to REGENERATION
if (129) LC_INH_NT_RGN_ST = 0
then (129) LV_RGN_NT_REQ = 1
else (129) LV_RGN_NT_REQ = 0
endif (129)
else (136)
if (& %■) LC_INH_NT_RGN_ST = 0
then (& %■) stay in WARMUP
else (& %■) STATE_NOX = REGENER-
ATION % Exit
LV_RGN_NT_REQ = 0
endif (& %■)
endif (136)
else (3+) **stay in WARMUP**
endif (3+)
endif (3)

Case STATE_NOX = LOAD
if (5) LV_NT_ACT = 0
then (5) STATE_NOX = PASSIVE % Exit to PASSIVE
else (5)

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if (5+) LV_PUC = 1 **AND**
MAF_INT_PUC_ACT(n-1) < MAF_INT_PUC_ACT(n) **A**

MAF_INT_PUC_ACT(n) >= C_MAF_INT_PUC_WAIT_MIN
then (5+) STATE_NOX = WAIT %
Exit to WAIT
else (5+) **if (5++)** LAMB_LS_UP_MIN < C_LAMB_RGN
then (5++) **call** transition actions load to regeneration
STATE_NOX = REGENERATION %Exit to REGENERATION
else (5++) stay in LOAD
endif (5++)
endif (5+)
endif (5)

case STATE_NOX = REGENERATION
if (6) LV_NT_ACT = 0
then (6) STATE_NOX = PASSIVE %
Exit to PASSIVE
else (6)
if (6+) (LV_RGN_NT_REQ = 1 **or** LAMB_LS_UP_MIN
<= C_LAMB_RGN)
then (6+) STATE_NOX = REGENERATION
in REGENERATION
else (6+) STATE_NOX = STOP %
Exit to STOP
SUM_NTL_CYC = SUM_NTL_CYC + 1
endif (6+)
endif (6)

case STATE_NOX = WAIT
if (7) LV_NT_ACT = 0
then (7) STATE_NOX = PASSIVE %
Exit to PASSIVE
else (7)
if (7+) LV_PUC = 1
then (7+) STATE_NOX = WAIT %
Stay in WAIT
else (7+) STATE_NOX = LOAD %
LAMB_LS_UP > C_LAMB_STC
endif (7+)
endif (7)

case STATE_NOX = STOP
if (8) LV_NT_ACT = 0
then (8) STATE_NOX = PASSIVE %
Exit to PASSIVE
else (8)
if (8+) LV_PUC = 1
then (8+) **call** transition actions on exiting STOP
STATE_NOX = WAIT % Exit to WAIT
else (8+)
if (8++) LAMB_LS_UP_MIN > C_LAMB_STC **and**
(LV_NT_AFS_REQ = 0 **or** LC_STATE_NOX_INH_NT_AFS_REQ = 1)

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then (8++) **call** transition actions on exiting STOP
STATE_NOX = LOAD % Exit to LOAD
else (8++) stay in STOP
endif (8++)
endif (8+)
endif (8)

7.86.1.1.2 Transition actions load to regeneration

NTLD_RGN_ST = NTLD_MDL
NTL_RGN_ST = NTL /C_FAC_O2_EQU + O2L /C_FAC_COR_O2L
NTL_RGN_ST_NOX = NTL
NOX_CONC_RED_MMV_RGN_ST = NOX_CONC_RED_MMV
NT_EFF_COR_RGN_ST = NT_EFF_COR
FLOW_NT_MMV = MAF_KGH
if(14) LV_RGN_NT_REQ = 1 % handling of LV_RGN_AGI
then (14) LV_RGN_AGI_i = 1
endif (14)
LV_RGN_AGI_VLD_i = 0 % final reset
LV_TRIG_AFR_AFL = 0 % reset triggerbit
STATE_AFL_PURGE[i] = DISABLED
MAF_INT_STOP_NTL = 0
if(141) LC_AFL_PURGE_RST = 0
then(141) T_STOP = 0
MAF_INT_STOP = 0
CTR_AFL_PURGE[i] = 0
else(141)
if(142) NTL > IP_NTL_MIN_AFL_PURGE(VS) **AND**
NTLD > IP_NTLD_MIN_AFL_PURGE(VS)
then(142) T_STOP = 0
MAF_INT_STOP = 0
CTR_AFL_PURGE[i] = 0
endif(142)
endif(141)

7.86.1.1.3 Transition actions on exiting STOP

NOX_OUT_MDL_INT = 0
LV_NOX_SENS_NOX_VLD_RGN_ST_i = 0
LV_T_AFL_MIN = 0
LV_TOUT_AFR = 0
LV_MDL_AFR = 0
FLOW_NT_MMV = MAF_KGH
if (16) T_NT_HOM > C_T_NT_HOM_MAX_VLD
then (16) LV_NT_HOM_INI = 0
endif (16)
DIST_AFL_ST = DIST
NOX_COR_INT = 0
STATE_AFL_PURGE[i] = DISABLED
LV_CAT_PURGE_REQ_POST_AFL[i] = 0
MAF_INT_STOP_NTL = 0
if(143) LC_AFL_PURGE_RST = 0

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then(143) T_STOP = 0
MAF_INT_STOP = 0
CTR_AFL_PURGE[i] = 0
endif(143)

Notes:

1. For the detection of a regeneration in catalyst purge the calibration data C_LAMB_RGN has to be calibrated always more lean than the calibrated lambda for catalyst purge.

The following table gives an overview, how variables are calculated depending on the NOx catalyst management state.

state-depending actions

	Passive/ Warmup	**RGN**	**Load**	**Wait**	**Stop**
NOX_COR_xx	0	0	C	0	0
NOX_CONC_xx	0	0	C	-	-
NT_STC_RNG_H	I	-	C	-	-
NTL	I	C	C	-	C
NTLD	0	C	C	-	C
NTLD_MDL	0	C	C	-	C
NT_EFF	0	0	C	0	0
NT_O2_STC	0	-	C	C	-
O2_FLOW	0	0	C	C	0
O2L	0	C	C	C	-
T_AFL	0	-	C	-	0
T_AFL_PUC	0	0	C	0	0
FLOW_NT_MMV	0	C	C	-	-
NTL_DEC_INT	0	C	0	0	-
Rgn request set	I	/	C	0	0
Purge request set / reset	0	C	C	0	0
Rgn request reset	/	C	/	0	0
AFS request block	0/C	C	C	C	C

I	initialise
0	set to zero
C	calculate
-	freeze value (no changes)
/	action forbidden

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7.86.1.2 STATE_NOX = PASSIVE

FUNCTION DESCRIPTION:

General information:

The state PASSIVE is active during engine stop, engine start, after start, warming up and inactivated NOx catalyst function.
The values of the variables listed below are their initialisation values.
If regeneration stop mode is model , NTL has to be initialised with a suitable high value in order to prevent the state manager to leave first regeneration (after function start) due to low model load.

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Application conditions

Initialisation:

```
at reset:
if (139)        LC_NTL_INI_ST = 1
then (139)        NTL = C_NTL_INI_ST
else (139)                  NTL = max(NTL(from NVMY) * C_FAC_
NTL_INI_ST,
                          C_NTL_INI_ST)
endif (139)
NTL_H = NTL
```

Recurrence: *20ms*

Activation: - -

Deactivation: - -

Formula section:

LV_TOUT_AFR = 0
LV_MDL_AFR = 0
LV_RGN_AGI_VLD_i = 0
LV_NT_HOM_INI = 0
LV_NOX_SENS_NOX_VLD_RGN_ST_i = 0
LV_T_AFL_MIN = 0
NOX_COR = 0
NOX_COR_RED = 0
NOX_COR_RED_MMV = 0
NOX_CONC_RAW = 0
NOX_CONC = 0
NOX_CONC_MMV = 0
NOX_CONC_RED = 0
NOX_CONC_RED_MMV = 0
NOX_CONC_OUT_MDL_MMV = 0
NOX_CONC_RED_MMV_RGN_ST = 0
NTLD = 0
NTLD_MDL = 0
NT_EFF = 0
NT_EFF_COR_RGN_ST = 1
NT_O2_STC = 0
O2_FLOW = 0
O2L = 0
T_AFL = 0
T_AFL_PUC = 0
NTL_DEC_INT_i = 0
NTL_DEC_INT_SWI_i = 0
NTL_RGN_ST = 0
NTL_RGN_ST_NOX = 0
NOX_OUT_MDL = 0
NOX_OUT_MDL_INT = 0
NOX_NS_AD_RGN_ST[i] = 0
FLOW_NT_MMV = 0
NT_AGI_AV = 1
NTL_DEC_INT_i = 0
LV_RGN_AGI_i = 0

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NOX_COR_INT = 0
DIST_AFL_ST = 0
DIST_AFL = 0
RATIO_NOX_OUT_INT_DIST_k = 0
RATIO_NOX_k = 0
LV_RGN_NT_REQ = 0
LV_ACT_INT_PUC_AFL_i = 0
NT_EFF_COR = 1
NT_STC_BAS_RNG_H = C_NT_STC_INI_RNG_H
LV_NT_AFS_REQ = LC_NT_AFS_REQ
NT_STC_RNG_H = C_NT_STC_INI_RNG_H
NTLD_RGN_ST = C_NTLD_RGN_ST_INI
T_NT_HOM = C_T_NT_HOM
LV_CAT_PURGE_REQ_POST_AFL[i] = 0
T_STOP = 0
MAF_INT_STOP = 0
MAF_INT_STOP_NTL = 0
CTR_AFL_PURGE[i] = 0
STATE_AFL_PURGE[i] = DISABLED
LV_NT_RGN_STOP_PUC = 0
MAF_INT_PUC_ACT(n-1) = MAF_INT_PUC_ACT(n)
if (140) LC_NTL_INI_ST = 1
then (140) NTL = C_NTL_INI_ST
NTL_H = NTL
endif (140)
LV_NTL_DEC_INT_AFR = 0
LV_NTL_DEC_INT_STOP_RGN = 0
LV_NT_RGN_2_NOT_VLD = 0
LV_NT_RGN_2_NOT_VLD_SET = 0
VLS_NOX_SENS_MMV = -200

7.86.1.3 STATE_NOX = WARMUP

Initialisation: - -
Recurrence: 100ms
Activation: - -
Deactivation: - -

Formula section:

% see also chapter 1.2.8
call "Homogeneous time counter handling"
T_NT_HOM = min (C_T_NT_HOM, T_NT_HOM(n-1) + 10 * T_NT_HOM_DELTA)

7.86.1.4 STATE_NOX = LOAD

FUNCTION DESCRIPTION:

Application conditions

Initialisation: – –
Recurrence: *20ms* (including all subchapters)

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Activation: – –

Deactivation: – –

General information:

The time counter for lean operation is incremented in STATE_NOX = LOAD
The integral of reducing agent is reset to zero, it is only valid in REGENERATION.

Formula section:

```
if (24)     LV_HOM_AFS_REQ = 0 and (LV_S_ACT = 1 or LV_HOM_AFL_ACT = 1)
then (24)     call "NOx emissions handling"
              call "NOx trap storage capacity and loading degree"
              call "NOx trap efficiency"
              call "Oxygen storage"
      if (25)          LV_NOX_SENS = 1
      then (25)
              if (123)         NC_NT_NR = NC_NOX_SENS_CONF
              then (123)          NOX_NS_AD_RGN_ST[i] = NOX_NS_AD[k]
              else (123)          NOX_NS_AD_RGN_ST[i] = NOX_NS_AD[1]
              endif (123)
      endif (25)
endif (24)

call "Filtered exhaust gas flow"
T_AFL (n)          = T_AFL (n-1) + TA           %TA = recurrence time
T_AFL_PUC (n)      = T_AFL_PUC (n-1) + TA
NTL_DEC_INT_i      = 0
if (26)    T_AFL >= C_T_AFL_NT_HOM_RST
     and            NTLD_MDL >= C_NTLD_NT_HOM_RST
then (26) T_NT_HOM = C_T_NT_HOM
endif (26)
```

7.86.1.4.1 NOx emissions handling

General information:

NOX_RED_FAC takes into account the amount of NOx emission, chemically reduced by the catalyst.

Signal flow diagram:

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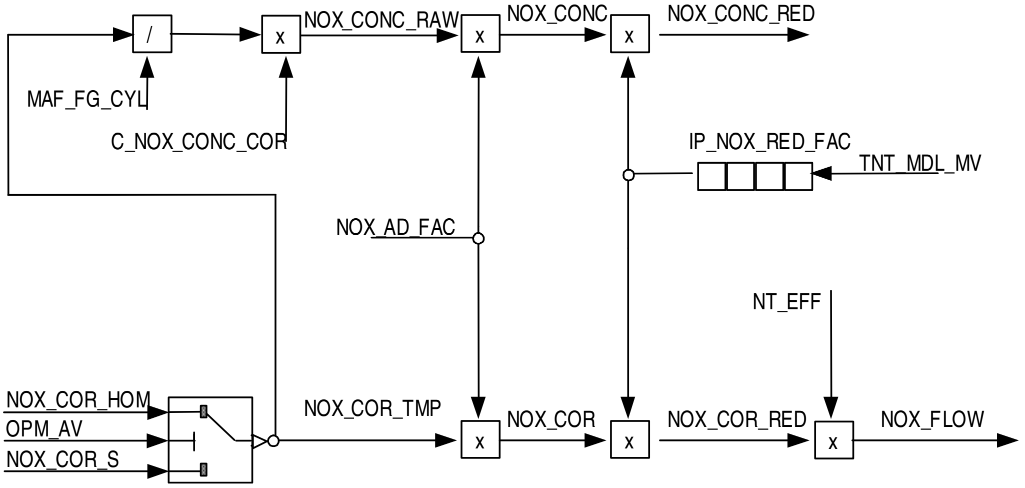

Figure 7.86.2: : NOx emissions handling

Formula section:

% Functions to calculate NOX_COR_S and NOX_COR_HOMS are calculated independently of this manager. All functions using NOX_COR_S or NOX_COR_HOMS have to be calculated after that.

case selection (125) on OPM_AV:

  case OPM_AV = "S":

    NOX_COR_TMP = NOX_COR_S

  case OPM_AV = "AFL" **or**
  case OPM_AV = "AFS":

    NOX_COR_TMP = NOX_COR_HOMS

  otherwise (default):

    NOX_COR_TMP = NOX_COR_HOMS

end case selection (125)

NOX_COR = NOX_COR_TMP * NOX_AD_FAC
NOX_COR_INT(n) = NOX_COR_INT(n-1) + NOX_COR(n) * recurrence
NOX_COR_RED = NOX_COR * IP_NOX_RED_FAC (TNT_MDL_MV)
NOX_COR_RED_MMV$_{n}$ = NOX_COR_RED * C_CRLC_NOX_COR_RED
    + NOX_COR_RED_MMV$_{n-1}$ * (1 - C_CRLC_NOX_COR_RED)
NOX_FLOW = NOX_COR_RED * NT_EFF

NOX_CONC_RAW = (NOX_COR_TMP /MAF_FG_CYL) * C_NOX_CONC_COR
NOX_CONC = NOX_CONC_RAW * NOX_AD_FAC
NOX_CONC_RED = NOX_CONC * IP_NOX_RED_FAC (TNT_MDL_MV)
NOX_CONC_MMV$_{n}$ = NOX_CONC * C_CRLC_NOX_CONC_RED
    + NOX_CONC_MMV$_{n-1}$ * (1 - C_CRLC_NOX_CONC_RED)
NOX_CONC_RED_MMV$_{n}$ = NOX_CONC_RED * C_CRLC_NOX_CONC_RED
    + NOX_CONC_RED_MMV$_{n-1}$ * (1 - C_CRLC_NOX_CONC_RED)

NOX_OUT_MDL = NOX_COR_RED * (1- NT_EFF)
NOX_CONC_OUT_MDL = NOX_CONC_RED * (1- NT_EFF)

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NOX_CONC_OUT_MDL_MMV$_{n}$ = NOX_CONC_OUT_MDL *
C_CRLC_NOX_CONC_OUT_MDL + NOX_CONC_OUT_MDL_MMV$_{n-1}$ *
(1 - C_CRLC_NOX_CONC_OUT_MDL)
NOX_OUT_MDL_INT= NOX_OUT_MDL_INT$_{n-1}$ + NOX_OUT_MDL
% NOX_OUT_MDL_INT has to be internally treated as a longint.

The factor C_NOX_CONC_COR consists of the following chemical constants:
C_NOX_CONC_COR = molmass air /molmass NO2 * (1/factor for transformation kg/h- -> kg/s) = 29 /46 * 3600 = 2269.565
This value should be the initialization value of the calibration data.
Due to possible small values of NOX_OUT_MDL, NOX_OUT_MDL_INT has to be internally treated as a longint.

7.86.1.4.2 NOx trap storage capacity and loading degree

General information:

The basic catalyst storage capacity is worked out by a map depending on the raw NOx concentration NOX_CONC and on the modelled NOx-trap temperature mean value. The aging factor NT_AGI_NTLD is delivered from the module NOx catalyst aging and reduces the basic storage capacity with the present aging state depending on catalyst temperature.
The current load of the NOx storage catalyst is worked out by the NOx mass flow actually available to be stored in the catalyst NOX_FLOW and the NOx trap efficiency NT_EFF.
The NOx trap loading degree is the ratio of the NOx trap absolute loading and the NOx storage capacity.
The increase of NTLD is limited to C_NTLD_LGRD per time step.

Signal flow diagram:

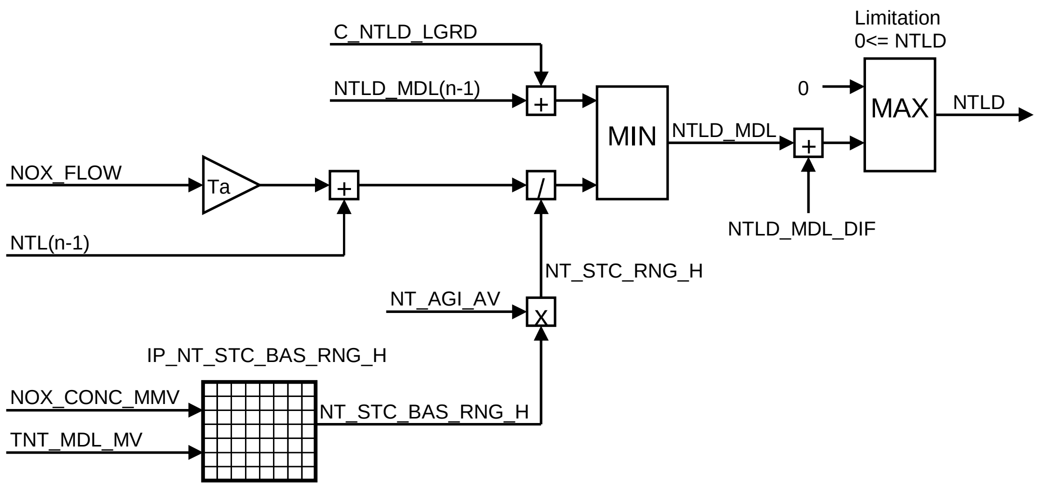

Figure 7.86.3: : NOx catalyst storage capacity, absolute loading and loading degree

Formula section:

NT_STC_BAS_RNG_H = IP_NT_STC_BAS_RNG_H (NOX_CONC_MMV, TNT_MDL_MV))
NT_AGI_AV = IP_NT_AGI_RGN_FRQ (NT_AGI_NTLD, TNT_MDL_MV)
NT_STC_RNG_H = NT_STC_BAS_RNG_H * NT_AGI_AV

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NTL_n = NTL_{n-1} + NOX_FLOW * Ta

if (164) TNT_MDL_MV >= (C_TNT_MDL_MV_NTL_H_RST_MIN + C_TNT_MDL_MV_NTL_H_RST_HYS) **AND**
TNT_MDL_MV <= (C_TNT_MDL_MV_NTL_H_RST_MAX - C_TNT_MDL_MV_NTL_H_RST_HYS)
then (164) NTL_H_n = NTL_H_{n-1} + NOX_FLOW * Ta
else (164)
if (165) LC_NTL_H_RST_LOAD_TNT = 1
then (165) *NTL_H is reset*
NTL_H_n = NTL_MIN
else (165) *NTL_H is frozen*
NTL_H_n = NTL_H_{n-1}
endif (165)
endif (164)

Attention!
- Observe different resolutions and value ranges of NTL, NTL_H and NTL_MIN.
- NTL and NTL_H should be internally calculated as longint.

NTLD_MDL = min (NTL /NT_STC_RNG_H, NTLD_MDL(n-1) + C_NTLD_LGRD)
NTLD = **max** (0, NTLD_MDL + NTLD_MDL_DIF)

7.86.1.4.3 NOx trap efficiency

General information:

The base NOx trap efficiency is given by a map depending on NOx trap loading degree and the modelled NOx trap temperature. The base value is corrected depending on the raw NOx mass flow NOX_COR.
Note: The value NT_EFF is limited to 1 in the program.

Signal flow diagram:

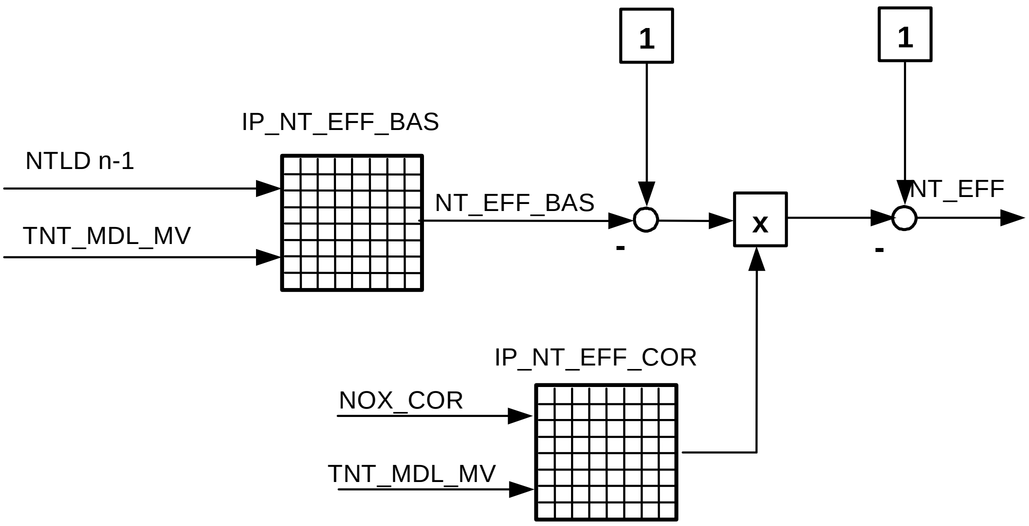

Figure 7.86.4: : NOx trap efficiency (simplified)

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Formula section:

if (30) LV_EF = 0
then (30) NT_EFF_BAS = IP_NT_EFF_BAS (NTLD, TNT_MDL_MV)
else (30) NT_EFF_BAS = IP_NT_EFF_BAS_EF_CLOSE (NTLD, TNT_MDL_MV)
% not shown in the figure

NT_EFF_COR = IP_NT_EFF_COR (NOX_COR, TNT_MDL_MV)
NT_EFF = 1 - ((1 - NT_EFF_BAS) * NT_EFF_COR)

7.86.1.4.4 Oxygen storage

General information:

During lean operation the NOx trap stores Oxygen. The current load of stored Oxygen in the NOx trap, O2L is worked out by a formula.

Signal flow diagram:

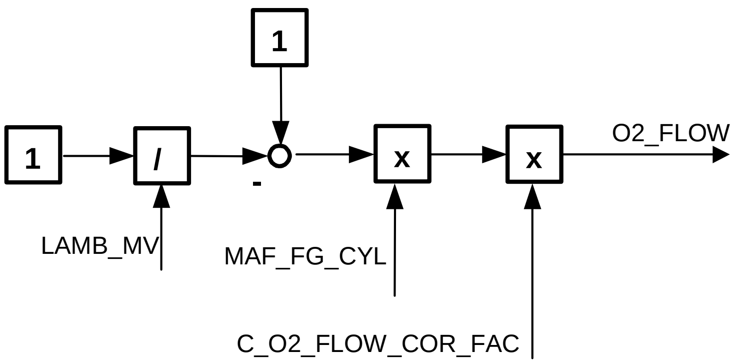

Figure 7.86.5: : Oxygen mass flow

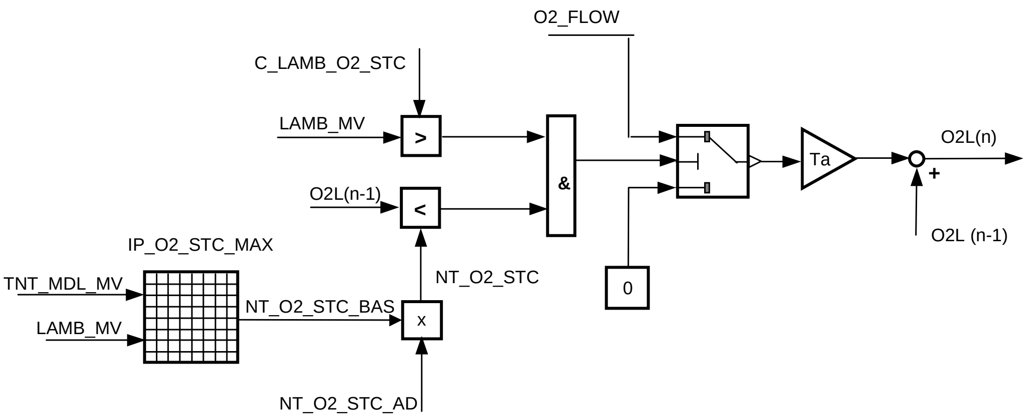

Figure 7.86.6: : Oxygen storage

Formula section:

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NT_O2_STC_BAS= IP_O2_STC_MAX (LAMB_LS_UP_MV, TNT_MDL_MV)
NT_O2_STC = NT_O2_STC_BAS * NT_O2_STC_AD
if (32) (LAMB_LS_UP_MV > C_LAMB_O2_STC)
and LAMB_LS_UP_MV > 1
and (O2L < NT_O2_STC)
then (32) O2_FLOW = (1 - (1/LAMB_LS_UP_MV))
* MAF_FG_CYL * C_O2_FLOW_COR_FAC
O2L (n) = O2L (n-1) + O2_FLOW * Ta
else (32) O2L (n) = O2L (n-1)
endif (32)
The factor C_O2_FLOW_COR_FAC consists of the following constants:
C_O2_FLOW_COR_FAC = (0.21* molmass(O2)) /molmass(air) * factor for transformation of MAF_FG_CYL (kg/h) to (mg/s)) = 0.21 * 32 /29 * 10ˆ6 /3600 = 64.37
This value should be the initialization value of the calibration data.

7.86.1.5 STATE_NOX = WAIT

FUNCTION DESCRIPTION:

Application conditions

Initialisation: – –

Recurrence: *10ms*

Activation: – –

Deactivation: – –

Formula section:

if (144) MAF_INT_PUC_ACT(n-1) < MAF_INT_PUC_ACT(n)
AND
MAF_INT_PUC_ACT(n) >= C_MAF_INT_PUC_RST_RGN_REQ
then (144) LV_RGN_NT_REQ = 0
endif (144)

Application conditions

Initialisation: – –

Recurrence: *20ms* (including all subchapters)

Activation: – –

Deactivation: – –

7.86.1.5.1 General, NOx storage

General information:

When the engine state LV_PUC is active (-> STATE_NOX = WAIT), the NOx trap loading calculation is frozen.

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Formula section:

NOX_COR = 0
NOX_COR_RED = 0
NOX_COR_RED_MMV = 0
NOX_CONC_RAW = 0
NOX_CONC = 0
NOX_CONC_RED = 0
NOX_CONC_MMV = NOX_CONC_MMV $_{n-1}$
NOX_CONC_RED_MMV = NOX_CONC_RED_MMV $_{n-1}$
NOX_CONC_OUT_MDL_MMV = NOX_CONC_OUT_MDL_MMV $_{n-1}$
NOX_OUT_MDL = 0
NT_STC_RNG_H = NT_STC_RNG_H(n-1)
NTLD = NTLD (n-1)
NTLD_MDL = NTLD_MDL (n-1)
NT_EFF = 0
T_AFL = T_AFL (n-1)
T_AFL_PUC = 0
NTL_DEC_INT_i = 0
T_NT_HOM = T_NT_HOM (n-1)
LV_CAT_PURGE_REQ_POST_AFL[i] = 0
NTL = NTL$_{n-1}$
if (161) **(** MAF_INT_PUC_ACT(n-1) $<$ MAF_INT_PUC_ACT(n)
AND
MAF_INT_PUC_ACT(n) $>$ C_MAF_INT_PUC_NTL_H_RST **)**
TNT_MDL_MV $<$ C_TNT_MDL_MV_NTL_H_RST_MIN
TNT_MDL_MV $>$ C_TNT_MDL_MV_NTL_H_RST_MAX
then (161) *NTL_H is reset*
NTL_H = NTL_MIN
else (161) *NTL_H is frozen*
NTL_H = NTL_H$_{n-1}$
endif (161)
LV_ACT_INT_PUC_AFL_i = 0

Evaluation of slope of MAF_INT_PUC_ACT moved from 20ms to 10ms.

7.86.1.5.2 Oxygen mass flow and oxygen storage

General information:

During the engine state LV_PUC the NOx catalyst stores oxygen. The current load of stored oxygen in the NOx trap is worked out by a formula.
The calculation of the following quantities is done in the same way as in STATE_NOX = LOAD.
(see subchapter STATE_NOX = LOAD , passage oxygen storage) (3 pages above)

Formula section:

call "Oxygen storage"

7.86.1.6 STATE_NOX = REGENERATION

FUNCTION DESCRIPTION:

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General information:

For the regeneration of the NOx trap a rich mixture is required.

Application conditions

Initialisation: – –

Recurrence: *10ms* (including all subchapters)

Activation: – –

Deactivation: – –

7.86.1.6.1 Miscellaneous

Formula section:

NOX_COR = 0
NOX_COR_RED = 0
NOX_COR_RED_MMV = 0
NOX_CONC_RAW = 0
NOX_CONC = 0
NOX_CONC_RED = 0
NOX_CONC_MMV = 0
NOX_CONC_RED_MMV = 0
NOX_CONC_OUT_MDL_MMV = 0
NOX_OUT_MDL = 0
NT_STC_RNG_H = NT_STC_RNG_H(n-1)
NT_EFF = 0
NT_O2_STC = NT_O2_STC(n-1)
O2_FLOW = 0
T_AFL = T_AFL (n-1)
T_AFL_PUC = 0
call " Filtered exhaust gas flow "
call "Homogeneous time counter handling"
T_NT_HOM = **min** (C_T_NT_HOM, T_NT_HOM$_{(n-1)}$ + T_NT_HOM_DELTA)

7.86.1.6.2 Handling of trigger bits for functions using RAI signal

Formula section:

% undefined exhaust gas during regeneration
if (38) LV_SCC[m] = 1
or LV_PUC = 1
or (C_STATE_SENS_AFR_i = "VLS_NOX_SENS" **and** LV_NOX_SENS_VLS_VLD_k = 0)
or (C_STATE_SENS_AFR_i = "LAMB_NOX_SENS" **and** LV_NOX_SENS_LAMB_VLD_k = 0)
then (38) LV_RGN_AGI_i = 0
endif (38)

% sensor switches during valid regeneration
if(39) LV_SENS_AFR_i = 1 **and** LV_RGN_AGI_i = 1
then (39) LV_RGN_AGI_i = 0

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LV_RGN_AGI_VLD_i = 1
endif (39)

7.86.1.6.3 Calculation of NTL_DEC and NTL_DEC_INT

General information:

For the regeneration of the NOx trap a rich mixture is required.
NTL_DEC_i represents the lack of oxygen during regeneration. This lack of oxygen corresponds to the reducing agent mass. The unit of NTL_DEC therefore is [mg O2 /time step].
NTL_DEC_INT_i represents the integral of the NTL_DEC_i during regeneration. It is calculated during the regeneration phase.
NTL_DEC_INT_SWI represents the NTL_DEC_INT up to the moment the downstream sensor switches from lean to rich. This value may be used for several adaptation purposes.
Due to possible small values of NTL_DEC (defined as a longint), NTL_DEC_INT has to be internally treated as a longint.

Formula section:

if (155) NC_NT_NR = 2
then (155) *Twin branch system with 2 TWC and 2 NOx catalysts NC_CBK_EX_NR = NC_NT_NR = 2 => i = m = 2*
if (147) LAMB_LS_UP[m] < 1.0
VLS_DOWN[m] >= C_VLS_DOWN_MIN_NTL_DEC[m]
then (147) NTL_DEC[i] = ((1 /LAMB_LS_UP[m]) - 1) * (MAF_FG_CYL /NC_CBK_EX_NR) * C_O2_FLOW_COR_FAC * Recurrence
NTL_DEC_INT_i = NTL_DEC_INT_i (n-1) + NTL_DEC[i]
else (147) NTL_DEC[i] = 0
NTL_DEC_INT_i = NTL_DEC_INT_i (n-1)
endif (147)

if (148) LC_SENS_AFR_MOD = 0
then (148)
if (40) LV_SENS_AFR[i] = 0
then (40) NTL_DEC_INT_SWI[i] = NTL_DEC_INT_i
endif (40)
else (148)
case selection on STATE_RGN[1]:
"H_AMPL":
if (149) LV_SENS_AFR[1] = 0
then (149) NTL_DEC_INT_SWI[1] = NTL_DEC_INT_1
endif (149)

"L_AMPL":
if (150) LV_SENS_AFR[2] = 0
then (150) NTL_DEC_INT_SWI[1] = NTL_DEC_INT_1
endif (150)

"PARK": - –
"PASSIVE" (default): - –
end case selection

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```
        case selection on STATE_RGN[2]:
            "H_AMPL":
                if (151)        LV_SENS_AFR[1] = 0
                then (151)          NTL_DEC_INT_SWI[2] = NTL_DEC_INT_2
                endif (151)

            "L_AMPL":
                if (152)        LV_SENS_AFR[2] = 0
                then (152)          NTL_DEC_INT_SWI[2] = NTL_DEC_INT_2
                endif (152)

            "PARK":         - –
            "PASSIVE" (default):        - –
        end case selection
    endif (148)

    NTL_DEC_SUM = NTL_DEC[1] + NTL_DEC[2]

else (155)          Single branch or Y system with 1 or 2 TWC and 1 NOx catalyst
    NC_CBK_EX_NR = m = 1,2; NC_NT_NR = i = 1
    if (156)                                        NC_CBK_EX_NR = 2
    then (156)          Y system with 2 TWC and 1 NOx catalyst
            NC_CBK_EX_NR = m = 2; NC_NT_NR = i = 1
        if (157)                                        LAMB_LS_UP_MV  < 1.0

                VLS_DOWN[1] >= C_VLS_DOWN_MIN_NTL_DEC[1]

                VLS_DOWN[2] >= C_VLS_DOWN_MIN_NTL_DEC[2]
        then (157)          NTL_DEC[1] = ((1 /LAMB_LS_UP_MV) - 1) * (MAF_FG_CYL /NC_
        CBK_EX_NR)  * C_O2_FLOW_COR_FAC * Recurrence
                    NTL_DEC_INT_1 = NTL_DEC_INT_1 (n-1) + NTL_DEC[1]
        else (157)          NTL_DEC[1] = 0
                    NTL_DEC_INT_1 = NTL_DEC_INT_1 (n-1)
        endif (157)

    else (156)          Single branch system with 1 TWC and 1 NOx catalyst
            NC_CBK_EX_NR = 1; NC_NT_NR = 1   =>   m = i = 1
        if (158)                                        LAMB_LS_UP[m]  < 1.0

                VLS_DOWN[m] >= C_VLS_DOWN_MIN_NTL_DEC[m]
        then (158)          NTL_DEC[1] = ((1 /LAMB_LS_UP[1]) - 1) * (MAF_FG_CYL /NC_
        CBK_EX_NR)  * C_O2_FLOW_COR_FAC * Recurrence
                    NTL_DEC_INT_1 = NTL_DEC_INT_1 (n-1) + NTL_DEC[1]
        else (158)          NTL_DEC[1] = 0
                    NTL_DEC_INT_1 = NTL_DEC_INT_1 (n-1)
        endif (158)

    endif (156)

    if (154)        LV_SENS_AFR[1] = 0
    then (154)          NTL_DEC_INT_SWI[1] = NTL_DEC_INT_1
    endif (154)
```

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NTL_DEC_SUM = NTL_DEC[1]

endif (155)

The factor C_O2_FLOW_COR_FAC consists of the following constants:
C_O2_FLOW_COR_FAC = (0.21* molmass(O2)) /molmass(air) * factor for transformation of MAF_FG_CYL (kg/h) to (mg/s)) = 0.21 * 32 /29 * 10^6 /3600 = 64.37
This value should be the initialization value of the calibration data.

NTL_DEC_INT has to be internally treated as a longint.

7.86.1.6.4 Decrementation of the NOx trap absolute loading of NOx and O2

General information:

During the regeneration phase the reducing agent is used for both, the reduction of the stored NOx and the stored O2. This is taken into account by using a share factor FAC_RGN_DEC_SHAR for the decrement of the NTL and the O2L. This share factor is calculated using the ratio of stored O2 to the sum of stored O2 and NOx.
C_FAC_O2_EQU and C_FAC_COR_O2L are based on the chemical equation of the regeneration phase.

1. C_FAC_O2_EQU should be calibrated with 1.25 to be neutral.
2. C_FAC_COR_O2L should be calibrated with 1 to be neutral.

The constant C_O2_FLOW_COR_FAC and is also defined in oxygen storage subchapter of STATE_NOX=LOAD chapter.

Signal flow diagram:

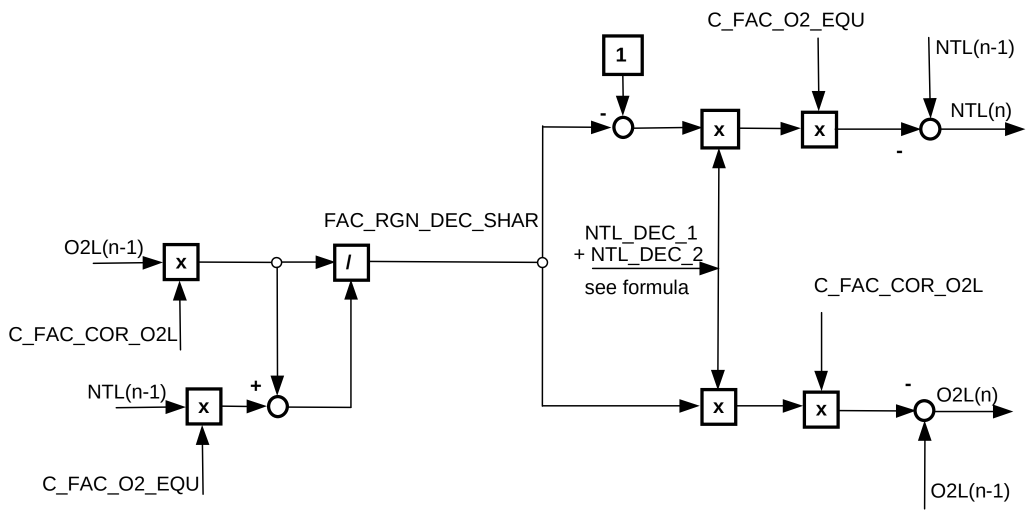

Figure 7.86.7: : NOx trap loading decrement during regeneration phase

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Formula section:

FAC_RGN_DEC_SHAR = O2L(n-1) * C_FAC_COR_O2L /
(O2L(n-1) * C_FAC_COR_O2L + NTL(n-1) * C_FAC_O2_EQU)

NTL_n = **max** [NTL_MIN, NTL_{n-1} - (1-FAC_RGN_DEC_SHAR) * NTL_DEC_SUM * C_FAC_O2_EQU]
NTL_H_n = **max** [NTL_MIN, NTL_H_{n-1} - (1-FAC_RGN_DEC_SHAR) * NTL_DEC_SUM * C_FAC_O2_EQU]
Attention!
- Observe different resolutions and value ranges of NTL, NTL_H and NTL_MIN.
- NTL and NTL_H should be internally calculated as longint.

O2L(n) = **max** (0, O2L (n-1) - FAC_RGN_DEC_SHAR * NTL_DEC_SUM * C_FAC_COR_O2L)
NTLD_MDL = NTL /NT_STC_RNG_H
NTLD = max (0, NTLD_MDL + NTLD_MDL_DIF)

7.86.1.7 STATE_NOX = STOP

FUNCTION DESCRIPTION:

General information:

When STATE_NOX remains in STOP (e.g. due to Lambda=1-engine operation), NTL_MIN can change due to trap temperature changes.
When the system remains in STATE_NOX = STOP for a longer time after a lean operation phase then the catalyst purge functionality is activated. The catalyst purge functionality is controlled by an own state machine.

Signal flow diagram:

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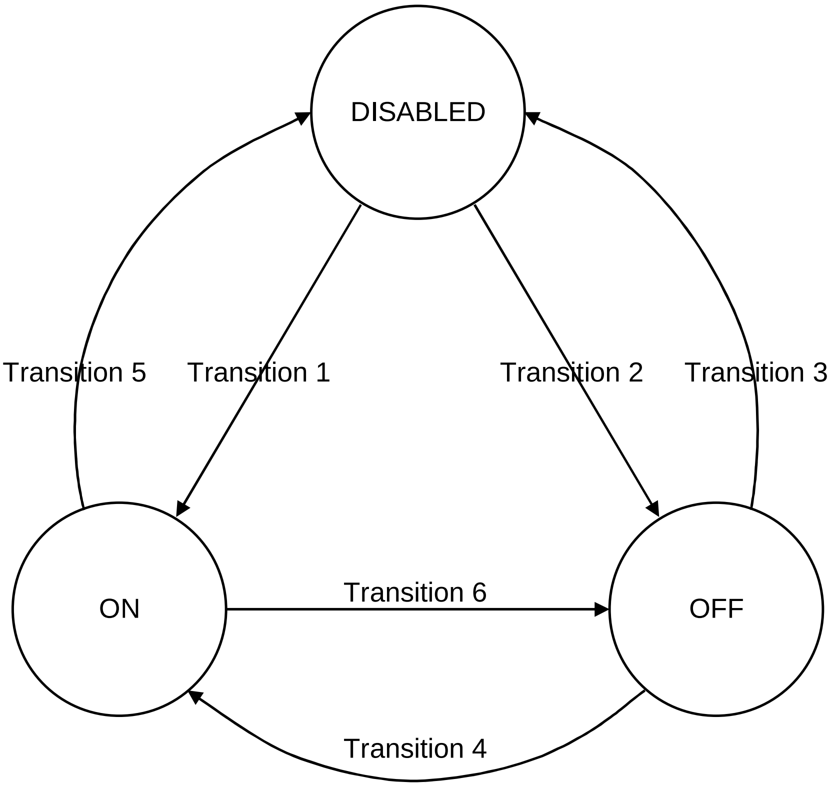

Figure 7.86.8: : State diagram for activation and deactivation of catalyst purge after lean operation

Application conditions

Initialisation: – –

Recurrence: *20ms*

Activation: – –

Deactivation: – –

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Formula section:

NOX_COR = 0
NOX_COR_RED = 0
NOX_COR_RED_MMV = 0
NOX_CONC_RAW = 0
NOX_CONC = 0
NOX_CONC_RED = 0
NOX_OUT_MDL = 0
NT_STC_RNG_H = NT_STC_RNG_H(n-1)
NT_EFF = 0
NT_O2_STC = NT_O2_STC(n-1)
O2_FLOW = 0
NTL_DEC_INT_i = NTL_DEC_INT_i (n-1)
NTLD_MDL = NTL /NT_STC_RNG_H
NTLD = max (0, NTLD_MDL + NTLD_MDL_DIF)

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call "Homogeneous time counter handling"
T_NT_HOM = **min** (C_T_NT_HOM, T_NT_HOM$_{(n-1)}$ + 2 * T_NT_HOM_DELTA)
LV_ACT_INT_PUC_AFL_i = 0 % purge with low priority, final reset
LV_RGN_AGI_i = 0 % final reset

if (146) T_NT_STST_ACT >= C_T_AFL_RST
then (146) T_AFL = 0
else (146) % T_AFL remains unchanged
T_AFL(n) = T_AFL(n-1)
endif (146)

if (162) MAF_INT_STOP_NTL < maximum value (FFFFH)
then (162) MAF_INT_STOP_NTL(n) = MAF_INT_STOP_NTL(n-1) + MAF_KGH * Recurrence
else (162) % integral remains unchanged on its maximum value
MAF_INT_STOP_NTL(n) = MAF_INT_STOP_NTL(n-1)
endif (162)

if (-) LV_SENS_AFR[i] = 1 % valid for all values of i
then (-) NTL = MIN (NTL (n-1), NTL_MIN)
NTL_H = MIN (NTL_H (n-1), NTL_MIN)
O2L = 0
else (-) NTL = NTL (n-1)
O2L = O2L(n-1)
if (163) MAF_INT_STOP_NTL > C_MAF_INT_STOP_NTL_H_RST **OR**
TNT_MDL_MV < C_TNT_MDL_MV_NTL_H_RST_MIN
TNT_MDL_MV > C_TNT_MDL_MV_NTL_H_RST_MAX
then (163) *NTL_H is reset*
NTL_H = NTL_MIN
else (163) *NTL_H is frozen*
NTL_H = NTL_H$_{n-1}$
endif (163)
endif (-)

if (91) T_STOP < maximum value (FFFFH)
then (91) increment T_STOP
else (91) % timer remains unchanged on its maximum value
T_STOP(n) = T_STOP(n-1)
endif (91)

if (92) MAF_INT_STOP < maximum value (FFFFH)
then (92) MAF_INT_STOP(n) = MAF_INT_STOP(n-1) + MAF_KGH * Recurrence
else (92) % integral remains unchanged on its maximum value
MAF_INT_STOP(n) = MAF_INT_STOP(n-1)
endif (92)

% State machine for set and reset of LV_CAT_PURGE_REQ_POST_AFL[i]
% The priorities of the conditions to change between states shall be defined by the order in which these conditions are listed within the appropriate state as described below.
% If a transition condition is fulfilled, then the following transition conditions are **not** calculated.

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STATE_AFL_PURGE[i] = "DISABLED" (default state)**:**

Transition 1: *"DISABLED" to "ON"*

if (93) LV_CAT_PURGE_REQ_POST_AFL[i] = 1 **AND**
TNT_MDL_MV > C_TNT_MDL_PURGE_MIN **AND**
TNT_MDL_MV < C_TNT_MDL_PURGE_MAX **AND**
VS < C_VS_PURGE_MAX **AND**
LV_NS_AD_REQ = 0 **AND**
(LV_NS_SHIFT_CMB_INT_REQ = 0 **OR**
LC_NS_SHIFT_INH_AFL_PURGE = 0**)** **AND**
(LV_VLS_NS_VLD[k] = 1 **OR** LC_VLS_NS_VLD_AFL_PURGE = 0**)**
then (93) STATE_AFL_PURGE[i] = "ON"
CTR_AFL_PURGE[i](n) = CTR_AFL_PURGE[i](n-1) + 1
else (93)

Transition 2: *"DISABLED" to "OFF"*

if (94) T_STOP <= C_T_STOP_AFL_PURGE_MAX **AND**
MAF_INT_STOP <= C_MAF_INT_STOP_AFL_PURGE_MAX
CTR_AFL_PURGE[i] < C_CTR_AFL_PURGE_MAX **AND**
TNT_MDL_MV > C_TNT_MDL_PURGE_MIN **AND**
TNT_MDL_MV < C_TNT_MDL_PURGE_MAX **AND**
VS < C_VS_PURGE_MAX **AND**
LV_NS_AD_REQ = 0 **AND**
(LV_NS_SHIFT_CMB_INT_REQ = 0 **OR**
LC_NS_SHIFT_INH_AFL_PURGE = 0**)** **AND**
(LV_VLS_NS_VLD[k] = 1 **OR** LC_VLS_NS_VLD_AFL_PURGE = 0**)**
then (94) STATE_AFL_PURGE[i] = "OFF"
else (94)

Steady state actions:

LV_CAT_PURGE_REQ_POST_AFL[i] = 0

endif (94)
endif (93)

STATE_AFL_PURGE[i] = "OFF":

Transition 3: *"OFF" to "DISABLED"*

if (95) T_STOP > C_T_STOP_AFL_PURGE_MAX **OR**
MAF_INT_STOP > C_MAF_INT_STOP_AFL_PURGE_MAX **OR**
CTR_AFL_PURGE[i] >= C_CTR_AFL_PURGE_MAX **OR**
TNT_MDL_MV < C_TNT_MDL_PURGE_DEAC **OR**
TNT_MDL_MV > C_TNT_MDL_PURGE_MAX **OR**
VS > C_VS_PURGE_MAX **OR**
LV_NS_AD_REQ = 1 **OR**
(LV_NS_SHIFT_CMB_INT_REQ = 1 **AND**
LC_NS_SHIFT_INH_AFL_PURGE = 1**)** **OR**
(LV_VLS_NS_VLD[k] = 0 **AND** LC_VLS_NS_VLD_AFL_PURGE = 1**)**
then (95) STATE_AFL_PURGE[i] = "DISABLED"
LV_CAT_PURGE_REQ_POST_AFL[i] = 0
else (95)

Transition 4: *"OFF" to "ON"*

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if (96) NC_NT_NR = 2 **AND** LC_SENS_AFR_MOD = 1

% NC_NT_NR = 2 means 2 NOx catalysts are within the exhaust system

% If NC_NT_NR = 1 or the case above then the calculation of branch 1 is sufficient. After that the branch 1 results are copied to branch 2.

then (96)

case selection on C_STATE_SENS_AFL_PURGE[1]**:**

case "VLS_DOWN":

if (97) VLS_DOWN[1] < C_VLS_DOWN_AFL_PURGE_ON

then (97) STATE_AFL_PURGE[1] = "ON"

LV_CAT_PURGE_REQ_POST_AFL[1] = 1

CTR_AFL_PURGE[1](n) = CTR_AFL_PURGE[1](n-1) + 1

endif (97)

case "VLS_NOX_SENS":

if (98) VLS_NOX_SENS[1] < C_VLS_NOX_SENS_AFL_PURGE_ON

then (98) STATE_AFL_PURGE[1] = "ON"

LV_CAT_PURGE_REQ_POST_AFL[1] = 1

CTR_AFL_PURGE[1](n) = CTR_AFL_PURGE[1](n-1) + 1

endif (98)

case "LAMB_NOX_SENS":

if (99) LAMB_NOX_SENS[1] > C_LAMB_NOX_SENS_AFL_PURGE_ON

then (99) STATE_AFL_PURGE[1] = "ON"

LV_CAT_PURGE_REQ_POST_AFL[1] = 1

CTR_AFL_PURGE[1](n) = CTR_AFL_PURGE[1](n-1) + 1

endif (99)

case "VLS_NT_DOWN":

if (100) VLS_NT_DOWN[1] < C_VLS_DOWN_AFL_PURGE_ON

then (100) STATE_AFL_PURGE[1] = "ON"

LV_CAT_PURGE_REQ_POST_AFL[1] = 1

CTR_AFL_PURGE[1](n) = CTR_AFL_PURGE[1](n-1) + 1

endif (100)

case "NONE":

- –

end case selection

STATE_AFL_PURGE[2] = STATE_AFL_PURGE[1]

LV_CAT_PURGE_REQ_POST_AFL[2] = LV_CAT_PURGE_REQ_POST_AFL[1]

CTR_AFL_PURGE[2] = CTR_AFL_PURGE[1]

else (96)

% Full 2 branch calculation.

case selection on C_STATE_SENS_AFL_PURGE[i]**:**

case "VLS_DOWN":

if (101) VLS_DOWN[m] < C_VLS_DOWN_AFL_PURGE_ON

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then (101) STATE_AFL_PURGE[i] = "ON"
LV_CAT_PURGE_REQ_POST_AFL[i] = 1
CTR_AFL_PURGE[i](n) = CTR_AFL_PURGE[i](n-1) + 1
endif (101)

case "VLS_NOX_SENS":
if (102) VLS_NOX_SENS[k] < C_VLS_NOX_SENS_AFL_PURGE_ON
then (102) STATE_AFL_PURGE[i] = "ON"
LV_CAT_PURGE_REQ_POST_AFL[i] = 1
CTR_AFL_PURGE[i](n) = CTR_AFL_PURGE[i](n-1) + 1
endif (102)

case "LAMB_NOX_SENS":
if (103) LAMB_NOX_SENS[k] > C_LAMB_NOX_SENS_AFL_PURGE_ON
then (103) STATE_AFL_PURGE[i] = "ON"
LV_CAT_PURGE_REQ_POST_AFL[i] = 1
CTR_AFL_PURGE[i](n) = CTR_AFL_PURGE[i](n-1) + 1
endif (103)

case "VLS_NT_DOWN":
if (104) VLS_NT_DOWN[k] < C_VLS_DOWN_AFL_PURGE_ON
then (104) STATE_AFL_PURGE[i] = "ON"
LV_CAT_PURGE_REQ_POST_AFL[i] = 1
CTR_AFL_PURGE[i](n) = CTR_AFL_PURGE[i](n-1) + 1
endif (104)

case "NONE":
- –

end case selection
endif (96)

Steady state actions:
- –

endif (95)

STATE_AFL_PURGE[i] = "ON":
Transition 5: *"ON" to "DISABLED"*
if (105) TNT_MDL_MV < C_TNT_MDL_PURGE_DEAC
OR
TNT_MDL_MV > C_TNT_MDL_PURGE_MAX **OR**
VS > C_VS_PURGE_MAX **OR**
LV_NS_AD_REQ = 1 **OR**
(LV_NS_SHIFT_CMB_INT_REQ = 1 **AND**
LC_NS_SHIFT_INH_AFL_PURGE = 1)
(LV_VLS_NS_VLD[k] = 0 **AND** LC_VLS_NS_VLD_AFL_PURGE = 1)
(LC_INH_AFL_PURGE_TOUT = 0 **AND**
(T_STOP > C_T_STOP_AFL_PURGE_MAX **OR**
MAF_INT_STOP > C_MAF_INT_STOP_AFL_PURGE_MAX

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CTR_AFL_PURGE[i] > C_CTR_AFL_PURGE_MAX))
then (105) STATE_AFL_PURGE[i] = "DISABLED"
LV_CAT_PURGE_REQ_POST_AFL[i] = 0
else (105)

Transition 6: *"ON" to "OFF"*
if (106) NC_NT_NR = 2 **AND** LC_SENS_AFR_MOD = 1
% NC_NT_NR = 2 means 2 NOx catalysts are within the exhaust system
% If NC_NT_NR = 1 or the case above then the calculation of branch 1 is sufficient. After that the branch 1 results are copied to branch 2.
then (106)
case selection on C_STATE_SENS_AFL_PURGE[1]:
case "VLS_DOWN":
if (107) VLS_DOWN[1] >= C_VLS_DOWN_AFL_PURGE_OFF
then (107) STATE_AFL_PURGE[1] = "OFF"
LV_CAT_PURGE_REQ_POST_AFL[1] = 0
endif (107)

case "VLS_NOX_SENS":
if (108) VLS_NOX_SENS[1] >= C_VLS_NOX_SENS_AFL_PURGE_OFF
then (108) STATE_AFL_PURGE[1] = "OFF"
LV_CAT_PURGE_REQ_POST_AFL[1] = 0
endif (108)

case "LAMB_NOX_SENS":
if (109) LAMB_NOX_SENS[1] <= C_LAMB_NOX_SENS_AFL_PURGE_OFF
then (109) STATE_AFL_PURGE[1] = "OFF"
LV_CAT_PURGE_REQ_POST_AFL[1] = 0
endif (109)

case "VLS_NT_DOWN":
if (110) VLS_NT_DOWN[1] >= C_VLS_DOWN_AFL_PURGE_OFF
then (110) STATE_AFL_PURGE[1] = "OFF"
LV_CAT_PURGE_REQ_POST_AFL[1] = 0
endif (110)

case "NONE":
- –
end case selection

STATE_AFL_PURGE[2] = STATE_AFL_PURGE[1]
LV_CAT_PURGE_REQ_POST_AFL[2] = LV_CAT_PURGE_REQ_POST_AFL[1]

else (106)
% Full 2 branch calculation.
case selection on C_STATE_SENS_AFL_PURGE[i]:
case "VLS_DOWN":

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if (111) VLS_DOWN[m] >= C_VLS_DOWN_AFL_PURGE_OFF
then (111) STATE_AFL_PURGE[i] = "OFF"
LV_CAT_PURGE_REQ_POST_AFL[i] = 0
endif (111)

case "VLS_NOX_SENS":
if (112) VLS_NOX_SENS[k] >= C_VLS_NOX_SENS_AFL_PURGE_OFF
then (112) STATE_AFL_PURGE[i] = "OFF"
LV_CAT_PURGE_REQ_POST_AFL[i] = 0
endif (112)

case "LAMB_NOX_SENS":
if (113) LAMB_NOX_SENS[k] <= C_LAMB_NOX_SENS_AFL_PURGE_OFF
then (113) STATE_AFL_PURGE[i] = "OFF"
LV_CAT_PURGE_REQ_POST_AFL[i] = 0
endif (113)

case "VLS_NT_DOWN":
if (114) VLS_NT_DOWN[k] >= C_VLS_DOWN_AFL_PURGE_OFF
then (114) STATE_AFL_PURGE[i] = "OFF"
LV_CAT_PURGE_REQ_POST_AFL[i] = 0
endif (114)

case "NONE":
- –

end case selection
endif (106)

Steady state actions:
- –

endif (105)
Notes:
1. For detection of a regeneration in catalyst purge the calibration data C_LAMB_RGN has to be calibrated always more lean than the calibrated lambda for catalyst purge.
2. C_NT_STC_BAS_MAX_RNG_H should represent the maximum value of the base NOx trap storage capacity map IP_NT_STC_BAS_RNG_H. If any changes occur to IP_NT_STC_BAS_RNG_H, this constant must be updated manually.

7.86.2 NOx catalyst management - request coordination

7.86.2.1 Called blocks

FUNCTION DESCRIPTION:

These blocks are executed when called

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7.86.2.1.1 Filtered exhaust gas flow

FUNCTION DESCRIPTION:

Application conditions

Initialisation:	*FLOW_NT_MMV = 0*
Recurrence:	*20 ms*
Activation:	– –
Deactivation:	– –

Formula section:

FLOW_NT_MMV = FLOW_NT_MMV$_{(n-1)}$ * (1-C_CRLC_FLOW_NT) + MAF_KGH * C_CRLC_FLOW_NT

7.86.2.1.2 Homogeneous time counter handling

FUNCTION DESCRIPTION:

Application conditions

Initialisation:	*T_NT_HOM_DELTA = 0*
Recurrence:	– –
Activation:	– –
Deactivation:	– –

Formula section:

```
% decrement per 10ms
if (46)         LV_HOM_AFS_ACT = 1
then (46)
    if (47)         LV_SENS_AFR_TRIM = 1
    then (47)       T_NT_HOM_DELTA = - IP_T_NT_HOM_DEC (MAF_KGH, LAMB_AV_COR)
    else (47)       T_NT_HOM_DELTA = IP_T_NT_HOM_INC (MAF_KGH, LAMB_AV_COR)
    endif (47)
else (46)       T_NT_HOM_DELTA = 0
endif (46)
```

7.86.2.2 General, definition of slow flags

FUNCTION DESCRIPTION:

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General information:

This block is executed in any STATE_NOX

The switch LC_NOX_SENS and the logical variable LV_NOX_SENS indicate the existence of a NOx-Sensor in the exhaust system.

The regeneration of the NOx catalyst can be started by the NOx-Sensor signal or by the NOx trap loading degree model. With LV_NOX_SENS_RGN, generated by the code word LC_NOX_SENS_RGN, it is possible to decide whether only the NOx sensor should be able to request a regeneration or both, model and sensor are able to request:

- LV_NOX_SENS_RGN = 1: The regeneration is started exclusively by the NOx sensor signal. The loading degree model is blocked (the regeneration request before switching to lambda 1 is not affected).
- LV_NOX_SENS_RGN = 0: The regeneration starts when the NOx catalyst loading degree exceeds a threshold or by the signal of the NOx-Sensor (which comes first)

If the system is not equipped with a NOx-Sensor, LV_RGN_REQ_NOX_SENS is permanently set to zero.

Application conditions

Initialisation:	– –
Recurrence:	*1000 ms*
Activation:	– –
Deactivation:	– –

Formula section:

LV_NOX_SENS = LC_NOX_SENS
LV_NOX_SENS_RGN =
(LV_NOX_SENS= 1 **and**
LC_NOX_SENS_RGN = 1 **and**
LV_INH_NOX_SENS_RGN = 0 **and**
LV_ADJ_NOX_SENS_RGN = 0)

7.86.2.3 General, definition of medium flags

FUNCTION DESCRIPTION:

General information:

This block is executed in any STATE_NOX except PASSIVE.

Application conditions

Initialisation:	– –
Recurrence:	*100ms*
Activation:	– –
Deactivation:	– –

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Formula section:

% definition of flag indicating initialised catalyst state
if (48) T_NT_HOM = 0
then (48) LV_NT_HOM_INI = 1
endif (48)

7.86.2.4 General, definition of fast flags

FUNCTION DESCRIPTION:

General information:

This block is executed in any STATE_NOX except PASSIVE.
At the beginning of a regeneration phase LV_TRIG_AFR_AFL must be 0. In order to trigger the transition from rich to lean operation the logical value LV_TRIG_AFR_AFL is set to 1 if the NTL becomes lower than C_NTL_TRIG_AFR_AFL.
Every time when a regeneration phase is finished the value SUM_NTL_CYC is incremented by 1. SUM_NTL_CYC has to be stored in the nonvolatile memory. SUM_NTL_CYC can be set to the specific value C_SUM_NTL_CYC_SP using the logical constant LC_SUM_NTL_CYC_NEW.
When either the binary lambda sensor or the NOx sensor indicates a rich exhaust gas downstream NOx trap, the logical variable LV_SENS_AFR_i is set to 1.
The mode of stopping a regeneration can be controlled by C_STATE_RGN_CTL. Thereby, it is possible to stop the regeneration only by the model, only by the sensor signal (LV_SENS_AFR) or by either model or sensor. In addition, a stop of regeneration after a constant regeneration time is possible. If a special regeneration (e.g. for adaptation purposes) was requested by LV_RGN_REQ_AD, the stop of the regeneration is forbidden until the adapting module re-enables it.

Application conditions

Initialisation: – –
Recurrence: *10ms*
Activation: – –
Deactivation: – –

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Formula section:

% definition of regeneration stop mode
LV_RGN_STOP_SENS = (LV_RGN_REQ_AD = 0) **and**
(C_STATE_RGN_CTL = SENSOR **or**
C_STATE_RGN_CTL = SENSOR_MODEL)

LV_RGN_STOP_MDL = (LV_RGN_REQ_AD = 0) **and**
(LV_INH_NT_RGN_STOP_MDL_DIAG[k] = 0
% valid if all [k] = 0
% condition should be removed at special
% case NC_NOX_SENS_CONF = 0
) **and**
(C_STATE_RGN_CTL = MODEL **or**
C_STATE_RGN_CTL = SENSOR_MODEL **or**
(LV_VLS_NS_VLD[k] = 0 **and**

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LC_VLS_NS_VLD_RGN_STOP_MDL = 1)
)

LV_RGN_STOP_TOUT = (LV_RGN_REQ_AD = 0)

% time counter for regeneration is always active; by selecting C_STATE_RGN_CTL=TIME, all other possibilities for stopping the regeneration are switched off

% handling of the cycle counter and over all lean-time-counter
if (49) LC_SUM_NTL_CYC_NEW = 1
then (49) SUM_NTL_CYC = C_SUM_NTL_CYC_SP
else (49)
if (49+) LV_RGN_NT_REQ = 1 **AND**
STATE_NOX = LOAD -> REGENERATION
then (49+) T_AFL_SUM$_n$= T_AFL_SUM$_{n-1}$ + T_AFL
endif (49+)
endif (49)

% calculation of trigger bit for end of regeneration
if (51) NTL < C_NTL_TRIG_AFR_AFL
then (51) LV_TRIG_AFR_AFL=1
endif (51)

if(52a) LC_SENS_AFR_MOD = 1
then (52a) **call** "Rich mode calculation of binary NOx-Senor signal"
else (52a)
if (53) LV_SENS_AFR_i = 0 **or** STATE_NOX <> REGENERATION
then (53)
case selection on C_STATE_SENS_AFR_i:
% detection of a rich exhaust gas downstream the NOx trap
VLS_DOWN:
LV_SENS_AFR_i = (VLS_DOWN[m] >=
ID_VLS_DOWN_RGN_STOP(NTLD_RGN_ST))
VLS_NOX_SENS:
if(54) LV_NOX_SENS_VLS_VLD_k = 0
% if at least one of all _i flags is 0
then (54) LV_RGN_STOP_MDL=1
else (54)
LV_SENS_AFR_i =
(VLS_NOX_SENS_k >= C_VLS_NOX_SENS_RGN_STOP)
and (NOX_NS_AD[k] >= C_NOX_NS_AD_RGN_STOP
or LV_NOX_NS_DIAG_VLD_k = 0)
endif (54)
LAMB_NOX_SENS:
if (55) LV_NOX_SENS_LAMB_VLD_k = 0
% if at least one of all _i flags is 0
then (55) LV_RGN_STOP_MDL=1
else (55) LV_SENS_AFR_i = (LAMB_NOX_SENS_k <=
C_LAMB_NOX_SENS_RGN_STOP)
endif (55)
VLS_NT_DOWN:

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LV_SENS_AFR_i = (VLS_NT_DOWN_k >=
ID_VLS_DOWN_RGN_STOP(NTLD_RGN_ST))
NONE:
LV_SENS_AFR_i = 0
end case selection
endif (53)
endif (52a)

% The homogeneous time counter T_NT_HOM is decremented, when the catalyst is operated slightly rich, i.e. the upstream lambda sensor indicates homogeneous mixture and the downstream sensor indicates slightly rich mixture; As the threshold for detecting a slightly rich mixture may be different from the threshold for stopping a regeneration, a separate flag is provided.
case selection on C_STATE_SENS_AFR_TRIM_i:
VLS_DOWN:
LV_SENS_AFR_TRIM_TMP_i = (VLS_DOWN[m] >= C_VLS_DOWN_AFR_TRIM)
VLS_NOX_SENS:
if (56) LV_NOX_SENS_VLS_VLD_k = 0 % if at least one of all _k flags is 0
then (56) LV_SENS_AFR_TRIM_TMP_i =0
else (56) LV_SENS_AFR_TRIM_TMP_i = (VLS_NOX_SENS_k >=
C_VLS_NOX_SENS_AFR_TRIM)
endif (56)
LAMB_NOX_SENS:
if (57) LV_NOX_SENS_LAMB_VLD_k = 0 % if at least one of all _k flags is 0
then (57) LV_SENS_AFR_TRIM_TMP_i =0
else (57) LV_SENS_AFR_TRIM_TMP_i = (LAMB_NOX_SENS_k <= C_LAMB_NOX_SENS_AFR_TRIM)
endif (57)
VLS_NT_DOWN:
LV_SENS_AFR_TRIM_TMP_i = (VLS_NT_DOWN_k >= C_VLS_DOWN_AFR_TRIM)
NONE:
LV_SENS_AFR_TRIM_TMP_i = 0
end case selection
LV_SENS_AFR_TRIM = LV_SENS_AFR_TRIM_TMP_1 **and** LV_SENS_AFR_TRIM_TMP_2

% detection of homogeneous lambda=1 or richer operation
if (58) {(LV_HOM_AFS_REQ = 1)
or [(LV_HOM_ACT = 1) **and** (LV_HOM_AFL_ACT = 0)]}
and (LV_PUC_REQ = 0)
then (58) LV_AFL_NOT = 1
else (58) LV_AFL_NOT = 0
endif (58)

7.86.2.4.1 Rich mode calculation of binary NOx-Senor signal

FUNCTION DESCRIPTION:

General information:

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7.86.3 Rich mode calculation of binary NOx-Sensor signal (named NOXY_VL-SAFCLC110 in Figure 10)

The function sets the status flag LV_SENS_AFR_1 to rich mode and parallel sets the end of first regeneration flag LV_SENS_RGN_1_READY when the binary NOx-Sensor signal goes up for the first time over a threshold and sets the status flag LV_SENS_AFR_2 to rich mode in three ways (see Figure 9 below):

a) when the same binary signal goes up for the second time over a threshold (see Figure 9a).

b) when the binary NOx-Sensor signal goes for the first time over the threshold, then it goes not down enough and finally goes up (see Figure 9b).

c) when the binary NOx-Sensor signal goes for the first time over the threshold and then goes not down and the maximal time is over (see Figure 9c).

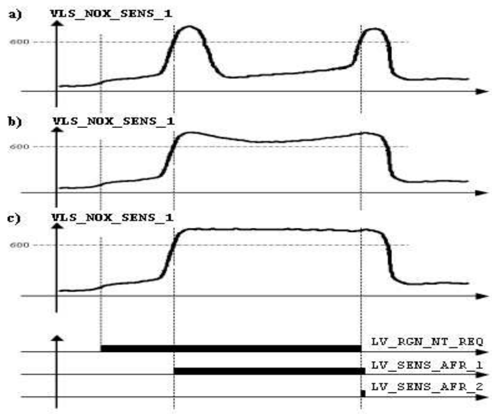

Figure 9: Signals during a NOx regeneration

This specification is special designed for systems with two banks (including two NOx-Traps) and Y-configuration of the exhaust gas system.

Description:

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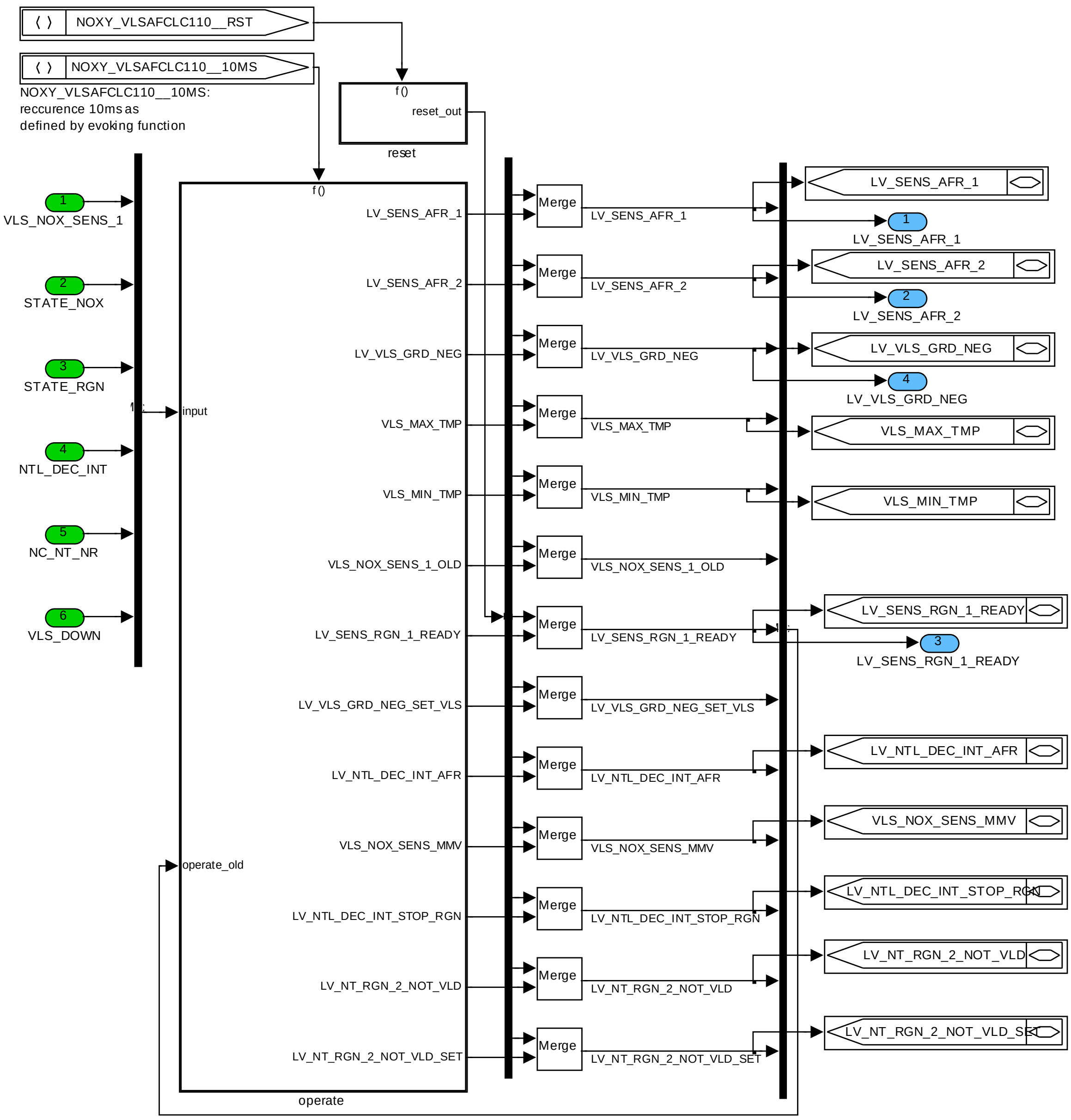

Figure 7.86.9: : NOXM_VLSAFCLC

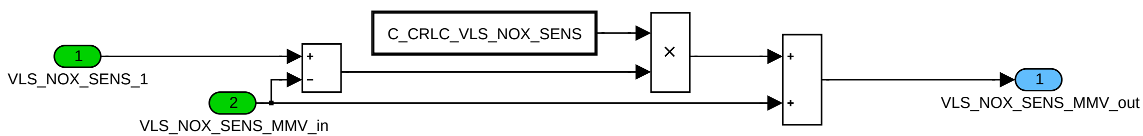

Figure 7.86.10: NOXM_VLSAFCLC/OPERATE/CRLC

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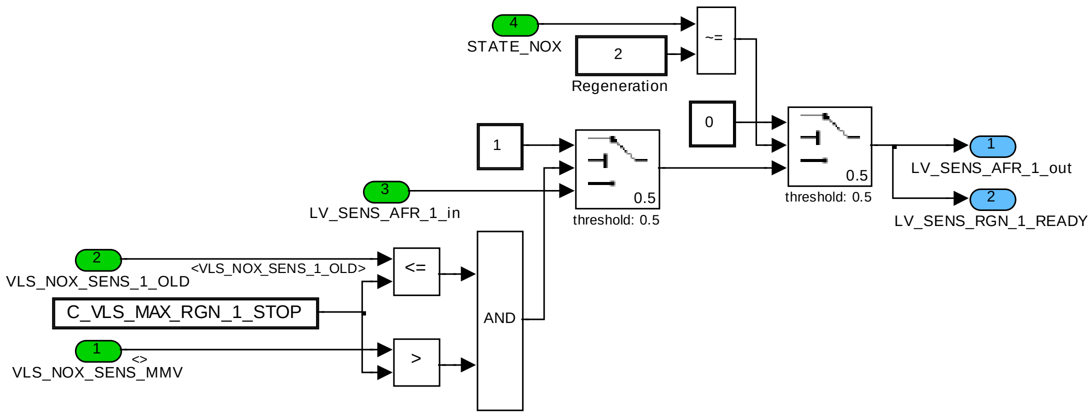

Figure 7.86.11: NOXM_VLSAFCLC/operate/SENS_AFR_1

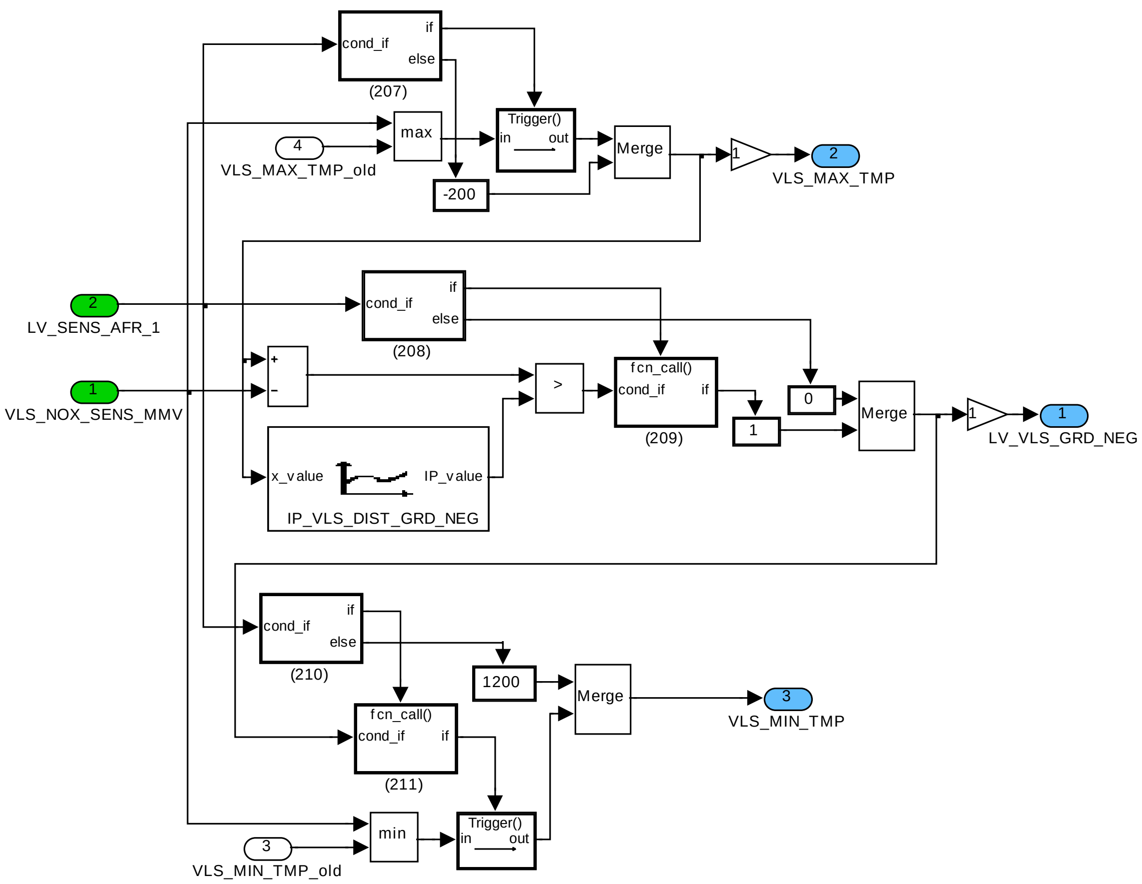

Figure 7.86.12: NOXM_VLSAFCLC/operate/GRD_CLC

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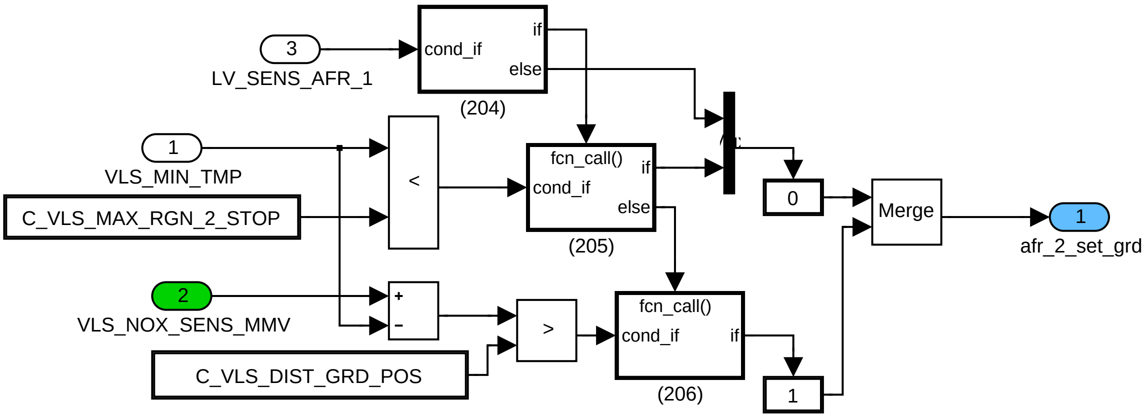

Figure 7.86.13: NOXM_VLSAFCLC/operate/AFR_2_SET_GRD

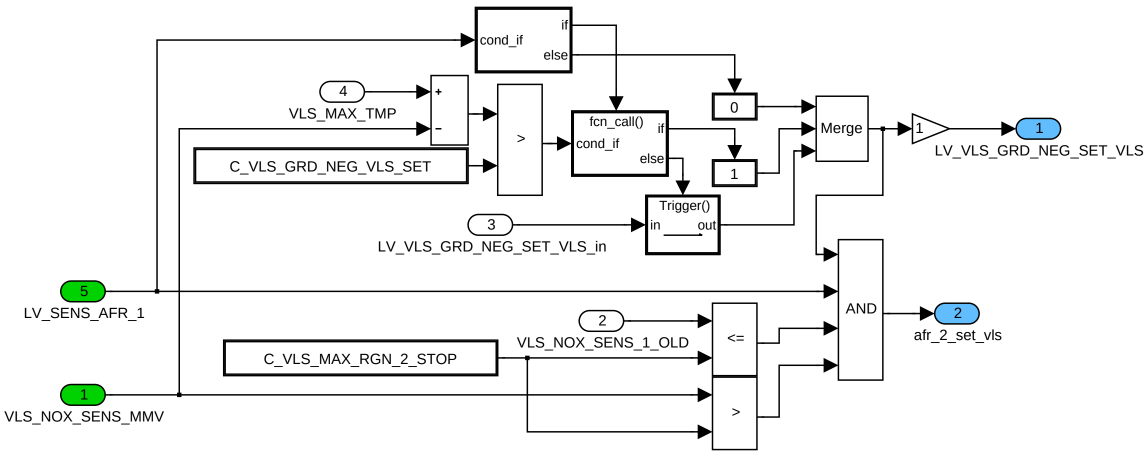

Figure 7.86.14: NOXM_VLSAFCLC/operate/AFR_2_SET_VLS

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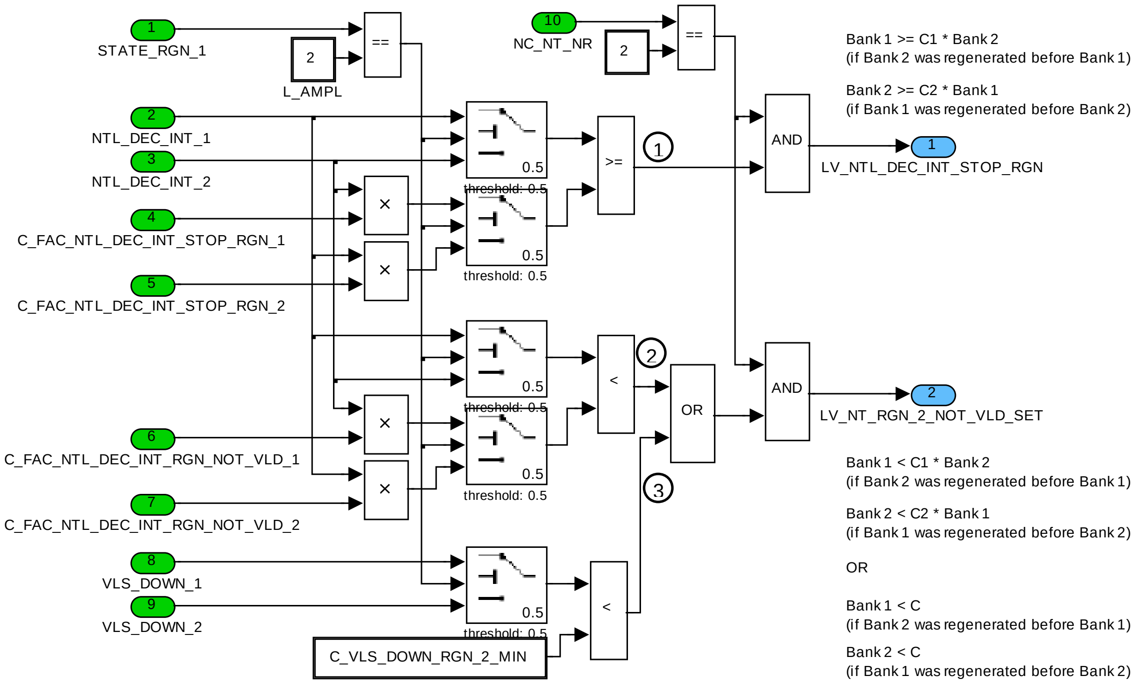

Fo

r NC_NT_NR = 1 the variables NTL_DEC_INT_2, C_FAC_NTL_DEC_INT_STOP_RGN_2 and C_FAC_NTL_DEC_INT_RGN_NOT_VLD_2 are not defined. In this case use as substitute the variables NTL_DEC_INT_1, C_FAC_NTL_DEC_INT_STOP_RGN_1 and C_FAC_NTL_DEC_INT_RGN_NOT_VLD_1.

Figure 16 NOXM_VLSAFCLC/operate/NTL_DEC_INT_THD

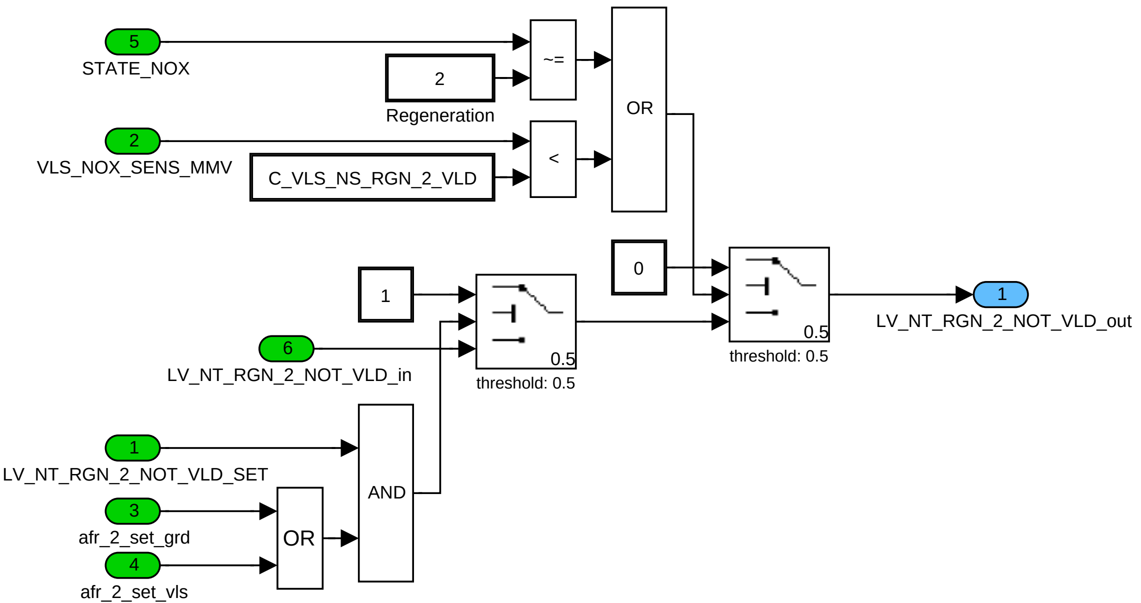

Figure 7.86.15: NOXM_VLSAFCLC/operate/RGN_NOT_VLD

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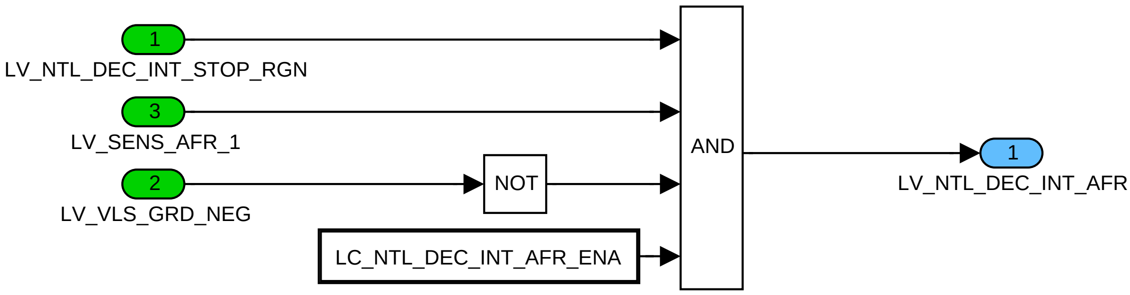
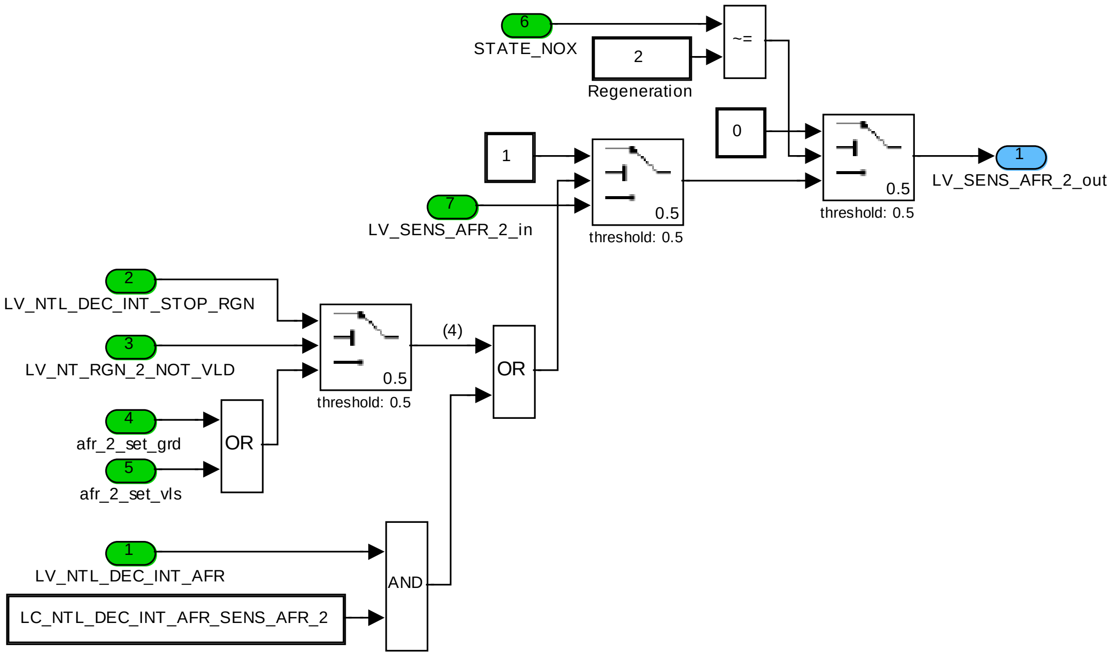


Figure 7.86.16: NOXM_VLSAFCLC/operate/NTL_DEC_INT_AFR



LV_SENS_AFR_2 will only be calculated if NC_NT_NR = 2

Figure 19 NOXM_VLSAFCLC/operate/SENS_AFR_2

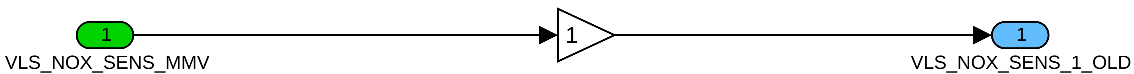


Figure 7.86.17: NOXM_VLSAFCLC/operate/OLD

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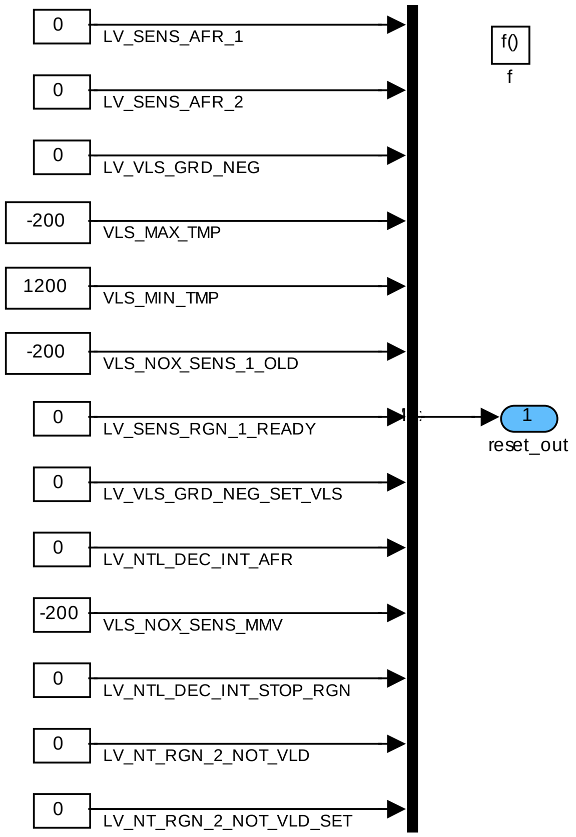

Figure 7.86.18: NOXM_VLSAFCLC/RESET

7.86.3.1 Request of a regeneration phase

FUNCTION DESCRIPTION:

General information:

This block is executed in STATE_NOX = LOAD

A request of a regeneration of the NOx catalyst can be made by the following conditions:

1. from the model by a high loading degree LV_RGN_REQ_NTLD
2. by the signal of the post-trap NOx-Sensor LV_RGN_REQ_NOX_SENS
3. before switching to lambda=1 or richer operation LV_RGN_REQ_AFS
4. by the diagnosis /adaptation module LV_RGN_REQ_AD

In order to guarantee a minimum duration of the lean phase the value IP_T_AFL_MIN has to be exceeded by the counter T_AFL before any regeneration request can be set.

In order to limit the regeneration frequency, T_AFL has to exceed C_T_AFL_RGN_REQ_NTLD before a regeneration request can be made by the loading degree model.

After a regeneration it is prohibited to generate a new regeneration request by the NOx sensor (LV_RGN_REQ_NOX_SENS_TMP_i = 1) for the time C_T_NOX_SENS_VLD. The time C_T_NOX_SENS_

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VLD is controlled by the timer T_AFL. T_AFL has to exceed C_T_NOX_SENS_VLD before a regeneration can be requested by the NOx sensor.
In case of active auxiliary functionalities module, a regeneration request by the loading degree model or by the NOx sensor may be inhibited by the flag LV_INH_RGN_AD.
When switching from lean conditions to lambda=1 or richer operation a regeneration can be required. The request of this regeneration phase depends on the maximum NOx-trap loading degree for stoichiometric operation IP_NTLD_MAX_AFS_MT /IP_NTLD_MAX_AFS_AT. The check for this maximum loading degree for stoichiometric operation is carried out ever when switching to homogeneous Lambda=1 or richer engine operation which should indicated by LV_AFL_NOT=1.
A regeneration can only be requested if various conditions for allowing a regeneration are fulfilled. In this case, the logical variable LV_RGN_CDN is set to 1.

Signal flow diagram:

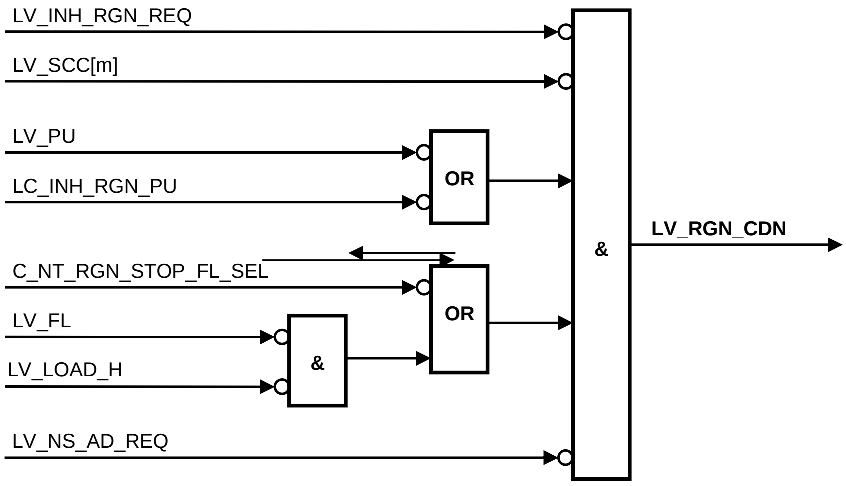

Figure 7.86.19: : determination of regeneration conditions

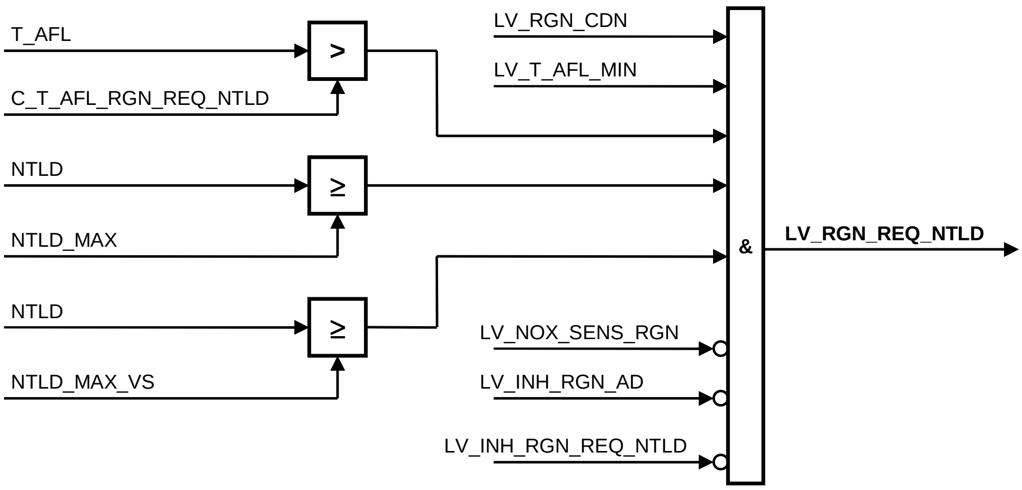

Figure 7.86.20: : regeneration request due to modelled loading degree

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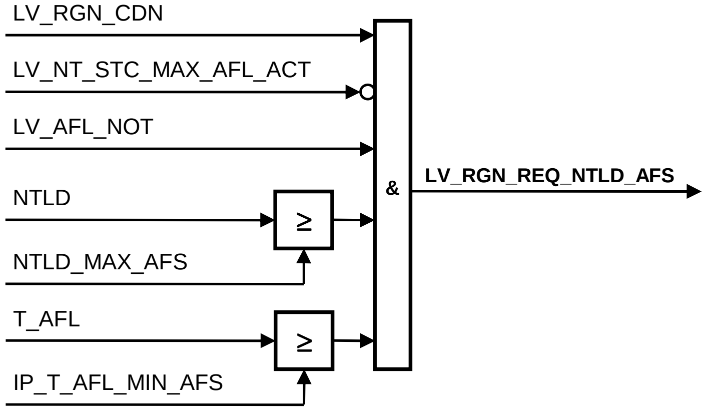

Figure 7.86.21: : regeneration request due to a transition to non-lean operation

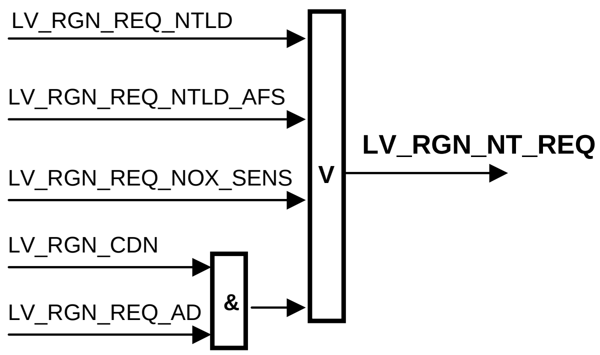

Figure 7.86.22: : central regeneration request

Application conditions

Initialisation: – –

Recurrence: *20ms*

Activation: – –

Deactivation: – –

Formula section:

if(59) LV_RGN_NT_REQ = 0
then (59) **call** 1.2.5.1 calculation of the sub-requests
endif (59)

// final regeneration request
LV_RGN_NT_REQ =
[LV_RGN_REQ_NTLD = 1
or (LV_RGN_REQ_NOX_SENS = 1)
or (LV_RGN_REQ_AD = 1 **and** LV_RGN_CDN = 1)
or LV_RGN_REQ_NTLD_AFS = 1]

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7.86.3.1.1 Calculation of the sub-requests

```
% calculation of maximum loading degree for a model based regeneration
% (position changed)
if (61) LV_NTLD_ADJ = 1
then (61)
            if (131) LV_AT = 1
            then (131)      NTLD_MAX = IP_NTLD_MAX_ADJ_AT (TQI_REQ_FAST, N_32)
            else (131)      NTLD_MAX = IP_NTLD_MAX_ADJ_MT (TQI_REQ_FAST, N_32)
            endif (131)
else (61)
            if (132) LV_AT = 1
            then (132)      NTLD_MAX = IP_NTLD_MAX_AT (TQI_REQ_FAST, N_32)
            else (132)      NTLD_MAX = IP_NTLD_MAX_MT (TQI_REQ_FAST, N_32)
            endif (132)
endif (61)

if (133) LV_AT = 1
then (133)      NTLD_MAX_VS = IP_NTLD_MAX_VS_AT (VS, NT_AGI_S_RED)
else (133)      NTLD_MAX_VS = IP_NTLD_MAX_VS_MT (VS, NT_AGI_S_RED)
endif (133)

% general conditions for a regeneration
if (62)         (LV_INH_RGN_REQ =   0)
        and         (LV_SCC[m] = 0)
        and         (LV_PU = 0 or LC_INH_RGN_PU = 0)
        and         ( (LV_FL = 0 and LV_LOAD_H = 0) or C_NT_RGN_STOP_FL_SEL = 0)
        and         (LV_NS_AD_REQ = 0)
then (62)       LV_RGN_CDN = 1
else (62)       LV_RGN_CDN = 0
endif (62)

% minimum lean time condition
if (127)        LV_NT_RGN_STOP_PUC = 0
then (127) LV_T_AFL_MIN = (T_AFL >= IP_T_AFL_MIN(VS))
else (127) LV_T_AFL_MIN =
        (T_AFL >= IP_T_AFL_MIN_NT_RGN_STOP(VS))
endif (127)

NOx sensor threshold calculation:
if (63)         LV_AT = 1
then (63)       NOX_SENS_MAX_BAS = IP_NOX_SENS_MAX_AT (FLOW_NT_MMV, N_32)
else (63)       NOX_SENS_MAX_BAS = IP_NOX_SENS_MAX_MT (FLOW_NT_MMV, N_32)
endif (63)

if (64)         LV_NOX_SENS_MAX_ADJ = 0
then (64)       NOX_SENS_MAX = NOX_SENS_MAX_BAS*
                        IP_FAC_NOX_SENS_MAX (NT_AGI_S_RED,TNT_MDL_MV)
else (64)       NOX_SENS_MAX = NOX_SENS_MAX_BAS + C_NOX_SENS_MAX_OFS
endif (64)

% regeneration request by NOx sensor signal
if (65)         LV_RGN_CDN = 1
```

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```
         and   LV_T_AFL_MIN = 1
         and   LV_NOX_SENS = 1
         and   LV_T_NS_VLD = 1                  % NOx sensor readiness
         and   LV_INH_RGN_REQ_NOX_SENS = 0
         and   LV_INH_RGN_AD = 0
         and   (LV_HOM_AFS_REQ = 0 and (LV_S_ACT = 1 or LV_HOM_AFL_ACT = 1))
then (65)      call  NOx sensor based regeneration request          (see next page)
else (65)        LV_RGN_REQ_NOX_SENS = 0
endif (65)

% regeneration request by modelled loading degree
LV_RGN_REQ_NTLD =
         [LV_RGN_CDN = 1
         and   LV_T_AFL_MIN = 1
         and   T_AFL > C_T_AFL_RGN_REQ_NTLD
         and   NTLD >= NTLD_MAX
         and   NTLD >= NTLD_MAX_VS
         and   LV_NOX_SENS_RGN = 0              % rgn req only by NOx sensor
         and   LV_INH_RGN_AD = 0
         and   LV_INH_RGN_REQ_NTLD = 0]

% regeneration request before switching to lambda=1.0 operation
if (66)              LV_AT = 1
then (66)          NTLD_MAX_AFS_BAS = IP_NTLD_MAX_AFS_AT (TQI_REQ_FAST, N_32)
else (66)          NTLD_MAX_AFS_BAS = IP_NTLD_MAX_AFS_MT (TQI_REQ_FAST, N_32)
endif (66)

if (67)          LV_ERR_EGR_2 = 1
then (67)          NTLD_MAX_AFS = NTLD_MAX_AFS_BAS*C_FAC_NTLD_MAX_AFS_ERR_EGR
else (67)          NTLD_MAX_AFS = NTLD_MAX_AFS_BAS
endif (67)

if (68)              LC_NTLD_MAX_AFS = 1
then (68)          LV_RGN_REQ_NTLD_AFS =
                       [LV_RGN_CDN = 1
         and               T_AFL >= IP_T_AFL_MIN_AFS(VS)
         and               LV_AFL_NOT = 1
         and               NTLD >= NTLD_MAX_AFS
         and               LV_NT_STC_MAX_AFL_ACT = 0]
else (68)          LV_RGN_REQ_NTLD_AFS =
                       [LV_RGN_CDN = 1
         and               T_AFL >= IP_T_AFL_MIN_AFS(VS)
         and               LV_AFL_NOT = 1
         and               NTLD_MDL >= NTLD_MAX_AFS
         and               LV_NT_STC_MAX_AFL_ACT = 0]
endif (68)
end
```

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7.86.3.1.2 NOx sensor based regeneration request

This block is executed when called

General information:

If the system has only 1 cylinder bank then the variable LV_RGN_REQ_NOX_SENS_TMP_1 generates directly the value of the logical variable LV_RGN_REQ_NOX_SENS.
If the system is equipped with 2 cylinder banks, a regeneration request is set LV_RGN_REQ_NOX_SENS = 1, if at least one cylinder bank requests a regeneration LV_RGN_REQ_NOX_SENS_TMP_i = 1.
With LV_NOX_SENS_NOX_VLD_k is indicated that the signal NOX_NS_AD[k] is valid. In this case NOX_NS_AD[k] can be used for the generation of a regeneration request. Otherwise the regeneration request can not be generated by using NOX_NS_AD[k].
A NOx regeneration request can be generated by different methods. These are:

- the NOx concentration, which is measured downstream of NOx catalyst, exceeds a threshold
- the downstream measured NOx integral exceeds a threshold
- the ratio of downstream measured NOx integral to mileage exceeds a threshold
- the ratio of downstream measured NOx integral to upstream modelled NOx integral exceeds a threshold

Recurrence: called by superior chapter

Signal flow diagram:

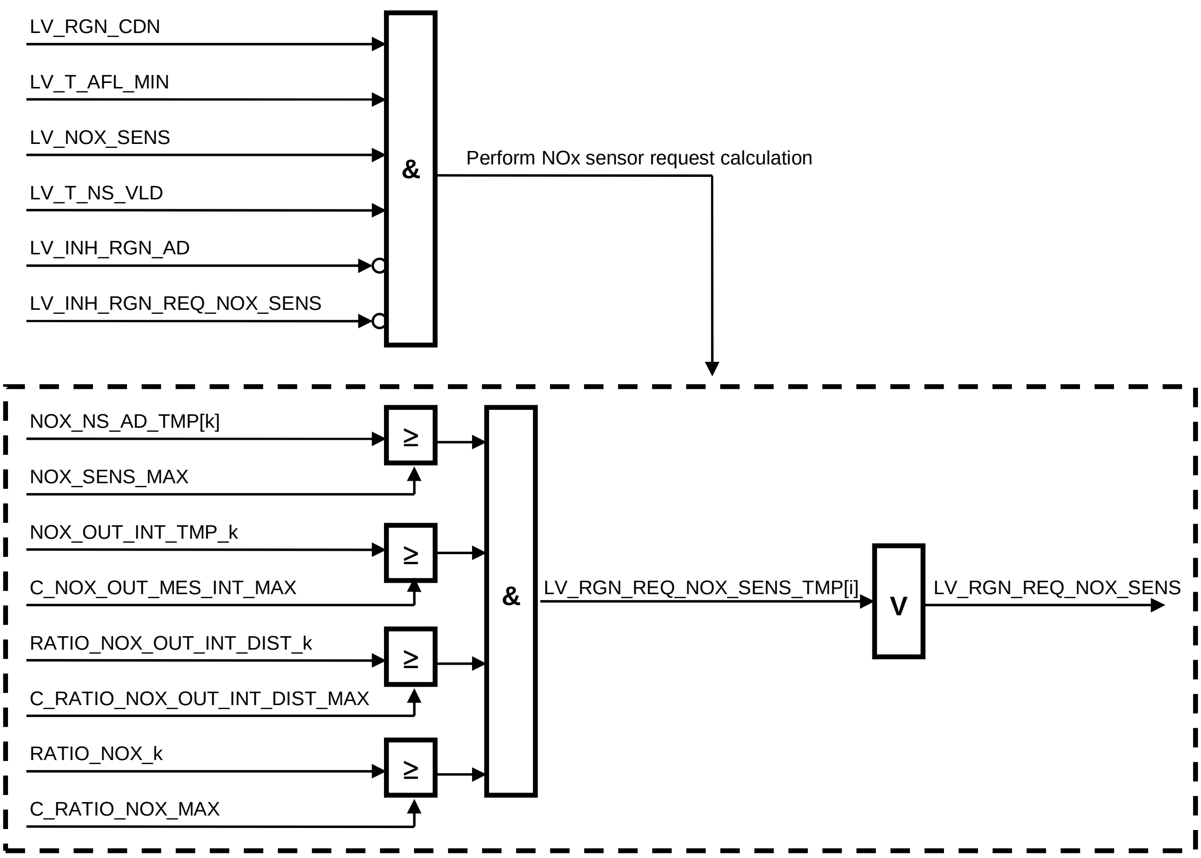

Figure 7.86.23: : Request of a catalyst regeneration by NOx sensor signal

Formula section:

If (69) LC_NOX_MDL_CTRL_ACT =1
and LV_INH_NOX_MDL_CTRL_RGN = 0

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```
      and | NOX_CONC_OUT_MDL_MMV - NOX_NS_AD[k] | <= C_NOX_NS_AD_DIF_MON
                  % NOX_NS_AD[k] separately treated
then (69)          NOX_NS_AD_TMP[k] = NOX_CONC_OUT_MDL_MMV
                  NOX_OUT_INT_TMP_k = NOX_OUT_MDL_INT
else (69) if (70)          LV_NOX_SENS_NOX_VLD_k = 1
            then (70)          NOX_NS_AD_TMP[k] = NOX_NS_AD[k]
                               NOX_OUT_INT_TMP_k = NOX_OUT_MES_INT_k
            else (70)          NOX_NS_AD_TMP[k] = 0
                               NOX_OUT_INT_TMP_k = 0
            endif (70)
endif (69)

DIST_AFL = (DIST - DIST_AFL_ST)
if (89)          DIST_AFL > C_DIST_AFL_MIN
then (89)          RATIO_NOX_OUT_INT_DIST_k = NOX_OUT_INT_TMP_k /DIST_AFL
else (89)          RATIO_NOX_OUT_INT_DIST_k = 0
endif (89)

if (90)          NOX_COR_INT > C_NOX_COR_INT_MIN
then (90)          RATIO_NOX_k = (NOX_OUT_INT_TMP_k /NOX_COR_INT) * 100%
else (90)          RATIO_NOX_k = 0
endif (90)

if (71)          NOX_NS_AD_TMP[k] >= NOX_SENS_MAX
      and      NOX_OUT_INT_TMP_k >= C_NOX_OUT_MES_INT_MAX
      and      RATIO_NOX_OUT_INT_DIST_k >= C_RATIO_NOX_OUT_INT_DIST_MAX
      and      RATIO_NOX_k >= C_RATIO_NOX_MAX
then (71)          LV_RGN_REQ_NOX_SENS_TMP_i = 1
endif (71)

if (72)          LV_RGN_REQ_NOX_SENS_TMP[1] = 1          or
                 LV_RGN_REQ_NOX_SENS_TMP[2] = 1
then (72)          LV_RGN_REQ_NOX_SENS = 1
                 LV_NOX_SENS_NOX_VLD_RGN_ST_i = LV_NOX_SENS_NOX_VLD_k
                          % both .._rgn_st_i flags have to be frozen if the common request is set
endif   (72)
```

7.86.3.2 Request of a NOx catalyst purge

FUNCTION DESCRIPTION:

General information:

This block is executed in STATE_NOX = LOAD
If there is no request for a regeneration before switching from lean burn condition to lambda=1 or richer mixture a NOx catalyst purge request is set dependent on the amount of stored NOx and O2 (NTL + O2L). The request is reset under the same conditions a regeneration is reset **or** when lambda exceeds C_LAMB_RGN.
The check for setting the request is only to be carried out if the request is yet unset.
LV_ACT_INT_PUC_AFL is passed to the *catalyst enrichment function (cat-purge function for continuous lambda control)* where a displacement of the lambda-controller setpoint will be done.

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Signal flow diagram:

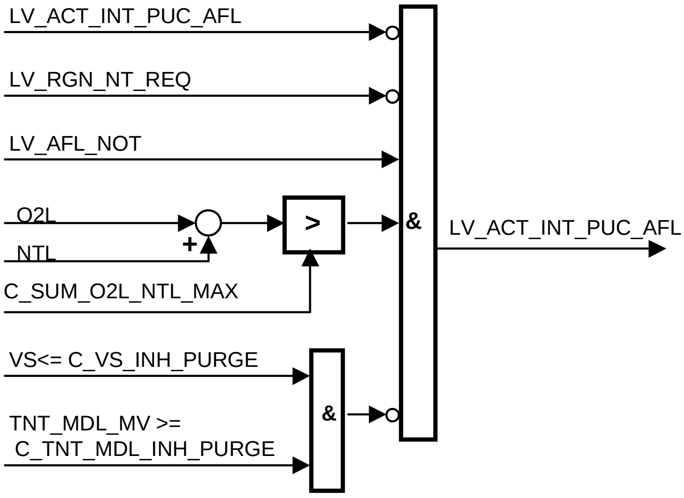

Figure 7.86.24: : request of a catalyst purge

Application conditions

Initialisation: – –

Recurrence: *20ms*

Activation: – –

Deactivation: - -

Formula section:

if (74) LV_ACT_INT_PUC_AFL_i = 0 **and**
separately treated
LV_RGN_NT_REQ = 0 **and**
LV_AFL_NOT = 1 **and**
(O2L + NTL) > C_SUM_O2L_NTL_MAX **and**
LV_NT_STC_MAX_AFL_ACT = 0 **and**
not (VS <= C_VS_INH_PURGE **and**
TNT_MDL_MV >= C_TNT_MDL_INH_PURGE) **and**
VS <= C_VS_PURGE_REQ_MAX **and**
TNT_MDL_MV <= C_TNT_MDL_PURGE_REQ_MAX
then (74) LV_ACT_INT_PUC_AFL_i = 1
LV_CAT_PURGE_REQ_POST_AFL[i] = 1
else (74)
if (130) LV_CAT_PURGE_REQ_POST_AFL[i] = 1 **and**
LV_AFL_NOT = 0
then (130) LV_ACT_INT_PUC_AFL_i = 0
LV_CAT_PURGE_REQ_POST_AFL[i] = 0
endif (130)
endif (74)

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7.86.3.3 Reset of regeneration and purge requests

FUNCTION DESCRIPTION:

General information:

This block is executed in STATE_NOX = REGENERATION

A regeneration phase is stopped under the following conditions:

1. The modelled loadings of NOx and O2L both fall below a threshold
2. All downstream sensors detect a rich mixture LV_SENS_AFR
3. A constant time period is exceeded
4. an engine state with higher priority is activated. These higher prior engine states can be fuel cut-off (PUC) or full load (FL).

The regeneration stopping conditions are valid under the following circumstances:

1. A stop out of the model is possible if LV_RGN_STOP_MDL is set to 1.
2. A stop by the sensor signal is possible if LV_RGN_STOP_SENS is set to 1.
3. A stop by the time counter is possible if LV_RGN_STOP_TOUT is set to 1.
4. Also a combination of sensor stop and model stop is possible.

The priority of the engine states fuel cut-off (PUC) and full load (FL) in relation to a running NOx regeneration are selectable by C_NT_RGN_STOP_PUC_SEL and C_NT_RGN_STOP_FL_SEL. It can be chosen:

C_NT_RGN_STOP_PUC_SEL =

0 ... the NOx catalyst control functionality does not react on the engine state fuel cut-off (PUC)

1 ... a running NOx regeneration is broken, when the air mass flow at PUC exceeds a threshold;
the minimum duration of next "LOAD" phase is defined by IP_T_AFL_MIN_NT_RGN_STOP

2 ... a running NOx regeneration is broken, when the air mass flow at PUC exceeds a threshold and the clutch is closed;
the minimum duration of next "LOAD" phase is defined by IP_T_AFL_MIN_NT_RGN_STOP

C_NT_RGN_STOP_FL_SEL =

0 ... the NOx catalyst control functionality does not react on the engine state full load or a high engine load near full load.

1 ... new NOx regeneration requests are inhibited up to the end of full load phase or high engine load phase;
a running NOx regeneration is broken, when the air mass flow at full load exceeds a threshold;
the minimum duration of next "LOAD" phase is defined by IP_T_AFL_MIN

2 ... new NOx regeneration requests are inhibited up to the end of full load phase or high engine load phase;
a running NOx regeneration is broken, when the air mass flow at full load exceeds a threshold;
the minimum duration of next "LOAD" phase is defined by IP_T_AFL_MIN_NT_RGN_STOP

3 ... new NOx regeneration requests are inhibited up to the end of full load phase or high engine load phase;
a running NOx regeneration is not broken

Calibration hint:

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The maps IP_NTL_MIN and IP_NTL_MIN_RGN_STOP should be calibrated on identical values.

Signal flow diagram:

Figure 28: check for resetting the regeneration requests

Application conditions

Initialisation: – –

Recurrence: 10ms

Activation: – –

Deactivation: – –

Formula section:

```
if (75)        NTL <= IP_NTL_MIN_RGN_STOP(TNT_MDL_MV)   and   O2L <= C_O2L_MIN
  and          LV_TOUT_AFR = 0
then (75)          LV_MDL_AFR = 1
endif (75)

if (76)
    T_RGN >= IP_T_RGN_MAX (FLOW_NT_MMV, NT_AGI_S_RED)

      ( LV_SENS_AFR_1 = 1                                                  AND
       ( T_RGN_2 > IP_T_MAX_RGN_2_STOP(NTL_RGN_ST, NTL_DEC_INT_1) OR
          T_RGN_2 > IP_T_MAX_RGN_2_STOP(NTL_RGN_ST, NTL_DEC_INT_2)
      )
      )                                                          OR
     NTL_DEC_INT_1 > IP_NTL_DEC_INT_MAX(NTL_RGN_ST)

     NTL_DEC_INT_2 > IP_NTL_DEC_INT_MAX(NTL_RGN_ST)
then (76)
      if (121)                               LV_INH_NT_RGN_STOP_MDL_DIAG[k] =
      0                                  % valid if all [k] = 0
      then (121)   LV_TOUT_AFR = 1
      else (121)
            if (122)                                         T_RGN >= C_T_RGN_MAX_
            DIAG
            then (122)          LV_TOUT_AFR = 1
            endif (122)
      endif (121)
endif (76)

if (79)          ((LV_SENS_AFR_1 and LV_SENS_AFR_2)          and          % stop from sensor
          LV_RGN_STOP_SENS)                                          or
          (LV_MDL_AFR = 1                                 and          % stop from model
          LV_RGN_STOP_MDL)                                         or
          (LV_TOUT_AFR = 1                                and          % stop from time counter
          LV_RGN_STOP_TOUT)                                         or
             (C_NT_RGN_STOP_FL_SEL = 1              and          % break by full load
               (LV_FL = 1 or LV_LOAD_H = 1)          and
              MAF_INT_FL_ACT >= C_MAF_INT_FL_RGN_STOP_MIN)          or
```

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LV_NTL_DEC_INT_AFR % stop from NTL_DEC_INT ratio

then (79) LV_RGN_CDN = 0
LV_RGN_REQ_NTLD = 0
LV_RGN_REQ_NTLD_AFS = 0
LV_RGN_REQ_NOX_SENS_TMP[i] = 0 *% reset all [i] requests*
LV_RGN_REQ_NOX_SENS = 0
O2L = 0
LV_RGN_NT_REQ = 0
LV_ACT_INT_PUC_AFL_i = 0 *% reset all [i] requests*
NTL = NTL_MIN
NTL_H = NTL_MIN
LV_NT_RGN_STOP_PUC = 0
endif (79)

if (126) (C_NT_RGN_STOP_PUC_SEL = 1 **AND**
LV_PUC = 1 **AND**
MAF_INT_PUC_ACT(n-1) < MAF_INT_PUC_ACT(n) **AND**
MAF_INT_PUC_ACT(n) >= C_MAF_INT_PUC_RGN_STOP_MIN) **OR**
(C_NT_RGN_STOP_PUC_SEL = 2 **AND**
LV_CLU_SWI = 0 **AND**
LV_PUC = 1 **AND**
MAF_INT_PUC_ACT(n-1) < MAF_INT_PUC_ACT(n) **AND**
MAF_INT_PUC_ACT(n) >= C_MAF_INT_PUC_RGN_STOP_MIN) **OR**
(LC_NT_RGN_STOP_IS = 1 **AND**
LV_IS = 1 **AND**
T_IS >= C_T_IS_RGN_STOP_MIN) **OR**

(C_NT_RGN_STOP_FL_SEL = 2 **AND**
(LV_FL = 1 **or** LV_LOAD_H = 1) **AND**
MAF_INT_FL_ACT >= C_MAF_INT_FL_RGN_STOP_MIN)
% Calibration remark: Consider failure reaction on open wire at clutch switch circuit!

then (126) *% break off NOx regeneration because of higher priority of PUC*
LV_RGN_CDN = 0
LV_RGN_REQ_NTLD = 0
LV_RGN_REQ_NTLD_AFS = 0
LV_RGN_REQ_NOX_SENS_TMP[i] = 0 *% reset all [i] requests*
LV_RGN_REQ_NOX_SENS = 0
LV_RGN_NT_REQ = 0
LV_ACT_INT_PUC_AFL_i = 0 *% reset all [i] requests*
LV_NT_RGN_STOP_PUC = 1
if (128) LC_NT_RGN_STOP_INI_NTL_O2L = 1
then (128) NTL = NTL_MIN
NTL_H = NTL_MIN
O2L = 0
else (128) NTL = NTL(n-1)
NTL_H = NTL_H(n-1)
O2L = O2L(n-1)
endif (128)
endif (126)

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if (116) NC_NT_NR = 2 **and** LC_SENS_AFR_MOD = 1
then (116)
if (117) LV_SENS_AFR_1 = 1
then (117) LV_ACT_INT_PUC_AFL_1 = 0
LV_ACT_INT_PUC_AFL_2 = 0
LV_CAT_PURGE_REQ_POST_AFL[1] = 0
LV_CAT_PURGE_REQ_POST_AFL[2] = 0
endif (117)
else (116)
if (118) LV_SENS_AFR_i = 1
then (118) LV_ACT_INT_PUC_AFL_i = 0
LV_CAT_PURGE_REQ_POST_AFL[i] = 0
endif (118)
endif (116)

7.86.3.4 Request of lambda =1 operation

FUNCTION DESCRIPTION:

General information:

This block is executed in any STATE_NOX except PASSIVE.
Depending on various conditions the lean operation of the engine can be forbidden using LV_NT_AFS_REQ. This flag is an input to the combustion manager. There, it forces the combustion manager to switch to lambda=1 homogeneous mode.
All conditions leading to stoichiometric homogeneous operation of all modules of the NOx trap functions (including NOx catalyst aging and NOx catalyst desulfation) are handled by this subroutine in order to get only one flag as interface to the combustion manager. These conditions are:

1. catalyst temperature too high
2. catalyst temperature too low
3. aging state too bad
4. desulfation introduced
5. other reasons considered in the corresponding application incidences module

Application conditions

Initialisation:
```
at reset:
TNT_MDL_MAX = 0
TNT_MDL_MIN = 0
LV_NT_AFS_REQ_PRED = 0
T_NT_AFS_REQ_PRED = 0
TQI_MMV_NOX = 0
VS_MMV_NOX = 0
VS_DIF_NOX = 0
VS_DIF_THD = 0
VS_DIF_HYS = 0
```

Recurrence: *100 ms*

Activation: - -

Deactivation: - -

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Formula section:

```
TQI_MMV_NOX(n) = TQI_AV * C_CRLC_TQI_MMV_NOX +
                 TQI_MMV_NOX(n-1)   * (1 - C_CRLC_TQI_MMV_NOX)
VS_MMV_NOX(n) = VS * C_CRLC_VS_MMV_NOX +
                 VS_MMV_NOX(n-1)   * (1 - C_CRLC_VS_MMV_NOX)
VS_DIF_NOX = VS - VS_MMV_NOX

if (124)       LV_NT_AFS_REQ_PRED = 1   AND   LV_RGN_NT_REQ = 0
then (124)         increment T_NT_AFS_REQ_PRED
else (124)         T_NT_AFS_REQ_PRED = 0
endif (124)

if (134)       LV_AT = 1
then (134)                TNT_MDL_MAX = IP_TNT_MDL_MAX_AT(NT_AGI_S_RED, VS) +
                          TNT_MDL_MAX_OFS
               if (88)           LV_IS = 1
               then (88)             TNT_MDL_MIN = IP_TNT_MDL_MIN_IS_AT(NT_AGI_S_RED)
               else (88)             TNT_MDL_MIN = IP_TNT_MDL_MIN_AT(NT_AGI_S_RED)
               endif (88)
               NOX_S_PRED_THD = IP_NOX_S_AFS_REQ_AT(TNT_MDL_L, NT_AGI_S_RED)
               NOX_S_PRED_HYS = IP_NOX_S_AFS_REQ_HYS_AT(N_32, TQI_MMV_NOX)
               NOX_HOMS_PRED_THD =
                                  IP_NOX_HOMS_AFS_REQ_AT(TNT_MDL_L, NT_AGI_S_RED)

               NOX_HOMS_PRED_HYS =
                                  IP_NOX_HOMS_AFS_REQ_HYS_AT(N_32, TQI_MMV_NOX)
               VS_DIF_THD = IP_VS_DIF_THD_BAS_AT(TNT_MDL_L, NT_AGI_S_RED) +
                                  IP_VS_DIF_THD_COR_AT(VS_MMV_NOX)
               VS_DIF_HYS = IP_VS_DIF_HYS_AT(VS_MMV_NOX)

else (134)                TNT_MDL_MAX = IP_TNT_MDL_MAX_MT(NT_AGI_S_RED, VS) +
                          TNT_MDL_MAX_OFS
               if (138)          LV_IS = 1
               then (138)            TNT_MDL_MIN = IP_TNT_MDL_MIN_IS_MT(NT_AGI_S_RED)
               else (138)            TNT_MDL_MIN = IP_TNT_MDL_MIN_MT(NT_AGI_S_RED)
               endif (138)
               NOX_S_PRED_THD = IP_NOX_S_AFS_REQ_MT(TNT_MDL_L, NT_AGI_S_RED)
               NOX_S_PRED_HYS = IP_NOX_S_AFS_REQ_HYS_MT(N_32, TQI_MMV_NOX)
               NOX_HOMS_PRED_THD =
                                  IP_NOX_HOMS_AFS_REQ_MT(TNT_MDL_L, NT_AGI_S_RED)

               NOX_HOMS_PRED_HYS =
                                  IP_NOX_HOMS_AFS_REQ_HYS_MT(N_32, TQI_MMV_NOX)
               VS_DIF_THD = IP_VS_DIF_THD_BAS_MT(TNT_MDL_L, NT_AGI_S_RED) +
                                  IP_VS_DIF_THD_COR_MT(VS_MMV_NOX)
               VS_DIF_HYS = IP_VS_DIF_HYS_MT(VS_MMV_NOX)
endif (134)


if (119)       LV_RGN_NT_REQ = 1
     and          ( NOX_COR_S_PRED > NOX_S_PRED_THD
            or              NOX_COR_HOMS_PRED > NOX_HOMS_PRED_THD )
     and          ( VS_DIF_NOX > VS_DIF_THD )
```

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```
then (119)          LV_NT_AFS_REQ_PRED = 1
else (119)
          if (120)          T_NT_AFS_REQ_PRED > C_T_NT_AFS_REQ_PRED_MAX
                     or ( LV_HOM_AFS_ACT = 1
                           and          LV_NT_AFS_REQ_PRED = 1
                           and          ( ( NOX_COR_S_PRED <=
                                        ( NOX_S_PRED_THD - NOX_S_PRED_HYS )
                                   and  NOX_COR_HOMS_PRED <=
                                        ( NOX_HOMS_PRED_THD - NOX_HOMS_PRED_HYS )
                                   )
                                   or( VS_DIF_NOX <= ( VS_DIF_THD - VS_DIF_HYS ) )
                                        )
                )
          then (120)          LV_NT_AFS_REQ_PRED = 0
          endif (120)
endif (119)


if (86)          TNT_MDL_H > TNT_MDL_MAX               % cat. temp. too high
or          TNT_MDL_L < TNT_MDL_MIN - C_TNT_MDL_MIN_HYS   % tnt too low
or          LV_NT_AFS_REQ_AGI                    = 1              % aging bad
or          LV_SO2P_REQ                  = 1                % SO2P introduced
or          LV_NT_AFS_REQ_PRED                     = 1
or          LV_INH_NT_AFL                  = 1                % flag from appl. inc. module
or          ( LV_NS_SHIFT_CMB_INT_REQ = 1
          and   LC_NT_AFS_REQ_NS_SHIFT = 1 )
then (86)          LV_NT_AFS_REQ = 1                            % lambda=1 request
endif (86)

if (87)          ( TNT_MDL_H < TNT_MDL_MAX - C_TNT_MDL_MAX_HYS
and          TNT_MDL_L >= TNT_MDL_MIN
and          LV_NT_AFS_REQ_AGI          = 0
and          LV_SO2P_REQ                 = 0
and LV_NT_AFS_REQ_PRED  = 0
and          LV_INH_NT_AFL                 = 0
  and          ( LV_NS_SHIFT_CMB_INT_REQ = 0
          or   LC_NT_AFS_REQ_NS_SHIFT = 0 ) )
or          ( LV_TNT_MDL_MAX_OFS = 1 and
          TNT_MDL_H < TNT_MDL_MAX - C_TNT_MDL_MAX_HYS )
then (87)          LV_NT_AFS_REQ          = 0
endif (87)
```

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7.87 NOx catalyst management (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_RGN_MDL_CTL	O/V	0... FFH	0... 255	1	-
Counter of model controlled NOx regenerations					
LV_ADJ_NOX_SENS_RGN	O/V	0... 1H	0 ...1	1	-
Exclusively regeneration by NOx-Sensor ist allowed (=0)					
LV_INH_NOX_SENS_RGN	O/V	0... 1H	0 ...1	1	-
Inhibition flag for NOx catalyst regeneration-stop request by NOx sensor readiness					
LV_INH_NT_ACT	O/V	0... 1H	0 ...1	1	-
flag inhibiting the NOx catalyst management					
LV_INH_NT_AFL	O/V	0... 1H	0 ...1	1	-
flag inhibiting lean operation (requests air/fuel stoichiometric)					
LV_INH_NT_AFL_NS_READY	O/V	0... 1H	0 ...1	1	-
Request of Lambda=1.0 engine operation due to missing NOx sensor readiness					
LV_INH_RGN_REQ	O/V	0... 1H	0 ...1	1	-
flag inhibiting the request of a NOx catalyst regeneration					
LV_INH_RGN_REQ_NOX_SENS	O/V	0... 1H	0 ...1	1	-
Inhibition flag for NOx catalyst regeneration request by NOx sensor readiness					
LV_INH_RGN_REQ_NTLD	O/V	0... 1H	0 ...1	1	-
flag inhibiting the request of a NOx catalyst regeneration due to high loading degree					
LV_LOAD_H	O/V	0... 1H	0 ...1	1	-
High engine load detected					
LV_NT_STST	O/V	0... 1H	0 ...1	1	-
Activation/deactivation of stop/start functionalities into NOx catalyst functions					
LV_NTLD_ADJ	O/V	0... 1H	0 ...1	1	-
Flag to activate NOx catalyst loading degree threshold for regeneration without NOx sensor readiness					
LV_TNT_MDL_MAX_OFS	O/V	0... 1H	0 ...1	1	-
Catalyst cooling function activation flag					
MAF_INT_FL_ACT	O/V	0... FFFFH	0... 6553.5	0.1	g
Air mass flow since activation of full load (LV_FL = 0->1)					
STATE_RGN_REQ	V	0H 1H	SENSOR MODEL	-	-
State of regeneration request					
T_AFL_MDL_CTL	O/V	0... FFFFH	0... 6553.5	0.1	s
Model controlled lean engine operation time after x model controlled NOx regenerations					
T_AFL_MDL_CTL_SUM	O/V	0... FFFFH	0... 6553.5	0.1	s
Summary model controlled lean engine operation time at actual driving cycle					
T_IPLSL_VLD_DLY	V	0... FFH	0... 25.5	0.1	s
Timer for hiding of short LV_IPLSL_VLD[i] = 0 phases at a MSA start					
T_VS_IS_NT	V	0... FFH	0... 25.5	0.1	s
Catalyst cooling function activation timer					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TCO_ST_NS	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature at start					
TNT_MDL_MAX_OFS	O/V	80... 7FH	-512 ...508	4	°C
NOx catalyst temperature offset to enable catalyst cooling at standing car					

Input data:

DIST_NT {p. 3180}	LC_NT_STST_ACT {p. 2999}	LV_AT {p. 654}	LV_ERR_CAM {p. 1505}
LV_ERR_EGR_2 {p. 987}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_MAF {p. 4815}	LV_ERR_NS_CAN_BOFF {p. 991}
LV_ERR_NS_CAN_MSG_LOST [NC_NOX_SENS_CONF] {p. 991}	LV_ERR_NS_OBD_1 [NC_NOX_SENS_CONF] {p. 4915}	LV_ERR_TCO {p. 4496}	LV_FL {p. 1759}
LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	LV_IS {p. 1720}	LV_NOX_NS_ACT [NC_NOX_SENS_CONF] {p. 6358}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}
LV_NOX_NS_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_NT_ACT {p. 2982}	LV_RGN_NT_REQ {p. 2983}	LV_STST_PRE_STOP_REQ {p. 8220}
LV_STST_STOP_CYC {p. 805}	LV_T_NS_VLD {p. 3193}	LV_VLS_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_VLS_NS_VLD [NC_NOX_SENS_CONF] {p. 992}
MAF_KGH {p. 1195}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}
NT_AGI {p. 3073}	NT_SUL {p. 3113}	NTLD {p. 2986}	OPM_AV {p. 8137}
STATE_END_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	STATE_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	STATE_NOX {p. 2986}	T_AST {p. 1766}
T_AST_SAE {p. 1766}	T_NOX_NS_HLD [NC_NOX_SENS_CONF] {p. 992}	T_RGN {p. 2885}	TCO_ST {p. 1100}
TCO_ST_DC {p. 1100}	TNT_MDL_H {p. 8237}	TQI_SP_MAF {p. 8380}	VS {p. 1176}

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DIST_NT_INH_RGN_REQ_NTLD_AT	-	0... FFFFH	0... 524280	8	km
Inhibition of NOx regeneration requests due to NTLD at new vehicle - AT vehicle					
C_DIST_NT_INH_RGN_REQ_NTLD_MT	-	0... FFFFH	0... 524280	8	km
Inhibition of NOx regeneration requests due to NTLD at new vehicle - MT vehicle					
C_ERR_NS_NT_AFL_BIT_SEL	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to set lean engine operation request					
C_N_32_NT_STST_ACT	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for activation of stop/start functionalities into NOx catalyst functions					
C_N_32_NT_STST_DEAC	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for deactivation of stop/start functionalities into NOx catalyst functions					
C_NT_AGI_INH_RGN_REQ_NTLD_AT	-	0... FFFFH	0... 0.99998	15.3e-6	-
Inhibition of NOx regeneration requests due to NTLD at new NOx catalyst - AT vehicle					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NT_AGI_INH_RGN_REQ_NTLD_MT	-	0... FFFFH	0... 0.99998	15.3e-6	-
Inhibition of NOx regeneration requests due to NTLD at new NOx catalyst - MT vehicle					
C_NT_SUL_MIN_OFS	-	0... FFFFH	0... 10485.6	0.16	mg
Min NOx catalyst sulphur load to enable cat cooling at standing car					
C_NTLD_STATE_RGN_REQ	-	0... FFFFH	0... 0.99998	15.3e-6	-
Minimum NOx catalyst loadig degree to switch to model (< NTLD_MAX)					
C_STATE_NS_OBD_BIT_SEL_MDL	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor OBDII diagnosis types for changing from model to sensor mode					
C_T_AST_MIN_NS_READY	-	0... FFFFH	0... 65535	1	s
Minimum time after start to allow lean operation in case of late readiness of NOx sensor					
C_T_AST_NT_STST_DEAC	-	0... FFFFH	0... 6553.5	0.1	s
Time after start threshold for deactivation of stop/start functionalities into NOx catalyst functions					
C_T_IPLSL_VLD_DLY	-	0... FFH	0... 25.5	0.1	s
Delay time, during there LV_IPLSL_VLD[i] = 0 is hided for NOx catalyst management					
C_T_NOX_SENS_VLD_STATE_RGN_REQ	-	0... FFFFH	0... 655.35	0.01	s
Minimum time with NOx sensor not valid to switch to model					
C_T_RGN_MIN_NS_READY	-	0... FFFFH	0... 655.35	0.01	s
Minimum NOx regeneration duration for counting as model controlled NOx regeneration					
C_T_VS_IS_NT	-	0... FFH	0... 25.5	0.1	s
Duration cat cooling at standing car is allowed					
C_TNT_MDL_H_MAX_OFS	-	0... FFH	0... 1020	4	°C
Min NOx catalyst temperature to enable cat cooling at standing car					
C_TNT_MDL_H_MAX_OFS_HYS	-	0... FFH	0... 1020	4	°C
NOx catalyst temperature hysteresis to disable catalyst cooling					
C_TNT_MDL_MAX_OFS	-	80... 7FH	-512 ...508	4	°C
NOx catalyst temperature offset to enable cat cooling at standing car					
C_TNT_MDL_THD_RGN_NOT	-	0... FFH	0... 1020	4	°C
NOx trap monolith temperature max. threshold for inhibit a regeneration					
C_TNT_MDL_THD_RGN_NOT_HYS	-	0... FFH	0... 1020	4	°C
NOx trap monolith temperature hysteresis for inhibit a regeneration					
C_TQI_SP_MAF_LOAD_H_HYS	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque threshold hysteresis for reset of high engine load flag					
C_VS_MIN_RGN	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed for requesting a NOx regeneration					
C_VS_TNT_MDL_MIN	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold to enable cat cooling at standing car					
C_VS_TNT_MDL_MIN_OFF	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold to disable catalyst cooling					
ID_CTR_RGN_MDL_CTL_MAX	-	0... FFH	0... 255	1	-
LDP_TCO_ST_NS_ID_CTR_RGN_MDL	6	0... FEH	-48... 142.5	0.75	°C
Maximum number of model controlled NOx regenerations					
IP_T_AFL_MDL_CTL_MAX	-	0... FFFFH	0... 6553.5	0.1	s

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_TCO_ST_NS_IP_T_AFL_MDL	6	0... FEH	-48... 142.5	0.75	°C
Maximum model controlled lean engine operation time after x model controlled NOx regenerations					
IP_T_AFL_MDL_CTL_SUM_MAX	-	0... FFFFH	0... 6553.5	0.1	s
LDP_TCO_ST_NS_IP_T_AFL_MDL_SUM	6	0... FEH	-48... 142.5	0.75	°C
Maximum model controlled lean engine operation time at actual driving cycle					
IP_T_AST_SAE_MDL_CTL_MAX	-	0... FFFFH	0... 65535	1	s
LDP_TCO_ST_NS_IP_T_AST_SAE	6	0... FEH	-48... 142.5	0.75	°C
Maximum model controlled lean engine operation duration after start					
IP_TQI_SP_MAF_LOAD_H	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_LOAD_H	8	0... FFH	0... 8160	32	rpm
Torque threshold for detecting high engine load					
LC_INH_NT_ACT_OFF	-	0... 1H	0 ...1	1	-
Codeword for the manual setting of the inhibiting bit					
LC_INH_NT_AFL	-	0... 1H	0 ...1	1	-
Codeword for forcing to Lambda=1 operation					
LC_INH_NT_AFL_OFF	-	0... 1H	0 ...1	1	-
Manual setting of inhibiting Lambda = 1 request					
LC_INH_NTLD_REQ_NOX_SENS_AUTH	-	0... 1H	0 ...1	1	-
Inhibition of NOx regeneration requests due to NTLD after the NOx sensor has reached its readiness					
LC_INH_NTLD_REQ_NOX_SENS_VLD	-	0... 1H	0 ...1	1	-
Inhibition of NOx regeneration requests due to NTLD, if the NOx signal is valid					
LC_INH_REQ_NOX_SENS_OFF	-	0... 1H	0 ...1	1	-
Manual setting of inhibiting exclusively regeneration out of NOx sensor					
LC_INH_RGN_IS	-	0... 1H	0 ...1	1	-
Inhibition of NOx regeneration requests at idle speed					
LC_INH_RGN_REQ_NTLD	-	0... 1H	0 ...1	1	-
Codeword for general inhibition of regeneration request due to loading degree					
LC_NOX_NS_AUTH_CHK	-	0... 1H	0 ...1	1	-
Activation of LV_NOX_NS_AUTH[...] for NOx sensor readiness check					
LC_OPM_AV_CHK	-	0... 1H	0 ...1	1	-
Activation of OPM_AV for determination of model controlled lean engine operation time					
LC_STATE_NOX_CHK	-	0... 1H	0 ...1	1	-
Activation of STATE_NOX for determination of model controlled lean engine operation time					
LC_STST_PRE_STOP_REQ_NT_ACT	-	0... 1H	0 ...1	1	-
Activation of stop/start functionalities into NOx catalyst functions by pre-stop request					
LC_TCO_ST_SEL	-	0... 1H	0 ...1	1	-
Selection of TCO_ST (=0) or TCO_ST_DC (=1) for use at this functionality					
LC_TNT_MDL_MAX_OFS	-	0... 1H	0 ...1	1	-
Switch to enable cat cooling at standing car					
LC_VLS_NS_AUTH_CHK	-	0... 1H	0 ...1	1	-
Activation of LV_VLS_NS_AUTH[...] for NOx sensor readiness check					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_VLS_NS_VLD_INH_RGN_ENA	-	0... 1H	0 ...1	1	-
Use LV_VLS_NS_VLD for calculation of LV_INH_RGN_REQ					

7.87.1 Inhibiting the NOx catalyst management

FUNCTION DESCRIPTION:

Number of NOx sensors: NC_NOX_SENS_CONF k = 1...NC_NOX_SENS_CONF
Number of lambda sensors: NC_CBK_EX_NR i = 1...NC_CBK_EX_NR

Typical configurations:
[NC_CBK_EX_NR:NC_NOX_SENS_CONF] =[1:1], [2:2], [2:1]

Description:

The timer T_IPLSL_VLD_DLY is limited to its maximum value. An overflow is not allowed.

Application conditions

Initialisation: at reset
LV_INH_NT_ACT = 0
T_IPLSL_VLD_DLY = 0

Recurrence: *100 ms*

Activation: *at every engine state*

Deactivation: –

Formula section:

if LV_IPLSL_VLD[i] = 0 *% valid if at least one [i] = 0*
then T_IPLSL_VLD_DLY(n) = T_IPLSL_VLD_DLY(n-1) + Recurrence
else T_IPLSL_VLD_DLY = 0
endif

if **((** LV_IPLSL_VLD[i] = 0 *% valid if at least one [i] = 0*
(readiness of upstream oxygen sensor)
and T_IPLSL_VLD_DLY >= C_T_IPLSL_VLD_DLY
)
or LV_ERR_TCO = 1
(error currently present on error location coolant temperature sensor)
or LV_ERR_MAF = 1
(error currently present on mass air flow acquisition)
or LV_ERR_CAM = 1
(global error on camshaft sensor)
)

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and LC_INH_NT_ACT_OFF = 0
then LV_INH_NT_ACT = 1
else LV_INH_NT_ACT = 0
endif

7.87.2 Inhibiting the NOx catalyst regeneration request

FUNCTION DESCRIPTION:

Application conditions

Initialisation: at reset
LV_INH_RGN_REQ = 1

Recurrence: *100 ms*

Activation: *LV_NT_ACT = 1*

Deactivation: *LV_NT_ACT = 0*

Formula section:

if TNT_MDL_H > C_TNT_MDL_THD_RGN_NOT **OR**
VS < C_VS_MIN_RGN **OR**
(LV_IS = 1 **AND** LC_INH_RGN_IS = 1) **OR**
(LV_VLS_NS_VLD[k] = 0 **AND***% valid if at least one [k] = 0*
LC_VLS_NS_VLD_INH_RGN_ENA = 1**)**
(readiness of the binary O2 signal from the NOx-Sensor)
then LV_INH_RGN_REQ = 1
else
if TNT_MDL_H < (C_TNT_MDL_THD_RGN_NOT -
C_TNT_MDL_THD_RGN_NOT_HYS) **AND**
VS >= C_VS_MIN_RGN **AND**
(LV_IS = 0 **OR** LC_INH_RGN_IS = 0) **AND**
(LV_VLS_NS_VLD[k] = 1 **OR***% valid for all [k] = 1*
LC_VLS_NS_VLD_INH_RGN_ENA = 0**)**
then LV_INH_RGN_REQ = 0
endif
endif

7.87.3 Inhibiting the regeneration request due to modeled loading degree

FUNCTION DESCRIPTION:

This is a dummy file provided for project-specific reasons to disable regeneration request due to high loading degree. Contrary to the previous subchapter, this new inhibition flag does not inhibit a regeneration due to a switch to homogeneous operation due to torque request by driver.

Application conditions

Initialisation: at reset
LV_INH_RGN_REQ_NTLD = 0

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Recurrence: *100 ms*

Activation: *LV_NT_ACT = 1*

Deactivation: *LV_NT_ACT = 0*

Formula section:

if LC_INH_RGN_REQ_NTLD = 1 **OR**
(LV_NOX_NS_AUTH[k] = 1 **AND** *% valid if all [k] = 1*
LC_INH_NTLD_REQ_NOX_SENS_AUTH = 1) **OR**
(LV_NOX_NS_VLD[k] = 1 **AND** *valid if all [k] = 1*
LC_INH_NTLD_REQ_NOX_SENS_VLD = 1) **OR**
(LV_AT = 0 **AND** NT_AGI > C_NT_AGI_INH_RGN_REQ_NTLD_MT) **OR**
(LV_AT = 1 **AND** NT_AGI > C_NT_AGI_INH_RGN_REQ_NTLD_AT) **OR**
(LV_AT = 0 **AND** DIST_NT < C_DIST_NT_INH_RGN_REQ_NTLD_MT) **OR**
(LV_AT = 1 **AND** DIST_NT < C_DIST_NT_INH_RGN_REQ_NTLD_AT)
then LV_INH_RGN_REQ_NTLD = 1
else LV_INH_RGN_REQ_NTLD = 0
endif

7.87.4 Inhibiting the lean operation (manual request of air/fuel stoichiometric)

FUNCTION DESCRIPTION:

The logical value LV_INH_NT_AFL allows to force a Lambda = 1.0 operation due to project specific requirements. Lambda = 1.0 operation is forced by an error of the NOx-Sensor or manual setting.

Application conditions

Initialisation: at reset
LV_INH_NT_AFL = 0

Recurrence: *100 ms*

Activation: *every time*

Deactivation: -

Formula section:

if (LV_ERR_NS_CAN_BOFF = 1
or LV_ERR_NS_CAN_MSG_LOST[k] = 1 *% valid if at least one [k] = 1*
or LV_ERR_NS_OBD_1[k] = 1 *% valid if at least one [k] = 1*
or (STATE_ERR_NS_OBD_2[k] **bitwise AND** C_ERR_NS_NT_AFL_BIT_SEL) != 0 *% valid if at least one [k] = 1*
or LV_ERR_LS_UP[i] = 1 *% valid if at least one [i] = 1*
or LV_INH_NT_AFL_NS_READY = 1
or LC_INH_NT_AFL = 1
)
and LC_INH_NT_AFL_OFF = 0
then LV_INH_NT_AFL = 1

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else LV_INH_NT_AFL = 0
endif

7.87.5 Change to model when invalid NOx-Sensor Signal flow diagram

FUNCTION DESCRIPTION:

If the function is active (LC_INH_REQ_NOX_SENS_OFF = 0) and the NOx signal is not valid during the NOx catalyst loading phase the mode of the NOx regeneration request is switched from "SENSOR" to "MODEL". The NOx regeneration request by NOx sensor is as long as forbidden until the NOx sensor OBDII diagnosis is carried out and no error is appeared.

Application conditions

Initialisation: at reset, at deactivation:
LV_INH_RGN_REQ_NOX_SENS = 0
LV_INH_NOX_SENS_RGN = 0
LV_NTLD_ADJ = 0
STATE_RGN_REQ = SENSOR

Recurrence: *100ms.*

Activation: *LC_INH_REQ_NOX_SENS_OFF = 0*

Deactivation: *LC_INH_REQ_NOX_SENS_OFF = 1*

Formula section:

Default State:
STATE_RGN_REQ = SENSOR

Transitions:

STATE_RGN_REQ: **SENSOR to MODEL**

if STATE_NOX = LOAD
and (LV_NOX_NS_VLD[k] = 0
and T_NOX_NS_HLD[k] >= C_T_NOX_SENS_VLD_STATE_RGN_REQ)
% valid if at least one condition for [k] = true
and LV_T_NS_VLD = 1
and NTLD >= C_NTLD_STATE_RGN_REQ
then STATE_RGN_REQ = MODEL
endif

STATE_RGN_REQ: **MODEL to SENSOR**

if *% valid if all conditions for [k] = true*
((**bit-wise not**(STATE_END_NS_OBD_2[k]) **bit-wise or** STATE_ERR_NS_OBD_2[k]) **bit-wise and** C_STATE_NS_OBD_BIT_SEL_MDL) = 0
and LV_ERR_NS_OBD_1[k]= 0
and LV_NOX_NS_AUTH[k] = 1
and LV_NOX_NS_ACT[k] = 1
then STATE_RGN_REQ = SENSOR
else STATE_RGN_REQ unchanged

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endif

Static state actions:

```
STATE_RGN_REQ = SENSOR
        LV_INH_RGN_REQ_NOX_SENS = 0
        LV_INH_NOX_SENS_RGN = 0
        LV_NTLD_ADJ = 0

STATE_RGN_REQ = MODEL
        LV_INH_RGN_REQ_NOX_SENS = 1
        LV_INH_NOX_SENS_RGN = 1
        LV_NTLD_ADJ = 1
```

7.87.6 Catalyst cooling function

Application conditions

Initialisation: at reset, at deactivation
LV_TNT_MDL_MAX_OFS = 0
TNT_MDL_MAX_OFS = 0
T_VS_IS_NT = 0

Recurrence: *100ms*

Activation: *LC_TNT_MDL_MAX_OFS = 1*

Deactivation: *LC_TNT_MDL_MAX_OFS = 0*

Formula section:

```
if        VS <= C_VS_TNT_MDL_MIN
    and   TNT_MDL_H > C_TNT_MDL_H_MAX_OFS
    and   NT_SUL >= C_NT_SUL_MIN_OFS
then         if        T_VS_IS_NT <= C_T_VS_IS_NT
             then   if     T_VS_IS_NT < maximum value (FFH)
                    then         T_VS_IS_NT = T_VS_IS_NT + Recurrence
                    else         T_VS_IS_NT(n) = T_VS_IS_NT(n-1)
                    endif
                    TNT_MDL_MAX_OFS = C_TNT_MDL_MAX_OFS
                 LV_TNT_MDL_MAX_OFS = 1
             else    TNT_MDL_MAX_OFS = 0
                 LV_TNT_MDL_MAX_OFS = 0
             endif
else         if        VS <= C_VS_TNT_MDL_MIN_OFF
               and                  TNT_MDL_H <= C_TNT_MDL_H_MAX_OFS -
                                      C_TNT_MDL_H_MAX_OFS_HYS
             then         T_VS_IS_NT = 0
                    TNT_MDL_MAX_OFS = 0
                    LV_TNT_MDL_MAX_OFS = 0
             endif
endif
```

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7.87.7 Enabling NOx Catalyst regeneration request by model

Application conditions

Initialisation: at reset
LV_ADJ_NOX_SENS_RGN = 0

Recurrence: *10 ms*

Activation: *at every engine state*

Deactivation: –

Formula section:

if LV_ERR_EGR_2 = 1
then LV_ADJ_NOX_SENS_RGN = 1
else LV_ADJ_NOX_SENS_RGN = 0
endif

7.87.8 Calculation of full load air mass flow integral

General information:

The air mass flow integral MAF_INT_FL_ACT is used for detection of short and long full load phases or high engine load phases inside of NOx catalyst management functionality. This classification of full load phases or high engine load phases is required for the decision whether a running NOx regeneration is terminated because of higher full load priority or not.

Description:

The constant NC_FAC_MAF_INT_FL includes the recurrence and converts the physical unit of MAF_KGH from [kg/h] to [g/ms].
NC_FAC_MAF_INT_FL = Recurrence/3.6
Note! The calculation of MAF_INT_FL_ACT shall be stopped if the maximum value of value range is reached. An overflow is not allowed.

Application conditions

Initialisation: at reset, at deactivation:
MAF_INT_FL_ACT = 0
LV_LOAD_H = 0

Recurrence: *100ms*

Activation: *LV_NT_ACT = 1*

Deactivation: *LV_NT_ACT = 0*

Formula section:

if TQI_SP_MAF > IP_TQI_SP_MAF_LOAD_H(N_32)
then LV_LOAD_H = 1
else
if TQI_SP_MAF < IP_TQI_SP_MAF_LOAD_H(N_32) - C_TQI_SP_MAF_LOAD_H_HYS

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then LV_LOAD_H = 0
else LV_LOAD_H remains unchanged
endif
endif

if LV_FL = 1 **OR** LV_LOAD_H = 1
then MAF_INT_FL_ACT(n) = MAF_INT_FL_ACT(n-1) + MAF_KGH * NC_FAC_MAF_INT_FL
else MAF_INT_FL_ACT = 0
endif

7.87.9 Stop/start functionality activation

General information:

LV_NT_STST = 1 activates into the NOx catalyst control functions special variable calculations in order to handle the stop/start phases.

Description:

The special stop/start functionalities into the NOx catalyst control functions are enabled or disabled by LC_NT_STST_ACT.

Application conditions

Initialisation:	at reset, at deactivation: LV_NT_STST = 0
Recurrence:	*10ms*
Activation:	*LC_NT_STST_ACT = 1*
Deactivation:	*LC_NT_STST_ACT = 0*

Formula section:

if (LV_STST_STOP_CYC = 1 **AND** N_32 < C_N_32_NT_STST_ACT) **OR**
(LV_STST_PRE_STOP_REQ = 1 **AND** LC_STST_PRE_STOP_REQ_NT_ACT = 1)
then LV_NT_STST = 1
else
if T_AST >= C_T_AST_NT_STST_DEAC
(LV_STST_STOP_CYC = 0 **OR**
(LV_STST_STOP_CYC = 1 **AND** N_32 > C_N_32_NT_STST_DEAC))
then LV_NT_STST = 0
endif
endif

7.87.10 Request of Lambda=1.0 operation due to missing NOx sensor readiness

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General information:

The engine system is able to start with lean engine operation without a ready NOx sensor for NOx emission control. In this case the NOx emission control runs completely model controlled. The aim of this section is the limitation of this system state by requesting Lambda=1.0 engine operation up to the NOx sensor reaches its operation readiness.

Description:

Application conditions

Initialisation: at reset, at deactivation:
LV_INH_NT_AFL_NS_READY = 0
CTR_RGN_MDL_CTL = 0
T_AFL_MDL_CTL = 0
T_AFL_MDL_CTL_SUM = 0
TCO_ST_NS = 0

Recurrence: *100ms*

Activation: *LV_IGK = 1*

Deactivation: –

Formula section:

Selection of TCO_ST signal

if LC_TCO_ST_SEL = 1
then TCO_ST_NS = TCO_ST_DC
else TCO_ST_NS = TCO_ST
endif

Counting of model controlled NOx regenerations

if **(**LV_NOX_NS_AUTH[k] = 0 **OR** LC_NOX_NS_AUTH_CHK = 0**)** **AND**
(LV_VLS_NS_AUTH[k] = 0 **OR** LC_VLS_NS_AUTH_CHK = 0**)**
LV_RGN_NT_REQ(n-1) = 1 **AND**
LV_RGN_NT_REQ(n) = 0 **AND**
T_RGN(n-1) >= C_T_RGN_MIN_NS_READY
then *Model controlled NOx regeneration detected*
increment CTR_RGN_MDL_CTL
endif

Measurement of time without NOx sensor readiness

if **(**LV_NOX_NS_AUTH[k] = 0 **OR** LC_NOX_NS_AUTH_CHK = 0**)** **AND**
(LV_VLS_NS_AUTH[k] = 0 **OR** LC_VLS_NS_AUTH_CHK = 0**)**
(STATE_NOX = "LOAD" **OR** LC_STATE_NOX_CHK = 0**)**
(OPM_AV = "S" **OR** OPM_AV = "AFL" **OR** LC_OPM_AV_CHK = 0**)**
then *Model controlled lean engine operation detected*
increment T_AFL_MDL_CTL_SUM

if CTR_RGN_MDL_CTL >= ID_CTR_RGN_MDL_CTL_MAX(TCO_ST_NS)

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then *Model controlled lean engine operation time after x model controlled NOx regenerations*
increment T_AFL_MDL_CTL
endif
endif

Request of Lambda=1.0 engine operation
if **(**LV_NOX_NS_AUTH[k] = 0 **OR** LC_NOX_NS_AUTH_CHK = 0**)** **AND**
(LV_VLS_NS_AUTH[k] = 0 **OR** LC_VLS_NS_AUTH_CHK = 0**)**
then *Waiting on NOx sensor readiness*
if CTR_RGN_MDL_CTL >= ID_CTR_RGN_MDL_CTL_MAX(TCO_ST_NS) **A**

T_AFL_MDL_CTL >= IP_T_AFL_MDL_CTL_MAX(TCO_ST_NS)

T_AFL_MDL_CTL_SUM >= IP_T_AFL_MDL_CTL_SUM_MAX(TCO_ST_NS)

T_AST_SAE >= IP_T_AST_SAE_MDL_CTL_MAX(TCO_ST_NS)
then *Maximum model controlled lean engine operation duration is reached*
Set of Lambda=1.0 operation request
LV_INH_NT_AFL_NS_READY = 1
else *Model controlled lean engine operation is running*
LV_INH_NT_AFL_NS_READY = 0
endif
else *NOx sensor has reached its readiness*
if T_AST_SAE >= C_T_AST_MIN_NS_READY
Reset of Lambda=1.0 operation request
LV_INH_NT_AFL_NS_READY = 0
Reset of counter & timers after NOx sensor readiness
CTR_RGN_MDL_CTL = 0
T_AFL_MDL_CTL = 0
T_AFL_MDL_CTL_SUM = 0
endif
endif

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7.88 NOx tailpipe emission

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NOX_OUT_MES [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 1023.98437	0.015625	mg/s
Tailpipe NOx emission					
NOX_OUT_MES_INT [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 10485.6	0.16	mg
Absolute tailpipe NOx emission during stratified operation mode					

Input data:

C_NOX_CONC_COR {p. 2990}	LV_ERR_NS_CAN_MSG_LOST [NC_NOX_SENS_CONF] {p. 991}	LV_ERR_NS_OBD_1 [NC_NOX_SENS_CONF] {p. 4915}	LV_NOX_NS_VLD [NC_NOX_SENS_CONF] {p. 991}
LV_NOX_SENS {p. 2982}	LV_T_NS_VLD {p. 3193}	MAF_FG_CYL {p. 1212}	NC_NOX_SENS_CONF {p. 643}
NOX_NS_AD [NC_NOX_SENS_CONF] {p. 3193}	STATE_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	STATE_NOX {p. 2986}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ERR_NS_NOX_OUT_BIT_SEL	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit NOX_OUT_MES... calculations					
LC_NOX_OUT_MES_INT_ACT	-	0... 1H	0 ...1	1	-
Switch to enable calculation of NOx tailpipe emission					

FUNCTION DESCRIPTION:

LV_ERR_NS_OBD_2[NC_NOX_SENS_CONF]

General information

The NOx signal of the NOx sensor is used to calculate the NOx tailpipe emission during lean operation mode.
The NOx concentration measured behind the NOx catalyst is converted into a mass flow. This NOx mass flow is integrated up to the absolute NOx tailpipe emission during a lean phase.

NC_NOX_SENS_CONF is the number of NOx sensors within the system. Therefore the index i represents:

i = 1 ... signals based on NOx sensor 1, which is mounted at cylinder bank 1 or at a summary tailpipe section of a Y exhaust line configuration

i = 2 ... signals based on NOx sensor 2, which is mounted at cylinder bank 2

Application conditions

Initialisation:

```
at reset
NOX_OUT_MES_INT[i] = 0
NOX_OUT_MES[i] = 0
```

Recurrence:

```
20 ms
```

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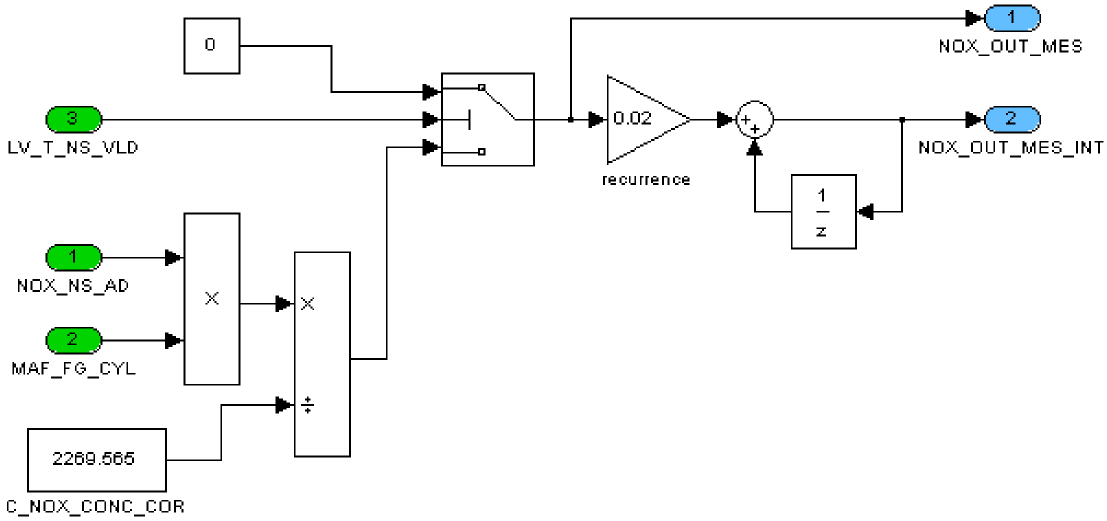
Activation:
```
if    NC_NOX_SENS_CONF > 0
then    every time
endif
```

Deactivation:
```
NC_NOX_SENS_CONF = 0
```

Signal flow diagram:



This signal flow diagram shows the calculation principle. For details see the "Formula section" below.

Formula section:

if (1) STATE_NOX(n-1) = STOP
STATE_NOX(n) = **NOT** (STOP)
then (1) NOX_OUT_MES_INT[i] = 0
endif (1)

if (2) LC_NOX_OUT_MES_INT_ACT = 1
then (2)
if (3) STATE_NOX(n) = LOAD **AND**
LV_NOX_SENS = 1 **AND**
LV_NOX_NS_VLD[i] = 1 **AND**
LV_ERR_NS_CAN_MSG_LOST_[i] = 0 **AND**
LV_ERR_NS_OBD_1[i]i = 0 **AND**

(STATE_ERR_NS_OBD_2[i] **bitwise AND**
C_ERR_NS_NOX_OUT_BIT_SEL) != 0
then (3)
if (4) LV_T_NS_VLD = 0
then (4) NOX_OUT_MES[i] = 0
else (4) NOX_OUT_MES[i] = NOX_NS_AD[i] *
(MAF_FG_CYL /NC_NOX_SENS_CONF) /
C_NOX_CONC_COR

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endif (4)
NOX_OUT_MES_INT[i] (n) = NOX_OUT_MES_INT[i] (n-1) + NOX_OUT_MES[i] * recurrence
(Internally calculation with higher resolution)
else (3) NOX_OUT_MES_INT[i] (n) = NOX_OUT_MES_INT[i] (n-1)
endif (3)
else (2) NOX_OUT_MES_INT[i] = 0
endif (2)

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7.89 NOx engine out emission adaptation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_NOX_AD_DYW	O/V	0... 1H	0 ...1	1	-
Logical value for active limited dynamics					
MAF_FG_CYL_MMV	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Moving mean value of mass air flow					
NOX_COR_S_MMV	V	0... FFFFH	0... 1023.98437	0.015625	mg/s
Moving mean value of NOx emission					

Input data:

C_MFF_SP_S_NT_AGI_MAX {p. 3108}	C_MFF_SP_S_NT_AGI_MIN {p. 3108}	C_N_32_NT_AGI_MAX {p. 3108}	C_N_32_NT_AGI_MIN {p. 3108}
LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_HOM_AFS_REQ {p. 8136}	LV_NOX_NS_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_PUC {p. 1720}
LV_T_NS_VLD {p. 3193}	MAF_FG_CYL {p. 1212}	MFF_SP_S {p. 8243}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}	NOX_COR_S {p. 2976}	STATE_NOX {p. 2986}
VS {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_MAF_FG_CYL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant of air mass flow					
C_CRLC_NOX_AD	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant of NOx emission					
C_LAMB_NOX_AD_DYW	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda lthreshold for limited dynamics					
C_MAF_FG_CYL_DYW	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
air mass flow limit for limited dynamics					
C_MAF_MIN_RGN_NOX_AD	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Minimum mass air flow for use adaptation value					
C_N_32_MIN_RGN_NOX_AD	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for use adaptation value					
C_NOX_AD_DYW	-	0... FFFFH	0... 1023.98437	0.015625	mg/s
NOx emission limit for limited dynamics					
C_VS_MIN_RGN_NOX_AD	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed for use adaptation value					

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FUNCTION DESCRIPTION:

General information:

Number of NOx catalyst: NC_NT_NR i = 1...NC_NT_NR
Number of NOx sensors: NC_NOX_SENS_CONF k = 1...NC_
NOX_SENS_CONF

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Number of lambda sensors: NC_CBK_EX_NR m = 1...NC_CBK_EX_NR

Typical configurations:
[NC_CBK_EX_NR:NC_NT_NR:NC_NOX_SENS_CONF] =[1:1:1], [2:2:2], [2:2:1], [2:1:1]

7.89.1 Limited Dynamics

Initialisation: -
Recurrence: 20 ms
Activation: at any state

Formula section:

if (1) STATE_NOX = STOP - -> !STOP % initialisation of LV_NOX_AD_DYW
then(1) LV_NOX_AD_DYW = 1
NOX_COR_S_MMV (n) = NOX_COR_S
endif(1)

MAF_FG_CYL_MMV (n) = MAF_FG_CYL_MMV (n-1) * (1 - C_CRLC_MAF_FG_CYL) + C_CRLC_MAF_FG_CYL * MAF_FG_CYL

Limited dynamics for stratified operation:

if(1) STATE_NOX = LOAD **and** LV_HOM_AFS_REQ = 0
%monitoring limited dynamics during stratified mode
then(1)
NOX_COR_S_MMV (n) = NOX_COR_S_MMV (n-1) * (1 - C_CRLC_NOX_AD) +
C_CRLC_NOX_AD * NOX_COR_S
if(2) |NOX_COR_S - NOX_COR_S_MMV| > C_NOX_AD_DYW **or**
(LV_NOX_NS_VLD[k] = 0 **and** LV_T_NS_VLD = 1)
% valid if any condition for [k] is true
or LAMB_LS_UP[m] < C_LAMB_NOX_AD_DYW
% valid if any condition for [m] is true
or N_32 <= C_N_32_NT_AGI_MIN
or N_32 >= C_N_32_NT_AGI_MAX
or MFF_SP_S <= C_MFF_SP_S_NT_AGI_MIN
or MFF_SP_S >= C_MFF_SP_S_NT_AGI_MAX
then(2) LV_NOX_AD_DYW = 0
else(2) LV_NOX_AD_DYW remains unchanged
endif(2)
else(1) LV_NOX_AD_DYW remains unchanged
endif(1)

Limited dynamics for regeneration:

if(1) STATE_NOX = REGENERATION %monitoring limited dynamics during stratified mode
then(1)
if(2) | MAF_FG_CYL - MAF_FG_CYL_MMV | > C_MAF_FG_CYL_DYW
or VS C_VS_MIN_RGN_NOX_AD
or N_32 < C_N_32_MIN_RGN_NOX_AD
or MAF_FG_CYL < C_MAF_MIN_RGN_NOX_AD

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or LV_PUC = 1
then(2) LV_NOX_AD_DYW = 0
else(2) LV_NOX_AD_DYW remains unchanged
endif(2)
else(1) LV_NOX_AD_DYW remains unchanged
endif(1)

chapter 1.2 and 1.3 deleted

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7.90 NOx catalyst aging

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_NT_AGI_AD	V	0... FEH	0... 254	1	-
counter of aging adaptation attempts (with closed EGR valve)					
CTR_NT_AGI_AD_CMPL	O/V	0... FEH	0... 254	1	-
counter of completed aging adaptation cycles during driving cycle					
CTR_NT_AGI_AD_CMPL_SUM	O/V/S	0... FFFFH	0... 65535	1	-
counter of completed aging adaptation					
CTR_NT_AGI_SO2P_FQ	O/V/S	0... FFFFH	0... 65535	1	-
counter of completed aging adaptation during FQ adaptation					
DIF_CTR_NT_AGI_CMPL_SUM	V	0... FFFFH	0... 65535	1	-
Completed aging adaptation due to FQ adaptation					
FAC_NT_AGI_LIM	O/V/S	0... FFFFH	0... 0.99998474	15.2587e-6	-
Limited NOx trap aging factor					
FAC_NT_AGI_THERMO_SNG [NC_NT_NR]	O/V	0... FFFFH	0... 0.99998474	15.2587e-6	-
Temporary aging factor					
FAC_SU_CONC_FUEL	O/V	0... FFH	0... 255	1	-
Interface factor to sulphur model for calibrating fuel sulphur concentration					
LV_AGI_AD_TRIG	V	0... 1H	0 ...1	1	-
Logical value for the request of adaptaion of aging factor					
LV_AGI_VLD	O/V	0... 1H	0 ...1	1	-
Logical value for completed aging adaption					
LV_CDN_NT_AGI_THERMO_AD	O/V	0... 1H	0 ...1	1	-
flag: thermal aging adaptation enabled (due to low sulphur load)					
LV_EGR_RATIO_SP_AGI_ACT	O/V	0... 1H	0 ...1	1	-
request to close EGR valve for better NT aging adaptation performance					
LV_NOX_NS_SIG_CHK_NT_AGI	V	0... 1H	0 ...1	1	-
Check of the NOx signal shift and gain adaptation					
LV_NT_AFS_REQ_AGI	O/V/S	0... 1H	0 ...1	1	-
Logical value for the request of lambda=1 operation					
LV_NT_AFS_REQ_AGI_TMP_1	V	0... 1H	0 ...1	1	-
Logical value for the request of lambda=1 operation					
LV_NT_AFS_REQ_AGI_TMP_2	V	0... 1H	0 ...1	1	-
Logical value for the request of lambda=1 operation					
LV_NT_AFS_REQ_AGI_TMP_3	O/V/S	0... 1H	0 ...1	1	-
Logical value for the request of lambda =1 operation					
LV_NT_AGI_BAS_ENA	V	0... 1H	0 ...1	1	-
basic aging factor calculation enabled					
LV_NT_AGI_ENA	O/V	0... 1H	0 ...1	1	-
aging factor (sulphur or thermal) calculation enabled					
LV_NT_AGI_ENA_AFS	O/V	0... 1H	0 ...1	1	-
value for HOM_REQ befor aging adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_NT_AGI_ENA_AFS_TMP	O/V	0... 1H	0 ...1	1	-
Temorary value for HOM_REQ befor aging adaptation					
LV_NT_AGI_ENA_TMP	V	0... 1H	0 ...1	1	-
temporary value for LV_NT_AGI_ENA calculation					
LV_NT_AGI_ENA_TNT	V	0... 1H	0 ...1	1	-
temperature initialisation condition for aging adaptation given					
LV_NT_AGI_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
External data for NOx trap aging values available					
LV_NT_AGI_EXT_RES	O/V	0... 1H	0 ...1	1	-
External reset of data for NOx trap aging values					
LV_NT_AGI_TRIG_ENA	V	0... 1H	0 ...1	1	-
Enabling of trigger for aging calculation					
LV_SO2P_REQ_1	O/V/S	0... 1H	0 ...1	1	-
Request of a desulfation					
LV_SO2P_REQ_2	O/V/S	0... 1H	0 ...1	1	-
Request of a desulfation (forces catalyst heating)					
LV_SO2P_REQ_FQ	O/V/S	0... 1H	0 ...1	1	-
Logical value for active FQ adaptation					
LV_SWI_MDL_THERMO_AGI_ACT	V	0... 1H	0 ...1	1	-
Switch to modeled aging factor before sulphur aging model caluclation active					
NOX_EFF [NC_NT_NR]	V	0... FFFFH	0... 0.99998474	15.2587e-6	-
actual NOx trap efficiency (not defined in binary Lambda-Sensor mode) (bench selective)					
NT_AGI	O/V/S	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor					
NT_AGI_BAS [NC_NT_NR]	O/V	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor base value (not defined in binary Lambda-Sensor mode)					
NT_AGI_NTLD	O/V	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor					
NT_AGI_OBS	O/V	0... FFFFH	0... 0.99998474	15.2587e-6	-
quick aging monitoring value					
NT_AGI_OBS_SNG [NC_NT_NR]	O/V	0... FFFFH	0... 0.99998474	15.2587e-6	-
quick aging monitoring value (bench selective)					
NT_AGI_S_RED	O/V	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor					
NT_AGI_SO2P_FQ	V	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor					
NT_AGI_SO2P_FQ_SUM	O/V/S	0... FFFFFFH	0... 255.999985	15.2587e-6	-
Sum of NOx trap aging factor during FQ adaptation					
NT_AGI_SUL	O/V/S	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor due to sulphur load					
NT_AGI_SUL_SNG [NC_NT_NR]	O/V/S	0... FFFFFFFFH	0 ...1	232.83e-12	-
NOx trap aging factor due to sulphur load (bench selective)					
NT_AGI_THERMO	O/V/S	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor due to thermal aging					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NT_AGI_THERMO_SNG [NC_NT_NR]	O/V/S	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor due to thermal aging (bench selective)					
NT_SUL_AGI	O/V	0... FFFFH	0... 10485.6	0.16	mg
Interface variable for update of sulphur release model by aging function					
NT_SUL_AGI_SNG [NC_NT_NR]	O/V	0... FFFFH	0... 10485.6	0.16	mg
Interface variable for update of sulphur release model by aging function (bench selective)					
NT_SUL_UPD	O/V	0... FFFFH	0... 10485.6	0.16	mg
interface variable for update of sulphur model by aging function					
NTLD_AGI [NC_NT_NR]	V	0... FFFFH	0... 0.99998474	15.2587e-6	-
"reverse" NOx trap loading degree					
STATE_NOX_OLD_AGI	-	0H 1H 2H 3H 4H 5H	PASSIV LOAD REGENERATION WAIT STOP WARMUP	-	-
Old value of STATE_NOX for edge detection					

Input data:

C_NT_STC_BAS_MAX_RNG_H {p. 2991}	CTR_NT_AGI_AD_CMPL_SUM_EXT_ADJ {p. 7679}	CTR_NT_AGI_SO2P_FQ_EXT_ADJ {p. 7679}	DIST_NS_NEW {p. 3193}
DIST_NT {p. 3180}	FAC_NOX_NS_AD [NC_NOX_SENS_CONF] {p. 3189}	FAC_NT_AGI_LIM_EXT_ADJ {p. 7680}	FAC_NT_AGI_MDL_THERMO {p. 3437}
LC_NOX_RGN_CMPL {p. 997}	LV_EF {p. 3614}	LV_ERR_NS_OBD_1 [NC_NOX_SENS_CONF] {p. 4915}	LV_INH_NT_AGI {p. 3107}
LV_INH_NT_AGI_BAS {p. 3107}	LV_INH_NT_AGI_TNT_BAS {p. 3107}	LV_NOX_AD_CMPL {p. 996}	LV_NOX_SENS {p. 2982}
LV_NOX_SENS_NOX_VLD_RGN_ST [NC_NT_NR] {p. 2982}	LV_NT_AFS_REQ_AGI_TMP_3_EXT_ADJ {p. 7680}	LV_NT_AGI_INI_EXT_ADJ_NEW_CAT {p. 804}	LV_NT_AGI_OBS_EGR_ENA {p. 3107}
LV_NT_AGI_OBS_ENA {p. 3107}	LV_NT_HOM_INI {p. 2982}	LV_NT_SO2P_EXT_ADJ_ACT {p. 3144}	LV_RGN_REQ_NOX_SENS {p. 2983}
LV_RGN_REQ_NTLD {p. 2983}	LV_S_ACT {p. 8137}	LV_SO2P_ACT {p. 3129}	LV_SO2P_REQ {p. 3129}
LV_SO2P_REQ_2_EXT_ADJ {p. 7680}	LV_SO2P_REQ_FQ_EXT_ADJ {p. 7680}	LV_SUL_EXT_ADJ {p. 3113}	LV_SUL_EXT_RES {p. 3113}
NC_NOX_SENS_CONF {p. 643}	NC_NT_NR {p. 644}	NOX_CONC_RED_MMV_RGN_ST {p. 2984}	NOX_NS_AD_RGN_ST [NC_NT_NR] {p. 2984}

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NT_AGI_AV {p. 2985}	NT_AGI_INC_SO2P [NC_NT_NR] {p. 3113}	NT_AGI_SO2P_FQ_SUM_EXT_ADJ {p. 7682}	NT_AGI_SUL_SNG_EXT_ADJ [NC_NT_NR] {p. 7682}
NT_AGI_THERMO_SNG_EXT_ADJ [NC_NT_NR] {p. 7682}	NT_EFF_COR_RGN_ST {p. 2985}	NT_STC_BAS_RNG_H {p. 2985}	NT_SUL {p. 3113}
NT_SUL_H {p. 3113}	NTL_RGN_ST_NOX {p. 2986}	NTLD {p. 2986}	NTLD_MDL {p. 2986}
RATIO_MMV_NS_SHIFT_DIAG [NC_NOX_SENS_CONF] {p. 6412}	STATE_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	STATE_NOX {p. 2986}	T_AFL {p. 2987}
TNT_MDL_MV {p. 8237}	VS {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_NT_AGI_OBS	-	0... FFFFH	0... 0.99998	15.3e-6	-
filter constant for NT_AGI_OBS calculation					
C_CRLC_NT_AGI_SUL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for the calculation of the aging factor due sulphur load					
C_CRLC_NT_AGI_THERMO_DEC	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for the calculation of the thermal aging factor (decreasing factor)					
C_CRLC_NT_AGI_THERMO_INC	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for the calculation of the thermal aging factor (increasing factor)					
C_CTR_NT_AGI_AD_CMPL_MAX	-	0... FFH	0... 255	1	-
max. number of successfull adapt. per cycle					
C_CTR_NT_AGI_AD_MAX	-	0... FFH	0... 255	1	-
max. number of attemps for adaptation (incl. successful attempts)					
C_CTR_NT_AGI_SO2P_FQ_MIN	-	0... FFFFH	0... 65535	1	-
Counter thresholdf or aging adaptation after FQ-desulfation					
C_DIST_NT_AGI_LIM	-	0... FFFFH	0... 524280	8	km
mileage threshold for limited NOx trap aging factor					
C_DIST_NT_AGI_MDL_1	-	0... FFFFH	0... 524280	8	km
Threshold of distance for switching to modeled factor					
C_DIST_NT_AGI_MDL_2	-	0... FFFFH	0... 524280	8	km
Threshold of distance for switching to modeled factor, included sulfur model					
C_FAC_AGI_THD_SENS_DIF_MDL_1	-	0... FFFFH	0... 0.99998	15.3e-6	-
Threshold for difference between aging factors					
C_FAC_AGI_THD_SENS_DIF_MDL_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
Threshold for difference between aging factors, including sulfur model					
C_FAC_NOX_NS_AD_AGI_MDL_MAX	-	0... FFFFH	0... 127.99804	1.9531e-3	-
Maximal threshold of NOx signal gain adaptation to switch to modeled aging factor					
C_FAC_NOX_NS_AD_AGI_MDL_MIN	-	0... FFFFH	0... 127.99804	1.9531e-3	-
Minimal threshold of NOx signal gain adaptation to switch to modeled aging factor					
C_FAC_NT_AGI_MDL_ACT_1	-	0... FFFFH	0... 0.99998	15.3e-6	-
Threshold of NT aging for switching to modeled factor					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_NT_AGI_MDL_ACT_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
Threshold of NT aging for switching to modeled factor, included sulfur model					
C_FAC_SU_CONC_FUEL	-	0... FFH	0... 255	1	-
Interface factor to sulphur model for calibrating fuel sulphur concentration					
C_NOX_RGN_ST_MAX_AGI	-	0... 05DCH	0... 1500	1	ppm
max. NOx sensor signal threshold for enabling an aging adaptation					
C_NOX_RGN_ST_MIN_AGI	-	0... 05DCH	0... 1500	1	ppm
min. NOx sensor signal threshold for enabling an aging adaptation					
C_NT_AGI_1	-	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap aging factor threshold for the desulfation request 1					
C_NT_AGI_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap aging factor threshold for the desulfation request 2					
C_NT_AGI_3	-	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap aging factor threshold for the request of lambda=1 operation					
C_NT_AGI_INI [NC_NT_NR]	-	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap aging factor initializing value (branch selective)					
C_NT_AGI_NTLD_MAN	-	0... FFFFH	0... 0.99998	15.3e-6	-
Manual set of NT_AGI_NTLD					
C_NT_AGI_OBS_MIN	-	0... FFFFH	0... 0.99998	15.3e-6	-
aging monitoring minimum threshold to request lambda=1 operation					
C_NT_AGI_OBS_MIN_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
aging monitoring minimum threshold 2 to request l 1 operation					
C_NT_AGI_OBS_MIN_EGR_ERR	-	0... FFFFH	0... 0.99998	15.3e-6	-
aging monitoring minimum threshold to request l 1 operation if EGR valve stucked close					
C_NT_AGI_OBS_MIN_IS	-	0... FFFFH	0... 0.99998	15.3e-6	-
aging monitoring minimum threshold to request lambda=1 operation during idle speed					
C_NT_AGI_S_RED_MAN	-	0... FFFFH	0... 0.99998	15.3e-6	-
Manual set of NT_AGI_S_RED					
C_NT_AGI_THERMO_SO2P_FQ_INI	-	0... FFFFH	0... 0.99998	15.3e-6	-
Initial aging value after FQ-desulfation					
C_NT_SUL_MAX_1	-	0... FFFFH	0... 10485.6	0.16	mg
sulphur model threshold to request set desulfation request 1					
C_NT_SUL_MAX_DEAC	-	0... FFFFH	0... 10485.6	0.16	mg
sulphur model threshold to request reset desulfation request 2 during active desulfation					
C_NT_SUL_SO2P_FQ	-	0... FFFFH	0... 10485.6	0.16	mg
sulphur model value to start FQ-desulfation					
C_NTLD_SO2P_FQ	-	0... FFFFH	0... 0.99998	15.3e-6	-
NOx loading degree to stop aging adaptation after FQ-desulfation					
C_NTLD_TRIG_AGI_MAX_RGN_NS	-	0... FFFFH	0... 0.99998	15.3e-6	-
Maximum NOx trap loading degree for aging calculation at regeneration request by NOx sensor					
C_NTLD_TRIG_AGI_MAX_RGN_NTLD	-	0... FFFFH	0... 0.99998	15.3e-6	-
Maximum NOx trap loading degree for aging calculation at regeneration request by NTLD threshold					
C_NTLD_TRIG_AGI_MIN_RGN_NS	-	0... FFFFH	0... 0.99998	15.3e-6	-
Minimum NOx trap loading degree for aging calculation at regeneration request by NOx sensor					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NTLD_TRIG_AGI_MIN_RGN_NTLD	-	0... FFFFH	0... 0.99998	15.3e-6	-
Minimum NOx trap loading degree for aging calculation at regeneration request by NTLD threshold					
C_RATIO_NS_SHIFT_AGI_MDL_MAX	-	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Maximal threshold of NOx signal shift to switch to modeled aging factor					
C_RATIO_NS_SHIFT_AGI_MDL_MIN	-	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Minimal threshold of NOx signal shift to switch to modeled aging factor					
C_STATE_ERR_NS_MDL_SWI	-	0... FFFFH	0... 65535	1	-
Choice of OBD 2 diagnosis for switching from sensor to model					
C_STATE_NT_AGI_NTLD	-	0H 1H 2H 3H 4H	ALL THERMO SUL MAN LIM	-	-
Mode to switch NT_AGI_NTLD					
C_STATE_NT_AGI_S_RED	-	0H 1H 2H 3H 4H	ALL THERMO SUL MAN LIM	-	-
Mode to switch NT_AGI_S_RED					
C_SUL_THD_AGI_THERMO	-	0... FFFFH	0... 10485.6	0.16	mg
threshold for reset of thermal aging adaptation /SUL no more neglectable					
C_T_AFL_MAX_AGI_ENA	-	0... FFFFH	0... 1310.7	0.02	s
maximum lean phase time without aging enabling bit yet set					
C_TNT_MDL_AGI_ENA_TNT	-	0... FFH	0... 1020	4	°C
threshold for temperature initialisation condition					
C_TNT_MDL_NT_AGI_OBS_INI	-	0... FFH	0... 1020	4	°C
threshold for resetting the quick aging monitoring values					
C_VS_OBS_MIN	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold to switch aging monitoring					
ID_FAC_NT_AGI_DIF_NS	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_DIST_NS_DIF_ID_FAC_NT_AGI	6	0... FFFFH	0... 524280	8	km
Safety margin for aged NOx sensor for thermal NT aging factor derived from NOx sensor					
IP_FAC_NT_AGI	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_TNT_MDL_MV_IP_FAC_NT_AGI	6	0... FFFFH	0... 1023.98437	0.015625	°C
Correction factor for NT_AGI depending on NOx catalyst temperature					
IP_NT_AGI_NT_SUL	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_NT_SUL_IP_NT_AGI_NT_SUL	6	0... FFFFH	0... 10485.6	0.16	mg
Correlation sulphur loading - aging factor due sulphur load					
IP_NT_SUL_H_MIN	-	0... FFFFH	0... 10485.6	0.16	mg
LDPM_NT_AGI_THERMO	6	0... FFFFH	0... 0.99998	15.3e-6	-
NOx Trap sulphur loading threshold (for high sulphured fuel) for desulfation request 2					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_NT_SUL_MAX_2	-	0... FFFFH	0... 10485.6	0.16	mg
LDPM_NT_AGI_THERMO	6	0... FFFFH	0... 0.99998	15.3e-6	-
sulphur model threshold to request set desulfation request 2					
IP_NT_SUL_MAX_2_DEAC	-	0... FFFFH	0... 10485.6	0.16	mg
LDPM_NT_AGI_THERMO	6	0... FFFFH	0... 0.99998	15.3e-6	-
sulphur model threshold to request reset desulfation request 2					
IP_NT_SUL_MAX_3	-	0... FFFFH	0... 10485.6	0.16	mg
LDPM_NT_AGI_THERMO	6	0... FFFFH	0... 0.99998	15.3e-6	-
sulphur model threshold to request l 1 operation					
IP_NT_SUL_NT_AGI	-	0... FFFFH	0... 10485.6	0.16	mg
LDP_NT_AGI_SUL_IP_NT_SUL_NT_AGI	6	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation aging factor due sulphur load - sulphur loading					
IP_NTLD_AGI	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_NOX_EFF	2	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_TNT_MDL_NOX_NT	2	0... FFFFH	0... 1023.98437	0.015625	°C
NOx trap loading degree , has to be inverse to IP_NT_EFF_BAS					
IP_NTLD_AGI_EF_CLOSE	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_NOX_EFF	2	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_TNT_MDL_NOX_NT	2	0... FFFFH	0... 1023.98437	0.015625	°C
NOx trap loading degree , has to be inverse to IP_NT_EFF_BAS_EF_CLOSE					
LC_AGI_AD_TRIG_MAN	-	0... 1H	0 ...1	1	-
Manual trigger for starting aging adaption					
LC_ENA_SUL_UPD	-	0... 1H	0 ...1	1	-
Logical constant to enable adaptation between sulfur modell and aging factor detemination					
LC_NOX_AD_CMPL_OFF	-	0... 1H	0 ...1	1	-
switch to ignore NOx raw emission adaptation					
LC_NT_AGI_AD_CTR_RST_TNT	-	0... 1H	0 ...1	1	-
switch for resetting the adaptation cycle counters depending on NT temperature					
LC_NT_AGI_EGR_CLOSE	-	0... 1H	0 ...1	1	-
switch: close EGR during aging adaptation					
LC_NT_AGI_INI_MAN	-	0... 1H	0 ...1	1	-
Manual reset of the logical variables for desulfation					
LC_NT_AGI_MAN	-	0... 1H	0 ...1	1	-
Logical constant for manual switch of aging factor determination					
LC_NT_AGI_MIN	-	0... 1H	0 ...1	1	-
Logical constant for selecting NT_AGI					
LC_NT_AGI_NT_SUL_MPG	-	0... 1H	0 ...1	1	-
Logical constant to enable calibration of NT_SUL with aging determination					
LC_NT_AGI_OBS_INI	-	0... 1H	0 ...1	1	-
switch for manual initialisation of quick aging monitoring values					
LC_NT_AGI_SUL_INI	-	0... 1H	0 ...1	1	-
NOx trap aging factor due sulphur load initializing value (branch selective)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_NT_AGI_THERMO_INI	-	0... 1H	0 ...1	1	-
NOx trap aging factor due thermal aging initializing value (branch selective)					
LC_SUL_SWI_1_THERMO_ACT	-	0... 1H	0 ...1	1	-
Manual activation of switching to modeled aging factor at calculation of sulphur aging					
LC_SUL_THERMO_COR	-	0... 1H	0 ...1	1	-
Logical constant for switching betwenn absolut and relativ NT_SUL					
LC_SUL_UPD	-	0... 1H	0 ...1	1	-
Logical constant to enable calibration of NT_AGI_SUL with sulfur modell					

Action definition

ACTION_NOXM_CleanNTAdaptAgi ()	Mode: O
Initialization of NOx trap adaptation values of aging module	

ACTION_NOXM_WriteAgingExtAdj ()	Mode: O
New external values for aging calculation available	

General information

The NOx catalyst aging function can handle single branched and twin branched exhaust gas lines with the configuration data NC_NT_NR defined in the NOx catalyst management module.
If NC_NT_NR=1, just one exhaust line is taken into account, if NC_NT_NR=2, the software calculates the twin branch version.
i characterises the variable of branches which can be counted up

The NOx storage catalyst looses its storage capacity due to thermal aging and sulfur poisoning.
The aging is determined by the NOx-signal of a NOx-sensor, mounted downstream the NOx catalyst. The information, which kind of sensor is installed is included in LV_NOX_SENS.
The aging state of the catalyst is evaluated by an aging factor NT_AGI_SNG_i. The value of this factor is 1 in the case of a fresh catalyst, a value near zero indicates a destroyed catalyst. The resulting aging factor NT_AGI is the minimum of all existing NT_AGI_SNG_i.
The aging factors NT_AGI_SNG_i mainly will be decreased by the aging determination in this routine. Due to desulfation, the aging state of the catalyst can be improved (storage capacity increases). This increase is calculated by the desulfation function and passed to the aging function by NT_AGI_INC_SO2P. This value is set to 0 if no desulfation is active, otherwise it includes the incremetation of the aging factor per time step. This increment is added to the aging factor at every call of the aging function.
Handling of the aging states
When the resulting aging factor NT_AGI falls below the threshold C_NT_AGI_1 the desulfation request bit LV_SO2P_REQ_1 is set.
When the aging factor falls below the threshold C_NT_AGI_2 the desulfation request bit LV_SO2P_REQ_2 is set, this means an active catalyst heating is required.
When the aging factor falls below the threshold C_NT_AGI_3 a desulfation is requested. If this desulfation is not successful lean operation has to be forbidden, the request bit LV_NT_AFS_REQ_AGI for lambda=1 operation due to aging state is set.
The request for a desulfation or for operation in lambda=1 mode can be manually reseted by LC_NT_AGI_INI_MAN, in this case NT_AGI_SNG_i is initialized with C_NT_AGI_INI_i.
The values NT_AGI, NT_AGI_i have to be stored in the non-volatile memory.
Calculation of the base aging factor
The basis aging factor is determined by the NOx-signal of the NOx-Sensor NOX_PPM_i and the calculated reduced NOx raw emissions NOX_CONC_RED. In the moment the first NOx-Sensor detects

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an inadmissible high NOx concentration downstrem the NOx catalyst and as a consequence LV_RGN_REQ_NOX_SENS is switched from 0 to 1, the actual storage capacity is calculated and compared with the base storage capacity of a fresh catalyst. The aging factor is calculated using the ratio of the actual storage capacity and the base storage capacity NT_STC. The calculation is carried out once when the regeneration starts.

Signal flow diagram

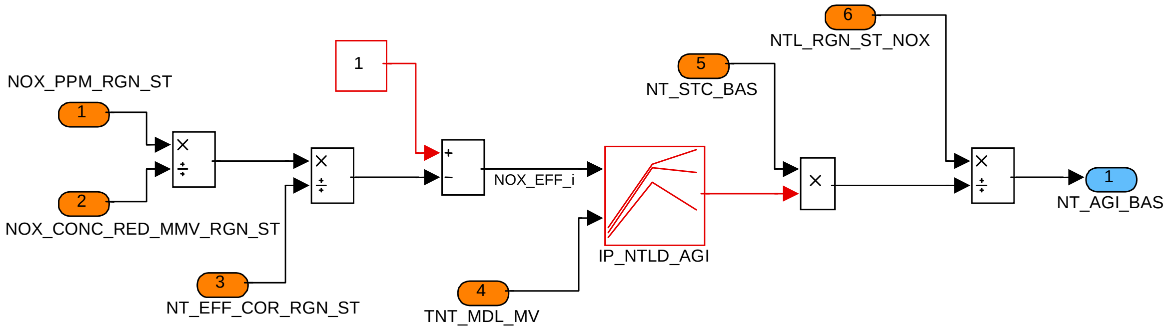

Figure 7.90.1: : Aging factor calculation // NOx- Sensor installed

Application Condition

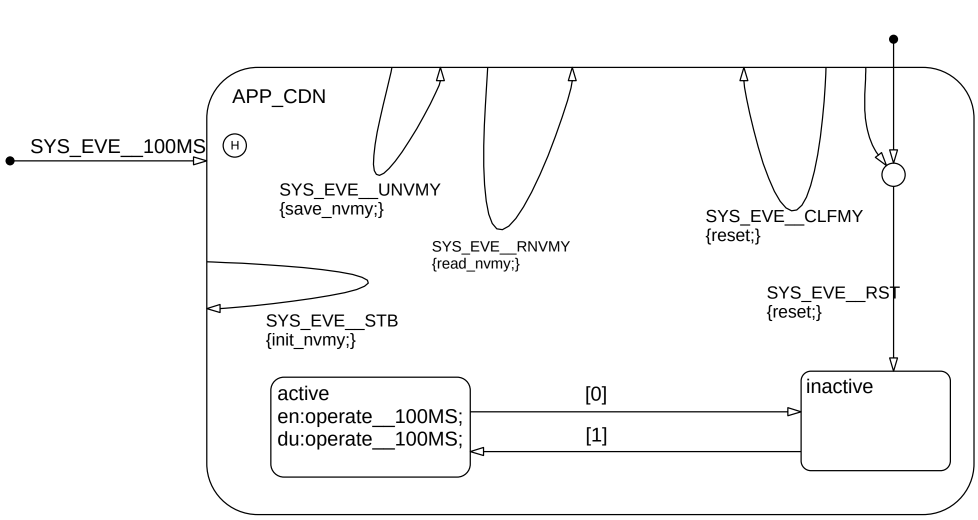

Figure 7.90.2: NOXM_MODUL703P/APP_CDN/Chart

Function Description

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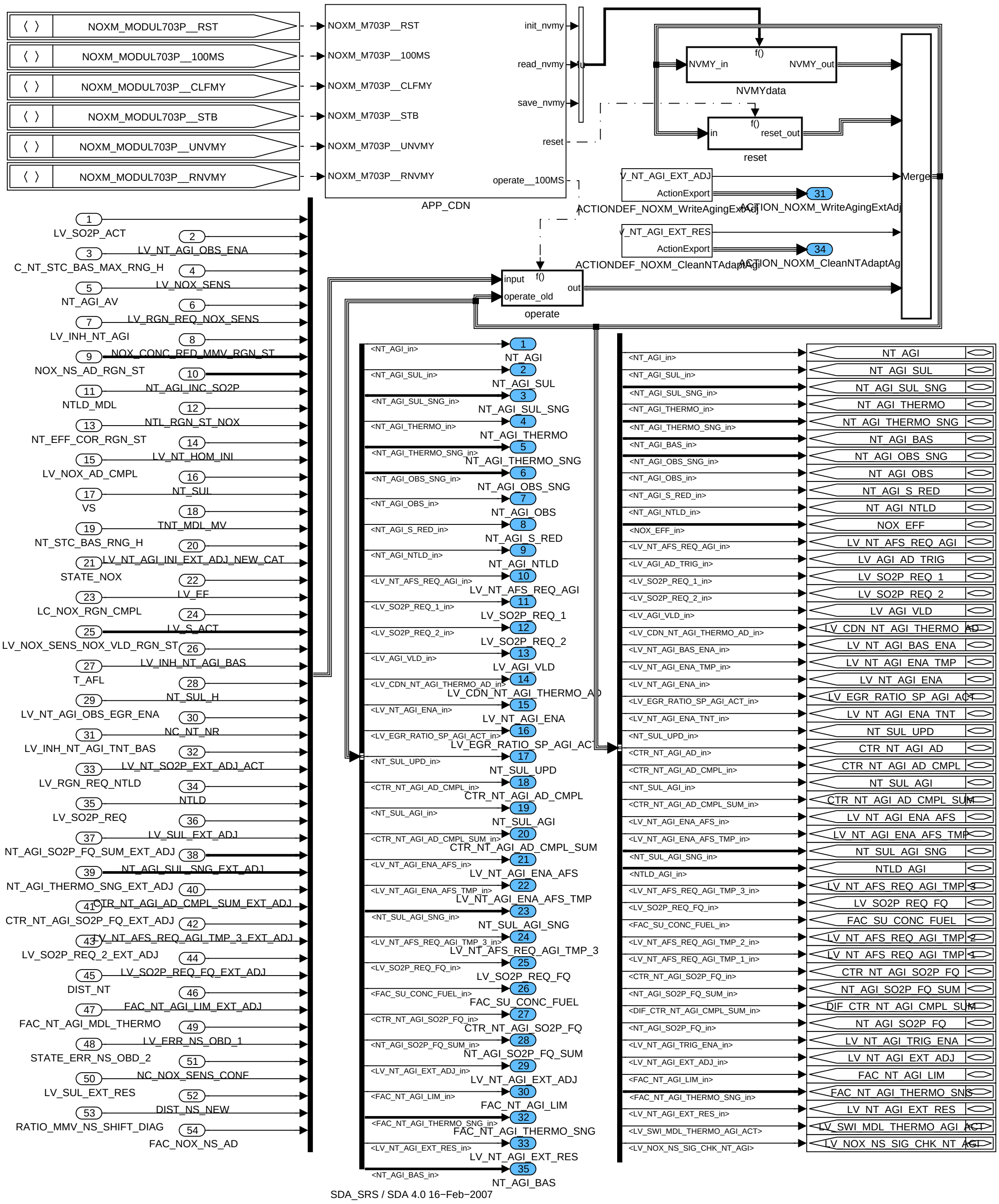

Figure 7.90.3: NOXM_MODUL703P

7.90.1 SUBFUNCTION: ACTIONDEF_NOXM_CleanNTAdaptAgi

Description for ACTION_NOXM_CleanNTAdaptAgi

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ACTION_NOXM_CleanNTAdaptAgi()					
Initialization of NOx trap adaptation values of aging module					
Parameter	**Type**	**Hex. limits**	**Phys. limits**	**Resol.**	**Unit**

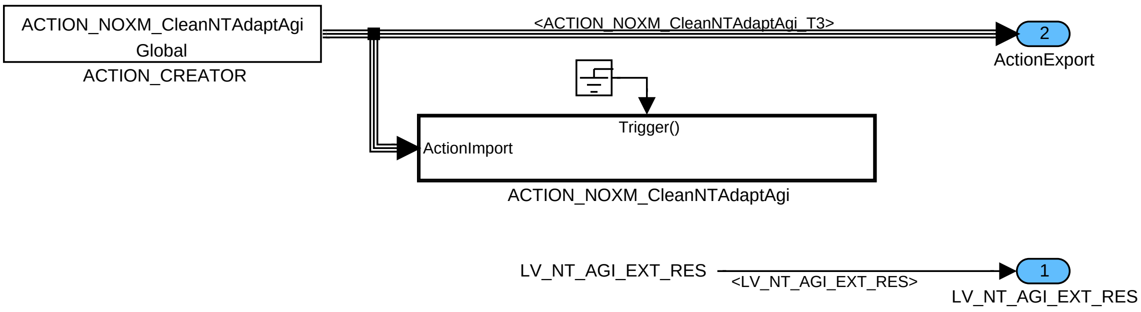

Figure 7.90.4: NOXM_MODUL703P/ACTIONDEF_NOXM_CleanNTAdaptAgi

The flag LV_NT_AGI_EXT_RES is set by this action. It shows that the non-volatile values have to be reset inside next 100 ms recurrence (if sulfur model values are already set to zero).

Figure 7.90.5:
NOXM_MODUL703P/ACTIONDEF_NOXM_CleanNTAdaptAgi/ACTION_NOXM_CleanNTAdaptAgi

7.90.2 SUBFUNCTION: ACTIONDEF_NOXM_WriteAgingExtAdj

Description for ACTION_NOXM_WriteAgingExtAdj

ACTION_NOXM_WriteAgingExtAdj()					
New external values for aging calculation available					
Parameter	**Type**	**Hex. limits**	**Phys. limits**	**Resol.**	**Unit**

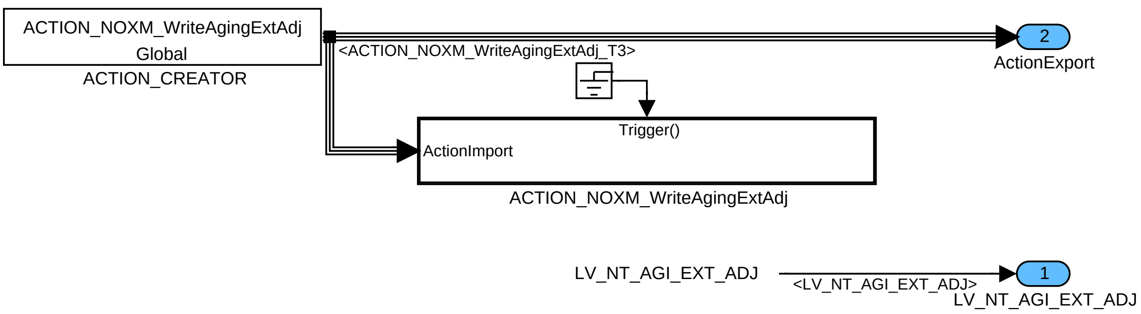

Figure 7.90.6: NOXM_MODUL703P/ACTIONDEF_NOXM_WriteAgingExtAdj

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The flag LV_NT_AGI_EXT_ADJ is set by this action. It shows that the external values have to be used inside next 100 ms recurrence (if sulfur model values are already updated).

Figure 7.90.7:
NOXM_MODUL703P/ACTIONDEF_NOXM_WriteAgingExtAdj/ACTION_NOXM_WriteAgingExtAdj

7.90.3 OPERATE

This picture shows the main sequence of the aging loop. Both calibration values allow to switch between manual initializing and normal aging calculation.

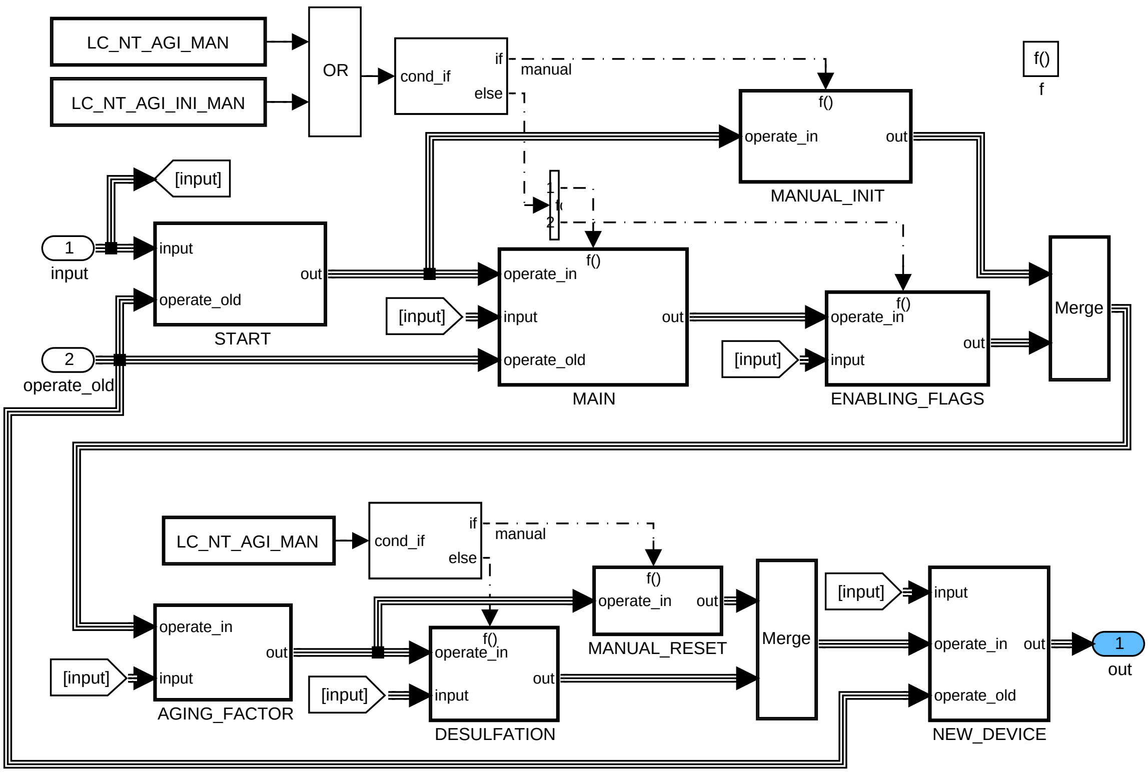

Figure 7.90.8: NOXM_MODUL703P/operate

<u>START: calculation of start conditions</u>

- definition of the area for thermal aging adaptation
- temperature initalisiation condition for enabling aging adaptation
- conditions and trigger for base aging factor calculation

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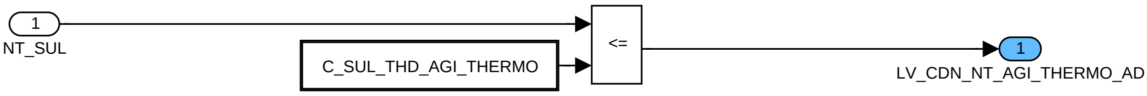

Figure 7.90.9: NOXM_MODUL703P/operate/START/CLC1

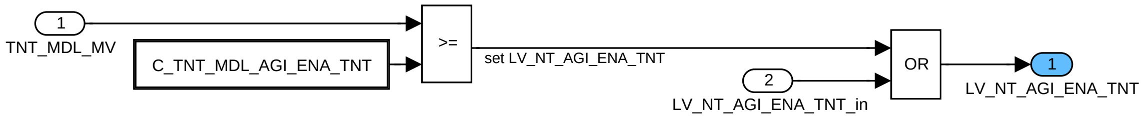

Figure 7.90.10: NOXM_MODUL703P/operate/START/CLC2

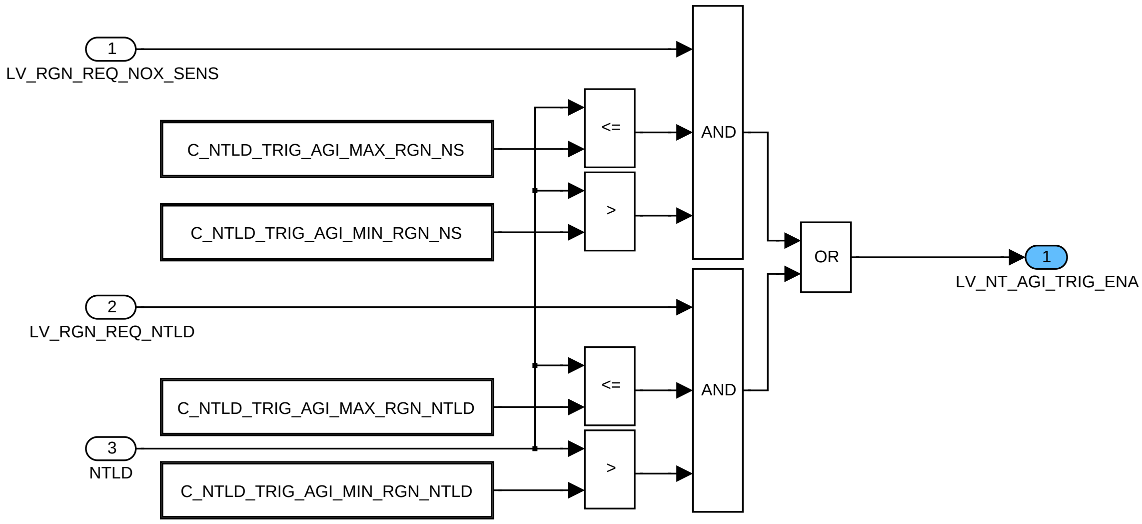

Figure 7.90.11: NOXM_MODUL703P/operate/START/CLC3

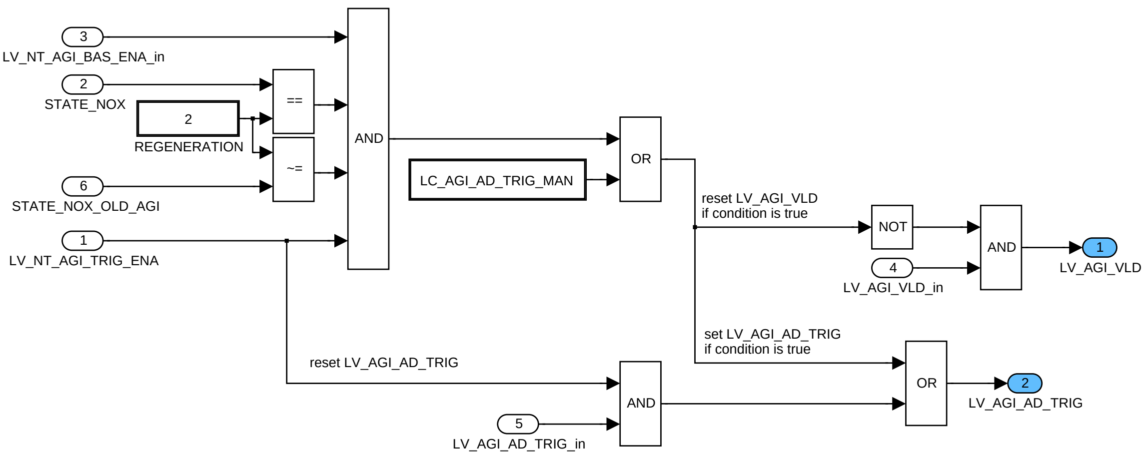

Figure 7.90.12: NOXM_MODUL703P/operate/START/CLC4

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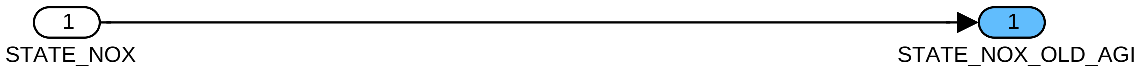

Figure 7.90.13: NOXM_MODUL703P/operate/START/CLC5

MANUAL_INIT: Manual initialisation of sulphur and thermal aging factors

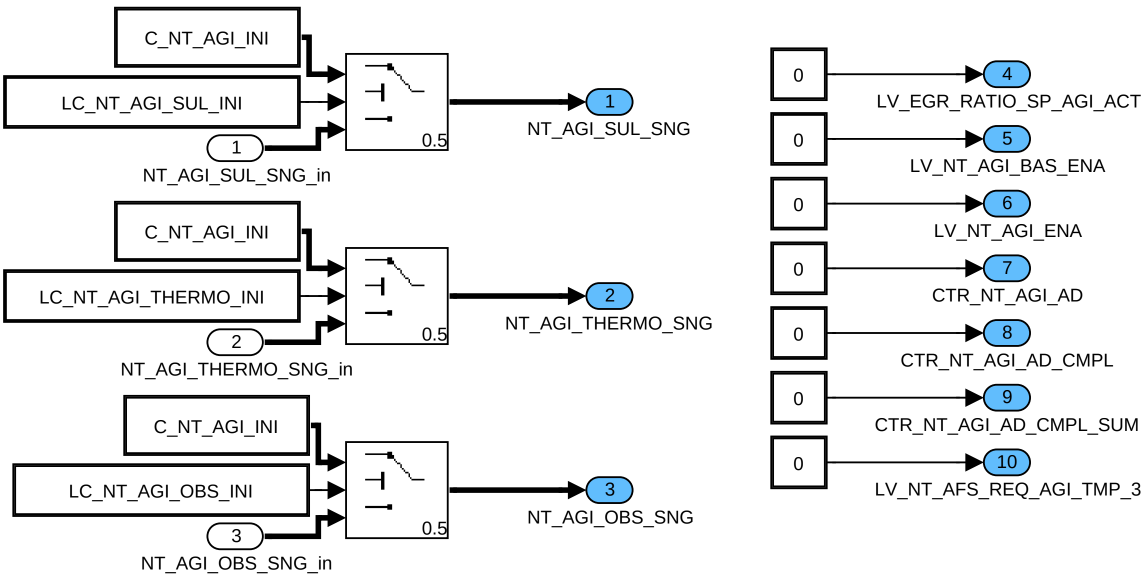

Figure 7.90.14: NOXM_MODUL703P/operate/MANUAL_INIT/CLC

Check result of the NOx signal shift diagnosis an gain adaptation

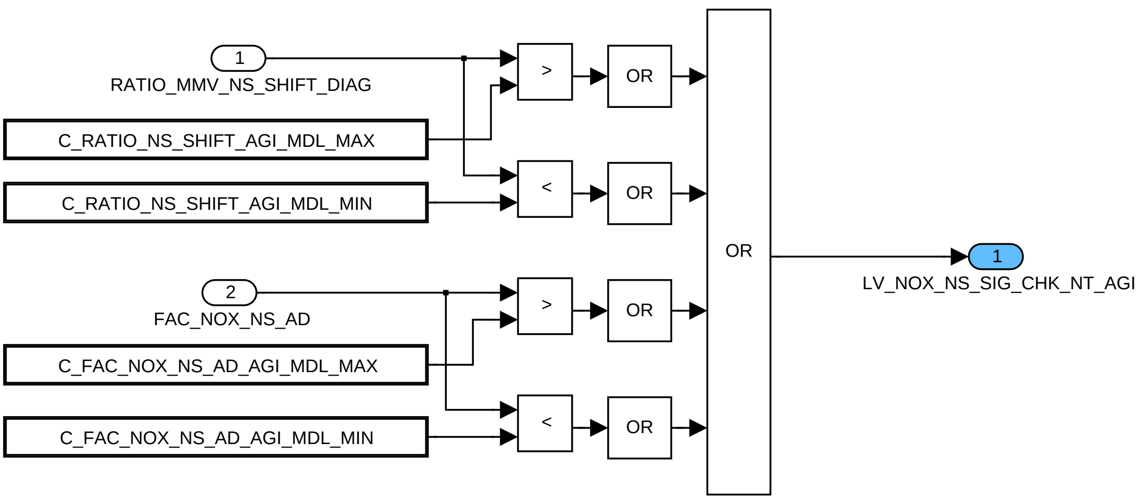

Figure 7.90.15: NOXM_MODUL703P/operate/MAIN/CBK/CHK_RATIO

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Calculation of LV_SWI_MDL_THERMO_AGI_ACT

Calculation of Switch to modeled aging factor before sulphur aging model caluclation is active

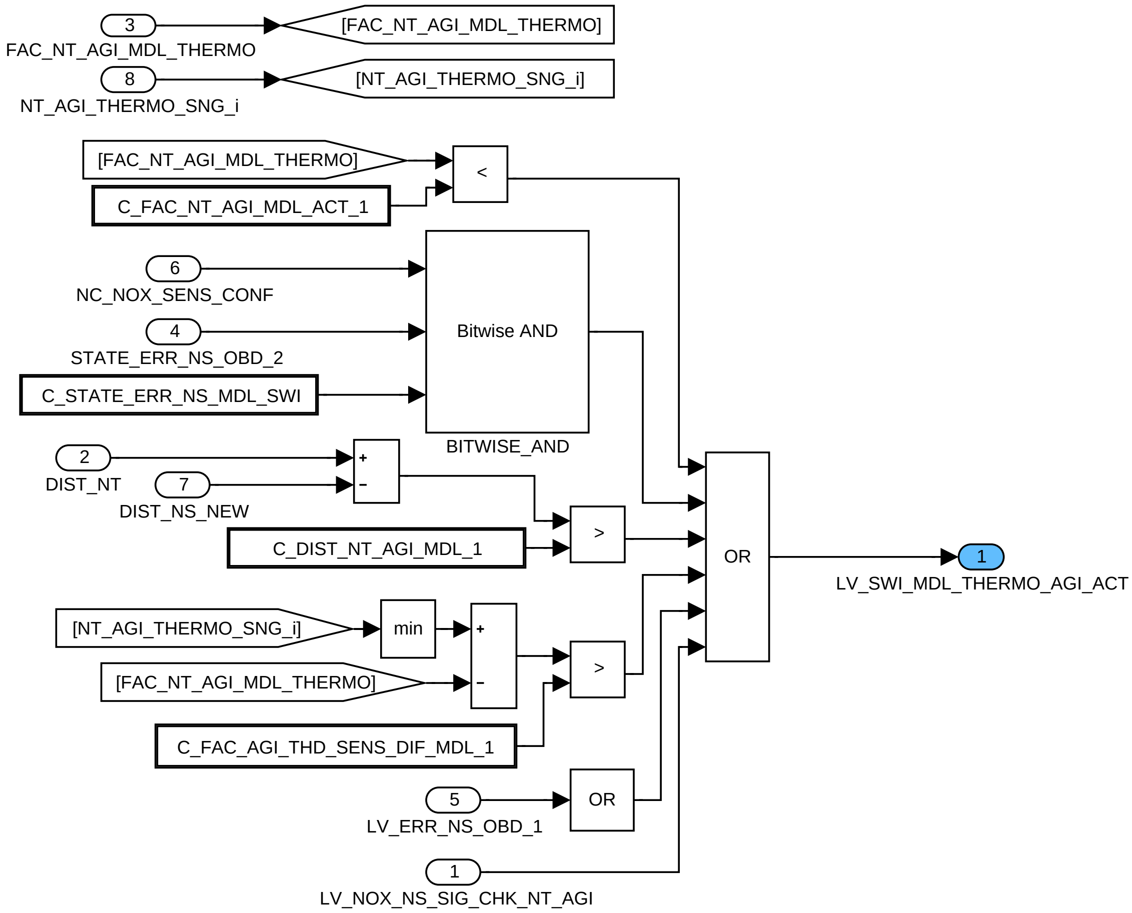

Figure 7.90.16: NOXM_MODUL703P/operate/MAIN/CBK/CLC_LV_SWI

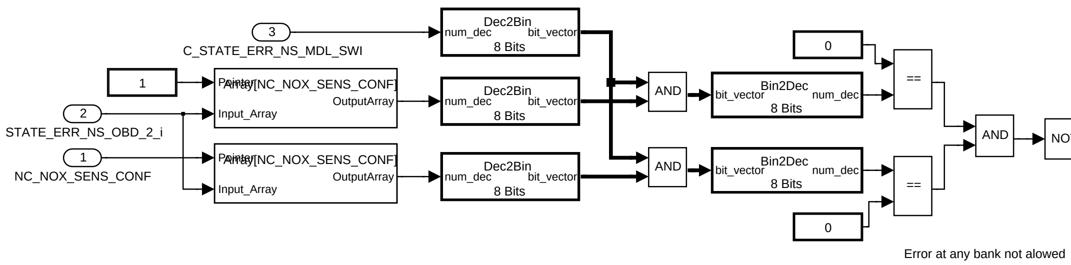

Figure 7.90.17: NOXM_MODUL703P/operate/MAIN/CBK/CLC_LV_SWI/BITWISE_AND

MAIN (for each NOx trap)

The following calculation will be done for each NOx trap, controlled by NC_NT_NR.

Aging calculation will only be done if a rising edge of the trigger signal LV_AGI_AD_TRIG occurs and the NOx sensor reaches a threshold at start of regeneration.

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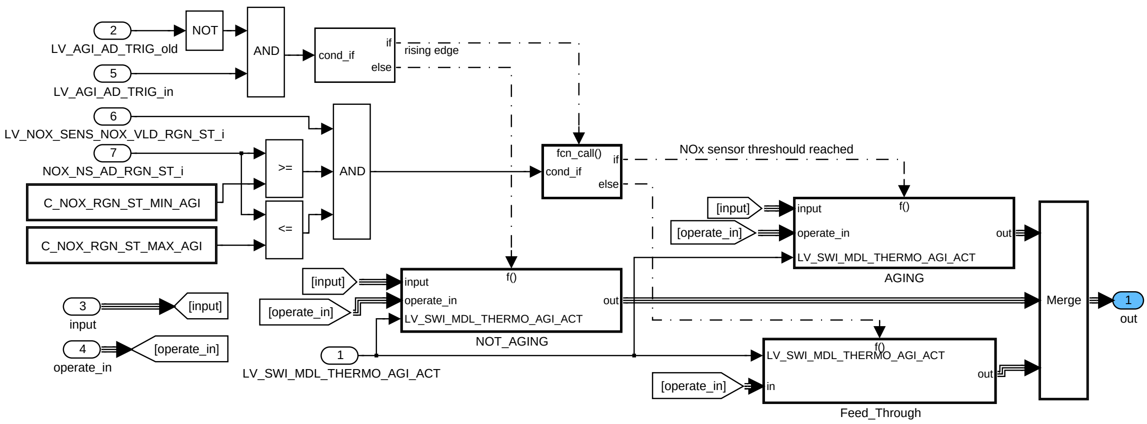

Figure 7.90.18: NOXM_MODUL703P/operate/MAIN/CBK/SELECT

Calculation of the new base aging factor

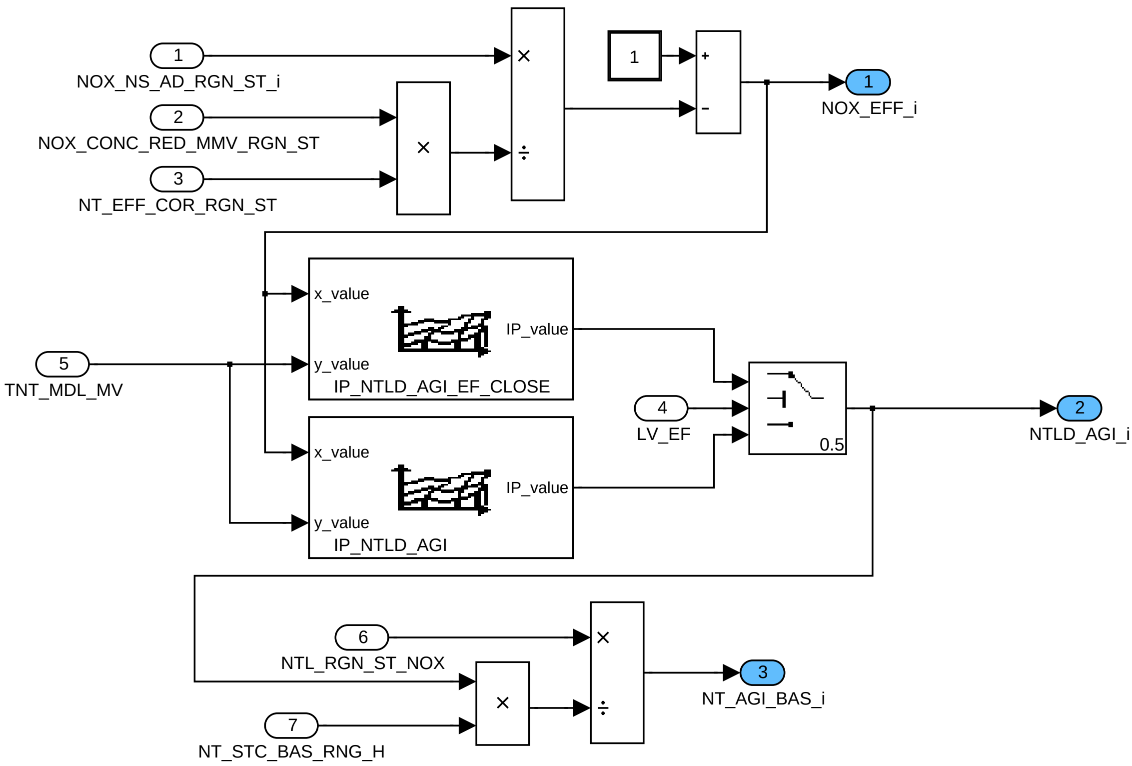

Figure 7.90.19: NOXM_MODUL703P/operate/MAIN/CBK/SELECT/AGING/CLC1

Calculation of quick aging monitoring factors by filtering of the base aging factor

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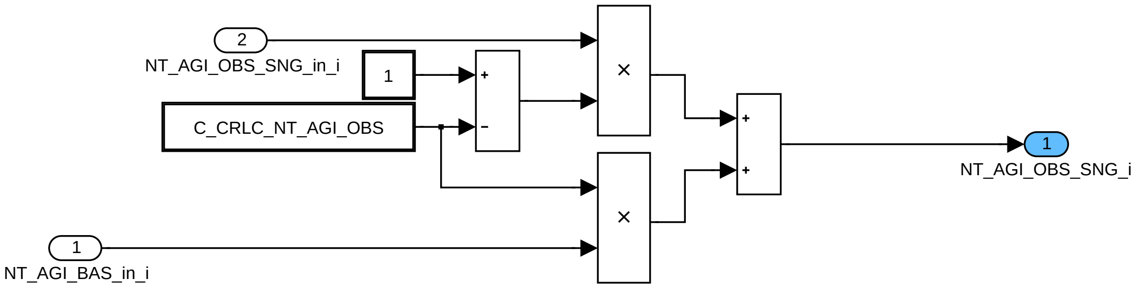

Figure 7.90.20: NOXM_MODUL703P/operate/MAIN/CBK/SELECT/AGING/CLC2

Depending on sulfur load, either the aging factor due to thermal aging (this picture) or the aging factor due to sulphur load will be calculated (next picture). Both results will be get by filtering of the base aging factor.

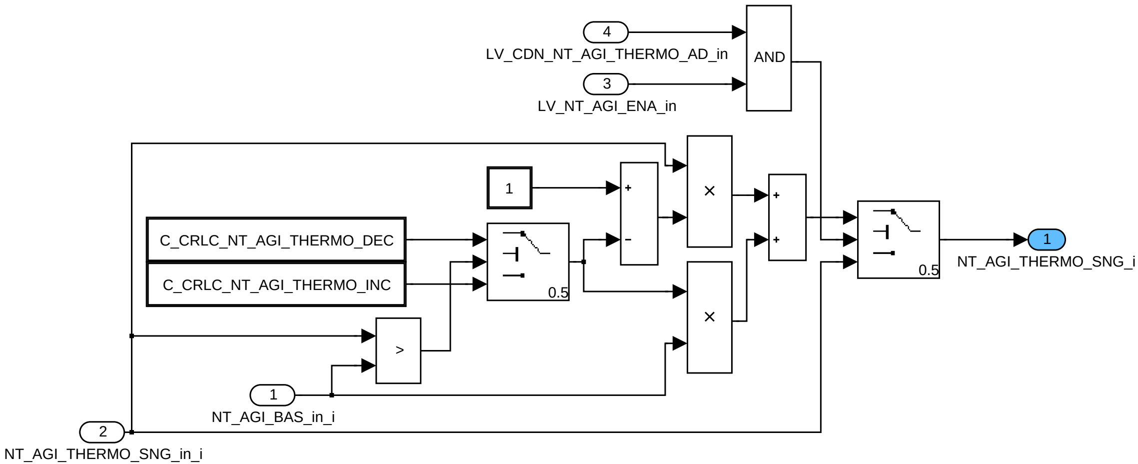

Figure 20 NOXM_MODUL703P/ operate/ MAIN/ CBK/ SELECT/ AGING/ CLC3

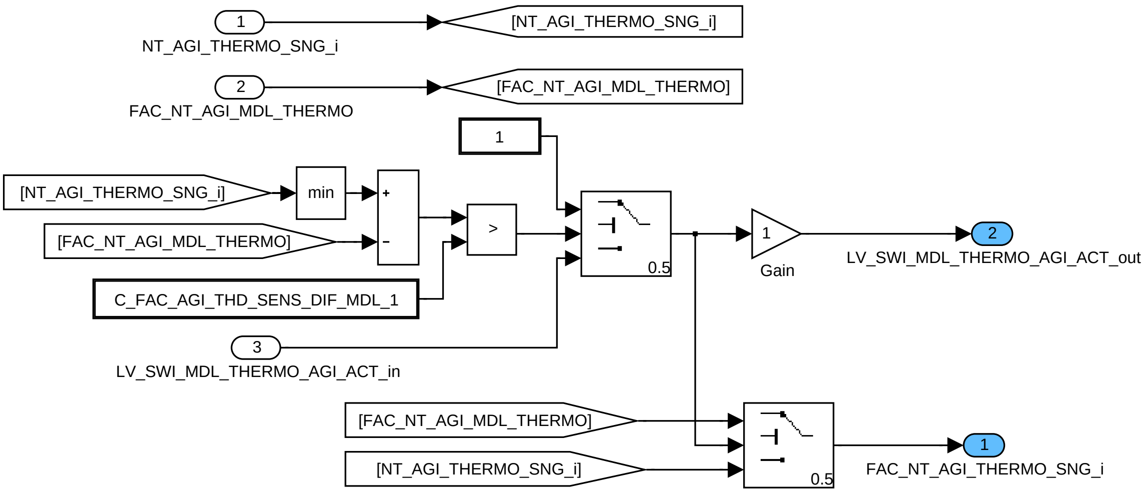

Figure 7.90.21: NOXM_MODUL703P/operate/MAIN/CBK/SELECT/AGING/CLC4

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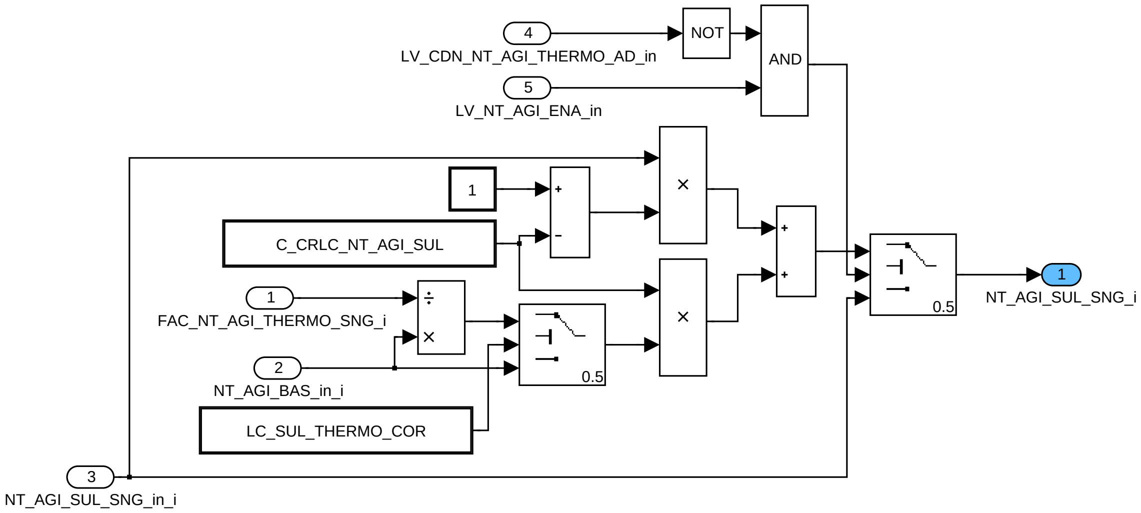

Figure 7.90.22: NOXM_MODUL703P/operate/MAIN/CBK/SELECT/AGING/CLC5

Update of sulphur aging factor during desulfation (during desulfation, the sulphur load is decreased and the sulphur load aging factor is incremented).

Initialisation of quick aging monitoring factors

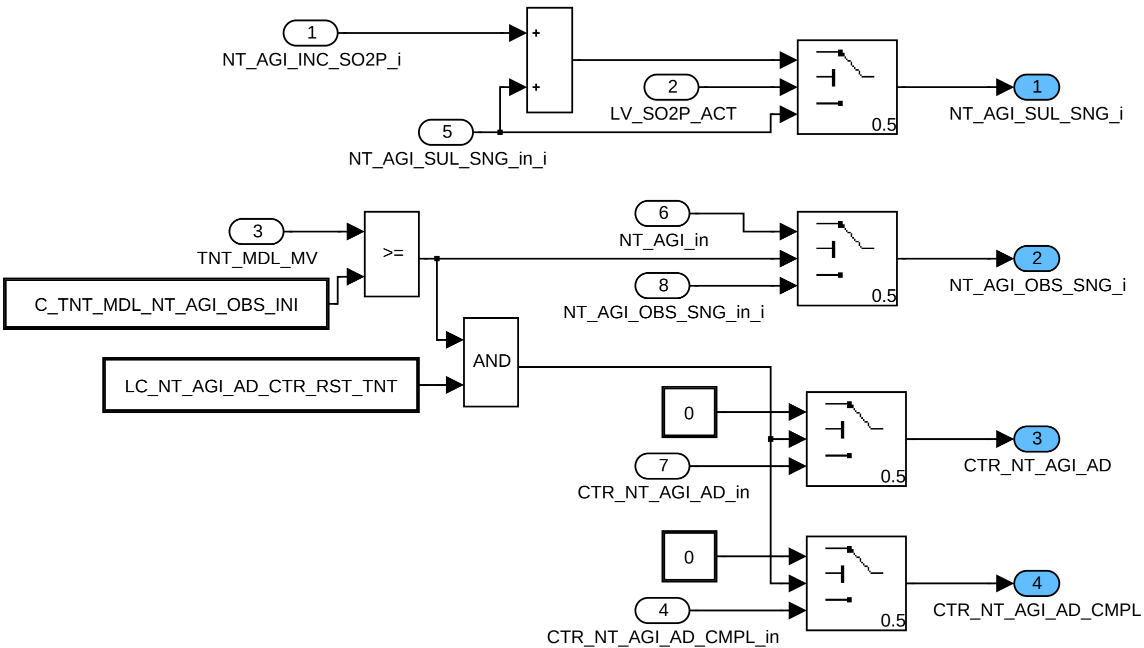

Figure 7.90.23: NOXM_MODUL703P/operate/MAIN/CBK/SELECT/NOT_AGING/CLC

MAIN (after calculations for each NOx trap)

The incrementation of the counters and the integral for the fuel quality calculation have to be calculated once if the condition is true for one bank or both banks.

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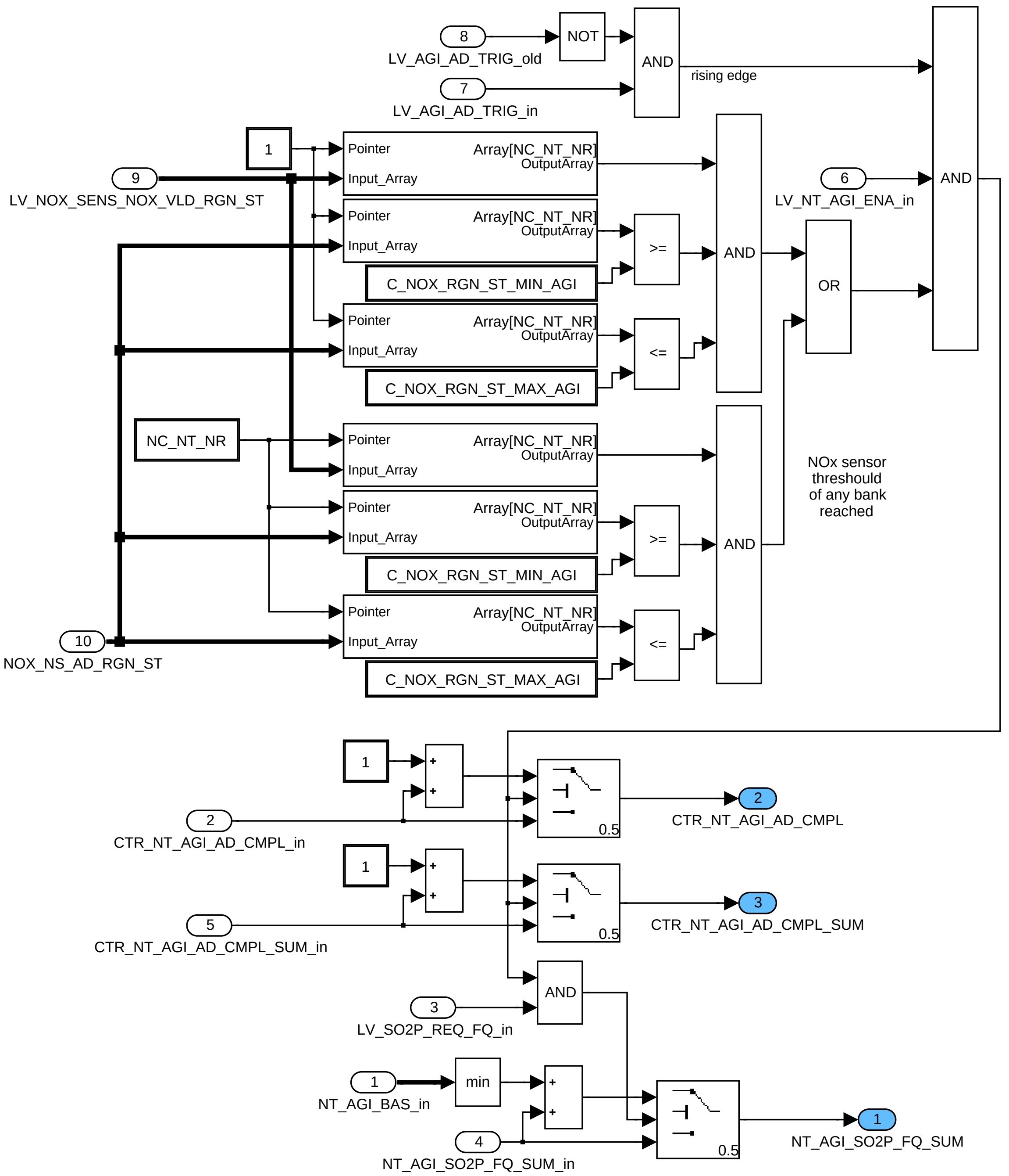

Figure 7.90.24: NOXM_MODUL703P/operate/MAIN/CTR

ENABLING_FLAGS

The calculation of the aging enabling flags is done after the aging calculation, thereby it's possible to reset LV_NT_AGI_ENA in regeneration, the aging calculation is done at the first calculation of the main loop in regeneration.

Conditions to enable base aging fctor calculation/quick monitoring

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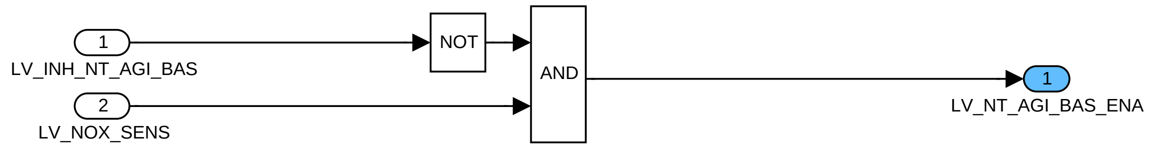

Figure 7.90.25: NOXM_MODUL703P/operate/ENABLING_FLAGS/CLC1

Condition to enable aging factor calculation

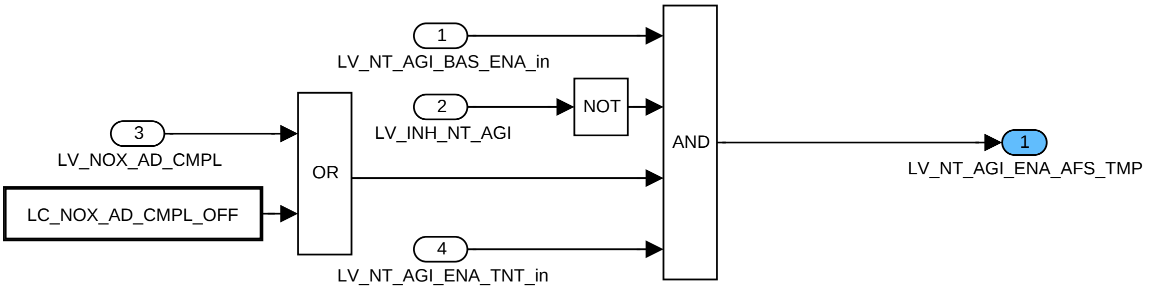

Figure 7.90.26: NOXM_MODUL703P/operate/ENABLING_FLAGS/CLC2

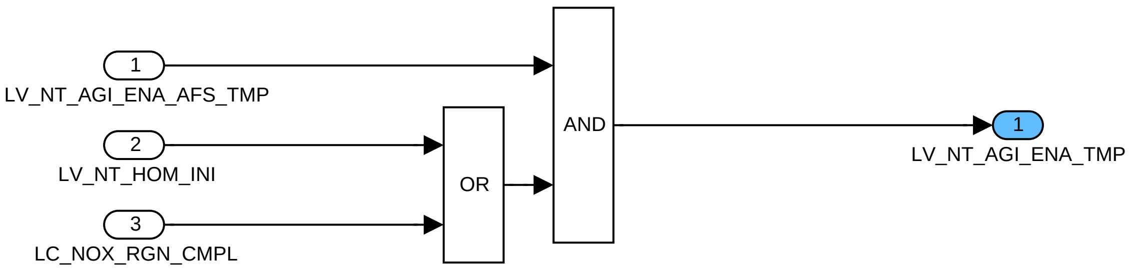

Figure 7.90.27: NOXM_MODUL703P/operate/ENABLING_FLAGS/CLC3

The T_AFL condition uses only lean phases whith LV_NT_AGI_ENA given at the beginning of the lean phase; aim is to prevent a closing of the EGR valve in the middle of a lean phase due to aging adaptation conditions given starting there as well as performing an adaptation after a lean phase with adaptation condition given only temporary.
CTR_NT_AGI_AD and CTR_NT_AGI_AD_CMPL have physical limits from 0 to 254 whereas the corresponing threshold constants C_CTR_NT_AGI_AD_MAX & C_CTR_NT_AGI_AD_CMPL_MAX have physical limits from 0 to 255. Thus by setting the constants to their maximum value the condition CTR $<$ thd is always true and no limitation of the adaptation attemps /adaptation cycles will occur

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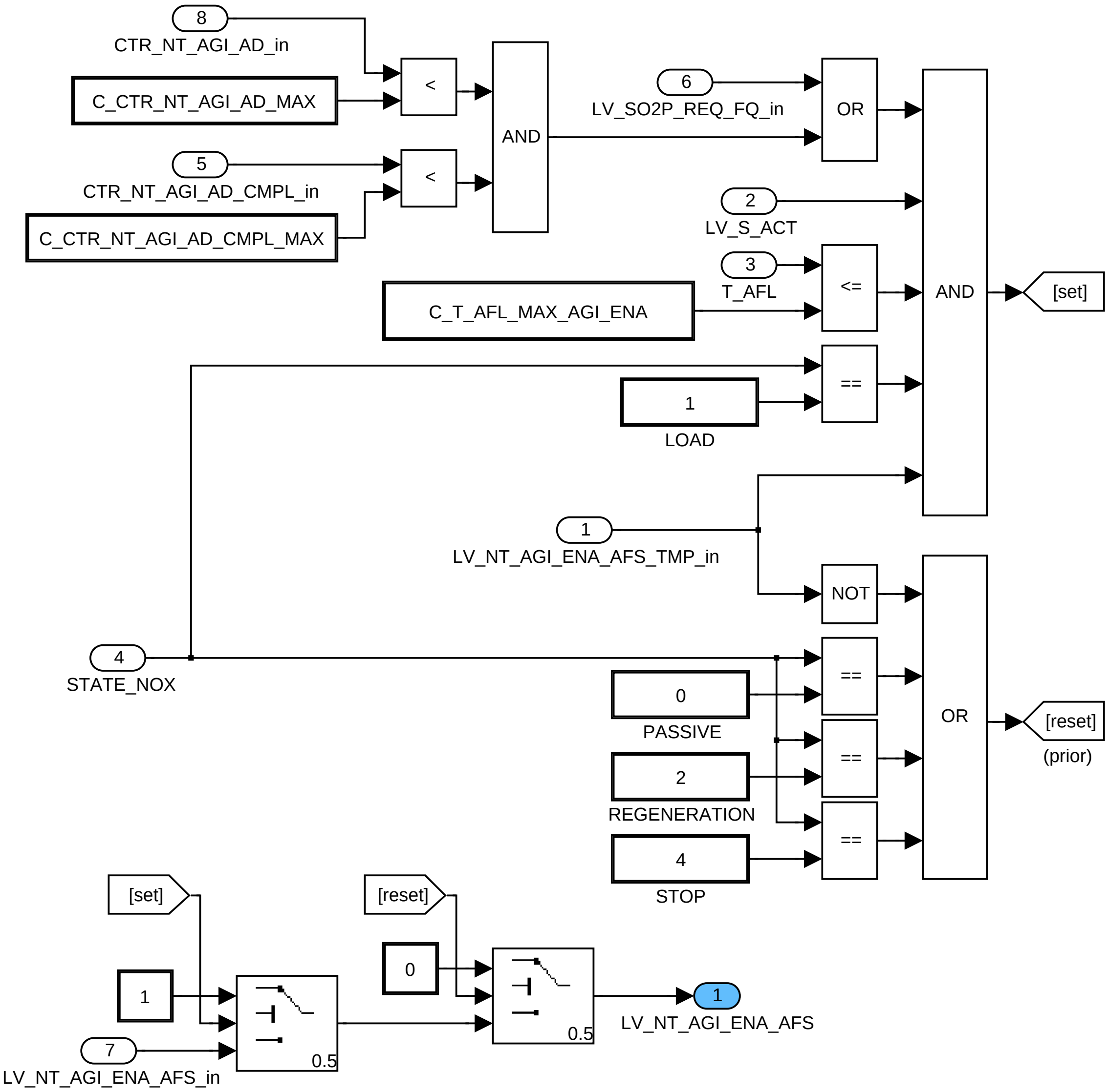

Figure 7.90.28: NOXM_MODUL703P/operate/ENABLING_FLAGS/CLC4

Conditions to close EGR valve during aging adaptation

The attemps counter is only calculated if EGR was closed; if the function is calibrated passive (i.e. without closing EGR) the number of attempts is not limited.

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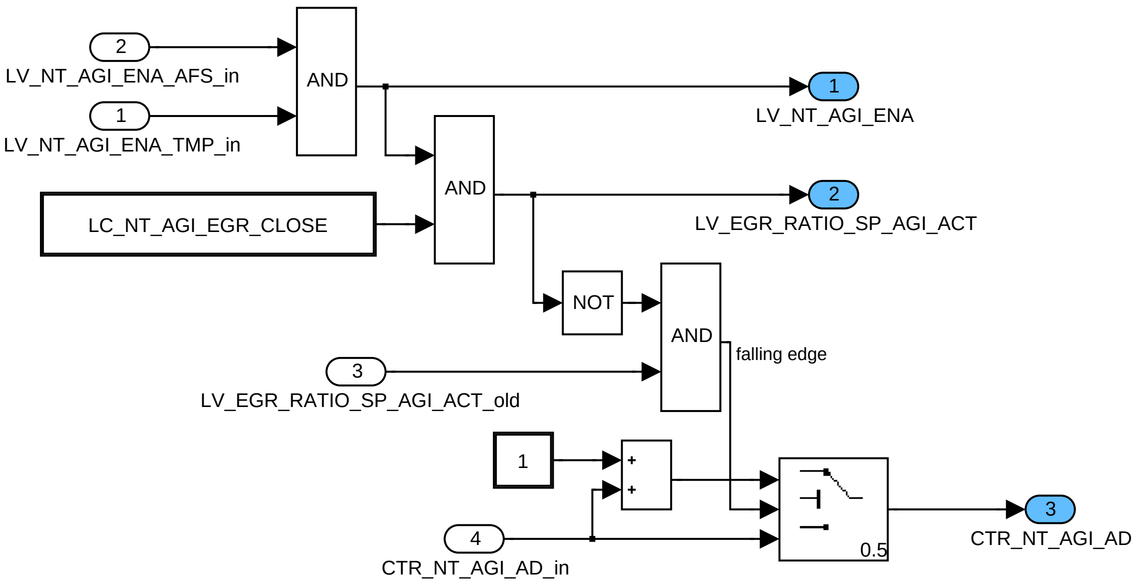

Figure 7.90.29: NOXM_MODUL703P/operate/ENABLING_FLAGS/CLC5

AGING_FACTOR: Aging factor handling

NT_SUL_AGI_SNG will be calculated from the aging factor due to sulphur load for each bank, defined by NC_NT_NR.

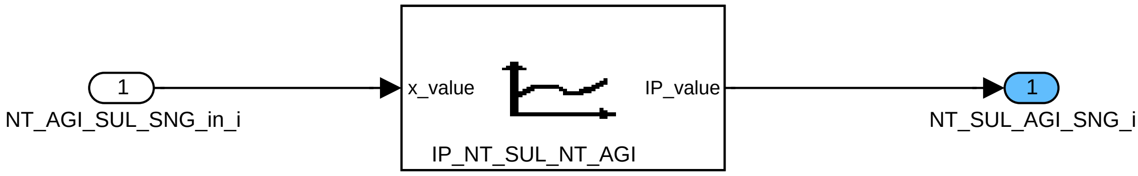

Figure 7.90.30: NOXM_MODUL703P/operate/AGING_FACTOR/CBK/CLC1

Bank selective values will be combined: minimum of aging factors and maximum of sulphur load.

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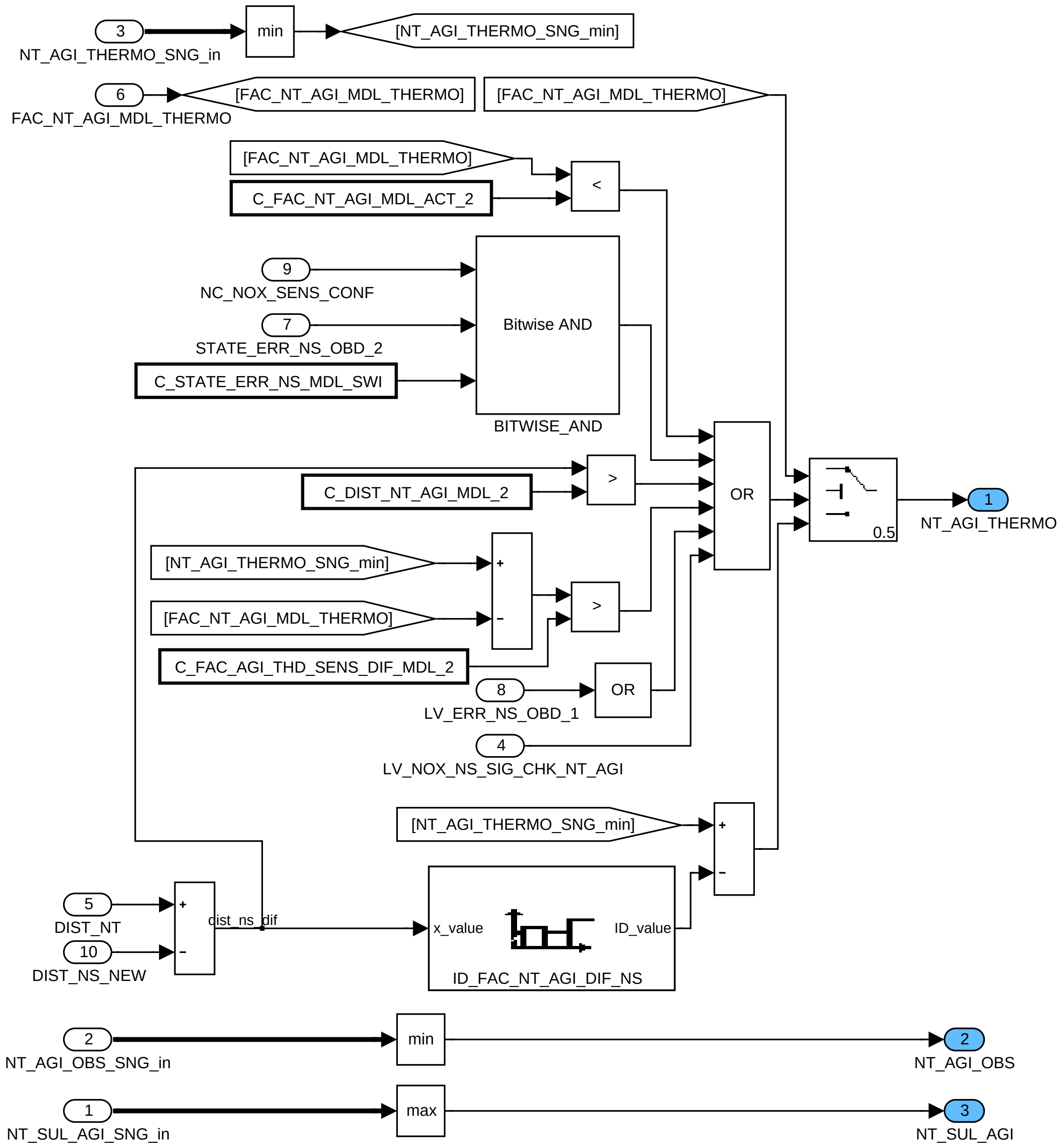

Figure 7.90.31: NOXM_MODUL703P/operate/AGING_FACTOR/CLC2

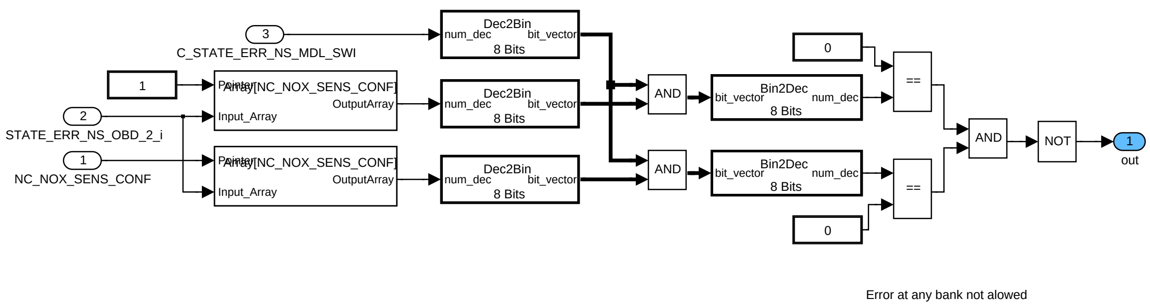

Figure 7.90.32: NOXM_MODUL703P/operate/AGING_FACTOR/CLC2/BITWISE_AND

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The NOx trap aging factor may be updated from updated from sulphur model (this picture) or vice versa (next picture)

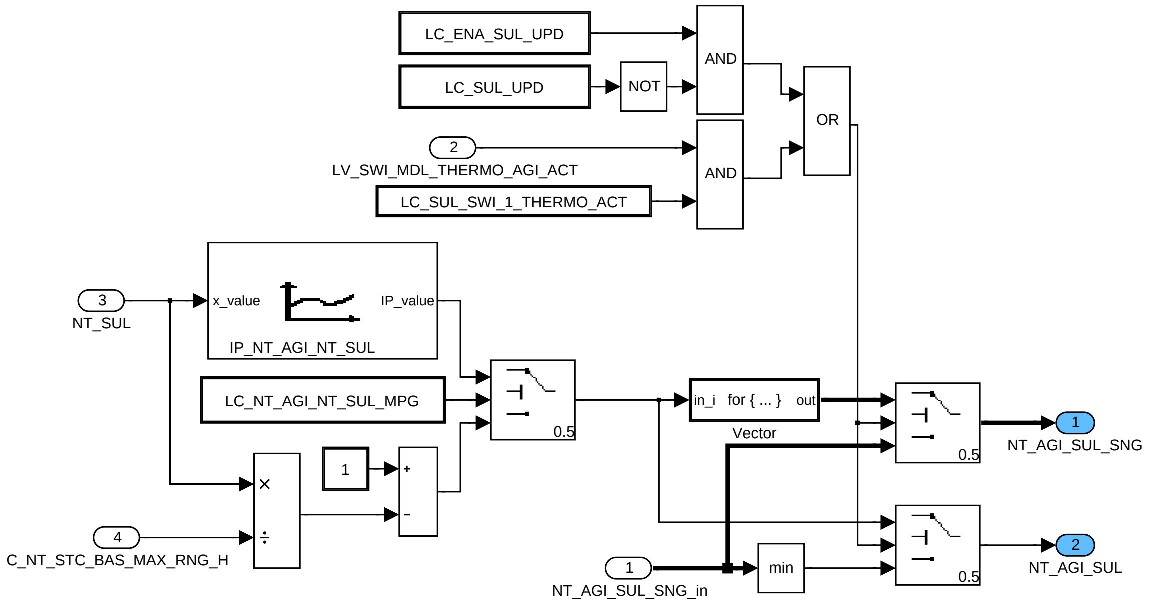

Figure 7.90.33: NOXM_MODUL703P/operate/AGING_FACTOR/CLC3

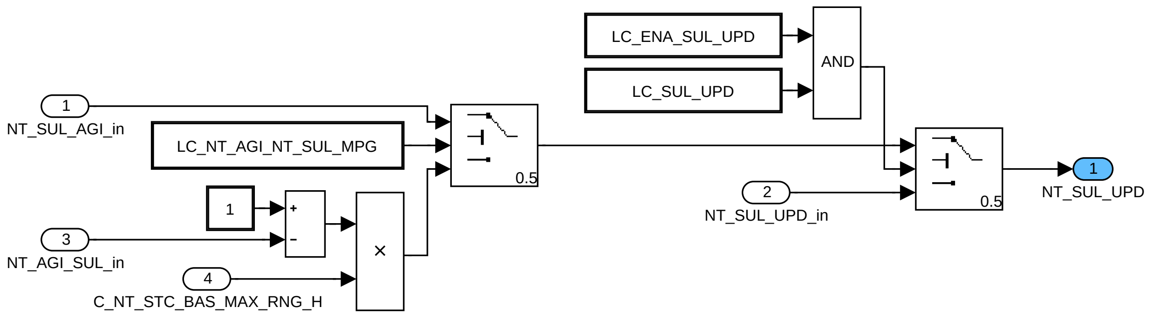

Figure 7.90.34: NOXM_MODUL703P/operate/AGING_FACTOR/CLC4

The following pictures show that NOx trap aging factors may be selected from different sources.

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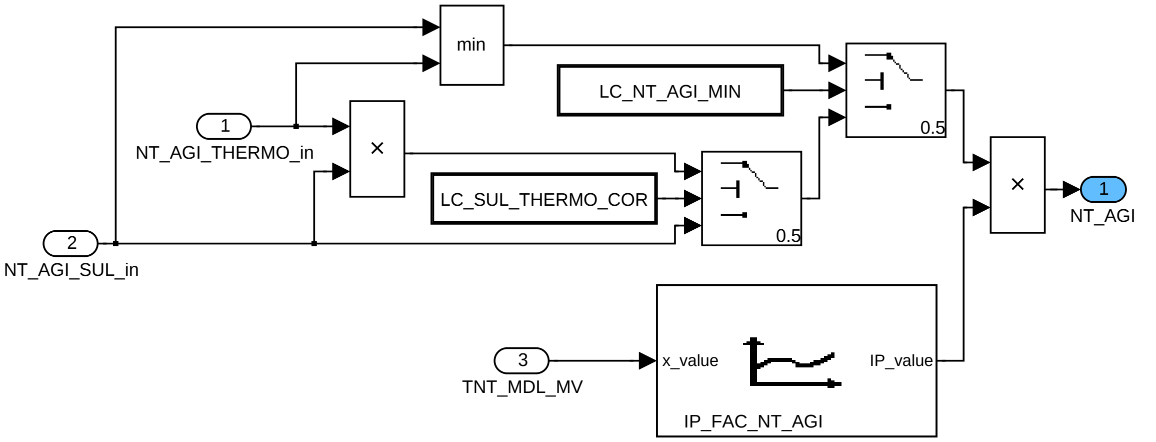

Figure 7.90.35: NOXM_MODUL703P/operate/AGING_FACTOR/CLC5

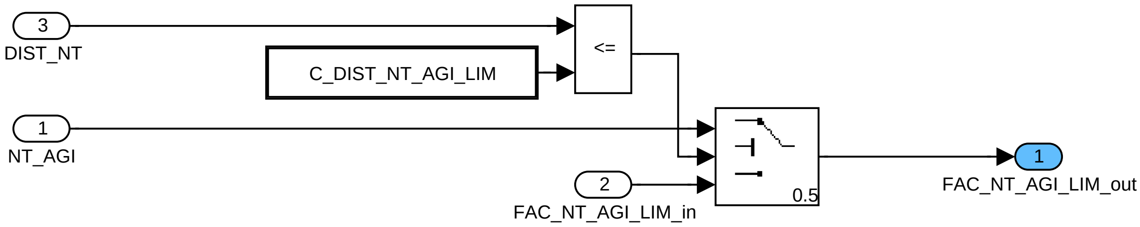

Figure 7.90.36: NOXM_MODUL703P/operate/AGING_FACTOR/CLC6

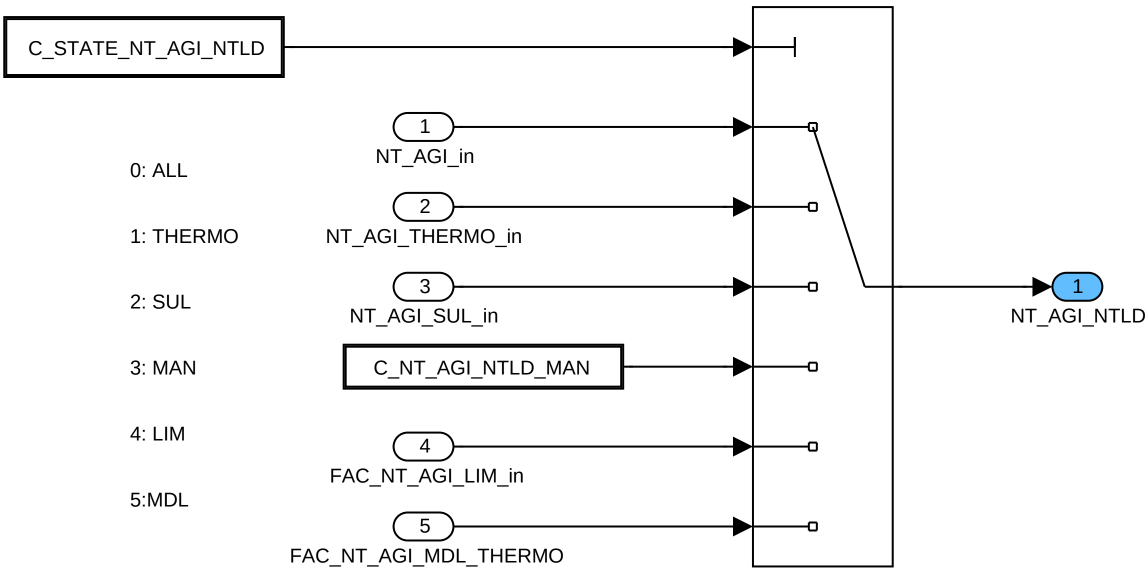

Figure 7.90.37: NOXM_MODUL703P/operate/AGING_FACTOR/CLC7

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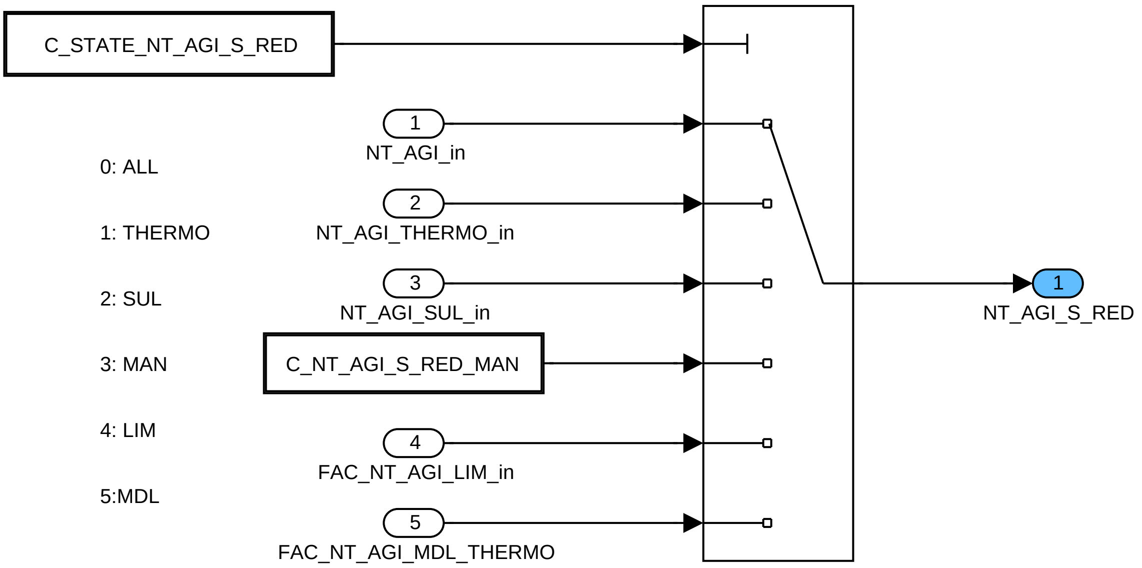

Figure 7.90.38: NOXM_MODUL703P/operate/AGING_FACTOR/CLC8

MANUAL_RESET: Manual reset of desulfation requests

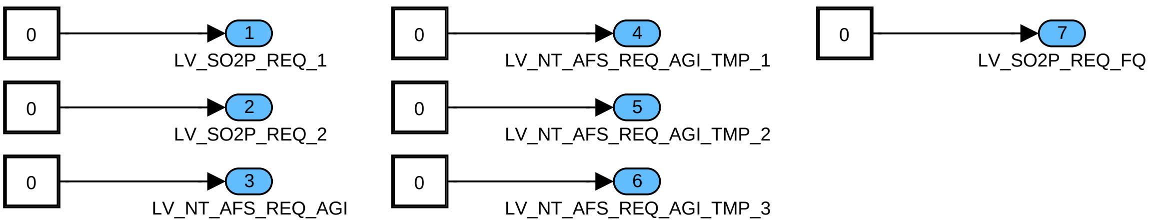

Figure 7.90.39: NOXM_MODUL703P/operate/MANUAL_RESET/CLC

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DESULFATION

If aging factor or sulphur load reaches the first threshold, then the first desulfation request will be set.

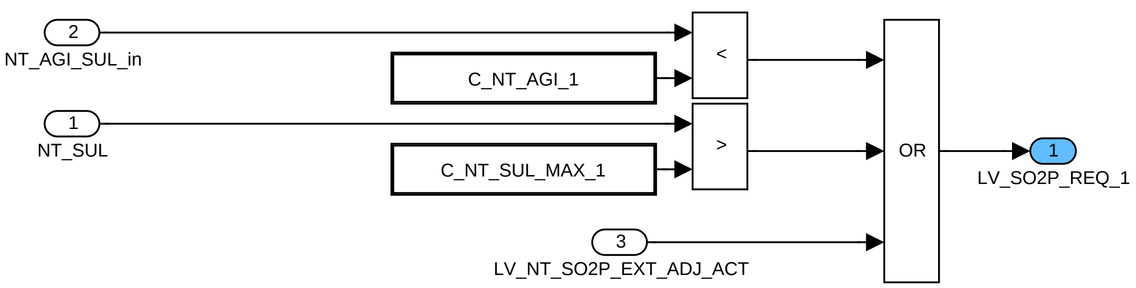

Figure 7.90.40: NOXM_MODUL703P/operate/DESULFATION/CLC1

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If the values become worse and reach the second threshold, then the second desulfation request will be set. In standard cases with no need of separate reset conditions for LV_SO2P_REQ_2, IP_NT_SUL_MAX_2_DEAC and IP_NT_SUL_MAX_2 have to be calibrated identically

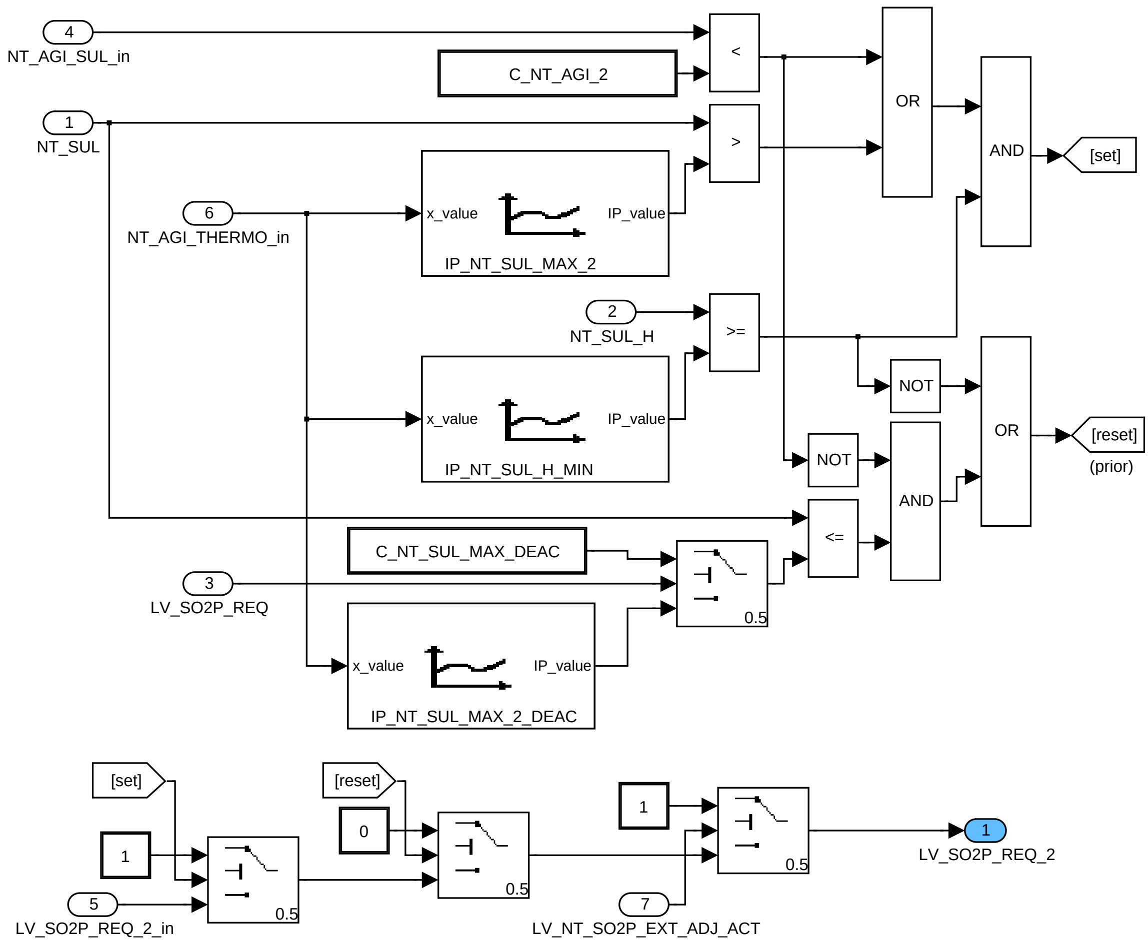

Figure 7.90.41: NOXM_MODUL703P/operate/DESULFATION/CLC2

Condition for lambda=1 request

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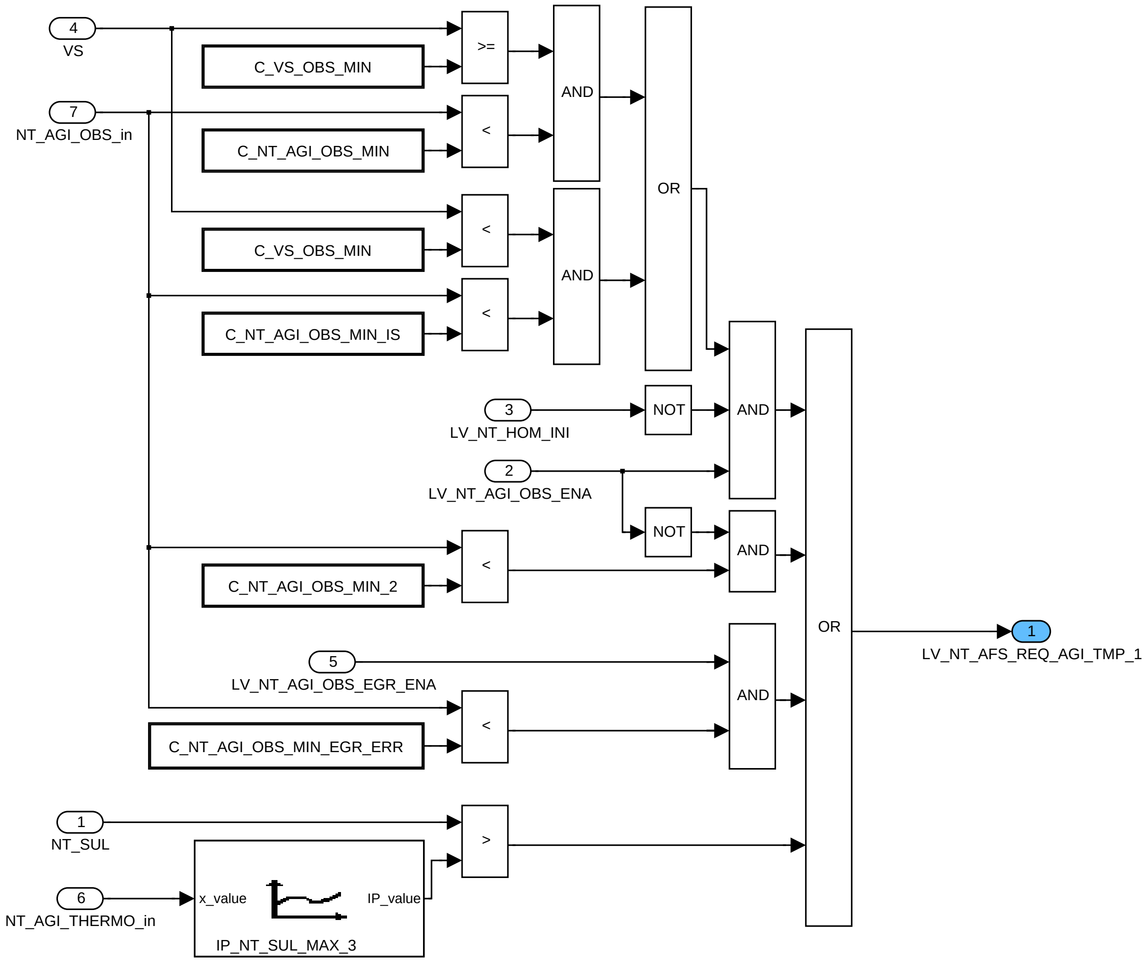

Figure 7.90.42: NOXM_MODUL703P/operate/DESULFATION/CLC3

Structure of fuel quality check

If the thermal aging factor reaches the third threshold, then the fuel quality check will be started. In that case a desulfation will be requested and the sulfur model will be calculated with higher sulfur ratio, controlled by FAC_SU_CONC_FUEL.
After desulfation (LV_SO2P_REQ_1=0) the prohibition of stratified mode (LV_NT_AFS_REQ_AGI_TMP_2) will be canceled.
Either the aging factor is OK and the fuel check will be finished immediately (sub-system OK) or after a calibratable number of cycles a decicion will be made (sub-system END) whether the NOx trap is OK or not. If OK the fuel quality check will be finished, if not the lambda=1 mode will be forced (LV_NT_AFS_REQ_AGI_TMP_3=1) because the trap is defect.

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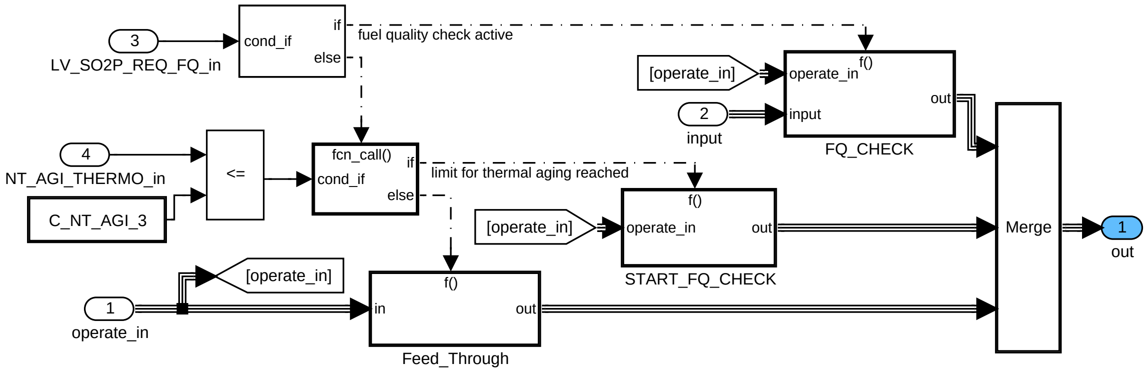

Figure 7.90.43: NOXM_MODUL703P/operate/DESULFATION/CLC4

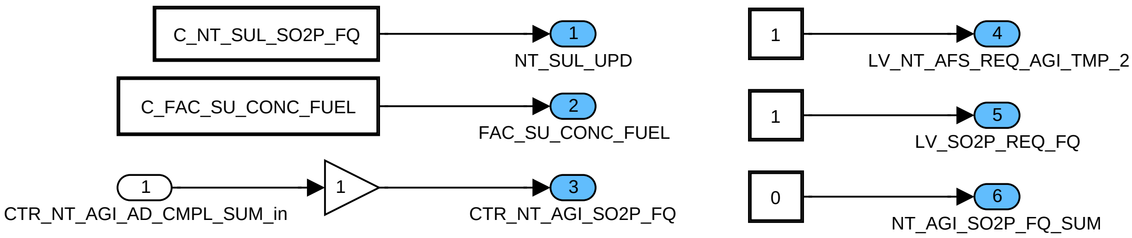

Figure 7.90.44: NOXM_MODUL703P/operate/DESULFATION/CLC4/START_FQ_CHECK/CLC

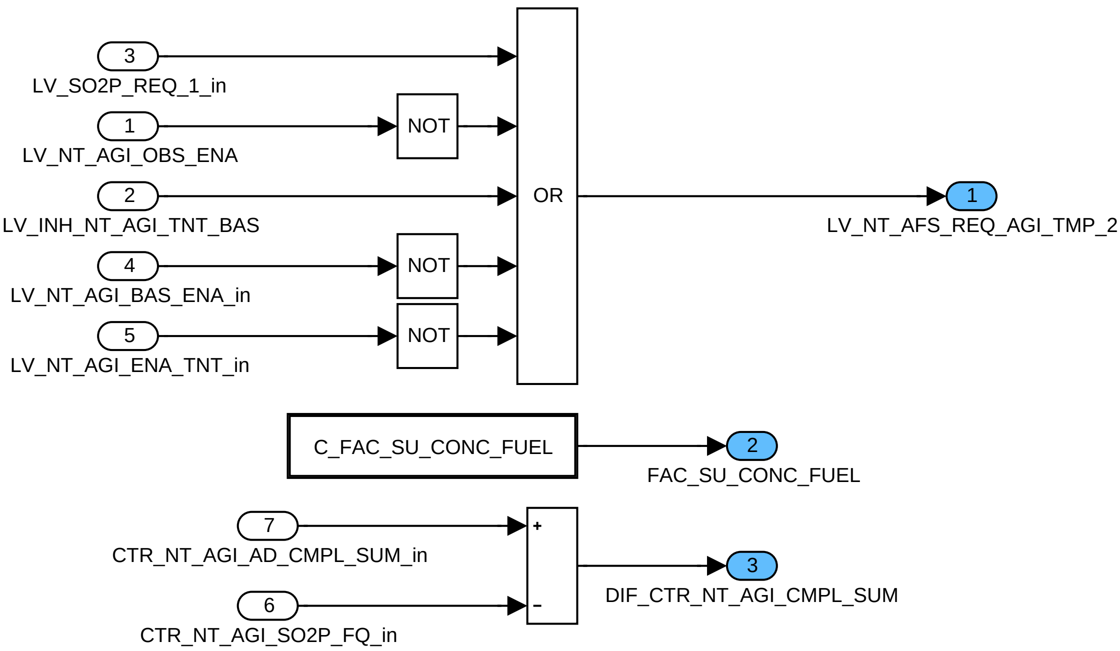

Figure 7.90.45: - NOXM_MODUL703P/operate/DESULFATION/CLC4/FQ_CHECK/CLC1

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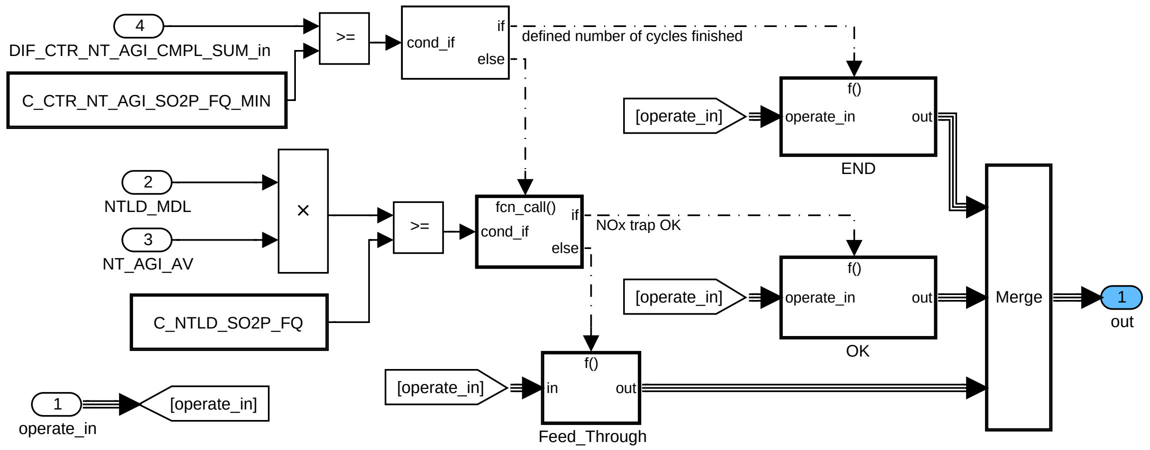

Figure 7.90.46: NOXM_MODUL703P/operate/DESULFATION/CLC4/FQ_CHECK/CLC2

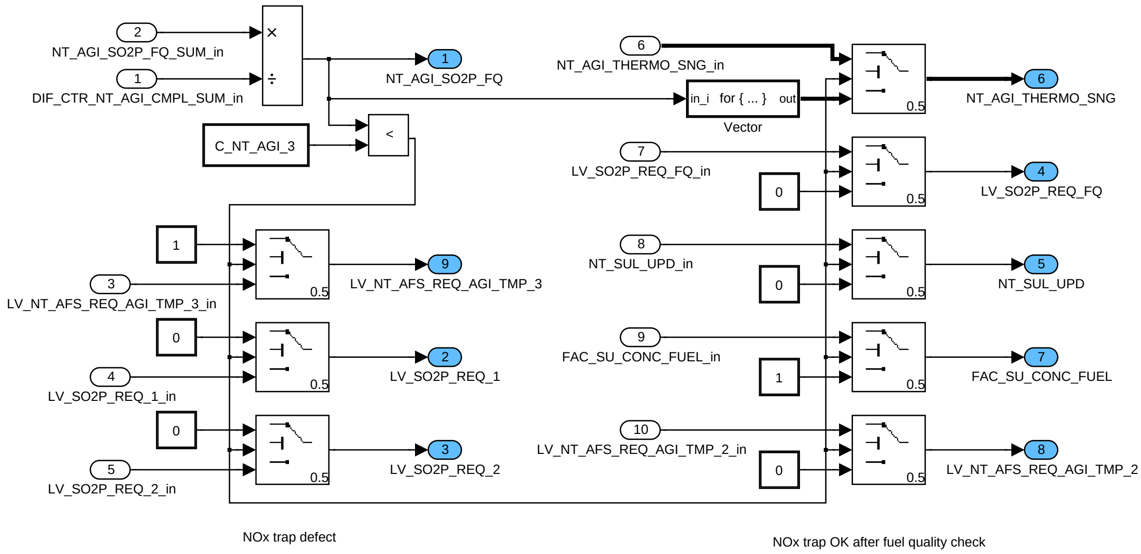

Figure 7.90.47: NOXM_MODUL703P/operate/DESULFATION/CLC4/FQ_CHECK/CLC2/END/CLC

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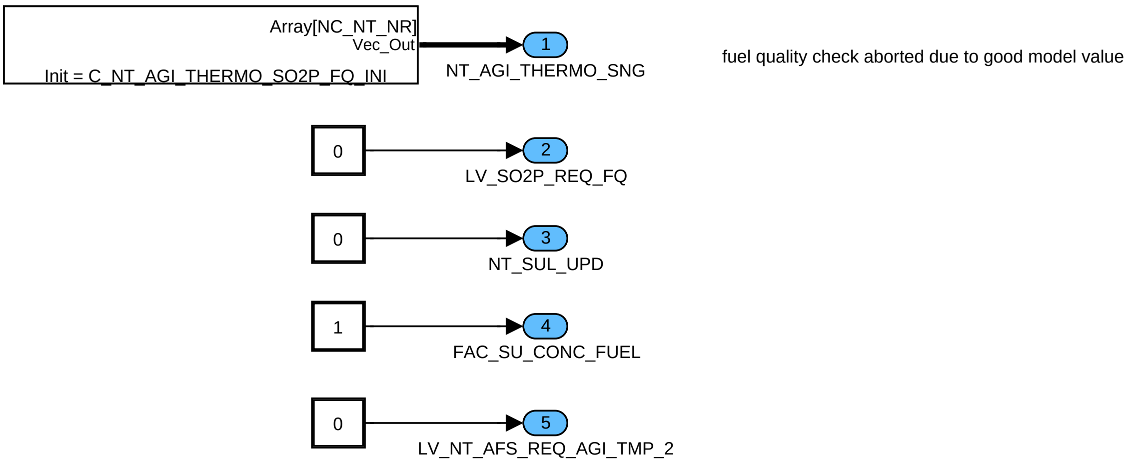

Figure 7.90.48: NOXM_MODUL703P/operate/DESULFATION/CLC4/FQ_CHECK/CLC2/OK/CLC

Collection of all lambda=1 requests.

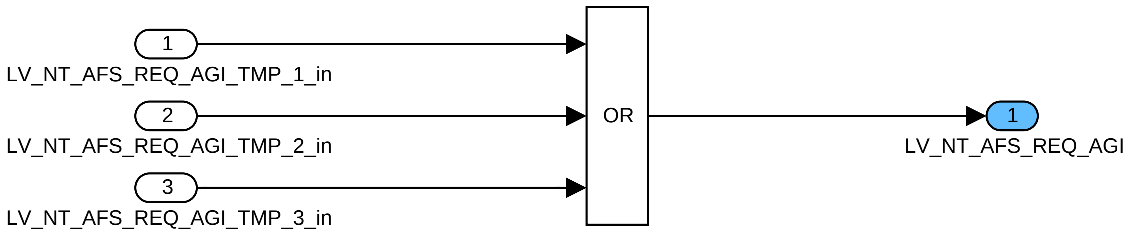

Figure 7.90.49: NOXM_MODUL703P/operate/DESULFATION/CLC5

NEW_DEVICE: Initialisation by scan tool

If a new NOx trap is built in, then a initialization via a scan tool have to be made.

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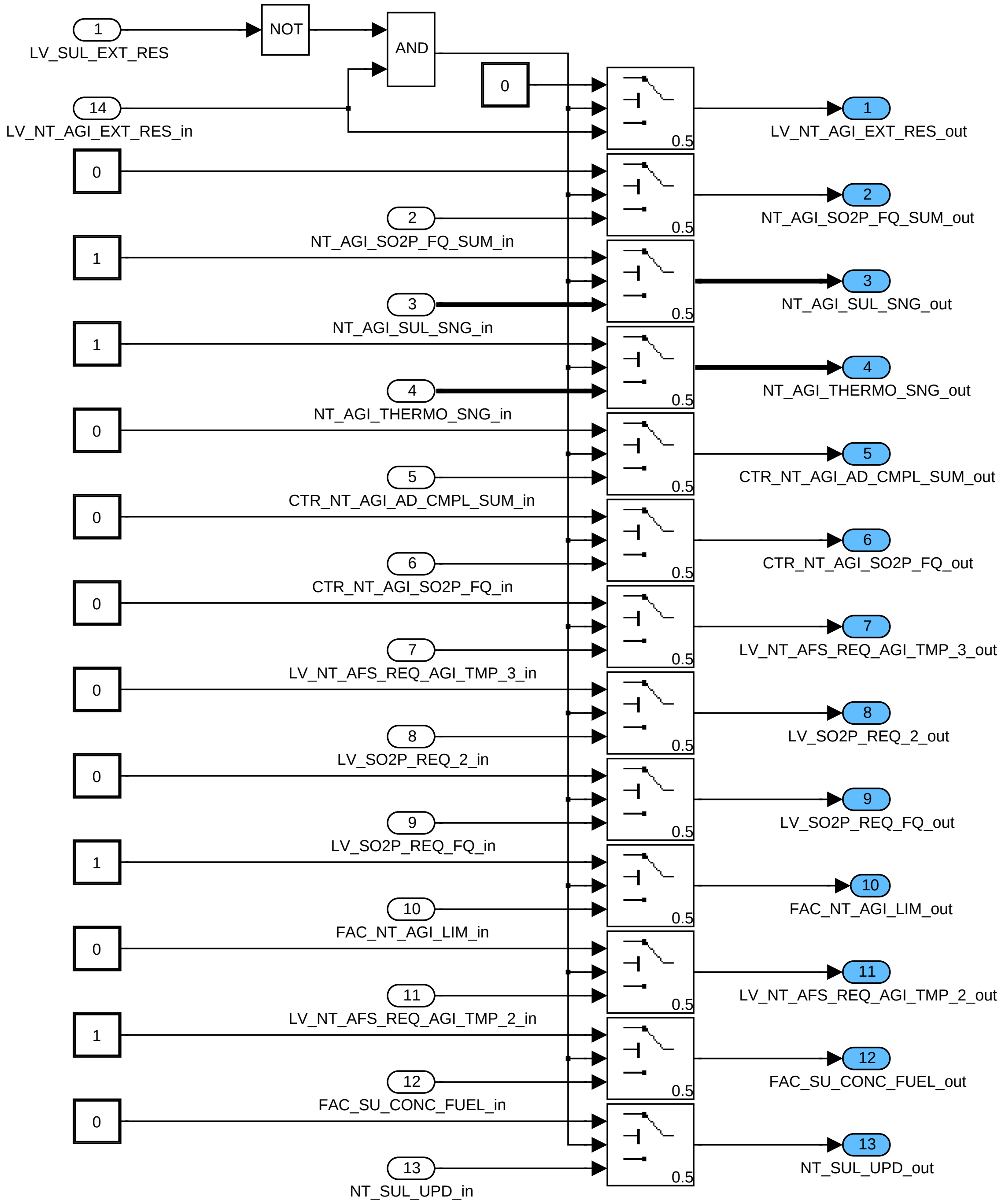

Figure 7.90.50: NOXM_MODUL703P/operate/NEW_DEVICE/CLC1

Update of external adjustment values

If the flag LV_NT_AGI_EXT_ADJ was set by action ACTION_NOXM_WriteAgingExtAdj and the external sulfur model values are already written, then the external values will be used and the flag will be reset.

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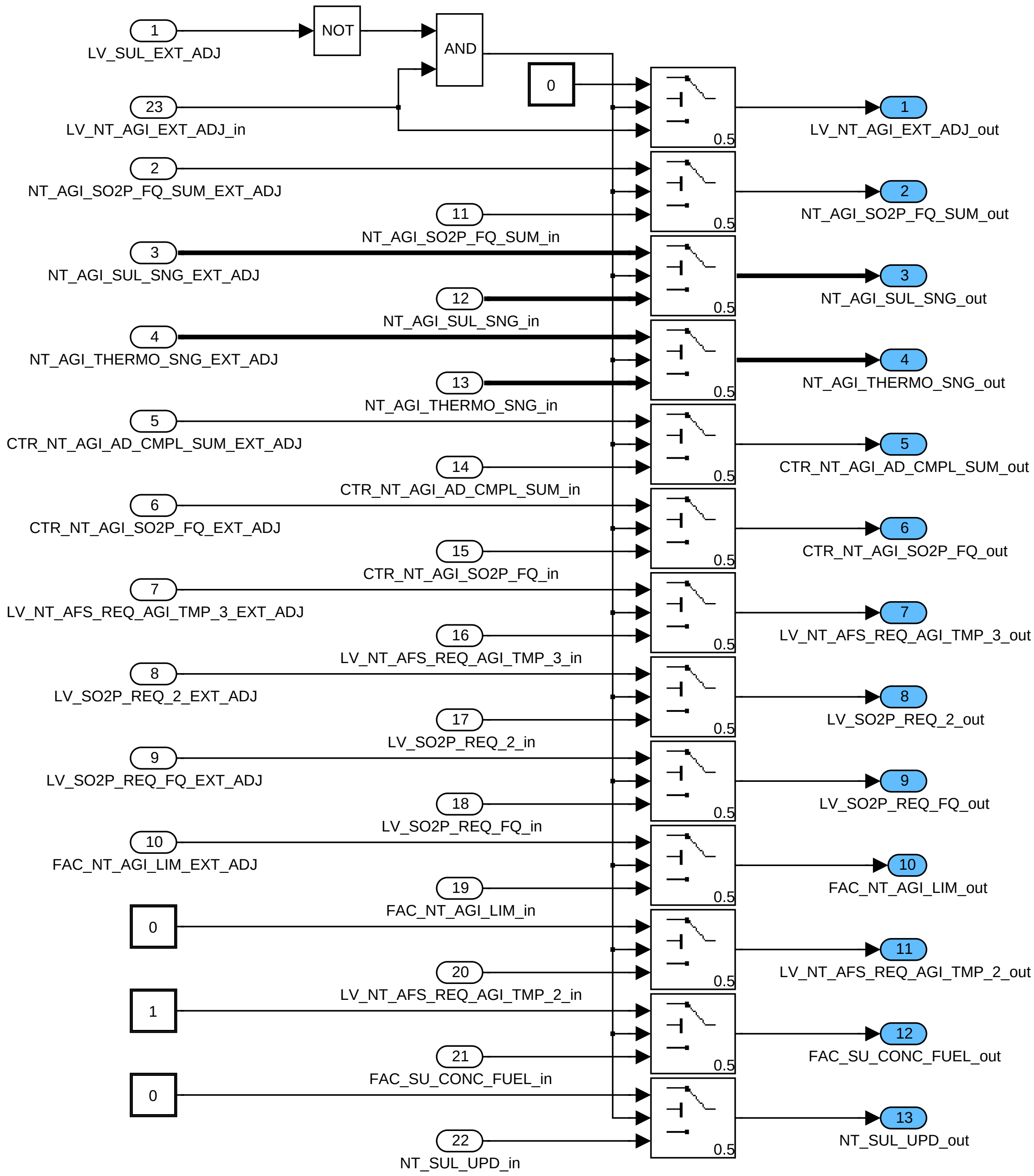

Figure 7.90.51: NOXM_MODUL703P/operate/NEW_DEVICE/CLC2

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7.90.4 RESET

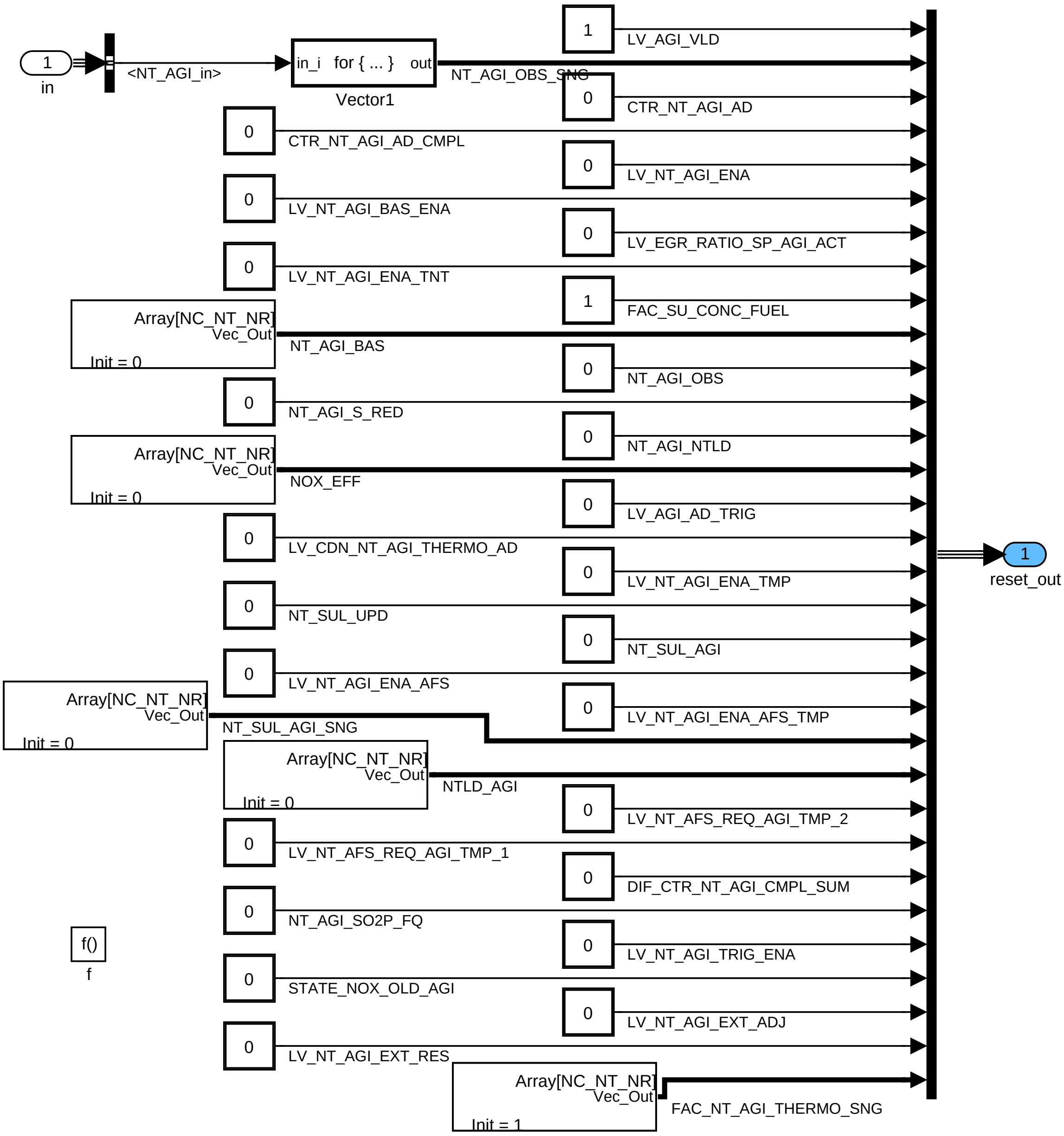

Figure 7.90.52: NOXM_MODUL703P/reset

7.90.5 Handling of non-volatile memory

The non-volatile data will be read out of the memory at the after power-on and stored in the memory before power-off. The initialization of the non-volatile memory is shown in the next picture.

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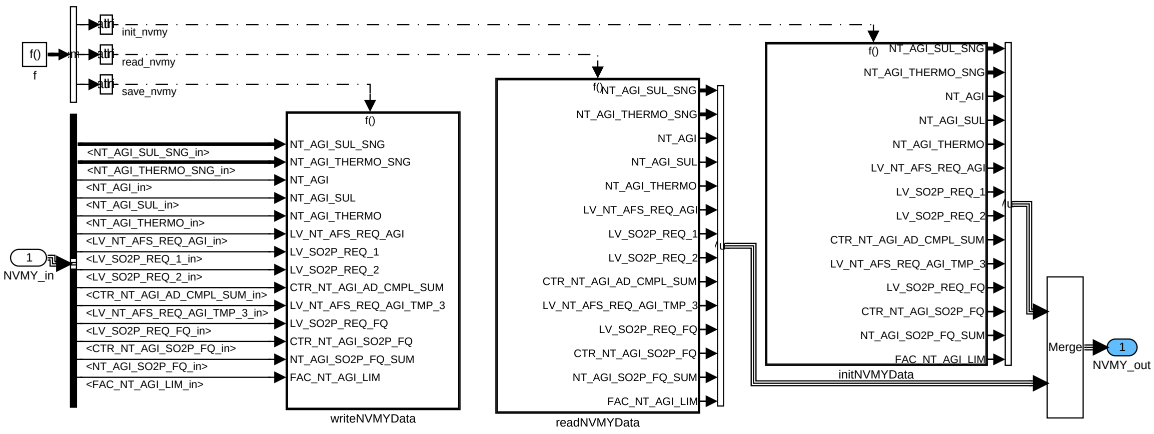

Figure 7.90.53: NOXM_MODUL703P/NVMYdata

Initialization of non-volatile memory

The aging factors will be set to one, that means fresh catalyst. All other values will be initialized to its inactive value.

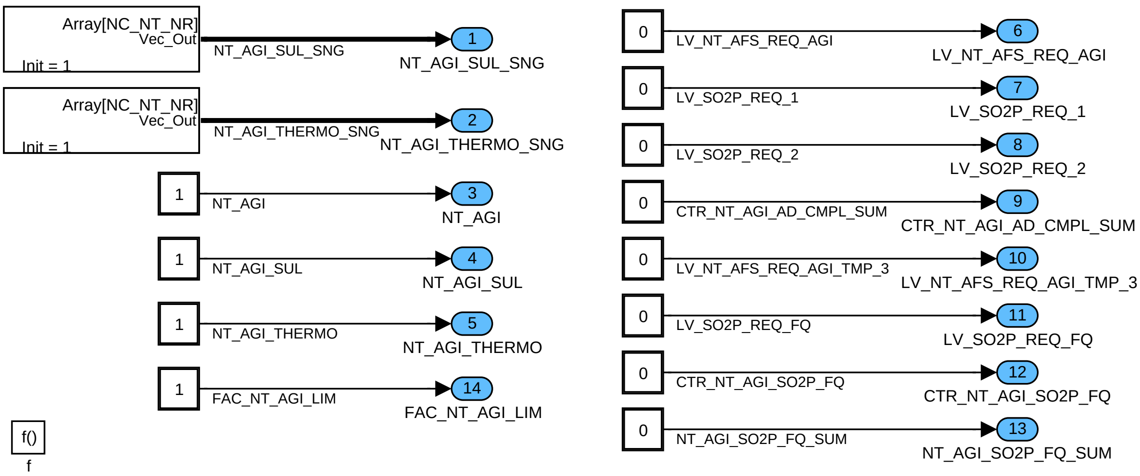

Figure 7.90.54: NOXM_MODUL703P/NVMYdata/initNVMYData

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7.91 NOx catalyst aging (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_KM_CAN_ST	V	0... FFFFH	0... 655350	10	km
vehicle kilometer reading from Kombi at motor start					
LV_INH_NT_AGI	O/V	0... 1H	0 ...1	1	-
flag inhibiting the NOx catalyst aging adaptation					
LV_INH_NT_AGI_BAS	O/V	0... 1H	0 ...1	1	-
flag inhibiting the NOx catalyst aging adaptation					
LV_INH_NT_AGI_ERR	O/V	0... 1H	0 ...1	1	-
inhibition of the NOx catalyst aging adaptation due error on sensor or subsystem					
LV_INH_NT_AGI_THD	V	0... 1H	0 ...1	1	-
inhibition of the NOx catalyst aging adaptation due to MFF or N					
LV_INH_NT_AGI_TNT	V	0... 1H	0 ...1	1	-
inhibition of the NOx catalyst aging adaptation due to temperature window control					
LV_INH_NT_AGI_TNT_BAS	O/V	0... 1H	0 ...1	1	-
inhibition of the NOx catalyst aging adaptation due to temperature window control					
LV_NOX_SENS_MAX_ADJ	O/V	0... 1H	0 ...1	1	-
Flag to enable adjustment of NOx Sensor threshold for regeneration by aging adaptation					
LV_NT_AGI_OBS_EGR_ENA	O/V	0... 1H	0 ...1	1	-
Activation Conditions for continuous Aging Observation					
LV_NT_AGI_OBS_ENA	O/V	0... 1H	0 ...1	1	-
Activation Conditions for continuous Aging Observation					
NT_AGI_THERMO_GRD	O/V/S	8000... 0H	-0.1 ...0	3.0518e-6	1/km
Gradient of NT_AGI_THERMO from motor start to stop of last driving cycle normalized to distance					
NT_AGI_THERMO_ST	V	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap aging factor due to thermal aging at motor start					
TNT_MDL_NT_AGI_DYW [NC_NT_NR]	V	0... FFFFH	0... 1023.98437	0.015625	°C
NOx trap temperature of limited dynamic window out of TNT_MDL_MV					

Input data:

AMP {p. 982}	CTR_KM_CAN {p. 1563}	FAC_NT_AGI_LIM {p. 3072}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}
LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}	LV_ERR_CPS {p. 1001}	LV_ERR_EGR {p. 801}	LV_ERR_EGR_2 {p. 987}
LV_ERR_EL_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ERR_NS_CAN_MSG_ LOST [NC_NOX_SENS_CONF] {p. 991}	LV_ERR_NS_OBD_1 [NC_NOX_SENS_CONF] {p. 4915}
LV_ERR_OBD_LSH_ DOWN [NC_CBK_EX_NR] {p. 5198}	LV_ERR_TEG_PCAT_ DOWN {p. 4713}	LV_ERR_TIA_IM {p. 984}	LV_HOM_AFS_REQ {p. 8136}
LV_NOX_AD_DYW {p. 3069}	LV_NOX_SENS {p. 2982}	LV_NT_AGI_ENA {p. 3072}	MFF_SP_S {p. 8243}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}	NC_NT_NR {p. 644}

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NT_AGI_THERMO {p. 3073}	STATE_CAT_DIAG [NC_CBK_EX_NR] {p. 5474}	STATE_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	STATE_NOX {p. 2986}
TIA_IM {p. 984}	TNT_MDL_1 [NC_NT_NR] {p. 8237}	TNT_MDL_2 [NC_NT_NR] {p. 8237}	TNT_MDL_H {p. 8237}
TNT_MDL_L {p. 8237}	TNT_MDL_MV {p. 8237}	TOIL {p. 8204}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_NT_AGI_MIN	-	0... FFFFH	0... 5434	0.0829175	hPa
Min. Ambient Pressure threshold for enabling /disabling an aging adaptation					
C_CRLC_TNT_MDL_NT_AGI_DYW	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation factor for calculation of TNT of dynamic window limitation					
C_CTR_KM_CAN_DIF_MIN	-	0... FFFFH	0... 655350	10	km
minimum vehicle kilometer for calculation of thermal aging gradient					
C_ERR_EGR_3_REQ_CTR_MIN	-	0... FFH	0... 255	1	-
threshold for enabling aging factor observation considering EGR problems					
C_ERR_NS_NT_AGI_BIT_SEL	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit NOx catalyst aging determination					
C_LAMB_NT_AGI_MIN	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda threshold for enabling /disabling an aging adaptation					
C_MFF_SP_S_NT_AGI_MAX	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass flow threshold for enabling /disabling an aging adaptation					
C_MFF_SP_S_NT_AGI_MIN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass flow threshold for enabling /disabling an aging adaptation					
C_N_32_NT_AGI_MAX	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for enabling /disabling an aging adaptation					
C_N_32_NT_AGI_MIN	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for enabling /disabling an aging adaptation					
C_TIA_NT_AGI_MIN	-	0... FEH	-48... 142.5	0.75	°C
Min. Intake Air Temperature threshold for enabling /disabling an aging adaptation					
C_TNT_MDL_NT_AGI_DELTA	-	0... FFH	0... 1020	4	°C
max. deviation between higher and lower NT temp. for enabling an aging adaptation					
C_TNT_MDL_NT_AGI_DYW	-	0... FFH	0... 1020	4	°C
Temperature threshold for dynamic window limitation					
C_TOIL_NT_AGI_MAX	-	0... C8H	-40 ...160	1	°C
Max. Oil Temperature threshold for enabling /disabling an aging adaptation					
C_TOIL_NT_AGI_MIN	-	0... C8H	-40 ...160	1	°C
Min. Oil Temperature threshold for enabling /disabling an aging adaptation					
ID_TNT_MDL_MV_AGI_MAX	-	0... FFH	0... 1020	4	°C
LDPM_FAC_NT_AGI_LIM_1_NOXM	6	0... FFFFH	0... 0.99998	15.3e-6	-
Temperature threshold for enabling /disabling an aging adaptation					
ID_TNT_MDL_MV_AGI_MIN	-	0... FFH	0... 1020	4	°C
LDPM_FAC_NT_AGI_LIM_1_NOXM	6	0... FFFFH	0... 0.99998	15.3e-6	-
Temperature threshold for enabling /disabling an aging adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_TNT_MDL_NT_AGI_MAX	-	0... FFH	0... 1020	4	°C
LDPM_FAC_NT_AGI_LIM_1_NOXM	6	0... FFFFH	0... 0.99998	15.3e-6	-
Temperature threshold for enabling /disabling an aging adaptation					
ID_TNT_MDL_NT_AGI_MIN	-	0... FFH	0... 1020	4	°C
LDPM_FAC_NT_AGI_LIM_1_NOXM	6	0... FFFFH	0... 0.99998	15.3e-6	-
Temperature threshold for enabling /disabling an aging adaptation					
LC_INH_NT_AGI_MAN	-	0... 1H	0 ...1	1	-
Deativation flag (for the manual setting of the inhibiting bit NOx trap aging adaptation)					
LC_INH_NT_AGI_OFF	-	0... 1H	0 ...1	1	-
Deativation flag for the deactivation of inhibiting the NOx trap aging adaptation (1 = disenable deactivation)					
LC_NOX_SENS_MAX_AGI_ADJ_ENA	-	0... 1H	0 ...1	1	-
Switch to enable adjustment of NOx Sensor threshold for regeneration by aging adaptation					

7.91.1 Activation Conditions for NOx catalyst aging

FUNCTION DESCRIPTION:

General information:

This flag deactivates the NOx catalyst aging adaptation when errors occure which must not stop the lean operation and the NOx catalyst management, but can cause an inaccuracy in the model, which must not be adapted.
With the calibration data LC_INH_NT_AGI_MAN it is possible to deactivate the NOx trap aging adaptation manually.
With the calibration data LC_INH_NT_AGI_OFF it is possible to make the adaptation allways working.
These bits are useful for the calibration phase.
Number of NOx catalyst: NC_NT_NR i = 1...NC_NT_NR
Number of NOx sensors: NC_NOX_SENS_CONF k = 1...NC_NOX_SENS_CONF
Number of lambda sensors: NC_CBK_EX_NR m = 1...NC_CBK_EX_NR

Typical configurations:
[NC_CBK_EX_NR:NC_NT_NR:NC_NOX_SENS_CONF] =[1:1:1], [2:2:2], [2:2:1], [2:1:1]

Application conditions

Recurrence: 10 ms

Activation: - -

Deactivation: - -

Initialisation: - -

Formula section:

if(0) STATE_NOX = STOP - -> !STOP
then(0) LV_INH_NT_AGI_THD = 0
LV_INH_NT_AGI_TNT = 0
TNT_MDL_NT_AGI_DYW[i] = TNT_MDL_1[i]

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endif(0)

Application conditions

Recurrence: 100 ms has to be calculated before the modul "NOX Catalyst aging"
xx703P03.00x

Activation: - -

Deactivation: - -

Initialisation: LV_INH_NT_AGI = 0
TNT_MDL_NT_AGI_DYW[i] = 0

% NOx catalyst temperature dynamic window
TNT_MDL_NT_AGI_DYW[i]$_n$ =
(TNT_MDL_NT_AGI_DYW[i]$_{n-1}$ * (1- C_CRLC_TNT_MDL_NT_AGI_DYW))
+ (TNT_MDL_1[i] * C_CRLC_TNT_MDL_NT_AGI_DYW)

% NOx catalyst temperature conditions for aging
if (1) | TNT_MDL_NT_AGI_DYW[i] - TNT_MDL_1[i] | > C_TNT_MDL_NT_AGI_DYW
% at least one of the two benches has to fulfill the conditions
or TNT_MDL_L <= ID_TNT_MDL_NT_AGI_MIN(FAC_NT_AGI_LIM)
or TNT_MDL_H >= ID_TNT_MDL_NT_AGI_MAX(FAC_NT_AGI_LIM)
or TNT_MDL_MV <= ID_TNT_MDL_MV_AGI_MIN(FAC_NT_AGI_LIM)
or TNT_MDL_MV >= ID_TNT_MDL_MV_AGI_MAX(FAC_NT_AGI_LIM)
or TNT_MDL_H - TNT_MDL_L >= C_TNT_MDL_NT_AGI_DELTA
or TIA_IM < C_TIA_NT_AGI_MIN
or TOIL <= C_TOIL_NT_AGI_MIN
or TOIL > C_TOIL_NT_AGI_MAX
or AMP < C_AMP_NT_AGI_MIN
then (1) LV_INH_NT_AGI_TNT_BAS = 1
else (1) LV_INH_NT_AGI_TNT_BAS = 0
endif (1)

if(2) STATE_NOX = LOAD and LV_HOM_AFS_REQ = 0
then(2) *% NOx catalyst temperature dynamic window*
% NOx catalyst temperature conditions for aging
if(3) LV_INH_NT_AGI_TNT_BAS = 1
then(3) LV_INH_NT_AGI_TNT = 1
else(3) LV_INH_NT_AGI_TNT remains unchanged
endif(3)

% monitoring of engine speed and Fuel mass flow
if(4) N_32 <= C_N_32_NT_AGI_MIN
or N_32 >= C_N_32_NT_AGI_MAX
or MFF_SP_S <= C_MFF_SP_S_NT_AGI_MIN
or MFF_SP_S >= C_MFF_SP_S_NT_AGI_MAX
or LAMB_LS_UP[m] < C_LAMB_NT_AGI_MIN
% valid if at least one [m] < C_LAMB_NT_AGI_MIN
then(4) LV_INH_NT_AGI_THD = 1
else(4) LV_INH_NT_AGI_THD remains unchanged
endif(4)
else(2) LV_INH_NT_AGI_THD remains unchanged

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LV_INH_NT_AGI_TNT remains unchanged
endif(2)

if (5) LC_INH_NT_AGI_OFF = 1
then (5) LV_INH_NT_AGI_ERR = 0
LV_INH_NT_AGI = 0

else (5)
% component error check for aging
LV_INH_NT_AGI_ERR =
(LV_ERR_TEG_PCAT_DOWN[m] = 1 *% valid if at least one [m] = 1*
(error currently present on location Exh.gas temp.sens.downstr. precat)
or LV_ERR_TIA_IM = 1
(error currently present on location temperature sensor intake air)
or LV_ERR_EGR = 1
(error currently present on exhaust gas recirculation system)
or LV_ERR_EGR_2 = 1
(EGR valve stuck)
or LV_ERR_CPS = 1
(electr.error currently present on error location canister purge solenoid)
or LV_ERR_CAT_DIAG[m] = 1 *% valid if at least one [m] = 1*
(pre catalyst diagnosis value reached the threshold)

(Downstream lambda sensor specific errors)
or [LV_NOX_SENS = 0
and (*(failure bit for downstream oxygen sensor)*
or LV_ERR_EL_LS_DOWN[m] = 1 *% valid if at least one [m] = 1*
or LV_ERR_LSH_DOWN[m] =1 *% valid if at least one [m] = 1*
(downstr. oxygen sensor heater power stage)
or LV_ERR_OBD_LSH_DOWN[m] = 1)] *% valid if at least one [m] = 1*

(NOx sensor specific errors)
or [LV_NOX_SENS = 1
and (LV_ERR_NS_OBD_1[k] = 1 *% valid if at least one [k] = 1*
(OBD I error from smart NOx sensor)
or (STATE_ERR_NS_OBD_2[k] **bitwise AND** C_ERR_NS_NT_AGI_BIT_SEL) != 0 *% valid if at least one [k] = 1*
(OBD II error on NOx sensor)
or LV_ERR_NS_CAN_MSG_LOST[k] =1
% valid if at least one [k] = 1
)
]
)

% building the central inhibition flag for aging function
LV_INH_NT_AGI =
(LC_INH_NT_AGI_MAN = 1
(codeword for manual setting of inhibiting the aging adaptation)
or LV_INH_NT_AGI_TNT = 1
(NOx trap temperature window control)
or LV_INH_NT_AGI_ERR = 1

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(error on adaptation relevant sensors /subsystems present)
or LV_NOX_AD_DYW = 0
(limited dynamics concerning NOx concentration and MAF)
or LV_INH_NT_AGI_THD = 1)
endif (5)

LV_INH_NT_AGI_BAS =
(LC_INH_NT_AGI_MAN = 1
(codeword for manual setting of inhibiting the aging adaptation)
or LV_INH_NT_AGI_ERR = 1)

7.91.2 Adjustment of NOx Sensor threshold for regeneration

If (6) LC_NOX_SENS_MAX_AGI_ADJ_ENA =1
and STATE_CAT_DIAG[m] = END % valid if all [m] = END
and LV_NT_AGI_ENA = 1
then (6) LV_NOX_SENS_MAX_ADJ = 1
else (6) LV_NOX_SENS_MAX_ADJ = 0
endif (6)

7.91.3 Activation Conditions for continuous Aging Observation

if (7) STATE_CAT_DIAG[m] = END % valid if all [m] = END
then (7) LV_NT_AGI_OBS_ENA = 1
LV_NT_AGI_OBS_EGR_ENA = 0
else (7) LV_NT_AGI_OBS_ENA = 0
if (8) LV_ERR_EGR
then(8) LV_NT_AGI_OBS_EGR_ENA = 1
endif (8)
endif (7)

7.91.4 Gradient of NT_AGI_THERMO

Application conditions

Recurrence: – –

Activation: – –

Deactivation: – –

Initialisation:

```
at transition 'engine stop to engine run':
   NT_AGI_THERMO_ST = NT_AGI_THERMO
   CTR_KM_CAN_ST = CTR_KM_CAN
 at transition 'engine run to engine stop':
if  (CTR_KM_CAN-CTR_KM_CAN_ST) > C_CTR_KM_CAN_DIF_MIN
     AND NT_AGI_THERMO < NT_AGI_THERMO_ST
    then
NT_AGI_THERMO_GRD =
       (NT_AGI_THERMO - NT_AGI_THERMO_ST) /
       (CTR_KM_CAN - CTR_KM_CAN_ST)
    endif
```

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7.92 NOx catalyst sulphur model

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SUL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
External data for sulfur model available					
LV_SUL_EXT_RES	O/V	0... 1H	0 ...1	1	-
External reset of data for sulfur model					
MFF_OFS_EGR_NT_SUL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Correction of mass fuel flow setpoint for sulphur model due to unsymmetrical EGR branch					
NT_AGI_INC_SO2P [NC_NT_NR]	O/V	0... FFFFFFFFH	0 ...1	232.83e-12	-
Nox trap ageing factor increment per time step due to sulphur release					
NT_SUL	O/V	0... FFFFH	0... 10485.6	0.16	mg
NOx trap sulphur loading					
NT_SUL_32 [NC_NT_NR]	O/V/S	0... FFFFFFFFH	0... 10485.6	2.44& -6	mg
NOx trap sulphur loading with high resolution					
NT_SUL_AGI_DELTA [NC_NT_NR]	V	80000000... 7FFFFFFFH	-5242.8 ...5242.8	2.44& -6	mg
NT_SUL_AGI delta due to desulfation					
NT_SUL_DELTA [NC_NT_NR]	V	80000000... 7FFFFFFFH	-5242.8 ...5242.8	2.44& -6	mg
NT_SUL delta due to desulfation or loading					
NT_SUL_H	O/V	0... FFFFH	0... 10485.6	0.16	mg
NOx trap sulphur loading for high sulphured fuel					
NT_SUL_H_32 [NC_NT_NR]	O/V/S	0... FFFFFFFFH	0... 10485.6	2.44& -6	mg
NOx trap sulphur loading with high resolution for high sulphured fuel					
NT_SUL_H_DELTA [NC_NT_NR]	V	80000000... 7FFFFFFFH	-5242.8 ...5242.8	2.44& -6	mg
NT_SUL_H delta due to desulfation or loading					
NT_SUL_H_SO2P_BEG [NC_NT_NR]	V	0... FFFFH	0... 10485.6	0.16	mg
NOx trap sulphur loading for high sulphured fuel at desulfation begin					
NT_SUL_MAX [NC_NT_NR]	O/V	0... FFFFH	0... 10485.6	0.16	mg
maximum NOx trap sulphur loading					
NT_SUL_SO2P_BEG [NC_NT_NR]	V	0... FFFFH	0... 10485.6	0.16	mg
NOx trap sulphur loading at desulfation begin					
NT_SUL_UPD_OLD	-	0... FFFFH	0... 10485.6	0.16	mg
old value of interface variable for update of sulphur model by aging function					

Input data:

C_NT_STC_BAS_MAX_RNG_H {p. 2991}	EGR_RATIO {p. 8277}	FAC_SU_CONC_FUEL {p. 3072}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}
LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_PUC {p. 1720}	LV_SO2P_ACT {p. 3129}	MFF_SP [NC_CBK_EX_NR] {p. 2151}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_NT_NR {p. 644}	NT_AGI_THERMO_SNG [NC_NT_NR] {p. 3074}
NT_SUL_32_EXT_ADJ [NC_NT_NR] {p. 7682}	NT_SUL_AGI_SNG [NC_NT_NR] {p. 3074}	NT_SUL_H_32_EXT_ADJ [NC_NT_NR] {p. 7682}	NT_SUL_UPD {p. 3074}

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STATE_NOX {p. 2986}	T_SO2P_DLY {p. 3129}	TNT_MDL_MV_SNG [NC_NT_NR] {p. 8237}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_SU_NOX	-	0... FFFFH	0... 0.0000000281215	429e-15	-
Correlation constant					
C_LAMB_SP_MIN_SUL	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Lambda threshold for sulphur poisonning in homogenous lambda 1					
C_NT_SUL_INI	-	0... FFFFH	0... 10485.6	0.16	mg
Manual initialisation value for NOx trap sulphur model					
C_STATE_EGR_CBK	-	0... 2H	0 ...2	1	-
Configuration of asymmetrical EGR branch for sulphur model (0: no unsymmetry, 1 or 2: EGR branch on this bank)					
C_SU_CONC_FUEL	-	0... FFH	0... 510	2	ppm
Fuel sulphur concentration					
C_SU_CONC_FUEL_H	-	0... FFH	0... 510	2	ppm
Fuel sulphur concentration for high sulphured fuel					
IP_CRLC_SUL_AFS	-	0... FFFFH	0 ...1	15.259e-6	-
LDP_TNT_MDL_MV_IP_CRLC_SUL_AFS	4	0... FFFFH	0... 1023.98	0.015625	°C
Conversion factor for sulphur poisonning in homogenous lambda 1 according to TNT_MDL_MV					
IP_NT_SUL_DEC_BAS	-	0... FFFFH	0... 40.959375	625e-6	mg
LDPM_LAMB_MV_IP_NT_SUL_DEC_BAS	4	0... 7FFFH	0... 31.9990234	976.563e-6	-
LDP_TNT_MDL_MV_IP_NT_SUL_DEC	4	0... FFFFH	0... 1023.98	0.015625	°C
Basic sulphur loading decrement per time step (layer 1)					
IP_NT_SUL_DEC_FAC_1	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
LDPM_NT_SUL_IP_NT_SUL_DEC_FAC_1	6	0... FFFFH	0... 10485.6	0.16	mg
LDP_NT_SUL_SO2P_BEG_IP_NT_SUL_1	6	0... FFFFH	0... 10485.6	0.16	mg
Correction factor for sulphur release					
IP_NT_SUL_DEC_FAC_2	-	0... FFFFH	0 ...1	15.259e-6	-
LDP_NT_AGI_THERMO_IP_NT_SUL_2	6	0... FFFFH	0... 0.99998474	15.2587e-6	-
Correction factor for sulphur release on all layers on thermal aging factor					
IP_NT_SUL_H_DEC_FAC_1	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
LDPM_NT_SUL_IP_NT_SUL_DEC_FAC_1	6	0... FFFFH	0... 10485.6	0.16	mg
LDP_NT_SUL_SO2P_BEG_IP_NT_SUL_1	6	0... FFFFH	0... 10485.6	0.16	mg
Correction factor for sulphur release for high sulphured fuel					
IP_NT_SUL_MAX	-	0... FFFFH	0... 10485.6	0.16	mg
LDPM_NT_AGI_THERMO	6	0... FFFFH	0... 0.99998474	15.2587e-6	-
maximum sulphur loading for layer 1 respecting NT_AGI_THERMO					
IP_T_SO2P_DLY	-	0... FFFFH	0... 6553.5	0.1	s
LDPM_LAMB_MV_IP_T_SO2P_DLY	4	0... 7FFFH	0... 31.9990234	976.563e-6	-
Delay time before sulfur release					
LC_NT_SUL_INI_MAN	-	0... 1H	0 ...1	1	-
Logical constant for manual initialisation of NOx trap sulphur model					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_NT_SUL_LIM_NOT	-	0... 1H	0 ...1	1	-
Logical constant for continue incrementation of the layer 3 above NT_SUL_MAX_3					

Action definition

ACTION_NOXM_CleanNTAdaptSul ()	Mode: O
Initialization of NOx trap adaptation values of sulfur module	

ACTION_NOXM_WriteSulfurExtAdj ()	Mode: O
New external values for sulfur model available	

7.92.1 NOx catalyst sulphur model (NOXM modul 704G)

General information:
The NOx catalyst sulphur model can handle single branched and twin branched exhaust gas lines with the configuration data NC_NT_NR defined in the NOx catalyst management module.
If NC_NT_NR=1, just one exhaust line is taken into account, if NC_NT_NR=2, the software calculates the twin branch version.
i belongs to NC_NT_NR.

Description:

The NOx catalyst sulphur model calculates the NOx catalyst sulphur loading.

The sulphur loading is increased only in lean burn phase (-> STATE_NOX = LOAD). The sulphur loading increment is calculated out of the fuel sulphur concentration and converted to a NOx mass loading equivalent (sulphur load in NO2 mass loading equivalent is loss of NOx storage capacity).
When the desulfation is active, the sulphur which is chemically stored in the NOx-trap is released depending on the NOx-trap monolith temperature, lambda, the modeled sulphur load NT_SUL on the corresponding layer and the value of NT_AGI_THERMO.

During the desulfation the NOx-trap sulphur load is decremented until it reaches 0.

C_CRLC_SU_NOX includes
- the factor for transformation of MFF_SP * N_32 {mg/stk * 1/min} to a fuel mass flow
{mg /TA} =0,1s /2 /60s = 1 /1200)
- and the factor for number of cylinders and number of NOx traps
= NC_CYL_NR /NC_NT_NR
- and the factor for transformation of C_SU_CONC_FUEL {ppm} to mass part sulphur
in fuel {mg S/mg fuel} = 1E-6
- and the factor for transformation of sulphur load {mg S} to sulphur load NO2 equivalent
{mg NO2} = 2 * 46 /32 = 2,875.

Example values:
- four cylinder and one NOx trap: 9,5833 E-9
- six cylinder and two NOx traps: 7,1875 E-9

Calculation inside this function is done by high resolution variable NT_SUL_32. Valid output to other functions is low resolution variable NT_SUL.

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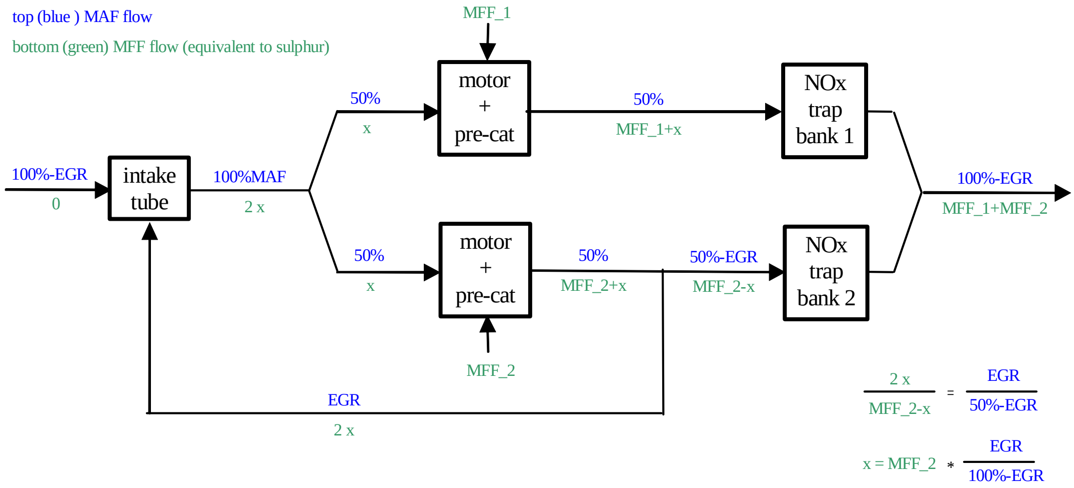
Unsymmetrical EGR branch

If the exhaust gas recirculation is unsymmetrical (exaust gas is taken from one bank and added to the intake air for both banks) then the different sulfur loading of the NOx traps will be considered by setting C_STATE_EGR_CBK to the bank with the EGR branch. In a symmetrical or a one-bank-system C_STATE_EGR_CBK have to be set to 0.
The splitting of the sulfur to both NOx traps is shown in the following picture. The sulphur is proportional to the fuel flow and the fuel split is controlled by the air flow, which depends from the EGR ratio.



Application Condition

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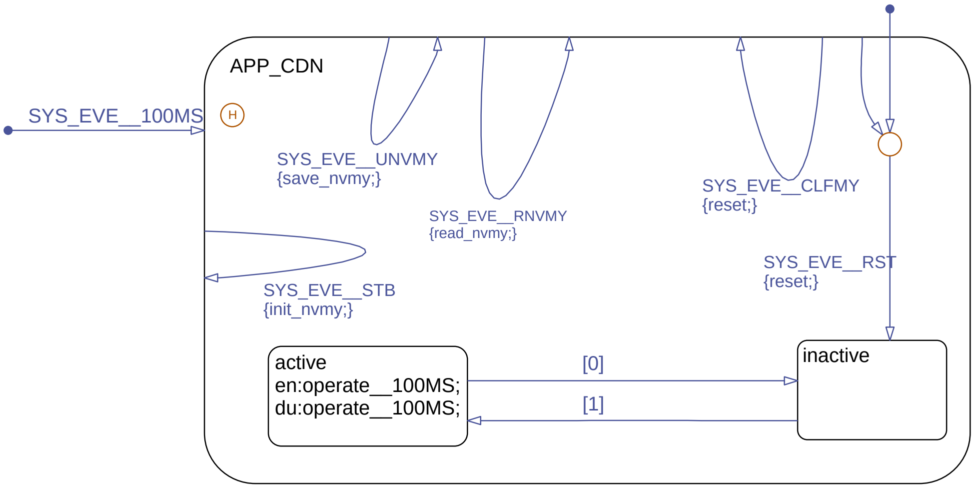

Figure 7.92.1: NOXM_MODUL704G/APP_CDN/Chart

Function Description

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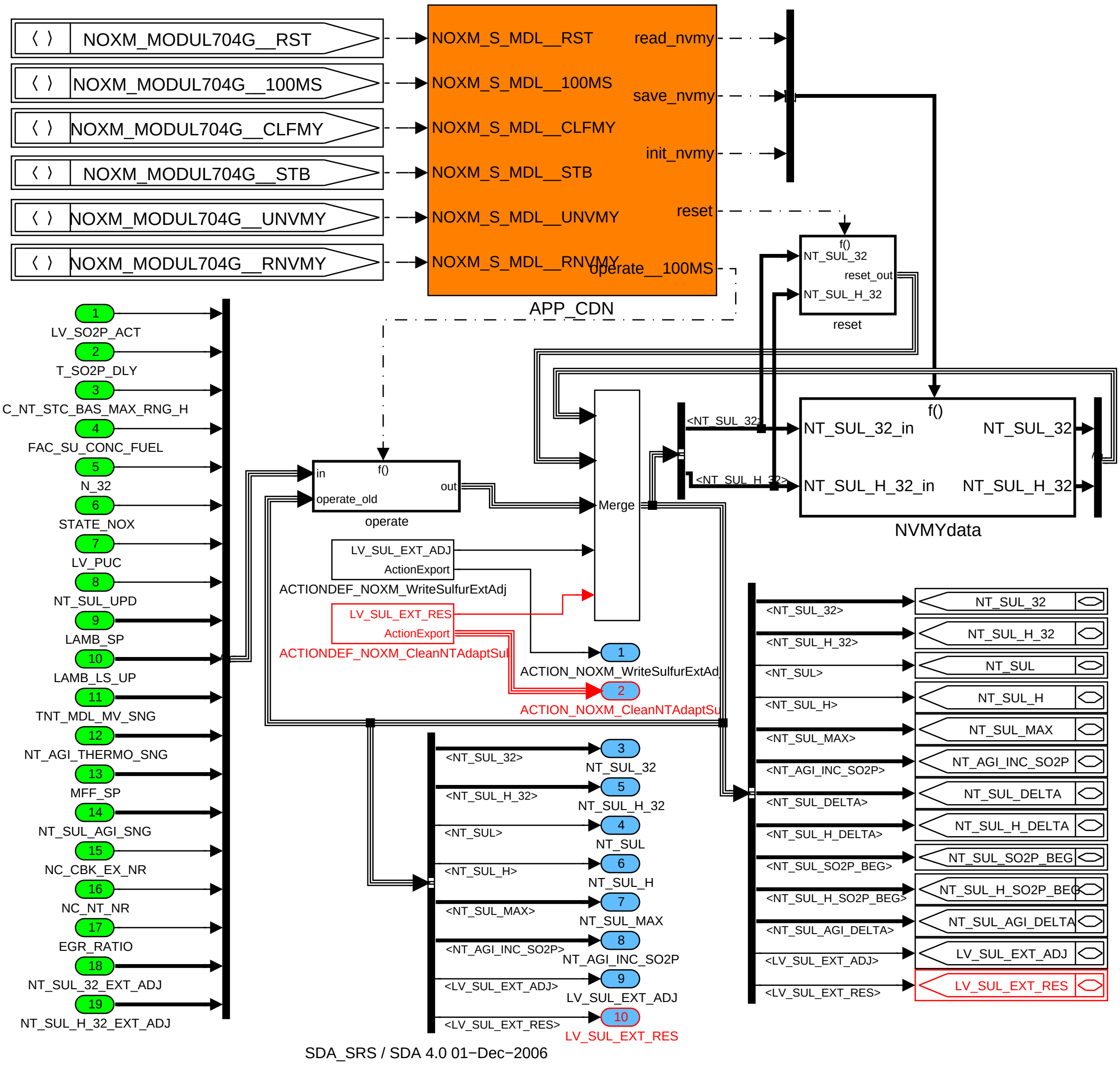

Figure 7.92.2: NOXM_MODUL704G

7.92.1.1 SUBFUNCTION: ACTIONDEF_NOXM_CleanNTAdaptSul

Description for ACTION_NOXM_CleanNTAdaptSul

ACTION_NOXM_CleanNTAdaptSul()					
Initialization of NOx trap adaptation values of sulfur module					
Parameter	**Type**	**Hex. limits**	**Phys. limits**	**Resol.**	**Unit**

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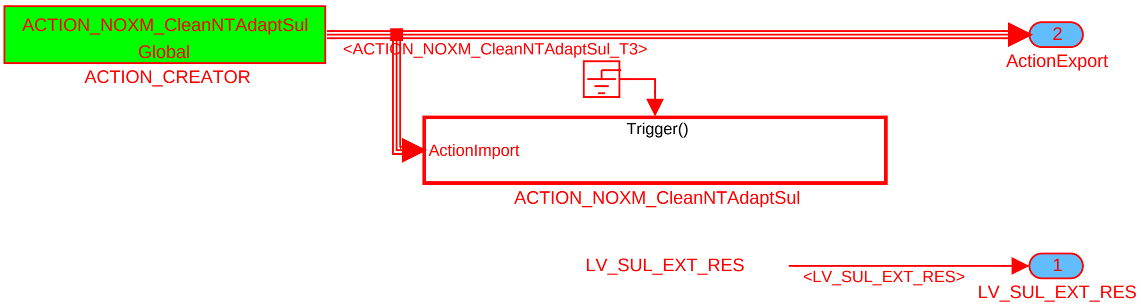

Figure 7.92.3: NOXM_MODUL704G/ACTIONDEF_NOXM_CleanNTAdaptSul

The flag LV_SUL_EXT_RST is set by this action. It shows that the sulfur values have to be reset inside next 100 ms recurrence.

Figure 7.92.4: NOXM_MODUL704G/ACTIONDEF_NOXM_CleanNTAdaptSul/ACTION_NOXM_CleanNTAdaptSul

7.92.1.2 SUBFUNCTION: ACTIONDEF_NOXM_WriteSulfurExtAdj

Description for ACTION_NOXM_WriteSulfurExtAdj

ACTION_NOXM_WriteSulfurExtAdj()					
New external values for sulfur model available					
Parameter	**Type**	**Hex. limits**	**Phys. limits**	**Resol.**	**Unit**

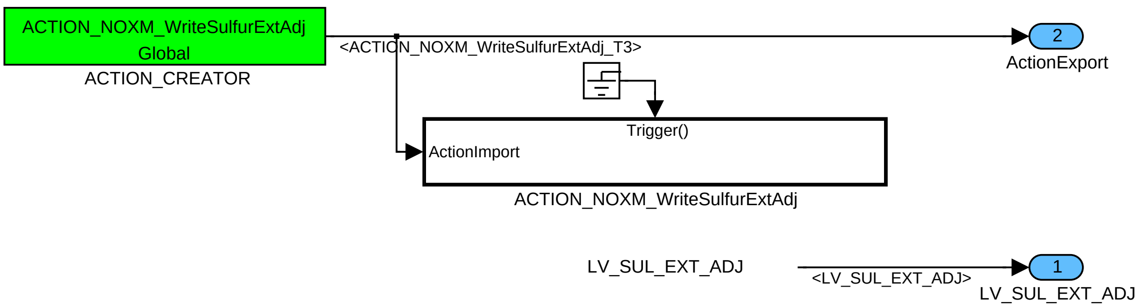

Figure 7.92.5: NOXM_MODUL704G/ACTIONDEF_NOXM_WriteSulfurExtAdj

The flag LV_SUL_EXT_ADJ is set by this action. It shows that the external values have to be used inside next 100 ms recurrence.

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Figure 7.92.6:
NOXM_MODUL704G/ACTIONDEF_NOXM_WriteSulfurExtAdj/ACTION_NOXM_WriteSulfurExtAdj

7.92.1.3 OPERATE

Calculation before MAIN

Before the MAIN part, which is calculated for each bank, the difference of the fuel due to the unsymmetrical EGR will be calculated. It will be added or subtracted inside MAIN to both banks.

(If MFF_SP_2 is not existing caused by NC_CBK_EX_NR = 1, but access demanded by other variables depending on other indices of bigger size, then MFF_SP_1 is used.)

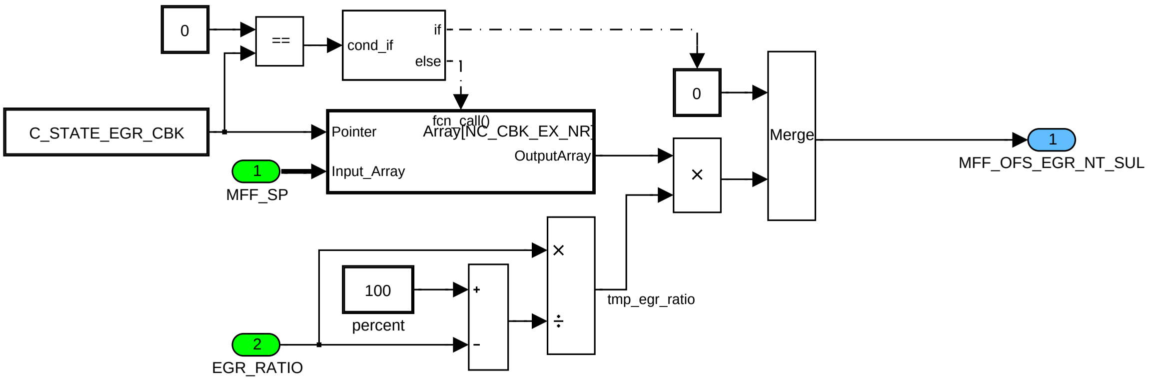

Figure 7.92.7: NOXM_MODUL704G/operate/BEFORE_MAIN

MAIN (for each NOx trap)

The function consists of the following parts
- manual initialization
- sulphur load update (from NOx catalyst aging)
- sulphur loading during LOAD phase
- sulphur release during desulfation
(splitted in two parts: before and after T_SO2P_DLY)

The for loop of the MAIN part is controlled by the number of NOx traps

NC_NT_NR = 1 means one NOx trap (calculation for i = 1)
NC_NT_NR = 2 means two NOx traps (calculation for i = 1 and 2)

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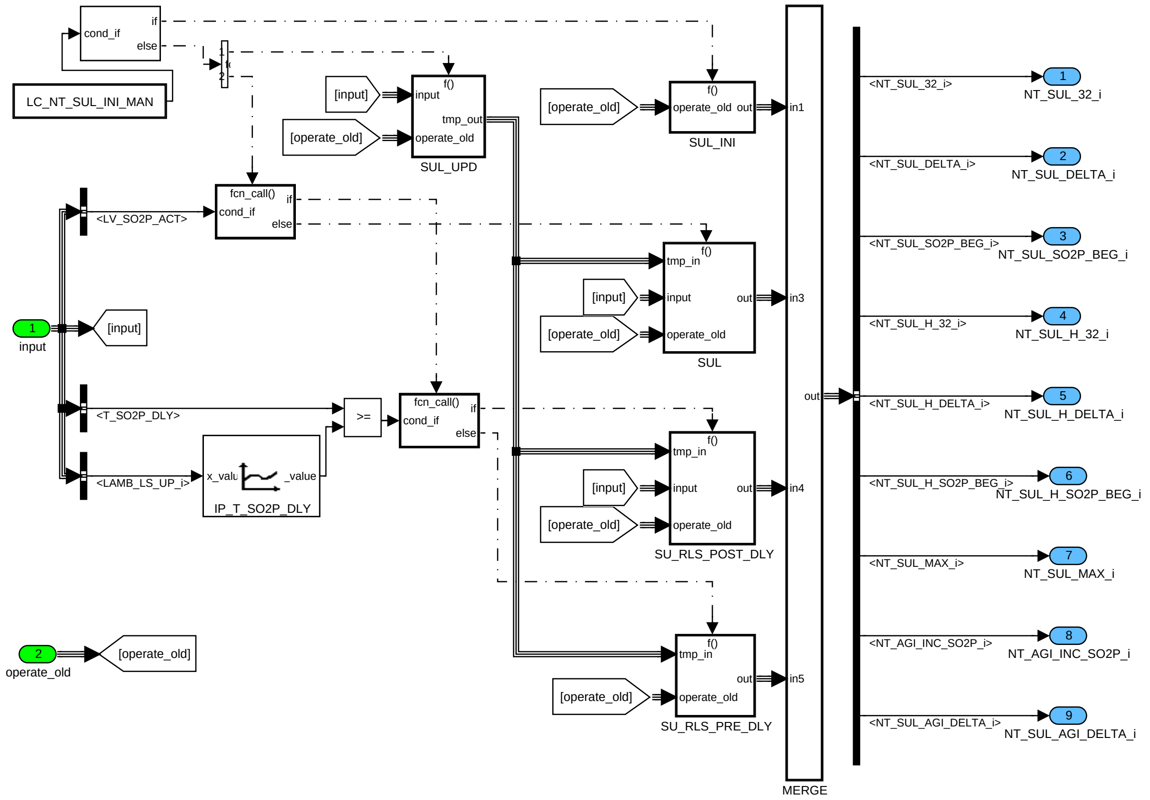

Figure 7.92.8: NOXM_MODUL704G/operate/CBK_MNG/MAIN

Manual initialization

If LC_NT_SUL_INI_MAN ist set, then the sulfur load of the NOx traps will be initialized with C_NT_SUL_INI.

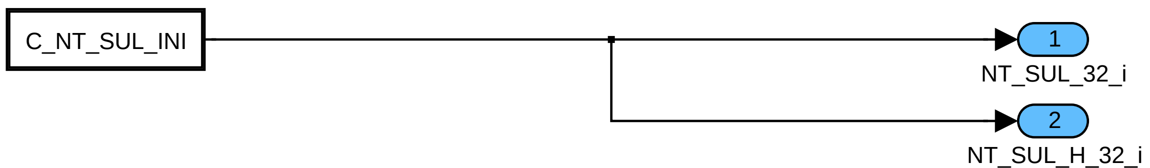

Figure 7.92.9: NOXM_MODUL704G/operate/CBK_MNG/MAIN/SUL_INI/CLC

Sulphur load update

The update value NT_SUL_UPD comes from the aging modul. The update takes place if the value is new and not zero.

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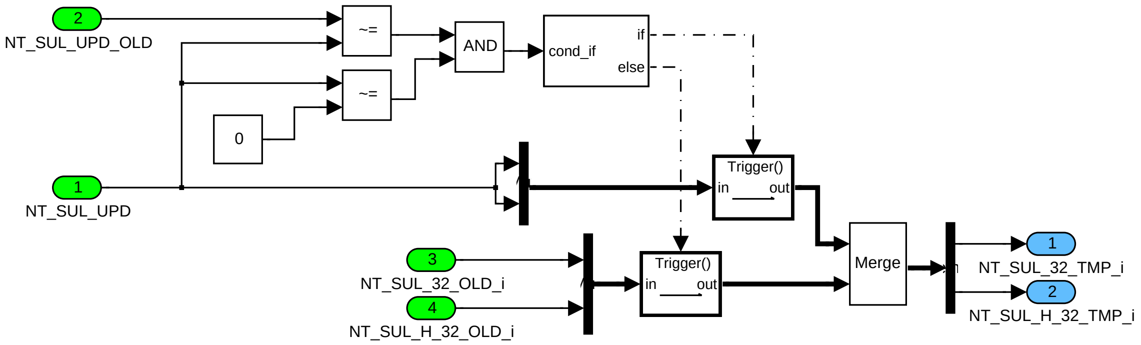

Figure 7.92.10: NOXM_MODUL704G/operate/CBK_MNG/MAIN/SUL_UPD/CLC

Calculation of sulphur loading increment

The offset of the EGR depending fuel will be added to the bank without EGR branch and subtracted to the bank with EGR. C_STATE_EGR_CBK selects the bank with EGR branch. From these corrected fuel values the sulphur increment for the NOx traps will be calculated.
The temporary variable mff_sp_tmp_i has the same resolution and limits as MFF_SP.
(If MFF_SP_2 is not existing caused by NC_CBK_EX_NR = 1, but access demanded by other variables depending on other indices of bigger size, then MFF_SP_1 is used.)

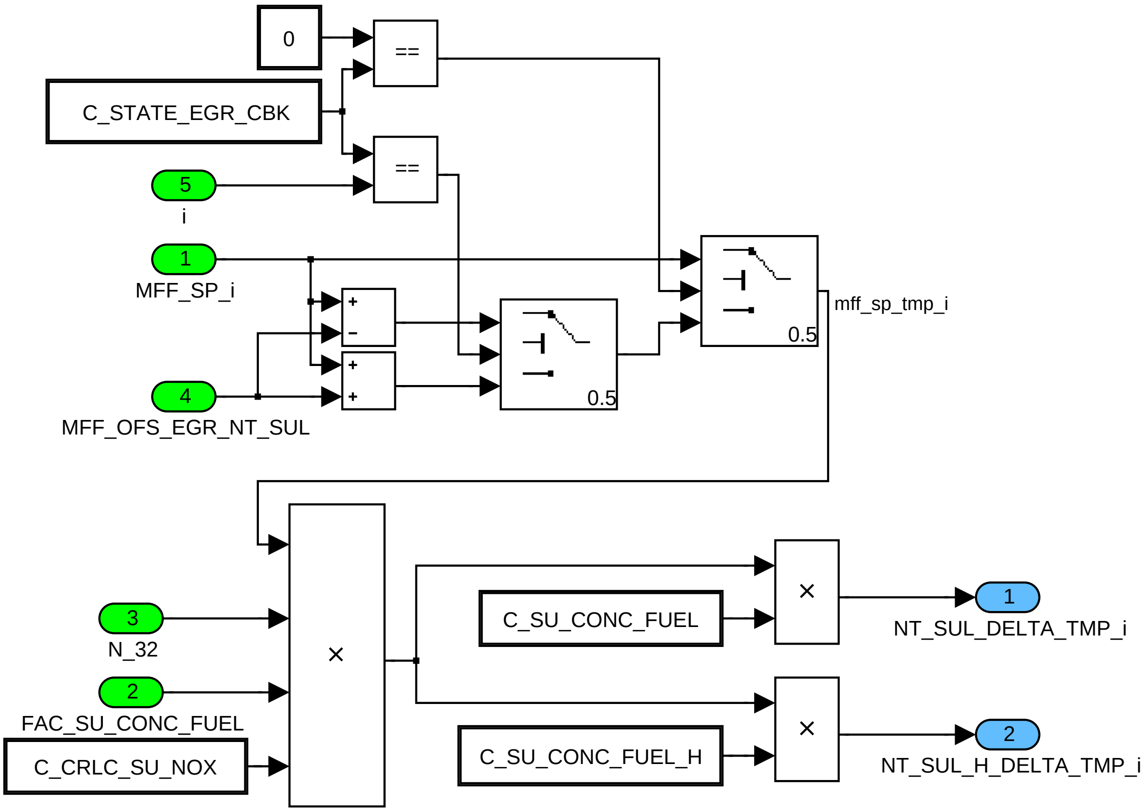

Figure 7.92.11: NOXM_MODUL704G/operate/CBK_MNG/MAIN/SUL/CLC/CLC1

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Selection of sulphur loading increment

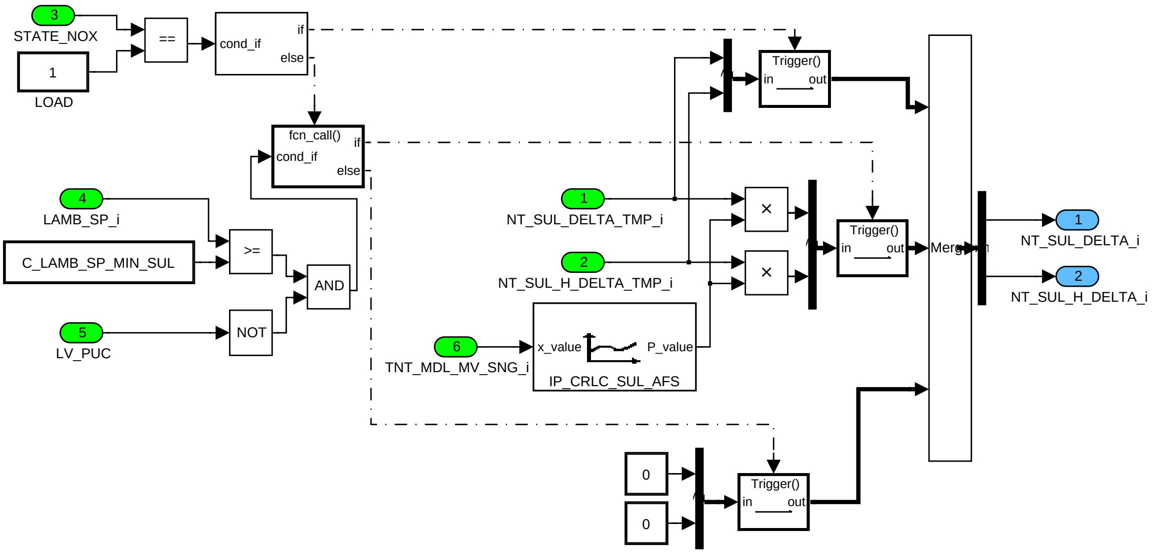

Figure 7.92.12: NOXM_MODUL704G/operate/CBK_MNG/MAIN/SUL/CLC/CLC2

Integral of sulphur

The sulphur increments will be added until a temperature dependent maximum. The limitation may be disabled. by LC_NT_SUL_LIM_NOT.

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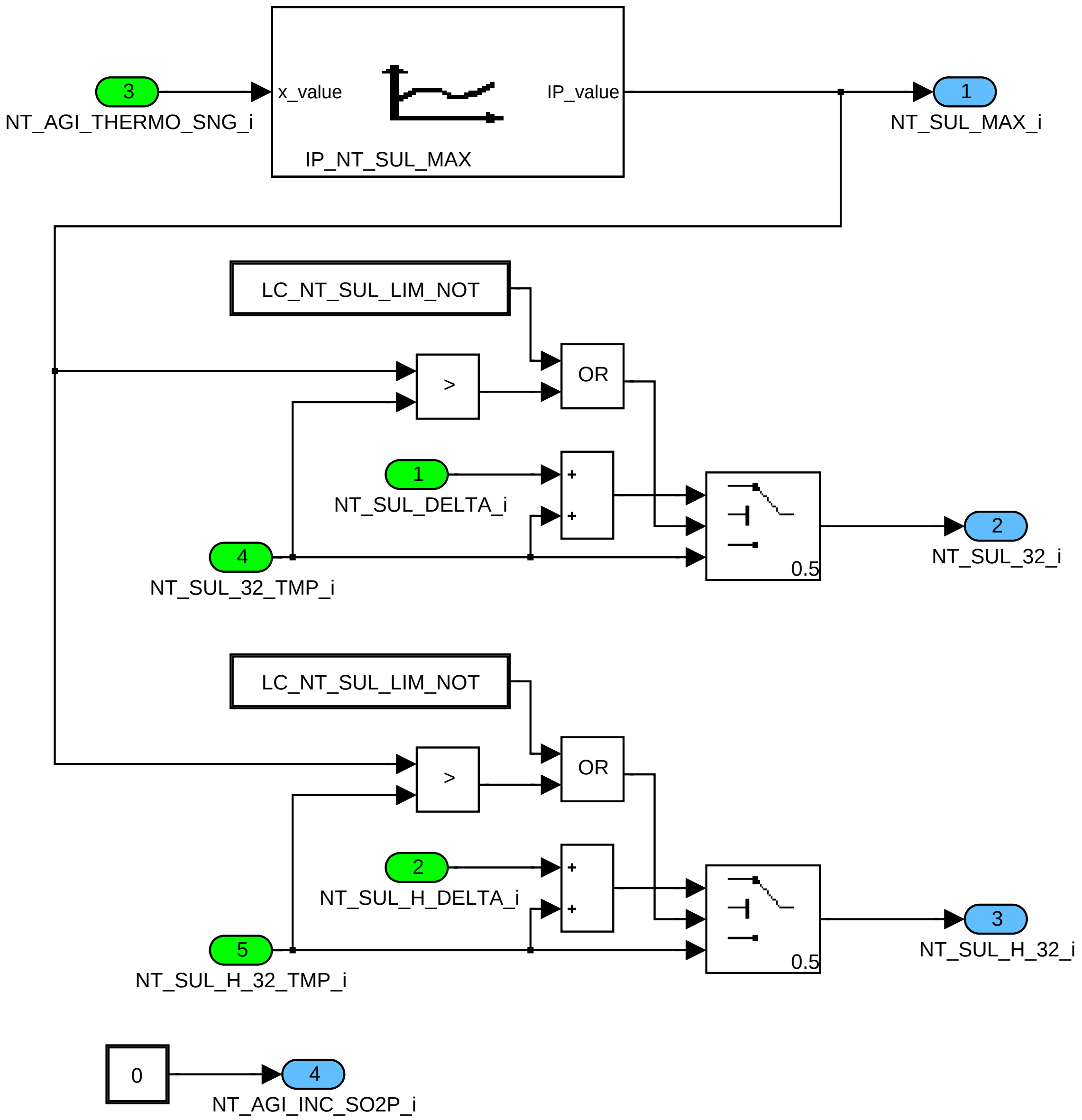

Figure 7.92.13: NOXM_MODUL704G/operate/CBK_MNG/MAIN/SUL/CLC/CLC3

Sulphur release phase post after delay time

The decrement of sulfur during release phase will be calculated by maps. The downward integration is limited to zero.

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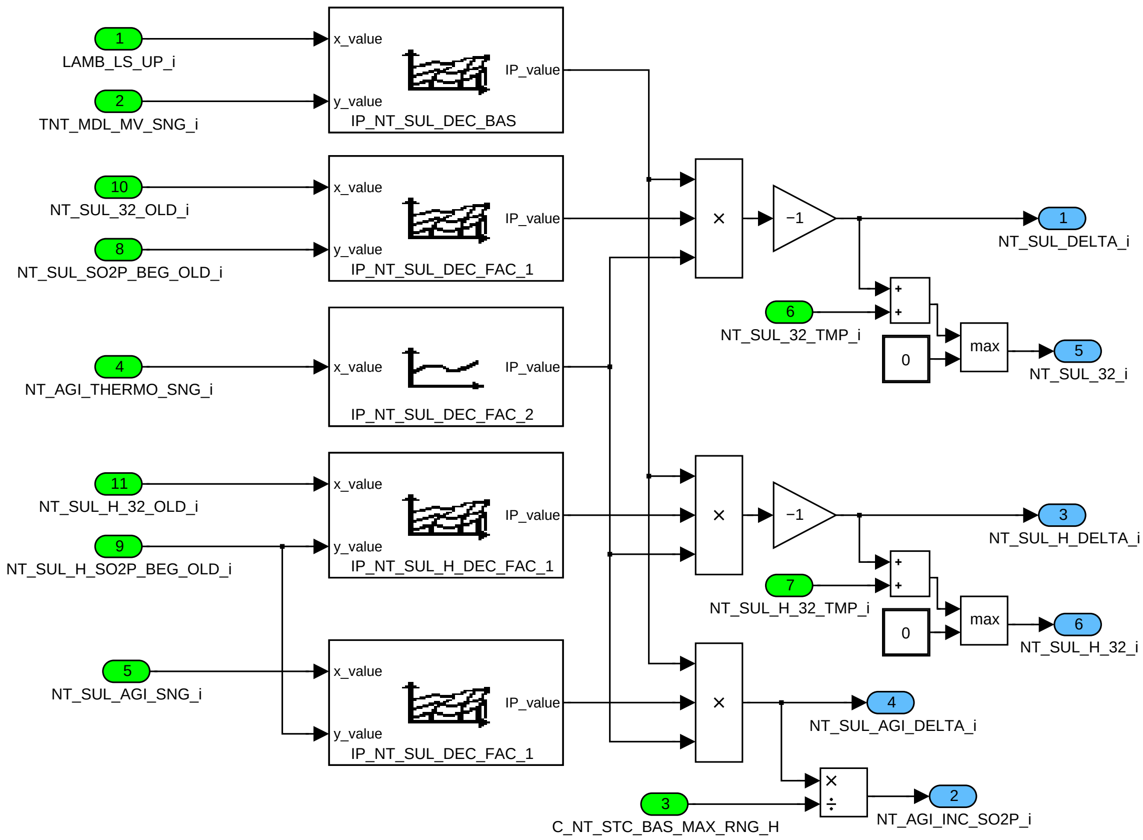

Figure 7.92.14: NOXM_MODUL704G/operate/CBK_MNG/MAIN/SU_RLS_POST_DLY/CLC

Sulphur release phase before delay time

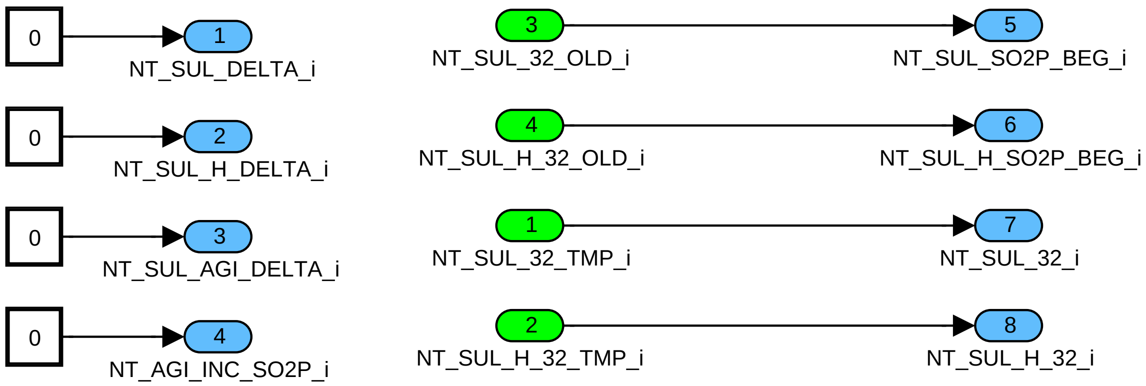

Figure 7.92.15: NOXM_MODUL704G/operate/CBK_MNG/MAIN/SU_RLS_PRE_DLY/CLC

Update of external adjustment values

If flag LV_SUL_EXT_ADJ was set by action ACTION_NOXM_WriteSulfurExtAdj, then the external values will be used and the flag will be reset.

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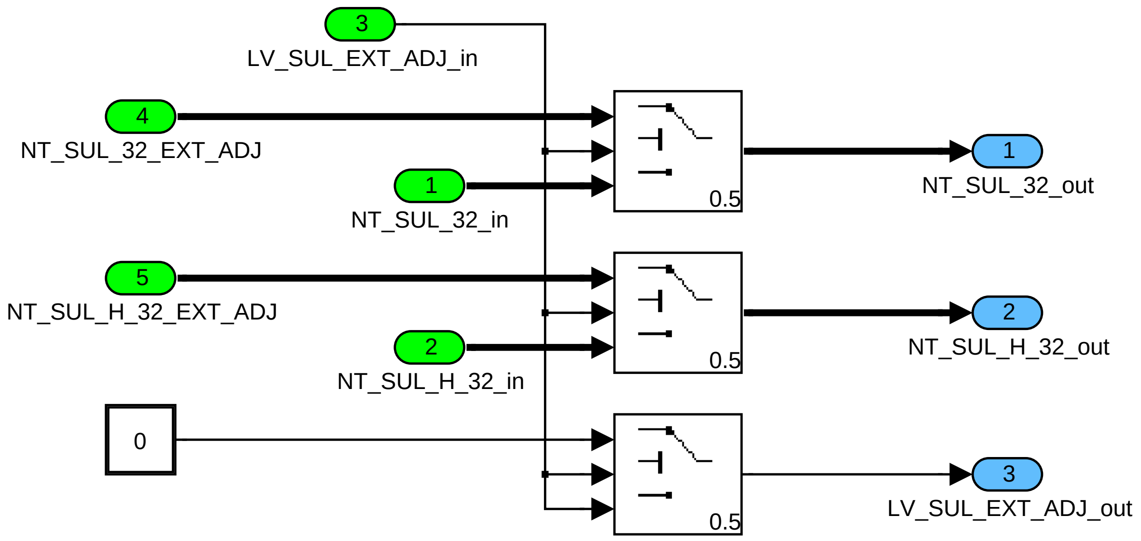

Figure 7.92.16: NOXM_MODUL704G/operate/AFTER_MAIN/CLC1

Reset of sulfur values in case of new NOx traps

If flag LV_SUL_EXT_RES was set by action ACTION_NOXM_CleanNTAdaptSul, then the sulfur values will be set to zero and the flag will be reset.

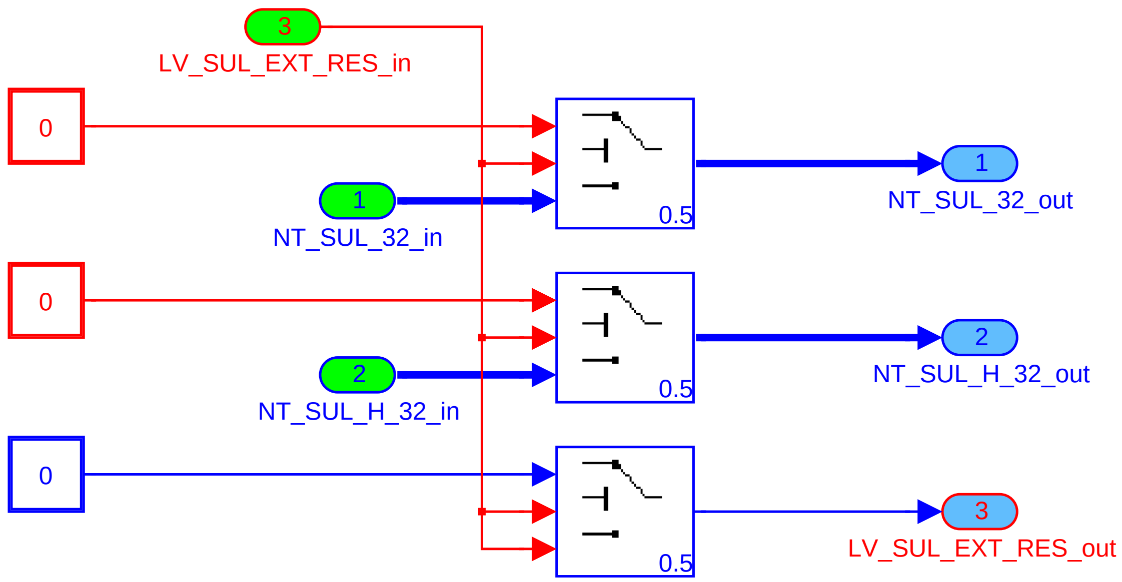

Figure 7.92.17: NOXM_MODUL704G/operate/AFTER_MAIN/CLC2

Maximum calculation

After the MAIN part, which is calculated for each bank, the old value of the input NT_SUL_UPD and the maximum of the internal 32-bit values of all banks will be calculated as 16-bit value.

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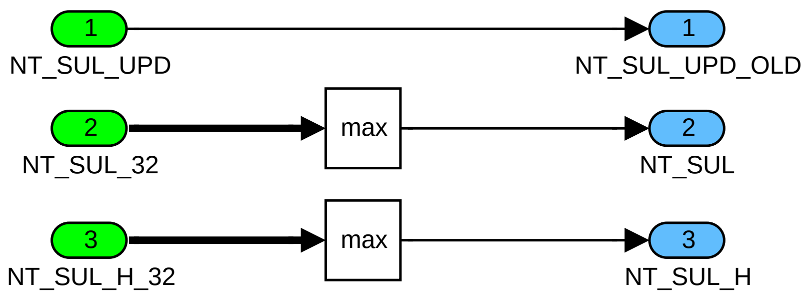

Figure 7.92.18: NOXM_MODUL704G/operate/AFTER_MAIN/CLC3

7.92.1.4 Handling of non-volatile memory for NT_SUL_32 and NT_SUL_H_32

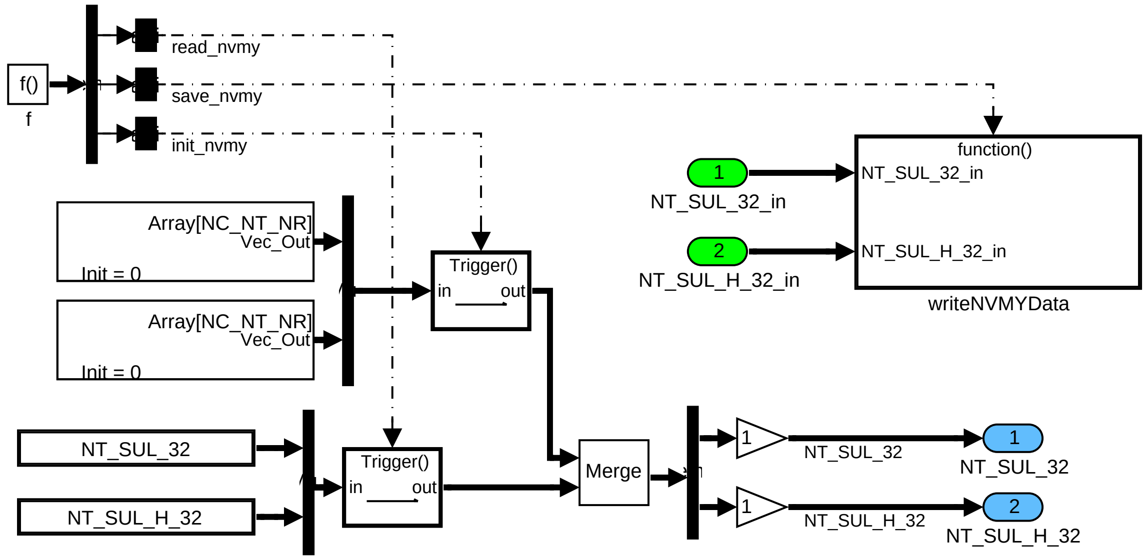

Figure 7.92.19: NOXM_MODUL704G/NVMYdata

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7.92.1.5 SUBFUNCTION: reset

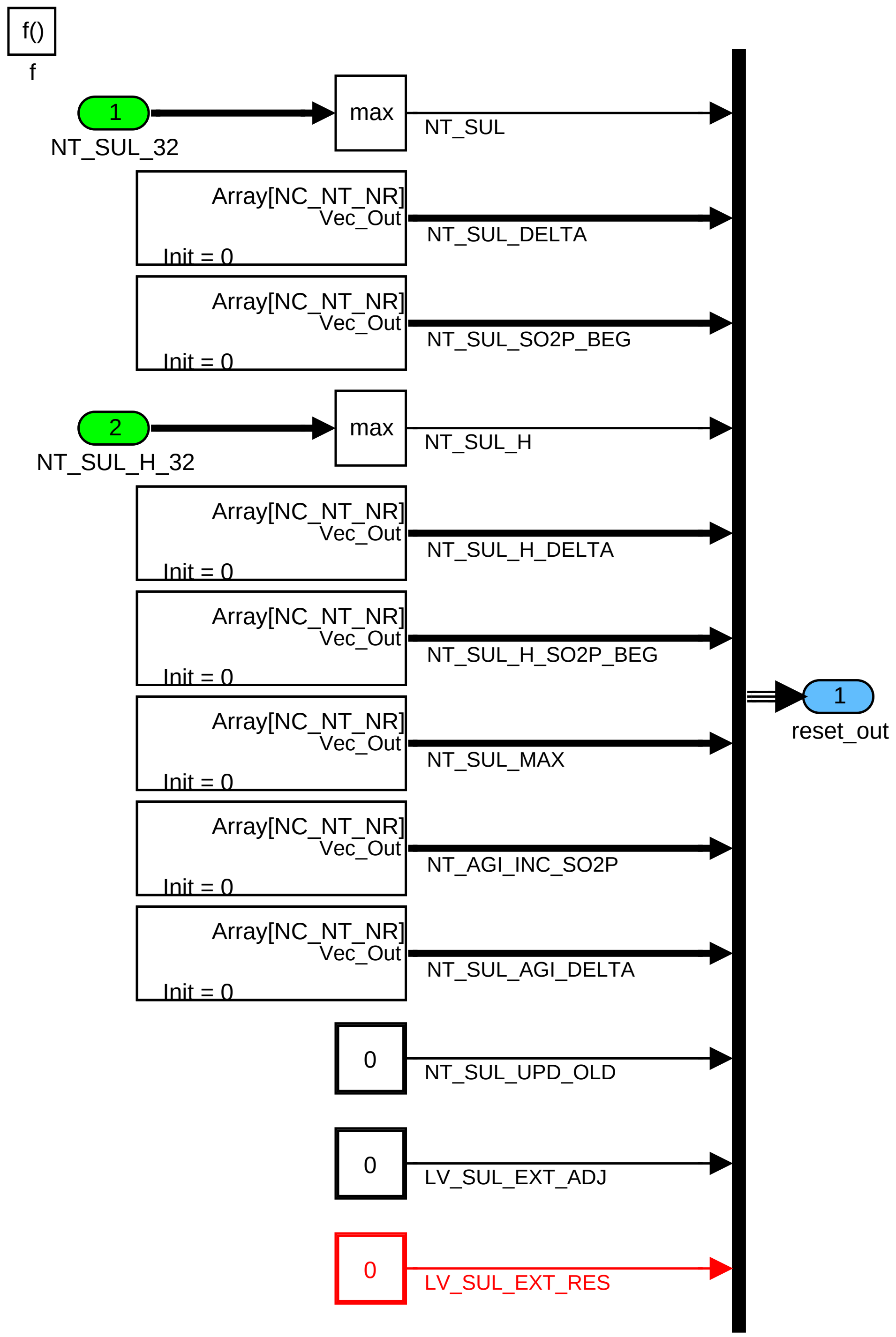

Figure 7.92.20: NOXM_MODUL704G/reset

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7.93 NOx catalyst desulfation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_SO2P_PLS	V	0... FFH	0... 255	1	-
Counter for alternating desulfation cycles before activation of fast desulfation					
LAMB_SO2P [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda setpoint for desulfation					
LV_NT_SO2P_INH_IS	V	0... 1H	0 ...1	1	-
Inhibition of desulfation at idle speed					
LV_SO2P_ACT	O/V	0... 1H	0 ...1	1	-
NOx trap desulfation active					
LV_SO2P_ACT_LAMB [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
NOx trap desulfation lambda condition fulfilled					
LV_SO2P_ACT_TNT	O/V	0... 1H	0 ...1	1	-
NOx trap desulfation temperature condition fulfilled					
LV_SO2P_AFR_CORD	O/V	0... 1H	0 ...1	1	-
Rich operation for fast desulfation request					
LV_SO2P_AFR_CTR	V	0... 1H	0 ...1	1	-
Active if any exhaust bank is rich, used for lean-rich edge detection					
LV_SO2P_FAST_REQ	O/V	0... 1H	0 ...1	1	-
Fast desulfation request					
LV_SO2P_LAMB_PULS	O/V	0... 1H	0 ...1	1	-
Lambda alternation request					
LV_SO2P_REQ	O/V	0... 1H	0 ...1	1	-
General desulfation request					
T_SO2P_DLY	O/V	0... FFFFH	0... 6553.5	0.1	s
Delay time counter before sulfur release					
T_SO2P_NOT	O/V	0... FFFFH	0... 6553.5	0.1	s
Time counter for non-desulfation atmosphere					
VLS_REF_SO2P [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Reference signal value for desulfation atmosphere detection					

Input data:

CL_MMV {p. 3698}	IP_VLS_REF_LAMB_LS_UP {p. 3152}	IP_VLS_REF_LAMB_NS {p. 3152}	IP_VLS_REF_VLS_NS {p. 3152}
LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_NS [NC_NOX_SENS_CONF] {p. 991}	LV_INH_NT_SO2P_REQ {p. 3144}	LV_IS {p. 1720}
LV_NT_SO2P_EXT_ADJ_ACT {p. 3144}	LV_NT_SO2P_FAST_REQ_EXT {p. 3144}	LV_SO2P_AFR [NC_CBK_EX_NR] {p. 3150}	LV_SO2P_REQ_1 {p. 3073}
NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}	NT_AGI_SUL {p. 3073}	NT_SUL {p. 3113}
TNT_MDL_H {p. 8237}	TNT_MDL_MV {p. 8237}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_NS [NC_NOX_SENS_CONF] {p. 992}

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VLS_NT_DOWN [NC_NOX_SENS_CONF] {p. 811}	VS {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MMV_SO2P_IS_MAX	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Maximum canister load for NOx trap desulfation at idle speed					
C_LAMB_SO2P_PAS	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Passive lambda value if the desulfation is not active					
C_NT_AGI_SO2P_MAX	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Maximal NOx trap aging factor					
C_NT_AGI_SUL_SO2P_FAST	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
NOx trap aging threshold for fast desulfation					
C_NT_AGI_SUL_SO2P_FAST_HYS	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
NOx trap aging hysteresis for fast desulfation					
C_NT_SUL_SO2P_MAX	-	0... FFFFH	0... 10485.6	0.16	mg
Maximal NOx trap sulphur load out of sulphur model					
C_STATE_SENS_VLS_DOWN_SO2P_ACT [NC_CBK_EX_NR]	-	0H 1H 2H 3H 4H 5H	LAMB_LS_UP VLS_DOWN VLS_NS LAMB_NS VLS_NT_DOWN MANUAL	-	-
Mode to determine the sensor used for detection of a desulfating atmosphere					
C_T_SO2P_NOT_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Maximal time for desulfation interruption before desulfation timer reset					
C_TNT_MDL_SO2P_FAST	-	0... FFH	0... 1020	4	°C
NOx trap temperature threshold for switching to fast desulfation					
C_TNT_MDL_SO2P_FAST_HYS	-	0... FFH	0... 1020	4	°C
NOx trap temperature hysteresis for switching back to alternating desulfation					
C_TNT_MDL_SO2P_HYS	-	0... FFH	0... 1020	4	°C
NOx trap monolith temperature hysteresis for SO2 purge deactivation					
C_TNT_MDL_SO2P_MIN	-	0... FFH	0... 1020	4	°C
NOx trap monolith temperature threshold for SO2 purge possible					
C_TNT_MDL_SO2P_MIN_EXT	-	0... FFH	0... 1020	4	°C
NOx trap monolith temperature threshold for SO2 purge possible by external request					
C_VLS_REF_SO2P	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Reference signal manual value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_SO2P_HYS	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
VLS hysteresis for SO2 purge active detection					
C_VLS_SO2P_MIN	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Threshold for SO2 purge activation					
C_VS_SO2P_FAST_HYS	-	0... FFH	0... 255	1	km/h
Vehicle speed hysteresis for switching back to alternating desulfation					
IP_CTR_SO2P_PLS_AGI	-	0... FFH	0... 255	1	-
LDP_AGI_SUL_IP_CTR	4	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Number of alternating desulfation cycles before fast desulfation (depending on sulfur aging)					
IP_CTR_SO2P_PLS_SUL	-	0... FFH	0... 255	1	-
LDP_SUL_IP_CTR	4	0... FFFFH	0... 10485.6	0.16	mg
Number of alternating desulfation cycles before fast desulfation (depending on sulfur load)					
IP_LAMB_SO2P	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDP_TNT_MDL_MV_IP_LAMB_SO2P	8	0... FFFFH	0... 1023.984375	0.015625	°C
Required lambda setpoint during desulfation					
IP_LAMB_SO2P_EXT	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDP_TNT_MDL_MV_IP_LAMB_SO2P_EXT	8	0... FFFFH	0... 1023.984375	0.015625	°C
Required lambda setpoint during desulfation by external request					
IP_VS_SO2P_FAST_THD	-	0... FFH	0... 255	1	km/h
LDP_TNT_MDL_MV_IP_VS_SO2P_FAST	4	0... FFH	0... 1020	4	°C
Vehicle speed threshold for switching to fast desulfation according to TNT_MDL_MV					
LC_SO2P_FAST_MAN	-	0... 1H	0 ...1	1	-
Manual switch to fast desulfation mode					

General Information

Gasoline contains sulphur, which is chemically stored in the NOx catalyst. Due to this sulphur compounds, the NOx trap storage capacity and the NOx trap efficiency will decrease. The sulphates can be decomposed under high temperature with rich mixture. This catalyst state (high temperature, rich exhaust gas composition) is called NOx catalyst desulfation.
If a desulfation request is set, the function is able to request catalyst heating. When an enough high monolith-temperature is reached the desulfation is started by switching to a suitable lambda value. This desulfation lambda depends on the actual minimum monolith temperature and on the desulfation mode.
Two desulfation modes are implemented: a fast way with a single, rich lambda value or a way with a lambda alternating around lambda=1 and thereby with two main lambda values, a lower rich value and an upper lean value. This way permits low H2S emissions.
The decision, which desulfation process is chosen, is made dependent on the vehicle speed or a manual application.
It can't be guaranteed the setting of a lambda request is followed immediately by a change of lambda. For this reason, this function contents a detection of a desulfating atmosphere (that means a high temperature level and a rich exhaust gas composition.

Application Conditions

Initialization: RST

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Recurrence: 100MS
Activation: always
Deactivation: never

Function description

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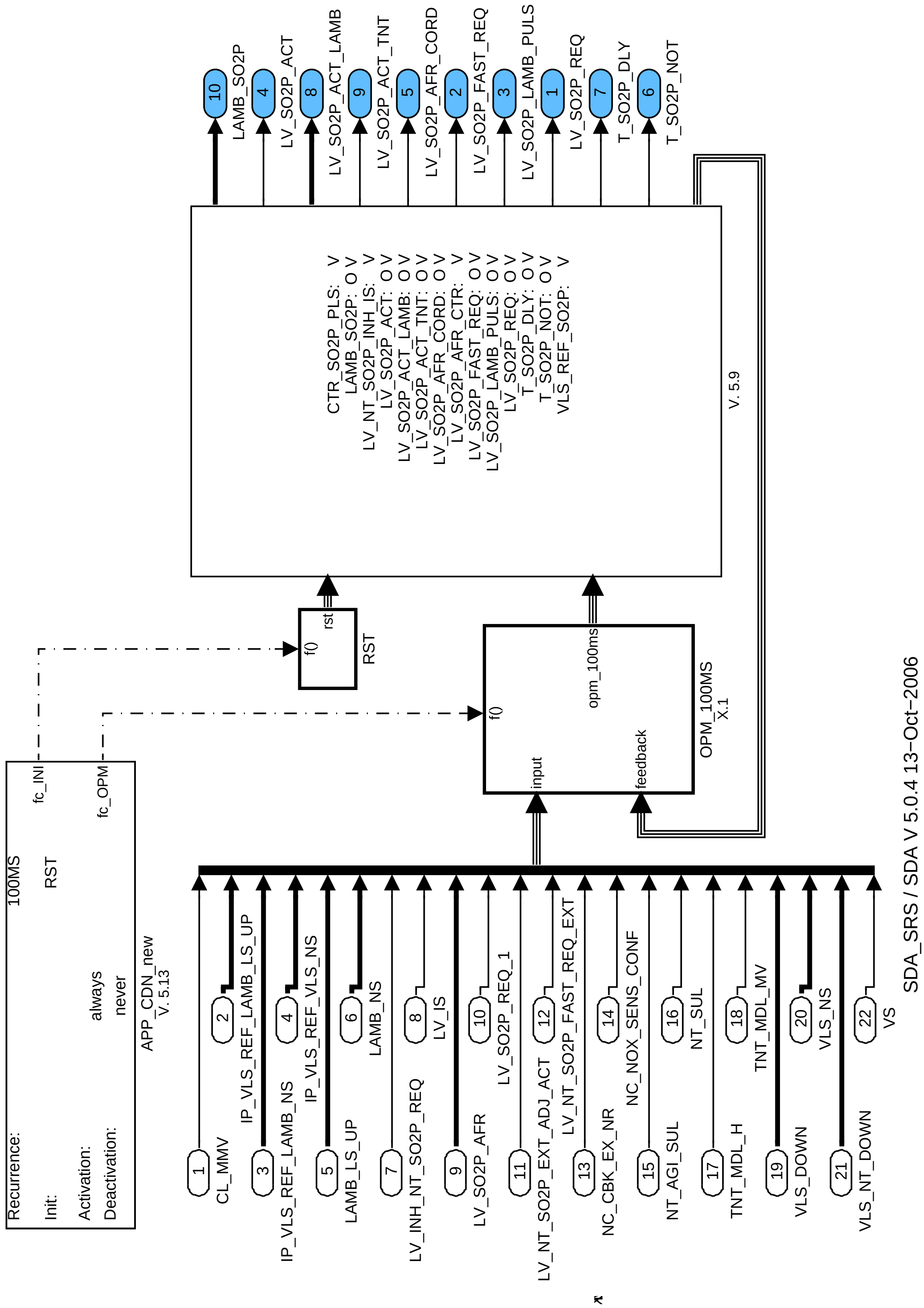

Figure 7.93.1: : Path: NOXM_REQGNNTD0

7.93.1 FORMULA SECTION

The bank specific and bank not specific calculations are done separately.

First the bank specific calculations are done (SO2P_ACT_MNG). This section contains detection of the desulfation atmosphere.
Bank not specific and bank diagonal calculations are included in subsystem REQ_CLC. In this section the request for desulfation is calculated.

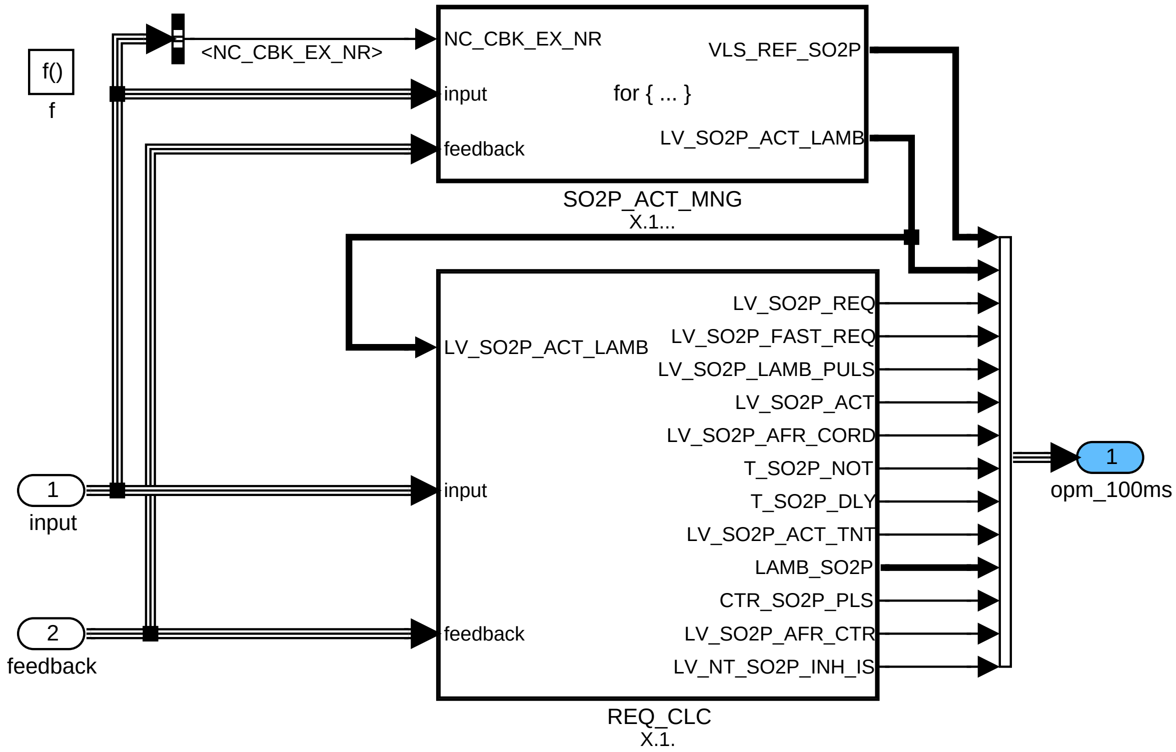

Figure 7.93.2: : Path: NOXM_REQGNNTD0/OPM_100MS

7.93.1.1 BANK SPECIFIC CALCULATIONS

7.93.1.1.1 Management of different exhaust gas configurations

Index "k" corresponds to number of NOx Sensors in the system. Supported is only configuration where number of NOx Sensors is less or equal to number of exhaust banks. If one NOx Sensor and two banks exist then for both banks shall be taken the same NOx Sensor voltage signal

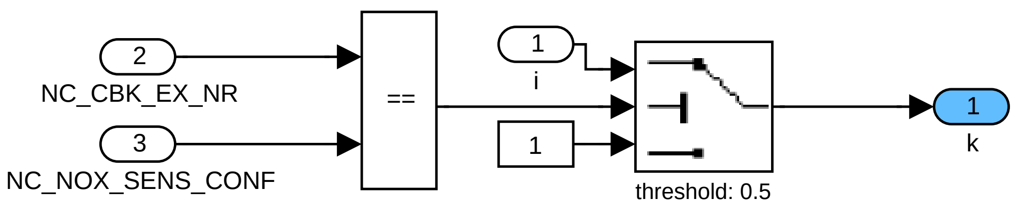

Figure 7.93.3: : Path: NOXM_REQGNNTD0/OPM_100MS/SO2P_ACT_MNG/CLC_k

7.93.1.1.2 Detection of a desulfating or non-desulfating atmosphere

For the detection of the exhaust gas composition one of available signals is chosen and converted to binary voltage value of lambda if needed. After that the desulfation atmosphere can be detected using Lambda value.

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7.93.1.1.2.1 Selection of sensor signal

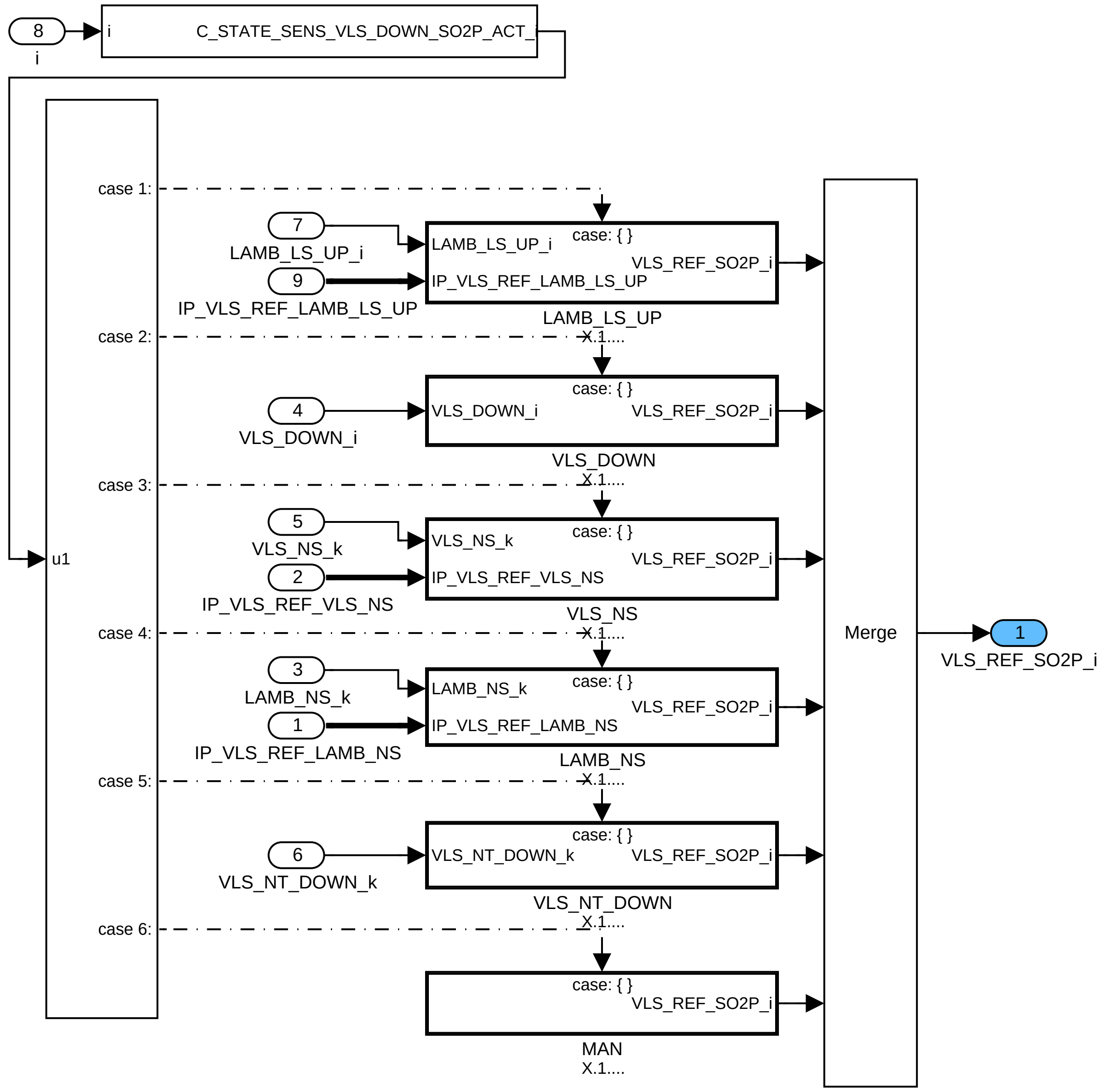

Figure 7.93.4: : Path:
NOXM_REQGNNTD0/OPM_100MS/SO2P_ACT_MNG/SO2P_ACT/CHK_SEL_STATE

7.93.1.1.2.1.1 Linear lambda before pre-catalyst

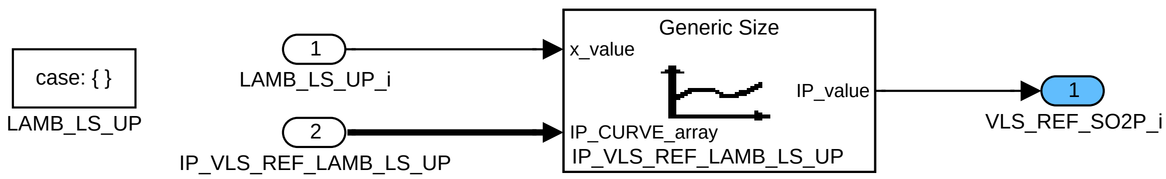

Figure 7.93.5: : Path:
NOXM_REQGNNTD0/OPM_100MS/SO2P_ACT_MNG/SO2P_ACT/CHK_SEL_STATE/LAMB_LS_UP

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7.93.1.1.2.1.2 Binary lambda sensor after pre-catalyst

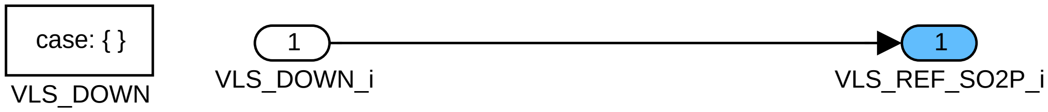

Figure 7.93.6: : Path:
NOXM_REQGNNTD0/OPM_100MS/SO2P_ACT_MNG/SO2P_ACT/CHK_SEL_STATE/VLS_DOWN

7.93.1.1.2.1.3 Binary lambda signal of NOx sensor

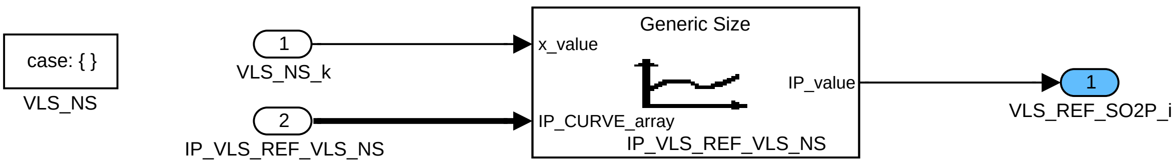

Figure 7.93.7: : Path:
NOXM_REQGNNTD0/OPM_100MS/SO2P_ACT_MNG/SO2P_ACT/CHK_SEL_STATE/VLS_NS

7.93.1.1.2.1.4 Linear lambda signal of NOx sensor

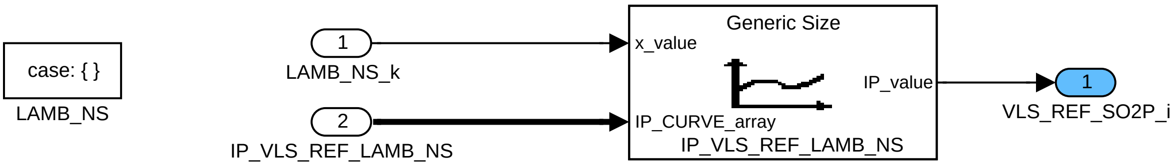

Figure 7.93.8: : Path:
NOXM_REQGNNTD0/OPM_100MS/SO2P_ACT_MNG/SO2P_ACT/CHK_SEL_STATE/LAMB_NS

7.93.1.1.2.1.5 Binary lambda sensor after NOx trap

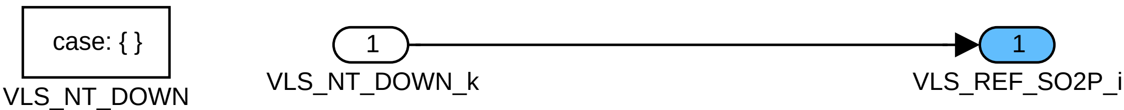

Figure 7.93.9: : Path: NOXM_REQGNNTD0/OPM_100MS/SO2P_ACT_MNG/SO2P_ACT/
CHK_SEL_STATE/VLS_NT_DOWN

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7.93.1.1.2.1.6 Manuel value

Figure 7.93.10: : Path: NOXM_REQGNNTD0/OPM_100MS/SO2P_ACT_MNG/SO2P_ACT/CHK_SEL_STATE/MAN

7.93.1.1.2.2 Detection of suitable lambda for desulfation

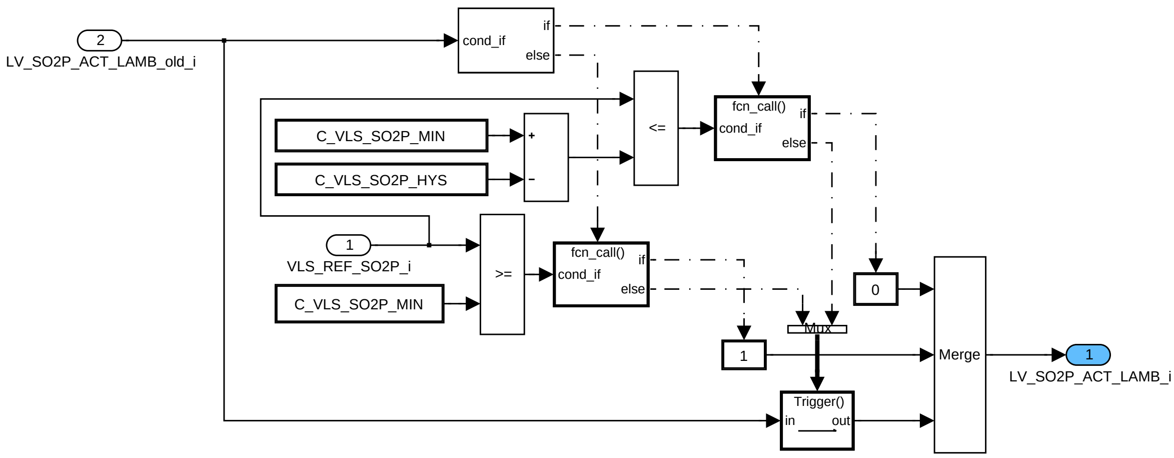

Figure 7.93.11: : Path: NOXM_REQGNNTD0/OPM_100MS/SO2P_ACT_MNG/SO2P_ACT/CHK_COMB_CDN

7.93.1.2 BANK NOT SPECIFIC AND BANK DIAGONAL CALCULATIONS

7.93.1.2.1 Selection of minimum temperature for desulfation

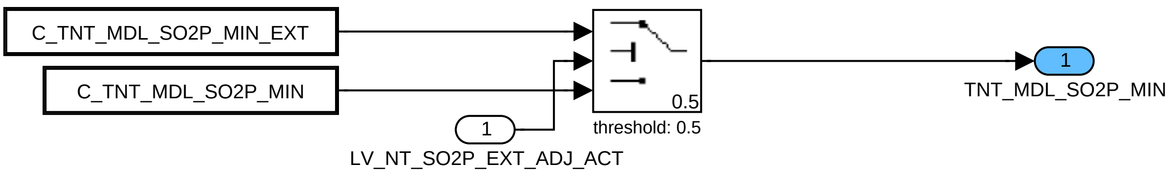

Figure 7.93.12: : Path: NOXM_REQGNNTD0/OPM_100MS/REQ_CLC/TNT_MDL_SO2P_MIN

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7.93.1.2.2 Inhibition of desulfation at idle speed

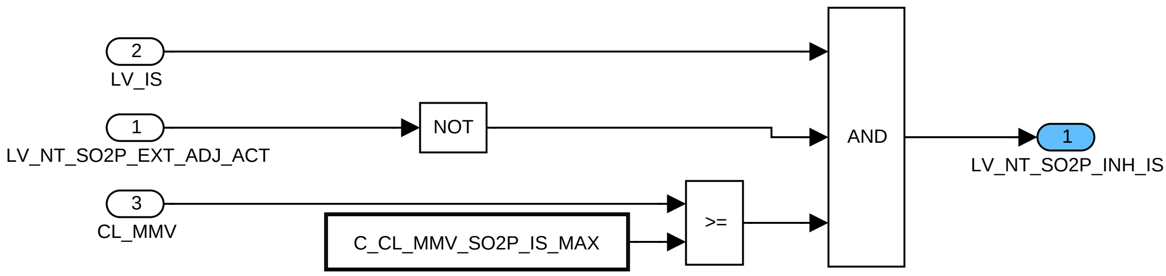

Figure 7.93.13: : Path: NOXM_REQGNNTD0/OPM_100MS/REQ_CLC/SO2P_INH_IS

7.93.1.2.3 Desulfation request start condition

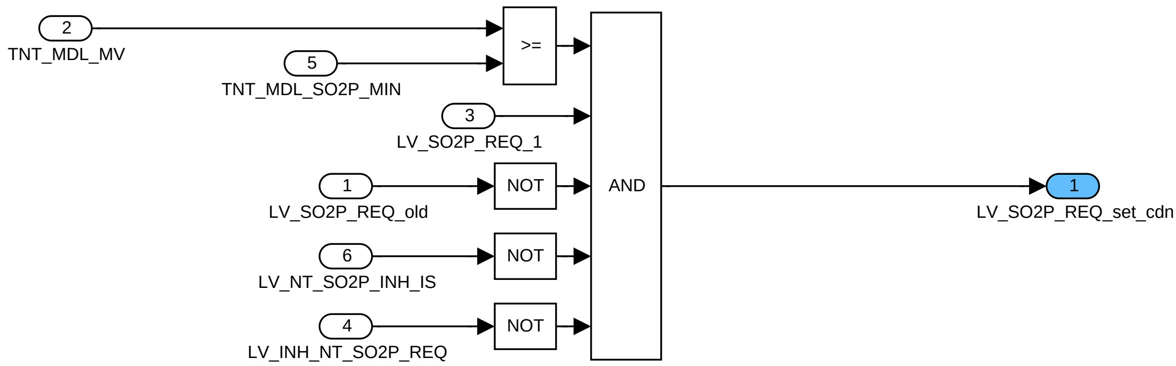

Figure 7.93.14: : Path: NOXM_REQGNNTD0/OPM_100MS/REQ_CLC/SO2P_REQ_CDN

7.93.1.2.4 Calculation of the desulfation request

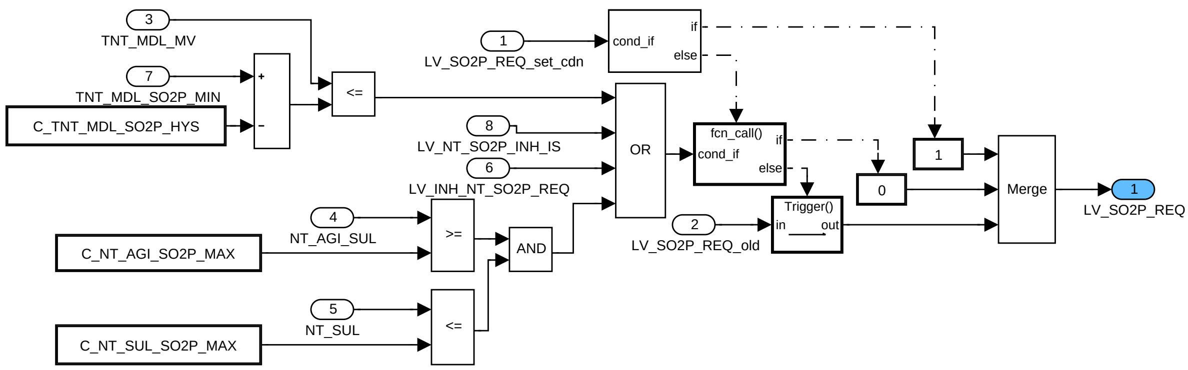

Figure 7.93.15: : Path: NOXM_REQGNNTD0/OPM_100MS/REQ_CLC/SO2P_REQ

7.93.1.2.5 Determination of desulfation mode

Alternating or fast desulfation is used depending on several conditions. Additionally, at the start of a fast desulfation some alternating desulfation cycles may be calibrated.

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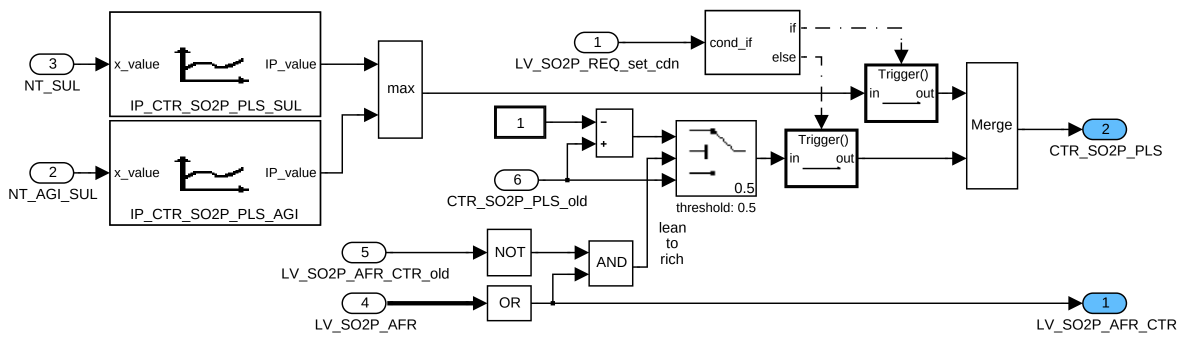

Figure 7.93.16: : Path: NOXM_REQGNNTD0/OPM_100MS/REQ_CLC/CTR_SO2P

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7.93.1.2.6 Fast or alternating desulfation

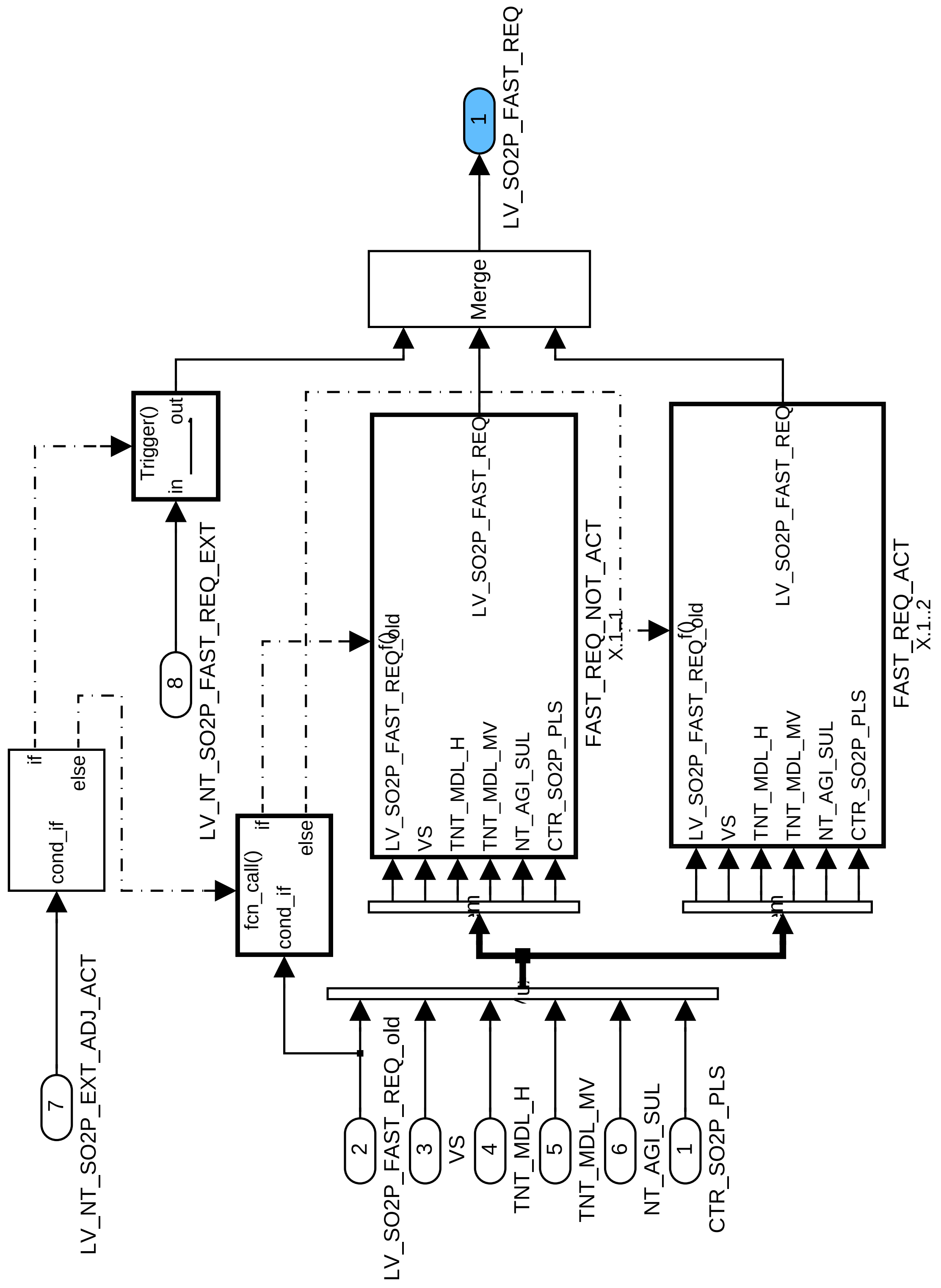

Figure 7.93.17: : Path: NOXM_REQGNNTD0/OPM_100MS/REQ_CLC/SO2P_FAST_REQ

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7.93.1.2.6.1 FAST_REQ_NOT_ACT

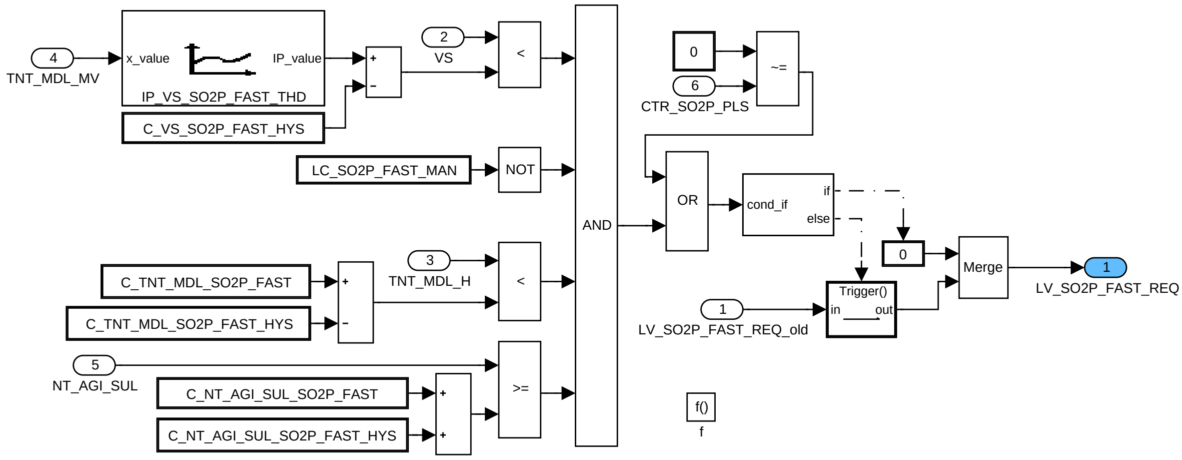

Figure 7.93.18: : Path:
NOXM_REQGNNTD0/OPM_100MS/REQ_CLC/SO2P_FAST_REQ/FAST_REQ_NOT_ACT

7.93.1.2.6.2 FAST_REQ_ACT

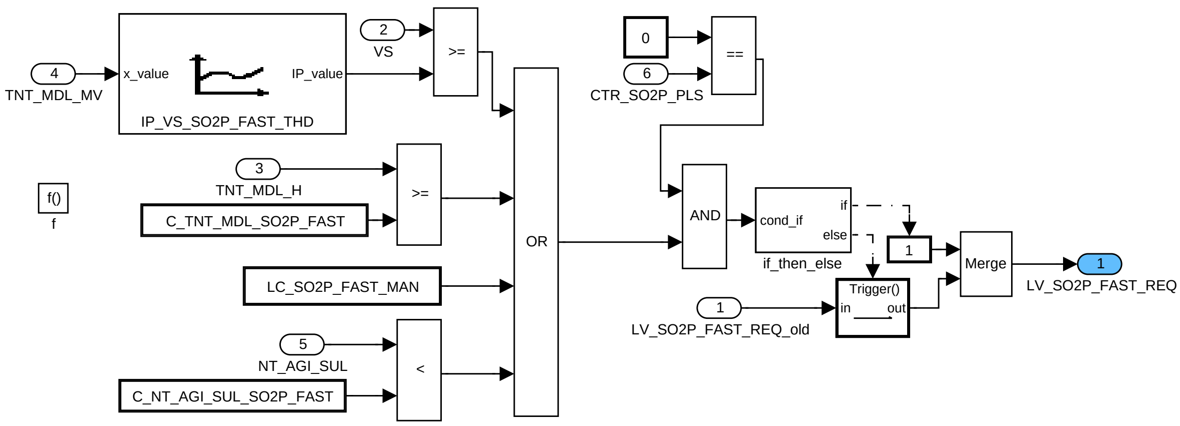

Figure 7.93.19: : Path:
NOXM_REQGNNTD0/OPM_100MS/REQ_CLC/SO2P_FAST_REQ/FAST_REQ_ACT

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7.93.1.2.7 Determination of the flags for the desulfation lambda alternation and catalyst heating manager

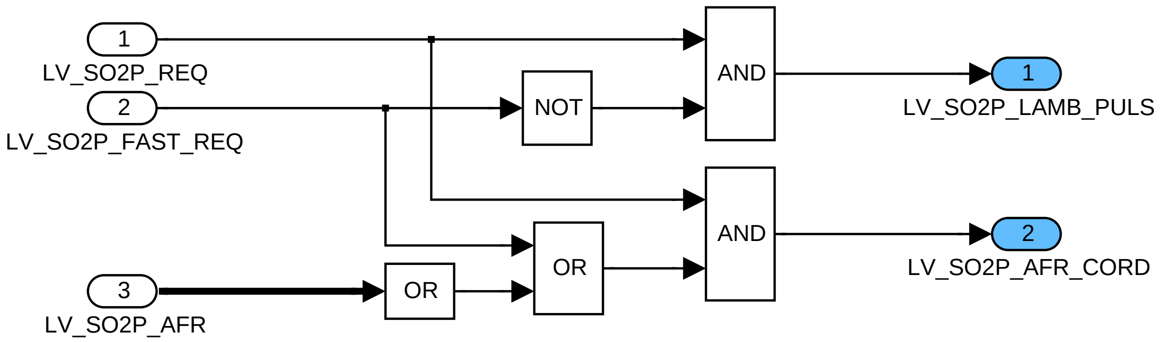

Figure 7.93.20: : Path: NOXM_REQGNNTD0/OPM_100MS/REQ_CLC/SO2P_LAMB_PULS

7.93.1.2.8 Calculation of activation flag for desulfation regarding modeled NOx trap temperature

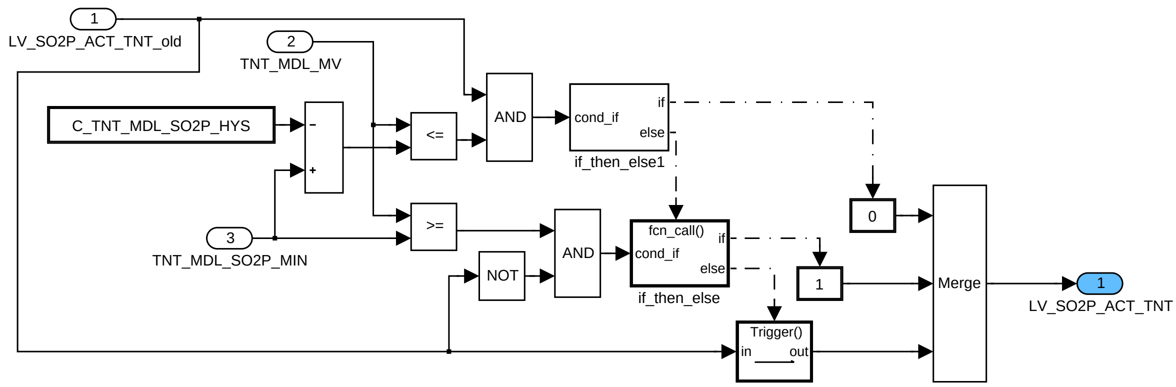

Figure 7.93.21: : Path: NOXM_REQGNNTD0/OPM_100MS/REQ_CLC/SO2P_ACT_TNT

7.93.1.2.9 Set of desulfation activation indicator and calculation of non-desulfation time

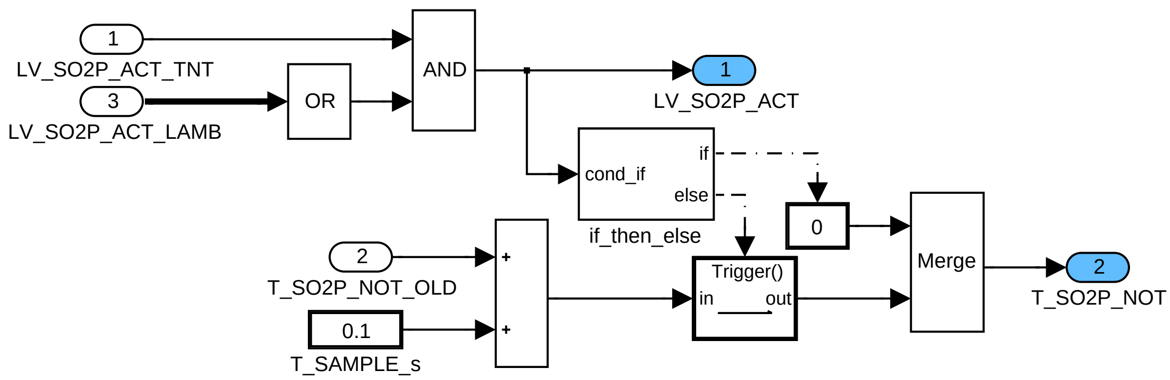

Figure 7.93.22: : Path: NOXM_REQGNNTD0/OPM_100MS/REQ_CLC/SO2P_ACT

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7.93.1.2.10 Calculation of delay time before the sulfur release is active

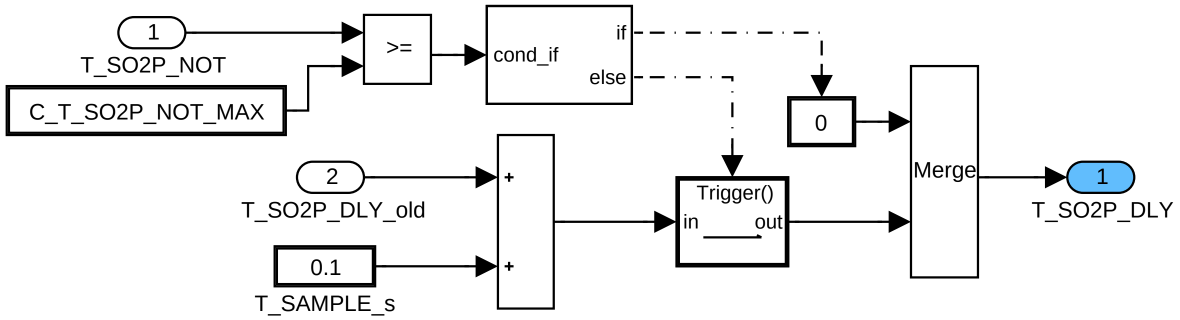

Figure 7.93.23: : Path: NOXM_REQGNNTD0/OPM_100MS/REQ_CLC/SO2P_DLY

7.93.1.2.11 Lambda setpoint for fast NOx Catalyst desulfation

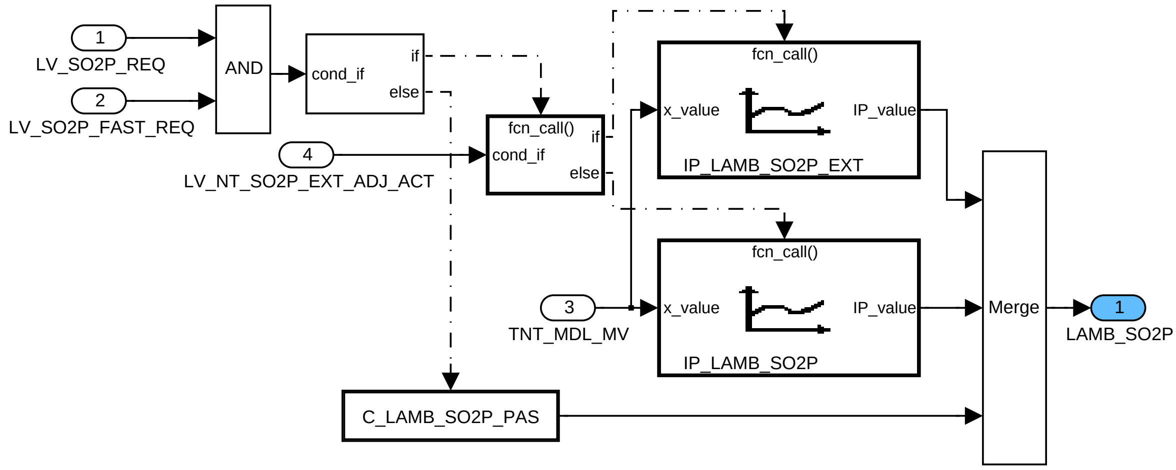

Figure 7.93.24: : Path: NOXM_REQGNNTD0/OPM_100MS/REQ_CLC/CLC_LAMB_SO2P

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7.94 NOx catalyst desulfation (Appl. Inc)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CH_SO2P_WOUT_LIM	O/V/S	0... 1H	0 ...1	1	-
Catalyst heating for desulfation without any limitation due to fuel consumption					
LV_INH_NT_SO2P_REQ	O/V	0... 1H	0 ...1	1	-
Deactivation of desulfation request					
LV_NT_SO2P_EXT_ADJ_ACT	O/V	0... 1H	0 ...1	1	-
NOx trap desulfation started by external adjustment is active					
LV_NT_SO2P_EXT_ADJ_ENA	V	0... 1H	0 ...1	1	-
Condition for enabling desulfation by external request					
LV_NT_SO2P_EXT_ADJ_ST	V	0... 1H	0 ...1	1	-
Start condition for desulfation by external request					
LV_NT_SO2P_EXT_ADJ_STOP	V	0... 1H	0 ...1	1	-
Stop condition for desulfation by external request					
LV_NT_SO2P_FAST_REQ_EXT	O/V	0... 1H	0 ...1	1	-
Fast desulfation request controlled by external request					
STATE_KWP_SO2P	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H	NOT_START ST_INH PAR_NOT_PLAUS WAIT_REL UNDEF ACT END_WOUT_RESULT ABORTED END_WOUT_ERR END_WITH_ERR	-	-
State variable for desulfation by external request					
STATE_NT_SO2P_EXT_ADJ_ACT	O/V	0H 1H 2H 3H	PASSIVE SPEED-UP HEATING-UP DESULFATION	-	-
Additional status information for desulfation by external request					
T_NT_SO2P_EXT_ADJ_ACT	O/V	0... FFFFH	0... 6553.5	0.1	s
Timer for desulfation by external request					

Input data:

GEAR {p. 1302}	LV_CLU_SWI {p. 996}	LV_ERR_TEG_PCAT_DOWN {p. 4713}	LV_NT_SO2P_EXT_ADJ_REQ_NOT_STOP {p. 7763}
LV_NT_SO2P_EXT_ADJ_REQ_ST {p. 7763}	LV_SO2P_REQ_2 {p. 3073}	N_32 {p. 1525}	NT_SUL {p. 3113}

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PV_AV {p. 1269}	STATE_GEAR_REV_AT_AMT {p. 1302}	STATE_NT_SO2P_EXT_ADJ {p. 7766}	TNT_MDL_MV {p. 8237}
VS {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_IS_SO2P_MIN	-	0... FFH	0... 8160	32	rpm
Threshold for detecting running engine					
C_N_SO2P_EXT_MIN_DISP	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for change display status from Speed-up to Heating-up					
C_NT_SUL_SO2P_EXT_MIN	-	0... FFFFH	0... 10485.6	0.16	mg
NOx trap sulphur loading limit for end of desulfation by external request					
C_PV_SO2P_EXT_MAX	-	0... FFH	0... 99.60937	0.390625	%
Accelerator pedal threshold for disabling external request for desulfation					
C_STATE_INH_FAST_SO2P_EXT	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode for fast or alternating desulfation at external request					
C_STATE_INH_NT_SO2P_REQ	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of desulfation request					
C_T_SO2P_EXT_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time for desulfation by external request					
C_T_SO2P_EXT_MIN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for desulfation by external request					
C_TNT_SO2P_EXT_MIN_DISP	-	0... FFFFH	0... 1023.98437	0.015625	°C
NOx trap temperature threshold for change display status from Speed-up to Heating-up					
C_VS_SO2P_EXT_MAX	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for disabling external request for desulfation					
LC_NT_SO2P_EXT_MAN	-	0... 1H	0 ...1	1	-
Manual start and stop of external requested desulfation					

Action definition

ACTION_NOXM_StartCatHeatDesu ()	Mode: O
Start catalyst heating for desulfation without any limitation due to fuel consumption	

ACTION_NOXM_StopCatHeatDesu ()	Mode: O
Stop catalyst heating for desulfation without any limitation due to fuel consumption	

FUNCTION DESCRIPTION:

Description for ACTION_NOXM_StartCatHeatDesu

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ACTION_NOXM_StartCatHeatDesu()					
Start catalyst heating for desulfation without any limitation due to fuel consumption					
Parameter	**Type**	**Hex. limits**	**Phys. limits**	**Resol.**	**Unit**

If LV_SO2P_REQ_2 = 1 % catalyst heating already requested
Then LV_CH_SO2P_WOUT_LIM = 1 % fuel consumption not limited for CH
End If

Description for ACTION_NOXM_StopCatHeatDesu

ACTION_NOXM_StopCatHeatDesu()					
Stop catalyst heating for desulfation without any limitation due to fuel consumption					
Parameter	**Type**	**Hex. limits**	**Phys. limits**	**Resol.**	**Unit**

LV_CH_SO2P_WOUT_LIM = 0 % fuel consumption limited for CH

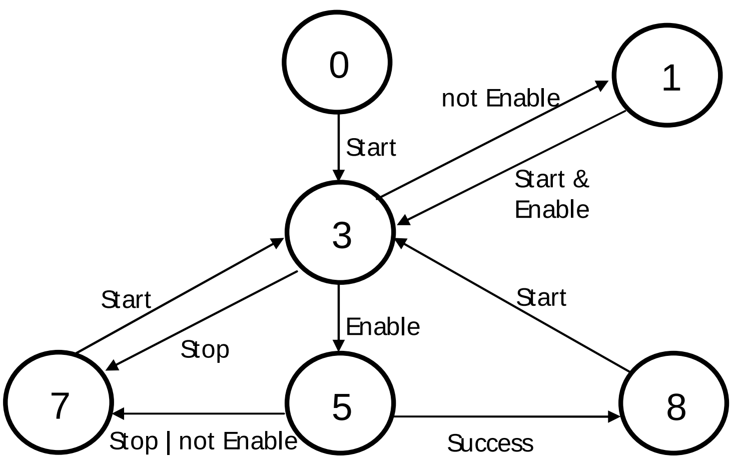
Application conditions:

This module controls the desulfation that is forced by an external request.
Initialization : reset all values from output table except LV_CH_SO2P_WOUT_LIM to zero
Recurrence : **100** ms

Formula section:

Catalyst heating without limitations due to fuel consumptions
If LV_SO2P_REQ_2 = 0 % desulfation successful finished
Then LV_CH_SO2P_WOUT_LIM = 0 % fuel consumption limited for CH
End If

State machine for desulfation by scan tool



Diagram

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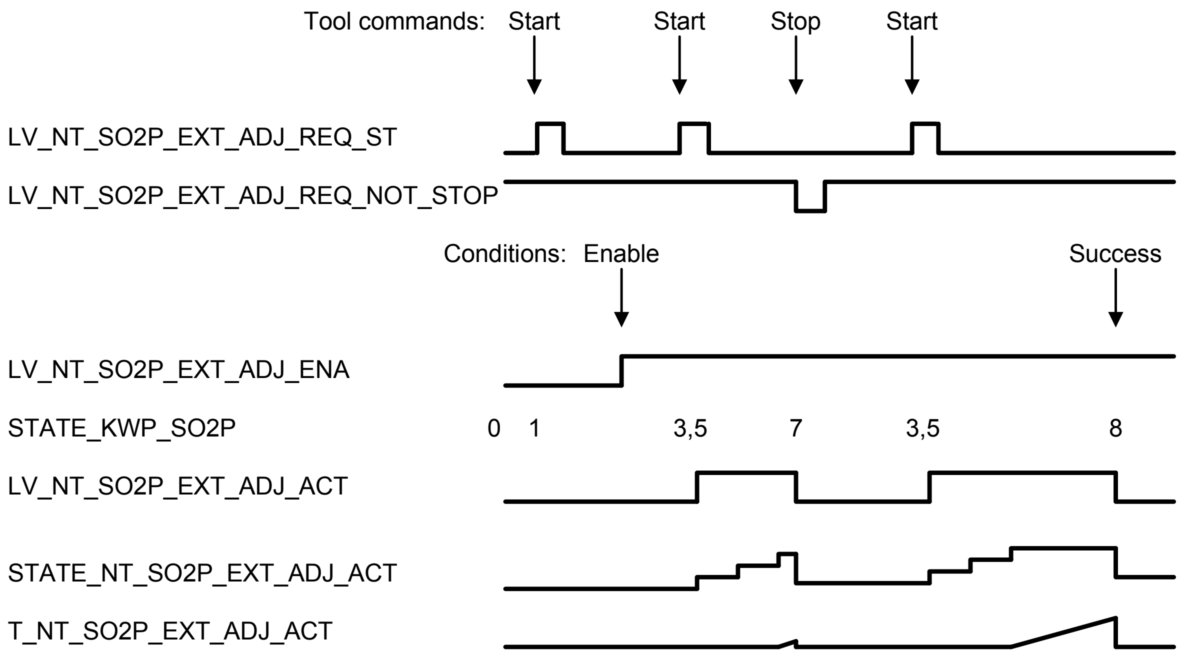


```
LV_NT_SO2P_EXT_ADJ_ENA =                    N_32 >= C_N_IS_SO2P_MIN                AN
% Enable
                GEAR = 0                          AND
                STATE_GEAR_REV_AT_AMT = 0                     AND
                LV_CLU_SWI = 0                        AND
                VS <= C_VS_SO2P_EXT_MAX                       AND
                PV_AV <= C_PV_SO2P_EXT_MAX

LV_NT_SO2P_EXT_ADJ_ST =
          LV_NT_SO2P_EXT_ADJ_REQ_ST = 1          OR                  % Start
          LC_NT_SO2P_EXT_MAN = 0→1

LV_NT_SO2P_EXT_ADJ_STOP =
          LV_NT_SO2P_EXT_ADJ_REQ_NOT_STOP = 0          OR                  %
Stop
          LC_NT_SO2P_EXT_MAN = 1→0

case selection on STATE_KWP_SO2P
STATE_KWP_SO2P = 0:
     If        LV_NT_SO2P_EXT_ADJ_ST = 1                                  %
Start
     Then      STATE_KWP_SO2P = 3
     End If

STATE_KWP_SO2P = 1:
     If        LV_NT_SO2P_EXT_ADJ_ST = 1       AND           % Start
             LV_NT_SO2P_EXT_ADJ_ENA = 1                                   %
Enable
     Then      STATE_KWP_SO2P = 3
     End If
```

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```
STATE_KWP_SO2P = 3:
        If          LV_NT_SO2P_EXT_ADJ_STOP = 1                              % Stop
        Then        STATE_KWP_SO2P = 7
        Else If         LV_NT_SO2P_EXT_ADJ_ENA = 1                           % Enable
        Then        STATE_KWP_SO2P = 5
        Else          STATE_KWP_SO2P = 1
        End If

STATE_KWP_SO2P = 5:
        If          LV_NT_SO2P_EXT_ADJ_STOP = 1        OR               % Stop
                  LV_NT_SO2P_EXT_ADJ_ENA = 0                            % not Enable
        Then        STATE_KWP_SO2P = 7
                                                   % Success
        Else If         T_NT_SO2P_EXT_ADJ_ACT > C_T_SO2P_EXT_MAX       OR
                  (T_NT_SO2P_EXT_ADJ_ACT > C_T_SO2P_EXT_MIN       AND
                  NT_SUL <= C_NT_SUL_SO2P_EXT_MIN)
        Then        STATE_KWP_SO2P = 8
        End If

STATE_KWP_SO2P = 7:
        If          LV_NT_SO2P_EXT_ADJ_ST = 1                               % Start
        Then        STATE_KWP_SO2P = 3
        End If

STATE_KWP_SO2P = 8:
        If          LV_NT_SO2P_EXT_ADJ_ST = 1                               % Start
        Then        STATE_KWP_SO2P = 3
        End If

default:
        STATE_KWP_SO2P = 0
end case selection


Control of idle speed reference, catalyst heating and desulfation
If        STATE_KWP_SO2P = 5                                    % ACT
Then        LV_NT_SO2P_EXT_ADJ_ACT = 1
Else        LV_NT_SO2P_EXT_ADJ_ACT = 0
End If

Desulfation status
If        STATE_KWP_SO2P = 5                                    % ACT
Then        If          N_32 < C_N_SO2P_EXT_MIN_DISP
        Then          STATE_NT_SO2P_EXT_ADJ_ACT = 1                      %SPEED-UP
        Else If          TNT_MDL_MV < C_TNT_SO2P_EXT_MIN_DISP
        Then          STATE_NT_SO2P_EXT_ADJ_ACT = 2                      % HEATING-UP
```

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```
        Else            STATE_NT_SO2P_EXT_ADJ_ACT = 3                                   %DESUL
FATION
        End If
Else        STATE_NT_SO2P_EXT_ADJ_ACT = 0                                       %PAS-
SIVE
End If
```

Desulfation timer

```
If          STATE_KWP_SO2P = 5                                      % ACT
Then        If          STATE_NT_SO2P_EXT_ADJ_ACT = 3
FATION
        Then            increment T_NT_SO2P_EXT_ADJ_ACT
        End If
Else        T_NT_SO2P_EXT_ADJ_ACT = 0
End If
```

Control of fast or alternating desulfation at external request

```
case selection on C_STATE_INH_FAST_SO2P_EXT
        C_STATE_INH_FAST_SO2P_EXT = 0:                  % AUTO
                if          STATE_NT_SO2P_EXT_ADJ = 1       % ALTERNATING
                then            LV_NT_SO2P_FAST_REQ_EXT = 0     % ALTERNATING
                else            LV_NT_SO2P_FAST_REQ_EXT = 1                         %
FAST
                endif

        C_STATE_INH_FAST_SO2P_EXT = 1:                  % DISABLE
                LV_NT_SO2P_FAST_REQ_EXT = 0             % ALTERNATING

        C_STATE_INH_FAST_SO2P_EXT = 2:                  % ENABLE
                LV_NT_SO2P_FAST_REQ_EXT = 1             % FAST
end case selection
```

Inhibition mode of desulfation request

```
case selection on C_STATE_INH_NT_SO2P_REQ
        C_STATE_INH_NT_SO2P_REQ = 0 ('AUTO'):
                if          LV_ERR_TEG_PCAT_DOWN = 1
                then            LV_INH_NT_SO2P_REQ = 1
                else            LV_INH_NT_SO2P_REQ = 0
                endif

        C_STATE_INH_NT_SO2P_REQ = 1 ('DISABLE'):
                LV_INH_NT_SO2P_REQ = 1

        C_STATE_INH_NT_SO2P_REQ = 2 ('ENABLE'):
                LV_INH_NT_SO2P_REQ = 0
end case selection
```

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7.95 NOx catalyst desulfation - lambda stimulation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_VLS_DOWN_AFL_CYC [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Denotes number of AF cycles since lambda controller last activated at LS downstream position					
LAMB_PULS_SO2P [NC_CBK_EX_NR]	O/V	80... 7FH	-0.125... 0.12402344	976.563e-6	-
Delta lambda to pass to the lambda stimulation coordination routine					
LAMB_PULS_SO2P_H_RES [NC_CBK_EX_NR]	V	8000... 7FFFH	-0.125... 0.12499619	3.8147e-6	-
Delta lambda with high resolution					
LV_SO2P_AFR [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Rich phase of alternation					
LV_VLS_DOWN_AFL [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Monitoring sensor has detected "lean"					
LV_VLS_DOWN_TRA [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Transition of Air-Fuel mixture by downstream sensor					
T_AFL_DOWN_LOCK [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer indicating duration of LV_AFL lock at LS downstream position					
T_LAM_DLY_SO2P [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Total LAM -P-jump delay time for transition due to desulfation lambda alternation					
T_VLS_DOWN_CYC_AFL [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Lean mixture cycle time at LS downstream position					
T_VLS_DOWN_CYC_AFR [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Rich mixture cycle time at LS downstream position					
VLS_DOWN_REF [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511719	0.00488281	V
Voltage signal observed for downstream AF cycle evaluation					

Input data:

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_NS [NC_NOX_SENS_CONF] {p. 991}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_FL {p. 1759}
LV_INH_LAMB_PULS_SO2P {p. 3176}	LV_IS {p. 1720}	LV_PL {p. 1720}	LV_PU {p. 1720}
LV_PUC {p. 1720}	LV_S_ACT {p. 8137}	LV_SCC [NC_CBK_EX_NR] {p. 2295}	LV_SO2P_LAMB_PULS {p. 3129}
LV_ST_END {p. 1720}	MAF {p. 8277}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}
NC_NOX_SENS_CONF {p. 643}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_NS [NC_NOX_SENS_CONF] {p. 992}	VLS_NT_DOWN [NC_NOX_SENS_CONF] {p. 811}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DELTA_LAMB_AFL_SO2P	-	8000... 7FFFH	-0.125... 0.12499	3.8147e-6	-
Delta lambda value for lean phase of desulfation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DELTA_LAMB_AFR_SO2P	-	8000... 7FFFH	-0.125... 0.12499	3.8147e-6	-
Delta lambda value for rich phase of desulfation					
C_DELTA_LAMB_SP_SO2P	-	0... 800H	0 ...2	976.599e-6	-
Permissible deviation of the lambda-controller setpoint for desultation with lambda alternation					
C_LAMB_SP_SO2P	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Basis lambda setpoint for calculation of activation condition for desulfation					
C_STATE_VLS_SENS_REF [NC_CBK_EX_NR]	-	0H 1H 2H 3H 4H 5H	LAMB_LS_UP VLS_DOWN VLS_NS LAMB_NS VLS_NT_ DOWN MANUAL	-	-
Mode to determine sensor signal in the first sensor position					
C_T_VLS_DOWN_CYC_AFL_MAX	-	0... FFFFH	0... 1310.7	0.02	s
Maximum lean mixture cycle time at LS downstream position					
C_T_VLS_DOWN_CYC_AFR_MAX	-	0... FFFFH	0... 1310.7	0.02	s
Maximum rich mixture cycle time at LS downstream position					
C_VLS_DOWN_AFL	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold for detection of lean mixture at LS downstream position					
C_VLS_DOWN_AFR	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold for detection of rich mixture at LS downstream position					
C_VLS_REF_SO2P_LAMB_SP	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Reference signal manual value					
IP_LAM_SO2P_NEG_I	V	0... 7FH	0... 0.12402	976.599e-6	-
LDPM_N_32_1_LAMB_PULS_SO2P	2	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_LAMB_PULS_SO2P	2	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic value of LAMB_PULS_SO2P integral component when lambda < 1					
IP_LAM_SO2P_NEG_P	V	0... 7FH	0... 0.12402	976.599e-6	-
LDPM_N_32_1_LAMB_PULS_SO2P	2	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_LAMB_PULS_SO2P	2	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic value of the proportional component of delta lambda during transition from lean to rich					
IP_LAM_SO2P_POS_I	V	0... 7FH	0... 0.12402	976.599e-6	-
LDPM_N_32_1_LAMB_PULS_SO2P	2	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_LAMB_PULS_SO2P	2	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic value of LAMB_PULS_SO2P integral component when lambda > 1					
IP_LAM_SO2P_POS_P	V	0... 7FH	0... 0.12402	976.599e-6	-
LDPM_N_32_1_LAMB_PULS_SO2P	2	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_LAMB_PULS_SO2P	2	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic value of the proportional component of delta lambda during transition from rich to lean					
IP_T_AFL_DOWN_LOCK_AFL	V	0... FFFFH	0... 1310.7	0.02	s
LDPM_N_32_1_LAMB_PULS_REF	2	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_LAMB_PULS_REF	2	0... FFFFH	0... 1389	0.0211948	mg/stk
LV_AFL transition lock-out time after transition of AF mixture to lean at LS downstream position					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_T_AFL_DOWN_LOCK_AFR	V	0... FFFFH	0... 1310.7	0.02	s
LDPM_N_32_1_LAMB_PULS_REF	2	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_LAMB_PULS_REF	2	0... FFFFH	0... 1389	0.0211948	mg/stk
LV_AFL transition lock-out time after transition of AF mixture to rich at LS downstream position					
IP_T_LAM_DLY_SO2P_NEG	V	0... FFFFH	0... 1310.7	0.02	s
LDPM_N_32_1_LAMB_PULS_SO2P	2	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_LAMB_PULS_SO2P	2	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic LAM -P-jump delay time from rich to lean transition					
IP_T_LAM_DLY_SO2P_POS	V	0... FFFFH	0... 1310.7	0.02	s
LDPM_N_32_1_LAMB_PULS_SO2P	2	0... FFH	0... 8160	32	rpm
LDPM_MAF_1_LAMB_PULS_SO2P	2	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic LAM -P-jump delay time from lean to rich transition					
IP_VLS_REF_LAMB_LS_UP	-	0... 3FFH	0... 4.99511	4.8828e-3	V
LDP_LAMB_LS_UP_IP_VLS_REF	8	0... 7FFFH	0... 31.99902	976.599e-6	-
Reference map for upstream lambda to binary lambda value					
IP_VLS_REF_LAMB_NS	-	0... 3FFH	0... 4.99511	4.8828e-3	V
LDP_LAMB_NS_IP_VLS_REF_LAMB_NS	8	0... 7FFFH	0... 31.99902	976.599e-6	-
Scaling map for sensor on the first position from NOx Sensor lambda signal to VLS signal					
IP_VLS_REF_VLS_NS	-	0... 3FFH	0... 4.99511	4.8828e-3	V
LDP_VLS_NS_IP_VLS_REF_VLS_NS	8	0... 578H	-200 ...1200	1	mV
Scaling map sensor from NOx Sensor binary signal to VLS					
LC_T_AFL_DOWN_CTL	-	0... 1H	0 ...1	1	-
Consider time thresholds for switching lean to rich or rich to lean					

General information

The sub function *Desulfation controlled lambda alternation* allows a desulfation with an alternating lambda value controlled by the output voltage of the downstream sensor. The deviation of the basic lambda setpoint will only be carried out, if the lambda setpoint is in the range of 1. Alternation is defined by the maximum rich rsp. lean lambda shift, the p-jump and the delay time at rich or lean side befor p-jump. Gradients are defined according to engine conditions.

Definition of lambda deviation for lambda controller:

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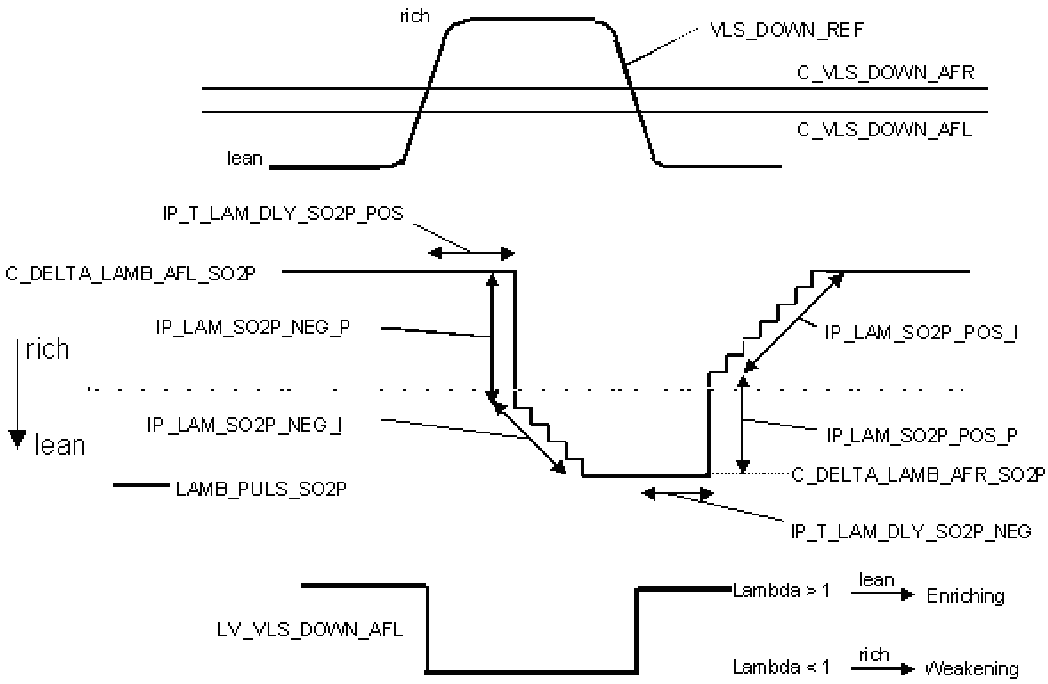
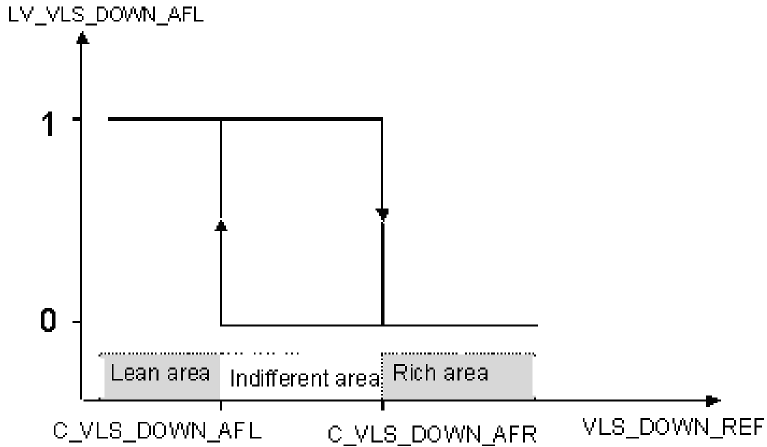


State and hysteresis of LV_VLS_DOWN_AFL as function of VLS_DOWN:



Physical relationship between values, Air-Fuel cycle evaluation at LS downstream:

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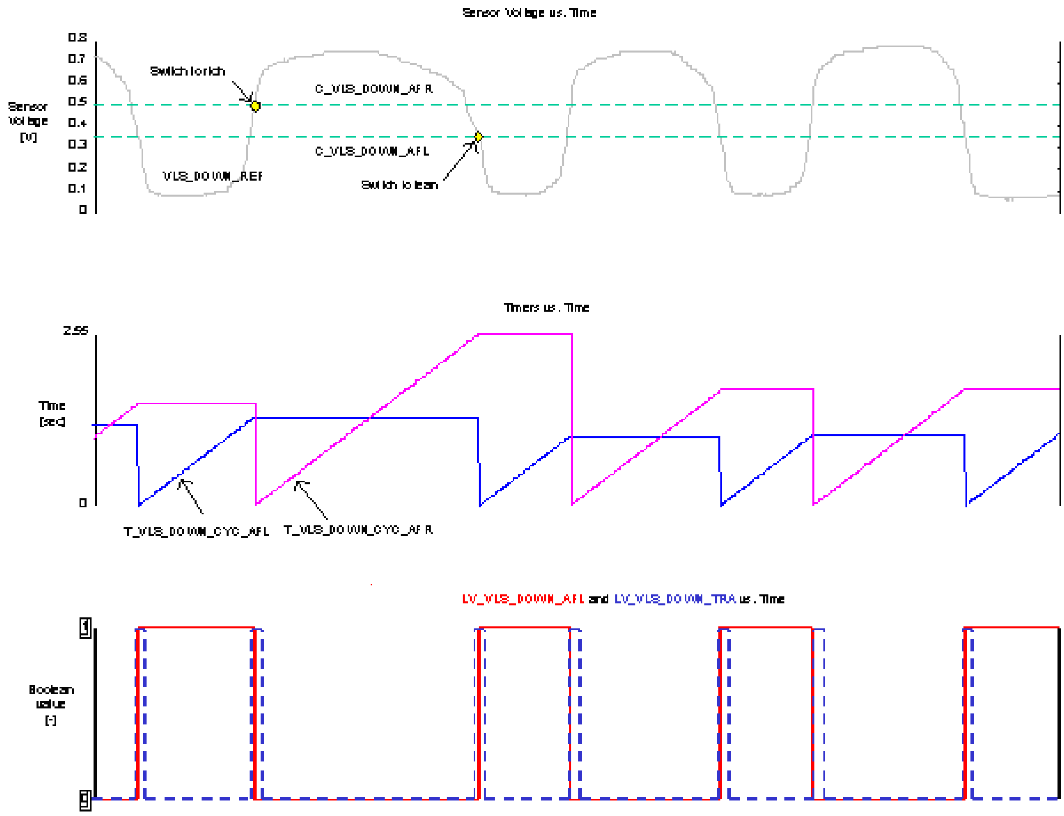

Application Condition

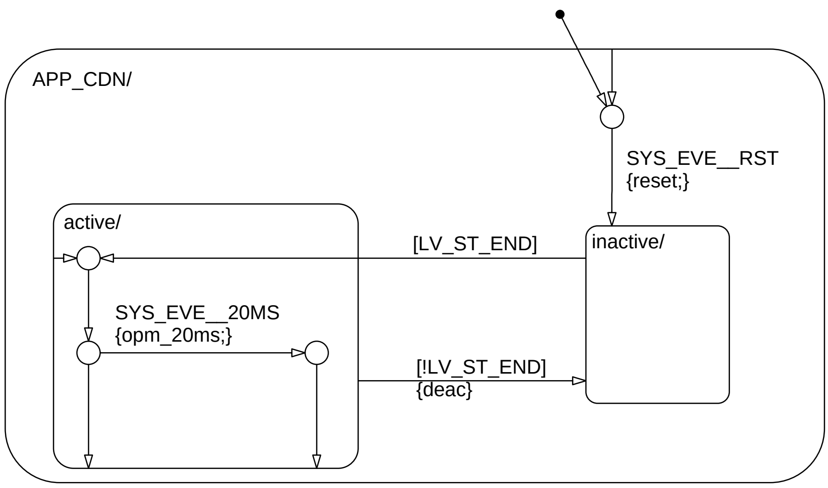

Figure 7.95.1: NOXM_DEFSPNTDLS0/APP_CDN/Chart1

Function Description

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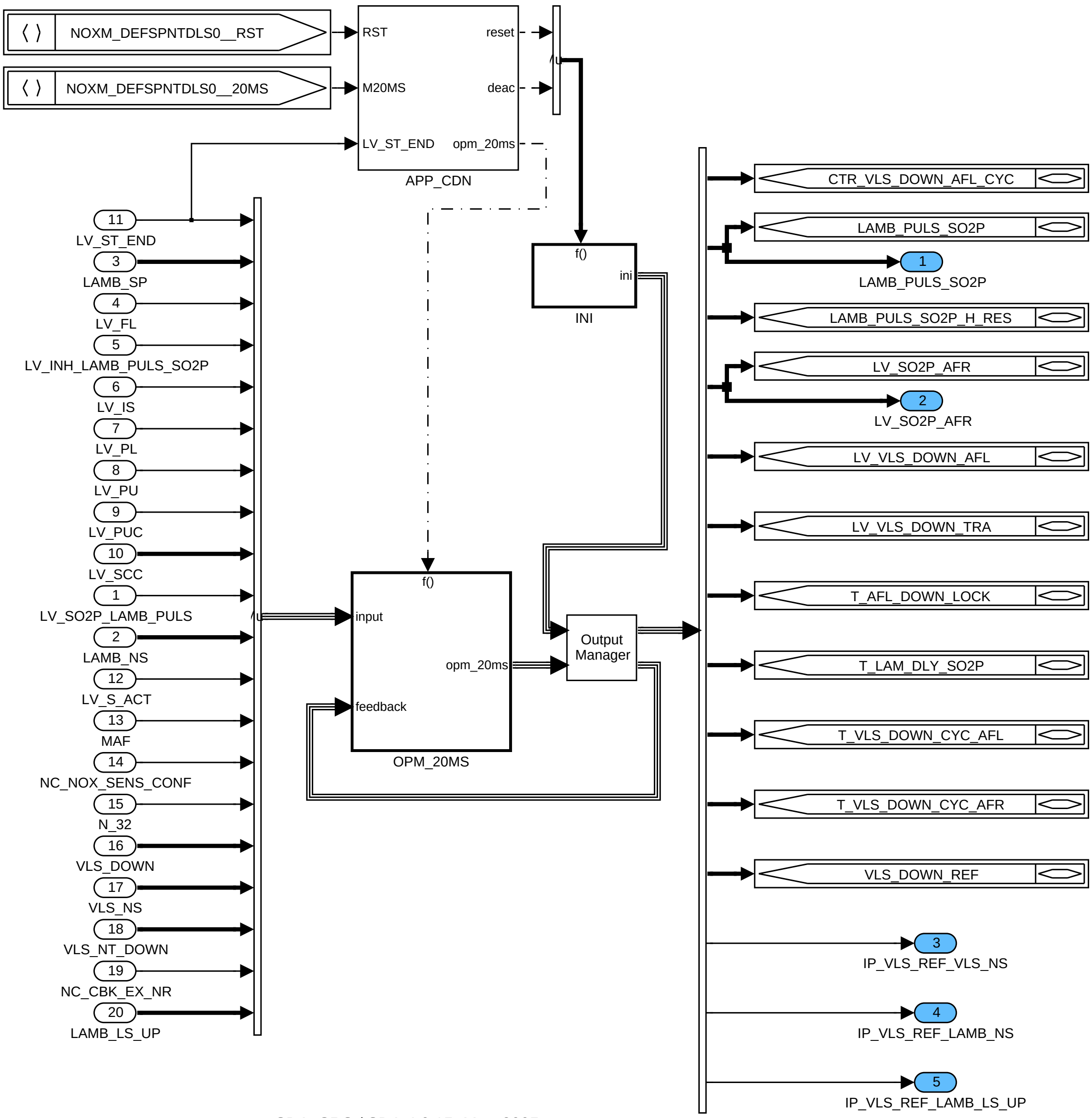

Figure 7.95.2: NOXM_DEFSPNTDLS0

7.95.1 INITIALIZATION

Initialization at reset

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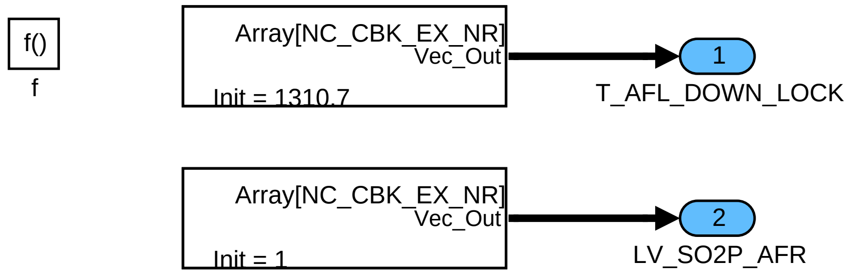

Figure 7.95.3: NOXM_DEFSPNTDLS0/INI/INI_reset

Initialization at deactivation

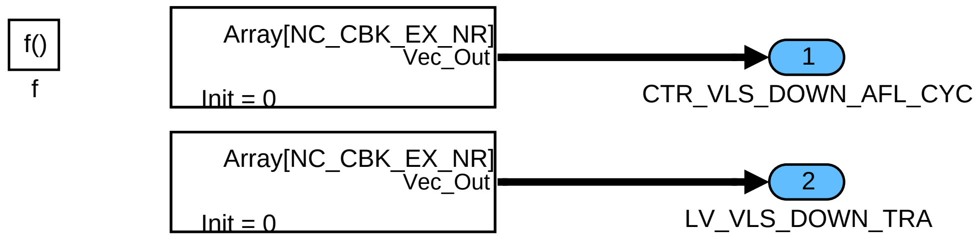

Figure 7.95.4: NOXM_DEFSPNTDLS0/INI/INI_deac

7.95.2 FORMULA SECTION

The function contains of two main Sections:
SECTION 1: Detection of lean/rich mixture
SECTION 2: Realization of lambda controller deviation

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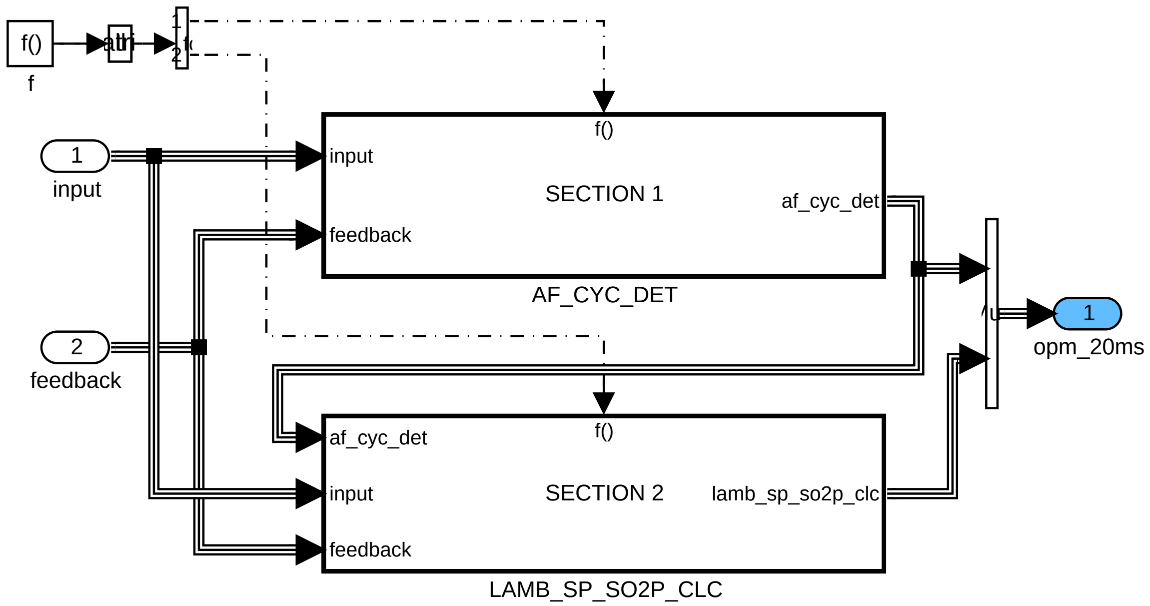

Figure 7.95.5: NOXM_DEFSPNTDLS0/OPM_20MS

SECTION 1: Detection of lean/rich mixture

The function shall provide an indication of the current Air-Fuel mixture ratio at LS downstream position, i.e. mixture lean or rich, and determine the lean and rich cycle time separately for further evaluation by other functions. This shall be carried out as follows:
AF transition detection:
There are several possibilities as reference for oxygen signal depending on existing sensors and their provided signals: NOx-sensor or binary oxygen sensor. The choosen output signal is scaled if necessary to the reference signal VLS_DOWN_REF.
The function shall detect a change in AF mixture from lean to rich or vice versa ignoring possible jitter in the sensor signal. This shall be facilitated by the following method: If the timer T_AFL_DOWN_LOCK falls below the threshold IP_T_AFL_DOWN_LOCK_xxx, the timer shall be incremented and the transition flag LV_VLS_DOWN_TRA shall be reset. Should, during following recurrence cycles, the timer equal or exceed the threshold and if the AF mixture flag is currently indicating lean, the function shall observe the VLS_DOWN_i signal for a change to rich as indicated by VLS_DOWN_i exceeding the threshold C_VLS_DOWN_AFR. Once this has occurred, the LV_VLS_DOWN_AFL flag shall be changed to indicate a rich mixture (LV_VLS_DOWN_AFL = 0), the counter CTR_VLS_DOWN_AFL_CYC shall be incremented to indicate the number of complete AF cycles since the last activation of the lambda controller, the timer T_AFL_DOWN_LOCK shall be reset and LV_VLS_DOWN_TRA is set to indicate the AF mixture transition. The same procedure, except increment of counter CTR_VLS_DOWN_AFL_CYC, applies for a currently rich mixture. A transition to a lean mixture shall be detected by VLS_DOWN falling below threshold C_VLS_DOWN_AFL.
Remark: The timer T_AFL_DOWN_LOCK and associated engine operating point dependent threshold IP_T_AFL_DOWN_LOCK_xxx reduce the effect of rapid oxygen sensor signal changes, noise generated by cylinder to cylinder AF mixture deviations, that would cause the lambda controller to execute a P-jump. The mapped lock-out time represents the delay between injection of the AF mixture and the burnt AF mixture reaching and being detected by the downstream oxygen sensor. The lock-out time shall not exceed the exhaust gas delay for any particular engine operating point otherwise the lambda controller frequency will be affected. Downstream oxygen sensor signal changes occurring within this delay time may not be considered to be due to the change in controlled lambda but from noise and shall be ignored.

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Timer /counter incrementation:

The function shall increment the respective timer dependent on the current state of the AF mixture, as determined by LV_VLS_DOWN_AFL (lean mixture; increment T_VLS_DOWN_CYC_AFL. rich mixture; increment T_VLS_DOWN_CYC_AFR). Should at any time the desulfation control be deactivated, the function shall reset the counter CTR_VLS_DOWN_AFL_CYC.

As calibrateable back up solution a switch of LV_VLS_DOWN_AFL can also be forced by exceeding the time counter threshold for the corresponding cycle time (C_T_VLS_DOWN_CYC_AFL/AFR_MAX)

Increment T_VLS_DOWN_CYC_AFL /Increment T_VLS_DOWN_CYC_AFR

The timers T_VLS_DOWN_CYC_AFL and T_VLS_DOWN_CYC_AFR shall be incremented according to their specified conditions until they reach a maximum value of FFFFH at which point they shall no longer be incremented.

Increment CTR_VLS_DOWN_AFL_CYC

The Air-Fuel cycle counter CTR_VLS_DOWN_AFL_CYC shall be incremented for every lean to rich AF mixture transition, to indicate that a complete AF cycle has passed. The counter shall be incremented in such manner until it reaches a maximum value of FFFFH at which point it shall no longer be incremented.

Increment T_AFL_DOWN_LOCK

The timer T_AFL_DOWN_LOCK shall be incremented according to the specified conditions until it reaches a maximum value of FFFFH at which point it shall no longer be incremented.

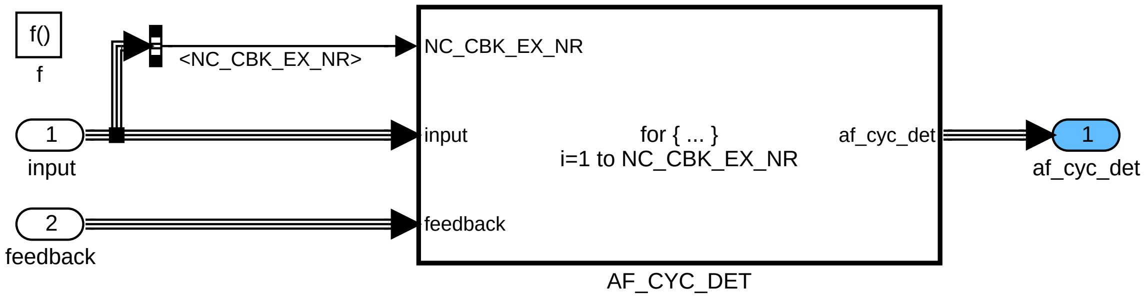

Figure 7.95.6: NOXM_DEFSPNTDLS0/OPM_20MS/AF_CYC_DET

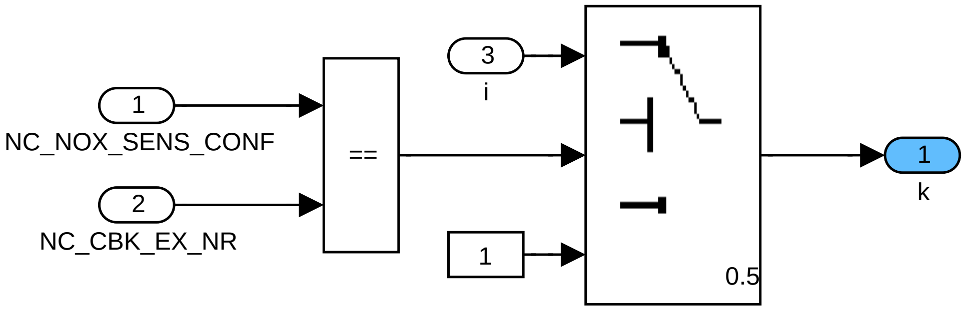

Figure 7.95.7: NOXM_DEFSPNTDLS0/OPM_20MS/AF_CYC_DET/AF_CYC_DET/INPUT/CLC_k

Content of SECTION 1

Section 1 contains of two other sections:

SECTION 1.1: Calculation of a voltage reference signal (CASE_SEL)

SECTION 1.2: Detection of transition between rich/lean phases and current mixture state (CHK_AF_CDN)

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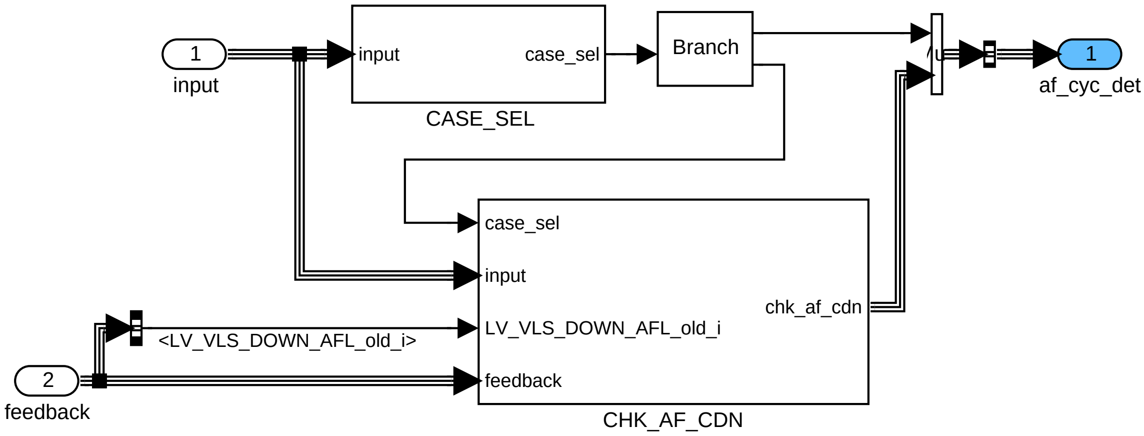

Figure 7.95.8: NOXM_DEFSPNTDLS0/OPM_20MS/AF_CYC_DET/AF_CYC_DET/AF_CYC_DET

SECTION 1.1: Calculation of a voltage reference signal

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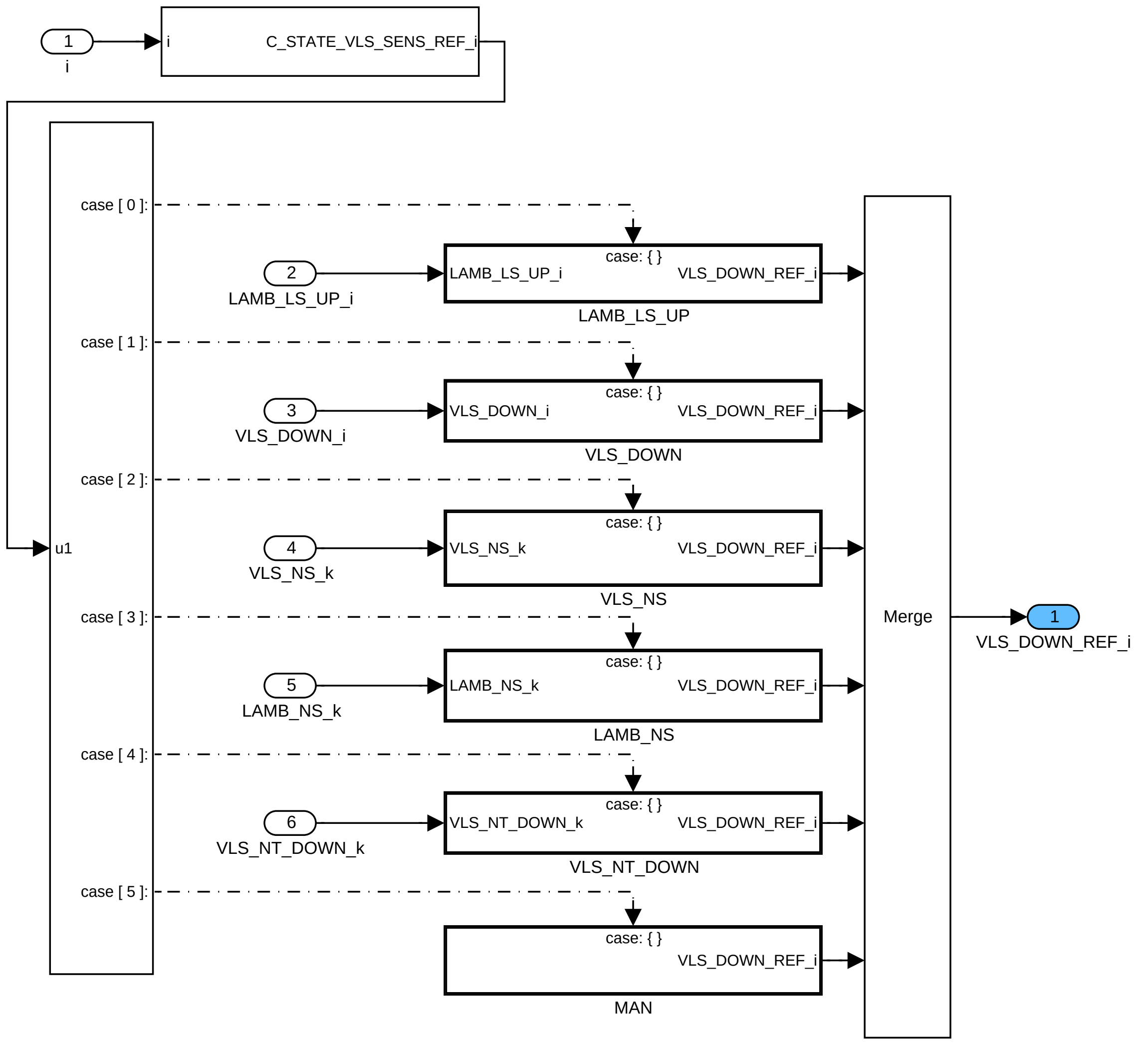

Figure 7.95.9: NOXM_DEFSPNTDLS0/OPM_20MS/AF_CYC_DET/AF_CYC_DET/AF_CYC_DET/CASE_SEL/CASE_SEL

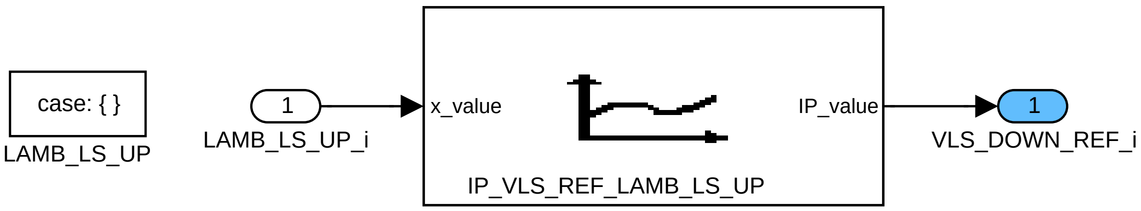

Figure 7.95.10: NOXM_DEFSPNTDLS0/OPM_20MS/AF_CYC_DET/AF_CYC_DET/AF_CYC_DET/CASE_SEL/CASE_SEL/LAMB_LS_UP

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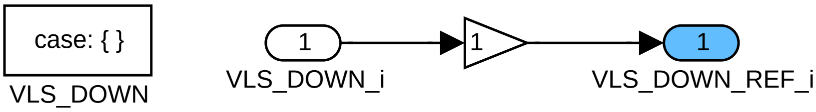

Figure 7.95.11: NOXM_DEFSPNTDLS0/OPM_20MS/AF_CYC_DET/AF_CYC_DET/AF_CYC_DET/CASE_SEL/CASE_SEL/VLS_DOWN

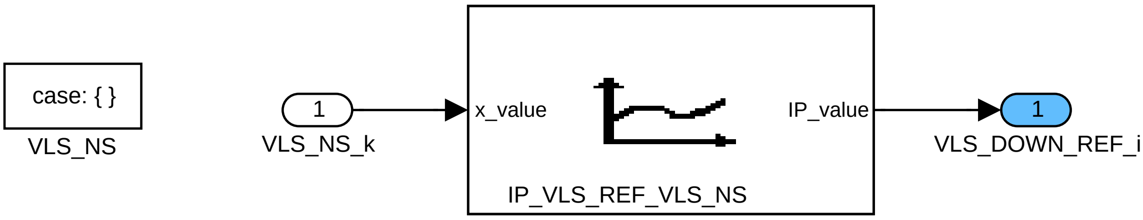

Figure 7.95.12: NOXM_DEFSPNTDLS0/OPM_20MS/AF_CYC_DET/AF_CYC_DET/AF_CYC_DET/CASE_SEL/CASE_SEL/VLS_NS

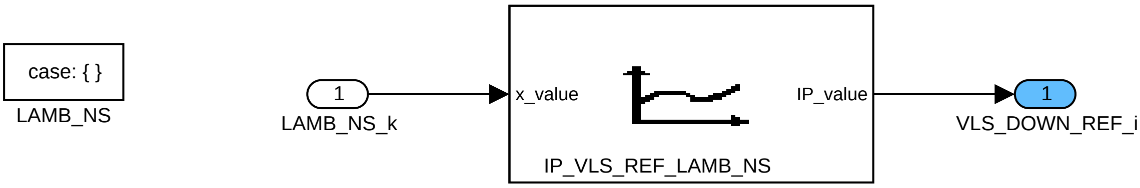

Figure 7.95.13: NOXM_DEFSPNTDLS0/OPM_20MS/AF_CYC_DET/AF_CYC_DET/AF_CYC_DET/CASE_SEL/CASE_SEL/LAMB_NS

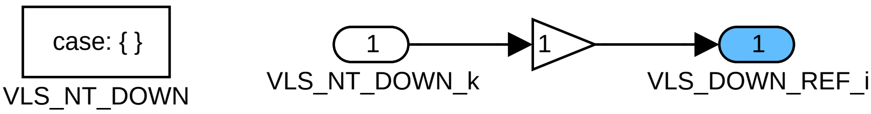

Figure 7.95.14: NOXM_DEFSPNTDLS0/OPM_20MS/AF_CYC_DET/AF_CYC_DET/AF_CYC_DET/CASE_SEL/CASE_SEL/VLS_NT_DOWN

Figure 7.95.15: NOXM_DEFSPNTDLS0/OPM_20MS/AF_CYC_DET/AF_CYC_DET/AF_CYC_DET/CASE_SEL/CASE_SEL/MAN

SECTION 1.2: Detection of transition between rich/lean phases and current mixture state

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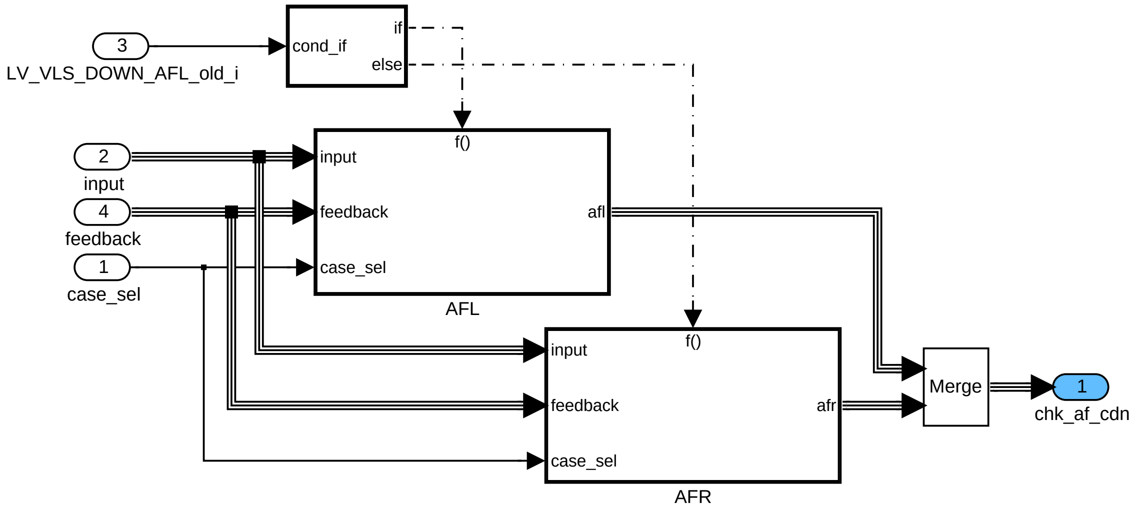

Figure 7.95.16:
NOXM_DEFSPNTDLS0/OPM_20MS/AF_CYC_DET/AF_CYC_DET/AF_CYC_DET/CHK_AF_CDN

SECTION 1.2.1: AFL phase

Calculation of timer for lean cycle

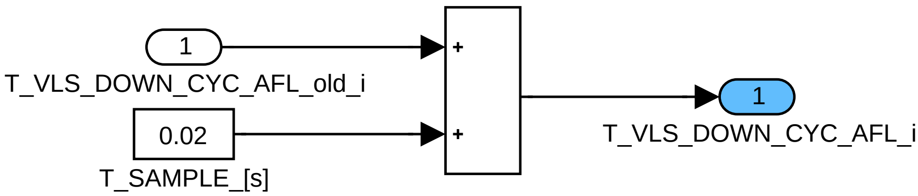

Figure 7.95.17: NOXM_DEFSPNTDLS0/OPM_20MS/AF_CYC_DET/AF_CYC_DET/AF_CYC_DET/
CHK_AF_CDN/AFL/T_CYC_AFL_CLC

Calculation of transition condition

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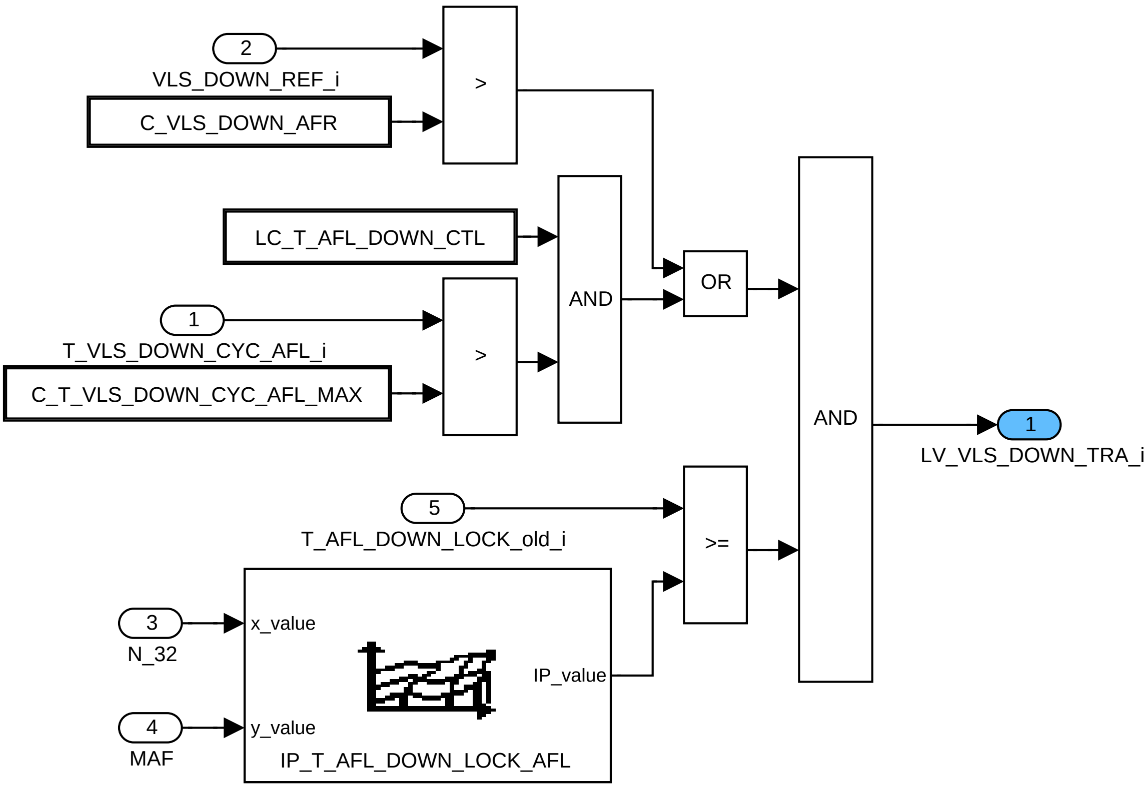

Figure 7.95.18: NOXM_DEFSPNTDLS0/OPM_20MS/AF_CYC_DET/AF_CYC_DET/AF_CYC_DET/CHK_AF_CDN/AFL/LV_TRA_CLC

Calculation of mixture state

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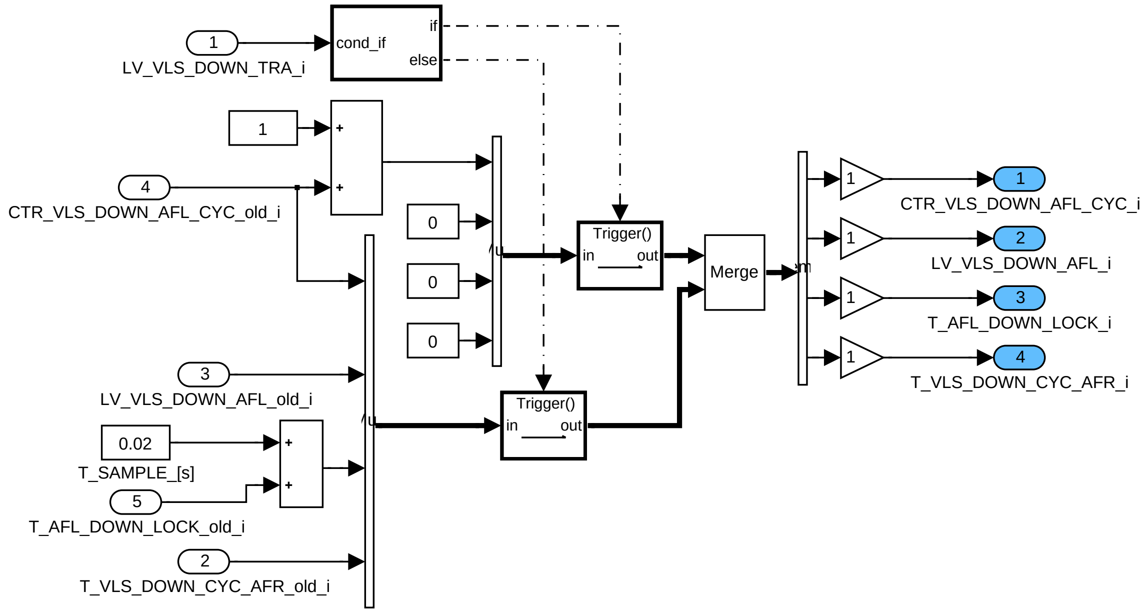

Figure 7.95.19: NOXM_DEFSPNTDLS0/OPM_20MS/AF_CYC_DET/AF_CYC_DET/AF_CYC_DET/CHK_AF_CDN/AFL/LV_AFL_CLC

SECTION 1.2.2: AFR phase

Calculation of timer for rich cycle

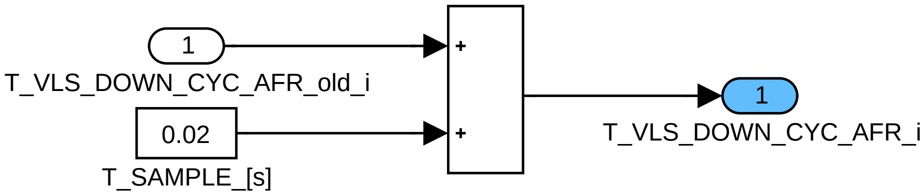

Figure 7.95.20: NOXM_DEFSPNTDLS0/OPM_20MS/AF_CYC_DET/AF_CYC_DET/AF_CYC_DET/CHK_AF_CDN/AFR/T_CYC_AFR_CLC

Calculation of transition condition

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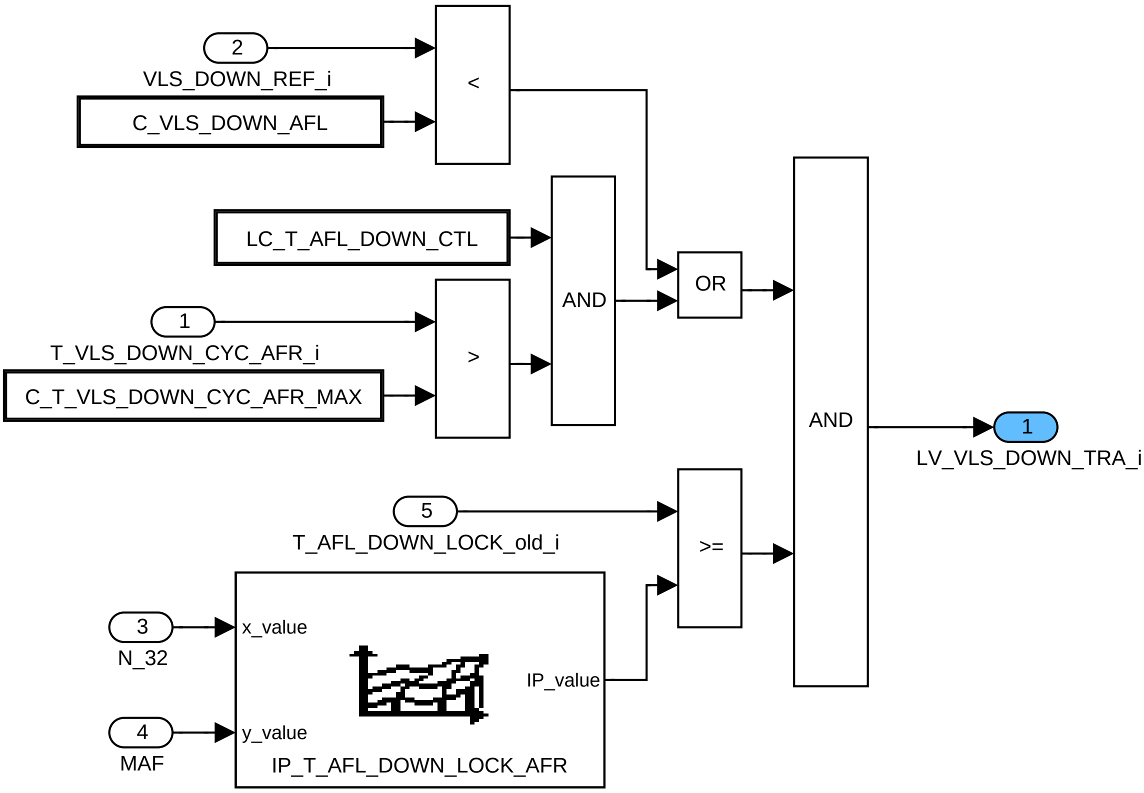

Figure 7.95.21: NOXM_DEFSPNTDLS0/OPM_20MS/AF_CYC_DET/AF_CYC_DET/AF_CYC_DET/
CHK_AF_CDN/AFR/LV_TRA_CLC

Calculation of mixture state

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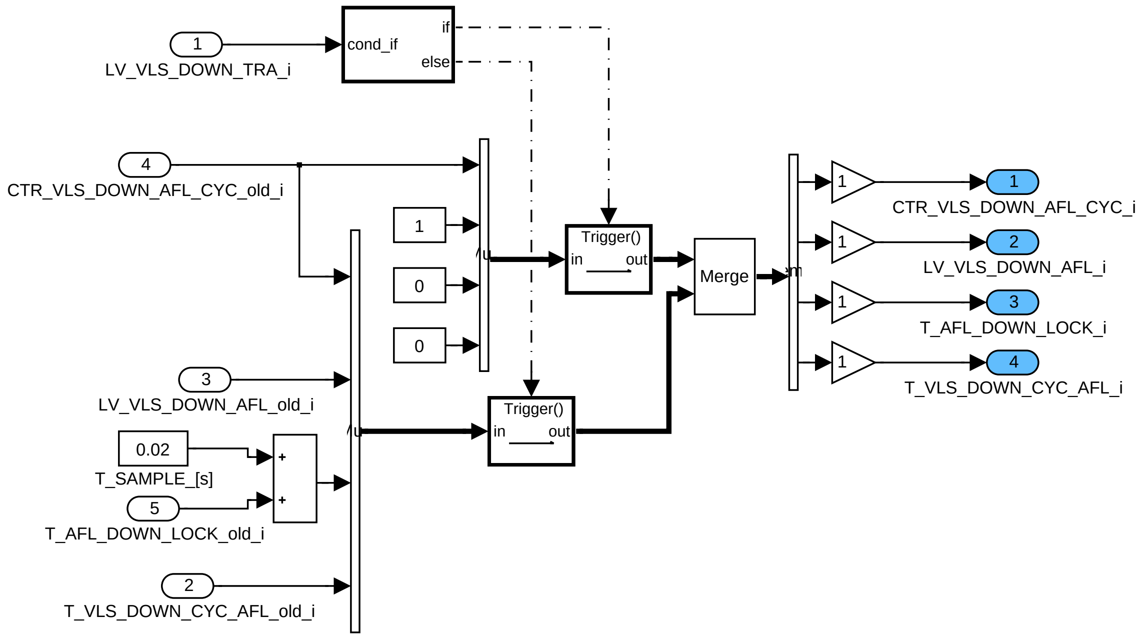

Figure 7.95.22: NOXM_DEFSPNTDLS0/OPM_20MS/AF_CYC_DET/AF_CYC_DET/AF_CYC_DET/CHK_AF_CDN/AFR/LV_AFR_CLC

SECTION 2: Realization of lambda controller deviation

The lambda control correction adjusts the fuel-air mixture to richness 1 in average. The lambda controller uses a PI strategy. It is adjusted to produce a leaner or a richer mixture according to the oxygen sensor information.
If LAMB_PULS_SO2P exceeds the limitations C_DELTA_LAMB_AFL/AFR_SO2P then LAMB_PULS_SO2P is limited to those values.
The calibration constants C_T_LAM_DLY_SO2P_POS and C_T_LAM_DLY_SO2P_NEG are provided for the pre-control of the P-jump delay. The IP_LAM_XX_YY maps have common data points.
The last calculated LAMB_PULS_SO2P value before the corresponding Lambda transition from lean to rich and from rich to lean remains constant until the delay time T_LAM_DLY_SO2P has come to an end, i.e. I component is frozen. LAMB_PULS_SO2P can not be changed or reset during this time.
To provide best performance (drivability, interface to other functions as e.g. desulfation) all banks reaching lean status wait with P-jump to rich side until last bank also has reached lean status (common P-jump to rich side).
High resolution variable LAMB_PULS_SO2P_H_RES_i shall be used for internal calculation. LAMB_PULS_SO2P_i with low resolution shall be the relevant output for other functions.
Remark: The transition flag LV_VLS_DOWN_TRA is just set during one recurrence of the corresponding specification. It has to be ensured that this spike is noticed by this part.
This SECTION contains of two main chapters:
SECTION 2.1: Calculation of activation condition and check of all banks (not for loop)
SECTION 2.2: Lambda deviation calculation (for loop)

SECTION 2.1: Calculation of activation condition and check of all banks (not for loop)

Activation condition for desulfation

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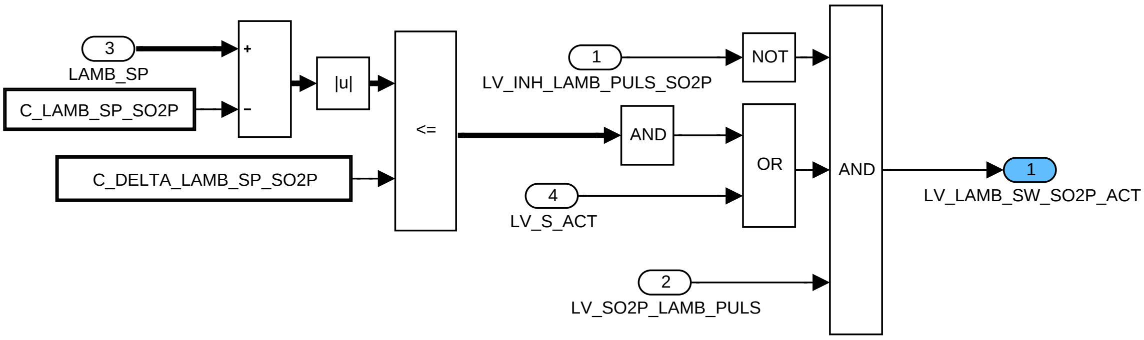

Figure 7.95.23:
NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/ACT__AFL_DET/SO2P_ACT_CDN

Check all exhaust banks

Index "any" means that minimum for one bank the condition is fulfilled.
Index "all" means that for all banks the condition must be fulfilled.

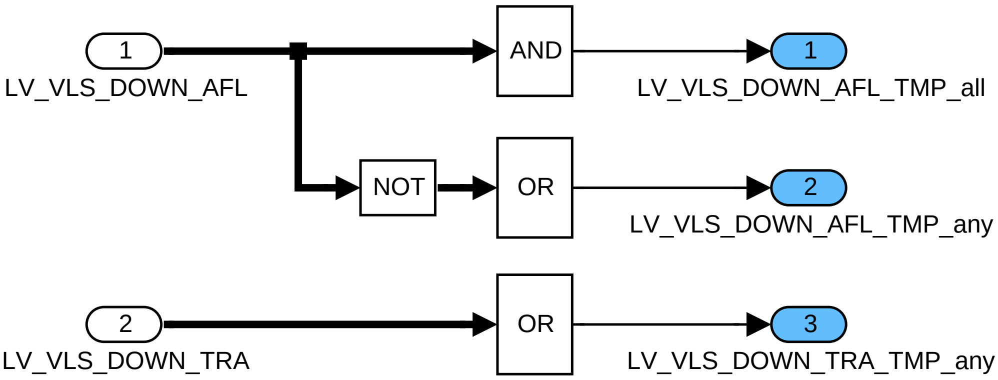

Figure 7.95.24:
NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/ACT__AFL_DET/AFL_DOWN_DET

SECTION 2.2: Lambda deviation calculation (for loop)

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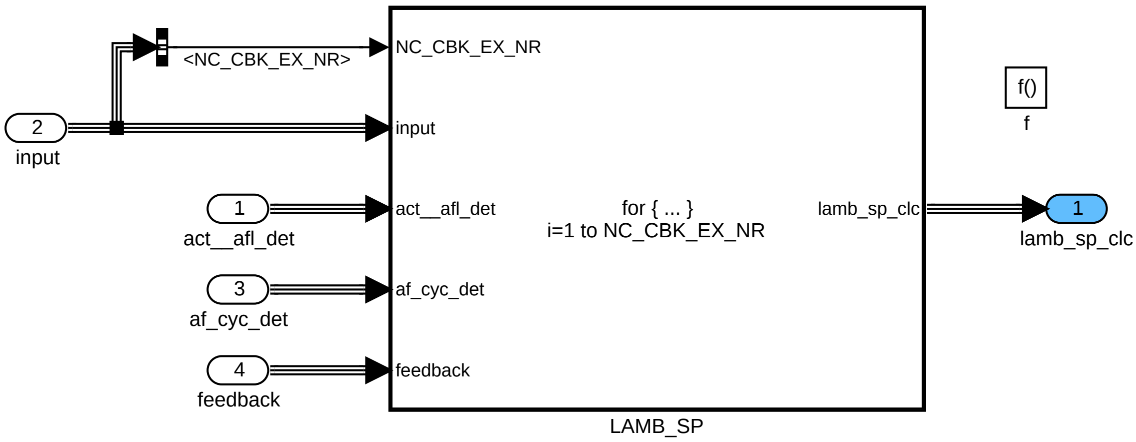

Figure 7.95.25: NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/LAMB_SP

SECTION 2.2.1: Calculation of lambda deviation for desulfation (H_RES)

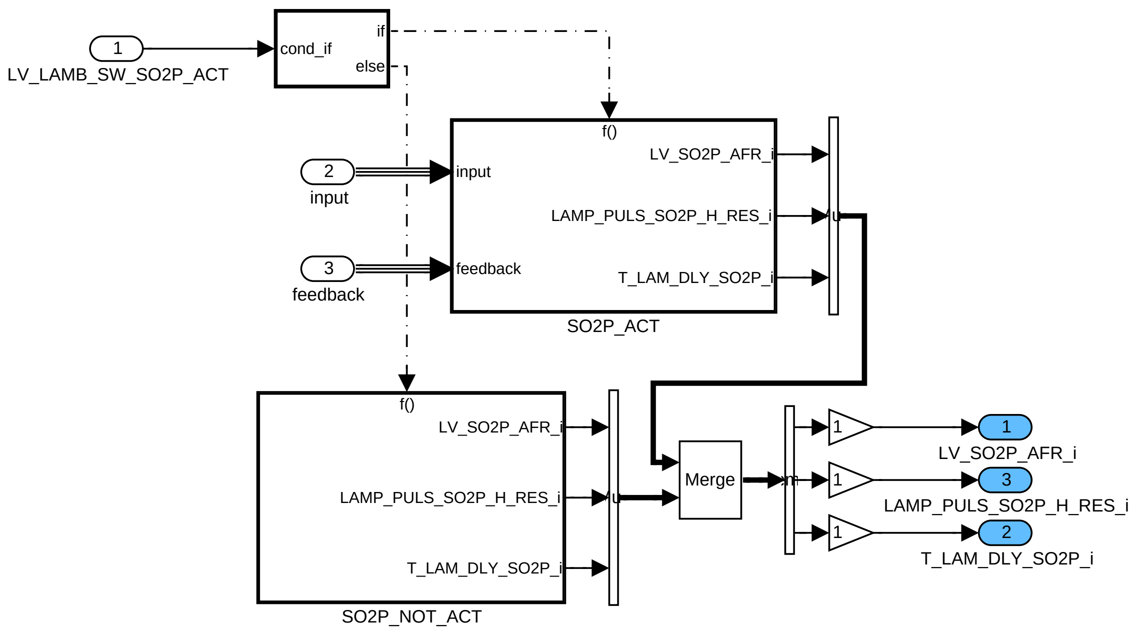

Figure 7.95.26: NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/LAMB_SP/LAMB_SP/LAMB_SP/LAMB_SP_H_RES_CLC

SECTION 2.2.1.1: Desulfation active (SO2P_ACT)

SECTION 2.2.1.1.1: Check of combustion condition 1:

Calculation of lambda deviation at trailing throttle fuel cut-off or full load or single cylinder cut off

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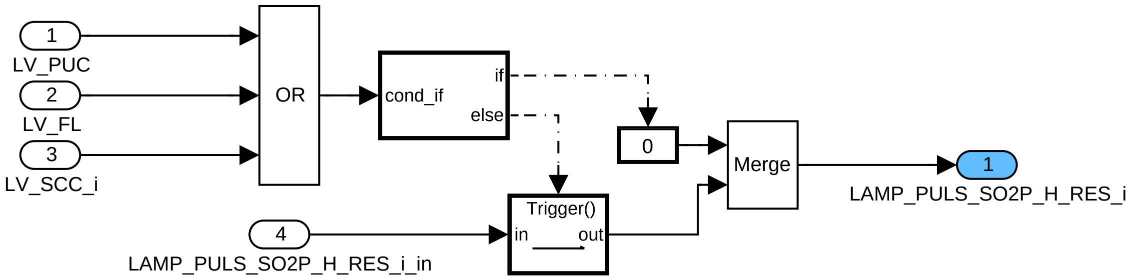

Figure 7.95.27: NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/LAMB_SP/LAMB_SP/LAMB_SP/LAMB_SP_H_RES_CLC/SO2P_ACT/CMB_CDN_1

SECTION 2.2.1.1.2: Check of combustion condition 2:

Controller setting at part load or trailing throttle or idle

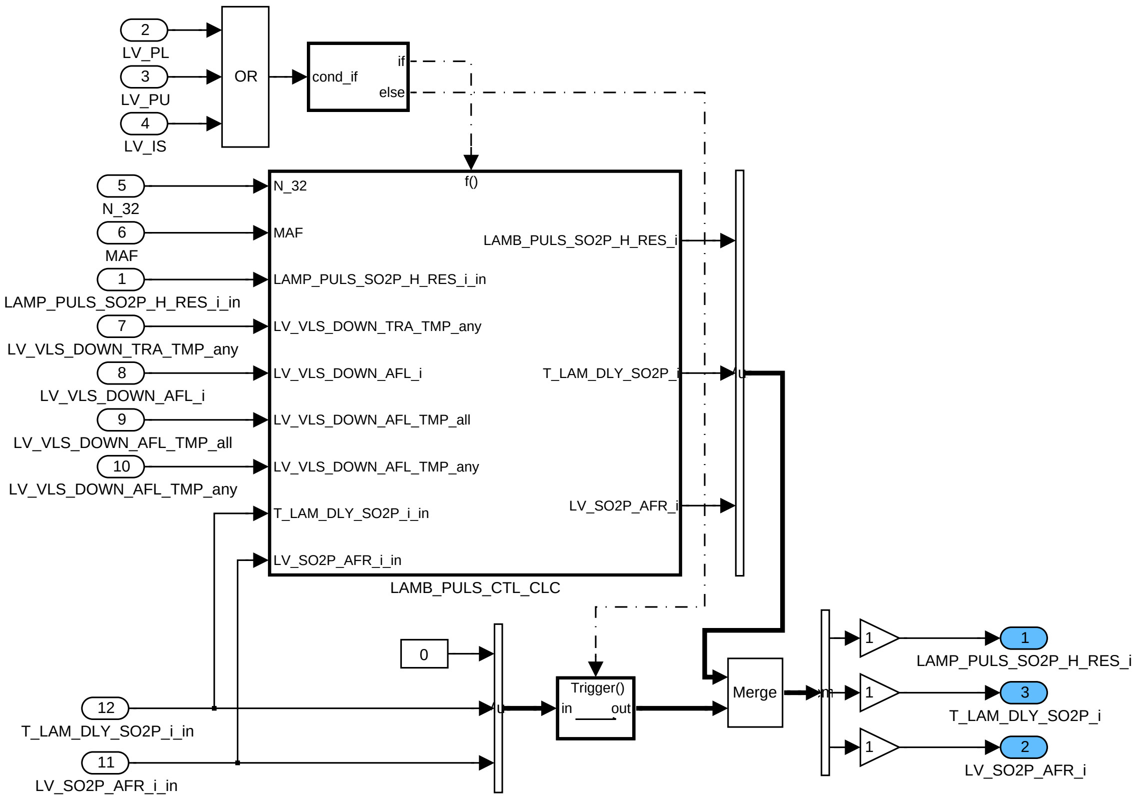

Figure 7.95.28: NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/LAMB_SP/LAMB_SP/LAMB_SP/LAMB_SP_H_RES_CLC/SO2P_ACT/CMB_CDN_2

SECTION 2.2.1.1.2.1: LAMB_PULS_CTL_CLC

In this section the controller setting is calculated for transition phase and during rich/lean phase

SECTION 2.2.1.1.2.1.1: Controller setting for transition phase

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Initialization of delay time at changing of combustion mixture and calculation which phase is active

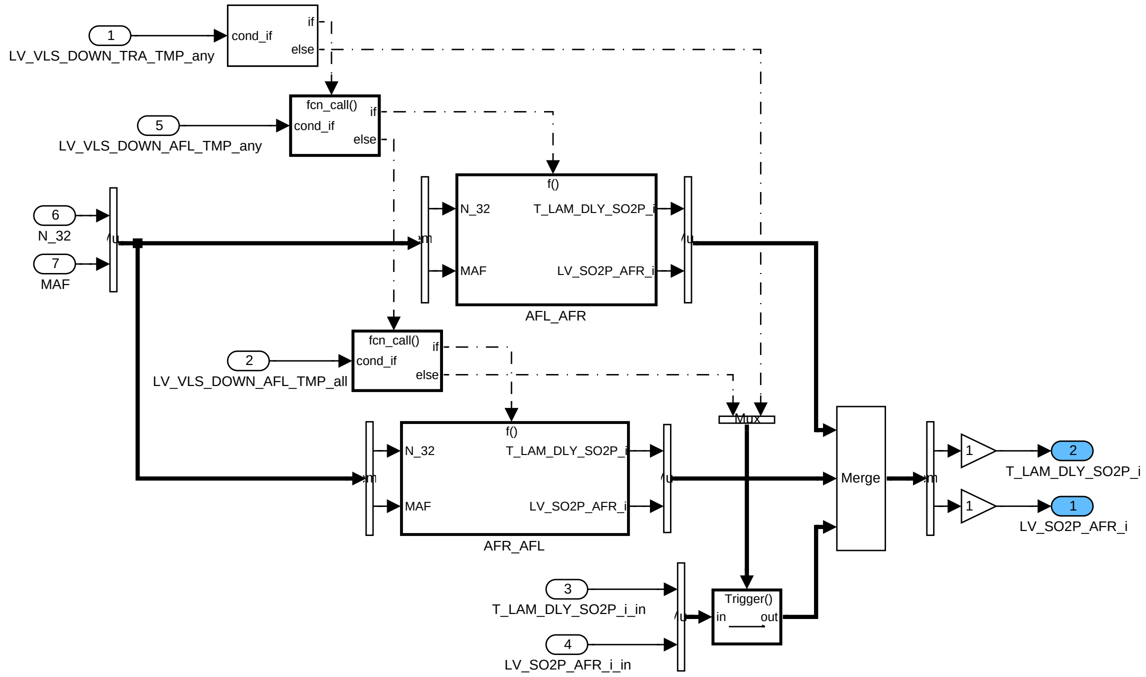

Figure 7.95.29: NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/LAMB_SP/LAMB_SP/LAMB_SP/LAMB_SP_H_RES_CLC/SO2P_ACT/CMB_CDN_2/LAMB_PULS_CTL_CLC/TRA

AFL to AFR

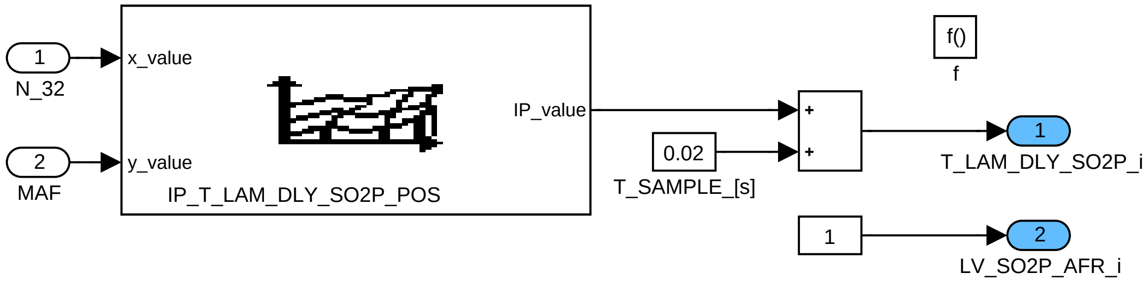

Figure 7.95.30:
NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/LAMB_SP/LAMB_SP/LAMB_SP/LAMB_SP_H_RES_CLC/SO2P_ACT/CMB_CDN_2/LAMB_PULS_CTL_CLC/TRA/AFL_AFR

AFR to AFL

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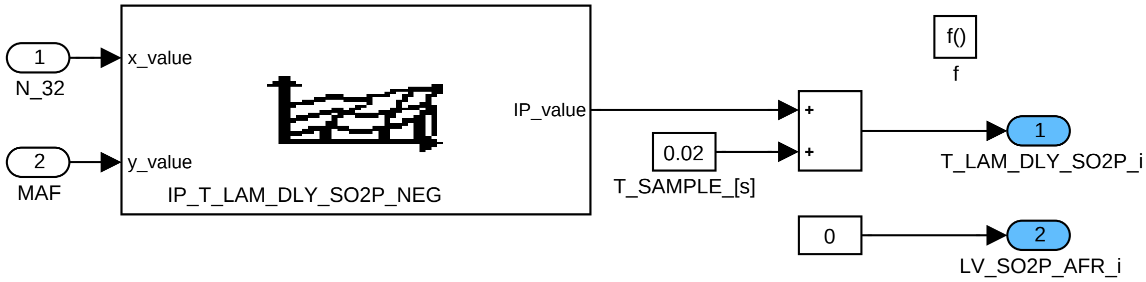

Figure 7.95.31:
NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/LAMB_SP/LAMB_SP/LAMB_SP/
LAMB_SP_H_RES_CLC/SO2P_ACT/CMB_CDN_2/LAMB_PULS_CTL_CLC/TRA/AFR_AFL

SECTION 2.2.1.1.2.1.2: Controller setting for lean/rich phase

If the delay time has been running over the "I" component of controller is calculated

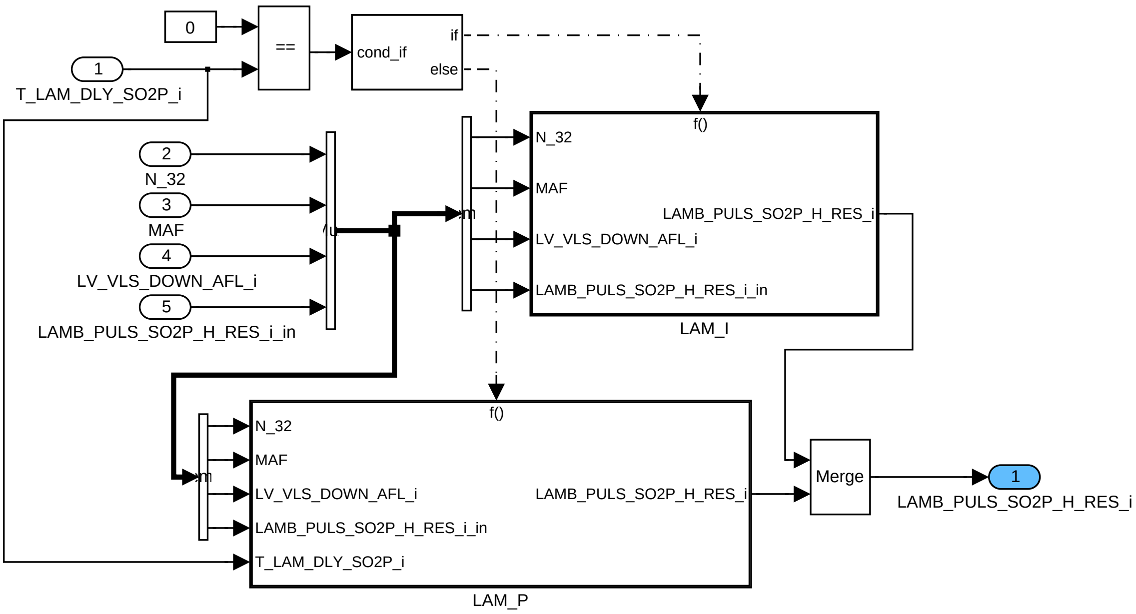

Figure 7.95.32: NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/LAMB_SP/LAMB_SP/
LAMB_SP/LAMB_SP_H_RES_CLC/SO2P_ACT/CMB_CDN_2/LAMB_PULS_CTL_CLC/CTL

LAM_I

Calculation of controller "I" component

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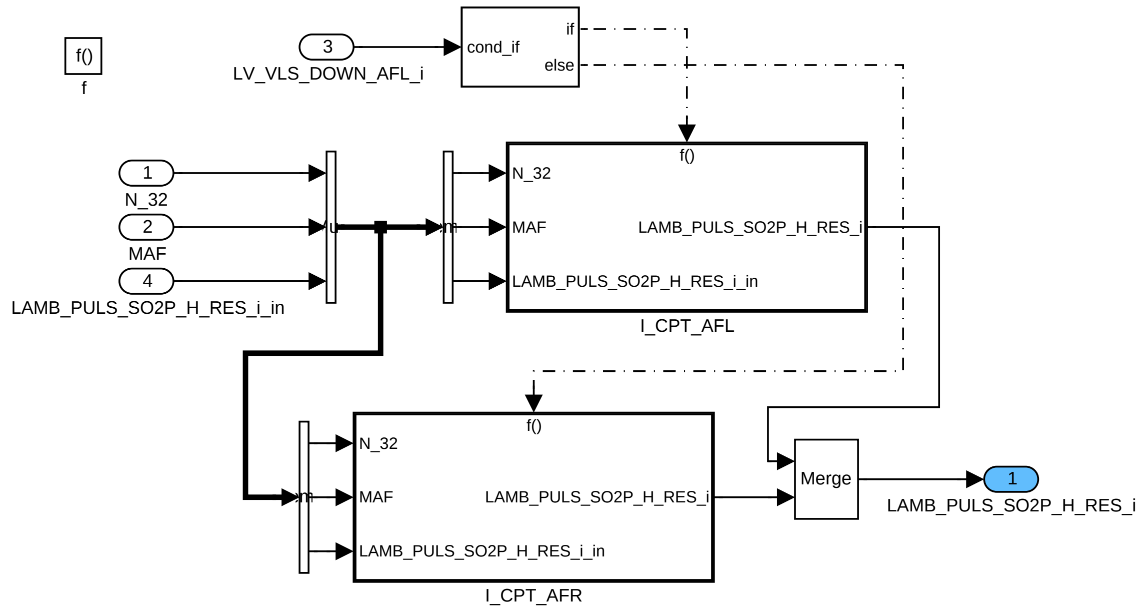

Figure 7.95.33: NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/LAMB_SP/LAMB_SP/LAMB_SP/LAMB_SP_H_RES_CLC/SO2P_ACT/CMB_CDN_2/LAMB_PULS_CTL_CLC/CTL/LAM_I

LAM_I/I_CPT_AFL

Controller "I" component for lean phase

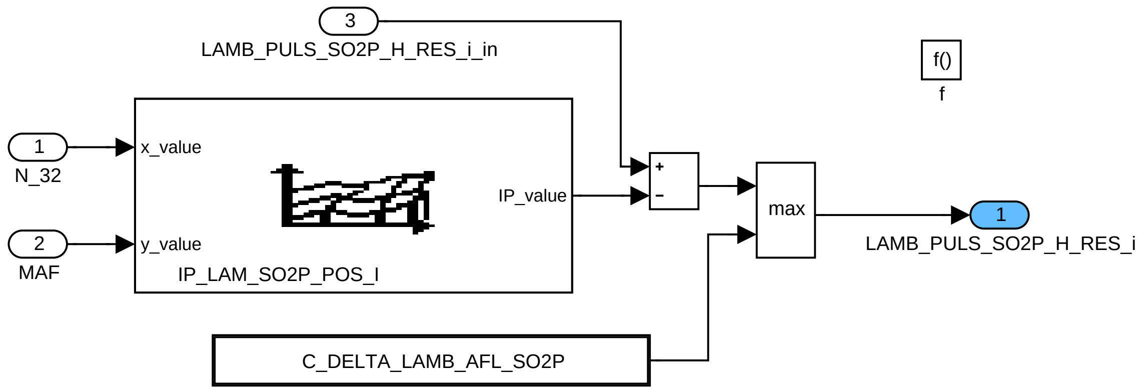

Figure 7.95.34: NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/LAMB_SP/LAMB_SP/LAMB_SP/LAMB_SP_H_RES_CLC/SO2P_ACT/CMB_CDN_2/LAMB_PULS_CTL_CLC/CTL/LAM_I/I_CPT_AFL

LAM_I/I_CPT_AFR

Controller "I" component for rich phase

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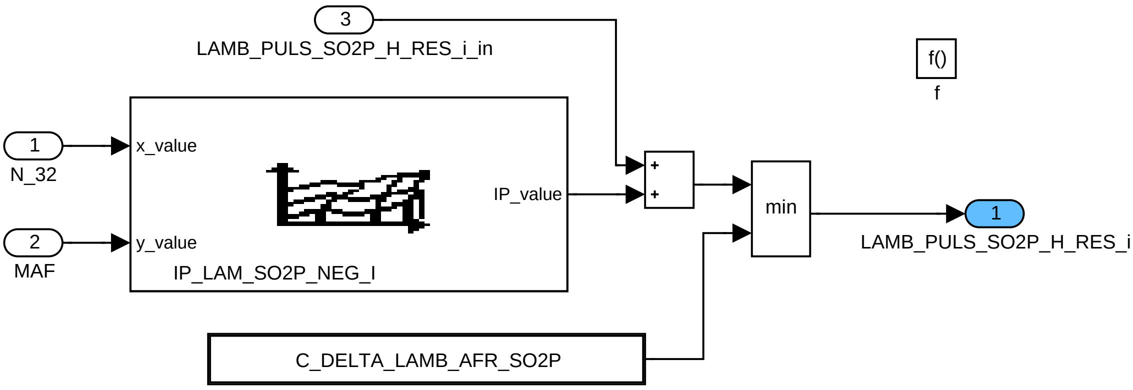

Figure 7.95.35:
NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/LAMB_SP/LAMB_SP/LAMB_SP/
LAMB_SP_H_RES_CLC/SO2P_ACT/CMB_CDN_2/LAMB_PULS_CTL_CLC/CTL/LAM_I/I_CPT_AFR

LAM_P

Calculation of controller "P" component. At the last cycle before delay time is over the "P" component is calculated for realization of "P" jump

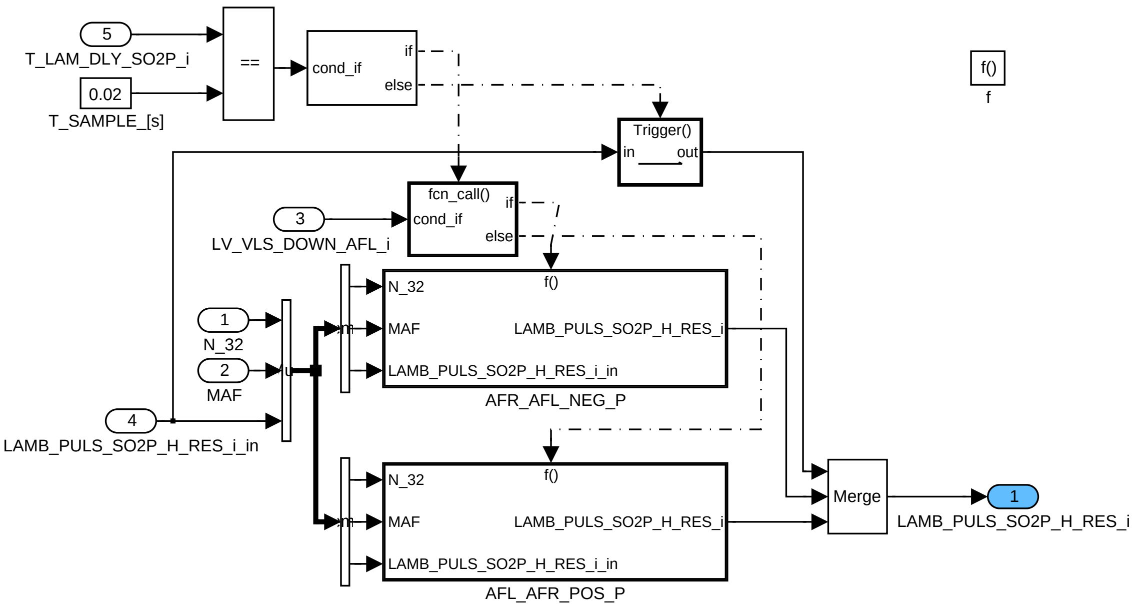

Figure 7.95.36: NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/LAMB_SP/LAMB_SP/
LAMB_SP/LAMB_SP_H_RES_CLC/SO2P_ACT/CMB_CDN_2/LAMB_PULS_CTL_CLC/CTL/LAM_P

LAM_P/AFR_AFL_NEG_P

Controller "P" component for lean to rich transition

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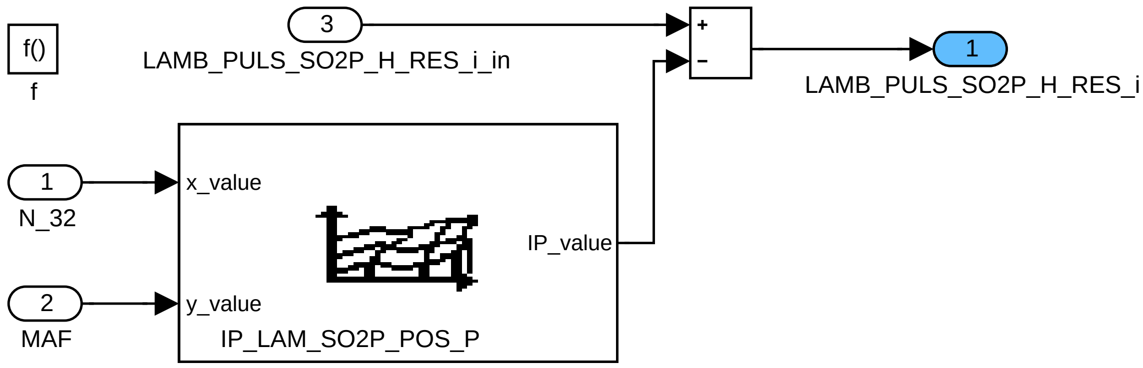

Figure 7.95.37: NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/LAMB_SP/LAMB_SP/LAMB_SP/LAMB_SP_H_RES_CLC/SO2P_ACT/CMB_CDN_2/LAMB_PULS_CTL_CLC/CTL/LAM_P/AFR_AFL_NEG_P

LAM_P/AFL_AFR_POS_P

Controller "P" component for rich to lean transition

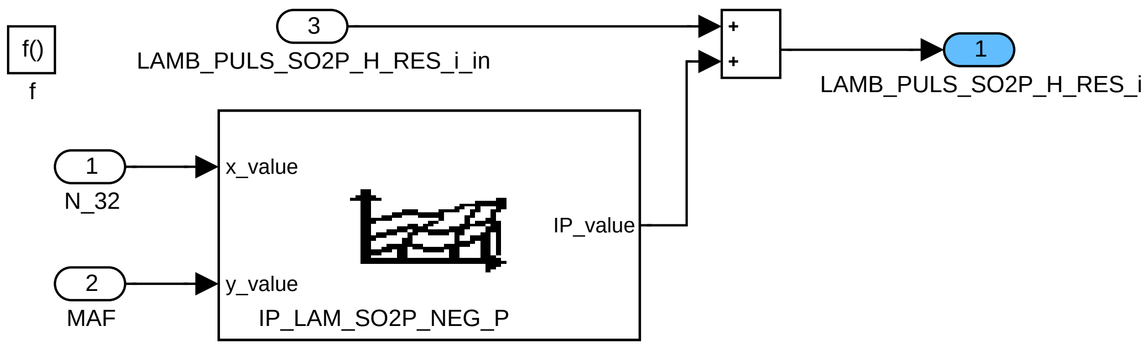

Figure 7.95.38: NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/LAMB_SP/LAMB_SP/LAMB_SP/LAMB_SP_H_RES_CLC/SO2P_ACT/CMB_CDN_2/LAMB_PULS_CTL_CLC/CTL/LAM_P/AFL_AFR_POS_P

SECTION 2.2.1.1.3: Calculation of delay time for controller setting

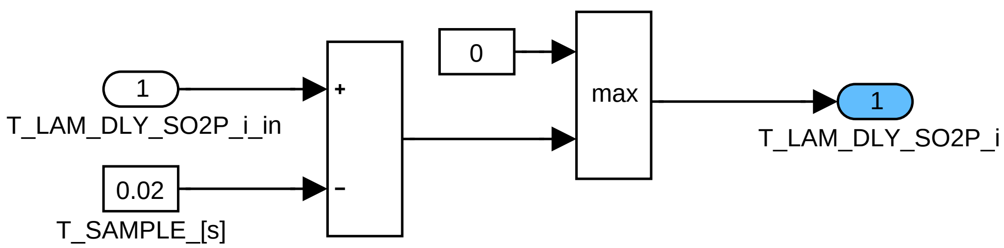

Figure 7.95.39: NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/LAMB_SP/LAMB_SP/LAMB_SP/LAMB_SP_H_RES_CLC/SO2P_ACT/T_LAM_DLY_CLC

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SECTION 2.2.1.2: Desulfation not active (SO2P_NOT_ACT)

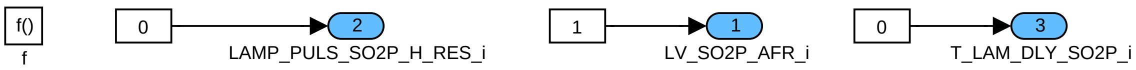

Figure 7.95.40: NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/LAMB_SP/LAMB_SP/LAMB_SP/LAMB_SP_H_RES_CLC/SO2P_NOT_ACT

SECTION 2.2.2: Calculation of lambda deviation for desulfation

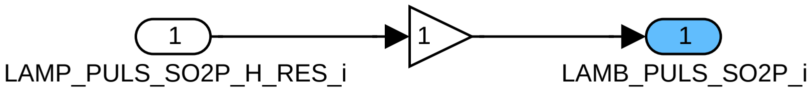

Figure 7.95.41: NOXM_DEFSPNTDLS0/OPM_20MS/LAMB_SP_SO2P_CLC/LAMB_SP/LAMB_SP/LAMB_SP/LAMB_SP_CLC

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7.96 NOx catalyst desulfation - lambda stimulation (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_LAMB_PULS_SO2P	O/V	0... 1H	0 ...1	1	-
flag inhibiting the NOx catalyst desulfation - lambda stimulation					

Input data:

LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_INH_LAMB_PULS_SO2P_MAN	-	0... 1H	0 ...1	1	-
Codeword for the manual setting of the inhibiting bit NOx trap desulfation by lambda stimulation					
LC_INH_LAMB_PULS_SO2P_OFF	-	0... 1H	0 ...1	1	-
Codeword for the deactivation of inhibiting the NOx trap desulfation by lambda stimulation					

Description:

This flag deactivates the NOx catalyst desulfation with lambda stimulation.
With the calibration data LC_INH_LAMB_PULS_SO2P_MAN it is possible to deactivate the NOx trap desulfation with lambda stimulation.
With the calibration data LC_INH_ LAMB_PULS_SO2P_OFF it is possible to make the NOx trap desulfation with lambda stimulation allways working.

Application conditions

Initialisation: 0 at reset

Recurrence: 100ms

Activation:

```
at every engine state
If          LC_INH_LAMB_PULS_SO2P_OFF = 1
then     LV_INH_LAMB_PULS_SO2P = 0       % no further calculation
necessary
```

endif

Formula section:

```
If          LV_ERR_LS_DOWN[i] = 1              // at least one
   or     LC_INH_LAMB_PULS_SO2P_MAN = 1
then     LV_INH_LAMB_PULS_SO2P = 1
else     LV_INH_LAMB_PULS_SO2P = 0
endif
```

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7.97 NOx catalyst oxygen storage capacity adaptation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DIST_O2_STC_OLD	O/V/S	0... FFFFH	0... 524280	8	km
mileage of last O2_STC adaptation					
LV_NT_O2_STC_LIM	O/V/S	0... 1H	0 ...1	1	-
bit for limitation of OSC adaptation cycle					
LV_NT_O2_STC_REQ	O/V/S	0... 1H	0 ...1	1	-
bit for requesting an OSC adaptation cycle					
LV_NT_O2_STC_VLD	O/V/S	0... 1H	0 ...1	1	-
Flag for valid status of OSC adaptation measurement					
NT_O2_STC_AD	O/V/S	0... FFH	0... 1.99218	0.0078125	-
adaptation factor for NOx catalyst oxygen storage capacity					
NT_O2_STC_OFS	O/V/S	8000... 7FFFH	-10485.76 ...10485.44	0.32	mg
adaptation offset for NOx catalyst oxygen storage capacity					

Input data:

DIST_NT {p. 3180}	LV_NT_AD_CMPL {p. 996}	LV_NT_AD_VLD {p. 996}	LV_NT_O2_STC_ACT {p. 996}
NT_O2_STC_BAS {p. 2985}	NTL_DEC_INT_AD {p. 996}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DIST_O2_STC	-	0... FFFFH	0... 524280	8	km
mileage distance to be passed before next O2_STC measurement					
C_DIST_O2_STC_VLD	-	0... FFFFH	0... 524280	8	km
mileage distance to be passed before O2_STC measurement is not valid anymore					
C_NT_O2_STC_AD_MAN	-	0... FFH	0... 1.99218	0.0078125	-
manual initialsisation value for oxygen storage capacity adaptation value					
C_NT_O2_STC_DELTA	-	0... 7FFFH	0... 10485.44	0.32	mg
permissible deviation between old and new osc value					
LC_NT_O2_STC_AD_MAN	-	0... 1H	0 ...1	1	-
logical constant for manual initialisation of NT_O2_STC_AD					
LC_NT_O2_STC_REP_OFF	-	0... 1H	0 ...1	1	-
logical constant for disabling a repetition of osc-measurement in case of gradient limitation					
LC_NT_O2_STC_REQ	-	0... 1H	0 ...1	1	-
logical constant for manually requesting an O2_STC adaptation cycle					
LC_NT_O2_STC_VLD	-	0... 1H	0 ...1	1	-
logical constant for manually setting of valid bit of O2_STC value					

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FUNCTION DESCRIPTION:

General information:

The oxygen storage capacity adaptation allowes an adaptation of the NOx catalyst oxygen storage capacity which will decrease within time due to thermal aging effects.

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The adaptation can be taken into consideration as factor or as offset value; this module offers both possibilities.
The main adaptation value is the factor, the offset is calculated using the factor.

Description:

Application conditions

Initialisation:

```
If          there are no stored values or checksum error
has occured or scantool reset
then        NT_O2_STC_AD = 1; LV_NT_O2_STC_LIM = 1, set all
other default values (=0)
else        use previously stored values
```

endif

Recurrence: 1000 ms

Activation: at every engine state

Formula section:

```
If      LC_NT_O2_STC_AD_MAN=1
then    LV_NT_O2_STC_REQ = 0
        LV_NT_O2_STC_VLD = 1
        NT_O2_STC_AD = C_NT_O2_STC_AD_MAN
        NT_O2_STC_OFS = (NT_O2_STC_AD-1) * NT_O2_STC_BAS
else    % O2_STC request coordination
        If      (DIST_NT - DIST_O2_STC_OLD) >= C_DIST_O2_STC
        or      LC_NT_O2_STC_REQ = 1
        then    LV_NT_O2_STC_REQ = 1
        endif
        If      [(DIST_NT - DIST_O2_STC_OLD) < C_DIST_O2_STC_VLD
        and     LV_NT_O2_STC_LIM = 0]
        or      LC_NT_O2_STC_VLD = 1
        then    LV_NT_O2_STC_VLD = 1
        else    LV_NT_O2_STC_VLD = 0
        endif
        % O2_STC-adaptation-factor rsp. -offset calculation
        If      LV_NT_AD_CMPL = 0 -> 1
        and     LV_NT_AD_VLD = 1                  %ad.cyc. completed
        and     LV_NT_O2_STC_ACT = 1        %ad.cyc. was osc meas.
        then    DIST_O2_STC_OLD = DIST_NT
                NT_O2_STC_OFS_TMP = (NT_O2_STC_AD - 1) * NT_O2_STC_BAS
                NT_O2_STC_OFS =                  % gradient limitation
                MAX(MIN(NTL_DEC_INT_AD - NT_O2_STC_BAS,
                NT_O2_STC_OFS_TMP + C_NT_O2_STC_DELTA),
                NT_O2_STC_OFS_TMP - C_NT_O2_STC_DELTA)
                If      NT_O2_STC_OFS = NTL_DEC_INT_AD - NT_O2_STC_BAS
                        %no limitation
                or      LC_NT_O2_STC_REP_OFF = 1
                        % no repetition of ad.cyc. when limited
```

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```
                then        LV_NT_O2_STC_REQ = 0                  % reset request
          bit
                      LV_NT_O2_STC_LIM = 0
                else        LV_NT_O2_STC_LIM = 1
                endif                                         % if nt_o2_stc_ofs_...
                NT_O2_STC_AD = 1 + NT_O2_STC_OFS /NT_O2_STC_BAS
          endif                                           % if lv_nt_ad_cmpl_ctl...
endif                                                 % if lc_nt_o2_stc_ad_man...
```

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7.98 NOx catalyst oxygen storage capacity adaptation (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DIST_NT	O/V	0... FFFFH	0... 524280	8	km
mileage counter for NOx trap purposes					

Input data:

CTR_KM_CAN {p. 1563}			

7.98.1 General

FUNCTION DESCRIPTION:

General information:

The range and resolution of CTR_KM_CAN and DIST_NT differ: both are words, resolution of CTR_KM_CAN (BMW): 10 km, DIST_NT: 8km

Recurrence: **1000** ms
Initialisation: DIST_NT = CTR_KM_CAN *at reset*

% CTR_KM_CAN already read from NVMY
Activation: *at every engine state*

Formula section:

DIST_NT = CTR_KM_CAN % resolution transformation

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7.99 NOx catalyst monolith temperature model

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_COLD_ST_NT	O/V/S	0... FFH	0... 255	1	-
Number of cold starts for NOx catalyst					
CTR_EGY_DEW_NT	V	0... FFFFH	0... 6553.5	0.1	-
Counter for correction of energy threshold for nox trap dew point detection					
EGY_DEW_END_NT	O/V	0... FFFFFFFFH	0... 536870911.875	0.125	Ws
Total amount of energy until nox trap dew point detection					
EGY_DEW_END_NT_INT	O/V	0... FFFFFFFFH	0... 536870911.875	0.125	Ws
Amount of energy brought into exhaust system for nox trap dew point detection					
EGY_DEW_NT_STOP	O/V/S	0... FFFFFFFFH	0... 536870911.875	0.125	Ws
additional amount of energy for nox trap dew point detection from last engine run without passed dew point					
FAC_EGY_DEW_END_NT	V	0... FFFFH	0... 1.99996	30.5e-6	-
factor for correction of energy threshold for nox trap dew point detection					
FAC_EGY_DEW_NT_STOP	V	0... FFH	-1... 1.55	0.01	-
factor for correction of energy amount that is stored in NVMY					
LV_TNT_MIN_THD_2	O/V	0... 1H	0 ...1	1	-
dew point recognition (second monolith)					
MAF_KGH_MIN_EGY_DEW_NT	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
minimum air-mass flow that has to exceeded for incrementing CTR_EGY_DEW_NT					
RATIO_EGY_DEW_NT	V	0... FFFFH	0... 1.99996	30.5e-6	-
Ratio of energy brought into exhaust system to energy threshold					
TEG_PCAT_DOWN_COR [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Sensor input NOx catalyst monolith temperature					

Input data:

CAN_HW_NS [NC_NOX_SENS_CONF] {p. 1398}	CAN_R_RATIO_NOX_SENS [NC_NOX_SENS_CONF] {p. 1398}	EGY_DEW_NT_DOWN {p. 8236}	LV_CHECK_MDL_ST {p. 8236}
LV_ES {p. 1720}	LV_ST {p. 1720}	LV_ST_END {p. 1720}	MAF_KGH {p. 1195}
T_AST {p. 1766}	T_ES_2 {p. 1444}	TAM {p. 1579}	TAM_ST {p. 1214}
TCO_ST {p. 1100}	TEG_PCAT_DOWN [NC_CBK_EX_NR] {p. 1253}	TEG_PCAT_DOWN_ADD {p. 3188}	TEG_WALL_NT_DOWN_MDL {p. 8237}
TEG_WALL_NT_DOWN_MDL_ST {p. 8237}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DLY_DEW_NT	-	0... FFH	0... 25.5	0.1	s
time delay for nox trap dew point detection					
C_EGY_DEW_NT_STOP	-	0... FFFFFFFFH	0... 536870911.875	0.125	Ws
Initialization value of energy for nox trap dew point detection from last engine run					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_EGY_DEW_NT_STOP	-	0... FFH	0... 0.99609	3.9063e-3	-
Weighting factor on restart for nox trap dew point detection					
C_TEG_WALL_NT_HYS	-	0... 1FFFH	0... 188.393	0.023	°C
Reference temperature hysteresis to set nox trap dew point after cooled exhaust pipe again					
C_TEG_WALL_NT_RED	-	0... FFFFH	-48 ...1	0.023	°C
Reference temperature to erase nox trap dew point at cooled exhaust pipe					
ID_MAF_KGH_MIN_EGY_DEW_NT	-	0... FFFFH	0... 1023.98437	0.015625	kg/h
LDP_TEG_WALL_NT_DOWN_MDL_ID_MAF	8	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
MAF threshold for incrementing CTR_EGY_DEW_END_NT					
IP_EGY_DEW_END_NT	V	0... FFFFFFFFH	0... 536870911.875	0.125	Ws
LDP_TCO_ST__EGY_DEW_END_NT	8	0... FEH	-48... 142.5	0.75	°C
LDP_TEG_WALL_NT_DOWN_MDL_ST	8	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Energy threshold for nox trap dew point detection					
IP_EGY_DEW_NT_MAX	V	0... FFFFFFFFH	0... 536870911.875	0.125	Ws
LDP_TCO_ST__EGY_DEW_NT_MAX	8	0... FEH	-48... 142.5	0.75	°C
LDP_TAM_ST__EGY_DEW_NT_MAX	8	0... FEH	-48... 142.5	0.75	°C
Maximum energy that has to be brought into a full flooded exhaust manifold until all water is condensed					
IP_FAC_EGY_DEW_END_NT	V	0... 7FH	0... 1.98437	0.015625	-
LDP_CTR_EGY_DEW_NT	8	0... FFFFH	0... 6553.5	0.1	-
LDP_MAF_KGH_IP_FAC_EGY_DEW_END	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
factor for correction of energy threshold for nox trap dew point detection					
IP_FAC_EGY_DEW_END_NT_STOP	V	0... FFH	-1... 1.55	0.01	-
LDP_RATIO_EGY_DEW_NT	16	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_TAM__FAC_EGY_DEW_END_NT	2	0... FEH	-48... 142.5	0.75	°C
factor for correction of energy amount that is stored in NVMY					
IP_FAC_EGY_DEW_END_NT_TAM_T_ES	V	0... FFH	-4... 3.96875	0.03125	-
LDP_T_ES_2__IP_FAC_EGY_DEW_END	4	1... FFFFH	1... 65535	1	s
LDP_TAM__IP_FAC_EGY_DEW_END	4	0... FEH	-48... 142.5	0.75	°C
Factor for correction of energy-threshold dependent on TAM and T_ES_2					
IP_R_RATIO_NOX_SENS_MIN_DEW	V	0... FFFFH	-32768 ...32767	1	-
LDP_TAM__IP_R_RATIO_NOX_SENS	8	0... FEH	-48... 142.5	0.75	°C
LDP_NR_CAN_HW_NS	8	0... FFH	0... 255	1	-
Minimum sensor element temperature depended resistance ratio as 1000 * R/R25 for dew point detection dependant on NOx sensor hardware version					
IP_TEG_WALL_NT_DOWN_ST	-	0... FFFFH	-48 ...1	0.023	°C
LDP_TAM__TEG_WALL_NT_DOWN_ST	8	0... FEH	-48... 142.5	0.75	°C
temperature treshold for nox trap dew point detection					

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Action definition

ACTION_EXTD_InitNTEgyStop ()	Mode: O
Initialization of energy for nox trap dew point detection from last engine run	

Description for ACTION_EXTD_InitNTEgyStop

ACTION_EXTD_InitNTEgyStop()					
Initialization of energy for nox trap dew point detection from last engine run					
Parameter	**Type**	**Hex. limits**	**Phys. limits**	**Resol.**	**Unit**

EGY_DEW_NT_STOP = C_EGY_DEW_NT_STOP % initialization via tester service job

7.99.1 Dew point determination

Application conditions

Activation: `LV_ST = 0 and LV_ES = 0`

Deactivation: `LV_ES = 1`

Recurrence: `100 ms`

Initialisation:

Initialisation at engine start: transition LV_ES = 1 -> 0
LV_TNT_MIN_THD_2 = 0
LV_TNT_MIN_THD_READY_2 = 0

Initialisation at engine stop: transition LV_ES = 0 -> 1
LV_TNT_MIN_THD_READY_2 = 0
LV_TNT_MIN_THD_2 = 0 % for a system with a NOx-sensor, the sensor
% heating is activated by LV_TNT_MIN_THD_2.
% Hence for a stopped engine the bit must be
% initialized
% Initialisation is done after calculation of EGY_DEW_NT_STOP

Function description:

On engine start, the calculated manifold wall temperature is compared to the reference value IP_TEG_WALL_TNT_DOWN_ST. If that temperature is higher than the reference value, it is assumed that no condensed water condenses from the exhaust gas. The status regarding reaching the dew point is represented by the bit LV_TNT_MIN_THD_2.
If the manifold wall temperature calculated is lower than the reference value (end of dew point not reached LV_TNT_MIN_THD_2 = 0), an additional amount of heat must be introduced into the exhaust-system branch. If the wall temperature exceeds the reference temperature or the amount of energy introduced into the exhaust system exceeds a certain threshold, end of dew point reached (LV_TNT_MIN_THD_2 = 1).
LV_TNT_MIN_THD_READY_2 is an internal flag to detect the first readyness after function start. To trigger the heater management function depending on low wall temperature (long PUC phase) the dew point detection is reseted below C_TEG_WALL_TNT_RED.
To set the dew point again, the hysteresis C_TEG_WALL_TNT_HYS must be passed.
To ensure, that values for TEG_WALL_NT_DOWN_MDL and TEG_WALL_NT_DOWN_MDL_ST are valid, the dew point detection is delayed by C_DLY_DEW_NT.

Formula section:

End of dew point after start:
If(1) T_AST > C_DLY_DEW_NT

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```
Then (1)
  If(2)          LV_TNT_MIN_THD_READY_2 == 0          and
                  (TEG_WALL_NT_DOWN_MDL > IP_TEG_WALL_NT_DOWN_ST and
                  EGY_DEW_END_NT_INT    EGY_DEW_END_NT) and
                  CAN_R_RATIO_NOX_SENS  IP_R_RATIO_NOX_SENS_MIN_DEW
  then(2)       LV_TNT_MIN_THD_2    =  1
                 if(3a)            TEG_WALL_NT_DOWN_MDL     C_TEG_WALL_NT_RED
                 then(3a)        LV_TNT_MIN_THD_READY_2 =  1
                 endif(3a)
  else(2)       // Hysteresis of dew point during engine run
               if(3b)              LV_TNT_MIN_THD_READY_2 == 1
     then(3b)
               if(4)       TEG_WALL_NT_DOWN_MDL   < C_TEG_WALL_NT_RED
               then(4)    LV_TNT_MIN_THD_2    =  0
               else(4)
                    if(5)             TEG_WALL_NT_DOWN_MDL >
                                   C_TEG_WALL_NT_RED + C_TEG_WALL_NT_HYS
                     then(5)       LV_TNT_MIN_THD_2          =  1
                     endif(5)
               endif(4)
                 else(3b)             LV_TNT_MIN_THD_2     =  0
               endif(4b)
  endif(2)
endif (1)
```

7.99.2 Calculation of the NOx catalyst monolith temperature (sensor input)

Formula section:

TEG_PCAT_DOWN_COR[NC_CBK_EX_NR]
= TEG_PCAT_DOWN[NC_CBK_EX_NR] +TEG_PCAT_DOWN_ADD

7.99.2.1 Calculation of number of cold starts for Nox catalyst

After leaving the engine state ST the value of CTR_COLD_ST_NT is incremented by the increment one. At the same time dew point state detection is initialized LV_TNT_MIN_THD_2 = 0, i.e. the exhaust gas temperature is less than the temperature that characterizes the dew point.
The value CTR_COLD_ST_NT is a measure of the number of cold-start tests and has to be stored in the flash-memory when the engine is switched off (LV_IGK = 0). After a new start of the engine CTR_COLD_ST_NT is initialised with the stored value.
CTR_COLD_ST_NT is set to zero when the dew point of Temp_Model_2 is passed (LV_TNT_MIN_THD_2 = 1). The initialisation depends on Temp_Model_2 since it takes the longest for the second part of the Nox catalyst monolith to pass the dew-point.
In that way CTR_COLD_ST_NT is incremented for each engine start if the dew point of Temp_Model_2 was not passed before.

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Application conditions

Initialisation: *from nonvolatile memory or = 0 if not possible*

Recurrence: *only once per engine run* *%CTR_COLD_ST_NT is only incremented per engine run*

Activation: *LV_ES =0*

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Formula section:

If LV_TNT_MIN_THD_2 = 0 % at each transition from LV_ES = 1 -> 0
then CTR_COLD_ST_NT ++ % CTR_COLD_ST_NT is incremented; if there is a
else CTR_COLD_ST_NT = 0 % a transition of LV_TNT_MIN_THD = 0 -> 1 within the
endif % same DC, CTR_COLD_ST_NT has to be set to 0

7.99.3 Increasing the required energy

Function description:

On each restart, the amount of condensed water first increases and then decreases until the dew point is reached. To this effect, the energy introduced into the exhaust system EGY_DEW_END_NT_INT is calculated from the start and saved in the non-volatile memory at "engine stop" and after the latching phase has elapsed.
The amount of energy that has been brought into the exhaust system is weighted with FAC_EGY_DEW_NT_STOP, a factor dependent on the ambient temperature and the ratio of EGY_DEW_END_NT_INT and the threshold EGY_DEW_END_NT.
The result of this whole calculation is stored as EGY_DEW_NT_STOP in non volatile memory.
If the dewpoint is passed, EGY_DEW_NT_STOP is set to 0.

Application conditions

Initialisation: *at reset: from nonvolatile memory or = 0 if not possible*

Recurrence: only once after transition from LV_ES 0 ->1
Activation: at transition from LV_ES 0->1

Formula section:

RATIO_EGY_DEW_NT = EGY_DEW_END_NT_INT /EGY_DEW_END_NT
FAC_EGY_DEW_NT_STOP = IP_FAC_EGY_DEW_END_NT_STOP
If LV_TNT_MIN_THD_2 = 0
then if FAC_EGY_DEW_NT_STOP >= 0
then EGY_DEW_NT_STOP$_{(new)}$ = EGY_DEW_NT_STOP$_{(last)}$
+ IP_EGY_DEW_END_NT * FAC_EGY_DEW_NT_STOP
else EGY_DEW_NT_STOP$_{(new)}$ = EGY_DEW_NT_STOP$_{(last)}$
+ EGY_DEW_NT_STOP$_{(last)}$* FAC_EGY_DEW_NT_STOP
endif
else EGY_DEW_NT_STOP$_{(new)}$ = 0
endif

7.99.4 Integration of energy brought into the exhaust system

Function description:

For dew point detection of the NOX-Trap, the energy, that is brought into the exhaust system, has to be integrated.

Application conditions

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Initialisation: *EGY_DEW_END_NT_INT = 0 at transition LV_ES 1 -> 0*

Recurrence: *200ms*

Activation: *LV_ST_END= 1 and LV_ES = 0*

Deactivation: LV_ES =1

Formula section:

EGY_DEW_END_NT_INT = EGY_DEW_END_NT_INT$_{(n-1)}$ + EGY_DEW_NT_DOWN * 0,2s

7.99.5 Calculation of the total energy until end of dew point

Application conditions

Activation: LV_CHECK_MDL_ST = 1

Deactivation: LV_ES = 1

Recurrence: 100ms

Initialisation:

Initialisation at engine start: transition LV_ES = 1 -> 0
EGY_DEW_END_NT = FFFFFFFFH
CTR_EGY_DEW_NT = 0

Function description:

To enable detection end of dew point, the necessary energy that has to be introduced into the exhaust system must be calculated first.

The value for the missing amount of energy is obtained from the map IP_EGY_DEW_END_NT. Input for this map is TEG_WALL_NT_DOWN_MDL_ST and TCO_ST.

ID_MAF_KGH_MIN_EGY_DEW_NT is a curve versus the wall temperature TEG_WALL_NT_DOWN_MDL which describes the minimum mass air flow, that has to exceeded to trigger the incrementing of CTR_EGY_DEW_NT.

MAF_KGH and of CTR_EGY_DEW_NT are inputs for IP_FAC_EGY_DEW_END_NT which will provide another factor for decreasing EGY_DEW_END_NT.

Formula section:

MAF_KGH_MIN_EGY_DEW_NT = ID_MAF_KGH_MIN_EGY_DEW_NT

If MAF_KGH > MAF_KGH_MIN_EGY_DEW_NT
Then CTR_EGY_DEW_NT ++ *% increment by 0.1*
Else CTR_EGY_DEW_NT = 0 *% reset counter*

FAC_EGY_DEW_END_NT = IP_FAC_EGY_DEW_END_NT
FAC_EGY_DEW_END_NT_TAM_T_ES = IP_FAC_EGY_DEW_END_NT_TAM_T_ES

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EGY_DEW_END_NT_TMP = **MIN**{ [(IP_EGY_DEW_END_NT * FAC_EGY_DEW_END_NT_TAM_T_ES + EGY_DEW_NT_STOP)*FAC_EGY_DEW_END_NT] ; IP_EGY_DEW_NT_MAX * FAC_EGY_DEW_END_NT }

EGY_DEW_END_NT = **MIN**(EGY_DEW_END_NT_TMP ; EGY_DEW_END_NT$_{(n-1)}$)

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7.100 NOx catalyst monolith temperature model (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TNT_MIN_COR_n	O/V	0... FFH	0... 1.99219	0.007812	-
Factor to reduce dew-point time of NOx cat. monolith temp. model					
TEG_PCAT_DOWN_ADD	O/V	8000... 7FFFH	-512 ...512	0.015625	°C
Temperature offset to correct the influence of the Exhaust flap and temp. sensor position					

Input data:

LV_ES {p. 1720}	LV_ST {p. 1720}		

7.100.1 Additive correction of the input temperature TEG_PCAT_DOWN

FUNCTION DESCRIPTION:

For systems containing an exhaust flap a correction of the model input temperature TEG_PCAT_DOWN can be necessary.

Application conditions

Activation: `- engine state LV_ST = 0`
`- engine state LV_ES = 0`

Deactivation: *- engine state ES is active (LV_ES = 1)*

Recurrence: *100 ms*

Formula section:

TEG_PCAT_DOWN_ADD = 0

FAC_TNT_MIN_COR_1 = 1 % default value, no reduction of dew point time
FAC_TNT_MIN_COR_2 = 1 % default value, no reduction of dew point time

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7.101 NOx signal gain adaptation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_NS_AD_CYC [NC_NOX_SENS_CONF]	O/V/S	0... FFFFH	0... 65535	1	-
Counter of NOx signal gain adaptations					
DIST_NT_NS_AD [NC_NOX_SENS_CONF]	O/V/S	0... FFFFH	0... 524280	8	km
Current distance from last NOx signal gain adaptation					
FAC_NOX_NS_AD [NC_NOX_SENS_CONF]	O/V/S	0... FFFFH	0... 127.99804	1.9531e-3	-
Adaptation of the NOx sensor characteristic shift					
LV_NS_AD_REQ	O/V	0... 1H	0 ...1	1	-
Request for NOx signal gain adaptation					
STATE_OPM_REQ_NS_AD	O/V	0... FFFFH	0... 65535	1	-
Request for operation mode for executing of NOx sensor adaptation					

Input data:

NC_NOX_SENS_CONF {p. 643}			

Action definition

ACTION_NOXD_CleanNSAdapt ()	Mode: O
Initialization of NOx signal shift diagnosis variables	

ACTION_NOXD_WriteNSGainDiagExtAdj ()	Mode: O
Write external adjust values for NOx signal shift diagnosis	

Description for Actions

ACTION_NOXD_CleanNSAdapt()
Initialization of NOx signal shift diagnosis variables

ACTION_NOXD_WriteNSGainDiagExtAdj()
Write external adjust values for NOx signal shift diagnosis

FUNCTION DESCRIPTION:

General Information

Stub module for recource optimization

Application Conditions

Initialization: at reset

CTR_NS_AD_CYC[i] = 0

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DIST_NT_NS_AD[i] = 0
FAC_NOX_NS_AD[i] = 1
LV_NS_AD_REQ[i] = 0
STATE_OPM_REQ_NS_AD[i] = 0

Recurrence:

Activation:

Deactivation:

7.101.1 Detailed description for Action: ACTION_NOXD_CleanNSAdapt

FUNCTION DESCRIPTION:

- –

7.101.2 Detailed description for Action: ACTION_NOXD_WriteNSGainDiagExtAdj

FUNCTION DESCRIPTION:

- –

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7.102 NOx sensor setpoint shift diagnosis - lambda intervention

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_ADJ_NS_SHIFT_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to switch trim control parameters for NS shift diagnosis					
VLS_DELTA_LAM_ADJ_NS_SHIFT [NC_CBK_EX_NR]	O/V	FC00... 3FFH	-5... 4.99511	4.8828e-3	V
Sensor voltage set point shift in case of NOx sensor shift diagnosis					
VLS_DELTA_TMP_NS_SHIFT [NC_CBK_EX_NR]	V	FC00... 3FFH	-5... 4.99511	4.8828e-3	V
Temporary sensor voltage set point shift for NOx sensor shift diagnosis					

Input data:

LV_NS_SHIFT_CMB_INT_REQ {p. 6426}	NC_CBK_EX_NR {p. 1829}	OPM_REQ_CUS {p. 8137}	VLS_SP_LAM_ADJ [NC_CBK_EX_NR] {p. 2590}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_NS_SHIFT_CMB_ACT	-	0... FFFFH	0... 65535	1	-
Check if combustion mode for NOx signal internal shift diagnosis is active (FFFFh means check is disabled)					
C_VLS_DELTA_LAM_NS_MAX [NC_CBK_EX_NR]	-	FC00... 3FFH	-5... 4.99511	4.8828e-3	V
Maximum offset for trim controller set-point for NOx sensor shift diagnosis					
C_VLS_DELTA_LAM_NS_MIN [NC_CBK_EX_NR]	-	FC00... 3FFH	-5... 4.99511	4.8828e-3	V
Minimum offset for trim controller set-point for NOx sensor shift diagnosis					
C_VLS_SP_NS_SHIFT [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Trim controller set-point for NOx sensor shift diagnosis					
LC_VLS_LAM_ADJ_NS_SHIFT [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Enable offset for trim control at NOx sensor shift diagnosis					

FUNCTION DESCRIPTION:

General information:

This module influences the trim control set-point during NOx sensor shift diagnosis by setting an offset to the actual value for the trim controller.

Calculation has to be done for each trim controller: i = 1 ... NC_CBK_EX_NR

Application conditions

Recurrence: 100 ms

Activation: - -

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Deactivation: - -

Initialisation at reset: LV_LAM_ADJ_NS_SHIFT_DIAG[i] = 0
VLS_DELTA_LAM_ADJ_NS_SHIFT[i] = 0 V
VLS_DELTA_TMP_NS_SHIFT[i] = 0 V

Formula section:

VLS_DELTA_TMP_NS_SHIFT[i] = VLS_SP_LAM_ADJ[i] - C_VLS_SP_NS_SHIFT[i]

If VLS_DELTA_TMP_NS_SHIFT[i] > C_VLS_DELTA_LAM_NS_MAX[i]
Then VLS_DELTA_TMP_NS_SHIFT[i] = C_VLS_DELTA_LAM_NS_MAX[i]
ElseIf VLS_DELTA_TMP_NS_SHIFT[i] < C_VLS_DELTA_LAM_NS_MIN[i]
Then VLS_DELTA_TMP_NS_SHIFT[i] = C_VLS_DELTA_LAM_NS_MIN[i]
Endif

If LC_VLS_LAM_ADJ_NS_SHIFT[i] **AND**
LV_NS_SHIFT_CMB_INT_REQ = 1 **AND**
(OPM_REQ_CUS = C_STATE_NS_SHIFT_CMB_ACT **OR**
C_STATE_NS_SHIFT_CMB_ACT = 0FFFFh**)**
Then LV_LAM_ADJ_NS_SHIFT_DIAG[i] = 1
VLS_DELTA_LAM_ADJ_NS_SHIFT[i] = VLS_DELTA_TMP_NS_SHIFT[i]
Else LV_LAM_ADJ_NS_SHIFT_DIAG[i] = 0
VLS_DELTA_LAM_ADJ_NS_SHIFT[i] = 0
Endif

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7.103 NOx sensor function

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DIST_NS_NEW	O/V/S	0... FFFFH	0... 524280	8	km
mileage counter value of last exchange of NOx sensor					
FAC_NOX_NS_AD_GAIN [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 127.998047	0.00195313	-
Correction of the NOx sensor signal due to signal shift					
LV_NOX_OFS_LOAD [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx minimum observation activation					
LV_T_NS_VLD	O/V	0... 1H	0 ...1	1	-
NOx sensor signal valid after regeneration					
LV_T_NS_VLD_TMP [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor signal valid after regeneration (bank selective)					
NOX_NS_AD [NC_NOX_SENS_CONF]	O/V	0... 5DCH	0... 1500	1	ppm
NOx concentration in the exhaust gas downstream of NOx catalyst					
NOX_NS_AD_ADD [NC_NOX_SENS_CONF]	O/V	FF9C... 5DCH	-100 ...1500	1	ppm
Offset adaptation value for the NOx signal					
NOX_NS_AD_DELTA [NC_NOX_SENS_CONF]	V	FA24... 5DCH	-1500 ...1500	1	ppm
NOx sensor signal gradient (bank selective)					
NOX_NS_AD_DELTA_MMV [NC_NOX_SENS_CONF]	V	FA24... 5DCH	-1500 ...1500	1	ppm
NOx sensor signal gradient moving mean value (bank selective)					
NOX_NS_OFS_AD_MIN [NC_NOX_SENS_CONF]	O/V	FF9C... 5DCH	-100 ...1500	1	ppm
Minumum NOx signal after LOAD phase					
NOX_OFS_LOAD [NC_NOX_SENS_CONF]	O/V/S	FF9C... 5DCH	-100 ...1500	1	ppm
NOx signal offset value, measured after start of a LOAD phase					
NOX_OFS_PUC [NC_NOX_SENS_CONF]	O/V/S	FF9C... 5DCH	-100 ...1500	1	ppm
NOx signal offset value, measured at PUC					
T_NOX_NS_AD_DELTA_VLD [NC_NOX_SENS_CONF]	V	0... FFH	0... 25.5	0.1	s
Timer for NOx sensor signal valid regarding gradient observation					

Input data:

CTR_NT_AGI_AD_CMPL_SUM {p. 3072}	DIST_NS_NEW_EXT_ADJ {p. 7679}	DIST_NT {p. 3180}	FAC_NOX_NS_AD [NC_NOX_SENS_CONF] {p. 3189}
LV_NOX_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_SENS {p. 2982}	LV_NT_HOM_INI {p. 2982}	LV_PUC {p. 1720}
MAF_INT_PUC_ACT {p. 2942}	NC_NOX_SENS_CONF {p. 643}	NC_NT_NR {p. 644}	NOX_NS [NC_NOX_SENS_CONF] {p. 992}

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NOX_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}	NT_AGI {p. 3073}	NT_AGI_SUL {p. 3073}	NT_SUL {p. 3113}
RATIO_MMV_NS_SHIFT_DIAG [NC_NOX_SENS_CONF] {p. 6412}	STATE_NOX {p. 2986}	T_AFL {p. 2987}	T_AFL_PUC {p. 2987}
T_NOX_NS_MDL [NC_NOX_SENS_CONF] {p. 992}	T_NOX_NS_OSC [NC_NOX_SENS_CONF] {p. 1381}	TNT_MDL_H {p. 8237}	TNT_MDL_L {p. 8237}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_NOX_NS_AD_DELTA	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Correlation factor to calculate moving mean value of the NOx sensor signal gradient					
C_CRLC_NOX_OFS_PUC	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Correlation constant for calculation of PUC offset value					
C_CTR_NT_AGI_AD_CMPL_SUM_AD_MIN	-	0... FFFFH	0... 65535	1	-
Minimum completed sulphur adaptations for set free of NOx signal offset adaptation					
C_FAC_NOX_NS_AD_MAX	-	0... FFFFH	0... 127.998047	0.00195313	-
Maximal allowed correction of characteristic shift down of NOx signal					
C_FAC_NOX_NS_AD_MIN	-	0... FFFFH	0... 127.998047	0.00195313	-
Minimal allowed correction of characteristic shift down of NOx signal					
C_MAF_INT_PUC_MIN_NOX	-	0... FFFFH	0... 2912.67	0.04444444	g
Minimum air mass flow threshold for starting the NOx signal offset adaptation at PUC					
C_NOX_AD_ADD_MAX	-	FF9C... 5DCH	-100 ...1500	1	ppm
Maximum limit of NOx signal offset adaptation value					
C_NOX_AD_ADD_MIN	-	FF9C... 5DCH	-100 ...1500	1	ppm
Minimum limit of NOx signal offset adaptation value					
C_NOX_ADD_ZERO_MAX	-	FF9C... 5DCH	-100 ...1500	1	ppm
Upper NOx signal offset adaptation value threshold to set the adaptation value to 0					
C_NOX_ADD_ZERO_MIN	-	FF9C... 5DCH	-100 ...1500	1	ppm
Lower NOx signal offset adaptation value threshold to set the adaptation value to 0					
C_NOX_NS_AD_ADD [NC_NOX_SENS_CONF]	-	FF9C... 5DCH	-100 ...1500	1	ppm
Manual NOx signal offset					
C_NOX_NS_AD_DELTA_MMV_MAX	-	FA24... 5DCH	-1500 ...1500	1	ppm
Maximum allowed NOx sensor signal gradient					
C_NOX_NS_AD_DELTA_MMV_MIN	-	FA24... 5DCH	-1500 ...1500	1	ppm
Minimum allowed NOx sensor signal gradient					
C_NOX_NS_AD_MAX_SENS_VLD	-	0... 5DCH	0... 1500	1	ppm
Maximum NOx sensor signal to enable gradient observation					
C_NOX_OFS_PUC_MAX	-	FF9C... 5DCH	-100 ...1500	1	ppm
Maximum NOx signal offset value at PUC phase					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NOX_OFS_SEL	-	0H 1H 2H 3H	PUC_OFFSET LOAD_ OFFSET MIN_OFFSET MAN_OFFSET	-	-
Selection of a NOx signal adaptation method					
C_NT_AGI_NOX_OFS_MIN	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx catalyst aging threshold for calculation of a new NOx signal offset value					
C_NT_AGI_SUL_NOX_OFS_AD_MIN	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Minimum NOx catalyst aging factor due to sulphur for set free of NOx signal offset adaptation					
C_NT_HOM_INI_USE	-	0... 3H	0 ...3	1	-
Configutation of adaptation function					
C_NT_SUL_NOX_OFS_AD_MAX	-	0... FFFFH	0... 10485.6	0.16	mg
Maximum NOx catalyst sulphur load for set free of NOx signal offset adaptation					
C_T_AFL_NOX_OFS_MIN	-	0... FFFFH	0... 1310.7	0.02	s
Min. lean time for calculation of NOx signal offset adaptation value					
C_T_NOX_NS_AD_DELTA_MIN	-	0... FFH	0... 25.5	0.1	s
Minimum time for set NOx-Sensor signal to valid regarding NOx-Signal gradient observation					
C_T_NOX_NS_OFS	-	0... FFFFH	0... 655.35	0.01	s
Min. NOx signal time for enable of NOx signal offset adaptation					
C_T_NOX_NS_OFS_PUC	-	0... FFFFH	0... 655.35	0.01	s
Minimum time NOx-Signal is valid for enable of NOx signal offset adaptation in PUC phase					
C_T_NOX_NS_OSC_OFS	-	0... FFFFH	0... 655.35	0.01	s
Waiting time after last detection of an oscillation of NOx signal for offset adaptation					
C_T_NS_VLD	-	0... FFFFH	0... 1310.7	0.02	s
Minimum lean time to set NOx sensor signal to valid					
C_T_NS_VLD_PUC	-	0... FFFFH	0... 1310.7	0.02	s
Minimum PUC time to set NOx sensor signal to valid					
C_TNT_MDL_NOX_OFS_MAX	-	0... FFFFH	0... 1023.98	0.015625	°C
Maximum temperature of NOx catalyst, at which the NOx signal offset adaptation at LOAD is active					
C_TNT_MDL_NOX_OFS_MIN	-	0... FFFFH	0... 1023.98	0.015625	°C
Minimum temperature of NOx catalyst, at which the NOx signal offset adaptation at LOAD is active					
IP_CRLC_NOX_OFS_LOAD	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
LDP_NOX_NS_OFS_AD_MIN_IP_LOAD	4	0... 640H	-100 ...1500	1	ppm
Correlation constant for calculation of LOAD offset value					
IP_FAC_NOX_NS_AD_COR	-	0... FFFFH	0... 127.998047	0.00195313	-
LDP_NOX_NS_AD_IP_FAC_COR	6	0... 5DCH	0... 1500	1	ppm
LDP_FAC_NOX_NS_AD_IP_FAC_NOX	6	0... FFFFH	0... 127.998047	0.00195313	-
Correction of gain adaptation factor due to non-linearity of the characteristic shift down					
IP_FAC_RATIO_NS_SHIFT_COR	-	0... FFFFH	0... 127.998047	0.00195313	-
LDP_RATIO_NS_SHIFT_IP_FAC_COR	6	0... FFFFH	-1... 0.99996948	30.5175e-6	-
NOx signal correction factor depending on RATIO					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_NOX_NS_OFS_VLD_ON	-	0... 1H	0 ...1	1	-
Valid NOx-Sensor signal is necessary for this offset adaptation (on/off)					

Action definition

ACTION_NOXD_CleanAdDataNS (OUT<trig_CLR_AD>)	Mode: O
Clean adaptation data of NOx Sensor	

ACTION_NOXD_WriteNSAdExtAdj (OUT<trig_EXT_ADJ>)	Mode: O
Write external adjust values for NOx Sensor	

Overview

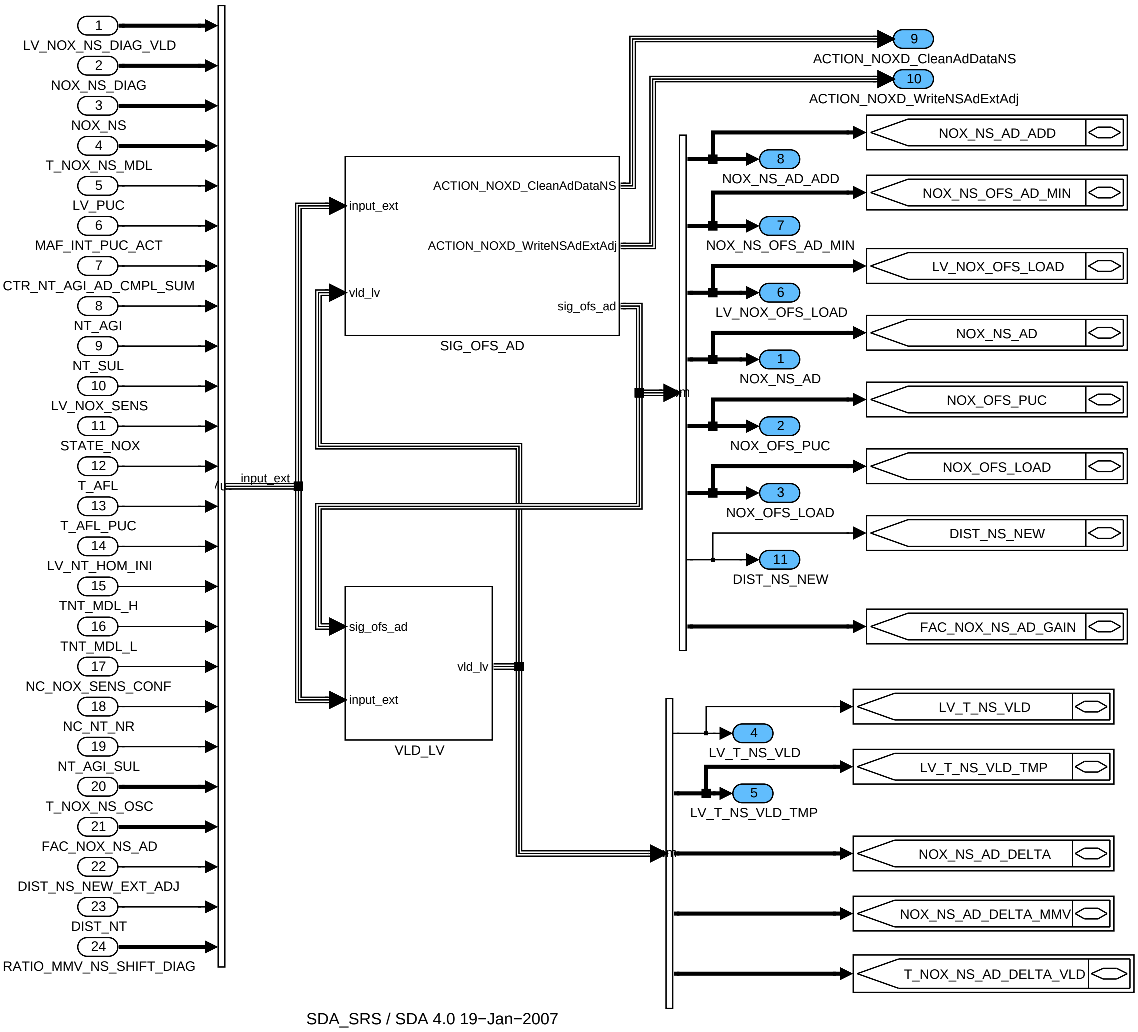

Figure 7.103.1: NOXD_MDLADNSFCN0

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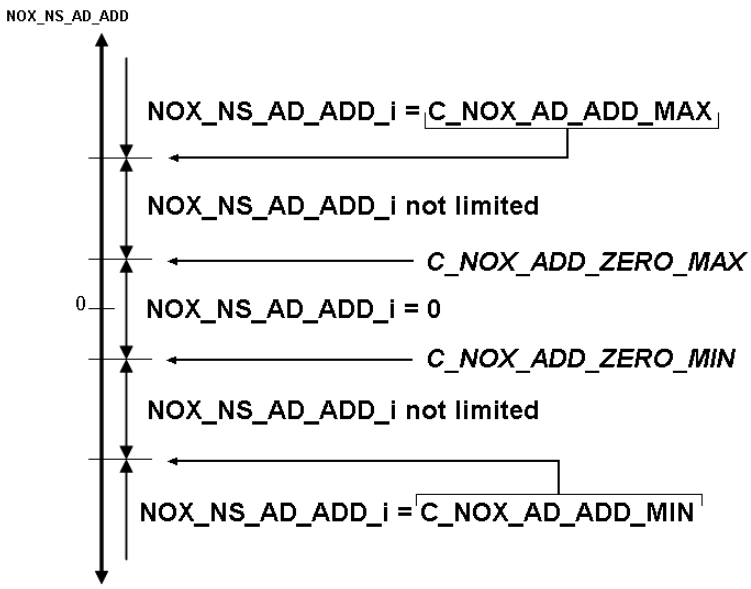
7.103.1 NOx signal offset adaptation

NOx signal offset adaptation can be done at PUC phase. At PUC phase NOx signal is influenced by the humidity cross-sensitivity of NOx-Sensor. The NOx signal is a combination out of signal offset and humidity cross-sensitivity.
Another possibility for NOx signal offset adaptation is after the start of a new NOx catalyst LOAD phase. At this time the NOx catalyst stores the NOx so that the NOx emissions are nearly to 0 [ppm]. Hence the NOx signal is dominated by signal offset. Attention! After an incompletely NOx regeneration or when the NOx catalyst has got a high sulphur load this offset adaptation must be inhibited.
This NOx signal offset adaptation calculates all offset values. Which offset value is used for the NOx signal offset adaptation, is possible to calibrate.
The NOx signal NOX_NS_i is compared with C_NOX_OFS_PUC_MAX before a new adaptation value (NOX_OFS_PUC_i) is calculated. This check is for prevention of adaptation failures.
C_NOX_OFS_PUC_MAX is the sum of the maximum humidity cross-sensitivity and the maximum positive NOx signal offset according to the sensor specification.
The calibration constant C_NT_HOM_INI_USE is used for independent configuration of offset calculation at PUC and of offset calculation after start of LOAD phase .

C_NT_HOM_INI_USE	**Description**
Bit B0	The offset calculation at PUC considers LV_NT_HOM_INI at offset determination (1...on/ 0...off).
Bit B1	The offset calculation after start of “LOAD” phase considers LV_NT_HOM_INI at offset determination (1...on/ 0...off).
Bit B2	not used
Bit B3	not used
Bit B4	not used
Bit B5	not used
Bit B6	not used
Bit B7	not used

The final NOx signal offset adaptation value NOX_NS_AD_ADD _i arises out of PUC offset value (NOX_OFS_PUC_i), LOAD offset value (NOX_OFS_LOAD_i) or manual offset value (C_ NOX_NS_AD_ADD_i). The used value is selected by C_NOX_OFS_SEL.
After the calculation of NOX_NS_AD_ADD_i it is limited (see below).



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Setting NOX_NS_AD_ADD_i to 0 within the gap C_NOX_ADD_ZERO_MIN < NOX_NS_AD_ADD_i < C_NOX_ADD_ZERO _MAX was implemented in order to switch off the NOx signal offset adaptation if the calculated offset value is within the specified NOx signal tolerance (see NOx-Sensor specification).
NOX_NS_AD_i is the measured signal which is corrected by the signal offset NOX_NS_AD_ADD_i.
The calculation of NOX_NS_AD_i is done with a recurrence, which is in accordance with the NOx catalyst regeneration request calculation.
Additional information:
Suffix "_cur" is an abbreviation of current and means that the value is calculated in the same recurrence not first time.
Suffix "_old" means that this value is calculated last time in previous recurrence.

Application Condition

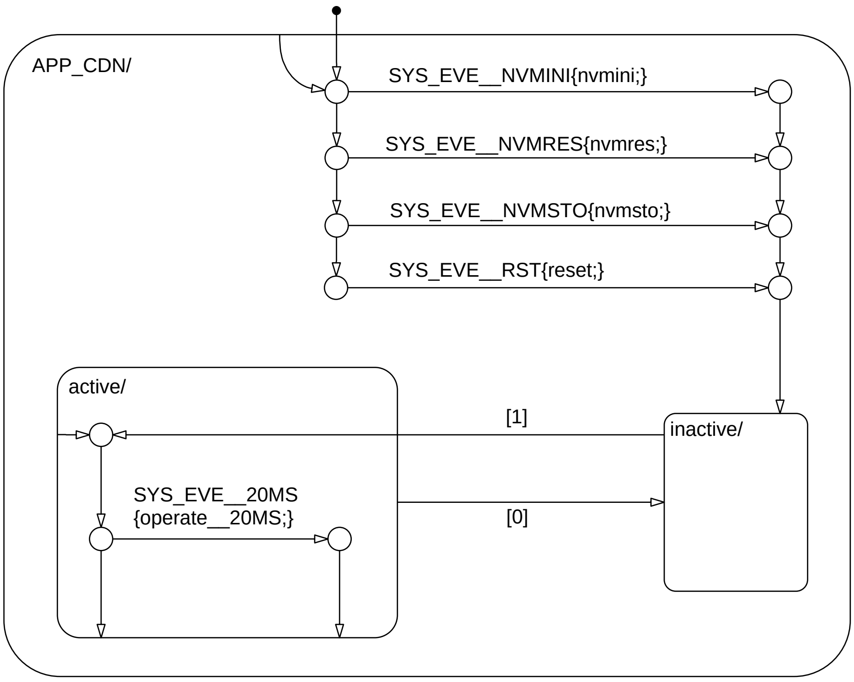

Figure 7.103.2: NOXD_MDLADNSFCN0/SIG_OFS_AD/APP_CDN/Chart

Function Description

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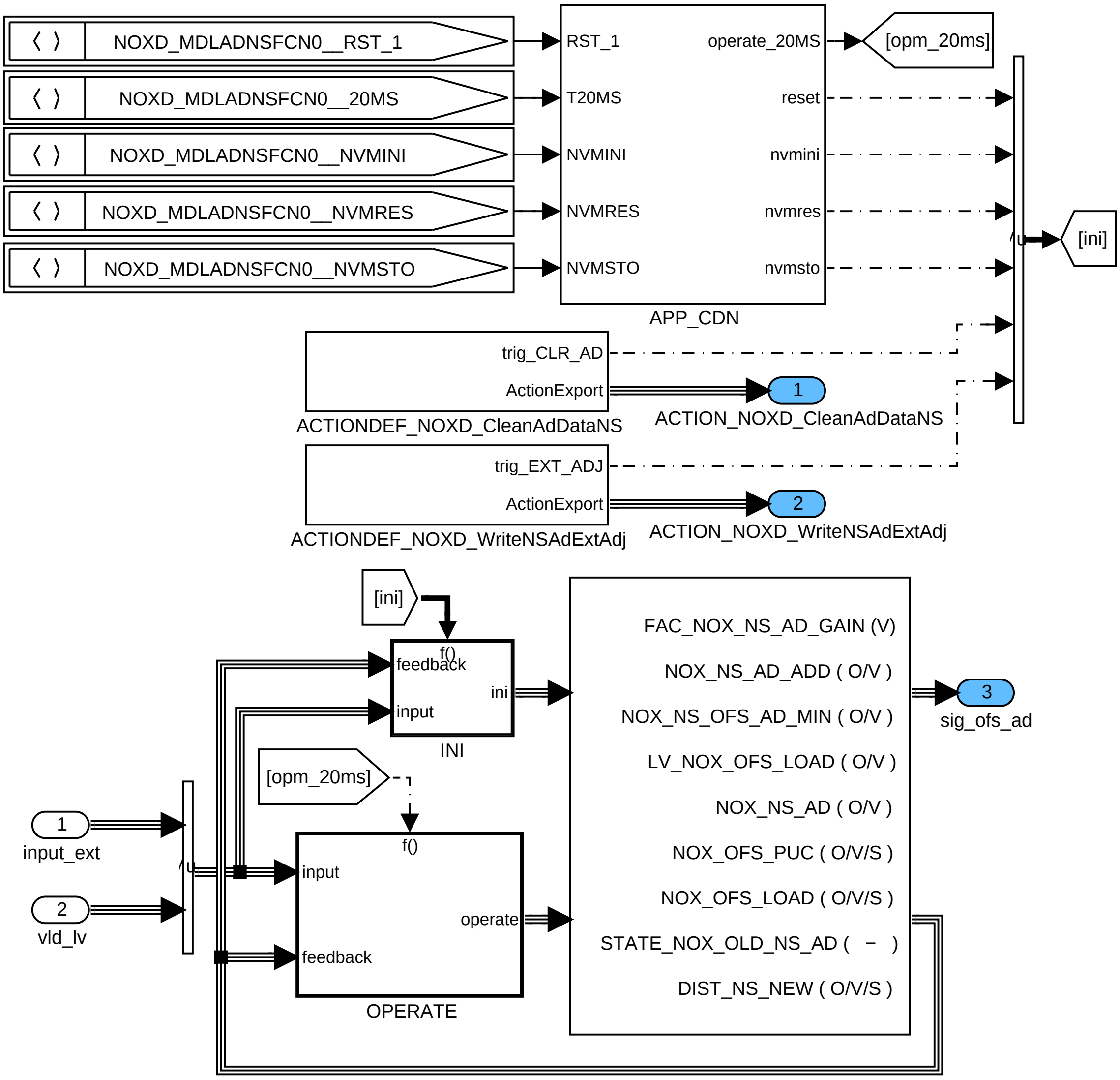

Figure 7.103.3: NOXD_MDLADNSFCN0/SIG_OFS_AD

7.103.1.1 SUBFUNCTION: ACTIONDEF_NOXD_CleanAdDataNS

Description for ACTION_NOXD_CleanAdDataNS

ACTION_NOXD_CleanAdDataNS(OUT <trig_CLR_AD>)					
Clean adaptation data of NOx Sensor					
Parameter	**Type**	**Hex. limits**	**Phys. limits**	**Resol.**	**Unit**
trig_CLR_AD					

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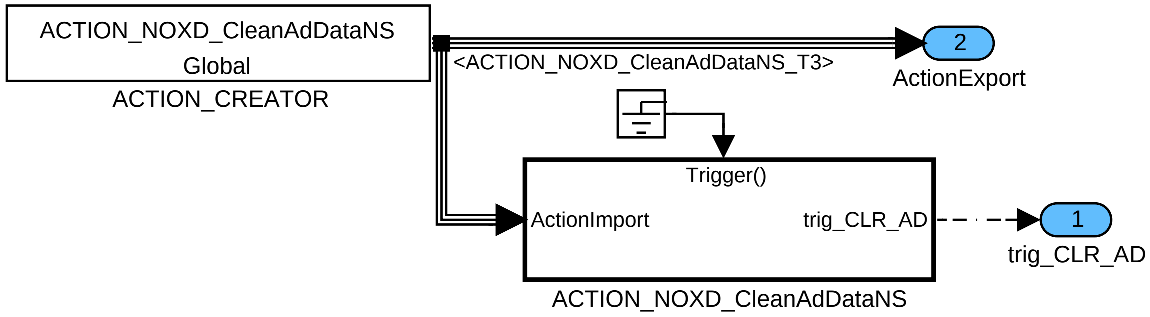

Figure 7.103.4: NOXD_MDLADNSFCN0/SIG_OFS_AD/ACTIONDEF_NOXD_CleanAdDataNS

ACTION_NOXD_CLEANADDATANS

This action generates a function call to clear adaptation values.

Figure 7.103.5: NOXD_MDLADNSFCN0/SIG_OFS_AD/ACTIONDEF_NOXD_CleanAdDataNS/ACTION_NOXD_CleanAdDataNS

7.103.1.2 SUBFUNCTION: ACTIONDEF_NOXD_WriteNSAdExtAdj

Description for ACTION_NOXD_WriteNSAdExtAdj

ACTION_NOXD_WriteNSAdExtAdj(OUT <trig_EXT_ADJ>)					
Write external adjust values for NOx Sensor					
Parameter	**Type**	**Hex. limits**	**Phys. limits**	**Resol.**	**Unit**
trig_EXT_ADJ					

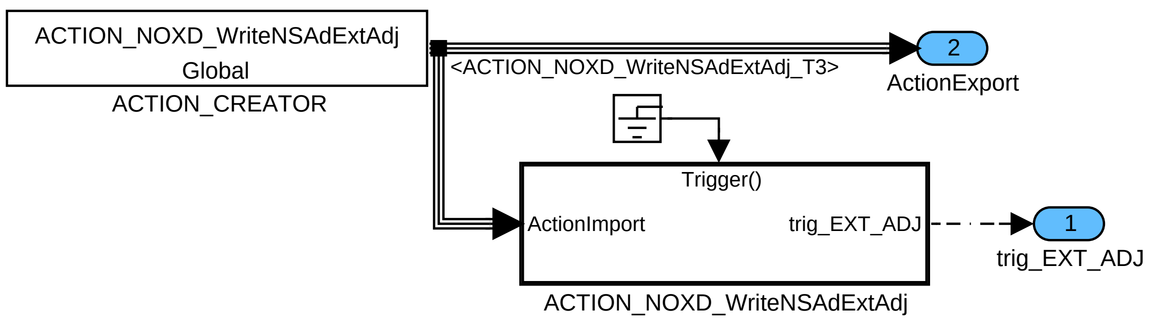

Figure 7.103.6: NOXD_MDLADNSFCN0/SIG_OFS_AD/ACTIONDEF_NOXD_WriteNSAdExtAdj

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ACTION_NOXD_WRITENSADEXTADJ

This action generates a function call to set adaptation values by external values.

Figure 7.103.7: NOXD_MDLADNSFCN0/SIG_OFS_AD/ACTIONDEF_NOXD_WriteNSAdExtAdj/ ACTION_NOXD_WriteNSAdExtAdj

7.103.1.3 INITIALIZATION

At reset all variables except NVMY data are initialized with "0"

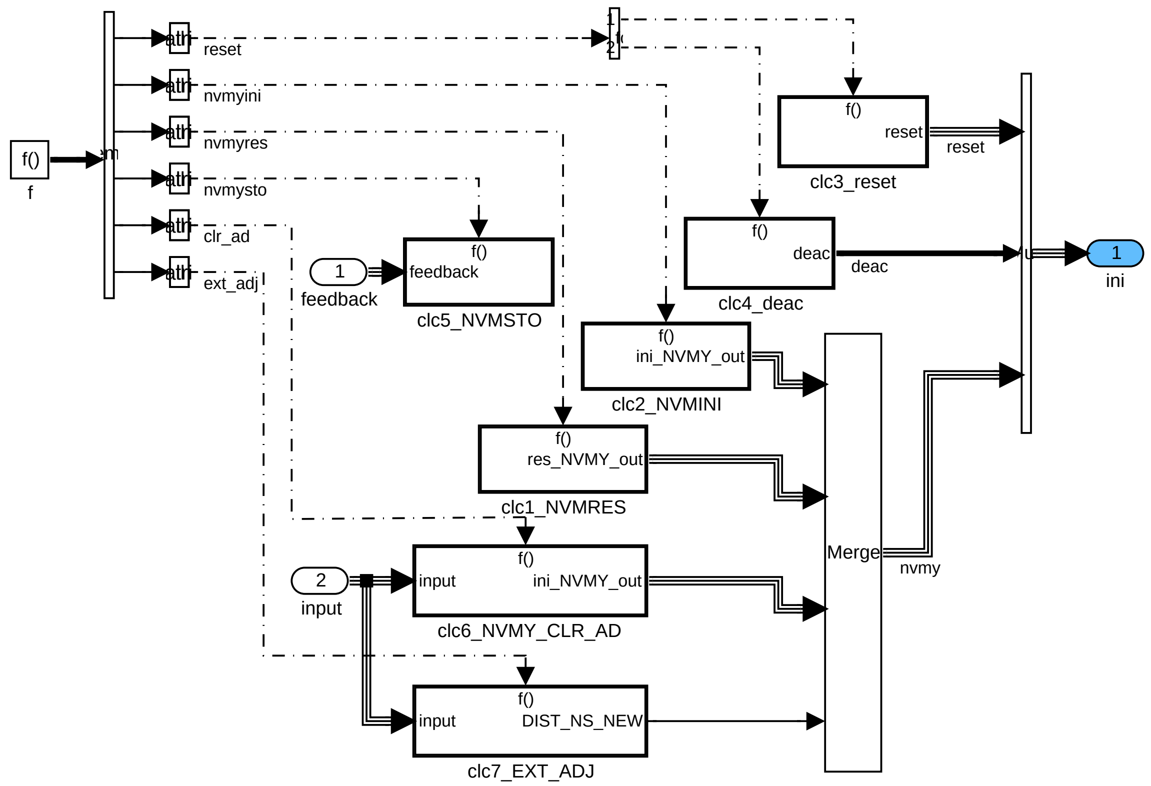

Figure 7.103.8: NOXD_MDLADNSFCN0/SIG_OFS_AD/INI

Initialization of NVMY data

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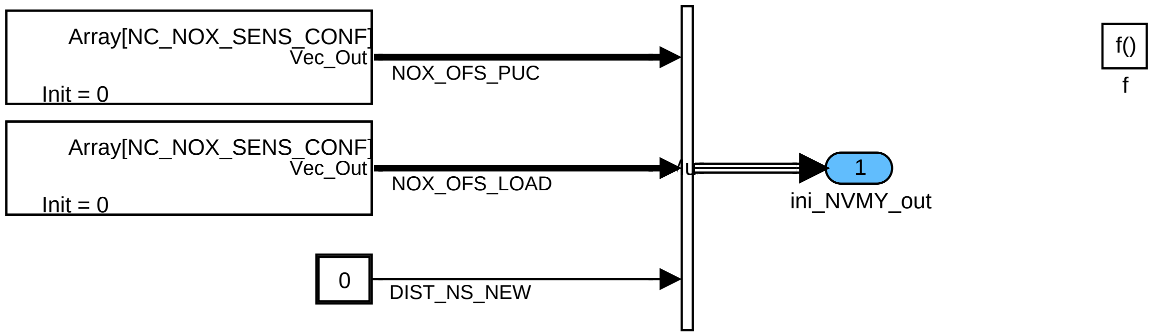

Figure 7.103.9: NOXD_MDLADNSFCN0/SIG_OFS_AD/INI/clc2_NVMINI

Initialization at deactivation

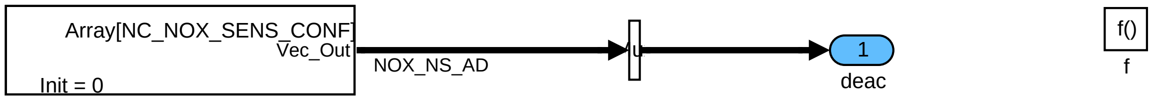

Figure 7.103.10: NOXD_MDLADNSFCN0/SIG_OFS_AD/INI/clc4_deac

Initialization if new sensor was built-in

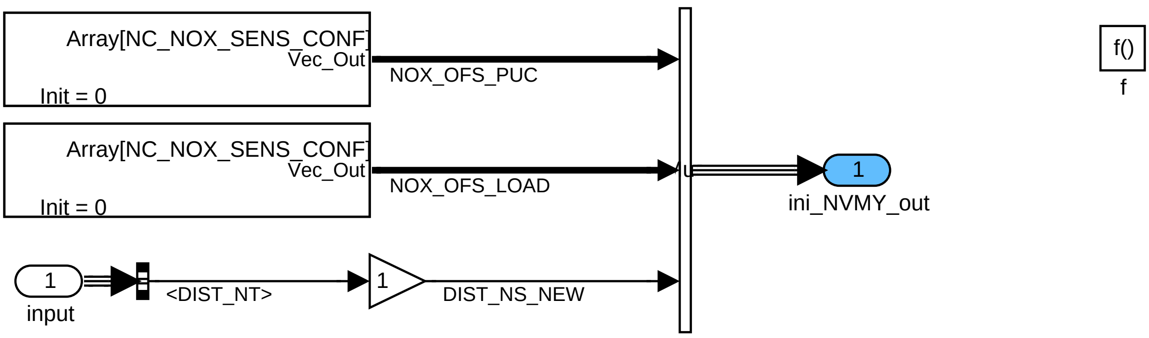

Figure 7.103.11: NOXD_MDLADNSFCN0/SIG_OFS_AD/INI/clc6_NVMY_CLR_AD

Initialization at external adjust

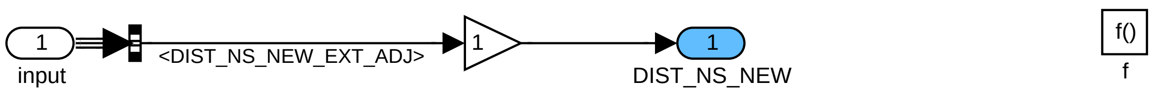

Figure 7.103.12: NOXD_MDLADNSFCN0/SIG_OFS_AD/INI/clc7_EXT_ADJ

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7.103.1.4 FORMULA SECTION

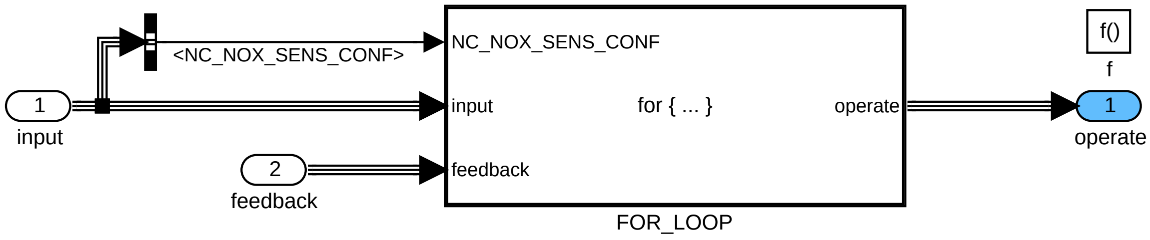

Figure 7.103.13: NOXD_MDLADNSFCN0/SIG_OFS_AD/OPERATE

For loop realization

For loop is realized using number of NOx Sensors (NC_NOX_SENS_CONF). The index for NOx Specific variables is "i".

Formula section for NOx Sensor specific calculations

Formula section contains:
SECTION 1: Offset value calculation
SECTION 2: Case selection for finally adaptation value calculation
SECTION 3: Limitation of chose adaptation value
SECTION 4: Realization of adaptation on measured signal

SECTION 1: Offset value calculation

This section contains:
SECTION 1.1: Offset calculation at PUC phase
SECTION 1.2: Offset calculation at LOAD phase

SECTION 1.1: Offset calculation at PUC phase

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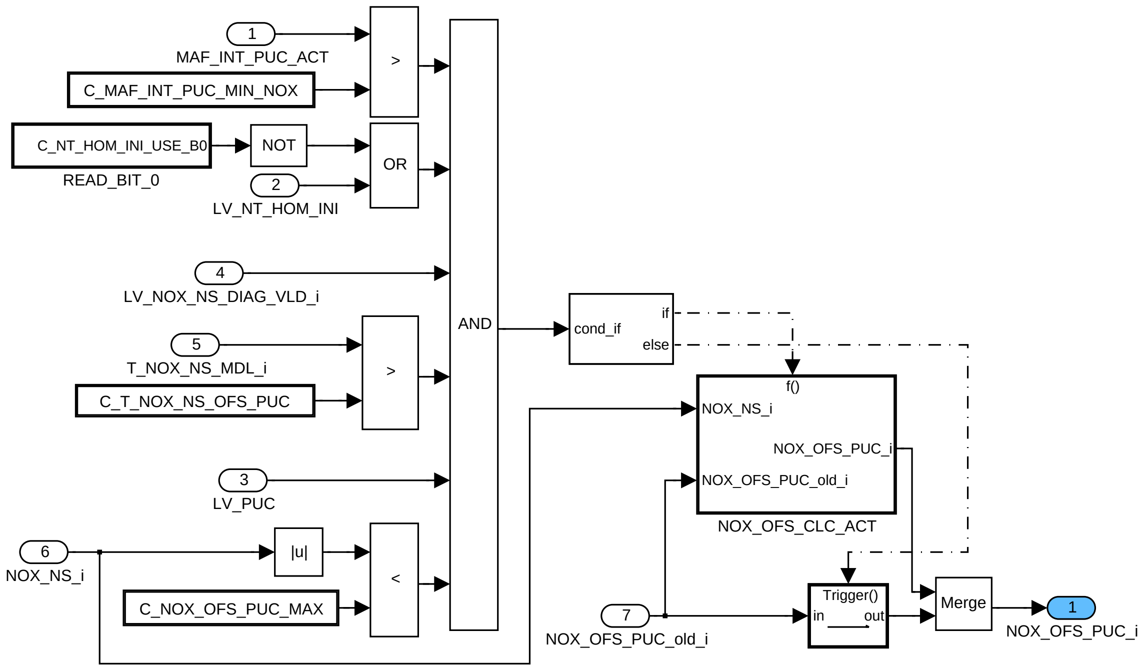

Figure 7.103.14: NOXD_MDLADNSFCN0/SIG_OFS_AD/OPERATE/FOR_LOOP/NS_SPC_FCN/
CLC1_OFS/CLC1_NOX_OFS_PUC

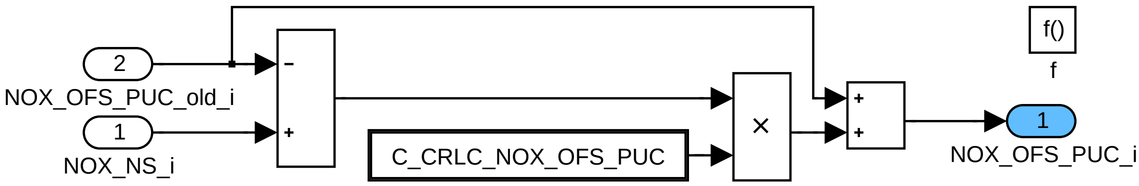

Figure 7.103.15: NOXD_MDLADNSFCN0/SIG_OFS_AD/OPERATE/FOR_LOOP/NS_SPC_FCN/
CLC1_OFS/CLC1_NOX_OFS_PUC/NOX_OFS_CLC_ACT

SECTION 1.2: Offset calculation at LOAD phase

This section contains:
SECTION 1.2.1: Activation of NOx minimum observation
SECTION 1.2.2: Calculation of NOx sensor signal minimum value
SECTION 1.2.3: Calculation of offset value after left of LOAD phase
SECTION 1.2.4: Reset of activation flag for NOx signal minimum observation
SECTION 1.2.5: Calculation of old values

SECTION 1.2.1: Activation of NOx minimum observation

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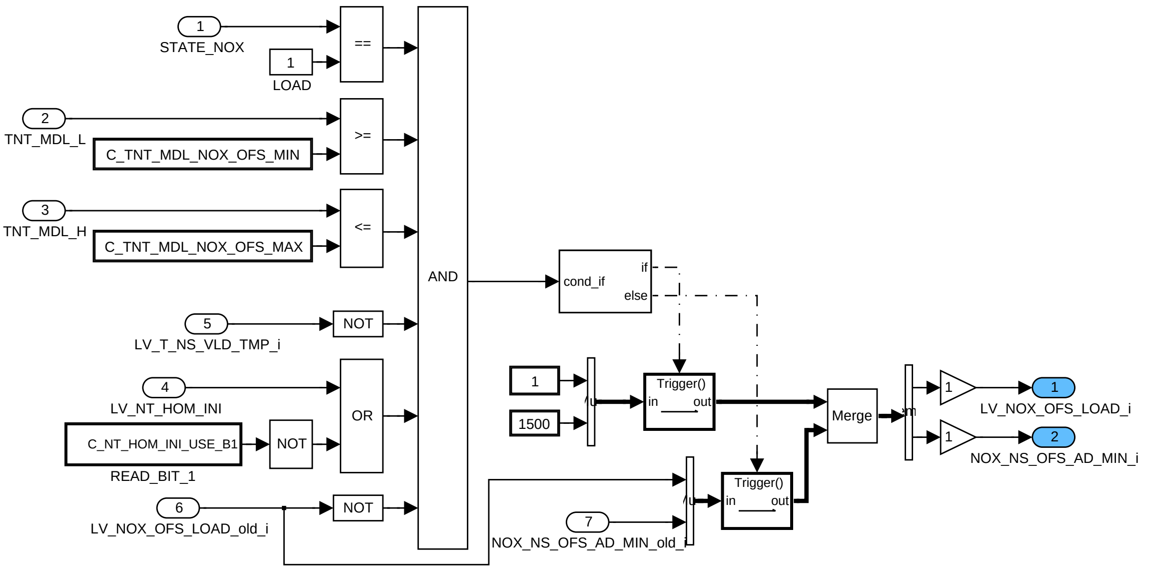

Figure 7.103.16: NOXD_MDLADNSFCN0/SIG_OFS_AD/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC1_OFS/CLC2_NOX_OFS_LOAD/CLC1_DIAG_MIN_OBS_ACT

SECTION 1.2.2: Calculation of NOx sensor signal minimum value

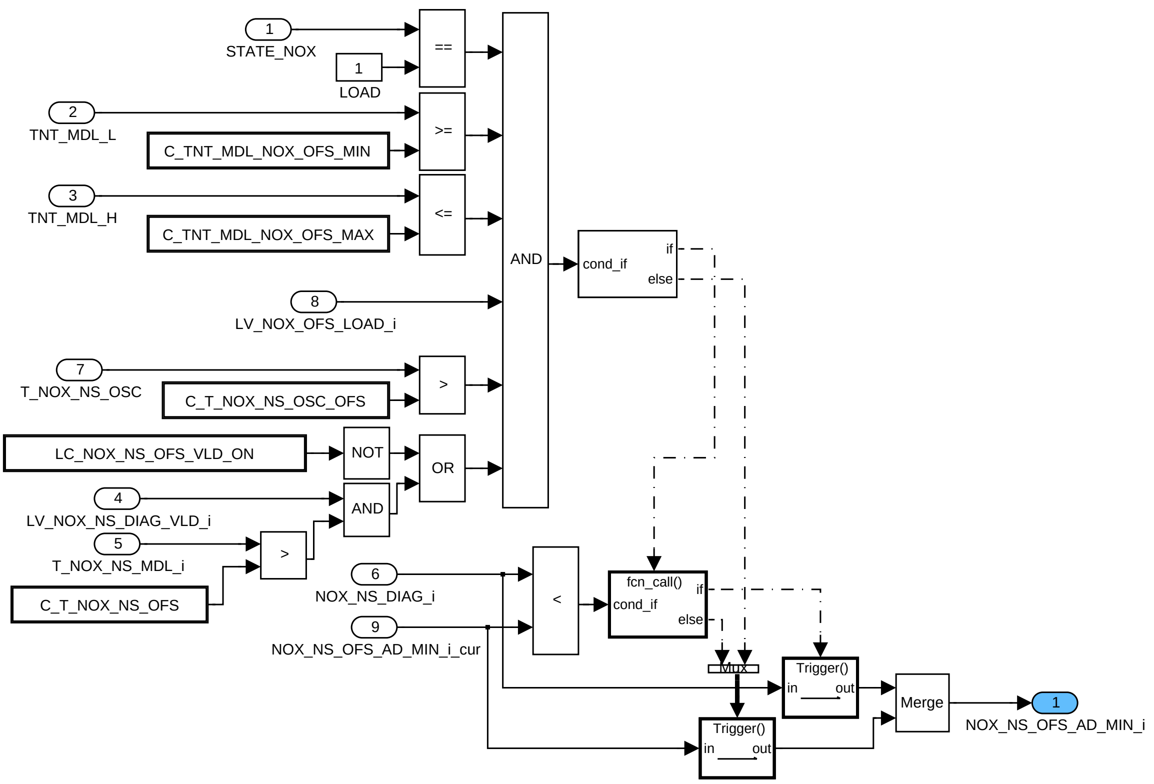

Figure 7.103.17: NOXD_MDLADNSFCN0/SIG_OFS_AD/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC1_OFS/CLC2_NOX_OFS_LOAD/CLC2_NS_DIAG_MIN

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SECTION 1.2.3: Calculation of offset value after left of LOAD phase

Calculation of activation condition for calculation

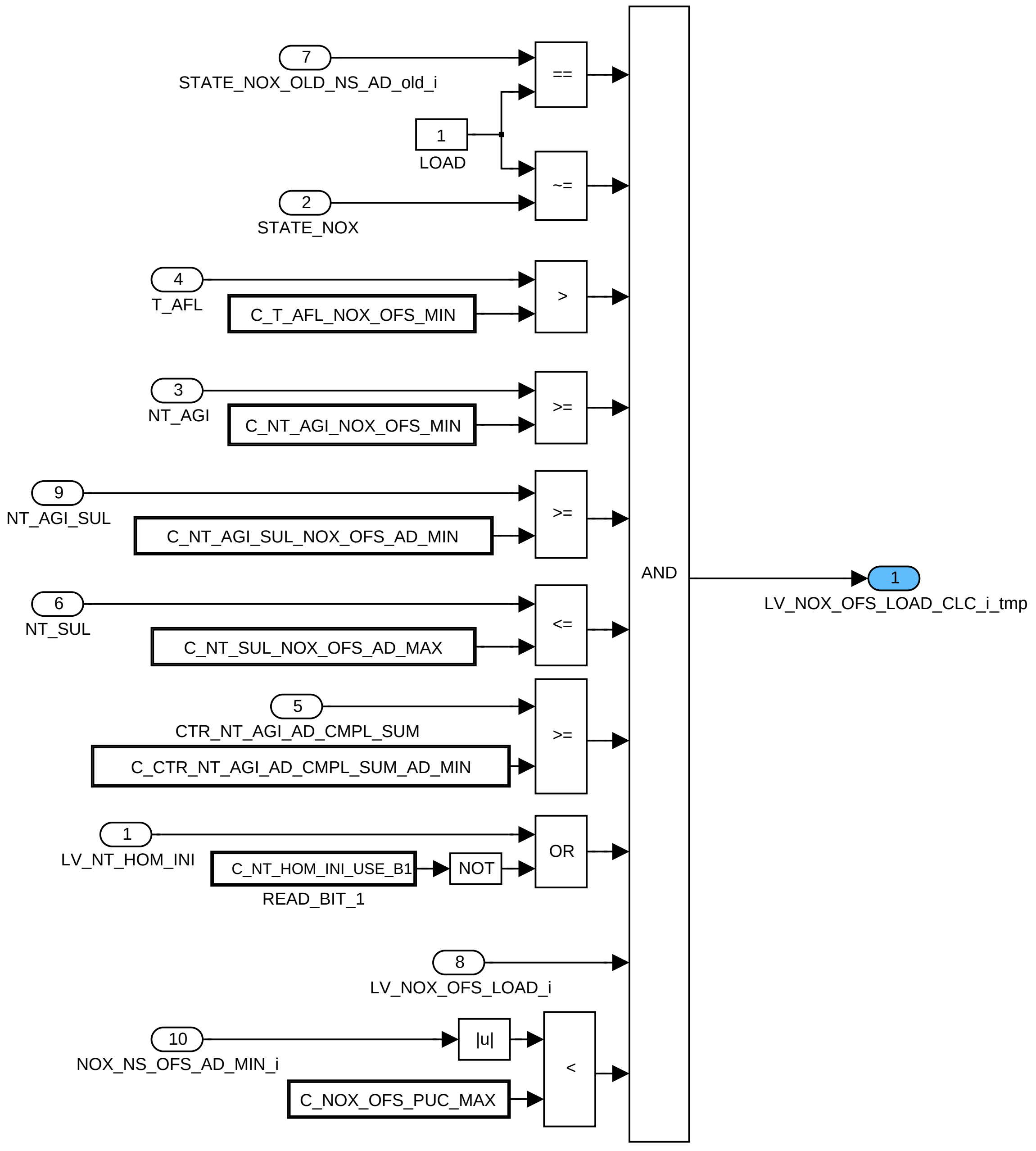

Figure 7.103.18: NOXD_MDLADNSFCN0/SIG_OFS_AD/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC1_OFS/CLC2_NOX_OFS_LOAD/CLC3_NOX_OFS_LOAD/CLC1_LV_ACT

Check of activation condition

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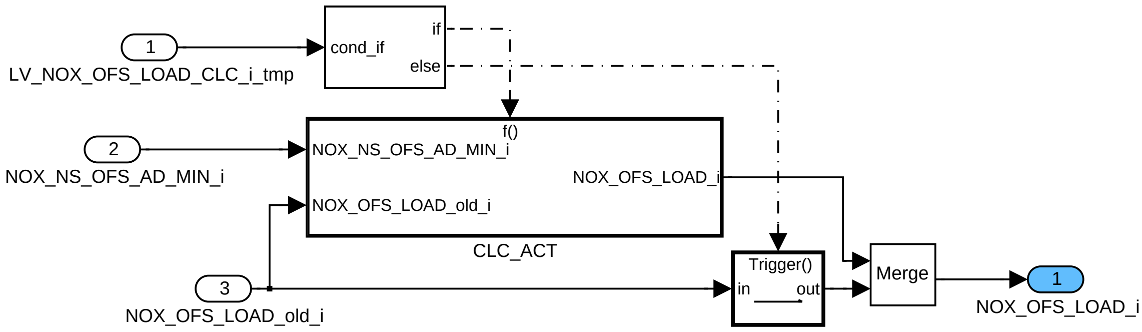

Figure 7.103.19: NOXD_MDLADNSFCN0/SIG_OFS_AD/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC1_OFS/CLC2_NOX_OFS_LOAD/CLC3_NOX_OFS_LOAD/CLC2_NOX_OFS_LOAD

Calculation if the activation condition is fulfilled

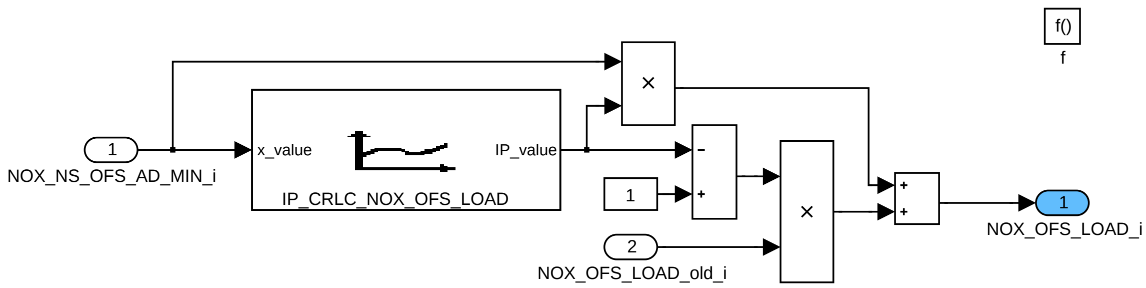

Figure 7.103.20: NOXD_MDLADNSFCN0/SIG_OFS_AD/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC1_OFS/CLC2_NOX_OFS_LOAD/CLC3_NOX_OFS_LOAD/CLC2_NOX_OFS_LOAD/CLC_ACT

SECTION 1.2.4: Reset of activation flag for NOx signal minimum observation

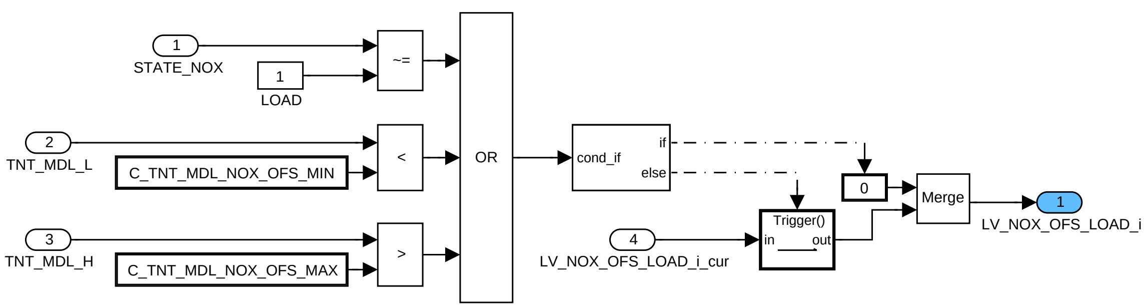

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Figure 21 NOXD_MDLADNSFCN0/ SIG_OFS_AD/ OPERATE/ FOR_LOOP/ NS_SPC_FCN/ CLC1_OFS/ CLC2_NOX_OFS_LOAD/ CLC4_LV_NOX_OFS_LOAD

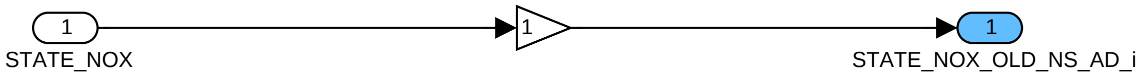

Figure 7.103.21: NOXD_MDLADNSFCN0/SIG_OFS_AD/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC1_OFS/CLC2_NOX_OFS_LOAD/CLC5_STATE_NOX_OLD_NS_AD

SECTION 2: Case selection for finally adaptation value calculation

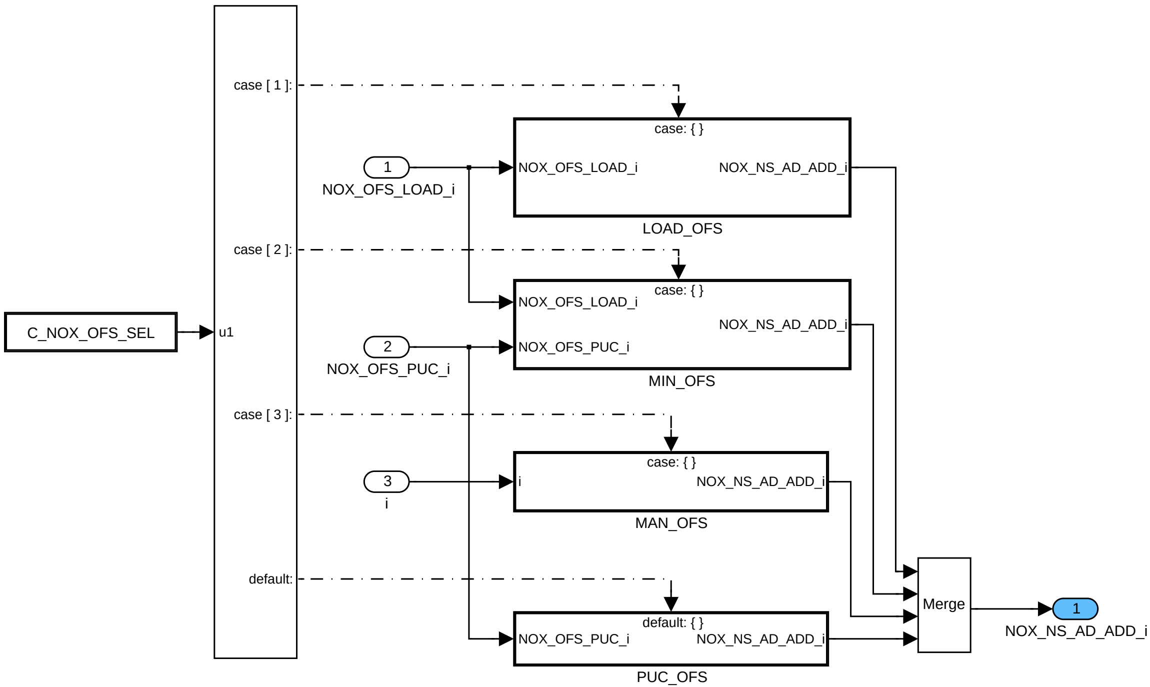

Figure 7.103.22: NOXD_MDLADNSFCN0/SIG_OFS_AD/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC2_ADD_VALUE/CLC1_NOX_AD_ADD

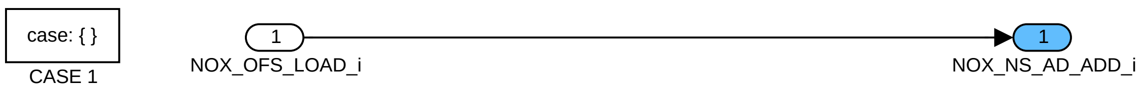

Figure 7.103.23: NOXD_MDLADNSFCN0/SIG_OFS_AD/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC2_ADD_VALUE/CLC1_NOX_AD_ADD/LOAD_OFS

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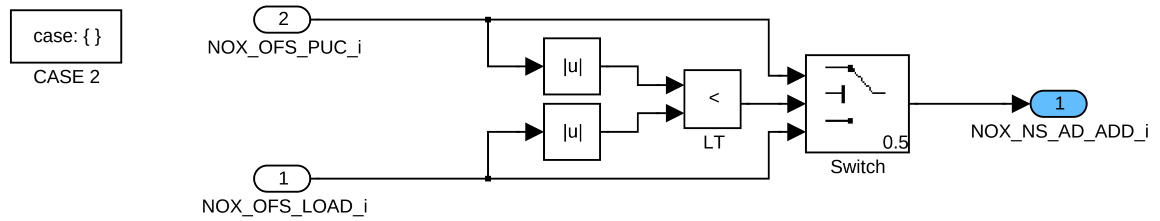

Figure 7.103.24: NOXD_MDLADNSFCN0/SIG_OFS_AD/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC2_ADD_VALUE/CLC1_NOX_AD_ADD/MIN_OFS

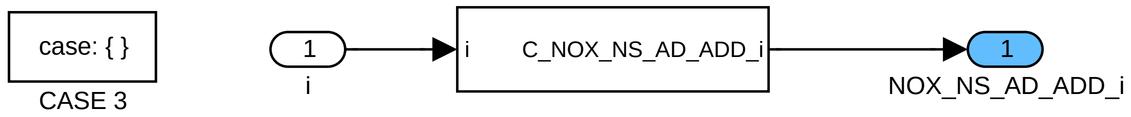

Figure 7.103.25: NOXD_MDLADNSFCN0/SIG_OFS_AD/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC2_ADD_VALUE/CLC1_NOX_AD_ADD/MAN_OFS

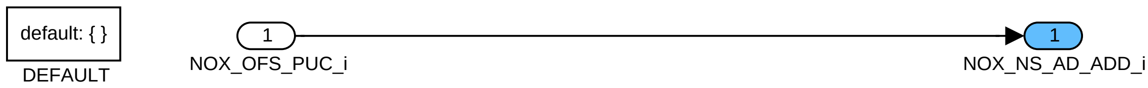

Figure 7.103.26: NOXD_MDLADNSFCN0/SIG_OFS_AD/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC2_ADD_VALUE/CLC1_NOX_AD_ADD/PUC_OFS

SECTION 3: Limitation of chosen adaptation value

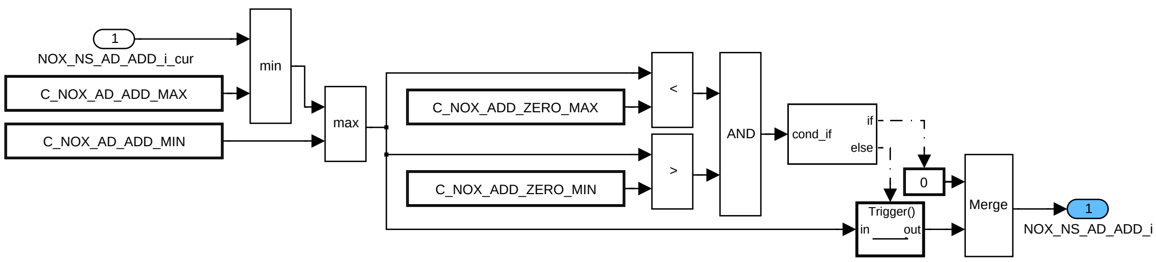

Figure 7.103.27: NOXD_MDLADNSFCN0/SIG_OFS_AD/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC3_ADD_VALUE_LIM/NOX_ADAPT_CLC

SECTION 4: Realization of adaptation on measured signal

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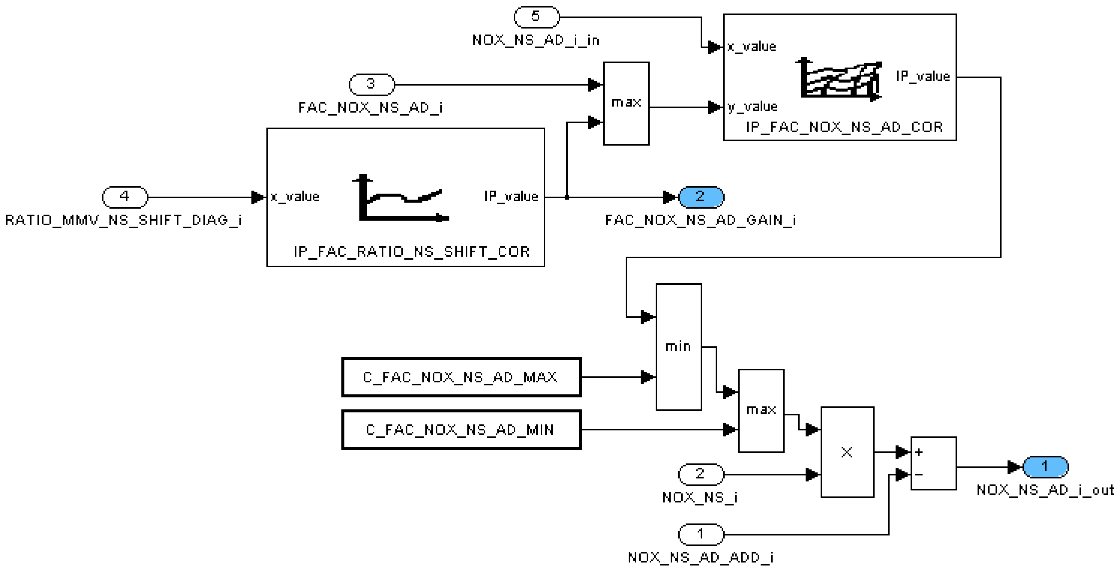

Figure 7.103.28: NOXD_MDLADNSFCN0/SIG_OFS_AD/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC4_FINAL_ADD/CLC1_NOX_NS_AD

7.103.2 NOx sensor valid flag after regeneration

After regeneration it is prohibited to generate a new regeneration request by the NOx sensor (LV_RGN_REQ_NOX_SENS_i = 1) if the signal is not valid. This can be triggered by observation of the signal gradient or the time C_T_NOX_SENS_VLD. The gradient has to be permanently within a certain range for a continuous time. The time C_T_NOX_SENS_VLD is controlled by the timer T_AFL. T_AFL has to exceed C_T_NOX_SENS_VLD before regeneration can be requested by the NOx sensor.

Application Condition

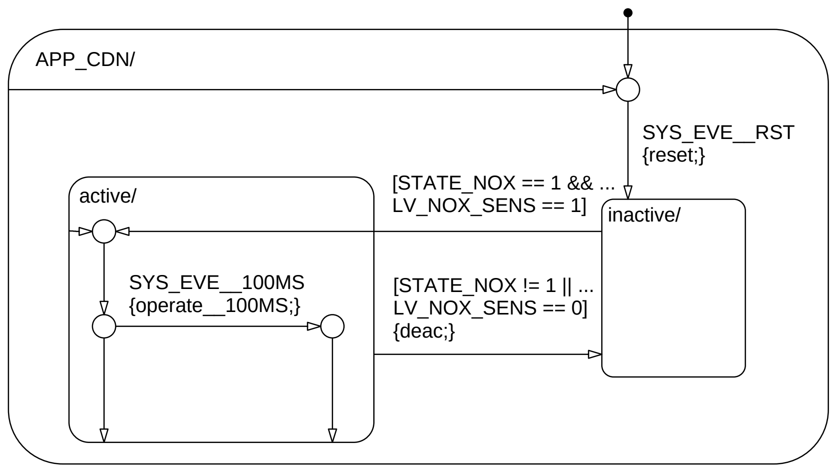

Figure 7.103.29: NOXD_MDLADNSFCN0/VLD_LV/APP_CDN/Chart

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Function Description

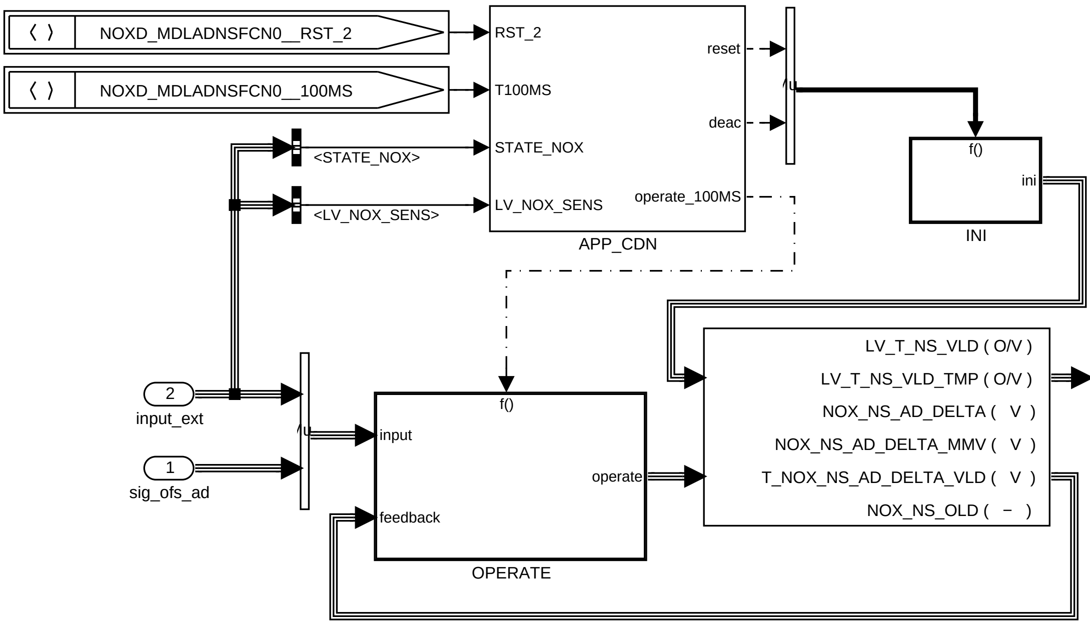

Figure 7.103.30: NOXD_MDLADNSFCN0/VLD_LV

7.103.2.1 INITIALIZATION

At reset all variables are initialized with "0"

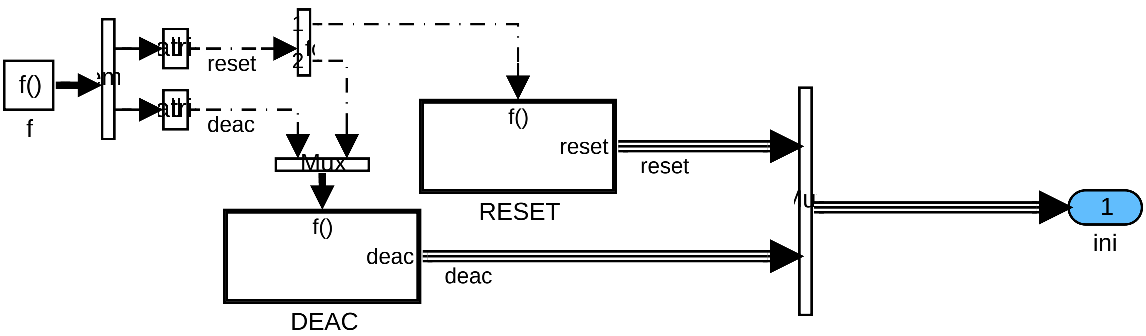

Figure 7.103.31: NOXD_MDLADNSFCN0/VLD_LV/INI

Initialization at deactivation

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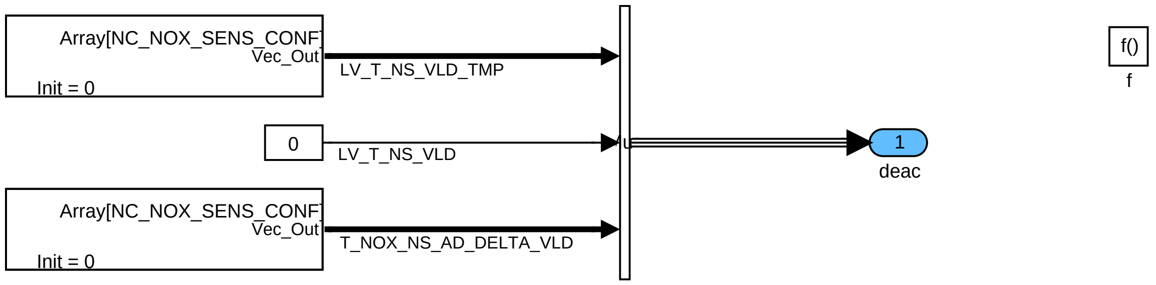

Figure 7.103.32: NOXD_MDLADNSFCN0/VLD_LV/INI/DEAC

7.103.2.2 FORMULA SECTION

Formula section contains two main sections:
SECTION 1: NOx sensor specific functionality
SECTION 2: NOx sensor not specific functionality

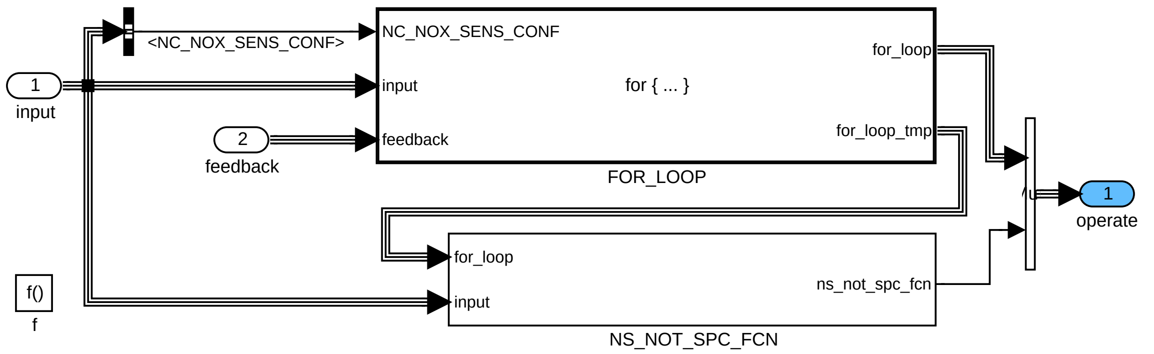

Figure 7.103.33: NOXD_MDLADNSFCN0/VLD_LV/OPERATE

SECTION 1: NOx sensor specific functionality

Calculation of NOx sensor signal gradient

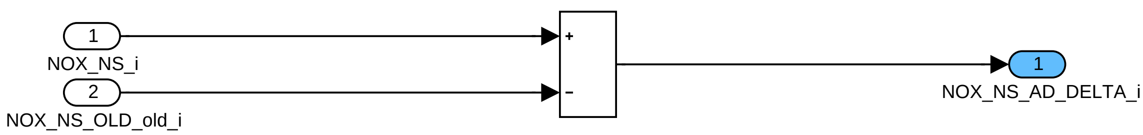

Figure 7.103.34:
NOXD_MDLADNSFCN0/VLD_LV/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC1_DELTA

Filtering of NOx sensor signal gradient

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The NOx signal is going down after regeneration in normal case. The gradient observation process can set the NOx Sensor signal validation flag earlier.

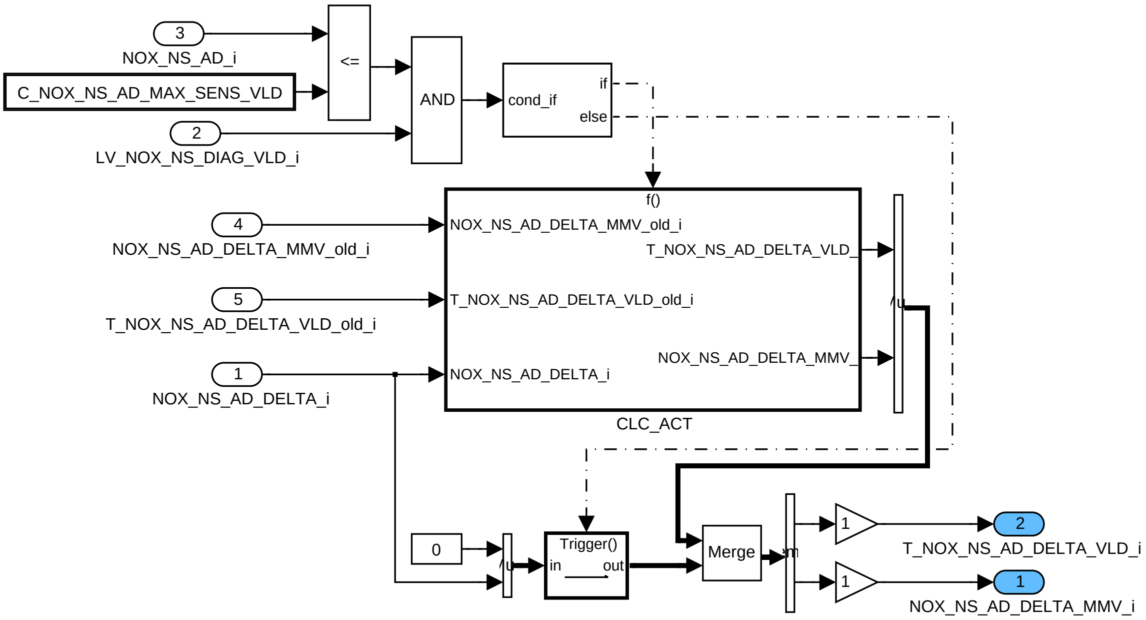

Figure 7.103.35:
NOXD_MDLADNSFCN0/VLD_LV/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC2_DELTA_MMV

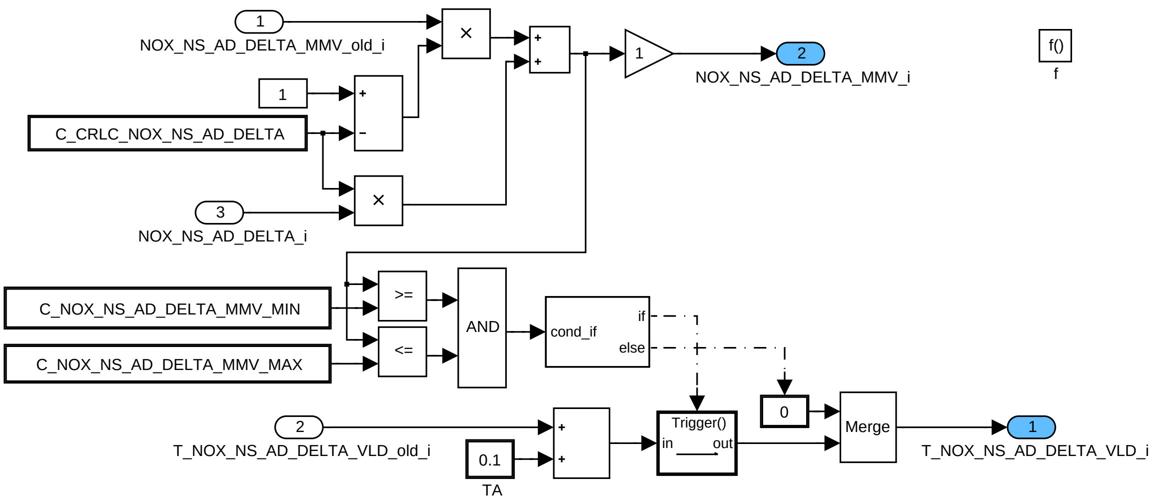

Figure 7.103.36: NOXD_MDLADNSFCN0/VLD_LV/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC2_DELTA_MMV/CLC_ACT

Calculation of NOx sensor specific validation bit of NOx sensor signal

Set of NOx Sensor validation flag is done using gradient observation, check of minimal time after PUC phase or minimal LOAD time.

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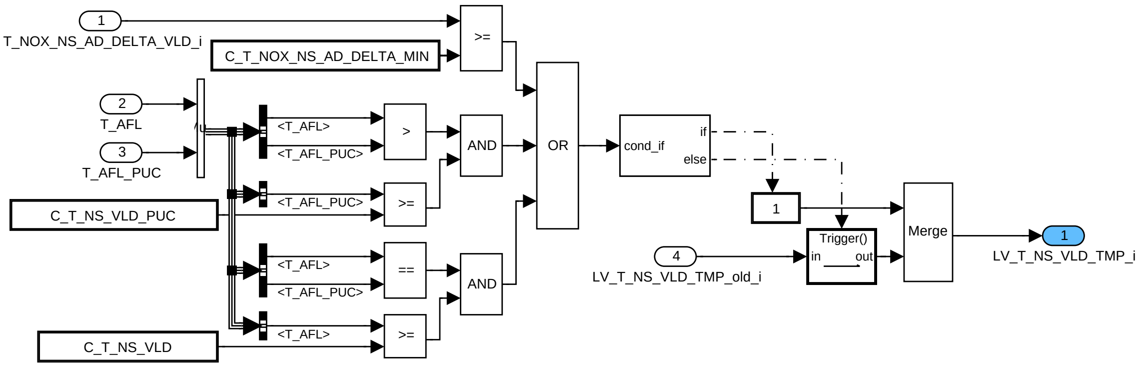

Figure 7.103.37:
NOXD_MDLADNSFCN0/VLD_LV/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC3_NS_VLD_TMP

Calculation of old values

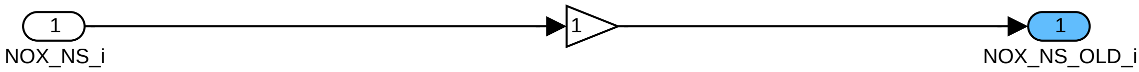

Figure 7.103.38:
NOXD_MDLADNSFCN0/VLD_LV/OPERATE/FOR_LOOP/NS_SPC_FCN/CLC4_NOX_NS_AD_OLD

SECTION 2: NOx sensor not specific functionality

Calculation of validation bit for all NOx sensors

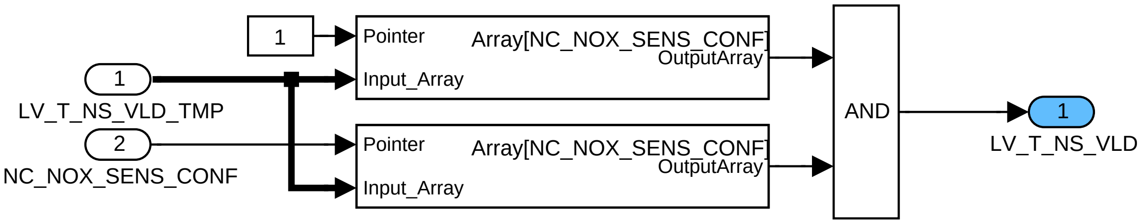

Figure 7.103.39:
NOXD_MDLADNSFCN0/VLD_LV/OPERATE/NS_NOT_SPC_FCN/CLC1_SENS_VLD

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7.104 Coordination of the injection time correction factors for CYBL

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DLY_TI_BAL_COR_ENA	V	0... FFH	0... 255	1	-
Segment counter to delay cylinder balancing TI correction activation					
CTR_STEP_FAC_TI_BAL [NC_CYL_NR]	V	80... 7FH	0... 127	1	-
Number of cylinder balancing multiple correction steps					
EGY_LEVEL_IV_BAL [NC_CYL_NR]	O/V	E000... 2000H	0... 50	0.00610352	%
Cylinder balancing injection valve energy level, cylinder individual					
EGY_LEVEL_IV_BAL_ADJ [NC_CYL_NR]	V	E000... 2000H	0... 50	0.00610352	%
Cylinder balancing injection valve energy level adjustment					
EGY_LEVEL_IV_BAL_CONV [NC_CYL_NR]	O/V	E000... 2000H	0... 50	0.00610352	%
Cylinder balancing injection valve energy level converter output					
EGY_LEVEL_IV_BAL_CTL [NC_CYL_NR]	V	E000... 2000H	0... 50	0.00610352	%
Cylinder balancing injection valve energy level control					
EGY_LEVEL_IV_BAL_CTL_MAX [NC_CYL_NR]	V	0... FFFFH	0... 65535	1	-
Cylinder balancing injection valve energy level maximum controller output value reached					
EGY_LEVEL_IV_BAL_LIM	V	E000... 2000H	0... 50	0.00610352	%
Cylinder balancing injection valve energy level converter output limited					
FAC_TI_BAL [NC_CYL_NR]	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Total cylinder balancing multiple correction factor					
FAC_TI_DIF_BAL [NC_CYL_NR]	V	8000... 7FFFH	0... 0.99996948	305.176e3	-
Cylinder balancing multiple correction factor difference					
FAC_TI_SUM_BAL [NC_CYL_NR]	V	8000... 7FFFH	0... 0.99996948	305.176e3	-
Cylinder balancing multiple correction factor summary					
MFF_ADD_BAL [NC_CYL_NR]	O/V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Total cylinder balancing additive MFF correction value					
MFF_ADD_SUM_BAL [NC_CYL_NR]	V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Cylinder balancing additive MFF correction value summary					
NR_CYC_EGY_LEVEL_IV_BAL_CTL_MAX	V	0... FFH	0... 255	1	-
Corresponding segment number of the controller that has reached the maximum limit					

Input data:

FAC_CYL_LAM_COR [NC_CYL_NR] {p. 2731}	FAC_TI_ER_BAL [NC_CYL_NR] {p. 3298}	LV_S_ACT {p. 8137}	LV_ST_END {p. 1720}
MFF_ADD_CYL_LAM_COR_OUT [NC_CYL_NR] {p. 2733}	MFF_ADD_ER_BAL [NC_CYL_NR] {p. 3269}	MFF_SP_MV {p. 2151}	N {p. 1525}
NC_CYL_NR {p. 1526}	SEG_NR_ER {p. 1454}	STATE_TI_ER_BAL {p. 4006}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DLY_TI_BAL_COR_INI	-	0... FFH	0... 255	1	-
Segment counter initialization value to delay cylinder balancing TI correction activation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EGY_LEVEL_IV_BAL_MAX_NEG	-	E000... 2000H	0... 50	0.00610352	%
Maximum negative threshold for injection valve energy level value					
C_EGY_LEVEL_IV_BAL_MAX_POS	-	E000... 2000H	0... 50	0.00610352	%
Maximum positive threshold for injection valve energy level value					
C_EGY_LEVEL_IV_BAL_OFS	-	E000... 2000H	0... 50	0.00610352	%
Cylinder balancing injection valve energy level offset					
C_FAC_TI_BAL_ACT_MAN	-	0H 1H 2H 3H	DISABLE ADJUSTMENT CONTROL ADJCTL	-	-
Manual adjustment of activation conditions for injection valve energy level calculation					
C_FAC_TI_DIF_BAL	-	0... FFFFH	0... 1.99996948	305.176e3	-
Threshold for cylinder balancing multiple correction difference					
C_MFF_COR_BAL_MOD_MAN	-	0H 1H 2H 3H 4H 5H	NORM LAM ER TOT ER_ADD LAM_ADD	-	-
Manual switch for cylinder balancing correction mode determination					
IP_EGY_LEVEL_IV_BAL_CONV	-	0... 4000H	0... 50	0.00610352	%
LDP_FAC_TI_SUM_BAL_IP_EGY_BAL	8	0... FFFFH	0... 0.99996948	305.176e3	-
Index table for cylinder balancing injection valve energy level conversion					
IP_FAC_EGY_LEVEL_IV_BAL_COR	-	0... FFFFH	0... 3.99993896	610.352e3	-
LDP_MFF_SP_MV_IP_FAC_EGY_BAL	8	0... FFFFH	0... 1389	0.02119478	mg/stk
Index table for cylinder balancing injection valve energy level correction factor					
IP_FAC_MFF_ADD_ER_BAL	-	0... FFFFH	0... 1.999969	305.176e3	-
LDPM_N_2_CYBL	4	0... 1FE0H	0... 8160	1	rpm
LDPM_MFF_SP_MV_1_CYBL	4	0... FFFFH	0... 1389	0.02119478	mg/stk
Index table for cylinder balancing additive MFF correction factor					
LC_FAC_TI_BAL_RST_MAN	-	0... 1H	0 ...1	1	-
Manual switch for cylinder balancing multiple correction reset					

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General information

This module coordinates the adaptation and application of the correction factors calculated by the functions "Cylinder Balancing via ER" and "Cylinder Balancing via Lambda Sensor".

The module "Cylinder Balancing via Lambda Sensor" calculates the adaptation values only in homogenous modes (lean or stochiometric), while the module "Cylinder Balancing via ER" calculates the adaptation values only in stratified mode. it is possible to apply manually the calculated adaptation values either in homogeneous or stratified or in both combustion modes with a calibration constant.

With use of a calibration constant a manual adjustment of the used injector energy level calculation is possible. The complete energy level calculation is disabled and the corresponding output values for the injection path are set to zero if the switch is set to "Disable".

Two different algorithms are existing for the injection valve energy level calculation. While the manual switch is set to "Adjustment", the calculation is based on a step by step approximation until a stable

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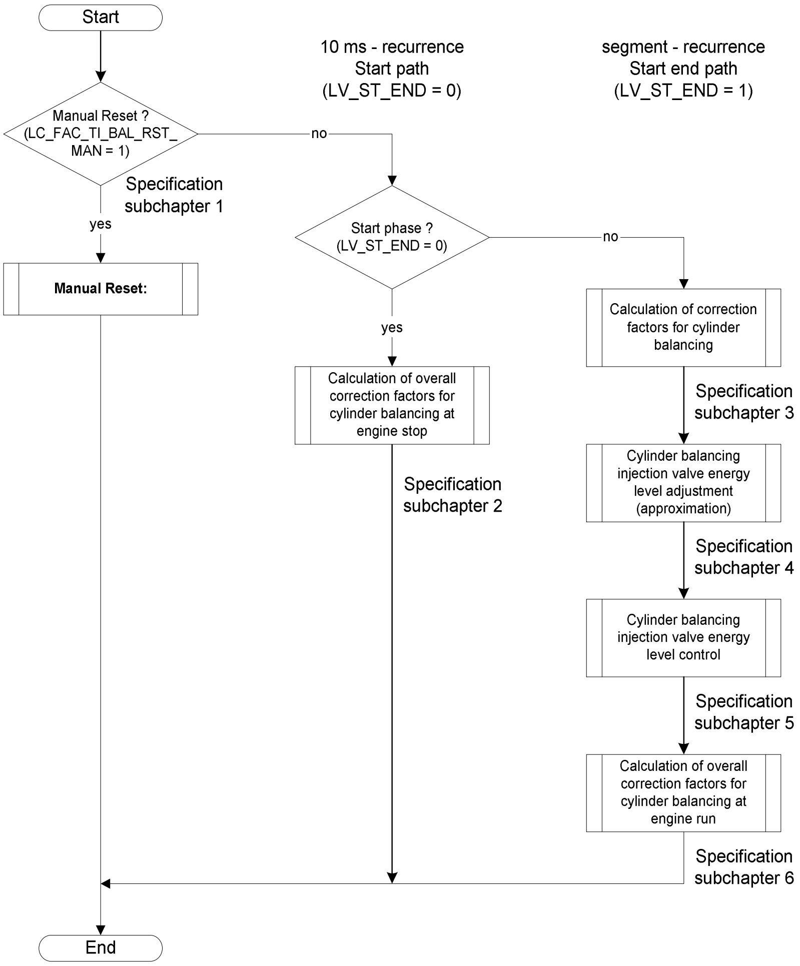
energy level is reached. In case the manual switch is set to "Control", the energy level is calculated by a converter.

Both calculation routines can be activated in parallel while the manual switch is set to "AJD/CTL". The common energy level then is a summary of the adjustment value with the controller value.



Application Condition

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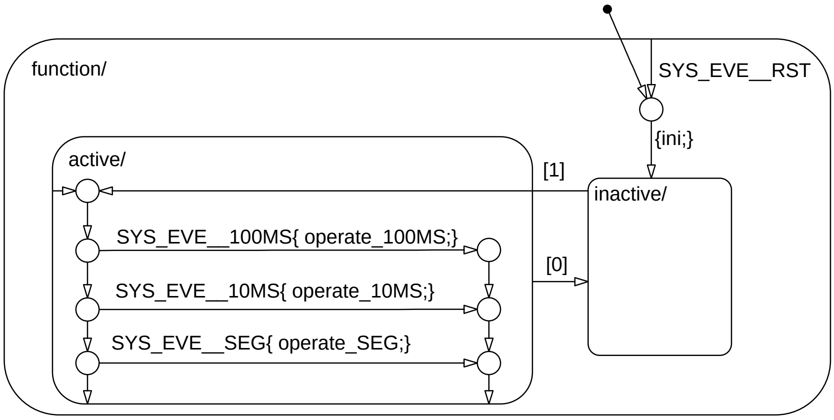

Figure 7.104.1: CYBL_M30704P01/APP_CDN/Chart

Function Description

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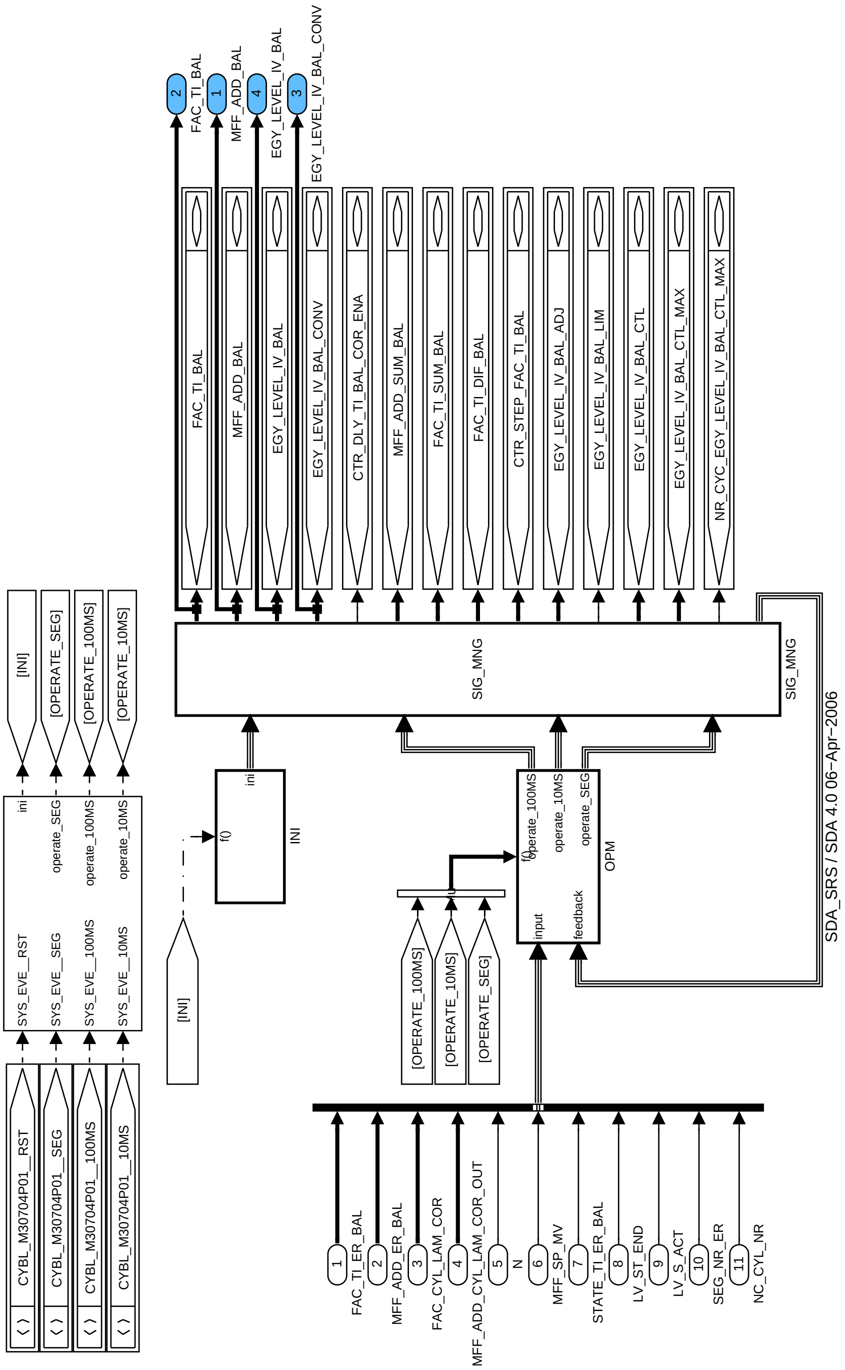

Figure 7.104.2: CYBL_M30704P01

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7.104.1 Calculation of variables at reset

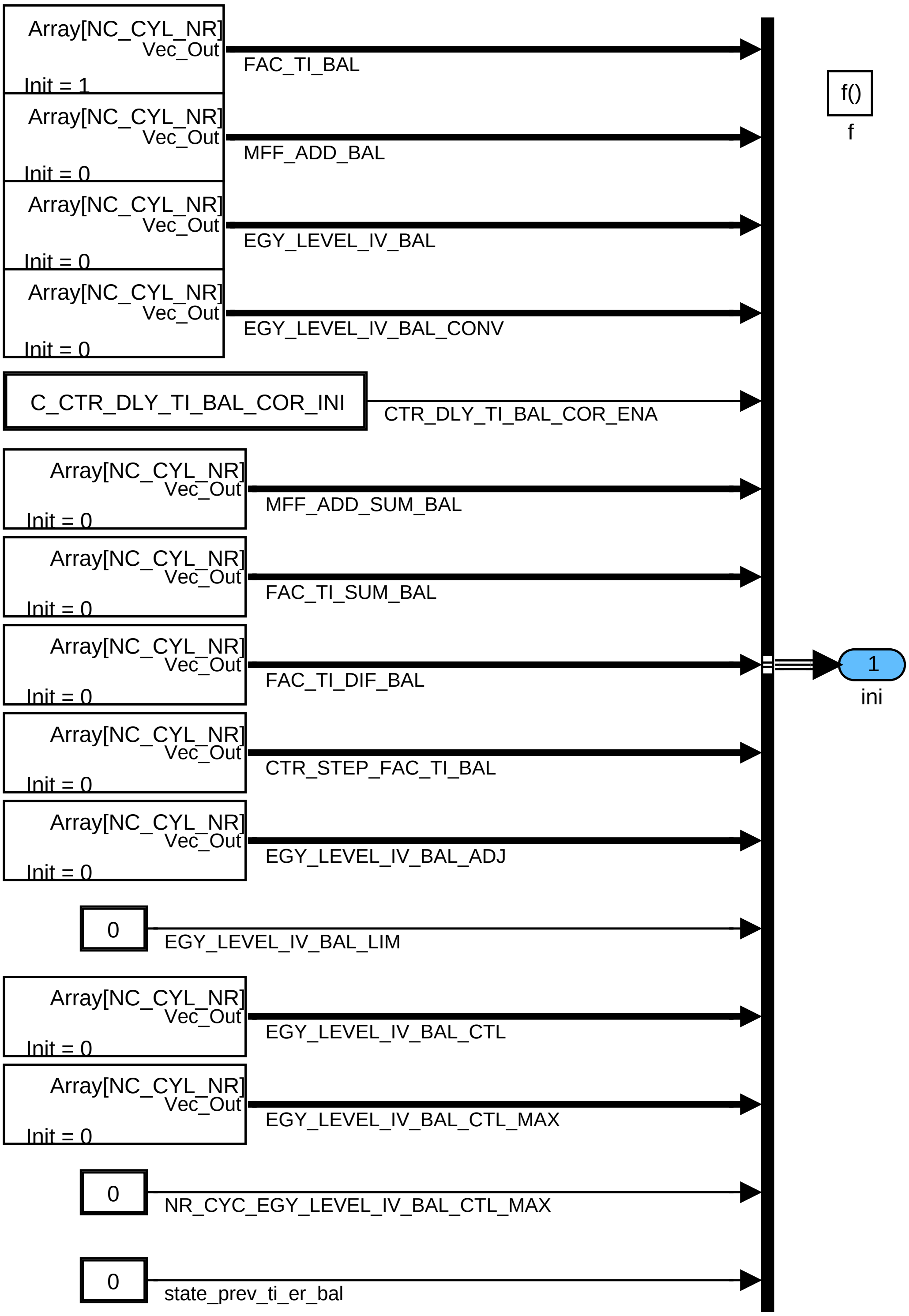

Figure 7.104.3: CYBL_M30704P01/INI

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7.104.2 Calculation of 100ms, 10ms and segment synchronous tasks

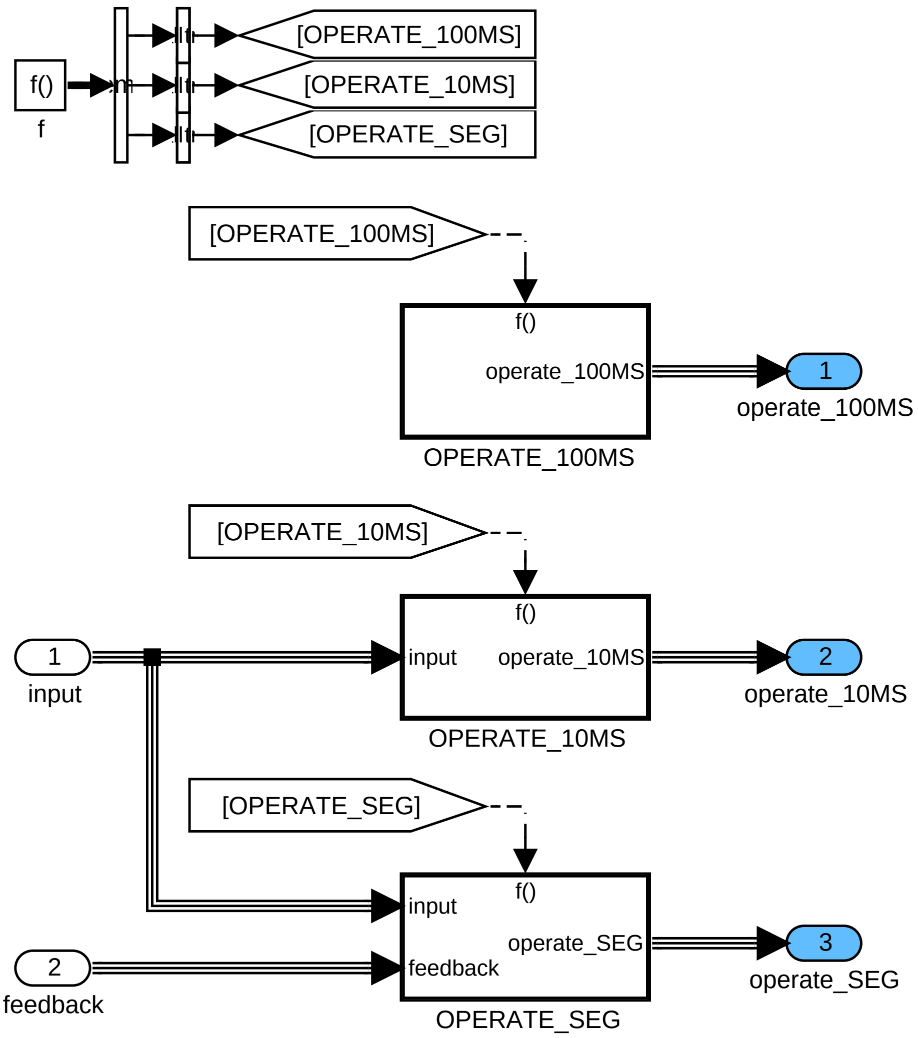

Figure 7.104.4: CYBL_M30704P01/OPM

Manual Reset of cylinder balancing correction values

In case of a manual reset it is possible to adjust the output data to neutral values to make the function test and handling more easier. While the manual function reset is activated, all following subchapters within the module "Coordination of the Injection Time Correction Factors for CYBL" are deactivated during the period.

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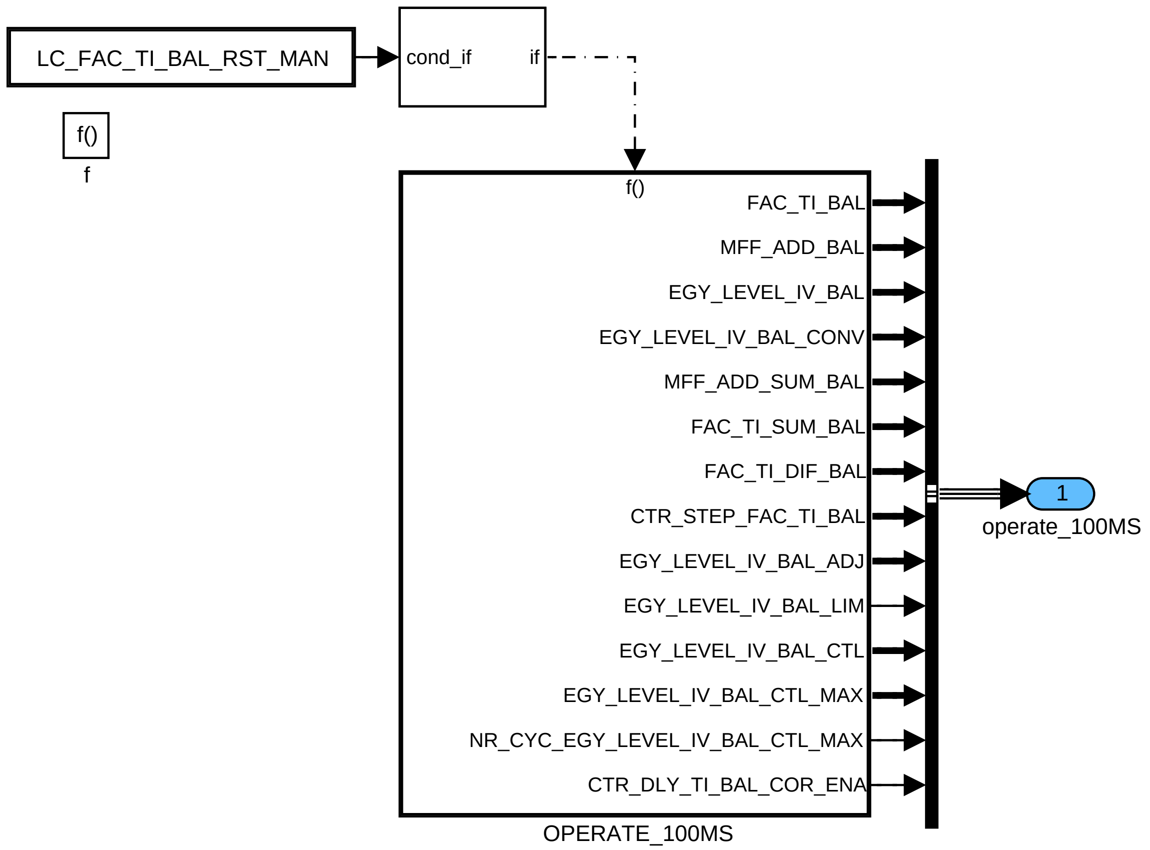

Figure 7.104.5: CYBL_M30704P01/OPM/OPERATE_100MS

Manual Reset of cylinder balancing correction values OPERATE_100MS

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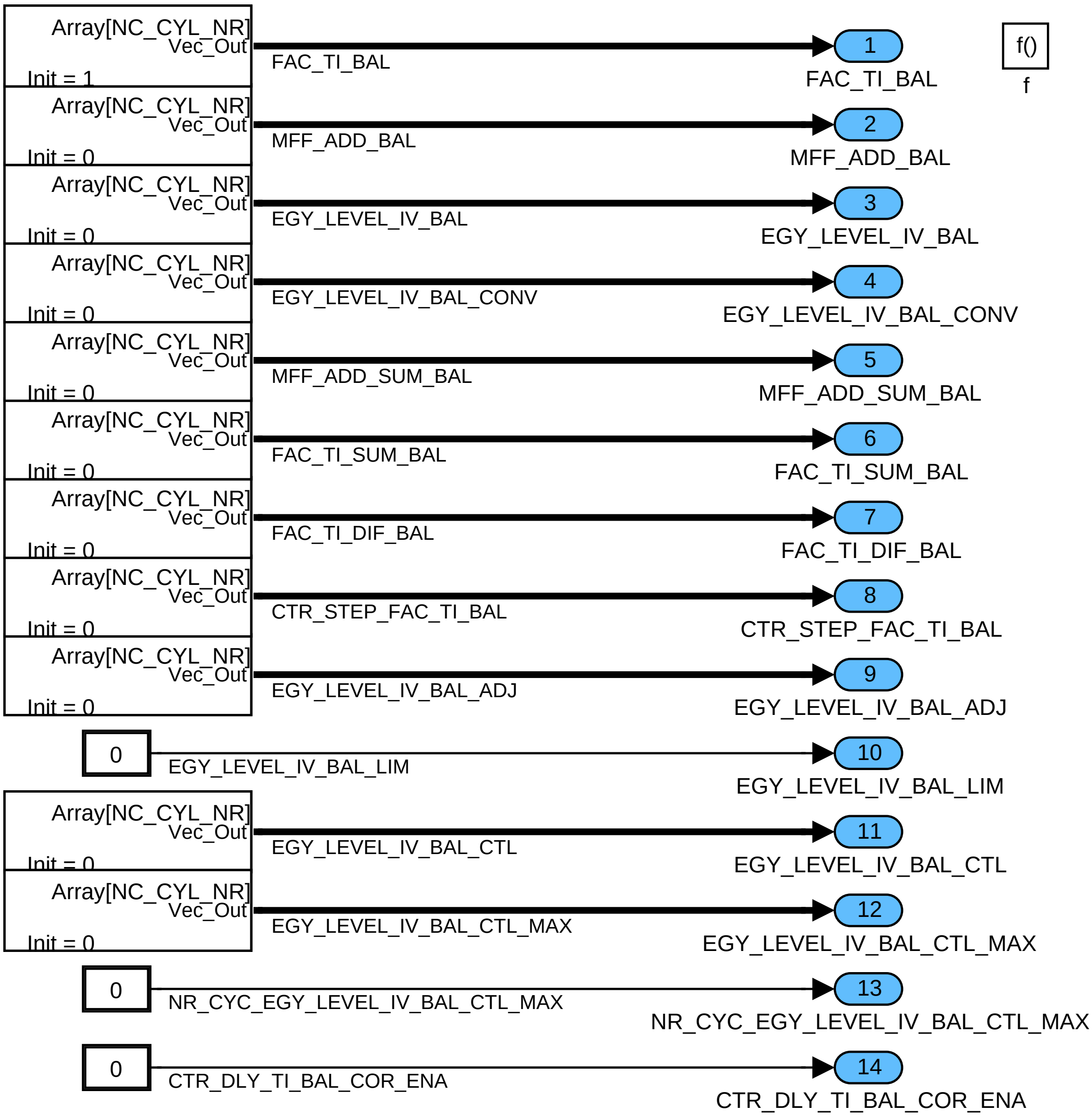

Figure 7.104.6: CYBL_M30704P01/OPM/OPERATE_100MS/OPERATE_100MS

Calculation of overall correction factors for cylinder balancing at engine stop

The formula section is only activated if the switch for a manual reset is set to "0". In case of a manual reset (refer:" Manual Reset of cylinder balancing correction values"), the calculations are stopped at once.

The calculation of the total cylinder balancing correction output values takes place at engine stop and engine start in fixed time steps. The output values are used to adjust the wanted cylinder individual corrections. All total cylinder correction values (for every cylinder) are calculated within one time step during this period.

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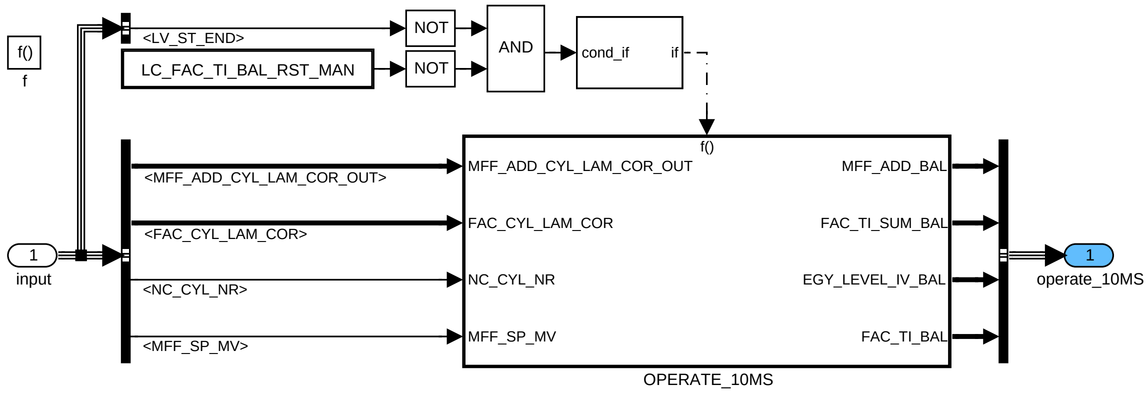

Figure 7.104.7: CYBL_M30704P01/OPM/OPERATE_10MS

Calculation of overall correction factors for cylinder balancing at engine stop OPERATE_10MS

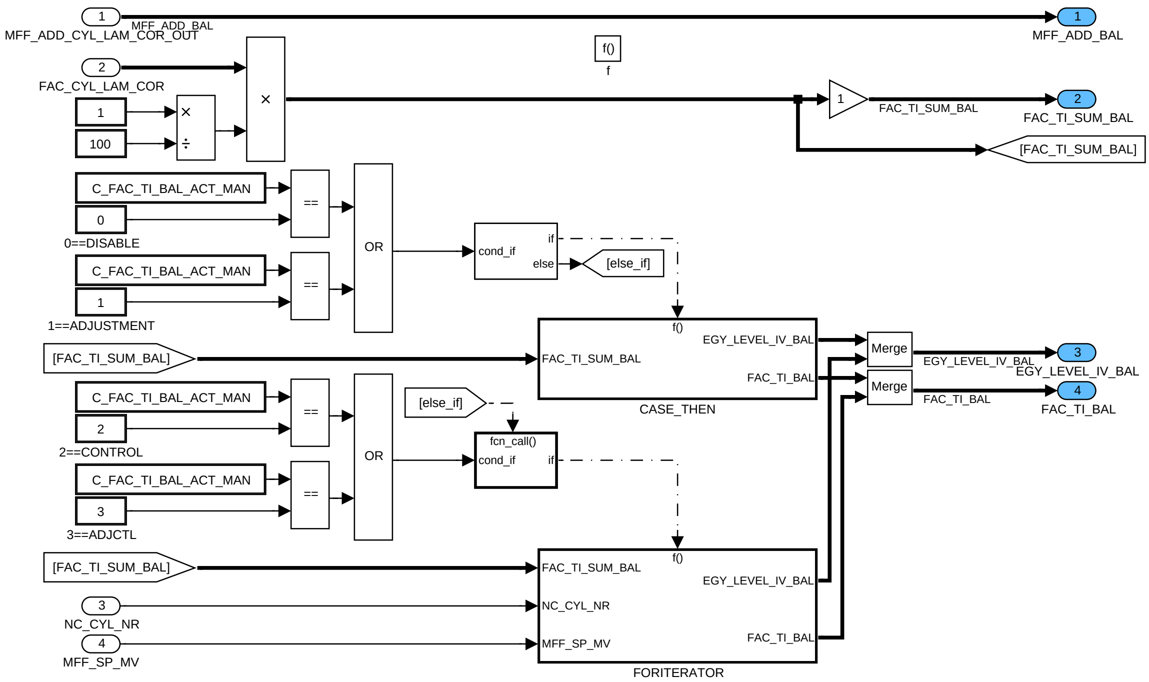

Figure 7.104.8: CYBL_M30704P01/OPM/OPERATE_10MS/OPERATE_10MS

Calculation of overall correction factors for cylinder balancing at engine stop OPERATE_10MS CASE_THEN

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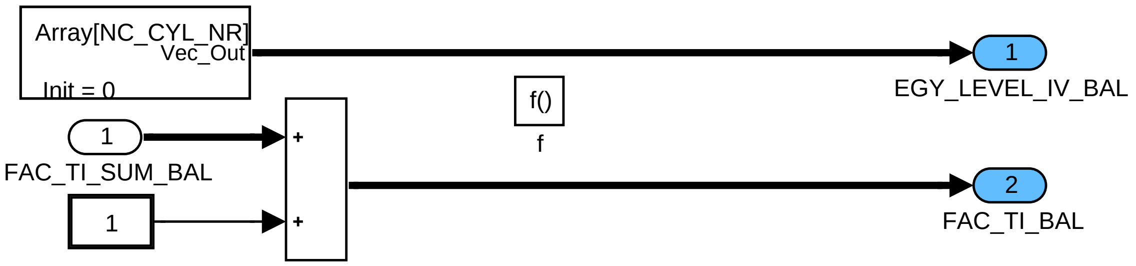

Figure 7.104.9: CYBL_M30704P01/OPM/OPERATE_10MS/OPERATE_10MS/CASE_THEN

Calculation of overall correction factors for cylinder balancing at engine stop OPERATE_10MS FORITERATOR

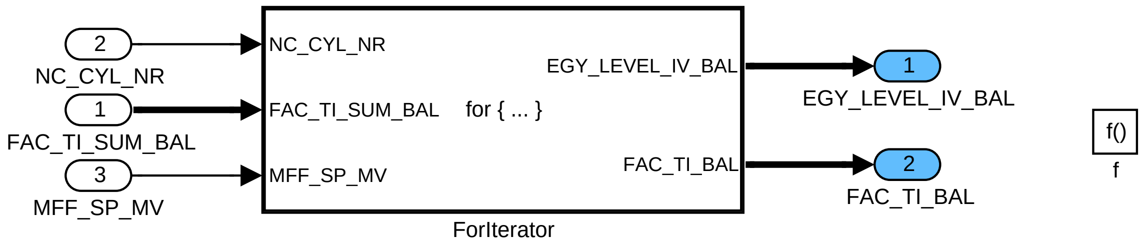

Figure 7.104.10: CYBL_M30704P01/OPM/OPERATE_10MS/OPERATE_10MS/FORITERATOR

Calculation of overall correction factors for cylinder balancing at engine stop OPERATE_10MS FORITERATOR FORITERATOR

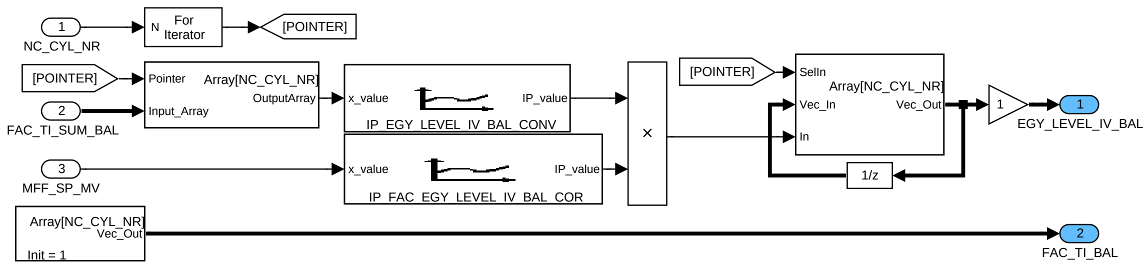

Figure 7.104.11:
CYBL_M30704P01/OPM/OPERATE_10MS/OPERATE_10MS/FORITERATOR/ForIterator

General information for OPERATE_SEG

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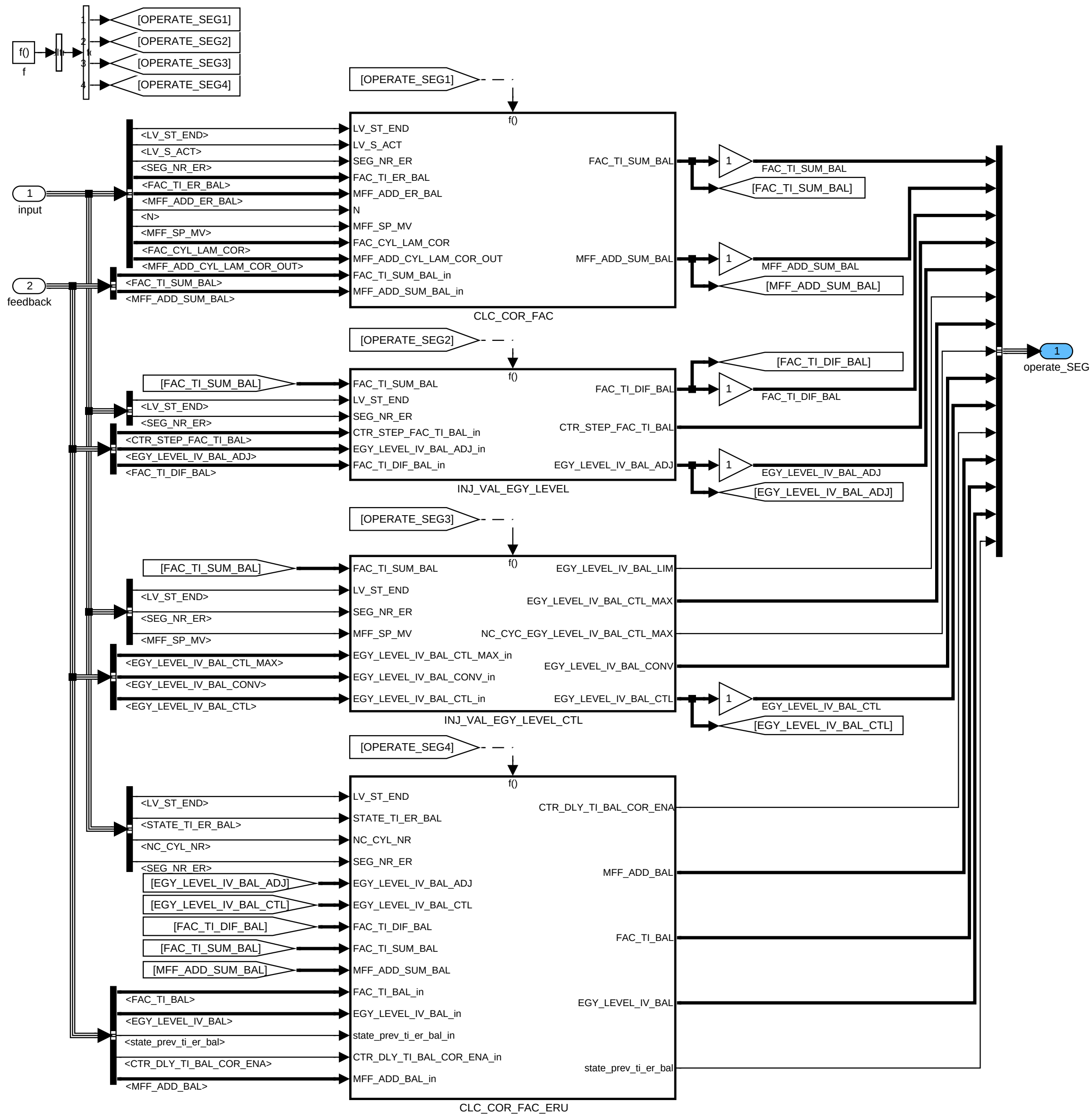

Figure 7.104.12: CYBL_M30704P01/OPM/OPERATE_SEG

Calculation of correction factors for cylinder balancing

The formula section is only activated if the switch for a manual reset is set to "0". In case of a manual reset (refer: "Manual Reset of cylinder balancing correction values"), the calculations are stopped at once.

The cylinder balancing correction factors for homogenous and stratified combustion mode are built from the input values of the different cylinder balancing adaptation functions. With a manual calibration constant it is possible to adjust the adaptation values at different combustion modes.

Short description of possible settings:

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Constant setting:		**CYBL via LAM sensor applied at combustion mode:**	**CYBL via ER applied at combustion mode:**
"NORM"	(**0**H)	HOM	STR
"LAM"	(**1**H)	HOM & STR	STR
"ER"	(**2**H)	HOM	STR & HOM
"TOT"	(**3**H)	HOM & STR	STR & HOM
"ER_ADD"	(**4**H)	HOM	STR (additive, multiple) HOM (additive)
"LAM_ADD"	(**5**H)	HOM & STR	STR (additive, multiple) HOM (additive)

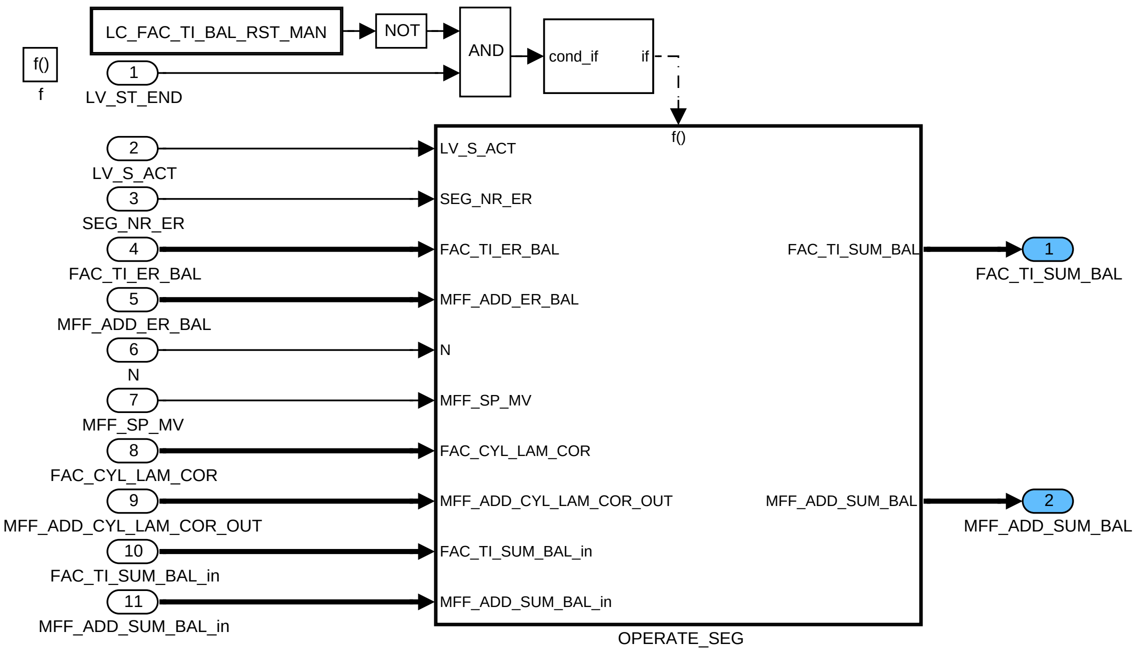

Figure 7.104.13: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC

Calculation of correction factors for cylinder balancing OPERATE_SEG

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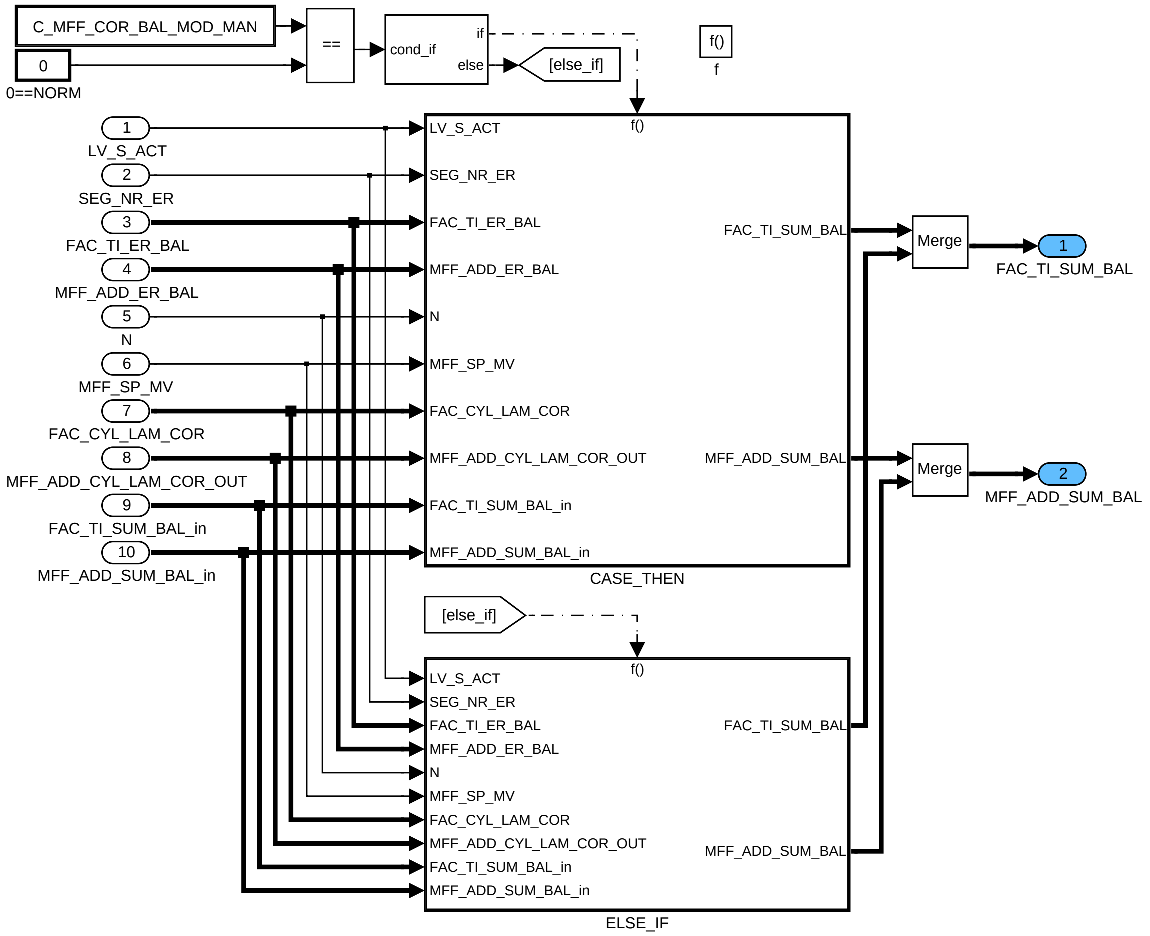

Figure 7.104.14: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC/OPERATE_SEG

Calculation of correction factors for cylinder balancing OPERATE_SEG CASE_THEN

//CYBL via LAM only applied in HOM, CYBL via ER only applied in STR

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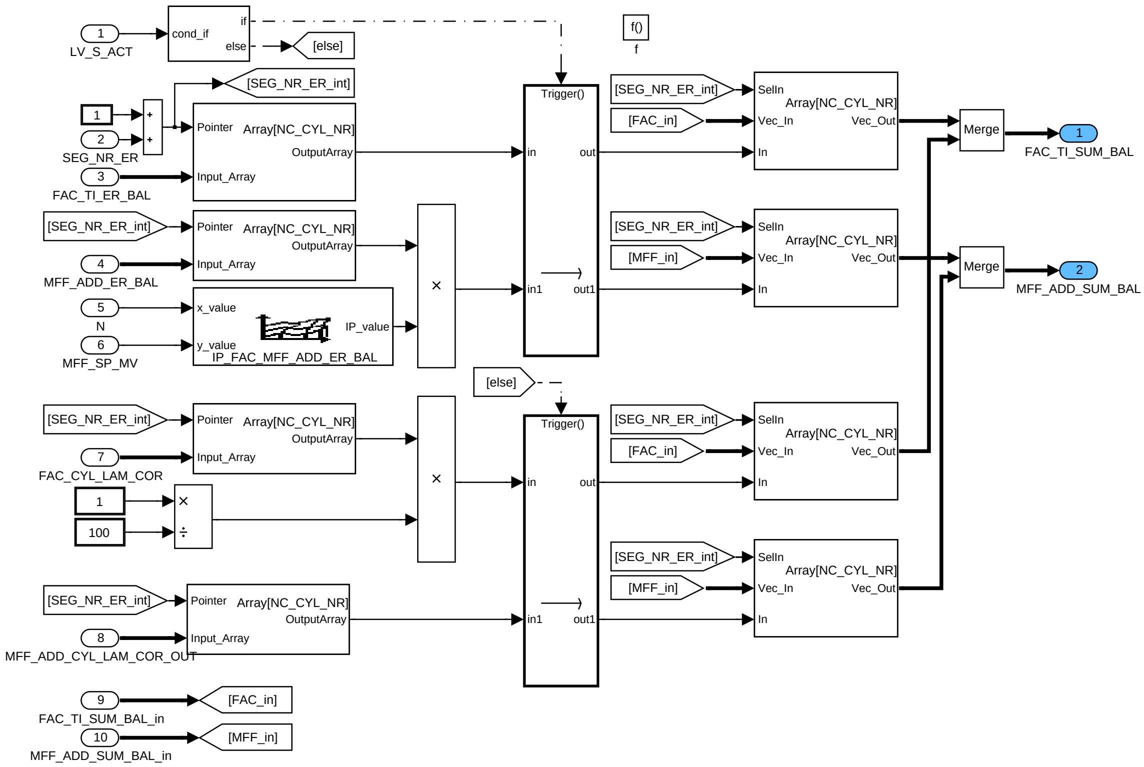

Figure 7.104.15:
CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC/OPERATE_SEG/CASE_THEN

Calculation of correction factors for cylinder balancing OPERATE_SEG ELSE_IF

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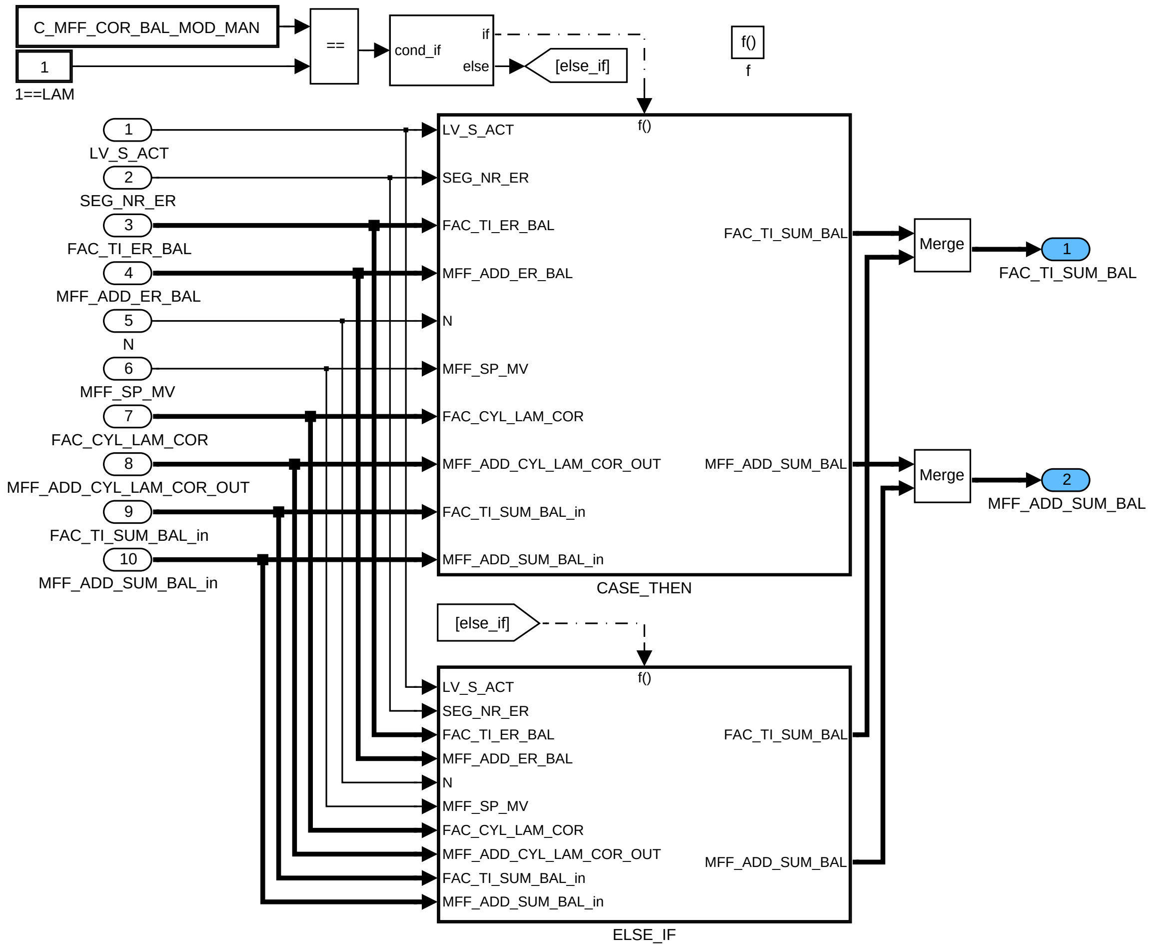

Figure 7.104.16:
CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC/OPERATE_SEG/ELSE_IF

Calculation of correction factors for cylinder balancing OPERATE_SEG ELSE_IF CASE_THEN

//CYBL via LAM applied in HOM and STR, CYBL via ER only applied in STR

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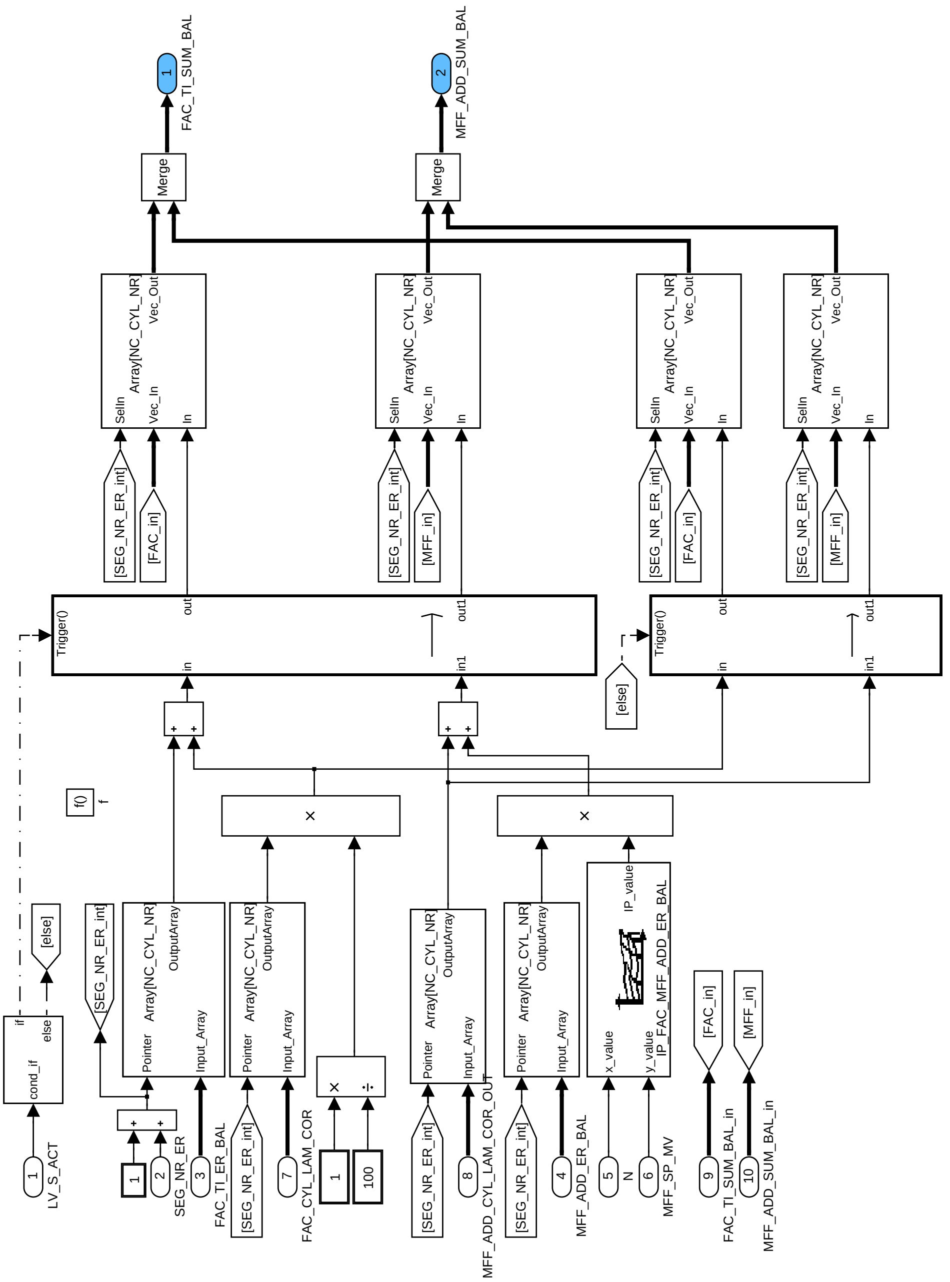

Figure 7.104.17:
CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC/OPERATE_SEG/ELSE_IF/CASE_THEN

Calculation of correction factors for cylinder balancing OPERATE_SEG ELSE_IF ELSE_IF

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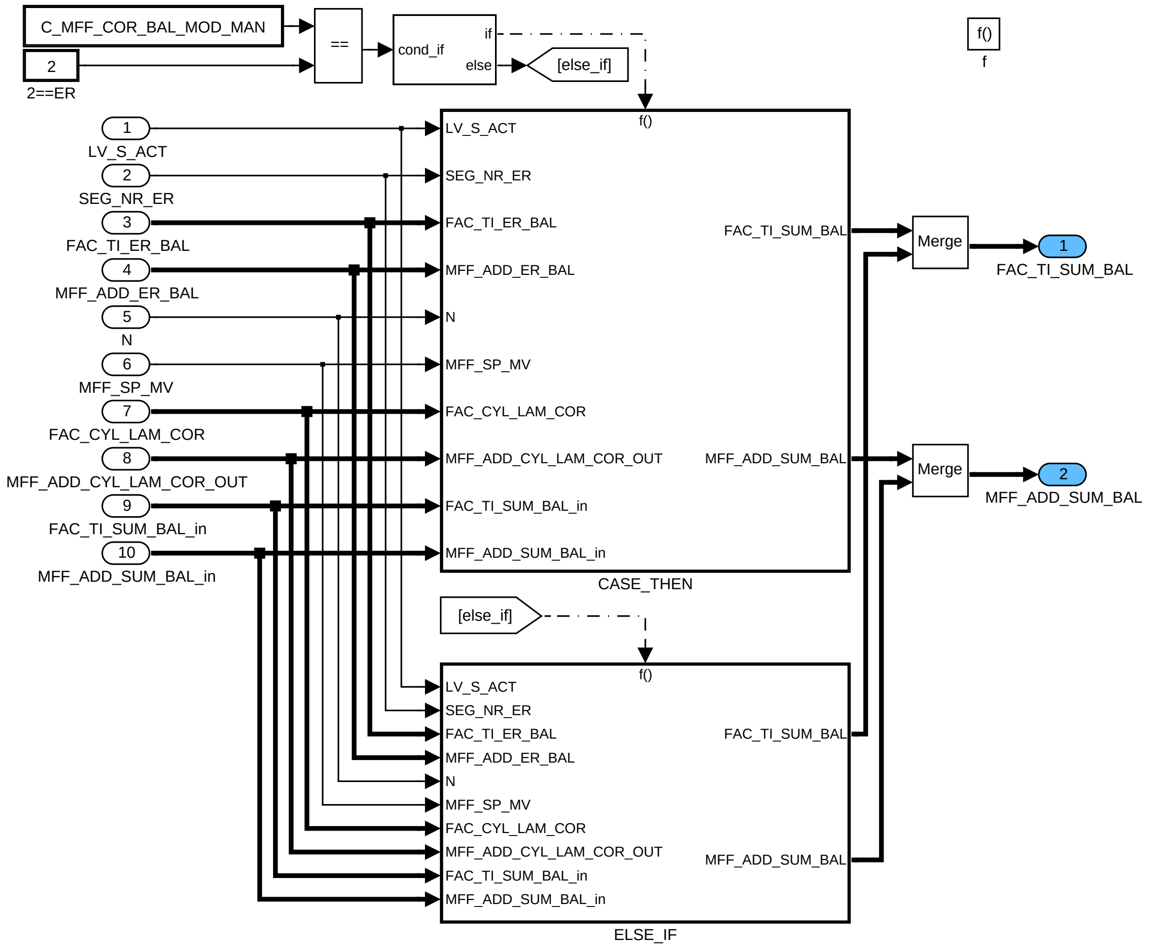

Figure 7.104.18:
CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC/OPERATE_SEG/ELSE_IF/ELSE_IF

Calculation of correction factors for cylinder balancing OPERATE_SEG ELSE_IF ELSE_IF CASE_THEN

//CYBL via LAM only applied in HOM, CYBL via ER applied in HOM and STR

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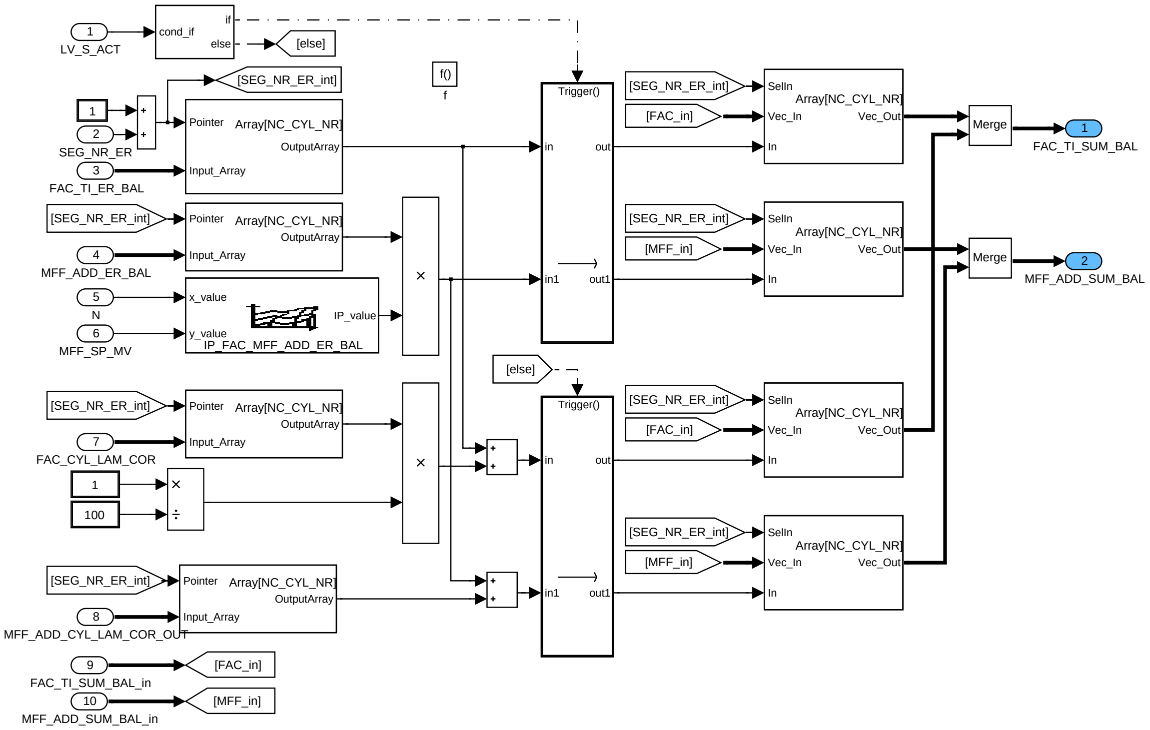

Figure 7.104.19: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC/OPERATE_SEG/ ELSE_IF/ELSE_IF/CASE_THEN

Calculation of correction factors for cylinder balancing OPERATE_SEG ELSE_IF ELSE_IF ELSE_IF

//no combustion mode restriction

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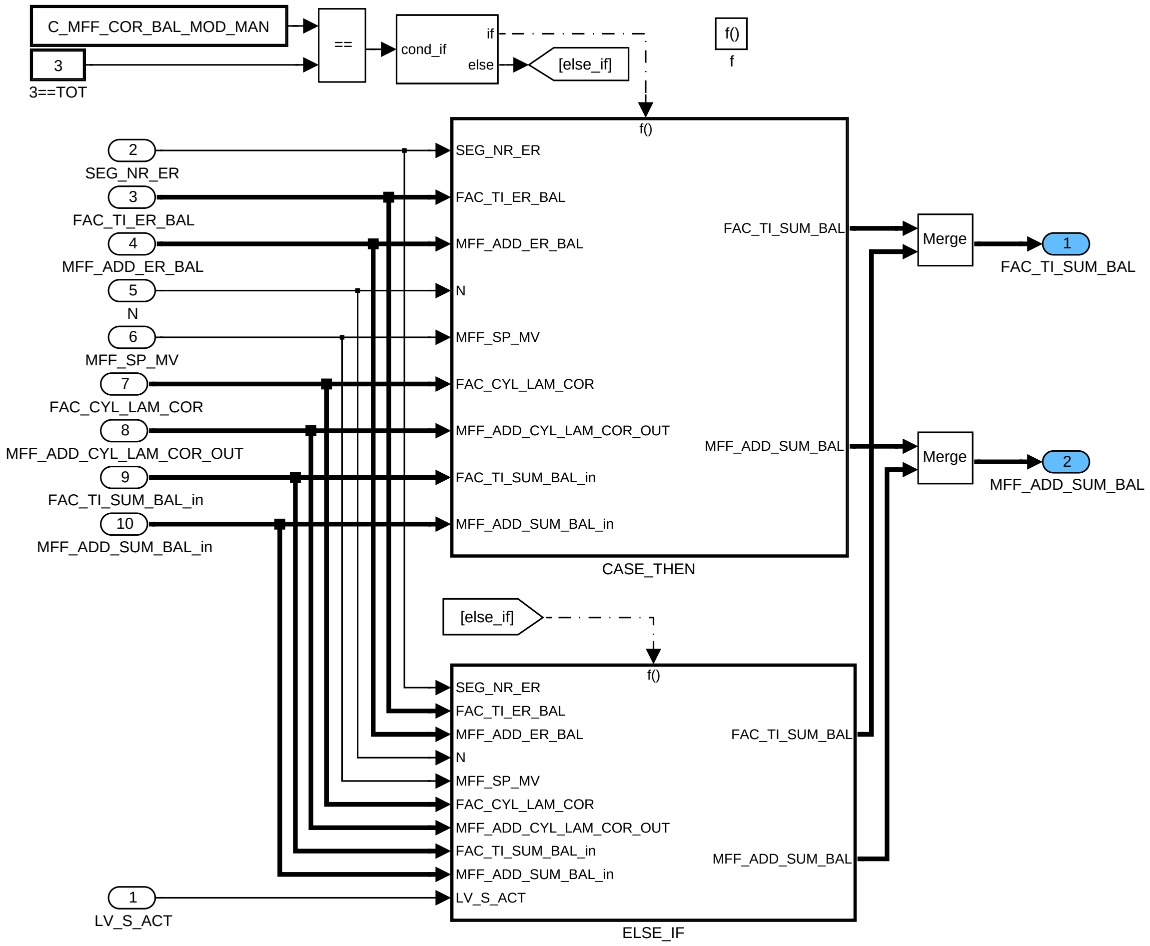

Figure 7.104.20: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC/OPERATE_SEG/ELSE_IF/ELSE_IF/ELSE_IF

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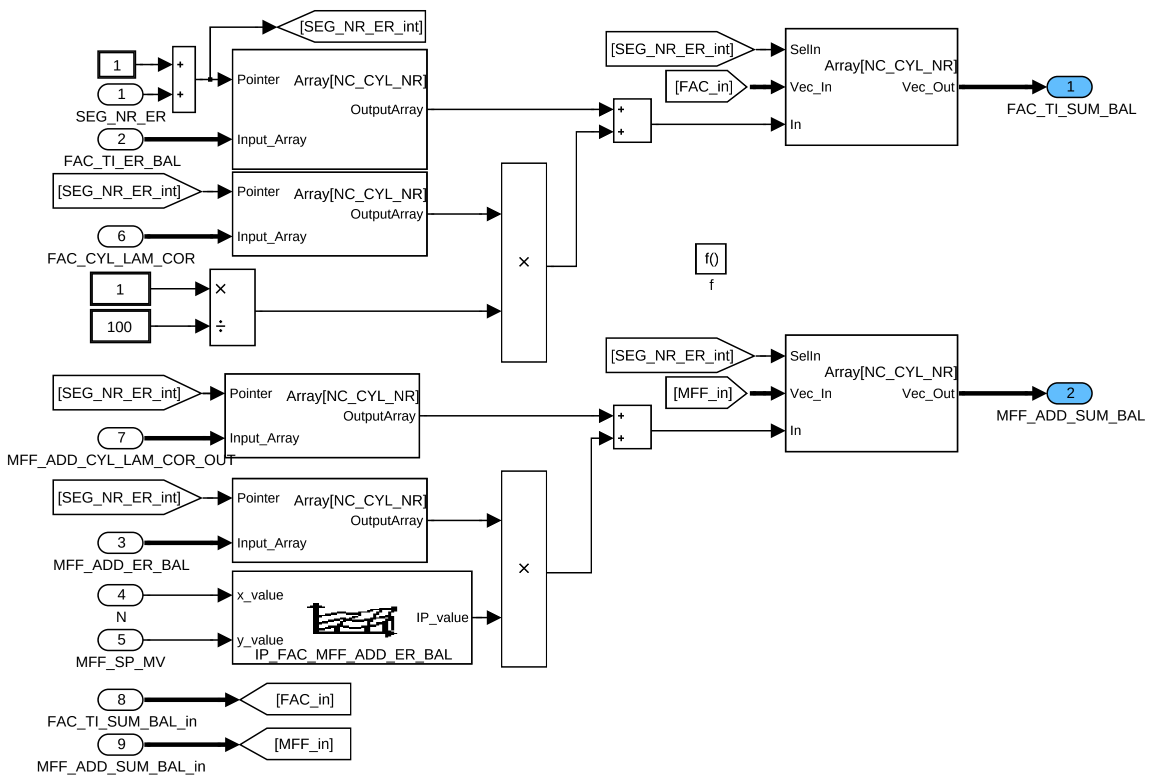

Figure 7.104.21: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC/OPERATE_SEG/ELSE_IF/ELSE_IF/ELSE_IF/CASE_THEN

Calculation of correction factors for cylinder balancing OPERATE_SEG ELSE_IF ELSE_IF ELSE_IF ELSE_IF

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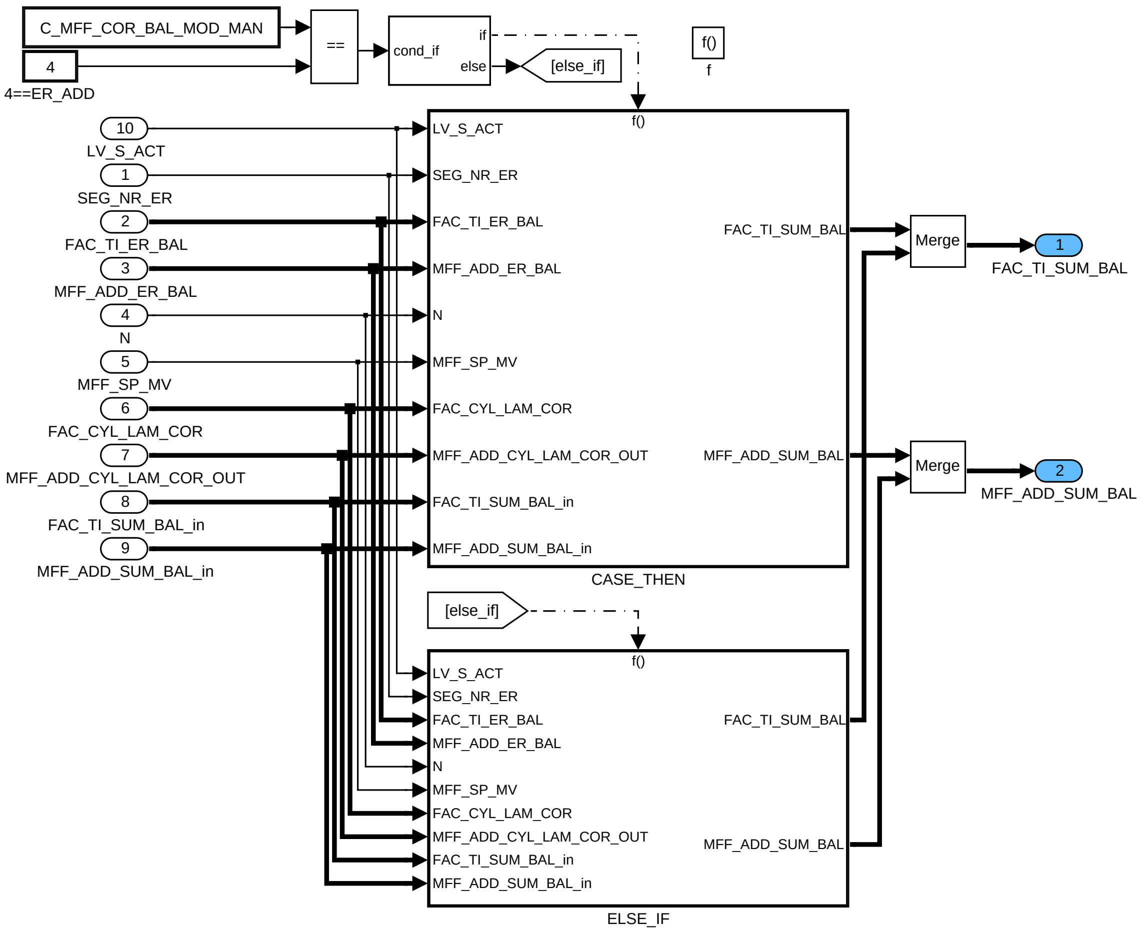

Figure 7.104.22: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC/OPERATE_SEG/ELSE_IF/ELSE_IF/ELSE_IF/ELSE_IF

Calculation of correction factors for cylinder balancing OPERATE_SEG ELSE_IF ELSE_IF ELSE_IF ELSE_IF CASE_THEN

//CYBL via LAM only applied in HOM, CYBL via ER applied in STR and partly in HOM

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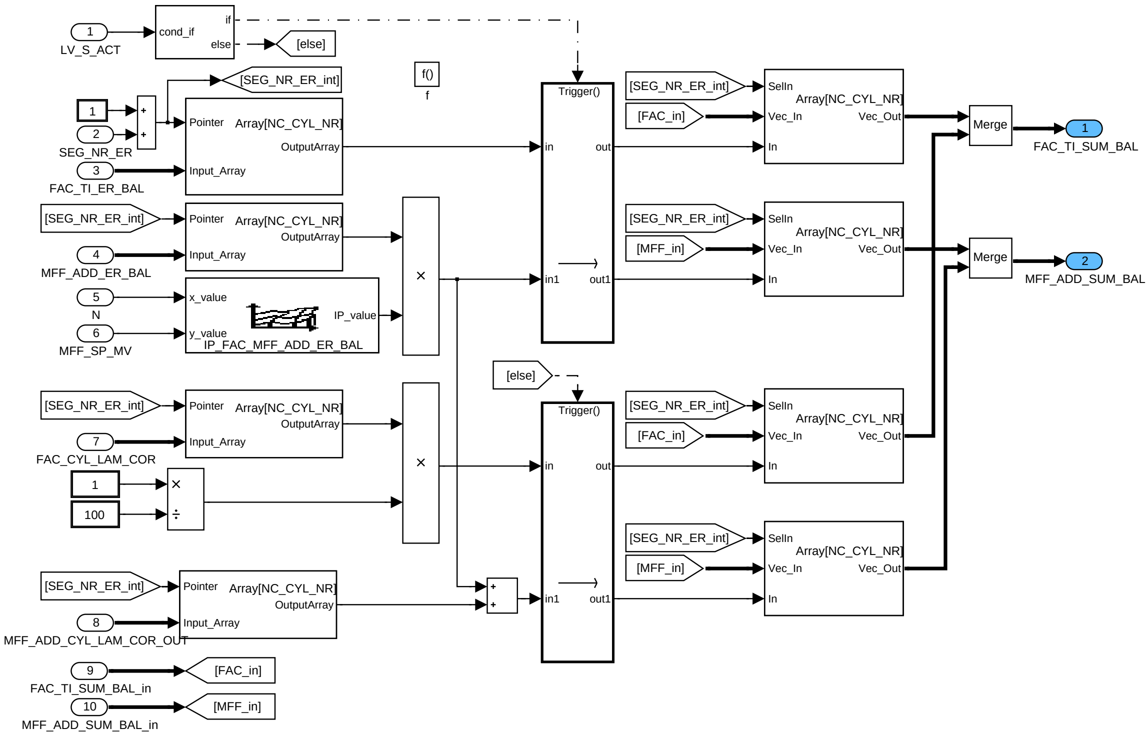

Figure 7.104.23: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC/OPERATE_SEG/ELSE_IF/ELSE_IF/ELSE_IF/ELSE_IF/CASE_THEN

Calculation of correction factors for cylinder balancing OPERATE_SEG ELSE_IF ELSE_IF ELSE_IF ELSE_IF ELSE_IF

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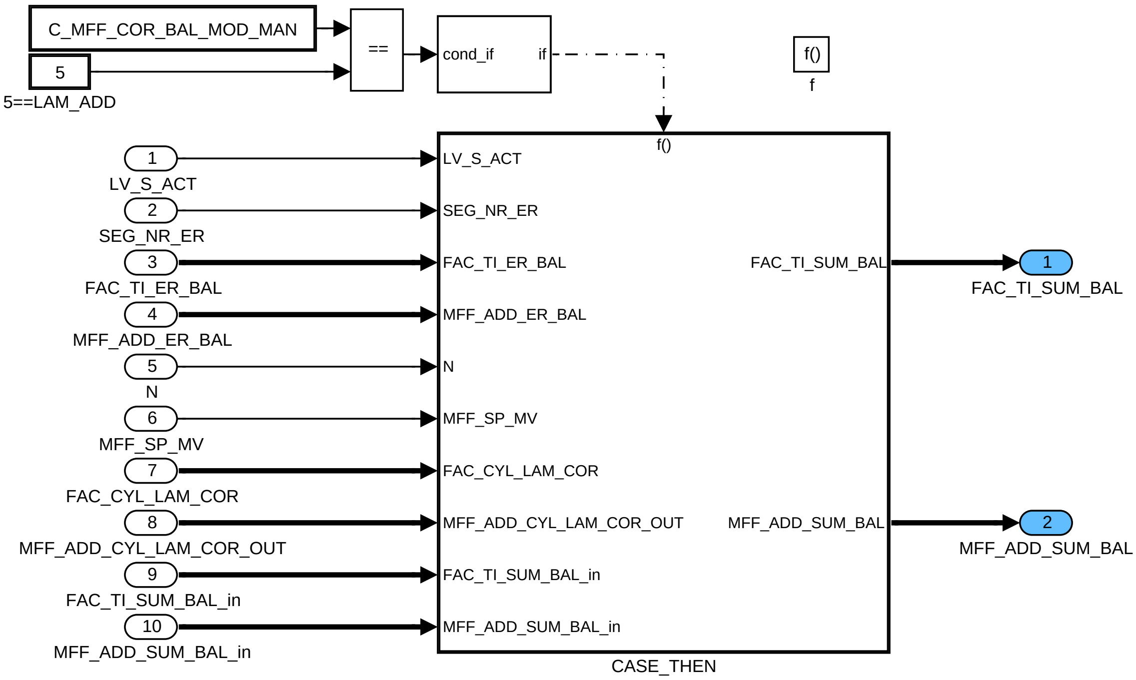

Figure 7.104.24: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC/OPERATE_SEG/ELSE_IF/ELSE_IF/ELSE_IF/ELSE_IF/ELSE_IF

Calculation of correction factors for cylinder balancing OPERATE_SEG ELSE_IF ELSE_IF ELSE_IF ELSE_IF ELSE_IF CASE_THEN

//CYBL via LAM applied in HOM and STR, CYBL ER applied in STR and partly in HOM

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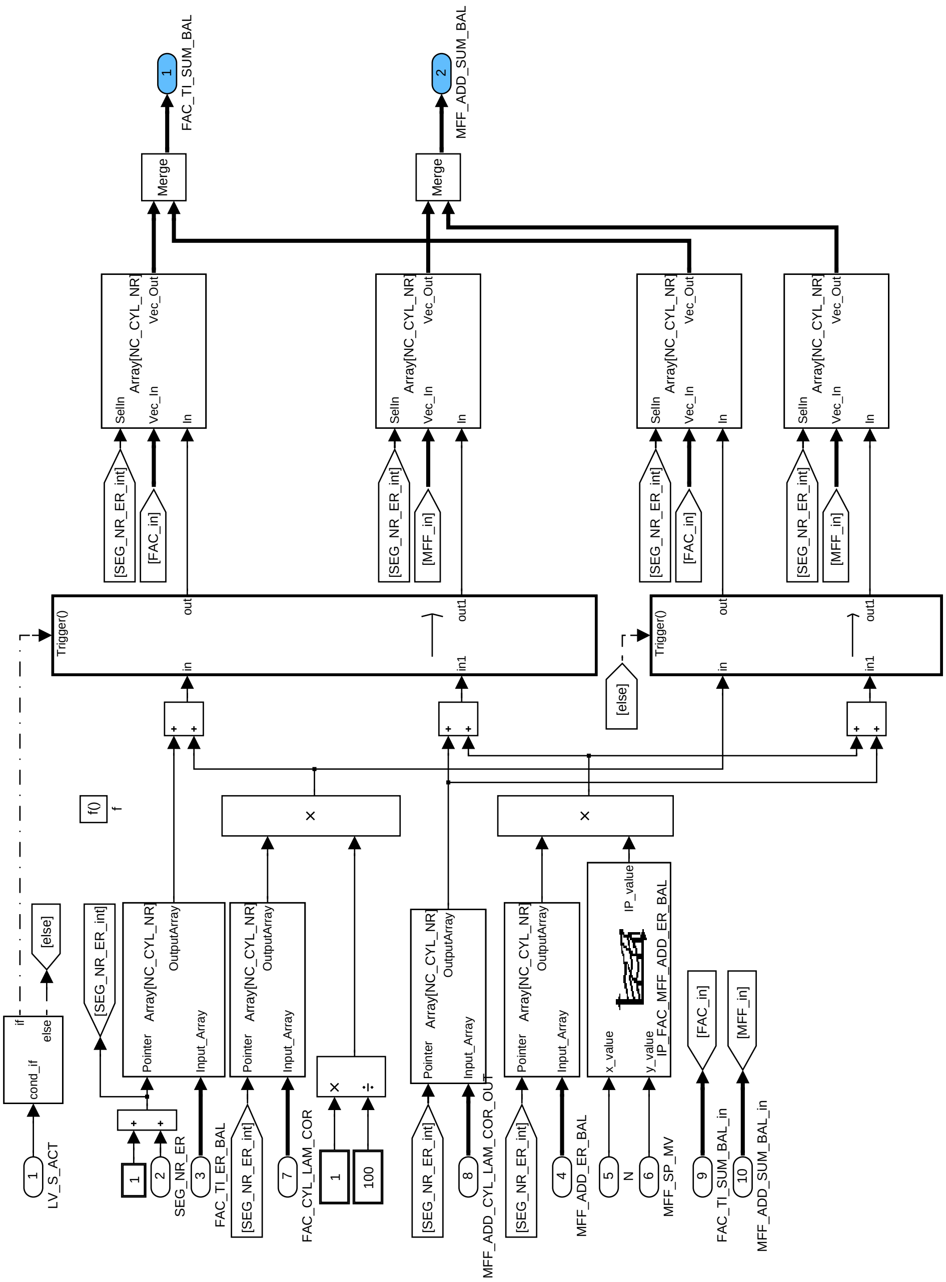

Figure 7.104.25: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC/OPERATE_SEG/ELSE_IF/ELSE_IF/ELSE_IF/ELSE_IF/ELSE_IF/CASE_THEN

Cylinder balancing injection valve energy level adjustment (approximation)

The formula section is only activated if the switch for a manual reset is set to "0". In case of a manual reset (refer: "Manual Reset of cylinder balancing correction values"), the calculations are stopped at once.

The approximation is only enabled while the manual switch for injection valve energy level calculation is set to "Adjustment" or "ADJ& CTL".

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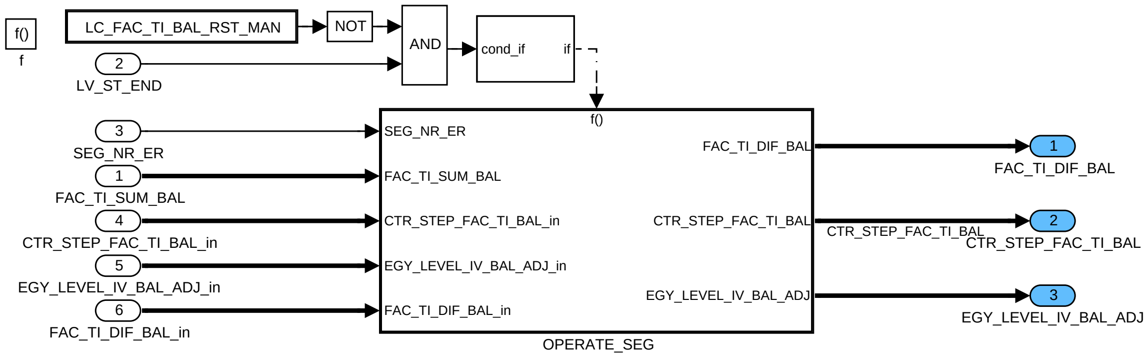

Figure 7.104.26: CYBL_M30704P01/OPM/OPERATE_SEG/INJ_VAL_EGY_LEVEL

Cylinder balancing injection valve energy level adjustment (approximation) OPERATE_SEG

("Calculation of the approximation part disabled") for EGY_LEVEL_IV_BAL_ADJ[m]=0

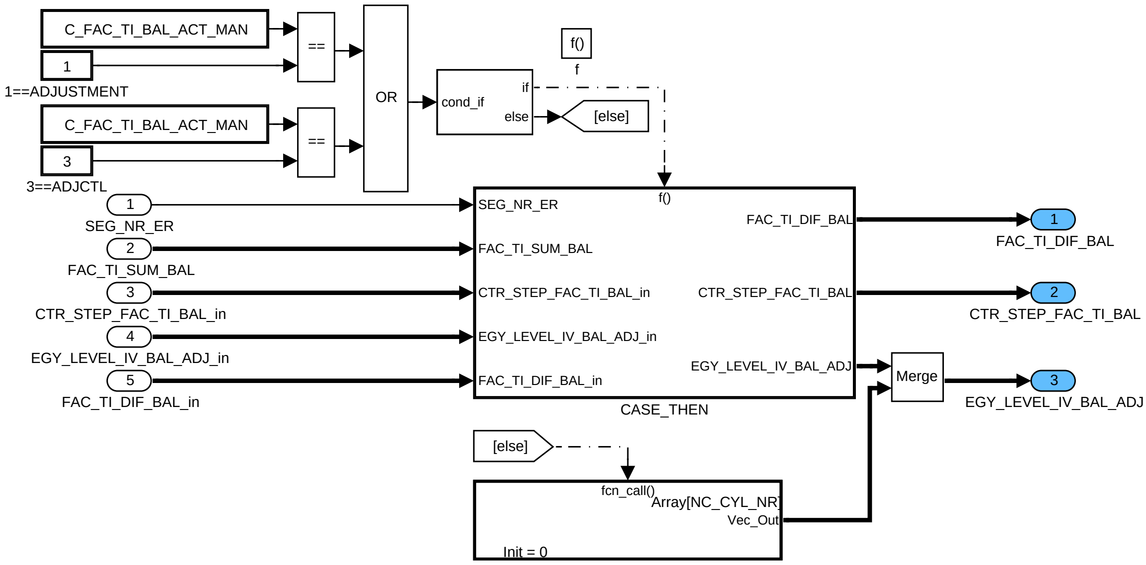

Figure 7.104.27: CYBL_M30704P01/OPM/OPERATE_SEG/INJ_VAL_EGY_LEVEL/OPERATE_SEG

Cylinder balancing injection valve energy level adjustment (approximation) OPERATE_SEG CASE_THEN

("Calculation of the approximation part enabled")

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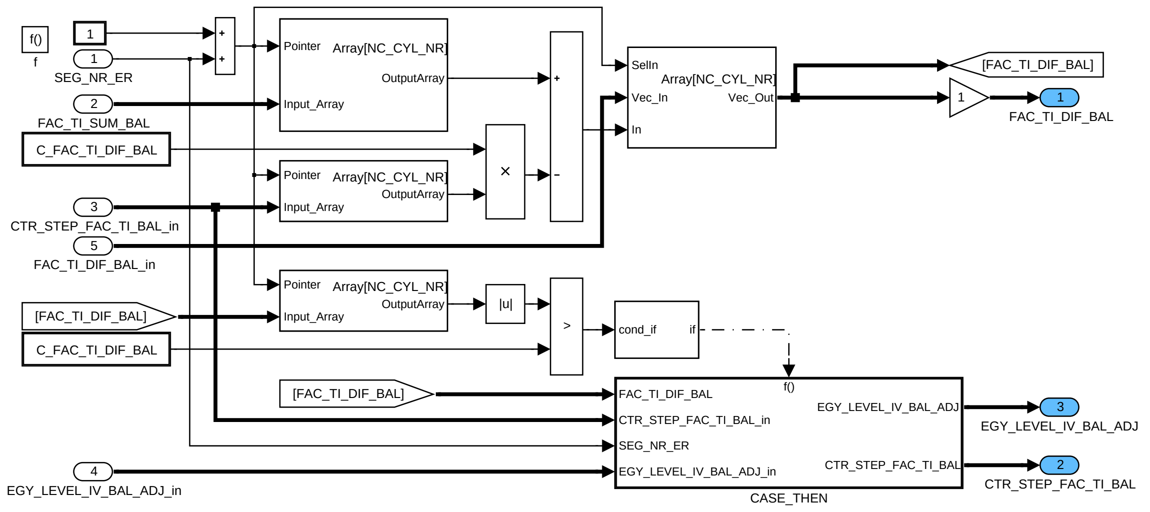

Figure 7.104.28:
CYBL_M30704P01/OPM/OPERATE_SEG/INJ_VAL_EGY_LEVEL/OPERATE_SEG/CASE_THEN

Cylinder balancing injection valve energy level adjustment (approximation) OPERATE_SEG CASE_THEN CASE_THEN

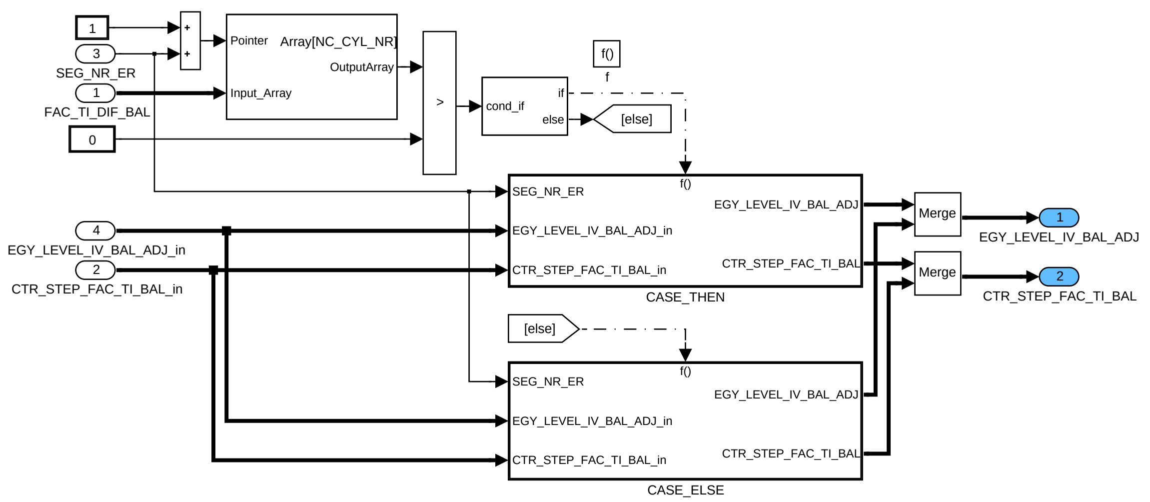

Figure 7.104.29: CYBL_M30704P01/OPM/OPERATE_SEG/INJ_VAL_EGY_LEVEL/OPERATE_SEG/
CASE_THEN/CASE_THEN

Cylinder balancing injection valve energy level adjustment (approximation) OPERATE_SEG CASE_THEN CASE_THEN CASE_THEN

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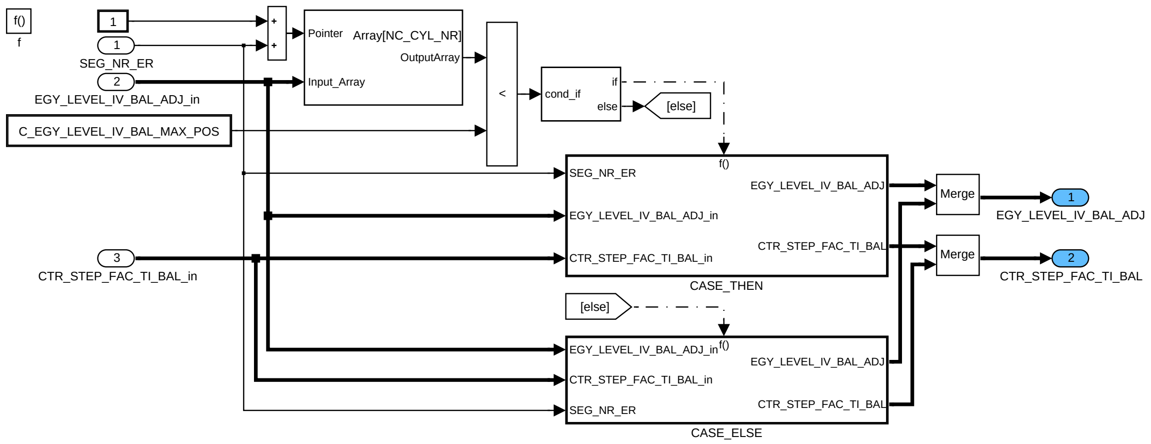

Figure 7.104.30: CYBL_M30704P01/OPM/OPERATE_SEG/INJ_VAL_EGY_LEVEL/OPERATE_SEG/CASE_THEN/CASE_THEN/CASE_THEN

Cylinder balancing injection valve energy level adjustment (approximation) OPERATE_SEG CASE_THEN CASE_THEN CASE_THEN CASE_THEN

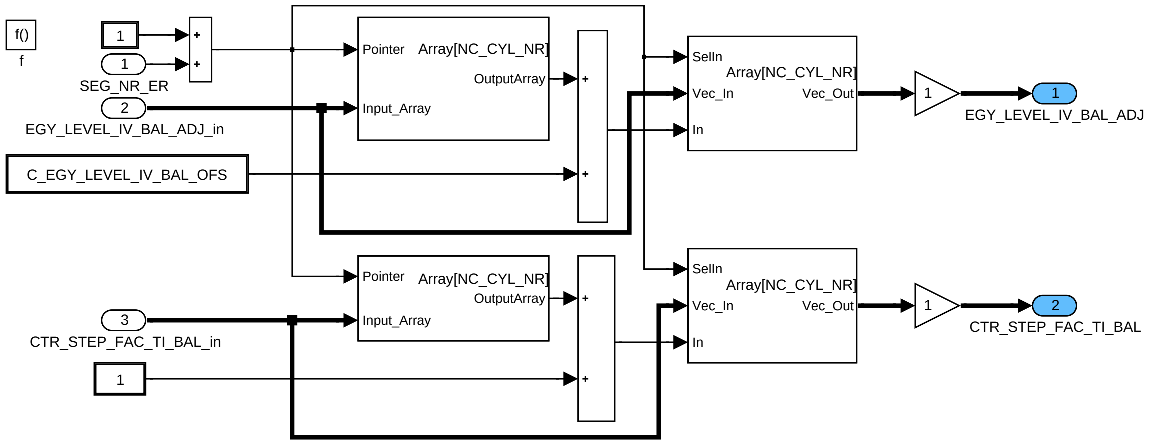

Figure 7.104.31: CYBL_M30704P01/OPM/OPERATE_SEG/INJ_VAL_EGY_LEVEL/OPERATE_SEG/CASE_THEN/CASE_THEN/CASE_THEN/CASE_THEN

Cylinder balancing injection valve energy level adjustment (approximation) OPERATE_SEG CASE_THEN CASE_THEN CASE_THEN CASE_ELSE

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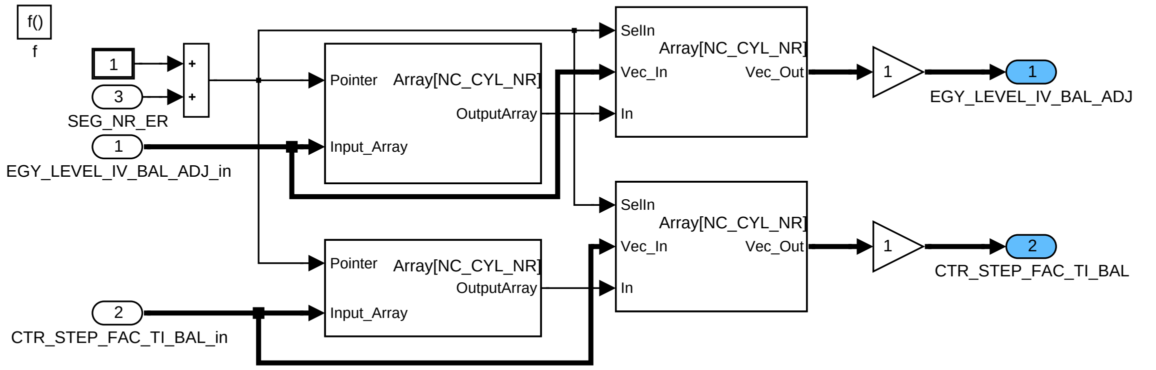

Figure 7.104.32: CYBL_M30704P01/OPM/OPERATE_SEG/INJ_VAL_EGY_LEVEL/OPERATE_SEG/ CASE_THEN/CASE_THEN/CASE_THEN/CASE_ELSE

Cylinder balancing injection valve energy level adjustment (approximation) OPERATE_SEG CASE_THEN CASE_THEN CASE_ELSE

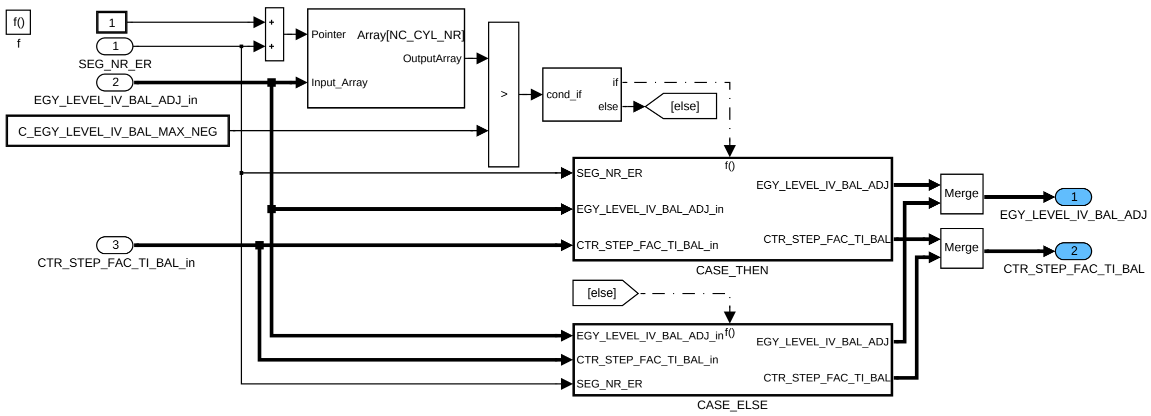

Figure 7.104.33: CYBL_M30704P01/OPM/OPERATE_SEG/INJ_VAL_EGY_LEVEL/OPERATE_SEG/ CASE_THEN/CASE_THEN/CASE_ELSE

Cylinder balancing injection valve energy level adjustment (approximation) OPERATE_SEG CASE_THEN CASE_THEN CASE_ELSE CASE_THEN

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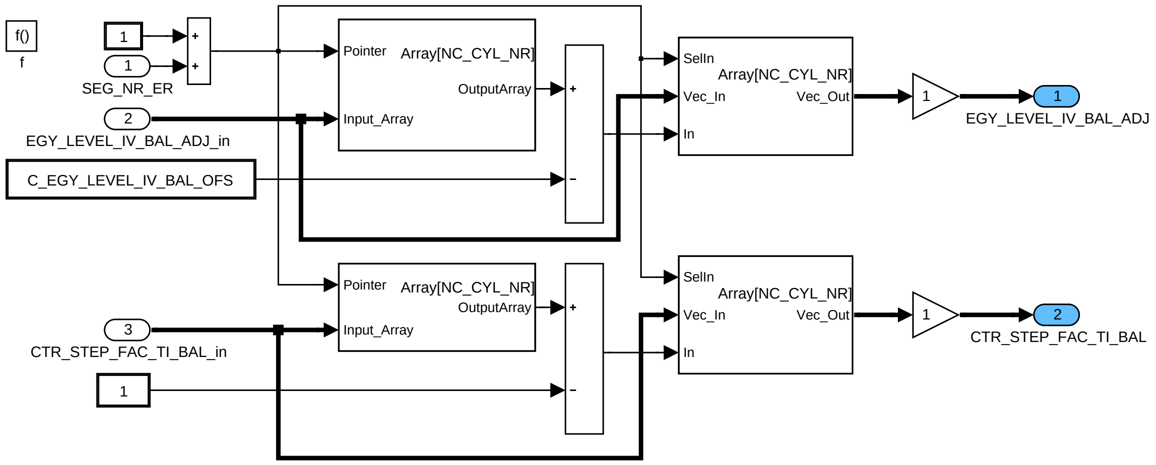

Figure 7.104.34: CYBL_M30704P01/OPM/OPERATE_SEG/INJ_VAL_EGY_LEVEL/OPERATE_SEG/ CASE_THEN/CASE_THEN/CASE_ELSE/CASE_THEN

Cylinder balancing injection valve energy level adjustment (approximation) OPERATE_SEG CASE_THEN CASE_THEN CASE_ELSE CASE_ELSE

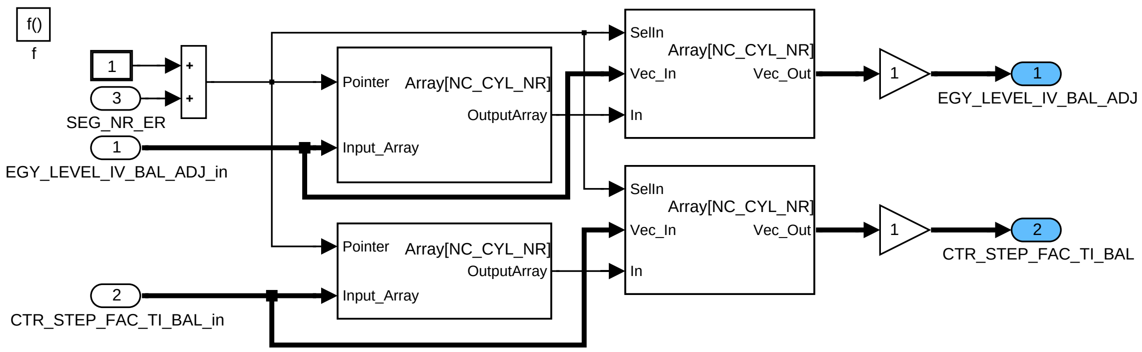

Figure 7.104.35: CYBL_M30704P01/OPM/OPERATE_SEG/INJ_VAL_EGY_LEVEL/OPERATE_SEG/ CASE_THEN/CASE_THEN/CASE_ELSE/CASE_ELSE

Cylinder balancing injection valve energy level control

The formula section is only activated if the switch for a manual reset is set to "0". In case of a manual reset (refer: "Manual Reset of cylinder balancing correction values"), the calculations are stopped at once.

The energy level conversion is only enabled while the manual switch for injection valve energy level calculation is set to "Control" or "ADJ& CTL".

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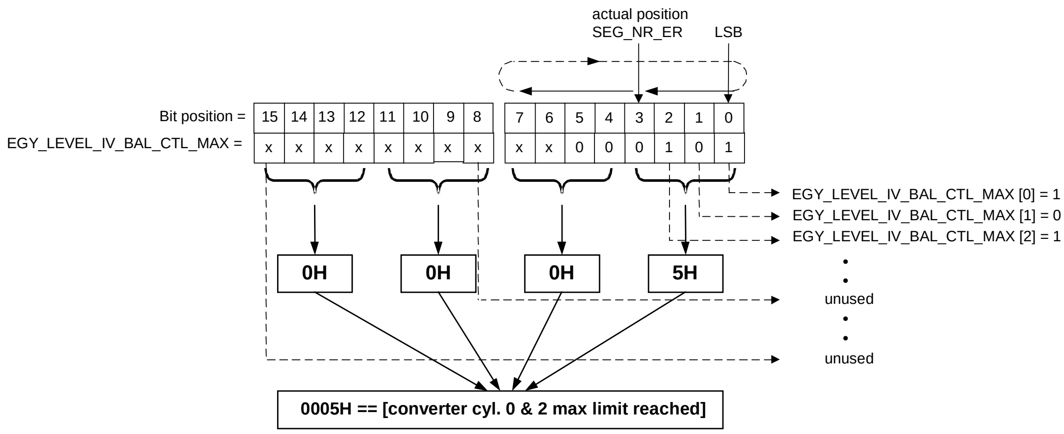
Signalization of converter maximum output value reached



Note: always the complete WORD (16BIT) is displayed as visible value

As soon as an energy level conversion of one cylinder is reaching its maximum, a corresponding value is set to "1" to indicate the related cylinder. To save memory resources, the information for all cylinders is located within one output date (WORD). Each BIT information within the WORD is used to indicate one cylinder. It is possible to handle up to 16 cylinders with this method.

For a description more in detail please have a look to the signal flow diagram above. As example, a sixcylinder engine with two converters, which have reached the limits is shown.

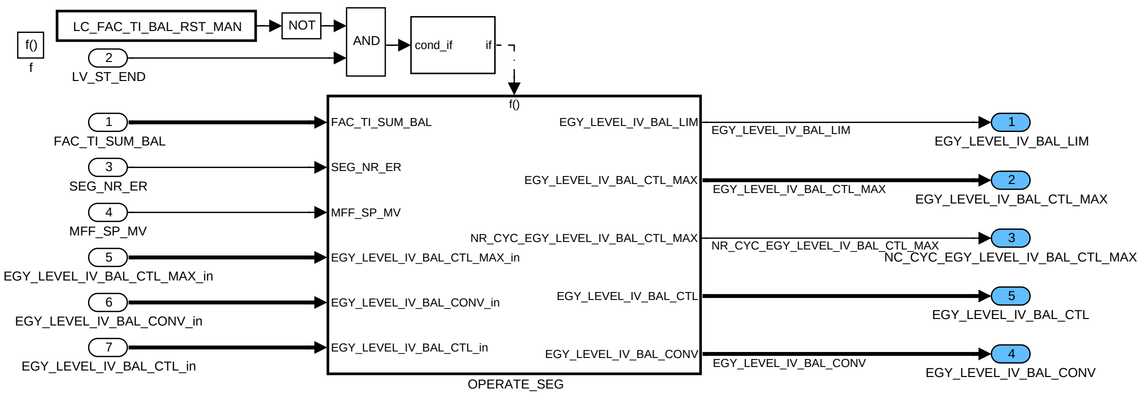


Figure 7.104.36: CYBL_M30704P01/OPM/OPERATE_SEG/INJ_VAL_EGY_LEVEL_CTL

Cylinder balancing injection valve energy level control OPERATE_SEG

("Calculation of the converter part disabled") (CASE_ELSE)

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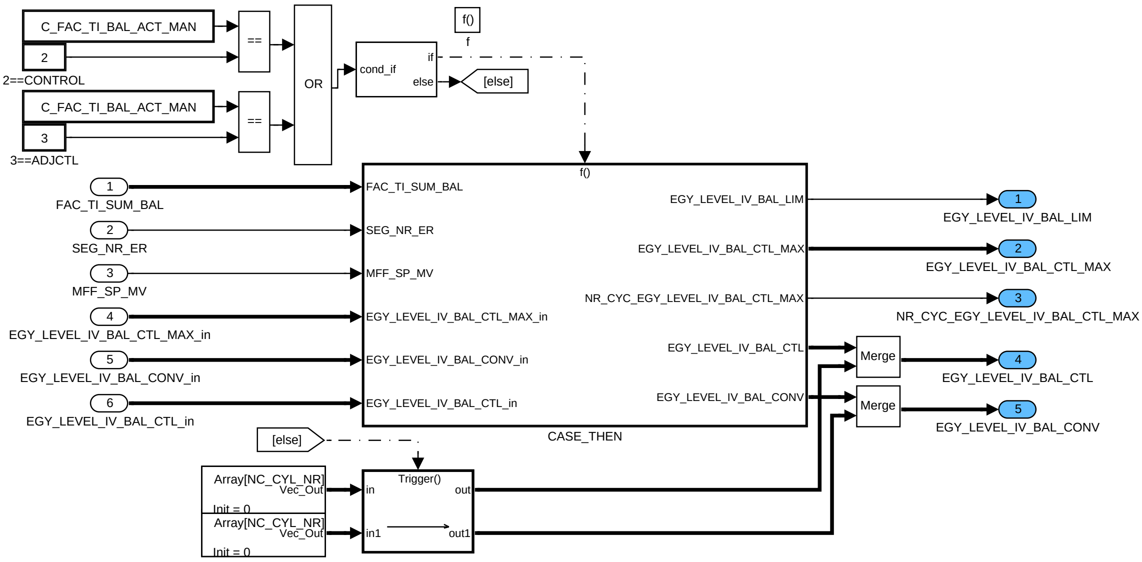

Figure 7.104.37:
CYBL_M30704P01/OPM/OPERATE_SEG/INJ_VAL_EGY_LEVEL_CTL/OPERATE_SEG

Cylinder balancing injection valve energy level control OPERATE_SEG CASE_THEN

("Calculation of the converter part enabled")

Task of this section is to convert the multiple correction factor provided by the cylinder balancing functions into a corresponding energy level value. The energy level signal is used to adjust the injector needle lift.

The outputs of the converter are limited to a calibrateable threshold. If one converter output has reached the limit a flag is set to one and the corresponding segment number is displayed.

The final converter outputs are corrected with a multiple factor out of an interpolation table to compensate different conversion rates for the energy levels at all engine operating areas.

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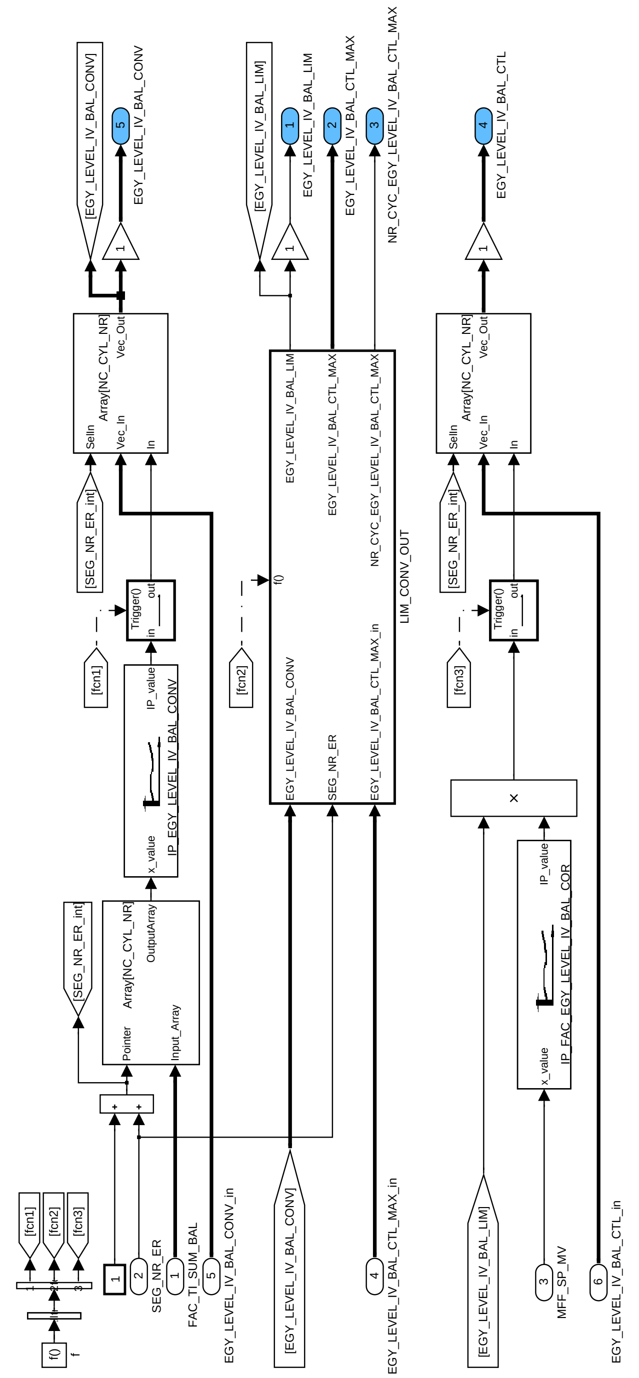

Figure 7.104.38: CYBL_M30704P01/OPM/OPERATE_SEG/INJ_VAL_EGY_LEVEL_CTL/ OPERATE_SEG/CASE_THEN

Cylinder balancing injection valve energy level control OPERATE_SEG CASE_THEN LIM_CONV_OUT

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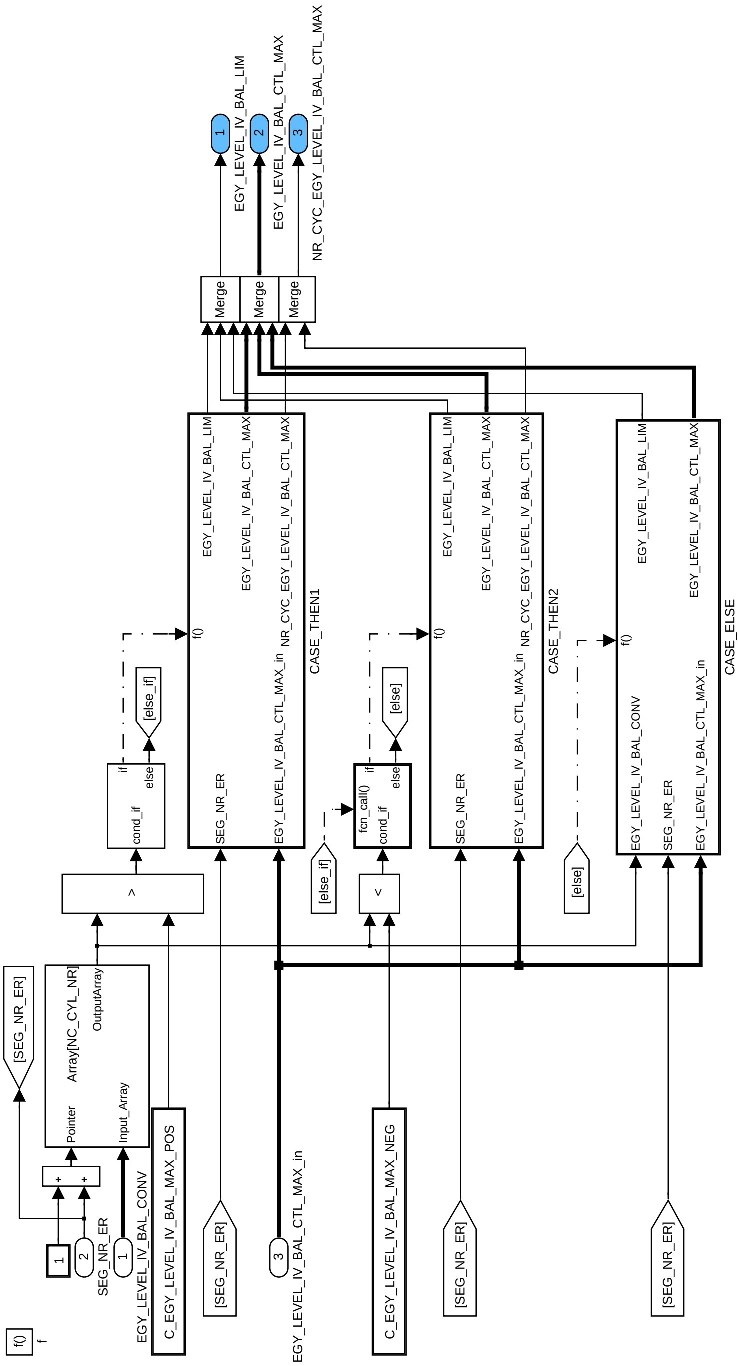

Figure 7.104.39: CYBL_M30704P01/OPM/OPERATE_SEG/INJ_VAL_EGY_LEVEL_CTL/ OPERATE_SEG/CASE_THEN/LIM_CONV_OUT

Cylinder balancing injection valve energy level control OPERATE_SEG CASE_THEN LIM_CONV_OUT CASE_THEN1

//corresponding segment number where the controller has reached the limit

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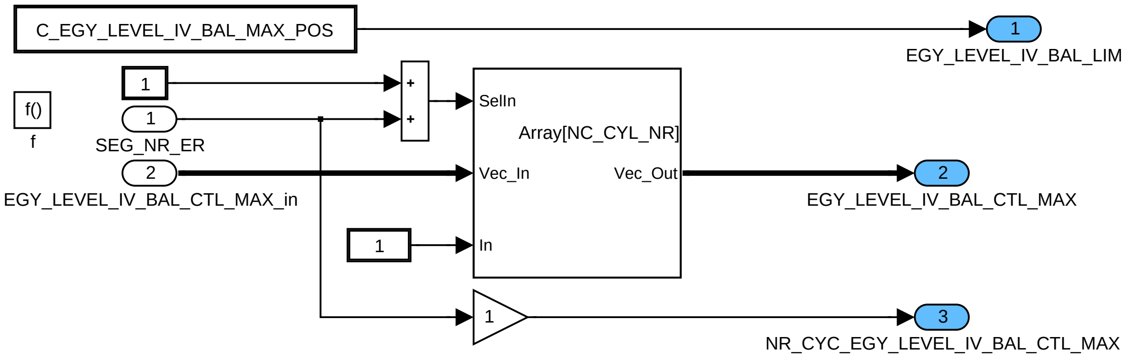

Figure 7.104.40: CYBL_M30704P01/OPM/OPERATE_SEG/INJ_VAL_EGY_LEVEL_CTL/
OPERATE_SEG/CASE_THEN/LIM_CONV_OUT/CASE_THEN1

Cylinder balancing injection valve energy level control OPERATE_SEG CASE_THEN LIM_CONV_OUT CASE_THEN2

//corresponding segment number where the controller has reached the limit

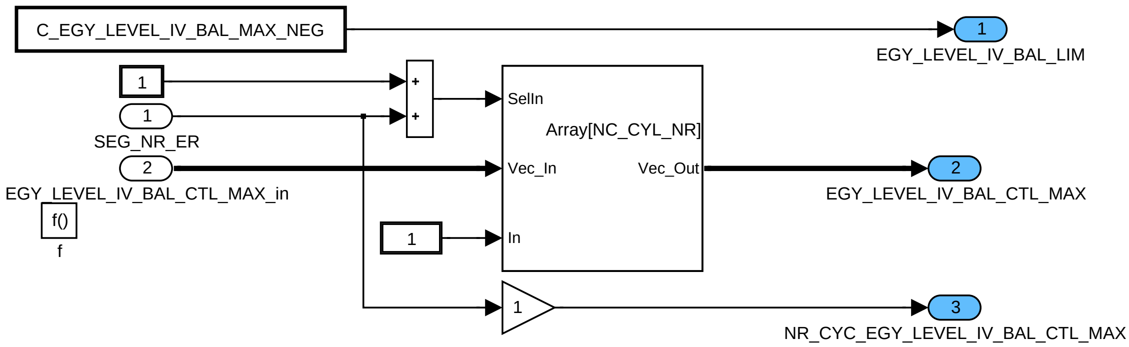

Figure 7.104.41: CYBL_M30704P01/OPM/OPERATE_SEG/INJ_VAL_EGY_LEVEL_CTL/
OPERATE_SEG/CASE_THEN/LIM_CONV_OUT/CASE_THEN2

Cylinder balancing injection valve energy level control OPERATE_SEG CASE_THEN LIM_CONV_OUT CASE_ELSE

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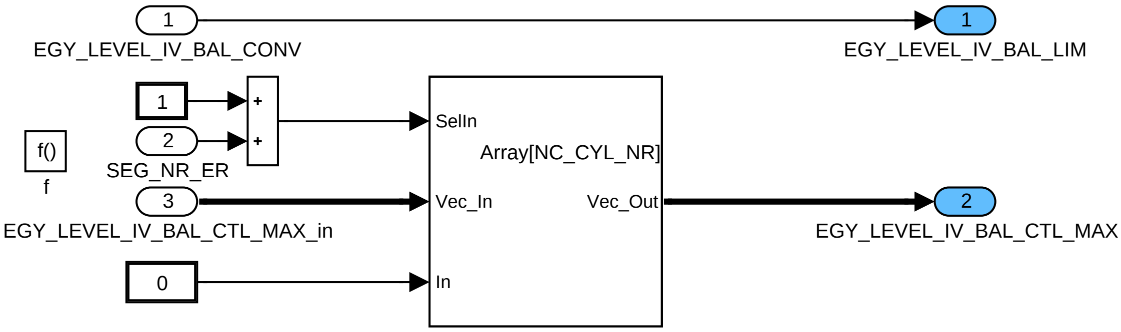

Figure 7.104.42: CYBL_M30704P01/OPM/OPERATE_SEG/INJ_VAL_EGY_LEVEL_CTL/OPERATE_SEG/CASE_THEN/LIM_CONV_OUT/CASE_ELSE

Calculation of overall correction factors for cylinder balancing at engine run

The formula section is only activated if the switch for a manual reset is set to "0". In case of a manual reset (: "Manual Reset of cylinder balancing correction values"), the calculations are stopped at once.

Finally, the calculation of the total cylinder balancing correction output values takes place. The output values are used to adjust the wanted cylinder individual corrections. All injection valve correction values are calculated at any engine operating area depending of the chosen control strategy.

To avoid high cylinder to cylinder torque differences, especially at first activation after engine start and at cylinder balancing via ER activation, all total cylinder correction values are calculated within one segment. Later on, only the correction values of the current valid segment is calculated. The control is realized by a calibrateable forloop with adjustable "start" and "stop" parameters.

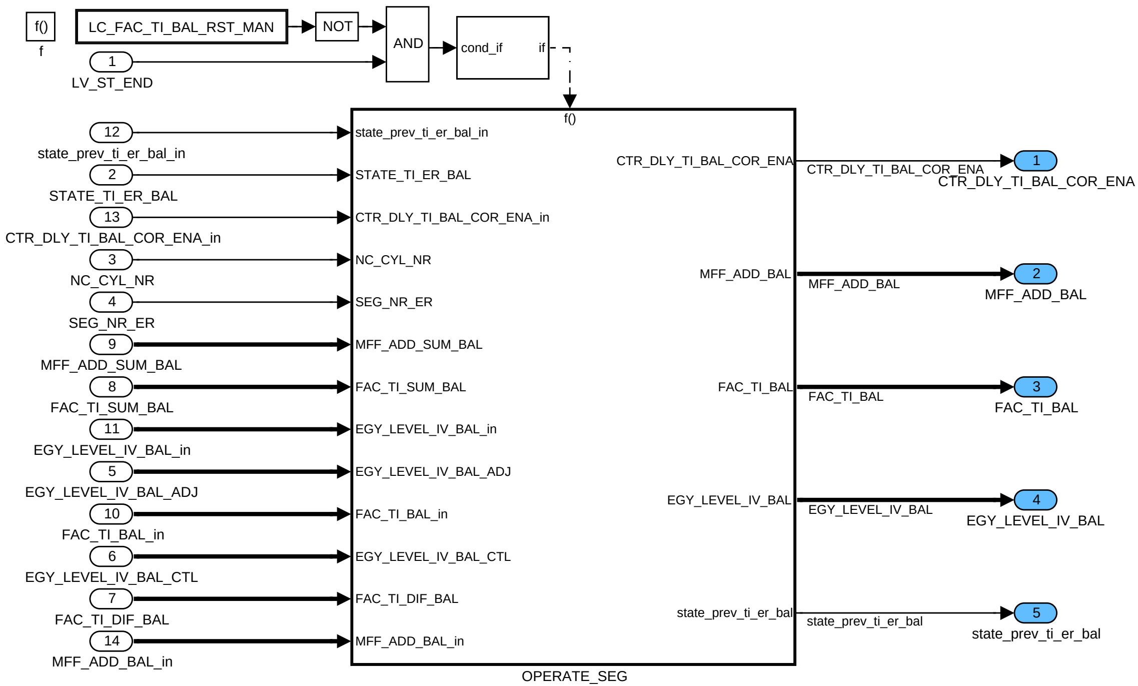

Figure 7.104.43: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC_ERU

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Calculation of overall correction factors for cylinder balancing at engine run OPERATE_SEG

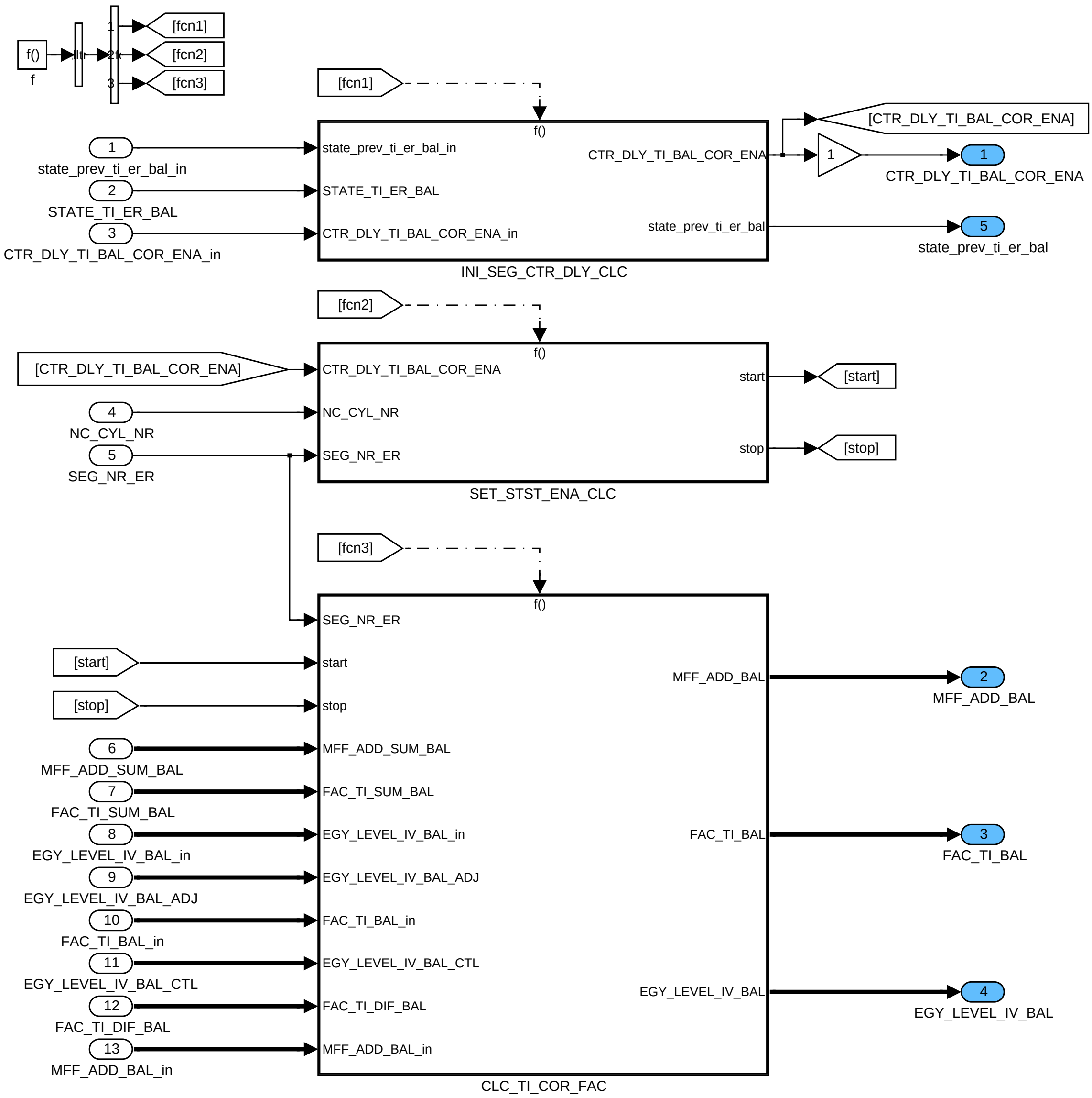

Figure 7.104.44: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC_ERU/OPERATE_SEG

Calculation of overall correction factors for cylinder balancing at engine run OPERATE_SEG INI_SEG_CTR_DLY_CLC

Initialization of segment counter to delay calculation of overall TI correction factors at engine run:

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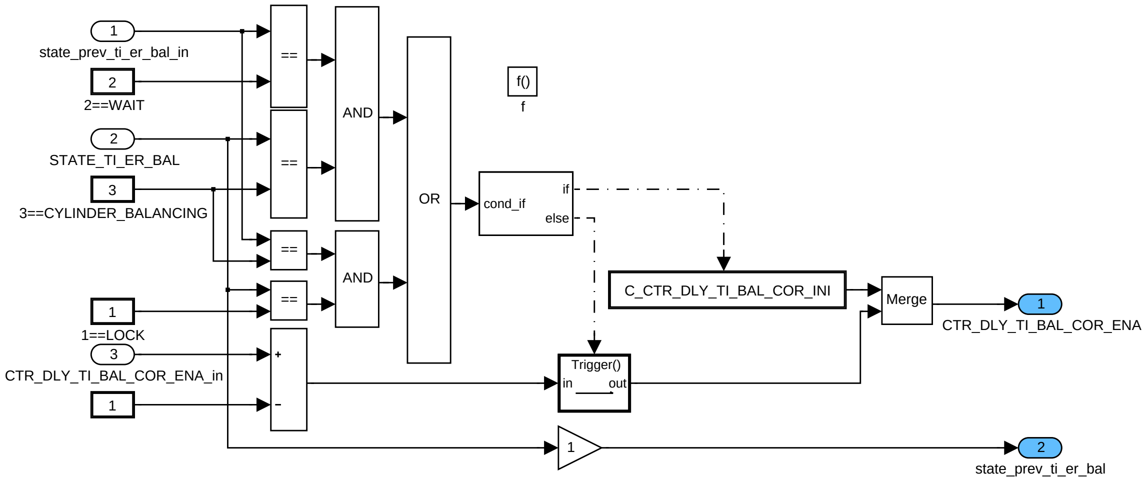

Figure 7.104.45: - CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC_ERU/OPERATE_SEG/INI_SEG_CTR_DLY_CLC

Calculation of overall correction factors for cylinder balancing at engine run OPERATE_SEG SET_STST_ENA_CLC

Setting of "start - "stop" - parameter to enable calculation of overall TI correction factors at engine run:

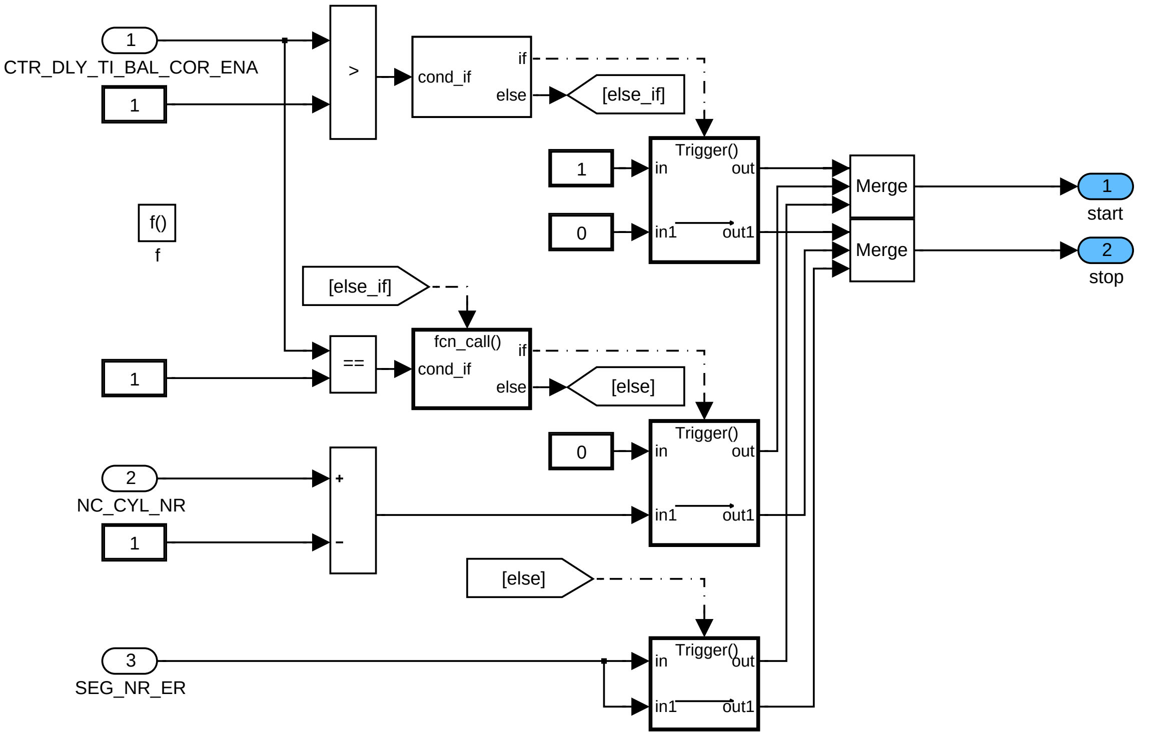

Figure 7.104.46: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC_ERU/OPERATE_SEG/SET_STST_ENA_CLC

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Calculation of overall correction factors for cylinder balancing at engine run OPERATE_SEG CLC_TI_COR_FAC

Calculation of overall TI correction factors (additive, multiple, energy levels) at engine run:

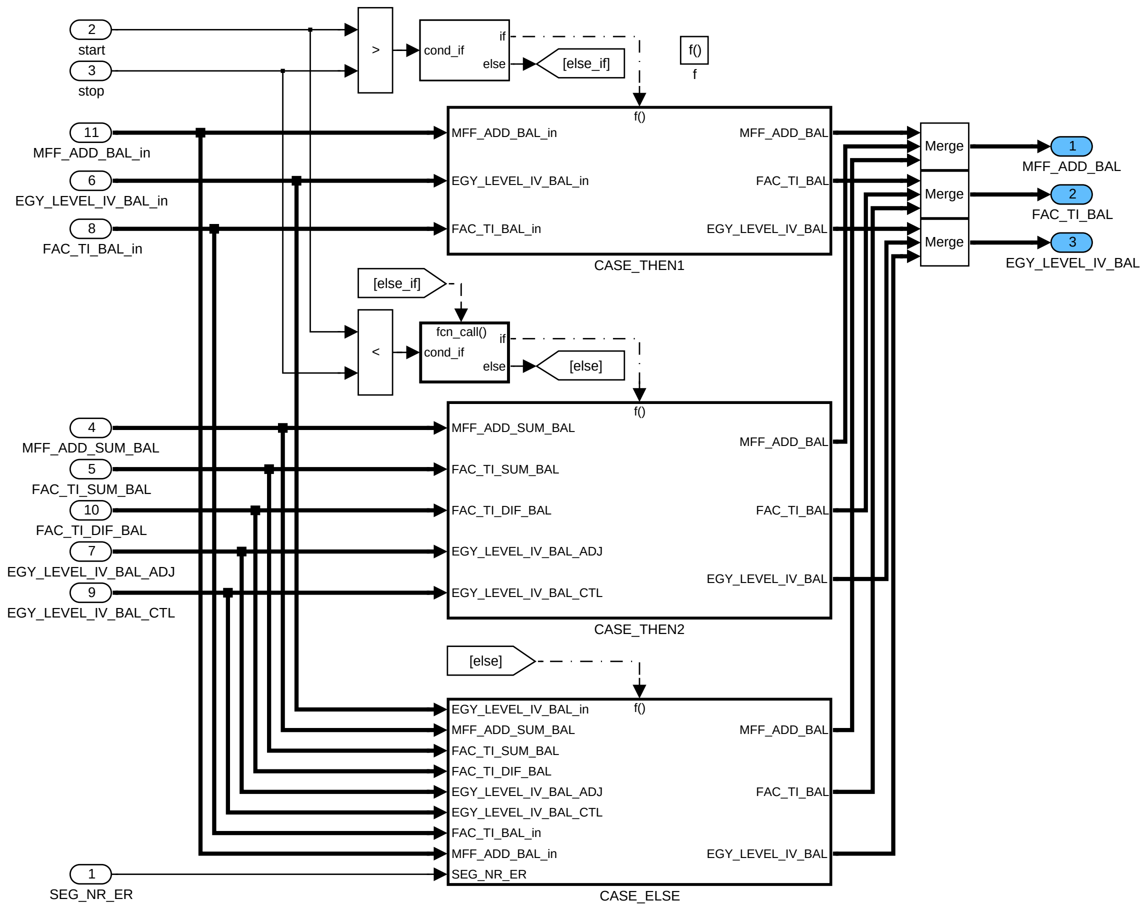

Figure 7.104.47: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC_ERU/OPERATE_SEG/CLC_TI_COR_FAC

Calculation of overall correction factors for cylinder balancing at engine run OPERATE_SEG CLC_TI_COR_FAC CASE_THEN1

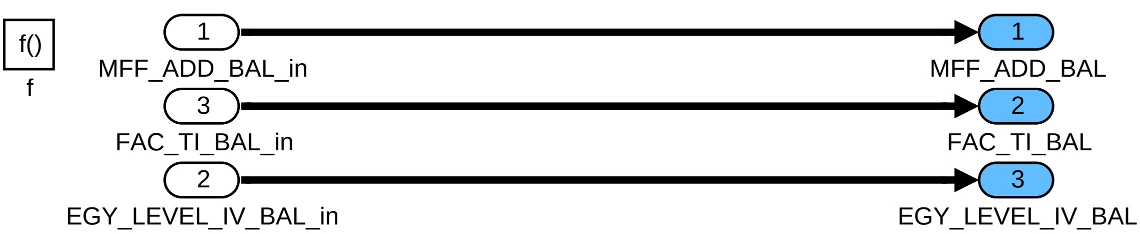

Figure 7.104.48: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC_ERU/OPERATE_SEG/CLC_TI_COR_FAC/CASE_THEN1

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Calculation of overall correction factors for cylinder balancing at engine run OPERATE_SEG CLC_TI_COR_FAC CASE_THEN2

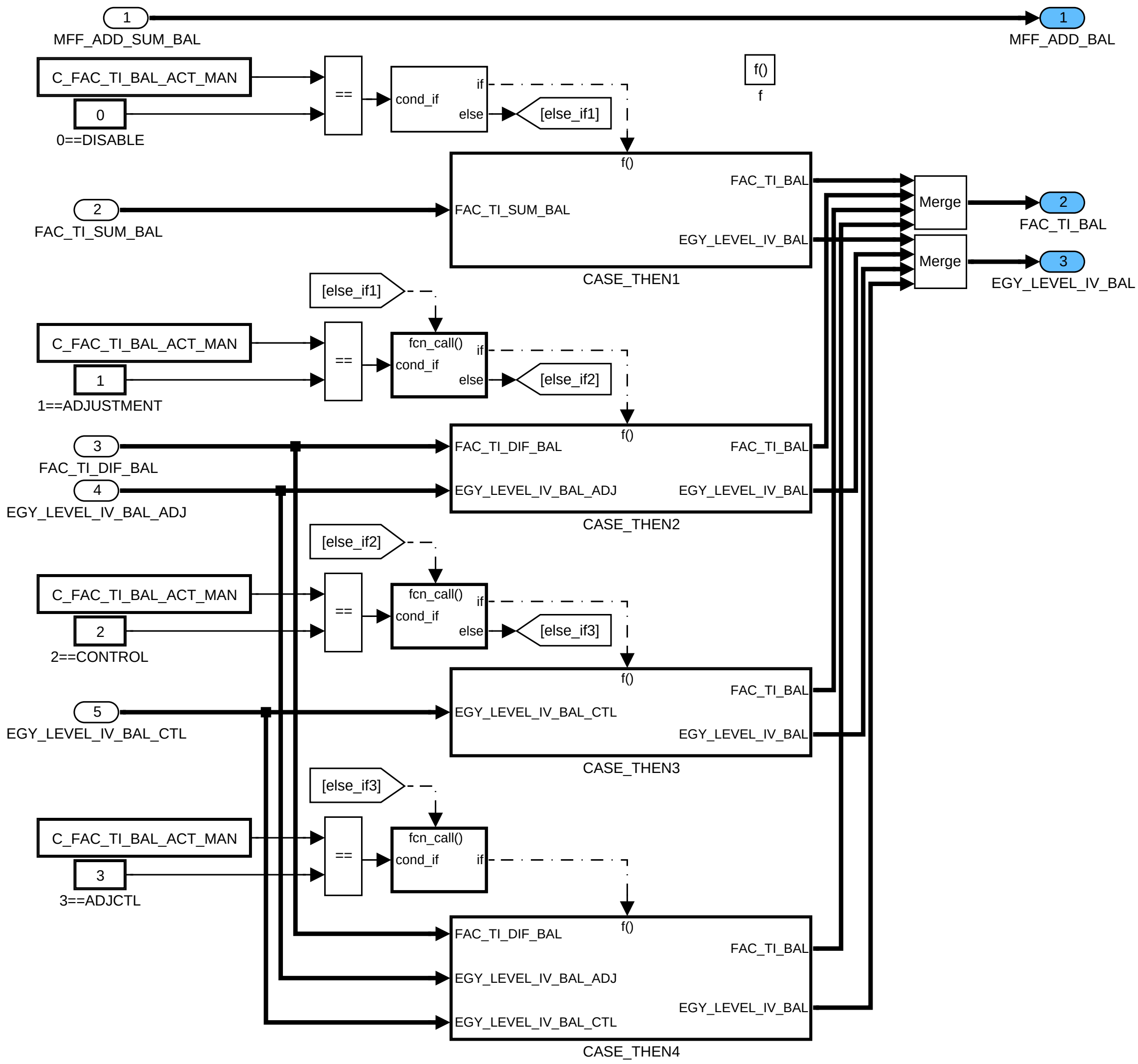

Figure 7.104.49: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC_ERU/OPERATE_SEG/CLC_TI_COR_FAC/CASE_THEN2

Calculation of overall correction factors for cylinder balancing at engine run OPERATE_SEG CLC_TI_COR_FAC CASE_THEN2 CASE_THEN1

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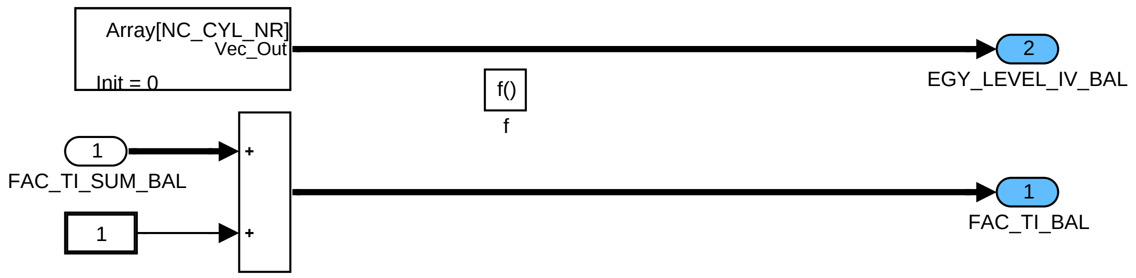

Figure 7.104.50: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC_ERU/OPERATE_SEG/CLC_TI_COR_FAC/CASE_THEN2/CASE_THEN1

Calculation of overall correction factors for cylinder balancing at engine run OPERATE_SEG CLC_TI_COR_FAC CASE_THEN2 CASE_THEN2

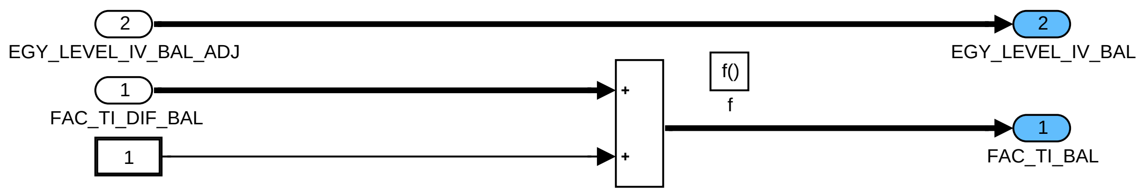

Figure 7.104.51: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC_ERU/OPERATE_SEG/CLC_TI_COR_FAC/CASE_THEN2/CASE_THEN2

Calculation of overall correction factors for cylinder balancing at engine run OPERATE_SEG CLC_TI_COR_FAC CASE_THEN2 CASE_THEN3

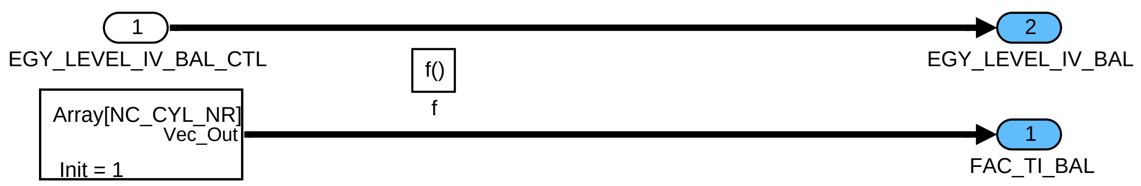

Figure 7.104.52: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC_ERU/OPERATE_SEG/CLC_TI_COR_FAC/CASE_THEN2/CASE_THEN3

Calculation of overall correction factors for cylinder balancing at engine run OPERATE_SEG CLC_TI_COR_FAC CASE_THEN2 CASE_THEN4

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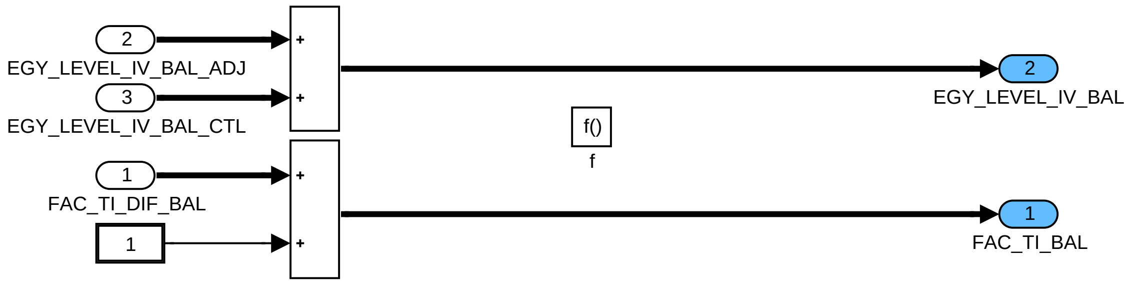

Figure 7.104.53: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC_ERU/OPERATE_SEG/CLC_TI_COR_FAC/CASE_THEN2/CASE_THEN4

Calculation of overall correction factors for cylinder balancing at engine run OPERATE_SEG CLC_TI_COR_FAC CASE_ELSE

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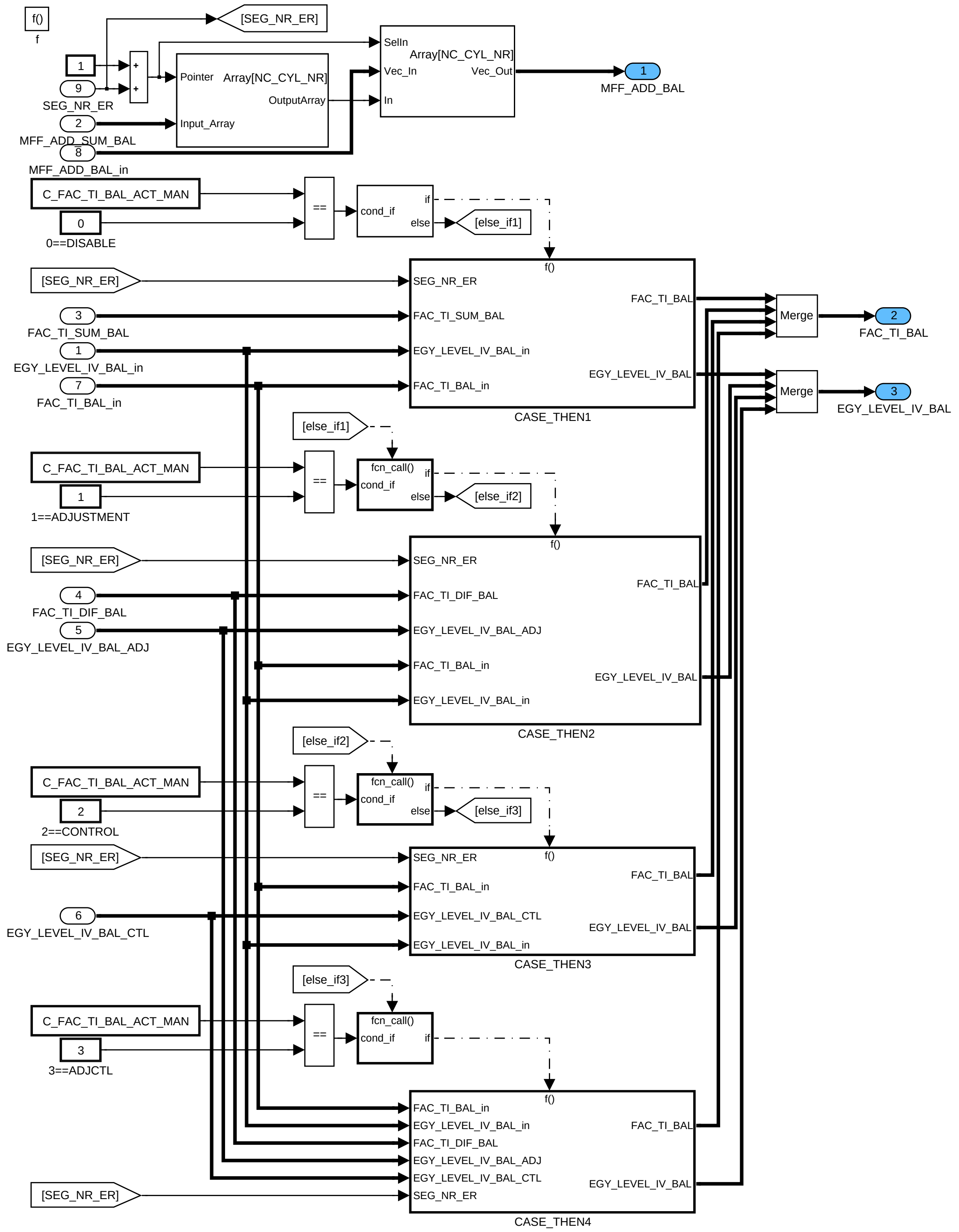

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Figure 7.104.54: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC_ERU/OPERATE_SEG/CLC_TI_COR_FAC/CASE_ELSE

Calculation of overall correction factors for cylinder balancing at engine run OPERATE_SEG CLC_TI_COR_FAC CASE_ELSE CASE_THEN1

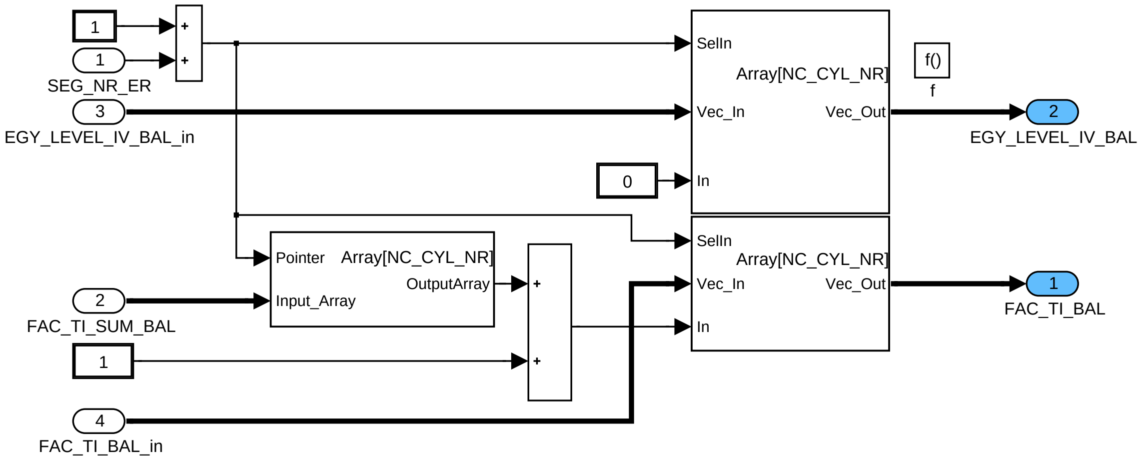

Figure 7.104.55: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC_ERU/OPERATE_SEG/CLC_TI_COR_FAC/CASE_ELSE/CASE_THEN1

Calculation of overall correction factors for cylinder balancing at engine run OPERATE_SEG CLC_TI_COR_FAC CASE_ELSE CASE_THEN2

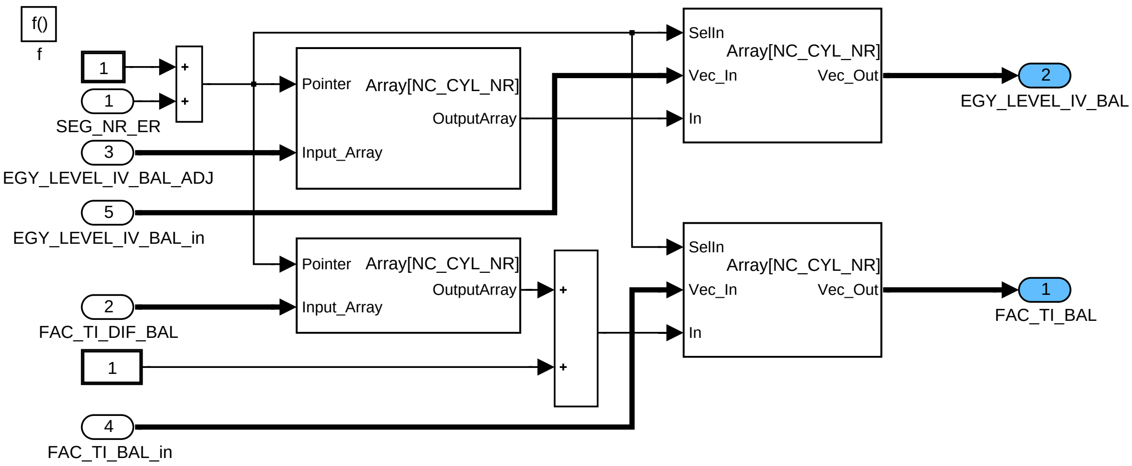

Figure 7.104.56: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC_ERU/OPERATE_SEG/CLC_TI_COR_FAC/CASE_ELSE/CASE_THEN2

Calculation of overall correction factors for cylinder balancing at engine run OPERATE_SEG CLC_TI_COR_FAC CASE_ELSE CASE_THEN3

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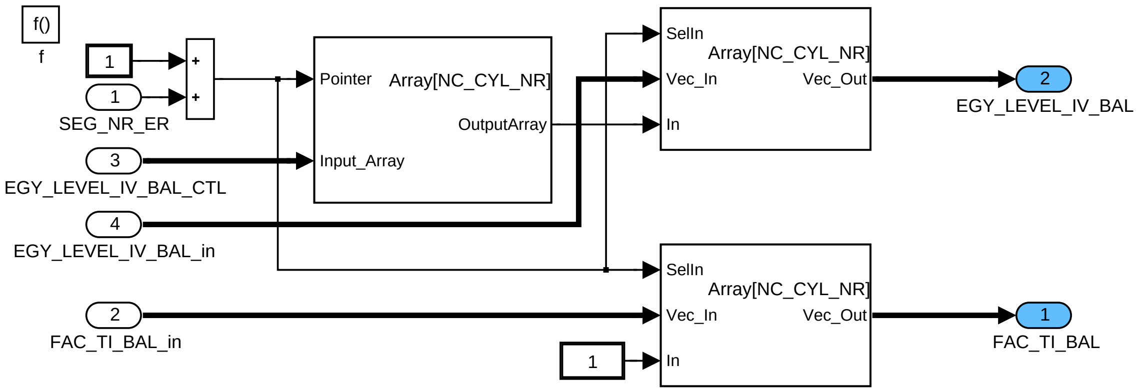

Figure 7.104.57: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC_ERU/OPERATE_SEG/
CLC_TI_COR_FAC/CASE_ELSE/CASE_THEN3

Calculation of overall correction factors for cylinder balancing at engine run OPERATE_SEG CLC_TI_COR_FAC CASE_ELSE CASE_THEN4

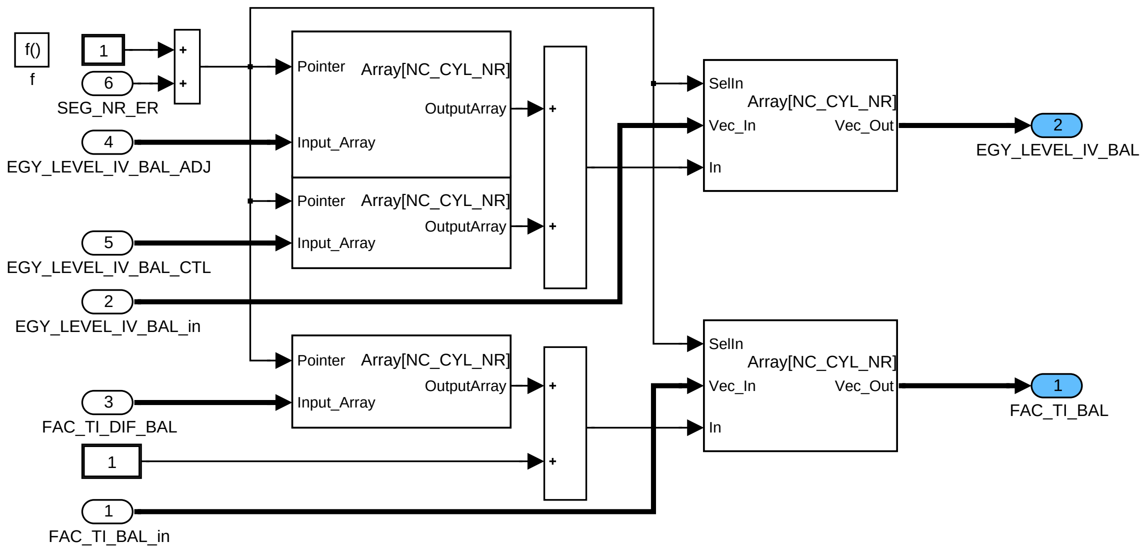

Figure 7.104.58: CYBL_M30704P01/OPM/OPERATE_SEG/CLC_COR_FAC_ERU/OPERATE_SEG/
CLC_TI_COR_FAC/CASE_ELSE/CASE_THEN4

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7.104.3 SUBFUNCTION: SIG_MNG

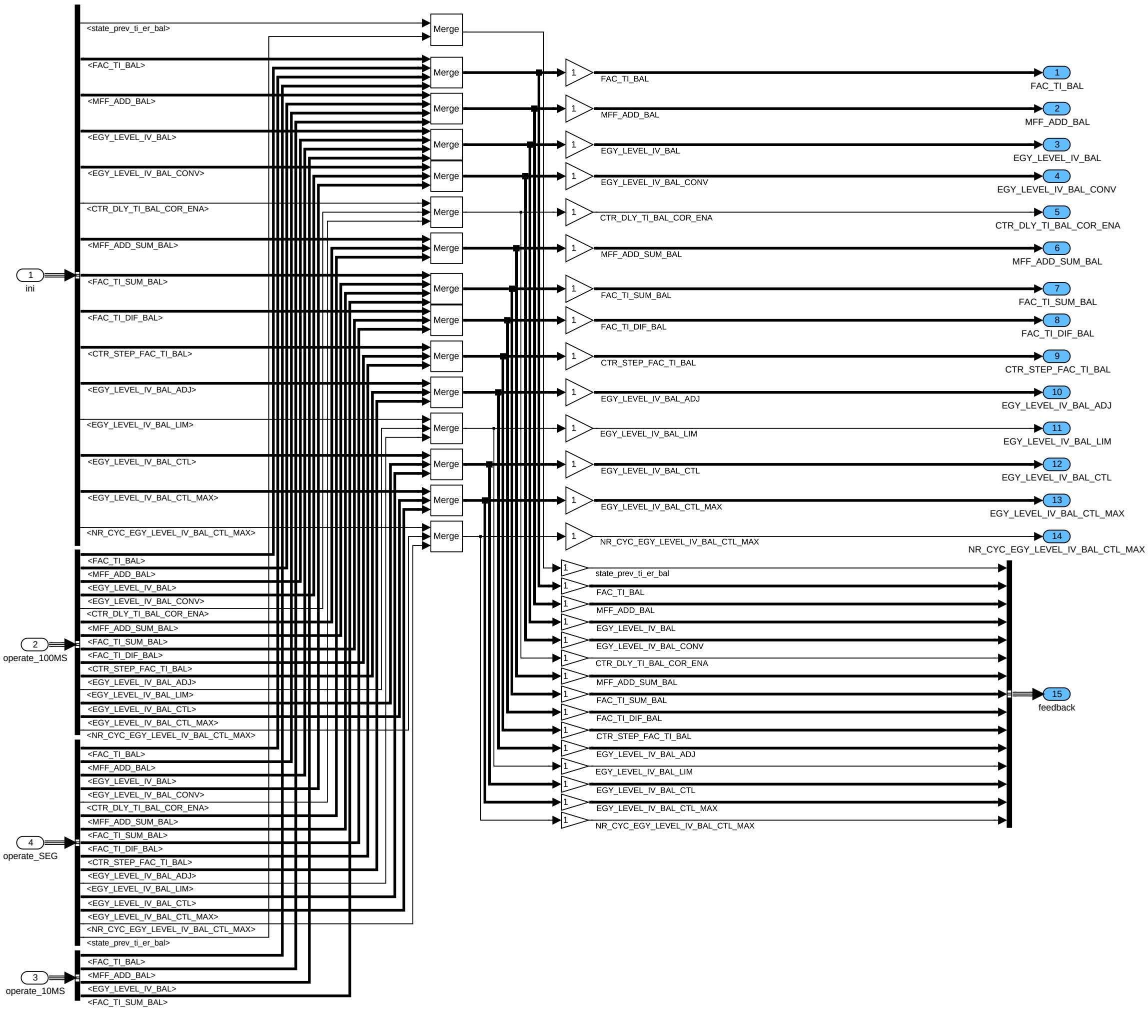

Figure 7.104.59: CYBL_M30704P01/SIG_MNG

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7.105 Cylinder balancing via engine roughness (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DIST_IV_DIF	-	0... FFFFH	0... 524280	8	km
Difference between actual distance and distance at last injector change					
LV_CYL_BAL_HOM_REQ_EXT	O/V	0... 1H	0 ...1	1	-
External homogenous combustion mode request for cylinder balancing					
MFF_ADD_BAL_EXT [NC_CYL_NR]	O/V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
External cylinder balancing additive MFF correction value					
T_AST_BAL	O/V	0... FFFFH	0... 6553.5	0.1	s
Time after exit start for cylinder balancing					
TCO_ST_BAL	O/V	0... FEH	0... 142.5	0.75	°C
Coolant temperature at start for cylinder balancing					

Input data:

DIST_IV_CHG [NC_CYL_NR] {p. 2289}	DIST_KWP {p. 1183}	LF_ERR_PLAUS_IV_MFF_CAL {p. 4790}	LV_CYL_BAL_ER_CDN_BAS {p. 4022}
LV_CYL_BAL_LAM_AD_REQ_CUS {p. 1015}	LV_LAM_ORNG_LAM_AD_REQ [NC_CBK_EX_NR] {p. 6141}	LV_ST_END {p. 1720}	MFF_ABSV_IV_EXT_ADJ [NC_CYL_NR] {p. 7681}
NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	T_AST {p. 1766}	TCO_ST {p. 1100}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MFF_ABSV_IV_EXT_ADJ [NC_CYL_NR]	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Default value for external cylinder balancing absolute MFF correction value					
C_MFF_NOM_IV_EXT_ADJ	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Default value for external cylinder balancing nominal MFF correction value					
IP_MFF_ADD_IV_AGI_DIST	-	0... FFFFH	0... 694.489403	0.02119478	mg/stk
LDP_DIST_IV_DIF_IP_MFF_ADD_AGI	16	0... FFFFH	0... 524280	8	km
Additive MFF correction value depending on driving distance for compensation of aging effects					
LC_MFF_ADD_IV_EXT_ADJ_ENA	-	0... 1H	0 ...1	1	-
Logical constant to enable external adjustment of cylinder balancing additive MFF correction					

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General information

This application incidence module is used as interface module between the project specific key word protocol (KWP) and the generic cylinder balancing functionality. The KWP provides for every piezo injector and absolute MFF value, which is determined at end of injector production line and imported to the ECU at vehicle production.

To take the aging of each injector into consideration, the distance since the last injector change is calculated. The determined distance is basic for an additive MFF offset value out of an interpolation table.

It is possible to adjust default values provided by a constant array instead of the input values from the key word protocol (KWP). For this purpose a separate switch (logical constant) is existing to manage the absolute MFF setpoint values. In serial production, always the KWP values have to be used.

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Application Condition

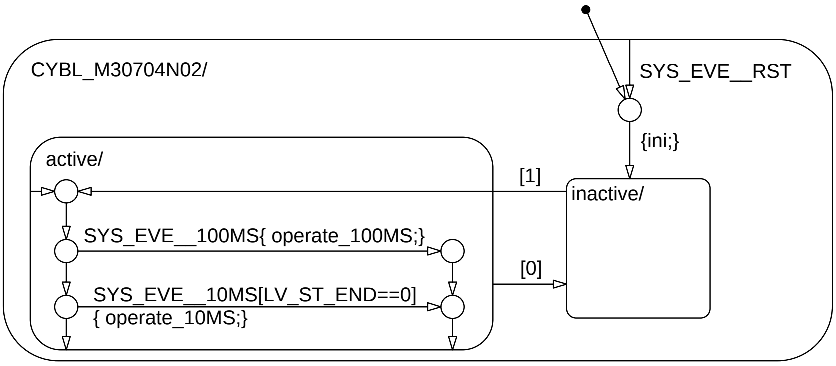

Figure 7.105.1: CYBL_M30704N01/APP_CDN/Chart

Function Description

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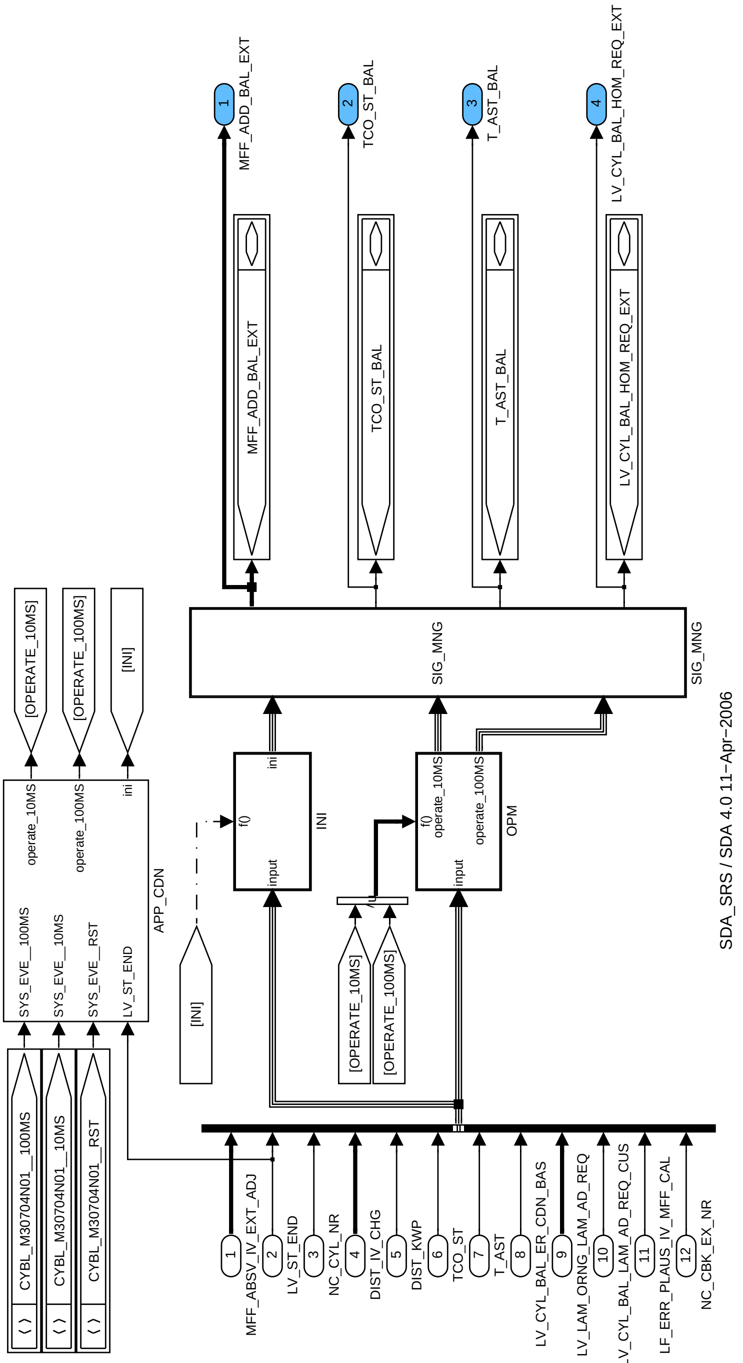

Figure 7.105.2: CYBL_M30704N01

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7.105.1 Calculation of variables at reset

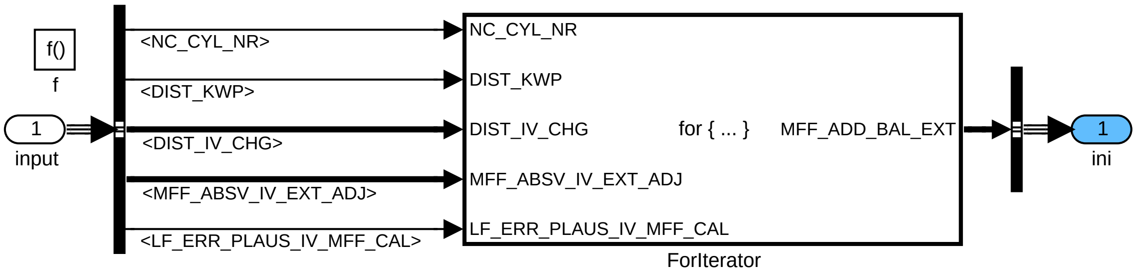

Figure 7.105.3: CYBL_M30704N01/INI

Calculation of variables at reset FORITERATOR

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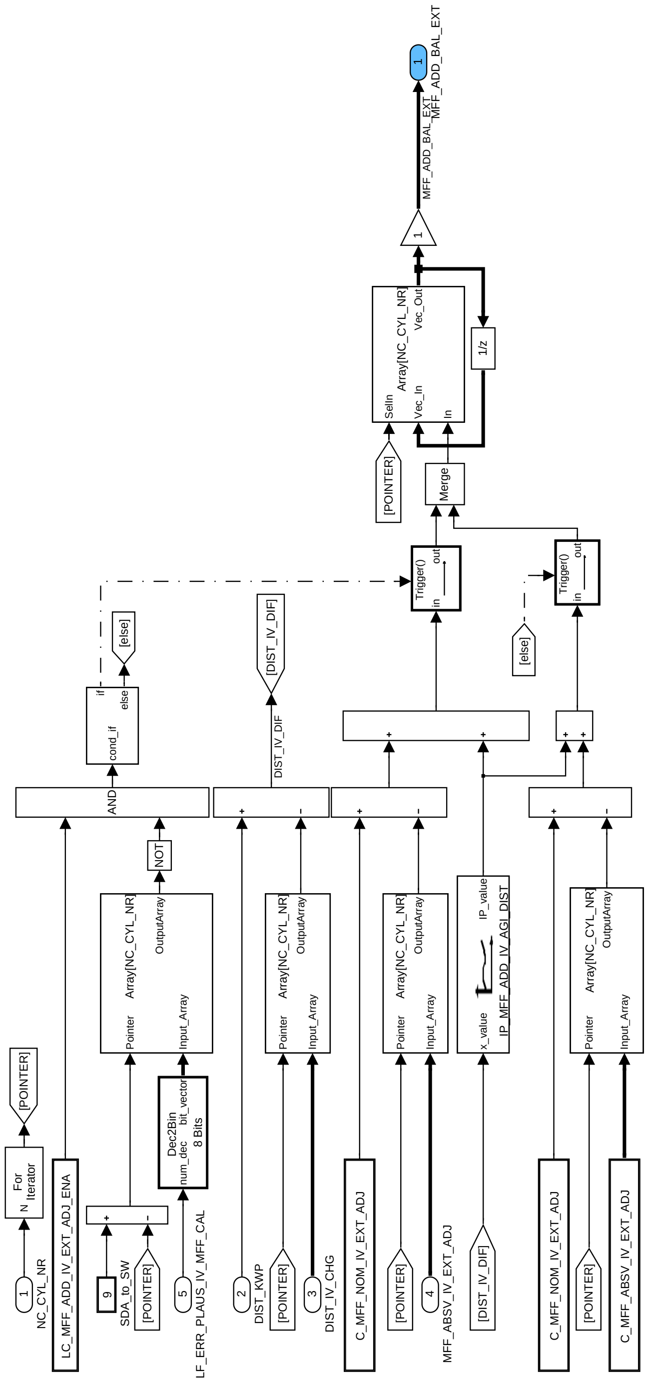

Figure 7.105.4: CYBL_M30704N01/INI/ForIterator

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7.105.2 Calculation of 100ms and 10ms tasks

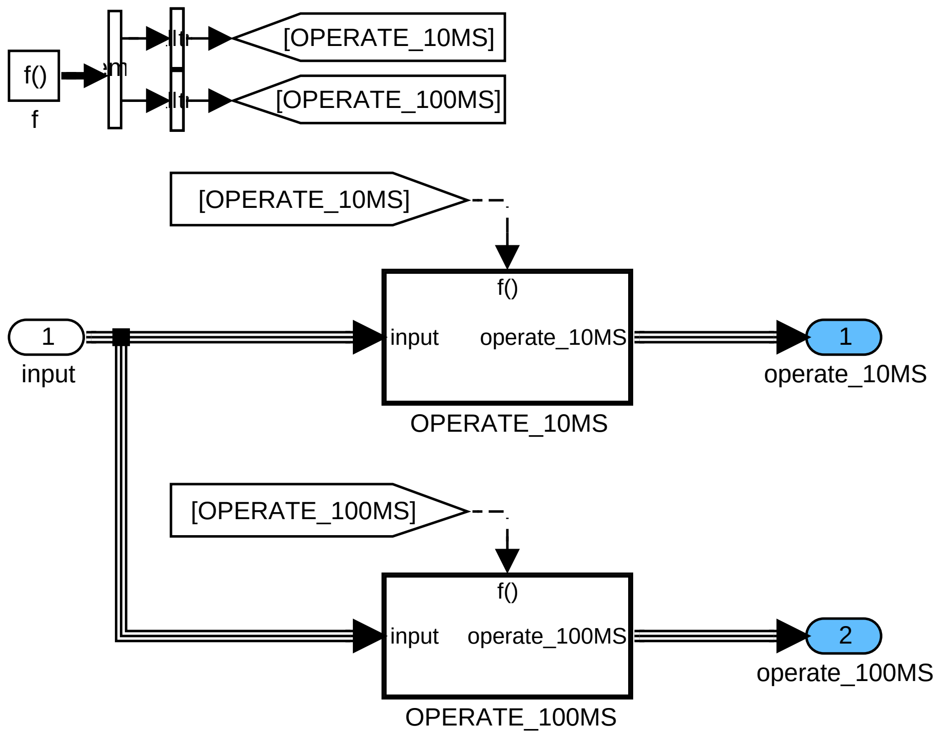

Figure 7.105.5: CYBL_M30704N01/OPM

External aging and coding correction values for cylinder balancing

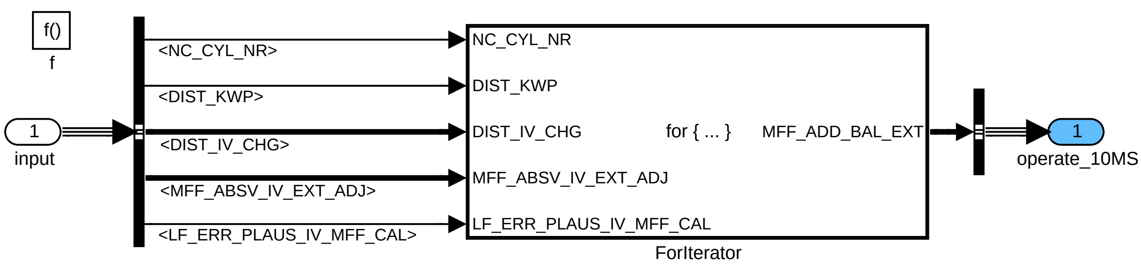

Figure 7.105.6: CYBL_M30704N01/OPM/OPERATE_10MS

Calculation of external additive MFF offset values

//calculation of additive MFF offset values with KWP inputs (case then)
//adjustment of default additive MFF offset values from constant array (case then)

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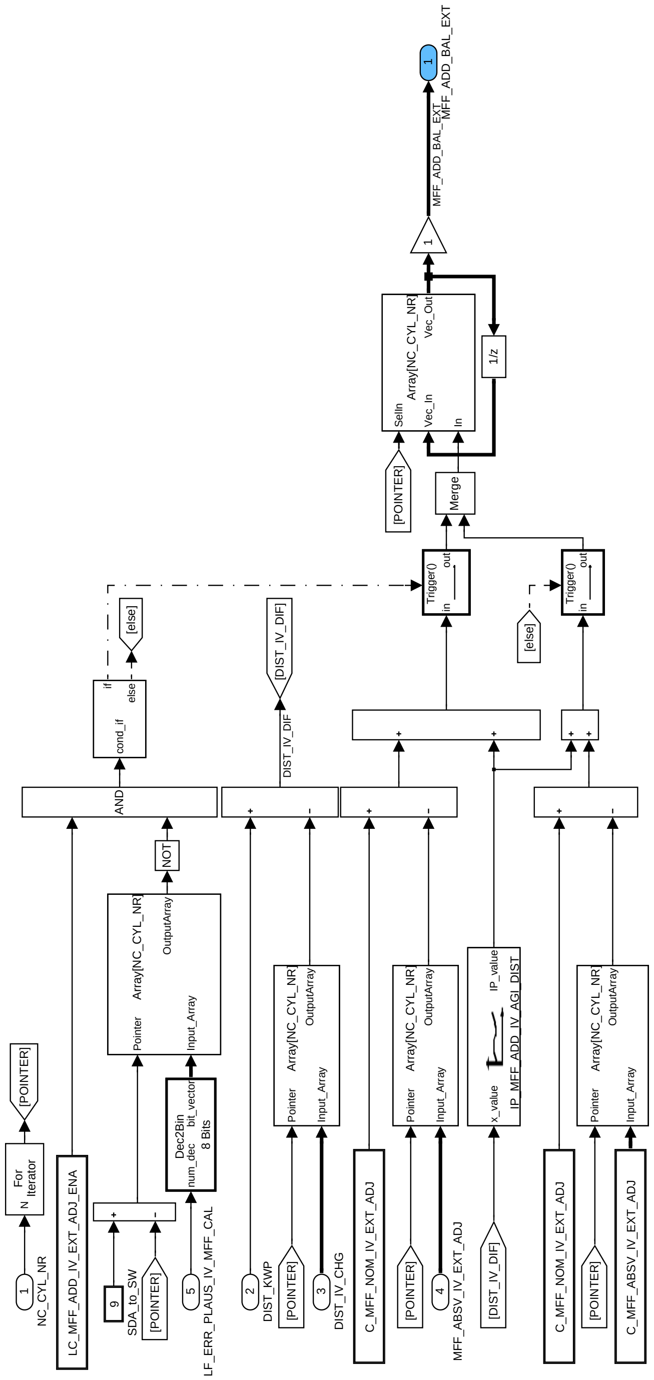

Figure 7.105.7: CYBL_M30704N01/OPM/OPERATE_10MS/ForIterator

Adjustment of interface parameter for cylinder balancing

Goal of this chapter is to adjust interface parameter from other aggregates to cylinder balancing issues. Due to this modification it is possible to use one cylinder balancing version for all projects.

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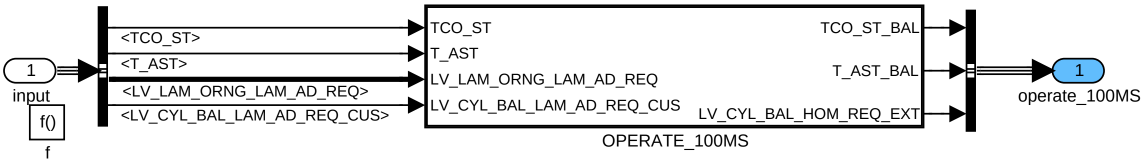

Figure 7.105.8: CYBL_M30704N01/OPM/OPERATE_100MS

Adjustment of interface parameter for cylinder balancing OPERATE_100MS

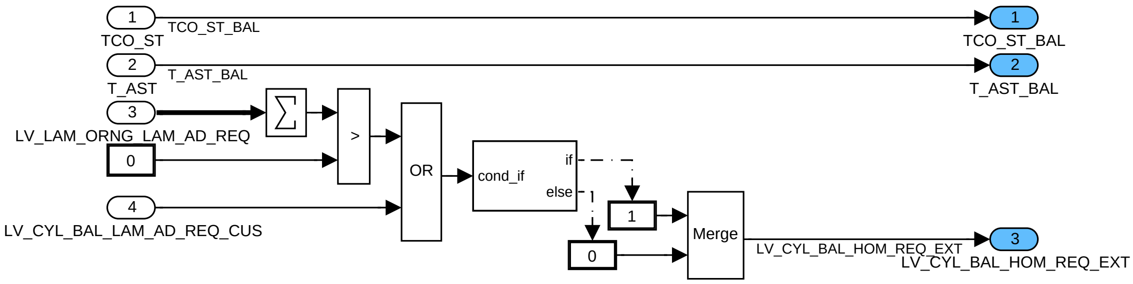

Figure 7.105.9: CYBL_M30704N01/OPM/OPERATE_100MS/OPERATE_100MS

7.105.3 SUBFUNCTION: SIG_MNG

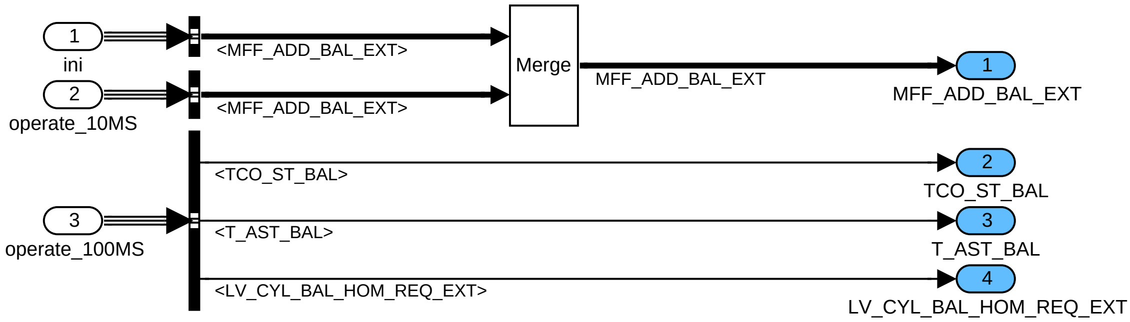

Figure 7.105.10: CYBL_M30704N01/SIG_MNG

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7.106 Cylinder balancing via additive mass fuel flow intervention

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ER_STND_MFF_ADD_ER_BAL	V	8000... 7FFFH	0... 325.77	0.00994202	1/s**2
Controller input value at additive path of cylinder balancing via MFF intervention					
LV_ER_STND_MFF_ADD_ER_BAL	V	0... 1H	0 ...1	1	-
Flag for controller input at additive path of cylinder balancing via MFF intervention					
LV_MFF_ADD_ER_BAL_OBD_MAX_NEG [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for minimum OBD limit reached at additive part of engine roughness based cylinder balancing					
LV_MFF_ADD_ER_BAL_OBD_MAX_POS [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for maximum OBD limit reached at additive part of engine roughness based cylinder balancing					
MFF_ADD_AD_ER_BAL [NC_CYL_NR]	O/V/S	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Additive adaptation value for cylinder balancing via MFF intervention					
MFF_ADD_ER_BAL [NC_CYL_NR]	O/V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Additive correction value for cylinder balancing via MFF intervention					
MFF_ADD_ER_BAL_COR [NC_CYL_NR]	V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Corrected additive correction value for cylinder balancing via MFF intervention					
MFF_ADD_ER_BAL_CTL	V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Controller output value at additive path of cylinder balancing via MFF intervention					
MFF_ADD_ER_BAL_CTL_I [NC_CYL_NR]	V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
I part of the controller output value at additive path of cylinder balancing via MFF intervention					
MFF_ADD_ER_BAL_CTL_MAX	V	0... FFFFH	0... 65535	1	-
Controller output value maximum limit reached at additive path of cylinder balancing via MFF intervention					
MFF_ADD_ER_BAL_CTL_P	V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
P part of the controller output value at additive path of cylinder balancing via MFF intervention					
MFF_ADD_ER_BAL_LIM [NC_CYL_NR]	V	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Limited controller output value at additive path of cylinder balancing via MFF intervention					
NR_CYC_MFF_ADD_ER_BAL_CTL_MAX	V	0... FFH	0... 255	1	-
Corresponding segment number of the controller that has reached the maximum limit (additive MFF path)					

Input data:

ER_STND_MMV_DIF_BAL [NC_CYL_NR] {p. 1489}	LV_MFF_ADD_AD_ER_BAL_ENA {p. 4006}	LV_MFF_ADD_AD_ER_BAL_EXT_ADJ {p. 7483}	LV_MFF_ADD_ER_BAL_ENA {p. 4006}
LV_TI_ER_BAL_ACT {p. 4022}	NC_CYL_NR {p. 1526}	SEG_NR_ER {p. 1454}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CYCNR_MFF_ADD_ER_BAL	-	1... FFH	1... 255	1	-
Number of cycles for calculation of controller output values for cylinder balancing via MFF intervention					
C_ER_STND_THD_NEG_MFF_ADD_BAL	-	8000... 7FFFH	0... 325.77	0.00994202	1/s**2
Negative threshold for ER input value at additive path of cylinder balancing via MFF intervention					
C_ER_STND_THD_POS_MFF_ADD_BAL	-	8000... 7FFFH	0... 325.77	0.00994202	1/s**2
Positive threshold for ER input value at additive path of cylinder balancing via MFF intervention					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MFF_ADD_ER_BAL_CTL_MAX_NEG	-	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Negative maximum limit for controller output at additive path of cylinder balancing via MFF intervention					
C_MFF_ADD_ER_BAL_CTL_MAX_POS	-	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Positive maximum limit for controller output at additive path of cylinder balancing via MFF intervention					
C_MFF_ADD_ER_BAL_OBD_MAX_NEG	-	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Negative maximum OBD limit for additive correction value of cylinder balancing via MFF intervention					
C_MFF_ADD_ER_BAL_OBD_MAX_POS	-	8000... 7FFFH	0... 694.489403	0.02119478	mg/stk
Positive maximum OBD limit for additive correction value of cylinder balancing via MFF intervention					
C_MFF_ADD_ER_BAL_RST	-	0H 1H 2H	INI_ZERO INI_CTL INI_AD	-	-
Reset of additive correction and adaptation values for cylinder balancing via MFF intervention					
IP_MFF_ADD_I_ER_BAL	-	0... FFFFH	0... 694.489403	0.02119478	mg/stk
LDP_ER_STND_MFF_ADD_IP_I_ER_BAL	8	0... FFFFH	0... 325.77	0.0099313	1/s**2
Controller I part value for additive path of cylinder balancing via MFF intervention					
IP_MFF_ADD_P_ER_BAL	-	0... FFFFH	0... 694.489403	0.02119478	mg/stk
LDP_ER_STND_MFF_ADD_IP_P_ER_BAL	8	0... FFFFH	0... 325.77	0.0099313	1/s**2
Controller P part value for additive path of cylinder balancing via MFF intervention					
LC_MFF_ADD_AD_ER_BAL_RST_MAN	-	0... 1H	0 ...1	1	-
Manual reset of additive adaptation values for cylinder balancing via MFF intervention					
LC_MFF_ADD_ER_BAL_COR	-	0... 1H	0 ...1	1	-
Manual switch for overall correction of controller output values for cylinder balancing via MFF intervention					
LC_MFF_ADD_ER_BAL_RST_MAN	-	0... 1H	0 ...1	1	-
Manual reset of additive correction values for cylinder balancing via MFF intervention					

General information

The calculation of the additive correction or adaptation values is performed, depending on the settings of the corresponding logical activation variable. LV_MFF_ADD_ER_BAL_ENA is used to enable the correction path, while LV_MFF_ADD_AD_ER_BAL_ENA enables the adaptation path. As soon as the corresponding logical value is set to 1 in combination with additional activation conditions, the calculation is started.

The calculated additive adaptation value MFF_ADD_AD_ER_BAL[NC_CYL_NR] for each cylinder is stored in the nonvolatile memory to be available for initialization issues at next engine run.

With use of the manual reset it is possible to initialize the additive correction or adaptation values with zero at any time. In this case, the flags which indicate the exceeding of a controller output limitation are set to zero as well (refer: Initialization at Manual Reset)

Signal flow diagram:

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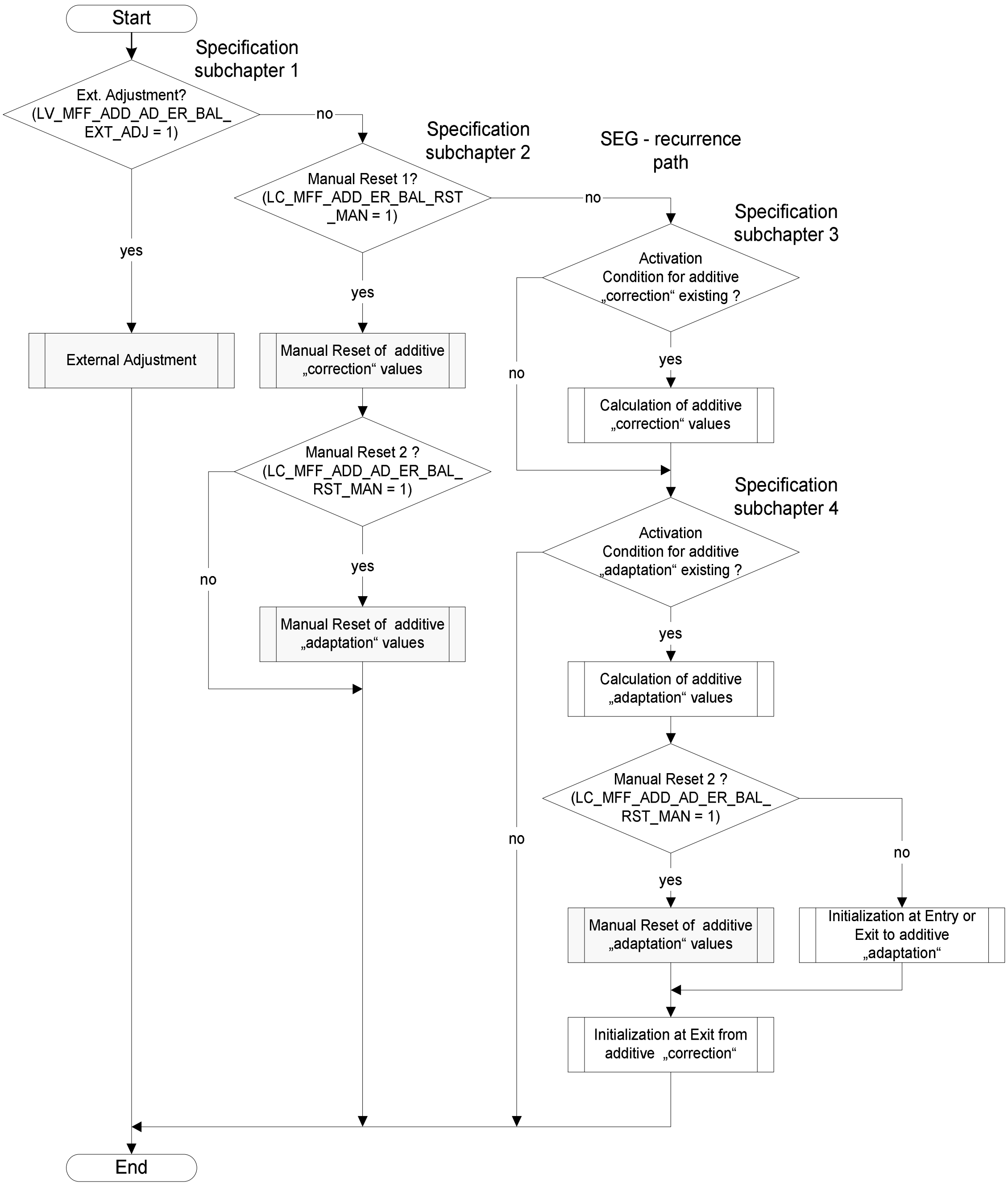

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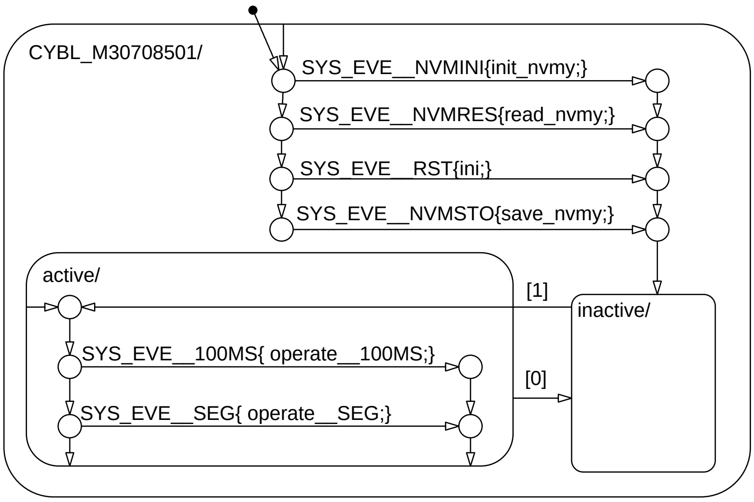

Figure 7.106.1: CYBL_M30708501/APP_CDN/Chart

Function Description

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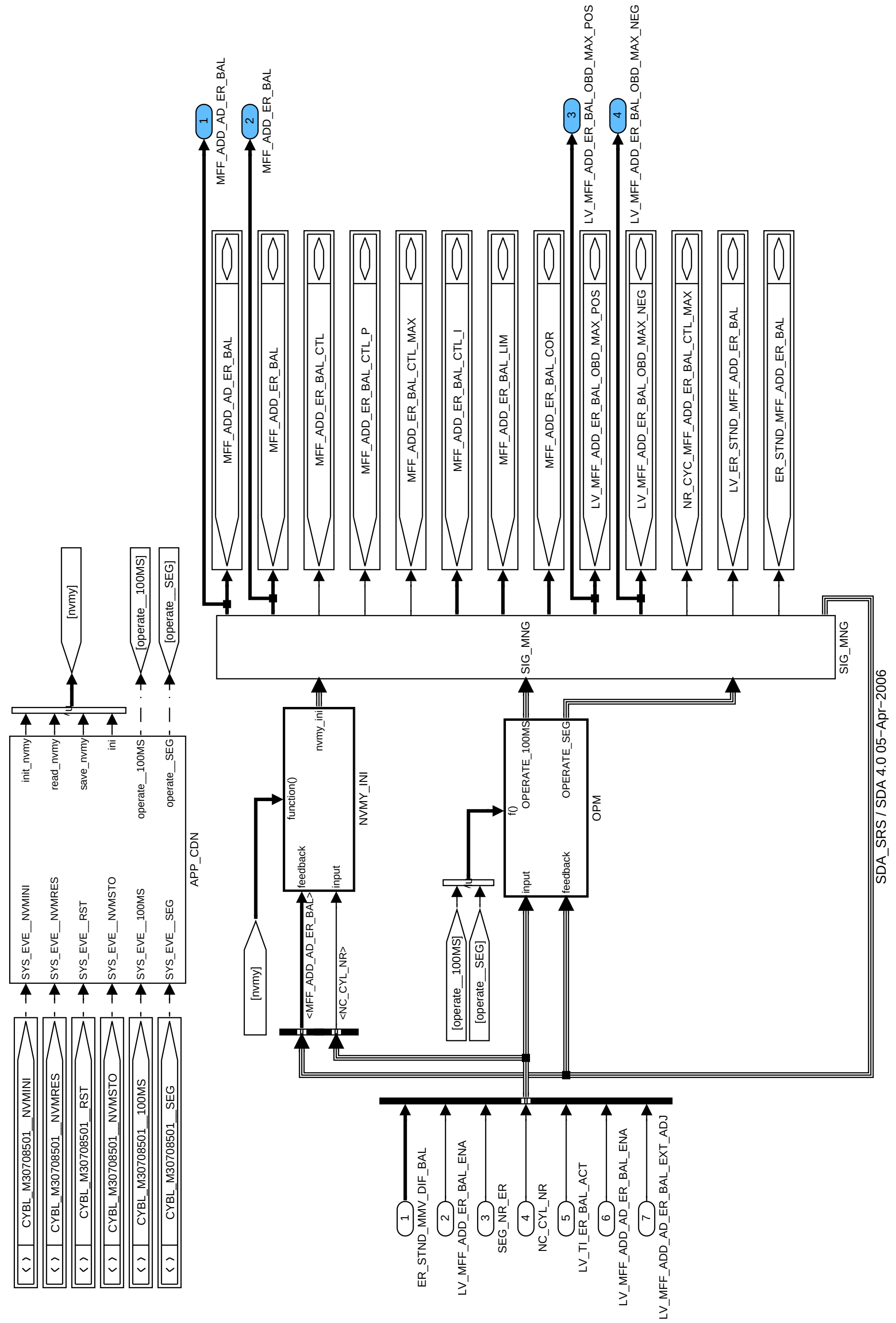

Figure 7.106.2: CYBL_M30708501

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7.106.1 Calculation of non volatile memory tasks

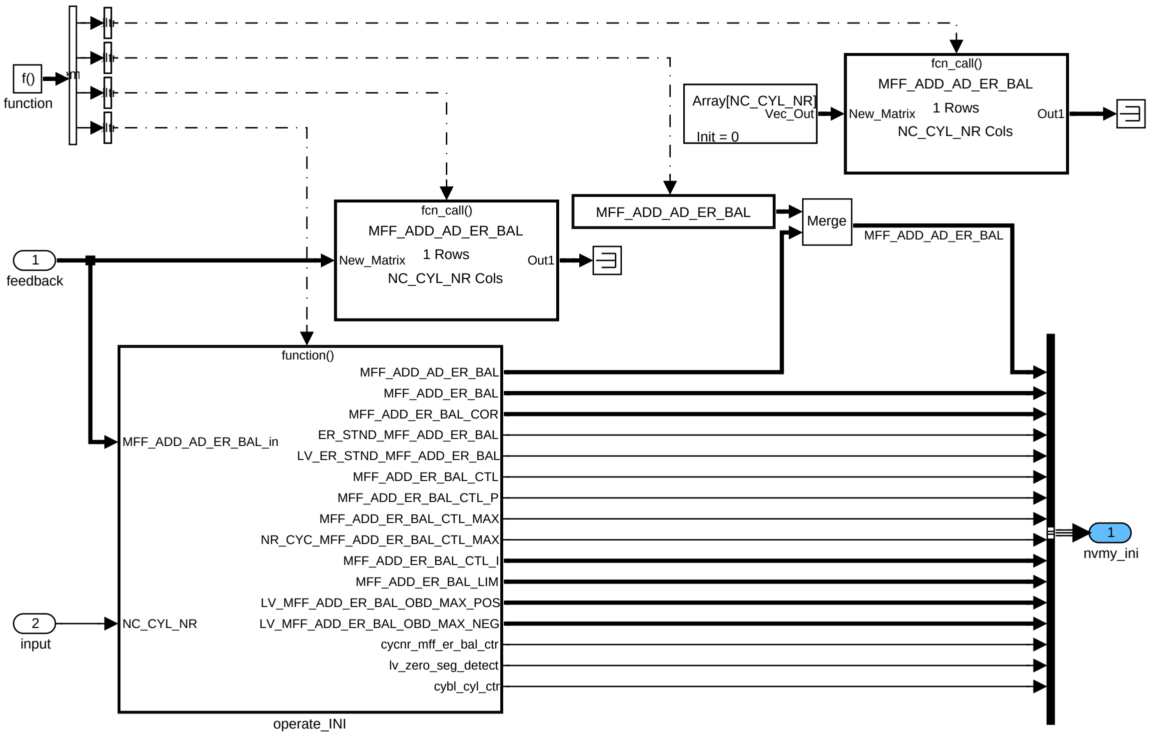

Figure 7.106.3: CYBL_M30708501/NVMY_INI

Calculation of variables at reset task

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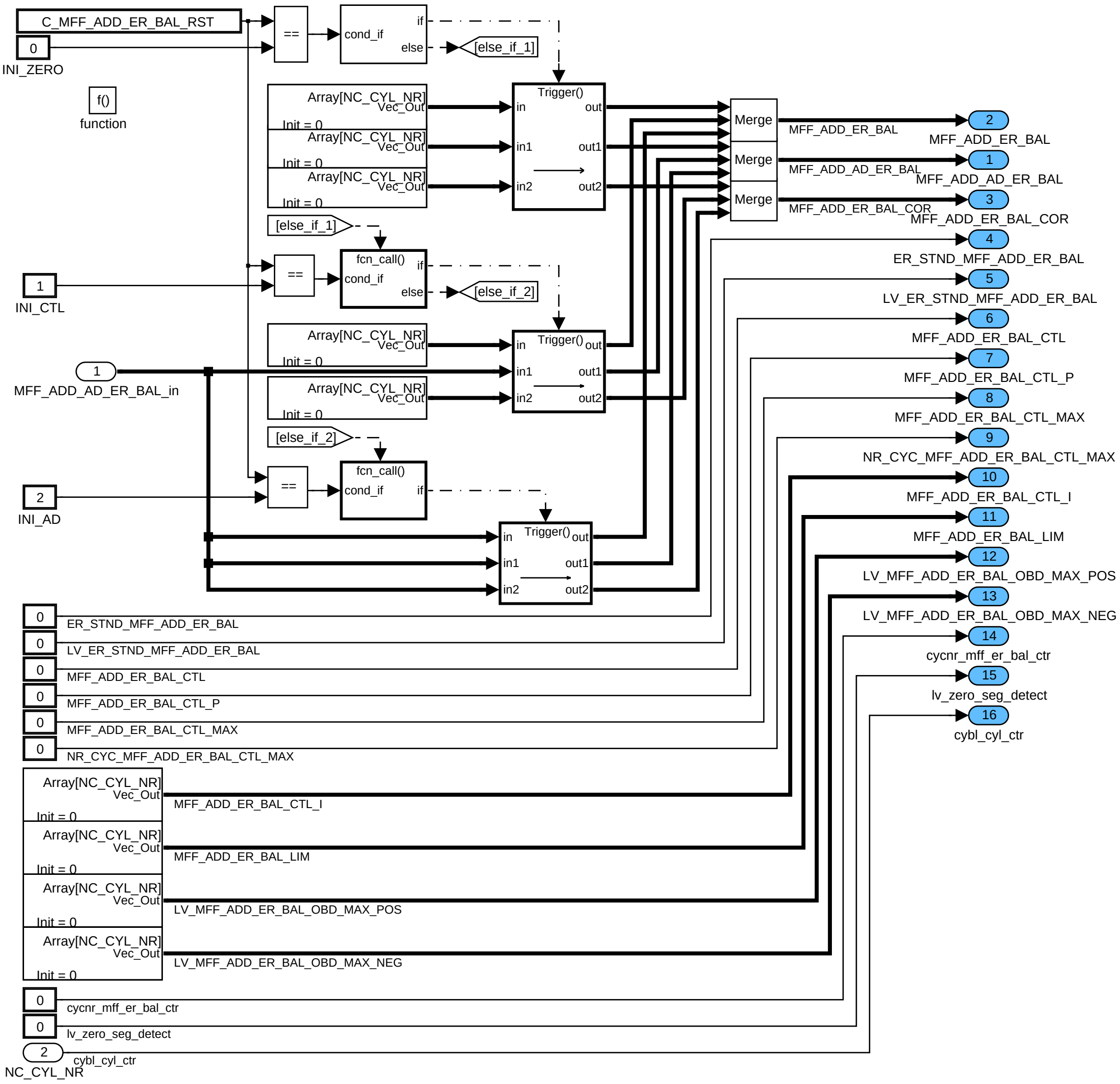

Figure 7.106.4: CYBL_M30708501/NVMY_INI/operate_INI

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7.106.2 Calculation of 100ms and segment synchronous tasks

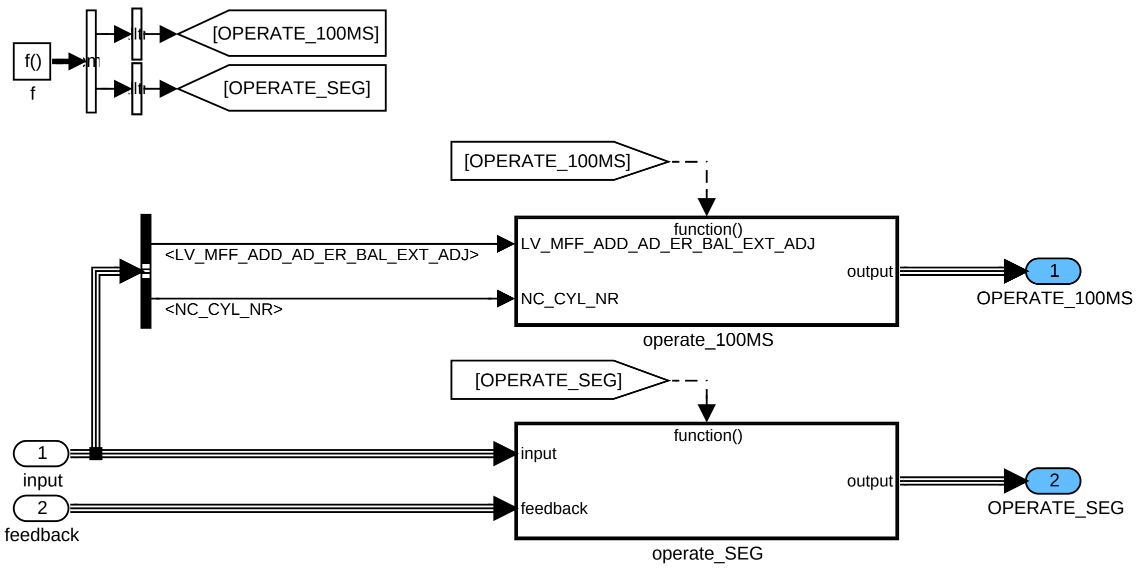

Figure 7.106.5: CYBL_M30708501/OPM

External adjustment of additive correction values

In case of an external adjustment (request from key word protocol) the additive adaptation values for all cylinders are set to zero. While the external adjustment is activated, all following subchapters within the module "Cylinder balancing via additive MFF intervention" are deactivated and the corresponding "Initialization at Deactivation" process for this chapters is blocked during this period.

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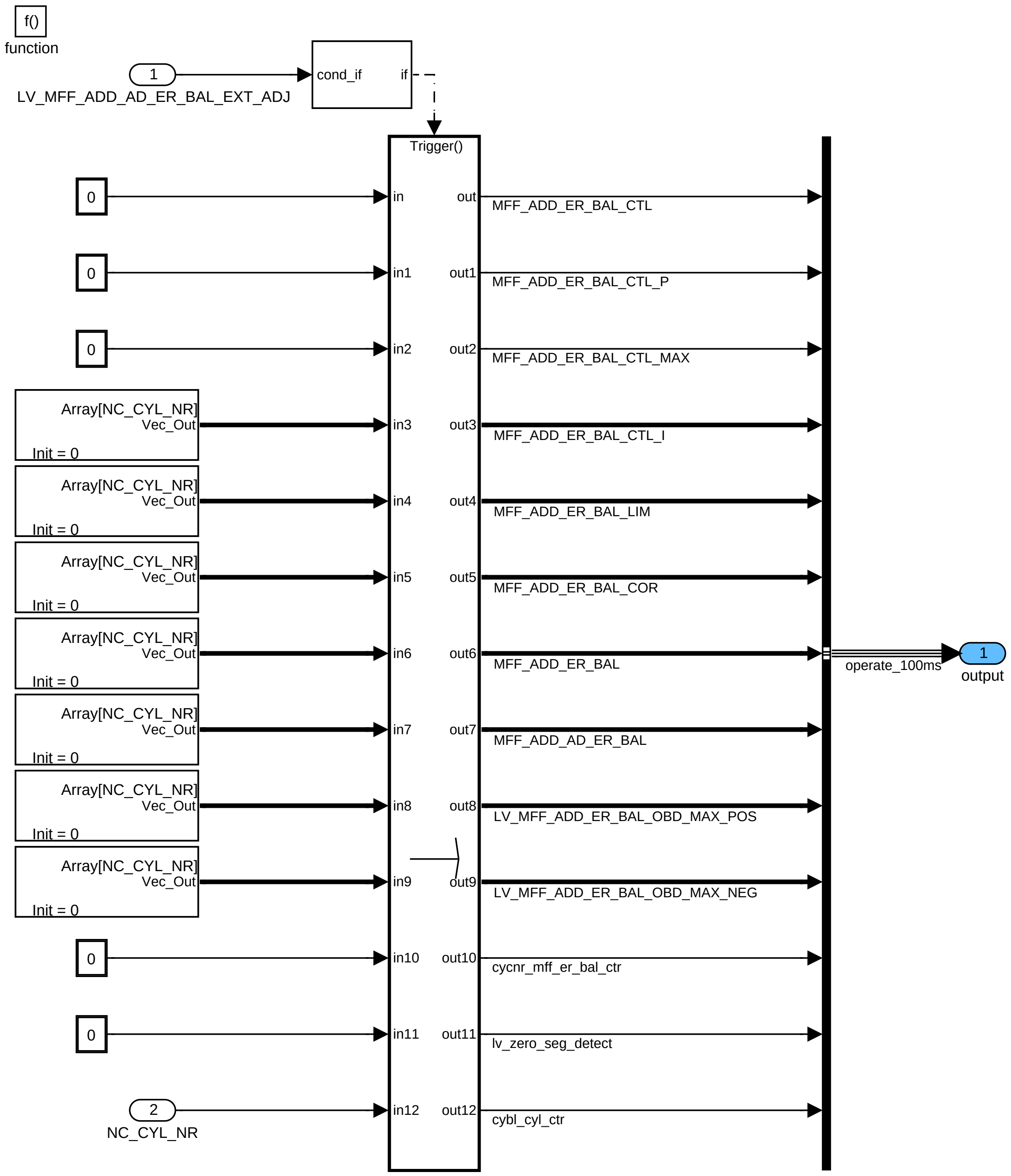

Figure 7.106.6: CYBL_M30708501/OPM/operate_100MS

Calculation of segment task

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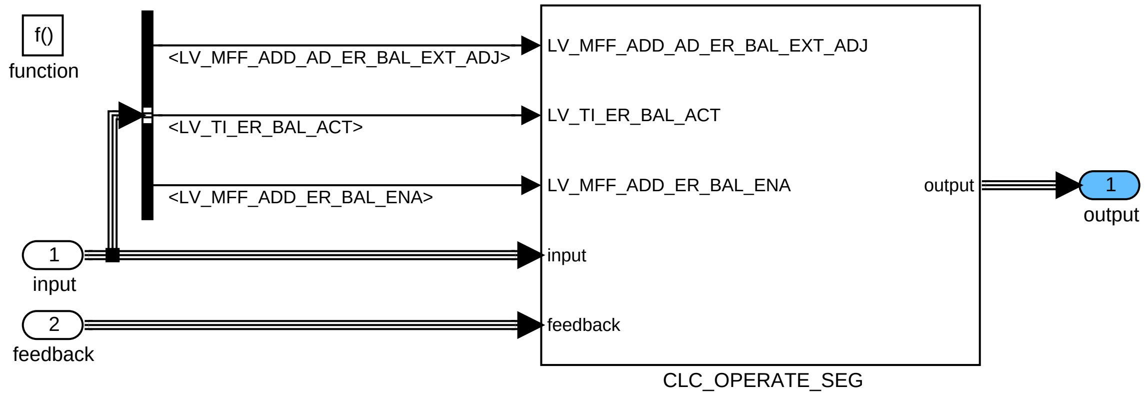

Figure 7.106.7: CYBL_M30708501/OPM/operate_SEG

Calculation of manual reset, injection time correction and injection time adaptation

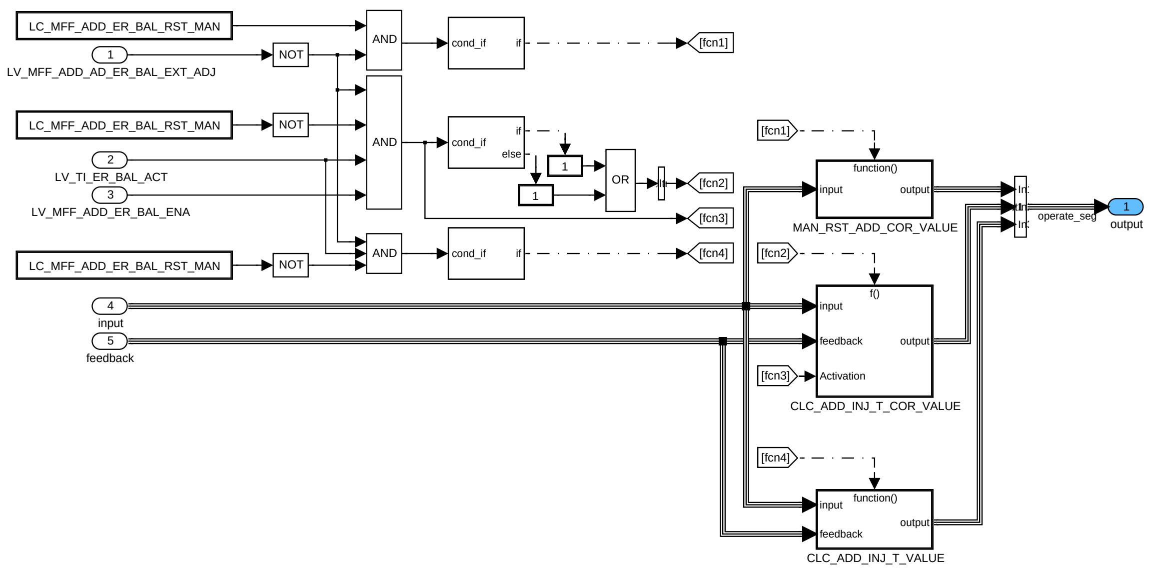

Figure 7.106.8: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG

Manual reset of additive correction values

In case of a manual reset it is possible to adjust the exported output data to a wanted value to make the function test and handling more easier. While the manual function reset is activated, all following subchapters within the module "Cylinder balancing via additive MFF intervention" are deactivated and the corresponding "Initialization at Deactivation" process for this chapters is blocked during this period.

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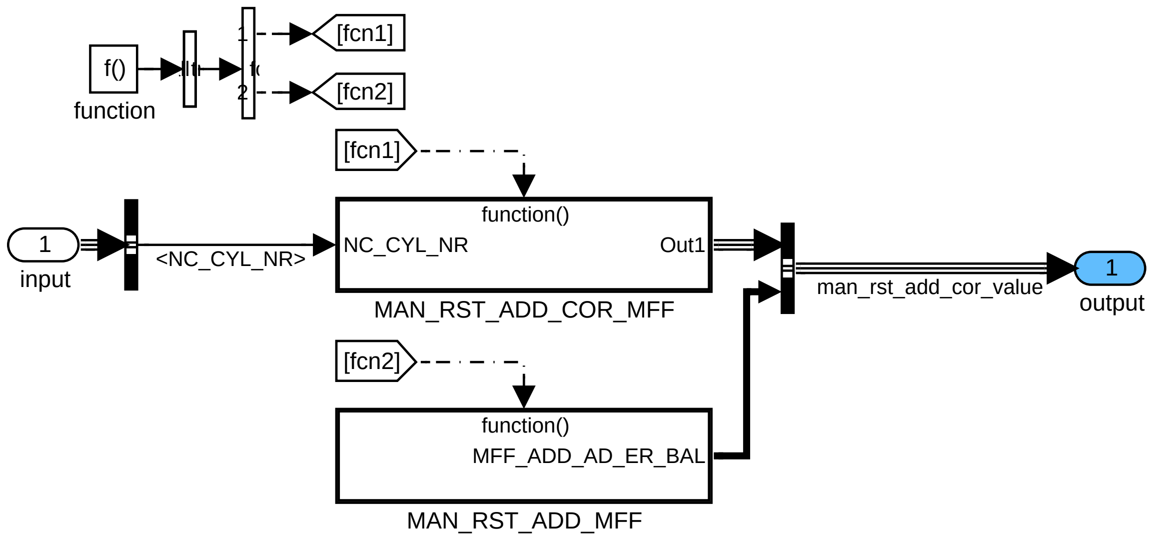

Figure 7.106.9:
CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/MAN_RST_ADD_COR_VALUE

Manual reset of additive correction values for cylinder balancing via MFF intervention

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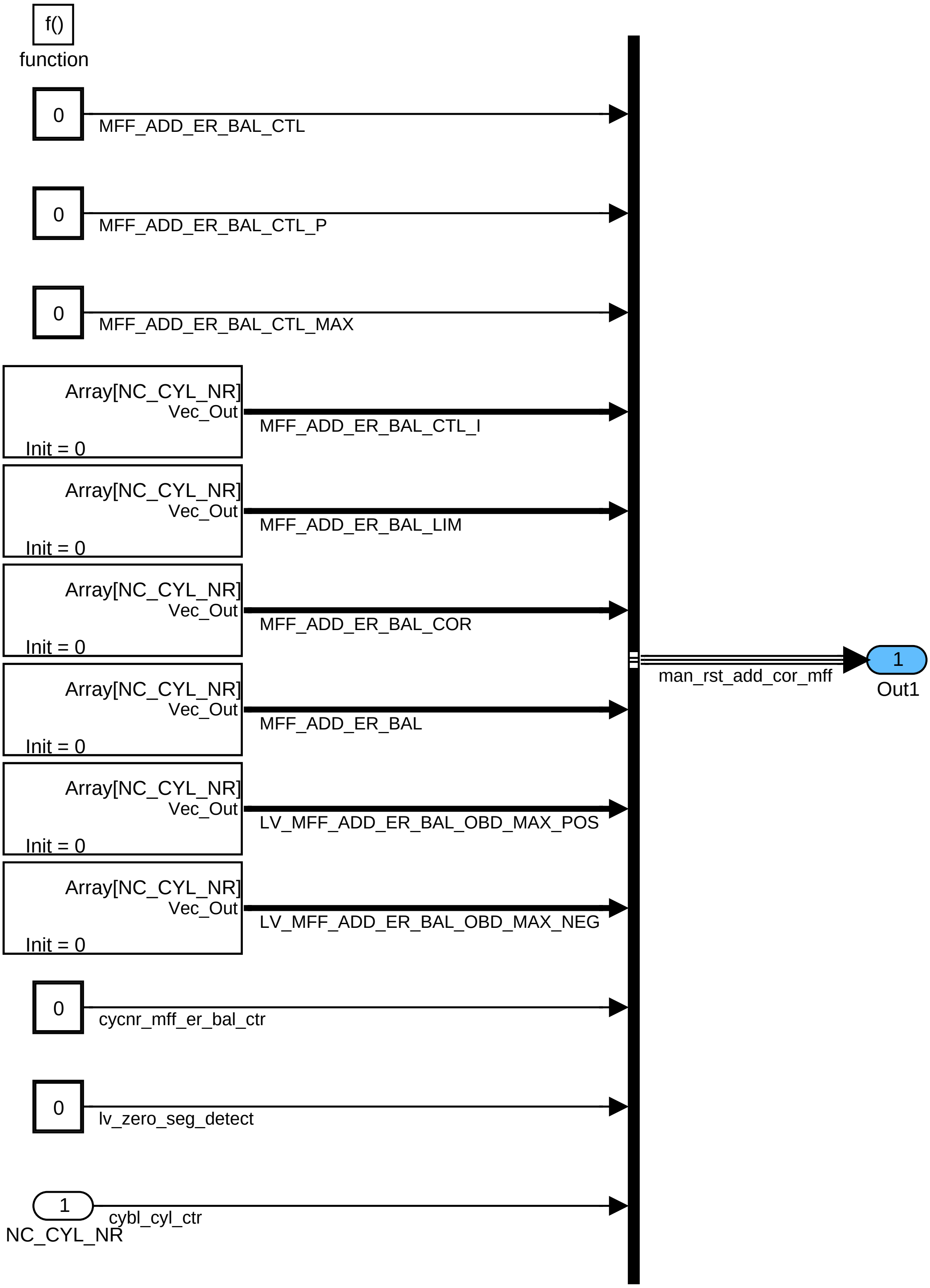

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Figure 7.106.10: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/
MAN_RST_ADD_COR_VALUE/MAN_RST_ADD_COR_MFF

Manual reset of additive adaptation values for cylinder balancing via MFF intervention

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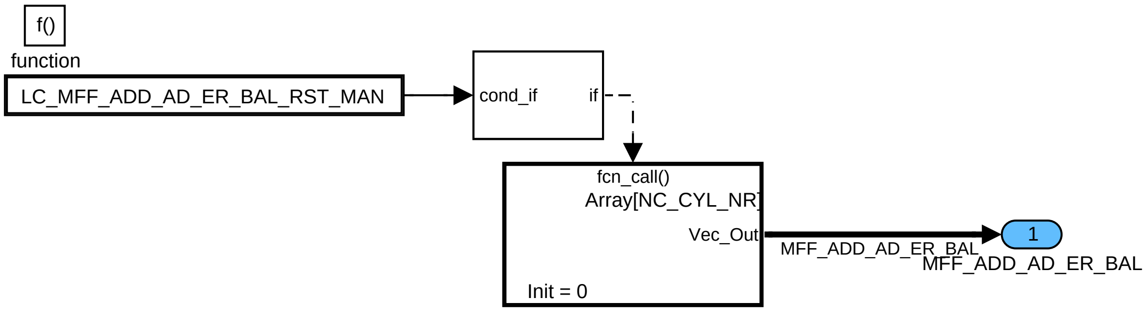
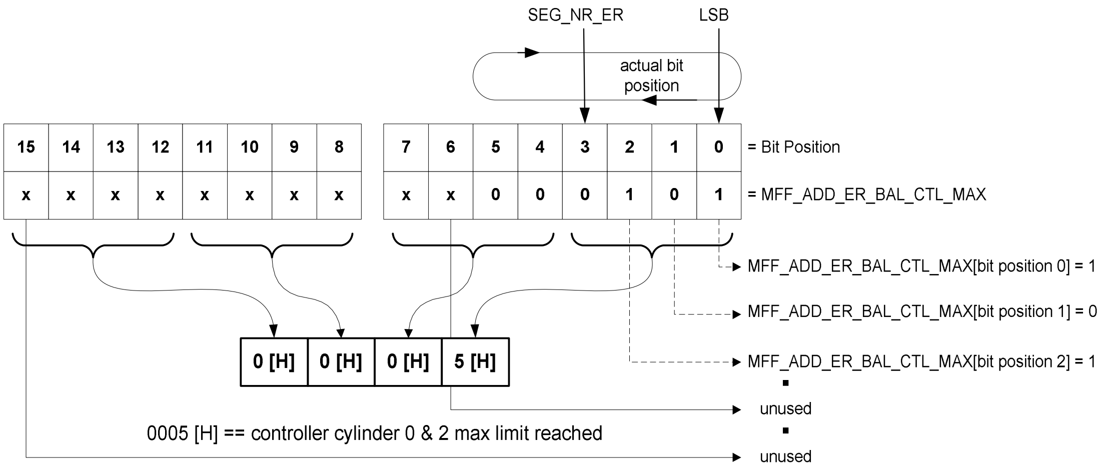


Figure 7.106.11: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/
MAN_RST_ADD_COR_VALUE/MAN_RST_ADD_MFF

Calculation of the additive injection time correction values

The calculation of the additive injection time correction values are only performed if the corresponding enable bit LV_MFF_ADD_ER_BAL_ENA is set to logical 1 in combination with additional activation conditions. In this case, a separate correction value for each cylinder is determined with use of a PIcontroller.
As soon as a PIcontroller of one cylinder is reaching its maximum, a corresponding value is set to 1 to indicate the related cylinder. To save memory resources, the information for all cylinders is located within one output data (WORD). Each BIT information within the WORD is used to indicate one cylinder. It is possible to handle up to 16 cylinders with this method.
For a description more in detail please have a look to the signal flow diagram below. As example, a sixcylinder engine with two PIcontrollers, which have reached the limits is shown.
Signal flow diagram:

Signalization of controller max. output value reached for additive path



Note: always the complete WORD (16 BIT) is displayed as visible value

Calculation of the additive injection time correction /adaptation values in general

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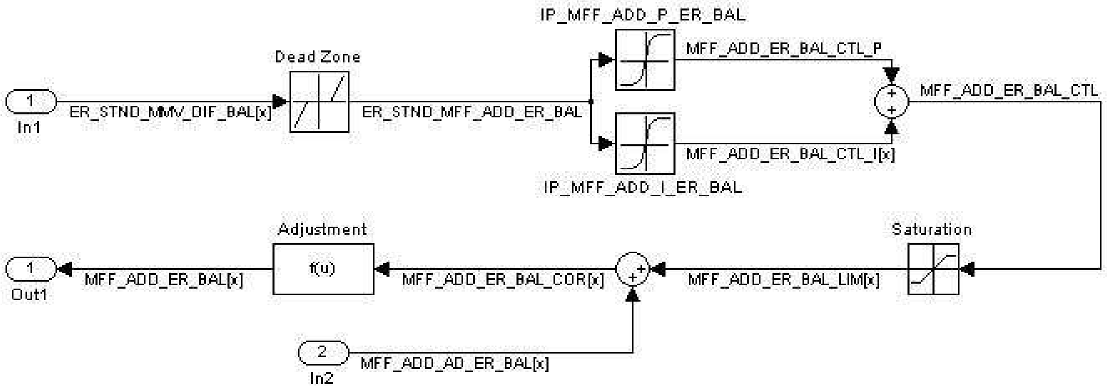

Note: [_x] is representing [SEG_NR_ER] in the signal flow diagram above

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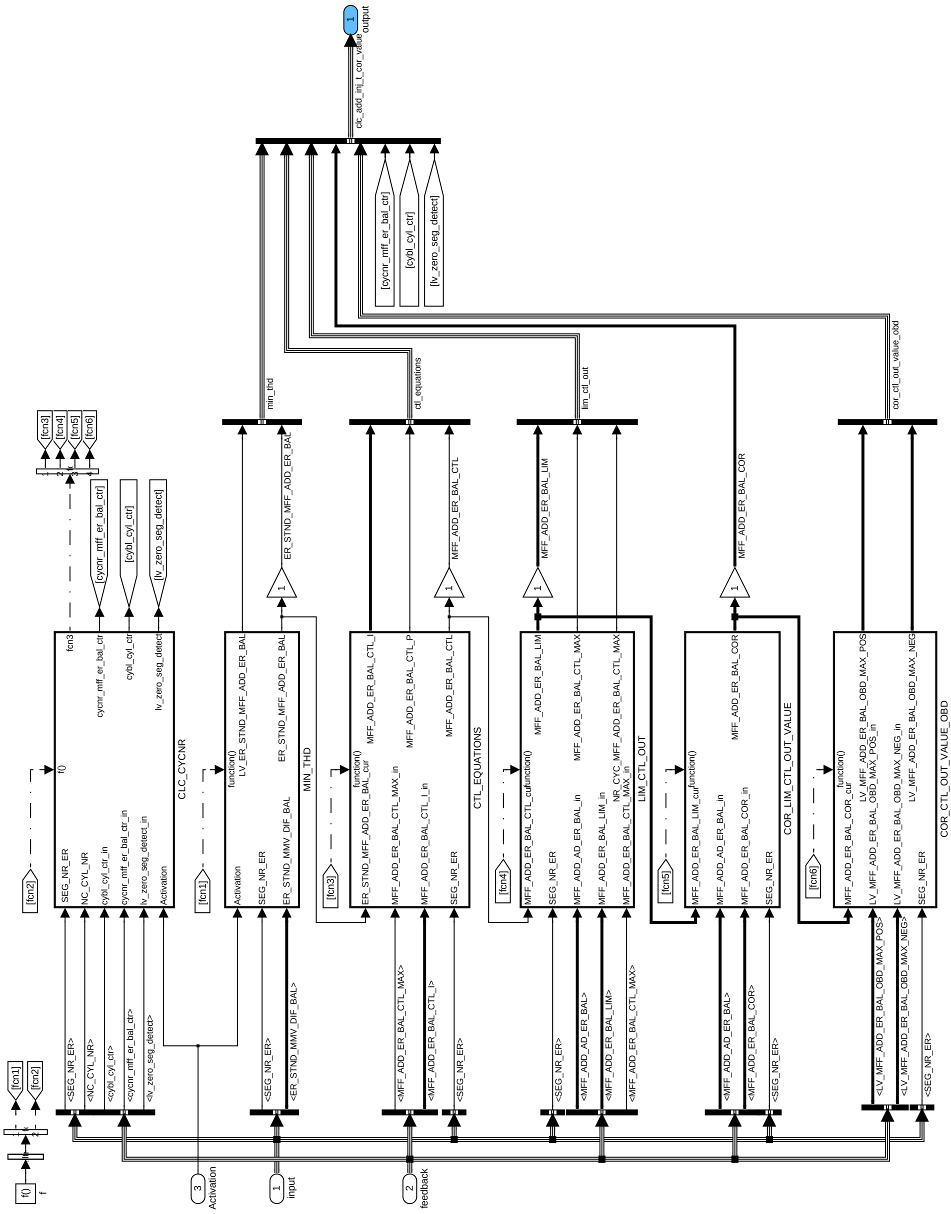

Figure 7.106.12:
CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/CLC_ADD_INJ_T_COR_VALUE

Minimum threshold

If the defined cylinder balancing input values ER_STND_MMV_DIF_BAL[SEG_NR_ER] are outside a calibrateable range, the controller is calculated. Otherwise the controller inputs are set to zero.

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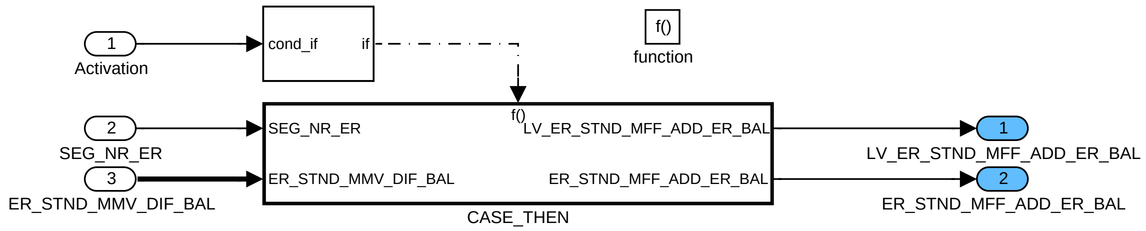

Figure 7.106.13: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_ADD_INJ_T_COR_VALUE/MIN_THD

Minimum threshold CASE_THEN

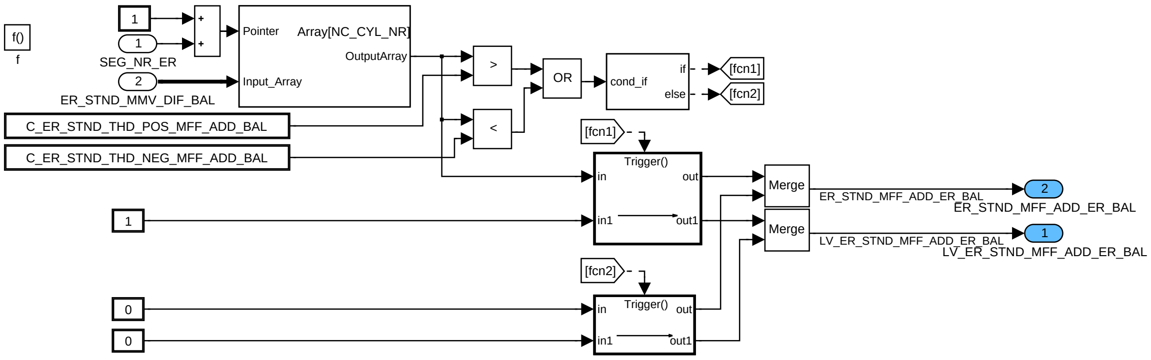

Figure 7.106.14: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_ADD_INJ_T_COR_VALUE/MIN_THD/CASE_THEN

Calculation of segment tasks CLC_OPERATE_SEG CLC_ADD_INJ_T_COR_VALUE CLC_CYCNR

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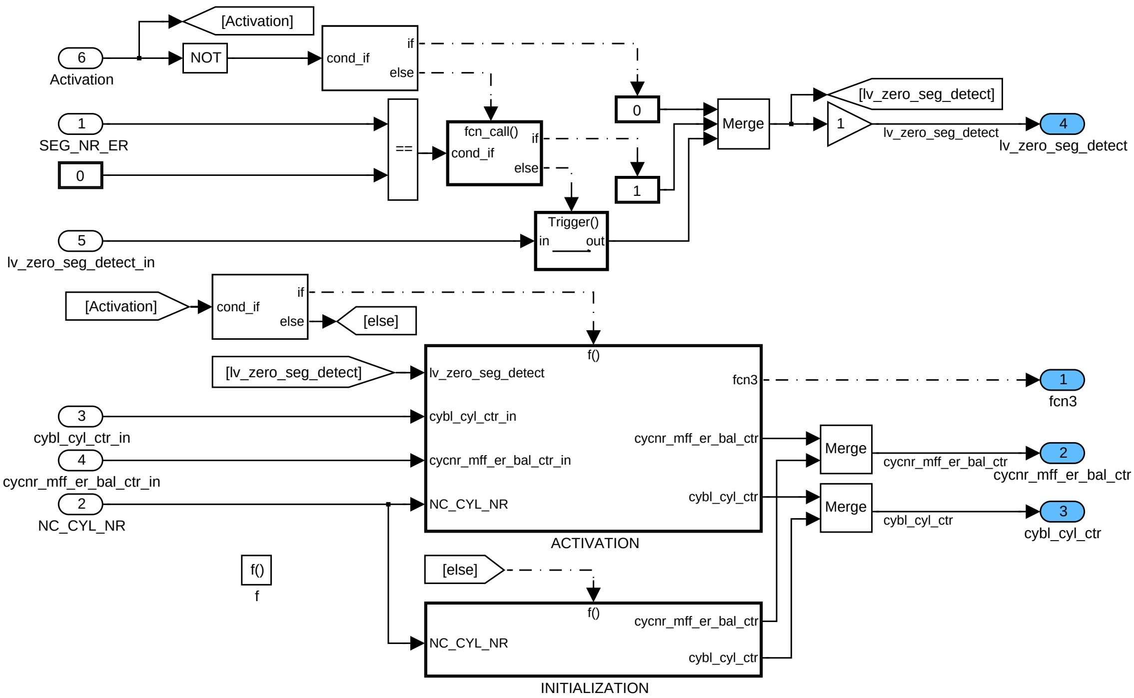

Figure 7.106.15: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_ADD_INJ_T_COR_VALUE/CLC_CYCNR

Calculation of segment tasks CLC_OPERATE_SEG CLC_ADD_INJ_T_COR_VALUE CLC_CYCNR ACTIVATION

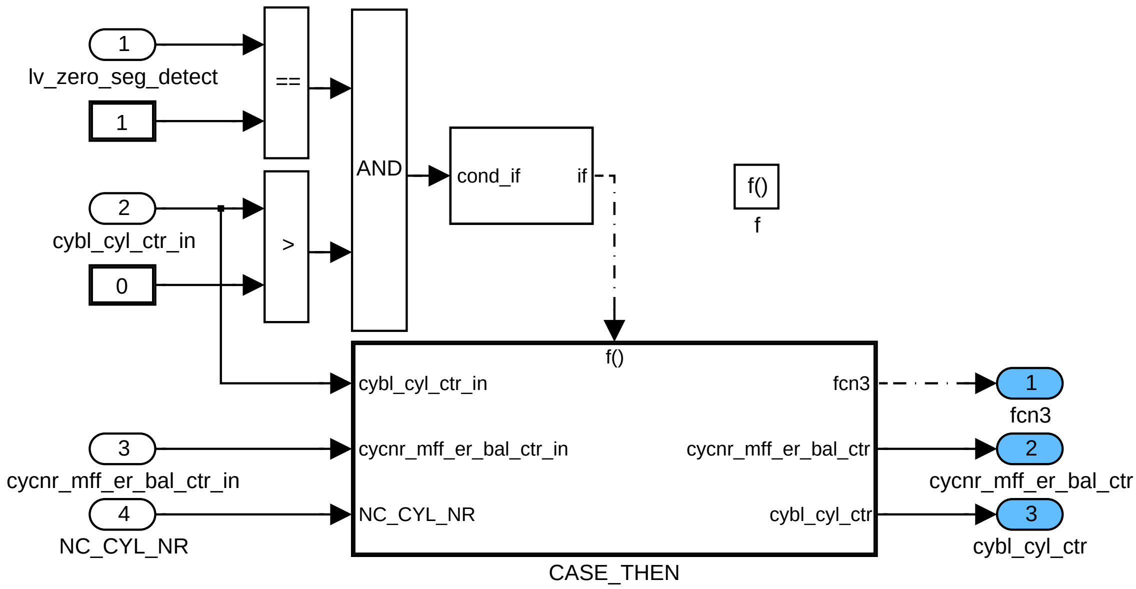

Figure 7.106.16: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_ADD_INJ_T_COR_VALUE/CLC_CYCNR/ACTIVATION

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Calculation of segment tasks CLC_OPERATE_SEG CLC_ADD_INJ_T_COR_VALUE CLC_CYCNR ACTIVATION CASE_THEN

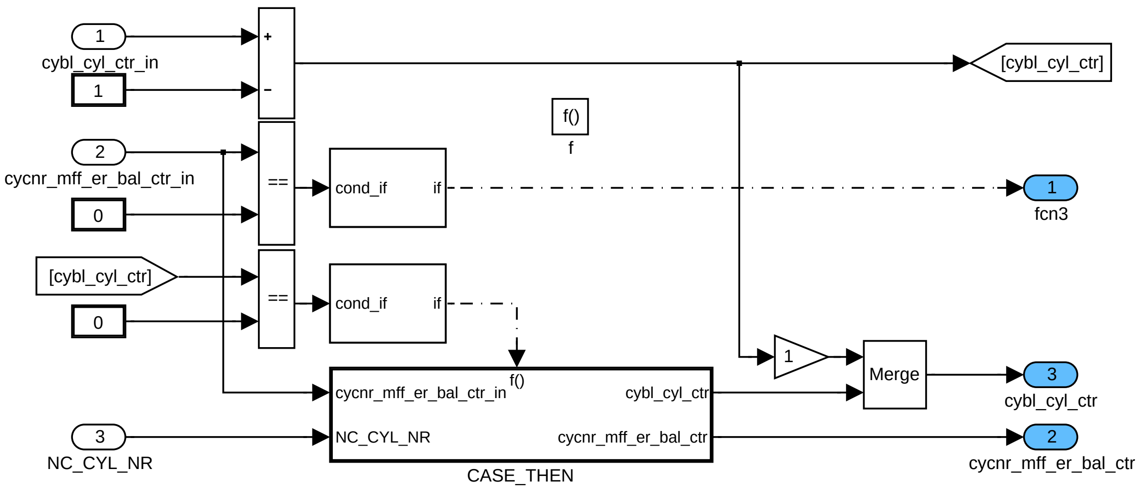

Figure 7.106.17: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/ CLC_ADD_INJ_T_COR_VALUE/CLC_CYCNR/ACTIVATION/CASE_THEN

Calculation of segment tasks CLC_OPERATE_SEG CLC_ADD_INJ_T_COR_VALUE CLC_CYCNR ACTIVATION CASE_THEN CASE_THEN

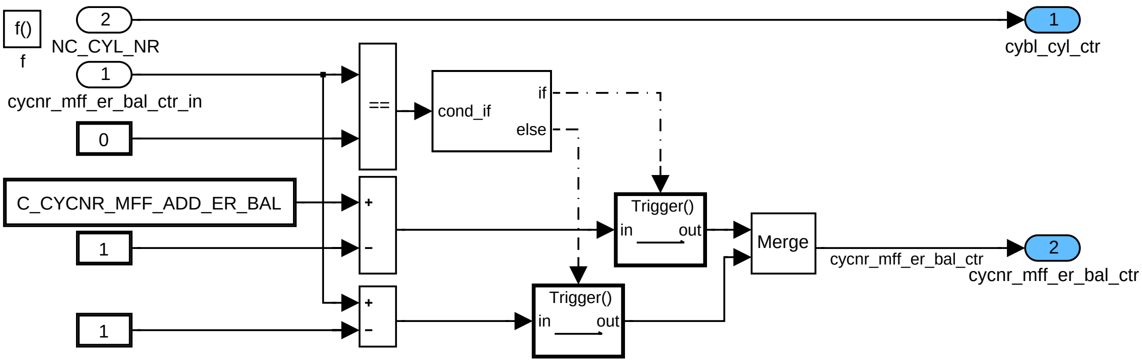

Figure 7.106.18: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/ CLC_ADD_INJ_T_COR_VALUE/CLC_CYCNR/ACTIVATION/CASE_THEN/CASE_THEN

Calculation of segment tasks CLC_OPERATE_SEG CLC_ADD_INJ_T_COR_VALUE CLC_CYCNR INITIALIZATION

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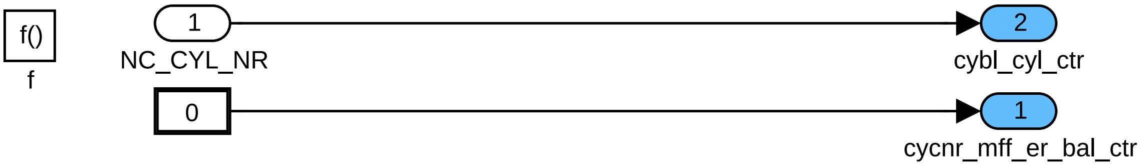

Figure 7.106.19: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_ADD_INJ_T_COR_VALUE/CLC_CYCNR/INITIALIZATION

Controller Equataions

For the additive correction mode, a separate set of NC_CYL_NR controllers exists operating in parallel (one controller for each cylinder).
The computation of the output values is carried out every C_CYCNR_MFF_ADD_ER_BAL engine cycles (= calibrateable number of engine cycles).
Only in case of C_CYCNR_MFF_ADD_ER_BAL = 1, the calculation of the additive path is done without interruption. At every segment the corresponding cylinder specific correction value is built.
If the computation is not done at every engine cycle (C_CYCNR_MFF_ADD_ER_BAL > 1), the trigger of the controller output calculation is always related to SEG_NR_ER = 0.

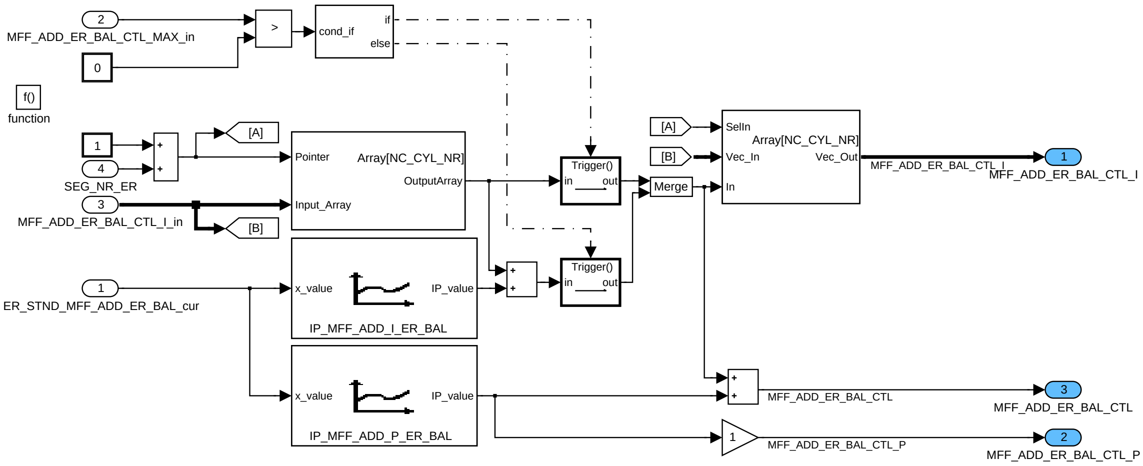

Figure 7.106.20: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_ADD_INJ_T_COR_VALUE/CTL_EQUATIONS

Limitation of the Controller output

The outputs of the controllers are limited to a calibrateable threshold. If one controller output has reached the limit, a flag is set at one and the corresponding segment number is displayed.

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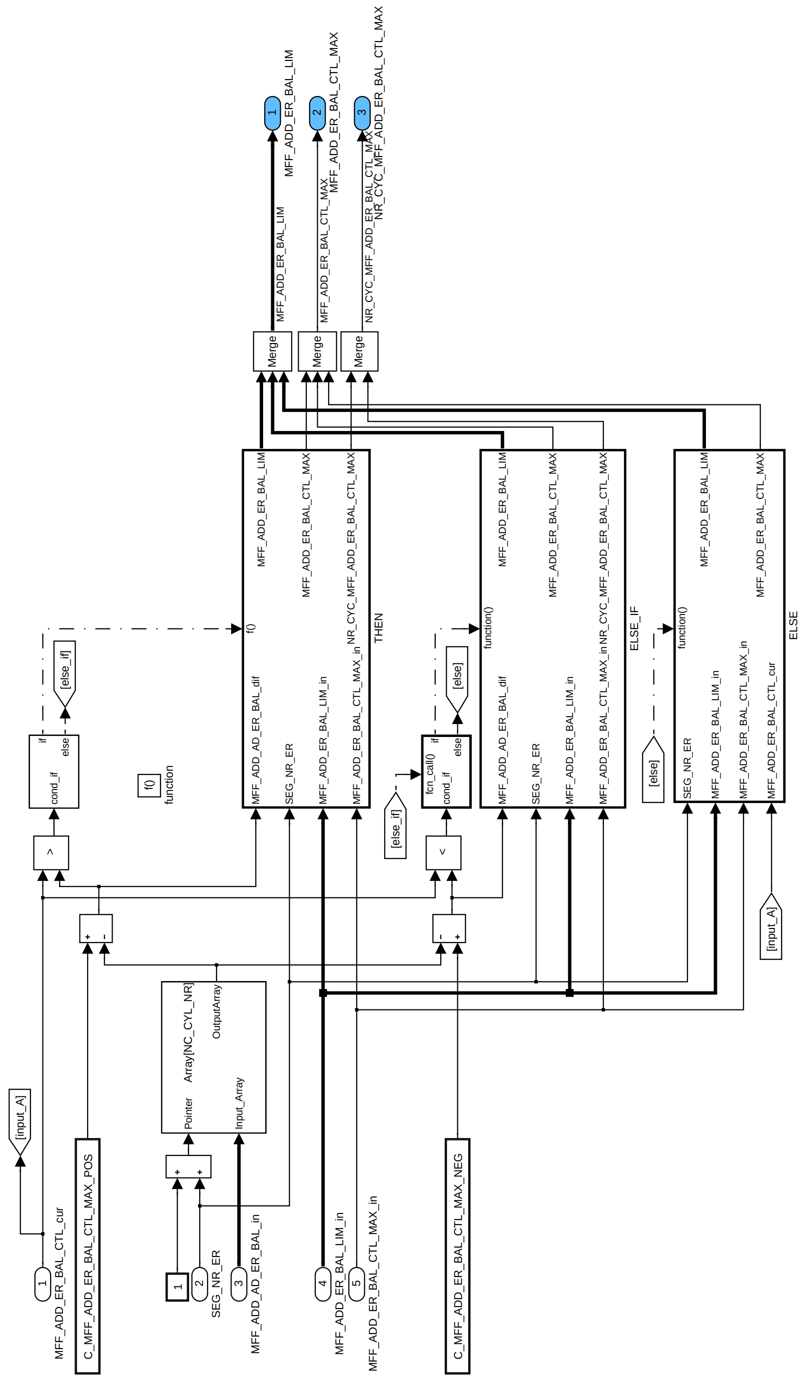

Figure 7.106.21: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_ADD_INJ_T_COR_VALUE/LIM_CTL_OUT

Limitation of the Controller output THEN

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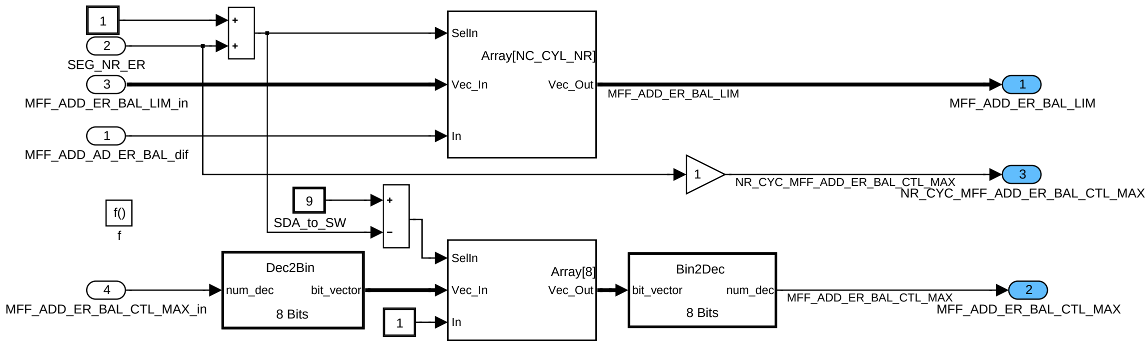

Figure 7.106.22: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_ADD_INJ_T_COR_VALUE/LIM_CTL_OUT/THEN

Limitation of the Controller output ELSE_IF

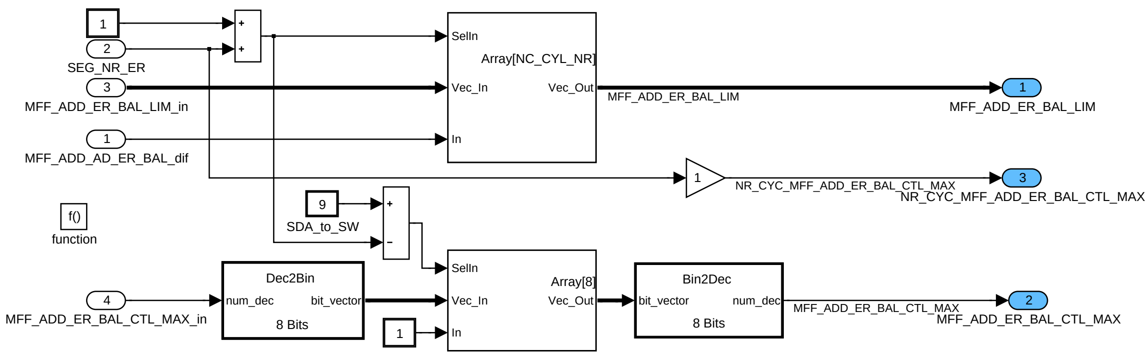

Figure 7.106.23: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_ADD_INJ_T_COR_VALUE/LIM_CTL_OUT/ELSE_IF

Limitation of the Controller output ELSE

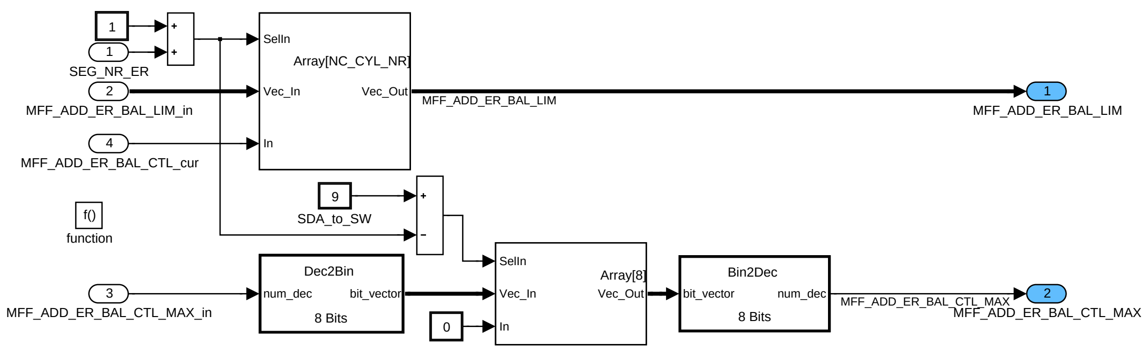

Figure 7.106.24: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_ADD_INJ_T_COR_VALUE/LIM_CTL_OUT/ELSE

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Correction of limited controller output values with adaptation values

The limited controller output values are corrected with the currently available adaptive correction values, which are saved in the NVMY and updated at Activation or Deactivation of the additive adaptation path (LV_MFF_ADD_AD_ER_BAL_ENA)

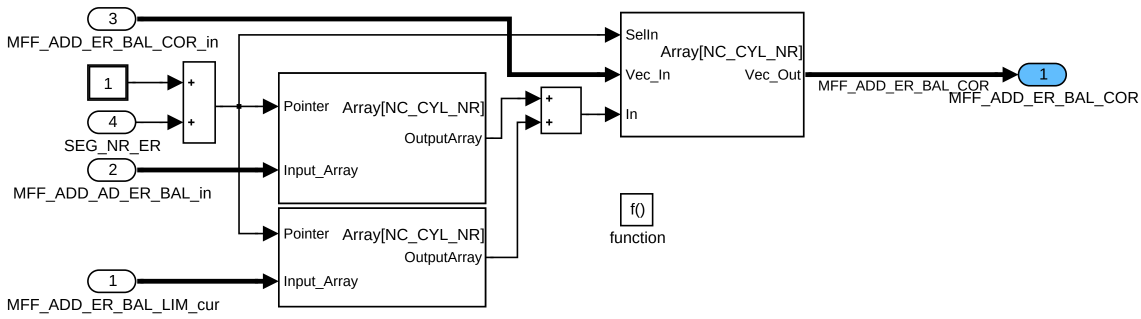

Figure 7.106.25: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/ CLC_ADD_INJ_T_COR_VALUE/COR_LIM_CTL_OUT_VALUE

Observation of corrected controller output values for OBD issues

The additive correction values out of the correction path are observed for OBD purposes. As soon as the minimum or maximum diagnosis threshold is exceeded, a corresponding flag for the related cylinder is set. In this case the OBD system is indicated to handle the further failure treatment. The diagnosis thresholds have always to be less or equal to the absolute minimum or maximum controller output limits.

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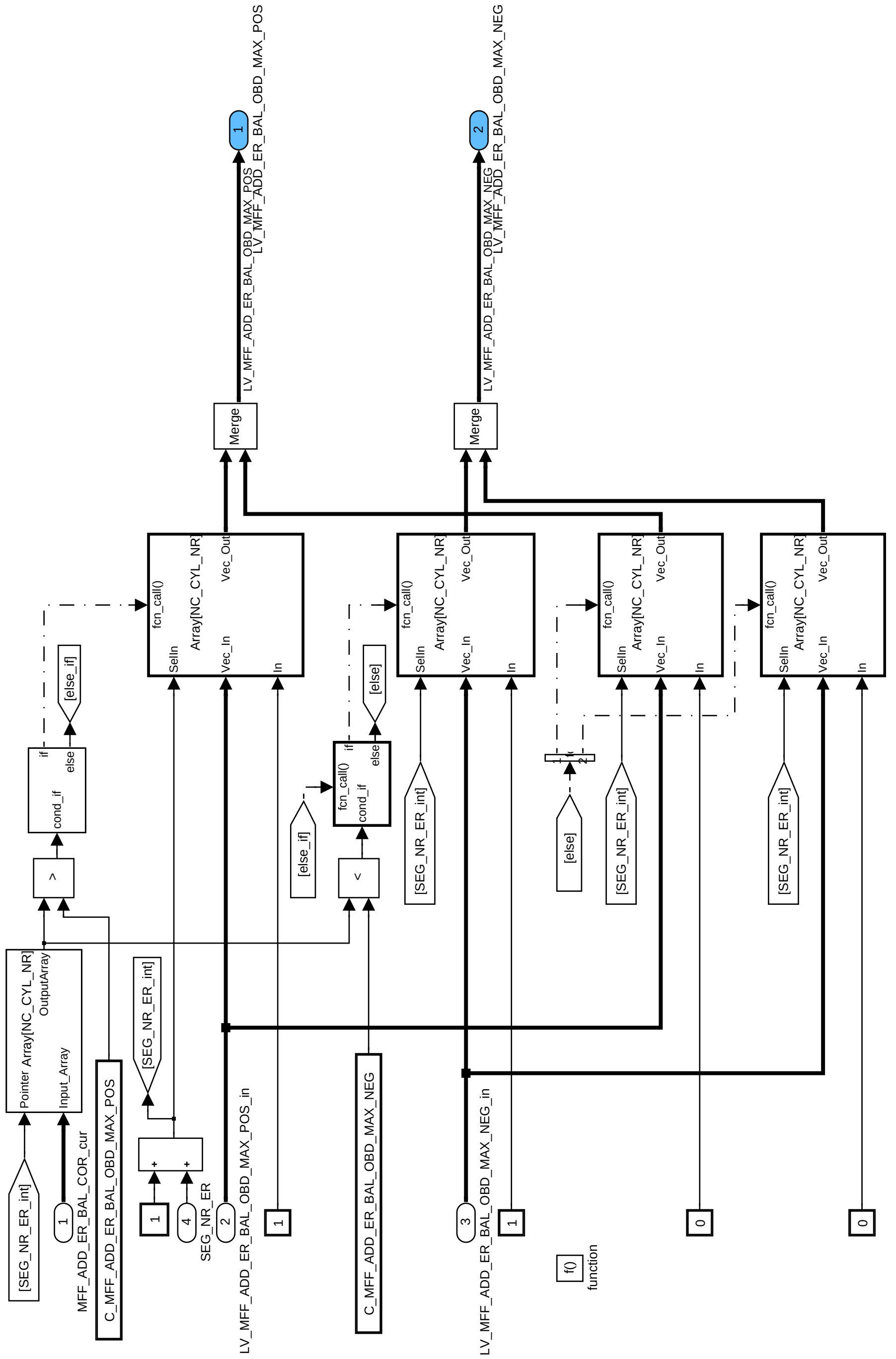

Figure 7.106.26: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/CLC_ADD_INJ_T_COR_VALUE/COR_CTL_OUT_VALUE_OBD

Calculation of the additive injection time adaptation values

The corrected NC_CYL_NR controller output values are adjusted dependent on the corresponding segment number SEG_NR_ER. During the function is activated, at every new segment the corresponding MFF_ADD_ER_BAL value is updated. Due to this correction the sum of all adaptation output values remains zero to guarantee that the overall injection spreading stays unchanged.

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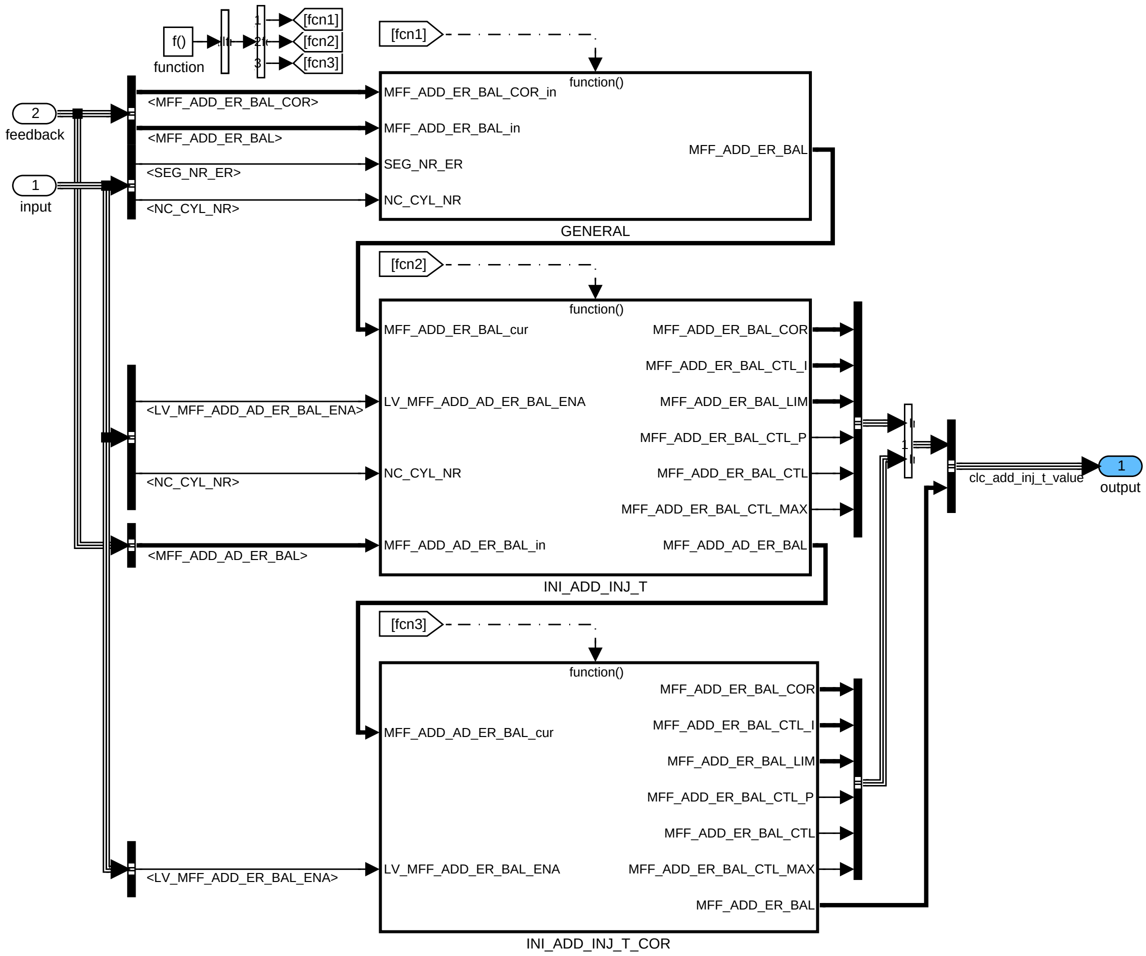

Figure 7.106.27:
CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/CLC_ADD_INJ_T_VALUE

Calculation of the additive injection time adaptation values GENERAL

Sum of all NC_CYL_NR controller output values /number of cylinders

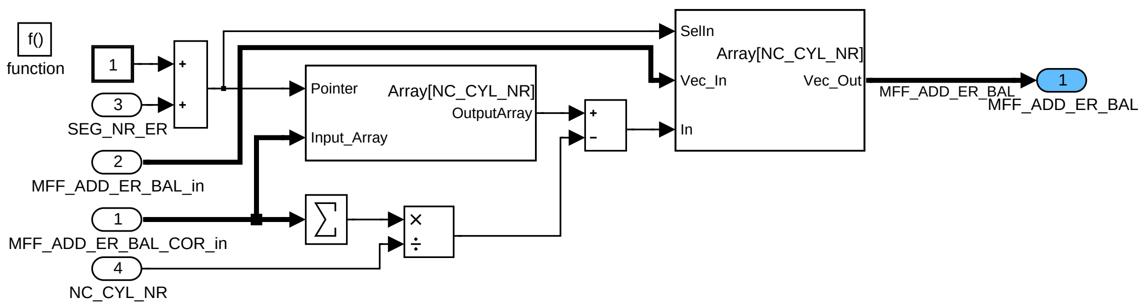

Figure 7.106.28:
CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/CLC_ADD_INJ_T_VALUE/GENERAL

Initialization at Entry or Exit to additive injection time adaptation

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As soon as the additive injection time adaptation is enabled or disabled, the stored adaptive correction values are overwritten with the currently present global adaptive value and the controller output values are set to zero.

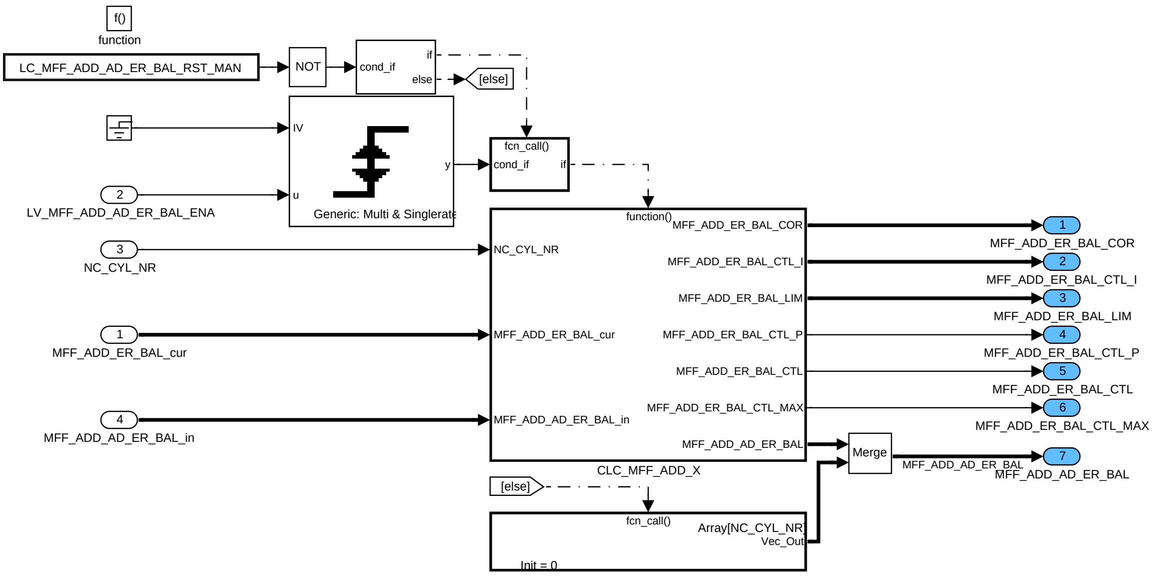

Figure 7.106.29: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_ADD_INJ_T_VALUE/INI_ADD_INJ_T

Initialization at Entry or Exit to additive injection time adaptation CLC_MFF_ADD_X

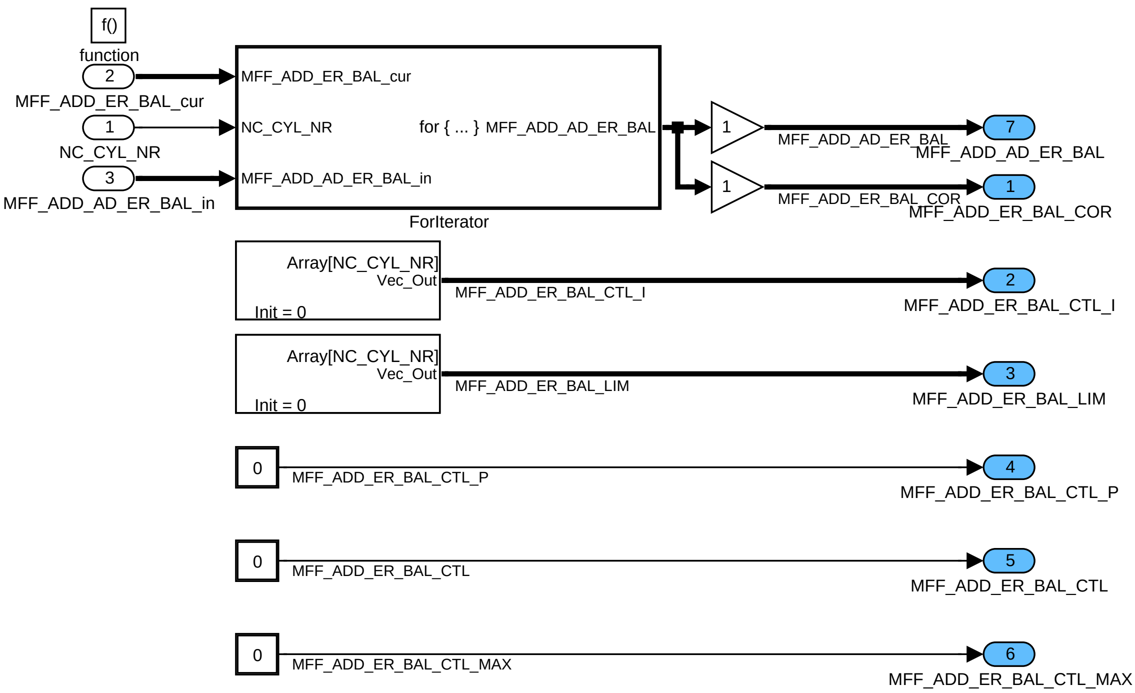

Figure 7.106.30: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_ADD_INJ_T_VALUE/INI_ADD_INJ_T/CLC_MFF_ADD_X

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Initialization at Entry or Exit to additive injection time adaptation CLC_MFF_ADD_X FORITERATOR

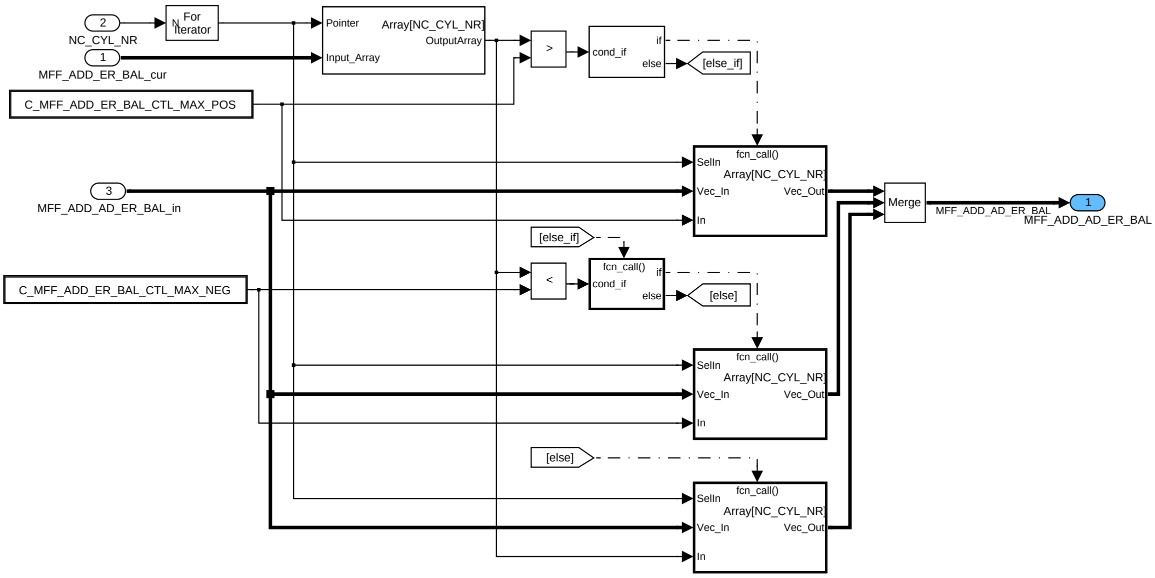

Figure 7.106.31: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/ CLC_ADD_INJ_T_VALUE/INI_ADD_INJ_T/CLC_MFF_ADD_X/ForIterator

Initialization at Exit from additive injection time correction

As soon as the additive injection time correction is disabled in combination with the manual switch to force the overall correction (LC_MFF_ADD_ER_BAL_COR), the controller output values are set to zero.
The initialization only takes place, if the logical constant for a manual reset of the additive controller values is set to zero (LC_MFF_ADD_ER_BAL_RST_MAN = 0).

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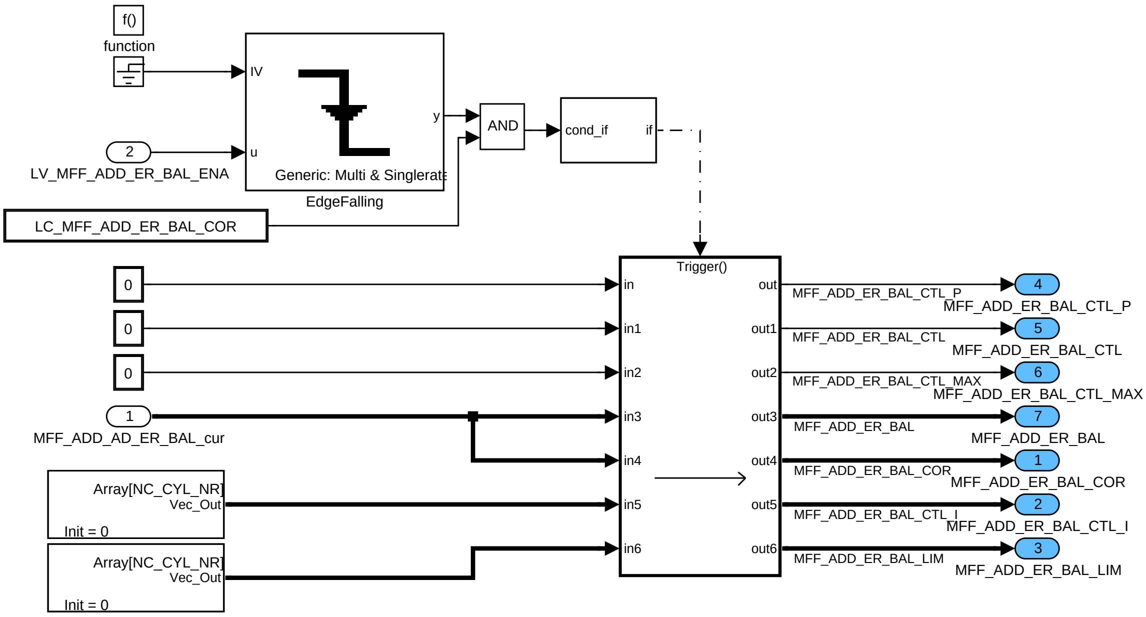

Figure 7.106.32: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_ADD_INJ_T_VALUE/INI_ADD_INJ_T_COR

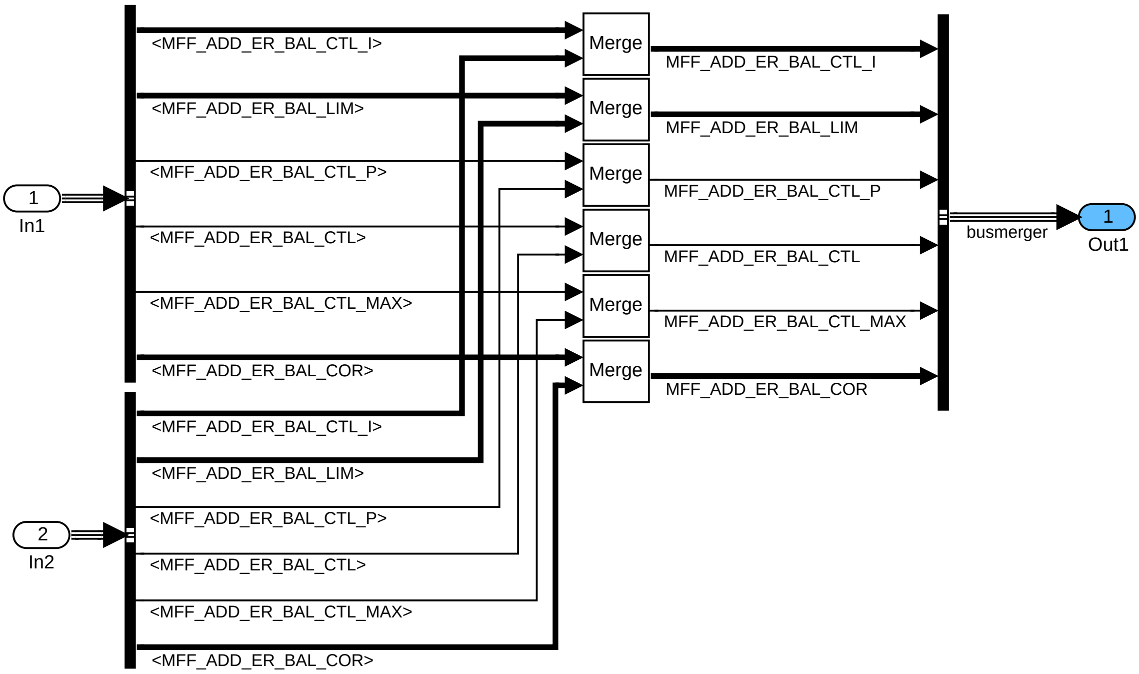

Figure 7.106.33:
CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/CLC_ADD_INJ_T_VALUE/BusMerger

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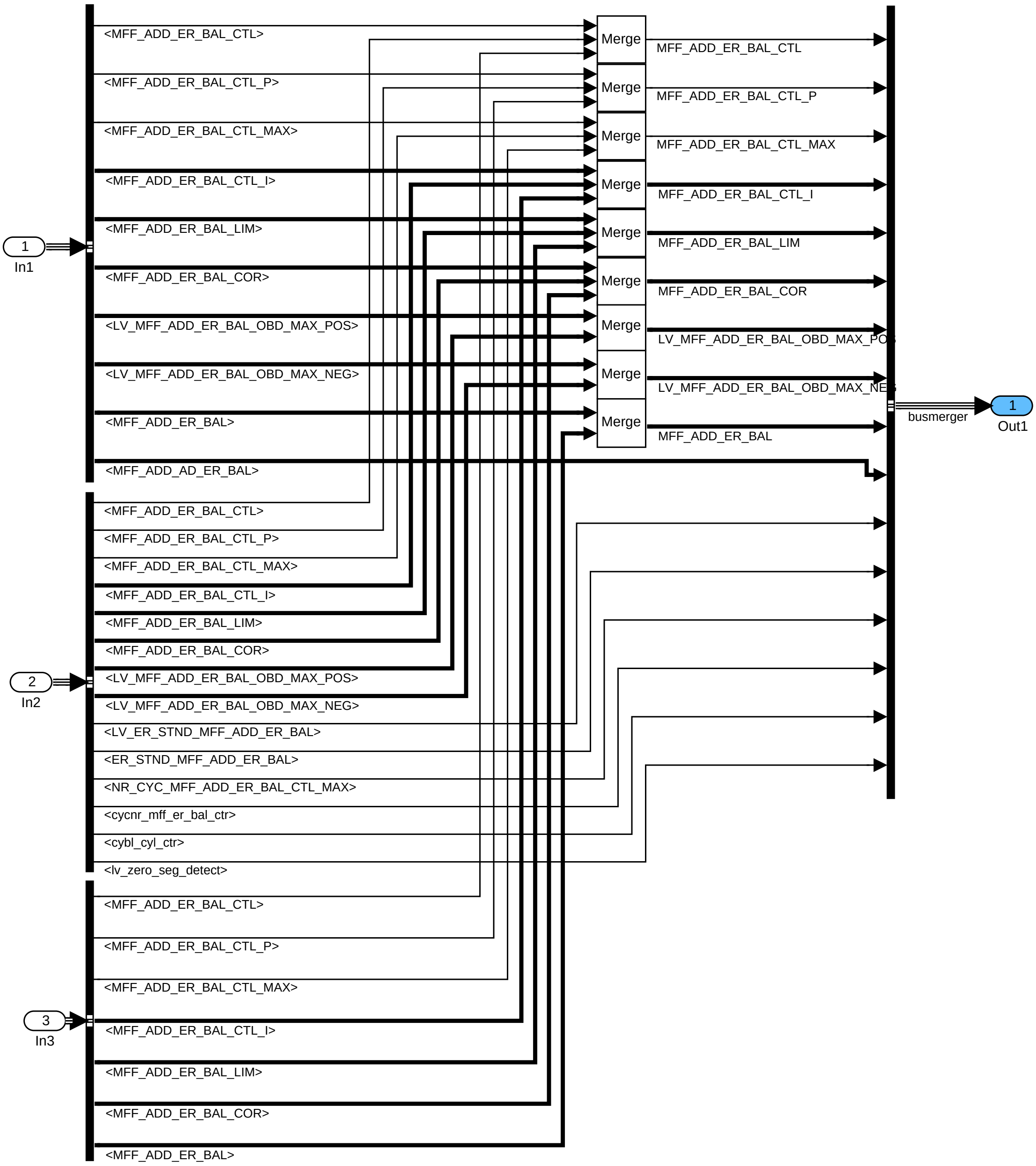

Figure 7.106.34: CYBL_M30708501/OPM/operate_SEG/CLC_OPERATE_SEG/BusMerger

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7.106.3 SUBFUNCTION: SIG_MNG

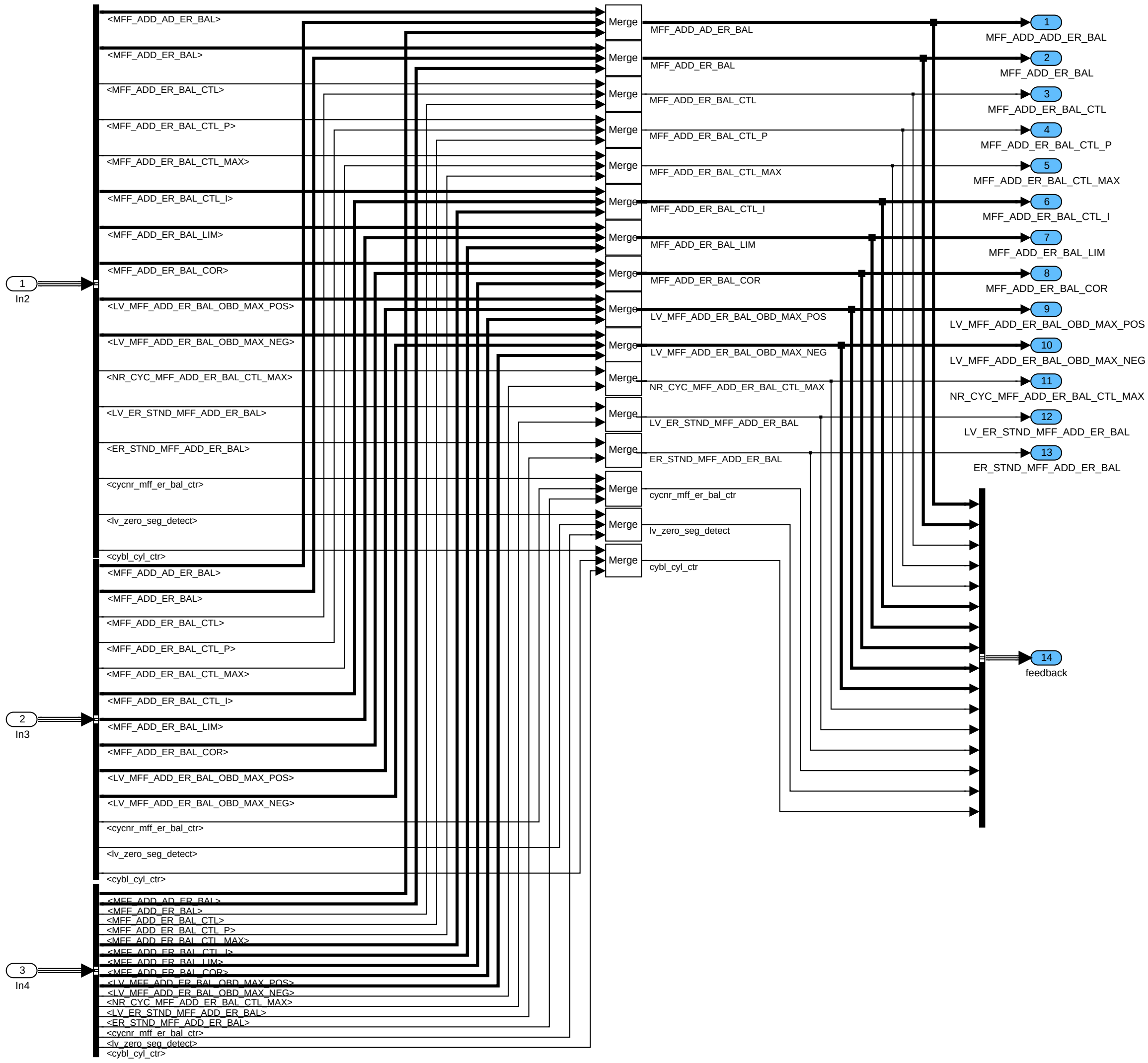

Figure 7.106.35: CYBL_M30708501/SIG_MNG

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7.107 Cylinder balancing via multiple injection time intervention

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ER_STND_FAC_TI_ER_BAL	V	8000... 7FFFH	0... 325.77	0.00994202	1/s**2
Controller input value at multiple path of cylinder balancing via TI intervention					
FAC_TI_AD_ER_BAL [NC_CYL_NR]	O/V/S	8000... 7FFFH	0... 0.99996948	305.176e3	-
Multiple adaptation value for cylinder balancing via TI intervention					
FAC_TI_ER_BAL [NC_CYL_NR]	O/V	8000... 7FFFH	0... 0.99996948	305.176e3	-
Multiple correction value for cylinder balancing via TI intervention					
FAC_TI_ER_BAL_COR [NC_CYL_NR]	V	8000... 7FFFH	0... 0.99996948	305.176e3	-
Corrected multiple correction value for cylinder balancing via TI intervention					
FAC_TI_ER_BAL_CTL	V	8000... 7FFFH	0... 0.99996948	305.176e3	-
Controller output value at multiple path of cylinder balancing via TI intervention					
FAC_TI_ER_BAL_CTL_I [NC_CYL_NR]	V	8000... 7FFFH	0... 0.99996948	305.176e3	-
I part of the controller output value at multiple path of cylinder balancing via TI intervention					
FAC_TI_ER_BAL_CTL_MAX	V	0... FFFFH	0... 65535	1	-
Controller output value maximum limit reached at multiple path of cylinder balancing via TI intervention					
FAC_TI_ER_BAL_CTL_P	V	8000... 7FFFH	0... 0.99996948	305.176e3	-
P part of the controller output value at multiple path of cylinder balancing via TI intervention					
FAC_TI_ER_BAL_LIM [NC_CYL_NR]	V	8000... 7FFFH	0... 0.99996948	305.176e3	-
Limited controller output value at multiple path of cylinder balancing via TI intervention					
LV_ER_STND_FAC_TI_ER_BAL	V	0... 1H	0 ...1	1	-
Flag for controller input at multiple path of cylinder balancing via TI intervention					
LV_MFF_FAC_ER_BAL_OBD_MAX_NEG [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for minimum OBD limit reached at multiple part of engine roughness based cylinder balancing					
LV_MFF_FAC_ER_BAL_OBD_MAX_POS [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Flag for maximum OBD limit reached at multiple part of engine roughness based cylinder balancing					
NR_CYC_FAC_TI_ER_BAL_CTL_MAX	V	0... FFH	0... 255	1	-
Corresponding segment number of the controller that has reached the maximum limit (multiple TI path)					

Input data:

ER_STND_MMV_DIF_BAL [NC_CYL_NR] {p. 1489}	LV_FAC_TI_AD_ER_BAL_ ENA {p. 4006}	LV_FAC_TI_ER_BAL_ENA {p. 4006}	LV_MFF_FAC_AD_ER_ BAL_EXT_ADJ {p. 7483}
LV_TI_ER_BAL_ACT {p. 4022}	NC_CYL_NR {p. 1526}	SEG_NR_ER {p. 1454}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CYCNR_FAC_TI_ER_BAL	-	1... FFH	1... 255	1	-
Number of cycles for calculation of controller output values for cylinder balancing via multiple TI intervention					
C_ER_STND_THD_NEG_FAC_TI_BAL	-	8000... 7FFFH	0... 325.77	0.00994202	1/s**2
Negative threshold for ER input value at multiple path of cylinder balancing via TI intervention					
C_ER_STND_THD_POS_FAC_TI_BAL	-	8000... 7FFFH	0... 325.77	0.00994202	1/s**2
Positive threshold for ER input value at multiple path of cylinder balancing via TI intervention					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TI_ER_BAL_CTL_MAX_NEG	-	8000... 7FFFH	0... 0.99996948	305.176e3	-
Negative maximum limit for controller output at multiple path of cylinder balancing via TI intervention					
C_FAC_TI_ER_BAL_CTL_MAX_POS	-	8000... 7FFFH	0... 0.99996948	305.176e3	-
Positive maximum limit for controller output at multiple path of cylinder balancing via TI intervention					
C_FAC_TI_ER_BAL_OBD_MAX_NEG	-	8000... 7FFFH	0... 0.99996948	305.176e3	-
Negative maximum OBD limit for multiple correction value of cylinder balancing via TI intervention					
C_FAC_TI_ER_BAL_OBD_MAX_POS	-	8000... 7FFFH	0... 0.99996948	305.176e3	-
Positive maximum OBD limit for multiple correction value of cylinder balancing via TI intervention					
C_FAC_TI_ER_BAL_RST	-	0H 1H 2H	INI_ZERO INI_CTL INI_AD	-	-
Reset of multiple correction and adaptation values for cylinder balancing via TI intervention					
IP_FAC_TI_I_ER_BAL	-	0... FFFFH	0... 0.99996948	305.176e3	-
LDP_ER_STND_FAC_TI_IP_I_ER_BAL	8	0... FFFFH	0... 325.77	0.0099313	1/s**2
Controller I part value for multiple path of cylinder balancing via TI intervention					
IP_FAC_TI_P_ER_BAL	-	0... FFFFH	0... 0.99996948	305.176e3	-
LDP_ER_STND_FAC_TI_IP_P_ER_BAL	8	0... FFFFH	0... 325.77	0.0099313	1/s**2
Controller P part value for multilple path of cylinder balancing via TI intervention					
LC_FAC_TI_AD_ER_BAL_RST_MAN	-	0... 1H	0 ...1	1	-
Manual reset of multiple adaptation values for cylinder balancing via TI intervention					
LC_FAC_TI_ER_BAL_COR	-	0... 1H	0 ...1	1	-
Manual switch for overall correction of controller output values for cylinder balancing via multiple TI intervention					
LC_FAC_TI_ER_BAL_RST_MAN	-	0... 1H	0 ...1	1	-
Manual reset of multiple correction values for cylinder balancing via TI intervention					

General information:

The calculation of the multiple correction or adaptation values is performed, depending on the settings of the corresponding logical activation variable. LV_FAC_TI_ER_BAL_ENA is used to enable the correction path, while LV_FAC_TI_AD_ER_BAL_ENA enables the adaptation path. As soon as the corresponding logical value is set to "1" in combination with additional activation conditions, the calculation is started.
The calculated additive adaptation value FAC_TI_AD_ER_BAL[NC_CYL_NR] for each cylinder is stored in the nonvolatile memory to be available for initialization issues at next engine run.
With use of the manual reset it is possible to initialize the multiple correction or adaptation values with zero at any time. In this case, the flags which indicate the exceeding of a controller output limitation are set to zero as well (refer: "Initialization at Manual Reset")
Signal flow diagram:

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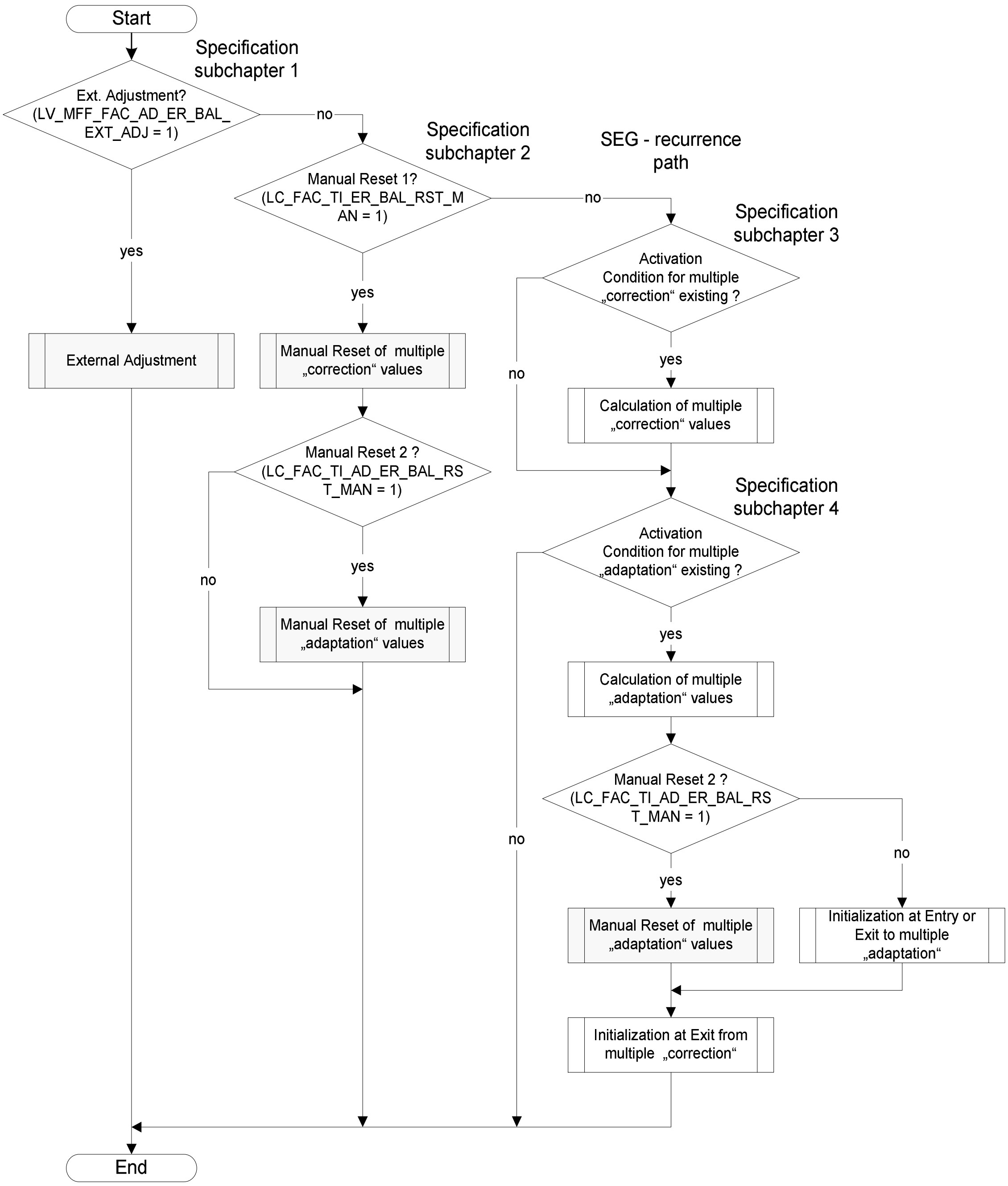

Application Condition

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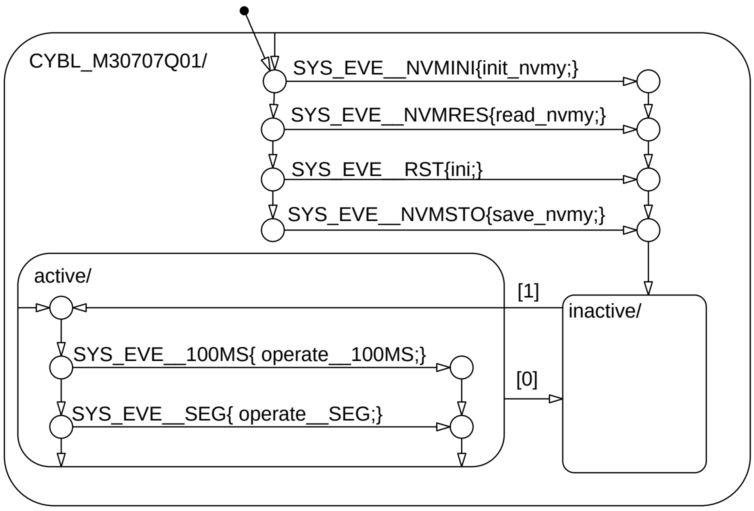

Figure 7.107.1: CYBL_M30707Q01/APP_CDN/Chart

Function Description

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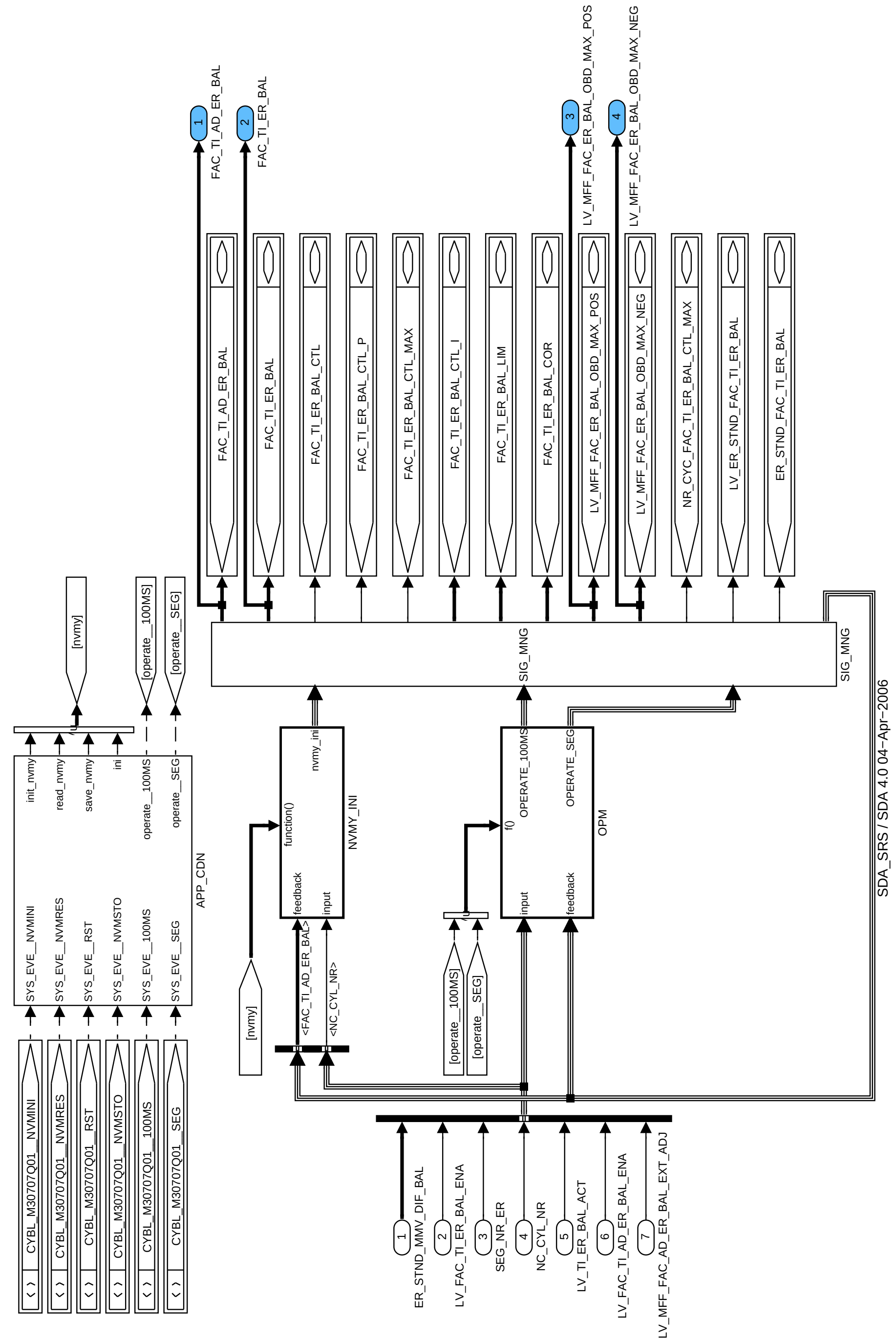

Figure 7.107.2: CYBL_M30707Q01

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7.107.1 Calculation of non volatile memory tasks

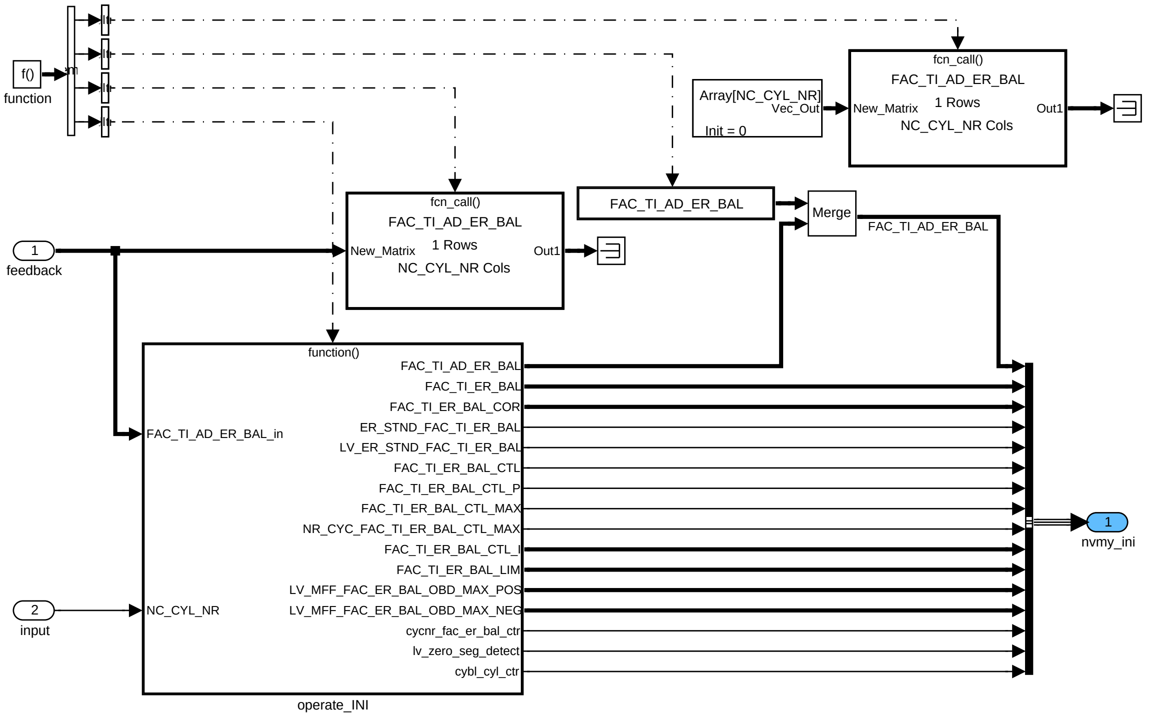

Figure 7.107.3: CYBL_M30707Q01/NVMY_INI

Calculation of variables at reset task

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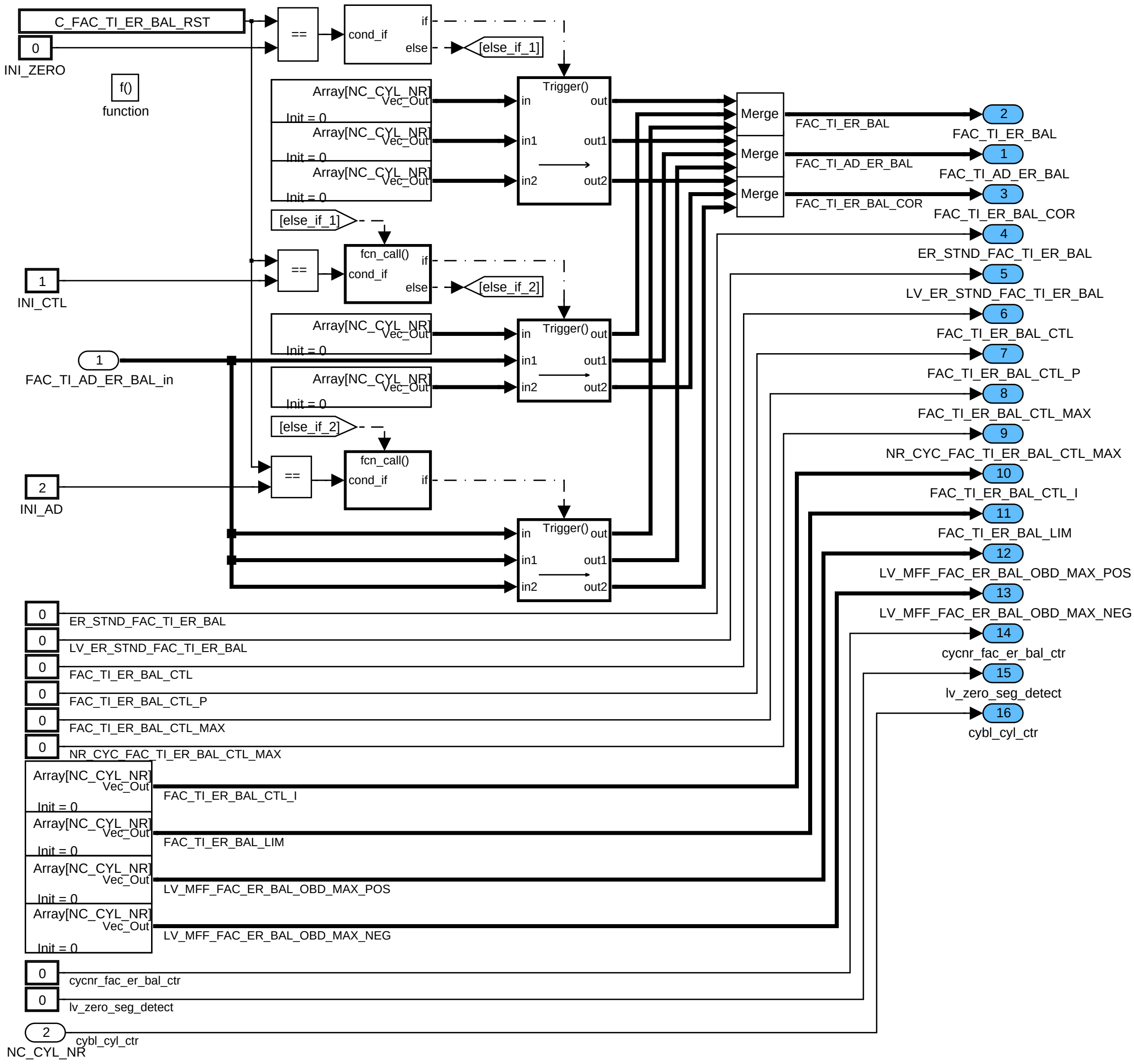

Figure 7.107.4: CYBL_M30707Q01/NVMY_INI/operate_INI

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7.107.2 Calculation of 100ms and segment synchronous tasks

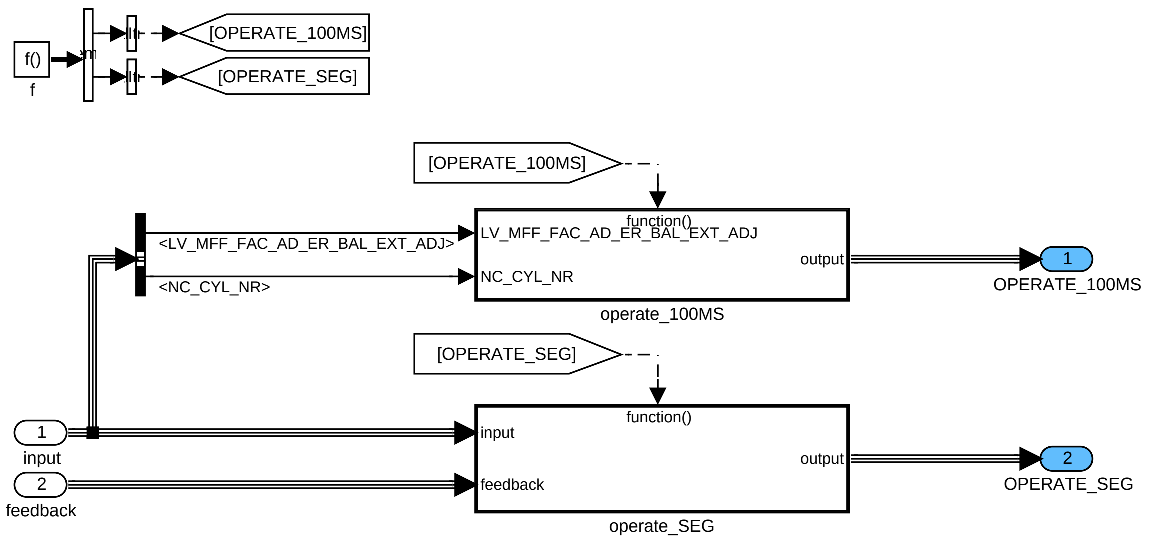

Figure 7.107.5: CYBL_M30707Q01/OPM

External adjustment of multiple correction values

In case of an external adjustment (request from key word protocol) the additive adaptation values for all cylinders are set to zero. While the external adjustment is activated, all following subchapters within the module "Cylinder balancing via multiple TI intervention" are deactivated and the corresponding "Initialization at Deactivation" process for this chapter is blocked during this period.

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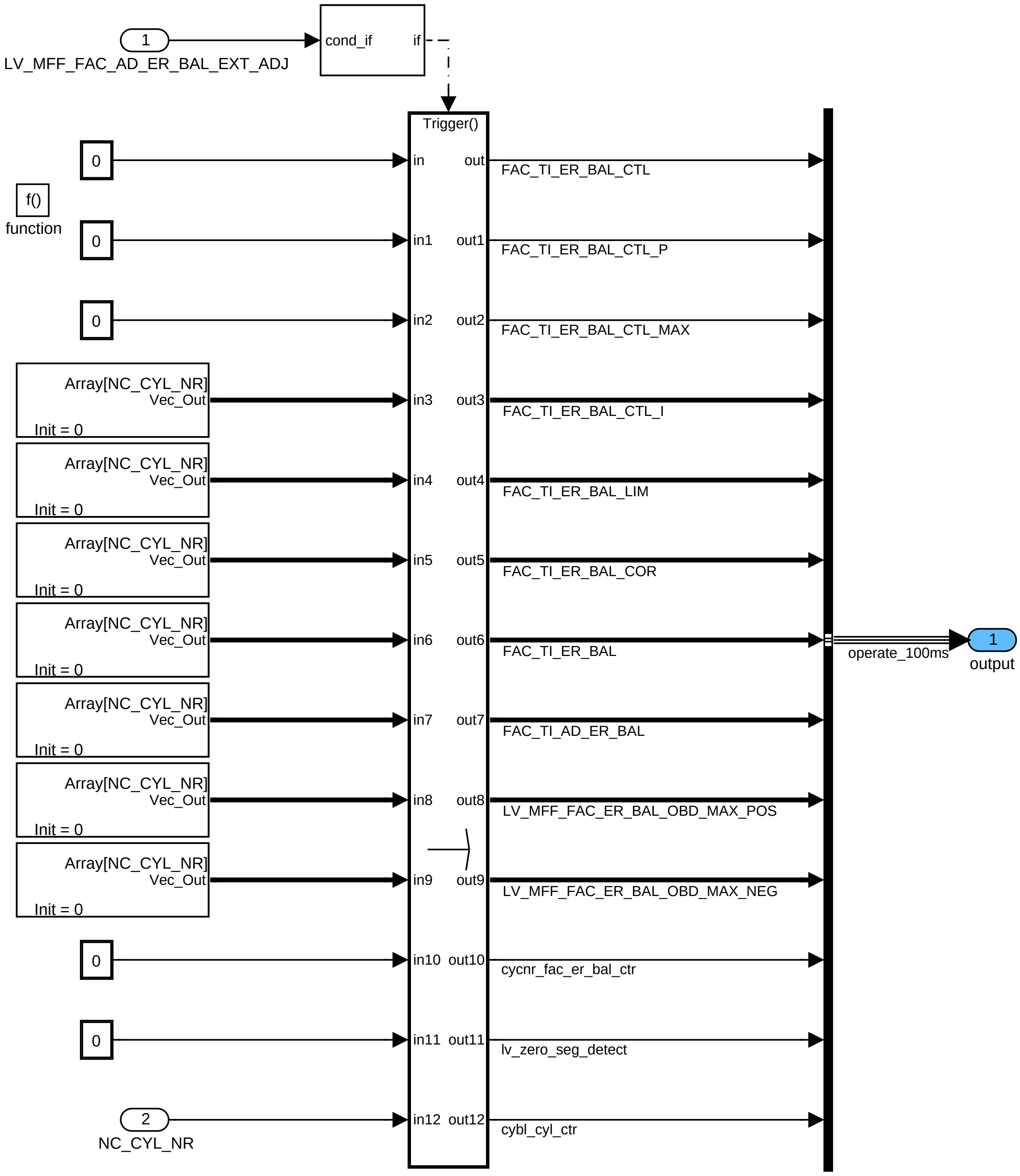

Figure 7.107.6: CYBL_M30707Q01/OPM/operate_100MS

Calculation of segment task

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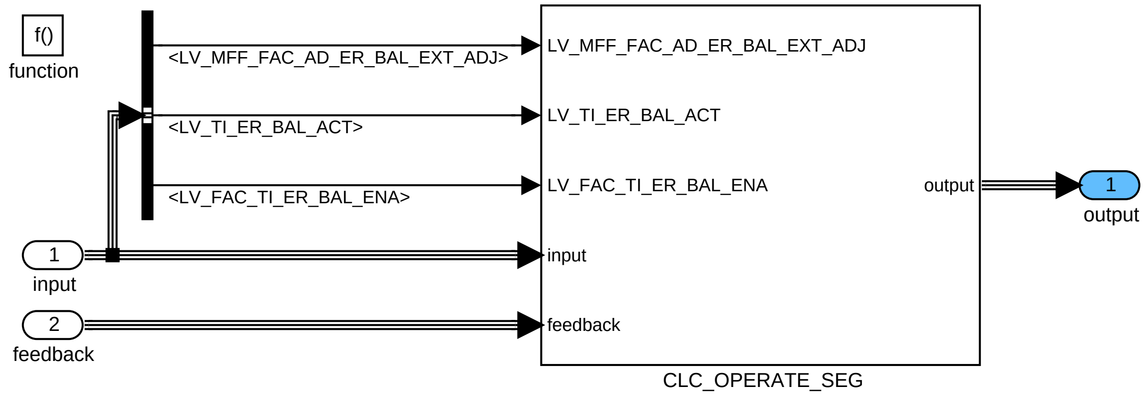

Figure 7.107.7: CYBL_M30707Q01/OPM/operate_SEG

Calculation of manual reset, injection time correction and injection time adaptation

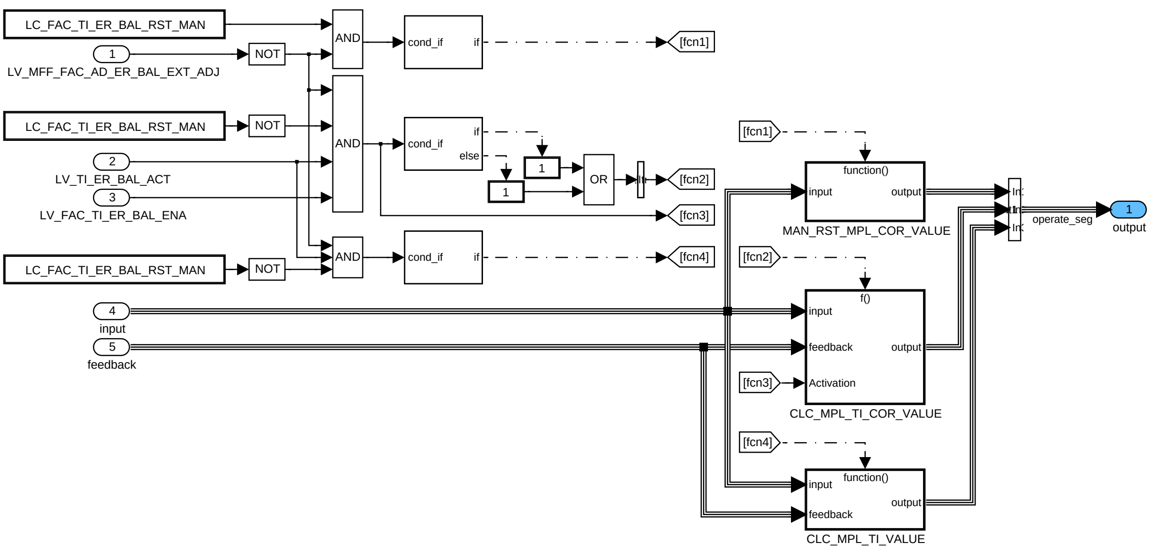

Figure 7.107.8: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG

Manual reset of multiple correction values

In case of a manual reset it is possible to adjust the exported output data to a wanted value to make the function test and handling more easier. While the manual function reset is activated, all following subchapters within the module "Cylinder balancing via multiple TI intervention" are deactivated and the corresponding "Initialization at Deactivation" process for this chapters is blocked during this period.

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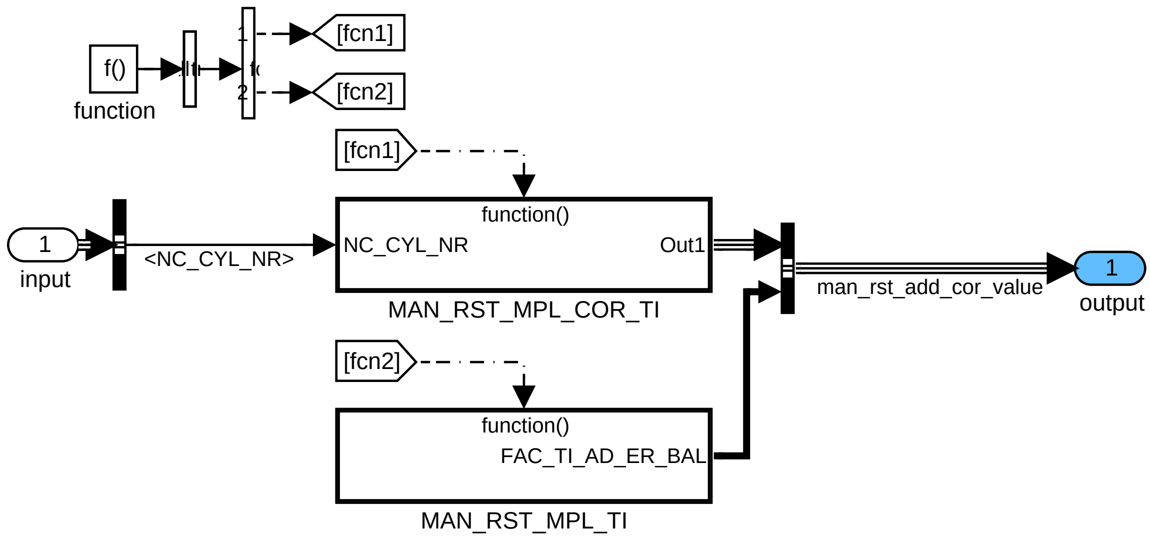

Figure 7.107.9:
CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/MAN_RST_MPL_COR_VALUE

Manual reset of multiple correction values for cylinder balancing via TI intervention

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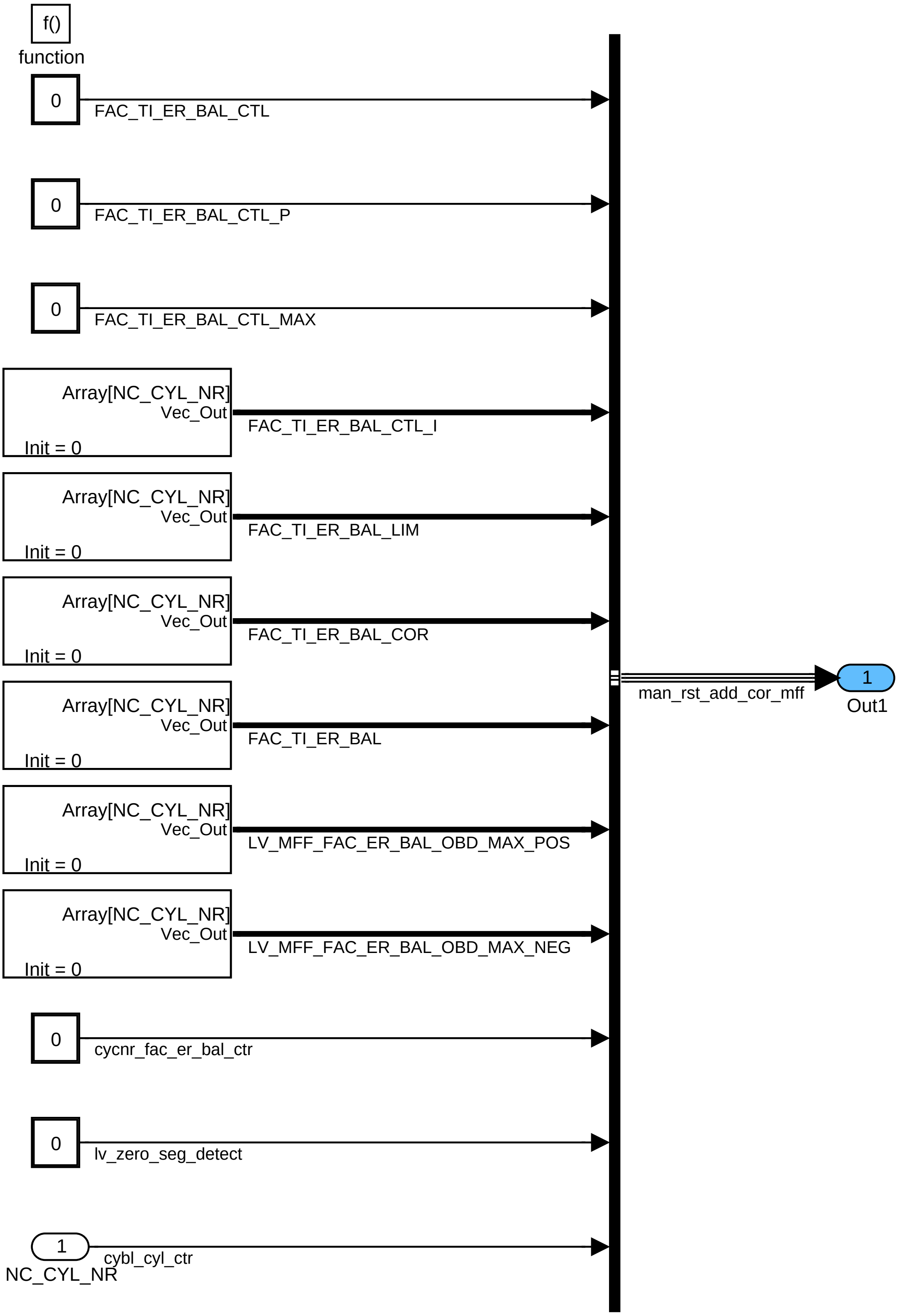

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Figure 7.107.10: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/
MAN_RST_MPL_COR_VALUE/MAN_RST_MPL_COR_TI

Manual reset of multiple adaptation values for cylinder balancing via TI intervention

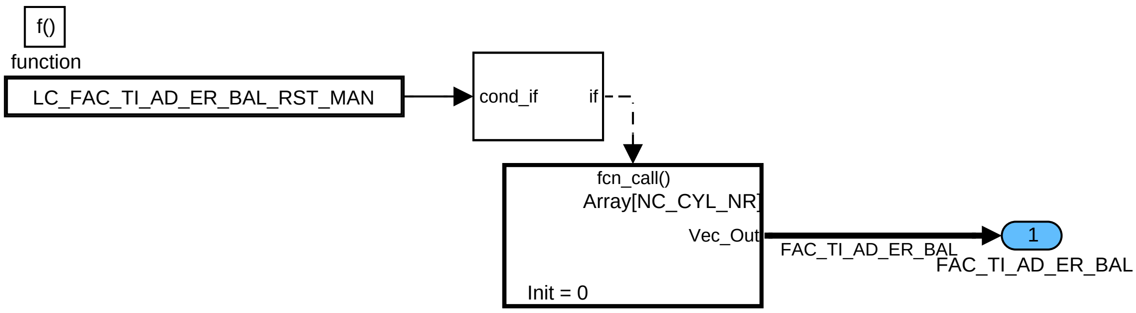
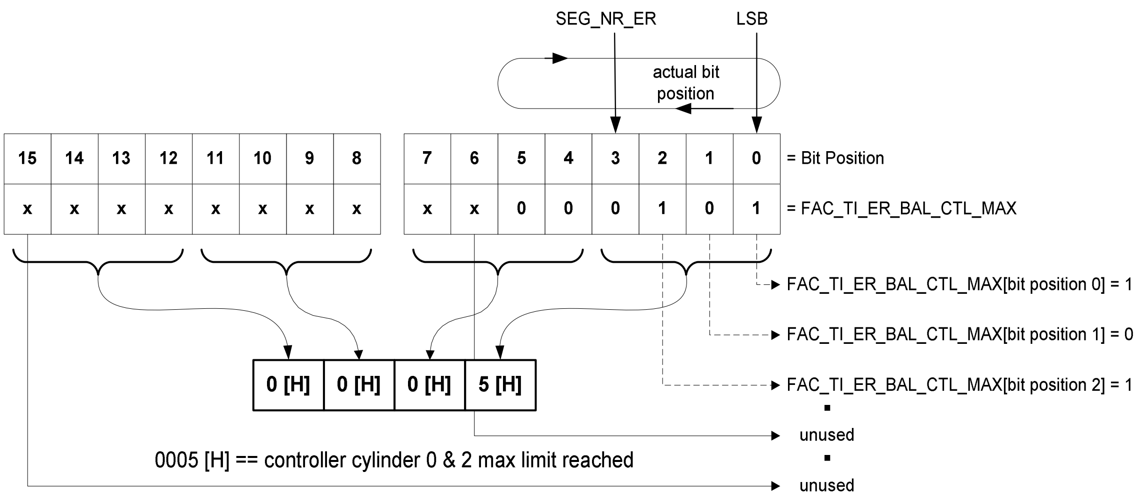


Figure 7.107.11: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/
MAN_RST_MPL_COR_VALUE/MAN_RST_MPL_TI

Structure of the multiple injection time correction values

The calculation of the multiple injection time correction values are only performed if the corresponding enable bit LV_FAC_TI_ER_BAL_ENA is set to logical "1" in combination with additional activation conditions. In this case, a separate correction value for each cylinder is determined with use of a PIcontroller.
As soon as a PIcontroller of one cylinder is reaching its maximum, a corresponding value is set to "1" to indicate the related cylinder. To save memory resources, the information for all cylinders is located within one output data (WORD) is used to indicate one cylinder. It is possible to handle up to 16 cylinders with this method.
For a description more in detail please have a look to the signal flow diagram below. As example, a sixcylinder engine with two PIcontrollers, which have reached the limits, is shown.
Signal flow diagram:
Signalization of controller max. output value reached for multiple path



Note: always the complete WORD (16 BIT) is displayed as visible value

Calculation of the multiple injection time correction /adaptation values in general

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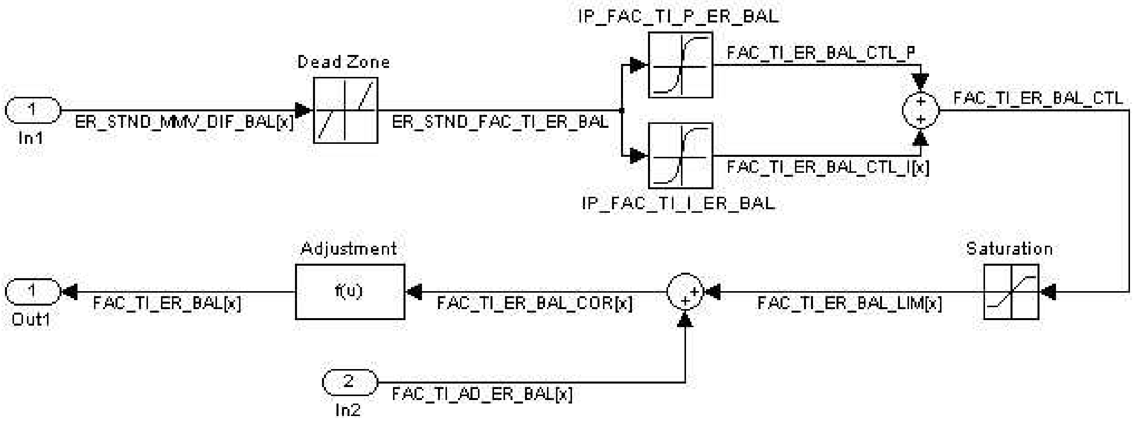

Note: [_x] is representing [SEG_NR_ER] in the signal flow diagram above

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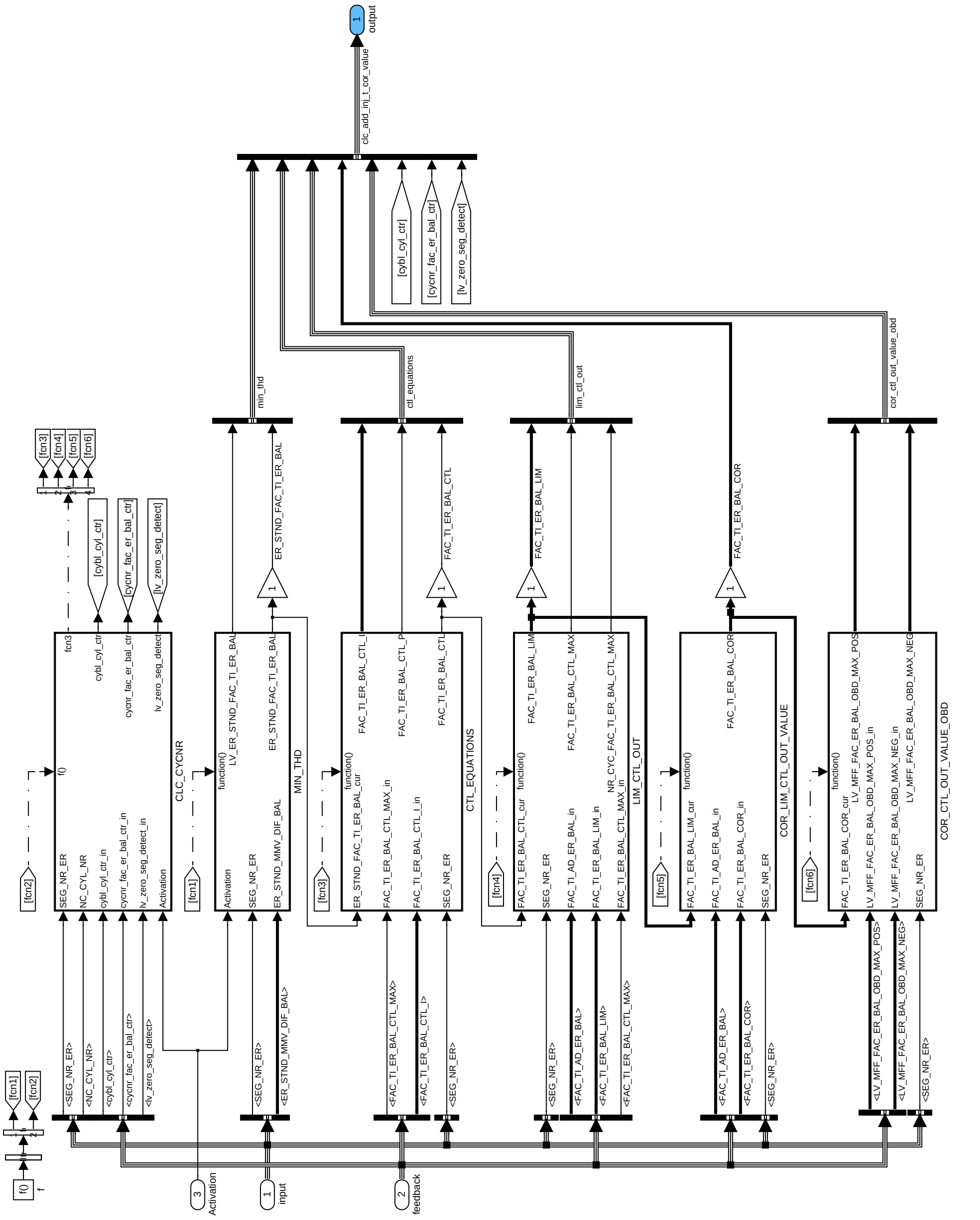

Figure 7.107.12:
CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/CLC_MPL_TI_COR_VALUE

Minimum threshold

If defined cylinder balancing input values ER_STND_MMV_DIF_BAL[SEG_NR_ER] are outside a calibrateable range, the controller is calculated. Otherwise the controller inputs are set to zero.

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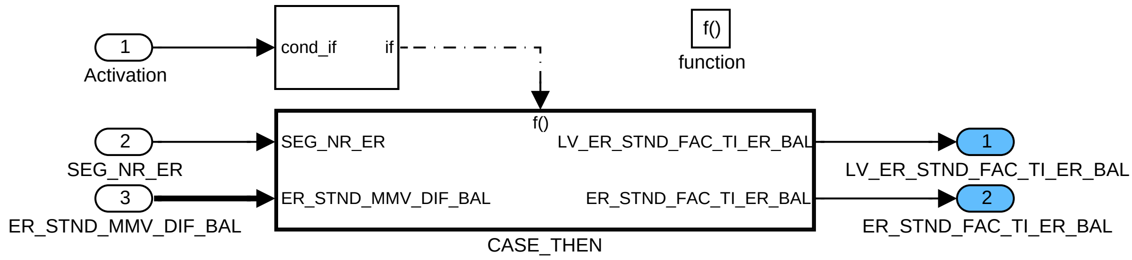

Figure 7.107.13:
CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/CLC_MPL_TI_COR_VALUE/MIN_THD

Minimum threshold CASE_THEN

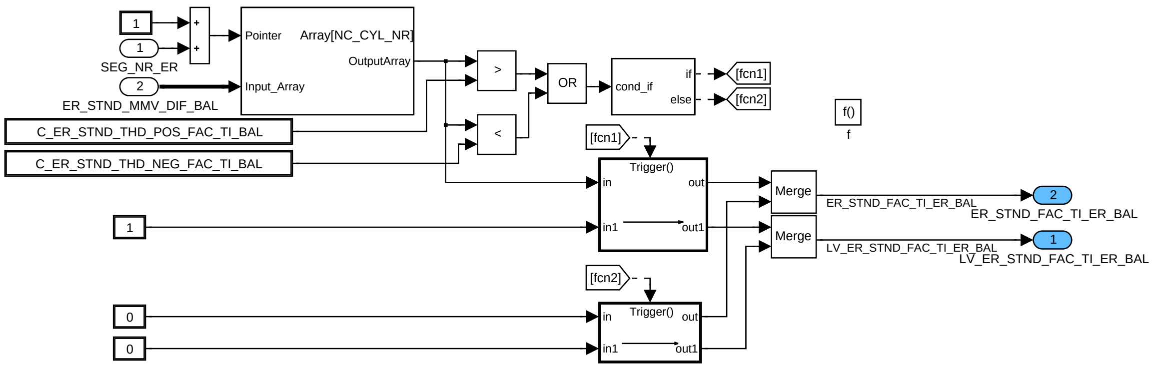

Figure 7.107.14: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_MPL_TI_COR_VALUE/MIN_THD/CASE_THEN

Calculation of segment tasks CLC_OPERATE_SEG CLC_MPL_TI_COR_VALUE CLC_CYCNR

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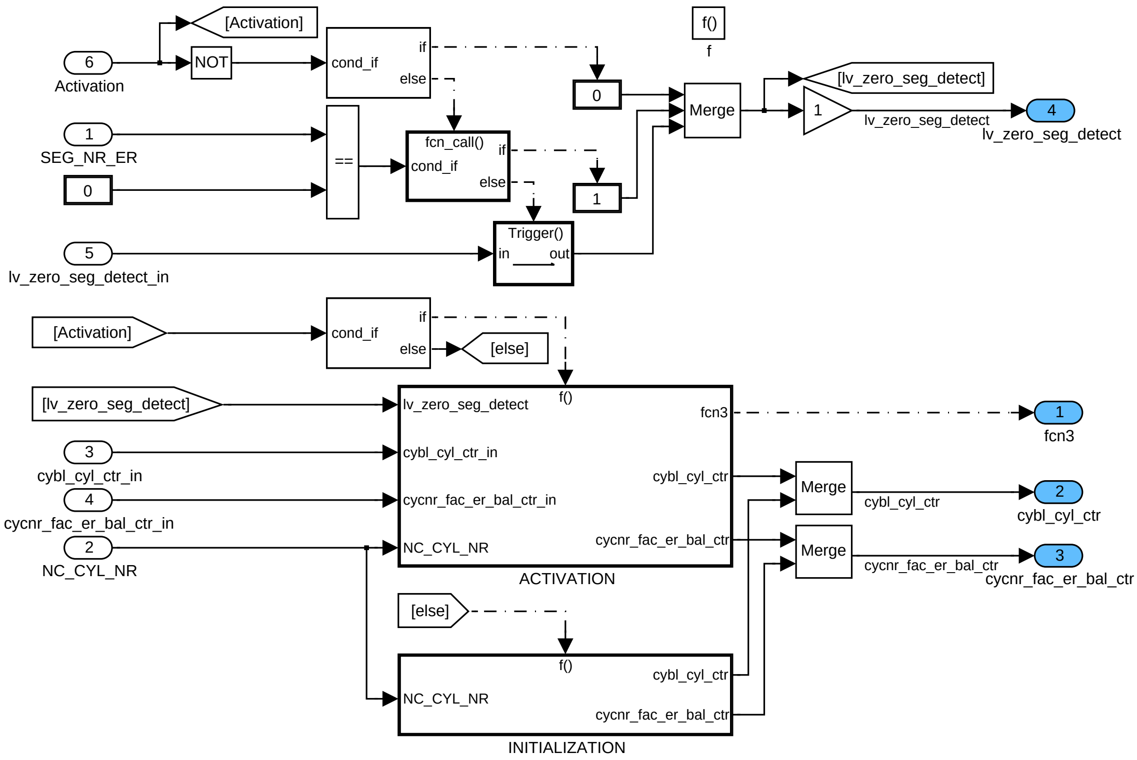

Figure 7.107.15: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_MPL_TI_COR_VALUE/CLC_CYCNR

Calculation of segment tasks CLC_OPERATE_SEG CLC_MPL_TI_COR_VALUE CLC_CYCNR ACTIVATION

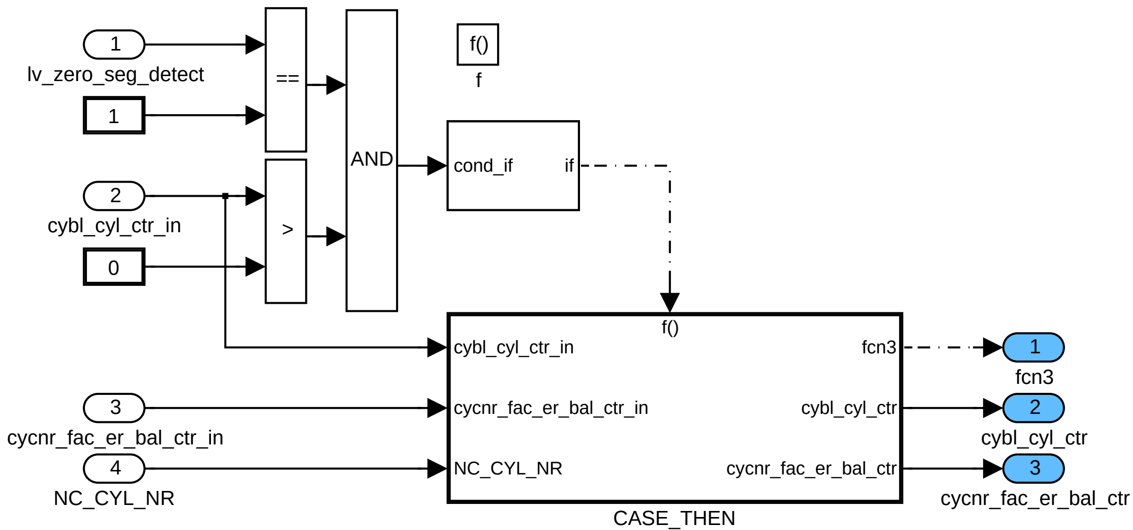

Figure 7.107.16: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_MPL_TI_COR_VALUE/CLC_CYCNR/ACTIVATION

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Calculation of segment tasks CLC_OPERATE_SEG CLC_MPL_TI_COR_VALUE CLC_CYCNR ACTIVATION CASE_THEN

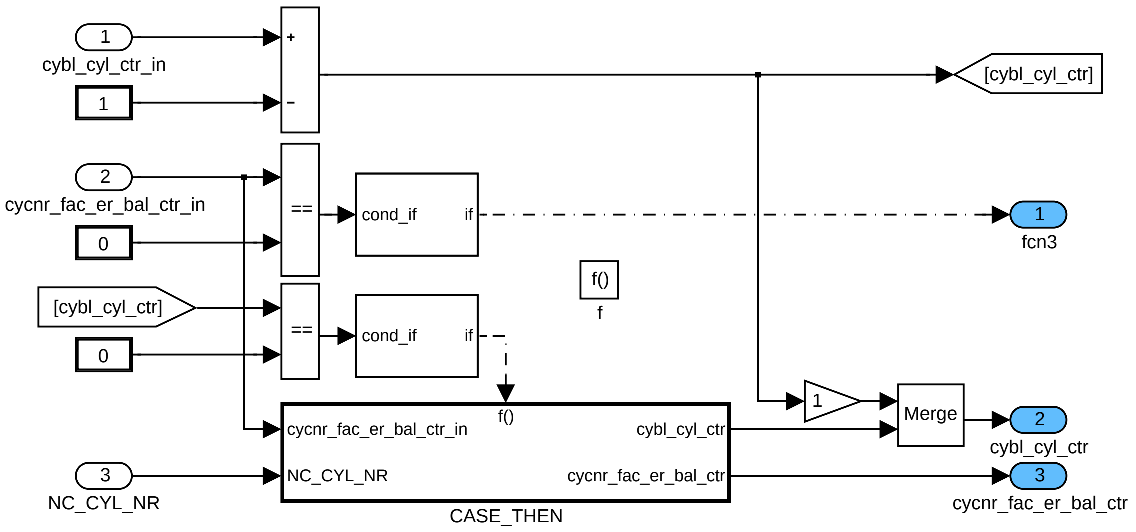

Figure 7.107.17: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_MPL_TI_COR_VALUE/CLC_CYCNR/ACTIVATION/CASE_THEN

Calculation of segment tasks CLC_OPERATE_SEG CLC_MPL_TI_COR_VALUE CLC_CYCNR ACTIVATION CASE_THEN CASE_THEN

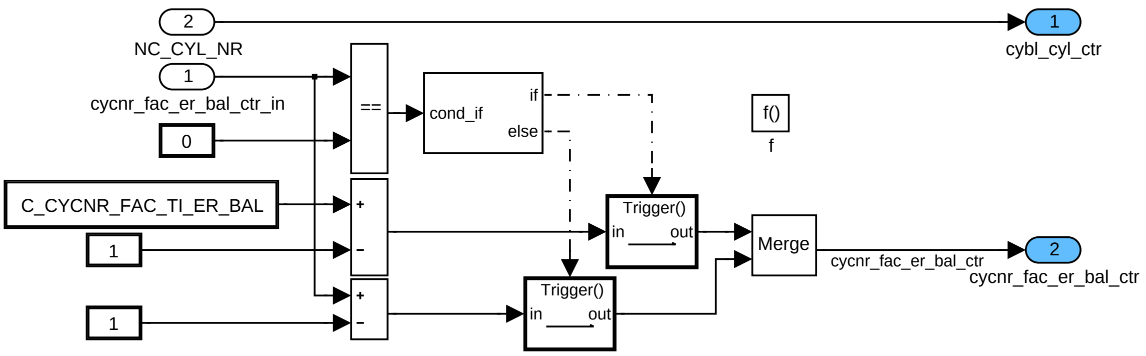

Figure 7.107.18: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_MPL_TI_COR_VALUE/CLC_CYCNR/ACTIVATION/CASE_THEN/CASE_THEN

Calculation of segment tasks CLC_OPERATE_SEG CLC_MPL_TI_COR_VALUE CLC_CYCNR INITIALIZATION

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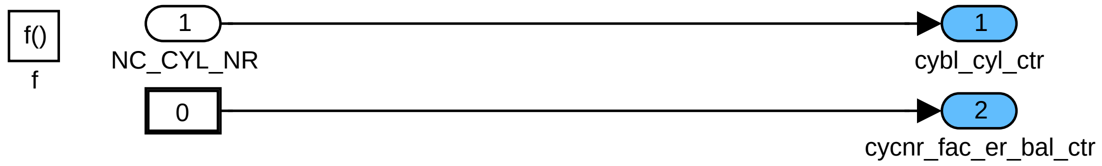

Figure 7.107.19: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_MPL_TI_COR_VALUE/CLC_CYCNR/INITIALIZATION

Controller Equations

For the multiple correction mode, a separate set of NC_CYL_NR controllers exists operating in parallel (one controller for each cylinder).
The computation of the output values is carried out every C_CYCNR_FAC_TI_ER_BAL engine cycles (= calibrateable number of engine cycles).
Only in case of C_CYCNR_FAC_TI_ER_BAL = 1, the calculation of the additive path is done without interruption. At every segment the corresponding cylinder correction value is built.
If the computation is not done at every engine cycle (C_CYCNR_FAC_TI_ER_BAL > 1), the trigger of the controller output calculation is always related to SEG_NR_ER = 0.

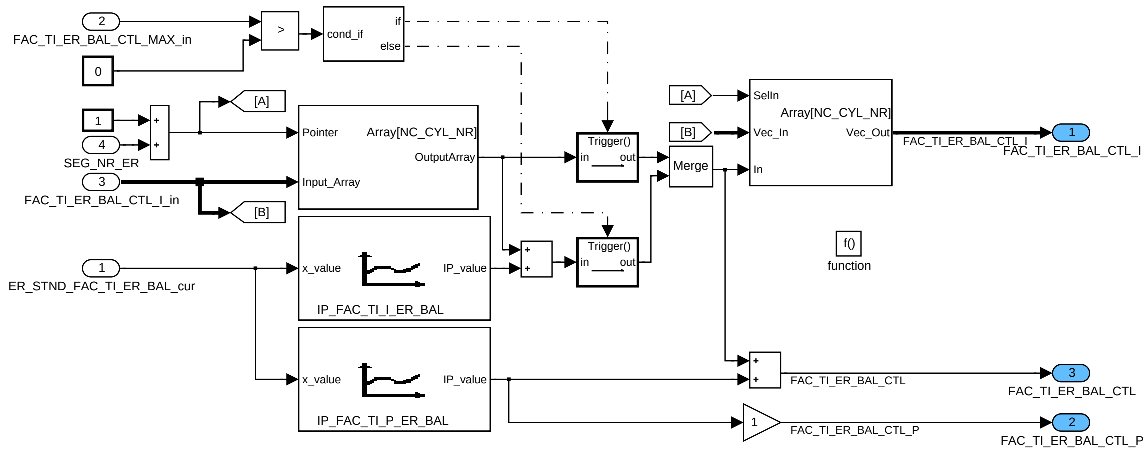

Figure 7.107.20: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_MPL_TI_COR_VALUE/CTL_EQUATIONS

Limitation of the Controller Output

The outputs of the controllers are limited to calibrateable threshold. If one controller output has reached the limit, a flag is set at one and the corresponding segment number is displayed.

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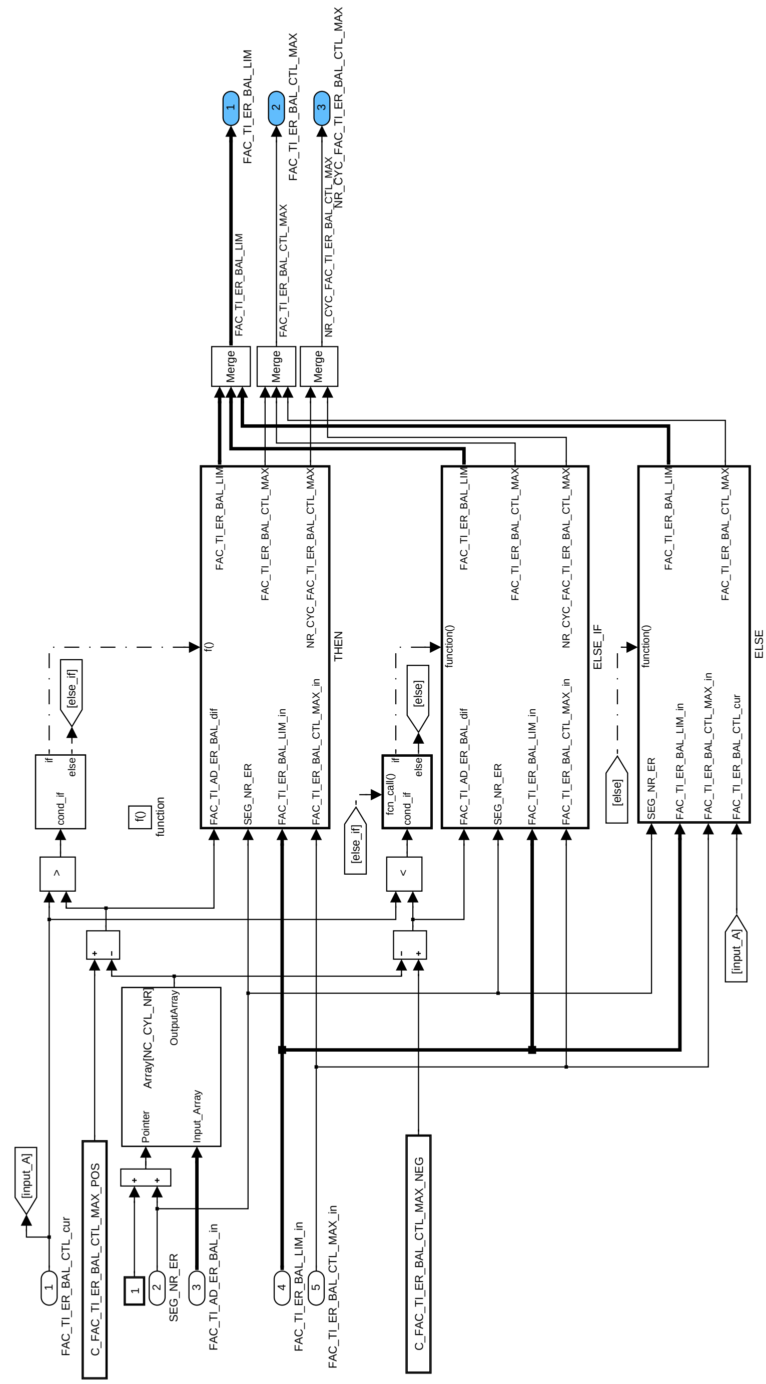

Figure 7.107.21: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_MPL_TI_COR_VALUE/LIM_CTL_OUT

Limitation of the Controller Output - then branch

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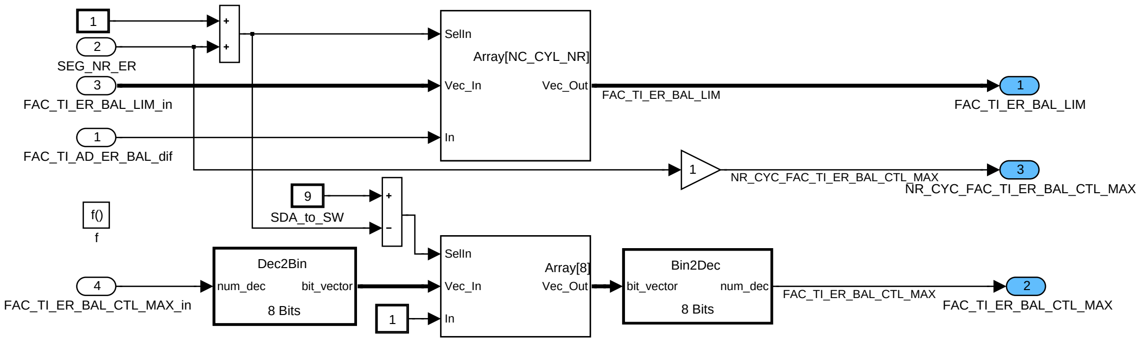

Figure 7.107.22: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_MPL_TI_COR_VALUE/LIM_CTL_OUT/THEN

Limitation of the Controller Output - else if branch

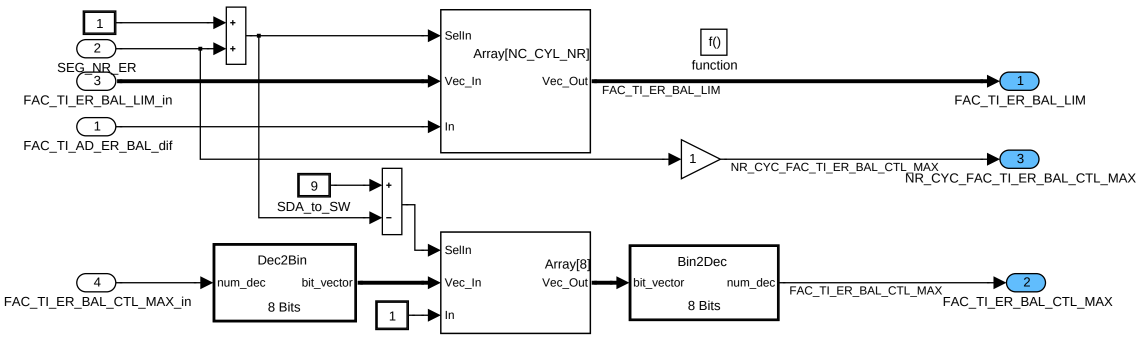

Figure 7.107.23: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_MPL_TI_COR_VALUE/LIM_CTL_OUT/ELSE_IF

Limitation of the Controller Output - else branch

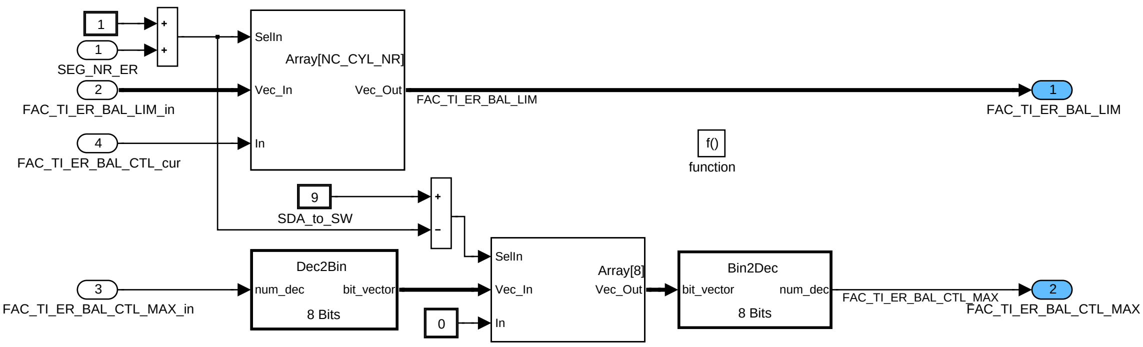

Figure 7.107.24: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_MPL_TI_COR_VALUE/LIM_CTL_OUT/ELSE

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Correction of limited controller output values with adaptation values

The limited controller output values are corrected with the currently available adaptive correction values, which is saved in NVMY and updated at Activation or Deactivation of the multiple adaptation path (LV_FAC_TI_AD_ER_BAL_ENA)

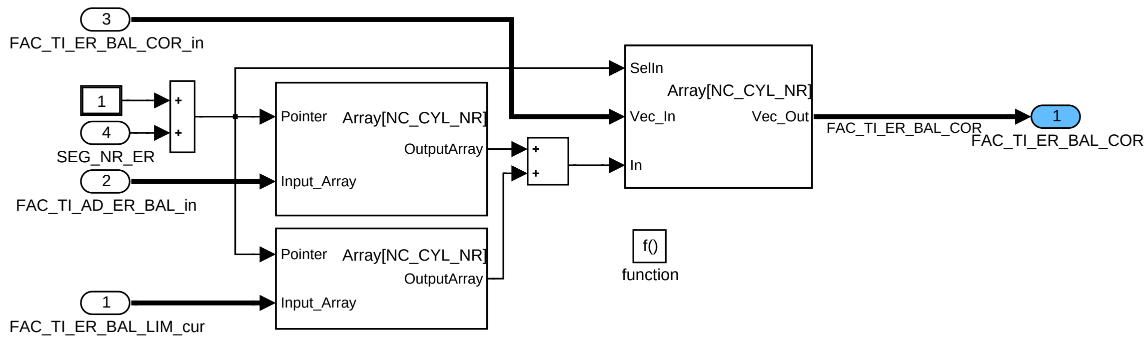

Figure 7.107.25: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/ CLC_MPL_TI_COR_VALUE/COR_LIM_CTL_OUT_VALUE

Observation of corrected controller output values for OBD issues

The multiple correction values out of the correction path are observed for OBD purposes. As soon as the minimum or maximum diagnosis threshold is exceeded, a corresponding flag for the related cylinder is set. In this case the OBD system is indicated to handle the further failure treatment. The diagnosis thresholds have always to be less or equal to the absolute minimum or maximum controller output limits.

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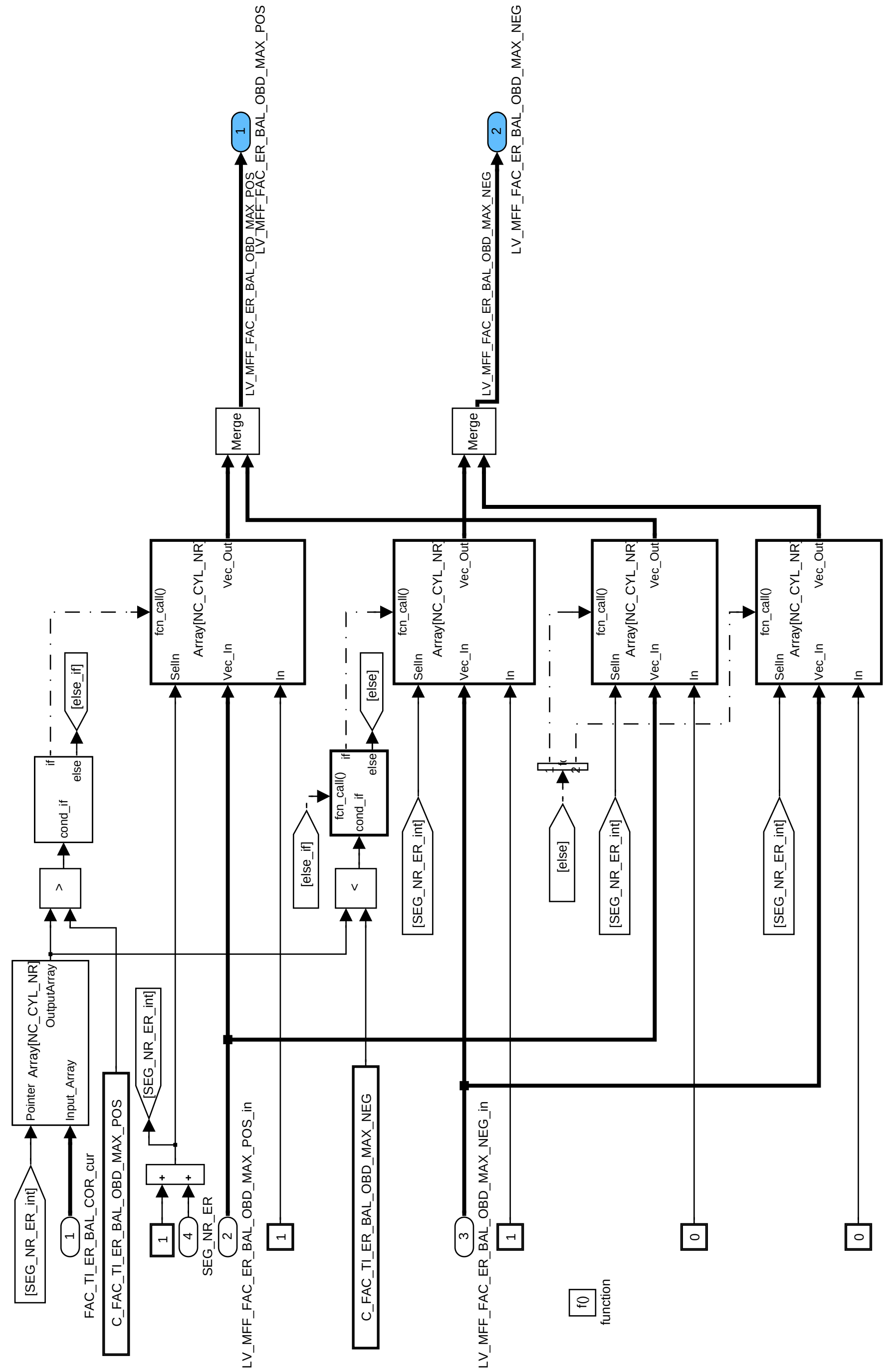

Figure 7.107.26: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_MPL_TI_COR_VALUE/COR_CTL_OUT_VALUE_OBD

Calculation of the multiple injection time adaptation values

The corrected NC_CYL_NR controller output values are adjusted dependent on the corresponding segment number SEG_NR_ER. During the function is activated, at every new segment the corresponding FAC_TI_ER_BAL value is updated. Due to this correction the sum of all adaptation output values remains zero to guarantee that the overall injection spreading stays unchanged.

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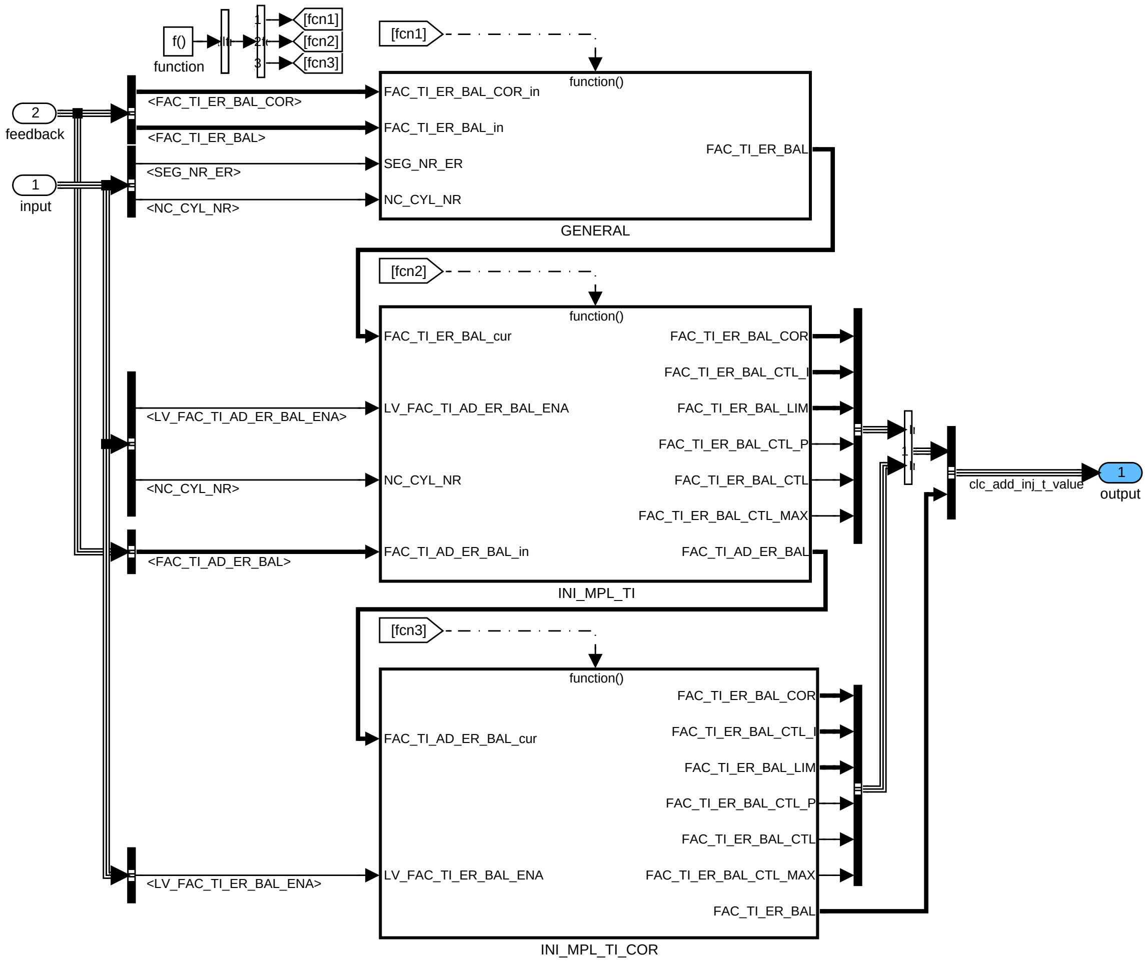

Figure 7.107.27: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/CLC_MPL_TI_VALUE

Calculation of the multiple injection time adaptation values General

Sum of all NC_CYL_NR controller output values /number of cylinders

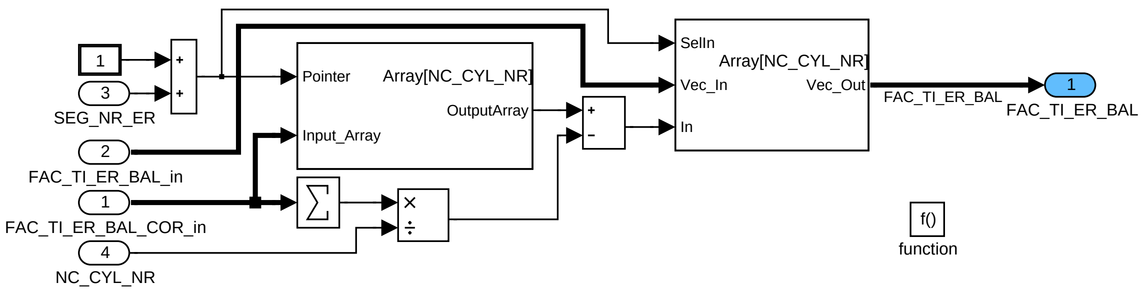

Figure 7.107.28:
CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/CLC_MPL_TI_VALUE/GENERAL

Initialization at Entry or Exit to multiple injection time adaptation

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As soon as the multiple injection time adaptation is enabled or disabled, the stored adaptive correction values are overwritten with the currently present global adaptive value and the controller output values are set to zero.

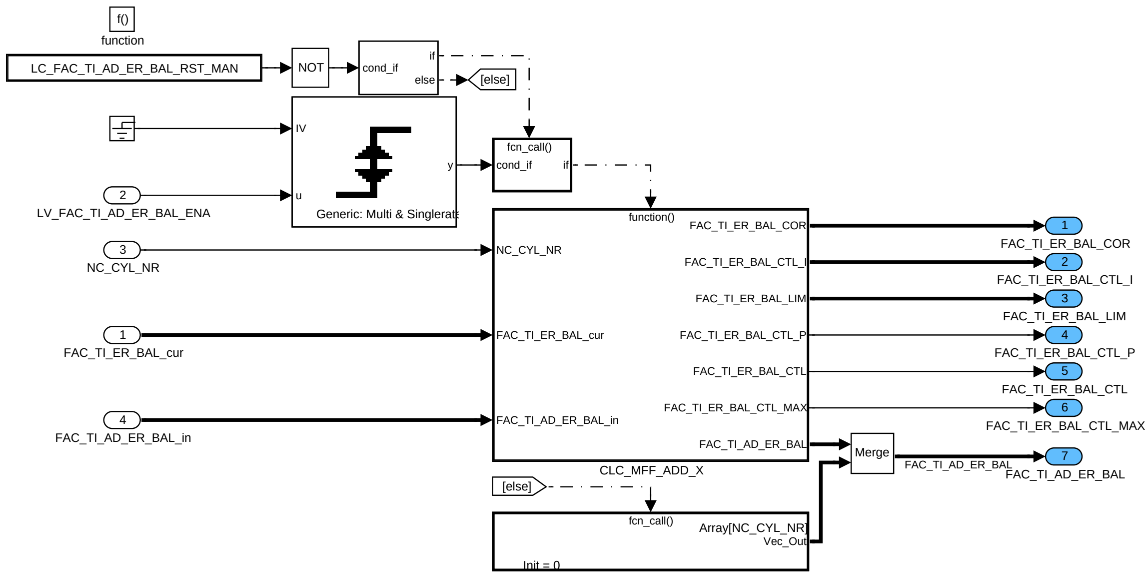

Figure 7.107.29:
CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/CLC_MPL_TI_VALUE/INI_MPL_TI

Initialization at Entry or Exit to multiple injection time adaptation - then - then branch

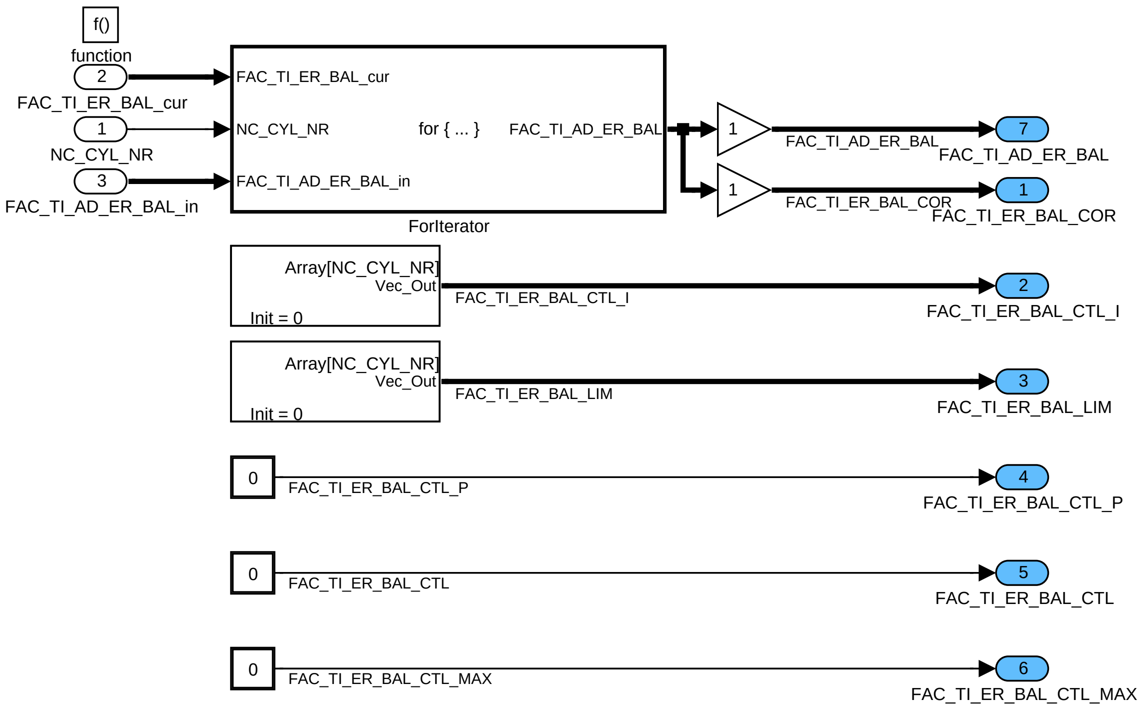

Figure 7.107.30: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_MPL_TI_VALUE/INI_MPL_TI/CLC_MFF_ADD_X

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Initialization at Entry or Exit to multiple injection time adaptation - then - then - for iterator branch

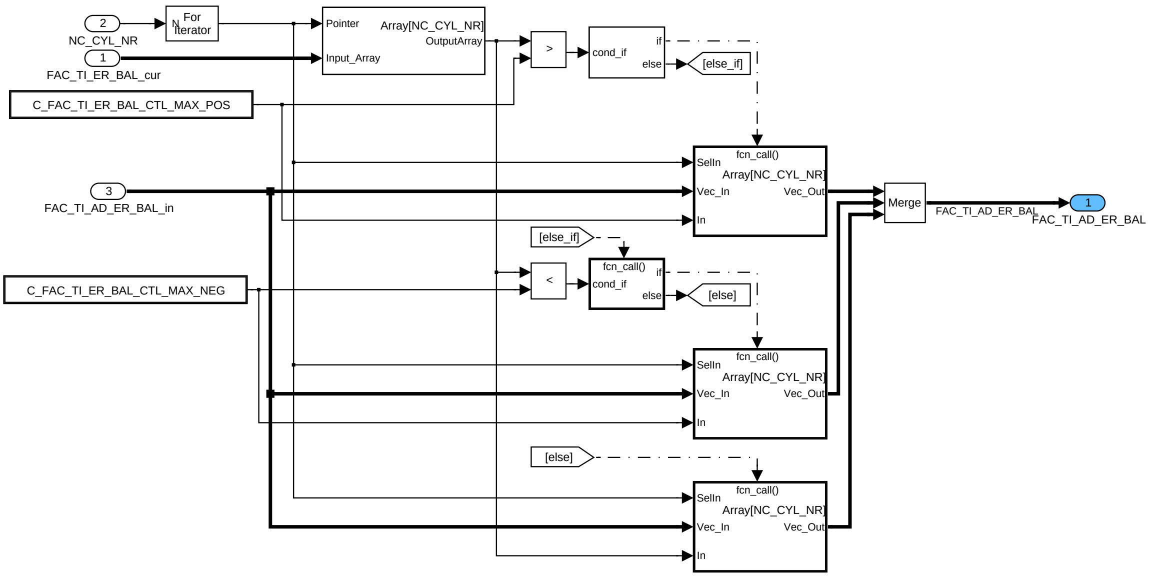

Figure 7.107.31: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/ CLC_MPL_TI_VALUE/INI_MPL_TI/CLC_MFF_ADD_X/ForIterator

Initialization at Exit from multiple injection time correction

As soon as the multiple injection time correction is disabled in combination with the manual switch to force the overall correction (LC_FAC_TI_ER_BAL_COR), the controller output values are set to zero. The initialization only takes place, if the logical constant for a manual reset of the multiple controller values is set to zero (LC_FAC_TI_ER_BAL_RST_MAN =0).

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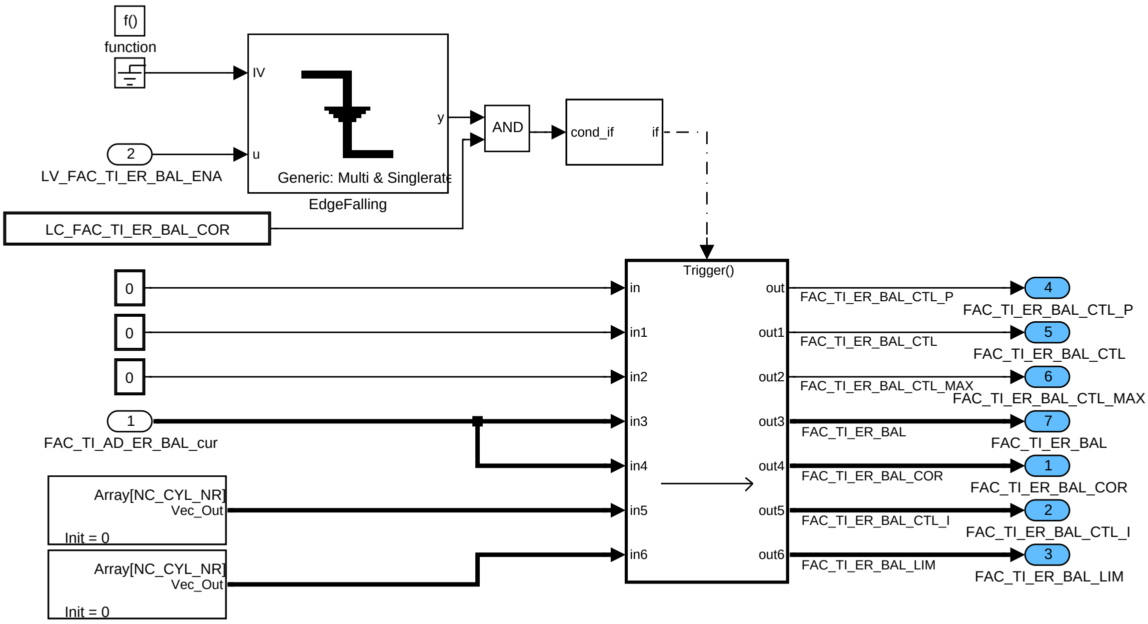

Figure 7.107.32: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/
CLC_MPL_TI_VALUE/INI_MPL_TI_COR

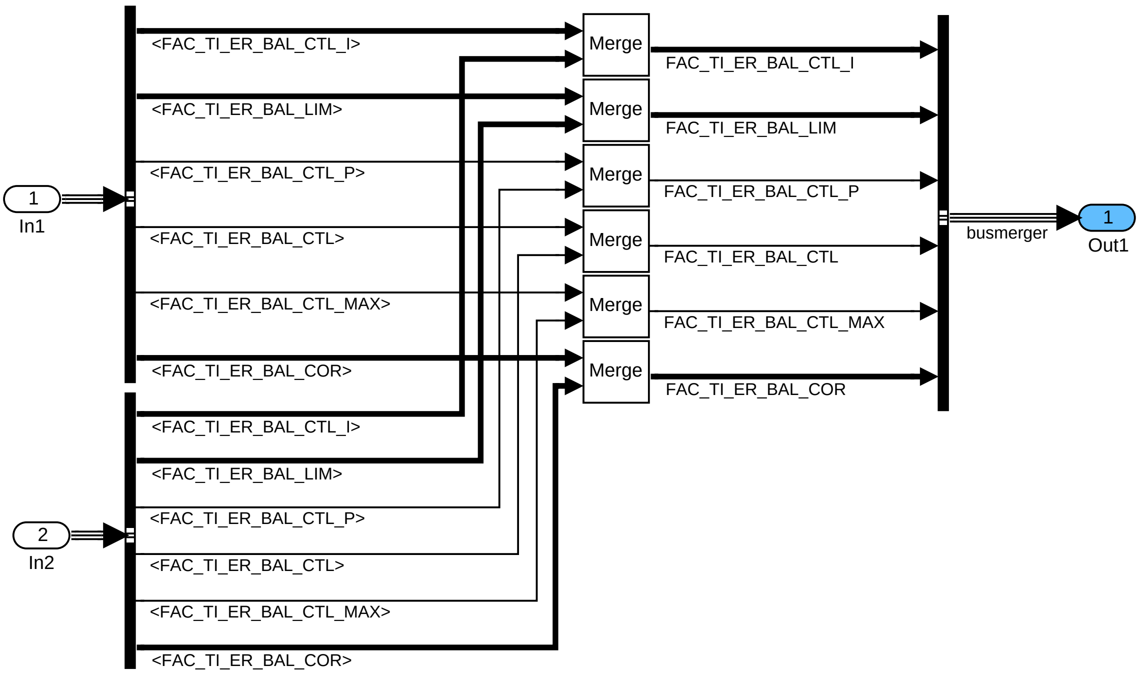

Figure 7.107.33:
CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/CLC_MPL_TI_VALUE/BusMerger

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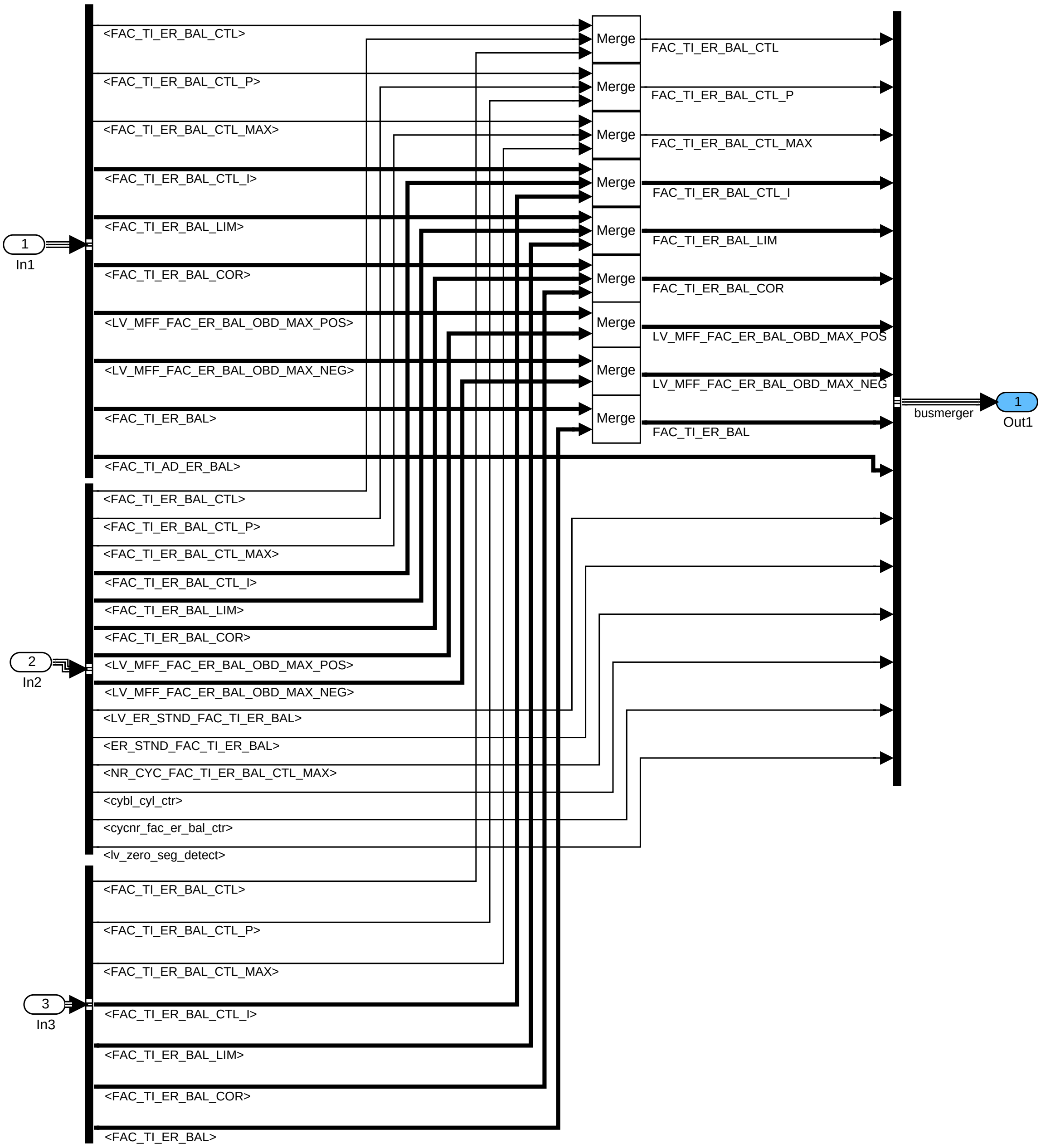

Figure 7.107.34: CYBL_M30707Q01/OPM/operate_SEG/CLC_OPERATE_SEG/BusMerger

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7.107.3 SUBFUNCTION: SIG_MNG

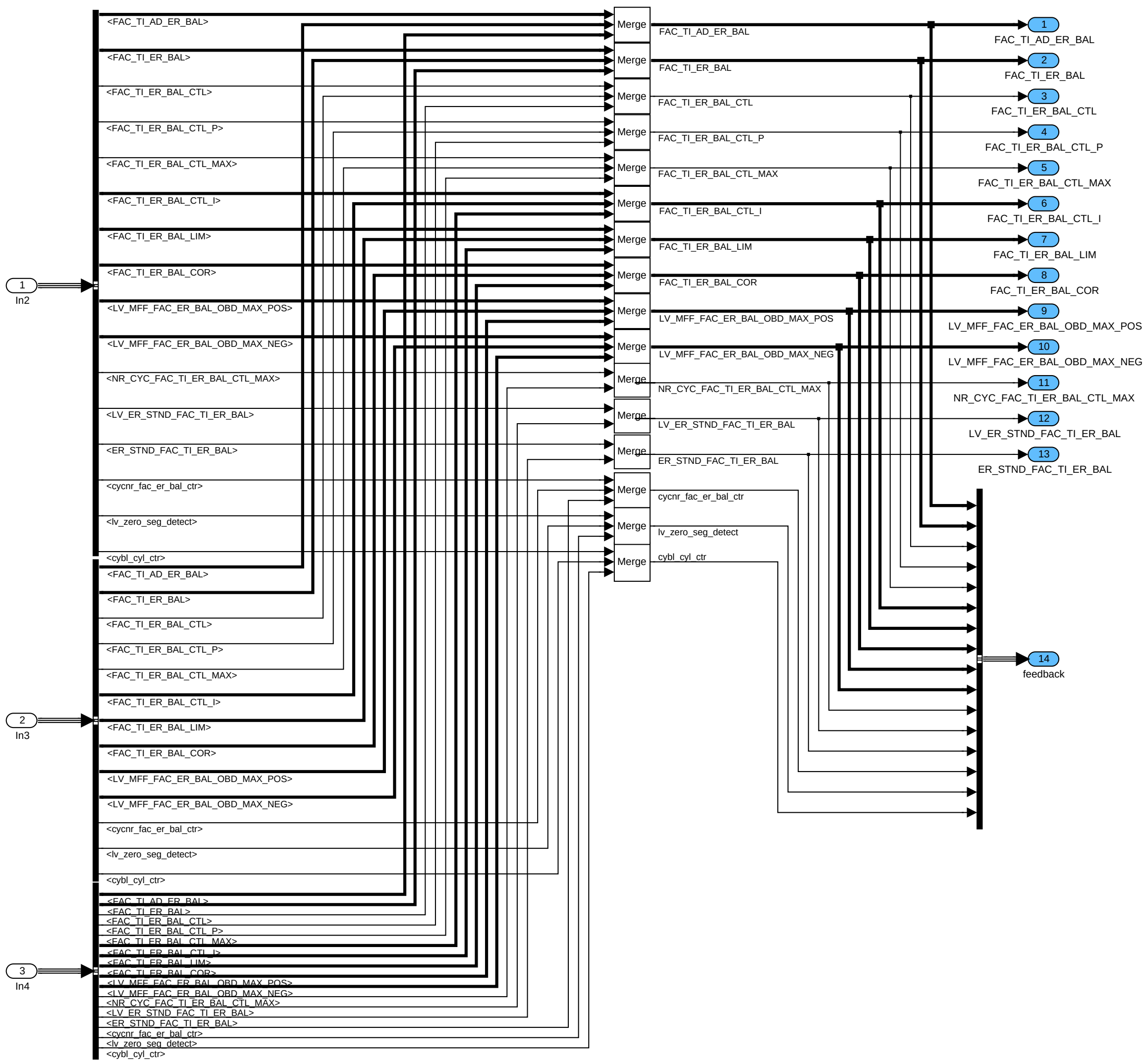

Figure 7.107.35: CYBL_M30707Q01/SIG_MNG

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7.108 Injection realization (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRK_PSN_STAT_IGN_UPD_END	O/V	0... 780H	0... 720	0.375	°CRK
End of static ignition update window for ignition/injeciton synchronization					
CRK_PSN_STAT_IGN_UPD_ST	O/V	0... 780H	0... 720	0.375	°CRK
Start of static ignition update window for ignition/injeciton synchronization					
CRK_PSN_STAT_WIN_END	O/V	0... 780H	0... 720	0.375	°CRK
End position of static injection update window					
CRK_PSN_STAT_WIN_ST	O/V	0... 780H	0... 720	0.375	°CRK
Start position of static injection update window					
CTR_CBK_EX_NR_ST_CLC_INJR	O	0... 1H	1 ...2	1	-
Start number of exhaust bank for calculations					
CTR_CBK_EX_NR_STOP_CLC_INJR	O	0... 1H	1 ...2	1	-
Stop number of exhaust bank for calculations					
CTR_CBK_IN_NR_ST_CLC_INJR	O	0... 1H	1 ...2	1	-
Start number of intake bank for calculations					
CTR_CBK_IN_NR_STOP_CLC_INJR	O	0... 1H	1 ...2	1	-
Stop number of intake bank for calculations					
CTR_CYL_NR_ST_CLC_INJR	O/V	0... 7H	0 ...7	1	-
Number of first cylinder in calculation order					
CTR_CYL_NR_STOP_CLC_INJR	V	0... 7H	0 ...7	1	-
Number of last cylinder in calculation order					
CTR_TEST_MOD_IV_EXT [NC_CYL_NR]	O	0... FFH	0... 255	1	-
Counter of number of injection valve actuator test cycles for external use, cylinder individual					
FAC_N	O/V	0... 1FE0H	0... 48.96	0.006	°CRK/ms
Engine speed factor					
FAC_TI_EXT_ADJ	O	0... FFH	0... 1.99218	0.0078125	-
external injection time adjustment factor					
FAC_TI_L_PRS	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Injection time correction factor in case of low pressure					
FUP_H_INJ [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure (high range) for calculation of injection parameters					
FUP_H_SP_S_INJ [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint for stratified mode (high range) for calculation of injection parameters					
IDX_PRS_COR_CYL_CLC_MPLH [NC_CBK_HPP_NR]	O/V	0... 7H	0 ...7	1	-
Index to assign the logical cylinder for calculation of pressure correction for homogeneous multiple mode					
IDX_PRS_COR_CYL_CLC_S [NC_CBK_HPP_NR]	O/V	0... 7H	0 ...7	1	-
Index to assign the logical cylinder for calculation of pressure correction for stratified mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INJ_MOD_GLOBAL	O/V	1H 2H 3H 4H 6H 7H 21H 22H 41H 42H 43H 62H 80H 81H 82H 83H	SNGS MPLS MPLS+PLS3 PRE_INJ CRASH TEST_PULSE SNGS+MPLP MPLS+MPLP HOMS-SNG HOMS HOMS+PLS3 HOMS+MPLP DISABLE SNGH MPLH MPLH+PLS3	-	-
Global injection mode for all cylinders					
INJ_MOD_SP [NC_CYL_NR]	O/V	1H 2H 3H 4H 6H 7H 21H 22H 41H 42H 43H 62H 80H 81H 82H 83H	SNGS MPLS MPLS+PLS3 PRE_INJ CRASH TEST_PULSE SNGS+MPLP MPLS+MPLP HOMS-SNG HOMS HOMS+PLS3 HOMS+MPLP DISABLE SNGH MPLH MPLH+PLS3	-	-
Injection mode set point, cylinder individual					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INJ_MOD_SP_HOM [NC_CYL_NR]	O/V	1H 2H 3H 4H 6H 7H 21H 22H 41H 42H 43H 62H 80H 81H 82H 83H	SNGS MPLS MPLS+PLS3 PRE_INJ CRASH TEST_PULSE SNGS+MPLP MPLS+MPLP HOMS-SNG HOMS HOMS+PLS3 HOMS+MPLP DISABLE SNGH MPLH MPLH+PLS3	-	-
Injection mode set point for homogeneous combustion mode, cylinder individual					
INJ_MOD_SP_HOMS [NC_CYL_NR]	O/V	1H 2H 3H 4H 6H 7H 21H 22H 41H 42H 43H 62H 80H 81H 82H 83H	SNGS MPLS MPLS+PLS3 PRE_INJ CRASH TEST_PULSE SNGS+MPLP MPLS+MPLP HOMS-SNG HOMS HOMS+PLS3 HOMS+MPLP DISABLE SNGH MPLH MPLH+PLS3	-	-
Injection mode set point for homogeneous-stratified combustion mode, cylinder individual					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INJ_MOD_SP_S [NC_CYL_NR]	O/V	1H 2H 3H 4H 6H 7H 21H 22H 41H 42H 43H 62H 80H 81H 82H 83H	SNGS MPLS MPLS+PLS3 PRE_INJ CRASH TEST_PULSE SNGS+MPLP MPLS+MPLP HOMS-SNG HOMS HOMS+PLS3 HOMS+MPLP DISABLE SNGH MPLH MPLH+PLS3	-	-
Injection mode set point for stratifed combustion mode, cylinder individual					
LF_EGY_RNG_HOM_EXT	O/V	0... FFH	0... 255	1	-
Bit coded external injector needle lift set point during HOM mode - 1: high lift; 0: low lift - each bit represents one injection pulse.					
LF_IV_INH_PUC_EXT	O/V	0... FFH	0... 255	1	-
External injection inhibit pattern, which can be applied during PUC-phases					
LF_PRS_COR_HPP_ENA	O/V	0... FFH	0... 255	1	-
Logical field to enable injection pressure correction for each fuel bank; bit coded					
LFT_L_IV_HOM_REQ	O/V	0... FFH	0... 255	1	-
Dynamic injector needle lift selection request for homogeneous combustion mode - bit coded; LSB represents pulse 1, etc.					
LFT_L_IV_HOMS_REQ	V	0... FFH	0... 255	1	-
Dynamic injector needle lift selection request for homs combustion mode - bit coded; LSB represents pulse 1, etc.					
LFT_L_IV_S_REQ	O/V	0... FFH	0... 255	1	-
Dynamic injector needle lift selection request for stratified combustion mode - bit coded; LSB represents pulse 1, etc.					
LV_EGY_RNG_HOM_EXT_ENA	O/V	0... 1H	0 ...1	1	-
Bit to enable external injector needle lift set point for homogeneous mode.					
LV_FAC_TI_EXT_ADJ	O	0... 1H	0 ...1	1	-
Flag for external injection time adjustment factor active					
LV_IDX_CYL_CLC_MPLH_VLD	-	0... 1H	0 ...1	1	-
Flag to indicate, that at least one calculated cylinder requests triple injection					
LV_INJ_CRASH_ACT	O	0... 1H	0 ...1	1	-
Flag to authorize the crash signal reaction of the injection driver					
LV_INJ_PUC_ENA	O/V	0... 1H	0 ...1	1	-
Flag to set inhibit pattern for PUC to external pattern in case of PUC-phases					
LV_IV_TEST_MOD_AUTH	O/V	0... 1H	0 ...1	1	-
Flag to authorize the injection valve actuator test					
LV_MFF_SP_HOM_VLD	V	0... 1H	0 ...1	1	-
Flag which indicates a valid fuel amount of at least one cylinder					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_N_TOOTH_END_ACT	O/V	0... 1H	0 ...1	1	-
Flag for indication that engine speed is over N_TOOTH_END					
LV_PRS_COR_MPLH_ENA	O/V	0... 1H	0 ...1	1	-
Switch to activate pressure pulsation correction for homogeneous multi injection mode					
LV_PRS_COR_SNGH_ENA	O/V	0... 1H	0 ...1	1	-
Switch to activate pressure pulsation correction for the first pulse homogeneous mode					
LV_ST_INJ_REQ	O/V	0... 1H	0 ...1	1	-
Start request flag for the injection driver					
LV_TI_EXT_ADJ [NC_CYL_NR]	O	0... 1H	0 ...1	1	-
Flag for external injection time adjustment					
MAP_INJ [NC_CBK_HPP_NR]	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Intake manifold pressure for calculation of injection parameters					
MFF_ADD_REAC [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Additive fuel amount at reactivation of fuel feed					
N_FAST_INJ	O	0... 1FE0H	0... 8160	1	rpm
Engine Speed- Resolution 1 rpm					
NR_CYL_CLC_RED_INJ	O/V	1... 8H	1 ...8	1	-
Number of calculated cylinders per segment in case of runtime reduction of the aggregate INJR					
NR_CYL_IV_TEST_MOD	O/V	0... 7H	0 ...7	1	-
Logical cylinder number of that cylinder for which the actuator test is in progress					
STATE_INJ_MOD_HOM_REQ	O/V	1H 2H 3H 41H 42H 43H 80H 81H 82H 83H	SNGS MPLS MPLS+PLS3 HOMS-SNG HOMS HOMS+PLS3 DISABLE SNGH MPLH MPLH+PLS3	-	-
Injection mode request for all cylinders for homogeneous combustion mode					
STATE_INJ_MOD_HOMS_REQ	O/V	1H 2H 3H 41H 42H 43H 80H 81H 82H 83H	SNGS MPLS MPLS+PLS3 HOMS-SNG HOMS HOMS+PLS3 DISABLE SNGH MPLH MPLH+PLS3	-	-
Injection mode request for all cylinders for homogeneous-stratified combustion mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_INJ_MOD_REQ	O/V	1H 2H 3H 41H 42H 43H 80H 81H 82H 83H	SNGS MPLS MPLS+PLS3 HOMS-SNG HOMS HOMS+PLS3 DISABLE SNGH MPLH MPLH+PLS3	-	-
Injection mode request for all cylinders for requested combustion mode					
STATE_INJ_MOD_S_REQ	O/V	1H 2H 3H 41H 42H 43H 80H 81H 82H 83H	SNGS MPLS MPLS+PLS3 HOMS-SNG HOMS HOMS+PLS3 DISABLE SNGH MPLH MPLH+PLS3	-	-
Injection mode request for all cylinders for stratified combustion mode					
STATE_INJ_MOD_SWI_ACT	O/V	0... FFH	0... 255	1	-
State indicates a currently ongoing injection mode change, if not equal to zero					
STATE_INJ_UPD_ENA	O/V	0... FFH	0... 255	1	-
Bitmask to enable/disable injection update calculations					
TFU_INJ	O/V	0... FEH	-48... 142.5	0.75	°C
Fuel temperature for injection system					
TI_EXT_ADJ [NC_CYL_NR]	O	0... FFFFH	0... 65.535	0.001	ms
External injection time adjustment					

Input data:

C_N_TOOTH_END {p. 1526}	CTR_CBK_EX_NR_ST_CLC {p. 1754}	CTR_CBK_EX_NR_STOP_CLC {p. 1754}	CTR_CBK_IN_NR_ST_CLC {p. 1754}
CTR_CBK_IN_NR_STOP_CLC {p. 1754}	CTR_CYL_NR_ST_CLC {p. 1754}	CTR_CYL_NR_STOP_CLC {p. 1754}	FUP_H {p. 1283}
INJ_MOD [NC_CYL_NR] {p. 2037}	INJ_MOD_HOM_REQ {p. 8241}	INJ_MOD_S_REQ {p. 8242}	LFT_L_IV_REQ_HOM_CUS {p. 8269}
LFT_L_IV_REQ_HOMS_CUS {p. 8269}	LFT_L_IV_REQ_S_CUS {p. 8269}	LV_ERR_FTL_MIN {p. 4762}	LV_FUP_LIH_L_PRS_CTL_REQ {p. 4001}
LV_IGA_AND_INJ_SWI {p. 8136}	LV_IGA_AND_INJ_SWI_HOMS {p. 8136}	LV_LAM_AD_INJ_CUS_ACK [NC_CBK_EX_NR] {p. 8269}	LV_PRS_COR_MPLH_ENA_CUS {p. 8270}

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LV_PRS_COR_SNGH_ENA_CUS {p. 8270}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}	LV_ST_INJ {p. 2038}
LV_ST_INJ_AUTH {p. 8242}	MAF_CYL {p. 8277}	MAP {p. 8278}	MFF_SP_1_HOM [NC_CYL_NR] {p. 8242}
N {p. 1525}	N_TOOTH_CUS {p. 1042}	NC_CBK_EX_NR {p. 1829}	NC_CBK_IN_NR {p. 604}
NC_CYL_NR {p. 1526}	NC_INJ_MOD_SINGLE {p. 2045}	NC_NR_IV_PLS {p. 627}	NR_INJ_PLS_HOM_REQ {p. 8243}
NR_INJ_PLS_S_REQ {p. 8243}	PREV_STATE_IV {p. 2039}	SEG_NR {p. 1525}	STATE_EFP_CRASH_CAN {p. 1573}
TAM {p. 1579}	TCYL_MDL_CUS {p. 8270}	TFU_IV {p. 1232}	

Calibration data:

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRK_PSN_STAT_IGN_UPD_END	-	0... 780H	0... 720	0.375	°CRK
End of static ignition update window for ignition/injeciton synchronization					
C_CRK_PSN_STAT_IGN_UPD_ST	-	0... 780H	0... 720	0.375	°CRK
Start of static ignition update window for ignition/injeciton synchronization					
C_CRK_PSN_STAT_WIN_ST	-	0... 780H	0... 720	0.375	°CRK
Start position of static injection update window					
C_FAC_MAP_TCYL_MDL	-	0... FFFFH	0... 6553.5	0.1	N/ (kg*K*m**2)
Constant term of ideal gas law to calculate physical model of cylinder pressure.					
C_INJ_MOD_SP_MAN	-	1H 2H 3H 41H 42H 43H 80H 81H 82H 83H	SNGS MPLS MPLS+PLS3 HOMS-SNG HOMS HOMS+PLS3 DISABLE SNGH MPLH MPLH+PLS3	-	-
Injection mode set-point for manual selection					
C_NR_CYL_OFS_CLC_RED_INJ	-	0... 7H	0 ...7	1	-
Segment offset to calculated cylinders for INJR runtime optimization strategy					
CLF_EGY_RNG_LAM_AD_INJ	-	0... FFH	0... 255	1	-
Bit coded injector needle lift set point during active MFMA - 1: high lift; 0: low lift - each bit represents one injection pulse.					
ID_NR_CYL_CLC_RED_INJ	-	1... 8H	1 ...8	1	-
LDP_N_ID_NR_CYL_CLC_RED_INJ	4	0... 1FE0H	0... 8160	1	rpm
Number of calculated cylinders per segment in case of INJR runtime optimization					
IP_FAC_TI_FUP_L_PRS	-	0... FFFFH	0... 15.99975	244.1e-6	-
LDP_FUP_H_INJ_IP_FAC_TI_FUP	4	0... FFFFH	0... 347776	5.3067216	hPa
Injection time correction factor depending on low pressure limp home or minimum fuel tank level error					
IP_FAC_TI_TEMP_L_PRS	V	0... FFFFH	0... 15.99975	244.1e-6	-
LDP_TFU_INJ_IP_FAC_TI_TEMP	6	0... FEH	-48... 142.5	0.75	°C
LDP_TAM_IP_FAC_TI_TEMP	6	0... FEH	-48... 142.5	0.75	°C
Weighted TI correction depending on fuel temperature for injection system and ambient temperature during low pressure limp home or minimum fuel tank level error					
IP_MFF_ADD_REAC	V	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_MFF_SP_HOM_IP_MFF_ADD_REAC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_IP_MFF_ADD_REAC	8	0... 1FE0H	0... 8160	1	rpm
Additive fuel amount at reactivation of fuel feed					
LC_EGY_RNG_LAM_AD_INJ_ENA	-	0... 1H	0 ...1	1	-
Switch to enable manual injector needle lift selection during active MFMA.					
LC_FAC_TI_ENA_FTL_MIN	-	0... 1H	0 ...1	1	-
Switch to enable activation of TI correction in case of low pressure also in case of minimum fuel tank level error					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_INJ_MOD_SP_MAN_ENA	-	0... 1H	0 ...1	1	-
Logical constant to enable manual injection mode selection					
LC_LOAD_CPU_RED_INJ	-	0... 1H	0 ...1	1	-
Switch to enable INJR runtime optimization strategy					
LC_MAP_PHY_CLC_ENA	-	0... 1H	0 ...1	1	-
Switch to enable physical model for cylinder pressure calculation.					
LC_MFF_ADD_REAC_ENA	-	0... 1H	0 ...1	1	-
Switch to enable wallfilm correction on fuel mass					

Exported actions:

ACTION_INJR_SetStateInjUpdEna(IN <Cyl>, IN <State_Inj_Upd_Ena>)
This action sets the cylinder individual bit <Cyl> of STATE_INJ_UPD_ENA to <State_Inj_Upd_Ena>.

FUNCTION DESCRIPTION:

General information:

This specification is for project specific adaptations.

7.108.1 Runtime reduction

Description:

This chapter describes runtime reduction steps. First step is to reduce cylinder dependent calculations from all cylinders to one cylinder, dependent on the engine speed. An additional step is to reduce bank dependent calculations to that intake or exhaust bank, which is allocated to the related cylinder by NC_ IN_REF and NC_LAMB_REF. The control variables for cylinder and bank dependent calculations will be imported via CTR_CYL_NR_xxx and CTR_CBK_xxx data.

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Application conditions

Activation : `every engine state`

Deactivation : –

Initialization: –

Recurrence :
```
LV_ST_END = 0:  10 ms
LV_ST_END = 1:  segment sychronous
```

Formula Section :

For loop for runtime optimization:
In this specification the for loop
FOR i = 0, i < NR_CYL_CLC_RED_INJ **DO**
x = CTR_CYL_NR_ST_CLC_INJR + i
(1a)**IF** x >= NC_CYL_NR
(1a)**THEN**

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x = x - NC_CYL_NR
(1a)**ENDIF**
<**loop content**>
ENDFOR
is substituted by
FOR cylinder_start to cylinder_stop **DO**
<**loop content**>
ENDFOR
Note: In the for loops, x will be used as loop variable to indicate the cylinder x!

Determine cylinder and bank numbers for follow up calculations

CTR_CYL_NR_ST_CLC_INJR = CTR_CYL_NR_ST_CLC
CTR_CYL_NR_STOP_CLC_INJR = CTR_CYL_NR_STOP_CLC
CTR_CBK_IN_NR_ST_CLC_INJR = CTR_CBK_IN_NR_ST_CLC
CTR_CBK_IN_NR_STOP_CLC_INJR = CTR_CBK_IN_NR_STOP_CLC
CTR_CBK_EX_NR_ST_CLC_INJR = CTR_CBK_EX_NR_ST_CLC
CTR_CBK_EX_NR_STOP_CLC_INJR = CTR_CBK_EX_NR_STOP_CLC

Note: NR_CYL_CLC_RED_INJ has to be greater than zero and less or equal than NC_CYL_NR;

(1)IF LC_LOAD_CPU_RED_INJ = 0
OR CTR_CYL_NR_ST_CLC_INJR $\neq$ 0
OR CTR_CYL_NR_STOP_CLC_INJR $\neq$ (NC_CYL_NR - 1)
OR LV_ST_END = 0
OR SUM(LV_LAM_AD_INJ_CUS_ACK[ ]) $\neq$ 0 // sum over all elements; at least one exhaust-bank requests MFMA
(1)THEN
NR_CYL_CLC_RED_INJ = CTR_CYL_NR_STOP_CLC_INJR - CTR_CYL_NR_ST_CLC_INJR + 1

7.108.2 (1)ELSE

7.108.3 (2)IF SEG_NR < C_NR_CYL_OFS_CLC_RED_INJ

7.108.4 (2)THEN

7.108.5 CTR_CYL_NR_STOP_CLC_INJR = NC_CYL_NR + SEG_NR

7.108.6 - C_NR_CYL_OFS_CLC_RED_INJ

7.108.7 (2)ELSE

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7.108.8 CTR_CYL_NR_STOP_CLC_INJR = SEG_NR - C_NR_CYL_OFS_CLC_RED_INJ

7.108.9 (2)ENDIF

7.108.10 NR_CYL_CLC_RED_INJ = ID_NR_CYL_CLC_RED_INJ(Input: N)

7.108.11 (3)IF CTR_CYL_NR_STOP_CLC_INJR < (NR_CYL_CLC_RED_INJ - 1)

7.108.12 (3)THEN

CTR_CYL_NR_ST_CLC_INJR = NC_CYL_NR
+ CTR_CYL_NR_STOP_CLC_INJR - NR_CYL_CLC_RED_INJ + 1

(3)ELSE

7.108.13 CTR_CYL_NR_ST_CLC_INJR = CTR_CYL_NR_STOP_CLC_INJR

7.108.14 - NR_CYL_CLC_RED_INJ + 1

7.108.15 (3)ENDIF

7.108.16 (1)ENDIF

7.108.17 General tasks

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Application conditions

Activation : every engine state

Deactivation : -

Initialization: at reset : FAC_TI_EXT_ADJ = 1
LV_TI_EXT_ADJ[NC_CYL_NR] = 0
TI_EXT_ADJ[NC_CYL_NR] = 0

Recurrence : LV_ST_END = 0: 10 ms
LV_ST_END = 1: segment synchronous

Formula Section :

To prevent N_FAST_INJ from signal jittering a hysteresis for the calculation is introduced:
(1) IF (N > = C_N_TOOTH_END)
(1) THEN
LV_N_TOOTH_END_ACT = 1

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```
(1) ELSE
  (2) IF (N < C_N_TOOTH_END - 100)
  (2) THEN
            LV_N_TOOTH_END_ACT = 0
  (2) ENDIF
(1) ENDIF
(3) IF (LV_N_TOOTH_END_ACT = 1)
(3) THEN
   N_FAST_INJ = N
(3) ELSE
   N_FAST_INJ = N_TOOTH_CUS
(3) ENDIF

(4) IF (LV_ST_INJ = 0)
(4) THEN
LV_MFF_SP_HOM_VLD = 0
(1) FOR x = 0 TO (NC_CYL_NR -1)
         (2) IF ((Mk_soll_h[x][0] > 0) OR (Mk_soll_h[x][1] > 0) OR (Mk_soll_h[x][2] > 0))
         (2) THEN
                  LV_MFF_SP_HOM_VLD = 1
         (2) ENDIF
(1) END FOR
(5) IF (LV_MFF_SP_HOM_VLD = 1) AND (LV_ST_INJ_AUTH = 1)
(5) THEN
            LV_ST_INJ_REQ = 1
(5) ELSE
            LV_ST_INJ_REQ = 0
(5) ENDIF
(4) ELSE
            LV_ST_INJ_REQ = 0
(4) ENDIF

TFU_INJ = TFU_IV
FAC_N = N_FAST_INJ  * 360 /(1000 * 60)
LV_FAC_TI_EXT_ADJ = 0
FAC_TI_EXT_ADJ = 1
LV_PRS_COR_SNGH_ENA = LV_PRS_COR_SNGH_ENA_CUS
LV_PRS_COR_MPLH_ENA = LV_PRS_COR_MPLH_ENA_CUS
(2)FOR cylinder_start to cylinder_stop DO
   LV_TI_EXT_ADJ[x] = 0
   TI_EXT_ADJ[x]= 0
(2) END FOR

FUP_H_INJ[0] = FUP_H
FUP_H_SP_S_INJ[0] = FUP_H
LV_INJ_PUC_ENA = 0
LF_IV_INH_PUC_EXT = 255 // all bits must be set to 1

(6)IF LC_MAP_PHY_CLC_ENA = 1
(6)THEN - physical calculation of cylinder pressure at inlet closing
      The cylinder pressure is calculated by use of the ideal gas law:
```

$$p = m * T * R_S/V$$

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R_S/V as well as the unit conversions (1hPa = 100N/m^2 and 1rpm = 30stk/h) is included in C_FAC_MAP_TCYL_MDL (C_FAC_MAP_TCYL_MDL = R_S/(V*3000)).

MAP_INJ[0] = MAF_CYL * TCYL_MDL_CUS * C_FAC_MAP_TCYL_MDL /N

(6)ELSE

MAP_INJ[0] = MAP

(6)ENDIF

7.108.18 Compensation of missing residual-gas amount after PUC

Description:

This chapter describes the compensation of missing residual-gas amount at restart of fuel feed. This is caused by a inhibit of injection in the past. At restart of fuel feed for the first combustion residual-gas amount is missing. Therfore the calculated fuel amount is wrong. This functionality should compensate this effect.

Application conditions

Activation : *LV_ST_END = 0*
Deactivation : –
Initialization: –
Recurrence : *10 ms*

Formula Section :

FOR x = 0 **TO** NC_CYL_NR-1
MFF_ADD_REAC[x] = 0
END FOR

Application conditions

Activation : *LV_ST_END = 1*
Deactivation : –
Initialization: –
Recurrence : *segment sychronous*

Formula Section :

(1)IF LC_MFF_ADD_REAC_ENA = 1
(1)THEN
FOR cylinder_start to cylinder_stop **DO**
IF (Bit-Nr x of PREV_STATE_IV = 0)
THEN
MFF_ADD_REAC[x] = IP_MFF_ADD_REAC
Input for IP_MFF_ADD_REAC is (MFF_SP_1_HOM[x], N)
ELSE
MFF_ADD_REAC[x] = 0
ENDIF
END FOR
(1)ENDIF

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7.108.19 Injector test mode

Application conditions

Activation: *LV_ES = 1*

Deactivation: –

Initialization: –

Recurrence: 1 s

This chapter describes the necessary interfaces to the procedure for actuator tests by diagnostic tester.

7.108.19.1 Formula Section:

LV_IV_TEST_MOD_AUTH = 0
NR_CYL_IV_TEST_MOD = 0
(1) FOR x = 0 **TO** (NC_CYL_NR -1)
CTR_TEST_MOD_IV_EXT[x] = CTR_TEST_MOD_IV[x]
(1) END FOR
Please note! This for-loop should be realized in SW with a #define. CTR_TEST_MOD_IV_EXT[NC_CYL_NR] has to be realized also as a #define for CTR_TEST_MOD_IV to preserve resources.

7.108.20 Crash signal reaction of injection driver

Application conditions

Activation: *every engine state*

Deactivation: –

Initialization: –

Recurrence: 10 ms

This chapter describes the necessary interfaces to customer signals to react on a vehicle crash.

7.108.20.1 Formula Section:

(1) IF STATE_EFP_CRASH_CAN = 2H
(1) THEN
LV_INJ_CRASH_ACT = 1
(1) ELSE
LV_INJ_CRASH_ACT = 0
(1) ENDIF

7.108.21 Select injection mode STATE_INJ_MOD_REQ and copy information of dynamic needle lift selection from customer nomenclature to supplier nomenclature

Application conditions

Activation : every engine state

Deactivation : –

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Initialization:

```
at reset :  STATE_INJ_MOD_REQ = 'DISABLE'
            STATE_INJ_MOD_HOM_REQ = 'SNGH'
            STATE_INJ_MOD_S_REQ = 'SNGS'
            STATE_INJ_MOD_HOMS_REQ = 'HOMS-SNG'
            LFT_L_IV_HOM_REQ = 0
            LFT_L_IV_S_REQ = 0
            INJ_MOD_GLOBAL = "DISABLE"
            STATE_INJ_MOD_SWI_ACT = 0
at engine run to engine stop event:   INJ_MOD_GLOBAL = "DISABLE"
                                      STATE_INJ_MOD_SWI_ACT = 0
```

Recurrence :

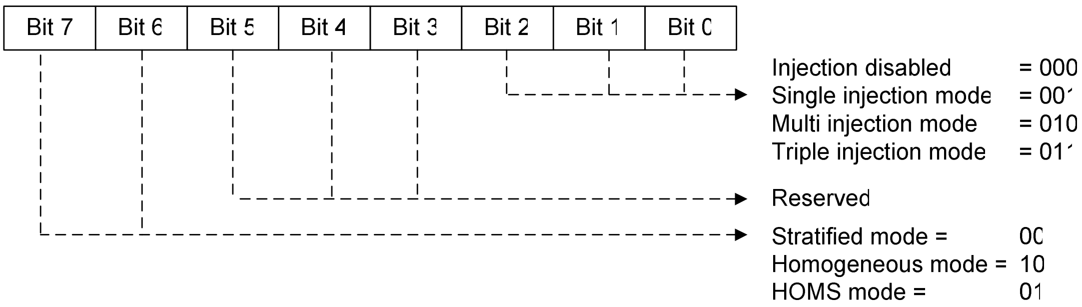
```
LV_ST_END = 0:  10 ms
LV_ST_END = 1:  segment synchronous
```

Description:

This section determines the actual set injection mode request.

Byte definition

Definitions bit masks for injection modes: STATE_INJ_MOD_REQ, STATE_INJ_MOD_HOM_REQ, STATE_INJ_MOD_S_REQ and STATE_INJ_MOD_HOMS_REQ



Example: homogenous multi injection mode (MPLH)

1	0	0	0	0	0	1	0

The mapping of the information about injector needle lift selection is done from a bit field as input to bit field as output. Here, the conversion from customer pulse numeration to supplier numeration is done.
Important note: For better readability of the specification, the LSB of each bit field, which corresponds to the physically first injection pulse, is referred to as bit 1 (**not** bit 0 as it would be in SW). The next bit would be bit 2 etc.

Definition of NC constants

NC_INJ_MOD_SINGLE = 0x01H

Formula Section :

(1) IF (LC_INJ_MOD_SP_MAN_ENA = 1)
THEN
    (2) IF (C_INJ_MOD_SP_MAN = 'SNGH') OR (C_INJ_MOD_SP_MAN = 'DISABLE')
    (2) THEN
        STATE_INJ_MOD_REQ = 'SNGH'
        STATE_INJ_MOD_HOM_REQ = 'SNGH'
        STATE_INJ_MOD_S_REQ = 'SNGS'
        STATE_INJ_MOD_HOMS_REQ = 'HOMS-SNG'

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(2) ENDIF
(3) IF (C_INJ_MOD_SP_MAN = 'MPLH')
(3) THEN
STATE_INJ_MOD_REQ = 'MPLH'
STATE_INJ_MOD_HOM_REQ = 'MPLH'
STATE_INJ_MOD_S_REQ = 'SNGS'
STATE_INJ_MOD_HOMS_REQ = 'HOMS-SNG'
(3) ENDIF

(4) IF (C_INJ_MOD_SP_MAN = 'MPLH+PLS3')
(4) THEN
STATE_INJ_MOD_REQ = 'MPLH+PLS3'
STATE_INJ_MOD_HOM_REQ = 'MPLH+PLS3'
STATE_INJ_MOD_S_REQ = 'SNGS'
STATE_INJ_MOD_HOMS_REQ = 'HOMS-SNG'
(4) ENDIF

(5) IF (C_INJ_MOD_SP_MAN = 'SNGS')
(5) THEN
STATE_INJ_MOD_REQ = 'SNGS'
STATE_INJ_MOD_HOM_REQ = 'SNGH'
STATE_INJ_MOD_S_REQ = 'SNGS'
STATE_INJ_MOD_HOMS_REQ = 'HOMS-SNG'
(5) ENDIF

(6) IF (C_INJ_MOD_SP_MAN = 'MPLS')
(6) THEN
STATE_INJ_MOD_REQ = 'MPLS'
STATE_INJ_MOD_HOM_REQ = 'SNGH'
STATE_INJ_MOD_S_REQ = 'MPLS'
STATE_INJ_MOD_HOMS_REQ = 'HOMS'
(6) ENDIF

(6a) IF (C_INJ_MOD_SP_MAN = 'MPLS+PLS3')
(6a) THEN
STATE_INJ_MOD_REQ = 'MPLS+PLS3'
STATE_INJ_MOD_HOM_REQ = 'SNGH'
STATE_INJ_MOD_S_REQ = 'MPLS+PLS3'
STATE_INJ_MOD_HOMS_REQ = 'HOMS+PLS3'
(6a) ENDIF

(6b) IF (C_INJ_MOD_SP_MAN = 'HOMS-SNG')
(6b) THEN
STATE_INJ_MOD_REQ = 'HOMS-SNG'
STATE_INJ_MOD_HOM_REQ = 'SNGH'
STATE_INJ_MOD_S_REQ = 'SNGS'
STATE_INJ_MOD_HOMS_REQ = 'HOMS-SNG'
(6b) ENDIF

(7) IF (C_INJ_MOD_SP_MAN = 'HOMS')
(7) THEN

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STATE_INJ_MOD_REQ = 'HOMS'
STATE_INJ_MOD_HOM_REQ = 'SNGH'
STATE_INJ_MOD_S_REQ = 'MPLS'
STATE_INJ_MOD_HOMS_REQ = 'HOMS'
(7) ENDIF

(7a) IF (C_INJ_MOD_SP_MAN = 'HOMS+PLS3')
(7a) THEN
STATE_INJ_MOD_REQ = 'HOMS+PLS3'
STATE_INJ_MOD_HOM_REQ = 'SNGH'
STATE_INJ_MOD_S_REQ = 'MPLS+PLS3'
STATE_INJ_MOD_HOMS_REQ = 'HOMS+PLS3'
(7a) ENDIF

LFT_L_IV_HOM_REQ = 0
LFT_L_IV_S_REQ = 0

(1) ELSE

(8) IF (INJ_MOD_HOM_REQ = NC_INJ_MOD_SINGLE)
(8) THEN
STATE_INJ_MOD_HOM_REQ = 'SNGH'
Bit 1 of LFT_L_IV_HOM_REQ = Bit 1 of LFT_L_IV_REQ_HOM_CUS
Bit 2 of LFT_L_IV_HOM_REQ = Bit 3 of LFT_L_IV_HOM_REQ = 0
(8) ELSE
(9) IF (NR_INJ_PLS_HOM_REQ = 3)
(9) THEN
STATE_INJ_MOD_HOM_REQ = 'MPLH+PLS3'
Bit 1 of LFT_L_IV_HOM_REQ = Bit 1 of LFT_L_IV_REQ_HOM_CUS
Bit 2 of LFT_L_IV_HOM_REQ = Bit 2 of LFT_L_IV_REQ_HOM_CUS
Bit 3 of LFT_L_IV_HOM_REQ = Bit 3 of LFT_L_IV_REQ_HOM_CUS
(9) ELSE
STATE_INJ_MOD_HOM_REQ = 'MPLH'
Bit 1 of LFT_L_IV_HOM_REQ = Bit 1 of LFT_L_IV_REQ_HOM_CUS
Bit 2 of LFT_L_IV_HOM_REQ = Bit 2 of LFT_L_IV_REQ_HOM_CUS
Bit 3 of LFT_L_IV_HOM_REQ = 0
(9) ENDIF
(8) ENDIF

(10) IF (INJ_MOD_S_REQ = NC_INJ_MOD_SINGLE)
(10) THEN
STATE_INJ_MOD_S_REQ = 'SNGS'
STATE_INJ_MOD_HOMS_REQ = 'HOMS-SNG'
Bit 1 of LFT_L_IV_S_REQ = Bit 3 of LFT_L_IV_REQ_S_CUS
Bit 2 of LFT_L_IV_S_REQ = Bit 3 of LFT_L_IV_S_REQ = 0
Bit 1 of LFT_L_IV_HOMS_REQ = Bit 3 of LFT_L_IV_REQ_HOMS_CUS
Bit 2 of LFT_L_IV_HOMS_REQ = Bit 3 of LFT_L_IV_HOMS_REQ = 0

(10) ELSE
(10a) IF (NR_INJ_PLS_S_REQ = 3)
(10a) THEN
STATE_INJ_MOD_S_REQ = 'MPLS+PLS3'

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```
                STATE_INJ_MOD_HOMS_REQ = 'HOMS+PLS3'
                Bit 1 of LFT_L_IV_S_REQ = Bit 1 of LFT_L_IV_REQ_S_CUS
                Bit 2 of LFT_L_IV_S_REQ = Bit 2 of LFT_L_IV_REQ_S_CUS
                Bit 3 of LFT_L_IV_S_REQ = Bit 3 of LFT_L_IV_REQ_S_CUS
                Bit 1 of LFT_L_IV_HOMS_REQ = Bit 1 of LFT_L_IV_REQ_HOMS_CUS
                Bit 2 of LFT_L_IV_HOMS_REQ = Bit 2 of LFT_L_IV_REQ_HOMS_CUS
                Bit 3 of LFT_L_IV_HOMS_REQ = Bit 3 of LFT_L_IV_REQ_HOMS_CUS
        (10a) ELSE
                STATE_INJ_MOD_S_REQ = 'MPLS'
                STATE_INJ_MOD_HOMS_REQ = 'HOMS'
                Bit 1 of LFT_L_IV_S_REQ = Bit 2of LFT_L_IV_REQ_S_CUS
                Bit 2 of LFT_L_IV_S_REQ = Bit 3 of LFT_L_IV_REQ_S_CUS
                Bit 3 of LFT_L_IV_S_REQ = 0
                Bit 1 of LFT_L_IV_HOMS_REQ = Bit 1 of LFT_L_IV_REQ_HOMS_CUS
                Bit 2 of LFT_L_IV_HOMS_REQ = Bit 3 of LFT_L_IV_REQ_HOMS_CUS
                Bit 3 of LFT_L_IV_HOMS_REQ = 0
            (10a) ENDIF
    (10) ENDIF

    (11) IF (LV_IGA_AND_INJ_SWI = 1)
    (11) THEN (HOM)
        STATE_INJ_MOD_REQ = STATE_INJ_MOD_HOM_REQ
    (11) ELSE (S or HOMS)

        (12) IF (LV_IGA_AND_INJ_SWI_HOMS = 1)
        (12) THEN
                STATE_INJ_MOD_REQ = STATE_INJ_MOD_HOMS_REQ
        (12) ELSE
            STATE_INJ_MOD_REQ = STATE_INJ_MOD_S_REQ
        (12) ENDIF

    (11) ENDIF

  (13) IF (LV_IGA_AND_INJ_SWI_HOMS = 1)
    (13) THEN
            LFT_L_IV_S_REQ = LFT_L_IV_HOMS_REQ
    (13) ENDIF

 (1) ENDIF
```

Calculation of injection mode setpoints:

```
(1)FOR cylinder_start to cylinder_stop DO
      Bit x of STATE_INJ_UPD_ENA = 1
      (1)IF LV_S_CLC = 1
      (1)THEN
            INJ_MOD_SP_S[x] = STATE_INJ_MOD_S_REQ
            INJ_MOD_SP_HOMS[x] = STATE_INJ_MOD_HOMS_REQ
      (1)ELSE
            INJ_MOD_SP_S[x] = "DISABLE"
            INJ_MOD_SP_HOMS[x] = "DISABLE"
```

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```
        (1)ENDIF
(1)ENDFOR
```

Calculate indices for pressure correction:
IDX_PRS_COR_CYL_CLC_S[0] = CTR_CYL_NR_ST_CLC_INJR
LF_PRS_COR_HPP_ENA = 1 // set bit 0 to 1 to indicate that fuel bank 1 has to be calculated

```
(1)IF SUM(LV_LAM_AD_INJ_CUS_ACK[ ]) ≠ 0     // sum over all elements; at least one
                                                  exhaust-bank requests MFMA
    AND STATE_INJ_MOD_REQ = "MPLH+PLS3"
(1)THEN - Minimum fuel mass adaptation is requested and at least 1 cylinder requests triple
          injection
        LV_IDX_CYL_CLC_MPLH_VLD = 0   // this local flag indicates, that at least one cylinder
                                         within the for-loop requests triple injection
    (2)FOR cylinder_start to cylinder_stop DO
            (2)IF MFF_SP_3_HOM[x] > 0
            (2)THEN - cylinder x requests triple injection
                    INJ_MOD_SP_HOM[x] = "MPLH+PLS3"
                    INJ_MOD_SP[x] = "MPLH+PLS3"
                    IDX_PRS_COR_CYL_CLC_MPLH[0] = x
                    LV_IDX_CYL_CLC_MPLH_VLD = 1
            (2)ELSE
                    (3)IF MFF_SP_2_HOM[x] = 0
                    (3)THEN - cylinder x requests single injection
                          INJ_MOD_SP_HOM[x] = "SNGH"
                          INJ_MOD_SP[x] = "SNGH"
                    (3)ELSE - cylinder x requests double injection (invalid for MFMA)
                          INJ_MOD_SP_HOM[x] = "MPLH+PLS3"
                          INJ_MOD_SP[x] = "MPLH+PLS3"
                          (4)IF LV_IDX_CYL_CLC_MPLH_VLD = 0
                          (4)THEN
                                IDX_PRS_COR_CYL_CLC_MPLH[0] = x
                          (4)ENDIF
                    (3)ENDIF
            (2)ENDIF
        (2)ENDFOR
(1)ELSE
        (3)FOR cylinder_start to cylinder_stop DO
            INJ_MOD_SP[x] = STATE_INJ_MOD_REQ
            INJ_MOD_SP_HOM[x] = STATE_INJ_MOD_HOM_REQ
        (3)ENDFOR
        IDX_PRS_COR_CYL_CLC_MPLH[0] = CTR_CYL_NR_ST_CLC_INJR
(1)ENDIF
```

Calculate activation of external injector needle lift set point for homogeneous mode (in case of active MFMA functionality, the injector needle lift shall be set to a calibratable set point):

```
(1)IF LC_EGY_RNG_LAM_AD_INJ_ENA = 1
    AND SUM(LV_LAM_AD_INJ_CUS_ACK[ ]) ≠ 0     // sum over all elements; at least one
                                                  exhaust-bank requests MFMA
(1)THEN // active MFMA - set needle lift to calibratable set point
        LV_EGY_RNG_HOM_EXT_ENA = 1
(1)ELSE // no external needle lift set point
```

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LV_EGY_RNG_HOM_EXT_ENA = 0
(1)ENDIF

Calculate variables used by other functionalities (stable interface):

INJ_MOD_GLOBAL = STATE_INJ_MOD_REQ
(1)FOR cylinder_start to cylinder_stop **DO**
(1)IF INJ_MOD_SP[x] $\neq$ INJ_MOD[x]
(1)THEN
Bit x of STATE_INJ_MOD_SWI_ACT = 1
(1)ELSE
Bit x of STATE_INJ_MOD_SWI_ACT = 0
(1)ENDIF
(1)ENDFOR

7.108.22 Calculation of injection fixed update window and ignition update window

Application conditions

Activation : every engine state

Deactivation : –

Initialization: at reset : **calculate Formula Section**

Recurrence : 1s

Description:

This section calculates the crank windows for ignition and injection update. The initialization routine at reset is the same as the time synchronous routine (1s)!

Formula Section :

CRK_PSN_STAT_WIN_ST = C_CRK_PSN_STAT_WIN_ST
(1)IF CRK_PSN_STAT_WIN_ST >= ((720°/NC_CYL_NR)*1.1)
(1)THEN
CRK_PSN_STAT_WIN_ST = ((720°/NC_CYL_NR)*1.1)
CRK_PSN_STAT_WIN_END = 720°
(1)ELSE
CRK_PSN_STAT_WIN_END = 720° - ((720°/NC_CYL_NR)*1.1
- CRK_PSN_STAT_WIN_ST)
(1)ENDIF
CRK_PSN_STAT_IGN_UPD_ST = C_CRK_PSN_STAT_IGN_UPD_ST
CRK_PSN_STAT_IGN_UPD_END = C_CRK_PSN_STAT_IGN_UPD_END

Copy calibratable needle lift set point during MFMA to aggregate interface:
LF_EGY_RNG_HOM_EXT = CLF_EGY_RNG_LAM_AD_INJ
Note: Bit 0 of CLF_EGY_RNG_LAM_AD_INJ represents the needle lift of the first pulse, bit 1 the lift of the second and bit 2 the lift of the third pulse!

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7.108.23 Correction of Injection time in case of low pressure and high temperature

Description:

This chapter calculates the injection time correction factor depending on fuel pressure, fuel temperature of injection system and ambient temperature.

Application conditions

Activation : every engine state

Deactivation : –

Initialization: at reset*:* FAC_TI_L_PRS = 1

Recurrence : LV_ST_END = 0: 10 ms
LV_ST_END = 1: segment synchronous

Formula Section :

(1) IF (LV_ERR_FTL_MIN **AND** LC_FAC_TI_ENA_FTL_MIN)
OR LV_FUP_LIH_L_PRS_CTL_REQ

(1) THEN

FAC_TI_L_PRS = (IP_FAC_TI_FUP_L_PRS(FUP_H_INJ) * IP_FAC_TI_TEMP_L_PRS(TFU_INJ, TAM)) + 1

/* FUP_H_INJ and TFU_INJ must be calculated before the calculation of FAC_TI_L_PRS */

(1) ELSE

FAC_TI_L_PRS = 1

(1) ENDIF

7.108.24 Description of exported actions

7.108.24.1 Description of ACTION_INJR_SetStateInjUpdEna

ACTION_INJR_SetStateInjUpdEna(IN <Cyl>, IN <State_Inj_Upd_Ena>)					
This action sets the cylinder individual bit <Cyl> of STATE_INJ_UPD_ENA to <State_Inj_Upd_Ena>.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
Cyl	IN	0 ... 7	0 ... 7	1	-
Number of logical cylinder.					
State_Inj_Upd_Ena	IN	0 ... 1	0 ... 1	1	-
Logical value for setting or resetting the corresponding cylinder value.					

Formula Section:

Bit Cyl of STATE_INJ_UPD_ENA = State_Inj_Upd_Ena
Note: The LSB of STATE_INJ_UPD_ENA is referred to as Bit 0 (zero based indication)!

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7.109 Activation of lambda adaptation via injection mode

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ABC_DET_MIS_LAM_AD_INJ [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for misfire events during lambda adaptation for injection mode					
CTR_AD_COLD_LAM_AD_INJ	O/V/S	0... FFH	0... 255	1	-
Counter for finished adaptation cycles for cold adaptation for lambda adaptation via injection mode					
CTR_AD_HOT_LAM_AD_INJ	O/V/S	0... FFH	0... 255	1	-
Counter for finished adaptation cycles for hot adaptation for lambda adaptation via injection mode					
CTR_MIS_AD_MISS_COLD_LAM_AD_INJ [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Counter for missed adaptation cycles by misfire in a driving cycle at cold temperature for lambda adaptation via injection mode					
CTR_MIS_AD_MISS_HOT_LAM_AD_INJ [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Counter for missed adaptation cycles by misfire in a driving cycle at hot temperature for lambda adaptation via injection mode					
CTR_MIS_DC_COLD_LAM_AD_INJ [NC_CYL_NR]	V/S	0... FFH	0... 255	1	-
Number of driving cycles with not finished adaptations due to misfire at cold temperature for lambda adaptation via injection mode					
CTR_MIS_DC_HOT_LAM_AD_INJ [NC_CYL_NR]	V/S	0... FFH	0... 255	1	-
Number of driving cycles with not finished adaptations due to misfire at hot temperature for lambda adaptation via injection mode					
CTR_MIS_LAM_AD_INJ [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Number of following adaptaions with misfire detection at lambda adaptation via injection mode					
DIST_LAM_AD_INJ_COLD	V/S	0... FFFFH	0... 524280	8	km
Distance threshold for next start of lambda adaptation via injection mode at cold condition					
DIST_LAM_AD_INJ_HOT	V/S	0... FFFFH	0... 524280	8	km
Distance threshold for next start of lambda adaptation via injection mode at hot condition					
FAC_LAM_MV_OFS_LDC_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Filtered lambda controller output offset for limited dynamics calculation of lambda adaptation via injection mode					
FAC_TQ_REQ_OFS_LDC_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
Torque scaling factor offset for limited dynamics calculation of lambda adaptation via injection mode					
LV_ERR_MIS_LAM_AD_INJ [NC_CYL_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag indicating a repeating misfire error during lambda adaptation via injection mode					
LV_LAM_AD_INJ_ACT	O/V	0... 1H	0 ...1	1	-
Lambda adaptation via injection mode active					
LV_LAM_AD_INJ_ACT_COLD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation of lambda adaptation via injection mode for lower temperature range					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_AD_INJ_ACT_HOT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation of lambda adaptation via injection mode for upper temperature range					
LV_LAM_AD_INJ_EXT_ENA	O/V	0... 1H	0 ...1	1	-
Set the external enable the lambda adaption via injection mode with a test device					
LV_LAM_AD_INJ_INTR	O/V	0... 1H	0 ...1	1	-
Interuption of adaptation for lambda adaptation via injection mode					
LV_LAM_AD_INJ_INTR_2 [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Maximum number of adaptations with misfire reached in adaptation cycle for lambda adaptation via injection mode					
LV_LAM_AD_INJ_INTR_LAM	O/V	0... 1H	0 ...1	1	-
Interuption of adaptation for lambda adaptation via injection mode due to lambda controller threshold					
LV_LAM_AD_INJ_REP	O/V	0... 1H	0 ...1	1	-
Repeat of adaptation for lambda adaptation via injection mode					
LV_LDC_LAM_AD_INJ [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Limited dynamic conditions for lambda adaptation via injection mode					
LV_MIS_LAM_AD_INJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Misfire detected during adaptation for lambda adaptation via injection mode					
MAF_INT_LDC_LAM_AD_INJ [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666667	0.0277778	g
Air mass flow integral during limited dynamics for lambda adaptation via injection mode					
MAF_OFS_LDC_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Air mass flow offset for limited dynamics calculation for lambda adaptation via injection mode					
N_OFS_LDC_LAM_AD_INJ [NC_CBK_EX_NR]	V	E020... 1FE0H	-8160 ...8160	1	rpm
Engine speed offset for limited dynamics calculation of lambda adaptation via injection mode					
TEMP_LAM_AD_INJ	O/V	0... FEH	-48... 142.5	0.75	°C
Temperature for lambda adaptation via injection mode					

Input data:

C_CRLC_TQ_DIF_SLOW_ LAM_AD_INJ {p. 3406}	DIST_KWP {p. 1183}	FAC_LAM_MV {p. 1014}	FAC_LAM_MV_DELTA_ LDC [NC_CBK_EX_NR] {p. 2585}
FAC_TQ_REQ_DELTA_ LDC {p. 2585}	LC_MFF_ADD_LAM_AD_ INJ_CLR {p. 3408}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_CYL_BAL_LAM_SEL_ AD_COLD_DC {p. 4066}
LV_CYL_BAL_LAM_SEL_ AD_HOT_DC {p. 4066}	LV_DET_CFM_MIS {p. 6237}	LV_HOM_ACT {p. 8136}	LV_INH_LAM_AD_INJ [NC_CBK_EX_NR] {p. 3398}
LV_LAM_AD_INJ_CLR_ AD_EXT {p. 7483}	LV_LAM_AD_INJ_COLD_ END [NC_CBK_EX_NR] {p. 3379}	LV_LAM_AD_INJ_HOT_ END [NC_CBK_EX_NR] {p. 3379}	LV_LAM_AD_INJ_MV_ CLC_END [NC_CBK_EX_NR] {p. 3405}
LV_MPL_INJ_ACT [NC_CBK_EX_NR] {p. 3379}	LV_SNG_INJ_ACT [NC_CBK_EX_NR] {p. 3379}	MAF_CYL {p. 8277}	MAF_DELTA_LDC {p. 2585}

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MFF_SP_MV {p. 2151}	MFF_SP_S_SWI_HOM {p. 8243}	N_32 {p. 1525}	N_DELTA_LDC {p. 2585}
NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NR_CYL_LAM_AD_INJ [NC_CBK_EX_NR] {p. 3379}	SEG_NR_ER {p. 1454}
STATE_IV_CHG {p. 7683}	STATE_LAM_AD_INJ_ACT [NC_CBK_EX_NR] {p. 3379}	T_AST {p. 1766}	TCO {p. 1100}
TCO_ST_DC {p. 1100}	TEMP_CAPA_IV_MV {p. 2241}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	TFU_INJ {p. 3332}
TFU_IV {p. 1232}	TQ_DIF_I_IS {p. 3441}	TQ_DIF_P_D_SLOW_IS {p. 3442}	TQ_IS_SNG_INJ_LAM_AD_INJ {p. 3406}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_ABC_MAX_MIS_LAM_AD_INJ	-	0... FFH	0... 255	1	-
Threshold of misfire events to interrupt an adaptation for lambda adaptation via injection mode					
C_CTR_MAX_DC_LAM_AD_INJ	-	0... FFH	0... 255	1	-
Number of driving cycles with missed adaptation by misfire to set error flag for lambda adaptation via injection mode					
C_CTR_MIS_AD_MAX_LAM_AD_INJ	-	0... FFH	0... 255	1	-
Maximum numbr of missed adaptation in a driving cycle to start lambda adaptation via injection mode					
C_CTR_MIS_LAM_DC_MIN_LAM_AD_INJ	-	0... FFH	0... 255	1	-
Number of adaptation cycles with misfire to increment misfire driving cycle counter for lambda adaptation via injection mode					
C_CTR_MIS_MAX_LAM_AD_INJ	-	0... FFH	0... 255	1	-
Maximum number of adaptions with misfire for one cylinder in an adaptation cycle for lmbda adaptation via injection mode					
C_FAC_LAM_LDC_MPL_LAM_AD_INJ	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lambda controller window for limited dynamic conditions at multiple injection for lambda adaptation via injection mode					
C_FAC_LAM_LDC_SNG_LAM_AD_INJ	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lambda controller window for limited dynamic conditions at single injection for lambda adaptation via injection mode					
C_FAC_LAM_MV_MAX_AD_LAM_AD_INJ	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Maximum lambda controller threshold to interrupt the lambda adaptation via injection mode					
C_FAC_LAM_MV_MAX_LAM_AD_INJ	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Maximum limit on mean value of lambda controller output for lambda adaptation via injection mode					
C_FAC_LAM_MV_MIN_AD_LAM_AD_INJ	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Minimum lambda controller threshold to interrupt the lambda adaptation via injection mode					
C_FAC_LAM_MV_MIN_LAM_AD_INJ	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Minimum limit on mean value of lambda controller output for lambda adaptation via injection mode					
C_FAC_TQ_REQ_DYW_LDC_LAM_AD_INJ	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Torque scaling factor window for limited dynamic conditions Lambda adaptation via injection mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_DYW_LDC_LAM_AD_INJ	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Air mass flow window for limited dynamic conditions of lambda adaptation via injection mode					
C_MAF_INT_LDC_LAM_AD_INJ	-	0... FFFFH	0... 1820.41666667	0.0277778	g
Air mass flow integral for duration of violation of limited dynamic conditions for lambda adaptation via injection mode					
C_N_BOL_LAM_AD_INJ	-	0... FFH	0... 8160	32	rpm
Lower limit on engine speed for lambda adaptation via injection mode					
C_N_DYW_LDC_LAM_AD_INJ	-	0... 1FE0H	0... 8160	1	rpm
Engine speed window for limited dynamic conditions trim control					
C_N_TOL_LAM_AD_INJ	-	0... FFH	0... 8160	32	rpm
Upper limit on engine speed for lambda adaptation via injection mode					
C_NR_MIN_AD_LAM_AD_INJ_COLD_ADD	-	0... FFH	0... 255	1	-
Minimum number of hot adaptations before the cold adaptation starts					
C_TCO_MIN_LAM_AD_INJ	-	0... FEH	-48... 142.5	0.75	°C
Minimum TCO to start the lambda adaptation via injection mode					
C_TEMP_CAT_MAX_LAM_AD_INJ	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Maximum catalyst temperature to start the lambda adaptation via injection mode					
C_TEMP_LAM_AD_INJ_ENA	-	0H 1H 2H 3H	TCO TFU_IV TFU_INJ TEMP_CAPA_IV_MV	-	-
Temperature for calculation in lambda adaptation via injection mode					
C_TEMP_MAX_LAM_AD_INJ_COLD	-	0... FEH	-48... 142.5	0.75	°C
Maximum temperature for cold adaptation range for lambda adaptation via injection mode					
C_TEMP_MAX_LAM_AD_INJ_HOT	-	0... FEH	-48... 142.5	0.75	°C
Maximum temperature for hot adaptation range for lambda adaptation via injection mode					
C_TEMP_MIN_LAM_AD_INJ_COLD	-	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for cold adaptation range for lambda adaptation via injection mode					
C_TEMP_MIN_LAM_AD_INJ_HOT	-	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for hot adaptation range for lambda adaptation via injection mode					
C_TQ_DIF_IS_AD_LAM_AD_INJ	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Idle speed controller threshold to repeat a adaptation of lambda adaptation via injection mode					
ID_MFF_SP_BOL_LAM_AD_INJ	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_MFF_SP_1_MFMA	6	0... FFH	0... 8160	32	rpm
Lower limit on MFF_SP for lambda adaptation via injection mode					
ID_MFF_SP_TOL_LAM_AD_INJ	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_MFF_SP_1_MFMA	6	0... FFH	0... 8160	32	rpm
Upper limit on MFF_SP for lambda adaptation via injection mode					
IP_DIST_LAM_AD_INJ_COLD	V	0... FFFFH	0... 524280	8	km
LDP_CTR_COLD_IP_DIST_LAM_AD_INJ	4	0... FFH	0... 255	1	-
LDPM_DIST_1_LAM_AD_INJ	2	0... FFFFH	0... 524280	8	km
Update of cold distance threshold for lambda adaptaiton via injection mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_DIST_LAM_AD_INJ_HOT	V	0... FFFFH	0... 524280	8	km
LDP_CTR_HOT_IP_DIST_LAM_AD_INJ	4	0... FFH	0... 255	1	-
LDPM_DIST_1_LAM_AD_INJ	2	0... FFFFH	0... 524280	8	km
Update of hot distance threshold for lambda adaptaiton via injection mode					
IP_T_AST_ENA_LAM_AD_INJ	-	0... FFFFH	0... 6553.5	0.1	s
LDP_TCO_ST_IP_T_AST_LAM_AD_INJ	8	0... FEH	-48... 142.5	0.75	°C
Minimum time for the activation of lambda adaptation via injection mode depending on TCO_ST					
LC_CTR_MIS_DC_LAM_AD_INJ_CLR	-	0... 1H	0 ...1	1	-
Enable to clear the CTR_MIS_DC_COLD/HOT_LAM_AD_INJ at finished learning of all cylinders					
LC_CYL_BAL_COLD_DEAC_LAM_AD_INJ	-	0... 1H	0 ...1	1	-
Deactivation of CILC condition for cold lambda activation via injection mode					
LC_CYL_BAL_HOT_DEAC_LAM_AD_INJ	-	0... 1H	0 ...1	1	-
Deactivation of CILC condition for hot lambda activation via injection mode					
LC_DIST_CLR_LAM_AD_INJ	-	0... 1H	0 ...1	1	-
Clear the distance threshold counter for lambda adaptation via injection mode					
LC_ERR_CLR_LAM_AD_INJ	-	0... 1H	0 ...1	1	-
Clear the error in lambda adaptation via injection mode					
LC_LAM_AD_INJ_ACT_COLD_MAN	-	0... 1H	0 ...1	1	-
Manual activation of cold conditons for lambda adaptation via injection mode					
LC_LAM_AD_INJ_ACT_HOT_MAN	-	0... 1H	0 ...1	1	-
Manual activation of hot conditons for lambda adaptation via injection mode					

Action definition

ACTION_MFMA_GetEnableCondition (**OUT**<PRM_LV_LAM_AD_INJ_EXT_ENA>)	Mode: O
Enable of the lambda adaptation via injection mode	

ACTION_MFMA_SetEnableCondition (**IN**<PRM_FLAG_PAR_IN>)	Mode: O
Activates lambda adaption via tester	

Description for Actions

ACTION_MFMA_GetEnableCondition(OUT <PRM_LV_LAM_AD_INJ_EXT_ENA>)					
Enable of the lambda adaptation via injection mode					
Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_LV_LAM_AD_INJ_EXT_ENA	OUT	0... 1H	0... 1	1	[-]
Set the external enable the lambda adaption via injection mode with a test device					

ACTION_MFMA_SetEnableCondition(IN <PRM_FLAG_PAR_IN>)					
Activates lambda adaption via tester					
Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_FLAG_PAR_IN	IN	0... 1H	0... 1	1	[-]
Set the flag FLAG_PAR_IN to 1 if a tester device activate thbe lambda adaptation via injection mode					

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This module handles the activation for the upper and lower temperature range for the lambda adaptation via injection mode and the engine speed controller, the lambda controller and the misfire detection are monitored during the adaptation.

Application Conditions

Initialization: RST, IGKON, NVMINI, NVMRES, NVMSTO
Activation: 20MS: always
SEG: always
ES2ERU: always
Deactivation: never

Function description

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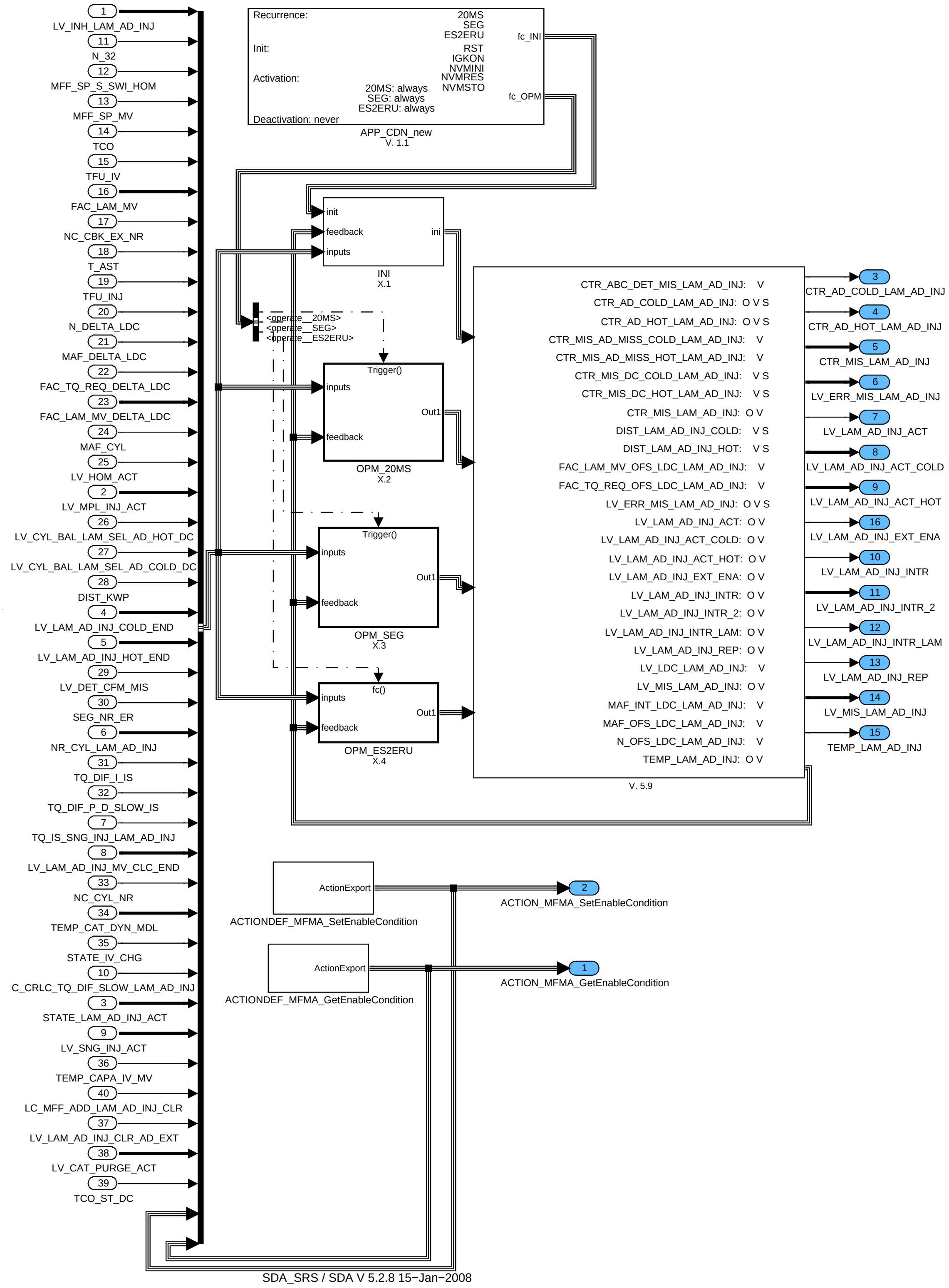

Figure 7.109.1: :

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7.109.1 Initialization

Initialization of the variables at ignition on and reading and writing of the variables stored in the non volatile memory.

7.109.1.1 Initialization of the online variables at reset

All variables are initialized with 0 at reset.

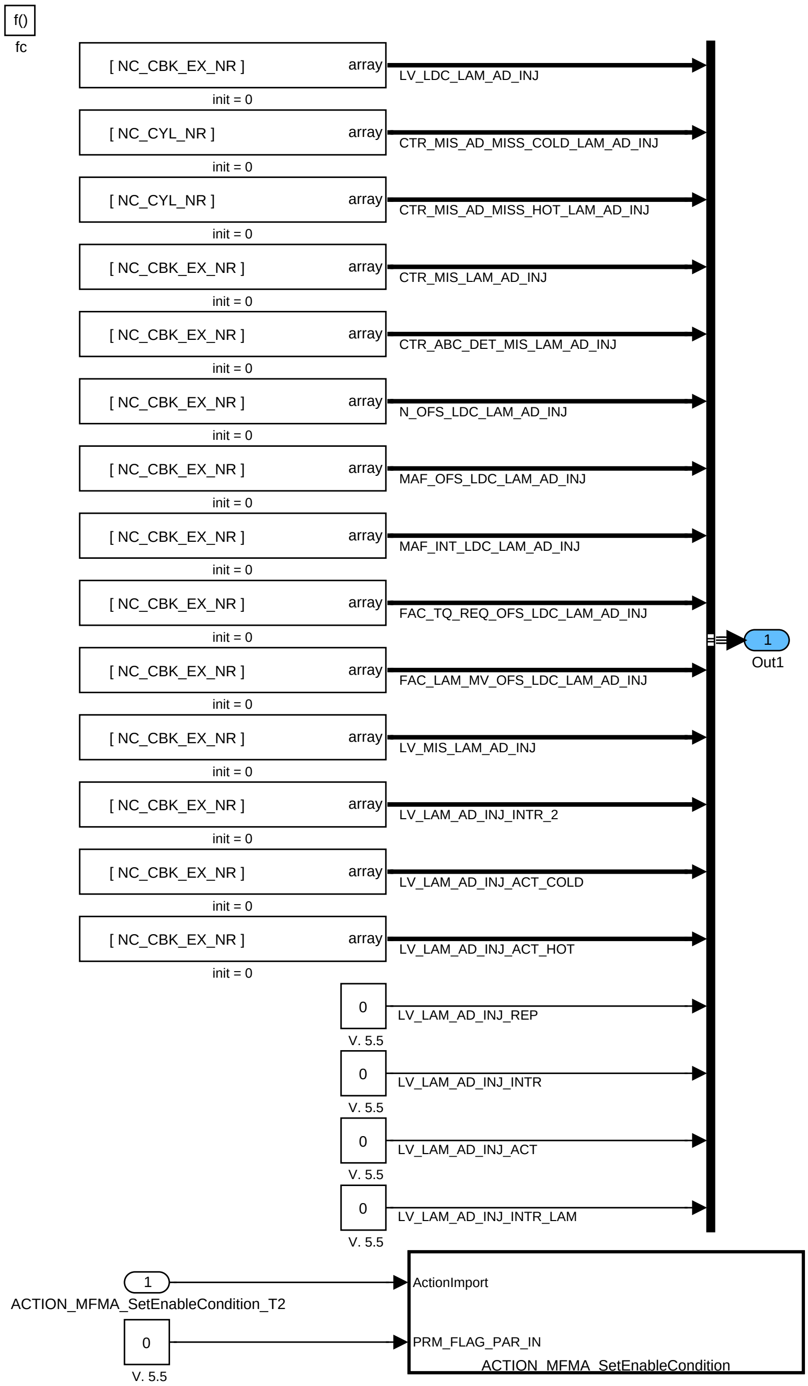

Figure 7.109.2: :

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7.109.1.2 Initialization of the online variables at IGK on

All values, except CTR_MIS_AD_MISS_COLD/HOT_LAM_AD_INJ, are initialized with 0 at IGKON.

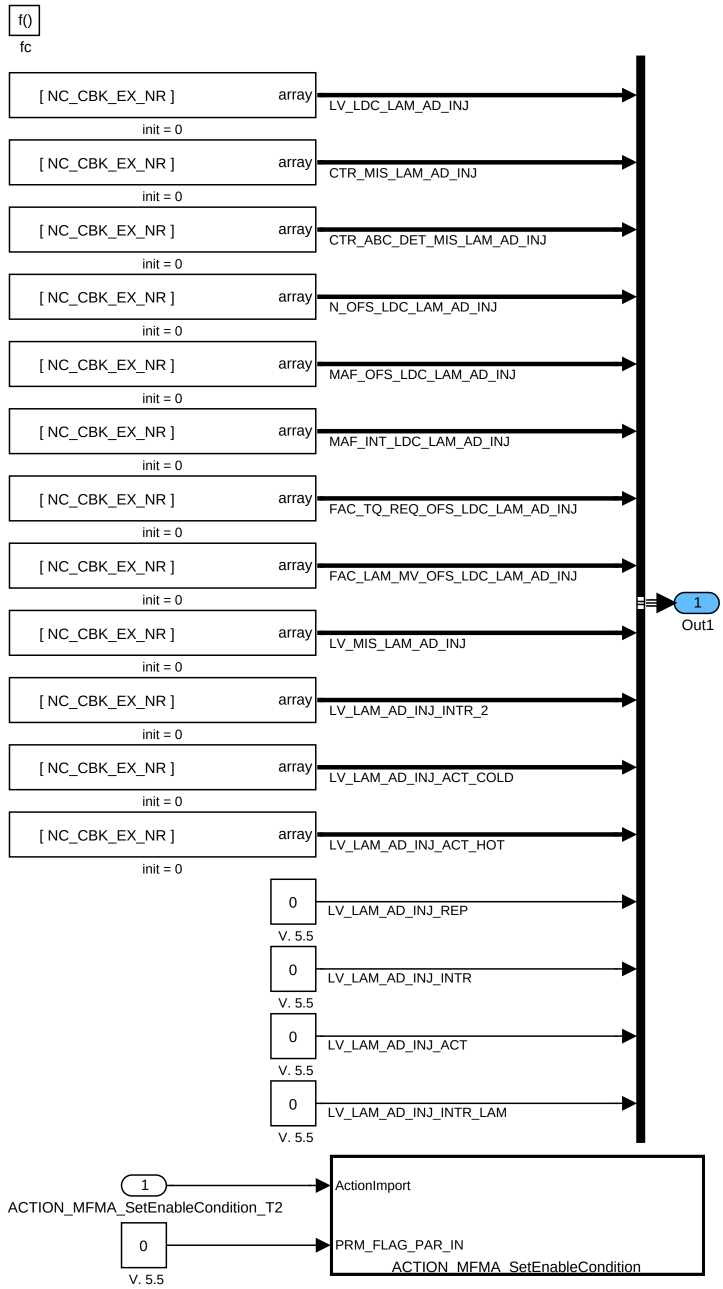

Figure 7.109.3: :

7.109.1.3 Initialization and reading of non volatile memory variables

The values are read from the NVMY memory. The first initialization of the values is done in an other subsystem, DIST_LAM_AD_INJ_COLD/HOT are not initialized with zero.

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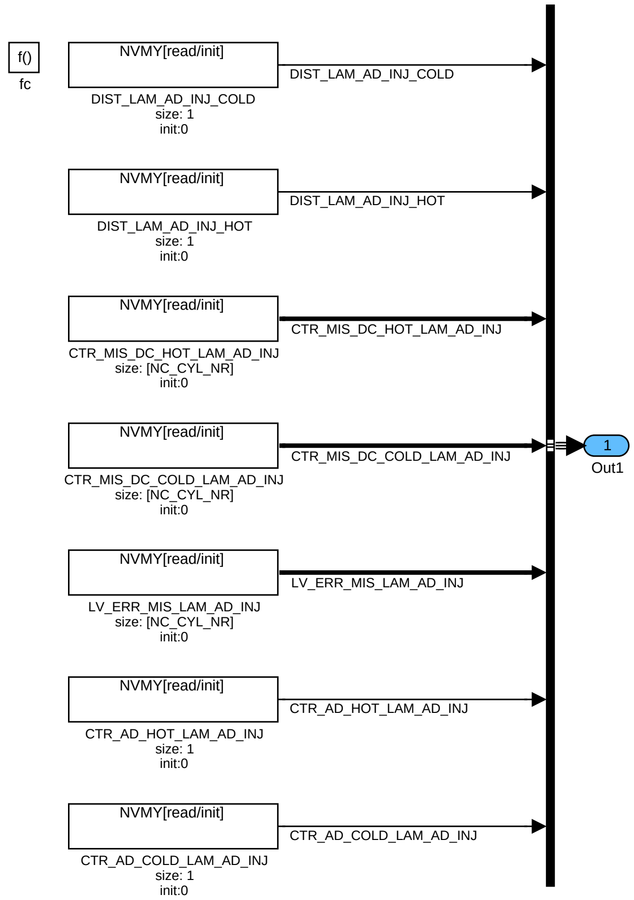

Figure 7.109.4: :

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7.109.1.4 Writing of non volatile memory variables

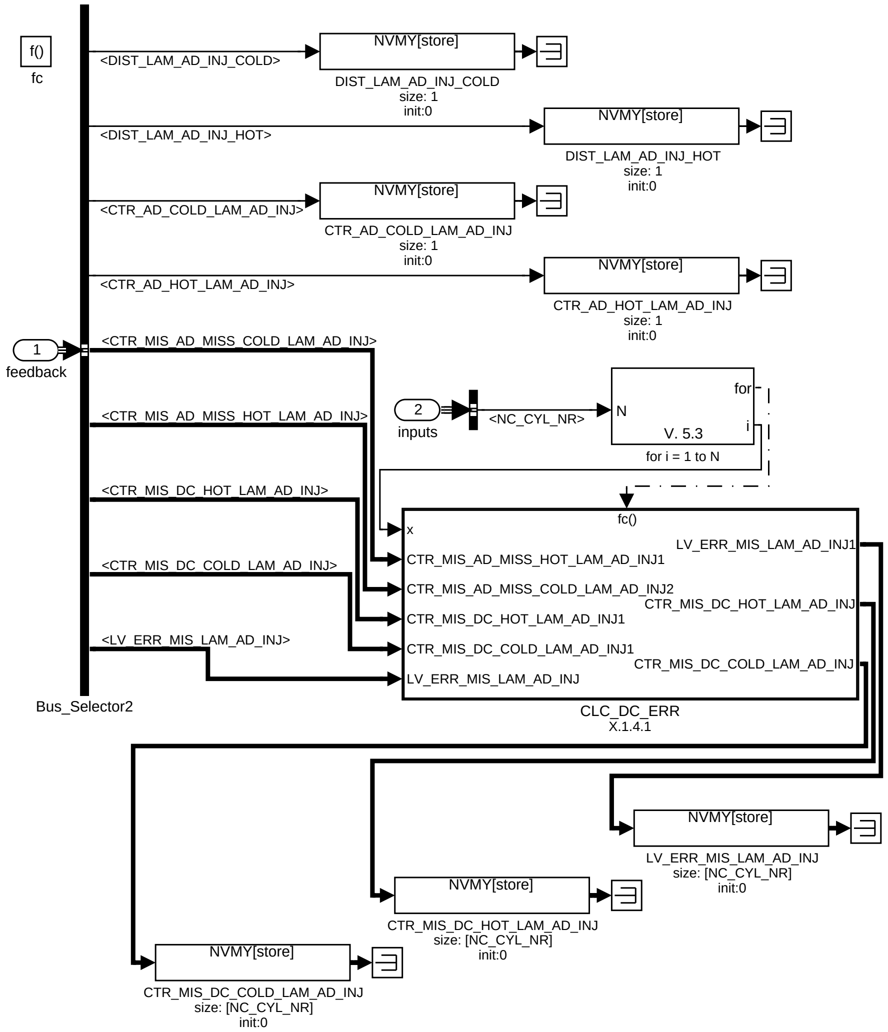

Figure 7.109.5: :

7.109.1.4.1 Calculation of driving cycle counter and creation of error flags

For each cylinder the number of driving cycles with missed adaptation due to misfire are counted. If the counter exceeds a threshold, the error flag will be set at the end of a driving cycle.

7.109.1.4.1.1 Calculation of driving cycle counter and error flags

If the number of missed adaptation cycles due to misfire in a driving cycle exceeds the threshold C_CTR_MIS_LAM_DC_MIN_LAM_AD_INJ, the counter for driving cycles with missed adaptation is increased. If the number of driving cycles with failed adaptations reaches the threshold C_CTR_MAX_DC_LAM_AD_INJ, the error flag for the depending cylinder is set.

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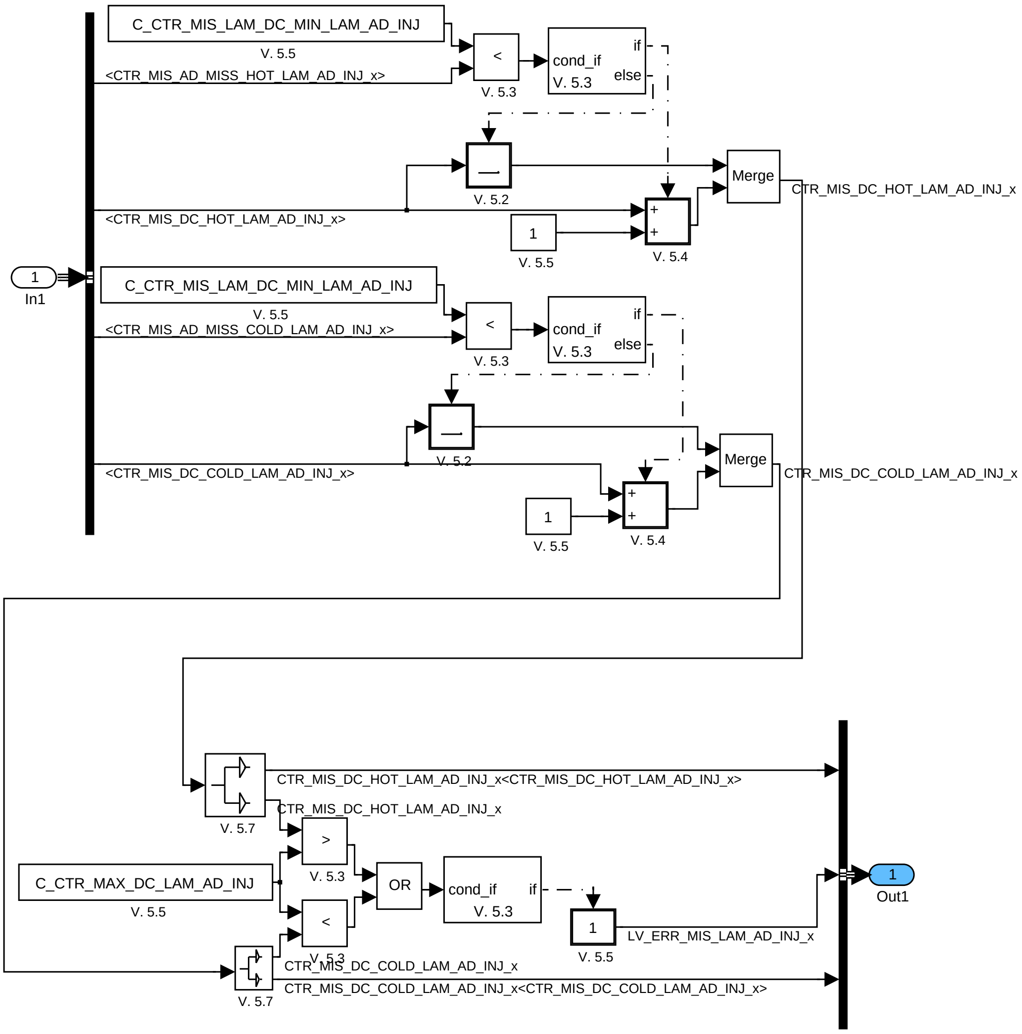

Figure 7.109.6: :

7.109.1.5 NVMY initialization

The distance counter is initialized at non volatile memory initialization with the sum of the mileage counter and the output of the map IP_DIST_LAM_AD_INJ_HOT/COLD. With this calculation the first adaptation after NVMY initialization will start after a mileage distance defined in the map. All other values are initialized with zero.

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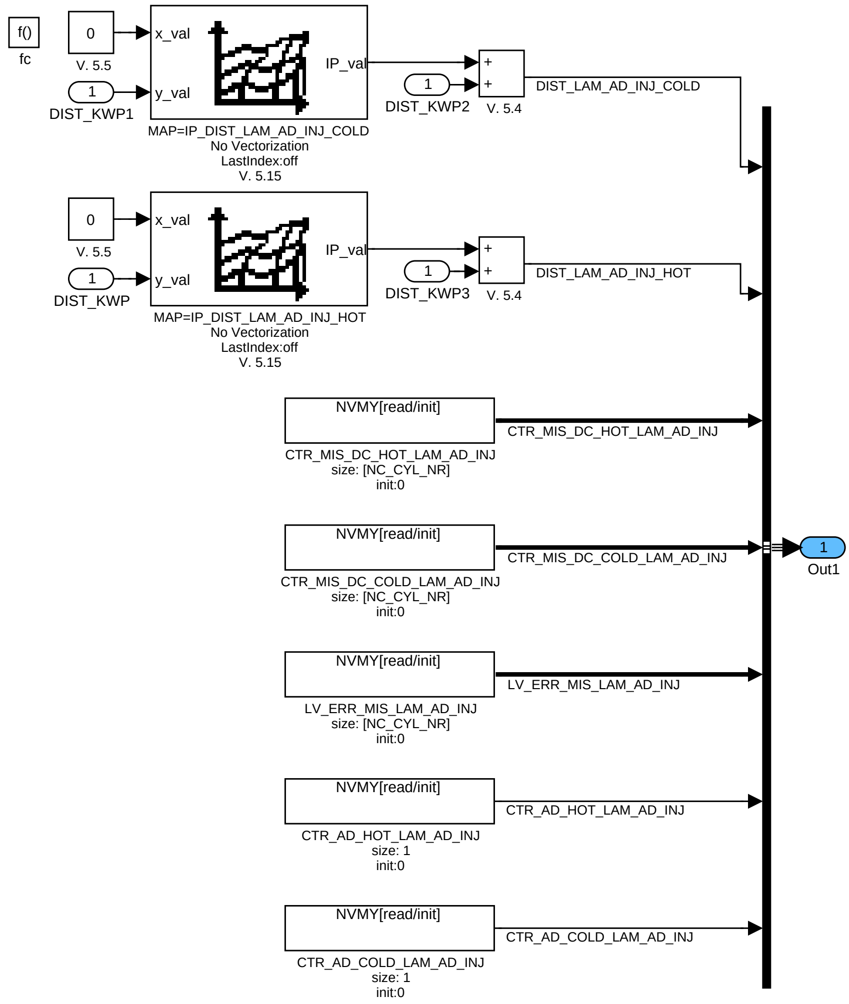

Figure 7.109.7: :

7.109.2 Determination of the adaptation conditions

The determination of adaptation conditions is divided into bank specific and bank independent calculations.

7.109.2.1 Bank independent calculations

The bank independent calculations are divided in general calculations, temperature calculations and the clearance of interruption and repeat flags.

7.109.2.1.1 General activation conditions

For activation of the adaptation the fuel mass flow and the engine speed has to be inside limitations. Also a certain time after engine start has to be passed.

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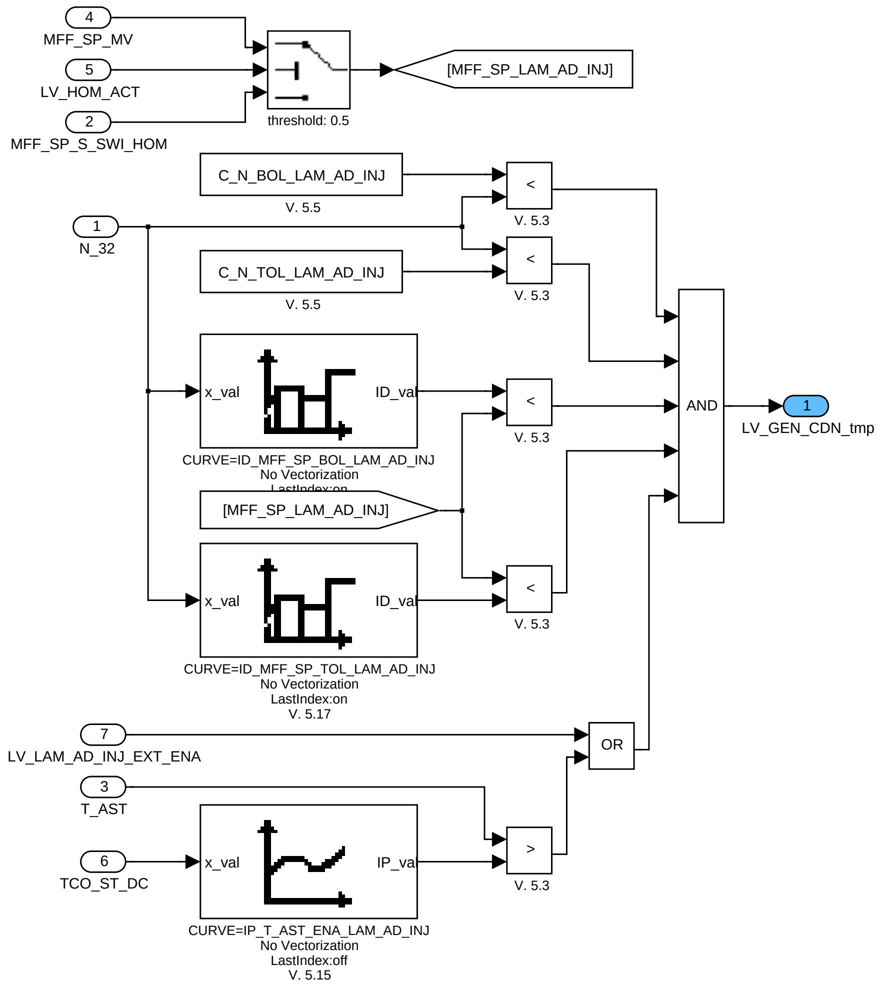

Figure 7.109.8: :

7.109.2.1.2 Temperature range activation conditions

To activate the adaptation for cold and hot adaptation range the depending temperature can bee chosen between coolant temperature and fuel temperature. For activation the temperature has to be inside limitations, the general conditions has to be fulfilled, the cylinder individual lambda controller has to be ready and the condition for the mileage counter has to be fulfilled. Also the maximum number of adaptation cycles in the driving cycle has not to be reached.

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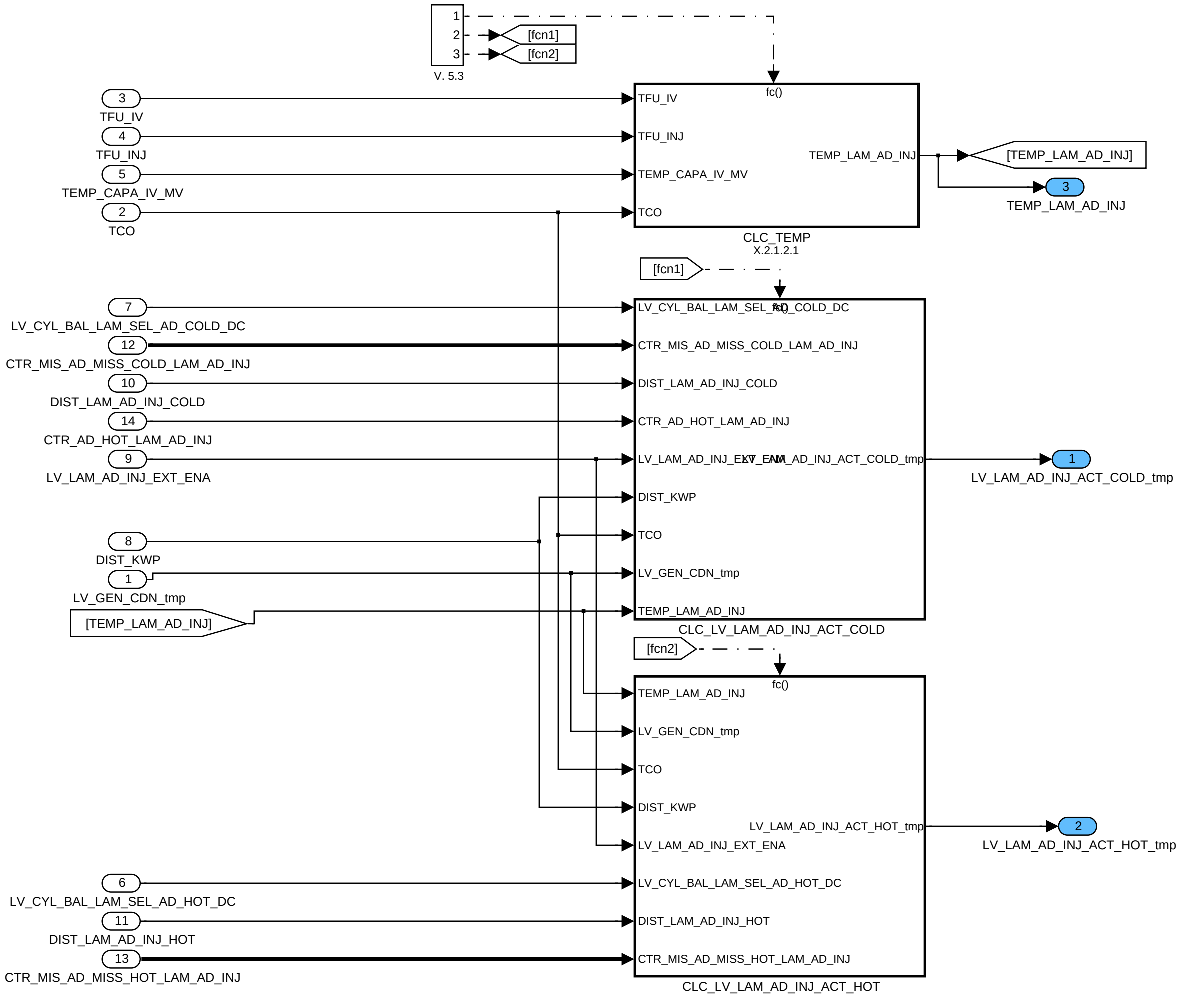

Figure 7.109.9: :

7.109.2.1.2.1 Selection of temperature value

Using the calibration C_TEMP_LAM_AD_INJ_ENA the temperature for use within the lambda adaptation via injection mode can be chosen.

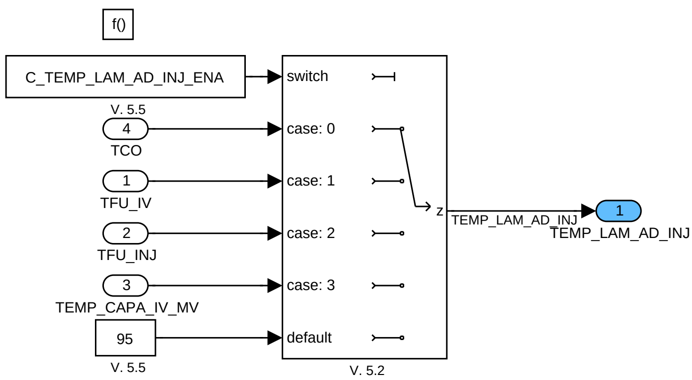

Figure 7.109.10: :

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7.109.2.1.2.2 Condition for the lower adaptation range

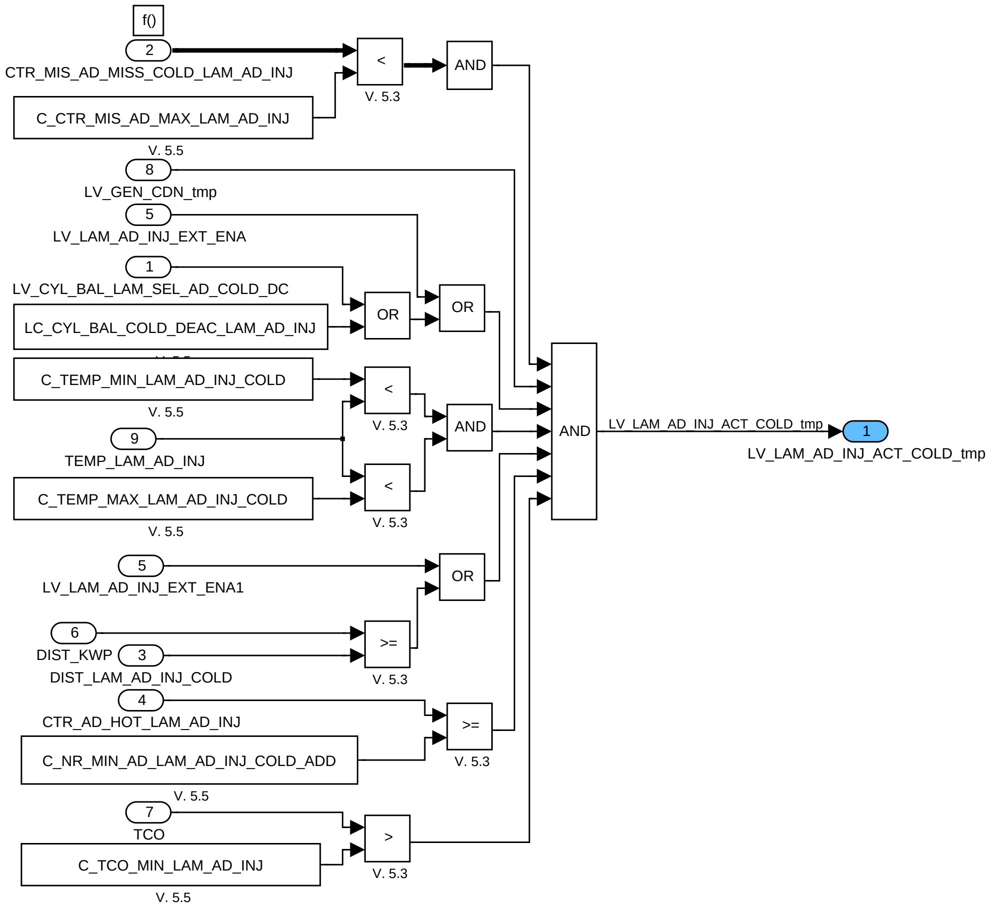

Figure 7.109.11: :

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7.109.2.1.2.3 Condition for the upper adaptation range

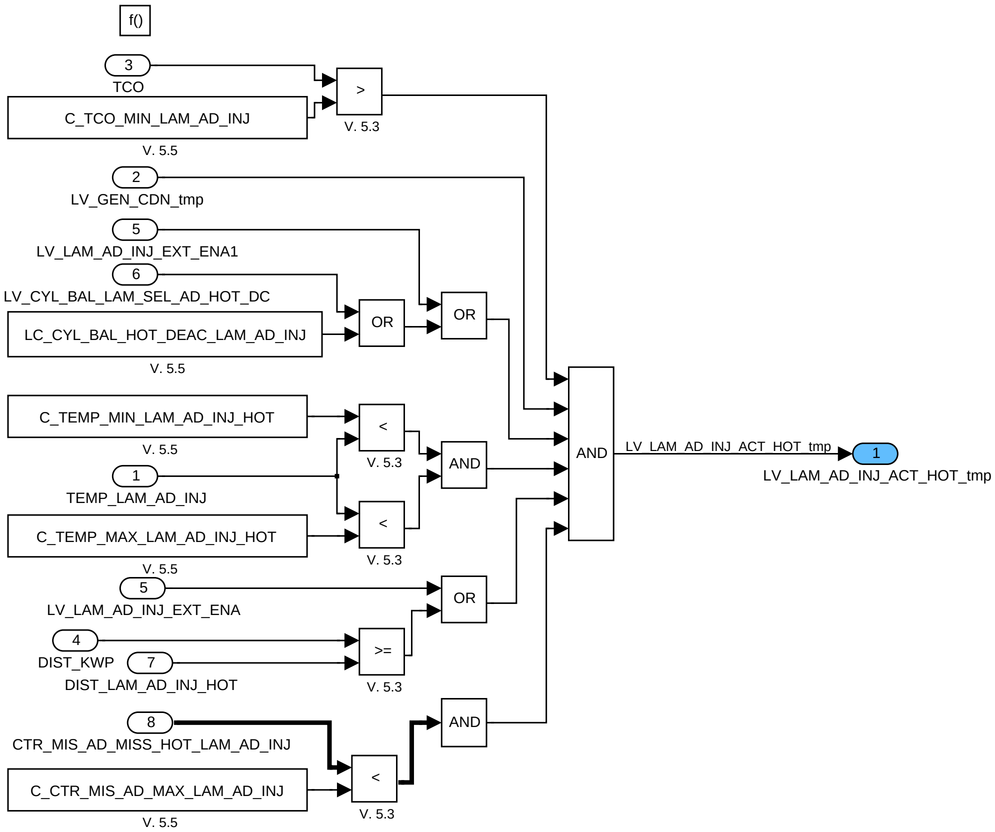

Figure 7.109.12: :

7.109.2.1.3 Clear the values for interruption and repeat

If all banks are not in multiple and not in single injections, the flags to interrupt and repeat the adaptation are reset. In single injection for all banks the flags and counter for misfire are reset.

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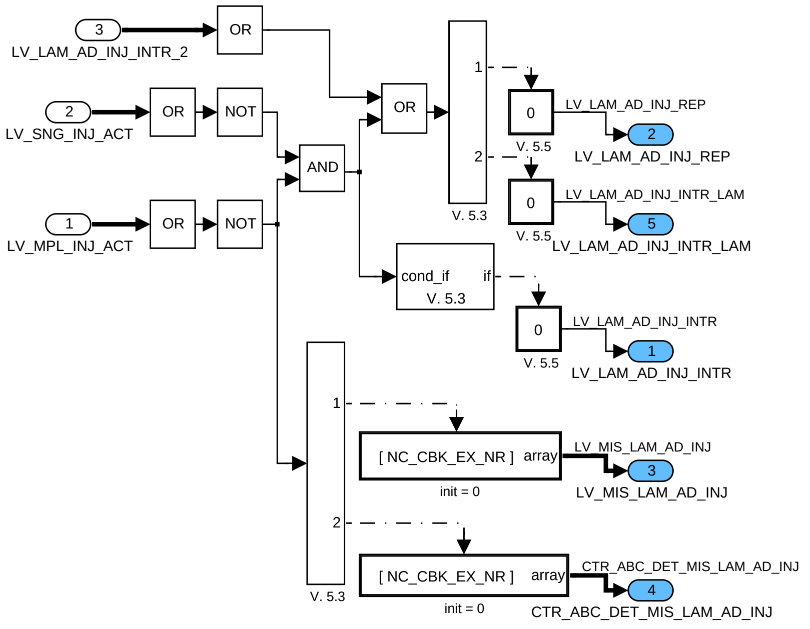

Figure 7.109.13: :

7.109.2.1.4 Reset of LV_LAM_AD_INJ_EXT_ENA

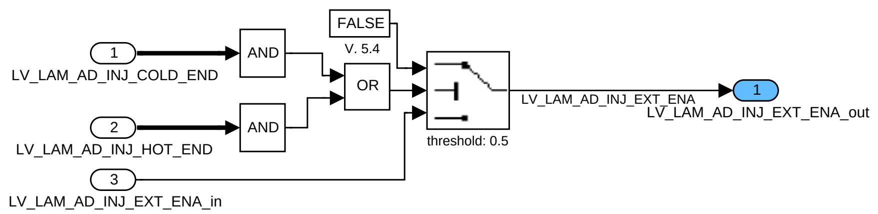

Figure 7.109.14: :

7.109.2.2 Bank specific calculations

The following calculations are done for all cylinder banks. Inside the model the bank specific values are denoted with the suffix _i whereas in the textual description they are referenced via [i].

7.109.2.2.1 Limited dynamics determination

The flag LV_LDC_LAM_AD_INJ[i] is calculated using N, MAF; FAQ_TQ_REQ and FAC_LAM_MV conditions. During multiple injections the monitoring of FAC_LAM_MV can be changed by using different thresholds.

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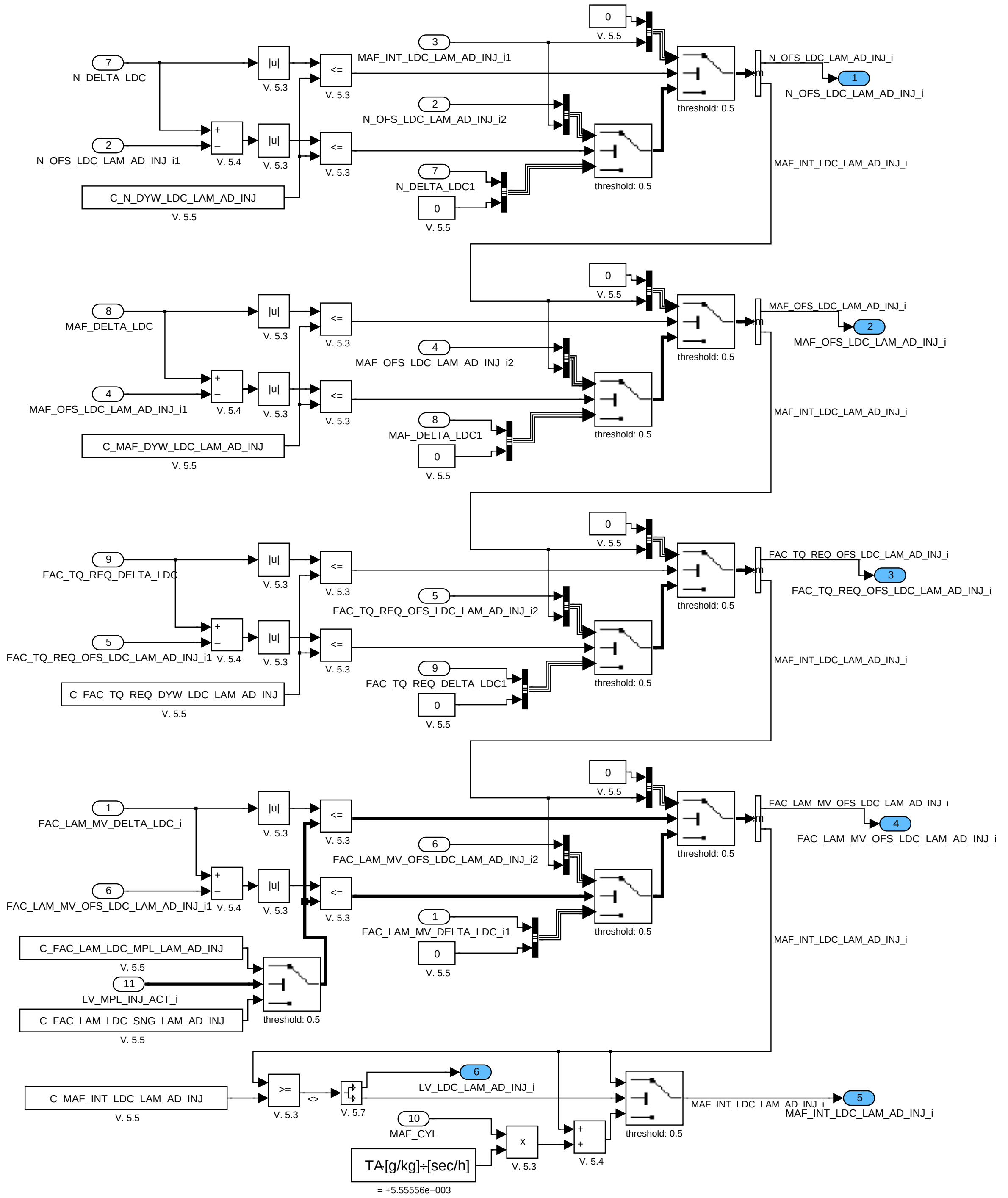

Figure 7.109.15: :

7.109.2.2.2 Determination of adaptation conditions for upper or lower temperature range

If the limited dynamics are given and the lambda controller operates within defined limits, depending on the temperature conditions the adaptation for the upper or lower temperature range is enabled, if all banks fulfil these conditions and the catalyst temperature has to be below a threshold. Or the adaptation can be activated manually via calibration value.

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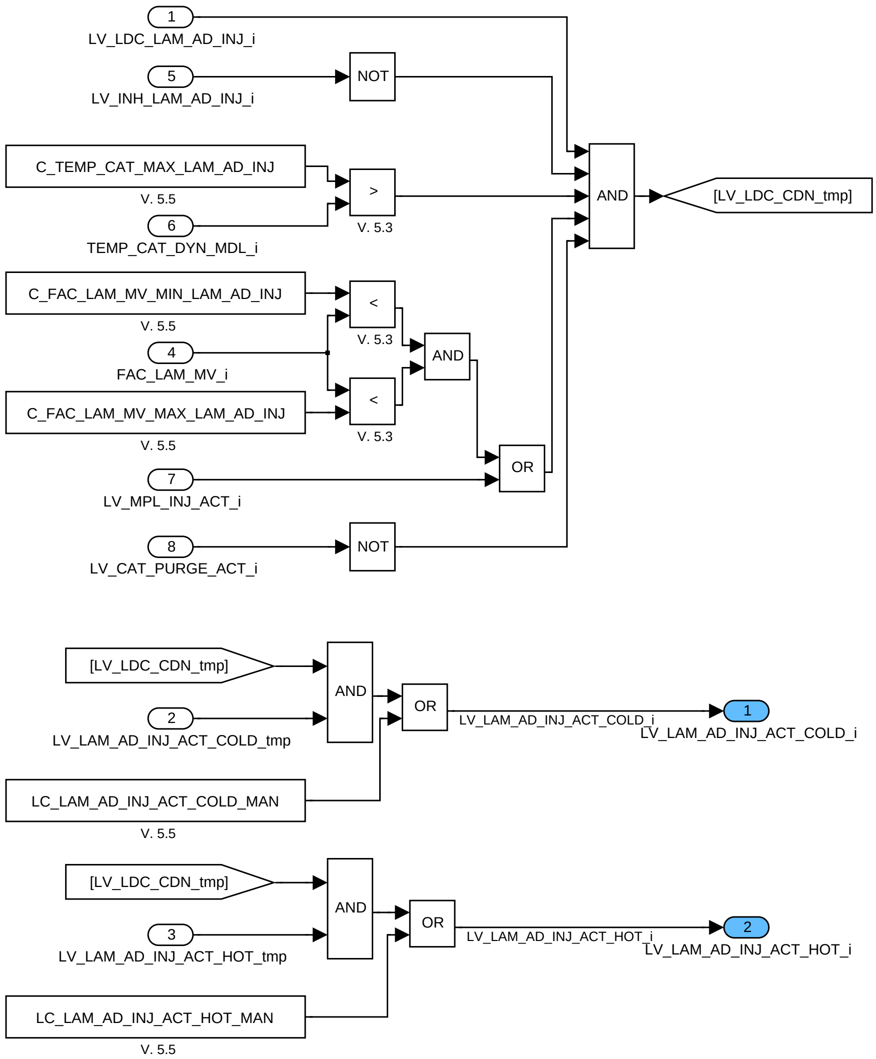

Figure 7.109.16: :

7.109.2.2.3 Monitoring of ENSC, LACO and MISF

During the multiple injection phase the output of the engine speed controller, the lambda controller and the misfire detection are monitored.At a certain number of misfire events or at a certain deviation in the lambda controller output the adaptation is interrupted immediately and the adaptation is repeated.For a deviation in the engine speed controller, the adaptation is at first finished and then repeated.

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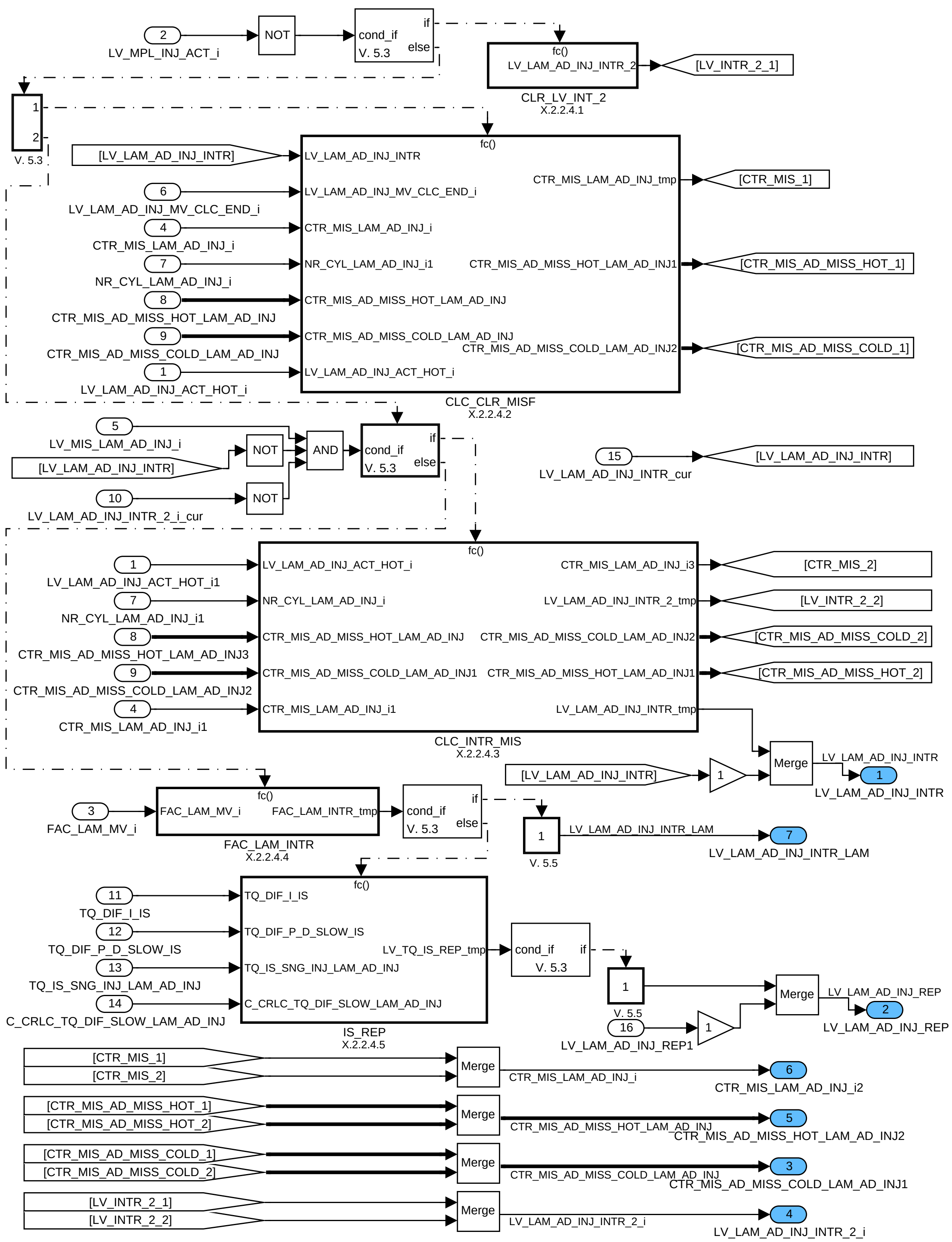

Figure 7.109.17: :

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7.109.2.2.3.1 Clear interruption flag

Figure 7.109.18: :

7.109.2.2.3.2 Clear the counter for misfire handling

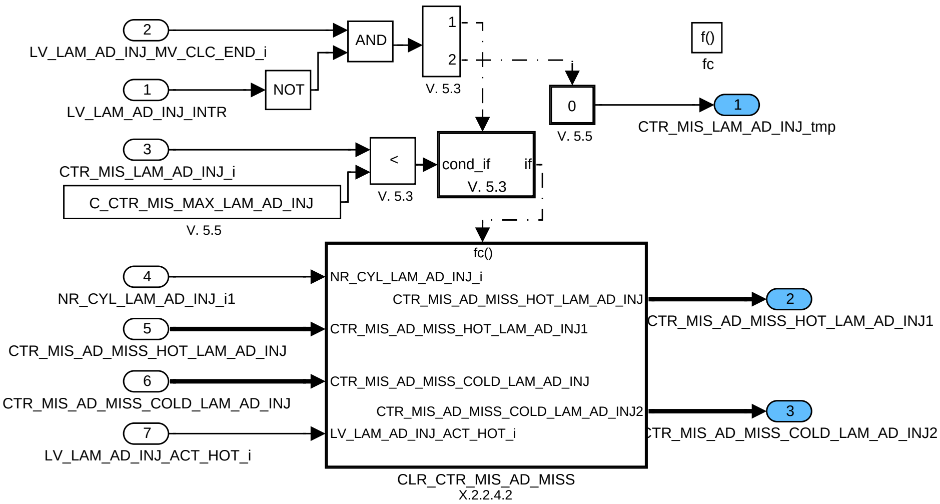

Figure 7.109.19: :

7.109.2.2.3.2.1 Clear temperature depending counters for misfire handling

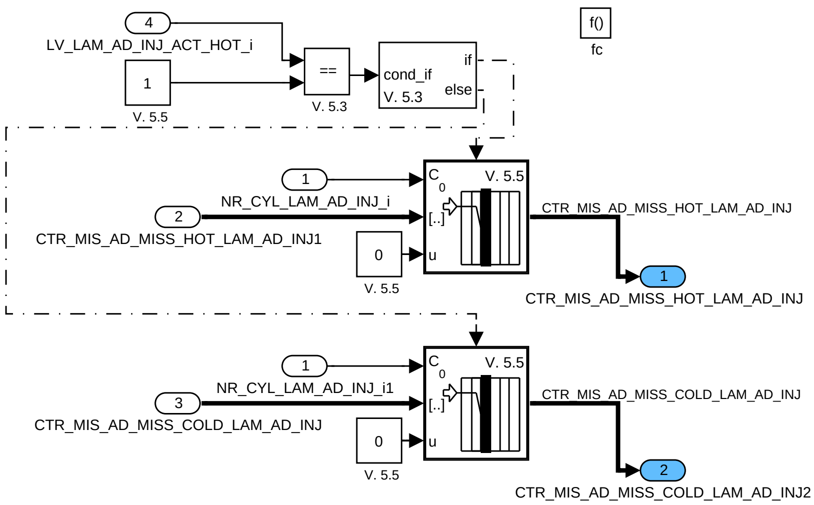

Figure 7.109.20: :

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7.109.2.2.3.3 Calculate counter for misfire handling

This calculation are done, if a misfire during multiple injection is detected. At misfire the misfire counter is incremented an the interruption flag is set, which leads to a repeat of the adaptation. If the maximum number of repeated adaptation due to misfire are reached, a second interruption flag is set, a counter is incremented and the adaptation is continued with all left cylinders.

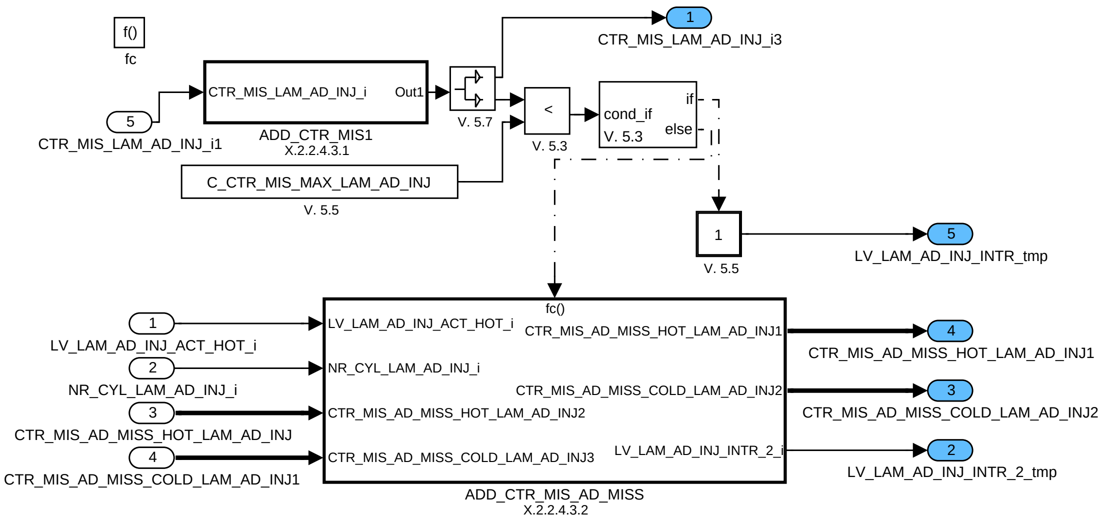

Figure 7.109.21: :

7.109.2.2.3.3.1 Incrementation of CTR_MIS_LAM_AD_INJ

The counter is incremented and limited.

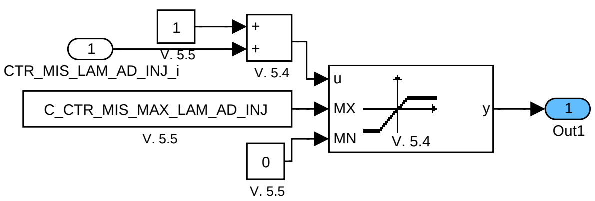

Figure 7.109.22: :

7.109.2.2.3.3.2 Incrementation of of CTR_MIS_AD_MISS_COLD/HOT_LAM_AD_INJ

Depending on the temperature range the counters are incremented.

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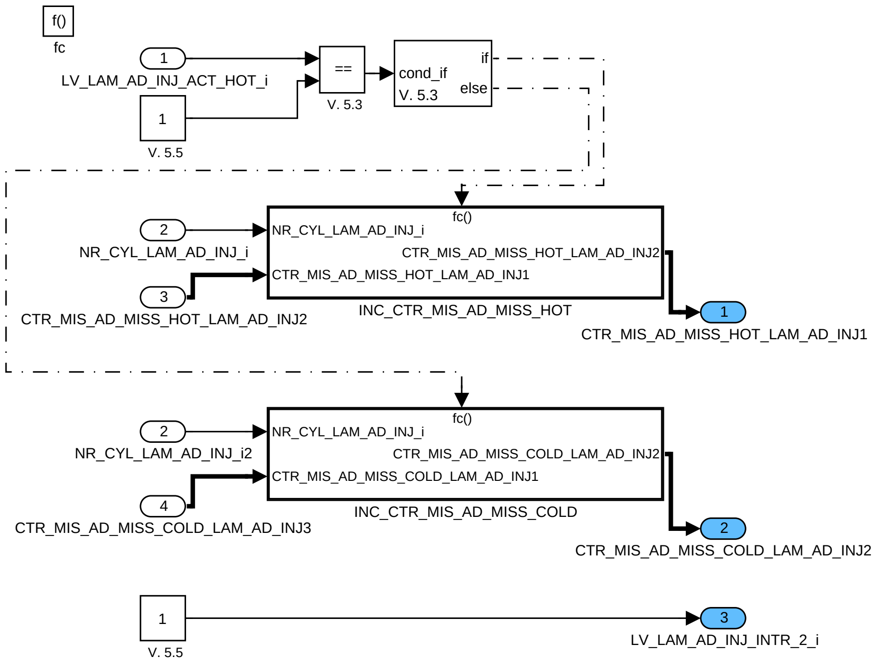

Figure 7.109.23: :

7.109.2.2.3.4 Conditions for interruption due to lambda conditions

If the lambda controller output exceeds the limitations, the adaptation is interrupted.

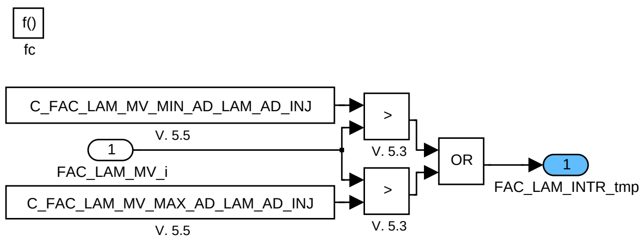

Figure 7.109.24: :

7.109.2.2.3.5 Conditions for interruptions due to ENSC controller output deviation

For a big difference in the idle speed controller in single and multiple injection, the adaptation will be finished and repeted.

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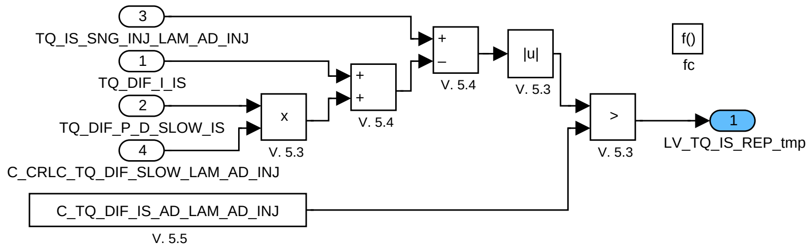

Figure 7.109.25: :

7.109.2.3 Calculation of general activation flag and update of the distance counter

The general activation flag is set if the bank specific condition for hot or cold conditions are given. Also the update of the mileage threshold is updated.

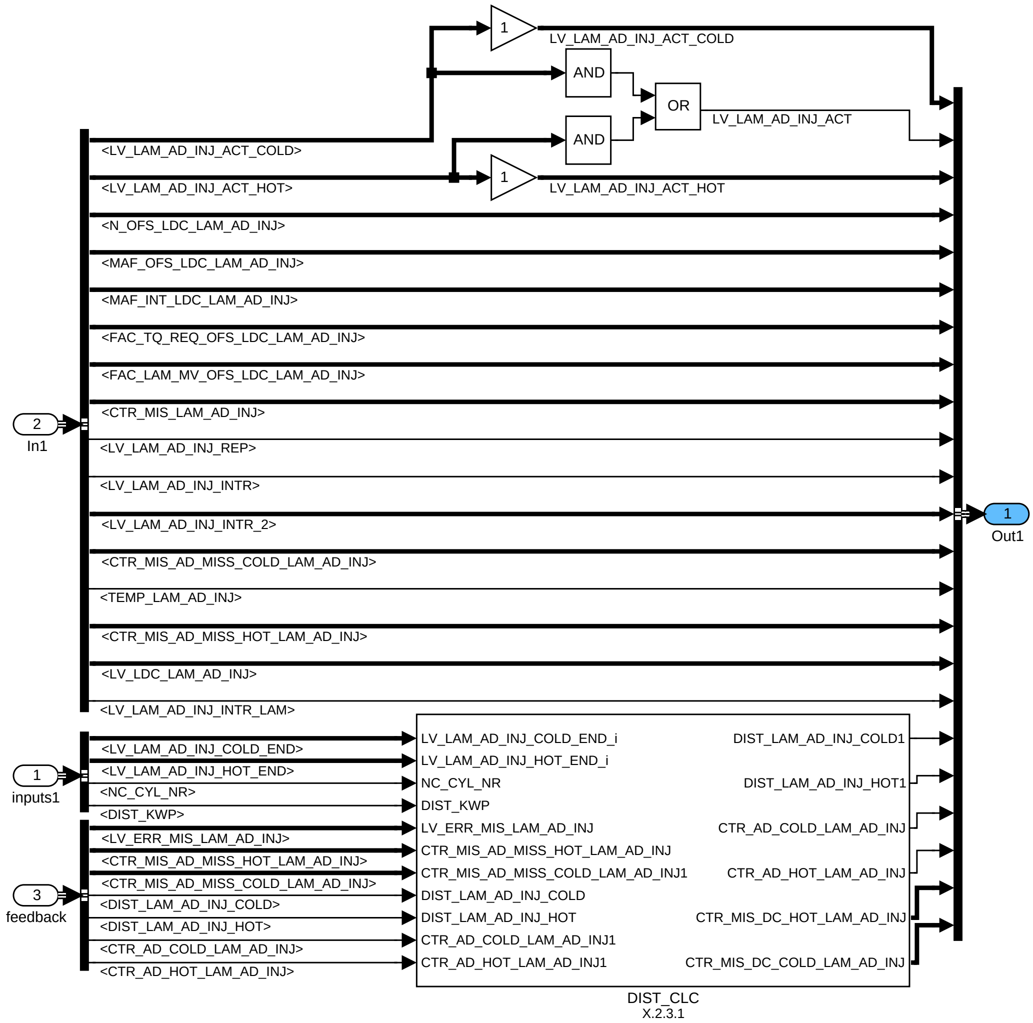

Figure 7.109.26: :

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7.109.2.3.1 Update of the mileage threshold

The mileage threshold is separately updated for hot and cold adaptation if the adaptation is finished successfully for all cylinders and no repeat of adaptation due to misfire is necessary.

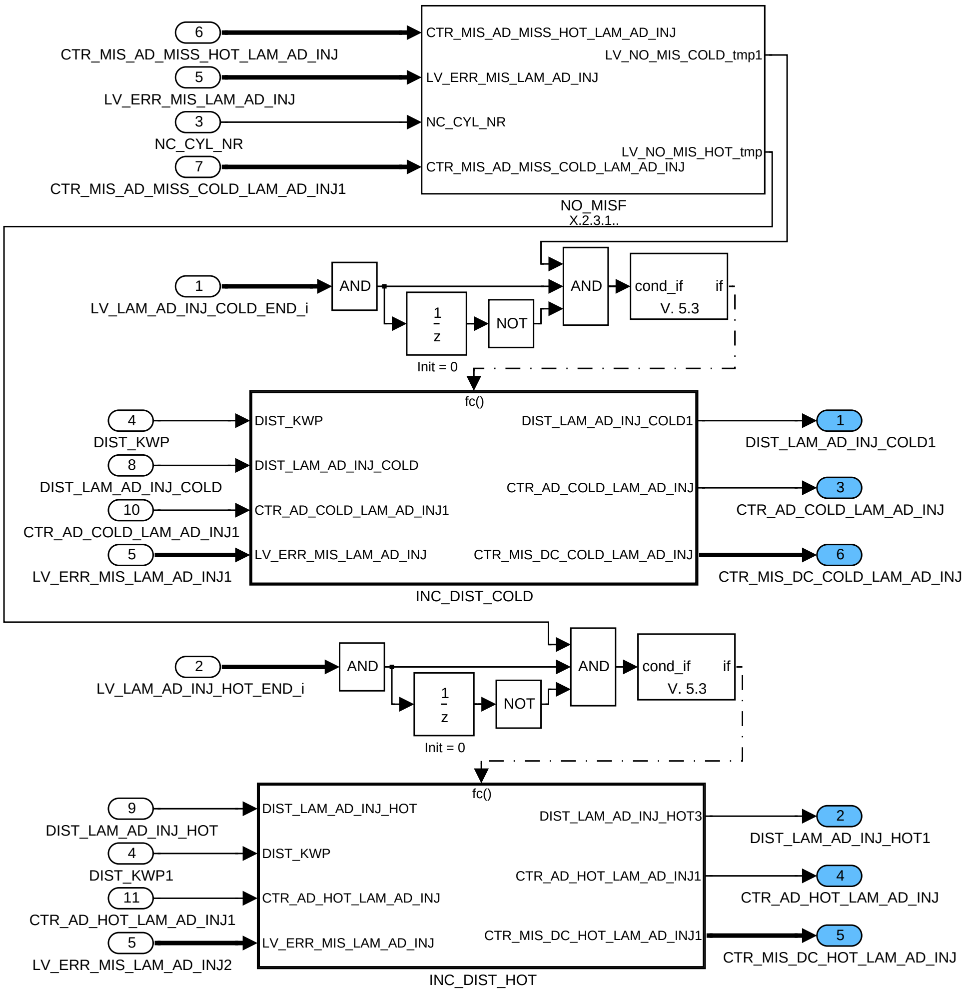

Figure 7.109.27: :

7.109.2.3.1.1 Distance threshold incrementation for cold adaptation

At successful adaptation the distance counter will be incremented; the CTR_AD_COLD_LAM_AD_INJ will be incremented and if no error is present and the LC_CTR_MIS_DC_LAM_AD_INJ_CLR is set the CTR_MIS_DC_COLD_LAM_AD_INJ is cleared.

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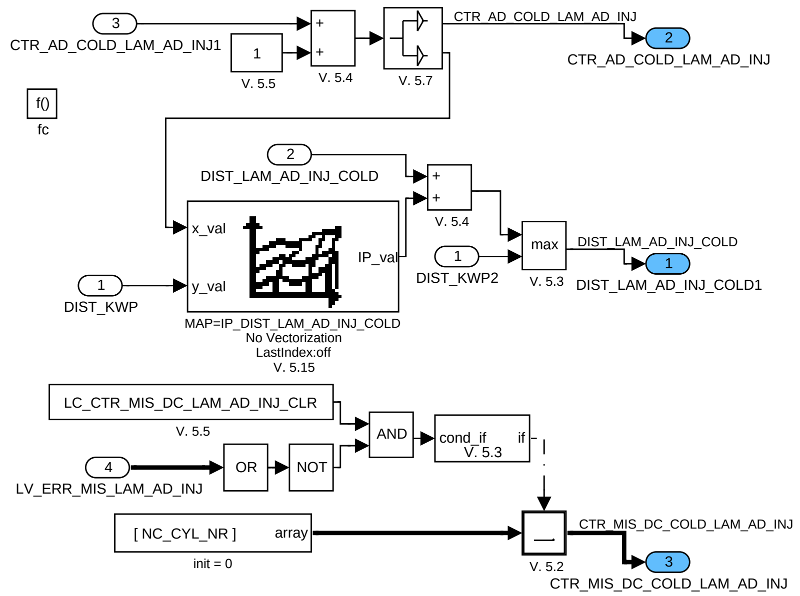

Figure 7.109.28: :

7.109.2.3.1.2 Distance threshold incrementation for hot adaptation

At successful adaptation the distance counter will be incremented; the CTR_AD_HOT_LAM_AD_INJ will be incremented and if no error is present and the LC_CTR_MIS_DC_LAM_AD_INJ_CLR is set the CTR_MIS_DC_HOT_LAM_AD_INJ is cleared.

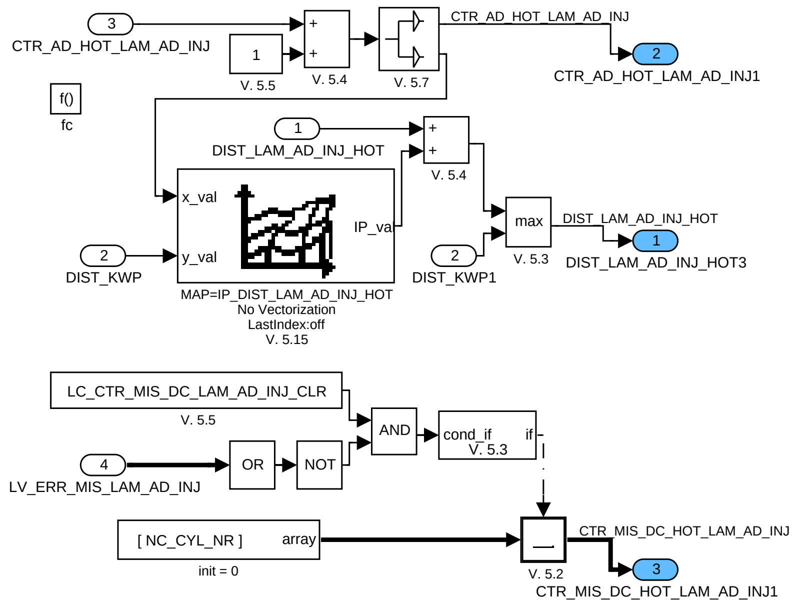

Figure 7.109.29: :

7.109.2.3.1.3 No misfire condition for mileage threshold update

The mileage threshold can be updated, if the condition "no misfire" is present for all cylinders.

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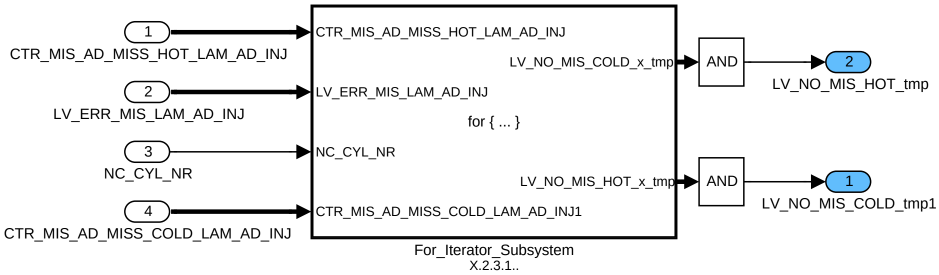

Figure 7.109.30: :

7.109.2.3.1.3.1 No misfire condition

For each cylinder it tested, if no misfire was present or the error for misfire is already present.

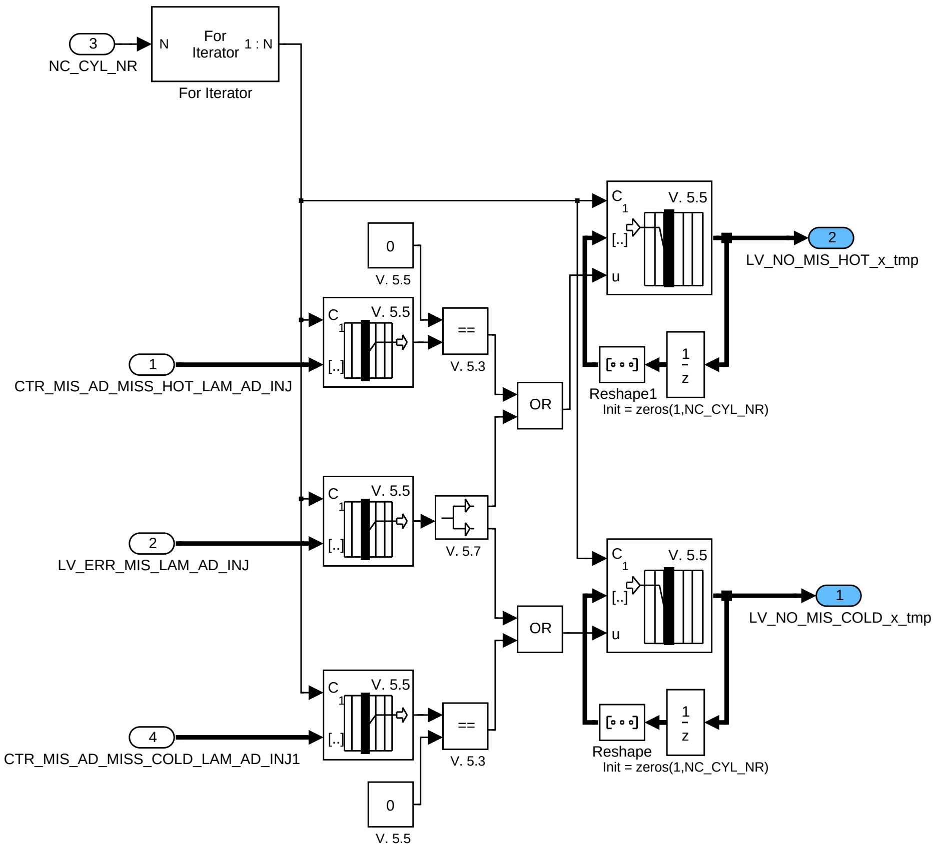

Figure 7.109.31: :

7.109.3 Segment synchronous calculations to detect misfire

Calculations to detect misfire with the same recurrence as the misfire calculations. Misfire will be detected only at multiple injection phase, represented by STATE_LAM_AD_INJ_ACT $>$ 2 (single injection)

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7.109.3.1 Detection of misfire

If misfire is detected for the cylinder with multiple injections, a misfire counter is incremented. The flag indicating misfire is set, if the counter reach a threshold.

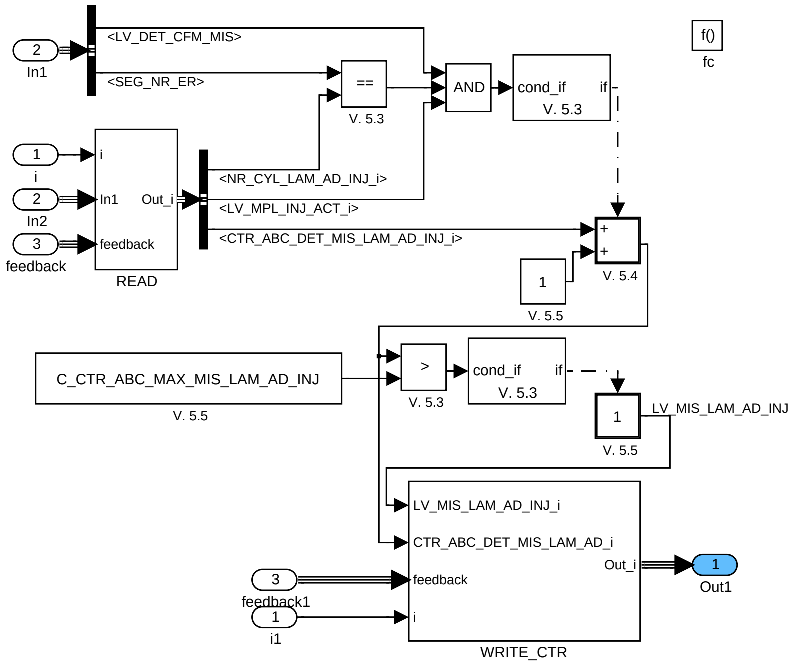

Figure 7.109.32: :

7.109.4 Calculations at event engine stop to engine run

Cylinder individual calculations to clear the error flags.

7.109.4.1 Clear error flags, distance threshold and counters

At a change of an injector, the CTR_AD_HOT/COLD_LAM_AD_INJ and the error flags and counter are cleared. The distance threshold and the error can also be cleared by calibration data.
If a resetting of the NVMY data via service tester is requested with the flag LV_LAM_AD_INJ_CLR_AD_EXT, the counters and the distance thresholds are cleared.

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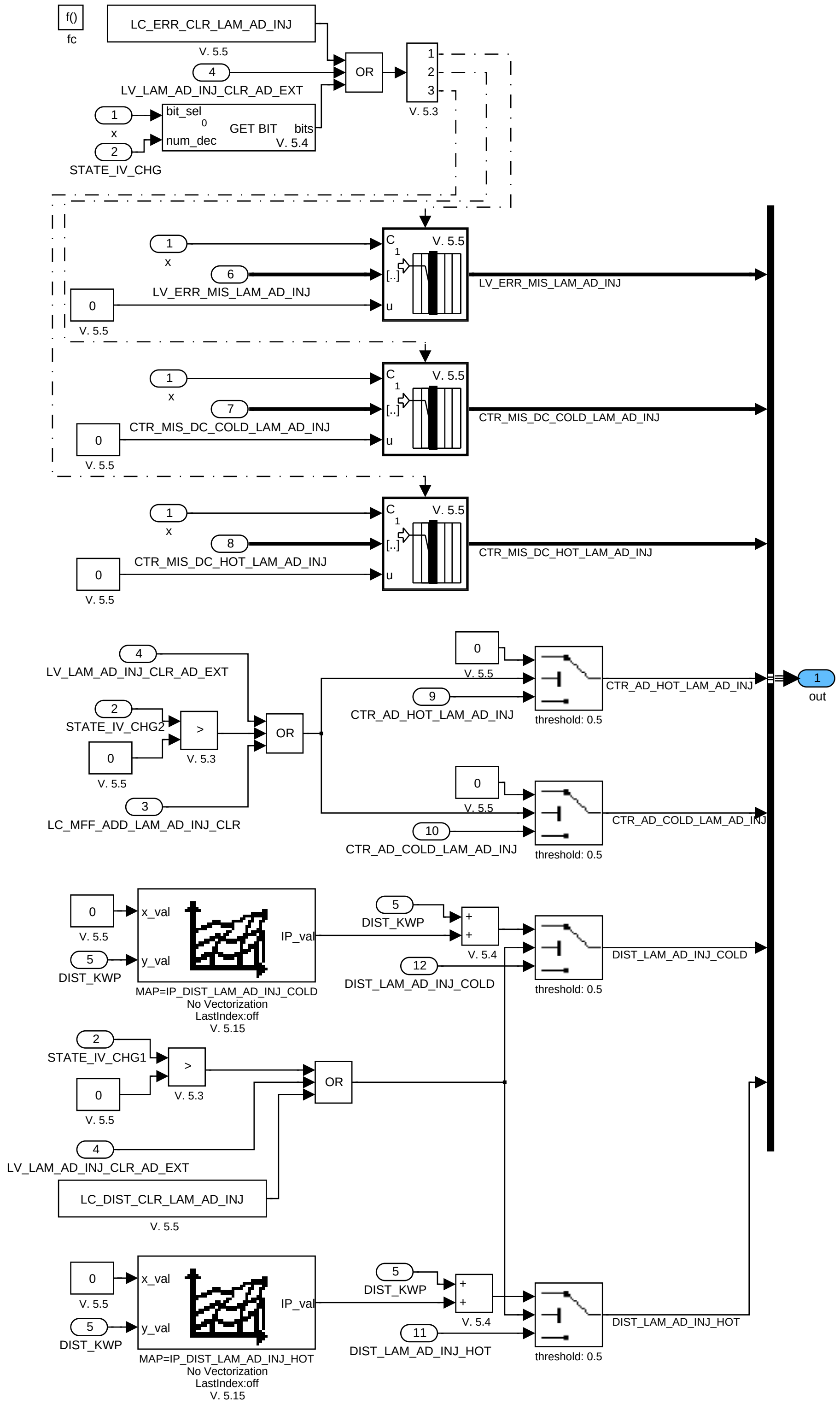

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7.109.5 Detailed description for Action: ACTION_MFMA_GetEnableCondition

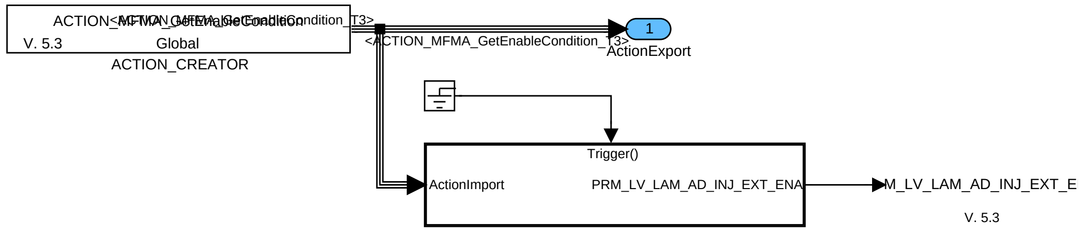

Figure 7.109.34: :

7.109.5.1 No title given

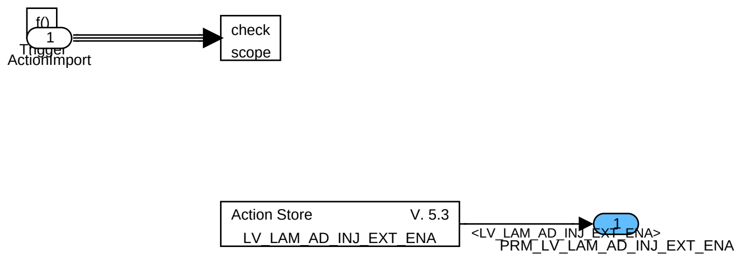

Figure 7.109.35: :

7.109.6 Detailed description for Action: ACTION_MFMA_SetEnableCondition

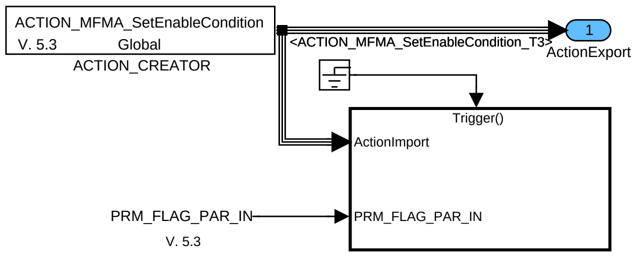

Figure 7.109.36: :

7.109.6.1 No title given

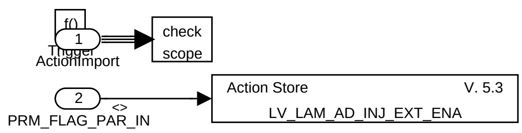

Figure 7.109.37: :

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7.110 Coordination of lambda adaptation via injection mode

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_AD_INJ_COLD_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that the lambda adaptation via injection mode for the lower temp range is finished					
LV_LAM_AD_INJ_HOT_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that the lambda adaptation via injection mode for the higher temp range is finished					
LV_LAM_AD_INJ_PHA_0 [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag to memorize that first adaptation phase is active					
LV_MPL_INJ_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that multiple injection for lambda adaptation via injection mode is active					
LV_SNG_INJ_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that single injection for lambda adaptation via injection mode is active					
NR_CYL_LAM_AD_INJ [NC_CBK_EX_NR]	O/V	80... 7FH	-128 ...127	1	-
Defines the cylinder that is currently using multiple injections for lambda adaptation					
NR_PHA_LAM_AD_INJ_COLD [NC_CBK_EX_NR]	V/S	0... FH	0... 15	1	-
Currently desired lambda adaptation via injection mode phase for the lower temp range					
NR_PHA_LAM_AD_INJ_HOT [NC_CBK_EX_NR]	V/S	0... FH	0... 15	1	-
Currently desired lambda adaptation via injection mode phase for the upper temp range					
STATE_LAM_AD_INJ_ACT [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H 10H 11H 12H 13H 14H 15H 16H 17H 18H	NOT_ACT SNG_ALL_L SNG_ALL_H MPL_CYL0_L MPL_CYL0_H MPL_CYL1_L MPL_CYL1_H MPL_CYL2_L MPL_CYL2_H MPL_CYL3_L MPL_CYL3_H MPL_CYL4_L MPL_CYL4_H MPL_CYL5_L MPL_CYL5_H MPL_CYL6_L MPL_CYL6_H MPL_CYL7_L MPL_CYL7_H	-	-
Current injeciton state for each cylinder requested by lambda adaptation via injection mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_LAM_AD_INJ_MNG [NC_CBK_EX_NR]	V	0H 1H 2H	NOT_ACT CLC_CYL_STATE WAIT_LAM_AD_INJ	-	-
State of the lambda adaptation via injection mode manager					

Input data:

LV_ERR_MIS_LAM_AD_INJ [NC_CYL_NR] {p. 3348}	LV_LAM_AD_INJ_ACT_COLD [NC_CBK_EX_NR] {p. 3348}	LV_LAM_AD_INJ_ACT_HOT [NC_CBK_EX_NR] {p. 3349}	LV_LAM_AD_INJ_CLR_AD_EXT {p. 7483}
LV_LAM_AD_INJ_CUS_ACK [NC_CBK_EX_NR] {p. 8269}	LV_LAM_AD_INJ_INTR {p. 3349}	LV_LAM_AD_INJ_INTR_2 [NC_CBK_EX_NR] {p. 3349}	LV_LAM_AD_INJ_INTR_LAM {p. 3349}
LV_LAM_AD_INJ_MV_CLC_END [NC_CBK_EX_NR] {p. 3405}	LV_LAM_AD_INJ_REP {p. 3349}	NC_CBK_EX_NR {p. 1829}	NC_NR_PHA_LAM_AD_INJ {p. 827}
STATE_LS [NC_CBK_EX_NR] {p. 2448}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NR_PHA_LAM_AD_INJ	-	0... FH	0... 15	1	-
Number of adaptation cycles for lambda adaptation via injection mode					
ID_NR_CYL_LAM_AD_INJ [NC_CBK_EX_NR]	-	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H 10H 11H 12H 13H 14H 15H 16H 17H 18H	NOT_ACT SNG_ALL_L SNG_ALL_H MPL_CYL0_L MPL_CYL0_H MPL_CYL1_L MPL_CYL1_H MPL_CYL2_L MPL_CYL2_H MPL_CYL3_L MPL_CYL3_H MPL_CYL4_L MPL_CYL4_H MPL_CYL5_L MPL_CYL5_H MPL_CYL6_L MPL_CYL6_H MPL_CYL7_L MPL_CYL7_H	-	-

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_NR_ID_NR_CYL_LAM_AD_INJ	NC_ NR_ PHA_ LAM_ AD_ INJ	0... FH	0... 15	1	-
Desired injection order for all banks					

General Information

This module coordinates the usage of single and multiple injections for lambda adaptation via injection mode.

Application Conditions

Initialization: RST, IGKON, NVMRES, NVMINI, NVMSTO
Activation: 20MS: always
ES2ERU: always
Deactivation: never

Function description

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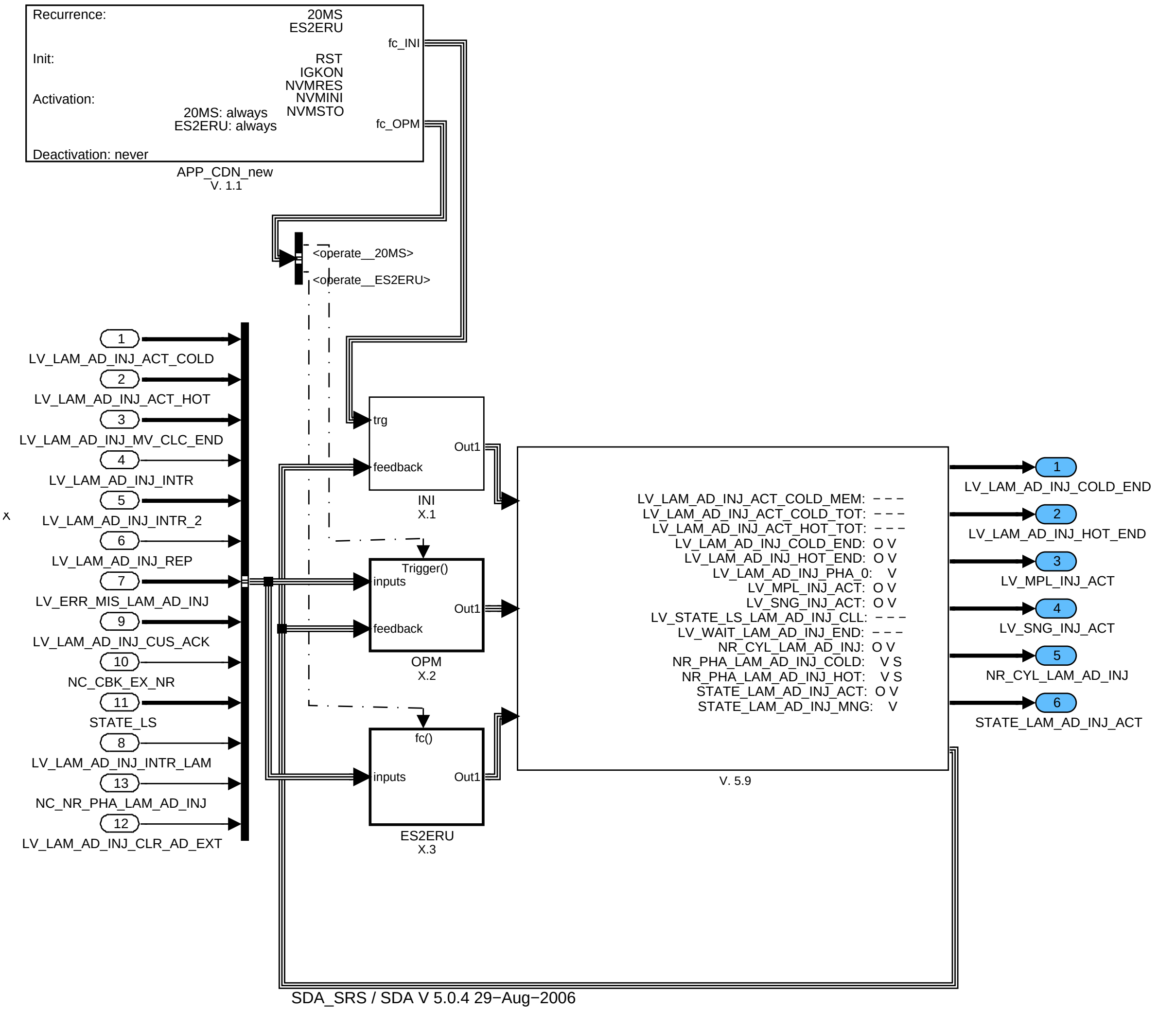

Figure 7.110.1: : Path: MFMA_REQCOAIMM0

7.110.1 Initialization and NVMY management

7.110.1.1 Reading from non-volatile memory

The phase number NR_PHA_LAM_AD_INJ_COLD/HOT are initialized from the non-volatile memory.

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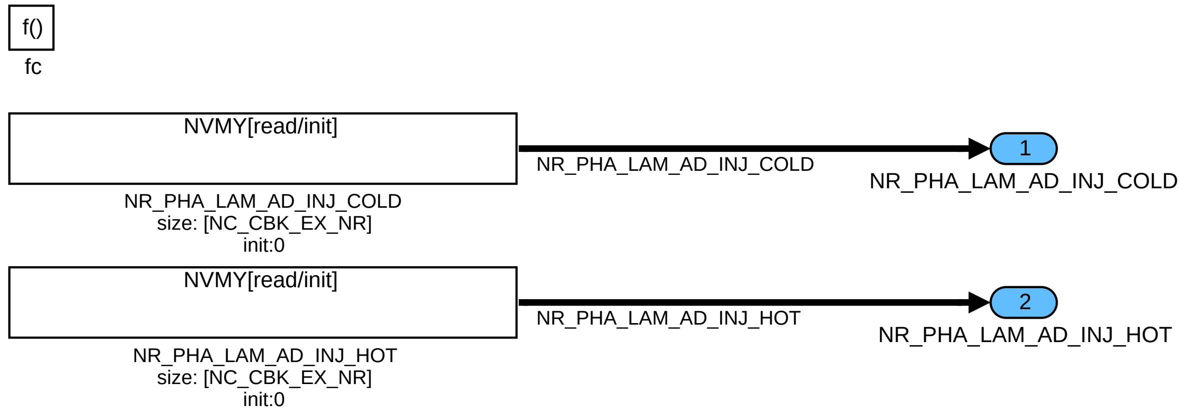

Figure 7.110.2: : Path: MFMA_REQCOAIMM0/INI/NVMY_RD

7.110.1.2 Writing to the non-volatile memory

After powerlatch the values of NR_PHA_LAM_AD_INJ_COLD/HOT are written to the non-volatile memory.

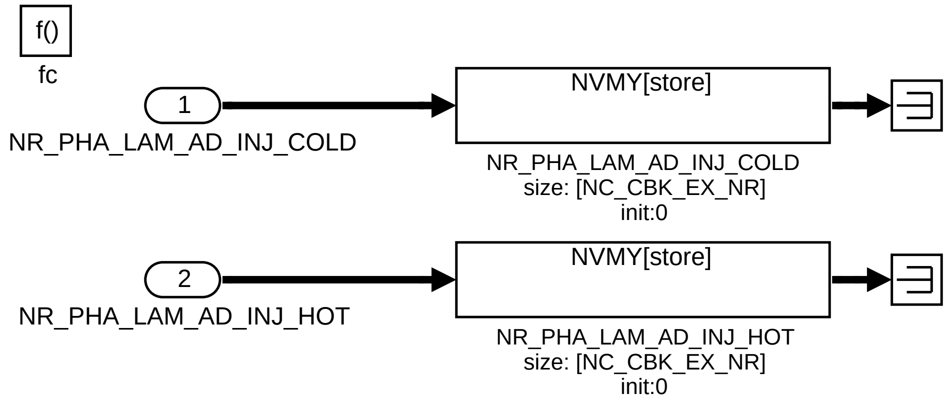

Figure 7.110.3: : Path: MFMA_REQCOAIMM0/INI/NVMY_WR

7.110.1.3 Initialization

All variables are initialized with 0 at reset or IGKON.

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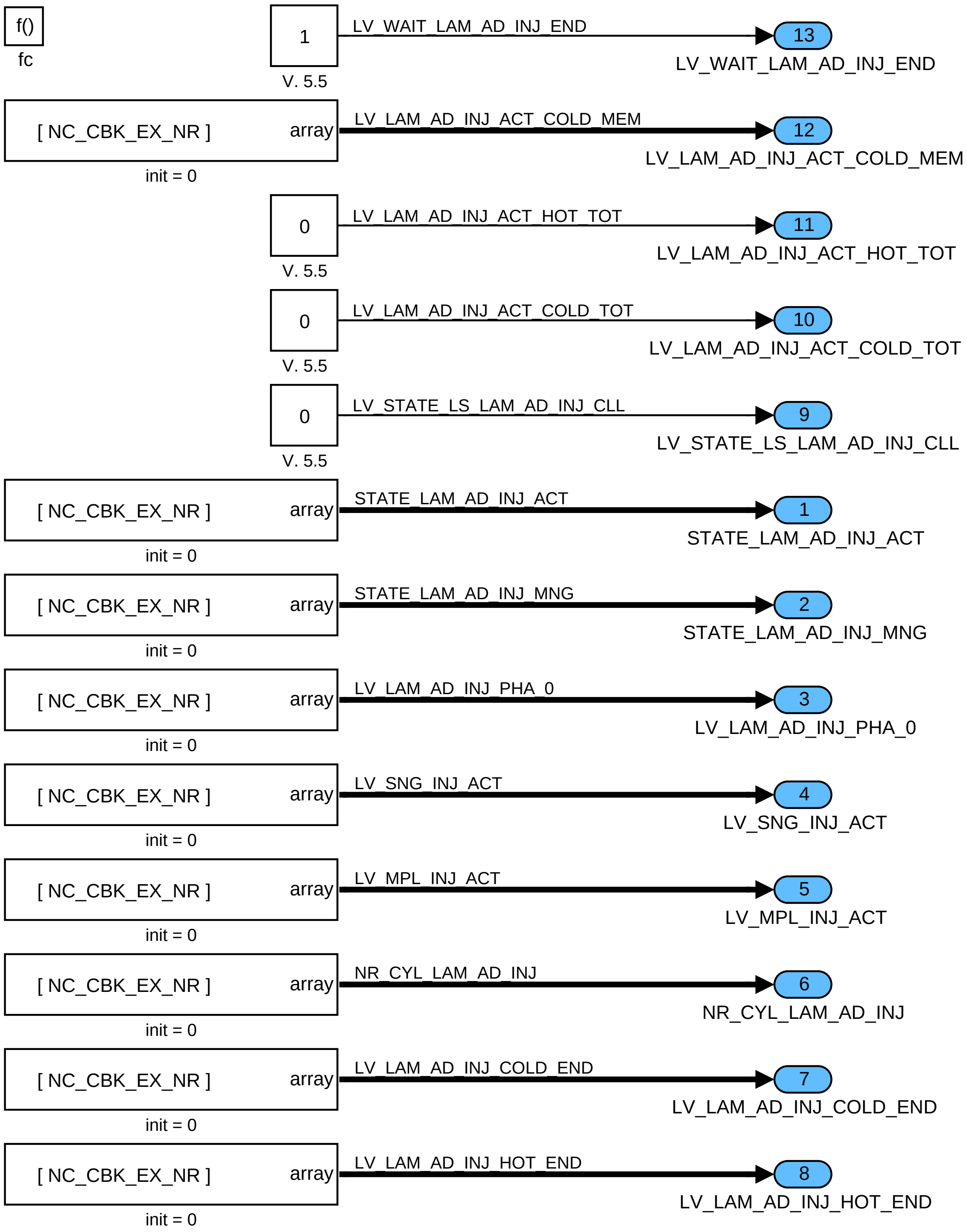

Figure 7.110.4: : Path: MFMA_REQCOAIMM0/INI/INI

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7.110.2 Bank specific calculations

All calculations are done for every bank. The value for the specific bank is denoted in the graphical model with the suffix _i whereas in the textual description the bank specific values are referred to with [i].

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7.110.2.1 Preliminary calculations

7.110.2.1.1 Calculation of LV_LAM_AD_INJ_ACT_COLD_MEM, LV_WAIT_LAM_AD_INJ_END and LV_STATE_LS_LAM_AD_INJ_CLL

The flag LV_WAIT_LAM_AD_INJ_END is set if the adaptation signals the end of the mean value calculation for both banks. The values of LV_LAM_AD_INJ_ACT_COLD are memorized in LV_LAM_AD_INJ_ACT_COLD_MEM as this is used for determination of the phase numbers NR_PHA_LAM_AD_INJ_COLD/HOT. To get a bank synchronous switching of the state machine, the activation conditions for the lambda controller are checked for all banks and stored in LV_STATE_LS_LAM_AD_INJ_CLL.

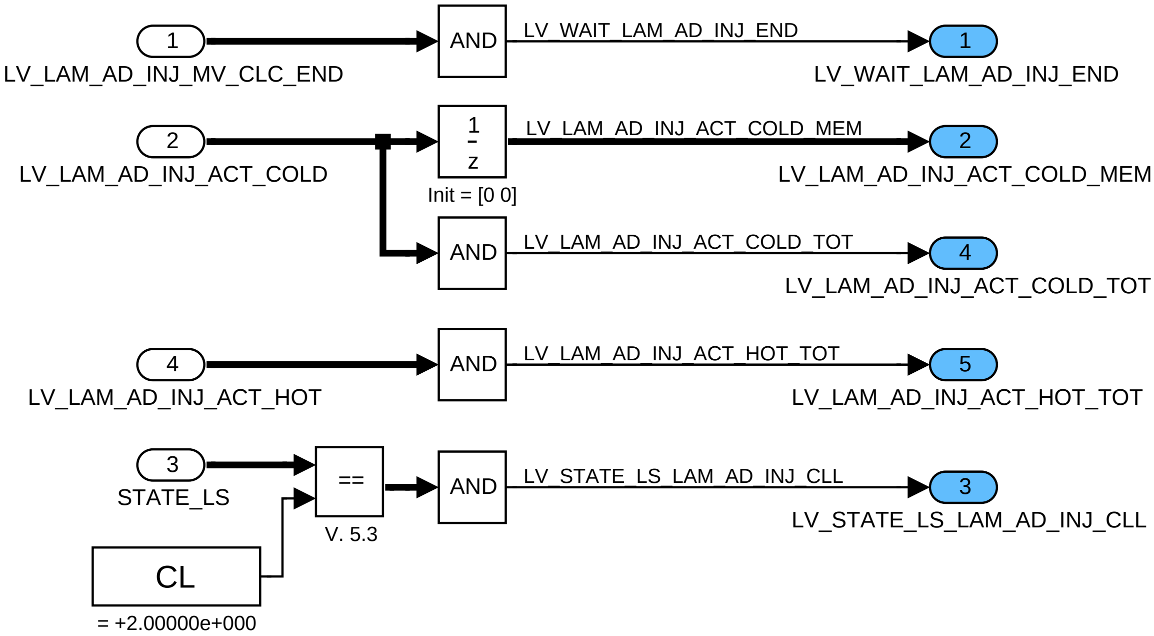

Figure 7.110.5: : Path: MFMA_REQCOAIMM0/OPM/CLC_MEM/CLC

7.110.2.2 Adaptation manager

The adaptation manager consists of three states STATE_LAM_AD_INJ[i]:
NOT_ACT: inactive state
CLC_CYL_STATE: intermediate state to determine single/multiple injection-mode for the next adaptation phase
WAIT_LAM_AD_INJ: the adaptation enabled for the injection-mode defined in the previous state

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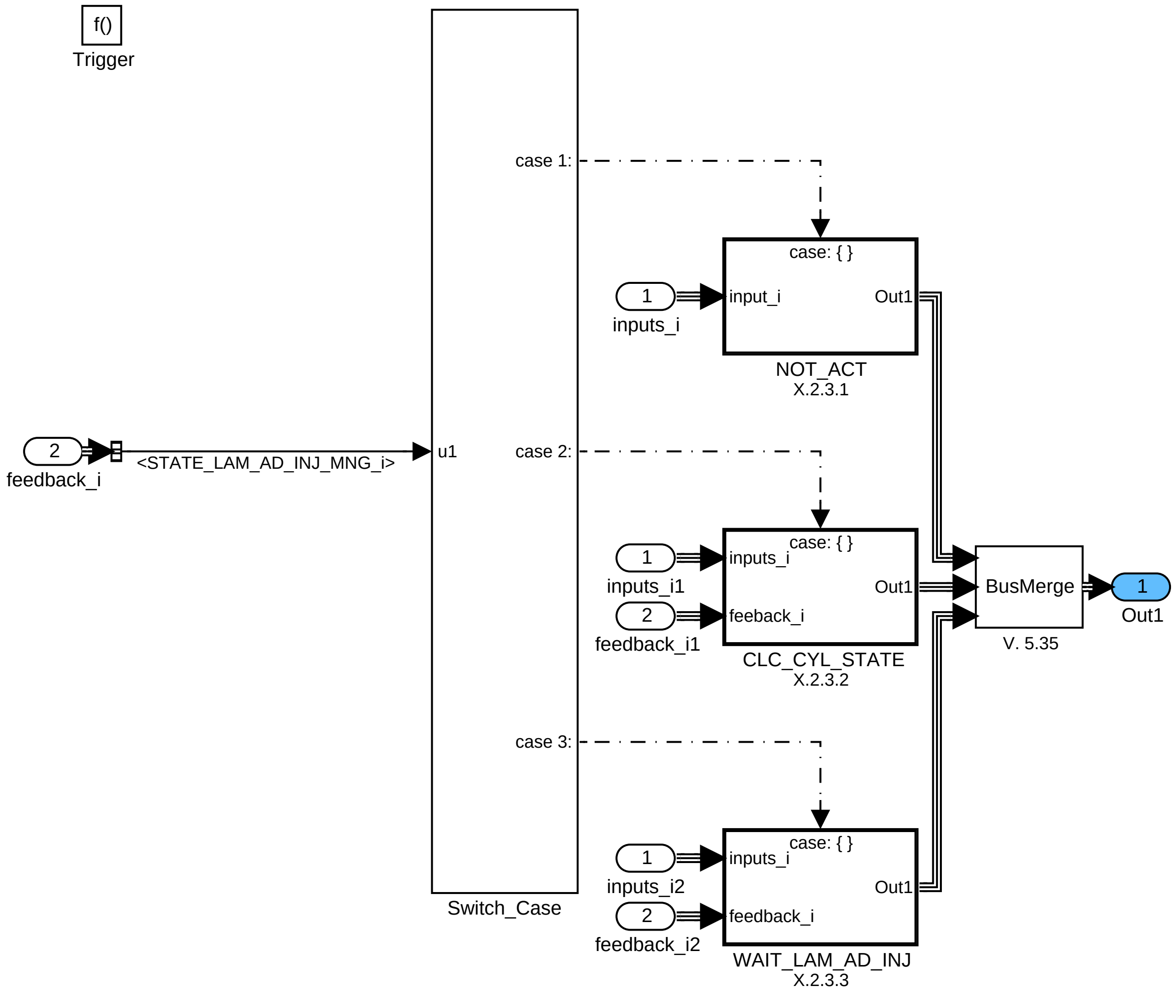

Figure 7.110.6: : Path: MFMA_REQCOAIMM0/OPM/STATE_MNG

7.110.2.2.1 NOT_ACT

In this state the adaptation is inactive. If the conditions for the adaptation in the upper or lower temperature range apply, the injection mode control is requested by setting the state STATE_LAM_AD_INJ_ACT[i] different from zero.

7.110.2.2.1.1 Transition conditions

If the adaptation conditions apply the injection mode control is requested and the state is left if it is granted (LV_LAM_AD_INJ_CUS_ACK = 1).

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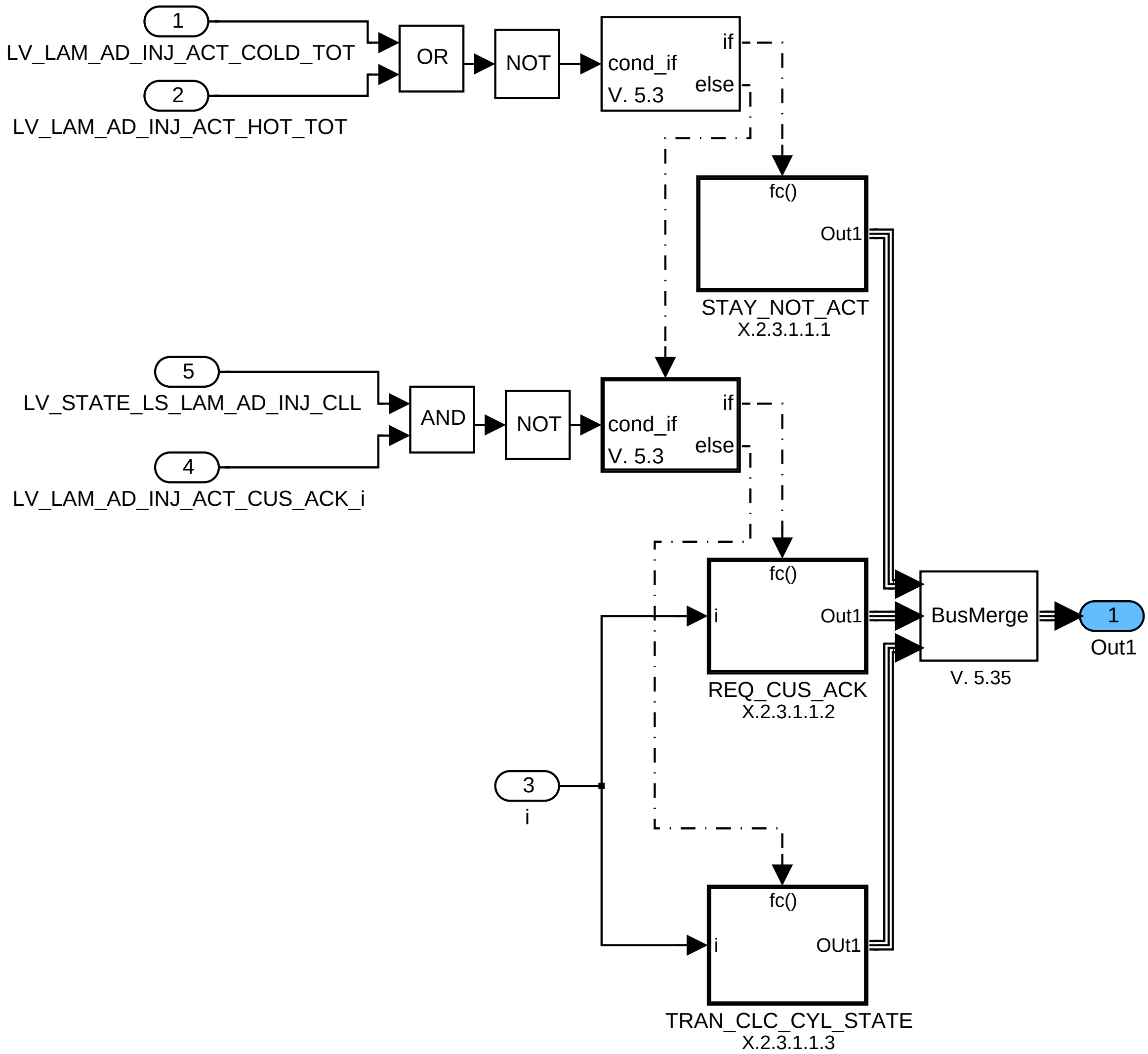

Figure 7.110.7: : Path: MFMA_REQCOAIMM0/OPM/STATE_MNG/NOT_ACT/CLC

7.110.2.2.1.1.1 Remaining in NOT_ACT

7.110.2.2.1.1.1.1 Reset of the request for the injection mode control

The request is reset if the conditions are no more fulfilled.

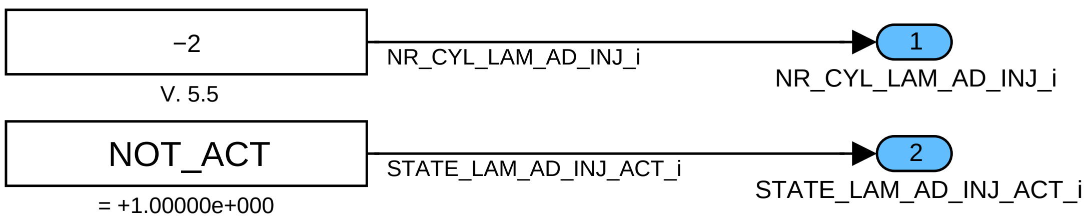

Figure 7.110.8: : Path: MFMA_REQCOAIMM0/OPM/STATE_MNG/NOT_ACT/CLC/STAY_NOT_ACT/CLC

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7.110.2.2.1.1.2 Start of injection mode control handshake

The injection mode for the bank is requested.

7.110.2.2.1.1.2.1 Request for injection mode control

The control of the injection mode is requested by setting the STATE_LAM_AD_INJ_ACT[i] to the first element of ID_NR_CYL_LAM_AD_INJ[i], which should be set to one or two to request single injections.

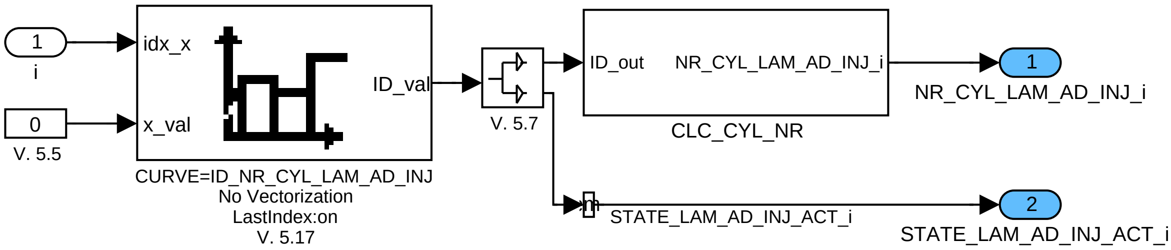

Figure 7.110.9: : Path:
MFMA_REQCOAIMM0/OPM/STATE_MNG/NOT_ACT/CLC/REQ_CUS_ACK/CLC

7.110.2.2.1.1.3 Injection mode control granted

7.110.2.2.1.1.3.1 Transition to CLC_CYL_STATE

If the acknowledge bit for injection mode control LV _LAM_AD_INJ_CUS_ACK is set, the state is left towards CLC_CYL_STATE.

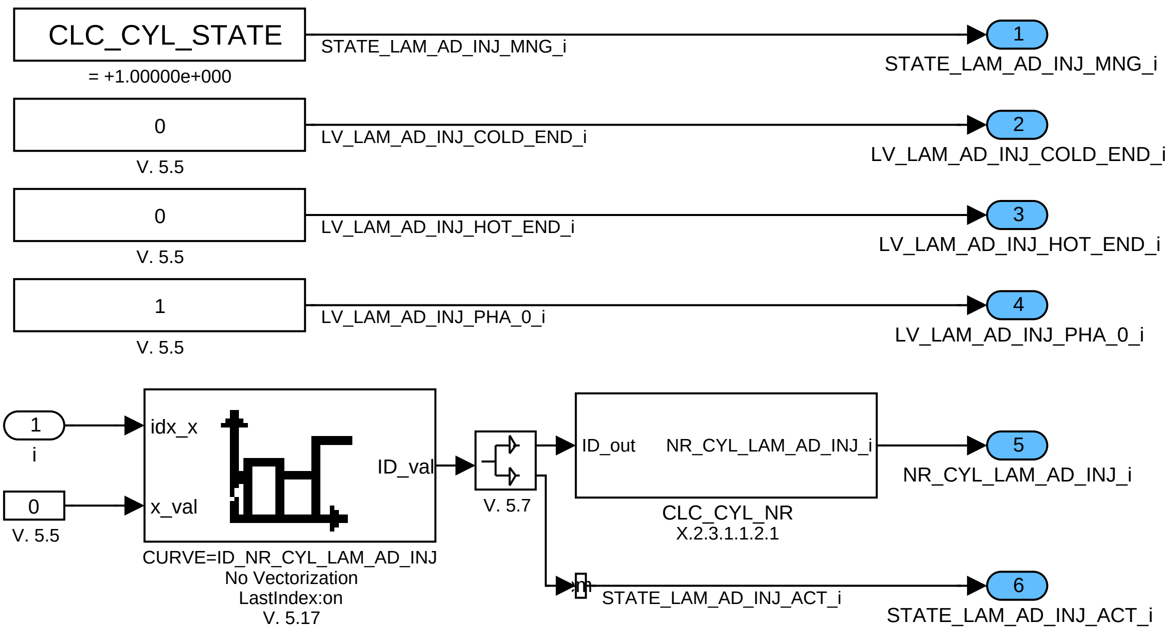

Figure 7.110.10: : Path:
MFMA_REQCOAIMM0/OPM/STATE_MNG/NOT_ACT/CLC/TRAN_CLC_CYL_STATE/CLC

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7.110.2.2.1.1.3.1.1 Calculation of the cylinder number from STATE_LAM_AD_INJ_ACR

The conversion from ID_out[i] to NR_CYL_LAM_AD_INJ[i] can be done in the code as follows:
NR_CYL_LAM_AD_INJ[i] = (signed)((ID_out+1) >> 1) - 2;
Therewith the conversion should be done as follows:

ID_OUT	NR_CYL_LAM_AD_INJ
0	-2
1	-1
2	-1
3	0
4	0
...	...
18	7

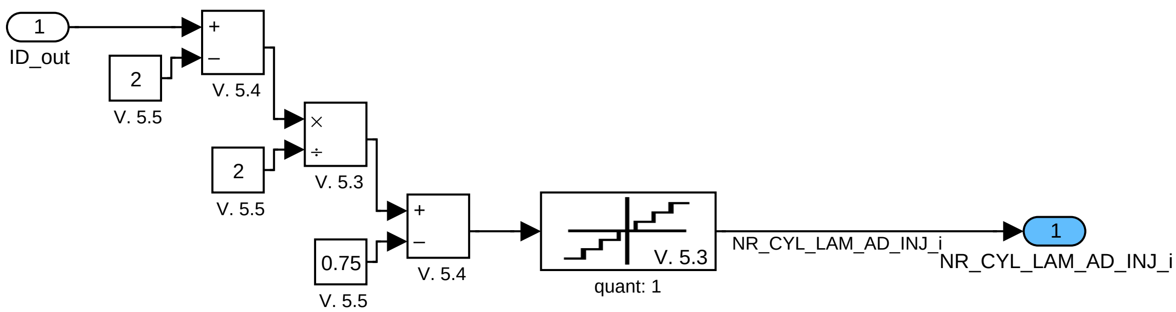

Figure 7.110.11: : Path: MFMA_REQCOAIMM0/OPM/STATE_MNG/NOT_ACT/CLC/
TRAN_CLC_CYL_STATE/CLC/CLC_CYL_NR

7.110.2.2.2 CLC_CYL_STATE

This state is used for determination of the injection mode for the next adaptation phase.

7.110.2.2.2.1 Transition conditions

If the cylinder number of the current bank NR_CYL_LAM_AD_INJ[i] is equal to -2, the current adaptation is assumed to be finished and the state is left to NOT_ACT. If the adaptation is interrupted due to the lack of the necessary conditions, a transition to NOT_ACT is performed, too. Otherwise the state changes to WAIT_LAM_AD_INJ.

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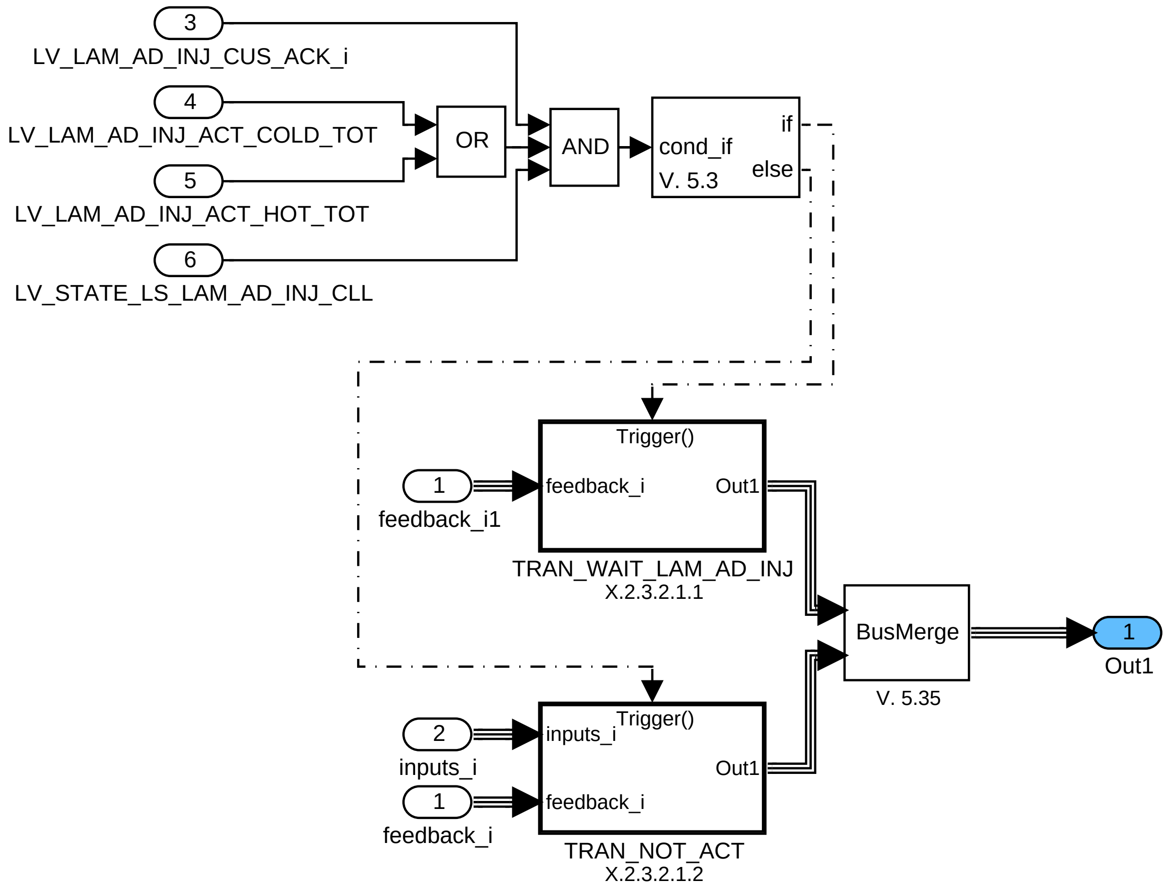

Figure 7.110.12: : Path: MFMA_REQCOAIMM0/OPM/STATE_MNG/CLC_CYL_STATE/CLC

7.110.2.2.2.1.1 Transition to WAIT_LAM_AD_INJ

7.110.2.2.2.1.1.1 Setting of LV_SNG/MPL_ACT

If the STATE_LAM_AD_INJ_ACT[i] is bigger than 2, multiple injections for this cylinder number are requested and therefore LV_MPL_INJ_ACT[i] is set. Otherwise LV_SNG_INJ_ACT[i] is set to enable the corresponding adaptation.

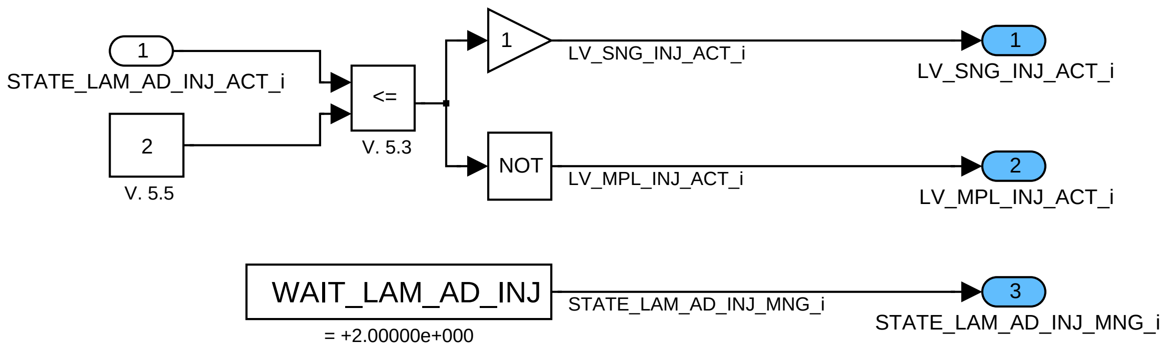

Figure 7.110.13: : Path:
MFMA_REQCOAIMM0/OPM/STATE_MNG/CLC_CYL_STATE/CLC/TRAN_WAIT_LAM_AD_INJ/CLC

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7.110.2.2.2.1.2 Transition to NOT_ACT due to interruption

7.110.2.2.2.1.2.1 Saving of the last completed phase number

If the adaptation is interrupted, the last completed adaptation phase number is stored in NR_PHA_LAM_AD_INJ_COLD/HOT[i], to make sure the adaptation is continued with the correct phase number if the conditions apply again and therefore all cylinders are adapted.

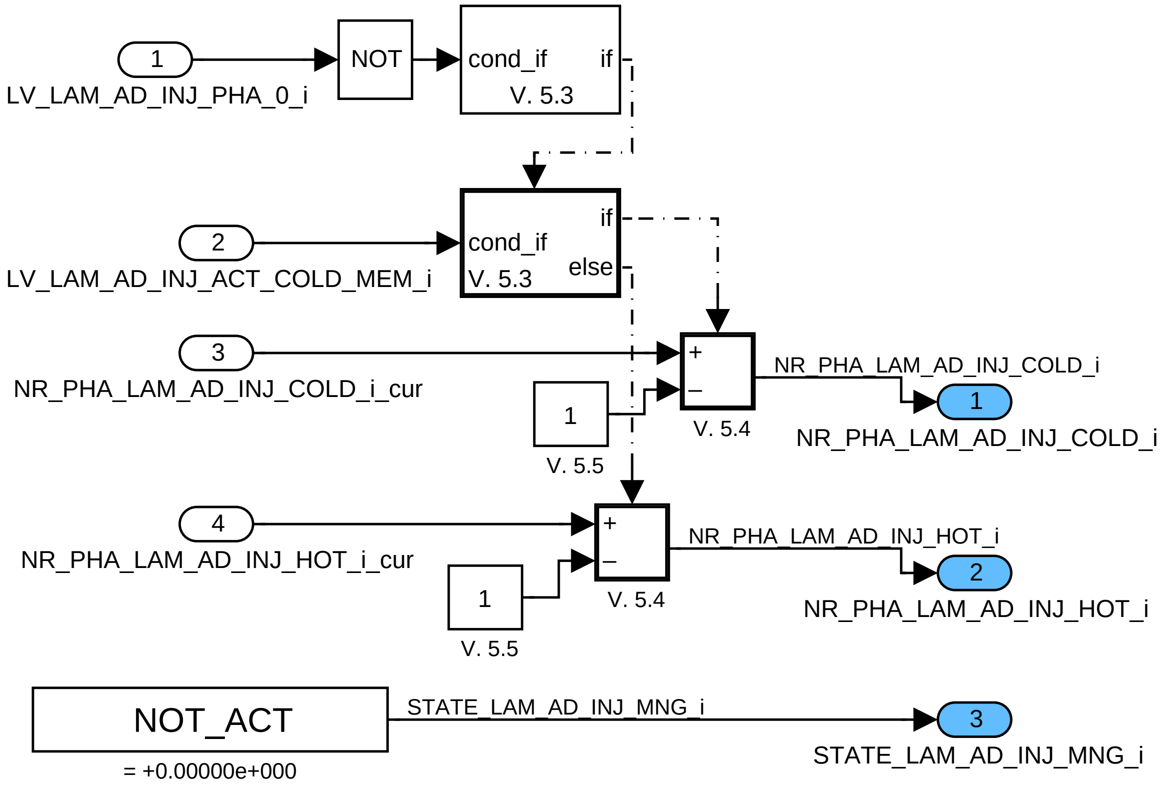

Figure 7.110.14: : Path:
MFMA_REQCOAIMM0/OPM/STATE_MNG/CLC_CYL_STATE/CLC/TRAN_NOT_ACT/CLC

7.110.2.2.3 WAIT_LAM_AD_INJ

This state waits for the current adaptation phase to be completed or the adaptation conditions to be stopped.

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7.110.2.2.3.1 Transitions conditions

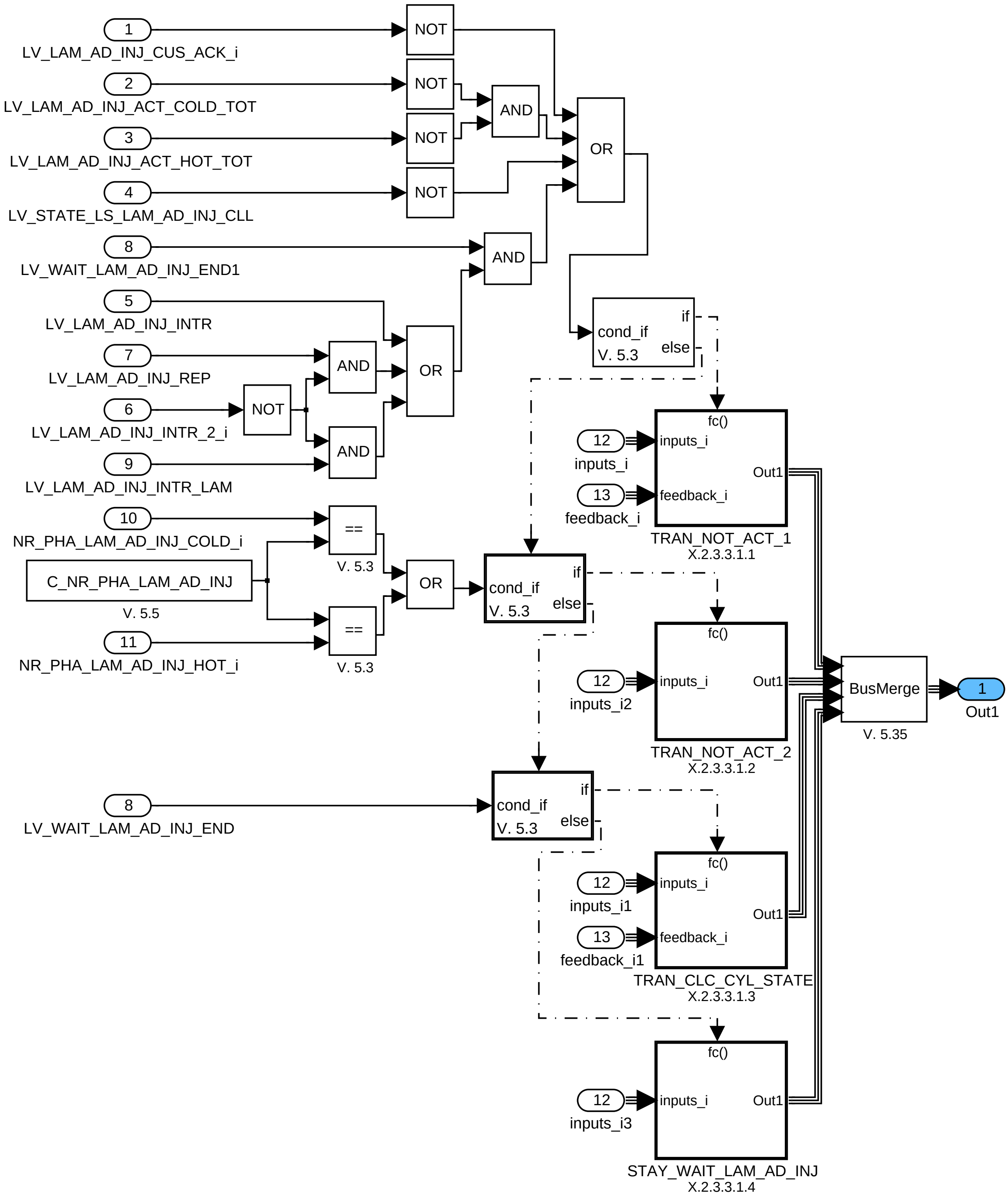

Figure 7.110.15: : Path: MFMA_REQCOAIMM0/OPM/STATE_MNG/WAIT_LAM_AD_INJ/CLC

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7.110.2.2.3.1.1 Transition to NOT_ACT due to interruption

7.110.2.2.3.1.1.1 Saving of the last completed phase number

If the adaptation is interrupted, the last completed adaptation phase number is stored in NR_PHA_LAM_AD_INJ_COLD/HOT[i], to make sure the adaptation is continued with the correct phase number if the conditions apply again and therefore all cylinders are adapted.
Furthermore the activation flags LV_SNG/MPL_ACT[i] are reset, to ensure that the current adaptation phase is stopped.

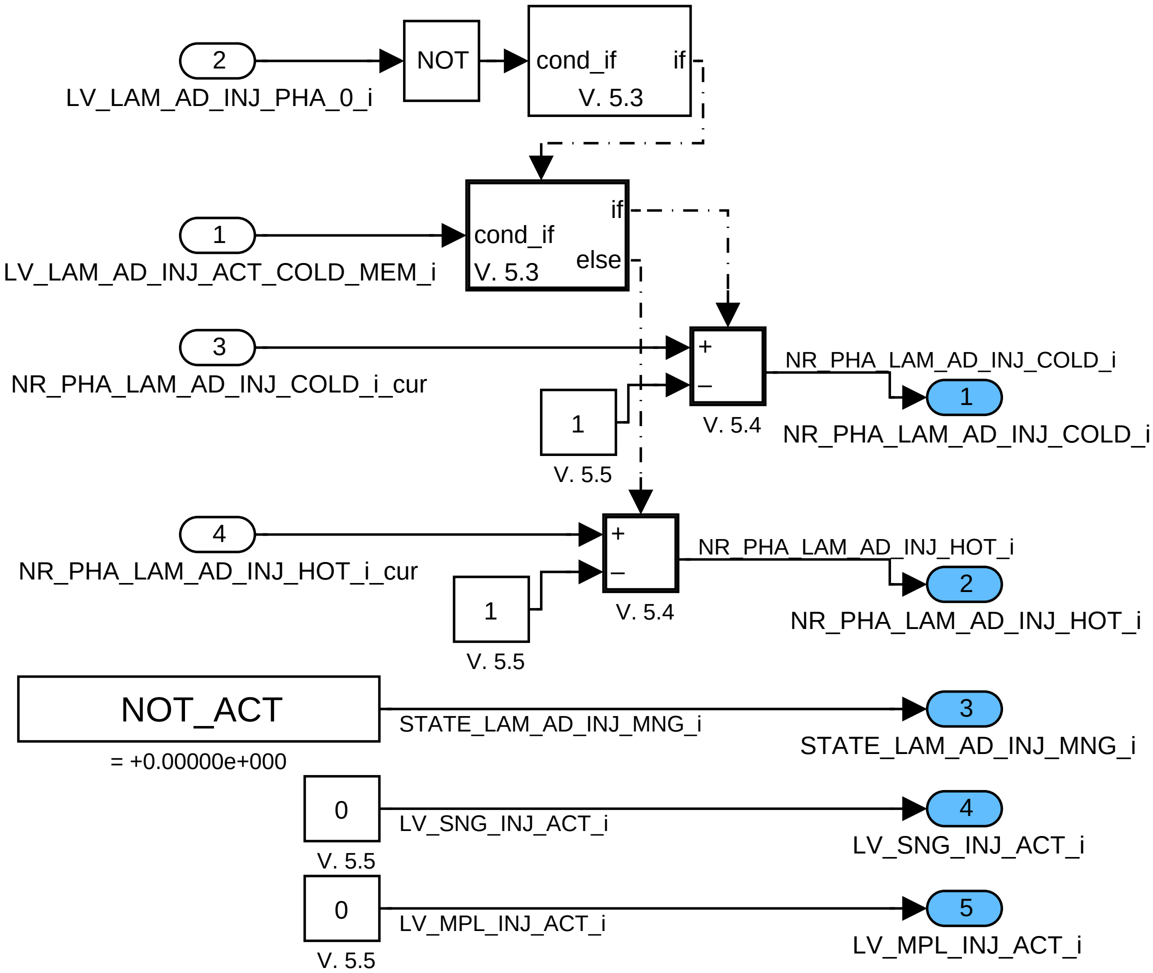

Figure 7.110.16: : Path:
MFMA_REQCOAIMM0/OPM/STATE_MNG/WAIT_LAM_AD_INJ/CLC/TRAN_NOT_ACT_1/CLC

7.110.2.2.3.1.2 Transition to NOT_ACT due to finished adaptation

7.110.2.2.3.1.2.1 Setting of LV_LAM_AD_INJ_COLD/HOT_END

As the adaptation for the current temperature range is finished, the corresponding end-flag is set and the corresponding phase number NR_PHA_LAM_AD_INJ_COLD/HOT[i] is reset to 0. Therefore the adaptation starts from the beginning if the conditions apply for the next time.

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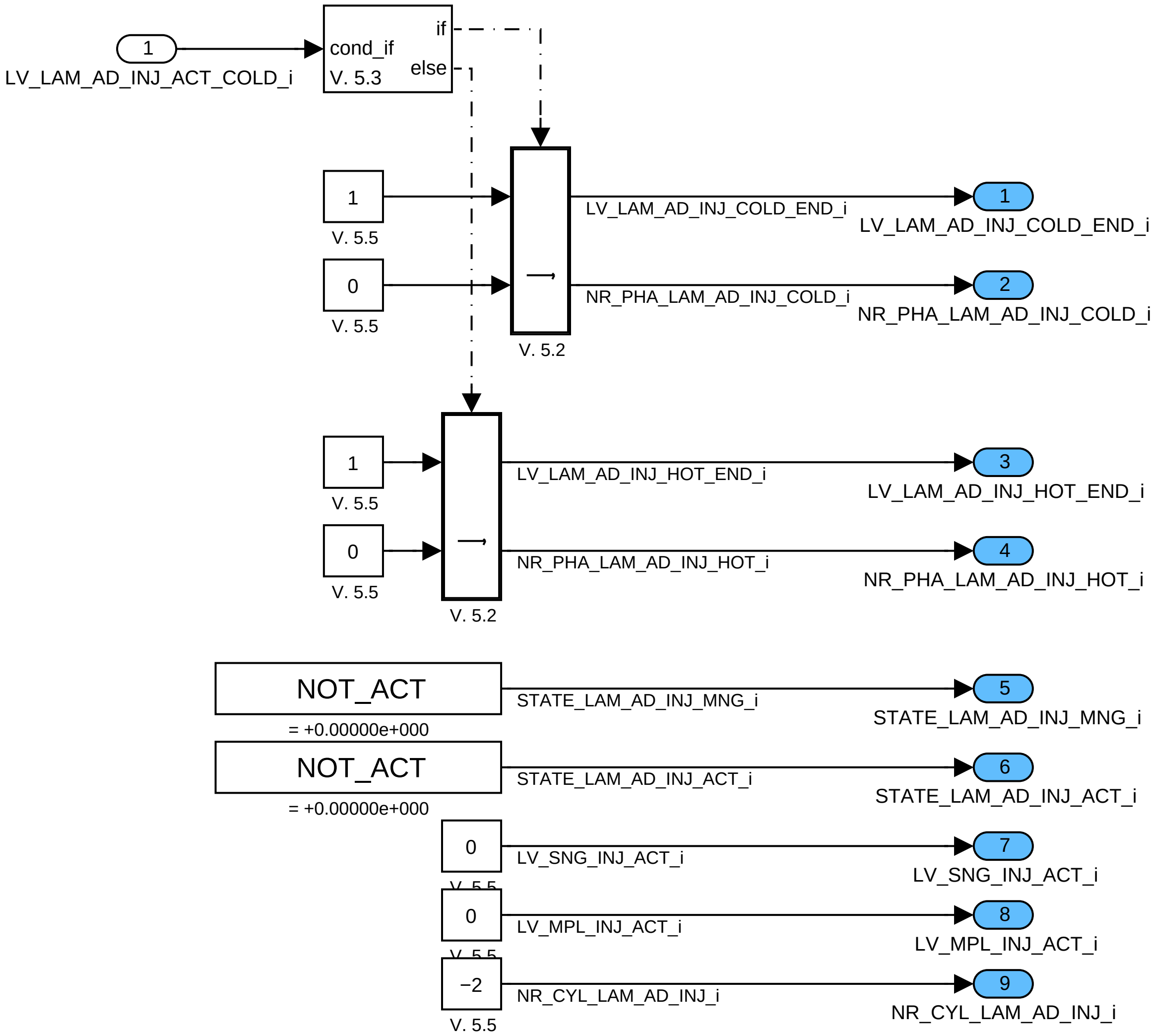

Figure 7.110.17: : Path:
MFMA_REQCOAIMM0/OPM/STATE_MNG/WAIT_LAM_AD_INJ/CLC/TRAN_NOT_ACT_2/CLC

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7.110.2.2.3.1.3 Transition to CLC_CYL_STATE

7.110.2.2.3.1.3.1 Determination of the injection mode for the next adaptation phase

The injection mode for the next adaptation phase is determined from the map ID_NR_CYL_LAM_AD_INJ[i] and requested via STATE_LAM_AD_INJ_ACT[i]. If multiple injections for one cylinder of the current bank is requested, the corresponding cylinder number is stored in NR_CYL_LAM_AD_INJ[i]. Otherwise -1 (single injection) or -2(end of adaptation) is used.

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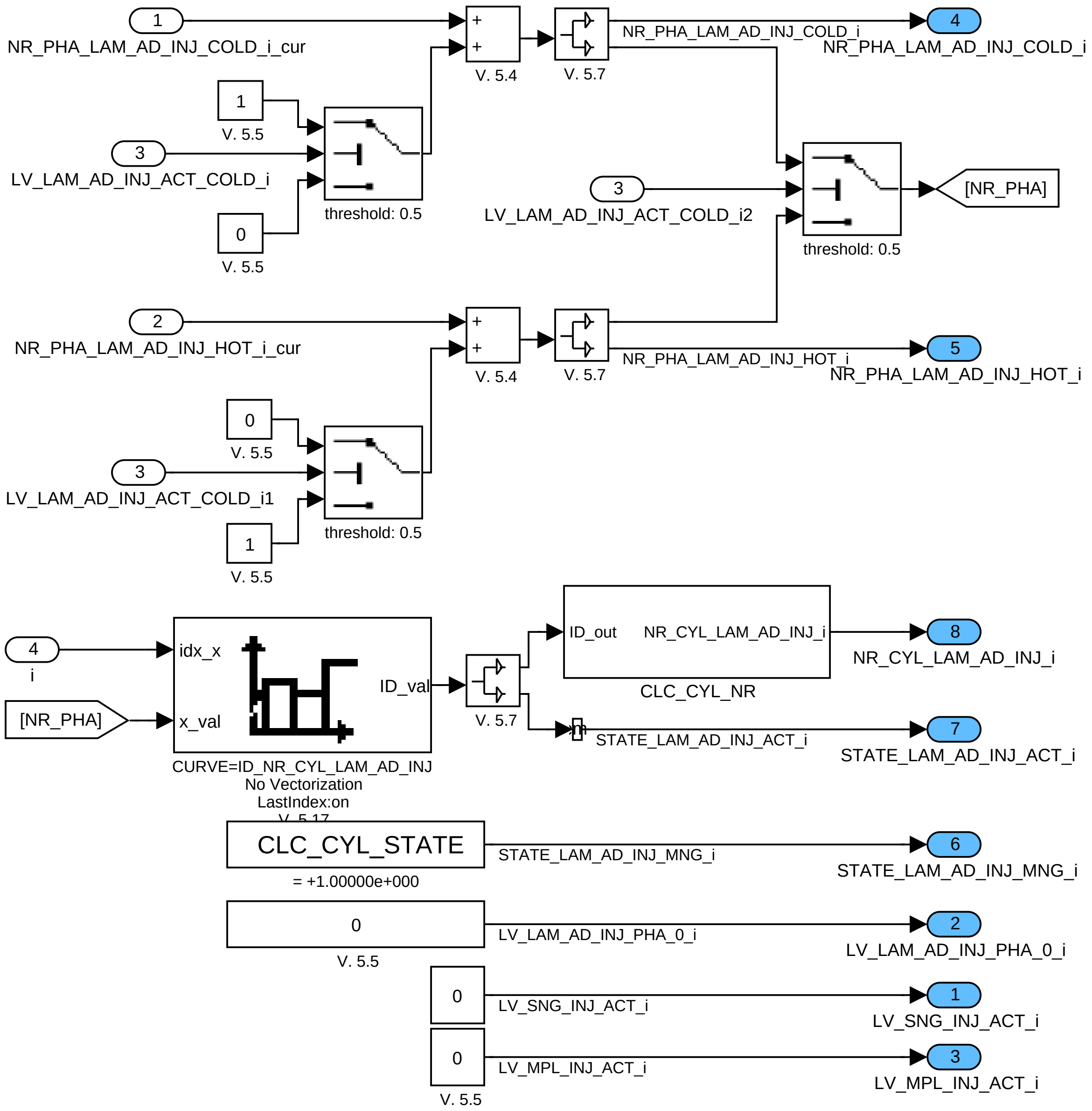

Figure 7.110.18: : Path: MFMA_REQCOAIMM0/OPM/STATE_MNG/WAIT_LAM_AD_INJ/CLC/TRAN_CLC_CYL_STATE/CLC_1

7.110.2.2.3.1.3.2 Cancelling of multiple injection due to misfire error

If the flag LV_ERR_MIS_LAM_AD_INJ[x] (where x denotes the current cylinder number) is set, i.e. a repeated misfire error is detected, the request for multiple injections is cancelled and another single injection phase will be started to continue with the adaptation of the other cylinders.

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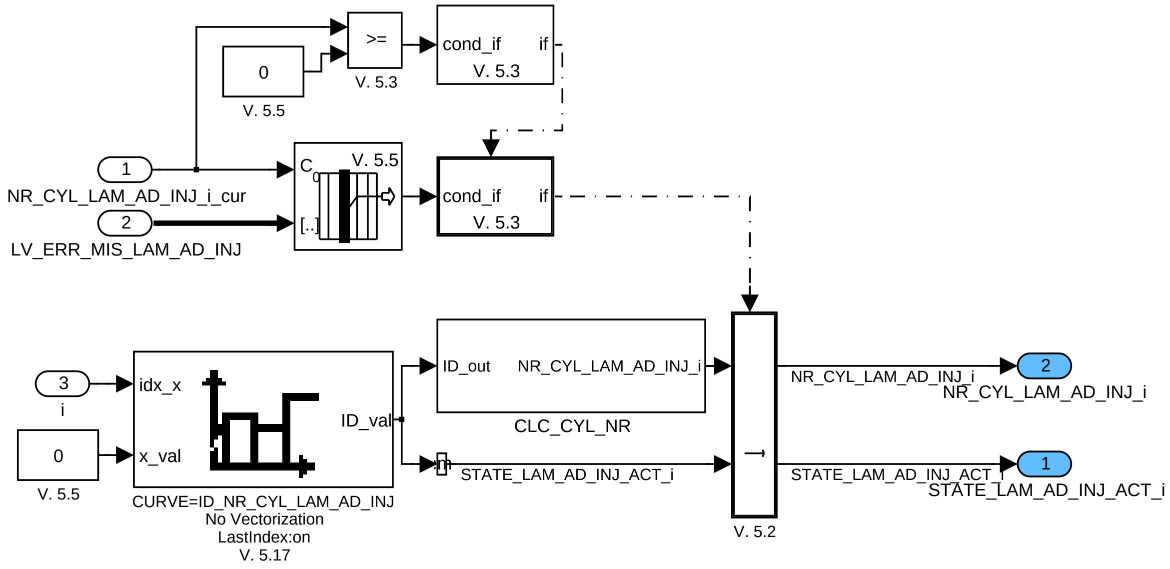

Figure 7.110.19: : Path: MFMA_REQCOAIMM0/OPM/STATE_MNG/WAIT_LAM_AD_INJ/CLC/TRAN_CLC_CYL_STATE/CLC_2

7.110.2.2.3.1.4 Waiting for the end of the current adaptation cycle

7.110.2.2.3.1.4.1 Resetting of LV_SNG/MPL_INJ_ACT

If one bank signals the end of its adaptation phase (LV_LAM_AD_INJ_MV_CLC_END[i]), the corresponding activation flags LV_SNG/MPL_INJ_ACT[i] are reset. If the flag LV_LAM_AD_INJ_INTR_2[i] is set, repeated misfire is detected on the current cylinder and therefore single injection is requested.

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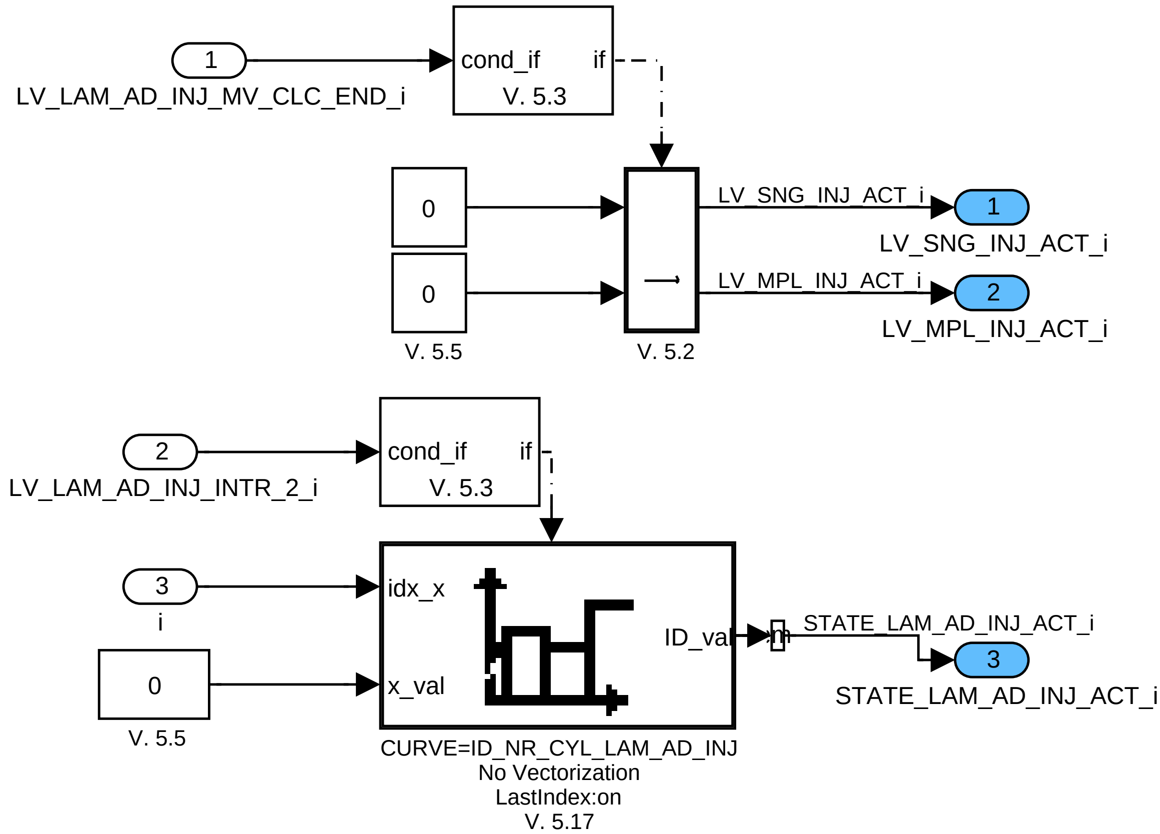

Figure 7.110.20: : Path: MFMA_REQCOAIMM0/OPM/STATE_MNG/WAIT_LAM_AD_INJ/CLC/STAY_WAIT_LAM_AD_INJ/CLC

7.110.3 Operations at transition engine stop to engine run

7.110.3.1 Resetting of the phase numbers

If a resetting of the NVMY data via service tester is requested with the flag LV_LAM_AD_INJ_CLR_AD_EXT, the phase numbers of both banks for the upper and lower temperature range are reset to 0.

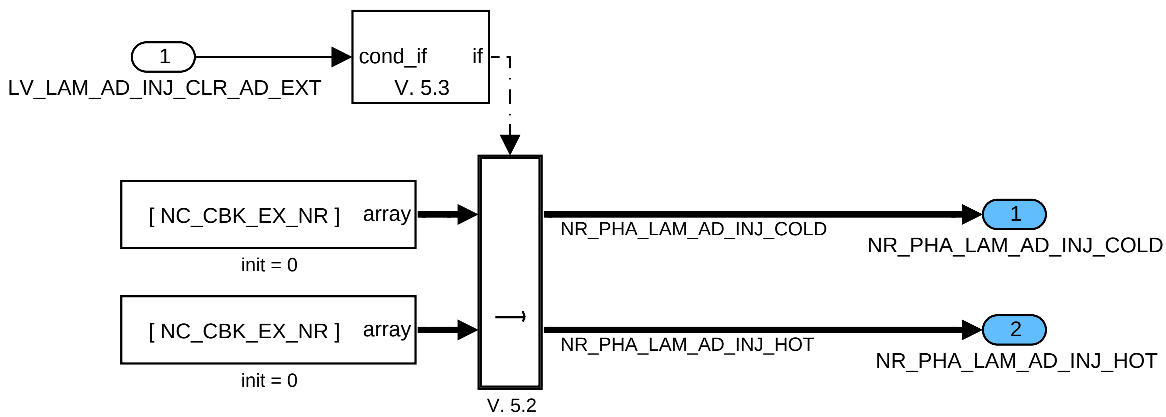

Figure 7.110.21: : Path: MFMA_REQCOAIMM0/ES2ERU/CLC

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7.111 Lambda adaptation via injection mode (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_LAM_AD_INJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Lambda adapation via injection mode inhibition flag					

Input data:

LV_ACT_DIAGCPS {p. 5926}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM {p. 1505}
LV_ERR_CAM_DE_IVVT_EX [NC_NR_CBK_IVVT] {p. 800}	LV_ERR_CAM_DE_IVVT_IN [NC_NR_CBK_IVVT] {p. 800}	LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}	LV_ERR_CPS {p. 1001}
LV_ERR_CRK {p. 4455}	LV_ERR_CYL_BAL_LAM [NC_CYL_NR] {p. 5112}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}
LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FTL_MIN {p. 4762}	LV_ERR_FUP {p. 4717}
LV_ERR_FUP_EFP {p. 4733}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}
LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ERR_MAF {p. 4815}
LV_ERR_MAP {p. 982}	LV_ERR_MAP_DIP_SHIFT {p. 4824}	LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_PLAUS {p. 1062}
LV_ERR_MEC_OPEN_CPS {p. 1001}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}
LV_ERR_RATIO_CHK {p. 982}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TCO {p. 4496}
LV_ERR_TIA_IM {p. 984}	LV_ERR_TIA_THR {p. 984}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_1 {p. 4951}
LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}	LV_ERR_VCV_PLAUS {p. 6062}
LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_ERR_WG_DR [NC_CBK_EX_NR]	LV_LIH_ERR_CRK {p. 1505}	LV_MIS_STATE_B1 {p. 6238}

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LV_MIS_STATE_B4 {p. 6238}	NC_CBK_EX_NR {p. 1829}	STATE_CAT_DIAG [NC_CBK_EX_NR] {p. 5474}	STATE_LS [NC_CBK_EX_NR] {p. 2448}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LAM_AD_INJ_INH	-	0... 1H	0 ...1	1	-
Manual inhibition of lambda adaptation via injection mode					

General Information

In the application incidence module the inhibition flag LV_INH_LAM_AD_INJ[i] for every exhaust cylinder bank is calculated.

Application Conditions

Initialization: RST, IGKON
Recurrence: 20MS
Activation: always
Deactivation: never

Function description

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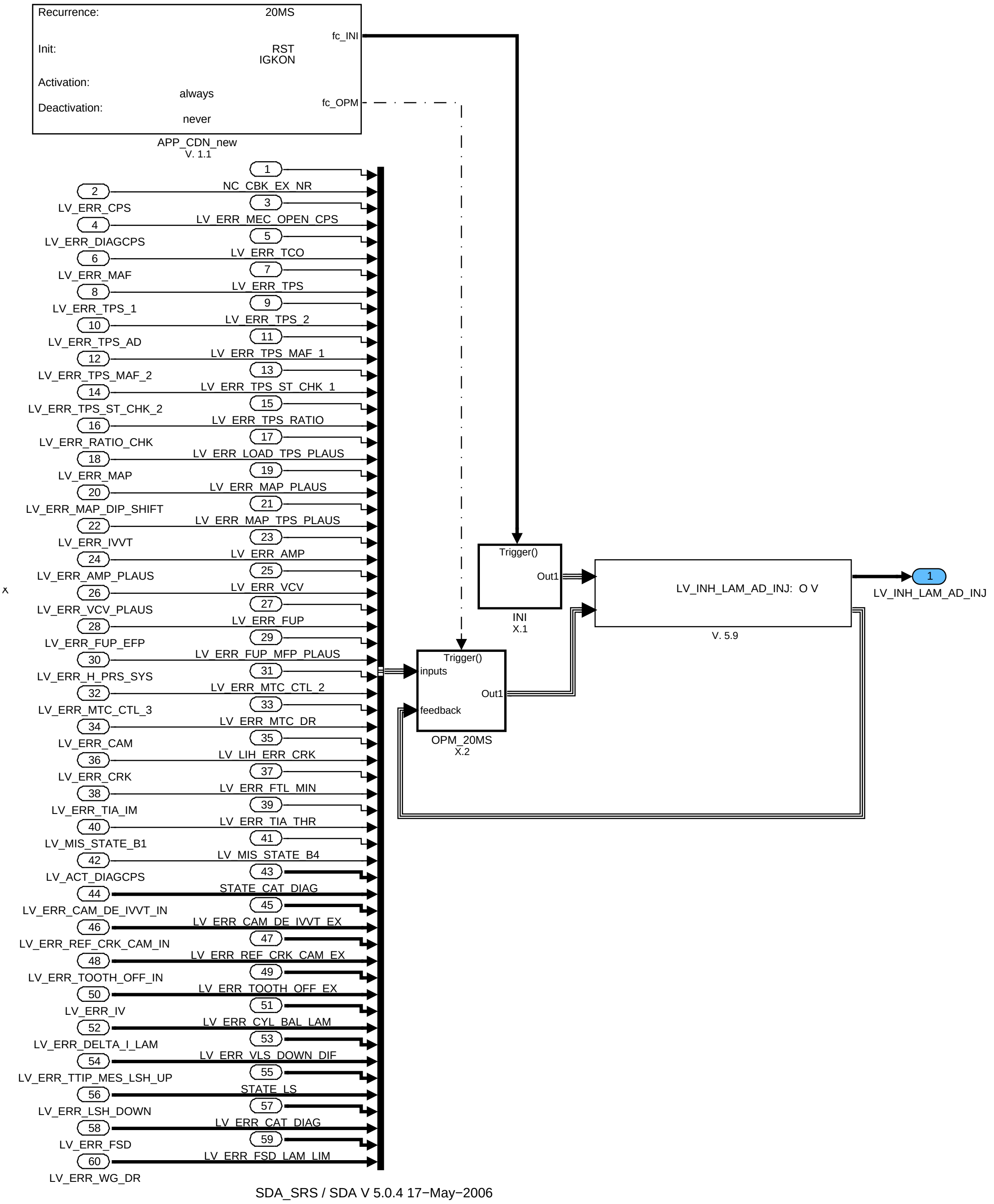

Figure 7.111.1: : Path: MFMA_ISPCLAIMI0

7.111.1 Initialization

The inhibition flag is initialized at reset and at ignition key on.

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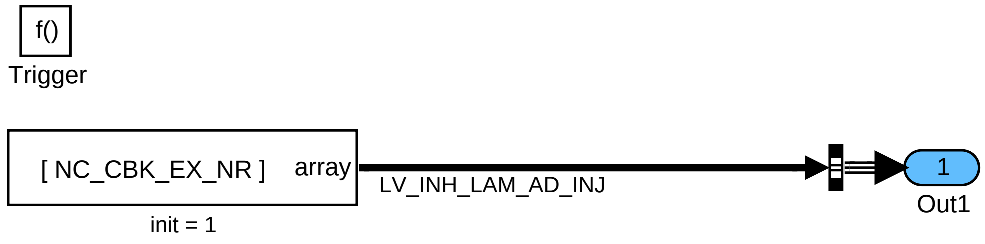

Figure 7.111.2: : Path: MFMA_ISPCLAIMI0/INI

7.111.2 Inhibition conditions calculation

The inhibition conditions calculation is divided into two parts. The first part consists of conditions, which do not depend on a specific exhaust cylinder bank, and therefore any of the conditions will inhibit the adaptation of all banks. The second part consists only of conditions, which depend on a specific bank and will inhibit only the adaptation on the corresponding bank.

7.111.2.1 Bank independent conditions

The bank independent conditions are also split in two parts, where the first part uses all scalar conditions/ error flags and the second part uses the non-scalar (array) conditions.

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7.111.2.1.1 Scalar conditions

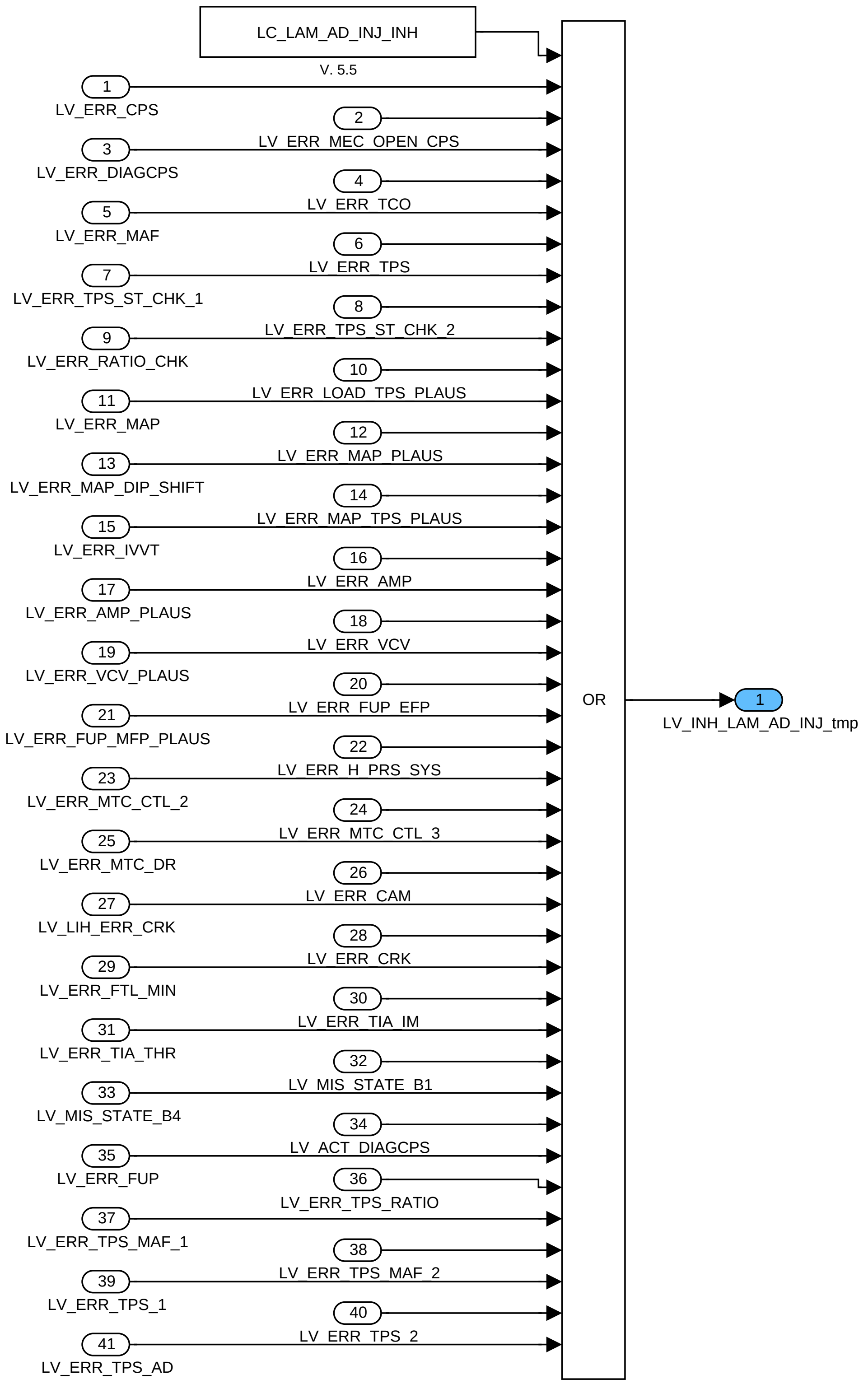

Figure 7.111.3: : Path: MFMA_ISPCLAIMI0/OPM_20MS/BANK_INDEP_CLC/CLC_1

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7.111.2.1.2 Non-scalar conditions

In this block the all conditions whose dimension can be bigger than 1 are used for the calculation of the inhibition flag. The OR-blocks with only one input return true of at least one index of the array is set to 1.

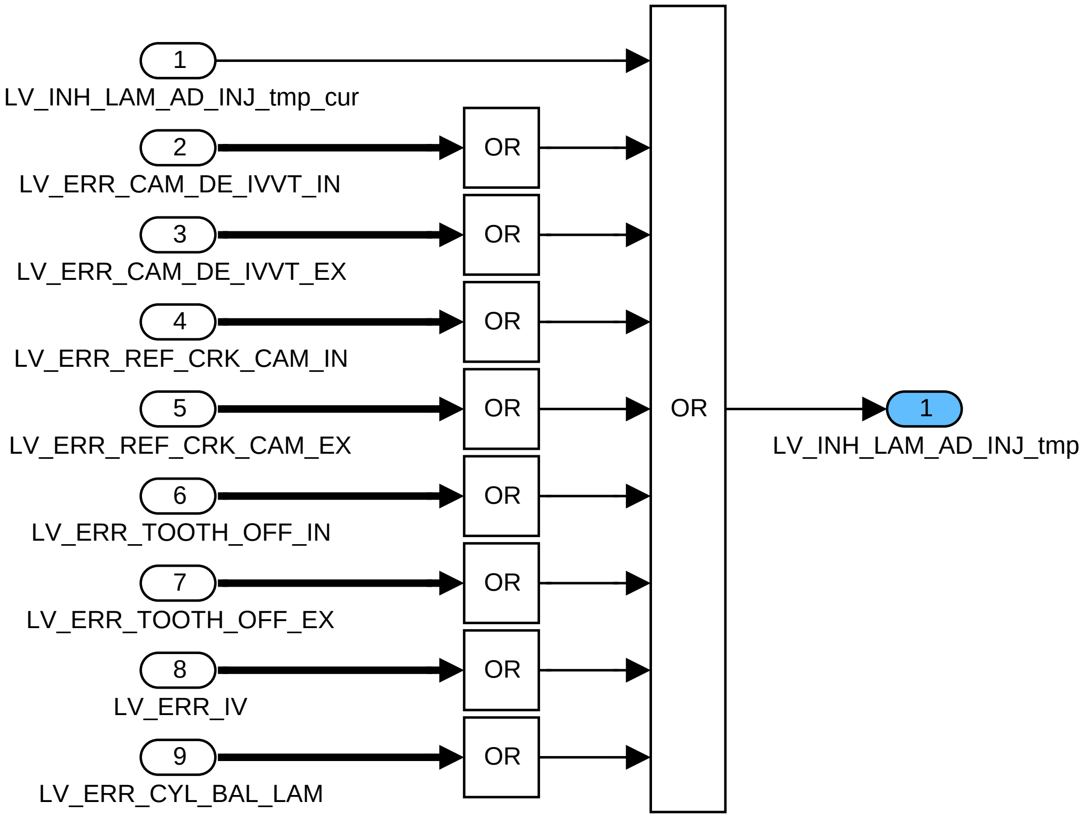

Figure 7.111.4: : Path: MFMA_ISPCLAIMI0/OPM_20MS/BANK_INDEP_CLC/CLC_2

7.111.2.2 Bank specific calculations

The bank specific calculations are done for every exhaust cylinder bank (1...NC_CBK_EX_NR). The index of the current cylinder bank is denoted with the suffix _i in the model whereas in the text square brackets are used (e.g. LV_INH_LAM_AD_INJ[i]).

7.111.2.2.1 Bank selective inhibition conditions

If one of the bank selective conditions applies, only the adaptation of the corresponding bank is inhibited. If LV_INH_LAM_AD_INJ_tmp (bank independent condition) is set, both banks will be inhibited.

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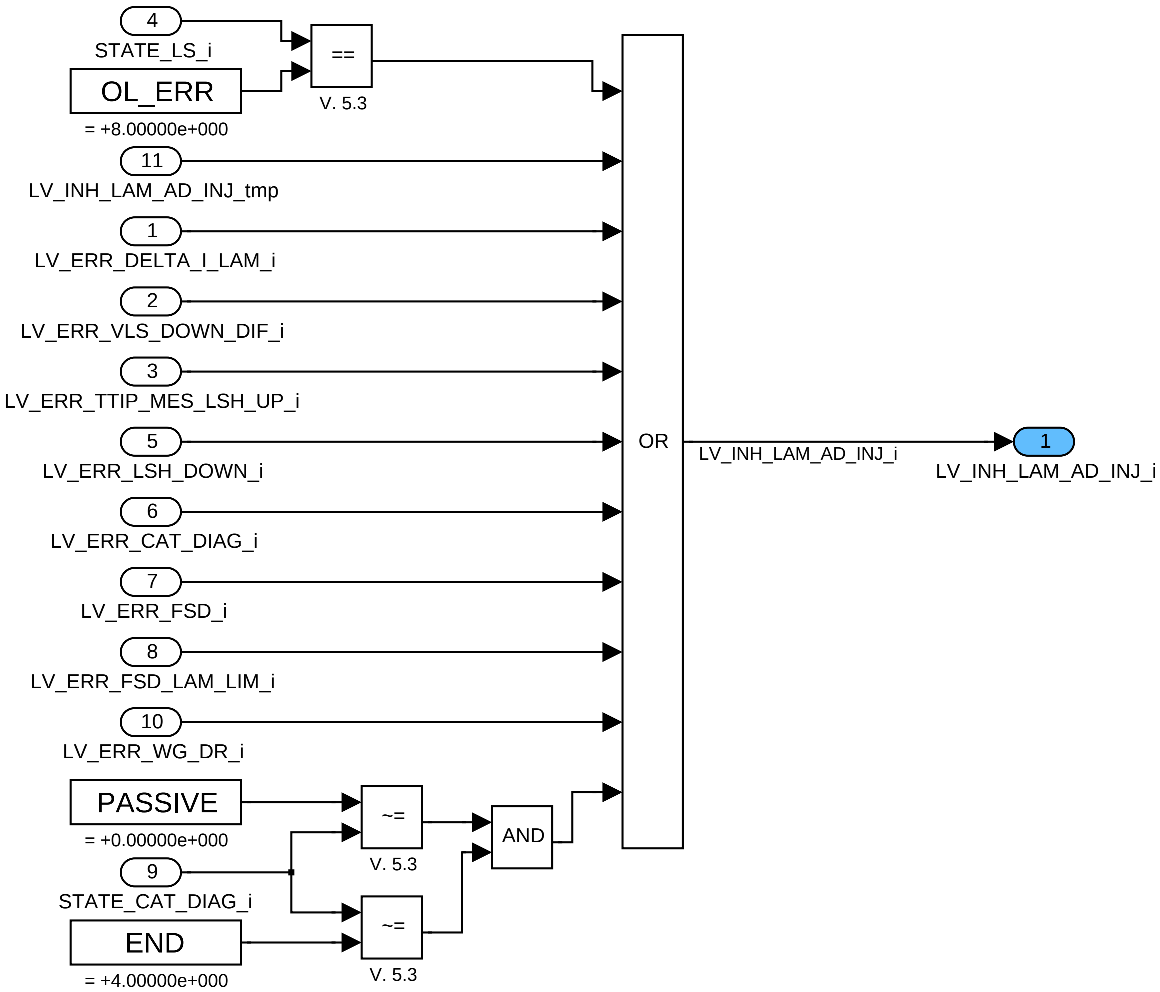

Figure 7.111.5: : Path: MFMA_ISPCLAIMI0/OPM_20MS/BANK_SPECIFIC_CLC/CLC

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7.112 Lambda adaptation via injection mode

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_ADJ_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lambda controller difference between single injection and multiple injection					
FAC_LAM_MV_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lamda controller mean value for lambda adaptation via injection mode					
FAC_LAM_MV_MMV_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lamda controller moving mean value for lambda adaptation via injection mode					
FAC_LAM_MV_MPL_INJ_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lambda controller mean value at multiple injection					
FAC_LAM_MV_SNG_INJ_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lambda controller mean value at single injection					
LV_LAM_AD_INJ_MV_CLC_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Lambda mean value calculation for lambda adaptation via injection mode finished					
MAF_INT_LAM_AD_INJ [NC_CBK_EX_NR]	V	0... FFFFH	0... 1023.984375	0.015625	g
MAF integral for lambda adaptation via injection					
MFF_ADD_COLD_LAM_AD_INJ [NC_CYL_NR]	V/S	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Additional fuel flow at cold condition for lambda adaptation via injection					
MFF_ADD_HOT_LAM_AD_INJ [NC_CYL_NR]	V/S	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Additional fuel flow at hot condition for lambda adaptation via injection					
MFF_ADD_LAM_AD_INJ [NC_CYL_NR]	O/V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Additional fuel mass correction for minimum injection					
MFF_ADD_MIS_COLD_LAM_AD_INJ [NC_CYL_NR]	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Additional fuel mass in case of misfire for lower temperature adapation range					
MFF_ADD_MIS_HOT_LAM_AD_INJ [NC_CYL_NR]	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Additional fuel mass in case of misfire for upper temperature adapation range					
MFF_DELTA_ADD_LAM_AD_INJ [NC_CBK_EX_NR]	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Fuel mass difference for one injection pulse for multiple injection					
STATE_LAM_AD_INJ [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H	NOT_ACT TRA_PHA MV_CLC LAM_AD	-	-
Lambda adaptation via injection mode state					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_INT_LAM_AD_INJ [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Time integral for lambda adaptation via injection					
TQ_IS_SNG_INJ_LAM_AD_INJ	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Idle speed controller output for monitoring in lambda adaptation via injection mode					

Input data:

C_TEMP_MAX_LAM_AD_ INJ_COLD {p. 3351}	C_TEMP_MIN_LAM_AD_ INJ_HOT {p. 3351}	CTR_AD_COLD_LAM_AD_ INJ {p. 3348}	CTR_AD_HOT_LAM_AD_ INJ {p. 3348}
CTR_MIS_LAM_AD_INJ [NC_CBK_EX_NR] {p. 3348}	FAC_LAM_LIM [NC_CBK_EX_NR] {p. 2461}	LV_LAM_AD_INJ_ACT_ COLD [NC_CBK_EX_NR] {p. 3348}	LV_LAM_AD_INJ_CLR_ AD_EXT {p. 7483}
LV_LAM_AD_INJ_INTR {p. 3349}	LV_LAM_AD_INJ_INTR_2 [NC_CBK_EX_NR] {p. 3349}	LV_LAM_AD_INJ_INTR_ LAM {p. 3349}	LV_MIS_LAM_AD_INJ [NC_CBK_EX_NR] {p. 3349}
LV_MPL_INJ_ACT [NC_CBK_EX_NR] {p. 3379}	LV_SNG_INJ_ACT [NC_CBK_EX_NR] {p. 3379}	MAF_CYL {p. 8277}	MFF_SP [NC_CBK_EX_NR] {p. 2151}
MFF_SP_1_HOM [NC_CYL_NR] {p. 8242}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_NR_MIS_REP_LAM_ AD_INJ {p. 827}
NC_NR_MPL_INJ_LAM_ AD_INJ {p. 827}	NR_CYL_LAM_AD_INJ [NC_CBK_EX_NR] {p. 3379}	STATE_IV_CHG {p. 7683}	TEMP_LAM_AD_INJ {p. 3349}
TQ_DIF_I_IS {p. 3441}	TQ_DIF_P_D_SLOW_IS {p. 3442}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_LAM_MMV_LAM_AD_INJ	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlaton constant for lambda controller output moving mean value					
C_CRLC_FAC_LAM_MV_LAM_AD_INJ	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlaton constant for lambda controller output mean value					
C_CRLC_MFF_ADD_COLD_LAM_AD_INJ	-	0... 80H	0 ...1	7.8125e-3	-
Correlation constant for filterd cold adaptation value					
C_CRLC_MFF_ADD_HOT_LAM_AD_INJ	-	0... 80H	0 ...1	7.8125e-3	-
Correlation constant for filterd hot adaptation value					
C_CRLC_TQ_DIF_SLOW_LAM_AD_INJ	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for use of TQ_DIF_P_D_SLOW_IS in TQ_IS_SNG_INJ_LAM_AD_INJ calculation					
C_FAC_LAM_ADJ_MIN_LAM_AD_INJ	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Min. difference between lambda mean value at SNG and MPL inj. to update the adaptation value					
C_FAC_LAM_FIL_DIF_LAM_AD_INJ	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Threshold for difference of first and second filterd lambda value to detect lambda stabilization					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_MFF_COR_CYL_LAM_AD_INJ [NC_CYL_NR]	-	0... FFH	0... 3.984375	0.015625	-
Weighting factor for each cylinder to map adjust cylinder selective influence on lambda signal					
C_MAF_INT_MV_CLC_LAM_AD_INJ	-	0... FFFFH	0... 1023.984375	0.015625	g
Time integral threshold for mean value phase end					
C_MAF_INT_MV_CLC_LAM_AD_INJ_2	-	0... FFFFH	0... 1023.984375	0.015625	g
Time integral threshold for mean value phase end if LV_LAM_AD_INJ_EXT_ENA = 1					
C_MAF_INT_TRA_PHA_LAM_AD_INJ	-	0... FFFFH	0... 1023.984375	0.015625	g
MAF integral threshold for transient phase end					
C_MAF_INT_TRA_PHA_LAM_AD_INJ_2	-	0... FFFFH	0... 1023.984375	0.015625	g
MAF integral threshold for transient phase end if LV_LAM_AD_INJ_EXT_ENA = 1					
C_MFF_ADD_LAM_AD_MAX	-	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Maximum limit for adaptation values for lambda adaptation via injection mode					
C_MFF_ADD_LAM_AD_MIN	-	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
Minimum limit for adaptation values for lambda adaptation via injection mode					
C_T_INT_MV_CLC_LAM_AD_INJ	-	0... FFFFH	0... 1310.7	0.02	s
Time integral threshold for mean value phase end					
C_T_INT_MV_CLC_LAM_AD_INJ_2	-	0... FFFFH	0... 1310.7	0.02	s
Time integral threshold for mean value phase end if LV_LAM_AD_INJ_EXT_ENA = 1					
C_T_INT_TRA_PHA_LAM_AD_INJ	-	0... FFFFH	0... 1310.7	0.02	s
Time integral threshold for transient phase end					
C_T_INT_TRA_PHA_LAM_AD_INJ_2	-	0... FFFFH	0... 1310.7	0.02	s
Time integral threshold for transient phase end if LV_LAM_AD_INJ_EXT_ENA = 1					
ID_CRLC_MFF_ADD_COLD_LAM_AD_INJ	-	0... 80H	0 ...1	7.8125e-3	-
LDP_CTR_NR_COLD_ID_CTR	4	0... FFH	0... 255	1	-
Correlation constant for filtered cold adaptation value					
ID_CRLC_MFF_ADD_HOT_LAM_AD_INJ	-	0... 80H	0 ...1	7.8125e-3	-
LDP_CTR_NR_HOT_ID_CTR	4	0... FFH	0... 255	1	-
Correlation constant for filtered hot adaptation value					
ID_MFF_DELTA_MIS_LAM_AD_INJ	S	0... FFFFH	-694.510597391 ...694.489402609	0.0211948	mg/stk
LDP_CTR_MIS_ID_MFF_LAM_AD_INJ	NC_ NR_ MIS_ REP_ LAM_ AD_ INJ	0... FFH	0... 255	1	-
Additional fuel mass in case of misfire for lambda adapation via injection mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_MFF_ADD_LAM_AD_INJ	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDP_MFF_IP_MFF_ADD_LAM_AD_INJ	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Normalization of the adaptation value to the reference fuel mass					
LC_MFF_ADD_LAM_AD_INJ_CLR	-	0... 1H	0 ...1	1	-
Switch to clear adaptation values of lambda adaptation via injection mode					
LC_MFF_CLC_ADD_LAM_COLD_ADD	-	0... 1H	0 ...1	1	-
Activation of MFF correction calculation by using the hot adapt. value for the whole range and the cold adapt. value as offset for the cold area					

Import actions:

ACTION_MFMA_GetEnableCondition (**OUT**<PRM_LV_LAM_AD_INJ_EXT_ENA>)

General Information

The adaptation of the additional fuel mass at minimum fuel mass injection is divided in a time slice with single injection and with multiple injections. At the beginning of each phase a certain time is waited in a transient phase for system stabilization. In a second phase the lambda mean value is calculated. At the end of the phase with multiple injections, the additional fuel at minimum injection is calculated from the lambda controller output difference of the single and multiple injection phase.

Application Conditions

Initialization: RST, IGKON, NVMRES, NVMSTO, NVMINI
Activation: 20MS: always
1S: always
ES2ERU: always
Deactivation: never

Function description

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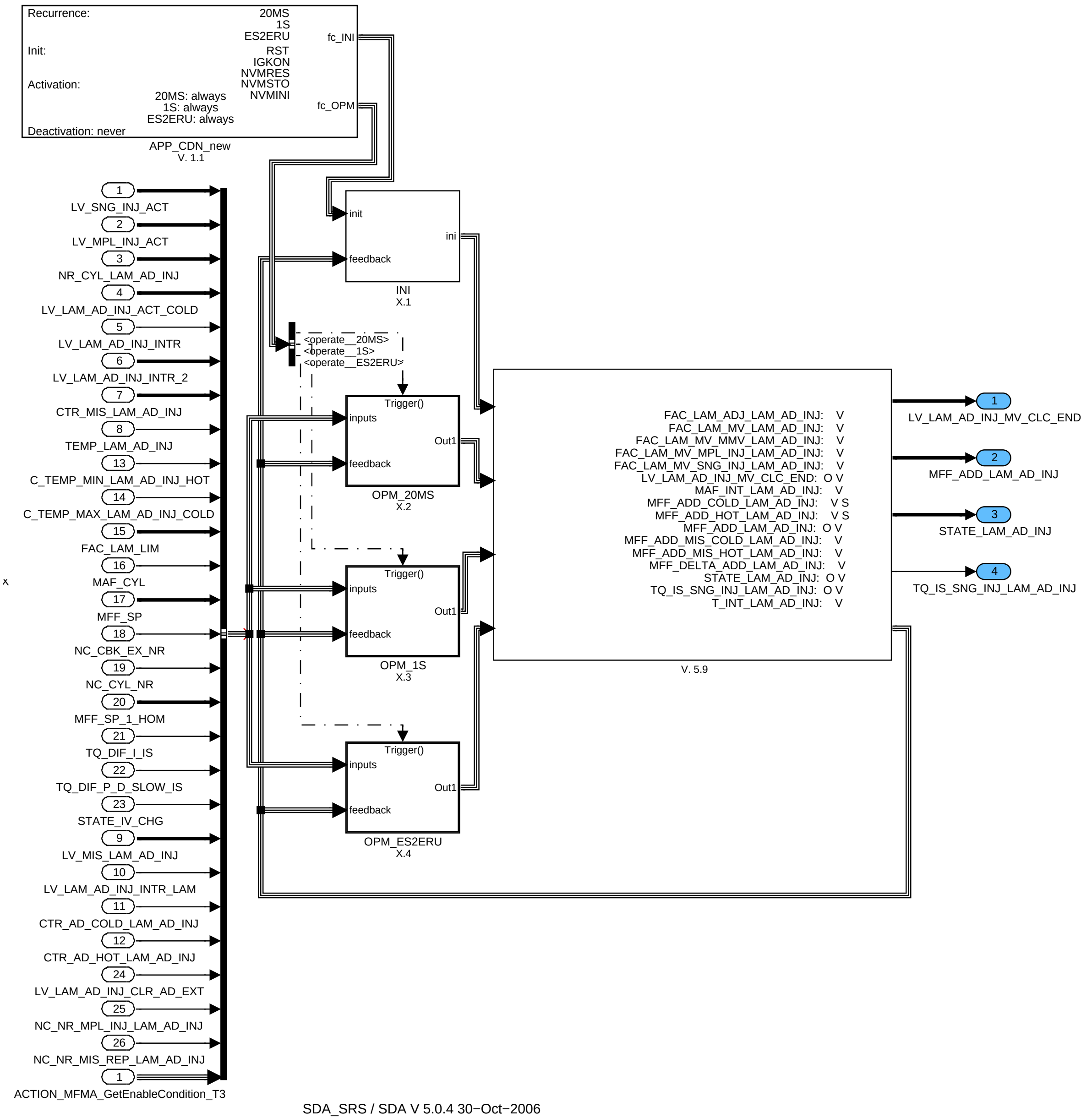

Figure 7.112.1: : Path: MFMA_ISPCLAIM0

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7.112.1 Initialization and NVMY management

7.112.1.1 Initialization at RST and IGKON

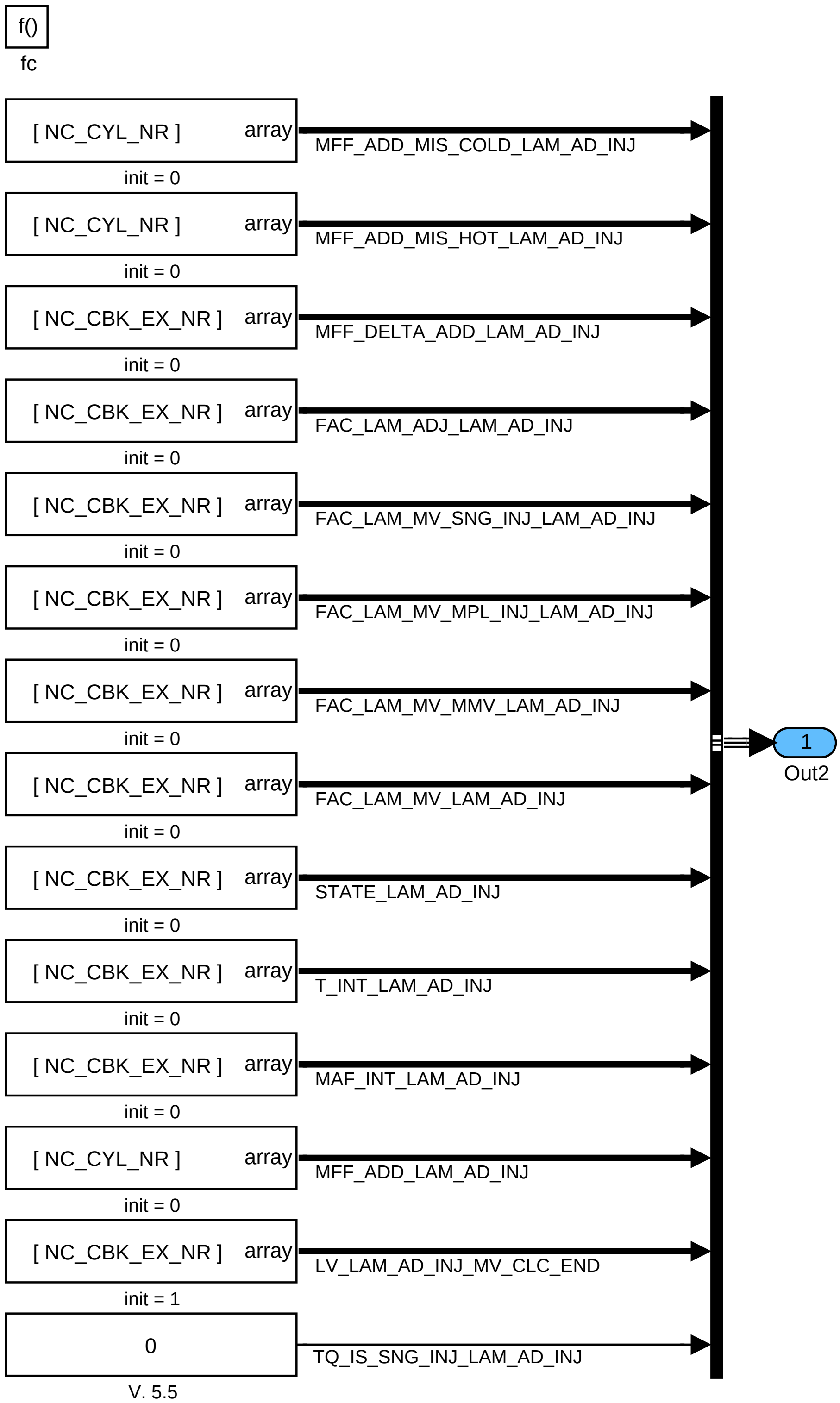

Figure 7.112.2: : Path: MFMA_ISPCLAIM0/INI/RST_IGKON

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7.112.1.2 Initialization and reading of NVMY values

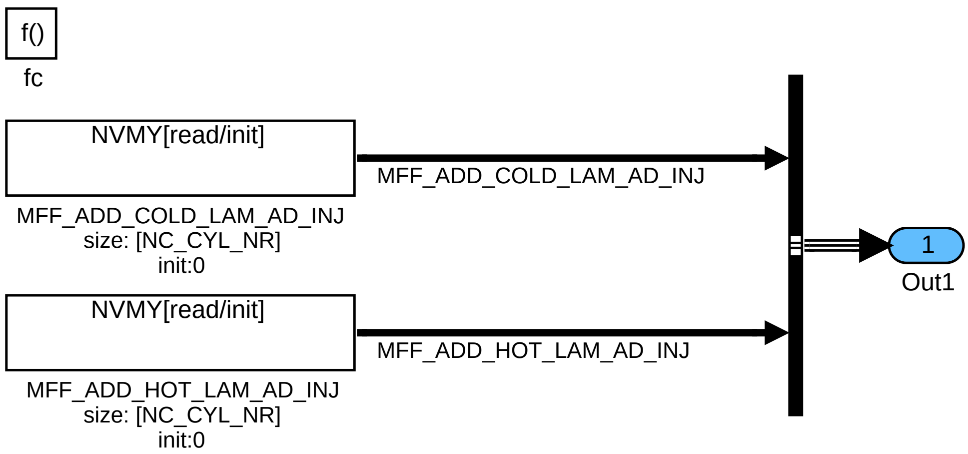

Figure 7.112.3: : Path: MFMA_ISPCLAIM0/INI/NVMINI_NVMRES

7.112.1.3 Writing of the NVMY values

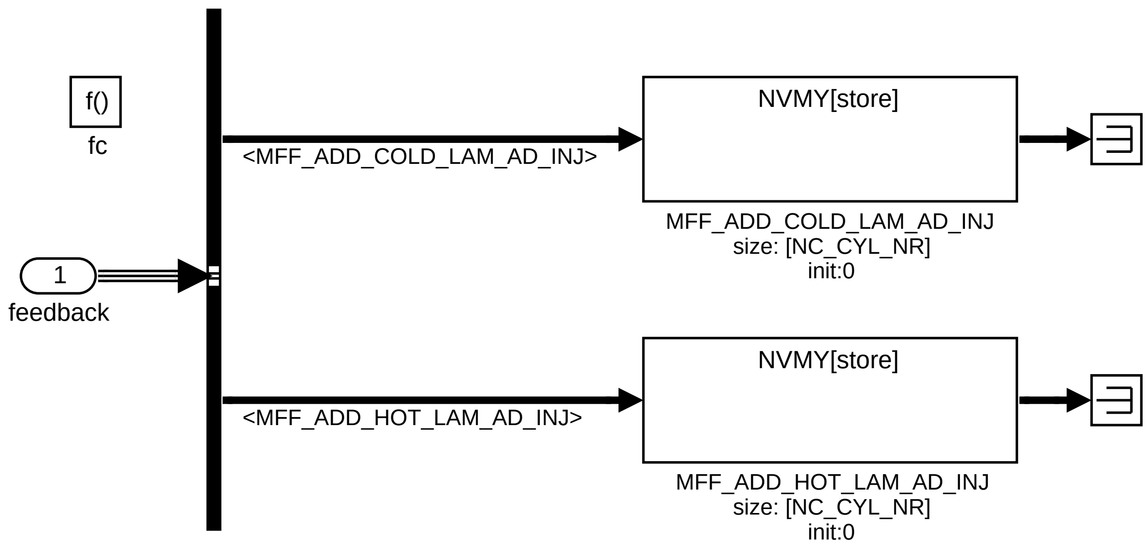

Figure 7.112.4: : Path: MFMA_ISPCLAIM0/INI/NVMSTO

7.112.2 20ms operations

All calculations are done for each exhaust cylinder bank, where the bank specific values are denoted within the graphical model with the suffix _i, in the textual description they are referenced via [i].

7.112.2.1 State machine and general calculations

Calculation of state transitions, state actions and general calculations.

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7.112.2.1.1 State transitions

7.112.2.1.1.1 State selection

7.112.2.1.1.1.1 NOT_ACT

If the next adaptation cycle starts (either with single or multiple injections), the state is left towards TRA_PHA.

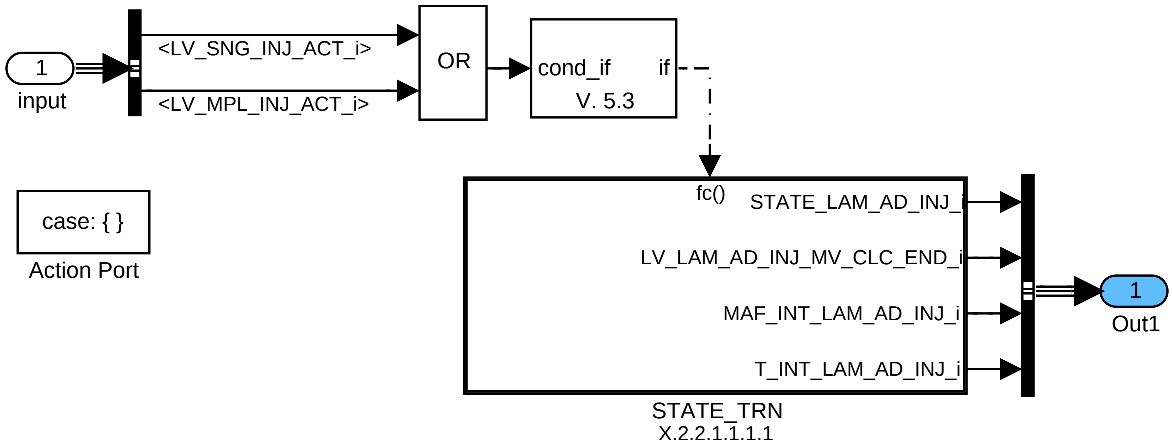

Figure 7.112.5: : Path: MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_TRANSITION/CLC/NOT_ACT

7.112.2.1.1.1.1.1 Transition to TRA_PHA

On the transition to TRA_PHA the MAF and time integrals are set to 0 and furthermore the end flag used in the manager module is reset.

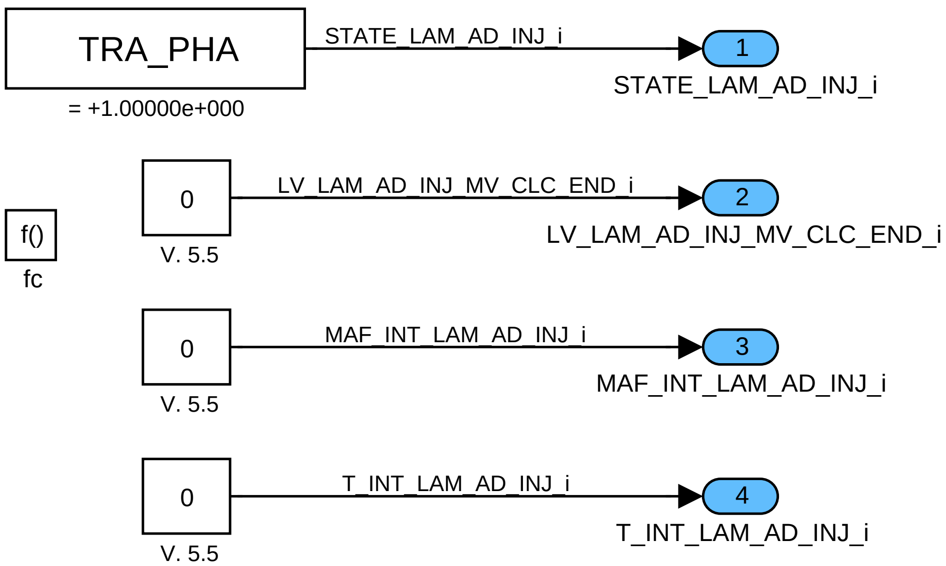

Figure 7.112.6: : Path:
MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_TRANSITION/CLC/NOT_ACT/STATE_TRN

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7.112.2.1.1.1.2 TRA_PHA

The state TRA_PHA is usually left towards MV_CLC, but if the adaptation is interrupted, the state will change back to NOT_ACT.

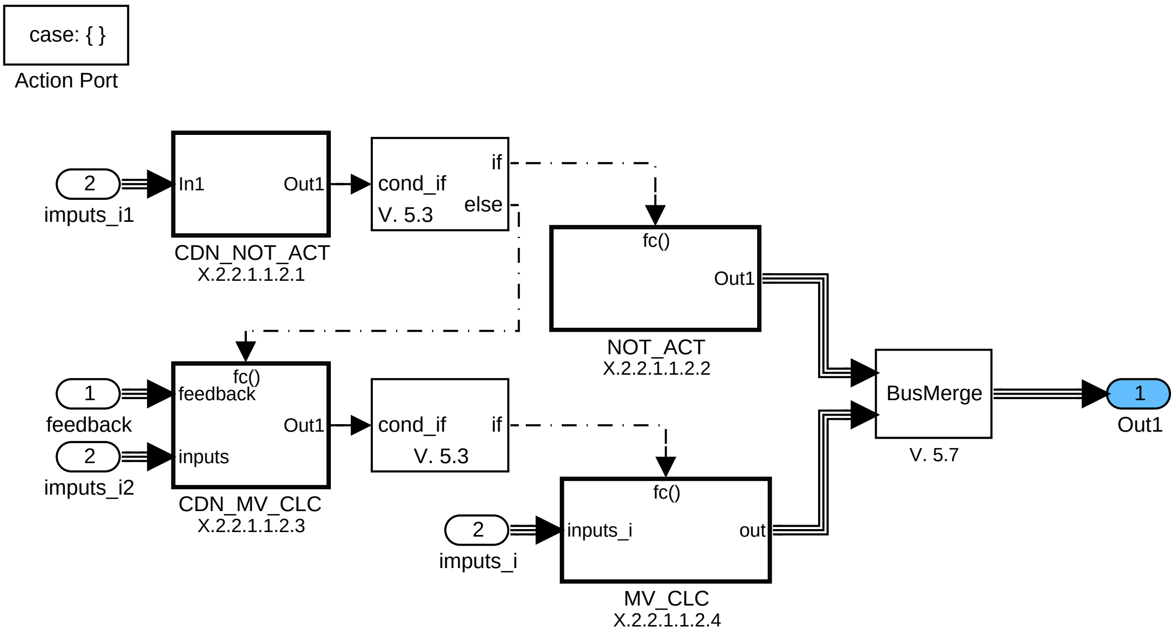

Figure 7.112.7: : Path: MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_TRANSITION/CLC/TRA_PHA

7.112.2.1.1.1.2.1 Conditions for NOT_ACT

If none of the flags LV_SNG/MPL_INJ_ACT is set, the state is left towards NOT_ACT.

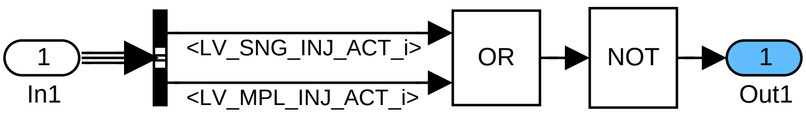

Figure 7.112.8: : Path: MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_TRANSITION/CLC/TRA_PHA/CDN_NOT_ACT

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7.112.2.1.1.1.2.2 Transition to NOT_ACT

Figure 7.112.9: : Path:
MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_TRANSITION/CLC/TRA_PHA/NOT_ACT

7.112.2.1.1.1.2.3 Conditions for MV_CLC

If the MAF and time integrals have reached a threshold and if the lambda controller output has stabilized, the state is left towards MV_CLC. Furthermore this transition is done if misfire is detected or the lambda controller had reached its limitations.

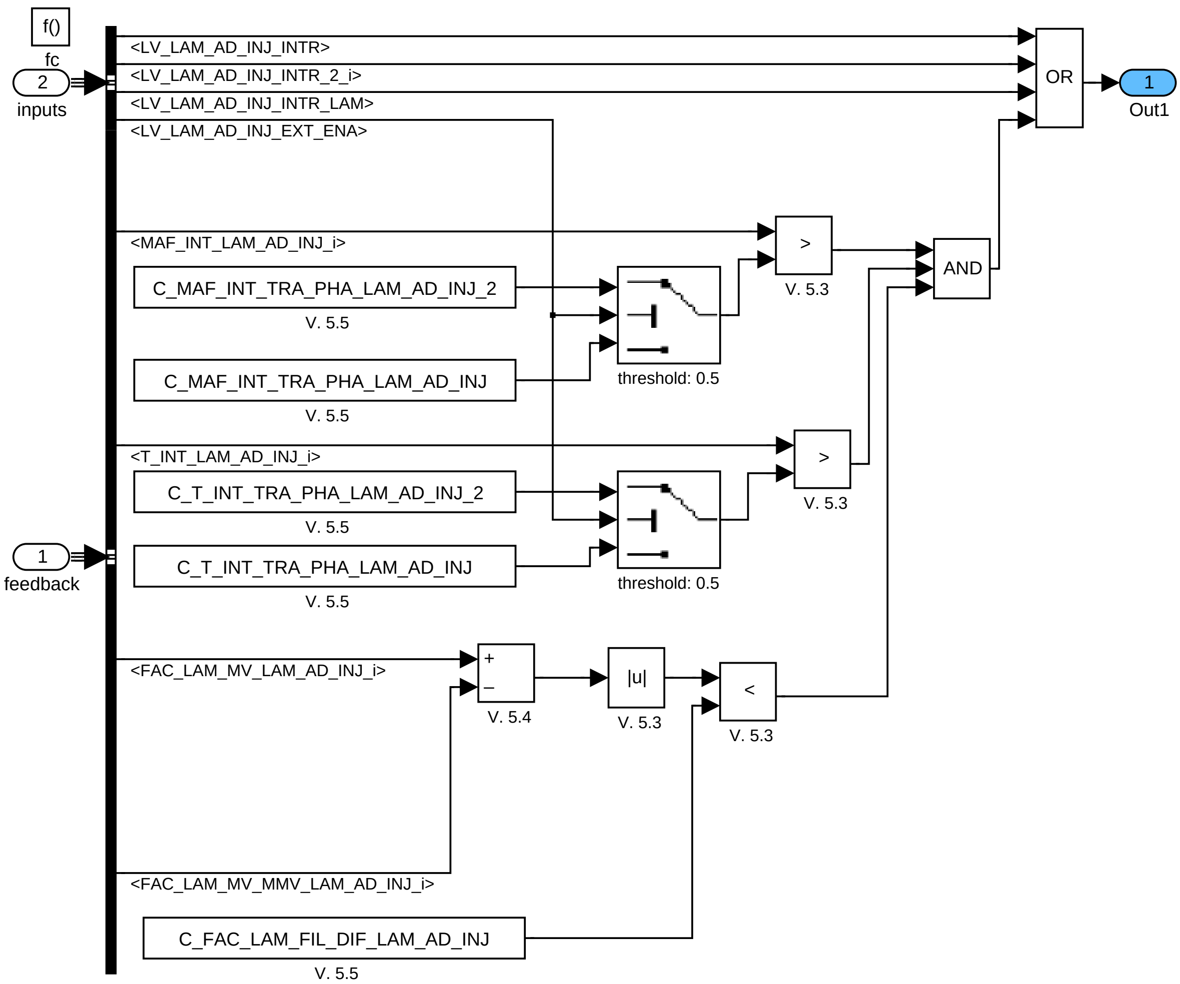

Figure 7.112.10: : Path:
MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_TRANSITION/CLC/TRA_PHA/CDN_MV_CLC

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7.112.2.1.1.1.2.4 Transition to MV_CLC

On transition to MV_CLC the MAF and time integrals are reset.

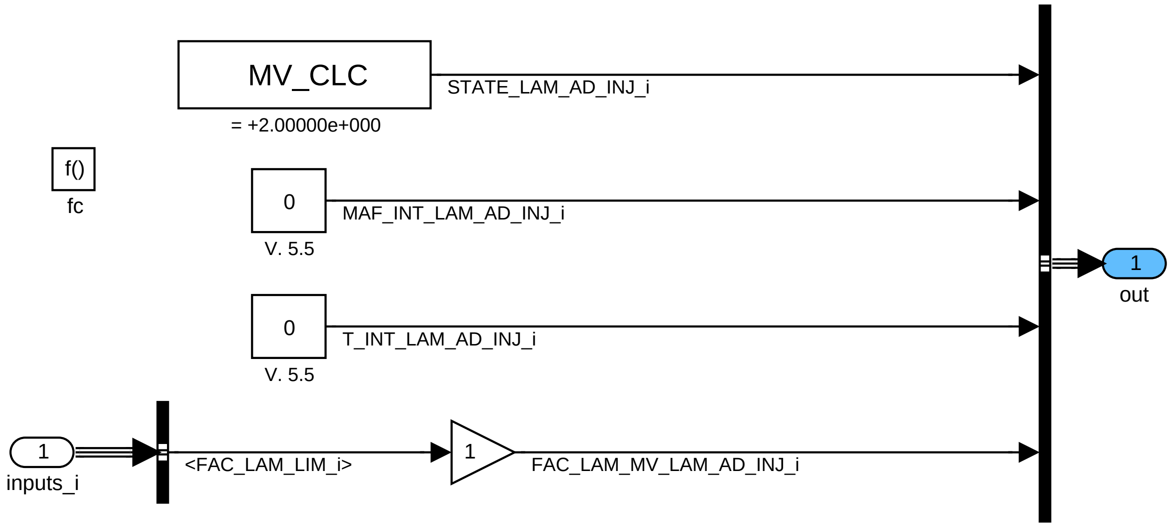

Figure 7.112.11: : Path:
MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_TRANSITION/CLC/TRA_PHA/MV_CLC

7.112.2.1.1.1.3 MV_CLC

The state MV_CLC is usually left towards NOT_ACT after a single injection adaptation phase or due to interruption, and towards LAM_AD after a multiple injection adaptation phase.

7.112.2.1.1.1.3.1 Interruption of the mean-value calculation

If neither single nor multiple injection adaptation is allowed anymore, the state is left towards NOT_ACT.

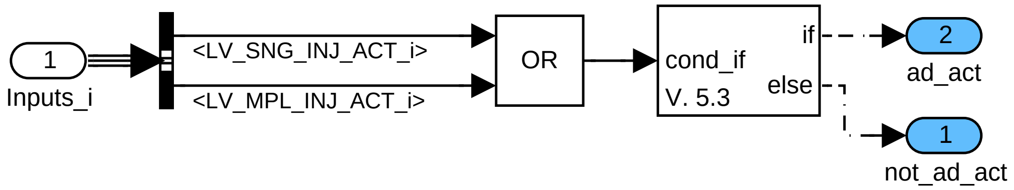

Figure 7.112.12: : Path:
MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_TRANSITION/CLC/MV_CLC/CDN_AD_ACT

7.112.2.1.1.1.3.2 Conditions for normal end of MV_CLC

If the MAF and time integrals reach a threshold, the state is left to NOT_ACT after single injections and to LAM_AD after multiple injections. If misfire is detected or the lambda controller had reached its limitations, the state is also left immediately.

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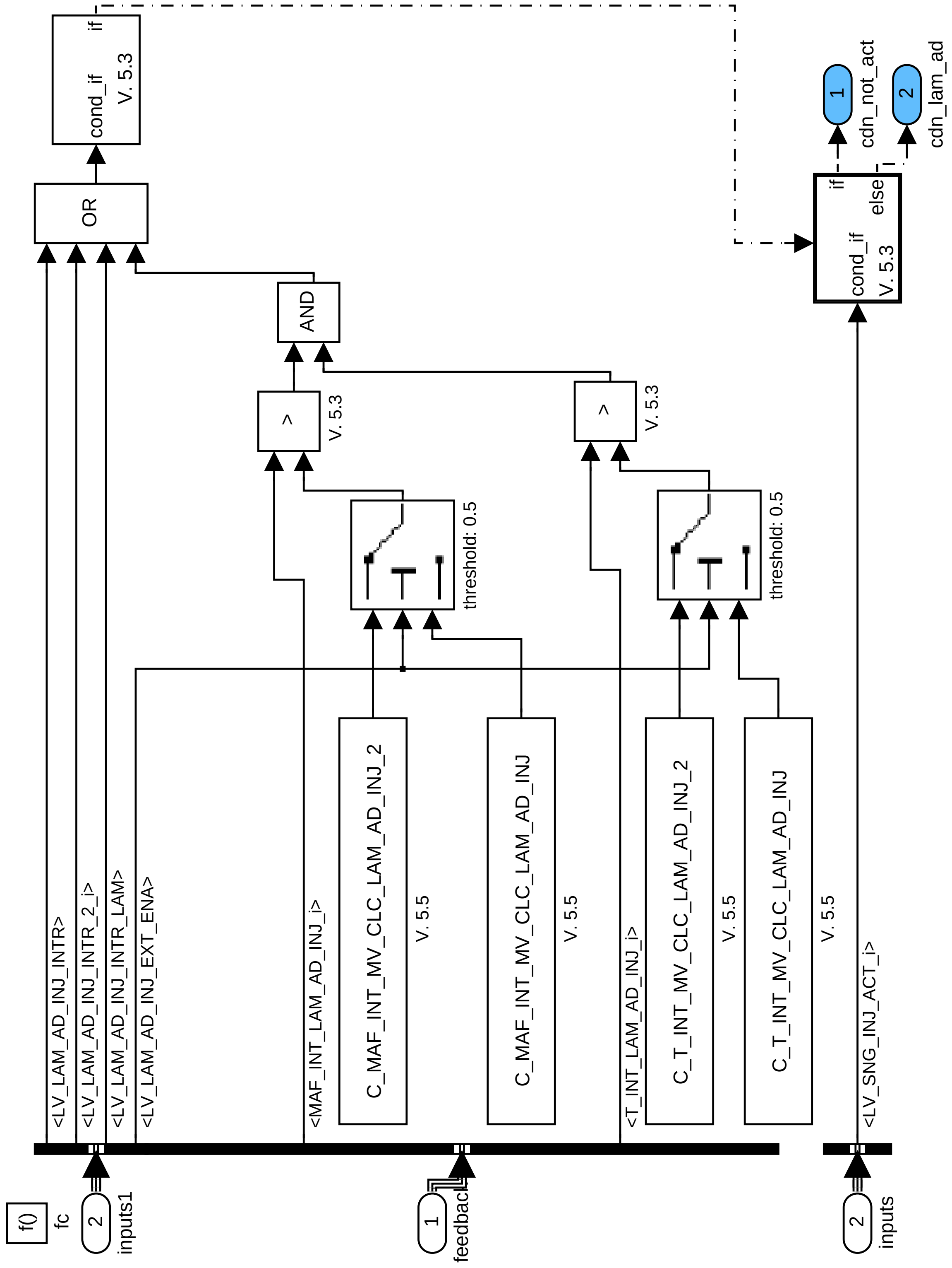

Figure 7.112.13: : Path:
MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_TRANSITION/CLC/MV_CLC/CDN_INT_MAX

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7.112.2.1.1.1.3.3 Transition to NOT_ACT due to interruption

Figure 7.112.14: : Path:
MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_TRANSITION/CLC/MV_CLC/NOT_ACT_1

7.112.2.1.1.1.3.4 Transition to NOT_ACT due to normal ending

7.112.2.1.1.1.3.4.1 Memorization of lambda and engine speed controller outputs

The lambda and engine speed controller outputs are memorized for comparison after/in the multiple injection adaptation phases.

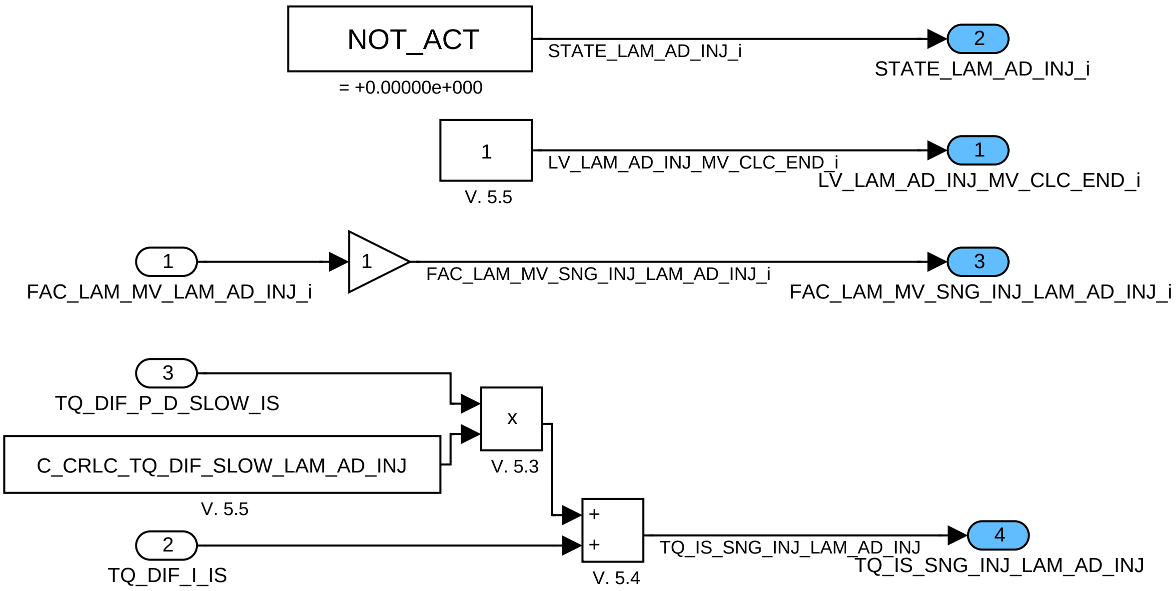

Figure 7.112.15: : Path:
MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_TRANSITION/CLC/MV_CLC/NOT_ACT_2/CLC

7.112.2.1.1.1.3.5 Transition to LAM_AD

7.112.2.1.1.1.3.5.1 Calculation of FAC_LAM_MV_MPL_INJ_LAM_AD_INJ[i]

The lambda controller output (mean value) of the multiple injection phase is stored.

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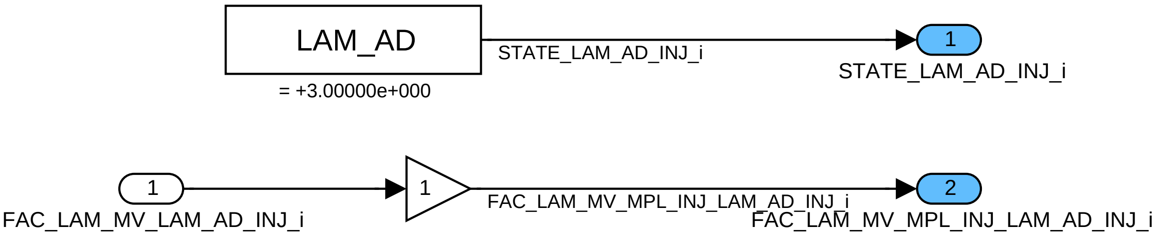

Figure 7.112.16: : Path: MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_TRANSITION/CLC/MV_CLC/LAM_AD/CLC

7.112.2.1.1.1.4 LAM_AD

The state LAM_AD is left immediately towards NO_ACT after the adaptation value has be calculated.

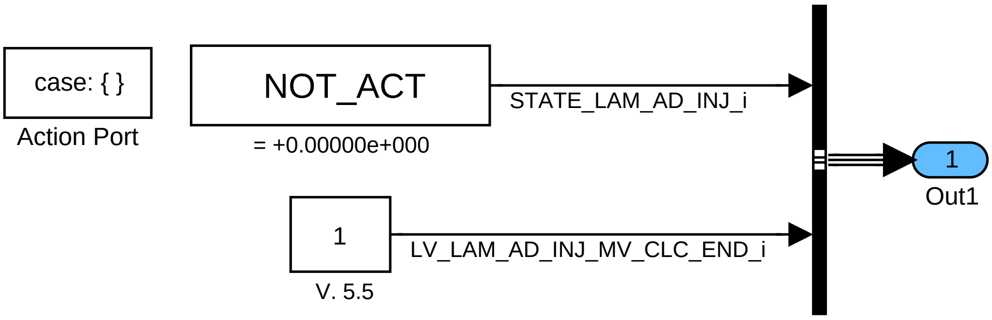

Figure 7.112.17: : Path: MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_TRANSITION/CLC/LAM_AD

7.112.2.1.2 State actions

7.112.2.1.2.1 State selection

7.112.2.1.2.1.1 TRA_PHA

7.112.2.1.2.1.1.1 MAF and time integral calculation

During the state TRA_PHA the MAF and time integrals are calculated.

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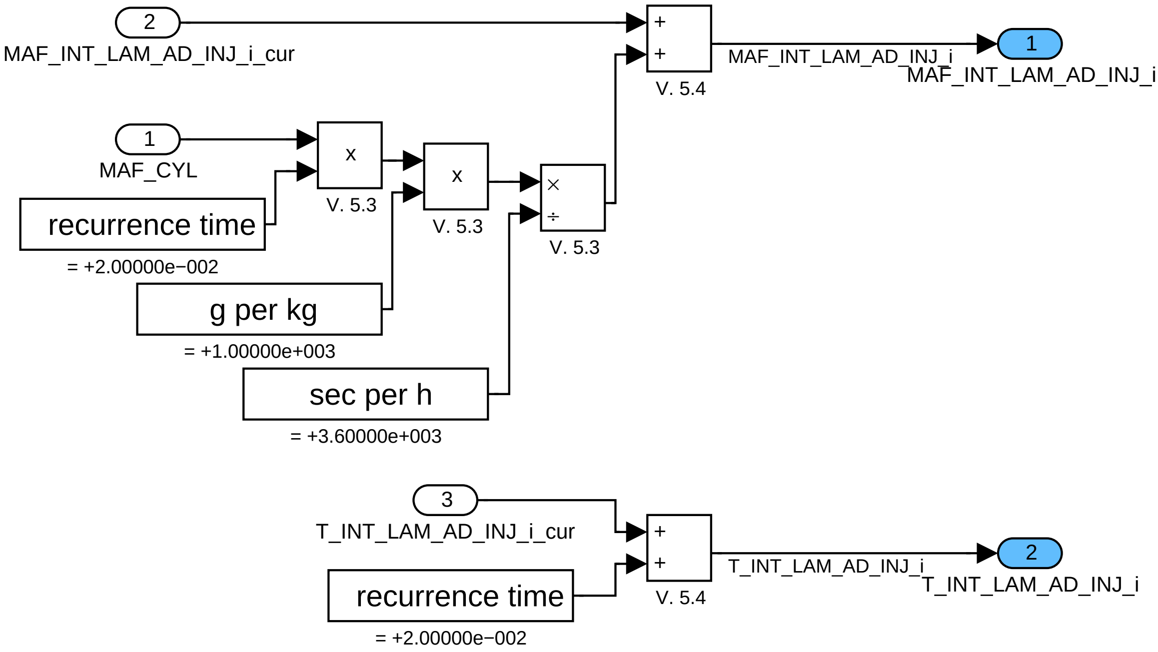

Figure 7.112.18: : Path: MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_ACTION/CLC/TRA_PHA/CLC

7.112.2.1.2.1.2 MV_CLC

7.112.2.1.2.1.2.1 MAF and time integral calculation

During the state MV_CLC the MAF and time integrals are calculated.

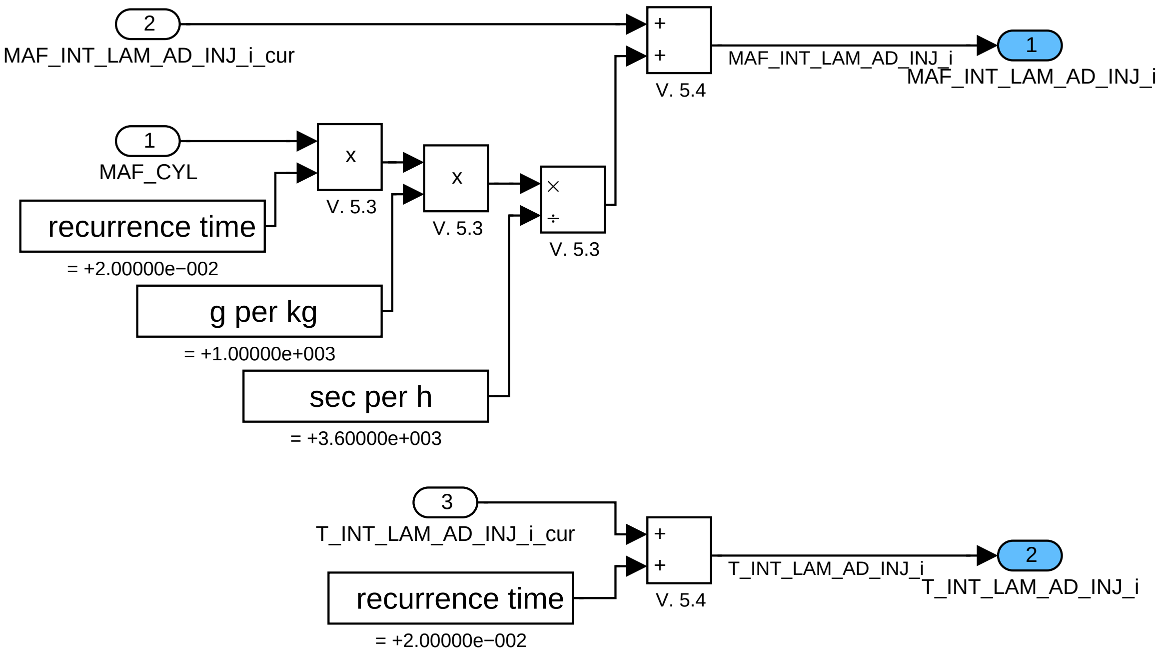

Figure 7.112.19: : Path: MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_ACTION/CLC/MV_CLC/CLC

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7.112.2.1.2.1.3 LAM_AD

During the state LAM_AD the lambda controller output difference and the corresponding fuel mass caused by multiple injections are calculated and then stored in the adaptation values of the active temperature range.

7.112.2.1.2.1.3.1 Lambda controller difference and fuel mass calculation

7.112.2.1.2.1.3.1.1 Calculation of FAC_LAM and MFF_DELTA

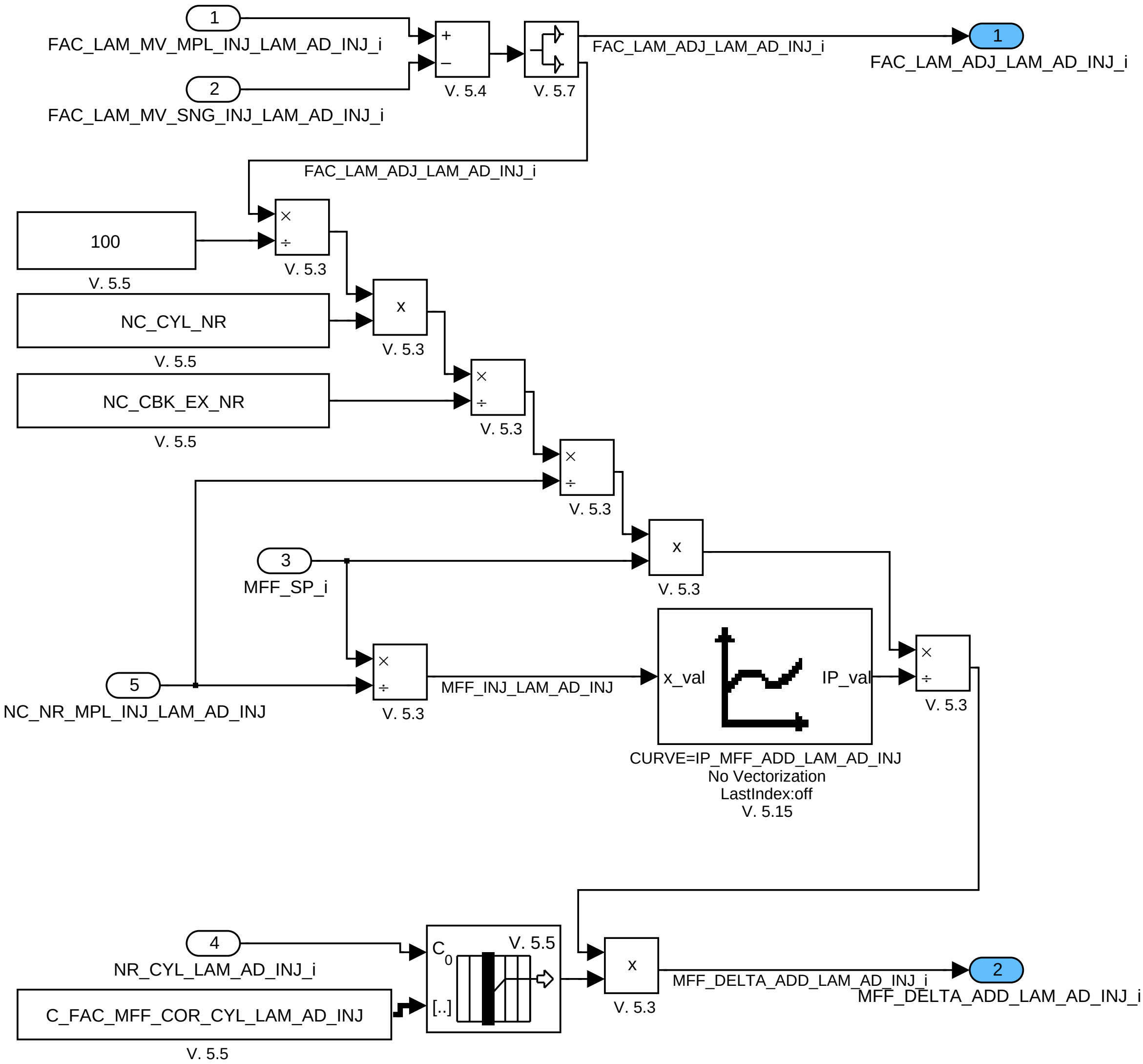

Figure 7.112.20: : Path: MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_ACTION/CLC/LAM_AD/CLC_MFF_DELTA/CLC

7.112.2.1.2.1.3.2 Lower temperature range

If the lower temperature range is active, the adaptation values are written to the corresponding variables.

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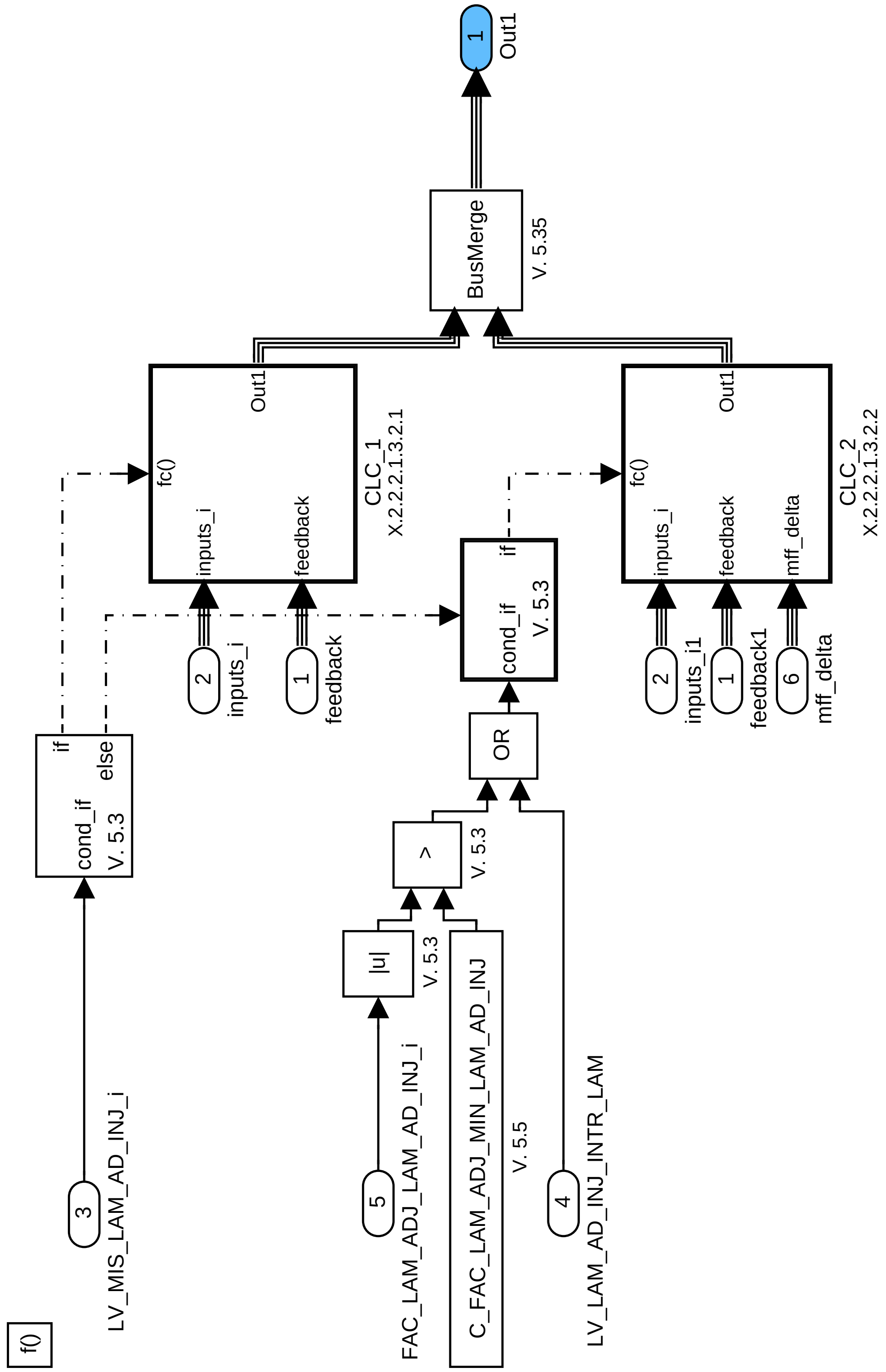

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Figure 7.112.21: : Path:
MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_ACTION/CLC/LAM_AD/CLC_COLD

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7.112.2.1.2.1.3.2.1 Correction of adaptation values in case of misfire

7.112.2.1.2.1.3.2.1.1 Determination of corrective fuel mass for misfire

In case misfire was detected on the active cylinder during multiple injections, an additional fuel mass is determined from the map ID_MFF_DELTA_MIS_LAM_AD_INJ.

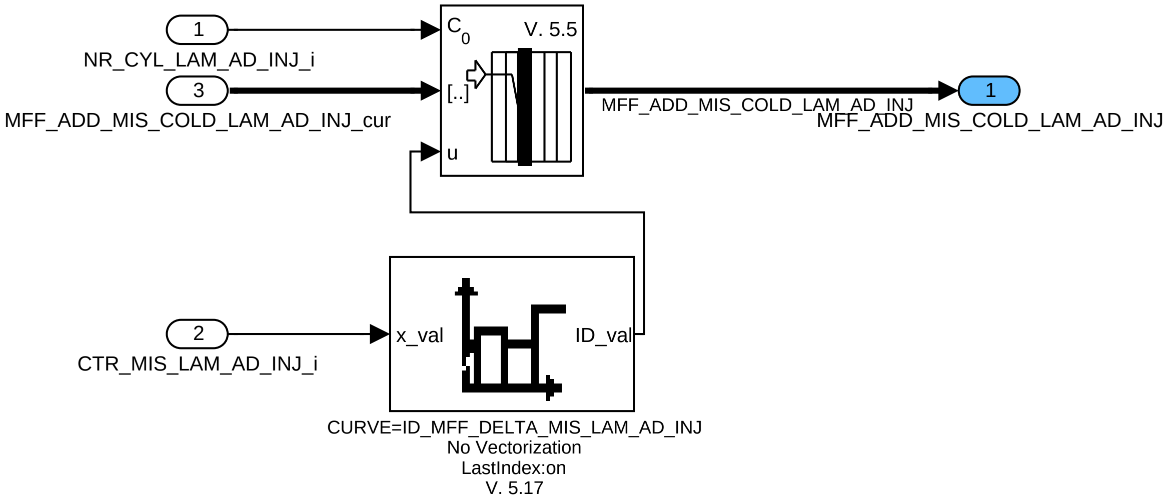

Figure 7.112.22: : Path: MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_ACTION/CLC/LAM_AD/CLC_COLD/CLC_1/CLC

7.112.2.1.2.1.3.2.2 Calculation of the adaptation value

7.112.2.1.2.1.3.2.2.1 Calculation of MFF_ADD_COLD_LAM_AD_INJ

The adaptation value is determined from its old value and the actual calculated difference using the correlation factor C_CRLC_MFF_ADD_COLD_LAM_AD_INJ. Afterwards the additional misfire fuel mass is reset to 0.

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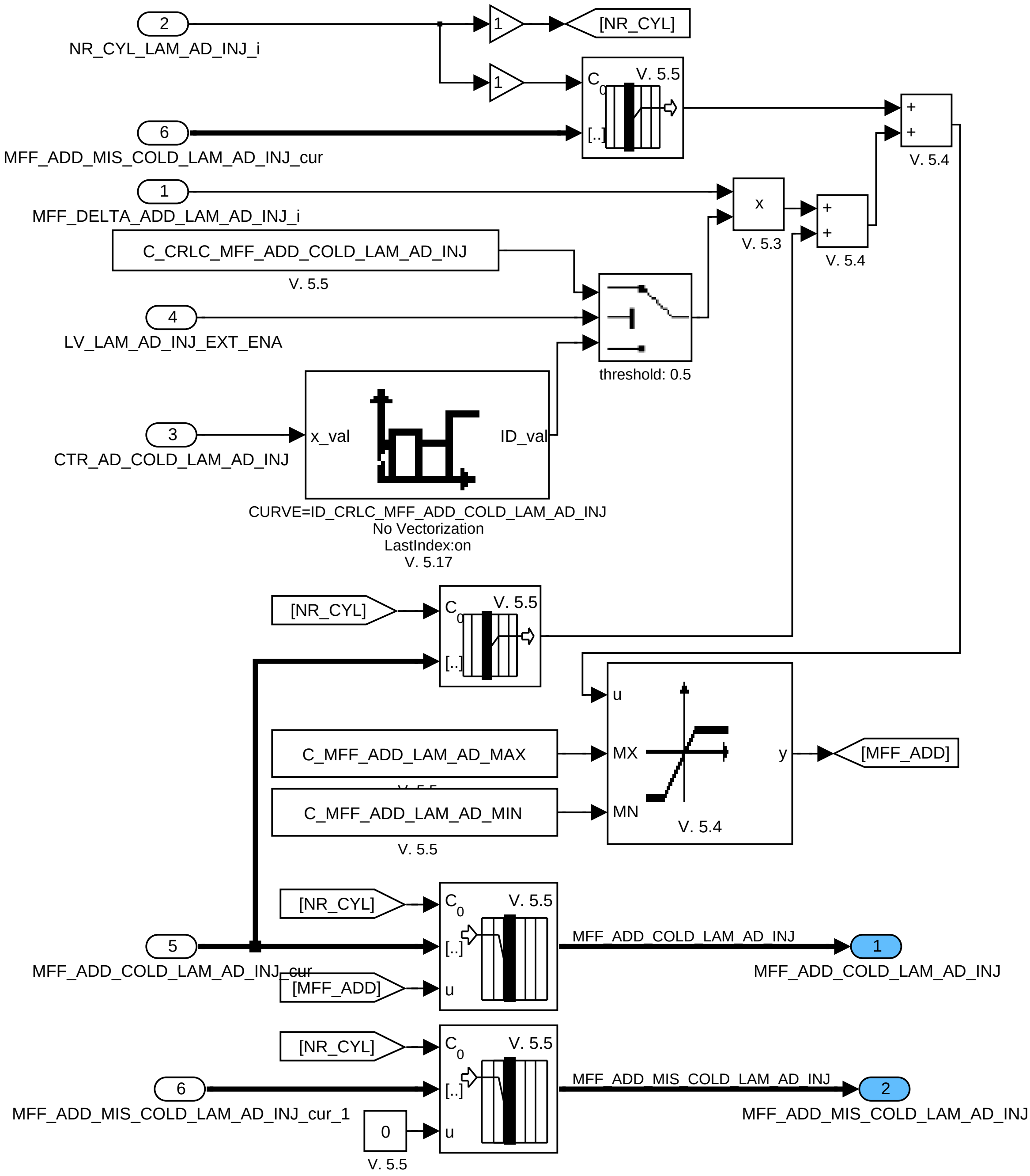

Figure 7.112.23: : Path:
MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_ACTION/CLC/LAM_AD/CLC_COLD/CLC_2/CLC

7.112.2.1.2.1.3.3 Upper temperature range

If the upper temperature range is active, the adaptation values are written to the corresponding variables.

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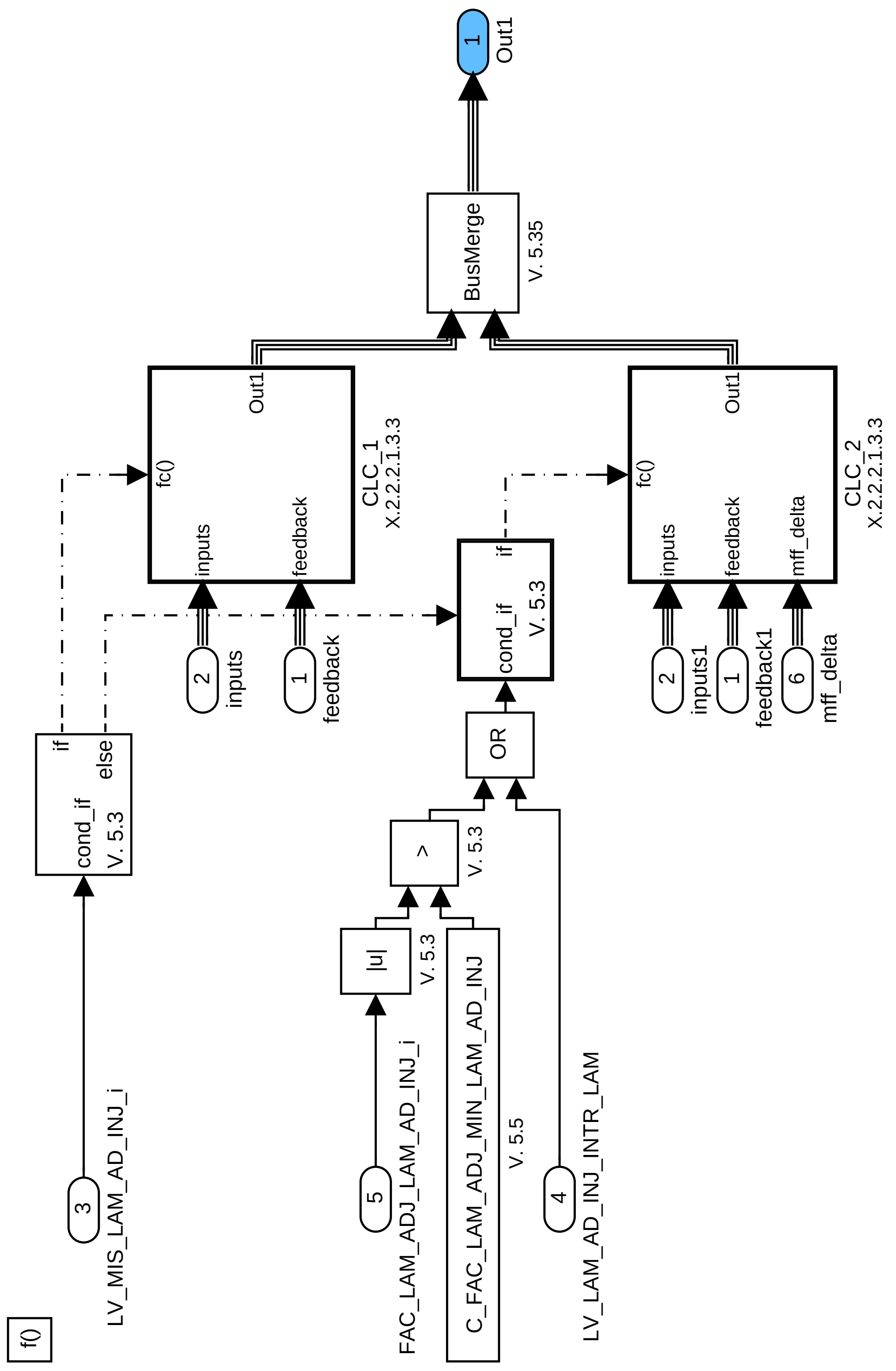

Figure 7.112.24: : Path:
MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_ACTION/CLC/LAM_AD/CLC_HOT

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7.112.2.1.2.1.3.3.1 Correction of adaptation values in case of misfire

7.112.2.1.2.1.3.3.1.1 Determination of corrective fuel mass for misfire

In case misfire was detected on the active cylinder during multiple injections, an additional fuel mass is determined from the map ID_MFF_DELTA_MIS_LAM_AD_INJ.

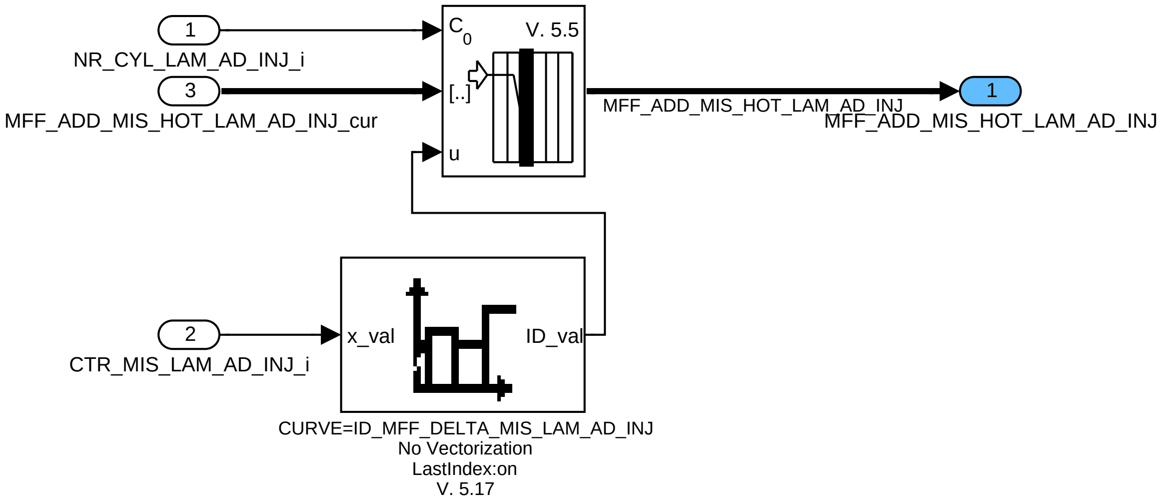

Figure 7.112.25: : Path:
MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_ACTION/CLC/LAM_AD/CLC_HOT/CLC_1/CLC

7.112.2.1.2.1.3.3.2 Calculation of the adaptation value

7.112.2.1.2.1.3.3.2.1 Calculation of MFF_ADD_HOT_LAM_AD_INJ

The adaptation value is determined from its old value and the actual calculated difference using the correlation factor C_CRLC_MFF_ADD_HOT_LAM_AD_INJ. Afterwards the additional misfire fuel mass is reset to 0.

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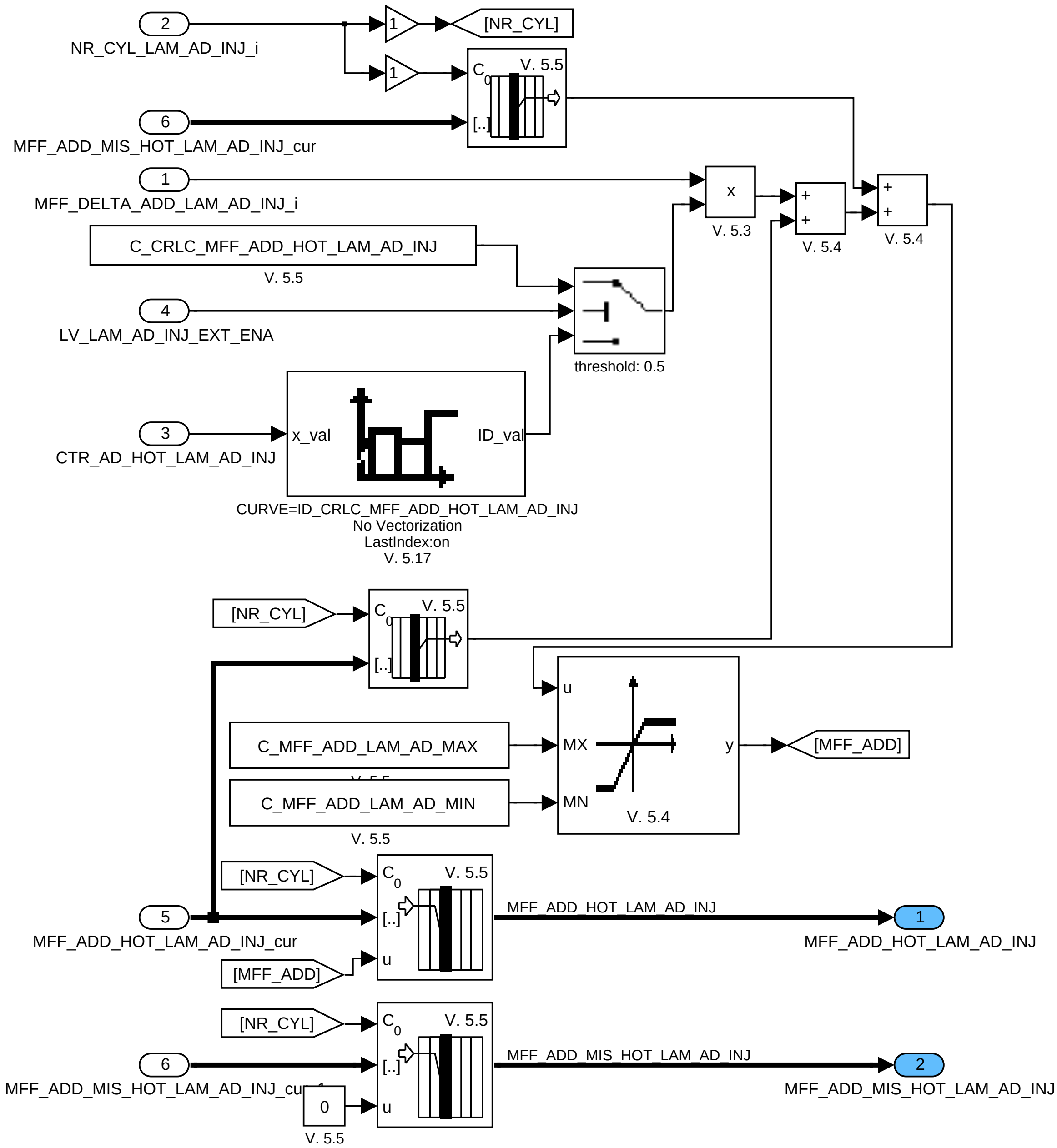

Figure 7.112.26: : Path: MFMA_ISPCLAIM0/OPM_20MS/CLC/STATE_ACTION/CLC/LAM_AD/CLC_HOT/CLC_2/CLC

7.112.2.1.3 General calculations

The mean value calculations are done for the current active bank(s).

7.112.2.1.3.1 Mean value calculation

The mean value calculations are done for the current active bank(s).

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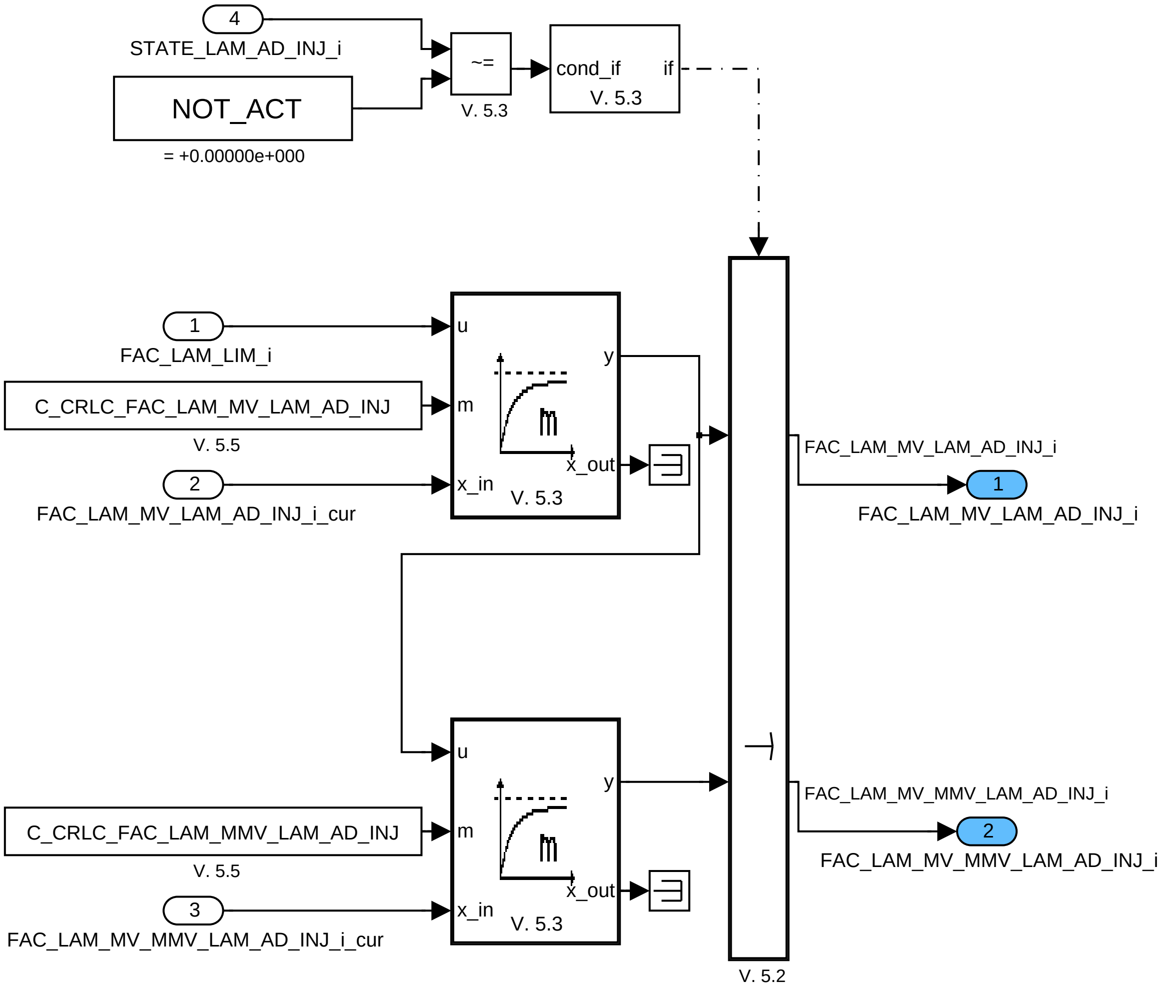

Figure 7.112.27: : Path: MFMA_ISPCLAIM0/OPM_20MS/CLC/GEN_CALC/CLC

7.112.3 1s operations

All calculations are done for each cylinder, where the cylinder specific values are denoted within the graphical model with the suffix _x, in the textual description they are referenced via [x].

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7.112.3.1 Calculation of the adaptation value

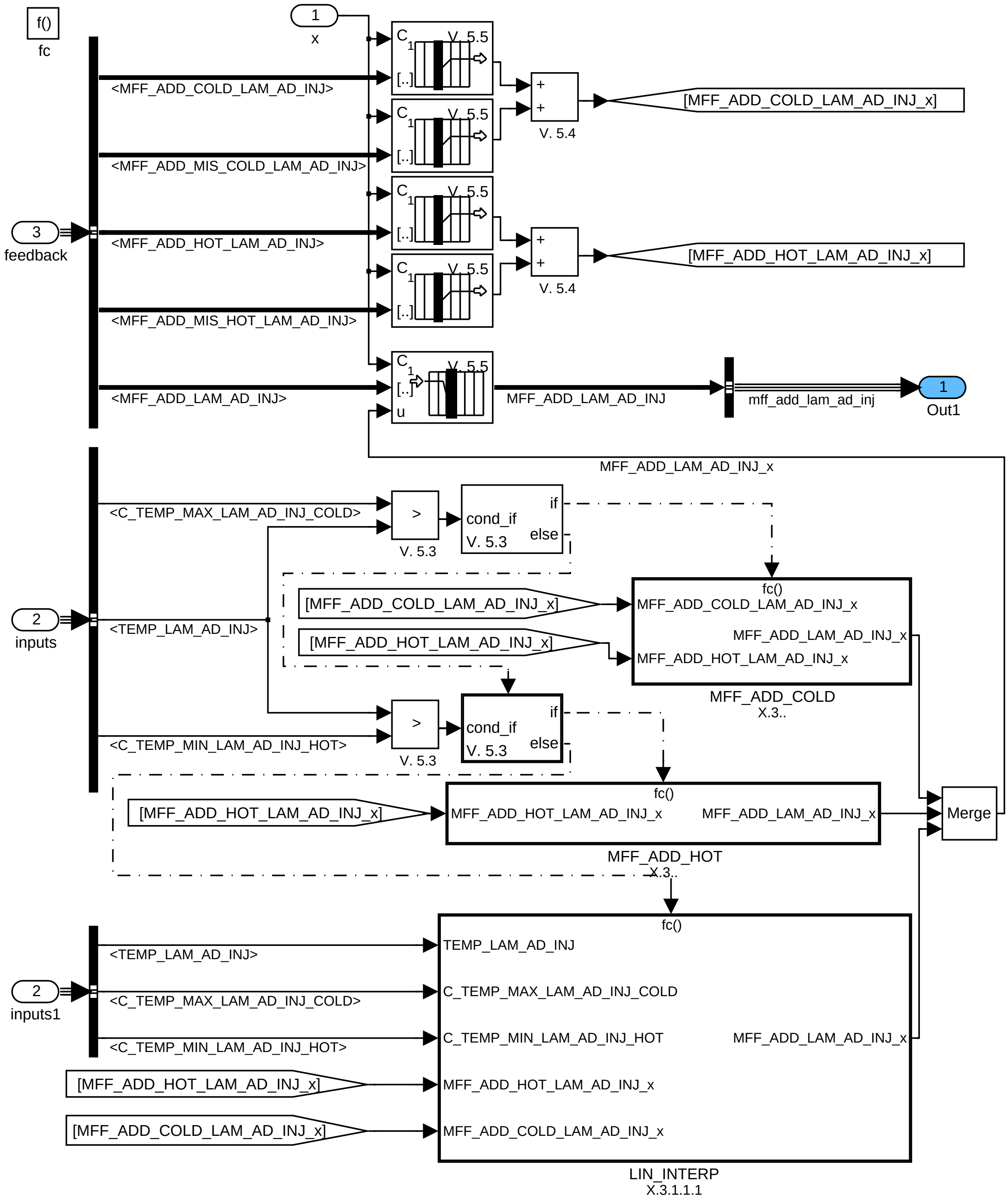

Figure 7.112.28: : Path: MFMA_ISPCLAIM0/OPM_1S/CLC_AD_VALUE

7.112.3.1.1 Linear interpolation

Depending on the calibration data LC_MFF_CLC_ADD_LAM_COLD_ADD two different ways of calculation for the adaptation value can be chosen. For setting the calibration to zero here is a linear interpolation between the upper and lower temperature range. For one the cold adaptation value is

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added as an offset to the hot adaptation value. The offset is faded out between the upper temperature threshold for the cold area and the lower threshold for the hot area.

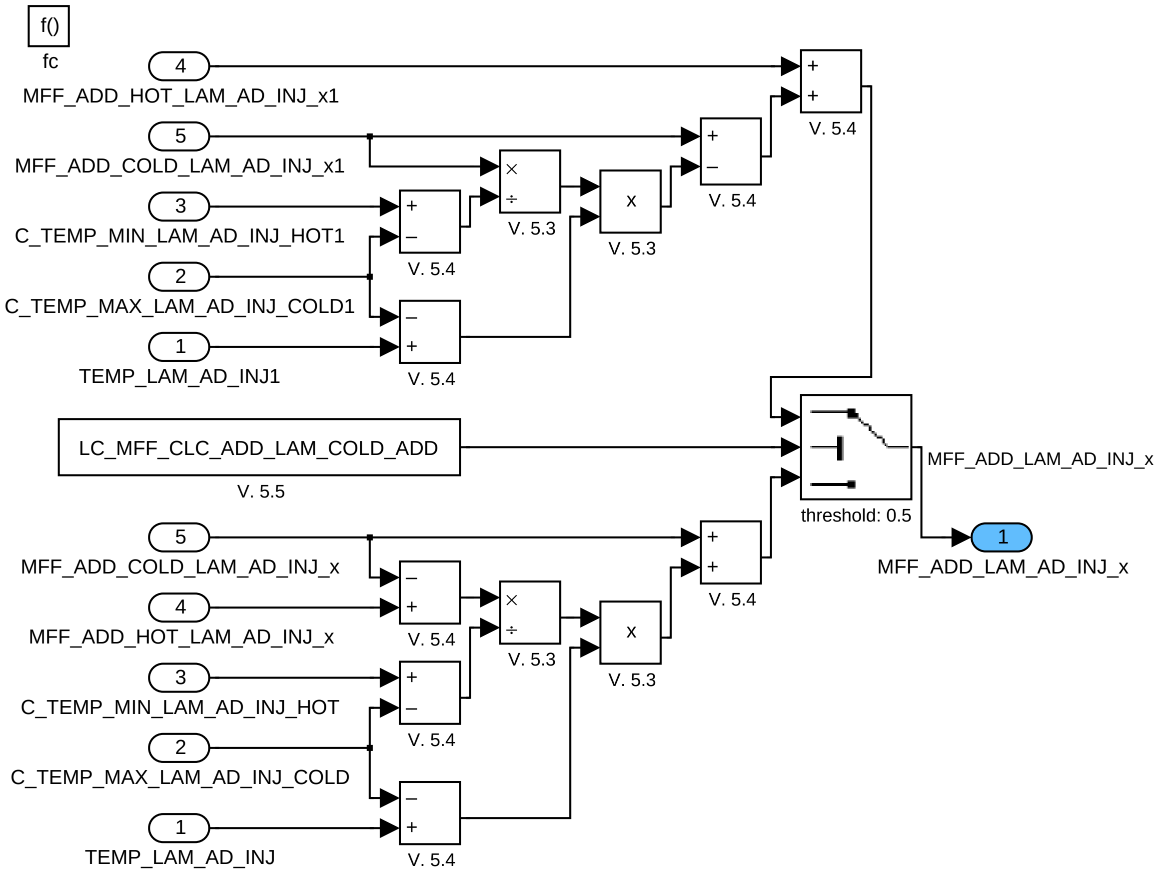

Figure 7.112.29: : Path: MFMA_ISPCLAIM0/OPM_1S/CLC_AD_VALUE/LIN_INTERP

7.112.3.1.2 Cold adaptation value

Depending on the calibration value LC_MFF_CLC_ADD_LAM_COLD_ADD the adaptation value for the cold range can be used alone or the adaptation of the cold range can be used as an offset for the hot range adaptation value.

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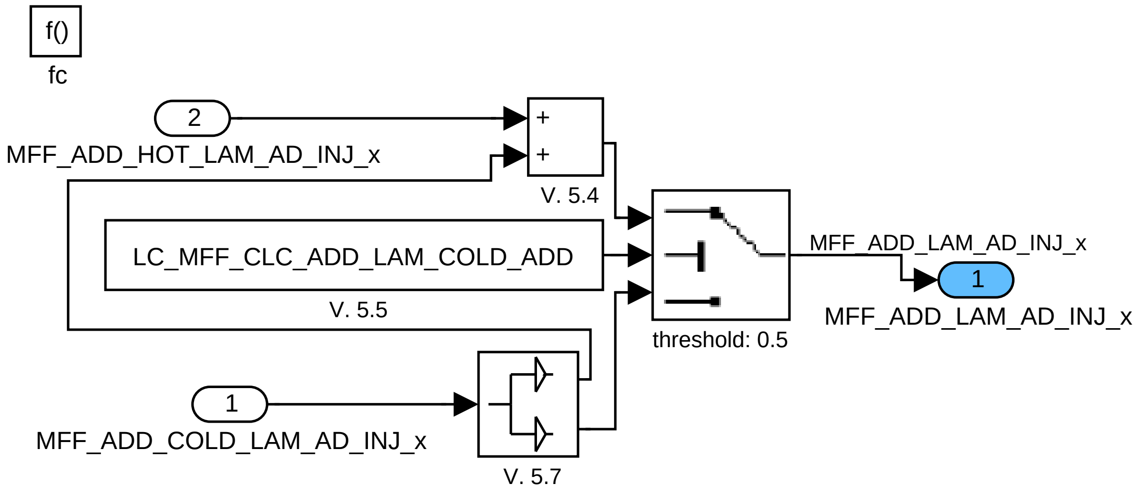

Figure 7.112.30: : Path: MFMA_ISPCLAIM0/OPM_1S/CLC_AD_VALUE/MFF_ADD_COLD

7.112.3.1.3 Hot adaptation value

At hot temperature range, the hot adaptation value is valid.

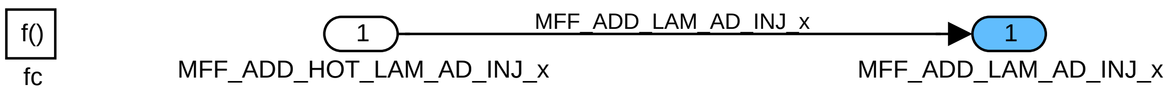

Figure 7.112.31: : Path: MFMA_ISPCLAIM0/OPM_1S/CLC_AD_VALUE/MFF_ADD_HOT

7.112.4 Resetting of adaptation values

The need to reset the adaptation values is checked every time at the transition engine off to engine on. The condition is checked for each cylinder, where the cylinder specific values are denoted within the graphical model with the suffix _x, in the textual description they are referenced via [x].

7.112.4.1 Reset due to manual request or injector change

If an injector was changed (i.e. the corresponding STATE_IV_CHG is set to one), the corresponding adaptation value is reset. If a manual reset is requested via LC_MFF_ADD_LAM_AD_INJ_CLR, all adaptation values are set to 0.
If a resetting of the NVMY data via service tester is requested with the flag LV_LAM_AD_INJ_CLR_AD_EXT, the adaptation values are also reset to 0.

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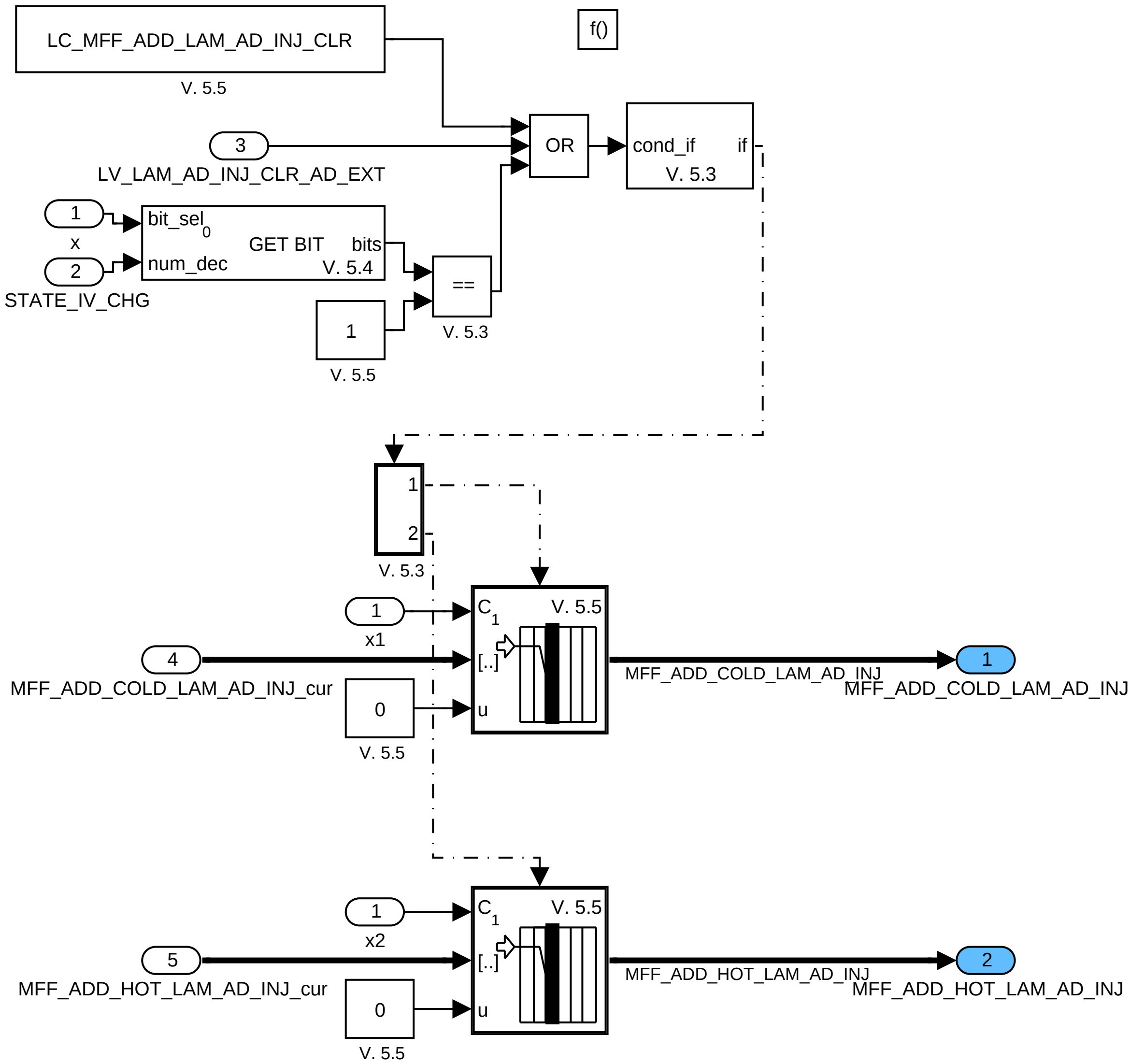

Figure 7.112.32: : Path: MFMA_ISPCLAIM0/OPM_ES2ERU/CLC

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7.113 Piezo power stage offset cancellation and gain calibration

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CHR_TRIM_DIF_0_FIL [NC_PBK_IV_NR]	V	8000... 7FFFH	-3276.8 ...3276.7	0.1	µAs
Filtered charge difference of the trim values used for offset cancellation					
CHR_TRIM_DIF_1_FIL [NC_PBK_IV_NR]	V	8000... 7FFFH	-3276.8 ...3276.7	0.1	µAs
Filtered charge difference of the trim values used for gain calibration.					
CTR_PLAUS_CHA_CAL	V	0... FFFFFFFFH	0... 4294967295	1	-
Counts the number of positive plausibility checks for gain calibration since last reset.					
CTR_PLAUS_CUR_OFS	V	0... FFFFFFFFH	0... 4294967295	1	-
Counts the number of positive plausibility checks for offset cancellation since last reset.					
CTR_PLAUS_CUR_OFS_TOT	V	0... FFFFFFFFH	0... 4294967295	1	-
Counts the total number of recurrences of offset cancellation /gain calibration calculation since last reset.					
CUR_CHA_OFS_CNL_OUT [NC_PBK_IV_NR]	O/V	8000... 7FFFH	-8.3886 ...8.38835	0.000256	A
Current applied to compensate the integrator offset for charge measurement					
FAC_COR_SLOP_CHA_CAL [NC_PBK_IV_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Correction factor for integrator gain value					
RATIO_PLAUS_CHA_CAL	V	0... FFFFH	0... 1.99996	30.5e-6	-
Ratio of plausible gain calibration input values to total number of input values.					
RATIO_PLAUS_CUR_OFS	V	0... FFFFH	0... 1.99996	30.5e-6	-
Ratio of plausible offset cancellation input values to total number of input values.					

Input data:

CHR_INJ_TRIM_0 [NC_PBK_IV_NR] {p. 2035}	CHR_INJ_TRIM_1 [NC_PBK_IV_NR] {p. 2035}	CHR_INJ_TRIM_2 [NC_PBK_IV_NR] {p. 2035}	CHR_INJ_TRIM_3 [NC_PBK_IV_NR] {p. 2035}
CUR_CHA_OFS_CNL [NC_PBK_IV_NR] {p. 2036}	INH_INJ {p. 2295}	N {p. 1525}	NC_CHR_INJ_REF {p. 626}
NC_CYL_NR {p. 1526}	NC_PBK_IV_NR {p. 628}	NC_PBK_IV_TYP {p. 628}	PREV_STATE_IV {p. 2039}
STATE_ERR_PBK_IV {p. 4797}	STATE_PBK_IV_INI {p. 2040}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CHR_INJ_REF	-	8000... 7FFFH	-3276.8 ...3276.7	0.1	µAs
Calibratable reference charge value used for integrator gain calibration.					
C_CHR_TRIM_MAX_PLAUS_BEG	-	8000... 7FFFH	-3276.8 ...3276.7	0.1	µAs
Maximum plausible value for trim pulse charge; begin of trim and end of offset cancellation.					
C_CHR_TRIM_MAX_PLAUS_END	-	8000... 7FFFH	-3276.8 ...3276.7	0.1	µAs
Maximum plausible value for trim pulse charge; end of gain calibration.					
C_CHR_TRIM_MIN_PLAUS_BEG	-	8000... 7FFFH	-3276.8 ...3276.7	0.1	µAs
Minimum plausible value for trim pulse charge; begin of trim and end of offset cancellation.					
C_CHR_TRIM_MIN_PLAUS_END	-	8000... 7FFFH	-3276.8 ...3276.7	0.1	µAs
Minimum plausible value for trim pulse charge; end of gain calibration.					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CUR_CHA_OFS_CNL_MAX	-	8000... 7FFFH	-8.3886 ...8.38835	0.000256	A
Maximal threshold for offset cancelation charge current					
C_CUR_CHA_OFS_CNL_MIN	-	8000... 7FFFH	-8.3886 ...8.38835	0.000256	A
Minimal threshold for offset cancelation charge current					
C_CUR_CHA_OFS_PI_CTL_I_LIM_MAX	-	8000... 7FFFH	-8.3886 ...8.38835	0.000256	A
Upper limit for the integral part of the current charge offset cancellation PI controller					
C_CUR_CHA_OFS_PI_CTL_I_LIM_MIN	-	8000... 7FFFH	-8.3886 ...8.38835	0.000256	A
Lower limit for the integral part of the current charge offset cancellation PI controller					
C_FAC_FIL_CHR_TRIM	-	0... FFFFH	0... 0.99998	15.3e-6	-
Filter factor for trim pulse charge difference					
C_KI_PI_CTL_CUR_CHA_OFS_CNL	-	8000... 7FFFH	-0.1... 0.09999	3.0518e-6	1/(µs*s)
Coefficient for the integral part of the PI controller used for the offset cancellation charge current					
C_KR_PI_CTL_CUR_CHA_OFS_CNL	-	8000... 7FFFH	-0.1... 0.0999969	3.0518e-6	1/µs
Coefficient for the proportional part of the PI controller used for the offset cancellation charge current					
C_N_MIN_OFS_CNL_CHA_CAL	-	0... 1FE0H	0... 8160	1	rpm
Minimum engine speed to activate offset cancellation and gain calibration.					
LC_CUR_CHA_OFS_CNL_ENA	-	0... 1H	0 ...1	1	-
Enables the PI controller used for the offset cancellation of the charge current					
LC_CUR_CHA_OFS_CNL_RST	-	0... 1H	0 ...1	1	-
Reset the offset cancellation current and the integral part of the pi controller					
LC_CUR_OFS_CNL_CHA_CAL_ENA	-	0... 1H	0 ...1	1	-
Switch to enable piezo power stage offset cancellation and gain calibration					
LC_CUR_SLOP_COR_CHR_REF	-	0... 1H	0 ...1	1	-
Selects between the calibratable (=0) and the configurable (=1) charge reference.					
LC_FAC_COR_SLOP_CHA_CAL_ENA	-	0... 1H	0 ...1	1	-
Actives the correction of the mesaured charge in relation to a a reference charge					

Exported actions:

ACTION_INJR_SetOfsCurIni(IN <Bank>, IN <OfsCurIni>)
This action initializes the bank individual offset cancellation current of bank <Bank> with the value <OfsCurIni>.

FUNCTION DESCRIPTION:

General information:

The value of the piezo charge is determined by an analog integration of the piezo current over time. The integrator output can be converted into a charge value via A/D conversion.
Due to integrator offset currents and drift of integrator gain, the accuracy of the measured charge may differ. Therefore those two effects have to be corrected.
The offset current is corrected by a variable current source. The integrator gain error is measured by applying a known amount of charge (reference charge) to the integrator and by correcting the differences between reference charge and measured charge with use of a correction factor.
This procedure is applied for each electrical bank.

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Note: The local variables I_PI_TMP and PI_PI_TMP as well as the static nonvisible variable I_PI_CTL_CUR_CHA_OFS_CNL should be 32-bit and should have the resolution 1e-6 A (that is, their resolution should be 256-times finer than the one of the output variable CUR_CHA_OFS_CNL_OUT).

Signal flow diagram:

Description:

Application conditions

Initialisation:

```
at reset:
   CHR_TRIM_DIF_0_FIL[ ] = 0 // all NC_PBK_IV_NR elements
  (1)IF  LC_CUR_SLOP_COR_CHR_REF = 1
  (1)THEN
     CHR_TRIM_DIF_1_FIL[ ] = NC_CHR_INJ_REF
     // all NC_PBK_IV_NR elements
  (1)ELSE
     CHR_TRIM_DIF_1_FIL[ ] = C_CHR_INJ_REF
                               // all NC_PBK_IV_NR elements
 (1)ENDIF
   FAC_COR_SLOP_CHA_CAL[ ] = 1     // all NC_PBK_IV_NR elements
   CUR_CHA_OFS_CNL_OUT[ ] = 0 // all NC_PBK_IV_NR elements
   I_PI_CTL_CUR_CHA_OFS_CNL[ ] = 0   // all NC_PBK_IV_NR
     elements
   CTR_PLAUS_CUR_OFS_TOT = 0
   CTR_PLAUS_CUR_OFS = 0
   CTR_PLAUS_CHA_CAL = 0
   RATIO_PLAUS_CUR_OFS = 0
   RATIO_PLAUS_CHA_CAL = 0
```

Recurrence: *1 s*

Activation:

```
LC_CUR_OFS_CNL_CHA_CAL_ENA = 1
AND  STATE_PBK_IV_INI = "INIT_FINISHED"
 AND STATE_ERR_PBK_IV = 0
 AND NC_PBK_IV_TYP = 1 (for ATIC88)
 AND N > C_N_MIN_OFS_CNL_CHA_CAL
 AND PREV_STATE_IV = (2^NC_CYL_NR) - 1
 AND INH_INJ = 0
```

Deactivation: *If activation conditions are **not** fulfilled, function must be deactivated.*

Formula section:

(1)FOR m = 0 **TO** NC_PBK_IV_NR - 1 **DO**

The compensation of the remaining charge (Offset Cancellation) and the analog integrator gain correction are carried out for each electrical bank.

Low pass filter for measured trim pulses:

Two PT1-filters are applied to the difference of the measured voltage values CHA_TRIM_1 - CHA_TRIM_0 and to the difference of the measured voltage values CHA_TRIM_3 - CHA_TRIM_2. The factor of the filter is defined by C_FAC_FIL_CHR_TRIM = 1 - exp(-2*pi*fs*Ts), where Ts=1 s (recurrence of the block) and fs is the cut off frequency of the filter.

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7.113.1 PI-controller for applied offset cancellation current:

Plausibility check:
To track errors within the trimming system and the A/D conversion, a plausibility check of the analogue measured charge values is done. For visualization purposes, the ration between plausible values and the total number of values is calculated for offset cancellation and gain calibration separately.

CTR_PLAUS_CUR_OFS_TOT = CTR_PLAUS_CUR_OFS_TOT + 1
(4)IF LC_CUR_CHA_OFS_CNL_ENA = 1
(4)THEN
 Plausibility check:
 (4a)IF (CHR_INJ_TRIM_0[m] < C_CHR_TRIM_MAX_PLAUS_BEG
  AND CHR_INJ_TRIM_0[m] > C_CHR_TRIM_MIN_PLAUS_BEG
  AND CHR_INJ_TRIM_1[m] < C_CHR_TRIM_MAX_PLAUS_BEG
  AND CHR_INJ_TRIM_1[m] > C_CHR_TRIM_MIN_PLAUS_BEG)
 (4a)THEN
  Increment plausibility counter and calculate ratio:
  CTR_PLAUS_CUR_OFS = CTR_PLAUS_CUR_OFS + 1
  RATIO_PLAUS_CUR_OFS = CTR_PLAUS_CUR_OFS
   /CTR_PLAUS_CUR_OFS_TOT
  Filter input signal:
  CHR_TRIM_DIF_0_FIL[m] = (C_FAC_FIL_CHR_TRIM *
   ((CHR_INJ_TRIM_1[m] - CHR_INJ_TRIM_0[m])
   - CHR_TRIM_DIF_0_FIL[m](n-1))) + CHR_TRIM_DIF_0_FIL[m](n-1)
  I_PI_TMP = I_PI_CTL_CUR_CHA_OFS_CNL[m](n-1)
   - CHR_TRIM_DIF_0_FIL[m] * C_KI_PI_CTL_CUR_CHA_OFS_CNL * 1 s
  I_PI_TMP = **MIN**(I_PI_TMP, C_CUR_CHA_OFS_PI_CTL_I_LIM_MAX)
  I_PI_CTL_CUR_CHA_OFS_CNL[m] =
   MAX(I_PI_TMP, C_CUR_CHA_OFS_PI_CTL_I_LIM_MIN)
  PI_PI_TMP = C_KR_PI_CTL_CUR_CHA_OFS_CNL *
   (- CHR_TRIM_DIF_0_FIL[m]) + I_PI_CTL_CUR_CHA_OFS_CNL[m]
  PI_PI_TMP = **MIN**(PI_PI_TMP, C_CUR_CHA_OFS_CNL_MAX)
  CUR_CHA_OFS_CNL_OUT[m] =
   MAX(PI_PI_TMP, C_CUR_CHA_OFS_CNL_MIN)
 (4a)ENDIF
(4)ELSE
 CUR_CHA_OFS_CNL_OUT[m] = CUR_CHA_OFS_CNL[m]
(4)ENDIF
(5)IF LC_CUR_CHA_OFS_CNL_RST = 1
(5)THEN
 CUR_CHA_OFS_CNL_OUT[m] = 0
 I_PI_CTL_CUR_CHA_OFS_CNL[m] = 0
(5)ENDIF

7.113.2 Calculation of gain calibration:

The integrator gain factor, used to calculate the charge of the piezoelectric actuator, must be corrected by the factor FAC_COR_SLOP_CHA_CAL, which is calculated using a configurable reference charge value NC_CHR_INJ_REF or a calibratable reference charge value C_CHR_INJ_REF. The selection between these two reference values is made by LC_CUR_SLOP_COR_CHR_REF.

(6)IF LC_FAC_COR_SLOP_CHA_CAL_ENA = 1
(6)THEN
 Plausibility check:
 (6a)IF (CHR_INJ_TRIM_2[m] < C_CHR_TRIM_MAX_PLAUS_BEG

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AND CHR_INJ_TRIM_2[m] > C_CHR_TRIM_MIN_PLAUS_BEG
AND CHR_INJ_TRIM_3[m] < C_CHR_TRIM_MAX_PLAUS_END
AND CHR_INJ_TRIM_3[m] > C_CHR_TRIM_MIN_PLAUS_END)
(6a)THEN
Increment plausibility counter and calculate ratio:
CTR_PLAUS_CHA_CAL = CTR_PLAUS_CHA_CAL + 1
RATIO_PLAUS_CHA_CAL = CTR_PLAUS_CHA_CAL
/CTR_PLAUS_CUR_OFS_TOT
Filter input signal:
CHR_TRIM_DIF_1_FIL[m] = (C_FAC_FIL_CHR_TRIM *
((CHR_INJ_TRIM_3[m] - CHR_INJ_TRIM_2[m])
- CHR_TRIM_DIF_1_FIL[m](n-1))) + CHR_TRIM_DIF_1_FIL[m](n-1)
(7)IF LC_CUR_SLOP_COR_CHR_REF = 1
(7)THEN
FAC_COR_SLOP_CHA_CAL[m] = NC_CHR_INJ_REF
/CHR_TRIM_DIF_1_FIL[m]
(7)ELSE
FAC_COR_SLOP_CHA_CAL[m] = C_CHR_INJ_REF
/CHR_TRIM_DIF_1_FIL[m]
(7)ENDIF
(6a)ENDIF
(6)ELSE
FAC_COR_SLOP_CHA_CAL[m] = 1
(6)ENDIF
(1)ENDFOR

7.113.3 Description of exported actions

7.113.3.1 Description of ACTION_INJR_SetOfsCurIni

ACTION_INJR_SetOfsCurIni(IN <Bank>, IN <OfsCurIni>)					
This action initializes the bank individual offset cancellation current of bank <Bank> with the value <OfsCurIni>.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
Bank	IN	0 ... 7	0 ... 7	1	-
Number of injection bank.					
OfsCurIni	IN	8000...7FFFH	-8.38860... 8.38835	0.00025 6	[A]
Initial value of offset cancellation current.					

Formula Section:

Set offset cancellation current to initial value, but limit it to the calibratable thresholds. Also set the I-controller value of the PI-controller to 0 (controller reset).
CUR_CHA_OFS_CNL_OUT[Bank] = OfsCurIni
CUR_CHA_OFS_CNL_OUT[Bank] =
MIN(CUR_CHA_OFS_CNL_OUT[Bank], C_CUR_CHA_OFS_CNL_MAX)
CUR_CHA_OFS_CNL_OUT[Bank] =
MAX(CUR_CHA_OFS_CNL_OUT[Bank], C_CUR_CHA_OFS_CNL_MIN)
I_PI_CTL_CUR_CHA_OFS_CNL[Bank] = CUR_CHA_OFS_CNL_OUT[Bank]

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7.114 NOx catalyst aging model

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_NT_AGI_MDL	O/V	0... FFFFFFFFH	0... 0.99999	232.8e-12	-
Modeled aging of NT					
FAC_NT_AGI_MDL_THERMO	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Converted modeled aging factor to thermo aging factor					

Action definition

ACTION_NOXM_CleanNTAdaptAgiMdl ()	Mode: O
External service for Initiaöization of Modelled Aging values	

ACTION_NOXM_WriteAgiMExtAdj ()	Mode: O
Reset of NSC modelled value using external value	

FUNCTION DESCRIPTION:

General information:

This modul has no functionality. It provides only all existing interfaces for other moduls.

Application conditions

Initialisation: *at reset set all output values to 1 (means new NOx catalyst)*

Recurrence:no
Activation:

Action definition:

Both actions have no functionality.

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8 - Engine Speed Control

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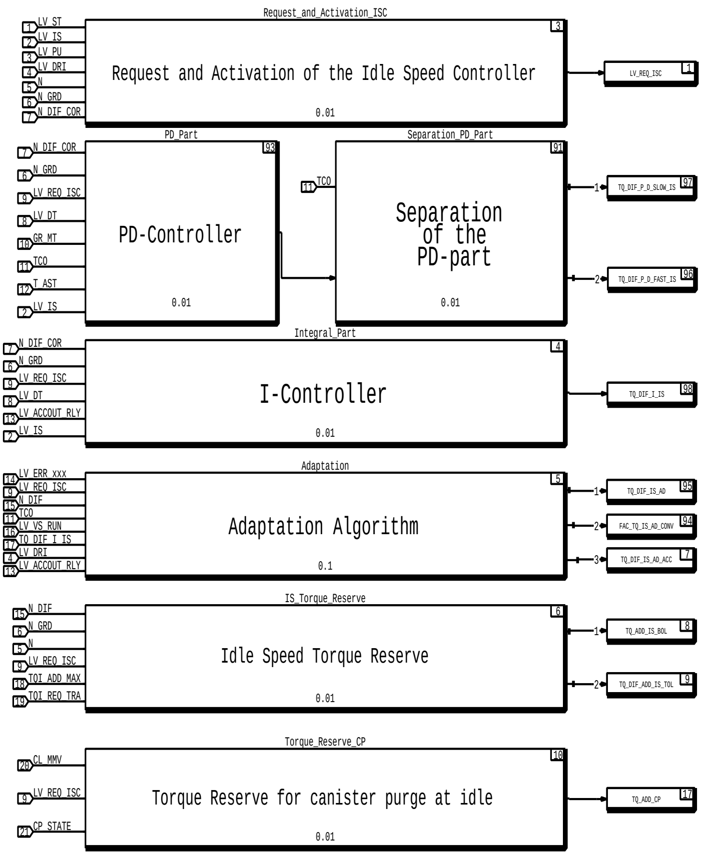
8.1 Idle speed control general

22-FEB-99

Discrete SuperBlock	Sample Period	Sample Skew	Inputs	Outputs	Enable Signal
Idle_Speed_Control_General	0.01	0.	21	10	Parent



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8.2 Idle speed control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_N_GRD_IS	V	0... FFH	0... 1.9921875	0.0078125	-
Factor in dependance of TCO and TOIL for weighting the speed gradient influence on the PD-part (for LV_DT=0)					
FAC_N_GRD_IS_SLOW	V	0... FFH	0... 1.9921875	0.0078125	-
Factor in dependance of TCO and TOIL for weighting the speed gradient influence on the PD-part (for LV_DT=0)					
IP_FAC_P_D_SLOW_TCO_IS	-	0... FFFFH	0... 1.999969	30.5175e-6	-
TCO depending factor for slow-path of torque coordination					
LV_PAS_RAMP_ACT_I_IS	O/V	0... 1H	0 ...1	1	-
Logical value for I-part passive ramp active					
LV_PAS_RAMP_ACT_P_D_IS	O/V	0... 1H	0 ...1	1	-
Logical value for PD-part passive ramp active					
LV_TQ_DIF_I_IS_INI_ACT	O/V	0... 1H	0 ...1	1	-
Flag for activating the re-initialisation of I-Part of idle speed controller (f.e. by LV_DT=1->0)					
LV_TQ_ISC_I_TQ_PSTE	O/V	0... 1H	0 ...1	1	-
Logical variable for limitation due to PSTE					
LV_TQ_P_D_ACT_FAST	V	0... 1H	0 ...1	1	-
Logical variable for PD-part fast active (STATE_P_D_ISC = P_D_NORMAL)					
LV_TQ_P_D_ACT_FAST_TEMP	V	0... 1H	0 ...1	1	-
Flag to activate LV_TQ_P_D_ACT_FAST in case of manual or automatic transmission					
LV_TQ_P_D_ACT_SLOW	V	0... 1H	0 ...1	1	-
Logical variable for PD-part air path active (STATE_P_D_ISC = P_D_NORMAL)					
N_GRD_FAC_P_D	V	80... 7FH	-4096 ...4064	32	rpm/s
output of N_GRD_P_D_IS * FAC_N_GRD_IS; gradient input of the PD-part maps					
N_GRD_FAC_P_D_SLOW	V	80... 7FH	-4096 ...4064	32	rpm/s
output of N_GRD_P_D_IS * FAC_N_GRD_IS_SLOW; gradient input of the PD-slow-part maps					
N_GRD_I_IS	V	80... 7FH	-4096 ...4064	32	rpm/s
Filtered gradient; gradient input of the I-part maps					
N_GRD_P_D_IS	V	80... 7FH	-4096 ...4064	32	rpm/s
Filtered gradient; gradient input of the PD-part maps					
STATE_I_ISC	V	0H 1H 2H 3H	I_PASSIVE I_NORMAL RAMP_TO_ PAS RAMP_TO_LIM	-	-
State of the integral part: I_PASSIVE, I_NORMAL, RAMP_TO_PAS, RAMP_TO_LIM					
STATE_P_D_ISC	V	0H 1H 2H	P_D_PASSIVE P_D_NORMAL RAMP_TO_ ZERO	-	-
State of the PD-part: P_D_PASSIVE, P_D_NORMAL, RAMP_TO_ZERO					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_PAS_RAMP_ACT_I_IS	O/V	0... FFH	0... 255	1	-
Circular buffer for the logical value for I-part passive ramp active					
STATE_PAS_RAMP_ACT_P_D_IS	O/V	0... FFH	0... 255	1	-
Circular buffer for the logical value for PD-part passive ramp active					
TQ_ADD_I_IS	V	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
Incrememt of limited integrator					
TQ_ADD_I_RAMP	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Increment of the I-part ramps					
TQ_ADD_P_D_RAMP_FAST	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Increment of the PD-part ramps ignition path					
TQ_ADD_P_D_RAMP_SLOW	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Increment of the PD-part ramps air path					
TQ_DIF_I_IS	O/V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I-part					
TQ_DIF_I_IS_1	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I-part at normal out of calculation					
TQ_DIF_I_IS_2	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I-part at normal but ramp operation					
TQ_DIF_P_D_DT_IS_1	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part at drive train into fast path					
TQ_DIF_P_D_DT_IS_1_SLOW	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part at drive train into slow path					
TQ_DIF_P_D_DT_IS_OPM_1	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part at drive train into fast path (mode1)					
TQ_DIF_P_D_DT_IS_OPM_2	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part at drive train into fast path (mode2)					
TQ_DIF_P_D_DT_IS_SEL	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Resulting PD-part at drive train into fast path					
TQ_DIF_P_D_DT_IS_SLOW_OPM_1	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part at drive train into slow path (mode1)					
TQ_DIF_P_D_DT_IS_SLOW_OPM_2	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part at drive train into slow path (mode2)					
TQ_DIF_P_D_DT_IS_SLOW_SEL	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Resulting PD-part at drive train into slow path					
TQ_DIF_P_D_FAST_IS	O/V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part for fast-path of torque coordination					
TQ_DIF_P_D_IS_FAST	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part before separation into fast/slow path					
TQ_DIF_P_D_IS_OPM_1	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part before separation into fast/slow path					
TQ_DIF_P_D_IS_OPM_2	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part before separation into fast/slow path					
TQ_DIF_P_D_IS_SEL	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Resulting PD-part before separation into fast/slow path					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_DIF_P_D_IS_SLOW	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part before separation into fast/slow path					
TQ_DIF_P_D_IS_SLOW_OPM_1	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part before separation into fast/slow path					
TQ_DIF_P_D_IS_SLOW_OPM_2	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part before separation into fast/slow path					
TQ_DIF_P_D_IS_SLOW_SEL	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Resulting PD-part before separation into fast/slow path					
TQ_DIF_P_D_SLOW_IS	O/V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
PD-part for slow-path of torque coordination					
TQ_I_DT_IS_OPM_1	V	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
I-part at closed drive train out of calculation (mode1)					
TQ_I_DT_IS_OPM_2	V	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
I-part at closed drive train out of calculation (mode2)					
TQ_I_DT_IS_SEL	V	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
Resulting I-part at closed drive train out of calculation					
TQ_I_IS_OPM_1	V	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
I-part at normal out of calculation (mode1)					
TQ_I_IS_OPM_2	V	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
I-part at normal out of calculation (mode2)					
TQ_I_IS_SEL	V	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
Resulting I-part at normal out of calculation					
TQ_LIM_I_IS	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Actual torque limitation value for integral part					
TQ_PAS_I_ACC_IS_OPM_1	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I-component for idle speed controller at transition out of Passive with air condition (mode1)					
TQ_PAS_I_ACC_IS_OPM_2	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I-component for idle speed controller at transition out of Passive with air condition (mode2)					
TQ_PAS_I_ACC_IS_SEL	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Resulting I-component for idle speed controller at transition out of Passive with air condition					
TQ_PAS_I_IS_OPM_1	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I-component for idle speed controller at transition out of Passive with (mode1)					
TQ_PAS_I_IS_OPM_2	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I-component for idle speed controller at transition out of Passive with (mode2)					
TQ_PAS_I_IS_SEL	V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Resulting I-component for idle speed controller at transition out of Passive with					

Input data:

FAC_TQ_ADD_IS_OPM_SEL {p. 8212}	GR_AT {p. 1302}	GR_MT {p. 1302}	ID_IDX_OPM_DROF {p. 1112}
ID_TQ_ADD_IS_OPM_AV {p. 3545}	ID_TQ_ADD_IS_OPM_REQ {p. 3545}	LV_ACCOUT_RLY {p. 3589}	LV_AT {p. 654}
LV_CS {p. 8394}	LV_DT {p. 1310}	LV_ES {p. 1720}	LV_IGK {p. 906}
LV_ISC_INH_EXT_ADJ {p. 803}	LV_ISC_OFF_DROF {p. 1112}	LV_REQ_ISC {p. 3501}	LV_VAR_TCT {p. 656}

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N {p. 1525}	N_DIF_COR {p. 1122}	N_GRD {p. 1525}	N_SP_IS {p. 1122}
OPM_AV {p. 8137}	OPM_REQ {p. 8137}	T_AST {p. 1766}	TCO {p. 1100}
TQ_ADD_CH {p. 6582}	TQ_ADD_PSTE {p. 6621}	TQ_LOSS_PSTE {p. 6622}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_N_GRD	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Filter correlation constant					
C_N_DIF_I_IS_INI	-	E020... 1FE0H	-8160 ...8160	1	rpm
engine speed difference to setpoint for re-initialisation of I-Part of idle speed controller					
C_NR_BUF_N_GRD_FIL	-	0... 6H	0 ...6	1	-
number of relevant buffer cells for N_GRD_FIL_1_IS					
C_T_RAMP_LIM_I_DT_IS	-	0... FFFFH	0... 1310.7	0.02	s
Time constant for ramp limit of I-controller output in case of idle speed controller passive and drive train engagedResolution is directly coupled with update rate					
C_T_RAMP_LIM_I_IS	-	0... FFFFH	0... 1310.7	0.02	s
Time constant for ramp limit of I-controller output in case of idle speed controller passiveResolution is directly coupled with update rate					
C_T_RAMP_LIM_P_D_DT_IS	-	0... FFFFH	0... 655.35	0.01	s
Time constant for ramp limit of P-, D-controller output in case of idle speed controller passive and LV_DT=1					
C_T_RAMP_LIM_P_D_IS	-	0... FFFFH	0... 655.35	0.01	s
Time constant for ramp limit of P-, D-controller output in case of idle speed controller passive					
C_T_TQ_ISC_I_TQ_PSTE_LIM	-	0... FFFFH	0... 1310.7	0.02	s
Delay time to reset the idle speed controller limitation due to PSTE					
C_THD_TQ_ADD_PSTE_I_ISC	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
TQ_ADD_PSTE threshold for calc of I limitation threshold					
C_THD_TQ_ADD_PSTE_I_ISC_HYS	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Hysteresis for TQ_ADD_PSTE threshold to leave I limitation					
C_THD_TQ_LOSS_PSTE_I_ISC	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
TQ_LOSS_PSTE threshold for calc of I limitation threshold					
C_THD_TQ_LOSS_PSTE_I_ISC_HYS	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Hysteresis for TQ_LOSS_PSTE threshold to leave I limitation					
C_TQ_BOL_I_DT_AT_IS	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Bottom limit for I-controller output and drive train closed-Automatic Transmission					
C_TQ_BOL_I_DT_IS	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Bottom limit for I-controller output and drive train closed					
C_TQ_BOL_I_IS	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Bottom limit for I-controller output					
C_TQ_DIF_I_IS_DT_THD	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Threshold value for reset of TQ_DIF_I_IS in case of LV_DT = 0 - -> 1					
C_TQ_DIF_I_IS_INI	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Initialization value of TQ_DIF_I_IS in case of LV_DT = 0 - -> 1					
C_TQ_ISC_I_MAX_TQ_DROF	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I limitation at drive off					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQ_ISC_I_MAX_TQ_PSTE	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I limitation max value at PSTE intervention					
C_TQ_ISC_I_MIN_TQ_DROF	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I limitation at drive off					
C_TQ_ISC_I_MIN_TQ_PSTE	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
I limitation min value at PSTE intervention					
C_TQ_MAX_ISC_TQ_DROF_FAST	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
P_D Limitation at Drive off					
C_TQ_MAX_ISC_TQ_DROF_SLOW	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
P_D limitation at drive off					
C_TQ_MIN_ISC_TQ_DROF_FAST	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
P_D Limitation at Drive off					
C_TQ_MIN_ISC_TQ_DROF_SLOW	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
P_D limitation at drive off					
C_TQ_TOL_I_DT_IS_OPM_1	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Top limit for I-controller output and drive train closed in operation mode 1					
C_TQ_TOL_I_DT_IS_OPM_2	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Top limit for I-controller output and drive train closed in operation mode 2					
C_TQ_TOL_I_IS	-	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Top limit for I-controller output					
ID_FAC_AT_P_D_DT_IS	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
LDPM_GR_AT_3	8	0... FFH	0... 255	1	-
Weighting factor for TQ_DIF_P_D_DT_IS_SEL for AT					
ID_FAC_AT_P_D_DT_IS_SLOW	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
LDPM_GR_AT_3	8	0... FFH	0... 255	1	-
Weighting factor for TQ_DIF_P_D_DT_IS_SLOW_SEL for AT					
ID_FAC_MT_P_D_DT_IS	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
LDPM_GR_MT_2	8	0... FFH	0... 255	1	-
Weighting factor for TQ_DIF_P_D_DT_IS_SEL for MT					
ID_FAC_MT_P_D_DT_IS_SLOW	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
LDPM_GR_MT_2	8	0... FFH	0... 255	1	-
Weighting factor for TQ_DIF_P_D_DT_IS_SLOW_SEL for MT					
IP_FAC_N_GRD_IS	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_TCO_IP_FAC_N_GRD_IS	8	0... FEH	-48... 142.5	0.75	°C
LDP_T_AST_IP_FAC_N_GRD_IS	8	0... FFFFH	0... 6553.5	0.1	s
Weighting factor for N_GRD input for IP_P_D_IS					
IP_FAC_N_GRD_IS_SLOW	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_TCO__FAC_N_GRD_IS	8	0... FEH	-48... 142.5	0.75	°C
LDPM_T_AST__FAC_N_GRD_IS	8	0... FFFFH	0... 6553.5	0.1	s
Weighting factor for N_GRD input for IP_P_D_IS					
IP_FAC_P_D_FAST_IS	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
LDPM_TCO_IS_1	8	0... FEH	-48... 142.5	0.75	°C
LDPM_TQ_ADD_CH_IS_1	6	0... FFFFH	-1024... 1023.97	0.03125	Nm
TCO and TQ_ADD_CH depending factor for fast-path of torque coordination					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_P_D_SLOW_IS	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
LDPM_TCO_IS_1	8	0... FEH	-48... 142.5	0.75	°C
LDPM_TQ_ADD_CH_IS_1	6	0... FFFFH	-1024... 1023.97	0.03125	Nm
TCO and TQ_ADD_CH depending factor for slow-path of torque coordination					
IP_FAC_T_AST_I_IS_OPM_1	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
LDPM_TCO__FAC_N_GRD_IS_2	4	0... FEH	-48... 142.5	0.75	°C
LDPM_T_AST__FAC_N_GRD_IS	8	0... FFFFH	0... 6553.5	0.1	s
TQ_ADD_I_IS correction after start in operation mode 1					
IP_FAC_T_AST_I_IS_OPM_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_TCO__FAC_N_GRD_IS_2	4	0... FEH	-48... 142.5	0.75	°C
LDPM_T_AST__FAC_N_GRD_IS	8	0... FFFFH	0... 6553.5	0.1	s
TQ_ADD_I_IS correction after start in operation mode 2					
IP_FAC_TCO_PAS_I_IS	-	0... FFH	0... 0.99609	0.0039063	-
LDP_TCO__FAC_TCO_PAS_I_IS	4	0... FEH	-48... 142.5	0.75	°C
TCO correction at entry in I - share calculation					
IP_P_D_DT_IS_OPM_1	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_P_D_DT_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_P_D_DT_IS_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
P- and D-component for idle speed controller at closed drive train (mode1)					
IP_P_D_DT_IS_OPM_2	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_P_D_DT_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_P_D_DT_IS_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
P- and D-component for idle speed controller at closed drive train (mode2)					
IP_P_D_DT_IS_SLOW_OPM_1	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_P_D_DT_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_P_D_DT_IS_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
P- and D-component for idle speed controller at closed drive train (mode1)					
IP_P_D_DT_IS_SLOW_OPM_2	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_P_D_DT_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_P_D_DT_IS_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
P- and D-component for idle speed controller at closed drive train (mode2)					
IP_P_D_IS_OPM_1	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_P_D_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_P_D_IS_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
P- and D-component for idle speed controller at open drive train (mode1)					
IP_P_D_IS_OPM_2	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_P_D_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_P_D_IS_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
P- and D-component for idle speed controller at open drive train (mode2)					
IP_P_D_IS_SLOW_OPM_1	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_P_D_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_P_D_IS_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
P- and D-component for idle speed controller at open drive train (mode1)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_P_D_IS_SLOW_OPM_2	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_P_D_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_P_D_IS_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
P- and D-component for idle speed controller at open drive train (mode2)					
IP_TQ_I_DT_IS_OPM_1	-	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
LDPM_N_DIF_COR_TQ_I_DT_IS_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
I-component for idle speed controller at closed drive train (mode1)					
IP_TQ_I_DT_IS_OPM_2	-	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
LDPM_N_DIF_COR_TQ_I_DT_IS_OPM_2	12	0... FFFFH	-32768 ...32767	1	rpm
I-component for idle speed controller at closed drive train (mode2)					
IP_TQ_I_IS_OPM_1	-	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
LDPM_N_DIF_COR_TQ_I_IS_1_OPM_1	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_TQ_I_IS_1_OPM_1	8	0... FFH	-4096 ...4064	32	rpm/s
I-component for idle speed controller at open drive train (mode1)					
IP_TQ_I_IS_OPM_2	-	8000... 7FFFH	-4... 3.99987793	122.07e-6	Nm
LDPM_N_DIF_COR_TQ_I_IS_1_OPM_2	12	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_TQ_I_IS_1_OPM_2	8	0... FFH	-4096 ...4064	32	rpm/s
I-component for idle speed controller at open drive train (mode2)					
IP_TQ_PAS_I_ACC_IS_OPM_1	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_TQ_I_IS_OPM_1	4	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_TQ_I_IS_OPM_1	4	0... FFH	-4096 ...4064	32	rpm/s
I-component for idle speed controller at transition out of Passive with air condition (mode1)					
IP_TQ_PAS_I_ACC_IS_OPM_2	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_TQ_I_IS_OPM_2	4	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_TQ_I_IS_OPM_2	4	0... FFH	-4096 ...4064	32	rpm/s
I-component for idle speed controller at transition out of Passive with air condition (mode2)					
IP_TQ_PAS_I_IS_OPM_1	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_TQ_I_IS_OPM_1	4	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_TQ_I_IS_OPM_1	4	0... FFH	-4096 ...4064	32	rpm/s
I-component for idle speed controller at transition out of Passive with (mode1)					
IP_TQ_PAS_I_IS_OPM_2	-	0... FFFFH	-1024... 1023.97	0.03125	Nm
LDPM_N_DIF_COR_TQ_I_IS_OPM_2	4	0... FFFFH	-32768 ...32767	1	rpm
LDPM_N_GRD_TQ_I_IS_OPM_2	4	0... FFH	-4096 ...4064	32	rpm/s
I-component for idle speed controller at transition out of Passive with (mode2)					
LC_ISC_INH	-	0... 1H	0 ...1	1	-
Bit for inhibiting the PD- and integral part - default value = 0					
LC_N_GRD_FIL_I_SWI	-	0... 1H	0 ...1	1	-
Logical variable for changing between N_GRD_FIL_1_IS and N_GRD_FIL_IS					
LC_N_GRD_FIL_P_D_SWI	-	0... 1H	0 ...1	1	-
Logical variable for switching between N_GRD_FIL_1_IS and N_GRD_FIL_IS					
LC_P_D_ACT_FAST_AT	-	0... 1H	0 ...1	1	-
Logical variable to activate LV_TQ_P_D_FAST_out for automatic transmission path					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_P_D_ACT_FAST_MT	-	0... 1H	0 ...1	1	-
Logical variable to activate LV_TQ_P_D_FAST_out for manual transmission path					
LC_P_D_SLOW_FAST_SEL_ENA	-	0... 1H	0 ...1	1	-
Enable separation of slow and fast path of TQ_DIF_P_D_IS - default value at initialisation = 0					
LC_TQ_ADD_I_INH_AS	-	0... 1H	0 ...1	1	-
Logical variable for ISC I-part map output deactivation - default value at initialisation = 0					
LC_TQ_DIF_I_INH_AS	-	0... 1H	0 ...1	1	-
Logical variable for ISC I-part deactivation (completely) - default value at initialisation = 0					
LC_TQ_DIF_I_IS_DT_INI	-	0... 1H	0 ...1	1	-
Logical variable to activate the re-initialisation of I-Part of idle speed controller at LV_DT=1->0					
LC_TQ_DIF_P_D_INH_AS	-	0... 1H	0 ...1	1	-
Bit for inhibiting the PD-part - default value = 0					
LC_TQ_P_D_FAST_INH_AS	-	0... 1H	0 ...1	1	-
Logical variable for deactivation of TQ_DIF_P_D_IS - default value at initialisation = 0					
LC_TQ_P_D_SLOW_INH_AS	-	0... 1H	0 ...1	1	-
Logical variable for deactivation of TQ_DIF_P_D_IS - default value at initialisation = 0					

Local actions:

ACTION_ENSC_OPERATION_MANAGER(IN <IN1>, IN <IN2>, OUT <OUT>, OUT <TQ_DIF_OPM_1>, OUT <TQ_DIF_OPM_2>)
Operation manager

Overview

The controller consists of three parts:

PD-part
PD-part separation into slow and fast path
I-part

An operation mode manager splits up each controller part (applied for 2 different operation modes) in accordance with the received interpolation factor FAC_TQ_ADD_IS_OPM_SEL.
The operation manager for idle speed control operates with the operation mode parameters used in the module *Idle speed torque reserve*.

Application Condition

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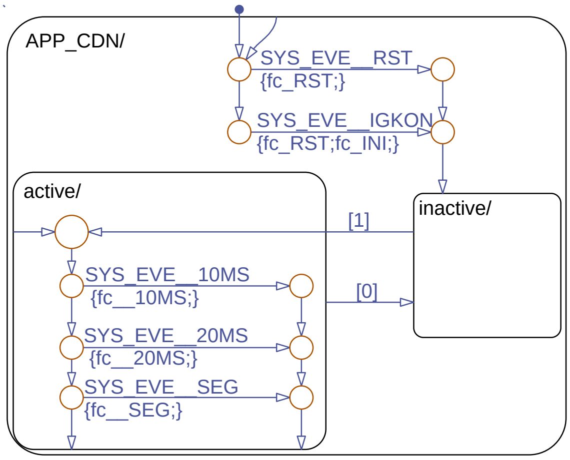

Figure 8.2.1: ENSC_M8006/APP_CDN/APPCND

Function Description

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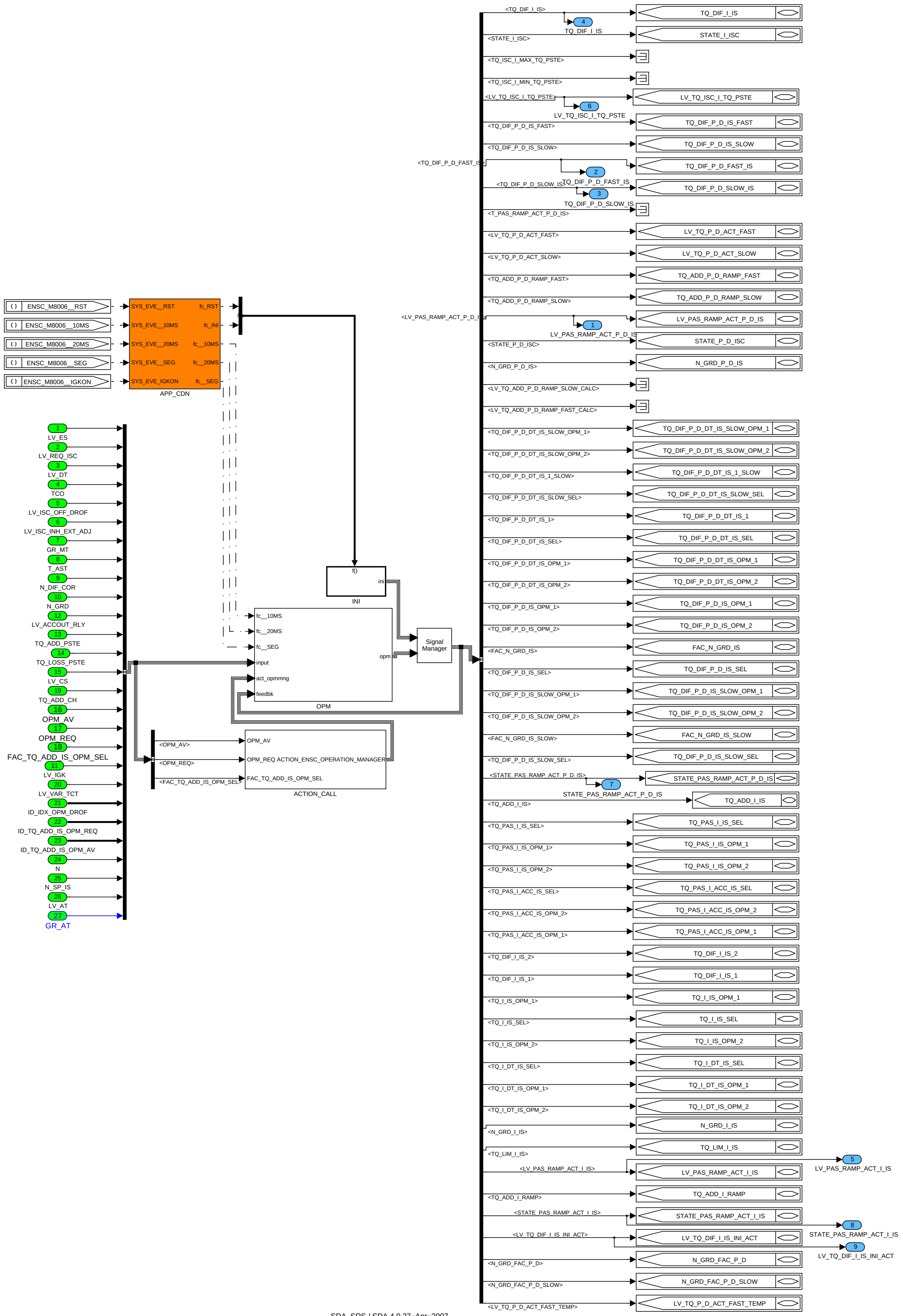

Figure 8.2.2: ENSC_M8006

8.2.1 Operation mode manager

There are two input values IN_1, IN_2. Each input value belongs to a special operation mode OPM_1, OPM_2. Moreover the value OPM_SEL_AV indicates the active and OPM_SEL_REQ indicates the requested operation mode. The aim of the operation manager is to create an output value depending

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on the active operation mode. If there is a switch from one mode to another a smooth changeover from one input value to the other is possible by using the interpolation factor FAC_OPM_SEL.
A special logic takes care that the needed part is calculated only. That means if OPM_1 is active and there is no switch requested then the output value of the operation manager = IN_1 and some part of the algorithm for IN_2 are not calculated anymore. In this case the bit LV_OPM_SEL_1=1 indicates that only the calculation of the IN_1-path is done.
The information of the actual and the requested operation mode can be changed by interpretations maps ID_...OPM_SEL. The effect of this is, that by calibration the operation mode 1 can be wired to the input 2. That means the belonging for a operation mode to an input value is flexible.

The following tables defines the local variables described above:

Common variables:

OPM_AV (from Layer)	OPM_AV	Input	Actual operation mode
OPM_REQ (from Layer)	OPM_REQ	Input	Requested operation mode
-	OPM_SEL_AV	Internal value	Actual active operation mode after interpretation
-	OPM_SEL_REQ	Internal value	Requested operation mode after interpretation
FAC_TQ_ADD_IS_OPM_SEL (from Layer)	FAC_OPM_SEL	Input	Interpolation factor
LV_TQ_DIF_IS_OPM_SEL_1	LV_OPM_SEL_1	Output	Operation mode 1 active
LV_TQ_DIF_IS_OPM_SEL_2	LV_OPM_SEL_2	Output	Operation mode 2 active
LV_TQ_DIF_IS_OPM_RLS	LV_OPM_RLS	Output	Operation mode within valid range
ID_TQ_ADD_IS_OPM_AV	ID_OPM_AV	cal	Mapping of active operation mode
ID_TQ_ADD_IS_OPM_REQ	ID_OPM_REQ	cal	Mapping of requested operation mode

Controller parameter:

P_D_SLOW:

TQ_DIF_P_D_IS_SLOW_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_DIF_P_D_IS_SLOW_OPM_2	IN_2	Input	Input value for operation mode 2
TQ_DIF_P_D_IS_SLOW_SEL	OUT	Output	Result of interpolation

P_D_FAST:

TQ_DIF_P_D_IS_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_DIF_P_D_IS_OPM_2	IN_2	Input	Input value for operation mode 2
TQ_DIF_P_D_IS_SEL	OUT	Output	Result of interpolation

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P_D_DT_SLOW:

TQ_DIF_P_D_DT_IS_SLOW_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_DIF_P_D_DT_IS_SLOW_OPM_2	IN_2	Input	Input value for operation mode 2
TQ_DIF_P_D_DT_IS_SLOW_SEL	OUT	Output	Result of interpolation

P_D_DT_FAST:

TQ_DIF_P_D_DT_IS_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_DIF_P_D_DT_IS_OPM_2	IN_2	Input	Input value for operation mode 2
TQ_DIF_P_D_DT_IS_SEL	OUT	Output	Result of interpolation

I:

TQ_I_IS_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_I_IS_OPM_2	IN_2	Input	Input value for operation mode 2
TQ_I_IS_SEL	OUT	Output	Result of interpolation

I_DT:

TQ_I_DT_IS_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_I_DT_IS_OPM_2	IN_2	Input	Input value for operation mode 2
TQ_I_DT_IS_SEL	OUT	Output	Result of interpolation

I_PAS:

TQ_PAS_I_IS_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_PAS_I_IS_OPM_2	IN_2	Input	Input value for operation mode 2
TQ_PAS_I_IS_SEL	OUT	Output	Result of interpolation

I_PAS_ACC:

TQ_PAS_I_ACC_IS_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_PAS_I_ACC_IS_OPM_2	IN_2	Input	Input value for operation mode 2
TQ_PAS_I_ACC_IS_SEL	OUT	Output	Result of interpolation

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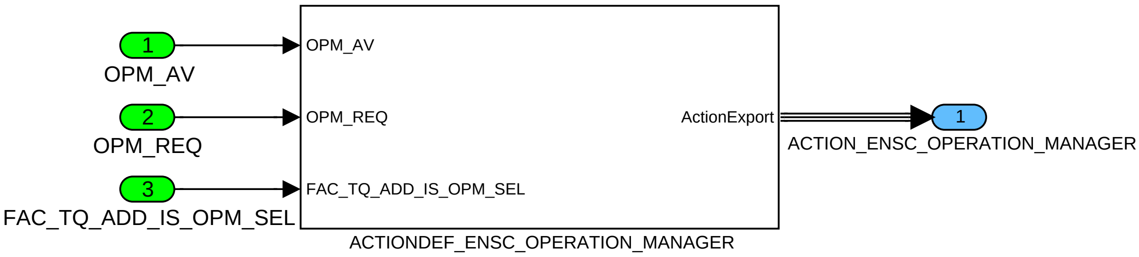

Figure 8.2.3: ENSC_M8006/ACTION_CALL

8.2.2 Operation Manager Overview

Description for ACTION_ENSC_OPERATION_MANAGER

ACTION_ENSC_OPERATION_MANAGER(IN <IN1>, IN <IN2>, OUT <OUT>, OUT <TQ_DIF_OPM_1>, OUT <TQ_DIF_OPM_2>)					
Operation manager for idle speed controller					
Parameter	**Type**	**Hex. limits**	**Phys. limits**	**Resol.**	**Unit**
IN1	IN	8000...7FFFH	-1.024E+3 ... 1.02397E+3	0.03125	Nm
Input to action manager					
IN2	IN	8000...7FFFH	-1.024E+3 ... 1.02397E+3	0.03125	Nm
Input to action manager					
OUT	OUT	8000...7FFFH	-1.024E+3 ... 1.02397E+3	0.03125	Nm
Output of operation manager					
TQ_DIF_OPM_1	OUT	8000...7FFFH	-1.024E+3 ... 1.02397E+3	0.03125	Nm
Output #1 of operation manager					
TQ_DIF_OPM_2	OUT	8000...7FFFH	-1.024E+3 ... 1.02397E+3	0.03125	Nm
Output #2 of operation manager					

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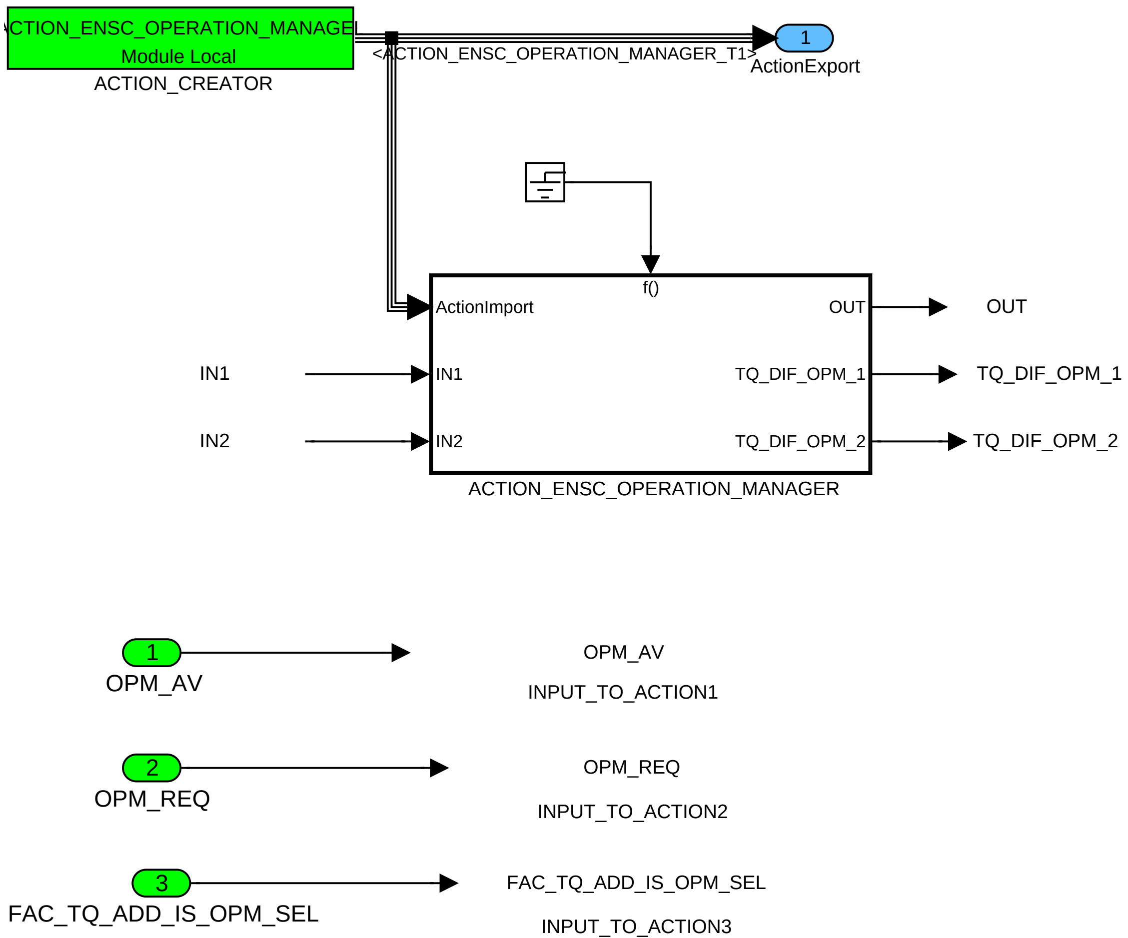

Figure 8.2.4: ENSC_M8006/ACTION_CALL/ACTIONDEF_ENSC_OPERATION_MANAGER

Selection of inputs to operation manager switch

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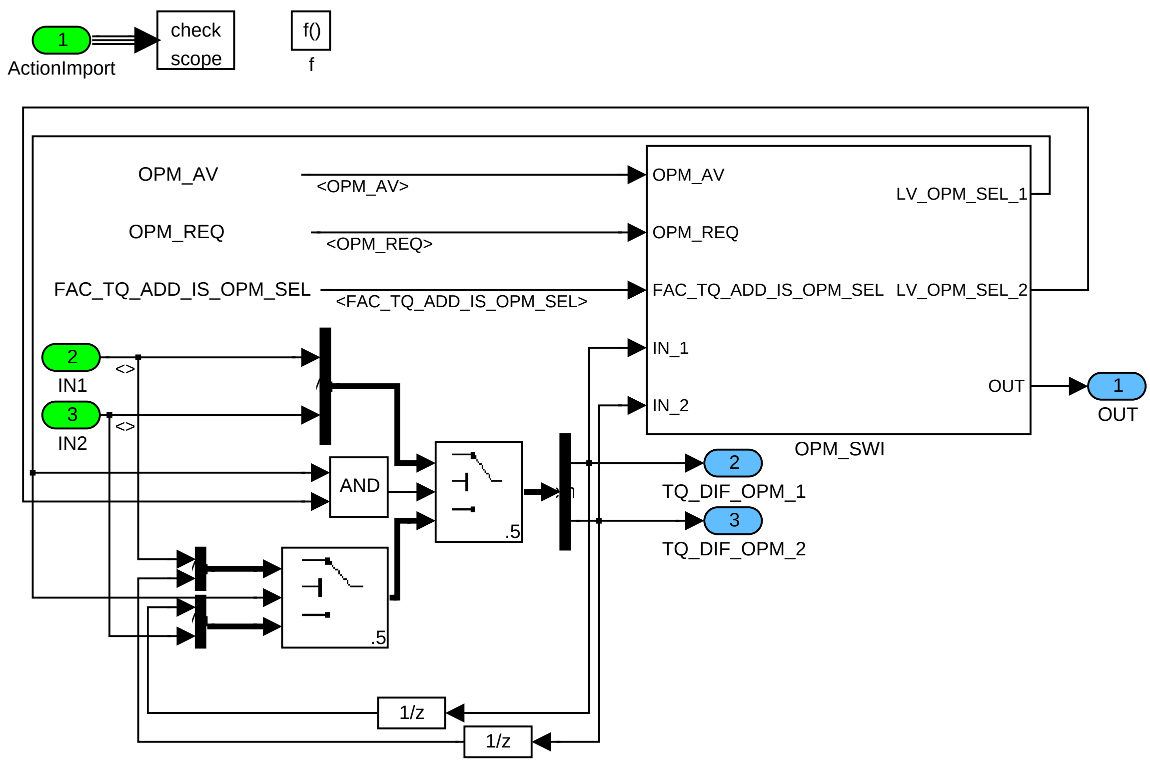

Figure 8.2.5: ENSC_M8006/ACTION_CALL/ACTIONDEF_ENSC_OPERATION_MANAGER/ ACTION_ENSC_OPERATION_MANAGER

Operation manager switch

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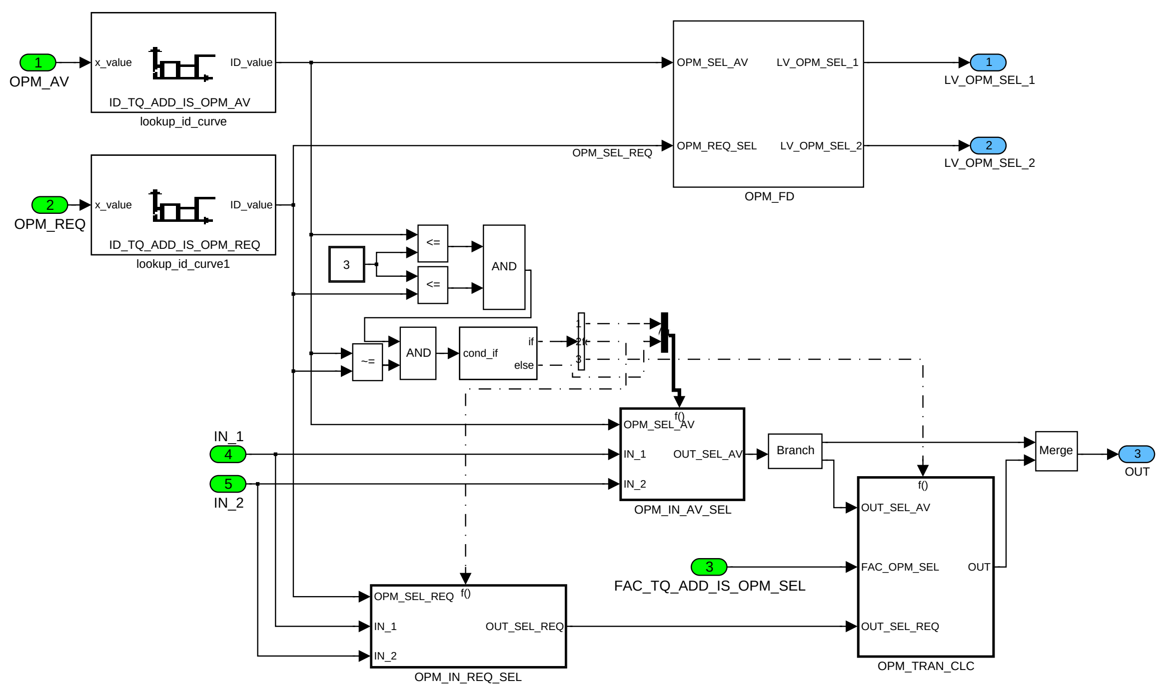

Figure 8.2.6: ENSC_M8006/ACTION_CALL/ACTIONDEF_ENSC_OPERATION_MANAGER/
ACTION_ENSC_OPERATION_MANAGER/OPM_SWI

Operation manager feedback

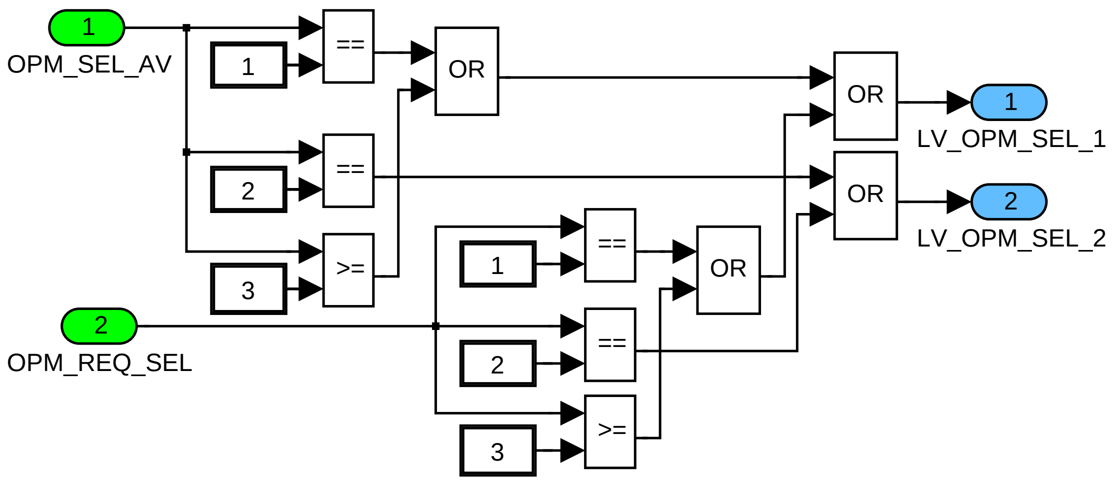

Figure 8.2.7: ENSC_M8006/ACTION_CALL/ACTIONDEF_ENSC_OPERATION_MANAGER/
ACTION_ENSC_OPERATION_MANAGER/OPM_SWI/OPM_FD

Selection of active operation mode

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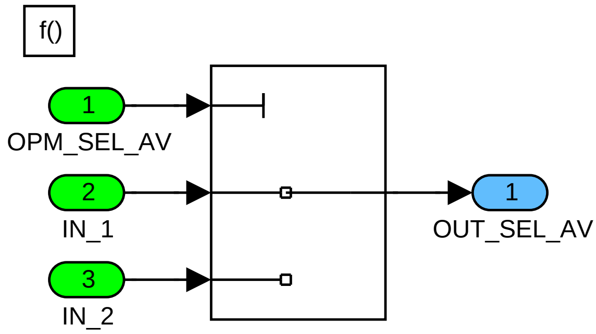

Figure 8.2.8: ENSC_M8006/ACTION_CALL/ACTIONDEF_ENSC_OPERATION_MANAGER/ACTION_ENSC_OPERATION_MANAGER/OPM_SWI/OPM_IN_AV_SEL

Selection of requested operation mode

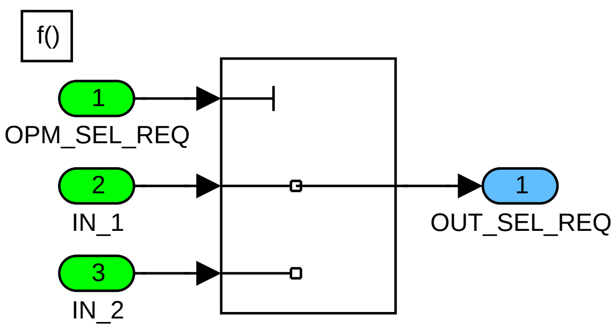

Figure 8.2.9: ENSC_M8006/ACTION_CALL/ACTIONDEF_ENSC_OPERATION_MANAGER/ACTION_ENSC_OPERATION_MANAGER/OPM_SWI/OPM_IN_REQ_SEL

Output from the operation manager

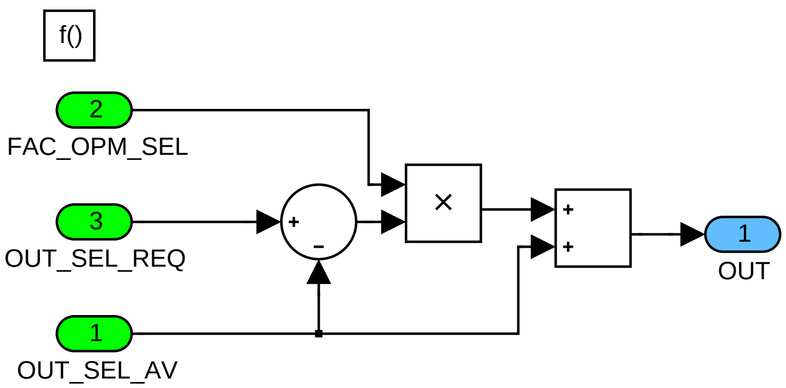

Figure 8.2.10: ENSC_M8006/ACTION_CALL/ACTIONDEF_ENSC_OPERATION_MANAGER/ACTION_ENSC_OPERATION_MANAGER/OPM_SWI/OPM_TRAN_CLC

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8.2.3 Initialisation at system event reset and igkon

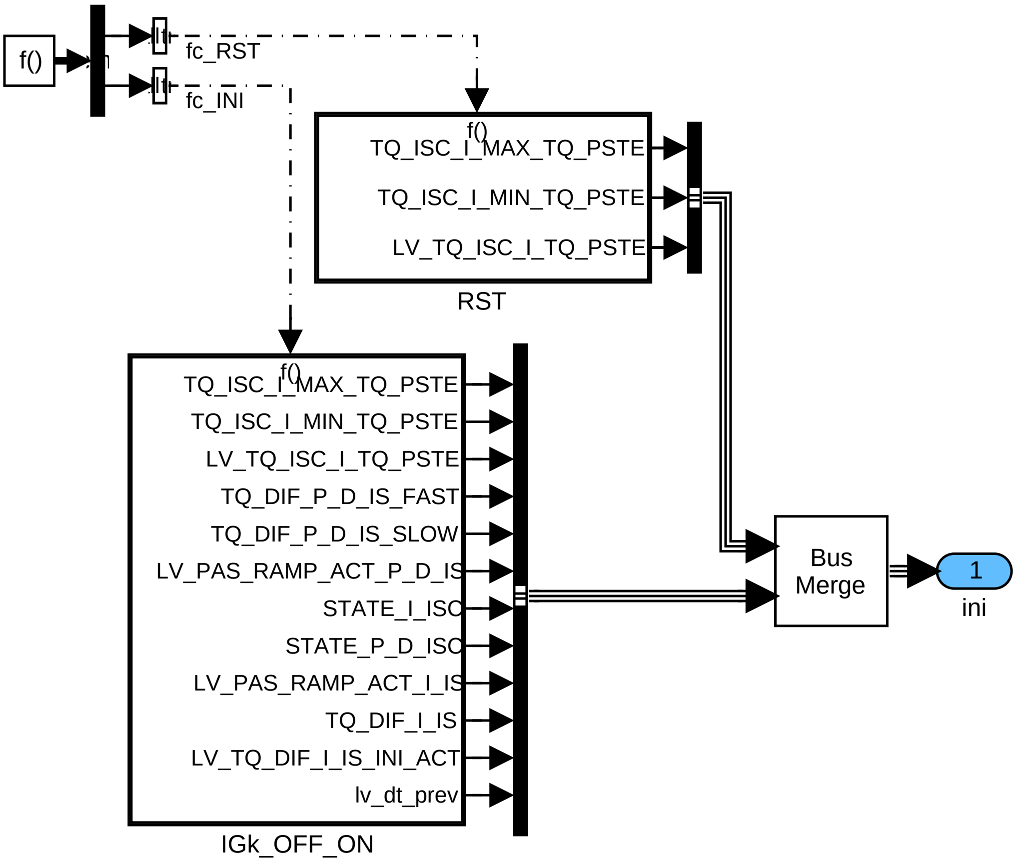

Figure 8.2.11: ENSC_M8006/INI

Initialisation at igkon

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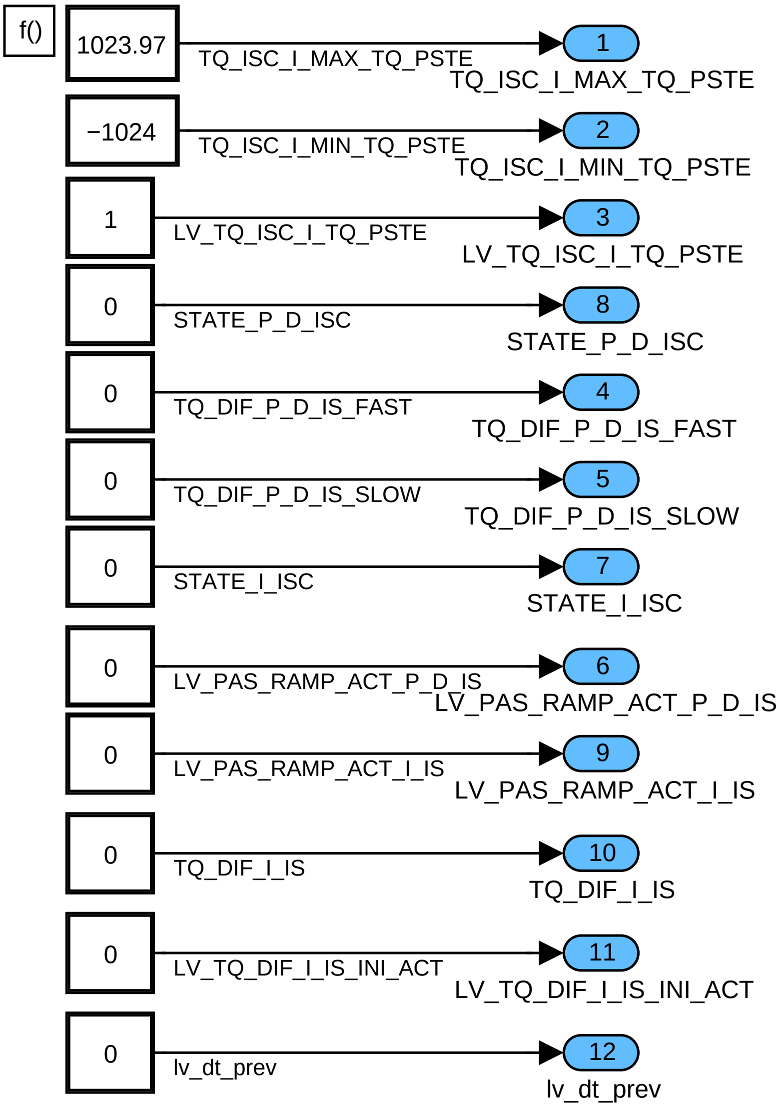

Figure 8.2.12: ENSC_M8006/INI/IGk_OFF_ON

Initialisation at system event reset

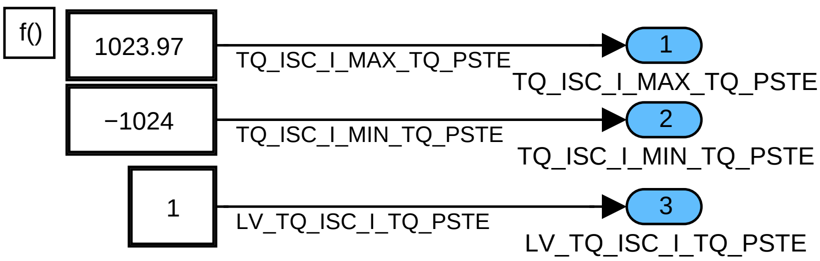

Figure 8.2.13: ENSC_M8006/INI/RST

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8.2.4 Formula section

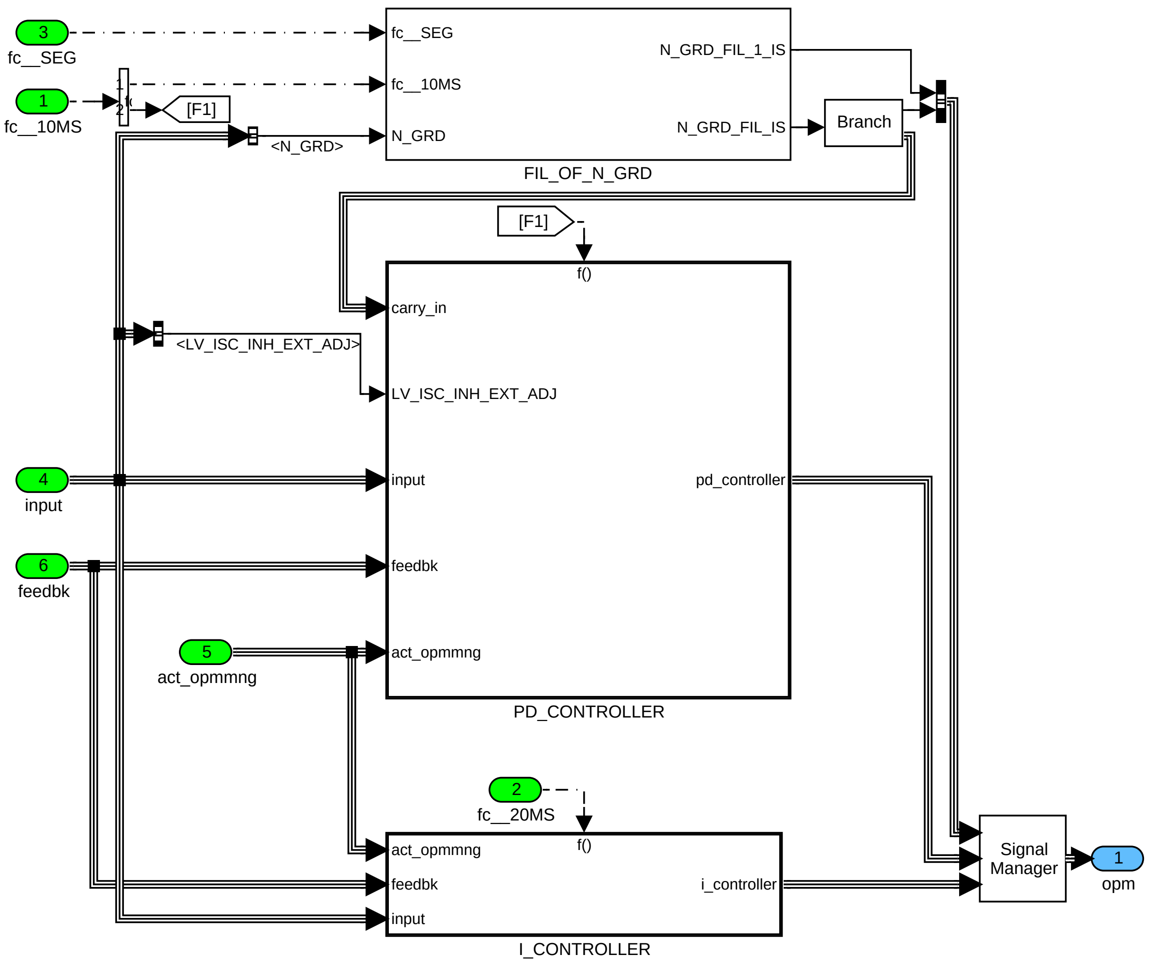

Figure 8.2.14: ENSC_M8006/OPM

Filtering of N_GRD

General information:
In order to be able to smooth the gradient for the idle speed control, there are 2 options for filtering the raw engine speed gradient N_GRD:
1) with ring buffer with 1 ... 6 buffers (calibrateable)
2) with 1^{st} order low-pass filter.

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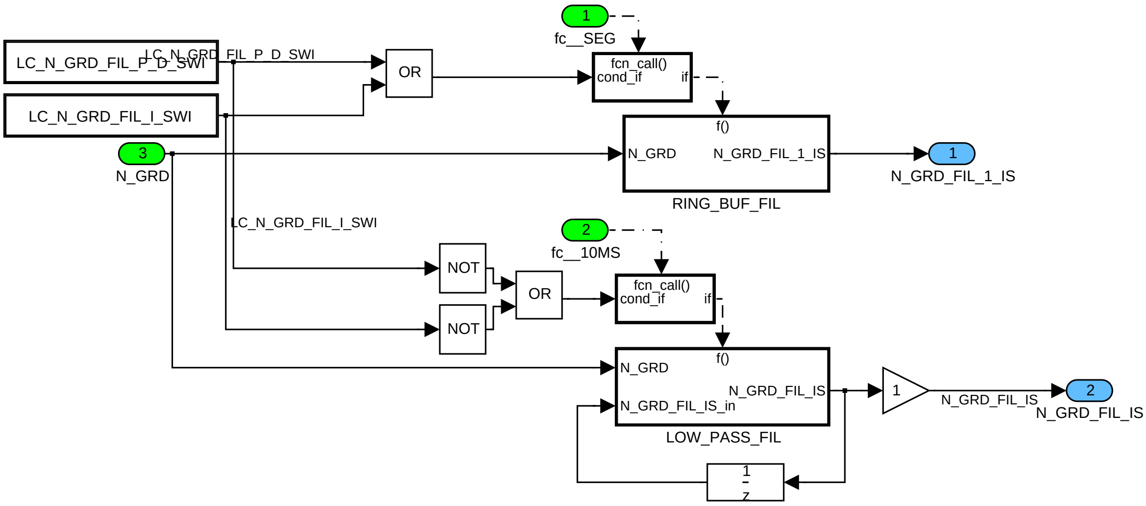

Figure 8.2.15: ENSC_M8006/OPM/FIL_OF_N_GRD

Low pass filtering of N_GRD at 10ms recurrence.

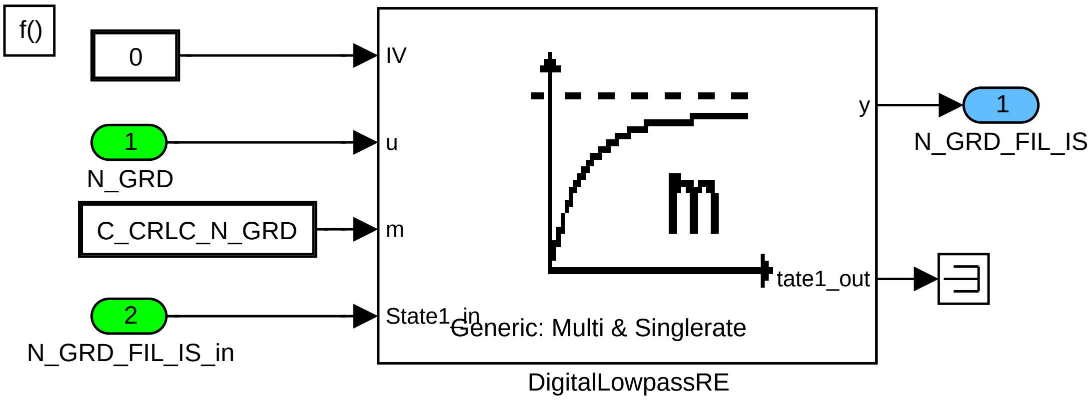

Figure 8.2.16: ENSC_M8006/OPM/FIL_OF_N_GRD/LOW_PASS_FIL

Ring buffer filter at segment synchronous system recurrence

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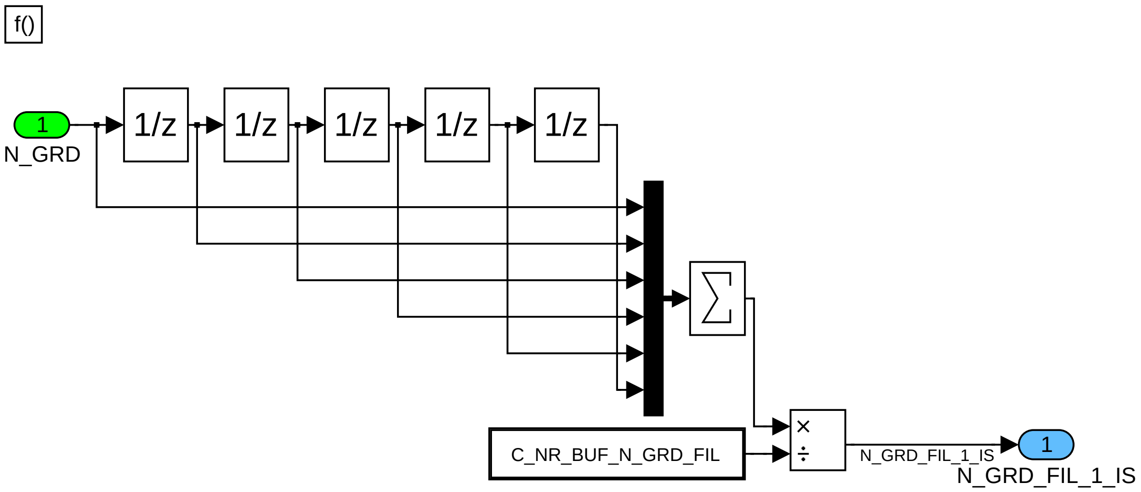

Figure 8.2.17: ENSC_M8006/OPM/FIL_OF_N_GRD/RING_BUF_FIL

I-Controller

General information:

Signal flow diagram:

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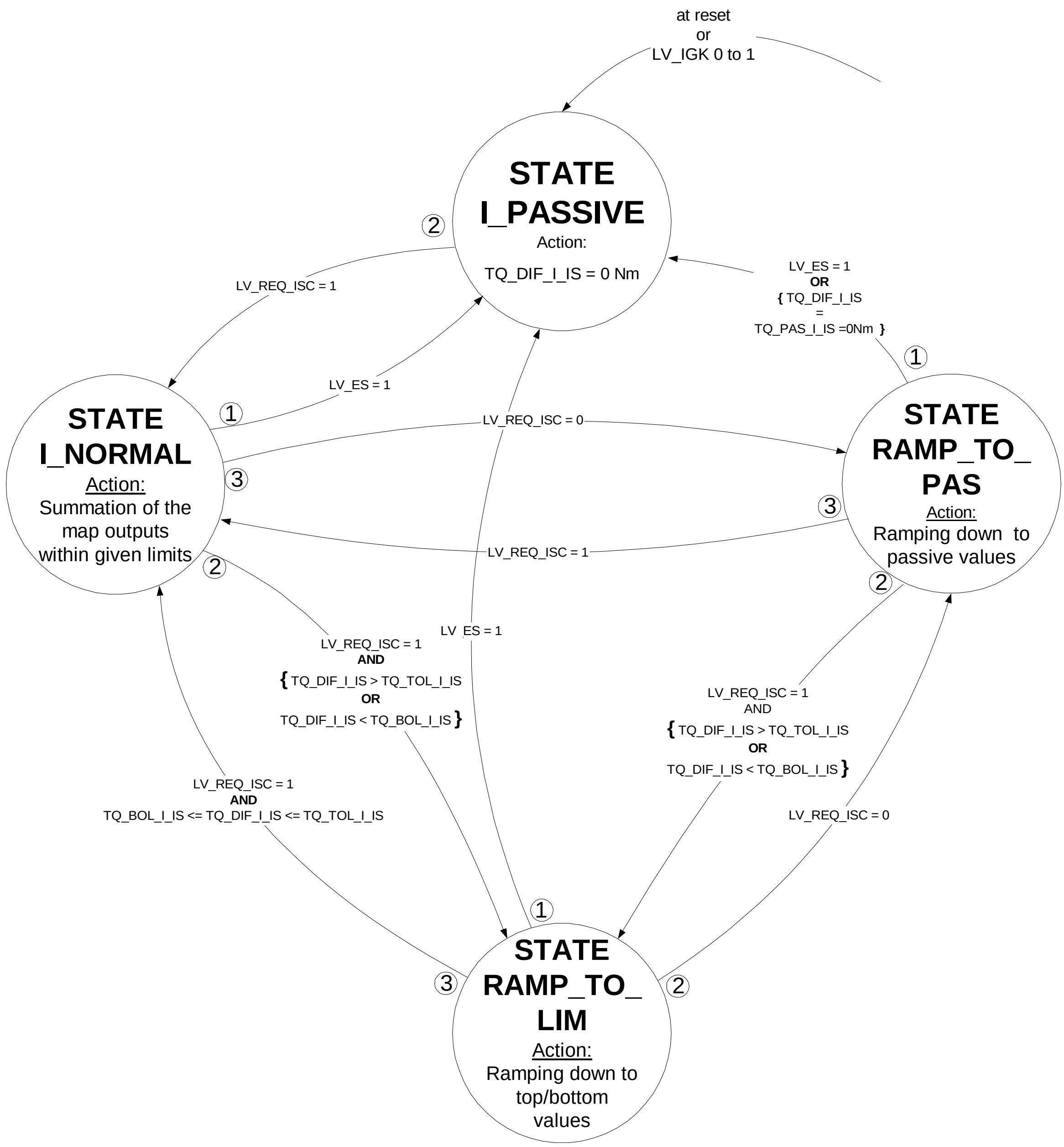

Figure 8.2.18: : State diagram of the integral part

The integral part is devided into four states:

STATE_I_ISC = I_PASSIVE:

Initialization (at reset or when LV_IGK = 0   1; from all other states in case of LV_ES = 1)

STATE_I_ISC = I_NORMAL:

In   this state the evaluation of the controller maps and the "normal" integration takes place.

STATE_I_ISC = RAMP_TO_LIM:

Ramp to limits; in this state the integral part is ramped down to the calibratible top/bottom limit values.

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STATE_I_ISC = RAMP_TO_PAS:
Ramp to passive value 0 Nm; in this state the integral part is ramped down to zero in case LV_REQ_ISC = 0.

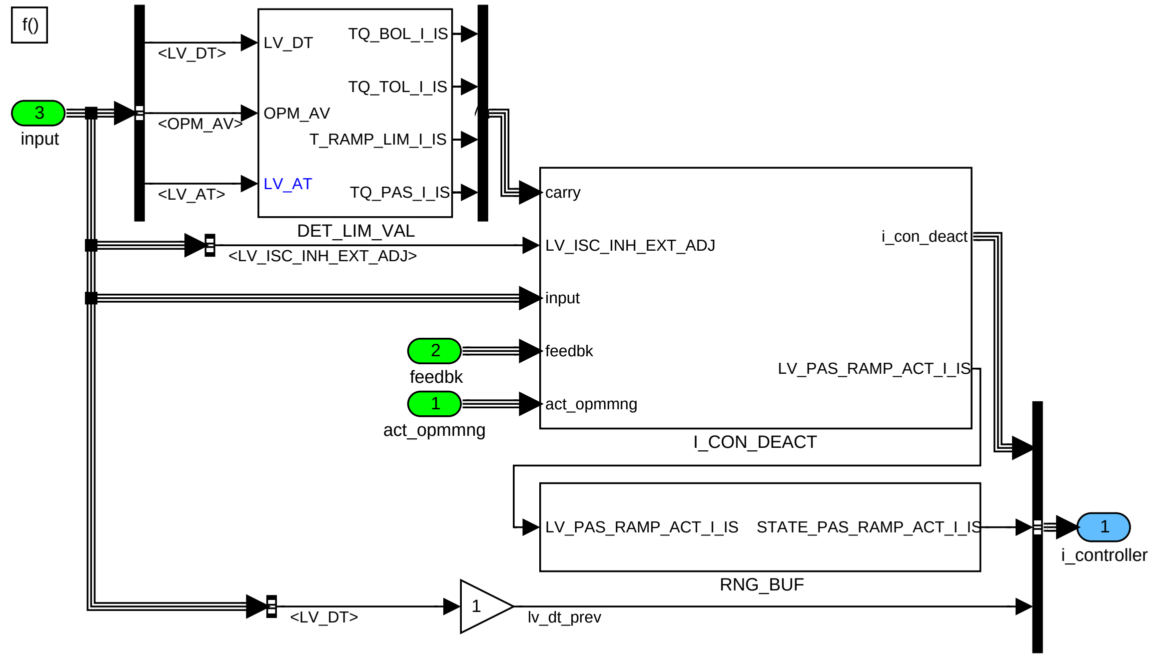

Figure 8.2.19: ENSC_M8006/OPM/I_CONTROLLER

Determination of the top/bottom limit values:

The passive value **(target value)** of the ramp operation is 0 Nm.
TQ_PAS_I_IS = 0Nm

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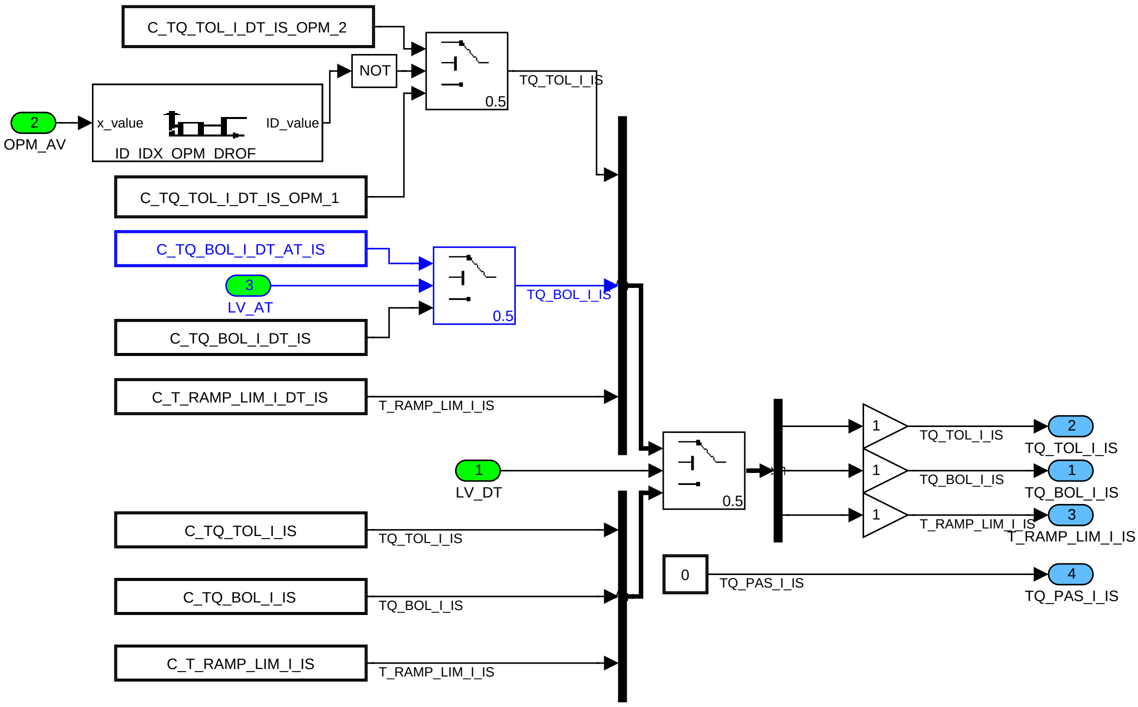

Figure 8.2.20: ENSC_M8006/OPM/I_CONTROLLER/DET_LIM_VAL

Activation condition for I controller

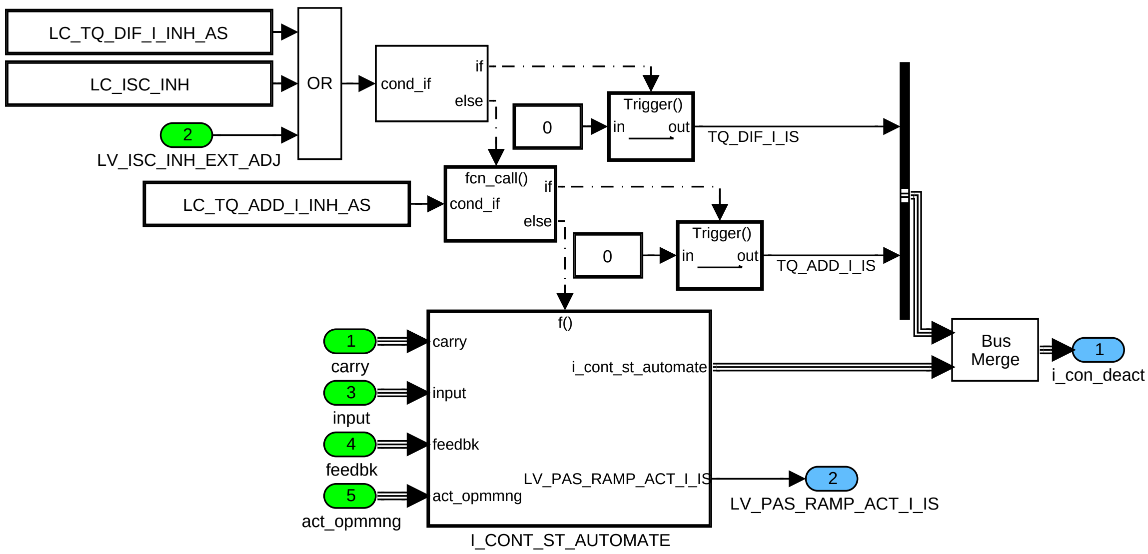

Figure 8.2.21: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT

I controller overview

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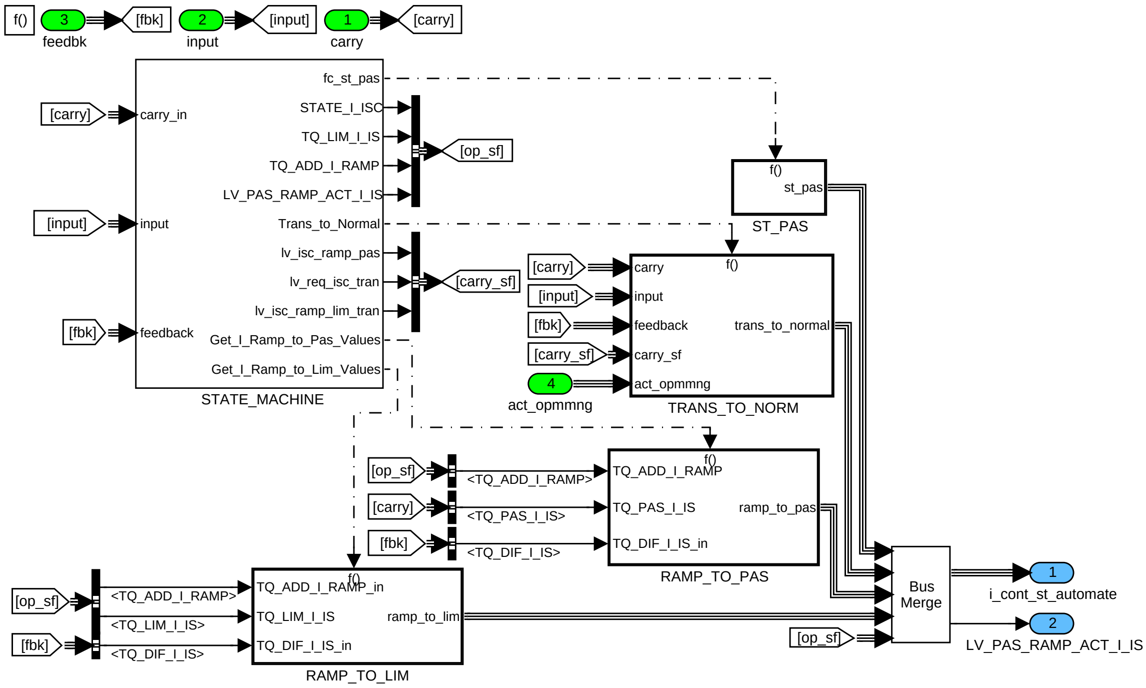

Figure 8.2.22: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE

State machine of I controller

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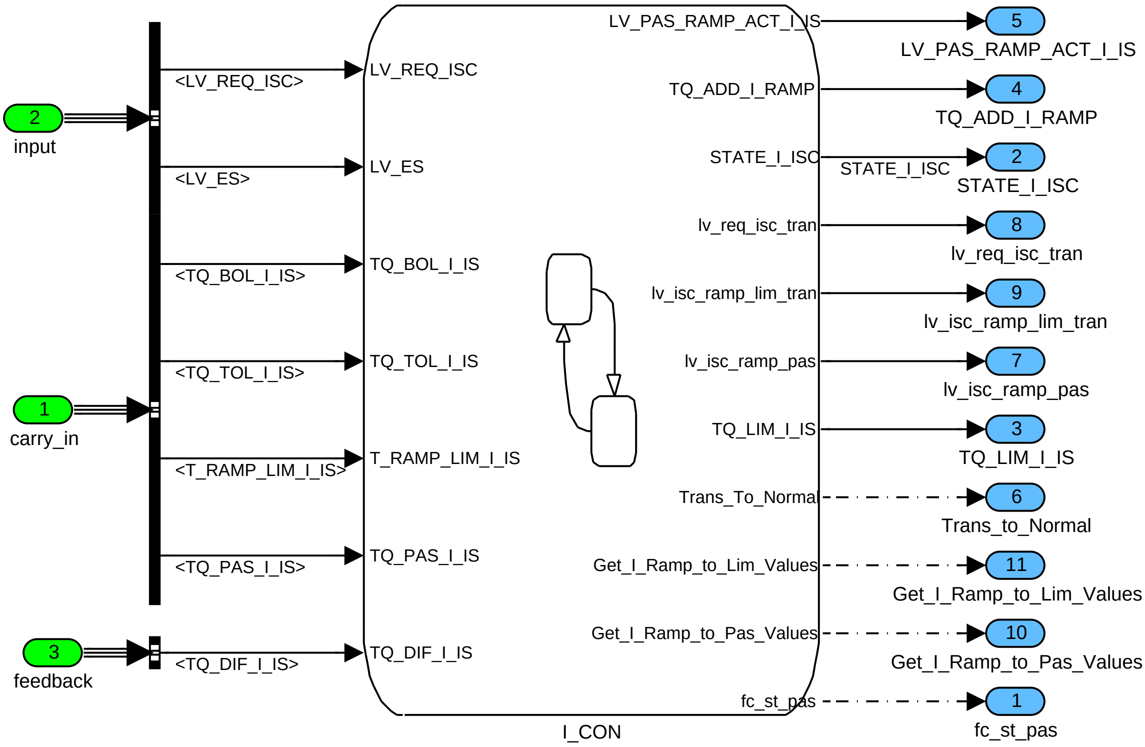

Figure 8.2.23:
ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/STATE_MACHINE

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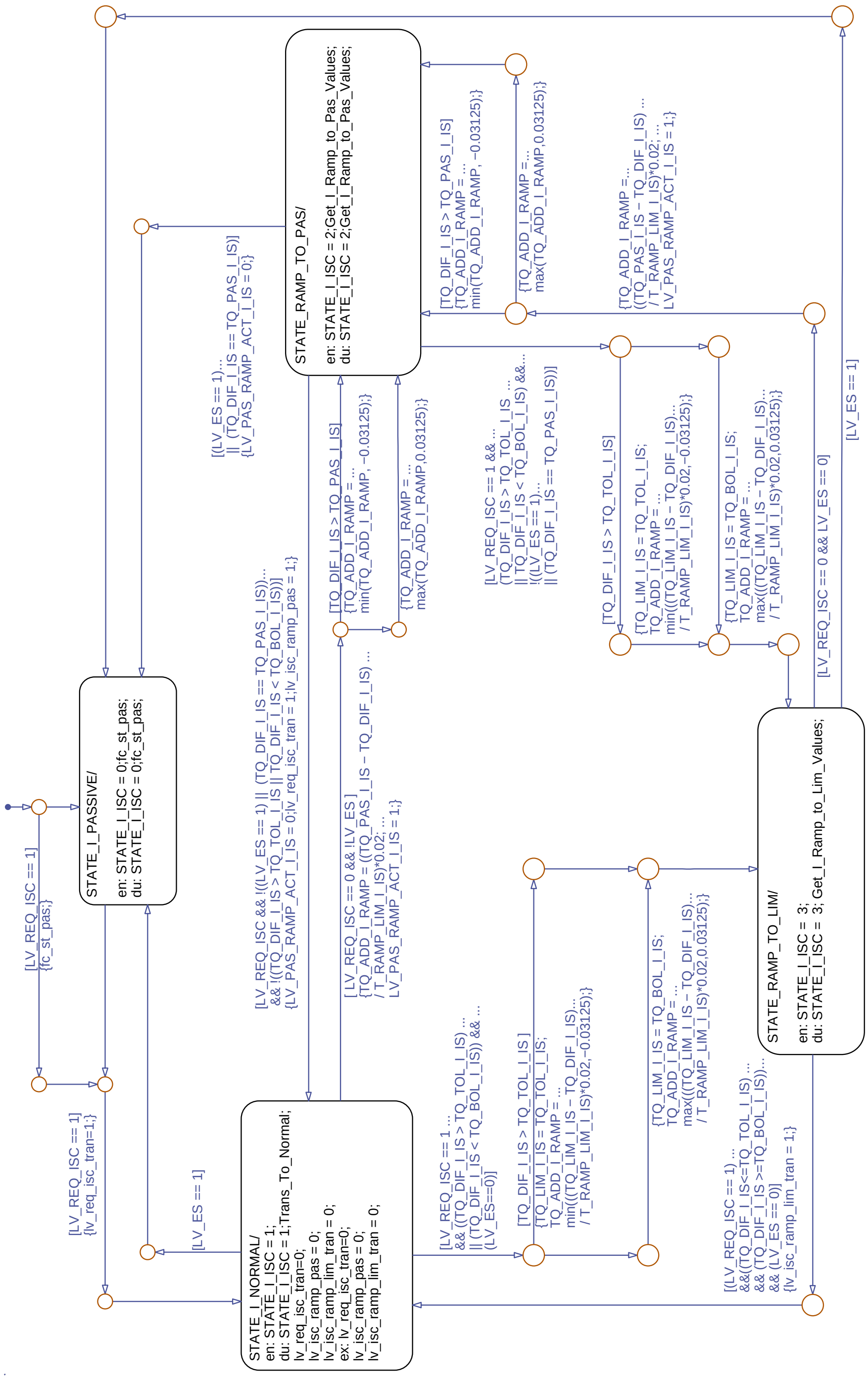

Figure 8.2.24: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/STATE_MACHINE/I_CON

STATE RAMP_TO_LIM

If this state is active and so the integrator output is outside the allowed boundaries, its value is controlled back to the valid boundaries on a ramp.

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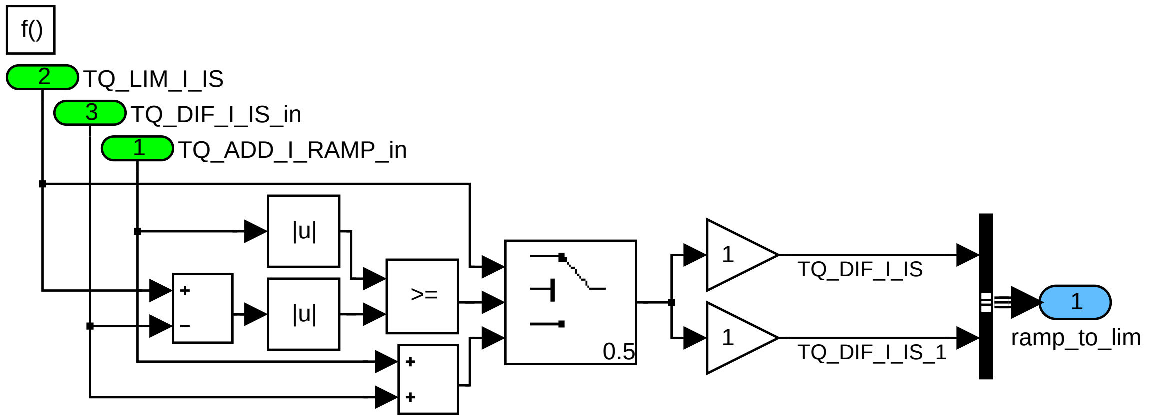

Figure 8.2.25:
ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/RAMP_TO_LIM

Calculation at state passive

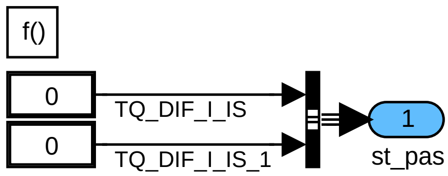

Figure 8.2.26:
ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/ST_PAS

Overview of calculations at normal state in state machine

If idle speed control is reacitvated during the ramp limit operation then the integrator starts with "first setting of TQ_DIF_I_IS value (see. calculation of I_NORMAL).

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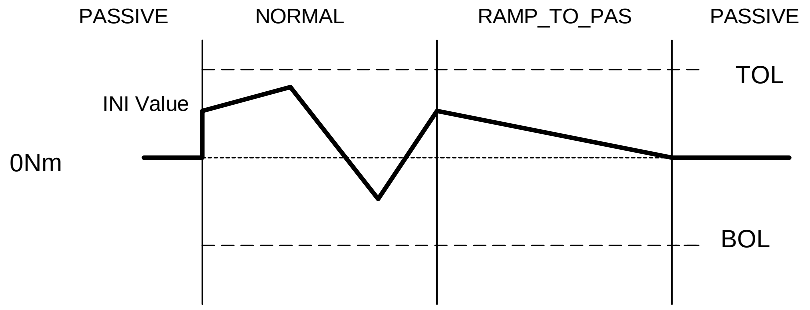
Excample of I share calculation without limitation



Excample of I share calculation with limitation

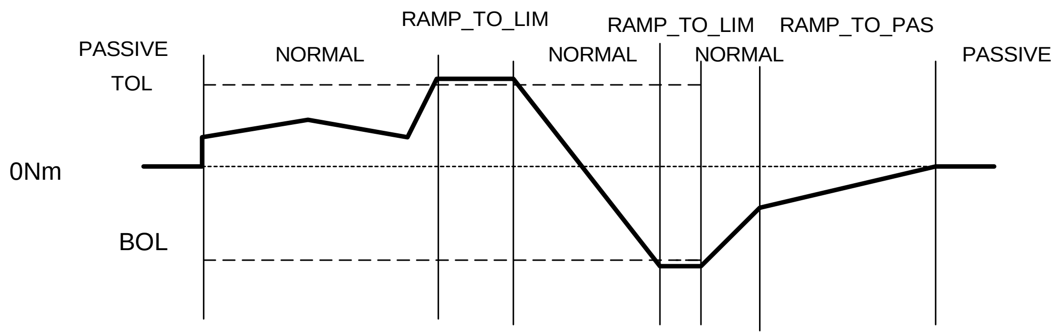


Figure 8.2.27: : Principle operation of I share

Selection of N_GRD_I_IS

Calculation N_GRD_I_IS.

N_GRD_I_IS is calculated from N_GRD_FIL_IS and N_GRD_FIL_1_IS.

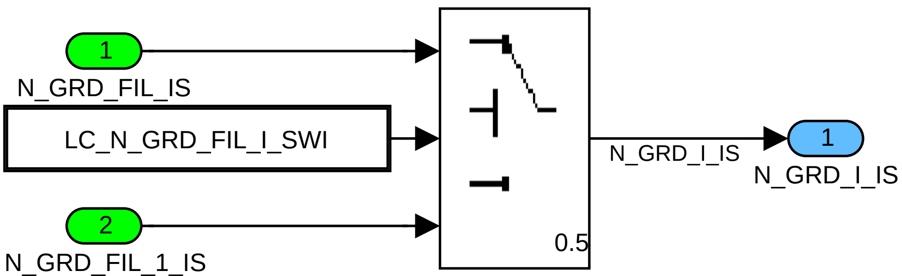


Figure 8.2.28: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/
TRANS_TO_NORM/CLC_N_GRD_I_IS/CLC

Check for transition from ramp to pas

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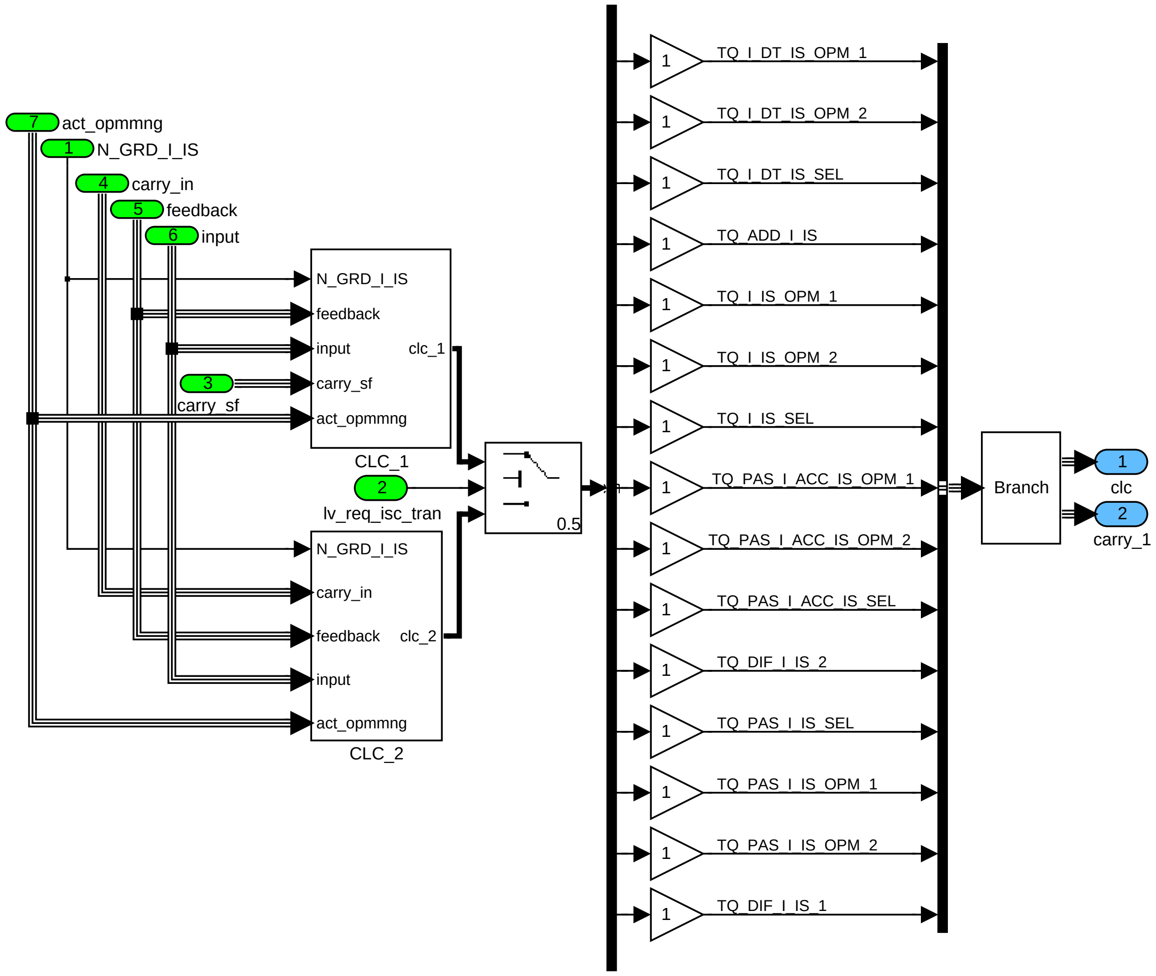

Figure 8.2.29: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/TRANS_TO_NORM/CLC

Initialisaton of I share

Feed through

Old values are passed as it is.

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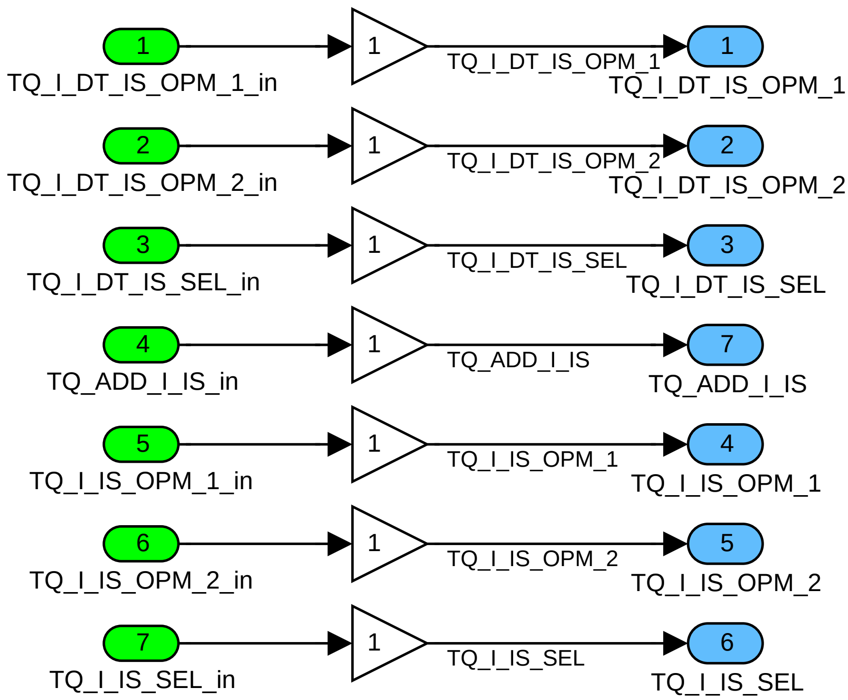

Figure 8.2.30: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/TRANS_TO_NORM/CLC/CLC_1/DEFAULT

Condition check on LV_ACCOUT_RLY variable.

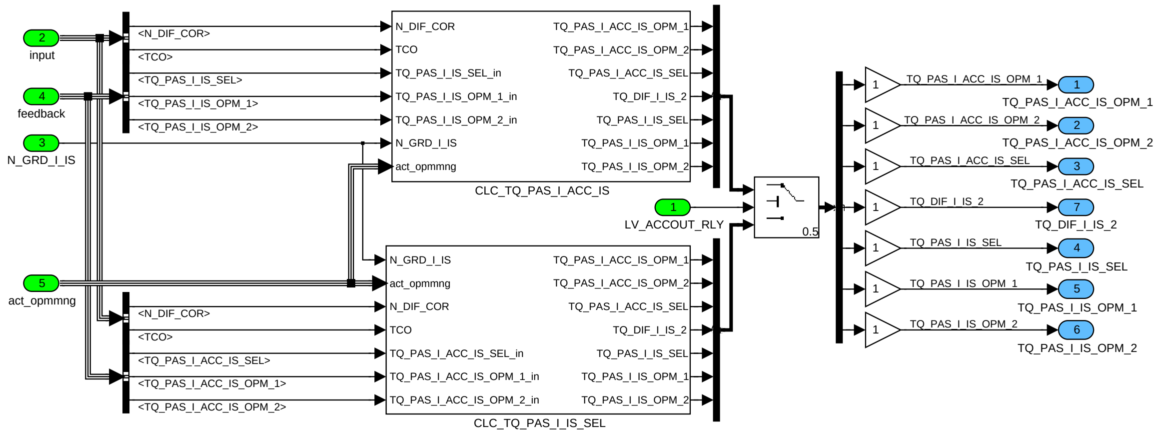

Figure 8.2.31: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/TRANS_TO_NORM/CLC/CLC_1/CLC

Calculation of TQ_PAS_I_IS_SEL and TQ_DIF_I_IS_2 when condition check LV_ACCOUT_RLY is false.

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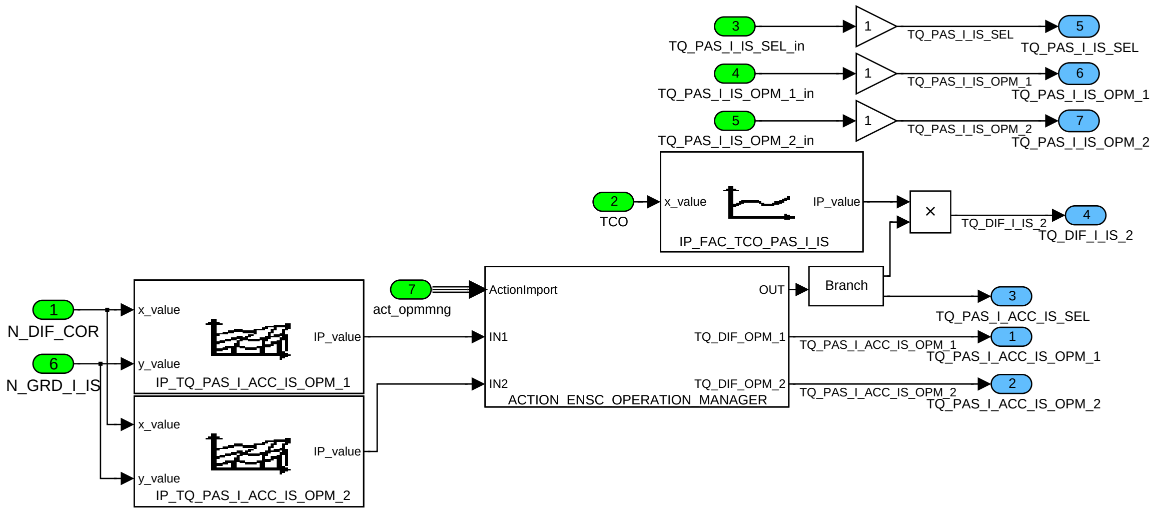

Figure 8.2.32: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/
TRANS_TO_NORM/CLC/CLC_1/CLC/CLC_TQ_PAS_I_ACC_IS

Calculation of TQ_PAS_I_ACC_IS_SEL and TQ_DIF_I_IS_2 when condition check LV_ACCOUT_RLY is true.

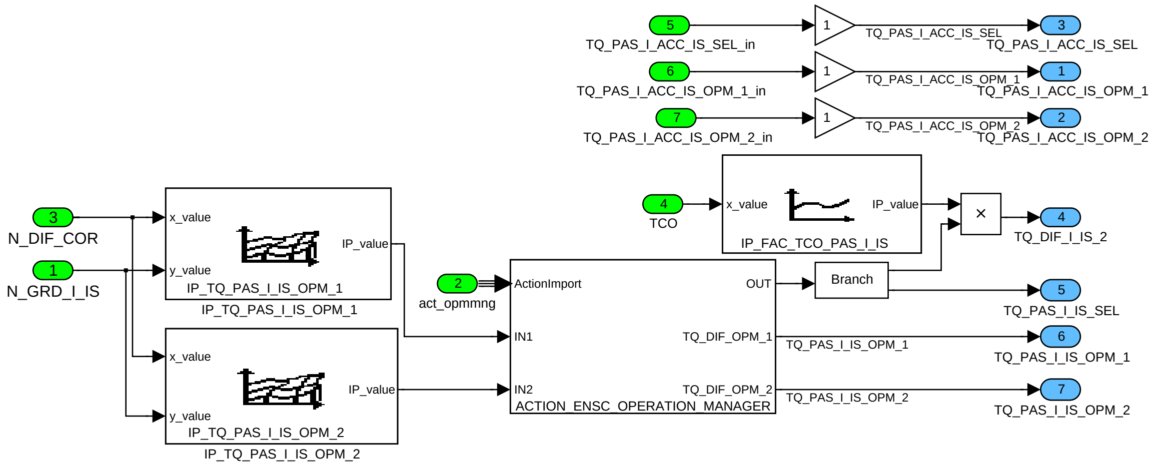

Figure 8.2.33: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/
TRANS_TO_NORM/CLC/CLC_1/CLC/CLC_TQ_PAS_I_IS_SEL

Calculation of TQ_DIF_I_IS_1

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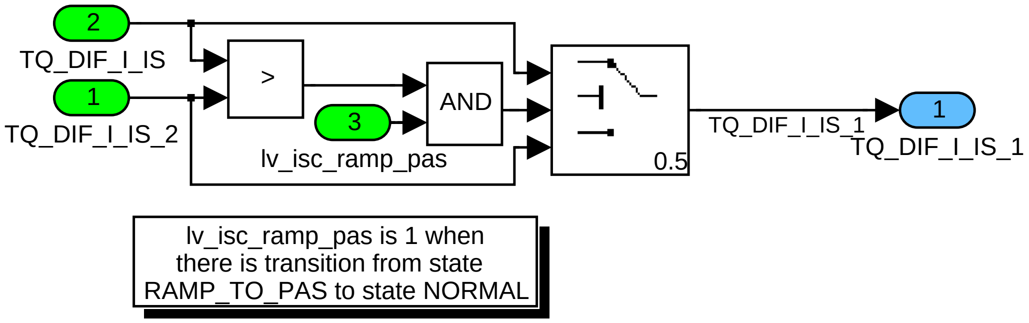

Figure 8.2.34: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/TRANS_TO_NORM/CLC/CLC_1/CLC_TQ_DIF_I_IS_1

Calculation when there is no transition from passive or "ramp to pas" to normal state.

Condition check on LV_DT and determination of TQ_ADD_I_IS

In STATE I_NORMAL, see figure 5, the "normal" integration takes place. A torque difference TQ_ADD_I_IS is determined in dependence of the speed deviation N_DIF_COR and the speed gradient N_GRD_I_IS (for LV_DT = 0) and only in dependance of the speed deviation N_DIF_COR for LV_DT = 1 and in addition depending on time after start T_AST, figure 6.
Considering the operation mode manager there are included separated paths in the functionality for the calculation of the idle speed controller I-share. This enables a proper engine running in throttled and unthrottled mode. Also in after start an additional factor is used for each mode.
To reach two important targets, TQ_ADD_I_IS should be calibrated as follows:

compensation of a speed offset
automatic precalibration of the integral part: if there is a load active after the driver released the gas pedal (ACC, power steering, etc), then speed falls with a higher gradient into idle range than in comparision to the situation without load. This means, that the integral part should carry higher (positive) values to intercept speed. That means, that with the help of the gradient dependancy in the integral part an automatic precalibration of the TQ_ADD_I_IS (so TQ_DIF_I_IS) can be reached, which is load dependant. It must be said, that this interception function must be synchronized with the PD-part calibration. With the correct calibration, the passive values are not needed any more.

The integration takes place within calibratible boundaries, figure 7.

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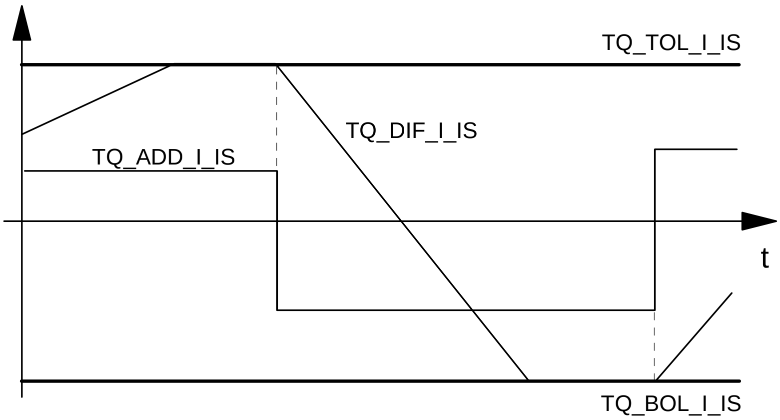

Figure 8.2.35: : Limited integration

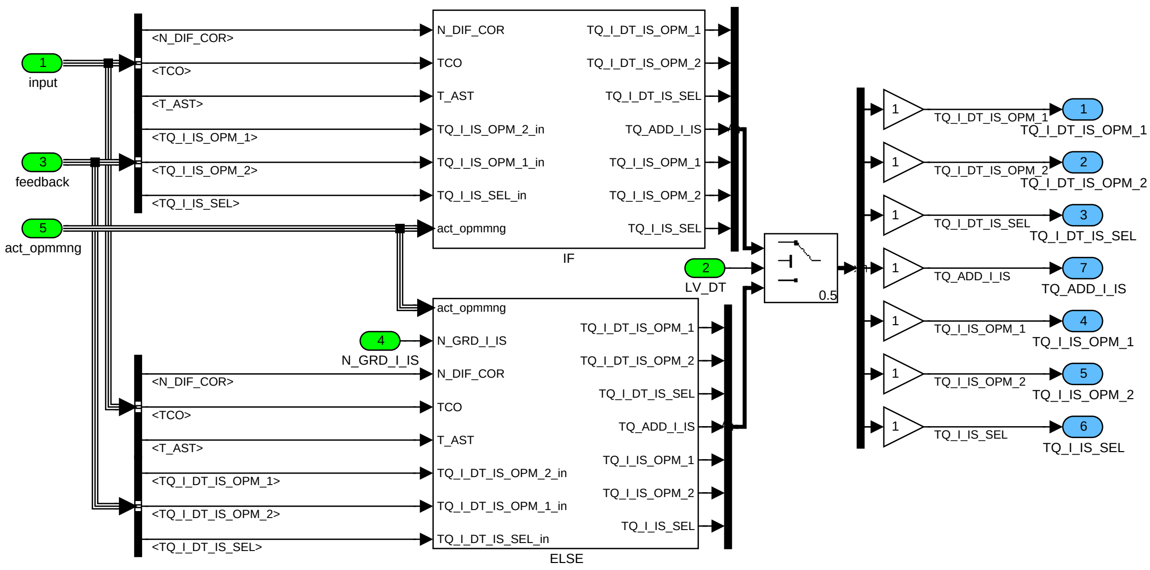

Figure 8.2.36: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/ TRANS_TO_NORM/CLC/CLC_2/CLC_1

Calculation of TQ_ADD_I_IS, TQ_I_DT_IS_SEL, TQ_I_DT_IS_OPM_1 and TQ_I_DT_IS_OPM_2

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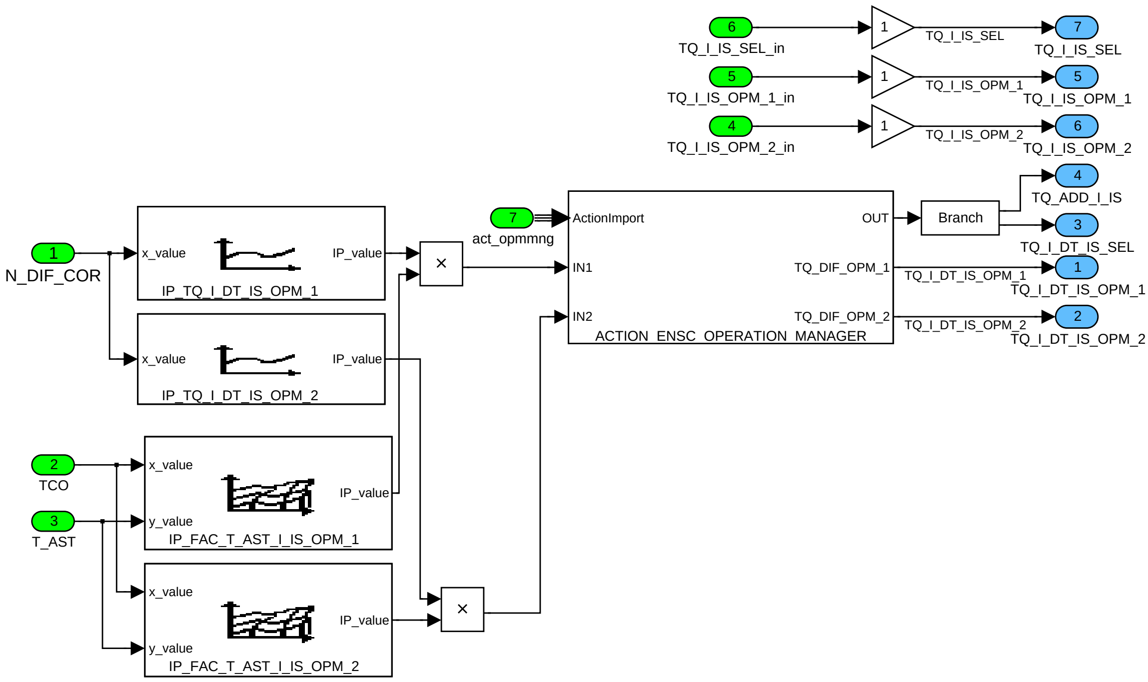

Figure 8.2.37: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/
TRANS_TO_NORM/CLC/CLC_2/CLC_1/IF

Calculation of TQ_ADD_I_IS, TQ_I_IS_SEL, TQ_I_IS_OPM_1 and TQ_I_IS_OPM_2

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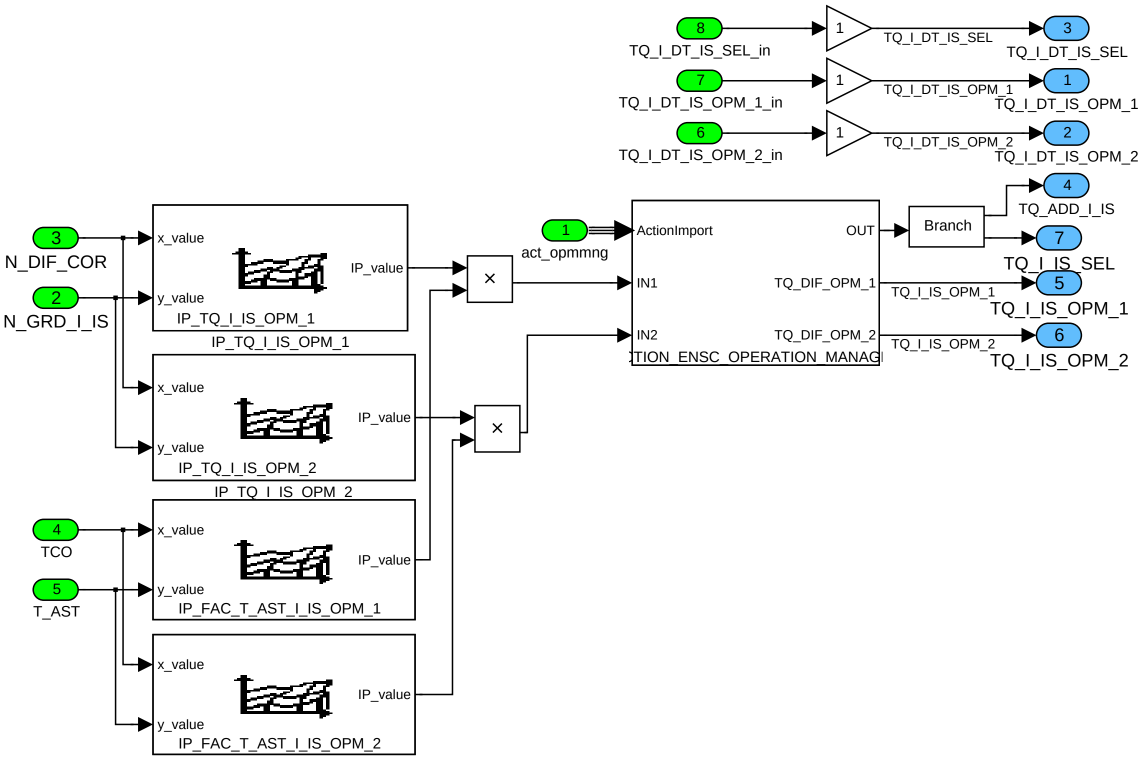

Figure 8.2.38: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/ TRANS_TO_NORM/CLC/CLC_2/CLC_1/ELSE

Calculation of TQ_DIF_I_IS_1 as an ouput of integrator

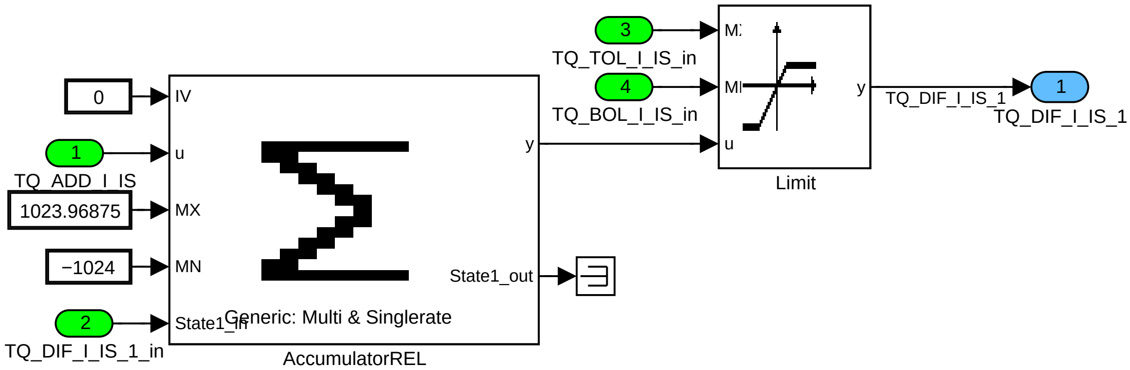

Figure 8.2.39: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/ TRANS_TO_NORM/CLC/CLC_2/CLC_2

Old value assignment

No calculations.

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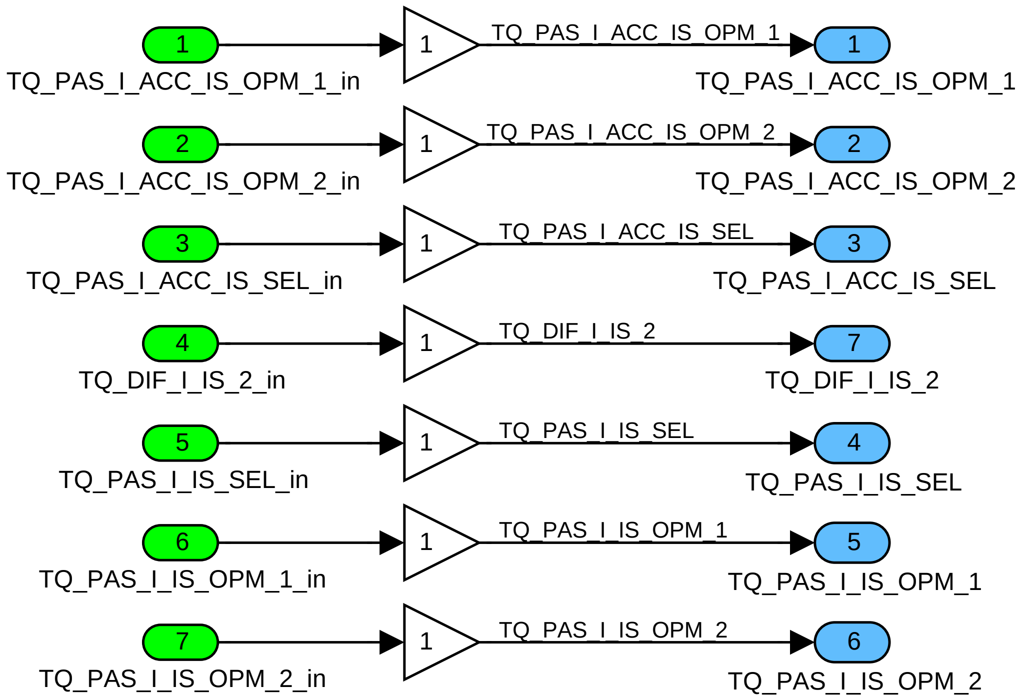

Figure 8.2.40: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/TRANS_TO_NORM/CLC/CLC_2/DEFAULT

Calculation of PSTE limitation

Calculation of T_TQ_ISC_I_TQ_PSTE_LIM

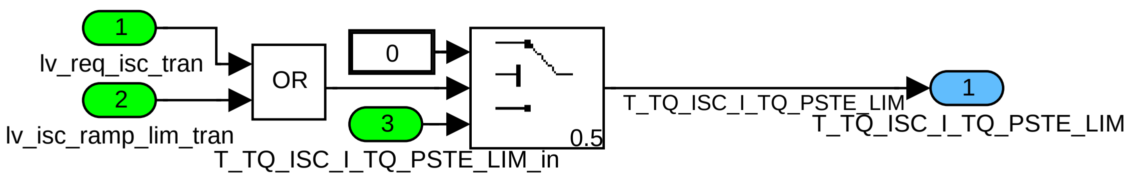

Figure 8.2.41: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/TRANS_TO_NORM/CLC_PSTE_LIM/CLC

Condition check for Calculation of TQ_ISC_I_MAX/MIN_TQ_PSTE and Lock time for pste limitation

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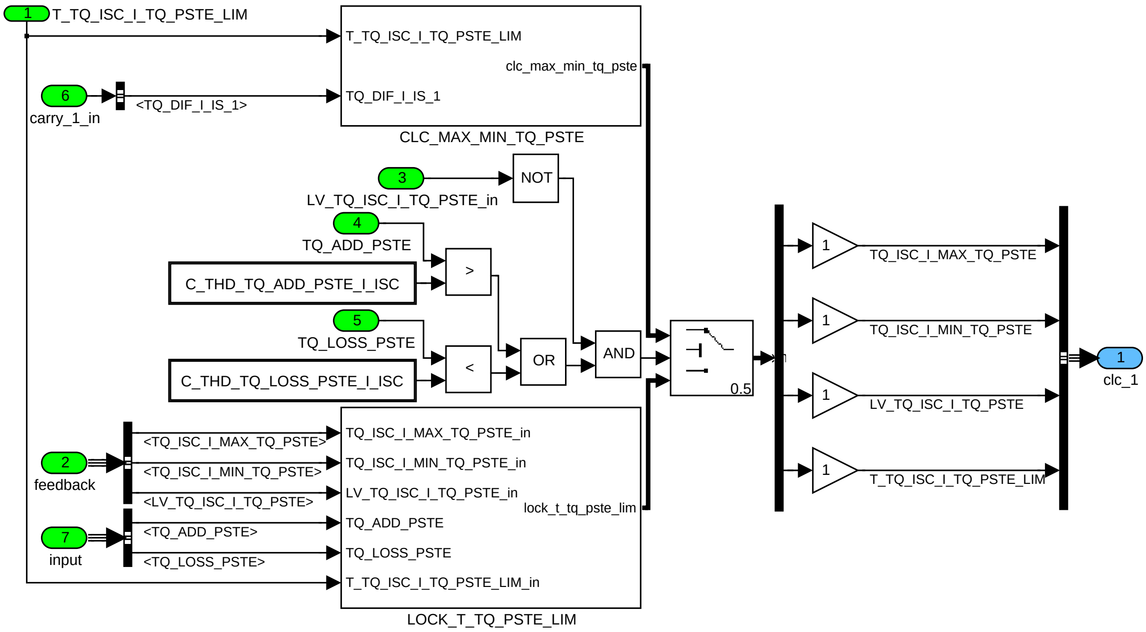

Figure 8.2.42: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/TRANS_TO_NORM/CLC_PSTE_LIM/CLC_1

Calculation of TQ_ISC_I_MAX/MIN_TQ_PSTE

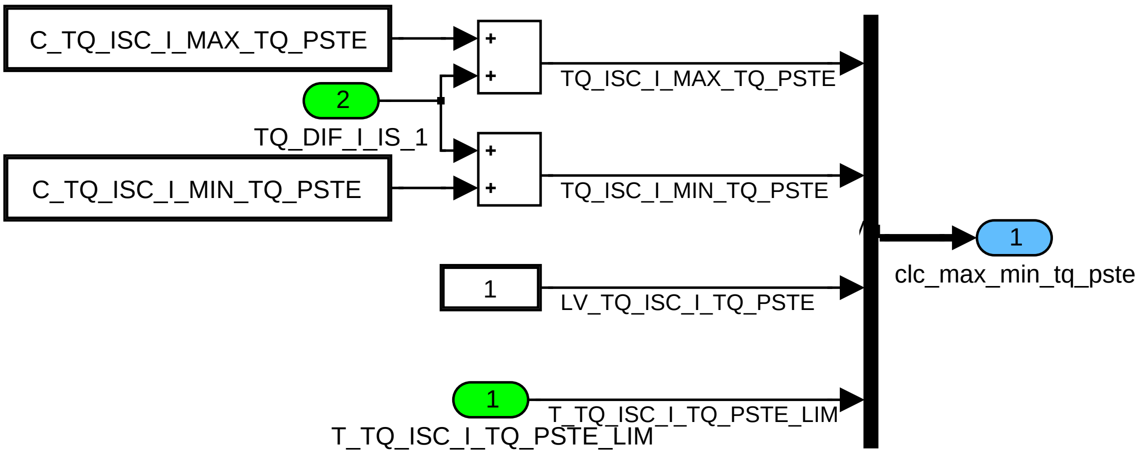

Figure 8.2.43: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/TRANS_TO_NORM/CLC_PSTE_LIM/CLC_1/CLC_MAX_MIN_TQ_PSTE

Lock time for pste limitation

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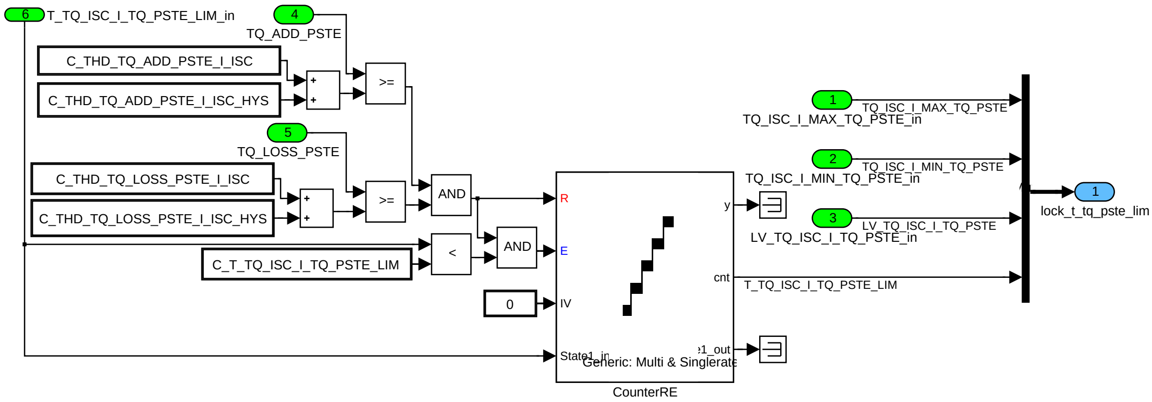

Figure 8.2.44: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/ TRANS_TO_NORM/CLC_PSTE_LIM/CLC_1/LOCK_T_TQ_PSTE_LIM

Calculation for PSTE and DROF limitation

Condition check for calculation at PSTE and DROF limitation

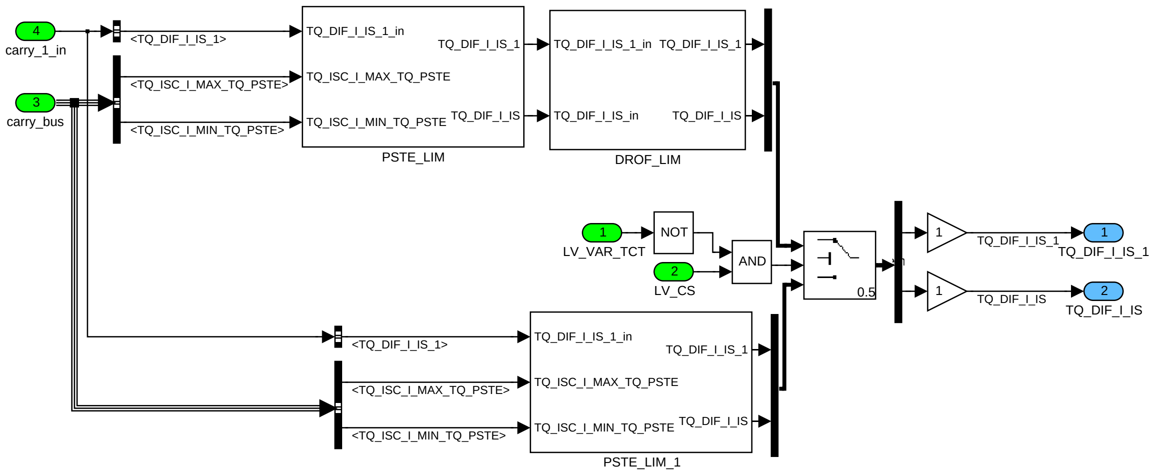

Figure 8.2.45: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/ TRANS_TO_NORM/CLC_PSTE_DROF_LIM/CLC

Condition true- – ->PSTE part of PSTE-DROF limitation is applied

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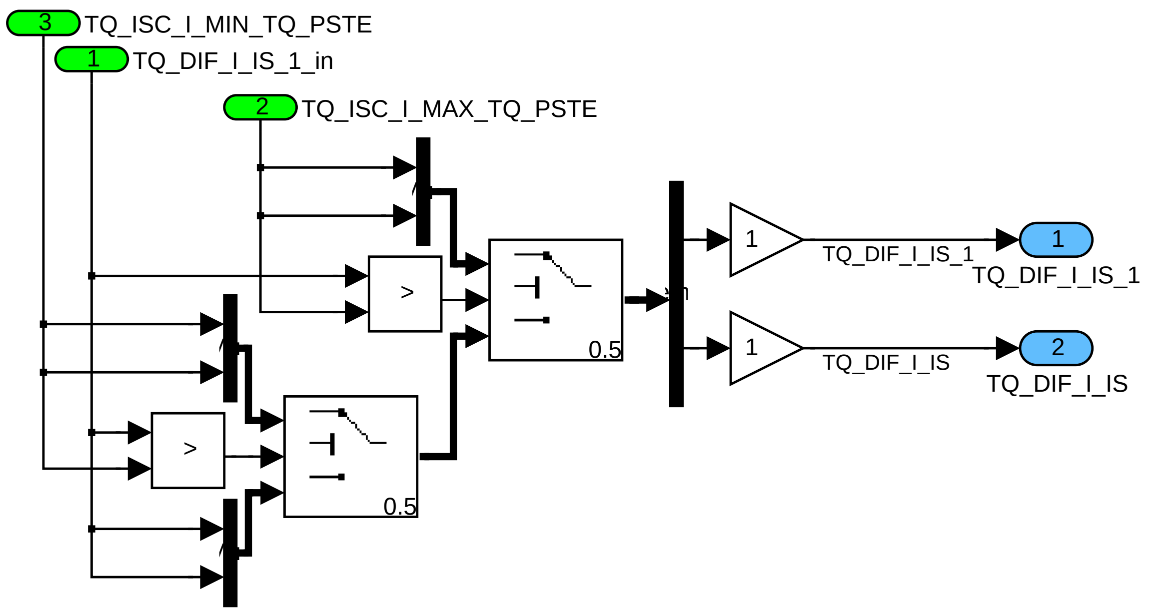

Figure 8.2.46: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/TRANS_TO_NORM/CLC_PSTE_DROF_LIM/CLC/PSTE_LIM

Condition true- – ->DROF part of PSTE-DROF limitation is applied

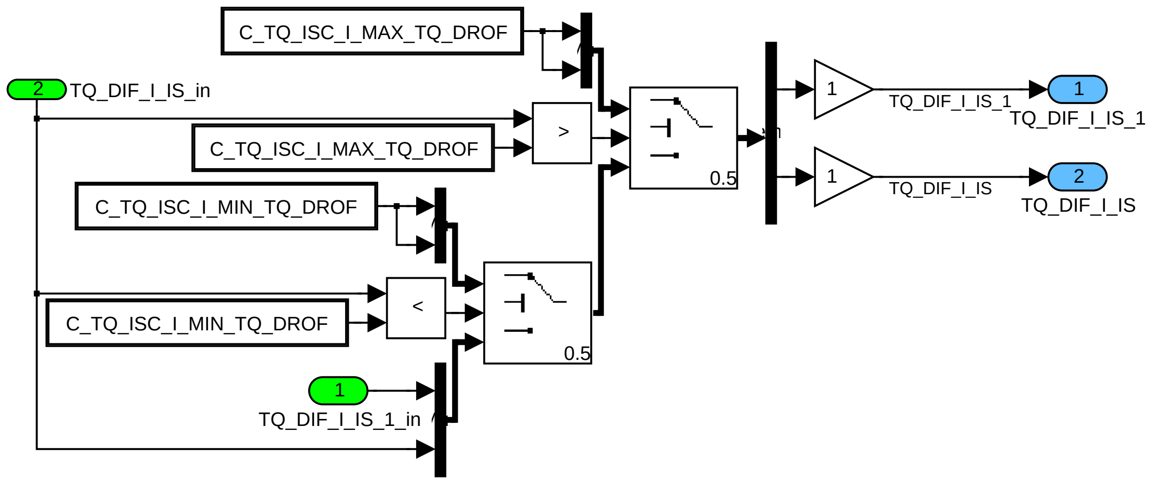

Figure 8.2.47: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/TRANS_TO_NORM/CLC_PSTE_DROF_LIM/CLC/DROF_LIM

Condition false- –> Only PSTE limitation applied

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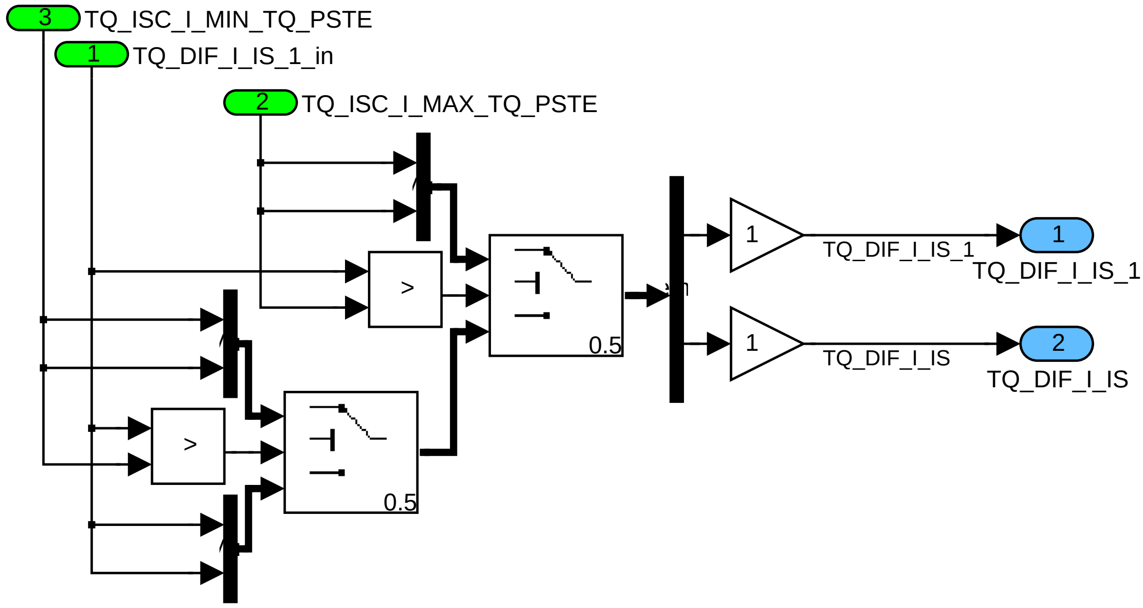

Figure 8.2.48: - ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/TRANS_TO_NORM/CLC_PSTE_DROF_LIM/CLC/PSTE_LIM_1

Re-initialization of TQ_DIF_I_IS

Calculation of TQ_DIF_I_IS

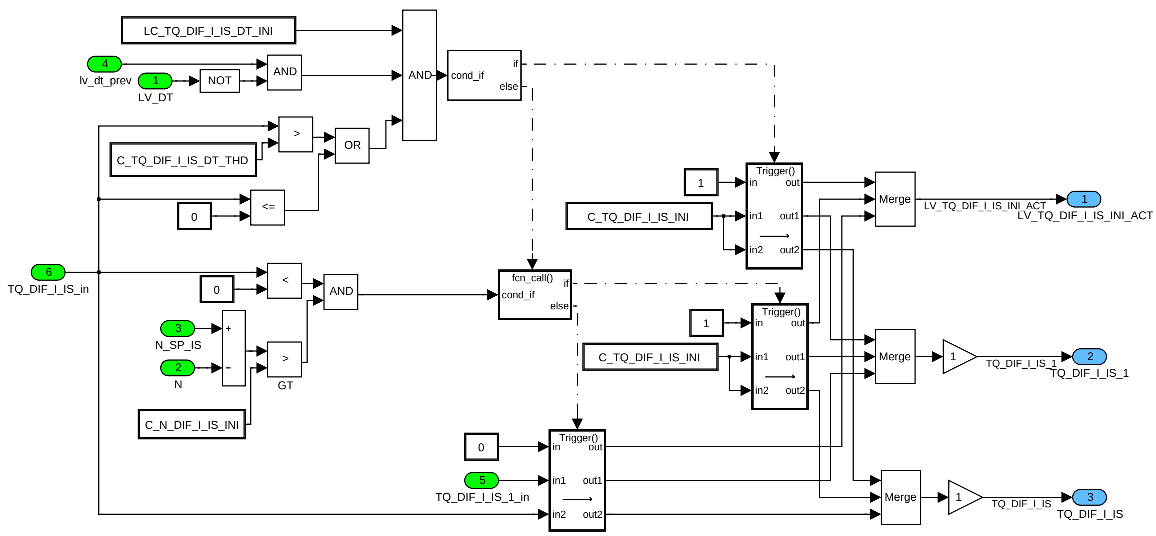

Figure 8.2.49: ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/TRANS_TO_NORM/RE_INI_TQ_DIF_I_IS/CLC_TQ_DIF_I_IS

STATE RAMP_TO_PAS

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At deactivation of ISC the integrator output is controlled to a passive-value by ramp limit activation. The determination of the ramp takes place in the same way as described before for the top/bottom limit ramps.

Actions:

The ramp limit operation starts at deactivation of the ISC. The necessary increment (**TQ_ADD_I_RAMP**) to reach the required ramp-slope **is only calculated once while transitioning into this state**. This value is valid until deactivation of the ramp limit operation.

While transition into this state, so while the ramp is active, there could be a change in TQ_PAS_I_IS. If in this case TQ_ADD_I_RAMP is negative for example and the passive value is higher than the actual value, then the new requested passive value can never be reached, because TQ_ADD_I_RAMP is only calculated once. Therefore TQ_PAS_I_IS is fixed while transition into this state to prevent a wrong comparison in the following condition:

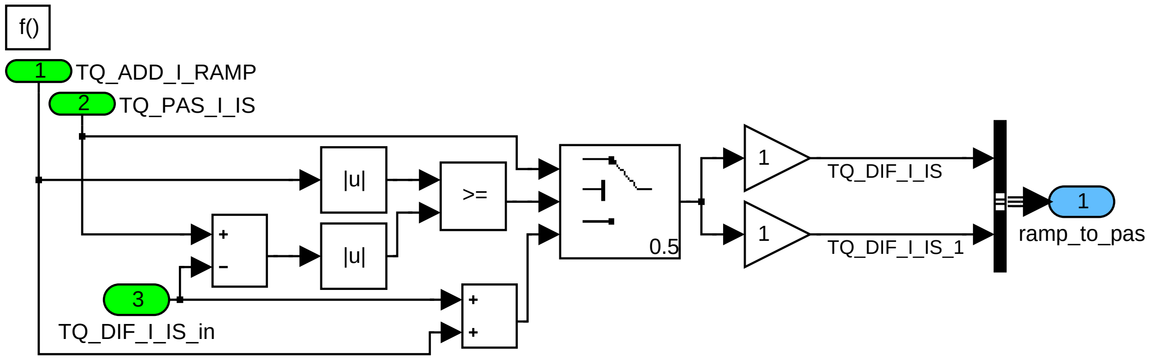
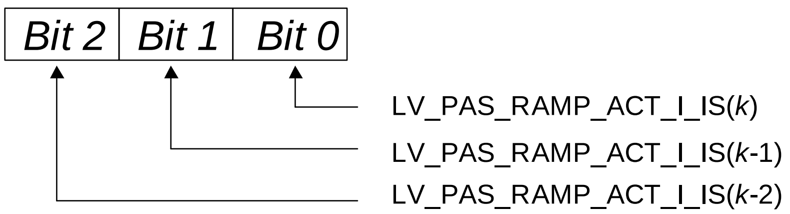


Figure 8.2.50:
ENSC_M8006/OPM/I_CONTROLLER/I_CON_DEACT/I_CONT_ST_AUTOMATE/RAMP_TO_PAS

Circular buffer for LV_PAS_RAMP_ACT_I_IS

In the following circular buffer STATE_PAS_RAMP_ACT_I_IS, the last three values of LV_PAS_RAMP_ACT_I_IS are stored:



This information is needed for the monitoring of the idle speed controller. It is updated every 20ms; the values are shifted from Bit j to Bit j+1, j=0,1.

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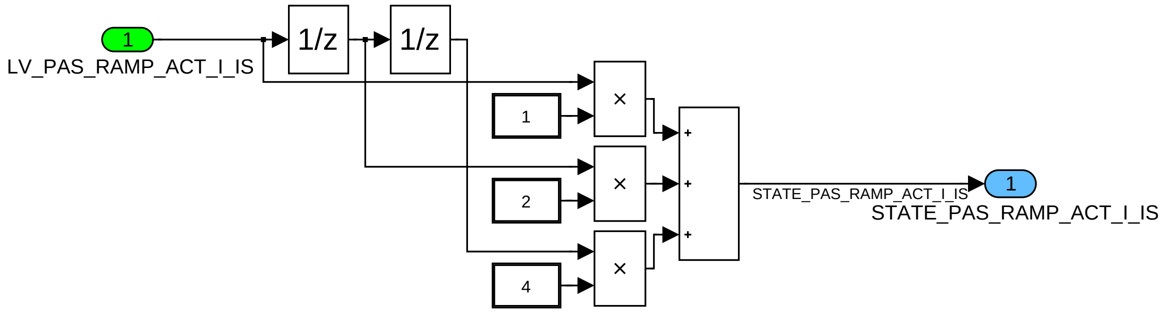
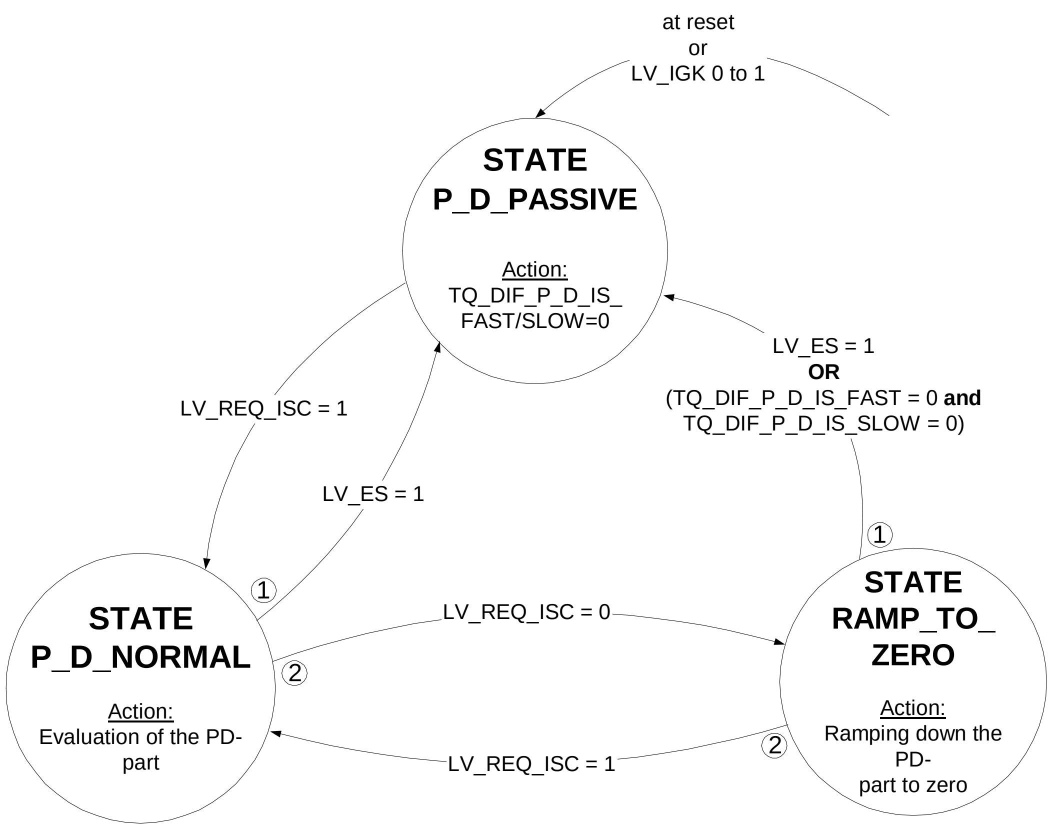


Figure 8.2.51: ENSC_M8006/OPM/I_CONTROLLER/RNG_BUF

PD- Controller

General information:

State Machine



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FUNCTION DESCRIPTION:

Figure 2: *State of the PD-part*

The PD-part is devided into three states:

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STATE_P_D_ISC = P_D_PASSIVE:
Initialization (at reset or from LV_IGK = 0   1; from all other states in case of LV_ES = 1)

STATE_P_D_ISC = P_D_NORMAL:
In   this state the evaluation of the controller maps takes place.

STATE_P_D_ISC = RAMP_TO_ZERO:
Ramp to passive value, which is always zero for the PD-part; in this state the PD-part is ramped down to zero in case of deactivation of the PD-part

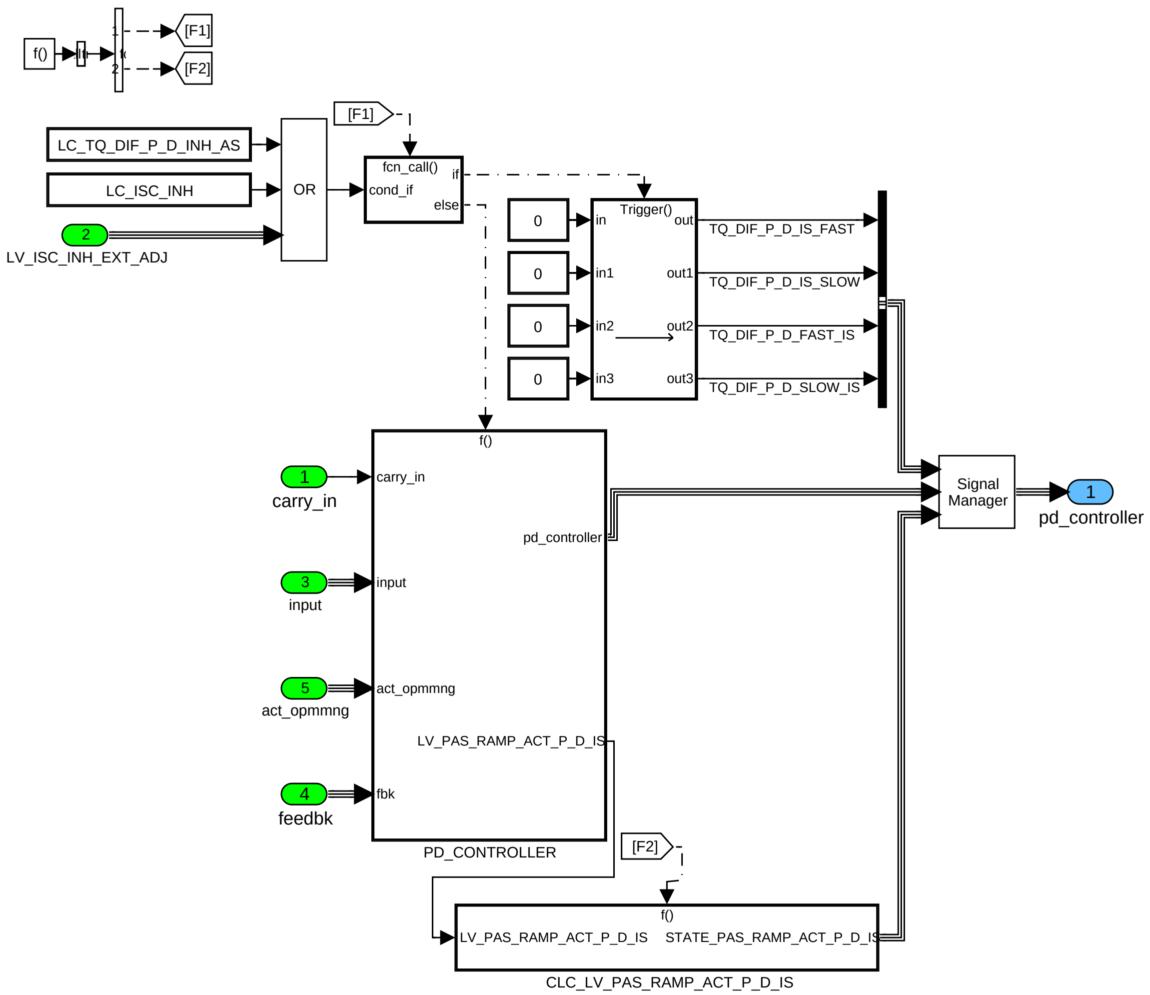

Figure 8.2.52: ENSC_M8006/OPM/PD_CONTROLLER

PD controller state machine and state calculation overview

For special function test, it s possible to set TQ_DIF_P_D_IS_FAST /SLOW_OPM_x = 0 Nm by application system or diagnostic tool (LV_ISC_INH_EXT_ADJ).

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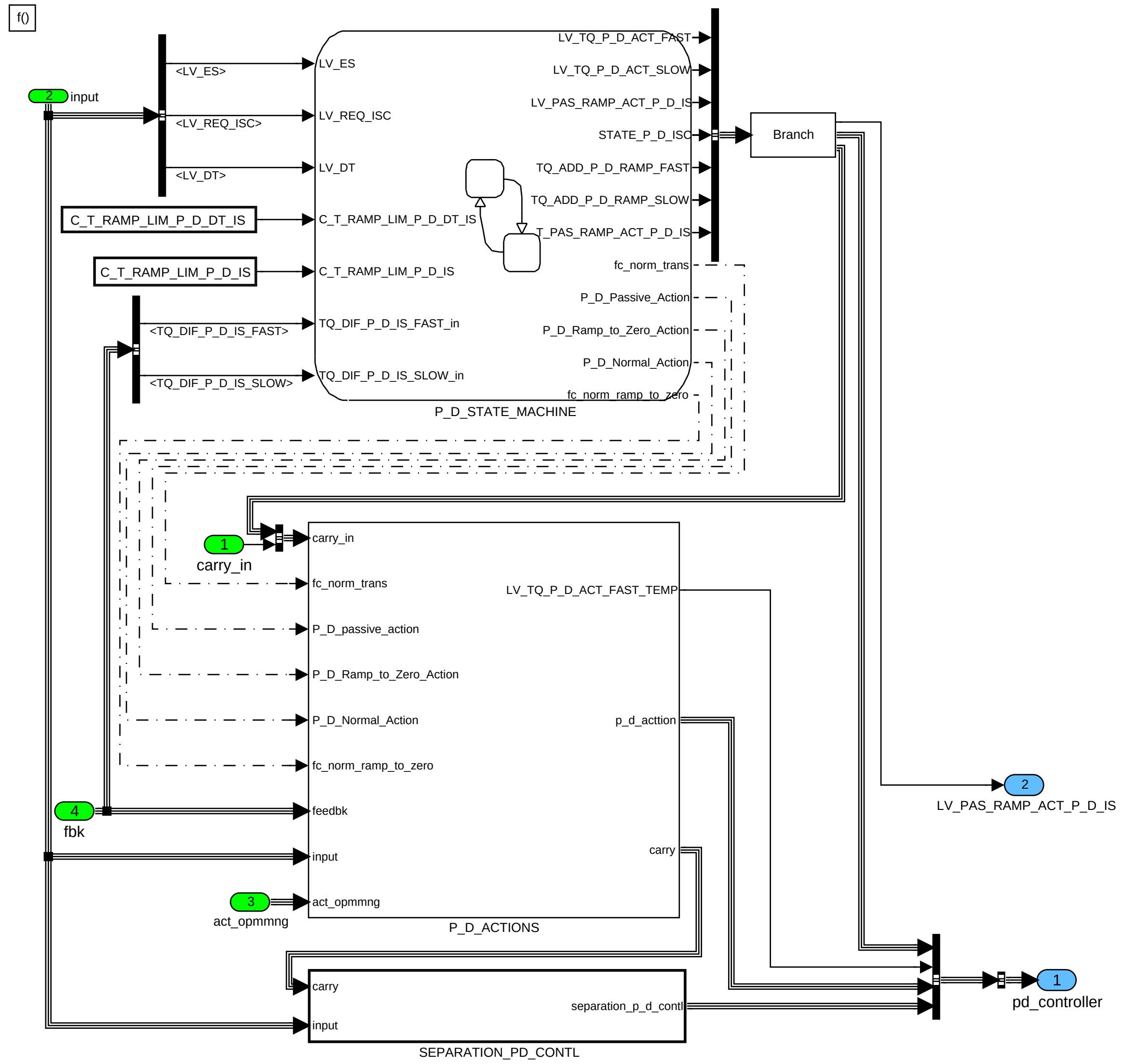

Figure 8.2.53: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER

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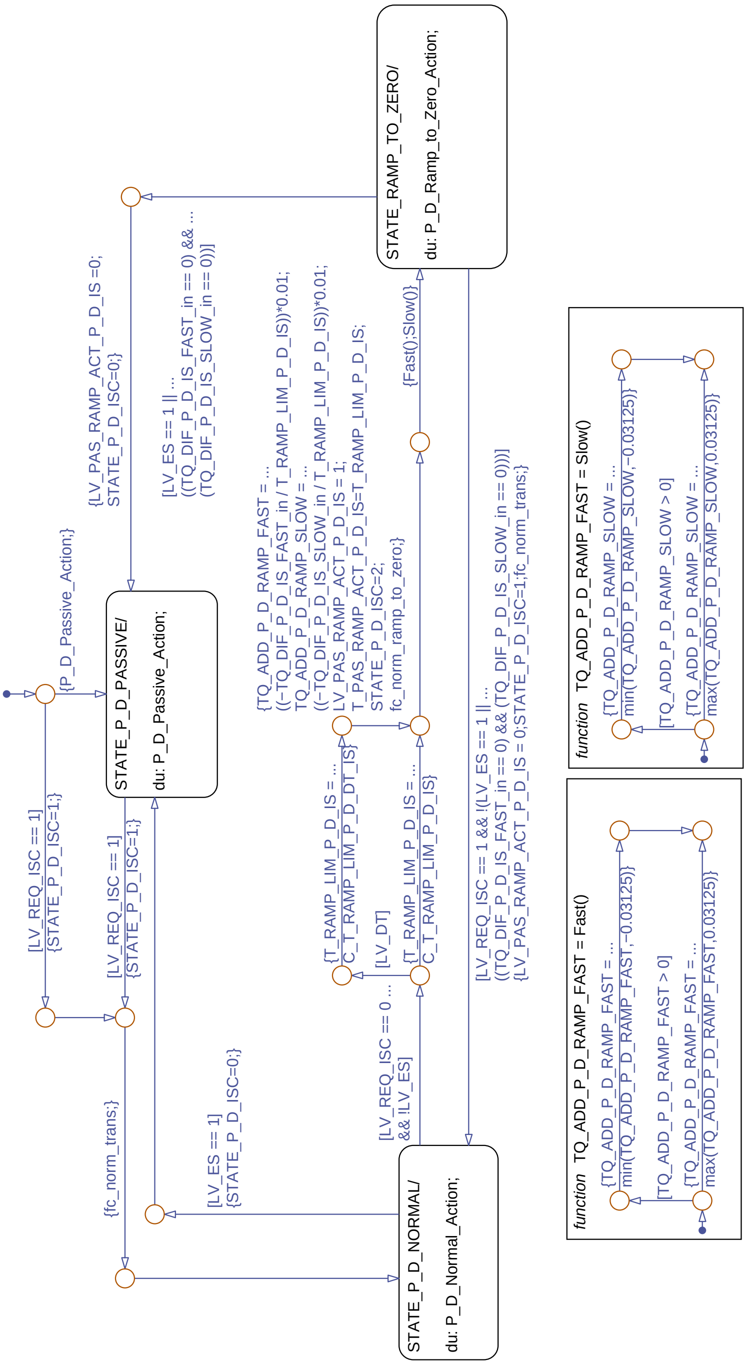

Figure 8.2.54: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_STATE_MACHINE

Calculation of N_GRD_P_D_IS and calculations at gear engaged and disengaged.

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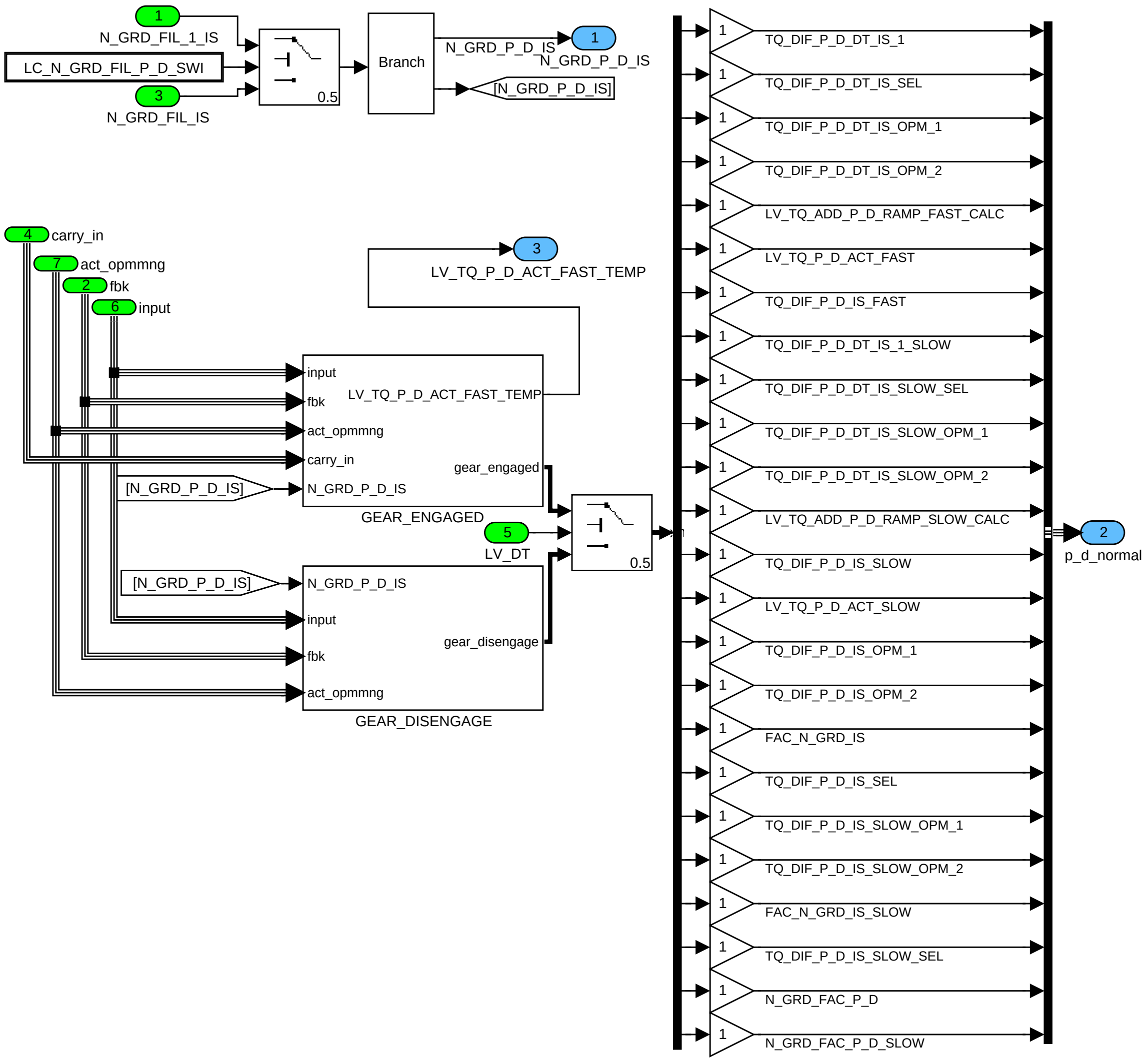

Figure 8.2.55: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/
P_D_NORMAL/P_D_NORMAL

Calculations at gear engaged

Gear engaged is calculated when LV_DT is 1

Calculations at PD part fast

Output from operation manager in PD part fast

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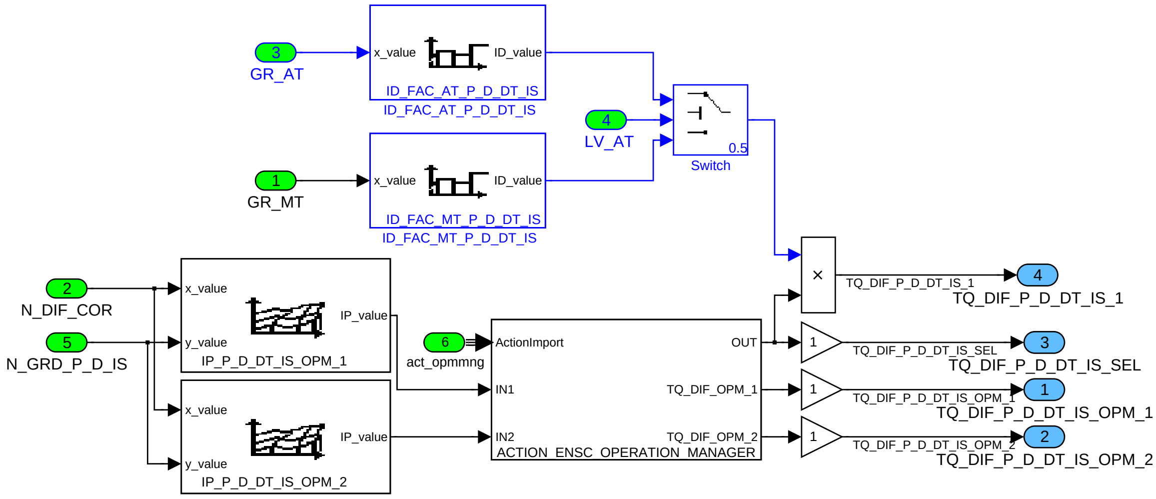

Figure 8.2.56: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/
P_D_NORMAL/P_D_NORMAL/GEAR_ENGAGED/PD_PART_FAST/CLC_P_D_DT_IS

Calculation of TQ_DIF_P_D_IS_FAST and LV_TQ_P_D_ACT_FAST

Calculation of LV_TQ_P_D_ACT_FAST

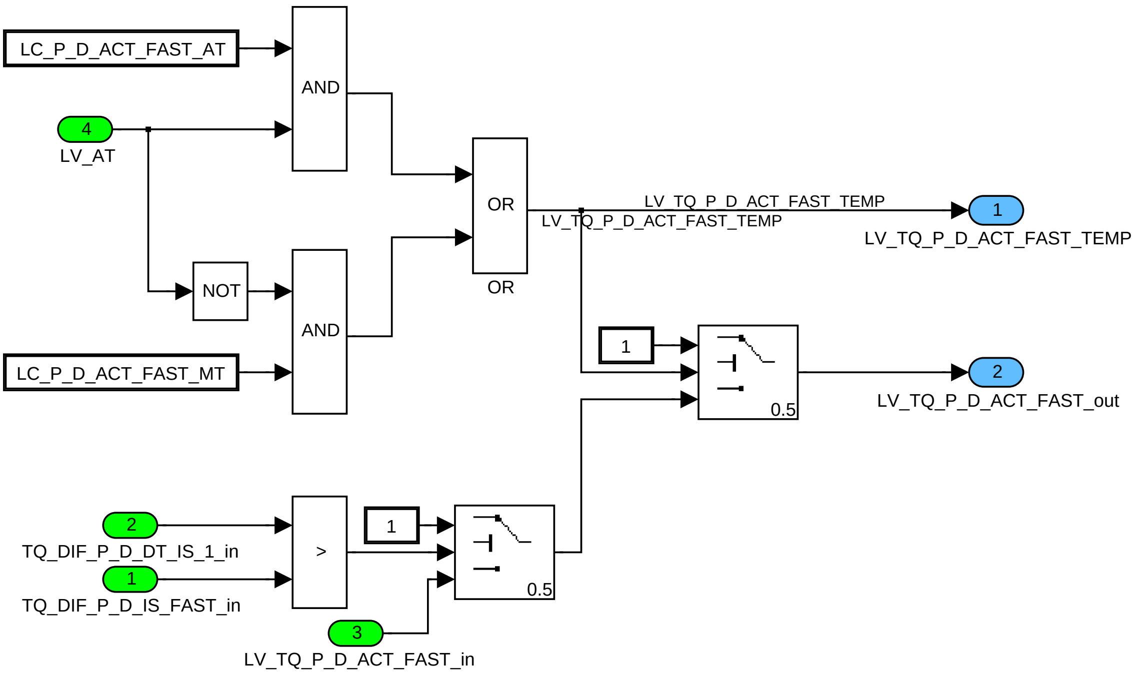

Figure 8.2.57:
ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/P_D_NORMAL/
P_D_NORMAL/GEAR_ENGAGED/PD_PART_FAST/CLC_P_D_IS/CLC_LV_TQ_P_D_ACT_FAST

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Calculation of LV_TQ_ADD_P_D_RAMP_FAST_CALC and TQ_DIF_P_D_IS_FAST

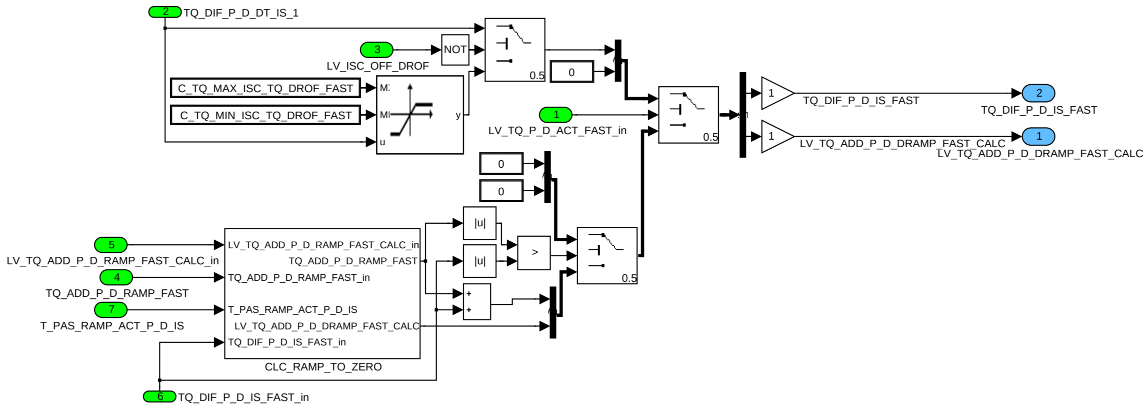

Figure 8.2.58: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/
P_D_NORMAL/P_D_NORMAL/GEAR_ENGAGED/PD_PART_FAST/CLC_P_D_IS/CLC_P_D_IS

Calculation of LV_TQ_ADD_P_D_RAMP_FAST_CALC and TQ_DIF_P_D_IS_FAST at ramp_to_zero

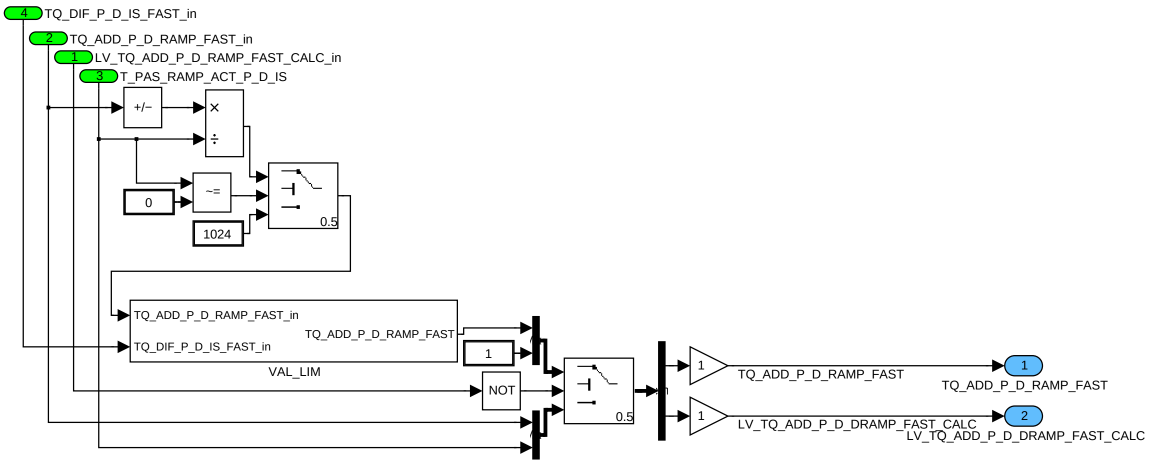

Figure 8.2.59: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/P_D_
NORMAL/P_D_NORMAL/GEAR_ENGAGED/PD_PART_FAST/CLC_P_D_IS/CLC_P_D_IS/
CLC_RAMP_TO_ZERO

Limiting the value of TQ_DIF_P_D_IS_FAST

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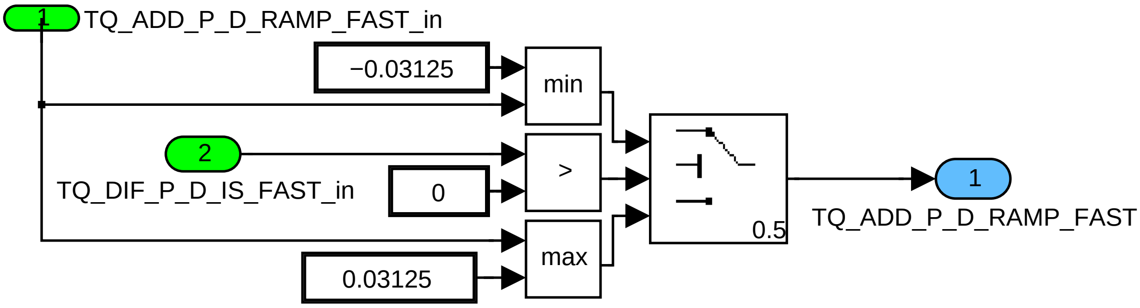

Figure 8.2.60: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/P_D_NORMAL/P_D_NORMAL/GEAR_ENGAGED/PD_PART_FAST/CLC_P_D_IS/CLC_P_D_IS/CLC_RAMP_TO_ZERO/VAL_LIM

Calculation at PD_slow

Output from operation manager in PD slow

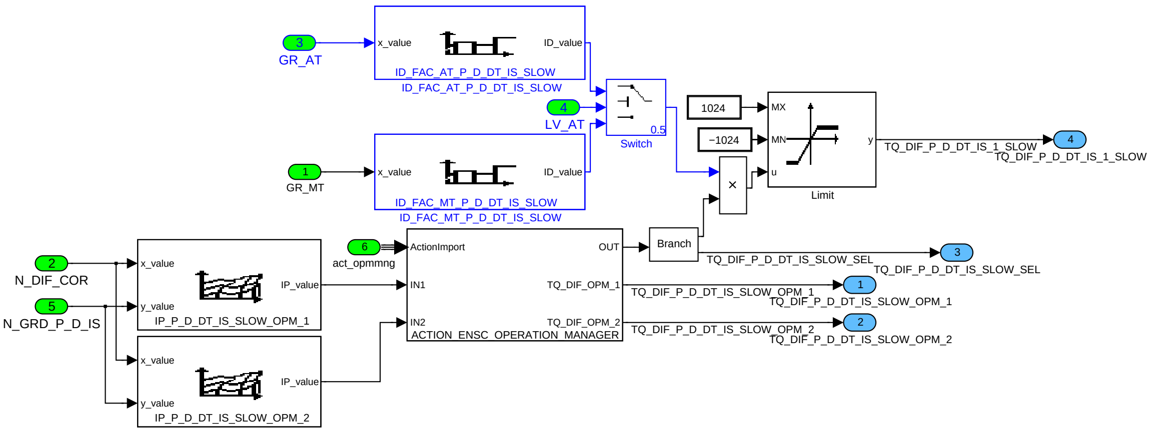

Figure 8.2.61: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/P_D_NORMAL/P_D_NORMAL/GEAR_ENGAGED/PD_PART_SLOW/CLC_P_D_DT_IS

Calculation of LV_TQ_PD_ACT_SLOW and TQ_DIF_P_D_IS_SLOW

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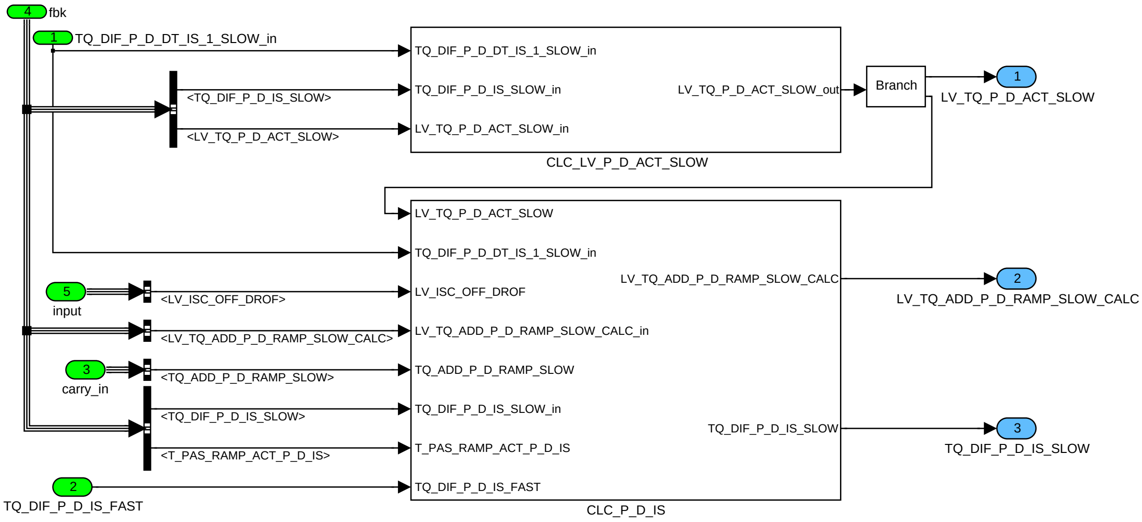

Figure 8.2.62: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/ P_D_NORMAL/P_D_NORMAL/GEAR_ENGAGED/PD_PART_SLOW/CLC_P_D_IS

Calculation of LV_ACT_P_D_IS_SLOW

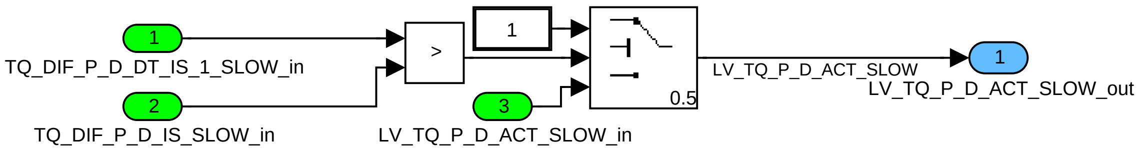

Figure 8.2.63: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/P_D_NORMAL/ P_D_NORMAL/GEAR_ENGAGED/PD_PART_SLOW/CLC_P_D_IS/CLC_LV_P_D_ACT_SLOW

Calculation of TQ_DIF_P_D_IS_SLOW and LV_TQ_ADD_P_D_RAMP_SLOW_CALC

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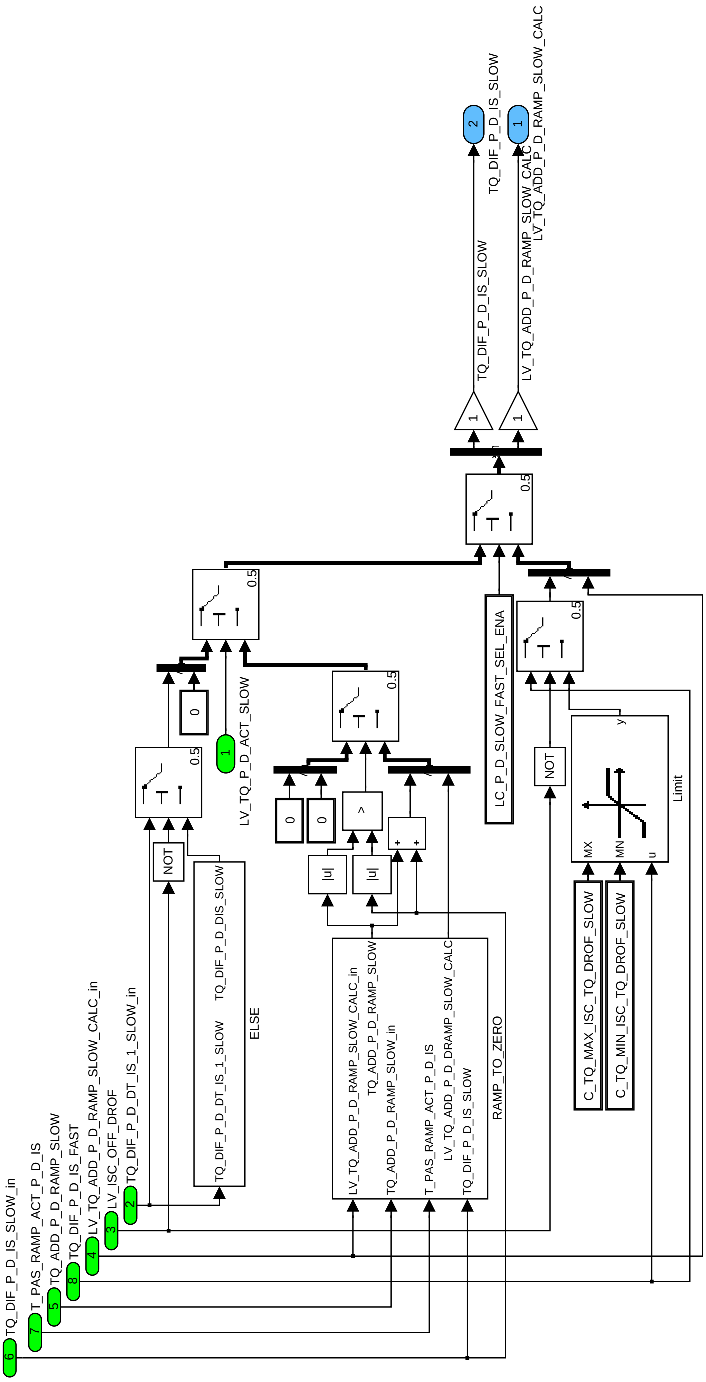

Figure 8.2.64: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/
P_D_NORMAL/P_D_NORMAL/GEAR_ENGAGED/PD_PART_SLOW/CLC_P_D_IS/CLC_P_D_IS

Limiting the value of TQ_DIF_P_D_IS_SLOW

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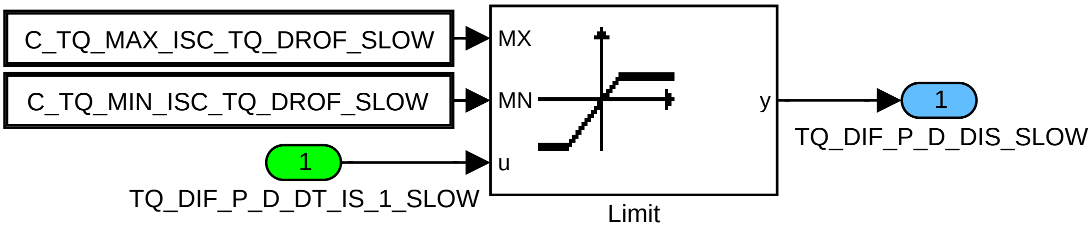

Figure 8.2.65:
ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/P_D_NORMAL/
P_D_NORMAL/GEAR_ENGAGED/PD_PART_SLOW/CLC_P_D_IS/CLC_P_D_IS/ELSE

Calculation at ramp_to_zero

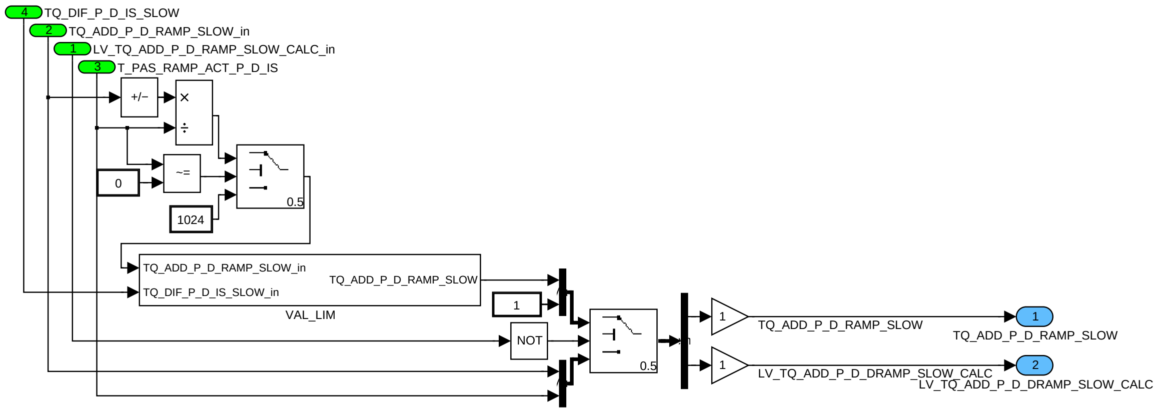

Figure 8.2.66:
ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/P_D_NORMAL/
P_D_NORMAL/GEAR_ENGAGED/PD_PART_SLOW/CLC_P_D_IS/CLC_P_D_IS/RAMP_TO_ZERO

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Limiting the value of TQ_DIF_P_IS_SLOW

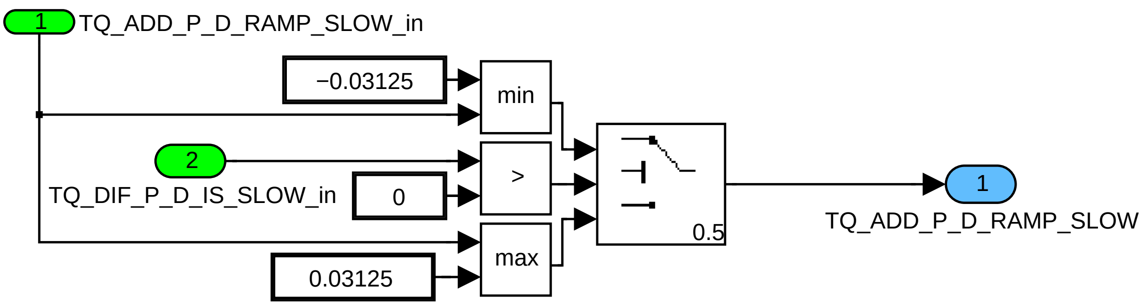

Figure 8.2.67: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/P_D_
NORMAL/P_D_NORMAL/GEAR_ENGAGED/PD_PART_SLOW/CLC_P_D_IS/CLC_P_D_IS/
RAMP_TO_ZERO/VAL_LIM

Passing the of old value

NO calculation

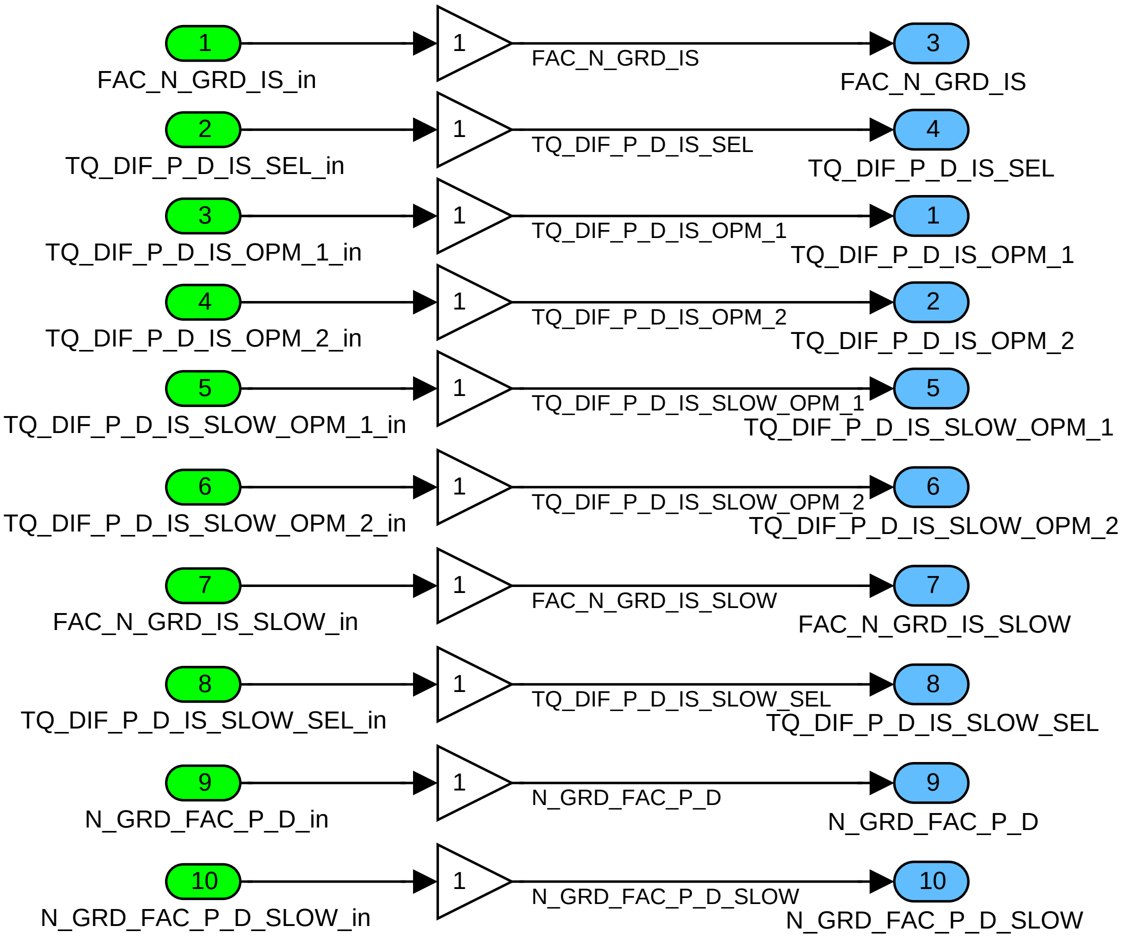

Figure 8.2.68: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/
P_D_NORMAL/P_D_NORMAL/GEAR_ENGAGED/OLD_VALUES

Calculation at gear disengaged.

Calculations at gear disengaged occurs when LV_DT = 0;

Calculation gear disengaged- –> PD part fast

Output from operation manager in PD part fast

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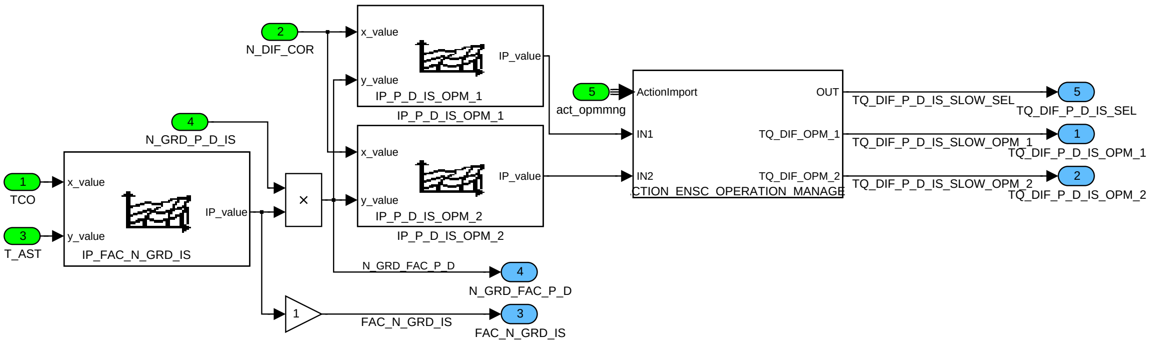

Figure 8.2.69: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/
P_D_NORMAL/P_D_NORMAL/GEAR_DISENGAGE/PD_PART_FAST/CLC_P_D_DT_IS

Calculation of LV_TQ_ADD_P_D_RAMP_FAST_CALC and TQ_DIF_P_D_IS_FAST.

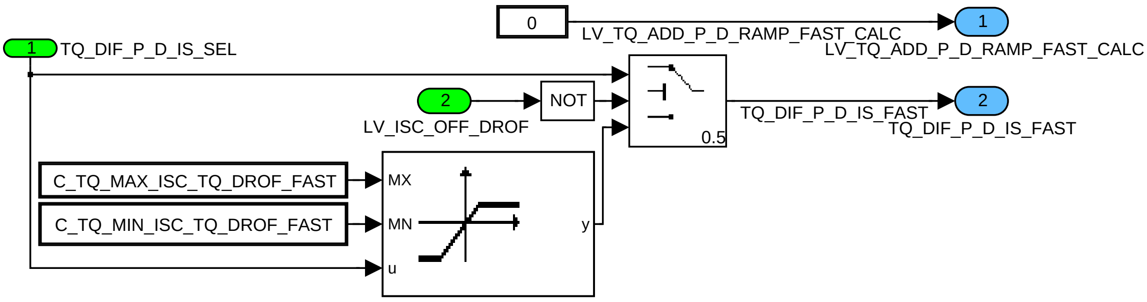

Figure 8.2.70: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/
P_D_NORMAL/P_D_NORMAL/GEAR_DISENGAGE/PD_PART_FAST/CLC_P_D_IS

Calculation at PD part slow

Condition check for calculation in PD part slow

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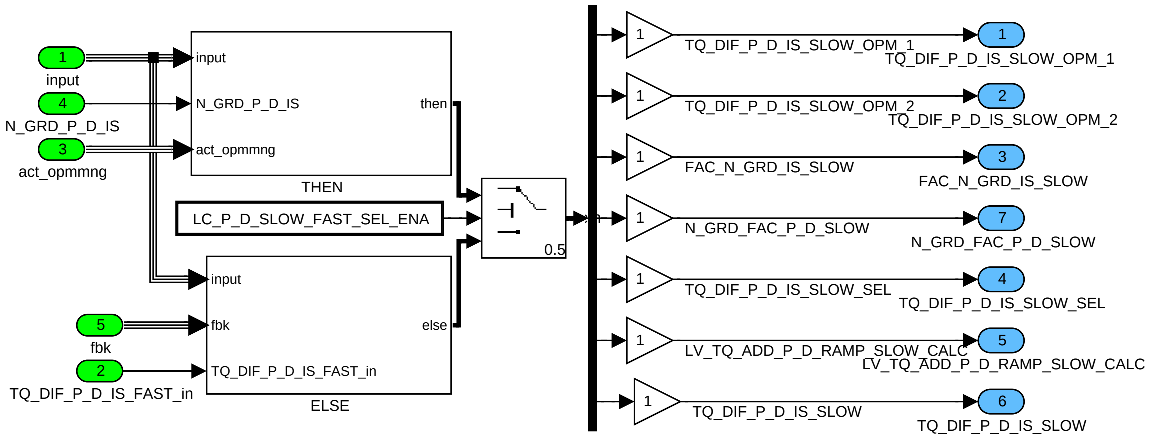

Figure 8.2.71: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/
P_D_NORMAL/P_D_NORMAL/GEAR_DISENGAGE/PD_PART_SLOW/CLC_P_D_IS

Calculation at pd part slow when condition is true.

Output from operation manager

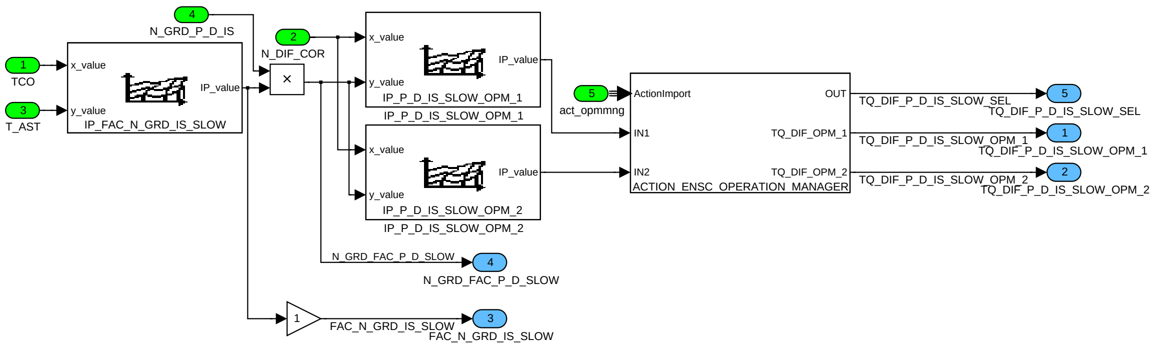

Figure 8.2.72:
ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/P_D_NORMAL/
P_D_NORMAL/GEAR_DISENGAGE/PD_PART_SLOW/CLC_P_D_IS/THEN/CLC_P_D_DT_IS

Calculation of TQ_DIF_P_D_IS_SLOW

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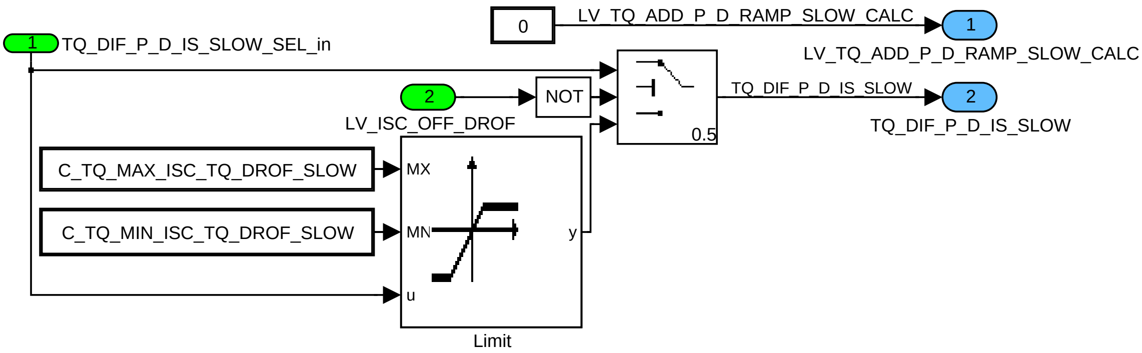

Figure 8.2.73: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/P_D_NORMAL/P_D_NORMAL/GEAR_DISENGAGE/PD_PART_SLOW/CLC_P_D_IS/THEN/THEN_TQ_DIF_P_D_IS_SLOW

Calculation at pd part slow when condition is false.

Calculation of TQ_DIF_P_D_IS_SLOW and LV_TQ_ADD_P_D_RAMP_SLOW_CALC

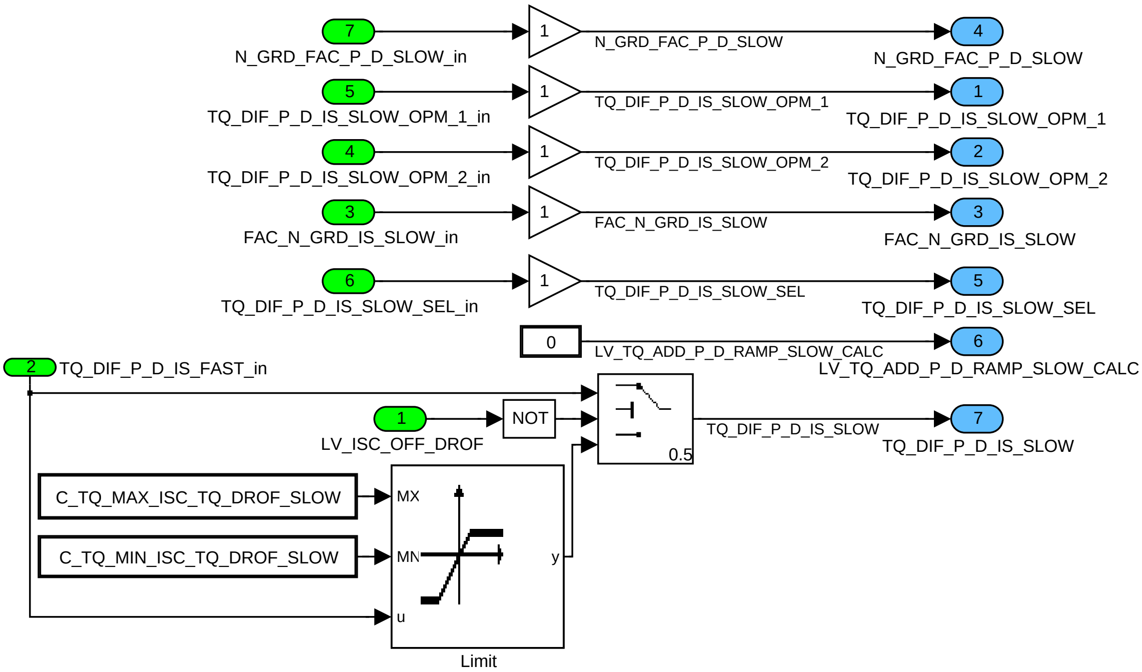

Figure 8.2.74: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/P_D_NORMAL/P_D_NORMAL/GEAR_DISENGAGE/PD_PART_SLOW/CLC_P_D_IS/ELSE/CLC

Feed through

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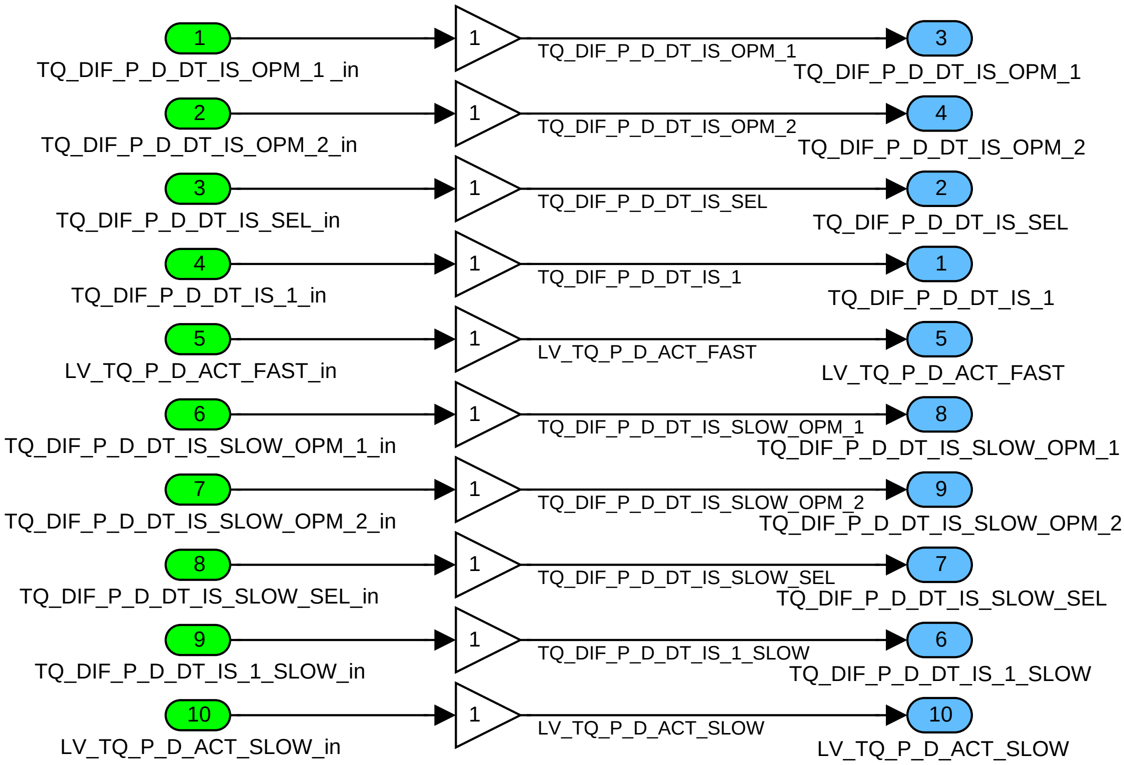

Figure 8.2.75: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/
P_D_NORMAL/P_D_NORMAL/GEAR_DISENGAGE/OLD_VALUES

Calculation at state ramp_to_zero

To prevent a torque jump if the PD part is on a certain value and the driver hits the pedal (transition to part load), it s necessary to reduce the PD-part s value by a deactivation ramp. The **target value** of the ramp operation is always TQ_DIF_P_D_IS_FAST /SLOW = 0 [Nm].

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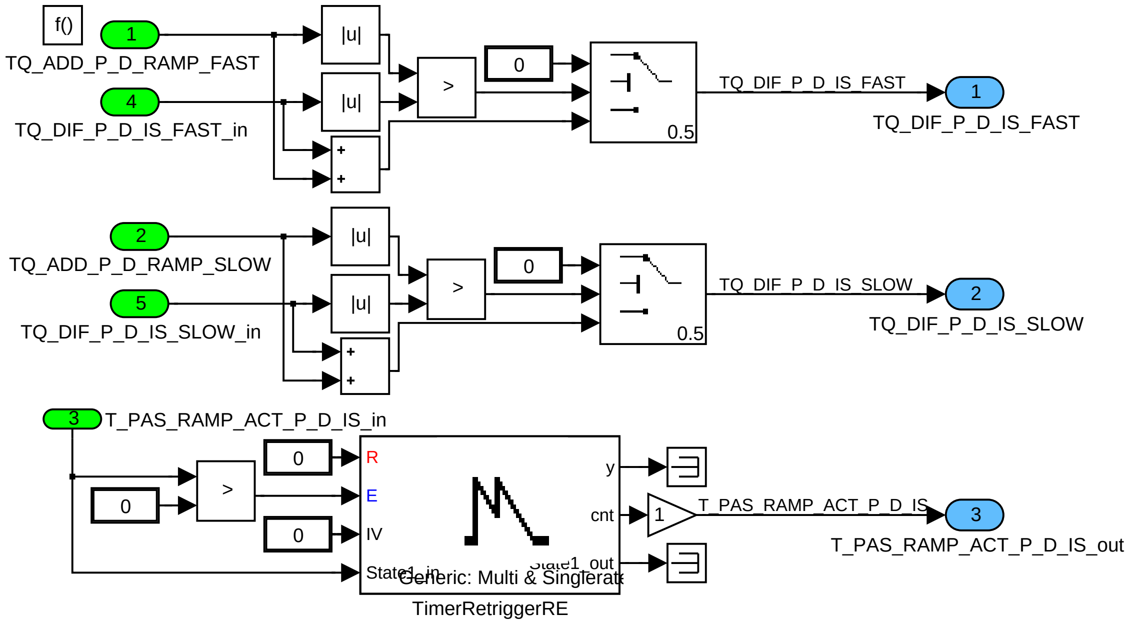

Figure 8.2.76:
ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/P_D_ACTIONS/RAMP_TO_ZERO

Calculation of TQ_DIF_P_D_SLOW_IS

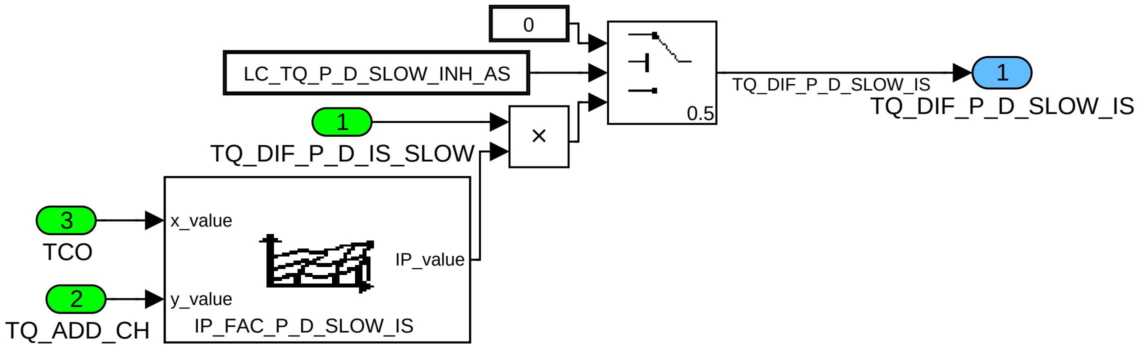

Figure 8.2.77: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/
SEPARATION_PD_CONTL/DET_TQ_DIF_P_D_SLOW_IS

Calculation of TQ_DIF_P_D_SLOW_IS

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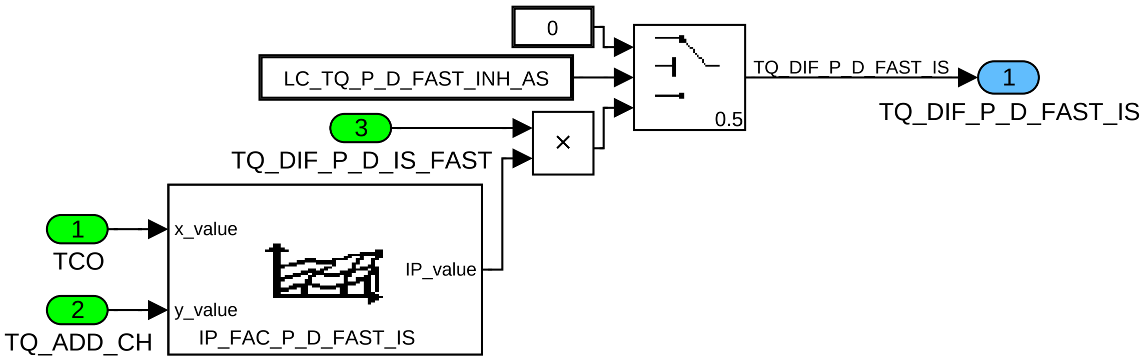
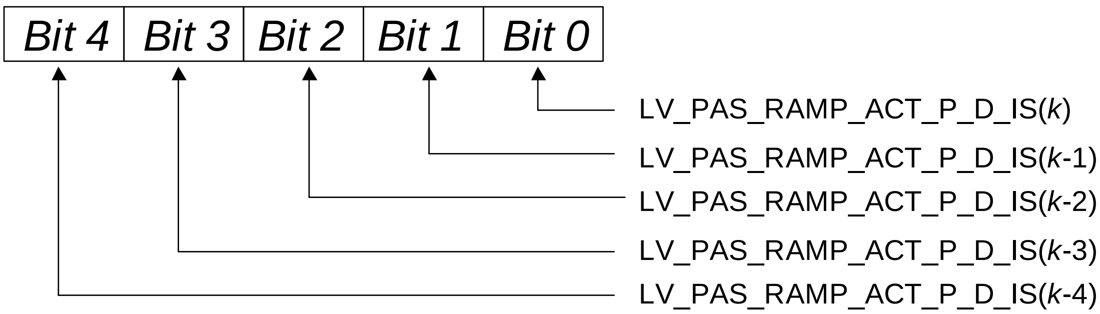


Figure 8.2.78: ENSC_M8006/OPM/PD_CONTROLLER/PD_CONTROLLER/
SEPARATION_PD_CONTL/DET_TQ_DIF_P_D_FAST_IS

Circular buffer for LV_PAS_RAMP_ACT_P_D_IS

In the following circular buffer STATE_PAS_RAMP_ACT_P_D_IS, the last five values of LV_PAS_RAMP_ACT_P_D_IS are stored. This information is needed for the Level 2 which has a recurrency of 40 ms and would not detected a high-low-high flank change inside 40 ms:



This information is needed for the monitoring of the idle speed controller. It is updated every 10ms; the values are shifted from Bit j to Bit j+1, j=0,1,2,3.

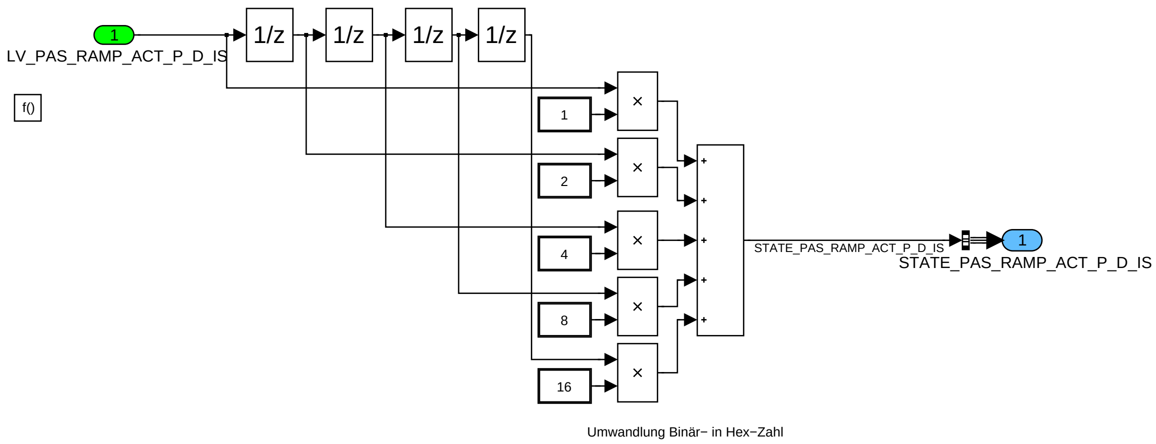


Figure 8.2.79: ENSC_M8006/OPM/PD_CONTROLLER/CLC_LV_PAS_RAMP_ACT_P_D_IS

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8.3 Application conditions for idle speed control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_NEG_N_GRD_FIL_MEM	V	0... 1H	0 ...1	1	-
Memory bit for falling gradient after start					
LV_REQ_ISC	O/V	0... 1H	0 ...1	1	-
Logical variable for idle speed controller activatIon request					
N_GRD_FIL_ISC_ACT_AST	V	80... 7FH	-4096 ...4064	32	rpm/s
Filtered gradient for ISC after start activation					
STATE_REQ_ISC	V	0H 1H 2H 3H 4H	ISC_PASSIVE AFTER_START NORMAL TRAILING_ THR PART_LOAD	-	-
Actual state for ISC request					
T_CTR_PU_ISC_ACT	O/V	0... FFFFH	0... 655.35	0.01	s
Time counter for ISC activation in PU					

Input data:

LV_AMT_CRAWL_ON {p. 799}	LV_AT {p. 654}	LV_DT {p. 1310}	LV_IS {p. 1720}
LV_N_SP_IS_CS {p. 1122}	LV_PL {p. 1720}	LV_PU {p. 1720}	LV_ST {p. 1720}
N {p. 1525}	N_DIF_COR {p. 1122}	N_GB {p. 1569}	N_GRD {p. 1525}
N_SP_IS {p. 1122}	N_SP_IS_RATIO {p. 1122}	VS {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_N_GRD_FIL_ISC_ACT_AST	-	0... FFFFH	0... 0.99998	15.3e-6	-
Filter correlation factor for speed gradient filtering in connection with after start activation of ISC					
C_N_DIF_ISC_ACT_AST	-	8000... 7FFFH	-32768 ...32767	1	rpm
Additive term to define the low limit for ISC activation after start					
C_N_DIF_ISC_ACT_PL_DOWN	-	8000... 7FFFH	-32768 ...32767	1	rpm
Additive term to define the low limit for ISC activation in PL					
C_N_DIF_ISC_ACT_PL_UP	-	8000... 7FFFH	-32768 ...32767	1	rpm
Additive term to define the upper limit for ISC deactivation in PL					
C_N_GB_DIF_N	-	0... FFFEH	0... 8191.75	0.125	rpm
Difference in input shaft speed turbine/gear box and engine speed					
C_N_SP_IS_MAX_PL_ACT	-	0... 1FE0H	0... 8160	1	rpm
Speed setpoint threshold for part load activation					
C_T_DLY_ISC_ACT_PU	-	0... FFFFH	0... 655.35	0.01	s
Time limit for ISC activation in PU					
IP_N_GRD_N_SP_IS_RATIO	-	0... FFH	-4096 ...4064	32	rpm/s
LDP_N_SP_IS_RATIO	8	0... FFFFH	0... 7.99987	122.1e-6	-
IP for Engine Speed Gradient					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_ISC_ACT_AST_CDN_SWI	-	0... 1H	0 ...1	1	-
Switch for using different after start ISC activation conditions					
LC_ISC_ACT_CDN_SWI	-	0... 1H	0 ...1	1	-
Calibratible logical bit for switching between different activation conditions					
LC_ISC_PL_ACT_INH	-	0... 1H	0 ...1	1	-
Calibratible bit to inhibit ISC activation in part load					

Application conditions

Activation:

```
IF   LC_ISC_ACT_CDN_SWI == 1
   THEN
        Use these application incidences
   ELSE IF LV_AMT_CRAWL_ON = 1
          THEN        LV_REQ_ISC  =  0
     ELSE              LV_REQ_ISC  =  LV_IS
                         ENDIF
ENDIF
At reset:                STATE_REQ_ISC = ISC_PASSIVE
    T_CTR_PU_ISC_ACT = C_T_DLY_ISC_ACT_PU
```

Update rate: 10 ms

At deactivation: T_CTR_PU_ISC_ACT = C_T_DLY_ISC_ACT_PU

8.3.1 General

The activation of the idle speed controller depends on different driving situations. Five states are distinguished. The actual status of the idle speed activation is stored in STATE_REQ_ISC.

State 0: Idle speed controller is passive **(STATE_REQ_ISC = ISC_PASSIVE)**.

State 1: Activation of the ISC after start **(STATE_REQ_ISC = AFTER_START)**.

State 2: "Normal activation": Activiation of the ISC in case of LV_IS = 1 **(STATE_REQ_ISC = NORMAL)**

State 3: Activation of the ISC if speed remains stationary at a certain value in trailing throttle state **(STATE_REQ_ISC = TRAILING_THR)**.

State 4: Activation of the ISC in part load, in case of underspeed. **(STATE_REQ_ISC = PART_LOAD)**.

Formula section:

Action:

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FlipFlop condition (LV_FF):

IF N > (N_SP_IS + C_N_DIF_ISC_ACT_PL_UP) **THEN** LV_FF = 0
ELSE **IF** N < (N_SP_IS - C_N_DIF_ISC_ACT_PL_DOWN) **THEN** LV_FF = 1

IF **{** LV_PL == 1 } **AND**

{ LV_FF == 1 } **AND**

N_SP_IS < C_N_SP_IS_MAX_PL_ACT **AND**

{ LC_ISC_PL_ACT_INH == 0 }

OR

{ LV_N_SP_IS_CS **AND** { **NOT** LV_IS } **AND** { **NOT** LV_ST } }

THEN

LV_TEMP_PL_CDN = 1

ELSE

LV_TEMP_PL_CDN = 0

The following state diagram illustrates the connection between these five cases, figure 1.

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Formula section:

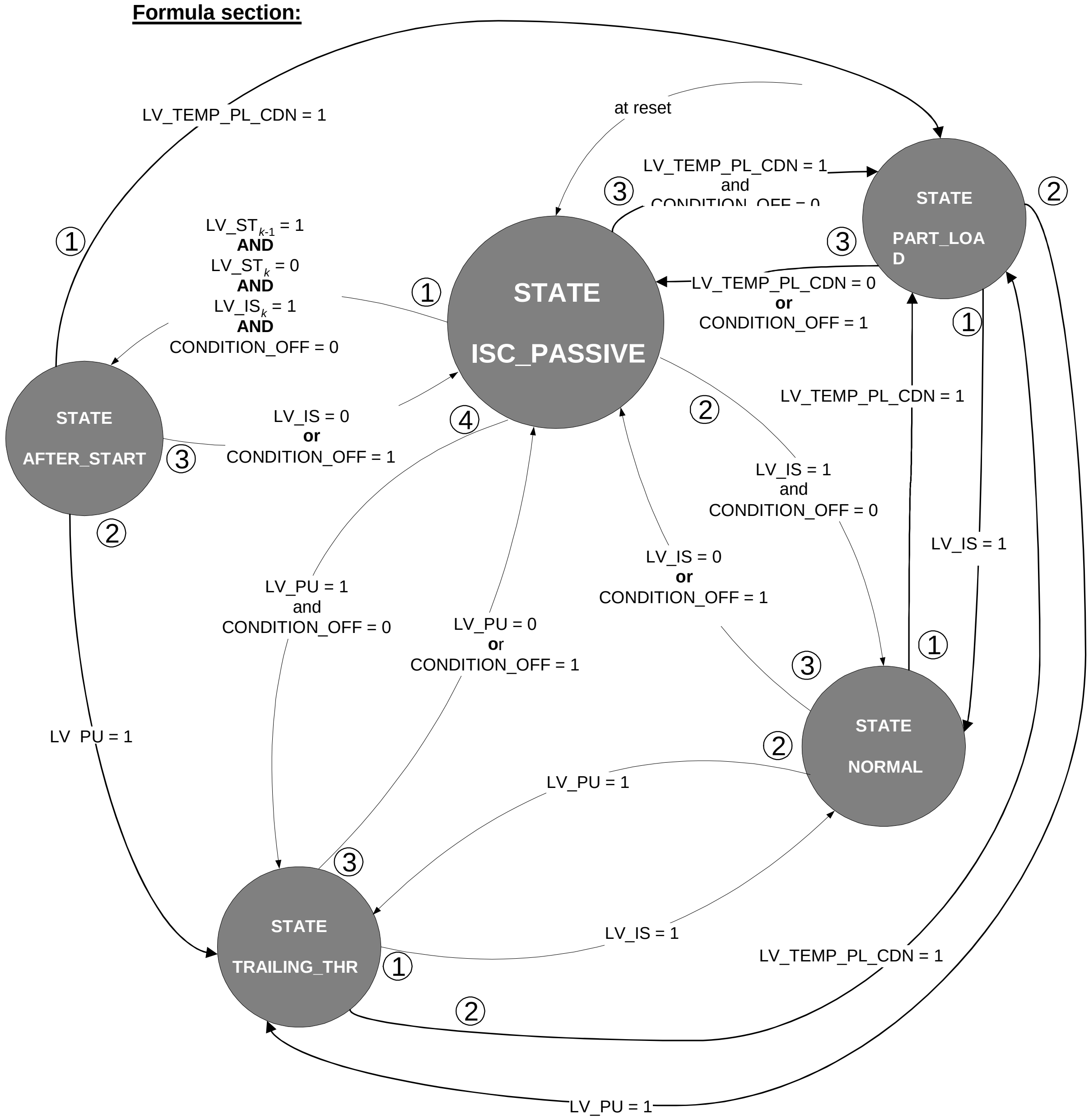

Figure 8.3.1: : State diagram of the ISC activation.

The numbers at different transitions of one state to another represent the priority in which the transitions have to be checked.

8.3.2 ISC Passive (STATE ISC_PASSIVE)

FUNCTION DESCRIPTION:

This state is the idle speed controller passive state. The controller is deactivated if there is a transition to this state.

Formula section:

Action: LV_REQ_ISC = 0

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Transition: see figure 1

Action during transition to AFTER_START: LV_NEG_N_GRD_FIL_MEM = 0
N_GRD_FIL_ISC_ACT_AST = 0

8.3.3 Checking ISC activation conditions after start (Entry into IS after ST, STATE AFTER_START)

FUNCTION DESCRIPTION:

After transition from engine state ST to IS, the activation of the ISC is requested if speed reaches a calibratible offset from N_SP_IS with a negative gradient N_GRD, figure 2. If speed does not reach this offset after decreasing and increasing again, the controller is also activated.

Transition: see figure 1

Action:

IF LC_ISC_ACT_AST_CDN_SWI == 1
THEN
LV_REQ_ISC = 1
ELSE
{
% Calculation of a filtered gradient for after start activation

$N\_GRD\_FIL\_ISC\_ACT\_AST_k = N\_GRD\_FIL\_ISC\_ACT\_AST_{k-1} + C\_CRLC\_N\_GRD\_FIL\_ISC\_ACT\_AST \; \{N\_GRD_k - N\_GRD\_FIL\_ISC\_ACT\_AST_{k-1}\}$

% If N reaches the calibratible offset N_SP_IS + C_N_DIF_ISC_ACT_AST
% with a negative gradient, then the controller is activated. If
% speed increases again *before* reaching N_SP_IS + C_N_DIF_ISC_ACT_AST,
% then the controller is activated, too. The falling gradient
% is layed up in LV_NEG_N_GRD_FIL_MEM.

IF N_GRD_FIL_ISC_ACT_AST $<$ 0
THEN
LV_NEG_N_GRD_FIL_MEM = 1

IF **{** N $<$ N_SP_IS + C_N_DIF_ISC_ACT_AST **}**
THEN
LV_REQ_ISC =1
ENDIF

ELSEIF **{** N_GRD_FIL_ISC_ACT_AST $>=$ 0 **}AND**
{ LV_NEG_N_GRD_FIL_MEM == 1**}**

THEN
LV_REQ_ISC =1

ENDIF

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}

After setting LV_NEG_N_GRD_FIL_MEM, its value will not be changed until the after start is left to STATE 0.

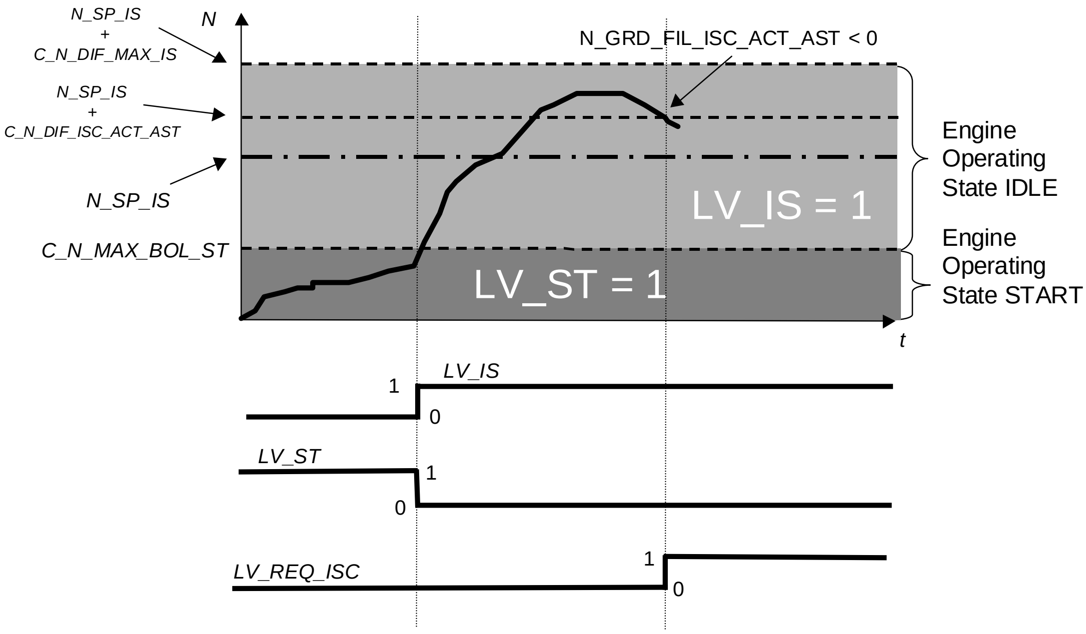

Figure 8.3.2: : ISC activation after start

8.3.4 Checking ISC activation conditions for "normal activation", STATE NORMAL)

The idle speed controller is activated on principle in case of LV_IS = 1 (except STATE 1 is active).

UNSUPPORTED IMAGE FORMAT

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Figure 3: *Activation of the ISC in case of LV_IS = 1*

Formular section:

Transition:see figure 1

Action:

IF(LV_AT = 1)
THEN IF (LV_DT = 0)
THEN LV_REQ_ISC = 1
ELSEIF (N_GB $<$ N - C_N_GB_DIF_N **OR** N_GRD $<$ IP_N_GRD_N_SP_IS_RATIO **OR** N_DIF_COR $>$0)
THEN LV_REQ_ISC = 1

ELSE LV_REQ_ISC = 1;

8.3.5 ISC activation in case of low engine speed decrease in trailing throttle state (LV_PU = 1, STATE TRAILING_THR)

If speed decrease in trailing throttle state is very low or speed does not decrease, the idle speed controller is activated after a calibratible time *C_T_DLY_ISC_ACT_PU*. The condition for that is a standing vehicle (VS=0). The counter is started when entering PU (LV_PU_{k-1} = 0 LV_PU_k = 1). The counter is reinitialized with C_T_DLY_ISC_ACT_PU when leaving PU. See figure 4.

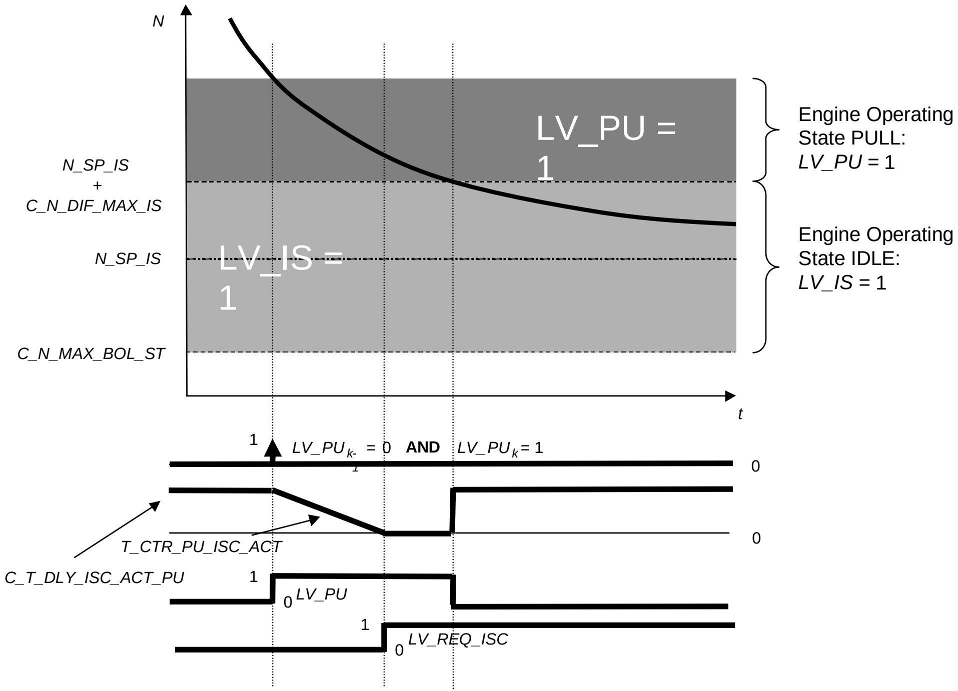

Figure 8.3.3: : Activation of the ISC in PU in case the speed decrease is too low and ***the vehicle does not move (VS = 0)***. *The counter starts from a tunable value C_T_DLY_ISC_ACT_PU and stops at zero.*

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Formular section:

Transition: see figure 1

Action: start toramp down *T_CTR_PU_ISC_ACT* when entering PU
(the initialization of *T_CTR_PU_ISC_ACT* was already done before)

IF **{** VS == 0 **OR** LV_DT == 0 **}** **AND** **{** T_CTR_PU_ISC_ACT == 0 **}**
THEN
LV_REQ_ISC = 1
ELSE
LV_REQ_ISC = 0
ENDIF

Reinitialize *T_CTR_PU_ISC_ACT* with C_T_DLY_ISC_ACT_PU when leaving state TRAILING_THR

8.3.6 Conditions for ISC part load activation (STATE PART_LOAD)

In part load, the driver or cruise control torque request can be so small, that the idle speed setpoint N_SP_IS cannot be held and speed is decreasing. In this case, the idle speed controller is used to guaranty N N_SP_IS. The conditions for activating the ISC in this case depend on the speed and a calibratible hysteresis, figure 5.

UNSUPPORTED IMAGE FORMAT

Figure 5: Activating the ISC in part load

Formula section:

Transition: see figure 1

Action: LV_REQ_ISC = 1

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8.3.7 Checking ISC inhibit interfaces

During AMT shift intervention Phase 1 (LV_AMT_CRAWL_ON = 1) an additional Converter torque is calculated; during this time the ISC is looked State "PASSIVE".

All inhibit interfaces lead to CONDITION_OFF which is used in the state diagram (figure 1).

IF LV_AMT_CRAWL_ON = 1
THEN CONDITION_OFF = 1
ELSE CONDITION_OFF = 0
ENDIF

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8.4 Idle speed adaptation

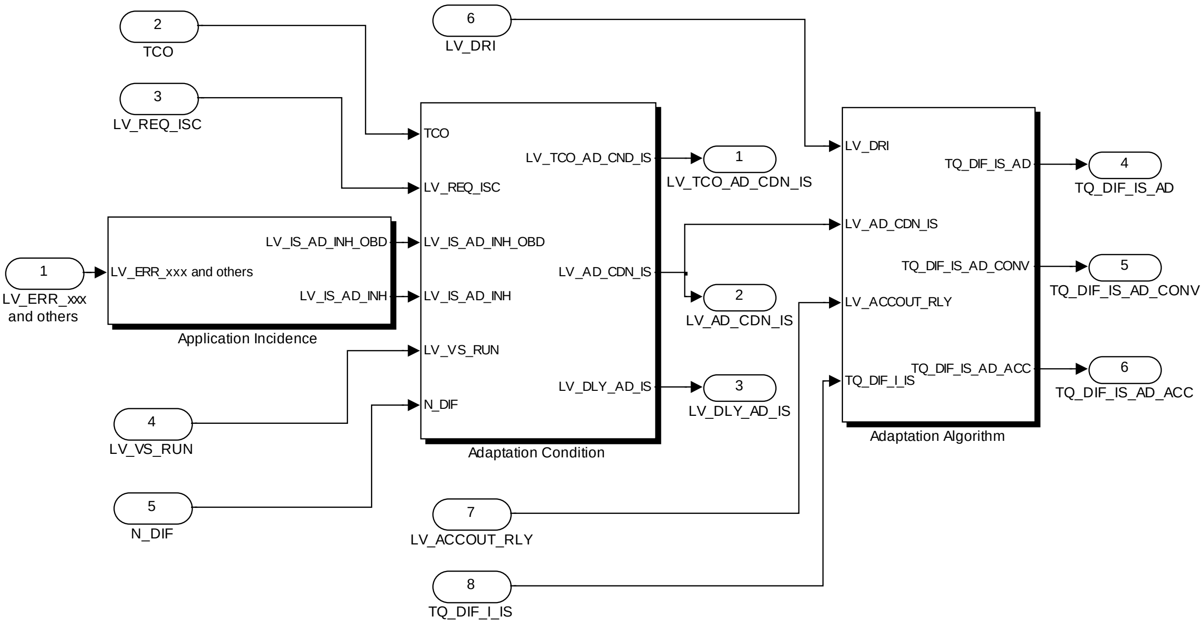

Figure 8.4.1: : Idle Speed Adaptation, Overview

Functional Description:

The present adaptation is introduced to compensate spread and series variation of engine, air conditioning compressor and hydraulic converter torque losses. It is calculated during idle speed, using the integral part of the idle speed controller for the adaptation of three different parameters:

TQ_DIF_IS_AD is the adaptation of the basic engine torque losses, without taking the drivetrain into account (disengaged gear),
TQ_DIF_IS_AD_CONV is an adaptation of the hydraulic converter torque request at idle speed (for automatic transmission only),
TQ_DIF_IS_AD_ACC is an adaptation value which consideres two adaptation cases depending on the actual situation:

air conditioning compressor and converter active at the same time
only air conditioning compressor active

The function consists of the following blocks:

Application Incidence: Checks whether a relevant error has occurred.
Adaptation Condition: Checks whether the adaptation conditions are fulfilled.

- Adaptation Algorithm: Calculation of the specific adaptation parameters.

These parameters are integrated directly in the specific functions, i.e. the adaptation of the converter torque TQ_DIF_IS_AD_CONV is used in the function "Converter torque" ...

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Adaptation parameters for new torque consuming components should be integrated in the same way into the adaptation algorithm module.

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8.5 TQM - Idle speed adaptation (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_IS_AD_INH	O/V	0... 1H	0 ...1	1	-
Application incidence value (additional adaptation inhibitation conditions, project specific)					
LV_IS_AD_INH_OBD	O/V	0... 1H	0 ...1	1	-
Application incidence value					

Input data:

ANG_PSTE {p. 1561}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_BN_VS_TCS {p. 4871}
LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_EL_CPS {p. 4708}	LV_ERR_IGC {p. 4772}
LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_TPS_PLAUS {p. 1062}	LV_ERR_PVS_DOUBLE {p. 4216}
LV_ERR_TCO {p. 4496}	LV_ERR_TOUT_ASR_1 {p. 802}	LV_ERR_TPS {p. 4982}	LV_ERR_VS {p. 5021}
LV_MIS_STATE_A {p. 6238}	LV_MTC_CUR_OFF {p. 6565}	LV_ST_END {p. 1720}	LV_TQ_ADD_PSTE_IS_AD_INH {p. 6621}
LV_TQ_DROF_IS_AD_INH {p. 1112}	LV_TQ_LOSS_ARS_IS_AD_INH {p. 6650}	LV_TQ_LOSS_PSTE_IS_AD_INH {p. 6621}	LV_VAR_TCT {p. 656}
STATE_ERR_IV {p. 4803}	TCO {p. 1100}	TQ_TCT_CAN {p. 1582}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ANG_PSTE_MAX_IS_AD	V	8000... 7FFFH	-1439.98976 ...1439.945815	0.043945	°STW
Max steering angle threshold to inhibit idle speed adaptation					
C_TQ_TCT_CAN_MAX_IS_AD	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum torque at clutch for TCT for idle speed adaptation					
IP_T_AST_IS_AD_INH	V	0... FFFFH	0... 6553.5	0.1	s
LDP_TCO_IP_T_AST_IS_AD_INH	4	0... FEH	-48... 142.5	0.75	°C
Time after start during which idle speed adaptation is disabled					

General information

The idle speed adaptation is inhibited if on of the errors described in the formula section occur. Additionally it is possible to inihibit the idle speed adaptation for a certain time after start dependent on the start temperature.

Description:
If one of these error bits is set, LV_IS_AD_INH_OBD = 1 and LV_IS_AD_INH = 1.
Adaptation is not allowed see application conditions.

Application conditions:

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Initialisation: all 0 at LV_IGK 0 > 1 and reset

Activation: at every engine state

Deactivation: –

Recurrence: 100 ms

Function description:

Formula section:

```
If      LV_ST_END = 0→1
Then    T_AST_IS_AD_INH = IP_T_AST_IS_AD_INH     / *LV_ST_END setting initiates
                                                   timer*/
Else    T_AST_IS_AD_INH - -                       / *timer is decremented*/
Endif
```

```
If         abs(ANG_PSTE) > C_ANG_PSTE_MAX_IS_AD            or
           (LV_VAR_TCT = 1 and  TQ_TCT_CAN > C_TQ_TCT_CAN_MAX_IS_AD)  or
           T_AST_IS_AD_INH > 0                        or
           LV_ERR_MAF = 1                             or
           LV_ERR_PVS_DOUBLE = 1                      or
           STATE_ERR_IV <>                            or
           LV_ERR_IGC                                 or
           LV_ERR_LOAD_TPS_PLAUS = 1                  or
           LV_ERR_TPS = 1                             or
           LV_ERR_EL_CPS = 1                          or
           LV_ERR_DIAGCPS = 1                         or
           LV_MIS_STATE_A = 1                         or
           LV_ERR_TCO = 1                             or
           LV_ERR_AMP = 1                             or
           LV_ERR_AMP_PLAUS = 1                       or
           LV_MTC_CUR_OFF = 1                         or
           LV_TQ_LOSS_PSTE_IS_AD_INH = 1              or
           LV_TQ_ADD_PSTE_IS_AD_INH = 1               or
           LV_TQ_LOSS_ARS_IS_AD_INH = 1               or
           LV_TQ_DROF_IS_AD_INH = 1                   or
           LV_ERR_VS = 1                              or
           LV_ERR_MAP_TPS_PLAUS                       or
Then       LV_IS_AD_INH = 1
           LV_IS_AD_INH_OBD = 1
Else       LV_IS_AD_INH = 0
           LV_IS_AD_INH_OBD = 0
Endif
```

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8.6 TQM - Idle speed adaptation conditions

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_AD_CDN_IS	O/V	0... 1H	0 ...1	1	-
Adaptation condition					
LV_DLY_AD_IS	O/V	0... 1H	0 ...1	1	-
Logical bit "Idle speed has settled for a given time delay"					
LV_TCO_AD_CDN_IS	O/V	0... 1H	0 ...1	1	-
Logical bit "Coolant temperature in operating range"					

Input data:

LV_IS_AD_INH {p. 3512}	LV_IS_AD_INH_OBD {p. 3512}	LV_REQ_ISC {p. 3501}	LV_VS_RUN {p. 1176}
N_DIF {p. 1122}	TCO {p. 1100}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DLY_AD_IS	-	0... FFH	0... 25.5	0.1	s
time delay for ISC adaptation					
C_N_DELTA	-	0... 1FE0H	0... 8160	1	rpm
engine speed threshold for ISC adaptation					
C_TCO_AD_MAX_IS	-	0... FEH	0... 142.5	0.75	°C
temperature top limit for ISC adaptation					
C_TCO_AD_MIN_IS	-	0... FEH	0... 142.5	0.75	°C
temperature bottom limit for ISC adaptation					

8.6.1 Activation conditions for the Idle Speed Adaptation

The adaptation process is released when all of the following conditions are fulfilled (LV_AD_CDN_IS = 1):

engine running in idle state (LV_REQ_ISC = 1)
idle speed has settled for a given time delay (T_DLY_AD_IS is the timer value):

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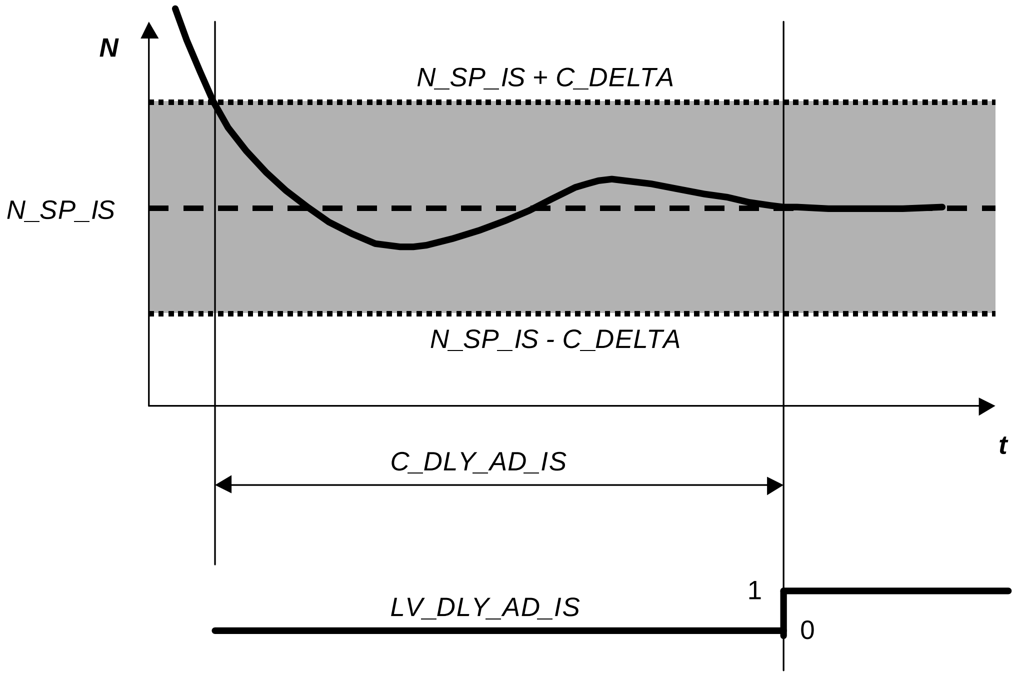
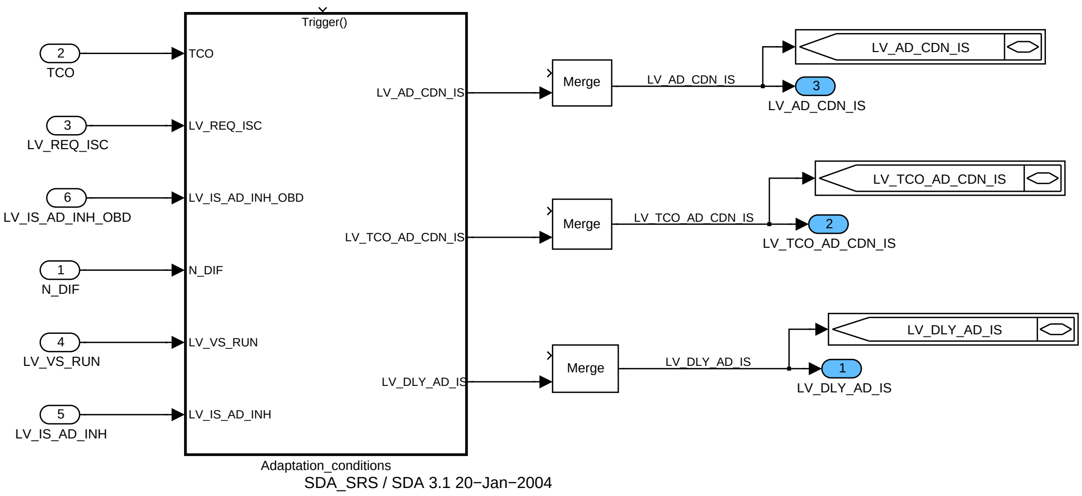


Delay timer for idle speed adaptation activation

vehicle stopped (LV_VS_RUN = 0)
coolant temperature in operating range:
LV_IS_AD_INH_OBD = 0 (see module "Application Incidence")
LV_IS_AD_INH = 0 (see module "Application Incidence")

Function Description



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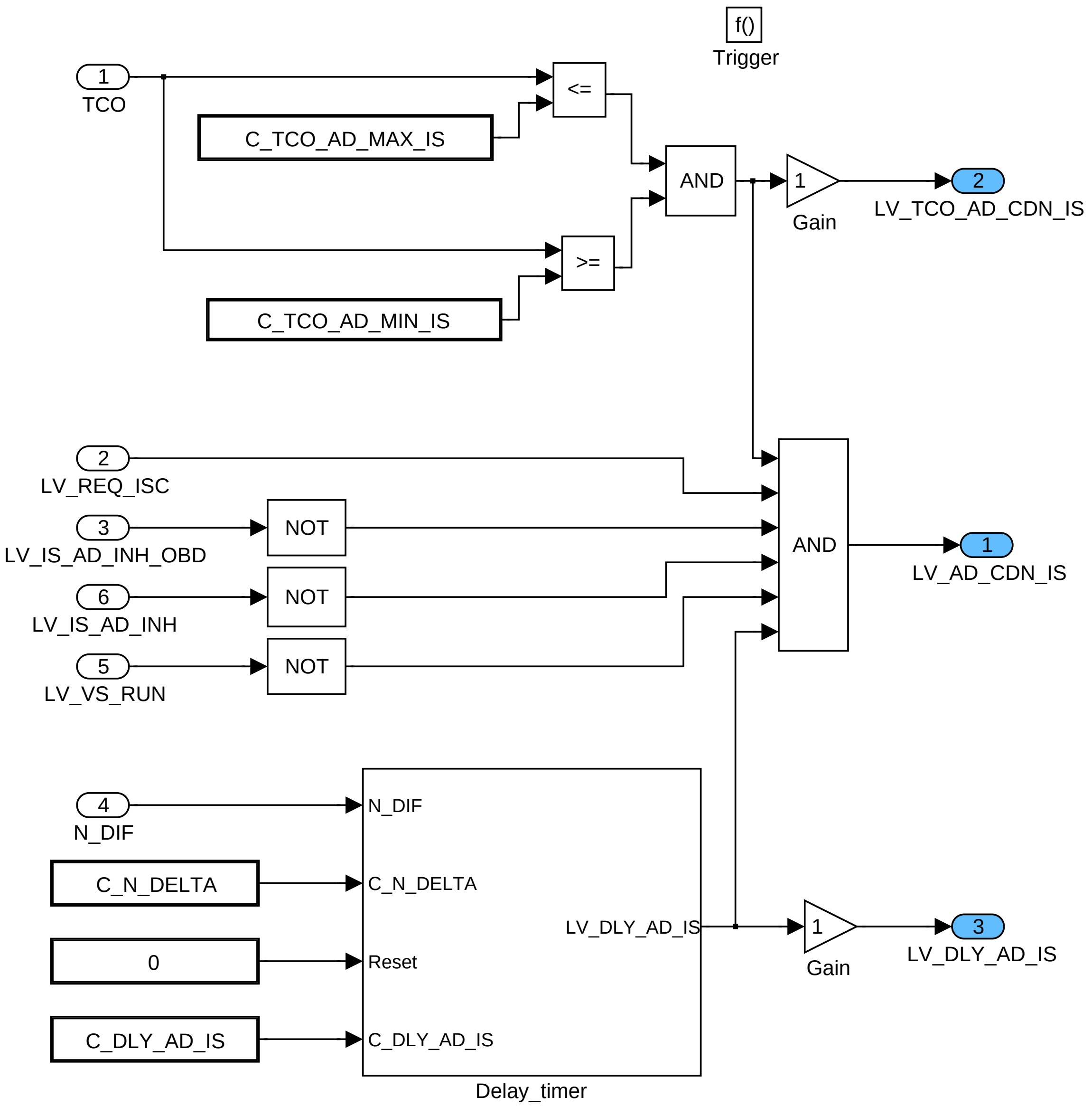
M800M

8.6.1.1 SUBFUNCTION: ADAPTATION_CONDITIONS



M800M/Adaptation_conditions

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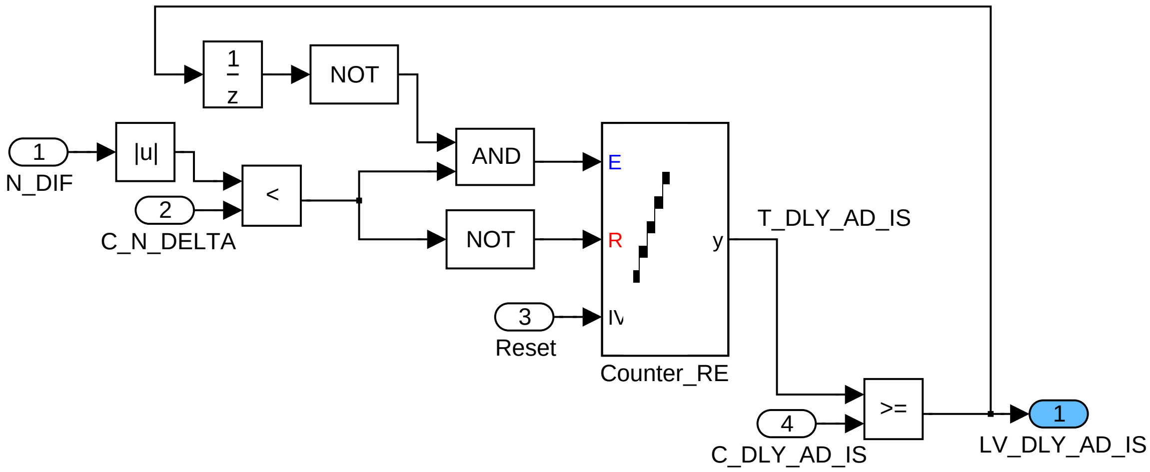

M800M/Adaptation_conditions/Delay_timer

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8.7 TQM - Idle speed adaptation algorithm

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_DIF_IS_AD	V	0... FFFFH	0... 0.99998474121	15.2588e-6	-
ISC adaptation factor					
LV_AT_NEUT_CTL	V	0... 1H	0 ...1	1	-
Logical variable for neutral control active/passive (drive engaged)					
LV_OPM_SEL_TQ_IS_AD_1	V	0... 1H	0 ...1	1	-
Last operation mode calculation active					
LV_OPM_SEL_TQ_IS_AD_2	V	0... 1H	0 ...1	1	-
Requested value active					
TQ_DIF_IS_AD	O/V/S	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Basic ISC adaptation					
TQ_DIF_IS_AD_ACC	O/V/S	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Low-pass filtered ACC torque adaptation or ACC and Hydraulic converter torque adaptation					
TQ_DIF_IS_AD_ACC_1	O/V/S	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
ACC torque adaptation					
TQ_DIF_IS_AD_ACC_1_INTER	V	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC torque adaptation, intermediate value with high resolution (long signed word)					
TQ_DIF_IS_AD_ACC_1_OPM_1	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC torque adaptation, intermediate value with high resolution (long signed word) OPM1					
TQ_DIF_IS_AD_ACC_1_OPM_2	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC torque adaptation, intermediate value with high resolution (long signed word) OPM2					
TQ_DIF_IS_AD_ACC_CONV	O/V/S	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
ACC and Hydraulic converter torque adaptation					
TQ_DIF_IS_AD_ACC_CONV_INTER	V	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC and Hydraulic converter torque adaptation, intermediate value with high resolution (long signed word)					
TQ_DIF_IS_AD_ACC_CONV_OPM_1	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC and Hydraulic converter torque adaptation, intermediate value with high resolution (long signed word) OPM1					
TQ_DIF_IS_AD_ACC_CONV_OPM_2	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC and Hydraulic converter torque adaptation, intermediate value with high resolution (long signed word) OPM2					
TQ_DIF_IS_AD_ACC_NEUT	O/V/S	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
ACC and Hydraulic converter torque adaptation with neutral control active					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_DIF_IS_AD_ACC_NEUT_INTER	V	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC torque adaptation with neutral control active and drive engaged, intermediate value with high resolution (long signed word)					
TQ_DIF_IS_AD_ACC_NEUT_OPM_1	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC and Hydraulic converter torque adaptation with neutral control active, intermediate value with high resolution (long signed word) OPM1					
TQ_DIF_IS_AD_ACC_NEUT_OPM_2	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
ACC and Hydraulic converter torque adaptation with neutral control active, intermediate value with high resolution (long signed word) OPM2					
TQ_DIF_IS_AD_CONV	O/V/S	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Hydraulic converter adaptation torque					
TQ_DIF_IS_AD_CONV_1	O/V/S	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Hydraulic converter adaptation torque with neutral control passive					
TQ_DIF_IS_AD_CONV_1_INTER	V	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Adaptation torque for hydraulic converter, intermediate value with high resolution (long signed word)					
TQ_DIF_IS_AD_CONV_1_OPM_1	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Hydraulic converter adaptation torque with neutral control passive, intermediate value with high resolution (long signed word) OPM1					
TQ_DIF_IS_AD_CONV_1_OPM_2	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Hydraulic converter adaptation torque with neutral control passive, intermediate value with high resolution (long signed word) OPM2					
TQ_DIF_IS_AD_CONV_NEUT	O/V/S	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Hydraulic converter adaptation torque with neutral control active					
TQ_DIF_IS_AD_CONV_NEUT_INTER	V	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Hydraulic converter adaptation torque with neutral control active, intermediate value with high resolution (long signed word)					
TQ_DIF_IS_AD_CONV_NEUT_OPM_1	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Hydraulic converter adaptation torque with neutral control active, intermediate value with high resolution (long signed word) OPM1					
TQ_DIF_IS_AD_CONV_NEUT_OPM_2	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Hydraulic converter adaptation torque with neutral control active, intermediate value with high resolution (long signed word) OPM2					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_DIF_IS_AD_INTER	V	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Basic ISC adaptation, intermediate value with high resolution (long signed word)					
TQ_DIF_IS_AD_OPM_1	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Basic ISC adaptation, intermediate value with high resolution (long signed word) OPM1					
TQ_DIF_IS_AD_OPM_2	O/V/S	80000000... 7FFFFFFFH	-1024... 1023.99999952	476.837e-9	Nm
Basic ISC adaptation, intermediate value with high resolution (long signed word) OPM2					

Input data:

FAC_TQ_LOSS_OPM_SEL {p. 8385}	LC_AD_CLR {p. 526}	LV_ACCOUT_RLY {p. 3589}	LV_AD_CDN_IS {p. 3514}
LV_DRI {p. 1302}	LV_TQ_LOSS_AD_CLR_EXT_ADJ {p. 7483}	N_32 {p. 1525}	OPM_AV {p. 8137}
OPM_REQ {p. 8137}	STATE_MOD_GB {p. 1575}	TQ_DIF_I_IS {p. 3441}	TQ_REQ_CLU {p. 8390}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_TQ_DIF_IS_AD_ACC	-	0... FFH	0... 0.99609375	3.90625e-3	-
Filter constant for LOW_PASS_1 (smoothing of the ACC-adaptation values)					
C_CRLC_TQ_DIF_IS_AD_CONV	-	0... FFH	0... 0.99609375	3.90625e-3	-
Filter constant for smoothing of the converter torque adaptation values					
C_TQ_DIF_IS_AD_ACC_CONV_MAX	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Max. limitation of air conditioning compressor and converter torque adaptation					
C_TQ_DIF_IS_AD_ACC_CONV_MIN	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min. limitation of air conditioning compressor and converter torque adaptation					
C_TQ_DIF_IS_AD_ACC_MAX	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Max. limitation for ACC torque adaptation					
C_TQ_DIF_IS_AD_ACC_MIN	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min. limitation for ACC adaptation					
C_TQ_DIF_IS_AD_CONV_MAX	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Max. limitation for converter torque adaptation					
C_TQ_DIF_IS_AD_CONV_MIN	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min. limitation of converter torque adaptation					
C_TQ_DIF_IS_AD_MAX	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Max. limitation of engine torque losses adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQ_DIF_IS_AD_MIN	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min. limitation of engine torque losses adaptation					
ID_TQ_DIF_IS_AD_OPM_AV	-	1... 8H	1 ...8	1	-
LDP_OPM_AV_TQLO	8	0... 8H	0 ...8	1	-
Table of index OPM_AV					
ID_TQ_DIF_IS_AD_OPM_REQ	-	1... 8H	1 ...8	1	-
LDP_OPM_AV_TQLO	8	0... 8H	0 ...8	1	-
Table of index OPM_REQ					
IP_FAC_TQ_DIF_IS_AD	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
LDP_TQ_DIF_I_IS_FAC_TQ_IS_AD	4	0... 7FFFH	0... 1023.96875	0.03125	Nm
ISC adaptation factor depend on absolut value of TQ_DIF_IS_I					
IP_FAC_TQ_DIF_IS_AD_N_32	-	0... FFH	0 ...1	3.92157e-3	-
LDP_N_32_IP_FAC_TQ_DIF_IS_AD	4	0... FFH	0... 8160	32	rpm
Factor considered for the calculation adapted torque losses					
IP_FAC_TQ_DIF_IS_AD_OPM_MV	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDP_N_32_FAC_TQ_DIF_IS_AD	6	0... FFH	0... 8160	32	rpm
LDP_TQ_REQ_CLU_FAC_TQ_DIF_IS_AD	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Factor for fading between TQ_DIF_IS_AD_INTER and the mean value of the adaptation values TQ_DIF_IS_AD_OPM_1/_2 in dependency of engine speed/load					

Action definition:

ACTION_TQLO_OPM_M800N(IN <IN1>, **IN** <IN2>, **OUT** <OUT>, **OUT** <LV_OPM_SEL_TQ_IS_AD_1>, **OUT** <LV_OPM_SEL_TQ_IS_AD_2>)					Mode: O
OPM with I/O resolution 4.768E-7 and phys limits -1024...1023.9999[Nm]					
Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
IN1	IN	80000000... 7FFFFFFFH	-1024 ...1024	476.837e-9	Nm
Basic ISC adaptation, intermediate value with high resolution (long signed word)					
IN2	IN	80000000... 7FFFFFFFH	-1024 ...1024	476.837e-9	Nm
Basic ISC adaptation, intermediate value with high resolution (long signed word)					
OUT	OUT	80000000... 7FFFFFFFH	-1024 ...1024	476.837e-9	Nm
Basic ISC adaptation, intermediate value with high resolution (long signed word)					
LV_OPM_SEL_TQ_IS_AD_1	OUT	0... 1H	0... 1	1	-
Last operation mode calculation active					
LV_OPM_SEL_TQ_IS_AD_2	OUT	0... 1H	0... 1	1	-
Requested value active					

General information:

Application conditions:

Initialization:
E2PROM Variables
At first initialization, after a checksum failure or at service tester request LV_TQ_LOSS_AD_CLR_EXT_ADJ or LC_AD_CLR 0 ->1 , all parameters are set to zero:
TQ_DIF_IS_AD = 0 Nm,

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TQ_DIF_IS_AD_CONV_NEUT = 0 Nm,
TQ_DIF_IS_AD_CONV = 0 Nm,
TQ_DIF_IS_AD_CONV_1 = 0 Nm,
TQ_DIF_IS_AD_ACC_NEUT = 0 Nm,
TQ_DIF_IS_AD_ACC_CONV = 0 Nm,
TQ_DIF_IS_AD_ACC = 0 Nm,
TQ_DIF_IS_AD_ACC_1 = 0 Nm,

TQ_DIF_IS_AD_OPM_1 = 0 Nm,
TQ_DIF_IS_AD_OPM_2 = 0 Nm,
TQ_DIF_IS_AD_ACC_1_OPM_1 = 0 Nm,
TQ_DIF_IS_AD_ACC_1_OPM_2 = 0 Nm,
TQ_DIF_IS_AD_ACC_CONV_OPM_1 = 0 Nm,
TQ_DIF_IS_AD_ACC_CONV_OPM_2 = 0 Nm,
TQ_DIF_IS_AD_CONV_1_OPM_1 = 0 Nm,
TQ_DIF_IS_AD_CONV_1_OPM_2 = 0 Nm,
TQ_DIF_IS_AD_ACC_NEUT_OPM_1 = 0 Nm,
TQ_DIF_IS_AD_ACC_NEUT_OPM_2 = 0 Nm,
TQ_DIF_IS_AD_CONV_NEUT_OPM_1 = 0 Nm,
TQ_DIF_IS_AD_CONV_NEUT_OPM_2 = 0 Nm

Variables initialized after reset and after the E2PROM has been read

TQ_DIF_IS_AD_ACC_1_INTER = TQ_DIF_IS_AD_ACC_1,
TQ_DIF_IS_AD_ACC_NEUT_INTER = TQ_DIF_IS_AD_ACC_NEUT,
TQ_DIF_IS_AD_ACC_CONV_INTER = TQ_DIF_IS_AD_ACC_CONV,
TQ_DIF_IS_AD_CONV_NEUT_INTER = TQ_DIF_IS_AD_CONV_NEUT,
TQ_DIF_IS_AD_CONV_1_INTER = TQ_DIF_IS_AD_CONV_1,
LV_AT_NEUT_CTL = 0 [-]

Activation:
always

Deactivation:
-

Update rate:
100 ms

FUNCTION DESCRIPTION:
The complete function is calculated every 100ms independent of the status of the adaptation condition. If the adaptation conditions are fulfilled (LV_AD_CDN_IS = 1), the corresponding adaptation value is fed by the I-gain of the idle speed controller value TQ_DIF_I_IS :

The adaptation of ACC and CONV (TQ_DIF_IS_AD_ACC_CONV) is calculated if the gear is engaged (LV_DRI = 1) and the air conditioning compressor is switched on (LV_ACCOUT_RLY = 1).
The adaptation of ACC and CONV with neutral control active (TQ_DIF_IS_AD_ACC_NEUT) is calculated if the gear is engaged (LV_DRI = 1), neutral control active (LV_AT_NEUT_CTL = 1) and the air conditioning compressor is switched on (LV_ACCOUT_RLY = 1).

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If LV_ACCOUT_RLY = 1 and LV_DRI = 0, the adaptation of the air conditioning compressor is calculated (TQ_DIF_IS_AD_ACC_1).
The Hydraulic converter torque adaptation with neutral control passive (TQ_DIF_IS_AD_CONV_1) is calculated if LV_DRI = 1, LV_AT_NEUT_CTL = 0 and LV_ACCOUT_RLY =0.
The Hydraulic converter torque adaptation with neutral control active (TQ_DIF_IS_AD_CONV_NEUT) is calculated if LV_DRI = 1, LV_AT_NEUT_CTL = 1 and LV_ACCOUT_RLY =0.
The basic adaptation of the idle speed controller (TQ_DIF_IS_AD) is calculated if the gear is disengaged (LV_DRI = 0) and the air conditioning compressor is switched off (LV_ACCOUT_RLY = 0).

Therefore, a fraction of the integral part of the idle speed controller (FAC_TQ_DIF_IS_AD * TQ_DIF_I_IS) is added at each cycle to the concerned adaptation parameter, whose value is limited through a min/max limiter. The adaptation parameters are stored, even after deactivation of the function. These values are used as start values after re-entering into the same adaptation path.
The outputs of the different adaptation paths are always covered with values of the last adaptation, even if the adaptation conditions are not fulfilled or the engine is not in idle. But these values will only be adapted (changed) if the certain adaptation path is activated and they are certainly only considered in the single modules (Torque Loss and Lead for ACC , Converter Torque) in conformance with the actual situation (ACC on, drivetrain engaged). Only the basic torque losses (TQ_DIF_IS_AD) are always considered in the module Torque Losses .
TQ_DIF_IS_AD_CONV is considered in the converter torque calculation module, TQ_DIF_IS_AD_ACC in the calculation of the air conditioning compressor losses. TQ_DIF_IS_AD is added in the torque losses.

The integration is done with high resolution values (long signed word).
At the end of the integration the conversion from high resolution (signed long word) to normal resolution (signed word) is done. Only the high word is taken from the signed long word value.

Application conditions:

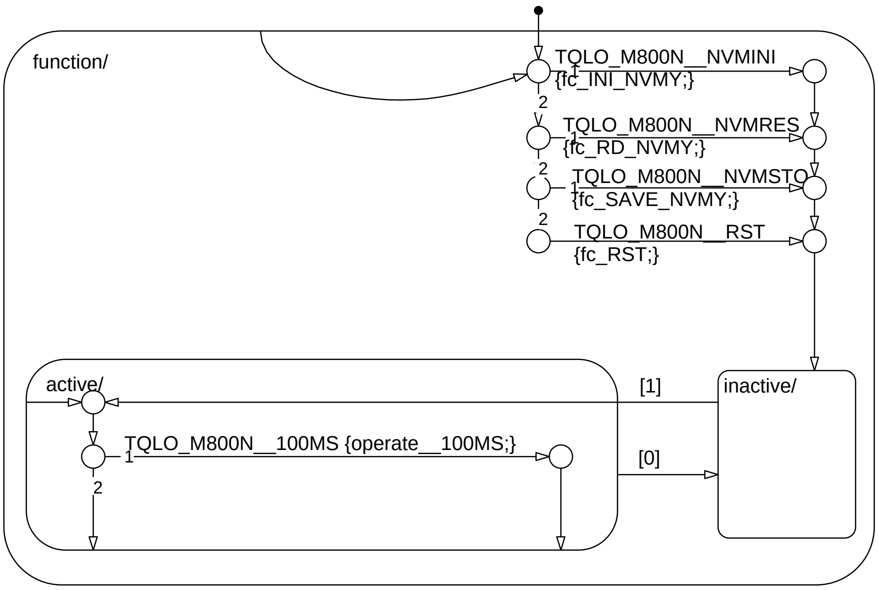

Figure 8.7.1: :

Function description:

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Formula section:

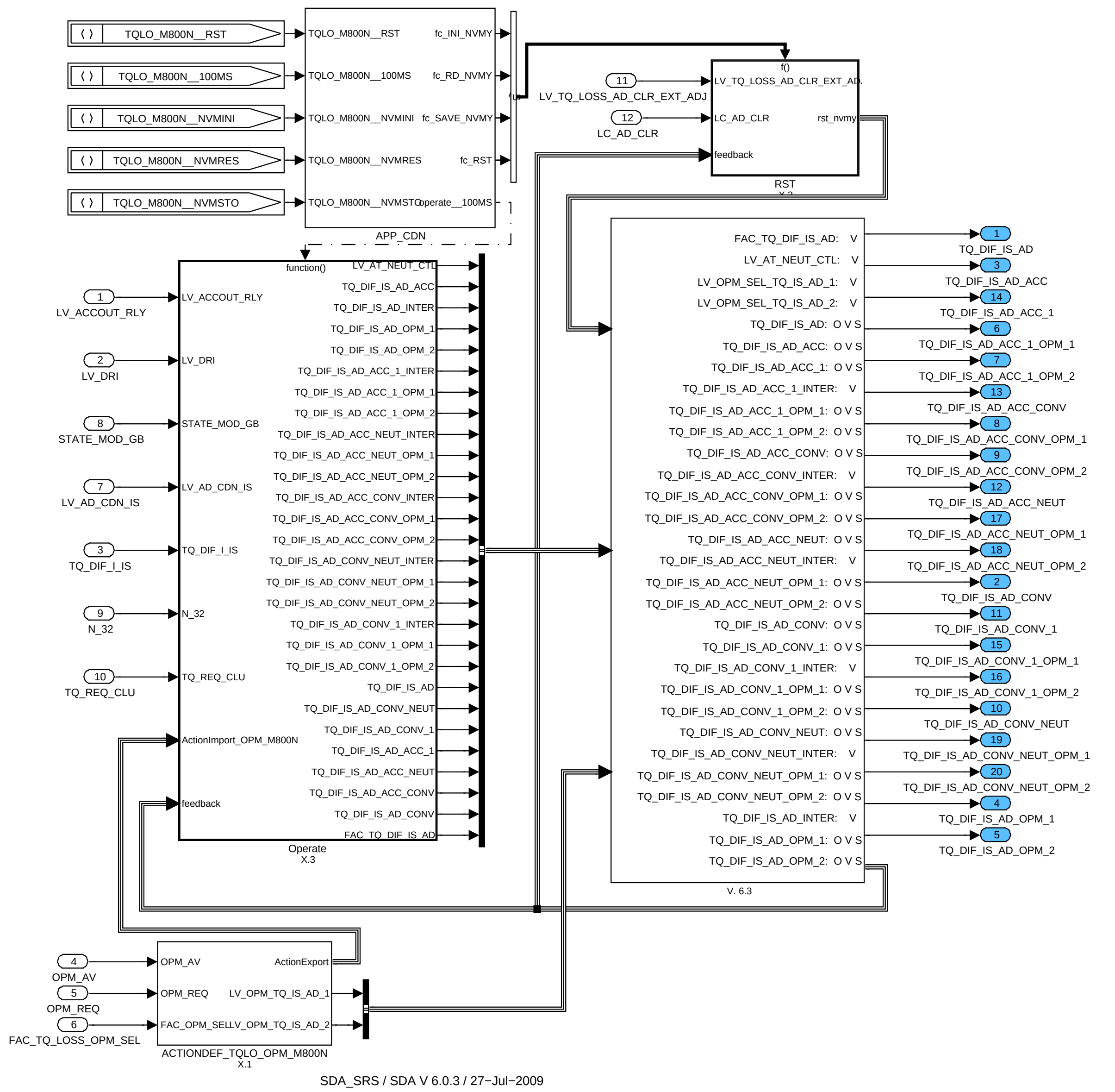

Figure 8.7.2: :

8.7.1 Detailed description for Action: ACTION_TQLO_OPM_M800N

The function controls the transition between the operating modes. As the operating mode changes the adaptation values change as well.

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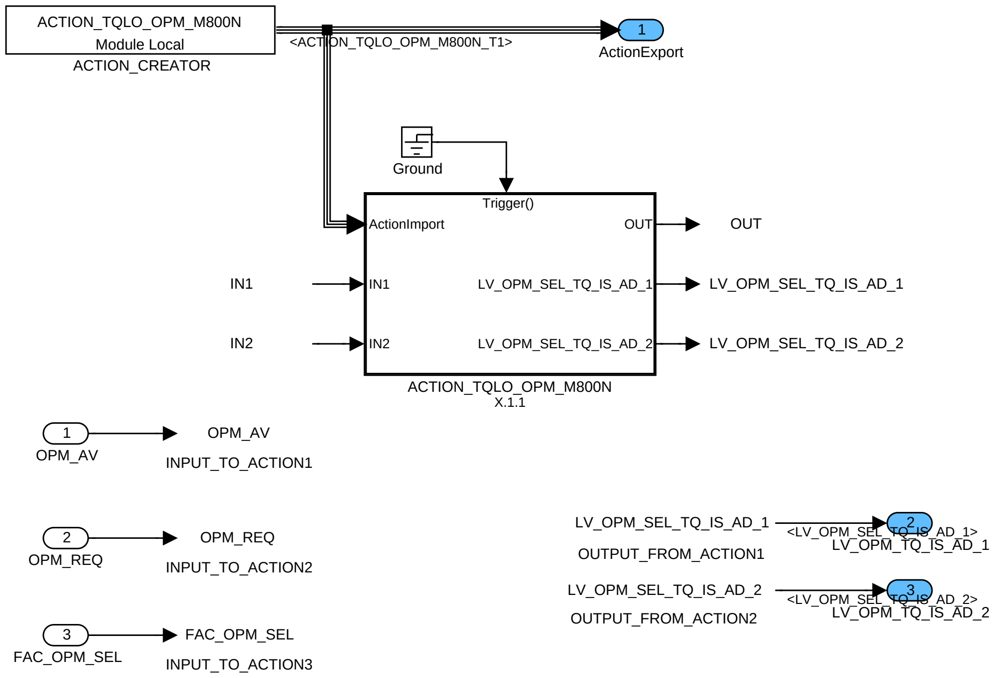

Figure 8.7.3: :

8.7.1.1 No title given

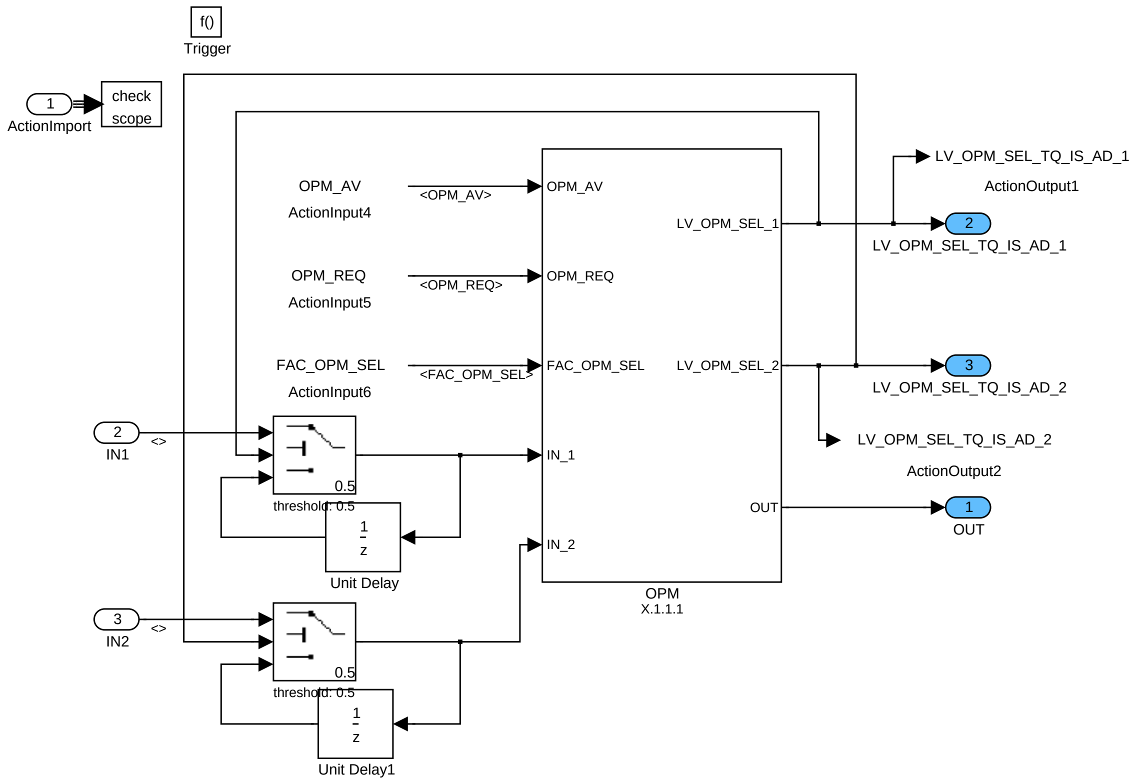

Figure 8.7.4: :

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8.7.1.1.1 No title given

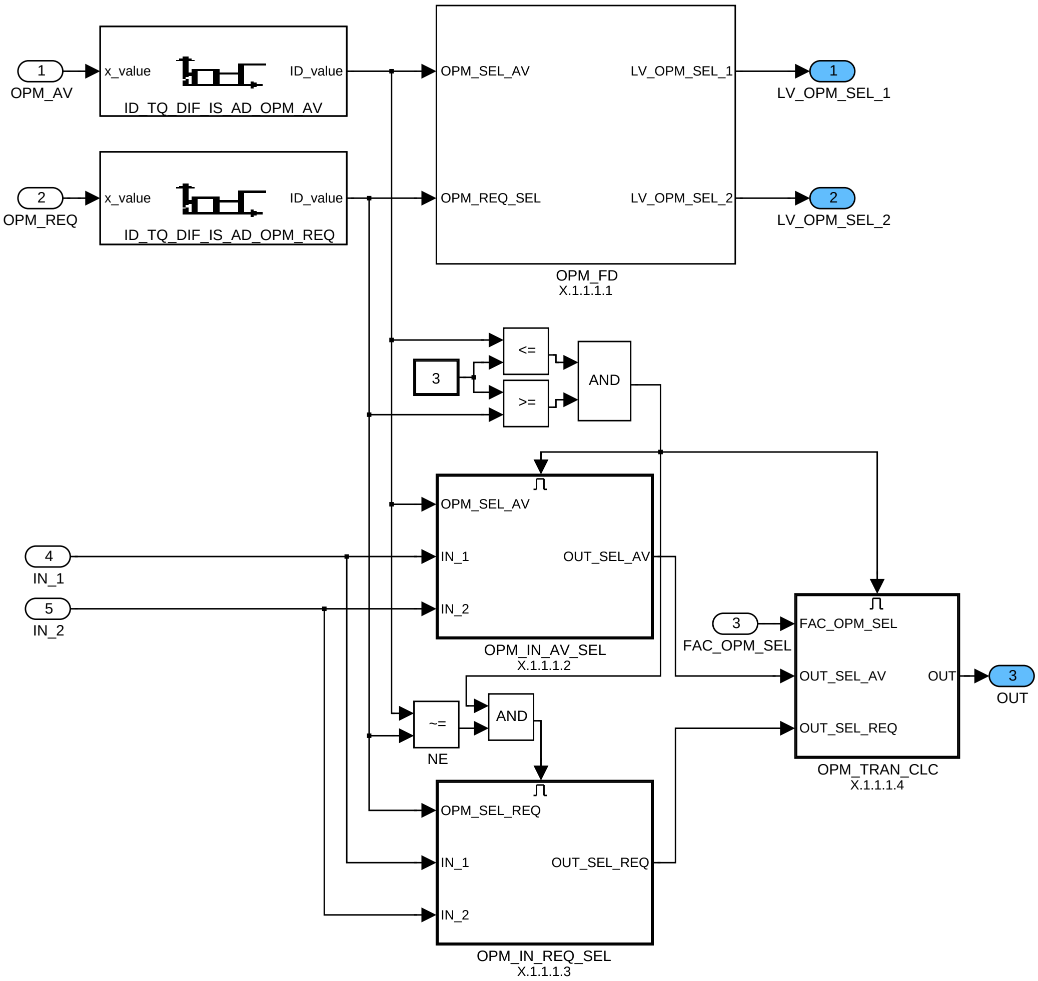

Figure 8.7.5: :

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8.7.1.1.1.1 No title given

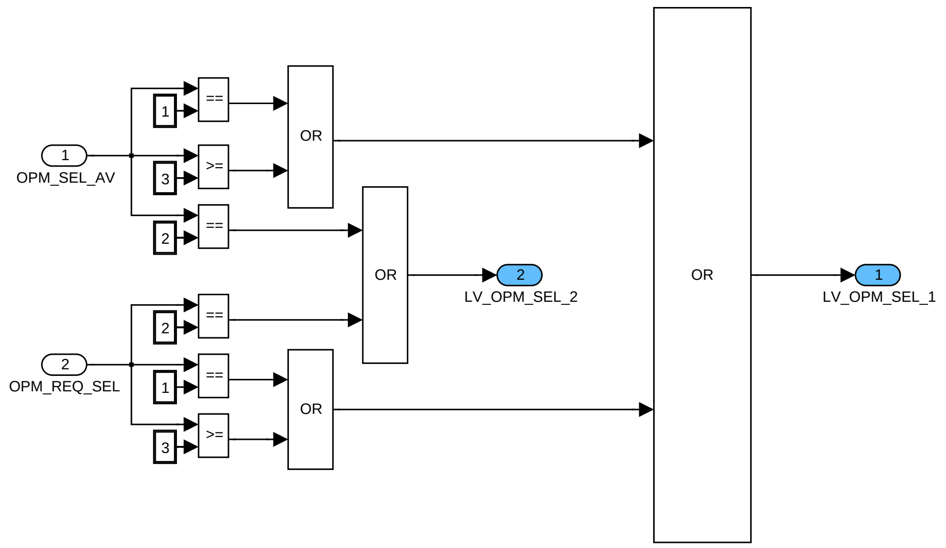

Figure 8.7.6: :

8.7.1.1.1.2 No title given

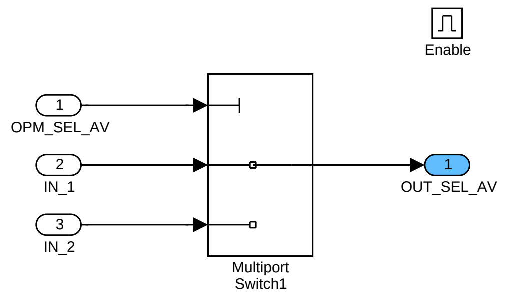

Figure 8.7.7: :

8.7.1.1.1.3 No title given

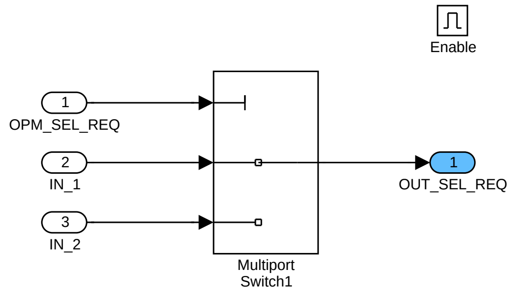

Figure 8.7.8: :

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8.7.1.1.1.4 No title given

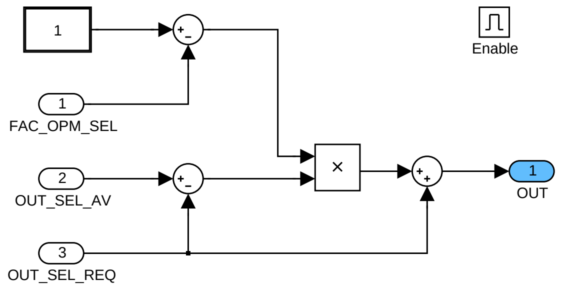

Figure 8.7.9: :

8.7.2 Overview Reset and NVMY handling

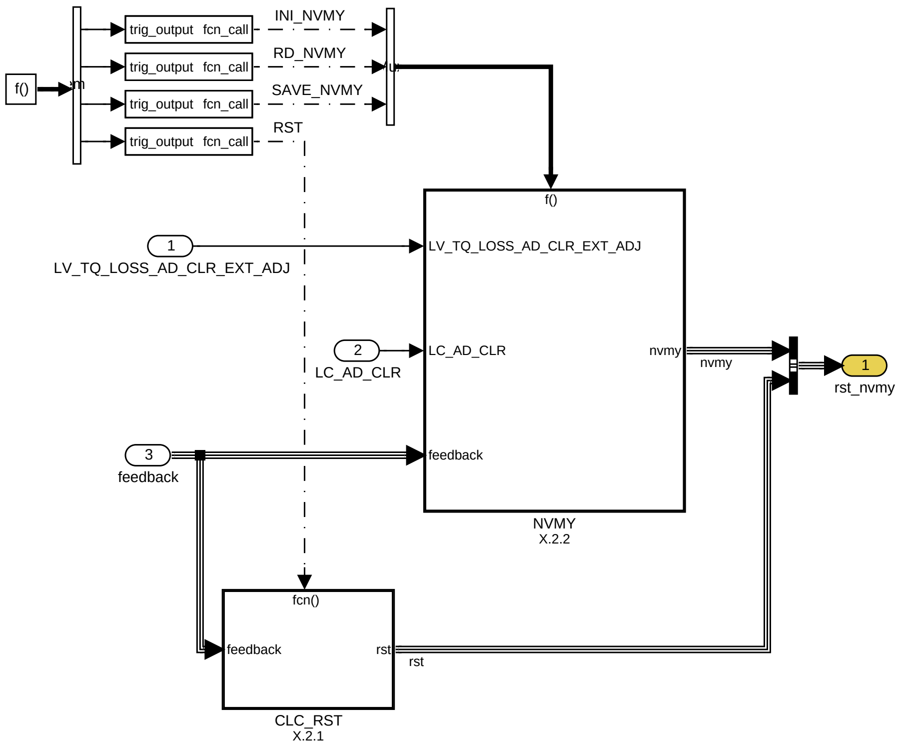

Figure 8.7.10: :

8.7.2.1 Initialization after ECU Reset

The following variables are initialized at ECU Reset. Note that this has to be performed after the E2PROB has been read!

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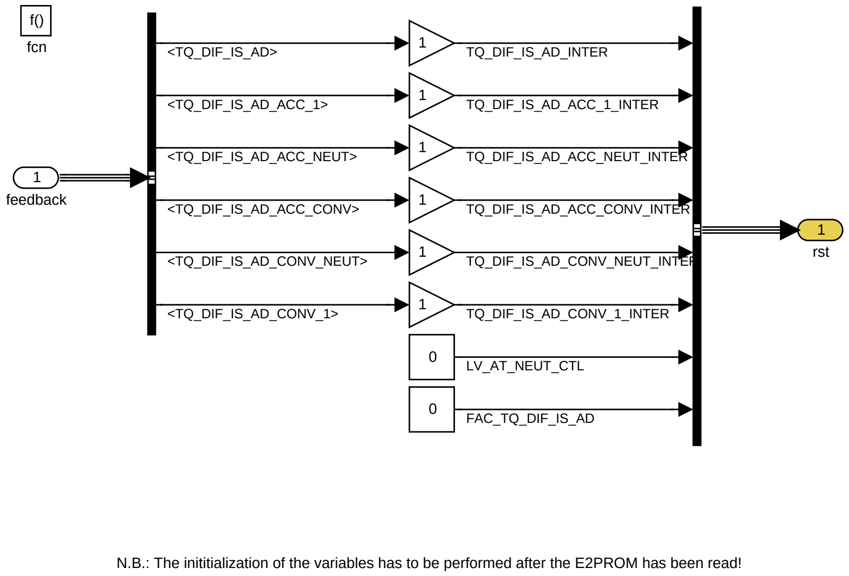

Figure 8.7.11: :

8.7.2.2 Overview of NVMY handling

Initialization, Saving and Reading adaptation values out of the E2PROM.

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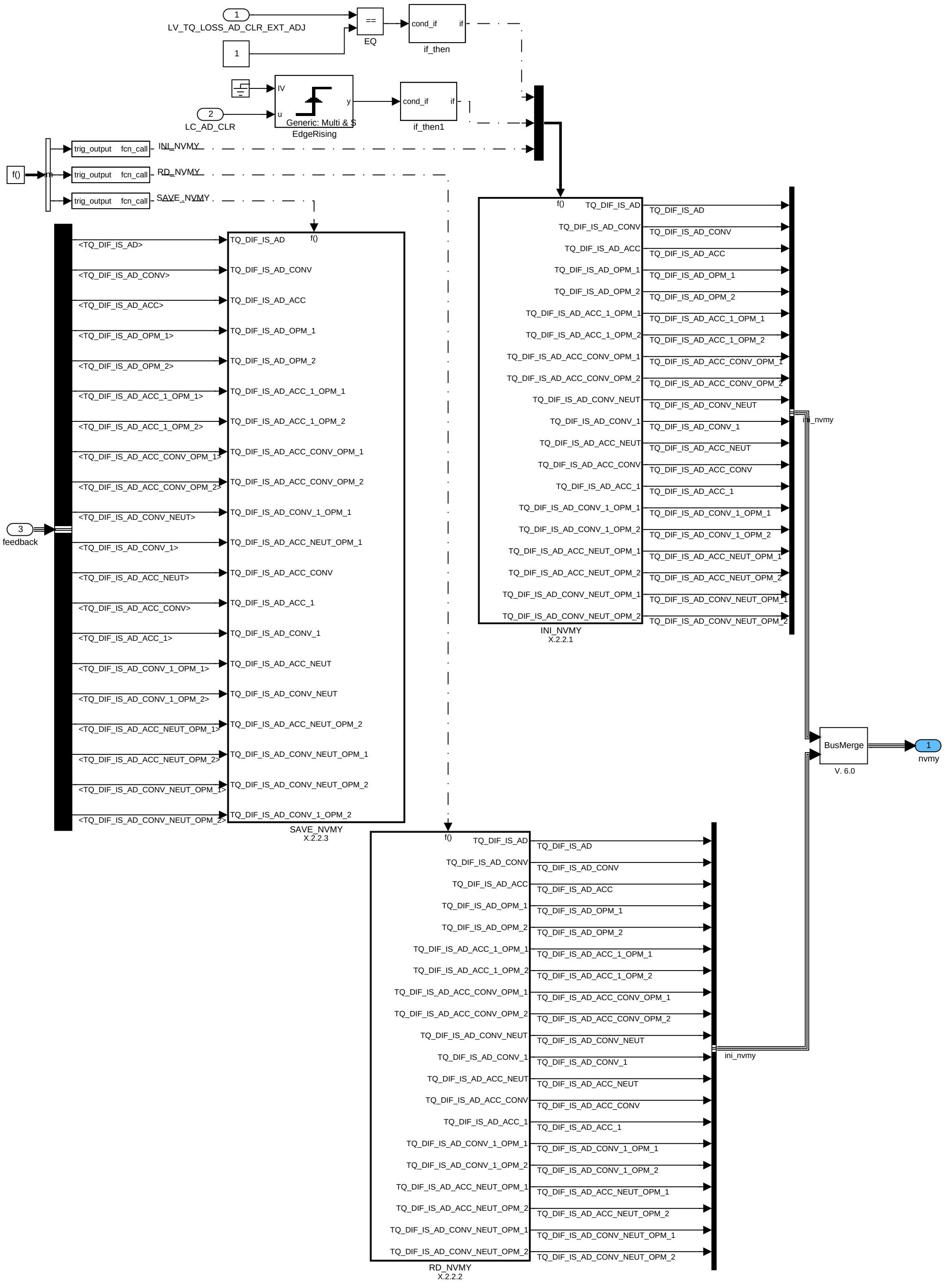

Figure 8.7.12: :

8.7.2.2.1 Initialization of NVMY data

Initialization of the NVMY data in the E2PROM in case of:

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- no adaptation values available
- checksum error in E2PROM sector
- cleared E2PROM sector by calibration system or service device

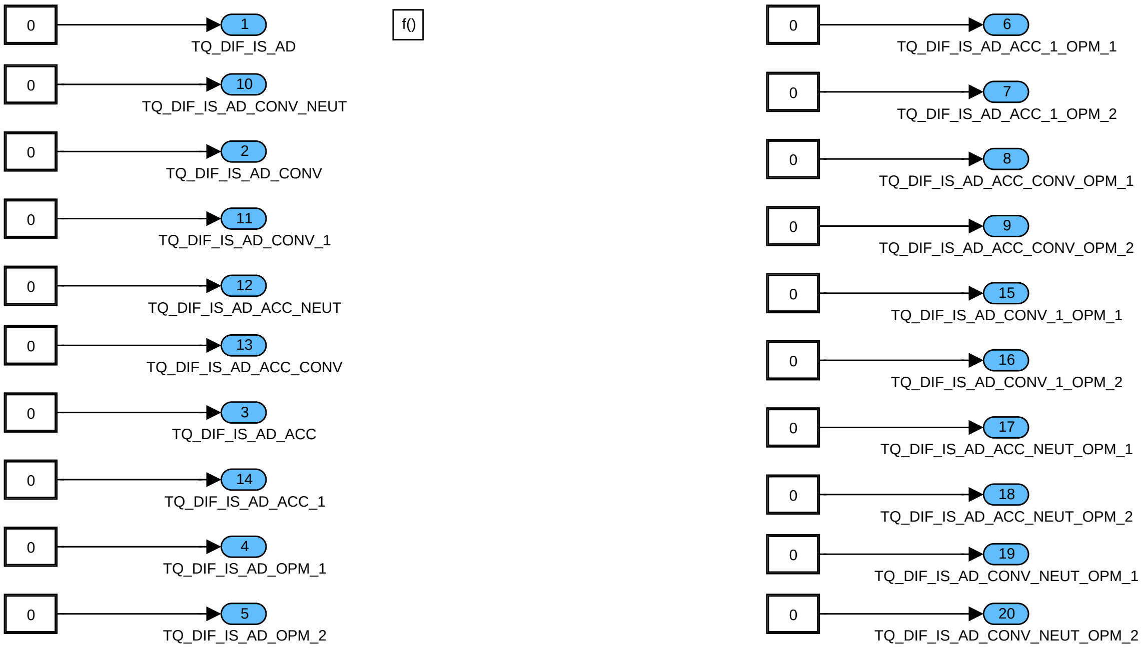

Figure 8.7.13: :

8.7.2.2.2 Reading of NVMY data

The following variables are read out of the NVMY after ECU Reset.

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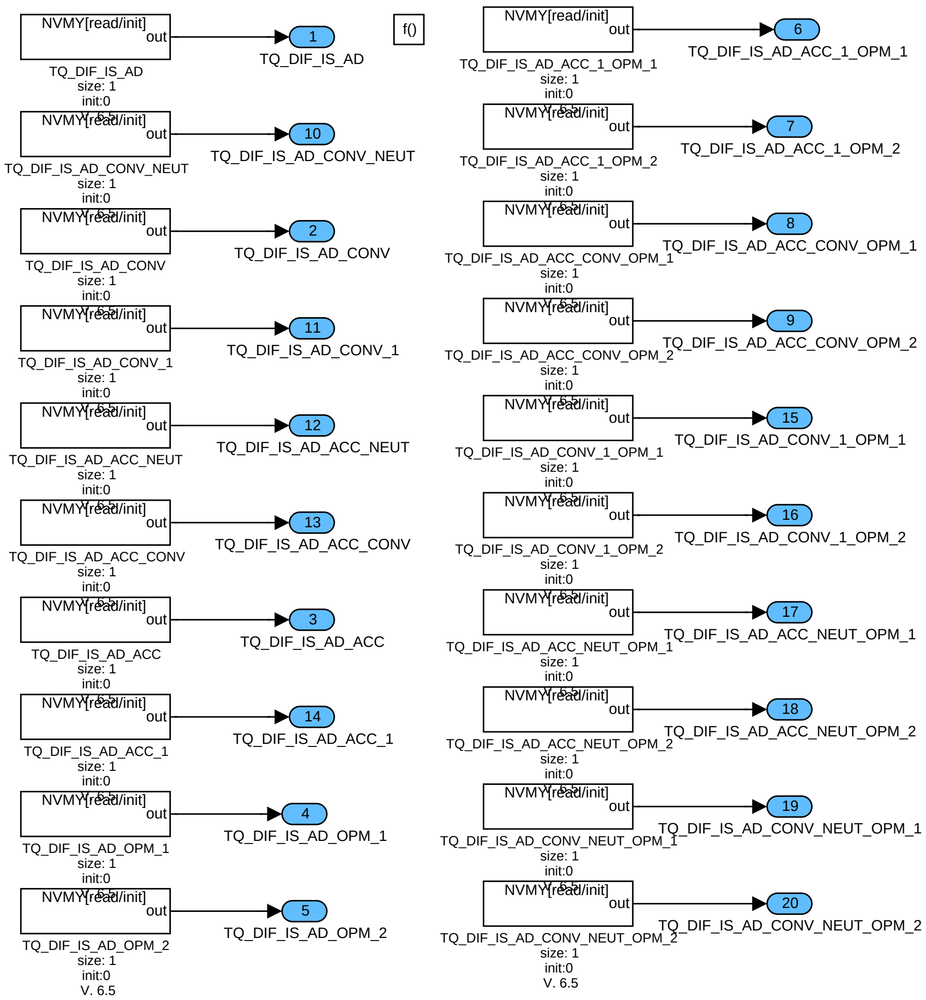

Figure 8.7.14: :

8.7.2.2.3 Saving of NVMY data

The following variables are stored in the NVMY.

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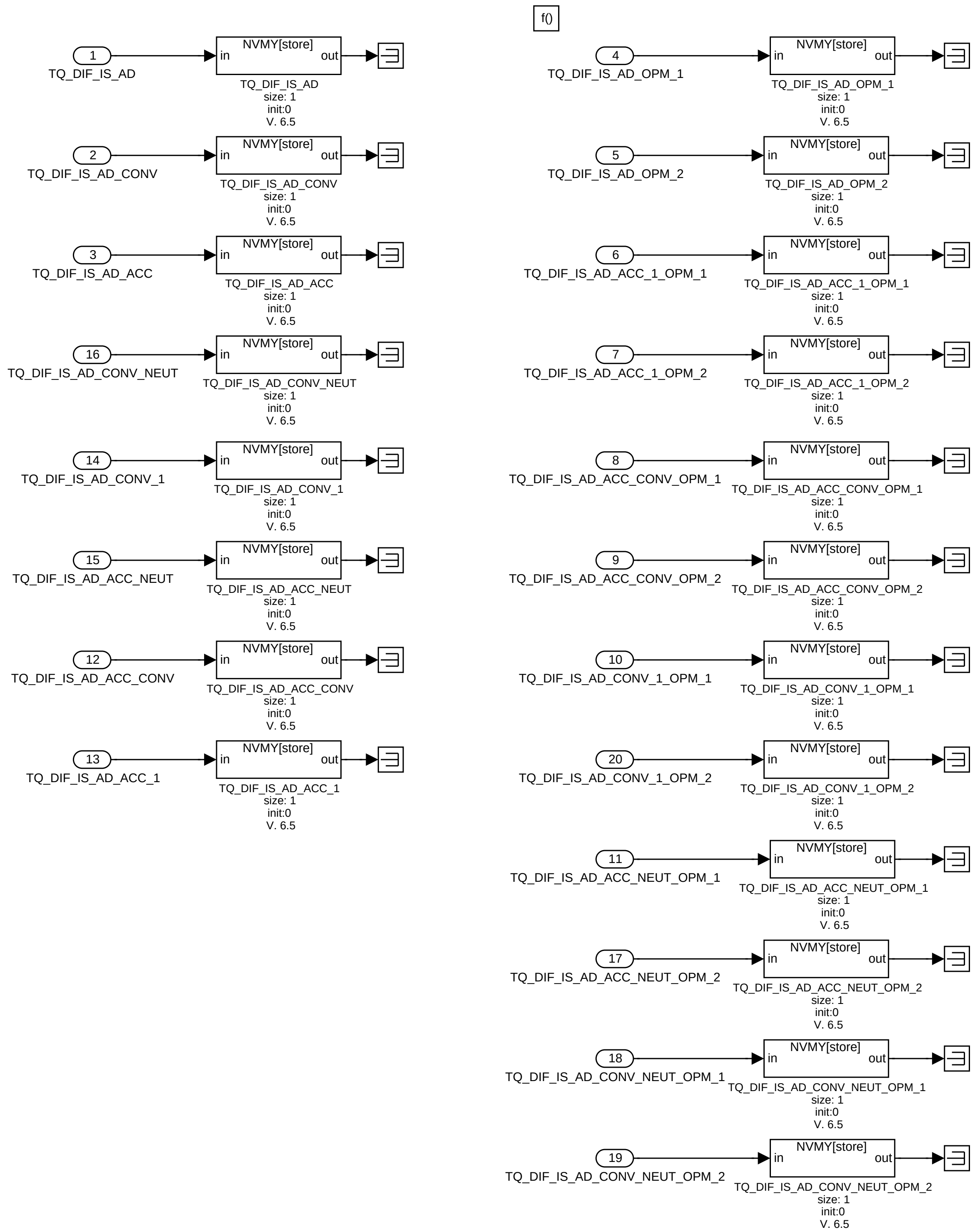

Figure 8.7.15: :

8.7.3 Functional overview of the adaptation algorithm

Depending of the status of several logical variables (LV_DRI, LV_ACCOUT_RLY, LV_AT_NEUT_CTL) and the automatic gearbox clutch information STATE_MOD_GB the different adaptation paths are cho-

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sen. With the help of the logical field STATE_MOD_GB the logical variable LV_AT_NEUT_CTL is created.
A filter first order is used to smooth the adaptation value changes in case of engaging/disengaging the drive w/o neutral control active and/or switching on/off the AC.

8.7.3.1 Setting of LV_AT_NEUT_CTL

With the help of the logical field STATE_MOD_GB the logical variable LV_AT_NEUT_CTL is created. Depending on that information a separate set of adaptation values is chosen.

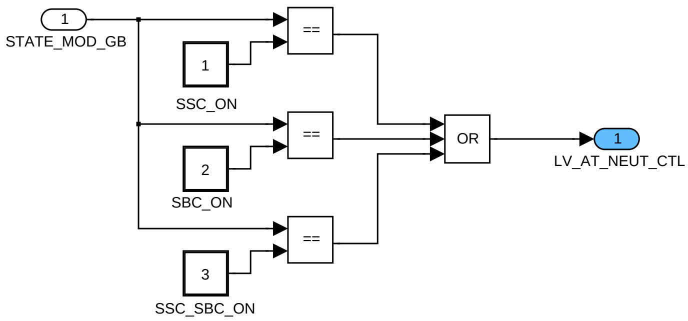

Figure 8.7.16: :

8.7.3.2 Calculation of the different adaptation values TQ_DIF_IS_AD_XXX

Depending of the status of several logical variables (LV_DRI, LV_ACCOUT_RLY, LV_AT_NEUT_CTL) the different adaptation paths are chosen.
To ensure that the adaptation values don't change during the transition from OPM_1 to OPM_2 and vice versa the flags LV_OPM_SEL_TQ_IS_AD_1/_2 are taken into account. Only if LV_OPM_SEL_TQ_IS_AD_1 is set or LV_OPM_SEL_TQ_IS_AD_2 is set the corresponding integrator out value is routed through.
IP_FAC_TQ_DIF_IS_AD_VS is used to consider the vehicle speed in the adapted torque losses of external devices (ACC, torque converter, SSC and SBC). This factor is not applied to the adapted engine torque losses TQ_DIF_IS_AD.

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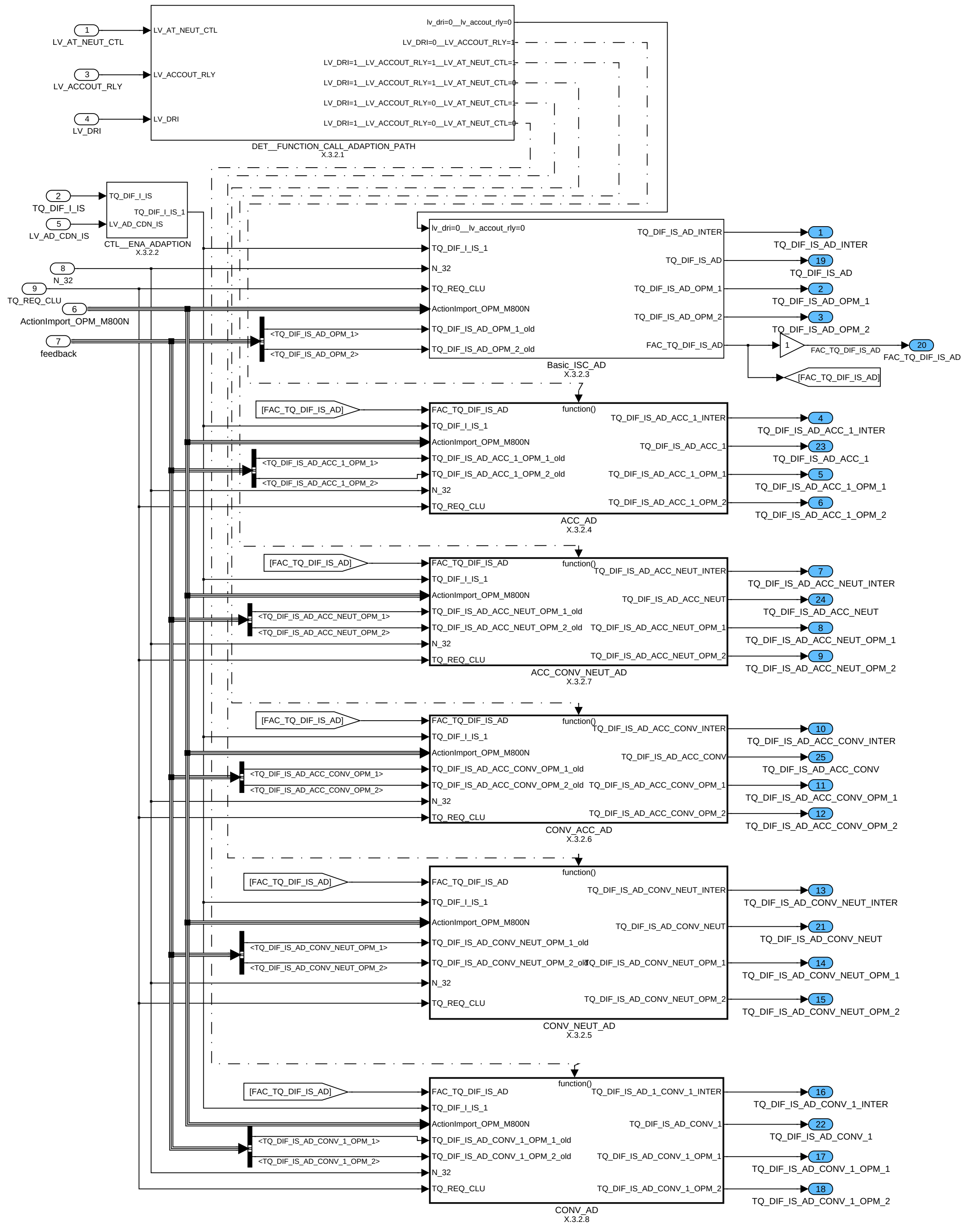

Figure 8.7.17: :

8.7.3.2.1 Creation of the function calls for the several adaptation values

Depending on the logical status of the flags LV_DRI, LV_AT_NEUT_CTL and LV_ACCOUT_RLY the corresponding subsystem is triggered. So in total 6 different combinations are possible.

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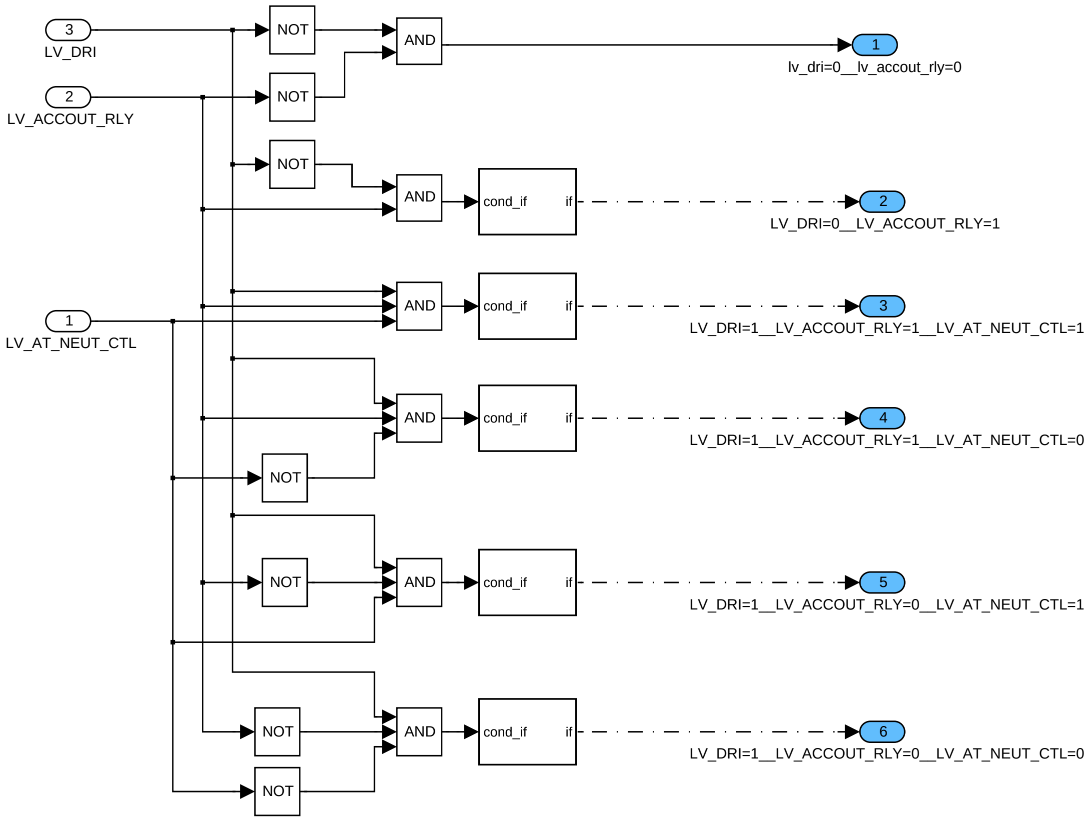

Figure 8.7.18: :

8.7.3.2.2 Input for adaptation algorithm TQ_DIF_I_IS

The adaptation algorithm is fed by the I-gain of the idle speed controller. Due to the fact that the whole function is calculated continuously the input into the adaptation algorithm is controlled via the enable flag LV_AD_CDN_IS. If the adaptation condition is not fulfilled the passive value 0 Nm is routed into the adaptation algorithm. Thus no adaptation value change takes place.

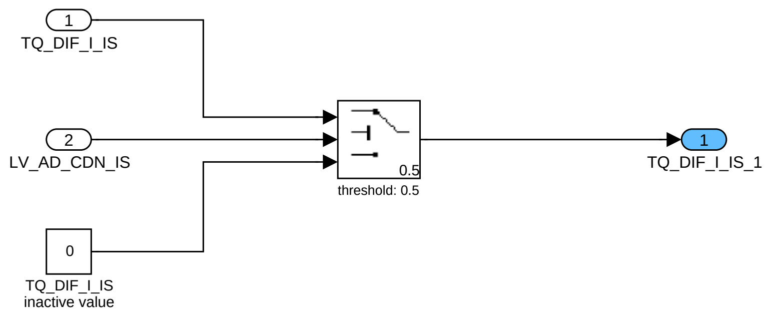

Figure 8.7.19: :

8.7.3.2.3 Basic adaptation value (TQ_DIF_IS_AD)

This adaptation value is applied for a MT or AT vehicle with drive not engaged.

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The speed of the adaptation process is defined through the calibration parameter The speed of the adaptation process is defined through the parameter FAC_TQ_DIF_IS_AD and the function s update rate. This factor is calculated in the map IP_FAC_TQ_DIF_IS_AD, which is depend on the absolut value of TQ_DIF_I_IS. This provides a fast or a slow adaptation.
The sign of the input in the integrator function will be inverted because the output of the Subsystem is coordinated into TQ_LOSS [neg....0] Nm .

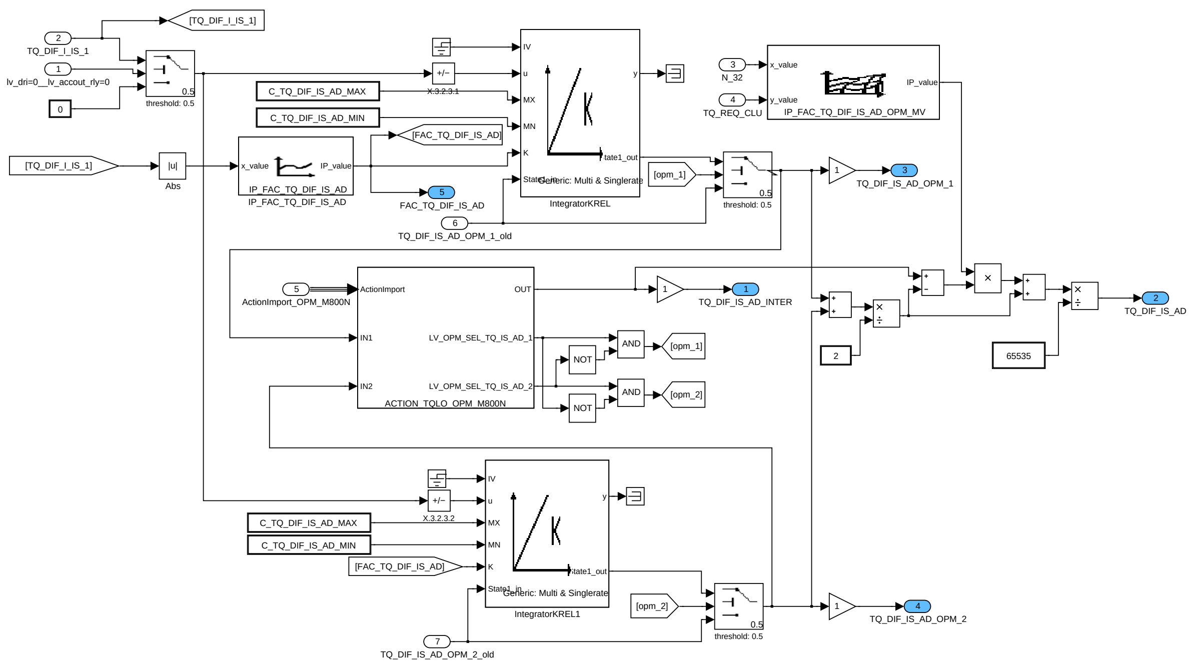

Figure 8.7.20: :

8.7.3.2.4 Adaptation value with AC on (TQ_DIF_IS_AD_ACC_1)

This adaptation value is applied for a MT or AT vehicle with drive not engaged and AC ON.
The speed of the adaptation process is defined through the parameter FAC_TQ_DIF_IS_AD and the function s update rate. This factor is calculated in the map IP_FAC_TQ_DIF_IS_AD, which is depend on the absolut value of TQ_DIF_I_IS. This provides a fast or a slow adaptation.
The sign of the input in the integrator function will be inverted because the output of the Subsystem is coordinated into TQ_LOSS_ACC [neg....0] Nm .

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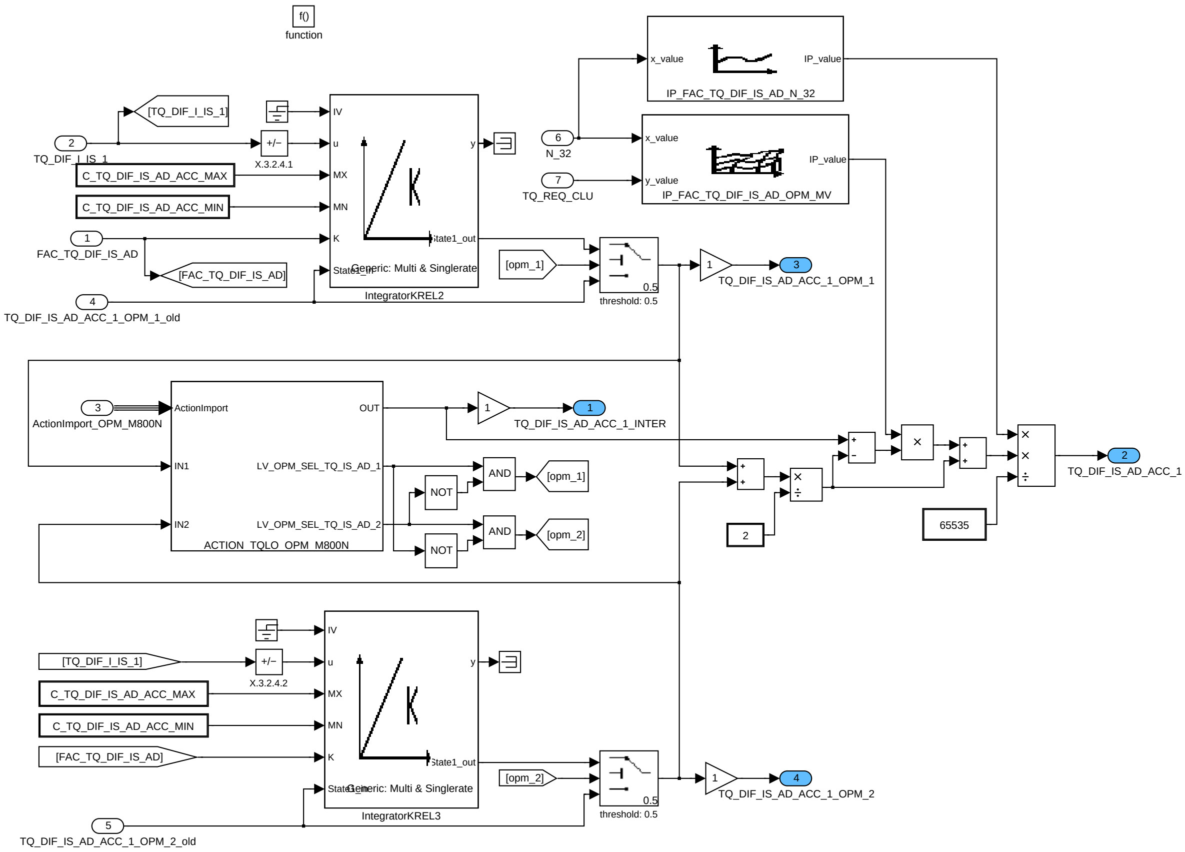

Figure 8.7.21: :

8.7.3.2.5 Adaptation value with DRI engaged, Neutral control active and AC off (TQ_DIF_IS_AD_CONV_NEUT)

This adaptation value is applied for an AT vehicle with drive engaged, Neutral control active and AC OFF.

The speed of the adaptation process is defined through the parameter FAC_TQ_DIF_IS_AD and the function s update rate. This factor is calculated in the map IP_FAC_TQ_DIF_IS_AD, which is depend on the absolut value of TQ_DIF_I_IS. This provides a fast or a slow adaptation.

The sign of the input in the integrator function will not be changed because the output of the Subsystem is coordinated into TQ_CONV [0...pos.] Nm .

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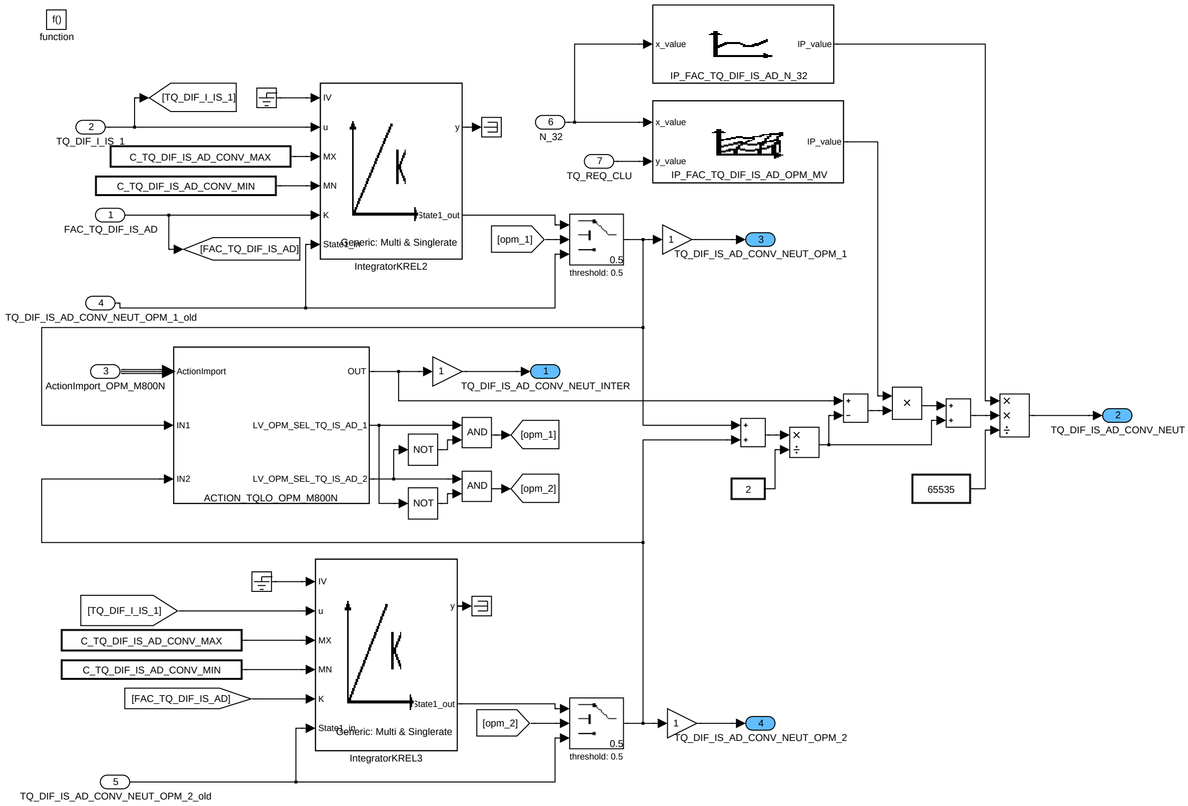

Figure 8.7.22: :

8.7.3.2.6 Adaptation value with DRI engaged, Neutral control passive and AC on (TQ_DIF_IS_AD_ACC_CONV)

This adaptation value is applied for an AT vehicle with drive engaged, Neutral control passive and AC ON.

The speed of the adaptation process is defined through the calibration parameter The speed of the adaptation process is defined through the parameter FAC_TQ_DIF_IS_AD and the function s update rate. This factor is calculated in the map IP_FAC_TQ_DIF_IS_AD, which is depend on the absolut value of TQ_DIF_I_IS. This provides a fast or a slow adaptation.

The sign of the input in the integrator function will be inverted because the output of the Subsystem is coordinated into TQ_LOSS_ACC [neg....0] Nm .

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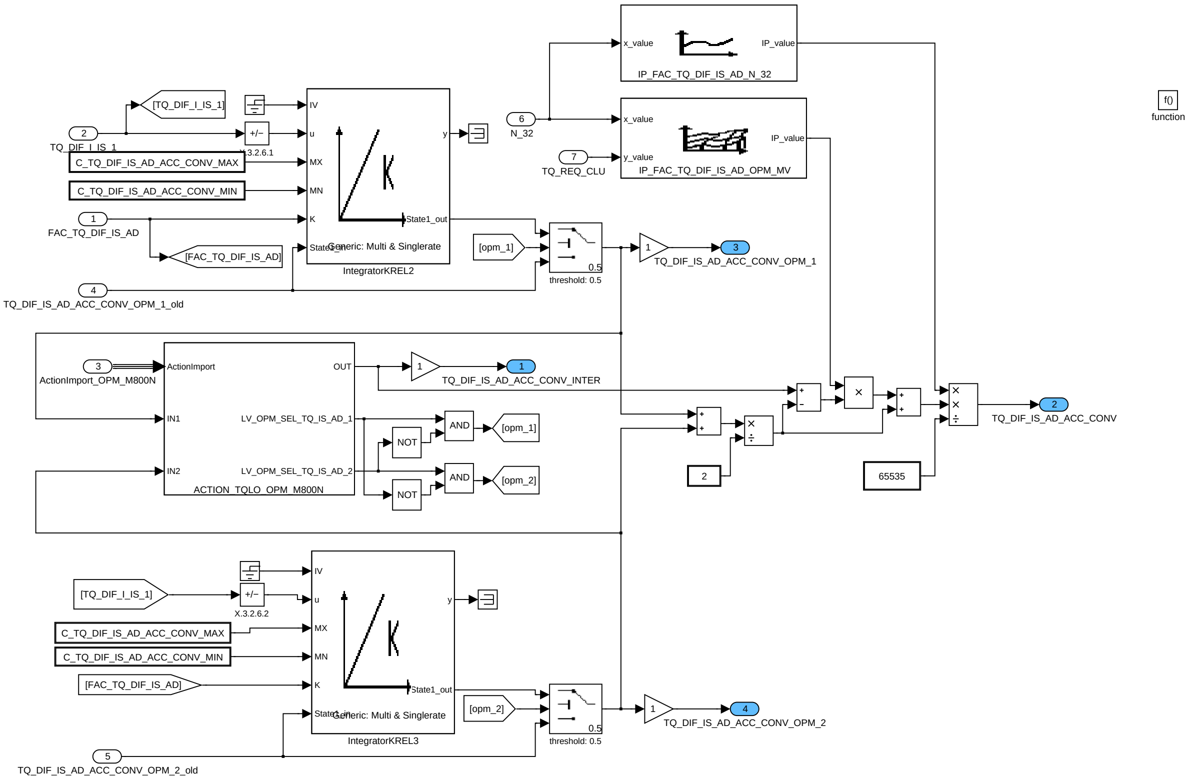

Figure 8.7.23: :

8.7.3.2.7 Adaptation value with DRI engaged, Neutral control active and AC on (TQ_DIF_IS_AD_ ACC_NEUT)

This adaptation value is applied for an AT vehicle with drive engaged, Neutral control active and AC ON.

The speed of the adaptation process is defined through the calibration parameter The speed of the adaptation process is defined through the parameter FAC_TQ_DIF_IS_AD and the function s update rate. This factor is calculated in the map IP_FAC_TQ_DIF_IS_AD, which is depend on the absolut value of TQ_DIF_I_IS. This provides a fast or a slow adaptation.

The sign of the input in the integrator function will be inverted because the output of the Subsystem is coordinated into TQ_LOSS_ACC [neg....0] Nm .

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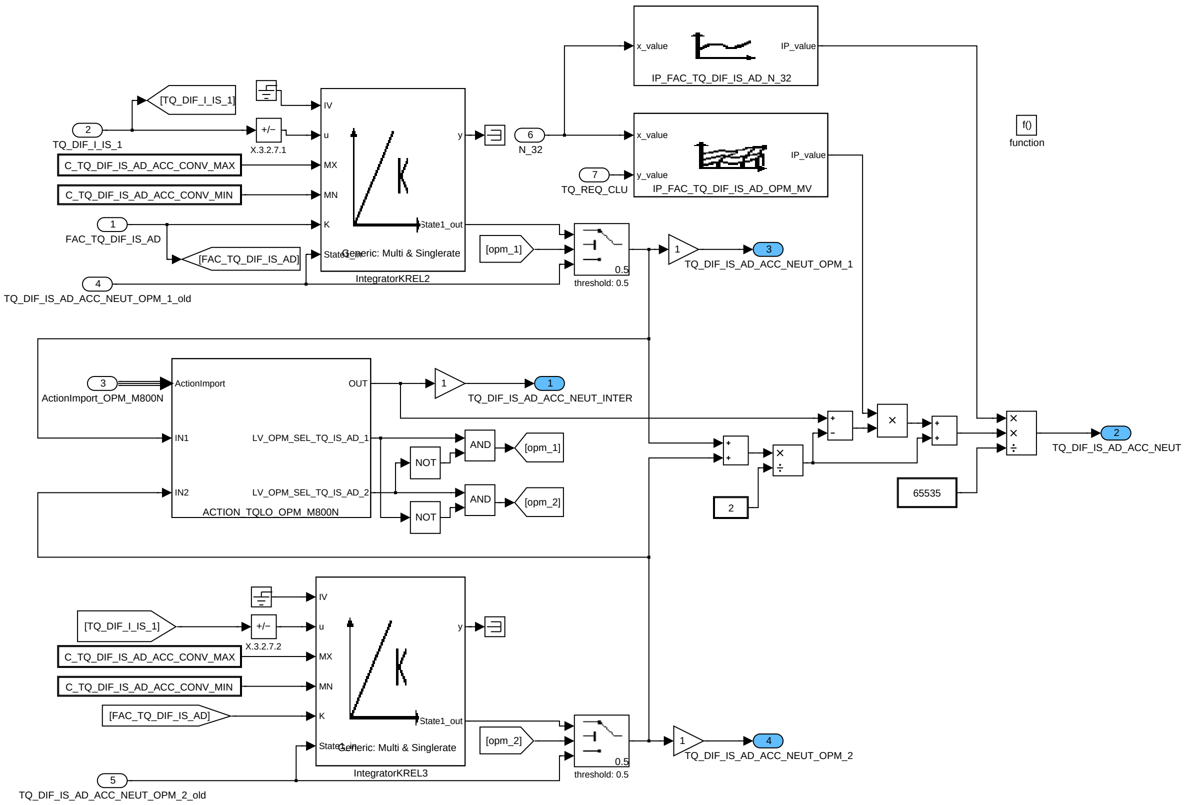

Figure 8.7.24: :

8.7.3.2.8 Adaptation value with DRI engaged, Neutral control passive and AC off (TQ_DIF_IS_AD_CONV_1)

This adaptation value is applied for an AT vehicle with drive engaged, Neutral control passive and AC OFF.

The speed of the adaptation process is defined through the parameter FAC_TQ_DIF_IS_AD and the function s update rate. This factor is calculated in the map IP_FAC_TQ_DIF_IS_AD, which is depend on the absolut value of TQ_DIF_I_IS. This provides a fast or a slow adaptation.

The sign of the input in the integrator function will not be changed because the output of the Subsystem is coordinated into TQ_CONV [0...pos.] Nm .

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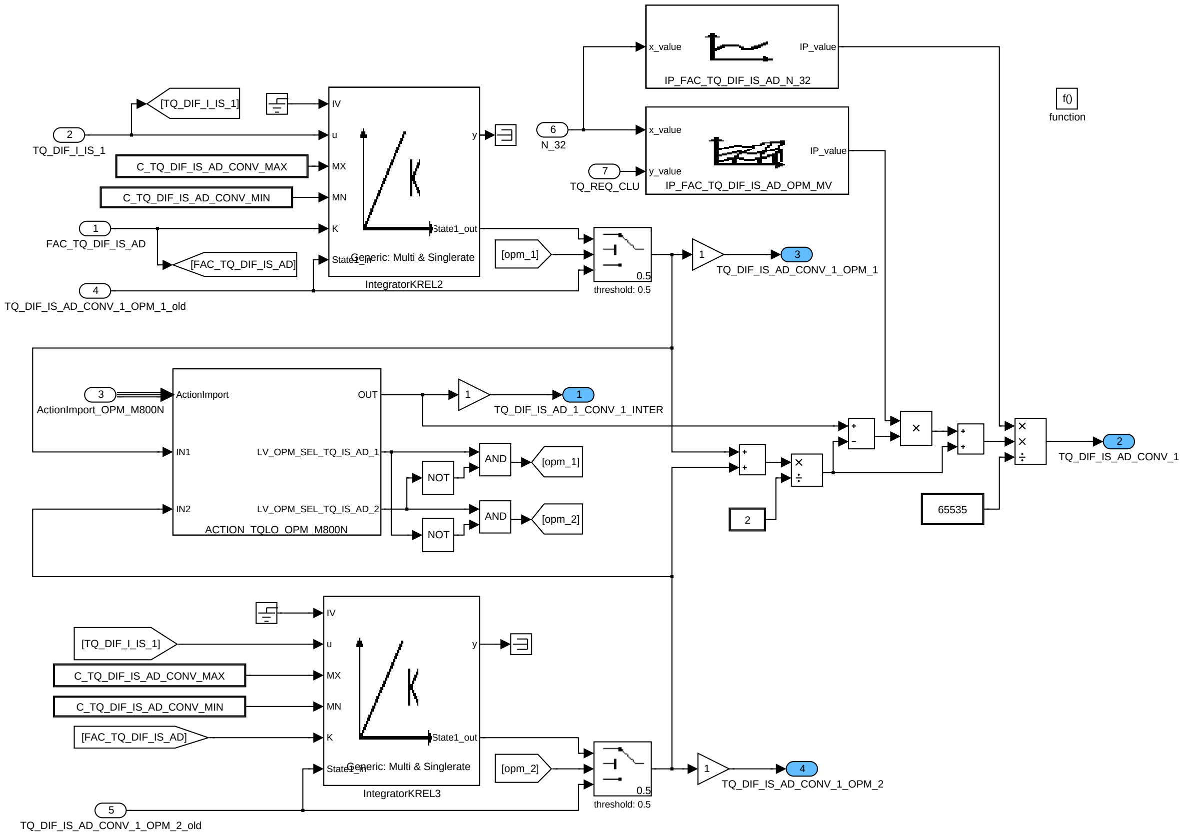

Figure 8.7.25: :

8.7.3.3 Filtering of the adaptation values

In order to be able to use one input for the ACC torque losses module and one adaptation value for the converter torque calculation module, switches are introduced to change between TQ_DIF_IS_AD_ACC_1, TQ_DIF_IS_AD_ACC_CONV and TQ_DIF_IS_AD_ACC_NEUT in dependency of the status of the logical inputs. To prevent abrupt changes in TQ_DIF_IS_AD_ACC (in case of switching between TQ_DIF_AD_IS_ACC_CONV to TQ_DIF_AD_IS_ACC_NEUT or the TQ_DIF_IS_AD_ACC_1), the output value of the final switch is smoothed by a low pass filter. The same strategy is applied in case of a change of the status of the neutral control. The change between TQ_DIF_IS_AD_CONV_NEUT and TQ_DIF_IS_AD_CONV_1 is also routed via a low pass filter.
During the first ACC adaptations, TQ_DIF_IS_AD_ACC may be erroneous and should therefore be limited to small values.

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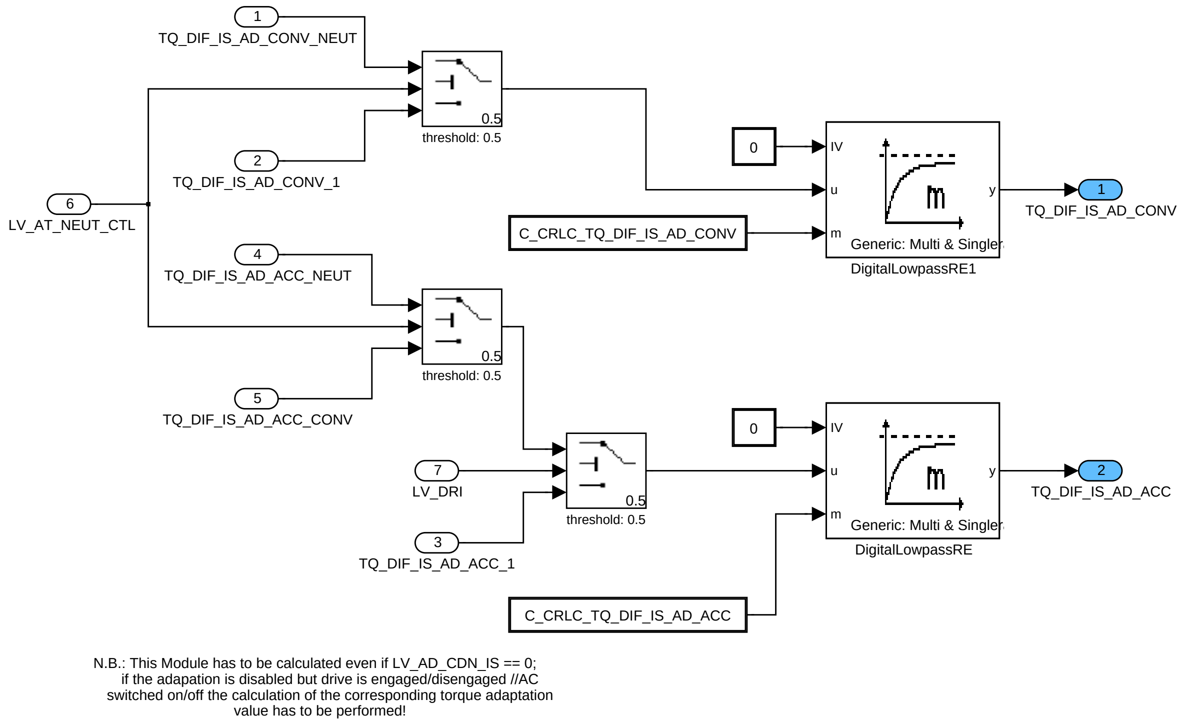

Figure 8.7.26: :

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8.8 Idle speed torque reserve

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_ADD_IS_BOL_OPM_1	V	0... FFH	0... 7.96875	0.03125	-
Resulting factor for TQ_ADD_IS_BOL_BAS (mode 1)					
FAC_TQ_ADD_IS_BOL_OPM_2	V	0... FFH	0... 7.96875	0.03125	-
Resulting factor for TQ_ADD_IS_BOL_BAS (mode 2)					
N_DIF_OFS_PRED_CS_OPM_1	V	8000... 7FFFH	0... 32767	1	rpm
Predicted engine speed difference for torque reserve calculation at drive off support (mode 1)					
N_DIF_OFS_PRED_CS_OPM_2	V	8000... 7FFFH	0... 32767	1	rpm
Predicted engine speed difference for torque reserve calculation at drive off support (mode 2)					
N_DIF_OFS_PRED_OPM_1	V	8000... 7FFFH	0... 32767	1	rpm
Predicted engine speed difference for torque reserve calculation (mode 1)					
N_DIF_OFS_PRED_OPM_2	V	8000... 7FFFH	0... 32767	1	rpm
Predicted engine speed difference for torque reserve calculation (mode 2)					
N_DIF_PRED_CS_OPM_1	V	8000... 7FFFH	0... 32767	1	rpm
Predicted idle speed control variable at drive off support (mode 1)					
N_DIF_PRED_CS_OPM_2	V	8000... 7FFFH	0... 32767	1	rpm
Predicted idle speed control variable at drive off support (mode 2)					
N_DIF_PRED_OPM_1	V	8000... 7FFFH	0... 32767	1	rpm
Predicted idle speed control variable (mode 1)					
N_DIF_PRED_OPM_2	V	8000... 7FFFH	0... 32767	1	rpm
Predicted idle speed control variable (mode 2)					
T_N_DIF_OFS_PRED_CS_OPM_1	V	0... FFH	0... 7.96875	0.03125	s
Prediction time for engine speed difference at drive off support (mode 1)					
T_N_DIF_OFS_PRED_CS_OPM_2	V	0... FFH	0... 7.96875	0.03125	s
Prediction time for engine speed difference at drive off support (mode 2)					
T_N_DIF_OFS_PRED_OPM_1	V	0... FFH	0... 7.96875	0.03125	s
Prediction time for engine speed difference (mode 1)					
T_N_DIF_OFS_PRED_OPM_2	V	0... FFH	0... 7.96875	0.03125	s
Prediction time for engine speed difference (mode 2)					
TQ_ADD_IS_BOL	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Filtered calculated torque reserve bottom limit at idle					
TQ_ADD_IS_BOL_OPM_1	V	0... 7FFFH	0... 1023.97	0.03125004	Nm
Torque reserve at idle (mode 1)					
TQ_ADD_IS_BOL_OPM_2	V	0... 7FFFH	0... 1023.97	0.03125004	Nm
Torque reserve at idle (mode 2)					
TQ_ADD_IS_BOL_SEL	V	0... 7FFFH	0... 1023.97	0.03125004	Nm
Calculated torque reserve botton limit at idle					
TQ_DIF_ADD_IS_TOL	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
Idle speed torque reserve limitiation for stabilizing the ISC at high torque reserves					

Input data:

FAC_TQ_ADD_IS_OPM_SEL {p. 8212}	ID_IDX_OPM_DROF {p. 1112}	LV_AT {p. 654}	LV_DRI {p. 1302}
LV_ES {p. 1720}	LV_IS {p. 1720}	LV_N_SP_IS_CS {p. 1122}	LV_VAR_TCT {p. 656}
MAF {p. 8277}	MAP_DIP_SP_MMV {p. 805}	N {p. 1525}	N_DIF {p. 1122}

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N_GRD {p. 1525}	N_SP_IS {p. 1122}	OPM_AV {p. 8137}	OPM_REQ {p. 8137}
TCO {p. 1100}	TIA {p. 1226}	TOIL {p. 8204}	TQI_ADD_MAX_TOL {p. 8391}
TQI_REQ_TRA {p. 8192}	VLFT_MIN {p. 811}	VS_FIL {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQ_ADD_IS_BOL_CRLC	-	0... FFH	0... 0.99609307	0.00390625	-
Filter constant for torque reserve					
C_TQ_DIF_ADD_IS_TOL_OPM_1	-	0... 7FFFH	0... 1023.97	0.03125	Nm
Idle speed torque reserve limitiation for stabilizing the ISC at high torque reserves in OPM_1					
C_TQ_DIF_ADD_IS_TOL_OPM_2	-	0... 7FFFH	0... 1023.97	0.03125	Nm
Idle speed torque reserve limitiation for stabilizing the ISC at high torque reserves in OPM_2					
ID_TQ_ADD_IS_OPM_AV	-	1... 8H	1 ...8	1	-
LDPM_OPM_AV	8	0... 8H	0 ...8	1	
Operation mode matix (actual)					
ID_TQ_ADD_IS_OPM_REQ	-	1... 8H	1 ...8	1	-
LDPM_OPM_REQ	8	0... 8H	0 ...8	1	
Operation mode matix (requested)					
IP_FAC_TEMP_TQ_ADD_IS_BAS_OPM_1	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_TIA_IP_FAC_TEMP_TQ_ADD_IS	6	0... FEH	0... 142.5	0.75	°C
LDPM_TOIL_IP_FAC_TEMP_TQ_ADD_IS	6	0... C8H	0... 160	1	°C
Temperature correction for IP_TQ_ADD_IS_BOL_BAS (mode1)					
IP_FAC_TEMP_TQ_ADD_IS_BAS_OPM_2	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_TIA_IP_FAC_TEMP_TQ_ADD_IS	6	0... FEH	0... 142.5	0.75	°C
LDPM_TOIL_IP_FAC_TEMP_TQ_ADD_IS	6	0... C8H	0... 160	1	°C
Temperature correction for IP_TQ_ADD_IS_BOL_BAS (mode2)					
IP_FAC_TQ_ADD_IS_BOL_CS_OPM_1	-	0... FFH	0... 7.96875	0.03125	-
LDP_N_DIF_PRED_CS_OPM_1	8	0... FFFFH	0... 32767	1	rpm
LDPM_MAF_FAC_TQ_ADD_IS	6	0... FFFFH	0... 1389	0.02119478	mg/stk
Factor for basis torque reserve at idle due to N_DIF_PRED and load for drive off support (mode1)					
IP_FAC_TQ_ADD_IS_BOL_CS_OPM_2	-	0... FFH	0... 7.96875	0.03125	-
LDP_N_DIF_PRED_CS_OPM_2	8	0... FFFFH	0... 32767	1	rpm
LDPM_MAF_FAC_TQ_ADD_IS	6	0... FFFFH	0... 1389	0.02119478	mg/stk
Factor for basis torque reserve at idle due to N_DIF_PRED and load for drive off support (mode2)					
IP_FAC_TQ_ADD_IS_BOL_DRI_OPM_1	-	0... FFH	0... 7.96875	0.03125	-
LDPM_N_DIF_PRED_OPM_1	8	0... FFFFH	0... 32767	1	rpm
LDPM_MAF_FAC_TQ_ADD_IS	6	0... FFFFH	0... 1389	0.02119478	mg/stk
Factor for basis torque reserve at idle due to N_DIF_PRED and load with drive (mode 1)					
IP_FAC_TQ_ADD_IS_BOL_DRI_OPM_2	-	0... FFH	0... 7.96875	0.03125	-
LDPM_N_DIF_PRED_OPM_2	8	0... FFFFH	0... 32767	1	rpm
LDPM_MAF_FAC_TQ_ADD_IS	6	0... FFFFH	0... 1389	0.02119478	mg/stk
Factor for basis torque reserve at idle due to N_DIF_PRED and load with drive (mode 2)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_TQ_ADD_IS_BOL_OPM_1	-	0... FFH	0... 7.96875	0.03125	-
LDPM_N_DIF_PRED_OPM_1	8	0... FFFFH	0... 32767	1	rpm
LDPM_MAF_FAC_TQ_ADD_IS	6	0... FFFFH	0... 1389	0.02119478	mg/stk
Factor for basis torque reserve at idle due to N_DIF_PRED and load without drive (mode1)					
IP_FAC_TQ_ADD_IS_BOL_OPM_2	-	0... FFH	0... 7.96875	0.03125	-
LDPM_N_DIF_PRED_OPM_2	8	0... FFFFH	0... 32767	1	rpm
LDPM_MAF_FAC_TQ_ADD_IS	6	0... FFFFH	0... 1389	0.02119478	mg/stk
Factor for basis torque reserve at idle due to N_DIF_PRED and load without drive (mode2)					
IP_FAC_VS_TQ_ADD_IS_BOL_OPM_1	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_VS_FIL_IP_FAC_VS_TQ_ADD_IS	4	0... FFFFH	0... 511.992188	0.0078125	km/h
Factor for IP_FAC_TQ_ADD_IS_BOL_CS_OPM_1 (mode 1)					
IP_FAC_VS_TQ_ADD_IS_BOL_OPM_2	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_VS_FIL_IP_FAC_VS_TQ_ADD_IS	4	0... FFFFH	0... 511.992188	0.0078125	km/h
Factor for IP_FAC_TQ_ADD_IS_BOL_CS_OPM2 (mode 2)					
IP_LGRD_TQ_ADD_IS_BOL	-	0... FFH	0... 7.96875	0.03125	Nm
LDPM_N_LGRD_TQ_ADD_IS_BOL	6	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_LGRD_TQ_ADD_IS_BOL	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Gradient for decrementation of the torque reserve at idle					
IP_LGRD_TQ_ADD_IS_BOL_OPM_2	-	0... FFH	0... 7.96875	0.03125	Nm
LDPM_N_LGRD_TQ_ADD_IS_BOL	6	0... 1FE0H	0... 8160	1	rpm
LDPM_MAF_LGRD_TQ_ADD_IS_BOL	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Gradient for decrementation of the torque reserve at idle for OPM 2					
IP_T_N_DIF_OFS_PRED_CS_OPM_1	-	0... FFH	0... 7.96875	0.03125	s
LDPM_N_T_N_DIF_OFS_PRED	8	0... 1FE0H	0... 8160	1	rpm
Time constant for calculation of predicted engine speed deviation at drive off support (mode1)					
IP_T_N_DIF_OFS_PRED_CS_OPM_2	-	0... FFH	0... 7.96875	0.03125	s
LDPM_N_T_N_DIF_OFS_PRED	8	0... 1FE0H	0... 8160	1	rpm
Time constant for calculation of predicted engine speed deviation at drive off support (mode2)					
IP_T_N_DIF_OFS_PRED_OPM_1	-	0... FFH	0... 7.96875	0.03125	s
LDPM_N_T_N_DIF_OFS_PRED	8	0... 1FE0H	0... 8160	1	rpm
Time constant for calculation of predicted engine speed deviation (mode 1)					
IP_T_N_DIF_OFS_PRED_OPM_2	-	0... FFH	0... 7.96875	0.03125	s
LDPM_N_T_N_DIF_OFS_PRED	8	0... 1FE0H	0... 8160	1	rpm
Time constant for calculation of predicted engine speed deviation (mode 2)					
IP_TQ_ADD_IS_BOL_BAS_OPM_1	-	0... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_N_SP_IS_TQ_ADD_IS_BOL_BAS	6	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_TQ_ADD_IS_BOL_BAS	6	0... FEH	0... 142.5	0.75	°C
Basis torque reserve at idle (mode1)					
IP_TQ_ADD_IS_BOL_BAS_OPM_2	-	0... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_N_SP_IS_TQ_ADD_IS_BOL_BAS	6	0... 1FE0H	0... 8160	1	rpm
LDPM_TCO_TQ_ADD_IS_BOL_BAS	6	0... FEH	0... 142.5	0.75	°C
Basis torque reserve at idle (mode2)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TQ_ADD_IS_COR_OPM_1	-	0... 7FFFH	0... 1023.97	0.03125	Nm
LDP_VLFT_MIN_IP_TQ_ADD_IS_COR	6	0... FFFFH	0... 65.535	0.001	mm
LDP_MAP_DIP_SP_MMV_IP_TQ_ADD_IS	6	0... FFFFH	0... 1279.96	0.0390625	hPa
Additive torque reserve at idle at VVT mode (mode1)					

Function description

General Information:
The module   Idle Speed Torque Reserve   consists of two parts:
1. Idle speed torque reserve due to low engine speed
2. Idle speed torque reserve limitiation for stabilizing the ISC at high torque reserves

1. Idle speed torque reserve due to low engine speed
Depending on the predicted engine speed difference N_DIF_PRED a torque reserve by increasing the load is calculated. If actual engine speed falls it is possible to increase load before the actual engine speed is below the engine speed setpoint for idle speed. At the same time a spark retard compensates the supposed torque increase. So a quick torque incraease by spark advance can be realized to stabilize engine speed at its setpoint.
For negative gradients of TQ_ADD_IS_BOL_SEL a PT1filter for TQ_ADD_IS_BOL calculation is applied to avoid torque jumps caused by fast changes of ignition angle. For positive gradients of the input TQ_ADD_IS_BOL_SEL the output value TQ_ADD_IS_BOL is identical to the input.

2. Idle speed torque reserve limitiation for stabilizing the ISC at high torque reserves
At high torque reserve requests (ex.: catalyst heating) the ignition angle can be retarded down to the minimum ignition angle IGA_MIN. This may cause problems with idle speed stability. In order to prevent speed from oscillating in case the actual ignition angle is in the near of IGA_MIN caused by high torque reserves, the maximum availible torque reserve must be limited. In order to reach this, a tunable calibration constant C_TQ_DIF_ADD_IS_TOL_OPM_1/2 is introduced. C_TQ_DIF_ADD_IS_TOL_OPM_1/2 has the same influence than TQ_ADD_IS_BOL: while the last defines a minimum torque reserve, C_TQ_DIF_ADD_IS_TOL_OPM_1/2 takes influence on the maximum torque reserve in idle. The availible torque reserve range is shown in figure 1.

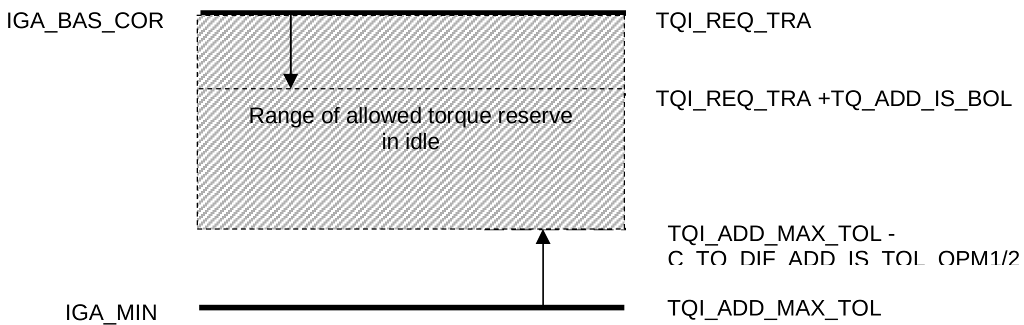

Figure 8.8.1: : Availible torque reserve range after limiting:

TQI_ADD_MAX_TOL   C_TQ_DIF_ADD_IS_TOL_OPM_1/2 defines the max. idle torque reserve

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Since C_TQ_DIF_ADD_IS_TOL_OPM_1/2 is a calibratable constant, this may cause a conflict situation as shown in figure 2.

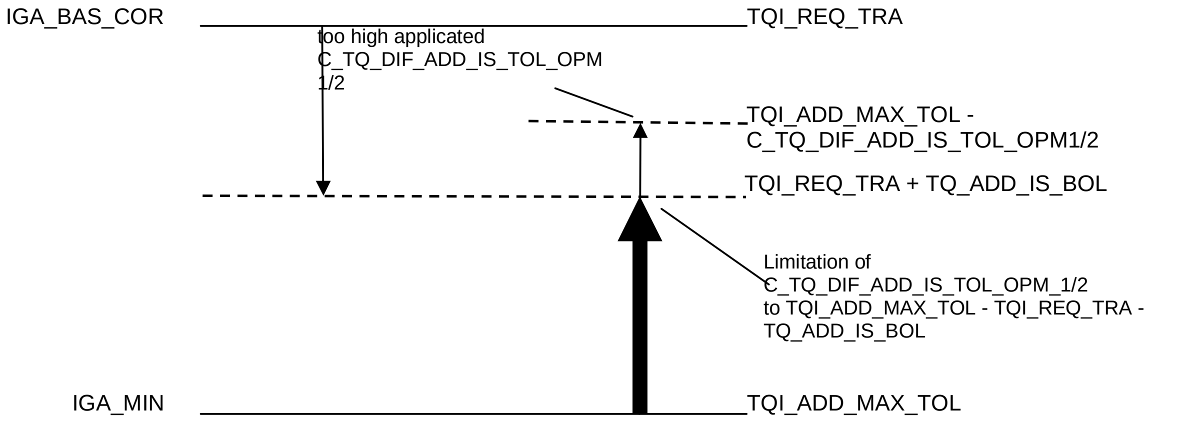

Figure 8.8.2: : Limiting C_TQ_DIF_ADD_IS_TOL_OPM_1/2 in case of a conflict

In this case TQ_ADD_IS_BOL has a higher priority than C_TQ_DIF_ADD_IS_TOL_OPM_1/2, since the possibility of moving the ignition angle in direction spark advance by building up a torque reserve is more essential than keeping it at a certain point from IGA_MIN, which „only“ causes irregular running. The condition for a non-critical situation, figure 1, is

TQI_REQ_TRA+TQ_ADD_IS_BOL<= TQI_ADD_MAX_TOL - C_TQ_DIF_ADD_IS_TOL_OPM_1/2 (1)

Solving this relation leads to

C_TQ_DIF_ADD_IS_TOL_OPM_1/2<=TQI_ADD_MAX_TOL - TQI_REQ_TRA - TQ_ADD_IS_BOL (2)

If relation (2) is not fulfilled, C_TQ_DIF_ADD_IS_TOL_OPM_1/2 is limited, figure 3.

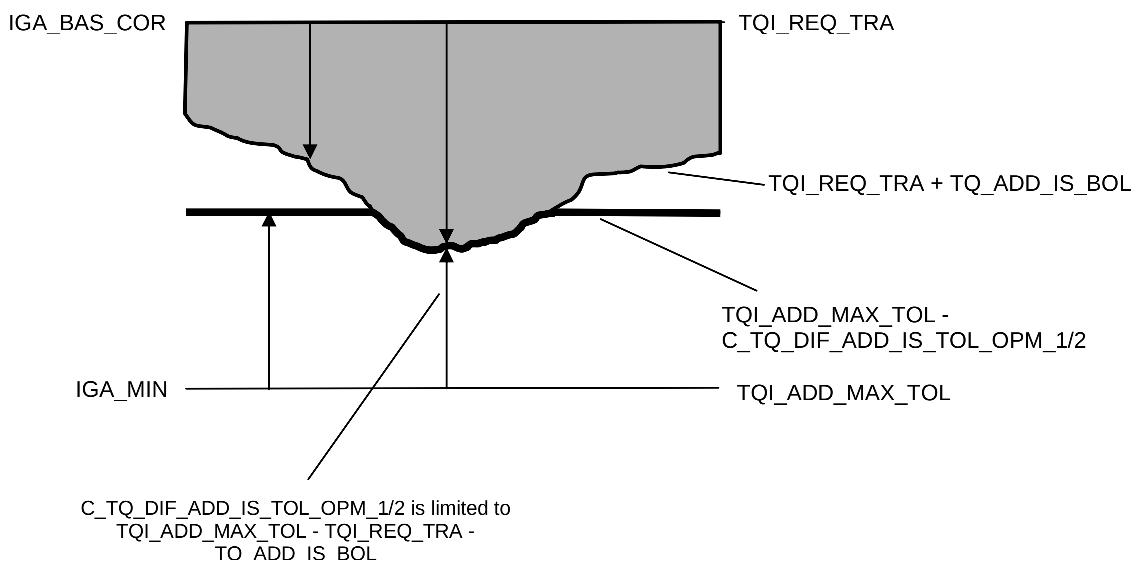

Figure 3: Limiting C_TQ_DIF_ADD_IS_TOL_OPM_1/2 in case TQI_REQ_TRA + TQ_ADD_IS_BOL is greater than TQI_ADD_MAX_TOL - C_TQ_DIF_ADD_IS_TOL_OPM_1/2

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Application Condition

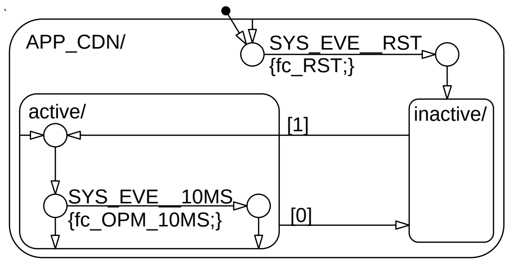

Figure 8.8.3: ENSC_M800I/APP_CDN/APP_CDN

Function Description

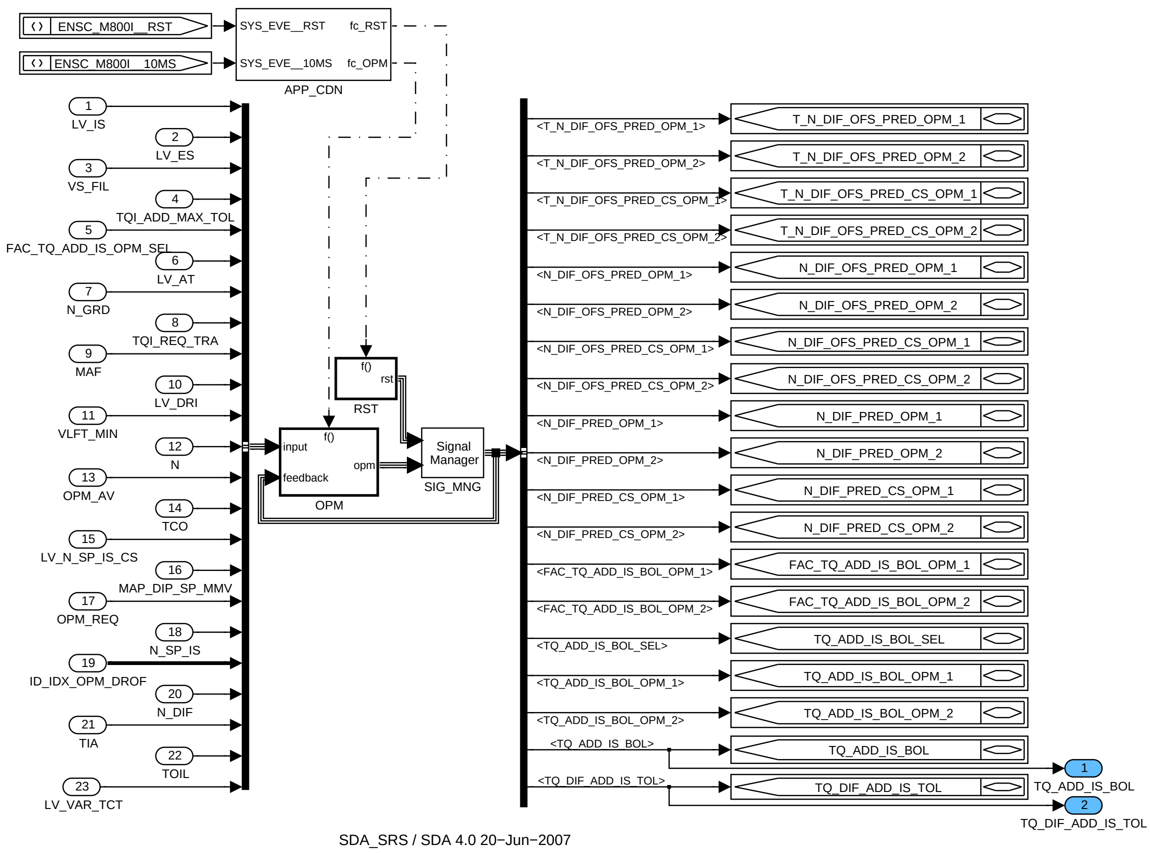

Figure 8.8.4: ENSC_M800I

8.8.1 Initialization at Reset event

The following variables are initialized to zero.

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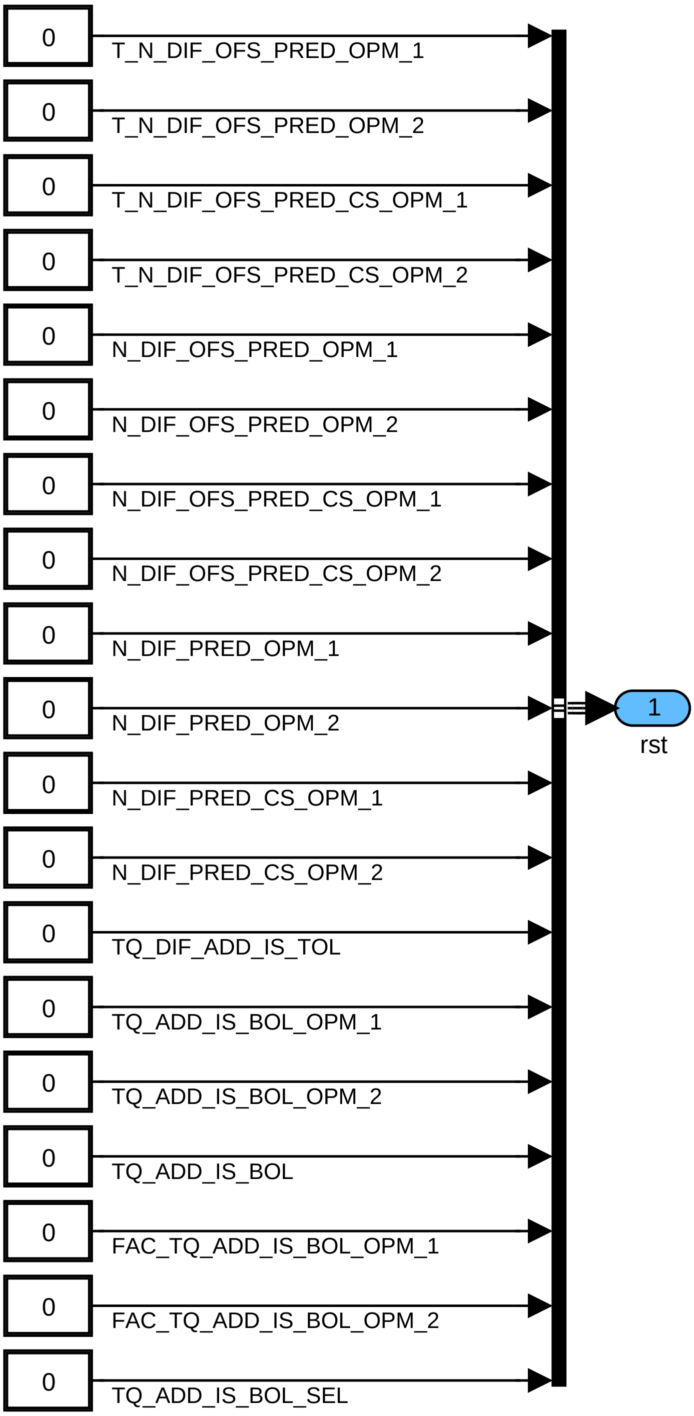

Figure 8.8.5: ENSC_M800I/RST/INI

8.8.2 Formula section

Check for activation

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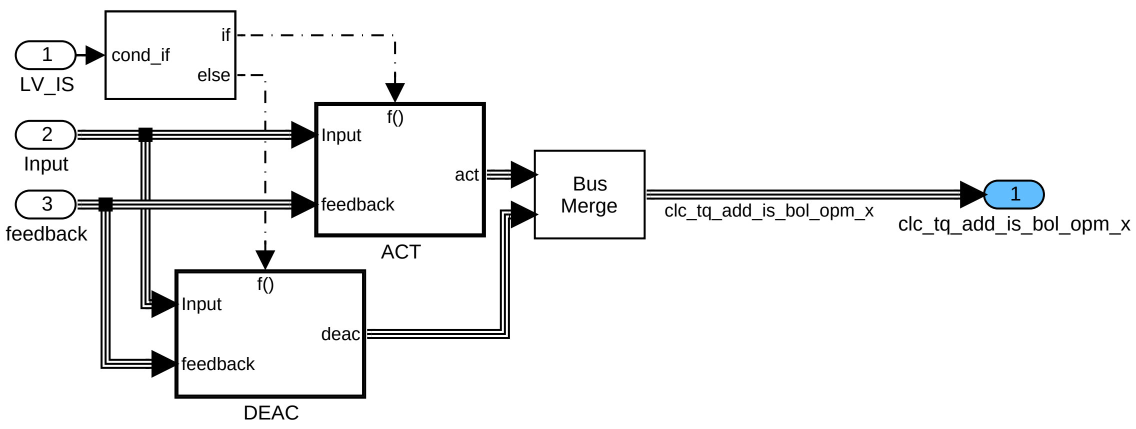

Figure 8.8.6: ENSC_M800I/OPM/CLC_TQ_ADD_IS_BOL_OPM_x

Activation

Operation mode manager

There are two input values IN_1, IN_2. Each input value belongs to a special operation mode OPM_1, OPM_2. Moreover the value OPM_SEL_AV indicates the active and OPM_SEL_REQ indicates the requested operation mode. The aim of the operation manager is to create an output value depending on the active operation mode. If there is a switch from one mode to another a smooth changeover from one input value to the other is possible by using the interpolation factor FAC_OPM_SEL.
A special logic takes care that the needed part is calculated only. That means if OPM_1 is active and there is no switch requested then the output value of the operation manager = IN_1 and some part of the algorithm for IN_2 are not calculated anymore. In this case the bit LV_OPM_SEL_1=1 indicates that only the calculation of the IN_1path is done.
The information of the actual and the requested operation mode can be changed by interpretations maps ID_...OPM_SEL. The effect of this is, that by calibration the operation mode 1 can be wired to the input 2. That means the belonging for a operation mode to an input value is flexible.

The following table defines the local variable described above:

TQ_ADD_IS_BOL_OPM_1	IN_1	Input	Input value for operation mode 1
TQ_ADD_IS_BOL_OPM_2	IN_2	Input	Input value for operation mode 2
OPM_AV (from Layer)	OPM_AV	Input	Actual operation mode
OPM_REQ (from Layer)	OPM_REQ	Input	Requested operation mode
-	OPM_SEL_AV	Internal value	Actual active operation mode after interpretation
-	OPM_SEL_REQ	Internal value	Requested operation mode after interpretation
FAC_TQ_ADD_IS_OPM_SEL (from Layer)	FAC_OPM_SEL	Input	Interpolation factor
LV_TQ_ADD_IS_OPM_SEL_1	LV_OPM_SEL_1	Output	Operation mode 1 active
LV_TQ_ADD_IS_OPM_SEL_2	LV_OPM_SEL_2	Output	Operation mode 2 active
TQ_ADD_IS_BOL_SEL_1	OUT	Output	Result of interpolation
LV_TQ_ADD_IS_OPM_RLS	LV_OPM_RLS	Output	Operation mode within valid range
ID_TQ_ADD_IS_OPM_AV	ID_OPM_AV	cal	Mapping of active operation mode
ID_TQ_ADD_IS_OPM_REQ	ID_OPM_REQ	cal	Mapping of requested operation mode

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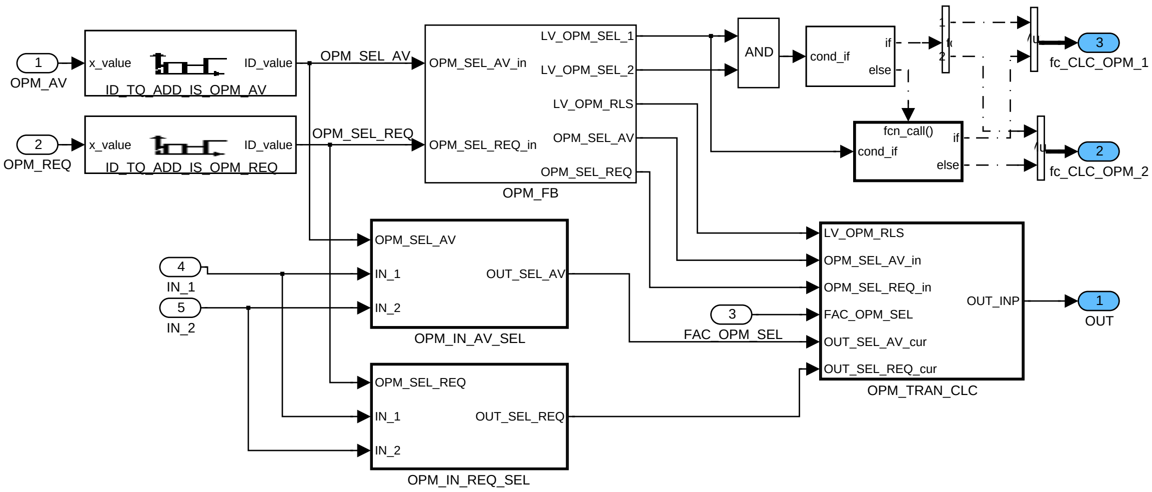

Figure 8.8.7: ENSC_M800I/OPM/CLC_TQ_ADD_IS_BOL_OPM_x/ACT/OPM_SWI

Check for activation of operation mode 1 and 2

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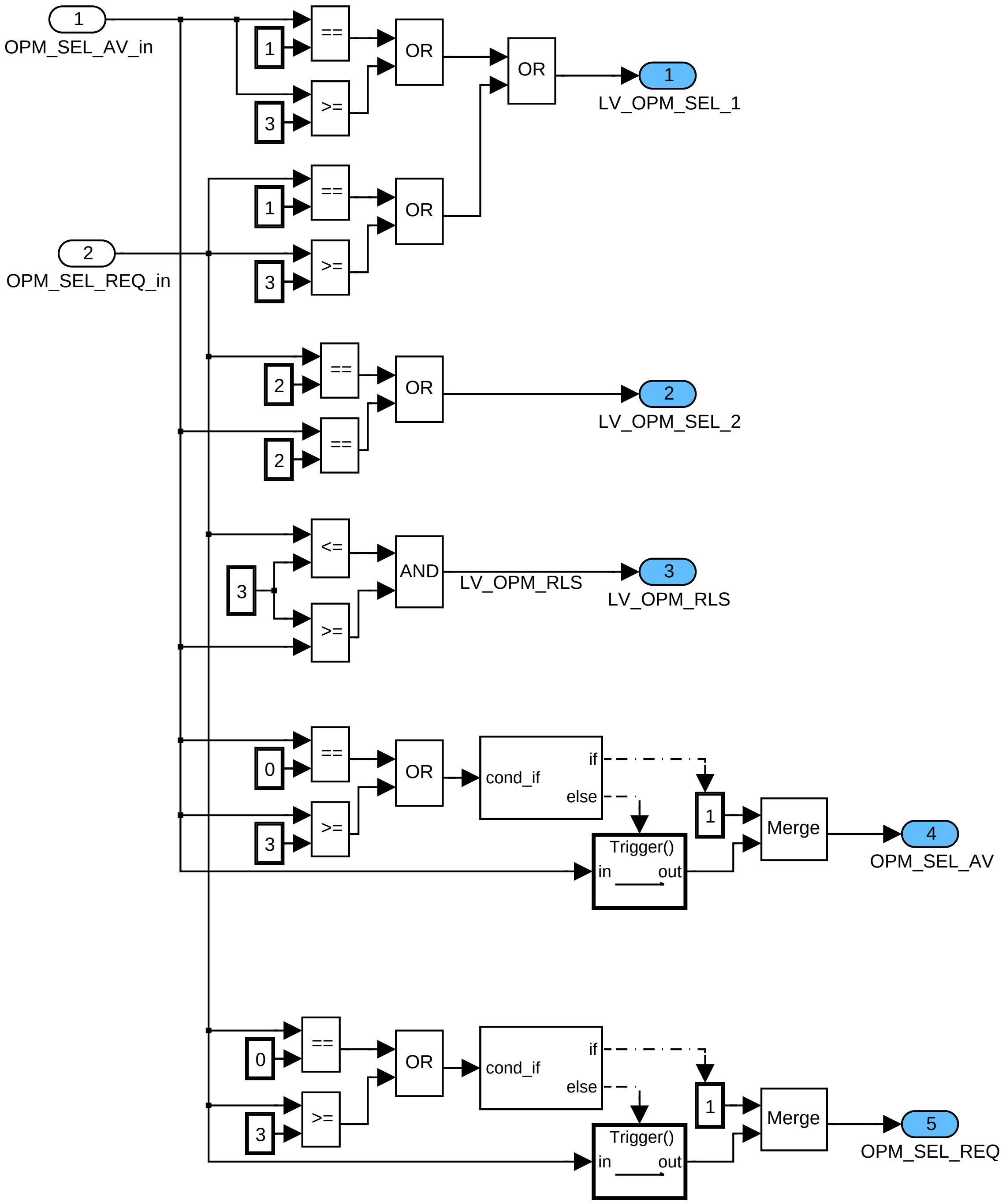

Figure 8.8.8: ENSC_M800I/OPM/CLC_TQ_ADD_IS_BOL_OPM_x/ACT/OPM_SWI/OPM_FB

Actual active operation mode after interpretation

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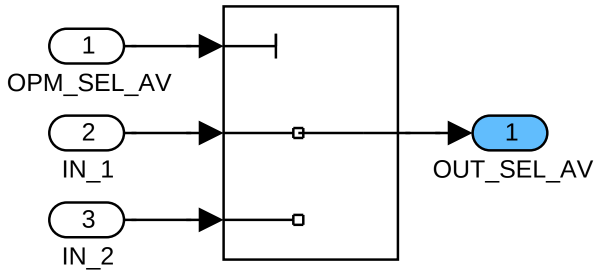

Figure 8.8.9: ENSC_M800I/OPM/CLC_TQ_ADD_IS_BOL_OPM_x/ACT/OPM_SWI/OPM_IN_AV_SEL

Requested operation mode after interpretation

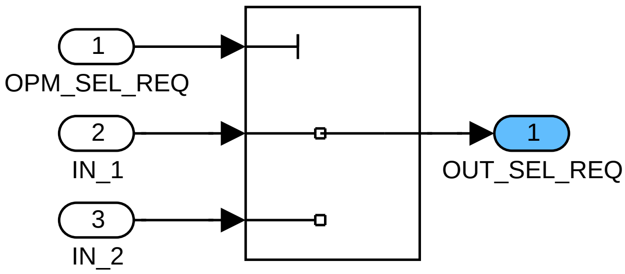

Figure 8.8.10:
ENSC_M800I/OPM/CLC_TQ_ADD_IS_BOL_OPM_x/ACT/OPM_SWI/OPM_IN_REQ_SEL

Calculation of TQ_ADD_IS_BOL_SEL_1

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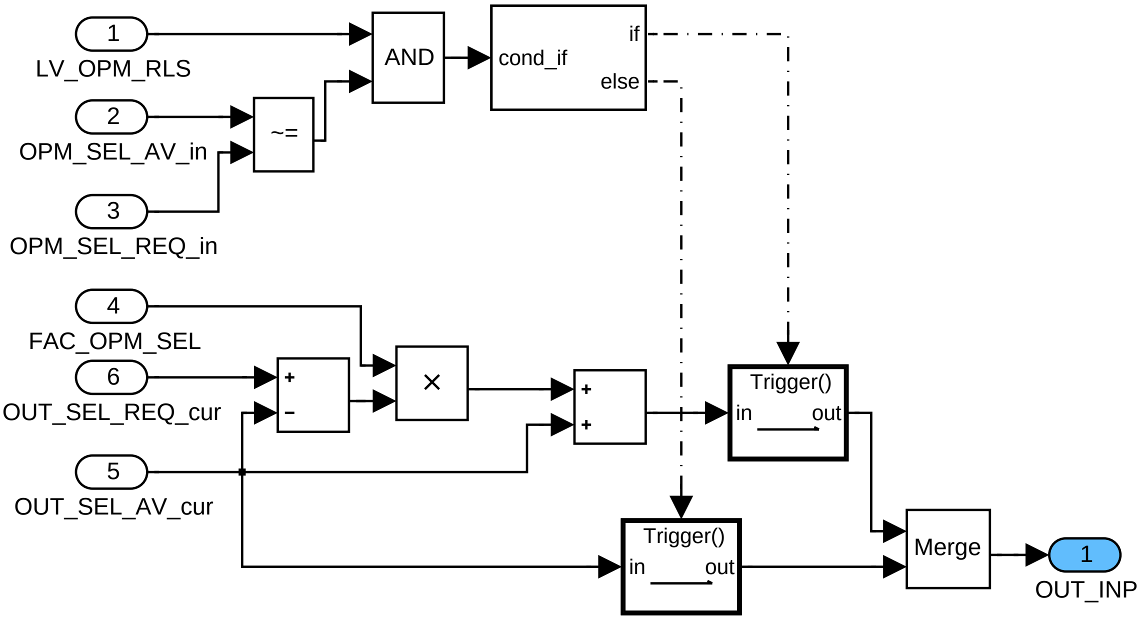

Figure 8.8.11:
ENSC_M800I/OPM/CLC_TQ_ADD_IS_BOL_OPM_x/ACT/OPM_SWI/OPM_TRAN_CLC

TQ_ADD_IS_BOL_OPM_1 calculation

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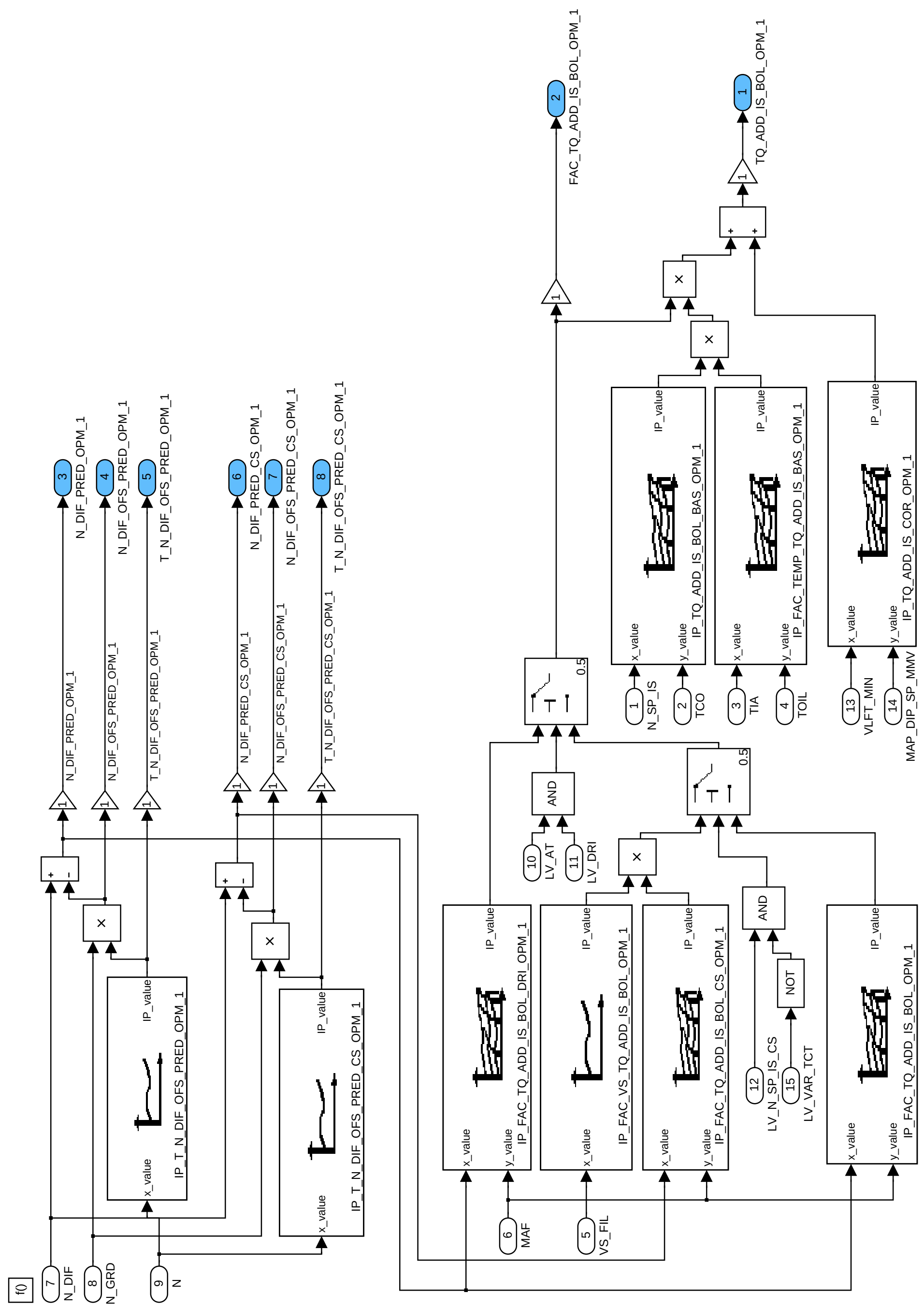

Figure 8.8.12: ENSC_M800I/OPM/CLC_TQ_ADD_IS_BOL_OPM_x/ACT/CLC_OPM_1

TQ_ADD_IS_BOL_OPM_2 calculation

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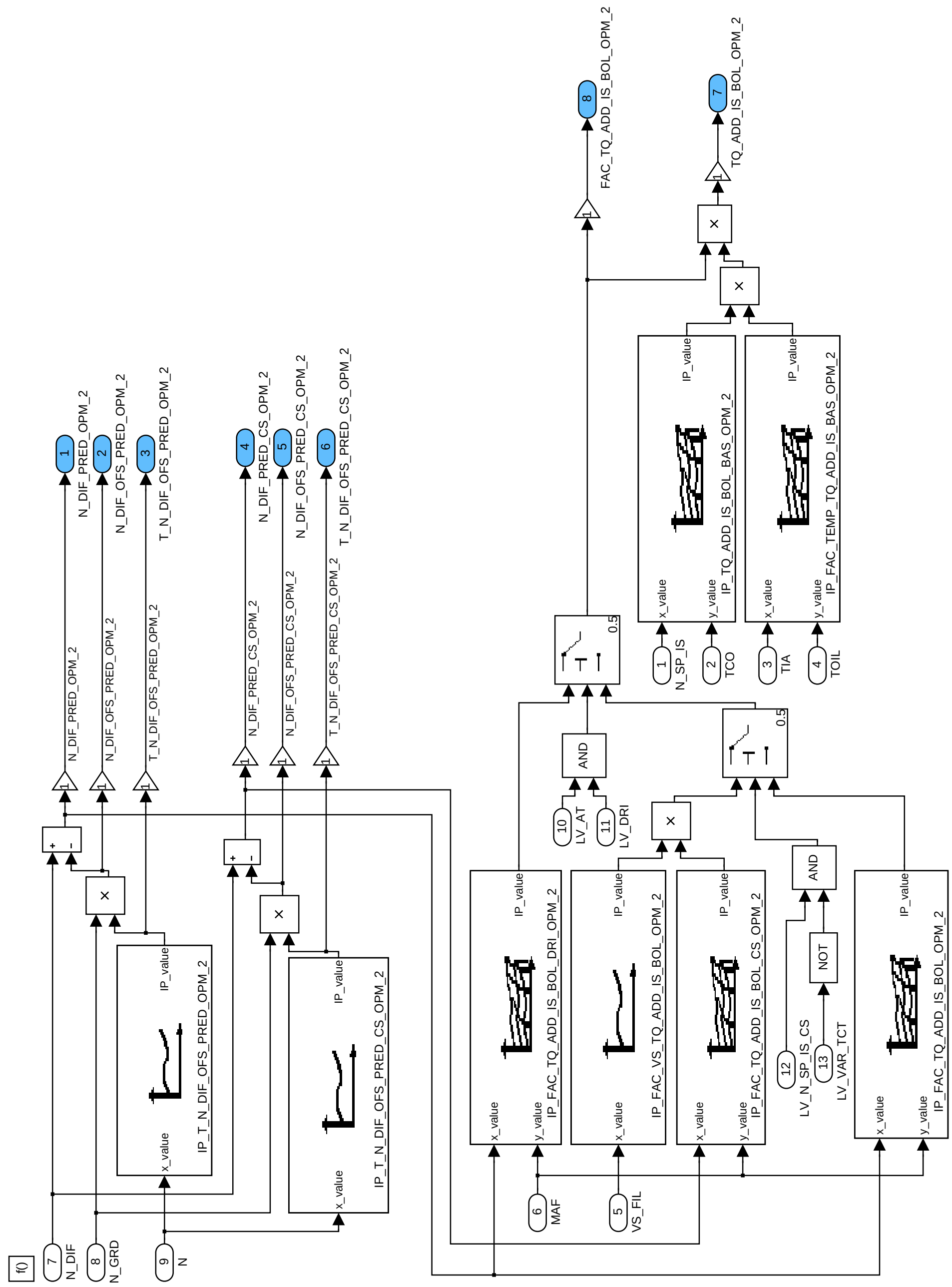

Figure 8.8.13: ENSC_M800I/OPM/CLC_TQ_ADD_IS_BOL_OPM_x/ACT/CLC_OPM_2

Deactivation

Check for Deactivation

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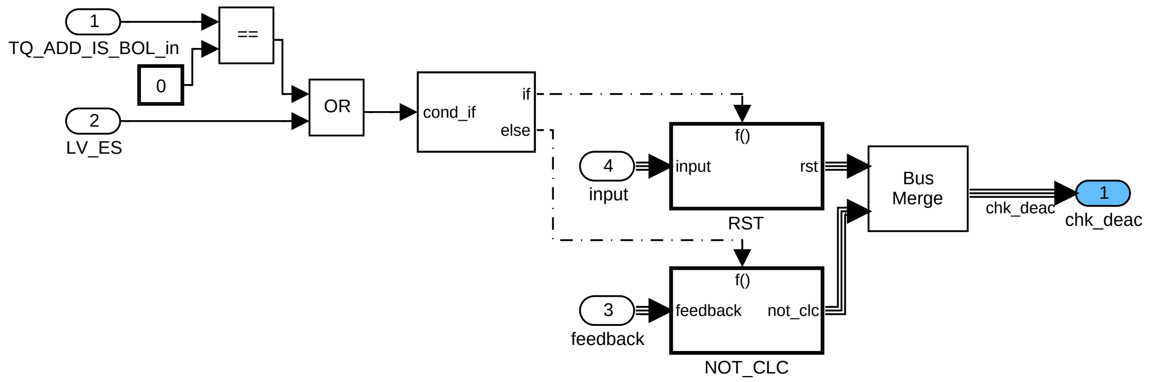

Figure 8.8.14: ENSC_M800I/OPM/CLC_TQ_ADD_IS_BOL_OPM_x/DEAC/CHK_DEAC

Reset variables during Deactivation

The following variables are initialized during event deactivation

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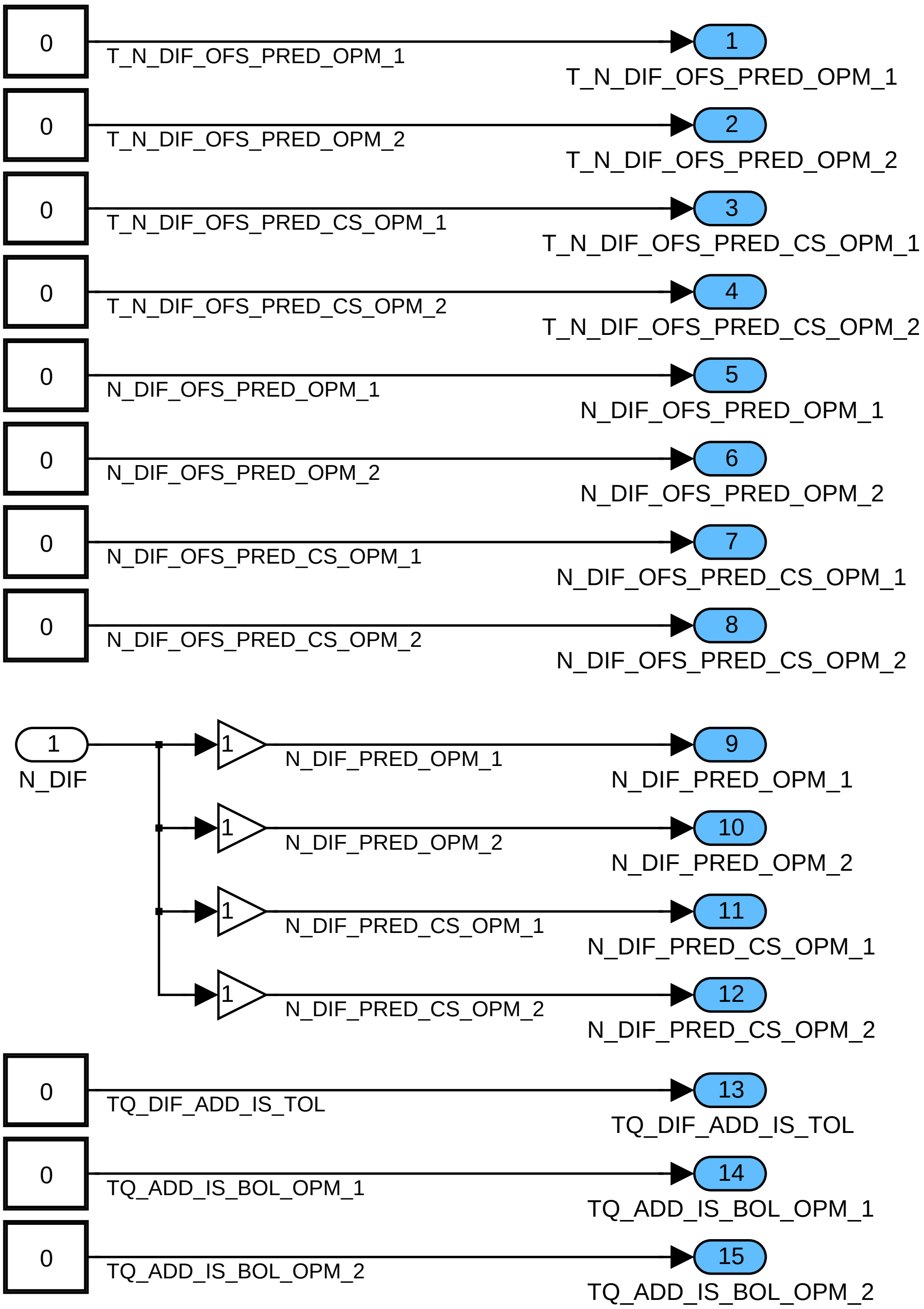

Figure 8.8.15: ENSC_M800I/OPM/CLC_TQ_ADD_IS_BOL_OPM_x/DEAC/CHK_DEAC/RST/CLC

NOT_CLC

No calculations

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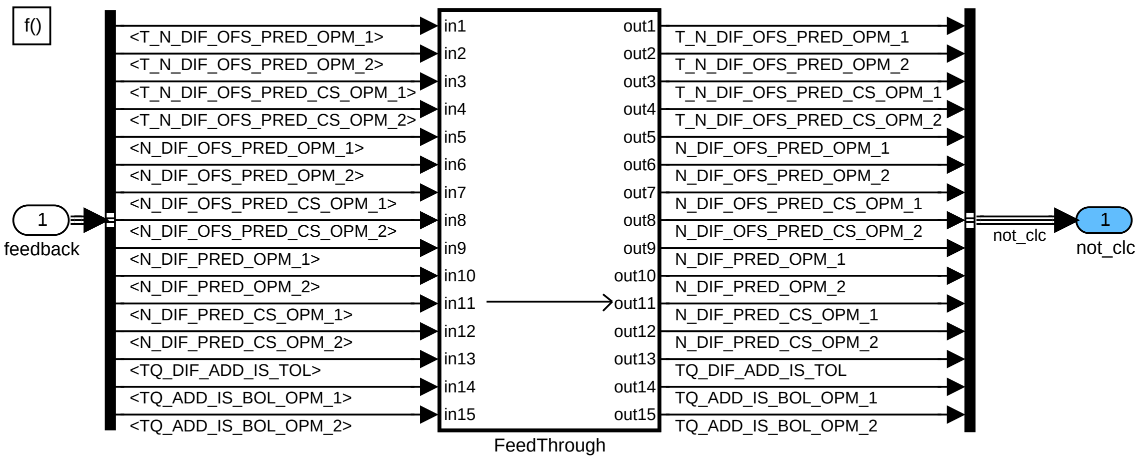

Figure 8.8.16: ENSC_M800I/OPM/CLC_TQ_ADD_IS_BOL_OPM_x/DEAC/CHK_DEAC/NOT_CLC

Ramp down TQ_ADD_IS_BOL_SEL

Calculations for TQ_ADD_IS_BOL_SEL

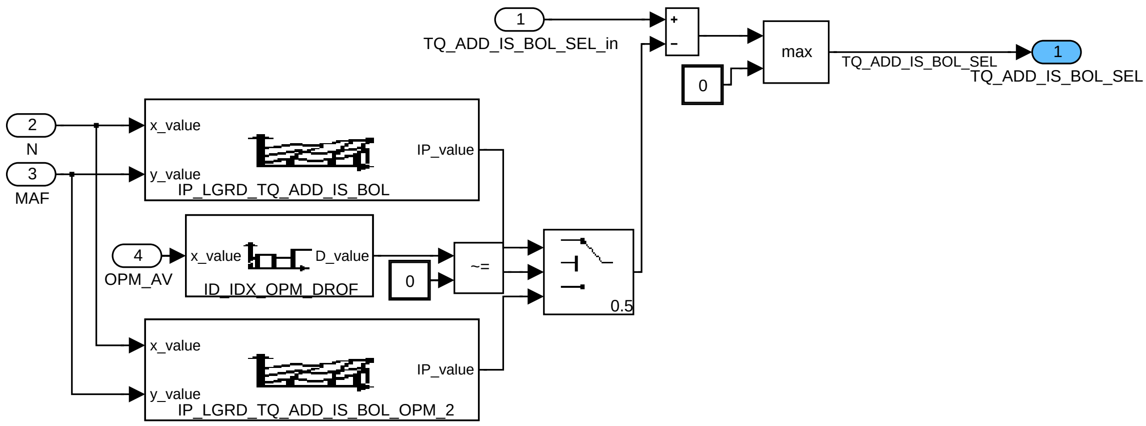

Figure 8.8.17: ENSC_M800I/OPM/CLC_TQ_ADD_IS_BOL_OPM_x/DEAC/
RAMP_DOWN_TQ_ADD_IS_BOL_SEL/CLC

PT1 Filter to limit negative gradient

For negative gradients of TQ_ADD_IS_BOL_SEL a PT1filter for TQ_ADD_IS_BOL calculation is applied to avoid torque jumps caused by fast changes of ignition angle. For positive gradients of the input TQ_ADD_IS_BOL_SEL the output value TQ_ADD_IS_BOL is identical to the input.

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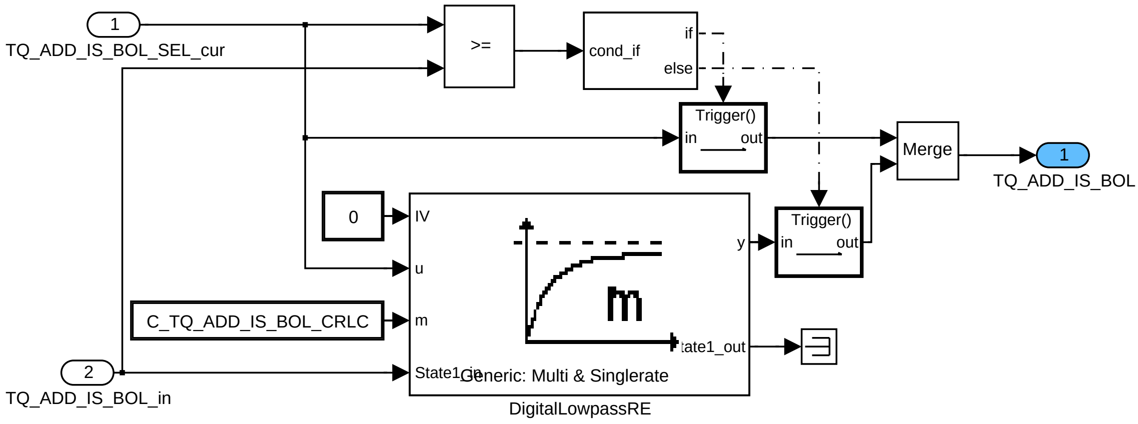

Figure 8.8.18: ENSC_M800I/OPM/PT1_FIL/CLC

Limitation of idle speed torque reserve

Idle speed torque reserve for stabilizing the ISC at high torque reserves

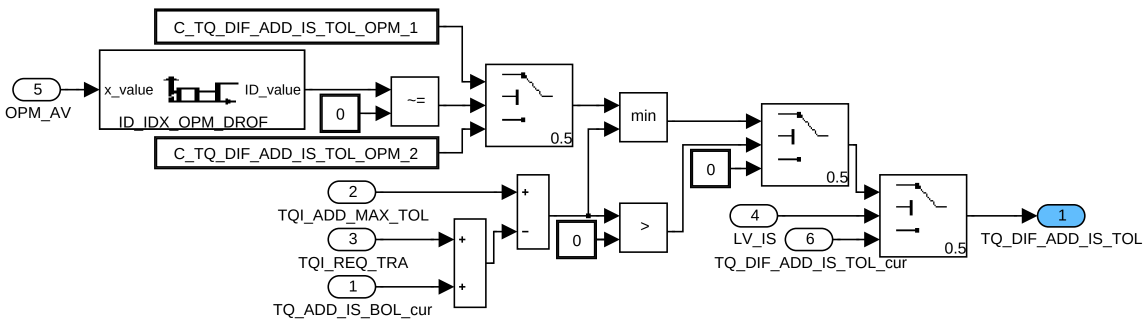

Figure 8.8.19: ENSC_M800I/OPM/LIM_IS_TQ/CLC

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8.9 Torque reserve for canister purge at idle

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_ADD_CP	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for canister purge at idle					

Input data:

CL_MMV {p. 3698}	LV_HOM_RUN {p. 8136}	LV_IS {p. 1720}	STATE_CP {p. 3637}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_TQ_ADD_CP	-	0... FFH	0... 0.99609	3.91e-3	-
Filter constant for canister purge torque reserve					
IP_TQ_ADD_CP	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_CL_MMV_IP_TQ_ADD_CP	8	0... FFH	0... 1.99218	0.0078125	-
Map for determination of TQ_ADD_CP in dependence of CL_MMV					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_TQ_ADD_CP_INH	-	0... 1H	0 ...1	1	-
Logical variable for inhibiting the torque reserve for canister purge in idle					

Input data table order: External inputs - Inputs from other EVAC modules

General Information:

The torque reserve for canister purge in idle should be active, when the canister purge function is in a controlled mode, so if STATE_CP = MAX_PURGE.
By increasing the engine load without increasing the torque output, a higher purge rate is possible.

Signal flow diagram:

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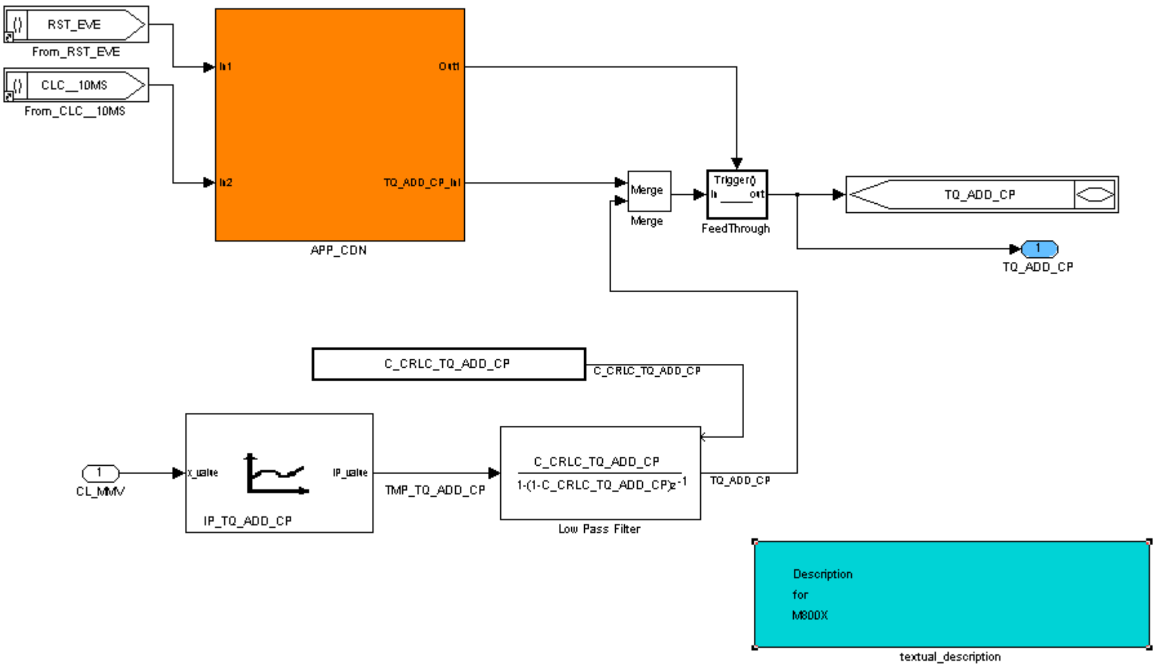

Figure 8.9.1: : Torque reserve for canister purge at idle

FUNCTION DESCRIPTION:

General information:

Activation:

LV_IS = 1
and STATE_CP = MAX_PURGE
and LC_TQ_ADD_CP_INH = 0
and LV_HOM_RUN = 1

Deactivation:

LV_IS = 0
or STATE_CP MAX_PURGE
or LC_TQ_ADD_CP_INH = 1
or LV_HOM_RUN = 0

Initialization: at reset or deactivation

TQ_ADD_CP = 0

Recurreny: **20** ms

Formula section:

TMP_TQ_ADD_CP = IP_TQ_ADD_CP (CL_MMV)

TQ_ADD_CP$_n$= // filtered value of *TMP_TQ_ADD_CP*

TQ_ADD_CP$_{n-1}$+ C_CRLC_TQ_ADD_CP * (*TMP_TQ_ADD_CP* - TQ_ADD_CP$_{n-1}$)

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8.10 Idle speed setpoint for catalyst heating

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_N_SP_IS_CH_DRI	V	0... 1H	0 ...1	1	-
Logical variable for driving position engaged (switch for N_SP_IS_CH maps)					
N_SP_IS_CH	O/V	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint for catalyst heating					

Input data:

GEAR {p. 1302}	LV_AT {p. 654}	LV_DLY_N_SP_IS {p. 6710}	LV_ST_END {p. 1720}
STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}	T_AST {p. 1766}	TCO_ST {p. 1100}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_SP_IS_CH_AST_MPLP	-	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint for stratified catalyst heating with post injection					
C_N_SP_IS_CH_AST_MPLP_DRI	-	0... 1FE0H	0... 8160	1	rpm
idle speed setpoint for stratified catalyst heating with post injection, engaged gear					
C_N_SP_IS_CH_L_HOM	-	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint for homogenous low load CH					
C_N_SP_IS_CH_L_S	-	0... 1FE0H	0... 8160	1	rpm
Idle speed setpoint for stratified low load CH					
IP_N_SP_IS_CH_AST_HOM	V	0... 1FE0H	0... 8160	1	rpm
LDPM_T_AST_5_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_5_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for homogeneous catalyst heating					
IP_N_SP_IS_CH_AST_HOM_DRI	V	0... 1FE0H	0... 8160	1	rpm
LDPM_T_AST_5_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_5_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for homogeneous catalyst heating, engaged gear					
IP_N_SP_IS_CH_AST_HOM_DRI_REV	V	0... 1FE0H	0... 8160	1	rpm
LDPM_T_AST_5_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_5_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for homogeneous catalyst heating, engaged reverse gear					
IP_N_SP_IS_CH_AST_MPLH	V	0... 1FE0H	0... 8160	1	rpm
LDPM_T_AST_5_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_5_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for homogeneous catalyst heating with multiple injection					
IP_N_SP_IS_CH_AST_MPLH_DRI	V	0... 1FE0H	0... 8160	1	rpm
LDPM_T_AST_5_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_5_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for homogeneous catalyst heating with multiple injection, engaged gear					
IP_N_SP_IS_CH_AST_MPLH_DRI_REV	V	0... 1FE0H	0... 8160	1	rpm
LDPM_T_AST_5_EXTC	8	0... FFFFH	0... 6553.5	0.1	s

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_TCO_ST_5_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for homogeneous catalyst heating with multiple injection, engaged reverse gear					
IP_N_SP_IS_CH_AST_MPLP_DRI_REV	V	0... 1FE0H	0... 8160	1	rpm
LDPM_T_AST_5_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_5_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Idle speed setpoint for stratified catalyst heating with post injection, engaged reverse gear					
LC_DRI_ACT_MT	-	0... 1H	0 ...1	1	-
Usage of gear-dependency of N_SP_IS_CH-maps for manual transmision					

Overview

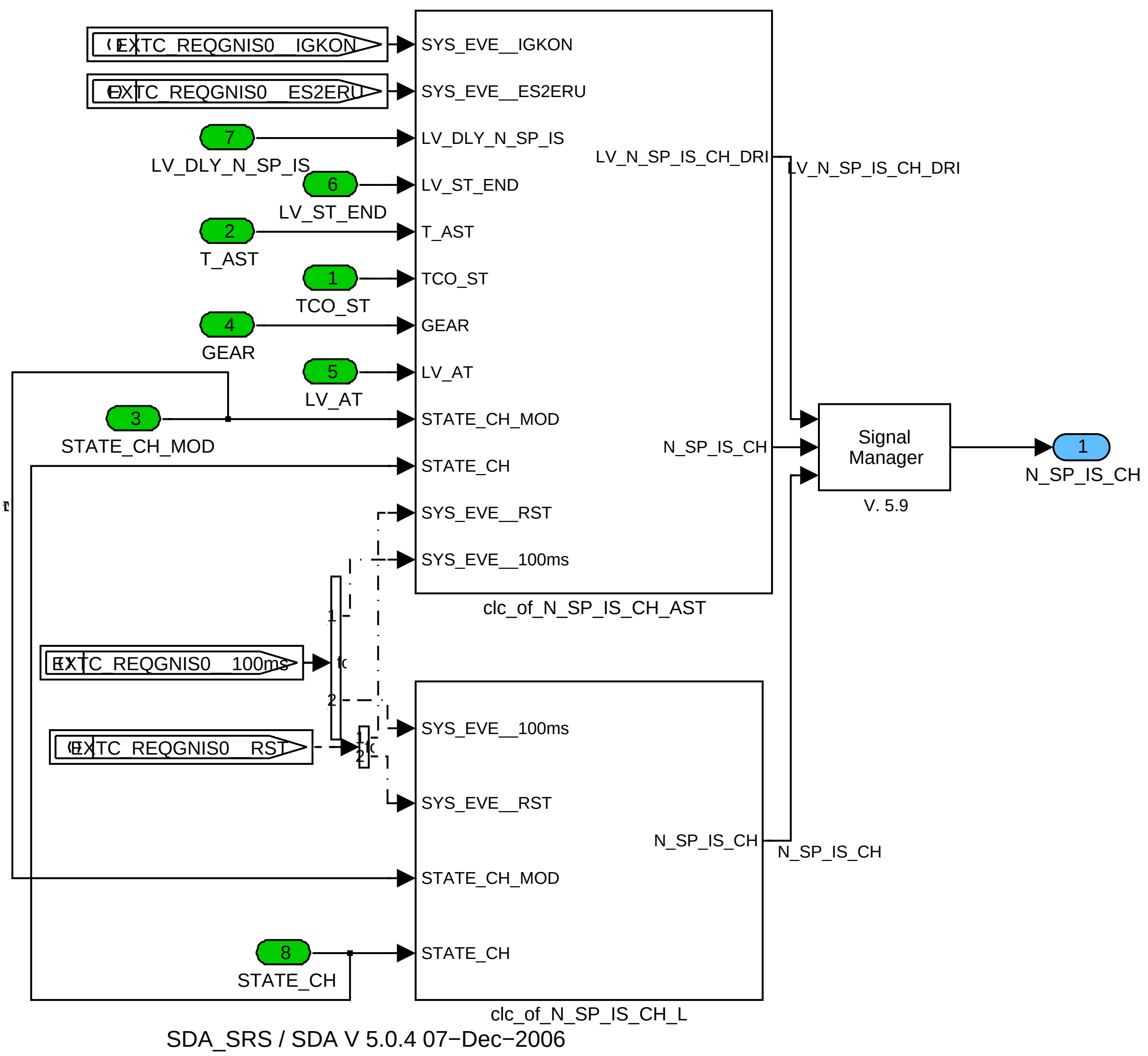

Figure 8.10.1: : Path: EXTC_REQGNIS0

General Information

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For catalyst heating an increased idle speed is needed. In this modul there is a setpointcalculation for each strategy which is only calculated if actually needed.

N_SP_IS_CH is initialized with 0 because N_SP_IS is generated by a maximum-selection.

8.10.1 After start catalyst heating

There are several maps for engaged gear and not engaged. Via LC it is possible to use this dependency also for manual transmission.

Application Conditions

Function description

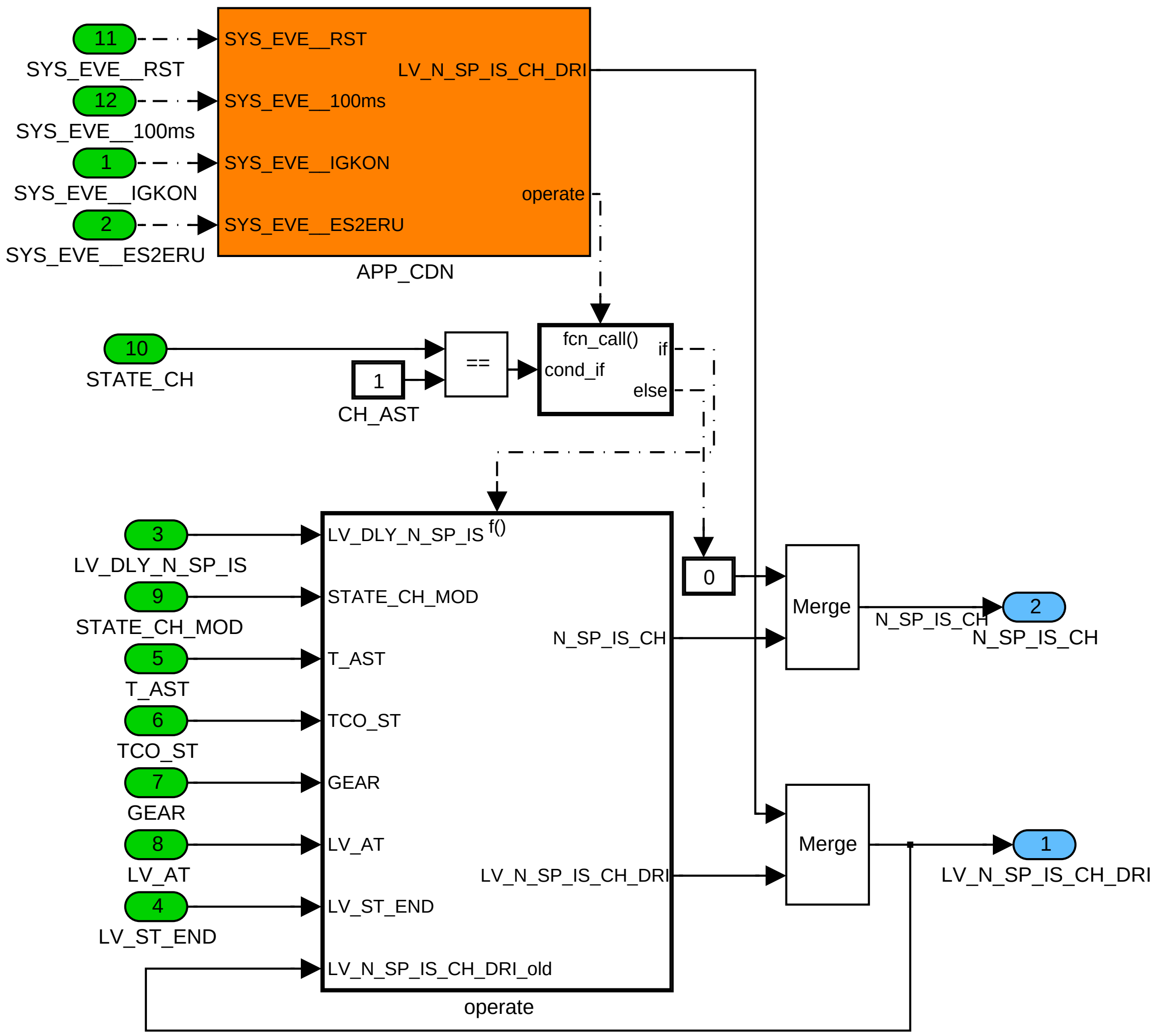

Figure 8.10.2: : Path: EXTC_REQGNIS0/clc_of_N_SP_IS_CH_AST

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8.10.1.1 Operate subsystem: after start catalyst heating

For Gear > 0 there are several maps. With LC_DRI_ACT_MT it is possible to use the duplicated maps also for manual transmission. If these maps are used once they will be used until next engine start.

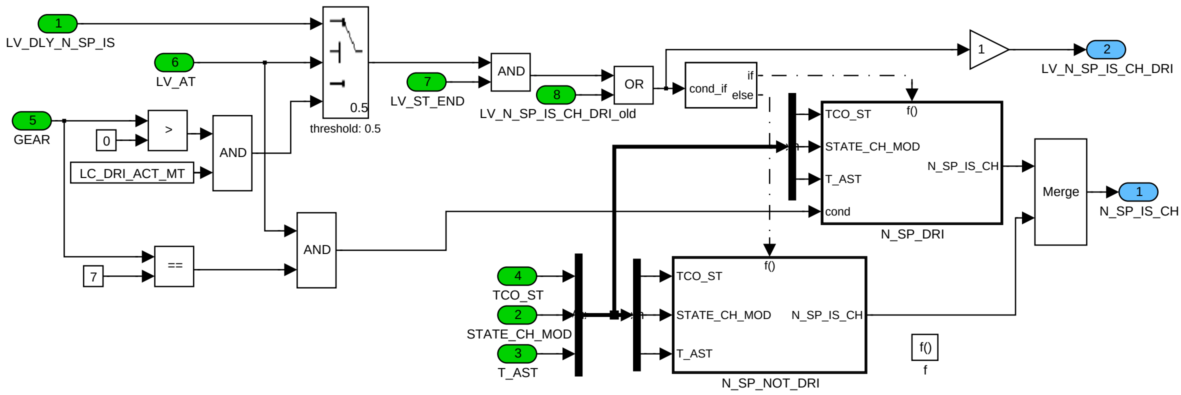

Figure 8.10.3: : Path: EXTC_REQGNIS0/clc_of_N_SP_IS_CH_AST/operate

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8.10.1.1.1 Calculation of N_SP_IS_CH

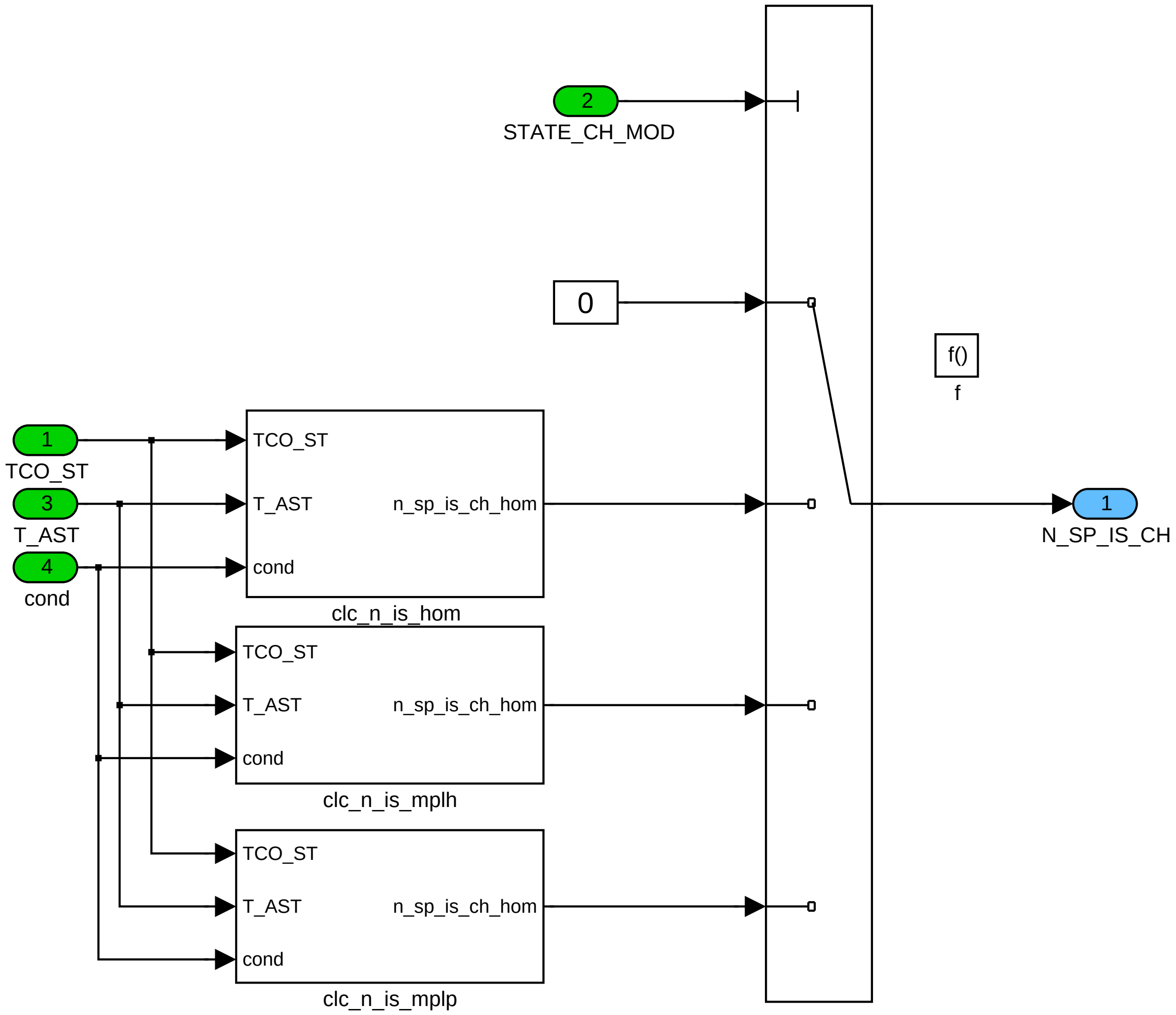

Figure 8.10.4: : Path: EXTC_REQGNIS0/clc_of_N_SP_IS_CH_AST/operate/N_SP_DRI

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8.10.1.1.1.1 Calculation of N_IS_HOM

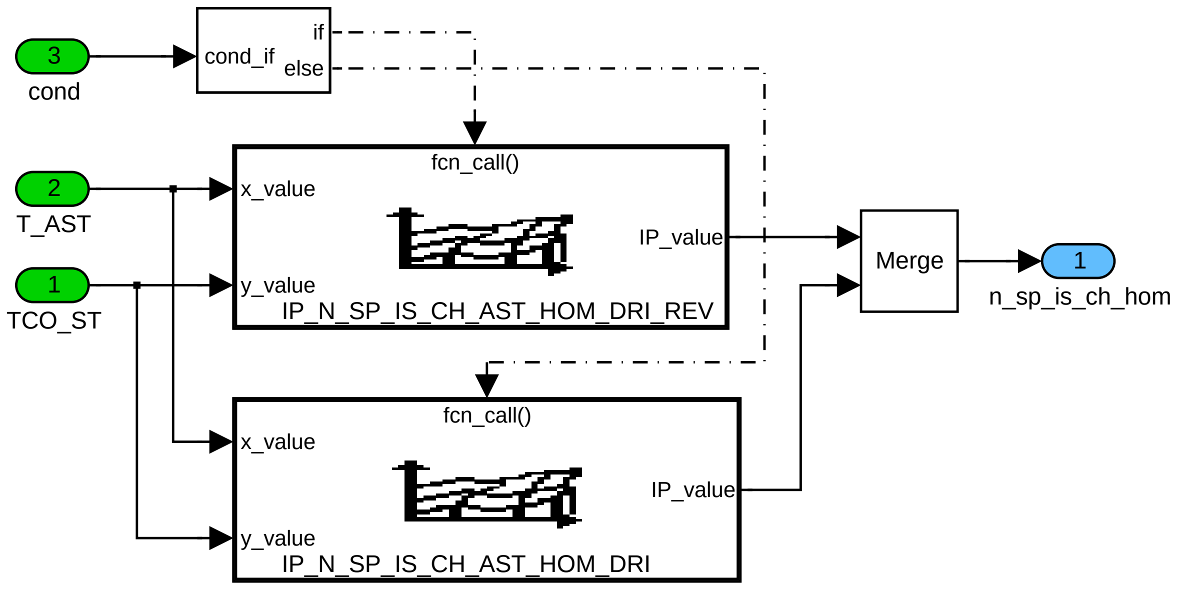

Figure 8.10.5: : Path:
EXTC_REQGNIS0/clc_of_N_SP_IS_CH_AST/operate/N_SP_DRI/clc_n_is_hom

8.10.1.1.1.2 Calculation of N_IS_MPLH

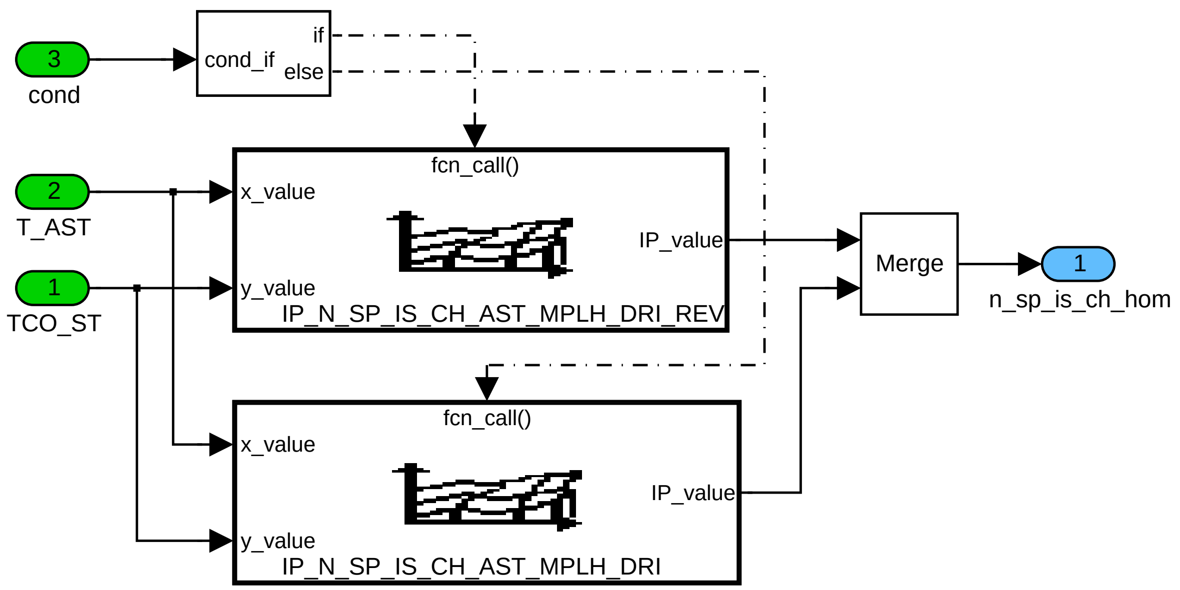

Figure 8.10.6: : Path:
EXTC_REQGNIS0/clc_of_N_SP_IS_CH_AST/operate/N_SP_DRI/clc_n_is_mplh

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8.10.1.1.1.3 Calculation of N_IS_MPLP

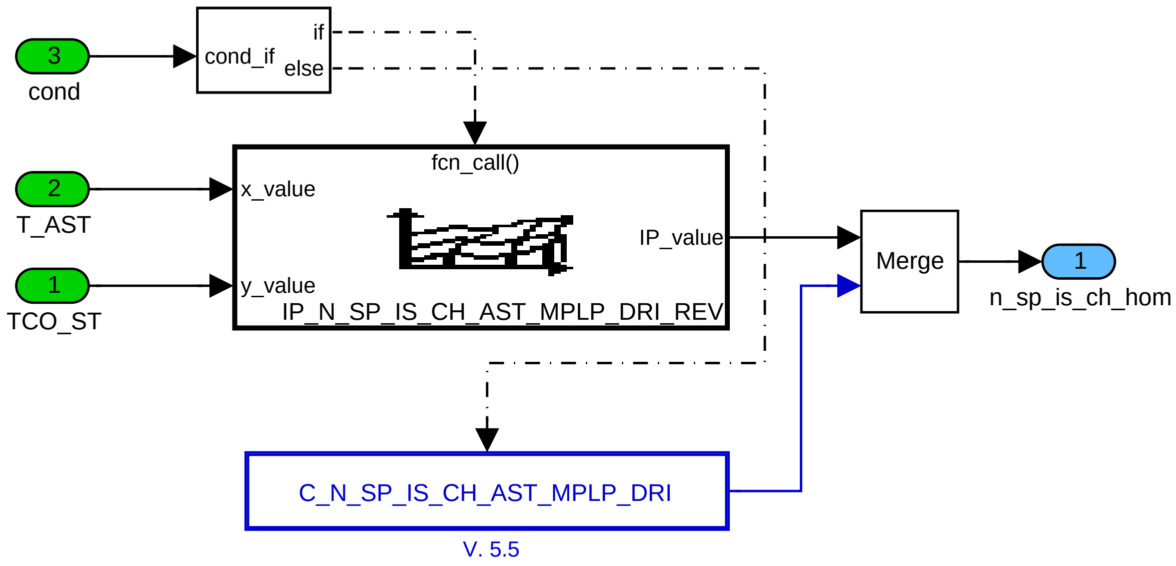

Figure 8.10.7: : Path: EXTC_REQGNIS0/clc_of_N_SP_IS_CH_AST/operate/N_SP_DRI/clc_n_is_mplp

8.10.1.1.2 Calculation of N_SP_IS_CH_AST

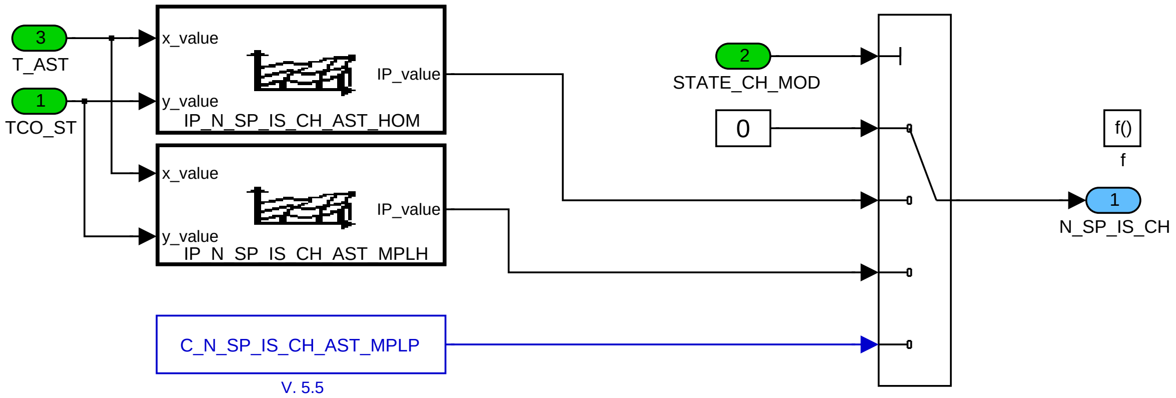

Figure 8.10.8: : Path: EXTC_REQGNIS0/clc_of_N_SP_IS_CH_AST/operate/N_SP_NOT_DRI

8.10.2 Low load catalyst heating

During low load catalyst heating there is no multiple injection in homogeneous mode.

Application Conditions

Function description

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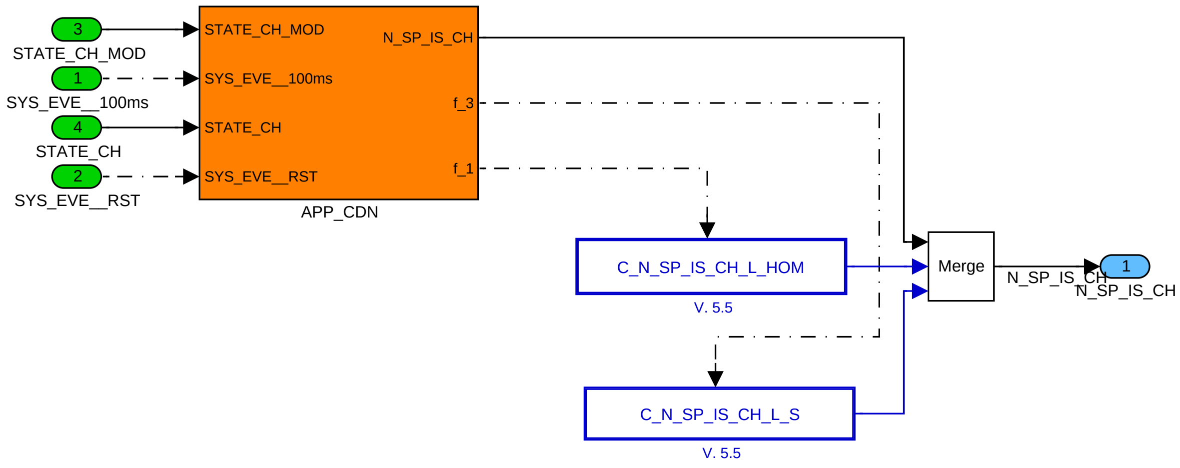

Figure 8.10.9: : Path: EXTC_REQGNIS0/clc_of_N_SP_IS_CH_L

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9 - Auxiliary functions

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9.1 Actuator setpoint selection

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
OPG_SP_ACR	O/V	0... FFFH	0... 99.9756	0.02441	%
Setpoint request after limitation for actuator position control					
OPG_SP_SEL_ACR	V	0... FFFH	0... 99.9756	0.02441	%
Setpoint request after setpoint selection for actuator position control					

Input data:

LV_OPG_SP_AD_ACR {p. 4320}	LV_OPG_SP_EXT_ACR {p. 3576}	LV_OPG_SP_LIH_ACR {p. 3576}	LV_OPG_SP_POP_ACR {p. 3576}
OPG_SP_AD_ACR {p. 4320}	OPG_SP_EXT_ACR {p. 3576}	OPG_SP_LIH_ACR {p. 3576}	OPG_SP_POP_ACR {p. 3576}
OPG_SP_REQ_ACR {p. 8197}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_OPG_SP_MAX_ACR	-	0... FFFH	0... 99.9756	0.02441	%
Upper limitation threshold of the actuator position setpoint					
C_OPG_SP_MIN_ACR	-	0... FFFH	0... 99.9756	0.02441	%
Lower limitation threshold of the actuator position setpoint					

General information

This module describes the generation of the actuator valve position setpoint for closed - loop digital position control. All setpoint requests delivered from the remaining software system are gathered, co-ordinated and filially limited in the physical limits of the actuator valve. At the end of the module the position setpoint is provided for the digital position controller directly.

Application Condition

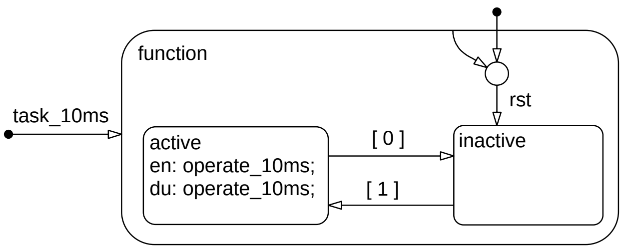

Figure 9.1.1: ACRC_setpoint_selection/APP_CDN/APP_CDN

Function Description

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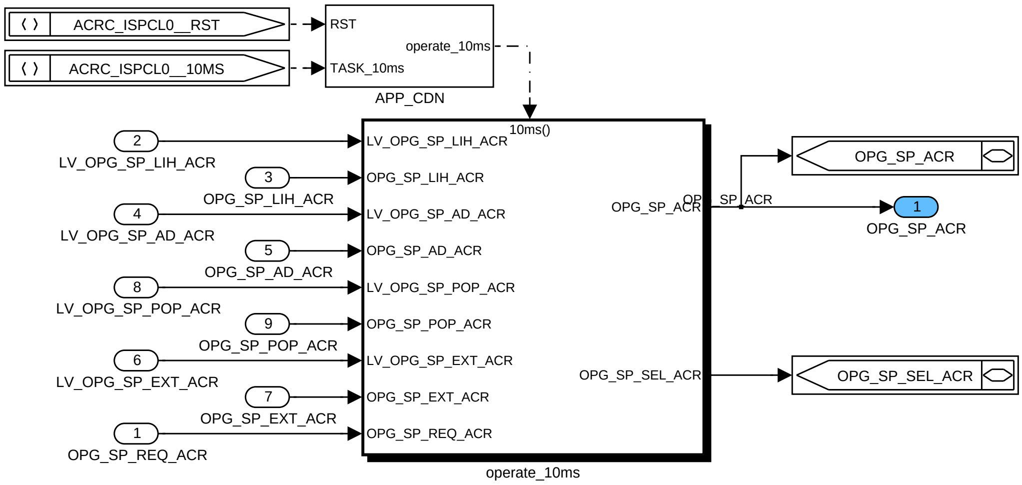

Figure 9.1.2: ACRC_setpoint_selection

9.1.1 ACRC setpoint functionality

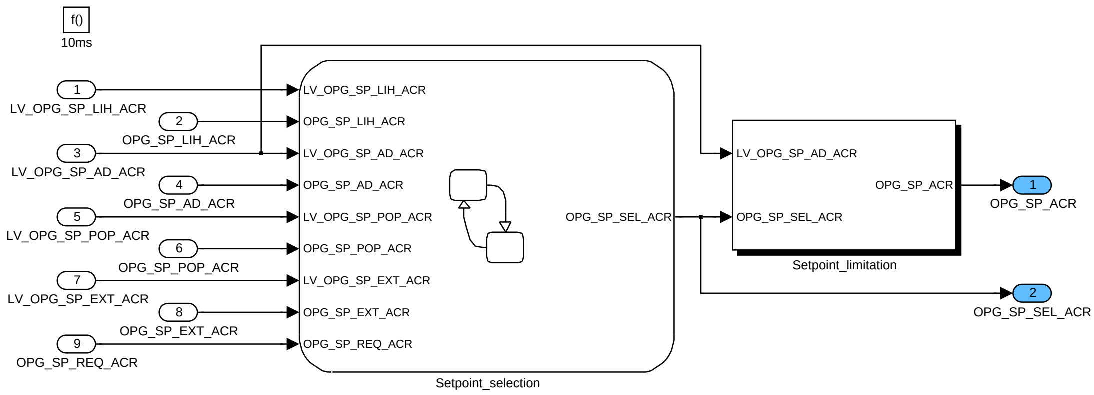

Figure 9.1.3: ACRC_setpoint_selection/operate_10ms

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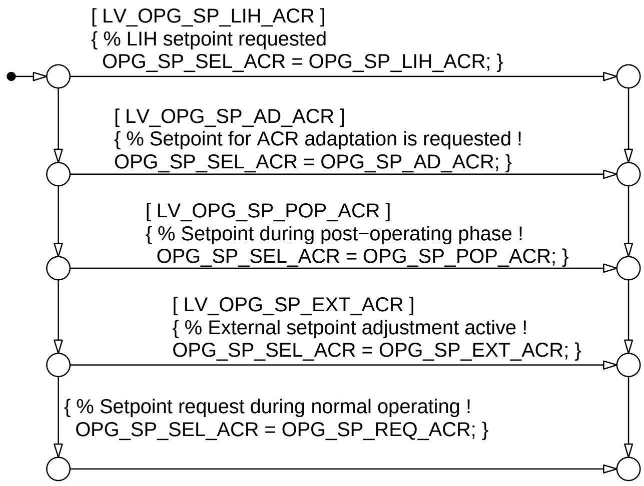

Figure 9.1.4: ACRC_setpoint_selection/operate_10ms/Setpoint_selection

Setpoint limitation

During the setpoint request from the actuator adaptation function the setpoint is not limited in increasing direction, the maximum value is 100 %.

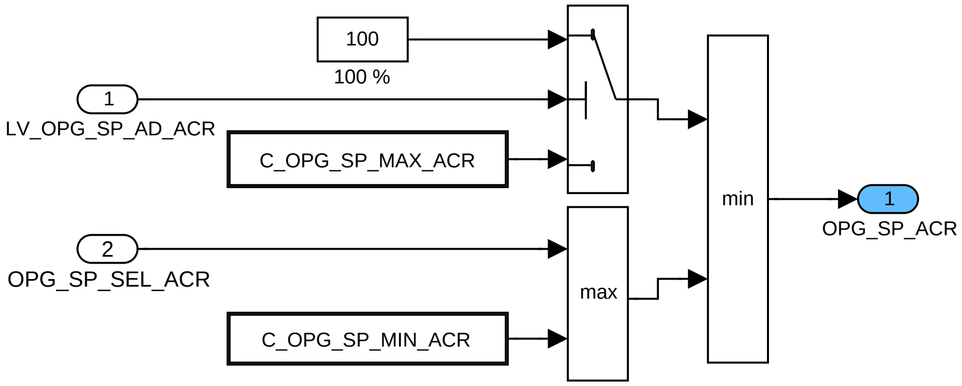

Figure 9.1.5: ACRC_setpoint_selection/operate_10ms/Setpoint_limitation

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9.2 Actuator setpoint selection (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_OPG_SP_EXT_ACR	O/V	0... 1H	0 ...1	1	-
Logical variable indicates a external setpoint request for actuator position control					
LV_OPG_SP_LIH_ACR	O/V	0... 1H	0 ...1	1	-
Logical variable indicates a LIH setpoint request for actuator position control					
LV_OPG_SP_POP_ACR	O/V	0... 1H	0 ...1	1	-
Logical variable indicates a setpoint request during the post operating phase for actuator position control					
OPG_SP_EXT_ACR	O/V	0... FFFH	0... 99.9755859	0.02441	%
External position setpoint for actuator position control					
OPG_SP_LIH_ACR	O/V	0... FFFH	0... 99.9755859	0.02441	%
Limp home position setpoint for actuator position control					
OPG_SP_POP_ACR	O/V	0... FFFH	0... 99.9755859	0.02441	%
Position setpoint during post operating phase for actuator position control					
STATE_ACR_CTL_REQ	O/V	0H 1H 2H	PWM_OFF PWM_STAT PWM_CTL	-	-
The state variable indicates the request for digital actuator control					

Input data:

LV_ES {p. 1720}	LV_IGK {p. 906}	LV_INH_ACR_CTL_AD {p. 4320}	LV_OPG_SP_ACR_EXT_ADJ {p. 7434}
LV_OPG_SP_AD_ACR {p. 4320}	OPG_SP_ACR_EXT_ADJ {p. 7435}	OPG_SP_REQ_ACR {p. 8197}	STATE_ACR_CTL {p. 3587}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DLY_ACR_CTL	-	0... FFH	0... 255	1	-
Time delay for the deactivation of the actuator position control					
C_CTR_OPG_SP_POP_ACR	-	0... FFH	0... 255	1	-
Delay counter for the deactivation of the position controller in the post operating phase					
C_OPG_SP_EXT_ACR	-	0... FFFH	0... 99.9755859	0.02441	%
External position setpoint requested from the calibration system					
C_OPG_SP_LIH_ACR	-	0... FFFH	0... 99.9755859	0.02441	%
Position setpoint request during limp home mode has been activated					
C_OPG_SP_MIN_ACR_CTL	-	0... FFFH	0... 99.9755859	0.02441	%
Deactivation threshold for actuator position control in normal operation					
C_OPG_SP_POP_ACR	-	0... FFFH	0... 99.9755859	0.02441	%
Position setpoint request in the post operating phase					
LC_OPG_SP_EXT_ACR	-	0... 1H	0 ...1	1	-
Activation of the external setpoint adjustment made with the calibration system					

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General information

The following module shall provide all remaining actuator valve position setpoint requests for all engine operating states. At the end of the function the power stage activation condition according to position setpoint request is calculated.

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Application Condition

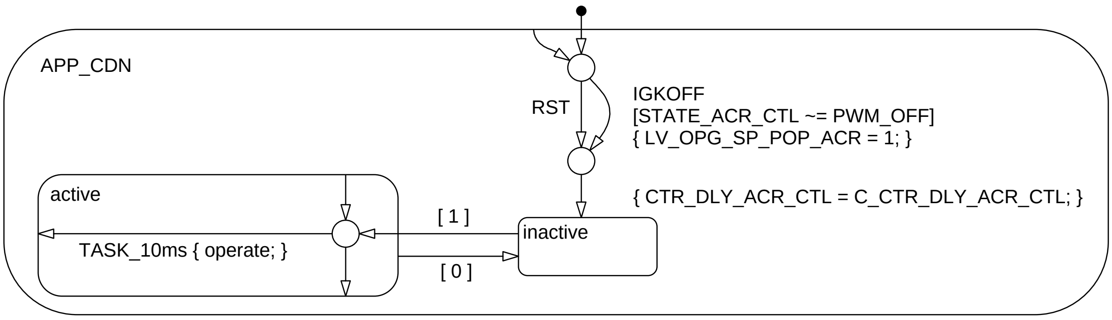

Figure 9.2.1: ACRC_setpoint_selection_ai/APP_CDN/APP_CDN

Function Description

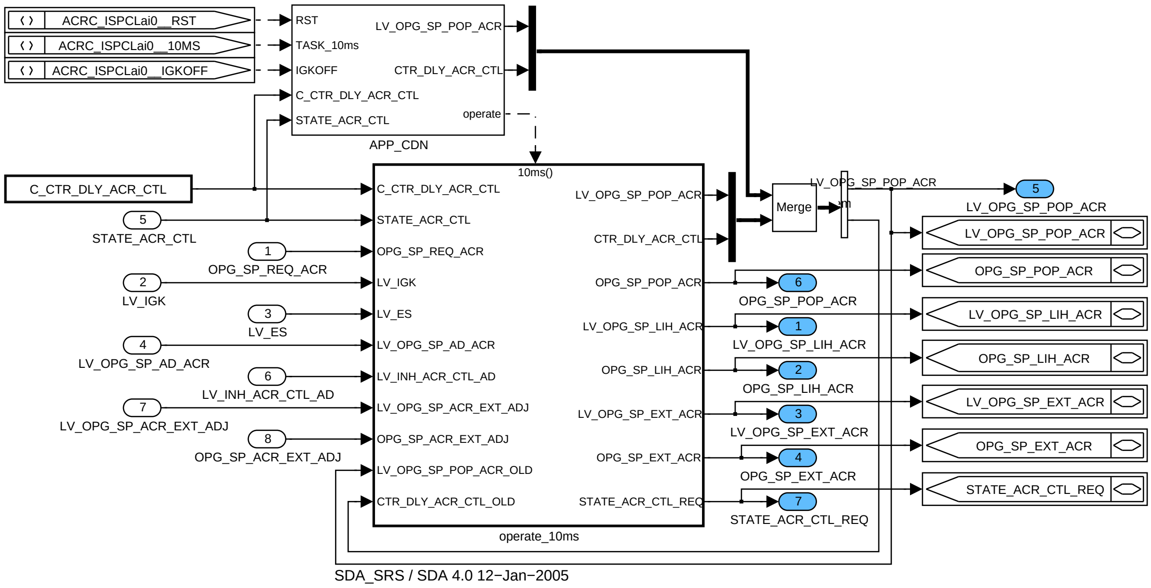

Figure 9.2.2: ACRC_setpoint_selection_ai

9.2.1 Setpoint generation

The module defines the following setpoint requests: Limp home position setpoint request active with deactivated power stage, external position setpoint request made with the calibration system and the setpoint request setpoint during post operating phase after ignition off. During the post operating phase the setpoint is set to C_OPG_SP_POP_ACR and will be removed first after a defined calibration time.
At the end of the function the power stage activation request is performed. In normal operating the transition between active and passive closed loop control is calculated here. Closed loop control will be finished after a defined delay time and position setpoint requests lower than C_OPG_SP_EXT_ACR. With passive closed loop control it is possible to deactivate the power stage via disable line or to close the actuator valve with output of a constant PWM duty cycle. The decision will be done with the logical configuration constant LC_PWM_ACR_OFF_ENA !

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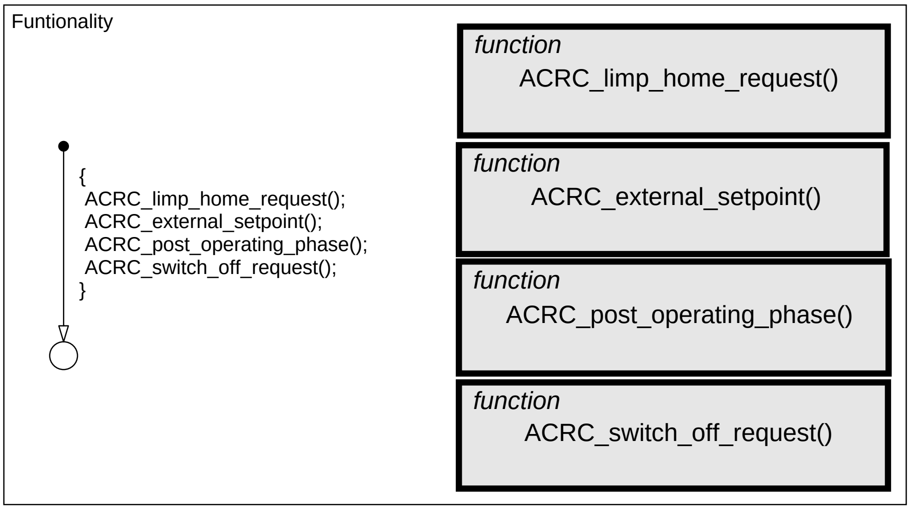

Figure 9.2.3: ACRC_setpoint_selection_ai/operate_10ms/Chart

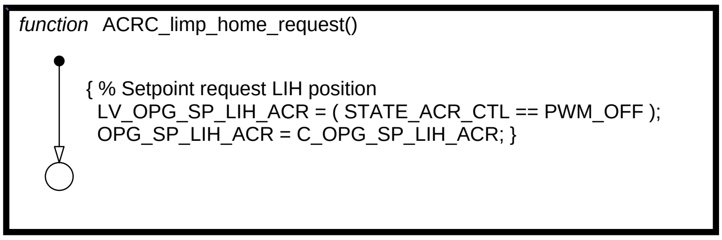

Figure 9.2.4:
ACRC_setpoint_selection_ai/operate_10ms/Chart/Funtionality/ACRC_limp_home_request

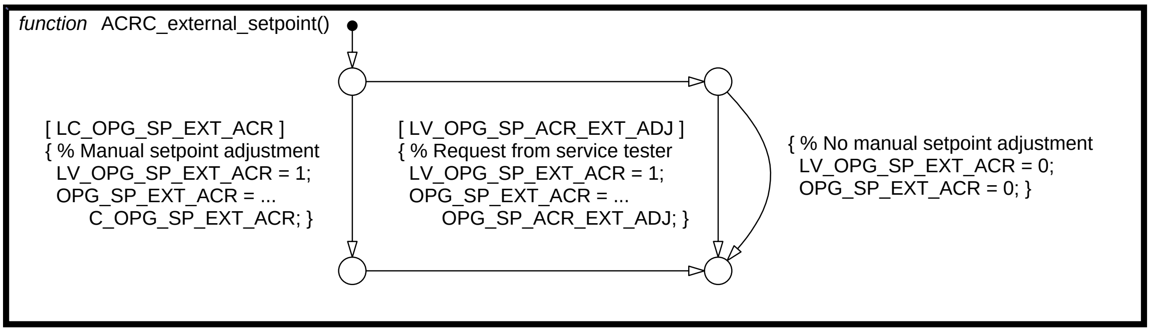

Figure 9.2.5: ACRC_setpoint_selection_ai/operate_10ms/Chart/Funtionality/ACRC_external_setpoint

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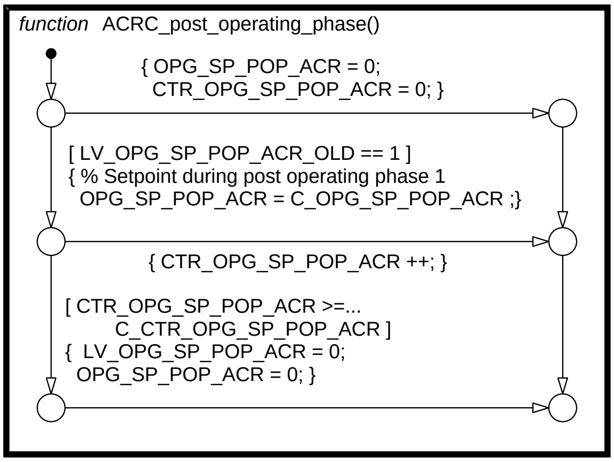

Figure 9.2.6:
ACRC_setpoint_selection_ai/operate_10ms/Chart/Funtionality/ACRC_post_operating_phase

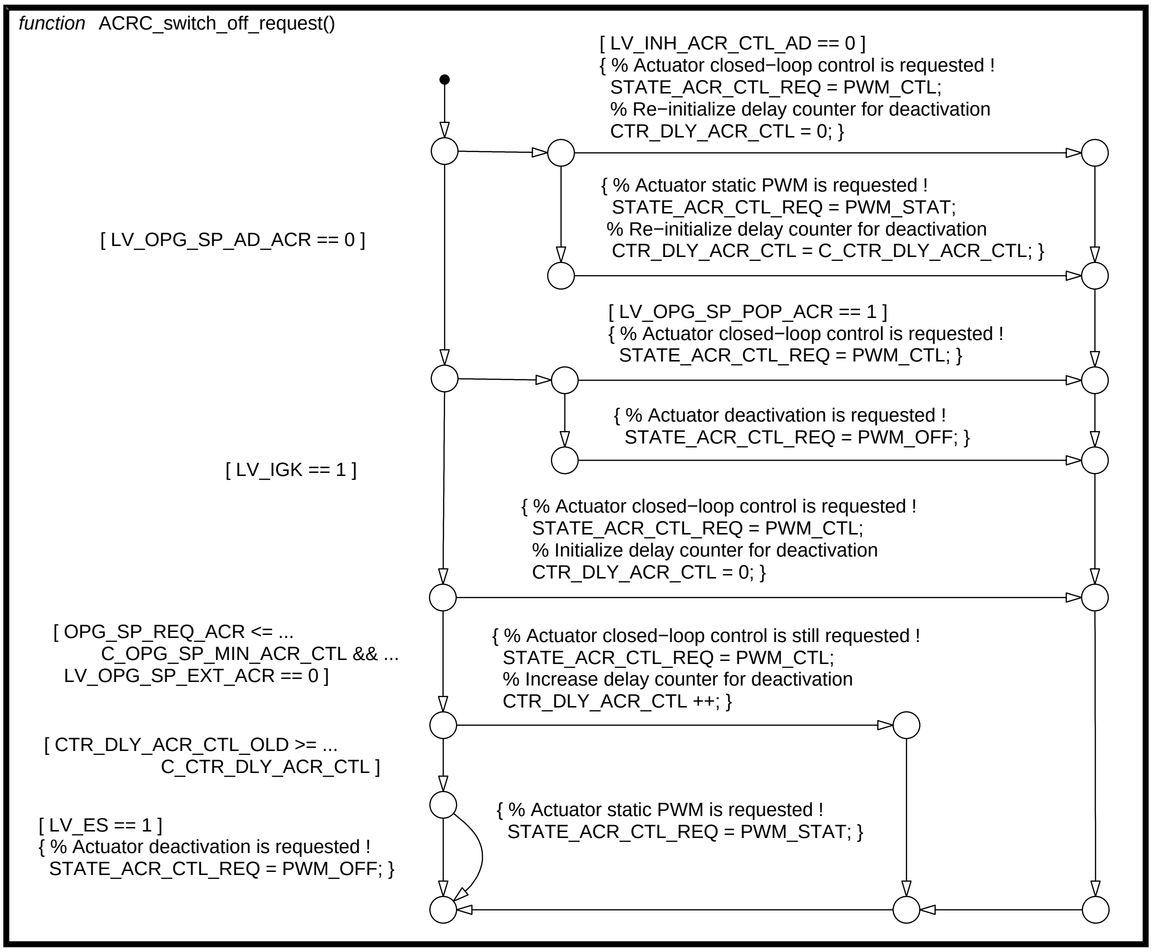

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Figure 9.2.7: ACRC_setpoint_selection_ai/operate_10ms/Chart/Funtionality/ACRC_switch_off_request

9.3 Actuator position controller

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_VB_PWM_ACR	V	0... 800H	0 ...2	97.65599e3	-
Factor for battery voltage correction					
OPG_DIF_ACR	O/V	F000... FFFH	0... 99.9756	0.02441	%
Control deviation of the digital actuator control					
OPG_SP_CTL_ACR	V	0... FFFH	0... 99.9755859	0.02441	%
Setpoint after prefilter for digital actuator control					
PWM_ACR	O/V	8000... 7FFFH	0... 99.9969	0.003052	%
Finally duty cycle of digital actuator control					

Input data:

LV_ACR_AD_ACT {p. 4333}	OPG_ACR {p. 1097}	OPG_SP_ACR {p. 3573}	STATE_ACR_CTL {p. 3587}
VB_MMV {p. 1185}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_C_1_ACR_CTL	-	8000... 7FFFH	0... 3.99987793	12.20699e3	-
Filter parameter c1 of the ACR position controller					
C_FAC_C_2_ACR_CTL	-	8000... 7FFFH	0... 3.99987793	12.20699e3	-
Filter parameter c2 of the ACR position controller					
C_FAC_C_3_ACR_CTL	-	8000... 7FFFH	0... 3.99987793	12.20699e3	-
Filter parameter c3 of the ACR position controller					
C_FAC_F_1_ACR_CTL	-	8000... 7FFFH	0... 3.99987793	12.20699e3	-
Filter parameter f1 of the ACR position controller					
C_FAC_F_2_ACR_CTL	-	8000... 7FFFH	0... 3.99987793	12.20699e3	-
Filter parameter f2 of the ACR position controller					
C_FAC_F_3_ACR_CTL	-	8000... 7FFFH	0... 3.99987793	12.20699e3	-
Filter parameter f3 of the ACR position controller					
C_FAC_K_FIL_ACR_CTL	-	0... FFFFH	0... 0.99998474	152.59e3	-
Pre filter amplification of the ACR position controller					
C_FAC_OPG_SP_ACR	-	0... FFH	0... 0.99609375	0.003906	-
Weigthing factor for setpoint rate limitation of the ACR position controller					
C_FRQ_PWM_ACR	-	0... FFFFH	0... 6553.5	0.1	Hz
Frequency of the PWM signal used for closed loop actuator control					
C_KP_ACR_CTL	-	0... 400H	0... 64	0.0625	-
Amplification factor of the ACR position controller					
C_PWM_ACR_CLOSE	-	8000... 7FFFH	0... 99.9969	0.003052	%
Static PWM duty cycle for the closing of the actuator					
C_PWM_MAX_ACR_AD	-	8000... 7FFFH	0... 99.9969	0.003052	%
Maximum value of the position controller output during actuator adaptation					
C_PWM_MAX_ACR_CTL	-	8000... 7FFFH	0... 99.9969	0.003052	%
Upper limitation threshold of the ACR position controller					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_PWM_MIN_ACR_CTL	-	8000... 7FFFH	0... 99.9969	0.003052	%
Lower limitation threshold of the ACR position controller					
C_RATE_OPG_SP_ACR	-	0... FFFH	0... 99.9755859	0.02441	%
Setpoint rate limitation threshold of the ACR position controller					
IP_FAC_VB_PWM_ACR	-	0... 800H	0 ...2	97.65599e3	-
LDP_VB_MMV_IP_FAC_VB_PWM_ACR	4	0... FFH	0... 25.8984375	0.1015625	V
Factor for battery voltage correction					
IP_PWM_ACR_STAT	-	0... FFFFH	0... 99.9969	0.003052	%
LDP_OPG_SP_ACR_IP_PWM_ACR_STAT	4	0... FFFH	0... 99.9755859	0.02441	%
Feedforward control of the ACR position controller					

Import actions:

ACTION_INFR_SetPwmDucyAcr (**IN**<Pwm_acr>)
ACTION_INFR_SetPwmFrqAcr (**IN**<Frq_pwm_acr>)

General information

This module describes the digital position controller used for the closedloop control of an electrical actuator. The position controller is carried out as a digital robust position controller. Calibration data are determined according to SiemensVDO internal position controller design algorithms. The controller algorithm is split in a 2 ms functionality for closedloop position control and a 10 ms functionality for static preload, battery voltage correction and position setpoint rate limitation.

Application Condition

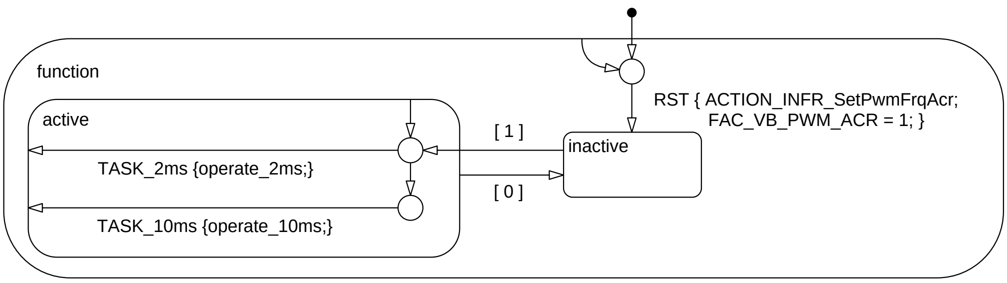

Figure 9.3.1: ACRC_position_controller/APP_CDN/APP_CDN

Function Description

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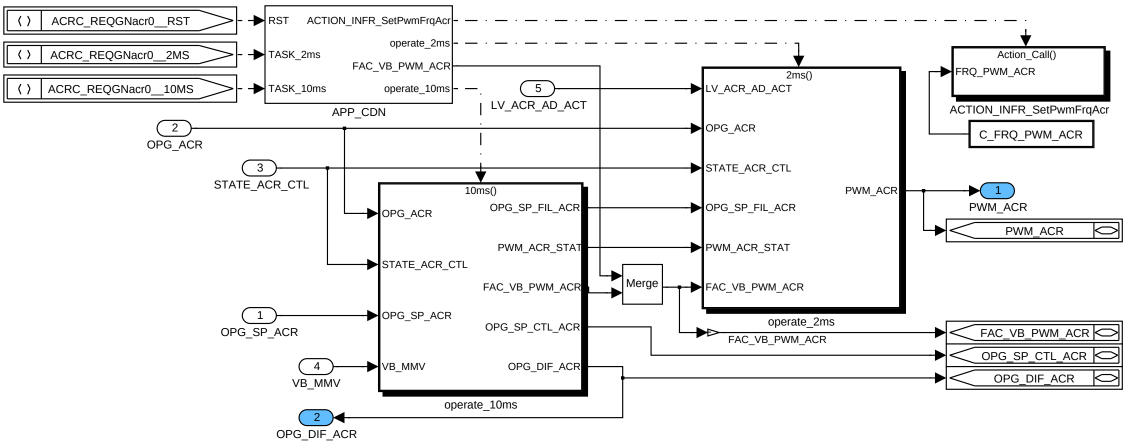

Figure 9.3.2: ACRC_position_controller

9.3.1 Functional part of 10ms

The 10 ms functionality of the position controller is only calculated if the closedloop position control has been requested. Closedloop position control will be indicated by the state PWM_CTL (= 2) of the state variable STATE_ACR_CTL.

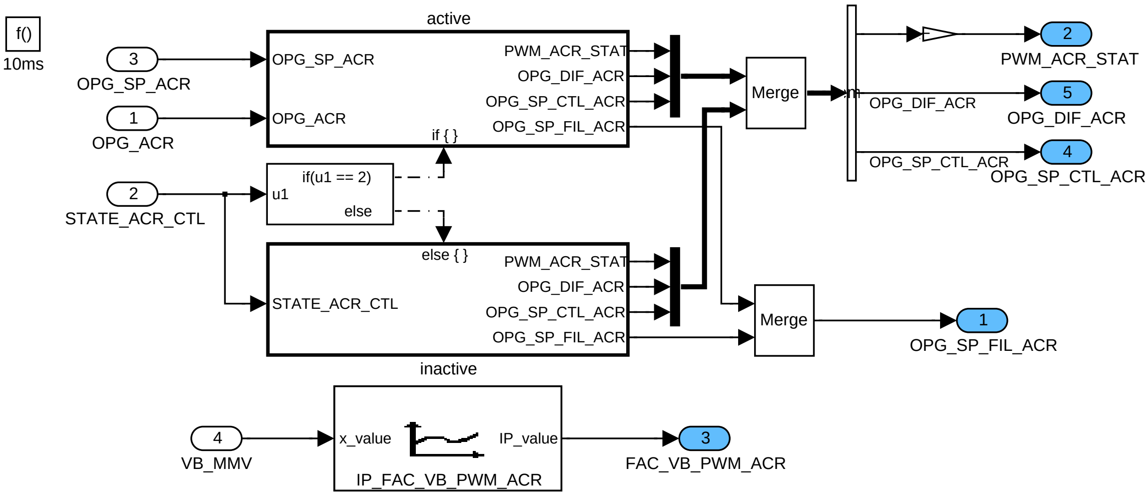

Figure 9.3.3: ACRC_position_controller/operate_10ms

ACR position controller

This function part contains the calculation of the battery correction factor, the static pre load of the position controller output and a final position setpoint filter function as a part of the closed loop position control. In the inactive state of the position control algorithm the battery voltage correction factor is set to 1, the static preload is set to C_PWM_ACR_CLOSE and all other values are set to zero.

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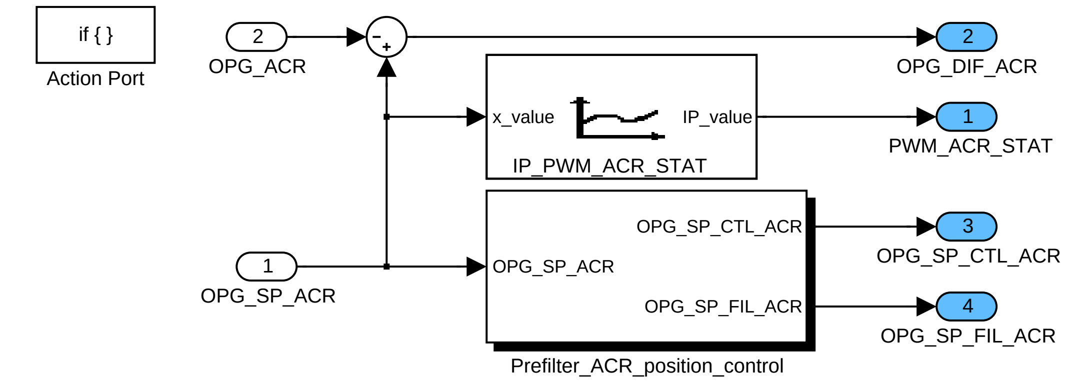

Figure 9.3.4: ACRC_position_controller/operate_10ms/active

Pre-filter functionality

The position setpoint filter function consists of a rate limitation functionality and a weighting between the described setpoint rate limitation and the direct setpoint request. The weighting can be chosen by the calibration constant C_FAC_OPG_SP_ACR. Finally the setpoint request for the digital position controller is corrected by the static transfer amplification factor C_FAC_K_FIL_ACR_CTL of the position controller filter function.

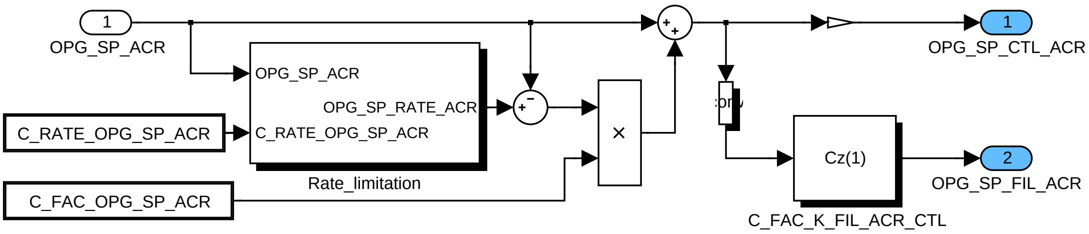

Figure 9.3.5: ACRC_position_controller/operate_10ms/active/Prefilter_ACR_position_control

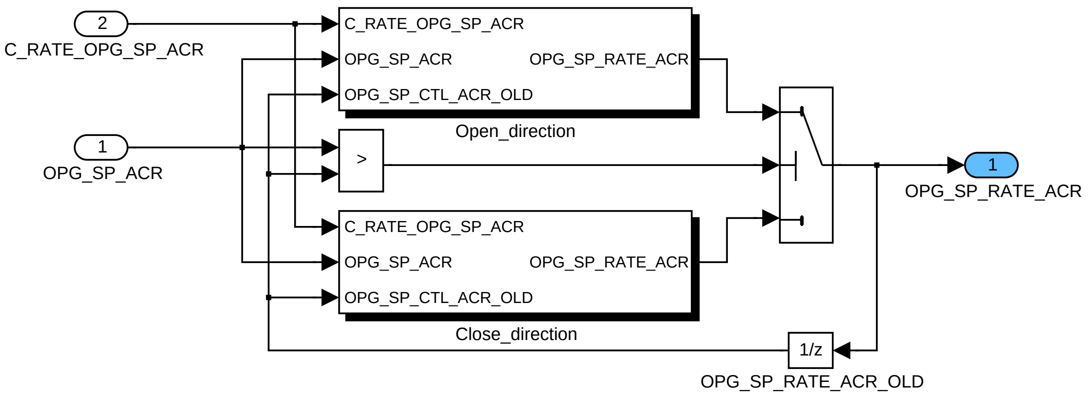

Figure 9.3.6:
ACRC_position_controller/operate_10ms/active/Prefilter_ACR_position_control/Rate_limitation

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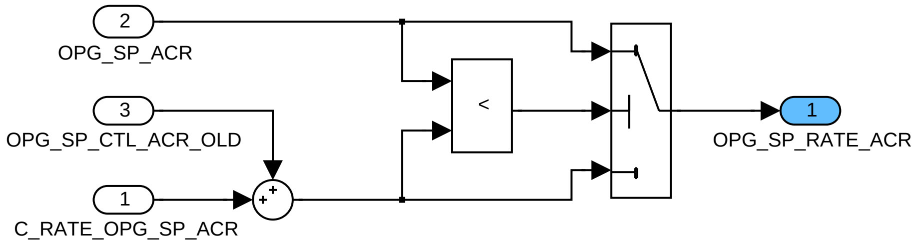


Figure 9.3.7: ACRC_position_controller/operate_10ms/active/Prefilter_ACR_position_control/Rate_limitation/Open_direction

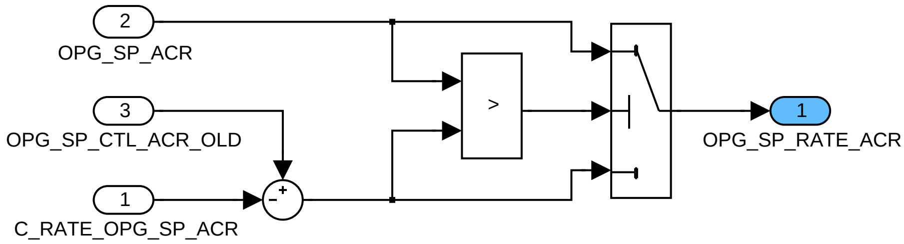
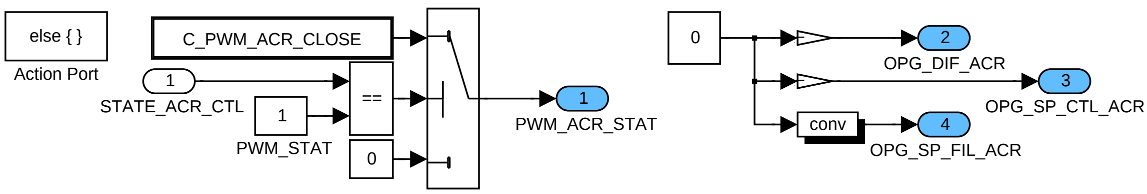


Figure 9.3.8: ACRC_position_controller/operate_10ms/active/Prefilter_ACR_position_control/Rate_limitation/Close_direction



Note: The state variable OPG_SP_RATE_ACR_OLD from the active part is also set to zero !

Figure 9.3.9: ACRC_position_controller/operate_10ms/inactive

9.3.2 Functional part of 2ms

The 2 ms functionality of the position controller is only calculated if the closedloop position control has been requested. Closedloop position control will be indicated by the state PWM_CTL (= 2)of the state variable STATE_ACR_CTL.
After the calculation of the position controller the static preload and the battery voltage correction are considered. Finally the PWM dutycycle of the position controller output will be limited between 100 % and 100 %.

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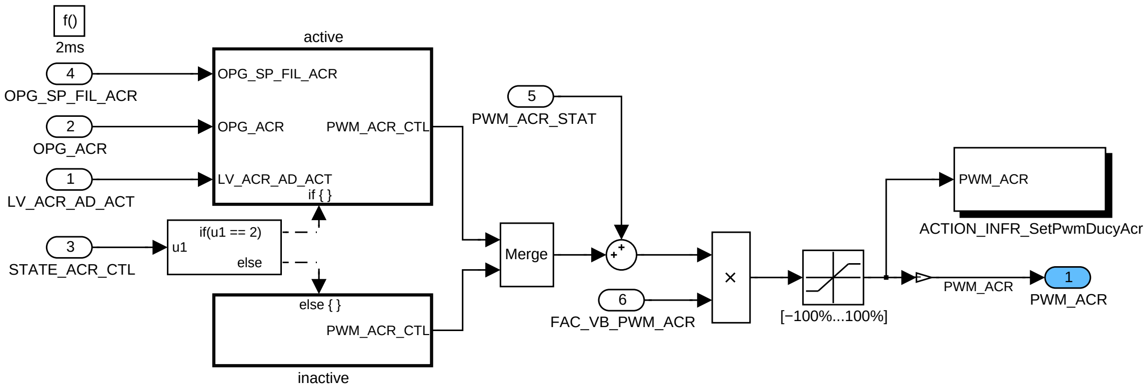
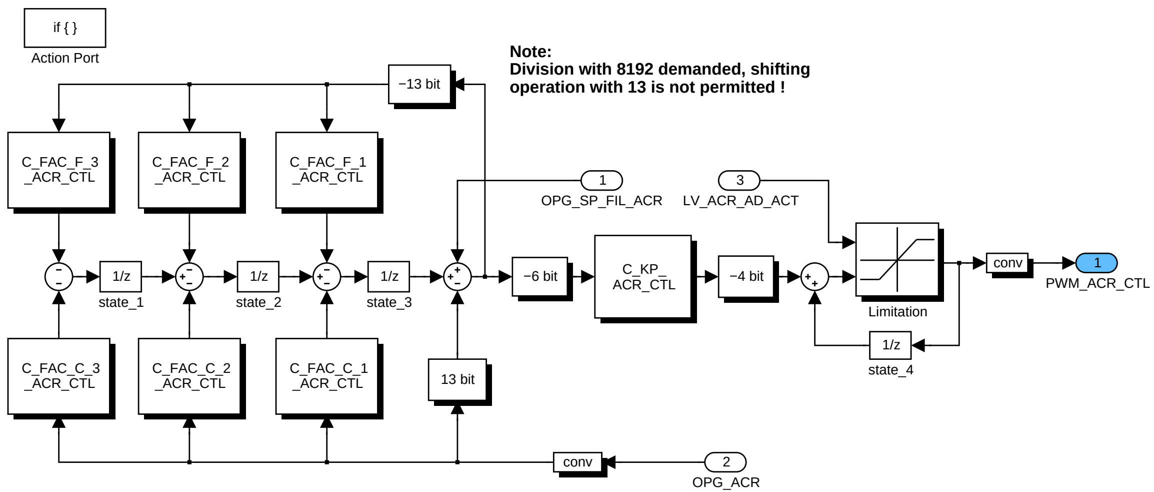


Figure 9.3.10: ACRC_position_controller/operate_2ms

ACR position controller

The position control algorithm is a robust digital position controller and based on the pole placement design. The position controller consists of a filter function third order in backwards direction and a amplification factor with integrated integrator in forward direction. The output of the integrator is limited between a lower and upper limitation threshold. In the inactive state of the controller algorithm all state variables (state_x, x = 1...4) and the controller output are set to zero.
Calibration data are determined according to SiemensVDO internal position controller design algorithms.



PWM_ACR = KP * z / (z − 1) * [C(1) / F(1) * OPG_SP_ACR − C(z) / F(z) * OPG_ACR]

C_FAC_x_y_ACR_CTL : HEX = 8000...7FFFH, DEC = −4...4, RES = 2^−13 = 1.2207e−4

C_KP_ACR_CTL : HEX = 0...400H, DEC = 0...64, RES = 2^−4 = 0.0625

Figure 9.3.11: ACRC_position_controller/operate_2ms/active

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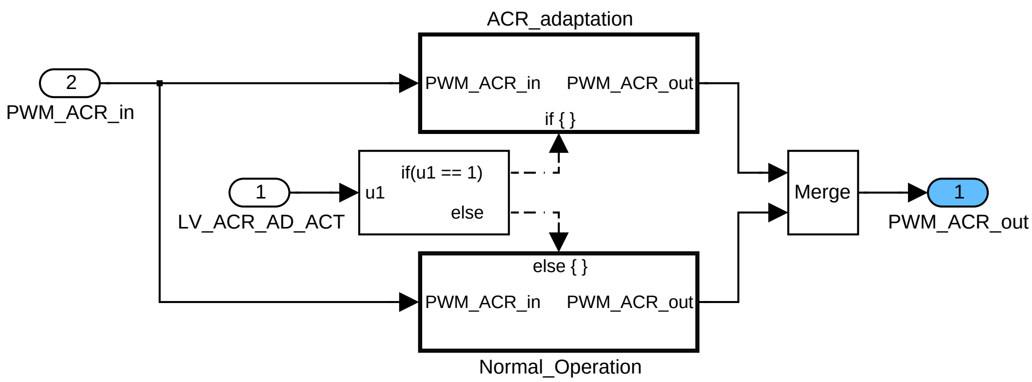


Figure 9.3.12: ACRC_position_controller/operate_2ms/active/Limitation

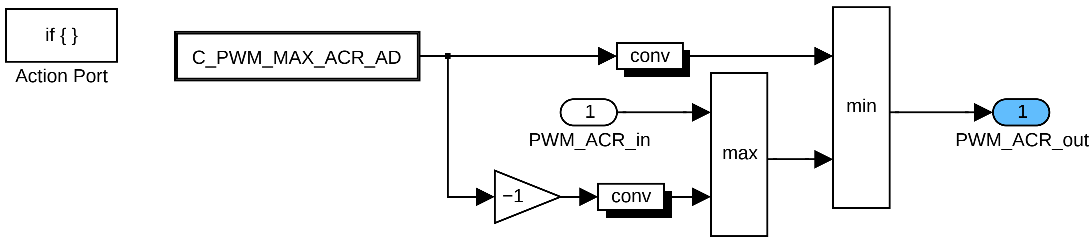


Figure 9.3.13: ACRC_position_controller/operate_2ms/active/Limitation/ACR_adaptation

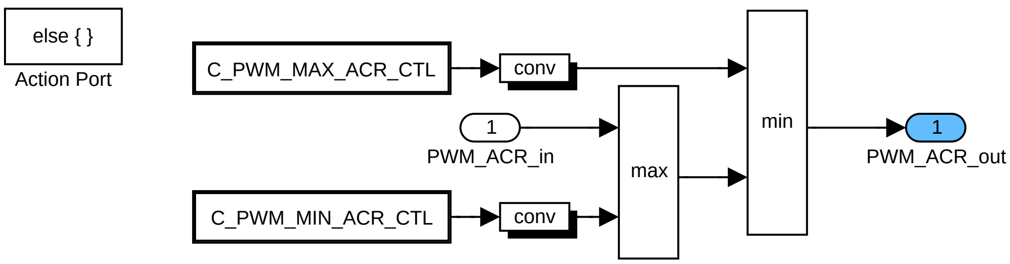
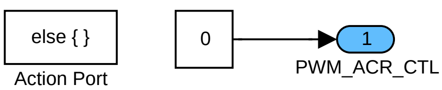


Figure 9.3.14: ACRC_position_controller/operate_2ms/active/Limitation/Normal_Operation



Note: All state variables (state_1...4) from the ACR position controller are set to zero in the inactive state !

Figure 9.3.15: ACRC_position_controller/operate_2ms/inactive

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9.4 Actuator position controller (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_ACR_CTL	O/V	0H 1H 2H	PWM_OFF PWM_STAT PWM_CTL	-	-
The state variable indicates the state of the ACR position control					

Input data:

LV_PWM_ACR_OFF_REQ {p. 4345}	STATE_ACR_CTL_REQ {p. 3576}		

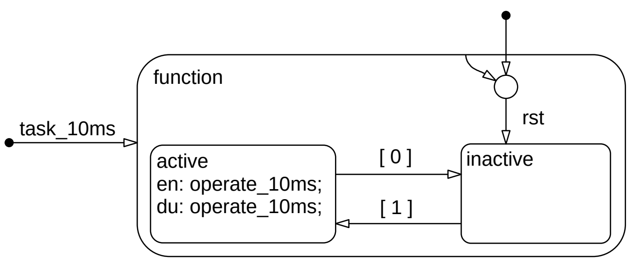
Import actions:

ACTION_INFR_DisableAcrDr ()
ACTION_INFR_EnableAcrDr ()

General information

The propose of this module is to coordinate all states of closed - loop position control. The state variable STATE_ACR_CTL indicates the current state of the actuator systems. The operating can be divided in the power stage is deactivated via disable line, the actuator is controlled means of static PWM dutycycle for active valve closing and the closed - loop position control.

Application Condition



ACRC_position_controller_ai/APP_CDN/APP_CDN

Function Description

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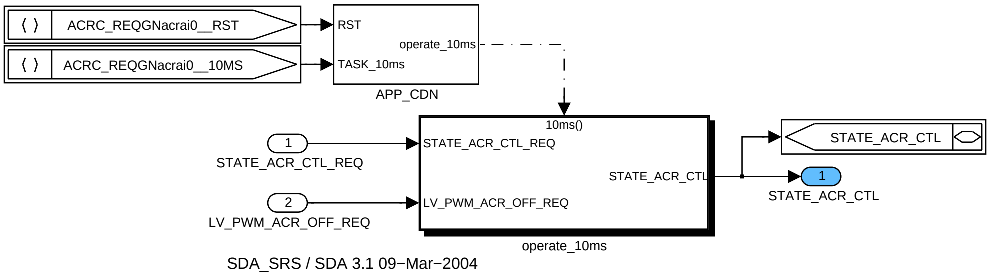
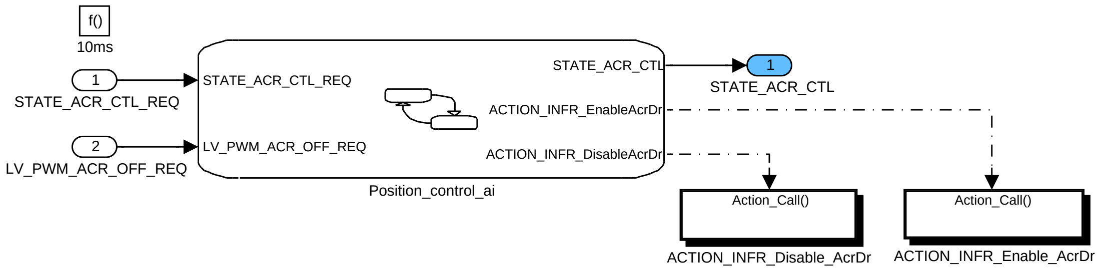
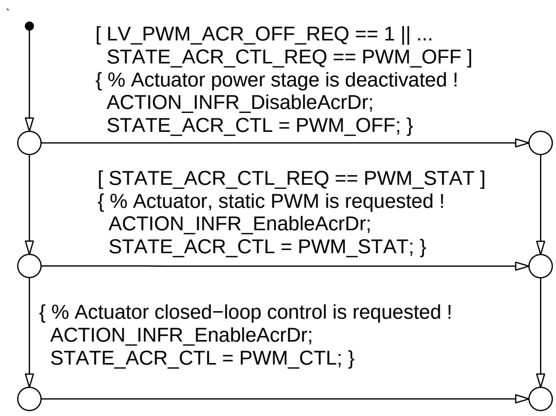


ACRC_position_controller_ai

9.4.1 Power stage coordination



ACRC_position_controller_ai/operate_10ms



ACRC_position_controller_ai/operate_10ms/Position_control_ai

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9.5 Control of air conditioner compressor (AT/MT no difference)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACCOUT_RLY	O/V	0... 1H	0 ...1	1	-
Air conditioning compressor clutch signal is enable					
LV_ACCOUT_RLY_ENA	O/V	0... 1H	0 ...1	1	-
LV indicating that the conditions for activating the ACC-relay are fulfilled					
LV_TOUT_ACC	O/V	0... 1H	0 ...1	1	-
logical variable to start deactivation of torque reserve and condition for switch off TQ_LOSS_ACC calculation					
T_ACC	O/V	0... FFFFH	0... 655.35	0.01	s
Timer for duration of transient TQ_LOSS_ACC correction					
T_ACC_DLY	O/V	0... FFH	0... 2.55	0.01	s
delay time for start of TQ_LOSS_ACC-calculation & de-/activation of the ACC-relay					

Input data:

LV_ACCIN {p. 1564}	LV_ACCOUT_RLY_ENA {p. 3589}	LV_ACCOUT_RLY_EXT_ADJ {p. 7431}	LV_ACT_ACCOUT_RLY_EXT_ADJ {p. 7432}
LV_ERR_BN_ACC {p. 4869}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_TOUT_ICL_3 {p. 802}	LV_ES {p. 1720}
LV_ST {p. 1720}	LV_SUPP_ACCIN_DIAGCPS {p. 5927}	LV_VAR_RLY_ACCOUT {p. 656}	N_32 {p. 1525}
PV_AV {p. 1269}	T_AST {p. 1766}	VS {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ACCIN_DLY_1	-	1... FFFFH	0.01... 655.35	0.01	s
Delay for ACC suppression in transition after full load					
C_ACCIN_DLY_1_LOCK_FL	-	1... FFFFH	0.01... 655.35	0.01	s
Blocking time for renewed triggering of the ACC suppression at high load					
C_ACCIN_DLY_4	-	1... FFFFH	0.1... 6553.5	0.1	s
Delay in transition from start					
C_ACCIN_DLY_5	-	1... FFFFH	0.01... 655.35	0.01	s
Delay before renewed reactivation of the ACC					
C_PVS_FL_ACCIN	-	0... FFH	0... 99.60937	0.390625	%
PV-threshold for ACC suppression					
C_T_TOUT_ACC	-	0... FFFFH	0... 655.35	0.01	s
calibration constant to start deactivation of ACC torque reserve					
C_VS_MAX_ACCIN	-	0... FFH	0... 255	1	km/h
Speed condition for ACC suppression at high load					
IP_T_ACC_DLY_OFF__N_32	-	0... FFH	0... 2.55	0.01	s
LDPM_N_32__T_ACC	3	0... FFH	0... 8160	32	rpm
Turn-Off-Delay for start of T_ACC depending on N_32					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_T_ACC_DLY_ON__N_32	-	0... FFH	0... 2.55	0.01	s
LDPM_N_32__T_ACC	3	0... FFH	0... 8160	32	rpm
Turn-On-Delay for start of T_ACC depending on N_32					

Import actions:

ACTION_INFR_SetACCOUT (**IN**<lv_accout_rly>)

9.5.1 Enabling the activation of the ACC-relay

FUNCTION DESCRIPTION:

General information:

The activation of the ACC-relay is controlled by the logical value LV_ACCOUT_RLY which is handled by this module. The A/C-ECU requests to switch the ACC-relay by LV_ACCIN. Under certain conditions the activation will be suppressed (LV_ACCOUT_RLY_ENA = 0). These conditions are
- engine stopped or start
- during time after transition from start
- during time after detecting high torque request when vehicle speed is low
- during time after last ACC-relay switch off
- CAN-Timeout (CAN11H) INSTR3-message: LV_ERR_TOUT_ICL_3
- CAN-Timeout (BN2000) IHKA-message: LV_ERR_BN_ACC
- CAN-Busoff

Activation : at every engine operating state
Deactivation : -
Initialization : LV_ACCOUT_RLY_ENA = 0 at reset
Update rate : 10 ms

Formula section:

a) If LV_ES = 1 or LV_ST = 1, then LV_ACCOUT_RLY_ENA = 0
b) If T_AST C_ACCIN_DLY_4 then LV_ACCOUT_RLY_ENA = 0
c) **If** PV_AV becomes C_PVS_FL_ACCIN when VS C_VS_MAX_ACCIN
then LV_ACCOUT_RLY_ENA = 0 for the time C_ACCIN_DLY_1 **and**
a timer (C_ACCIN_DLY_1_LOCK_FL) is started;
a renewed triggering of ACC-suppression due to condition c) is not possible:

- during the time C_ACCIN_DLY_1_LOCK_FL
- if time C_ACCIN_DLY_1_LOCK_FL has passed but the state FL has not been exited since last triggering due to c)

d) If time after last ACC-relay switch off C_ACCIN_DLY_5
then LV_ACCOUT_RLY_ENA = 0
This condition d) is not valid, if a blocking due to condition c) ends.

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h) If LV_ERR_BN_ACC = 1 then LV_ACCOUT_RLY_ENA = 0

i) If LV_ERR_TOUT_ICL_3 = 1 then LV_ACCOUT_RLY_ENA = 0

j) If LV_ERR_CAN_BOFF = 1 then LV_ACCOUT_RLY_ENA = 0

In all other cases : LV_ACCOUT_RLY_ENA = LV_ACCIN

9.5.2 Turn-On-/Turn-Off-Delay ACC-relay

Note: The imported actions are defined in the HVAC - IRS (infrastructure requirement specification).

FUNCTION DESCRIPTION:

General information:

If the enabling conditions for activating the ACC-relay are fulfilled (LV_ACCOUT_RLY_ENA = 01) then the ACC-relay is activated (LV_ACCOUT_RLY = 01) via a turn-on-delay. The same way the ACC-relay is deactivated (LV_ACCOUT_RLY = 10) via a turn-off-delay if LV_ACCOUT_RLY_ENA = 10.
If LV_SUPP_ACCIN_DIAGCPS = 1 due to functional check CPS then the state of LV_ACCOUT_RLY is freezed.
For test purpose at assembling line or workshop the ACC-relay can be switched by a serial communication tool, if available (external adjustment). These switchings are done without the turn-on-delay, so the engine speed will show a clear reaction.

Activation : at every engine operating state
Deactivation : -
Initialization : LV_ACCOUT_RLY = 0 at reset
LV_TOUT_ACC = 1
T_ACC = FFFFH
T_ACC_DLY = FFH

Update rate : 10 ms

Signal flow diagram:

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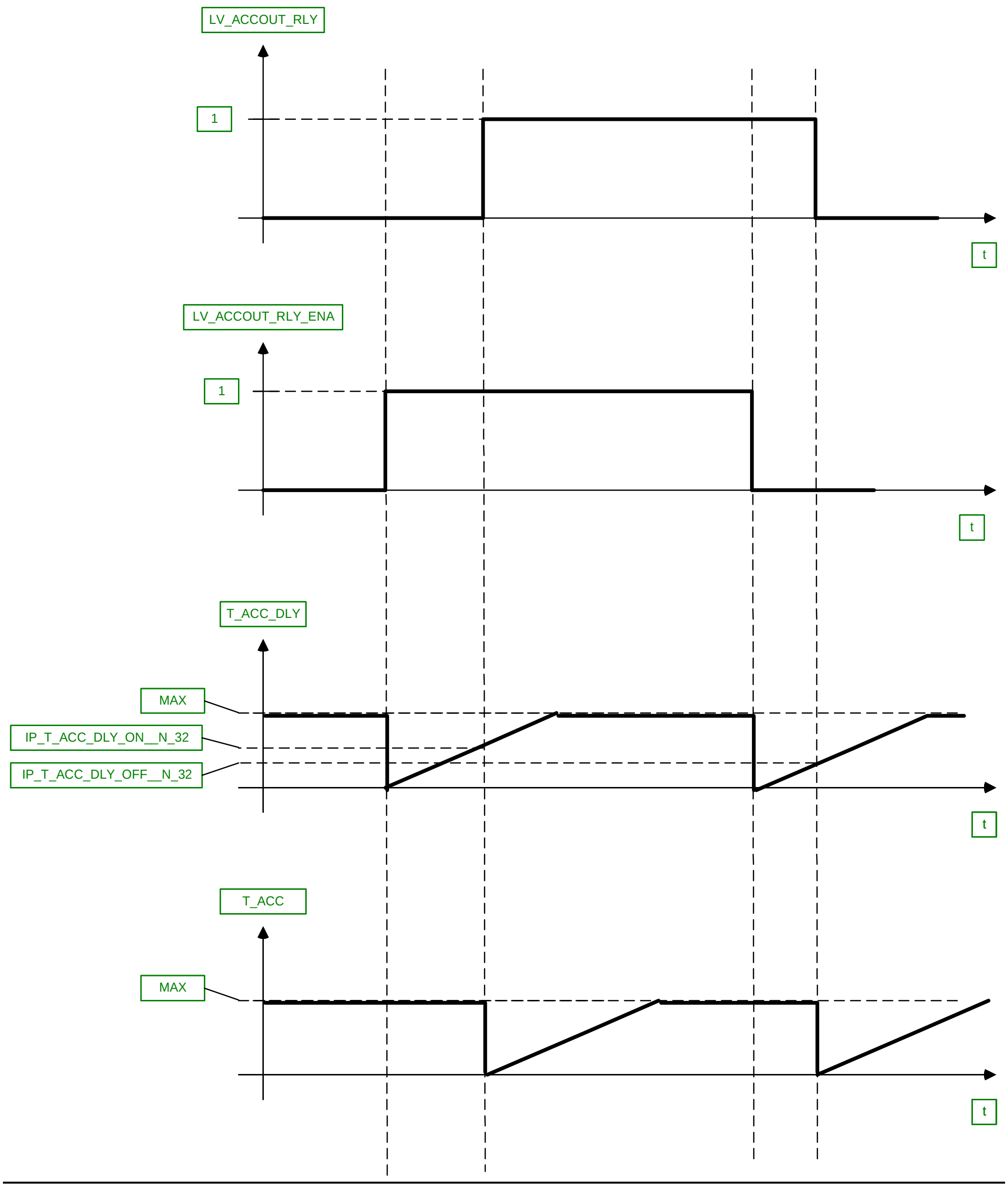

Valid, if external adjustment is not active

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Formula section:

Timer T_ACC_DLY :

IF LV_ACCOUT_RLY_ENA $_N$ <> LV_ACCOUT_RLY_ENA $_{N-1}$
THEN T_ACC_DLY = 0
ELSE **IF** T_ACC_DLY < FFH
THEN T_ACC_DLY = T_ACC_DLY + 10 ms
ENDIF
ENDIF

Turn-on-delay:

IF LV_ACCOUT_RLY_ENA = 1 **AND**
T_ACC_DLY = IP_T_ACC_DLY_ON__N_32

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THEN LV_ACCOUT_RLY = 1
ENDIF

Turn-off-delay:
IF LV_ACCOUT_RLY_ENA = 0 **AND**
T_ACC_DLY = IP_T_ACC_DLY_OFF__N_32
THEN LV_ACCOUT_RLY = 0
ENDIF

T_ACC for ramping torque loss:
IF LV_ACCOUT_RLY$_N$ $<>$ LV_ACCOUT_RLY $_{N-1}$
THEN T_ACC = 0
LV_TOUT_ACC =0
ELSE **IF** T_ACC $<$ FFFFH
THEN T_ACC = T_ACC + 10ms
ENDIF
IF T_ACC $<$ C_T_TOUT_ACC
THEN LV_TOUT_ACC = 0
ELSE LV_TOUT_ACC = 1
ENDIF
ENDIF

Freezing the state of LV_ACCOUT_RLY due to activation of DIAGCPS:

If LV_SUPP_ACCIN_DIAGCPS = 1,
then the status of LV_ACCOUT_RLY is freezed
until LV_SUPP_ACCIN_DIAGCPS = 0

LV_ACCOUT_RLY during external adjustment:

If LV_ACCOUT_RLY_EXT_ADJ = 1
then LV_ACCOUT_RLY = LV_ACT_ACCOUT_RLY_EXT_ADJ
else LV_ACCOUT_RLY determined as described before (external adjustment passive)
endif

If LV_VAR_RLY_ACCOUT = 1
then
After LV_ACCOUT_RLY calculation,
ACTION_INFR_SetACCOUT(IN $<$ LV_ACCOUT_RLY $>$**)**

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9.6 Engine cooling system control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_RAS	V	0... 1H	0 ...1	1	-
Bit used to determine if the radiator shutter should be open or closed (1 = shutter open, power off for the magnetic clamp; 0 = shutter closed, power on for the magnetic clamp)					
LV_RAS_OUT	O/V	0... 1H	0 ...1	1	-
Bit that is sent to the PIN that controls the magnetic clamp for the radiator shutter					

Input data:

LV_ACT_RAS_EXT_ADJ {p. 7432}	LV_ECRAS_UP {p. 8225}	LV_RAS_EXT_ADJ {p. 7434}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_RAS_ACT	-	0... 1H	0 ...1	1	-
Manual switch to activate or deactivate the functionality for the Radiator Shutter (RAS)					

Import actions:

ACTION_INFR_SetRas (**IN**<Lv_ras_out>)

FUNCTION DESCRIPTION:

Description:

This module contains the functionality for the control of the radiator shutter via a magnetic clamp. The output LV_RAS_OUT is sent to the PIN that controls the magnetic clamp for the radiator shutter.

Application conditions

Initialisation: *at reset all 0*

Recurrence: *100 ms*

Activation: *LC_RAS_ACT = 1*

Deactivation: *LC_RAS_ACT = 0*

Formula section:

if LV_ECRAS_UP = 1
then LV_RAS = 1
else LV_RAS = 0
endif

if LV_RAS_EXT_ADJ = 1

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then LV_RAS_OUT = LV_ACT_RAS_EXT_ADJ
else LV_RAS_OUT = LV_RAS
endif

ACTION_INFR_SetRas(LV_RAS_OUT)

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9.7 Cooling and condenser fan control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ECFPWM [NC_ECF_NR]	O/V	0... FFH	0... 99.60937	0.390625	%
Pulse width modulated output signal for the electronic controlled cooling fan(s)					
ECFPWM_IGK_OFF	O/V	0... FFH	0... 99.60937	0.390625	%
Electric fan pulse width modulation in the self-holding phase					
T_N_PERC_ECF_ACT	V	0... FFH	0... 51	0.2	s
Time condition for electric fan during self diagnostic					

Input data:

ECFPWM_ECF_EXT_ADJ {p. 7431}	ECU_STATE {p. 1091}	LV_ECFPWM_ECF_EXT_ADJ {p. 7433}	LV_ERR_ECF [NC_ECF_NR] {p. 3861}
LV_IGK {p. 906}	N_PERC_ECF {p. 8225}	NC_ECF_NR {p. 576}	T_PWL {p. 3776}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ECFPWM_ACT_ECF	-	0... FFH	0... 99.60937	0.390625	%
Min limitation ECFPWM_ECF from speed stage C_N_PERC_ACT_ECF					
C_ECFPWM_ECF_MAN	-	0... FFH	0... 99.60937	0.390625	%
Setpoint of ECFPWM_ECF; manual control					
C_N_PERC_ACT_ECF	-	0... FFH	0... 99.60937	0.390625	%
Set value for N_PERC_ECF					
C_T_ECFPWM_PWL	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time ECFPWM is sent at PWL					
C_T_N_PERC_ECF_ACT	-	0... FFH	0... 51	0.2	s
Time duration for electric fan during self diagnosis					
LC_ECFPWM_ECF_MAN	-	0... 1H	0 ...1	1	-
Constant to switch to manual ECFPWM_ECF activation					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ECFPWM_ECF_SUB_DIAG	-	0... FFH	0... 99.60937	0.390625	%
Configuration constant for ECFPWM in case of active failure					

9.7.1 Control of ECFPWM[NC_ECF_NR] with ignition key on

FUNCTION DESCRIPTION:

General information:

The electric fan is controlled with a 100 Hz PWM signal to regulate its rotational speed. The calculated pulse width modulation depends on various components which are handled by the BMW “Wärmeman-agementkoordinator”.

Application conditions

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Initialisation: `all = 0 at reset`
`T_N_PERC_ECF_ACT = C_T_N_PERC_ECF_ACT`

Recurrence: *200ms*

Activation: *LV_IGK = 1*

(see: "*ENTE scheduler*")

9.7.1.1 Calculation of PWM-signal for the electric cooling fan

Description:

All calculations which are necessary for the computation of the overall cooling fan speed are done by the BMW "Wärmemanagementkoordinator". Via layer BMW hands over the final cooling fan speed N_PERC_ECF which is already standardized to percentage.

Self-diagnosis runs each time the electric fan is switched on. The electric fan should be operated with constant, low speed stage for this.

If N_PERC_ECF > C_N_PERC_ACT_ECF **and**
T_N_PERC_ECF_ACT > 0 sec.
Then T_N_PERC_ECF_ACT is decremented
ECFPWM[0] = C_N_PERC_ACT_ECF
Else ECFPWM[0] = N_PERC_ECF
Endif

Formula section:

If (1) LV_ERR_ECF[0] = 1
then (1) ECFPWM[0] = NC_ECFPWM_ECF_SUB_DIAG
else (1)
if (2) LV_ECFPWM_ECF_EXT_ADJ = 1
then (2) ECFPWM[0] = ECFPWM_ECF_EXT_ADJ
else (2)
if (3) LC_ECFPWM_ECF_MAN = 1
then (3) ECFPWM[0] = C_ECFPWM_ECF_MAN
endif (3)
endif (2)
endif (1)
Default-value for NC_ECFPWM_ECF_SUB_DIAG = 2.37%

9.7.2 Control with ignition key off up to detection of ES and in the self-holding phase

General information:

With ignition key off until ES and in the self-holding phase of the control unit, the control frequency is switched over to 10Hz and a pulse width modulation ECFPWM_IGK_OFF is set. The power latch time is defined in Chapter Basic Software Inputs and Outputs.

Application conditions

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Recurrence: 100 ms

Activation:

```
  ECU_STATE = PWL
If          T_PWL < C_T_ECFPWM_PWL
then      ECFPWM_IGK_OFF = N_PERC_ECF
else     ECFPWM_IGK_OFF = 0
```

endif

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9.8 Exhaust gas recirculation (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACR_CTL_ENA	O/V	0... 1H	0 ...1	1	-
Logical variable for the release of ACR valve digital position control					

Input data:

LV_ERR_ACR_AD {p. 4320}	LV_ERR_ACR_CTL {p. 4337}	LV_ERR_ACR_DR {p. 4347}	LV_ERR_KNKS [NC_NR_SENS_KNK] {p. 4903}
LV_ERR_LOAD_TPS_ PLAUS {p. 1062}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP {p. 982}	LV_ERR_MAP_DIP_SHIFT {p. 4824}
LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}
LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}
LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_2 {p. 4951}
LV_FL {p. 1759}	LV_IS {p. 1720}	LV_PL {p. 1720}	LV_PWM_ACR_OFF_REQ {p. 4345}
N {p. 1525}	T_AST {p. 1766}	TCO {p. 1100}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_AST_EGR	-	0... FFFFH	0... 6553.5	0.1	s
Time delay for EGR active after start					
C_TCO_MIN_EGR	-	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for EGR-control active					
LC_ACR_CTL_ENA	-	0... 1H	0 ...1	1	-
Logical constant for the activation of actuator position control					

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General information:

The EGR-Control is activated (LV_ACR_CTL_ENA = 1), if the coolant temperature TCO is higher than a threshold value C_TCO_MIN_EGR and the engine is running at part load or idle speed (LV_FL=0). If idle speed is detected the EGR-function is activated after the time T_AST> C_T_AST_EGR.

Application conditions

Initialisation: *at RST set LV_ACR_CTL_ENA to zero !*

Recurrence: *20ms*

Activation: *at all engine operating states*

Deactivation: *no deactivation*

Formula section:

```
if      TCO > C_TCO_MIN_EGR                      and
        LV_ERR_MAF              == 0             and
        LV_ERR_MAP              == 0             and
        LV_ERR_KNKS_i           == 0             and
        LV_FL                   == 0             and
        LV_PWM_ACR_OFF_REQ      == 0             and
        LV_ERR_MAP_DIP_SHIFT    == 0             and
        LV_ERR_TPS_1            == 0             and
        LV_ERR_TPS_2            == 0             and
        LV_ERR_TPS_RATIO        == 0             and
        LV_ERR_TPS_AD           == 0             and
        LV_ERR_TPS_AD_BOL       == 0             and
        LV_ERR_TPS_MAF_1        == 0             and
        LV_ERR_TPS_MAF_2        == 0             and
        LV_ERR_TPS_ST_CHK_2     == 0             and
        LV_ERR_LOAD_TPS_PLAUS == 0               and
        LV_ERR_MTC_CTL_2        == 0             and
        LV_ERR_MTC_CTL_3        == 0             and
        LV_ERR_MTC_DR           == 0
        and
        LV_ERR_ACR_AD           == 0
        and
        LV_ERR_ACR_CTL          == 0
        and
        LV_ERR_ACR_DR           == 0
        and
        LV_ERR_MAP_TPS_PLAUS    == 0
        and
        [ (LV_IS == 1 and T_AST > C_T_AST_EGR) or LV_PL==1 ]     or
        LC_ACR_CTL_ENA          == 1
then    LV_ACR_CTL_ENA = 1
else    LV_ACR_CTL_ENA = 0
endif
```

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9.9 Camshaft setpoint for catalyst heating

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAM_SP_CH_EX	O/V	8000... 7FFFH	-768... 767.9765625	0.0234375	°CRK
Camshaft position setpoint during cat heating; exhaust					
CAM_SP_CH_IN	O/V	8000... 7FFFH	-768... 767.9765625	0.0234375	°CRK
Camshaft position setpoint during cat heating; inlet					
FAC_EFF_IGA_CH_SP	O/V	0... FFH	0... 0.99609375	3.90625e-3	-
Setpoint of factor for fading ignition angle efficiency in case of catalyst heating					
STATE_OPM_IVVT_CH	O/V	0... 2H	0 ...2	1	-
IVVT - strategy request; 0 = no request ; 1 = engine roughness-optimal ; 2 = emission-optimal					

Input data:

FAC_CAM_CH {p. 8379}	FAC_EFF_IGA_CH {p. 8379}	FAC_MAF_REL_EGR_COR {p. 8232}	LV_IS {p. 1720}
LV_SO2P_LAMB_PULS {p. 3129}	N {p. 1525}	STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}
STATE_CH_MOD_REQ {p. 1796}	T_AST {p. 1766}	TCO {p. 1100}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_OPM_IVVT_CH_L	-	0... 2H	0 ...2	1	-
IVVT - strategy request for low load catalyst heating					
ID_STATE_OPM_IVVT_CH_HOM_SO2P	V	0... 2H	0 ...2	1	-
LDP_N_ID_OPM_IVVT_CH_HOM_SO2P	6	0... 1FE0H	0... 8160	1	rpm
LDP_FAC_MAF_EGR_ID_CH_HOM_SO2P	6	0... BB8H	0... 300	0.1	%
IVVT - strategy request for catalyst heating for desulfation					
ID_STATE_OPM_IVVT_CH_MPLH_SO2P	V	1... 2H	1 ...2	1	-
LDP_N_ID_OPM_IVVT_CH_MPLH_SO2P	6	0... 1FE0H	0... 8160	1	rpm
LDP_FAC_MAF_EGR_ID_CH_MPLH_SO2P	6	0... BB8H	0... 300	0.1	%
IVVT - strategy request for catalyst heating for desulfation, multiple injection					
IP_CAM_CH_COLD_EX	V	0... FFH	-40... -135.625	-0.375	°CRK
LDPM_N_2_EXTC	10	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_2_EXTC	10	0... BB8H	0... 300	0.1	%
Outlet camshaft setpoint for catalyst heating					
IP_CAM_CH_COLD_EX_IS	V	0... FFH	-40... -135.625	-0.375	°CRK
LDPM_N_4_EXTC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_4_EXTC	10	0... BB8H	0... 300	0.1	%
Outlet camshaft setpoint for catalyst heating in idle					
IP_CAM_CH_COLD_IN	V	0... FFH	60... 155.625	0.375	°CRK
LDPM_N_2_EXTC	10	0... 1FE0H	0... 8160	1	rpm

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_FAC_MAF_REL_EGR_COR_2_EXTC	10	0... BB8H	0... 300	0.1	%
Inlet camshaft setpoint for catalyst heating					
IP_CAM_CH_COLD_IN_IS	V	0... FFH	60... 155.625	0.375	°CRK
LDPM_N_4_EXTC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_4_EXTC	10	0... BB8H	0... 300	0.1	%
Inlet camshaft setpoint for catalyst heating in idle					
IP_CAM_CH_HOM_HOT_EX	V	0... FFH	-40... -135.625	-0.375	°CRK
LDPM_N_1_EXTC	16	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_1_EXTC	10	0... BB8H	0... 300	0.1	%
Outlet camshaft setpoint for catalyst heating with single injection					
IP_CAM_CH_HOM_HOT_EX_IS	V	0... FFH	-40... -135.625	-0.375	°CRK
LDPM_N_3_EXTC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_3_EXTC	10	0... BB8H	0... 300	0.1	%
Outlet camshaft setpoint for catalyst heating with single injection in idle					
IP_CAM_CH_HOM_HOT_IN	V	0... FFH	60... 155.625	0.375	°CRK
LDPM_N_1_EXTC	16	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_1_EXTC	10	0... BB8H	0... 300	0.1	%
Inlet camshaft setpoint for catalyst heating with single injection					
IP_CAM_CH_HOM_HOT_IN_IS	V	0... FFH	60... 155.625	0.375	°CRK
LDPM_N_3_EXTC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_3_EXTC	10	0... BB8H	0... 300	0.1	%
Inlet camshaft setpoint for catalyst heating with single injection in idle					
IP_CAM_CH_MPLH_HOT_EX	V	0... FFH	-40... -135.625	-0.375	°CRK
LDPM_N_1_EXTC	16	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_1_EXTC	10	0... BB8H	0... 300	0.1	%
Outlet camshaft setpoint for catalyst heating with multiple injection					
IP_CAM_CH_MPLH_HOT_EX_IS	V	0... FFH	-40... -135.625	-0.375	°CRK
LDPM_N_3_EXTC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_3_EXTC	10	0... BB8H	0... 300	0.1	%
Outlet camshaft setpoint for catalyst heating with multiple injection in idle					
IP_CAM_CH_MPLH_HOT_IN	V	0... FFH	60... 155.625	0.375	°CRK
LDPM_N_1_EXTC	16	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_1_EXTC	10	0... BB8H	0... 300	0.1	%
Inlet camshaft setpoint for catalyst heating with multiple injection					
IP_CAM_CH_MPLH_HOT_IN_IS	V	0... FFH	60... 155.625	0.375	°CRK
LDPM_N_3_EXTC	8	0... 1FE0H	0... 8160	1	rpm
LDPM_FAC_MAF_REL_EGR_COR_3_EXTC	10	0... BB8H	0... 300	0.1	%
Inlet camshaft setpoint for catalyst heating with multiple injection in idle					
IP_FAC_EFF_IGA_CH_SP	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_T_AST_6_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_6_EXTC	8	0... FEH	-48... 142.5	0.75	°C
Setpoint of factor for fading ignition angle efficiency in case of catalyst heating					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_EFF_IGA_CH_SP_MPLH	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_T_AST_6_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_6_EXTC	8	0... FEH	-48... 142.5	0.75	°C
Setpoint of factor for fading ignition angle efficiency in case of catalyst heating with multiple injection					

General Information

In this module setpoints for the camshafts during catalyst heating are generated.

Application Conditions

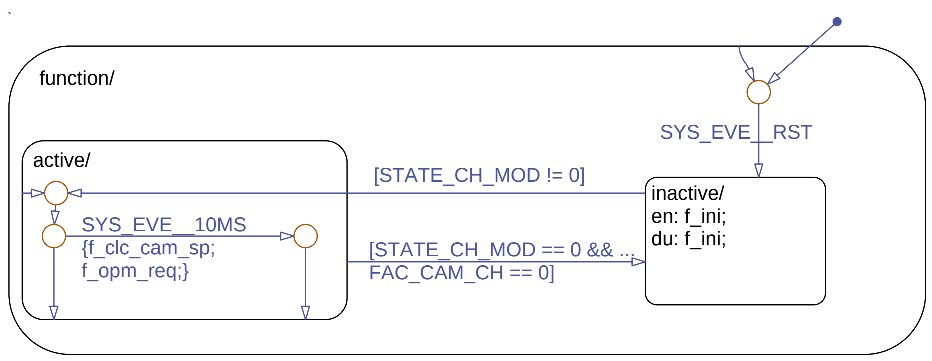

Figure 9.9.1: : Path: EXTC_REQGNcam0/APP_CDN/Chart

Function description

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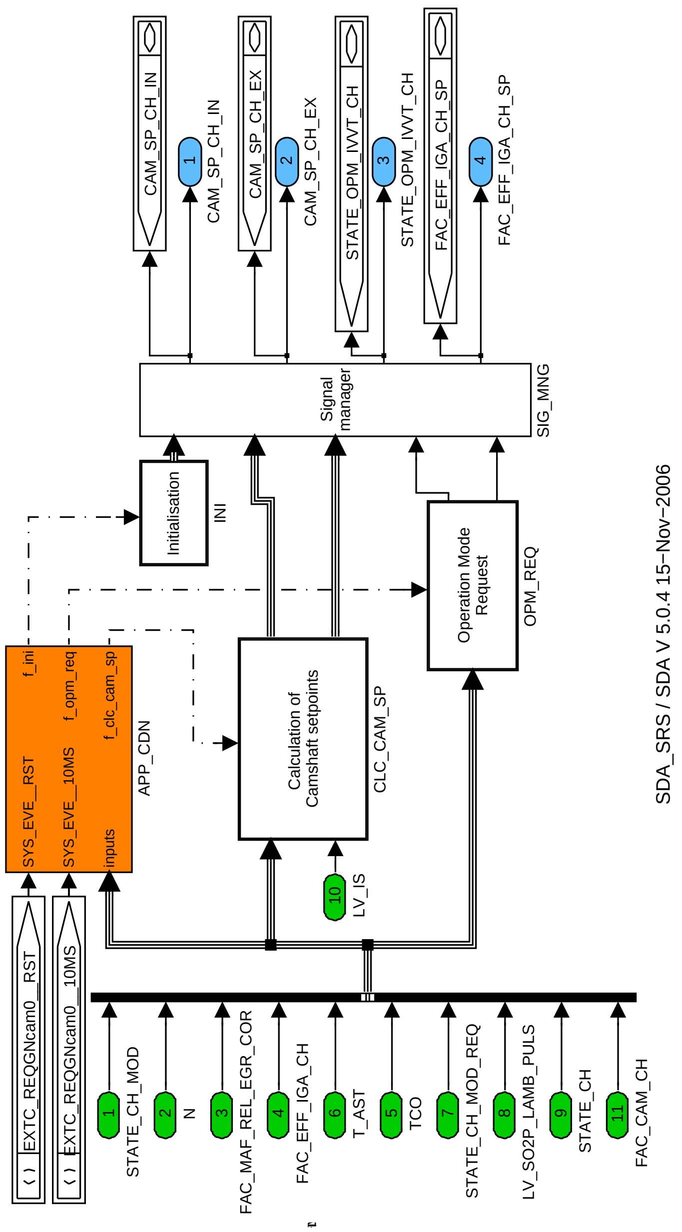

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Figure 9.9.2: : Path: EXTC_REQGNcam0

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9.9.1 Initialisation

9.9.1.1 Initialisation subsystem

The camshaft positions are initialised at reset and deactivated function with extreme-position-values

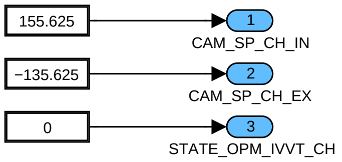

Figure 9.9.3: :   Path: EXTC_REQGNcam0/INI/INI_SUB

9.9.2 Calculation of camshaft setpoints

All maps for camshaft setpoints are twice available   for idle and for part load.

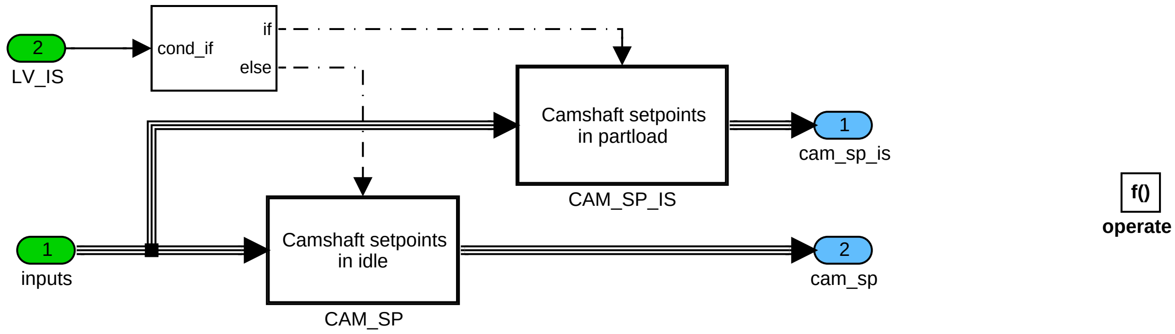

Figure 9.9.4: :   Path: EXTC_REQGNcam0/CLC_CAM_SP

9.9.2.1 EXTC_REQGNCAM0/CLC_CAM_SP/CAM_SP_IS

9.9.2.1.1 Camshaft setpoints in idle

There are 4 maps for camshaft-setpoints for catalyst heating which shell be used for emission-optimal calibration (2 for single and 2 for multiple injection). FAC_EFF_IGA_CH interpolates between the map-outputs and the outputs of 2   COLD -maps which are engine-roughness-optimal calibrated.

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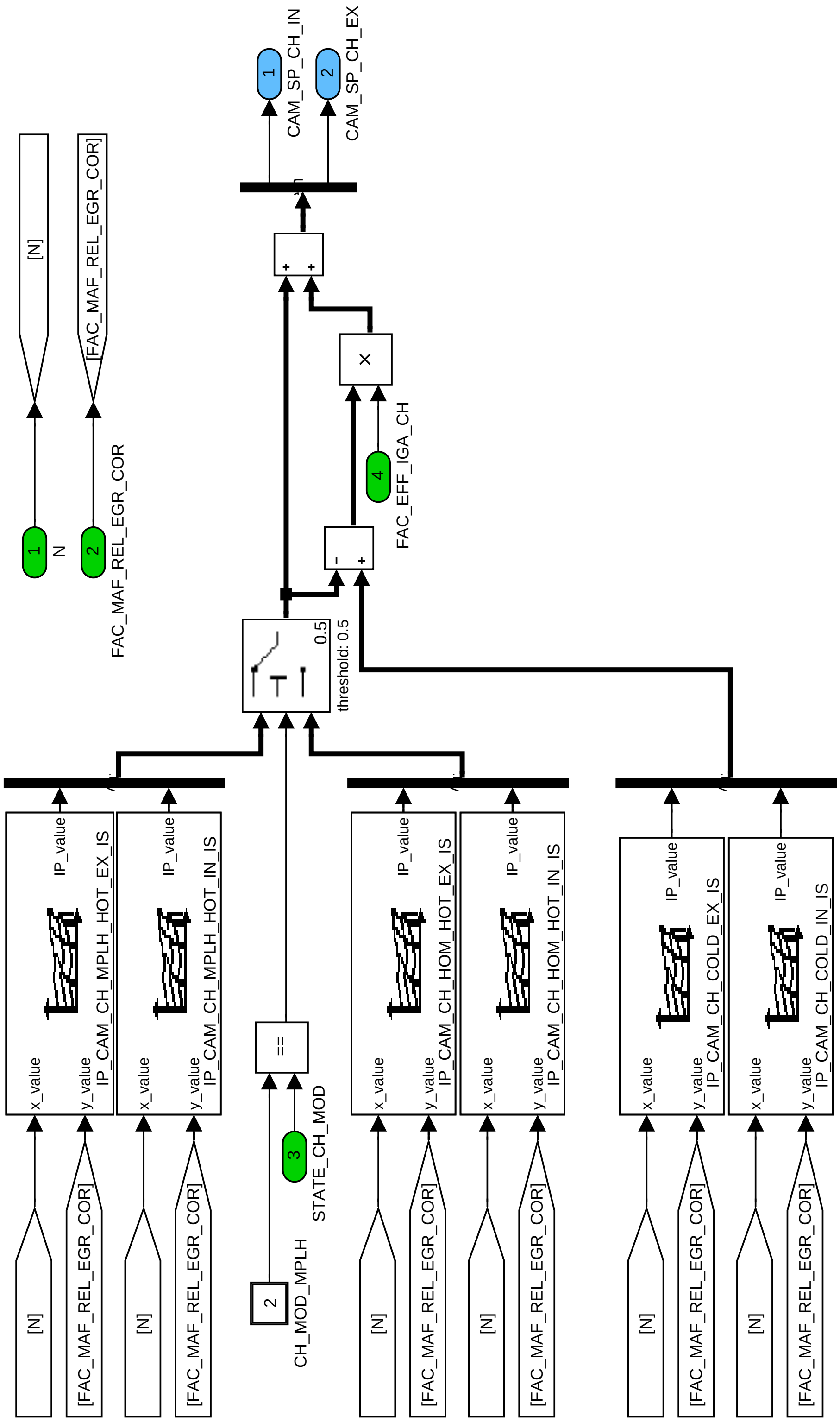

Figure 9.9.5: : Path: EXTC_REQGNcam0/CLC_CAM_SP/CAM_SP_IS/SUB

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9.9.2.2 EXTC_REQGNCAM0/CLC_CAM_SP/CAM_SP

9.9.2.2.1 Camshaft setpoints in partload

The function is dublicated from idle-speed-function.

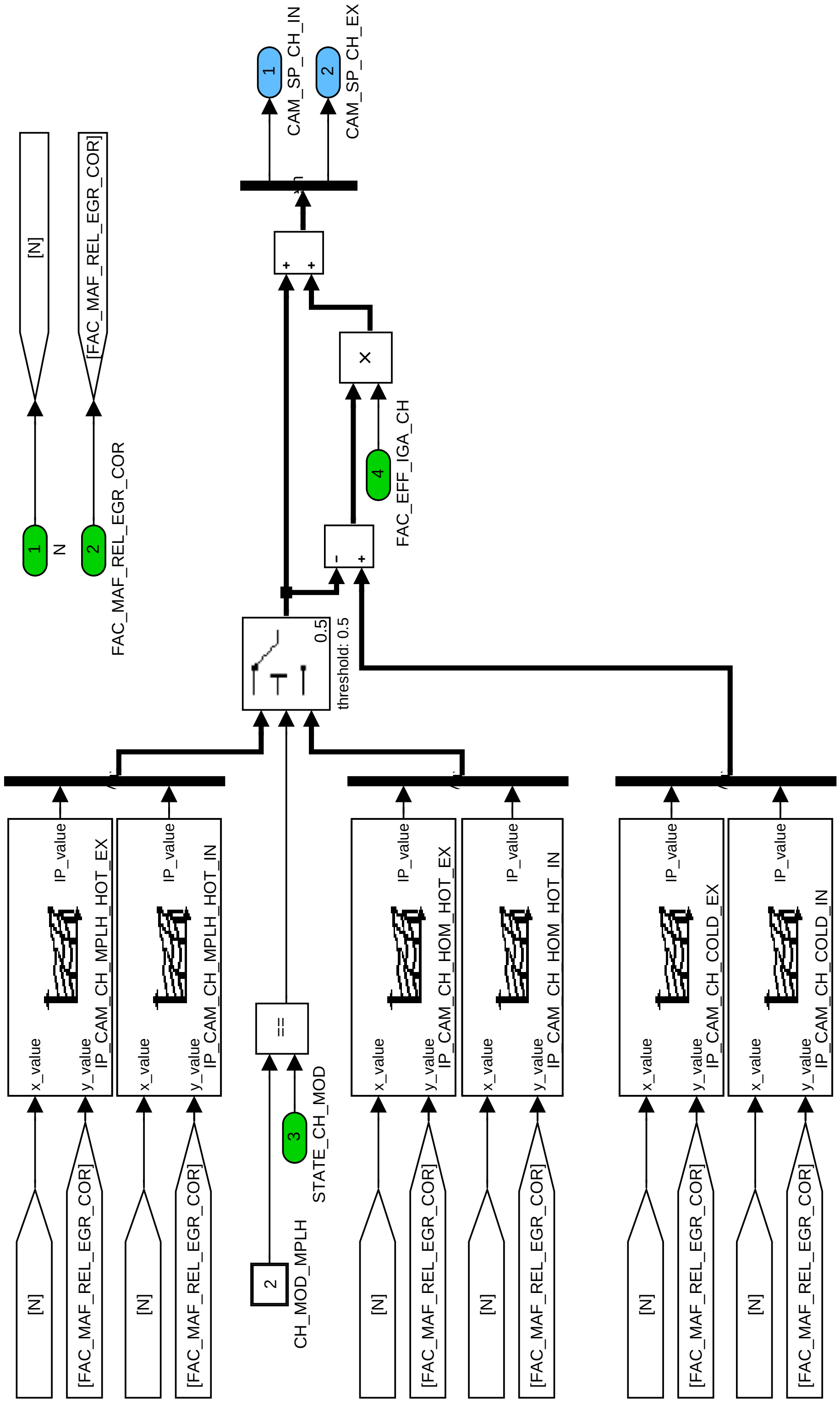

Figure 9.9.6: : Path: EXTC_REQGNcam0/CLC_CAM_SP/CAM_SP/SUB

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9.9.3 Operation mode request

9.9.3.1 Calculation

Depending on STATE_CH the calculation is separated for after start, low load and desulfation catalyst heating.

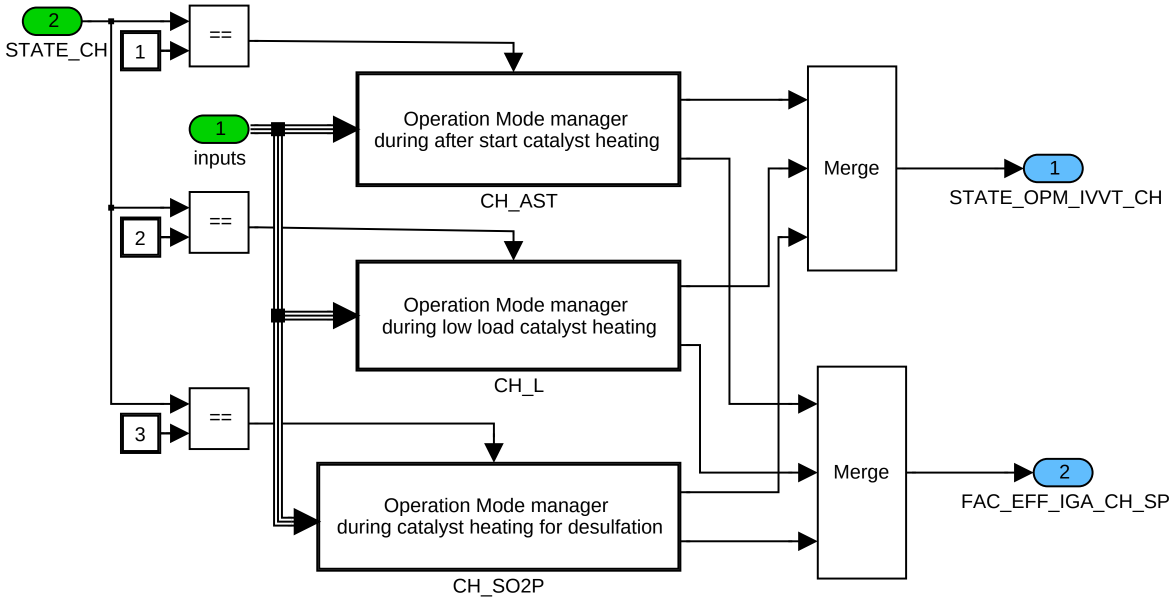

Figure 9.9.7: : Path: EXTC_REQGNcam0/OPM_REQ/SUB

9.9.3.1.1 EXTC_REQGNCAM0/OPM_REQ/SUB/CH_AST

9.9.3.1.1.1 Operation Mode manager during after start catalyst heating

FAC_EFF_IGA_CH_SP = 0 means that emission-optimal settings are to be chosen. FAC_EFF_IGA_CH_SP = 1 means that engine-roughness-optimal settings of camshafts shell be chosen. This setpoint value shell result in FAC_EFF_IGA_CH which is used for interpolation betweet emission- and engine-roughness-optimal maps. STATE_OPM_IVVT_CH contains the same information in logical way. 2 means emission-optimum, 1 means engine-roughness-optimum, 0 means no request from catalyst heating side.

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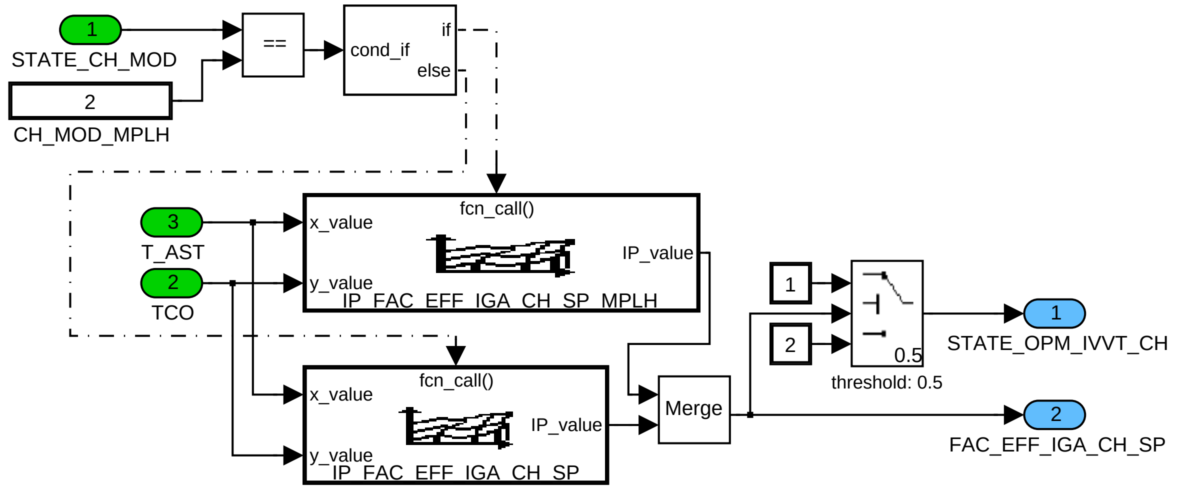

Figure 9.9.8: : Path: EXTC_REQGNcam0/OPM_REQ/SUB/CH_AST/SUB

9.9.3.1.2 EXTC_REQGNCAM0/OPM_REQ/SUB/CH_L

9.9.3.1.2.1 Operation Mode manager during low load catalyst heating

Only for homogeneous mode with single injection the setting of the operation mode request is calibratable. In all other cases ’0’ that means no alternation in camshaft setpoints is generated. FAC_EFF_IGA_CH_SP is set depending on the STATE so no values between 0 and 1 are possible.

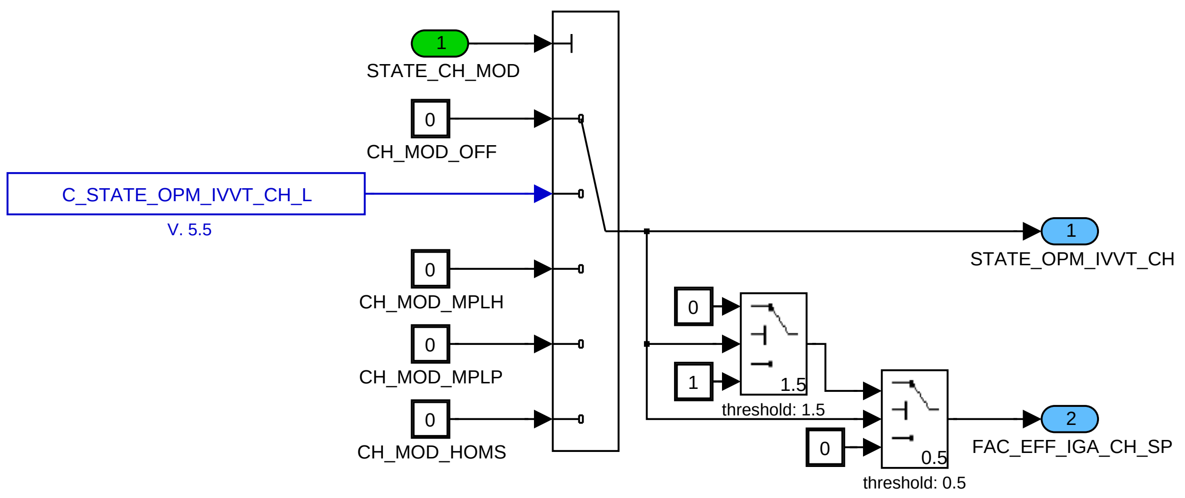

Figure 9.9.9: : Path: EXTC_REQGNcam0/OPM_REQ/SUB/CH_L/SUB

9.9.3.1.3 EXTC_REQGNCAM0/OPM_REQ/SUB/CH_SO2P

9.9.3.1.3.1 Operation Mode manager during catalyst heating for desulfation

For homogenous mode with single and with multiple injection the setting of the operation mode request is calibratable. In all other cases ’0’ that means no alternation in camshaft setpoints is generated. FAC_EFF_IGA_CH_SP is set depending on the STATE so no values between 0 and 1 are possible.

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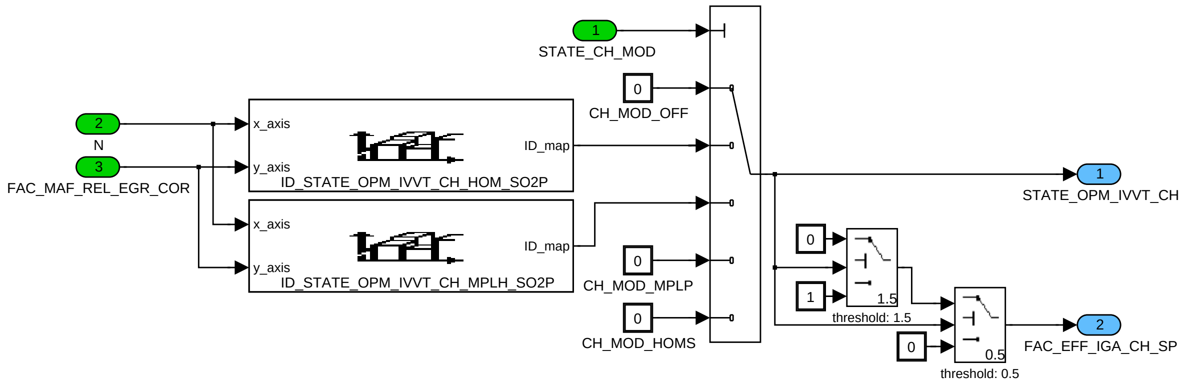

Figure 9.9.10: : Path: EXTC_REQGNcam0/OPM_REQ/SUB/CH_SO2P/SUB

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9.10 Fuel pressure for catalyst heating

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FUP_SP_CH	O/V	0... FFFFH	0... 347776	5.306722	hPa
Fuel pressure setpoint for catalyst heating					

Input data:

LV_MPLH_ACT {p. 8269}	N_32 {p. 1525}	STATE_CH_MOD {p. 1796}	STATE_CH_MOD_REQ {p. 1796}
T_AST {p. 1766}	TCO_ST {p. 1100}	TQI_REQ_TRA {p. 8192}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_SP_CH_PAS	-	0... FFFFH	0... 347776	5.306722	hPa
Passive value for fuel pressure setpoint for catalyst heating					
IP_FAC_FUP_SP_CH	-	0... FFH	0... 0.9960931	3.9063e-3	-
LDP_TCO_ST_IP_FAC_FUP_SP_CH	4	0... FEH	-48... 142.5	0.75	C
LDP_T_AST_IP_FAC_FUP_SP_CH	6	0... FFFFH	0... 6554	0.1	s
Factor for fuel pressure setpoint during (MPLH) - catalyst heating					
IP_FUP_SP_CH	-	0... FFFFH	0... 347776	5.306722	hPa
LDP_N_32_IP_FUP_SP_CH	6	0... FFH	0... 8160	32	rpm
LDP_TQI_REQ_TRA_IP_FUP_SP_CH	6	0... 7FFFH	0... 1024	0.03125	Nm
Fuel pressure setpoint for catalyst heating					

General Information

During homogeneous mode with double injection (MPLH mode) it is necessary to use a higher fuel pressure due to the 2nd "stratified" injection.

Application Conditions

Initialization: RST
Recurrence: 20MS
Activation: always
Deactivation: never

Function description

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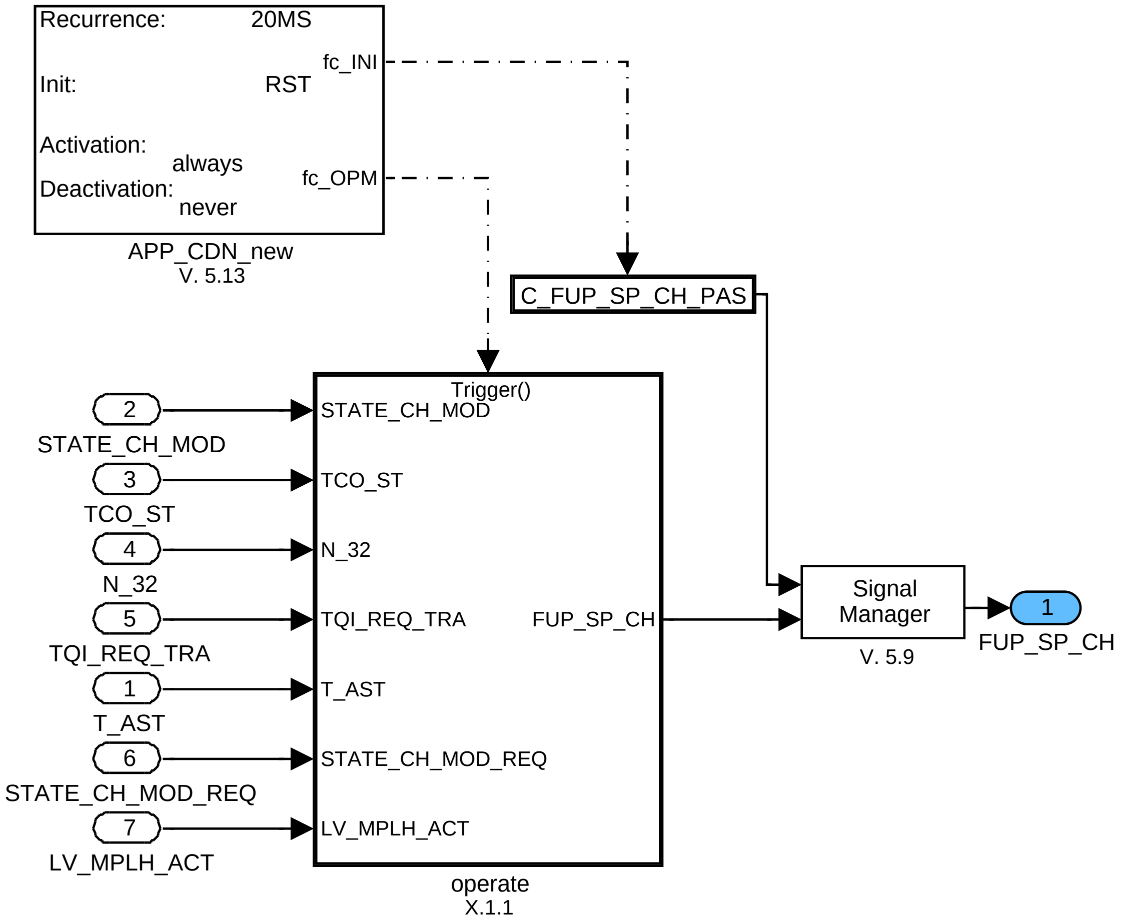

SDA_SRS / SDA V 5.0.1 02−Dec−2005

Figure 9.10.1: : Path: EXTC_REQGNFUP0

9.10.1 Operate Subsystem

If catalyst heating in MPLH-mode is active STATE_CH_MOD OR STATE_CH_MOD_REQ = 2 = CH_ MOD_MPLH the IP values are used. This can be during after start catalyst heating or catalyst heating for desulfation. In all other cases the passive value C_FUP_SP_CH_PAS is used.

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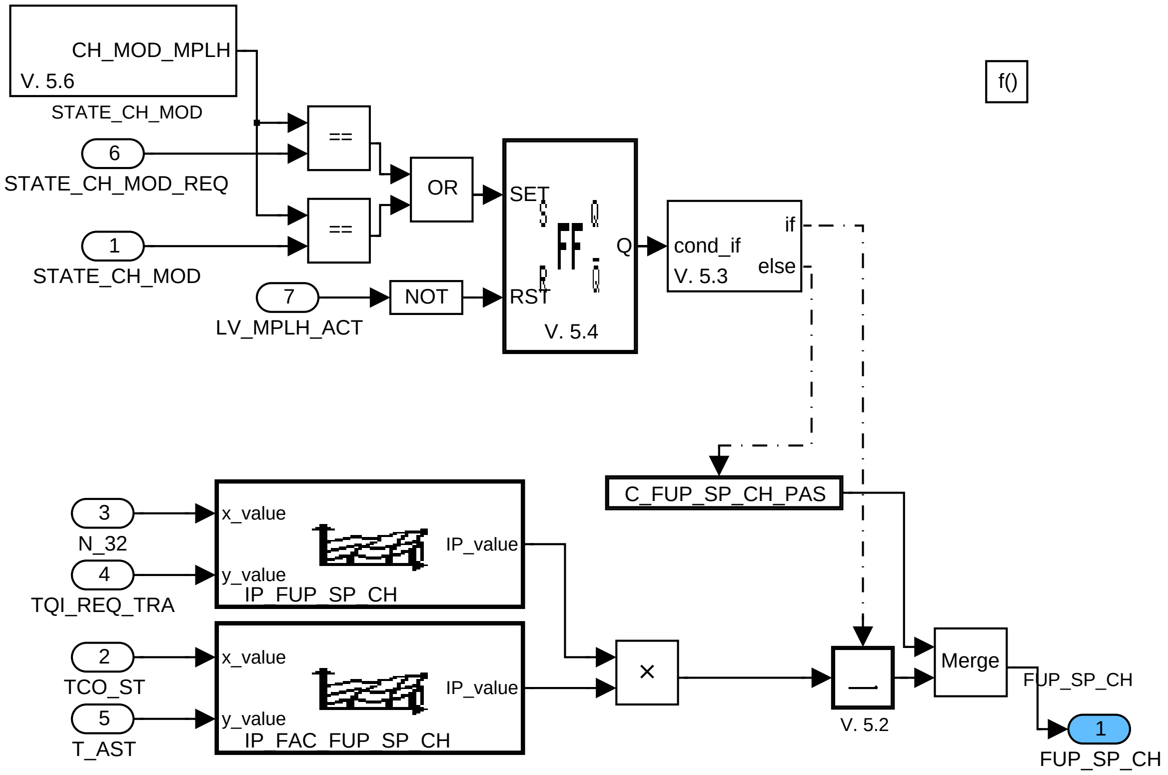

Figure 9.10.2: : Path: EXTC_REQGNFUP0/operate

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9.11 Exhaust gas sound flap

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_EF_THD	V	0... FFFFH	0... 1.99996	30.5e-6	-
Switching threshold for exhaust flap					
FAC_TQ_EF_THD_CTOP	V	0... FFFFH	0... 1.99996	30.5e-6	-
Switching threshold for exhaust flap without hysteresis					
LV_CDN_AC_VS	-	0... 1H	0 ...1	1	-
Logical value minimum speed AC exceeded					
LV_EF	O/V	0... 1H	0 ...1	1	-
Logical value exhaust flap, 1 = closed flap					
LV_EF_AC	V	0... 1H	0 ...1	1	-
Exhaust flap for accelerated passing by active via pedal value condition					
LV_EF_AC_ACT	O/V	0... 1H	0 ...1	1	-
Boolean for accelerated passing by active					
LV_EF_AC_CDN	V	0... 1H	0 ...1	1	-
Boolean condition for detection of accelerated passing-by met					
N_EF	V	0... FFH	0... 8160	32	rpm
N for exhaust flap					
PV_AV_THD_EF_AC	V	0... FFH	0... 99.60937	0.390625	%
Pedal value threshold for activation of accelerated passing by					
T_DLY_EF	V	0... FFH	0... 25.5	0.1	s
Time delay for closing exhaust flap					
T_DLY_EF_AC	V	0... FFFFH	0... 655.35	0.01	s
delay time to start TQ change calculation					
T_VS_CDN_EF_AC	V	0... FFFFH	0... 655.35	0.01	s
Minimum time condition for detection of accelerated passing by					
TQI_REQ_EF_AC_THD	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque start value accelerated passing by					
TQI_REQ_SLOW_EF_AC	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque request during accelerated passing by for deactivation					
VAR_GB_EF_AC	V	0... 1H	0 ...1	1	-
Indication for gearbox variant: 0 = manual, 1 = automatic					

Input data:

FAC_TQ_REQ {p. 6706}	GEAR_EF {p. 1302}	GR_AT {p. 1302}	GR_MT {p. 1302}
LV_ACT_EF_EXT_ADJ {p. 7432}	LV_AT {p. 654}	LV_CH_N_SP_IS {p. 1775}	LV_CTOP {p. 1565}
LV_EF_EXT_ADJ {p. 7434}	LV_ES {p. 1720}	LV_FL {p. 1759}	LV_ST {p. 1720}
LV_VAR_EF {p. 655}	N_32 {p. 1525}	PV_AV {p. 1269}	T_AST {p. 1766}
TCO {p. 1100}	TQ_LOSS {p. 8385}	TQ_REQ_CLU {p. 8390}	TQI_REQ_SLOW {p. 8391}
VS {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_END_EF_AC	-	0... FFH	0 ...1	3.9216e-3	-
Calibration factor to end detection for accelerated passing by					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_EF_THD_HYS	-	8000... 7FFFH	-2... 1.99993	61e-6	-
Hysteresis for switching threshold					
C_GR_AT_EF_1	-	0... FFH	0... 255	1	-
Automatic gearbox: accelerated pass gear 1					
C_GR_AT_EF_2	-	0... FFH	0... 255	1	-
Automatic gearbox: accelerated pass gear 2					
C_GR_MT_EF_1	-	0... FFH	0... 255	1	-
Manual gearbox: accelerated pass gear 1					
C_GR_MT_EF_2	-	0... FFH	0... 255	1	-
Manual gearbox: accelerated pass gear 2					
C_N_EF_HYS	-	0... FFH	0... 8160	32	rpm
Hysteresis for switching threshold					
C_PV_AV_THD_EF_AC	-	0... FFH	0... 99.60937	0.390625	%
Pedal value threshold for activation of accelerated passing by					
C_PV_AV_THD_EF_AC_AT	-	0... FFH	0... 99.60937	0.390625	%
Pedal value threshold for activation of accelerated passing by for AT					
C_T_DLY_EF_AC	-	0... FFFFH	0... 655.35	0.01	s
delay time to start TQ change calculation					
C_T_EF_AST	-	0... F8H	0... 62	0.25	s
Cranking time for EF actuation active					
C_T_VS_CDN_EF_AC	-	0... FFFFH	0... 655.35	0.01	s
Minimum time condition for detection of accelerated passing by					
C_TCO_EF_AC	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold for detection of accelerated passing by					
C_TQI_REQ_EF_AC_THD_GR_1	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque request limit during accelerated passing by in selected gear 1					
C_TQI_REQ_EF_AC_THD_GR_2	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque request limit during accelerated passing by in selected gear 2					
C_TQI_REQ_EF_AC_THD_GR_AT	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque request limit during accelerated passing by for AT					
C_VS_MAX_EF_AC_1	-	0... FFH	0... 255	1	km/h
Upper vehicle speed tight threshold for detection of accelerated passing by					
C_VS_MAX_EF_AC_2	-	0... FFH	0... 255	1	km/h
Upper vehicle speed wide threshold for detection of accelerated passing by					
C_VS_MIN_EF_AC_1	-	0... FFH	0... 255	1	km/h
Lower vehicle speed tight threshold for detection of accelerated passing by					
C_VS_MIN_EF_AC_2	-	0... FFH	0... 255	1	km/h
Lower vehicle speed wide threshold for detection of accelerated passing by					
C_VS_MIN_EF_AT	-	0... FFH	0... 255	1	km/h
Speed threshold for continuously opened exhaust flap, automatically shifted transmission					
C_VS_MIN_EF_MT	-	0... FFH	0... 255	1	km/h
Speed threshold for continuously opened exhaust flap, manually shifted transmission					
ID_FAC_TQ_EF_THD_CTOP_CLOSE_AT	V	0... FFFFH	0... 1.99996	30.5e-6	-

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_N_EF	6	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Switching threshold FAC_TQ_EF for convertible top closed AT					
ID_FAC_TQ_EF_THD_CTOP_CLOSE_MT	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_N_EF	6	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Switching threshold FAC_TQ_EF for convertible top closed MT					
ID_FAC_TQ_EF_THD_CTOP_OPEN_AT	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_N_EF	6	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Switching threshold FAC_TQ_EF for convertible top open AT					
ID_FAC_TQ_EF_THD_CTOP_OPEN_MT	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_N_EF	6	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Switching threshold FAC_TQ_EF for convertible top open MT					
IP_T_DLY_EF	-	0... FFH	0... 25.5	0.1	s
LDP_N_32_IP_T_DLY_EF	8	0... FFH	0... 8160	32	rpm
Time delay for closing exhaust flap					
IP_TQI_REQ_SLOW_EF_AC	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDP_VAR_GB_EF_AC	2	0... 1H	0 ...1	1	-
LDP_VS_EF_AC	6	0... FFH	0... 255	1	km/h
Torque request during accelerated passing by for deactivation					
LC_EF_CONF	-	0... 1H	0 ...1	1	-
Switch for inverted exhaust flap; = 0 normal flap; = 1 inverted flap					
LC_STATE_CH_EF	-	0... 1H	0 ...1	1	-
Exhaust flap actuation in case catalyst heating with increased idle speed					
LC_STATE_EF_AST	-	0... 1H	0 ...1	1	-
State exhaust flap after start					
LC_STATE_VS_MIN_EF_AT	-	0... 1H	0 ...1	1	-
Exhaust flap actuation in case of vs < C_VS_MIN_EF_AT for AT version					
LC_STATE_VS_MIN_EF_MT	-	0... 1H	0 ...1	1	-
Exhaust flap actuation in case of vs < C_VS_MIN_EF_MT for MT version					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_EF_NR	-	1... 4H	1 ...4	1	-
Number of the exhaust flaps in system					

Import actions:

ACTION_INFR_SetEf (**IN**<ef_nr>,**IN**<Lv_ef>)

General information:

To optimize the vehicle noise behaviour, an exhaust flap can be activated depending on the engine speed (N_EF) and the load (FAC_TQ_REQ). The exhaust flap is closed below a FAC_TQ_REQ value threshold, it is opened above the threshold.
The exhaust flap activation is only activated after the time C_T_EF_AST after the transition from Start.

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The switching threshold (FAC_TQ_EF_THD) is depending on enginespeed (N_EF), the selected gear (GEAR_EF), the transmission (manuell or automatic) and the convertible top (LV_CTOP = 0 closed, or LV_CTOP = 1 open).

To prevent the exhaust flap from switching continuously during constant driving at the switching threshold, two hysteresises (C_N_EF_HYS and C_FAC_TQ_EF_THD_HYS) are introduced for the switching process.
The closing of the exhaust flap is delayed depending on the enginespeed (N_32).

During catalyst heating with increased idle speed setpoint, the state of the exhaust flap is adjustable by C_STATE_CH_EF.

At low vehicle speeds the state of the exhaust flap is adjustable by C_STATE_VS_MIN_EF_xx, but C_STATE_CH_EF has higher priority as C_STATE_VS_MIN_EF_xx (xx = MT/AT).
For MSD85 is NC_EF_NR=2 and for all other projects is NC_EF_NR=1.

Application conditions

Initialisation: `all variables are initialised with 0 at deactivation`

Recurrence: `100 ms`

Activation: `LV_IGK = 1 and (LV_VAR_EF = 1` **`or`** `LV_EF_EXT_ADJ = 1)`

Deactivation: LV_IGK = 0;
at Deactivation LV_EF = LC_EF_CONF // is still calculated during PWL;

Formula section:

Control of sound exhaust flap by external adjustment
If LV_EF_EXT_ADJ = 1
Then LV_EF = LV_ACT_EF_EXT_ADJ
Else external adjustment passive/standard function active
Flap during start and engine stopped
If LV_ST = 1 or LV_ES = 1
Then LV_EF = LC_EF_CONF \\ flap opened; in case of LC_EF_CONF = 1 flap closed
Endif

Highest priority is ‘time after start’, P1
If VS > C_VS_MIN_EF_AC_2
Then LV_CDN_AC_VS = 1 *** *initialised at deactivation****
Endif;

If T_AST ≤ C_T_EF_AST **AND** LV_CDN_AC_VS = 0
then LV_EF = LC_STATE_EF_AST see next priority P2
endif

Next priority is ‘catalyst heating with increased idle speed setpoint’, P2
If LV_CH_N_SP_IS = 1
then LV_EF = LC_STATE_CH_EF see next priority P3
endif

Next priority is ‘Accelerated passing by’, P3

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If LV_EF_AC_ACT = 1
LV_EF = LV_EF_AC_ACT see next priority P4
endif

Next priority is 'vehicle speed dependency', P4
Automatic transmission vehicle (LV_AT = 1):
If VS $<$ C_VS_MIN_EF_AT
then LV_EF = LC_STATE_VS_MIN_EF_AT see next priority P5
endif
Manual transmission vehicle (LV_AT = 0):
If VS $<$ C_VS_MIN_EF_MT
then LV_EF = LC_STATE_VS_MIN_EF_MT see next priority P5
endif

Next priority is 'convertible top' , P5 \\ *calculation of thresholdvalues*
- enginespeed hysteresis

If LV_EF = 0
Then N_EF = N_32 + C_N_EF_HYS
Else N_EF = N_32

- Calculation switching threshold (FAC_TQ_EF_THD_CTOP)
IF (1) LV_AT = 0 \\ *manuel transmission*
IF LV_CTOP = 0 \\ *convertibel top closed*
Then FAC_TQ_EF_THD_CTOP =
ID_FAC_TQ_EF_THD_CTOP_CLOSE_MT (N_EF; GEAR_EF)
Else FAC_TQ_EF_THD_CTOP =
ID_FAC_TQ_EF_THD_CTOP_OPEN_MT (N_EF; GEAR_EF)
ELSE (1) \\ *automatic transmission*
IF LV_CTOP = 0 \\ *convertibel top closed*
Then FAC_TQ_EF_THD_CTOP =
ID_FAC_TQ_EF_THD_CTOP_CLOSE_AT (N_EF; GEAR_EF)
Else FAC_TQ_EF_THD_CTOP =
ID_FAC_TQ_EF_THD_CTOP_OPEN_AT (N_EF; GEAR_EF)

- Calculation switching threshold hyteresis
If LV_EF = 0 \\ flap opened; in case of LC_EF_CONF = 1 flap closed
Then FAC_TQ_EF_THD = FAC_TQ_EF_THD_CTOP - C_FAC_TQ_EF_THD_HYS
Else FAC_TQ_EF_THD = FAC_TQ_EF_THD_CTOP

- Compare threshold and actual value with close delay

IF FAC_TQ_REQ$_n$ $<$ FAC_TQ_EF_THD$_n$ **and** FAC_TQ_REQ$_{n-1}$ $\geq$ FAC_TQ_EF_THD$_{n-1}$
Then T_DLY_EF = IP_T_DLY_EF
Else T_DLY_EF - - - \\ *(decremenet T_DLY_EF)*

Endif

If FAC_TQ_REQ $\geq$ FAC_TQ_EF_THD
Then LV_EF = 0
Else **IF** T_DLY_EF = 0
Then LV_EF = 1

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Else LV_EF = 0
Endif
Endif

The output stage is energized to close the normal NC_EF_NR exhaust flaps and to open the inverted NC_EF_NR exhaust flaps (depending on LC_EF_CONF).

Switch Hardware PIN
For i=0...NC_EF_NR-1

IF LC_EF_CONF = 0
THEN Switch Pin (I/O Software) with LV_EF
ACTION_INFR_SetEf(IN<ef_nr>, IN <Lv_ef>**)**
ELSE Switch Basic (I/O Software) with not LV_EF
ACTION_INFR_SetEf(IN<ef_nr>, IN <Lv_ef>**)**

9.11.1 Torque limitation for accelerated passing-by

FUNCTION DESCRIPTION:

Application conditions

Recurrence: 10 ms

Initialisation at reset: all = 0

9.11.1.1 Detection of accelerated passing by

Application conditions

Activation/Deactivation:
```
if      {(LV_AT = 0   and (C_GR_MT_EF_1 <= GR_MT <= C_GR_MT_EF_2))        or
         (LV_AT = 1   and (C_GR_AT_EF_1 <= GR_AT <= C_GR_AT_EF_2))}
        and
         TCO > C_TCO_EF_AC
then    Formula section below
else    LV_EF_AC_CDN         = 0
        LV_EF_AC             = 0
        LV_EF_AC_ACT         = 0
        T_VS_CDN_EF_AC       is reset
        T_DLY_EF_AC          = 0
```
endif

Formula section:

- calculation of TQI_REQ_EF_AC_THD:

if LV_AT = 0
then VAR_GB_EF_AC = 0
if GR_MT = C_GR_MT_EF_1
then TQI_REQ_EF_AC_THD = C_TQI_REQ_EF_AC_THD_GR_1
else TQI_REQ_EF_AC_THD = C_TQI_REQ_EF_AC_THD_GR_2

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```
        endif
else          VAR_GB_EF_AC = 1
              TQI_REQ_EF_AC_THD = C_TQI_REQ_EF_AC_THD_GR_AT
endif
```

- Vehicle speed condition LV_EF_AC_CDN:

```
if            TQI_REQ_SLOW  <  TQI_REQ_EF_AC_THD
              and
            (LV_AT = 0 or (GR_AT > C_GR_AT_EF_1))
            and
            LV_EF_AC_ACT = 0
then    if    VS > C_VS_MIN_EF_AC_1   and
              VS < C_VS_MAX_EF_AC_1
              % => tight range for VS-condition fulfilled  %
        then    if    T_VS_CDN_EF_AC  <  C_T_VS_CDN_EF_AC
                then          T_VS_CDN_EF_AC is incremented
                              LV_EF_AC_CDN = 0
                else          LV_EF_AC_CDN = 1
                endif
        else          LV_EF_AC_CDN = 0
                        if        VS > C_VS_MIN_EF_AC_2   and
                                  VS < C_VS_MAX_EF_AC_2
                        % => wide range for VS-condition fulfilled  %
                        then   T_VS_CDN_EF_AC(n) = T_VS_CDN_EF_AC(n-1)
                        else   T_VS_CDN_EF_AC is reset
                        endif
        endif
else          if        TQI_REQ_SLOW >= TQI_REQ_EF_AC_THD      and
            (LV_AT = 0 or (GR_AT > C_GR_AT_EF_1))              and
            LV_EF_AC_CDN = 0
              then               T_VS_CDN_EF_AC is reset
              endif
endif
```

- Activation via pedal value LV_EF_AC:

```
if            LV_AT = 1
then          PV_AV_THD_EF_AC = C_PV_AV_THD_EF_AC_AT
else          PV_AV_THD_EF_AC = C_PV_AV_THD_EF_AC
endif

if            LV_EF_AC_CDN = 1                           and
            {LV_FL = 1      or        PV_AV > PV_AV_THD_EF_AC}
then          LV_EF_AC = 1
else          LV_EF_AC = 0
endif
```

9.11.1.2 Torque limitation for accelerated passing by

Application conditions

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Activation: `LV_EF_AC = 1`

Deactivation:

```
LV_EF_AC = 0
   at deactivation:
TQI_REQ_SLOW_EF_AC  = 7FFF hex /  1024Nm
LV_EF_AC_ACT           = 0
T_DLY_EF_AC            = 0
LV_EF_AC_CDN           = 0
```

Formula section:

- Torque limitation is active LV_EF_AC_ACT:

If LV_EF_AC_ACT = 0
then
if TQI_REQ_SLOW > TQI_REQ_EF_AC_THD
then TQI_REQ_SLOW_EF_AC = TQI_REQ_EF_AC_THD
T_DLY_EF_AC = 0
LV_EF_AC_ACT = 1
endif
else T_DLY_EF_AC is incremented
if T_DLY_EF_AC >= C_T_DLY_EF_AC
then TQI_REQ_SLOW_EF_AC = **MIN(**TQ_REQ_CLU - TQ_LOSS**;**
IP_TQI_REQ_SLOW_EF_AC**)**
endif

if TQI_REQ_SLOW_EF_AC >= C_FAC_END_EF_AC * (TQ_REQ_CLU - TQ_LOSS)
then LV_EF_AC_ACT = 0
LV_EF_AC = 0
LV_EF_AC_CDN = 0
T_VS_CDN_EF_AC is reset
T_DLY_EF_AC = 0
TQI_REQ_SLOW_EF_AC = 7FFF hex /1024Nm
endif
endif

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9.12 Variable intake manifold

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SWI_VIM_PAS	V	0... 1H	0 ...1	1	-
Logical variable to set VIM in passive mode					
LV_VIM	O/V	0... 1H	0 ...1	1	-
Logical value VIM power stage (2-stage-DISA); 0 passive, 1 active					
LV_VIM_1	O/V	0... 1H	0 ...1	1	-
setpoint VIM flap 1, 0: closed, 1: opened					
LV_VIM_2	O/V	0... 1H	0 ...1	1	-
setpoint VIM flap 2, 0: closed, 1: opened					
LV_VIM_RLS	O/V	0... 1H	0 ...1	1	-
conditions for release of VIM function are met					
LV_VIM_RLS_TMP	V	0... 1H	0 ...1	1	-
LV_VIM_RLS temporal value					
N_VIM	V	0... 1FE0H	0... 8160	1	rpm
corrected engine speed for VIM application					
T_DLY_VIM_OPEN_1	V	0... FFH	0... 2.55	0.01	s
Delay timer to open VIM flap 1					
T_DLY_VIM_OPEN_2	V	0... FFH	0... 2.55	0.01	s
Delay timer to open VIM flap 2					
T_OPEN_VIM_DEAC	V	0... FFH	0... 2.55	0.01	s
timer to open the VIM flaps before deactivating the VIM function					
T_VIM_CLOSE_MIN_1	V	0... FFH	0... 2.55	0.01	s
Timer to close VIM flap 1					
T_VIM_CLOSE_MIN_2	V	0... FFH	0... 2.55	0.01	s
Timer to close VIM flap 2					
T_VIM_LIH_MIN	V	0... FFH	0... 2.55	0.01	s
Limp-home timer for VIM function					
VIM_AV	O/V	0... FFFFH	0... 199.99694	3.0518e-3	%
actual position variable intake manifold					
VIMPWM_1	O/V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
pulse width modulated signal for actuator DISA_1					
VIMPWM_2	O/V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
pulse width modulated signal for actuator DISA_2					

Input data:

FAC_MAF_MAX {p. 1212}	LV_ACT_VIM_1_EXT_ADJ {p. 7433}	LV_ACT_VIM_2_EXT_ADJ {p. 7433}	LV_ERR_VIM_1 {p. 5065}
LV_ERR_VIM_2 {p. 5065}	LV_IGK {p. 906}	LV_ST_END {p. 1720}	LV_STST_STOP_CYC {p. 805}
LV_VIM_1_CUS {p. 8277}	LV_VIM_1_EXT_ADJ {p. 7435}	LV_VIM_2_CUS {p. 8277}	LV_VIM_2_EXT_ADJ {p. 7435}
LV_VIM_INH_CUS {p. 8277}	N {p. 1525}	N_32 {p. 1525}	TCO {p. 1100}
TIA {p. 1226}	VB {p. 1185}	VS {p. 1176}	

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_MAF_MAX_VIM	-	0... FFFFH	0... 1.99996	30.5e-6	-
load threshold					
C_FAC_MAF_MAX_VIM_HYS	-	0... FFFFH	0... 1.99996	30.5e-6	-
load threshold hysteresis					
C_N_VIM_H	-	0... 1FE0H	0... 8160	1	rpm
higher engine speed threshold					
C_N_VIM_HYS	-	0... 1FE0H	0... 8160	1	rpm
engine speed threshold hysteresis					
C_N_VIM_L	-	0... 1FE0H	0... 8160	1	rpm
lower engine speed threshold					
C_N_VIM_MID	-	0... 1FE0H	0... 8160	1	rpm
medium engine speed threshold					
C_PWM_VIM_CLOSE	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
PWM to close VIM flap					
C_PWM_VIM_DEAC	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
PWM-signal to deactivate VIM flap					
C_PWM_VIM_LIH	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
PWM for VIM limp home mode					
C_PWM_VIM_OPEN	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
PWM to open VIM flap					
C_STATE_VIM_1_SP_MAN	-	0... 1H	0 ...1	1	-
manual setting of the setpoint VIM flap 1 by calibration system, 0: closed, 1: opened					
C_STATE_VIM_2_SP_MAN	-	0... 1H	0 ...1	1	-
manual setting of the setpoint VIM flap 2 by calibration system, 0: closed, 1: opened					
C_T_DLY_PARK_PSN	-	0... FFH	0... 2.55	0.01	s
delay timer to open the VIM flaps before deactivating the VIM function (park position)					
C_T_DLY_VIM_OPEN	-	0... FFH	0... 2.55	0.01	s
delay timer to open the VIM flaps					
C_T_OPEN_VIM_DEAC	-	0... FFH	0... 2.55	0.01	s
time to open the VIM flaps before deactivating the VIM function					
C_T_VIM_CLOSE_MIN	-	0... FFH	0... 2.55	0.01	s
minimum time to close VIM flaps					
C_T_VIM_LIH_MIN	-	0... FFH	0... 2.55	0.01	s
minimum time to VIM limp home mode					
C_VB_MAX_VIM	-	0... FFH	0... 25.89843	0.1015625	V
maximum battery voltage to release VIM function					
C_VB_MIN_VIM	-	0... FFH	0... 25.89843	0.1015625	V
minimum battery voltage to release VIM function					
C_VIM_AV_1	-	0... FFFFH	0... 199.99694	3.0518e-3	%
VIM_AV for both flaps opened					
C_VIM_AV_2	-	0... FFFFH	0... 199.99694	3.0518e-3	%
VIM_AV for both flaps closed					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VIM_AV_3	-	0... FFFFH	0... 199.99694	3.0518e-3	%
VIM_AV for flap 1 opened, flap 2 closed					
C_VIM_AV_4	-	0... FFFFH	0... 199.99694	3.0518e-3	%
VIM_AV for flap 1 closed, flap 2 opened					
C_VIM_AV_DEAC	-	0... FFFFH	0... 199.99694	3.0518e-3	%
VIM_AV during deactivation					
C_VIM_AV_PAS	-	0... FFFFH	0... 199.99694	3.0518e-3	%
VIM_AV during passive function					
C_VIMPWM_PARK_PSN	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
PWM adjustment in case of park position					
C_VIMPWM_PAS	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
VIMPWM "passive"					
C_VIMPWM_PRE_PRK_PSN	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
PWM adjustment in case of pre-park position					
ID_STATE_RLS_VIM	-	0... 1H	0 ...1	1	-
temperature condition for VIM function is met (1) or not met (0)					
ID_STATE_VIM_1_SP	-	0... 1H	0 ...1	1	-
Table defining the setpoint VIM flap 1, 0: closed, 1: opened					
ID_STATE_VIM_2_SP	-	0... 1H	0 ...1	1	-
Table defining the setpoint VIM flap 2, 0: closed, 1: opened					
ID_SWI_VIM_PAS_N_VS	V	0... 1H	0 ...1	1	-
LDP_N_32_SWI_VIM_PAS	6	1... FFH	32... 8160	32	rpm
LDP_VS_SWI_VIM_PAS	6	0... FFH	0... 255	1	km/h
VIM Passive mode dependent on vehicle speed and motor speed					
IP_FAC_N_VIM	V	0... FFH	0... 1.99218	0.0078125	-
LDP_N_32_FAC_N_VIM	8	0... FFH	0... 8160	32	rpm
LDP_FAC_MAF_MAX_IP_FAC_N_VIM	6	0... FFFFH	0... 1.99996	30.5e-6	-
N_32 correction for VIM switch thresholds					
IP_FAC_TIA_N_VIM	-	0... FFH	0... 1.99218	0.0078125	-
LDP_TIA_FAC_TIA_N_VIM	8	0... FEH	-48... 142.5	0.75	°C
TIA correction for VIM switch thresholds					
LC_PWM_VIM_CUS	-	0... 1H	0 ...1	1	-
Logical constant to enable setting of customer VIM setpoint					
LC_PWM_VIM_MAN	-	0... 1H	0 ...1	1	-
Logical constant to enable manual setting of VIMPWM_1/2 by calibration system					

General information:

This function is used to control an open loop, 2- or 3-stage variable intake manifold. The output VIM_AV is generated to be used for the volumetric efficiency of the engine which is influenced by the VIM position. For a 2-stage variable intake manifold VIM_AV should be set to 0% /100% in order to facilitate the application of the volumetric efficiency.
For test purpose at assembling line or workshop the VIM can be switched by a serial communication tool, if available (external adjustment).

Signal flow diagram:

Determination of the used range

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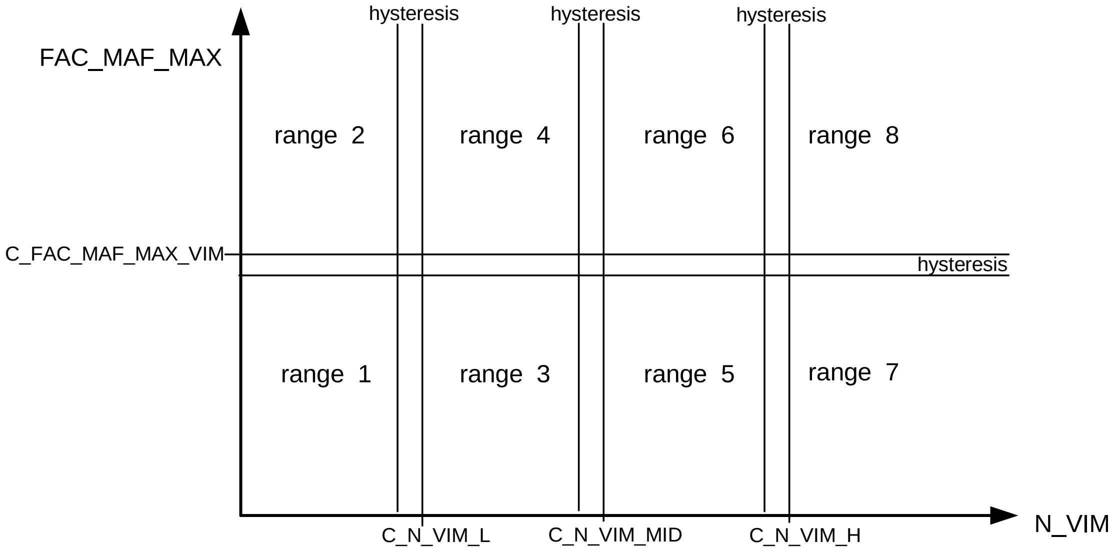

Diagram is valid if external adjustment is inactive.

Application conditions

Initialisation: VIMPWM_1 = C_VIMPWM_PAS at ECU initialisation VIMPWM_2 = C_VIMPWM_PAS and at function deactivation
VIM_AV = C_VIM_AV_1
T_OPEN_VIM_DEAC = C_T_OPEN_VIM_DEAC
all others: physical 0
at LV_IGK 0->1 or at reset : LV_VIM_RLS_TMP = 0

Recurrence: *10 ms*

Activation: *at every engine operating state*

Deactivation: –

Formula section:

Condition for release of VIM function

If LV_ST_END = 1 **and**
C_VB_MIN_VIM ≤ VB ≤ C_VB_MAX_VIM **and**
ID_STATE_RLS_VIM = 1 **and**
LV_ERR_VIM_1 = 0 **and**
LV_ERR_VIM_2 = 0
then LV_VIM_RLS = 1
else LV_VIM_RLS = 0
endif

Corrected engine speed for VIM function:

If LV_VIM_RLS = 1
then N_VIM = N * IP_FAC_N_VIM * IP_FAC_TIA_N_VIM
endif

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Hysteresis for switching thresholds:
Valid for all 4 thresholds, C_N_VIM_L, C_N_VIM_MID, C_N_VIM_H and C_FAC_MAF_MAX_VIM: when increasing the input value (N_VIM /FAC_MAF_MAX) then switch at
input value > threshold ,
when decreasing the input value then switch back at
input value < threshold - hysteresis .

threshold	C_N_VIM_L / -_MID / -_H	C_FAC_MAF_MAX_VIM
hysteresis	C_N_VIM_HYS	C_FAC_MAF_MAX_VIM_HYS

Determination of desired flap position
i = 1...2

```
if(1)      LC_PWM_VIM_MAN = 1
then(1)      LV_VIM_1  =  C_STATE_VIM_1_SP_MAN
             LV_VIM_2  =  C_STATE_VIM_2_SP_MAN
else(1)
   if(2)     LV_VIM_i_EXT_ADJ = 1
   then(2)   LV_VIM_i  =  LV_ACT_VIM_i_EXT_ADJ
   else(2)
      if(3)     LV_VIM_RLS = 1
      then(3)
         if(4)          LC_PWM_VIM_CUS = 1
         then(4)      LV_VIM_1 = LV_VIM_1_CUS
                      LV_VIM_2 = LV_VIM_2_CUS
       else(4)      LV_VIM_1  =  ID_STATE_VIM_1_SP        0: closed or 1: opened, according
                    LV_VIM_2  =  ID_STATE_VIM_2_SP  the determined range, see above
        endif(4)                                        diagram
      else(3)  LV_VIM_1  =  1                              flaps opened before
               LV_VIM_2  =  1                            switching off
      endif(3)
   endif(2)
endif(1)
```

Hint: the tables ID_STATE_VIM_1/2_SP contain 8 values which are divided in the 8 ranges, see above diagram. The lists of data points are fixed, not calibrateable. According the display conversion of the calibration system 'INCA', the table that can be seen on the INCA-screen is analogous the diagram above.

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	LDPM_IDX_1_SP_VIM_1_VIMA 0	1	2	3
LDPM_IDX_2_SP_VIM_1_VIMA 0	flap setpoint range 2	flap setpoint range 4	flap setpoint range 6	flap setpoint range 8
1	flap setpoint range 1	flap setpoint range 3	flap setpoint range 5	flap setpoint range 7

Calculation of VIMPWM_1 and_2:

i = 1...2

if(1) LC_PWM_VIM_MAN = 1
then(1)
if(2a) LV_VIM_i = 1
then(2a) VIMPWM_i = C_PWM_VIM_OPEN
else(2a) VIMPWM_i = C_PWM_VIM_CLOSE
endif(2a)
else(1)
if(2b) LV_VIM_i_EXT_ADJ = 1
then(2b)
if(3a) LV_VIM_i = 1
then(3a) VIMPWM_i = C_PWM_VIM_OPEN
else(3a) VIMPWM_i = C_PWM_VIM_CLOSE
endif(3a)
else(2b)
if(3b) LV_VIM_INH_CUS = 0
then(3b)
T_VIM_LIH_MIN = 0
if(4a) (LV_VIM_RLS = 1 **and** LV_IGK=1)
then(4a) T_OPEN_VIM_DEAC = 0 s
LV_VIM_RLS_TMP = 1
if(5a) LV_VIM_i = 1 /* output adjustment
then(5a) T_VIM_CLOSE_MIN_**i** = 0
If T_DLY_VIM_OPEN_**i** < C_T_DLY_VIM_OPEN
then
T_DLY_VIM_OPEN_**i** = T_DLY_VIM_OPEN_**i** + 10ms
VIMPWM_i = C_PWM_VIM_CLOSE
else
VIMPWM_i = C_PWM_VIM_OPEN
Endif
else(5a) T_DLY_VIM_OPEN_**i** = 0

/* torque adjustment
if (6a) T_VIM_CLOSE_MIN_**i** < C_T_VIM_CLOSE_MIN
then
T_VIM_CLOSE_MIN_**i** = T_VIM_CLOSE_MIN_**i** + 10ms

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```
            VIMPWM_i = C_PWM_VIM_CLOSE   /*Torque   adjustment for safe run up
    else (6a)
            LV_SWI_VIM_PAS = ID_SWI_VIM_PAS_N_VS (N, VS)
             /* see Calibration hints (1 , (2

            if (7a)        LV_SWI_VIM_PAS = 1
            then             VIMPWM_i = C_VIMPWM_PAS
            else (7a)
                           VIMPWM_i = C_PWM_VIM_CLOSE
            endif (7a)
    endif (6a)
           endif(5a)
      else(4a)    T_OPEN_VIM_DEAC   =  T_OPEN_VIM_DEAC_{n-1} + 10 ms
         if(5b)        T_OPEN_VIM_DEAC   <  C_T_OPEN_VIM_DEAC
         then(5b)  VIMPWM_i      =  C_PWM_VIM_DEAC
         else(5b)
               if (6b) T_OPEN_VIM_DEAC < C_T_DLY_PARK_PSN
    then     VIMPWM_i = C_VIMPWM_PAS
    else (6b)
            if (7b)  LV_STST_STOP_CYC = 1        or
                     LV_ERR_VIM_1 = 1 or
                     LV_ERR_VIM_2 = 1 or
                     LV_VIM_RLS_TMP = 0
             then      VIMPWM_i = C_VIMPWM_PRE_PRK_PSN
            else (7b)
                     T_DLY_VIM_OPEN_i = 0
                     /* parking position,
                     VIMPWM_i = C_VIMPWM_PARK_PSN
                     /* see Calibration hints (3
                          T_VIM_CLOSE_MIN_i = 0 /* needed for restart from PWL phase
            endif (7b)
    endif (6b)
  endif(5b)
      endif(4a)

else(3b)
    T_DLY_VIM_OPEN_i = 0
    LV_SWI_VIM_PAS = 0
    /* Limp home active, therefore VIMPWM_i = C_PWM_VIM_LIH
    T_VIM_CLOSE_MIN_i = 0
    /* limp home reappears :
    if (4b) T_VIM_LIH_MIN < C_T_VIM_LIH_MIN
    then
            T_VIM_LIH_MIN = T_VIM_LIH_MIN + 10ms
            VIMPWM_i = C_PWM_VIM_LIH /*see Calibration hints (4
            /*Desired adjustment for safe run up
    else (4b)
            VIMPWM_1 = C_VIMPWM_PAS
            VIMPWM_2 = C_VIMPWM_PAS
    endif(4b)
endif(3b)
endif(2b)
```

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endif(1)

Calculation of VIM_AV:

if(1) VIMPWM_1 = VIMPWM_2 = C_VIMPWM_PAS
then(1)
  if(2a) LV_SWI_VIM_PAS = 1
  then VIM_AV = VIM_AV (n-1) /* VIM flap remains in the old position*/
  else(2a) VIM_AV = C_VIM_AV_PAS
  endif(2a)
else(1)
 if(2) VIMPWM_1 = VIMPWM_2 = C_PWM_VIM_DEAC
  then(2) VIM_AV = C_VIM_AV_DEAC
   if(3) VIMPWM_1 = VIMPWM_2 = C_PWM_VIM_OPEN
   then(3) VIM_AV = C_VIM_AV_1
   else(3)
    if(4) VIMPWM_1 = VIMPWM_2 = C_PWM_VIM_CLOSE
    then(4) VIM_AV = C_VIM_AV_2
    else(4)
     if(5) VIMPWM_1 = C_PWM_VIM_OPEN **and**
      VIMPWM_2 = C_PWM_VIM_CLOSE
     then(5) VIM_AV = C_VIM_AV_3
     else(5) VIM_AV = C_VIM_AV_4
     endif(5)
    endif(4)
   endif(3)
 endif(2)
endif(1)

In case of inhibition of VIM by customer:
If LC_PWM_VIM_MAN = 0 **and**
 LV_VIM_i_EXT_ADJ = 0 **and**
 LV_VIM_INH_CUS = 1
then VIM_AV = C_VIM_AV_1
endif

LV_VIM:
If VIMPWM_1 C_PWM_VIM_CLOSE
 then LV_VIM = 1
 else LV_VIM = 0
endif

Calibration hints:

1. ID_SWI_VIM_PAS_N_VS out of 3000 rpm, ID_SWI_VIM_PAS_N_VS==0 (67% PWM isn´t allowed after 15% PWM)
2. ID_SWI_VIM_PAS_N_VS : Passive Mode for N< 3000U/min
3. C_VIMPWM_PARK_PSN: At parking position (15%- ->67%): PWM= 67%
4. C_PWM_VIM_LIH = 33 %

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9.13 EVAC flow setpoints

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_FLOW_COR_CLL_CP	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Flow target correction factor					
FAC_FLOW_SP_MIN_PURGE	V	0... FFFFH	0... 3.99993	61e-6	-
correction factor for the flow setpoint in MIN_PURGE when CL_MMV known					
FLOW_CPS_SP_MIN_PURGE	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Setpoint value for the flow through the CPS for MIN_PURGE mode					
FLOW_MAX_CPS	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Maximum setpoint value for the flow through the CPS					
FLOW_MAX_PHY_CPS	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Physical limit: flow at 100% opened valve					
MFF_KGH_MAX_CP	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Fuel flow max from the ACF					
MFF_MAX_CP	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Maximum limit on the fuel flow mass					
RATIO_FUEL_SP_MAX_PURGE	V	0... FFFFH	0... 0.99998	15.3e-6	-
Setpoint value for the relative part of fuel from CPS compared to total fuel in cylinder for normal operation					

Input data:

AMP {p. 982}	AMP_DELTA_IT_CP {p. 3698}	CL_MMV {p. 3698}	FTL {p. 1564}
LC_LAM_CBK_CPS {p. 3706}	LV_CL_CLC_VLD {p. 3635}	LV_CP_ACT {p. 3679}	LV_CP_ENA {p. 3737}
LV_HOM_ACT {p. 8136}	MAF_CYL {p. 8277}	MFF_SP_HOM_ENG [NC_CBK_EX_NR] {p. 2151}	MFF_SP_MV {p. 2151}
N_32 {p. 1525}	NC_CYL_NR {p. 1526}	PRS_CPS {p. 1540}	STATE_OPM_ENG_CP {p. 3680}
TCO {p. 1100}	TQI_SP_S {p. 8391}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MAX_MIN_PURGE	-	0... FFFFH	0... 1.99996	30.5e-6	-
on this worst case CL is based the base calibration of MIN_PURGE flow setpoint					
C_FAC_FLOW_COR_FTL_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Flow corrrection factor if fuel tank level condition is fulfilled					
C_FAC_FLOW_SP_MIN_PURGE_MAX	-	0... FFFFH	0... 3.99993	61e-6	-
maximum correction of MIN_PURGE flow setpoint					
C_FTL_MIN_FLOW_COR_CP	-	0... 7FH	0... 127	1	l
Lower fuel tank level threshold for flow correction					
C_MFF_MIN_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Minimum limit on mass fuel flow					
IP_FAC_FLOW_COR_AMP_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_AMP_IP_FAC_FLOW_COR_CP	8	0... FFFFH	0... 5434	0.0829175	hPa
Flow correction factor via AMP					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_FLOW_COR_AMP_DELTA_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_AMP_DELTA_IP_FAC_FLOW_COR	8	0... FFFFH	-2717.04145 ...2716.95854	0.0829175	hPa
Flow correction factor via AMP_DELTA_IT_CP					
IP_FAC_FLOW_SP_MIN_PURGE	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_CL_MMV_IP_FAC_FLOW_MIN	6	0... FFFFH	0... 1.99996	30.5e-6	-
weighting factor for the CL deviation from the worstcase CL					
IP_FLOW_CPS	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_PRS_CPS_1_EVAC	16	0... FFFFH	-2717... 2716.91708	0.0829163	hPa
FLOW_CPS for fully opened CPS (CPPWM=100%)					
IP_FLOW_CPS_ENG_MOD_0	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_EVAC	12	0... FFH	0... 1389	5.4470588	mg/stk
flow setpoint for MIN_PURGE at ENG_MOD_0					
IP_FLOW_CPS_ENG_MOD_1	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_TQI_SP_S_3_EVAC	12	0... 7FFFH	0... 1023.97	0.03125	Nm
flow setpoint for MIN_PURGE at ENG_MOD_1					
IP_FLOW_CPS_ENG_MOD_2	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_TQI_SP_S_3_EVAC	12	0... 7FFFH	0... 1023.97	0.03125	Nm
flow setpoint for MIN_PURGE at ENG_MOD_2					
IP_FLOW_MAX_2_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
flow setpoint for MAX_PURGE in stratifid mode					
IP_FLOW_MAX_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_EVAC	12	0... FFH	0... 1389	5.4470588	mg/stk
flow setpoint for MAX_PURGE					
IP_RATIO_FUEL_MAX_CP_COR	-	0... FFH	0... 0.99609	3.9063e-3	-
LDP_TCO_IP_RATIO_FUEL_MAX_CP	5	0... FEH	-48... 142.5	0.75	°C
Correction factor for MFF_MAX_CP					
IP_RATIO_FUEL_MAX_CP_MOD_0	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_EVAC	12	0... FFH	0... 1389	5.4470588	mg/stk
Maximum fuel flow through the CPS at MOD_0					
IP_RATIO_FUEL_MAX_CP_MOD_1	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDP_TQI_SP_S_IP_RATIO_FUEL_MAX	12	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum fuel flow through the CPS at MOD_1					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_RATIO_FUEL_MAX_CP_MOD_2	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDP_TQI_SP_S_IP_RATIO_FUEL_MAX	12	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum fuel flow through the CPS at MOD_2					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_FAC_FLOW_SP_MIN_PURGE	-	0... 1H	0 ...1	1	-
switch to activate /deactiate "intelligent MIN_PURGE"					

DI version
Input data table order: External inputs - Inputs from other EVAC modules

General information:

This module provides the flow setpoint for MIN_PURGE and the FUEL_FLOW setpoint for closed loop purge (“normal purge”).

Application conditions

Initialisation: *on activation and on deactivation:*
```
FLOW_CPS_SP_MIN_PURGE   = 0
RATIO_FUEL_SP_MAX_PURGE   = 0
MFF_MAX_CP              = 0
FLOW_MAX_CPS            = 0
FLOW_MAX_PHY_CPS   = 0
```

Recurrence: *100 ms*

Activation: *LV_CP_ACT = 1*

Deactivation *LV_CP_ACT = 0*

Formula section:

// Flow setpoint for MIN_PURGE & fuel flow ratio for closed loop

case selection of STATE_OPM_ENG_CP
ENG_MOD_0:
FLOW_CPS_SP_MIN_PURGE =
IP_FLOW_CPS_ENG_MOD_0 (N_32, MAF_SP_TQI)
RATIO_FUEL_SP_MAX_PURGE =
IP_RATIO_FUEL_MAX_CP_ENG_MOD_0 (N_32, MAF_SP_TQI)
ENG_MOD_1:
FLOW_CPS_SP_MIN_PURGE =
IP_FLOW_CPS_ENG_MOD_1 (N_32, TQI_SP_S)
RATIO_FUEL_SP_MAX_PURGE =
IP_RATIO_FUEL_MAX_CP_ENG_MOD_1 (N_32, TQI_SP_S)
ENG_MOD_2:
FLOW_CPS_SP_MIN_PURGE =
IP_FLOW_CPS_ENG_MOD_2 (N_32, TQI_SP_S)
RATIO_FUEL_SP_MAX_PURGE =
IP_RATIO_FUEL_MAX_CP_ENG_MOD_2 (N_32, TQI_SP_S)

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End case selection

if LC_LAM_CBK_CPS=0 // cylinder bank selection
then *TMP_MFF_SP* = MFF_SP_HOM_ENG[1]
else *TMP_MFF_SP* = MFF_SP_HOM_ENG[2]
endif
end

// Flow setpoint for MAX_PURGE
FLOW_MAX_PHY_CPS = IP_FLOW_CPS (PRS_CPS)

if FTL < C_FTL_MIN_FLOW_COR_CP
then
FAC_FLOW_COR_CLL_CP =
IP_FAC_FLOW_COR_AMP_CP(AMP)
* IP_FAC_FLOW_COR_AMP_DELTA_CP(AMP_DELTA_IT_CP)
else
FAC_FLOW_COR_CLL_CP =
IP_FAC_FLOW_COR_AMP_CP(AMP)
* IP_FAC_FLOW_COR_AMP_DELTA_CP(AMP_DELTA_IT_CP)
* C_FAC_FLOW_COR_FTL_CP
endif

if STATE_OPM_ENG_CP = 0
then FLOW_MAX_CPS = **min** [IP_FLOW_MAX_CPS (N_32, MAF_SP_TQI),
FLOW_MAX_PHY_CPS] * FAC_FLOW_COR_CLL_CP
else FLOW_MAX_CPS = **min** [IP_FLOW_MAX_2_CPS (N_32, MFF_SP_MV),
FLOW_MAX_PHY_CPS] * FAC_FLOW_COR_CLL_CP
endif

// "intelligent MIN_PURGE"
if LV_CL_CLC_VLD = 1
and LC_FAC_FLOW_SP_MIN_PURGE = 1
then FAC_FLOW_SP_MIN_PURGE =
min [C_FAC_FLOW_SP_MIN_PURGE_MAX,
C_CL_MAX_MIN_PURGE /CL_MMV
* IP_FAC_FLOW_SP_MIN_PURGE (CL_MMV)]
else FAC_FLOW_SP_MIN_PURGE = 1
endif
FLOW_CPS_SP_MIN_PURGE =
min [FLOW_CPS_SP_MIN_PURGE * FAC_FLOW_SP_MIN_PURGE,
FLOW_MAX_CPS]

moved here from EVAC management
// maximum CP fuel mass for closed loop
MFF_KGH_MAX_CP = [*TMP_MFF_SP* - C_MFF_MIN_CP] * (N_32 * NC_CYL_NR * 3) /10^5
mff_min from FMSP or INJR to be included according to old formula:
MFF_MAX_CP= [TMP_MFF_SP - C_MFF_MIN_CP - MFF_MIN_CP]
MFF_MAX_CP =
min [MFF_SP_MV * RATIO_FUEL_SP_MAX_PURGE *

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IP_RATIO_FUEL_MAX_CP_COR (TCO), MFF_KGH_MAX_CP]

end

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9.14 Evaporative emission control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CL_MMV_CLC_END	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Canister load at the end of MAX_PURGE operation					
FAC_TIA_AMP_CP	V	0... FFH	0... 1.99218	0.0078125	-
Flow correction versus air temperature and ambient pressure					
FLOW_COR_CPS	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
CPS flow setpoint, ambient conditions corrected, passed to valve control					
FLOW_CPS	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
CPS flow, pseudo-feedback value (limited to physical maximum)					
FLOW_CPS_OLD_1	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Old value (n-1) of FLOW_CPS for Pad Filter calculation for FLOW_DLY_CP					
FLOW_CPS_OLD_2	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Old value (n-2) of FLOW_CPS for Pad Filter calculation for FLOW_DLY_CP					
FLOW_CTL_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
CPS flow setpoint, EVAC internal setpoint					
FLOW_CTL_CPS_DI	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow through the CPS for disabled NORMAL_PURGE operation					
FLOW_DLY_CP	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Pad filter: filtered value of FLOW_CPS					
FLOW_DLY_MMV_CP	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Lowpass filter: filtered value of FLOW_DLY_CP					
FLOW_DLY_OLD_1_CP	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Old value (n-1) of FLOW_DLY_CP for Pad Filter calculation for FLOW_DLY_CP					
FLOW_DLY_OLD_2_CP	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Old value (n-2) of FLOW_DLY_CP for Pad Filter calculation for FLOW_DLY_CP					
FLOW_FAC_CP	V	0... FFFFH	0... 3.99993	61e-6	-
correction factor for flow decrementation during RAMP_CLOSE ramp					
FLOW_GRD_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow gradient (flow change /20ms) to be applied (may be added or substracted)					
FLOW_INC_CTR_TMP	-	0... FFH	0... 255	1	-
temporary variable: counter of incrementation steps during RAMP_OPEN & RAMP_OPEN_FAST					
FLOW_SP_CPS	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
CPS flow setpoint, after merge of all flow requests					
FLOW_TAR_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
CPS flow setpoint, target flow setpoint to be reached after ramping					
FLOW_TOT_CPS	V	0... FFFFFFFFH	0... 1455.99999	339e-9	g
Total of FLOW_CPS during emission cycle					
LV_CL_CLC_AVL	O/V	0... 1H	0 ...1	1	-
interface flag to cat.diag.: cl known;					
LV_CL_CLC_VLD	O/V	0... 1H	0 ...1	1	-
actual CL value usable for "intelligent MIN_PURGE"					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CL_MDL_CAT_PURGE_ACT_CP	O/V	0... 1H	0 ...1	1	-
Max purge state active at catalyst purge with canister load model					
LV_CP_ACT_REQ	O/V	0... 1H	0 ...1	1	-
Request to inhit Catalyst and O2 sensor diagnosis for allowing purge canister activation					
LV_CP_AFL_IT	-	0... 1H	0 ...1	1	-
temporary variable: internal copy of lv_afl (0: rich; 1: lean)					
LV_CP_CDN_RAMP_OPEN	O/V	0... 1H	0 ...1	1	-
RAMP_OPEN now possible					
LV_CP_CDN_RAMP_OPEN_FAST	V	0... 1H	0 ...1	1	-
RAMP_OPEN_FAST now possible					
LV_CP_CLL	O/V	0... 1H	0 ...1	1	-
=1: CP currently in close loop operation (=NORMAL_PURGE)					
LV_CP_RAMP_OPEN_ACT	O/V	0... 1H	0 ...1	1	-
Logical value for active RAMP_OPEN operation					
LV_DLY_GAS_CP	V	0... 1H	0 ...1	1	-
=0: waiting for gas transfer time before further flow incrementatin in RAMP_OPEN /RAMP_OPEN_FAST					
LV_RAMP_OPEN_ACT	O/V	0... 1H	0 ...1	1	-
Logical value for active RAMP_OPEN operation					
LV_STATE_MEM_CP_CLL	O/V	0... 1H	0 ...1	1	-
=1: last STATE_CP is a NORMAL_PURGE state					
LV_T_DLY_REQ_CP	V	0... 1H	0 ...1	1	-
C_T_DLY_REQ_CP time elapsed					
MAF_CP	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
(MAF_KGH throttle) MAF_KGH_THR + (Mass air flow through the canister purge valve) MAF_CPS					
MAF_CP_OLD_1	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Old value (n-1) of MAF_CP for Pad Filter calculation for MAF_DLY_CP					
MAF_CP_OLD_2	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Old value (n-2) of MAF_CP for Pad Filter calculation for MAF_DLY_CP					
MAF_CPS	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
MAF through the CPS					
MAF_CPS_OLD_1	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Old value (n-1) of MAF_CPS for Pad Filter calculation for MAF_DLY_CPS					
MAF_CPS_OLD_2	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Old value (n-2) of MAF_CPS for Pad Filter calculation for MAF_DLY_CPS					
MAF_DLY_CP	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Pad filter: filtered value of MAF_CP					
MAF_DLY_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Pad filter: filtered value of MAF_CPS					
MAF_DLY_MMV_CP	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Lowpass filter: filtered value of MAF_DLY_CP					
MAF_DLY_MMV_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Lowpass filter: filtered value of MAF_DLY_CPS					
MAF_DLY_OLD_1_CP	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Old value (n-1) of MAF_DLY_CP for Pad Filter calculation for MAF_DLY_CP					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MAF_DLY_OLD_1_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Old value (n-1) of MAF_DLY_CPS for Pad Filter calculation for MAF_DLY_CPS					
MAF_DLY_OLD_2_CP	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Old value (n-2) of MAF_DLY_CP for Pad Filter calculation for MAF_DLY_CP					
MAF_DLY_OLD_2_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Old value (n-2) of MAF_DLY_CPS for Pad Filter calculation for MAF_DLY_CPS					
MAF_INT_CP	V	0... FFFFH	0... 1820.42	0.0277778	g
MAF integal for lambda controller stabilisation in Wait Ramp Open					
PQ_CP_SP	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
PQ-setpoint for canister purge					
PQ_SP_CP_TMP	-	0... FFFFH	0... 0.99998	15.3e-6	-
temporary variable for PQ_SP_CP calculation					
STATE_CLL_DEAC_CP	O/V	0H 1H 2H 3H undef:1H	CP_NO_DEAC RAMP_OPEN_ DEAC MAX_PURGE_ DEAC RAMP_FAST_ DEAC	-	-
Deactivation states of the Evaporative Emission Control					
STATE_CP	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H AH BH	CP_NOT_ACT NO_PURGE RAMP_TO_ NO_PURGE WAIT_RAMP_ OPEN MIN_PURGE - - - RAMP_OPEN RAMP_OPEN_ FAST MAX_PURGE RAMP_CLOSE	-	-
State of Evaporative Emission Control Function					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_LOCK_CP	O/V	0H 1H 2H undef:1H	UNLOCKED NO_PURGE_LOCKED MIN_PURGE_LOCKED	-	-
STATE_CP locked in this state					
T_DI_CP	V	0... FFFFH	0... 6553.5	0.1	s
time counter for disabled RAMP_OPEN, RAMP_OPEN_FAST or MAX_PURGE					
T_DLY_CL_MDL	O/V	0... FFFFH	0... 6553.5	0.1	s
Time counter to activate CL-Model if lambda gradient greater than a threshold					
T_DLY_CP	V	0... FFFFH	0... 6553.5	0.1	s
lambda controller stabilisation time counter					
T_DLY_CP_OPEN	V	0... FFFFH	0... 6553.5	0.1	s
Time counter for gas transfer time waiting in RAMP_OPEN and RAMP_OPEN_FAST					
T_DLY_MAX_CP	O/V	0... FFFFH	0... 6553.5	0.1	s
Time counter between the end of a MAX_PURGE and a new learning request (distinction between RAMP_OPEN and RAMP_OPEN_FAST)					
T_DLY_REQ_CP_TMP	-	0... FFFFH	0... 65535	1	s
temporary variable: timer for LV_T_DLY_REQ_CP calculation					
T_LOCK_CP_TMP	V	0... FFFFH	0... 1310.7	0.02	s
Time counter for locking MIN_PURGE or NO_PURGE after canister empty detection					
T_MAF_INT_CP	V	0... FFFFH	0... 6553.5	0.1	s
Time limitation for MAF integration at state Wait Ramp Open					

Input data:

AMP {p. 982}	CL {p. 3698}	CL_MMV {p. 3698}	FAC_FLOW_COR_CLL_CP {p. 3630}
FAC_FLOW_COR_CP_EXT {p. 3679}	FAC_FLOW_TAR_COR_CP {p. 3679}	FLOW_CPS_SP_MIN_PURGE {p. 3630}	FLOW_MAX_CPS {p. 3630}
FLOW_MAX_PHY_CPS {p. 3630}	FLOW_SP_CPS_EVAP {p. 1001}	LC_CP_CLL_INH_MAN {p. 1544}	LV_CL_MDL_ACT {p. 3728}
LV_CL_MDL_ENA {p. 3728}	LV_CP_ACT {p. 3679}	LV_CP_AFL {p. 3699}	LV_CP_CAT_PURGE {p. 1540}
LV_CP_CDN_MIN_PURGE_FAST {p. 1540}	LV_CP_CLOSE_1 {p. 3679}	LV_CP_CLOSE_2 {p. 3679}	LV_CP_CLOSE_REQ {p. 1540}
LV_CP_CMU_CMB {p. 1540}	LV_CP_ENA {p. 3737}	LV_CP_NEW_RAMP_OPEN {p. 3699}	LV_CP_NEW_RAMP_OPEN_FAST {p. 3699}
LV_CPS_AD_ACT {p. 3756}	LV_DIAGCP_CPS_ACT {p. 1001}	LV_FAC_LAM_SHIFT_CP_AVL {p. 3699}	LV_FLOW_TAR_COR_CP {p. 3679}
LV_HOM_ACT {p. 8136}	LV_HOM_AFL_ACT {p. 8136}	LV_N_MAX_CP {p. 1540}	MAF {p. 8277}
MAF_CYL {p. 8277}	MAF_KGH_FG_PRED_COR_CP {p. 3692}	MAF_THR {p. 8278}	MFF_BUF_CP {p. 3692}

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MFF_CP {p. 3700}	MFF_MAX_CP {p. 3630}	MFF_SP_MV {p. 2151}	N_32 {p. 1525}
NC_CYL_NR {p. 1526}	PRS_CPS {p. 1540}	STATE_CDN_CP {p. 1541}	STATE_OPM_ENG_CP {p. 3680}
T_RAMP_OPEN_STAB {p. 3701}	TIA_THR {p. 984}	TQI_SP_S {p. 8391}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_CAT_DIAG	-	0... FFFFH	0... 1.99996	30.5e-6	-
Canister load threshold to enable cat.diag. in MIN_PURGE (if cl < thd)					
C_CL_MMV_PQ	-	0... FFFFH	0... 1.99996	30.5e-6	-
CL_MMV threshold to force PQ in Max purge during strat. or Hom. lean burn modes					
C_CL_MMV_REQ	-	0... FFFFH	0... 1.99996	30.5e-6	-
CL_MMV limit value to give priority to purge canister					
C_CRLC_PQ_SP_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
correlation constant to calculate PQ_SP_CP					
C_FAC_DEC_COR_1_CP	-	0... FFFFH	0... 3.99993	61e-6	-
correction factor for closing ramp speed when high closing speed requested from OBD sequencer					
C_FAC_DEC_COR_2_CP	-	0... FFFFH	0... 3.99993	61e-6	-
correction factor for closing ramp speed when medium closing speed requested from OBD sequencer					
C_FAC_DEC_COR_CMU_CP	-	0... FFFFH	0... 3.99993	61e-6	-
correction factor for closing ramp speed when combustion commutation requested					
C_FAC_FLOW_CAT_PURGE_CP	-	0... FFFFH	0... 3.99993	61e-6	-
Flow reduction factor at MaxPurge at Cat-purge with CL-Model activation					
C_FAC_FLOW_CAT_PURGE_INI_CP	-	0... FFFFH	0... 3.99993	61e-6	-
Flow reduction factor at reentry of MaxPurge at Cat-purge with CL-Model activation					
C_FAC_FLOW_MAX_INI_CP	-	0... FFH	0... 0.99609	3.9063e-3	-
Factor to limit FLOW_CTL_CPS at re-entering MAX_PURGE for low canister load					
C_FAC_T_DLY_PURGE_TUBE_CP	-	0... FFFFH	0... 3.99993	61e-6	-
Factor for Gas delay time in Wait Ramp Open					
C_FLOW_CPS_AS	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
FLOW_SP_CPS correction of application system					
C_FLOW_CPS_GRD_PURGE_TUBE	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow gradient for tube purging in WAIT_RAMP_OPEN					
C_FLOW_CPS_GRD_PURGE_TUBE_CLOSE	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow gradient for tube purging in WAIT_RAMP_OPEN (at closing cps)					
C_FLOW_CPS_SP_PURGE_TUBE	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow setpoint for tube purging in WAIT_RAMP_OPEN					
C_FLOW_DLY_CRLC_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for FLOW_DLY_CP-filter					
C_FLOW_INI_CPS	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
FLOW_CTL_CPS initialization value					
C_MAF_DLY_CRLC_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for MAF_DLY_CP-filter					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_DLY_CRLC_CPS	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for MAF_CPS_DLY-filter					
C_MAF_INT_MAX_CP_0	-	0... FFFFH	0... 1820.42	0.0277778	g
MAF integral threshold for lambda controller stabilisation in Wait Ramp Open (ENG_MODE = 0)					
C_MAF_INT_MAX_CP_1	-	0... FFFFH	0... 1820.42	0.0277778	g
MAF integral threshold for lambda controller stabilisation in Wait Ramp Open (ENG_MODE != 0)					
C_MFF_MAX_CPS_DI	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Max. MFF for flow through cps on reentering MAX_PURGE					
C_MFF_RATIO_FLOW_INI_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Fuel Ratio for calculation of flow setpoint at re-entry in Max Purge					
C_T_CP_PURGE_TUBE	-	0... FFFFH	0... 6553.5	0.1	s
Time at the start of WAIT_RAMP_OPEN wherein the purge tube may be purged itself					
C_T_DI_MAX_CP_0	-	1... FFFFH	0.1... 6553.5	0.1	s
Maximum time for disabling MAX_PURGE operation (ENG_MODE = 0)					
C_T_DI_MAX_CP_1	-	1... FFFFH	0.1... 6553.5	0.1	s
Maximum time for disabling MAX_PURGE operation (ENG_MODE != 0)					
C_T_DI_RAMP_FAST_CP_0	-	1... FFFFH	0.1... 6553.5	0.1	s
Maximum time for disabling RAMP_OPEN_FAST operation (ENG_MODE = 0)					
C_T_DI_RAMP_FAST_CP_1	-	1... FFFFH	0.1... 6553.5	0.1	s
Maximum time for disabling RAMP_OPEN_FAST operation (ENG_MODE != 0)					
C_T_DI_RAMP_OPEN_CP_0	-	1... FFFFH	0.1... 6553.5	0.1	s
Maximum time for disabling RAMP_OPEN operation (ENG_MODE = 0)					
C_T_DI_RAMP_OPEN_CP_1	-	1... FFFFH	0.1... 6553.5	0.1	s
Maximum time for disabling RAMP_OPEN operation (ENG_MODE != 0)					
C_T_DLY_CL_MDL	-	0... FFFFH	0... 6553.5	0.1	s
Time to activate CL-Model					
C_T_DLY_CP	-	1... FFFFH	0.1... 6553.5	0.1	s
Time for lambda control stabilization before to start RAMP_OPEN or RAMP_OPEN_FAST					
C_T_DLY_MAX_CP_0	-	0... FFFFH	0... 6553.5	0.1	s
Time between two MAX_PURGE operation for RAMP_OPEN_FAST activation (ENG_MODE = 0)					
C_T_DLY_MAX_CP_1	-	0... FFFFH	0... 6553.5	0.1	s
Time between two MAX_PURGE operation for RAMP_OPEN_FAST activation (ENG_MODE != 0)					
C_T_DLY_REQ_CP	-	0... FFFFH	0... 65535	1	s
Time to set LV_T_DLY_REQ_CP					
C_T_LOCK_CP	-	0... FFFFH	0... 1310.7	0.02	s
Locking time for locking MIN_PURGE or NO_PURGE after canister empty detection					
C_T_MAX_MAF_INT_CP_0	-	0... FFFFH	0... 6553.5	0.1	s
Maximum runtime of MAF integration as stabilisation time for the lambda controller (ENG_MODE = 0)					
C_T_MAX_MAF_INT_CP_1	-	0... FFFFH	0... 6553.5	0.1	s
Maximum runtime of MAF integration as stabilisation time for the lambda controller (ENG_MODE != 0)					
C_T_MIN_MAF_INT_CP_0	-	0... FFFFH	0... 6553.5	0.1	s
Minimum runtime of MAF integration as stabilisation time for the lambda controller (ENG_MODE = 0)					
C_T_MIN_MAF_INT_CP_1	-	0... FFFFH	0... 6553.5	0.1	s
Minimum runtime of MAF integration as stabilisation time for the lambda controller (ENG_MODE != 0)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_FLOW_INC_NR_CP	-	1... FFH	1... 255	1	-
LDP_N_32_ID_FLOW_INC_NR_CP	4	0... FFH	0... 8160	32	rpm
Increment number for FLOW_CTL_CPS calculation during RO and ROF (steps 20ms)					
IP_FAC_AMP_CP	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_AMP_1_EVAC	6	0... FFFFH	0... 5434	0.0829175	hPa
Correction factor for ambient pressure					
IP_FAC_TIA_CP	-	0... FFH	0... 1.99218	0.0078125	-
LDP_TIA_THR_IP_FAC_TIA_CP	6	0... FEH	-48... 142.5	0.75	°C
Correction factor for intake air temperature					
IP_FLOW_CPS_DEC	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_MFF_SP_MV_1_EVAC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Decrement value on FLOW_CTL_CPS during MAX_PURGE					
IP_FLOW_CPS_INC	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_MFF_SP_MV_1_EVAC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Increment value on FLOW_CTL_CPS during MAX_PURGE					
IP_FLOW_DEC_CP	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_MFF_SP_MV_1_EVAC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Decrement value for ramp decrease of FLOW_CTL_CPS					
IP_FLOW_FAC_CP	-	0... FFFFH	0... 3.99993	61e-6	-
LDP_CL_IP_FLOW_FAC	6	0... FFFFH	0... 1.99996	30.5e-6	-
Correction factor for ramp increase of FLOW_CTL_CPS					
IP_FLOW_INC_COR_HOM_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correction of FLOW_GRD_CPS in homogen mode					
IP_FLOW_INC_CP	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_MFF_SP_MV_1_EVAC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Increment value for ramp increase of FLOW_CTL_CPS in Ramp open mode					
IP_FLOW_INC_FAST_CP	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_MFF_SP_MV_1_EVAC	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Increment value for ramp increase of FLOW_CTL_CPS in Ramp Open Fast mode					
IP_FLOW_MAX_OPEN_CPS	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MAF_2_EVAC	12	0... FFH	0... 1389	5.4470588	mg/stk
Maximum limit for FLOW_CTL_CPS value for RAMP_OPEN & RAMP_OPEN_FAST					
IP_FLOW_MAX_OPEN_CPS_2	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_N_32_2_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_MV_2_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Max. limit for FLOW_CTL_CPS value for RAMP_OPEN & RAMP_OPEN_FAST with STATE_OPM_ENG_CP = 1					
IP_PQ_CP_SP	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_N_32_1_EVAC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_SP_S_2_EVAC	6	0... 7FFFH	0... 1023.97	0.03125	Nm
Forced PQ during stratified mode for RAMP_OPEN & MAX_PURGE					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_T_DLY_CL_MMV_DYW	-	1... FFFFH	0.1... 6553.5	0.1	s
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Stabilization delay on CL_MMV value during RAMP_OPEN					
IP_T_DLY_CP	-	0... FFFFH	0... 63.99902	976.599e-6	-
LDPM_MAF_KGH_COR_IP_T_DLY_CP	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Time delay for MAF_CYL (delay time (s) /time recurrence(0.1s))					
IP_T_DLY_CP_2	-	0... FFFFH	0... 63.99902	976.599e-6	-
LDPM_MAF_KGH_COR_IP_T_DLY_CP	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Time delay for MAF_CYL (delay time (s) /time recurrence(0.1s)) with STATE_OPM_ENG_CP = 1					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_MOD_SEL_CP	-	0H 1H 2H 3H undef:1H	SEL_NO_PURGE SEL_MIN_PURGE SEL_MAX_PURGE SEL_RAMP_CLOSE	-	-
selection of the purge mode with empty canister detected at end of RAMP_OPEN					
LC_CP_CAT_PURGE_MDL_ACT	-	0... 1H	0 ...1	1	-
transition to Wait-RO at cat-purge will inhibitied due to usage of CL modell					
LC_CP_FLOW_LIM_OPEN_FAST	-	0... 1H	0 ...1	1	-
enable old calc. of FLOW_TAR_CPS during ROF: fuel mass based					
LC_CP_TRA_MAX_MIN_CDN_ENA	-	0... 1H	0 ...1	1	-
enable transition MAX_PURGE (MIN_PURGE with STATE_CDN_CP = NO_CDN					
LC_CP_TRA_MIN_PURGE_DFT_ENA	-	0... 1H	0 ...1	1	-
1: enable transition NO_PURGE (MIN_PURGE with STATE_CDN_CP = NO_CDN					
LC_CP_TRA_MIN_RAMP_OPEN_DIS	-	0... 1H	0 ...1	1	-
enable trans. NO_PURGE (MIN_PURGE, if no RO or ROF is possible although STATE_CDN_CP=RO or ROF					
LC_CP_TRA_OPL_CDN_CLL_NOT	-	0... 1H	0 ...1	1	-
enable transition WAIT_RAMP_OPEN (NO_PURGE if LV_CP_CDN_RAMP_OPEN, _FAST no more given					
LC_CP_TRA_OPL_CDN_NOT	-	0... 1H	0 ...1	1	-
enable transition WAIT_RAMP_OPEN (NO_PURGE if STATE_CDN_CP = NO_CDN					
LC_CP_TRAN_DEAC_CLL	-	0... 1H	0 ...1	1	-
1: enable transition back to RAMP_OPEN_FAST after interruption					
LC_CP_TRAN_OPEN_MAX_ENA	-	0... 1H	0 ...1	1	-
enable transition RO (MaxP if flow target reached					
LC_FLOW_CPS_AS	-	0... 1H	0 ...1	1	-
C_FLOW_CPS_AS activation					
LC_LAM_LIN_CPS	-	0... 1H	0 ...1	1	-
Type of O2 sensor (0 -> binary sensor , 1 -> linear sensor)					
LC_PQ_SP_CP_HOM_AFL	-	0... 1H	0 ...1	1	-
switch to enable forced pq during hom_afl operation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Import actions:

ACTION_EVAM_Purge ()

Should be calculated before LACO calculation!
Input data table order: External inputs - Inputs from other EVAC modules
Hint: For each operating point, the corresponding value of IP_FLOW_MAX_OPEN_CPS and IP_FLOW_MAX_OPEN_CPS_2 must not exceed the corresponding value of IP_FLOW_MAX_CPS.

General information

General information:

The evaporative emissions of the fuel tank system are stored in an activated charcoal filter ACF to prevent an escape of the gas to the environment. The loading capacity of the filter is limited, so the filter must be purged temporarily. Therefore the canister purge solenoid CPS. that is positioned between the charcoal filter and the intake manifold is opened by the engine management system. To prevent driveability and emission problems, the opening of the CPS and so the purge flow MFF_CP must be controlled.
With the Evaporative Emission Control function, the opening of the CPS is controlled in dependence with the fuel mass stored in the canister. Therefore the canister load cl is calculated using the measured mass air flow MAF, the deviation of the lambda-control when the CPS is opened, the mass flow through the CPS and the stoichiometric constant of the fuel (14.7). The opening of the CPS is controlled in dependence with the canister load CL.

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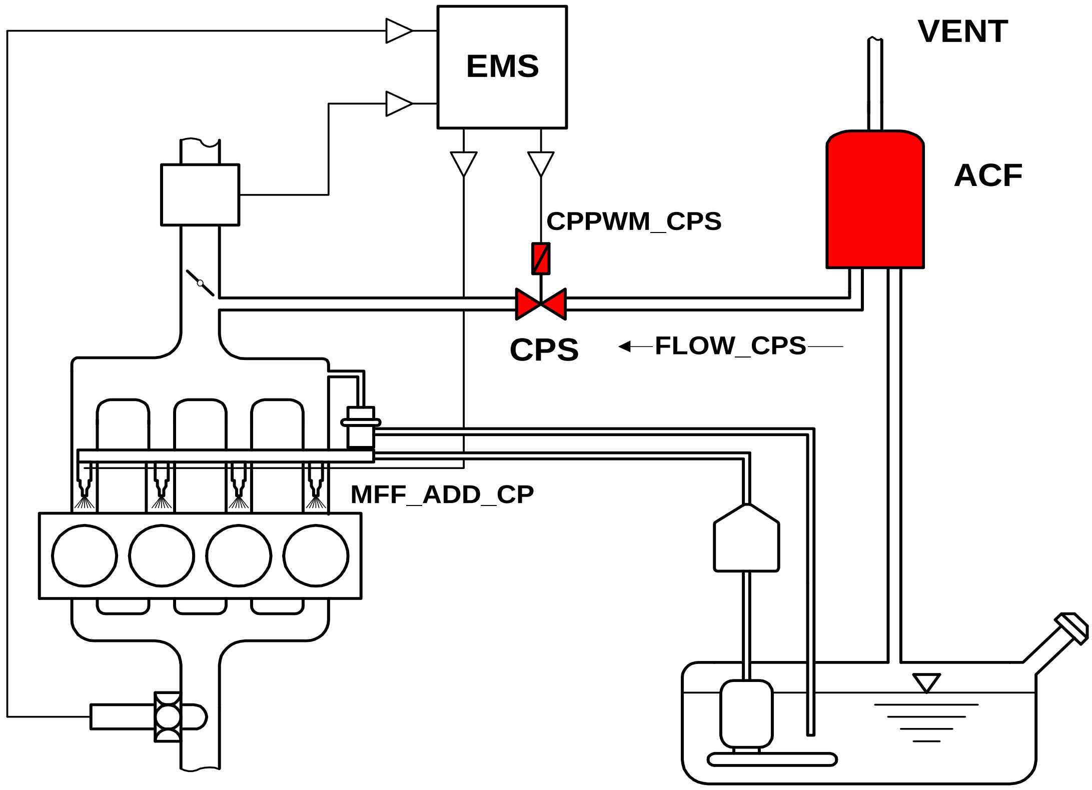

Figure 9.14.1: : evaporative emission control system

Application conditions

Initialisation: at RST, IGKON or transition to CP_NOT_ACT:

```
PQ_CP_SP       = 1
STATE_CP       = CP_NOT_ACT
STATE_CLL_DEAC_CP = CP_NO_DEAC
STATE_LOCK_CP    = UNLOCKED
all other values   = 0
```

Recurrence: *20 ms*

Activation: – –

Deactivation: – –

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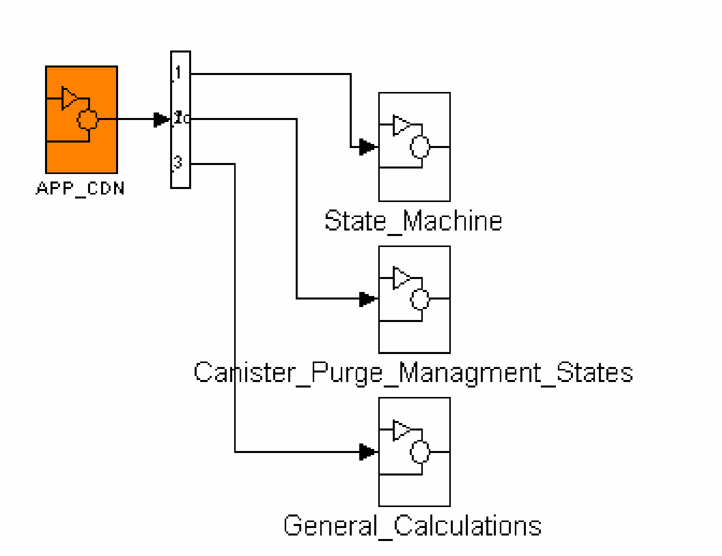

Figure 9.14.2: : structure of the evaporative emission control

Formula section:

call “State machine”
call “Canister purge management states”
call “General calculations”
end

Temporary adaptation flags :
LV_RAMP_OPEN_ACT = LV_CP_RAMP_OPEN_ACT

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9.14.1 State machine

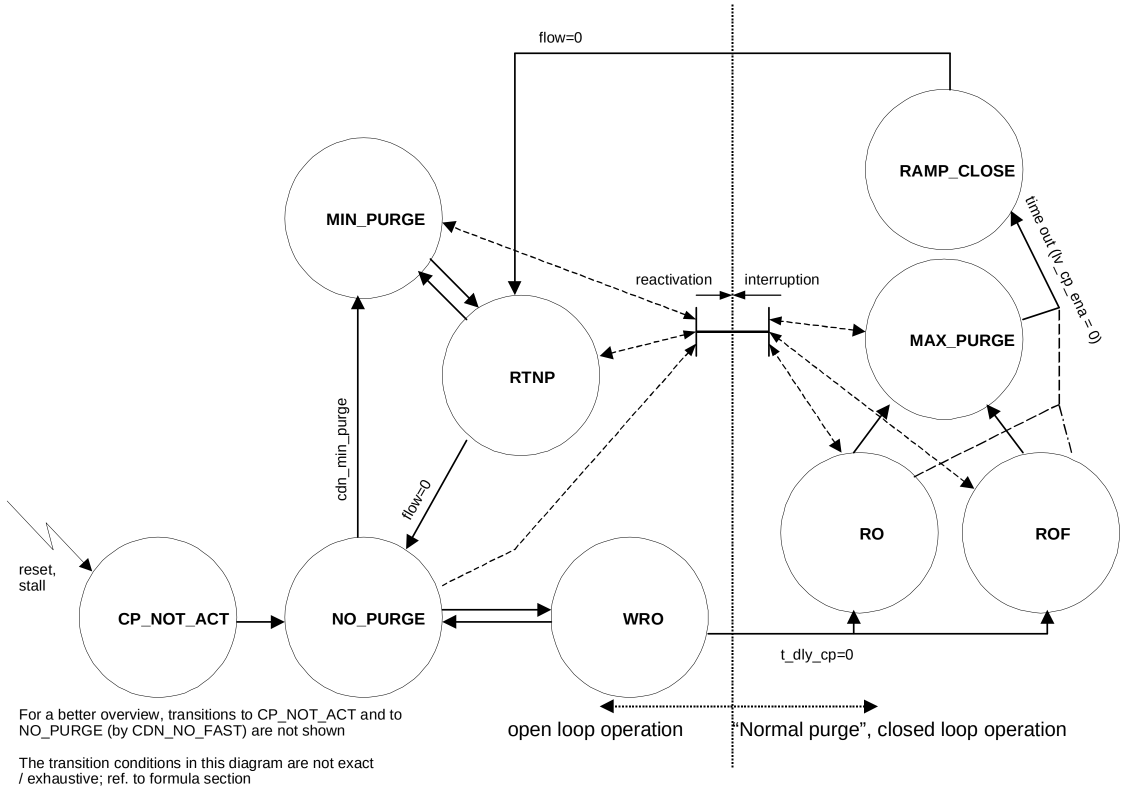

Figure 9.14.3: : State machine (simplified)

The canister purge control has the following states:

- CP_NOT_ACT function inactive, initial state
- NO_PURGE Valve closed, no purging.
- RAMP_TO_NO_PURGE Flow is currently ramped down from purging level to zero
- MIN_PURGE open loop purge with low flow
- WAIT_RAMP_OPEN waiting for lambda control stabilisation before leaning mode
- RAMP_OPEN Slow opening of the valve, learning mode
- RAMP_OPEN_FAST Faster opening of the valve; cl known from previous purge
- MAX_PURGE Controlled canister purge with high flow through the ACF
- RAMP_CLOSE Closing of the valve at the end of controlled operation

9.14.1.1 Brief description of the activation conditions of the different states

General information:

In the following, a brief description of the conditions of each state is given, this description is only for information and is not precise. In general, if the conditions below are met, the state described will be active.
The detailed conditions for transitions from each state to each other possible state and the actions to be done on the transitions are described in the next chapter "State Transitions".

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The “controlled states” are RAMP_OPEN, RAMP_OPEN_FAST, MAX_PURGE & RAMP_CLOSE.
The “non-controlled states” are NO_PURGE, RAMP_TO_NO_PURGE, MIN_PURGE and WAIT_RAMP_OPEN.

NORMAL_PURGE Operation (closed loop operation)
If the conditions for NORMAL_PURGE are fulfilled, the NORMAL_PURGE operation is proceeded in the following sequences:

	RAMP_OPEN	MAX_PURGE	RAMP_CLOSE
or	RAMP_OPEN_FAST	MAX_PURGE	RAMP_CLOSE

These sequences can change, if one of the phases is disabled for a short time and the interrupt is not longer than an applicable time constant

- C_T_DI_RAMP_OPEN_CP_0/_1 (STATE_CLL_DEAC_CP = RAMP_OPEN_DEAC) **or**
- C_T_DI_MAX_CP_0/_1 (STATE_CLL_DEAC_CP = MAX_PURGE_DEAC) **or**
- C_T_DI_RAMP_FAST_CP_0/_1 (STATE_CLL_DEAC_CP = RAMP_FAST_DEAC)

If RAMP_OPEN, RAMP_OPEN_FAST or MAX_PURGE operation was interrupted (any non-controlled state active) and the interruption time is lower than the adjustable times C_T_DI_RAMP_OPEN_CP_0/_1, C_T_DI_RAMP_FAST_CP_0/_1 rsp. C_T_DI_MAX_CP_0/_1, RAMP_OPEN, RAMP_OPEN_FAST or MAX_PURGE operation starts immediately with the values which were stored when the operation was interrupted.
When the interruption times are longer than the corresponding constants, NORMAL_PURGE states are re-started with a new RAMP_OPEN /RAMP_OPEN_FAST phase. (FLOW_CTL_CPS starts with zero.)

CP_NOT_ACT
Function inactive, initial state

1. Engine stopped or stalled
2. coolant temperature threshold not once exceeded

NO_PURGE
Valve closed, no purging.

1. STATE_CDN_CP = CDN_NO_PURGE or CDN_NO_FAST **and**
2. [Fast shut-off necessary **or**
3. ramp from purge states to NO_PURGE finished]

RAMP_TO_NO_PURGE
Flow is currently ramped down from purging level to zero
If fast shut-off is necessary, the state machine will directly switch to NO_PURGE (immediate valve closing without ramp), otherwise, RAMP_TO_NO_PURGE will be active as long as the valve is closed by a ramp

1. STATE_CDN_CP = CDN_NO_PURGE **and**
2. Fast shut-off not necessary **and**
3. Ramp from purge states to NO_PURGE not finished **and**
4. [Previous state was MIN_PURGE or WAIT_RAMP_OPEN **and** time out from time scheduler LV_CP_ENA = 0]

An immediate switch to NO_PURGE without ramp is requested by STATE_CDN_CP = CDN_NO_FAST. In this case, FLOW_CTL_CPS is directly set to 0, no ramping down will occur.

MIN_PURGE
No controlled purge possible, open loop purge with low flow, thus low disturbance of lambda contro.

1. STATE_CDN_CP = CDN_MIN_PURGE **or**
2. Empty canister detected at the end of RAMP_OPEN

RAMP_OPEN
Slow opening of the valve, canister load not known, will be learned during RAMP_OPEN

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1. STATE_CDN_CP = CDN_RAMP_OPEN **and**
2. Long time since the last MAX_PURGE (old cl value no more useable) **and**
3. The time delay for lambda control stabilization is elapsed or not necessary (due to MAX_PURGE or RAMP_OPEN disabling).

RAMP_OPEN_FAST

Faster opening of the valve than in RAMP_OPEN; cl known from previous normal purge operation

1. STATE_CDN_CP = CDN_RAMP_FAST **and**
2. Short time since the last MAX_PURGE (old cl value still useable) **and**
3. The time delay for lambda control stabilization is elapsed or not necessary (due to MAX_PURGE or RAMP_OPEN disabling)

MAX_PURGE

Controlled canister purge with high flow through the ACF

1. NO_PURGE /RAMP_TO_NO_PURGE /MIN_PURGE not requested **and**
2. RAMP_OPEN or RAMP_OPEN_FAST normally finished **and**
3. Can be directly reached from the non-controlled states, if MAX_PURGE was previously disabled and disabling time was lower than a threshold (STATE_CLL_DEAC_CP = MAX_PURGE_DEAC)
4. Can be entered at catalyst purge with canister load model running

RAMP_CLOSE

Closing of the valve at the end of controlled operation

1. NO_PURGE /RAMP_TO_NO_PURGE /MIN_PURGE not requested **and**
2. Canister purge time slice elablsed /Lambda adaption time active

9.14.1.2 Preliminary calculations

```
LV_CP_CDN_RAMP_OPEN_FAST =
        { [        T_DLY_MAX_CP > 0                        // cl from prev. purge useable
or      STATE_CLL_DEAC_CP = RAMP_FAST_DEAC ]               // re-entry with T_.. = 0
and [  STATE_CDN_CP        = CDN_RAMP_FAST
or      STATE_CDN_CP        = CDN_RAMP_OPEN ]
and    LV_CP_NEW_RAMP_OPEN = 0}
        // CDN_RAMP_OPEN may be given, although RAMP_OPEN_FAST is preferable

LV_CP_CDN_RAMP_OPEN =
         [  T_DLY_MAX_CP  = 0
and    STATE_CDN_CP        = CDN_RAMP_OPEN ]
end
```

9.14.1.3 CP_NOT_ACT

```
if          LV_CP_ACT       = 0
then        STATE_CP        = CP_NOT_ACT
else        call  "INITIALIZATION-VALUES on entering NO_PURGE"
             STATE_CP        = NO_PURGE
endif
end
```

9.14.1.4 NO_PURGE

```
if          LV_CP_ACT       = 0
then        STATE_CP        = CP_NOT_ACT

elseif          STATE_CDN_CP = CDN_NO_PURGE
or          STATE_CDN_CP = CDN_NO_FAST
```

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```
or          LV_CP_ENA      = 0
then        STATE_CP       = NO_PURGE                      // stay in NO_PURGE

elseif          STATE_CDN_CP = CDN_MIN_PURGE
then        call  "INITIALIZATION-VALUES on leaving NO_PURGE"
            call  "INITIALIZATION-VALUES on entering MIN_PURGE"
            STATE_CP       = MIN_PURGE

            // re-entry in Max Purge with activated canister load model at catalyst purge
elseif          STATE_CDN_CP = CDN_RAMP_OPEN
      and   LV_CP_CAT_PURGE = 1
      and   LV_CL_MDL_ACT = 1
then        call  "INITIALIZATION-VALUES on leaving NO_PURGE"
            call  "INITIALIZATION-VALUES on entering MAX_PURGE"
            STATE_CP       = MAX_PURGE

            // re-entry in normal purge states after short deactivation
elseif          STATE_CLL_DEAC_CP ≠ CP_NO_DEAC
            and   LV_CP_NEW_RAMP_OPEN = 0
            and   LV_CP_NEW_RAMP_OPEN_FAST = 0
then  case selection on STATE_CLL_DEAC_CP
            RAMP_OPEN_DEAC:
            if      LV_CP_CDN_RAMP_OPEN
            then call   "INITIALIZATION-VALUES on leaving NO_PURGE"
                  call   "INITIALIZATION-VALUES on entering RAMP_OPEN"
                  STATE_CP = RAMP_OPEN
            endif

            RAMP_FAST_DEAC:
            if      [ LV_CP_CDN_RAMP_OPEN_FAST
            and   LC_CP_TRAN_DEAC_CLL ]    // switch to enable old functionality
            then call   "INITIALIZATION-VALUES on leaving NO_PURGE"
                  call   "INITIALIZATION-VALUES on entering RAMP_OPEN_FAST"
                  STATE_CP = RAMP_OPEN_FAST
            endif

            MAX_PURGE_DEAC:
            call  "INITIALIZATION-VALUES on leaving NO_PURGE"
            call  "INITIALIZATION-VALUES on entering MAX_PURGE"
            STATE_CP       = MAX_PURGE
      end case selection

elseif          (LV_CP_CDN_RAMP_OPEN_FAST or LV_CP_CDN_RAMP_OPEN)
      and   (!LV_CP_CAT_PURGE or !LC_CP_CAT_PURGE_MDL_ACT)
then        call  "INITIALIZATION-VALUES on leaving NO_PURGE"
            call  "INITIALIZATION-VALUES on entering WAIT_RAMP_OPEN"
            STATE_CP       = WAIT_RAMP_OPEN
```

<u>No RO possible:</u>
imagine: turn on engine and stay in idle for a long time; STATE_CDN_CP = CDN_RAMP_OPEN_FAST (idle), but only RAMP_OPEN possible as no RO occurred before; we would never purge anything as we would wait in NoPurge.

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New: Possibility to switch to min_purge in this case (configurable).
Ref. to Thäder-mail 29.04.02
no consideration of lambda control (LV_LSCL_i = 1, both benches) necessary, as STATE_CDN_CP will be cdn_min_purge anyway, if at least one lambda controller is not active

NO_CDN-management:
As STATE_CDN_CP=NO_CDN is quite new, this state was previously not considered everywhere. If STATE_CDN_CP = NO_CDN, NO_PURGE is not forced and NORMAL_PURGE is not possible (except the re-entry in maxpurge after deac), so we may switch to MIN_PURGE (configurable)

```
elseif          {[STATE_CDN_CP = CDN_RAMP_FAST        // No RO possible
             and        LC_CP_TRA_MIN_RAMP_OPEN_DIS ]
       or    [ STATE_CDN_CP = NO_CDN                  // NO_CDN-management
             and        LC_CP_TRA_MIN_PURGE_DFT_ENA ]}
       and   (!LV_CP_CAT_PURGE or !LC_CP_CAT_PURGE_MDL_ACT)
then         call  "INITIALIZATION-VALUES on leaving NO_PURGE"
             call  "INITIALIZATION-VALUES on entering MIN_PURGE"
             STATE_CP        = MIN_PURGE

else         STATE_CP        = NO_PURGE                // default
endif
end
```

9.14.1.5 RAMP_TO_NO_PURGE

```
if           LV_CP_ACT       = 0
then         STATE_CP        = CP_NOT_ACT

elseif          STATE_CDN_CP = CDN_NO_FAST
or           FLOW_CTL_CPS = 0                          // flow reduction finished
then         call  "INITIALIZATION-VALUES on leaving RAMP_TO_NO_PURGE"
             call  "INITIALIZATION-VALUES on entering NO_PURGE"
             STATE_CP        = NO_PURGE
```

if flow_ctl_cps reaches 0 in the same moment than a switch to min_purge would be possible, the switch to no_purge has now priority. In the next recurrence, a switch from no_purge to min_purge will occur. This 20ms delay is seen as neglectable. (The high-end solution would be to check the flow_ctl_cps condition only if STATE_CDN_CP = cdn_no_purge)

```
elseif          STATE_CDN_CP = CDN_NO_PURGE
or           LV_CP_ENA       = 0
then         STATE_CP        = RAMP_TO_NO_PURGE        // stay in actual state

elseif          STATE_CDN_CP = CDN_MIN_PURGE
then         call  "INITIALIZATION-VALUES on leaving RAMP_TO_NO_PURGE"
             call  "INITIALIZATION-VALUES on entering MIN_PURGE"
             STATE_CP        = MIN_PURGE

             // re-entry in normal purge states after short deactivation
elseif          STATE_CLL_DEAC_CP ≠ CP_NO_DEAC
             and   LV_CP_NEW_RAMP_OPEN = 0
             and   LV_CP_NEW_RAMP_OPEN_FAST = 0
then   case selection on STATE_CLL_DEAC_CP
             RAMP_OPEN_DEAC:
             if      LV_CP_CDN_RAMP_OPEN
```

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```
            then  call   "INITIALIZATION-VALUES on leaving RAMP_TO_NO_PURGE"
                  call   "INITIALIZATION-VALUES on entering RAMP_OPEN"
                  STATE_CP = RAMP_OPEN
            endif

            RAMP_FAST_DEAC:
            if      [ LV_CP_CDN_RAMP_OPEN_FAST
            and     LC_CP_TRAN_DEAC_CLL ]    //switch to enable old functionality
            then call   "INITIALIZATION-VALUES on leaving RAMP_TO_NO_PURGE"
                  call   "INITIALIZATION-VALUES on entering RAMP_OPEN_FAST"
                  STATE_CP = RAMP_OPEN_FAST
            endif

            MAX_PURGE_DEAC:
            call   "INITIALIZATION-VALUES on leaving RAMP_TO_NO_PURGE"
            call   "INITIALIZATION-VALUES on entering MAX_PURGE"
            STATE_CP        = MAX_PURGE
        end case selection

elseif            [ STATE_CDN_CP = NO_CDN          // NO_CDN-management
and         LC_CP_TRA_MIN_PURGE_DFT_ENA ]
then        call   "INITIALIZATION-VALUES on leaving RAMP_TO_NO_PURGE"
            call   "INITIALIZATION-VALUES on entering MIN_PURGE"
            STATE_CP        = MIN_PURGE

else  STATE_CP              = RAMP_TO_NO_PURGE              // default
endif
end
```

9.14.1.6 MIN_PURGE

```
if          LV_CP_ACT       = 0
then        STATE_CP        = CP_NOT_ACT

elseif           STATE_CDN_CP = CDN_NO_FAST
then        call   "INITIALIZATION-VALUES on leaving MIN_PURGE"
            call   "INITIALIZATION-VALUES on entering NO_PURGE"
            STATE_CP        = NO_PURGE

elseif           STATE_CDN_CP = CDN_NO_PURGE
or          LV_CP_ENA       = 0
or            [ STATE_CLL_DEAC_CP = CP_NO_DEAC          // "wait ramp open"
        and  (LV_CP_CDN_RAMP_OPEN_FAST
        or    LV_CP_CDN_RAMP_OPEN) ]
then        call   "INITIALIZATION-VALUES on leaving MIN_PURGE"
            call   "INITIALIZATION-VALUES on entering RAMP_TO_NO_PURGE"
            STATE_CP        = RAMP_TO_NO_PURGE

elseif           STATE_CDN_CP = CDN_MIN_PURGE
then        STATE_CP        = MIN_PURGE                  // stay in MIN_PURGE

            // re-entry in normal purge states after short deactivation
elseif           STATE_CLL_DEAC_CP ≠ CP_NO_DEAC
```

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```
                  and    LV_CP_NEW_RAMP_OPEN = 0
                  and    LV_CP_NEW_RAMP_OPEN_FAST = 0
then  case selection on STATE_CLL_DEAC_CP
                  RAMP_OPEN_DEAC:
                  if       LV_CP_CDN_RAMP_OPEN
                  then call    "INITIALIZATION-VALUES on leaving MIN_PURGE"
                           call    "INITIALIZATION-VALUES on entering RAMP_OPEN"
                           STATE_CP = RAMP_OPEN
                  endif

                  RAMP_FAST_DEAC:
                  if       [ LV_CP_CDN_RAMP_OPEN_FAST
                  and    LC_CP_TRAN_DEAC_CLL ]     //switch to enable old functionality
                  then call    "INITIALIZATION-VALUES on leaving MIN_PURGE"
                           call    "INITIALIZATION-VALUES on entering RAMP_OPEN_FAST"
                           STATE_CP = RAMP_OPEN_FAST
                  endif

                  MAX_PURGE_DEAC:
```

The following two lines had to be inserted to prevent oscillation in case of a forced transition from max_ purge to min_purge on STATE_CDN_CP = NO_CDN

```
                  if       [ STATE_CDN_CP ≠ NO_CDN
                  or      LC_CP_TRA_MAX_MIN_CDN_ENA = 0 ]
                  then           call   "INITIALIZATION-VALUES on leaving MIN_PURGE"
                           call    "INITIALIZATION-VALUES on entering MAX_PURGE"
                           STATE_CP = MAX_PURGE
                  endif
         end case selection

else          STATE_CP         = MIN_PURGE                        // default
endif
end
```

9.14.1.7 WAIT_RAMP_OPEN

```
if             LV_CP_ACT        = 0
then           STATE_CP         = CP_NOT_ACT

elseif                STATE_CDN_CP = CDN_NO_FAST
or             STATE_CDN_CP = CDN_NO_PURGE
or             STATE_CDN_CP = CDN_MIN_PURGE
or             LV_CP_ENA        = 0
or                [ STATE_CDN_CP = NO_CDN
        and    LC_CP_TRA_OPL_CDN_NOT ]
or                [ LV_CP_CDN_RAMP_OPEN                       = 0
        and    LV_CP_CDN_RAMP_OPEN_FAST             = 0
        and    LC_CP_TRA_OPL_CDN_CLL_NOT ]
then           call    "INITIALIZATION-VALUES on leaving WAIT_RAMP_OPEN"
               call    "INITIALIZATION-VALUES on entering NO_PURGE"
               STATE_CP          = NO_PURGE

elseif                {        (MAF_INT_CP < C_MAF_INT_MAX_CP_0
                         and    T_MAF_INT_CP < C_T_MAX_MAF_INT_CP_0
```

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```
                  and   STATE_OPM_ENG_CP = ENG_MODE_0)
             or   (MAF_INT_CP < C_MAF_INT_MAX_CP_1
                  and   T_MAF_INT_CP < C_T_MAX_MAF_INT_CP_1
                  and   STATE_OPM_ENG_CP != ENG_MODE_0)}]
        or   T_DLY_CP > 0
        or   (T_MAF_INT_CP < C_T_MIN_MAF_INT_CP_0
             and   STATE_OPM_ENG_CP = ENG_MODE_0)
        or   (T_MAF_INT_CP < C_T_MIN_MAF_INT_CP_1
             and   STATE_OPM_ENG_CP != ENG_MODE_0)
        or   LV_CPS_AD_ACT = 1
then         STATE_CP        = WAIT_RAMP_OPEN              // stay in WRO

elseif            LV_CP_CDN_RAMP_OPEN
then         call  "INITIALIZATION-VALUES on leaving WAIT_RAMP_OPEN"
             call  "INITIALIZATION-VALUES on entering RAMP_OPEN"
             STATE_CP        = RAMP_OPEN

elseif            LV_CP_CDN_RAMP_OPEN_FAST
then         call  "INITIALIZATION-VALUES on leaving WAIT_RAMP_OPEN"
             call  "INITIALIZATION-VALUES on entering RAMP_OPEN_FAST"
             STATE_CP        = RAMP_OPEN_FAST

else         call  "INITIALIZATION-VALUES on leaving WAIT_RAMP_OPEN"
             call  "INITIALIZATION-VALUES on entering NO_PURGE"
             STATE_CP        = NO_PURGE                    // default, robustness
endif
end
```

9.14.1.8 RAMP_OPEN

```
if           LV_CP_ACT       = 0
then         STATE_CP        = CP_NOT_ACT

elseif            STATE_CDN_CP = CDN_NO_FAST
then         call  "INITIALIZATION-VALUES on leaving RAMP_OPEN"
             call  "INITIALIZATION-VALUES on entering NO_PURGE"
             STATE_CP        = NO_PURGE

elseif            STATE_CDN_CP = CDN_NO_PURGE
then         call  "INITIALIZATION-VALUES on leaving RAMP_OPEN"
             call  "INITIALIZATION-VALUES on entering RAMP_TO_NO_PURGE"
             STATE_CP        = RAMP_TO_NO_PURGE
```

LV_CP_CDN_RAMP_OPEN = 1 if STATE_CDN_CP = CDN_RAMP_OPEN, else it is = 0, also if STATE_CDN_CP = CDN_RAMP_OPEN_FAST
As CDN_NO_PURGE is checked one paragraph above, it's sufficient to check here for LV_CP_CDN_RAMP_OPEN

```
elseif            LV_CP_CDN_RAMP_OPEN = 0
        or   LV_CP_NEW_RAMP_OPEN = 1
        or   LV_CP_NEW_RAMP_OPEN_FAST = 1
then         call  "INITIALIZATION-VALUES on leaving RAMP_OPEN"
             call  "INITIALIZATION-VALUES on entering MIN_PURGE"
             STATE_CP        = MIN_PURGE
```

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```
elseif              LV_CP_ENA       = 0
then         call   "Storage of Values for OBDII EVAP-System Monitoring"
             call   "INITIALIZATION-VALUES on leaving RAMP_OPEN"
             call   "INITIALIZATION-VALUES on entering RAMP_CLOSE"
             STATE_CP        = RAMP_CLOSE

elseif             [ (  FLOW_CTL_CPS >= FLOW_TAR_CPS
       and LC_CP_TRAN_OPEN_MAX_ENA = 1)
       or     MFF_CP >= MFF_MAX_CP
       or     T_RAMP_OPEN_STAB = 0 ]                      // time counter for RO elapsed
       and    LV_FLOW_TAR_COR_CP = 0
       then   // RAMP_OPEN finished
              LV_CL_CLC_AVL = [CL_MMV <= C_CL_CAT_DIAG]
              LV_CL_CLC_VLD = 1
              if      [ LV_FAC_LAM_SHIFT_CP_AVL   = 0           // no lambda contr. shift done
              and     T_RAMP_OPEN_STAB = 0 ]                  // but time out
              then  call    "Selection of purge mode with empty canister"
              else  // regular transition to MAX_PURGE
                    call    "INITIALIZATION-VALUES on leaving RAMP_OPEN"
                    call    "INITIALIZATION-VALUES on entering MAX_PURGE"
                    STATE_CP = MAX_PURGE
              endif

else         STATE_CP        = RAMP_OPEN                      // default
endif
end
```

9.14.1.8.1 Selection of purge mode with empty canister

```
case selection on C_STATE_MOD_SEL_CP:
NO_PURGE:
       STATE_LOCK_CP        = NO_PURGE
       call    "INITIALIZATION-VALUES on leaving RAMP_OPEN"
       call    "INITIALIZATION-VALUES on entering RAMP_TO_NO_PURGE"
       STATE_CP                 = RAMP_TO_NO_PURGE
MIN_PURGE:
       STATE_LOCK_CP        = MIN_PURGE
       call    "INITIALIZATION-VALUES on leaving RAMP_OPEN"
       call    "INITIALIZATION-VALUES on entering MIN_PURGE"
       STATE_CP                 = MIN_PURGE
MAX_PURGE:
       call    "INITIALIZATION-VALUES on leaving RAMP_OPEN"
       call    "INITIALIZATION-VALUES on entering MAX_PURGE"
       STATE_CP                 = MAX_PURGE
RAMP_CLOSE:
       call    "INITIALIZATION-VALUES on leaving RAMP_OPEN"
       call    "INITIALIZATION-VALUES on entering RAMP_CLOSE"
       STATE_CP                 = RAMP_CLOSE
end case selection
end
```

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9.14.1.9 RAMP_OPEN_FAST

if LV_CP_ACT = 0
STATE_CP = **CP_NOT_ACT**

elseif STATE_CDN_CP = CDN_NO_FAST
then **call** "INITIALIZATION-VALUES on leaving RAMP_OPEN_FAST"
call "INITIALIZATION-VALUES on entering NO_PURGE"
STATE_CP = **NO_PURGE**

elseif STATE_CDN_CP = CDN_NO_PURGE
then **call** "INITIALIZATION-VALUES on leaving RAMP_OPEN_FAST"
call "INITIALIZATION-VALUES on entering RAMP_TO_NO_PURGE"
STATE_CP = **RAMP_TO_NO_PURGE**

elseif STATE_CDN_CP = CDN_MIN_PURGE
or STATE_CDN_CP = NO_CDN
or LV_CP_NEW_RAMP_OPEN = 1
or LV_CP_NEW_RAMP_OPEN_FAST = 1
then **call** "INITIALIZATION-VALUES on leaving RAMP_OPEN_FAST"
call "INITIALIZATION-VALUES on entering MIN_PURGE"
STATE_CP = **MIN_PURGE**

elseif LV_CP_ENA = 0
then **call** "Storage of Values for OBDII EVAP-System Monitoring"
call "INITIALIZATION-VALUES on leaving RAMP_OPEN_FAST"
call "INITIALIZATION-VALUES on entering RAMP_CLOSE"
STATE_CP = **RAMP_CLOSE**

elseif [FLOW_CTL_CPS >= FLOW_TAR_CPS
or MFF_CP >= MFF_MAX_CP]
and LV_FLOW_TAR_COR_CP = 0
then **call** "INITIALIZATION-VALUES on leaving RAMP_OPEN_FAST"
call "INITIALIZATION-VALUES on entering MAX_PURGE"
STATE_CP = **MAX_PURGE**

else STATE_CP = **RAMP_OPEN_FAST** // stay in current state
endif
Up to here, all possible states_cdn_cp except cdn_ramp_open & cdn_rof are checked, so RO or ROF conditions must be given
end

9.14.1.10 MAX_PURGE

if LV_CP_ACT = 0
then STATE_CP = **CP_NOT_ACT**

elseif STATE_CDN_CP = CDN_NO_FAST
then **call** "INITIALIZATION-VALUES on leaving MAX_PURGE"
call "INITIALIZATION-VALUES on entering NO_PURGE"
STATE_CP = **NO_PURGE**

elseif STATE_CDN_CP = CDN_NO_PURGE

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```
then        call   "INITIALIZATION-VALUES on leaving MAX_PURGE"
             if     LV_CP_CLOSE_REQ
             then  call "Storage of Values for OBDII EVAP-System Monitoring"
             endif
             call   "INITIALIZATION-VALUES on entering RAMP_TO_NO_PURGE"
             STATE_CP        = RAMP_TO_NO_PURGE

elseif              STATE_CDN_CP = CDN_MIN_PURGE
      and [  LV_CL_MDL_ENA = 0                         //   CL-mdl not enabled
      or     LV_CP_CDN_MIN_PURGE_FAST = 1 ]       // "hard" conditions for MIN_PURGE
      or     [  STATE_CDN_CP = NO_CDN                  // NO_CDN-management
      and    LC_CP_TRA_MAX_MIN_CDN_ENA ]
      or     LV_CP_NEW_RAMP_OPEN = 1
      or     LV_CP_NEW_RAMP_OPEN_FAST = 1
      or     [  LV_CL_MDL_CAT_PURGE_ACT_CP = 1
      and    { LV_CL_MDL_ACT = 0 or LV_CP_CAT_PURGE = 0} ]
then        call   "INITIALIZATION-VALUES on leaving MAX_PURGE"
             call   "INITIALIZATION-VALUES on entering MIN_PURGE"
             STATE_CP        = MIN_PURGE

elseif              LV_CP_ENA        = 0
then        call   "Storage of Values for OBDII EVAP-System Monitoring"
             call   "INITIALIZATION-VALUES on leaving MAX_PURGE"
             call   "INITIALIZATION-VALUES on entering RAMP_CLOSE"
             STATE_CP        = RAMP_CLOSE

else        STATE_CP        = MAX_PURGE                    // stay in current state
endif
end
```

9.14.1.11 RAMP_CLOSE

```
if          LV_CP_ACT        = 0
then        STATE_CP        = CP_NOT_ACT

elseif              STATE_CDN_CP = CDN_NO_FAST
then        call   "INITIALIZATION-VALUES on leaving RAMP_CLOSE"
             call   "INITIALIZATION-VALUES on entering NO_PURGE"
             STATE_CP        = NO_PURGE

elseif              FLOW_CTL_CPS = 0                      // RAMP_CLOSE finished
      or     STATE_CDN_CP = CDN_NO_PURGE
      or     STATE_CDN_CP = CDN_MIN_PURGE
      then  call   "INITIALIZATION-VALUES on leaving RAMP_CLOSE"
             call   "INITIALIZATION-VALUES on entering RAMP_TO_NO_PURGE"
             STATE_CP        = RAMP_TO_NO_PURGE

else        STATE_CP        = RAMP_CLOSE             // stay in current state
endif
```

9.14.1.12 INITIALIZATIONS on transitions

The following submodules are called on transitions between the different states of canister purge control

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9.14.1.12.1 Storage of Values for OBDII EVAP-System Monitoring (RO, ROF, MaxP)

This submodule is called, if RAMP_OPEN, RAMP_OPEN_FAST or MAX_PURGE is left due to purge time elapsed (LV_CP_ENA = 0).
In this case, the last calculated value of the canister load CL_MMV is stored as CL_MMV_CLC_END before RAMP_CLOSE operation starts. This value is used as input for the OBDII EVAP-System Monitoring.
In addition, this subroutine may be called if MAX_PURGE is left due to a valve closing request from OBD II function.

CL_MMV_CLC_END = CL_MMV
end

9.14.1.12.2 INITIALIZATION-VALUES on entering NO_PURGE

This submodule is called at every possible transition from any state to NO_PURGE except the transition CP_NOT_ACT NO_PURGE.
On entering NO_PURGE, the initialisations listed below are done.

// Initialisation of the time counter for lambda controller stabilisation
FLOW_GRD_CPS = 0
FLOW_TAR_CPS = 0
FLOW_CTL_CPS = 0
LV_CP_CLL = 0
LV_STATE_MEM_CP_CLL = 0
PQ_CP_SP = 1 // In this mode no forced PQ is required
end

9.14.1.12.3 INITIALIZATION-VALUES on leaving NO_PURGE

If the NO_PURGE operation is left towards any other state, the following initialisations are done.
- –
end

9.14.1.12.4 INITIALIZATION-VALUES on entering RAMP_TO_NO_PURGE

This submodule is called at every possible transition from any state to RAMP_TO_NO_PURGE.
On entering RAMP_TO_NO_PURGE, the initialisations listed below are done.
As cl is not updated during RAMP_TO_NO_PURGE, it’s sufficient to define the correction factor for closing speed FLOW_FAC_CP on transition from any state to RAMP_TO_NO_PURGE.
The start value of FLOW_CTL_CPS for the ramp has to be defined.

LV_CP_CLL = 0
FLOW_TAR_CPS = 0
FLOW_CTL_CPS = **min** [FLOW_CTL_CPS, FLOW_MAX_CPS]
PQ_CP_SP = 1 // In this mode no forced PQ is required
if STATE_CP = MIN_PURGE
then FLOW_FAC_CP = 1 // ramp decrement cor. factor
else FLOW_FAC_CP = IP_FLOW_FAC_CP (CL)
endif
end

9.14.1.12.5 INITIALIZATION-VALUES on leaving RAMP_TO_NO_PURGE

If the RAMP_TO_NO_PURGE operation is left towards any other state, the following initialisations are done.

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- –
end

9.14.1.12.6 INITIALIZATION-VALUES on entering MIN_PURGE

This submodule is called at every possible transition from any state to MIN_PURGE.
On entering MIN_PURGE, the initialisations listed below are done.
The start value of FLOW_CTL_CPS for the ramp has to be defined.

LV_CP_CLL = 0
FLOW_CTL_CPS = **min** [FLOW_CTL_CPS, FLOW_MAX_CPS]
PQ_CP_SP = 1 // In this mode no forced PQ is required
end

9.14.1.12.7 INITIALIZATION-VALUES on leaving MIN_PURGE

If the MIN_PURGE operation is left towards any other state, the following initialisations are done.

- –
end

9.14.1.12.8 INITIALIZATION-VALUES on entering WAIT_RAMP_OPEN

This submodule is called at every possible transition from any state to WAIT_RAMP_OPEN.
On entering WAIT_RAMP_OPEN, the initialisations listed below are done.
The only way to enter WRO is from NO_PURGE, so FLOW_CTL_CPS, LV_CP_CLL & PQ_CP_SP have not to be set on the entrance of this state

T_DI_CP = 0 // reset of time counter for disabled normal purge
STATE_CLL_DEAC_CP = CP_NO_DEAC
T_DLY_CP = C_T_CP_PURGE_TUBE+ IP_T_DLY_CP(MAF_KGH_FG_PRED_COR_CP) * C_FAC_T_DLY_PURGE_TUBE_CP
MAF_INT_CP = 0
T_MAF_INT_CP = 0
The only scenario of having state_cll_deac_cp <> no_deac on entry of wait_ramp_open is the following:
A ROF was disabled; during the disabling time, the time T_DLY_MAX_CP reaches 0, so in the following only RO is possible. So although LV_CDN_RAMP_OPEN may be given, no entry in deactivated RO or ROF will occur; then, the state machine will switch to WRO; to have STATE_CLL_DEAC_CP on a reasonable value after WRO & RO, it has to be reset here
end

9.14.1.12.9 INITIALIZATION-VALUES on leaving WAIT_RAMP_OPEN

If the WAIT_RAMP_OPEN operation is left towards any other state, the following initialisations are done.

end

9.14.1.12.10 INITIALIZATION-VALUES on entering RAMP_OPEN

This submodule is called at every possible transition from any state to RAMP_OPEN.
If the RAMP_OPEN operation was disabled (Conditions for RAMP_OPEN were not fulfilled) for a time < C_T_DI_RAMP_OPEN_CP_0/_1 (T_DI_CP > 0, STATE_CLL_DEAC_CP = RAMP_OPEN_DEAC), initialisations for disabled RAMP_OPEN are done, otherwise the standard initialisations for RAMP_OPEN are done.

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```
if      STATE_CLL_DEAC_CP        = RAMP_OPEN_DEAC
then                             // Initialisations for disabled RAMP_OPEN
        FLOW_CTL_CPS             = FLOW_CTL_CPS_DI
else                             // Standard-initialisations for RAMP_OPEN
        FLOW_CTL_CPS             = C_FLOW_INI_CPS
endif
LV_CP_CLL                        = 1
LV_CP_RAMP_OPEN_ACT              = 1
LV_DLY_GAS_CP                    = 0
LV_CP_AFL_IT                     = 1                    // lean
STATE_CLL_DEAC_CP                = CP_NO_DEAC
T_DI_CP                          = 0
if      STATE_OPM_ENG_CP = ENG_MODE_0
then  T_DLY_CP_OPEN              =
        max[IP_T_DLY_CP (MAF_KGH_FG_PRED_COR_CP),1hex]
else  T_DLY_CP_OPEN              =
        max[IP_T_DLY_CP_2 (MAF_KGH_FG_PRED_COR_CP),1hex]
endif
FLOW_CPS                         = FLOW_CTL_CPS
FLOW_CPS_OLD_1                   = FLOW_CTL_CPS
FLOW_CPS_OLD_2                   = FLOW_CTL_CPS
FLOW_DLY_OLD_1_CP                = FLOW_CTL_CPS
FLOW_DLY_OLD_2_CP                = FLOW_CTL_CPS
MAF_CP_OLD_1                     = MAF_CP
MAF_CP_OLD_2                     = MAF_CP
MAF_DLY_OLD_1_CP                 = MAF_CP
MAF_DLY_OLD_2_CP                 = MAF_CP
MAF_CPS_OLD_1                    = MAF_CPS
MAF_CPS_OLD_2                    = MAF_CPS
MAF_DLY_OLD_1_CPS                = MAF_CPS
MAF_DLY_OLD_2_CPS                = MAF_CPS
end
```

9.14.1.12.11 INITIALIZATION-VALUES on leaving RAMP_OPEN

If the RAMP_OPEN operation is left towards any other state, the following actual values for FLOW_CTL_CPS_DI are stored before the interruption of the operation:

```
LV_CP_RAMP_OPEN_ACT              = 0
LV_STATE_MEM_CP_CLL              = 1
FLOW_CTL_CPS_DI                  = FLOW_CTL_CPS
if      (LV_CP_NEW_RAMP_OPEN = 0
        and    LV_CP_NEW_RAMP_OPEN_FAST = 0)
and   STATE_LOCK_CP              = UNLOCKED
then  STATE_CLL_DEAC_CP          = RAMP_OPEN_DEAC
        if      STATE_OPM_ENG_CP = ENG_MODE_0
        then  T_DI_CP            = C_T_DI_RAMP_OPEN_CP_0
        else  T_DI_CP            = C_T_DI_RAMP_OPEN_CP_1
        endif
else  if      STATE_LOCK_CP      ≠ UNLOCKED
        then  T_LOCK_CP_TMP      = C_T_LOCK_CP
        endif
```

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endif
end

9.14.1.12.12 INITIALIZATION-VALUES on entering RAMP_OPEN_FAST

This submodule is called at every possible transition from any state to RAMP_OPEN_FAST.
If the RAMP_OPEN_FAST operation was disabled (Conditions for RAMP_OPEN were not fulfilled) for a time < C_T_DI_RAMP_FAST_CP_0/_1 (T_DI_CP > 0, STATE_CLL_DEAC_CP = RAMP_FAST_DEAC), initialisations for disabled RAMP_OPEN_FAST are done, otherwise the standard initialisations for RAMP_OPEN are done.

```
if      STATE_CLL_DEAC_CP       = RAMP_FAST_DEAC
then                            // Initialisations for disabled RAMP_OPEN_FAST
        FLOW_CTL_CPS            = FLOW_CTL_CPS_DI
else                            // Standard-initialisations for RAMP_OPEN_FAST
        FLOW_CTL_CPS            = C_FLOW_INI_CPS
endif
LV_CP_CLL                       = 1
LV_CP_RAMP_OPEN_ACT             = 1
LV_DLY_GAS_CP                   = 0
LV_CP_AFL_IT                    = 1                 // lean
STATE_CLL_DEAC_CP               = CP_NO_DEAC
T_DI_CP                         = 0
if      STATE_OPM_ENG_CP = ENG_MODE_0
then  T_DLY_CP_OPEN             =
        max[IP_T_DLY_CP (MAF_KGH_FG_PRED_COR_CP),1hex]
else  T_DLY_CP_OPEN             =
        max[IP_T_DLY_CP_2 (MAF_KGH_FG_PRED_COR_CP),1hex]
endif
FLOW_CPS                        = FLOW_CTL_CPS
FLOW_CPS_OLD_1                  = FLOW_CTL_CPS
FLOW_CPS_OLD_2                  = FLOW_CTL_CPS
FLOW_DLY_OLD_1_CP               = FLOW_CTL_CPS
FLOW_DLY_OLD_2_CP               = FLOW_CTL_CPS
MAF_CP_OLD_1                    = MAF_CP
MAF_CP_OLD_2                    = MAF_CP
MAF_DLY_OLD_1_CP                = MAF_CP
MAF_DLY_OLD_2_CP                = MAF_CP
MAF_CPS_OLD_1                   = MAF_CPS
MAF_CPS_OLD_2                   = MAF_CPS
MAF_DLY_OLD_1_CPS               = MAF_CPS
MAF_DLY_OLD_2_CPS               = MAF_CPS
end
```

9.14.1.12.13 INITIALIZATION-VALUES on leaving RAMP_OPEN_FAST

If the RAMP_OPEN_FAST operation is left towards any other state, the following initialisations are done.

```
LV_CP_RAMP_OPEN_ACT             = 0
LV_STATE_MEM_CP_CLL             = 1
FLOW_CTL_CPS_DI                 = FLOW_CTL_CPS
if      (LV_CP_NEW_RAMP_OPEN = 0
        and   LV_CP_NEW_RAMP_OPEN_FAST = 0 )
```

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```
then  STATE_CLL_DEAC_CP       = RAMP_FAST_DEAC
      if    STATE_OPM_ENG_CP = ENG_MODE_0
      then T_DI_CP                    = C_T_DI_RAMP_FAST_CP_0
      else T_DI_CP                    = C_T_DI_RAMP_FAST_CP_1
      endif
endif
end
```

9.14.1.12.14 INITIALIZATION-VALUES on entering MAX_PURGE

This submodule is called at every possible transition from any state to MAX_PURGE.
On entering MAX_PURGE, the initialisations listed below are done.
If the MAX_PURGE operation was disabled (Conditions for MAX_PURGE were not fulfilled) for a time t < C_T_DI_MAX_CP_0/_1 (T_DI_CP > 0, STATE_CLL_DEAC_CP = MAX_PURGE_DEAC), the initialisations for disabled MAX_PURGE are done additionally to the standard initialisations for MAX_PURGE.

```
if    STATE_CLL_DEAC_CP      = MAX_PURGE_DEAC
then  FLOW_CTL_CPS            = MIN (FLOW_CTL_CPS_DI;
                             FLOW_MAX_CPS * C_FAC_FLOW_MAX_INI_CP;
                             MFF_SP_MV * C_MFF_RATIO_FLOW_INI_CP
                             * [N_32 * NC_CYL_NR * 3) /10^5 ] / CL_MMV)
                             // [mg/stk] -> [kg/h]
else  ACTION_EVAM_Purge ()
endif
// standard initialisations
LV_CP_CLL                     = 1
STATE_CLL_DEAC_CP             = CP_NO_DEAC
T_DI_CP                       = 0
if          STATE_CP = RAMP_OPEN
then        T_DLY_REQ_CP_TMP        = C_T_DLY_REQ_CP
elseif            STATE_CP = NO_PURGE
            and   LV_CP_CAT_PURGE = 1
            and   LV_CL_MDL_ENA = 1
then        LV_CL_MDL_CAT_PURGE_ACT_CP = 1
            FLOW_CTL_CPS       = MIN (FLOW_MAX_CPS * C_FAC_FLOW_MAX_INI_CP;
                             MFF_SP_MV * C_MFF_RATIO_FLOW_INI_CP
                             * [N_32 * NC_CYL_NR * 3) /10^5 ] / CL_MMV)
                             * C_FAC_FLOW_CAT_PURGE_INI_CP
                             // [mg/stk] -> [kg/h]
endif

// Additionnal initialization in case of RAMP_OPEN_FAST to MAX_PURGE transition:
if    STATE_CP = RAMP_OPEN_FAST
then  FLOW_CPS_OLD_1          = FLOW_CPS
      FLOW_CPS_OLD_2          = FLOW_CPS
      FLOW_DLY_OLD_1_CP       = FLOW_CPS
      FLOW_DLY_OLD_2_CP       = FLOW_CPS
endif
end
```

9.14.1.12.15 INITIALIZATION-VALUES on leaving MAX_PURGE

If the MAX_PURGE operation is disabled or ends, the following actual values for FLOW_CTL_CPS_DI are stored before the interruption of the operation:

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```
LV_STATE_MEM_CP_CLL                = 1
FLOW_CTL_CPS_DI                    = FLOW_CTL_CPS
T_DLY_REQ_CP_TMP                   = 0
if     (LV_CP_NEW_RAMP_OPEN        = 0
        and   LV_CP_NEW_RAMP_OPEN_FAST = 0
        and   LV_CL_MDL_CAT_PURGE_ACT_CP = 0)
then  STATE_CLL_DEAC_CP            = MAX_PURGE_DEAC
        if     STATE_OPM_ENG_CP = MODE_0
        then  T_DI_CP              = C_T_DI_MAX_CP_0
        else  T_DI_CP              = C_T_DI_MAX_CP_1
        endif
endif
LV_CL_MDL_CAT_PURGE_ACT_CP      = 0
end
```

9.14.1.12.16 INITIALIZATION-VALUES on entering RAMP_CLOSE

This submodule is called at every possible transition from any state to RAMP_CLOSE.
On entering RAMP_CLOSE, the initialisations listed below are done.
The Initialization value of FLOW_CTL_CPS for RAMP_CLOSE is the last calculated value of min (FLOW_CTL_CPS, FLOW_MAX_CPS) if the preceding operation was MAX_PURGE. If the RAMP_OPEN operation was preceding the Initialization value is the last calculated value of FLOW_CTL_CPS of the RAMP_OPEN operation.
The only way to enter RC is from another normal_purge state, so LV_CP_CLL has not to be set on the entrance of this state

```
STATE_CLL_DEAC_CP       = CP_NO_DEAC
T_DI_CP                 = 0
PQ_CP_SP                = 1              // In this mode no forced PQ is required
FLOW_TAR_CPS            = 0
if     STATE_CP         = MAX_PURGE
then  FLOW_CTL_CPS      = min [FLOW_CTL_CPS, FLOW_MAX_CPS]
endif
end
```

9.14.1.12.17 INITIALIZATION-VALUES on leaving RAMP_CLOSE

If the RAMP_CLOSE operation is left towards any other state, the following initialisations are done.
LV_STATE_MEM_CP_CLL = 1
end

9.14.2 Canister purge management states

9.14.2.1 NO_PURGE

General information:

In the NO_PURGE state of the Evaporative Emission Control no calculation of the CPS flow set point flow_ctl_cps, the fuel flow from the activated charcoal filter (ACF) MFF_CP, the Canister Load cl and the additive fuel flow for injection correction will be done.

Formula section:

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call “Time counter for disabled RAMP_OPEN or MAX_PURGE”
end

9.14.2.2 RAMP_TO_NO_PURGE

Formula section:

FLOW_GRD_CPS = IP_FLOW_DEC_CP (MFF_SP_MV) * FLOW_FAC_CP
if LV_CP_CMU_CMB
then FLOW_GRD_CPS = FLOW_GRD_CPS * C_FAC_DEC_COR_CMU_CP
elseif LV_CP_CLOSE_1
then FLOW_GRD_CPS = FLOW_GRD_CPS * C_FAC_DEC_COR_1_CP
elseif LV_CP_CLOSE_2
then FLOW_GRD_CPS = FLOW_GRD_CPS * C_FAC_DEC_COR_2_CP
endif
call “FLOW_CTL_CPS ramping”
call “Time counter for disabled RAMP_OPEN or MAX_PURGE”
end

9.14.2.3 MIN_PURGE

General information:

In the MIN_PURGE state, the CPS flow is calculated from calibration datas depending on combustion mode.
FLOW_TAR_CPS = FLOW_CPS_SP_MIN_PURGE * FAC_FLOW_TAR_COR_CP
if FLOW_CTL_CPS$_{n-1}$ $>$ FLOW_TAR_CPS // actual value higher than SP
then FLOW_GRD_CPS = IP_FLOW_DEC_CP (MFF_SP_MV)// decreasing flow
else **if** LV_HOM_ACT = 1
then FLOW_GRD_CPS = IP_FLOW_INC_CP (MFF_SP_MV)
* IP_FLOW_INC_COR_HOM_CP (MAF_CYL) // increasing flow
else FLOW_GRD_CPS = IP_FLOW_INC_CP (MFF_SP_MV) // increasing flow
endif
LV_STATE_MEM_CP_CLL = 0 // transition from normal purge finished
endif
call “FLOW_CTL_CPS ramping”
call “Time counter for disabled RAMP_OPEN or MAX_PURGE”
end

9.14.2.4 WAIT_RAMP_OPEN

General information:

The WAIT_RAMP_OPEN state is reached if the conditions for normal entry in RAMP_OPEN or RAMP_OPEN_FAST are given but the time counter for lambda controller stabilisation is not yet elapsed or CPS adaptation is active. It can only be reached by NO_PURGE.
To speed up the reaction of the lambda sensor in RAMP_OPEN or RAMP_OPEN_FAST, the purge tube may be purged itself for a short instance in WAIT_RAMP_OPEN. Using this functionality, the purge valve is opened rapidly and wide for a very short time to purge the diluted gas in the tubes and fill the purge tubes with "fresh" gas from the ACF.
For the calcuation of the air mass flow integral the unit conversion:

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[g] = [kg/h] * [ms] * [(g*h) /(kg*ms)] /3600
has to be considered.

Formula section:

if LV_CPS_AD_ACT = 0
then
MAF_INT_CP = MAF_INT_CP + (MAF_CYL * TA /3600) // MAF Integral for Lambda controller stabilisation
T_MAF_INT_CP = T_MAF_INT_CP + TA // Total time of the MAF integration for min/max limitation
T_DLY_CP = **max** [T_DLY_CP$_{n-1}$ - TA, 0] // Purge tube time counter
// "purging the purge tube"
endif
if T_MAF_INT_CP $<$ C_T_CP_PURGE_TUBE
then
FLOW_TAR_CPS = C_FLOW_CPS_SP_PURGE_TUBE
FLOW_GRD_CPS = C_FLOW_CPS_GRD_PURGE_TUBE
else
FLOW_TAR_CPS = 0
FLOW_GRD_CPS = C_FLOW_CPS_GRD_PURGE_TUBE_CLOSE
endif
call "FLOW_CTL_CPS ramping"
end

9.14.2.5 RAMP_OPEN

General information:

After a reset, an engine stall or if a certain time since the last MAX_PURGE operation has passed, the load cl of the canister is considered as not known. In this case the canister load value cl is initialized to a constant value c_cl_st_cp and the CPS is opened slowly, using a ramp function. So a high deviation of the lambda control shall be prevented.
The RAMP_OPEN operation is finished when the fuel flow MFF_CP is greater than a maximum value MFF_MAX_CP or when the CL_MMV value stay in a dynamic window. Then the MAX_PURGE operation starts, if the cl is above a threshold, otherwise the reaction of the system is configurable.
At the end of the RAMP_OPEN operation the remaining time of purge is reevaluated versus Canister Load cl is reevaluated.

Formula section:

call "calculation of PQ_CP_SP" (common)
call "calculation of the flow setpoint" (common)
end

9.14.2.6 RAMP_OPEN_FAST Operation

General information:

After a short interruption of the MAX_PURGE operation the load cl of the ACF stay around the last value calculated. In this case the flow_ctl_cps is calculated as a function of the actual FLOW_CTL_CPS value and the objective value.

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The RAMP_OPEN_FAST operation is finished. when one of the following conditions is set:

- FLOW_CTL_CPS is greater or equal to the value FLOW_TAR_CPS
- The fuel flow MFF_CP is greater than a maximum value MFF_MAX_CP

Then the MAX_PURGE operation starts. If the purge time is elapsed (LV_CP_ENA=0), the RAMP_OPEN_FAST operation ends. the RAMP_CLOSE operation starts immediately.
At the end of the RAMP_OPEN_FAST operation the purge time is reevaluated (see chapter "time scheduler").

Formula section:

PQ_CP_SP =1 // In this mode no forced PQ is required by canister purge
call "calculation of the flow setpoint" (common)
end

9.14.2.7 MAX_PURGE Operation

General information:

The MAX_PURGE operation is started when the RAMP_OPEN operation or the RAMP_OPEN_FAST operation is finished.
The MAX_PURGE operation ends when the purge time is elapsed. Then the RAMP_CLOSE operation starts.
During MAX_PURGE, the time counter T_DLY_MAX_CP is initialised to C_T_DLY_MAX_CP_0/_1. When the MAX_PURGE operation ends or when the MAX_PURGE is disabled, the time T_DLY_MAX_CP starts to count backwards down to 0.

Calculation of FLOW_CTL_CPS for MAX_PURGE
The value of FLOW_CTL_CPS during MAX_PURGE operation is calculated as a function of the filtered canister load CL_MMV and the maximum allowable fuel flow from the CPS MFF_MAX_CP (see flow setpoints module).

Formula section:

call "calculation of PQ_CP_SP" (common)
call "Calculation of LV_T_DLY_REQ_CP"
FLOW_TAR_CPS = **min** [MFF_MAX_CP /CL_MMV, FLOW_MAX_CPS] * FAC_FLOW_TAR_COR_CP
if FLOW_CTL_CPS$_{n-1}$ $>$ FLOW_TAR_CPS // actual value higher than SP
then FLOW_GRD_CPS = IP_FLOW_CPS_DEC (MFF_SP_MV) // decreasing flow
else **if** LV_HOM_ACT = 1
then FLOW_GRD_CPS = IP_FLOW_CPS_INC (MFF_SP_MV) * IP_FLOW_INC_COR_HOM_CP (MAF_CYL)// increasing flow
else FLOW_GRD_CPS = IP_FLOW_CPS_INC (MFF_SP_MV) // increasing flow
endif
endif
(gradient limitation moved here from flow calculation chain)
call "FLOW_CTL_CPS ramping"
Should be limited by ip_..._inc; as mff_max_cp is now moved to flow_sp spec, it may be at a very high value on entrance of a disabled max_purge; in addition, a reasonable fuel_flow_max_cp will we available after latest 100ms (recurrence changed), so for this first 100ms, we should not have flow_ctl_cps being unreasonably high
end

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9.14.2.7.1 Calculation of LV_T_DLY_REQ_CP

This management is usefull esssentially during an emision cycle. The aim is to stop the purge in case of request from the catalyst diagnosis (or an other OBD2 diagnosis), one time during the cycle.
LV_T_DLY_REQ_CP is set C_T_DLY_REQ_CP seconds after a Ramp_Open and stay to 1 until next trip or engine stalling.
The flag is set after having been for a time C_T_DLY_REQ_CP in an un-interrupted MAX_PURGE coming from RAMP_OPEN and stay to 1 until next trip or engine stalling .
When coming from any other state than RAMP_OPEN, the flag is not calculated.

Signal flow diagram:

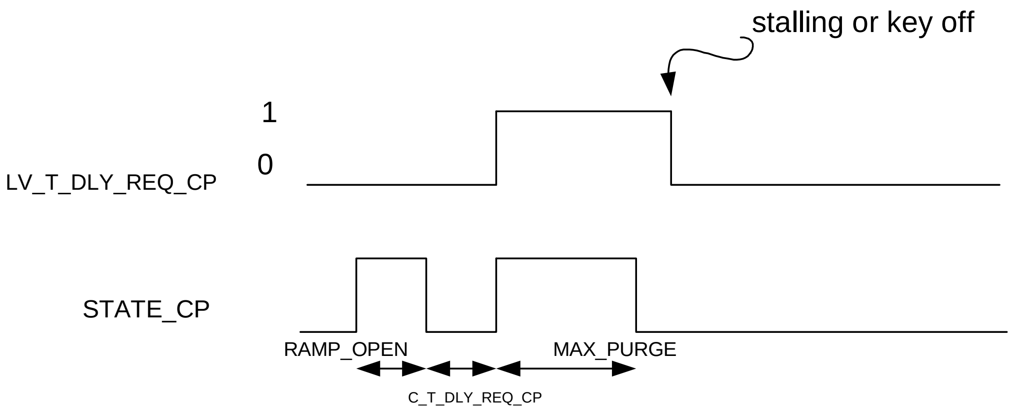

Figure 9.14.4: : LV_T_DLY_REQ_CP

Formula section:

if T_DLY_REQ_CP_TMP > 1h
then T_DLY_REQ_CP_TMP = **max** (1h, T_DLY_REQ_CP_TMP - TA)
endif
if T_DLY_REQ_CP_TMP = 1h
then LV_T_DLY_REQ_CP = 1
endif
end

9.14.2.8 RAMP_CLOSE Operation

General information:

The RAMP_CLOSE operation starts if the purge time is elapsed.
The RAMP_CLOSE operation ends when the value of FLOW_CTL_CPS is equal to 0.

Calculation of FLOW_CTL_CPS for RAMP_CLOSE
When the RAMP_CLOSE operation is activated FLOW_CTL_CPS is decremented. The decrement value depends on the map values of IP_FLOW_DEC_CP. The closing speed of the CPS is so controlled by the mass fuel flow setpoint MFF_SP_MV.

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Formula section:

FLOW_GRD_CPS = IP_FLOW_DEC_CP (MFF_SP_MV) * IP_FLOW_FAC_CP (CL)
call "FLOW_CTL_CPS ramping"
end

9.14.3 Common submodules

The keywords in brackets at the end of the headline of each following submodule indicates, by which STATE_CP the corresponding submodule is called. If STATE_CP = CP_NOT_ACT, none of the following submodules is called. The following abbreviations are used:

NP NO_PURGE
RTNP RAMP_TO_NO_PURGE
MinP MIN_PURGE
WRO WAIT_RAMP_OPEN
RO RAMP_OPEN
ROF RAMP_OPEN_FAST
MaxP MAX_PURGE
RC RAMP_CLOSE

9.14.3.1 Time counter for disabled RAMP_OPEN or MAX_PURGE (NP, RTNP, MinP)

General information:

This calculation is called in NO_PURGE, RAMP_TO_NO_PURGE and MIN_PURGE.
If the RAMP_OPEN or the MAX_PURGE operation was interrupted (NO_PURGE, RAMP_TO_NO_PURGE or MIN_PURGE active) and the time counter T_DI_CP is greater than zeor which means that the interrupt-time is lower than the adjustable times C_T_DI_RAMP_OPEN_CP_0/_1 (RAMP_OPEN) or C_T_DI_MAX_CP_0/_1 (MAX_PURGE), a direct switch back to the previous state RAMP_OPEN or MAX_PURGE is possible, if the conditions for this previous state are once again given.
Otherwise (time counter T_DI_CP reached zero), NORMAL_PURGE has to restart with RAMP_OPEN.
TA = recurrence

Formula section:

If (LV_CP_NEW_RAMP_OPEN = 0
and LV_CP_NEW_RAMP_OPEN_FAST = 0
then T_DI_CP$_n$ = **max** [0, T_DI_CP$_{n-1}$ - TA]
else T_DI_CP = 0
endif
T_LOCK_CP$_n$ = **max** [0, T_LOCK_CP$_{n-1}$ - TA]
if T_DI_CP = 0
then STATE_CLL_DEAC_CP = CP_NO_DEAC
endif
if T_LOCK_CP = 0
then STATE_LOCK_CP = UNLOCKED
endif
end

9.14.3.2 Calculation of PQ_CP_SP (RO, MaxP)

General information:

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This calculation is called only in Ramp_Open and MAX_PURGE, and available only in stratified and homogeneous lean burn modes.
In this mode a forced PQ is required by canister purge in order to increase PRS_CPS and to purge with more efficiency. IP_PQ_CP_SP is depending on engine speed and torque setpoint.

Formula section:

if [(LV_HOM_ACT = 0)
or (LV_HOM_AFL_ACT = 1 **and** LC_PQ_SP_CP_HOM_AFL=1)]
then if (CL_MMV $>$ C_CL_MMV_PQ)
then PQ_SP_CP_TMP = IP_PQ_CP_SP (N_32, TQI_SP_S)
else PQ_SP_CP_TMP = 1
endif
PQ_CP_SP$_n$ = PQ_CP_SP$_{n-1}$ +
(PQ_SP_CP_TMP - PQ_CP_SP$_{n-1}$) * C_CRLC_PQ_SP_CP
else PQ_CP_SP$_n$ = 1
endif

9.14.3.3 Calculation of the flow setpoint (RO, ROF)

General information:

This calculation is called in RAMP_OPEN and RAMP_OPEN_FAST.
Old spec: “An additional delay is performed if a linear O2 sensor is used.”
Not defined in SW and spec; should an c_offset be defined?

The opening of the CPS is controlled by the value of FLOW_CTL_CPS. This value describes the flow requested through the CPS. So a too high deviation of the lambda control at transient engine operation should be avoided. The opening sequence is as follows:

- When entering RAMP_OPEN or RAMP_OPEN_FAST, FLOW_CTL_CPS is initialised
- After start or re-start of RAMP_OPEN or RAMP_OPEN_FAST, the system waits for the gas transfer time between CPS valve and upstream lambda sensor (IP_T_DLY_CP).
- When this delay is elapsed or when using a binary lambda control and a transition rich to lean occurs, the next period of increment steps starts. The number of increment steps for this phase is defined from ID_FLOW_INC_NR_CP. This number is defined once at the beginning of the phase. For each increment the FLOW_CTL_CPS increase is fixed by IP_FLOW_INC_CP corrected by IP_FLOW_FAC_CP. The opening speed of the CPS is so controlled by the mass air flow MAF_CYL and the load CL of the activated charcoal canister ACF to avoid lambda regulation deviation.
- After the increment steps are carried out, the function waits again for gas transfer time or binary lambda sensor rich-lean transition.
- FLOW_CTL_CPS is limited to FLOW_TAR_CPS, the target flow setpoint.

The Pjump used depends of the bank selected (see canister load and lambda deviation module). The Pjump is related to gas enrichment.
The aim is to increase the FLOW_CTL_CPS with incremented values to prevent unexpected lambda deviation due to the lambda controller.
The increment number ID_FLOW_INC_NR_CP carried out is tuneable and depending on engine speed.
The time delay will allow to synchronize the flow variation, the gas transfer and the lambda control. As long as the maximum flow FLOW_TAR_CPS is not reached the sequence will start over.

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Signal flow diagram:

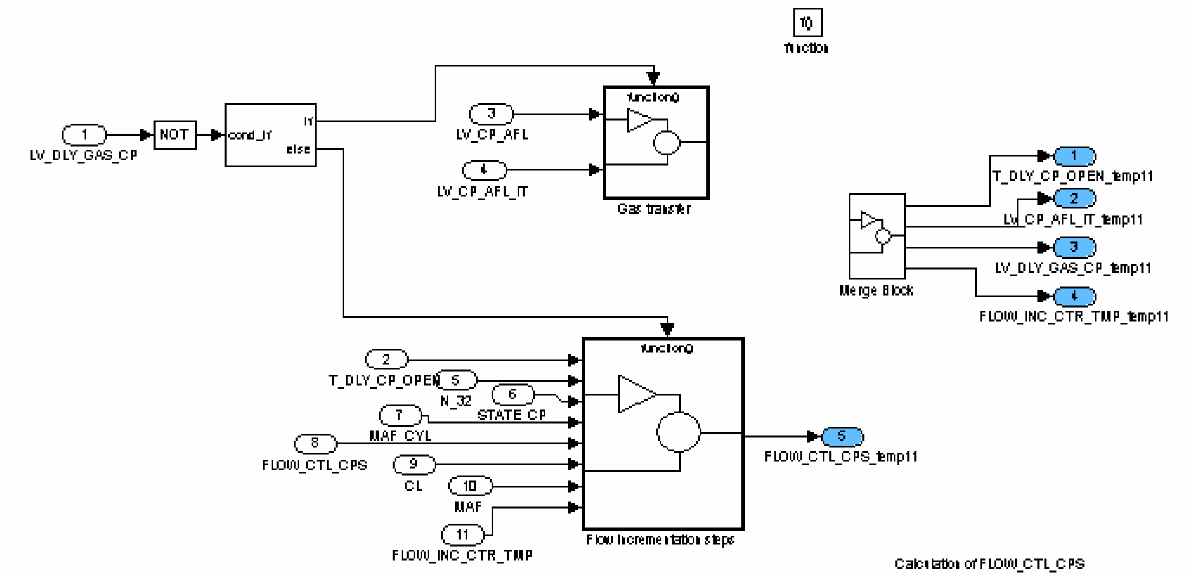

Figure 9.14.5: : calculation of FLOW_CTL_CPS for RAMP_OPEN_FAST

Formula section:

if LV_DLY_GAS_CP = 0
then **call** “Gas transfer” // waiting for gas transfer timer
else **call** “Flow incrementation steps”
endif
end

9.14.3.3.1 Gas transfer

T_DLY_CP_OPEN = **max** [0, T_DLY_CP_OPEN - TA]
if LC_LAM_LIN_CPS = 0 // binary lambda control
then LV_CP_AFL_IT = LV_CP_AFL
else LV_CP_AFL_IT = 1 // lean

endif
if T_DLY_CP_OPEN = 0
or LV_CP_AFL_IT 0 1 // rich lean
then LV_DLY_GAS_CP = 1
FLOW_INC_CTR_TMP = ID_FLOW_INC_NR_CP (N_32)
endif
end

9.14.3.3.2 Flow incrementation steps

if STATE_CP = RAMP_OPEN
then **if** LV_HOM_ACT = 1
then FLOW_GRD_CPS = IP_FLOW_INC_CP (MFF_SP_MV) *
IP_FLOW_INC_COR_HOM_CP (MAF_CYL) // RO
else FLOW_GRD_CPS = IP_FLOW_INC_CP (MFF_SP_MV) // RO
endif

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```
else   if LV_HOM_ACT = 1
         then  FLOW_GRD_CPS = IP_FLOW_INC_FAST_CP (MFF_SP_MV) *
                           IP_FLOW_INC_COR_HOM_CP (MAF_CYL) // ROF
         else FLOW_GRD_CPS = IP_FLOW_INC_FAST_CP (MFF_SP_MV) // ROF
         endif
endif
FLOW_GRD_CPS = FLOW_GRD_CPS * IP_FLOW_FAC_CP (CL)

if       STATE_CP = RAMP_OPEN_FAST
and    LC_CP_FLOW_LIM_OPEN_FAST = 0
then   FLOW_TAR_CPS        = min [MFF_MAX_CP /CL_MMV, FLOW_MAX_CPS]
else   [If STATE_OPM_ENG_CP = ENG_MODE_0
                then  FLOW_TAR_CPS        = IP_FLOW_MAX_OPEN_CPS (N_32, MAF)
                                                   * FAC_FLOW_COR_CLL_CP
                  else   FLOW_TAR_CPS        = IP_FLOW_MAX_OPEN_CPS_2 (N_32,
                                                MFF_SP_MV) * FAC_FLOW_COR_CLL_CP
         endif]
endif
FLOW_TAR_CPS = FLOW_TAR_CPS * FAC_FLOW_TAR_COR_CP
call     "FLOW_CTL_CPS ramping"
FLOW_INC_CTR_TMP                   = max [ 0, FLOW_INC_CTR_TMP - 1]

if       FLOW_INC_CTR_TMP           = 0
then   // gas delay timer init
         LV_DLY_GAS_CP                   = 0
         If STATE_OPM_ENG_CP = ENG_MODE_0
         then   T_DLY_CP_OPEN                   =
           max[IP_T_DLY_CP (MAF_KGH_FG_PRED_COR_CP),1hex]
         else    T_DLY_CP_OPEN                   =
           max[IP_T_DLY_CP_2 (MAF_KGH_FG_PRED_COR_CP),1hex]
         endif
         // T_DLY_CP_OPEN will be set to IP_T_DLY_CP /10
         LV_CP_AFL_IT                   = 1                           // lean
         FLOW_GRD_CPS        = 0
```

This line is not needed: with lc_lam_lin_cps, the variable is always =1 (is initialised to 1 at entry of ro, rof), so no transition can occur.

With lc_lam_lin_cps=0 and lambda control lean lv_cp_afl_it=1; if at the exit of this passage (flow incrementation) lv_cp_afl_it=0, a direct jump again to flow incrementation will occur; not critical as this can just appear with empty canister (otherwise lambda control rich)

Intake manifild model Rbg,. empty canister: lambda control at lean side, perhaps better to wait for 1xrich side, 1x lean side

endif
end

9.14.3.4 FLOW_CTL_CPS ramping

The ramping up and down of the internal flow setpoint FLOW_CTL_CPS is defined by the target (final setpoint to be reached) FLOW_TAR_CPS and the flow gradient (increment rsp. decrement) FLOW_GRD_CPS.

This calculation is applied in all states with any flow ramps.

if FLOW_CTL_CPS$_{n-1}$ $>$ FLOW_TAR_CPS // actual value higher than target
then FLOW_CTL_CPS$_n$ = // decreasing flow
max [FLOW_TAR_CPS, FLOW_CTL_CPS$_{n-1}$ - FLOW_GRD_CPS]

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else FLOW_CTL_CPS$_n$ = // increasing flow
min [FLOW_TAR_CPS, FLOW_CTL_CPS$_{n-1}$ + FLOW_GRD_CPS]
endif

9.14.4 General calculations

General information:

This submodule is calculated in every state_cp except CP_NOT_ACT
When the maximum engine speed limitation is reached (LV_N_MAX_CP) some of the calculations for the injection correction must be stopped to decrease the CPU load. If LV_N_MAX_CP is active then the normal calculations of the following variables are not done and the values of these variables are set to 0.

Application conditions

Initialisation: *at RST or IGKON. values are set to zero.*
Recurrence: *called by superior block*
Activation: – –
Deactivation: – –

Formula section:

call "Time counter for time after MAX_PURGE operation"
if LV_N_MAX_CP = 1
then call "Default values for disabled calculations"
else call "Commutation on diagnosis detection"
call "OBD2 diagnosis activation"
call "Calculation of FLOW_CPS and FLOW_COR_CPS"
endif
if LC_CP_CLL_INH_MAN = 0
then call "Pade-filter and PT1-Filter calculations"
endif
end

9.14.4.1 Time counter for time after MAX_PURGE operation

Depending on this time counter, RAMP_OPEN (counter=0) or RAMP_OPEN_FAST (>0) are activated for CL learning. As long as the counter has not reached zero, the CL used in the previous MAX_PURGE phase is considered as usable.

Formula section:

if STATE_CP = MAX_PURGE
then **if** STATE_OPM_ENG_CP = ENG_MOD_0
then T_DLY_MAX_CP = C_T_DLY_MAX_CP_0 // counter init
else T_DLY_MAX_CP = C_T_DLY_MAX_CP_1
T_DLY_CL_MDL = **max** [0, T_DLY_CL_MDL - TA]
elseif LV_CP_CLL = 0
then T_DLY_MAX_CP = **max** [0, T_DLY_MAX_CP - TA]
T_DLY_CL_MDL = C_T_DLY_CL_MDL
else T_DLY_MAX_CP$_n$ =T_DLY_MAX_CP$_{n-1}$

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T_DLY_CL_MDL$_n$ = T_DLY_CL_MDL$_{n-1}$
Endif

if LV_CP_NEW_RAMP_OPEN = 1
then T_DLY_MAX_CP = 0
endif

if T_DLY_MAX_CP = 0
then LV_CL_CLC_VLD = 0 // switch off int. MIN_PURGE
endif
end

9.14.4.2 Default values for disabled calculations

When the maximum engine speed limitation is reached (LV_N_MAX_CP) some of the calculations for the injection correction must be stopped to decrease the CPU load. If LV_N_MAX_CP is active then the normal calculations of the following variables are not done and the values of these variables are set to 0.

Formula section:

FLOW_SP_CPS = 0
FLOW_COR_CPS = 0
FLOW_CPS = 0
FLOW_TOT_CPS = 0
MAF_CPS = 0
end

9.14.4.3 OBD2 diagnosis activation

General information:
In order to manage the priority between canister purge and catalyst diagnosis or between canister purge and O2 sensor diagnosis, the bit information LV_CP_ACT_REQ will be sent to the diagnosis OBD2 manager. Two cases are possible :

- first of all, when the conditions to purge are set in order to learn the canister load (RAMP_OPEN phase).
- when LV_T_DLY_REQ_CP=1 if the canister load (CL_MMV) is greater than a calibrated value C_CL_MMV_REQ.

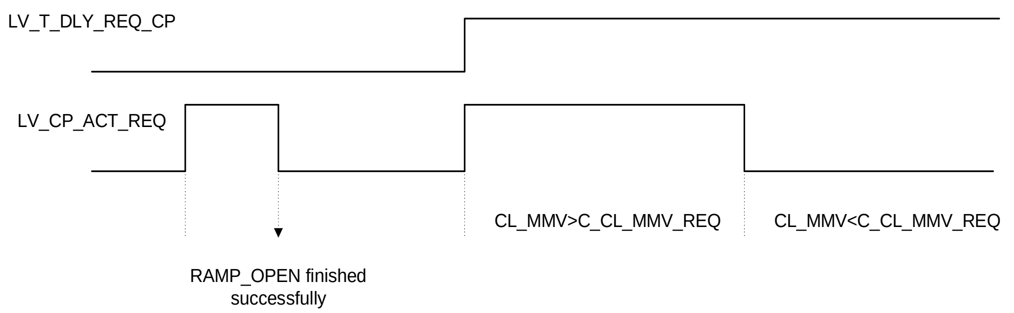

Figure 9.14.6: : LV_CP_ACT_REQ

Formula section:

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LV_CP_ACT_REQ =
[LV_T_DLY_REQ_CP **and** (CL_MMV > C_CL_MMV_REQ)]
or STATE_CP = RAMP_OPEN
end

9.14.4.4 Calculation of FLOW_CPS and FLOW_COR_CPS

The setpoint of the mass flow through the CPS (FLOW_COR_CPS) is calculated using the actual calculated values of FLOW_CTL_CPS, a ramp gradient depending on MAF_CYL and the correction factors on ambient pressure and ambient temperature.
If the OBD II evaporative system monitoring (vaccum method) function is active (LV_DIAGCP_CPS_ACT=1), the opening of the CPS is controlled by the value of FLOW_SP_CPS_EVAP (see chapter OBDII functions).
The opening of the CPS can also be controlled by the application system using the switch LC_FLOW_CPS_AS and C_FLOW_CPS_AS.
The calculation of FLOW_SP_CPS is limited using a gradient value.
In RAMP_OPEN, RAMP_OPEN_FAST, NO_PURGE and RAMP_TOP_NO_PURGE, the gradient limitation is no more applied.
The flow request through the CPS is limited by the physical maximum flow at fully openend valve defined in FLOW_MAX_PHY_CPS (depending on pressure difference ambient air - intake manifold)
The value FLOW_TOT_CPS permits to measure the quantity of flow during an emission cycle.

Signal flow diagrams:

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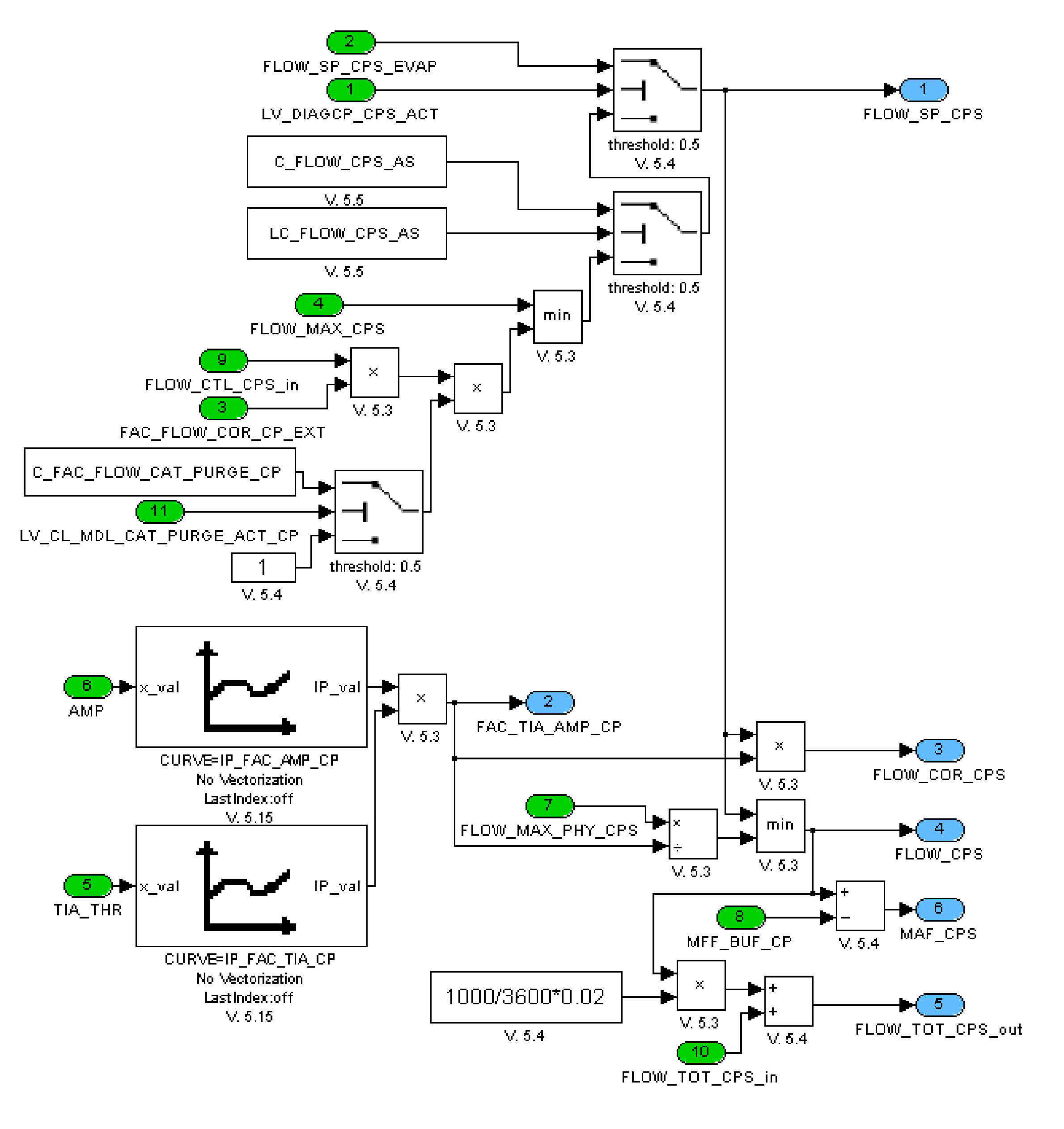

Figure 9.14.7: : Calculation of FLOW_CPS, FLOW_COR_CPS

Formula section:

if LV_DIAGCP_CPS_ACT // Interface with leak detection by vaccum method
then FLOW_SP_CPS = FLOW_SP_CPS_EVAP
elseif LC_FLOW_CPS_AS // manual setting of flow_sp_cps
then FLOW_SP_CPS = C_FLOW_CPS_AS
else **if** LV_CL_MDL_CAT_PURGE_ACT_CP = 0
then FLOW_SP_CPS = **min**
[FLOW_CTL_CPS * FAC_FLOW_COR_CP_EXT, FLOW_MAX_CPS]
else FLOW_SP_CPS = **min**

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[FLOW_CTL_CPS * FAC_FLOW_COR_CP_EXT * FAC_FLOW_CAT_PURGE_CP, FLOW_MAX_CPS]
endif

// correction factor for ambient air temperature and ambient air pressure
FAC_TIA_AMP_CP =
IP_FAC_AMP_CP (AMP)
* IP_FAC_TIA_CP (TIA_THR)

FLOW_COR_CPS = FLOW_SP_CPS * FAC_TIA_AMP_CP
FLOW_CPS = **min** [
FLOW_SP_CPS,
FLOW_MAX_PHY_CPS /FAC_TIA_AMP_CP]

FLOW_TOT_CPS = FLOW_TOT_CPS + FLOW_CPS /360
MAF_CPS = FLOW_CPS - MFF_BUF_CP
end

9.14.4.5 Pad - and Low pass filter calculations

(Calculation of FLOW_DLY_CP, FLOW_DLY_MMV_CP, MAF_CP, MAF_DLY_CP and MAF_DLY_MMV_CP)

Application conditions

Initialisation: – –

Recurrence: *100 ms*

Activation: – –

Deactivation: – –

Signal flow diagram:

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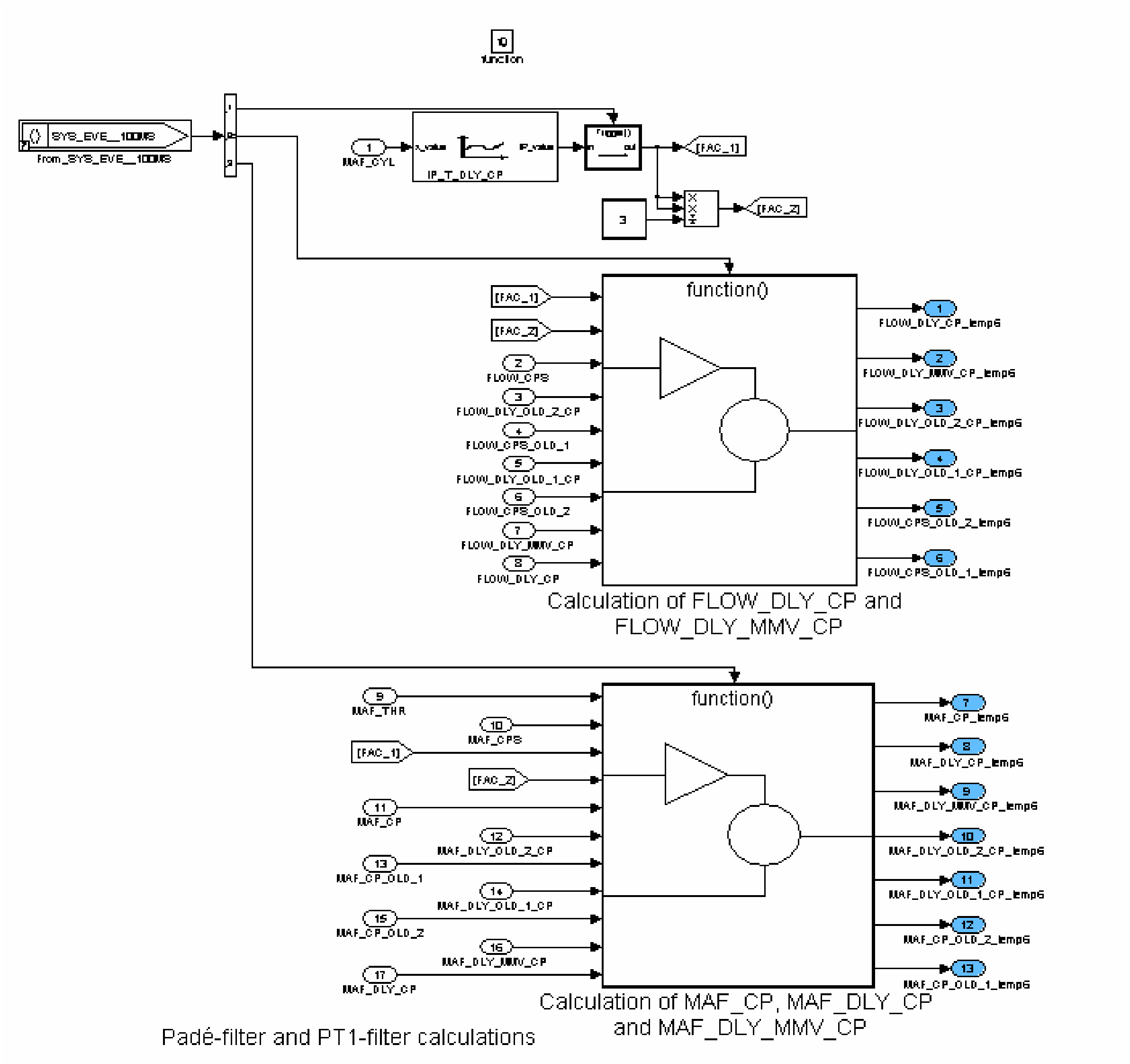

figure 9: Padé- and low pass filters

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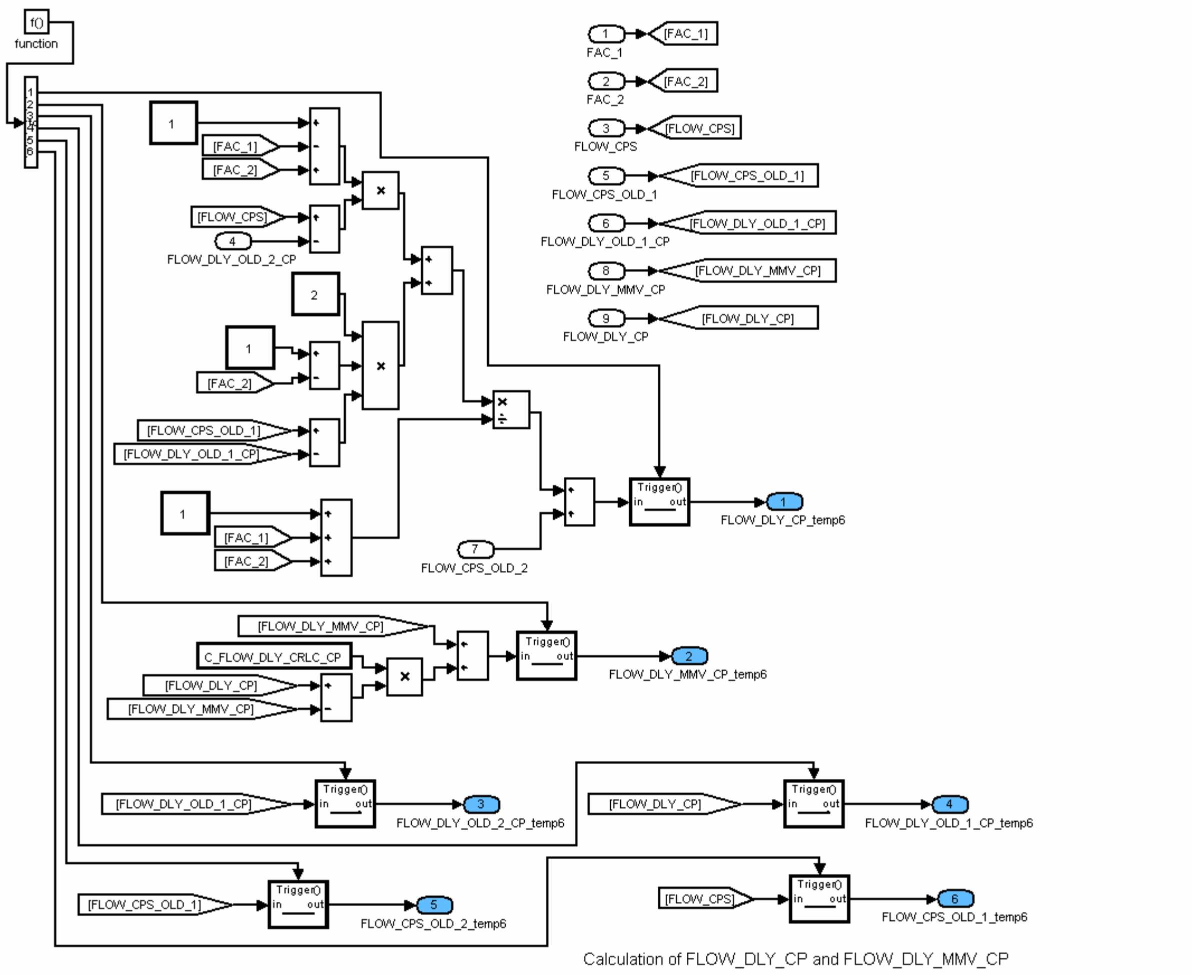

Figure 9.14.8: : calculation of FLOW_DLY_CP and FLOW_DLY_MMV_CP

the calc. of MAF_DLY_CP and MAF_DLY_MMV_CP is done following the same scheme

Formula section:

Padefilter-parameters

if STATE_OPM_ENG_CP = ENG_MODE_0
then FAC_1 = IP_T_DLY_CP (MAF_KGH_FG_PRED_COR_CP)
else FAC_1 = IP_T_DLY_CP_2 (MAF_KGH_FG_PRED_COR_CP)
FAC_2 = FAC_1 * FAC_1 /3

Calculation of FLOW_DLY_CP and FLOW_DLY_MMV_CP:
// Pade-filter
FLOW_DLY_CP=
1 /(1 + FAC_1 + FAC_2)
* (1 - FAC_1 + FAC_2)
* (FLOW_CPS - FLOW_DLY_OLD_2_CP)
+ 2 * (1 - FAC_2) * (FLOW_CPS_OLD_1 - FLOW_DLY_OLD_1_CP)
+ FLOW_CPS_OLD_2

// Low pass-filter

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FLOW_DLY_MMV_CP$_n$= FLOW_DLY_MMV_CP$_{n-1}$ +
(FLOW_DLY_CP$_n$ - FLOW_DLY_MMV_CP$_{n-1}$) * C_FLOW_DLY_CRLC_CP

// memorization for next recurrence
FLOW_DLY_OLD_2_CP = FLOW_DLY_OLD_1_CP
FLOW_DLY_OLD_1_CP = FLOW_DLY_CP
FLOW_CPS_OLD_2 = FLOW_CPS_OLD_1
FLOW_CPS_OLD_1 = FLOW_CPS

Calculation of MAF_CP, MAF_DLY_CP and MAF_DLY_MMV_CP:
MAF_CP = MAF_THR + MAF_CPS
Better: MAF_CP, only visible, no output

// Pade-filter
MAF_DLY_CP(n)=
1 /(1 + FAC_1 + FAC_2)
* (1 - FAC_1 + FAC_2)
* (MAF_CP$_n$- MAF_DLY_OLD_2_CP)
+ 2 * (1 - FAC_2) * (MAF_CP_OLD_1 - MAF_DLY_OLD_1_CP)
+ MAF_CP_OLD_2

// Lowpass-filter
MAF_DLY_MMV_CP$_n$= MAF_DLY_MMV_CP$_{n-1}$ +
(MAF_DLY_CP$_n$- MAF_DLY_MMV_CP$_{n-1}$) * C_MAF_DLY_CRLC_CP

// memorization for next recurrence
MAF_DLY_OLD_2_CP = MAF_DLY_OLD_1_CP
MAF_DLY_OLD_1_CP = MAF_DLY_CP
MAF_CP_OLD_2 = MAF_CP_OLD_1
MAF_CP_OLD_1 = MAF_CP

Calculation of MAF_DLY_CPS and MAF_DLY_MMV_CPS:
// Pade-filter
MAF_DLY_CPS(n)=
1 /(1 + FAC_1 + FAC_2)
* (1 - FAC_1 + FAC_2)
* (MAF_CPS$_n$- MAF_DLY_OLD_2_CPS)
+ 2 * (1 - FAC_2) * (MAF_CPS_OLD_1 - MAF_DLY_OLD_1_CPS)
+ MAF_CPS_OLD_2

// Lowpass-filter
MAF_DLY_MMV_CPS$_n$= MAF_DLY_MMV_CPS$_{n-1}$ +
(MAF_DLY_CPS$_n$- MAF_DLY_MMV_CPS$_{n-1}$) * C_MAF_DLY_CRLC_CPS

// memorization for next recurrence
MAF_DLY_OLD_2_CPS = MAF_DLY_OLD_1_CPS
MAF_DLY_OLD_1_CPS = MAF_DLY_CPS
MAF_CPS_OLD_2 = MAF_CPS_OLD_1
MAF_CPS_OLD_1 = MAF_CPS
end

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9.15 Evaporative emission control (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DLY_CLL_IS_S_CP	V	0... FFFFH	0... 65535	1	-
counter to disabled CLL at IS at unknown CL					
FAC_FLOW_COR_CP_EXT	O/V	0... FFH	0... 3.98437	0.015625	-
External factor to modify absolute flow					
FAC_FLOW_COR_CP_MIN_PURGE	O/V	0... FFH	0... 3.98437	0.015625	-
External factor to modify absolute flow for OPM_AV_CP = 1					
FAC_FLOW_TAR_COR_CP	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Reduction factor for the flow target at close engine mode swich					
LV_C_FAC_LAM_0_CP_WIDE	O/V	0... 1H	0 ...1	1	-
Set the limitations of C_FAC_LAM_0_CP to wide threshold					
LV_CP_ACT	O/V	0... 1H	0 ...1	1	-
Logical value for EVAP-Control active					
LV_CP_CLOSE_1	O/V	0... 1H	0 ...1	1	-
Request to inhibit the canister purge function with high closing speed					
LV_CP_CLOSE_2	O/V	0... 1H	0 ...1	1	-
Request to inhibit the canister purge function with medium closing speed					
LV_CP_CLOSE_3	O/V	0... 1H	0 ...1	1	-
Request to inhibit the canister purge function with normal closing speed					
LV_CP_DYW_EXT	O/V	0... 1H	0 ...1	1	-
flag collecting project specific dynamic window conditions					
LV_CPS_AD_INH	O/V	0... 1H	0 ...1	1	-
CPS adaptation inhibited					
LV_FLOW_TAR_COR_CP	O/V	0... 1H	0 ...1	1	-
Reduction for the flow target at close engine mode swich					
LV_INH_CLL_IS_S_CP	O/V	0... 1H	0 ...1	1	-
Flag for disabled CLL at IS at unknown CL					
LV_INH_CP	O/V	0... 1H	0 ...1	1	-
Inhibits any purge operation, forces NO_PURGE (via a ramp)					
LV_INH_CP_CLL	O/V	0... 1H	0 ...1	1	-
Inhibits closed loop operation, leads to MIN_PURGE, if no other reasons force NO_PURGE					
LV_INH_CP_FAST	O/V	0... 1H	0 ...1	1	-
Inhibits any purge operation, forces a direct jump to NO_PURGE					
LV_INH_CP_SDL	O/V	0... 1H	0 ...1	1	-
flag collecting project specific reasons to inhibit CP via time control /permanently enable CP					
LV_INH_LAM_AD_SDL	O/V	0... 1H	0 ...1	1	-
flag collecting project specific reasons to inhibit LAM_AD via time control /permanently enable LAM_AD					
LV_STATE_OPM_CHG_HOM_CP	O/V	0... 1H	0 ...1	1	-
Engine mode change ENG_MODE_0 <-> ENG_MODE_1or2					
LV_STATE_OPM_CHG_S_CP	O/V	0... 1H	0 ...1	1	-
Engine mode change ENG_MODE_1 <-> ENG_MODE_2					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_STATE_T_SDL_CP_LAM_AD_EXT	O/V	0... 1H	0 ...1	1	-
External condition to force the time management to switch to lambda adaptation time					
LV_T_DLY_CP_LAMB_CH	-	0... 1H	0 ...1	1	-
flag indicating that delay time to enable NO_PURGE after LAMB_CH has finished was started					
LV_T_SDL_EXT_REQ	O/V	0... 1H	0 ...1	1	-
flag collecting project specific reasons to temporarilly disabling CP and lambda adaptation					
MFF_GRD_CP	V	0... FFFFH	0... 1389	0.0211948	mg/stk
MFF gradient for canister purge					
MFF_GRD_MMV_CP	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Filtered MFF gradient for canister purge					
MFF_RED_OPM_THD_CP	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Area around the engine mode switch threshold to reduce the flow					
PRS_CPS_EXT	O/V	8000... 7FFFH	-2717.041... 2716.95854	0.0829175	hPa
Pressure difference envirionment over CP line					
STATE_OPM_ENG_CP	O/V	0H 1H 2H	ENG_MODE_0 ENG_MODE_1 ENG_MODE_2	-	-
Engine mode for CP					
T_AST_CP	O/V	0... FFFFH	0... 6553.5	0.1	s
Time after first start in driving cycle					
T_DLY_CP_LAMB_CH	V	0... FFFFH	0... 1310.7	0.02	s
Delay time after LAMB_CH has finished to enable NO_PURGE					
T_DLY_CP_OPM_AV	V	0... FFFFH	0... 1310.7	0.02	s
Delay time after OPM_AV change					
T_LAM_DEV_CHK_CP	V	0... FFFFH	0... 1310.7	0.02	s
Time couter for lambda deviation check					
T_LAM_DEV_SYM_CP	V	0... FFFFH	0... 1310.7	0.02	s
Time counter for the symptom in lambda deviation check					

Input data:

AMP {p. 982}	CL_MMV {p. 3698}	ERR_SYM_DMTLS {p. 4624}	FAC_LAM_AD_CUS [NC_CBK_EX_NR] {p. 8308}
FAC_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2461}	FAC_LAM_LIM [NC_CBK_EX_NR] {p. 2461}	FAC_MFF_ADD_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2641}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}
LC_LAM_CBK_CPS {p. 3706}	LV_ACT_SA_EOL {p. 7763}	LV_ACT_SAP_EXT_ADJ {p. 7432}	LV_ACT_SAV_EXT_ADJ {p. 7433}
LV_ACT_VLS_EOL_EXT_ADJ {p. 7763}	LV_AST {p. 1766}	LV_CP_CLL {p. 3636}	LV_CP_INH_CUS {p. 8229}
LV_CYL_BAL_LAM_AD_EOL {p. 4043}	LV_CYL_BAL_LAM_AD_REQ_CUS {p. 1015}	LV_DIAG_OPL_REQ_CBK [NC_CBK_EX_NR] {p. 5407}	LV_DIAGCPS_MIN_MOD {p. 5926}
LV_ENA_CHK_FUC_ROUGH_LEAK {p. 5964}	LV_ERR_AMP {p. 4822}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_DIAGCPS {p. 5926}

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MMV_CLL_IS_S_MAX	-	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum allowed CL_MMV for closed loop operation in stratified engine operation mode at idle speed					
C_CRLC_MFF_GRD_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation factor for MFF_GRD_CP calculation					
C_CTR_DLY_CLL_IS_S_DEC_CP	-	0... FFFFH	0... 65535	1	-
Decrement step for counter for to disabled CLL at IS at unknown CL					
C_CTR_DLY_CLL_IS_S_INC_CP	-	0... FFFFH	0... 65535	1	-
Increment step for counter to disabled CLL at IS at unknown CL					
C_CTR_DLY_CLL_IS_S_MAX_CP	-	0... FFFFH	0... 65535	1	-
Max value for counter to disabled CLL at IS at unknown CL					
C_FAC_FLOW_TAR_COR_MIN_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Lower thershold for the flow correction factor					
C_STATE_CONF_CAT_CP	-	0... 3H	0 ...3	1	-
Configuration byte for closing speed of canister purge before catalyst monitor test started					
C_STATE_CONF_TLDV_CP	-	0... 3H	0 ...3	1	-
Configuration byte for closing speed of canister purge before leak detection test started					
C_T_AST_MAX_INH_CP_SDL	-	0... FFFFH	0... 6553.5	0.1	s
Max time after start to reset LV_INH_CP_SDL					
C_T_DLY_CP_LAMB_CH	-	0... FFFFH	0... 1310.7	0.02	s
Calibrateable delay time after LAMB_CH has finished to enabe NO_PURGE					
C_T_DLY_CP_OPM_AV	-	0... FFFFH	0... 1310.7	0.02	s
Calibrateable time delay for NO_PURGE after STATE_OPM_AV changed					
C_T_LAM_DEV_CHK_MAX_CP	-	0... FFFFH	0... 1310.7	0.02	s
Time to detect the possibility of an error in the fuel system					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_LAM_DEV_SYM_MAX_CP	-	0... FFFFH	0... 1310.7	0.02	s
Threshold time for the symptom to detect the possibility of an error in the fuel system					
C_TCO_MAX_INH_CP_SDL	-	0... FEH	-48... 142.5	0.75	°C
Max cooling water temperature to reset LV_INH_CP_SDL					
ID_STATE_OPM_ENG_CP	-	0... 2H	0 ...2	1	-
LDPM_OPM_AV	8	0... 8H	0 ...8	1	-
Mode selection for canister purge depending on engine operation mode					
IP_FAC_LAM_DEV_MAX_CP	-	0... FFFFH	-100... 99.99694	3.0518e-3	%
LDPM_LAMB_SP_CP	4	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambdacontroller maximum threshold for possibility of fuel system erreor dependend on LAMB_SP[i]					
IP_FAC_LAM_DEV_MIN_CP	-	0... FFFFH	-100... 99.99694	3.0518e-3	%
LDPM_LAMB_SP_CP	4	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambdacontroller minimum threshold for possibility of fuel system erreor dependend on LAMB_SP[i]					
IP_FAC_REL_FLOW_CPS_WOUT_CAT	V	0... FFH	0... 3.98437	0.015625	-
LDPM_N_32_IP_REL_FLOW_MAX_CPS	12	0... FFH	0... 8160	32	rpm
LDPM_MAF_IP_REL_FLOW_MAX_CPS	12	0... FFH	0... 1389	5.4470588	mg/stk
Factor for CP MIN_PURGE					
IP_MFF_RED_OPM_CP	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_MFF_SP_MV_IP_MFF_RED_CP	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Area around the engine mode switch threshold to reduce the flow					
IP_T_ST_AST_TCO_ST_CPS_MIN	-	1... FFFFH	0.1... 6553.5	0.1	s
LDP_TCO_ST_IP_T_ST	6	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for EVAP-Control active					
LC_CP_ACT	-	0... 1H	0 ...1	1	-
central switch for activation /deactivation of canister purge functions					
LC_CP_AST_ACT	-	0... 1H	0 ...1	1	-
Use of LV_AST for activation of evaporative emission control function					
LC_ERR_AMP_INH_CLL	-	0... 1H	0 ...1	1	-
Inhibits the EVAC to be in close loop if an AMP error is detected					
LC_ERR_MAP_MIN_PURGE_CP	-	0... 1H	0 ...1	1	-
Enables Min Purge operation at MAP error, otherwise switched to No Purge					
LC_LAM_DEV_RESU_CP	-	0... 1H	0 ...1	1	-
Resume the lambda deviation detection					
LC_LAM_LIM_AD_ENA	-	0... 1H	0 ...1	1	-
switch to enable forced lambda adaptation					
LC_TLDV_NOT_SEQ	-	0... 1H	0 ...1	1	-
Configuration bit to select if the OBD2 sequencer is present (0) or not (1)					

9.15.1 Project specific definition for "Time after start"

General information:

T_AST_CP has to be written in general with T_AST. Only special configurations, e.g. for stop-start functionality, T_AST_CP has to be written with other values (e.g. T_AST_DC).

Application conditions

Initialisation: *T_AST_CP = 0 after reset*

Recurrence: *100ms*

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Activation: `all engine states`

Deactivation: `- -`

Formula section:

T_AST_CP = T_AST

9.15.2 Activation of the Evaporative Emission Control Function

General information:

The Evaporative Emission Control function is activated (LV_CP_ACT=1), if the time after start exceeds IP_T_ST_AST_TCO_ST_CPS_MIN, which depends on coolant temperature after start. The function is active during all engine operating states except the following states:

- engine stopped (LV_ES=1)
- engine start (LV_ST=1)

For the MSA stop/start functionality it is necessary to calculate a seperat T_AST_CP, which represents the time after first start in an driving cycle.

Application conditions

Initialisation: `LV_CP_ACT = 0 after reset or stalling`

Recurrence: `20ms`

Activation:

Deactivation: `- -`

Formula section:

LV_CP_ACT =
[T_AST_CP > IP_T_ST_AST_TCO_ST_CPS_MIN(TCO_ST)
and LV_ES = 0
and LV_ST = 0
and [LV_AST = 0 **or** LC_CP_AST_ACT = 0]
and LC_CP_ACT = 1]

9.15.3 Cross-locking table

General information:

This chapter describes the evaporative emission control inhibition.

Application conditions

Initialisation:

```
at reset:
 LV_INH_CP = 1
    LV_INH_CP_FAST = 0
    LV_INH_CP_CLL = 0
    LV_CP_DYW_EXT = 1      (never changed after initialisation)
    LV_INH_LAM_AD_SDL = 0     (never changed after initialisation)
    LV_INH_CP_SDL = 0
```

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```
        LV_T_DLY_CP_LAMB_CH = 0
        T_DLY_CP_LAMB_CH = 0
        LV_CPS_AD_INH        = 0     (never changed after initialisation)
     T_DLY_CP_OPM_AV = 0
     at  LV_IGK 0 -> 1
     LV_T_DLY_CP_LAMB_CH = 0
        T_DLY_CP_LAMB_CH = 0
     CTR_DLY_CLL_IS_S_CP = C_CTR_DLY_CLL_IS_S_MAX_CP
     LV_INH_CLL_IS_S_CP = 1
     T_DLY_CP_OPM_AV = 0
```

Recurrence: **20** ms

Activation: LV_ST_END = 1

Deactivation: LV_ST_END = 0

Formula section:

If LV_SA_END = 1 **and**
LV_TI_CH = 0 **and**
LV_T_DLY_CP_LAMB_CH$_n$ = 0
Then LV_T_DLY_CP_LAMB_CH$_{n-1}$ = 1
T_DLY_CP_LAMB_CH = C_T_DLY_CP_LAMB_CH
Endif

If LV_SA_END = 1 **and**
LV_TI_CH = 0 **and**
T_DLY_CP_LAMB_CH $>$ 0
Then T_DLY_CP_LAMB_CH = T_DLY_CP_LAMB_CH$_{n-1}$ - 20 ms
Endif

If OPM_AV$_n$!= OPM_AV$_{n-1}$
Then T_DLY_CP_OPM_AV = C_T_DLY_CP_OPM_AV
Else T_DLY_CP_OPM_AV $_n$ = T_DLY_CP_OPM_AV $_{n-1}$ - 20 ms
Endif
Counter to prevent RO/ROF at idle speed and stratified engine mode at unknown CL_MMV
If LV_CP_CLL = 1
Then CTR_DLY_CLL_IS_S_CP = **max**(0,CTR_DLY_CLL_IS_S_CP -
C_CTR_DLY_CLL_IS_S_DEC_CP)
If CTR_DLY_CLL_IS_S_CP = 0
Then LV_INH_CLL_IS_S_CP = 0
endif
Else CTR_DLY_CLL_IS_S_CP =
min(C_CTR_DLY_CLL_IS_S_MAX_CP,CTR_DLY_CLL_IS_S_CP +
C_CTR_DLY_CLL_IS_S_INC_CP)
If CTR_DLY_CLL_IS_S_CP = C_CTR_DLY_CLL_IS_S_MAX_CP
Then LV_INH_CLL_IS_S_CP = 1
endif

endif

For activation of **NO_PURGE (via a ramp)** and setting of the flag LV_INH_CP the following conditions must be fulfilled:
If LV_ERR_EL_CPS =1 **or**

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LV_ERR_DIAGCPS =1 **or**
{(LV_ERR_MAP_DIP_PLAUS or
LV_ERR_MAP_DIP_SENS or
LV_ERR_MAP_DIP_SHIFT) and
LC_ERR_MAP_MIN_PURGE_CP = 0} or
LV_ACT_SAV_EXT_ADJ =1 **or**
LV_ACT_SAP_EXT_ADJ =1 **or**
LV_ACT_SA_EOL =1 **or**
LV_NO_PURGE_DMTL = 1 **or**
ERR_SYM_DMTLS = SYM_1 **or**
LV_MIS_STATE_A = 1 **or**
T_DLY_CP_OPM_AV > 0 **or**
LV_SA_END = 0 **or**
LV_TI_CH = 1 **or**
LV_ENA_CHK_FUC_ROUGH_LEAK = 1 **or**
LV_CP_INH_CUS = 1 **or**
(LV_SA_END = 1 **and**
LV_TI_CH = 0 **and**
T_DLY_CP_LAMB_CH > 0 **)**
Then LV_INH_CP = 1
Else LV_INH_CP = 0
Endif

If LV_DIAG_OPL_REQ_CBK[i] = 1 **or** *//for any i*
LV_ACT_VLS_EOL_EXT_ADJ = 1
Then LV_INH_CP_FAST = 1
Else LV_INH_CP_FAST = 0
Endif

If (LV_CYL_BAL_LAM_AD_EOL = 1 **or**
T_AST > C_T_AST_MAX_INH_CP_SDL **or**
TCO > C_TCO_MAX_INH_CP_SDL) **and**
LV_LAM_AD_EXT_ADJ = 0
Then LV_INH_CP_SDL = 0
Else LV_INH_CP_SDL = 1
Endif

For activation of **MIN_PURGE** and setting of the flag LV_INH_CP_CLL the following conditions must be fulfilled:

If LV_ERR_MAF = 1 **or**
LV_ERR_TPS = 1 **or**
LV_ERR_TIA = 1 **or**
(LV_ERR_AMP = 1 **and**
LC_ERR_AMP_INH_CLL = 1) **or**
STATE_ERR_IV 0 **or**
LV_ERR_LS_UP[i] =1 **or**
LV_ERR_PVS_DOUBLE = 1 **or**
LV_ERR_IGC = 1 **or**
LV_ERR_LOAD_TPS_PLAUS = 1 **or**

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LV_ERR_LAM_ADJ[i] = 1 **or**
LV_ERR_CHG_LS_UP = 1 **or**
LV_DIAGCPS_MIN_MOD = 1 **or**
{(LV_ERR_MAP_DIP_PLAUS or
LV_ERR_MAP_DIP_SENS or
LV_ERR_MAP_DIP_SHIFT) and
LC_ERR_MAP_MIN_PURGE_CP = 1} or
// only open loop at idle speed and stratified engine mode and unknown CL
// If CL is known, closed loop only for low CL_MMV
[(LV_IS = 1 **and**
STATE_OPM_ENG_CP != ENG_MODE_0 **and**
{LV_INH_CLL_IS_S_CP = 1
or CL_MMV > C_CL_MMV_CLL_IS_S_MAX })]

Then LV_INH_CP_CLL = 1
Else LV_INH_CP_CLL = 0
Endif

9.15.4 Project specific factor for MIN purge flow

General information:

With this function, the MIN_PURGE flow can be varied by a factor from 0 to 4 for vehicles without catalyst and lambda sensors or in case of using different engine operation modes (STATE_OPM_ENG_CP).

Application conditions

Initialisation: FAC_FLOW_COR_CP_EXT = 1 *at reset* FAC_FLOW_COR_CP_MIN_PURGE = 1 *at reset*

Recurrence: *100ms*

Activation: *LV_ST_END = 1*

Deactivation: *LV_ST_END = 0*

Formula section:

If (1) LV_VAR_LSH_UP = 1
Then (1)
If (2) STATE_OPM_ENG_CP = 0
Then (2) FAC_FLOW_COR_CP_MIN_PURGE = 1
Else (2) FAC_FLOW_COR_CP_MIN_PURGE = IP_FAC_REL_FLOW_CPS_WOUT_CAT
Endif (2)
FAC_FLOW_COR_CP_EXT = 1
Else (1) FAC_FLOW_COR_CP_EXT = IP_FAC_REL_FLOW_CPS_WOUT_CAT
FAC_FLOW_COR_CP_MIN_PURGE = 1
Endif (1)

9.15.5 External calculations

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General information:

With this function, it is possible to supply the Evaporative emission control variables function with a measured canister purge differential preasure. For further information on the use of this external differential preasure please refer to chapter Evaporative emission control variables .

Application conditions

Initialisation:	*PRS_CPS_EXT= 0 at reset*
Recurrence:	*20ms*
Activation:	*LV_ST_END = 1*
Deactivation:	*LV_ST_END = 0*

Formula section:

PRS_CPS_EXT = MAP_DIP_MES_BAS_2SEG

9.15.6 Management of LV_CP_CLOSE_CP_x with no OBD sequencer

General information:

This chapter describes the recommendations for evaporative emission control inhibition when no OBD sequencer is used. In this case the flags LV_CP_CLOSE_1, LV_CP_CLOSE_2, and LV_CP_CLOSE_3 must be managed within this module.
Examples that need to close purge are OBD diagnostics for leak detection and catalyst monitor.
Normally the flags LV_CP_CLOSE_CP_x are managed and defined by the OBD sequencer, if there is no sequencer it is recommended to set LC_TLDV_NOT_SEQ =1 and define and calculate these flags in the application inc. spec.
C_STATE_CONF_TLDV_CP and C_STATE_CONF_CAT_CP are used to configure the closing ramp of the CPS valve to inhibit purge during an OBD test.
Values of C_STATE_CONF_TLDV_CP and C_STATE_CONF_CAT_CP:
0: Canister purge remains active, no request to close the valve
1: Canister purge closed with highest speed closing ramp
2: Canister purge closed with medium speed closing ramp
3: Canister purge closed with normal speed closing ramp

Application conditions

Initialisation:
```
at reset or power loss:
 LV_CP_CLOSE_1 = 0  (never changed after initialisation)
 LV_CP_CLOSE_2 = 0  (never changed after initialisation)
 LV_CP_CLOSE_3 = 0  (never changed after initialisation)
```
Recurrence: *only initialisation*

9.15.7 Selection of STATE_OPM_ENG_CP in case of engine operation mode change (OPM_AV)

General information:

This chapter describes the canister purge behaviour in case of changing engine operation mode (OPM_AV).

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Application conditions

Initialisation: *at reset or power loss STATE_OPM_ENG_CP = 0*

Recurrence: 100 ms

Activation: *every engine state*

Formula Section:

STATE_OPM_ENG_CP = ID_STATE_OPM_ENG_CP
Setting of the flag LV_STATE_OPM_CHG_HOM_CP to detect the engine mode change from homogenious (ENG_MODE_0) to stratified (ENG_MODE_1/2) and vice versa and the flag LV_STATE_OPM_CHG_S_CP to detect the schange of the stratified engine mode (ENG_MODE_1 to ENG_MODE_2 and vice versa.

if [(STATE_OPM_ENG_CP$_n$ = ENG_MODE_0
and STATE_OPM_ENG_CP$_{n-1}$!= ENG_MODE_0)
or (STATE_OPM_ENG_CP$_n$!= ENG_MODE_0
and STATE_OPM_ENG_CP$_{n-1}$ = ENG_MODE_0)]
then LV_STATE_OPM_CHG_HOM_CP = 1
else LV_STATE_OPM_CHG_HOM_CP = 0
endif

if [(STATE_OPM_ENG_CP$_n$ = ENG_MODE_1
and STATE_OPM_ENG_CP$_{n-1}$ = ENG_MODE_2)
or (STATE_OPM_ENG_CP$_n$ = ENG_MODE_2
and STATE_OPM_ENG_CP$_{n-1}$ = ENG_MODE_1)]
then LV_STATE_OPM_CHG_S_CP = 1
else LV_STATE_OPM_CHG_S_CP = 0

endif

9.15.8 end

9.15.9 Flow Reduction near engine operation mode switch

General information:

The two thresholds for an engine operating mode change is given by the two input values. Around this fuel mass point the flow through the CPS valve is reduced, to prevent disturbences at engine mode change by canister purge.

Application conditions

Initialisation: all values = 0 at reset

Recurrence: 20 ms

Activation: *every engine state*

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Formula Section:

MFF_GRD_CP = **abs**(MFF_SP_MV$_{n-1}$ - MFF_SP_MV$_{n}$)

MFF_GRD_MMV_CPn =
MFF_GRD_MMV_CP$_{n-1}$ + (MFF_GRD_CP - MFF_GRD_MMV_CP$_{n-1}$) * C_CRLC_MFF_GRD_CP
MFF_RED_OPM_THD_CP = IP_MFF_RED_OPM_CP(MFF_GRD_MMV_CP)

if **abs**(MFF_SP_MV-MFF_MAX_S_CUS) $<$ MFF_RED_OPM_THD_CP // HOMS$<$-$>$S
then LV_FLOW_TAR_COR_CP = 1
FAC_FLOW_TAR_COR_CP = max{ C_FAC_FLOW_TAR_COR_MIN_CP, **abs**(MFF_SP_MV-MFF_MAX_S_CUS)/MFF_RED_OPM_THD_CP}
elseif **abs**(MFF_SP_MV-MFF_MAX_HOMS_CUS) $<$ MFF_RED_OPM_THD_CP // HOMS$<$-$>$HOM
then LV_FLOW_TAR_COR_CP = 1
FAC_FLOW_TAR_COR_CP = max{ C_FAC_FLOW_TAR_COR_MIN_CP, **abs**(MFF_SP_MV-MFF_MAX_HOMS_CUS)/MFF_RED_OPM_THD_CP}
else LV_FLOW_TAR_COR_CP = 0
FAC_FLOW_TAR_COR_CP = 1
endif

end

9.15.10 Calculation of LV_C_FAC_LAM_0_CP_WIDE

General information:

At the start of each driving cycle the lambda deviation has to be monitored to detect the possibility of an error in the fuel system. If the possibility of an error is detected, the flag LV_C_FAC_LAM_0_CP_WIDE is set. This will open the limitations of FAC_LAM_0_CP.
TA = recurrence

Application conditions

Initialisation:

```
at RST or LV_IGK=1
   T_LAM_DEV_CHK_CP = C_T_LAM_DEV_CHK_MAX_CP
   T_LAM_DEV_SYM_CP = 0
   LV_C_FAC_LAM_0_CP_WIDE = 0
   if      LC_LAM_CBK_CPS=0
   then       idx_cp  = 0
   else       idx_cp  = 1
   endif
```

Recurrence: 20ms

Activation: *every engine state*

Deactivation: - -

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Formula section:

```
if      LC_LAM_DEV_RESU_CP = 1
        and STATE_CP = MAX_PURGE
then        T_LAM_DEV_CHK_CP = C_T_LAM_DEV_CHK_MAX_CP
        T_LAM_DEV_SYM_CP = 0
        LV_C_FAC_LAM_0_CP_WIDE = 0
endif

if      LV_LAM_LSCL[idx_cp] = 1                // lambda controller acting
        and T_LAM_DEV_CHK_CP > 0
        and (STATE_CP = CP_NOT_ACT
                or STATE_CP = NO_PURGE)
then        T_LAM_DEV_CHK_CP = max (0, T_LAM_DEV_CHK_CP - TA)
 if {LV_LAM_AD_EXT = 0
        and         [((FAC_LAM_LIM[idx_cp] + FAC_LAM_AD_OUT[idx_cp] + FAC_MFF_ADD_LAM_
        AD_OUT[idx_cp]) >= IP_FAC_LAM_DEV_MAX_CP(LAMB_SP))
                or((FAC_LAM_LIM[idx_cp] + FAC_LAM_AD_OUT[idx_cp] + FAC_MFF_ADD_LAM_AD_
        OUT[idx_cp]) <= IP_FAC_LAM_DEV_MIN_CP(LAMB_SP))]}
        or
        {LV_LAM_AD_EXT = 1
        and         [((FAC_LAM_LIM[idx_cp] + FAC_LAM_AD_CUS[idx_cp]) >= IP_FAC_LAM_DEV_
        MAX_CP(LAMB_SP))
                or((FAC_LAM_LIM[idx_cp] + FAC_LAM_AD_CUS[idx_cp]) <= IP_FAC_LAM_DEV_MIN_
        CP(LAMB_SP))]}
 then T_LAM_DEV_SYM_CP ++
        if T_LAM_DEV_SYM_CP = C_T_LAM_DEV_SYM_MAX_CP
                then        LV_C_FAC_LAM_0_CP_WIDE = 1
                endif
        endif
endif
end
```

9.15.11 External request for Time slice "Lambda adaption"

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General information:

With the flag LV_STATE_T_SDL_CP_LAM_AD_EXT the time management for lambda adaptation and canister purge can be forced to change and stay in one of the lambda adaptaiton time slices.

Application conditions

Initialisation: *LV_STATE_T_SDL_CP_LAM_AD_EXT = 0 after reset*

Recurrence: *20ms*

Activation: *all engine states*

Deactivation: *- -*

Formula section:

```
If      ( LV_LAM_LIM_LAM_AD [i] = 1        // shall be true, if at least one bench is true
        and         LC_LAM_LIM_AD_ENA = 1)        // immediate lambda adaptation required
```


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or LV_CYL_BAL_LAM_AD_REQ_CUS = 1
then LV_STATE_T_SDL_CP_LAM_AD_EXT = 1
else LV_STATE_T_SDL_CP_LAM_AD_EXT = 0

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9.16 Evaporative emission control - Injection correction

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
BUF_INP_CP	V	0... FFFFH	0... 0.99998	15.3e-6	-
Input for the fuel delay buffer					
BUF_OUT_CP	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Output of the fuel delay buffer					
IDX_CP	-	0... FFH	0... 255	1	-
Current position within the ring buffer					
IDX_RD_CP	-	0... FFH	0... 255	1	-
Reading position within the ring buffer					
IDX_STEP_CP	-	0... FFH	0... 255	1	-
number of elements to fill with actual input beginning with actual position					
MAF_KGH_FG_PRED_COR_CP	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Predicted fresh gas out of manifold corrected by MAP and TIA for CP					
MFF_ADD_BUF [NC_NR_CP_BUF]	V	0... FFFFH	0... 0.99998	15.3e-6	-
Array of MFF_ADD_CP_KGH values [NC_NR_CP_BUF elements default value= 20]					
MFF_ADD_CYL_CP	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass from the canister in the cylinder					
MFF_ADD_LAM_CP	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Additive adaptive correction of the mass fuel flow injection with active canister purge					
MFF_BUF_CP	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Fuel flow from the CPS to the Cylinder					
MFF_CPS	V	0... FFFFH	0... 1389	0.0211948	mg/stk
fuel mass calculation for torque correction in stratified combustion					
MFF_TOT_CP	V	0... FFFFFFFFH	0... 1455.99999	339e-9	g
Total of MFF_BUF_CP during emission cycle					
TQI_ADD_CP	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Canister purge torque gain					

Input data:

LC_CP_CLL_INH_MAN {p. 1544}	LV_CP_ACT {p. 3679}	LV_FAC_LAM_SHIFT_CP {p. 3699}	LV_HOM_ACT {p. 8136}
LV_N_MAX_CP {p. 1540}	MAF {p. 8277}	MAF_CPS {p. 3636}	MAF_CYL {p. 8277}
MAF_KGH_FG_PRED {p. 8278}	MAP {p. 8278}	MFF_ADD_CP_KGH {p. 3700}	N_32 {p. 1525}
NC_CYL_NR {p. 1526}	STATE_OPM_ENG_CP {p. 3680}	TIA {p. 1226}	TQI_SP_S {p. 8391}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_THR_MIN_BUF_CP	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Minimum MAF_THR value for Ringbuffer input calculation.					
IP_CRLC_MFF_BUF_CP	-	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Ratio for MFF_BUF_CP calculation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_IDX_STEP_CP	-	0... FFH	0... 255	1	-
LDPM_MAF_KGH_CLC_ID_IDX_STEP_CP	12	0... FFFFH	0... 2047.96875	0.03125	kg/h
number of elements+1 to fill with actual input beginning with actual position					
IP_IDX_STEP_CP_2	-	0... FFH	0... 255	1	-
LDPM_MAF_KGH_CLC_ID_IDX_STEP_CP	12	0... FFFFH	0... 2047.96875	0.03125	kg/h
number of elements+1 to fill with actual input beginning with actual position at STATE_OPM_ENG_CP = 1					
IP_MAF_KGH_PRED_COR_MAP_TIA	V	0... FFFFH	0... 7.99987	122.1e-6	-
LDPM_MAP_1_EVAC	6	0... FFFFH	0... 5434	0.0829175	hPa
LDPM_TIA_1_EVAC	3	0... FEH	-48... 142.5	0.75	°C
Correction factor for MAF_KGH_FG_PRED (MAP and TIA)					
IP_MAF_KGH_PRED_COR_MAP_TIA_2	V	0... FFFFH	0... 7.99987	122.1e-6	-
LDPM_MAP_1_EVAC	6	0... FFFFH	0... 5434	0.0829175	hPa
LDPM_TIA_1_EVAC	3	0... FEH	-48... 142.5	0.75	°C
Correction factor for MAF_KGF_FG_PRED (MAP and TIA) with of STATE_OP_ENG_CP = 1					
IP_MFF_DLY_CP	-	0... FFH	0... 255	1	-
LDPM_MAF_CYL_1_EVAC_MFF_DLY_CP	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Delay for MFF_BUF_CP calculation; maximum allowed calibration value is NC_NR_CP_BUF-1					
IP_MFF_DLY_CP_2	-	0... FFH	0... 255	1	-
LDPM_MAF_CYL_1_EVAC_MFF_DLY_CP	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Delay for MFF_BUF_CP calculation with STATE_OPM_ENG_CP = 1					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_FLOW_CPS_CAL	-	0... 1H	0 ...1	1	-
Choice of recurence for MFF_ADD_LAM_CP calculation					
LC_MAF_COR_ACT_CP	-	0... 1H	0 ...1	1	-
Activate the usage of the corrected MAF for reading the buffer					
NC_NR_CP_BUF	-	0... FFH	0... 255	1	-
Size of the fuel buffer FUEL_FLOW_ADD_BUF					

Input data table order: External inputs - Inputs from other EVAC modules

General information:

When the Evaporative Emission Control is active, the fuel injection is corrected by an additive value MFF_ADD_LAM_CP to avoid emission and driveability problems caused by the fuel flow through the CPS. This correction is done all the time.
During RAMP_OPEN when the lambda control is shifted the buffer will be initialized to the last MFF_ADD_CP_KGH value.
The MFF_BUF_CP value is calculated to take into account the distance between the CPS VALVE and the injectors.
The value MFF_ADD_LAM_CP is added with a minus sign to the total formula of the injection calculation (see chapter INJECTION).
The value MFF_TOT_CP allow to measure the quantity of fuel during an emission cycle.
After the initialization phase the buffer must be calculated all the time, in order to have the buffer empty when the evaporative function is stopped.

Application conditions

Initialisation:
```
at reset and engine stop
   MFF_TOT_CP                    = 0
```

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```
 at reset, engine stop and deactivation
MFF_ADD_BUF[all]                   = 0
 MFF_BUF_CP                        = 0
 MFF_ADD_LAM_CP                    = 0
 MFF_CPS                           = 0
 MFF_ADD_CYL_CP                    = 0
 TQI_ADD_CP                        = 0
 BUF_INP_CP                        = 0
 BUF_OUT_CP                        = 0
 IDX_CP                            = pointer at MFF_ADD_BUF[0]
```

Recurrence: **20** ms

Activation: *[LV_CP_ACT = 1* ***and*** *LC_CP_CLL_INH_MAN = 0]*

Deactivation: *[LV_CP_ACT = 0* ***or*** *LC_CP_CLL_INH_MAN = 1]*

Formula section:

if LV_N_MAX_CP = 1
then **call** "Default values for disabled calculations"
else **call** "handling of the ring buffer"
  if LV_HOM_ACT = 1
  then **call** "Injection correction calculation"
  else **call** "Torque Correction calculation"
  endif
  MFF_TOT_CP = MFF_TOT_CP + MFF_BUF_CP /360
  360 = transformation factor for [kg/h] [g/10ms]

endif
end

9.16.1 Default values for disabled calculations

When the maximum engine speed limitation is reached (LV_N_MAX_CP) some of the calculations for the injection correction must be stopped to decrease the CPU load. If LV_N_MAX_CP is active then the normal calculations of the following variables are not done and the values of these variables are set to 0.

Formula section:

MFF_ADD_BUF = 0 (all values of the array)
MFF_BUF_CP = 0
MFF_ADD_LAM_CP = 0
TQI_ADD_CP = 0
BUF_INP_CP = 0
MFF_CPS = 0
BUF_OUT_CP = 0
MFF_ADD_CYL_CP = 0
end

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9.16.2 Handling of the ring buffer

The recurrence of this subchapter is configurable by LC_FLOW_CPS_CAL:
if LC_FLOW_CPS_CAL=0 then reccurency **20** ms
if LC_FLOW_CPS_CAL=1 then reccurency **40** ms
The buffer MFF_ADD_BUF has NC_NR_CP_BUF elements
IDX_CP, IDX_RD_CP and IDX_STEP_CP are pointers within the ring buffer; they have to be checked for exceeding the limits of the ring buffer.
IDX_CP is the current position within the ring buffer MFF_ADD_BUF. This position is incremented every 20 rsp. 40 ms, depending on LC_FLOW_CPS_CAL

Formula section:

Correction of MAF_KGH_FG_PRED (MAP and TIA)

```
If      STATE_OPM_ENG_CP = ENG_MODE_0
        Then MAF_KGH_FG_PRED_COR_CP = MAF_KGH_FG_PRED *                 IP_
MAF_KGH_PRED_COR_MAP_TIA(MAP,TIA)
        Else  MAF_KGH_FG_PRED_COR_CP = MAF_KGH_FG_PRED *               IP_
MAF_KGH_PRED_COR_MAP_TIA_2(MAP,TIA)
```

// The overflow handling of the buffer indices is not described here and has to be done software-internal

```
// reading
If LC_MAF_COR_ACT_CP = 0
then
        if      STATE_OPM_ENG_CP = ENG_MODE_0
        then    IDX_RD_CP       = IDX_CP - IP_MFF_DLY_CP (MAF_CYL)
        else    IDX_RD_CP       = IDX_CP - IP_MFF_DLY_CP_2 (MAF_CYL)
        endif
else
        if      STATE_OPM_ENG_CP = ENG_MODE_0
                then        IDX_RD_CP       = IDX_CP -
                IP_MFF_DLY_CP (MAF_KGH_FG_PRED_COR_CP)
        else    IDX_RD_CP       = IDX_CP -
           IP_MFF_DLY_CP_2 (MAF_KGH_FG_PRED_COR_CP)
        endif
endif
```

BUF_OUT_CP = MFF_ADD_BUF[IDX_RD_CP] * MAF * N_32 * NC_CYL_NR * 3 / 10^5

```
// writing   IDX_STEP_CP elements are filled
if      MFF_ADD_CP_KGH = 0
then    BUF_INP_CP = 0
else    BUF_INP_CP      = MFF_ADD_CP_KGH /
              (max(MAF_THR,C_MAF_THR_MIN_BUF_CP) + MAF_CPS)
endif
if      LV_FAC_LAM_SHIFT_CP =1
        then  MFF_ADD_BUF [all]     = BUF_INP_CP
              BUF_OUT_CP            = MFF_ADD_CP_KGH
              MFF_BUF_CP            = MFF_ADD_CP_KGH
```

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```
        else   if STATE_OPM_ENG_CP = ENG_MODE_0
               then IDX_STEP_CP    = IP_IDX_STEP_CP (MAF_KGH_FG_PRED_COR_CP)
               else  IDX_STEP_CP    =
                IP_IDX_STEP_CP_2 (MAF_KGH_FG_PRED_COR_CP)
               endif
               for k = IDX_CP to IDX_CP + IDX_STEP_CP do
                      MFF_ADD_BUF[k] = BUF_INP_CP
               endfor
        endif
// moving the position index
IDX_CP = IDX_CP + IDX_STEP_CP + 1

// final filtered buffer output
    MFF_BUF_CP_n     = [MFF_BUF_CP_n-1 + IP_CRLC_MFF_BUF_CP (MAF_CYL)
                            * (BUF_OUT_ CP - MFF_BUF_CP_n-1)]
 end
```

calibration hint:

If a modification of the recurrence of the ring buffer is done (modification on LC_FLOW_CPS_CAL), the delay times, which are calibrated as index, have to be updated according to the new recurrence.

9.16.3 Injection correction calculation

This correction is applied for homogeneous mode only. In stratified mode, correction is applied by torque (see next paragraph)

init of TQI_ADD_CP for robustness reasons

is engine speed check for >0 necessary? if engine speed = 0, canister purge will be deactivated!

```
if      N_32 > 0
then  MFF_ADD_LAM_CP    = (MFF_BUF_CP * 10^5) /(N_32 * NC_CYL_NR * 3)
else  MFF_ADD_LAM_CP    = 0
endif
MFF_ADD_CYL_CP = MFF_ADD_LAM_CP
TQI_ADD_CP             = 0
end
```

9.16.4 Torque Correction calculation

During stratified combustion, the impact of the premixed fuel flow coming from the CPS has to be compensated in an alternative way. It was demonstrated that the torque increase due to canister purge is dependent on the mass fuel flow from the CPS, the engine speed, and, additionally, on the mass flow of fuel that originates from the injector. The corrective torque will be calculated in the project spezific Torque coordination.

Formula section:

```
if      N_32 > 0
then  MFF_CPS            = MFF_BUF_CP * 10^5 /(N_32 * NC_CYL_NR * 3)
else  MFF_CPS = 0
endif
MFF_ADD_CYL_CP = MFF_CPS
```

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MFF_ADD_LAM_CP = 0
TQI_ADD_CP = 0
end

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9.17 EVAC lambda deviation and canister load

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_LAMB_AFS_AMP_CP	V	8000... 7FFFH	-32768 ...32767	1	-
anti bounce counter for setting LV_LAMB_AFS_CP depending on AMP					
ABC_LAMB_AFS_T_AST_CP	V	8000... 7FFFH	-32768 ...32767	1	-
anti bounce counter for setting LV_LAMB_AFS_CP depending on T_AST					
AMP_DELTA_IT_CP	O/V	8000... 7FFFH	-2717.04145 ...2716.95854	0.0829175	hPa
Ambient preasure difference between AMP and AMP at reset					
AMP_ST_PRS_MEM_CP	V	0... FFFFH	0... 5434	0.0829175	hPa
Ambient preasure after reset					
CL	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Canister load					
CL_MMV	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Moving mean value of the canister load CL					
CL_MMV_DYW_MAX	V	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum value of the dynamic window during RAMP_OPEN					
CL_MMV_DYW_MIN	V	0... FFFFH	0... 1.99996	30.5e-6	-
Minimum value of the dynamic window during RAMP_OPEN					
CL_MMV_MEM_CL_MDL	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Last stored CL_MMV value before FAC_LAM_GRD_MMV exceeds a threshold					
CL_MMV_MEM_CL_MDL_OLD	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Old stored CL_MMV value before FAC_LAM_GRD_MMV exceeds a threshold					
CRLC_CL	V	0... FFFFH	0... 0.99998	15.3e-6	-
temporary variable: correlation constant for CL_MMV calculation					
CRLC_CL_TMP_0	-	0... FFFFH	0... 0.99998	15.3e-6	-
temporary variable: target value for CRLC_CL in RAMP_OPEN					
CRLC_CL_TMP_INI	-	0... FFFFH	0... 0.99998	15.3e-6	-
temporary variable: init value for CRLC_CL_TMP in RAMP_OPEN					
CRLC_FAC_LAM_MV_MMV_CP	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Filter constant for FAC_LAM_MV_MMV_CP calculation					
FAC_CRLC_CL	V	0... FFFFH	0... 0.99998	15.3e-6	-
Reduction factor at CL filter constant determination					
FAC_LAM_0_CP	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Start value of the lambda control correction FAC_LAM_CP before the CPS is opened					
FAC_LAM_CP	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lambda control correction value used for canister load calculation					
FAC_LAM_DIF_CP	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lambda control deviation with active canister purge					
FAC_LAM_GRD	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Gradient of lambda control output					
FAC_LAM_GRD_MMV	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Moving mean value of lambda gradient					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_SHIFT_CP	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Correction value for lambda control correction during RAMP_OPEN operation					
LAMB_LPF_0_CP	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Low pass flter Lambda for canister purge at start of RO					
LAMB_LPF_CP	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Low pass flter Lambda for canister purge					
LAMB_LPF_DIF_IT_CP	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Low pass flter Lambda for canister purge at start of RO					
LAMB_MMV_0_CP	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Filtered value of Lambda for canister purge at start of RO					
LAMB_MMV_0_GRD_CP	V/S	0... FFFFH	0... 1.99996	30.5e-6	-
Sampling point for straight line for correction of FAC_LAM_0_CP					
LAMB_MMV_0_GRD_NEW_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
Actually lambda value for correction of FAC_LAM_0_CP					
LAMB_MMV_0_TMP_CP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Temp. sampling point for calculation of LAMB_MMV_COR_CP					
LAMB_MMV_COR_CP	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Estimated lambda value for correction of FAC_LAM_0_CP					
LAMB_MMV_CP	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Filtered value of Lambda for canister purge					
LV_CL_GRD_CHK_MAX	V	0... 1H	0 ...1	1	-
CL value conformity check exceeds					
LV_CL_MMV_CAL_ACT	O/V	0... 1H	0 ...1	1	-
Conditions for calculation of CL_MMV are fulfilled					
LV_CP_AFL	O/V	0... 1H	0 ...1	1	-
copy of (bench-selective) LV_AFL (0: rich; 1: lean)					
LV_CP_NEW_RAMP_OPEN	O/V	0... 1H	0 ...1	1	-
Request for new Ramp Open, exit of normal purge					
LV_CP_NEW_RAMP_OPEN_FAST	O/V	0... 1H	0 ...1	1	-
Request for new Ramp Open Fast or Ramp Open, exit of normal purge					
LV_CP_OPP_WIN_1	O/V	0... 1H	0 ...1	1	-
Operating point exceed small window					
LV_CP_OPP_WIN_2	O/V	0... 1H	0 ...1	1	-
Operating point exceed large window					
LV_CP_PER_END_REQ_S_CP	V	0... 1H	0 ...1	1	-
Request to change to no purge					
LV_CRLC_CL_TRA	-	0... 1H	0 ...1	1	-
flag: transition of fast to slow filter in MAX_PURGE ongoing					
LV_FAC_LAM_DIF_CP_TMP	-	0... 1H	0 ...1	1	-
temporary variable: FAC_LAM_DIF_CP limits reached in RAMP_OPEN					
LV_FAC_LAM_SHIFT_CP	O/V	0... 1H	0 ...1	1	-
Logical value for lambda control correction during RAMP_OPEN operation					
LV_FAC_LAM_SHIFT_CP_AVL	O/V	0... 1H	0 ...1	1	-
=1: At least one lambda control shift during RAMP_OPEN done					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAMB_AFS_AMP_CP	O/V	0... 1H	0 ...1	1	-
Homogeneous lambda 1 combustion request by threshold f(delta_AMP)					
LV_LAMB_AFS_CP	O/V	0... 1H	0 ...1	1	-
Homogeneous lambda 1 combustion request					
LV_LAMB_AFS_T_AST_CP	O/V	0... 1H	0 ...1	1	-
Homogeneous lambda 1 combustion request by threshold f(T_AST)					
MFF_ADD_CP_KGH	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Additive adaptive fuel flow from the ACF for the injection fuel mass correction					
MFF_ADD_CP_OLD	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
stored value of MFF_ADD_CP_OLD on disabled RAMP_OPEN					
MFF_CP	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Fuel flow from the ACF					
MFF_LAM_CP	V	8000... 7FFFH	-4... 3.99987	122.1e-6	kg/h
Fuel flow lambda control part from the ACF					
MFF_SP_0_CP	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint at initialisation of FAC_LAM_0_CP					
N_32_0_CP	V	0... FFH	0... 8160	32	rpm
Engine speed at initialisation of FAC_LAM_0_CP					
RATE_FLOW_DLY	V	0... FFFFH	0... 0.99998	15.3e-6	-
Relative flow delay (FLOW_DLY_CP /MAF_DLY_MMV_CP)					
STATE_CLL_DEAC_CP_MEM	-	0H 1H 2H 3H undef:1H	CP_NO_DEAC RAMP_OPEN_DEAC MAX_PURGE_DEAC RAMP_FAST_DEAC	-	-
locally memorised version of STATE_CLL_DEAC_CP					
STATE_CP_MEM	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H AH BH	CP_NOT_ACT NO_PURGE RAMP_TO_NO_PURGE WAIT_RAMP_OPEN MIN_PURGE - - - RAMP_OPEN RAMP_OPEN_FAST MAX_PURGE RAMP_CLOSE	-	-
locally memorised version of STATE_CP					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_CP_PER_RUN_CP	V	1... FFFFH	0.02... 1310.7	0.02	s
Time of actual purge period					
T_LAMB_AFS_AMP_VLD_CP	V	0... FFFFH	0... 1310.7	0.02	s
Timer that limits homogeneous request by CL_MMV evaluation for AMP					
T_LAMB_AFS_T_AST	V	0... FFFFH	0... 1310.7	0.02	s
Time for homogenous engine mode request					
T_LAMB_AFS_T_AST_VLD_CP	V	0... FFFFH	0... 1310.7	0.02	s
Timer that limits homogeneous request by CL_MMV evaluation for T_AST					
T_LAMB_MMV_COR_UPD_CP	V	1... FFFFH	0.02... 1310.7	0.02	s
Timer since last adaption of correction straight line for FAC_LAM_0_CP					
T_RAMP_OPEN_STAB	V	0... FFFFH	0... 6553.5	0.1	s
Time counter for cl stabilisation during RAMP_OPEN					

Input data:

AMP {p. 982}	CL_MDL {p. 3728}	CPPWM_CPS {p. 3749}	ERR_SYM_EL_CPS {p. 4708}
FAC_LAM_MV_MMV_CP [NC_CBK_EX_NR] {p. 2462}	FLOW_CPS {p. 3635}	FLOW_DLY_CP {p. 3635}	FLOW_DLY_MMV_CP {p. 3635}
IP_T_DLY_CL_MMV_DYW {p. 3642}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP_FIL_S [NC_CBK_EX_NR] {p. 2462}	LAMB_SP_HOM [NC_CBK_EX_NR] {p. 8340}
LV_AFL [NC_CBK_EX_NR] {p. 2439}	LV_C_FAC_LAM_0_CP_WIDE {p. 3679}	LV_CL_MDL_ACT {p. 3728}	LV_CL_MDL_ENA {p. 3728}
LV_CP_ACT {p. 3679}	LV_CP_CLL {p. 3636}	LV_CP_DYW {p. 1540}	LV_CPS_AD_HOM_REQ {p. 3756}
LV_END_DIAG_AMP {p. 4822}	LV_ERR_AMP {p. 4822}	LV_FAC_LAM_SHIFT_CP_END [NC_CBK_EX_NR] {p. 2463}	LV_FLOW_TAR_COR_CP {p. 3679}
LV_HOM_ACT {p. 8136}	LV_HOM_AFL_ACT {p. 8136}	LV_STATE_MEM_CP_CLL {p. 3636}	LV_STATE_OPM_CHG_HOM_CP {p. 3679}
LV_STATE_OPM_CHG_S_CP {p. 3679}	MAF_CYL {p. 8277}	MAF_DLY_MMV_CP {p. 3636}	MFF_SP_MV {p. 2151}
N_32 {p. 1525}	PRS_CPS {p. 1540}	STATE_CLL_DEAC_CP {p. 3637}	STATE_CP {p. 3637}
STATE_OPM_ENG_CP {p. 3680}	T_AST_CP {p. 3680}	VS {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_LAMB_AFS_AMP_CP	-	0... 8000H	0... 32768	1	-
anti bounce counter decrementation for setting LV_LAMB_AFS_CP					
C_ABC_DEC_LAMB_AFS_T_AST_CP	-	0... 8000H	0... 32768	1	-
anti bounce counter decrementation for setting LV_LAMB_AFS_CP					
C_ABC_INC_LAMB_AFS_AMP_CP	-	0... 8000H	0... 32768	1	-
anti bounce counter incrementation for setting LV_LAMB_AFS_CP					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_LAMB_AFS_T_AST_CP	-	0... 8000H	0... 32768	1	-
anti bounce counter incrementation for setting LV_LAMB_AFS_CP					
C_CL_DYW_MAX_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum limit for canister load cl difference					
C_CL_FAC_LAM_DIF_MAX	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Upper limit on FAC_LAM_DIF_CP value variation					
C_CL_FAC_LAM_DIF_MIN	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lower limit on FAC_LAM_DIF_CP value variation					
C_CL_MAX_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum limit for canister load CL					
C_CL_MMV_DYW	-	0... FFFFH	0... 1.99996	30.5e-6	-
Dynamic window on CL_MMV value during RAMP_OPEN					
C_CL_ST_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
Initialization value for canister load CL					
C_CL_ST_FAC_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
Weight the CL_MMV deviation for initialization of CL/CL_MMV at entering RO					
C_CL_ST_MAX_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum initialization value for canister load CL					
C_CL_ST_MIN_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
Minimum Initialization value for canister load CL					
C_CPPWM_MIN_CL	-	0... FFH	0... 99.60937	0.390625	%
minimum valve pwm signal to enable CL calcualation					
C_CRLC_FAC_LAM_GRD	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for lambda gradient					
C_CRLC_LAMB_MMV_0_GRD_CP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for straight line for FAC_LAM_0_CP correction					
C_FAC_LAM_0_MAX	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Maximum limit for FAC_LAM_0_CP					
C_FAC_LAM_0_MAX_WIDE	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Maximum limit for FAC_LAM_0_CP to sharpen FSD					
C_FAC_LAM_0_MIN	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Minimum limit for FAC_LAM_0_CP					
C_FAC_LAM_0_MIN_WIDE	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Minimum limit for FAC_LAM_0_CP to sharpen FSD					
C_FAC_LAM_DIF_CP_AS	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Application system value to apply a lambda deviation					
C_FAC_LAM_DIF_MAX_CP	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Maximum lambda deviation for injection time correction during RAMP_OPEN					
C_FAC_LAM_THD_CL_MEM	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Threshold for FAC_LAM_GRD to save the last CL_MMV value					
C_FAC_OPP_CP_1	-	0... FFFFH	0 ...1	15.3e-6	-
Factor to reduce the MFF and N thresholds for the smaller OPP window					
C_FLOW_MIN_CPS	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Limit on FLOW_CPS value for CL_MMV calculation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FLOW_MIN_CPS_RO	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Limit on FLOW_CPS value for CL_MMV calculation (during RO and ROF)					
C_LAMB_AFS_AMP_MAX_CP	-	0... 8000H	0... 32768	1	-
Maximum value for the anti bounce counter for setting LV_LAMB_AFS_CP					
C_LAMB_AFS_T_AST_MAX_CP	-	0... 8000H	0... 32768	1	-
Maximum value for the anti bounce counter for setting LV_LAMB_AFS_CP					
C_LAMB_LPF_AD_MAX_CP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Maximum value of LAMB_LPF_AD for learning the straight line for LAMB_MMV_0_CP					
C_LAMB_LPF_AD_MIN_CP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Minimum value of LAMB_LPF_AD for learning the straight line for LAMB_MMV_0_CP					
C_LAMB_LPF_CLC_GRD_MIN_CP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Treshold for low pass flter Lambda for canister purge to activate adaption of the correction for FAC_LAM_0_CP					
C_MFF_SP_MIN_OPP_WIN_CP	-	0... FFFFH	0... 1389	0.0211948	mg/stk
MFF threshold below the usage of CL model for operation window is not used					
C_N_32_MIN_OPP_WIN_CP	-	0... FFH	0... 8160	32	rpm
N threshold below the usage of CL model for operation window is not used					
C_PRS_MAX_2_CPS	-	8000... 7FFFH	-2717.04145 ...2716.95854	0.0829175	hPa
Pressure difference limit (environment-intake manifold) for reactivation of the canister purge					
C_PRS_MAX_2_CPS_1	-	8000... 7FFFH	-2717.04145 ...2716.95854	0.0829175	hPa
Pressure diff. limit (environment-intake manifold) for reactivation of the canister purge for ENG_MODE not 0					
C_RAF_CLC_CP	-	0... FFFFH	0... 255.99609	3.9063e-3	-
stoiciometric fuel constant: ca. 14,7					
C_T_DLY_MAX_RAMP_OPEN	-	1... FFFFH	0.1... 6553.5	0.1	s
Time out value during RAMP_OPEN operation					
C_T_LAMB_AFS_AMP_VLD_CP	-	0... FFFFH	0... 1310.7	0.02	s
Maximum time for homogeneous request by CL_MMV evaluation for AMP					
C_T_LAMB_AFS_T_AST	-	0... FFFFH	0... 1310.7	0.02	s
Minimum time for homogenous engine mode request at low CL					
C_T_LAMB_AFS_T_AST_VLD_CP	-	0... FFFFH	0... 1310.7	0.02	s
Maximum time for homogeneous request by CL_MMV evaluation for T_AST					
C_VS_MIN_LAMB_AFS	-	0... FFH	0... 255	1	km/h
Minimum speed for homogenous engine mode request					
ID_CL_MMV_HOM_T_AST_DOWN_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_T_AST_CP_IP_CL	3	0... FFFFH	0... 6553.5	0.1	s
Limit on canister load to stay in homogenous mode depending on T_AST					
ID_CL_MMV_HOM_T_AST_UP_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_T_AST_CP_ID_CL	3	0... FFFFH	0... 6553.5	0.1	s
Limit on canister load to stay in homogenous mode depending on rising ambient preasure difference					
IP_CL_CRLC	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correlation constant for CL-filter for MAX_PURGE /RAMP_CLOSE					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_CL_CRLC_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correlation constant for CL-filter for MAX_PURGE at STATE_OPM_ENG_CP != MODE0					
IP_CL_CRLC_INI	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_CL_MMV_1_EVAC	3	0... FFFFH	0... 1.99996	30.5e-6	-
Initialization value for correlation factor value in MAX_PURGE					
IP_CL_CRLC_INI_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_CL_MMV_1_EVAC	3	0... FFFFH	0... 1.99996	30.5e-6	-
Initialization value for correlation factor value in MAX_PURGE at STATE_OPM_ENG_CP != MODE0					
IP_CL_CRLC_OPEN_FAST	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correlation constant for CL-filter for RAMP_OPEN_FAST					
IP_CL_CRLC_OPEN_FAST_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correlation constant for CL-filter for RAMP_OPEN_FAST at STATE_OPM_ENG_CP != MODE0					
IP_CL_CRLC_RAMP_OPEN	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correlation constant for CL-filter for RAMP_OPEN					
IP_CL_CRLC_RAMP_OPEN_2	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correlation constant for CL-filter for RAMP_OPEN at STATE_OPM_ENG_CP != MODE0					
IP_CL_MMV_HOM_PRS_DOWN_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_AMP_DELTA_CP_IP_CL	4	8000... 7FFFH	-2717.04145 ...2716.95854	0.0829175	hPa
Limit on canister load to go to stratified mode depending on falling ambient preasure difference					
IP_CL_MMV_HOM_PRS_UP_CP	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_AMP_DELTA_CP_IP_CL	4	8000... 7FFFH	-2717.04145 ...2716.95854	0.0829175	hPa
Limit on canister load to stay in homogenous mode depending on rising ambient preasure difference					
IP_CRLC_FAC_LAM_MV_MMV_CP_CLL	-	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
correlation constant for FAC_LAM_MV_MMV_CP calculation in case of Purge in closed loop					
IP_CRLC_FAC_LAM_MV_MMV_CP_OPL	-	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_MAF_CYL_1_EVAC	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
correlation constant for FAC_LAM_MV_MMV_CP calculation in case of Purge in open loop					
IP_CRLC_LAMB_LPF_CP	-	0... FFH	0... 0.99609	3.9063e-3	-
LDP_LAMB_LPF_CP_IP_CRLC_CP	6	0... 7FFFH	0... 31.99902	976.599e-6	-
Correlation constant for LAMB_MMV_CP calculation					
IP_CRLC_MMV_CP	-	0... FFH	0... 0.99609	3.9063e-3	-
LDP_LAMB_MMV_CP_IP_CRLC_CP	6	0... 7FFFH	0... 31.99902	976.599e-6	-
Correlation constant for LAMB_MMV_CP calculation					
IP_FAC_CPPWM	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_CPPWM_IP_FAC_CPPWM	6	0... FFH	0... 99.60937	0.390625	%
Reduction Factor at very low flow rates, dependent on CPPWM					

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IP_FAC_CRLC_CL	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_RATE_IP_FAC_CRLC_CL	6	0... FFFFH	0... 0.99998	15.3e-6	-
Reduction Factor at very low flow rates					
IP_FAC_LAM_GRD_MMV	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_FAC_IP_FAC_LAM_GRD_MMV	6	0... FFFFH	-50... 49.99847	1.5259e-3	%
Reduction Factor dependent on mean value of gradient of lamda control output					
IP_MFF_SP_OPP_MAX	V	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_4_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_3_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Upper MFF_SP threshold for operating point window					
IP_MFF_SP_OPP_MAX_1	V	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_4_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_3_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Upper MFF_SP threshold for operating point window for 2nd operation mode					
IP_MFF_SP_OPP_MIN	V	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_4_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_3_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower MFF_SP threshold for operating point window					
IP_MFF_SP_OPP_MIN_1	V	0... FFFFH	0... 1389	0.0211948	mg/stk
LDPM_N_32_4_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_3_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower MFF_SP threshold for operating point window for 2nd operation mode					
IP_N_32_OPP_MAX	V	0... FFH	0... 8160	32	rpm
LDPM_N_32_4_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_3_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Upper N_32 threshold for operating point window					
IP_N_32_OPP_MAX_1	V	0... FFH	0... 8160	32	rpm
LDPM_N_32_4_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_3_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Upper N_32 threshold for operating point window for 2nd operation mode					
IP_N_32_OPP_MIN	V	0... FFH	0... 8160	32	rpm
LDPM_N_32_4_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_3_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower N_32 threshold for operating point window					
IP_N_32_OPP_MIN_1	V	0... FFH	0... 8160	32	rpm
LDPM_N_32_4_EVAC	12	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_3_EVAC	12	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower N_32 threshold for operating point window for 2nd operation mode					
IP_NR_STEP_CL	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_CL_MMV_1_EVAC	3	0... FFFFH	0... 1.99996	30.5e-6	-
Number of step to change of correlation factor value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_T_CP_PER_END_COR_CP	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_CL_MMV_1_EVAC	3	0... FFFFH	0... 1.99996	30.5e-6	-
Canister load correction of maximum time to run a purge period in stratified mode					
IP_T_CP_PER_END_CP	V	1... FFFFH	0.02... 1310.7	0.02	s
LDP_LAMB_DIF_IP_T_END_CP	4	0... 7FFFH	0... 31.99902	976.599e-6	-
LDP_T_LAMB_COR_UPD_IP_T_END_CP	4	0... FFFFH	0... 1310.7	0.02	s
Maximum time to run a purge period in stratified mode					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_LAMB_SEL_S_CP	-	0H 1H 2H	BANK_0 BANK_1 MEAN_VALUE	-	-
Lambda controller selection for stratified mode					
LC_CL_FIL_INI_TRA_DEAC_CLL	-	0... 1H	0 ...1	1	-
Correlation factor calculation in case of NO_PURGE or MIN_PURGE -> MAX_PURGE transition					
LC_FAC_LAM_0_COR_ACT_CP	-	0... 1H	0 ...1	1	-
Enables the FAC_LAM_0_CP correction for stratified engine operation					
LC_INIT_CL_CRLC_RAMP_OPEN_FAST	-	0... 1H	0 ...1	1	-
Correlation factor calculation in case of RAMP_OPEN_FAST -> MAX_PURGE transition					
LC_LAM_CBK_CPS	-	0... 1H	0 ...1	1	-
Lambda controller selection (0 -> bank 0 , 1 -> bank1)					
LC_LAMB_AFS_CP_CPS_SCG	-	0... 1H	0 ...1	1	-
switch to force hom1 operation if cps valve short circuit to ground error present					
LC_STATE_OPM_CHG_HOM_CP	-	0... 1H	0 ...1	1	-
Enabels setting of LV_CP_NEW_RAMP_OPEN at LV_STATE_OPM_CHG_HOM_CP =1					
LC_STATE_OPM_CHG_S_CP	-	0... 1H	0 ...1	1	-
Enabels setting of LV_CP_NEW_RAMP_OPEN at LV_STATE_OPM_CHG_S_CP =1					

DI version

Input data table order: External inputs - Inputs from other EVAC modules

General information:

This module calculates the lambda deviation caused by the opening of the CPS valve and a canister load value using the lambda deviation value. The canister load is the concentration of fuel vapors within the mixture flow coming from the ACF.
The opening period cppwm of the CPS is controlled in dependence with the canister load CL.

Application conditions

Initialisation:

```
at RST, IGKON or deactivation
   all values = 0
   CL          = C_CL_ST_CP
   CL_MMV  = C_CL_ST_CP
   At first initialisation or NVMY error:  LAMB_MMV_0_GRD_
CP= 1
```

Recurrence: *20 ms*

Activation: *LV_CP_ACT = 1*

Deactivation: *LV_CP_ACT = 0*

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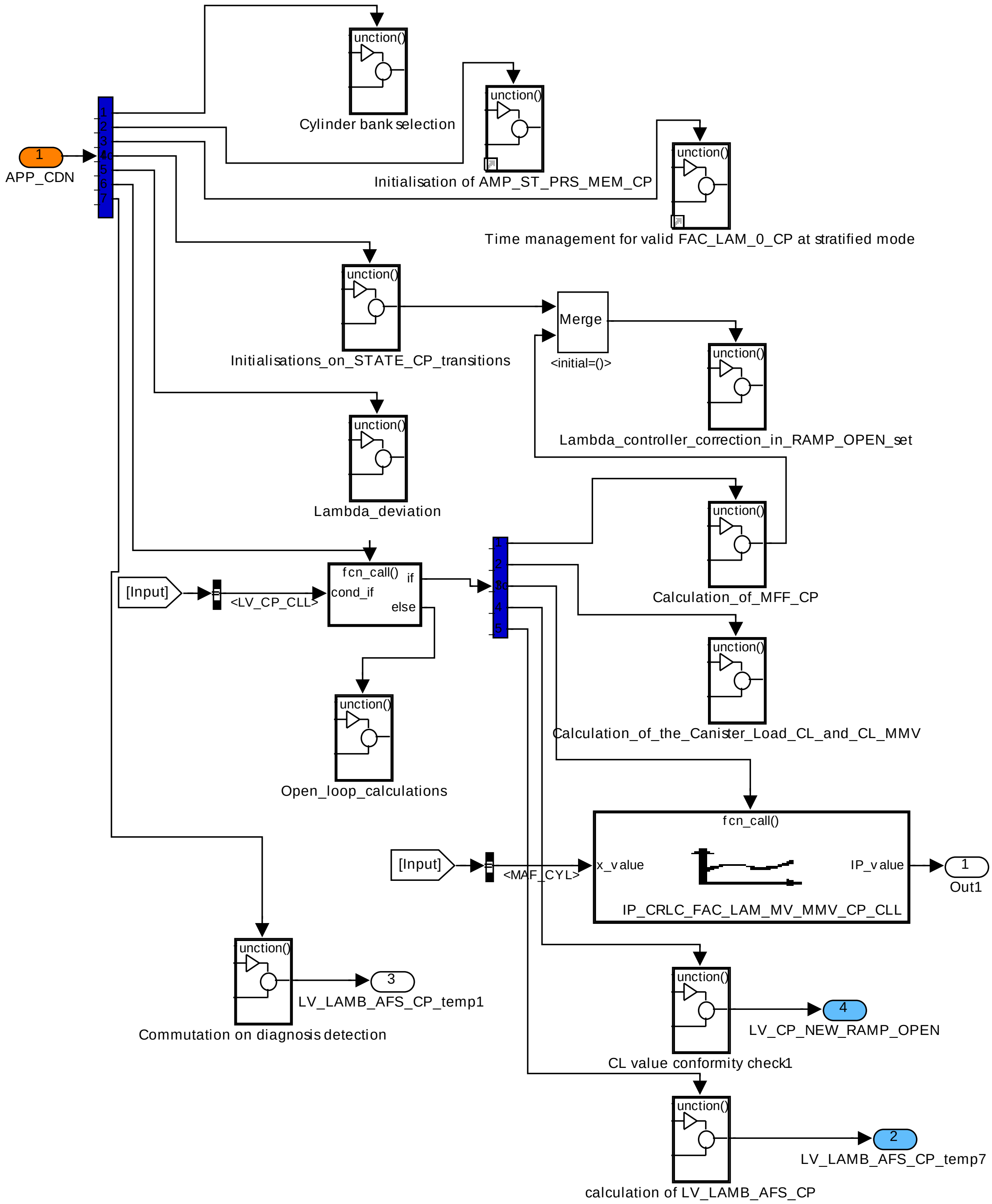
Signal flow diagram:



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Formula section:

if LC_LAM_CBK_CPS=0
then *idx_cp* = 1
else *idx_cp* = 2
endif

call "Initialisation of AMP_ST_PRS_MEM_CP"
call “Initialisations on STATE_CP transitions”
call “Lambda deviation”
T_LAMB_MMV_COR_UPD_CP$_n$ = T_LAMB_MMV_COR_UPD_CP$_{n-1}$ + 0.02
if LV_CP_CLL = 1 // “Normal purge” active
and LV_CL_MDL_ACT = 0
then **call** "Time management for valid FAC_LAM_0_CP at stratified mode"
call “calculation of MFF_CP”
call “calculation of the Canister Load CL, CL_MMV”
(moved to lambda deviation)
call “CL value conformity check”
else **call** “Open loop calculations”
endif
if LV_CP_CLL = 1
call "CL_MMV evaluation for homogeneous engine operation mode request"
endif
call "Calculation of LV_LAMB_AFS_CP"
call "Engine operating point window"
call "Request for new RAMP OPEN and RAMP OPEN FAST"
end

9.17.1 INITIALIZATION of AMP_ST_PRS_MEM_CP

Save the first valid ambient preasure AMP once after reset:

Application conditions

Initialisation: *AMP_ST_PRS_MEM_CP = 0 at RST*
Recurrence: ***100*** *ms*
Activation: – –
Deactivation: – –

if LV_ERR_AMP = 0 **and** LV_END_DIAG_AMP = 1 **and** AMP_ST_PRS_MEM_CP = 0
then AMP_ST_PRS_MEM_CP = AMP
end

9.17.2 INITIALIZATIONS on STATE_CP transitions

The following submodules are to be calculated on transitions between the different states of canister purge control.
To follow a transition in CP control module, STATE_CP and STATE_CLL_DEAC_CP have to be memorised in this module.
At the case of STATE_OPM_ENG_CP != MODE_0 the intialization value for CL and CL_MMV is corrected in the direction of the last known CL_MMV. The correction can be weighted and limited.
Problem: in cp-ctrl spec, STATE_CLL_DEAC_CP is reset after performing the inits of the entered state, so this reset of STATE_CLL_DEAC_CP will occur before the check of STATE_CLL_DEAC_CP in cl-spec. Therefore, a local copy of STATE_CLL_DEAC_CP   STATE_DEAC_CP_MEM is needed!

Formula section:

if STATE_CP   STATE_CP_MEM // transition detected
then **if** STATE_CP_MEM = RAMP_OPEN
then **call** “INITIALIZATION-VALUES on leaving RAMP_OPEN”
if STATE_CP = MAX_PURGE
and FAC_LAM_DIF_CP $>$ 0

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```
            then  call "lambda controller correction in RAMP_OPEN (set)"
            endif
      endif
      case selection on STATE_CP:
      RAMP_OPEN:              call "INITIALIZATION-VALUES on entering RAMP_OPEN"
      RAMP_OPEN_FAST:    call "INITIALIZATION-VALUES on ent. RAMP_OPEN_FAST"
      MAX_PURGE:              call "INITIALIZATION-VALUES on entering MAX_PURGE"
      end case selection
endif
// memorisation for next recurrence
STATE_CP_MEM                     = STATE_CP
STATE_CLL_DEAC_CP_MEM       = STATE_CLL_DEAC_CP
end
```

9.17.2.1 INITIALIZATION-VALUES on leaving RAMP_OPEN

```
MFF_ADD_CP_OLD    = MFF_ADD_CP_KGH
end
```

9.17.2.2 INITIALIZATION-VALUES on entering RAMP_OPEN

```
if      STATE_CLL_DEAC_CP_MEM = RAMP_OPEN_DEAC
then                                  // Initialisations for disabled RAMP_OPEN
      CL                              = CL_MMV
      MFF_ADD_CP_KGH                     = MFF_ADD_CP_OLD
else                                  // Standard-initialisations for RAMP_OPEN
      if      STATE_OPM_ENG_CP = STATE_ENG_0
      then  CL                          = C_CL_ST_CP
            CL_MMV                    = C_CL_ST_CP
      else  CL_MMV                       = MAX[MIN[C_CL_ST_CP+(CL_MMV-C_CL_ST_CP)
                              *C_CL_ST_FAC_CP, C_CL_ST_MAX_CP],C_CL_ST_MIN_CP]
            CL                        = CL_MMV
      endif
      CL_0_0                          = CL_MMV
      CL_0_1                          = 0
      CL_MMV_DYW_MAX                     = 0
      CL_MMV_DYW_MIN                     = FFFFH
      MFF_ADD_CP_KGH                     = 0
      LV_FAC_LAM_SHIFT_CP_AVL = 0
      LV_FAC_LAM_SHIFT_CP      = 0


      if LV_HOM_ACT = 1
      then
            if LV_C_FAC_LAM_0_CP_WIDE = 1
            then FAC_LAM_0_CP  =       max[C_FAC_LAM_0_MIN_WIDE, min[C_FAC_LAM_0_
    MAX_WIDE, FAC_LAM_CP]]
                  else FAC_LAM_0_CP  =
            max[C_FAC_LAM_0_MIN, min[C_FAC_LAM_0_MAX, FAC_LAM_CP]]
            endif
            LAMB_MMV_CP          = LAMB_LS_UP [idx_cp]
            LAMB_LPF_CP              = LAMB_SP_FIL_S [idx_cp]
      else
            N_32_0_CP                = N_32
```

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```
            MFF_SP_0_CP              = MFF_SP_MV
            Case selection of C_STATE_LAMB_SEL_S_CP:
            BANK_0:
                  LAMB_MMV_CP             = LAMB_LS_UP [0]
                  LAMB_LPF_CP             = LAMB_SP_FIL_S [0]
            BANK_1:
                  LAMB_MMV_CP             = LAMB_LS_UP [1]
                  LAMB_LPF_CP             = LAMB_SP_FIL_S [1]
            MEAN_VALUE:
                        LAMB_MMV_CP             = SUM{LAMB_LS_UP [i=0 to NC_CBK_EX_
      NR]} /NC_CBK_EX_NR
                        LAMB_LPF_CP             = SUM{LAMB_SP_FIL_S  [i=0 to NC_CBK_
      EX_NR]} /NC_CBK_EX_NR
            End of case
            call "Initalisation at RO and ROF for FAC_LAM_0_CP correction
                  at stratified mode"
            call "Calculation of the straight line for LAMB_MMV_COR_CP"
            call " Calculation of corrected FAC_LAM_0_CP in stratified"
endif
      // RAMP_OPEN time out initialization
      T_RAMP_OPEN_STAB        = C_T_DLY_MAX_RAMP_OPEN
LAMB_SP_FIL_S is also defined in homogeneous, only differs in resolution from LAMB_SP_FIL_HOM
endif
end
```

9.17.2.3 INITIALIZATION-VALUES on entering RAMP_OPEN_FAST

```
if    STATE_CLL_DEAC_CP_MEM = RAMP_FAST_DEAC
then  - -                         // Initialisations for disabled RAMP_OPEN_FAST
else                              // Standard-initialisations for RAMP_OPEN_FAST
      CL_0_0                      = CL_MMV
      CL_0_1                      = 0
         if LV_HOM_ACT = 1
      then
            if LV_C_FAC_LAM_0_CP_WIDE = 1
            then FAC_LAM_0_CP  =      max[C_FAC_LAM_0_MIN_WIDE, min[C_FAC_LAM_0_
    MAX_WIDE, FAC_LAM_CP]]
                  else FAC_LAM_0_CP  =
           max[C_FAC_LAM_0_MIN, min[C_FAC_LAM_0_MAX, FAC_LAM_CP]]
            endif
      else
            N_32_0_CP                = N_32
            MFF_SP_0_CP              = MFF_SP_MV
            call "Initalisation at RO and ROF for FAC_LAM_0_CP correction
                  at stratified mode"
            call "Calculation of the straight line for LAMB_MMV_COR_CP"
            call " Calculation of corrected FAC_LAM_0_CP in stratified"
      endif
endif
CL                                = CL_MMV
end
```

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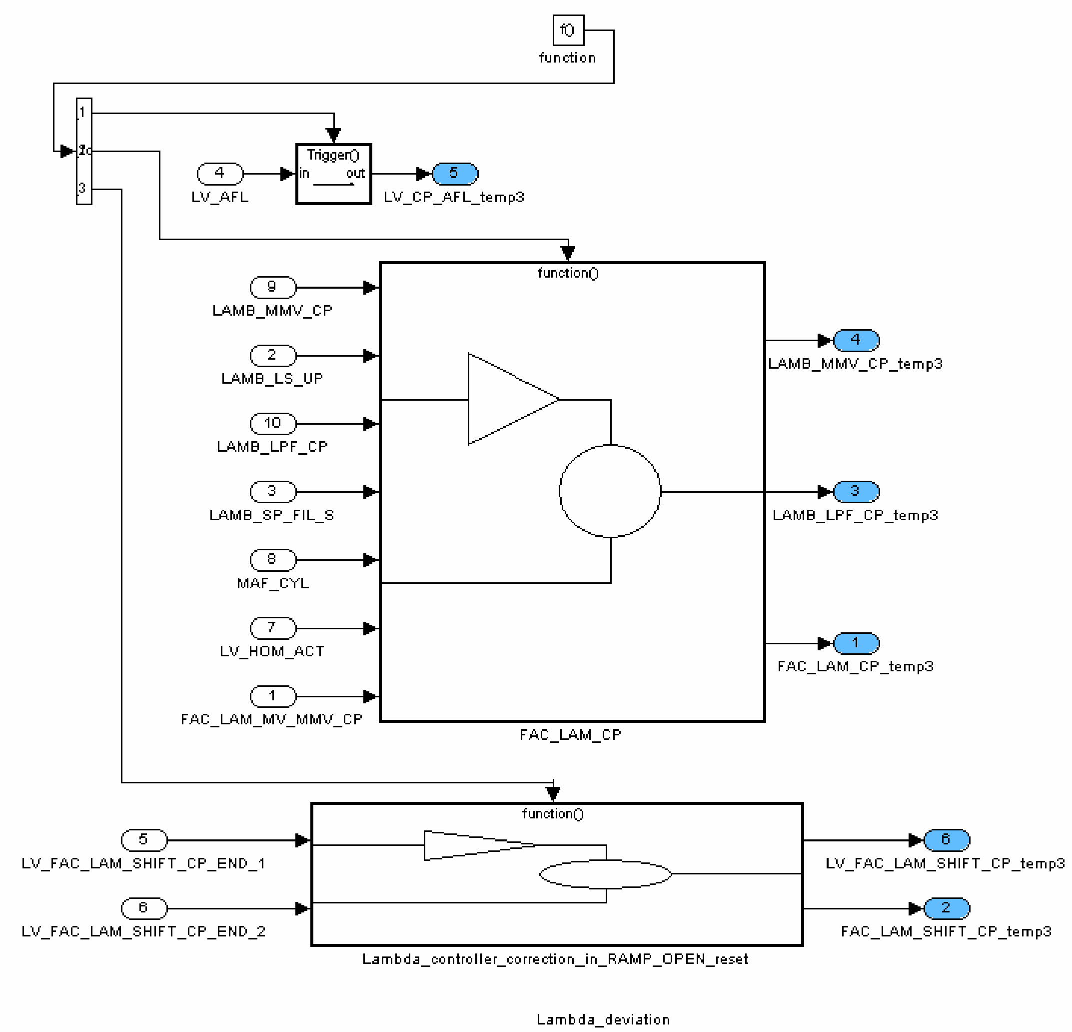
9.17.2.4 INITIALIZATION-VALUES on entering MAX_PURGE

if STATE_CLL_DEAC_CP_MEM = MAX_PURGE_DEAC
then CL = CL_MMV
endif
end

9.17.3 Lambda deviation

In case of two bank exhaust line configuration, the master-exhaust bank for evaporative emission control has to be defined using LC_LAM_CBK_CPS.
The additive constant C_FAC_LAM_DIF_CP_AS should be set to 0 in normal operation; it is only provided for validation purposes
The calculation of the filtered mean value of lambda controller output FAC_LAM_MV_MMV_CP is done inside LACO aggregate. Indeed, the filter constant for this calculation - CRLC_FAC_LAM_MV_MMV_CP - is provided by this module, depending on the STATE_CP.
In open loop, a strong filtering is desired to obtain a stable value for FAC_LAM_0_CP on entering the closed loop. Within the closed loop operation, the filtering should be less severe in order to enable a quick learning of CL and fast reactions on lambda deviations caused by canister purge.



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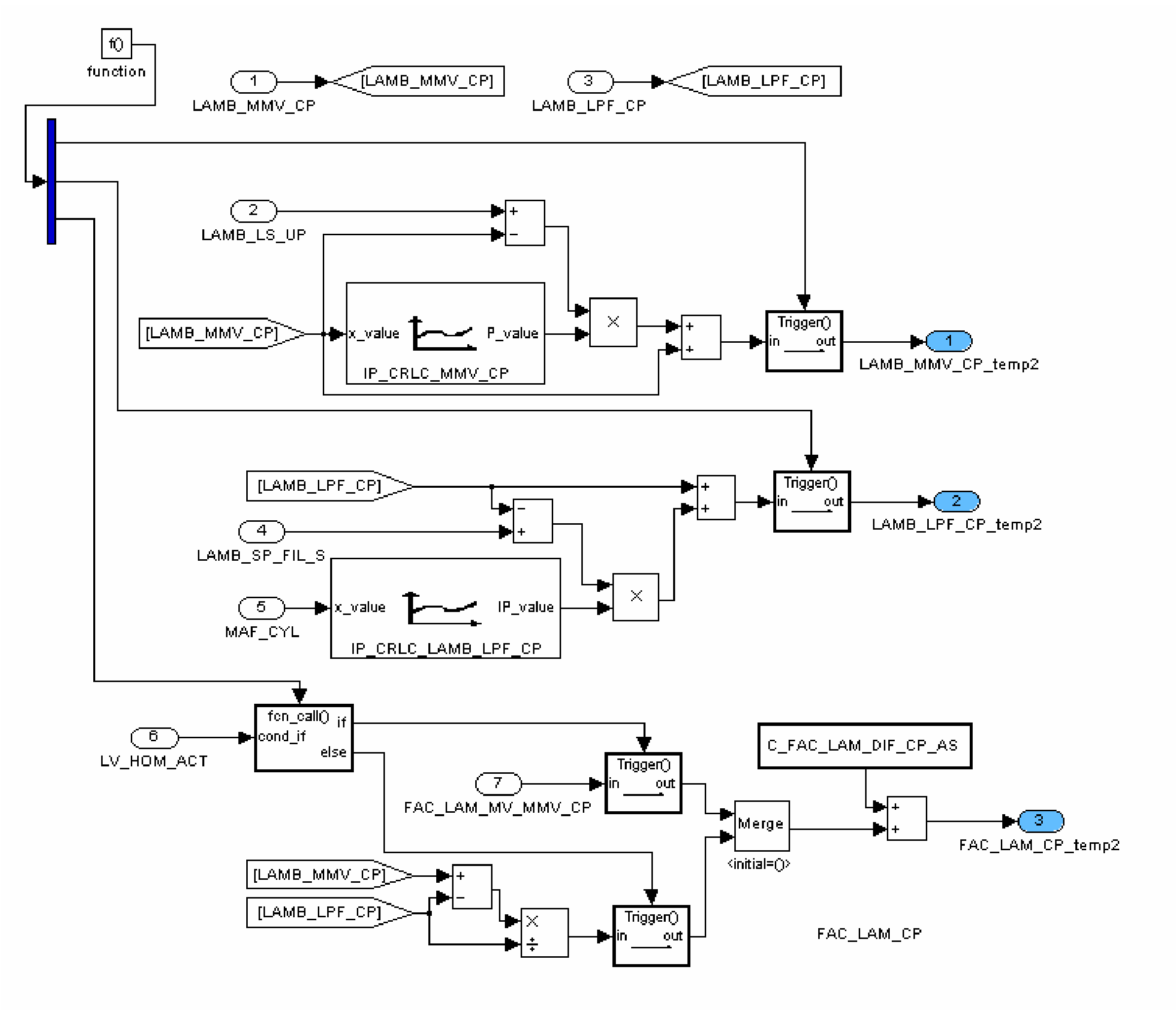
Formula section:

// determination of the filter constant for FAC_LAM_MV_MMV_CP
// this value is passed to LACO
if LV_CP_CLL = 1 // "Normal purge" active
then CRLC_FAC_LAM_MV_MMV_CP = IP_CRLC_FAC_LAM_MV_MMV_CP_CLL (MAF_CYL)
else CRLC_FAC_LAM_MV_MMV_CP = IP_CRLC_FAC_LAM_MV_MMV_CP_OPL (MAF_CYL)
endif
LV_CP_AFL = LV_AFL [*idx_cp*]

// determination of the lambda deviation
// FAC_LAM_MV_MMV_CP is received from LACO where it is calculated using the filter constant defined above
call "FAC_LAM_CP"
call "lambda controller correction in RAMP_OPEN (reset)" // check in every state_cp
end

9.17.3.1 FAC_LAM_CP



if LV_HOM_ACT = 1
then

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LAMB_MMV_CP$_n$= LAMB_MMV_CP$_{n-1}$ +
(LAMB_LS_UP [*idx_cp*] - LAMB_MMV_CP$_{n-1}$) *
IP_CRLC_MMV_CP (LAMB_MMV_CP)
LAMB_LPF_CP$_n$= LAMB_LPF_CP$_{n-1}$ +
(LAMB_SP_FIL_S [*idx_cp*] - LAMB_LPF_CP$_{n-1}$) *
IP_CRLC_LAMB_LPF_CP (MAF_CYL)
FAC_LAM_CP = FAC_LAM_MV_MMV_CP [*idx_cp*]
else
case selsction of C_STATE_LAM_SEL_S_CP:
BANK_0:
LAMB_MMV_CP$_n$= LAMB_MMV_CP$_{n-1}$ +
(LAMB_LS_UP [*0*] - LAMB_MMV_CP$_{n-1}$) *
IP_CRLC_MMV_CP (LAMB_MMV_CP)
LAMB_LPF_CP$_n$= LAMB_LPF_CP$_{n-1}$ +
(LAMB_SP_FIL_S [*0*] - LAMB_LPF_CP$_{n-1}$) *IP_CRLC_LAMB_LPF_CP(MAF_CYL)

BANK_1:
LAMB_MMV_CP$_n$= LAMB_MMV_CP$_{n-1}$ +
(LAMB_LS_UP [*1*] - LAMB_MMV_CP$_{n-1}$) *
IP_CRLC_MMV_CP (LAMB_MMV_CP)
LAMB_LPF_CP$_n$= LAMB_LPF_CP$_{n-1}$ +
(LAMB_SP_FIL_S [*1*] - LAMB_LPF_CP$_{n-1}$) *
IP_CRLC_LAMB_LPF_CP (MAF_CYL)
MEAN_VALUE:
LAMB_MMV_CP$_n$= LAMB_MMV_CP$_{n-1}$ +
(SUM[LAMB_LS_UP [*i=0 to* NC_CBK_EX_NR]]/NC_CBX_EX_NR
- LAMB_MMV_CP$_{n-1}$) *IP_CRLC_MMV_CP (LAMB_MMV_CP)
LAMB_LPF_CP$_n$= LAMB_LPF_CP$_{n-1}$ +
(SUM[LAMB_SP_FIL_S [*i=0 to NC_CBX_EX_NR*]]/NC_CBX_EX_NR - LAMB_LPF_
CP$_{n-1}$) *IP_CRLC_LAMB_LPF_CP (MAF_CYL)
end of case
FAC_LAM_CP =(LAMB_MMV_CP - LAMB_LPF_CP) /LAMB_LPF_CP
endif
FAC_LAM_CP = FAC_LAM_CP + C_FAC_LAM_DIF_CP_AS
end

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9.17.3.2 Lambda controller correction in RAMP_OPEN (reset)

The flag requesting a shift of the lambda controller LV_FAC_LAM_SHIFT_CP is reset after all acknowledge flags from lambda controller are received.

Formula section:

if LV_FAC_LAM_SHIFT_CP_END [i] = 1 // all benches have to be =1
then LV_FAC_LAM_SHIFT_CP = 0
FAC_LAM_SHIFT_CP = 0
endif
end

9.17.4 Calculation of MFF_CP

General information:

This calculation is calculated in RAMP_OPEN, RAMP_OPEN_FAST, MAX_PURGE and RAMP_CLOSE. The fuel flow from the ACF when the CPS is opened causes a deviation of the lambda control. This fuel flow can be calculated as a function of the difference of the lambda control values with closed /opened CPS, the mass air flow MAF_DLY_MMV_CP, the lambda value LAMB_LPF_CP and a constant taking into account the stoiciometric ratio C_RAF_CLC_CP.
The mass air flow MAF_DLY_MMV_CP is the filtered value of maf_cp using a Pade-filter and a moving mean value calculation to consider the delay time between the mass air flow maf_cp and the FAC_LAM_CP calculation. The fuel flow calculation MFF_LAM_CP is the result of the lambda control deviation.
The additive adaptive fuel mass flow MFF_ADD_CP_KGH caused by the canister purge is also regarded in the calculation.
When the deviation of the lambda control FAC_LAM_DIF_CP exceeds C_FAC_LAM_DIF_MAX_CP during RAMP_OPEN operation or when the RAMP_OPEN operation is finished successfully, the fuel injection time is corrected by an additive correction value and the lambda controller value FAC_LAM_CP is corrected by the value of FAC_LAM_DIF_CP. FAC_LAM_DIF_CP is then set to 0 because the lambda deviation is corrected.
During MAX_PURGE. RAMP_OPEN_FAST and RAMP_CLOSE operation there is a continuous additive adaptive correction of the fuel. The additive fuel flow MFF_ADD_CP_KGH is calculated from the calculated mass flow through the CPS FLOW_CPS and the filtered canister load CL_MMV.
During RAMP_OPEN, the MFF_ADD_CP_KGH is updated as soon as FAC_LAM_DIF_CP exceeds the threshold C_FAC_LAM_DIF_MAX_CP and a last time on the transition RAMP_OPEN to MAX_PURGE, so MFF_ADD_CP_KGH will change periodically during RAMP_OPEN. If RAMP_OPEN is disabled for a short time, the current value of MFF_ADD_CP_KGH is stored in MFF_ADD_CP_OLD on leaving RAMP_OPEN and restored on re-entering RAMP_OPEN (see initialisations).

Formula section:

```
if LV_HOM_ACT = 0
then call " Calculation of corrected FAC_LAM_0_CP in stratified"
endif
FAC_LAM_DIF_CP = FAC_LAM_0_CP - FAC_LAM_CP // calculation of FAC_LAM_DIF_CP
if     STATE_CP = RAMP_OPEN                          // lambda controller correction
then  if LV_HOM_ACT = 1
        then  if      FAC_LAM_DIF_CP > C_FAC_LAM_DIF_MAX_CP
                then MFF_ADD_CP_KGH = CL_MMV * FLOW_CPS
                        call "Lambda controller correction in RAMP_OPEN (set)"
                endif
        else   MFF_ADD_CP_KGH = CL_MMV * FLOW_CPS
                if      FAC_LAM_DIF_CP > C_FAC_LAM_DIF_MAX_CP
                then  LV_FAC_LAM_SHIFT_CP_AVL = 1
                endif
        endif
else   MFF_ADD_CP_KGH = CL_MMV * FLOW_CPS
endif
call    "MFF_LAM_CP"
MFF_CP = MFF_LAM_CP + MFF_ADD_CP_KGH
end
```

9.17.4.1 Lambda controller correction in RAMP_OPEN (set)

Called by:

- by RAMP_OPEN actions, when FAC_LAM_DIF_CP exceeds threshold
- On transition RAMP_OPEN to MAX_PURGE, if FAC_LAM_DIF_CP > 0

Formula section:

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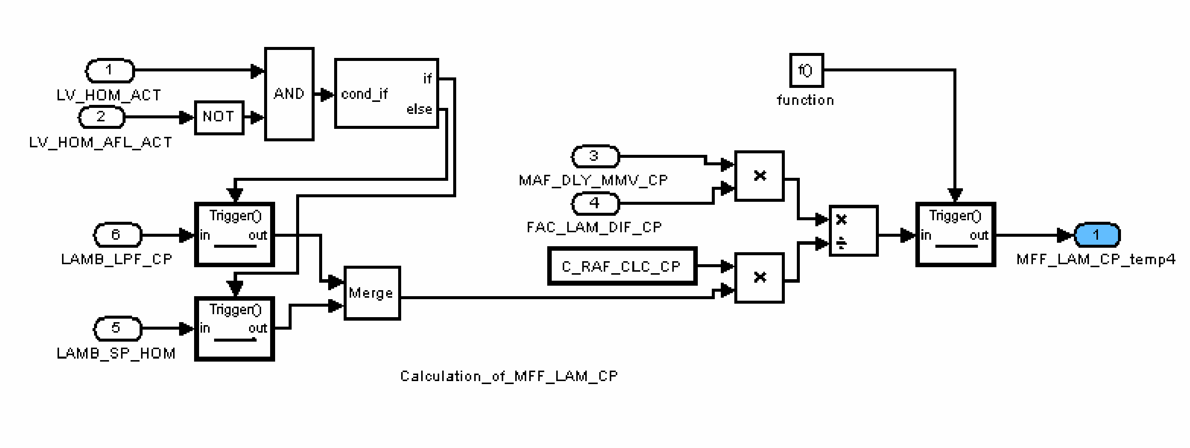
if LV_FAC_LAM_SHIFT_CP = 0
then LV_FAC_LAM_SHIFT_CP = 1
FAC_LAM_SHIFT_CP = FAC_LAM_DIF_CP
endif
FAC_LAM_DIF_CP = 0
LV_FAC_LAM_SHIFT_CP_AVL = 1
end

9.17.4.2 MFF_LAM_CP



if LV_HOM_ACT = 1 **and** LV_HOM_AFL_ACT= 0
then MFF_LAM_CP =
(MAF_DLY_MMV_CP * FAC_LAM_DIF_CP) /(C_RAF_CLC_CP * LAMB_SP_HOM)
else MFF_LAM_CP =
(MAF_DLY_MMV_CP * FAC_LAM_DIF_CP) /(C_RAF_CLC_CP * LAMB_LPF_CP)
endif
end

9.17.5 Calculation of the Canister Load CL, CL_MMV

General information:

This calculation is called in RAMP_OPEN, RAMP_OPEN_FAST, MAX_PURGE and RAMP_CLOSE.
The load CL of the ACF is calculated as the ratio of the fuel flow MFF_LAM_CP and the flow FLOW_DLY_MMV_CP added to the ratio of the fuel flow MFF_ADD_CP_KGH and the flow FLOW_CPS.
The flow FLOW_DLY_MMV_CP is the filtered value of FLOW_CPS using a Pade-filter and a moving mean value calculation to consider the delay between the FLOW_CPS and the MFF_LAM_CP calculation. Those calculations are described in a separate chapter.
The minimum and maximum values of this ratio are limited by 0 and C_CL_MAX_CP. The value of CL is filtered using a moving mean value calculation. The value of CL is only calculated when the engine is operated at limited dynamics (LV_CP_DYW=1).

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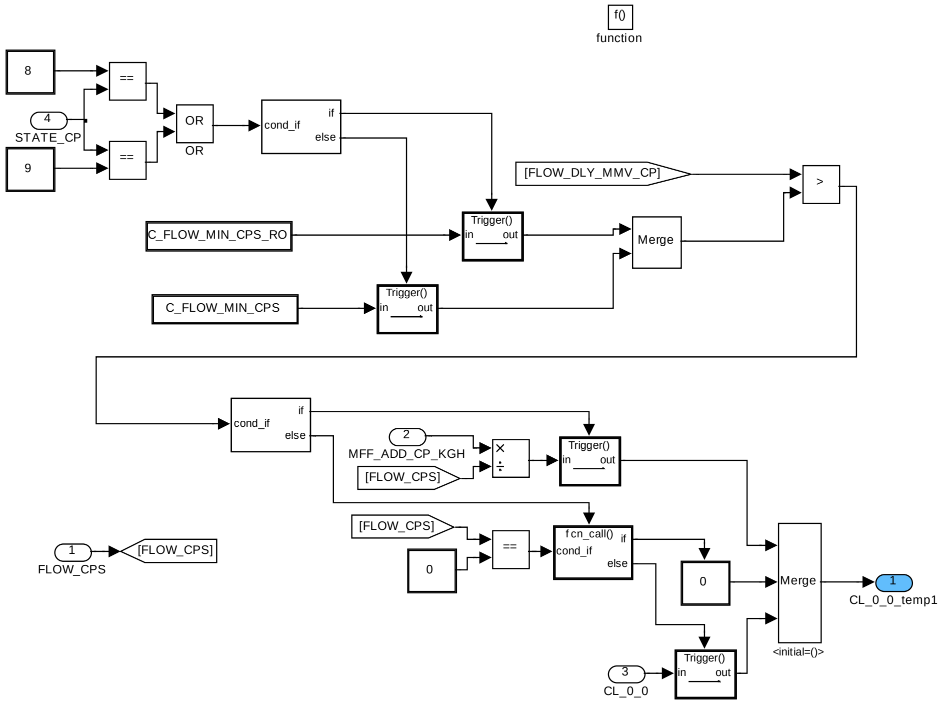
Application conditions

Initialisation: *all values = 0* *at RST or IGKON*

Recurrence: *100 ms*

Activation: *- - (called by superior block)*

Deactivation: *- - (called by superior block)*



Injection_part_of_CL_calculation

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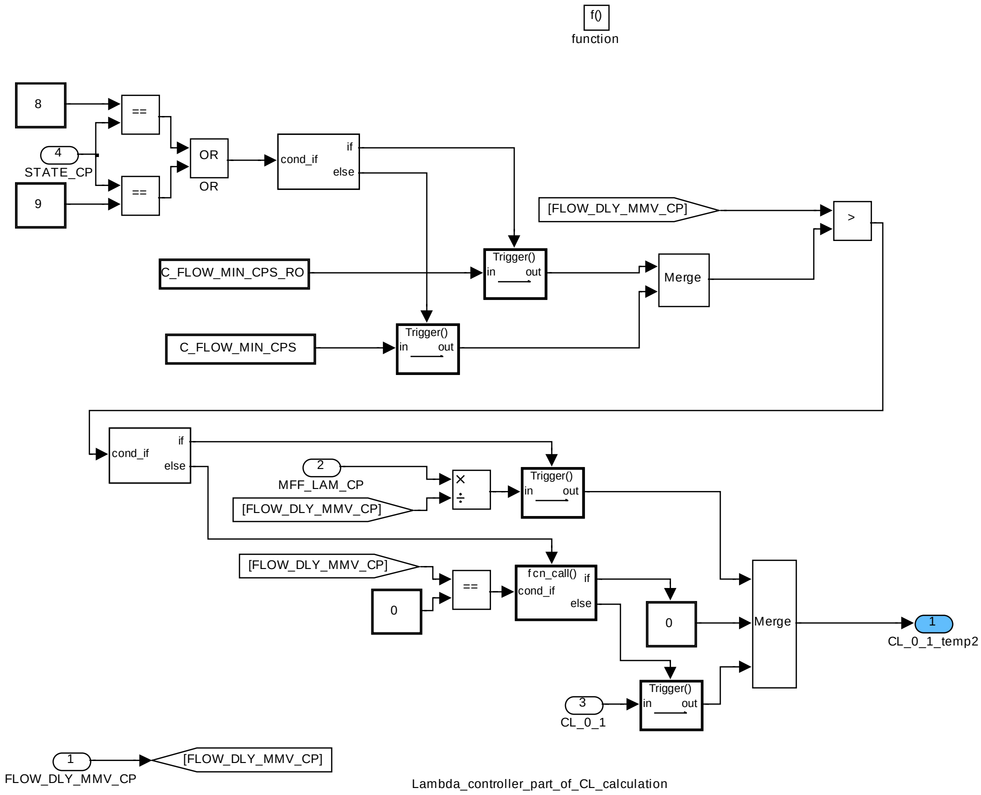

Formula section:

if STATE_CP = RAMP_OPEN **or** RAMP_OPEN_FAST
then

if [LV_CP_DYW = 1 //limited dynamics
and [(STATE_OPM_ENG_CP = ENG_MODE_0
and PRS_CPS > C_PRS_MAX_2_CPS) //minimum pressure difference
or (STATE_OPM_ENG_CP != ENG_MODE_0
and PRS_CPS > C_PRS_MAX_2_CPS_1)] //minimum pressure diff.
and FLOW_CPS > C_FLOW_MIN_CPS_RO //min. FLOW_CPS for RO/ROF
and FLOW_DLY_MMV_CP > C_FLOW_MIN_CPS_RO // min FLOW at lambda sensor for RO and ROF
and CPPMW_CPS > C_CPPWM_MIN_CL] // min valve opening
then LV_CL_MMV_CAL_ACT = 1 // calculation of CL/CL_MMV active
CL_0_0 = MFF_ADD_CP_KGH /FLOW_CPS // injection part of CL
CL_0_1 = MFF_LAM_CP /FLOW_DLY_MMV_CP // lambda ctl. part of CL
CL = **min** [CL_0_0 + CL_0_1, C_CL_MAX_CP] // limitation of CL
call “CL filter constant determination” // CRLC_CL calculation
CL_MMV$_n$ = CL_MMV$_{n-1}$ + (CL - CL_MMV$_{n-1}$) * CRLC_CL
call "calculation of time out"
else LV_CL_MMV_CAL_ACT = 0
CL_MMV$_n$ = CL_MMV$_{n-1}$
endif

else

if [LV_CP_DYW = 1 // limited dynamics

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and [(STATE_OPM_ENG_CP = ENG_MODE_0
and PRS_CPS $>$ C_PRS_MAX_2_CPS) //minimum pressure difference
or (STATE_OPM_ENG_CP != ENG_MODE_0
and PRS_CPS $>$ C_PRS_MAX_2_CPS_1)] //minimum pressure diff.
and FLOW_CPS $>$ C_FLOW_MIN_CPS // minimum FLOW_CPS
and FLOW_DLY_MMV_CP $>$ C_FLOW_MIN_CPS // minimum FLOW_CPS at lambda sensor
and CPPMW_CPS $>$ C_CPPWM_MIN_CL] // minimum valve opening
then LV_CL_MMV_CAL_ACT = 1 // calculation of CL/CL_MMV active
CL_0_0 = MFF_ADD_CP_KGH /FLOW_CPS // injection part of CL
CL_0_1 = MFF_LAM_CP /FLOW_DLY_MMV_CP // lambda control part of CL
CL = **min** [CL_0_0 + CL_0_1, C_CL_MAX_CP] // limitation of CL
call “CL filter constant determination” // CRLC_CL calculation
CL_MMV$_n$ = CL_MMV$_{n-1}$ + (CL - CL_MMV$_{n-1}$) * CRLC_CL
call "calculation of time out"
else LV_CL_MMV_CAL_ACT = 0
CL_MMV$_n$ = CL_MMV$_{n-1}$
endif
endif
end

9.17.5.1 Calculation of time out

(moved here from EVAC mng.)
If LV_FLOW_TAR_COR_CP = 0
then T_RAMP_OPEN_STAB = **max** [0, T_RAMP_OPEN_STAB-TA]
endif
if LV_FAC_LAM_SHIFT_CP_AVL
and [CL_MMV $<$ CL_MMV_DYW_MIN
or CL_MMV $>$ CL_MMV_DYW_MAX]
then CL_MMV_DYW_MIN = CL_MMV - C_CL_MMV_DYW
CL_MMV_DYW_MAX = CL_MMV + C_CL_MMV_DYW
// timer re-initialisation
T_RAMP_OPEN_STAB= IP_T_DLY_CL_MMV_DYW (MAF_CYL)
endif
end

9.17.5.2 CL filter constant determination

FAC_LAM_GRD = (FAC_LAM_CP - FAC_LAM_CP$_{n-1}$)
FAC_LAM_GRD_MMV = FAC_LAM_GRD_MMV$_{n-1}$ + (FAC_LAM_GRD - FAC_LAM_GRD_MMV$_{n-1}$) * C_CRLC_FAC_LAM_GRD
if FAC_LAM_GRD $<$ C_FAC_LAM_THD_CL_MEM
then CL_MMV_MEM_CL_MDL_OLD = CL_MMV_MEM_CL_MDL
CL_MMV_MEM_CL_MDL = CL_MMV
RATE_FLOW_DLY = FLOW_DLY_CP /MAF_DLY_MMV_CP
FAC_CRLC_CL = IP_FAC_CRLC_CL (RATE_FLOW_DLY) * IP_FAC_CPPWM (CPPWM_CPS) * IP_FAC_LAM_GRD (FAC_LAM_GRD_MMV)
case selection on STATE_CP:
RAMP_OPEN:
if STATE_OPM_ENG_CP = ENG_MODE_0
then CRLC_CL = IP_CL_CRLC_RAMP_OPEN (MAF_CYL) * FAC_CRLC_CL
else CRLC_CL = IP_CL_CRLC_RAMP_OPEN_2 (MAF_CYL) * FAC_CRLC_CL
RAMP_OPEN_FAST:

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```
        if      STATE_OPM_ENG_CP = ENG_MODE_0
        then    CRLC_CL = IP_CL_CRLC_OPEN_FAST (MAF_CYL) * FAC_CRLC_CL
        else    CRLC_CL = IP_CL_CRLC_OPEN_FAST_2 (MAF_CYL) * FAC_CRLC_CL
RAMP_CLOSE:
        CRLC_CL = IP_CL_CRLC (MAF_CYL) * FAC_CRLC_CL
MAX_PURGE:
        if      STATE_OPM_ENG_CP = ENG_MODE_0
        then    CRLC_CL_TMP_0        = IP_CL_CRLC (MAF_CYL) * FAC_CRLC_CL
                CRLC_CL_TMP_INI      = IP_CL_CRLC_INI (CL_MMV)
        else    CRLC_CL_TMP_0        = IP_CL_CRLC_2 (MAF_CYL) * FAC_CRLC_CL
                CRLC_CL_TMP_INI      = IP_CL_CRLC_INI_2 (CL_MMV)
        endif
        LV_FAC_LAM_DIF_CP_TMP =
                [(FAC_LAM_DIF_CP     > C_CL_FAC_LAM_DIF_MAX)
        or      (FAC_LAM_DIF_CP      < C_CL_FAC_LAM_DIF_MIN)]

        if              STATE_CP_MEM = RAMP_OPEN                    // switch to init map
        or              [ STATE_CP_MEM = RAMP_OPEN_FAST and
                        LC_INIT_CL_CRLC_RAMP_OPEN_FAST = 1]
        or              [(       STATE_CP_MEM = NO_PURGE
                or      STATE_CP_MEM = RAMP_TO_NO_PURGE
                or      STATE_CP_MEM = MIN_PURGE)
                and     LC_CL_FIL_INI_TRA_DEAC_CLL=1]
        or      [(LV_FAC_LAM_DIF_CP_TMP(n-1) = 0) and (LV_FAC_LAM_DIF_CP_TMP(n) = 1)]
        then    CRLC_CL(n) = CRLC_CL_TMP_INI
                LV_CRLC_CL_TRA = 1
        else    if      LV_CRLC_CL_TRA = 0
                then    CRLC_CL(n) = CRLC_CL_TMP_0
                else    CRLC_CL(n) = CRLC_CL(n-1)
                                - (CRLC_CL_TMP_INI - CRLC_CL_TMP_0)
                                 * IP_NR_STEP_CL (CL_MMV)
                        if      CRLC_CL   ≤ CRLC_CL_TMP_0
                        then    CRLC_CL   = CRLC_CL_TMP_0
                                LV_CRLC_CL_TRA      = 0
                        endif
                endif
        endif
end case selection
end
```

Note: All values of IP_CL_CRLC_INI have to be bigger than the highest value of IP_CL_CRLC; otherwise, the filter constant CRLC_CL will be unstable.

9.17.5.3 CL value conformity check :

General information:

This calculation is called in RAMP_OPEN, RAMP_OPEN_FAST and MAX_PURGE.
When the calculation of the canister load create a high difference between the previous value CL_{n-1} and the new value CL_n a transition to MIN_PURGE is requested by setting of LV_CL_GRD_CHK_MAX.

Formula section:

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LV_CL_GRD_CHK_MAX = [**abs** [CL$_{n-1}$ - CL$_{n}$] $>$ C_CL_DYW_MAX_CP]
end

9.17.6 CL_MMV evaluation for homogeneous engine operation mode request

Homogeneous lambda one combustion is requested by setting of the bit information LV_LAMB_AFS_CP (see chapter "Calculation of LV_LAMB_AFS_CP"). Two possibilities are given. If the canister load CL_MMV is greater then the threshold IP_CL_MMV_HOM_PRS_UP_CP. The threshold is taken from a map depending on the difference between the ambient preasure at reset and the actual ambient preasure. The bit information is reset if the canister load falls below the threshold IP_CL_MMV_HOM_PRS_DOWN_CP. The setting and reseting of the bit LV_LAMB_AFS_CP is debounced by the counters ABS_LAMB_AFS_CP.
The other possibility is given for lower CL_MMV values, if the vehicle drives not in the city. There is the increasement for purge flow much bigger then driving in the city. During driving in the city the fuel consumption increase is too high to request homogenious mode.

Application conditions

Initialisation:	*all values = 0*	*at RST or IGKON*
Recurrence:	***100*** *ms*	
Activation:	*– – (called by superior block)*	
Deactivation:	*– – (called by superior block)*	

Formula section:

if LV_ERR_AMP = 0 and L_END_DIAG_AMP = 1
then AMP_DELTA_IT_CP = AMP - AMP_ST_PRS_MEM_CP
else AMP_DELTA_IT_CP = 0
endif

```
if      CL_MMV <= IP_CL_MMV_HOM_PRS_DOWN_CP(AMP_DELTA_IT_CP)
then   // under   the lower threshold, count ABC down
        ABC_LAMB_AFS_AMP_CP = MAX[(-1)*C_LAMB_AFS_AMP_MAX_CP,
                ABC_LAMB_AFS_AMP_CP- C_ABC_DEC_LAMB_AFS_AMP_CP]
        if ABC_LAMB_AFS_AMP_CP <= (-1)*C_LAMB_AFS_AMP_MAX_CP
        then LV_LAMB_AFS_AMP_CP = 0
        endif
else   if      CL_MMV > IP_CL_MMV_HOM_PRS_UP_CP(AMP_DELTA_IT_CP)
        then   // above the upper threshold, count ABC up
                ABC_LAMB_AFS_AMP_CP = MIN[C_LAMB_AFS_AMP_MAX_CP ,
                ABC_LAMB_AFS_AMP_CP+ C_ABC_INC_LAMB_AFS_AMP_CP]
                if      ABC_LAMB_AFS_AMP_CP >= C_LAMB_AFS_AMP_MAX_CP
                then   LV_LAMB_AFS_AMP_CP = 1
                endif
        else // between the theresholds, count ABC to zero
                if ABC_LAMB_AFS_AMP_CP > 0
                then           ABC_LAMB_AFS_AMP_CP =
                        MAX[0,ABC_LAMB_AFS_AMP_CP- C_ABC_DEC_LAMB_AFS_AMP_CP]
                else if ABC_LAMB_AFS_AMP_CP < 0
                        then  ABC_LAMB_AFS_AMP_CP =
                               MIN[0, ABC_LAMB_AFS_AMP_CP+
```

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```
                              C_ABC_INC_LAMB_AFS_AMP_CP]
                         endif
                    endif
               endif
          endif

if        CL_MMV <= ID_CL_MMV_HOM_T_AST_DOWN_CP(T_AST_CP)
then   // under   the lower threshold, count ABC down
          ABC_LAMB_AFS_T_AST_CP = MAX[(-1)*C_LAMB_AFS_T_AST_MAX_CP,
                ABC_LAMB_AFS_T_AST_CP- C_ABC_DEC_LAMB_AFS_T_AST_CP]
          if ABC_LAMB_AFS_T_AST_CP <= (-1)*C_LAMB_AFS_T_AST_MAX_CP
          then LV_LAMB_AFS_T_AST_CP = 0
          endif
else   if       CL_MMV > ID_CL_MMV_HOM_T_AST_UP_CP(T_AST_CP)
          then   // above the upper threshold, count ABC up
                ABC_LAMB_AFS_T_AST_CP = MIN[C_LAMB_AFS_T_AST_MAX_CP ,
                ABC_LAMB_AFS_T_AST_CP+ C_ABC_INC_LAMB_AFS_T_AST_CP]
                if        ABC_LAMB_AFS_T_AST_CP >= C_LAMB_AFS_T_AST_MAX_CP
                then   LV_LAMB_AFS_T_AST_CP = 1
                endif
          else // between the theresholds, count ABC to zero
                if ABC_LAMB_AFS_T_AST_CP > 0
                then  ABC_LAMB_AFS_T_AST_CP =
                      MAX[0,ABC_LAMB_AFS_T_AST_CP- C_ABC_DEC_LAMB_AFS_T_AST_CP]
                else if ABC_LAMB_AFS_T_AST_CP < 0
                      then  ABC_LAMB_AFS_T_AST_CP =
                            MIN[0 , ABC_LAMB_AFS_T_AST_CP+
                            C_ABC_INC_LAMB_AFS_T_AST_CP]
                      endif
                endif
          endif
endif

end
```

9.17.7 Adaptation of FAC_LAM_0_CP in stratified mode

In stratified mode it is necessary to adapt the start value of the lambda deviation concerning to the lambda setpoint during canister purge. The deviation between lambda setpoint and measured lambda value is component specific. Therefor a straigt line is approximated at everv start of RO or ROF. If the lambda setpount is in a defined window, the straight line will be adapted to the actual start value. Out of this straight line, a corrected lambda value LAMB_MMV_COR_CP will be calculated.

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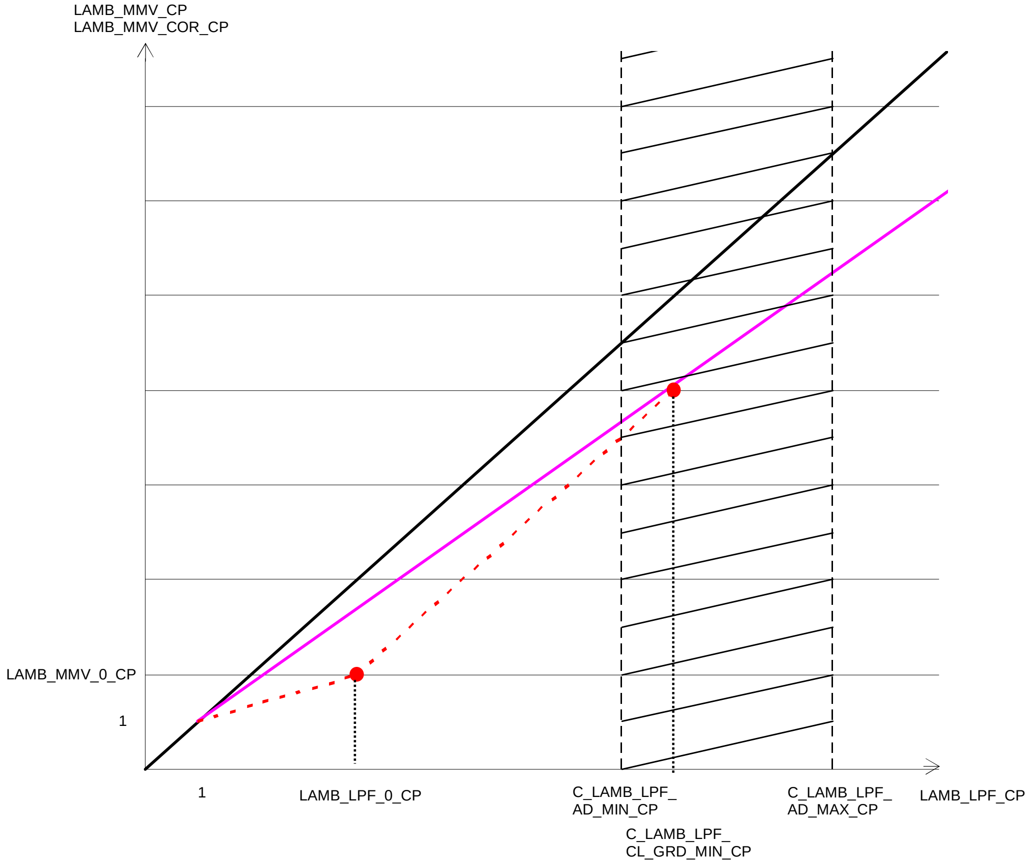

9.17.7.1 Initalisation at RO and ROF for FAC_LAM_0_CP correction at stratified mode

At initialization of RO or ROF the filtered lambda and lambda setpoint are stored.

LAMB_MMV_0_CP = LAMB_MMV_CP
LAMB_LPF_0_CP = LAMB_LPF_CP
T_CP_PER_RUN_CP = 0

9.17.7.2 Calculation of the straight line for LAMB_MMV_COR_CP

If LAMB_LPF_CP is in the window of C_LAMB_LPF_AD_MIN_CP and C_LAMB_LPF_AD_MAX_CP the straight line will be learned. The straight line is defined by the sampling point [LAMB_LPF_CP=1; LAMB_MMV_CP=1] and the gradient LAMB_MMV_0_GRD_CP.
if ((LAMB_LPF_CP $>$ C_LAMB_LPF_AD_MIN_CP)
and (LAMB_LPF_CP $<$ C_LAMB_LPF_AD_MAX_CP))
then

// new gradient calculated by the sampling points 1;1
and LAMB_MMV_0_CP; LAMB_LPF_0_CP //
LAMB_MMV_0_GRD_NEW_CP = (LAMB_MMV_CP-1)/(LAMB_LPF_CP-1)

// Filter for the gradient of the straight line //
LAMB_MMV_0_GRD_CP$_n$= LAMB_MMV_0_GRD_CP$_{n-1}$+
(LAMB_MMV_0_GRD_NEW_CP- LAMB_MMV_0_GRD_CP$_{n-1}$)
*C_CRLC_ LAMB_MMV_0_GRD_CP

T_LAMB_MMV_COR_UPD_CP = 0

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endif

9.17.7.3 Calculation of corrected FAC_LAM_0_CP in stratified

In stratified mode the value FAC_LAM_0_CP has to be corrected if the lambda setpoint changes. The calculation of the straight line depends on LAMB_LPF_CP and the start value LAMB_LPF_0_CP. If the start value is bigger then C_LAMB_LPF_AD_MIN_CP, the LAMB_MMV_COR_CP value will be on the solid line. If the start value is smaller then C_LAMB_LPF_AD_MIN_CP the value LAMB_MMV_COR_CP will be on the dotted line for LAMB_LPF_CP smaller then > C_LAMB_LPF_CLC_GRD_MIN_CP.

```
if      LC_FAC_LAM_0_COR_ACT_CP = 1
then
        if      (LAMB_LPF_0_CP   > C_LAMB_LPF_AD_MIN_CP or
                  LAMB_LPF_CP > C_LAMB_LPF_CLC_GRD_MIN_CP)
        then            // LAMB_MMV_COR_CP is on the solid straight line //
                LAMB_MMV_COR_CP = 1 + [LAMB_MMV_0_GRD_CP *(LAMB_LPF_CP - 1)]
                // linear equation with the sampling points 1;1 and the gradient
                // LAMB_MMV_0_GRD_CP
        elseif LAMB_LPF_CP > LAMB_LPF_0_CP
        then  LAMB_MMV_0_TMP_CP =
                        1+ [LAMB_MMV_0_GRD_CP * (C_LAMB_LPF_CLC_GRD_MIN_CP - 1)]
                // y-value for the sampling point C_LAMB_LPF_CLC_GRD_MIN_CP,
                // needed for the calculation of the dotted straight line
                LAMB_MMV_COR_CP = LAMB_MMV_0_CP +
                                [(LAMB_MMV_0_TMP_CP - LAMB_MMV_0_CP) *
                                (LAM_LPF_CP - LAMB_LPF_0_CP)/
                                (C_LAMB_LPF_CLC_GRD_MIN_CP - LAMB_LPF_0_CP)]
                // linear equation with the sampling points LAMB_LPF_0_CP;LAMB_MMV_0_CP
                // and C_LAMB_LPF_CLC_GRD_MIN_CP; LAMB_MMV_0_TMP_CP
                else   LAMB_MMV_COR_CP =
                        1 + [(LAMB_MMV_0_CP-1) * (LAMB_LPF_CL-1) /(LAMB_LPF_0_CP-1)]
                // linear equation with the sampling points 1;1 and
                // LAMB_LPF_0_CP;LAMB_MMV_0_CP
                endif
        endif
        FAC_LAM_0_CP = (LAMB_MMV_COR_CP - LAMB_LPF_CP) /LAMB_LPF_CP
else   FAC_LAM_0_CP = (LAMB_MMV_0_CP - LAMB_LPF_0_CP) /LAMB_LPF_0_CP
endif
```

9.17.7.4 Time management for valid FAC_LAM_0_CP at stratified mode

The run time of the current purge period is measured in T_CP_PER_RUN_CP. This time is compared with a thereshold caculated on the time since the last adaption of the straight line T_LAMB_MMV_COR_UPD_CP and the difference between the lambda setpoint at start of the purge period and the current setpoint. The threshold is weighted with a factor depending on the canister load.

```
T_CP_PER_RUN_CP = T_CP_PER_RUN_CP + 0.2
LAMB_LPF_DIF_IT_CP = ABS(LAMB_LPF_0_CP - LAMB_LPF_CP)
if      (LV_HOM_ACT = 0)
        & (T_CP_PER_RUN_CP >
        (IP_T_CP_PER_END_CP(LAMB_LPF_DIF_IT_CP,T_LAMB_MMV_COR_UPD_CP)
        *IP_T_CP_PER_END_COR_CP(CL_MMV)))
then   LV_CP_PER_END_REQ_S_CP = 1
else   LV_CP_PER_END_REQ_S_CP = 0
endif
```

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9.17.8 Open loop calculations

Formula section:

In NO_PURGE, & WRO, lv_state_mem_cp_cll=0, in min_purge, it is reset when the transition is finished, rtnp itself is left to no_purge, when the transition is finished

if LV_CL_MDL_ACT = 1
then CL_MMV_n = CL_MDL
else CL_MMV_n = CL_MMV_{n-1}
endif
if LV_STATE_MEM_CP_CLL
or LV_CL_MDL_ACT = 1
then MFF_ADD_CP_KGH = CL_MMV * FLOW_CPS
else MFF_ADD_CP_KGH = 0
endif
CL_n = CL_{n-1} // no calculation
if LV_CL_MDL_ACT = 1
then MFF_CP = MFF_ADD_CP_KGH
else MFF_CP = 0
endif
(moved to lambda deviation)
LV_CL_GRD_CHK_MAX = 0
FAC_LAM_DIF_CP = 0
LV_CP_PER_END_REQ_S_CP = 0
end

9.17.9 Calculation of LV_LAMB_AFS_CP

General information:

A commutation to homogeneous lambda one combustion with the flag LV_LAMB_AFS_CP is requested if a short circuit to the ground of the CPS is detected, if the CL-MMV evaluation or the CPS adaptation request this mode. As CL_MMV is only evalutated in closed loop operation, there is the risk of getting stuck in homogeneous operation. Therefore timers limit the request for both criteria (T_AST and AMP) to an applicable time after which a homogeneous request is cancelled.

Application conditions

Initialisation: *all values = 0* *at RST or IGKON*
Recurrence: ***20*** *ms*
Activation: *- - (called by superior block)*
Deactivation: *- - (called by superior block)*

Formula section:

// Timer calculation
T_LAMB_AFS_T_AST = **max**[T_LAMB_AFS_T_AST - TA, 0]
T_LAMB_AFS_AMP_VLD_CP = **max[**T_LAMB_AFS_AMP_VLD_CP - TA, 0**]**
T_LAMB_AFS_T_AST_VLD_CP = **max[**T_LAMB_AFS_T_AST_VLD_CP - TA, 0**]**

if (LV_LAMB_AFS_T_AST_CP = 1 **and** VS $>$ C_VS_MIN_LAMB_AFS)
then T_LAMB_AFS_T_AST = C_T_LAMB_AFS_T_AST
endif

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if LV_CP_CLL = 1
then T_LAMB_AFS_AMP_VLD_CP = C_T_LAMB_AFS_AMP_VLD_CP
T_LAMB_AFS_T_AST_VLD_CP = C_T_LAMB_AFS_T_AST_VLD_CP
end

// sum of the conditions for LV_LAMB_AFS_CP
LV_LAMB_AFS_CP =
[(ERR_SYM_EL_CPS = 2h **and** LC_LAMB_AFS_CP_CPS_SCG = 1**)** **or**
LV_CPS_AD_HOM_REQ = 1 **or**
(LV_LAMB_AFS_AMP_CP = 1 **and** T_LAMB_AFS_AMP_VLD_CP > 0**)** **or**
(T_LAMB_AFS_T_AST > 0 **and** T_LAMB_AFS_T_AST_VLD_CP > 0**)]**

end

9.17.10 Engine operating point window

General information:

If the operating point (N,MFF) has a big distance to the operating point stored at entering RO or ROF at stratified engine mode, it is useful to start a new purge phase, due to imprecision in the lambda signal. If the engine operating point will exceed a small window (window_1), the CL-model will be activated, if the CL-model is not valid, a new RO or ROF will be requested. If the operating point will exceed a large window (window_2), a new RO or ROF will be requested.

Formula section:

if$_1$ LV_CP_CLL = 1
then$_1$ **if**$_2$ **STATE_OPM_ENG_CP = ENG_MODE_2**
then$_2$ **if**$_3$ [(N_32_0_CP - N_32) >
(IP_N_32_OPP_MIN(N_32_0_CP, MFF_SP_0_CP)* C_FAC_OPP_CP_1)
or (N_32 - N_32_0_CP) >
(IP_N_32_OPP_MAX(N_32_0_CP, MFF_SP_0_CP)* C_FAC_OPP_CP_1)
or (MFF_SP_0_CP - MFF_SP_MV) >
(IP_MFF_SP_OPP_MIN(N_32_0_CP, MFF_SP_0_CP) * C_FAC_OPP_CP_1)
or (MFF_SP_MV - MFF_SP_0_CP) >
(IP_MFF_SP_OPP_MAX(N_32_0_CP, MFF_SP_0_CP)* C_FAC_OPP_CP_1)]
then$_3$ LV_CP_OPP_WIN_1 = 1
if$_4$ (N_32 < C_N_32_MIN_OPP_WIN_CP
and MFF_SP_MV < C_MFF_SP_MIN_OPP_WIN_CP)
or [(N_32_0_CP - N_32) >
IP_N_32_OPP_MIN(N_32_0_CP, MFF_SP_0_CP)
or (N_32 - N_32_0_CP) >
IP_N_32_OPP_MAX(N_32_0_CP, MFF_SP_0_CP)
or (MFF_SP_0_CP - MFF_SP_MV) >
IP_MFF_SP_OPP_MIN(N_32_0_CP, MFF_SP_0_CP)
or (MFF_SP_MV - MFF_SP_0_CP) >
IP_MFF_SP_OPP_MAX(N_32_0_CP, MFF_SP_0_CP)]
then$_4$ LV_CP_OPP_WIN_2 = 1
else$_4$ LV_CP_OPP_WIN_2 = 0
endif$_4$
else$_3$ LV_CP_OPP_WIN_1 = 0

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LV_CP_OPP_WIN_2 = 0
endif$_3$
else$_2$ **if**$_3$ **STATE_OPM_ENG_CP = ENG_MODE_1**
then$_3$**if**$_4$ [(N_32_0_CP - N_32) $>$
(IP_N_32_OPP_MIN_1(N_32_0_CP, MFF_SP_0_CP)* C_FAC_OPP_CP_1)
or (N_32 - N_32_0_CP) $>$
(IP_N_32_OPP_MAX_1(N_32_0_CP, MFF_SP_0_CP)* C_FAC_OPP_CP_1)
or (MFF_SP_0_CP - MFF_SP_MV) $>$
(IP_MFF_SP_OPP_MIN_1(N_32_0_CP, MFF_SP_0_CP) * C_FAC_OPP_CP_1)
or (MFF_SP_MV - MFF_SP_0_CP) $>$
(IP_MFF_SP_OPP_MAX_1(N_32_0_CP, MFF_SP_0_CP)* C_FAC_OPP_CP_
1)]
Then$_4$ LV_CP_OPP_WIN_1 = 1
If$_5$ (N_32 $<$ C_N_32_MIN_OPP_WIN_CP
and MFF_SP_MV $<$ C_MFF_SP_MIN_OPP_WIN_CP)
or [(N_32_0_CP - N_32) $>$
IP_N_32_OPP_MIN_1(N_32_0_CP, MFF_SP_0_CP)
or (N_32 - N_32_0_CP) $>$
IP_N_32_OPP_MAX_1(N_32_0_CP, MFF_SP_0_CP)
or (MFF_SP_0_CP - MFF_SP_MV) $>$
IP_MFF_SP_OPP_MIN_1(N_32_0_CP, MFF_SP_0_CP)
or (MFF_SP_MV - MFF_SP_0_CP) $>$
IP_MFF_SP_OPP_MAX_1(N_32_0_CP, MFF_SP_0_CP)]
Then$_5$ LV_CP_OPP_WIN_2 = 1
Else$_5$ LV_CP_OPP_WIN_2 = 0
Endif$_5$
Else$_4$ LV_CP_OPP_WIN_1 = 0
LV_CP_OPP_WIN_2 = 0
Endif$_4$
Else$_1$ LV_CP_OPP_WIN_1 = 0
LV_CP_OPP_WIN_2 = 0
Endif$_1$

end

9.17.11 Request for new RAMP OPEN and RAMP OPEN FAST :

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General information:

When the "CL value conformity check" detects a non plausible CL value or when the "Time management for valid FAC_LAM_0_CP at stratified mode" requests an new RAMP Open or the enginge operating mode switches or the engine opeating point exceeds a window a transition to MIN_PURGE is requested by setting of LV_CP_NEW_RAMP_OPEN.
In this case no re-entering in the normal purge is possible, instead, WAIT_RAMP_OPEN is activated when the conditions are fullfilled and the transition to RAMP_OPEN or RAMP_OPEN_FASTis done after WAIT_RAMP_OPEN.

Formula section:

LV_CP_NEW_RAMP_OPEN = LV_CL_GRD_CHK_MAX

LV_CP_NEW_RAMP_OPEN_FAST =

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[LV_CP_PER_END_REQ_S_CP
or (LV_STATE_OPM_CHG_HOM_CP **and** LC_STATE_OPM_CHG_HOM_CP)
or (LV_STATE_OPM_CHG_S_CP **and** LC_STATE_OPM_CHG_S_CP)
or (LV_CL_MDL_ENA = 0 and LV_CP_OPP_WIN_1 = 1)
or LV_CP_OPP_WIN_2**]**

end

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9.18 EVAC canister load model

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CL_MDL	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Value of Canister Load Model					
CL_MDL_SLOP	V	0... FFFFH	0... 1.99996	30.5e-6	-
slope of CL_MMV					
CL_MDL_SLOP_FAC	V	0... FFFFH	0... 0.99998	15.3e-6	-
final CL-model correction factor on CL_MMV					
CL_MDL_SLOP_INT	V	0... FFFFH	0... 1.99996	30.5e-6	-
Integral of CL_MDL_SLOP					
CL_MMV_MEM_MDL	V	0... FFFFH	0... 1.99996	30.5e-6	-
stored value of CL_MMV					
LV_CL_MDL_ACT	O/V	0... 1H	0 ...1	1	-
CL model active					
LV_CL_MDL_ENA	O/V	0... 1H	0 ...1	1	-
Activation of the CL model enabled					
LV_CL_MDL_END_CAT_PURGE	O/V	0... 1H	0 ...1	1	-
CL-model used in Cat-Purge phase					
LV_LAM_THD	V	0... 1H	0 ...1	1	-
Lambda gradient exceeds threshold					
STATE_CL_MDL	V	0H 1H 2H	DISABLED ENABLED ACTIVE	-	-
state of the CL model, if switched on					
STATE_CL_MDL_0	V	0H 1H	CL_MDL_OFF CL_MDL_ON	-	-
global state of the CL model (on/off)					
T_CL_MDL_ACT	V	0... FFFFH	0... 6553.5	0.1	s
Time counter for canister load usage time (counting forward)					
T_CL_MDL_CAT_PURGE_ENA	V	0... FFFFH	0... 6553.5	0.1	s
TIme counter to allow activation the model in Cat-Purge phase					
T_CL_MDL_CLL_ENA	V	0... FFFFH	0... 6553.5	0.1	s
Time counter in CP closed loop operation to enable canister load model usage (counting backward)					

Input data:

CL_MMV {p. 3698}	CL_MMV_MEM_CL_MDL {p. 3698}	CL_MMV_MEM_CL_MDL_OLD {p. 3698}	FAC_LAM_GRD_MMV {p. 3698}
LV_CP_ACT {p. 3679}	LV_CP_CAT_PURGE {p. 1540}	LV_CP_CDN_MIN_PURGE_FAST {p. 1540}	LV_CP_CLL {p. 3636}
LV_CP_OPP_WIN_1 {p. 3699}	STATE_CDN_CP {p. 1541}	STATE_CP {p. 3637}	T_DLY_CL_MDL {p. 3638}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_CL_MDL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for CL_MDL filtering					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_LAM_THD	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Upper threshold for lamgda control output gradient					
C_FAC_T_CL_MDL_ACT	-	0... FFFFH	0... 3.99993	61e-6	-
correction factor for re-init of CL mdl ena time counter after regaular leaving of active mode					
C_T_CL_MDL_ACT_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time of CL model usage					
C_T_CL_MDL_ACT_MAX_CAT_PURGE	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time of CL model usage at Catalyst purge					
C_T_CL_MDL_ACT_OFS	-	0... FFFFH	0... 6553.5	0.1	s
offset for re-init of CL mdl ena time counter after regaular leaving of active mode					
C_T_CL_MDL_CAT_PURGE_ENA	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time in open loop for activaton of the model in Cat-Purge phase					
C_T_CL_MDL_CLL_ENA_INC	-	0... FFFFH	0... 6553.5	0.1	s
Increment for enable time counter if not in CP closed loop operation					
C_T_CL_MDL_ENA	-	0... FFFFH	0... 6553.5	0.1	s
Time for enabled CL-Model after closed loop operation					
IP_CL_MDL_SLOP	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_CL_MDL_SLOP_0_IP_CL_SLOP	8	0... FFFFH	0... 1.99996	30.5e-6	-
Timeshape over CL_MDL_SLOP					
IP_CL_MDL_VALUE	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_CL_MDL_SLOP_INT_IP_CL_VALUE	6	0... FFFFH	0... 1.99996	30.5e-6	-
Increment value on FLOW_SP_CPS					
IP_T_CL_MDL_CLL_ENA	-	0... FFFFH	0... 6553.5	0.1	s
LDP_CL_IP_T_CL_MDL_CLL_ENA	6	0... FFFFH	0... 1.99996	30.5e-6	-
Minimum time in CP closed loop operation to enable CL model usage					
LC_CL_MDL_ACT	-	0... 1H	0 ...1	1	-
Switch for activation of CL model calculation					
LC_CL_MDL_ENA	-	0... 1H	0 ...1	1	-
Switch for enabling CL model usage					
LC_FAC_LAM_GRD	-	0... 1H	0 ...1	1	-
Switch for enabling lambda control output gradient check					

General information:

The evaporative emissions of the fuel tank system are stored in an activated charcoal filter ACF to prevent an escape of the gas to the environment. The loading capacity of the filter is limited, so the filter must be purged temporarily. Therefore the canister purge solenoid CPS. that is positioned between the charcoal filter and the intake manifold is opened by the engine management system. To prevent driveability and emission problems, the opening of the CPS and the purge flow MFF_CP must be controlled.
With the canister load modelling function (CL-Model), the continuity of the CL factor over time during phases of disturbed calculation is guarantied. Therefore the canister load CL will be substituted with the output of a SIMULINK model, which is a calculation result of a normalized exponential function.

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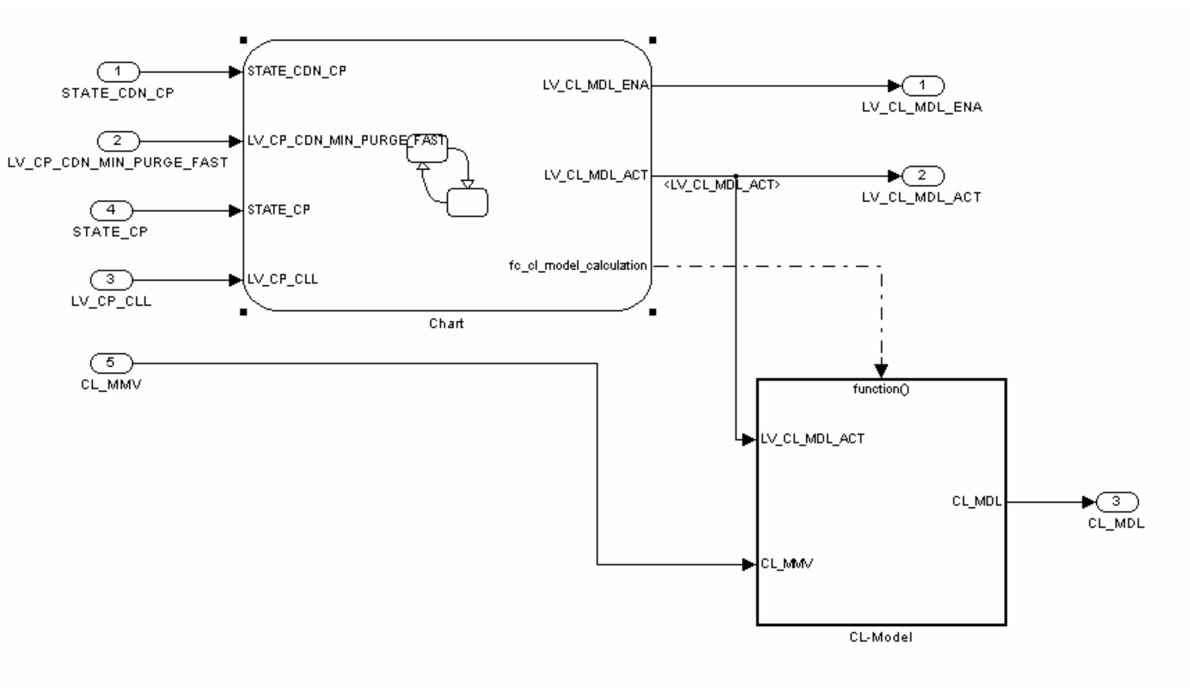


Application conditions

Initialisation: at RST, IGKON or deactivation
STATE_CL_MDL_0 = CL_MDL_OFF
STATE_CL_MDL = DISABLED
all other values = 0

Recurrence: *100 ms*

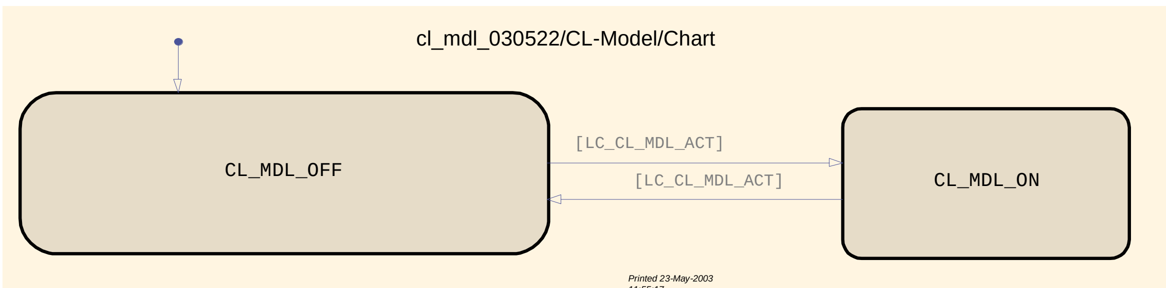
Activation: *LV_CP_ACT = 1*

Deactivation: *LV_CP_ACT = 0*

Formula section:

call "CL model state machine 0 (superstate)"
end

9.18.1 CL model state machine 0 (superstate)



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9.18.1.1 CL_MDL_OFF

Transitions:

```
if        LC_CL_MDL_ACT     = 1
then      STATE_CL_MDL_0    = CL_MDL_ON
          STATE_CL_MDL          = DISABLED
endif
end
```

Actions:

```
LV_CL_MDL_ACT     = 0
LV_CL_MDL_ENA     = 0
T_CL_MDL_CLL_ENA = IP_T_CL_MDL_CLL_ENA(CL_MMV)   // init
T_CL_MDL_ACT      = 0
end
```

9.18.1.2 CL_MDL_ON

Transitions:

```
if        LC_CL_MDL_ACT     = 0
then      STATE_CL_MDL_0    = CL_MDL_OFF
endif
end
```

Actions:

```
if
      STATE_CP = Max_Purge
then  If     LV_CP_CAT_PURGE = 0
      then   T_CL_MDL_CLL_ENA         = max [0, T_CL_MDL_CLL_ENA - TA]
             LV_CL_MDL_END_CAT_PURGE = 0
      endif
      T_CL_MDL_CAT_PURGE_ENA = C_T_CL_MDL_CAT_PURGE_ENA
else  T_CL_MDL_CLL_ENA          = min [IP_T_CL_MDL_CLL_ENA(CL_MMV),
             T_CL_MDL_CLL_ENA + TA * C_T_CL_MDL_CLL_ENA_INC]
      T_CL_MDL_CAT_PURGE_ENA = max[0,T_CL_MDL_CAT_PURGE_ENA - TA]
endif
if    (T_DLY_CL_MDL = 0
      and FAC_LAM_GRD_MMV > C_FAC_LAM_THD)
      and LC_FAC_LAM_GRD

      then   LV_LAM_THD = 1
      else   LV_LAM_THD = 0
endif

call   "CL model state machine"
call   "canister load modelling"
end
```

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9.18.2 CL model state machine

9.18.2.1 DISABLED

Transitions:

```
if          {(T_CL_MDL_CLL_ENA       = 0
                 and LV_CP_CAT_PURGE = 0
             or ( LV_CP_CAT_PURGE     = 1
                 and T_CL_MDL_CAT_PURGE_ENA > 0
                 and LV_T_CL_MDL_END_CAT_PURGE = 0)}
             and         LC_CL_MDL_ENA        = 1
then        STATE_CL_MDL          = ENABLED              // switch to enable CL model us-
age
endif
end
```

Actions:

```
LV_CL_MDL_ACT                  = 0
LV_CL_MDL_ENA                  = 0
T_CL_MDL_ACT                   = 0
end
```

9.18.2.2 ENABLED

Transitions:

```
if          T
            (T_CL_MDL_CLL_ENA          > 0
                   or LV_CP_CAT_PURGE = 1)
            and (LV_CP_CAT_PURGE = 0
                   or T_CL_MDL_CAT_PURGE_ENA = 0)
then        STATE_CL_MDL          = DISABLED

elseif          [STATE_CP                 = MAX_PURGE
            and   {(STATE_CDN_CP = CDN_MIN_PURGE
                  and LV_CP_CDN_MIN_PURGE_FAST = 0)
            or     LV_LAM_THD = 1
            or     LV_CP_OPP_WIN_1 = 1}]
        or  [LV_CP_CAT_PURGE = 1
            and {STATE_CDN_CP = CDN_RAMP_OPEN
            or STATE_CDN_CP = CDN_RAMP_FAST}]
then        STATE_CL_MDL          = ACTIVE
endif
end
```

Actions:

```
LV_CL_MDL_ACT                  = 0
LV_CL_MDL_ENA                  = 1
end
```

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9.18.2.3 ACTIVE

Transitions:

// canister purge closed loop operation abandoned
if T_CL_MDL_CLL_ENA > C_T_CL_MDL_ENA
and LV_CP_CAT_PURGE = 0
then STATE_CL_MDL = **DISABLED**

// max. time of CL model usage elapsed
elseif (T_CL_MDL_ACT   C_T_CL_MDL_ACT_MAX **and** LV_CP_CAT_PURGE = 0)
or (T_CL_MDL_ACT   C_T_CL_MDL_ACT_MAX_CAT_PURGE
and LV_CP_CAT_PURGE = 1)
then T_CL_MDL_CLL_ENA = IP_T_CL_MDL_CLL_ENA(CL_MMV) // init
if LV_CP_CAT_PURGE = 1
then LV_CL_MDL_END_CAT_PURGE = 1
endif
STATE_CL_MDL = **DISABLED**

// no more usage of CL model necessary; switch to "normal" MAX_PURGE
elseif **[**(STATE_CDN_CP ≠ CDN_MIN_PURGE **and** LV_LAM_THD = 0
and LV_CP_OPP_WIN_1 = 0)
and {LV_CP_CAT_PURGE = 0
or (STATE_CDN_CP ≠ CDN_RAMP_OPEN
and STATE_CDN_CP ≠ CDN_RAMP_FAST**)}]**
then T_CL_MDL_CLL_ENA = **min** [IP_T_CL_MDL_CLL_ENA(CL_MMV),
T_CL_MDL_ACT * C_FAC_T_CL_MDL_ACT +
C_T_CL_MDL_ACT_OFS]
if LV_CP_CAT_PURGE = 1
then LV_CL_MDL_END_CAT_PURGE = 1
endif
STATE_CL_MDL = **DISABLED**
endif
end

Actions:

LV_CL_MDL_ACT = 1
LV_CL_MDL_ENA = 1
T_CL_MDL_ACT = T_CL_MDL_ACT + TA
end

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9.18.3 Canister Load modelling

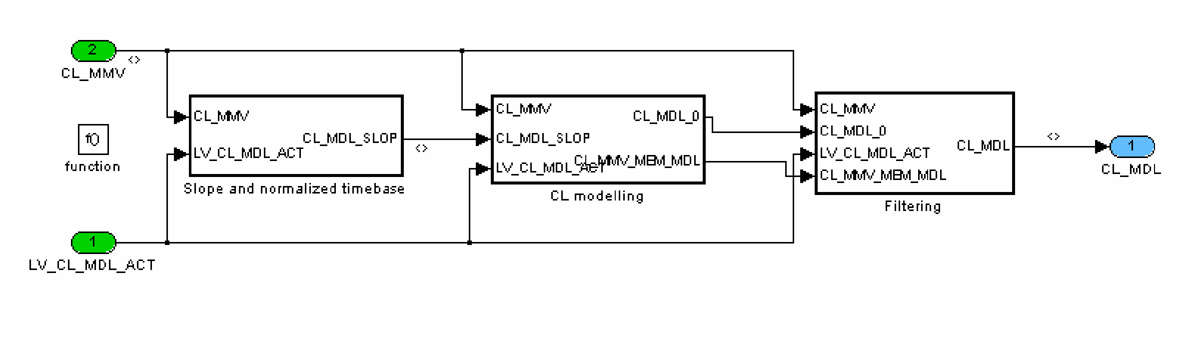

Figure 9.18.1: : structure of the canister load model

Formula section:

call “Slope and normalized timebase”
call “Modelling and output of CL_MDL”
call “Evaluation CL versus CL_MDL”
end

Calculation information:

The overview shows that the complete function is divided into three submodules, the used inputs are the recurrence time described in chapter Application conditions, the logical value LV_CL_MDL_VALUE_ ACT indicating instationary driving conditions it is the result of the Data Type Conversion block with STATE_CDN_CL_MDL as input and the value of Canister Load.
The outgoing CL_MDL value is chosen via a switch block between either the Canister Load during stationary driving conditions at the one hand and the modelled Canister Load Load during instationary driving conditions at the other hand indicated by the variable LV_CL_MDL_VALUE_ACT.

9.18.3.1 Slope and normalized timebase

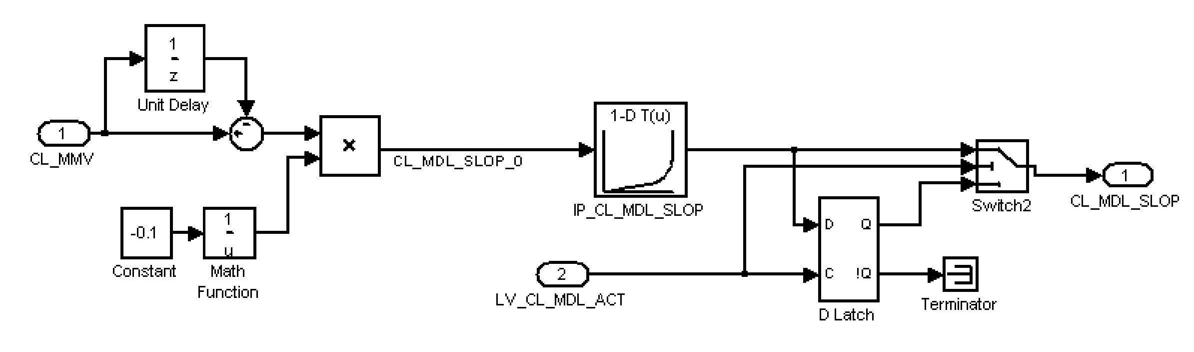

Figure 9.18.2: : slope and normalized timebase

This submodule calculates the (inverted) slope of CL_MMV by building the difference CL_MMV$_n$ minus CL_MMV$_{n-1}$. The slope is used with the Map IP_CL_MDL_SLOP to read out the normalized time

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constant CL_MDL_SLOP which indicates the time position on a exponential function using the slope as an input. The outgoing CL_MDL_SLOP value is frozen when LV_CL_MDL_ACT=1.

Formula section:

if LV_CL_MDL_ACT = 0
then CL_MDL_SLOP_0 = -(CL_MMV_MEM_CL_MDL-CL_MMV_MEM_CL_MDL_OLD)
CL_MDL_SLOP = IP_CL_MDL_SLOP (CL_MDL_SLOP_0)
else CL_MDL_SLOP_n = CL_MDL_SLOP_{n-1}
endif
end

9.18.3.2 Modelling and output of CL_MDL

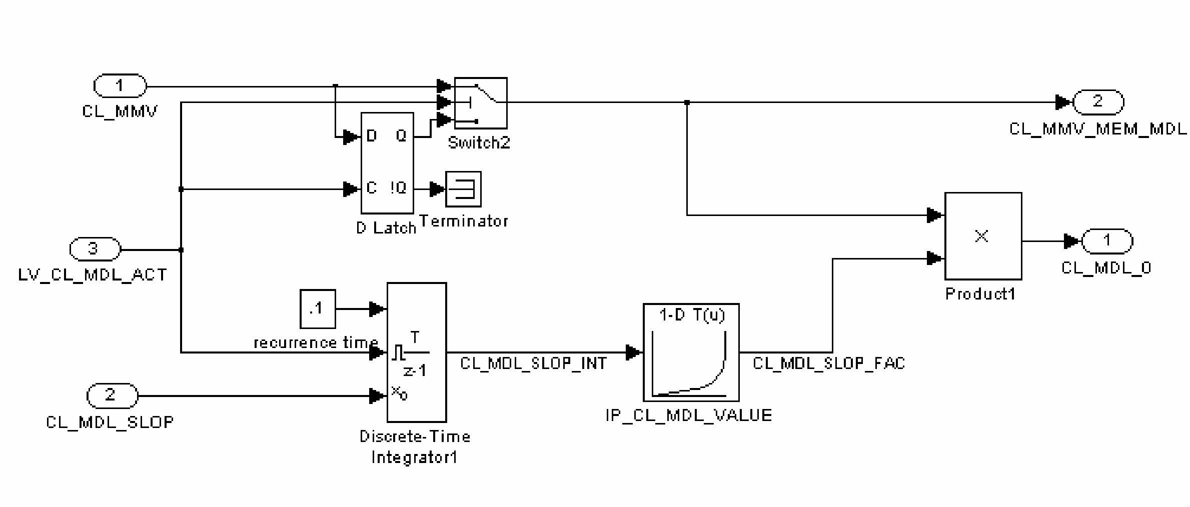

Figure 9.18.3: : modelling and output of CL_MDL

The output of IP_CL_MDL_VALUE is the normalized value of CL_MDL over $\text{CL\_MDL\_SLOP}_{integral}$. The input of IP_CL_MDL_VALUE is calculated with the Discrete-Time Integrator block. The starting point of integration is CL_MDL_SLOP.

Formula section:

if LV_CL_MDL_ACT = 0
then CL_MDL_0 = CL_MMV_MEM_CL_MDL
CL_MMV_MEM_MDL = CL_MMV_MEM_CL_MDL
CL_MDL_SLOP_INT = 0
else CL_MDL_SLOP_INT = $\text{CL\_MDL\_SLOP\_INT}_{n-1}$ + CL_MDL_SLOP
CL_MDL_SLOP_FAC = IP_CL_MDL_VALUE (CL_MDL_SLOP_INT)
CL_MDL_0 = CL_MMV_MEM_MDL * CL_MDL_SLOP_FAC
end

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9.18.3.3 Evaluation CL_MMV versus CL_MDL

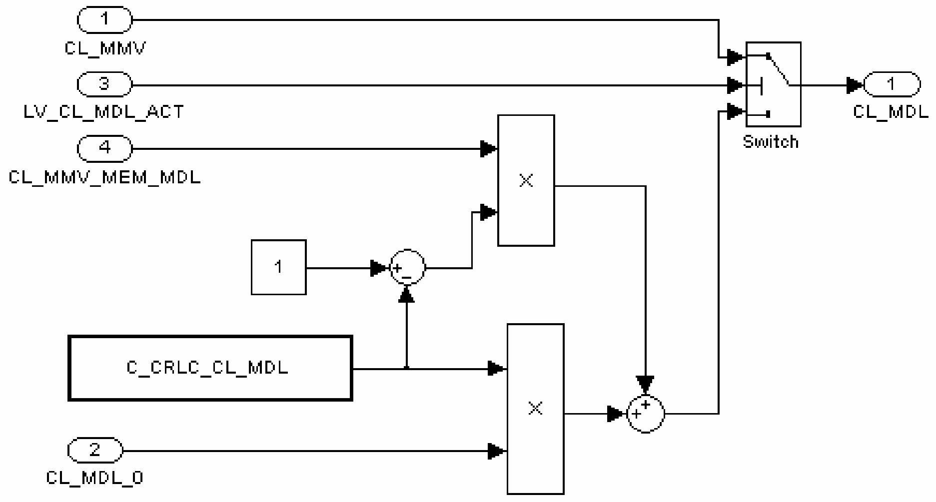

Figure 9.18.4: : evaluation CL versus CL_MDL

This submodul evaluates the CL_MMV_MEM_MDL value (frozen if LV_CL_MDL_ACT) versus the CL_ MDL_0 value by using the filter constant C_CRLC_CL_MDL.

Formula section:

if LV_CL_MDL_ACT = 0
then CL_MDL = CL_MMV
else CL_MDL = CL_MDL_0 * C_CRLC_CL_MDL
+ CL_MMV_MEM_MDL * (1-C_CRLC_CL_MDL)

end

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9.19 Time control between evaporative system and lambda adaptation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CP_ENA	O/V	0... 1H	0 ...1	1	-
Canister purge enabled					
LV_INH_SDL_CP	-	0... 1H	0 ...1	1	-
flag: normal scheduling disabled					
LV_LAM_AD_ENA	O/V	0... 1H	0 ...1	1	-
Lambda adaptation enabled					
LV_STATE_SDL_LOCK_CP	V	0... 1H	0 ...1	1	-
Fixed lambda adaptation is left due to finished lambda adaptation					
LV_T_SDL_NEW_RAMP_OPEN_CP	V	0... 1H	0 ...1	1	-
Flag: new Ramp Open after a lambda adaptation					
LV_TCO_ST_STAT_SDL_CP	V	0... 1H	0 ...1	1	-
Time slice for canister purge after start at hot conditions					
STATE_T_SDL_CP	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H	PASSIVE CP_FIXED LAM_FIXED WAIT_LAM LAM_DYN CP_DYN WAIT_CP OFF_CP EXT_REQ	-	-
State of Time Control Function					
T_AD	V	0... FFFFH	0... 6553.5	0.1	s
Time of actual lambda adaption time range					
T_CP	V	0... FFFFH	0... 6553.5	0.1	s
Time of actual CP time range					
T_MAX_AD	V	0... FFFFH	0... 6553.5	0.1	s
Maximum adaption time; used to disable CP when canister is detected empty					
T_TCO_ST_STAT_SDL_CP	V	0... FFFFH	0... 6553.5	0.1	s
Time counter for canister purge after start at hot conditions					

Input data:

CL_MMV {p. 3698}	LV_CP_ACT {p. 3679}	LV_CP_CLOSE_ACT {p. 3749}	LV_CYL_BAL_LAM_AD_ ENA_DC {p. 4066}
LV_ES {p. 1720}	LV_IGK {p. 906}	LV_INH_CP_SDL {p. 3679}	LV_INH_LAM_AD_SDL {p. 3679}
LV_LAM_AD_CDN {p. 2642}	LV_LAM_AD_END {p. 2642}	LV_STATE_T_SDL_CP_ LAM_AD_EXT {p. 3680}	LV_T_SDL_EXT_REQ {p. 3680}
NC_CBK_EX_NR {p. 1829}	STATE_CP {p. 3637}	T_AST_CP {p. 3680}	T_PRI_TOT_LAM_AD {p. 2643}
TCO {p. 1100}			

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MMV_T_BOL	-	0... FFFFH	0... 1.99996	30.5e-6	-
Time management canister load bottom limit					
C_CL_MMV_T_TOL	-	0... FFFFH	0... 1.99996	30.5e-6	-
Time management canister load top limit					
C_CL_MMV_T_WAIT_LAM	-	0... FFFFH	0... 1.99996	30.5e-6	-
CL threshold to switch off CP during WAIT_LAM					
C_T_2_CP	-	1... FFFFH	0.1... 6553.5	0.1	s
Duration of purge phase					
C_T_DI_CP	-	1... FFFFH	0.1... 6553.5	0.1	s
Disable time of purge phase when canister detected empty					
C_T_MFF_AD_MAX	-	1... FFFFH	0.1... 6553.5	0.1	s
Time out for adaption phase					
C_T_SDL_EXT_REQ	-	1... FFFFH	0.1... 6553.5	0.1	s
Time for external request					
C_T_TCO_ST_STAT_SDL_CP	-	0... FFFFH	0... 6553.5	0.1	s
Time for canister purge after start at hot conditions					
C_TCO_COLD_DYN_T_CTL_CP	-	0... FEH	-48... 142.5	0.75	°C
Maximum cold temperatur to activate the dymanic time slices at start of DC					
C_TCO_DYN_T_CTL	-	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for activation of dynamic time control between EVAP and lambda adaptation					
ID_T_SET_T_AST_LAM_CP	-	1H 2H 3H	CP_FIXED LAM_FIXED DYN_SDL	-	-
LDP_T_AST_SET_ID_T_AST	NC_ NR_ CP_ LAM_ AD	0... FFFFH	0... 6553.5	0.1	s
Indexiation for fixed time slices					
IP_T_MAX_CP	-	1... FFFFH	0.1... 6553.5	0.1	s
LDP_CL_MMV_IP_T_MAX_CP	6	0... FFFFH	0... 1.99996	30.5e-6	-
Duration of maximum purge versus Canister Load					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_MAN_SDL_CP	-	0H 1H 2H 3H	AUTOMATIC SDL_NONE SDL_CP LAM_AD	-	-
selection of manual scheduling mode					
LC_CL_CP_DYN_END_ENA	-	0... 1H	0 ...1	1	-
switch to enable end of CP phase when reaching low canister load					
LC_CP_ENA_WAIT_LAM	-	0... 1H	0 ...1	1	-
switch to permantently enable canister purge in WAIT_LAM					
LC_CYL_BAL_LAM_AD_INH_CP	-	0... 1H	0 ...1	1	-
Inhibition of: transition to LAM_DYN controlled by CYBL					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_MFF_AD_ENA_PAS	-	0... 1H	0 ...1	1	-
switch to enable lambda adaptation while cp passive					
LC_SDL_LAM_AD_CDN_OFF	-	0... 1H	0 ...1	1	-
switch to ignore LV_LAM_AD_CDN (adapt. ongoing) for end of lambda adapt. time slice calculation					
NC_NR_CP_LAM_AD	-	0... FFH	0... 255	1	-
Number of fixed CP /Lambda adaptation slices after engine start					

Input data table order: External inputs - Inputs from other EVAC modules

General information:

Lambda adapation and canister purge both use a lambda deviation for their purposes. Indeed, as the canister purge itself causes a certain lambda deviation, both functions can not work simultaneous. As a consequence, a time management has to be installed partitioning the engine opertating time and enabling either canister purge or lambda adaptation while disabling the other function.

Signal flow diagram:

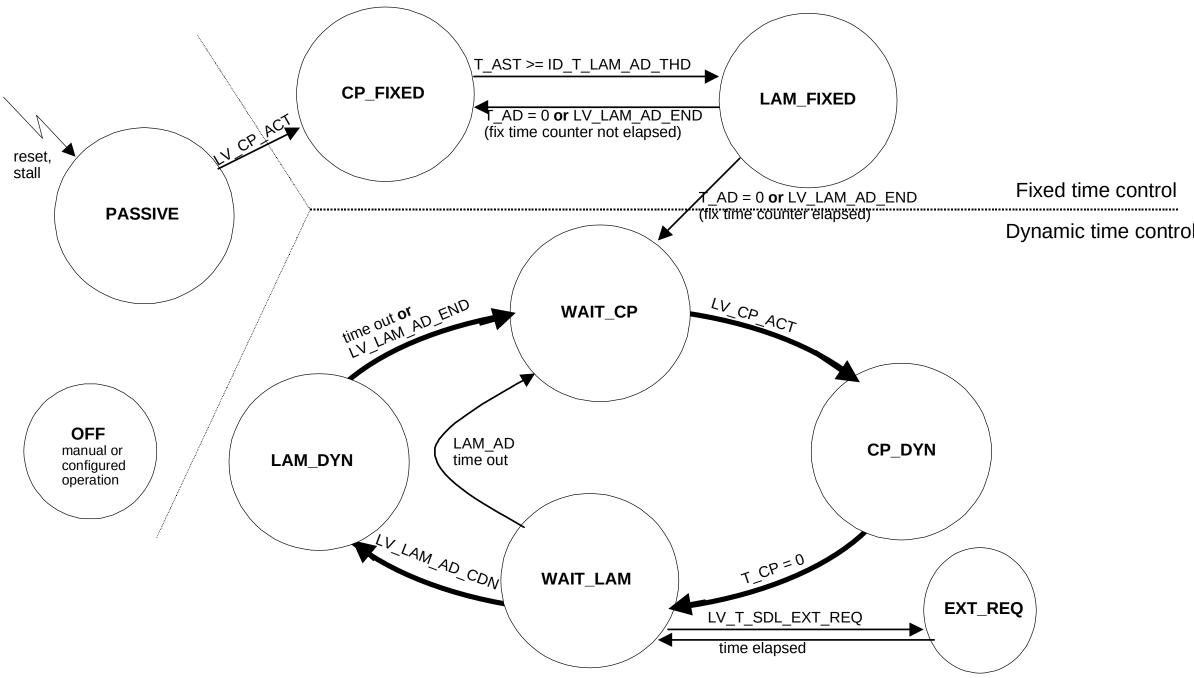

Figure 9.19.1: : time scheduler state diagram

The state diagram above only contains the recent transitions; all possible transitions are listed in the formula section below.
The following table indicates whether canister purge or lambda adapatation is enabled/disabled depending on the state STATE_T_SDL_CP of the time scheduler.

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STATE_T_SDL_CP	CP	LAM_AD
PASSIVE	✗	C
CP_FIXED	✓	✗
CP_DYN	✓	✗
WAIT_LAM	✓	✗
LAM_FIXED	✗	✓
LAM_DYN	✗	✓
WAIT_CP	✗	✓
EXT_REQ	✗	✗

configurable C
Lambda adaptation is enabled in the corresponding states after the CPS is closed
CP is enabled in WAIT_LAM for a calibratable time

Figure 9.19.2: : enabling of canister purge or lambda adaptation depending on state

In general the time control is splited into two main parts:

- At leaving start the time split between lambda adaption and canister purge is defined by a certain number of fixed time frames. The number of these fixed time frames is given by NC_NR_CP_LAM_AD -1 (last defines the start of dynamic time slices).
- After performing the fixed time frames, the time periods of canister purge and lambda adaption are depending on canister load and the necessity of lambda adaption, indicated by their corresponding functions, so dynamic time frames will be applied.
- For Hybrid and Stop/Start configurations the timers for the dynamic time slices are stopped during engine off time.

After the start phase has ended and canister purge is possible (LV_CP_ACT = 1), the manager starts with a time slice depending on TCO. For very cold condition, the dynamic time slices will be performed immediatily. For a mid range temperature, the fixed slices defined in ID_T_SET_T_AST_LAM_CP are done and for a high temperature at first one fixed canister purge time frame will perfaomed. After a defined time the manager will switch to the dynamic time slices.
During CP_FIXED period the canister purge is possible if the conditions for the function are fulfilled. If they're not fulfilled, neither canister purge nor lambda adaptation will be active.
During LAM_FIXED period the canister purge is disabled and the lambda adaptation is enabled. During this period and after the canister purge valve is closed, the lambda adaptation is possible if the conditions for the function are fulfilled. If they're not fulfilled, neither canister purge nor lambda adaptation will be active.
If the lambda adaptation sends its ready bit LV_LAM_AD_END, the lambda adaptation time will immediately end and the state switches to CP_FIXED.
This sequence (canister purge /lambda adapation) is repeated until ID_T_SET_T_AST_LAM_CP defines dynamic slices; for each period, the start time is defined by the corresponding value of the indexiation table ID_T_SET_T_AST_LAM_CP.
The dynamic time frames start with WAIT_CP after the fixed time frames are elapsed, see description of the different states below.

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Description of the different time control states

PASSIVE
After each reset or engine stalling the time control starts with state PASSIVE and switches to CP_FIXED or WAIT_CP depending on TCO and when canister purge starts to be active, i.e. LV_CP_ACT = 1 is fulfilled. Lambda adaptation can be activated during this state (configurable)

CP_FIXED
Only canister purge is enabled. This state is active as long as no lambda adaptation is triggered by the corresponding time threshold. If a lambda adaptation is urgently requested, LAM_FIXED is selected.

LAM_FIXED
Only lambda adaption is enabled. This state is left, if the adaptation is finished or the next fixed or dynamic slice starts. If immediate lambda adpatation is requested via the flag LV_STATE_T_SDL_CP_LAM_AD_EXT, this state is not left until these flags have been reset. Afterwards, the fixed time slices are resumed.

CP_DYN
Canister purge is enabled. This state is left, if the timecounter T_CP elapses or an urgent lambda adaptation is requested.

LAM_DYN
Lambda adaption is enabled. To leave this state, a time counter initialised when detecting an empty canister has to have elapsed. The state is left, if the standard adaptation time counter has elapsed and no adaptation is currently ongoing or if the end of an adaptation cycle is signaled by lambda adaptation itself.

WAIT_LAM
Within WAIT_LAM, canister purge is enabled; this enabling may expire after a calibratable time. As soon as the conditions for a lambda adaptation are given, this state is left towards LAM_DYN and lambda adaptation starts. If the time counter for lambda adaptation C_T_MFF_AD_MAX is elapsed, WAIT_CP is selected and canister purge is enabled.

WAIT_CP
Within WAIT_CP, lambda adaptation is enabled. As soon as canister purge function is active (LV_CP_ACT = 1), this state is left towards CP_DYN and canister purge is enabled.

EXT_REQ
If functions other than canister purge and lambda adaptation request a certain time slice with both, lambda adaptation and canister purge deactivated, the time scheduler may switch to the state EXT_REQ for a calibratable time.

In all states with enabled lambda adaptation, the enabling starts when the canister purge valve is closed (LV_CP_CLOSE_ACT = 1).
At the “regular” entry of MAX_PURGE (i.e. not a re-entry after a short deactivation but an entry after finishing canister load learning phases RAMP_OPEN or RAMP_OPEN_FAST) the time slices for CP and lambda adaptation are re-evaluated; remaining time for canister purge is the minimum of IP_T_MAX_CP (depending on canister load) and the lambda adaption priorisation time T_PRI_TOT_LAM_AD. A small time T_PRI_TOT_LAM_AD from lambda adaptation is related to a high priority for lambda adaptation as the canister purge time will be decreased.
Three cases are handled:

High canister load
If the canister is detected full at the end of the learning phase the time control gives priority to the evaporative emission control by increasing the remaining purge time in order to decrease the canister load. The purge time IP_T_MAX_CP is used to purge the canister.

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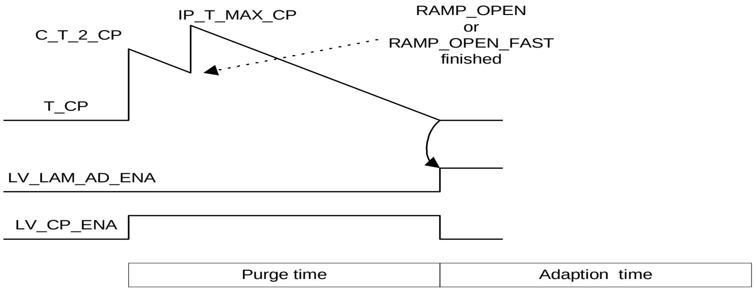

Figure 9.19.3: : canister purge time at high canister load

Medium canister load

If the canister is detected with a medium load, the purge time is calculated as the minimum value between the needs of the lambda adaption and canister purge using the lambda adaption priorisation time T_PRI_TOT_LAM_AD. A small time T_PRI_TOT_LAM_AD from lambda adaptation is related to a high priority for lambda adaptation as the canister purge time will be decreased.

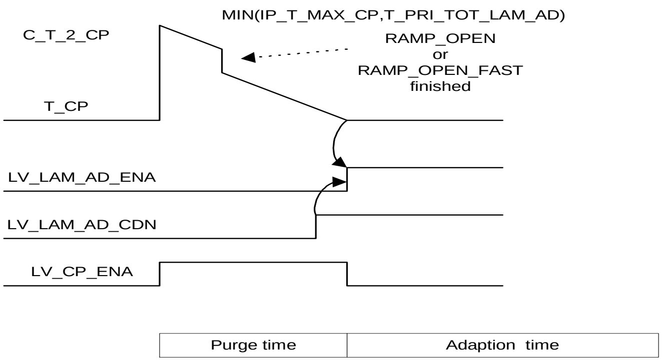

Figure 9.19.4: : canister purge time at medium canister load

Empty canister

If the canister is detected empty at the end of the learning phase, the canister purge is disabled for a time C_T_DI_CP and the lambda adaption is enabled.

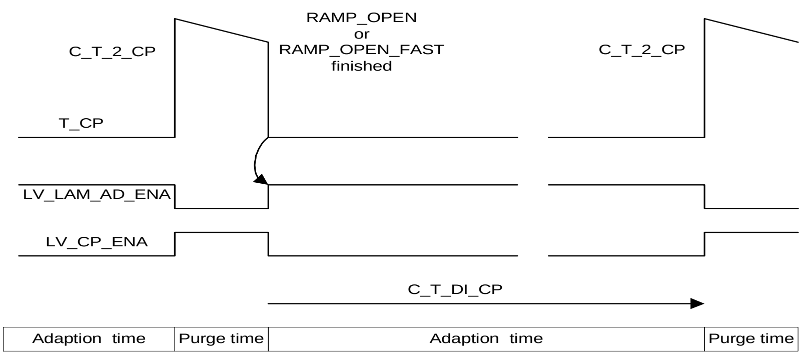

Figure 9.19.5: : canister purge time at low canister load

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Application conditions

Initialisation: at RST or IGKON:
STATE_T_SDL_CP = PASSIVE
all other values = 0

Recurrence: *100 ms*

Activation: *LV_IGK = 1*

Deactivation: - -

Formula section:

```
LV_INH_SDL_CP =
        [ LV_INH_LAM_AD_SDL = 1
or      LV_INH_CP_SDL          = 1
or      C_STATE_MAN_SDL_CP     ≠ AUTOMATIC ]

call    "Time control states"       (corresponding transition part)
call    "Time control states"       (corresponding action part)

if      LV_INH_SDL_CP              = 0
then call "Calculation of the time slices for canister purge and lambda adaption"
else    STATE_T_SDL_CP             = OFF_CP        // transition possible from all states
endif
end
```

9.19.1 Time control states

9.19.1.1 PASSIVE

Transitions:

```
if              LV_CP_ACT           = 1
then  if1       TCO <  C_TCO_COLD_DYN_T_CTL_CP
      then1          STATE_T_SDL_CP      = WAIT_CP
      else1  if2 TCO < C_TCO_DYN_T_CTL
             then2 if3 ID_T_SET_T_AST_LAM_CP (T_AST_CP) = DYN_SDL
                   then3 STATE_T_SDL_CP      = WAIT_CP
                   else3   STATE_T_SDL_CP    = CP_FIXED
                   endif3
             else2 T_TCO_ST_STAT_SDL_CP = C_ T_TCO_ST_STAT_SDL_CP
                   LV_TCO_ST_STAT_SDL_CP = 1
                   STATE_T_SDL_CP     = CP_FIXED
             endif2
      endif1
endif
end
```

Actions:

```
LV_CP_ENA           = 0         // inits
LV_LAM_AD_ENA       = [ LC_MFF_AD_ENA_PAS and LV_CP_CLOSE_ACT ]
T_CP                = 0
```

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T_AD = 0
T_MAX_AD = 0
end

9.19.1.2 CP_FIXED

Transitions:

if LV_CP_ACT = 0
then STATE_T_SDL_CP = **PASSIVE**

elseif LV_STATE_T_SDL_CP_LAM_AD_EXT = 1 // immediate lam. adapt. required
or (ID_T_SET_T_AST_LAM_CP (T_AST_CP) = LAM_FIXED
and LV_STATE_SDL_LOCK_CP = 0
and LV_TCO_ST_STAT_SDL_CP = 0)
then STATE_T_SDL_CP = **LAM_FIXED**
elseif LV_TCO_ST_STAT_SDL_CP = 1
and T_TCO_ST_STAT_SDL_CP = 0
then STATE_T_SDL_CP = **WAIT_LAM**
elseif ID_T_SET_T_AST_LAM_CP (T_AST_CP) = DYN_SDL
then STATE_T_SDL_CP = **WAIT_CP**
endif
end

Actions:

LV_CP_ENA = 1
LV_LAM_AD_ENA = 0
T_TCO_ST_STAT_SDL_CP = max(0, T_TCO_ST_STAT_SDL_CP - TA)
if ID_T_SET_T_AST_LAM_CP (T_AST_CP) = CP_FIXED
then LV_STATE_SDL_LOCK_CP = 0
endif
end

9.19.1.3 LAM_FIXED

Transitions:

if LV_STATE_T_SDL_CP_LAM_AD_EXT = 0
then **if** ID_T_SET_T_AST_LAM_CP (T_AST_CP) = DYN_SDL
then STATE_T_SDL_CP = **WAIT_CP**
elseif ID_T_SET_T_AST_LAM_CP (T_AST_CP) = CP_FIXED
then STATE_T_SDL_CP = **CP_FIXED**
elseif LV_LAM_AD_END = 1
then STATE_T_SDL_CP = **CP_FIXED**
LV_STATE_SDL_LOCK_CP = 1
endif
endif
end

Actions:

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LV_CP_ENA = 0
LV_LAM_AD_ENA = LV_CP_CLOSE_ACT
endif
end

9.19.1.4 WAIT_CP

Transitions:

if LV_CP_ACT = 1
then T_CP = C_T_2_CP
STATE_T_SDL_CP = **CP_DYN**
endif
end

Actions:

if LV_T_SDL_NEW_RAMP_OPEN_CP = 1
then LV_CP_ENA = 0
endif
LV_LAM_AD_ENA = LV_CP_CLOSE_ACT
LV_T_SDL_NEW_RAMP_OPEN_CP = 0
end

9.19.1.5 CP_DYN

Transitions:

if LV_STATE_T_SDL_CP_LAM_AD_EXT = 1 // immediate lam. adapt. required
or LV_CP_ACT = 0 // CP disabled
or T_CP = 0 // regular end of CP time
or [CL_MMV <= C_CL_MMV_T_BOL // canister empty
and STATE_CP = MAX_PURGE
and LC_CL_CP_DYN_END_ENA = 1]
then T_AD = C_T_MFF_AD_MAX
T_MAX_AD = 0
STATE_T_SDL_CP = **WAIT_LAM**
endif
end

Actions:

LV_CP_ENA = 1
LV_LAM_AD_ENA = 0
if LV_ES = 0
then T_CP = **max** [0, T_CP - TA]
endif

9.19.1.6 WAIT_LAM

Transitions:

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```
if        LV_STATE_T_SDL_CP_LAM_AD_EXT = 1 // immediate lam. adapt. required
then      STATE_T_SDL_CP      = LAM_DYN

elseif        LV_T_SDL_EXT_REQ  = 1
then      T_CP                        = C_T_SDL_EXT_REQ
          STATE_T_SDL_CP      = EXT_REQ

elseif        (LV_LAM_AD_CDN       = 1
     and  (LV_CYL_BAL_LAM_AD_ENA_DC = 1
          or LC_CYL_BAL_LAM_AD_INH_CP = 1))
then      STATE_T_SDL_CP      = LAM_DYN

elseif    [  T_AD                      = 0
     and   T_MAX_AD                    = 0 ]
```

insert switch to enable this transition; then (when disabling this transition), scheduler will stay in wait_lam (with possibility to purge) until next lambda adaptation is requested.

```
then      STATE_T_SDL_CP      = WAIT_CP
endif
end
```

Actions:

```
LV_CP_ENA                        = [CL_MMV   C_CL_MMV_T_WAIT_LAM]
LV_LAM_AD_ENA                     = 0
if LV_ES = 0
then   T_AD                          = max [0, T_AD - TA]
       T_MAX_AD                        = max [0, T_MAX_AD - TA]
endif
end
```

9.19.1.7 LAM_DYN

Transitions:

```
if          T_MAX_AD             = 0          // CP disabling time after low cl detection
  and           LV_STATE_T_SDL_CP_LAM_AD_EXT = 0
  and     [ LV_LAM_AD_END     = 1             // adapt. finished
       or     ( T_AD                    = 0           // time out
       and {  LV_LAM_AD_CDN        = 0     // and adapt. not ongoing
       or      LC_SDL_LAM_AD_CDN_OFF = 1}) ]
then        STATE_T_SDL_CP      = WAIT_CP
endif
end
```

Actions:

```
LV_CP_ENA                        = 0
LV_LAM_AD_ENA                     = LV_CP_CLOSE_ACT
if LV_ES = 0
then   T_AD                      = max [0, T_AD - TA]
       T_MAX_AD                    = max [0, T_MAX_AD - TA]
Endif
```

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```
LV_T_SDL_NEW_RAMP_OPEN_CP = 1
end
```

9.19.1.8 EXT_REQ

Transitions:

```
if      LV_STATE_T_SDL_CP_LAM_AD_EXT = 1 // immediate lam. adapt. required
or      T_CP                 = 0           // regular end of CP time
or      LV_T_SDL_EXT_REQ  = 0         // no more external request
then    STATE_T_SDL_CP      = WAIT_LAM
endif
end
```

Actions:

```
LV_CP_ENA                        = 0
LV_LAM_AD_ENA                      = 0
if LV_ES = 0
then   T_CP                     = max [0, T_CP - TA]
endif
// T_CP is used as counter to economize on a special counter T_EXT_REQ
end
```

9.19.1.9 OFF_CP

Transitions:

```
if      LV_INH_SDL_CP        = 0
then    STATE_T_SDL_CP      = PASSIVE
endif
end
```

Actions:

```
T_CP                              = 0          // inits
T_AD                              = 0
T_MAX_AD                    = 0

case selection on C_STATE_MAN_SLD_CP
        SDL_NONE:
        LV_CP_ENA              = 0
        LV_LAM_AD_ENA            = 0

        SDL_CP:
        LV_CP_ENA              = 1
        LV_LAM_AD_ENA            = 0

        LAM_AD:
        LV_CP_ENA              = 0
        LV_LAM_AD_ENA            = LV_CP_CLOSE_ACT
```

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AUTOMATIC:
if LV_INH_LAM_AD_SDL = 1 // both inhibited
and LV_INH_CP_SDL = 1
then LV_CP_ENA = 0
LV_LAM_AD_ENA = 0

elseif LV_INH_CP_SDL = 0
then LV_CP_ENA = 1
LV_LAM_AD_ENA = 0

elseif LV_INH_LAM_AD_SDL = 0
then LV_CP_ENA = 0
LV_LAM_AD_ENA = LV_CP_CLOSE_ACT
endif
end case selection
end

9.19.2 Calculation of the time slices for canister purge and lambda adaption

// also to be called with empty canister and C_STATE_MOD_SEL_CP = SEL_MAX_PURGE
if (STATE_CP $_{n-1}$ = RAMP_OPEN
or STATE_CP $_{n-1}$ = RAMP_OPEN_FAST)
and STATE_CP $_{n}$ = MAX_PURGE
and STATE_T_SDL_CP $>$ LAM_FIXED
then **call** “time slices calculation”
endif
end

9.19.2.1 time slices calculation

// high canister load
if CL_MMV C_CL_MMV_T_TOL
then T_CP = IP_T_MAX_CP (CL_MMV)

// medium canister load
elseif CL_MMV C_CL_MMV_T_BOL
then T_CP = **min** [IP_T_MAX_CP (CL_MMV),
T_PRI_TOT_LAM_AD]

// low canister load
else STATE_T_SDL_CP = **WAIT_LAM**
by this, the fixed time slices are left and the dynamic operation starts!
to be discussed or to be made configurable
T_AD = C_T_MFF_AD_MAX
T_MAX_AD = C_T_DI_CP
T_CP = 0
endif
end

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9.20 Canister purge valve control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CPPWM	V	0... FFH	0... 99.60937	0.390625	%
PWM signal for CPS opening					
CPPWM_CPS	O/V	0... FFH	0... 99.60937	0.390625	%
Corrected PWM signal for CPS opening					
FRQ_REQ_CP	O/V	0... FFH	0... 255	1	Hz
CPS Output frequency					
LV_CP_CLOSE_ACT	O/V	0... 1H	0 ...1	1	-
Logical value for CPS valve closed					
LV_FRQ_1_CPS	V	0... 1H	0 ...1	1	-
Logical value for CPS PWM frequency					

Input data:

CPPWM_ADD_AD {p. 3756}	CPPWM_EXT_ADJ {p. 7431}	CPPWM_LIH {p. 4708}	FLOW_COR_CPS {p. 3635}
FRQ_CPS_AD {p. 3756}	LV_CPPWM_EXT_ADJ {p. 7433}	LV_CPS_AD_ACT {p. 3756}	LV_ERR_EL_CPS {p. 4708}
LV_N_MAX_CP {p. 1540}	N_32 {p. 1525}	PRS_CPS {p. 1540}	VB {p. 1185}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CPPWM_AS	-	80... 7FH	-100... 99.21875	0.78125	%
Application system value for CPS opening					
C_CPPWM_FRQ_1	-	0... FFH	0... 255	1	Hz
First CPS output frequency					
C_CPPWM_FRQ_1_CPS	-	0... FFH	0... 99.60937	0.390625	%
Threshold on CPPWM to shift CPS frequency output					
C_CPPWM_FRQ_2	-	0... FFH	0... 255	1	Hz
Second CPS output frequency					
C_CPPWM_FRQ_2_CPS	-	0... FFH	0... 99.60937	0.390625	%
Threshold on CPPWM to shift CPS frequency output					
C_CPPWM_FRQ_HYS_CPS	-	0... FFH	0... 99.60937	0.390625	%
Hysteresis threshold on CPPWM to shift CPS frequency output					
C_CPPWM_MAX_FRQ_1_LIM_CP	-	0... FFH	0... 99.60937	0.390625	%
CPPWM_CPS maximum limit to assure the diagnosis with frequency 1					
C_CPPWM_MAX_FRQ_2_LIM_CP	-	0... FFH	0... 99.60937	0.390625	%
CPPWM_CPS maximum limit to assure the diagnosis with frequency 2					
C_CPPWM_MIN_FRQ_1_LIM_CP	-	0... FFH	0... 99.60937	0.390625	%
CPPWM_CPS minimum limit to assure the diagnosis with frequency 1					
C_CPPWM_MIN_FRQ_2_LIM_CP	-	0... FFH	0... 99.60937	0.390625	%
CPPWM_CPS minimum limit to assure the diagnosis with frequency 2					
C_N_FRQ_1_CPS	-	0... FFH	0... 8160	32	rpm
Threshold on engine speed to shift CPS frequency output					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_FRQ_2_CPS	-	0... FFH	0... 8160	32	rpm
Threshold on engine speed to shift CPS frequency output					
C_N_FRQ_HYS_CPS	-	0... FFH	0... 8160	32	rpm
Hysteresis threshold on engine speed to shift CPS frequency output					
IP_CPPWM	V	0... FFH	0... 99.60937	0.390625	%
LDP_FLOW_COR_CPS_IP_CPPWM	16	0... FFFFH	0... 7.99987	122.1e-6	kg/h
LDPM_PRS_CPS_1_EVAC	16	0... FFFFH	-2717... 2716.91708	0.0829163	hPa
CPS valve characteristic					
IP_CPPWM_COR_FRQ	-	0... FFH	0... 1.99218	0.0078125	-
LDP_CPPWM_IP_CPPWM_COR_FRQ	8	0... FFH	0... 99.60937	0.390625	%
PWM correction following frequency value					
IP_CPPWM_VB_ADD_1	-	0... FFH	-50... 49.60937	0.390625	%
LDPM_VB_1_EVAC	8	0... FFH	0... 25.89843	0.1015625	V
Additive VB correction for CPPWM and frequency 1					
IP_CPPWM_VB_ADD_2	-	0... FFH	-50... 49.60937	0.390625	%
LDPM_VB_1_EVAC	8	0... FFH	0... 25.89843	0.1015625	V
Additive VB correction for CPPWM and frequency 2					
IP_CPPWM_VB_FAC	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_VB_1_EVAC	8	0... FFH	0... 25.89843	0.1015625	V
Multiplicative VB correction for CPPWM					
IP_CPPWM_VB_FAC_PRS_CPS	-	0... FFH	0... 3.98437	0.015625	-
LDP_PRS_CPS_IP_CPPWM_VB_FAC	6	0... FFFFH	-2717... 2716.91708	0.0829163	hPa
Multiplicative VB correction for CPPWM					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_CPPWM_AS	-	0... 1H	0 ...1	1	-
C_CPPWM_AS activation					
LC_CPPWM_LIM_DIAG	-	0... 1H	0 ...1	1	-
Selection of diagnosis limit values on CPPWM_CPS					

Import actions:

ACTION_INFR_SetPWMDucyCPS (**IN**<Cppwm_cps>)
ACTION_INFR_SetPWMFrqCPS (**IN**<Frq_req_cp>)

Input data table order: External inputs - Inputs from other EVAC modules

General information:

The PWM-setpoint to control the opening of the canister purge valve CPPWM is calculated from a map as a function of the flow setpoint and the pressure difference. This flow setpoint is deliverd from evapoarative emission control module.
The influence of the battery voltage VB on the opening of the CPS is corrected by the additive value IP_CPPWM_VB_1_ADD or IP_CPPWM_VB_2_ADD and multiplicative value IP_CPPWM_VB_FAC.
Two frequencies of the CPS are possible; the selection of the current frequency is dependent on engine speed and valve opening.

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An additional PWM offset can be applied using C_CPPWM_AS (the offset) and LC_CPPWM_AS (the switch to turn the consideration of the offset on).
The term CPPWM_ADD_AD includes the valve adaptation value delivered from the canister purge valve characteristic adapation function (if included).
An external setpoint CPPWM_EXT_ADJ is applied, if LV_CPPWM_EXT_ADJ is true.
If a fault is detected on the canister purge valve (LV_ERR_EL_CPS=1), the opening of the CPS is controlled by the value of CPPWM_LIH (see chapter OBDI functions).
In case of high CPU load /high engine speed (LV_N_MAX_CP=1), the regular control of the valve is stopped to save CPU load.
The physical range for the frequency request FRQ_REQ_CP is 5 to 32 Hz.

Application conditions

Initialisation: *LV_CP_CLOSE_ACT=1 and all other values =0 at reset or stalling*

Recurrence: ***20*** *ms*

Activation: every engine state

Deactivation - -

Signal flow diagrams:

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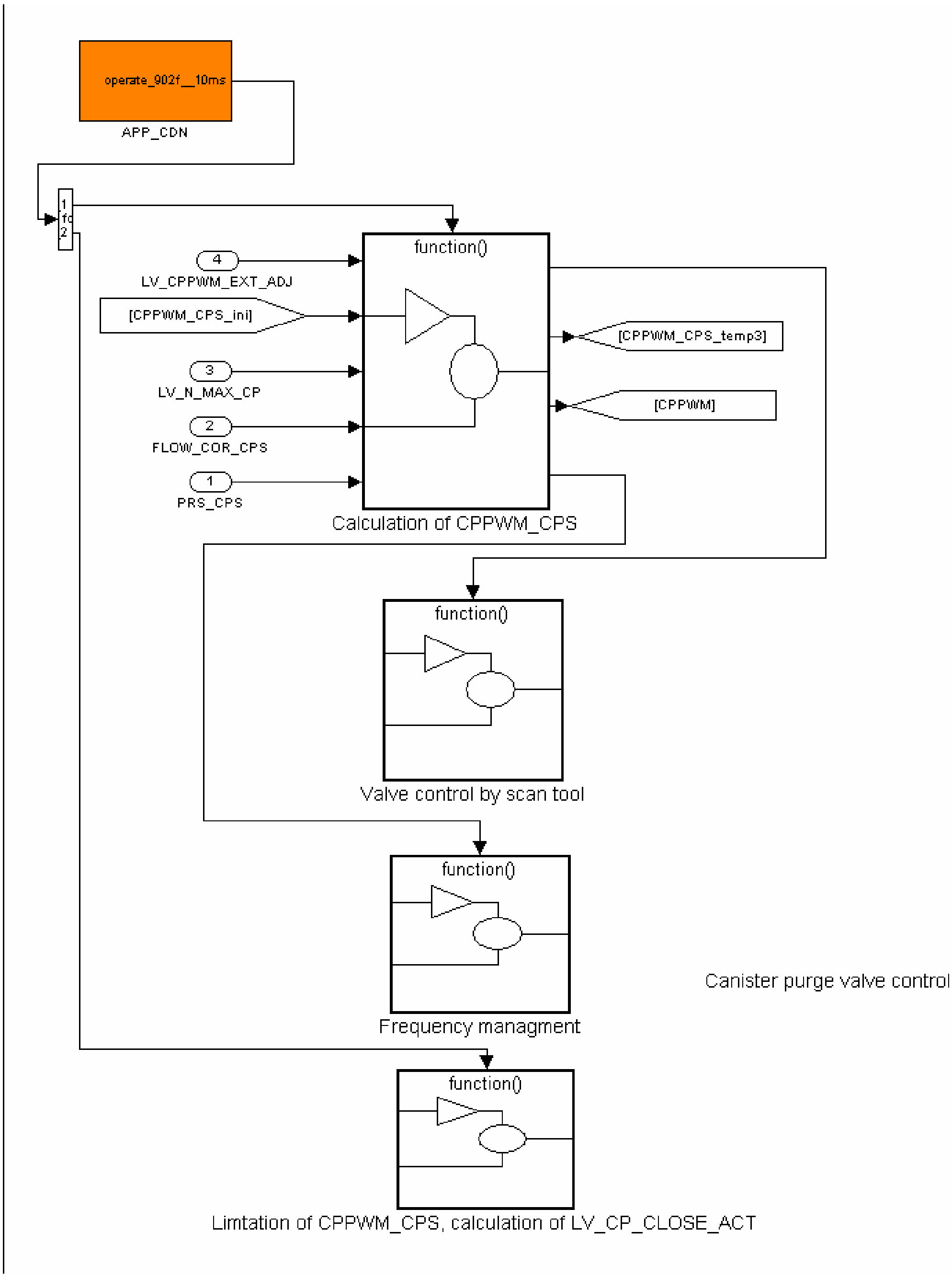

Figure 9.20.1: : overview valve control

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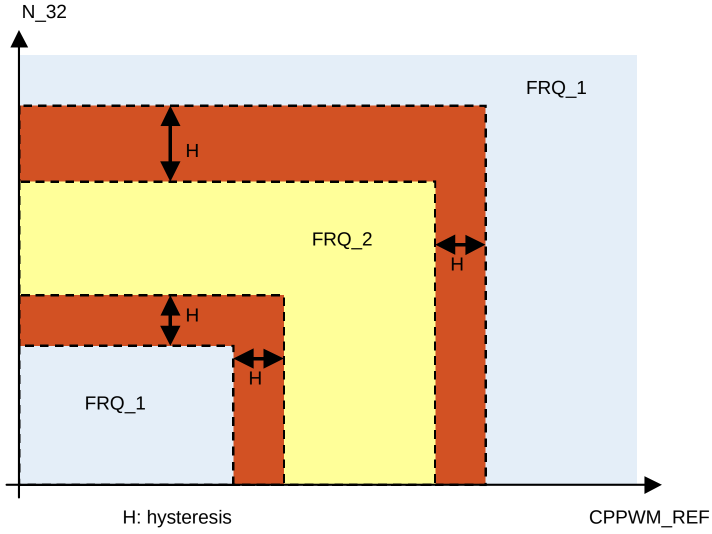

Figure 9.20.2: : frequency management

Formula section:

Calculation of CPPWM_CPS

```
if      LV_CPPWM_EXT_ADJ = 1
then  call  "Valve control by scan tool"
else  if      LV_N_MAX_CP    = 1
      then  CPPWM_CPS      = 0
      else  if            LV_ERR_EL_CPS = 1
            then          CPPWM      = CPPWM_LIH
            elseif              LV_CPS_AD_ACT = 1
            then          CPPWM      = CPPWM_ADD_AD
            elseif              FLOW_COR_CPS = 0
            then          CPPWM      = 0
            else          CPPWM      = max [0, IP_CPPWM (FLOW_COR_CPS, PRS_CPS)
                                  + CPPWM_ADD_AD]
            endif
           if            LC_CPPWM_AS  = 1
           then          CPPWM            = CPPWM + C_CPPWM_AS
           endif

            call  "Frequency management"
      endif
endif
call    "Limitation of CPPWM_CPS, calculation of LV_CP_CLOSE_ACT"
end
```

9.20.1 Valve control by scan tool

```
if      LV_CPPWM_EXT_ADJ = 1
then  FRQ_REQ_CP              = C_CPPWM_FRQ_2
      LV_FRQ_1_CPS                   = 0
      CPPWM                   = CPPWM_EXT_ADJ
```

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```
        CPPWM_CPS              = CPPWM_EXT_ADJ
        TMP_MAX_CPS_DIAG = C_CPPWM_MAX_FRQ_2_LIM_CP
        TMP_MIN_CPS_DIAG         = C_CPPWM_MIN_CPS_DIAG_FRQ_2
endif
end
```

9.20.2 Frequency management

frequency selection

```
if      LV_CPS_AD_ACT        = 1
then  FRQ_REQ_CP             = FRQ_CPS_AD
        LV_FRQ_1_CPS                = 0

if      LV_FRQ_1_CPS = 1
then  if       (CPPWM              < C_CPPWM_FRQ_2_CPS)
        and    (N_32                 < C_N_FRQ_2_CPS)
        and    [ (CPPWM                  > C_CPPWM_FRQ_1_CPS + C_CPPWM_FRQ_HYS_CPS)
        or      (N_32                 > C_N_FRQ_1_CPS            + C_N_FRQ_HYS_CPS) ]
        then  FRQ_REQ_CP   = C_CPPWM_FRQ_2
                   LV_FRQ_1_CPS          = 0
        else  FRQ_REQ_CP   = C_CPPWM_FRQ_1
                LV_FRQ_1_CPS          = 1
        endif
else   if       (CPPWM              > C_CPPWM_FRQ_2_CPS + C_CPPWM_FRQ_HYS_CPS)
        or      (N_32                 > C_N_FRQ_2_CPS            + C_N_FRQ_HYS_CPS)
        or      [ (CPPWM                  < C_CPPWM_FRQ_1_CPS)
        and    (N_32                 < C_N_FRQ_1_CPS) ]
        then  FRQ_REQ_CP   = C_CPPWM_FRQ_1
                   LV_FRQ_1_CPS          = 1
        else  FRQ_REQ_CP   = C_CPPWM_FRQ_2
                LV_FRQ_1_CPS          = 0
        endif
endif
```

battery voltage correction & diagnosis limit determination

```
if      CPPWM > 0
then  if       LV_FRQ_1_CPS          = 1
        then  CPPWM_CPS =
                CPPWM
                * IP_CPPWM_COR_FRQ (CPPWM)
                * IP_CPPWM_VB_FAC (VB)
                + IP_CPPWM_VB_ADD_1 (VB) * IP_CPPWM_VB_FAC_PRS_CPS (PRS_CPS)
                TMP_MIN_CPS_DIAG   = C_CPPWM_MIN_FRQ_1_LIM_CP
                TMP_MAX_CPS_DIAG  = C_CPPWM_MAX_FRQ_1_LIM_CP
        else  CPPWM_CPS =
                CPPWM
                * IP_CPPWM_VB_FAC (VB)
                + IP_CPPWM_VB_ADD_2 (VB) *   IP_CPPWM_VB_FAC_PRS_CPS (PRS_CPS)
                TMP_MIN_CPS_DIAG   = C_CPPWM_MIN_FRQ_2_LIM_CP
                TMP_MAX_CPS_DIAG  = C_CPPWM_MAX_FRQ_2_LIM_CP
        endif
else   CPPWM_CPS = 0
```

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TMP_MIN_CPS_DIAG = C_CPPWM_MIN_FRQ_2_LIM_CP
// *TMP_MIN_CPS_DIAG* is used for calculation of LV_CP_CLOSE_ACT, should be defined although CPPWM_CPS=0.
endif
end

9.20.3 Limitation of CPPWM_CPS, calculation of LV_CP_CLOSE_ACT

if LC_CPPWM_LIM_DIAG = 1
then **if** CPPWM_CPS > 0
then CPPWM_CPS = **min** [**max** [
CPPWM_CPS, *TMP_MIN_CPS_DIAG*], *TMP_MAX_CPS_DIAG*]
endif
LV_CP_CLOSE_ACT = [CPPWM_CPS <= *TMP_MIN_CPS_DIAG*]
else LV_CP_CLOSE_ACT = [CPPWM_CPS = 0]
endif
end

Call infrastructure to update the PWM duty-cycle

ACTION_INFR_SetPWMDucyCPS(CPPWM_CPS)

Call infrastructure to update the PWM frequency

ACTION_INFR_SetPWMFrqCPS(FRQ_REQ_CP)

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9.21 Canister purge valve adaptation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CPPWM_ADD_AD	O/V	0... 7FFFH	0... 99.996948	0.00305176	%
Additive adaptive CPPWM correction					
CPPWM_ADD_AD_MEM	V/S	0... FFFFH	0... 99.998474	0.00152588	%
final output of function: additive STO parameter written to non volatile memory					
CTR_1_CPS_AD	V	0... FFFFH	0... 1310.7	0.02	s
function duration time (in APP_CDN)					
CTR_2_CPS_AD	V	0... FFFFH	0... 1310.7	0.02	s
internal time counter for wait states and ramps					
CTR_CPS_AD_HOM_REQ	V	0... FFH	0... 255	1	-
Number of homogeneous operation mode requests from CPS adaptation.					
CTR_CYCNR_CPS_AD	V	0... FFH	0... 255	1	-
number of successful adaptation cycles during driving cycle					
FAC_FLOW_CPS_AD	V	0... FFH	0... 0.99609375	0.00390625	-
STO weighting factor depending on FLOW_COR_CPS					
FAC_LAMB_START_CPS_AD	V	8000... 7FFFH	0... 49.9984741	0.00152588	%
lambda deviation at begin of CPS_AD to eliminate a constant lambda offset					
FAC_PRS_CPS_AD	V	0... FFH	0... 1.9921875	0.0078125	-
STO weighting factor depending on PRS_CPS					
FAC_PWM_CPS_AD	V	0... FFH	0... 0.99609375	0.00390625	-
STO weighting factor depending on CPPWM_CPS					
FRQ_CPS_AD	O/V	0... FFH	0... 255	1	Hz
current CPS frequency for adaptation					
LV_CL_OK_CPS_AD	V	0... 1H	0 ...1	1	-
CL is sufficient for adaptation					
LV_CPS_AD_ACT	O/V	0... 1H	0 ...1	1	-
if positive: adaptation is active or waiting					
LV_CPS_AD_HOM_REQ	O/V	0... 1H	0 ...1	1	-
Flag to request homogeneous engine operation mode for CPS adaptation					
LV_CPS_AD_RUN_CDN_OK	O/V	0... 1H	0 ...1	1	-
all conditions for adaptation (including counter) fulfilled, adaptation can run					
LV_CPS_AD_ST_CDN_OK	V	0... 1H	0 ...1	1	-
all conditions for adaptation (including CL) fulfilled, adaptation can start					
LV_CPS_OK_CPS_AD	V	0... 1H	0 ...1	1	-
CP Sytem is ready for adaptation (STATE_CP etc.)					
LV_CTR_OK_CPS_AD	V	0... 1H	0 ...1	1	-
CPS_AD has not yet successfully finished the required number of cycles					
LV_ENG_OK_CPS_AD	V	0... 1H	0 ...1	1	-
engine conditions (N, etc.) are OK for adaptation					
LV_ERR_CPS_AD	V	0... 1H	0 ...1	1	-
during current driving cycle one or more adaptations of CPS have failed					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_T_OK_CPS_AD	V	0... 1H	0 ...1	1	-
all relevant time counters are OK for adaptation					
RATIO_FRQ	V	0... FFH	0... 15.9375	0.0625	-
ratio FRQ used for adaptation /minimum purge frequency					
STATE_CPS_AD	V	0H 1H 2H 4H 5H 6H	INACTIVE WAITING LEARNING INTERRUPTED FAILED FINISHED	-	-
current state of CPS adaptation reported by function					
STATE_CPS_AD_REQ	V	0H 1H 2H 4H 5H 6H	INACTIVE WAITING LEARNING INTERRUPTED FAILED FINISHED	-	-
state of CPS adaptation requested by APP_CDN (=activate etc.)					
T_CPS_AD_HOM_REQ	V	0... FFFFH	0... 1310.7	0.02	s
For this time homogeneous operation mode is requested (LV_CPS_AD_HOM_REQ = 1)					
T_DLY_CPS_AD_HOM_REQ	V	0... FFFFH	0... 1310.7	0.02	s
Time until the next homogeneous engine operation mode requests by CPS adaptation is possible					

Input data:

CL_MMV {p. 3698}	CPPWM_CPS {p. 3749}	FAC_LAM_MV {p. 1014}	FLOW_COR_CPS {p. 3635}
LV_CL_CLC_VLD {p. 3635}	LV_CP_CLOSE_REQ {p. 1540}	LV_CPS_AD_INH {p. 3679}	LV_HOM_ACT {p. 8136}
N {p. 1525}	PRS_CPS {p. 1540}	STATE_CP {p. 3637}	T_AST_CP {p. 3680}
TQI_AV {p. 981}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MIN_CPS_AD	-	0... FFFFH	0... 1.999969	305.176e3	-
minimum canister load for CPS adaptation					
C_CPPWM_AD_RATIO	-	0... FFH	0... 0.99609375	0.00390625	-
ratio new measured /old memorized value for new memorized CPPWM_ADD_AD_MEM					
C_CPPWM_ADD_AD_MEM_NVMY_INI	-	0... FFFFH	0... 99.9984741	0.00152588	%
First value of the additive STO parameter written to non volatile memory at NVMY_INI					
C_CPPWM_DELTA_AD	-	0... FFFFH	0... 99.998474	0.00152588	%
PWM distance to old STO for start adaptation					
C_CPPWM_DLY_LAM	-	0... FFFFH	0... 99.998474	0.00152588	%
delta PWM between STO and lambda reaction (time delay compensation)					
C_CPPWM_INC_AD	-	0... FFFFH	0... 99.998474	0.00152588	%
PWM increment for stop after aborted adaptation					
C_CPPWM_INC_STOP_AD	-	0... FFFFH	0... 99.998474	0.00152588	%
PWM increment for stop after aborted adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CPPWM_MAX_AD	-	0... FFFFH	0... 99.998474	0.00152588	%
maximum PWM for CPS adaptation					
C_CPPWM_MIN_AD	-	0... FFFFH	0... 99.998474	0.00152588	%
minimum PWM threshold for CPS adaptation					
C_CTR_CPS_AD_HOM_REQ_MAX	-	0... FFH	0... 255	1	-
Maximum number of homogeneous operation mode requests from CPS adaptation.					
C_CYCNR_CPS_AD	-	0... FFH	0... 255	1	-
maximum number of adaption cycles per driving cycle					
C_FAC_LAMB_DELTA_MIN_CPS_AD	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
lowest detectable lambda deviation					
C_FAC_LAMB_MAX_CPS_AD	-	8000... 7FFFH	0... 49.9984741	0.00152588	%
threshold for CPS adaptation abortion					
C_FLOW_CLC_DIF_CPS_AD	-	0... FFFFH	0... 7.99987793	12.20699e3	kg/h
Difference between C_FLOW_CLC_MAX_CPS_AD and begin of ramp					
C_FLOW_CLC_MAX_CPS_AD	-	0... FFFFH	0... 7.99987793	12.20699e3	kg/h
Maximum FLOW threshold for weighting STO ramp					
C_FRQ_CLC_1_CPS_AD	-	0... FFH	0... 255	1	Hz
numerator for adaptation frequency calculation					
C_FRQ_CLC_2_CPS_AD	-	80... 7FH	0... 127	1	Hz
offset for adaptation frequency calculation					
C_FRQ_MAX_MEC_CPS	-	0... FFH	0... 255	1	Hz
maximum allowed mechanical frequency for CPS					
C_FRQ_MIN_CPS_AD	-	0... FFH	0... 255	1	Hz
start frequency for finding adaptation frequency					
C_N_MAX_CPS_AD	-	0... 1FE0H	0... 8160	1	rpm
upper threshold of dynamic idle window for CPS adaptation					
C_N_MIN_CPS_AD	-	0... 1FE0H	0... 8160	1	rpm
lower threshold of dynamic idle window for CPS adaptation					
C_PRS_CPS_MAX_CPS_AD	-	8000... 7FFFH	0... 2716.96	0.08291752	hPa
Maximum PRS_CPS threshold for CPS adaptation					
C_PWM_CLC_DIF_CPS_AD	-	0... FFH	0... 99.609375	0.390625	%
Difference between CL_PWM_CLC_MAX_CPS_AD and begin of ramp					
C_PWM_CLC_MAX_CPS_AD	-	0... FFH	0... 99.609375	0.390625	%
Maximum CPPWM_CPS threshold for weighting STO ramp					
C_T_AST_DEAC_CPS_AD	-	0... FFFFH	0... 6553.5	0.1	s
Maximum start time for adaptation					
C_T_CPS_AD_HOM_REQ	-	0... FFFFH	0... 1310.7	0.02	s
Time while hom request is maintained (even if due to operation mode change not all CPS adaptation conditions are met)					
C_T_DLY_CPS_AD_HOM_REQ	-	0... FFFFH	0... 1310.7	0.02	s
Minimum time between two homogeneous engine operation mode requests by CPS adaptation					
C_T_DLY_FAC_LAMB_CPPWM_AD	-	0... FFFFH	0... 6553.5	0.1	s
time delay after change of fuel massflow during detectable lambda deviation (expecting 0 or above)					
C_T_INC_CPS_CLOSE	-	0... FFFFH	0... 6553.5	0.1	s
time increment between cps closing steps					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MAX_CPS_AD	-	0... FFFFH	0... 6553.5	0.1	s
maximum function duration time					
C_T_ST_CPS_AD	-	0... FFFFH	0... 6553.5	0.1	s
minimum time after start engine to allow CPS adaptation					
C_T_WAIT_CPS_AD	-	0... FFFFH	0... 6553.5	0.1	s
time delay after function call until start open CPS					
C_T_WAIT_LAMB_RGN	-	0... FFFFH	0... 6553.5	0.1	s
time after adaptation for "regeneration" of lambda regualtion					
C_TQI_AV_MAX_CPS_AD	-	8000... 7FFFH	0... 1023.97	0.03125	Nm
upper threshold of dynamic idle window for CPS adaptation					
C_TQI_AV_MIN_CPS_AD	-	8000... 7FFFH	0... 1023.97	0.03125	Nm
lower threshold of dynamic idle window for CPS adaptation					
IP_CPPWM_OPEN_CPS	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_PRS_CPS_IP_CPPWM_OPEN_CPS	6	8000... 7FFFH	0... 2716.96	0.08291752	hPa
Weighting factor for STO according to CPS characteristic					
LC_CPS_AD_CHK	-	0... 1H	0 ...1	1	-
Run adaptation for check, overriding conditions					

General information

The purpose of the CPS_AD function is to find the STO(starttoopenpoint) of the canisterpurgesolenoid (CPS): The PWMvalue (valid for the default frequency C_FRQ_MIN_CPS_AD) at which the CPS (canisterpurgesolenoidvalve) has reached the end of it s mechatronical delay time and starts to open (STO). Therefore the CPS is opened using a ramp, meanwhile monitoring the lambdaadaptation (FAC_LAMB) to detect a deviation caused by fuel purged through the CPS. Due to the fact that at a low canisterload (CL_MMV) the adaptation is getting less accurate or even impossible the purgemassflow during adaptation can be increased by rising the frequency (to have more openingperiods per second). The frequency is calculated according to CL_MMV. For PWM is a relative value (valid only for a special frequency) all PWMvalues have to be corrected after computing the frequency.

The function CPS_AD (CPSadaptation) is part of the EVACaggregate. To allow a fast purge of the ACF the PWMramp for opening the CPS has to start at the STO.

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APP_CDN:
This chart is the function s internal statemachine.

When the conditions (i.e. engine speed, canister load) are sufficient (checked by the function START_CDN_OK), the state active (substate adaptation) is entered.

For transparency the conditions are split into the flags: LV_CPS_AD_ST_CDN_OK, LV_CPS_AD_RUN_CDN_OK, LV_ENG_OK_CPS_ AD, LV_CPS_OK_CPS_AD, LV_T_OK_CPS_ AD, LV_CL_OK_CPS_ AD, LV_CTR_OK_CPS_AD. For details see APP_CDNblock.

The function LEARN_STO ist triggered during state active (by triggering the containing subsystem LEARN_STO). The output value STATE_CPS_AD_REQ is used to control the function s internal state while STATE_CPS_AD is the reporting value from the function. After an interrupt or failed adaptation the flag LV_ERR_CPS_AD is set. After that in state closing the valve is closed and in state waiting there is time to compensate any lambdadeviation caused by the function.
The value LC_CPS_AD_CHK allws an override of the CPS_ADconditions.

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If maybe once a LEARN_SLOPEfunction will be added, the state active will have to be divided into the substates LEARN_STO_active and LEARN_SLOPE_active.
At abortion (to avoid a lambdastep by suddenly closing the CPS) the function has to be shutdown by entering state CLOSE. This can be caused by changing conditions like N or by flags like LV_CPS_AD_INH. In this case the function goes into state CLOSING to prevent any further influence on the engine.
A decreasing CL_MMV value during adaptation is normal but - after a sufficient CLvalue has been assured before function start - does not require a shutdown; the value LV_CPS_AD_RUN_CDN_OK is still 1.

If all conditions for CPS adaptation are met but the engine is not in homogeneous operation mode, this mode is requested via the flag LV_CPS_AD_HOM_REQ.
This request is hold up for the time C_T_CPS_AD_HOM_REQ or if the engine mode changes until the adaptation is finished or was interrupted. After a nonsuccessful request or after the adaptation is finished /was interrupted, for the time C_T_DLY_CPS_AD_HOM_REQ no request for homogeneous operation mode is allowed.
After a nonsuccessful request or after the adaptation is finished/was interrupted, for the time C_T_DLY_CPS_AD_HOM_REQ no requests for homogeneous mode are allowed.
Per driving cycle only C_CTR_CPS_AD_HOM_REQ requests are allowed, afterwards CPS adaptation can only take place if the engine is in homogeneous operation mode due to other conditions.

Application Condition

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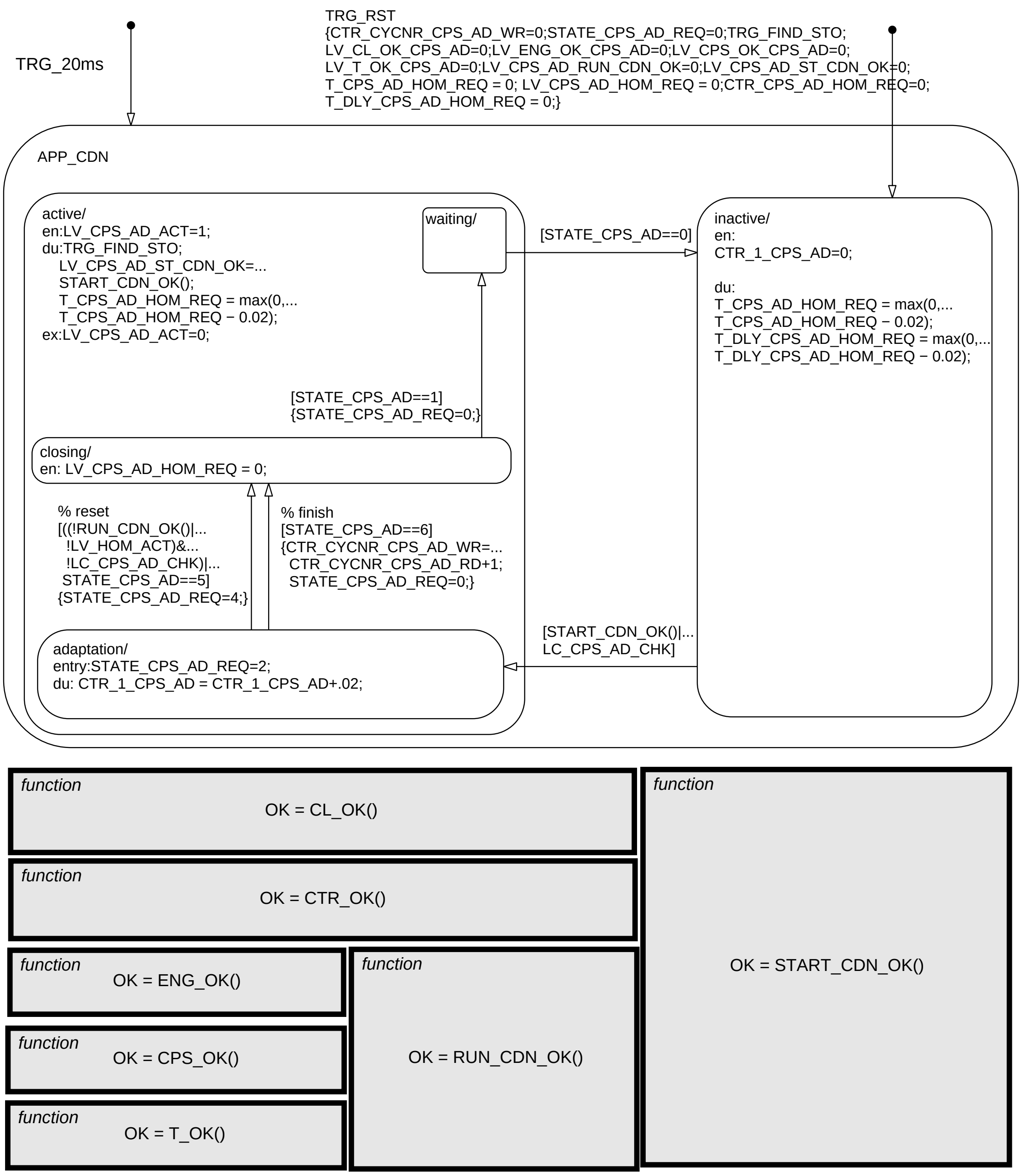

Figure 9.21.1: EVAC_CPS_AD/APP_CDN/APP_CDN_CHART

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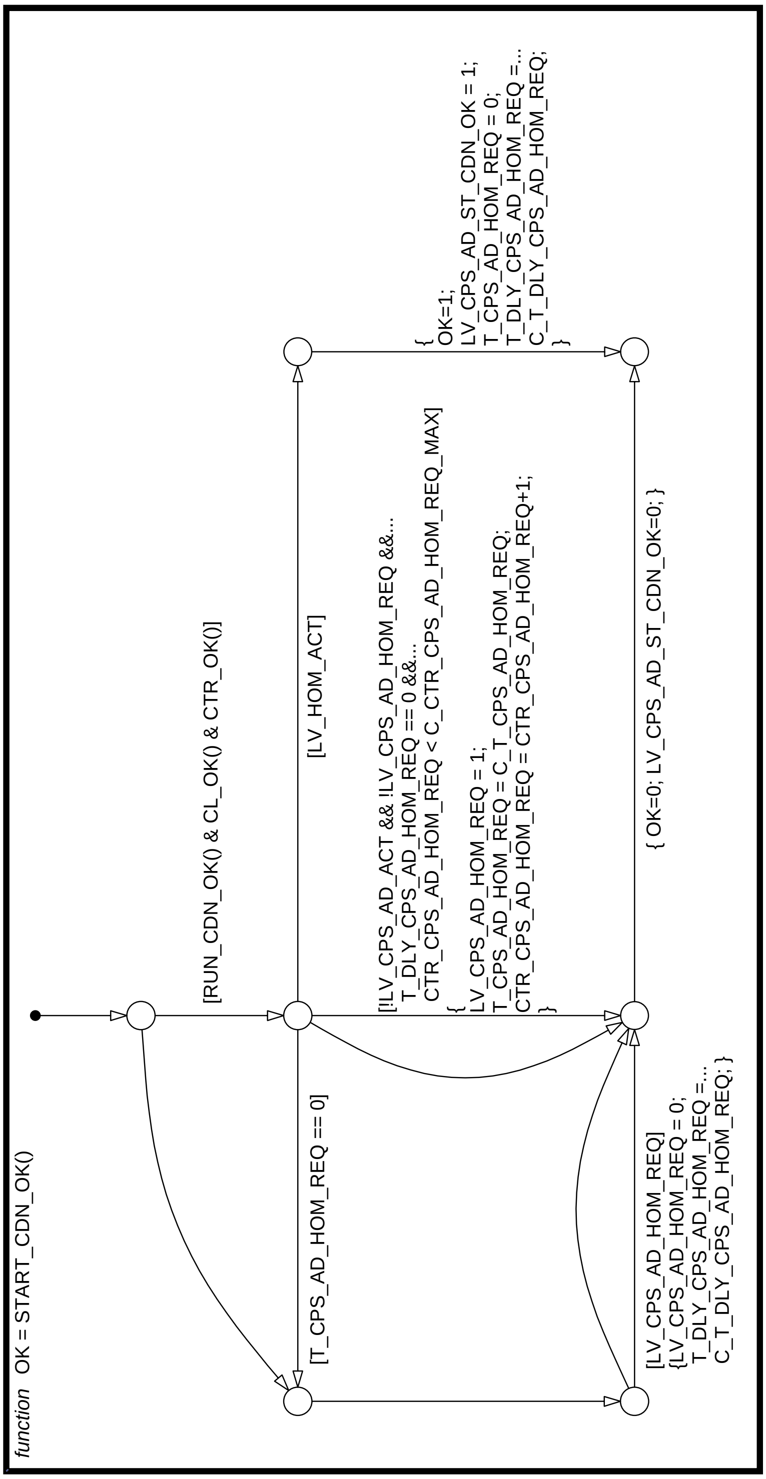

Figure 9.21.2: EVAC_CPS_AD/APP_CDN/APP_CDN_CHART/START_CDN_OK

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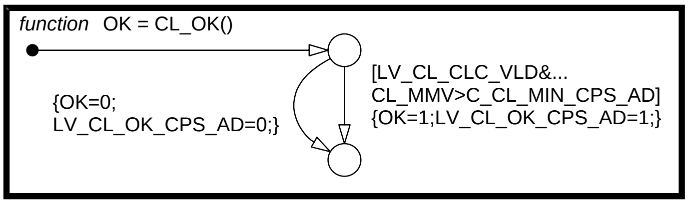

Figure 9.21.3: EVAC_CPS_AD/APP_CDN/APP_CDN_CHART/CL_OK

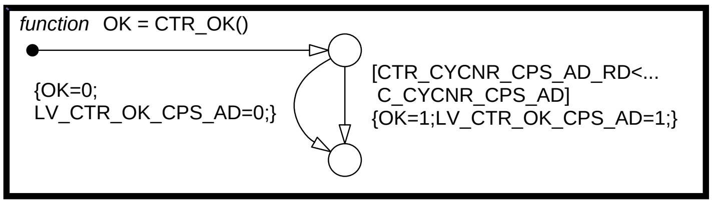

Figure 9.21.4: EVAC_CPS_AD/APP_CDN/APP_CDN_CHART/CTR_OK

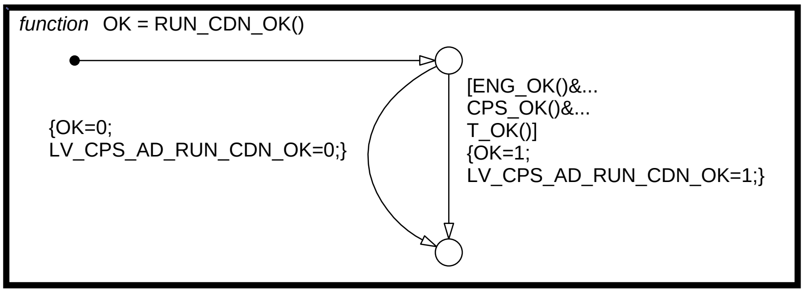

Figure 9.21.5: EVAC_CPS_AD/APP_CDN/APP_CDN_CHART/RUN_CDN_OK

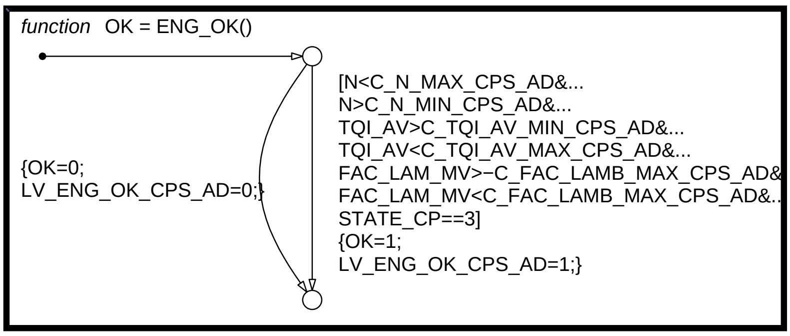

Figure 9.21.6: EVAC_CPS_AD/APP_CDN/APP_CDN_CHART/ENG_OK

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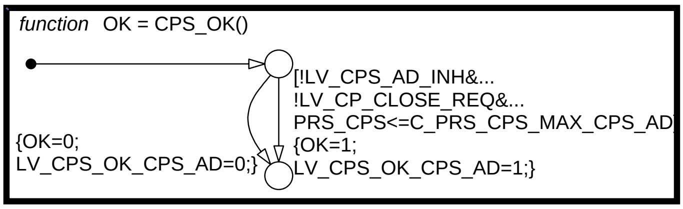

Figure 9.21.7: EVAC_CPS_AD/APP_CDN/APP_CDN_CHART/CPS_OK

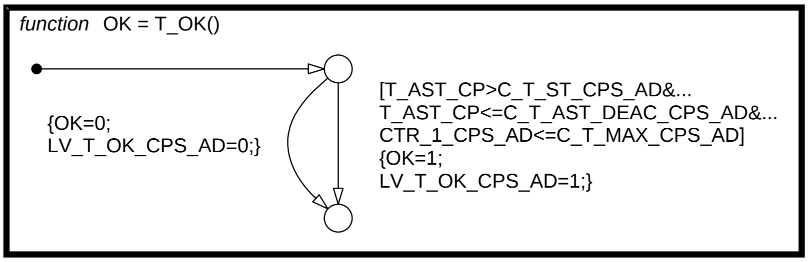

Figure 9.21.8: EVAC_CPS_AD/APP_CDN/APP_CDN_CHART/T_OK

Function Description

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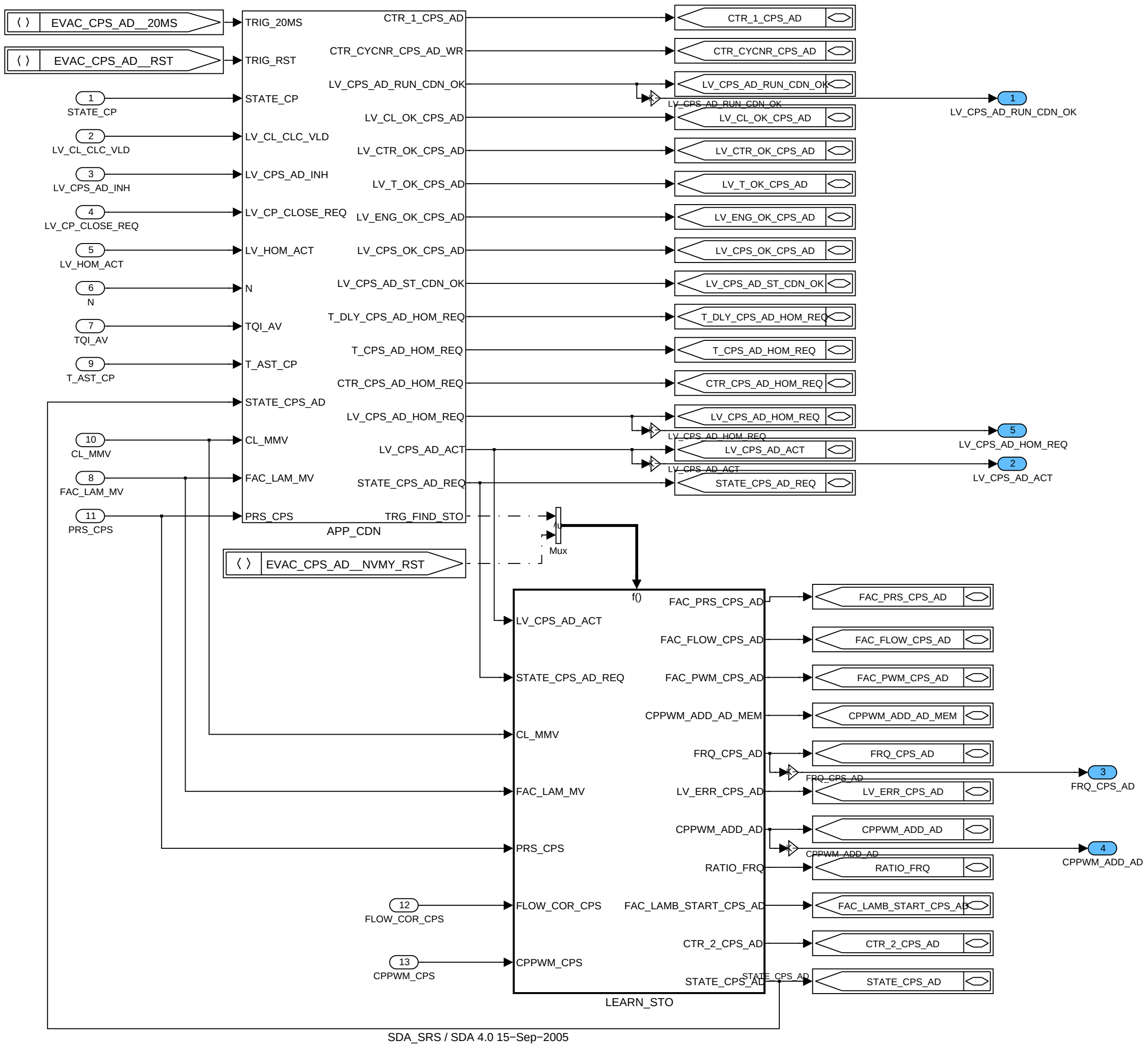

Figure 9.21.9: EVAC_CPS_AD

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9.21.1 SUBFUNCTION: LEARN_STO

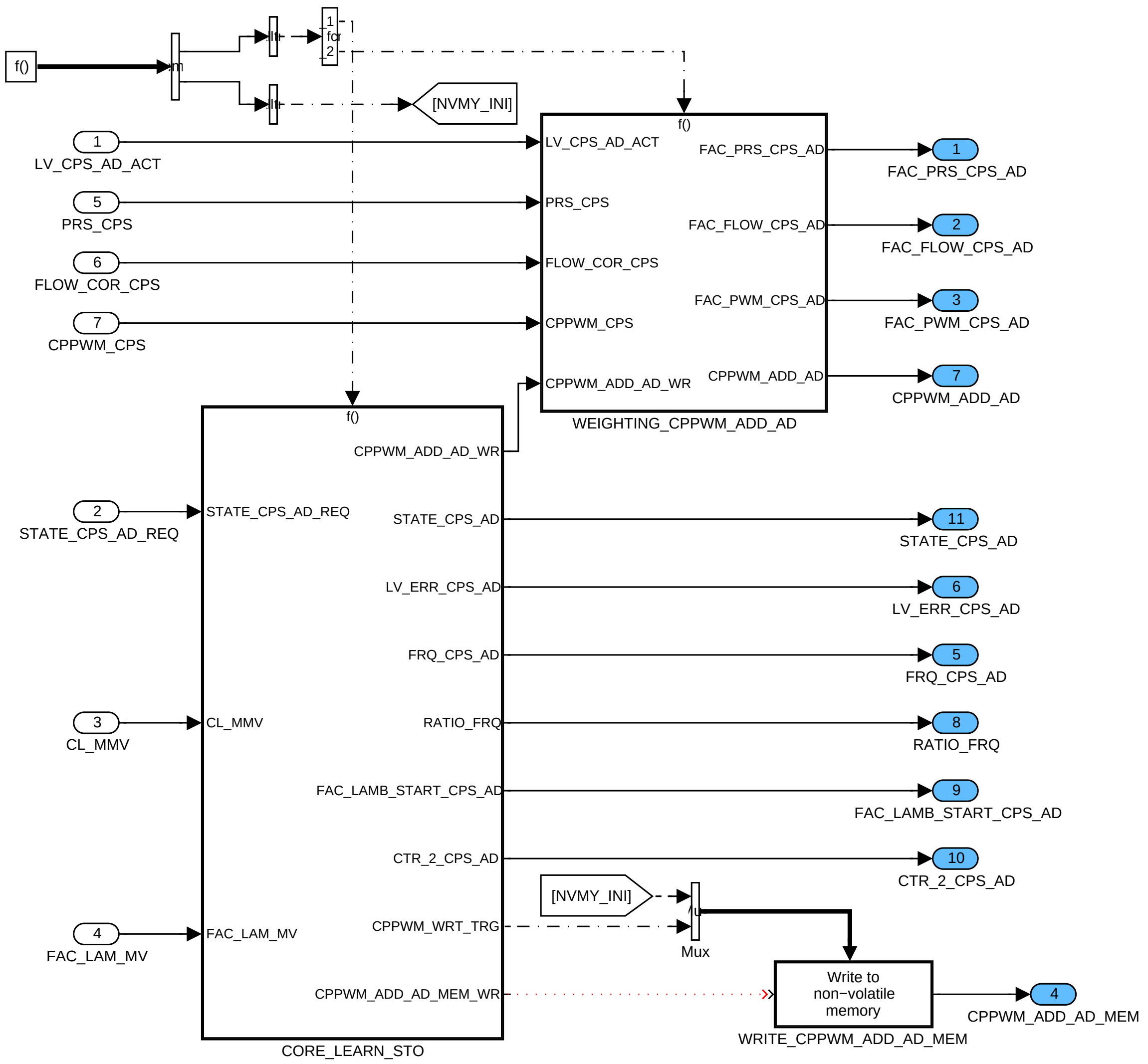

Figure 9.21.10: EVAC_CPS_AD/LEARN_STO

EVAC_CPS_AD/LEARN_STO/CORE_LEARN_STO

This chart is the core of the CPS_ADfunction. The states are:

Entry:
When entering the chart outputs are set to default values.
In case of a CPPWM_ADD_AD_MEM > maximum threshold (danger of engine disturbance) the memory value is set to minimum threshold.

CHECK_CONDITIONS:
This first substate is to prevent a new initialisation (state INIT) of the chart at the last trigger before it s state machine (APP_CDN) is leaving the state active. If PWMadaptation is demanded by APP_CDN, the state CHECK_CONDITION will be left because of STATE_CPS_AD_REQ==2.

INIT_WAIT:

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STATE_CPS_AD is set to 1 eporting that the function is in a waitstate (to allow manipulations during implementation using T_WAIT or provide some additional time for lambda recreation after any disturbance in the past).
CPPWM_ADD_AD_MEM_WR (output variable for CPPWM_ADD_AD_MEM in the nonvolatile memory) is set to the last known value of CPPWM_ADD_AD_MEM.

calculations:
FAC_LAMB_START is the memory for the current FAC_LAMBvalue to calculate a lambdadeviation caused by the function eliminating a constant lambdaoffset.
To minimize the measuring error during STOadaptation the adaptation has to be done at highest possible frequency to measure the highest possible fuel massflow. This is the frequency where the lambdadeviation caused by the openingincrement (CPPWM_INC_AD) is just small enough not to disturb the engine. CPPWM_INC_AD just as several other values are here adapted to the new frequency, using RATIO_FRQ which is calculated using the canister load CL_MMV.
Before entering INCREASE_PWM STATE_CPS is set to 7 reporting that PWMadaptation is in process.
The two junctions are to avoid a calculated FRQ which is above C_FRQ_MAX_MEC_CPS.

IMPORTANT:

The code *{FRQ=abs(...* is paid to a stateflow-bug for *abs(* in stateflow is really *abs(fix(* and there aint't no *fix(* in stateflow. The correct mathematical expression here is *{FRQ=fix(...* to cut out the comma.

INCREASE_PWM:
Here the STO is detected. Frequent entering of the junction beside allows the monitoring of the lambdadeviation while opening the CPS. The time delay C_T_DLY_FAC_LAMB is to let the lambdasensor detect the HC purged into the manifold.
If the function is interrupted (STATE_CPS_AD_REQ==4), the state ist left to go directly to CLOSE.

CLOSE:
The state CLOSE can be reached from INCREASE_PWM via regular (success) or errortransition. Here the measured value is checked against calibrationthresholds. Each transition reports via STATE_CPS. The successtransition calculates the memorized STO (for FRQ_MIN_CPS_AD) and mixes it with the old one using C_CPPWM_AD_RATIO.
The CPS is closed using a ramp until STO is reached (assuming a massflow=0 at STO), then the CPS is completely closed.

WAIT_CLOSE:
This stat is to provide a time delay (time increment) for the closing ramp.
WAIT_LAMB_RGN:
The state gives the engine some time to recover (C_T_WAIT_LAMB_RGN) from the lambdadeviation caused by the adaptation, i.e. to preserve a calm idlestate for the next adaptation cycle.

WRITE_CPPWM_ADD_AD_MEM:
This block defines the writetononvolatilememory of CPPWM_ADD_AD_MEM.

Due to change requirements the INTERNAL value CPPWM_ADD_AD has been deleted in this chart; there rests only the output CPPWM_ADD_AD_WR which is now replacing CPPWM_ADD_AD in the internal calculations.
At NVMY_INI, i.e. when the ECU is flashed with a new software, the adaptation value CPPWM_ADD_AD_MEM is initialized with the value C_CPPWM_ADD_AD_MEM_NVMY_INI and this value is written to the nonvolatile memory. By this it can be assured that a reasonable starttoopen point is used for the purging cycles before the first CPS adaptation could be done.

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For correct processing, the check of CPPWM_ADD_AD_MEM has been transferred from state CHECK_CONDITIONS to chart entry.

At NVMY_INI, i.e. when the ECU is flashed with a new software, the adaptation value CPPWM_ADD_AD_MEM is initialized with the value C_CPPWM_ADD_AD_MEM_NVMY_INI and this value is written to the nonvolatile memory. By this it can be assured that a reasonable starttoopen point is used for the purging cycles before the first CPS adaptation could be done.

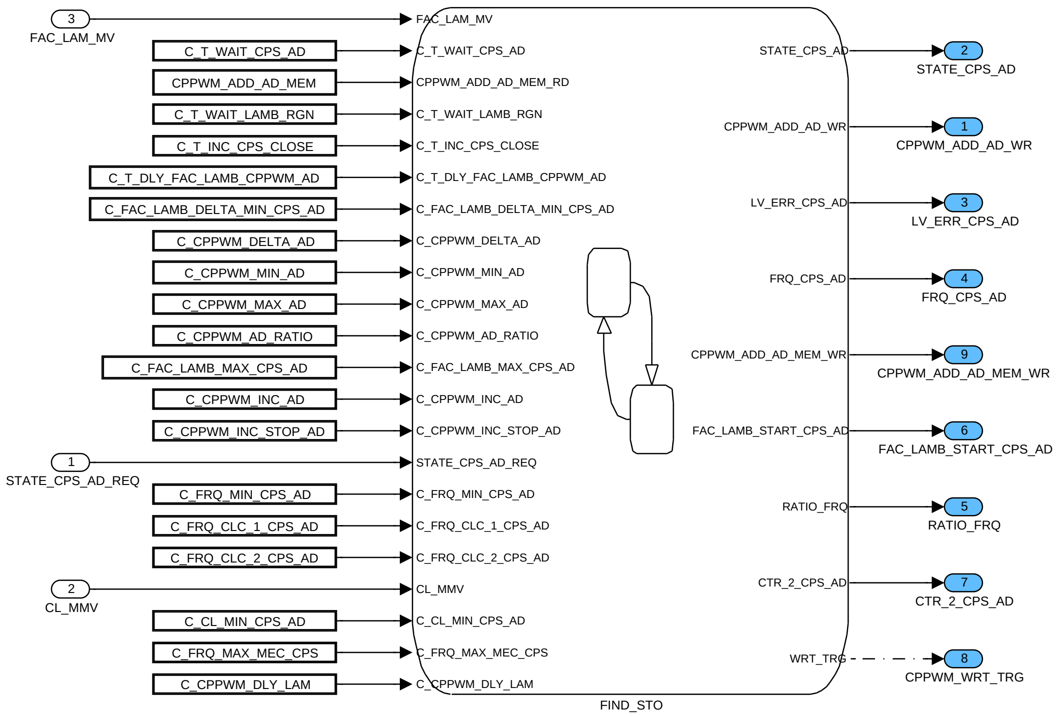

Figure 9.21.11: EVAC_CPS_AD/LEARN_STO/CORE_LEARN_STO

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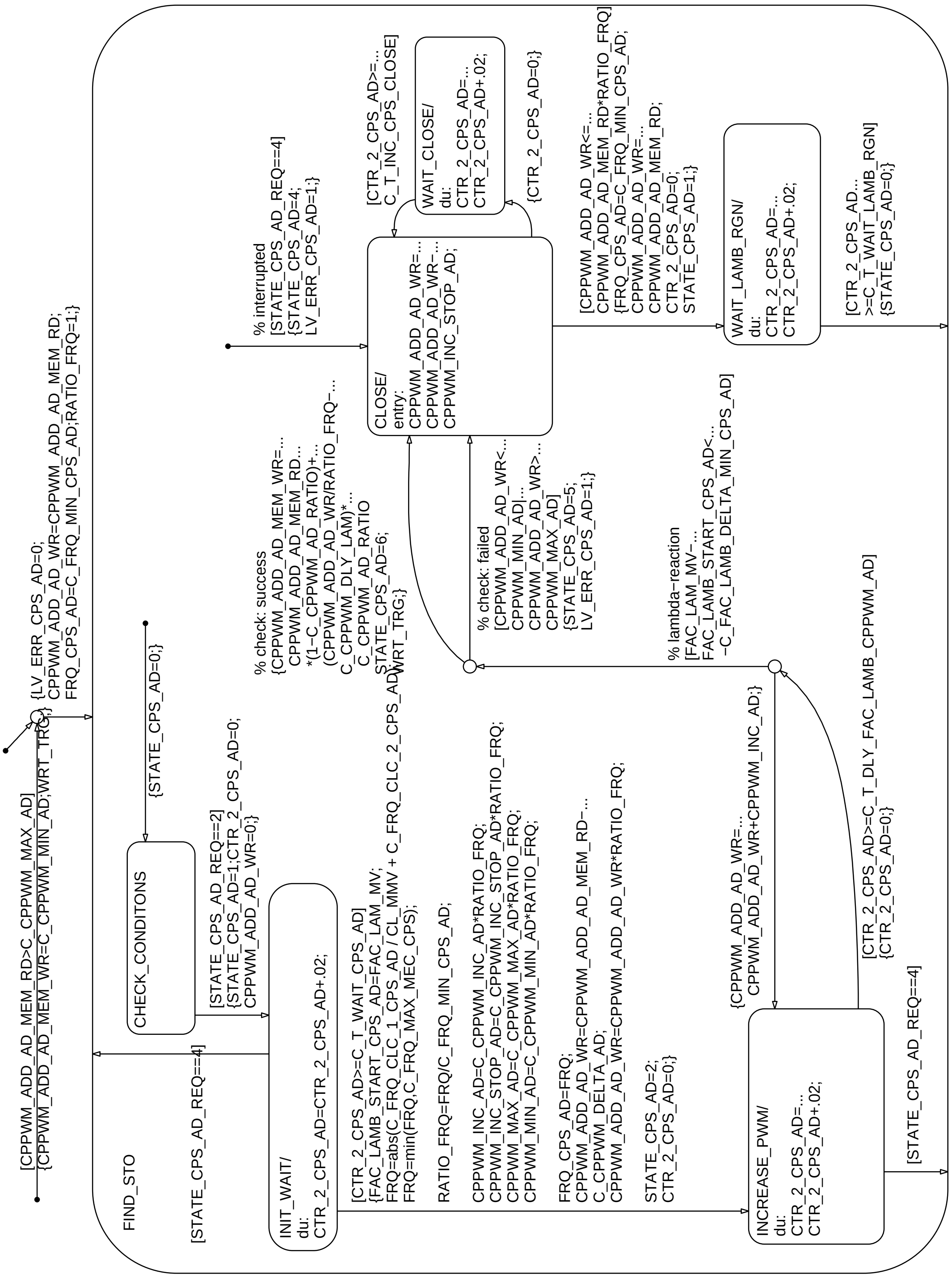

Figure 9.21.12: EVAC_CPS_AD/LEARN_STO/CORE_LEARN_STO/FIND_STO

EVAC_CPS_AD/LEARN_STO/WEIGHTING_CPPWM_ADD_AD

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This submodule does a weighting of the STO CPPWM_ADD_AD_WR to calculate the output CPPWM_ADD_AD. The PRS_CPS-weighting is to pay respect to a nonlinear behaviour of the CPS (to be defined by manufacturer, used for calibration of IP_CPPWM_OPEN_CPS). The FLOW- and PWM-weighting is to 'softly' eliminate the factor when reaching an operating state where STO is of almost no influence.

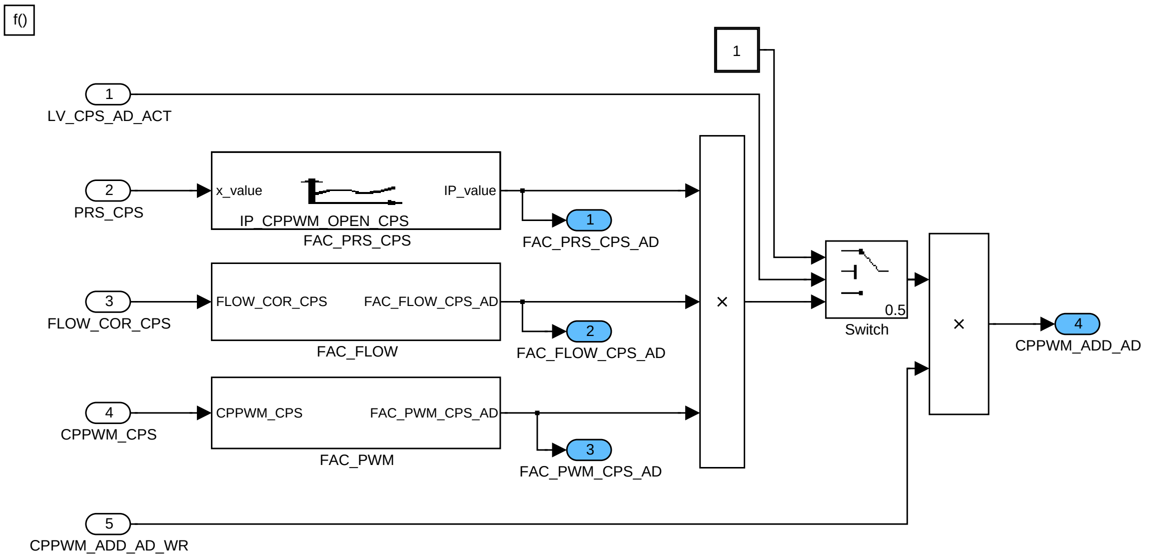

Figure 9.21.13: EVAC_CPS_AD/LEARN_STO/WEIGHTING_CPPWM_ADD_AD

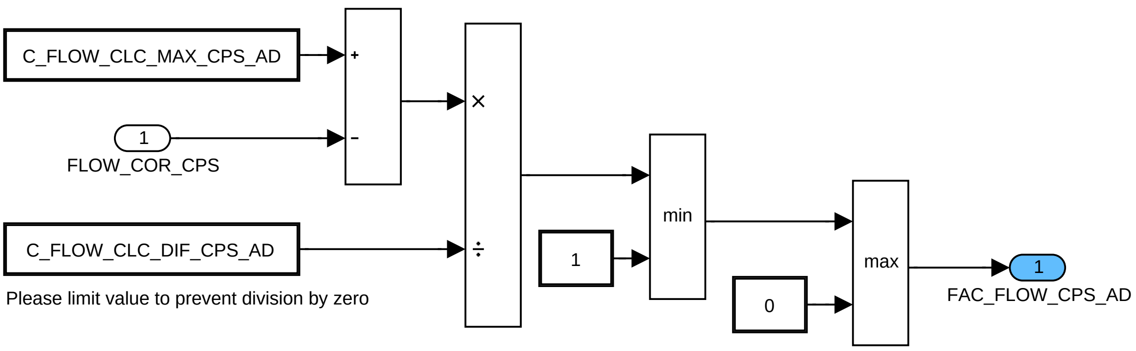

Figure 9.21.14: EVAC_CPS_AD/LEARN_STO/WEIGHTING_CPPWM_ADD_AD/FAC_FLOW

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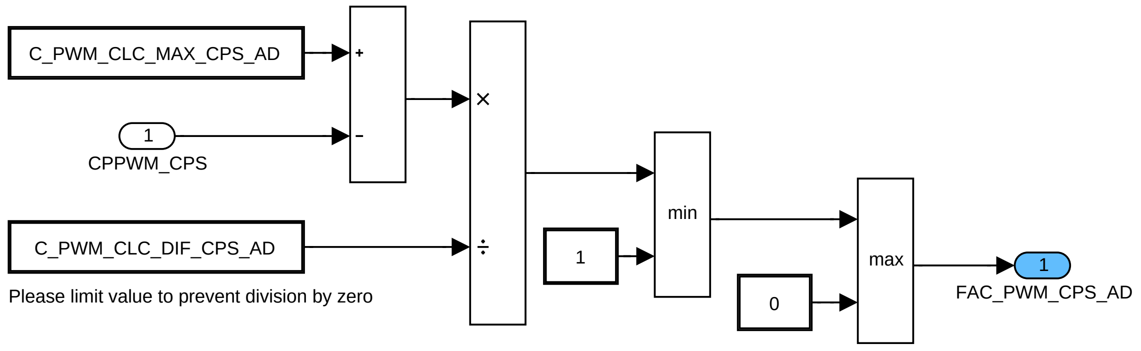

Figure 9.21.15: EVAC_CPS_AD/LEARN_STO/WEIGHTING_CPPWM_ADD_AD/FAC_PWM

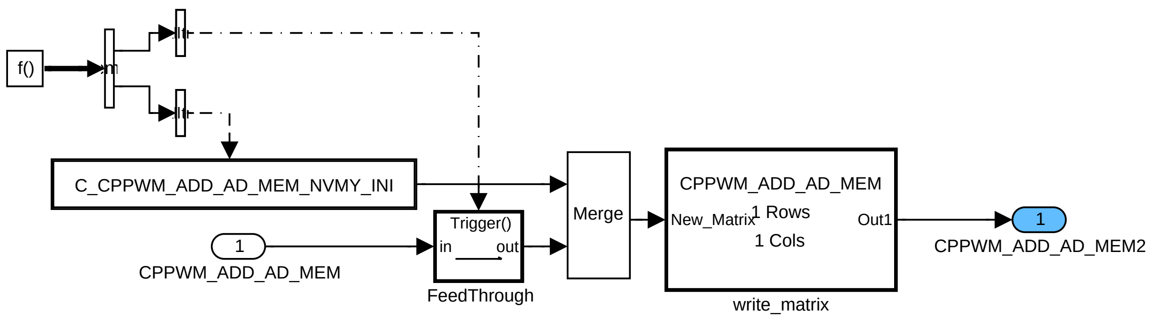

Figure 9.21.16: EVAC_CPS_AD/LEARN_STO/WRITE_CPPWM_ADD_AD_MEM

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9.22 Main relay control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_IGK_OFF_ACK	O/V	0... 1H	0 ...1	1	-
Acknowlegde IGK off state (0H = Pin level shall be switched to High, 1H = Pin level shall be switched to Low)					
LV_RLY_MAIN	O/V	0... 1H	0 ...1	1	-
Main relay control command state (0H = relay shall be switched off, 1H = relay shall be switched on)					
LV_RLY_MAIN_SYS	V	0... 1H	0 ...1	1	-
System depending main relay control command state (0H = off, 1H = on)					
T_ACK_IGK_OFF	V	0... 1FEH	0... 5.1	0.01	s
Timer for setting pin level to Low in case of acknowledge IGK off					
T_IGK_OFF_ACK_DIAG_PLS	V	0... FFH	0... 2.55	0.01	s
Timer for diagnosis pulse, in which acknowledge IGK off pin level is set to Low					

Input data:

C_T_MIN_PWL {p. 3776}	ECU_STATE {p. 1091}	LV_ACT_RLY_MAIN_EXT_ADJ {p. 7432}	LV_CUR_VCV_CTL_PRE_RUN {p. 3954}
LV_DC {p. 5746}	LV_ES {p. 1720}	LV_IGK {p. 906}	LV_RLY_MAIN_EXT_ADJ {p. 7434}
LV_RLY_ST_STST {p. 804}	LV_VAR_STST {p. 805}	PWL_LOCK_CDN {p. 3776}	STATE_ACK_IGK_OFF {p. 1570}
T_PWL {p. 3776}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_ACK_IGK_OFF	-	0... 1FEH	0... 5.1	0.01	s
Timer calibration for control of LV_IGK_OFF_ACK-pin in case of IGK shutdown request					
C_T_IGK_OFF_ACK_DIAG_PLS	-	0... FFH	0... 2.55	0.01	s
Timer constant for diagnosis pulse, in which acknowledge IGK off pin level is set to Low					
LC_IGK_OFF_ACK	-	0... 1H	0 ...1	1	-
LC for switching on/off functionality acknowledge IGK off (1= active)					
LC_IGK_OFF_DIAG_PLS	-	0... 1H	0 ...1	1	-
LC for activate diagnosis pulse (1= activated)					
LC_IGK_OFF_DIAG_PLS_SWI	-	0... 1H	0 ...1	1	-
LC for switch on diagnosis pulse in first start in DC or every start (1= diagnosis pulse activated every start)					
LC_RLY_MAIN_MAN_ADJ	-	0... 1H	0 ...1	1	-
LC for switching main relay (1 = active)					
LC_RLY_MAIN_MAN_REQ	-	0... 1H	0 ...1	1	-
LC for activation of manual switching of main relay (1 = active)					

Import actions:

ACTION_INFR_SetIGK_OFF (**IN**<lv_igk_off_ack>)

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9.22.1 Main relay control

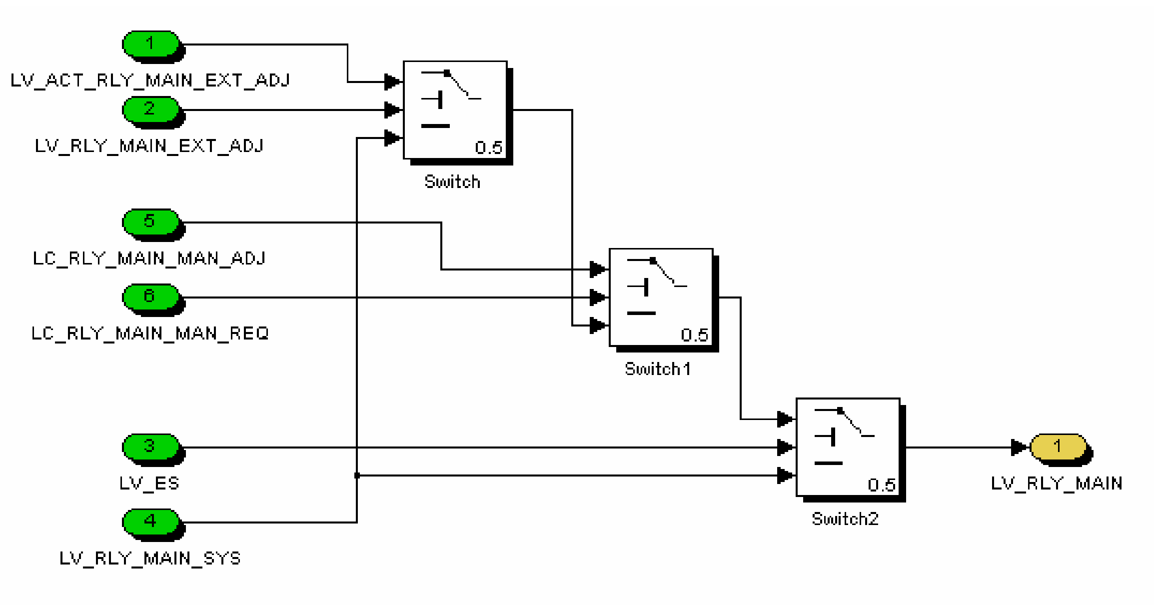
FUNCTION DESCRIPTION:

General information:

Purpose of this module is to get an entry point to switch on or off the main relay and get a status of the control command through LV_RLY_MAIN.
Upon ignition key transition from OFF to ON, the ECU voltage regulator is set to ON and the core microprocessor is reset. Then, so as to power up the system (system = ECU + actuators + sensors), the main relay has to be switched ON (most of actuators are supplied by the main relay).
Upon ignition key transition from ON to OFF, the ECU enters in the post-operating phase. At its end, the system shutdown is obtained by disabling the power supply on sensors and actuators. For that it is necessary to switch off the main relay. Then, the ECU can be switched off too.
To summarize, the main relay is switched on as soon as the ignition key is turned in the ON position and it remains ON until the ECU voltage regulator is switched off.

The system depending switching state is stored in the flag LV_RLY_MAIN_SYS. This request can be overruled by the request of the calibration system or tester (serial communication). To prevent destruction of components (actuators which are supplied via main relay), switching is only allowed when engine stopped (LV_ES =1). While engine is running, always the system depending switching state is used.

Signal flow diagram:



Application conditions

Initialisation: `all 0`

Recurrence: `10 ms`

Activation: `at reset`

Formula section:

IF (ECU_STATE = WAKE_UP **and** LV_CUR_VCV_CTL_PRE_RUN = 0) **or**

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```
        (    LV_IGK = 0                    and
             T_PWL > C_T_MIN_PWL        and
             PWL_LOCK_CDN = 0 (mask out: NC_PWL_LOCK_CDN_NVMY,
             NC_PWL_LOCK_CDN_RLY_MAIN,
             NC_PWL_LOCK_CDN_BN2000,
             NC_PWL_LOCK_CDN_CUS)
               )

    THEN     LV_RLY_MAIN_SYS = 0
    ELSE     LV_RLY_MAIN_SYS = 1

IF(1)       LV_ES = 0
THEN(1)    LV_RLY_MAIN = LV_RLY_MAIN_SYS
ELSE(1)    IF(2)            LC_RLY_MAIN_MAN_REQ = 1
            THEN(2)         LV_RLY_MAIN = LC_RLY_MAIN_MAN_ADJ
            ELSE(2)         IF(3)           LV_RLY_MAIN_EXT_ADJ = 1
                            THEN(3)       LV_RLY_MAIN = LV_ACT_RLY_MAIN_EXT_ADJ
                            ELSE(3)       LV_RLY_MAIN = LV_RLY_MAIN_SYS
                            ENDIF(3)
          ENDIF(2)
ENDIF(1)

If    LV_RLY_MAIN = 1
Then
      Switch ON main relay                    {set the status of the control command to ON }
Else
      Switch OFF main relay          {set the status of the control command to OFF}
End
```

9.22.2 Acknowledge IGK off

FUNCTION DESCRIPTION:

General information:

Purpose of this module is to send the acknowledge info via HW line for switching off KL15. The same pin is used in case of active engine start stop automatic (STST) in order to control the starter relay.

Application conditions

Initialisation: `at reset all 0`

Recurrence: `10 ms`

Activation: `at every engine state`

Deactivation: -

Formula section:

Definition of timer for pin control in case of diagnosis test pulse

If LC_IGK_OFF_DIAG_PLS = 1 **and** *//switch for diagnosis pulse activated*

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```
          [LV_DC = 0 -> 1                    or            //diagnosis pulse only at first DC
      start
          (LC_IGK_OFF_DIAG_PLS_SWI = 1        and           //switch for diagnosis pulse
      mode
          LV_ST_END = 0 -> 1)]                        // diagnosis pulse at every start
then      T_IGK_OFF_ACK_DIAG_PLS = C_T_IGK_OFF_ACK_DIAG_PLS
endif
If         LV_ST_END = 1
then      T_IGK_OFF_ACK_DIAG_PLS = T_IGK_OFF_ACK_DIAG_PLS -10ms
else      T_IGK_OFF_ACK_DIAG_PLS = 0
endif
```

Defintion of timer for pin control in case of acknowledge IGK off

```
If         STATE_ACK_IGK_OFF(n -1) = 0     and
           STATE_ACK_IGK_OFF(n) = 1
then      T_ACK_IGK_OFF = C_T_ACK_IGK_OFF
endif
If         STATE_ACK_IGK_OFF = 1
then      T_ACK_IGK_OFF = T_ACK_IGK_OFF - 10ms
else      T_ACK_IGK_OFF = 0
endif
If         [(T_ACK_IGK_OFF > 0              or
           T_IGK_OFF_ACK_DIAG_PLS > 0)   and
           LC_IGK_OFF_ACK = 1]             or
           (LV_VAR_STST = 1                and
          LV_RLY_ST_STST = 1)
then      LV_IGK_OFF_ACK = 1
else      LV_IGK_OFF_ACK = 0
endif
```

Control of HW-pin

ACTION_INFR_SetIGK_OFF(IN < LV_IGK_OFF_ACK >**)**

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9.23 Power latch management

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_PWL_TRAN_ES_EL	O/V	0... 1H	0 ...1	1	-
flag active in shutdown-phase: IGK on is not accepted without reset					
LV_PWL_ACT	O/V	0... 1H	0 ...1	1	-
power latch phase active (Do not use as Output)					
PWL_LOCK_CDN	O/V	0... FFFFH	0... 65535	1	-
Power latch extension by project-specific configuration:see configuration-values in bitmask NC_PWL_LOCK_CDN_XXX					
T_PWL	O/V	0... FFFFH	0... 6553.5	0.1	s
incrementing timer during PWL phase active					

Input data:

LV_DIAG_END_RLY_ MAIN_DLY {p. 4933}	NC_PWL_LOCK_CDN_ XXX	STATE_LRN_ECU {p. 657}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MAX_PWL	-	0... FFFFH	0... 6553.5	0.1	s
maximum power-latch time for ECU switch off (if reached => not saved data will be lost)					
C_T_MIN_PWL	-	0... FFFFH	0... 6553.5	0.1	s
minimum power-latch time for ECU switch off					

Action definition

ACTION_FCTM_ClrPwlLockCdn (**IN**<Param1>)	Mode: O
Clear related flag at pwl_lock_cdn	

ACTION_FCTM_SetPwlLockCdn (**IN**<Param1>)	Mode: O
Set related flag at pwl_lock_cdn	

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FUNCTION DESCRIPTION:

Initialisations:

T_PWL = 0 at RST **or** EXIT_PWL
LV_PWL_ACT = 0
LV_PWL_ACT = 1 at TO_PWL

Recurrence: 100 ms
Activation: LV_PWL_ACT = 1

General information:

The relevant informations for setting PWL_LOCK_CDN are transferred with the help of the action call.

The ECU keeps active for a minimum time after entering the powerlatch-phase.
The minimum ECU power latch time (C_T_MIN_PWL) can only be extended by other functions locking a PWL-resource using the bitword PWL_LOCK_CDN (see project specifc list of PWL configuration data (definition of NC_PWL_LOCK_CDN_XXX)). If the maximum powerlatch time C_T_PWL_MAX is reached the ECU will be shut down and all not saved data will be lost.

Bit-position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
PWL_LOCK_CDN																

Each other function is responsible itself to lock /unlock its own PWL-resource at entering /leaving the powerlatch-phase !

Formula section:

T_PWL = T_PWL + 100ms

If **(**T_PWL > C_T_MIN_PWL **and** PWL_LOCK_CDN = 0**)**
Or **(**T_PWL > C_T_MAX_PWL **and** atPWL_LOCK_CDN no NVMY Bit is set**)**
Or LV_INH_PWL_TRAN_ES_EL = 1 (already in shut down)
Then activate shut-down mechanism
Else do nothing
Endif

Actions for shut-down mechanism:

reactivation by switching IGK on is forbidden

- LV_INH_PWL_TRAN_ES_EL = 1
- disable Monitoring-unit (MU)
- wait until MU-disable is confirmed **or** Communication with MU failed **or** LV_DIAG_END_RLY_MAIN_DLY = 0
- all function specific initializations with end of power latch phase are done.
- The power-supply-pin of the ECU is switched off.
- Call 5V reset detection.

Requirements for ACTION_FCTM_SetPwlLockCdn(<param>):

param: NC_PWL_LOCK_CDN_xxx (see Appl. INCI)

Set related flag at pwl_lock_cdn

pwl_lock_cdn |= 1 shifted left by <param>

Requirements for ACTION_FCTM_ClrPwlLockCdn (IN <Param1>)

param: NC_PWL_LOCK_CDN_xxx (see Appl. INCI)

Clear related flag at pwl_lock_cdn

pwl_lock_cdn & = not (1 shifted left by <param>)

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9.24 Power latch management (Appl. Inc.)

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PWL_LOCK_CDN_BN2000	-	0... FFH	0... 255	1	-
PWL for BN2000					
NC_PWL_LOCK_CDN_CUS	-	0... FFH	0... 255	1	-
PWL for CUS functions required					
NC_PWL_LOCK_CDN_DMTL	-	0... FFH	0... 255	1	-
PWL for DMTL diagnosis					
NC_PWL_LOCK_CDN_EGR_AD	-	0... FFH	0... 255	1	-
PWL for EGR adaptation					
NC_PWL_LOCK_CDN_HPDI	-	0... FFH	0... 255	1	-
PWL for HPDI					
NC_PWL_LOCK_CDN_NVMY	-	0... FFH	0... 255	1	-
PWL for NVMY storage					
NC_PWL_LOCK_CDN_RLY_MAIN	-	0... FFH	0... 255	1	-
PWL for main relay diagnosis					
NC_PWL_LOCK_CDN_ROM_CHK	-	0... FFH	0... 255	1	-
PWL for ROM check					

General information:

The bitmask PWL_LOCK_CDN shows all functions by a defined bit-position, which has locked a PWL resource for PWL extension.

Bit-position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
PWL_LOCK_CDN																

It s also possible, that more than one function has locked the PWL.
Here all functions must unlock its request before the ECU is switched off.

Bitmask-name	Bitposition	PWL-lock-configuration-Description
NC_PWL_LOCK_CDN_XXX	0...15	
Values for project		
NC_PWL_LOCK_CDN_NVMY	0	PWL for NVMY storage
NC_PWL_LOCK_CDN_RLY_MAIN	1	PWL for main relay diagnosis
NC_PWL_LOCK_CDN_EGR_AD	2	PWL for EGR adaptation
NC_PWL_LOCK_CDN_BN2000	3	PWL for BN2000
NC_PWL_LOCK_CDN_DMTL	4	PWL for DMTL diagnosis
NC_PWL_LOCK_CDN_ROM_CHK	5	PWL for ROM check
NC_PWL_LOCK_CDN_CUS	6	PWL for CUS functions required
NC_PWL_LOCK_CDN_HPDI	7	PWL for HDPI (shaker function)
project-specific configuration of PWL resources, which can be locked		

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9.25 Engine speed limitation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_N_MAX	O/V	0... 1H	0 ...1	1	-
Logical variable engine speed limitation active					
LV_N_MAX_REQ_FCUT	O/V	0... 1H	0 ...1	1	-
Logical variable fuel cut off of all cylinder requested for engine speed limitation					
N_DIF_MAX_LIM	V	E020... 1FE0H	0... 8160	1	rpm
Engine speed difference as an input for PI controller					
N_GRD_FIL	V	80... 7FH	0... 4064	32	rpm/s
Engine speed gradient pre selection for low pass filter					
N_GRD_FIL_FIL	V	80... 7FH	0... 4064	32	rpm/s
Low pass filtered engine speed gradient for predicted engine speed					
N_PRED_MAX_LIM	V	0... 1FE0H	0... 8160	1	rpm
Predicted engine speed					
TQ_N_MAX_DIF	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Torque output of N_MAX PI Controller					
TQ_N_MAX_DIF_I	V	80000000... 7FFFFFFFH	0... 1024	47.6837e6	Nm
Torque output of N_MAX I Controller					
TQ_N_MAX_DIF_P	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Torque output of VS_MAX P Controller					
TQ_N_MAX_INP_I	V	8000... 7FFFH	0... 3.99987793	12.20699e3	Nm
Torque input for N_MAX I controller					
TQI_N_MAX	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Indicated engine torque setpoint for N_MAX limitation					
TQI_N_MAX_1	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Intermidiate value 1 for indicated engine torque after considering PI controller output					
TQI_N_MAX_2	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Intermidiate value 2 indicated engine torque after considering PI controller output					
TQI_N_MAX_REF	V	0... 7FFFH	0... 1023.97	0.03125	Nm
Reference indicated engine torque on which controller output is applied					

Input data:

GEAR {p. 1302}	LV_AT {p. 654}	LV_INH_GP_SUP {p. 1566}	LV_VAR_BN {p. 655}
LV_VAR_TCT {p. 656}	N {p. 1525}	N_32 {p. 1525}	N_GRD {p. 1525}
N_MAX_THD {p. 1148}	STATE_ETCU_PROG_INFO {p. 1574}	TQI_AV {p. 981}	TQI_REQ_TRA {p. 8192}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ADD_N_MAX_FCUT	-	0... 1FE0H	0... 8160	1	rpm
Additive threshold to maximum engine speed for activation fuel cut off all cylinders					
C_CRLC_N_GRD_FIL_1	-	0... FFFFH	0... 0.99998474	152.588e3	-
N_GRD_FIL low pass filter constant if LV_N_MAX = 0					
C_CRLC_N_GRD_FIL_2	-	0... FFFFH	0... 0.99998474	152.588e3	-
N_GRD_FIL low pass filter constant if LV_N_MAX = 1					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_GRD_HYS	-	80... 7FH	0... 4064	32	rpm/s
Hysteresis for N_GRD Filtering					
C_TQI_MAX_PAS	-	0... 7FFFH	0... 1023.97	0.03125	Nm
Passive value for TQI_N_MAX if engine speed limitation is passive					
C_TQI_N_MAX_INC	-	0... 7FFFH	0... 1023.97	0.03125	Nm
Maximum increment for the output when limiting increasing rate					
ID_FAC_N_MAX_I_AT__GEAR	-	0... FFFFH	0... 7.99987793	12.20699e3	Nm/rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
I control parameter for N_MAX controller automatic transmission and AMT					
ID_FAC_N_MAX_I_MT__GEAR	-	0... FFFFH	0... 7.99987793	12.20699e3	Nm/rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
I control parameter for N_MAX controller manual transmission					
ID_FAC_N_MAX_P_AT__GEAR	-	0... FFH	0... 7.96875	0.03125	Nm/rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
P control parameter for N_MAX controller automatic transmission and AMT					
ID_FAC_N_MAX_P_MT__GEAR	-	0... FFH	0... 7.96875	0.03125	Nm/rpm
LDPM_GEAR	9	0... FFH	0... 255	1	-
P control parameter for N_MAX controller manual transmission					
ID_FAC_TQI_N_MAX_REF	-	0... FFH	0... 0.99609375	0.00390625	-
LDPM_GEAR	9	0... FFH	0... 255	1	-
Factor on TQI_N_MAX_REF value to init. I controller					
ID_T_N_MAX_PRED_AT__GEAR	-	0... FFH	0... 7.96875	0.03125	s
LDPM_GEAR	9	0... FFH	0... 255	1	-
Prediction time for predicted engine speed for automatic transmission and AMT					
ID_T_N_MAX_PRED_AT_MAN	-	0... FFH	0... 7.96875	0.03125	s
LDPM_GEAR	9	0... FFH	0... 255	1	-
Prediction time for predicted engine speed for AT in manual mode M					
ID_T_N_MAX_PRED_MT__GEAR	-	0... FFH	0... 7.96875	0.03125	s
LDPM_GEAR	9	0... FFH	0... 255	1	-
Prediction time for predicted engine speed for manual transmission					
IP_N_GRD_THD__N_32	-	0... FFH	0... 4064	32	rpm/s
LDP_N_32_N_GRD_THD	6	0... FFH	0... 8160	32	rpm
Engine speed gradient threshold for filtering of basic engine speed gradient					
LC_VAR_ETCU_SPT_SWI	-	0... 1H	0 ...1	1	-
LC indicating version of AT or TCT transmission (0 = ETCU without sport switch, 1 = ETCU with sport switch)					

Function description

General information:
The objective of this function is to protect the engine against overspeed and therefore to control the engine speed. A PI controller is used to hold the engine speed at the engine speed limit setpoint, which derives from the module 'Engine speed limit coordination' from chapter 4. Engine overspeed mainly is controlled by reduction of engine torque. The output value of this module is TQI_N_MAX, which is an input in the torque coordination module. Different tasks are designed in this module:
prediction of engine speed to avoid great engine speed overshoots, especially in the first phase of controlling
activation of speed limit controller due to speed deviation between predicted engine speed and engine speed limit
PI controller
activation of fuel cut off for exceeding the engine speed limit for more than a calibratable difference

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rate limiter for the output in increasing direction to avoid uncomfortable jumps in the torque demand

Application Condition

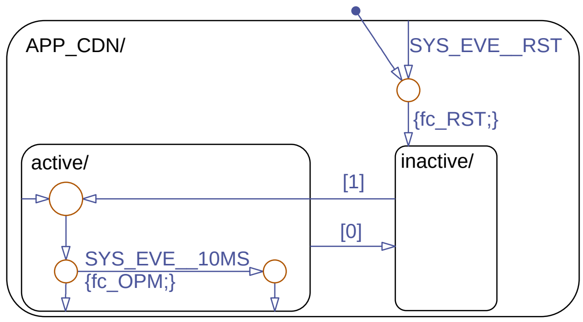

Figure 9.25.1: ENSL_M901E/APP_CDN/APPCND

Function Description

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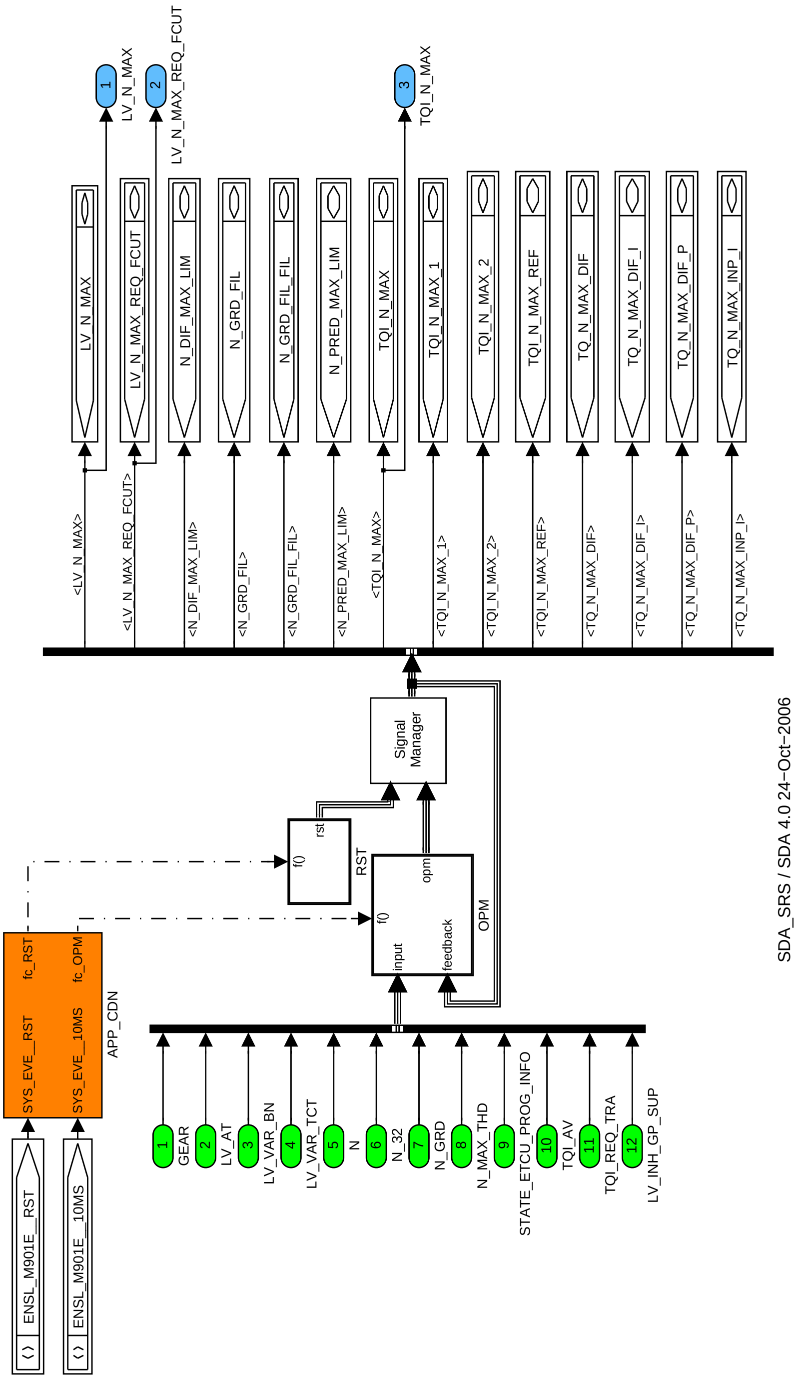

Figure 9.25.2: ENSL_M901E

9.25.1 Initialisation at system event reset

All output variables are initialised here.

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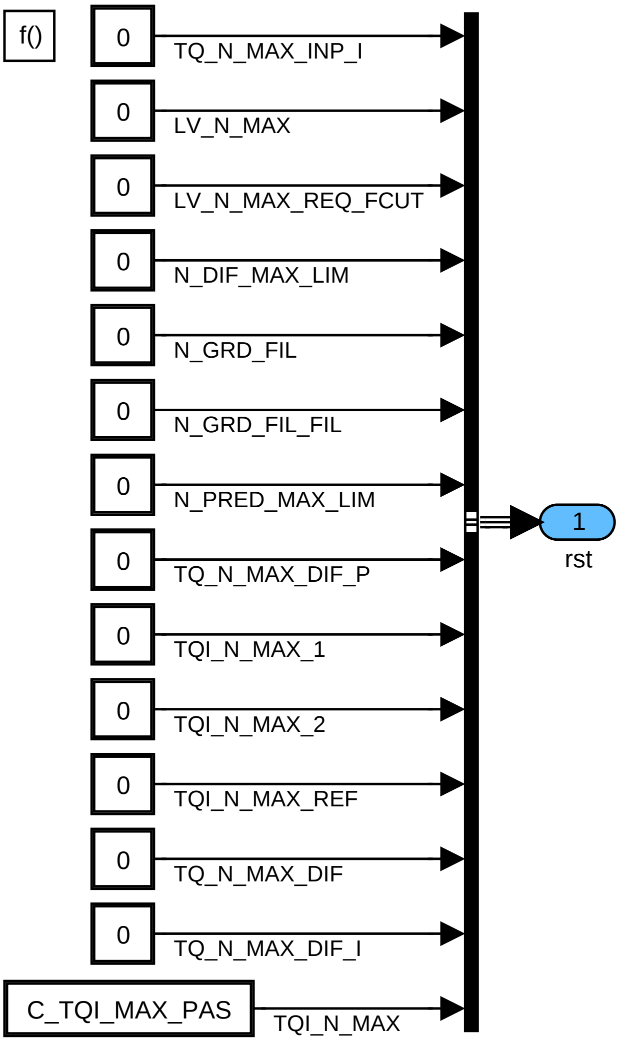

Figure 9.25.3: ENSL_M901E/RST

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9.25.2 Formula section

Calculation of predicted engine speed
The engine speed prediction shall activate the engine speed limitation controller before the real engine speed reaches the threshold N_MAX_THD. Therefore the complete controller has a PID behaviour at activation, to prevent high engine speed overshoot.
The prediction is deactivated, if the controller has stopped the engine speed increase. During the following period the PI controller can guarantee the engine speed limitation up to N_MAX_THD without predicting the engine speed.
Due to a bad resolution of N_GRD, the prediction is only calculated, if a clear high engine speed gradient is detected. This is possible by comparing the gradient N_GRD with an engine speed depending threshold IP_N_GRD_THD__N_32.
The prediction is stopped latest, if the real engine speed is no longer increasing
(N_GRD =< 0).
To prevent sudden changes for the engine speed limit controller input at activation or deactivation, it is necessary to have a PT1 filter for the engine speed controller input. So a negative feed back of the controller output to the real engine speed is prevented.

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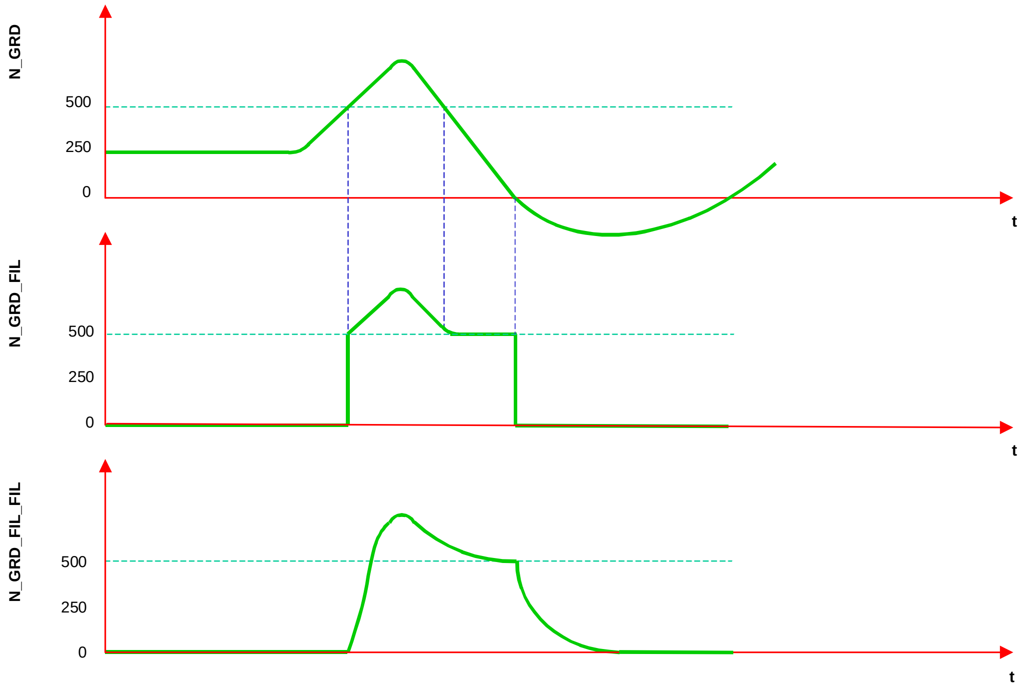

Figure 9.25.4: : Filtering of engine speed gradient

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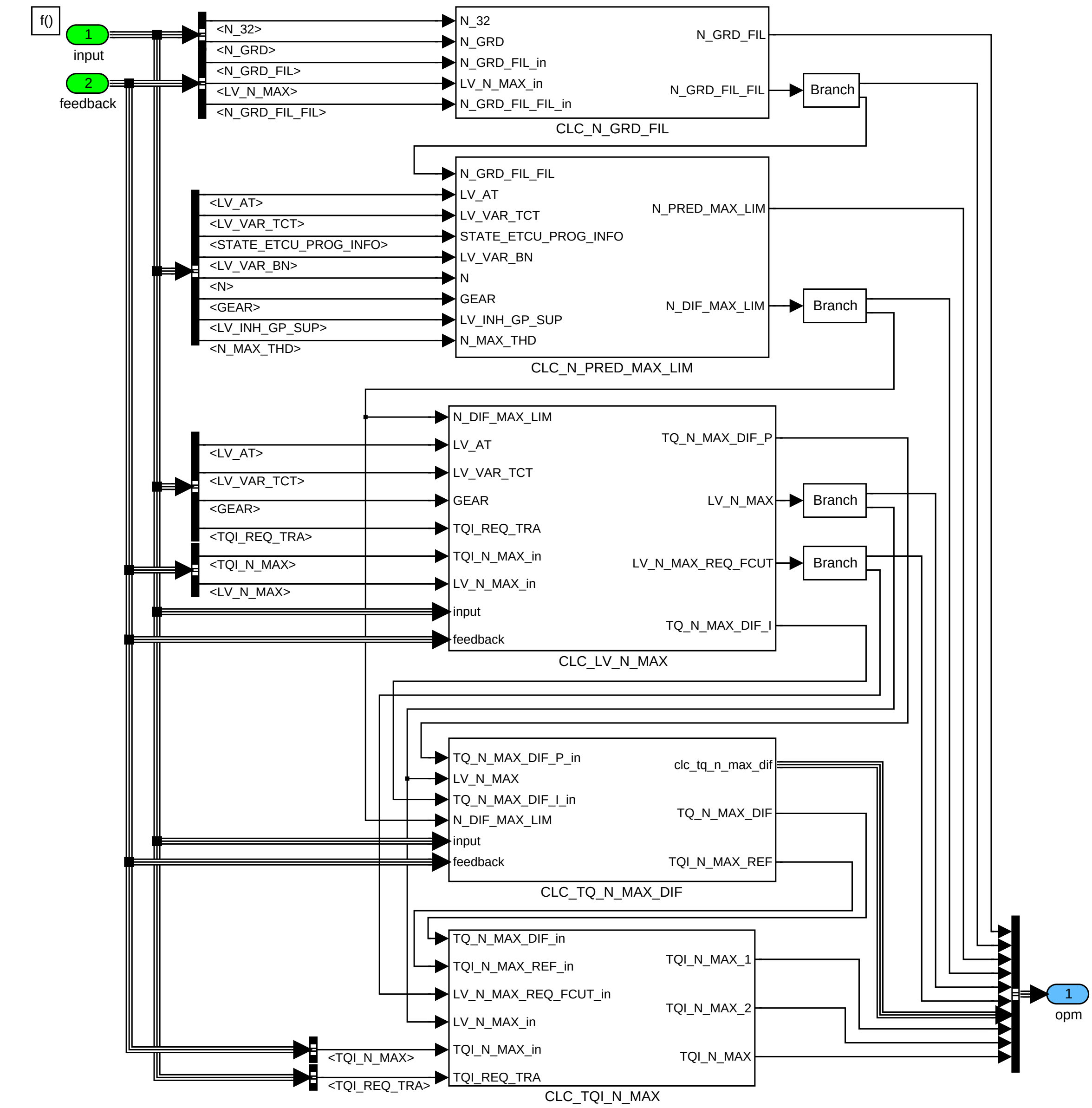

Figure 9.25.5: ENSL_M901E/OPM

Calculation of engine speed gradient pre selection and low pass filtered engine speed gradient for predicted engine speed

N_GRD_FIL and N_GRD_FIL_FIL are calculated.

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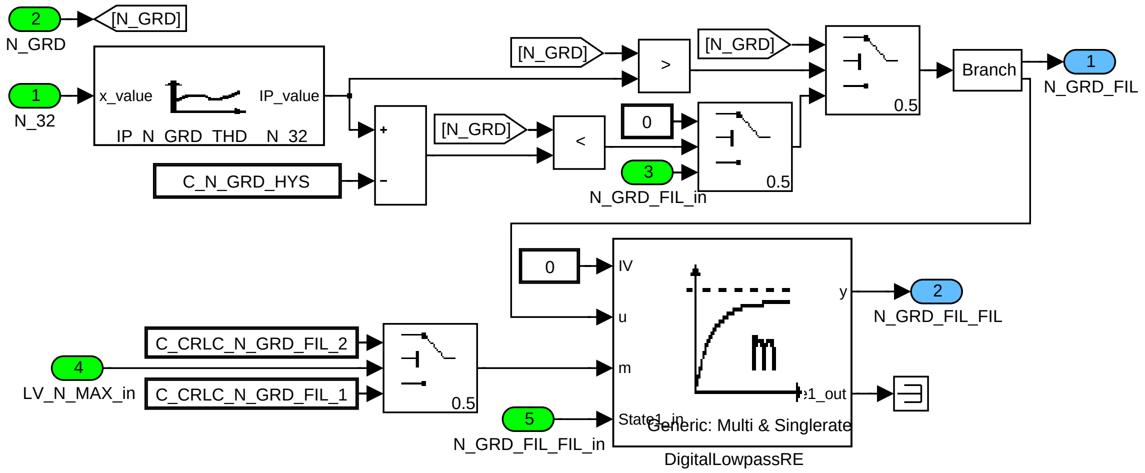

Figure 9.25.6: ENSL_M901E/OPM/CLC_N_GRD_FIL

Calculation of predicted engine speed and engine speed deviation from threshold

N_PRED_MAX_LIM and N_DIF_MAX_LIM are calculated

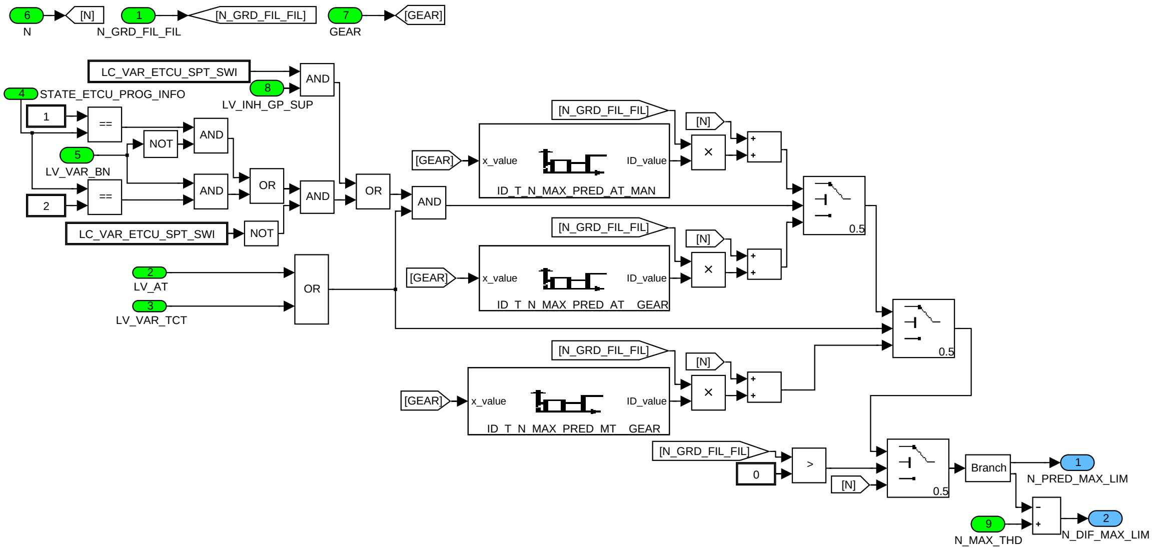

Figure 9.25.7: ENSL_M901E/OPM/CLC_N_PRED_MAX_LIM

Calculation of TQ_N_MAX_DIF_P, LV_N_MAX and LV_N_MAX_REQ_FCUT

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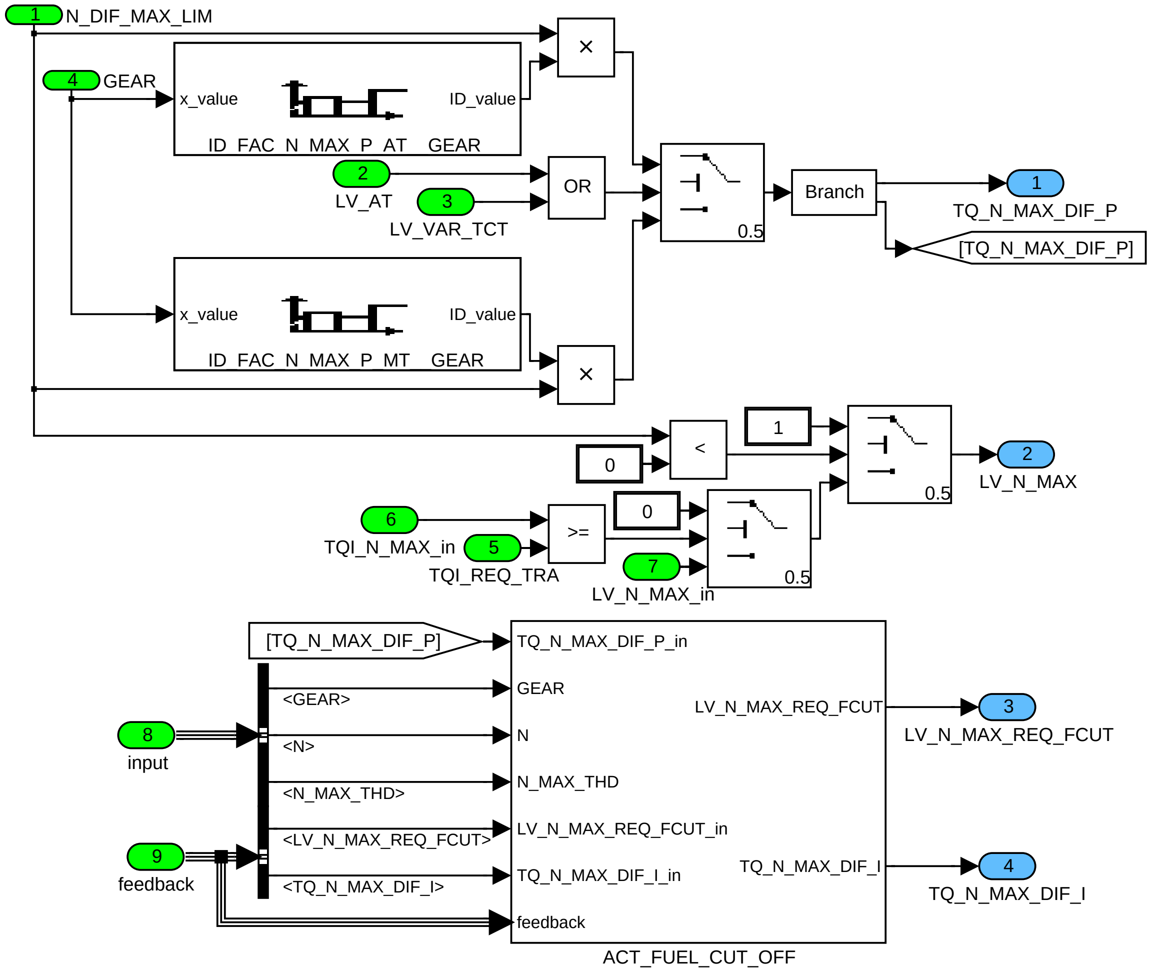

Figure 9.25.8: ENSL_M901E/OPM/CLC_LV_N_MAX

Calculation of logical variable for fuel cut off.

LV_N_MAX_REQ_FCUT is calculated.

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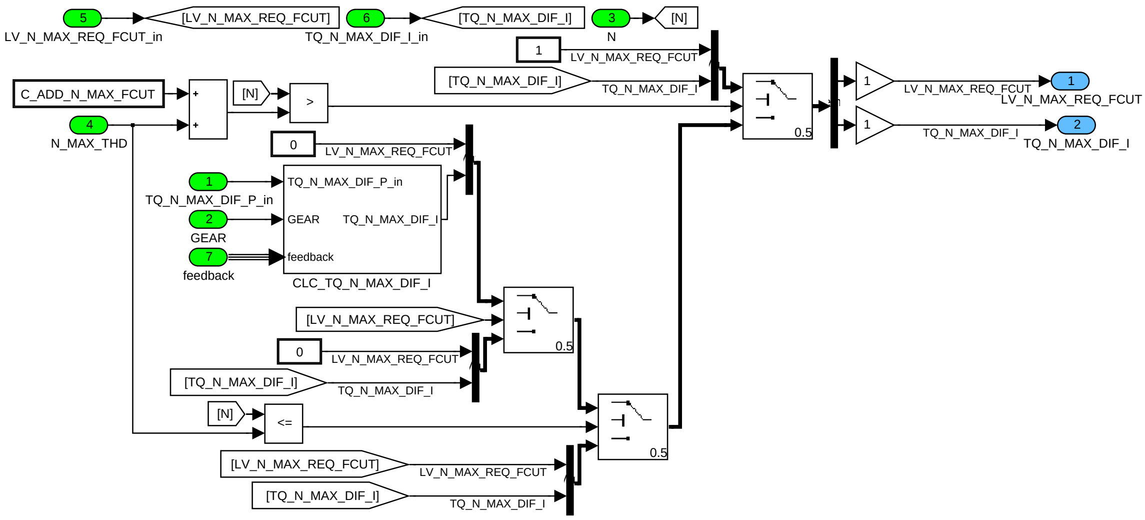

Figure 9.25.9: ENSL_M901E/OPM/CLC_LV_N_MAX/ACT_FUEL_CUT_OFF

Initialisation of N MAX integrator.

Calculation of TQ_N_MAX_DIF_I

The integrator has to be initialized for the transition of LV_N_MAX from 0 to 1 and for the transition of LV_N_MAX_REQ_FCUT from 1 to 0. In the first case the integrator output is set to zero and in the second case the integrator output has to ensure that the TQI_N_MAX does not show a step (during LV_N_MAX_REQ_FCUT active the TQI_N_MAX is set to zero).

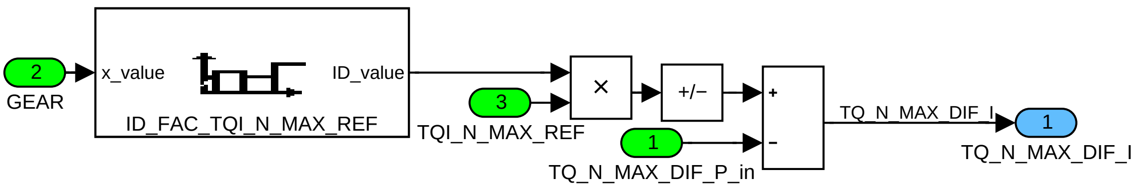

Figure 9.25.10: ENSL_M901E/OPM/CLC_LV_N_MAX/ACT_FUEL_CUT_OFF/
CLC_TQ_N_MAX_DIF_I/CLC_TQ_N_MAX_DIF_I

Determination n_max limitation TQ_N_MAX_DIF using N_MAX_PI controller

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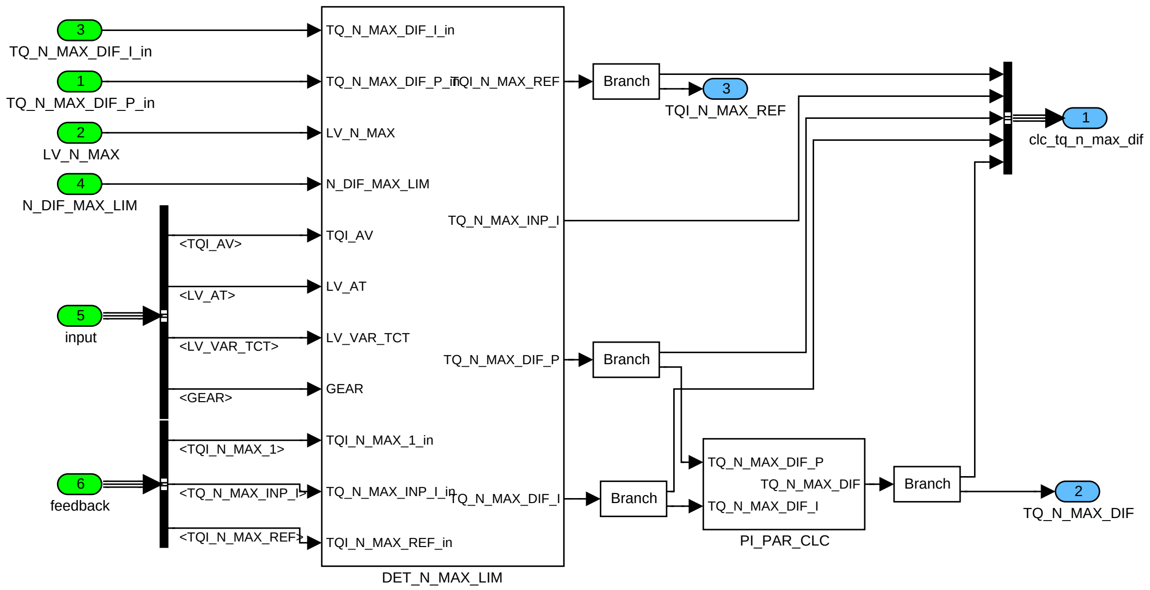

Figure 9.25.11: ENSL_M901E/OPM/CLC_TQ_N_MAX_DIF

Determination of TQ_N_MAX_REF, TQ_N_MAX_DIF_P, TQ_N_MAX_DIF_I and TQ_N_MAX_INP_I

The integrator input has to be set to zero, when the TQ_N_MAX_1 is smaller than zero and the calculated input TQ_N_MAX_INP_1 is smaller than or equal to zero. This avoids a steadily decrease of the integrator output which could cause problems when re entering the controller.
TQ_N_MAX_REF, TQ_N_MAX_DIF_P, TQ_N_MAX_DIF_I and TQ_N_MAX_INP_I are calculated here.

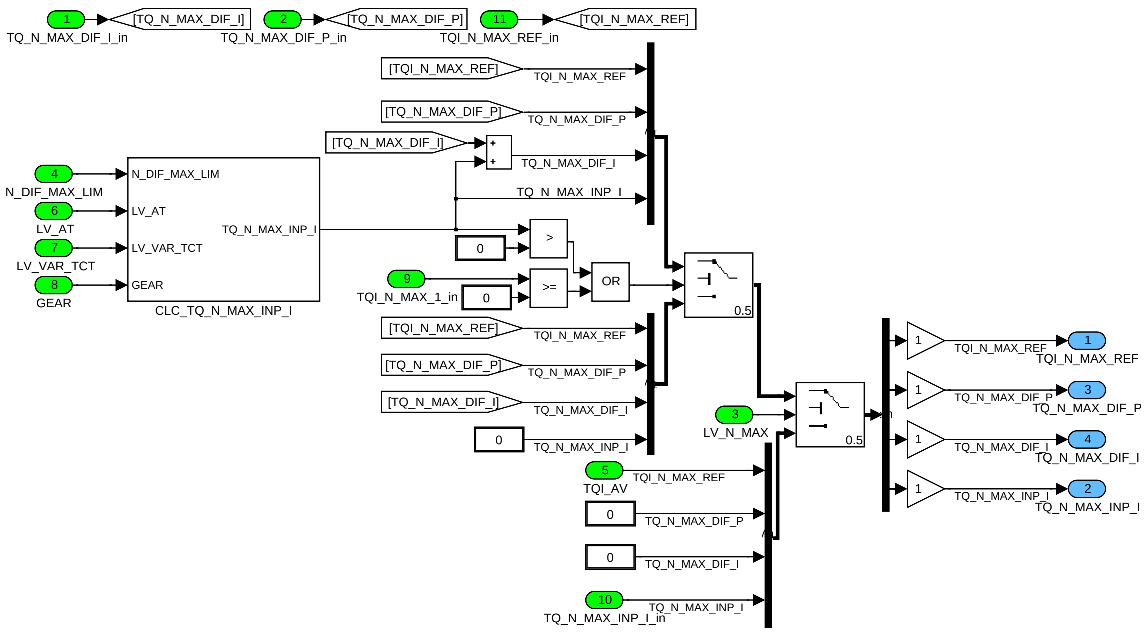

Figure 9.25.12: ENSL_M901E/OPM/CLC_TQ_N_MAX_DIF/DET_N_MAX_LIM

Calculation of TQ_N_MAX_INP_I

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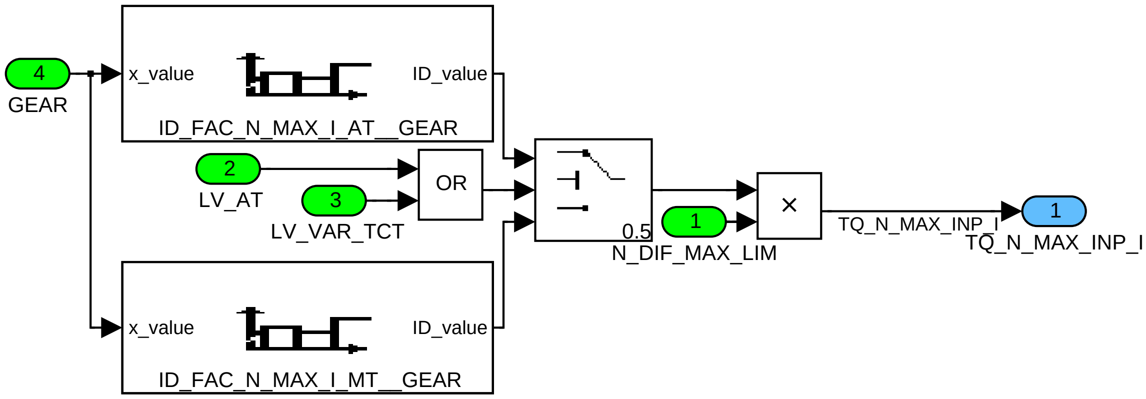

Figure 9.25.13:
ENSL_M901E/OPM/CLC_TQ_N_MAX_DIF/DET_N_MAX_LIM/CLC_TQ_N_MAX_INP_I

Calculation of TQ_N_MAX_DIF

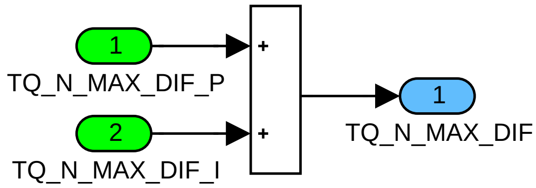

Figure 9.25.14: ENSL_M901E/OPM/CLC_TQ_N_MAX_DIF/PI_PAR_CLC

Determination of indicated engine torque setpoint for N_MAX limitation

TQ_N_MAX_1, TQ_N_MAX_2 and TQI_N_MAX are calculated here.

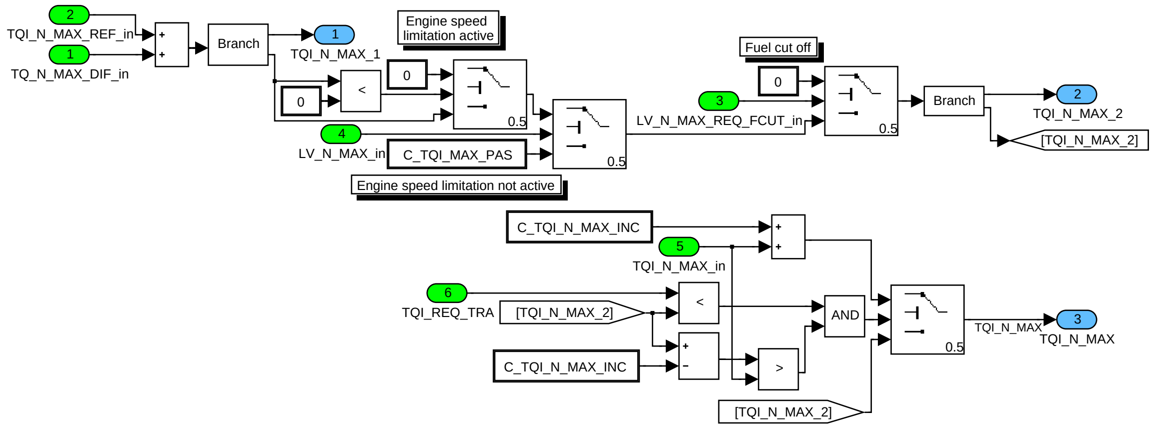

Figure 9.25.15: ENSL_M901E/OPM/CLC_TQI_N_MAX

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9.26 CAN protocol

The Software contains a CAN calibration protocol in accordance with the Spec

CAN-Calibration Protocol
Draft Version 2.1, 03-june-98

Remark: Online Data acquisition with CCP is also possible with connected ETK, but calibration with these ECUs is only possible via ETK.

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9.27 Fuel pressure setpoint of low pressure pump

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FUP_EFP_SP	O/V	0... FFFFH	0... 173888	2.6533608	hPa
Fuel pressure setpoint of electrical fuel pump					
FUP_EFP_SP_TMP	V	0... FFFFH	0... 173888	2.6533608	hPa
Temporary value of fuel pressure setpoint of electrical fuel pump before limitation					

Input data:

LV_FUP_EFP_SP_EXT_REQ {p. 988}	LV_FUP_LIH_L_PRS_CTL_REQ {p. 4001}	LV_PU {p. 1720}	LV_PUC {p. 1720}
MFF_SP_FUP_CTL {p. 2151}	N_32 {p. 1525}	STATE_EFP {p. 3797}	T_AST {p. 1766}
TCO_ST {p. 1100}	TFU {p. 1232}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_EFP_SP_EXT_REQ	-	0... FFFFH	0... 173888	2.6533608	hPa
External FUP_EFP_SP					
C_FUP_EFP_SP_HPP_LIH	-	0... FFFFH	0... 173888	2.6533608	hPa
Fuel pressure setpoint for high pressure pump limp home					
C_FUP_EFP_SP_LIM_DEC	-	0... FFFFH	0... 173888	2.6533608	hPa
Decrement for fuel pressure setpoint limitation					
C_FUP_EFP_SP_LIM_INC	-	0... FFFFH	0... 173888	2.6533608	hPa
Increment for fuel pressure setpoint limitation					
C_FUP_EFP_SP_MAN	-	0... FFFFH	0... 173888	2.6533608	hPa
Manual FUP_EFP_SP					
C_FUP_EFP_SP_PUC	-	0... FFFFH	0... 173888	2.6533608	hPa
Low fuel pressure setpoint in PU/PUC					
C_FUP_EFP_SP_PWL	-	0... FFFFH	0... 173888	2.6533608	hPa
Low fuel pressure setpoint during power latch phase of EFP					
IP_FUP_EFP_SP	V	0... FFFFH	0... 173888	2.6533608	hPa
LDP_MFF_SP_FUP_CTL_IP_EFP_SP	4	0... FFFFH	0... 1389	0.0211948	mg
LDP_N_32_IP_FUP_EFP_SP	4	0... FFH	0... 8160	32	rpm
Fuel pressure setpoint of low pressure pump for normal operation					
IP_FUP_EFP_SP_HST	-	0... FFFFH	0... 173888	2.6533608	hPa
LDP_MFF_SP_FUP_CTL_IP_EFP_MIN	8	0... FFFFH	0... 1389	0.0211948	mg
Map with the FUP_EFP setpoint for the hot start					
IP_FUP_EFP_SP_MIN	-	0... FFFFH	0... 173888	2.6533608	hPa
LDP_TFU_IP_FUP_EFP_SP	8	0... FEH	-48... 142.5	0.75	°C
Minimum fuel pressure setpoint of low pressure pump					
IP_T_FUP_EFP_SP_HST	-	1... FFFFH	0.01... 655.35	0.01	s
LDP_TCO_ST_IP_T_FUP_EFP_SP_HST	3	0... FEH	-48... 142.5	0.75	°C
Map with the time for the FUP_EFP setpoint for the hot start					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_FUP_EFP_SP_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual FUP_EFP_SP					

General information:

The module fuel pressure setpoint of electrical fuel pump delivers a fuel setpoint to the module fuel pressure control.

The fuel pressure setpoint of the low pressure pump is normally taken out of a map depending on engine speed and injected fuel mass. Exemptions are power latch phase of the electrical fuel pump and the pull mode. Additionally a testbench function is included. In order to avoid to big fuel pressure setpoint gradients a certain gradient limitation is included.

Application conditions:

Initialisation: RST
Recurrence: 100MS
Activation: always
Deactivation: never

Function description:

Formula section:

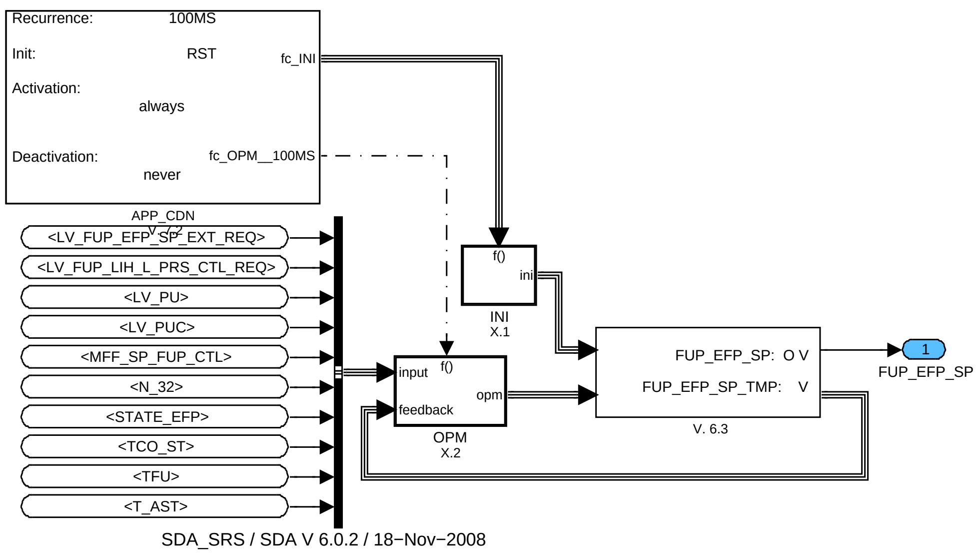

Figure 9.27.1: :

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9.27.1 Initialization

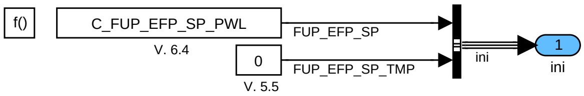

Figure 9.27.2: :

9.27.2 Formula Section:

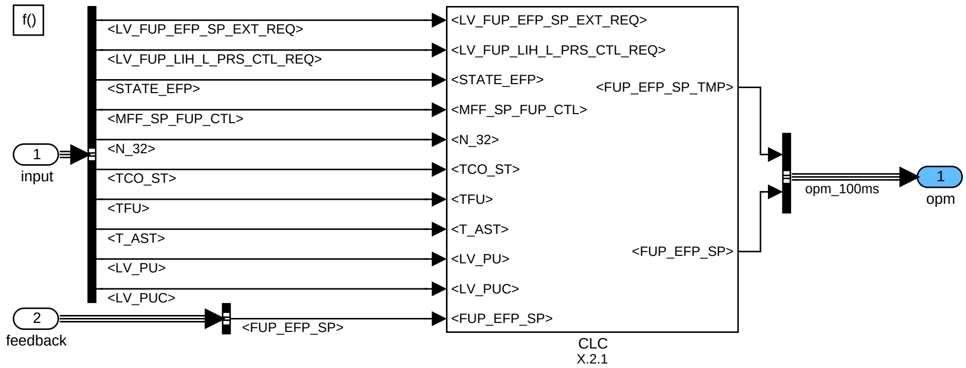

Figure 9.27.3: :

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9.27.2.1 Fuel pressure setpoint calculation

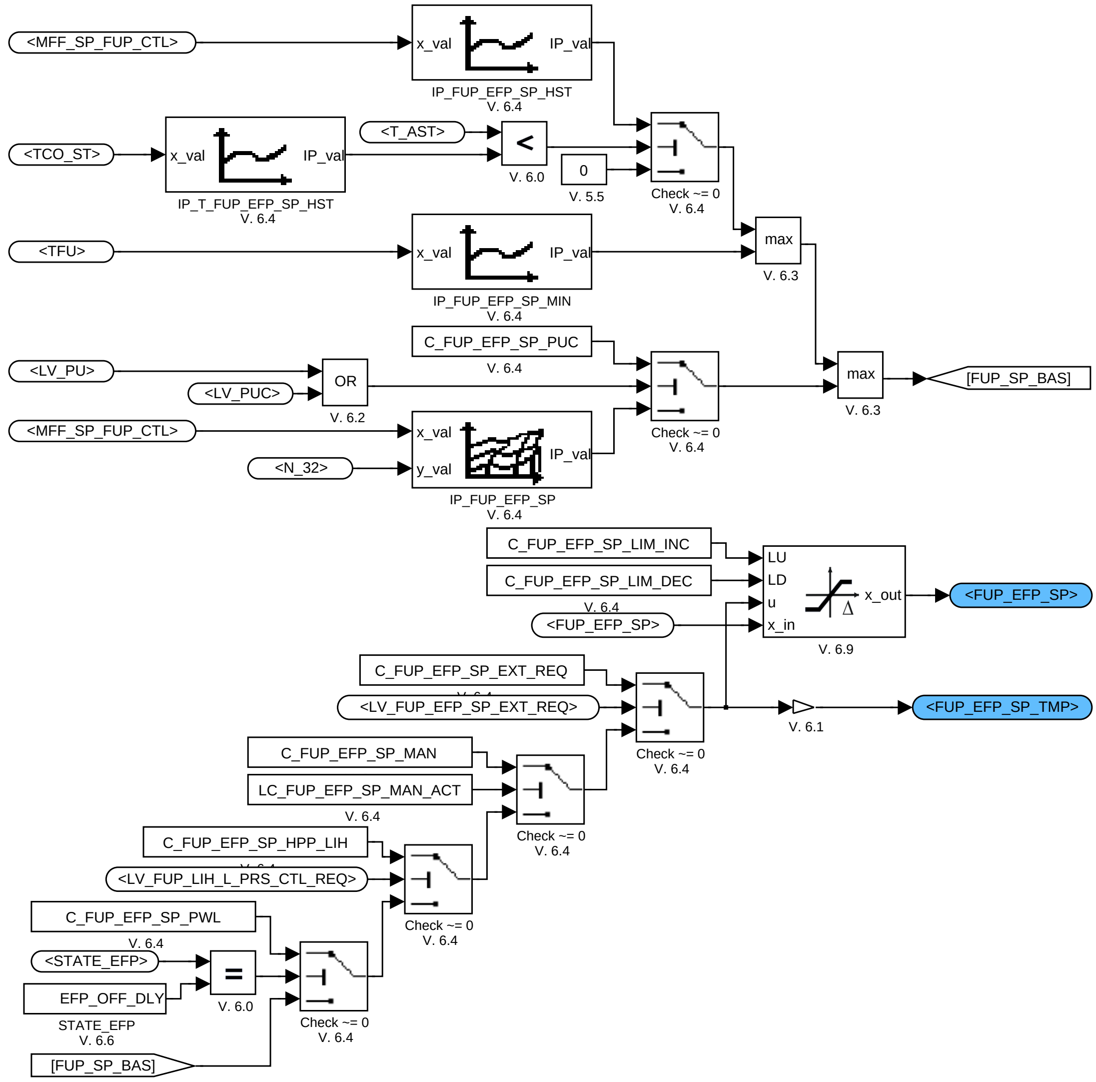

Figure 9.27.4: :

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9.28 Fuel pump low pressure control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_SEG_EFPPWM_I_AD	V	0... FFFFH	0... 65535	1	-
Segment counter before I-part adaptation is allowed					
CTR_SEG_EFPPWM_MIN_AD	V	0... FFFFH	0... 65535	1	-
Segment counter before minimum PWM adaptation is allowed					
EFPPWM	O/V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Pump speed of the electrical fuel pump as PWM signal					
EFPPWM_BAS	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Precontroller value of EFPPWM					
EFPPWM_I	O/V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
I-Part of the controller					
EFPPWM_I_AD	O/V/S	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Adaptive I-Part of the controller					
EFPPWM_I_AD_DIF	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Adaptive I-Part difference of the controller					
EFPPWM_I_TMP	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Temporary I-Part of the controller					
EFPPWM_MIN_AD	O/V/S	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Minimum pump speed of the electrical fuel pump as PWM signal					
EFPPWM_P	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
P-Part of the controller					
FUP_EFP_DIF	V	8000... 7FFFH	-869... 86942.67	2.6533608	hPa
Deviation of the fuel pressure after fuel pump from the setpoint					
FUP_EFP_GRD	V	8000... 7FFFH	-869... 86942.67	2.6533608	hPa/10ms
Calculated requested amount of fuel from the pump					
LV_EFP	O/V	0... 1H	0 ...1	1	-
Logical variable for electrical fuel pump active					
LV_EFPPWM_AD_STOP	O/V	0... 1H	0 ...1	1	-
Logical variable for adaptation stop					
LV_EFPPWM_CTL_RST	V	0... 1H	0 ...1	1	-
Logical variable for controller reset					
LV_EFPPWM_CTL_STOP	V	0... 1H	0 ...1	1	-
Logical variable for I-part freeze					
LV_EFPPWM_I_AD_VLD	O/V/S	0... 1H	0 ...1	1	-
Logical variable showing valid adaptive I-Part of EFPPWM					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_EFPPWM_MIN_AD_ACT	V	0... 1H	0 ...1	1	-
Logical variable showing active minimum EFPPWM adaptation					
LV_EFPPWM_MIN_VLD	O/V/S	0... 1H	0 ...1	1	-
Logical variable showing valid minimum of EFPPWM					
LV_FUP_EFP_LIM	V	0... 1H	0 ...1	1	-
Logical variable indicating VFF limitation for the EFP					
STATE_EFP	O/V	0H 1H 2H 3H 4H 5H 6H	EFP_OFF EFP_ACR_ TEST EFP_ON EFP_OFF_DLY EFP_EXT_ADJ EFP_CRASH EFP_LIH	-	-
States of electrical fuel pump function					
VFF_EFP_CLC	V	0... FFFFH	0... 255	3.89105e-3	l/h
Calculated requested amount of fuel from the pump					
VFF_EFP_COR	V	0... FFFFH	0... 255	3.89105e-3	l/h
Volume fuel flow for correction of the EFP volume fuel flow					
VFF_EFP_REQ	O/V	0... FFFFH	0... 255	3.89105e-3	l/h
Requested amount of fuel from the pump					

Input data:

EFPPWM_EXT_ADJ {p. 7431}	ERR_SYM_FUP_EFP {p. 4733}	FUP_DIF {p. 3909}	FUP_EFP {p. 1290}
FUP_EFP_SP {p. 3792}	FUP_SP_TMP {p. 3868}	LV_EFP_CTL_AD_CLR_EXT_REQ {p. 7483}	LV_EFP_MAX_REQ {p. 3822}
LV_EFP_RUN_WKU {p. 3822}	LV_EFPPWM_EXT_ADJ {p. 800}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_EFP {p. 4733}
LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_FUP_LIH_HOM_VCV_OPEN_REQ {p. 4001}	LV_FUP_LIH_L_PRS_CTL_REQ {p. 4001}
LV_PIN_ICH {p. 988}	LV_PUC {p. 1720}	LV_ST_END {p. 1720}	MFF_SP_FUP_CTL {p. 2151}
N_32 {p. 1525}	STATE_EFP_TRAN {p. 3822}	T_AST {p. 1766}	T_EFP_RUN_WKU {p. 3823}
T_SEG_AV {p. 1525}	TCO {p. 1100}	TFU {p. 1232}	TFU_EFP {p. 1232}
VFF_EFP_ADD {p. 3823}	VFF_VCV {p. 3956}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_EFPPWM_I_AD	V	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for I-part adaptation					
C_CTR_FUP_SP_LIM_VFF_EFP_COR	V	0... FFFFH	0... 65535	1	-
Counter for duration of the limitation for VFF_EFP					
C_CTR_SEG_EFPPWM_I_AD_MAX	V	0... FFFFH	0... 65535	1	-
Maximum segment counter for the I-part adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_SEG_EFPWPM_MIN_AD_MAX	V	0... FFFFH	0... 65535	1	-
Maximum segment counter for the minimum EFPPWM adaptation					
C_EFPPWM_ACR_TEST_INC	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Increment for the actuator test					
C_EFPPWM_CRASH	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Min. electrical fuel pump speed at state EFP_CRASH					
C_EFPPWM_DEAC	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Minimum EFPPWM at ACR_TEST					
C_EFPPWM_I_AD_MAX	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Max. value for the adaptive I-part of the controller					
C_EFPPWM_I_AD_MIN	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Min. value for the adaptive I-part of the controller					
C_EFPPWM_I_MAX	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Max. value for the I-part of the controller					
C_EFPPWM_I_MAX_LIH_HOM_VCV_OPEN	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Max. value for the I-part of the controller in case of VCV open limphome					
C_EFPPWM_I_MIN	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Min. value for the I-part of the controller					
C_EFPPWM_I_MIN_LIH_HOM_VCV_OPEN	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Min. value for the I-part of the controller in case of VCV open limphome					
C_EFPPWM_LIH	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
EFP actuation in case of LIH					
C_EFPPWM_LIH_ADD	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Additive EFPPWM in case of limp home					
C_EFPPWM_MAN_ACT	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Manual value for the EFPPWM					
C_EFPPWM_MAX	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Max. electrical fuel pump speed					
C_EFPPWM_MIN_1	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Min. electrical fuel pump speed at state EFP_ON					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EFPPWM_MIN_2	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Min. electrical fuel pump speed at state EFP_OFF					
C_EFPPWM_MIN_AD_INI	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Initial value for the EFPPWM_MIN adaptation					
C_EFPPWM_MIN_AD_TOL	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Maximum value for the EFPPWM_MIN adaptation					
C_EFPPWM_MIN_COR	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Correction value for the EFPPWM to reach zero delivery					
C_EFPPWM_MIN_LIH_HOM_VCV_OPEN	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Min. electrical fuel pump speed in case of VCV open limphome					
C_FUP_EFP_DIF_MAX_EFPPMW_AD	V	8000... 7FFFH	-869... 86942.67	2.6533608	hPa
Maximum deviation of the fuel pressure after fuel pump from the setpoint for adaptation					
C_FUP_EFP_GRD_MAX	V	8000... 7FFFH	-869... 86942.67	2.6533608	hPa/10ms
Fuel pressure gradient for freezing EFPPWM during PUC					
C_FUP_EFP_SP_MAX_EFPPWM_MIN_AD	V	0... FFFFH	0... 173888	2.6533608	hPa
Maximum FUP EFP setpoint for the minimum adaptation of EFPPWM					
C_FUP_EFP_SP_MIN_EFPPWM_MIN_AD	V	0... FFFFH	0... 173888	2.6533608	hPa
Minimum FUP EFP setpoint for the minimum adaptation of EFPPWM					
C_FUP_RHO_FUEL_EFP	V	153B... FFFFH	74.6395056077 ...900	0.0& %■331	mg/cm**3
Density of the fuel					
C_FUP_SP_DIF_LIM_VFF_EFP_COR	V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint difference threshold for activation of the VFF_EFP correction					
C_MFF_SP_MAX_EFPPWM_I_AD	V	0... FFFFH	0... 1389	0.0211948	mg
Maximum injected fuel mass for allowing I-part adaptation					
C_MFF_SP_MAX_EFPPWM_MIN_AD	V	0... FFFFH	0... 1389	0.0211948	mg
Maximum injected fuel mass for allowing minimum EFPPWM adaptation					
C_MFF_SP_MIN_EFPPWM_I_AD	V	0... FFFFH	0... 1389	0.0211948	mg
Minimum injected fuel mass for allowing I-part adaptation					
C_MFF_SP_MIN_EFPPWM_MIN_AD	V	0... FFFFH	0... 1389	0.0211948	mg
Minimum injected fuel mass for allowing minimum EFPPWM adaptation					
C_N_MAX_EFPPWM_I_AD	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for allowing I-part adaptation					
C_N_MAX_EFPPWM_MIN_AD	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for allowing minimum EFPPWM adaptation					
C_N_MIN_EFPPWM_I_AD	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for allowing I-part adaptation					
C_N_MIN_EFPPWM_MIN_AD	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for allowing minimum EFPPWM adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_AST_EFPPWM_MIN_AD	V	0... FFFFH	0... 6553.5	0.1	s
Time after engine start to allow minimum EFPPWM adaptation					
C_TCO_MAX_EFPPWM_AD	V	0... FEH	-48... 142.5	0.75	°C
Maximum coolant temperature for allowing adaptation					
C_TCO_MIN_EFPPWM_AD	V	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature for allowing adaptation					
C_VFF_DIF_LIM_VFF_EFP_COR	V	0... FFFFH	0... 255	3.89105e-3	l/h
Constant for manual VFF difference for VFF_EFP correction					
C_VFF_EFP_COR_GRD_DEC	V	0... FFFFH	0... 255	3.89105e-3	l/h
Decrement gradient limitation for VFF_EFP_COR					
C_VFF_EFP_REQ_LIH	V	0... FFFFH	0... 255	3.89105e-3	l/h
EFP volume fuel flow value for limp home of the fuel low pressure system					
CLF_EFP_AD_RST_L_PRS_LIH	V	0... FFFFH	0... 65535	1	-
Bit field used to define if low pressure adaptation values are individually reset on fuel low pressure control limphome					
IP_EFPPWM_BAS_L_POW	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
LDP_VFF_EFP_REQ_IP_EFPPWM_BAS	8	0... FFFFH	0... 255	3.89105e-3	l/h
Basic value of the EFPPWM for low power version					
IP_EFPPWM_I	V	0... FFFFH	-50... 49.9984741211	1.52588e-3	%
LDP_FUP_EFP_DIF_IP_EFPPWM_I	8	0... FFFFH	-869... 86942.67	2.6533608	hPa
I-part of the controller					
IP_EFPPWM_I_VCV_LIH	V	0... FFFFH	-50... 49.9984741211	1.52588e-3	%
LDP_FUP_DIF_IP_EFPPWM_I_VCV_LIH	8	0... FFFFH	-173890 ...173884	5.3066911	hPa
I part of the controller in case of VCV open limphome					
IP_EFPPWM_P	V	0... FFFFH	-50... 49.9984741211	1.52588e-3	%
LDP_FUP_EFP_DIF_IP_EFPPWM_P	8	0... FFFFH	-869... 86942.67	2.6533608	hPa
P-part of the controller					
IP_EFPPWM_P_VCV_LIH	V	0... FFFFH	-50... 49.9984741211	1.52588e-3	%
LDP_FUP_DIF_IP_EFPPWM_P_VCV_LIH	8	0... FFFFH	-173890 ...173884	5.3066911	hPa
P part of the controller					
IP_EFPPWM_WKU	V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
LDP_T_EFP_RUN_WKU_IP_EFPPWM_WKU	4	0... FFFFH	0... 655.35	0.01	s
PWM duty cycle for electrical fuel pump after ECU wake-up					
IP_FAC_EFPPWM_BAS_L_POW	V	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDP_TFU_EFP_IP_FAC_EFPPWM_BAS	6	0... FEH	-48... 142.5	0.75	°C
LDP_FUP_EFP_SP_IP_FAC_EFPPWM	8	0... FFFFH	0... 173888	2.6533608	hPa
Correction factor for the basic value of the EFPPWM for low power version					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FUP_EFP_SP_COR_VCV_OPEN	V	8000... 7FFFH	-869... 86942.67	2.6533608	hPa
LDP_TFU_IP_FUP_EFP_SP_COR_VCV	8	0... FFH	-50 ...205	1	°C
Correction for EFP in case of VCV open lih					
LC_EFPPWM_CTL_RST_ON_ERR	V	0... 1H	0 ...1	1	-
Switch to define if fuel pump low pressure controller is reset on raw error symptom (= 0) or on debounced error symptom (= 1) of fuel low pressure sensor					
LC_EFPPWM_I_AD_CLR	V	0... 1H	0 ...1	1	-
Logical variable to clear the adaptive I-Part of the controller					
LC_FUP_EFP_AVL	V	0... 1H	0 ...1	1	-
Logical variable indicating ‘ fuel pressure sensor for low pressure line available					
LC_VFF_DIF_LIM_VFF_EFP_COR_MAN	V	0... 1H	0 ...1	1	-
Logical constant for switch to manual VFF_DIF for VFF_EFP correction					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_T_DLY_EFP_ACR_TEST_MAX	V	0... FFFFH	0... 655.35	0.01	s
Duration time for the actuator test at EFPPWM = 100 % till switch off (value: 5 s)					

General information:

The electrical fuel pump is controlled by the EFPPWM.
The PI-controller is used to compensate deviations from the nominal fuel pressure after the fuel pump. If no sensor is applied the EFPPWM is only calculated with the help of the precontrol map, which corresponds to the pump data.
In order to control also deviations caused by external influences or aging two adaptation strategies are applied. One adaptation is used in a nominal operating point where the I-part of the controller is taken as an adaptive I-part. The other adaptation gives the minimum EFPPWM for ensuring the correct fuel pressure for the jet pumps without increasing the fuel pressure to the level where the overpressure release valve opens.

Application conditions:

Initialisation:	`RST, NVMRES, NVMINI, NVMSTO`
Recurrence:	`10MS, SEG`
Activation:	`always`
Deactivation:	`never`

Function description:

Formula section:

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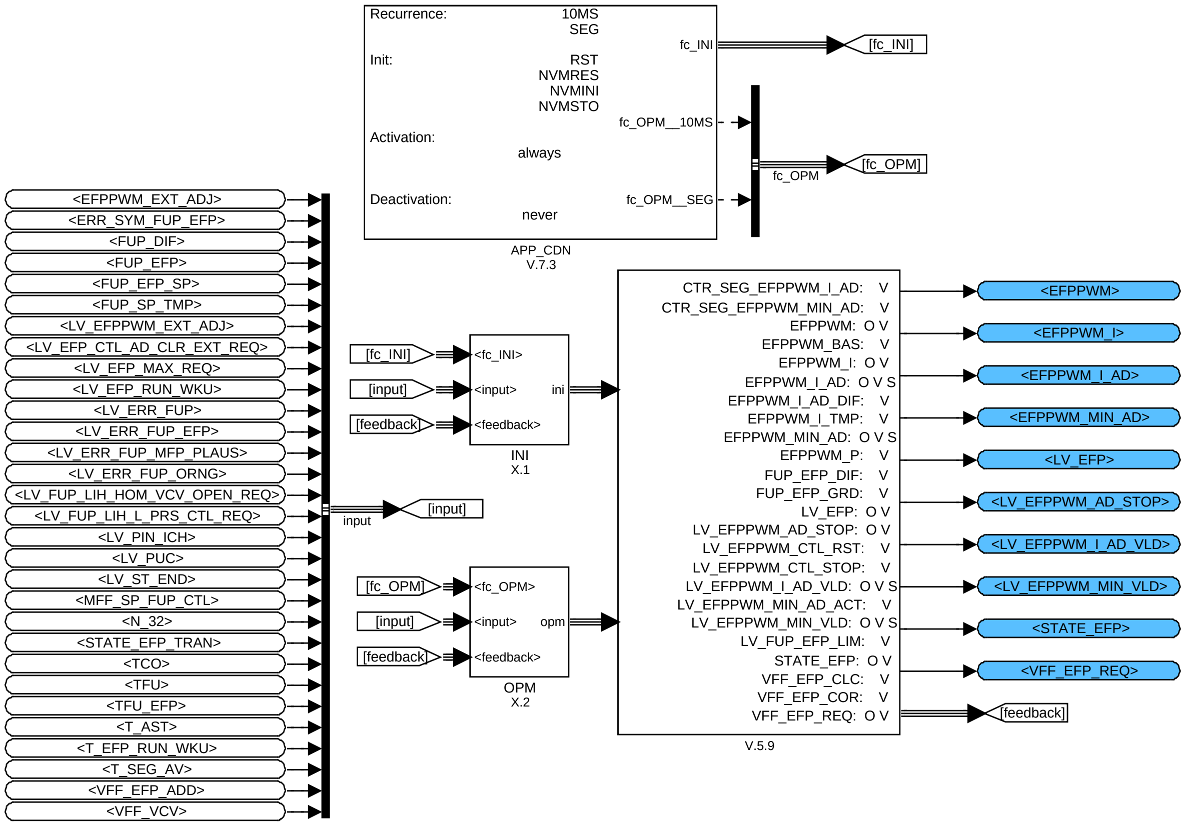

Figure 9.28.1: :

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9.28.1 Initialization

9.28.1.1 Initialisation of values at Reset

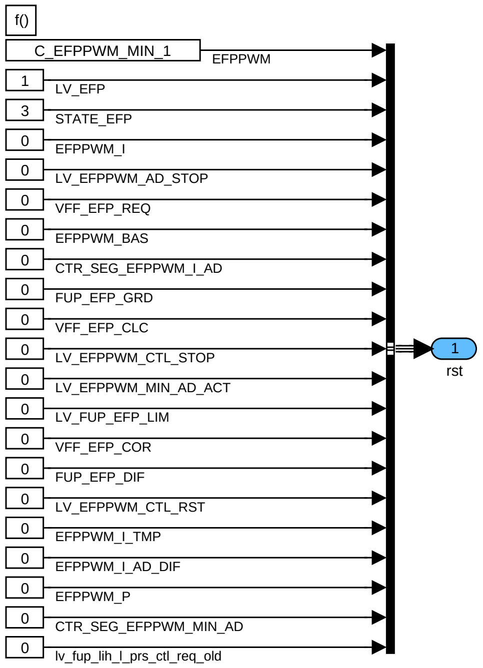

Figure 9.28.2: :

9.28.1.2 Initialisation at event "NVMY"

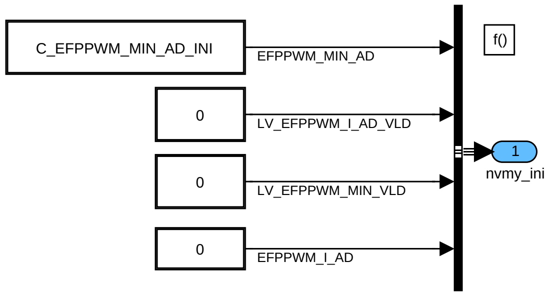

Figure 9.28.3: :

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9.28.1.3 Initialisation at "NVM_RES"

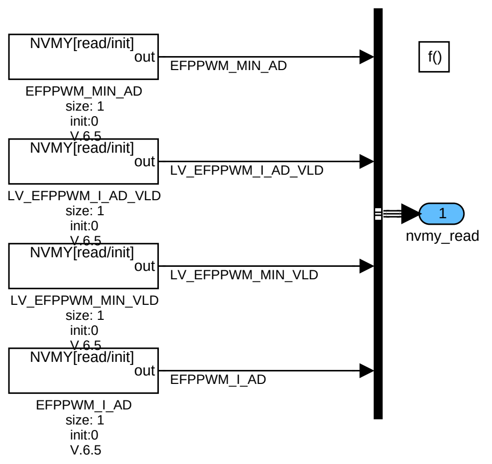

Figure 9.28.4: :

9.28.1.4 Initialisation at "NVMSTO"

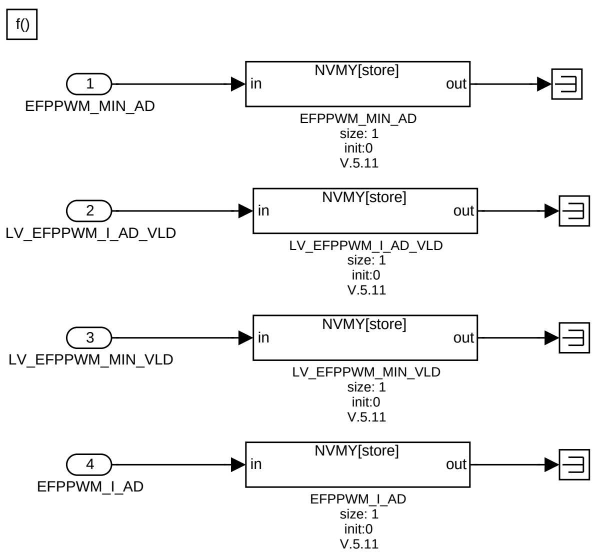

Figure 9.28.5: :

9.28.2 Electrical fuel pump main

This picture shows an overview of the structure.

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9.28.2.1 10 ms task

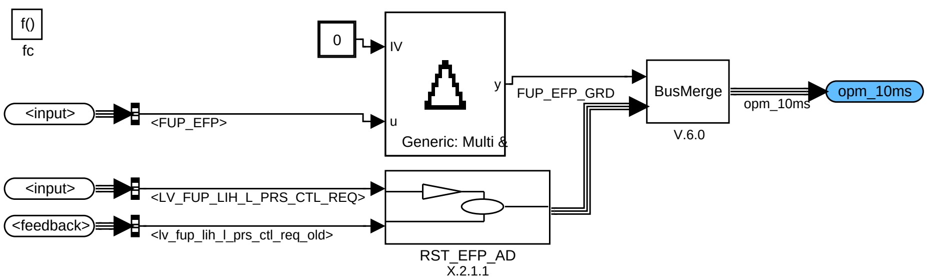

Figure 9.28.6: :

9.28.2.1.1 Reset of low pressure adaptation values depending on low pressure limp home request

The low pressure adaptation values are individually reset on rising edge of low pressure limp home request depending on CLF_EFP_AD_RST_L_PRS_LIH.

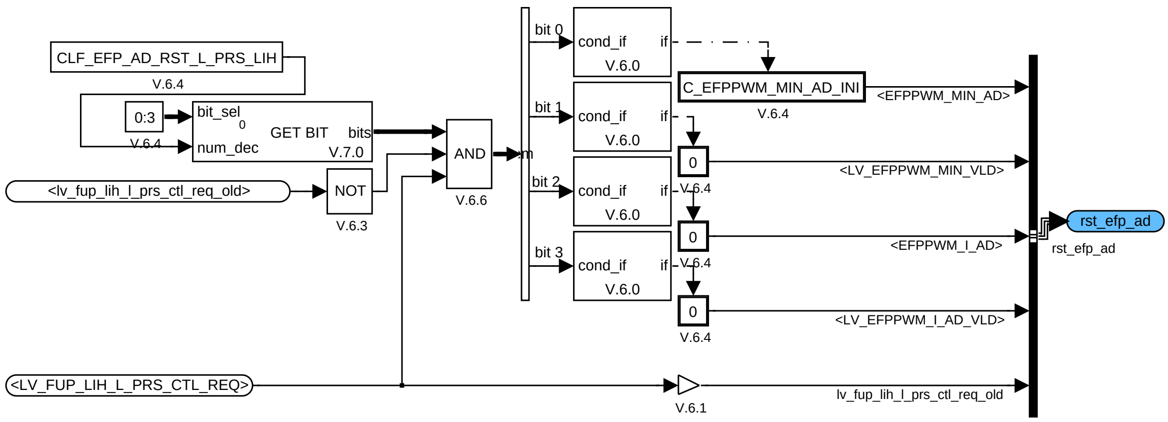

Figure 9.28.7: :

9.28.2.2 Electrical fuel pump calculation (calculatated with 10 ms recurrence on LV_ST_END == 0 or with segment recurrence on LV_ST_END == 1)

Calculation of the main function of the electrical fuel pump controller. The function is split into four parts corresponding to the calculated state.

STATE_EFP_CLC:
The different modules have to be calculated due to state diagram below. The input STATE_EFP_TRAN will be produced in the file Electrical fuel pump (Appl. Inc.).

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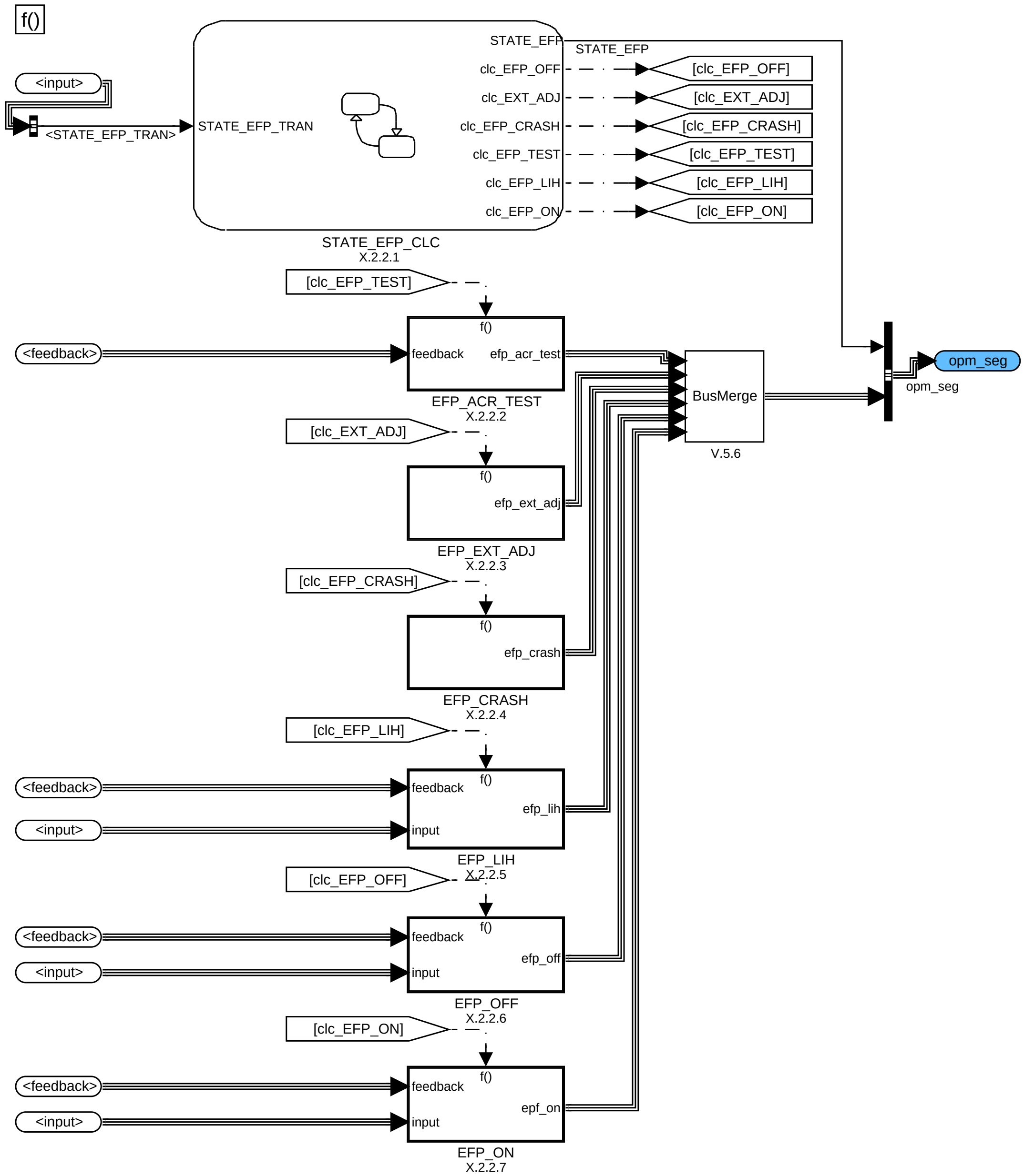

Figure 9.28.8: :

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9.28.2.2.1 STATE_EFP_CLC

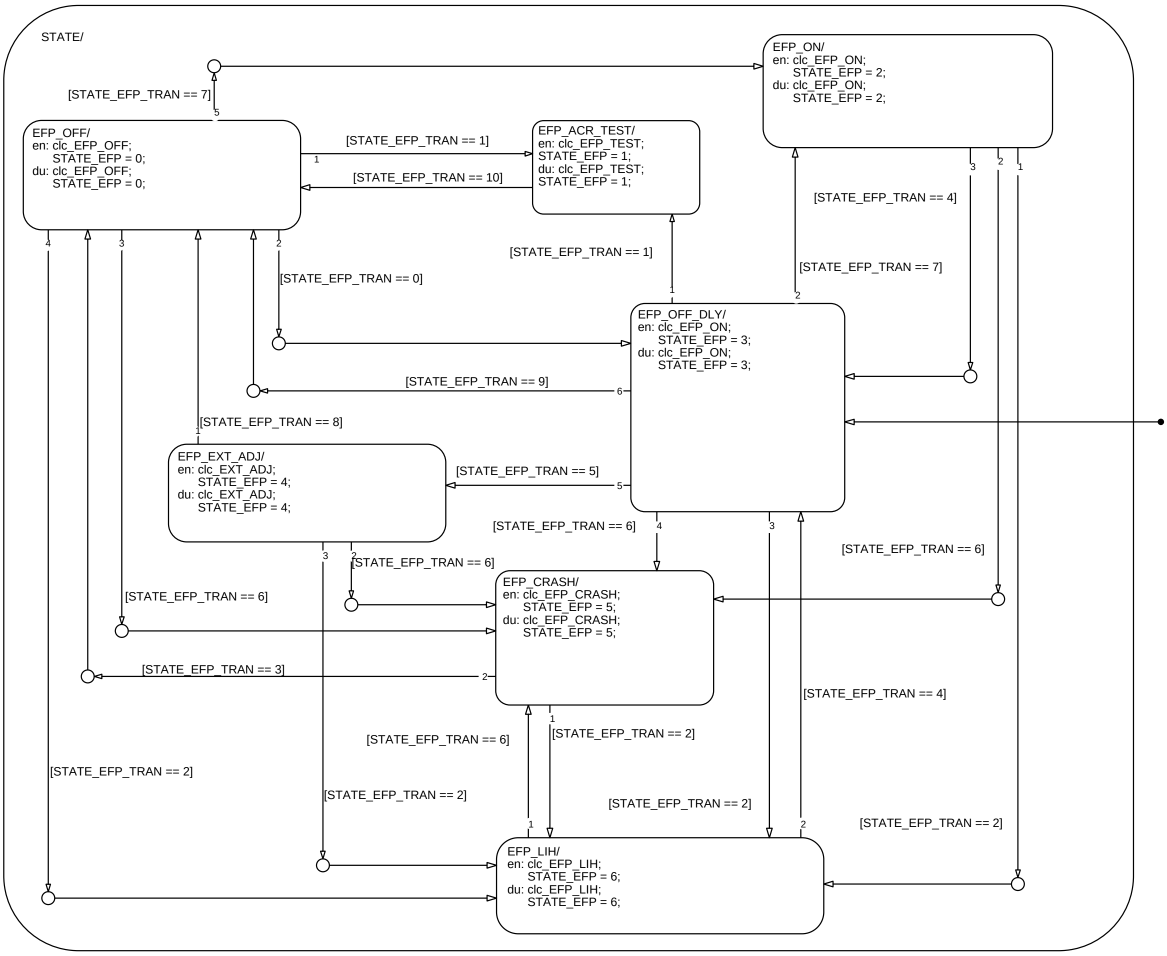

Figure 9.28.9: :

9.28.2.2.2 Electrical fuel pump actuator test

9.28.2.2.2.1 Actuator test

This testmode is request by an external customer test device. It forces the EFPPWM to have a certain testpattern defined in that function.

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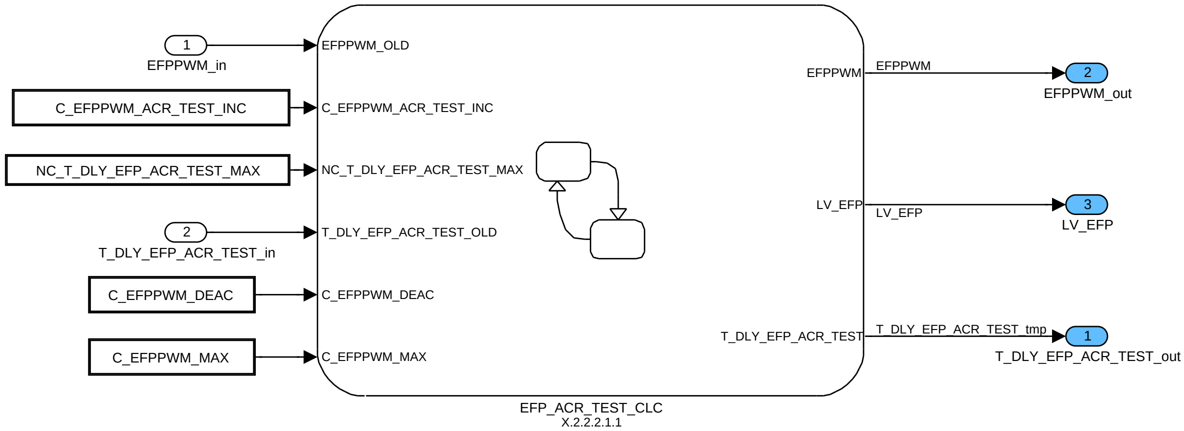

Figure 9.28.10: :

9.28.2.2.2.1.1 EFP_ACR_TEST_CLC

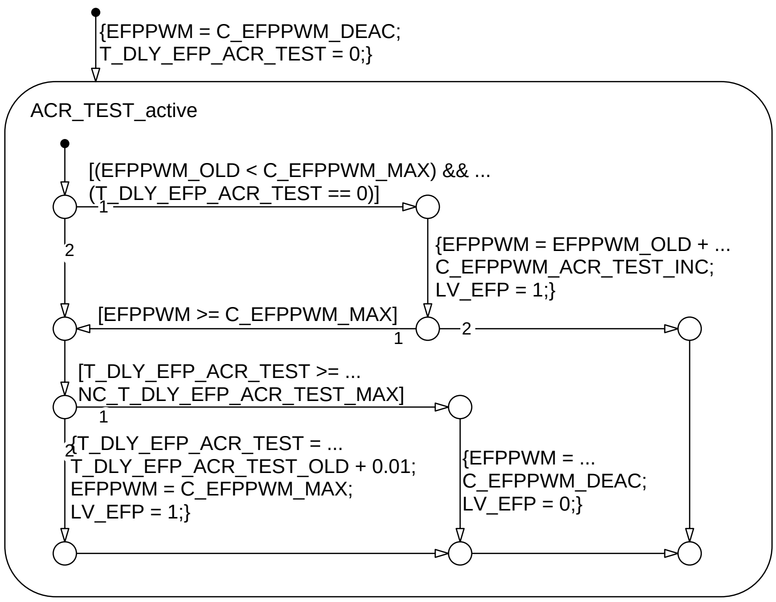

Figure 9.28.11: :

9.28.2.2.3 Electrical fuel pump external adjustment

9.28.2.2.3.1 External adjustment of the EFPPWM

For testing reasons this module can generate a manual EFPPWM.

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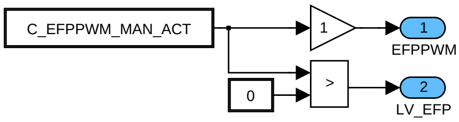

Figure 9.28.12: :

9.28.2.2.4 Electrical fuel pump crash

9.28.2.2.4.1 Calculation of EFPPWM in state "crash"

In case of crash a special EFPPWM should be given.

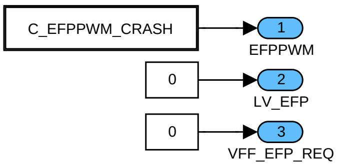

Figure 9.28.13: :

9.28.2.2.5 Electrical fuel pump limp home

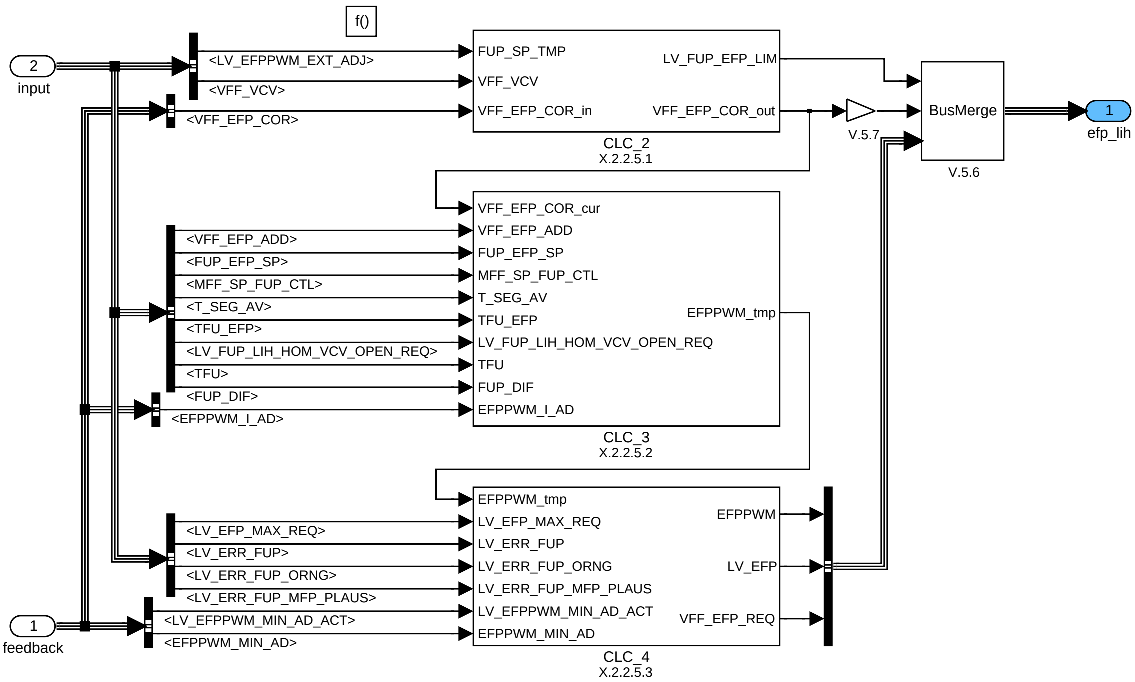

Figure 9.28.14: :

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9.28.2.2.5.1 Calculation of VFF_EFP_COR

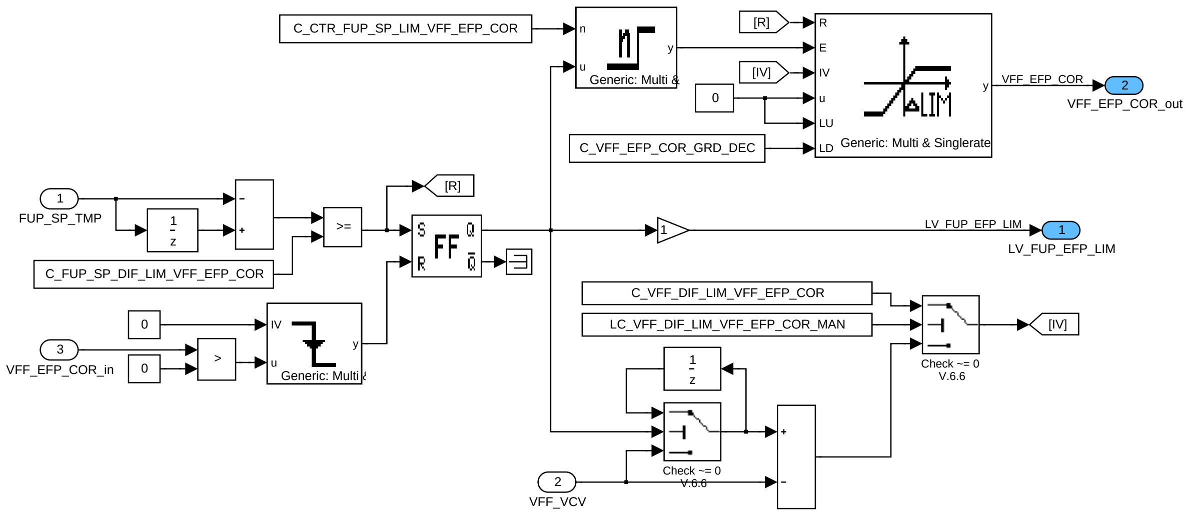

Figure 9.28.15: :

9.28.2.2.5.2 Calculation of Temporary Flag

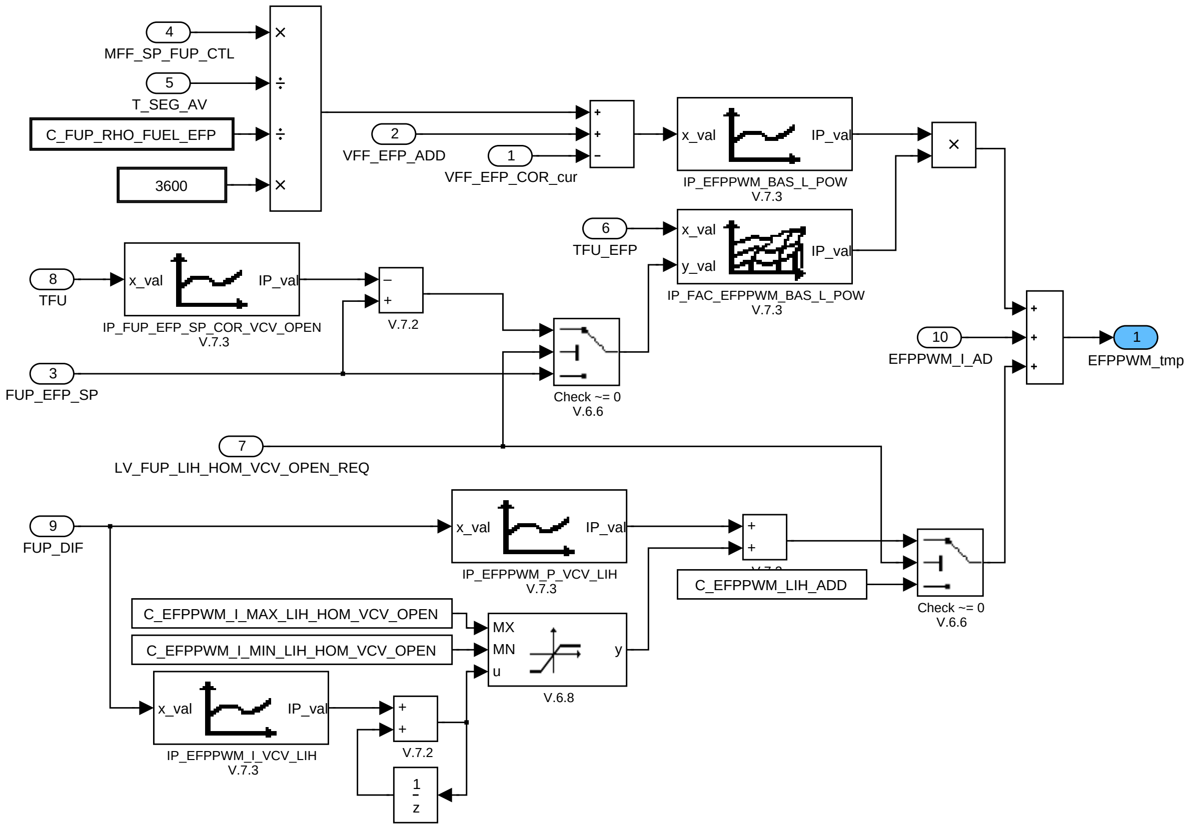

Figure 9.28.16: :

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9.28.2.2.5.3 Calculation

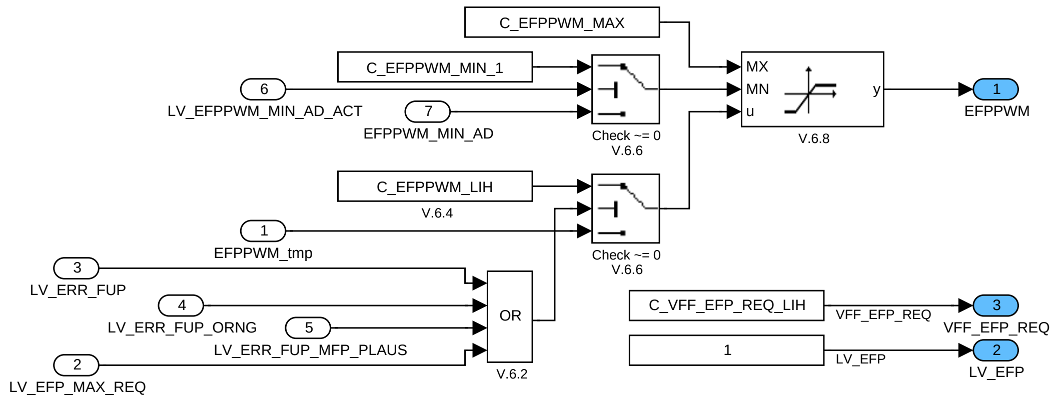

Figure 9.28.17: :

9.28.2.2.6 Electrical fuel pump off

9.28.2.2.6.1 Calculation of the controller in state "off"

If no fuel delivery is required the ECU has to give a minimum EFPPWM. The only operating point where this rule can not be applied is at request from the independent car heater. At this point the adapted minimum PWM is applied to the pump.

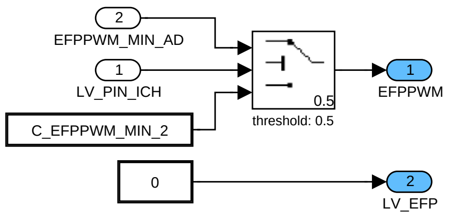

Figure 9.28.18: :

9.28.2.2.7 Electrical fuel pump on

Calculation of the Controller in state "on"
The functionality for the electrical fuel pump in status "on" is given here. It is split into a precontrol calculation part, a limitation signal generating part (mainly for PUC), an EFPPWM calculation part and the controller output part.

9.28.2.2.7.1 Electrical fuel pump on pre-control

Calculation of the precontroller
The precontrol part calculated the precontroller value out of the required fuel mass for the injection. Within the given two maps the basic controller output is calculated.

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9.28.2.2.7.1.1 Electrical fuel pump on pre-control

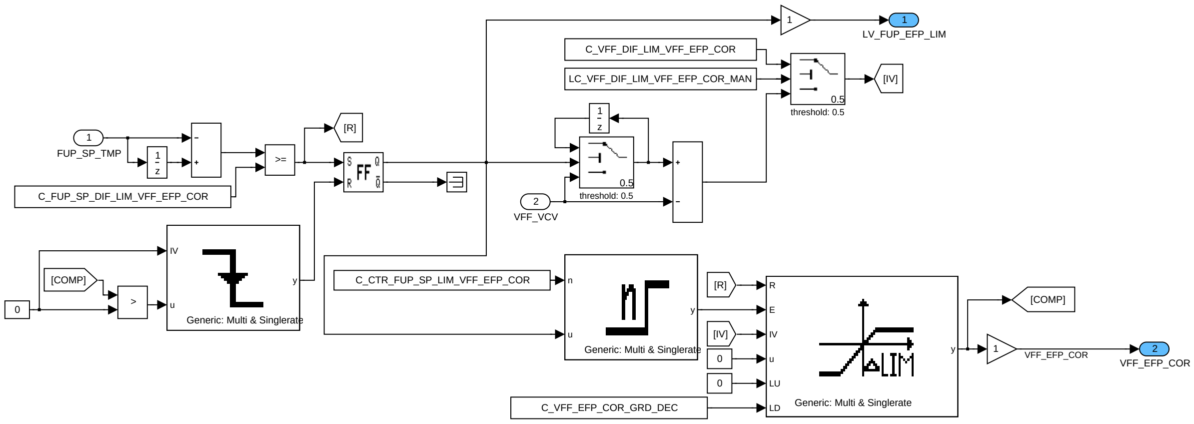

Figure 9.28.19: :

9.28.2.2.7.1.2 Calculation

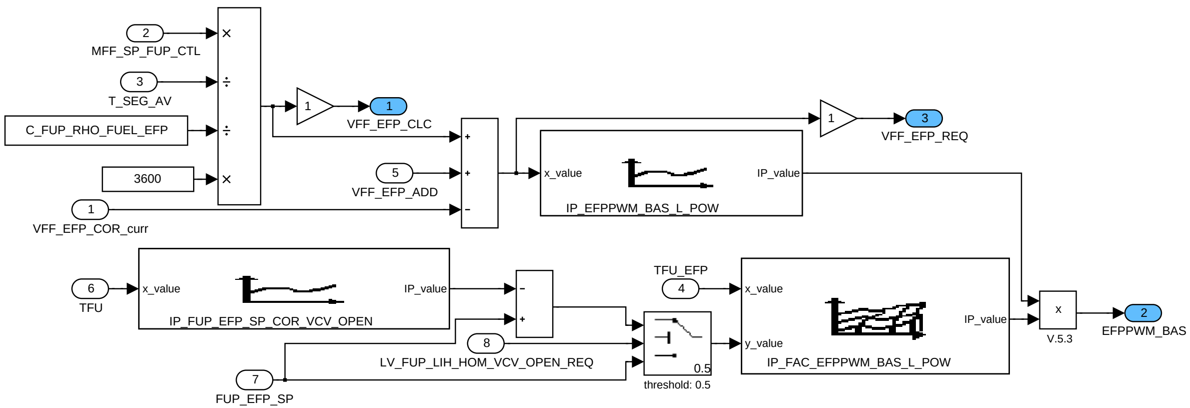

Figure 9.28.20: :

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9.28.2.2.7.2 Electrical fuel pump pwm signal limitation pull calculation

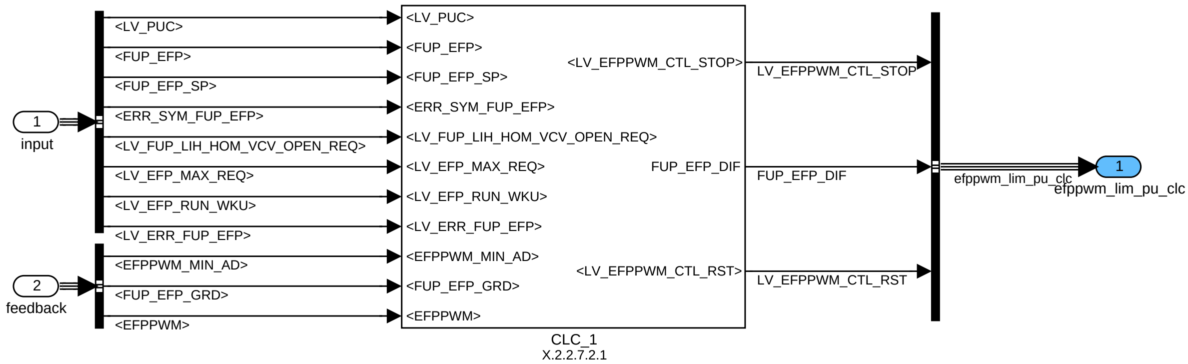

Figure 9.28.21: :

9.28.2.2.7.2.1 Limitation of the controller

Given by special conditions the controller is stopped. This is done within PUC when a too high fuel pressure gradient is measured and the fuel pressure is over the setpoint.
Also the total reset of the controller output can be necessary when there is a sensor error or no sensor is available (given by the flag).

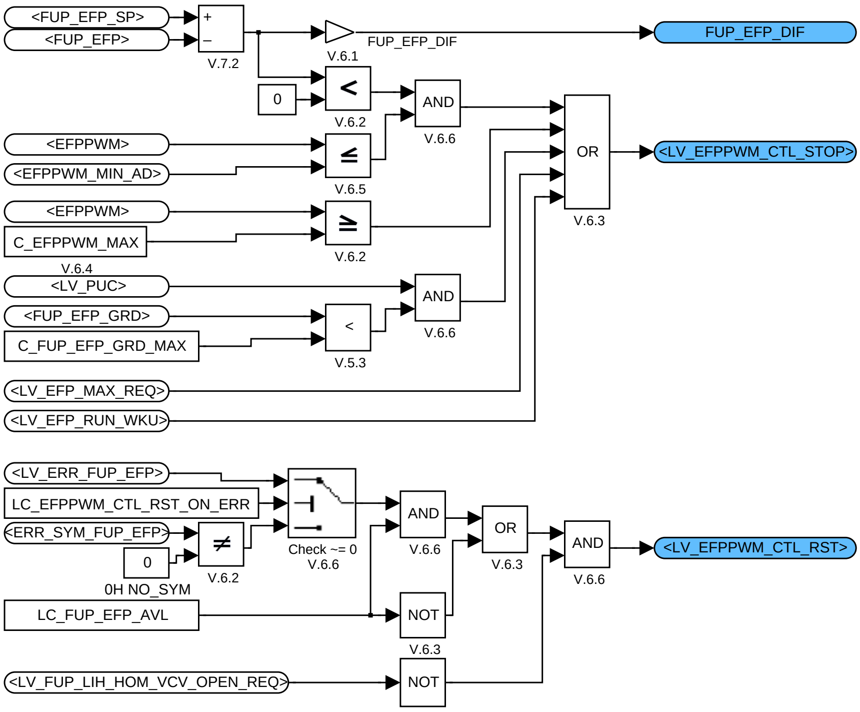

Figure 9.28.22: :

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9.28.2.2.7.3 Electrical fuel pump on control

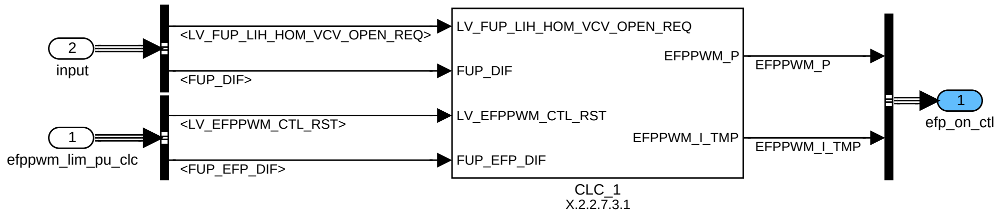

Figure 9.28.23: :

9.28.2.2.7.3.1 Calculation of the controller

The controller part gives the output of the controller maps for the I part. In case of given reset flag the I part and the P part are zero.

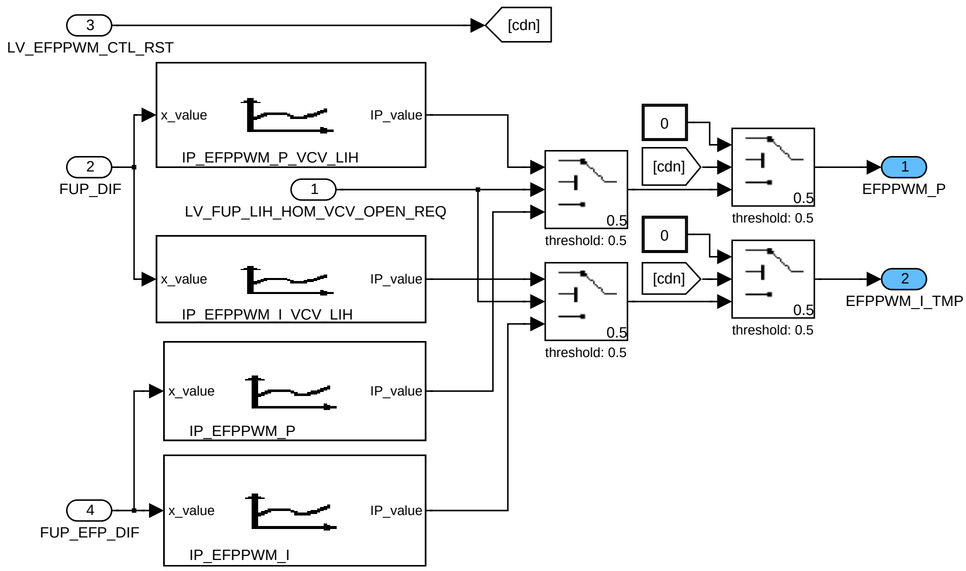

Figure 9.28.24: :

9.28.2.2.7.4 Electrical fuel pump pwm signal calculation

Calculation of the final output signal.
The EFPPWM calculation part is split into two parts. One is calculating the adaptation and the other part calculate the final EFPPWM output.

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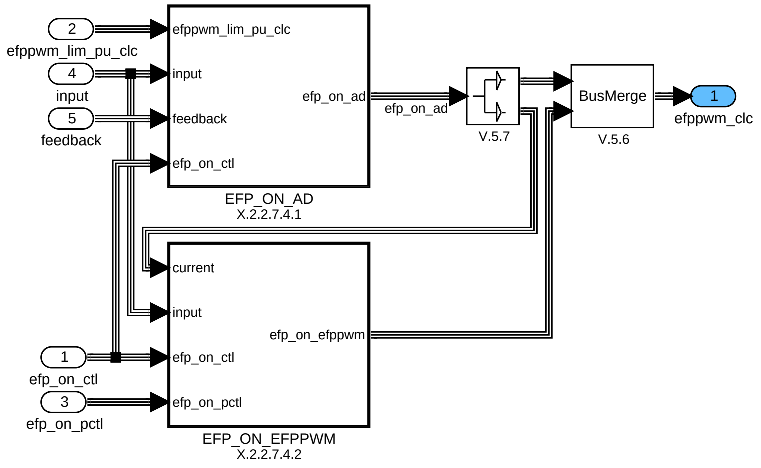

Figure 9.28.25: :

9.28.2.2.7.4.1 Electrical fuel pump on adaptive

Calculation of the adaptation

The adaptation part is split into the main adaptation inbit flag calculating module, the calculation part for the minimum EFPPWM adaptation part and two modules for the I part adaptation.

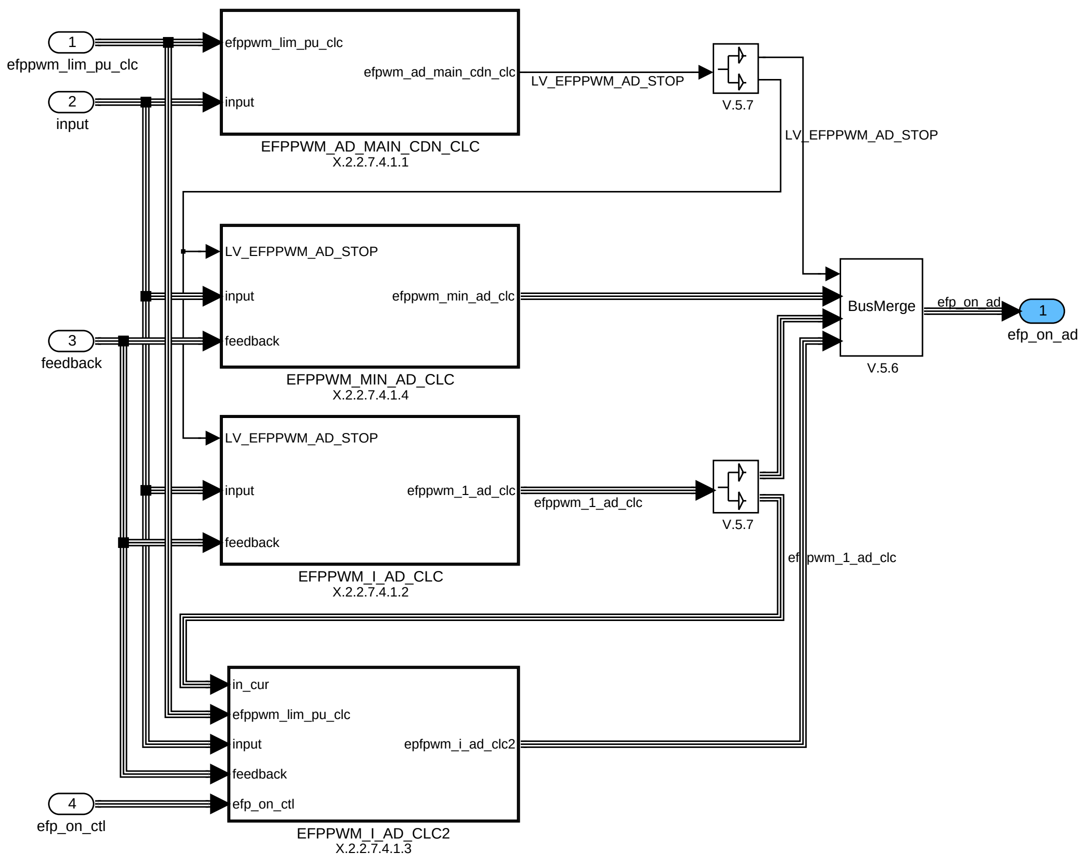

Figure 9.28.26: :

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9.28.2.2.7.4.1.1 Electrical fuel pump pwm signal adaptive main condition calculation

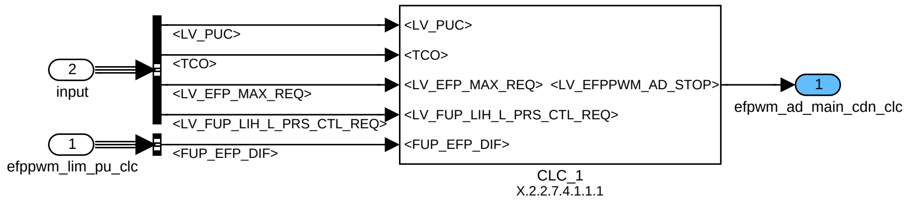

Figure 9.28.27: :

9.28.2.2.7.4.1.1.1 Main conditions for the adaptation

Within this module the inhibition flag for the adaptation is created.

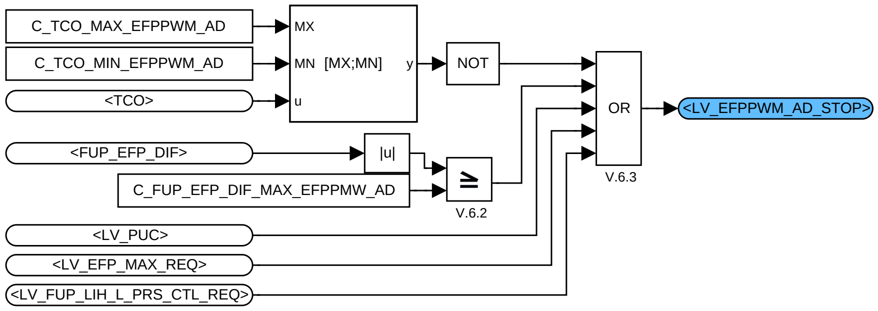

Figure 9.28.28: :

9.28.2.2.7.4.1.2 Electrical fuel pump pwm signal integral part of a control structure adaptive calculation

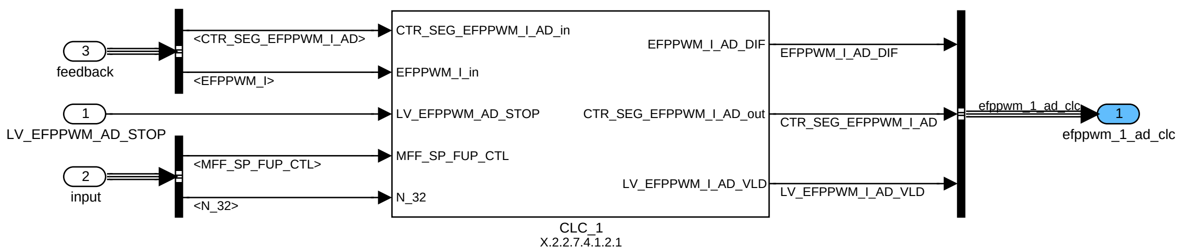

Figure 9.28.29: :

9.28.2.2.7.4.1.2.1 Calculation of the adaptation via I- part

The calculation of the adaptation via I- part of the controller is calculated within that module. The main function is descripted in the state diagram.

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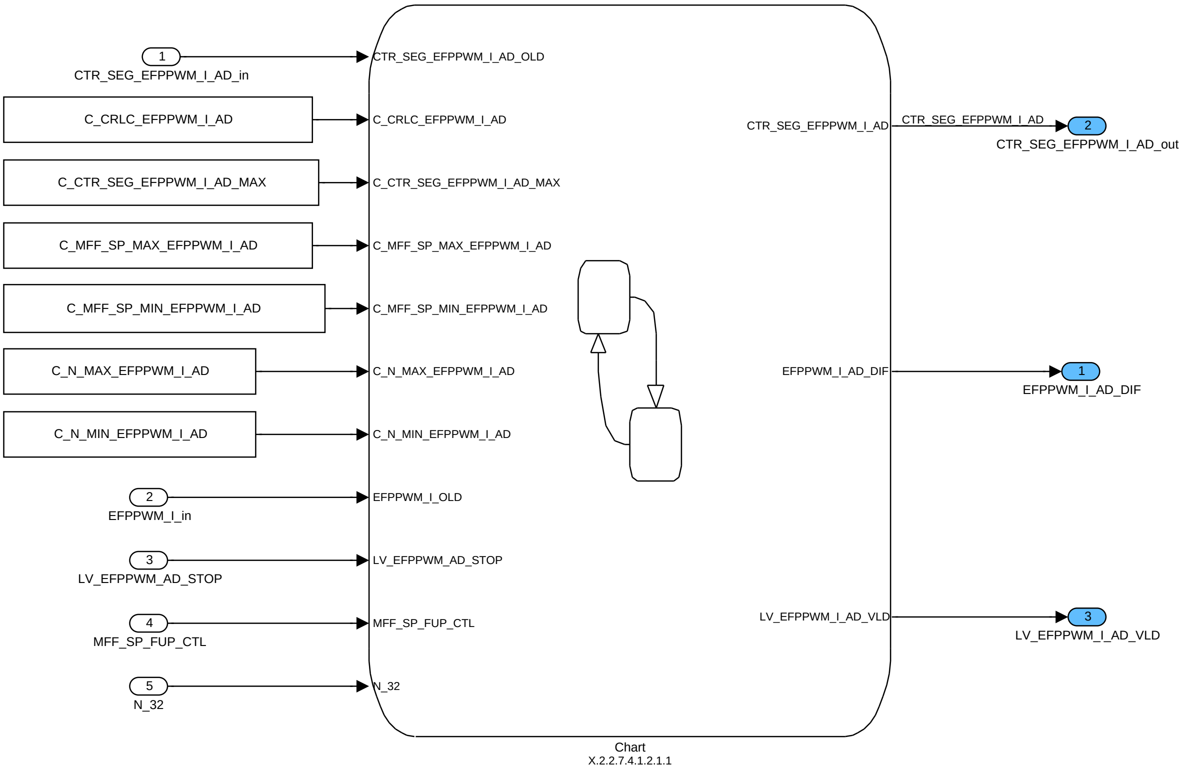

Figure 9.28.30: :

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9.28.2.2.7.4.1.2.1.1 Chart

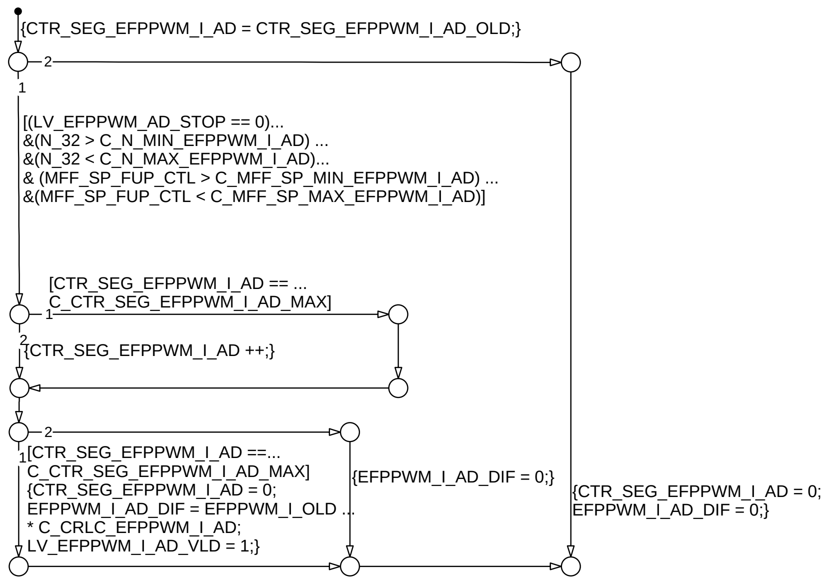

Figure 9.28.31: :

9.28.2.2.7.4.1.3 Electrical fuel pump pwm signal integral part of a control structure adaptive calculation 2

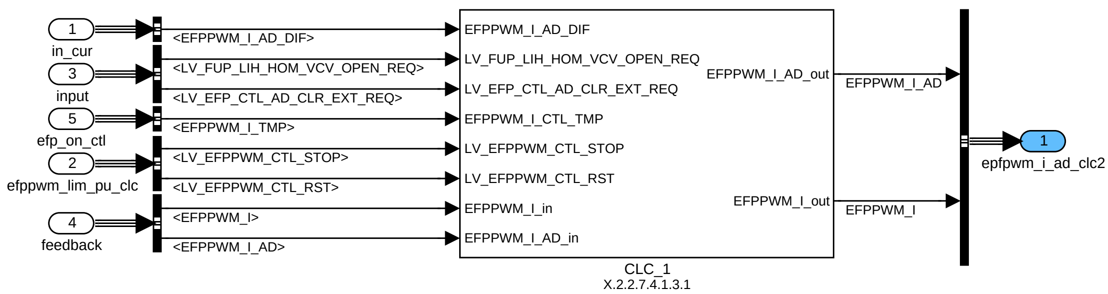

Figure 9.28.32: :

9.28.2.2.7.4.1.3.1 Final calculation of the I - part adaptation and the I - part of the controller

Out of the I part of the last calculation cycle and the difference of the adaptive I part of the controller and some other signals the final I part and the adaptive I part of the controller is calculated

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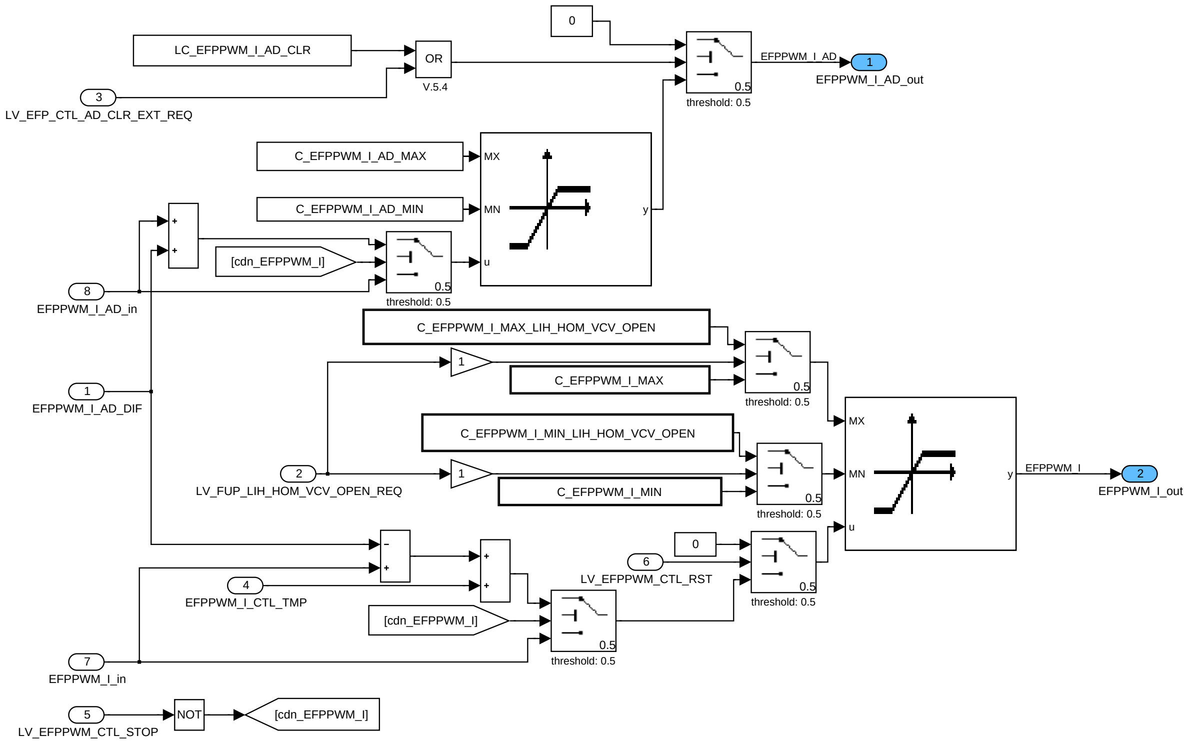

Figure 9.28.33: :

9.28.2.2.7.4.1.4 Electrical fuel pump pwm signal minimum adaptive calculation

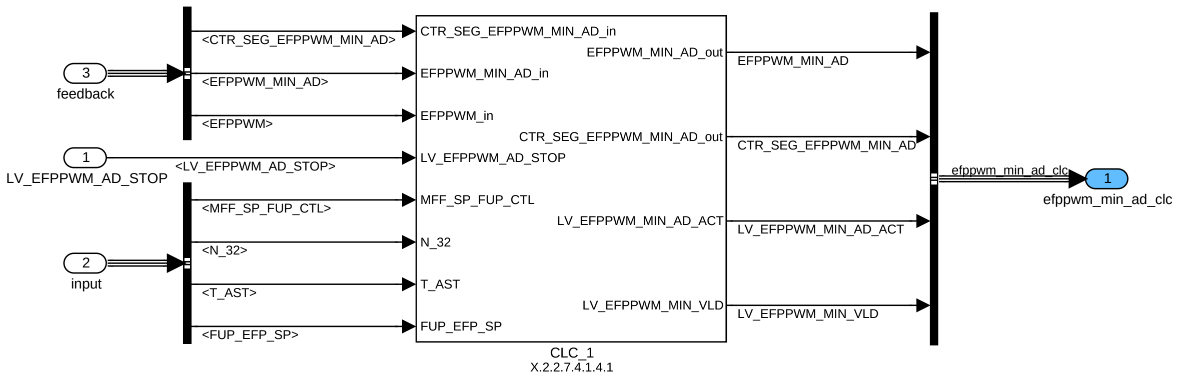

Figure 9.28.34: :

9.28.2.2.7.4.1.4.1 Calculation of the minimum EFPPWM

The minimum EFPPWM for the pump enabling the correct function of the jet pump is adapted within that function. The base is descripted in the state diagram.

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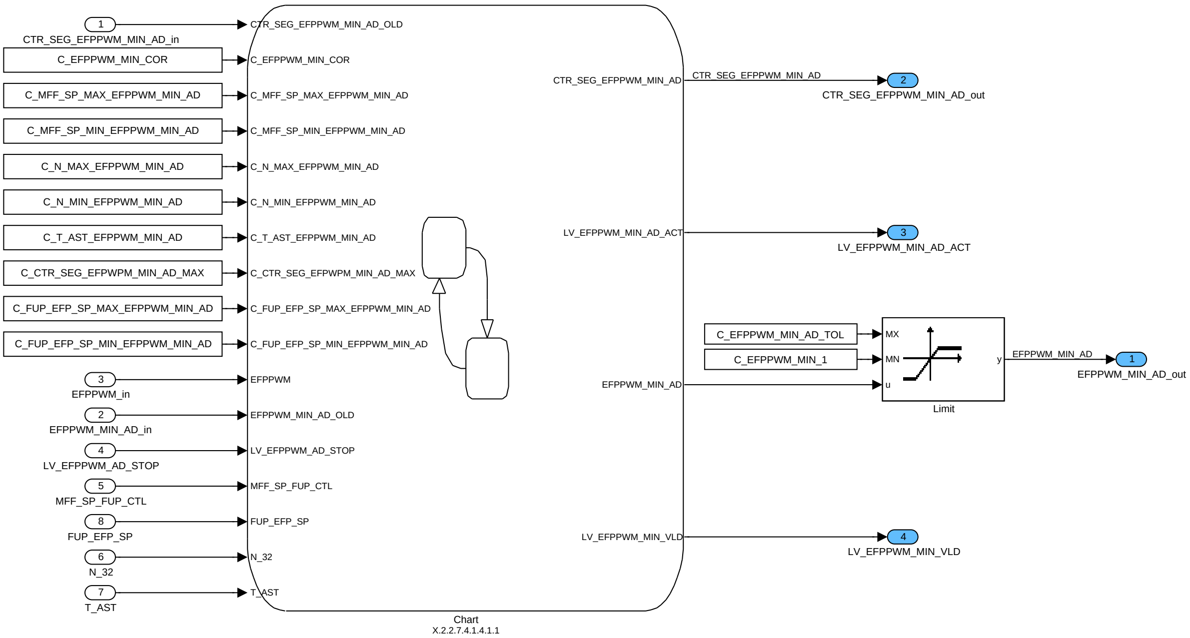

Figure 9.28.35: :

9.28.2.2.7.4.1.4.1.1 Chart

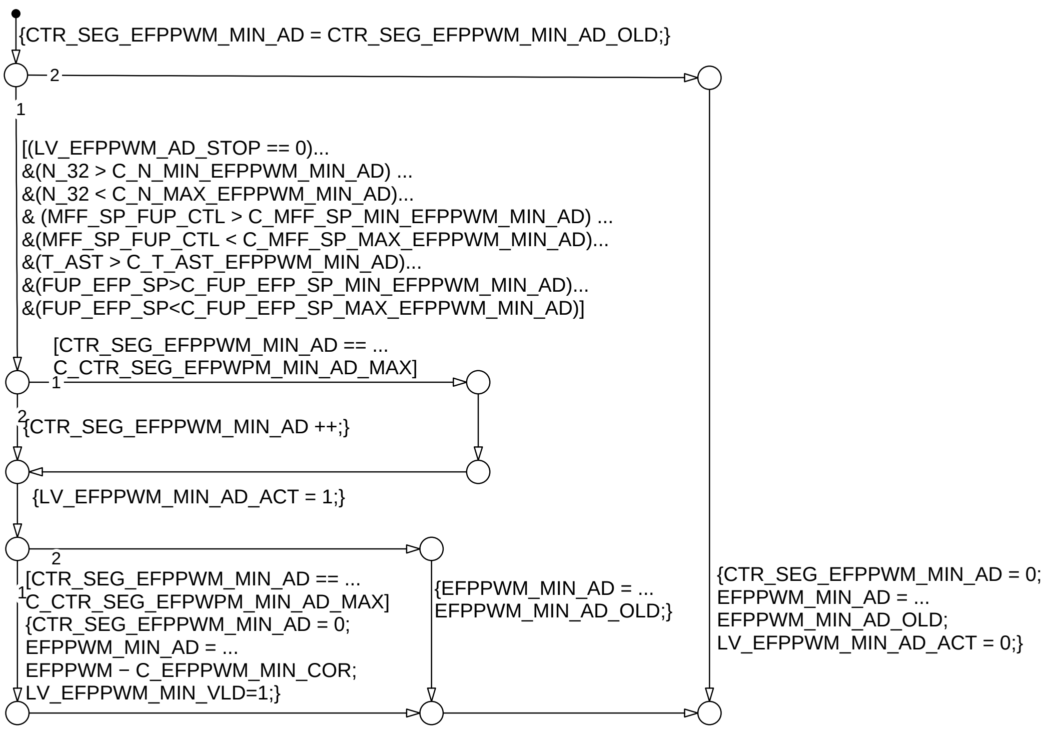

Figure 9.28.36: :

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9.28.2.2.7.4.2 Electrical fuel pump on electrical fuel pump pwm signal

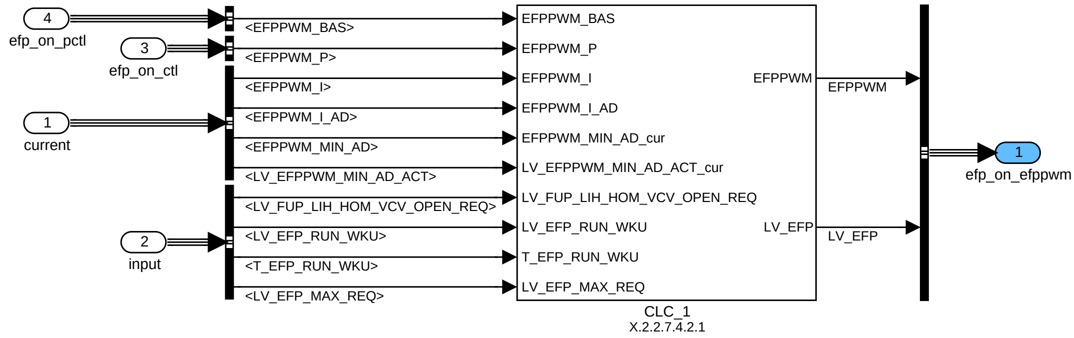

Figure 9.28.37: :

9.28.2.2.7.4.2.1 Calculation of the final output for the EFPPWM

In this module the final EFPPWM is calculated.

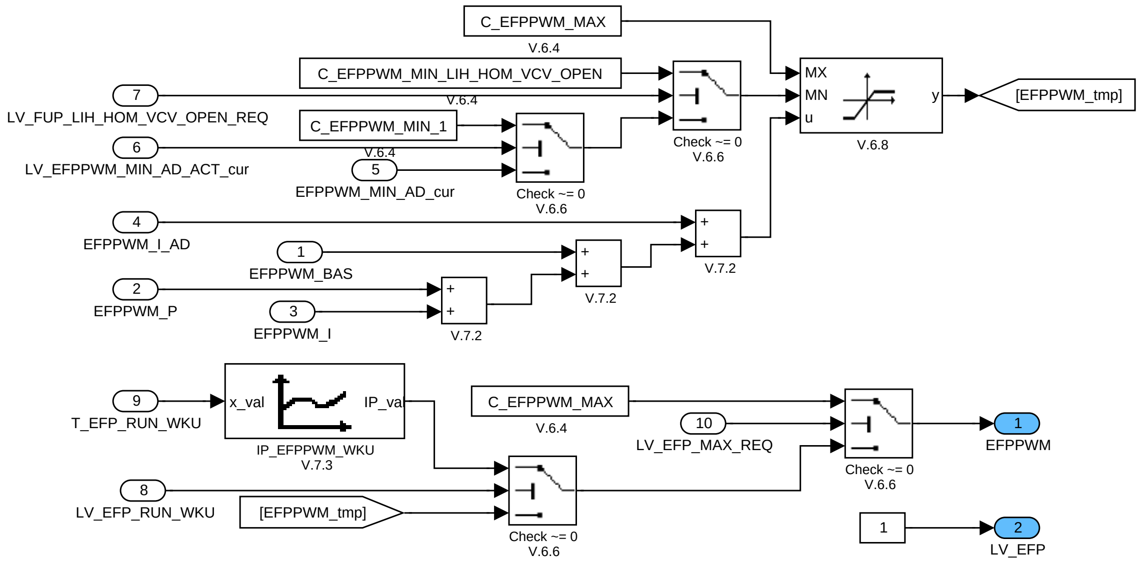

Figure 9.28.38: :

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9.29 Fuel pump low pressure control (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_EFP_RUN_WKU	O/V/S	0... FFH	0... 255	1	-
Variable is used to count ECU wake-up events without engine operation.					
FUP_EFP_ST_H	O/V/S	0... FFFFH	0... 173888	2.65336079	hPa
Pressure at observation start for the pressure increase					
FUP_EFP_ST_L	O/V/S	0... FFFFH	0... 173888	2.65336079	hPa
Pressure at observation start for the pressure decrease					
FUP_EFP_STOP_H	O/V/S	0... FFFFH	0... 173888	2.65336079	hPa
Pressure at observation stop for the pressure increase					
FUP_EFP_STOP_L	O/V/S	0... FFFFH	0... 173888	2.65336079	hPa
Pressure at observation stop for the pressure decrease					
FUP_EFP_TMP_H	V	0... FFFFH	0... 173888	2.65336079	hPa
Temporay pressure at observation start for the pressure increase					
FUP_EFP_TMP_L	V	0... FFFFH	0... 173888	2.65336079	hPa
Temporay pressure at observation start for the pressure decrease					
LV_EFP_MAX_REQ	O/V	0... 1H	0 ...1	1	-
Flag for requesting the maximum operation mode of the electrical fuel pump					
LV_EFP_RUN_WKU	O/V	0... 1H	0 ...1	1	-
Flag for requesting electrical fuel pump operation after ECU wake-up					
LV_ERR_FUP_EFP_LIH	V	0... 1H	0 ...1	1	-
Logical bit indicating limp home of EFP pump requested					
LV_PUMP_PRE_RUN_STOP	V	0... 1H	0 ...1	1	-
Logical bit indicating pre run of the pump stopped					
STATE_EFP_TRAN	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H AH	OFF_DLY ACR_TEST LIH CRASH2OFF ON2OFF_DLY ON2EXT_ADJ CRASH OFF_DLY2ON EXT_ADJ2OFF OFF_DLY2OFF ACR_ TEST2OFF	-	-
States of electrical fuel pump function					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_EFP	V	0... FFFFH	0... 655.35	0.01	s
Time counter for activated EFP					
T_EFP_ACT_H	V	0... FFFFH	0... 655.35	0.01	s
Timer for the pressure increase					
T_EFP_ACT_L	V	0... FFFFH	0... 655.35	0.01	s
Timer for the pressure decrease					
T_EFP_MEM_H	O/V/S	0... FFFFH	0... 655.35	0.01	s
Time for the pressure increase					
T_EFP_MEM_L	O/V/S	0... FFFFH	0... 655.35	0.01	s
Time for the pressure decrease					
T_EFP_RUN_WKU	O/V	0... FFFFH	0... 655.35	0.01	s
Timer used for electric fuel pump operation after ECU reset					
TCO_MEM_FUP_EFP_H	O/V/S	0... FEH	-48... 142.5	0.75	°C
Coolant temperature for the pressure increase					
TCO_MEM_FUP_EFP_L	O/V/S	0... FEH	-48... 142.5	0.75	°C
Coolant temperature for the pressure decrease					
TCO_TMP_H	V	0... FEH	-48... 142.5	0.75	°C
Temporary coolant temperature for the pressure increase					
TCO_TMP_L	V	0... FEH	-48... 142.5	0.75	°C
Temporary coolant temperature for the pressure decrease					
VFF_EFP_ADD	O/V	0... FFH	0... 255	1	l/h
Additive value for the amount of fuel from the pump					

Input data:

CLF_EFP_AD_RST_L_PRS_LIH {p. 3800}	CTR_KM_CAN {p. 1563}	ERR_SYM_FUP_EFP {p. 4733}	FTL {p. 1564}
FUP {p. 1283}	FUP_EFP {p. 1290}	FUP_EFP_MES {p. 1290}	FUP_EFP_SP {p. 3792}
LC_FUP_EFP_AVL {p. 3801}	LV_ACR_EFPPWM_TEST_REQ {p. 988}	LV_EFP_CTL_AD_CLR_EXT_REQ {p. 7483}	LV_ENG_OFF_N_CON {p. 988}
LV_ERR_EFPPWM_PLAUS {p. 6050}	LV_ERR_FTL_MIN {p. 4762}	LV_ERR_FUP_EFP {p. 4733}	LV_ES {p. 1720}
LV_FIRST_VLD_TOOTH {p. 1505}	LV_FUP_LIH_L_PRS_CTL_REQ {p. 4001}	LV_FUP_LIH_REQ {p. 988}	LV_IGK {p. 906}
LV_PIN_ICH {p. 988}	LV_RLY_ST_CAN {p. 1567}	LV_ST_END {p. 1720}	N_32 {p. 1525}
STATE_EFP {p. 3797}	STATE_EFP_CRASH_CAN {p. 1573}	T_AST {p. 1766}	T_ES {p. 1444}
TCO {p. 1100}	TCO_ST {p. 1100}	TIA {p. 1226}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DLY_EFP_MAX_REQ	-	0... FFH	0... 255	1	-
Delay counter to activate maximum operation of the electrical fuel pump after first valid tooth detection					
C_CTR_KM_EFP_RUN_WKU	-	0... FFFFH	0... 655350	10	km
Activation threshold for electrical fuel pump operation during ECU wake-up					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_MAX_EFP_RUN_WKU	-	0... FFH	0... 255	1	-
Counter to define the maximum number of ECU wake-up events without engine operation.					
C_FUP_EFP_MEM_L_DIF	-	0... FFFFH	0... 173888	2.65336079	hPa
Fuel pressure difference to store values for start pressure decrease observation					
C_FUP_EFP_ST_H_MIN	-	0... FFFFH	0... 173888	2.65336079	hPa
Start fuel pressure level to store values for start pressure increase observation in any case					
C_FUP_EFP_THD_PRE_RUN	-	0... FFFFH	0... 173888	2.65336079	hPa
Threshold for activation of EFP pre run					
C_FUP_MAX_EFP_RUN_WKU	-	0... FFFFH	0... 347776	5.30672159	hPa
Fuel pressure threshold to deactivate the electrical fuel pump during ECU wake-up					
C_N_MIN_EFP_MAX_REQ	-	0... FFH	0... 8160	32	rpm
Engine speed threshold to confirm EFP maximum fuel flow operation					
C_T_AST_EFP_MAX_REQ	-	0... FFFFH	0... 6553.5	0.1	s
Deactivation threshold for EFP maximum fuel flow operation dependent on time after engie start					
C_T_DLY_EFP_RUN_WKU	-	0... FFFFH	0... 655.35	0.01	s
Delay time to deactivate EFP wake-up function when the fuel pressure reach the defined limit					
C_T_EFP	-	0... FFFFH	0... 2621.4	0.04	s
Pre- and post operation time for the electrical fuel pump					
C_T_MAX_EFP_RUN_WKU	-	0... FFFFH	0... 655.35	0.01	s
Maximum time of electric fuel pump operation after ECU reset					
C_T_MIN_EFP_RUN_WKU	-	0... FFFFH	0... 655.35	0.01	s
Maximum time of electric fuel pump operation after ECU reset					
C_TCO_MEM_FUP_EFP_L_TOL	-	0... FEH	-48... 142.5	0.75	°C
Coolant temperature threshold to start fuel pressure decrease observation					
C_TCO_ST_EFP_MAX_REQ	-	0... FEH	-48... 142.5	0.75	°C
Activation threshold dependent on engine start temperature used for EFP maximum fuel flow request					
C_TIA_FUP_EFP_L_HYS	-	0... FEH	0... 190.5	0.75	°C
Intake temperature hysteresis for fuel pressure decrease observation					
C_VFF_EFP_ADD	-	0... FFH	0... 255	1	l/h
Additive value for the amount of fuel from the pump					
IP_IDX_EFP_RUN_WKU	-	0... 1H	0 ...1	1	-
LDP_T_ES_ID_IDX_EFP_RUN_WKU	4	0... FFFFH	0... 65535	1	min
LDP_TCO_ST_ID_IDX_EFP_RUN_WKU	6	0... FEH	-48... 142.5	0.75	°C
Deactivation condition for electrical fuel pump operation during ECU wake-up					
LC_EFPPWM_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual EFPPWM					
LC_FUP_EFP_LIH_ON_SYM	-	0... 1H	0 ...1	1	-
Switch to define if limp home of EFP pump is requested on raw error symptom of fuel low pressure sensor, additionally					

General information:

The electrical fuel pump is controlled by the EFPPWM.
The PI-controller is used to compensate deviations from the nominal fuel pressure after the fuel pump.
In this module the switching conditions for the main module are calculated. This includes also limp home and crash reactions. Application Condition

Application conditions:

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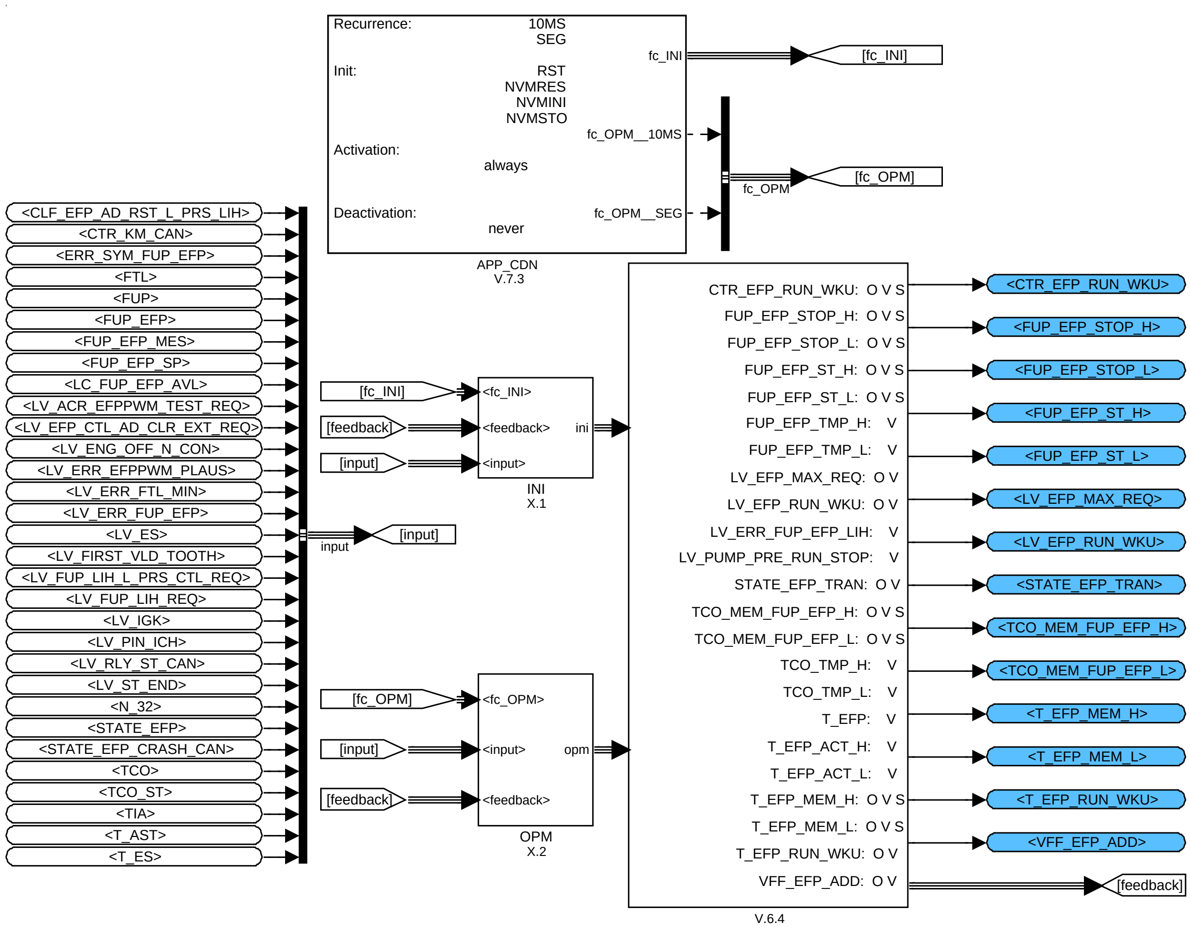
Initialisation:	`RST, NVMRES, NVMINI, NVMSTO`
Recurrence:	`10MS, SEG`
Activation:	`always`
Deactivation:	`never`

Function description:

Formula section:



SDA_SRS / SDA V 6.1.1 / 25−Feb−2011

Figure 9.29.1: :

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9.29.1 Initialization

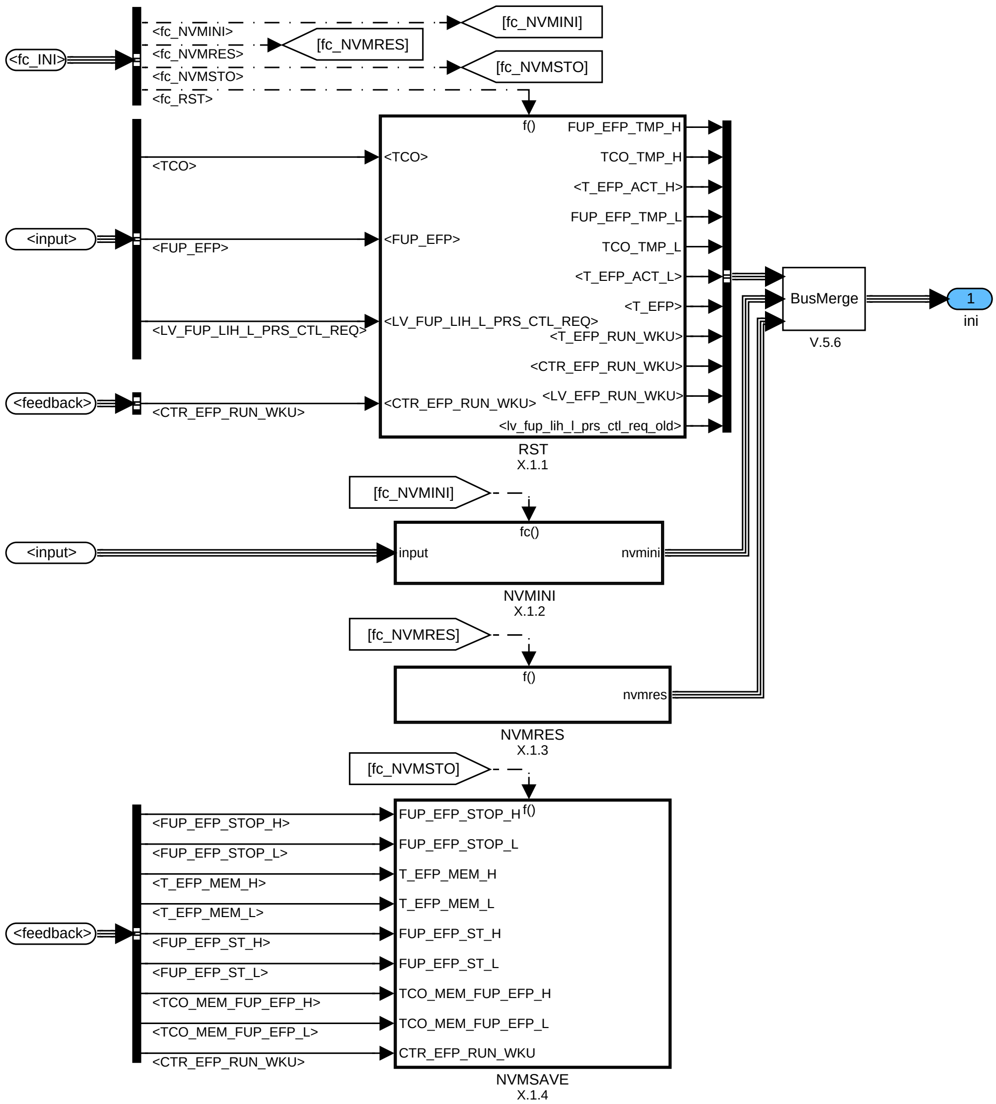

Figure 9.29.2: :

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9.29.1.1 Initialization during Reset

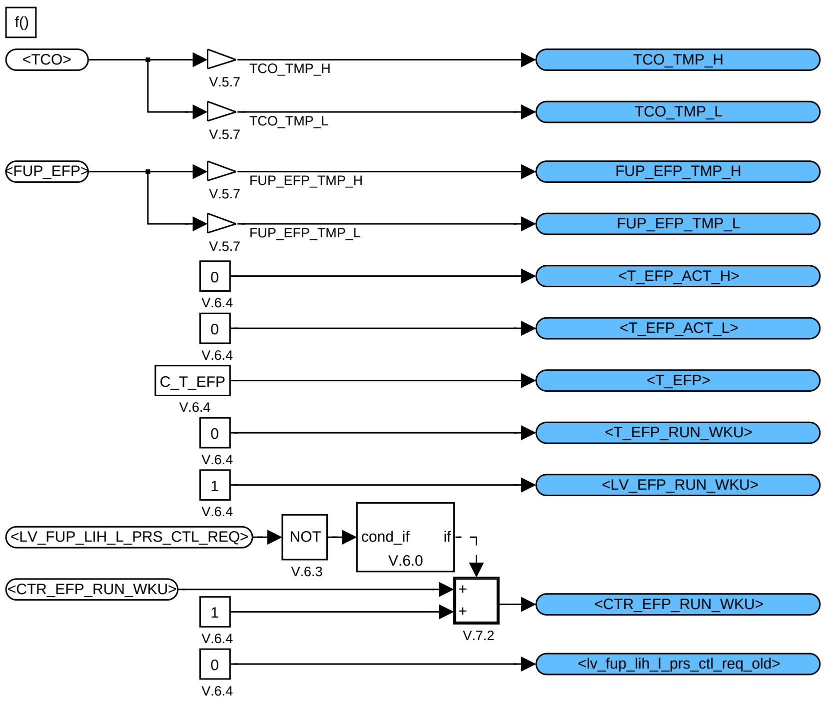

Figure 9.29.3: :

9.29.1.2 NVMY Initialization

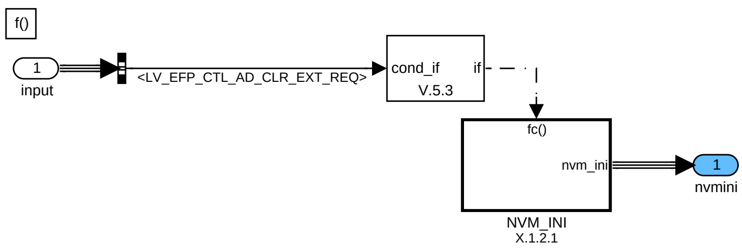

Figure 9.29.4: :

9.29.1.2.1 Initialization with FFFFH or FEH

If EEPROM error or ECU brandnew or cleared by service tool then the outputs are initialised with FFFFH or FEH

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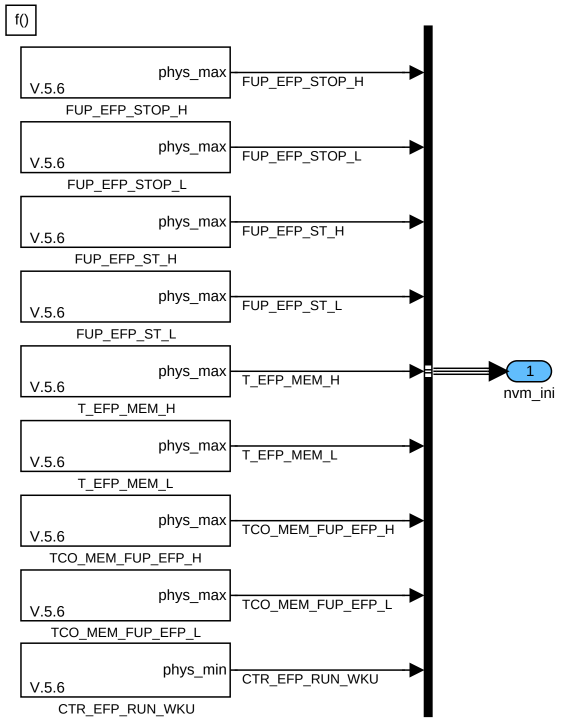

Figure 9.29.5: :

9.29.1.3 NVMY Restore

In this part outputs are initialised by EEPROM value.

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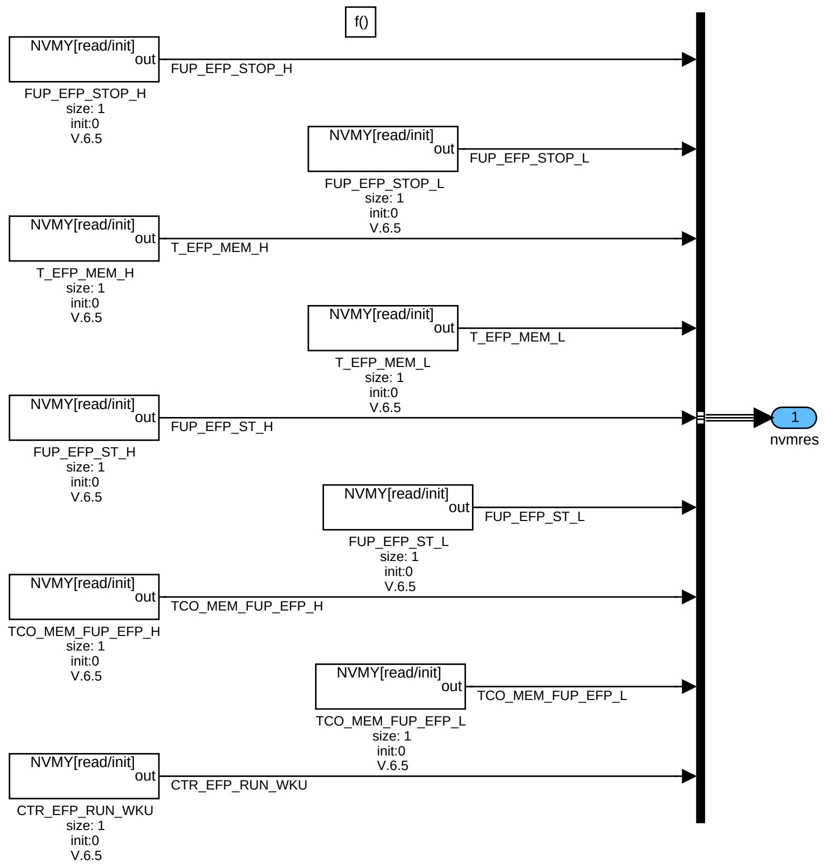

Figure 9.29.6: :

9.29.1.4 NVMY Save

In this part outputs are saved on the EEPROM

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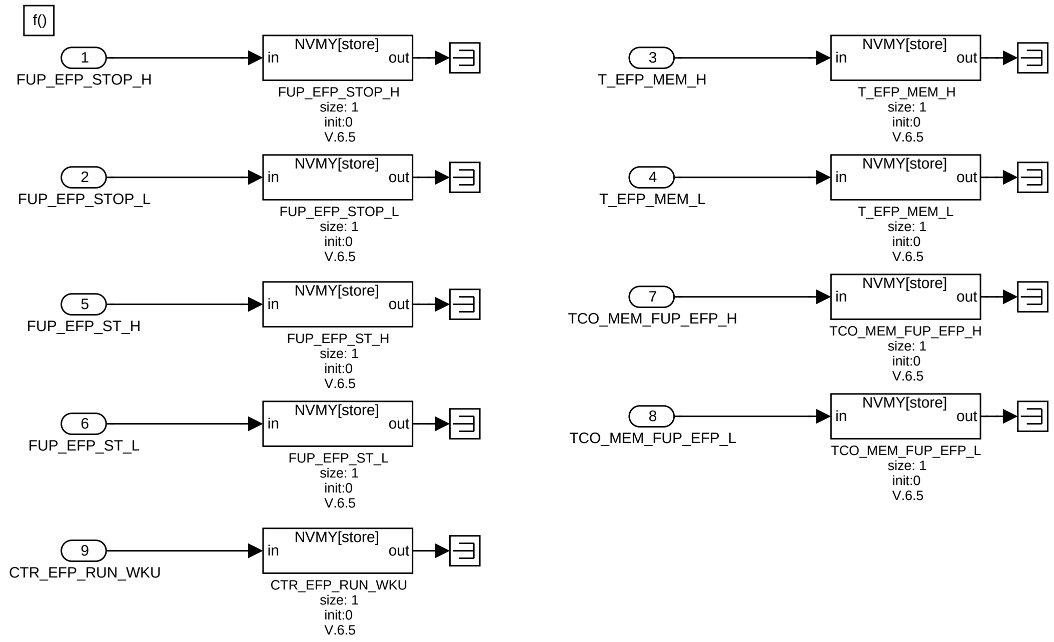

Figure 9.29.7: :

9.29.2 Electrical fuel pump control transition

The function is consisting out of the timer calculation for the EFP and the transition and limp home calculation. Additionally a calculation part for pressure increase and decrease observation is included

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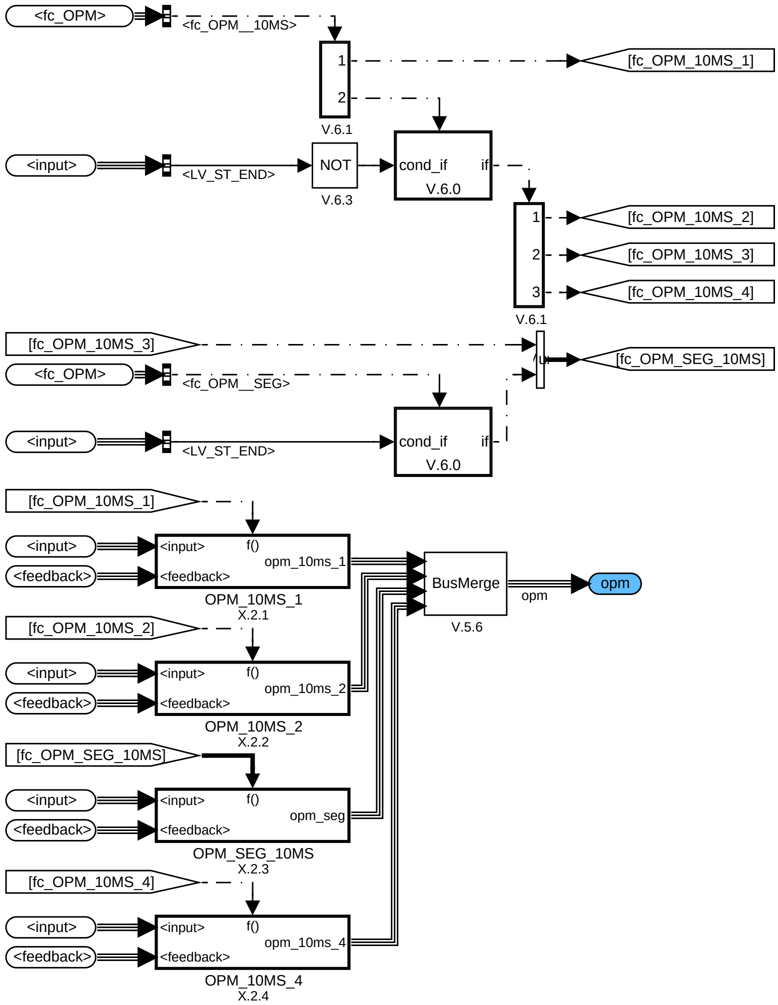

Figure 9.29.8: :

9.29.2.1 10ms task (always active)

The calculation of the low pressure system observation is split into a calculation for the high part and on calculation for the low part. Each part has an output for the start pressure, stop pressure, coolant temperature and the time for rising/falling pressure.

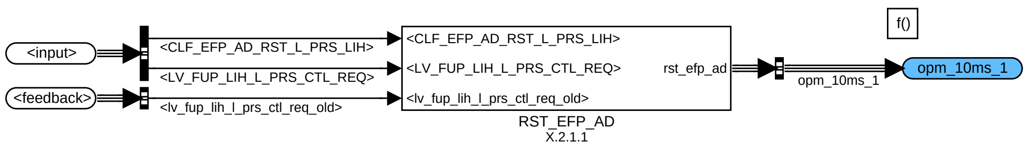

Figure 9.29.9: :

9.29.2.1.1 Reset of low pressure adaptation values depending on low pressure limp home request

The low pressure adaptation values are individually reset on rising edge of low pressure limp home request depending on CLF_EFP_AD_RST_L_PRS_LIH.

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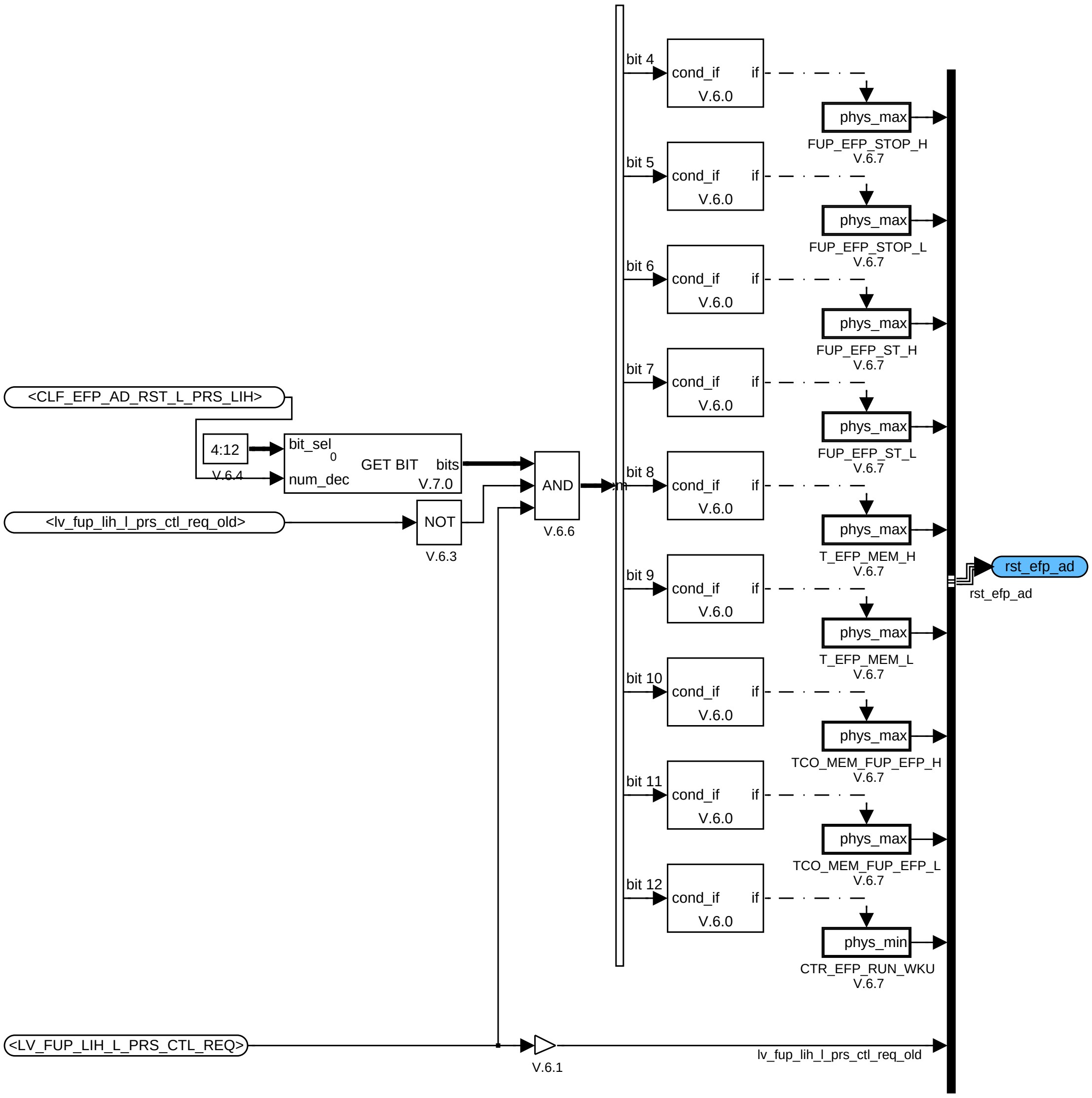

Figure 9.29.10: :

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9.29.2.2 10ms task (active on LV_ST_END == 0)

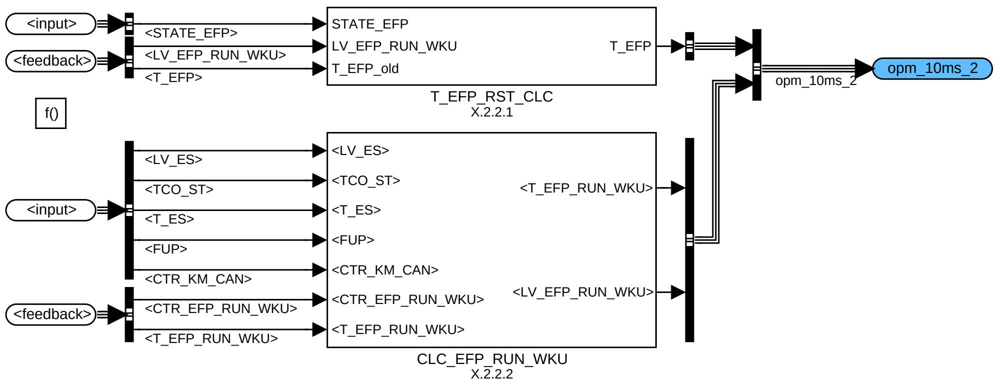

Figure 9.29.11: :

9.29.2.2.1 Reset of the timer

The reset of the timer is calculated according to the following module.

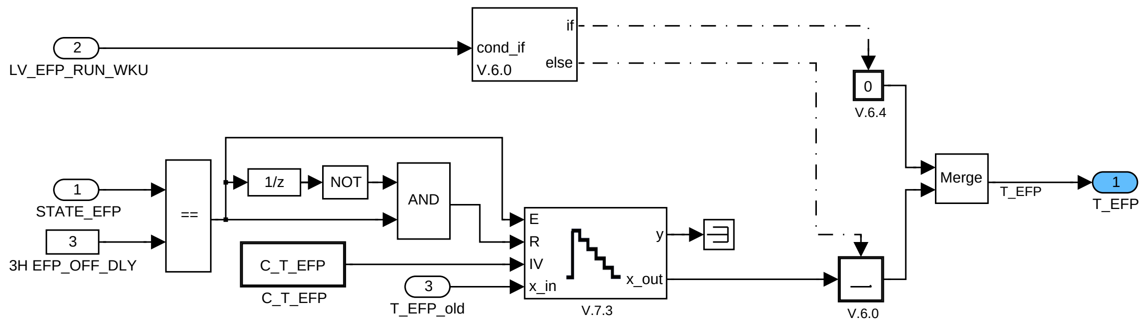

Figure 9.29.12: :

9.29.2.2.2 Activation of electrical fuel pump during ECU wake-up

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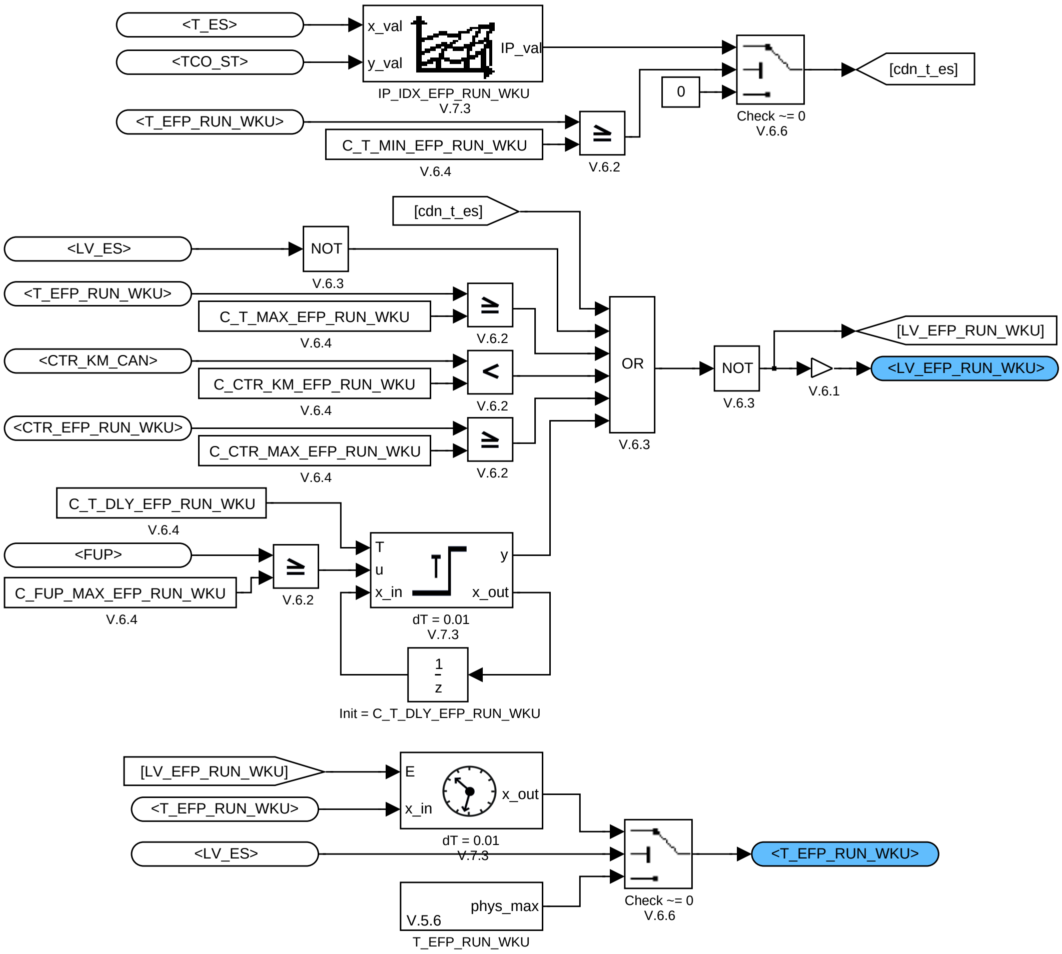

Figure 9.29.13: :

9.29.2.3 Segment task (active on LV_ST_END == 1) or 10ms task (active on LV_ST_END == 0)

This module is consisting out of the transition condition calculation, the addition flow calculation and the limp home determination

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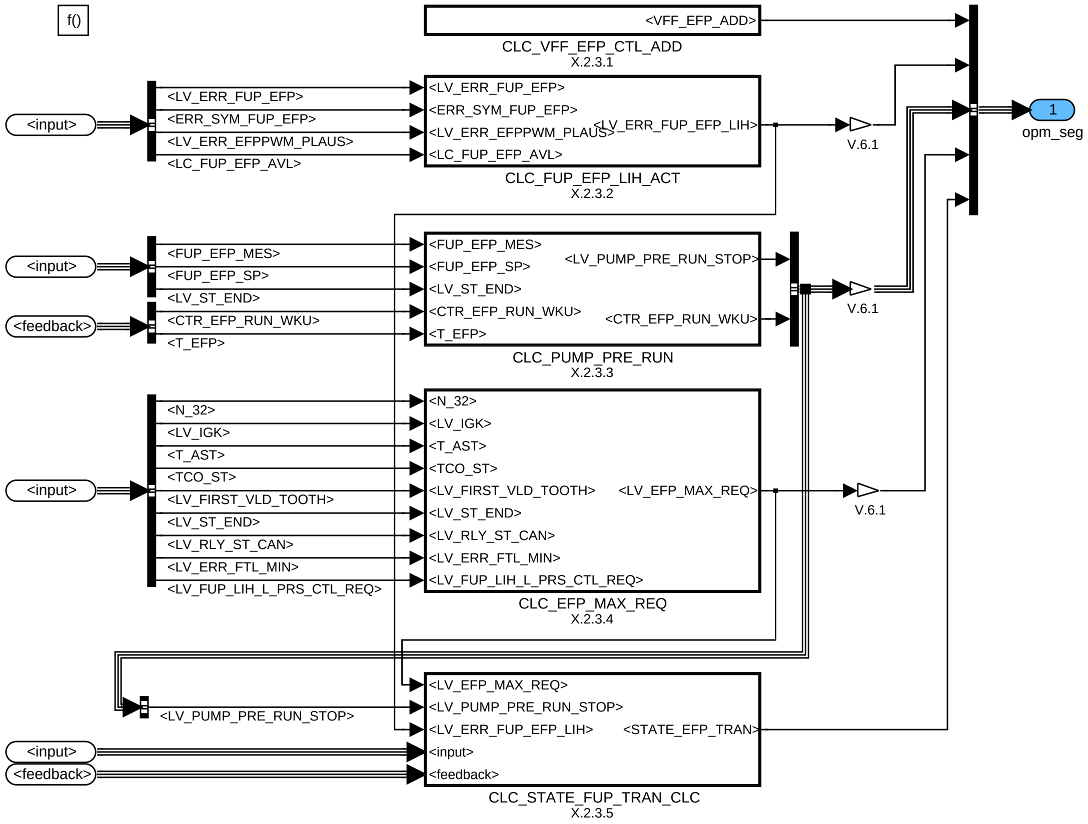

Figure 9.29.14: :

9.29.2.3.1 Volume fuel flow

An additional offset for the requested flow by the low pressure pump can be adjusted with the following constant.

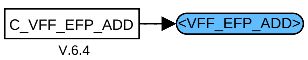

Figure 9.29.15: :

9.29.2.3.2 Limp home active

The limp home for the low pressure fuel pump is triggered by different error flags.

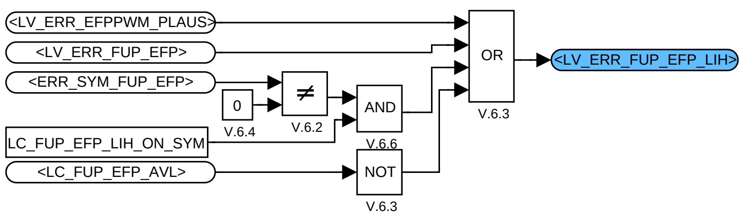

Figure 9.29.16: :

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9.29.2.3.3 Pump pre-run calculation

The pre-run of the low pressure pump is stopped when the fuel pressure set point of the low pressure pump has been reached by the measured fuel pressure (without filtering) or the timer has expired.

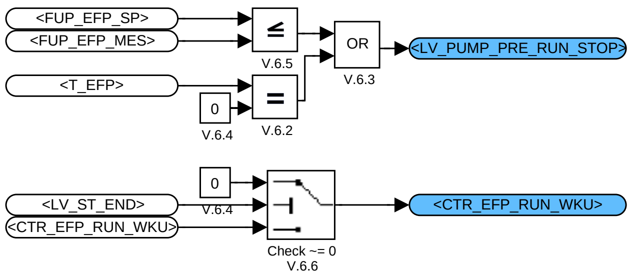

Figure 9.29.17: :

9.29.2.3.4 Calculation of maximum request for electrical fuel pump

Maximum fuel flow by electrical fuel pump is requested in case of hot start conditions.

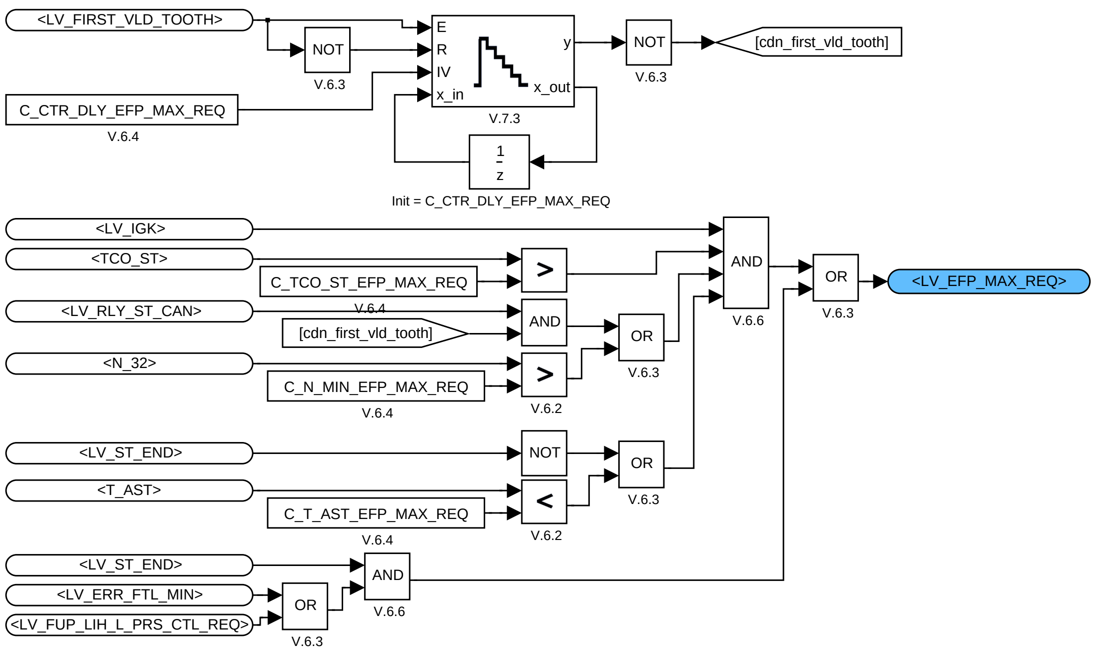

Figure 9.29.18: :

9.29.2.3.5 State fuel pressure transition calculation

The transition conditions are split into two parts due to a better overview.

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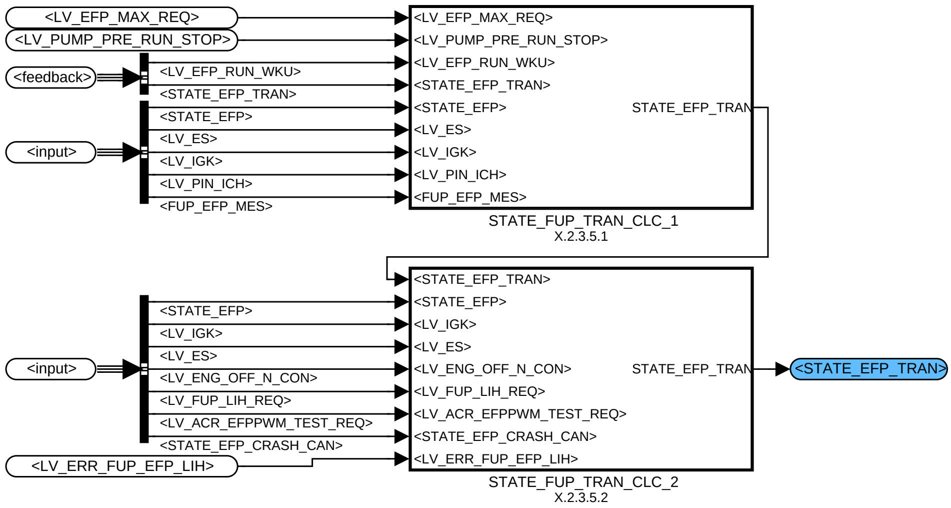

Figure 9.29.19: :

9.29.2.3.5.1 State fuel pressure transition calculation 1

In this part the first part of the transition conditions for the EFP state diagram are calculated.

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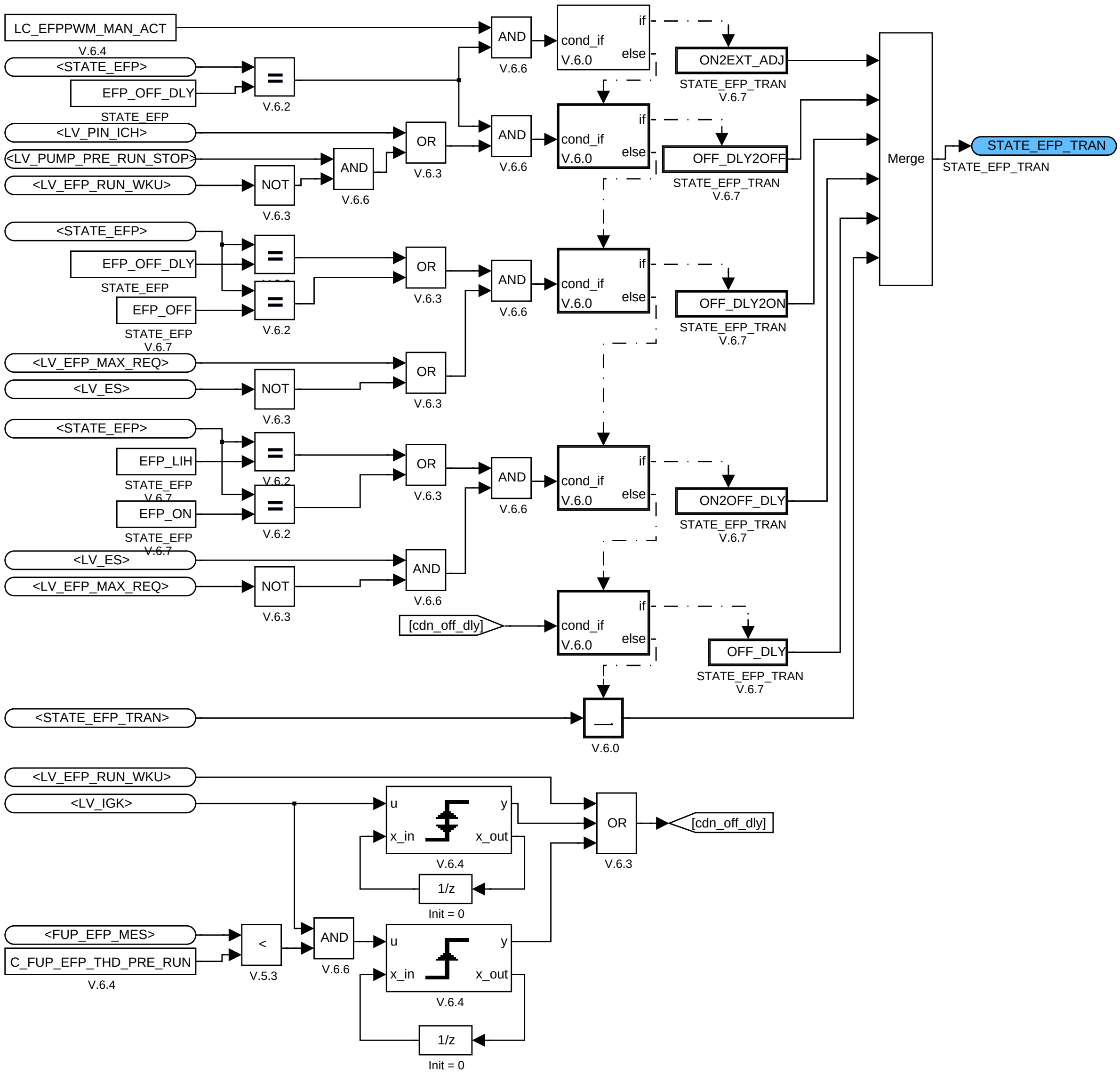

Figure 9.29.20: :

9.29.2.3.5.2 State fuel pressure transition calculation 2

In this part the first part of the transition conditions for the EFP state diagram are calculated. Main parts are the limp home conditions and the safety and security reasons.

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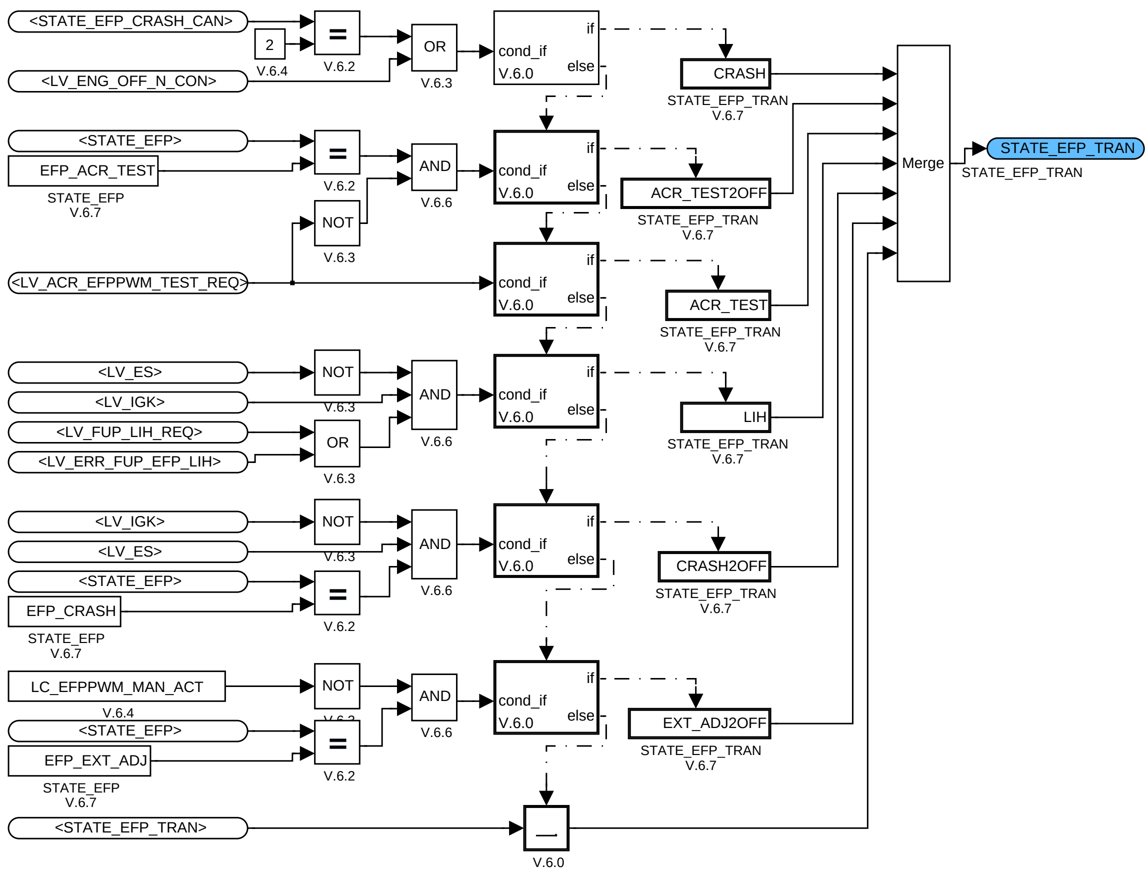

Figure 9.29.21: :

9.29.2.4 10m task (active on LV_ST_END == 0)

The calculation of the low pressure system observation is split into a calculation for the high part and on calculation for the low part. Each part has an output for the start pressure, stop pressure, coolant temperature and the time for rising/falling pressure.

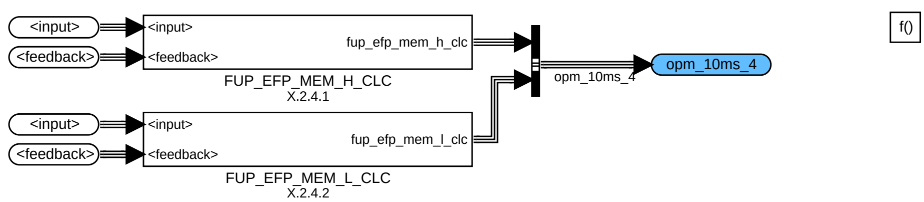

Figure 9.29.22: :

9.29.2.4.1 Electrical fuel pump memorize high calculation

In this part the high signals are calculated

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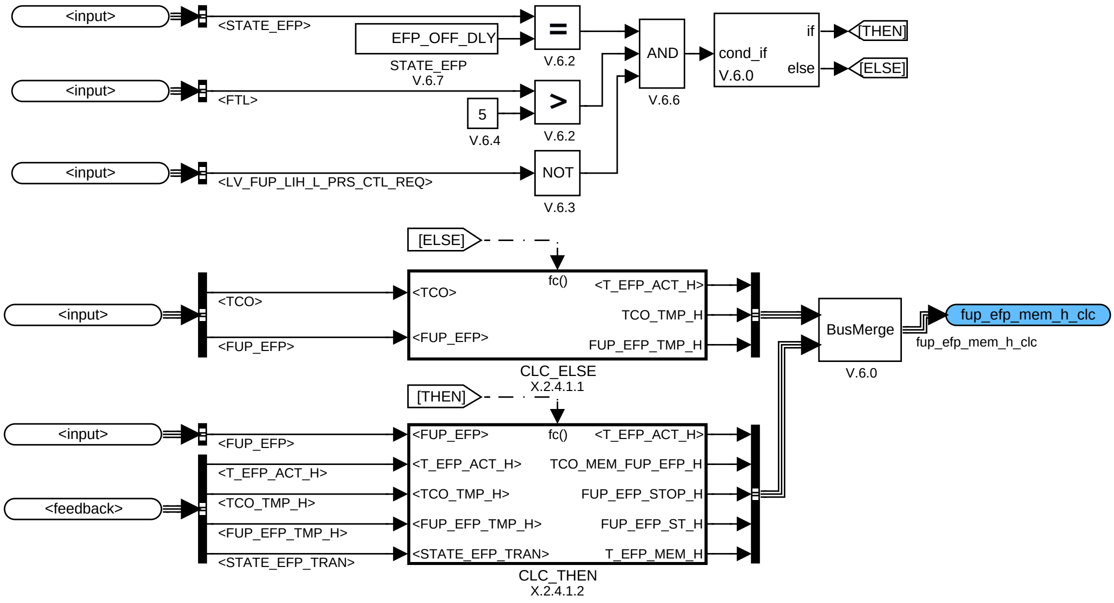

Figure 9.29.23: :

9.29.2.4.1.1 ELSE

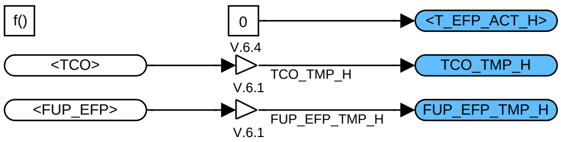

Figure 9.29.24: :

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9.29.2.4.1.2 THEN

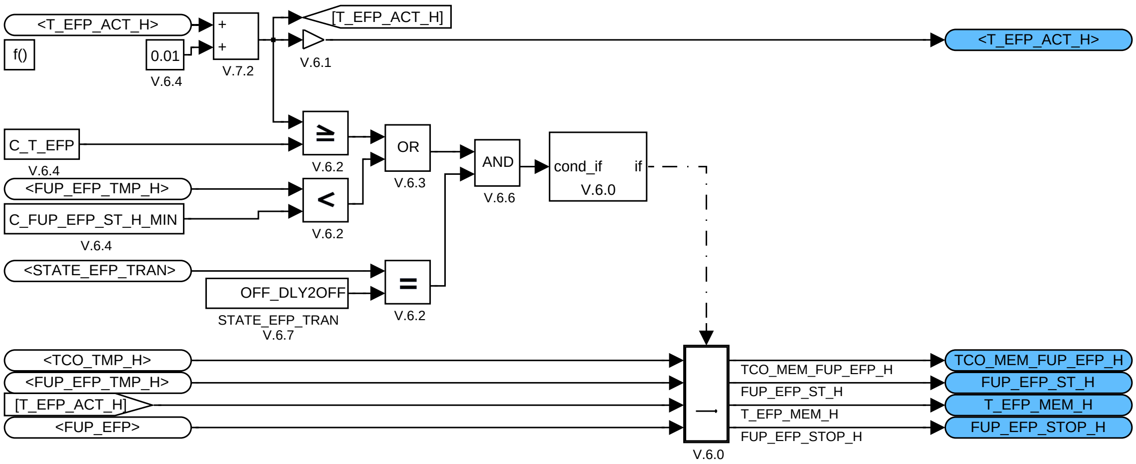

Figure 9.29.25: :

9.29.2.4.2 Electrical fuel pump memorize low calculation

In this part the low signals are calculated.

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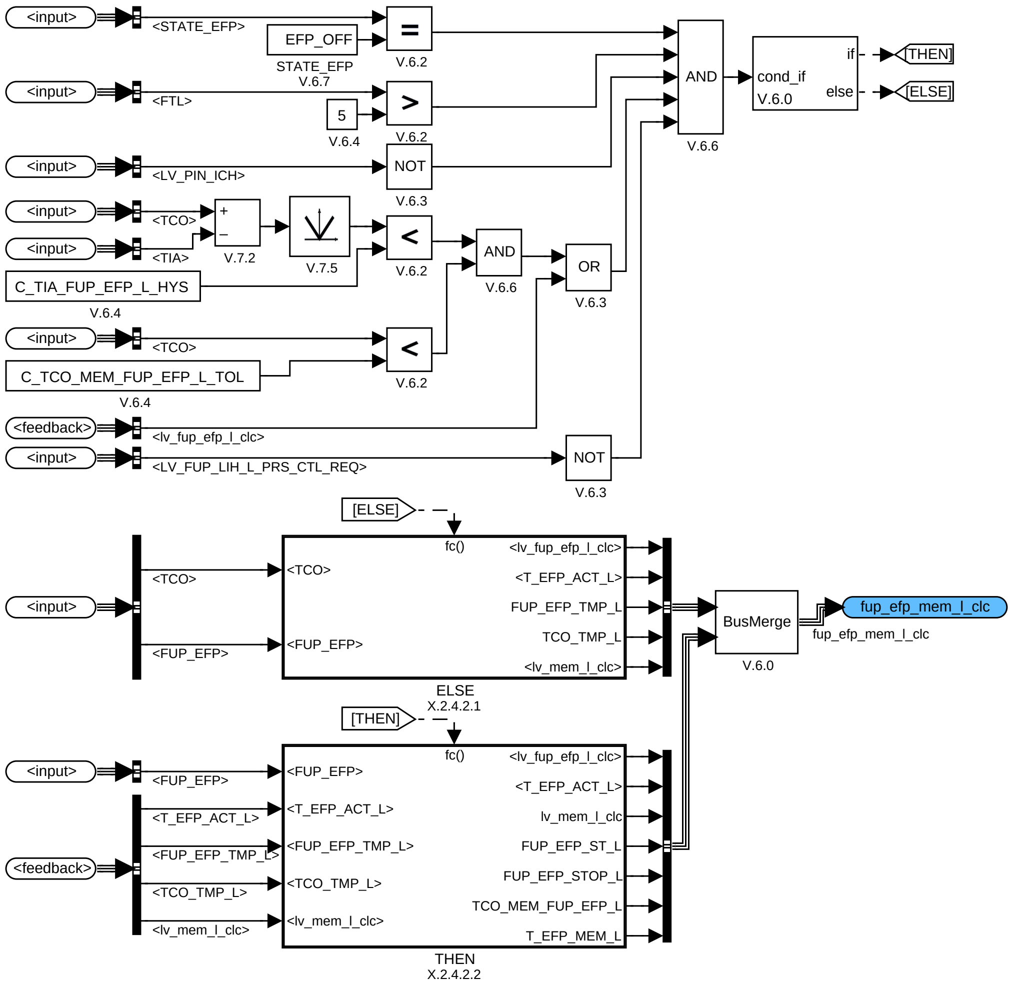

Figure 9.29.26: :

9.29.2.4.2.1 ELSE

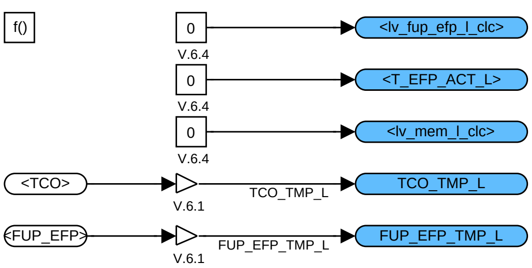

Figure 9.29.27: :

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9.29.2.4.2.2 THEN

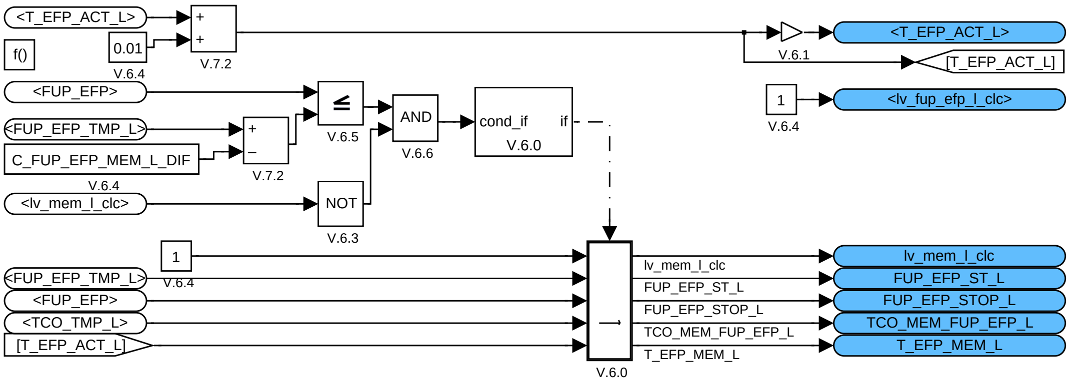

Figure 9.29.28: :

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9.30 Starter relay control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_RLY_ST	O/V	0... 1H	0 ...1	1	-
Starter relay output					

Input data:

LV_ACT_RLY_ST_EXT_ ADJ {p. 7432}	LV_RLY_ST_EXT_ADJ {p. 7434}	N_32 {p. 1525}	TCO {p. 1100}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_N_MAX_TOL_STR	-	0... FFH	0... 8160	32	rpm
LDPM_TCO_9	9	0... FEH	0... 142.5	0.75	°C
Top level end of starter relay control					

General information:

The function is defined to switch the starter relay output, dependent on the engine speed. An interface for external adjustment is offered. Through the action call is the ECU pin level "Starter Relay " set.

Application Condition

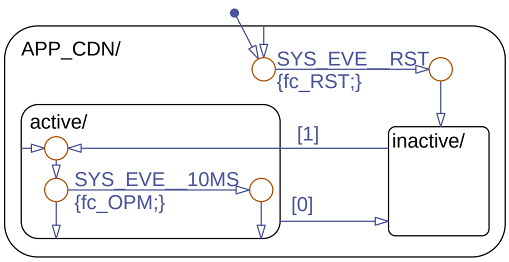

Figure 9.30.1: ENSS_M9015/APP_CDN/Chart

Function Description

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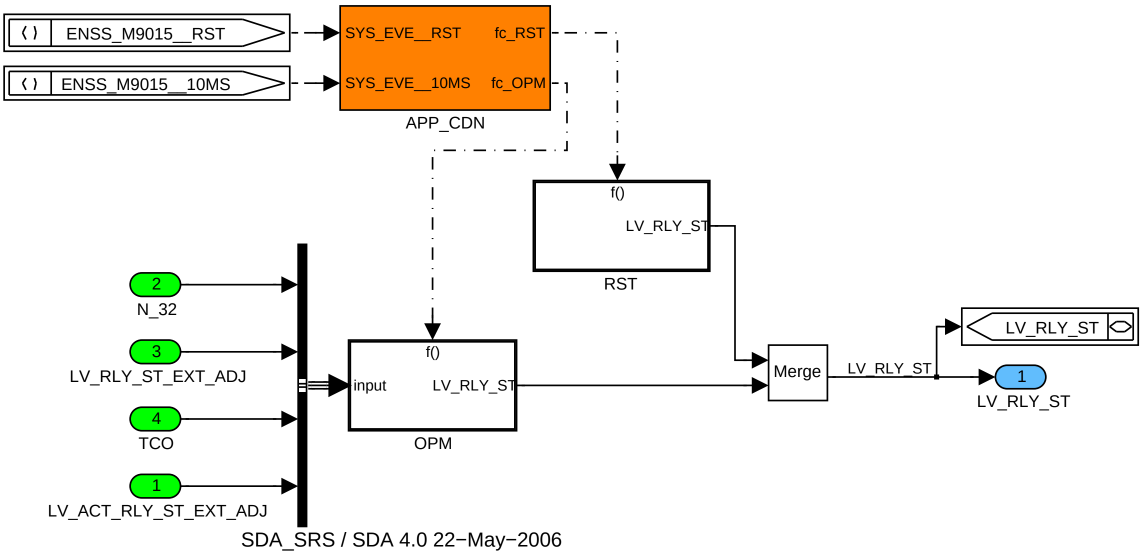

Figure 9.30.2: ENSS_M9015

9.30.1 Initialization at Reset

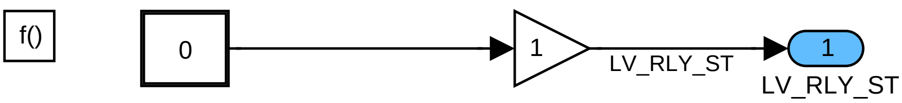

Figure 9.30.3: ENSS_M9015/RST

9.30.2 Formula section

Activation of Starter Relay

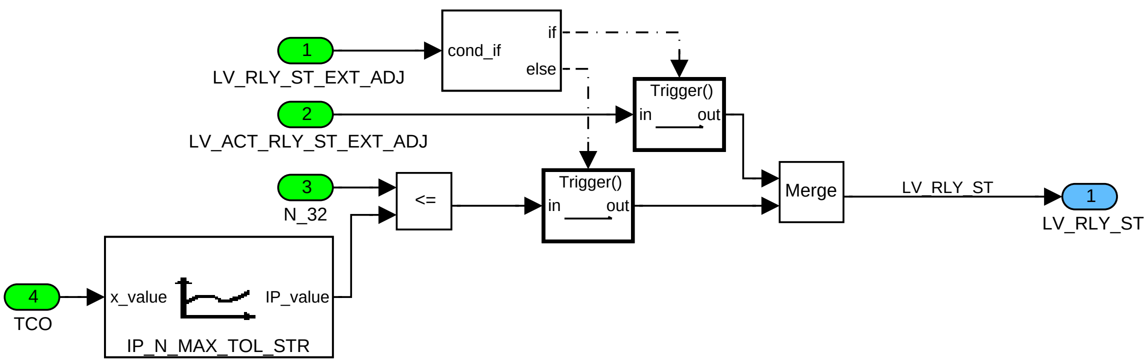

Figure 9.30.4: ENSS_M9015/OPM/CLC_LV_RLY_ST

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9.31 Fuel consumption calculation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_VS_MIN_FCO	V	0... FFH	0... 255	1	-
Counter indicating time since VS is below threshold					
FAC_FCO_FIL [2]	V	0... FFFFH	0... 0.99998	15.3e-6	-
Filter factor for FCO filter					
FCO	O/V	0... FFFFFFFFH	0... 4294967295	1	µl
integrated fuel consumption					
FCO_AV	V	0... FFFFH	0... 65535	1	µl
actual fuel consumption					
FCO_AV_1	O/V	0... FFFFH	0... 65535	1	µl
actual fuel consumption					
FCO_AV_2	O/V	0... FFFFH	0... 65535	1	µl
actual fuel consumption					
FCO_AV_FIL [2]	V	0... FFFFFFFFH	0... 65535	15.3e-6	µl
actual fuel consumption filtered					
FCO_AV_MMV	O/V	0... FFFFH	0... 65535	1	µl
Moving mean value of the actual fuel consumption					
FCO_DMTL	O/V	0... FFFFFFFFH	0... 4294967295	1	µl
integrated fuel consumption DMTL					
FCO_FIL_DIF	V	7FFFFFFFH 80000000... H	2147483647 -2147483648...	-	µl
difference of actual and filtered actual fuel consumption					
FCO_FIL_DIF_FB	V	7FFFFFFFH 80000000... H	2147483647 -2147483648...	-	µl
Feedback part to FCO calculation of difference of actual and filtered actual fuel consumption					
FCO_MFF_ADD_CYL_CP	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass from the canister in the cylinder, temp. value for FCO calculation					
T_FAC_FCO_FIL [2]	V	0... FFH	0... 25.5	0.1	s
Filter time for FCO filter					
T_RAMP_FCO_FIL	V	0... FFFFH	0... 655.35	0.01	s
Timer to ramp down the FCO-filter					

Input data:

EFF_SCC_AV {p. 6665}	FAC_FCO_KWP {p. 7541}	LV_AMT_ACT {p. 6658}	LV_DCC_INC_ACT {p. 6731}
LV_DCC_PUC_INH {p. 1565}	LV_ES {p. 1720}	LV_FCO_COR_REQ {p. 8242}	LV_GS_INC_ACT {p. 6718}
LV_IGK {p. 906}	LV_INH_PUC_CUS {p. 8209}	LV_LDM_PUC_INH {p. 6615}	LV_PUC {p. 1720}
LV_PUC_INH_TEMP_CAT {p. 8233}	LV_PUC_LOCK_TNT {p. 8199}	LV_PUC_REQ {p. 1720}	LV_PUC_SA_INH {p. 804}
LV_REQ_ISC {p. 3501}	MFF_ADD_CYL_CP {p. 3692}	MFF_SP [NC_CBK_EX_NR] {p. 2151}	MFF_SP_BAS {p. 8243}

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MFF_SP_FCO_COR {p. 8243}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}	NC_LAMB_REF [NC_CYL_NR] {p. 812}
OPM_AV {p. 8137}	SEG_NR {p. 1525}	VS {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FCO_AV	-	0... FFH	0... 0.99609	3.9063e-3	-
Correlation constant for moving mean value calculation of FCO					
C_CTR_VS_MIN_FCO	-	0... FFH	0... 255	1	-
Threshold of a counter (used in FCO calculation)					
C_FAC_MFF_FCO	-	0... FFFFH	0... 0.99998	15.3e-6	-
Transition factor MFF to FCO					
C_FAC_MFF_FCO_LAM_AD	-	0... FFH	0... 0.99609	3.9063e-3	-
weighting factor for using or not of lambda adaptation value for calculation of FCO					
C_FCO_DIF_GAIN	-	0... FFFFH	0 ...1	15.3e-6	-
Gain for P-controller					
C_FCO_DIF_MAX	-	0... FFFFH	0... 65535	1	µl
threshold to activate balance controller					
C_FCO_FIL_DIF_FB_MAX	-	7FFFFFFFH 80000000... H	2147483647 -2147483648...	-	µl
Maximum value of FCO_FIL_DIF_FB					
C_FCO_FIL_DIF_FB_MIN	-	7FFFFFFFH 80000000... H	2147483647 -2147483648...	-	µl
Minimun value of FCO_FIL_DIF_FB					
C_T_FAC_FCO_FIL_CUS [2]	-	0... FFH	0... 25.5	0.1	s
Filter constant for FCO filter during custumer corrected fuel mass setpoint					
C_T_FAC_FCO_FIL_ISC [2]	-	0... FFH	0... 25.5	0.1	s
Filter constant for FCO filter during active idle speed controller in stratified mode					
C_T_RAMP_FCO_FIL	-	0... FFFFH	0... 655.35	0.01	s
Constant indicating speed of ramping down the FCO-filter					
C_VS_MIN_FCO	-	0... FFH	0... 255	1	km/h
Threshold for VS used in FCO calculation					
LC_FCO_COR_REQ_ENA	-	0... 1H	0 ...1	1	-
use corrected MFF_SP during NOx Trap regeneration and desulfurization for FCO calculation					
LC_FCO_COR_REQ_PUC	-	0... 1H	0 ...1	1	-
Freeze FCO calculation on LV_PUC = 1					
LC_FCO_COR_REQ_PUC_INH	-	0... 1H	0 ...1	1	-
Freeze FCO calculation on LV_PUC_REQ = 1 and inhibit LV_PUC					
LC_FCO_MFF_ADD_CYL_CP	-	0... 1H	0 ...1	1	-
use Canister fuel flow for FCO calculation					

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General information:

The actual fuel consumption value (FCO_AV_1) is calculated from MFF_SP (incl. Lambdaadaptation) or MFF_SP_BAS (without Lam-ad) and several factors. During NOx regeneration additional FCO_AV_2 is calculated. This is not the real fuel mass, but it is used to avoid strong peaks in the FCO_AV signal. If NOx regeneration, desulfurization or the idle speed controller during stratifid mode is active, FCO_AV is additional filtered to avoid high gradients in the FCO signal. To ensure that the integrated fuel consumption (FCO) is still correct despite of the filtering and the use of FCO_AV_2 (-> FCO_FIL_DIF = 0), a balance controller (C_FCO_DIF_GAIN) is activated to balance FCO over a certain time.

Application conditions

Initialisation: `at reset or LV_IGK 0->1: all = 0, except FCO_DMTL = 0 only at reset and FCO_FIL_DIF =0 only at reset`

Recurrence: `every segment, except calculation of T_RAMP_FCO_FIL and FCO_FIL_DIF_FB, 10ms recurrence`

Activation: `LV_ES = 0`

Formula section:

// calculate FCO_AV_1
If LC_FCO_MFF_ADD_CYL_CP = 1 *// use Canister fuel flow for FCO calculation?*
then FCO_MFF_ADD_CYL_CP = MFF_ADD_CYL_CP
else FCO_MFF_ADD_CYL_CP = 0
endif
// calculate FCO_AV_1using MFF_SP with Lambdaadatation (C_FAC_MFF_FCO_LAM_AD=1) or without
FCO_AV_1 = **(**MFF_SP[NC_LAMB_REF[SEG_NR]] * C_FAC_MFF_FCO_LAM_AD + MFF_SP_BAS * (1- C_FAC_MFF_FCO_LAM_AD) + FCO_MFF_ADD_CYL_CP**)** * C_FAC_MFF_FCO * 46 * EFF_SCC_AV * (1 + FAC_FCO_KWP)

//calculate a second FCO during regeneration and desulfurization (not real mass fuel flow, used for filtering strong amplitudes due to regeneration):
If LV_FCO_COR_REQ = 1 **and**
LC_FCO_COR_REQ_ENA = 1
Then FCO_AV_2 = MFF_SP_FCO_COR * C_FAC_MFF_FCO * 46 * EFF_SCC_AV * (1 + FAC_FCO_KWP)
FCO_AV = FCO_AV_2
Else FCO_AV = FCO_AV_1
FCO_AV_2 = FCO_AV_1
Endif

// calculate FCO_DMTL and FCO_AV_MMV
$FCO\_DMTL_{n} = FCO\_DMTL_{n-1} + FCO\_AV$
$FCO\_AV\_MMV_{(n)} = FCO\_AV\_MMV_{(n-1)} + C\_CRLC\_FCO\_AV * (FCO\_AV - FCO\_AV\_MMV_{(n-1)})$

// initialize filter factors if requested
If LV_FCO_COR_REQ = 1
Then *//activation of filter in case of custumer corrected fuel mass setpoint:*
T_FAC_FCO_FIL[i] = C_T_FAC_FCO_FIL_CUS[i]
Elseif (OPM_AV = 1 **or** OPM_AV = 3) **and** LV_REQ_ISC = 1
Then *//activation of filter in case of active idle speed controller in stratified mode:*
T_FAC_FCO_FIL[i] = C_T_FAC_FCO_FIL_ISC[i]
Endif

// calculate filter outputs:
If T_FAC_FCO_FIL[1] > 0 **or** T_FAC_FCO_FIL[2] > 0
Then **if** LV_FCO_COR_REQ = 0 **and**

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```
            [(OPM_AV != 1 and OPM_AV != 3)  or  LV_REQ_ISC = 0]
      then  // ramp filter time/factors -> until FAC_FCO_FIL[i] = 0:
            if       T_RAMP_FCO_FIL >= C_T_RAMP_FCO_FIL
            then     T_RAMP_FCO_FIL = 0
                     T_FAC_FCO_FIL[i] = T_FAC_FCO_FIL[i] - 0,1s
            else     do nothing
            endif
      Endif
      // calculate filter factor FAC_FCO_FIL from filter time T_FAC_FCO and segment time (calculated from N_32):
      FAC_FCO_FIL[i] = 1 /( 1 + T_FAC_FCO_FIL[i] /(120 /(N_32 * NC_CYL_NR)) )
      // calculate filter outputs:
      FCO_AV_FIL[1](n)   =   FAC_FCO_FIL[1]  * FCO_AV
                           + (1 - FAC_FCO_FIL[1]) * FCO_AV_FIL[1](n-1)
      FCO_AV_FIL[2](n)   =   FAC_FCO_FIL[2]  * FCO_AV_FIL[1](n)
                           + (1 - FAC_FCO_FIL[2]) * FCO_AV_FIL[2](n-1)
Else  FCO_AV_FIL[i]      =   FCO_AV       //converted
Endif

// calculate FCO:
If      [LV_PUC = 1 and LC_FCO_COR_REQ_PUC = 1]                               or
     // no FCO display on fuel cut off

        [LV_PUC_REQ = 1 and LV_PUC = 0 and LC_FCO_COR_REQ_PUC_INH = 1
                                                                             and

        (LV_PUC_INH_TEMP_CAT = 1 or LV_PUC_LOCK_TNT = 1)                     and

        LV_LDM_PUC_INH = 0 and LV_DCC_PUC_INH = 0 and LV_AMT_ACT = 0 and LV_
        PUC_SA_INH = 0 and LV_DCC_INC_ACT = 0 and LV_GS_INC_ACT = 0 and LV_INH_
        PUC_CUS = 0]
        // no FCO display on requested but inhibited fuel cut off
Then
        // fuel consumption display in instrument cluster is deactived
        FCO(n) = FCO(n-1)
        FCO_FIL_DIF(n) = FCO_FIL_DIF(n-1) + FCO_AV_1
Else
   If   abs( FCO_FIL_DIF) > C_FCO_DIF_MAX      or
        LV_FCO_COR_REQ = 1                     or
        [(OPM_AV = 1 or OPM_AV = 3)  and  LV_REQ_ISC = 1]
   Then
        //check speed of vehicle, in case VS < threshold -> fuel consumption display in instrument
        cluster is deactived -> thus complete adding of FCO difference (FCO_FIL_DIF) to FCO
        signal can be done:
        IF     VS < C_VS_MIN_FCO
        THEN   CTR_VS_MIN_FCO ++
        ELSE   CTR_VS_MIN_FCO = 0
        ENDIF
        // for the following calculations FCO_AV_FIL[2] has to be converted!
        IF     CTR_VS_MIN_FCO <= C_CTR_VS_MIN_FCO
        THEN
               // calculate integrated fuel consumption with filter output and controller output:
               FCO(n)  =  FCO(n-1) + FCO_AV_FIL[2] + FCO_FIL_DIF_FB
```


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//calculate fuel difference between FCO_AV_1 and filter+controller output (integrated):

FCO_FIL_DIF$_{(n)}$ = FCO_FIL_DIF$_{(n-1)}$
+ [FCO_AV_1 - FCO_AV_FIL[2]]
- FCO_FIL_DIF_FB

//reset of FCO_FIL_DIF_FB:
FCO_FIL_DIF_FB = 0
ELSE
// calculate integrated fuel consumption with FCO_AV_1 (real FCO) and add complete FCO difference:
FCO$_{(n)}$ = FCO$_{(n-1)}$ + FCO_AV_1 + FCO_FIL_DIF

//reset FCO_FIL_DIF:
FCO_FIL_DIF$_{(n)}$ = 0

//reset of FCO_FIL_DIF_FB:
FCO_FIL_DIF_FB = 0
ENDIF

Else *// calculate integrated fuel consumption with FCO_AV:*
FCO $_{(n)}$ = FCO$_{(n-1)}$ + FCO_AV
// initialize values:
FCO_FIL_DIF = 0
Endif
Endif

Calculation of Timer T_RAMP_FCO_FIL (calculation with 10ms recurrence!):
If T_RAMP_FCO_FIL $<$ 655,35 s
Then T_RAMP_FCO_FIL = T_RAMP_FCO_FIL + 0,01s
Else *do nothing*
Endif

Calculation of FCO_FIL_DIF_FB (calculation with 10ms recurrence!):
IF abs(FCO_FIL_DIF) $>$ 0
Then **if** abs(FCO_FIL_DIF) $<$ C_FCO_FIL_DIF_FB_MIN
Then
FCO_FIL_DIF_FB = FCO_FIL_DIF
Else
//calculate FCO_FIL_DIF_FB and apply min/max check:
FCO_FIL_DIF_FB_1 = min(C_FCO_FIL_DIF_FB_MAX,
abs(FCO_FIL_DIF)* C_FCO_DIF_GAIN)
FCO_FIL_DIF_FB = max(C_FCO_FIL_DIF_FB_MIN,
FCO_FIL_DIF_FB_1)
//add correct sign to FCO_FIL_DIF_FB:
If FCO_FIL_DIF $<$ 0
Then FCO_FIL_DIF_FB = - FCO_FIL_DIF_FB
Else *unchanged*
Endif
Endif
Endif

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9.32 Sound flap

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_SOF_THD	V	0... FFFFH	0... 1.99996	30.5e-6	-
Switching threshold for sound flap					
FAC_TQ_SOF_THD_CTOP	V	0... FFFFH	0... 1.99996	30.5e-6	-
Switching threshold for sound flap without hysteresis					
LV_SOF	O/V	0... 1H	0 ...1	1	-
logical value sound flap (1 = activated)					
LV_SOF_SWI	O/V	0... 1H	0 ...1	1	-
Sport-mode switch acting					
LV_SOF_SWI_AMT	O/V	0... 1H	0 ...1	1	-
Sport-mode switch AMT acting					
LV_SOF_SWI_AMT_REQ	O/V	0... 1H	0 ...1	1	-
Sport-mode AMT required by switch					
LV_SOF_SWI_REQ	O/V	0... 1H	0 ...1	1	-
Sport-mode required by switch					
N_SOF	V	0... FFH	0... 8160	32	rpm
N for sound flap					
T_DLY_SOF	V	0... FFH	0... 25.5	0.1	s
Time delay for closing sound flap					
T_DLY_SOF_OPEN	V	0... FFH	0... 5.1	0.02	s
Time delay for opening sound flap					

Input data:

CONF_SOF_SWI {p. 654}	FAC_TQ_REQ {p. 6706}	GEAR_EF {p. 1302}	LV_ACT_SOF_EXT_ADJ {p. 7433}
LV_AT {p. 654}	LV_CITY {p. 799}	LV_CTOP {p. 1565}	LV_ERR_BN_GEAR_REV {p. 4870}
LV_ERR_BN_VEH_MOD {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_SOF_INH_MON {p. 6790}	LV_ERR_SOF_REQ {p. 4911}
LV_ES {p. 1720}	LV_IGK {p. 906}	LV_SOF_EXT_ADJ {p. 7435}	LV_ST {p. 1720}
LV_VAR_BN {p. 655}	LV_VAR_SOF {p. 656}	N_32 {p. 1525}	STATE_SPT_DISP_CAN {p. 8289}
STATE_VEH_MOD {p. 1578}	T_AST {p. 1766}	V_SOF_SWI {p. 831}	VS {p. 1176}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_SOF_THD_HYS	-	8000... 7FFFH	-2... 1.99993	61e-6	-
Hysteresis for switching threshold sound flap					
C_N_SOF_HYS	-	0... FFH	0... 8160	32	rpm
N hysteresis SOF					
C_T_SOF_AST	-	0... FFH	0... 25.5	0.1	s
cranking time for SOF actuation active					
C_V_SOF_SWI_AMT_ON_TOL	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage-threshold top limit for sport switch mode ON (AMT)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_SOF_SWI_ON_BOL	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage-threshold bottom limit for sport switch mode ON					
C_V_SOF_SWI_ON_TOL	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage-threshold top limit for sport switch mode ON					
C_VS_MIN_SOF_AT	-	0... FFH	0... 255	1	km/h
Speed threshold for continously opened sound flap (automatic transmission)					
C_VS_MIN_SOF_MT	-	0... FFH	0... 255	1	km/h
Speed threshold for continously opened sound flap (manuel transmission)					
ID_FAC_TQ_SOF_THD_CTOP_CLOSE_AT	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_N_SOF	10	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Switching threshold FAC_TQ_SOF for convertible top closed (automatic transmission)					
ID_FAC_TQ_SOF_THD_CTOP_CLOSE_MT	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_N_SOF	10	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Switching threshold FAC_TQ_SOF for convertible top closed (manuel transmission)					
ID_FAC_TQ_SOF_THD_CTOP_OPEN_AT	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_N_SOF	10	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Switching threshold FAC_TQ_SOF for convertible top open (automatic transmission)					
ID_FAC_TQ_SOF_THD_CTOP_OPEN_MT	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_N_SOF	10	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Switching threshold FAC_TQ_SOF for convertible top open (manuel transmission)					
ID_T_DLY_SOF_OPEN_CTOP_CLOSE_AT	V	0... FFH	0... 5.1	0.02	s
LDPM_N_SOF	10	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Time delay for opening sound flap for convertible top closed (automatic transmission)					
ID_T_DLY_SOF_OPEN_CTOP_CLOSE_MT	V	0... FFH	0... 5.1	0.02	s
LDPM_N_SOF	10	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Time delay for opening sound flap for convertible top closed (manuel transmission)					
ID_T_DLY_SOF_OPEN_CTOP_OPEN_AT	V	0... FFH	0... 5.1	0.02	s
LDPM_N_SOF	10	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Time delay for opening sound flap for convertible top open (automatic transmission)					
ID_T_DLY_SOF_OPEN_CTOP_OPEN_MT	V	0... FFH	0... 5.1	0.02	s
LDPM_N_SOF	10	0... FFH	0... 8160	32	rpm
LDPM_GEAR_EF_1	8	0... 7H	0 ...7	1	-
Time delay for opening sound flap for convertible top open (manuel transmission)					
IP_T_DLY_SOF	-	0... FFH	0... 25.5	0.1	s
LDP_N_32	8	0... FFH	0... 8160	32	rpm
Time delay for closing sound flap					

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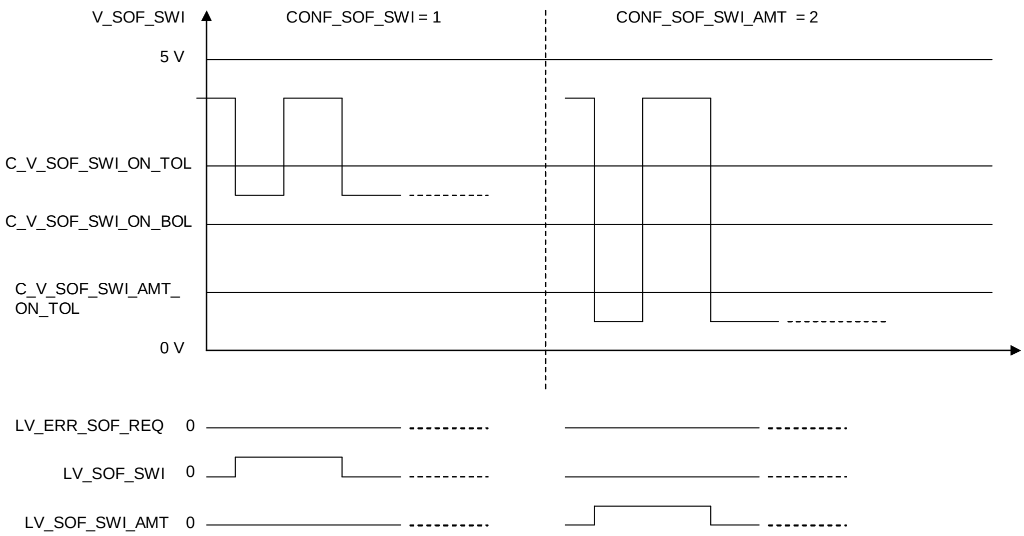
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_CONF_CITY_ENA	-	0... 1H	0 ...1	1	-
Enable condition regarding LV_CITY (1=on /0=off)					
LC_STATE_SOF_AST	-	0... 1H	0 ...1	1	-
State sound flap during C_T_SOF_AST					
LC_STATE_VS_MIN_SOF_AT	-	0... 1H	0 ...1	1	-
State sound flap in case of VS < C_VS_MIN_SOF_AT (automatic transmission)					
LC_STATE_VS_MIN_SOF_MT	-	0... 1H	0 ...1	1	-
State sound flap in case of VS < C_VS_MIN_SOF_MT (manuel transmission)					
LC_VAR_SOF_SWI	-	0... 1H	0 ...1	1	-
Calibration switch for sport switch (1=on /0=off)					
LC_VAR_SOF_SWI_AMT	-	0... 1H	0 ...1	1	-
Calibration switch for sport switch in AMT vehicles (1=on /0=off)					

9.32.1 Acquisition of sport-mode-switch

General information:

Calculation of the sport-mode request by taking the voltage of the sport-mode-switch.
The request acts according to the rising egde of the voltage signal.
There must be for 3 cyles the same result of LV_SOF_SWI(_AMT) to accept the level.

Signal flow diagram:



In case of failure LV_ERR_SOF_REQ =1 inhibitation of LV_SOF_SWI(_AMT):

Application conditions

Initialisation:

```
all variables are initialised with 0 at:
reset or LV_ES = 0- ->1
```

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Recurrence: *10ms*

Activation: *every engine state*

Formula section:

If (1) LV_VAR_BN = 0
Then (1)

If(2) LV_ERR_SOF_REQ = 0
Then(2)

If(3) (V_SOF_SWI > C_V_SOF_SWI_ON_TOL) changes to
(C_V_SOF_SWI_ON_BOL V_SOF_SWI C_V_SOF_SWI_ON_TOL)
(equal to 0 ->1)
And *this result is valid for 3 evaluations*
Then(3) LV_SOF_SWI **= !** LV_SOF_SWI
Endif(3)

If(4) (V_SOF_SWI > C_V_SOF_SWI_AMT_ON_TOL) changes to (V_
SOF_SWI C_V_SOF_SWI_AMT_ON_TOL)
(equal to 0 ->1)
And *this result is valid for 3 evaluations*
Then(4) LV_SOF_SWI_AMT **= !** LV_SOF_SWI_AMT
Endif(4)

Else(2) LV_SOF_SWI = 0
LV_SOF_SWI_AMT = 0

Endif(2)

Else (1)

If (5) LV_VAR_BN = 1 **And**
LV_ERR_BN_VEH_MOD = 0 **And**
LV_ERR_CAN_BOFF = 0 **And**
LV_ERR_BN_GEAR_REV = 0 **And**
((STATE_VEH_MOD = 2H) **Or**
((LC_VAR_SPT_SWI = 1) **And**
(STATE_SPT_DISP_CAN = 1H)))
Then (5) LV_SOF_SWI= 1
Else (5) LV_SOF_SWI = 0
Endif(5)

Endif (1)

Calculation of LV_SOF_SWI_REQ and LV_SOF_SWI_AMT_REQ:
If (LV_CITY = 0 **Or**
LC_CONF_CITY_ENA = 1) **And**
CONF_SOF_SWI 2 **And**
LC_VAR_SOF_SWI = 1 **And**
LV_SOF_SWI = 1 **And**
LV_ERR_SOF_INH_MON = 0
Then LV_SOF_SWI_REQ = 1

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Else LV_SOF_SWI_REQ = 0
Endif

If LV_CITY = 0 **And**
CONF_SOF_SWI = 2 **And**
LC_VAR_SOF_SWI_AMT = 1 **And**
LV_SOF_SWI_AMT = 1
Then LV_SOF_SWI_AMT_REQ = 1
Else LV_SOF_SWI_AMT_REQ = 0
Endif

9.32.2 Acquisition of sound-flap

General information:

To optimize the vehicle noise behaviour, an sound flap can be activated depending on the engine speed (N_SOF) and the load (FAC_TQ_REQ). The sound flap is closed below a FAC_TQ_REQ threshold, it is opened above the threshold.
The sound flap is only activ after the time C_T_SOF_AST after the transition from Start.
The switching threshold (FAC_TQ_SOF_THD) is depending on enginespeed (N_SOF), the selected gear (GEAR_EF), the transmission (manuell or automatic) and the convertible top (LV_CTOP = 0 closed, or LV_CTOP = 1 open).

To prevent the sound flap from switching continuously during constant driving at the switching threshold, two hysteresises (C_N_SOF_HYS and C_FAC_TQ_SOF_THD_HYS) are introduced for the switching process.
The closing of the sound flap is delayed depending on the engine speed (N_32). The opening of the sound flap is delayed depending on the engine speed (N_SOF), the selected gear (GEAR_EF), the transmission (manuell or automatic) and the convertible top (LV_CTOP = 0 closed, or LV_CTOP = 1 open).

At low vehicle speeds the state of the sound flap is adjustable by C_STATE_VS_MIN_SOF_xx (xx = MT/AT).

The sound flap can be tested via KWP protocol at EOL or at service station by setting LV_SOF_EXT_ADJ = 1.

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Application conditions

Initialisation: *all variables are initialised with 0 at deactivation*
Recurrence: *20ms*
Activation: *LV_VAR_SOF = 1* ***or*** *LV_SOF_EXT_ADJ = 1*
Deactivation: *LV_IGK = 0*

Formula section:

Control of sound-flap by external adjustment:
IF LV_SOF_EXT_ADJ = 1
THEN LV_SOF = LV_ACT_SOF_EXT_ADJ
Endif
Control of sound-flap
SOF during start and engine stopped

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If LV_ST = 1 or LV_ES = 1
Then LV_SOF = 0 \\ flap closed
Endif

Highest priority is time after start , P1
If T_AST $\leq$ C_T_SOF_AST
then LV_SOF = LC_STATE_SOF_AST see next priority P2
endif

Next priority is vehicle speed dependency , P2
Automatic transmission vehicle (LV_AT = 1):
If VS $<$ C_VS_MIN_SOF_AT
then LV_SOF = LC_STATE_VS_MIN_SOF_AT see next priority P3
endif
Manual transmission vehicle (LV_AT = 0):
If VS $<$ C_VS_MIN_SOF_MT
then LV_SOF = LC_STATE_VS_MIN_SOF_MT see next priority P3
endif

Next priority is 'convertible top' , P3 \\ *calculation of thresholdvalues*
- enginespeed hysteresis

If LV_SOF = 0
Then N_SOF = N_32 + C_N_SOF_HYS
Else N_SOF = N_32
Endif

- Calculation switching threshold(FAC_TQ_SOF_THD_CTOP)

IF (1) LV_AT = 0 \\ *manuel transmission*
IF LV_CTOP = 0 \\ *convertibel top closed*
Then FAC_TQ_SOF_THD_CTOP =
ID_FAC_TQ_SOF_THD_CTOP_CLOSE_MT (N_SOF; GEAR_EF)
Else FAC_TQ_SOF_THD_CTOP = \\ *convertibel top open*
ID_FAC_TQ_SOF_THD_CTOP_OPEN_MT (N_SOF; GEAR_EF)
ELSE (1) \\ *automatic transmission*
IF LV_CTOP = 0 \\ *convertibel top closed*
Then FAC_TQ_SOF_THD_CTOP =
ID_FAC_TQ_SOF_THD_CTOP_CLOSE_AT (N_SOF; GEAR_EF)
Else FAC_TQ_SOF_THD_CTOP = \\ *convertibel top open*
ID_FAC_TQ_SOF_THD_CTOP_OPEN_AT (N_SOF; GEAR_EF)

- Calculation switching threshold hyteresis

If LV_SOF = 0 \\ *flap closed*
Then FAC_TQ_SOF_THD = FAC_TQ_SOF_THD_CTOP - C_FAC_TQ_SOF_THD_HYS
Else FAC_TQ_SOF_THD = FAC_TQ_SOF_THD_CTOP \\ *flap open*

- Compare threshold and actual value with close delay

IF FAC_TQ_REQ $_{n}$ $<$ FAC_TQ_SOF_THD $_{n}$ **and**
FAC_TQ_REQ $_{n-1}\geq$ FAC_TQ_SOF_THD $_{n-1}$ **and**
T_DLY_SOF_OPEN = 0
Then T_DLY_SOF = IP_T_DLY_SOF

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Else T_DLY_SOF - - \\ *(decremenet T_DLY_SOF in 5 cycles by 100ms)*

Endif

IF FAC_TQ_REQ $_n \geq$ FAC_TQ_SOF_THD $_n$ **and**
FAC_TQ_REQ $_{n-1}$ $<$ FAC_TQ_SOF_THD $_{n-1}$ **and**
T_DLY_SOF = 0
Then if LV_AT = 0
then **if** LV_CTOP = 0
then T_DLY_SOF_OPEN =
ID_T_DLY_SOF_OPEN_CTOP_CLOSE_MT(N_SOF; GEAR_EF)
else T_DLY_SOF_OPEN =
ID_T_DLY_SOF_OPEN_CTOP_OPEN_MT(N_SOF; GEAR_EF)
endif
else if LV_CTOP = 0
then T_DLY_SOF_OPEN =
ID_T_DLY_SOF_OPEN_CTOP_CLOSE_AT(N_SOF; GEAR_EF)
else T_DLY_SOF_OPEN =
ID_T_DLY_SOF_OPEN_CTOP_OPEN_AT(N_SOF; GEAR_EF)
endif
endif
Else T_DLY_SOF_OPEN - - \\ *(decremenet T_DLY_SOF_OPEN every cycle by 20ms)*

Endif

IF FAC_TQ_REQ $\geq$FAC_TQ_SOF_THD
Then **if** T_DLY_SOF_OPEN = 0
then LV_SOF = 1 \\ flap open
else LV_SOF = 0
endif
Else **If** T_DLY_SOF = 0
then LV_SOF = 0 \\ flap closed
else LV_SOF = 1 \\ flap open
endif
Endif
Endif

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9.33 Electronically controlled thermostat

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ECTPWM	O/V	0... FFFFH	0... 99.99847	1.53e-3	%
Pulse width modulated output signal for the electronic controlled thermostat					
T_ECTPWM_AST	-	0... FFH	0... 255	1	s
time for ECTPWM-calculation after start					

Input data:

ECTPWM_CLC {p. 8225}	ECTPWM_EXT_ADJ {p. 7431}	LV_ECTPWM_EXT_ADJ {p. 7433}	LV_ERR_ECT_EL {p. 4530}
LV_ERR_ECT_EL_OC {p. 4530}	LV_ERR_ECT_EL_SCP {p. 4530}	LV_ES {p. 1720}	LV_ST_END {p. 1720}
TCO {p. 1100}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ECTPWM_AST	-	0... FFFFH	0... 99.99847	1.5259e-3	%
calibratable ECTPWM after start					
C_ECTPWM_MAN	-	0... FFFFH	0... 99.99847	1.53e-3	%
Manual adjustable PWM output signal for the electronic controlled thermostat					
C_T_ECTPWM_AST	-	0... FFH	0... 255	1	s
time for ECTPWM-calculation after start					
C_TCO_ECTPWM	-	0... FEH	-48... 142.5	0.75	°C
calibratable TCO-threshold for ECTPWM after start					
LC_ECTPWM_MAN	-	0... 1H	0 ...1	1	-
Configuration bit for activation of manual PWM output signal adjustment					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ECTPWM_MAX	-	0... FFFFH	0... 99.99847	1.53e-3	%
Maximum PWM output signal for the electronic controlled thermostat					
NC_ECTPWM_MIN	-	0... FFFFH	0... 99.99847	1.53e-3	%
Minimum PWM output signal for the electronic controlled thermostat					
NC_ECTPWM_SUB_DIAG	-	0... FFFFH	0... 99.99847	1.53e-3	%
PWM output signal for the electronic controlled thermostat in case of a failure					

9.33.1 Adjustment of the pulse width modulated output signal (ECTPWM)

FUNCTION DESCRIPTION:

General information:

For calibration issues and service tool operations the calculated pulse width modulated signal (ECT-PWM_CLC) has to be adjusted manually before it is sent to the power stage of the electronic controlled thermostat (ECTPWM). Two possibilities for the manual adjustment are existing. With the logical constant LC_ECTPWM_MAN it is possible to adjust the calibratable value C_ECTPWM_MAN to the PWM output with use of the calibration system. The service tool allows the adjustment of the PWM signal as

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well. In this case the logical variable LV_ECTPWM_EXT_ADJ is set from logical low (0) to logical high (1) and the adjustable value ECTPWM_EXT_ADJ is used as output signal (ECTPWM).
As soon as the thermostat failure algorithm detects a electrical thermostat failure, the PWM output signal is set to a calibratable value (NC_ECTPWM_SUB_DIAG) at once and the ECT control state "LIH" is activated.

Application conditions

Initialisation:

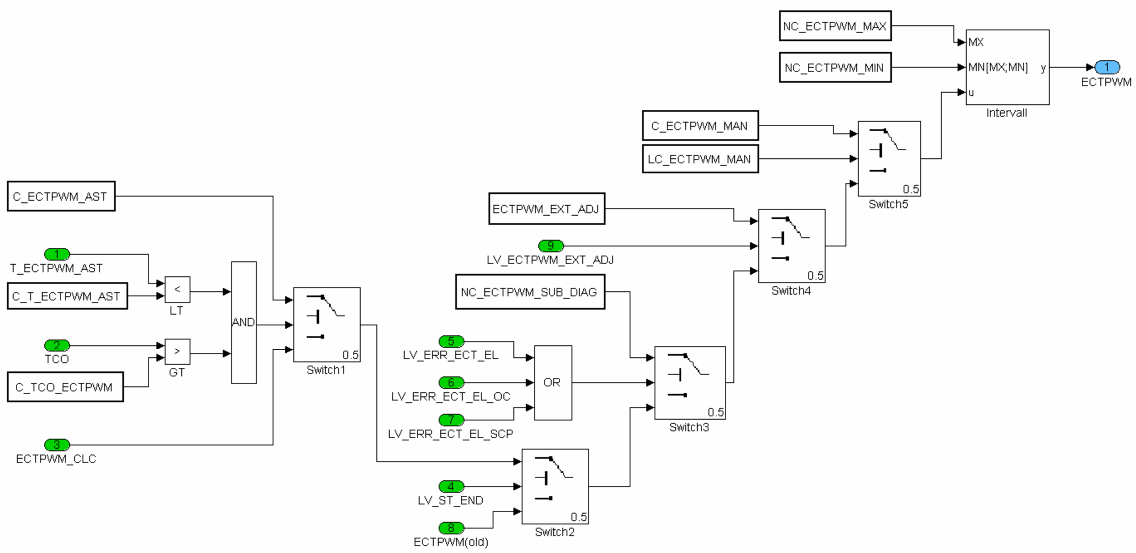
```
 all 0 at reset,
   Except:  T_ECTPWM_AST :
at reset or at transition LV_ES 0 - -> 1:   T_ECTPWM_AST =
0
 // the time condition C_T_ECTPWM_AST is reset each time
 the engine state "engine stop" is reached or ecu is reset
```

Recurrence: *1000 ms*

Activation: *at every engine operating state*

Deactivation: –

Signal flow diagram:



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Formula section:

If LV_ST_END = 1 **and** T_ECTPWM_AST < C_T_ECTPWM_AST
Then T_ECTPWM_AST = ++
Endif

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If (1) LC_ECTPWM_MAN = 1
Then (1) ECTPWM = C_ECTPWM_MAN
Else (1) **If (2)** LV_ECTPWM_EXT_ADJ = 1
Then(2)ECTPWM = ECTPWM_EXT_ADJ
Else (2)If(3) LV_ERR_ECT_EL = 1 **OR**
LV_ERR_ECT_EL_OC = 1 **OR**
LV_ERR_ECT_EL_SCP = 1
Then(3)ECTPWM = NC_ECTPWM_SUB_DIAG
Else(3)If(4) LV_ST_END = 1
Then(4)
If(5) 0 <= T_ECTPWM_AST < C_T_ECTPWM_AST
// time C_T_ECTPWM_AST has not elapsed
and
TCO < C_TCO_ECTPWM
Then(5) ECTPWM = C_ECTPWM_AST
// for time C_T_ECTPWM_AST
Else (5) ECTPWM = ECTPWM_CLC
Endif (5)
Endif(4)
Endif(3)
Endif (2)
Endif (1)

9.33.2 Limitation of the pulse width modulated output signal (ECTPWM)

FUNCTION DESCRIPTION:

General information:

The limits of the pulse width modulated output signal for the electronic controlled thermostat are fixed to NC_ECTPWM_MIN for the lower and NC_ECTPWM_MAX for the upper value. The controller output signal must be limited as soon as the amount of the controller is reaching the limits.
The power stage output signal for the electronic controlled thermostat is limited to a minimum and a maximum value to guarantee a continuous working electrical diagnosis of the power stage.

Application conditions

Initialisation: *all 0 at reset*
Recurrence: *1000 ms*
Activation: *at every engine operating state*
Deactivation: –

Formula section:

NC_ECTPWM_MIN $\leq$ ECTPWM $\leq$ NC_ECTPWM_MAX

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9.34 ENTE scheduler

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_ECF [NC_ECF_NR]	O/V	0... 1H	0 ...1	1	-
Boolean for electronic controlled cooling fan error					
POW_OUT_ECF	O/V	0... FFH	0... 99.61	0.39	%
Cooling fan power output of all available fan(s) at the vehicle					

Input data:

ECFPWM [NC_ECF_NR] {p. 3596}	ECFPWM_IGK_OFF {p. 3596}	LV_ERR_ECF_EL [NC_ECF_NR] {p. 4507}	NC_ECF_CONF {p. 576}
NC_ECF_NR {p. 576}			

FUNCTION DESCRIPTION:

General information:

This manager specifies the sequencing of project specific ENTE tasks.

Description:

Within the aggregate ENTE, the cooling fan functions (acquisition, control, diagnosis, torque loss) are handled project specific with use of HOOK modules. Because different projects use different update rates for the functions, it is necessary to handle the function calls specific within this module.

Application conditions

Recurrence: see formula section below

Activation: at every engine operating state

Deactivation: –

Formula section:

#IF NC_ECF_CONF = 0 **(** control of cooling fan(s) only by Relay(s) **)**

Tasks
No action

#ENDIF

#IF NC_ECF_CONF = 1 **(** control of cooling fan(s) only by PWM(s) **)**

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RESET - Task
POW_OUT_ECF = 0% LV_ERR_ECF[NC_ECF_NR] = 0
10ms - Task
ENTE_ACCTLECT1 (Electronically controlled Thermostat (Appl. Inc.) - "*Conversion from ECTPWM to LV_ECTPWM_STAT*" chapter 1.1.1)
100ms - Task
if (LV_IGK = 0) **then** ENTE_ACCTLECF1 (Cooling and condenser fan control - "*Control with ignition key off up to detection of ES and in the self-holding phase*" chapter 1.2)
if (LV_IGK = 1 *AND* LV_ES = 0) **then** ENTE_REQGNTQECF1 (Torque Loss - Electronic cooling fan PWM)

200ms - Task
if (LV_IGK = 1) **then** ENTE_ACCTLECF1 (Cooling and condenser fan control - *"Control of ECFPWM[NC_ECF_NR] with ignition key on*" chapter 1.1)
ENTE_IFINFECF1 (Acquisition of electronically controlled cooling fan signal) Note: When using ISR-action, this spec does not need to appear in the calculation order!

1000ms - Task
if (LV_ES = 0) **then** ENTE_ACCTLECF1 (Cooling and condenser fan control - *"Calculation of TEMP_MMV_SUB_CAT_ECF*" chapter 1.1.2)
if (LV_IGK = 1) **then** POW_OUT_ECF = ECFPWM[1] **if** (LV_IGK = 0) **then** POW_OUT_ECF = ECFPWM_IGK_OFF
ENTE_OUTDGECF1 (Cooling fan diagnosis)
LV_ERR_ECF[NC_ECF_NR] = LV_ERR_ECF_EL[NC_ECF_NR]

#ENDIF

#IF NC_ECF_CONF = 2 **(** control of cooling fan(s) by Relay(s) **or** PWM(s) **)**

Tasks
No action

#ENDIF

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9.35 Electronically controlled radiator shutter

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ECRAS_EOL	V	0... FFH	0... 255	1	-
Counter for stopping ECRAS system test (EOL)					
ECRASPWM	O/V	0... FFH	0... 99.60937	0.390625	%
PWM for ectrical radiator shutter					
LV_ECRAS_DOWN_1	O/V	0... 1H	0 ...1	1	-
Bit used to determine ECRASPWM (input for ID)					
LV_ECRAS_EOL	V	0... 1H	0 ...1	1	-
Bit for determining ECRASPWM during ECRAS system test (EOL)					
LV_ECRAS_EOL_END	V	0... 1H	0 ...1	1	-
Bit indicating finished ECRAS system test (EOL)					
LV_ECRAS_EOL_INH	O/V	0... 1H	0 ...1	1	-
Bit indicating inhibition or ECRAS EOL (if = 1 EOL stopped)					
LV_ECRAS_UP_1	O/V	0... 1H	0 ...1	1	-
Bit used to determine ECRASPWM (input for ID)					
LV_ERR_ECRAS_EOL	O/V	0... 1H	0 ...1	1	-
Bit indicating ECRAS error during EOL ECRAS system test					
STATE_ECRAS_SYS	O/V	0... FFFFH	0... 65535	1	-
State of ECRAS system					
T_ECRAS_UP_DET	V	0... FFH	0... 25.5	0.1	-
Timer indicating time until learning stopped (if no variant recognised)					
T_WAIT_ECRAS_EOL	V	0... FFH	0... 25.5	0.1	s
Timer for switch ECRAS control output					

Input data:

LC_AD_CLR_VAR {p. 528}	LV_ACT_ECRAS_DOWN_EXT_ADJ {p. 7432}	LV_ACT_ECRAS_EOL_EXT_ADJ {p. 7763}	LV_ACT_ECRAS_UP_EXT_ADJ {p. 7432}
LV_CDN_VB_MIN_DIAG {p. 1185}	LV_DIAG_ECRAS {p. 4515}	LV_DIAG_ECRAS_END {p. 4515}	LV_DIAG_ECRAS_ERR_END {p. 4515}
LV_ECRAS_DOWN {p. 8225}	LV_ECRAS_DOWN_DET_ACT {p. 4515}	LV_ECRAS_DOWN_DET_SET {p. 4515}	LV_ECRAS_DOWN_EXT_ADJ {p. 7433}
LV_ECRAS_UP {p. 8225}	LV_ECRAS_UP_EXT_ADJ {p. 7433}	LV_END_DIAG_ECRAS_DOWN_FB {p. 4515}	LV_END_DIAG_ECRAS_EL {p. 4515}
LV_END_DIAG_ECRAS_UP_FB {p. 4515}	LV_ERR_ECRAS {p. 4515}	LV_ERR_ECRAS_DOWN_FB {p. 4515}	LV_ERR_ECRAS_EL {p. 4515}
LV_ERR_ECRAS_UP_FB {p. 4515}	LV_IGK {p. 906}	LV_VAR_ECRAS_DOWN {p. 4515}	LV_VAR_ECRAS_UP {p. 655}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_ECRAS_EOL	-	0... FFH	0... 255	1	-
Counter threshold for stopping ECRAS system test (EOL)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ECRASPWM_10	-	0... FFH	0... 99.60937	0.390625	%
ECRASPWM for diagnosis mode of ECRAS control unit (10% PWM)					
C_ECRASPWM_90	-	0... FFH	0... 99.60937	0.390625	%
ECRASPWM for learning of ECRAS_DOWN (90% PWM)					
C_ECRASPWM_DIAG	-	0... FFH	0... 99.60937	0.390625	%
PWM for radiator shutter for diagnosis readyness					
C_ECRASPWM_MAN	-	0... FFH	0... 99.60937	0.390625	%
Manually given ECRASPWM					
C_T_ECRAS_UP_DET	-	0... FFH	0... 25.5	0.1	s
Timer threshold for learning ECRAS_UP					
C_T_WAIT_ECRAS_EOL	-	0... FFH	0... 25.5	0.1	s
Timer threshold for switch ECRAS control output					
ID_ECRASPWM	V	0... FFH	0... 99.60937	0.390625	%
LDP_LV_ECRAS_UP_1	2	0... 1H	0 ...1	1	-
LDP_LV_ECRAS_DOWN_1	2	0... 1H	0 ...1	1	-
Map for determining ECRASPWM					
LC_ECRASPWM_MAN	-	0... 1H	0 ...1	1	-
Switch for manual setting of ECRASPWM					

FUNCTION DESCRIPTION:

Description:

This modul consists of three parts.

- End of line Sytem test functionality
- Calculation of ECRASPWM
- Setting of STATE_ECRAS_SYS

EOL-System test: the system test is activated by LV_ACT_ECRAS_EOL_EXT_ADJ which is set by tester (see "Services for EOL tests" chapter). During this EOL test several ECRASPWM will be set for a certain time. This allows that every possible failure can be detected by the ECRAS feedback diagnosis.
Calculation of ECRASPWM: The ECRAS PWM signal will be claculated. ECRASPWM requests will be prioritised.
Setting of STATE_ECRAS_SYS: A State STATE_ECRAS_SYS is created which displays specific information about the whole ECRAS system (eg. diagnosis, EOL etc.).

Application conditions

Initialisation: *reset* ***or*** *LV_IGK = 0 -> 1 all 0, except ECRASPWM = C_ECRASPWM_DIAG*

Recurrence: *100 ms*

Activation: *always*

Deactivation: *none*

Formula section:

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EOL System test

```
if      LV_ACT_ECRAS_EOL_EXT_ADJ = 1
then            // if activation by tester request recognised reset values
                if      LV_ACT_ECRAS_EOL_EXT_ADJ   0->1
                then    LV_ECRAS_EOL_END = 0
                        T_WAIT_ECRAS_EOL = 0
                        CTR_ECRAS_EOL = 0
                        LV_ECRAS_EOL = 0
                        LV_ERR_ECRAS_EOL = 0
                endif

                // increment timer
                if      LV_DIAG_ECRAS_END = 1               and
                        LV_ECRAS_DOWN_DET_ACT = 0
                then    T_WAIT_ECRAS_EOL = T_WAIT_ECRAS_EOL + 100ms
                endif

                // toggle control of ECRAS flaps (see also calculation of ECRASPWM to enable diagno-
                sis
                if      T_WAIT_ECRAS_EOL >= C_T_WAIT_ECRAS_EOL
                then    if      LV_ECRAS_EOL = 0
                        then    LV_ECRAS_EOL = 1
                        else    LV_ECRAS_EOL = 0
                        endif
                        T_WAIT_ECRAS_EOL = 0
                        CTR_ECRAS_EOL = CTR_ECRAS_EOL + 1
                endif

                // set end of EOL system test
                if      CTR_ECRAS_EOL>=C_CTR_ECRAS_EOL        or LV_DIAG_ECRAS_ERR_
                END = 1
                then    LV_ECRAS_EOL_INH = 1
                        LV_ECRAS_EOL_END = 1
                endif

                // set LV_ERR_ECRAS_EOL if during EOL error is occurred or present
                if      LV_ERR_ECRAS = 1
                then    LV_ERR_ECRAS_EOL = 1
                endif
else
                LV_ECRAS_EOL_INH = 0
endif
```

Calculation of ECRASPWM

```
if              LV_VAR_ECRAS_UP = 1
then            // priorisation of ECRASPWM requests
                if      LC_ECRASPWM_MAN = 1
                then    ECRASPWM = C_ECRASPWM_MAN
                elseif  LV_ECRAS_DOWN_DET_ACT = 1
                then    ECRASPWM = C_ECRASPWM_90
                elseif  LV_DIAG_ECRAS = 1
```

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```
            then    ECRASPWM = C_ECRASPWM_10
            else    if      LV_ACT_ECRAS_EOL_EXT_ADJ = 1
                    then    LV_ECRAS_UP_1 = LV_ECRAS_EOL
                            LV_ECRAS_DOWN_1 = LV_ECRAS_EOL
                    else    if      LV_ECRAS_UP_EXT_ADJ = 1
                            then    LV_ECRAS_UP_1 = LV_ACT_ECRAS_UP_EXT_ADJ
                            else    LV_ECRAS_UP_1 = LV_ECRAS_UP
                            endif
                            if      LV_ECRAS_DOWN_EXT_ADJ = 1
                            then    LV_ECRAS_DOWN_1=
                                            LV_ACT_ECRAS_DOWN_EXT_ADJ
                            else    if      LV_VAR_ECRAS_DOWN = 1
                                    then    LV_ECRAS_DOWN_1 = LV_ECRAS_DOWN
                                    else    LV_ECRAS_DOWN_1 = 0
                                    endif
                            endif
                    endif
                    ECRASPWM = ID_ECRASPWM
            endif
else
            if      LV_CDN_VB_MIN_DIAG = 1
            then    T_ECRAS_UP_DET = T_ECRAS_UP_DET + 100ms
            else    freeze timer
            endif
            if      T_ECRAS_UP_DET >= C_T_ECRAS_UP_DET
            then    ECRASPWM = 0
            else    // waiting, learning of LV_VAR_ECRAS_UP still possible
                    ECRASPWM = C_ECRASPWM_DIAG
            endif
endif
```

Setting of STATE_ECRAS_SYS

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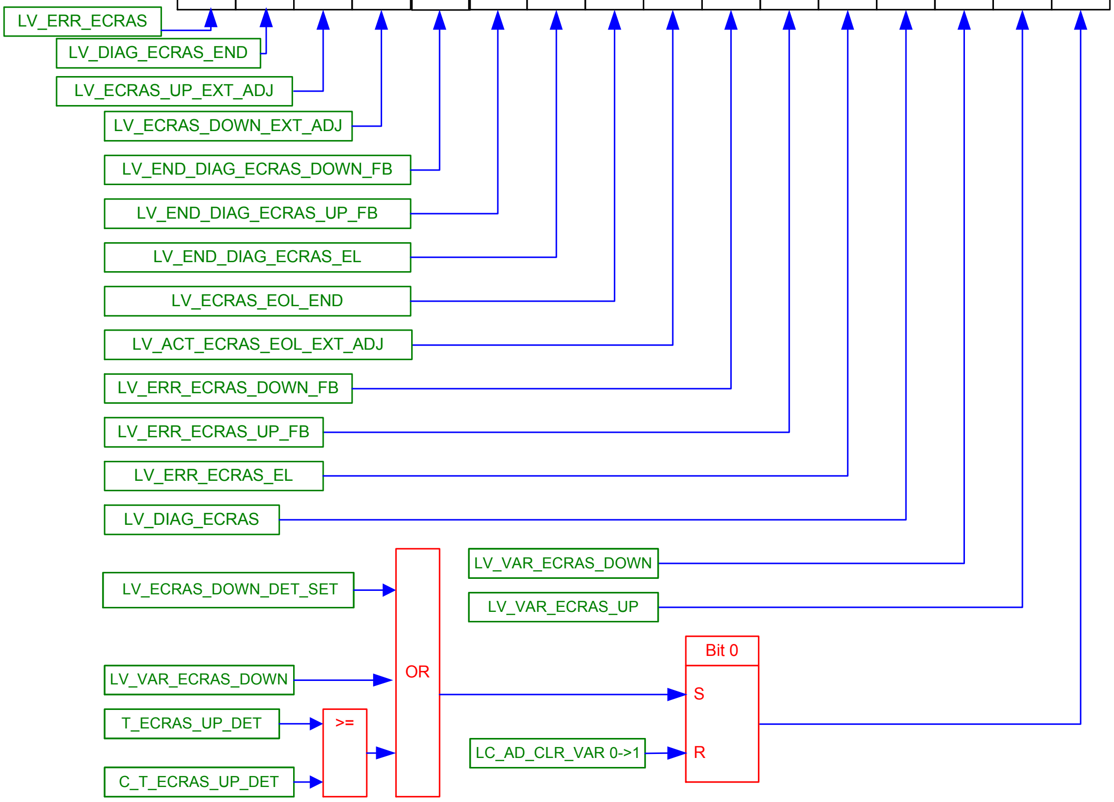
STATE_ECRAS_SYS (2 Byte)															
high Byte								low Byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X



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9.36 Fuel pressure setpoint calculation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FUP_H_SP_S	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint for stratified mode, high range					
FUP_RNG_H_SP	O/V	0... FFFFH	0... 255.99609375	3.90625e-3	MPa
Fuel pressure setpoint					
FUP_RNG_H_SP_S	O/V	0... FFFFH	0... 255.99609375	3.90625e-3	MPa
Fuel pressure setpoint for stratified mode					
FUP_SP	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint					
FUP_SP_GRD_ACT	V	0... FH	0... 15	1	-
Indicator for gradient limitation out of start active					
FUP_SP_ST	V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure for start					
FUP_SP_TMP	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint (before limitation)					
FUP_SP_TMP_1	V	0... FFFFH	0... 347776	5.3067216	hPa
Intermediate value for FUP_SP filter					
LV_FUP_SP_ADD	O/V	0... 1H	0 ...1	1	-
Logical variable indicating that the additional fuel pressure setpoint in the PUC phase is enable					

Input data:

C_CTR_MIN_VFF_VCV_MIN_AD_SWI {p. 3957}	CTR_MIN_VFF_VCV_MIN_AD_SWI {p. 3953}	FUP_H_SP_S_EXT {p. 8262}	FUP_RNG_H_SP_CH {p. 988}
FUP_RNG_H_SP_OHP {p. 988}	FUP_SP_EXT {p. 8262}	LV_ES {p. 1720}	LV_FIRST_VLD_TOOTH {p. 1505}
LV_FUP_LIH_HOM_REQ {p. 4001}	LV_FUP_LIH_HOM_VCV_OPEN_REQ {p. 4001}	LV_FUP_LIH_L_PRS_CTL_REQ {p. 4001}	LV_FUP_SP_EXT_REQ {p. 8262}
LV_FUP_SP_SWI {p. 8136}	LV_IGK {p. 906}	LV_PU {p. 1720}	LV_PUC {p. 1720}
LV_ST_END {p. 1720}	LV_ST_H_PRS {p. 8242}	MFF_SP_FUP_CTL {p. 2151}	N_32 {p. 1525}
NC_NR_MFF_SP_FUP_SP {p. 989}	NC_NR_N_FUP_SP {p. 989}	NR_CYL_VVL_H_ACT {p. 988}	STATE_CH {p. 1777}
STATE_MPLH_MOD {p. 988}	T_AST {p. 1766}	TCO_ST {p. 1100}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_FUP_SP_VVL_LGRD	-	0... FFH	0... 255	1	-
Counter for fuel pressure setpoint gradient limitation after switching of VVL					
C_FAC_FUP_SP	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Factor for the fuel pressure setpoint temp change influence to the FUP_SP					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_SP_ADD	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Additional fuel pressure setpoint in the PUC phase					
C_FUP_SP_CRLC_2	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for the FUP_SP					
C_FUP_SP_IGK_NOT	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint at IGK off					
C_FUP_SP_IGK_NOT_LIM_DEC	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint decrement during IGK off					
C_FUP_SP_IGK_NOT_LIM_INC	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint increment during IGK off					
C_FUP_SP_L_PRS_ST	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint for low pressure start					
C_FUP_SP_LIH_HOM	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint for homogenous limphome					
C_FUP_SP_LIH_VCV_OPEN	-	0... FFFFH	0... 347776	5.3067216	hPa
FUP setpoint for VCV open limphome					
C_FUP_SP_LIM_DEC	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint decrement during normal operation					
C_FUP_SP_LIM_INC	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint increment during normal operation					
C_FUP_SP_MAN	-	0... FFFFH	0... 347776	5.3067216	hPa
Manual fuel pressure setpoint					
C_FUP_SP_MPLH_OPP	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint for double injection mode					
C_FUP_SP_PU_LIM_DEC	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint decrement during PU/PUC					
C_FUP_SP_PU_LIM_INC	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint increment during PU/PUC					
C_FUP_SP_ST_LGRD_DEC	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint decrement out of start					
C_FUP_SP_ST_LGRD_INC	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint increment till st end					
C_FUP_SP_VVL_LGRD	-	0... FFFFH	0... 347776	5.3067216	hPa
Gradient limitation for fuel pressure setpoint increment and decrement after switching of VVL					
C_T_AST_FUP_SP_GRD_SWI	-	0... FFFFH	0... 6553.5	0.1	s
Time after start to switch the fuel pressure gradient					
C_T_FUP_SP_ADD_1	-	0... FFFFH	0... 655.35	0.01	s
Time of counter number 1 for additional fuel pressure setpoint in the PUC phase					
C_T_FUP_SP_ADD_2	-	0... FFFFH	0... 655.35	0.01	s
Time of counter number 2 for additional fuel pressure setpoint in the PUC phase					
IP_FUP_SP_HOM	V	0... FFFFH	0... 347776	5.3067216	hPa
LDPM_N_32_2_FUSL	8	0... FFH	0... 8160	32	rpm

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_MFF_SP_FUP_CTL_1_FUSL	10	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel pressure setpoint for homogenous engine operation					
IP_FUP_SP_PU	V	0... FFFFH	0... 347776	5.3067216	hPa
LDPM_N_32_2_FUSL	8	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_FUP_CTL_1_FUSL	10	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel pressure setpoint for PU and PUC engine operation					
IP_FUP_SP_S	V	0... FFFFH	0... 347776	5.3067216	hPa
LDPM_N_32_2_FUSL	8	0... FFH	0... 8160	32	rpm
LDPM_MFF_SP_FUP_CTL_1_FUSL	10	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel pressure setpoint for stratified engine operation					
IP_FUP_SP_ST	V	0... FFFFH	0... 347776	5.3067216	hPa
LDPM_TCO_ST_1_FUSL	6	0... FEH	-48... 142.5	0.75	°C
LDP_N_32_IP_FUP_SP_ST	6	0... FFH	0... 8160	32	rpm
Fuel pressure setpoint for the start					
LC_FUP_SP_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual fuel pressure setpoint					

General Information

There are maps for homogeneous mode and stratified mode according to the variable, which shows the actual engine mode. In PU and PUC a different map for the fuel pressure setpoint is selected.

Additionally a testbench function is also included. In order to avoid too big fuel pressure setpoint gradients a certain gradient limitation is included. That limitation is consisting out of a increment and decrement limitation. For PU and PUC a different limitation for increment and decrement is selected.

Application Conditions

Initialization: RST, ERU2ES
Recurrence: SEG activated if LV_ST_END==1
10MS activated if LV_ST_END==0
Deactivation: !LV_ST_END

Function description

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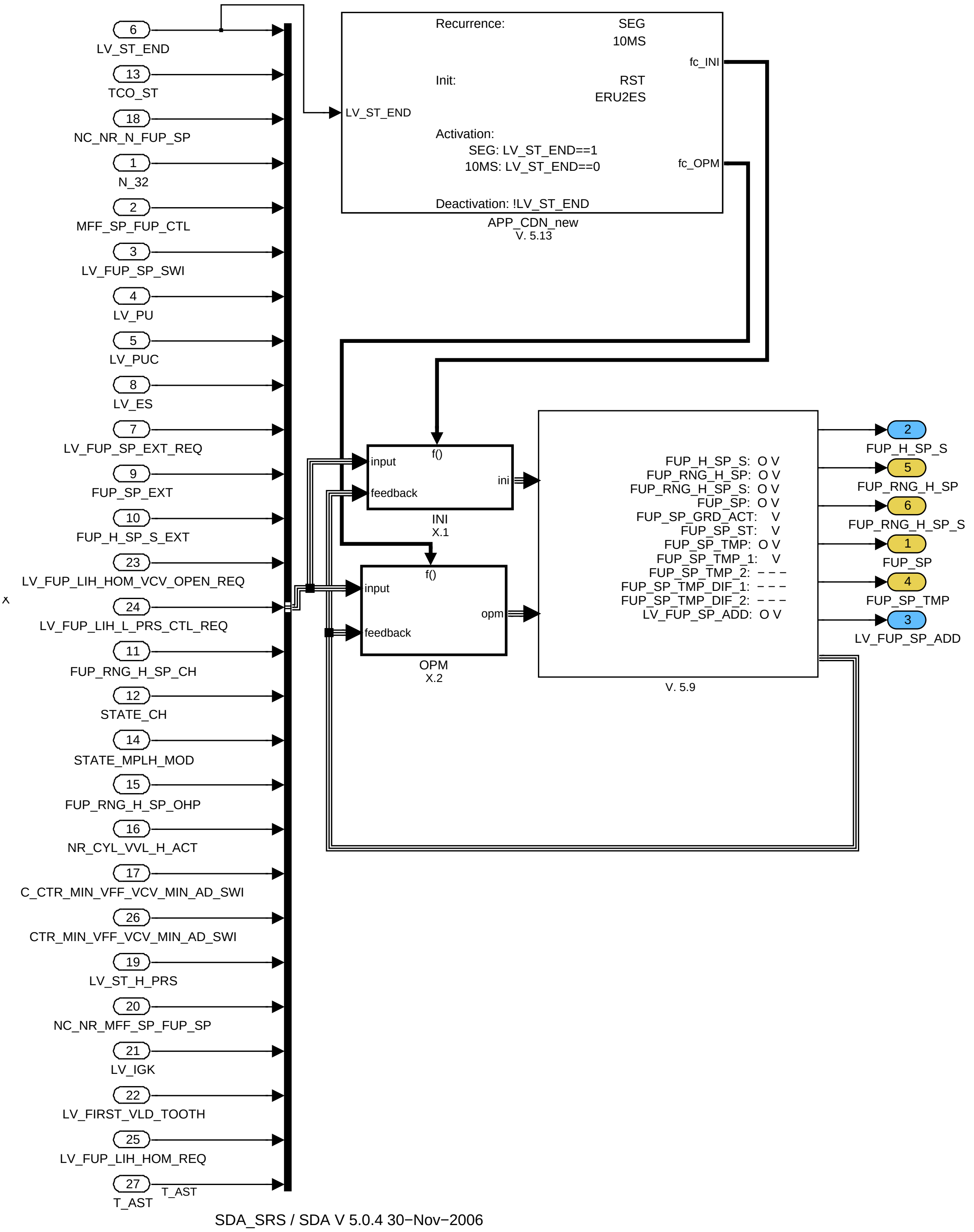

Figure 9.36.1: : Path: FUSL_M904A

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9.36.1 Calculation overview for initialisation

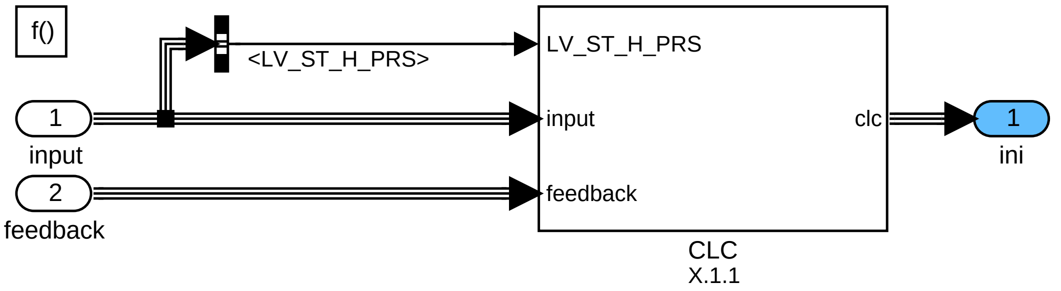

Figure 9.36.2: : Path: FUSL_M904A/INI

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9.36.1.1 Initialisation

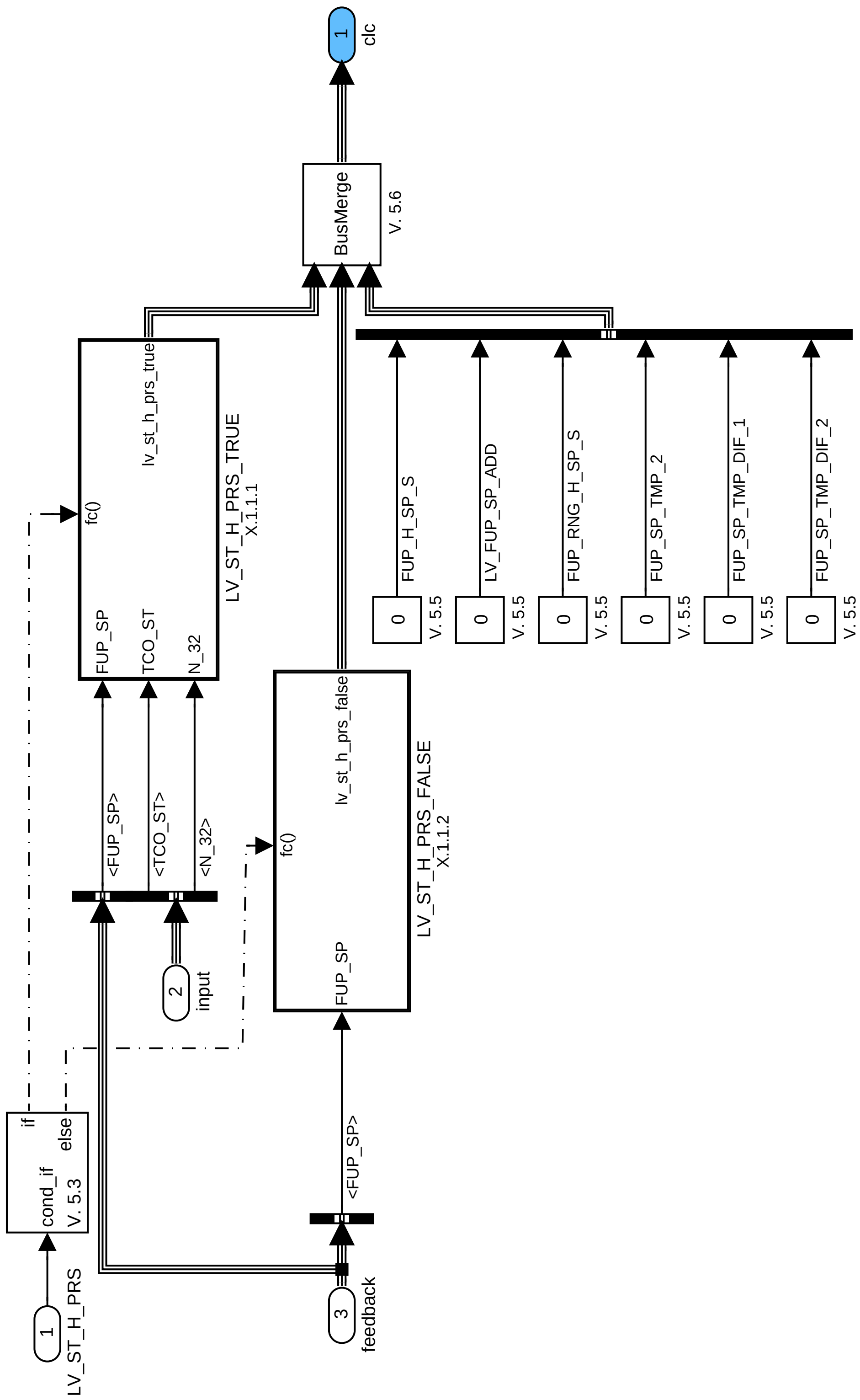

Figure 9.36.3: : Path: FUSL_M904A/INI/CLC

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9.36.1.1.1 Initialisation if LV_ST_H_PRS is false

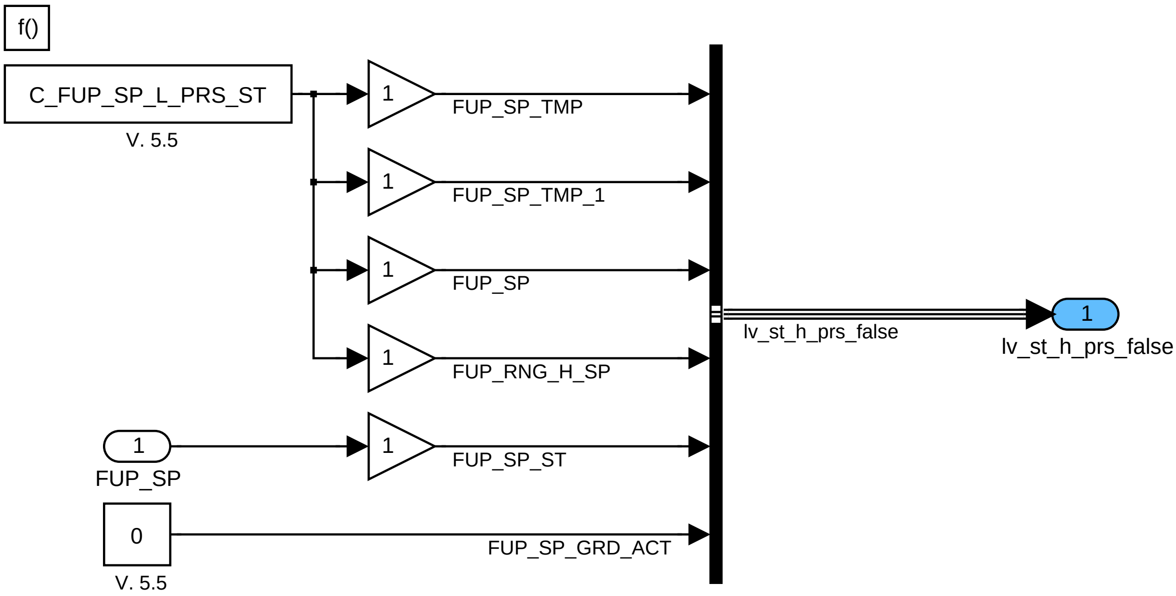

Figure 9.36.4: : Path: FUSL_M904A/INI/CLC/LV_ST_H_PRS_FALSE

9.36.1.1.2 Initialisation if LV_ST_H_PRS is true

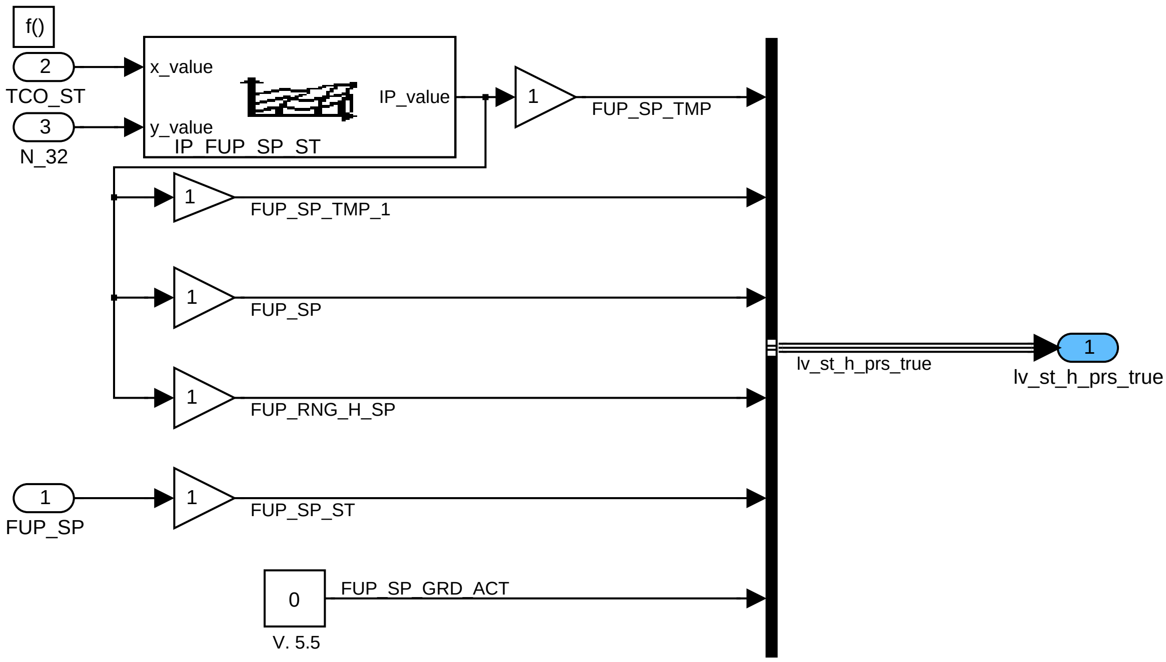

Figure 9.36.5: : Path: FUSL_M904A/INI/CLC/LV_ST_H_PRS_TRUE

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9.36.2 Formula section

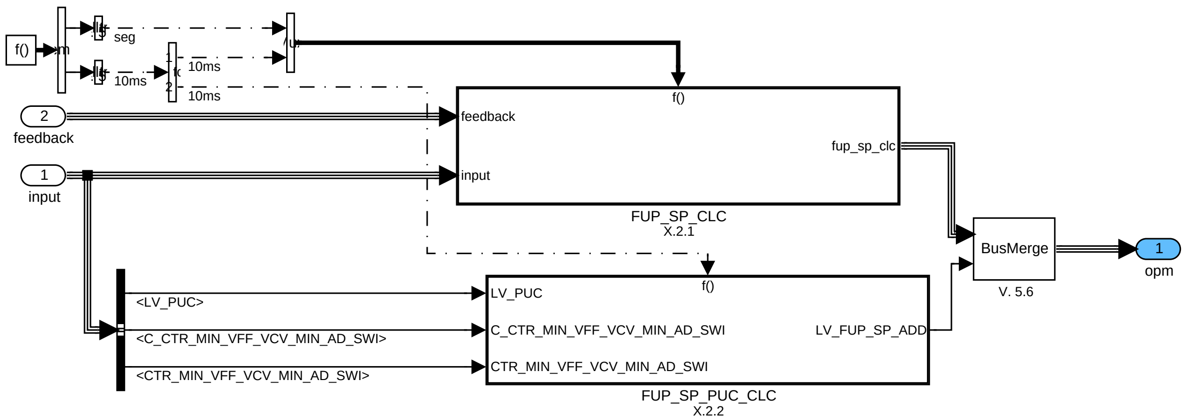

Figure 9.36.6: : Path: FUSL_M904A/OPM

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9.36.2.1 Fuel pressure setpoint calculation overview

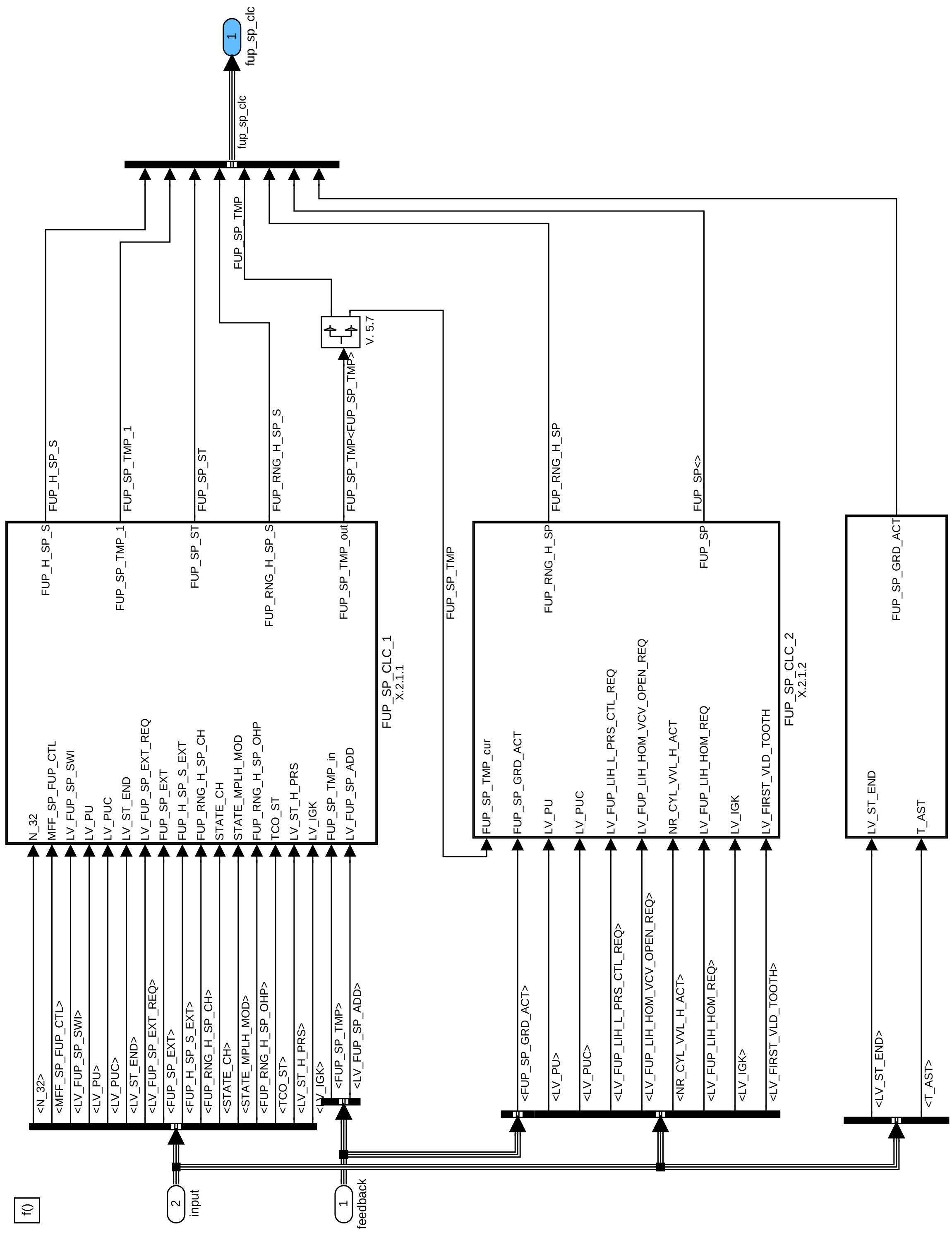

Figure 9.36.7: : Path: FUSL_M904A/OPM/FUP_SP_CLC

9.36.2.1.1 Calculation of fuel pressure high setpoint

The actual fuel pressure setpoint is taken out the two maps. Only for PU and PUC mode different fuel pressure setpoints can be selected due to injector requirement.

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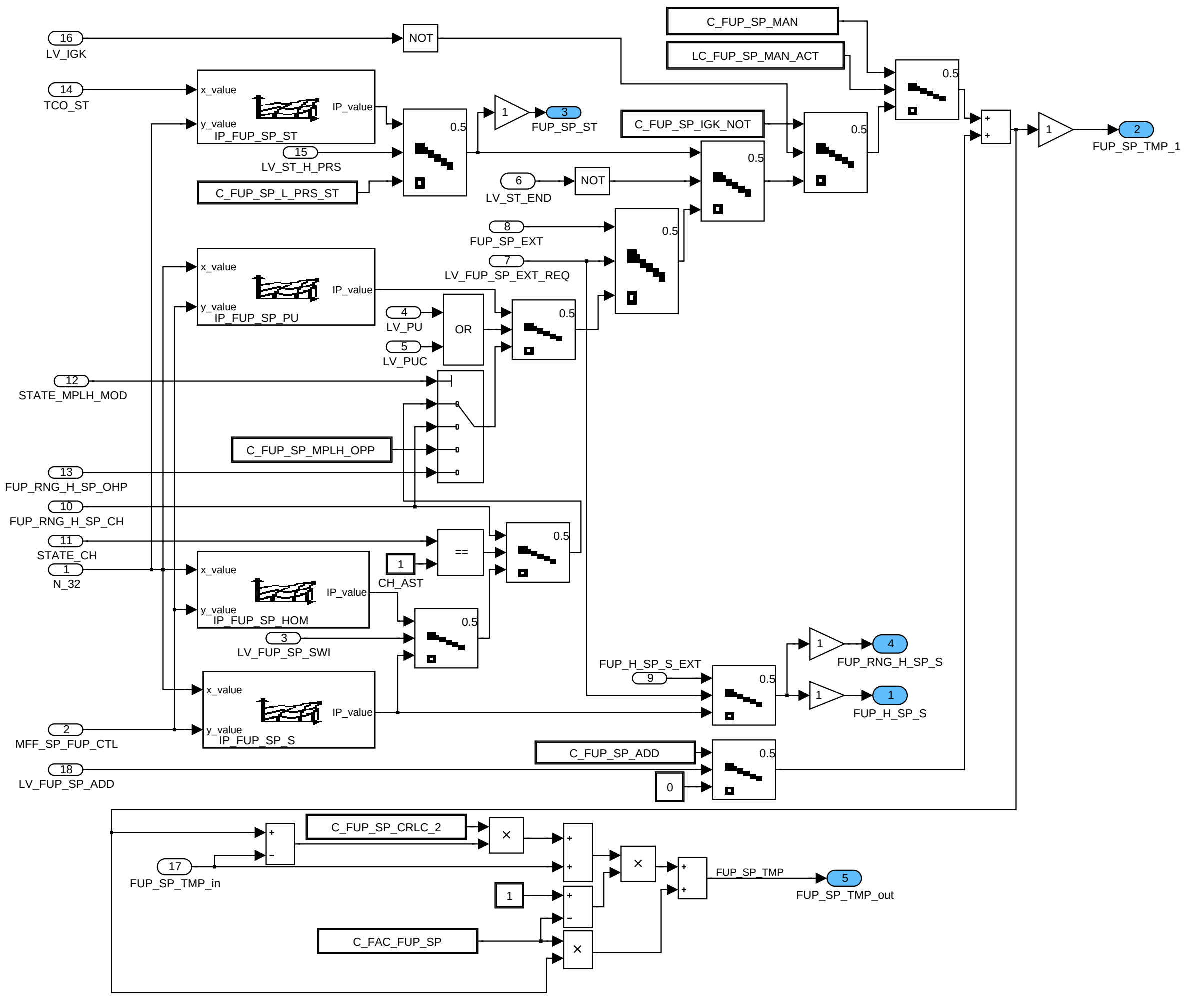

Figure 9.36.8: : Path: FUSL_M904A/OPM/FUP_SP_CLC/FUP_SP_CLC_1

9.36.2.1.2 Calculation of fuel pressure setpoint

For the gradient limitation the calibration should be started with the highest value for all gradient limitations. The values should be lowered by applying jumps the FUP_SP via manual intervention.

The internal value in the difference limiter has to be initialised with FUP_SP_TMP at reset.

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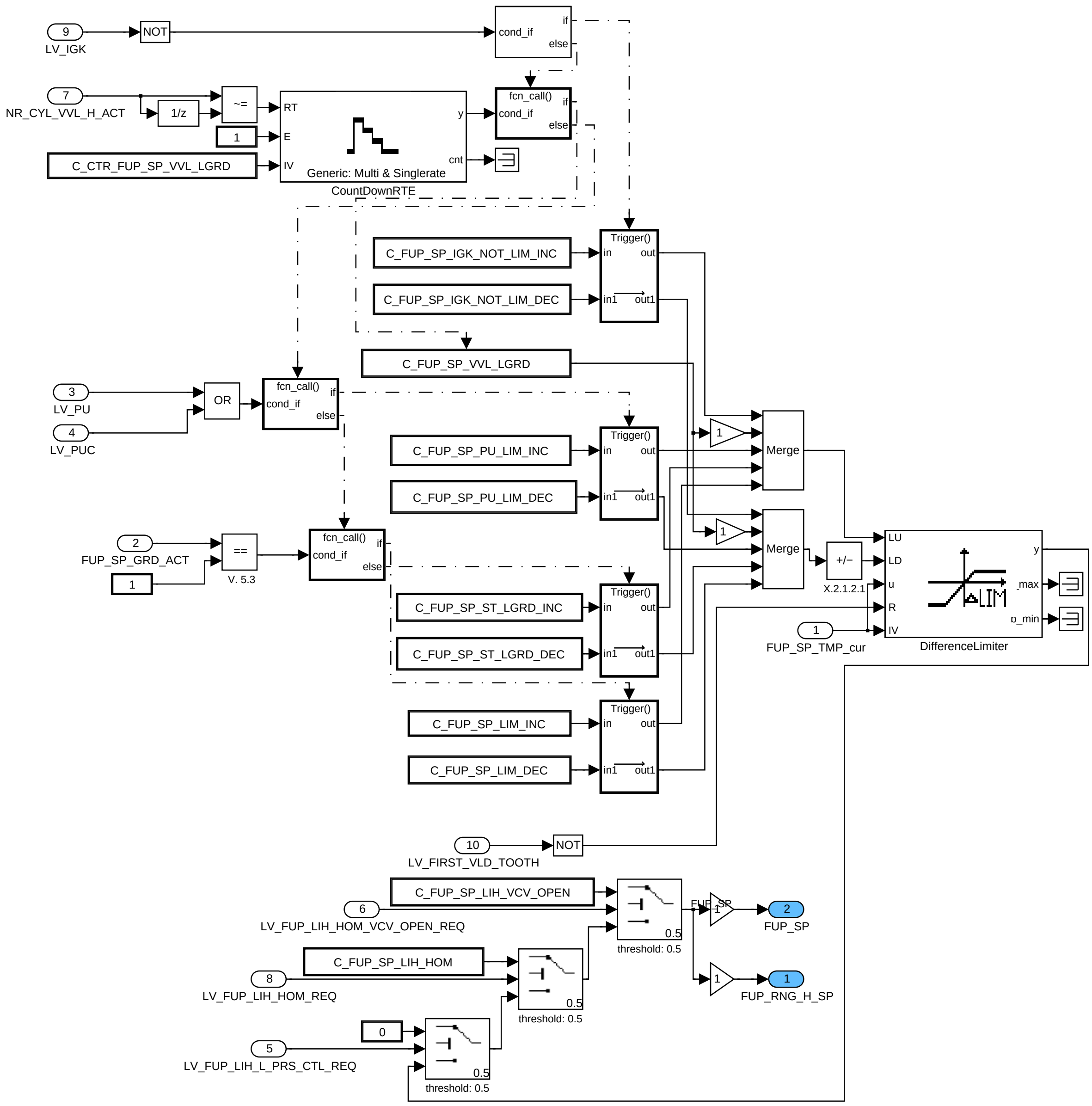

Figure 9.36.9: :   Path: FUSL_M904A/OPM/FUP_SP_CLC/FUP_SP_CLC_2

9.36.2.1.3 Fuel pressure setpoint gradient calculation

The gradient limitation out the start phase will be stopped until the FUP_SP is reached.

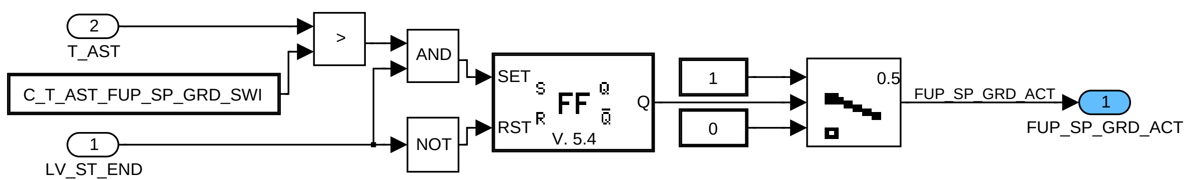

Figure 9.36.10: :   Path: FUSL_M904A/OPM/FUP_SP_CLC/FUP_SP_CLC_3

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9.36.2.2 Calculation of LV_FUP_SP_AD

This block is triggered every time at 10ms without the LV_ST_END == 0 condition.

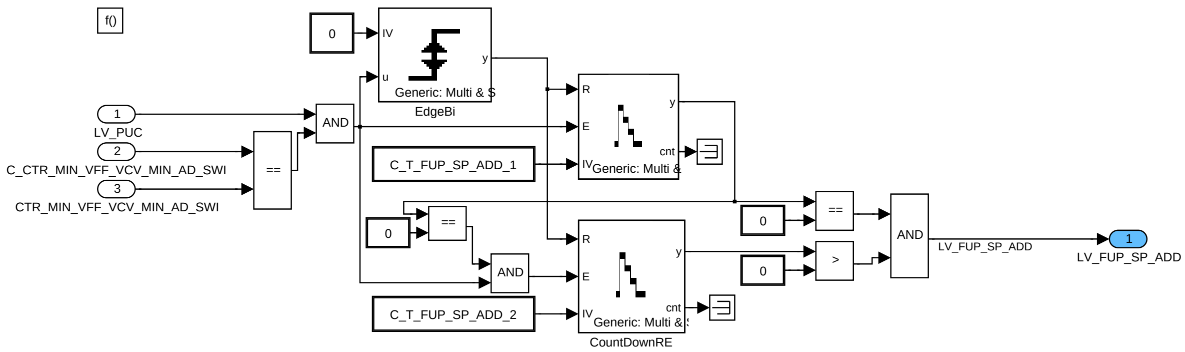

Figure 9.36.11: :   Path: FUSL_M904A/OPM/FUP_SP_PUC_CLC

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9.37 Fuel pressure control coordination

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_FUP_PRS	V	0... FFFFH	0... 65535	1	-
Counter for maximum segment cycles for setting of the pressure controller in the intervention mode					
CTR_SEG_FUP_OFS_BOL	V	0... FFH	0... 255	1	-
Counter for forced leaving of pressure control					
CTR_SEG_FUP_OFS_TOL	V	0... FFH	0... 255	1	-
Counter for forced leaving of flow control					
CUR_VCV_BAS_AD_VAR_2_ADD_SET	O/V	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Setting value due to intervention mode for additive component of second variant of VCV flow adaptation					
FPA_MFF	O/V	0... FFFFH	0... 255	3.89105e-3	l/h
Fuel flow through the regulator					
FUEL_MASS_REQ_I_CTL_SET	O/V	80000000... 7FFFFFFFH	-694.510597391 ...694.489402609	323.402e-9	mg
Setting value of the I-part of the flow controller in interwention mode					
FUP_DIF_FUEL_MASS_REQ_SET	V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Deviation of fuel pressure for setting of the I-part of the flow controller					
FUP_DIF_FUP_REQ_FPA_RST	O/V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Fuel pressure difference at switching from pressure to flow control in intervention mode					
FUP_DIF_ST_FUEL_MASS_REQ_SET	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Deviation of fuel pressure for setting of the I-part of the flow controller					
FUP_ST_PRS	V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure in the beginning of the pressure control phase for the intervention mode					
FUP_STOP_PRS	V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure in the end of the pressure control phase for the intervention mode					
LV_FUEL_MASS_AD_STOP	O/V	0... 1H	0 ...1	1	-
Logical variable requesting adaption stop of controller for demand control					
LV_FUEL_MASS_CTL_RST	O/V	0... 1H	0 ...1	1	-
Logical variable requesting I-part reset of controller for flow control					
LV_FUEL_MASS_CTL_STOP	O/V	0... 1H	0 ...1	1	-
Logical variable requesting I-part freeze of controller for flow control					
LV_FUEL_MASS_REQ_RST_FUP	V	0... 1H	0 ...1	1	-
Logical variable indicating resetting of the I-Part of the flow controller becouse of overpressure					
LV_FUP_DIF_FUP_REQ_FPA_RST	O/V	0... 1H	0 ...1	1	-
Logical variable indicating the setting of the pressure I-part of the controller in intervention mode					
LV_FUP_PRS_CTL_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable requesting pressure control mode					
LV_FUP_REQ_FPA_RST	O/V	0... 1H	0 ...1	1	-
Logical variable requesting I-part reset of controller for pressure control					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_FUP_REQ_FPA_STOP	O/V	0... 1H	0 ...1	1	-
Logical variable requesting I-part freeze of controller for pressure control					
LV_VFF_VCV_MIN	V	0... 1H	0 ...1	1	-
Logical variable indicating volume flow through VCV reaches limit					
STATE_FUP_CTL	O/V	0H 1H 2H 3H	FLOW_ CONTROL FLOW2PRS PRESSURE_ CONTROL PRS2FLOW	-	-
Operating state for the global fuel pressure regulation strategy					
STATE_FUP_CTL_TRAN	V	0H 1H 2H 3H	FLOW_REQ FLOW2PRS_ REQ PRS_REQ PRS2FLOW_ REQ	-	-
Transistion conditions for the STATE_FUP_CTL					
T_FUEL_MASS_REQ_I_CTL_SET	V	0... FFFFH	0... 655.35	0.01	s
Maximum time in the flow control mode for setting of the I-part of the flow controller					
VFF_MFF_SP_FUP_CTL	O/V	0... FFFFH	0... 255	3.89105e-3	l/h
Volume fuel flow through the injectors					
VFF_TMP	-	0... FFFFH	0... 255	3.89105e-3	l/h
Temporary value for volume fuel flow					
VFF_VCV_FUEL_MASS_REQ_SET	V	0... FFFFH	0... 255	3.89105e-3	l/h
Setting volume fuel flow for the I-part of the flow controller					

Input data:

C_RHO_FUEL {p. 3960}	FAC_CLC_FUEL_MASS_ FUP {p. 3908}	FUEL_MASS_REQ_I_CTL_ H_RES {p. 3908}	FUP {p. 1283}
FUP_DIF {p. 3909}	FUP_SP {p. 3868}	LV_ES {p. 1720}	LV_FUEL_MASS_CTL_ RST_REQ {p. 3954}
LV_FUEL_MASS_CTL_ STOP_DIAG {p. 4001}	LV_FUEL_MASS_CTL_ STOP_REQ {p. 3954}	LV_FUP_DIF_FUP_REQ_ FPA_RST_ACT {p. 3930}	LV_FUP_REQ_FPA_RST_ ACT {p. 3930}
LV_IS {p. 1720}	LV_PUC {p. 1720}	MFF_SP_FUP_CTL {p. 2151}	N_32 {p. 1525}
STATE_PWM_VCV {p. 3955}	STATE_VFF_VCV_MIN {p. 3955}	T_AST {p. 1766}	T_SEG_AV {p. 1525}
VFF_VCV {p. 3956}	VFF_VCV_MIN {p. 3956}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_FUP_PRS	-	0... FFFFH	0... 65535	1	-
Constant for maximal segment cycle number for setting of the pressure controller in the intervention mode					
C_CTR_SEG_FUP_OFS_BOL_MAX	-	0... FFH	0... 255	1	-
Max. value for the counter for forced leaving of pressure control					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_SEG_FUP_OFS_TOL_MAX	-	0... FFH	0... 255	1	-
Max. value for the counter for forced leaving of flow control					
C_CUR_VCV_BAS_AD_VAR_2_ADD_SET	-	0... FFFFH	-32.768 ...32.767	1e-3	A
Setting value for the adaptation at setting of the flow controller					
C_FUP_CTL_MOD	-	0H 1H 2H	AUTOMATIC FLOW_ CONTROL PRESSURE_ CONTROL	-	-
Request for operating state of the global fuel pressure regulation strategy					
C_FUP_OFS_BOL	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Offset to the FUP for the forced leaving of pressure control					
C_FUP_OFS_TOL	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Offset to the FUP for the forced leaving of flow control					
C_FUP_SP_DEC_TOL	-	0... FFFFH	0... 347776	5.3067216	hPa
Offset to the FUP for the forced leaving of flow control					
C_T_AST_MIN_I_CTL_SET	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time after start for enabling the setting of the flow controller and adaptation value					
C_T_FUEL_MASS_REQ_I_CTL_SET	-	0... FFFFH	0... 655.35	0.01	s
Constant for the maximum time in the flow control mode for setting of the I-part of the flow controller					
C_VFF_MFF_SP_VCV_BAS_AD_SET_LIM	-	0... FFFFH	0... 255	3.89105e-3	l/h
Limit VFF_MFF_SP_FUP_CTL value for setting of the I-part of the flow controller					
C_VFF_SWI_THD	-	0... FFFFH	0... 255	3.89105e-3	l/h
Switch threshold selecting VFF_VCV or VFF_MFF_SP_FUP_CTL as input for struc. change					
C_VFF_VCV_BAS_AD_SET_LIM	-	0... FFFFH	0... 255	3.89105e-3	l/h
Limit VFF_VCV value for setting of the I-part of the flow controller					
C_VFF_VCV_MIN_BOL_HYS	-	0... FFFFH	0... 255	3.89105e-3	l/h
Hysteresis to the lower switch limit					
C_VFF_VCV_MIN_TOL_HYS	-	0... FFFFH	0... 255	3.89105e-3	l/h
Hysteresis to the upper switch limit					
IP_FAC_FUEL_MASS_REQ_SET_N	-	0... FFFFH	0... 31.999	488.273e-6	mg/(l/h)
LDP_IP_FAC_FUEL_MASS_SET	8	0... FFH	0... 8160	32	rpm
Calculation of the mg value for setting of the I-part of the flow controller due to engine speed					
IP_FUP_DIF_FUP_REQ_FPA_RST	-	0... FFFFH	-173890 ...173884	5.3066911	hPa
LDP_FUP_DIF_IP_FUP_REQ_FPA_RST	8	0... FFFFH	-173890 ...173884	5.3066911	hPa
Interpolation curve for setting of the pressure controller in the intervention mode					
IP_VFF_VCV_I_CTL_SET	-	0... FFFFH	-255 ...0	3.89105e-3	l/h
LDP_VFF_VCV_IP_VFF_VCV_CTL_SET	6	0... FFFFH	0... 255	3.89105e-3	l/h
Calculation map for the setting value of the I-part of the flow controller due to fuel volume flow					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_FUEL_MASS_CTL_RST	-	0... 1H	0 ...1	1	-
Logical switch requesting I-part reset of controller for flow control at leaving pressure control					
LC_FUP_REQ_FPA_RST	-	0... 1H	0 ...1	1	-
Logical switch requesting I-part reset of controller for pressure control at leaving flow control					
LC_INH_SWI_THD_PUC	-	0... 1H	0 ...1	1	-
Logical constant for inhibit of the fuel pressure intervention mode in PUC					
LC_VFF_SWI	-	0... 1H	0 ...1	1	-
Logical switch selecting VFF_VCV or VFF_MFF_SP_FUP_CTL as input for struc. Change (1:VFF_VCV)					

Overview

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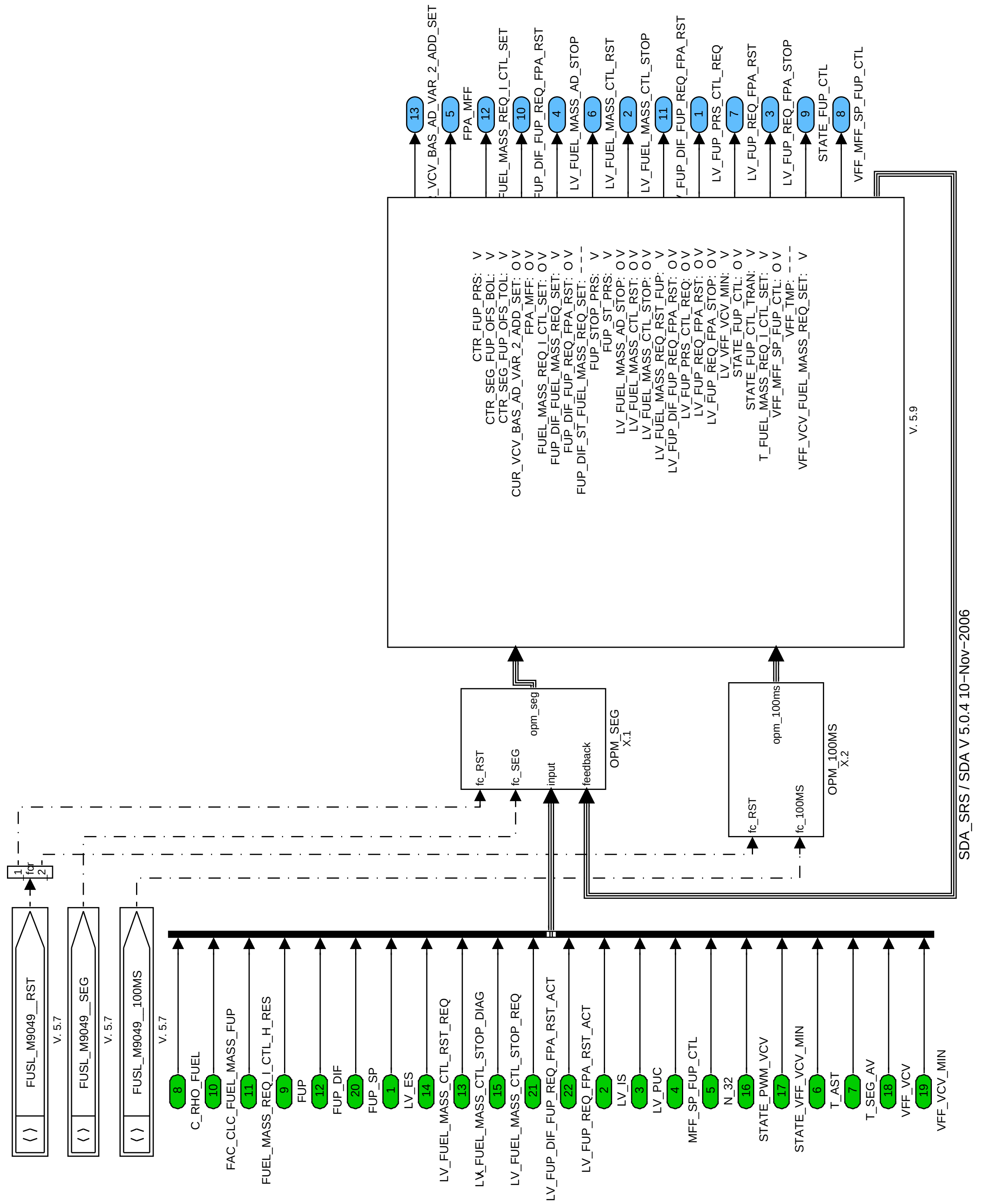

Figure 9.37.1: :   Path: FUSL_M9049

General Information

A variant of the fuel pressure control system is a threewayvalve as a control mode, which combines the volume control valve and the regulator functionality. In that case the regulator is obsolete.

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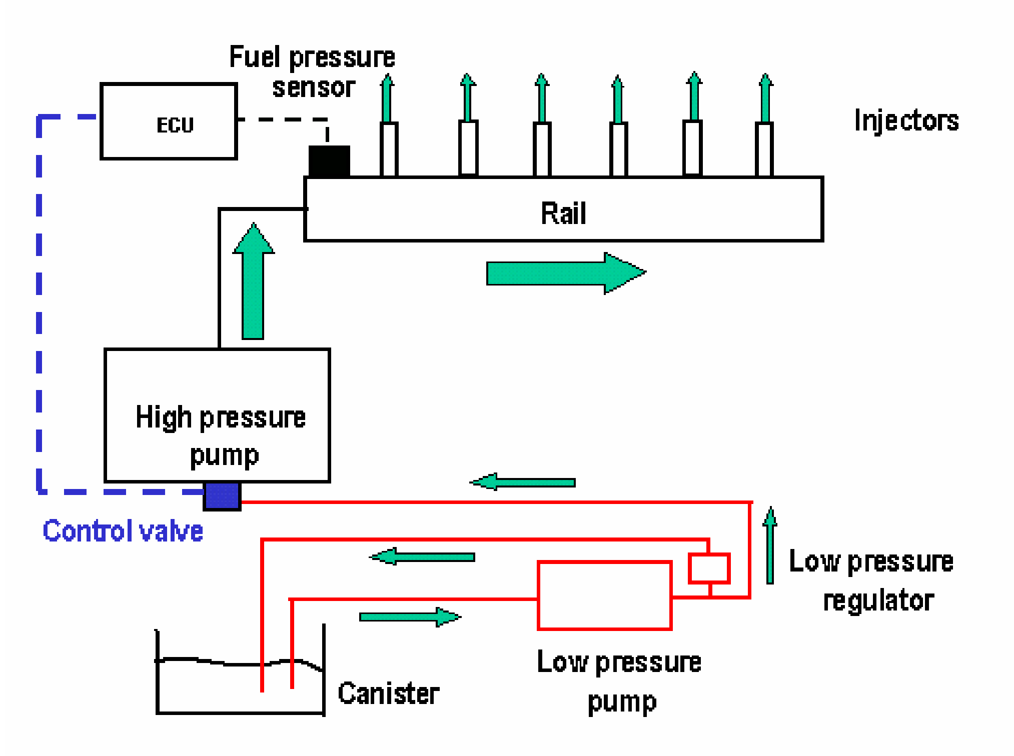

General scheduling

Segment synchronious tasks:

1. Fuel pressure of low pressure pump
2. Fuel pressure
3. {Injection related parts of SW}
4. Electrical fuel pump control (Appl. Inc.)
5. Electrical fuel pump
6. Fuel supply general
7. Fuel pressure setpoint calculation
8. Fuel pressure control
9. High pressure pump control

1 ms tasks:

1. Fuel pressure of low pressure pump

10 ms tasks:

1. Fuel pressure of low pressure pump
2. Fuel pressure
3. {Injection related parts of SW}
4. Electrical fuel pump control (Appl. Inc.)
5. Electrical fuel pump
6. Fuel pressure setpoint calculation
7. Fuel pressure control (Appl. Inc.)
8. Fuel pressure control

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9. High pressure pump control (Appl. Inc.)
10. High pressure pump control

20 ms tasks:

1. Fuel system pressure diagnosis for low pressure (Appl. Inc)
2. Fuel system pressure diagnosis for low pressure
3. Fuel system pressure diagnosis (Appl. Inc.)
4. Fuel system pressure diagnosis

40 ms tasks:

1. Fuel pressure sensor diagnosis for low pressure (Appl. Inc.)
2. Fuel pressure sensor diagnosis for low pressure
3. Fuel pressure sensor diagnosis (Appl. Inc.)
4. Fuel pressure sensor diagnosis

100 ms tasks:

1. Electrical diagnosis of fuel pressure actuator (Appl. Inc.)
2. Electrical diagnosis of fuel pressure actuator
3. Fuel pressure setpoint of electrical fuel pump
4. Fuel pressure control (Appl. Inc.)
5. Fuel pressure control
6. High pressure pump control
7. Fuel supply general

1000 ms tasks:
Fuel pressure actuator temperature calculation

Management of the pressure and flow controlers in the intervention mode

Condition VFF_VCV under the C_VFF_SWI_THD

In idle speed:

Reset of the I part of the flow controller
Set of the I part of the pressure controller
No reset of the I part of the pressure controller
No Execution of the adaptations

In PUC:

No reset of the I part of the flow controller
Set of the I part of the pressure controller
Reset of the I part of the pressure controller depending on the reset LC's
Alternative execution of the pressure /leakage adaptations

In PU:

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No reset of the I part of the flow controller
Set of the I part of the pressure controller
Reset of the I part of the pressure controller depending on the reset LC's
No Execution of the adaptations.

9.37.1 Function description of 100MS task

Application Conditions

Initialization: RST
Recurrence: 100MS
Activation: always
Deactivation: never

Function description

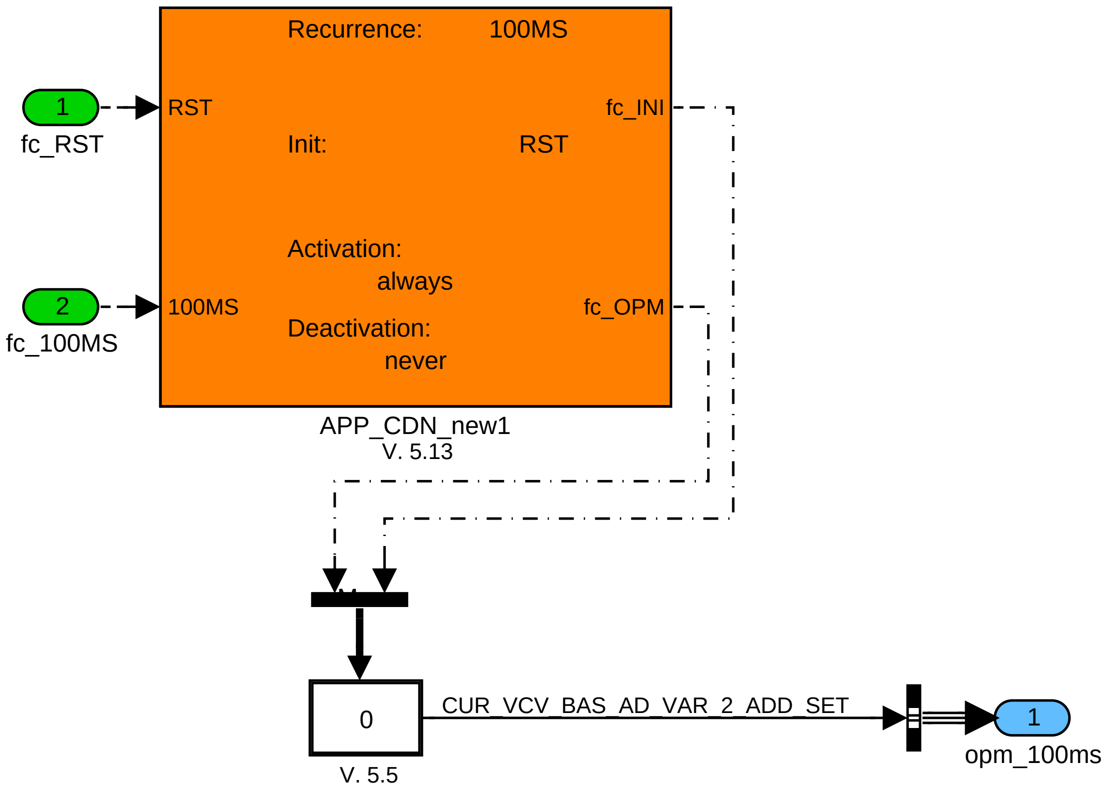

Figure 9.37.2: : Path: FUSL_M9049/OPM_100MS

9.37.2 Function Description of segment synchronous task

The fuel supply general organizes the different fuel pressure control possiblities. It can be achieved an automatic mode where the flow control and pressure control mode is chosen by the flow through the volume control valve. Also only flow control or pressure control can be selected. The pressure control part can be divided into pressure control with or without flow precontrol and the flow control can be combined with or without pressure control.

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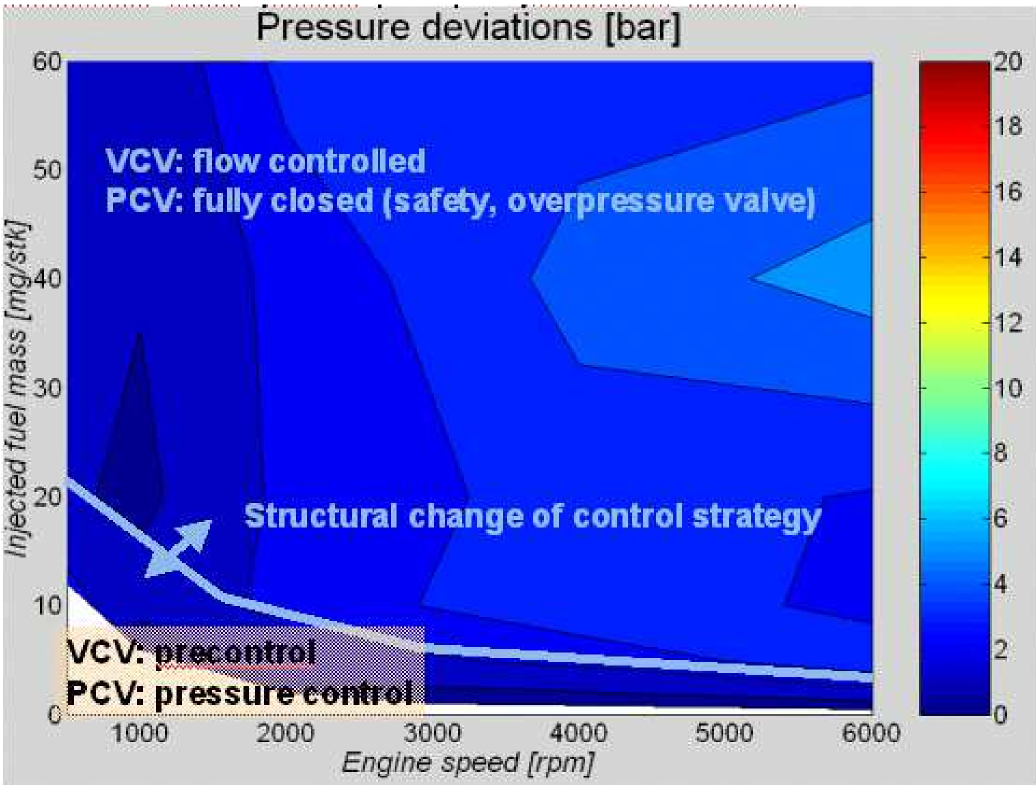

Application Conditions

Initialization: RST
Recurrence: SEG
Activation: LV_ES == 0
Deactivation: LV_ES == 1

Function description

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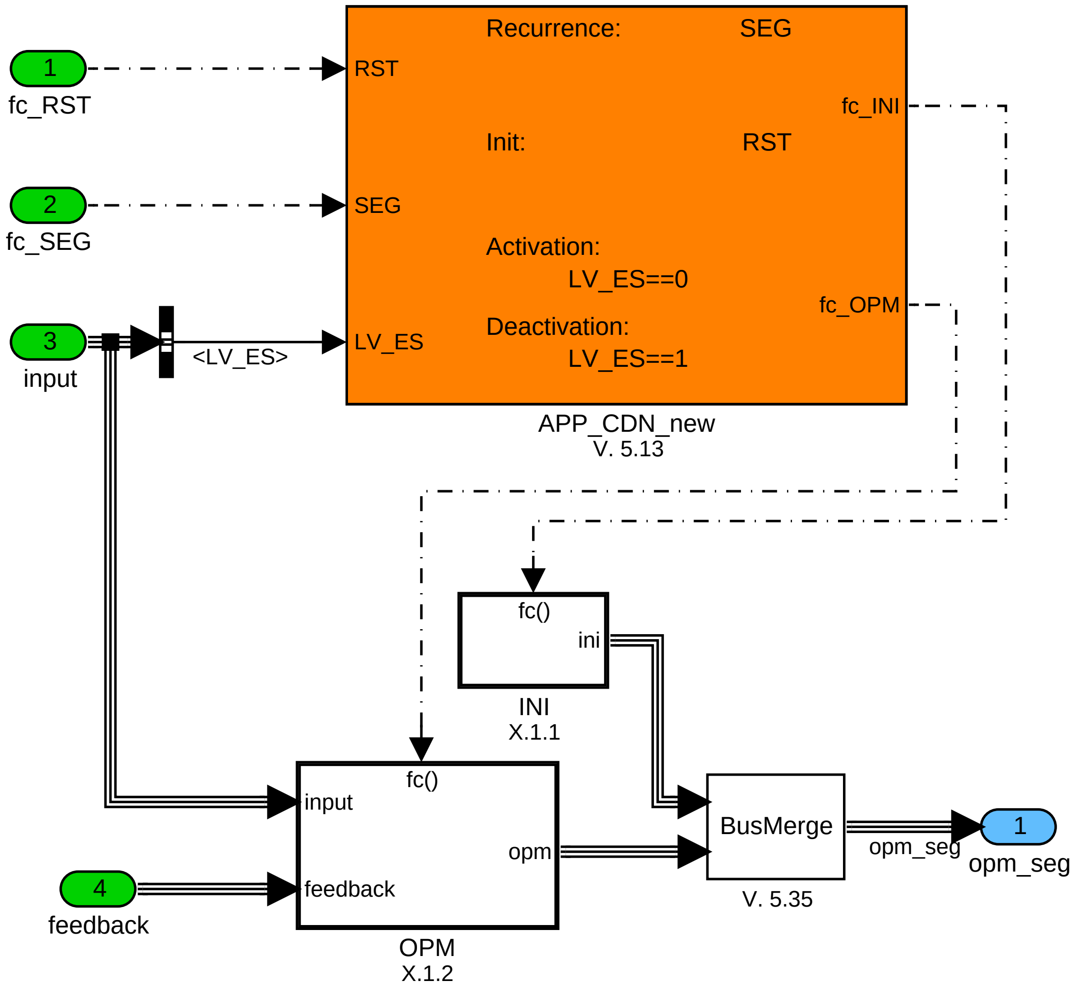

Figure 9.37.3: : Path: FUSL_M9049/OPM_SEG

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9.37.2.1 Initialisation at reset event

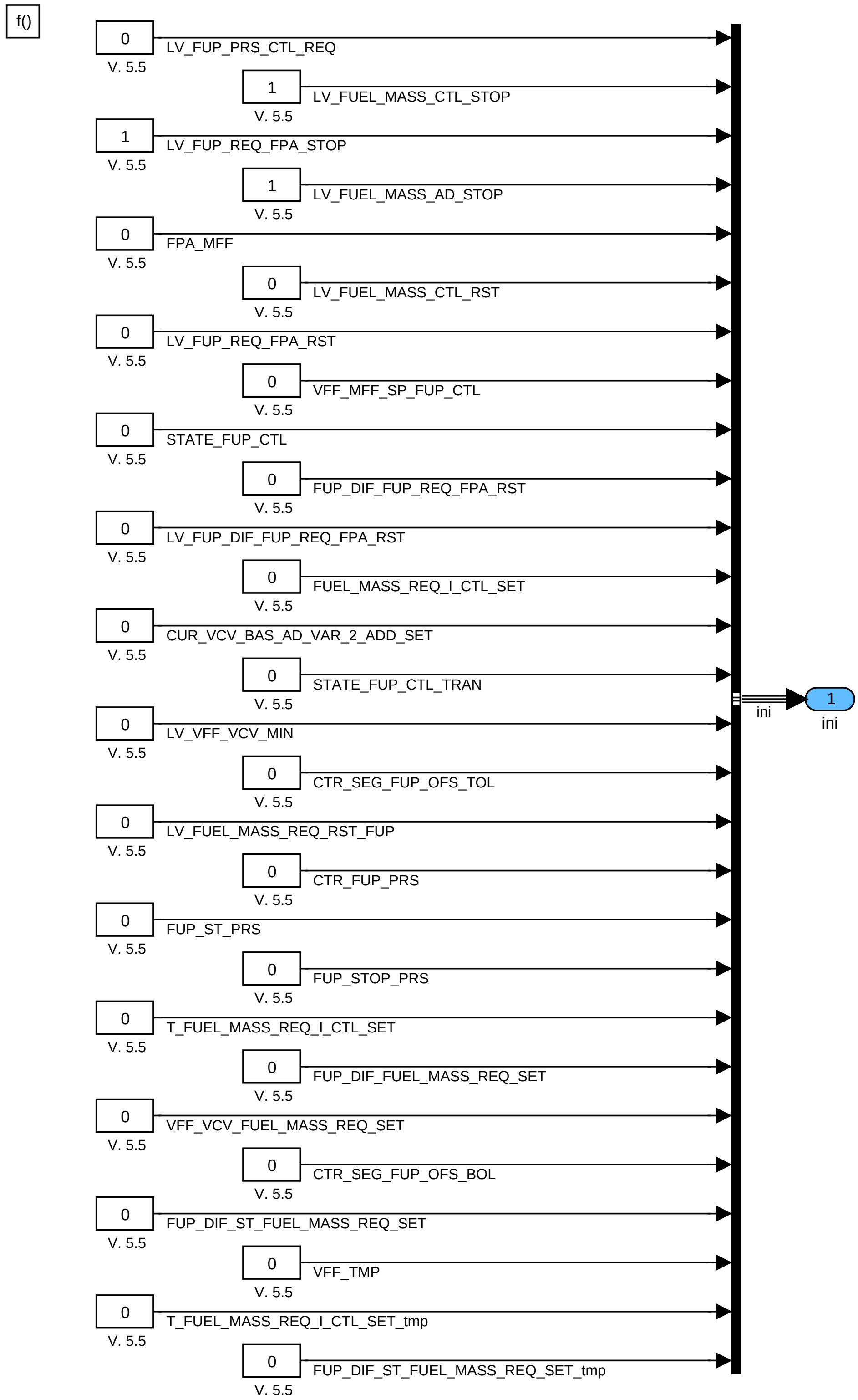

Figure 9.37.4: : Path: FUSL_M9049/OPM_SEG/INI

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9.37.2.2 Calculation

For better visibility the functionality is split into three subsystems

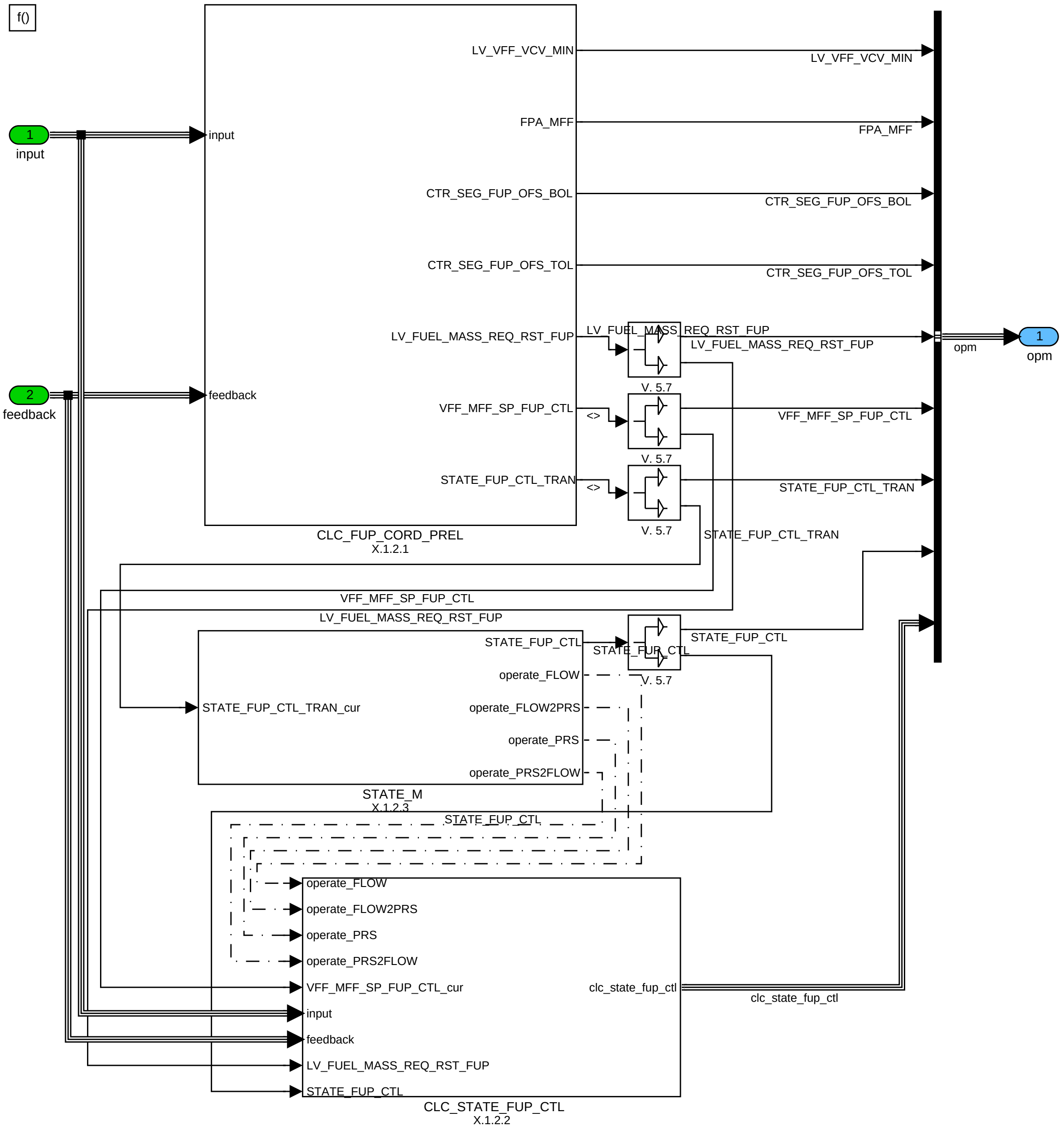

Figure 9.37.5: :   Path: FUSL_M9049/OPM_SEG/OPM

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9.37.2.2.1 Preliminary fuel pressure co-ordination

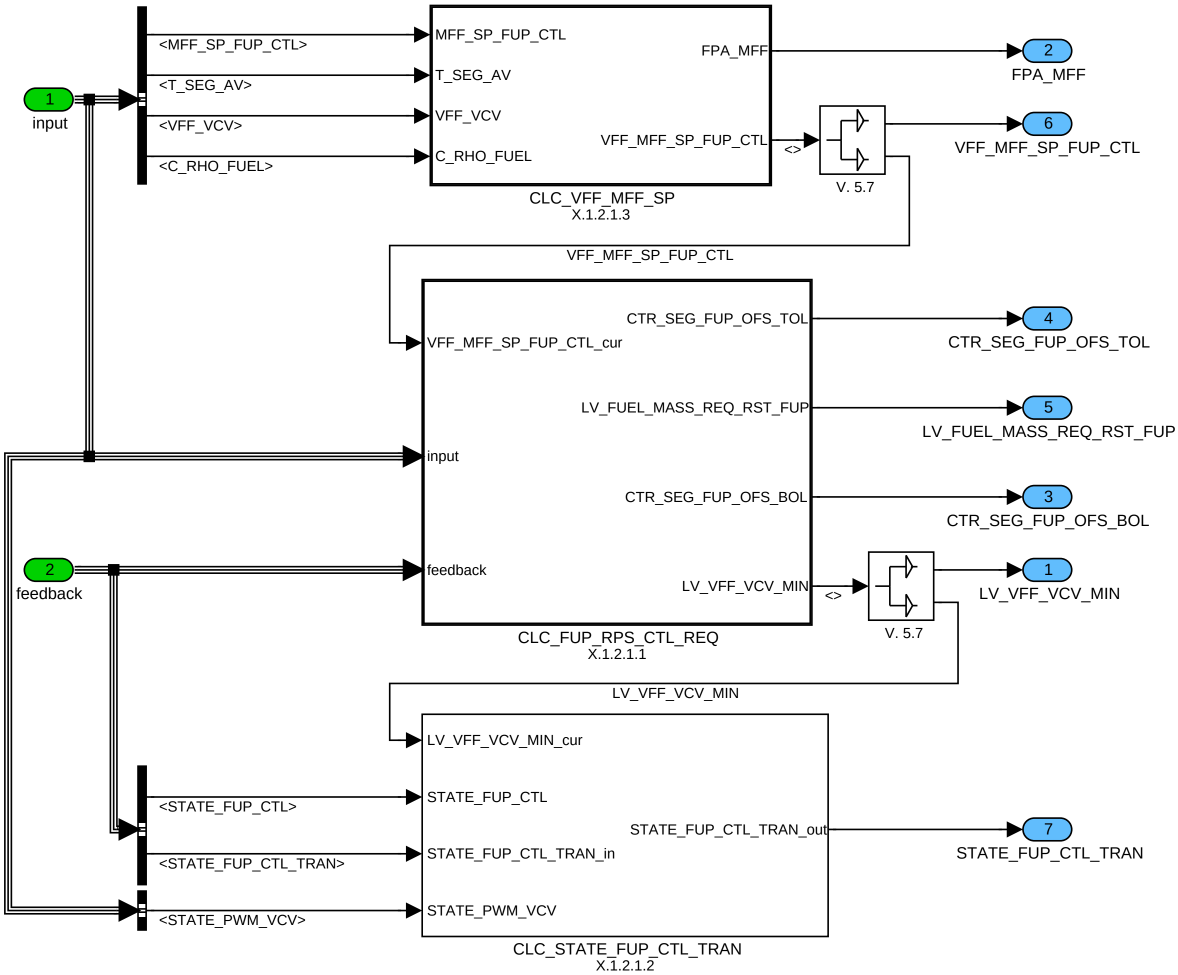

Figure 9.37.6: : Path: FUSL_M9049/OPM_SEG/OPM/CLC_FUP_CORD_PREL

9.37.2.2.1.1 Fuel pressure request control

The following blocks calculate the switching between pressure and flow control mode

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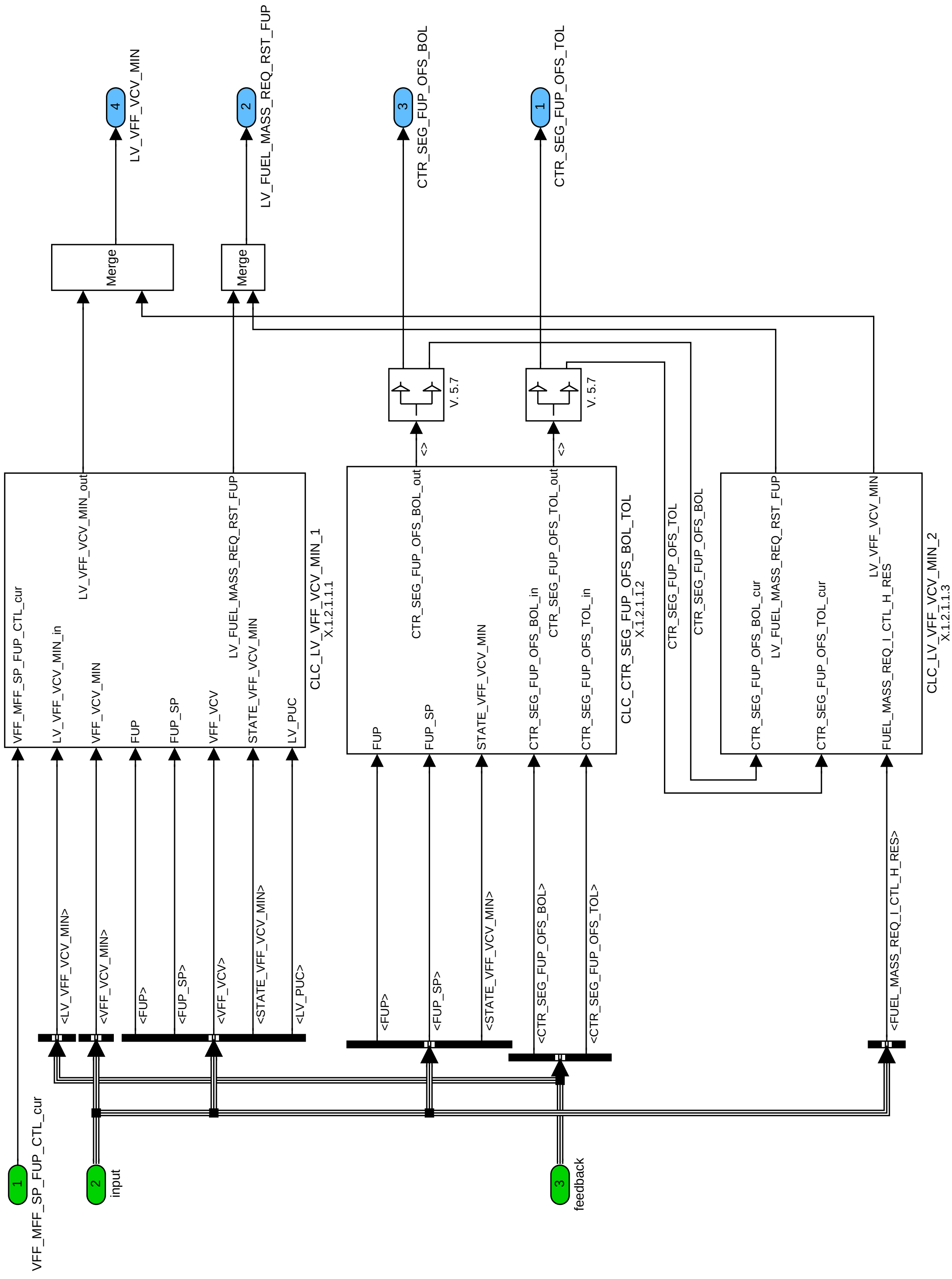

Figure 9.37.7: : Path:
FUSL_M9049/OPM_SEG/OPM/CLC_FUP_CORD_PREL/CLC_FUP_RPS_CTL_REQ

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9.37.2.2.1.1.1 Calculation of fuel pressure limits

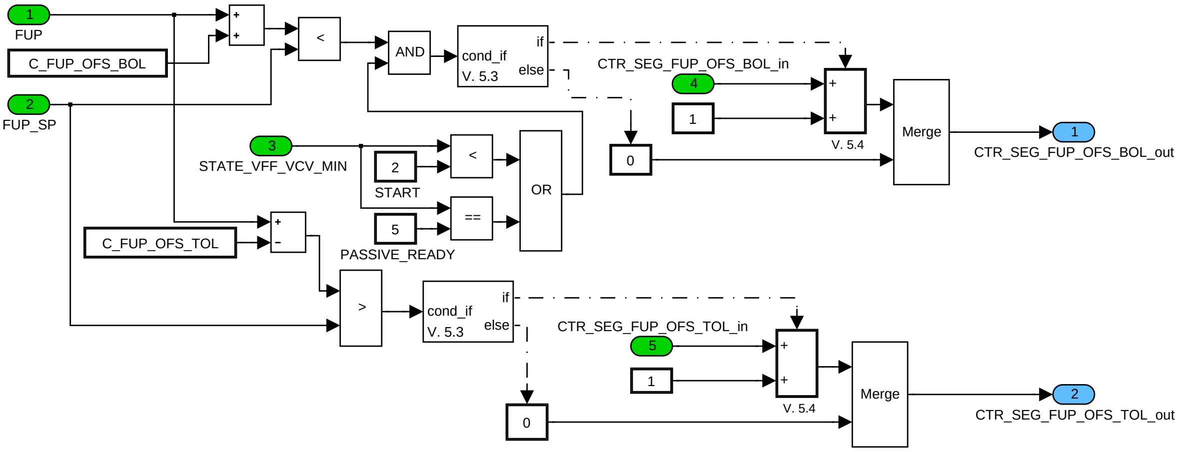

Figure 9.37.8: : Path: FUSL_M9049/OPM_SEG/OPM/CLC_FUP_CORD_PREL/
CLC_FUP_RPS_CTL_REQ/CLC_CTR_SEG_FUP_OFS_BOL_TOL

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9.37.2.2.1.1.2 Minimum volumetric fuel flow calculation

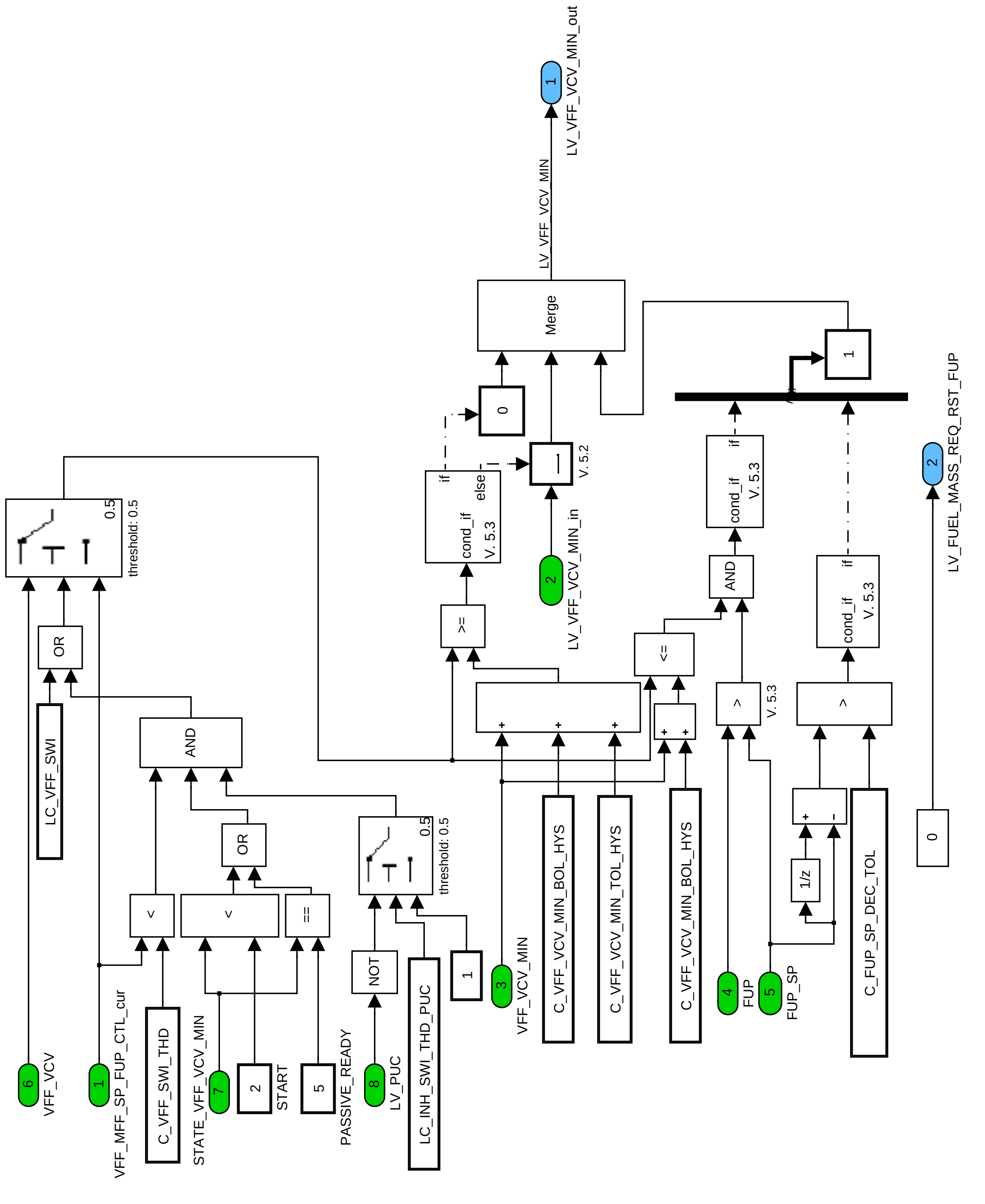

Figure 9.37.9: : Path: FUSL_M9049/OPM_SEG/OPM/CLC_FUP_CORD_PREL/
CLC_FUP_RPS_CTL_REQ/CLC_LV_VFF_VCV_MIN_1

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9.37.2.2.1.1.3 Minimum fuel flow based on fuel pressure offset

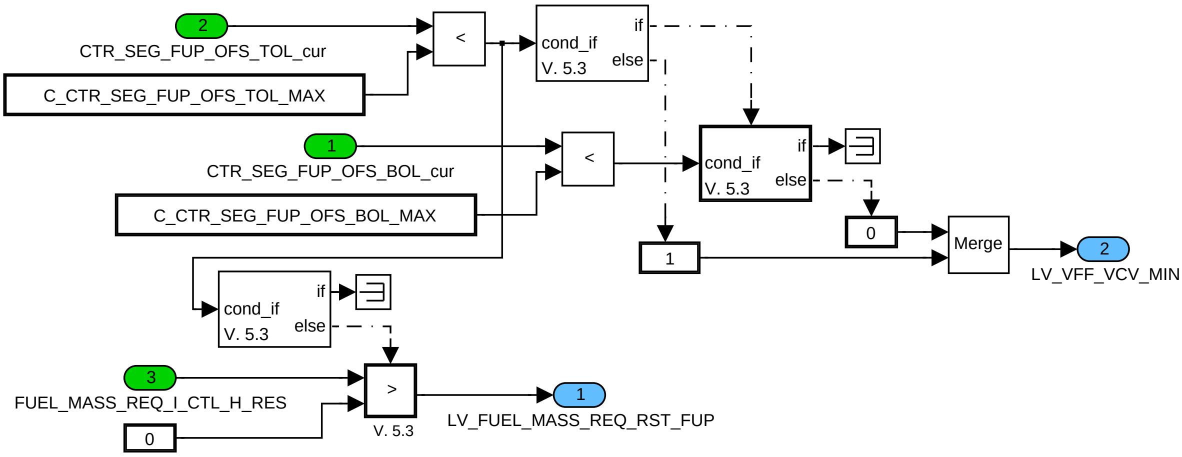

Figure 9.37.10: : Path: FUSL_M9049/OPM_SEG/OPM/CLC_FUP_CORD_PREL/CLC_FUP_RPS_CTL_REQ/CLC_LV_VFF_VCV_MIN_2

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9.37.2.2.1.2 Fuel pressure control transition

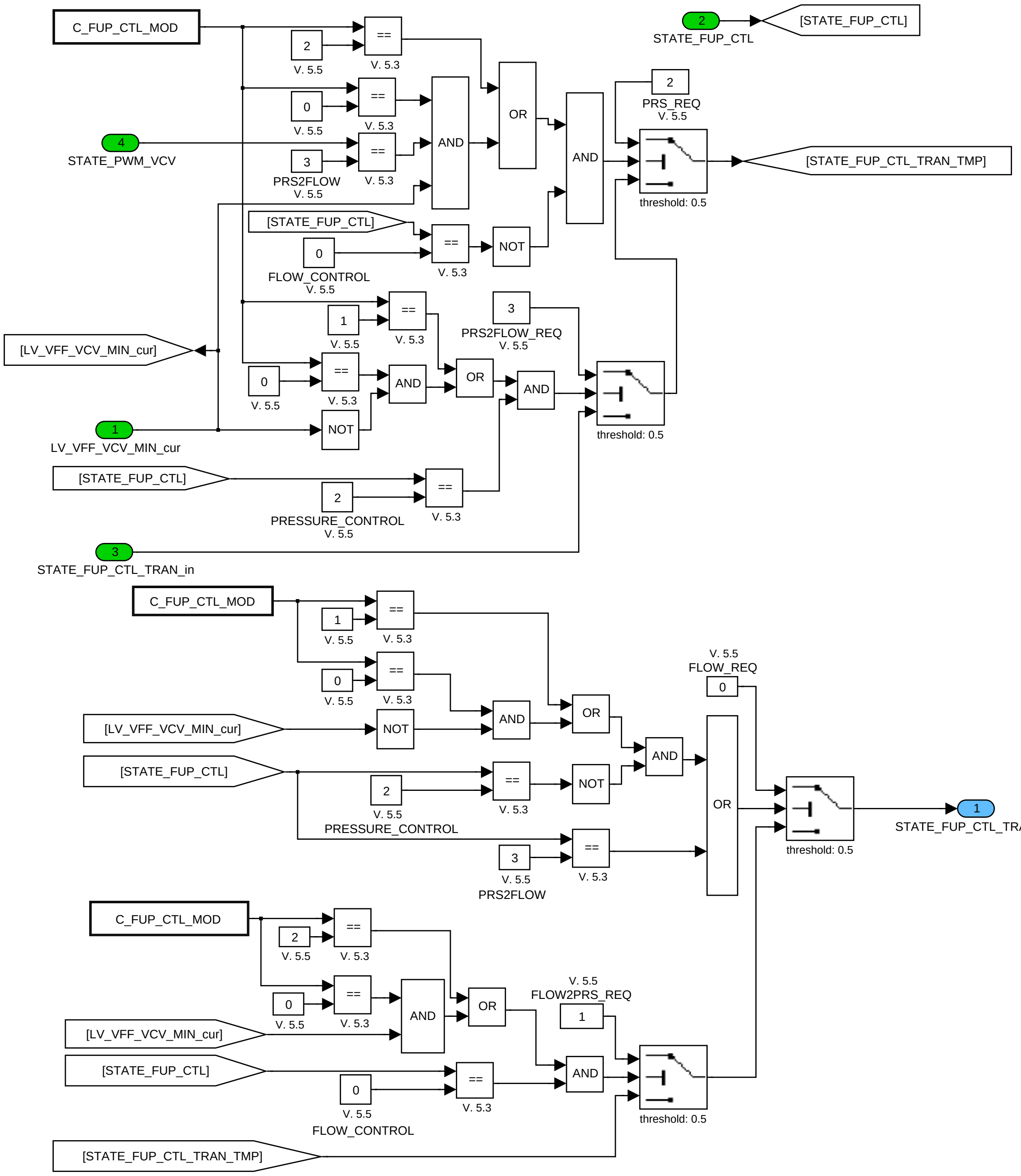

Figure 9.37.11: : Path:
FUSL_M9049/OPM_SEG/OPM/CLC_FUP_CORD_PREL/CLC_STATE_FUP_CTL_TRAN

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9.37.2.2.1.3 Calculation of Fuel pressure control

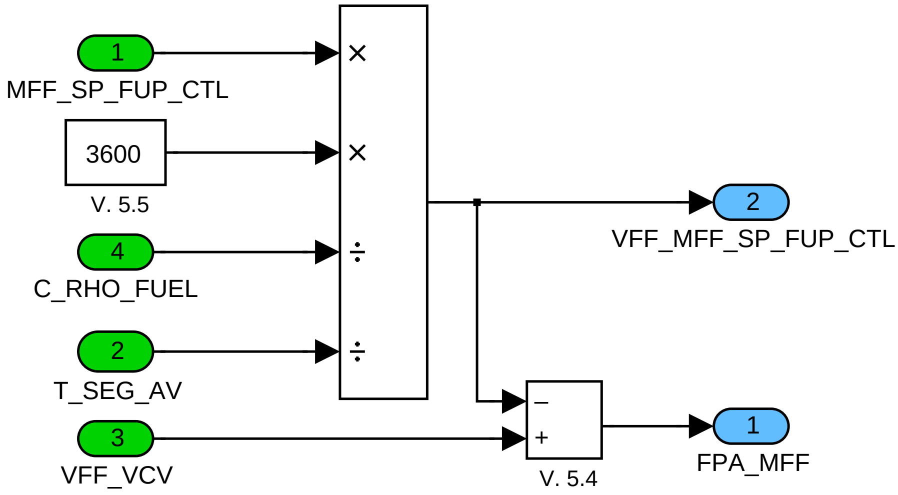

Figure 9.37.12: : Path: FUSL_M9049/OPM_SEG/OPM/CLC_FUP_CORD_PREL/CLC_VFF_MFF_SP

9.37.2.2.2 State Machine

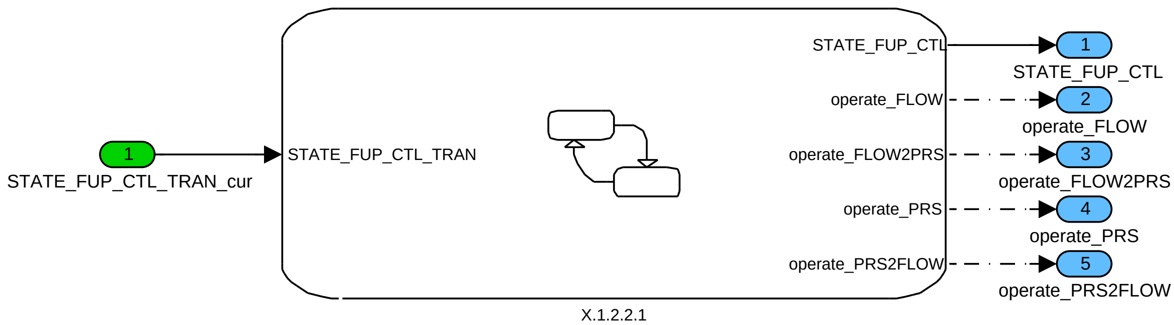

Figure 9.37.13: : Path: FUSL_M9049/OPM_SEG/OPM/STATE_M

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9.37.2.2.2.1 Chart

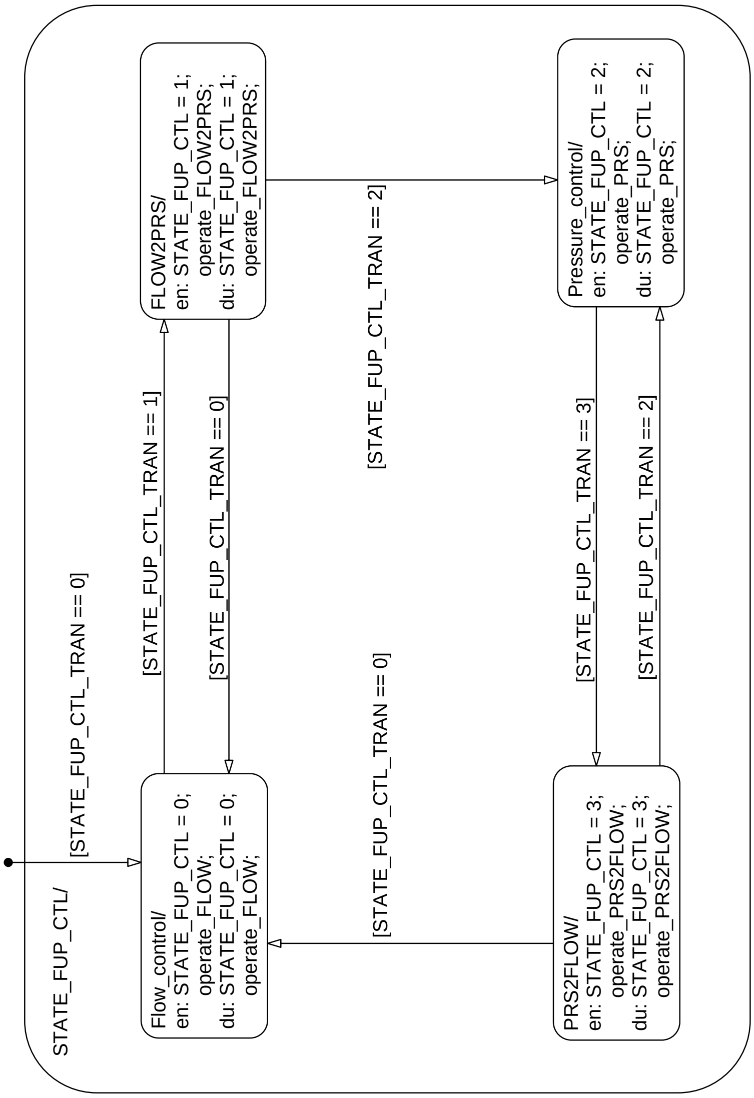

Figure 9.37.14: : Path: FUSL_M9049/OPM_SEG/OPM/STATE_M/Chart

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9.37.2.2.3 State action calculation overview

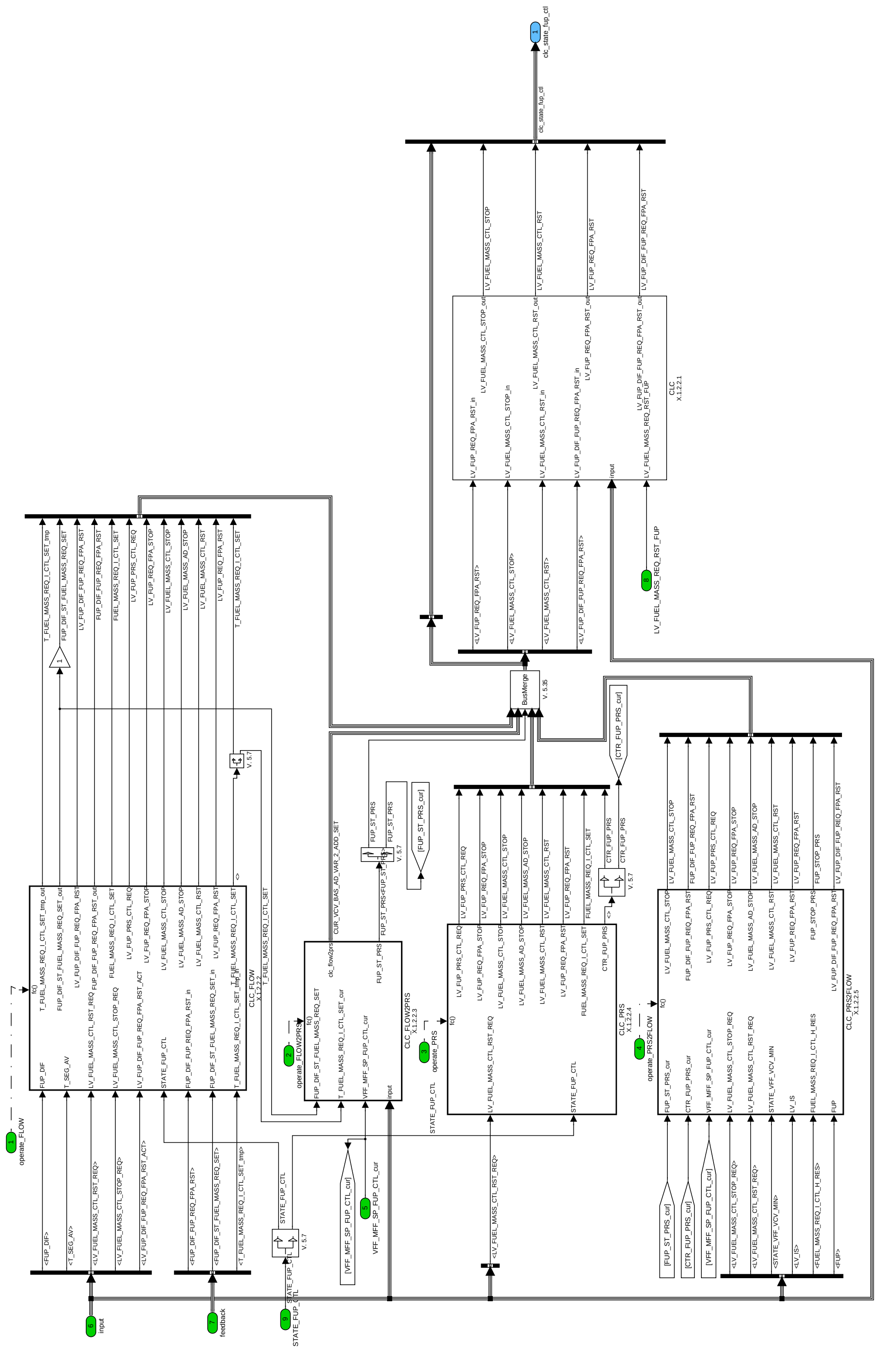

Figure 9.37.15: : Path: FUSL_M9049/OPM_SEG/OPM/CLC_STATE_FUP_CTL

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9.37.2.2.3.1 Calculation

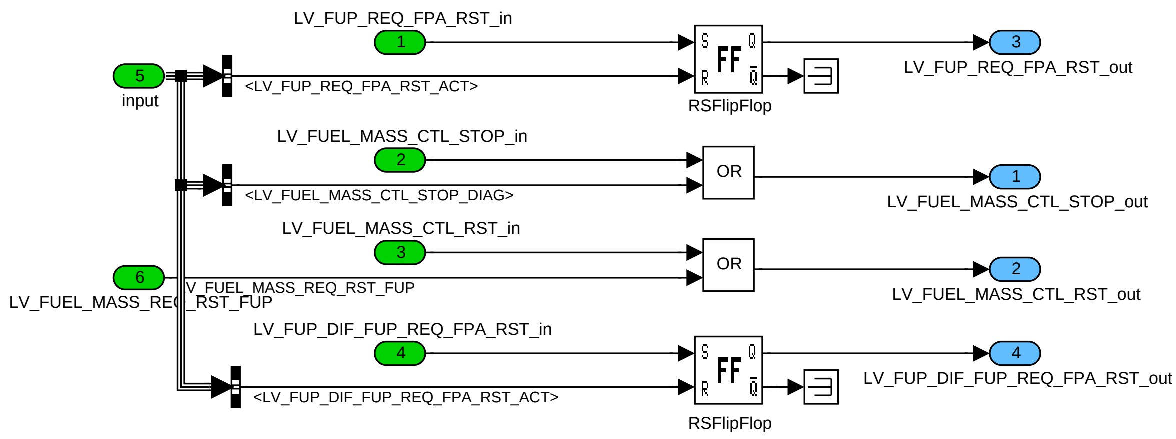

Figure 9.37.16: : Path: FUSL_M9049/OPM_SEG/OPM/CLC_STATE_FUP_CTL/CLC

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9.37.2.2.3.2 Flow calculation

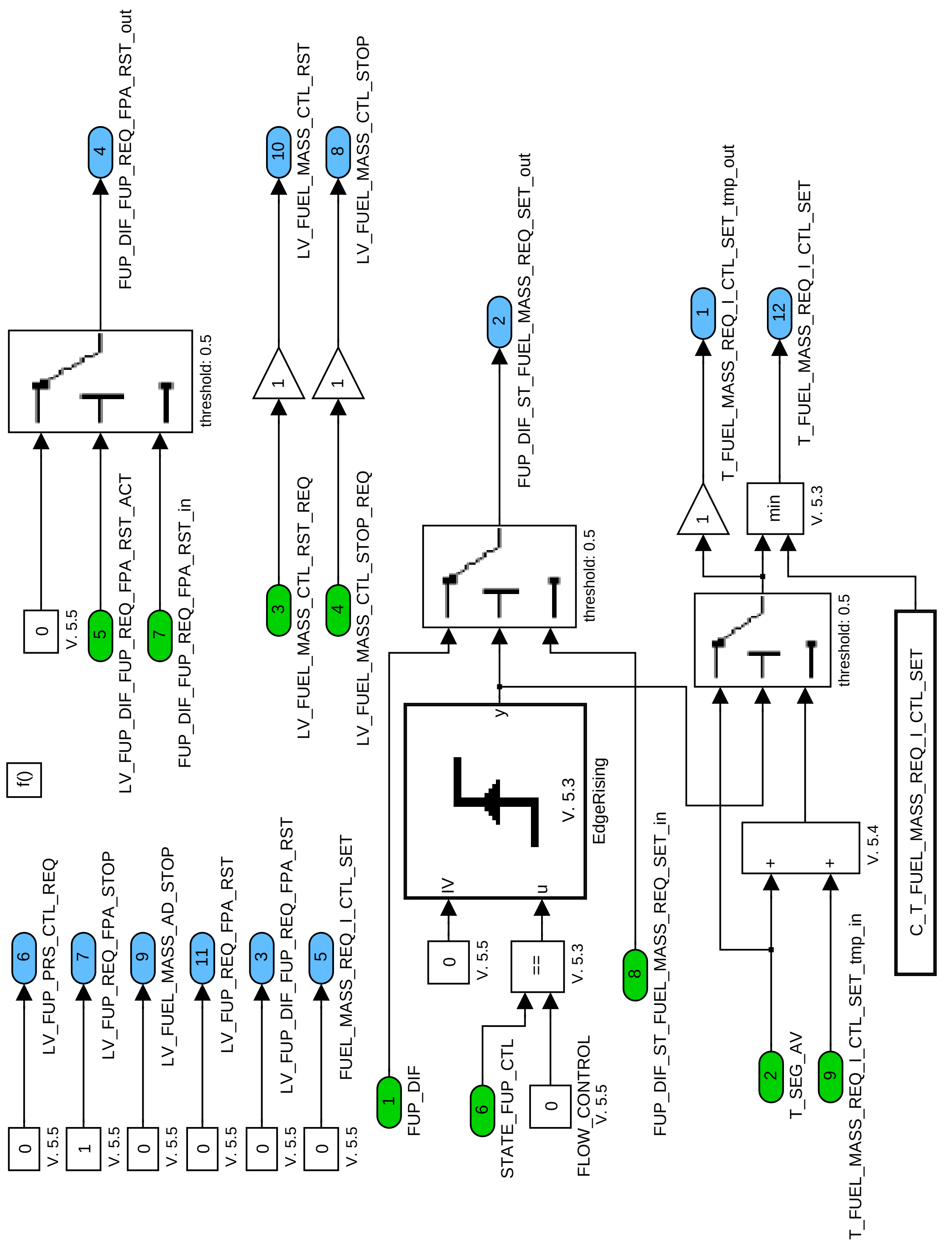

Figure 9.37.17: : Path: FUSL_M9049/OPM_SEG/OPM/CLC_STATE_FUP_CTL/CLC_FLOW

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9.37.2.2.3.3 Flow to pressure calculation overview

For better visibility the functionality is divided into two different systems

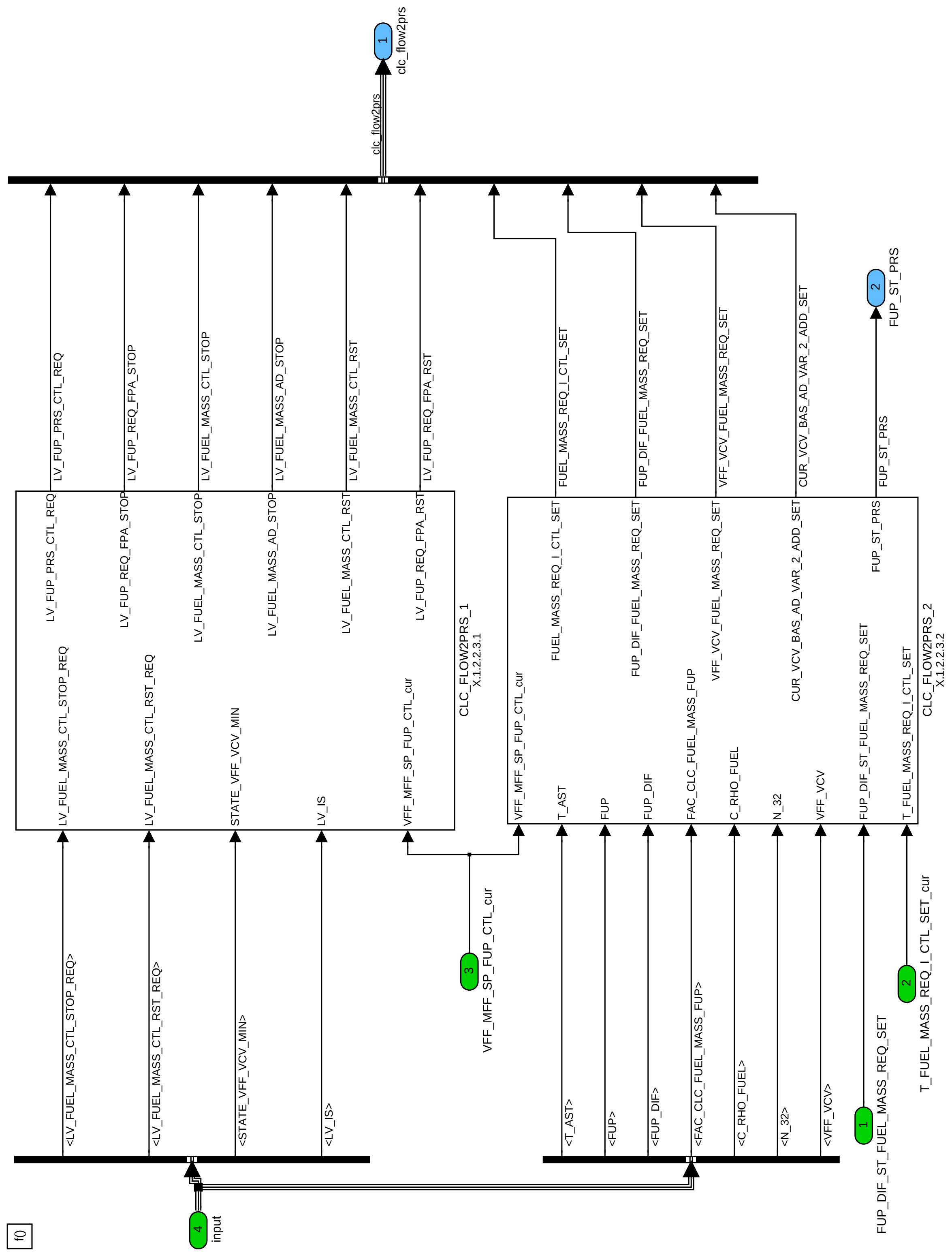

Figure 9.37.18: : Path: FUSL_M9049/OPM_SEG/OPM/CLC_STATE_FUP_CTL/CLC_FLOW2PRS

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9.37.2.2.3.3.1 Fuel pressure actuator reset calculation

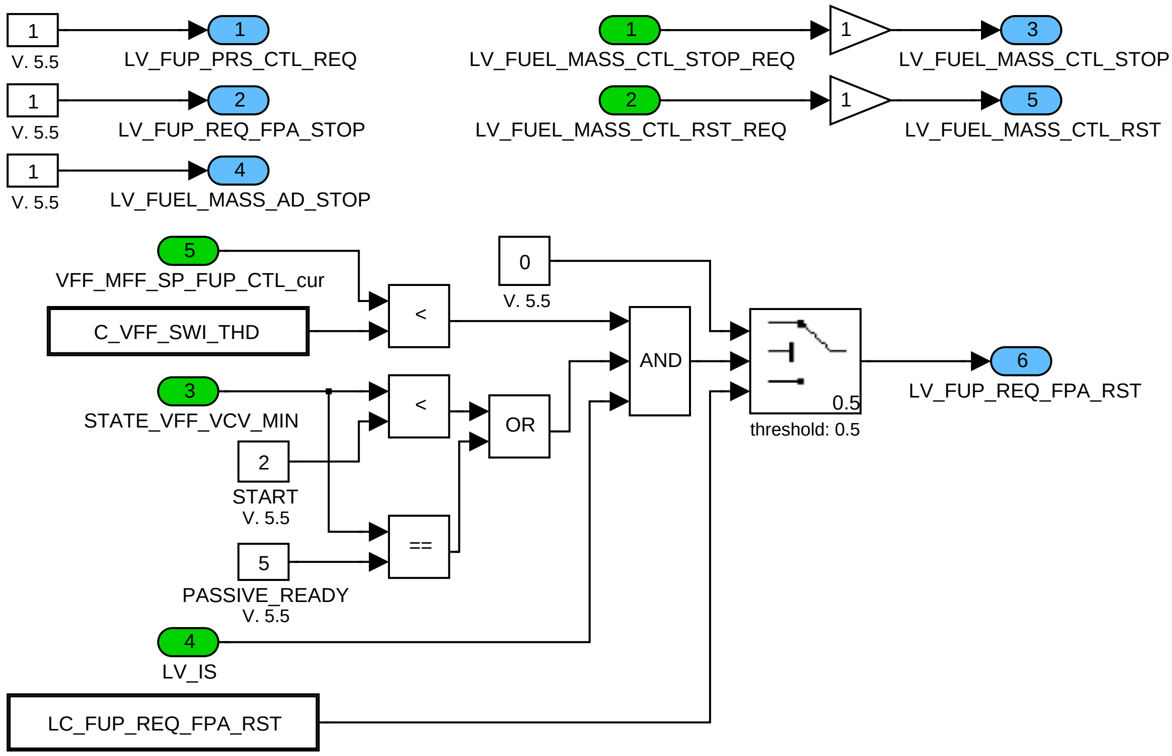

Figure 9.37.19: : Path:
FUSL_M9049/OPM_SEG/OPM/CLC_STATE_FUP_CTL/CLC_FLOW2PRS/CLC_FLOW2PRS_1

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9.37.2.2.3.3.2 Fuel mass request control & set calculation

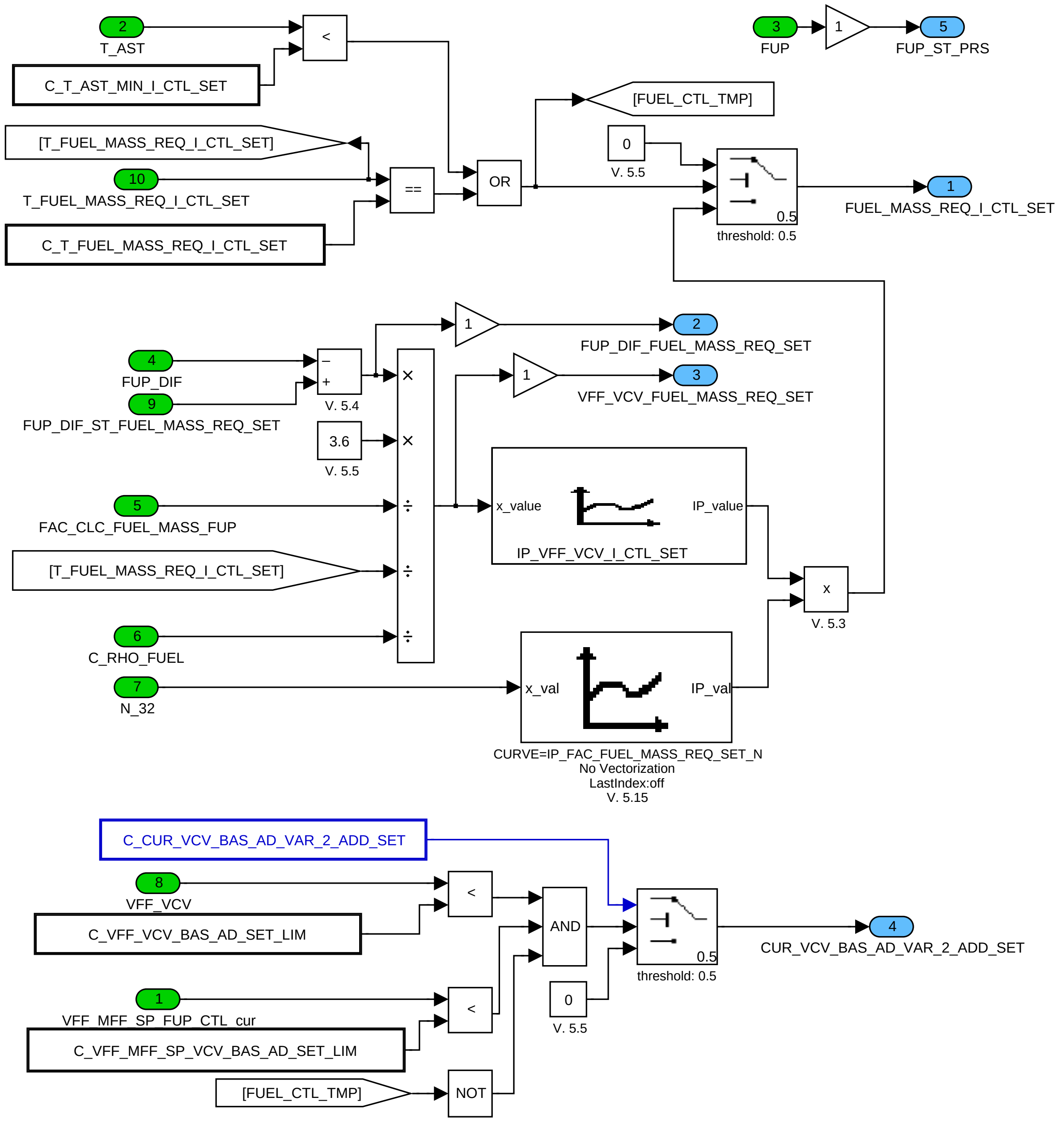

Figure 9.37.20: : Path:
FUSL_M9049/OPM_SEG/OPM/CLC_STATE_FUP_CTL/CLC_FLOW2PRS/CLC_FLOW2PRS_2

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9.37.2.2.3.4 Pressure calculation

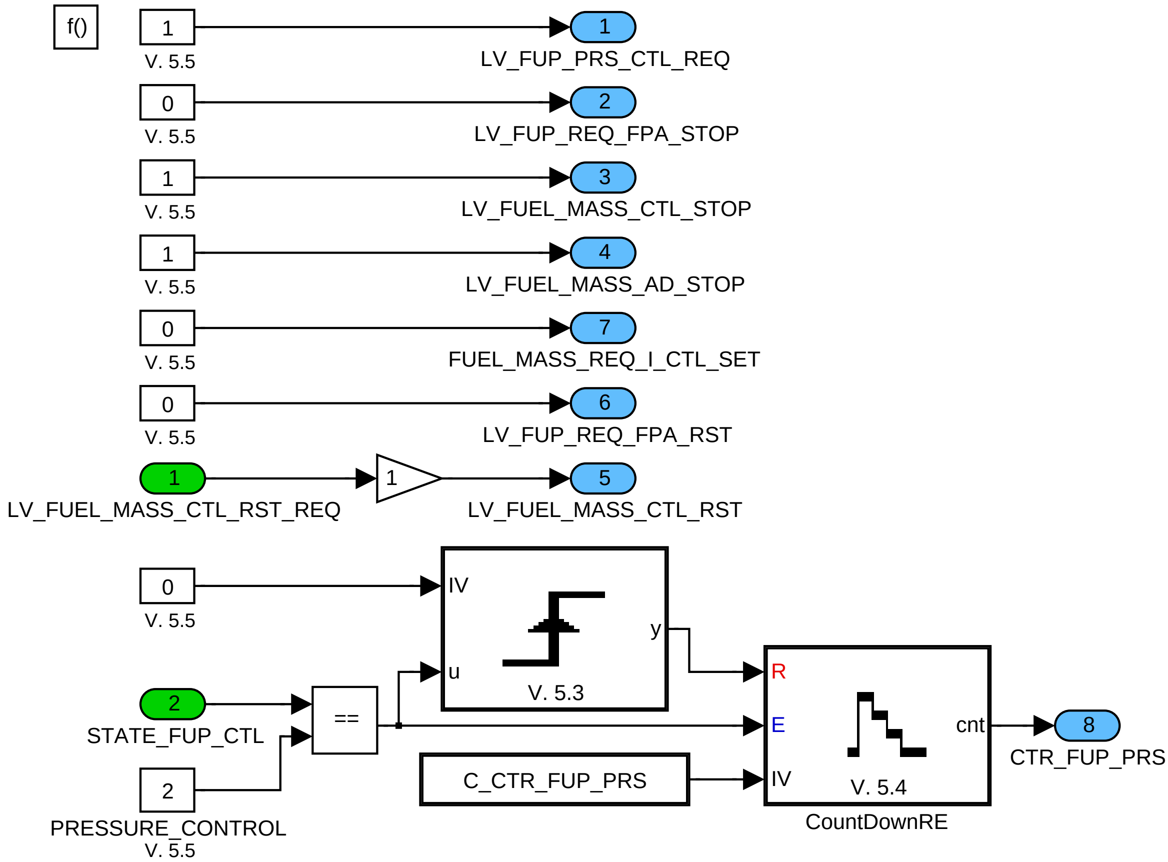

Figure 9.37.21: : Path: FUSL_M9049/OPM_SEG/OPM/CLC_STATE_FUP_CTL/CLC_PRS

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9.37.2.2.3.5 Pressure to flow calculation

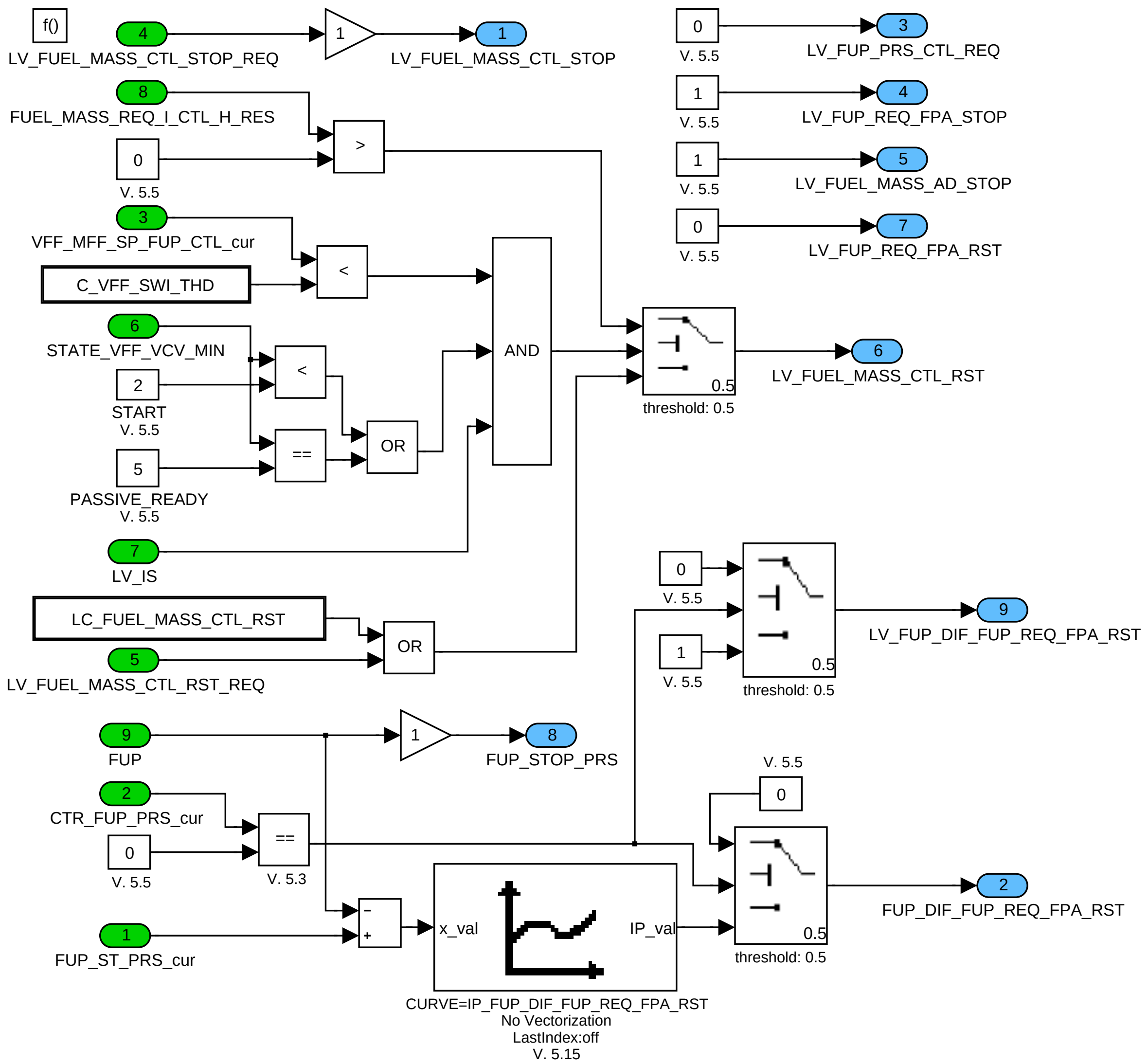

Figure 9.37.22: : Path: FUSL_M9049/OPM_SEG/OPM/CLC_STATE_FUP_CTL/CLC_PRS2FLOW

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9.38 Fuel pressure control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_CLC_FUEL_MASS_FUP	O/V	0... FFH	0... 510	2	hPa/mg
Factor for compressibility and density of gasoline and rail					
FAC_FUEL_MASS_REQ_PCTL	V	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Weighting factor for the precontroller					
FUEL_MASS_AD	O/V/S	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Adaptive fuel mass					
FUEL_MASS_AD_DIF	O/V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Deviation of the fuel mass for the adaption					
FUEL_MASS_REQ	O/V	0... FFFFH	0... 1389	0.0211948	mg
Requested fuel mass from the pump					
FUEL_MASS_REQ_CTL	O/V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Controller output					
FUEL_MASS_REQ_D_CTL	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
D-part of controller					
FUEL_MASS_REQ_I_CTL_H_RES	O/V	80000000... 7FFFFFFFH	-694.510597391 ...694.489402609	323.402e-9	mg
I-part of the controller					
FUEL_MASS_REQ_I_CTL_MMV	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Mean value of the I-part of the controller					
FUEL_MASS_REQ_MFF	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Additive fuel mass (DT1) due to injection fuel mass					
FUEL_MASS_REQ_P_CTL	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
P-part of the controller					
FUEL_MASS_REQ_PCTL	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Requested fuel mass from the precontroller					
FUEL_MASS_REQ_PCTL_TMP	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Requested fuel mass from the precontroller (without the influence of the weighting factor)					
FUEL_MASS_REQ_TQ	V	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Additive fuel mass (DT1) due to Torque request					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FUP_DIF	O/V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Deviation of fuel pressure setpoint and measured fuel pressure					
FUP_DIF_CTL	V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Deviation of measured fuel pressure and FUP_MDL or FUP_SP (depending on LC_USE_FUP_MDL_CTL)					
FUP_DIF_MMV	O/V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Deviation of fuel pressure setpoint and measured fuel pressure moving mean value					
FUP_DIF_PCTL	V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Deviation of fuel pressure setpoint and FUP_MDL or FUP (depending on LC_USE_FUP_MDL_PCTL)					
FUP_GRD	V	8000... 7FFFH	-869... 86942.67	2.6533608	hPa/10ms
Fuel pressure gradient					
LV_FUEL_ADD_ACT	V	0... 1H	0 ...1	1	-
Logical variable indicating that additional fuel mass is added to precontrol					
SEG_CTR_FUEL_MASS_AD	V	0... FFFFH	0... 65535	1	-
Segment counter before adaptation is allowed					
TQ_REQ_CLU_LIM	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Limited requested torque at clutch for FUSL DT1 activation					

Input data:

FUEL_MASS_REQ_I_CTL_SET {p. 3880}	FUP {p. 1283}	FUP_SP {p. 3868}	LV_ERR_FUP_MFP_PLAUS {p. 6062}
LV_ES {p. 1720}	LV_FUEL_MASS_AD_STOP {p. 3880}	LV_FUEL_MASS_CTL_RST {p. 3880}	LV_FUEL_MASS_CTL_STOP {p. 3880}
LV_ST_END {p. 1720}	MFF_SP_FUP_CTL {p. 2151}	N_32 {p. 1525}	PV_AV {p. 1269}
PV_AV_GRD {p. 1269}	STATE_PWM_VCV {p. 3955}	T_SEG_AV {p. 1525}	TFU {p. 1232}
TQ_MAX_CLU {p. 8380}	TQ_REQ_CLU {p. 8390}	VFF_VCV {p. 3956}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CLC_FUEL_PUMP_CTL	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Amount of segments of calculation recurrency of high pressure pump control					
C_CRLC_FUP_DIF_MMV	-	0... FFH	0... 0.99609375	3.90625e-3	-
Filter constant for the fuel pressure difference					
C_CTR_CYC_FUEL_ADD	-	0... FFFFH	0... 65535	1	-
Number of segments where adding additional fuel mass to precontrol is active					
C_DLY_FUP_SP	-	1... 6H	1 ...6	1	-
Delay of the FUP_SP in calculation cycles					
C_FAC_FUEL_MASS_TQ	-	0... FFFFH	0... 1.99996948242	30.5176e-6	mg/Nm
Correlation factor from Nm to mg/stk					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_REQ_FUEL_MASS	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Factor to limit the TQ_REQ_CLU to the real value (no over Request)					
C_FUEL_MASS_AD_COR_CRLC	-	0... FFH	0... 0.99609375	3.90625e-3	-
Filter constant for the fuel mass adaptation					
C_FUEL_MASS_AD_MAX	-	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Maximum adaptive fuel mass					
C_FUEL_MASS_AD_MIN	-	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Minimum adaptive fuel mass					
C_FUEL_MASS_REQ_ADD	-	0... FFFFH	0... 1389	0.0211948	mg
Additive fuel mass depending on engine speed.					
C_FUEL_MASS_REQ_I_CTL_INI	-	0... FFFFH	-694.5... 694.478806	0.02119-	mg
Initialisation of the I-part of the flow controller depending on the fuel temperature					
C_FUEL_MASS_REQ_I_CTL_MAX	-	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Maximum I-part of the controller					
C_FUEL_MASS_REQ_I_CTL_MIN	-	8000... 7FFFH	-694.510597391 ...694.489402609	0.0211948	mg
Minimum I-part of the controller					
C_FUEL_MASS_REQ_I_CTL_MMV_CRLC	-	0... FFH	0... 0.99609375	3.90625e-3	-
Filter constant for moving mean value calculation of the I-part					
C_N_FUEL_MASS_AD_MAX	-	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold for allowing fuel mass adaption					
C_N_FUEL_MASS_AD_MIN	-	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for allowing fuel mass adaption					
C_PV_GRD_THD_FUEL_ADD	-	0... FFH	-1250... 1240.234375	9.765625	%/s
Pedal value gradient threshold for adding fuel mass					
C_PV_THD_FUEL_ADD	-	0... FFH	0... 99.609375	0.390625	%
Pedal value threshold for adding fuel mass					
C_SEG_CTR_FUEL_MASS_AD_MAX	-	0... FFFFH	0... 65535	1	-
Number of segments with stable conditions before an adaptation occurs					
C_VFF_VCV_I_CTL_STOP_MAX	-	0... FFFFH	0... 255	3.89105e-3	l/h
Last breakpoint of the characteristic line of the VCV					
C_VFF_VCV_I_CTL_STOP_MIN	-	0... FFFFH	0... 255	3.89105e-3	l/h
First breakpoint of the characteristic line of the VCV					
ID_DLY_FUP_GRD	-	1... 5H	1 ...5	1	-
LDP_N_32_ID_DLY_FUP_GRD	8	0... FFH	0... 8160	32	rpm
Number of filtersteps for FUP_GRD calculation					
IP_FAC_CLC_FUEL_MASS_FUP	-	0... FFH	0... 510	2	hPa/mg
LDP_TFU_IP_FAC_CLC_FUEL_MASS	3	0... FEH	-48... 142.5	0.75	°C
Factor for compressibility and density of gasoline and rail					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_FUEL_MASS_REQ_D_CTL	-	0... FFH	0... 3.984375	0.015625	-
LDPM_N_32_FUSL_1	8	0... FFH	0... 8160	32	rpm
Weighting factor for the controller					
IP_FAC_FUEL_MASS_REQ_I_CTL	-	0... FFH	0... 3.984375	0.015625	-
LDPM_N_32_FUSL_1	8	0... FFH	0... 8160	32	rpm
Weighting factor for the controller					
IP_FAC_FUEL_MASS_REQ_P_CTL	-	0... FFH	0... 3.984375	0.015625	-
LDPM_N_32_FUSL_1	8	0... FFH	0... 8160	32	rpm
Weighting factor for the controller					
IP_FAC_FUEL_MASS_REQ_PCTL	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
LDP_FUP_DIF_PCTL_IP_FAC_FUEL	8	0... FFFFH	-173890 ...173884	5.3066911	hPa
Weighting factor for the precontroller					
IP_FAC_N_MASS_FUEL_REQ_PCTL	-	0... FFH	0... 9.9609375	0.0390625	-
LDP_N_32_IP_FAC_N_FUEL_REQ_PCTL	8	0... FFH	0... 8160	32	rpm
Factor for the precontroller depending on engine speed					
IP_FUEL_MASS_REQ_ADD_MFF_SP	-	0... FFH	0... 255	1	seg
LDPM_MFF_SP_FUP_CTL_2_FUSL	8	0... FFFFH	0... 1389	0.0211948	mg/stk
DT1 factor (output = input*K/T1) depending on injection fuel mass					
IP_FUEL_MASS_REQ_ADD_TQ	-	0... FFH	0... 255	1	seg
LDPM_TQ_REQ_CLU_LIM_1_FUSL	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
DT1 Factor (output = input*K/T1) depending on Torque request					
IP_FUEL_MASS_REQ_D_CTL	V	0... FFFFH	-694.5... 694.478806	0.02119-	mg
LDP_FUP_GRD_IP_FUEL_MASS_REQ	12	0... FFFFH	-869... 86942.67	2.6533608	hPa/10ms
LDP_FUP_DIF_CTL_IP_FUEL_MASS	12	0... FFFFH	-173890 ...173884	5.3066911	hPa
D-part of the controller					
IP_FUEL_MASS_REQ_I_CTL	-	0... FFFFH	-694.5... 694.478806	0.02119-	mg
LDPM_FUP_DIF_CTL_1_FUSL	8	0... FFFFH	-173890 ...173884	5.3066911	hPa
I-part of the controller					
IP_FUEL_MASS_REQ_P_CTL	-	0... FFFFH	-694.5... 694.478806	0.02119-	mg
LDPM_FUP_DIF_CTL_1_FUSL	8	0... FFFFH	-173890 ...173884	5.3066911	hPa
P-part of the controller					
IP_T1_FUEL_MASS_ADD_MFF_SP	-	0... FFH	0... 255	1	seg
LDPM_MFF_SP_FUP_CTL_2_FUSL	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Constant time (in segment) for additive fuel mass (DT1) depending on injection fuel mass					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_T1_FUEL_MASS_ADD_TQ	-	0... FFH	0... 255	1	seg
LDPM_TQ_REQ_CLU_LIM_1_FUSL	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Constant time (in segment) for additive fuel mass (DT1) depending on Torque request					
LC_AD_CLR_FUEL_MASS_AD	-	0... 1H	0 ...1	1	-
Switch for reseting the fuel mass adaptation					
LC_FUEL_MASS_REQ_CTL_CLR	-	0... 1H	0 ...1	1	-
Switch for enabling CTL/AD part reset at fast pressure decrease					
LC_USE_FUEL_MASS_REQ_CTL	-	0... 1H	0 ...1	1	-
Switch for using the controller output for the fuel mass requested calculation					
LC_VFF_VCV_I_CTL_RST	-	0... 1H	0 ...1	1	-
Enabling of I-Part controler reset if the first or last breakpoint of the characteristic line for the VCV is reached					

General information:

The control algorithm can be used for all kind of flow controlled pump. This function is the interface of the fuel pressure acquisition and the fuel pressure setpoint calculation to the fuel pump control.

It calculates basically a requested fuel mass to be delivered into the fuel rail by the HP pump. This calculation is based on the fuel pressure setpoint, measrured fuel pressure, the fuel mass flow setpoint and the feedback of the pump interface, which is the fuel mass delivered by the pump. Additionally there is the input fuel temperature, which is needed to correct the calculation of the fuel mass in the rail.

Signal flow diagram:

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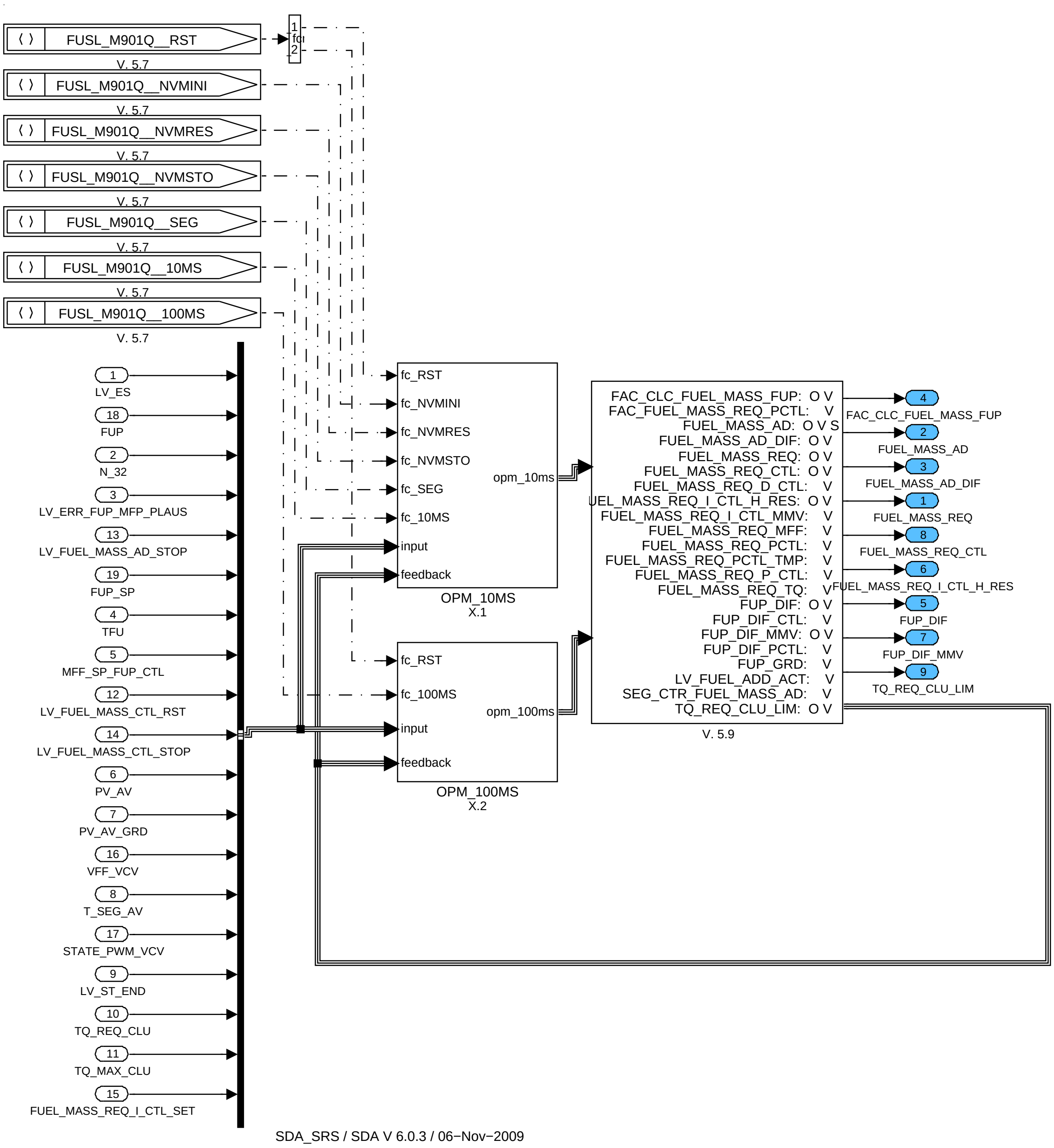

Figure 9.38.1: :

9.38.1 Function Description of 10MS

General information:

The functionality is split into several parts. First part is the precalcualtion of the fuel mass. In this module first the deviation between the fuel pressure setpoint and the measured fuel pressure is calculated. This deviation is the basis for the calculation of the requested fuel mass from the precontroller. This input will be corrected by a weighting factor and a conversion factor, which includes the density of the fuel and the compressibility of the rail and the fuel.

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To get a correct input for the mass fuel flow this will be corrected within the module mass fuel flow setpoint for fuel pressure control with the effective fuel cut off ratio.

The controller is split into the fuel mass adaptation and the actual controller. The calculated fuel mass adaptation takes as a basis the old value to the adaptive fuel mass and uses a actual calculated fuel mass adapation deviation. The adaptive fuel mass is min/max limited. The fuel mass adapation deviation is only calculated if the engine speed and the pump fuel mass is within certain limits. Another criteria is a segment counter, which allows the adaptation only after a certain amount of segments with stable conditions. The basis for the adapation is a filtered I-part of the controller.

The input of the actual controller is also a fuel pressure deviation. This time the deviation is calculated out of the measured fuel pressure fuel pressure setpoint. Out of this deviation the P part and the I part of the controller is calculated out of maps. After that calculation the P part can be reseted by certain conditions. The I part taken out of the map will be added up with the old value. This value can be 'frozen or reseted. Anyway there is limitation to min/max values. The I part and the P part are finally added up to the controller output.

With this controller output, the precalculation and the corrected mass fuel flow setpoint value the requested fuel mass is calculated.

Application conditions:

Initialisation:	`RST, NVMINI, NVMRES, NVMSTO`
Recurrence:	`SEG, 10MS`
Activation:	`SEG: LV_ES == 0 && LV_ST_END == 1 10MS: LV_ES == 0 && LV_ST_END == 0`
Deactivation:	`LV_ES == 1`

Function description:

Formula section:

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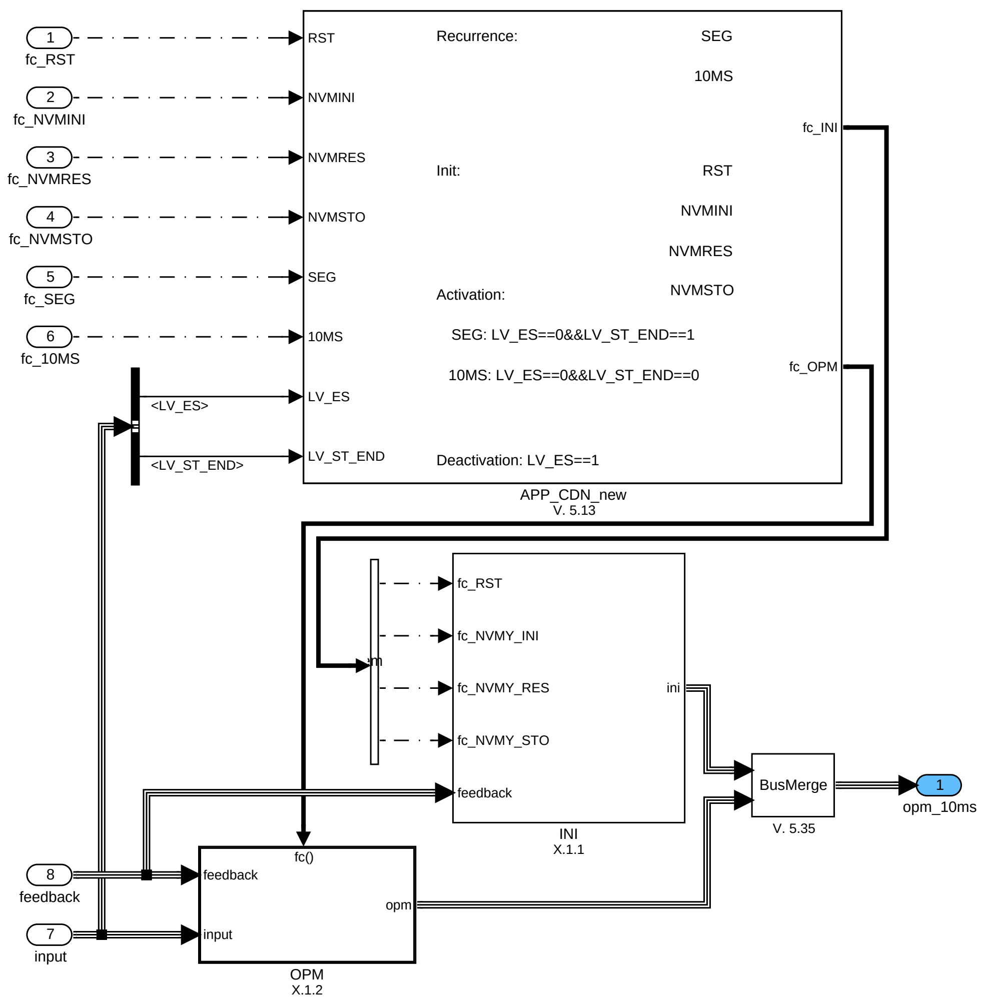

Figure 9.38.2: :

9.38.1.1 Initialisation

Initialisation at reset event & Non volatile memory management is done here.

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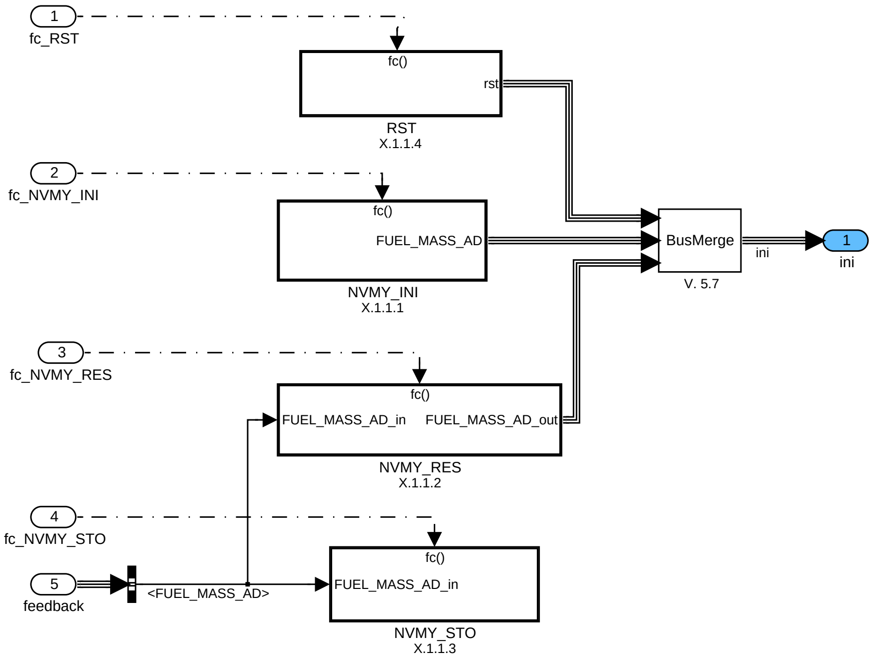

Figure 9.38.3: :

9.38.1.1.1 Initialisation at Non-Volatile memory

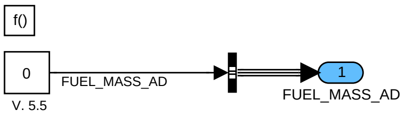

Figure 9.38.4: :

9.38.1.1.2 Restore management at Non-Volatile memory

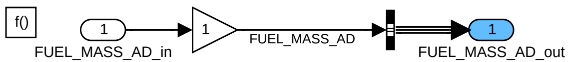

Figure 9.38.5: :

9.38.1.1.3 Store management at Non-Volatile memory

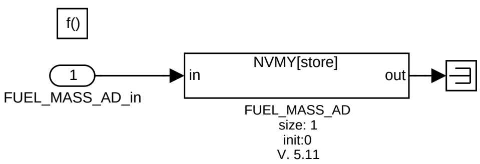

Figure 9.38.6: :

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9.38.1.1.4 Initialisaion at reset event

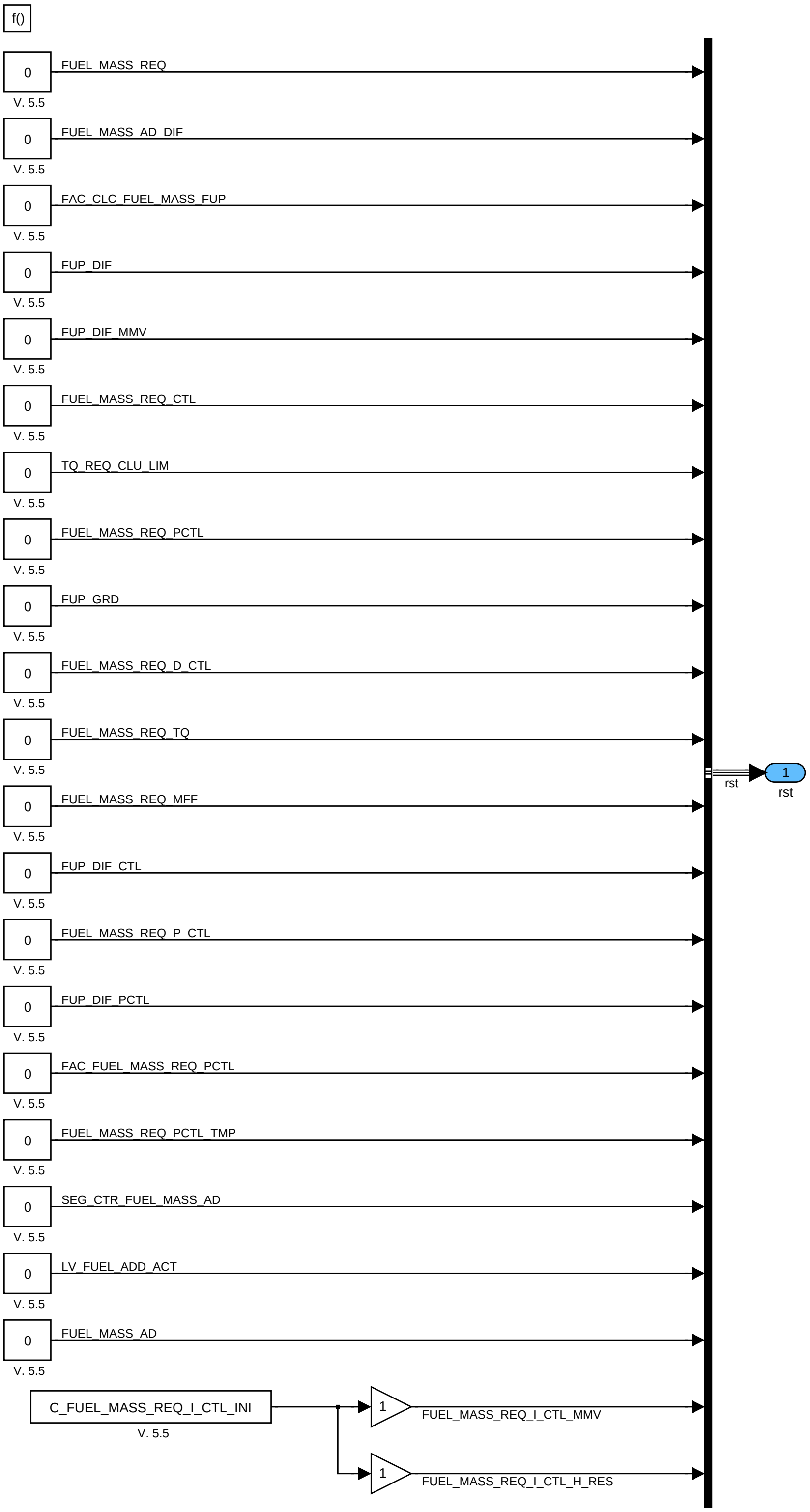

Figure 9.38.7: :

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9.38.1.2 Fuel mass & fuel pressure control

For better visibility of the function the calculation is split into 3 parts.

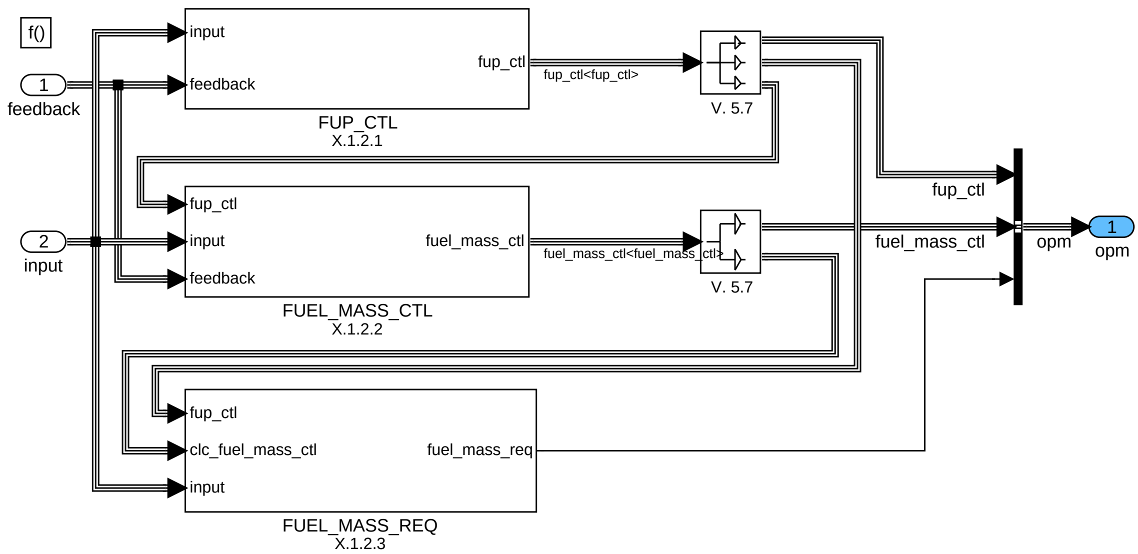

Figure 9.38.8: :

9.38.1.2.1 Calculation of Fuel pressure control

This subblock is split into three other blocks in which the precontrol, the adaptive parts and the conditions for a additive fuel mass for the precontrol are calculated

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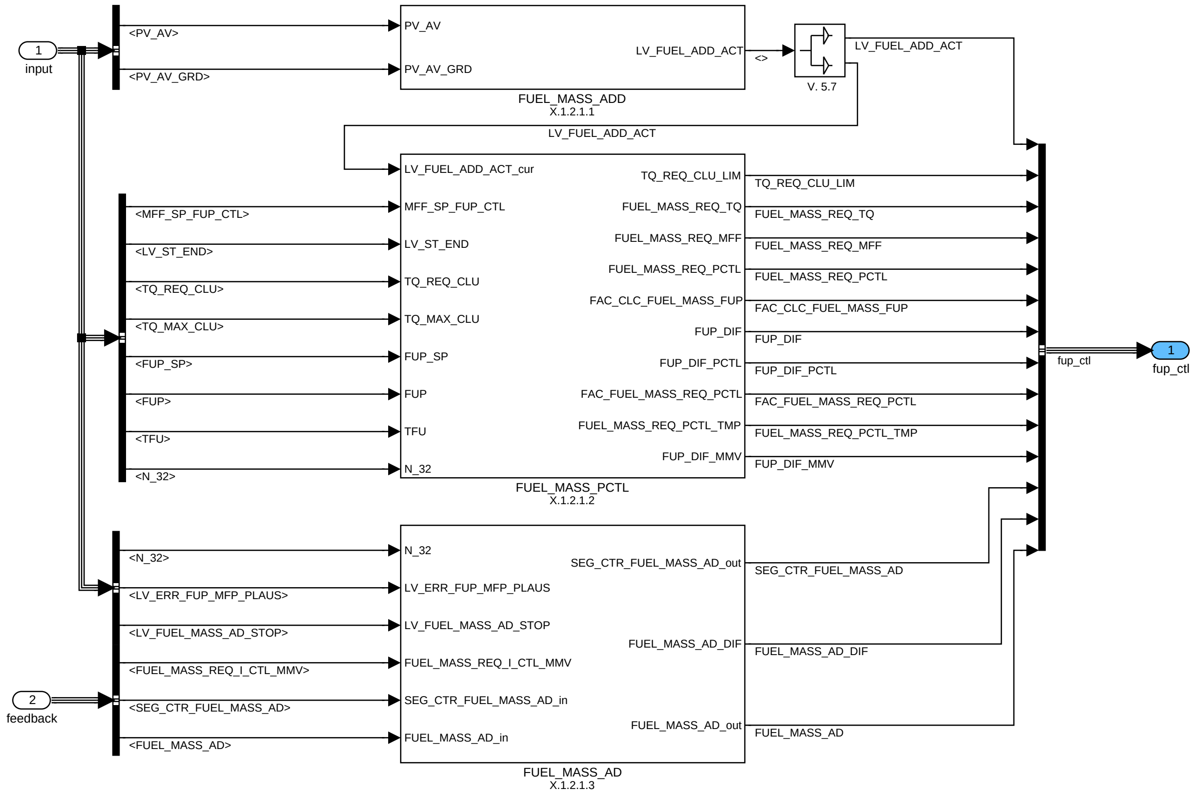

Figure 9.38.9: :

9.38.1.2.1.1 Additional fuel mass active

Depending on the pedal value and the pedal value gradient a fuel mass is added to the precontroller for a certain amount of cycles. This is indicated by a flag.

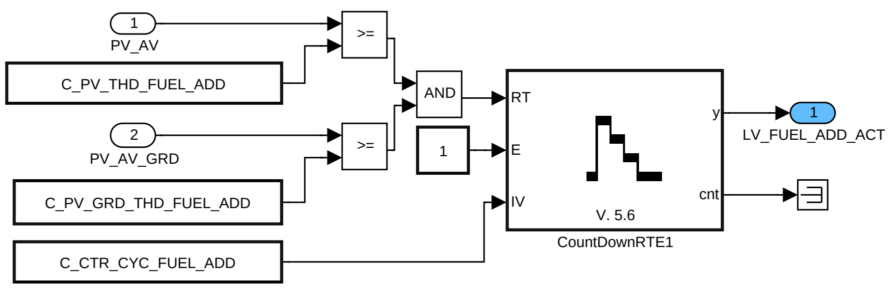

Figure 9.38.10: :

9.38.1.2.1.2 Calculation

Out of the fuel pressure deviation related to the used fuel pressure the precontrol value is calculated. This value can be modified by the weighting factor given by the map. Out of this calculated precontrol fuel pressure value a precontrol fuel mass must be chosen. This is done by the second map. Additionally to that a fuel mass can be added to the precontrol.

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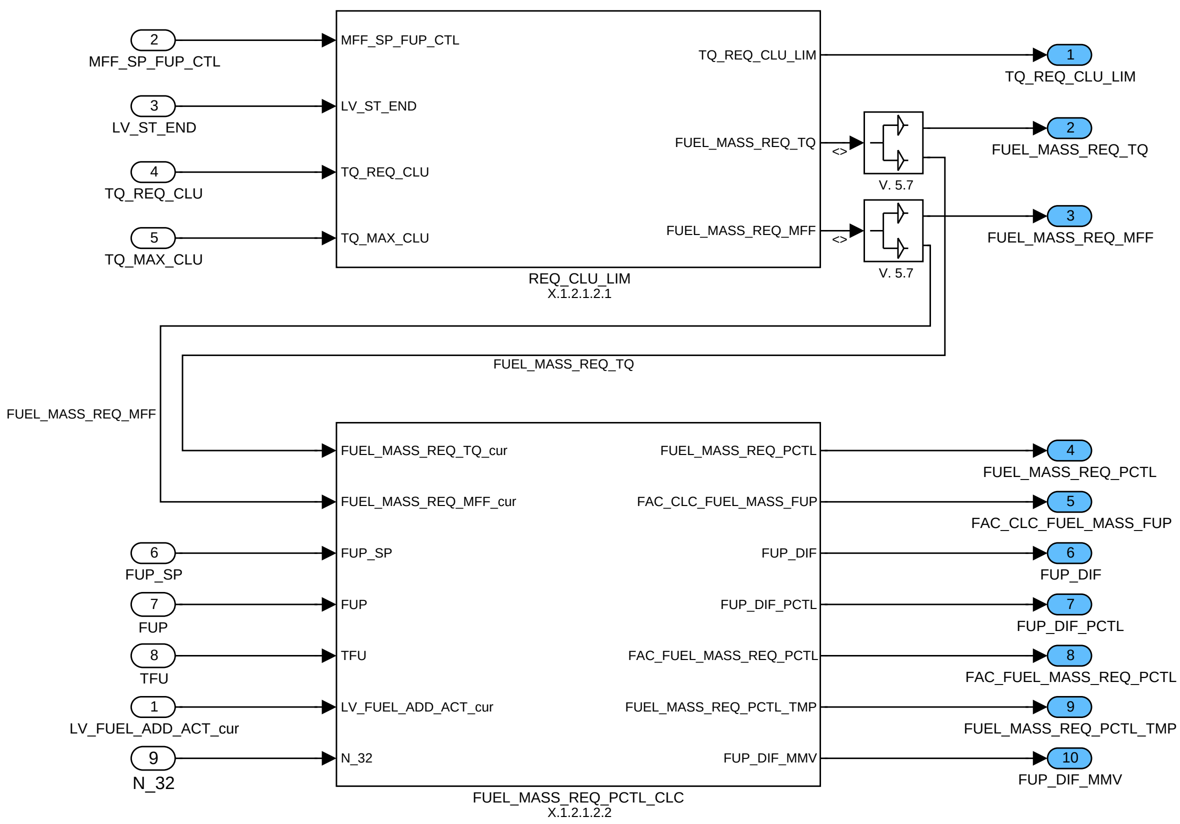

Figure 9.38.11: :

9.38.1.2.1.2.1 Calulcation of Mass fuel flow

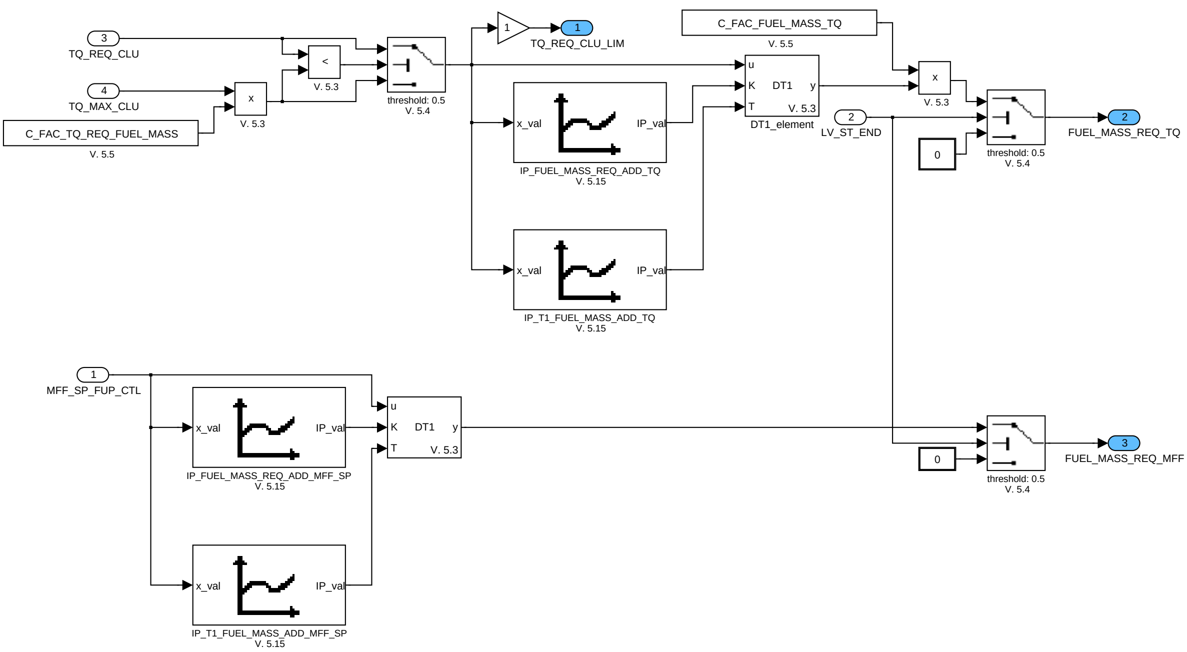

Figure 9.38.12: :

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9.38.1.2.1.2.2 Calculation of requested fuel mass from precontroller

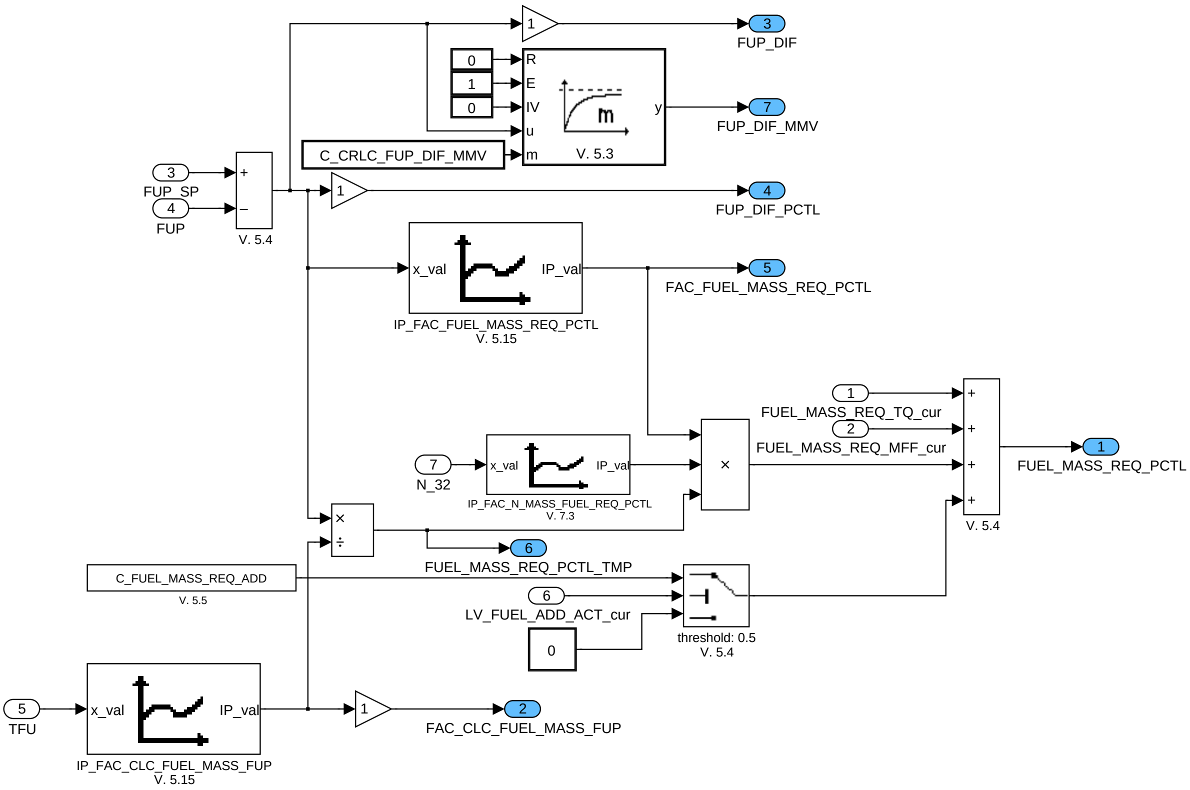

Figure 9.38.13: :

9.38.1.2.1.3 Calculation of fuel mass adaptation

The adaptation is split into two parts. One is calculated the adaptive fuel mass difference and one is responsible for the actual fuel mass determination

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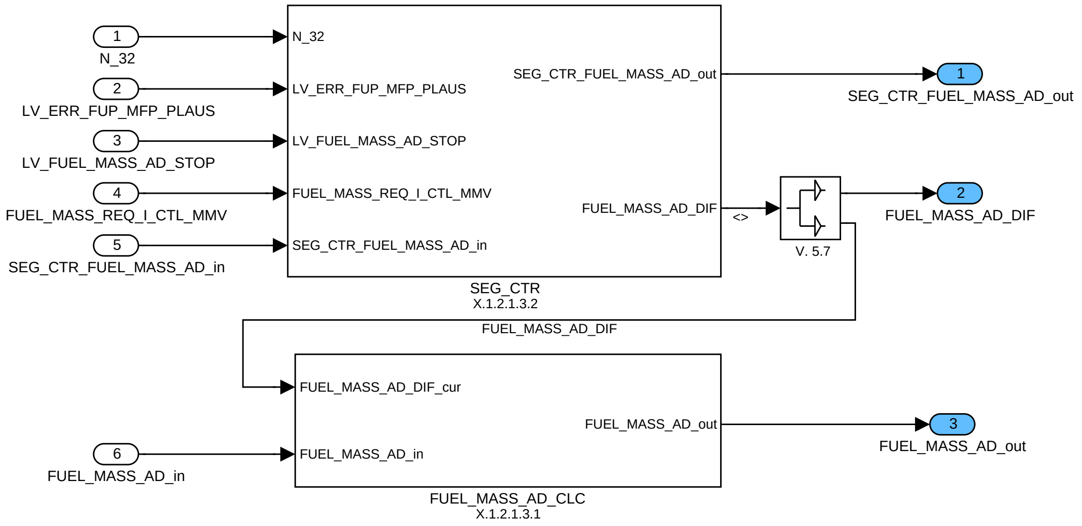

Figure 9.38.14: :

9.38.1.2.1.3.1 Calculation of adaptive fuel mass

The adapation value should not be above a maximum value and below a minimum value.

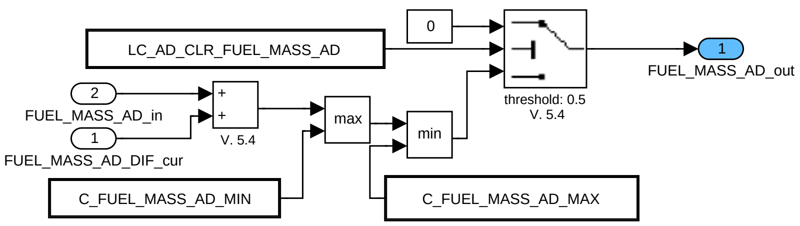

Figure 9.38.15: :

9.38.1.2.1.3.2 Calculation of adaptive fuel mass condition

In this block the adaptation condition are determined

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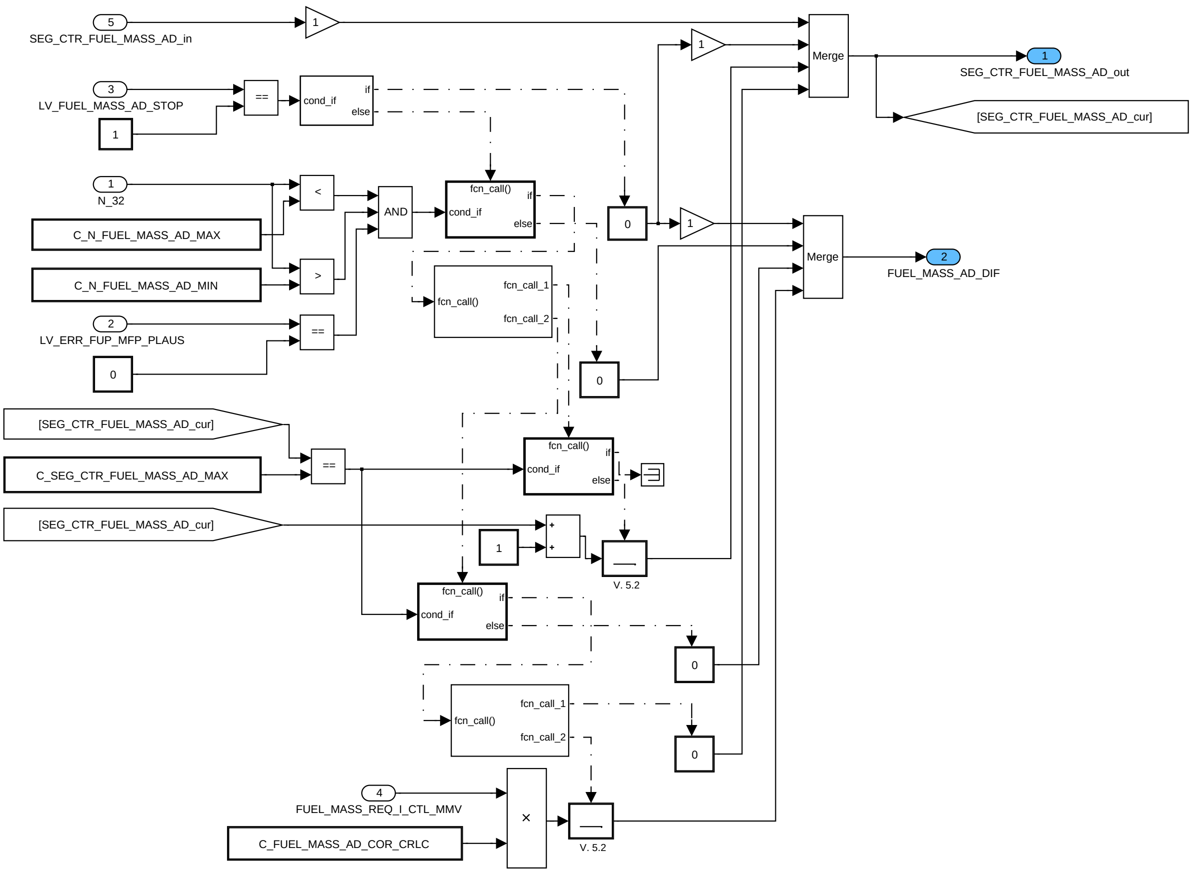

Figure 9.38.16: :

9.38.1.2.2 Fuel mass control

For a better overview the controller is split into two parts.

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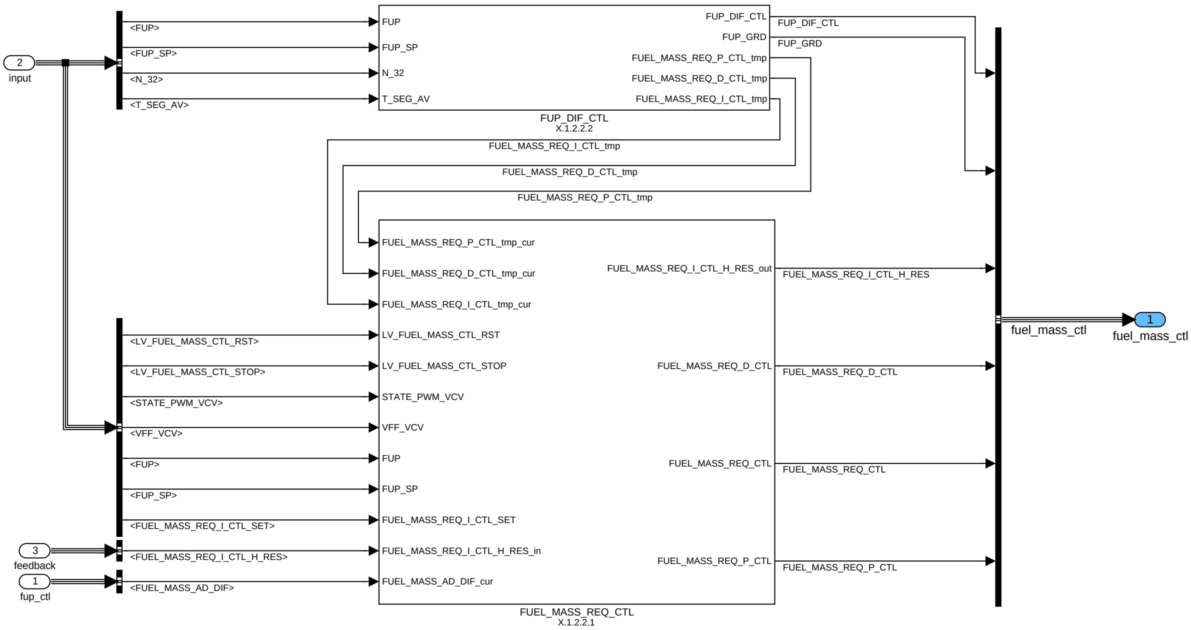

Figure 9.38.17: :

9.38.1.2.2.1 Calculation of requested fuel mass by controller

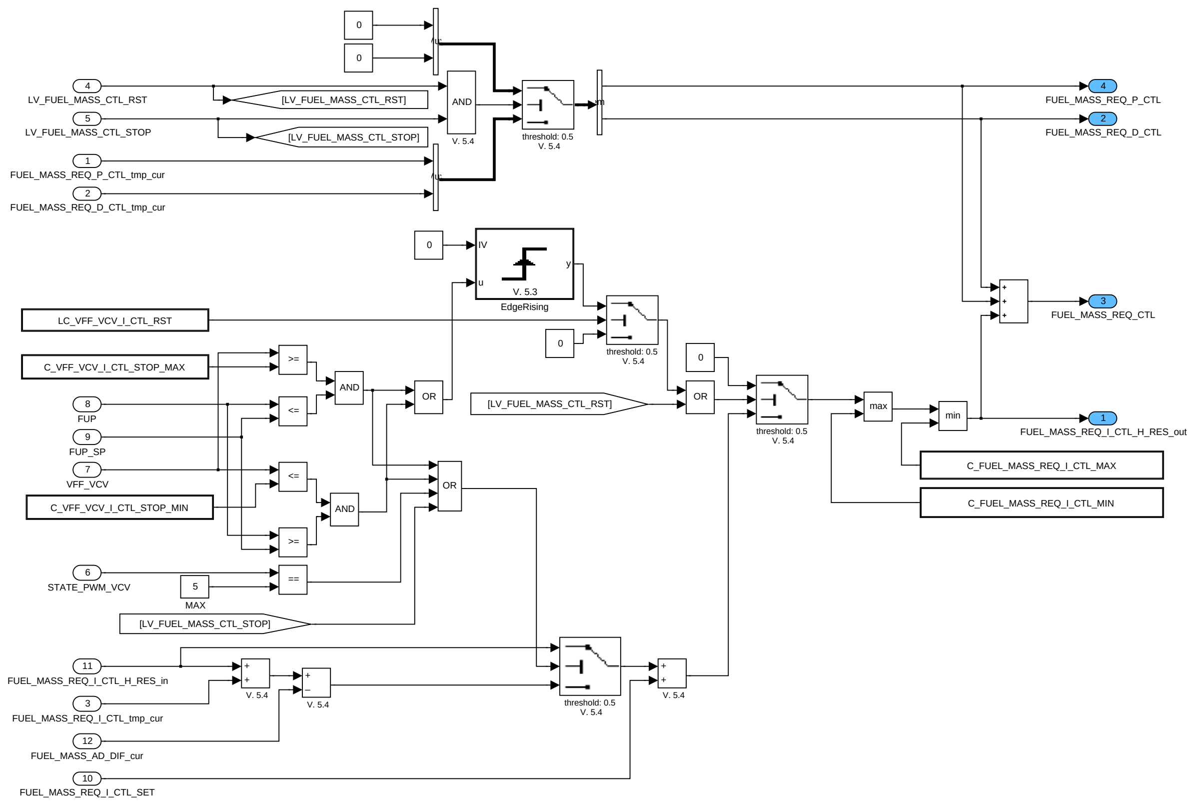

Figure 9.38.18: :

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9.38.1.2.2.2 Calculation of fuel pressure deviation

The controller values are calculated out of the fuel pressure setpoint value with a delay and the fuel pressure.

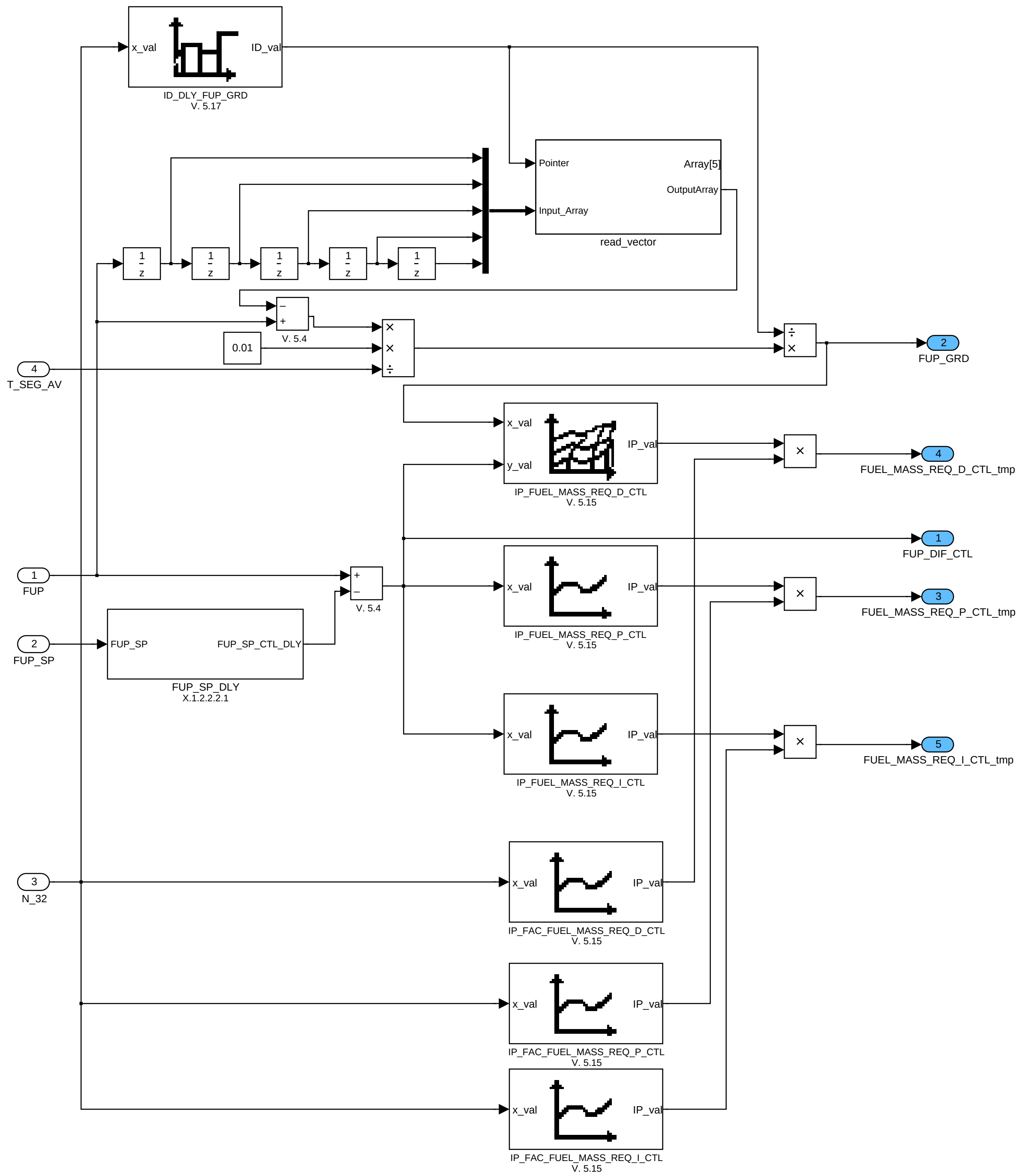

Figure 9.38.19: :

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9.38.1.2.2.2.1 Calculation of fuel pressure setpoint with delay

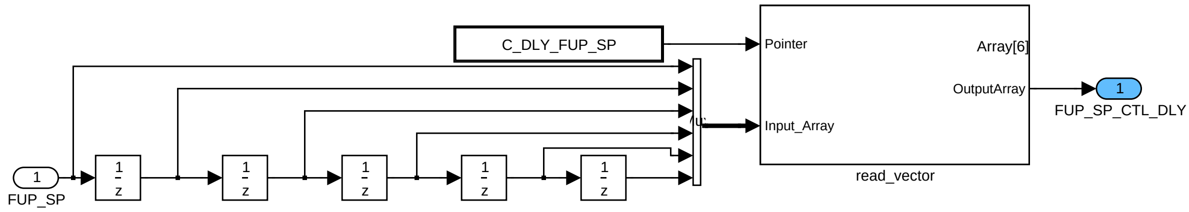

Figure 9.38.20: :

9.38.1.2.3 Calculation of fuel mass request

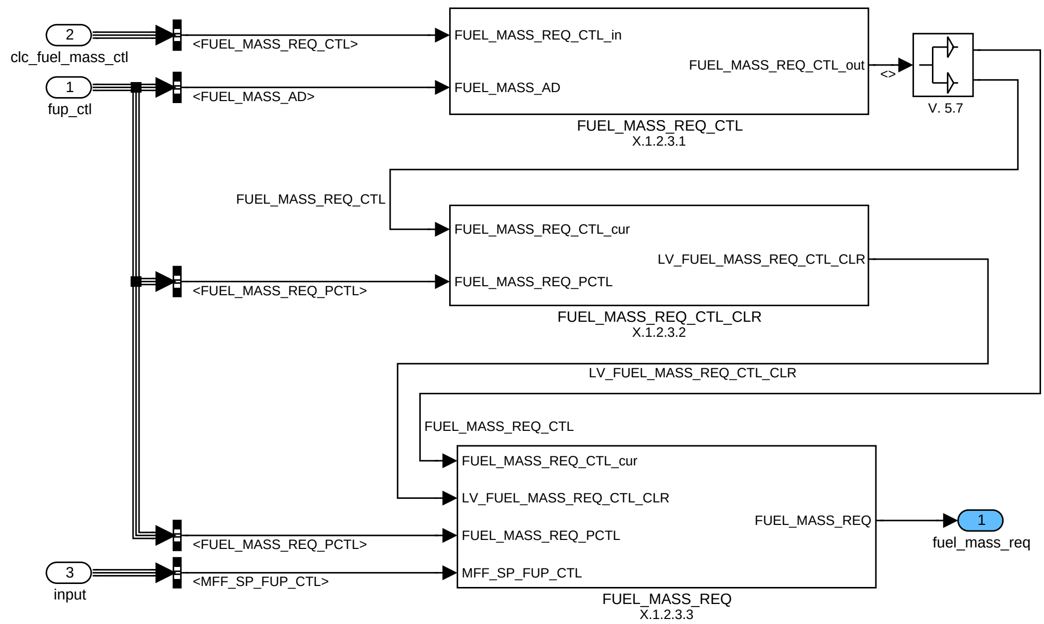

Figure 9.38.21: :

9.38.1.2.3.1 Calculation of Fuel mass request control

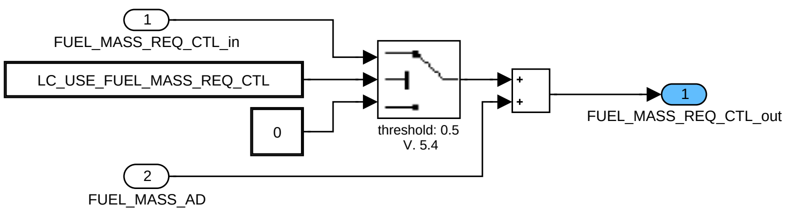

Figure 9.38.22: :

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9.38.1.2.3.2 Calculation of logical variable for reset of CTL/AD part of fast pressure

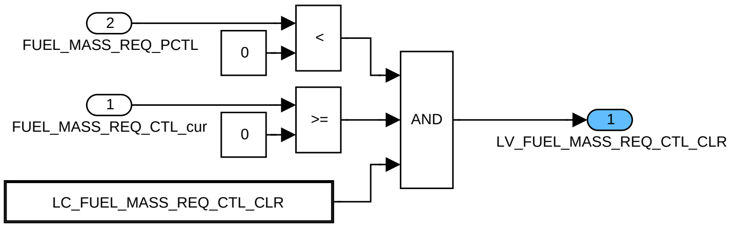

Figure 9.38.23: :

9.38.1.2.3.3 Calculation of fuel mass request

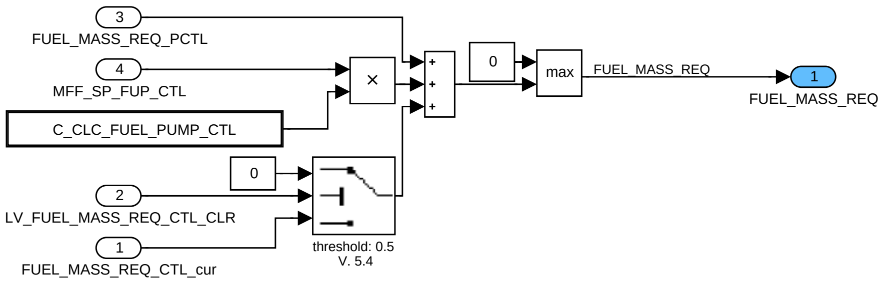

Figure 9.38.24: :

9.38.2 Function Description of 100MS

General information:

Only the module FUEL_MASS_MDL_DIF_I_MMV_CLC will be calculated every 100 ms.

Application conditions:

Initialisation:	RST
Recurrence:	100MS
Activation:	LV_ES == 0
Deactivation:	LV_ES == 1

Function description:

Formula section:

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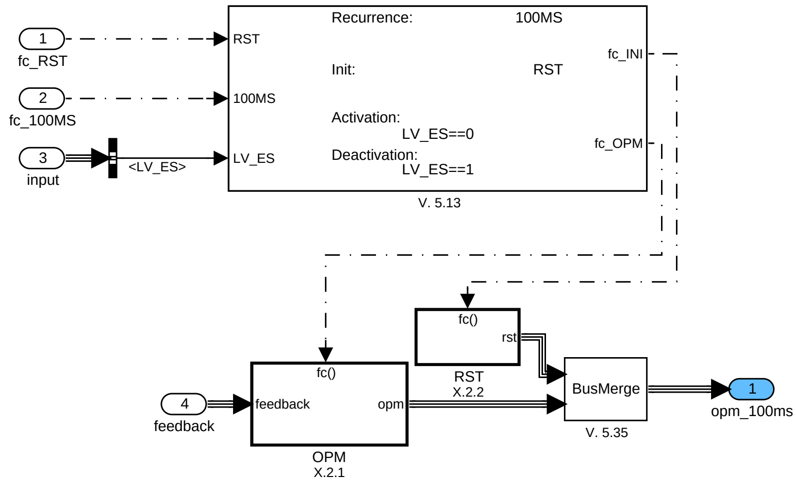

Figure 9.38.25: :

9.38.2.1 Formula Section

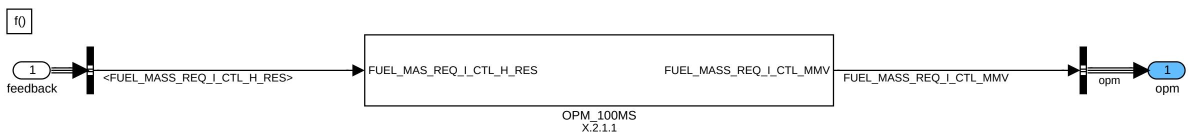

Figure 9.38.26: :

9.38.2.1.1 Moving mean value of fuel mass request control

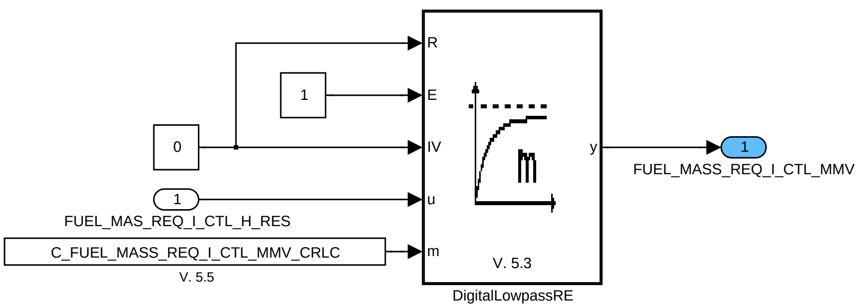

Figure 9.38.27: :

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9.38.2.2 Initialisation at reset event

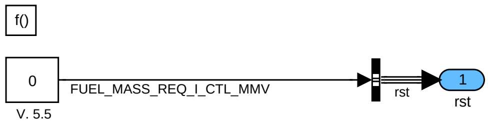

Figure 9.38.28: :

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9.39 Fuel pressure control (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FUP_DIF_DLY	V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Deviation of FUP_SP and FUP with the delay of FUP_SP					
FUP_REQ_FPA	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Required fuel pressure from the FPA					
FUP_REQ_FPA_I	O/V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
I-part of FUP_REQ_FPA					
FUP_REQ_FPA_I_TMP	V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Temporary I-part of FUP_REQ_FPA					
FUP_REQ_FPA_P	V	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
P-part of FUP_REQ_FPA					
FUP_REQ_FPA_PCTL	V	0... FFFFH	0... 347776	5.3067216	hPa
Requested fuel pressure by the precontrol					
FUP_SP_FIL	V	0... FFFFH	0... 347776	5.3067216	hPa
Filtered fuel pressure setpoint					
LV_DLY_FPA_CLL_REQ	V	0... 1H	0 ...1	1	-
Logical variable for closed-loop control request to avoid overheating					
LV_FUP_DIF_FUP_REQ_FPA_RST_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable indicating that the setting of the pressure I-part of the controller in intervention mode is active					
LV_FUP_REQ_FPA_AD_INH	V	0... 1H	0 ...1	1	-
Logical variable requesting inhibition of the adaptation of the controller					
LV_FUP_REQ_FPA_RST_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable indicating resetting of the I-part of the pressure controler					
STATE_FUP	O/V	0H 1H 2H 3H 4H 5H	LOW_ PRESSURE_ STATE FAST_ PRESSURE_ INCREASE PRESSURE_ CONTROL OVER_ PRESSURE OPEN_LOOP EMERGENCY	-	-
State of the fuel pressure controller					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_FUP_TRAN	V	0H 1H 2H 3H 4H 5H 6H 7H 8H	EMERGENCY LP LP_FPLN FPLN_PCTL OPL PCTL_OVP OVP_PCTL OPL_PCTL PCTL_FPLN	-	-
Transistion conditions for the state of the fuel pressure controller					
T_DLY_ERR_FUP	V	0... FFFFH	0... 655.35	0.01	s
Delay time for a fuel pressure error to start controller invention					
T_DLY_FPA_CLL_REQ	V	0... FFFFH	0... 655.35	0.01	s
Delay time for closed loop control to avoid overheating					
T_DLY_FPA_PROT	V	0... FFFFH	0... 655.35	0.01	s
Delay time for protection of the component					
T_DLY_FUP_MAX	V	0... FFFFH	0... 655.35	0.01	s
Delay time for the maximum fuel pressure to start controller invention					
T_FUP_VCV_MOVE_ACT	V	0... FFFFH	0... 655.35	0.01	s
Time for activation of VCV shake function at sticking VCV					
T_FUP_VCV_MOVE_DET	V	0... FFFFH	0... 655.35	0.01	s
Time for detection of sticking VCV at shake function					
T_FUP_VCV_MOVE_READY	V	0... FFFFH	0... 655.35	0.01	s
Time between detection and activation of shake function at sticking VCV					

Input data:

FUP {p. 1283}	FUP_DIF {p. 3909}	FUP_DIF_FUP_REQ_FPA_RST {p. 3880}	FUP_SP {p. 3868}
LV_ERR_CRASH_SIG {p. 801}	LV_ERR_EFP {p. 4721}	LV_ERR_FPA {p. 801}	LV_ERR_FUP {p. 4717}
LV_ERR_TCO {p. 4496}	LV_ERR_VB {p. 802}	LV_ES {p. 1720}	LV_FIRST_VLD_TOOTH {p. 1505}
LV_FUP_DIF_FUP_REQ_FPA_RST {p. 3880}	LV_FUP_REQ_FPA_RST {p. 3880}	LV_FUP_REQ_FPA_STOP {p. 3881}	LV_IGK {p. 906}
LV_RLY_ST {p. 3844}	LV_ST_H_PRS {p. 8242}	N_32 {p. 1525}	STATE_ERR_IV {p. 4803}
STATE_PWM_VCV {p. 3955}	STATE_VFF_VCV_MIN {p. 3955}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_FUP_SP_PCTL	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Factor for fuel pressure setpoint change influence to the feed forward controller					
C_FUP_DIF_VCV_MOVE_MIN	-	0... FFFFH	0... 347776	5.3067216	hPa
Threshold for difference between FUP and FUP_SP for the VCV shake function					
C_FUP_MAX	-	0... FFFFH	0... 347776	5.3067216	hPa
Maximum fuel pressure without controller intervention					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_OFS_CTL	-	0... FFFFH	0... 347776	5.3067216	hPa
Offset to the fuel pressure setpoint for controller strategy switch					
C_FUP_OFS_ST	-	0... FFFFH	0... 347776	5.3067216	hPa
Offset to the fuel pressure setpoint for controller strategy switch out of start					
C_FUP_REQ_FPA_I_MAX	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Maximum value for integral part of FUP_REQ_FPA					
C_FUP_REQ_FPA_I_MIN	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Minimum value for integral part of FUP_REQ_FPA					
C_FUP_REQ_FPA_I_VCV_MOVE_MIN	-	0... FFFFH	0... 347776	5.3067216	hPa
Threshold for I-part of the pressure controller for the VCV shake function					
C_FUP_REQ_FPA_INI	-	0... FFFFH	0... 347776	5.3067216	hPa
Initial value for FUP_REQ_FPA					
C_FUP_REQ_FPA_MAX	-	0... FFFFH	0... 347776	5.3067216	hPa
Maximum value for FUP_REQ_FPA					
C_FUP_REQ_FPA_MIN	-	0... FFFFH	0... 347776	5.3067216	hPa
Minimum value for FUP_REQ_FPA					
C_FUP_REQ_FPA_VCV_MOVE_MAX	-	0... FFFFH	0... 347776	5.3067216	hPa
Maximum FUP_REQ_FPA value for shake function					
C_FUP_SP_CRLC	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for the FUP_SP for the PI-control					
C_FUP_SP_PCTL_CRLC	-	0... FFH	0... 0.99609375	3.90625e-3	-
FUP_SP correlation constant for the precontrol of FPA_REQ_FPA					
C_FUP_VCV_MOVE_MIN	-	0... FFFFH	0... 347776	5.3067216	hPa
Threshold for comparison of FUP and FUP_old for the VCV shake function					
C_FUP_VCV_MOVE_OFS	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Offset for FUP for the shake function in case of sticking VCV					
C_N_32_FPA	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for leaving low pressure state					
C_T_DLY_ERR_FUP	-	0... FFFFH	0... 655.35	0.01	s
Delay time for a fuel pressure error to start controller invention					
C_T_DLY_FPA_CLL_REQ	-	0... FFFFH	0... 655.35	0.01	s
Delay time for closed loop control to avoid overheating					
C_T_DLY_FPA_PROT	-	0... FFFFH	0... 655.35	0.01	s
Delay time for protection of the component					
C_T_DLY_FUP_MAX	-	0... FFFFH	0... 655.35	0.01	s
Delay time for the maximum fuel pressure to start controller invention					
C_T_FUP_VCV_MOVE_ACT	-	0... FFFFH	0... 655.35	0.01	s
Time for activation of VCV shake function at sticking VCV					
C_T_FUP_VCV_MOVE_DET	-	0... FFFFH	0... 655.35	0.01	s
Time for detection of sticking VCV at shake function					

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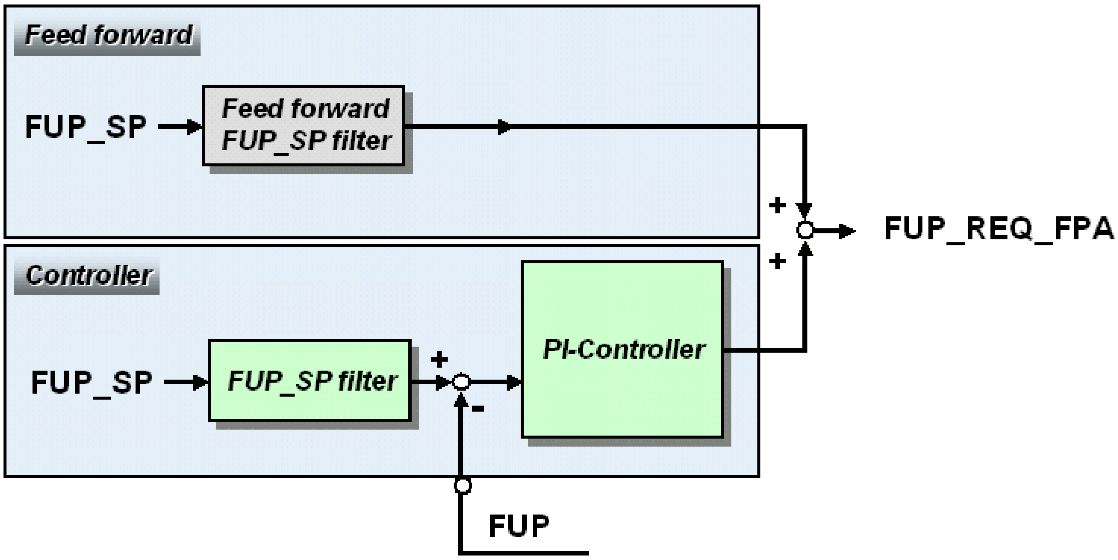
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_FUP_VCV_MOVE_READY	-	0... FFFFH	0... 655.35	0.01	s
Time between detection and activation of shake function at sticking VCV					
IP_FUP_REQ_FPA_I	-	0... FFFFH	-173890 ...173884	5.3066911	hPa
LDPM_FUP_DIF_DLY_FUSL_1	8	0... FFFFH	-173890 ...173884	5.3066911	hPa
Integral parameter of FUP_REQ_FPA					
IP_FUP_REQ_FPA_P	-	0... FFFFH	-173890 ...173884	5.3066911	hPa
LDPM_FUP_DIF_DLY_FUSL_1	8	0... FFFFH	-173890 ...173884	5.3066911	hPa
Proportional parameter of FUP_REQ_FPA					

General Information

Application hint: NC_CLC_FUEL_PUMP_CTL = 1 for inlet controlled multi piston pump

The fuel pressure control (Appl. Inc.) provides a fuel pressure demand for the regulator. It is depending on fuel pressure setpoint and the fuel pressure. The structure is constiting out of a feed forward and a controller part.



Application Conditions

Initialization: RST
Recurrence: 10MS
Activation: 1
Deactivation: 0

Function description

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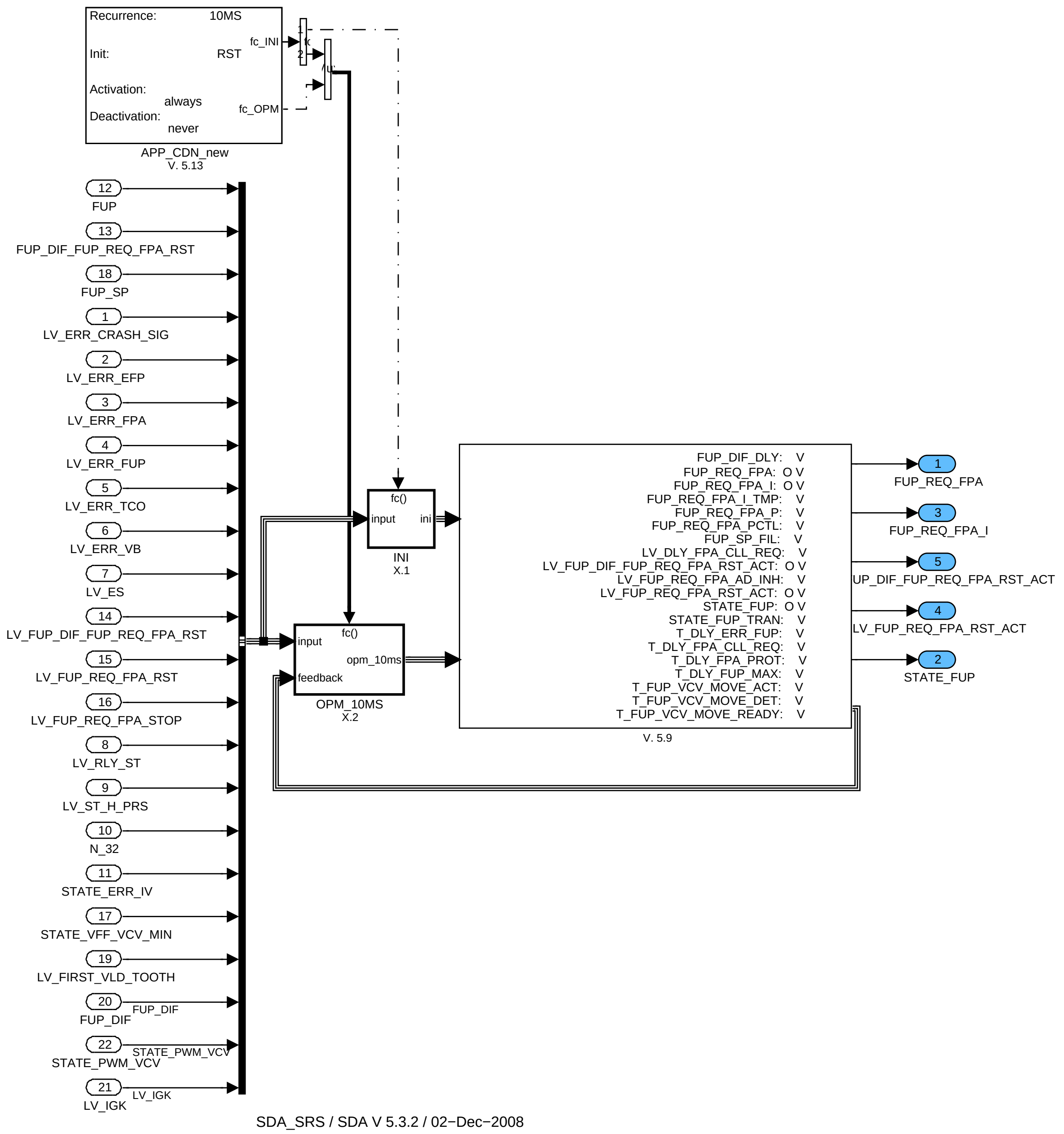

Figure 9.39.1: : Path: FUSL_M903W

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9.39.1 INITILISATION of Variables at Reset

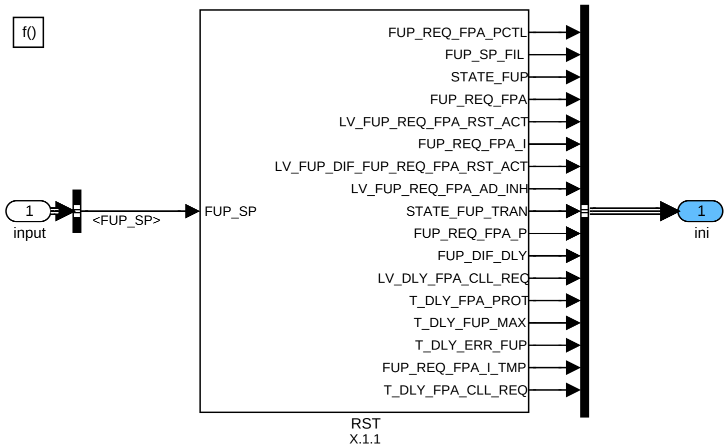

Figure 9.39.2: : Path: FUSL_M903W/INI

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9.39.1.1 Initilisation

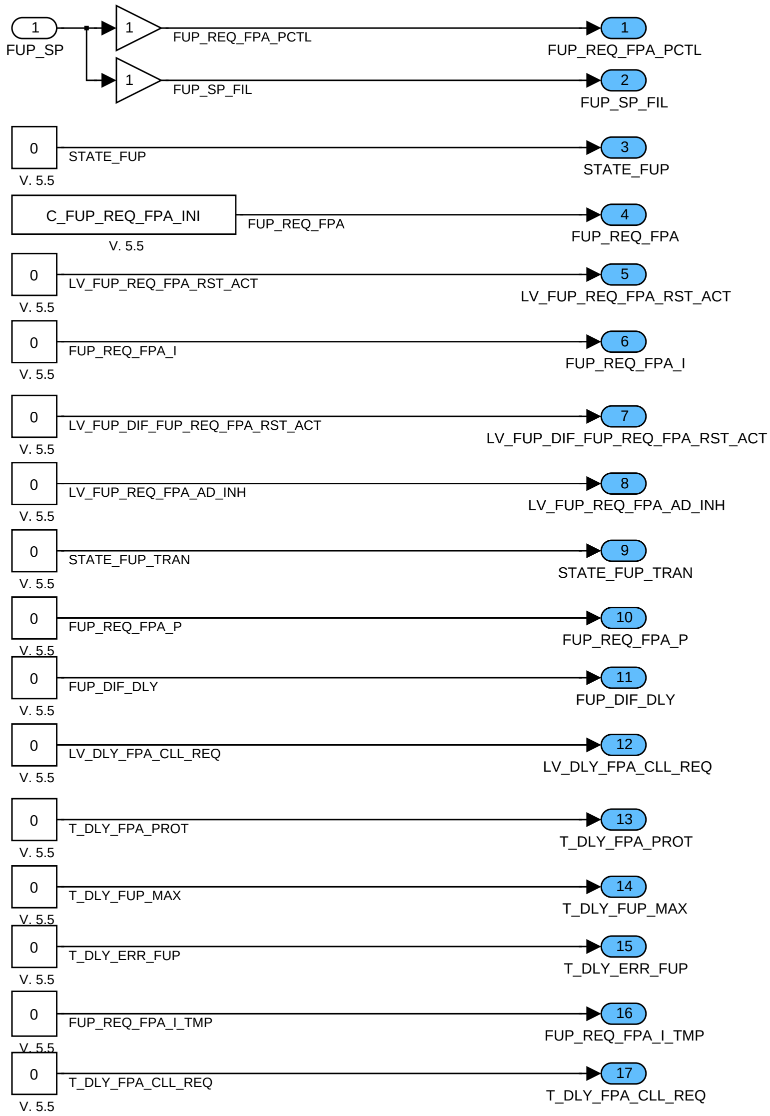

Figure 9.39.3: : Path: FUSL_M903W/INI/RST

9.39.2 Formula Section

The functionality is consiting mainly out of transistion calculation part and a controller part.

The transistion are calculated out of several external inputs and the controller is taken into account this external influences.

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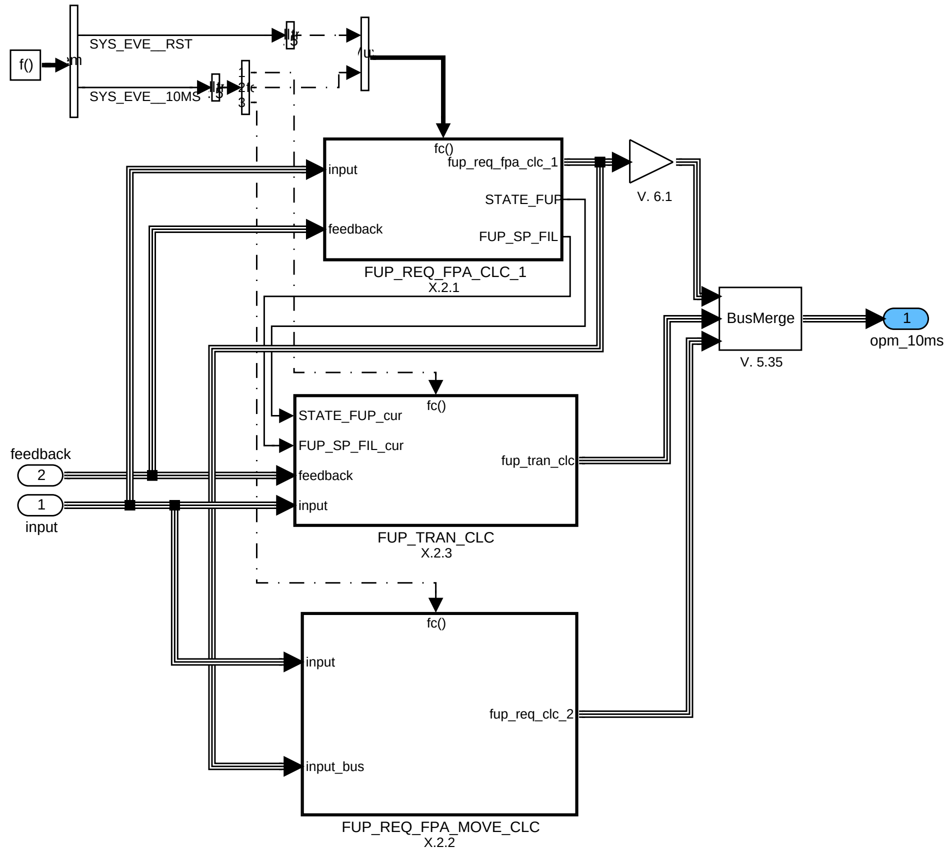

Figure 9.39.4: : Path: FUSL_M903W/OPM_10MS

9.39.2.1 Calculation

Out of the result of the state diagram a certain PWM is calculated within that subblocks.

The state diagram is corresponding to the different states of the controller. All the transition conditions are defined in the application incidence of fuel pressure control.

In Low pressure state the FPAPWM signal has minimum value. Also all the initialization is done in this state. Then in order to reach the fuel pressure setpoint the transition is done to Fast pressure increase . In this state the regulator has its maximum FPAPWM value in order to ensure the maximum pressure increase. In the state Pressure control the feed forward controller and the PIcontroller are active. The state Overpressure is selected when the pressure in the rail is too high. Here the FPAPWM signal has minimum value. In the state Limp home the control loop is opened and only the feed forward controller is active.

When a low pressure start is required the controller starts in Low pressure state until STATE_FUP_ TRAN = 2. This variable is defined in application incidences. After the start phase the fuel pressure should reach the setpoint in state Fast pressure increase . After fulfilling STATE_FUP_TRAN = 3 (setpoint is reached) the state Pressure control will be entered.

In case of a high pressure start the controller remains in Low pressure state until STATE_FUP_TRAN = 2 (starter relay is activated). This is done for security reasons in order to protect the regulator for overheating. In state Fast pressure increase the fasted pressure increase is performed. After fulfilling STATE_FUP_TRAN = 3 (setpoint is reached) the state Pressure control will be activated.

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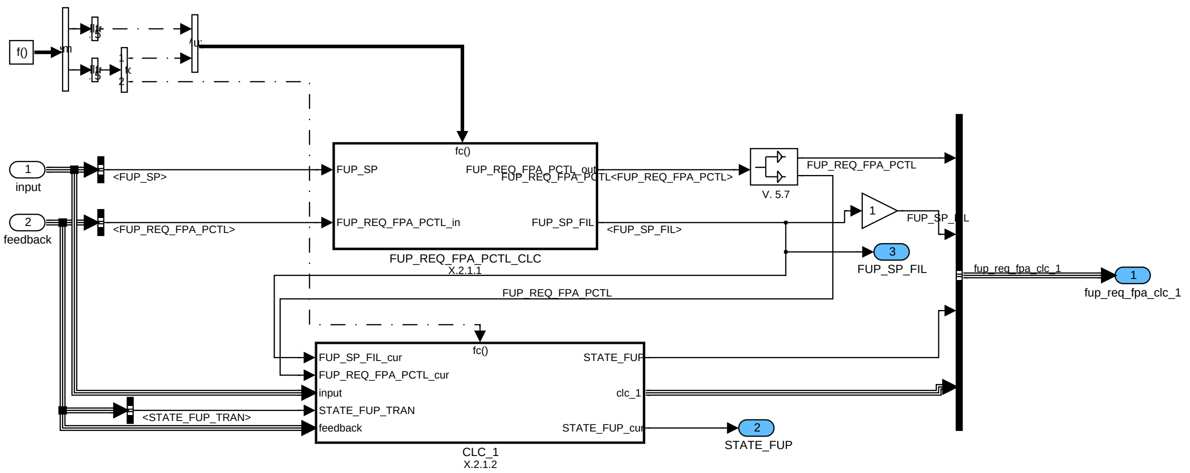

Figure 9.39.5: : Path: FUSL_M903W/OPM_10MS/FUP_REQ_FPA_CLC_1

9.39.2.1.1 FUSL_M903W/OPM_10MS/FUP_REQ_FPA_CLC_1/CLC_1

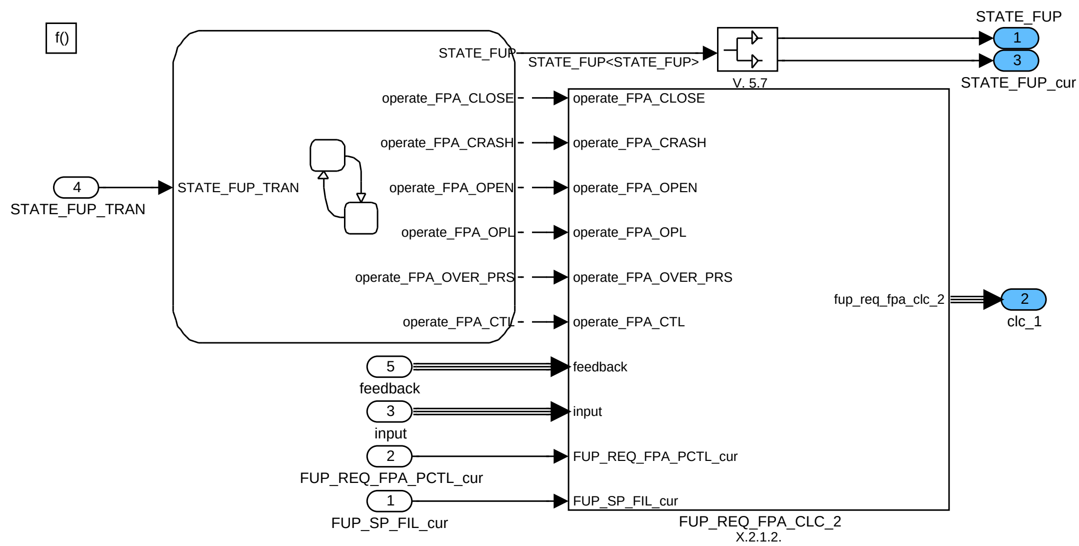

Figure 9.39.6: : Path: FUSL_M903W/OPM_10MS/FUP_REQ_FPA_CLC_1/CLC_1

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9.39.2.1.1.1 Chart

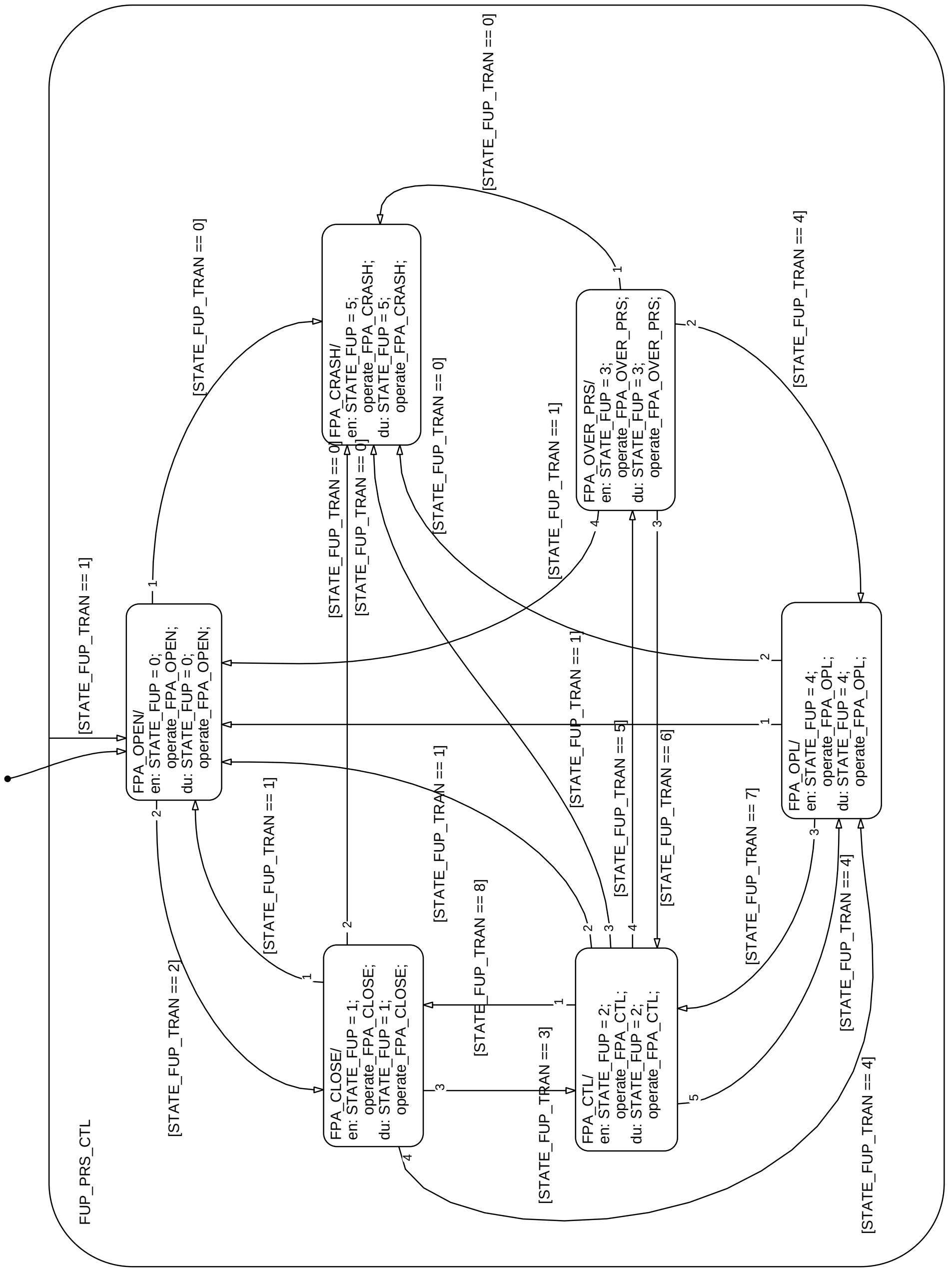

Figure 9.39.7: : Path: FUSL_M903W/OPM_10MS/FUP_REQ_FPA_CLC_1/CLC_1/Chart

9.39.2.1.1.2 Calculation of Variables based on State Variables

Within that blocks the different signals are calculated depending on the state of the state diagram

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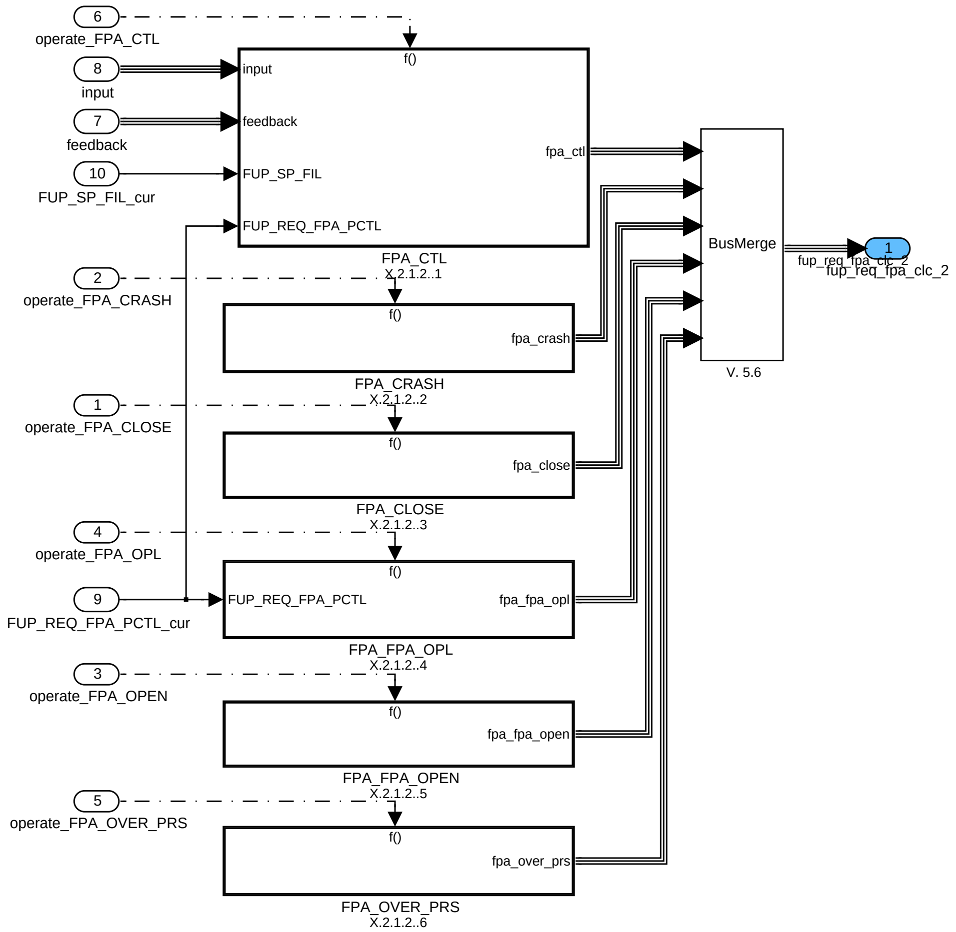

Figure 9.39.8: : Path:
FUSL_M903W/OPM_10MS/FUP_REQ_FPA_CLC_1/CLC_1/FUP_REQ_FPA_CLC_2

9.39.2.1.1.2.1 Calculation at FPA_CLOSE

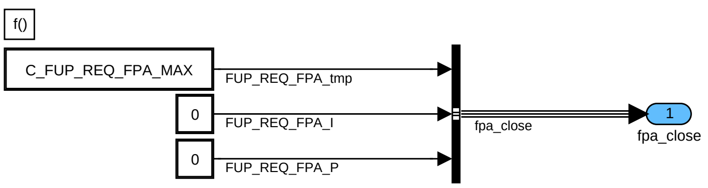

Figure 9.39.9: : Path:
FUSL_M903W/OPM_10MS/FUP_REQ_FPA_CLC_1/CLC_1/FUP_REQ_FPA_CLC_2/FPA_CLOSE

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9.39.2.1.1.2.2 Calculation at FUP_CRASH

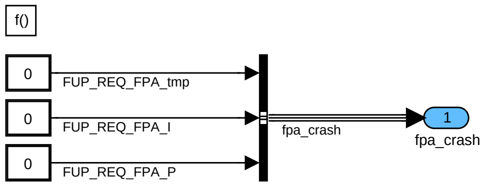

Figure 9.39.10: : Path: FUSL_M903W/OPM_10MS/FUP_REQ_FPA_CLC_1/CLC_1/FUP_REQ_FPA_CLC_2/FPA_CRASH

9.39.2.1.1.2.3 Calculation

Withing that two blocks the adaptation and the fuel pressure request for the FPA are calculated.

The calculation of the I and Ppart is done with the help of the fuel pressure deviation and two maps. The Ipart is not allowed to be outside of certain limits. Out of the precontrol, Ipart and Ppart the final fuel pressure demand for the high pressure pump control is generated.

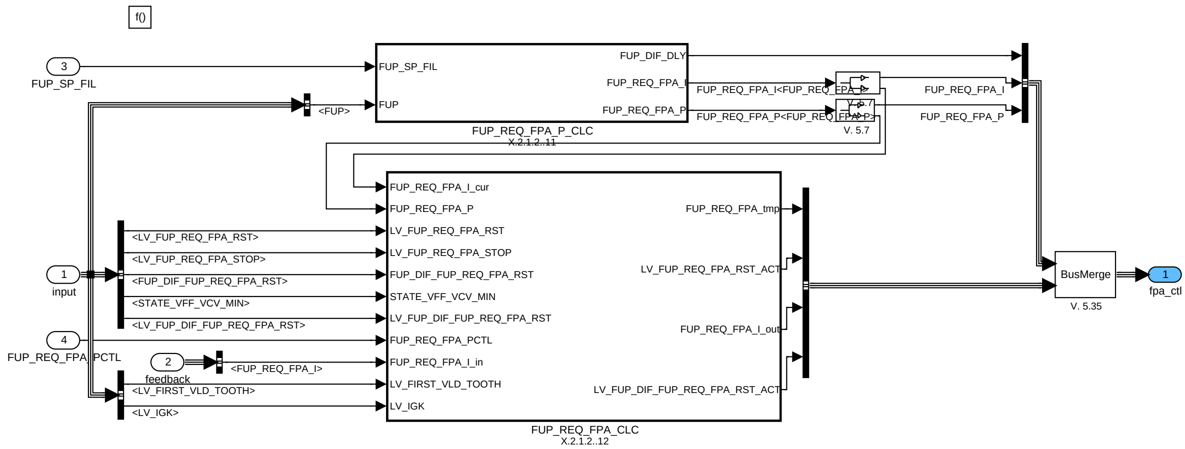

Figure 9.39.11: : Path: FUSL_M903W/OPM_10MS/FUP_REQ_FPA_CLC_1/CLC_1/FUP_REQ_FPA_CLC_2/FPA_CTL

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9.39.2.1.1.2.3.1 Calculation of FUP and LV variables

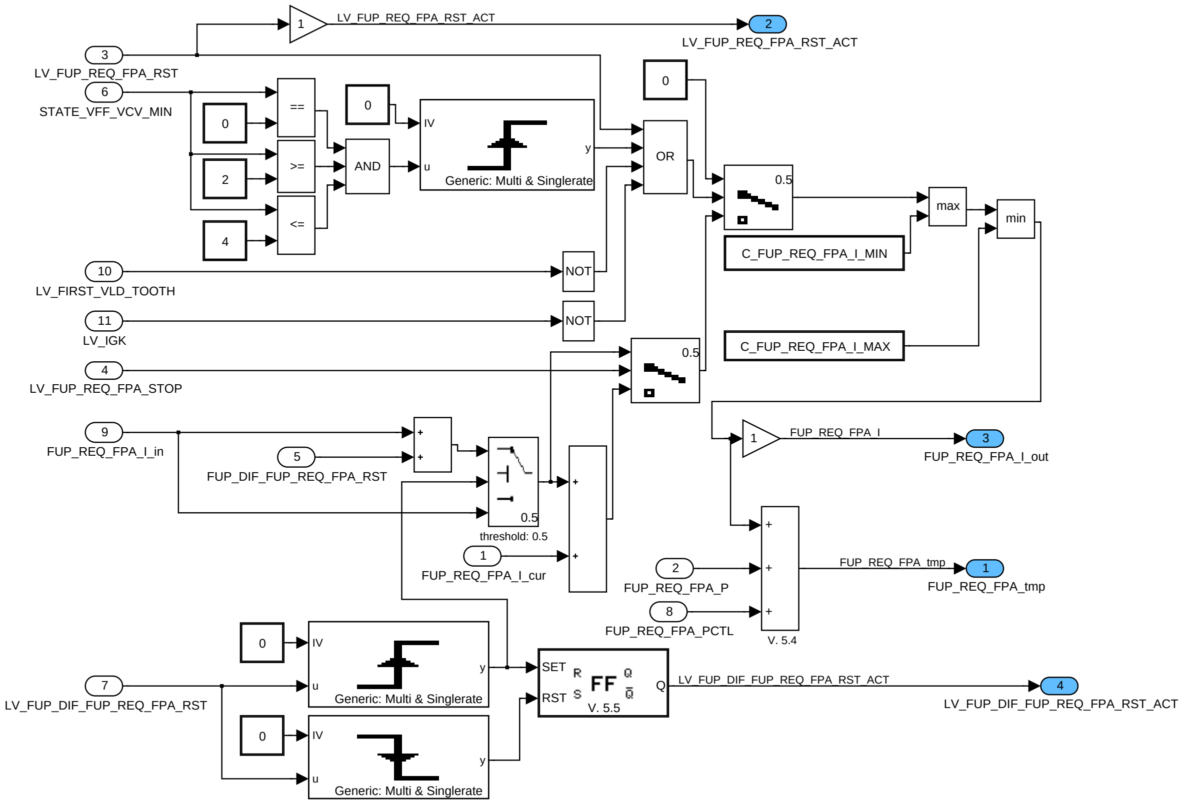

Figure 9.39.12: : Path: FUSL_M903W/OPM_10MS/FUP_REQ_FPA_CLC_1/CLC_1/
FUP_REQ_FPA_CLC_2/FPA_CTL/FUP_REQ_FPA_CLC

9.39.2.1.1.2.3.2 Calculation of FUP variables

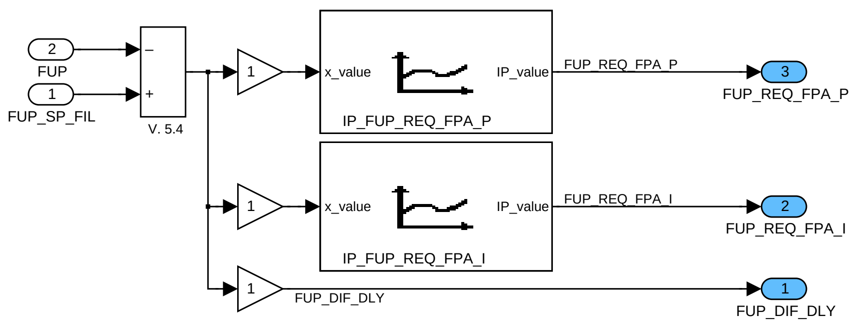

Figure 9.39.13: : Path: FUSL_M903W/OPM_10MS/FUP_REQ_FPA_CLC_1/CLC_1/
FUP_REQ_FPA_CLC_2/FPA_CTL/FUP_REQ_FPA_P_CLC

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9.39.2.1.1.2.4 Calculation at FPA_FPA_OPEN

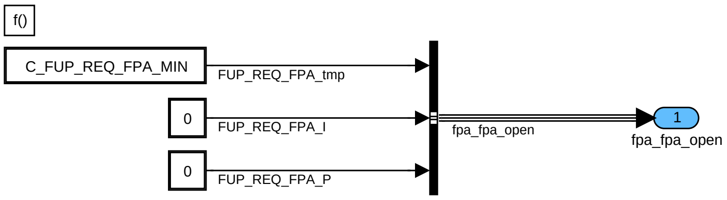

Figure 9.39.14: : Path: FUSL_M903W/OPM_10MS/FUP_REQ_FPA_CLC_1/CLC_1/FUP_REQ_FPA_CLC_2/FPA_FPA_OPEN

9.39.2.1.1.2.5 Calculation at FPA_FPA_OPL

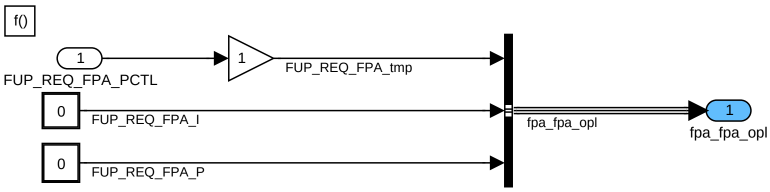

Figure 9.39.15: : Path: FUSL_M903W/OPM_10MS/FUP_REQ_FPA_CLC_1/CLC_1/FUP_REQ_FPA_CLC_2/FPA_FPA_OPL

9.39.2.1.1.2.6 Calculation at FPA_OVER_PRS

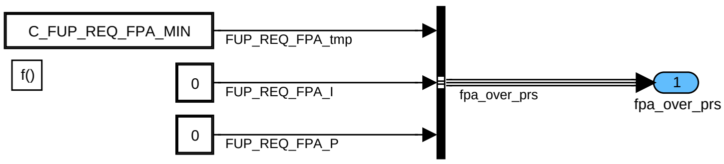

Figure 9.39.16: : Path: FUSL_M903W/OPM_10MS/FUP_REQ_FPA_CLC_1/CLC_1/FUP_REQ_FPA_CLC_2/FPA_OVER_PRS

9.39.2.1.2 Set point calculation

Within this subblock the filtered fuel pressure setpoint and the precontroller is calculated.

The aim of the precontroller is to prevent overshoots or undershoots of the fuel pressure at big fuel pressure setpoint slopes. This whole block is basically representing a PPT1block.

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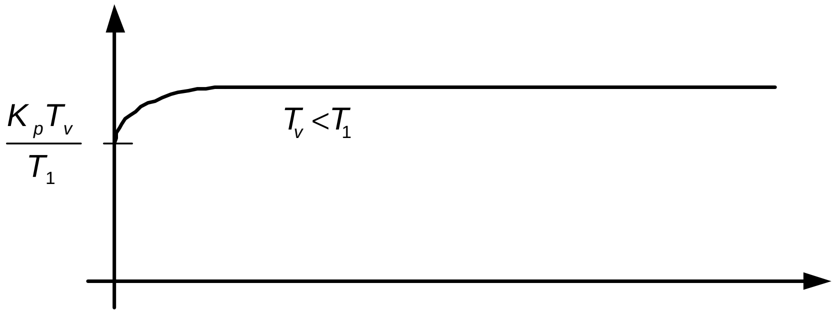

Source: PPT1-response.vsd

The factor KpTv/T1 ist represented by FAC_FUP_SP_PCTL. This factor is depending on the FUP_SP change. This factor will be multiplicated with FUP_SP, which is the basis for the FPAPWM value. The FUP_SP value is also filtered with a modified PT1filter.

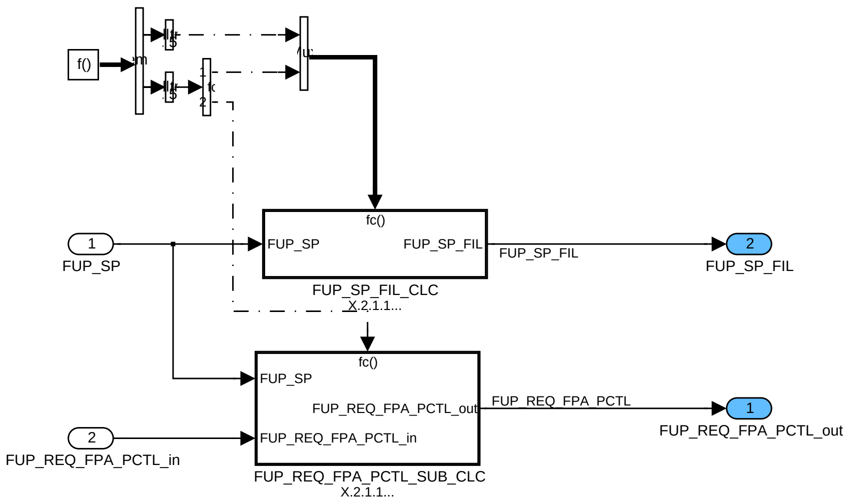

Figure 9.39.17: : Path:
FUSL_M903W/OPM_10MS/FUP_REQ_FPA_CLC_1/FUP_REQ_FPA_PCTL_CLC

9.39.2.1.2.1 Calculation

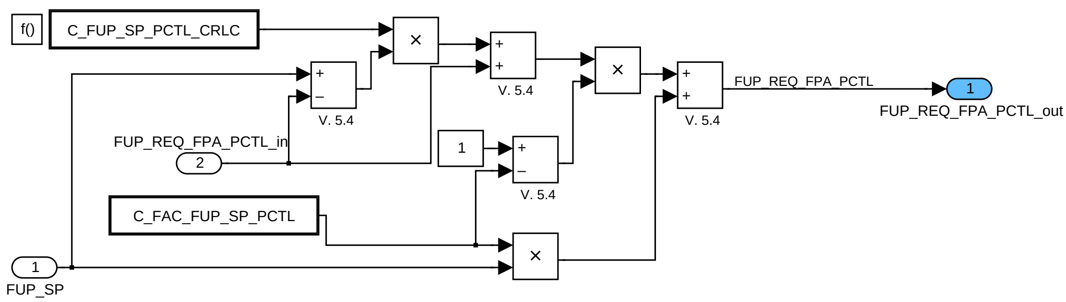

Figure 9.39.18: : Path: FUSL_M903W/OPM_10MS/FUP_REQ_FPA_CLC_1/
FUP_REQ_FPA_PCTL_CLC/FUP_REQ_FPA_PCTL_SUB_CLC

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9.39.2.1.2.2 Filter

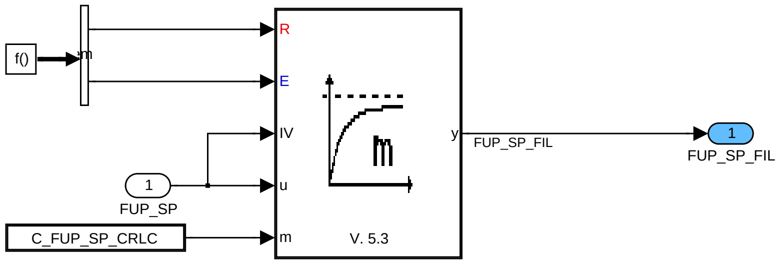

Figure 9.39.19: : Path: FUSL_M903W/OPM_10MS/FUP_REQ_FPA_CLC_1/FUP_REQ_FPA_PCTL_CLC/FUP_SP_FIL_CLC

9.39.2.2 VCV movement functionality

At Reset the timers have to be initialized with the coresponding constants.

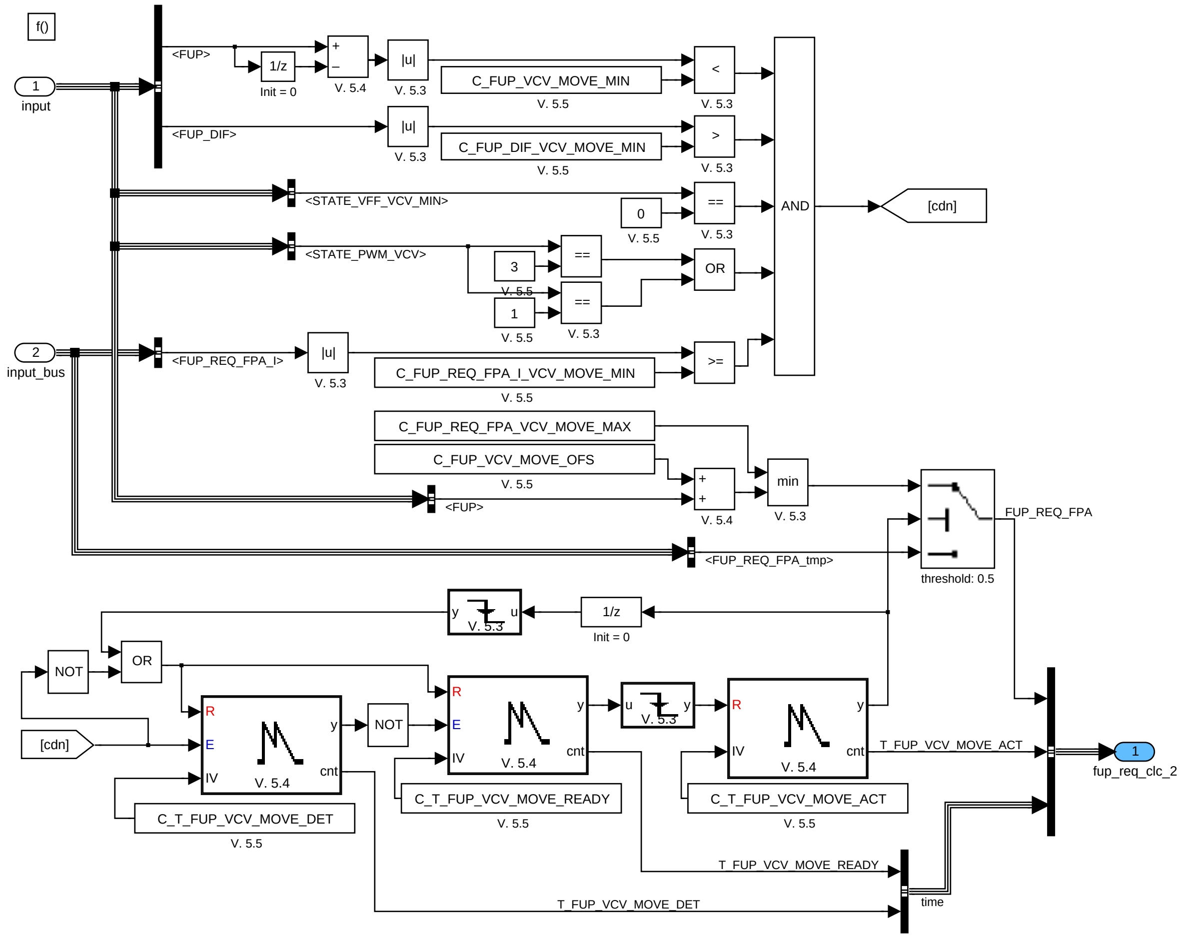

Figure 9.39.20: : Path: FUSL_M903W/OPM_10MS/FUP_REQ_FPA_MOVE_CLC

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9.39.2.3 Calculation of FUP_TRAN_CLC

In this overview the calculation blocks of the transitions, the adaptation inhibition and the different timers for component protections are listed

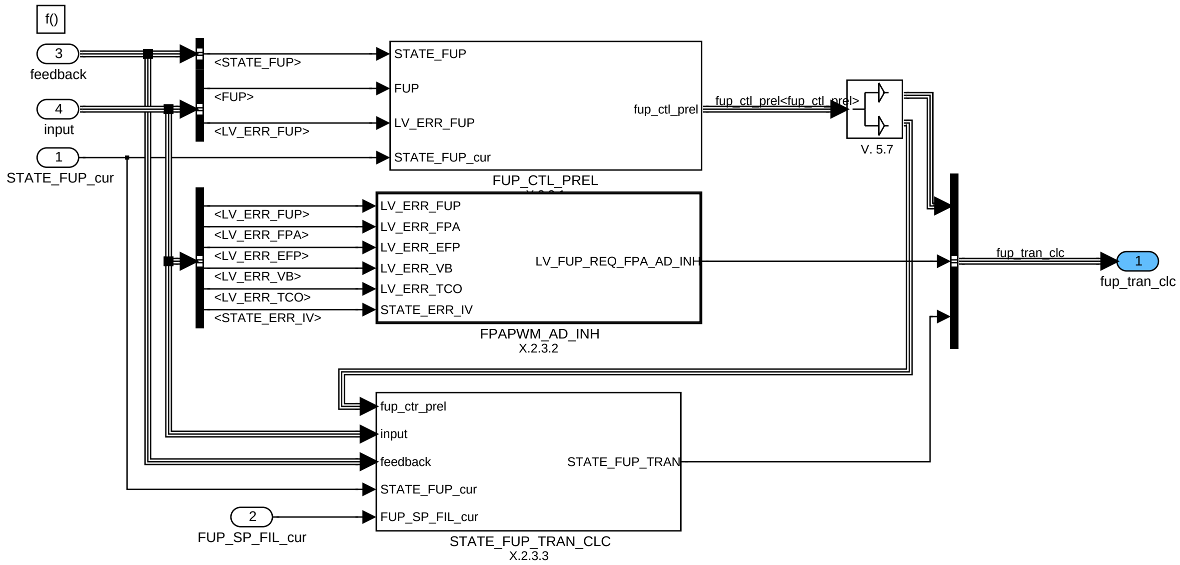

Figure 9.39.21: : Path: FUSL_M903W/OPM_10MS/FUP_TRAN_CLC

9.39.2.3.1 Calculation of FPAPWM_AD_INH

Several external errors can forbid the adaptation

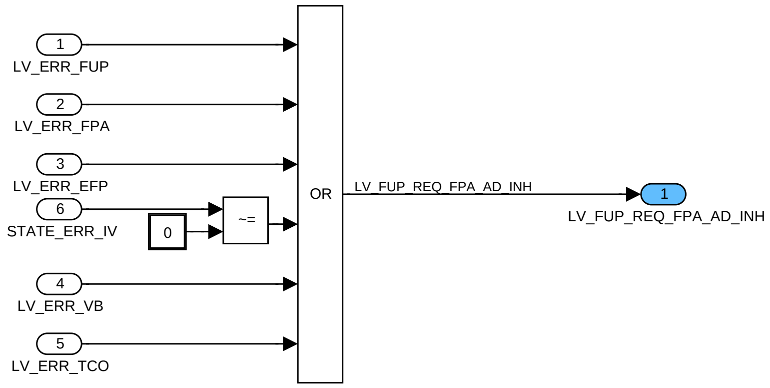

Figure 9.39.22: : Path: FUSL_M903W/OPM_10MS/FUP_TRAN_CLC/FPAPWM_AD_INH

9.39.2.3.2 Timer Calculation

The different timers for the component protection are calculated within that subblock

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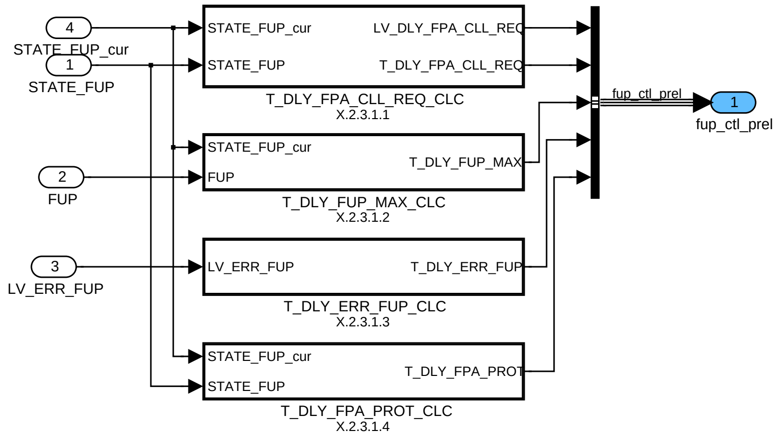

Figure 9.39.23: : Path: FUSL_M903W/OPM_10MS/FUP_TRAN_CLC/FUP_CTL_PREL

9.39.2.3.2.1 Timer Calculation

In case of a fuel pressure error a timer is started

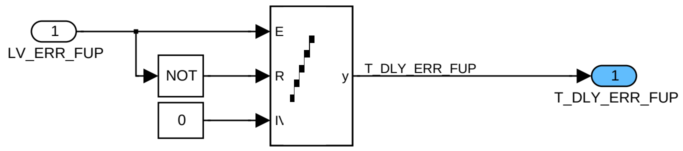

Figure 9.39.24: : Path:
FUSL_M903W/OPM_10MS/FUP_TRAN_CLC/FUP_CTL_PREL/T_DLY_ERR_FUP_CLC

9.39.2.3.2.2 Calculation of Timer and LV variales

For the start a higher PWM than allowed can be requested to enable a fast pressure increase. This timer prevents a severe component damage due to overheating
Note: Due to the functionality high pressure pump control the regulator can maybe not respond to that strategy!

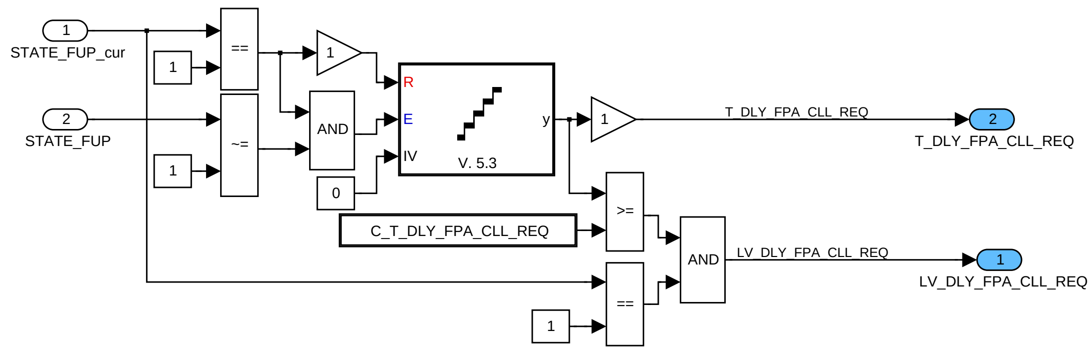

Figure 9.39.25: : Path:
FUSL_M903W/OPM_10MS/FUP_TRAN_CLC/FUP_CTL_PREL/T_DLY_FPA_CLL_REQ_CLC

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9.39.2.3.2.3 Timer Calculation

Corresponding to the timer before a certain time has to be waited until reaching high PWM again.
Note: Due to the functionality high pressure pump control the regulator can maybe not respond to that strategy!

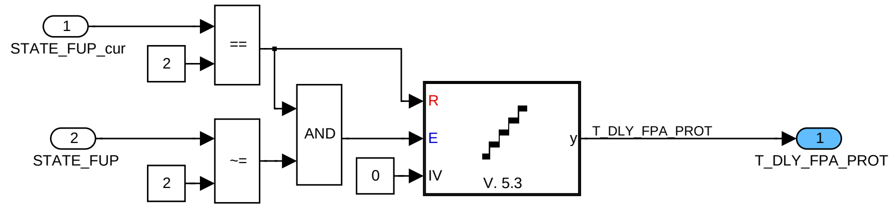

Figure 9.39.26: : Path:
FUSL_M903W/OPM_10MS/FUP_TRAN_CLC/FUP_CTL_PREL/T_DLY_FPA_PROT_CLC

9.39.2.3.2.4 Timer Calculation

This timer is observing to overpressure and gives signals to the state diagram.

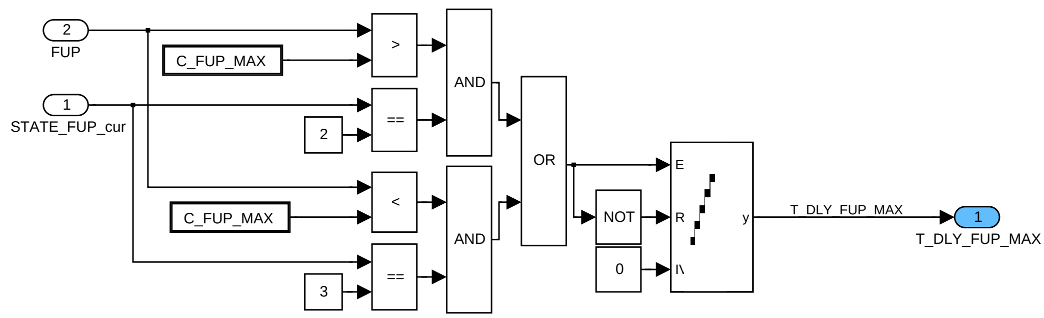

Figure 9.39.27: : Path:
FUSL_M903W/OPM_10MS/FUP_TRAN_CLC/FUP_CTL_PREL/T_DLY_FUP_MAX_CLC

9.39.2.3.3 Calculation

Due to complexibility of the transition calculation this function part is split into three parts.

In the first part the crash state will be achieved in case of crash event. When the engine stops the low pressure state will be selected. In case of overpressure more than a certain time the overpressure state should be reached. After disappearing of the overpressure more than a certain time this state will be left. In case of fuel pressure sensor failure the open loop state should be selected.

The second part gives possiblities to reach close state. This state might be not valid due to external influences at the actual actuator control done in high pressure pump control.

In the third part mainly start conditions are mentioned. In case of required high pressure start the high request for the FPA control is given as soon as the starter relay has closed. Otherwise a certain engine speed has to be reached.

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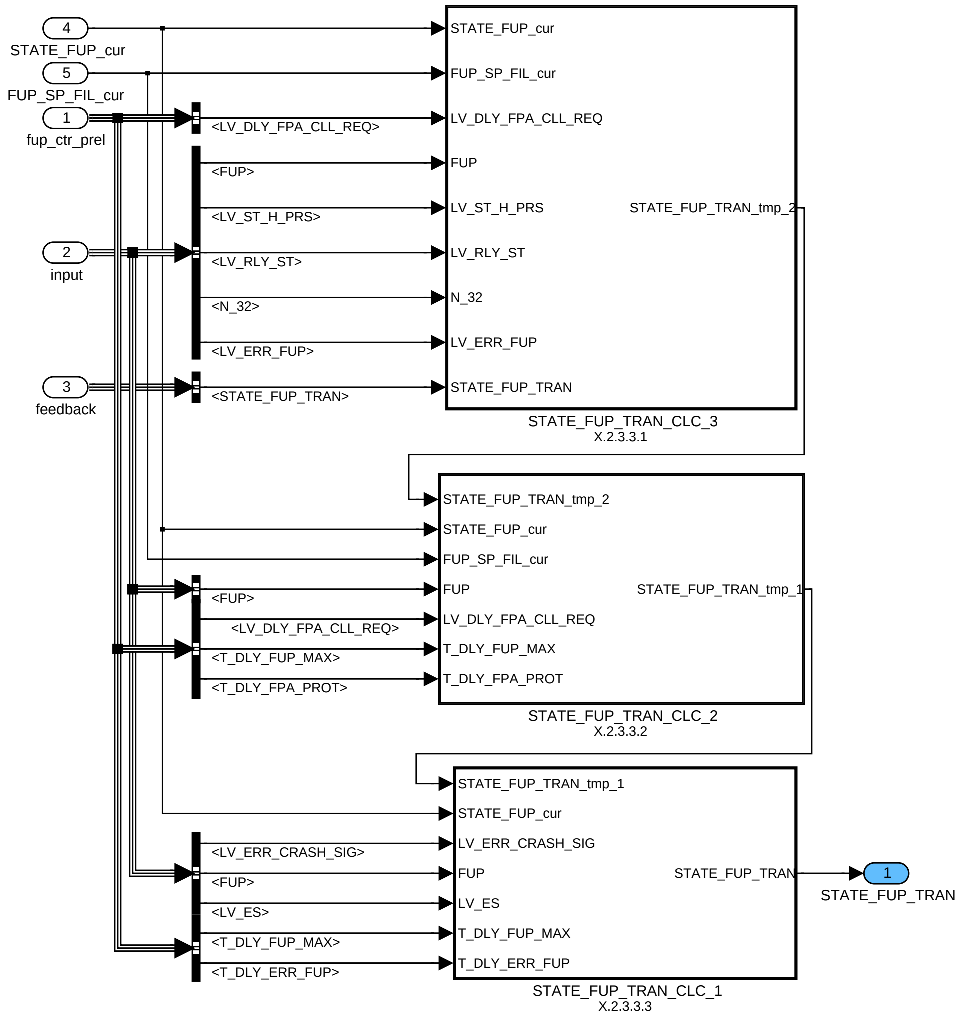

Figure 9.39.28: : Path: FUSL_M903W/OPM_10MS/FUP_TRAN_CLC/STATE_FUP_TRAN_CLC

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9.39.2.3.3.1 Calculation at STATE_FUP_TRAN_CLC_1

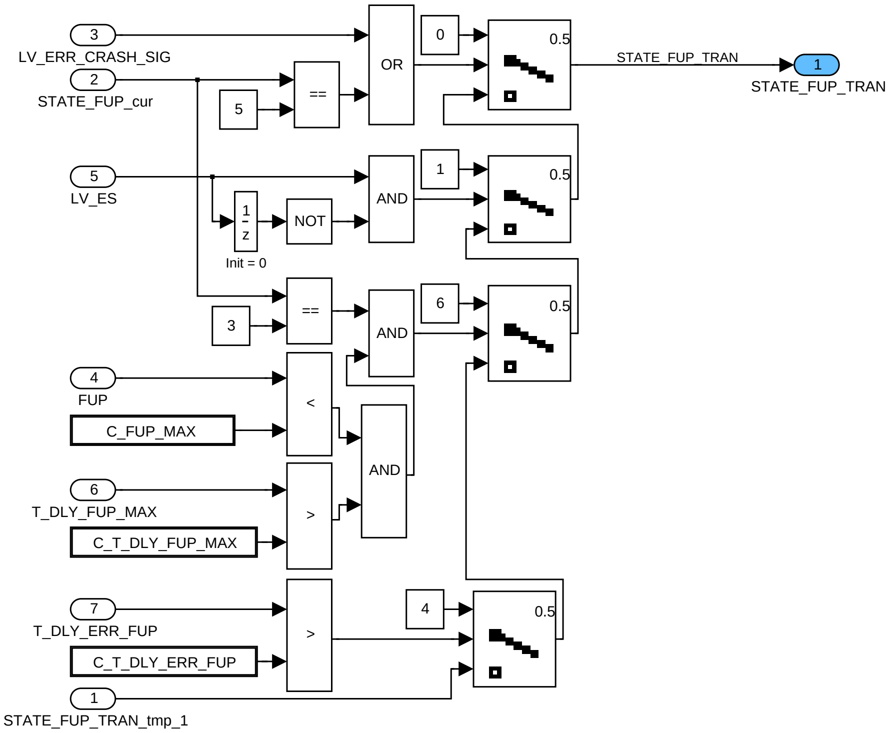

Figure 9.39.29: : Path:
FUSL_M903W/OPM_10MS/FUP_TRAN_CLC/STATE_FUP_TRAN_CLC/STATE_FUP_TRAN_CLC_1

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9.39.2.3.3.2 Calculation at STATE_FUP_TRAN_CLC_2

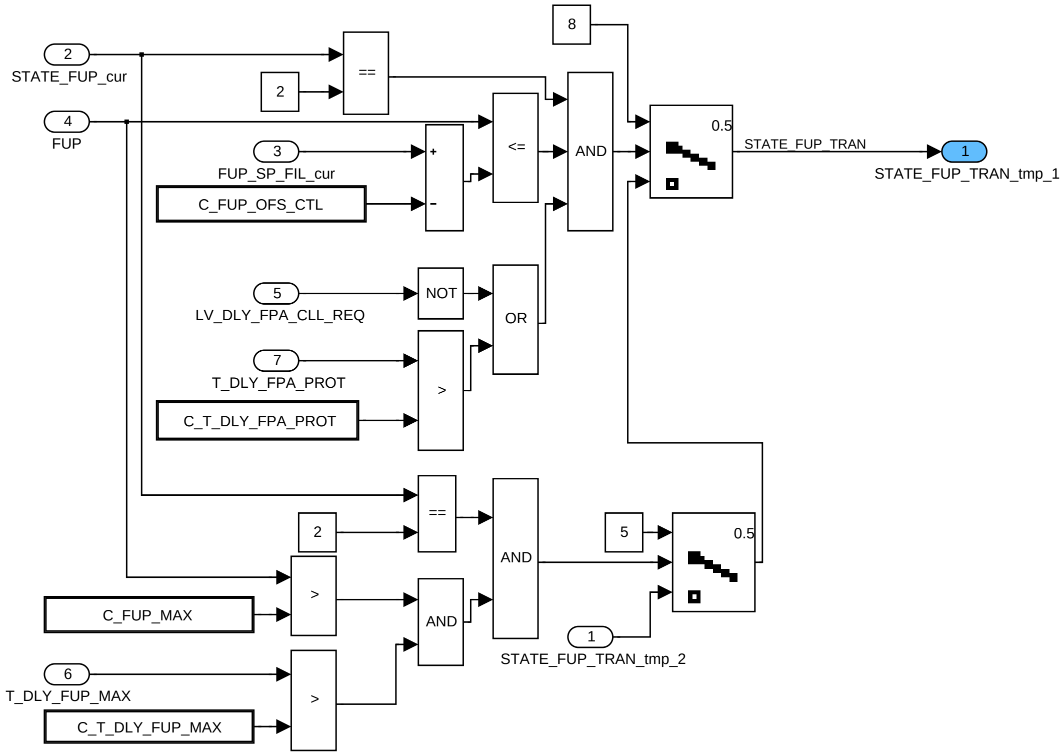

Figure 9.39.30: : Path:
FUSL_M903W/OPM_10MS/FUP_TRAN_CLC/STATE_FUP_TRAN_CLC/STATE_FUP_TRAN_CLC_2

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9.39.2.3.3.3 Calculation at STATE_FUP_TRAN_CLC_3

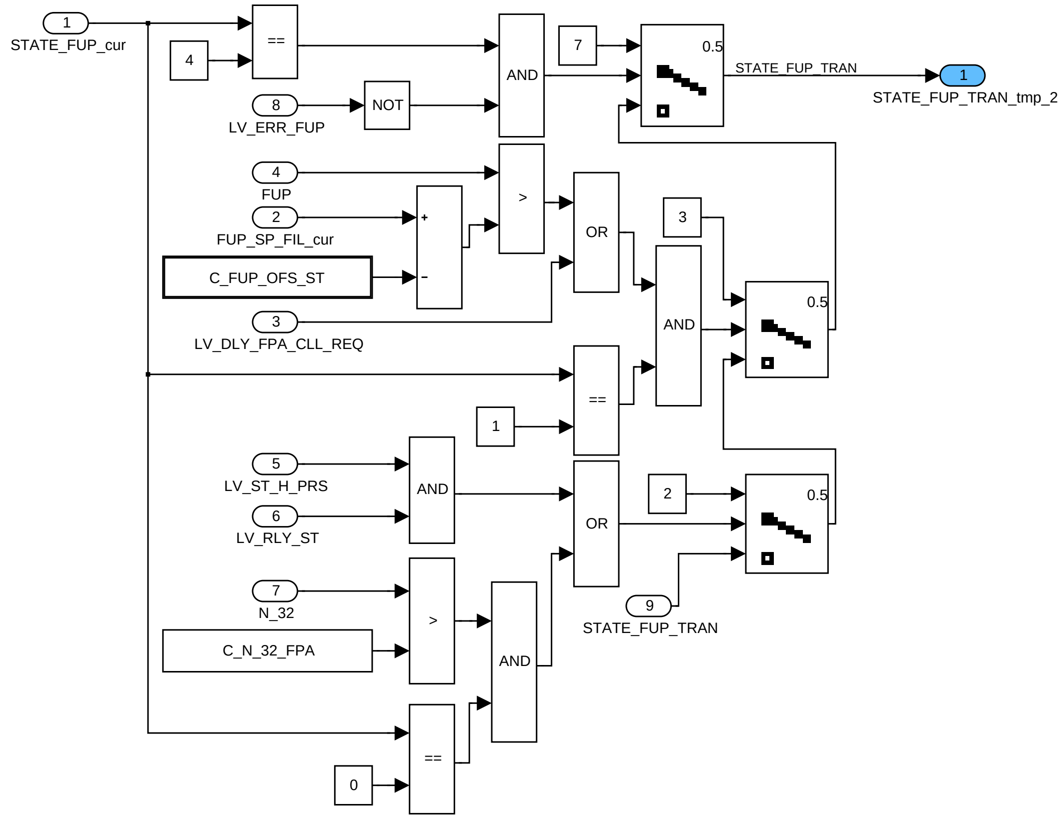

Figure 9.39.31: : Path:
FUSL_M903W/OPM_10MS/FUP_TRAN_CLC/STATE_FUP_TRAN_CLC/STATE_FUP_TRAN_CLC_3

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9.40 Fuel pressure actuator control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CUR_VCV_AST_MOVE_ACT	V	0... FFH	0... 255	1	-
Countdown for CUR pulses to move the VCV after engine stop					
CTR_CUR_VCV_MAX	V	0... FFH	0... 255	1	-
Counter in Operation max mode					
CTR_MIN_VFF_VCV_MIN_AD_SWI	O/V	0... FFH	0... 255	1	-
Variable indicating the cycle of the frequency of the lekage adaptation					
CUR_VCV	V	0... FFFFH	0... 65.535	1e-3	A
Actulal current of the VCV					
CUR_VCV_BAS	O/V	0... FFFFH	0... 65.535	1e-3	A
Desired value for the current of the VCV					
CUR_VCV_BAS_AD_VAR_2_ADD	O/V/S	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Additive component of second variant of VCV flow adaptation					
CUR_VCV_CTL	V	0... FFFFH	0... 65.535	1e-3	A
Requested current for the VCV in CTL mode					
CUR_VCV_DIF	V	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Current difference of VCV current controller					
CUR_VCV_DIF_REL	O/V	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Relative current deviation of VCV current controller					
CUR_VCV_DIF_REL_MMV	V	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Filtered relative deviation of the VCV current controller					
CUR_VCV_MAX	V	0... FFFFH	0... 65.535	1e-3	A
Maximum allowed current for the VCV					
CUR_VCV_MIN	V	0... FFFFH	0... 65.535	1e-3	A
Requested for the VCV in pressure control mode					
CUR_VCV_MIN_AD	O/V	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Adapted current of VCV in pressure control mode					
CUR_VCV_MIN_AD_1	O/V/S	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Adapted CUR of the first point pressure control part					
CUR_VCV_MIN_AD_2	O/V/S	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Adapted CUR of the second point pressure control part					
CUR_VCV_REQ	V	0... FFFFH	0... 65.535	1e-3	A
Requested current for the VCV					
FAC_CUR_VCV_BAS_AD_VAR_2	O/V/S	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Multiplicative component of second variant of VCV flow adaptation					
FAC_CUR_VCV_BAS_AD_VAR_2_TMP	O/V/S	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Temporary variable for the multiplicative component of second variant of VCV flow adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_CUR_VCV_CTL	V	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Output of VCV current controller					
FAC_CUR_VCV_MIN_AD	V	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	A/hPa
Factor for the correction of the pressure control part					
FAC_V_SLOP_CUR_VCV	O/V	0... FFFFH	0... 3.99993896484	61.0352e-6	-
Slope/factor value of the VCV current measurement					
FAC_VFF_FPA	V	0... FFH	0... 0.99609375	3.90625e-3	-
Factor for the flow through the regulator part of 3W-valve (depending on VFF_VCV_MIN)					
FAC_VFF_VCV_MIN	O/V	0... FFH	0... 9.9609375	0.0390625	-
Correction factor for the leakage adaptation					
FRQ_REQ_VCV	O/V	0... 3FFH	0... 1023	1	Hz
Required frequency for the volume control valve (typical range 10 - 1023 Hz)					
FUP_CUR_VCV_MIN_AD_1	O/V/S	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure first adaptation point pressure control					
FUP_CUR_VCV_MIN_AD_2	O/V/S	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure second adaptation point pressure control					
FUP_SP_VFF_VCV_MIN_AD_END	V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint level for ending the VFF_VCV_MIN adaptation					
FUP_SP_VFF_VCV_MIN_AD_ST	V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint level for starting the VFF_VCV_MIN adaptation					
FUP_VFF_VCV_MIN_AD_ST	V	0... FFFFH	0... 347776	5.3067216	hPa
Initial fuel pressure where the VCV_MIN calculation starts at					
LV_CUR_VCV_AST_MOVE_ACT	V	0... 1H	0 ...1	1	-
Logical value for move VCV after engine stop active					
LV_CUR_VCV_CTL_AD_ENA	V	0... 1H	0 ...1	1	-
Logical value to enable VCV PWM adaption due to CUR CTL					
LV_CUR_VCV_CTL_PRE_RUN	O/V	0... 1H	0 ...1	1	-
Logical value for VCV_PRE_RUN					
LV_CUR_VCV_CTL_PRE_RUN_ACT	V	0... 1H	0 ...1	1	-
Logical value for VCV_PRE_RUN active					
LV_CUR_VCV_CTL_PRE_RUN_EDGE	V	0... 1H	0 ...1	1	-
Logical value for start of VCV_PRE_RUN					
LV_CUR_VCV_ST_ACT	V	0... 1H	0 ...1	1	-
Logical value for setting of CUR_VCV at start					
LV_FUEL_MASS_CTL_RST_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable for reseting P and I-part of the controller					
LV_FUEL_MASS_CTL_STOP_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable requesting freezing the I-part of the controller					
LV_PWL_LOCK_CDN_HPDI	V	0... 1H	0 ...1	1	-
Power latch extension for CUR pulses to move the VCV after engine stop					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_STATE_VFF_VCV_MIN_RST	V	0... 1H	0 ...1	1	-
Logical bit requesting STATE_VFF_VCV_MIN reset					
LV_V_CUR_VCV_BOOT_NOT_VLD	O/V	0... 1H	0 ...1	1	-
Bit indicating out of bounce trim values.					
LV_VFF_VCV_MIN_AD_ENA	V	0... 1H	0 ...1	1	-
Adaptation conditions for the minimum flow through the VCV are fullfilled					
PWM_VCV	O/V	0... FFFFH	0... 99.9984741211	1.52588e-3	%
PWM signal for the VCV					
PWM_VCV_BAS	V	0... FFFFH	0... 99.998474	1.52588e-3	%
Base PWM signal for the VCV					
PWM_VCV_MAX	V	0... FFFFH	0... 99.998474	1.52588e-3	%
Maximum PWM signal for the VCV					
STATE_PWM_VCV	O/V	0H 1H 2H 3H 4H 5H 6H	VCV_TEST START MFP_CTL VCV_CLOSE VCV_CRASH MFP_MAX VCV_LIH	-	-
State diagram for the VCV control					
STATE_PWM_VCV_TRAN	V	0H 1H 2H 3H 4H 5H 6H 7H	CRASH OPEN CLOSE CONTROL MANUAL MANUAL_ OPEN MAXIMUM VCV_LIH	-	-
Transition state diagram for the VCV control					
STATE_VFF_VCV_MIN	O/V	0H 1H 2H 3H 4H 5H	PASSIVE READY START ACTIVE END PASSIVE_ READY	-	-
Minimum VCV adaptation state					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_CUR_VCV_CTL_PRE_RUN	V	0... FFH	0... 25.5	0.1	s
Time for VCV_PRE_RUN active					
T_VFF_VCV_LIM	V	0... FFFFH	0... 655.35	0.01	s
Maximum time for leakage adaption					
T_VFF_VCV_MIN	V	0... FFFFH	0... 655.35	0.01	s
Time measured for the pressure increase during adaptation					
T_VFF_VCV_MIN_AD_READY	O/V	0... FFFFH	0... 655.35	0.01	s
Time for waiting in the Passive_ready state of the leakage adaptation					
T_VFF_VCV_MIN_AD_ST	O/V	0... FFFFH	0... 655.35	0.01	s
Timer to start the pressure increase during adaptation					
V_CUR_VCV_MES_MV	V	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Measured voltage of shunt for VCV current controll					
V_OFS_CUR_VCV	O/V	8000... 7FFFH	-5... 4.99984741211	152.588e-6	V
Offset value of the VCV current measurement					
VB_VCV_MMV	V	0... FFH	0... 25.8984375	0.1015625	V
Filtered battery voltage for VCV control					
VFF_VCV	O/V	0... FFFFH	0... 255	3.89105e-3	l/h
Requested volume fuel flow through the VCV					
VFF_VCV_MIN	O/V	0... FFFFH	0... 255	3.89105e-3	l/h
Adapted minimum volume fuel flow through the VCV					
VFF_VCV_MIN_BAS	O/V/S	0... FFFFH	0... 255	3.89105e-3	l/h
Adapted minimum volume fuel flow through the VCV (normalized value)					
VFF_VCV_MIN_MMV	V	0... FFFFH	0... 255	3.89105e-3	l/h
Adapted minimum volume fuel flow through the VCV after filter					
VFF_VCV_MIN_MMV_INI	V	0... FFFFH	0... 255	3.89105e-3	l/h
Adapted minimum volume fuel flow through the VCV (normalized value), Ini value for VFF_VCV_MIN_MMV					

Input data:

C_FUP_SP_ADD {p. 3869}	C_IDX_TRIM {p. 989}	C_V_CUR_VCV_BOOT_H	C_V_CUR_VCV_BOOT_H_CMPL
C_V_CUR_VCV_BOOT_L	C_V_CUR_VCV_BOOT_L_CMPL	CUR_VCV_BAS_AD_VAR_2_ADD_SET {p. 3880}	ECU_STATE {p. 1091}
FAC_CLC_FUEL_MASS_FUP {p. 3908}	FUEL_MASS_REQ {p. 3908}	FUEL_MASS_REQ_I_CTL_H_RES {p. 3908}	FUP {p. 1283}
FUP_DIF {p. 3909}	FUP_REQ_FPA {p. 3930}	FUP_REQ_FPA_I {p. 3930}	FUP_SP {p. 3868}
LV_EFP_RUN_WKU {p. 3822}	LV_ERR_CRASH_SIG {p. 801}	LV_ERR_FUP_STOP {p. 6062}	LV_ES {p. 1720}
LV_FIRST_VLD_TOOTH {p. 1505}	LV_FUP_LIH_HOM_REQ {p. 4001}	LV_FUP_LIH_HOM_VCV_OPEN_REQ {p. 4001}	LV_FUP_LIH_L_PRS_CTL_REQ {p. 4001}
LV_FUP_PRS_CTL_REQ {p. 3880}	LV_FUP_SP_ADD {p. 3868}	LV_HPP_CTL_AD_CLR_EXT_REQ {p. 7483}	LV_IGK {p. 906}

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LV_PUC {p. 1720}	LV_ST_END {p. 1720}	LV_ST_H_PRS {p. 8242}	LV_VCV_RLY {p. 988}
MFF_SP_FUP_CTL {p. 2151}	N {p. 1525}	NC_PWL_LOCK_CDN_HPDI {p. 3778}	NC_V_CUR_VCV_MES {p. 653}
STATE_FUP_CTL {p. 3881}	T_SEG_AV {p. 1525}	TCO {p. 1100}	TCO_ST {p. 1100}
TECU {p. 1256}	TFU {p. 1232}	V_CUR_VCV_MES_ACTION_INFR	VB {p. 1185}
VFF_MFF_SP_FUP_CTL {p. 3881}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FUP_CUR_VCV_MIN_AD	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for the MMV calculation of FUP for the adaptation					
C_CRLC_VB_VCV_MMV	-	0... FFH	0... 0.99609375	3.90625e-3	-
Averaging constant of VB filter for VCV control					
C_CRLC_VFF_VCV_MIN_BAS_MMV	-	0... FFH	0... 0.99609375	3.90625e-3	-
Filter constant for moving mean value calculation of the VFF_VCV_MIN_BAS					
C_CRLC_VFF_VCV_MIN_MMV	-	0... FFH	0... 0.99609375	3.90625e-3	-
Filter constant for moving mean value calculation of the VFF_VCV_MIN					
C_CTR_CUR_VCV_AST_MOVE_ACT	-	0... FFH	0... 255	1	-
Number of CUR pulses to move the VCV after engine stop					
C_CTR_CUR_VCV_BAS_AD_VAR_2_MAX	-	0... FFH	0... 255	1	-
Counter for the second variant of the flow control adaptation					
C_CTR_CUR_VCV_CTL_STOP	-	0... FFFFH	0... 65535	1	-
Counter for stopping the VCV current control in intervention mode					
C_CTR_CUR_VCV_MAX	-	0... FFH	0... 255	1	-
Calibration for Counter in Operation max mode					
C_CTR_CUR_VCV_MIN_AD_MAX	-	0... FFH	0... 255	1	-
Counter for the pressure control part adaptation					
C_CTR_MIN_VFF_VCV_MIN_AD_INI	-	0... FFH	0... 255	1	-
Constant for initialisation of counter for frequency of the lekage adaptation					
C_CTR_MIN_VFF_VCV_MIN_AD_SWI	-	0... FFH	0... 255	1	-
Constant deciding the frequency of the lekage adaptation					
C_CUR_BAS_CUR_VCV_CTL_MAX	-	0... FFFFH	0... 65.535	1e-3	A
Maximum current to enable VCV current controler					
C_CUR_BAS_CUR_VCV_CTL_MIN	-	0... FFFFH	0... 65.535	1e-3	A
Minimun current to enable VCV current controler					
C_CUR_VCV_AD_CORD_2	-	0... FFFFH	0... 0.0000999984	1.52588e-9	A/hPa
Correlation constant for transfering the I-part into the PWM_VCV_BAS curve					
C_CUR_VCV_AD_VAR_2_CORD_1	-	0... FFFFH	0... 0.049999237	762.939e-9	A/mg
Correlation constant for transfering the I-part into the flow control curve for second variant of the VCV flow adaptation					
C_CUR_VCV_AST_MOVE	-	0... FFFFH	0... 65.535	1e-3	A
PWM for moving the VCV after engine stop					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CUR_VCV_AST_MOVE_MIN	-	0... FFFFH	0... 65.535	1e-3	A
VCV current threshold to activate the VCV after engine stop movement wthout LV_ERR_FUP_STOP					
C_CUR_VCV_BAS_AD_VAR_2_ADD_INI	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Initialisation value for the additive component ot the second variant of the VCV flow adaptation					
C_CUR_VCV_BAS_AD_VAR_2_ADD_MAX	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Maximum value for the additive component in the second variant of the VCV flow adaptation					
C_CUR_VCV_BAS_AD_VAR_2_ADD_MIN	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Minimum value for the additive component in the second variant of the VCV flow adaptation					
C_CUR_VCV_CRASH	-	0... FFFFH	0... 65.535	1e-3	A
CUR for VCV in CRASH					
C_CUR_VCV_CTL_AD_MAX	-	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Maximum allowed current deviation to enable PWM adaption					
C_CUR_VCV_DIF_REL_PRE_RUN_MIN	-	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Deviation of the VCV current controler to enable VCV_PRE_RUN					
C_CUR_VCV_LIH	-	0... FFFFH	0... 65.535	1e-3	A
CURfor VCV in limphome					
C_CUR_VCV_LIM_INC	-	0... FFFFH	0... 65.535	1e-3	A
Gradient limitation for increment of CUR_VCV					
C_CUR_VCV_MAN	-	0... FFFFH	0... 65.535	1e-3	A
Manual CURsignal for the VCV					
C_CUR_VCV_MIN_AD_1_INI	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Initialisation value CUR_VCV first point of pressure control part					
C_CUR_VCV_MIN_AD_1_MAX	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Maximum value for the adaptation of point 1 of the pressure control part					
C_CUR_VCV_MIN_AD_1_MIN	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Minimum value for the adaptation of point 1 of the pressure control part					
C_CUR_VCV_MIN_AD_2_INI	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Initialisation value CUR_VCV second point of pressure control part					
C_CUR_VCV_MIN_AD_2_MAX	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Maximum value for the adaptation of point 2 of the pressure control part					
C_CUR_VCV_MIN_AD_2_MIN	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Minimum value for the adaptation of point 2 of the pressure control part					
C_CUR_VCV_MIN_AD_MAX	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Maximum value for the adaptation of the pressure control part					
C_CUR_VCV_MIN_AD_MIN	-	8000... 7FFFH	-32.768 ...32.767	1e-3	A
Minimum value for the adaptation of the pressure control part					
C_CUR_VCV_MIN_OPL	-	0... FFFFH	0... 65.535	1e-3	A
Minimum CURsignal for the VCV in open loop (at engine stop)					
C_CUR_VCV_MIN_TOL	-	0... FFFFH	0... 65.535	1e-3	A
Maximum value for CUR_VCV_MIN					
C_CUR_VCV_PRE_RUN	-	0... FFFFH	0... 65.535	1e-3	A
Current for VCV_PRE_RUN					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CUR_VCV_SP_MAX	-	0... FFFFH	0... 65.535	1e-3	A
Maximum allowed current for VCV					
C_CUR_VCV_VFF_VCV_MIN_AD	-	0... FFFFH	0... 65.535	1e-3	A
CUR value for the leakage adaptation					
C_FAC_CUR_VCV_AD_VAR_2_CORD_2	-	1... FFH	0.000392157 ...0.100000035	392.157e-6	1/mg
Correlation constant for transfering the I-part into the CUR_VCV_BAS curve for second variant of the VCV flow adaptation					
C_FAC_CUR_VCV_BAS_AD_2_TMP_INI	-	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Initialisation value for the temporary variable for the multiplicative component ot the second variant of the VCV flow adaptation					
C_FAC_CUR_VCV_BAS_AD_VAR_2_MAX	-	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Maximum value for the multiplicative component of the second variant of VCV flow adaptation					
C_FAC_CUR_VCV_BAS_AD_VAR_2_MIN	-	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Minimum value for the multiplicative component of the second variant of VCV flow adaptation					
C_FAC_CUR_VCV_CTL_MAX	-	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Maximum output of VCV current controller					
C_FAC_CUR_VCV_CTL_MIN	-	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Minimum output of VCV current controller					
C_FAC_PWM_VCV_MIN	-	0... FFH	0... 9.9609375	0.0390625	-
Correction factor for the PWM_VCV_MIN by the flow through the regulator part					
C_FRQ_PWM_VCV_OPL	-	0... 3FFH	0... 1023	1	Hz
Required frequency for the VCV for open position (typical 10 - 1023 Hz); Initialisation with 100Hz					
C_FRQ_PWM_VCV_PRE_RUN	-	0... 3FFH	0... 1023	1	Hz
Required frequency for the VCV for pre run (typical 10 - 1023 Hz); Initialisation with 100Hz					
C_FRQ_REQ_VCV_AST_MOVE	-	0... 3FFH	0... 1023	1	Hz
Required frequency for moving the VCV after engine stop (typical 10 - 1023 Hz)					
C_FUP_CUR_VCV_MIN_AD_1	-	0... FFFFH	0... 347776	5.3067216	hPa
Mean fuel pressure for adaptation of point 1 of pressure control part					
C_FUP_CUR_VCV_MIN_AD_1_INI	-	0... FFFFH	0... 347776	5.3067216	hPa
Initialisation value for the fuel pressure first adaptation point pressure control part					
C_FUP_CUR_VCV_MIN_AD_2	-	0... FFFFH	0... 347776	5.3067216	hPa
Mean fuel pressure for adaptation of point 2 of pressure control part					
C_FUP_CUR_VCV_MIN_AD_2_INI	-	0... FFFFH	0... 347776	5.3067216	hPa
Initialisation value for the fuel pressure second adaptation point pressure control part					
C_FUP_CUR_VCV_MIN_HYS_1	-	0... FFFFH	0... 347776	5.3067216	hPa
Hysteresis of fuel pressure for adaptation of point 1 of pressure control part					
C_FUP_CUR_VCV_MIN_HYS_2	-	0... FFFFH	0... 347776	5.3067216	hPa
Hysteresis of fuel pressure for adaptation of point 2 of pressure control part					
C_FUP_DIF_CUR_VCV_AD	-	0... FFFFH	0... 347776	5.3067216	hPa
Max. fuel pressure deviation to allow adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_DIF_CUR_VCV_AD_VAR_2	-	0... FFFFH	0... 347776	5.3067216	hPa
Max. fuel pressure deviation to allow the second variant of the flow adaptation					
C_FUP_DIF_MAX_VFF_VCV_MIN_AD	-	0... FFFFH	0... 347776	5.3067216	hPa
Maximum pressure deviation allowed for adaptation of VFF_VCV_MIN					
C_FUP_MAX_PRE_RUN_ACT	-	0... FFFFH	0... 347776	5.3067216	hPa
Maximum fuel pressure for activation of prerun					
C_FUP_OFS_MFP_MAX	-	0... FFFFH	-173890 ...173884	5.3066911	hPa
FUP offset for high pressure start					
C_FUP_SP_VFF_VCV_MIN_AD_END	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint additional value for ending the VFF_VCV_MIN adaptation					
C_FUP_VCV_AST_MOVE_MAX	-	0... FFFFH	0... 347776	5.3067216	hPa
FUP threshold to activate the VCV after engine stop movement wthout LV_ERR_FUP_STOP					
C_FUP_VFF_VCV_MIN_AD_HYS	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure difference for VFF_VCV_MIN adaptation					
C_FUP_VFF_VCV_MIN_AD_RED	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure reduction value due to temperature for VFF_VCV_MIN adaptation					
C_FUP_VFF_VCV_MIN_AD_ST	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure value for VFF_VCV_MIN adaptation start					
C_MFF_SP_VCV_BAS_AD_MAX	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Maximum mass fuel flow to allow the VCV flow adaptation					
C_PWM_VCV_MIN_OPL	-	0... FFFFH	0... 99.998474	1.52588e-3	%
Minimum PWM signal for the VCV in open loop (at engine stop)					
C_RHO_FUEL	-	153B... FFFFH	74.6395056077 ...900	0.0& %■331	mg/cm**3
Density of the fuel					
C_T_CUR_VCV_AST_MOVE	-	0... FFFFH	0... 655.35	0.01	s
Time for the CUR to move the VCV after engine stop					
C_T_CUR_VCV_CTL_PRE_RUN	-	0... FFH	0... 25.5	0.1	s
Time for the VCV_PRE_RUN					
C_T_CUR_VCV_CTL_PRE_RUN_ACT_MIN	-	0... FFFFH	0... 655.35	0.01	s
Minimum time for VCV pre run duration					
C_T_DLY_CUR_VCV_AST_MOVE	-	0... FFFFH	0... 655.35	0.01	s
Delaytime for the CUR to move the VCV after engine stop					
C_T_FIRST_DLY_CUR_VCV_AST_MOVE	-	0... FFFFH	0... 655.35	0.01	s
First delaytime for the CUR to move the VCV after engine stop					
C_T_VFF_VCV_LIM_MAX	-	0... FFFFH	0... 655.35	0.01	s
Maximum time for the leakage adaptation					
C_T_VFF_VCV_MIN_AD_READY	-	0... FFFFH	0... 655.35	0.01	s
Maximum time for the leakage adaptation					
C_T_VFF_VCV_MIN_AD_ST_MAX	-	0... FFFFH	0... 655.35	0.01	s
Time for VFF_VCV_MIN adaptation start					
C_TFU_CUR_VCV_AD_MAX	-	0... FEH	-48... 142.5	0.75	°C
Maximum temperature for the adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TFU_CUR_VCV_AD_MIN	-	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for the adaptation					
C_TFU_VFF_VCV_MIN_CLC_MAX	-	0... FEH	-48... 142.5	0.75	°C
Maximum temperature for the leakage adaptation					
C_TFU_VFF_VCV_MIN_CLC_MIN	-	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for the leakage adaptation					
C_V_CUR_VCV_BOOT_H_INI	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Measured voltage at high current					
C_V_CUR_VCV_BOOT_H_MAX	-	8000... 7FFFH	-5... 4.99984741211	152.588e-6	V
Maximum threshold for VCV trim value					
C_V_CUR_VCV_BOOT_H_MIN	-	8000... 7FFFH	-5... 4.99984741211	152.588e-6	V
Minimum threshold for VCV trim value					
C_V_CUR_VCV_BOOT_H_STD	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Measured voltage at high current standard value					
C_V_CUR_VCV_BOOT_L_INI	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Measured voltage at low current initial value					
C_V_CUR_VCV_BOOT_L_MAX	-	8000... 7FFFH	-5... 4.99984741211	152.588e-6	V
Maximum threshold for VCV trim value					
C_V_CUR_VCV_BOOT_L_MIN	-	8000... 7FFFH	-5... 4.99984741211	152.588e-6	V
Minimum threshold for VCV trim value					
C_V_CUR_VCV_BOOT_L_STD	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Measured voltage at low current standard value					
C_VB_CUR_VCV_CTL_AD_MAX	-	0... FFH	0... 25.8984375	0.1015625	V
Maximum battery voltage to enable PWM adaption					
C_VB_CUR_VCV_CTL_AD_MIN	-	0... FFH	0... 25.8984375	0.1015625	V
Minimum battery voltage to enable PWM adaption					
C_VB_CUR_VCV_CTL_PRE_RUN_MAX	-	0... FFH	0... 25.8984375	0.1015625	V
Maximum battery voltage to enable VCV_PRE_RUN					
C_VB_CUR_VCV_CTL_PRE_RUN_MIN	-	0... FFH	0... 25.8984375	0.1015625	V
Minimum battery voltage to enable VCV_PRE_RUN					
C_VFF_CUR_VCV_BAS_AD_2_BOL_1	-	0... FFFFH	0... 255	3.89105e-3	l/h
VFF bottom limit to allow the adaptation of the additive component in the second variant of the VCV flow adaptation					
C_VFF_CUR_VCV_BAS_AD_2_BOL_2	-	0... FFFFH	0... 255	3.89105e-3	l/h
VFF bottom limit to allow the adaptation of the multiplicative component in the second variant of the VCV flow adaptation					
C_VFF_CUR_VCV_BAS_AD_2_TOL_1	-	0... FFFFH	0... 255	3.89105e-3	l/h
VFF top limit to allow the adaptation of the additive component in the second variant of the VCV flow adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VFF_CUR_VCV_BAS_AD_2_TOL_2	-	0... FFFFH	0... 255	3.89105e-3	l/h
VFF top limit to allow the adaptation of the multiplicative component in the second variant of the VCV flow adaptation					
C_VFF_VCV_MIN_BOL	-	0... FFFFH	0... 255	3.89105e-3	l/h
VFF_VCV_MIN adaptation bottom value					
C_VFF_VCV_MIN_INI	-	0... FFFFH	0... 255	3.89105e-3	l/h
VFF_VCV_MIN_BAS initial value					
C_VFF_VCV_MIN_TOL	-	0... FFFFH	0... 255	3.89105e-3	l/h
VFF_VCV_MIN adaptation top value					
ID_FRQ_PRS_PWM_VCV_STND	-	0... 3FFH	0... 1023	1	Hz
LDP_N_ID_FRQ_PRS_PWM_VCV_STND	8	0... 1FE0H	0... 8160	1	rpm
Required frequency for the VCV for standard operation in pressure mode					
ID_FRQ_PWM_VCV_STND	-	0... 3FFH	0... 1023	1	Hz
LDP_N_ID_FRQ_PRS_PWM_VCV_STND	8	0... 1FE0H	0... 8160	1	rpm
Required frequency for the VCV for standard operation (typical range 10 - 1023 Hz)					
IP_CRLC_CUR_VCV_DIF_REL	-	0... FFH	0... 0.99609375	3.90625e-3	-
LDP_CUR_DIF_REL_IP_CRLC_CUR	6	0... FFFFH	-32.768 ...32.767	1e-3	A
Corelation value for filtering of relative current deviation VCV current controll					
IP_CUR_SP_FLOW_CTL_VCV	-	0... FFFFH	0... 65.535	1e-3	A
LDP_VFF_VCV_IP_CUR_SP_FLOW	16	0... FFFFH	0... 255	3.89105e-3	l/h
Current setpoint of VCV in flow controll					
IP_CUR_SP_PRS_CTL_VCV	-	0... FFFFH	0... 65.535	1e-3	A
LDP_FUP_REQ_FPA_IP_CUR_SP_PRS	16	0... FFFFH	0... 347776	5.3067216	hPa
Current setpoint of VCV in pressure controll					
IP_CUR_VCV_LIM_DEC	V	0... FFFFH	0... 65.535	1e-3	A
LDP_FUP_IP_CUR_VCV_LIM_DEC	4	0... FFFFH	0... 347776	5.3067216	hPa
LDP_CUR_VCV_BAS_IP_CUR_VCV_LIM	4	0... FFFFH	0... 65.535	1e-3	A
Gradient limitation for decrement of CUR_VCV					
IP_CUR_VCV_MES	-	0... FFFFH	0... 65.535	1e-3	A
LDP_V_CUR_IP_V_CUR_VCV_MES	6	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Transfer from measured voltage to current of the VCV					
IP_CUR_VCV_ST	-	0... FFFFH	0... 65.535	1e-3	A
LDPM_TCO_ST_1_FUSL	6	0... FEH	-48... 142.5	0.75	°C
CUR_VCV for the start after the event 1TOOTH					
IP_FAC_CUR_VCV_I_CTL	-	0... FFFFH	-2... 1.99993896484	61.0352e-6	-
LDP_CUR_DIF_MMV_IP_CUR_I_CTL	8	0... FFFFH	-2... 1.99993896484	61.0352e-6	-
I- share of VCV current controller					
IP_FAC_FRQ_V_CUR_VCV_MES	-	0... FFFFH	0... 3.99993896484	61.0352e-6	-
LDP_FRQ_REQ_V_CUR_VCV_MES	8	0... 3FFH	0... 1023	1	Hz
Frequency correction of the measured feedback					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_PWM_VCV_TFU	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_TFU_IP_FAC_PWM_VCV	8	0... FEH	-48... 142.5	0.75	°C
Correction factor for the PWM_VCV by the fuel temperature					
IP_FAC_PWM_VCV_VB	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDPM_VB_FUSL	8	0... FFH	0... 26	0.1019608	V
Correction factor for the PWM_VCV by the battery voltage					
IP_FAC_TECU_V_CUR_VCV_MES	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_TECU_IP_FAC_V_CUR_VCV_MES	8	0... FEH	-48... 142.5	0.75	°C
Temperature correction of the measured feedback					
IP_FAC_VB_PWM_V_CUR_VCV_MES	V	0... FFFFH	0... 7.99987792969	122.07e-6	-
LDP_VB_IP_FAC_V_CUR_VCV_MES	9	0... FFH	0... 26	0.1019608	V
LDP_PWM_VCV_IP_FAC_V_CUR_VCV	8	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Correction factor for current feedback VB vs PWM					
IP_FAC_VFF_VCV_MIN	-	0... FFH	0... 9.9609375	0.0390625	-
LDP_TFU_IP_FAC_VFF_VCV_MIN	4	0... FEH	-48... 142.5	0.75	°C
Correction factor for the leakage adaptation					
IP_PWM_VCV_STND	-	0... FFFFH	0... 99.9984741211	1.52588e-3	%
LDP_CUR_VCV_IP_PWM_BAS	6	0... FFFFH	0... 65.535	1e-3	A
Transfer from desired current to standard PWM					
IP_VCV_STATE_CUR_VCV_MAX	-	0... FFFFH	0... 65.535	1e-3	A
LDPM_TCO_ST_1_FUSL	6	0... FEH	-48... 142.5	0.75	°C
CUR signal for VCV in STATE_PWM_VCV = Max					
LC_CUR_VCV_CTL_RST	-	0... 1H	0 ...1	1	-
Switch to reset the VCV current controller					
LC_CUR_VCV_CTL_STOP	-	0... 1H	0 ...1	1	-
Switch to stop the VCV current controller					
LC_CUR_VCV_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual CUR_VCV					
LC_HPP_CTL_AD_CLR	-	0... 1H	0 ...1	1	-
Clearing of adaptation values of high pressure pump control					
LC_PRS_H_ST	-	0... 1H	0 ...1	1	-
Logical constant for selecting the high pressure start					
LC_V_CUR_VCV_BOOT_INI_MAN	-	0... 1H	0 ...1	1	-
Switch to use INI values for current measurement					
LC_VCV_AST_MOVE_ACT_MAN	-	0... 1H	0 ...1	1	-
Logical variable to activate the VCV after engine stop movement without LV_ERR_FUP_STOP					
LC_VCV_ST_CLOSE_TRAN	-	0... 1H	0 ...1	1	-
Logical constant enabling transition from start to close VCV state					

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General information:

The fuel pressure in the rail can be controlled by an volume control valve at the inlet side. Depending on the requested fuel mass to be delivered by the fuel pump the inlet valve to the pump has to be controlled.

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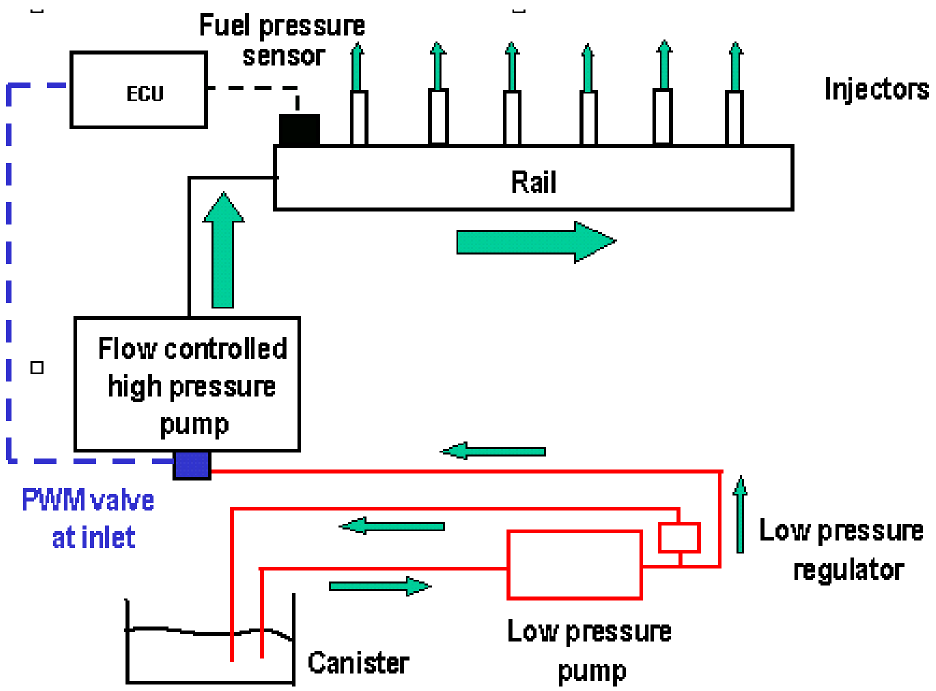

Figure 9.40.1: :

In case of checksum error or new ECU initial values are taken for the corresponding variables. Otherwise the stored values are taken. All adapted values can be cleared by the variable LC_HPP_CTL_AD_CLR.

Use ACTION_INFR_SetPwmVcv(IN<ducy>)
ACTION_INFR_SetFrqPwmVcv(IN<frq>)
IF NC_V_CUR_VCV_MES > 0 (Shunt for VCV current is present in ECU)
THEN ACTION_INFR_GetVVcvCurMes(OUT <v_cur_vcv_mes>)
ELSE
END

At reset call
ACTION_INFR_SetPwmVcv(IN<ducy>)
ACTION_INFR_SetFrqPwmVcv(IN<frq>)

IF LV_ST_END ==0
THEN call at 10ms
IF NC_V_CUR_VCV_MES > 0 (Shunt for VCV current is present in ECU)
THEN ACTION_INFR_GetVVcvCurMes(OUT <v_cur_vcv_mes>)
ELSE
END
IF NOT (LV_PWL_LOCK_CDN_HPDI(n-1)) AND
LV_PWL_LOCK_CDN_HPDI(n)
THEN ACTION_FCTM_SetPwlLockCdn(IN <nc_pwl_lock_cdn_hpdi>)
END

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IF LV_PWL_LOCK_CDN_HPDI(n-1) AND
NOT (LV_PWL_LOCK_CDN_HPDI(n))
THEN ACTION_FCTM_ClrPwlLockCdn(IN <nc_pwl_lock_cdn_hpdi>)
END

by final calculation of pwm_vcv and frq_req_vcv
ACTION_INFR_SetPwmVcv(IN<ducy>)
ACTION_INFR_SetFrqPwmVcv(IN<frq>)
ELSE call at segment
IF NC_V_CUR_VCV_MES > 0 (Shunt for VCV current is present in ECU)
THEN ACTION_INFR_GetVVcvCurMes(OUT <v_cur_vcv_mes>)
ELSE
END
by final calculation of pwm_vcv and frq_req_vcv
ACTION_INFR_SetPwmVcv(IN<ducy>)
ACTION_INFR_SetFrqPwmVcv(IN<frq>)
END

V_CUR_VCV_MES_ACTION_INFR isn't a real input and isn't generated by an other specification. It is only the voltage from the ACTION_INFR_GetVVcvCurMes(OUT <v_cur_vcv_mes>)

Application conditions:

Initialisation:	`RST, NVMINI, NVMRES, NVMSTO`
Recurrence:	`10MS activated if LV_ST_END==0 100MS activated if always SEG activated if LV_ST_END==1`
Activation:	`-`
Deactivation:	`never or if activation-condition of other event is true`

Function description:

Formula section:

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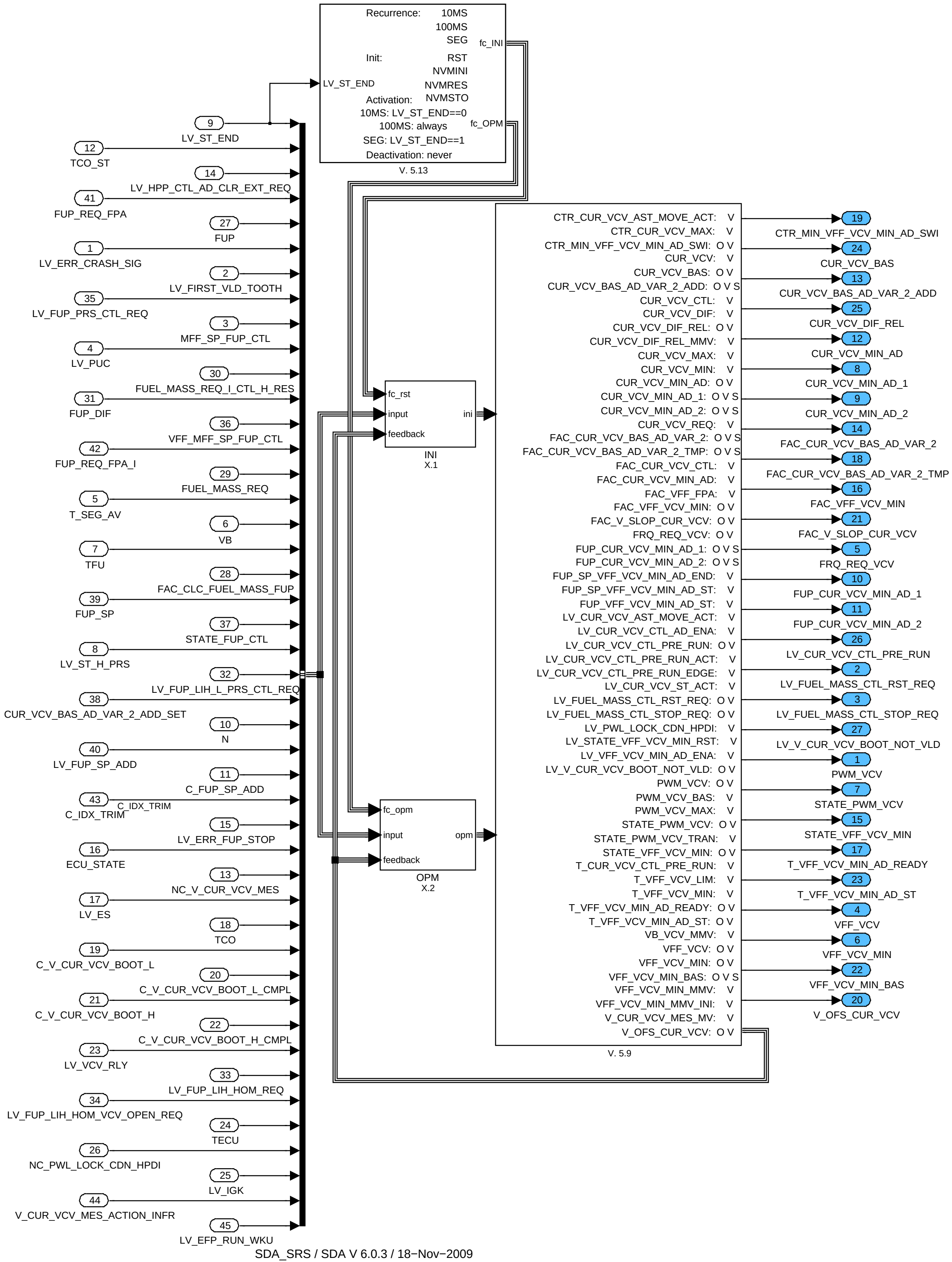

Figure 9.40.2: :

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9.40.1 Initialization:

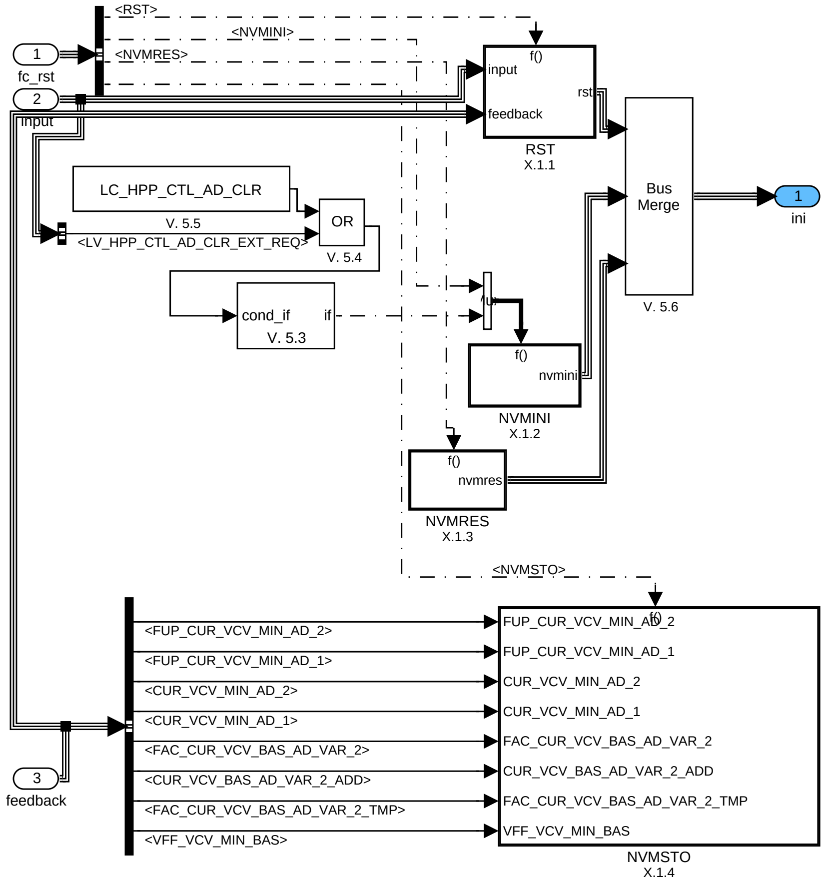

Figure 9.40.3: :

9.40.1.1 Reset

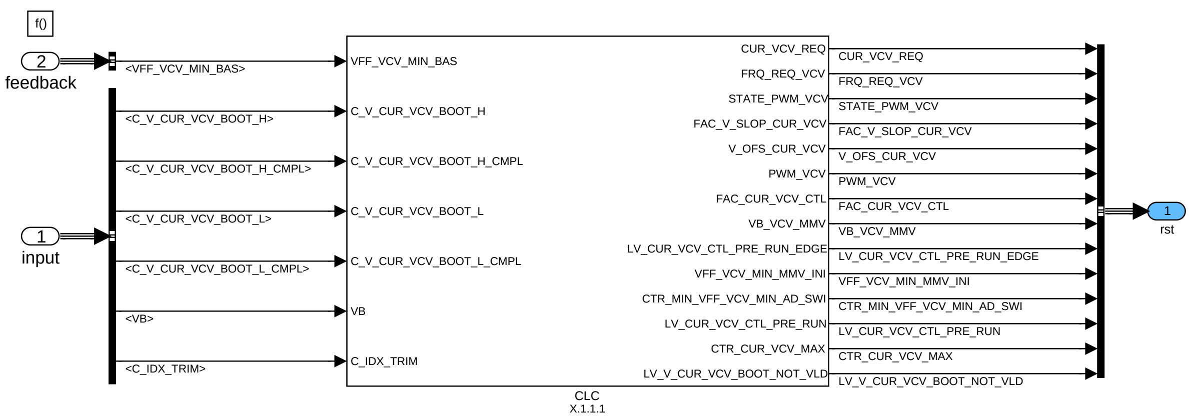

Figure 9.40.4: :

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9.40.1.1.1 Calculation:

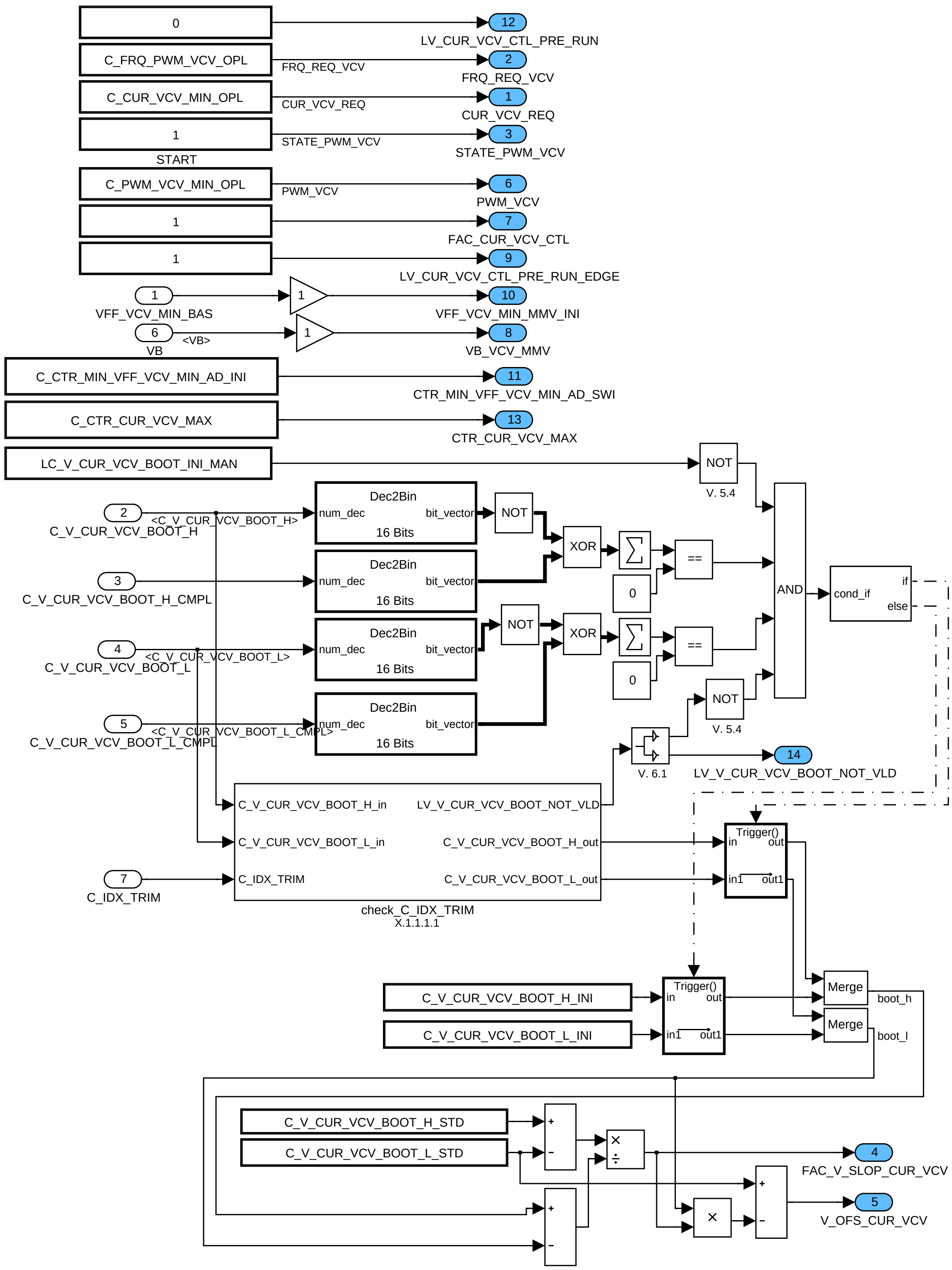

Figure 9.40.5: :

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9.40.1.1.1.1 Check of C_IDX_TRIM and range check

Here the trim-ID is checked additonal a range check of the trim values is done. In the case that the trim values are out of a defined range the use of the trim-values is inhibited (via LV_V_CUR_VCV_BOOT_NOT_VLD). Via LV_V_CUR_VCV_BOOT_NOT_VLD also an error entry can be triggered.

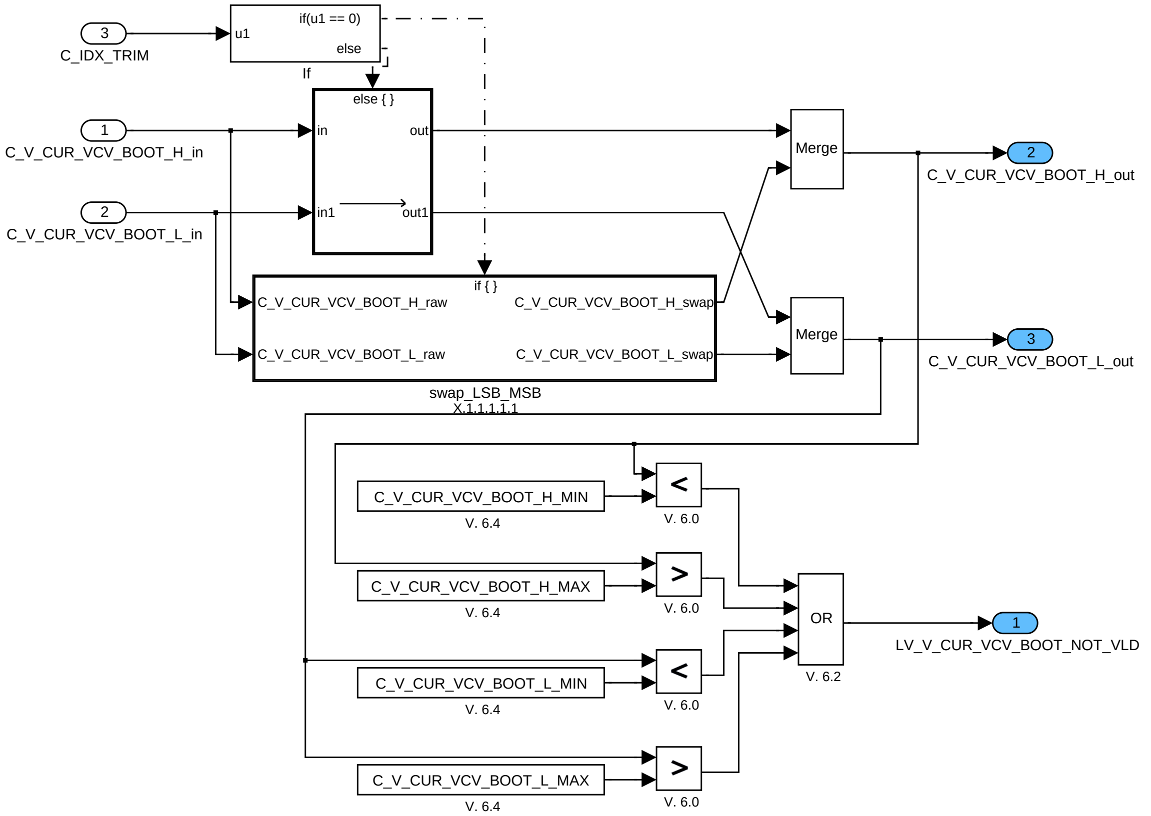

Figure 9.40.6: :

9.40.1.1.1.1.1 Swap of lower and upper bytes

LSB_MSB_swap and the Trim ID C_IDX_TRIM
C_V_CUR_VCV_BOOT_H/L are voltages that are measured during production phase and stored along with their complements in the logistic area. They are the trim values for the volume control valve (VCV) of the high preassure pump. The ASW reads those values during initialisation. The values are stored in HEX-format. For MSD87-6 there are different ways the HEX values are stored (order of MostSignificantByte/LeastSignificatByte). To distingush the different HEX-conventions used during trim process a trim ID was indroduced. It has the label name C_IDX_TRIM.

Example:
analog voltages are digitised
3,1061V=20356digits
(hint: HexValue 4F84 in Microsoft- Windows Calculator;
the value which is stored in the logistic area in the MSD80 project is 844F)

the value which is stored in the logistic area in the MSD87-6 project differs depending on the Trim ID C_IDX_TRIM
ECUs with TrimmID 0 use the format 4F84
ECUs with TrimmID 1 use the format 844F

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The ASW has to take care of the LSB/MSB_order of the HEX values when it reads them back. LSB/MSB need to be swapped or not, depending on the trimID. Complement values use the same format as the trim values that is why the LSB_MSB swap has only to be done for the calculation in the formula section.

see also 'logistic concept for production line test'
Trim_VCV order:
0x00 =
(only sample production)
adr. n = MSB,
adr (n+1)=LSB
0x01 =
(serial production)
adr. n = LSB,
adr (n+1)=MSB

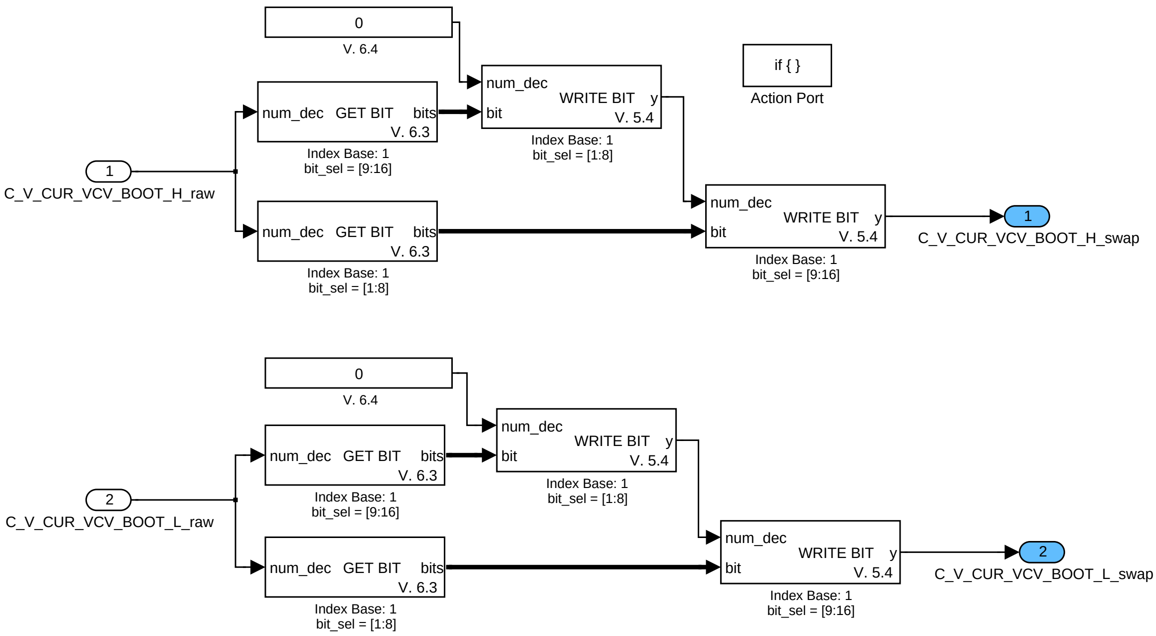

Figure 9.40.7: :

9.40.1.2 NVMY Initialization:

Please note: the Constant blocks that have been terminated are to indicate the init values of the variables at NVMY initialisation.

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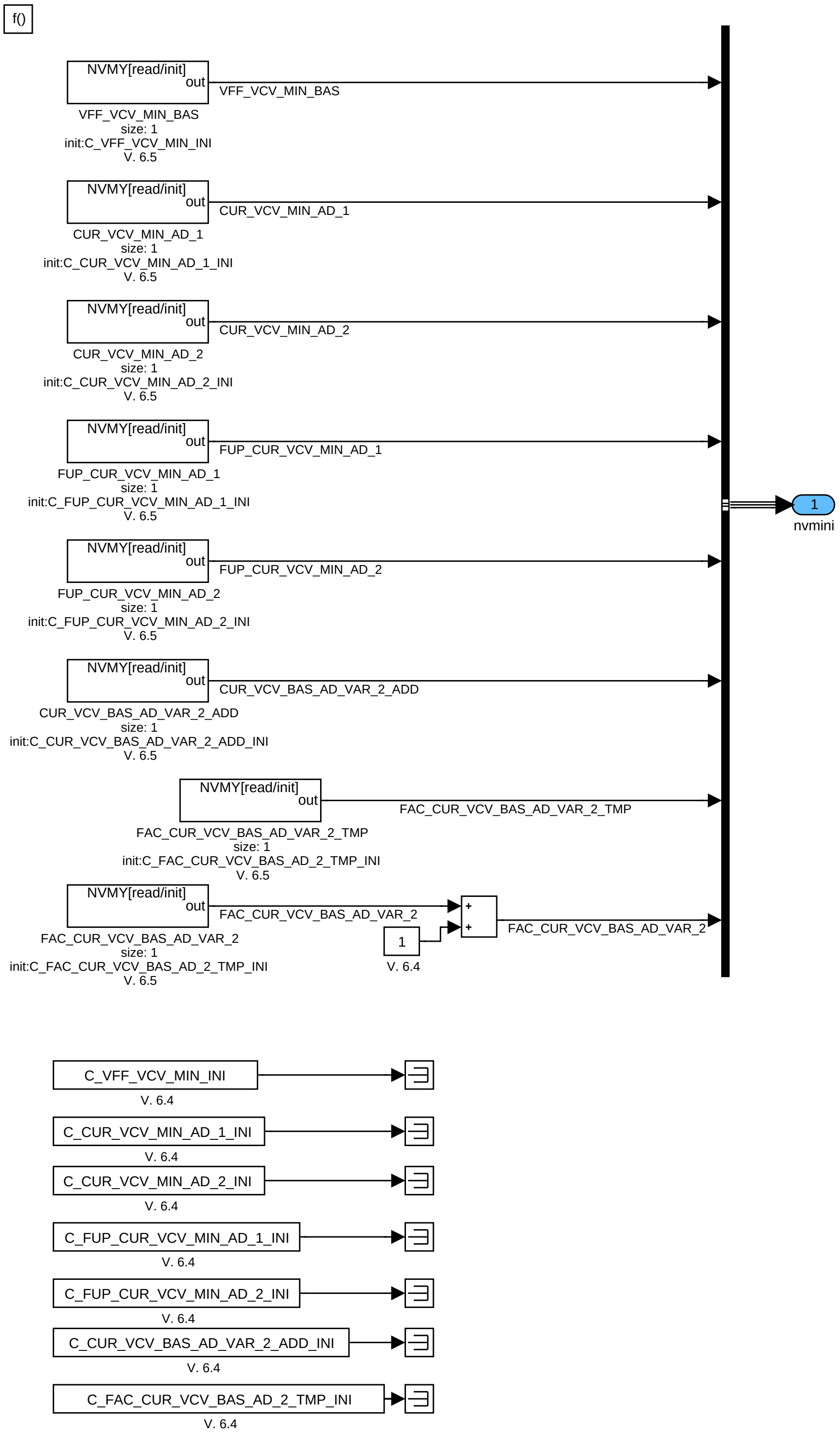

Figure 9.40.8: :

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9.40.1.3 NVMY Restore

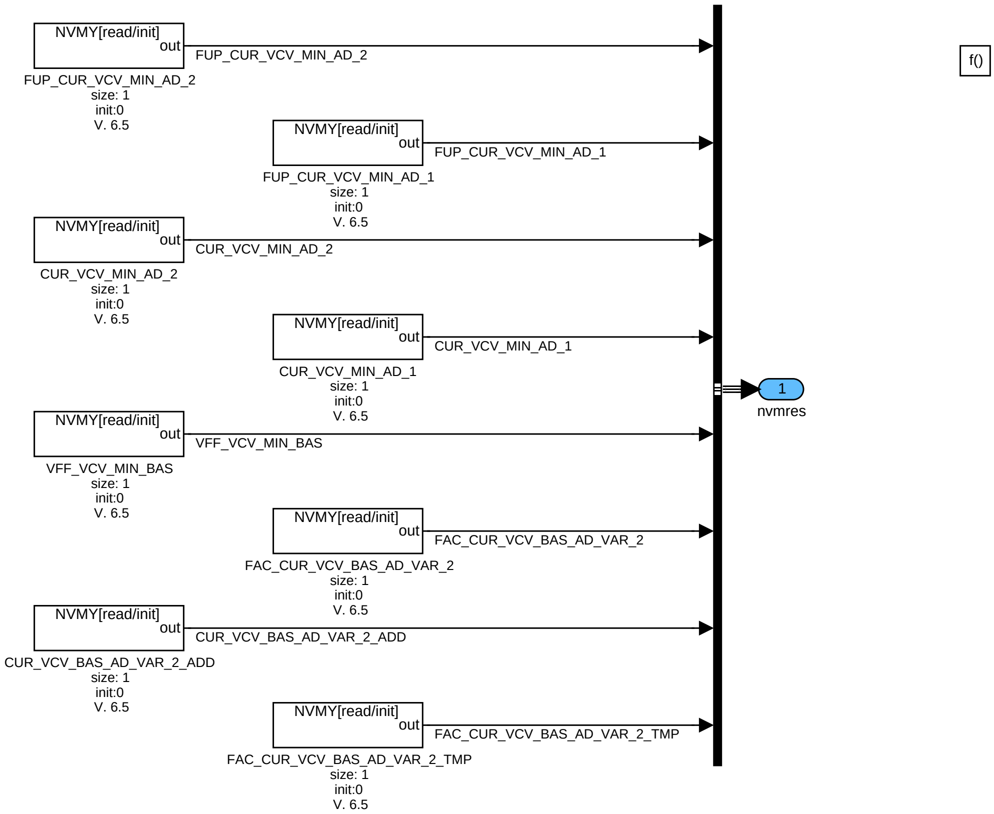

Figure 9.40.9: :

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9.40.1.4 NVMY Store

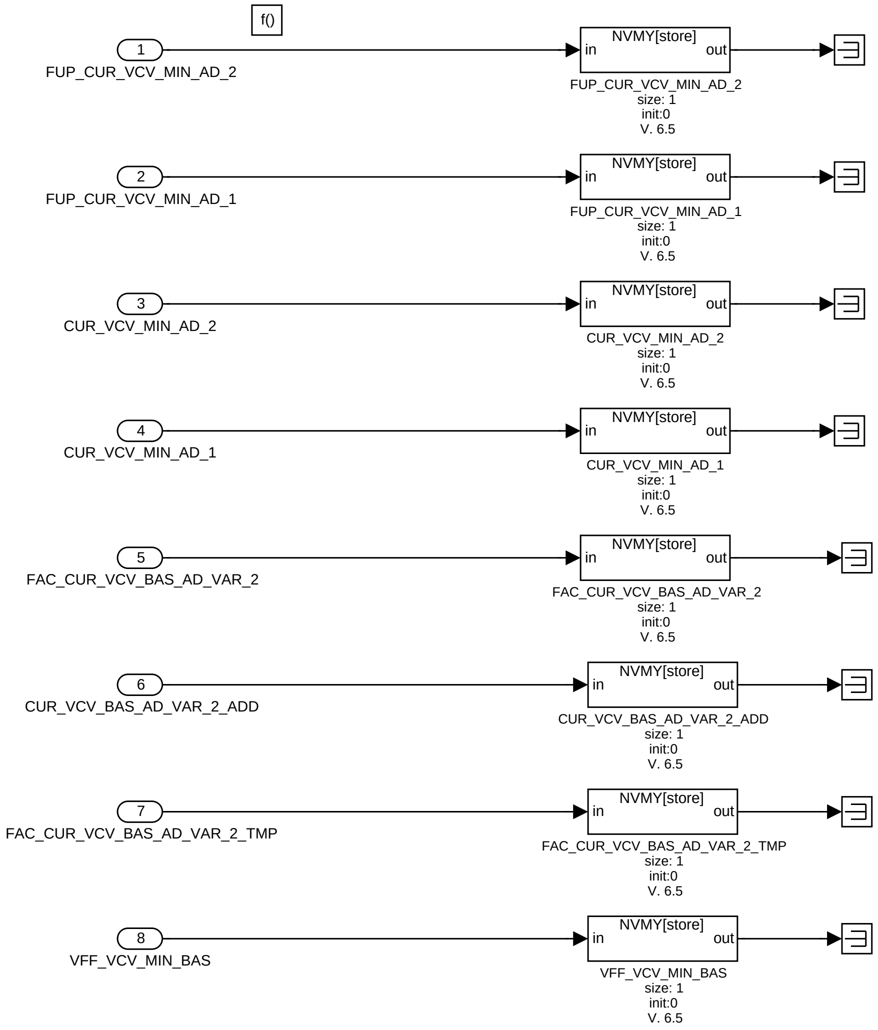

Figure 9.40.10: :

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9.40.2 Formula Section

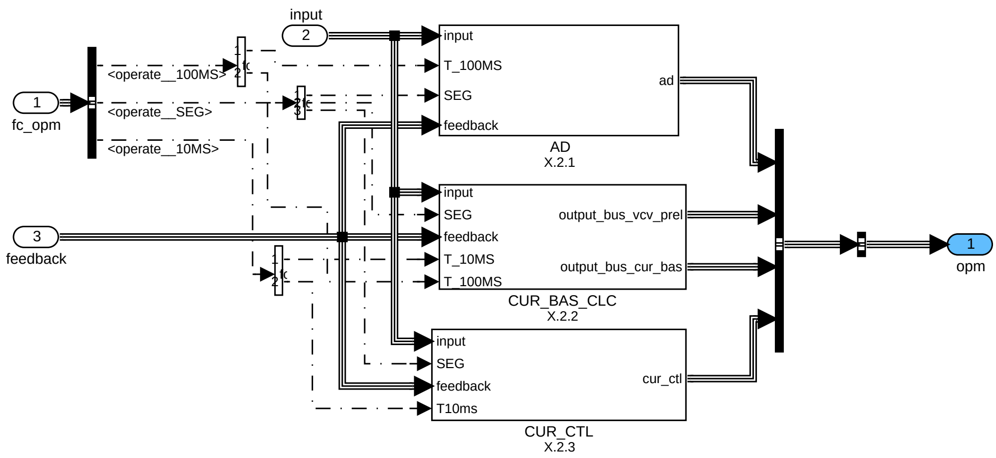

Figure 9.40.11: :

9.40.2.1 Adaptation

This function part provides the adaptation values of the VCV.

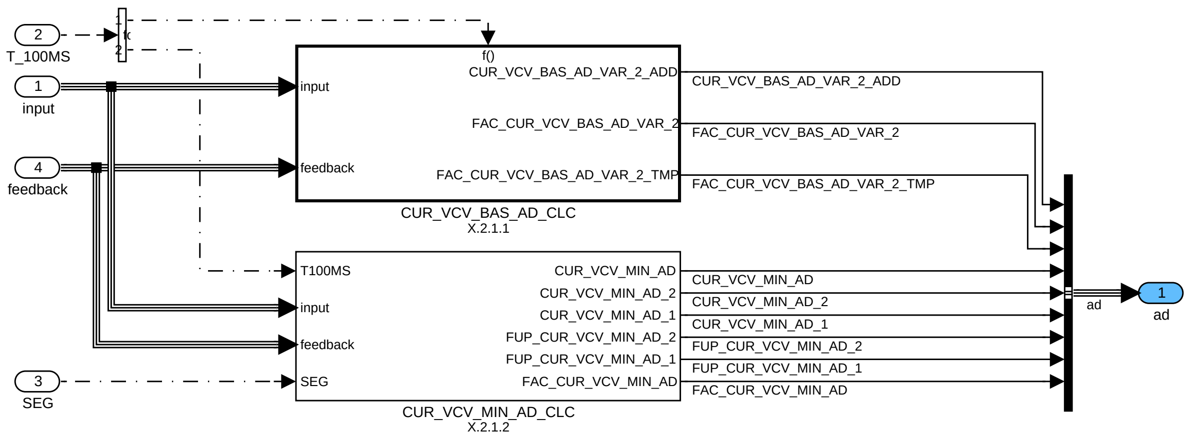

Figure 9.40.12: :

9.40.2.1.1 Adaptation of valve characteristics:

In this block the factor of the second variant of the VCV_BAS adaptation is calculated.

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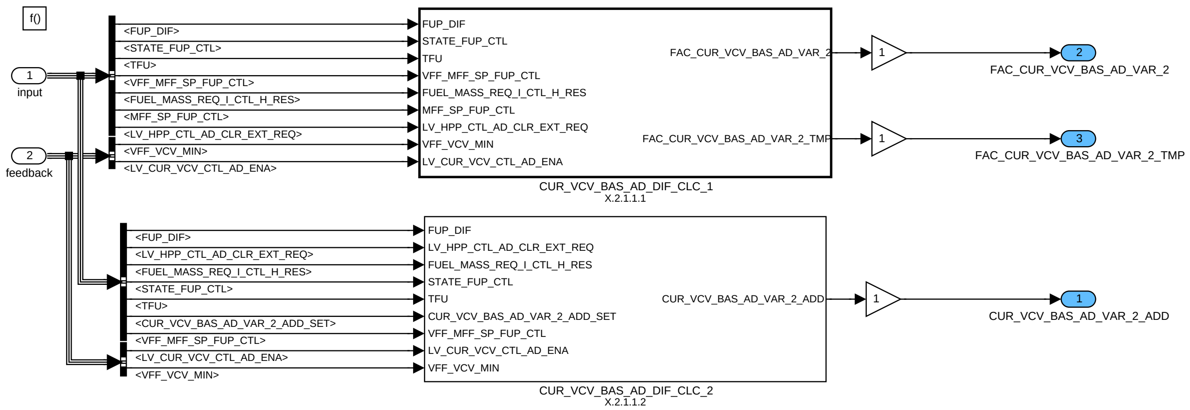

Figure 9.40.13: :

9.40.2.1.1.1 Additive component calculation

In this block the additive component of the second variant of the VCV_BAS adaptation is calculated.

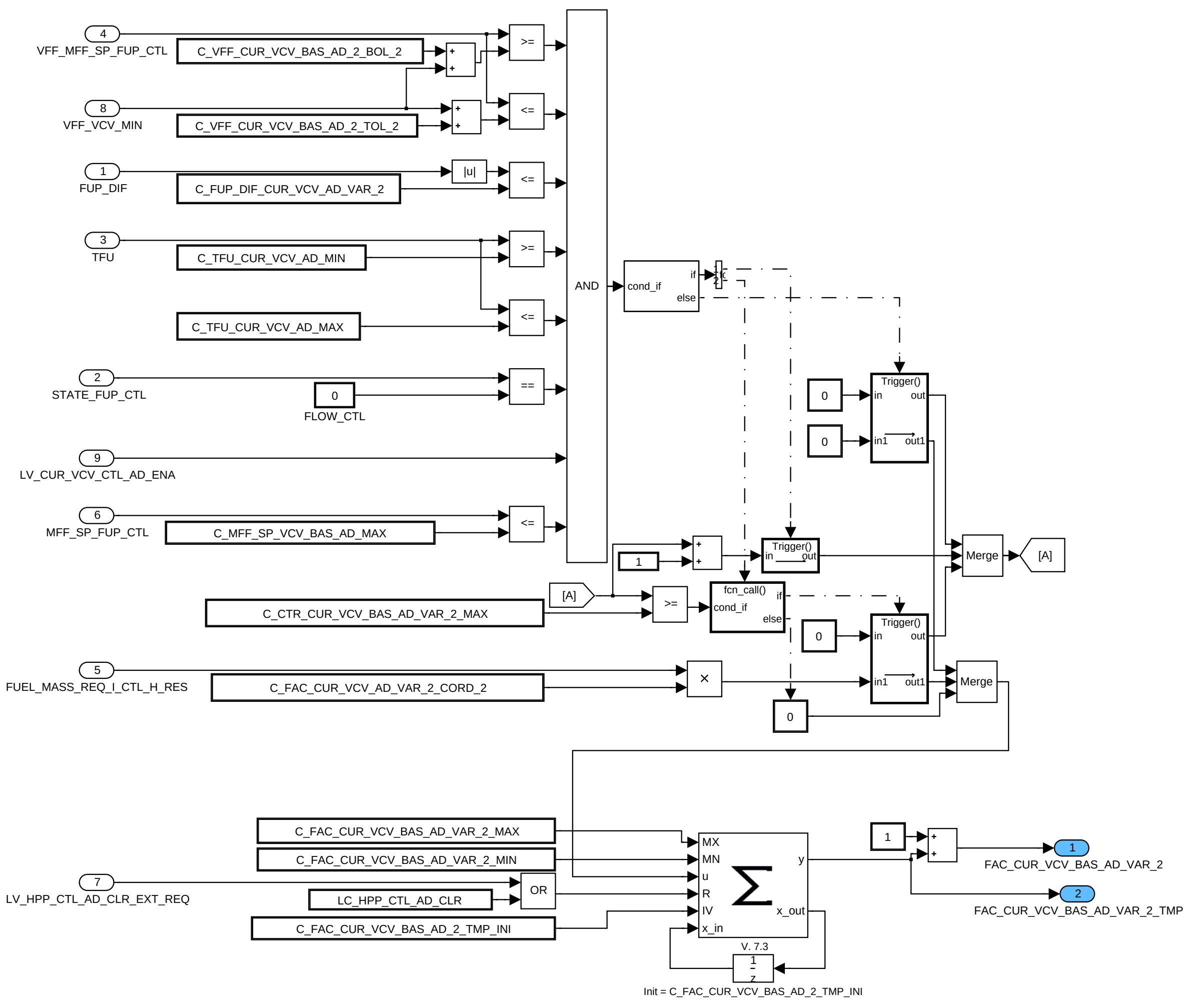

Figure 9.40.14: :

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9.40.2.1.1.2 Factor Calculation

In this block the factor of the second variant of the VCV_BAS adaptation is calculated.

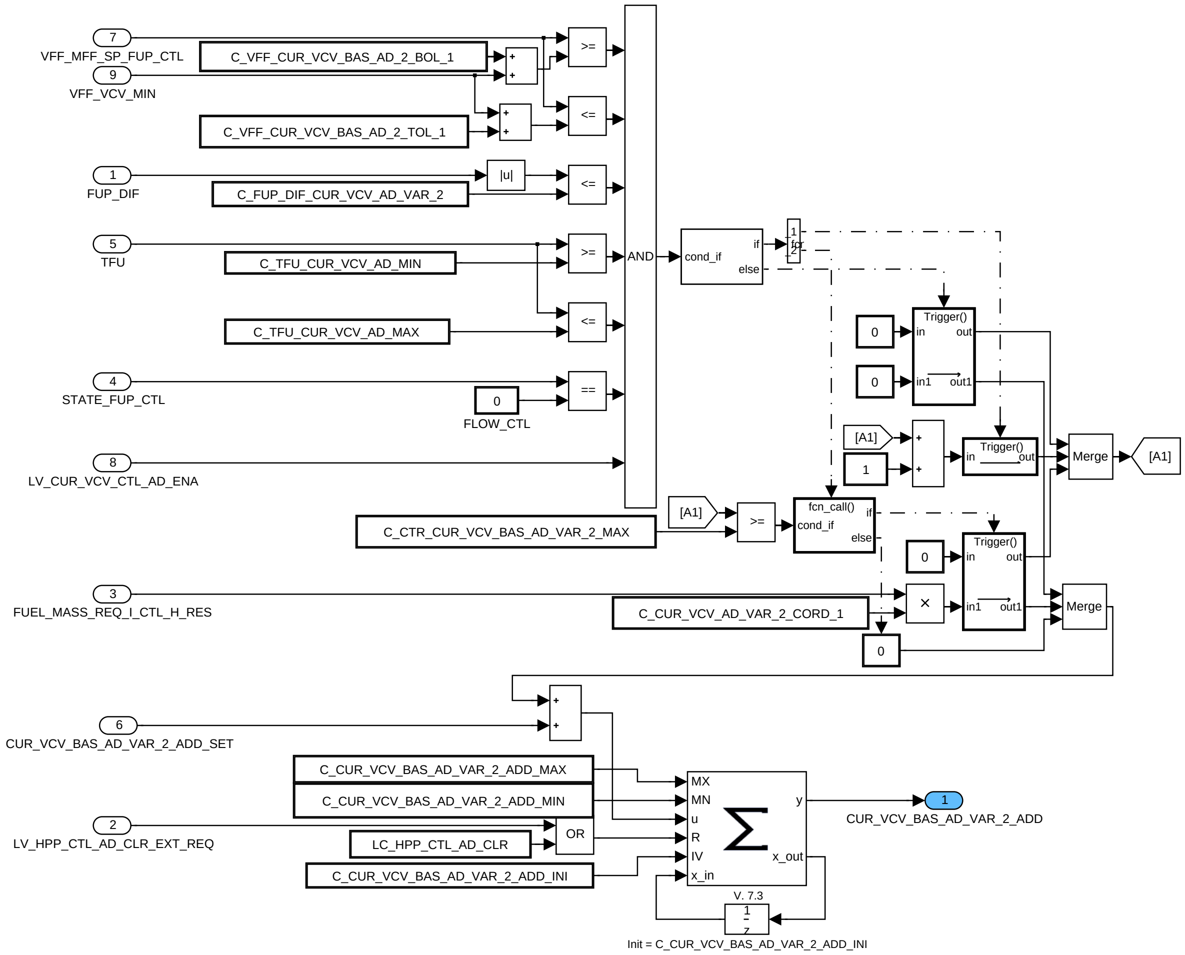

Figure 9.40.15: :

9.40.2.1.2 Pressure control line adaptation of the VCV valve

This calculation is split into the calculations of the two points, the calculation of a factor and the final calculation of the adaptation value for the pressure control part of the valve.
! CUR_VCV_MIN_AD_CLC has to be calculated at first inside segment synchronous task.

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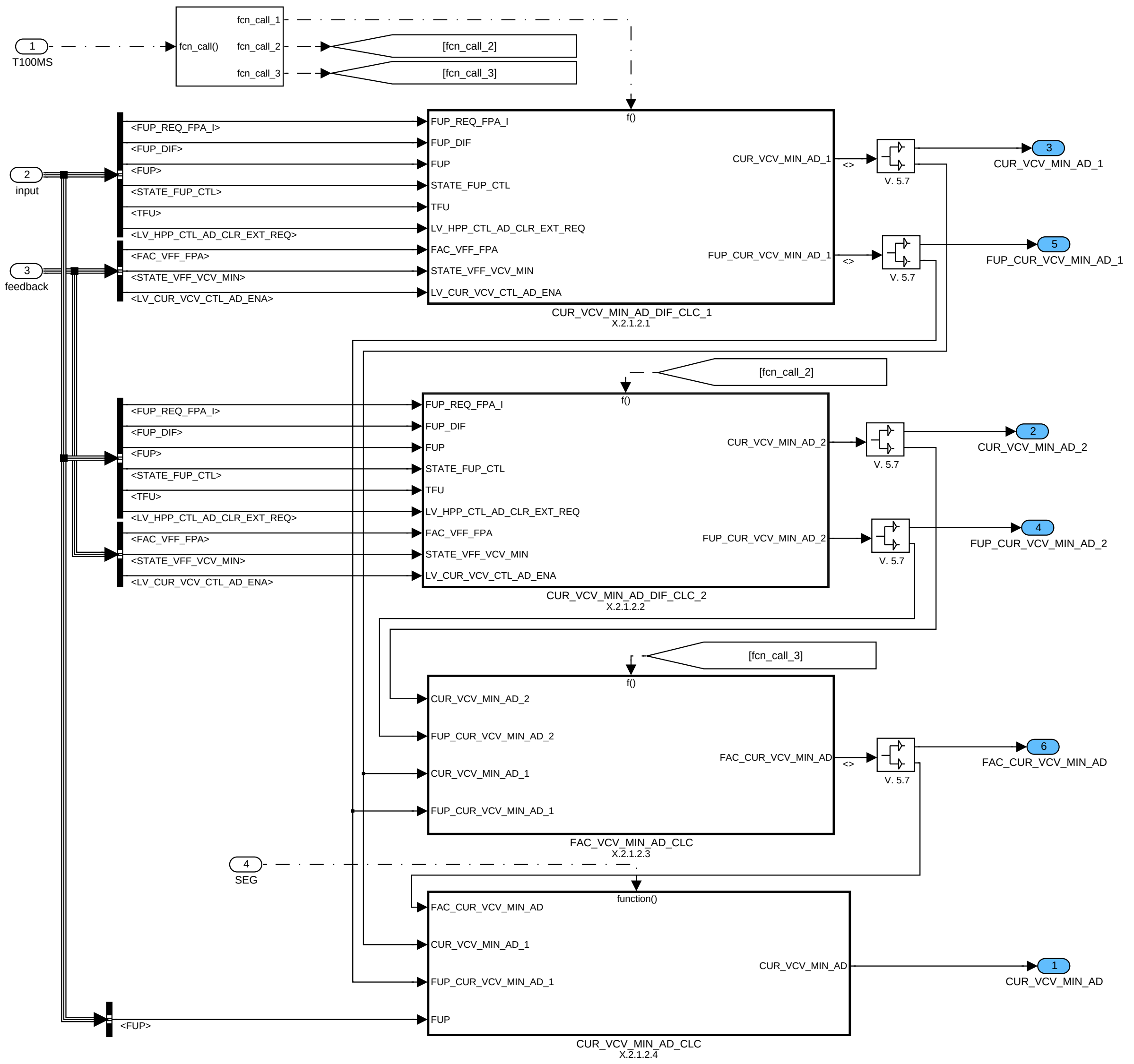

Figure 9.40.16: :

9.40.2.1.2.1 Adaptation of point 2 of pressure control line

The calculation of the first point of the adaptation of the pressure control line is constisting out of a MMV calculation of the flow and the corresponding state chart

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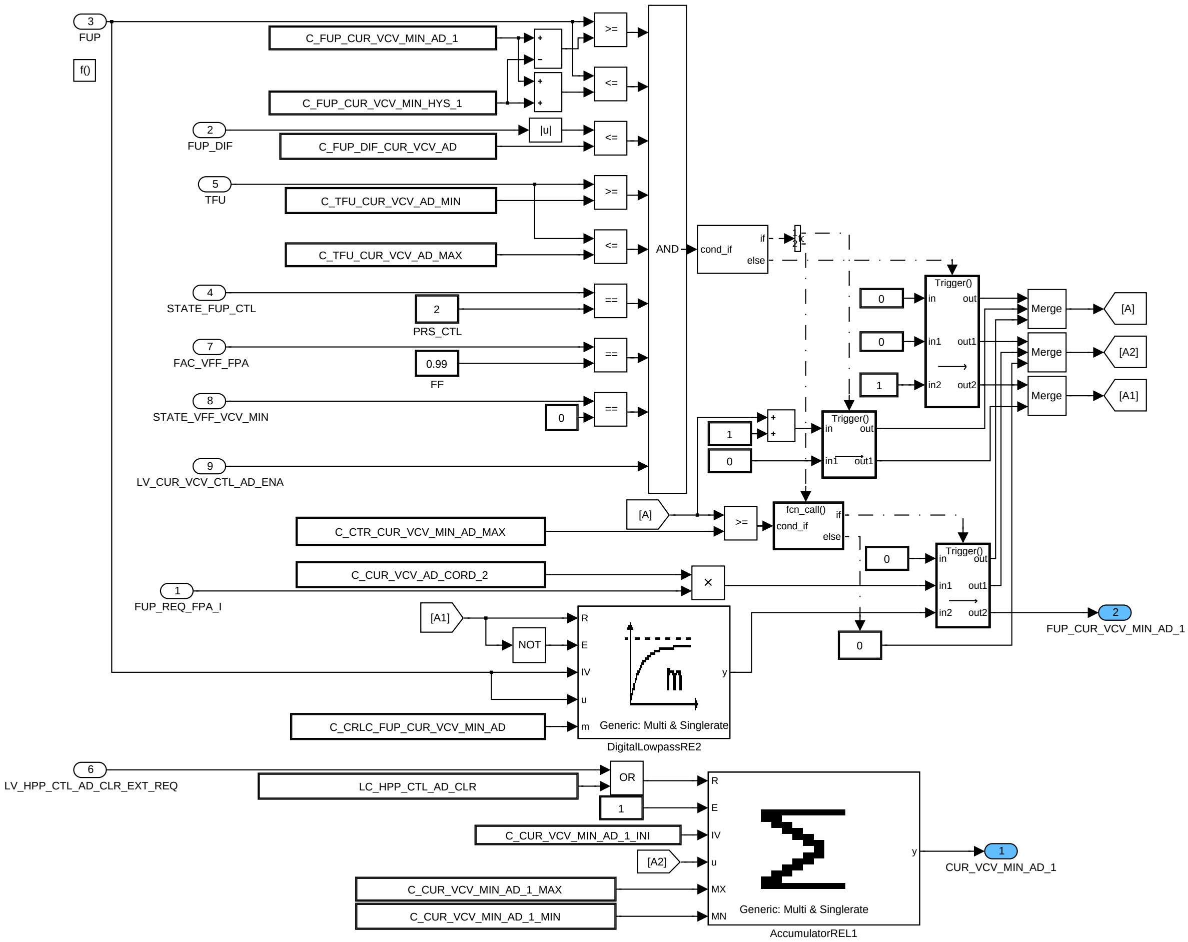

Figure 9.40.17: :

9.40.2.1.2.2 Calculation of point 1 of pressure control line

The calculation of the second point of the adaptation of the pressure control line is consisting out of a MMV calculation of the flow and the corresponding state chart.

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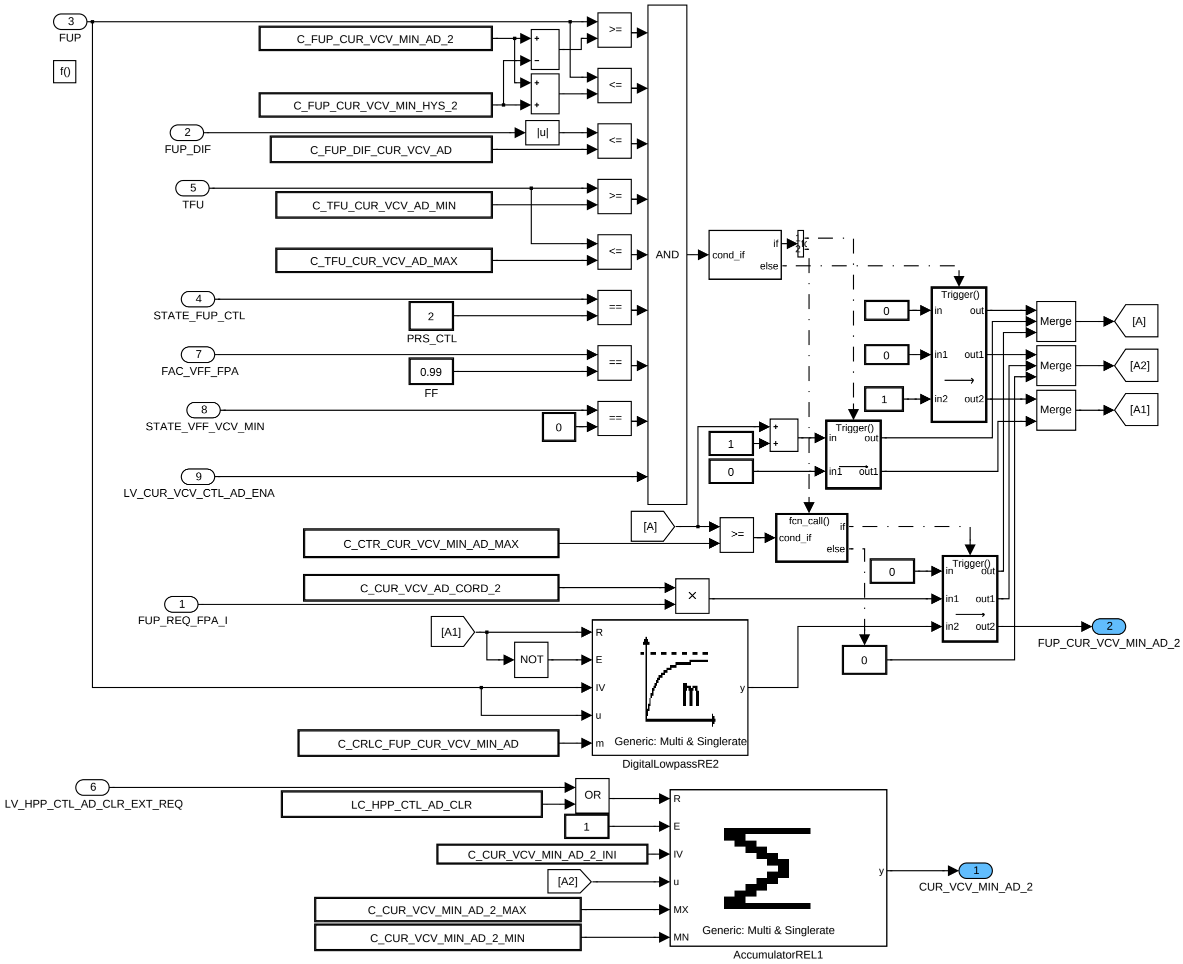

Figure 9.40.18: :

9.40.2.1.2.3 Calculation of the slope of the pressure control line

In this block the slope for the correction of the pressure control part of the valve is calculated.

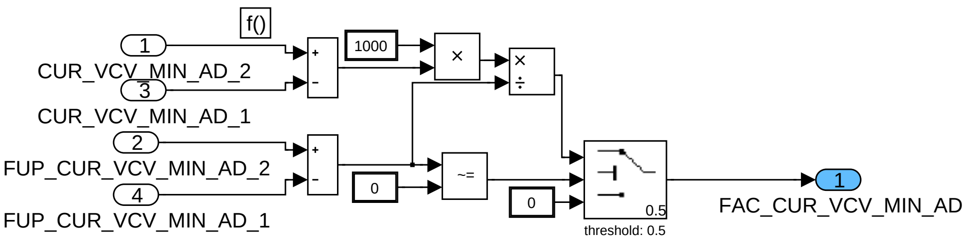

Figure 9.40.19: :

9.40.2.1.2.4 Calculation of the final pressure control line adaptation value

The final adaptation value for the pressure control part of the valve is calculated in that block.

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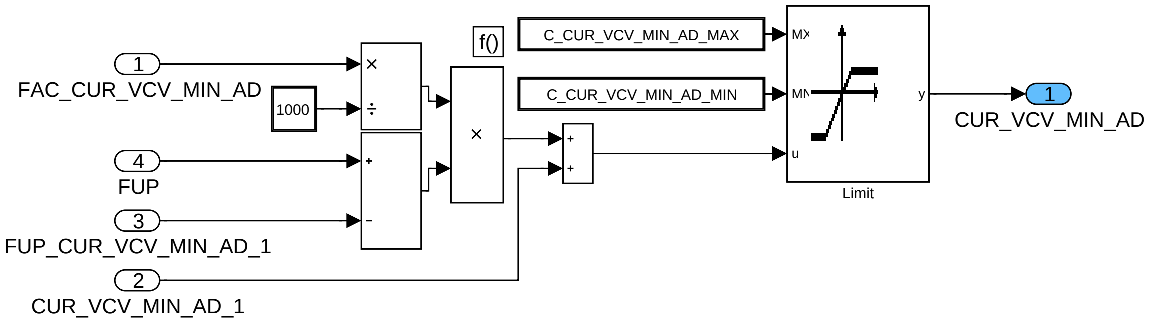

Figure 9.40.20: :

9.40.2.2 Basic VCV Current Calculation

Overview of basic VCV current calculation. This function part provides the desired VCV current.

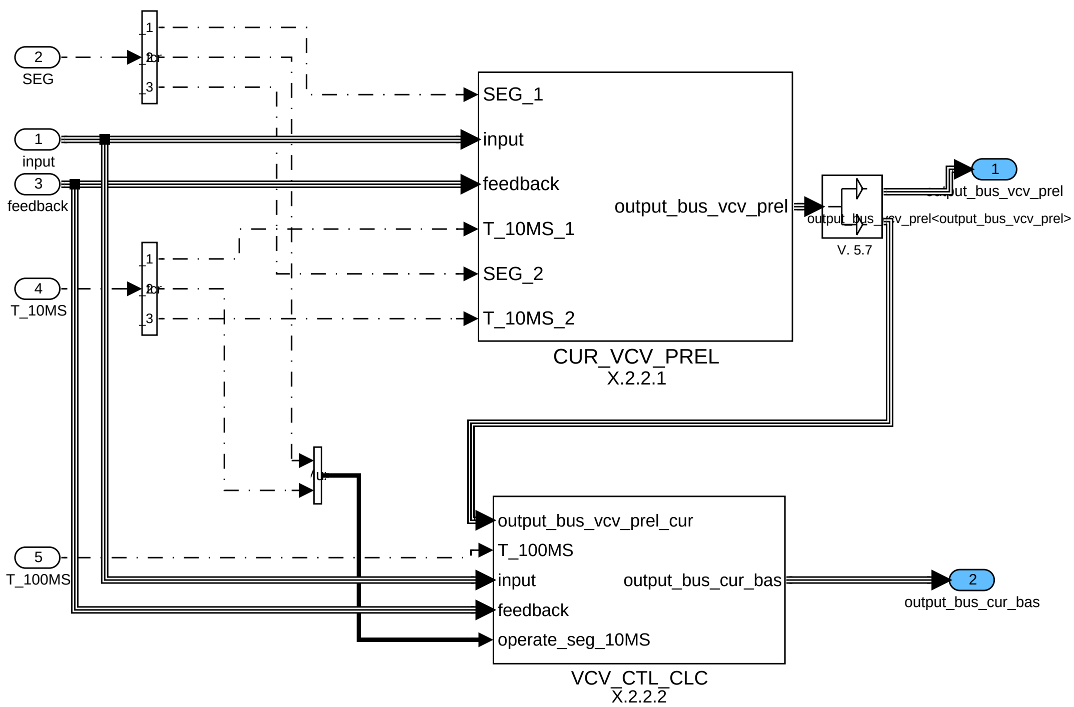

Figure 9.40.21: :

9.40.2.2.1 Calculation of the basic fuel flows through the valve

The requested volume fuel flow through the volume control valve is calculated by the requested fuel mass and a conversion calculation taken into account the segment time and the density of the fuel. The real pumped fuel flow volume is calculated out of the calculated pump fuel mass.

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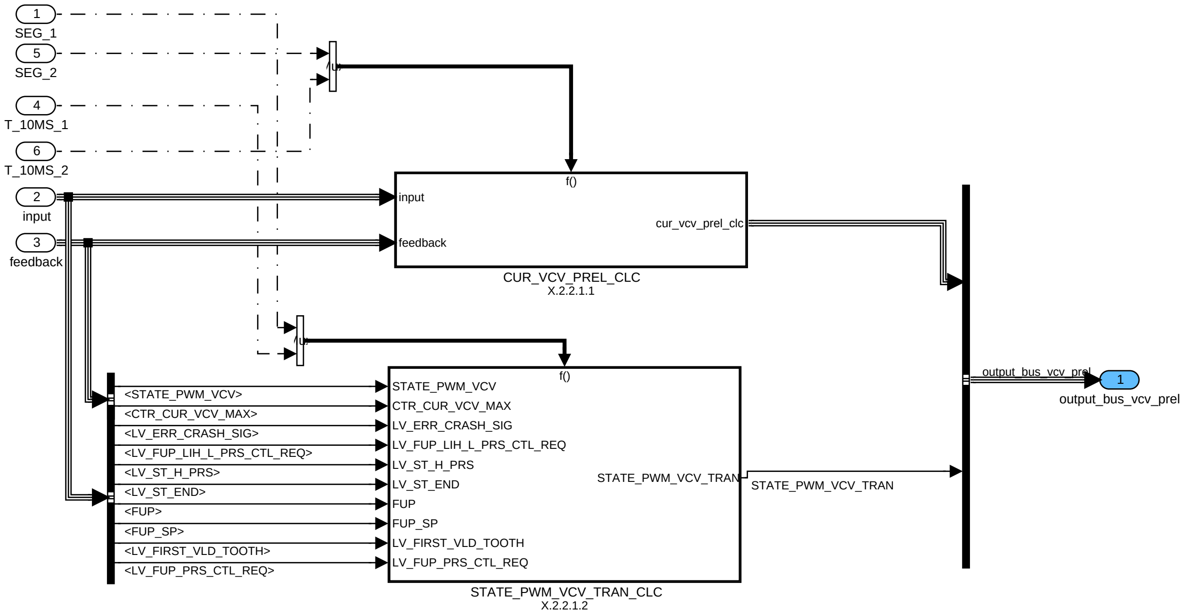

Figure 9.40.22: :

9.40.2.2.1.1 CUR_VCV_PREL_CLC

This part has been divided into 3 parts

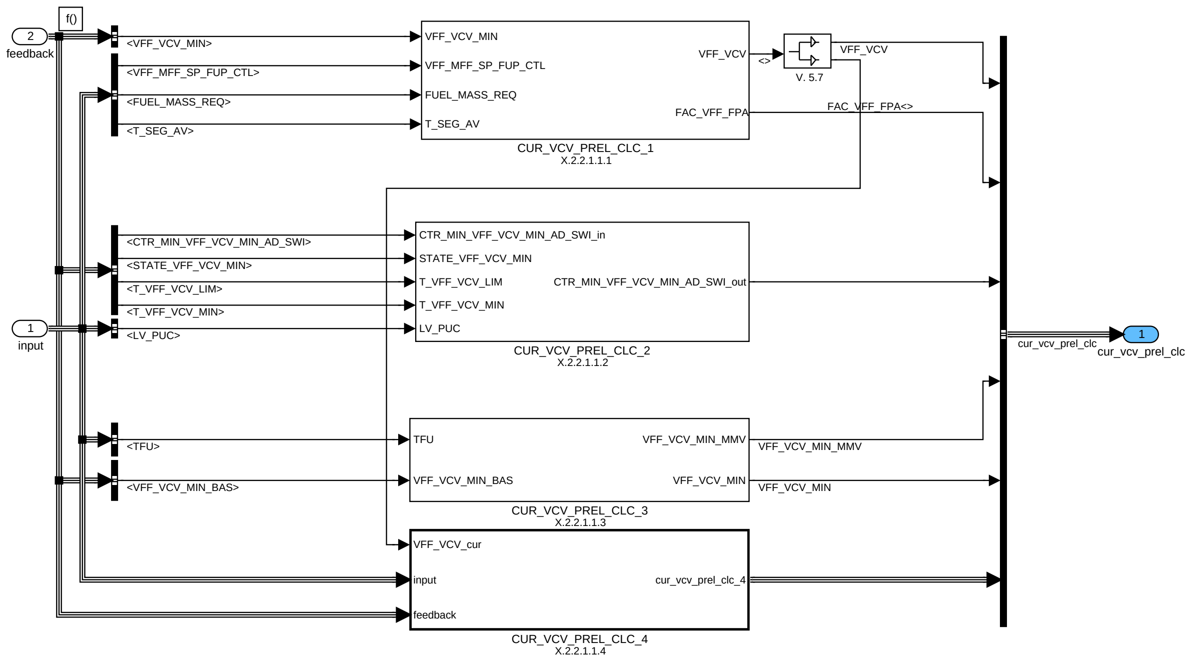

Figure 9.40.23: :

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9.40.2.2.1.1.1 CUR_VCV_PREL_CLC_1

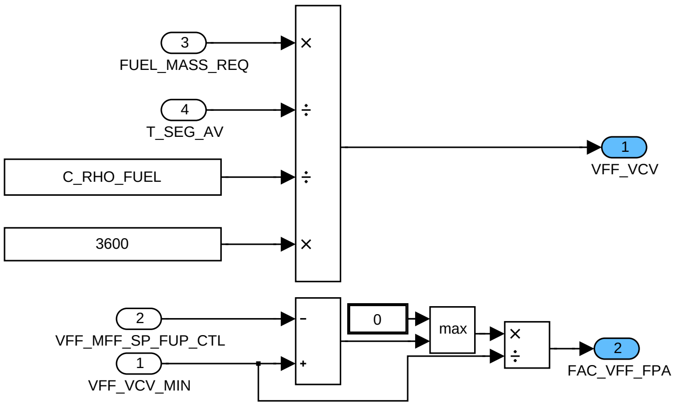

Figure 9.40.24: :

9.40.2.2.1.1.2 CUR_VCV_PREL_CLC_2

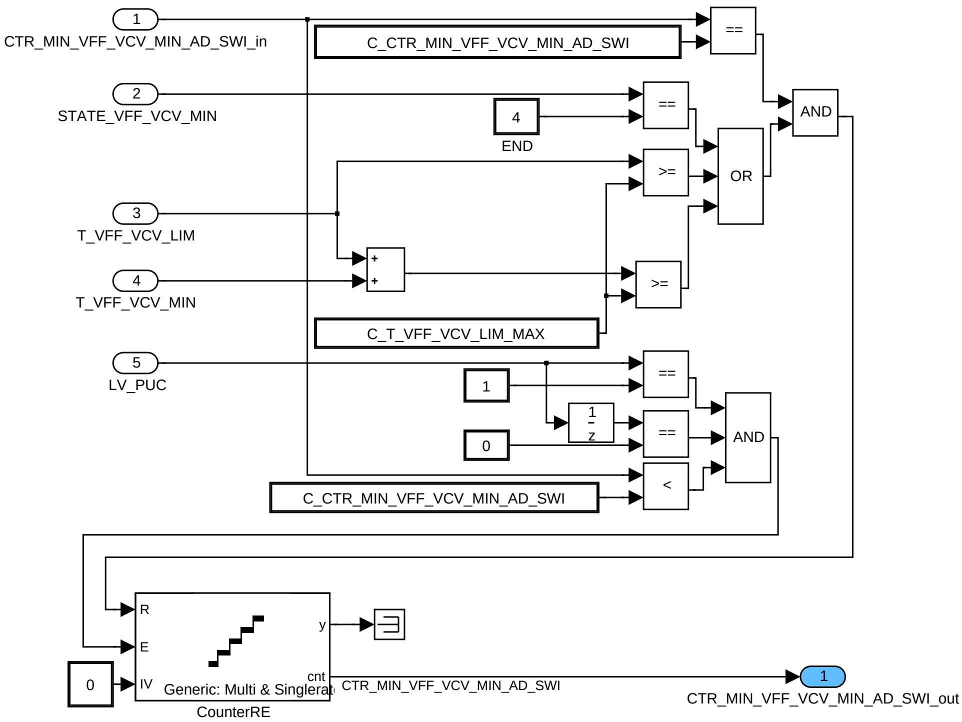

Figure 9.40.25: :

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9.40.2.2.1.1.3 CUR_VCV_PREL_CLC_3

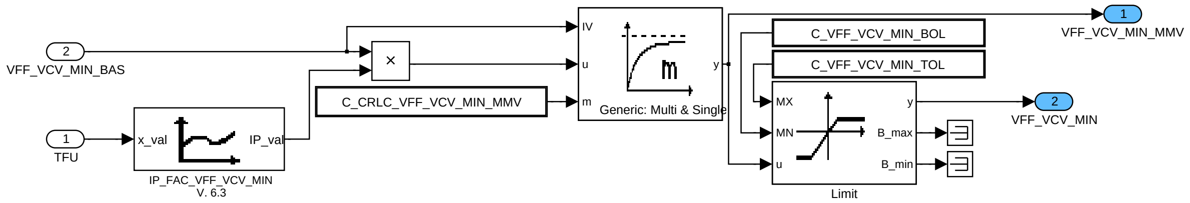

Figure 9.40.26: :

9.40.2.2.1.1.4 CUR_VCV_PREL_CLC_4

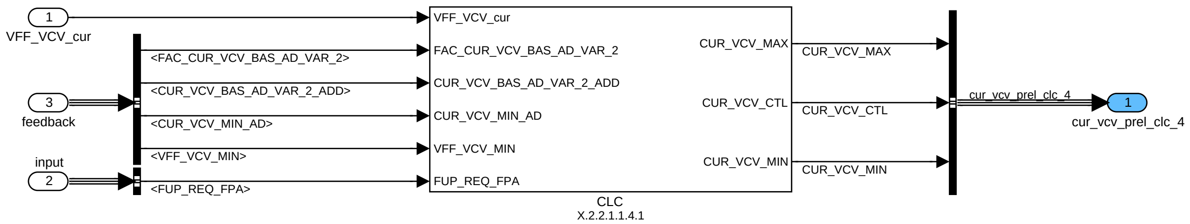

Figure 9.40.27: :

9.40.2.2.1.1.4.1 Calculation

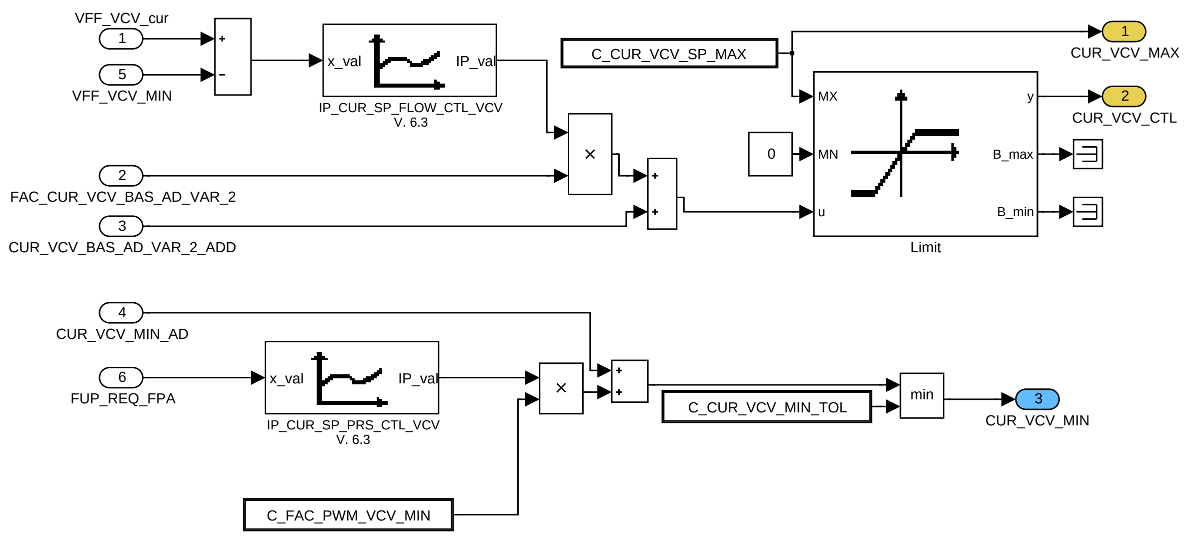

Figure 9.40.28: :

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9.40.2.2.1.2 Calculation of the transition conditions for the different working areas of the volume control valve

In this block the conditions for operating the state diagram are given. At crash event a safe state should be reached. In case of pull the valve should be closed and in case of engine stop the valve should be open. Manual operation can be selected by a flag. If none of the above mentioned cases are valid the normal operation mode can be done.

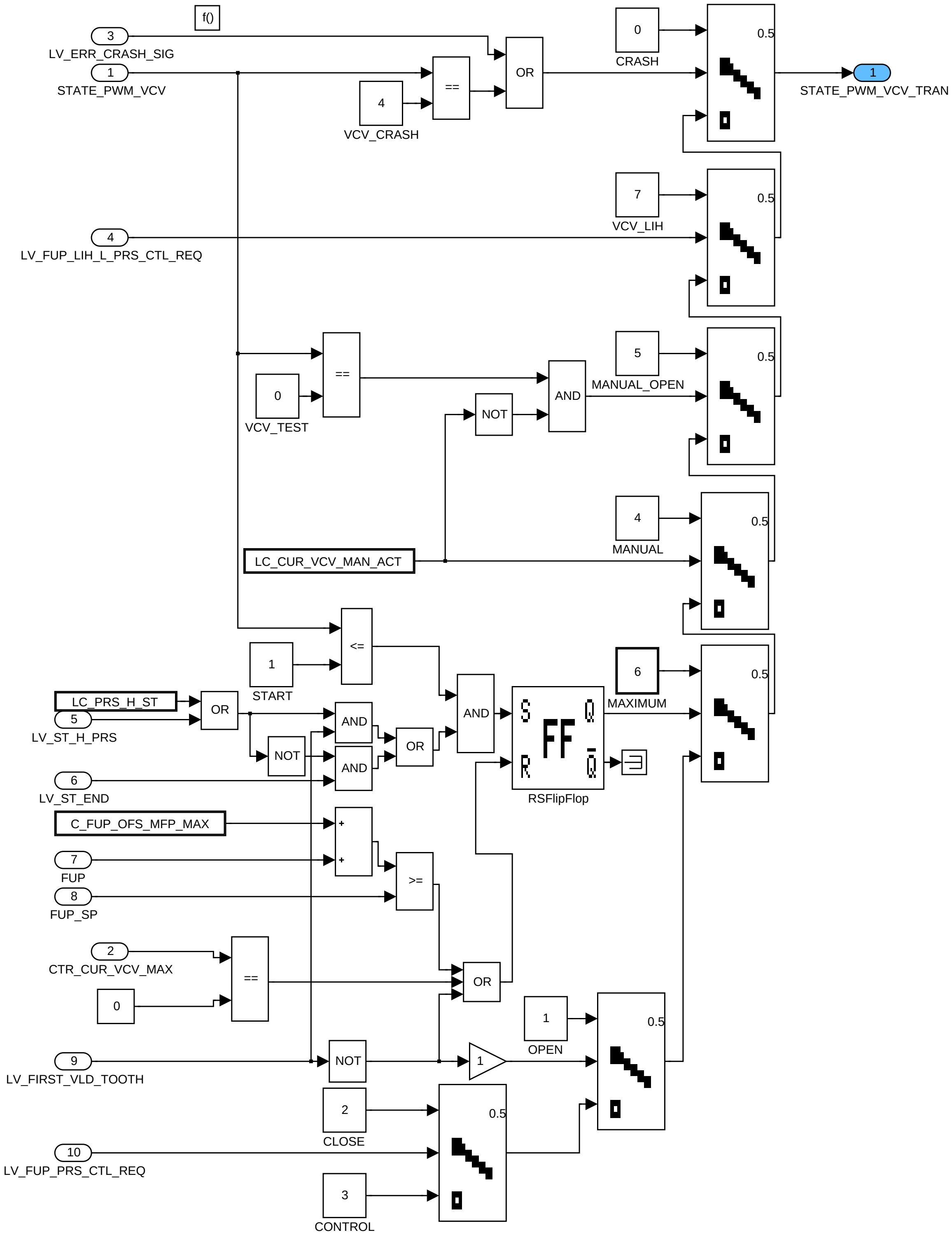

Figure 9.40.29: :

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9.40.2.2.2 Final calculation of the output signals

In the state diagram the states are set corresponding to the transition conditions defined before. Out of the conditions the PWM can be calculated with the two blocks following the state diagram.

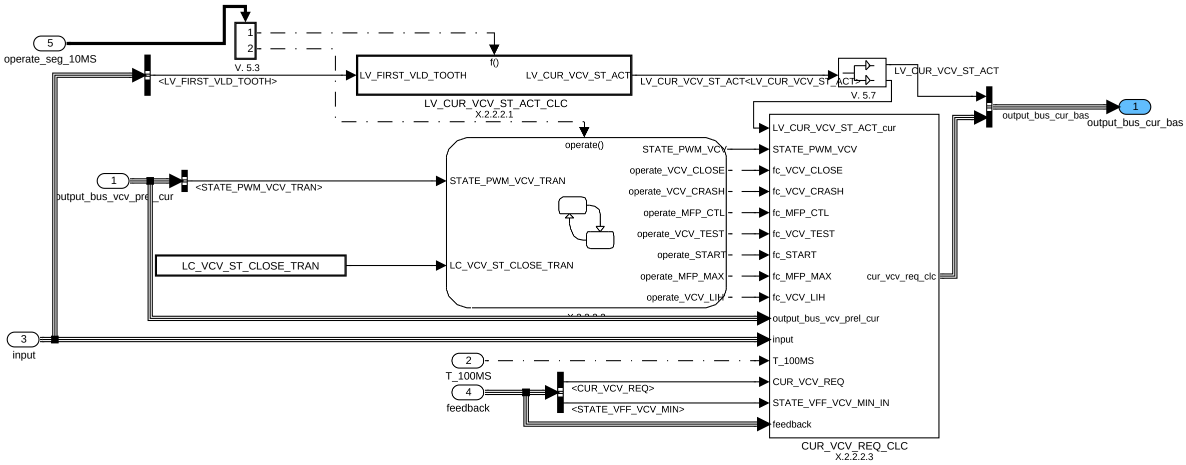

Figure 9.40.30: :

9.40.2.2.2.1 Calculation of LV_CUR_VCV_ST_ACT_CLC

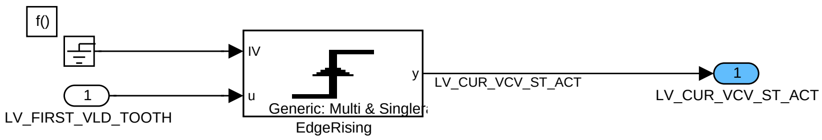

Figure 9.40.31: :

9.40.2.2.2.2 Chart1

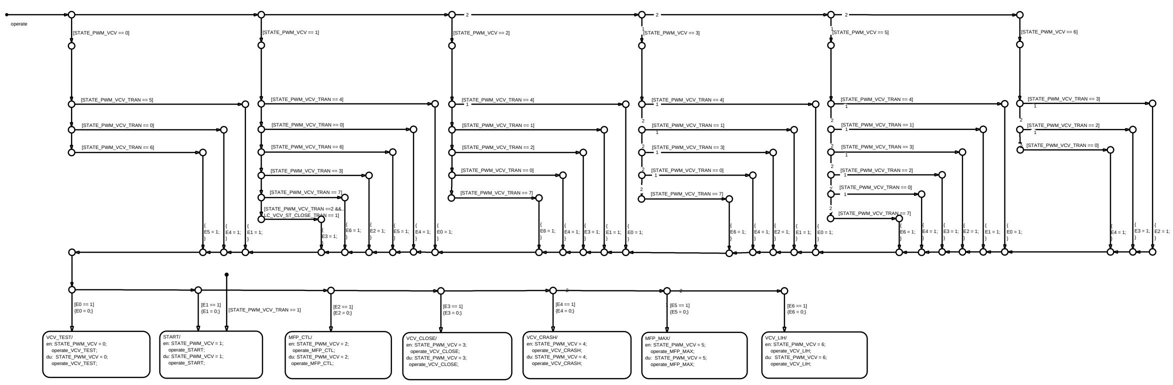

Figure 9.40.32: :

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9.40.2.2.2.3 Calculation of CUR_VCV_REQ_CLC

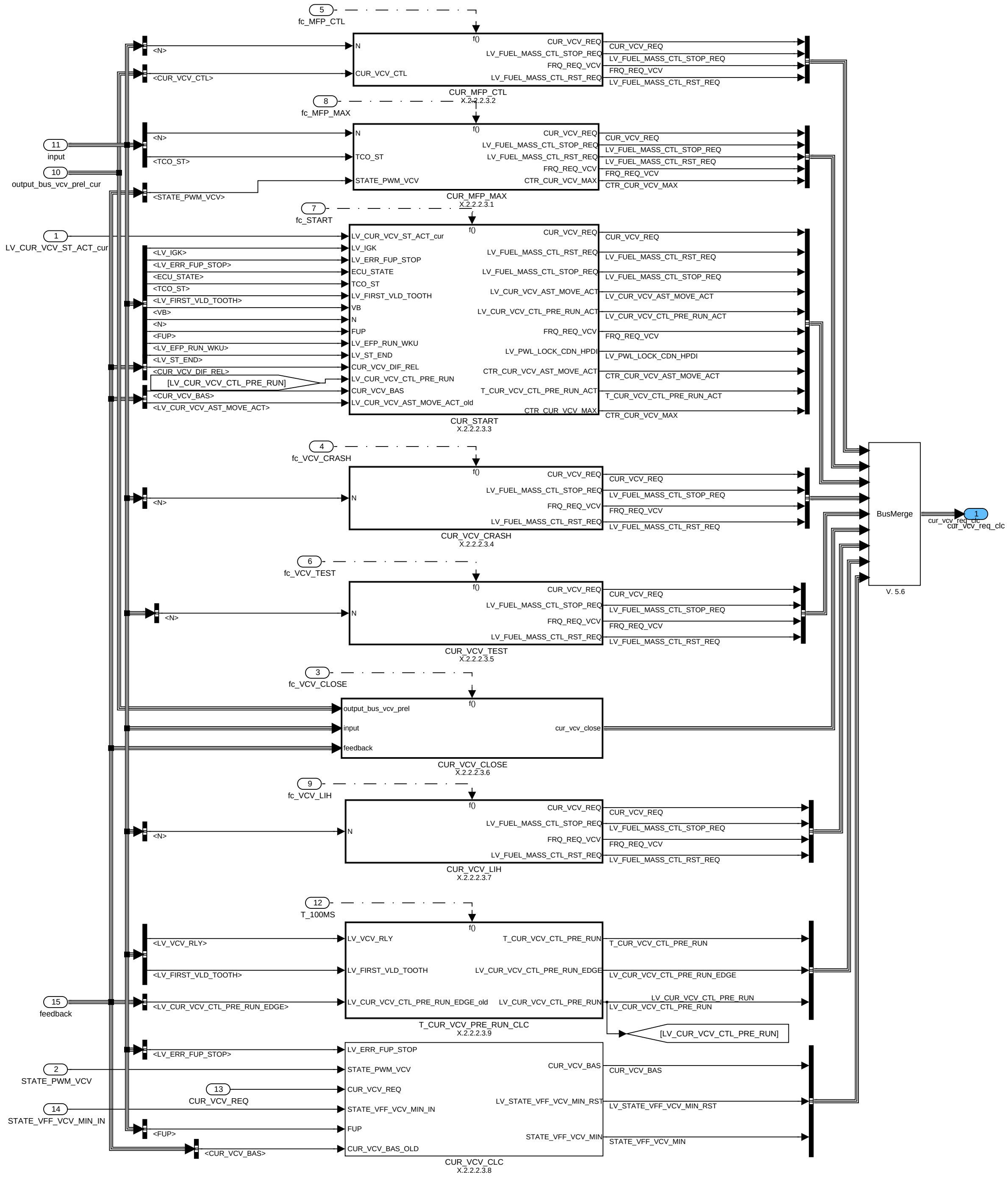

Figure 9.40.33: :

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9.40.2.2.2.3.1 CUR_MFP_MAX

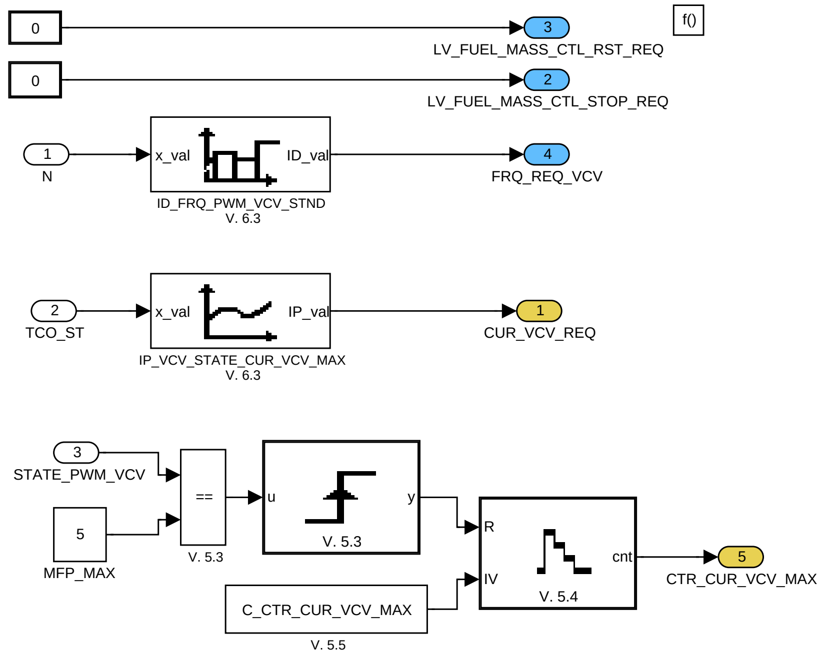

Figure 9.40.34: :

9.40.2.2.2.3.2 CUR_MFP_CTL

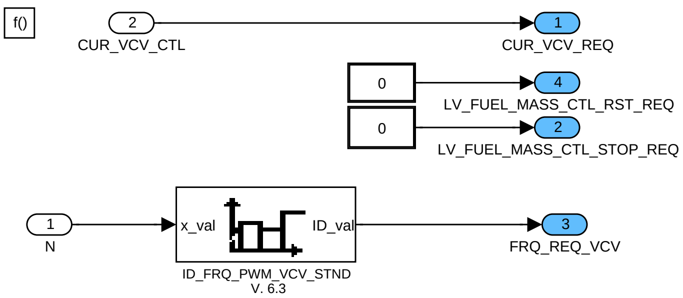

Figure 9.40.35: :

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9.40.2.2.2.3.3 CUR_START

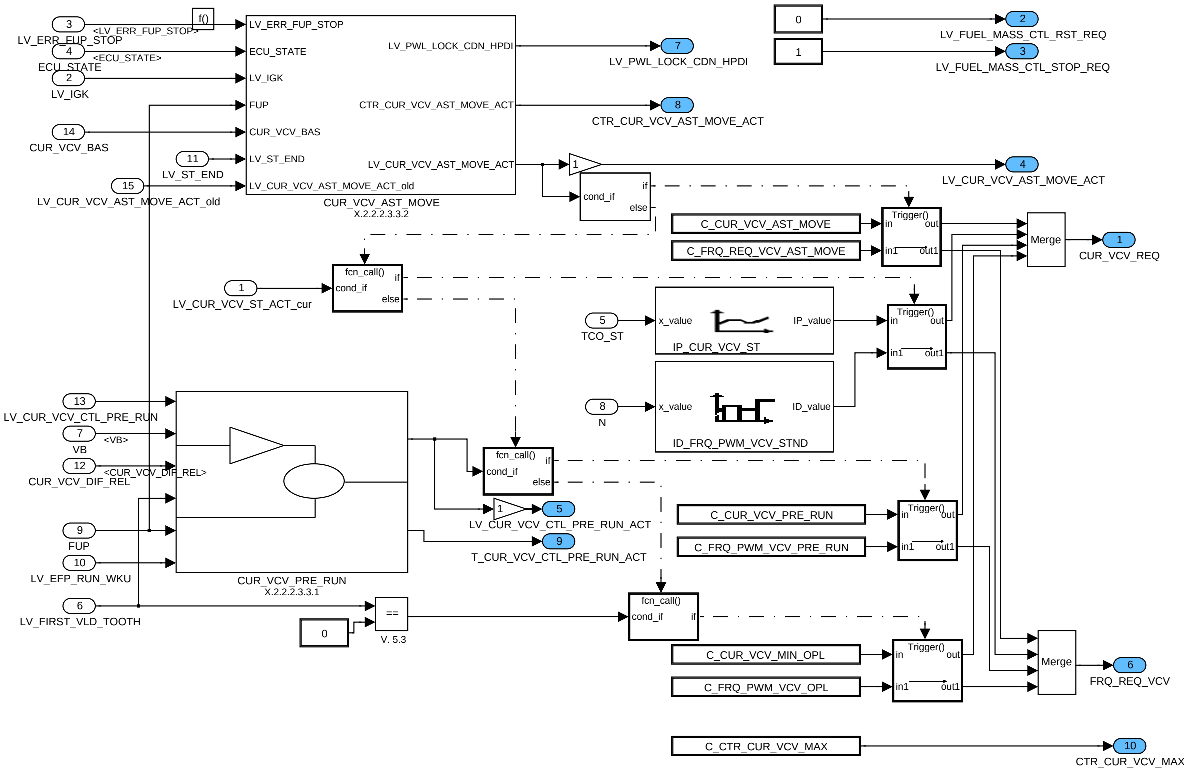

Figure 9.40.36: :

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9.40.2.2.2.3.3.1 Calculation of LV_CUR_VCV_CTL_PRE_RUN_ACT

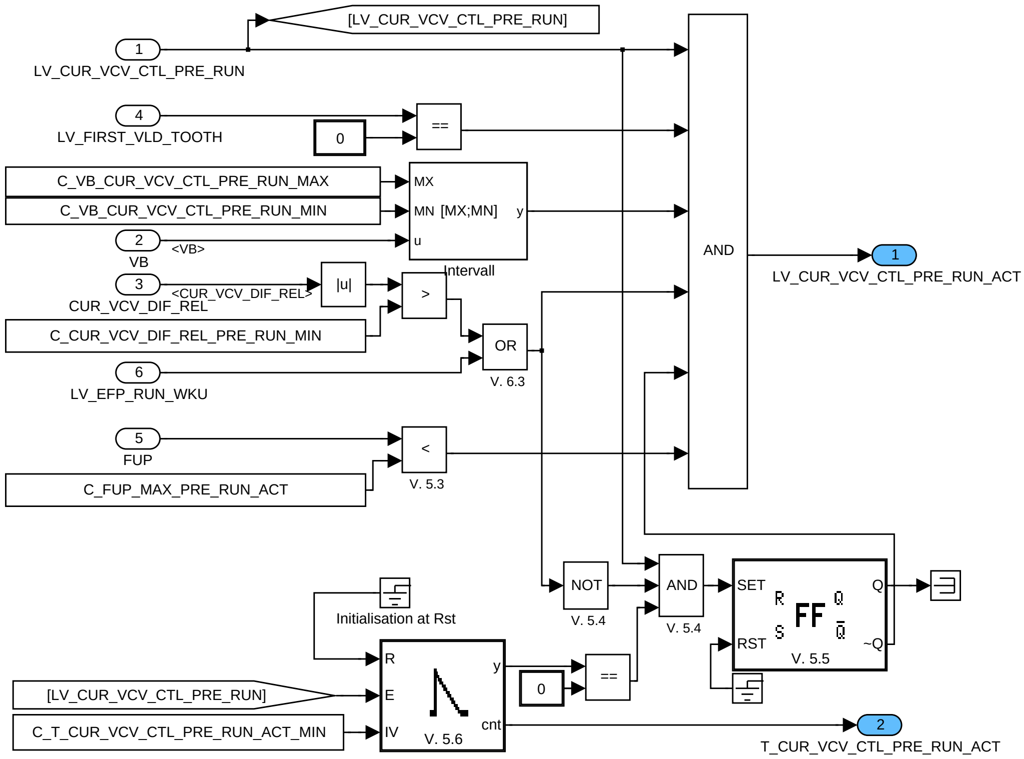

Figure 9.40.37: :

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9.40.2.2.2.3.3.2 Movement of VCV after engine stop.

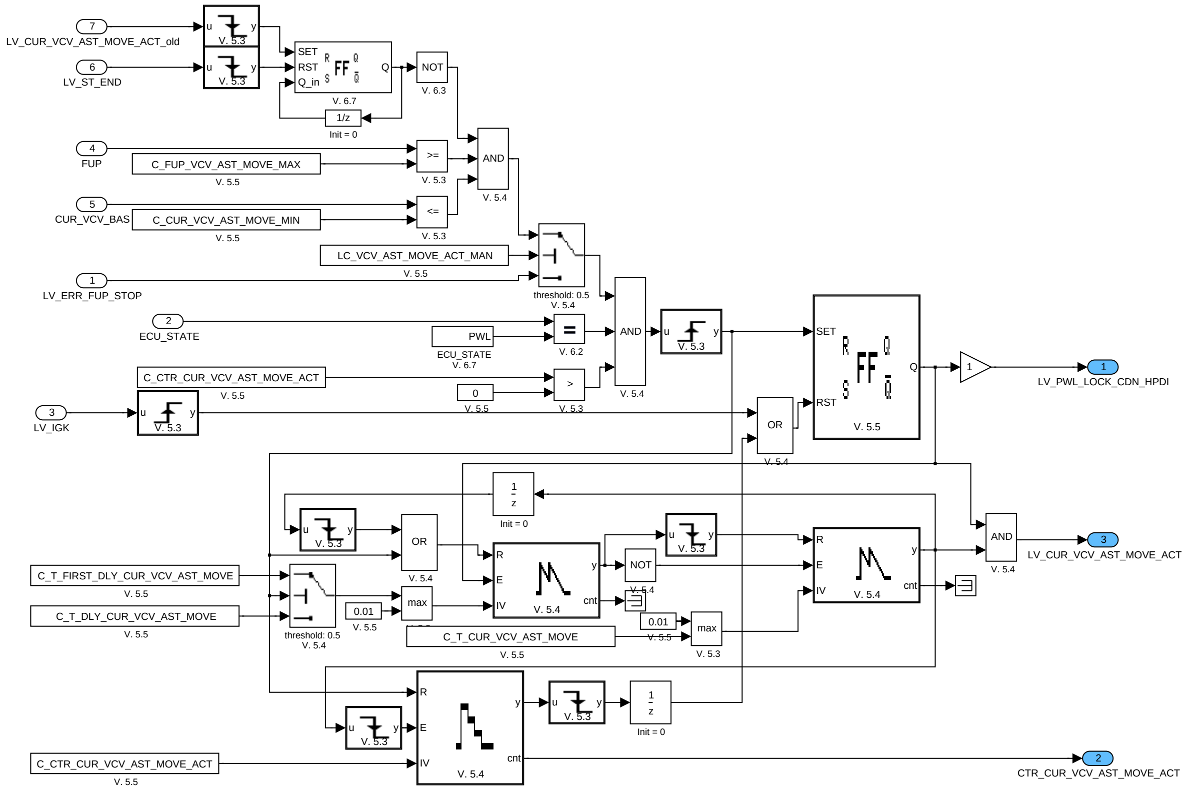

Figure 9.40.38: :

9.40.2.2.2.3.4 CUR_VCV_CRASH

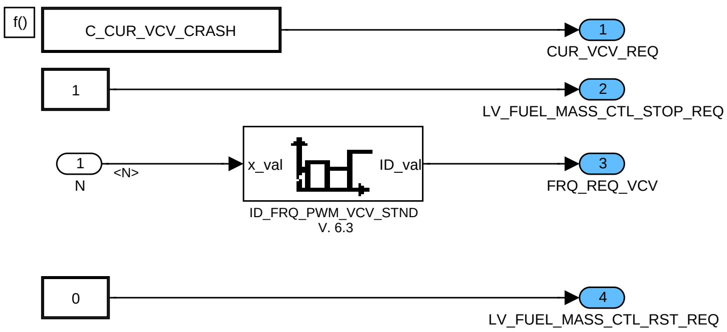

Figure 9.40.39: :

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9.40.2.2.2.3.5 CUR_VCV_TEST

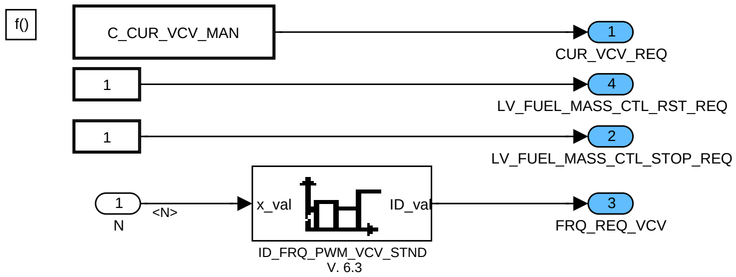

Figure 9.40.40: :

9.40.2.2.2.3.6 Leakage adaptation in the state 'close'

The minimum flow through the VCV can be adapted by the following principle.

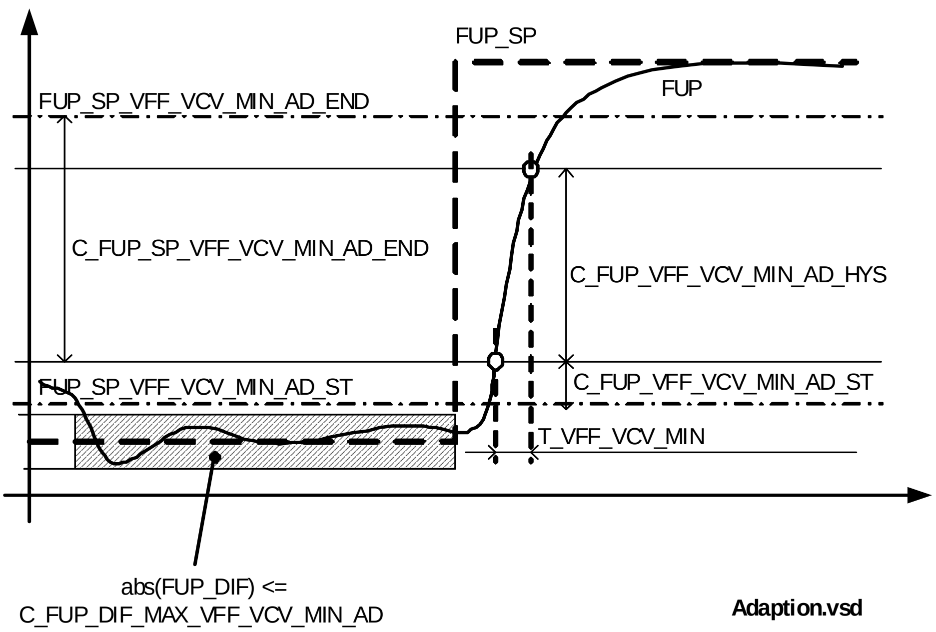

Figure 9.40.41: :

! The internal value of VFF_VCV_MIN_BAS digital lowpass filter has to be initialised by VFF_VCV_ MIN_BAS value at reset.

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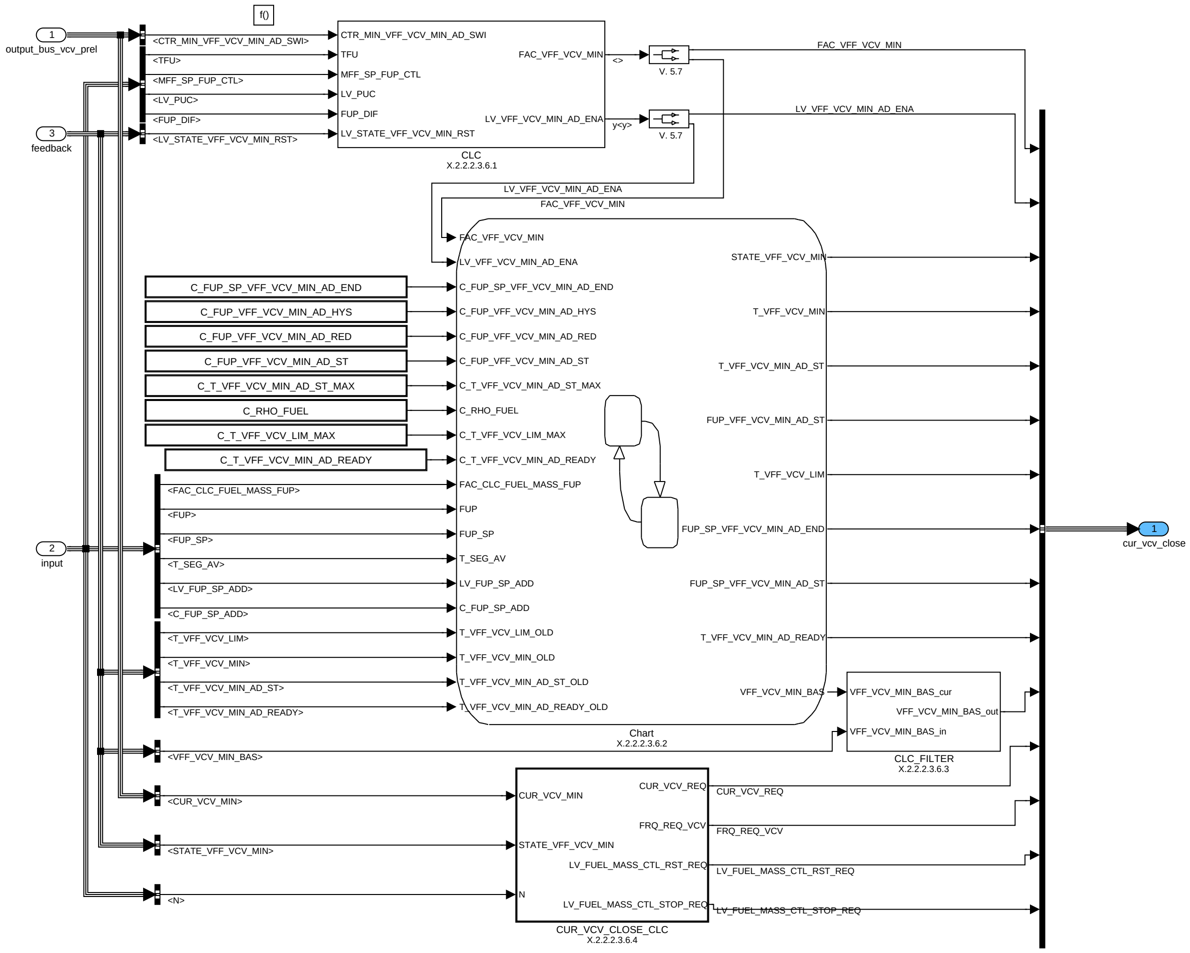

Figure 9.40.42: :

9.40.2.2.2.3.6.1 FUSL_M904B/OPM/CUR_BAS_CLC/VCV_CTL_CLC/CUR_VCV_REQ_CLC/CUR_VCV_CLOSE/CLC

CONTENT

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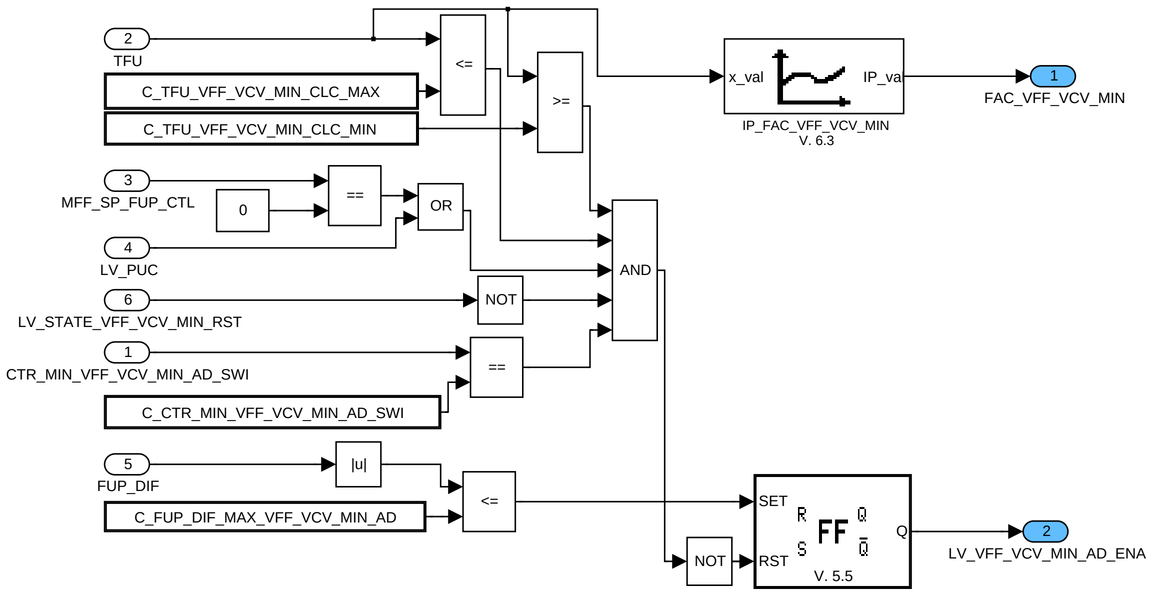

Figure 9.40.43: :

9.40.2.2.2.3.6.2 Chart

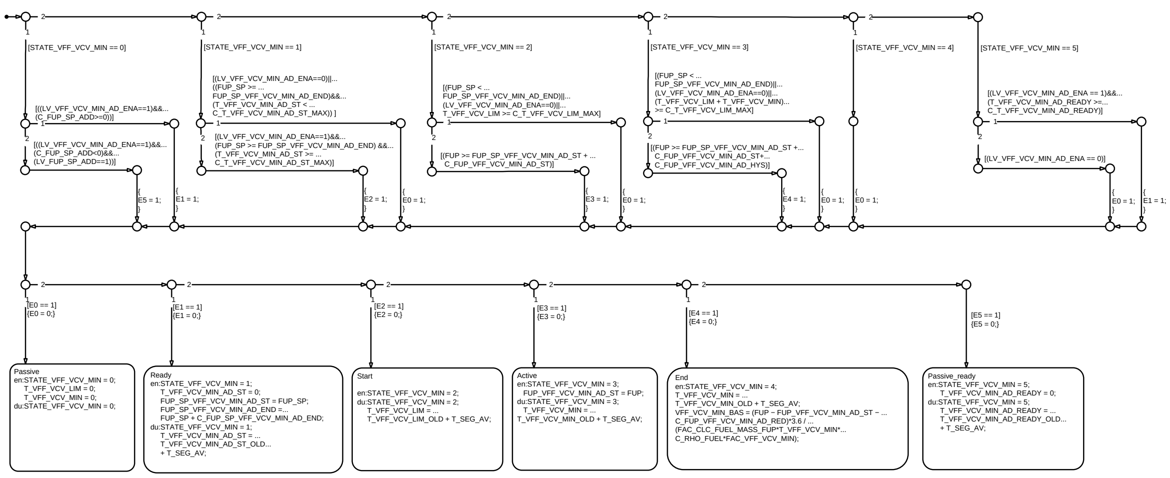

Figure 9.40.44: :

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9.40.2.2.2.3.6.3 FUSL_M904B/OPM/CUR_BAS_CLC/VCV_CTL_CLC/CUR_VCV_REQ_CLC/CUR_VCV_CLOSE/CLC_FILTER

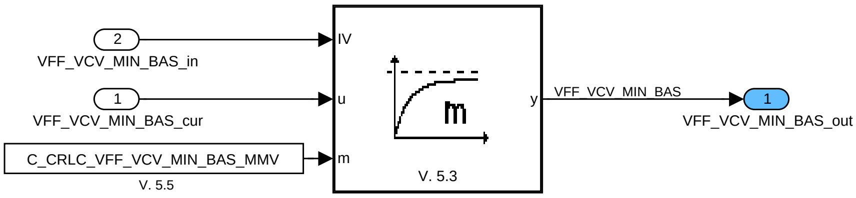

Figure 9.40.45: -:

9.40.2.2.2.3.6.4 FUSL_M904B/OPM/CUR_BAS_CLC/VCV_CTL_CLC/CUR_VCV_REQ_CLC/CUR_VCV_CLOSE/CUR_VCV_CLOSE_CLC

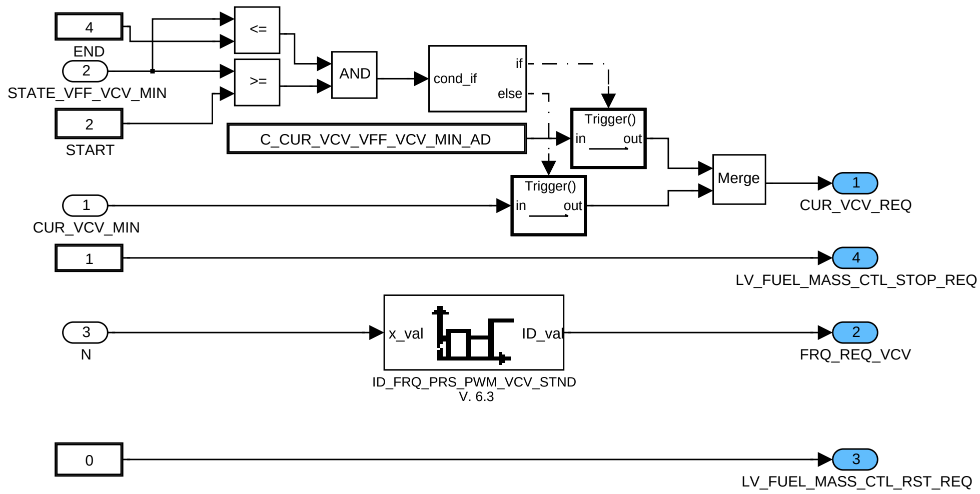

Figure 9.40.46: :

9.40.2.2.2.3.7 CUR_VCV_LIH

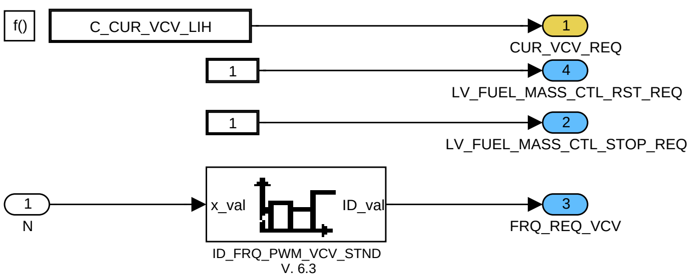

Figure 9.40.47: :

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9.40.2.2.2.3.8 Final calculation of the CUR_VCV

The gradient limitation will only be applied at special states to avoid big PWM jumps. There are several constants for positive PWM change and negative PWM change.

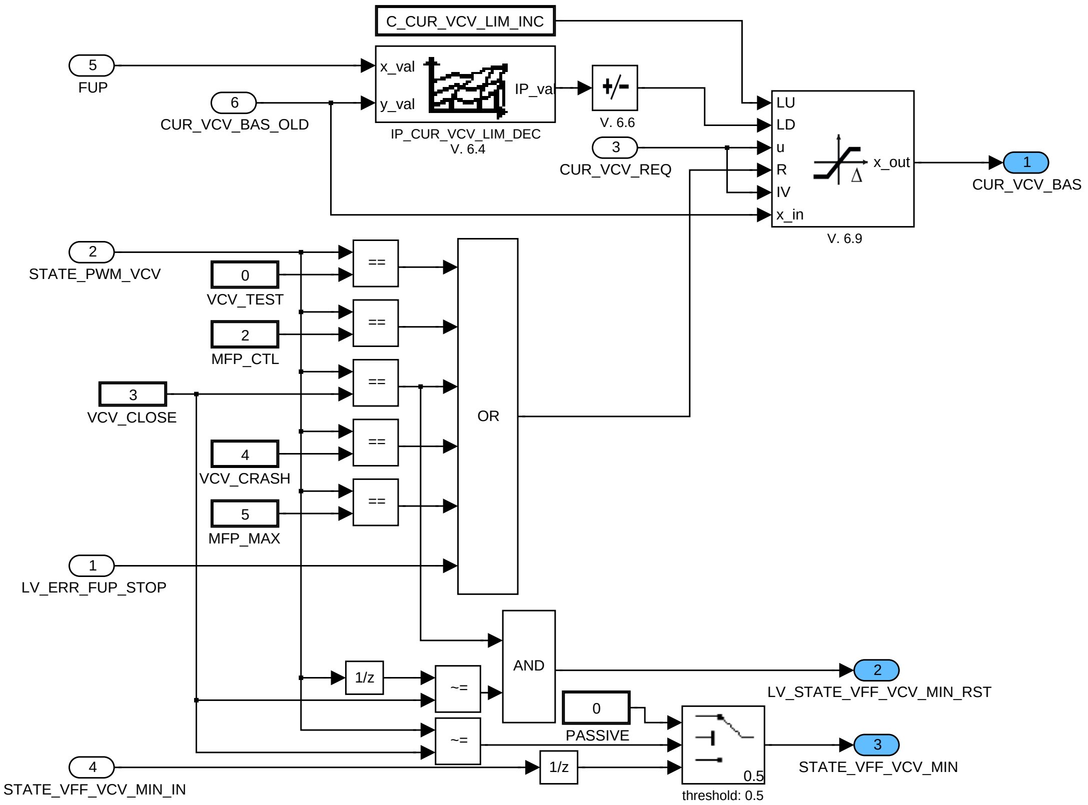

Figure 9.40.48: :

9.40.2.2.2.3.9 T_CUR_VCV_PRE_RUN_CLC

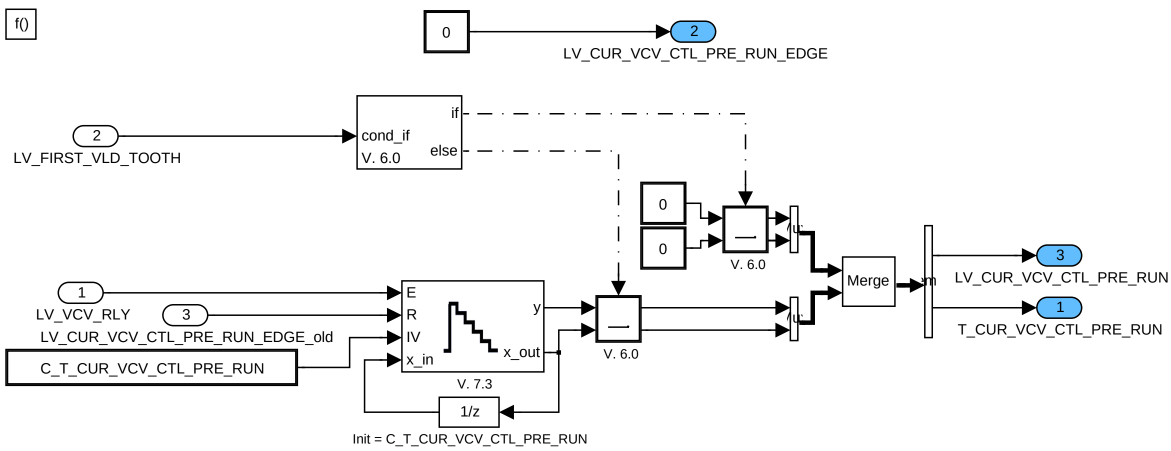

Figure 9.40.49: :

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9.40.2.3 Overview of VCV current controller

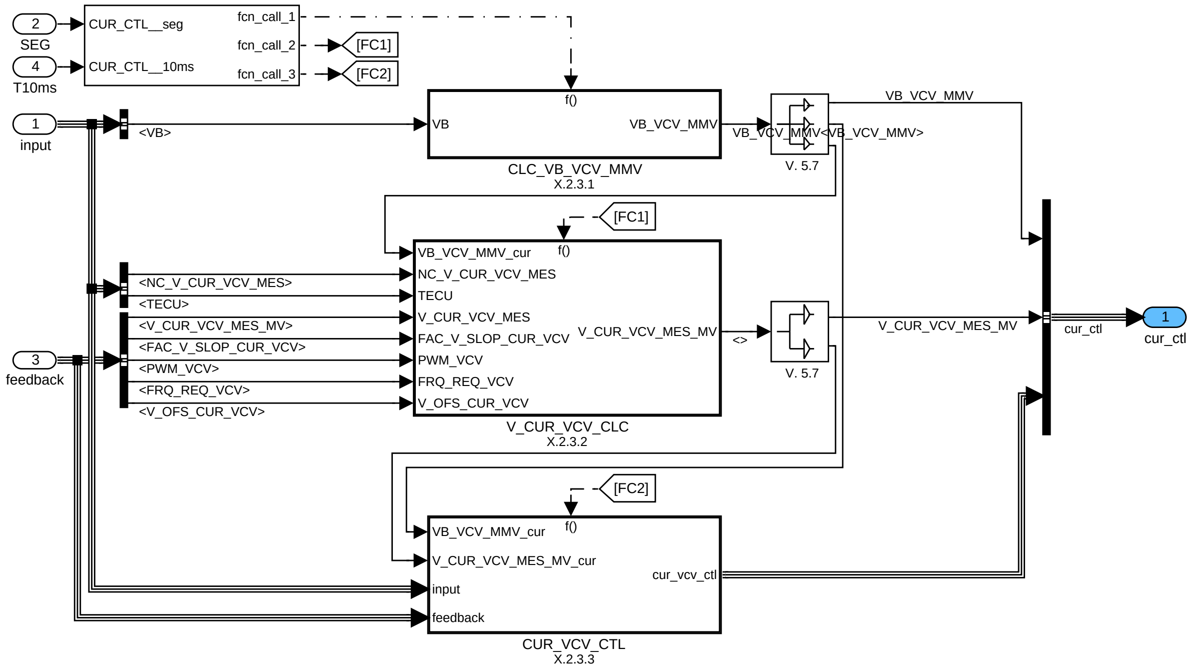

Figure 9.40.50: :

9.40.2.3.1 Calculation of VB_VCV_MMV

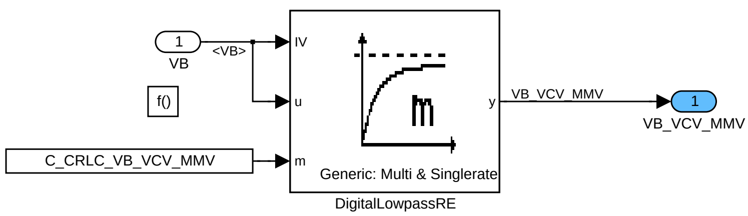

Figure 9.40.51: :

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9.40.2.3.2 Calculation of V_CUR_VCV_CLC

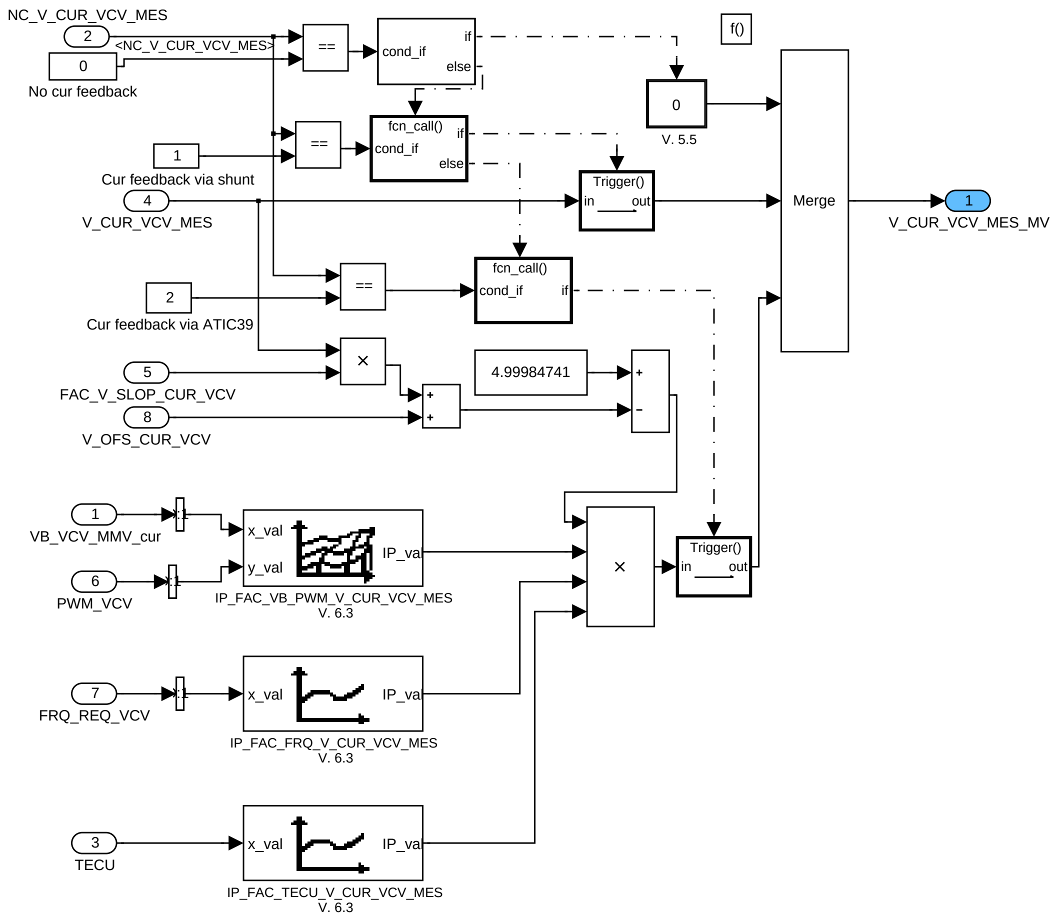

Figure 9.40.52: :

9.40.2.3.3 FUSL_M904B/OPM/CUR_CTL/CUR_VCV_CTL

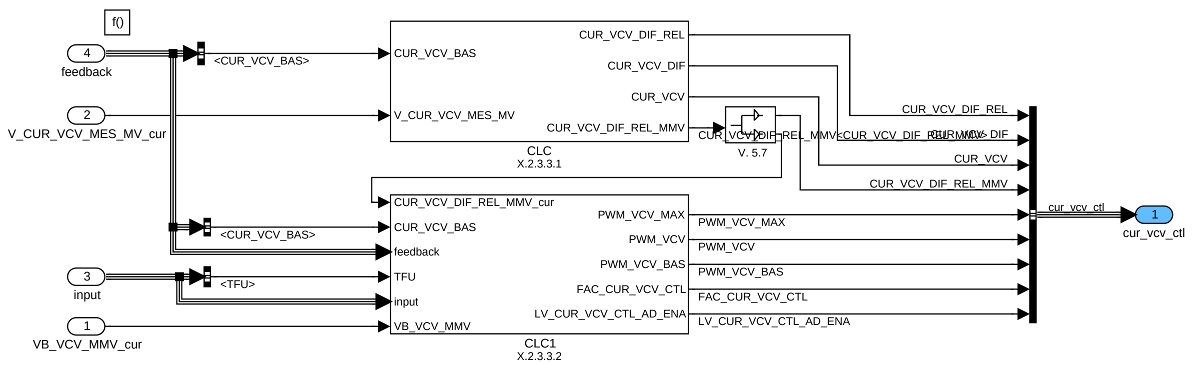

Figure 9.40.53: :

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9.40.2.3.3.1 FUSL_M904B/OPM/CUR_CTL/CUR_VCV_CTL/CLC

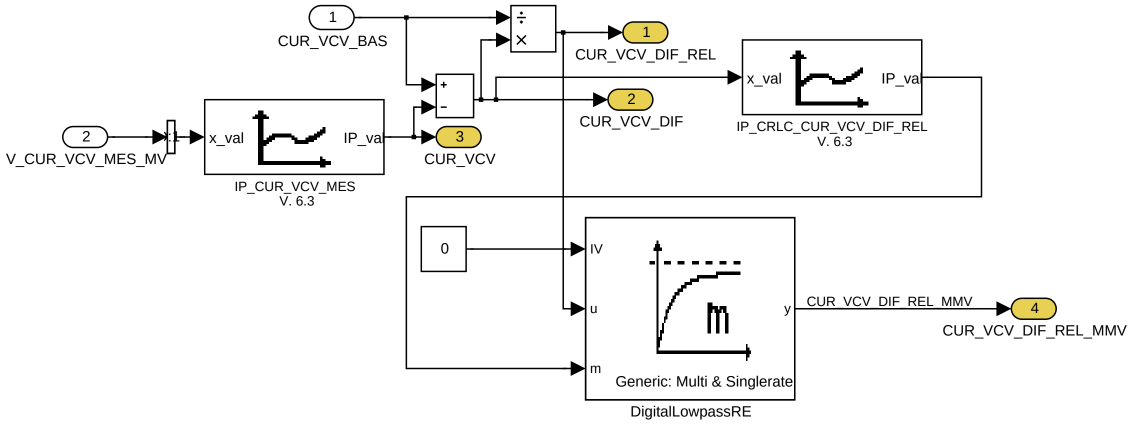

Figure 9.40.54: :

9.40.2.3.3.2 Calculation 1

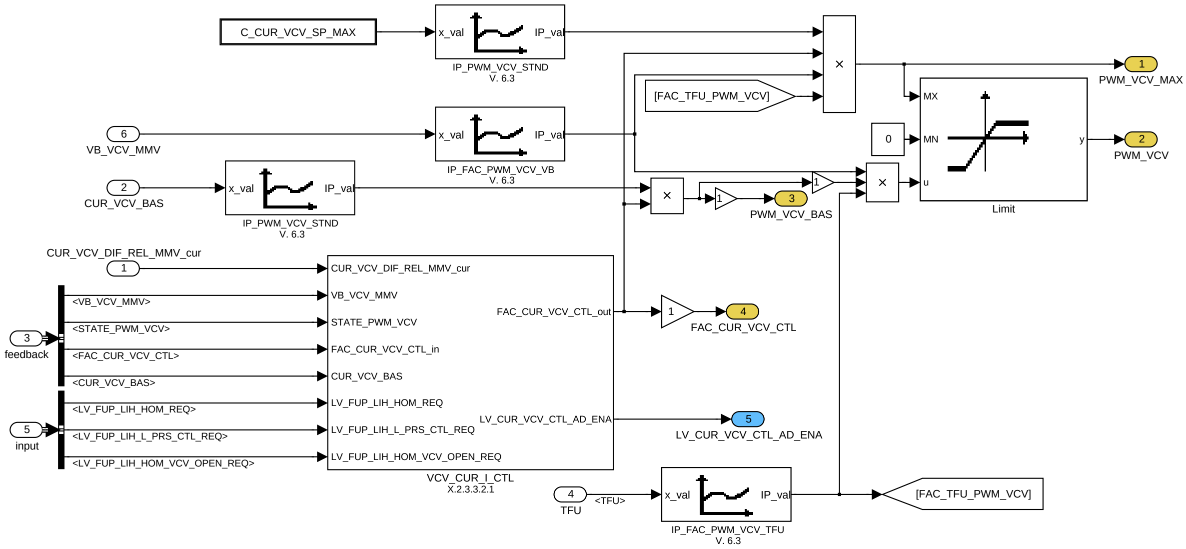

Figure 9.40.55: :

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9.40.2.3.3.2.1 VCV_CUR_I_CTL

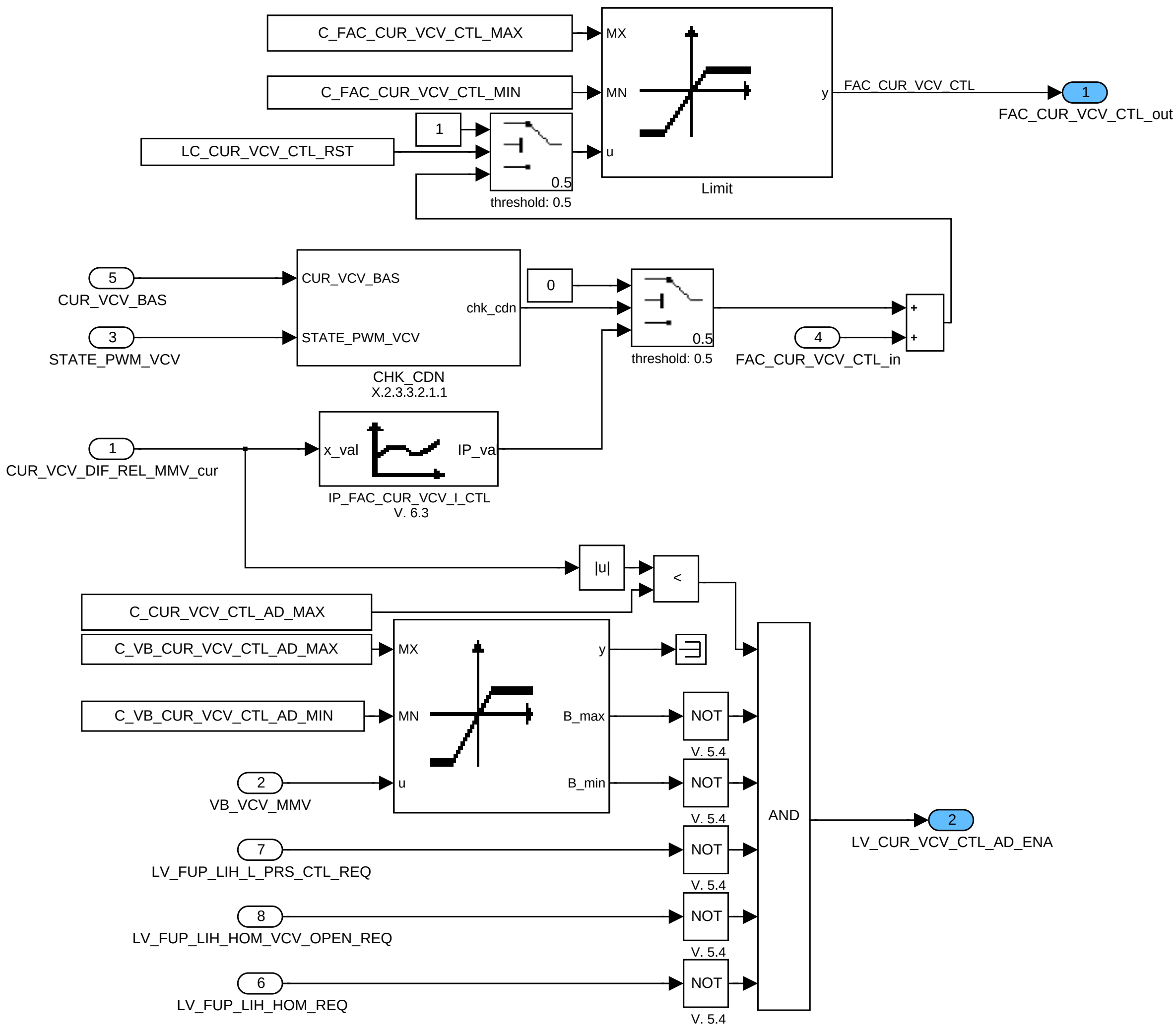

Figure 9.40.56: :

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9.40.2.3.3.2.1.1 Condition Check

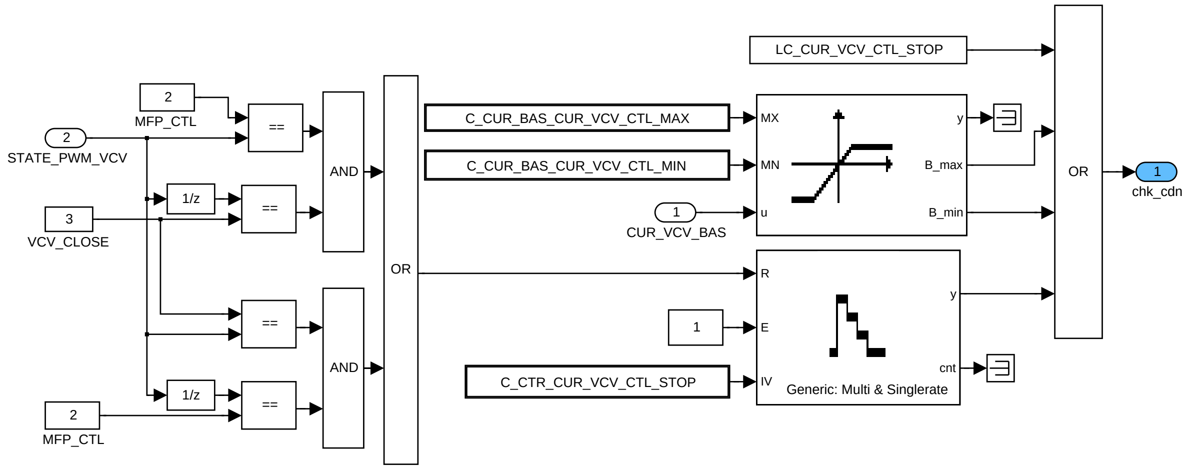

Figure 9.40.57: :

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9.41 Fuel pressure actuator control (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_FUEL_MASS_CTL_STOP_DIAG	O/V	0... 1H	0 ...1	1	-
Logical variable freeze the controller while the limphome phase					
LV_FUP_LIH_HOM_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable indicating LIH mode for HPP requested					
LV_FUP_LIH_HOM_VCV_OPEN_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable requesting limphome for VCV open					
LV_FUP_LIH_L_PRS_CTL_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable requesting fuel low pressure control limphome					

Input data:

ERR_SYM_FUP_CH {p. 6102}	ERR_SYM_H_PRS_SYS_ PRE {p. 6060}	FUP {p. 1283}	LV_ERR_CRASH_SIG {p. 801}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_CH {p. 6102}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_H_PRS_SYS_ PRE {p. 6062}	LV_ERR_VCV {p. 4729}	LV_ERR_VCV_PLAUS {p. 6062}	LV_ES {p. 1720}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_LIH_VCV_OPEN	V	0... FFFFH	0... 347776	5.30672159	hPa
Fuel pressure threshold for switching to VCV open limphome mode					
C_T_FUP_LIH_HOM_VCV_OPEN_REQ	V	0... FFFFH	0... 655.35	0.01	s
Timer for activation of the VCV open limphome					
C_T_FUP_LIH_L_PRS_CTL_REQ	V	0... FFFFH	0... 655.35	0.01	s
Timer for freeze the controller in FUP_LIH_L_PRS_CTL					
LC_T_FUP_LIH_L_PRS_CTL_REQ	V	0... 1H	0 ...1	1	-
Switch for enabling of the timer for freeze the controller in FUP_LIH_L_PRS_CTL					

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General information:

In this module the limphome bits for the high pressure pump control are calculated.

Application conditions:

Initialisation: `all outputs to zero at RST`
Recurrence: `10MS`
Activation: `always`
Deactivation: `never`

Function description:

Formula section:

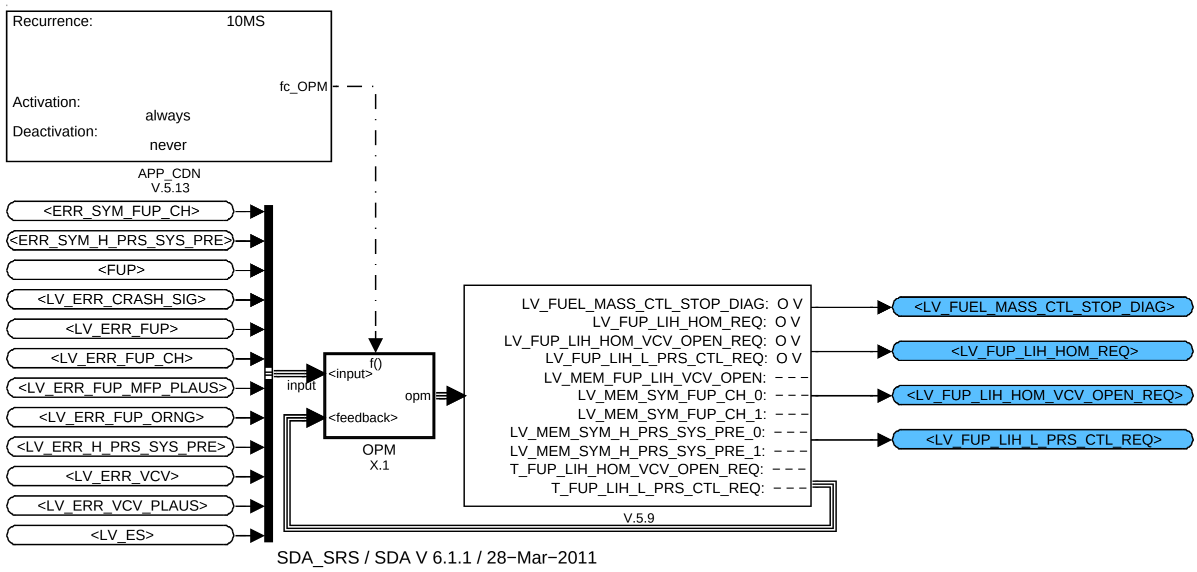

Figure 9.41.1: :

9.41.1 Formula Section

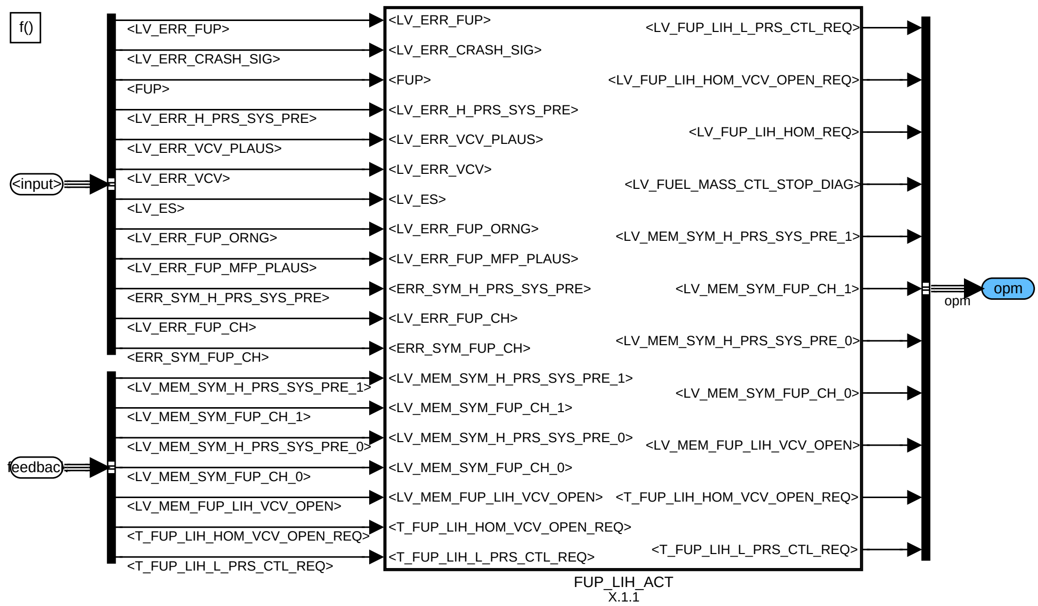

Figure 9.41.2: :

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9.41.1.1 FUP_LIH_ACT

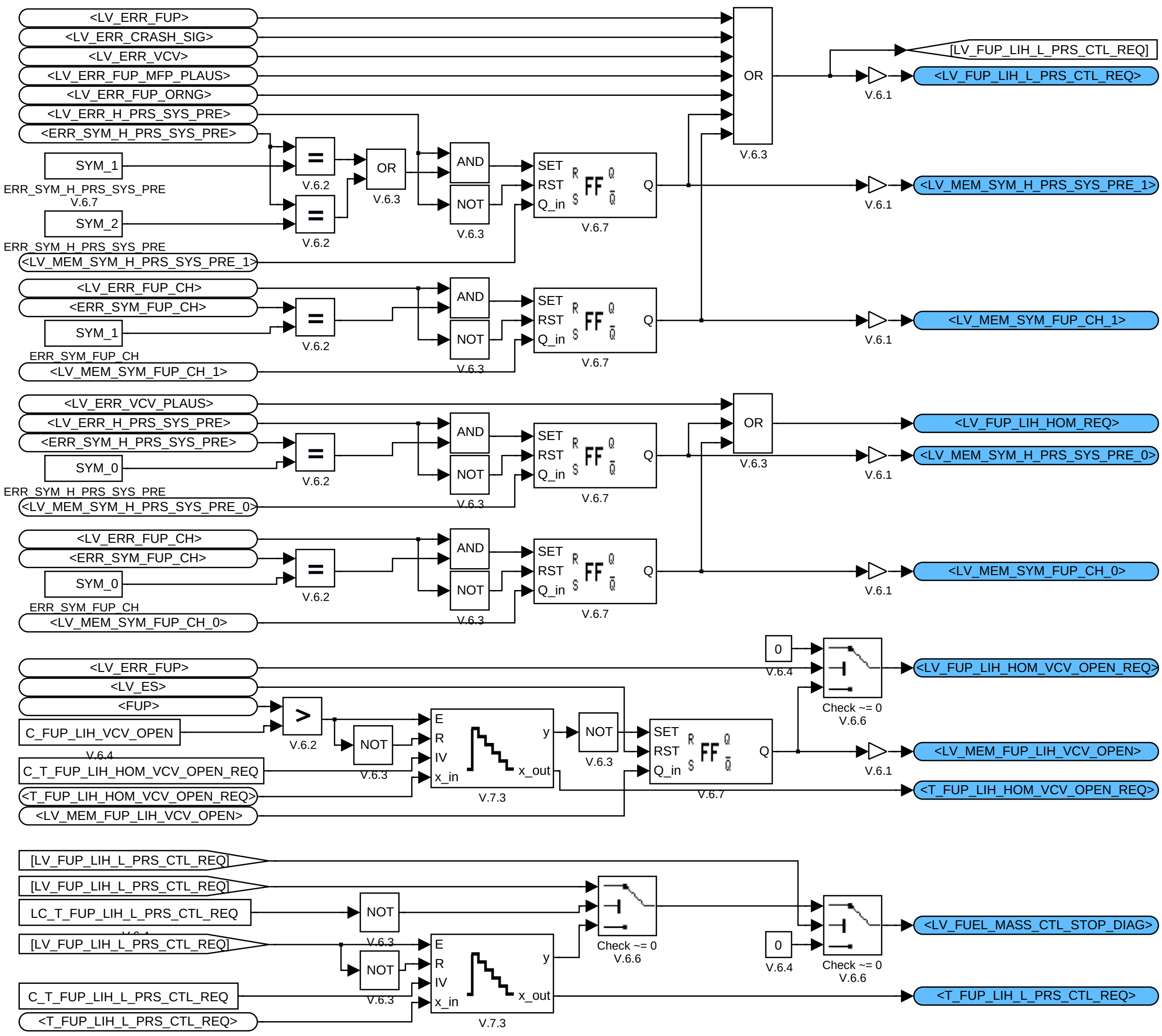

Figure 9.41.3: :

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9.42 Fuel supply system temperatures

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TFPA	O/V	0... FEH	-48... 142.5	0.75	°C
Fuel pressure acutuator temperature					

Input data:

TFU {p. 1232}			

9.42.1 Fuel pressure actuator temperature at available fuel temperature

General Information

In case of an available temperature of the fuel either modelled or measured this temperature is taken as a substitute for the temperature for the fuel pressure actuator

Application conditions

Initialisation: *at reset: TFPA = TFU*

Recurrence: *1 s*

Activation: *every engine state*

FUNCTION DESCRIPTION:

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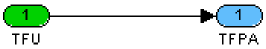
SIEMENS VDO Automotive



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Name: Fuel pressure actuator temperature
Description: Based on 03903F01.00A
File: 03903F01.00C **Developer:** Mallejac, Patrice
Date: 2/10/00 **State:** WB_TLS **Last User:** Mallejac, Patrice **Page:** 1/ 1

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9.43 Cylinder balancing manager

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_TI_ER_BAL_ENA	V	0... FFFFH	0... 65535	1	-
Engine cycle counter to delay TI intervention at entry to state cylinder balancing					
LV_ER_STD_MMV_MAX_TI_ER_BAL	V	0... 1H	0 ...1	1	-
Flag for maximum ER_STD_MMV_BAL value for cylinder balancing via TI intervention					
LV_ER_STND_MMV_MAX_TI_ER_BAL	V	0... 1H	0 ...1	1	-
Flag for maximum ER_STND_MMV_BAL value for cylinder balancing via TI intervention					
LV_FAC_TI_AD_ER_BAL_ENA	O/V	0... 1H	0 ...1	1	-
Flag for multiple cylinder balancing TI adaptation active					
LV_FAC_TI_ER_BAL_ENA	O/V	0... 1H	0 ...1	1	-
Flag for multiple cylinder balancing TI correction active					
LV_MFF_ADD_AD_ER_BAL_ENA	O/V	0... 1H	0 ...1	1	-
Flag for additive cylinder balancing MFF adaptation active					
LV_MFF_ADD_ER_BAL_ENA	O/V	0... 1H	0 ...1	1	-
Flag for additive cylinder balancing MFF correction active					
LV_TI_ER_BAL_ENA	V	0... 1H	0 ...1	1	-
Flag for cylinder balancing via TI intervention enabled					
STATE_CTL_TI_ER_BAL	O/V	0H 1H 2H 3H 4H	NON ADDITIVE ADDITIVE_AD MULTIPLE MULTIPLE_AD	-	-
State of cylinder balancing via TI intervention					
STATE_TI_ER_BAL	O/V	0H 1H 2H 3H	INITIALIZATION LOCK WAIT CYLINDER_ BALANCING	-	-
State of cylinder balancing via TI intervention					

Input data:

ER_STD_MMV_BAL [NC_CYL_NR] {p. 1489}	ER_STND_MMV_BAL [NC_CYL_NR] {p. 1489}	LC_TI_ER_BAL_STOP_MAN {p. 4023}	LV_DRV1_STND_BAL_FDOUT {p. 1489}
LV_IS {p. 1720}	LV_MFF_ADD_AD_ER_BAL_ENA_EXT {p. 4022}	LV_MFF_COR_ER_BAL_ENA_EXT {p. 4022}	LV_MFF_FAC_AD_ER_BAL_ENA_EXT {p. 4022}
MFF_SP_S {p. 8243}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}	SEG_NR_ER {p. 1454}
TCO {p. 1100}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ER_STD_MMV_MAX_TI_ER_BAL	-	8000... 7FFFH	0... 325.77	0.00994202	1/s**2
Maximum ER_STD_MMV_BAL value for cylinder balancing via TI intervention					
C_ER_STND_MMV_MAX_TI_ER_BAL	-	8000... 7FFFH	0... 325.77	0.00994202	1/s**2
Maximum ER_STND_MMV_BAL value for cylinder balancing via TI intervention					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MFF_SP_MAX_FAC_TI_AD_ER_BAL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Maximum mass fuel flow setpoint for cylinder balancing multiple TI adaptation					
C_MFF_SP_MAX_FAC_TI_ER_BAL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Maximum mass fuel flow setpoint for cylinder balancing multiple TI correction					
C_MFF_SP_MAX_MFF_ADD_AD_ER_BAL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Maximum mass fuel flow setpoint for cylinder balancing additive MFF adaptation					
C_MFF_SP_MAX_MFF_ADD_ER_BAL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Maximum mass fuel flow setpoint for cylinder balancing additive MFF correction					
C_MFF_SP_MIN_FAC_TI_AD_ER_BAL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Minimum mass fuel flow setpoint for cylinder balancing multiple TI adaptation					
C_MFF_SP_MIN_FAC_TI_ER_BAL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Minimum mass fuel flow setpoint for cylinder balancing multiple TI correction					
C_MFF_SP_MIN_MFF_ADD_AD_ER_BAL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Minimum mass fuel flow setpoint for cylinder balancing additive MFF adaptation					
C_MFF_SP_MIN_MFF_ADD_ER_BAL	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Minimum mass fuel flow setpoint for cylinder balancing additive MFF correction					
C_N_32_MAX_FAC_TI_AD_ER_BAL	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for cylinder balancing multiple TI adaptation					
C_N_32_MAX_FAC_TI_ER_BAL	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for cylinder balancing multiple TI correction					
C_N_32_MAX_MFF_ADD_AD_ER_BAL	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for cylinder balancing additive MFF adaptation					
C_N_32_MAX_MFF_ADD_ER_BAL	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for cylinder balancing additive MFF correction					
C_N_32_MIN_FAC_TI_AD_ER_BAL	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for cylinder balancing multiple TI adaptation					
C_N_32_MIN_FAC_TI_ER_BAL	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for cylinder balancing multiple TI correction					
C_N_32_MIN_MFF_ADD_AD_ER_BAL	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for cylinder balancing additive MFF adaptation					
C_N_32_MIN_MFF_ADD_ER_BAL	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for cylinder balancing additive MFF correction					
C_TCO_MAX_TI_ER_BAL	-	0... FEH	0... 142.5	0.75	°C
Maximum coolant temperature value for cylinder balancing via TI intervention					
C_TCO_MIN_FAC_TI_AD_ER_BAL	-	0... FEH	0... 142.5	0.75	°C
Minimum coolant temperature value for cylinder balancing multiple TI adaptation					
C_TCO_MIN_MFF_ADD_AD_ER_BAL	-	0... FEH	0... 142.5	0.75	°C
Minimum coolant temperature value for cylinder balancing additive MFF adaptation					
C_TCO_MIN_TI_ER_BAL	-	0... FEH	0... 142.5	0.75	°C
Minimum coolant temperature value for cylinder balancing via TI intervention					
IP_CTR_TI_ER_BAL_ENA_INI	-	0... FFFFH	0... 65535	1	-
LDP_N_32_IP_CTR_TI_ER_BAL_INI	4	0... FFH	0... 8160	32	rpm
Engine cycle counter start value to delay TI intervention at entry to state cylinder balancing					

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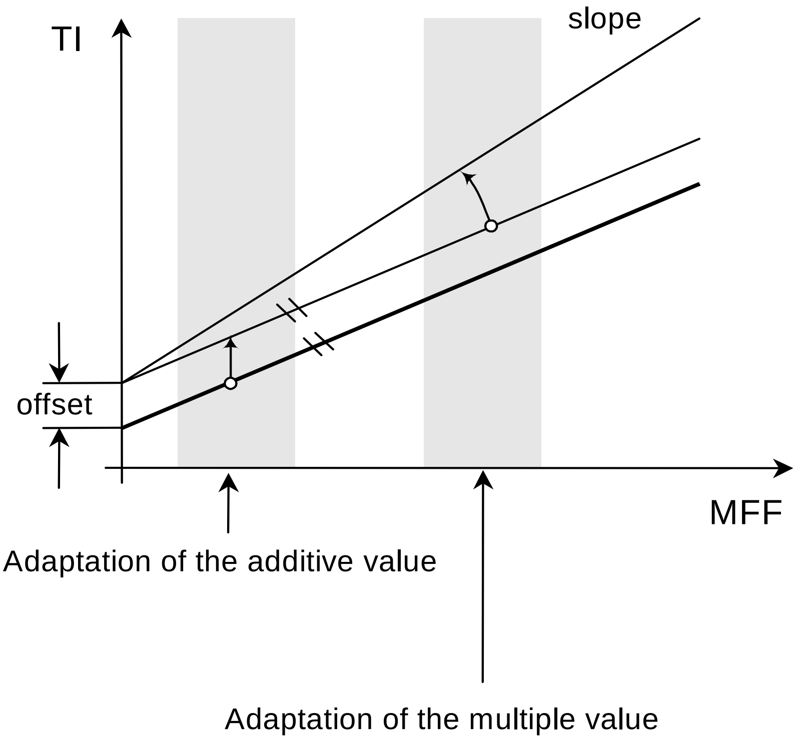
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_MFF_ADD_ER_BAL_ENA	-	0... 1H	0 ...1	1	-
Logical constant to enable additive MFF intervention out of idle					

General information:

Cylinder balancing via TI intervention means a correction of the cylinder individual injection time values to achieve a balancing of the indicated torque between the single cylinders based on engine roughness calculation. Target is to achieve a smooth engine running.
The "Balancing Manager" is realized with a state machine. Different states with a defined setting of corresponding output variables are existing as well as clear conditions to change from one state to another. The calculation of adaptation values is controlled by the states of the state machine.
By means of the logical constant LC_MFF_ADD_ER_BAL_ENA it is possible to enable (LC_MFF_ADD_ER_BAL_ENA = 1) or disable (LC_MFF_ADD_ER_BAL_ENA = 0) the additive adaptation in part load. At idle speed the additive adaptation is always enabled.
In order to compensate torque differences, e.g. caused by manufacturing tolerances of the injection valves, either an additive or a multiple adaptation correction of the injection times is carried out at state "Cylinder Balancing" depending on the current mass fuel flow setpoint.
The additive adaptation value, which influences the offset of the injection valve characteristic line is learned at low mass fuel flow values. The multiple adaptation factor however, which influences the slop of the injector characteristic line, is learned at higher mass fuel flow values (refer: figure).



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Application Condition

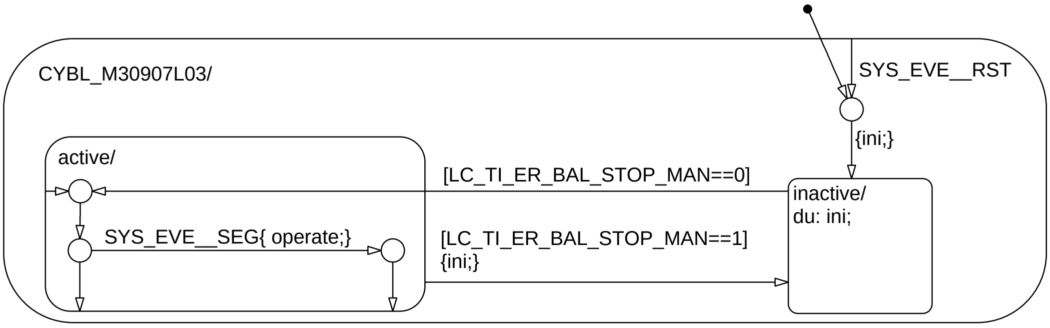

Figure 9.43.1: CYBL_M30907L03/APP_CDN/Chart

Function Description

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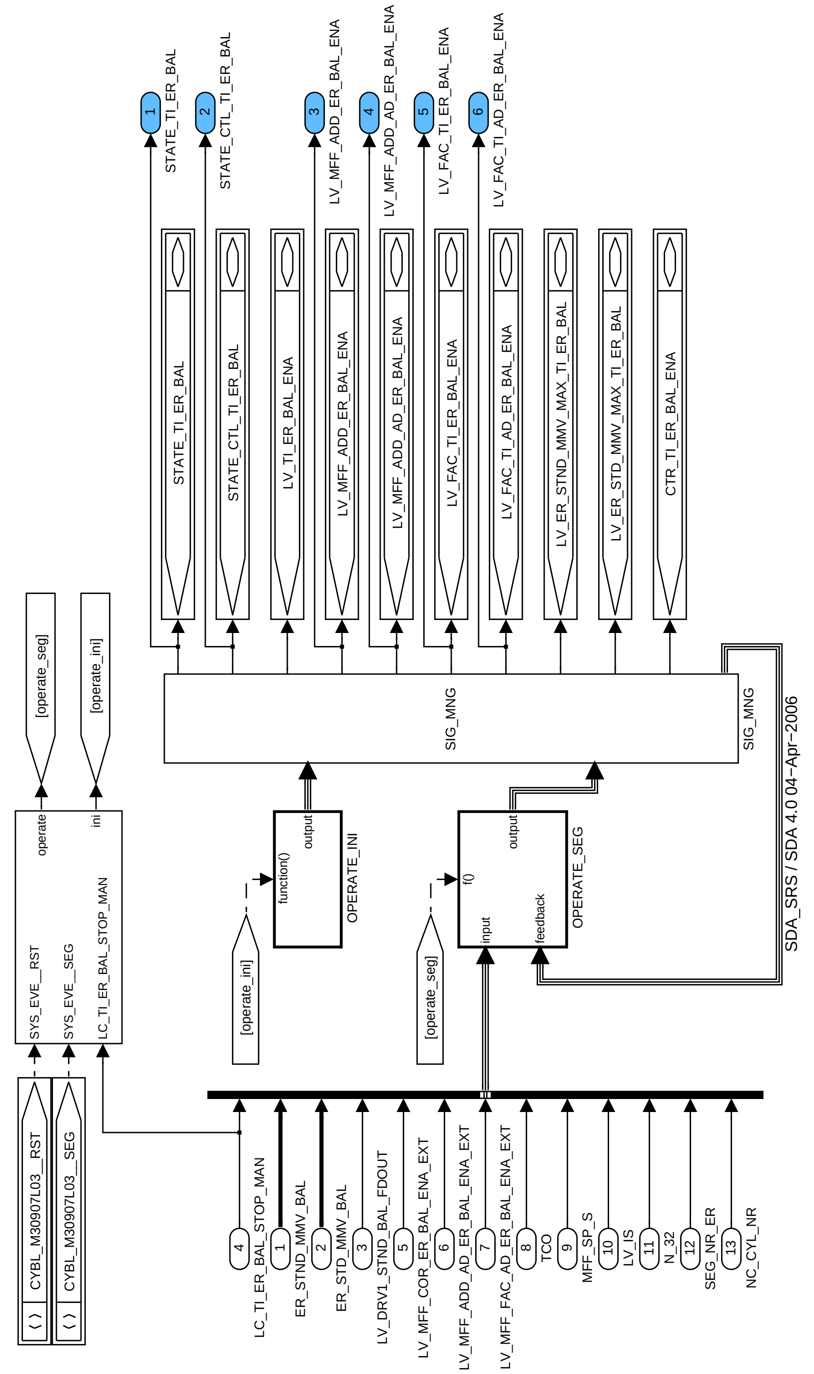

Figure 9.43.2: CYBL_M30907L03

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9.43.1 Initialization of variables

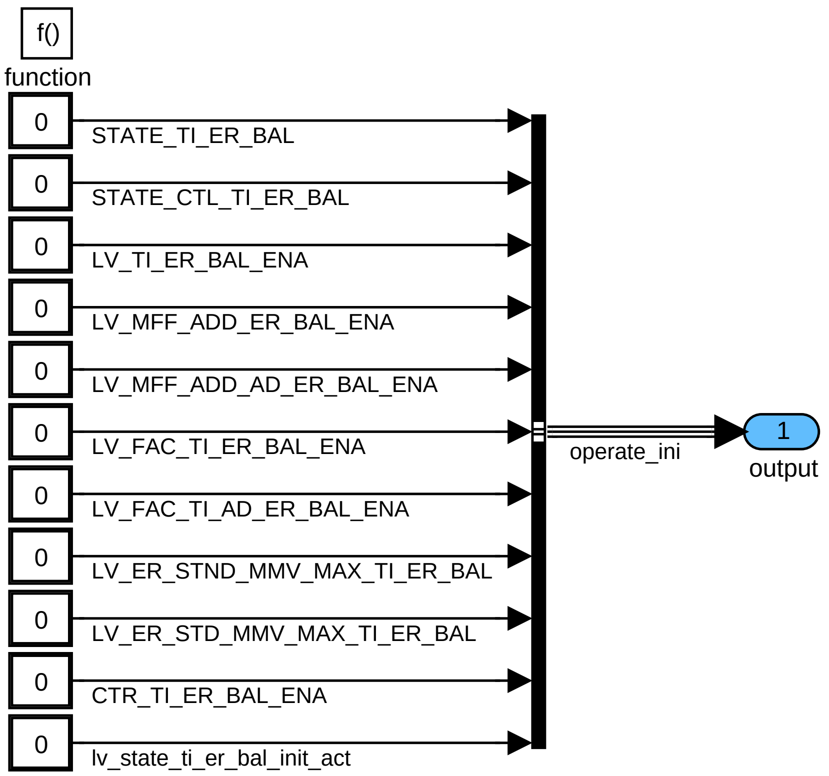

Figure 9.43.3: CYBL_M30907L03/OPERATE_INI

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9.43.2 Calculation of segment task

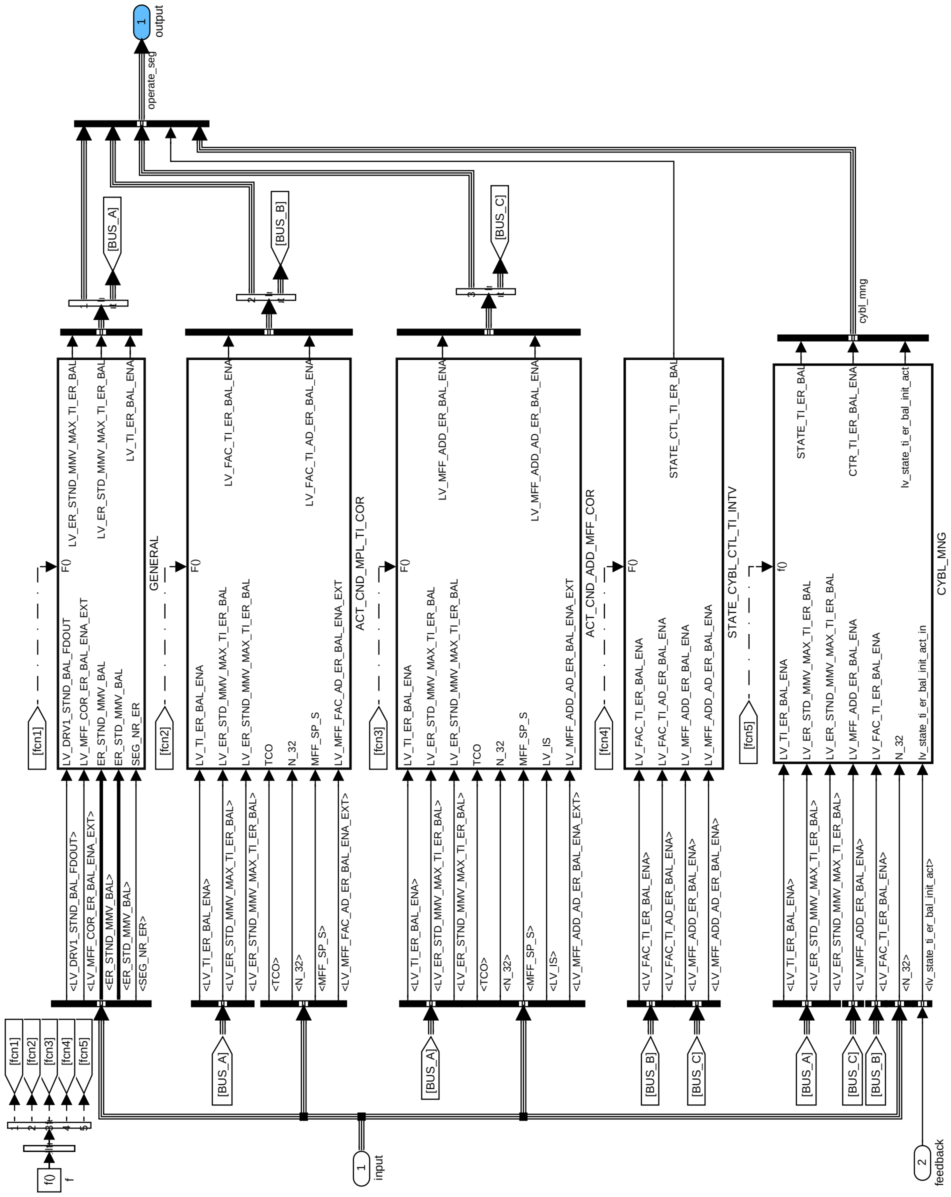

Figure 9.43.4: CYBL_M30907L03/OPERATE_SEG

Calculation of general tasks

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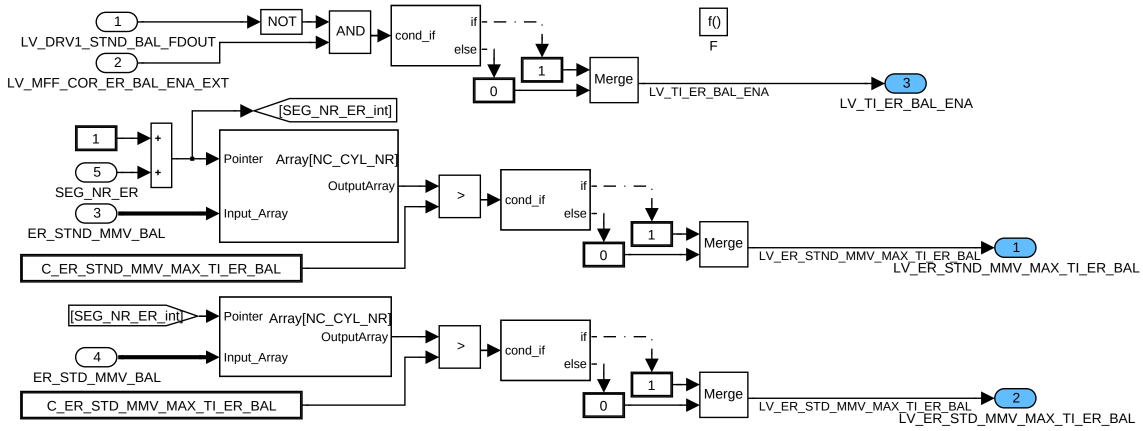

Figure 9.43.5: CYBL_M30907L03/OPERATE_SEG/GENERAL

Action condition for multiple cylinder balancing TI correction:

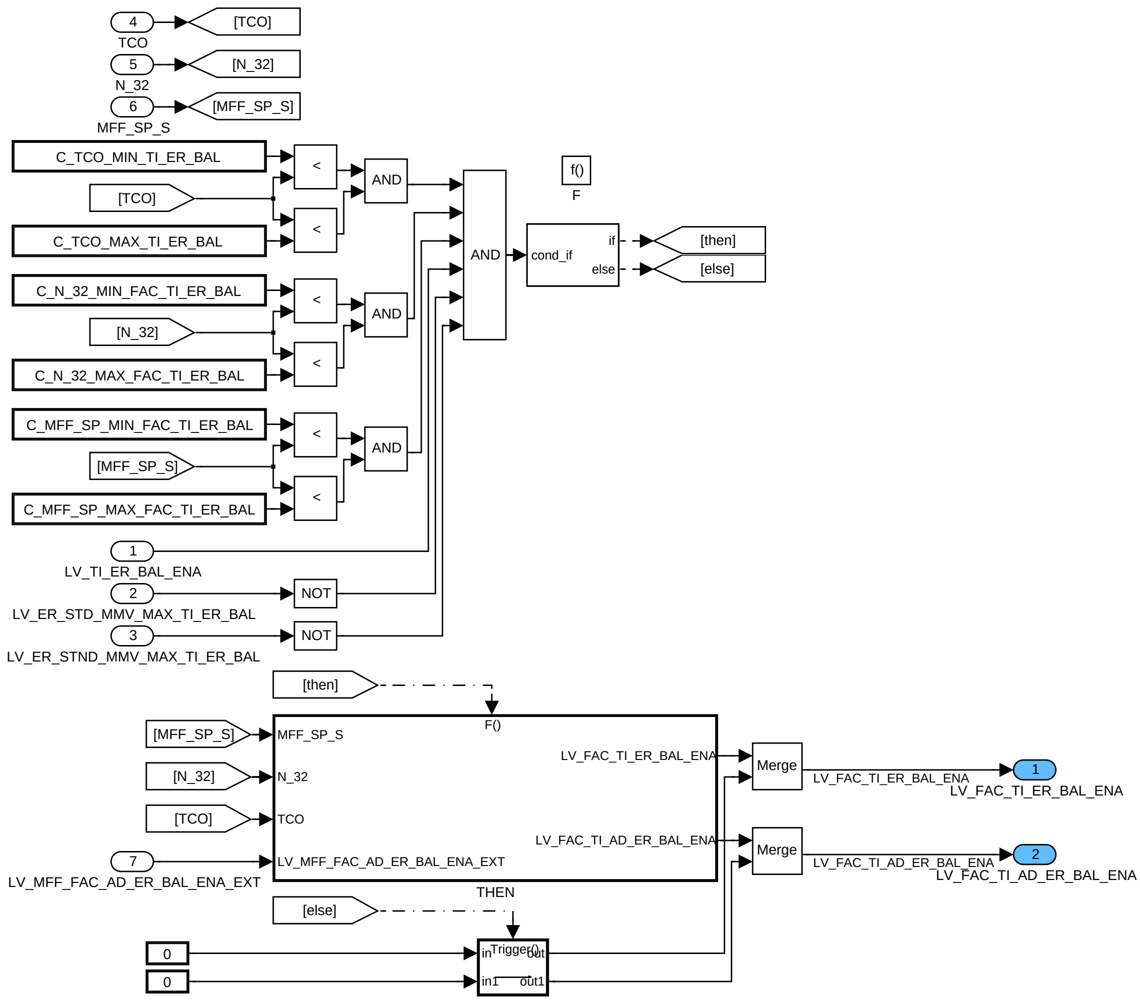

Figure 9.43.6: CYBL_M30907L03/OPERATE_SEG/ACT_CND_MPL_TI_COR

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Action condition for multiple cylinder balancing TI correction - THEN branch

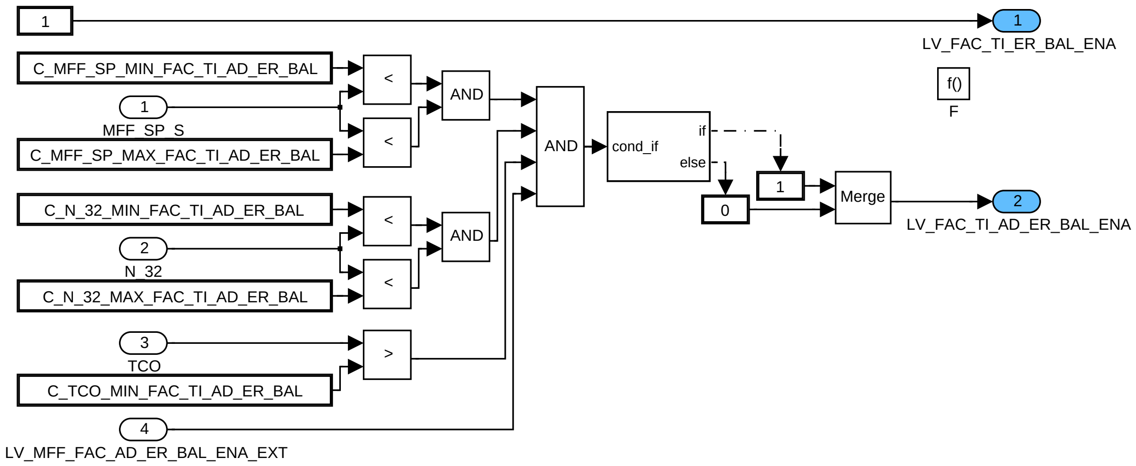

Figure 9.43.7: CYBL_M30907L03/OPERATE_SEG/ACT_CND_MPL_TI_COR/THEN

Action condition for additive cylinder balancing MFF correction:

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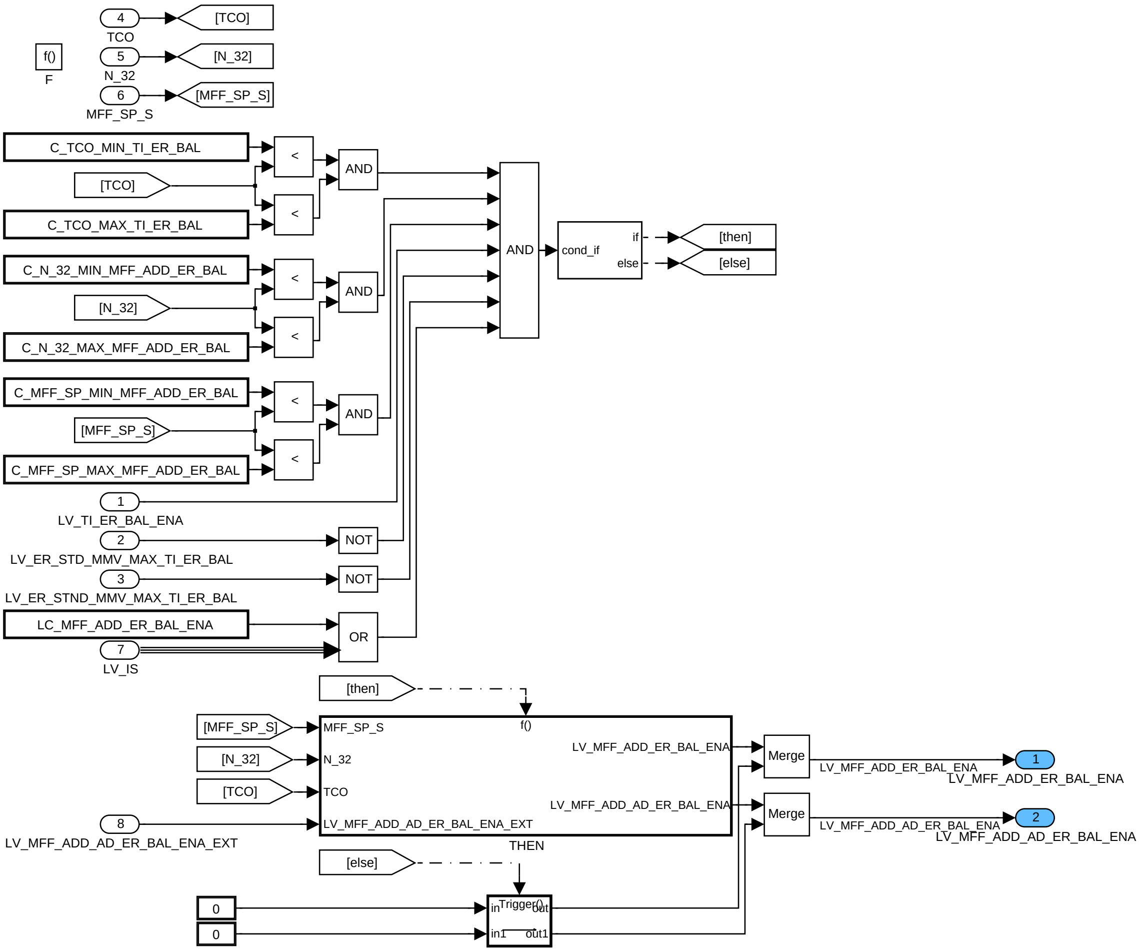

Figure 9.43.8: CYBL_M30907L03/OPERATE_SEG/ACT_CND_ADD_MFF_COR

Action condition for additive cylinder balancing MFF correction THEN branch

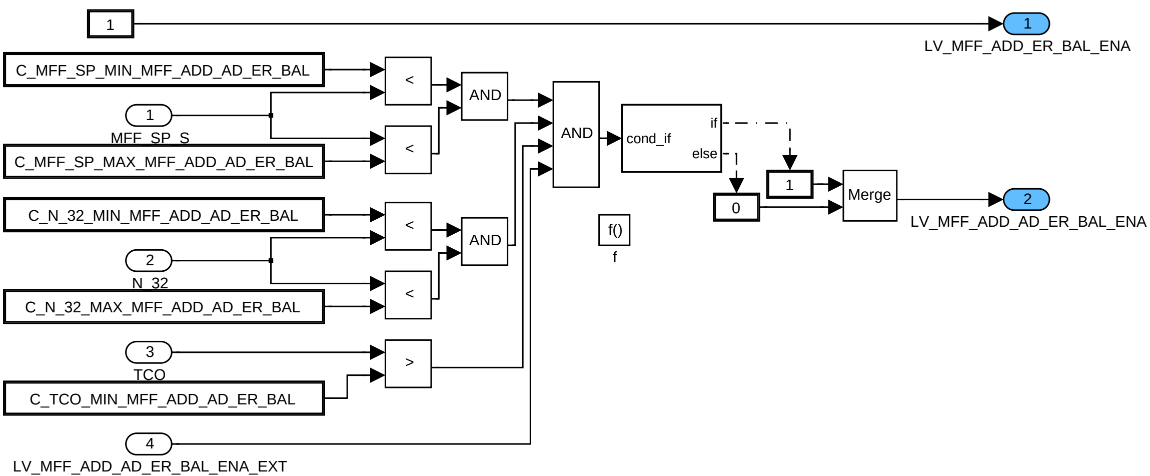

Figure 9.43.9: CYBL_M30907L03/OPERATE_SEG/ACT_CND_ADD_MFF_COR/THEN

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State of cylinder balancing control via TI intervention:

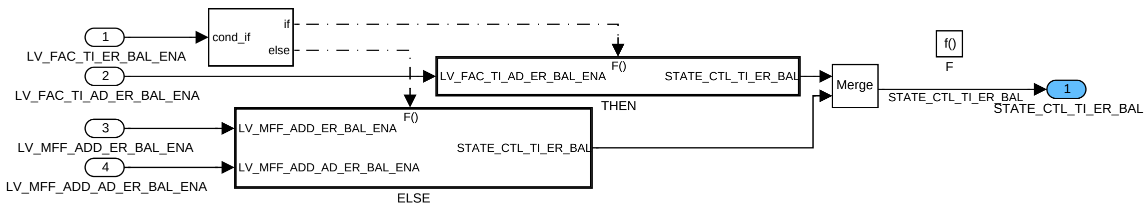

Figure 9.43.10: CYBL_M30907L03/OPERATE_SEG/STATE_CYBL_CTL_TI_INTV

State of cylinder balancing control via TI intervention - THEN branch

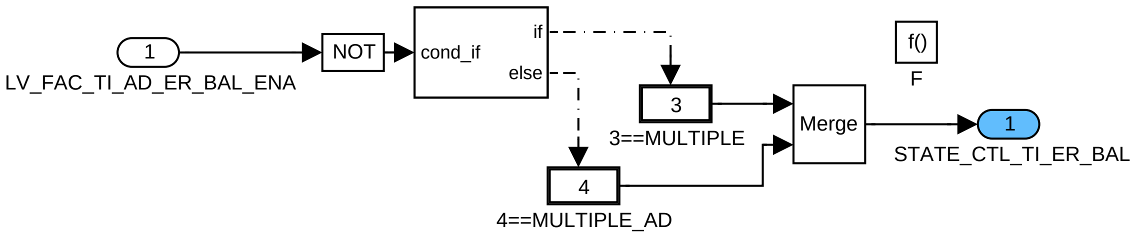

Figure 9.43.11: CYBL_M30907L03/OPERATE_SEG/STATE_CYBL_CTL_TI_INTV/THEN

State of cylinder balancing control via TI intervention - ELSE branch

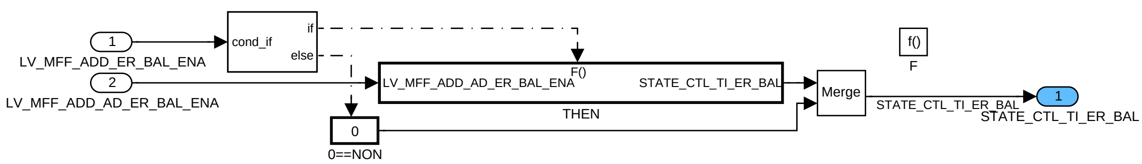

Figure 9.43.12: CYBL_M30907L03/OPERATE_SEG/STATE_CYBL_CTL_TI_INTV/ELSE

State of cylinder balancing control via TI intervention - ELSE THEN branch

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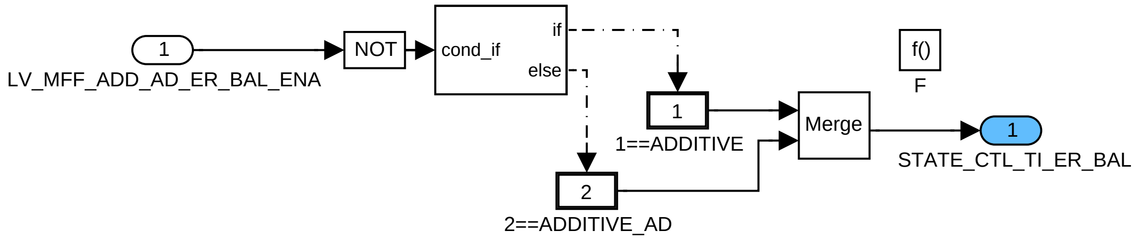
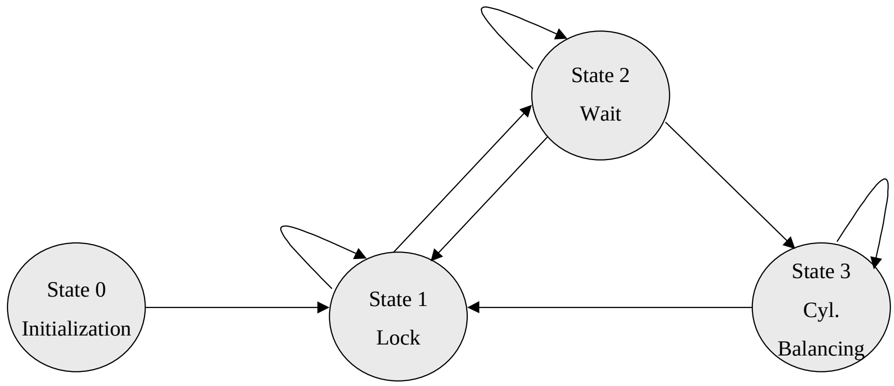


Figure 9.43.13: CYBL_M30907L03/OPERATE_SEG/STATE_CYBL_CTL_TI_INTV/ELSE/THEN

Description of the Cylinder Balancing Manager

State diagram:



Cylinder Balancing Manager: State 0H - Initialization

At reset the state of cylinder balancing changes at once to state "Initialization". The state "Initialization" is active for one recurrence (first segment after reset). As soon as the next segment (second segment after reset) is valid, the state changes immediately to state "Lock".

Cylinder Balancing Manager: State 1[H] - Lock

The algorithm stays in this state until the flags LV_TI_ER_BAL_ENA is set to 1 . This flag is set when certain conditions for controlling and adaptation are fulfilled.

Cylinder Balancing Manager: State 2[H] - Wait

The counter CTR_TI_ER_BAL_ENA starts to run. It counts down from its calibrate able initial value IP_CTR_TI_ER_BAL_ENA_INI to zero (decrease of 1 every engine cycle).

Furthermore the input values ER_STND_MMV_BAL[SEG_NR_ER] and ER_STD_MMV_BAL[SEG_NR_ER] have to below a certain limit:

Cylinder Balancing Manager: State [3] - Cylinder Balancing

The input values ER_STND_MMV_BAL[SEG_NR_ER] and ER_STD_MMV_BAL[SEG_NR_ER] have to below a certain limit (analogue to state 2).

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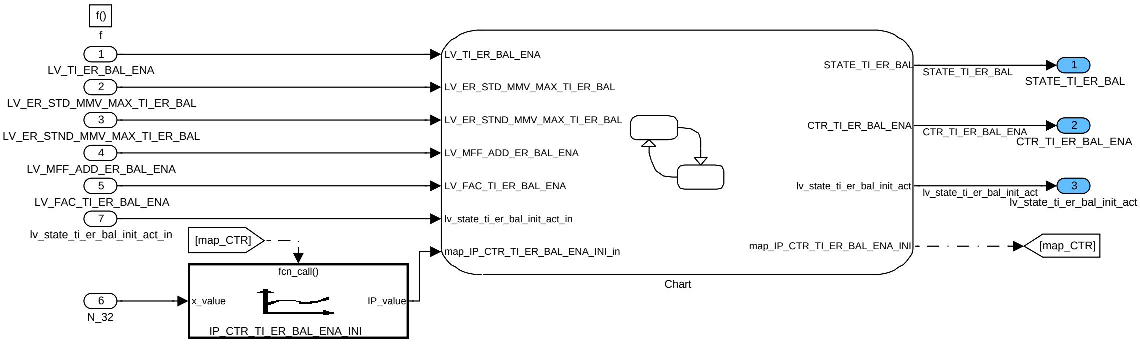

Figure 9.43.14: CYBL_M30907L03/OPERATE_SEG/CYBL_MNG

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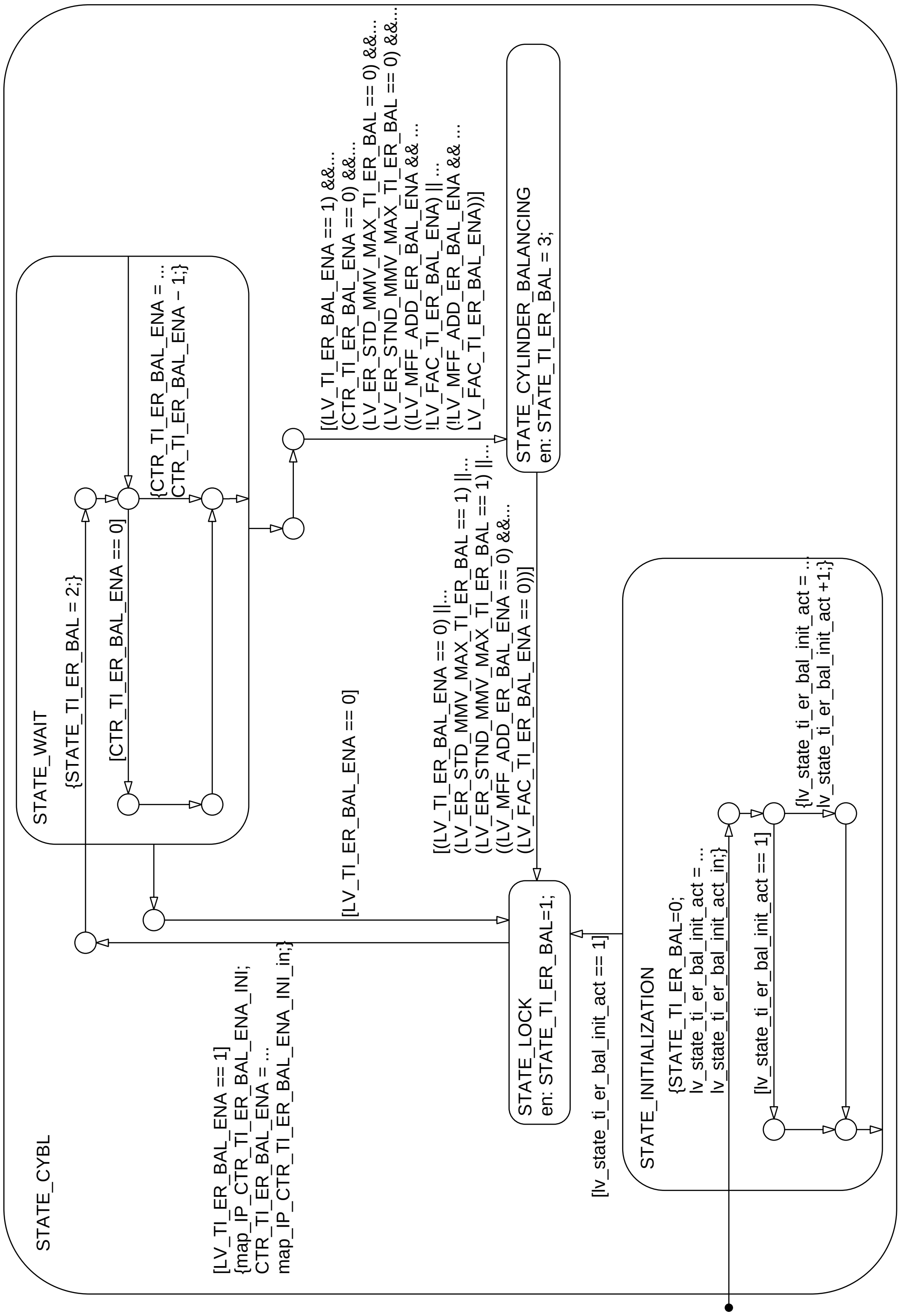

Figure 9.43.15: CYBL_M30907L03/OPERATE_SEG/CYBL_MNG/Chart

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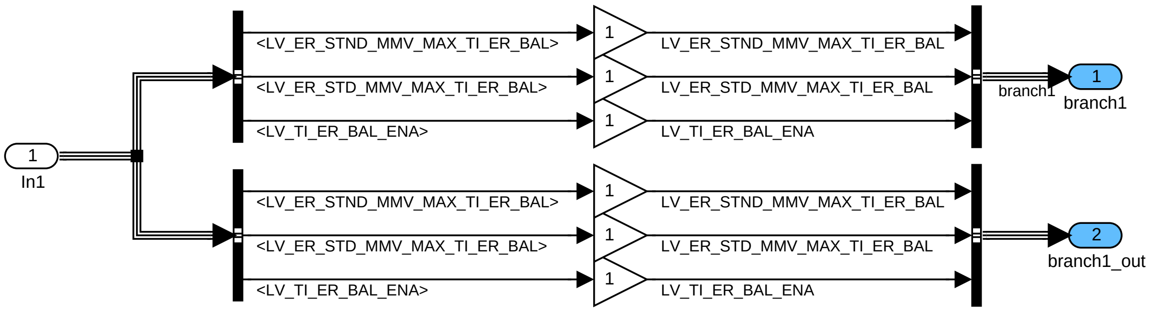

Figure 9.43.16: CYBL_M30907L03/OPERATE_SEG/BRANCH1

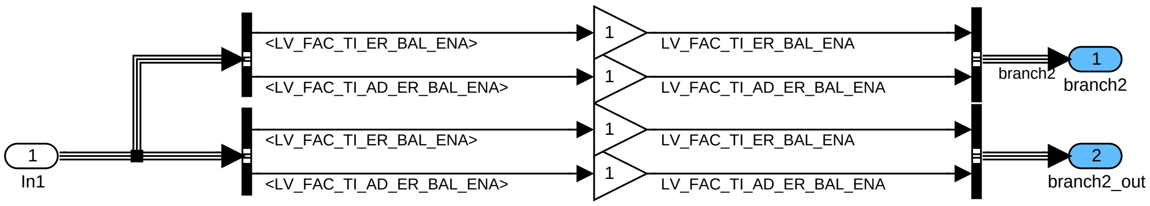

Figure 9.43.17: CYBL_M30907L03/OPERATE_SEG/BRANCH2

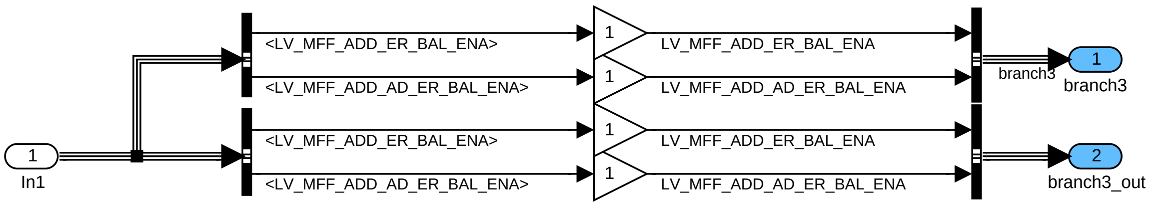

Figure 9.43.18: CYBL_M30907L03/OPERATE_SEG/BRANCH3

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9.43.3 SUBFUNCTION: SIG_MNG

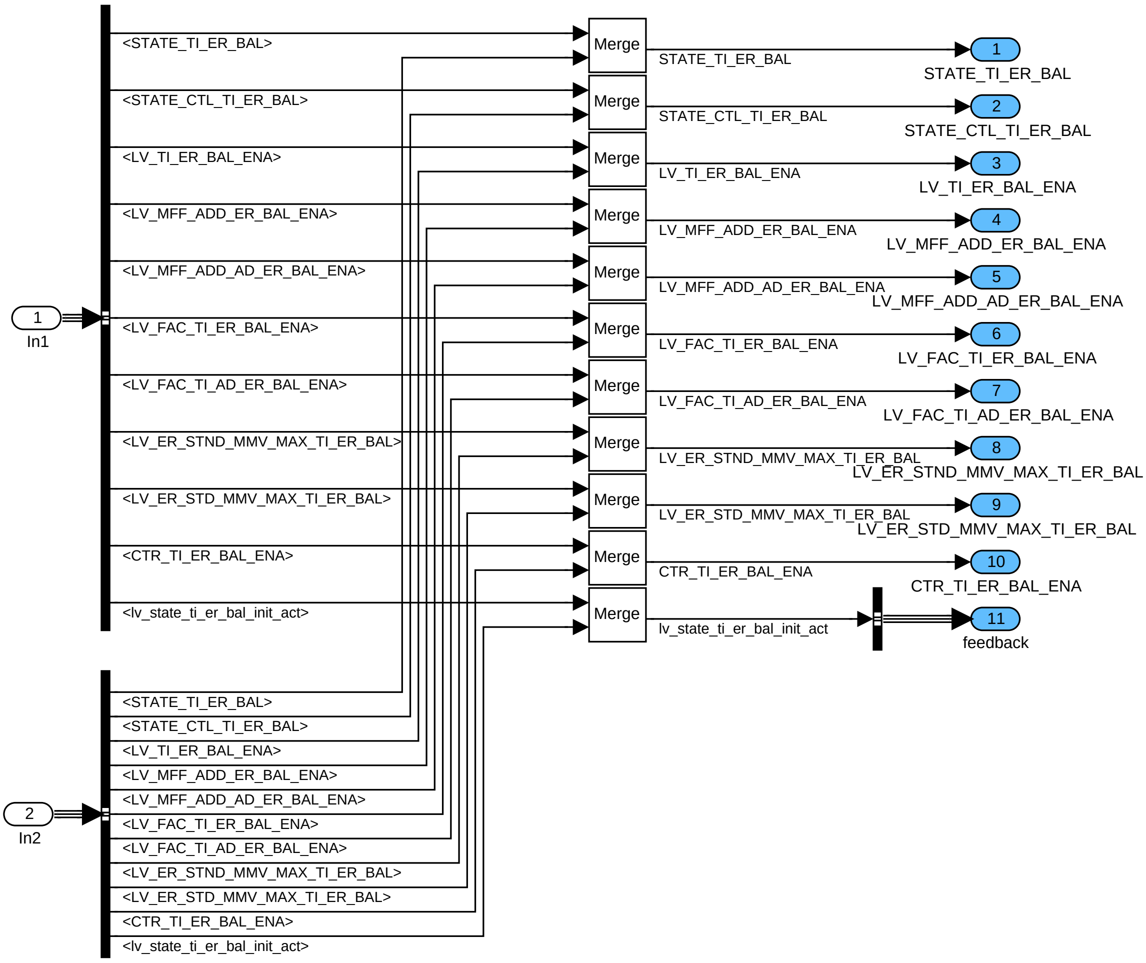

Figure 9.43.19: CYBL_M30907L03/SIG_MNG

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9.44 Cylinder balancing manager (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CYL_BAL_ER_CDN_BAS	O/V	0... 1H	0 ...1	1	-
Basic condition to enable cylinder balancing calculations					
LV_DRV1_ER_BAL_ACT	O/V	0... 1H	0 ...1	1	-
Activation condition to enable cylinder balancing fade out calculation					
LV_ER_STND_ER_BAL_ACT	O/V	0... 1H	0 ...1	1	-
Activation condition to enable cylinder balancing signal preparation calculation					
LV_MFF_ADD_AD_ER_BAL_ENA_EXT	O/V	0... 1H	0 ...1	1	-
External condition to enable cylinder balancing additive adaptation manager calculations					
LV_MFF_COR_ER_BAL_ENA_EXT	O/V	0... 1H	0 ...1	1	-
External condition to enable cylinder balancing manager calculations					
LV_MFF_FAC_AD_ER_BAL_ENA_EXT	O/V	0... 1H	0 ...1	1	-
External condition to enable cylinder balancing multiple adaptation manager calculations					
LV_TI_CYL_BAL_ER_ACT	O/V	0... 1H	0 ...1	1	-
Flag for cylinder balancing (TI intervention) via engine roughness activated					
LV_TI_CYL_BAL_LAM_ACT	O/V	0... 1H	0 ...1	1	-
Flag for cylinder balancing (TI intervention) via lambda sensor activated					
LV_TI_ER_BAL_ACT	O/V	0... 1H	0 ...1	1	-
Activation condition to enable cylinder balancing TI intervention calculation					

Input data:

LV_CH {p. 8232}	LV_DET_MIS {p. 6276}	LV_ENA_ER {p. 1454}	LV_ER_FDOUT {p. 987}
LV_ERR_CAM {p. 1505}	LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}	LV_ERR_CRK {p. 4455}	LV_ERR_CYL_BAL_ER [NC_CYL_NR] {p. 5112}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}
LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}	LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_SEG_AD_ER {p. 4367}
LV_ERR_T_SEG_ER {p. 4367}	LV_ERR_TCO {p. 4496}	LV_ERR_TPS {p. 4982}	LV_ERR_VCV {p. 4729}
LV_FCUT_IND {p. 2295}	LV_FL {p. 1759}	LV_INH_BAL_CUS {p. 8187}	LV_INH_CYL_BAL_ER_ LIH_CTL {p. 803}
LV_INH_CYL_BAL_LAM_ LIH_CTL {p. 803}	LV_MIS_STATE_A {p. 6238}	LV_MIS_STATE_B4 {p. 6238}	LV_PUC {p. 1720}
LV_RGN_NT_REQ {p. 2983}	LV_S_ACT {p. 8137}	LV_SEG_AD_AVL_ER {p. 1473}	LV_SEG_AD_LIM_ER {p. 1473}
LV_STATE_RR {p. 6301}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	STATE_ERR_IV {p. 4803}
STATE_TI_ER_BAL {p. 4006}	T_AST {p. 1766}	TQI_AV_S {p. 8380}	

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DRV1_ER_BAL_ACT_MAN	-	0H 1H 2H	NEUTRAL ENABLE DISABLE	-	-
Manual adjustment of activation conditions for cylinder balancing fade out					
C_ER_STND_ER_BAL_ACT_MAN	-	0H 1H 2H	NEUTRAL ENABLE DISABLE	-	-
Manual adjustment of activation conditions for cylinder balancing signal preparation					
C_T_AST_MIN_TI_ER_BAL	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time after engine start for cylinder balancing via TO intervention					
C_TI_ER_BAL_ACT_MAN	-	0H 1H 2H	NEUTRAL ENABLE DISABLE	-	-
Manual adjustment of activation conditions for cylinder balancing via TI intervention					
C_TQI_MAX_TI_ER_BAL	-	8000... 7FFFH	0... 1023.97	0.03125	Nm
Maximum engine torque for cylinder balancing via TI intervention					
C_TQI_MIN_TI_ER_BAL	-	8000... 7FFFH	0... 1023.97	0.03125	Nm
Minimum engine torque for cylinder balancing via TI intervention					
LC_TI_ER_BAL_STOP_MAN	-	0... 1H	0 ...1	1	-
Logical constant for manual stop (=1) of all cylinder balancing functions (TI intervention)					

General information

The Appl. Inc. module is used to keep the cylinder balancing functions modular. Therefore the activation conditions for the signal preparation functions, the balancing manager and the cylinder balancing adaptation functions are set within this module. The cylinder balancing functions are activated as soon as the corresponding activation condition is enabled (=1).

With the logical variable LV_MFF_COR_ER_BAL_ENA_EXT it is possible to adapt the main enable condition (to start cylinder balancing via TI intervention) with additional external requirements. The flag is used as input signal for the cylinder balancing manager.

With the logical variable LV_MFF_ADD_AD_ER_BAL_ENA_EXT it is possible to adapt the main adaptation condition (to start cylinder balancing additive adaptation) with additional external requirements. The flag is used as input signal for the cylinder balancing manager.

A logical calibration constant is available to stop all cylinder balancing interventions at once. In case of LC_TI_ER_BAL_STOP_MAN = 1, several activation conditions for the cylinder balancing functions are disabled (=0). If the logical constant is enabled (=1), a reinitialisation ("0"[hex]) of all output values occurs.

Application Condition

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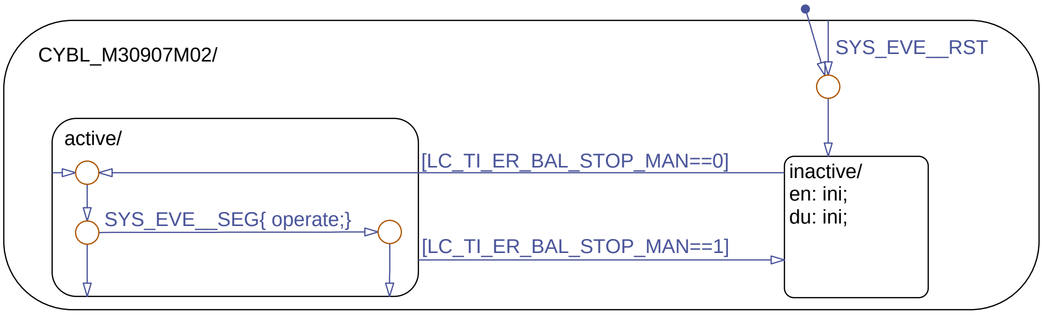

Figure 9.44.1: CYBL_M30907M02/APP_CDN/Chart

Function Description

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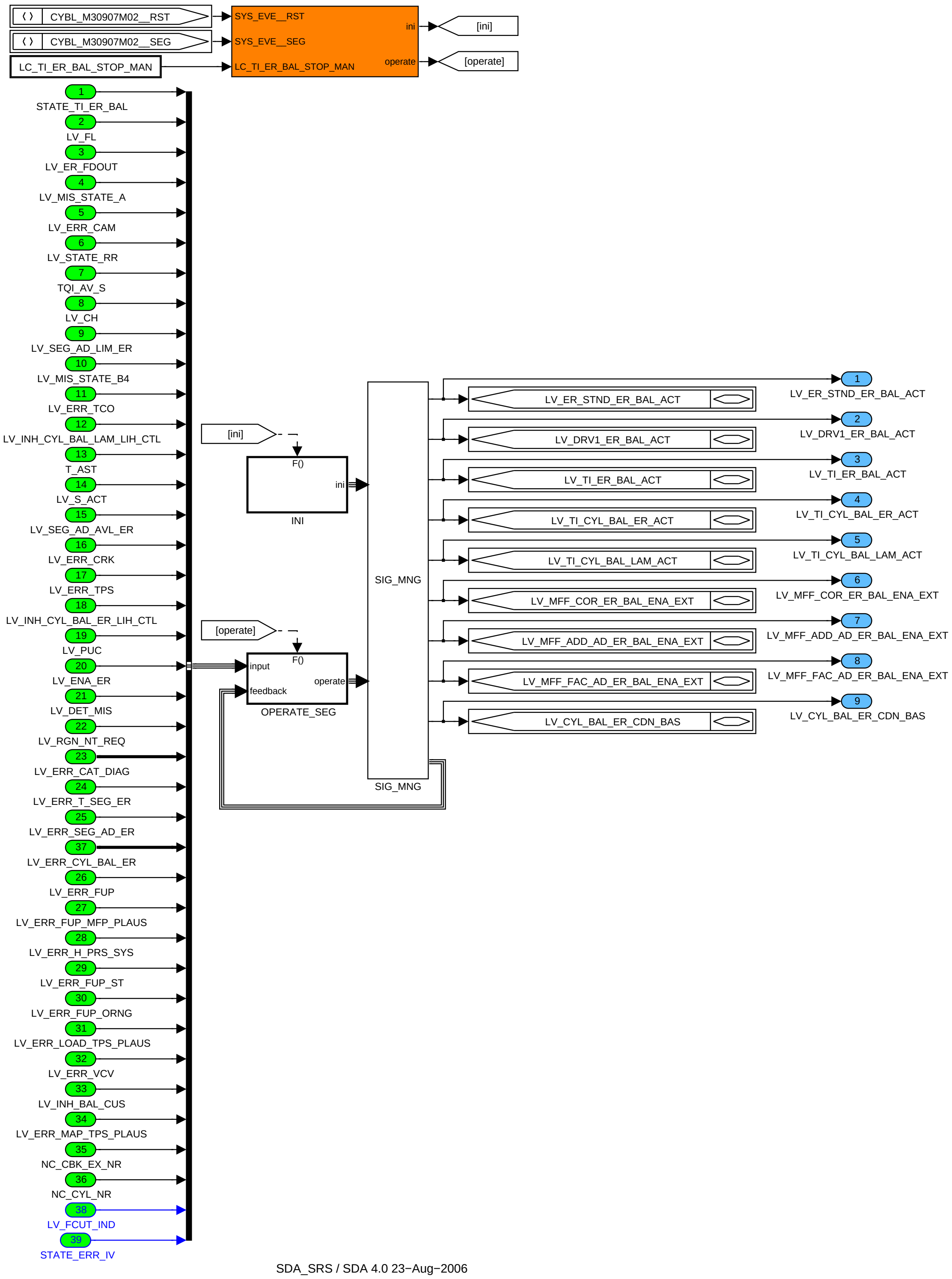

Figure 9.44.2: CYBL_M30907M02

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9.44.1 Calculation of all variables at reset task or LC_TI_ER_BAL_STOP_MAN = 1

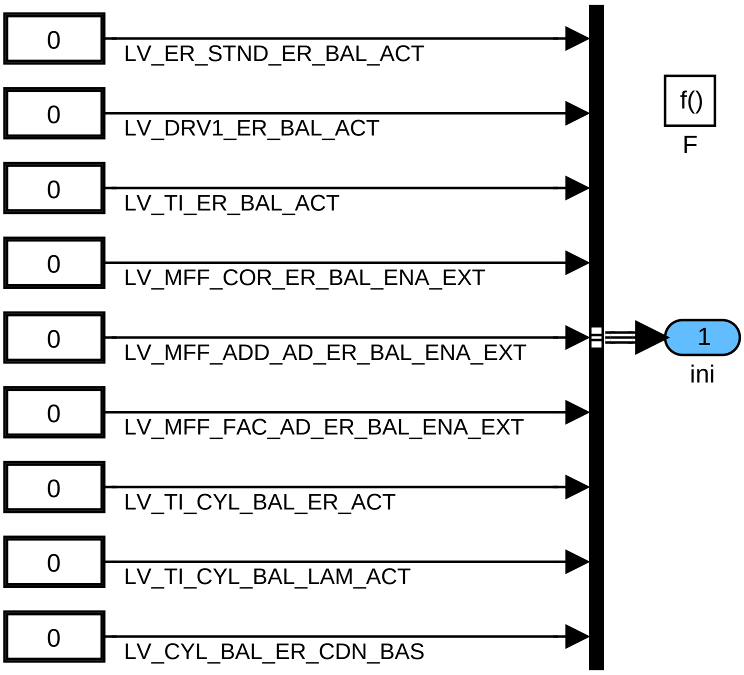

Figure 9.44.3: CYBL_M30907M02/INI

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9.44.2 Calculation of segment task

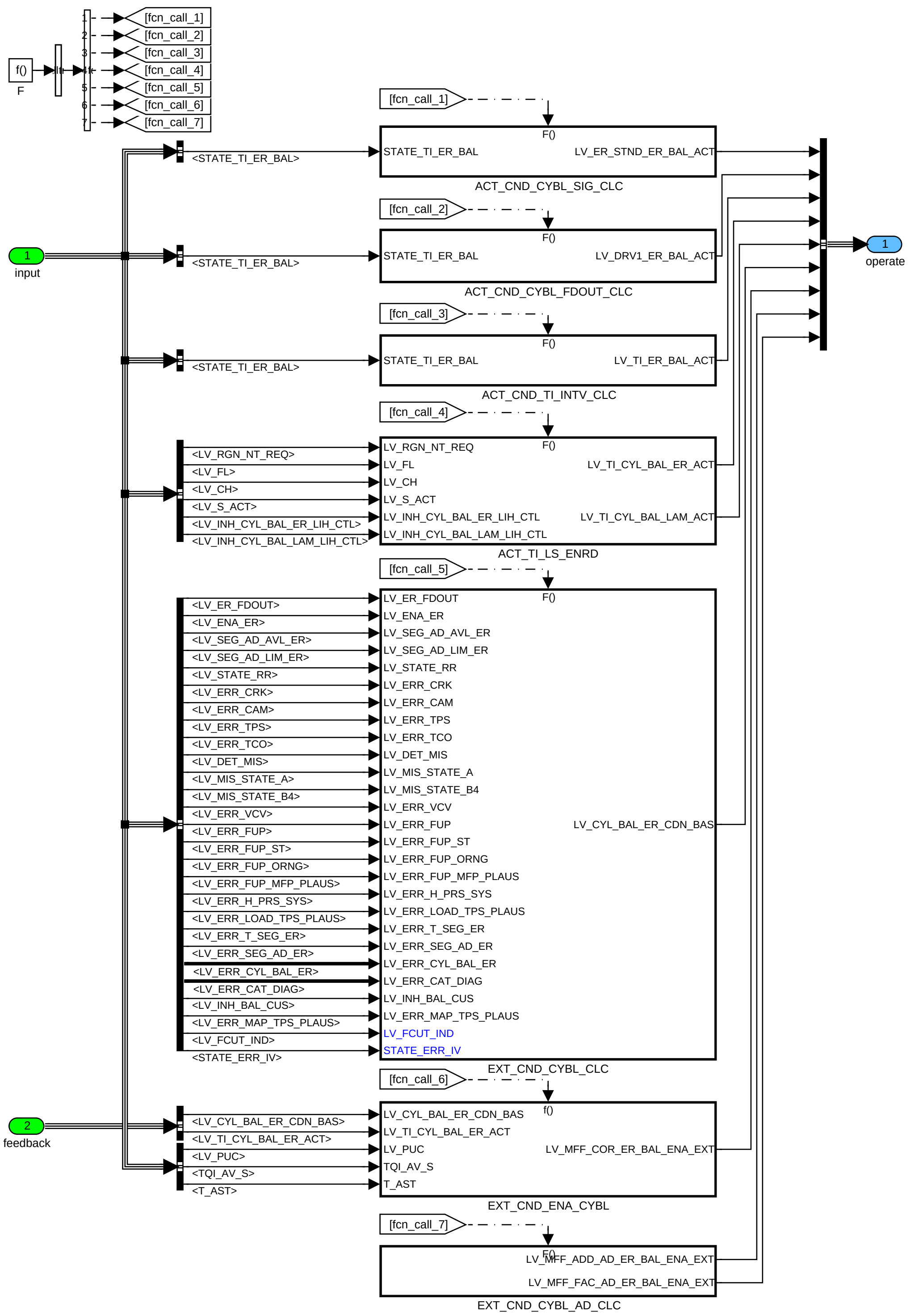

Figure 9.44.4: CYBL_M30907M02/OPERATE_SEG

Activation conditions for cylinder balancing signal preparation calculation

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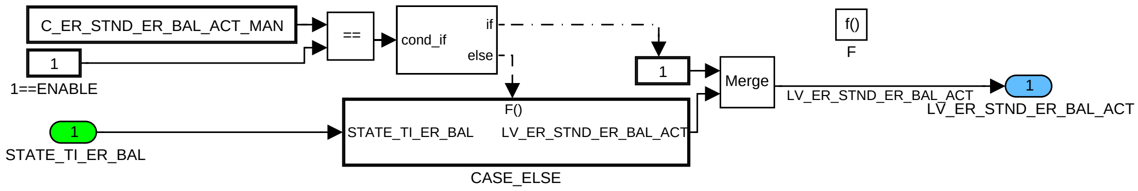

Figure 9.44.5: CYBL_M30907M02/OPERATE_SEG/ACT_CND_CYBL_SIG_CLC

ACT_CND_CYBL_SIG_CLC - elseif branch

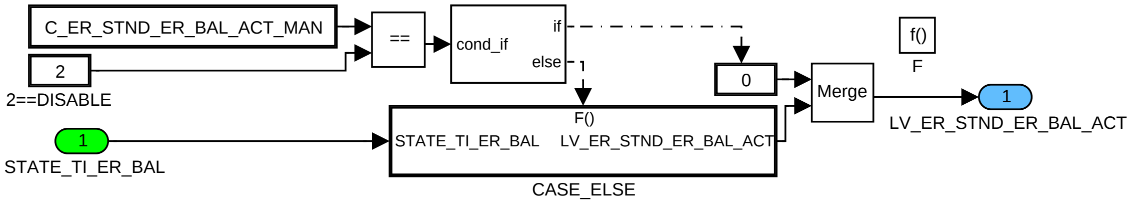

Figure 9.44.6: CYBL_M30907M02/OPERATE_SEG/ACT_CND_CYBL_SIG_CLC/CASE_ELSE

ACT_CND_CYBL_SIG_CLC - elseif branch - else branch

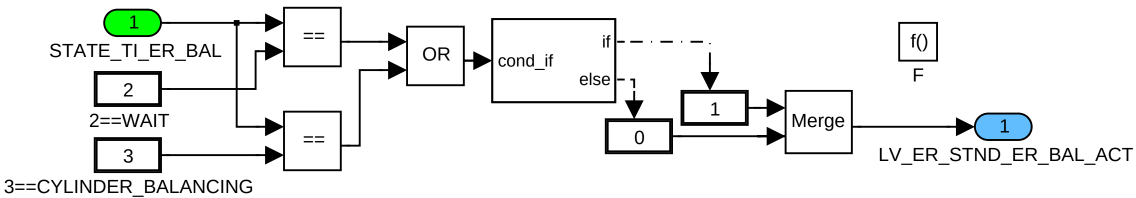

Figure 9.44.7:
CYBL_M30907M02/OPERATE_SEG/ACT_CND_CYBL_SIG_CLC/CASE_ELSE/CASE_ELSE

Activation conditions for cylinder balancing fade out calculation

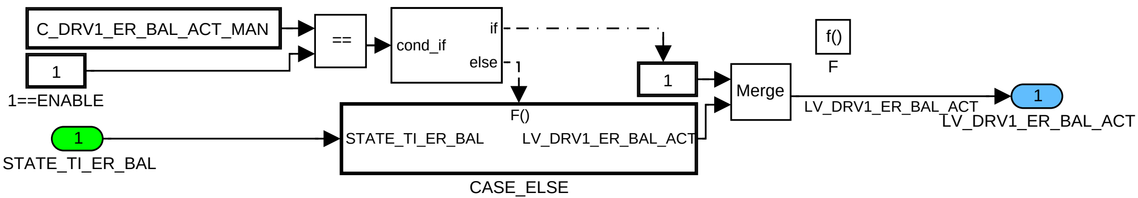

Figure 9.44.8: CYBL_M30907M02/OPERATE_SEG/ACT_CND_CYBL_FDOUT_CLC

ACT_CND_CYBL_FDOUT_CLC - elseif branch

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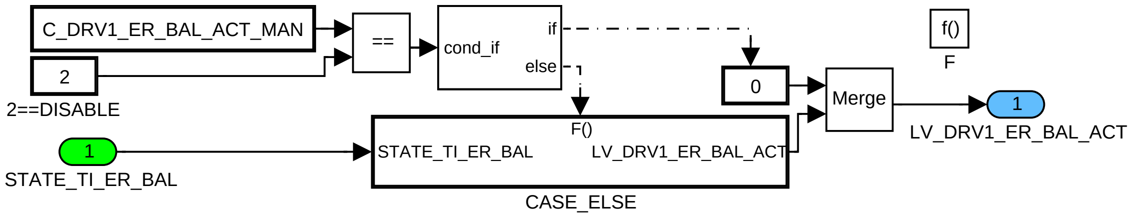

Figure 9.44.9: CYBL_M30907M02/OPERATE_SEG/ACT_CND_CYBL_FDOUT_CLC/CASE_ELSE

ACT_CND_CYBL_FDOUT_CLC - elseif branch - else branch

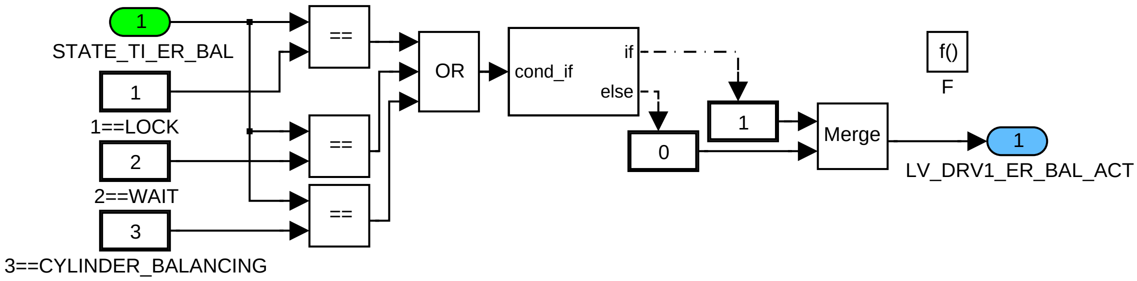

Figure 9.44.10:
CYBL_M30907M02/OPERATE_SEG/ACT_CND_CYBL_FDOUT_CLC/CASE_ELSE/CASE_ELSE

Activation conditions for cylinder balancing TI intervention calculation

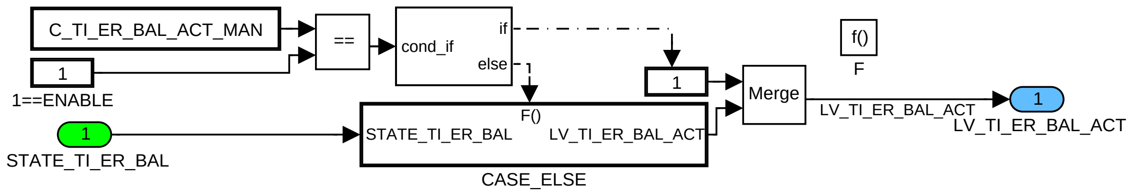

Figure 9.44.11: CYBL_M30907M02/OPERATE_SEG/ACT_CND_TI_INTV_CLC

ACT_CND_TI_INTV_CLC - elseif branch

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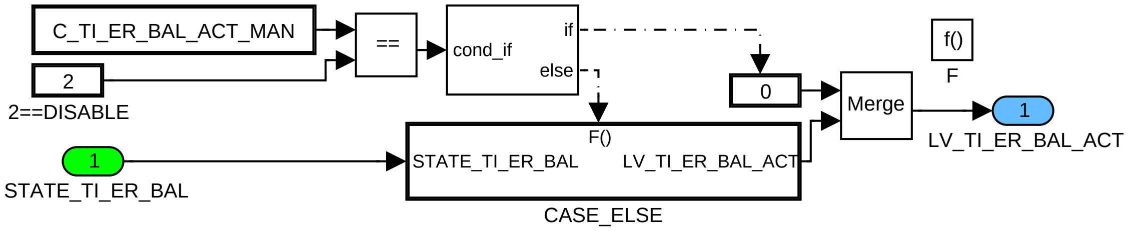

Figure 9.44.12: CYBL_M30907M02/OPERATE_SEG/ACT_CND_TI_INTV_CLC/CASE_ELSE

ACT_CND_TI_INTV_CLC - elseif branch - else branch

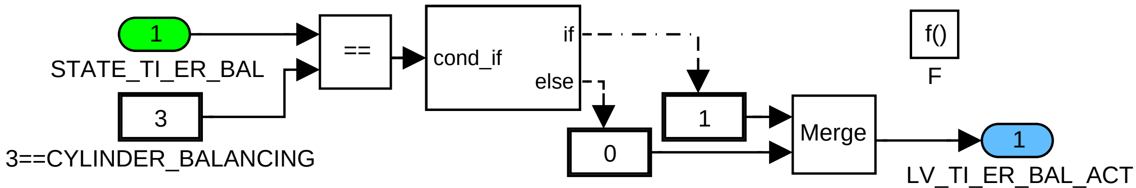

Figure 9.44.13:
CYBL_M30907M02/OPERATE_SEG/ACT_CND_TI_INTV_CLC/CASE_ELSE/CASE_ELSE

Activation of cylinder balancing (TI intervention) via lambda sensor or engine roughness

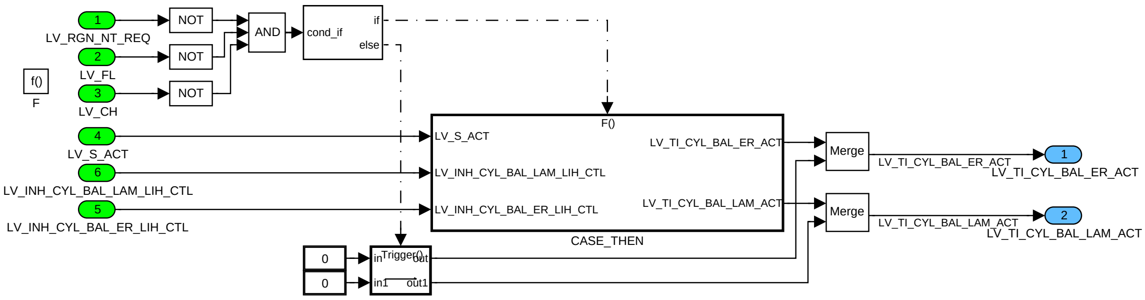

Figure 9.44.14: CYBL_M30907M02/OPERATE_SEG/ACT_TI_LS_ENRD

ACT_TI_LS_ENRD - thenif branch

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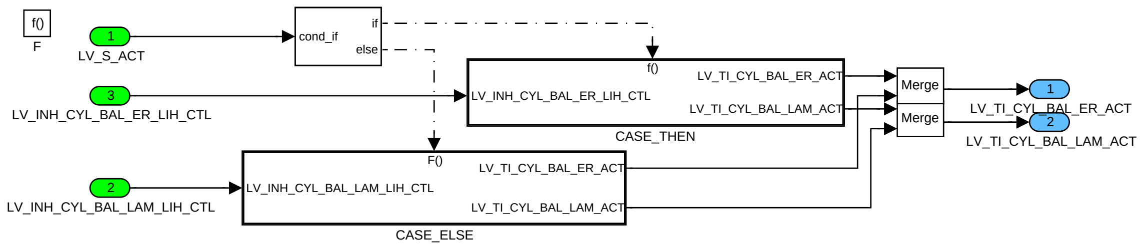

Figure 9.44.15: CYBL_M30907M02/OPERATE_SEG/ACT_TI_LS_ENRD/CASE_THEN

ACT_TI_LS_ENRD - thenif branch - else branch

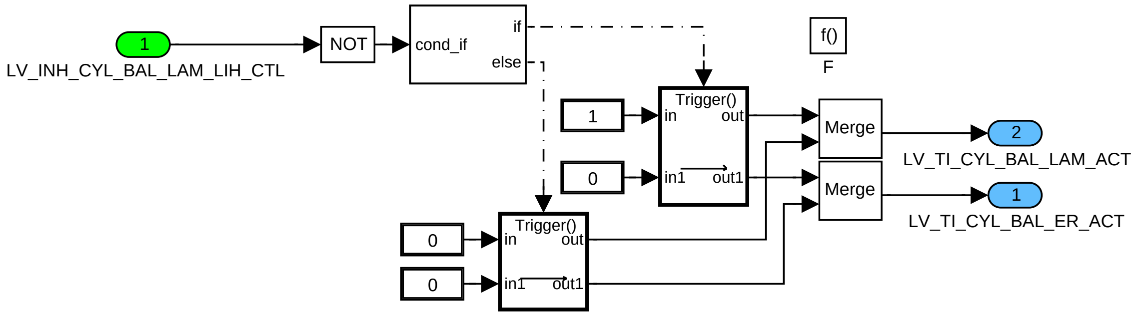

Figure 9.44.16: CYBL_M30907M02/OPERATE_SEG/ACT_TI_LS_ENRD/CASE_THEN/CASE_ELSE

ACT_TI_LS_ENRD - thenif branch CASE_THEN

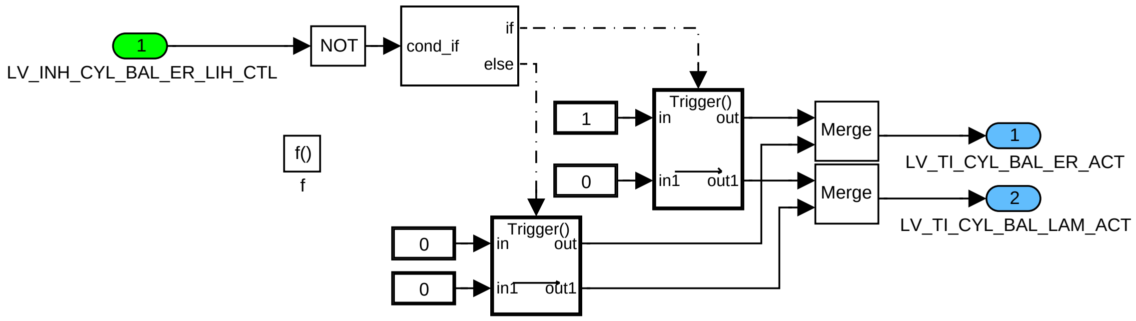

Figure 9.44.17: CYBL_M30907M02/OPERATE_SEG/ACT_TI_LS_ENRD/CASE_THEN/CASE_THEN

Basic condition to enable cylinder balancing manager calculations

LV_ER_FDOUT (flag for engine roughness fade out condition)
LV_ENA_ER (calculation of engine roughness (ER) values valid)
LV_SEG_AD_AVL_ER (segment adaptation process achieved at least one time)
LV_SEG_AD_LIM_ER (engine roughness (ER) adaptation values not out of range)
LV_STATE_RR (no rough road detected)

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LV_ERR_CRK (no failure present on crankshaft sensor)
LV_ERR_CAM (no failure present on camshaft sensor)
LV_ERR_TPS (flag for throttle position error)
LV_ERR_TCO (flag for TCO sensor error)
LV_ERR_VCV (flag for voltage supply error)
LV_ERR_FUP (flag for fuel pressure sensor error)
LV_ERR_FUP_ST (flag for "fuel pressure at start to low" error)
LV_ERR_FUP_ORNG (flag for "fuel pressure out of range" error)
LV_ERR_FUP_MFP_PLAUS (flag for "FUPmass fuel pump relation" error)
LV_ERR_H_PRS_SYS (flag for abnormal fuel pressure error)
LV_ERR_LOAD_TPS_PLAUS (flag for "LOADthrottle position relation" error)
LV_ERR_T_SEG_ER (flag for "segment time adaptive value" error)
LV_ERR_SEG_AD_ER (flag for "ER segment time adaptation" error)
LV_ERR_CYL_BAL_ER[x] (flag for cylinder balancing error, AND condition over all cylinders
[x] is representing each cylinder separately [1...NC_CYL_NR])
LV_ERR_CAT_DIAG[i] (flag for cat diagnosis error, AND condition over all exhaust banks
[i] is representing each exhaust bank separately [1...NC_CBK_EX_NR])
LV_INH_BAL_CUS (customer request to inhibit the function]
LV_ERR_MAP_TPS_PLAUS (flag for MAPthrottle position plausibility error)
LV_DET_MIS (status for actual detected misfire)
LV_MIIS_STATE_A (no CARB A[200 CRK] misfire failure present)
LV_MIS_STATE_B4 (no CARB B4[1000 CRK] misfire failure present)
LV_FCUT_IND (flag for cylinder shut off)
STATE_ERR_IV (error pattern for injection valve failure)

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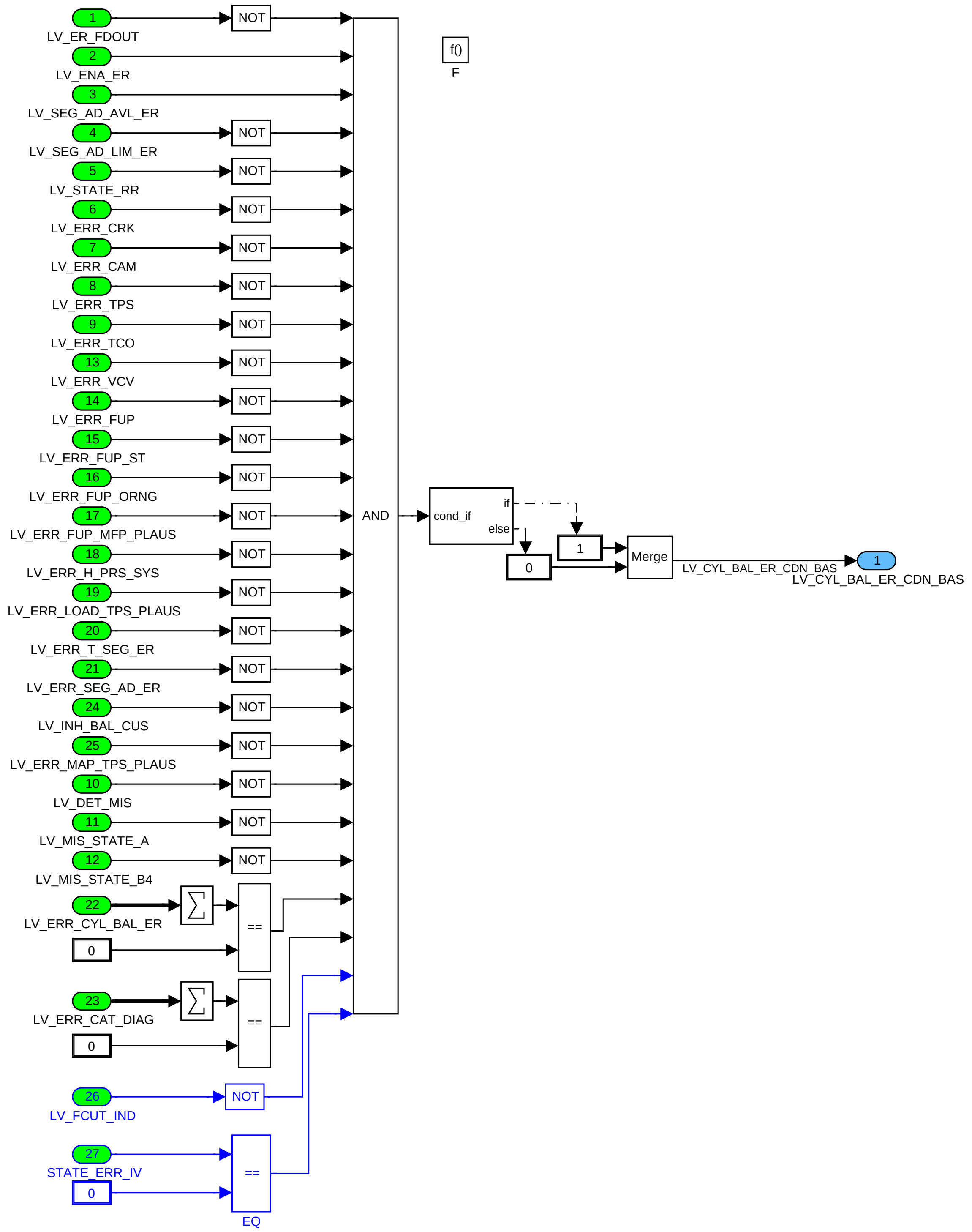

Figure 9.44.18: CYBL_M30907M02/OPERATE_SEG/EXT_CND_CYBL_CLC

External condition to enable cylinder balancing manager calculations

LV_CYL_BAL_ER_CND_BAS (Flag for basic condition to enable cylinder balancing calculations)
LV_TI_CYL_BAL_ER_ACT (Flag for cylinder balancing (TI intervention) via ER activated)
LV_PUC (flag for trailing throttle fuel cut off)

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C_TQI_MIN_TI_ER_BAL (minimum indicated engine torque for cylinder balancing)
C_TQI_MAX_TI_ER_BAL (maximum indicated engine torque for cylinder balancing)
C_T_AST_MIN_TI_ER_BAL (minimum time after start for cylinder balancing)

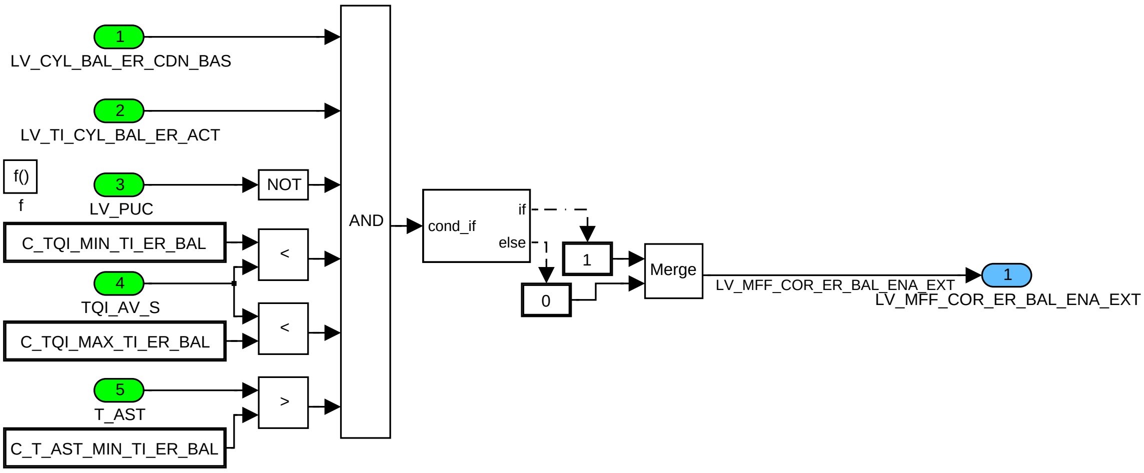

Figure 9.44.19: CYBL_M30907M02/OPERATE_SEG/EXT_CND_ENA_CYBL

External conditions to enable cylinder balancing adaptation manager calculations

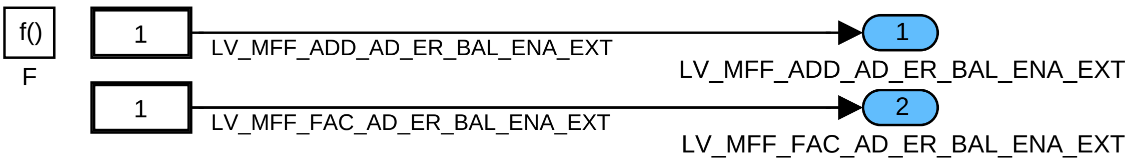

Figure 9.44.20: CYBL_M30907M02/OPERATE_SEG/EXT_CND_CYBL_AD_CLC

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9.44.3 SUBFUNCTION: SIG_MNG

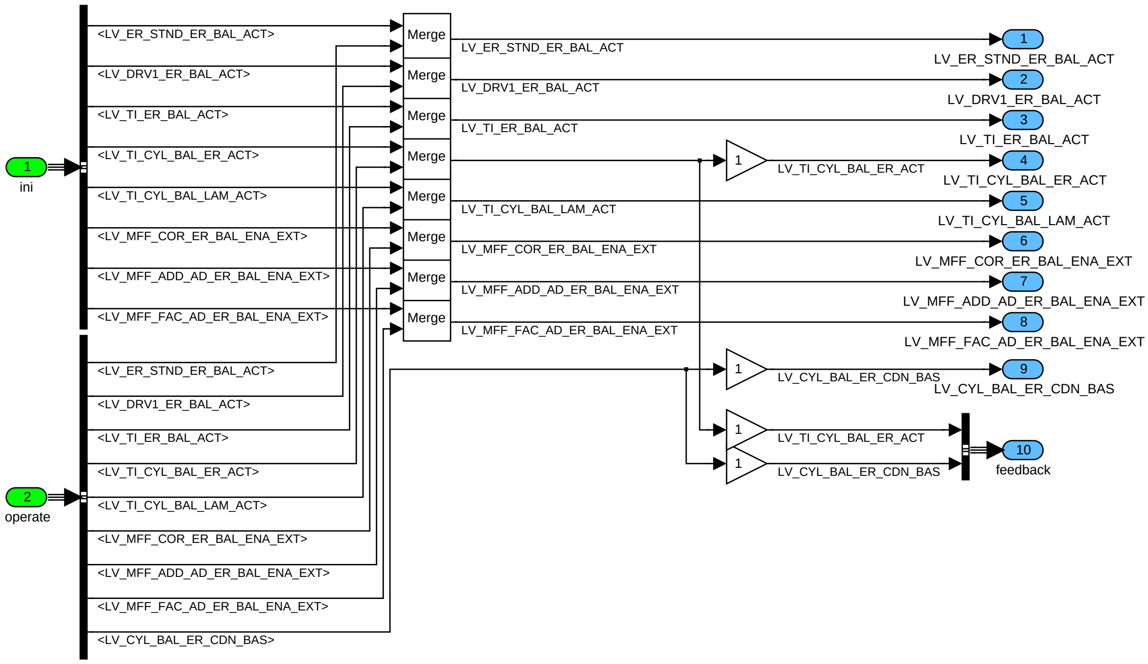

Figure 9.44.21: CYBL_M30907M02/SIG_MNG

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9.45 CYBL scheduler

Input data:

ER_STD_MMV_BAL [NC_CYL_NR] {p. 1489}	ER_STND_MMV_BAL [NC_CYL_NR] {p. 1489}	ER_STND_MMV_STD_BAL [NC_CYL_NR] {p. 1489}	FAC_TI_AD_ER_BAL [NC_CYL_NR] {p. 3298}
LC_CYL_BAL_AD_DC_RST {p. 4070}	LC_CYL_BAL_AD_EOL_RST {p. 4046}	LC_CYL_BAL_CORD_DC_STOP_MAN {p. 4070}	LC_CYL_BAL_CORD_EOL_STOP_MAN {p. 4046}
LC_FAC_TI_AD_ER_BAL_RST_MAN {p. 3299}	LC_FAC_TI_BAL_RST_MAN {p. 3216}	LC_FAC_TI_ER_BAL_RST_MAN {p. 3299}	LC_MFF_ADD_AD_ER_BAL_RST_MAN {p. 3270}
LC_MFF_ADD_ER_BAL_RST_MAN {p. 3270}	LC_TI_ER_BAL_STOP_MAN {p. 4023}	LV_CYL_BAL_ER_AD_ADD_EOL {p. 4043}	LV_CYL_BAL_ER_AD_FAC_EOL {p. 4043}
LV_CYL_BAL_LAM_AD_ADD [NC_CBK_EX_NR] {p. 4043}	LV_CYL_BAL_LAM_AD_ADD_DC [NC_CBK_EX_NR] {p. 4066}	LV_CYL_BAL_LAM_AD_DC {p. 4066}	LV_CYL_BAL_LAM_AD_EOL {p. 4043}
LV_CYL_BAL_LAM_AD_FAC [NC_CBK_EX_NR] {p. 4043}	LV_CYL_BAL_LAM_AD_FAC_H_DC [NC_CBK_EX_NR] {p. 4066}	LV_CYL_BAL_LAM_AD_FAC_L_DC [NC_CBK_EX_NR] {p. 4066}	LV_CYL_BAL_LAM_SEL_AD_COLD [NC_CBK_EX_NR] {p. 4043}
LV_CYL_BAL_LAM_SEL_AD_COLD_DC {p. 4066}	LV_CYL_BAL_LAM_SEL_AD_COLD_EOL {p. 4043}	LV_CYL_BAL_LAM_SEL_AD_HOT_DC {p. 4066}	LV_CYL_BAL_LAM_SEL_AD_HOT_EOL {p. 4043}
LV_CYL_BAL_LAM_SEL_AD_RNG_H [NC_CBK_EX_NR] {p. 4043}	LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC [NC_CBK_EX_NR] {p. 4066}	LV_CYL_BAL_LAM_SEL_AD_RNG_L [NC_CBK_EX_NR] {p. 4043}	LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC [NC_CBK_EX_NR] {p. 4067}
LV_CYL_BAL_LAM_SEL_RNG_COLD_DC [NC_CBK_EX_NR] {p. 4067}	MFF_ADD_AD_ER_BAL [NC_CYL_NR] {p. 3269}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
T_CYL_BAL_LAM_AD_DC {p. 4068}	T_CYL_BAL_LAM_SEL_DC {p. 4068}		

FUNCTION DESCRIPTION:

General information:

This manager specifies the sequencing of all CYBL tasks.

Description:

Within the cylinder balancing package (CYBL), all functions for Cylinder balancing via engine roughness" (CYBL_ER) are included. This scheduler has to manage the coordination of all involved parts.

Application conditions

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Recurrence: *see formula section below*

Activation: *at every engine operating state*

Deactivation: –

Formula section:

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9.45.1 Non volatile memory tasks (CYBL_ER):

NVMY_STB	
NVMY_STB	Engine roughness signal preparation for Cylinder balancing (402U) /* ER_STND_MMV_BAL[x] (NVMY) = 0 /* ER_STND_MMV_STD_BAL[x] (NVMY) = 0 /* ER_STD_MMV_BAL[x] (NVMY) = 0
NVMY_STB	Cylinder balancing via additive MFF intervention (7085) /* MFF_ADD_AD_ER_BAL[x] (NVMY) = 0
NVMY_STB	Cylinder balancing via multiple TI intervention (707Q) /* FAC_TI_AD_ER_BAL[x] (NVMY) = 0
NVMY_STB	Cylinder balancing coordination at EOL (908O) /* LV_CYL_BAL_LAM_AD_EOL (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_COLD_EOL (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_HOT_EOL (NVMY) = 0 /* LV_CYL_BAL_ER_AD_FAC_EOL (NVMY) = 0 /* LV_CYL_BAL_ER_AD_ADD_EOL (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_COLD[m] (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] (NVMY) = 0 /* LV_CYL_BAL_LAM_AD_FAC[m] (NVMY) = /* LV_CYL_BAL_LAM_AD_ADD[m] (NVMY) = 0
NVMY_STB	Cylinder balancing coordination at DC (908P) /* T_CYL_BAL_LAM_SEL_DC (NVMY) = 0 /* T_CYL_BAL_LAM_AD_DC (NVMY) = 0 /* LV_CYL_BAL_LAM_AD_DC (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_HOT_DC (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_COLD_DC (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] (NVMY) = 0 /* LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] (NVMY) = 0 /* LV_CYL_BAL_LAM_AD_ADD_DC[m] (NVMY) = 0 /* LV_CYL_BAL_LAM_AD_FAC_L_DC[m] (NVMY) = 0 /* LV_CYL_BAL_LAM_AD_FAC_H_DC[m] (NVMY) = 0
NVMY_RST	
NVMY_RST	Engine roughness signal preparation for Cylinder balancing (402U) /* ER_STND_MMV_BAL[x] (NVMY) --> (RAM) /* ER_STND_MMV_STD_BAL[x] (NVMY) --> (RAM) /* ER_STD_MMV_BAL[x] (NVMY) --> (RAM)
NVMY_RST	Cylinder balancing via additive MFF intervention (7085) /* MFF_ADD_AD_ER_BAL[x] (NVMY) --> (RAM)
NVMY_RST	Cylinder balancing via multiple TI intervention (707Q) /* FAC_TI_AD_ER_BAL[x] (NVMY) --> (RAM)
NVMY_RST	Cylinder balancing coordination at EOL (908O) /* LV_CYL_BAL_LAM_AD_EOL (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_COLD_EOL (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_HOT_EOL (NVMY) --> (RAM) /* LV_CYL_BAL_ER_AD_FAC_EOL (NVMY) --> (RAM) /* LV_CYL_BAL_ER_AD_ADD_EOL (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_COLD[m] (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_AD_FAC[m] (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_AD_ADD[m] (NVMY) --> (RAM)
NVMY_RST	Cylinder balancing coordination at DC (908P) /* T_CYL_BAL_LAM_SEL_DC (NVMY) --> (RAM) /* T_CYL_BAL_LAM_AD_DC (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_AD_DC (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_HOT_DC (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_COLD_DC (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] (NVMY) --> (RAM)

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	/* LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_AD_ADD_DC[m] (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_AD_FAC_L_DC[m] (NVMY) --> (RAM) /* LV_CYL_BAL_LAM_AD_FAC_H_DC[m] (NVMY) --> (RAM)
NVMY_UPD	
NVMY_UPD	Engine roughness signal preparation for Cylinder balancing (402U) /* ER_STND_MMV_BAL[x] (RAM) --> (NVMY) /* ER_STND_MMV_STD_BAL[x] (RAM) --> (NVMY) /* ER_STD_MMV_BAL[x] (RAM) --> (NVMY)
NVMY_UPD	Cylinder balancing via additive MFF intervention (7085) /* MFF_ADD_AD_ER_BAL[x] (RAM) --> (NVMY)
NVMY_UPD	Cylinder balancing via multiple TI intervention (707Q) /* FAC_TI_AD_ER_BAL[x] (RAM) --> (NVMY)
NVMY_UPD	Cylinder balancing coordination at EOL (908O) /* LV_CYL_BAL_LAM_AD_EOL (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_COLD_EOL (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_HOT_EOL (RAM) --> (NVMY) /* LV_CYL_BAL_ER_AD_FAC_EOL (RAM) --> (NVMY) /* LV_CYL_BAL_ER_AD_ADD_EOL (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_COLD[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_AD_FAC[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_AD_ADD[m] (RAM) --> (NVMY)
NVMY_UPD	Cylinder balancing coordination at DC (908P) /* T_CYL_BAL_LAM_SEL_DC (RAM) --> (NVMY) /* T_CYL_BAL_LAM_AD_DC (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_AD_DC (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_HOT_DC (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_COLD_DC (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_AD_ADD_DC[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_AD_FAC_L_DC[m] (RAM) --> (NVMY) /* LV_CYL_BAL_LAM_AD_FAC_H_DC[m] (RAM) --> (NVMY)

/* ** Description **
/* NVMY_STB: --> Initialization of NVMY cells at first engine run or NVMY error
/* NVMY_RST: --> Initialization of RAM cells with NVMY cells at RESET
/* NVMY_UPD: --> Initialization of NVMY cells with RAM cells at ECU power latch
/* [x] is representing [NC_CYL_NR] at the task definition above
/* [m] is representing [NC_CBK_EX_NR] at the task definition above

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9.45.2 Initialization tasks (CYBL_ER):

RESET (no sequencing behind - only for info)	
RST	/* the RESET of aggregate ENTE has to be performed before CYBL RESET tasks
RST	Cylinder balancing via ER (Appl. Inc.) (704N)
RST	Cylinder balancing manager (Appl. Inc.) (907M)
RST	Engine roughness signal preparation for Cylinder balancing (402U)
RST	Cylinder balancing manager (907L)
RST	Cylinder balancing via multiple TI intervention (707Q)
RST	Cylinder balancing via additive MFF intervention (7085)
RST	Coord. of the injection time correction factors for cylinder balancing (704P)
RST	Cylinder balancing coordination at DC (908P)
RST	Cylinder balancing coordination at EOL (908O)
EXIT_ST (no sequencing behind - only for info)	
EXIT_ST	Cylinder balancing coordination at EOL (908O - chapter 1.3)
STOP_MAN (no system event , section located within SW code- only for info)	
# IF (LC_TI_ER_BAL_STOP_MAN = 1)	
STOP_MAN	Cylinder balancing manager (Appl. Inc.) (907M) /* Initialization at manual stop of function
STOP_MAN	Cylinder balancing manager (907L) /* Initialization at manual stop of function
# ENDIF	
# IF (LC_CYL_BAL_CORD_EOL_STOP_MAN = 1)	
STOP_MAN	Cylinder balancing coordination at EOL (908O - chapter 1.4, 1.5, 1.6) /* Initialization at manual stop of functions
# ENDIF	
# IF (LC_CYL_BAL_CORD_DC_STOP_MAN = 1)	
STOP_MAN	Cylinder balancing coordination at DC (908P - chapter 1.2, 1.3, 1.4, 1.5, 1.6) /* Initialization at manual stop of function
# ENDIF	
RESET_MAN (no system event, section located within SW code - only for info)	
# IF (LC_FAC_TI_BAL_RST_MAN = 1)	
RST_MAN	Coord. of the injection time correction factors for cylinder balancing (704P) /* Manual reset of injector energy correction values
# ENDIF	
# IF (LC_MFF_ADD_ER_BAL_RST_MAN = 1)	
RST_MAN	Cylinder balancing via additive MFF intervention (7085) /* Manual reset of additive correction values
# ENDIF	
# IF (LC_MFF_ADD_AD_ER_BAL_RST_MAN = 1)	
RST_MAN	Cylinder balancing via additive MFF intervention (7085) /* Manual reset of additive adaptation correction values
# ENDIF	
# IF (LC_FAC_TI_ER_BAL_RST_MAN = 1)	
RST_MAN	Cylinder balancing via multiple TI intervention (707Q) /* Manual reset of multiple correction values
# ENDIF	
# IF (LC_FAC_TI_AD_ER_BAL_RST_MAN = 1)	
RST_MAN	Cylinder balancing via multiple TI intervention (707Q) /* Manual reset of multiple adaptation correction values

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# ENDIF	
# IF (LC_CYL_BAL_AD_EOL_RST = 1)	
RST_MAN	Cylinder balancing coordination at EOL (908O) /* Manual reset of cylinder balancing adaptation flags at end of line (EOL)
# ENDIF	
# IF (LC_CYL_BAL_AD_DC_RST = 1)	
RST_MAN	Cylinder balancing coordination at DC (908P) /* Manual reset of cylinder balancing adaptation flags at active driving cycle (DC)
# ENDIF	
RESET_DEAC (no system event , section located within SW code - only for info)	
RST_DEAC	Cylinder balancing coordination at EOL (908O - chapter 1.4, 1.5, 1.6) /* Initialization at function deactivation
RST_DEAC	Cylinder balancing coordination at DC (908P - chapter 1.2, 1.3, 1.4, 1.5, 1.6) /* Initialization at function deactivation
/* *** Description *** /* RST: --> ECU RESET /* RST_MAN: --> Initialization with use of a logical constant for setting of the wanted values /* RST_DEAC: --> Initialization at function deactivation /* STOP_MAN: --> Initialization at manual stop of function /* EXIT_ST: --> Initialization at exit start	

9.45.3 Recurring tasks(CYBL_ER):

SEG Task	
CYBL_ER	Cylinder balancing manager (Appl. Inc.) (907M)
CYBL_ER	Engine roughness signal preparation for Cylinder balancing (402U)
CYBL_ER	Cylinder balancing manager (907L)
CYBL_ER	Cylinder balancing via multiple TI intervention (707Q)
CYBL_ER	Cylinder balancing via additive MFF intervention (7085)
CYBL_ER	Coord. of the injection time correction factors for cylinder balancing (704P)
10ms - Task	
CYBL_ER	Cylinder balancing via ER (Appl. Inc.) (704N)
CYBL_ER	Coord. of the injection time correction factors for cylinder balancing (704P)
20ms - Task	
CYBL_ER	Cylinder balancing coordination at DC (908P)
CYBL_ER	Cylinder balancing coordination at EOL (908O)
100ms - Task	
CYBL_ER	Cylinder balancing via ER (Appl. Inc.) (704N)
CYBL_ER	Cylinder balancing via multiple TI intervention (707Q)
CYBL_ER	Cylinder balancing via additive MFF intervention (7085)
CYBL_ER	Coord. of the injection time correction factors for cylinder balancing (704P)
CYBL_ER	Cylinder balancing coordination at DC (908P)
CYBL_ER	Cylinder balancing coordination at EOL (908O)
/* *** Description ***	

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9.45.4 Main interfering AGGR tasks for CYBL_ER:

AGGR Task before CYBL_ER	
AGGR_xx	
ENSD	Engine Position and Speed Determination
ENRD	Engine Roughness Determination
FMSP	Fuel Mass Setpoint
LACO	Lambda Control
CILC	Cylinder Individual Lambda Control
AGGR_xx	
CYBL_ER Task	
CYBL_ER	Cylinder balancing via engine roughness
AGGR - Task after CYBL_ER	
AGGR_xx	
INJR	Injection Realisation
IGRE	Ignition Realisation
AGGR_xx	
/* ** Description **	

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9.46 Cylinder balancing coordination at EOL

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CYL_BAL_LAM_CBK_AD [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter for cylinder balancing lambda adaptation at end of line within limits					
ER_STND_MMV_DIF_BAL_DYW	V	8000... 7FFFH	-325.78 ...325.77	0.00994	1/s^2
Dynamic window value for cylinder balancing engine roughness adaptation at end of line					
ER_STND_MMV_DIF_BAL_MAX_DYW	V	8000... 7FFFH	-325.78 ...325.77	0.00994	1/s^2
Maximum ER_STND_MMV_BAL value for dynamic window calculation at end of line					
ER_STND_MMV_DIF_BAL_MIN_DYW	V	8000... 7FFFH	-325.78 ...325.77	0.00994	1/s^2
Minimum ER_STND_MMV_BAL value for dynamic window calculation at end of line					
LV_CYL_BAL_AD_WG_OPEN_REQ_EOL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag for waste gate open requested for cylinder balancing adaptation at end of line					
LV_CYL_BAL_AD_WG_OPEN_TMP_EOL [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for temporary waste gate open request for cylinder balancing adaptation at end of line					
LV_CYL_BAL_ER_AD_ADD_EOL	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing additive engine roughness adaptation at end of line finished					
LV_CYL_BAL_ER_AD_FAC_EOL	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing multiple engine roughness adaptation at end of line finished					
LV_CYL_BAL_LAM_AD_ADD [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation (additive) exhaust bank specific					
LV_CYL_BAL_LAM_AD_EOL	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation at end of line finished					
LV_CYL_BAL_LAM_AD_FAC [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation (multiple) exhaust bank specific					
LV_CYL_BAL_LAM_SEL_AD_COLD [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (cold) exhaust bank specific					
LV_CYL_BAL_LAM_SEL_AD_COLD_EOL	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (cold) at end of line finished					
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (hot) at end of line finished					
LV_CYL_BAL_LAM_SEL_AD_RNG_H [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (high range) exhaust bank specific					
LV_CYL_BAL_LAM_SEL_AD_RNG_L [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (low range) exhaust bank specific					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_STATE_CYL_BAL_LAM_CHG_AD	V	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation to state adaptation requested					
LV_STATE_CYL_BAL_LAM_CHG_WAIT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation to state wait requested					
LV_STATE_CYL_BAL_SEL_CHG_AD	V	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation to state adaptation requested					
LV_STATE_CYL_BAL_SEL_CHG_WAIT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation to state wait requested					
STATE_CYL_BAL_ER_AD_EOL	V	0H 1H 2H	Ready Wait Adaptation	-	-
State of cylinder balancing engine roughness adaptation at end of line					
STATE_CYL_BAL_LAM_AD_EOL	V	0H 1H 2H	Ready Wait Adaptation	-	-
State of cylinder balancing lambda adaptation at end of line					
STATE_CYL_BAL_LAM_SEL_AD_EOL	V	0H 1H 2H	Ready Wait Adaptation	-	-
State of cylinder balancing cylinder selective lambda adaptation at end of line					
T_CYL_BAL_ER_AD	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing engine roughness adaptation at end of line					
T_CYL_BAL_ER_AD_DYW	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing engine roughness adaptation at end of line within limits					
T_CYL_BAL_LAM_AD	V	0... FFFFH	0... 1310.7	0.02	s
Time for cylinder balancing lambda adaptation at end of line					
T_CYL_BAL_LAM_SEL_AD	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing cylinder selective lambda adaptation at end of line					
T_CYL_BAL_LAM_SEL_CBK_AD [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing cylinder selective lambda adaptation at end of line within limits					

Input data:

DIST_KWP {p. 1183}	ER_STND_MMV_DIF_BAL [NC_CYL_NR] {p. 1489}	FAC_CYL_LAM_ABSV_SUM [NC_CBK_EX_NR] {p. 2730}	FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}
FAC_LAM_ADJ_LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_LAM_CYL_SEL_ADJ_CST [NC_CYL_NR] {p. 2731}	FAC_LAM_CYL_SEL_ADJ_H_RNG [NC_CYL_NR] {p. 2731}	FAC_LAM_CYL_SEL_ADJ_L_RNG [NC_CYL_NR] {p. 2731}
FAC_TI_AD_ER_BAL [NC_CYL_NR] {p. 3298}	LC_TCHA_CONF {p. 658}	LV_CYL_BAL_AD_EOL_EXT_ADJ {p. 7483}	LV_FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}
LV_FAC_TI_AD_ER_BAL_ENA {p. 4006}	LV_LAM_AD_STOP [NC_CBK_EX_NR] {p. 2642}	LV_LAM_CYL_ENA_CYL_BAL_DC [NC_CBK_EX_NR] {p. 2864}	LV_LAM_CYL_SEL_ADJ_VLD [NC_CBK_EX_NR] {p. 2732}

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LV_MFF_ADD_AD_ER_BAL_ENA {p. 4006}	LV_MFF_ADD_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2642}	LV_TI_CYL_BAL_ER_ACT {p. 4022}	LV_TI_CYL_BAL_LAM_ACT {p. 4022}
MFF_ADD_AD_ER_BAL [NC_CYL_NR] {p. 3269}	MFF_ADD_LAM_AD [NC_CBK_EX_NR] {p. 2642}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}
NC_CYL_NR {p. 1526}	STATE_LAM_CYL_SEL_ADJ [NC_CBK_EX_NR] {p. 2733}	STATE_TI_ER_BAL {p. 4006}	T_AST_BAL {p. 3261}
TCO {p. 1100}	TCO_ST_BAL {p. 3261}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DEC_CYL_BAL_LAM_CBK_AD	-	0... FFFFH	0... 65535	1	-
Counter decrement value for cylinder balancing lambda adaptation within limits at end of line					
C_CTR_MIN_CYL_BAL_LAM_AD_ADD	-	0... FFFFH	0... 65535	1	-
Minimum counter value for cylinder balancing lambda adaptation (additive) within limits at end of line					
C_CTR_MIN_CYL_BAL_LAM_AD_FAC	-	0... FFFFH	0... 65535	1	-
Minimum counter value for cylinder balancing lambda adaptation (multiple) within limits at end of line					
C_CYL_BAL_AD_EOL_RST	-	0H 1H 2H 3H 4H 5H 6H 7H	ZERO ON LAM_AD SEL_COLD SEL_HOT ER_FAC ER_ADD WG_OPEN	-	-
Reset of cylinder balancing adaptation readiness flags at end of line					
C_CYL_BAL_LAM_AD_EOL_CONF	-	0H 1H 2H 3H	ZERO ADD FAC_L ADD_FAC_L	-	-
Configuration of lambda adaptation correction values for cylinder balancing at end of line					
C_CYL_BAL_LAM_SEL_HOT_EOL_CONF	-	0H 1H 2H 3H	ZERO LOW HIGH LOW_HIGH	-	-
Configuration of cylinder selectiv lambda adaptation correction values (hot) for cylinder balancing at end of line					
C_T_DEC_CYL_BAL_ER_AD_DYN	-	0... FFFFH	0... 6553.5	0.1	s
Time decrement value for cylinder balancing engine roughness adaptation within limits at end of line					
C_T_DEC_CYL_BAL_LAM_SEL_CBK_AD	-	0... FFFFH	0... 6553.5	0.1	s
Time decrement value for cylinder balancing cylinder selectiv lambda adaptation within limits at end of line					
C_T_MAX_CYL_BAL_ER_AD	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time for cylinder balancing engine roughness adaptation at end of line					
C_T_MAX_CYL_BAL_LAM_AD	-	0... FFFFH	0... 1310.7	0.02	s
Maximum time for cylinder balancing lambda adaptation at end of line					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MAX_CYL_BAL_LAM_SEL_AD_COLD	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time for cylinder balancing cylinder selective lambda adaptation (cold) at end of line					
C_T_MAX_CYL_BAL_LAM_SEL_AD_HOT	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time for cylinder balancing cylinder selective lambda adaptation (hot) at end of line					
C_T_MIN_CYL_BAL_ER_AD_DYN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for cylinder balancing engine roughness adaptation within limits at end of line					
C_T_MIN_CYL_BAL_LAM_SEL_AD_COLD	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for cylinder balancing cylinder selective lambda adaptation (cold) within limits at end of line					
C_T_MIN_CYL_BAL_LAM_SEL_AD_HOT	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for cylinder balancing cylinder selective lambda adaptation (hot) within limits at end of line					
C_TCO_MAX_CYL_BAL_WG_OPEN	-	0... FEH	-48... 142.5	0.75	°C
Maximum coolant temperature for cylinder balancing waste gate open request at end of line					
IP_ER_STND_MMV_DIF_BAL_DYW	-	0... FFFFH	-325.78 ...325.77	0.00994	1/s^2
LDP_N_32_IP_ER_STND_MMV_DIF_DYW	6	0... FFH	0... 8160	32	rpm
LDP_DIST_KWP_IP_ER_STND_DIF_DYW	6	0... FFFFH	0... 524280	8	km
Dynamic window threshold for cylinder balancing engine roughness adaptation within limits at end of line					
IP_FAC_CYL_LAM_ABSV_SUM_CYL_BAL	-	0... 7FFFH	0... 49.998474	1.5259e-3	%
LDP_DIST_KWP_IP_FAC_CYL_LAM_BAL	4	0... FFFFH	0... 524280	8	km
Threshold for cylinder balancing cylinder selective lambda adaptation within limits at end of line					
IP_FAC_L_LAM_ADJ_DIF_CYL_BAL	-	0... FFFFH	-50... 49.998474	1.5259e-3	%
LDP_DIST_KWP_IP_FAC_L_LAM_BAL	4	0... FFFFH	0... 524280	8	km
Lambda factor threshold for cylinder balancing lambda adaptation within limits at end of line					
IP_FAC_MFF_LAM_ADJ_DIF_CYL_BAL	-	0... FFFFH	-50... 49.998474	1.5259e-3	%
LDP_DIST_KWP_IP_FAC_MFF_LAM_BAL	4	0... FFFFH	0... 524280	8	km
Lambda additive threshold for cylinder balancing lambda adaptation within limits at end of line					
IP_T_AST_MAX_CYL_BAL_WG_OPEN	-	0... FFFFH	0... 6553.5	0.1	s
LDP_TCO_ST_BAL_IP_T_AST_WG_OPEN	4	0... FEH	-48... 142.5	0.75	°C
Maximum time after start for cylinder balancing waste gate open request at end of line					
LC_CYL_BAL_AD_EOL_RST	-	0... 1H	0 ...1	1	-
Manual switch for cylinder balancing adaptation reset at end of line					
LC_CYL_BAL_CORD_EOL_STOP_MAN	-	0... 1H	0 ...1	1	-
Logical constant for manual stop (=1) of cylinder balancing coordination at end of line					

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FUNCTION DESCRIPTION:

General information:

Task of the cylinder balancing coordination is to observe the balancing adaptation functions at end of line test and to set a readiness information as soon as a defined adaptation limit for each adaptation has been reached.

Application conditions

Initialization at first Engine run or NVMY-error:

```
LV_CYL_BAL_LAM_AD_EOL = 0                 (first initialization)
LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 0        (first initialization)
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 0         (first initialization)
LV_CYL_BAL_ER_AD_FAC_EOL = 0              (first initialization)
LV_CYL_BAL_ER_AD_ADD_EOL = 0              (first initialization)
FOR m = 0 to NC_CBK_EX_NR - 1
```

```
    LV_CYL_BAL_LAM_SEL_AD_COLD[m] = 0          (first initialization)
    LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 0         (first initialization
    LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 0         (first initialization
    LV_CYL_BAL_LAM_AD_FAC[m] = 0               (first initialization
    LV_CYL_BAL_LAM_AD_ADD[m] = 0               (first initialization
END FOR
```

Initialization at Reset:

```
LV_CYL_BAL_LAM_AD_EOL = LV_CYL_BAL_LAM_AD_EOL          (NVMY)
LV_CYL_BAL_ER_AD_FAC_EOL = LV_CYL_BAL_ER_AD_FAC_EOL    (NVMY)
LV_CYL_BAL_ER_AD_ADD_EOL = LV_CYL_BAL_ER_AD_ADD_EOL    (NVMY)
LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = LV_CYL_BAL_LAM_SEL_AD_COLD_
EOL (NVMY)
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = LV_CYL_BAL_LAM_SEL_AD_HOT_
EOL (NVMY)
```

FOR m = 0 to NC_CBK_EX_NR - 1

LV_CYL_BAL_LAM_SEL_AD_COLD[m] = LV_CYL_BAL_LAM_SEL_AD_COLD[m] *(NVMY)*
LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] *(NVMY)*
LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] *(NVMY)*
LV_CYL_BAL_LAM_AD_FAC[m] = LV_CYL_BAL_LAM_AD_FAC[m] *(NVMY)*
LV_CYL_BAL_LAM_AD_ADD[m] = LV_CYL_BAL_LAM_AD_ADD[m] *(NVMY)*

END FOR

(NVMY: values stored in the non-volatile memory)

Recurrence: See separate chapters
Activation: See separate chapters
Deactivation: See separate chapters

Signal flow diagram:

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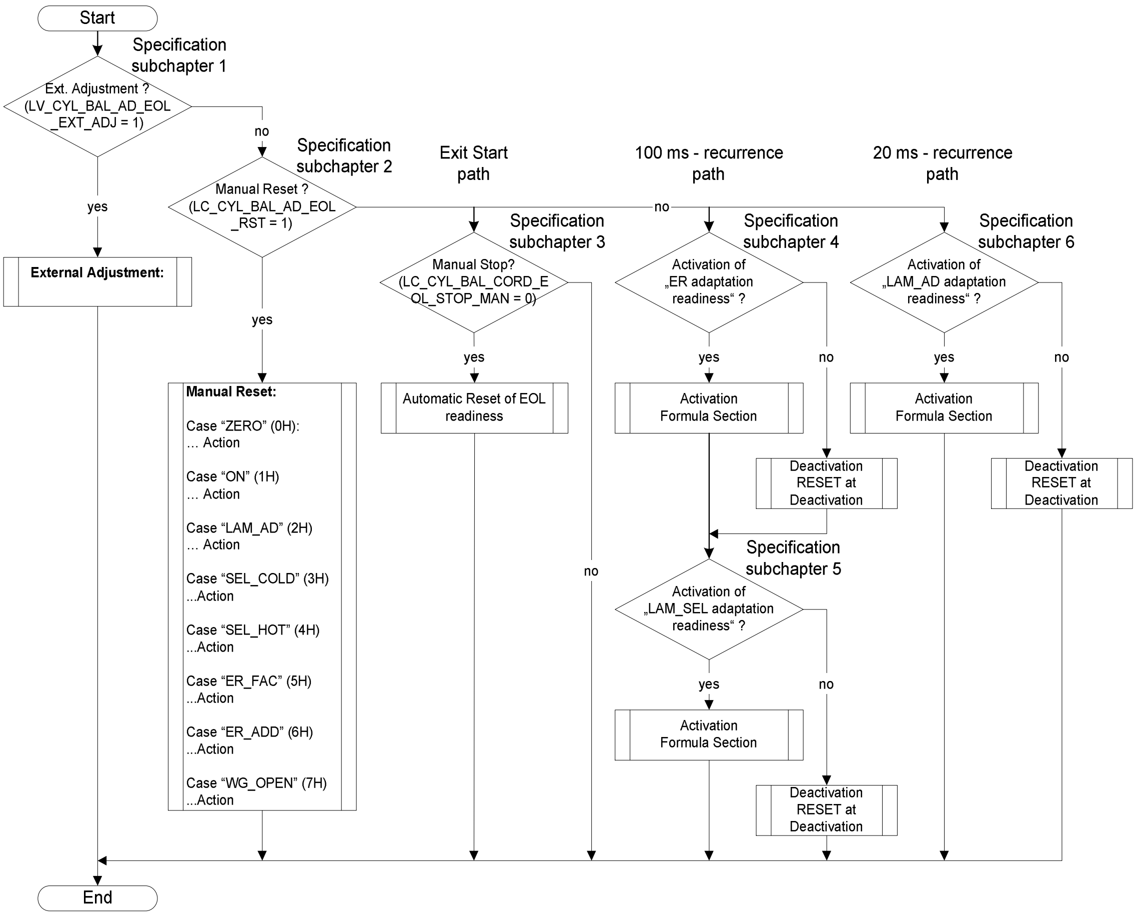

9.46.1 External adjustment of cylinder balancing readiness at end of line (EOL):

FUNCTION DESCRIPTION:

General information:

In case of an external adjustment (request from key word protocoll) the readiness bits for all cylinder balancing adaptation functions at EOL are set to zero. While the external adjustment is activated, all following subchapters within the module "Cylinder balancing coordination at EOL" are deactivated and the corresponding "Initialization at Deactivation" process for this chapters is blocked during the period.

Application conditions

Recurrence: *100 ms*

Activation: *LV_CYL_BAL_AD_EOL_EXT_ADJ = 1*

Deactivation: *LV_CYL_BAL_AD_EOL_EXT_ADJ = 0*

Formula section:

LV_CYL_BAL_LAM_AD_EOL = 0

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LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 0
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 0
LV_CYL_BAL_ER_AD_FAC_EOL = 0
LV_CYL_BAL_ER_AD_ADD_EOL = 0
FOR m = 0 to NC_CBK_EX_NR - 1
    LV_CYL_BAL_LAM_SEL_AD_COLD[m] = 0
    LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 0
    LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 0
    LV_CYL_BAL_LAM_AD_FAC[m] = 0
    LV_CYL_BAL_LAM_AD_ADD[m] = 0
END FOR

9.46.2 Manual reset of cylinder balancing readiness at end of line (EOL):

FUNCTION DESCRIPTION:

General information:

In case of a manual reset it is possible to adjust the exported output data to a wanted value to make the function test and handling more easier. While the manual function reset is activated, all following subchapters within the module "Cylinder balancing coordination at EOL" are deactivated and the corresponding "Initialization at Deactivation" process for this chapters is blocked during the period.

Application conditions

Recurrence: *100 ms*

Activation: LV_CYL_BAL_AD_EOL_EXT_ADJ = 0 **and**
LC_CYL_BAL_AD_EOL_RST = 1

Deactivation: LV_CYL_BAL_AD_EOL_EXT_ADJ = 0 **and**
[LC_CYL_BAL_AD_EOL_RST = 0 **]**

Formula section:

IF C_CYL_BAL_AD_EOL_RST = ZERO (0**H**)
THEN LV_CYL_BAL_LAM_AD_EOL = 0
    LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 0
    LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 0
    LV_CYL_BAL_ER_AD_FAC_EOL = 0
    LV_CYL_BAL_ER_AD_ADD_EOL = 0
    FOR m = 0 to NC_CBK_EX_NR - 1
        LV_CYL_BAL_LAM_SEL_AD_COLD[m] = 0
        LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 0
        LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 0
        LV_CYL_BAL_LAM_AD_FAC[m] = 0
        LV_CYL_BAL_LAM_AD_ADD[m] = 0
        LV_CYL_BAL_AD_WG_OPEN_REQ_EOL[m] = 0
    END FOR

ELSEIF C_CYL_BAL_AD_EOL_RST = ON (1**H**)
THEN LV_CYL_BAL_LAM_AD_EOL = 1

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LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 1
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 1
LV_CYL_BAL_ER_AD_FAC_EOL = 1
LV_CYL_BAL_ER_AD_ADD_EOL = 1
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_SEL_AD_COLD[m] = 1
LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 1
LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 1
LV_CYL_BAL_LAM_AD_FAC[m] = 1
LV_CYL_BAL_LAM_AD_ADD[m] = 1
LV_CYL_BAL_AD_WG_OPEN_REQ_EOL[m] = 1
END FOR

ELSEIF C_CYL_BAL_AD_EOL_RST = LAM_AD (2**H**)
THEN LV_CYL_BAL_LAM_AD_EOL = 1

ELSEIF C_CYL_BAL_AD_EOL_RST = SEL_COLD (3**H**)
THEN LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 1

ELSEIF C_CYL_BAL_AD_EOL_RST = SEL_HOT (4**H**)
THEN LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 1

ELSEIF C_CYL_BAL_AD_EOL_RST = ER_FAC (5**H**)
THEN LV_CYL_BAL_ER_AD_FAC_EOL = 1

ELSEIF C_CYL_BAL_AD_EOL_RST = ER_ADD (6**H**)
THEN LV_CYL_BAL_ER_AD_ADD_EOL = 1

ELSEIF C_CYL_BAL_AD_EOL_RST = WG_OPEN (7**H**)
THEN
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_AD_WG_OPEN_REQ_EOL[m] = 1
END FOR
ENDIF

9.46.3 Automatic reset of cylinder balancing end of line (EOL) readiness:

FUNCTION DESCRIPTION:

General information:

In case of lost adaptation values due to a manual reset at the garage or faulty non-volatile memory entries, the system detects the changes and the corresponding end of line readiness is reset automatically.

Application conditions:

Initialization at exit start (EXIT_ST):
IF LC_CYL_BAL_CORD_EOL_STOP_MAN = 0 **and**
LC_CYL_BAL_AD_EOL_RST = 0 **and**
LV_CYL_BAL_AD_EOL_EXT_ADJ = 0

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THEN

Reset of cylinder balancing global lambda adaptation readiness:

IF (1) LV_CYL_BAL_LAM_AD_EOL = 1

THEN (1)

IF (2) **(** C_CYL_BAL_LAM_AD_EOL_CONF = FAC_L (2**H**) **or**

C_CYL_BAL_LAM_AD_EOL_CONF = ADD_FAC_L (3**H**) **)** **and**

$$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \left|\mathrm{FAC\_L\_RNG\_LAM\_AD[m]}\right| = 0$$

THEN **(2)** LV_CYL_BAL_LAM_AD_EOL = 0

FOR m = 0 to NC_CBK_EX_NR - 1

LV_CYL_BAL_LAM_AD_FAC[m] = 0

END FOR

ENDIF (2)

IF (2) **(** C_CYL_BAL_LAM_AD_EOL_CONF = ADD (1**H**) **or**

C_CYL_BAL_LAM_AD_EOL_CONF = ADD_FAC_L (3**H**) **)** **and**

$$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \left|\mathrm{MFF\_ADD\_LAM\_AD[m]}\right| = 0$$

THEN **(2)** LV_CYL_BAL_LAM_AD_EOL = 0

FOR m = 0 to NC_CBK_EX_NR - 1

LV_CYL_BAL_LAM_AD_ADD[m] = 0

END FOR

ENDIF (2)

ENDIF (1)

Reset of cylinder balancing lambda selective (cold condition) adaptation readiness:

IF (1) LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 1

THEN (1)

IF (2)

$$\sum_{i=0}^{\mathrm{i=NC\_CYL\_NR-1}} \left|\mathrm{FAC\_LAM\_CYL\_SEL\_ADJ\_CST[i]}\right| = 0$$

THEN **(2)** LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 0

FOR m = 0 to NC_CBK_EX_NR - 1

LV_CYL_BAL_LAM_SEL_AD_COLD[m] = 0

END FOR

ENDIF (2)

ENDIF (1)

Reset of cylinder balancing lambda selective (hot condition) adaptation readiness:

IF (1) LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 1

THEN (1)

IF (2) **(** C_CYL_BAL_LAM_SEL_HOT_EOL_CONF = LOW (1**H**) **or**

C_CYL_BAL_LAM_SEL_HOT_EOL_CONF = LOW_HIGH (3**H**) **)** **and**

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$$\sum_{i=0}^{i=NC\_CYL\_NR-1} |FAC\_LAM\_CYL\_SEL\_ADJ\_L\_RNG[i]| = 0$$

THEN **(2)** LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 0
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 0
END FOR
ENDIF (2)
IF (2) **(** C_CYL_BAL_LAM_SEL_HOT_EOL_CONF = HIGH (2**H**) **or** C_CYL_BAL_LAM_SEL_HOT_EOL_CONF = LOW_HIGH (3**H**) **)** **and**

$$\sum_{i=0}^{i=NC\_CYL\_NR-1} |FAC\_LAM\_CYL\_SEL\_ADJ\_H\_RNG[i]| = 0$$

THEN **(2)** LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 0
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 0
END FOR
ENDIF (2)
ENDIF (1)
Reset of cylinder balancing multiple engine roughness adaptation readiness:
IF (1) LV_CYL_BAL_ER_AD_FAC_EOL = 1
THEN (1)

IF (2)
$$\sum_{i=0}^{i=NC\_CYL\_NR-1} |FAC\_TI\_AD\_ER\_BAL[i]| = 0$$

THEN **(2)** LV_CYL_BAL_ER_AD_FAC_EOL = 0
ENDIF (2)
ENDIF (1)
Reset of cylinder balancing additive engine roughness adaptation readiness:
IF (1) LV_CYL_BAL_ER_AD_ADD_EOL = 1
THEN (1)

IF (2)
$$\sum_{i=0}^{i=NC\_CYL\_NR-1} |MFF\_ADD\_AD\_ER\_BAL[i]| = 0$$

THEN **(2)** LV_CYL_BAL_ER_AD_ADD_EOL = 0
ENDIF (2)
ENDIF (1)
ENDIF

9.46.4 Calculation of cylinder balancing engine roughness adaptation readiness (EOL):

FUNCTION DESCRIPTION:

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General information:

After activation of the corresponding adaptation function (multiple or additive) at stratified combustion mode, a timer is started to observe the filtered engine roughness values used as input for the adaptation controllers. As soon as all controller input values are within a defined range for a specific time interval, readiness is indicated. The function is controlled by a state machine.

Application conditions:

Initialization at Reset **or** *Deactivation*

STATE_CYL_BAL_ER_AD_EOL = "Ready" (0[**H**])
T_CYL_BAL_ER_AD = 0.0[s]
T_CYL_BAL_ER_AD_DYW = 0.0[s]
ER_STND_MMV_DIF_BAL_DYW = 0.0[1/sˆ2]
ER_STND_MMV_DIF_BAL_MIN_DYW = 0.0[1/sˆ2]
ER_STND_MMV_DIF_BAL_MAX_DYW = 0.0[1/sˆ2]

Recurrence: 100 ms

Activation:

LC_CYL_BAL_AD_EOL_RST = 0 **and**
LV_CYL_BAL_AD_EOL_EXT_ADJ = 0 **and**
LC_CYL_BAL_CORD_EOL_STOP_MAN = 0 **and**
LC_TCHA_CONF = 0 **and**
LV_TI_CYL_BAL_ER_ACT = 1 **and**
(LV_CYL_BAL_ER_AD_FAC_EOL = 0 **or**
LV_CYL_BAL_ER_AD_ADD_EOL = 0 **)**

Deactivation:

LC_CYL_BAL_AD_EOL_RST = 0 **and**
LV_CYL_BAL_AD_EOL_EXT_ADJ = 0 **and**
[LC_CYL_BAL_CORD_EOL_STOP_MAN = 1 **or**
LC_TCHA_CONF = 1 **or**
LV_TI_CYL_BAL_ER_ACT = 0 **or**
(LV_CYL_BAL_ER_AD_FAC_EOL = 1 **and**
LV_CYL_BAL_ER_AD_ADD_EOL = 1 **)** **]**

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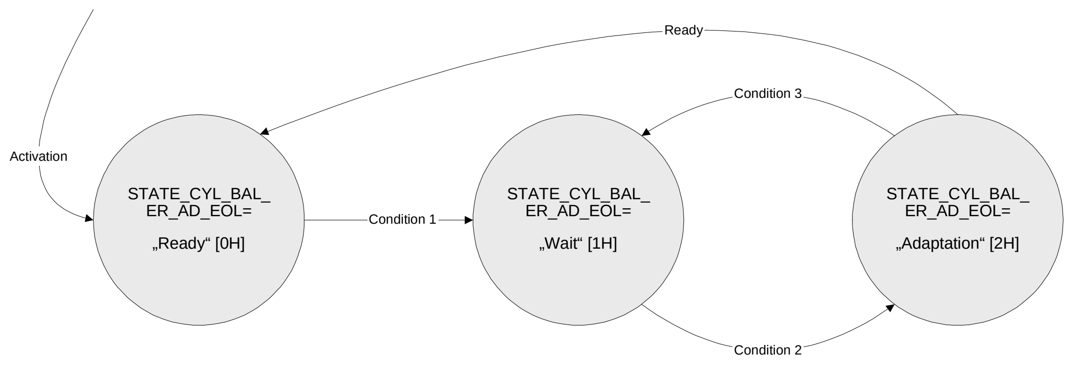
Signal flow diagram:



Formula section:

Note: At function activation always State "Ready" is entered

Cylinder balancing engine roughness adaptation at EOL: State 0[H] - Ready

Assignments at entry to state Ready :
STATE_CYL_BAL_ER_AD_EOL = "Ready" (0[**H**])
Actions during state "Ready":
Transition to State 1[H] Wait (Condition 1)
// at least one cylinder balancing engine roughness adaptation at EOL not yet finished
IF **(** LV_CYL_BAL_ER_AD_FAC_EOL = 0 **or** LV_CYL_BAL_ER_AD_ADD_EOL = 0 **)**
Assignments at exit from state Ready :
No assignments

Cylinder balancing engine roughness adaptation at EOL: State 1[H] - Wait

Assignments at entry to state Wait :
STATE_CYL_BAL_ER_AD_EOL = "Wait" (1[**H**])
Actions during state "Wait":
Transition to State 2[H] Adaptation (Condition 2)
// conditions for cylinder balancing engine roughness adaptation achieved (multiple or additive)
IF **(** STATE_TI_ER_BAL = Cylinder Balancing (3[**H**]) **and**
LV_FAC_TI_AD_ER_BAL_ENA = 1 **and**
LV_CYL_BAL_ER_AD_FAC_EOL = 0 **)**
OR
(STATE_TI_ER_BAL = Cylinder Balancing (3[**H**]) **and**
LV_MFF_ADD_AD_ER_BAL_ENA = 1 **and**
LV_CYL_BAL_ER_AD_ADD_EOL = 0 **)**
Assignments at exit from state Wait :
T_CYL_BAL_ER_AD = 0.0[s]
T_CYL_BAL_ER_AD_DYW = 0.0[s]
ER_STND_MMV_DIF_BAL_MAX_DYW = 0.0[1/s^2]
ER_STND_MMV_DIF_BAL_MIN_DYW = 0.0[1/s^2]

Cylinder balancing engine roughness adaptation at EOL: State 2[H] - Adaptation

Assignments at entry to state Adaptation :
STATE_CYL_BAL_ER_AD_EOL = "Adaptation" (2[**H**])
Actions during state "Adaptation":
Calculations:
// incrementation of cylinder balancing engine roughness adaptation time with 0.1[s]
T_CYL_BAL_ER_AD(n) = T_CYL_BAL_ER_AD(n-1) + 0.1[s]
// determination of MIN- and MAX-dynamic window values for overall filtered engine roughness values

```
FOR i = 0 to NC_CYL_NR - 1
  IF        ER_STND_MMV_DIF_BAL[i] > ER_STND_MMV_DIF_BAL_MAX_DYW
    THEN      ER_STND_MMV_DIF_BAL_MAX_DYW = ER_STND_MMV_DIF_BAL[i]
    ELSEIF    ER_STND_MMV_DIF_BAL[i] < ER_STND_MMV_DIF_BAL_MIN_DYW
    THEN      ER_STND_MMV_DIF_BAL_MIN_DYW = ER_STND_MMV_DIF_BAL[i]
    ENDIF
END FOR
```

// calculation of dynamic window based on MIN- and MAX-dynamic window values
ER_STND_MMV_DIF_BAL_DYW = ER_STND_MMV_DIF_BAL_MAX_DYW - ER_STND_MMV_DIF_BAL_MIN_DYW
// calculation of cylinder balancing engine roughness adaptation time within dynamic window
IF ER_STND_MMV_DIF_BAL_DYW < IP_ER_STND_MMV_DIF_BAL_DYW

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THEN T_CYL_BAL_ER_AD_DYW(n) = T_CYL_BAL_ER_AD_DYW(n-1) + 0.1[s]
ELSE T_CYL_BAL_ER_AD_DYW(n) = T_CYL_BAL_ER_AD_DYW(n-1) - C_T_DEC_CYL_BAL_ER_AD_DYN
// counter value limited to zero, no timer underrun possible
ENDIF
// calculation of cylinder balancing engine roughness adaptation readiness at end of line
IF (1) T_CYL_BAL_ER_AD ≥ C_T_MAX_CYL_BAL_ER_AD **or**
T_CYL_BAL_ER_AD_DYW ≥ C_T_MIN_CYL_BAL_ER_AD_DYN
THEN (1)
IF (2) LV_FAC_TI_AD_ER_BAL_ENA = 1
THEN (2) LV_CYL_BAL_ER_AD_FAC_EOL = 1
ELSE (2) LV_CYL_BAL_ER_AD_ADD_EOL =1
ENDIF(2)
ENDIF (1)
// initialization of MIN- and MAX-dynamic window values for next dynamic window calculation
ER_STND_MMV_DIF_BAL_MAX_DYW = 0.0[1/s^2]
ER_STND_MMV_DIF_BAL_MIN_DYW = 0.0[1/s^2]
Transition to State 0[H] "Ready (Ready)
// cylinder balancing engine roughness adaptation at EOL finished
IF **(** LV_CYL_BAL_ER_AD_FAC_EOL = 1 **and** LV_CYL_BAL_ER_AD_ADD_EOL = 1 **)**
Transition to State 1[H] Wait (Condition 3)
// conditions for cylinder balancing engine roughness adaptation not achieved
IF STATE_TI_ER_BAL ≠ Cylinder Balancing (3[**H]**)
OR
(LV_FAC_TI_AD_ER_BAL_ENA = 0 **and** LV_MFF_ADD_AD_ER_BAL_ENA = 0 **)**
OR
(LV_FAC_TI_AD_ER_BAL_ENA = 1 **and** LV_CYL_BAL_ER_AD_FAC_EOL = 1 **)**
OR
(LV_MFF_ADD_AD_ER_BAL_ENA = 1 **and** LV_CYL_BAL_ER_AD_ADD_EOL = 1
)
Assignments at exit from state Adaptation :
No assignments

9.46.5 Calculation of cylinder balancing selective lambda adaptation readiness (EOL):

FUNCTION DESCRIPTION:

General information:

After activation of the corresponding adaptation function (hot or cold) at homogenous combustion mode, a timer is started to observe the characteristic quantity of estimated cylinder individual lambda deviation. As soon as the deviation values are within a defined range for a specific time interval, readiness is indicated. The function is controlled by a state machine.

Application conditions:

Initialization at Reset ***or*** *Deactivation*
FOR m = 0 to NC_CBK_EX_NR - 1
LV_STATE_CYL_BAL_SEL_CHG_WAIT[m] = 0

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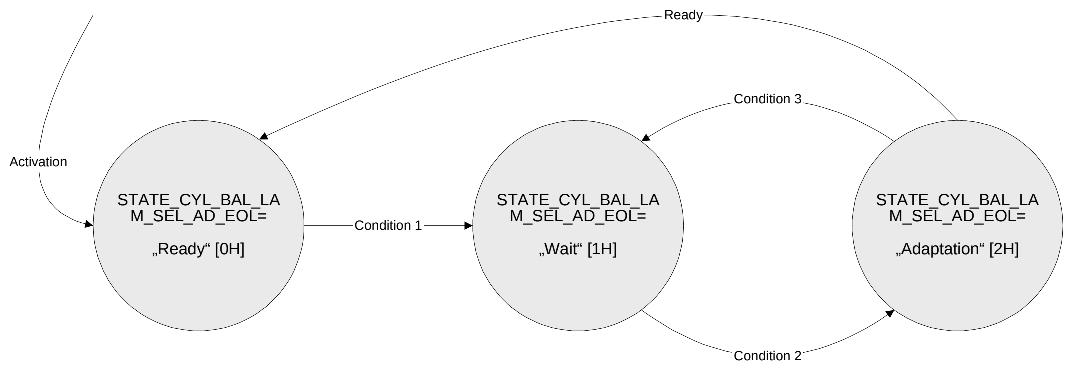
LV_CYL_BAL_AD_WG_OPEN_REQ_EOL[m] = 0
LV_CYL_BAL_AD_WG_OPEN_TMP_EOL[m] = 0
T_CYL_BAL_LAM_SEL_CBK_AD[m] = 0.0[s]
END FOR
T_CYL_BAL_LAM_SEL_AD = 0.0[s]
LV_STATE_CYL_BAL_SEL_CHG_AD = 0
STATE_CYL_BAL_LAM_SEL_AD_EOL = "Ready" (0[**H**])

Recurrence: 100 ms

Activation:
LC_CYL_BAL_AD_EOL_RST = 0 **and**
LV_CYL_BAL_AD_EOL_EXT_ADJ = 0 **and**
LC_CYL_BAL_CORD_EOL_STOP_MAN = 0 **and**
LV_TI_CYL_BAL_LAM_ACT = 1 **and**
(LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 0 **or**
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 0 **)**

Deactivation:
LC_CYL_BAL_AD_EOL_RST = 0 **and**
LV_CYL_BAL_AD_EOL_EXT_ADJ = 0 **and**
[LC_CYL_BAL_CORD_EOL_STOP_MAN = 1 **or**
LV_TI_CYL_BAL_LAM_ACT = 0 **or**
(LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 1 **and**
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 1 **)** **]**

Signal flow diagram:



Formula section:

// calculation of request for waste gate open for turbo engine (LC_TCHA_CONF=1)
IF LC_TCHA_CONF=1
THEN *// for turbo engine*
FOR m = 0 to NC_CBK_EX_NR - 1
IF LV_LAM_CYL_ENA_CYL_BAL_DC[m] = 1
AND
T_AST_BAL < IP_T_AST_MAX_CYL_BAL_WG_OPEN
AND
([TCO < C_TCO_MAX_CYL_BAL_WG_OPEN **and**
LV_CYL_BAL_LAM_SEL_AD_COLD[m] = 0 **]**

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OR
[TCO > C_TCO_MAX_CYL_BAL_WG_OPEN **and**
{ LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 0 **or**
LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 0 **}** **])**
THEN LV_CYL_BAL_AD_WG_OPEN_TMP_EOL[m] = 1
ELSE LV_CYL_BAL_AD_WG_OPEN_TMP_EOL[m] = 0
ENDIF
END FOR
FOR m = 0 to NC_CBK_EX_NR - 1

IF $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_AD\_WG\_OPEN\_TMP\_EOL[m] > 0$

THEN LV_CYL_BAL_AD_WG_OPEN_REQ_EOL[m] = 1
ELSE LV_CYL_BAL_AD_WG_OPEN_REQ_EOL[m] = 0
ENDIF
END FOR
ELSE *// for non turbo engine*
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_AD_WG_OPEN_REQ_EOL[m]= 0
END FOR
ENDIF

// calculation of state machine cylinder balancing selective lambda adaptation readiness at EOL
Note: At function activation always State "Ready" is entered
Cylinder balancing selective lambda adaptation at EOL: State 0[H] - Ready
Assignments at entry to state Ready :
STATE_CYL_BAL_LAM_SEL_AD_EOL = "Ready" (0[**H**])
Actions during state "Ready":
Transition to State 1[H] Wait (Condition 1)
// at least one cylinder balancing selective lambda adaptation at EOL not yet finished
IF LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 0 **or**
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 0
Assignments at exit from state Ready :
No assignments

Cylinder balancing selective lambda adaptation at EOL: State 1[H] - Wait
Assignments at entry to state Wait :
STATE_CYL_BAL_LAM_SEL_AD_EOL = "Wait" (1[**H**])
Actions during state "Wait":
// calculation of logical value to change state to adaptation
FOR m = 0 to NC_CBK_EX_NR - 1
IF **(** STATE_LAM_CYL_SEL_ADJ[m] = ADJ_ENG_COLD (2[**H**]) **and**
LV_CYL_BAL_LAM_SEL_AD_COLD[m] = 0 **)**
OR
(STATE_LAM_CYL_SEL_ADJ[m] = ADJ_NOM_L_RNG (4[**H**]) **and**
LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 0 **)**
OR
(STATE_LAM_CYL_SEL_ADJ[m] = ADJ_NOM_H_RNG (5[**H**]) **and**
LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 0 **)**
THEN LV_STATE_CYL_BAL_SEL_CHG_AD = 1
ENDIF

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END FOR

Transition to State 2[H] Adaptation (Condition 2)

// conditions for cylinder selective lambda adaptation achieved (cold or hot)

IF LV_STATE_CYL_BAL_SEL_CHG_AD = 1

Assignments at exit from state Wait :

T_CYL_BAL_LAM_SEL_AD = 0.0[s]

LV_STATE_CYL_BAL_SEL_CHG_AD = 0

FOR m = 0 to NC_CBK_EX_NR - 1

    T_CYL_BAL_LAM_SEL_CBK_AD[m] = 0.0[s]

END FOR

Cylinder balancing selective lambda adaptation at EOL: State 2[H] - Adaptation

Assignments at entry to state Adaptation :

STATE_CYL_BAL_LAM_SEL_AD_EOL = "Adaptation" (2[**H**])

Actions during state "Adaptation":

Calculations:

// calculation of logical value to change state to wait

FOR m = 0 to NC_CBK_EX_NR - 1

    IF **(** STATE_LAM_CYL_SEL_ADJ[m] <> ADJ_ENG_COLD (2[**H**]) **and**
    STATE_LAM_CYL_SEL_ADJ[m] <> ADJ_NOM_L_RNG (4[**H**]) **and**
    STATE_LAM_CYL_SEL_ADJ[m] <> ADJ_NOM_H_RNG (5[**H**]) **)**
    OR
    (STATE_LAM_CYL_SEL_ADJ[m] = ADJ_ENG_COLD (2[**H**]) **and**
    LV_CYL_BAL_LAM_SEL_AD_COLD[m] = 1 **)**
    OR
    (STATE_LAM_CYL_SEL_ADJ[m] = "ADJ_NOM_L_RNG (4[**H**]) **and**
    LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 1 **)**
    OR
    (STATE_LAM_CYL_SEL_ADJ[m] = "ADJ_NOM_H_RNG (5[**H**]) **and**
    LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 1 **)**
    THEN LV_STATE_CYL_BAL_SEL_CHG_WAIT[m] = 1
    T_CYL_BAL_LAM_SEL_CBK_AD[m] = 0.0[s]
    ELSE LV_STATE_CYL_BAL_SEL_CHG_WAIT[m] = 0
    ENDIF

END FOR

// incrementation of cylinder selective lambda adaptation time with 0.1[s]

T_CYL_BAL_LAM_SEL_AD(n) = T_CYL_BAL_LAM_SEL_AD(n-1) + 0.1[s]

// determination of characteristic quantity of estimated cylinder individual lambda deviation values

FOR (1) m = 0 to NC_CBK_EX_NR - 1

    IF (2) LV_LAM_CYL_SEL_ADJ_VLD[m] = 1
    THEN (2)
        IF FAC_CYL_LAM_ABSV_SUM[m] < IP_FAC_CYL_LAM_ABSV_SUM_CYL_
BAL
        THEN T_CYL_BAL_LAM_SEL_CBK_AD[m](n) =
        T_CYL_BAL_LAM_SEL_CBK_AD[m](n-1) + 0.1[s]
        // timer incremantation with 0.1[s]
        ELSE T_CYL_BAL_LAM_SEL_CBK_AD[m](n) =
        T_CYL_BAL_LAM_SEL_CBK_AD[m](n-1) -
        C_T_DEC_CYL_BAL_LAM_SEL_CBK_AD
        // timer value limited to zero, no timer underrun possible
        ENDIF
    ENDIF (2)

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END FOR (1)
// calculation of cylinder selective lambda adaptation readiness at end of line (exhaust bank specific)
FOR m = 0 to NC_CBK_EX_NR - 1
IF (1a) STATE_LAM_CYL_SEL_ADJ[m] = ADJ_ENG_COLD (2[**H**]) **and**
LV_CYL_BAL_LAM_SEL_AD_COLD[m] = 0
THEN (1a)
IF T_CYL_BAL_LAM_SEL_CBK_AD[m] > C_T_MIN_CYL_BAL_LAM_SEL_AD_COLD **or**
T_CYL_BAL_LAM_SEL_AD > C_T_MAX_CYL_BAL_LAM_SEL_AD_COLD
THEN LV_CYL_BAL_LAM_SEL_AD_COLD[m] = 1
ENDIF
ELSEIF (1b) STATE_LAM_CYL_SEL_ADJ[m] = "ADJ_NOM_L_RNG (4[**H**]) **and**
LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 0
THEN (1b)
IF T_CYL_BAL_LAM_SEL_CBK_AD[m] > C_T_MIN_CYL_BAL_LAM_SEL_AD_HOT **or**
T_CYL_BAL_LAM_SEL_AD > C_T_MAX_CYL_BAL_LAM_SEL_AD_HOT
THEN LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 1
ENDIF
ELSEIF (1c) STATE_LAM_CYL_SEL_ADJ[m] = "ADJ_NOM_H_RNG (5[**H**]) **and**
LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 0
THEN (1c)
IF T_CYL_BAL_LAM_SEL_CBK_AD[m] > C_T_MIN_CYL_BAL_LAM_SEL_AD_HOT **or**
T_CYL_BAL_LAM_SEL_AD > C_T_MAX_CYL_BAL_LAM_SEL_AD_HOT
THEN LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 1
ENDIF
ENDIF (1)
END FOR
// calculation of cylinder selective lambda adaptation readiness (hot condition) at end of line (global)
IF (1a) C_CYL_BAL_LAM_SEL_HOT_EOL_CONF = ZERO (0**H**)
THEN (1a)
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 1
LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 1
END FOR
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 1
// adaptation of all exhaust banks finished at EOL
ELSEIF (1b) C_CYL_BAL_LAM_SEL_HOT_EOL_CONF = LOW (1**H**)
THEN (1b)
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_SEL_AD_RNG_H[m] = 1
END FOR

IF $$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \mathrm{LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_L[m]} = \mathrm{NC\_CBK\_EX\_NR}$$

THEN LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 1
// adaptation of all exhaust banks (low range) are finished at EOL

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ENDIF
ELSEIF (1c) C_CYL_BAL_LAM_SEL_HOT_EOL_CONF = HIGH (2**H**)
THEN (1c)
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_SEL_AD_RNG_L[m] = 1
END FOR

IF $$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \mathrm{LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_H[m]} = \mathrm{NC\_CBK\_EX\_NR}$$

THEN LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 1
// adaptation of all exhaust banks (high range) are finished at EOL
ENDIF
ELSEIF (1d) C_CYL_BAL_LAM_SEL_HOT_EOL_CONF = LOW_HIGH (3**H**)
THEN (1d)

IF $$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \mathrm{LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_L[m]} = \mathrm{NC\_CBK\_EX\_NR}$$
and
$$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \mathrm{LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_H[m]} = \mathrm{NC\_CBK\_EX\_NR}$$

THEN LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 1
// ad. of all exhaust banks (low and high range) are finished at EOL
ENDIF
ENDIF (1)
// calculation of cylinder selective lambda adaptation readiness (cold condition) at end of line (global)

IF $$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \mathrm{LV\_CYL\_BAL\_LAM\_SEL\_AD\_COLD[m]} = \mathrm{NC\_CBK\_EX\_NR}$$

THEN LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 1
// cold adaptation of all exhaust banks are finished at end of line
ENDIF
Transition to State 0[H] "Ready (Ready)
// cylinder selective lambda adaptation at EOL finished
IF LV_CYL_BAL_LAM_SEL_AD_COLD_EOL = 1 **and**
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL = 1
Transition to State 1[H] Wait (Condition 3)
// conditions for cylinder selective lambda adaptation not achieved

IF $$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \mathrm{LV\_STATE\_CYL\_BAL\_SEL\_CHG\_WAIT[m]} = \mathrm{NC\_CBK\_EX\_NR}$$

// adaptation condition for all exhaust banks are not fulfilled
Assignments at exit from state Adaptation :
FOR m = 0 to NC_CBK_EX_NR - 1
LV_STATE_CYL_BAL_SEL_CHG_WAIT[m] = 0

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END FOR

9.46.6 Calculation of cylinder balancing lambda adaptation readiness (EOL):

FUNCTION DESCRIPTION:

General information:

After activation of the corresponding adaptation function at homogenous combustion mode, a timer is started to observe the deviation between the actual and the last learned lambda deviation value. As soon as the deviation values are within a defined range for a specific time interval, readiness is indicated. The function is controlled by a state machine.

Application conditions:

Initialization at Reset **or** *Deactivation*

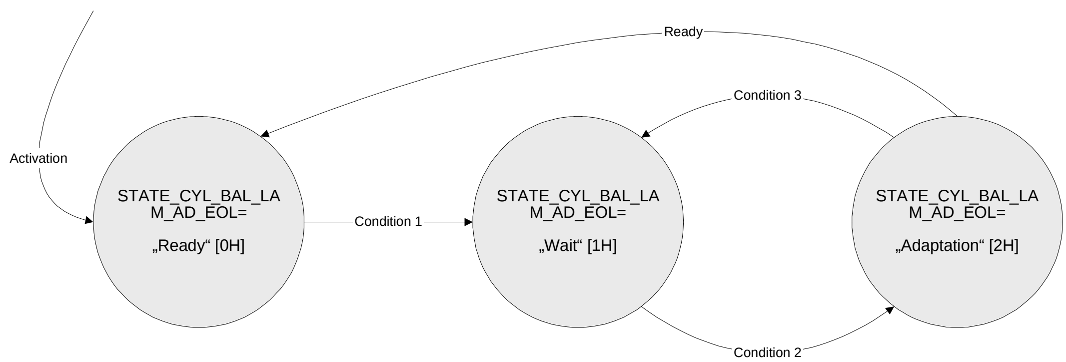
FOR m = 0 to NC_CBK_EX_NR - 1
  LV_STATE_CYL_BAL_LAM_CHG_WAIT[m] = 0
  CTR_CYL_BAL_LAM_CBK_AD[m] = 0
END FOR
T_CYL_BAL_LAM_AD = 0.00[s]
LV_STATE_CYL_BAL_LAM_CHG_AD = 0
STATE_CYL_BAL_LAM_AD_EOL = "Ready" (0[**H**])

Recurrence: 20 ms

Activation:
LC_CYL_BAL_AD_EOL_RST = 0 **and**
LV_CYL_BAL_AD_EOL_EXT_ADJ = 0 **and**
LC_CYL_BAL_CORD_EOL_STOP_MAN = 0 **and**
LV_CYL_BAL_LAM_AD_EOL = 0

Deactivation:
LC_CYL_BAL_AD_EOL_RST = 0 **and**
LV_CYL_BAL_AD_EOL_EXT_ADJ = 0 **and**
[LC_CYL_BAL_CORD_EOL_STOP_MAN = 1 **or**
LV_CYL_BAL_LAM_AD_EOL = 1 **]**

Signal flow diagram:



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Formula section:

Note: At function activation always State "Ready" is entered

Cylinder balancing lambda adaptation at EOL: State 0[H] - Ready

Assignments at entry to state Ready :
STATE_CYL_BAL_LAM_AD_EOL = "Ready" (0[**H**])
Actions during state "Ready":
Transition to State 1[H] Wait (Condition 1)
// global lambda adaptation for at least one exhaust bank at EOL not yet finished
IF LV_CYL_BAL_LAM_AD_EOL = 0
Assignments at exit from state Ready :
No assignments

Cylinder balancing lambda adaptation at EOL: State 1[H] - Wait

Assignments at entry to state Wait :
STATE_CYL_BAL_LAM_AD_EOL = "Wait" (1[**H**])
Actions during state "Wait":
// calculation of logical value to change state to adaptation

```
FOR m = 0 to NC_CBK_EX_NR - 1
        IF      ( LV_FAC_L_RNG_LAM_AD[m] = 1 and LV_CYL_BAL_LAM_AD_FAC[m] = 0 )
                OR
                ( LV_MFF_ADD_RNG_LAM_AD[m] =1 and LV_CYL_BAL_LAM_AD_ADD[m] = 0 )
        THEN        LV_STATE_CYL_BAL_LAM_CHG_AD = 1
        ENDIF
END FOR
```

Transition to State 2[H] Adaptation (Condition 2)
// conditions for global lambda adaptation achieved (multiple or additive)
IF LV_STATE_CYL_BAL_LAM_CHG_AD = 1
Assignments at exit from state Wait :
T_CYL_BAL_LAM_AD = 0.00[s]
LV_STATE_CYL_BAL_LAM_CHG_AD = 0

```
FOR m = 0 to NC_CBK_EX_NR - 1
        CTR_CYL_BAL_LAM_CBK_AD[m] = 0
END FOR
```

Cylinder balancing lambda adaptation at EOL: State 2[H] - Adaptation

Assignments at entry to state Adaptation :
STATE_CYL_BAL_LAM_AD_EOL = "Adaptation" (2[**H**])
Actions during state "Adaptation":
Calculations:
// calculation of logical value to change state to wait

```
FOR m = 0 to NC_CBK_EX_NR - 1
        IF      ( LV_FAC_L_RNG_LAM_AD[m] = 0 and LV_MFF_ADD_RNG_LAM_AD[m] = 0 )
                OR
                ( LV_FAC_L_RNG_LAM_AD[m] = 1 and LV_CYL_BAL_LAM_AD_FAC[m] = 1 )
                OR
                ( LV_MFF_ADD_RNG_LAM_AD[m] = 1          and LV_CYL_BAL_LAM_AD_ADD[m]
= 1 )
        THEN        LV_STATE_CYL_BAL_LAM_CHG_WAIT[m] = 1
                CTR_CYL_BAL_LAM_CBK_AD[m] = 0
        ELSE        LV_STATE_CYL_BAL_LAM_CHG_WAIT[m] = 0
        ENDIF
END FOR
```

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```
// incrementation of lambda adaptation time with 0.02[s]
T_CYL_BAL_LAM_AD(n) = T_CYL_BAL_LAM_AD (n-1) + 0.02[s]
// determination of deviation between the actual and the last learned lambda adaptation values
FOR m = 0 to NC_CBK_EX_NR - 1
        IF (1)                  Transition LV_LAM_AD_STOP[m] = "0" -> "1"
        THEN (1)
                IF (2a)                 LV_FAC_L_RNG_LAM_AD[m] = 1
                THEN            (2a)
                        IF (3a)                 | FAC_LAM_ADJ_LAM_AD[m] | <
                                        IP_FAC_L_LAM_ADJ_DIF_CYL_BAL
                        THEN (3a)               CTR_CYL_BAL_LAM_CBK_AD[m](n) =
                                        CTR_CYL_BAL_LAM_CBK_AD[m](n-1) + 1
                                // counter incremantation with 1
                        ELSE (3a)               CTR_CYL_BAL_LAM_CBK_AD[m](n) =
                                        CTR_CYL_BAL_LAM_CBK_AD[m](n-1) -
                                        C_CTR_DEC_CYL_BAL_LAM_CBK_AD
                                //  counter value limited to zero, no counter underrun possible
                        ENDIF (3a)
                ELSEIF (2b)             LV_MFF_ADD_RNG_LAM_AD[m] = 1
                THEN            (2b)
                        IF (3b)                 | FAC_LAM_ADJ_LAM_AD[m] | <
                                        IP_FAC_MFF_LAM_ADJ_DIF_CYL_BAL
                        THEN (3b)               CTR_CYL_BAL_LAM_CBK_AD[m](n) =
                                        CTR_CYL_BAL_LAM_CBK_AD[m](n-1) +1
                                // counter incremantation with 1
                        ELSE (3b)               CTR_CYL_BAL_LAM_CBK_AD[m](n) =
                                        CTR_CYL_BAL_LAM_CBK_AD[m](n-1) -
                                        C_CTR_DEC_CYL_BAL_LAM_CBK_AD
                                //  counter value limited to zero, no counter underrun possible
                        ENDIF (3b)
                ENDIF (2)
        ENDIF (1)
END FOR
// calculation lambda adaptation readiness at end of line (exhaust bank specific)
FOR m = 0 to NC_CBK_EX_NR - 1
        IF (1a)                 LV_FAC_L_RNG_LAM_AD[m] = 1                      and
                        LV_CYL_BAL_LAM_AD_FAC[m] = 0
        THEN (1a)
                IF        T_CYL_BAL_LAM_AD > C_T_MAX_CYL_BAL_LAM_AD                     or
                        CTR_CYL_BAL_LAM_CBK_AD[m] > C_CTR_MIN_CYL_BAL_LAM_AD_FAC
                THEN            LV_CYL_BAL_LAM_AD_FAC[m] = 1
                ENDIF
        ELSEIF (1b)             LV_MFF_ADD_RNG_LAM_AD[m] = 1                    and
                        LV_CYL_BAL_LAM_AD_ADD[m] = 0
        THEN (1b)
                IF        T_CYL_BAL_LAM_AD(n) > C_T_MAX_CYL_BAL_LAM_AD                  or
                        CTR_CYL_BAL_LAM_CBK_AD[m] > C_CTR_MIN_CYL_BAL_LAM_AD_ADD
                THEN            LV_CYL_BAL_LAM_AD_ADD[m] = 1
                ENDIF
        ENDIF (1)
END FOR
// calculation of lambda adaptation readiness at end of line (global)
```

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IF (1a) C_CYL_BAL_LAM_AD_EOL_CONF = ZERO (0**H**)
THEN (1a)
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_AD_FAC[m] = 1
LV_CYL_BAL_LAM_AD_ADD[m] = 1
END FOR
LV_CYL_BAL_LAM_AD_EOL = 1
// adaptation of all exhaust banks finished at EOL
ELSEIF (1b) C_CYL_BAL_LAM_AD_EOL_CONF = ADD (1**H**)
THEN (1b)
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_AD_FAC[m] = 1
END FOR

IF $$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_AD\_ADD[m] = NC\_CBK\_EX\_NR$$

THEN LV_CYL_BAL_LAM_AD_EOL = 1
// adaptation of all exhaust banks (additive) are finished at EOL
ENDIF
ELSEIF (1c) C_CYL_BAL_LAM_AD_EOL_CONF = FAC_L (2**H**)
THEN (1c)
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_AD_ADD[m] = 1
END FOR

IF $$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_AD\_FAC[m] = NC\_CBK\_EX\_NR$$

THEN LV_CYL_BAL_LAM_AD_EOL = 1
// adaptation of all exhaust banks (multiple) are finished at EOL or time out
ENDIF
ELSEIF (1d) C_CYL_BAL_LAM_AD_EOL_CONF = ADD_FAC_L (3**H**)
THEN (1d)

IF $$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_AD\_FAC[m] = NC\_CBK\_EX\_NR$$ **and**

$$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_AD\_ADD[m] = NC\_CBK\_EX\_NR$$

THEN LV_CYL_BAL_LAM_AD_EOL = 1
// ad. of all exhaust banks (multiple and additive) are finished at EOL or time out
ENDIF
ENDIF (1)
Transition to State 0[H] "Ready (Ready)
// global lambda adaptation at EOL finished (multiple and additive)
IF LV_CYL_BAL_LAM_AD_EOL = 1

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Transition to State 1[H] Wait (Condition 3)

// conditions for global lambda adaptation (multiple or additive) not achieved

IF $$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \text{LV\_STATE\_CYL\_BAL\_LAM\_CHG\_WAIT[m]} = \text{NC\_CBK\_EX\_NR}$$

// adaptation condition for all exhaust banks are not fulfilled

Assignments at exit from state Adaptation :

FOR m = 0 to NC_CBK_EX_NR - 1

LV_STATE_CYL_BAL_LAM_CHG_WAIT[m] = 0

END FOR

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9.47 Cylinder balancing coordination at DC

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CYL_BAL_AD_HOM_REQ_DC	O/V	0... 1H	0 ...1	1	-
Flag for homogenous combustion mode for cylinder balancing adaptation requested at active driving cycle					
LV_CYL_BAL_AD_WG_OPEN_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag for waste gate open requested for cylinder balancing adaptation					
LV_CYL_BAL_AD_WG_OPEN_REQ_DC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for waste gate open requested for cylinder balancing adaptation at active driving cycle					
LV_CYL_BAL_HOM_REQ_INT_DC	V	0... 1H	0 ...1	1	-
Flag for homogenous combustion mode requested internal at active driving cycle					
LV_CYL_BAL_LAM_AD_ADD_DC [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation (additive) exhaust bank specific at active driving cycle					
LV_CYL_BAL_LAM_AD_DC	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation at active driving cycle					
LV_CYL_BAL_LAM_AD_ENA_DC	O/V	0... 1H	0 ...1	1	-
Flag for EVAC time controller to enable lambda adaptation area for active driving cycle					
LV_CYL_BAL_LAM_AD_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to indicate end of lambda adaptation cycle for cylinder balancing at active driving cycle					
LV_CYL_BAL_LAM_AD_FAC_H_DC [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation (multiple high) exhaust bank specific at active driving cycle					
LV_CYL_BAL_LAM_AD_FAC_L_DC [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation (multiple low) exhaust bank specific at active driving cycle					
LV_CYL_BAL_LAM_AD_HOM_REQ_DC	V	0... 1H	0 ...1	1	-
Flag for HOM request for cylinder balancing lambda adaptation at active driving cycle					
LV_CYL_BAL_LAM_AD_REQ_DC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation request at active driving cycle					
LV_CYL_BAL_LAM_SEL_AD_COLD_DC	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (cold) at active driving cycle					
LV_CYL_BAL_LAM_SEL_AD_HOT_DC	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (hot) at active driving cycle					
LV_CYL_BAL_LAM_SEL_AD_REQ_DC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for cylinder balancing selective lambda adaptation request at active driving cycle					
LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (high range) bank specific at active driving cycle					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (low range) bank specific at active driving cycle					
LV_CYL_BAL_LAM_SEL_HOM_REQ_DC	V	0... 1H	0 ...1	1	-
Flag for HOM request for cylinder balancing selective lambda adaptation at active driving cycle					
LV_CYL_BAL_LAM_SEL_RNG_COLD_DC [NC_CBK_EX_NR]	O/V/S	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation (cold range) bank specific at active driving cycle					
LV_STATE_LAM_AD_DC_CHG_REQ	O/V	0... 1H	0 ...1	1	-
Flag for stage change to "request" for cylinder balancing lambda adaptation at active driving cycle					
LV_STATE_LAM_AD_DC_CHG_WAIT	V	0... 1H	0 ...1	1	-
Flag for stage change to "wait" for cylinder balancing lambda adaptation at active driving cycle					
LV_STATE_LAM_SEL_DC_CHG_REQ	V	0... 1H	0 ...1	1	-
Flag for stage change to "request" for cylinder balancing selective lambda adaptation at active driving cycle					
LV_STATE_LAM_SEL_DC_CHG_WAIT	V	0... 1H	0 ...1	1	-
Flag for stage change to "wait" for cylinder balancing selective lambda adaptation at active driving cycle					
LV_T_STEP_CYL_BAL_LAM_AD_DC	O/V	0... 1H	0 ...1	1	-
Flag for cylinder balancing lambda adaptation fixed time steps enabled at active driving cycle					
LV_T_STEP_CYL_BAL_LAM_SEL_DC	V	0... 1H	0 ...1	1	-
Flag for cylinder balancing cylinder selective lambda adaptation fixed time steps enabled at active driving cycle					
STATE_CYL_BAL_LAM_AD [NC_CBK_EX_NR]	V	0H 1H 2H 3H 4H 5H 6H 7H	INIT WAIT CDN_FAC_L CDN_FAC_H CDN_ADD ADAPT_FAC_L ADAPT_FAC_H ADAPT_ADD	-	-
Cylinder balancing lambda adaptation state					
STATE_CYL_BAL_LAM_AD_DC	V	0H 1H 2H	Wait Request Adaptation	-	-
State of cylinder balancing lambda adaptation at active driving cycle					
STATE_CYL_BAL_LAM_SEL_AD_DC	V	0H 1H 2H	Wait Request Adaptation	-	-
State of cylinder balancing cylinder selective lambda adaptation at active driving cycle					
T_CYL_BAL_HOM_REQ_INT_DC	V	0... FFFFH	0... 6553.5	0.1	s
Time intervals for internal homogenous combustion mode request at active driving cycle					
T_CYL_BAL_HOM_REQ_INT_DC_STOP	V	0... FFFFH	0... 6553.5	0.1	s
Time interval for internal homogenous combustion mode request at engine stop conditions					
T_CYL_BAL_LAM_AD_ADD_DC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing lambda adaptation (additive) exhaust bank specific at active driving cycle					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_CYL_BAL_LAM_AD_DC	O/V/S	0... FFFFFFFFH	0... 429496729.5	0.1	s
Time gap between cylinder balancing lambda adaptation parts at active driving cycle					
T_CYL_BAL_LAM_AD_FAC_H_DC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing lambda adaptation (multiple high) exhaust bank specific at active driving cycle					
T_CYL_BAL_LAM_AD_FAC_L_DC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing lambda adaptation (multiple low) exhaust bank specific at active driving cycle					
T_CYL_BAL_LAM_AD_REQ_DC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing lambda adaptation request at active driving cycle					
T_CYL_BAL_LAM_AD_WAIT_DC	V	0... FFFFH	0... 6553.5	0.1	s
Waiting time for cylinder balancing lambda adaptation activation at active driving cycle					
T_CYL_BAL_LAM_SEL_AD_REQ_DC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing selective lambda adaptation request at active driving cycle					
T_CYL_BAL_LAM_SEL_AD_RNG_H_DC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing cylinder selective lambda adaptation (high range) bank specific at active driving cycle					
T_CYL_BAL_LAM_SEL_AD_RNG_L_DC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing cylinder selective lambda adaptation (low range) bank specific at active driving cycle					
T_CYL_BAL_LAM_SEL_AD_WAIT_DC	V	0... FFFFH	0... 6553.5	0.1	s
Waiting time for cylinder balancing selective lambda adaptation activation at active driving cycle					
T_CYL_BAL_LAM_SEL_DC	O/V/S	0... FFFFFFFFH	0... 429496729.5	0.1	s
Time gap between cylinder balancing cylinder selective lambda adaptation parts at active driving cycle					
T_CYL_BAL_LAM_SEL_RNG_COLD_DC [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time for cylinder balancing cylinder selective lambda adaptation (cold range) bank specific at active driving cycle					

Input data:

FAC_CYL_LAM_ABSV_SUM [NC_CBK_EX_NR] {p. 2730}	GEAR {p. 1302}	LC_CYL_BAL_CORD_EOL_STOP_MAN {p. 4046}	LC_TCHA_CONF {p. 658}
LV_AT {p. 654}	LV_CYL_BAL_AD_WG_OPEN_REQ_EOL [NC_CBK_EX_NR] {p. 4043}	LV_CYL_BAL_HOM_REQ_EXT {p. 3261}	LV_FAC_H_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}
LV_FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	LV_LAM_AD_ENA {p. 3737}	LV_LAM_AD_END_CBK [NC_CBK_EX_NR] {p. 2642}	LV_LAM_AD_STOP [NC_CBK_EX_NR] {p. 2642}
LV_LAM_CYL_SEL_ADJ_VLD [NC_CBK_EX_NR] {p. 2732}	LV_MFF_ADD_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2642}	LV_NT_RGN_REQ {p. 996}	LV_ST_END {p. 1720}
NC_CBK_EX_NR {p. 1829}	NT_AGI {p. 3073}	STATE_CDN_LAM_CYL_SEL_ADJ_RNG [NC_CBK_EX_NR] {p. 2864}	STATE_LAM_AD [NC_CBK_EX_NR] {p. 2643}

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STATE_LAM_CYL_SEL_ADJ [NC_CBK_EX_NR] {p. 2733}	T_AST_BAL {p. 3261}	TCO {p. 1100}	TCO_ST_BAL {p. 3261}
VS {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CYL_BAL_AD_DC_RST	-	0H 1H 2H 3H 4H 5H 6H	ZERO ON LAM_AD SEL_HOT WG_REQ HOM_REQ SEL_COLD	-	-
Reset of cylinder balancing adaptation readiness flags at active driving cycle					
C_CYL_BAL_LAM_AD_DC_CONF	-	0H 1H 2H 3H	ADD FAC_L ADD_FAC_L ADD_FAC_ALL	-	-
Configuration of lambda adaptation correction values for cylinder balancing at active driving cycle					
C_CYL_BAL_LAM_SEL_HOT_DC_CONF	-	0H 1H 2H	LOW HIGH LOW_HIGH	-	-
Configuration of cylinder selective lambda adaptation correction values for cylinder balancing at driving cycle					
C_FAC_CYL_LAM_ABSV_SUM_BAL_DC	-	0... 7FFFH	0... 49.998474	1.5259e-3	%
Threshold for cylinder balancing cylinder selective lambda adaptation within limits at active driving cycle					
C_GEAR_MIN_CYL_BAL_AD_REQ_DC	-	0... FH	0... 15	1	-
Minimum gear required to enable cylinder balancing lambda adaptation request at active driving cycle					
C_T_AST_MAX_2_CYL_BAL_AD_DC	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time after start for control of cybl selective lambda adaptation at active driving cycle (time slot Japan)					
C_T_AST_MAX_CYL_BAL_AD_DC	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time after start for control of cylinder balancing selective lambda adaptation at active driving cycle					
C_T_AST_MAX_CYL_BAL_AD_DC_STOP	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time after start for control of cybl selective lambda adaptation at active driving cycle (stop conditions)					
C_T_AST_MIN_2_CYL_BAL_AD_DC	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time after start for control of cybl selective lambda adaptation at active driving cycle (time slot Japan)					
C_T_ES_MAX_CYL_BAL_HOM_REQ_INT	-	0... FFH	0... 255	1	min
This is a ES time maximum T_ES for internal homogenous combustion mode request at active driving cycle					
C_T_MAX_CYL_BAL_LAM_AD_DC	-	0... FFFFFFFFH	0... 429496729.5	0.1	s
Maximum time to enable cylinder balancing lambda adaptation part at active driving cycle					
C_T_MAX_CYL_BAL_LAM_SEL_DC	-	0... FFFFFFFFH	0... 429496729.5	0.1	s
Maximum time to enable cylinder balancing cylinder selective lambda adaptation part at active driving cycle					
C_T_MIN_CYL_BAL_AD_REQ_DC	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for cylinder balancing adaptation conditions within limits at active driving cycle					
C_T_MIN_CYL_BAL_AD_WAIT_DC	-	0... FFFFH	0... 6553.5	0.1	s
Minimum waiting time at entry to state adaptation for cylinder balancing adaptation at active driving cycle					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MIN_CYL_BAL_LAM_AD_DC	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time to enable cylinder balancing lambda adaptation part at active driving cycle					
C_T_MIN_CYL_BAL_LAM_SEL_DC	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time to enable cylinder balancing cylinder selective lambda adaptation part at active driving cycle					
C_TCO_ST_MAX_CYL_BAL_AD_DC	-	0... FEH	-48... 142.5	0.75	°C
Maximum TCO_ST start for control of cylinder balancing selective lambda adaptation at active driving cycle					
C_TCO_ST_MAX_ES_CYL_BAL_AD_DC	-	0... FEH	-48... 142.5	0.75	°C
Maximum TCO_ST at ES for control of cylinder balancing selective lambda adaptation at active driving cycle					
C_TCO_ST_MIN_CYL_BAL_AD_DC	-	0... FEH	-48... 142.5	0.75	°C
Minimum TCO_ST start for control of cylinder balancing selective lambda adaptation at active driving cycle					
C_TCO_ST_MIN_ES_CYL_BAL_AD_DC	-	0... FEH	-48... 142.5	0.75	°C
Minimum TCO_ST at ES for control of cylinder balancing selective lambda adaptation at active driving cycle					
C_TCO_THD_CYL_BAL_LAM_SEL_DC	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold for control of cylinder balancing selective lambda adaptation at active driving cycle					
C_VS_MAX_CYL_BAL_AD_REQ_DC	-	0... FFH	0... 255	1	Km/h
Maximum VS required to enable cylinder balancing lambda adaptation request at active driving cycle					
C_VS_MIN_CYL_BAL_AD_REQ_DC	-	0... FFH	0... 255	1	Km/h
Minimum VS required to enable cylinder balancing lambda adaptation request at active driving cycle					
ID_IDX_CYL_BAL_HOM_REQ_INT_AT	-	0... 4H	0 ...4	1	-
LDP_NT_AGI_ID_IDX_REQ_INT_DC	6	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap aging index value for internal homogenous combustion mode request at active driving cycle for AT					
ID_IDX_CYL_BAL_HOM_REQ_INT_MT	-	0... 4H	0 ...4	1	-
LDP_NT_AGI_ID_IDX_REQ_INT_DC	6	0... FFFFH	0... 0.99998474	1.52588E- 5	-
NOx trap aging index value for internal homogenous combustion mode request at active driving cycle					
ID_T_CYL_BAL_HOM_REQ_INT_DC_AT [5]	-	0... FFFFH	0... 6553.5	0.1	s
LDPM_T_AST_BAL_ID_T_REQ_INT_DC [5]	14	0... FFFFH	0... 6553.5	0.1	s
Time intervals for internal homogenous combustion mode request at active driving cycle for AT					
ID_T_CYL_BAL_HOM_REQ_INT_DC_MT [5]	-	0... FFFFH	0... 6553.5	0.1	s
LDPM_T_AST_BAL_ID_T_REQ_INT_DC [5]	14	0... FFFFH	0... 6553.5	0.1	s
Time intervals for internal homogenous combustion mode request at active driving cycle for MT					
ID_T_CYL_BAL_HOM_REQ_INT_STOP [5]	-	0... FFFFH	0... 6553.5	0.1	s
LDP_T_AST_BAL_ID_T_REQ_INT_STOP [5]	8	0... FFFFH	0... 6553.5	0.1	s
Time interval maps for internal homogenous combustion mode request at engine stop conditions					
ID_T_CYL_BAL_LAM_AD_DC	-	0... FFFFH	0... 6553.5	0.1	s
LDP_T_AST_BAL_ID_T_LAM_AD_DC	8	0... FFFFH	0... 6553.5	0.1	s
Time intervals for control of cylinder balancing lambda adaptation at active driving cycle					
ID_T_CYL_BAL_LAM_SEL_AD_DC	-	0... FFFFH	0... 6553.5	0.1	s
LDP_T_AST_BAL_ID_T_LAM_SEL_DC	8	0... FFFFH	0... 6553.5	0.1	s
Time intervals for control of cylinder balancing selective lambda adaptation at active driving cycle					
LC_CYL_BAL_AD_DC_RST	-	0... 1H	0 ...1	1	-
Manual switch for cylinder balancing adaptation reset at active driving cycle					
LC_CYL_BAL_CORD_DC_STOP_MAN	-	0... 1H	0 ...1	1	-
Logical constant for manual stop (=1) of cylinder balancing coordination at driving cycle					

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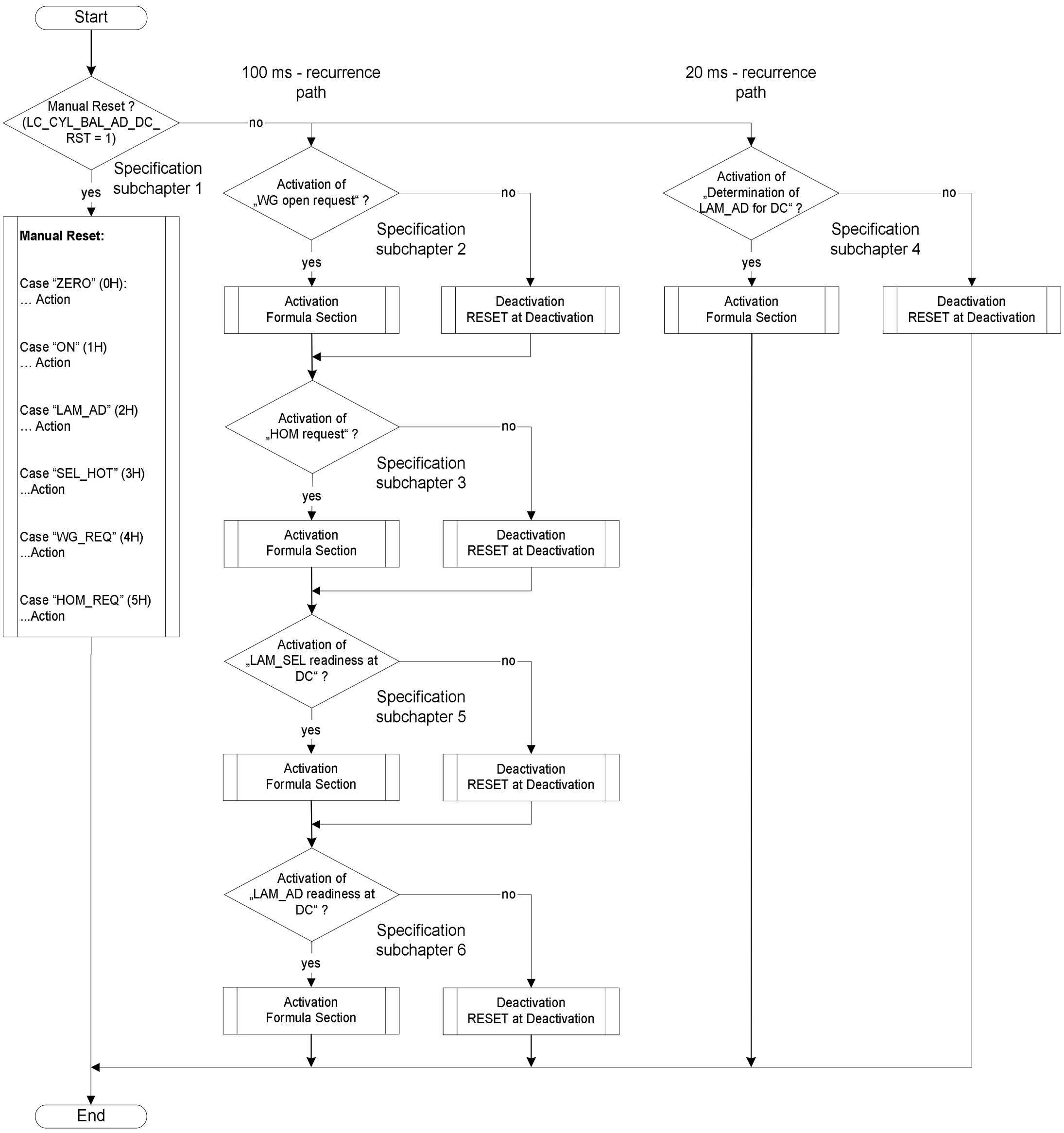
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

FUNCTION DESCRIPTION:

Task of the cylinder balancing coordination at DC is to control the adaptation functions during the current driving cycle.

Signal flow diagram:



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Application conditions

Initialisation: See separate chapters

Recurrence: *See separate chapters*

Activation: *See separate chapters*

Deactivation: *See separate chapters*

9.47.1 Manual reset of cylinder balancing readiness at active drving cycle (DC):

FUNCTION DESCRIPTION:

General information:

In case of a manual reset it is possible to adjust the exported output data to a wanted value to make the function test and handling more easier. While the manual function reset is activated, all following subchapters within the module "cylinder balancing coordination at DC" are deactivated and the corresponding "Initialization at Deactivation" process for this chapters is blocked during this period.

Application conditions

Recurrence: *100 ms*

Activation: *LC_CYL_BAL_AD_DC_RST = 1*

Deactivation: *LC_CYL_BAL_AD_DC_RST = 0*

Formula section:

```
IF        C_CYL_BAL_AD_DC_RST =  ZERO  (0H)
THEN      LV_CYL_BAL_LAM_AD_DC = 0
            LV_CYL_BAL_LAM_SEL_AD_HOT_DC = 0
            LV_CYL_BAL_LAM_SEL_AD_COLD_DC = 0
            LV_CYL_BAL_AD_HOM_REQ_DC = 0
            FOR m = 0 to NC_CBK_EX_NR - 1
                  LV_CYL_BAL_AD_WG_OPEN_REQ[m] = 0
            END FOR

ELSEIF    C_CYL_BAL_AD_DC_RST =  ON  (1H)
THEN      LV_CYL_BAL_LAM_AD_DC = 1
            LV_CYL_BAL_LAM_SEL_AD_HOT_DC = 1
            LV_CYL_BAL_LAM_SEL_AD_COLD_DC = 1
            LV_CYL_BAL_AD_HOM_REQ_DC = 1
            FOR m = 0 to NC_CBK_EX_NR - 1
                  LV_CYL_BAL_AD_WG_OPEN_REQ[m] = 1
            END FOR

ELSEIF    C_CYL_BAL_AD_DC_RST =  LAM_AD  (2H)
THEN      LV_CYL_BAL_LAM_AD_DC = 1

ELSEIF    C_CYL_BAL_AD_DC_RST =  SEL_HOT  (3H)
THEN      LV_CYL_BAL_LAM_SEL_AD_HOT_DC = 1

ELSEIF    C_CYL_BAL_AD_DC_RST =  WG_REQ  (4H)
THEN      FOR m = 0 to NC_CBK_EX_NR - 1
```

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LV_CYL_BAL_AD_WG_OPEN_REQ[m] = 1
END FOR

ELSEIF C_CYL_BAL_AD_DC_RST = HOM_REQ (5**H**)
THEN LV_CYL_BAL_AD_HOM_REQ_DC = 1

ELSEIF C_CYL_BAL_AD_DC_RST = SEL_COLD (6**H**)
THEN LV_CYL_BAL_LAM_SEL_AD_COLD_DC = 1
ENDIF

9.47.2 Waste gate open request for cylinder balancing adaptation:

FUNCTION DESCRIPTION:

General information:

For a turbo engine, the cylinder individual lambda control is only possible while the waste gate is sufficient opened to identify the exhaust package for each cylinder. In case of a planned adaptation, a request to open the waste gate is carried out for each turbine before.

Application conditions:

Initialization at Reset ***or*** *Deactivation:*
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_AD_WG_OPEN_REQ[m] = 0
END FOR

Recurrence: 100 ms

Activation: LC_CYL_BAL_AD_DC_RST = 0 **and**
LC_TCHA_CONF = 1 **and**
(LC_CYL_BAL_CORD_DC_STOP_MAN = 0 **or**
LC_CYL_BAL_CORD_EOL_STOP_MAN = 0 **)**

Deactivation: LC_CYL_BAL_AD_DC_RST = 0 **and**
[LC_TCHA_CONF = 0 **or**
(LC_CYL_BAL_CORD_DC_STOP_MAN = 1 **and**
LC_CYL_BAL_CORD_EOL_STOP_MAN = 1 **)** **]**

Formula section:

FOR m = 0 to NC_CBK_EX_NR - 1
IF LV_CYL_BAL_AD_WG_OPEN_REQ_EOL[m] = 1 **or**
LV_CYL_BAL_AD_WG_OPEN_REQ_DC[m] = 1
THEN LV_CYL_BAL_AD_WG_OPEN_REQ[m] = 1
ELSE LV_CYL_BAL_AD_WG_OPEN_REQ[m] = 0
ENDIF
END FOR

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9.47.3 Homogenous combustion mode request for cylinder balancing adaptation:

FUNCTION DESCRIPTION:

General information:

For a stratified combustion engine, the cylinder individual lambda control as well as the global lambda adaptation are only possible while the engine is running in homogenous combustion mode with activated lambda control. In case of a planned adaptation, a request to switch to homogenous combustion is carried out before.

Application conditions:

Initialization at Reset ***or*** *Deactivation:*
LV_CYL_BAL_AD_HOM_REQ_DC = 0

Recurrence: 100 ms

Activation:
LC_CYL_BAL_AD_DC_RST = 0 **and**
LC_TCHA_CONF = 0 **and**
LC_CYL_BAL_CORD_DC_STOP_MAN = 0

Deactivation:
LC_CYL_BAL_AD_DC_RST = 0 **and**
[LC_TCHA_CONF = 1 **or**
LC_CYL_BAL_CORD_DC_STOP_MAN = 1 **]**

Formula section:

// determination of NOx aging for homogenous combustion mode request at active driving cycle
IF LV_ST_END = 0
THEN
IF LV_AT = 1
THEN IDX = ID_IDX_CYL_BAL_HOM_REQ_INT_AT(NT_AGI)
ELSE IDX = ID_IDX_CYL_BAL_HOM_REQ_INT _MT(NT_AGI)
ENDIF
// NOx aging for homogenous combustion mode request at active driving cycle
ENDIF

// calculation of internal homogenous combustion mode request at active driving cycle
IF LV_AT = 1
THEN T_CYL_BAL_HOM_REQ_INT_DC =
ID_T_CYL_BAL_HOM_REQ_INT_DC_AT[IDX](T_AST_BAL)
ELSE T_CYL_BAL_HOM_REQ_INT_DC =
ID_T_CYL_BAL_HOM_REQ_INT_DC_MT[IDX](T_AST_BAL)
ENDIF

T_CYL_BAL_HOM_REQ_INT_DC_STOP =
ID_T_CYL_BAL_HOM_REQ_INT_STOP[IDX](T_AST_BAL)

IF

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[[*//EU /Japan1*
T_AST_BAL < C_T_AST_MAX_CYL_BAL_AD_DC and *// max time*
TCO_ST_BAL < C_TCO_ST_MAX_CYL_BAL_AD_DC and *// TCO_ST_MAX*
TCO_ST_BAL > C_TCO_ST_MIN_CYL_BAL_AD_DC and *// TCO_ST_MIN*
T_AST_BAL < T_CYL_BAL_HOM_REQ_INT_DC *// time shape*
]
OR
[*// Japan 2*
T_AST_BAL > C_T_AST_MIN_2_CYL_BAL_AD_DC and *// 2.time intervall*
T_AST_BAL < C_T_AST_MAX_2_CYL_BAL_AD_DC and *// 2.time intervall*
TCO_ST_BAL < C_TCO_ST_MAX_CYL_BAL_AD_DC and *// TCO_ST_MAX*
TCO_ST_BAL > C_TCO_ST_MIN_CYL_BAL_AD_DC and *// TCO_ST_MIN*
T_AST_BAL < T_CYL_BAL_HOM_REQ_INT_DC *// time shape*
]
OR
[// Stop Condition
T_AST_BAL < C_T_AST_MAX_CYL_BAL_AD_DC_STOP and *// max time*
T_ES_CUS < C_T_ES_MAX_CYL_BAL_HOM_REQ_INT and *// stop time*
TCO_ST_BAL < C_TCO_ST_MAX_ES_CYL_BAL_AD_DC and *// TCO_ST_MAX*
TCO_ST_BAL > C_TCO_ST_MIN_ES_CYL_BAL_AD_DC and *// TCO_ST_MIN*
T_AST_BAL < T_CYL_BAL_HOM_REQ_INT_DC_STOP *// time shape*
]]
THEN LV_CYL_BAL_HOM_REQ_INT_DC = 1
// internal homogen combustion mode request at active driving cycle
ELSE LV_CYL_BAL_HOM_REQ_INT_DC = 0
ENDIF

// calculation of overall homogen combustion mode request at active driving cycle
IF LV_CYL_BAL_LAM_SEL_HOM_REQ_DC = 1 **or**
LV_CYL_BAL_LAM_AD_HOM_REQ_DC = 1 **or**
LV_CYL_BAL_HOM_REQ_INT_DC = 1 **or**
LV_CYL_BAL_HOM_REQ_EXT = 1
THEN LV_CYL_BAL_AD_HOM_REQ_DC = 1
ELSE LV_CYL_BAL_AD_HOM_REQ_DC = 0
ENDIF

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9.47.4 Determination of lambda adaptation cycle for cylinder balancing at DC

FUNCTION DESCRIPTION:

General information:

Because the lambda adaptation function is running with a higher recurrence in comparison to cylinder balancing coordination at DC, the determination of a finished lambda adaptation cycle has to be carried out faster to avoid signal under-sampling.

Initialization at Reset ***or*** *Deactivation:*
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_AD_END[m] = 0

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STATE_CYL_BAL_LAM_AD[m] = "INIT" (0[**H**])
END FOR

Recurrence: 20 ms

Activation: LC_CYL_BAL_AD_DC_RST = 0 **and**
LC_TCHA_CONF = 0 **and**
LC_CYL_BAL_CORD_DC_STOP_MAN = 0

Deactivation: LC_CYL_BAL_AD_DC_RST = 0 **and**
[LC_TCHA_CONF = 1 **or**
LC_CYL_BAL_CORD_DC_STOP_MAN = 1 **]**

Formula section:

FOR m = 0 to NC_CBK_EX_NR - 1
IF LV_LAM_AD_STOP[m] = 0 - -> 1
THEN LV_CYL_BAL_LAM_AD_END[m] = LV_LAM_AD_END_CBK[m]
STATE_CYL_BAL_LAM_AD[m] = STATE_LAM_AD[m]
ENDIF
END FOR

9.47.5 Calculation of cylinder balancing selective lambda adaptation readiness (DC):

FUNCTION DESCRIPTION:

General information:

A periodic request for homogenous combustion mode is carried out in defined time intervals to allow the start of the cylinder selective adaptation functions, which are only activated in homogenous combustion mode. In case of a turbo engine, a periodic request to open the waste gate is carried out.

Application conditions:

Initialization at first Engine run or NVMY-error:
T_CYL_BAL_LAM_SEL_DC = 0.0[s] *(first initialization)*
LV_CYL_BAL_LAM_SEL_AD_HOT_DC = 0 *(first initialization)*
LV_CYL_BAL_LAM_SEL_AD_COLD_DC = 0 *(first initialization)*
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 0 *(first initialization)*
LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 0 *(first initialization)*
LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] = 0 *(first initialization)*
END FOR

Initialization at Reset:
T_CYL_BAL_LAM_SEL_DC = T_CYL_BAL_LAM_SEL_DC *(NVMY)*
LV_CYL_BAL_LAM_SEL_AD_HOT_DC = LV_CYL_BAL_LAM_SEL_AD_HOT_DC *(NVMY)*
LV_CYL_BAL_LAM_SEL_AD_COLD_DC = LV_CYL_BAL_LAM_SEL_AD_COLD_DC *(NVMY)*
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] =

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LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] *(NVMY)*
LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] =
LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] *(NVMY)*
LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] =
LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] *(NVMY)*
END FOR
(NVMY: values stored in the non-volatile memory)
FOR m = 0 to NC_CBK_EX_NR - 1
IF C_CYL_BAL_LAM_SEL_HOT_DC_CONF = LOW (0**H**)
THEN LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 1
ELSEIF C_CYL_BAL_LAM_SEL_HOT_DC_CONF = HIGH (1**H**)
THEN LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 1
ENDIF
END FOR

Initialization at Reset ***or*** *Deactivation:*
LV_CYL_BAL_LAM_SEL_HOM_REQ_DC = 0
STATE_CYL_BAL_LAM_SEL_AD_DC = "Wait" (0[**H**])
LV_STATE_LAM_SEL_DC_CHG_REQ = 0
LV_STATE_LAM_SEL_DC_CHG_WAIT = 0
T_CYL_BAL_LAM_SEL_AD_WAIT_DC = 0.0[s]
LV_T_STEP_CYL_BAL_LAM_SEL_DC = 0
FOR m = 0 to NC_CBK_EX_NR - 1
T_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 0.0[s]
T_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 0.0[s]
T_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] = 0.0[s]
LV_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = 0
T_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = 0.0[s]
LV_CYL_BAL_AD_WG_OPEN_REQ_DC[m] = 0
END FOR

Recurrence: 100 ms

Activation: LC_CYL_BAL_AD_DC_RST = 0 **and**
LV_ST_END = 1 **and**
LC_CYL_BAL_CORD_DC_STOP_MAN = 0

Deactivation: LC_CYL_BAL_AD_DC_RST = 0 **and**
[LV_ST_END = 0 **or**
LC_CYL_BAL_CORD_DC_STOP_MAN = 1 **]**

Signal flow diagram:

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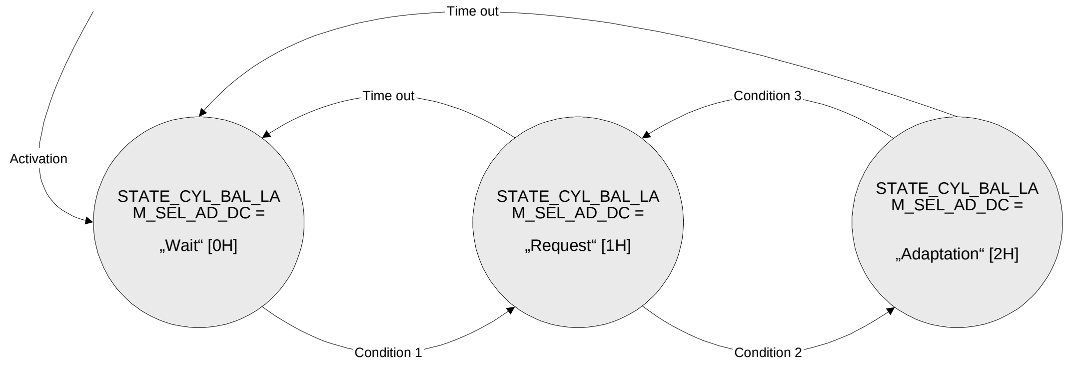

Formula section:

IF(1)
[[*//EU /Japan1*
T_AST_BAL < C_T_AST_MAX_CYL_BAL_AD_DC and *// max time*
TCO_ST_BAL < C_TCO_ST_MAX_CYL_BAL_AD_DC and *// TCO_ST_MAX*
TCO_ST_BAL > C_TCO_ST_MIN_CYL_BAL_AD_DC *// TCO_ST_MIN*
]
OR
[*// Japan 2*
T_AST_BAL > C_T_AST_MIN_2_CYL_BAL_AD_DC and *// 2.time intervall*
T_AST_BAL < C_T_AST_MAX_2_CYL_BAL_AD_DC and *// 2.time intervall*
TCO_ST_BAL < C_TCO_ST_MAX_CYL_BAL_AD_DC and *// TCO_ST_MAX*
TCO_ST_BAL > C_TCO_ST_MIN_CYL_BAL_AD_DC *// TCO_ST_MIN*
]
OR
[// Stop Condition
T_AST_BAL < C_T_AST_MAX_CYL_BAL_AD_DC_STOP and *// max time*
T_ES_CUS < C_T_ES_MAX_CYL_BAL_HOM_REQ_INT and *// stop time*
TCO_ST_BAL < C_TCO_ST_MAX_ES_CYL_BAL_AD_DC and *// TCO_ST_MAX*
TCO_ST_BAL > C_TCO_ST_MIN_ES_CYL_BAL_AD_DC *// TCO_ST_MIN*
]]
THEN (1) *// DC adaptation requests controlled by fix time steps*
IF (2) T_AST_BAL < ID_T_CYL_BAL_LAM_SEL_AD_DC *// time shape*
THEN (2) LV_STATE_LAM_SEL_DC_CHG_REQ = 1
LV_STATE_LAM_SEL_DC_CHG_WAIT = 0
LV_T_STEP_CYL_BAL_LAM_SEL_DC = 1
ELSE (2) LV_STATE_LAM_SEL_DC_CHG_REQ = 0
LV_STATE_LAM_SEL_DC_CHG_WAIT = 1
LV_T_STEP_CYL_BAL_LAM_SEL_DC = 0
ENDIF (2)
ELSE (1) *// DC adaptation requests for controlled by flexible time steps*
LV_T_STEP_CYL_BAL_LAM_SEL_DC = 0
IF (2) T_CYL_BAL_LAM_SEL_DC < C_T_MAX_CYL_BAL_LAM_SEL_DC
THEN (2) T_CYL_BAL_LAM_SEL_DC(n) = T_CYL_BAL_LAM_SEL_DC(n-1) + 0.1[s]
// waiting time incrementation, flexible time steps running
IF (3) (LV_CYL_BAL_LAM_SEL_AD_COLD_DC = 0 **and**
TCO < C_TCO_THD_CYL_BAL_LAM_SEL_DC)
OR

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(LV_CYL_BAL_LAM_SEL_AD_HOT_DC = 0 **and**
TCO ≥ C_TCO_THD_CYL_BAL_LAM_SEL_DC)
THEN (3) *// enable conditions to change adaptation state from "Wait" to "Request"*
LV_STATE_LAM_SEL_DC_CHG_REQ = 1
LV_STATE_LAM_SEL_DC_CHG_WAIT = 0
ELSE (3) *// enable conditions to change adaptation state from "Request" to "Wait"*
LV_STATE_LAM_SEL_DC_CHG_REQ = 0
LV_STATE_LAM_SEL_DC_CHG_WAIT = 1
ENDIF (3)
ELSE (2) *// reset of waiting time, new beginning of flexible time steps*
T_CYL_BAL_LAM_SEL_DC = 0.0[s]
LV_CYL_BAL_LAM_SEL_AD_HOT_DC = 0
LV_CYL_BAL_LAM_SEL_AD_COLD_DC = 0
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] = 0
T_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] = 0.0[s]
IF C_CYL_BAL_LAM_SEL_HOT_DC_CONF = LOW (0**H**)
THEN LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 0
T_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 0.0[s]
ELSEIF C_CYL_BAL_LAM_SEL_HOT_DC_CONF = HIGH (1**H**)
THEN LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 0
T_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 0.0[s]
ELSEIF C_CYL_BAL_LAM_SEL_HOT_DC_CONF = LOW_HIGH (2**H**)
THEN LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 0
LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 0
T_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 0.0[s]
T_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 0.0[s]
ENDIF
END FOR
ENDIF (2)
ENDIF (1)

Note: At function activation always State "Wait" is entered
Cylinder balancing adaptation at DC: State 0[H] - Wait
Assignments at entry to state Wait :
STATE_CYL_BAL_LAM_SEL_AD_DC = "Wait" (0[**H**])
LV_CYL_BAL_LAM_SEL_HOM_REQ_DC = 0
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_AD_WG_OPEN_REQ_DC[m] = 0
END FOR

Action during state "Wait":
Transition to State 1[H] Request (Condition 1)
// Lambda Adaptation manager request for change of state
IF LV_STATE_LAM_SEL_DC_CHG_REQ = 1

Assignments at exit from state Wait :
No assignments

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Cylinder balancing adaptation at DC: State 1[H] - Request
Assignments at entry to state Request :
STATE_CYL_BAL_LAM_SEL_AD_DC = "Request" (1[**H**])

Action during state "Request":
Transition to State 0[H] Wait (Time out)
// Lambda Adaptation manager request for change of state
IF LV_STATE_LAM_SEL_DC_CHG_WAIT = 1
Calculations:
// conditions for cylinder balancing selective lambda adaptation achieved
FOR m = 0 to NC_CBK_EX_NR - 1
IF **(** STATE_CDN_LAM_CYL_SEL_ADJ_RNG[m] = LOW_RNG (1[**H**]) **and**
[LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 0 **or**
LV_T_STEP_CYL_BAL_LAM_SEL_DC = 1 **]** **)**
OR
(STATE_CDN_LAM_CYL_SEL_ADJ_RNG[m] = HIGH_RNG (2[**H**]) **and**
[LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 0 **or**
LV_T_STEP_CYL_BAL_LAM_SEL_DC = 1 **]** **)**
OR
(STATE_CDN_LAM_CYL_SEL_ADJ_RNG[m] = COLD_RNG (3[**H**]) **and**
[LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] = 0 **or**
LV_T_STEP_CYL_BAL_LAM_SEL_DC = 1 **]** **)**
THEN T_CYL_BAL_LAM_SEL_AD_REQ_DC[m](n) =
T_CYL_BAL_LAM_SEL_AD_REQ_DC[m](n-1) + 0.1[s]
ELSE T_CYL_BAL_LAM_SEL_AD_REQ_DC[m](n) = 0.0[s]
ENDIF
END FOR
// calculation of request for bank specific homogenuous cobustion mode switch
FOR m = 0 to NC_CBK_EX_NR - 1
IF (T_CYL_BAL_LAM_SEL_AD_REQ_DC[m] ≥ C_T_MIN_CYL_BAL_AD_REQ_DC
AND GEAR ≥ C_GEAR_MIN_CYL_BAL_AD_REQ_DC
AND VS ≥ C_VS_MIN_CYL_BAL_AD_REQ_DC)
THEN LV_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = 1
ELSE LV_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = 0
ENDIF
END FOR
// calculation of request for homogenous combustion mode switch for non turbo engine
IF (1) LC_TCHA_CONF = 0
THEN (1)

IF (2) $$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \mathrm{LV\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m]} > 0$$

// homogenous switch after waiting time
OR
([LV_NT_RGN_REQ = 1 **or** LV_T_STEP_CYL_BAL_LAM_SEL_DC = 1 **]** **and**

$$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \mathrm{T\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m]} > 0.0[s]$$ **)**

// immediate homogenous switch in case of NT request or fixed time steps

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THEN (2) LV_CYL_BAL_LAM_SEL_HOM_REQ_DC = 1
ENDIF (2)
ELSE (1)
// calculation of request for waste gate open for turbo engine (LC_TCHA_CONF=1)
FOR (2) m = 0 to NC_CBK_EX_NR - 1

IF (3) $$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m] > 0$$

// waste gate open after waiting time
OR
(LV_T_STEP_CYL_BAL_LAM_SEL_DC = 1 **and**

$$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} T\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m] > 0.0[s]$$ **)**

// immediate waste gate open in case of fixed time steps
THEN (3) LV_CYL_BAL_AD_WG_OPEN_REQ_DC[m] = 1
ENDIF (3)
END FOR (2)
ENDIF (1)

Transition to State 2[H] Adaptation (Condition 2)
// conditions for combustion mode switch to homogenuous or waste gate open achieved
IF LV_CYL_BAL_LAM_SEL_HOM_REQ_DC = 1 **or**

$$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_AD\_WG\_OPEN\_REQ\_DC[m] > 0$$

Assignments at exit from state Request :
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = 0
T_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = 0.0[s]
END FOR

Cylinder balancing adaptation at DC: State 2[H] - Adaptation
Assignments at entry to state Adaptation :
STATE_CYL_BAL_LAM_SEL_AD_DC = "Adaptation" (2[**H**])
T_CYL_BAL_LAM_SEL_AD_WAIT_DC = C_T_MIN_CYL_BAL_AD_WAIT_DC
FOR m = 0 to NC_CBK_EX_NR - 1
T_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = C_T_MIN_CYL_BAL_AD_WAIT_DC
END FOR

Actions during state "Adaptation":
Transition to State 0[H] Wait (Time out)
// Lambda Adaptation manager request for change of state
IF LV_STATE_LAM_SEL_DC_CHG_WAIT = 1

Transition to State 1[H] Request (Condition 3)
// conditions for combustion mode switch to homogenuous or waste gate open not achieved
IF (LC_TCHA_CONF = 0 **and** LV_CYL_BAL_LAM_SEL_HOM_REQ_DC = 0) **or**

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(LC_TCHA_CONF = 1 **and** $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \mathrm{LV\_CYL\_BAL\_AD\_WG\_OPEN\_REQ\_DC[m]} = 0$)

Calculations:
// calculation of waiting time after entry in homogenuous combustion mode or waste gate open
IF (1) T_CYL_BAL_LAM_SEL_AD_WAIT_DC = 0.0 [s]
// waiting time after switch to homogenous combustion mode elapsed
THEN (1)
FOR (2) m = 0 to NC_CBK_EX_NR - 1
IF (3) (STATE_LAM_CYL_SEL_ADJ[m] <> ADJ_NOM_L_RNG (4[**H**]) **and**
STATE_LAM_CYL_SEL_ADJ[m] <> ADJ_NOM_H_RNG (5[**H**]) **and**
STATE_LAM_CYL_SEL_ADJ[m] <> "ADJ_ENG_COLD (2[**H**]))
// low range, high range, cold range CILC adaptation area not active
THEN (3) T_CYL_BAL_LAM_SEL_AD_REQ_DC[m](n) =
T_CYL_BAL_LAM_SEL_AD_REQ_DC[m](n-1) - 0.1[s]
ELSE (3) T_CYL_BAL_LAM_SEL_AD_REQ_DC[m](n) =
C_T_MIN_CYL_BAL_AD_WAIT_DC
ENDIF (3)
IF (3) T_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = 0.0 [s]
// time with no CILC adaptation area active elapsed
OR
(STATE_LAM_CYL_SEL_ADJ[m] = ADJ_NOM_L_RNG (4[**H**]) **and**
LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 1)
// low range CILC adaptation active - adaptation result achieved
OR
(STATE_LAM_CYL_SEL_ADJ[m] = ADJ_NOM_H_RNG (5[**H**]) **and**
LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 1)
// high range CILC adaptation active - adaptation result achieved
OR
(STATE_LAM_CYL_SEL_ADJ[m] = "ADJ_ENG_COLD (2[**H**]) **and**
LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] = 1)
// cold range CILC adaptation active - adaptation result achieved
THEN (3) LV_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = 0
// conditions for CILC adaptation no longer present
ELSE (3) LV_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = 1
// conditions for CILC adaptation still present
ENDIF (3)
END FOR (2)
IF (2) LC_TCHA_CONF = 0 *//no turbo engeine*
THEN (2)

IF (3) $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \mathrm{LV\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m]} = 0$

// conditions for CILC no longer achieved for all exhaust banks
THEN (3) LV_CYL_BAL_LAM_SEL_HOM_REQ_DC = 0
// reset of homogenous combustion mode request
ENDIF (3)
ELSE (2) *// turbo engeine*

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FOR (3) m = 0 to NC_CBK_EX_NR - 1

IF (4) $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \mathrm{LV\_CYL\_BAL\_LAM\_SEL\_AD\_REQ\_DC[m]} = 0$

THEN (4) LV_CYL_BAL_AD_WG_OPEN_REQ_DC[m] = 0
ENDIF (4)
END FOR (3)
ENDIF (2)
ELSE (1)
IF (2) LV_T_STEP_CYL_BAL_LAM_SEL_DC = 0
THEN (2) T_CYL_BAL_LAM_SEL_AD_WAIT_DC(n) =
T_CYL_BAL_LAM_SEL_AD_WAIT_DC(n-1) - 0.1[s]
// decrementation of waiting time after switch to homogenous combustion mode
ENDIF (2)
ENDIF (1)
// determination of cylinder individual lambda adaptation quality at active driving cycle and
// determination of minimum adaptation time reached for cylinder individual lambda adaptation areas
FOR m = 0 to NC_CBK_EX_NR - 1
IF (1) STATE_LAM_CYL_SEL_ADJ[m] = ADJ_NOM_L_RNG (4[**H**])
THEN (1)
IF (2) LV_LAM_CYL_SEL_ADJ_VLD[m] = 1 **and**
FAC_CYL_LAM_ABSV_SUM[m] $<$
C_FAC_CYL_LAM_ABSV_SUM_BAL_DC
THEN (2) LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 1
ENDIF (2)
IF (2) T_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] $\geq$
C_T_MIN_CYL_BAL_LAM_SEL_DC
// minimum adaptation time for CILC (low range) elapsed
THEN (2) LV_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m] = 1
ELSE (2) T_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m](n) =
T_CYL_BAL_LAM_SEL_AD_RNG_L_DC[m](n-1) + 0.1[s]
// incrementation of minimum adaptation time for CILC (low range)
ENDIF (2)
ELSEIF (1) STATE_LAM_CYL_SEL_ADJ[m] = ADJ_NOM_H_RNG (5[**H**])
THEN (1)
IF (2) LV_LAM_CYL_SEL_ADJ_VLD[m] = 1 **and**
FAC_CYL_LAM_ABSV_SUM[m] $<$
C_FAC_CYL_LAM_ABSV_SUM_BAL_DC
THEN (2) LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 1
ENDIF (2)
IF (2) T_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] $\geq$
C_T_MIN_CYL_BAL_LAM_SEL_DC
// minimum adaptation time for CILC (high range) elapsed
THEN (2) LV_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m] = 1
ELSE (2) T_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m](n) =
T_CYL_BAL_LAM_SEL_AD_RNG_H_DC[m](n-1) + 0.1[s]
// incrementation of minimum adaptation time for CILC (high range)
ENDIF (2)
ELSEIF (1) STATE_LAM_CYL_SEL_ADJ[m] = "ADJ_ENG_COLD (2[**H**])
THEN (1)

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IF (2) LV_LAM_CYL_SEL_ADJ_VLD[m] = 1 **and**
FAC_CYL_LAM_ABSV_SUM[m] <
C_FAC_CYL_LAM_ABSV_SUM_BAL_DC
THEN (2) LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] = 1
ENDIF (2)
IF (2) T_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] ≥
C_T_MIN_CYL_BAL_LAM_SEL_DC
// minimum adaptation time for CILC (cold range) elapsed
THEN (2) LV_CYL_BAL_LAM_SEL_RNG_COLD_DC[m] = 1
ELSE (2) T_CYL_BAL_LAM_SEL_RNG_COLD_DC[m](n) =
T_CYL_BAL_LAM_SEL_RNG_COLD_DC[m](n-1) + 0.1[s]
// incrementation of minimum adaptation time for CILC (cold range)
ENDIF (2)
ENDIF (1)
END FOR
// calculation of cylinder individual lambda adaptation readiness (hot) at active driving cycle (global)

IF ($\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \mathrm{LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_L\_DC[m]} = \mathrm{NC\_CBK\_EX\_NR}$ **and**

$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \mathrm{LV\_CYL\_BAL\_LAM\_SEL\_AD\_RNG\_H\_DC[m]} = \mathrm{NC\_CBK\_EX\_NR}$)

THEN LV_CYL_BAL_LAM_SEL_AD_HOT_DC = 1
// hot adaptation values of all exhaust banks are within limits at active DC
ENDIF
// calculation of cylinder individual lambda adaptation readiness (cold) at active driving cycle (global)

IF $\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \mathrm{LV\_CYL\_BAL\_LAM\_SEL\_RNG\_COLD\_DC[m]} = \mathrm{NC\_CBK\_EX\_NR}$

THEN LV_CYL_BAL_LAM_SEL_AD_COLD_DC = 1
// cold adaptation values of all exhaust banks are within limits at active DC
ENDIF

Assignments at exit from state Adaptation :
LV_CYL_BAL_LAM_SEL_HOM_REQ_DC = 0
T_CYL_BAL_LAM_SEL_AD_WAIT_DC = 0.0[s]
FOR m = 0 to NC_CBK_EX_NR - 1
T_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = 0.0 [s]
LV_CYL_BAL_LAM_SEL_AD_REQ_DC[m] = 0
LV_CYL_BAL_AD_WG_OPEN_REQ_DC[m] = 0
END FOR

9.47.6 Calculation of cylinder balancing lambda adaptation readiness (DC):

FUNCTION DESCRIPTION:

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General information:

A periodic request for homogenous combustion mode is carried out in defined time intervals to allow the start of the lambda adaptation functions, which are only activated in homogenous combustion mode.

Application conditions:

Initialization at first Engine run or NVMY-error:
T_CYL_BAL_LAM_AD_DC = 0.0[s] *(first initialization)*
LV_CYL_BAL_LAM_AD_DC = 0 *(first initialization)*
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_AD_ADD_DC[m] = 0 *(first initialization)*
LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0 *(first initialization)*
LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = 0 *(first initialization)*
END FOR

Initialization at Reset:
T_CYL_BAL_LAM_AD_DC = T_CYL_BAL_LAM_AD_DC *(NVMY)*
LV_CYL_BAL_LAM_AD_DC = LV_CYL_BAL_LAM_AD_DC *(NVMY)*
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_AD_ADD_DC[m] = LV_CYL_BAL_LAM_AD_ADD_DC[m] *(NVMY)*
LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = LV_CYL_BAL_LAM_AD_FAC_L_DC[m] *(NVMY)*
LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = LV_CYL_BAL_LAM_AD_FAC_H_DC[m] *(NVMY)*
END FOR
(NVMY: values stored in the non-volatile memory)
FOR m = 0 to NC_CBK_EX_NR - 1
IF C_CYL_BAL_LAM_AD_DC_CONF = ADD (0**H**)
THEN LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = 1
LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = 1
ELSEIF C_CYL_BAL_LAM_AD_DC_CONF = FAC_L (1**H**)
THEN LV_CYL_BAL_LAM_AD_ADD_DC[m] = 1
LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = 1
ELSEIF C_CYL_BAL_LAM_AD_DC_CONF = ADD_FAC_L (2**H**)
THEN LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = 1
ENDIF
END FOR

Initialization at Reset ***or*** *Deactivation:*
LV_CYL_BAL_LAM_AD_HOM_REQ_DC = 0
STATE_CYL_BAL_LAM_AD_DC = "Wait" (0[**H**])
LV_STATE_LAM_AD_DC_CHG_REQ = 0
LV_STATE_LAM_AD_DC_CHG_WAIT = 0
T_CYL_BAL_LAM_AD_WAIT_DC = 0.0[s]
LV_T_STEP_CYL_BAL_LAM_AD_DC = 0
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_AD_REQ_DC[m] = 0
T_CYL_BAL_LAM_AD_ADD_DC[m] = 0.0[s]
T_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0.0[s]
T_CYL_BAL_LAM_AD_FAC_H_DC[m] = 0.0[s]
T_CYL_BAL_LAM_AD_REQ_DC[m] = 0.0[s]
END FOR

Recurrence: 100 ms

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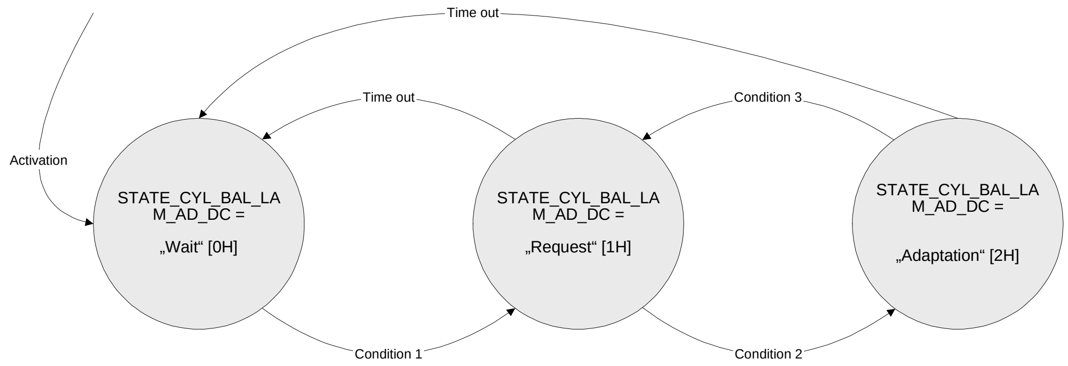
Activation: LC_CYL_BAL_AD_DC_RST = 0 **and**
LV_ST_END = 1 **and**
LC_TCHA_CONF = 0 **and**
LC_CYL_BAL_CORD_DC_STOP_MAN = 0

Deactivation: LC_CYL_BAL_AD_DC_RST = 0 **and**
[LV_ST_END = 0 **or**
LC_TCHA_CONF = 1 **or**
LC_CYL_BAL_CORD_DC_STOP_MAN = 1 **]**

Signal flow diagram:



Formula section:

IF (1)
[[*//EU /Japan1*
T_AST_BAL < C_T_AST_MAX_CYL_BAL_AD_DC and *// max time*
TCO_ST_BAL < C_TCO_ST_MAX_CYL_BAL_AD_DC and *// TCO_ST_MAX*
TCO_ST_BAL > C_TCO_ST_MIN_CYL_BAL_AD_DC *// TCO_ST_MIN*
]
OR
[*// Japan 2*
T_AST_BAL > C_T_AST_MIN_2_CYL_BAL_AD_DC and *// 2.time intervall*
T_AST_BAL < C_T_AST_MAX_2_CYL_BAL_AD_DC and *// 2.time intervall*
TCO_ST_BAL < C_TCO_ST_MAX_CYL_BAL_AD_DC and *// TCO_ST_MAX*
TCO_ST_BAL > C_TCO_ST_MIN_CYL_BAL_AD_DC *// TCO_ST_MIN*
]
OR
[// Stop Condition
T_AST_BAL < C_T_AST_MAX_CYL_BAL_AD_DC_STOP and *// max time*
T_ES_CUS < C_T_ES_MAX_CYL_BAL_HOM_REQ_INT and *// stop time*
TCO_ST_BAL < C_TCO_ST_MAX_ES_CYL_BAL_AD_DC and *// TCO_ST_MAX*
TCO_ST_BAL > C_TCO_ST_MIN_ES_CYL_BAL_AD_DC *// TCO_ST_MIN*
]]

THEN (1) *// DC adaptation requests controlled by fix time steps*

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```
        IF (2)          T_AST_BAL < ID_T_CYL_BAL_LAM_AD_DC    // time shape
        THEN (2)        LV_STATE_LAM_AD_DC_CHG_REQ = 1
                        LV_STATE_LAM_AD_DC_CHG_WAIT = 0
                        LV_T_STEP_CYL_BAL_LAM_AD_DC = 1
        ELSE (2)        LV_STATE_LAM_AD_DC_CHG_REQ = 0
                        LV_STATE_LAM_AD_DC_CHG_WAIT = 1
                        LV_T_STEP_CYL_BAL_LAM_AD_DC = 0
        ENDIF (2)
ELSE (1)        // DC adaptation requests for controlled by flexible time steps
        LV_T_STEP_CYL_BAL_LAM_AD_DC = 0
        IF (2)          T_CYL_BAL_LAM_AD_DC < C_T_MAX_CYL_BAL_LAM_AD_DC
        THEN (2)        T_CYL_BAL_LAM_AD_DC(n) = T_CYL_BAL_LAM_AD_DC(n-1) + 0.1[s]
                        // waiting time incrementation, flexible time steps running
                IF (3)          LV_CYL_BAL_LAM_AD_DC = 0
                THEN (3)        // enable conditions to change adaptation state from "Wait" to "Re-
quest"
                                LV_STATE_LAM_AD_DC_CHG_REQ = 1
                                LV_STATE_LAM_AD_DC_CHG_WAIT = 0
                ELSE (3)        // enable conditions to change adaptation state from "Request" to
"Wait"
                                LV_STATE_LAM_AD_DC_CHG_REQ = 0
                                LV_STATE_LAM_AD_DC_CHG_WAIT = 1
                ENDIF (3)
        ELSE (2)        // reset of waiting time, new beginning of flexible time steps
                T_CYL_BAL_LAM_AD_DC = 0.0[s]
                LV_CYL_BAL_LAM_AD_DC = 0
                FOR m = 0 to NC_CBK_EX_NR - 1
                        IF              C_CYL_BAL_LAM_AD_DC_CONF =  ADD  (0H)
                        THEN                    LV_CYL_BAL_LAM_AD_ADD_DC[m] = 0
                                        T_CYL_BAL_LAM_AD_ADD_DC[m] = 0.0[s]
                        ELSEIF                  C_CYL_BAL_LAM_AD_DC_CONF =  FAC_L  (1H)
                        THEN                    LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0
                                        T_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0.0[s]
                        ELSEIF                  C_CYL_BAL_LAM_AD_DC_CONF =  ADD_FAC_L
(2H)
                        THEN                    LV_CYL_BAL_LAM_AD_ADD_DC[m] = 0
                                        LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0
                                        T_CYL_BAL_LAM_AD_ADD_DC[m] = 0.0[s]
                                        T_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0.0[s]
                        EISEIF                  C_CYL_BAL_LAM_AD_DC_CONF =  ADD_FAC_
ALL  (3H)
                        THEN                    LV_CYL_BAL_LAM_AD_ADD_DC[m] = 0
                                        LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0
                                        LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = 0
                                        T_CYL_BAL_LAM_AD_ADD_DC[m] = 0.0[s]
                                        T_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0.0[s]
                                        T_CYL_BAL_LAM_AD_FAC_H_DC[m] = 0.0[s]
                        ENDIF
                END FOR
        ENDIF (2)
ENDIF (1)
```

Note: At function activation always State "Wait" is entered

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Cylinder balancing adaptation at DC: State 0[H] - Wait
Assignments at entry to state Wait :
STATE_CYL_BAL_LAM_AD_DC = "Wait" (0[**H**])
LV_CYL_BAL_LAM_AD_HOM_REQ_DC = 0

Action during state "Wait":
Transition to State 1[H] Request (Condition 1)
// Lambda Adaptation manager request for change of state
IF LV_STATE_LAM_AD_DC_CHG_REQ = 1

Assignments at exit from state Wait :
No assignments

Cylinder balancing adaptation at DC: State 1[H] - Request
Assignments at entry to state Request :
STATE_CYL_BAL_LAM_AD_DC = "Request" (1[**H**])

Action during state "Request":
Transition to State 0[H] Wait (Time out)
// Lambda Adaptation manager request for change of state
IF LV_STATE_LAM_AD_DC_CHG_WAIT = 1

Calculations:
// conditions for cylinder balancing global lambda adaptation achieved
FOR m = 0 to NC_CBK_EX_NR - 1
IF **([** STATE_LAM_AD[m] = "CDN_FAC_L" (2[**H**]) **or**
STATE_LAM_AD[m] = "ADAPT_FAC_L" (5[**H**]) **]** **and**
[LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = 0 **or**
LV_T_STEP_CYL_BAL_LAM_AD_DC = 1 **]** **)**
OR
([STATE_LAM_AD[m] = "CDN_FAC_H" (3[**H**]) **or**
STATE_LAM_AD[m] = "ADAPT_FAC_H" (6[**H**]) **]** **and**
[LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = 0 **or**
LV_T_STEP_CYL_BAL_LAM_AD_DC = 1 **]** **)**
OR
([STATE_LAM_AD[m] = "CDN_ADD" (4[**H**])]) **or**
STATE_LAM_AD[m] = "ADAPT_ADD" (7[**H**]) **]** **and**
[LV_CYL_BAL_LAM_AD_ADD_DC[m] = 0 **or**
LV_T_STEP_CYL_BAL_LAM_AD_DC = 1 **]** **)**
THEN T_CYL_BAL_LAM_AD_REQ_DC[m](n) =
T_CYL_BAL_LAM_AD_REQ_DC[m](n-1) + 0.1[s]
ELSE T_CYL_BAL_LAM_AD_REQ_DC[m](n) = 0.0[s]
ENDIF
END FOR
// calculation of request for bank specific homogenuous cobustion mode switch
FOR m = 0 to NC_CBK_EX_NR - 1
IF [T_CYL_BAL_LAM_AD_REQ_DC[m] ≥ C_T_MIN_CYL_BAL_AD_REQ_DC]
AND
[(
GEAR ≥ C_GEAR_MIN_CYL_BAL_AD_REQ_DC AND
VS ≥ C_VS_MIN_CYL_BAL_AD_REQ_DC
)

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OR
VS <= C_VS_MAX_CYL_BAL_AD_REQ_DC
]

THEN LV_CYL_BAL_LAM_AD_REQ_DC[m] = 1
ELSE LV_CYL_BAL_LAM_AD_REQ_DC[m] = 0
ENDIF
END FOR
// calculation of request flag for EVAC controller to allow activation of lambda adaptation

IF (1) $$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \mathrm{T\_CYL\_BAL\_LAM\_AD\_REQ\_DC[m]} > 0.0[s]$$

THEN (1) LV_CYL_BAL_LAM_AD_ENA_DC = 1
ELSE (1) LV_CYL_BAL_LAM_AD_ENA_DC = 0
ENDIF (1)
// calculation of request for homogenous combustion mode switch
IF (1) **(** LV_CYL_BAL_LAM_AD_ENA_DC = 1 **and**
LV_NT_RGN_REQ = 1 **and**
LV_LAM_AD_ENA = 1 **)**
OR
(LV_LAM_AD_ENA = 1 **and**

$$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \mathrm{LV\_CYL\_BAL\_LAM\_AD\_REQ\_DC[m]} > 0$$ **)**

OR
(LV_T_STEP_CYL_BAL_LAM_AD_DC = 1 **and**
LV_CYL_BAL_LAM_AD_ENA_DC = 1 **and**
LV_LAM_AD_ENA = 1 **)**
THEN (1) LV_CYL_BAL_LAM_AD_HOM_REQ_DC = 1
ENDIF (1)

Transition to State 2[H] Adaptation (Condition 2)
// conditions for combustion mode switch to homogenuous
IF LV_CYL_BAL_LAM_AD_HOM_REQ_DC = 1

Assignments at exit from state Request :
LV_CYL_BAL_LAM_AD_ENA_DC = 0
FOR m = 0 to NC_CBK_EX_NR - 1
LV_CYL_BAL_LAM_AD_REQ_DC[m] = 0
T_CYL_BAL_LAM_AD_REQ_DC[m] = 0
END FOR

Cylinder balancing adaptation at DC: State 2[H] - Adaptation
Assignments at entry to state Adaptation :
STATE_CYL_BAL_LAM_AD_DC = "Adaptation" (2[**H**])
T_CYL_BAL_LAM_AD_WAIT_DC = C_T_MIN_CYL_BAL_AD_WAIT_DC
FOR m = 0 to NC_CBK_EX_NR - 1
T_CYL_BAL_LAM_AD_REQ_DC[m] = C_T_MIN_CYL_BAL_AD_WAIT_DC
END FOR

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Actions during state "Adaptation":

Transition to State 0[H] Wait (Time out)

// Lambda Adaptation manager request for change of state

IF LV_STATE_LAM_AD_DC_CHG_WAIT = 1

Transition to State 1[H] Request (Condition 3)

// conditions for combustion mode switch to homogenuous or waste gate open not achieved

IF LV_CYL_BAL_LAM_AD_HOM_REQ_DC = 0 **or**
LV_LAM_AD_ENA = 0

Calculations:

// calculation of waiting time after entry in homogenuous combustion mode for non turbo engine

IF (1) T_CYL_BAL_LAM_AD_WAIT_DC = 0.0[s]
// waiting time after switch to homogenous combustion mode elapsed

THEN (1)
FOR (2) m = 0 to NC_CBK_EX_NR - 1
IF (3) **(** LV_MFF_ADD_RNG_LAM_AD[m] = 0 **and**
LV_FAC_L_RNG_LAM_AD[m] = 0 **and**
LV_FAC_H_RNG_LAM_AD[m] = 0 **)**
// neither low range, nor high range,nor add range lambda adaptation area active

THEN (3) T_CYL_BAL_LAM_AD_REQ_DC[m](n) =
T_CYL_BAL_LAM_AD_REQ_DC[m](n-1) - 0.1 [s]

ELSE (3) T_CYL_BAL_LAM_AD_REQ_DC[m](n) =
C_T_MIN_CYL_BAL_AD_WAIT_DC

ENDIF (3)

IF (3) T_CYL_BAL_LAM_AD_REQ_DC[m] = 0.0 [s]
// time with no lamba adaptation area active elapsed
OR
(LV_MFF_ADD_RNG_LAM_AD[m] = 1 **and**
LV_CYL_BAL_LAM_AD_ADD_DC[m] = 1 **)**
// additive range lambda adaptation active - adaptation result achieved
OR
(LV_FAC_L_RNG_LAM_AD[m] = 1 **and**
LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = 1 **)**
// low range lambda adaptation active - adaptation result achieved
OR
(LV_FAC_H_RNG_LAM_AD[m] = 1 **and**
LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = 1 **)**
// high range lambda adaptation active - adaptation result achieved

THEN (3) LV_CYL_BAL_LAM_AD_REQ_DC[m] = 0
// conditions for lambda adaptation no longer present

ELSE (3) LV_CYL_BAL_LAM_AD_REQ_DC[m] = 1
// conditions for lambda adaptation still present

ENDIF (3)

END FOR (2)

IF (2)
$$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} \mathrm{LV\_CYL\_BAL\_LAM\_AD\_REQ\_DC[m]} = 0$$

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// conditions for lambda adaptation no longer achieved for all exhaust banks

THEN (2) LV_CYL_BAL_LAM_AD_HOM_REQ_DC = 0
// reset of homogenous combustion mode request
ENDIF (2)
ELSE (1)
IF (2) LV_T_STEP_CYL_BAL_LAM_AD_DC = 0
THEN (2) T_CYL_BAL_LAM_AD_WAIT_DC(n) = T_CYL_BAL_LAM_AD_WAIT_DC(n-1) - 0.1[s]
// decrementation of waiting time after switch to homogenous combustion mode
ENDIF (2)
ENDIF (1)
// determination of learned lambda adaptation values
FOR m = 0 to NC_CBK_EX_NR - 1
IF (1) LV_CYL_BAL_LAM_AD_END[m] = 1
THEN (1)
LV_CYL_BAL_LAM_AD_END[m] = 0
IF (2a) STATE_CYL_BAL_LAM_AD[m] = "ADAPT_ADD" (7[**H**])
THEN (2a) LV_CYL_BAL_LAM_AD_ADD_DC[m] = 1
ELSEIF (2b) STATE_CYL_BAL_LAM_AD[m] = "ADAPT_FAC_L" (5[**H**])
THEN (2b) LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = 1
ELSEIF (2c) STATE_CYL_BAL_LAM_AD[m] = "ADAPT_FAC_H" (6[**H**])
THEN (2c) LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = 1
ENDIF (2)
ENDIF (1)
END FOR
// determination of minimum adaptation time reached for lambda adaptation areas
FOR m = 0 to NC_CBK_EX_NR - 1
IF (1a) LV_MFF_ADD_RNG_LAM_AD[m] = 1
THEN (1a)
IF (2a) T_CYL_BAL_LAM_AD_ADD_DC[m] $\geq$ C_T_MIN_CYL_BAL_LAM_AD_DC
// minimum adaptation time for lambda adaptation (add range) elapsed
THEN (2a) LV_CYL_BAL_LAM_AD_ADD_DC[m] = 1
ELSE (2a) T_CYL_BAL_LAM_AD_ADD_DC[m](n) =
T_CYL_BAL_LAM_AD_ADD_DC[m](n-1) + 0.1[s]
// incrementation of min. adaptation time for LAM_AD (add range)
ENDIF (2a)
ELSEIF (1b) LV_FAC_L_RNG_LAM_AD[m] = 1
THEN (1b)
IF (2b) T_CYL_BAL_LAM_AD_FAC_L_DC[m] $\geq$ C_T_MIN_CYL_BAL_LAM_AD_DC
// minimum adaptation time for lambda adaptation (fac low range) elapsed
THEN (2b) LV_CYL_BAL_LAM_AD_FAC_L_DC[m] = 1
ELSE (2b) T_CYL_BAL_LAM_AD_FAC_L_DC[m](n) =
T_CYL_BAL_LAM_AD_FAC_L_DC[m](n-1) + 0.1[s]
// incrementation of min. adaptation time for LAM_AD (fac low range)
ENDIF (2b)
ELSEIF (1c) LV_FAC_H_RNG_LAM_AD[m] = 1
THEN (1c)
IF (2c) T_CYL_BAL_LAM_AD_FAC_H_DC[m] $\geq$ C_T_MIN_CYL_BAL_LAM_AD_DC

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// minimum adaptation time for lambda adaptation (fac high range) elapsed
THEN (2c) LV_CYL_BAL_LAM_AD_FAC_H_DC[m] = 1
ELSE (2c) T_CYL_BAL_LAM_AD_FAC_H_DC[m](n) =
T_CYL_BAL_LAM_AD_FAC_H_DC[m](n-1) + 0.1[s]
// incrementation of min. adaptation time for LAM_AD (fac high range)
ENDIF (2c)
ENDIF (1)
END FOR
// calculation of lambda adaptation readiness at active driving cycle (global)

IF $$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_AD\_ADD\_DC[m] = NC\_CBK\_EX\_NR$$ **and**

$$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_AD\_FAC\_L\_DC[m] = NC\_CBK\_EX\_NR$$ **and**

$$\sum_{m=0}^{m=NC\_CBK\_EX\_NR-1} LV\_CYL\_BAL\_LAM\_AD\_FAC\_H\_DC[m] = NC\_CBK\_EX\_NR$$

THEN LV_CYL_BAL_LAM_AD_DC = 1
// adaptation values of all exhaust banks are within limits at active driving cycle
ENDIF

Assignments at exit from state Adaptation :
LV_CYL_BAL_LAM_AD_HOM_REQ_DC = 0
T_CYL_BAL_LAM_AD_WAIT_DC = 0.0[s]
FOR m = 0 to NC_CBK_EX_NR - 1
T_CYL_BAL_LAM_AD_REQ_DC[m] = 0.0 [s]
LV_CYL_BAL_LAM_AD_REQ_DC[m] = 0
END FOR

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9.48 Bit serial data component driver

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ALTER_COD_0	O/V	0... 7H	0 ...7	1	-
manufacturer identifier					
ALTER_COD_1	O/V	0... 1FH	0... 31	1	-
type identifier alternator					
ALTER_COD_2	O/V	0... 3H	0 ...3	1	-
controller version alternator					
ALTER_COD_3	O/V	0... FH	0... 15	1	-
chip version alternator					
B_OZFBSD	O/V	0... 1H	0 ...1	1	-
failure in oil-BSD-bevice					
BSD_SENS_BAT_SMT_ADR	O/V	0... FFH	0... 255	1	-
Actual register number					
BSD_SENS_BAT_SMT_INFO	O/V	0... FFH	0... 255	1	-
Content of register					
CTR_ALTER_EVE_WR	V	0... FFH	0... 255	1	-
eo-write counter					
CTR_BSD_CPT_COM_OK	-	0... FFH	0... 255	1	-
Number of "ok" communications between ECU and BSD devices per scheduling timing table list					
CTR_T_RD_PER_ALTER_TBL_2	-	0... FFH	0... 10.2	0.04	s
Time for reading register 2					
CTR_T_RD_PER_ALTER_TBL_5	-	0... FFH	0... 10.2	0.04	s
Time for reading register 5					
CTR_T_WR_PER_ALTER_TBL_0	-	0... FFH	0... 10.2	0.04	s
Time for write register 0					
CTR_T_WR_PER_ALTER_TBL_1	-	0... FFH	0... 10.2	0.04	s
Time for write register 1					
CUR_ALTER_EXCT	O/V	0... 3EH	0... 7.75	0.125	A
actual value exciting current alternator					
CUR_ALTER_EXCT_LIM	O/V	0... 1FH	0... 7.75	0.25	A
actual value exciting current limitation alternator					
CUR_CNS_CWP	O/V	0... FFH	0... 127.5	0.5	A
Register 4 (ewpi) /required current of the el. Water pump					
IDX_BSD_SDL_TBL	-	0... FFH	0... 255	1	-
Index of the timing scheduler for the BSD devices					
LF_ALTER_EVE_WR	V	0... FFH	0... 255	1	-
Logical field for eo-write operation					
LF_BSD_CPT_AVL	O/V	0... FFH	0... 255	1	-
Logical data field displaying the learnt and configured BSD devices					
LF_BSD_SENS_BAT_SMT_CTL	O/V	0... FFH	0... 255	1	-
Communication coordination byte (logical field)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LF_CWP_INFO_COD	O/V	0... FFH	0... 255	1	-
Register 5 Bit 5...7 <<5 /Supplier information (Pierburg /SiemensVDO)					
LF_POW_CWP_COD	O/V	0... FFH	0... 255	1	-
Register 5 Bit 0...4 /CWP power HW version (200W or 350/400W)					
LV_ALTER_BSD_PROT_2	O/V	0... 1H	0 ...1	1	-
condition for BSD protocol controller type 2					
LV_ALTER_COM_ACT	-	0... 1H	0 ...1	1	-
Flag indication communication on BSD to alternator disturbed					
LV_ALTER_ERR_EL	O/V	0... 1H	0 ...1	1	-
electrical fault alternator					
LV_ALTER_ERR_IF	O/V	0... 1H	0 ...1	1	-
Alternator interface failure.					
LV_ALTER_ERR_MEC	O/V	0... 1H	0 ...1	1	-
mechanical fault alternator					
LV_ALTER_ERR_TEMP	O/V	0... 1H	0 ...1	1	-
(excess) temperature fault alternator					
LV_ALTER_EVE_RD	O/V	0... 1H	0 ...1	1	-
condition: eo-read					
LV_ALTER_EVE_WR	O/V	0... 1H	0 ...1	1	-
condition: eo-write					
LV_ALTER_IF_ACT	O/V	0... 1H	0 ...1	1	-
condition alternator interface activ					
LV_CWP_BLOCK_DEAC	O/V	0... 1H	0 ...1	1	-
Register 6 Bit 7 (ewpdblk) /automatic de-blocking active					
LV_CWP_COM_ACT	-	0... 1H	0 ...1	1	-
Flag indication communication on BSD to coolant water pump disturbed					
LV_CWP_HW_LIH_IN_CHK	O/V	0... 1H	0 ...1	1	-
Register 6 Bit 2 /Supply voltage to CWP (HW PIN) connected correctly - LIH stategy in case of BSD com. error					
LV_CWP_LOCK	O/V	0... 1H	0 ...1	1	-
Register 6 Bit 4 (ewpblk1) /CWP blocked or requests a too high current					
LV_CWP_PRE_LOCK	O/V	0... 1H	0 ...1	1	-
Register 6 Bit 5 (ewptlf) /CWP running dry					
LV_CWP_TEMP_HIGH	O/V	0... 1H	0 ...1	1	-
Register 6 Bit 3 (ewpft) /over-temperature shut down					
LV_CWP_VCC_PLAUS	O/V	0... 1H	0 ...1	1	-
Register 6 Bit 6 (ewpfu) /voltage supply not in the correct range					
LV_EXC_CUR_ALTER_EXCT_LIM_SP	-	0... 1H	0 ...1	1	-
Indicates "B_chexc" condition					
LV_EXC_T_LOAD_RESP_ALTER_SP_0	-	0... 1H	0 ...1	1	-
Indicates "B_chtlrgen" condition					
LV_EXC_V_ALTER_SP	-	0... 1H	0 ...1	1	-
Indicates "B_chugen" condition					
LV_LOAD_RESP_ALTER_CND_1	O/V	0... 1H	0 ...1	1	-
alternator load response condition for register 1 activ					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LOAD_RESP_ALTER_THD_ACT	O/V	0... 1H	0 ...1	1	-
shut of the load response threshold for alternator (copy of SP)					
LV_N_MON_CWP_DEAC	O/V	0... 1H	0 ...1	1	-
Register 6 Bit 1 (ewpnoff) /no CWP speed monitoring active					
LV_QOIL_COM_ACT	-	0... 1H	0 ...1	1	-
Flag indication communication on BSD to oil quality sensor disturbed					
LV_REQ_GEN_RD_REG2	-	0... 1H	0 ...1	1	-
Request read register 2					
LV_REQ_GEN_RD_REG5	-	0... 1H	0 ...1	1	-
Request read register 5					
LV_REQ_GEN_WR_REG0	-	0... 1H	0 ...1	1	-
Request write register 0					
LV_REQ_GEN_WR_REG1	-	0... 1H	0 ...1	1	-
Request write register 1					
LV_REQ_GEN_WR_REG3	-	0... 1H	0 ...1	1	-
Request write register 3					
LV_SENS_BAT_SMT_ACT	O/V	0... 1H	0 ...1	1	-
Communication to IBS has been detected as alive					
LV_SENS_BAT_SMT_COM_ACT	-	0... 1H	0 ...1	1	-
Flag indication communication on BSD to intelligent battery sensor disturbed					
LV_SENS_BAT_SMT_DET	O/V/S	0... 1H	0 ...1	1	-
IBS has been detected					
LV_STEP_BSD_ALTER	-	0... 1H	0 ...1	1	-
Request action on "ablaufwr"					
N_REL_CWP	O/V	0... FFH	0... 255	1	-
Register 1 Bit 0 (ewpiwbsd) /actual rpm stage of the el. water pump					
NR_ALTER_EVE_WR	V	0... FFH	0... 255	1	-
Number of eo-write event					
ozleitr_w	O/V	0... FFFFH	0... 27	0.000412	-
ÖZS: oil sensor raw value of oil resitance					
oznivpr_w	O/V	0... FFFFH	0... 65535	1	-
ÖZS: oil sensor raw value of oil level calculated out of permitivity					
oznivr	O/V	0... FFH	0... 255	1	mm
signal oil level					
Ozoelkm	O/V	0... FFFFH	0... 655350	10	km
Ölkilometer					
ozpermr_w	O/V	0... FFFFH	0... 1024	1	-
signal oil quality					
OZSTATUS	O/V	0... FFH	0... 255	1	-
status of oil sensor					
OZTEMPR	O/V	0... FFH	0... 255	1	°C
signal oil temperature					
POW_REL_ALTER	O/V	0... 1FH	0... 96.875	3.125	%
Exitation of the alternator					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
POW_REL_ALTER_L_RES	O/V	0H 1H 2H 3H	DF<50% 50%<DF<75% 75%<DF<100% 100%	-	-
DF rough value (occupancy factor) from alternator					
STATE_ALTER_VALUE_WR	V	0... FFH	0... 255	1	-
State for selection of eo-write value					
STATE_BSD_COM	-	0... FFH	0... 255	1	-
Actual status of the communication between ECU and BSD devices					
STATE_BSD_CPT	-	0H 3H 4H 6H	SENS_BAT_ SMT CWP QOIL ALTER	-	-
Actually communicating BSD device					
T_FIL_CUR_EXCT_ALTER	O/V	0... FFH	0... 2.55	0.01	s
Calibratable filter time constant for exciting current of the alternator (Powermanagement)					
T_LOAD_RESP_ALTER	O/V	0... 3H	0... 15	0	s
actual value from alternator load response time					
TEMP_ALTER_MC	O/V	0... 1FH	-32 ...216	8	°C
chip temperature alternator					
TEMP_EL_CWP	O/V	0... FFH	-50 ...205	1	°C
electronic temperature coolant water pump /Register 3 (ewpt)					
V_ALTER	O/V	0... 3FH	10.6 ...16.9	0.1	V
received voltage alternator					
V_ALTER_NOM	O/V	0H 1H	14V 42V	-	-
Nominal voltage alternator /bord net version 14/42V					
V_CWP	O/V	0... FFH	0... 25.5	0.1	V
Register 2 (ewpu) /Supply voltage at el. Water pump					

Input data:

C_CTR_MAX_ALTER_COM_STOP {p. 4835}	C_CTR_MAX_CWP_COM_STOP {p. 4835}	C_CTR_MAX_QOIL_COM_STOP {p. 4835}	C_CTR_MAX_SENS_BAT_SMT_COM_STOP {p. 4835}
C_T_WR_PER_ALTER_TBL_0 {p. 4097}	C_T_WR_PER_ALTER_TBL_1 {p. 4097}	CTR_ABC_SENS_BAT_SMT_COM {p. 4832}	CTR_MSG_SENS_BAT_SMT_COM_DIAG {p. 4832}
CUR_ALTER_EXCT_LIM {p. 4093}	ECU_STATE {p. 1091}	LV_ERR_ALTER_COM {p. 4834}	LV_ERR_BSD {p. 4834}
LV_ERR_CWP_COM {p. 4834}	LV_ERR_QOIL_COM {p. 4834}	LV_ERR_SENS_BAT_SMT_COM {p. 4834}	LV_IGK {p. 906}
LV_LOAD_RESP_ALTER_THD_ACT_SP {p. 8368}	LV_VAR_BN {p. 655}	LV_VAR_VEH {p. 656}	N_REL_CWP_SP {p. 8225}

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POW_REL_ALTER_CLC {p. 8368}	STATE_BSD_MSG_COM_STOP {p. 4834}	T_LOAD_RESP_ALTER {p. 4096}	V_ALTER {p. 4096}
VB {p. 1185}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_BSD_CPT_DET	-	0... FFH	0... 255	1	-
Number of required consecutive positive acknowledges to get a component learnt					
C_STATE_BSD_CPT_AVL	-	0... FFH	0... 255	1	-
Actual used BSD devices (bit coded! 1 = used)					
C_STATE_BSD_CPT_DET	-	0... FFH	0... 255	1	-
BSD devices, which are set by default (bit coded! 1 = not to be learnt)					
C_T_FIL_CUR_EXCT_ALTER	-	0... FFH	0... 2.55	0.01	s
calibratible filter time for exciting current (alternator powermanagement)					
C_T_RD_PER_ALTER_TBL_2	-	0... FFH	0... 10.2	0.04	s
calibratible time period for reading register 2 (alternator powermanagement)					
C_T_RD_PER_ALTER_TBL_5	-	0... FFH	0... 10.2	0.04	s
calibratible time period for reading register 5 (alternator powermanagement)					
C_T_WR_PER_ALTER_TBL_0	-	0... FFH	0... 10.2	0.04	s
calibratible time period for write register 0 (alternator powermanagement)					
C_T_WR_PER_ALTER_TBL_1	-	0... FFH	0... 10.2	0.04	s
calibratible time period for write register 0 (alternator powermanagement)					
C_VB_MIN_BSD_DIAG	-	0... FFH	0... 25.89843	0.1015625	V
Battery Voltage threshold of power management diagnosis					
ID_NR_ALTER_EVE_WR	-	0... 7H	0 ...7	1	-
LDP_IDX_LF_ALTER_EVE_WR	32	0... 7FH	0... 127	1	-
Map for selection of eo-write event					
ID_STATE_ALTER_VALUE_WR	-	0... 3H	0 ...3	1	-
LDP_IDX_NR_ALTER_EVE_WR	8	0... 7H	0 ...7	1	-
LDP_IDX_CTR_ALTER_EVE_WR	3	0... 2H	0 ...2	1	-
Map for selection of eo-write value					
ID_STATE_BSD_SDL_TBL	-	0... FFH	0... 255	1	-
LDP_IDX_BSD_SDL_TBL	32	0... FFH	0... 255	1	-
BSD component device scheduling timing table					
LC_ALTER_BSD_PROT_2	-	0... 1H	0 ...1	1	-
logical constant: software swich to choose BSD protocol					
LC_POW_CORD_INH	-	0... 1H	0 ...1	1	-
Configuration switch of alternator powermanagement					
S_RDGENTYP	-	0... FFH	0... 255	1	-
Switch of generatur identify					

Import actions:

ACTION_COMS_SetBsdGlobalCom (**IN**<CTR_BSD_CPT_COM_OK>)
ACTION_COMS_SetBsdSingleCom (**IN**<STATE_BSD_CPT>,**IN**<STATE_BSD_COM>)

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9.48.1 BSD-Drivers

9.48.1.1 Device-detection algorithm

FUNCTION DESCRIPTION:

General information:

There is an algorithm installed to detect the single component devices connected to the ECU via BSD. At every ECU reset the learning algorithm is started and for each possible device it is checked whether the device is available or not. In case the consecutive positive acknowledges of the device reach the calibratabel threshold C_CTR_BSD_CPT_DET the corresponding device has been learnt. Once a device has been detected it is assumed that it is installed for ever and for this specific device the learning algorithm is deactivated. To realise this the flag indicating whether a device is learnt or not is stored in the NVMY. The learnt devices can solely be deleted via tester tool. They can be read via KWP job. Alternator, QLT and electronically controlled water pump are assumed to be there in every case, resulting in a fulltime activation of the corresponding device drivers. In addition each device can be set by a SW constant as to be available (C_STATE_BSD_CPT_AVL) and if the available devices should be leart or not (C_STATE_BSD_CPT_DET) (set as loc. True!)

Description:

The following bit-coding is applied to the calibration constants C_STATE_BSD_CPT_AVL, C_STATE_BSD_CPT_DET and the status byte LF_BSD_CPT_AVL (set as loc. True!)
The logical data field LF_BSD_CPT_AVL displays the configured and learnt BSD components. In case there is a mismatch between C_STATE_BSD_CPT_AVL and LF_BSD_CPT_AVL obviously a problem occurred in the BSD components learning session. The by the constant C_STATE_BSD_CPT_DET configured BSD components are directly set in the logical data field LF_BSD_CPT_AVL. The BSD components which have to be learnt are set after the learning process has been finished. In case the BSD component has been successfully learnt the corresponding bit is set to 1 in the logical data field LF_BSD_CPT_AVL. Otherwise the corresponding device bit stays 0.
.

Bit position	BSD device
0	SENS_BAT_SMT -- Intelligent battery sensor (IBS)
1	-- O3 Sensor
2	-- el. waterpump electronics
3	CWP -- electrical coolant water pump
4	QOIL - oil quality sensor (QLT)
5	-- alternator 2
6	ALTER - alternator
7	-- glow plug control unit

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Application conditions

Initialisation: *all variables are initialised out of NVMY*

Recurrence: *once after LV_IGK = 1*

Activation: *LV_IGK = 1*

Deactivation: *LV_IGK = 0*

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Formula section:

If KT_IBS_VAR = 1 (ASW, BSW Interface)
Then LV_SENS_BAT_SMT_DET = 1
Else LV_SENS_BAT_SMT_DET = 0
Endif

If LV_SENS_BAT_SMT_DET = 0
Then Device-detection algorithm for IBS is activated
Else Device-detection algorithm for IBS is deactivated
Endif

If LV_SENS_BAT_SMT_DET = 1 /*IBS learnt in this or in any former driving cycle*/
Then Component driver for IBS is activated
Else Component driver for IBS is deactivated
Endif

Signal flow diagram:

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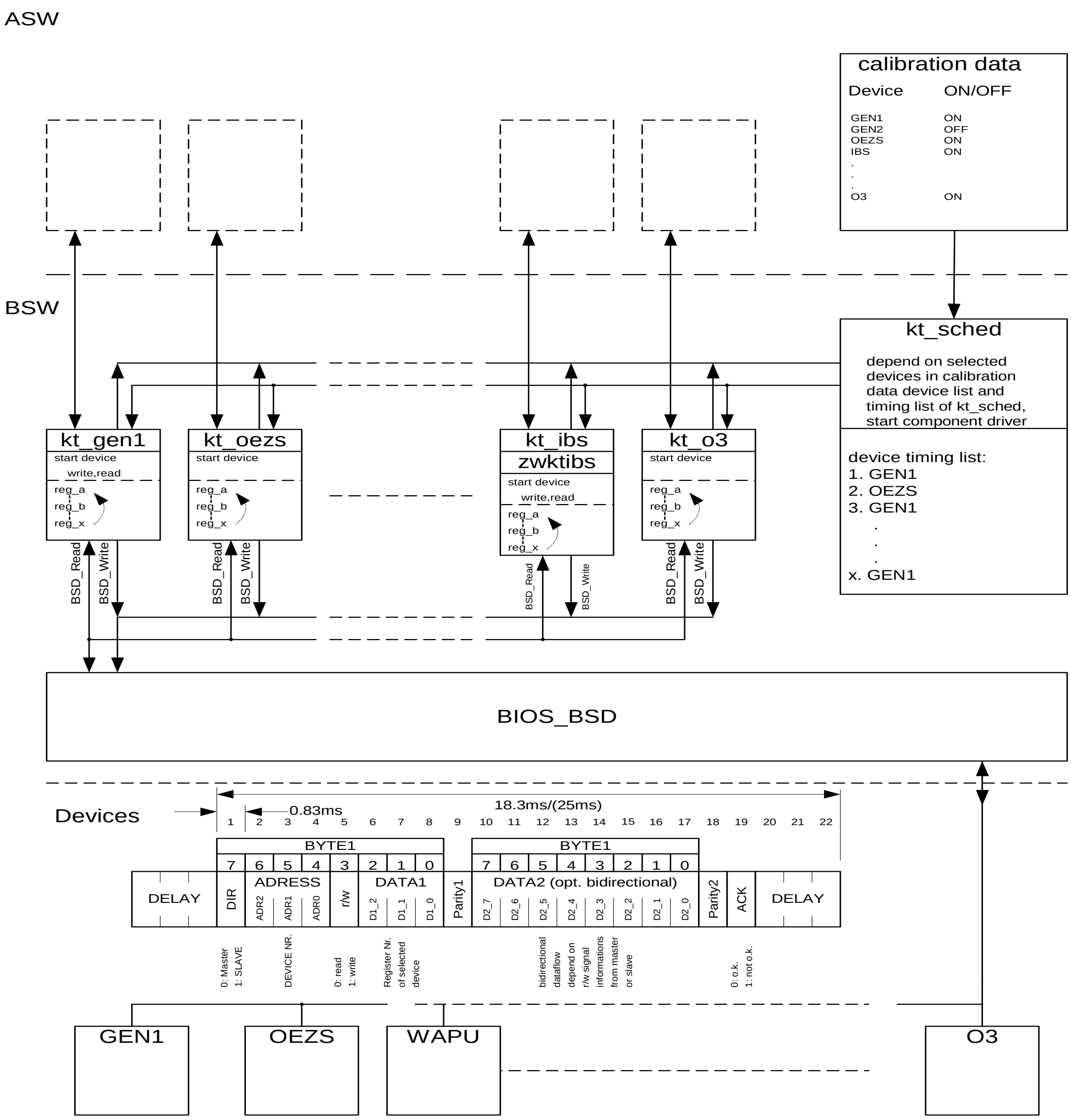

9.48.1.2 BSD-Timing coordinaton and BSD timing table

Description for actions:

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ACTION_COMS_*SetBsdGlobalCom* (<CTR_BSD_CPT_COM_OK>)					
Action which delivers at the end of the BSD timing table the status of the communication of all BSD devices of the list; number of successful communications for one scheduling timing list cycle					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
CTR_BSD_CPT_COM_OK	IN	0...FFH	0...255	1	-
Number of the 'ok' communications per total scheduling timing list cycle of the BSD devices					
ACTION_COMS_*SetBsdSingleCom* (<STATE_BSD_CPT>,<STATE_BSD_COM>)					
Action which delivers at the end of the BSD timing slot the status of the communication of the actual BSD device of the scheduling list					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
STATE_BSD_CPT	IN	0...FFH	0...255	1	-
BSD device, which communicates actually with the ECU via BSD					
STATE_BSD_COM	IN	0...FFH	0...255	1	-
Status of the communication to the BSD devices (faulty /o.k.)					

FUNCTION DESCRIPTION:

General information:

The BSD timing coordinator handles the scheduling of the device drivers. The 8 possible component devices (bit 0...3) can be configured in the table ID_STATE_BSD_SDL_TBL. In addition the configuration can be configered for 3 different states (Engine running (bit 4), power latch (bit 5), wake up (bit3)). The table configures the scheduling of the BSD devices. The end of the scheduling table is marked by FFH.

For each BSD device the status of the communication is checked. In case of no acknowledge of the device the flags LV_CWP_COM_ACT, LV_ALTER_COM_ACT, LV_QOIL_COM_ACT, LV_SENS_BAT_SMT_COM_ACT are set at the end of the timing slot and the action ACTION_COMS_*SetBsdSingleCom (*IN <STATE_BSD_CPT>, IN <STATE_BSD_COM>) is called.

The action feeds the diagnosis of the individual BSD devices in term of the detection of a communication error.

After the detection of faulty communication in a certain timing slot the next corresponding timing slot is served with a 22 synchronisation pulse phase followed by a none acknoledge!

Unter certain circumstances the communication to a device can be stopped (LV_MSG_xxx_COM_STOP) although the time slot is still reserved for this device. The staus byte STATE_BSD_MSG_COM_STOP communicates the information via to the BSD timing coordinator to which BSD component a timout is applied. Background: it is assumed that after a disturbed communication to a device has been detected a break in the communication could cure the problem.

Before the BSD device scheduling timing table is started again (IDX_BSD_SDL_TBL =0) the flags LV_xxx_COM_ACT have to be reset to 0. In case no acknowledge is set through the whole BSD timing table, the flags LV_xxx_COM_ACT are still =0 at the end of the timing table, so therefore the global BSD error can be fed with this information. For each positive acknowledge per timing slot the counter CTR_BSD_CPT_COM_OK is incremented by 1. CTR_BSD_CPT_COM_OK equal to 0 indicates a global BSD communication error. At the end of the list IDX_BSD_SDL_TBL(ID_STATE_BSD_SDL_TBL = FFH) the action ACTION_COMS_*SetBsdGlobalCom*(<CTR_BSD_CPT_COM_OK>) is called and the global BSD error can be debounced by the ERRM.

The communication to the devices is monitored by the BSW.

The error symptom detection is made out of basic software information BIOS_BSD_xx.

If a problem is detected the corresponding malfunction of the communication between the ECU and the BSD device is indicated by the corresponding flag LV_xxx_COM_ACT.

With xxx: ALTER - alternator
CWP - electrical coolant water pump
QOIL - oil quality sensor (QLT)
SENS_BAT_SMT - intelligent battery sensor (IBS)

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Description:

The driver of a certain device is only called if the device has been learnt. Some BSD device drivers are not called (writing only!) if the message to be written has not changed. So if it is not necessary for the device driver to send (e.g. if the values did not change), this is reported to the timing coordinator. The timing coordinator can then pass on this time slot to the next BSD device in the scheduling timing table.

Design of the scheduling timing table of the BSD devices:

ID_STATE_BSD_SDL_TBL

IDX_BSD_SDL_TBL	Bit 7 not used	Bit 6 not used	Bit 5 'wake up' ECU_STATE = 6H	Bit 4 'engine running' ECU_STATE = 0H v	Bit 3 'power latch' ECU_STATE = 4H	Bit 2	Bit 1	Bit 0	
0	0	0	0	1	0	1	1	0	e.g. Alternator ***SetBsdSingleCom***
1	0	0	1	1	0	0	0	0	e.g. Battery sensor ***SetBsdSingleCom***
2	0	0	1	1	1	0	1	1	e.g. Coolant water pump ***SetBsdSingleCom***
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	
17	1	1	1	1	1	1	1	1	FFH - End of table; goto begin of table ***SetBsdGlobalCom***
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	
30	0	0	0	0	0	0	0	0	
31	0	0	0	0	0	0	0	0	

The BSD device   is coded in Bit 0...2.

Application conditions

Initialisation: `0at WakeUp`
Recurrence: `20ms (optional 25ms in MS-)`

Activation: `WakeUp`

Deactivation: `Sleeping`

Formula section:

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Handling of the single /global BSD com error /counter CTR_BSD_CPT_COM_OK:

If IDX_BSD_SDL_TBL < IDX_BSD_SDL_TBL(ID_STATE_BSD_SDL_TBL = FFH)
//Pointer of the BSD timing coordinator is between the starting point of the scheduling timing table
and the end of the Scheduling timing table//

Then
If LV_MSG_xxx_COM_STOP = 0 (STATE_BSD_MSG_COM_STOP)
Then **If** ECU receives no positive acknowledge from slave device
Then LV_xxx_COM_ACT = 0 **and**
Send a 22 sychronisation pulse phase
in next corresponding time slot followed by
LV_xxx_COM_ACT == 0
Else LV_xxx_COM_ACT = 1
Endif
If LV_xxx_COM_ACT = 1
With: xxx - corresponding to the actual time slot device
Then CTR_BSD_CPT_COM_OK ++
Endif
// the end of the timing table is not reached-transmit single message error status//
Call ACTION_COMS_*SetBsdSingleCom* (IN <STATE_BSD_CPT>, IN <STATE_BSD_COM>)
IDX_BSD_SDL_TBL++
Else stop communication to device xxx in the corresponding time slot
STATE_BSD_COM = FFH
Call ACTION_COMS_*SetBsdSingleCom* (IN <STATE_BSD_CPT>, IN <STATE_BSD_COM>)
IDX_BSD_SDL_TBL++

Endif

//Counter is reset to 0 at the end of the Scheduling timing table after the action has been called//
// the end of the timing table is reached-transmit global BSD error status//
Else Call ACTION_COMS_*SetBsdGlobalCom*(IN <CTR_BSD_CPT_COM_ACT>) CTR_BSD_CPT_COM_OK = 0 // reset communication counter//*
IDX_BSD_SDL_TBL = 0 // re-started BSD timing table//*
LV_CWP_COM_ACT = 0 // Table is re-started ; reset communication flags//*
LV_ALTER_COM_ACT = 0
LV_QOIL_COM_ACT = 0
LV_SENS_BAT_SMT_COM_ACT = 0
Endif

Control of the communication after an communication error has been detected:

If C_CTR_MAX_xxx_COM_STOP <> FFFFH **and**
LV_ERR_xxx_COM = 1
Then stop communication with this device for this DC (LV_IGK 1- ->0)
Else communication with the corresponding device to be continued

With:
STATE_BSD_CPT = STATE_BSD_SDL_TBL(bit0...2)
STATE_BSD_COM = LV_xxx_COM_ACT

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STATE_BSD_MSG_COM_STOP = LV_MSG_xxx_COM_STOP

STATE_BSD_CPT	STATE_BSD_COM
0H --SENS_BAT_SMT-intelligent battery sensor	1H = LV_SENS_BAT_SMT_COM_ACT=0
3H -- CWP- electrical coolant water pump	8H = LV_CWP_COM_ACT = 0
4H - QOIL - oil quality sensor (QLT)	10H = LV_QOIL_COM_ACT = 0
6H -- ALTER - alternator	40H = LV_ALTER_COM_ACT = 0

Figure 9.48.1: STATE_BSD_CPT

STATE_BSD_CPT	STATE_BSD_MSG_COM_STOP
0H --SENS_BAT_SMT-intelligent battery sensor	1H = LV_MSG_SENS_BAT_SMT_COM_STOP=1
3H -- CWP- electrical coolant water pump	8H = LV_MSG_CWP_COM_STOP = 1
4H - QOIL - oil quality sensor (QLT)	10H = LV_MSG_QOIL_COM_STOP = 1
6H -- ALTER - alternator	40H = LV_MSG_ALTER_COM_STOP = 1

9.48.1.3 Component driver

FUNCTION DESCRIPTION:

General information:

Basics that should be implemented in a device driver:

Description:

To be translated:

Wenn Werte geschrieben werden sollen, soll abgeprüft werden ob der Wert gleich dem zuletzt gesendeten Wert ist. Ist dieses der Fall, kann die Funktion für diesen Buszyklus wieder verlassen werden.
Diese Funktionalität dient dazu, die Busbelastung niedrig zu halten.
Der nächste Teilnehmer laut Timing-Liste kann dann diesen Zeitslot nutzen.

Nach dem Lernprozess wird das angeschlossene Gerät vom BSD-Timing-Koordinator als vorhanden markiert. Jetzt wird die eigentliche BSD-Kommunikation mit dem ausgewähltem Gerät gestartet. Dabei läuft innerhalb des Komponententreibers wiederum ein Schreib-Lese-Koordinator, welcher in seiner Abfolge frei definiert werden kann. Getaktet wird dieser Vorgang durch den Aufruf des BSD-Timing-Koordinators.

Application conditions

Recurrence: `wird durch BSD-Timingcoordinator generiert`

Activation: `WakeUp`

Deactivation: `Sleeping`

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9.48.2 Component Driver for BSD-alternator

9.48.2.1 Identification of the controller type

FUNCTION DESCRIPTION:

This function allows to identify the controller type of the alternator that is installed and to choose the communication protocol via code word. Possible controller types:

General information:

BSD-controller II measures and limits the exciting current. Additional a detection of the chip temperature. It provides information about the actual alternator torque for a torque model. The communication of the BSD-controller type I is different to the BSD-controller type II. In the first phase BSD-controller type I or type II can be installed. At init., register 7 provides information about controller- and chip version and the nominal voltage. Address 6 communicates with type I and type II. Later on a mix of type I and type II assembly is impossible.

Description:

Detection of the controller type (Register 7, Bit 6/7):

Type	ALTER_COD_2
BSD-controller I	00
BSD-controller II	01

Choosing the communication protocol via code word:

Type	LC_ALTER_BSD_PROT_2
BSD-controller I	0
BSD-controller II	1

Combinations and possible BSD protocol:

ALTER_COD_2	LC_ALTER_BSD_PROT_2	LV_ALTER_BSD_PROT_2
00	0	0
00	1	0
01	0	0
01	1	1

Conditions to be choose by software switch:

sw-switch / codeword	condition	meaning	BMW naming
LC_ALTER_BSD_PROT_2	LV_ALTER_BSD_PTOT_2	BSD-prot 1 or 2	CW_GENPROT

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9.48.2.2 BSD controller I

Id. for address 0x06 (BSD component driver controller typ I)

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Part: electr. alternator, electronic: address: 6

Remark: address 6 must communicate with type I and type II (depending of the detection what type is installed).

Specification only for BSD-controller type I !!

Id	Parameter	LS Bit	Bit Anz.	w(rite) r(ead)	unit	function
0	V_ALTER_SP	0	6	r/w	V	Alternator voltage / without control XX00 0000 = 10,6V limited XX11 0110 = 16,0V XX11 1111 = 16,0V
	T_LOAD_RESP_ALTER_SP	6	2	r/w	s	Load Response (LR) 00XX XXXX = 0s 01XX XXXX = 3s 10XX XXXX = 6s 11XX XXXX = 9s
1	--	--	--		--	not used
2	POW_REL_ALTER	0	5	-/r	%	DF-monitor XXX0 0000 = 0% capacity XXX1 1111 = 96,875% capacity
	LV_ALTER_ERR_EL	5	1	-/r	-	electrical alternator error XX0X XXXX = no error XX1X XXXX = error present
	LV_ALTER_ERR_MEC	6	1	-/r		mec. Alternator error X0XX XXXX = no error X1XX XXXX = error present
	LV_ALTER_ERR_TEMP	7	1	-/r	-	High temperature protection 0XXX XXXX = no error 1XXX XXXX = error present
3	--	--	--		--	not used
4	--	--	--		--	not used
5	--	--	--		--	not used
6	ALTER_COD_0	5	3	-/r	-	manufacturer ID 000X XXXX = Bosch 001X XXXX = Valeo
	ALTER_COD_1	0	5	-/r	-	alternator type coding XXX0 0000
7	ALTER_COD_2	6	2	-/r	-	BSD-controller version 00XX XXXX = BSD1 01XX XXXX = BSD2
	V_ALTER_NOM	4	2	-/r	V	nominal voltage alternator controller XX01 XXXX = 14V
	ALTER_COD_3	0	4	-/r	-	Chip-version BSD controller (Index) XXXX 0000 = 0 XXXX 1111 = 15

Formula section:

If LC_ALTER_BSD_PROT_2 = 1 And
ALTER_COD_2 = 1
Then LV_ALTER_BSD_PROT_2 = 1
Else LV_ALTER_BSD_PROT_2 = 0
Endif

IF (BSD status is ok, BSD device send an answer to alternator)
Then LV_ALTER_ERR_IF = 0

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Else LV_ALTER_ERR_IF = 1 (communication BSD device alternator was incorrect)
Endif
If LV_ALTER_EVE_WR Or
LV_ALTER_EVE_RD = 1
Then T_FIL_CUR_EXCT_ALTER = C_T_FIL_CUR_EXCT_ALTER * 2
Endif

FUNCTION DESCRIPTION:

General information:

V_ALTER_SP will be limited to the upper threshold 16.0 V. After that it will be provided to the BSW for the BSD interface.
T_LOAD_RESP_ALTER will be converted to 3 s resolution, limited between 0 and 9 seconds and provided to the BSW for the BSD interface as well.
ALTER_COD_1 delivers the type of alternator
ALTER_COD_0 delivers the manufactory of alternator
This both information is necessary to identify the alternator. Depending on this information the power management is able to switch different calibrations.

Application conditions:
Activation: at every engine operating state
Deactivation: -
Initialization: all outputs 0 (LV_GEN_xx = FALSE)
ALTER_COD_1 = 1F H /*initalisation to max value*/
ALTER_COD_0 = 7 H /*initalisation to max value*/

Update-Rate: 50 ms

Formula section:

if no valid message was received during a timeout : T_LOAD_RESP_ALTER = 3 s
V_ALTER = 14.3 V
else : POW_REL_ALTER_CLC, T_LOAD_RESP_ALTER and V_ALTER are received via BSD interface.

The failure-bits LV_GEN_xxare received via BSD interface.

9.48.2.3 BSD controller II

Id. for address 0x06 (BSD component driver controller typ II)
Part: electr. alternator, electronic: address:6
Remark: Specification only for BSD-controller type II !!

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Id	Parameter	LS Bit	Bit Anz.	w(rite) r(ead)	unit	function
0	V_ALTER_SP	0	6	r/w	V	Alternator voltage / without control XX00 0000 = 10,6V limited XX11 0110 = 16,0V XX11 1111 = 16,0V
1	LV_LOAD_RESP_ALTER_THD_ACT_SP	0	1	r/w	-	Shut of speed threshold (s.o.s.t.) for LR-function. at 0 more than approx. 3000 alternator revolutions 0 = s.o.s.t. akt. (def.) 1 = s.o.s.t. deactivated
	LV_LOAD_RESP_ALTER_CND_1	4	1	r/w	-	condition LR register 1 aktiv 0 = LR in reg. 0 act. (def.) 1 = LR in reg. 1 activ
	T_LOAD_RESP_ALTER_SP	5	3	r/w	s	LR- value 000X XXXX = 0s 001X XXXX = 0,2s 010X XXXX = 0,4s 011X XXXX = 3s 100X XXXX = 6s 101X XXXX = 9s 110X XXXX = 12s 111X XXXX = 15s
2	POW_REL_ALTER	0	5	r/-	%	DF-monitor XXX0 0000 = 0% capacity XXX1 1111 = 96,875% capacity
	LV_ALTER_ERR_EL	5	1	r/-	-	electrical alternator error XX0X XXXX = no error XX1X XXXX = error present
	LV_ALTER_ERR_MEC	6	1	r/-		mec. Alternator error X0XX XXXX = no error X1XX XXXX = error present
	LV_ALTER_ERR_TEMP	7	1	r/-	-	High temperature protection 0XXX XXXX = no error 1XXX XXXX = error present
3	CUR_ALTER_EXCT	0	6	r/-	A	read exciting current step 125mA XX00 0000 = 0A XX11 1110 = 7,75A XX11 1111 = 7,75A
	CUR_ALTER_EXCT_LIM_SP	1	5	-/w	A	exciting current limit. XX00 0000 = no limitation up to XX00 0010 = lim. to act. value up to XX00 0100 = lim. to 2A up to XX01 0000 = lim. to 2A up to XX01 0010 = lim. to 2,25A up to XX11 1110 = lim. to 7,75A

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	POW_REL_ALTER_L_RES	6	2	r/-	%	DF-rough value 00XX XXXX = DF< 50% 01XX XXXX = 50% <DF< 75% 10XX XXXX = 75% <DF< 100% 11XX XXXX = 100%
4	--	--	--		--	--
5	TEMP_ALTER_MC	1	5	r/-	°C	Chiptemperature XX00 000(0) = < -32°C Up to XX10 111(0) = ≤ 152°C XX11 001(0) = > 152°C (Bit 0=1/0 depending on Gen type. no info. about temp.)
6	ALTER_COD_0	5	3	r/-	-	manufacturer ID 000X XXXX = Bosch 001X XXXX = Valeo
	ALTER_COD_1	0	5	r/-	-	alternator type coding XXX0 0000
7	ALTER_COD_2	6	2	r/-	-	BSD-controller version 00XX XXXX = BSD1 01XX XXXX = BSD2
	V_ALTER_NOM	4	2	r/-	V	nominal voltage alternator controller (bord net version 14/42V) XX00 XXXX = 14V XX01 XXXX = 42V
	ALTER_COD_3	0	4	r/-	-	Chip-version BSD controller (Index) XXXX 0000 = 0 XXXX 1111 = 15

I

FUNCTION DESCRIPTION:

General information:

LF_ALTER_EVE_WR is a status flag, which is generated by comparison of the variables CUR_ALTER_EXCT_LIM, T_LOAD_RESP_ALTER, V_ALTER and the corresponding setpoints.
NR_ALTER_EVE_WR is the output of the map **ID_NR_ALTER_EVE_WR** and describes the number of the eo-write event. In case of equality of LF_ALTER_EVE_WR and the datapoint of ID_NR_ALTER_EVE_WR one of 8 possible write events is selected, otherwise the output of ID_NR_ALTER_EVE_WR is 0.
CTR_ALTER_EVE_WR is the counter for the eo-write event process.
STATE_ALTER_VALUE_WR is the output of the map **ID_STATE_ALTER_VALUE_WR** and selects dependant on CTR_ALTER_EVE_WR and NR_ALTER_EVE_WR the next value to write on the bus.

9.48.2.3.1 Additional information for the BSD controller II protocol.

Writing only after a value has changed (after events) therefore comparison of value and reference value (for example Tlrgen -> Tlrfgen).

register 1:
Tlrgen (LR-value) should be round down to the next value of tn. For more details see 1.2.3.5 table writing reg 1. When writing the LR-value then the bit B_lrreg1ak = 1.

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Writing of the set points to the alternator register 0 only in a defined time schedule (depending on C_T_WR_PER_ALTER_TBL_0)

register 2:

Reading of the values only in a defined time schedule (depending on C_T_RD_PER_ALTER_TBL_2).

register 3:

Read of register 3 as often as possible without eo-communication (defined in the flow chart 1.2.3.2). Minimum every second time slot = read register 3. At successfully communication the variable lerrfgrenz is written.

register 5:

Reading of the values only in a defined time schedule (depending on C_T_RD_PER_ALTER_TBL_5)

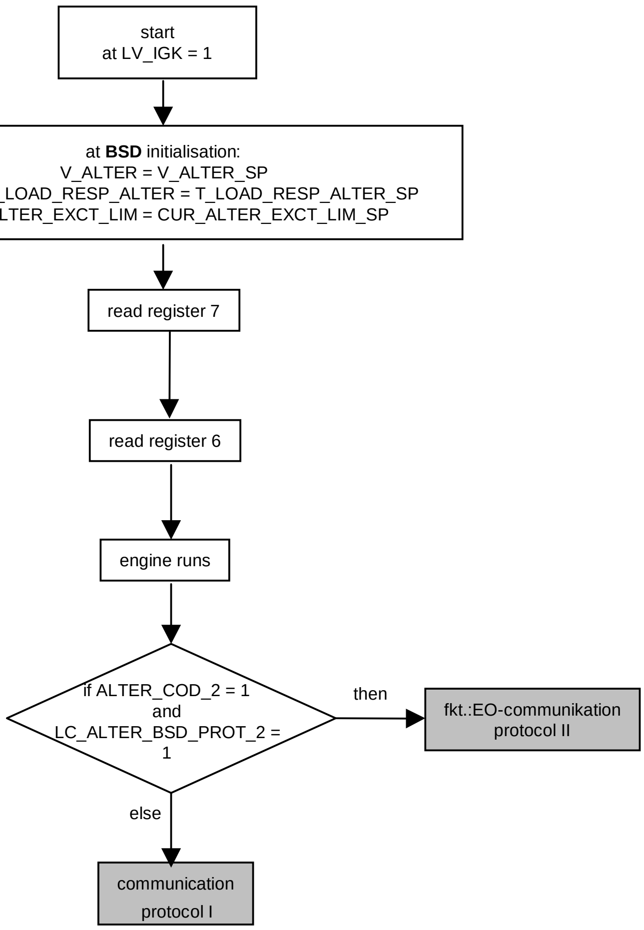
register 6:

Reading once at start communication BSD

register 7:

Reading once at start communication BSD

General flowchart KT_Gen BSD controller II



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9.48.2.3.2 Flow chart for function EO-communication BSD controller II

Superior function KT_Sched (time scheduler)

only for example, content of time slots not describe the software !!!

20 ms	20 ms	20 ms	20 ms	20 ms	20 ms	20 ms	20 ms	20 ms	20 ms	20 ms
alter- nator	battery sensor	electr. cwp	QLT	alter- nator	battery sensor	electr. cwp	QLT	alter- nator	battery sensor	....

By a time scheduler every 20 ms a new communication is triggered. During this time one register can be in progress (sending a protocol and call a driver). If KT_Gen is triggered, then the progress shown below is started.

Subordinated function EO communication KT_GEN

Application conditions

Initialisation: *only if LV_ALTER_BSD_PROT_2 = 1*

Recurrence: *40 ms*

Activation: *at every engine state*

Deactivation: –

Following flow charts are only a functional description of EO-communication BSD controller II.
Due to the fact, that it is not possible to do action on BSD immediately for the requested device (for e.g. Generator), the requested jobs has to be stored in circular buffer (FIFO).

In case of GEN slot is carry out the jobs in the buffer will be executed according the FIFO principle.

In case of "V_ALTER_SP (U_gen)" goes to 10,6V, immediately write of REG 0 and delete all other Jobs in the queue.

In case of "wrablauf > 0", immediately execute function "ablaufwr" and delete all other Jobs in the queue. New entries can be done after the last requested job from "ablaufwr" was executed.

Was a deleting of the queue performed and there are still jobs for reading Reg. 2 or Reg. 5 in the buffer, the jobs are lost.
Due to the fact, there is no positive response for reading Reg.2 or Reg.5, therefore set the timers for Reg.2 and Reg.5 again.

The recurrence of calculation "Generator BSD Controller II function" (40ms) could be higher than the BSD-Driver execute the Generator components (best case 20ms, worst case more than 40ms).
To avoid multiple entries for the same job in the buffer (because there was no update yet), the job entry in the buffer is locked till this job was performed by the BSD Driver.

The locking of the Register will be indicated with following flags:

- LV_REQ_GEN_WR_REG0
- LV_REQ_GEN_WR_REG 1
- LV_REQ_GEN_WR_REG 3
- LV_REQ_GEN_RD_REG 2

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- LV_REQ_GEN_RD_REG 5
- LV_STEP_BSD_ALTER

the corresponding flags will be set to "0" after job has been perfomed.

Following locks in the buffer could be possible:

wrablauf = 0
Lock requested writing Reg. 0, 1, 3 till this job is done.
wrablauf > 0
Immediately execute function "ablaufwr", writing all jobs that are defined in ID_STATE_ALTER_VALUE_WR and lock new entry in the queue.

Lock reading Reg. 2 or Reg. 5 till reading was successfully executed.

In case of C_T_WR_PER_ALTER_TBL_0 /1 are set to "0" not time triggert write to REG 0 /1 will be executed, only event triggert action can be perfomed.

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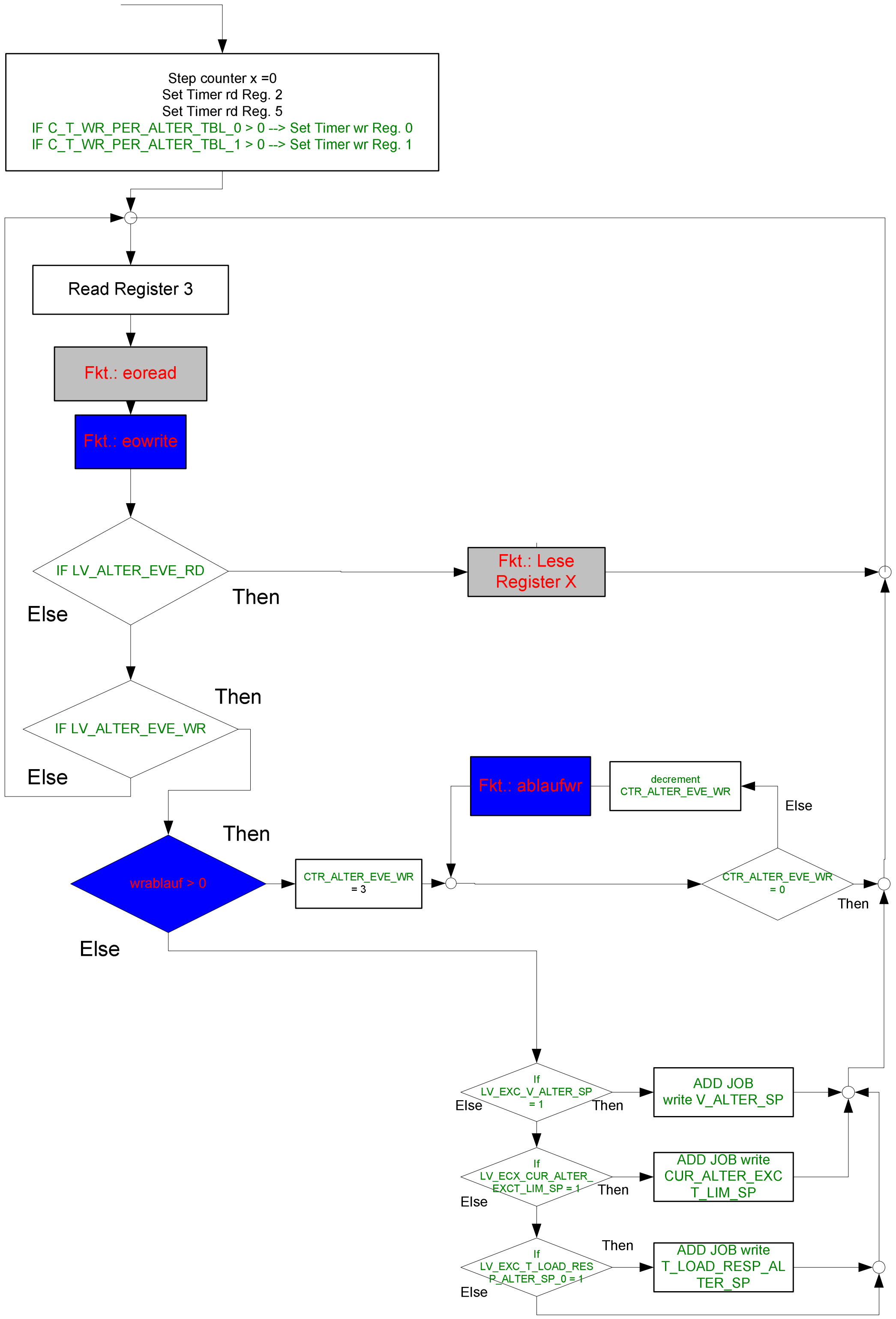
Fkt.: EO-Kommunikation



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9.48.2.3.3 Flow chart for the function eowrite

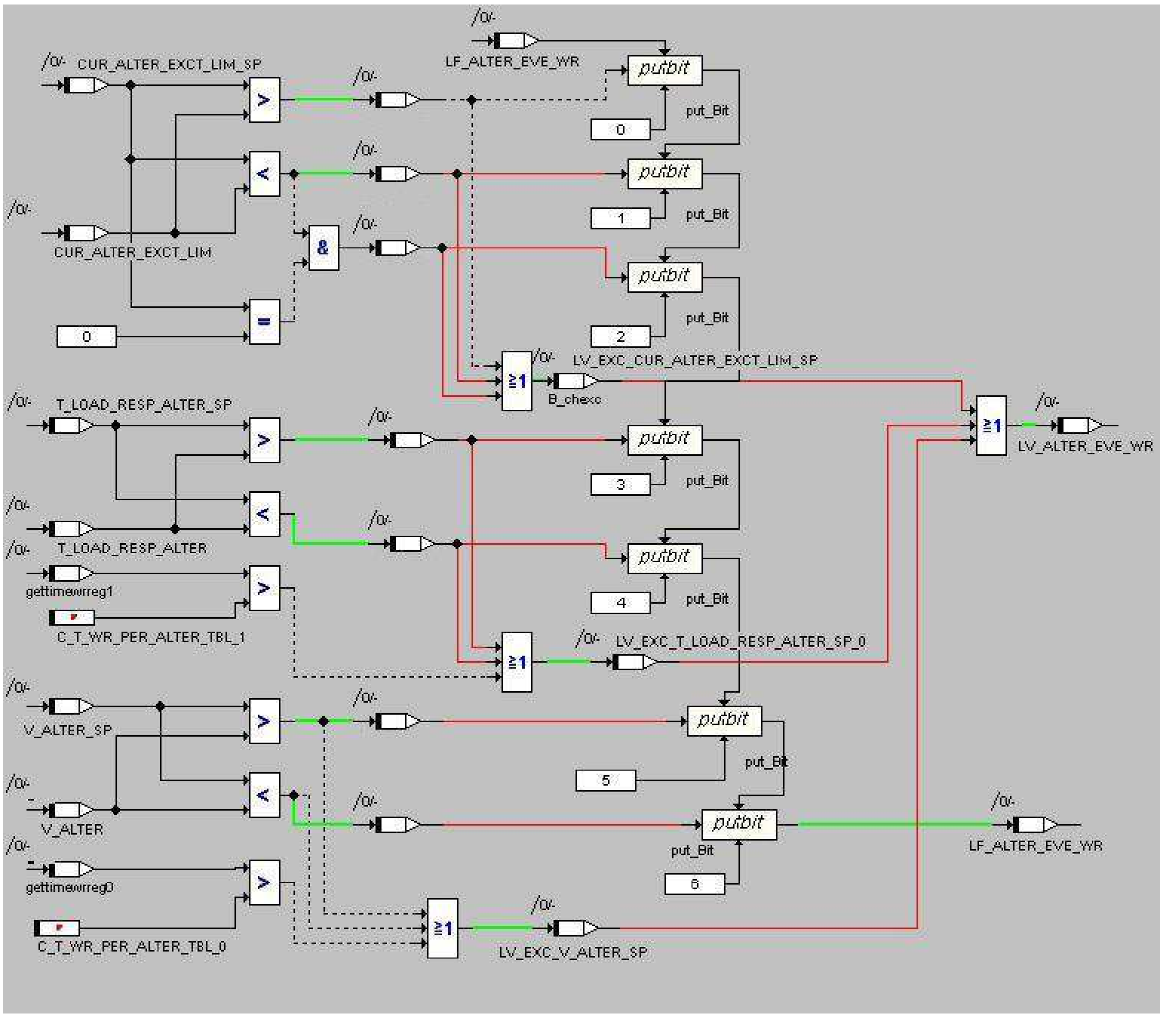
Application conditions

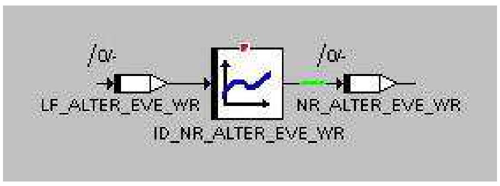
Initialisation: only if LV_ALTER_BSD_PROT_2 = 1

Recurrence: 40 ms

Activation: at every engine state

Deactivation: –





9.48.2.3.4 Flow chart for the function eoread

Application conditions

Initialisation: only if LV_ALTER_BSD_PROT_2 = 1

Recurrence: 40 ms

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Activation: `at every engine state`

Deactivation: –

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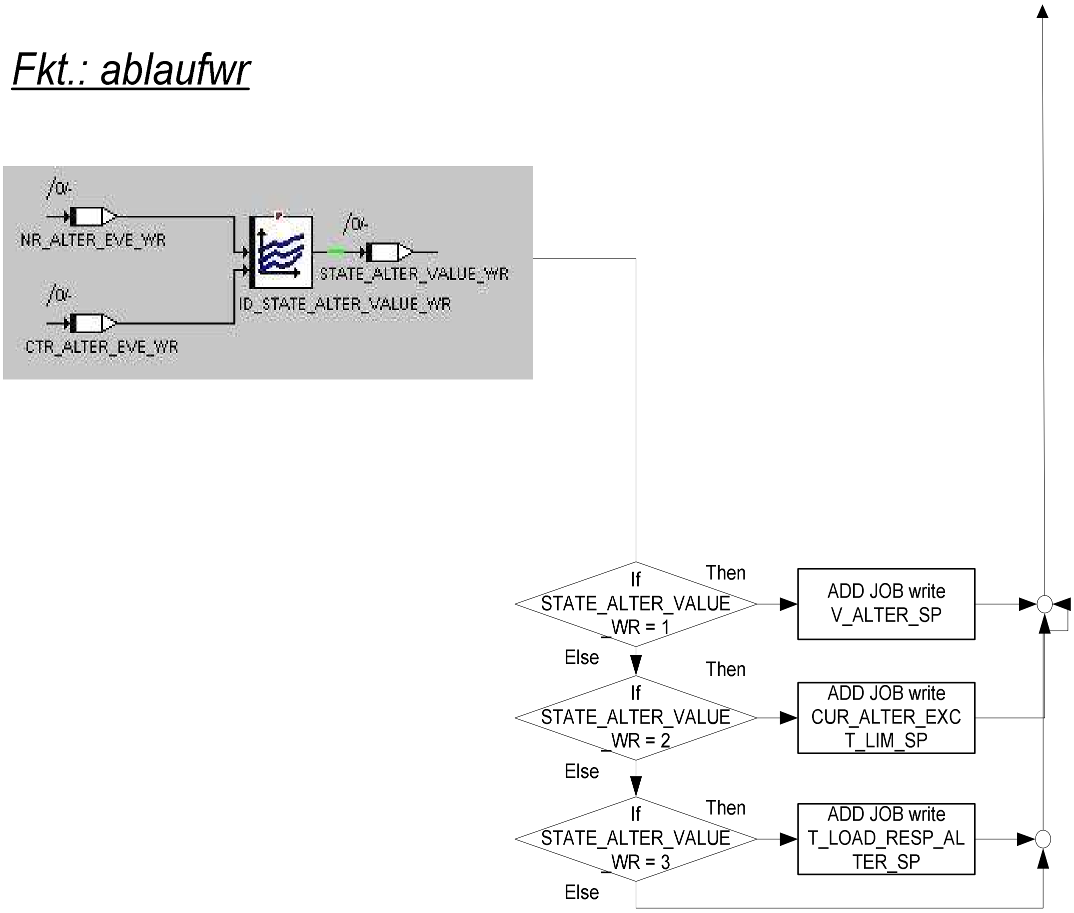
9.48.2.3.5 Flow charts for the functions ablaufwr /LR-write /read reg.x /calculation of the filter time

Fkt.: ablaufwr



Fkt.: LR-write

The translation table for the fkt.: LR-write are shown in the AGGR-Spec PWSL!!

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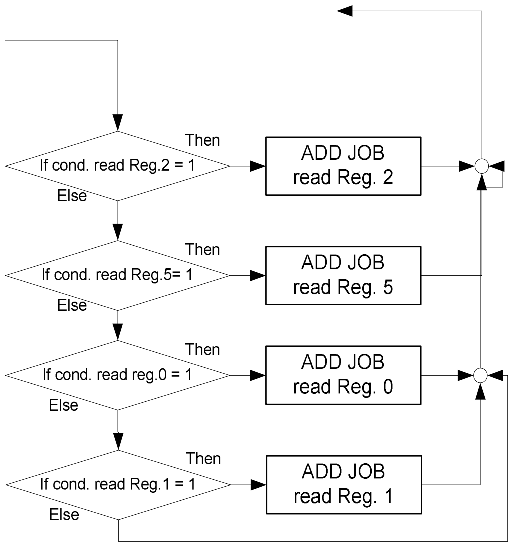
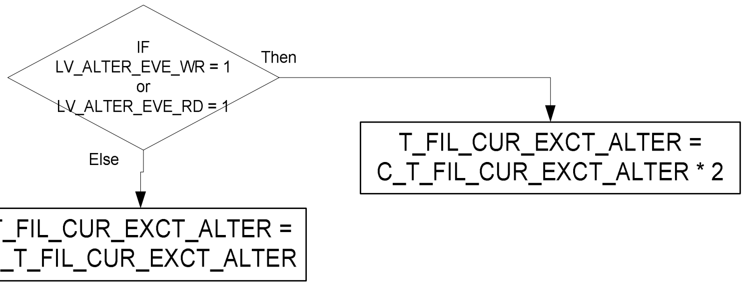
Fkt.: read register X



Fkt.: calculation of the filter time



9.48.2.4 State machine Component Driver for BSD-alternator Type I

FUNCTION DESCRIPTION:

General information:

Der Komponententreiber wird durch einen Zustandsautomaten der im Aufrufraster des BSD-Timing-Koordinator läuft dargestellt. Wie der **Abbildung 1-1** zu entnehmen ist besteht der KT aus mehreren Zuständen die im folgenden näher beschrieben werden.

Signal flow diagram:

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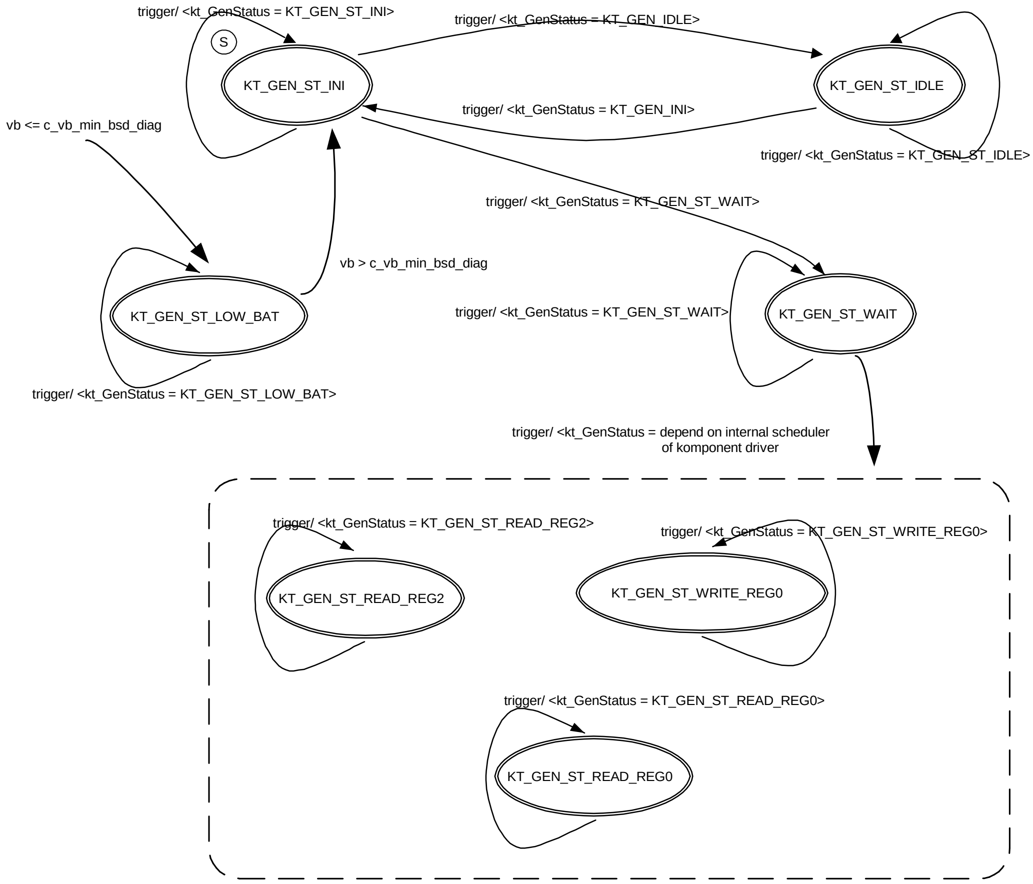

Abbildung 1-1: Statemachine KT-Treiber Generator

Description:

A) Allgemeiner Zustand:

In jedem Zustand des KT werden folgende Fehler geprüft:

Überschreitet der ***timeout counter for valid message*** die Schwelle **KT_GEN_VALID_MESSAGE_ TIMEOUT** so wird die Größe **V_ALTER** auf den Applikationswert **UGENTYP** (13.8V entspricht den Notlaufwert des Generators) bzw. die Größe **T_LOAD_RESP_ALTER** auf den Applikatonswert **TL-RDEFAULT** (0x1E entspricht den Notlaufwert des Generators) gesetzt ansonsten wird der ***timeout counter for valid message*** inkrementiert (bei gültigen Daten wird dieser durch die Call_Back-Function zurückgesetzt).

Anschließend wird geprüft ob das Generatorinterface aktiv ist d.h. Bedingung ***B_genactiv*** = True, wenn ja wird der ***timeout send counter*** und der ***timeout read counter*** inkrementiert (bei gültigen Daten wird dieser durch die jeweilige Call_Back-Function zurückgesetzt).

Desweiteren wird im jedem Zustand geprüft ob der ***timeout send counter*** die Schwelle **KT_GEN_ SEND_TIMEOUT** bzw. der ***timeout read counter*** die Schwelle **KT_GEN_SEND_TIMEOUT** überschritten hat. Wurde einer dieser Schwellen überschritten geht der KT in den Zustand *kt_GenStatus = KT_GEN_ST_INI* über .

B) Zustand KT_GEN_ST_INI:

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Zu Beginn wird der KT initialisiert d.h.
V_ALTER = 0;
T_LOAD_RESP_ALTER = 0;
LV_GEN_ERR_EL = FALSE;
LV_GEN_ERR_TEMP = FALSE;
LV_GEN_ERR_MEC = FALSE;
LV_GEN_IF_OFF = FALSE;
POW_REL_ALTER_CLC = 0;

und andere diverse Größen wie Fehlerzähler usw..

Nach der Initialisierung befindet sich der KT im Zustand *kt_GenStatus = KT_GEN_ST_INI*. In diesem Zustand wird zyklisch ein ***initialization timeout counter*** hochgezählt und dem Hardwaretreiber (HWT) Initialisierungsdaten übergeben und anschließend der HWT gestartet. Als Initialisierungsdaten werden dem HWT folgende Größen übergeben:

period length
low_time Sync pulse
low_time of sended LOW Bit
low_time of sended HIGH Bit
pointer to callback function for read register when result is ready
pointer to callback function for send register when quit from peripherie is OK
pointer to error handler

Wie oben zu sehen ist, werden dem HWT unter anderem zwei Pointer für die Call-Back-Funktion übergeben genaueres hierzu folgt etwas später.

Nun wird der ***initialization timeout counter*** inkrementiert. Anschließend wird geprüft ob der ***initialization timeout counter*** die Initialisierungsschwelle **KT_GEN_INI_TIMEOUT** überschritten hat, wenn ja geht der KT in dem Zustand *kt_GenStatus = KT_GEN_ST_IDLE* über und der ***initialization timeout counter*** wird zurückgesetzt.

Nachdem der HWT gestartet worden ist, geht der KT in dem Zustand *kt_GenStatus = KT_GEN_ST_WAIT* über.

C) Zustand KT_GEN_ST_WAIT:

In diesem Zustand wird gewartet bis der HWT den Status work mitteilt. Hier muß durch den BSD-Timing-Koordinator angezeigt werden ob sich der Treiber noch im Lernmodus befindet . Ist dieser Lernprozess abgeschlossen wird der ***initialization timeout counter*** , ***timeout counter send message*** und der ***timeout counter read message*** zurückgesetzt und die Bedingung ***B_genactiv*** auf True gesetzt (generator interface is active). Anschließend geht der KT in den Status über welcher vom internen Schreib-Lese-Koordinator vorgegeben wird.

D) Zustand KT_GEN_ST_IDLE:

Befindet sich der KT im Zustand *kt_GenStatus = KT_GEN_ST_IDLE* wird dem HWT ein ausschalten des generator interface mitgeteilt, d.h. die Kommunikation auf der BSD-Schnittstelle bzgl. Generator wird eingestellt. Anschließend wird gewartet bis der HWT ein generator interface off mitteilt.
Nachdem vom HWT ein generator interface off mitgeteilt wurde wird die Bedingung ***B_genactiv*** auf False gesetzt, die Bedingung ***LV_GEN_IF_OFF*** auf True gesetzt und in diesem Zustand verharrt. Die Bedingung ***LV_GEN_IF_OFF*** wird nur oberhalb einer Batterie Spannungsschwelle VB >=C_VB_MIN_POW_DIAG aktiviert.

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E) Zustand KT_GEN_ST_WRITE_REG0:
Die Generatorsollspannung ***V_ALTER_SP*** zwischen den beiden Applikationswerten **UGMN** und **UGMX** begrenzt. Ist ***V_ALTER_SP*** kleiner gleich **UGMN** wird als Generatorsollspannung der Applikationswert **OUINIGEN** verwendet.

Nach einer Umquantisierung des Sollwerts Load- Response- Zeit Generator ***T_LOAD_RESP_ALTER_SP*** wird diese zwischen den beiden Applikationswerten **TLRMN** und **TLRMX** begrenzt.

Anschließend wird dem HWT über einen Funktionsaufruf die Generatorsollspannung ***V_ALTER_SP*** und der Sollwert der Load-Response-Zeit ***T_LOAD_RESP_ALTER_SP*** mitgeteilt. Wurden diese Werte vom HWT über die BSD-Schnittstelle gesendet, wird die Call-Back-Funktion *KT_gen_sendErgHandler* über einen Pointer aufgerufen.

Nachdem die Werte dem HWT übergeben worden sind, geht der KT in den nächsten angeforderten Zustand *kt_GenStatus* über.

F) Zustand KT_GEN_ST_READ_REG0:
Es werden HWT Daten von der BSD-Schnittstelle bzw. vom Generator durch einen Funktionsaufruf des HWT mit gültiger Generatoradressse angefordert.

Liegen Daten vom BSD-Generator dem HWT vor, so ruft der HWT durch einen Pointer die Call-Back-Funktion *KT_gen_readErgHandler* auf.
Nachdem die Werte durch den HWT übernommen worden sind, geht der KT in den nächsten angeforderten Zustand *kt_GenStatus* über.

G) Zustand KT_GEN_ST_READ_REG2:
Es werden HWT Daten von der BSD-Schnittstelle bzw. vom Generator durch einen Funktionsaufruf des HWT mit gültiger Generatoradressse angefordert.

Liegen Daten vom BSD-Generator dem HWT vor, so ruft der HWT durch einen Pointer die Call-Back-Funktion *KT_gen_readErgHandler* auf.

Nachdem die Werte durch den HWT übernommen worden sind, geht der KT in den nächsten angeforderten Zustand *kt_GenStatus* über.

H) Call-Back-Funktion KT_gen_sendErgHandler:
Wie bereits im Kapitel erwähnt, wird bei einer erfolgreichen Übertragung der Generatorsollspannung ***V_ALTER_SP*** bzw. des Sollwerts Load- Response- Zeit ***T_LOAD_RESP_ALTER_SP*** durch den HWT die Call-Back-Funktion *KT_gen_sendErgHandler* über einen Pointer durch den HWT aufgerufen.

In dieser Call-Back-Funktion wird der ***timeout counter for valid message*** sowie der ***timeout send counter*** zurückgesetzt.
I) Call-Back-Funktion KT_gen_readErgHandler:
Liegen Daten vom BSD-Generator dem HWT vor, so ruft der HWT durch einen Pointer die Call-Back-Funktion *KT_gen_readErgHandler* and the flag LV_ALTER_ERR_IF is reset.

In dieser Call-Back-Funktion wird zunächst der ***timeout counter for valid message*** sowie der ***timeout read counter*** zurückgesetzt. Anschließend werden die vom HWT übergebenen Daten ausgewertet bzw. nach einer entsprechenden Umquantisierung abgespeichert.

J) Fehler-Handler-Funktion KT_gen_errHandler:

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Erkennt der HWT Fehler auf der BSD-Schnitstelle, geht der KT in den Zustand *kt_GenStatus = KT_GEN_ST_INI* über and the flag LV_ALTER_ERR_IF is set.

9.48.3 Component Driver (Interface) for Intelligent Battery Sensor IBS - %ZWK-TIBS 1.20

FUNCTION DESCRIPTION:

Beschreibung der Schnittstelle HW-Treiber - Komponententreiber für die Verbindung IBS - DME

General information:

Der intelligente Batteriesensor bietet eine Reihe unterschiedlicher Einsatzmöglichkeiten und wird darum auf längere Sicht Gegenstand der Entwicklung sein. Dabei ist abzusehen, dass bei den unterschiedlichen Nutzungen auch wechselnde Variablen, Parameter und sonstige Datenstrukturen von und zum Sensor übertragen werden müssen. Es ist daher sinnvoll, in der Kommunikation zwischen Host und Sensor eine invariante Schnittstelle zu definieren, die die variablen Schichten des Komponententreibers und der Anwendersoftware vom Hardwaretreiber trennt, der nur einmal implementiert wird.

Description:

A) Realisierung Schnittstelle

Zum Datenaustausch in beiden Richtungen werden 3 Variable vom Typ unsigned char verwendet.: BSD_SENS_BAT_SMT_INFO, BSD_SENS_BAT_SMT_ADR und LF_BSD_SENS_BAT_SMT_CTL. Sie sind im Modul des Hardwaretreibers global vereinbart.

BSD_SENS_BAT_SMT_INFO überträgt den Inhalt eines der acht BSD Register.

BSD_SENS_BAT_SMT_ADR (0 .. 7) adressiert das gewünschte Register.

LF_BSD_SENS_BAT_SMT_CTL enthält 7 Flags, die als Anforderung, Quittung, Fehlermeldung etc. die Kommunikation zwischen Komponententreiber (KT) und Hardwaretreiber (HT) koordinieren.

Um eine möglichst schnelle Übertragung zu erreichen, müssen der KT und der HT nacheinander in dieser Reihenfolge von der gleichen zyklischen Task aufgerufen werden.

B) Flags zur Kommunikation Hardware-/Komponententreiber, in LF_BSD_SENS_BAT_SMT_CTL

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Name	*Bit*	*gesetzt durch*	*gelöscht durch*	*Bedeutung*
BSDHTOK LV_SENS_BAT_SMT_BSD_DR_OK	0	HT	HT	Hardware Treiber ist bereit zur Übertragung; Flag bleibt an solange kein Fehlerzustand
BSDWRITE LV_SENS_BAT_SMT_BSD_WR	1	KT	KT	Richtung, hi: Register im Sensor schreiben
BSDDO LV_SENS_BAT_SMT_BSD_RUN	2	KT	HT	Anforderung von Komponenten- an Hardwaretreiber zum Start einer Übertragung
BSDBSY LV_SENS_BAT_SMT_BSD_WORK	3	HT	HT	Übertragung aktiv, Hardwaretreiber busy; Flag wird z.Zt. vom KT nicht benutzt
BSDRXRDY LV_SENS_BAT_SMT_BSD_TRM_END_AVL	4	HT	KT	Übertragung beendet, eingelesenes Byte ist verfügbar; Flag von Handler () im HT gesetzt
BSDTXOK LV_SENS_BAT_SMT_BSD_TRM_END_OK	5	HT	KT	Übertragung beendet, Byte wurde erfolgreich gesendet; Flag von Handler () im HT gesetzt
BSDERR LV_SENS_BAT_SMT_BSD_ERR_IT	7	HT	HT	BSD Fehler

Nur die fett gedruckten Flags werden für die laufende Kommunikation zwischen Komponenten- und Hardwaretreiber benötigt.

C) Ablauf der Übertragung eines BSD Telegramms

1. Nach KL15 an löscht die Hardwaretreiber- Initialisierung alle Flags in LF_BSD_SENS_BAT_SMT_CTL.
2. Der Hardwaretreiber baut die Verbindung zur Schnittstellen- Hardware auf. Nach erfolgreicher Verbindung und bei Funktionsbereitschaft setzt der HT das Flag LV_SENS_BAT_SMT_BSD_DR_OK.
3. Ist ausschließlich das Bit LV_SENS_BAT_SMT_BSD_DR_OK in LF_BSD_SENS_BAT_SMT_CTL gesetzt, interpretiert der KT dies als Startbedingung und setzt seine zyklische Kommunikation zum Sensor auf.
4. Der Komponententreiber prüft LV_SENS_BAT_SMT_BSD_DR_OK vor jeder Aktion. Ist der HT bereit, wird das gewünschte Register in BsdReg adressiert. Bei Schreiboperationen wird das Bit LV_SENS_BAT_SMT_BSD_WR und das Datenbyte BSD_SENS_BAT_SMT_INFO belegt. Der KT setzt das Bit LV_SENS_BAT_SMT_BSD_RUN.
5. Der Hardwaretreiber erkennt an LV_SENS_BAT_SMT_BSD_RUN die Anforderung zur Übertragung. Soll gesendet werden, übermittelt er das Datenbyte an die Hardware und startet die Sendung zum gewünschten Register, andernfalls veranlasst er den Empfang eines Bytes aus dem Sensor. Der HT löscht dann die Anforderung LV_SENS_BAT_SMT_BSD_RUN und setzt statt dessen das Flag LV_SENS_BAT_SMT_BSD_WORK.
6. Das Ende einer Übertragung wird je nach Implementierung durch schnelles Polling oder per Interrupt festgestellt, der HT enthält eine entsprechende Handler Routine. Diese löscht LV_SENS_BAT_SMT_BSD_WORK, kopiert nach einem Lesevorgang das eingelesene Byte nach BSD_SENS_BAT_SMT_INFO und setzt das Flag LV_SENS_BAT_SMT_BSD_TRM_END_AVL

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zum Zeichen, dass der Komponententreiber ein empfangenes Byte auslesen kann. Nach einem erfolgreichen Schreibvorgang wird nur das Flag LV_SENS_BAT_SMT_BSD_TRM_END_OK gesetzt.

7. Der Komponententreiber liest LV_SENS_BAT_SMT_BSD_TRM_END_AVL bzw. LV_SENS_BAT_SMT_BSD_TRM_END_OK und löscht diese Flags, nachdem er ggf. das eingelesene Byte übernommen hat. Nach einem erneuten Test auf LV_SENS_BAT_SMT_BSD_DR_OK kann die nächste Übertragung durch Setzen von LV_SENS_BAT_SMT_BSD_RUN gestartet werden, s. 4).

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Bemerkungen:
Das Flag LV_SENS_BAT_SMT_BSD_WORK wird z.Zt. nur HT- intern verwendet, der KT greift nicht darauf zurück.
Bei interruptgesteuerten Handler Routinen muss die Möglichkeit einer Unterbrechung von HT oder KT durch den Interrupt berücksichtigt werden. Im Komponententreiber wird darum eine lokale Kopie von LF_BSD_SENS_BAT_SMT_CTL verwendet.

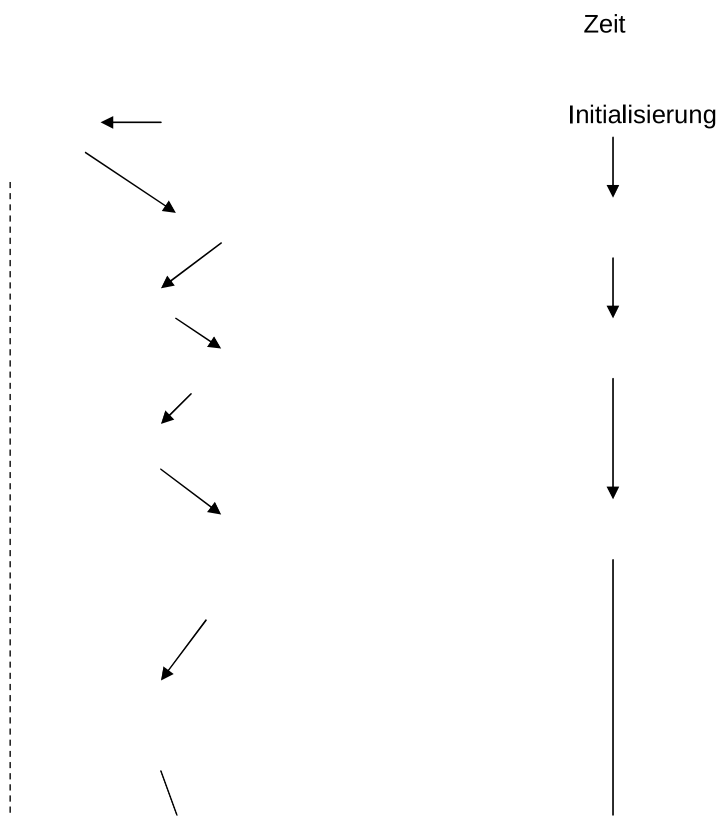
D) Fehlerbehandlung durch den HT

Wenn der Hardwaretreiber initial die Verbindung nicht herstellen kann oder wenn zwischenzeitlich die Verbindung abreisst, wird das Flag LV_SENS_BAT_SMT_BSD_DR_OK nicht gesetzt bzw. gelöscht.
In der Folge werden laufend neue Versuche zur Verbindung unternommen. Ist nach Ablauf einer entsprechenden Wartezeit Ibs_Ht_TimeOut keine Verbindung zustande gekommen, wird das Flag LV_SENS_BAT_SMT_BSD_ERR_IT gesetzt und alle anderen Flags gelöscht.
Der HT nimmt anschliessend einen Idle- Zustand ein, aus dem er nach der Zeit Ibs_Ht_IdleTime erwacht und wieder für Ibs_Ht_TimeOut weitere Initialisierungen versucht. Bei Erfolg kann wieder LV_SENS_BAT_SMT_BSD_DR_OK gesetzt und alle anderen Flags gelöscht werden, andernfalls bleibt die Fehlermeldung stehen.

Ibs_Ht_TimeOut: 20 Lese/ Schreibversuche

Ibs_Ht_IdleTime: applizierbar, vorbelegt 100s

E) Schema Flagaustausch zwischen Komponenten- und Hardwaretreiber



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Application conditions

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Activation: if **LC_POW_CORD_INH = 0** and
LV_VAR_BN = 1 and
LV_VAR_VEH = 0

Deactivation: –

Update rate: 100ms

Formula section:

Setting of LV_SENS_BAT_SMT_ACT:
if ReadyStatus from BSD-interface
then LV_SENS_BAT_SMT_ACT = 1
endif

Re-setting of LV_SENS_BAT_SMT_ACT:
if BSD-control-flag IBS_BSD = 1
then LV_SENS_BAT_SMT_ACT = 0
endif

Control of error interface across the BMW Layer for the PWSL OBJ file
As soon as a certain number of communications between the IBS and the ECU were not succesful the bit LV_SENS_BAT_SMT_ERR_IT is set. This bit is part of the logical field LF_BSD_SENS_BAT_SMT_CTL (bit 7). This logical field is then copied across the BMW Layer and used in the PWSL functionality. In case of a global BSD error the bit is set as well. Due to the fact that the single BSD error is de-bounced with a anti bounce counter and the counter CTR_MSG_SENS_BAT_SMT_COM_DIAG is reset to 0 after each increment of the anti bounce counter the anti bounce counter has to be taken into account as well.

IF LV_SENS_BAT_SMT_DET = 1 **and**
[CTR_MSG_SENS_BAT_SMT_COM_DIAG $\geq$ 1 **or**
CTR_ABC_SENS_BAT_SMT_COM $\geq$ 1 **or**
LV_ERR_BSD = 1]
THEN LV_SENS_BAT_SMT_BSD_ERR_IT = 1
EISE LV_SENS_BAT_SMT_BSD_ERR_IT = 0

9.48.4 Component Driver for electrical water pump

FUNCTION DESCRIPTION:

General information:

Register 0 and 6 is continuously updated although the LH requires a demand oriented writing of the messages (e.g. N_REL_CWP_SP). This is due to the fact that the CWP SW expectes at least all 2,5secs an updated information otherwise LIH mode is activated by the CWP SW.

Description:

Please find in the following section the **r/w** operations for the registers of the CWP.

1.	Time slot for CWP	KT_WE_ST_**WRITE**_REG0	Speed Setpoint
2.	Time slot for CWP	KT_WE_ST_*READ*_REG5	Variant
3.	Time slot for CWP	KT_WE_ST_*READ*_REG2	Supply Voltage

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4. Time slot for CWP KT_WE_ST_*READ*_REG1 Actual Speed
5. Time slot for CWP KT_WE_ST_*READ*_REG6 Error Section
6. Time slot for CWP KT_WE_ST_**WRITE**_REG0 Speed Setpoint
7. Time slot for CWP KT_WE_ST_*READ*_REG3 Temperature Electronics
8. Time slot for CWP KT_WE_ST_*READ*_REG2 Supply Voltage
9. Time slot for CWP KT_WE_ST_*READ*_REG1 Actual Speed
10. Time slot for CWP KT_WE_ST_*READ*_REG4 Current consumption
1. . .
. .
. .

Identifikationsbeschreibung für Adresse 0x03 (Wasserpumpe Elektronik)
Bauteil: elektr. Wasserpumpe, Elektronik, Adresse: 3

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Ident	Parameter	LS Bit	Bit Anz.	w(rite) r(ead)	Ein-heit	Funktion
0	WE_PDZS	0	8	-/w	[-]	Setpoint speed CWP ewpswbsd) 0...250 setpoint stages 251...254 power latch request 255 delete powerlatch reqest
						N_REL_CWP_SP (u8)
1	WE_PDZI	0	8	r/-	[-]	Actual speed CWP (ewpiwbsd)
						N_REL_CWP
2				r/-	[V]	Supply voltage CWP (ewpu)
						V_CWP (u8)
3				r/-	[°C]	Temperature of CWP electronics (ewpt)
						TEMP_EL_CWP (u8)
4				r/-	[A]	current consumption CWP
						CUR_CNS_CWP (u8)
5	WE_VAR	0	5	r/-	[-]	Mounted CWP type (0 = 200Watt or 1= 350/400Watt)
						LF_POW_CWP_COD
		5	3	r/-	[-]	Supplier of CWP (0 = Pierburg / 1 = supplier)
						LF_CWP_INFO_COD
6	WE_ERR2	1	1	r/-	-	rpm monitoring CWP deactivated
						LV_N_MON_CWP_DEAC (flag)
	WE_ERR3	2	1	r/-	-	Continuous monitoring of HW power supply of the CWP; used for LIH strategy in case of BSD communication faulty (CWP)
						LV_CWP_HW_LIH_IN_CHK (flag)
	WE_ERR4	3	1	r/-	-	Electronics CWP overtemperature (ewpft)
						LV_CWP_TEMP_HIGH (flag)
	WE_ERR5	4	1	r/-	-	CWP blocked / Current consumption too high (ewpblk1)
						LV_CWP_LOCK (flag)
	WE_ERR6	5	1	r/-	-	CWP running dry
						LV_CWP_PRE_LOCK (flag)

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	WE_ERR7	6	1	r/-	-	Voltage supply too high(ewpfu)
						LV_CWP_VCC_PLAUS (flag)
	WE_ERR8	7	1	r/-	-	Automatic de-blocking active
						LV_CWP_BLOCK_DEAC (flag)
7	WE_RES	0	8	r/-	-	Reserved for supplier

9.48.5 Aquisition values for QLT - sensor

FUNCTION DESCRIPTION:

General information:

The oil sensor (QLT = Quality Level Temperature) delivers information about the oil temperature, the oil level and the oil quality. This sensor is located in oil pan. The communication between this oil sensor and the engine management systen (ECU) is done via BSD-interface.

Description:

A) Describtion of communication of the BSD-Interface

On the SW-side in the ECU the recieved BSD-messages are treated with a "component driver".
5 Registers are relevant:
0 Oiltemperatur
1 Oilniveau
2,3 Permittivity
6 Status /Variant
this values are updated every 200ms

In case of a BSD-communication error the bit B_ozfbsd is set

B) Describtion of the registers

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Ident	Parameter	LS Bit	Bit Anz.	w(rite) r(ead)	Ein-heit	Function
0	OZ_TEMP	0	8	-/r	°C	Öltemperatur (8Bit)
1	OZ_NIV	0	8	-/r	mm	Ölstand (8Bit)
2	OZ_PERML	0	8	-/r	--	Permittivität/ Ölqualität (LSB von 16 Bit)
3	OZ_PERMM	8	2	-/r	--	Permittivität/ Ölqualität (MSB von 16 Bit)
4	--	--	--	--	--	not used
5	--	--	--	--	--	not used
6	OZ_ERRx	0	6	-/r	--	Status- und Fehlerinformationen: xxxxx1 = Sensorfehler Permittivität Anzeigekriterium: OZ-PERMM/OZ-PERML ungültig
						Status- und Fehlerinformationen: xxxx1x = Sensorfehler Ölniveau Anzeigekriterium: OZ_NIV ungültig
						Status- und Fehlerinformationen: xxx1xx = Sensorfehler Öltemperatur Anzeigekriterium: OZ_TEMP ungültig
	OZ_VAR	6	2	-/r	--	Sensortyp / Variante
						00 = offen 01 = TEMIC (Temp/Ölniveau/Permittivitätsz.) 10 = offen 11 = offen
7	OZ_RES	0	8	-/r	--	01 = reserviert für Prüfzwecke Lieferant rest = offen

Signal Öltemperatur:

Label : OZ_TEMP
Skalierungsbereich: -55,2 bis +175,4 = 01 h bis FE h [°C]
Plausibler Bereich: -40°C bis +160°C Messwertebereich = 200 K
Messbereichsverletzung: 00 h Messbereichsunterschreitung
FF h Messbereichsüberschreitung
Fehlerkennzeichnung: DATA2 = 4 h Sensorfehler Öltemperaturmessung
Auflösung: 8 bit

Signal Ölstand:

Label : OZ_NIV
Skalierungsbereich: 0.bis 75 = 01 h .bis.FE h [mm]

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Plausibler Bereich: 0 bis 75 mm Messwertebereich = 75 mm
Messbereichsverletzung: 00 h Messbereichsunterschreitung
FF h Messbereichsüberschreitung
Fehlerkennzeichnung: DATA2 = 2 h Sensorfehler Ölstandsmessung
Auflösung: 8 bit

Signal Ölzustand (Permittivitätszahl $_r$):

Label : OZ_PERMM /OZ_PERML
Skalierungsbereich: 1 bis 6 = 0001 h bis 03FE h
Plausibler Bereich: 1 bis 6 Messwertebereich = 5
Messbereichsverletzung: 0000 h Messbereichsunterschreitung
03FF h Messbereichsüberschreitung
Fehlerkennzeichnung: DATA2 = 1 h Sensorfehler Permittivitätsmessung
Auflösung: 10 bit

Application conditions

Initialisation: *all 0 at reset*

Recurrence: *200ms*

Activation: *at every engine state*

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9.49 Alternator management

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_STATE_TBL_ALTER_INH	V	0... 1H	0 ...1	1	-
Bit indicating that writing of STATE_TBL_ALTER_DC is stopped					
STATE_TBL_ALTER [7][5][5]	O/V/S	0... FFH	0... 99.60937	0.390625	%
Table with profile of alternator over alternator chip-temperature, load and speed (saved in NVMY)					
STATE_TBL_ALTER_DC [7][5][5]	O/V	0... FFFFH	0... 65535	1	s
Table with profile of alternator over alternator chip-temperature, load and speed during driving cycle (in s)					
T_STATE_TBL_ALTER	O/V/S	0... FFFFFFFFH	0... 4294967295	1	s
Time since starting to write STATE_TBL_ALTER (saved in NVMY)					
T_STATE_TBL_ALTER_DC	V	0... FFFFH	0... 65535	1	s
Time since starting to write STATE_TBL_ALTER_DC					

Input data:

LC_AD_CLR {p. 526}	LC_AD_CLR_ALTER {p. 526}	LV_ES {p. 1720}	LV_ST_END {p. 1720}
N_ALTER {p. 8368}	POW_REL_ALTER {p. 4095}	TEMP_ALTER_MC {p. 4096}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_STATE_LOAD_ALTER	-	1... 5H	1 ...5	1	-
LDP_POW_REL_ALTER	5	0... 1FH	0... 96.875	3.125	%
Table with y-axis for STATE_TBL_ALTER and STATE_TBL_ALTER_DC					
ID_STATE_N_ALTER	-	1... 5H	1 ...5	1	-
LDP_N_ALTER	5	0... FFFFH	-32768 ...32767	1	rpm
Table with z-axis for STATE_TBL_ALTER and STATE_TBL_ALTER_DC					
ID_STATE_TEMP_ALTER	-	1... 7H	1 ...7	1	-
LDP_TEMP_ALTER_MC	7	0... 1FH	-32 ...216	8	°C
Table with x-axis for STATE_TBL_ALTER and STATE_TBL_ALTER_DC					

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FUNCTION DESCRIPTION:

This function delivers a alternator use profile over alternator load, alterantor chip temperatur and alterantor speed.
During a driving cycle (LV_ES = 0 and LV_ST_END = 1) the absolute temporary use profile STATE_TBL_ALTER_DC is calculated. It is a accumulated time of the related alternator operating points. Additional an timer is incremented (T_STATE_TBL_ALTER_DC) during calculation of STATE_TBL_ALTER_DC.
After a driving cycle (LV_ES 0->1) the relative use profile STATE_TBL_ALTER is calculated out of STATE_TBL_ALTER_DC, the old profile STATE_TBL_ALTER and the timer T_STATE_TBL_ALTER /_DC. This profile is saved in non volatile memory. The timer is calculated out of it's old value and the new timer T_STATE_TBL_ALTER_DC and is saved in non volatile memory. The timer T_STATE_TBL_ALTER and the profile STATE_TBL_ALTER show the behaviour of the alternator during the lifetime of the vehicle.
T_STATE_TBL_ALTER and STATE_TBL_ALTER are saved in NVMY during power latch phase.

Application conditions

Initialisation: `STATE_TBL_ALTER and T_STATE_TBL_ALTER from NVMY, all other = 0 at reset, at LC_AD_CLR 0->1` **or** `LC_AD_CLR_ALTER 0->1, T_STATE_TBL_ALTER = 0 and STATE_TBL_ALTER = 0`

Recurrence: *1s*

Activation: *at every engine state*

Formula section:

```
// Calculation of alternator profile during driving cycle:
If      LV_ES = 0   and   LV_ST_END = 1   and   LV_STATE_TBL_ALTER_INH = 0
Then        // calculation of STATE_TBL_ALTER_DC with x = ID_STATE_TEMP_ALTER,        // y =
ID_STATE_LOAD_ALTER, z = ID_STATE_N_ALTER:
            STATE_TBL_ALTER_DC[x][y][z] = STATE_TBL_ALTER_DC[x][y][z] + 1
            // increment timer:
            T_STATE_TBL_ALTER_DC ++
            // stop calculation if limit reached:
            If       T_STATE_TBL_ALTER_DC = 65335s
            Then   LV_STATE_TBL_ALTER_INH = 1
            Endif
Else        do nothing - calculation of STATE_TBL_ALTER_DC stopped
Endif

// Calculation of alterantor profile for NVMY:
If              LV_ES 0 ->1
Then        //write STATE_TBL_ALTER_DC in STATE_TBL_ALTER:
             For x=1:7
             {         For y=1:5
                       {         For z=1:5
                              {    STATE_TBL_ALTER[x][y][z] =
                                   ( STATE_TBL_ALTER[x][y][z] * T_STATE_TBL_ALTER
                                        + STATE_TBL_ALTER_DC[x][y][z] )
                                   /( T_STATE_TBL_ALTER + T_STATE_TBL_ALTER_DC )
                              }
                       }
             }
             //calculate new time since starting to write STATE_TBL_ALTER:
             T_STATE_TBL_ALTER = T_STATE_TBL_ALTER + T_STATE_TBL_ALTER_DC
             //reset of temporary values:
             T_STATE_TBL_ALTER_DC = 0
             STATE_TBL_ALTER_DC[ ][ ][ ] = 0                    // complete map = 0
             LV_STATE_TBL_ALTER_INH = 0
Endif
```

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9.50 E-box cooling fan

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_EBOX_CFA	O/V	0... 1H	0 ...1	1	-
Control bit EBOX cooling fan					

Input data:

LV_ACT_EBOX_CFA_ EXT_ADJ {p. 7432}	LV_EBOX_CFA_EXT_ADJ {p. 7433}	LV_END_DIAG_EBOX_ CFA {p. 4626}	LV_ERR_EBOX_CFA {p. 4627}
LV_IGK {p. 906}	LV_VAR_EBOX_CFA {p. 655}	N {p. 1525}	TECU {p. 1256}
TIA {p. 1226}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_THD_EBOX_CFA_ACT	-	0... 1FE0H	0... 8160	1	rpm
N threshold for activation of EBOX_CFA after Kl.15 on (For diagnosis)					
C_T_MAX_EBOX_CFA_ACT	-	0... FFH	0... 255	1	s
Maximum time for activation of EBOX_CFA after Kl.15 on (for diagnosis)					
C_TECU_HYS_EBOX_CFA	-	0... FEH	0... 190.5	0.75	°C
TECU hysteresis for EBOX cooling fan					
C_TECU_THD_EBOX_CFA	-	0... FEH	-48... 142.5	0.75	°C
TECU threshold for EBOX cooling fan ON					
C_TIA_HYS_EBOX_CFA	-	0... FEH	0... 190.5	0.75	°C
TIA hysteresis for EBOX cooling fan					
C_TIA_THD_EBOX_CFA	-	0... FEH	-48... 142.5	0.75	°C
TIA threshold for EBOX cooling fan ON					

General information:

The function should prevent a overheating of the ECUs in the EBOX. For that, a cooling fan is controlled in dependency of the ECU temperature and the intake air temperature.

Application conditions

Initialisation:
```
LV_EBOX_CFA = 0 ,
 T_MAX_EBOX_CFA_ACT = 0  at transition LV_IGK 0 - ->1
 LV_EBOX_CFA_ACT_TEST_END = 0 at transition LV_IGK 0 - ->1
```

Recurrence: *1000 ms*

Activation:
```
at every engine operating states and
       LV_VAR_EBOX_CFA = 1
```

FUNCTION DESCRIPTION:

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Description:

There are two operating states for the activation of the Ebox-cooling-fan:
1) for power stage diagnosis:
the Ebox-cooling-fan has to be briefly activated at every transition LV_IGK 0 - -> 1 in order to be able to perform a complete diagnosis cycle. After LV_IGK 0 - -> 1 and the exceeding of a calibratable N-threshold the Ebox-CFA is activated either until LV_END_DIAG_EBOX_CFA is set to 1 (diagnosis completed) or the maximum time C_T_MAX_EBOX_CFA_ACT has been reached.
2) normal operation:
activation via external adjustment or due to cooling request because of high TIA or TECU

Formula section:

```
// Activation of Ebox-cooling-fan - for diagnosis (at every transition LV_IGK 0 - -> 1):
If (1)        LV_IGK = 1     and
           N > C_N_THD_EBOX_CFA_ACT     and
              LV_EBOX_CFA_EXT_ADJ = 0       and
           LV_EBOX_CFA_ACT_TEST_END = 0
then (1)    if (2)          (T_MAX_EBOX_CFA_ACT < C_T_MAX_EBOX_CFA_ACT)   and
                            LV_END_DIAG_EBOX_CFA <> 1
             then (2)       T_MAX_EBOX_CFA_ACT = ++
                         LV_EBOX_CFA = 1
           else (2)        LV_EBOX_CFA = 0
                              LV_EBOX_CFA_ACT_TEST_END = 1
             endif (2)
else (1)
// Activation of Ebox-cooling-fan - normal operation:
             If (4)            LV_IGK = 1           and
                          ( N > C_N_THD_EBOX_CFA_ACT       or
EBOX_CFA_EXT_ADJ = 1)
           then (4)
                      if (5)    LV_EBOX_CFA_EXT_ADJ = 1
                         Then (5)       LV_EBOX_CFA = LV_ACT_EBOX_CFA_EXT_ADJ
                   Else(5)
                         If(6) LV_EBOX_CFA_ACT_TEST_END = 1                   and
                                    LV_ERR_EBOX_CFA = 0
                         Then(6)
                               If (7)     TECU > C_TECU_THD_EBOX_CFA          and
                                               TIA > C_TIA_THD_EBOX_CFA
                                    Then (7)       LV_EBOX_CFA = 1
                                     Else (7)
                                    If (8)     TECU > (C_TECU_THD_EBOX_CFA
                                                      - C_TECU_HYS_EBOX_CFA)      and
                                                TIA > (C_TIA_THD_EBOX_CFA
                                                     -  C_TIA_HYS_EBOX_CFA)        and
                                                  LV_EBOX_CFA = 1
                                         Then (8)        LV_EBOX_CFA = 1
                                            Else (8)        LV_EBOX_CFA = 0
                                           Endif (8)
                                    Endif (7)
                              Else(6)
                                    LV_EBOX_CFA = 0
```

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Endif (6)

Endif(5)

Else (4) LV_EBOX_CFA = 0

Endif (4)

endif(1)

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9.51 Active engine brackets

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SWI_AEB	O/V	0... 1H	0 ...1	1	-
switch to control the active engine brackets					

Input data:

LV_ES {p. 1720}	LV_IGK {p. 906}	LV_IGK_PREL {p. 906}	LV_ST {p. 1720}
LV_STST_ES {p. 804}	LV_STST_PRE_STOP_REQ {p. 8220}	LV_STST_ST_REQ {p. 804}	LV_SWI_AEB_ACT_EXT_ADJ {p. 7435}
LV_SWI_AEB_EXT_ADJ {p. 7435}	LV_VAR_AEB {p. 655}	N_32 {p. 1525}	OPM_AV {p. 8137}
VS {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_32_SWI_AEB_HOM_AFL	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for switching active engine brackets in HOM_AFL mode					
C_N_32_SWI_AEB_HOM_AFS	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for switching active engine brackets in HOM_AFS mode					
C_N_32_SWI_AEB_HYS	-	0... FFH	0... 8160	32	rpm
Engine speed hysteresis for switching active engine brackets					
C_N_32_SWI_AEB_S	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for switching active engine brackets in S mode					
C_VS_SWI_AEB_HOM_AFL	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for switching active engine brackets in HOM_AFL mode					
C_VS_SWI_AEB_HOM_AFS	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for switching active engine brackets in HOM_AFS mode					
C_VS_SWI_AEB_HYS	-	0... FFH	0... 255	1	km/h
Vehicle speed hysteresis for switching active engine brackets					
C_VS_SWI_AEB_S	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for switching active engine brackets in S mode					
LC_SWI_AEB_IGK_PREL_ENA	-	0... 1H	0 ...1	1	-
Engine brackets stop position enabled to preliminary ignition shut off					
LC_SWI_AEB_ST	-	0... 1H	0 ...1	1	-
Active engine brackets for engine start					
LC_SWI_AEB_STOP	-	0... 1H	0 ...1	1	-
Active engine brackets for engine stop					
LC_SWI_AEB_STST_PRE_STOP_ENA	-	0... 1H	0 ...1	1	-
Enable switch for pre stop request					
LC_SWI_AEB_TYP	-	0... 1H	0 ...1	1	-
Active engine brackets switch for different engine type					

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9.51.1 MISC_M905G

The functionality active engine bracket supports the controllable engine suspension. To improve the driveability of the vehicle and to decrease the transmission of engine vibrations, it is possible to switch the engine bracket from the state stiff to the state soft .

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To compensate the more rough combustion in stratified mode the engine brackets are switched into a soft characteristic.

Application Condition

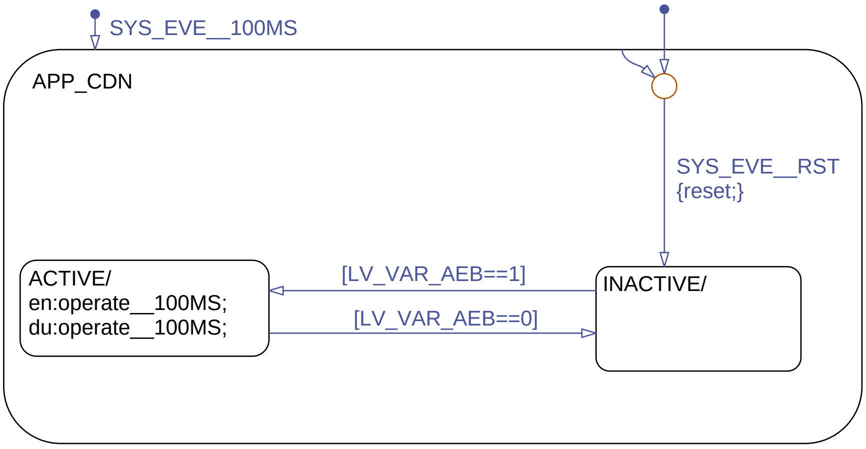

Figure 9.51.1: MISC_M905G/APP_CDN/Chart1

Function Description

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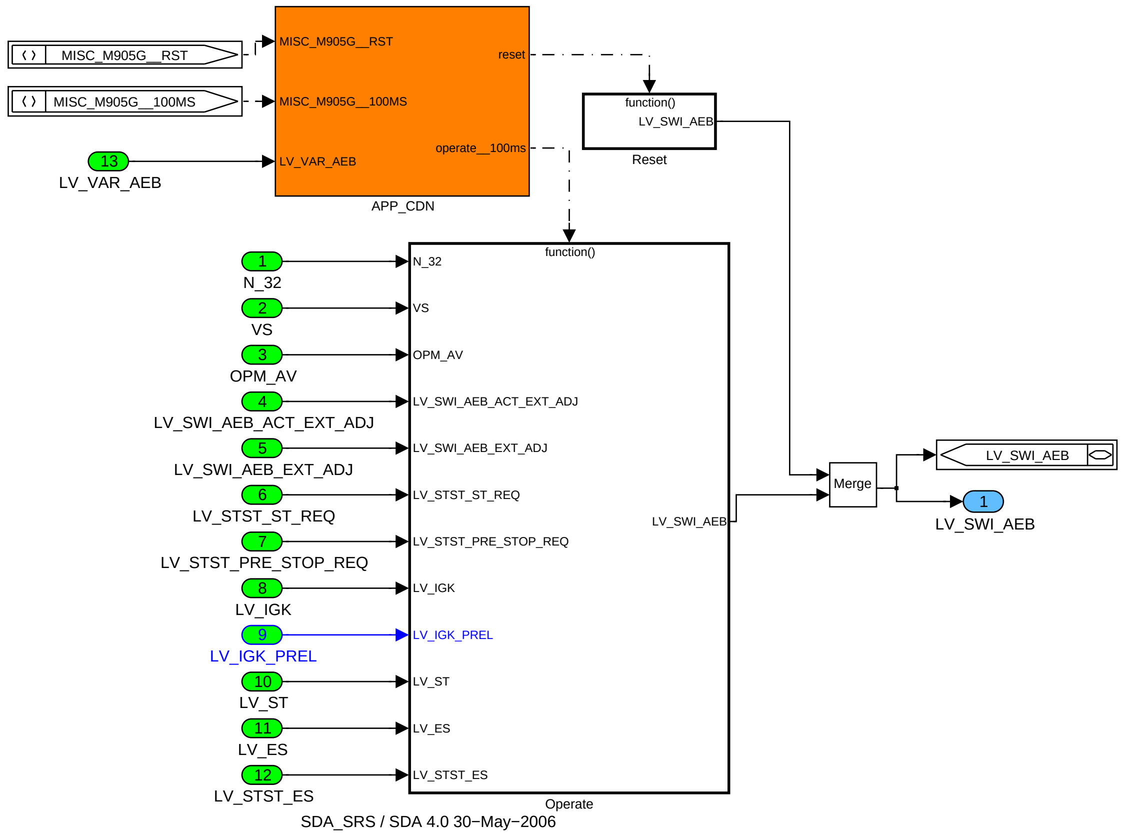

Figure 9.51.2: MISC_M905G

9.51.1.1 MISC_M905G/OPERATE

Dependent on engine speed and vehicle speed in each combustion mode, the logical variable LV_SWI_AEB is set to 1 and the corresponding ECUPin is set under current. In this case the engine bracket is switched to the state soft . Otherwise the "stiff" mode of the engine brackets is active. There is a hysteresis for engine speed and vehicle speed (common for all combustion modes) to avoid toggling of LV_SWI_AEB. The logical constant LC_SWI_AEB_TYP is introduced to take the different engine bracket types into account, which are provided from different suppliers.

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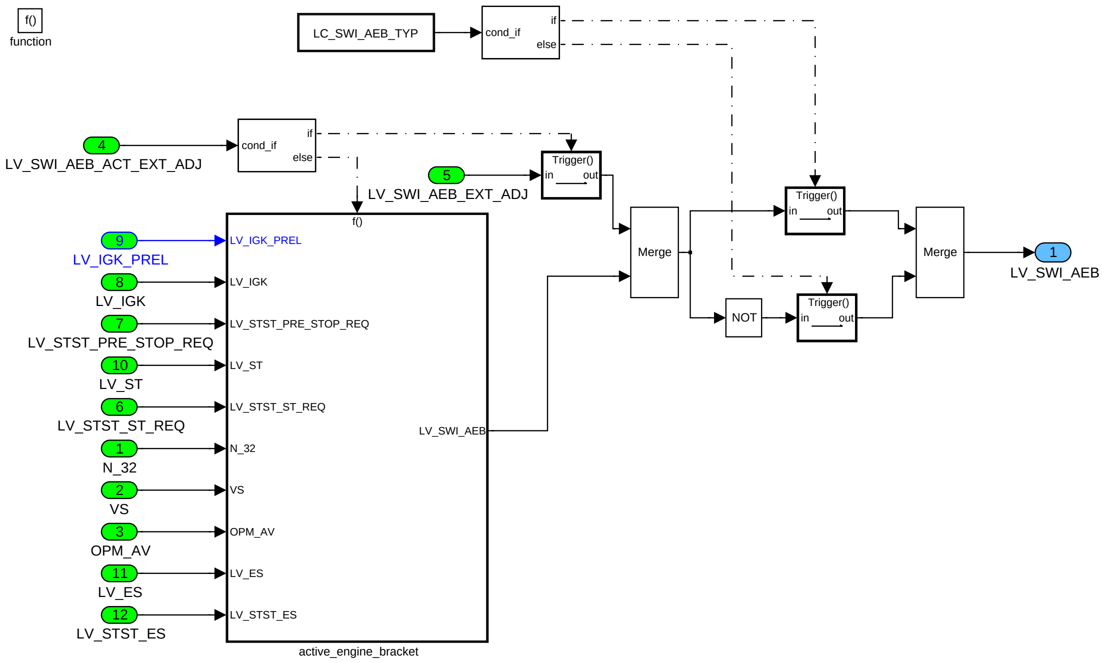

Figure 9.51.3: MISC_M905G/Operate

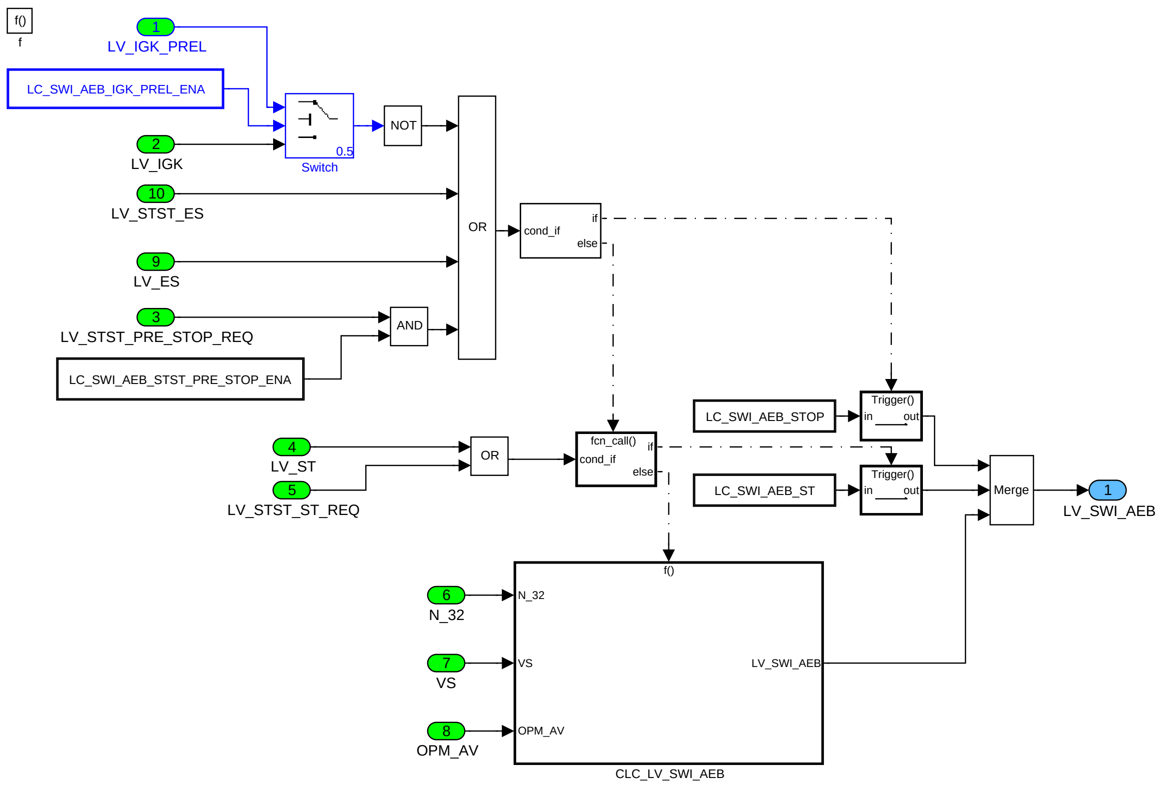

Figure 9.51.4: MISC_M905G/Operate/active_engine_bracket

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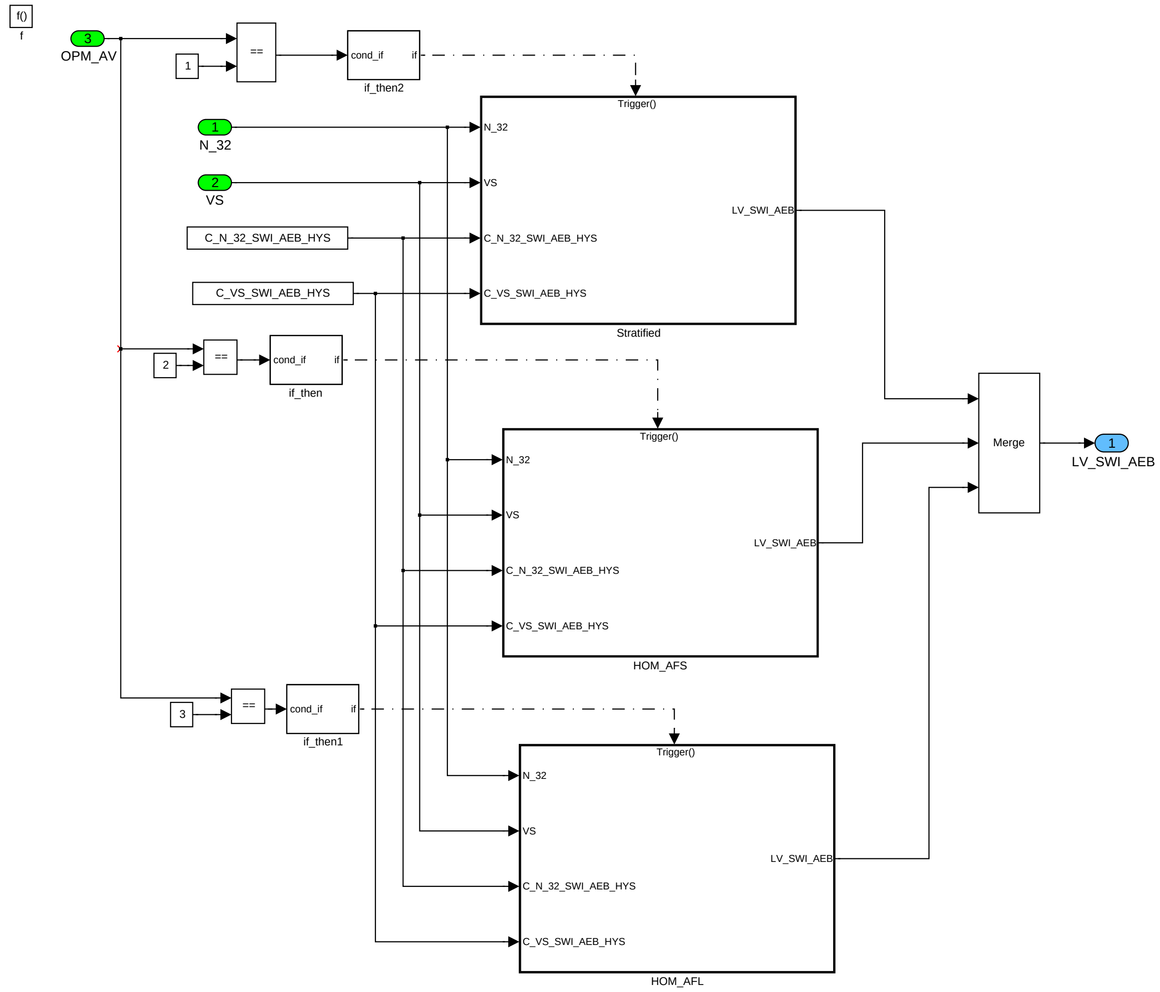

Figure 9.51.5: MISC_M905G/Operate/active_engine_bracket/CLC_LV_SWI_AEB

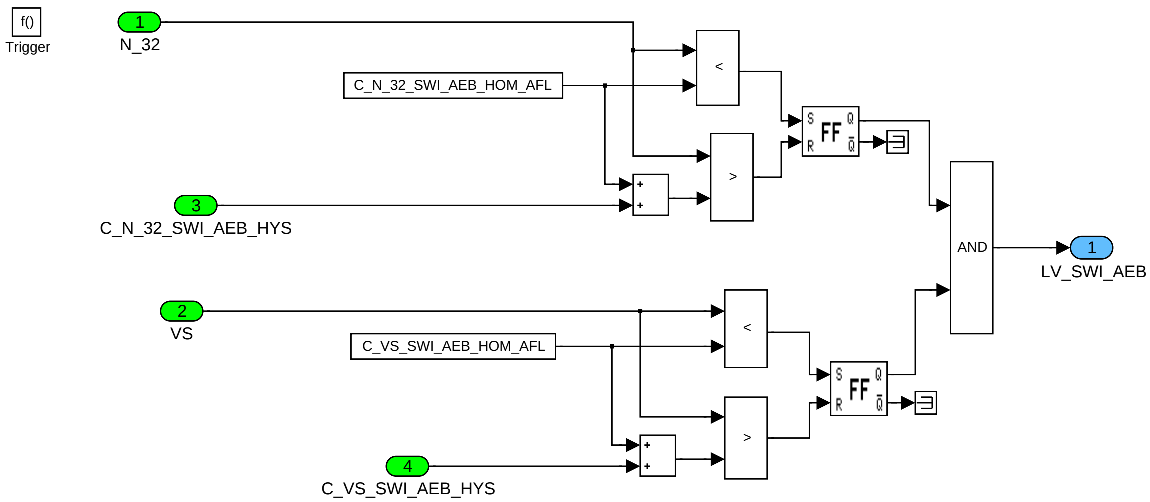

Figure 9.51.6: MISC_M905G/Operate/active_engine_bracket/CLC_LV_SWI_AEB/HOM_AFL

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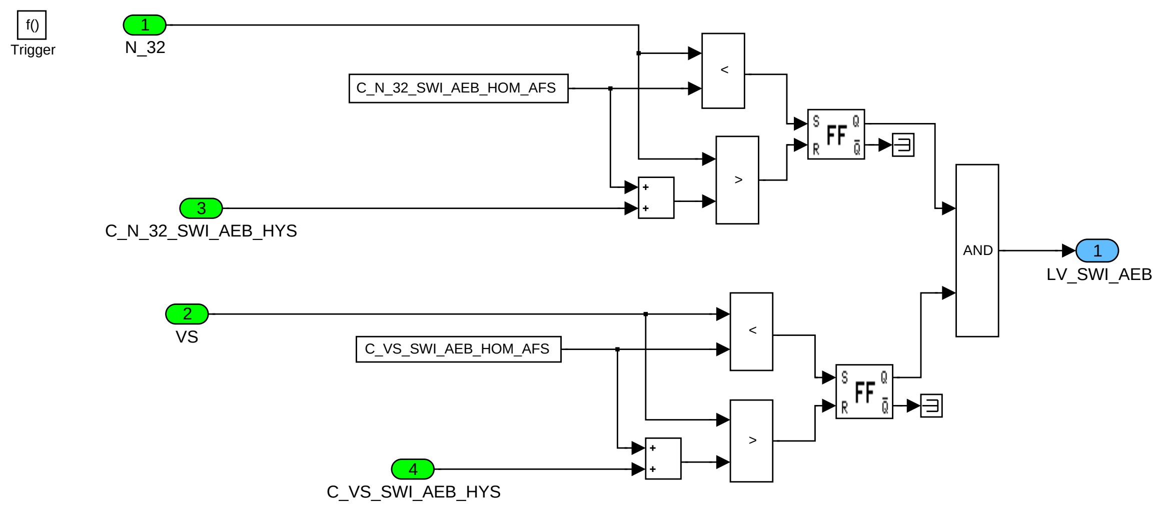

Figure 9.51.7: MISC_M905G/Operate/active_engine_bracket/CLC_LV_SWI_AEB/HOM_AFS

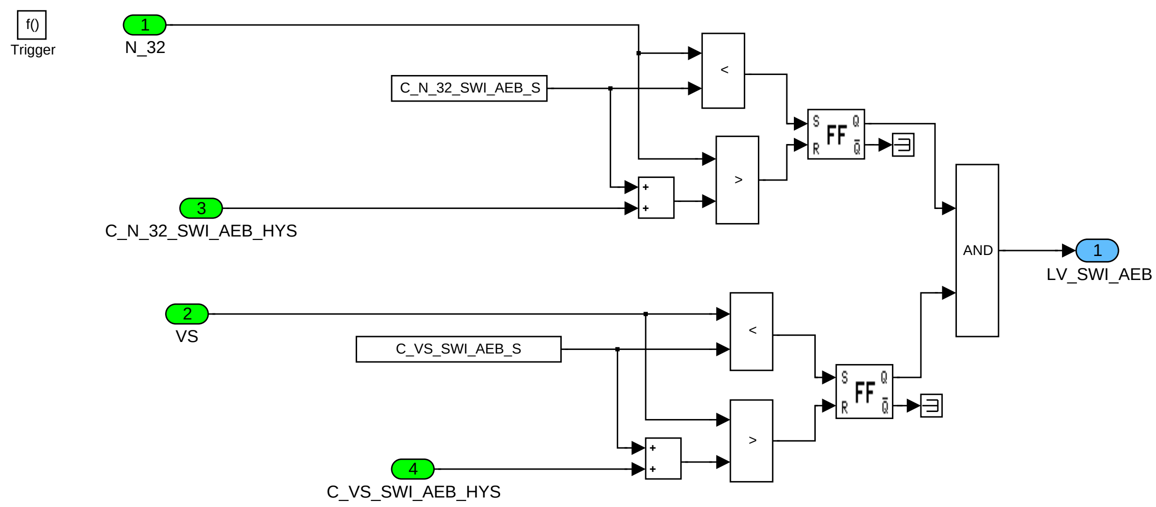

Figure 9.51.8: MISC_M905G/Operate/active_engine_bracket/CLC_LV_SWI_AEB/Stratified

9.51.1.2 SUBFUNCTION: Reset

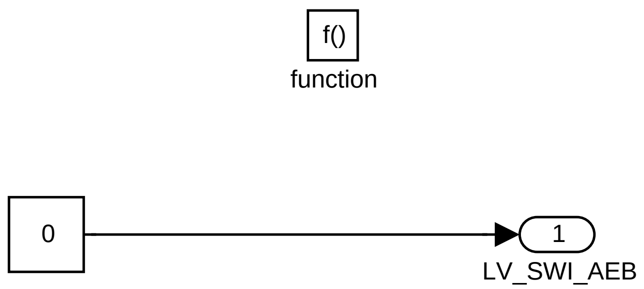

Figure 9.51.9: MISC_M905G/Reset

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9.52 Crankcase ventilation heater control (HVAC)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_RLY_CRCV_HEAT	O/V	0... 1H	0 ...1	1	-
Crankcase ventilation heater relay (1:activated, 0:deactivated)					

Input data:

LV_ACT_RLY_CRCV_ HEAT_EXT_ADJ {p. 7432}	LV_ERR_RLY_CRCV_ HEAT {p. 4627}	LV_IGK {p. 906}	LV_RLY_CRCV_HEAT_ EXT_ADJ {p. 7434}
T_AST {p. 1766}	TIA {p. 1226}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_AST_MIN_RLY_CRCV_HEAT	-	0... FFFFH	0... 6553.5	0.1	s
Minimal time after start for CRCV_HEAT activation (default: 60s)					
C_TIA_HYS_RLY_CRCV_HEAT	-	0... FEH	-48... 142.5	0.75	°C
intake air temperature hysteresis between activation and deactivation of CRCV_HEAT (default: 3°C)					
C_TIA_MAX_RLY_CRCV_HEAT	-	0... FEH	-48... 142.5	0.75	°C
Maximal intake air temperature for CRCV_HEAT activation (default: 0°C)					

9.52.1 Import Actions

ACTION_INFR_SetCRCVHEAT(IN <lv_rly_crcv_heat>**)**
This action sets the output pin for the "CRCV_HEAT Switch"

Note: The imported actions are defined in the HVAC - IRS (infrastructure requirement specification).

General information:

To prevent crankcase ventilation from fouling under cold conditions it is necessary to heat the ventilation rail. For the power stage of this heating an external relay plus heating foil is introduced. The control stage is realised by the engine management system using the below statemachine.

Application conditions

Initialisation: *at reset and deactivation all var. are initialised with 0*

Recurrence: *1000ms*

Activation: see signal flow diagram

Deactivation: see signal flow diagram

Signal flow diagram:

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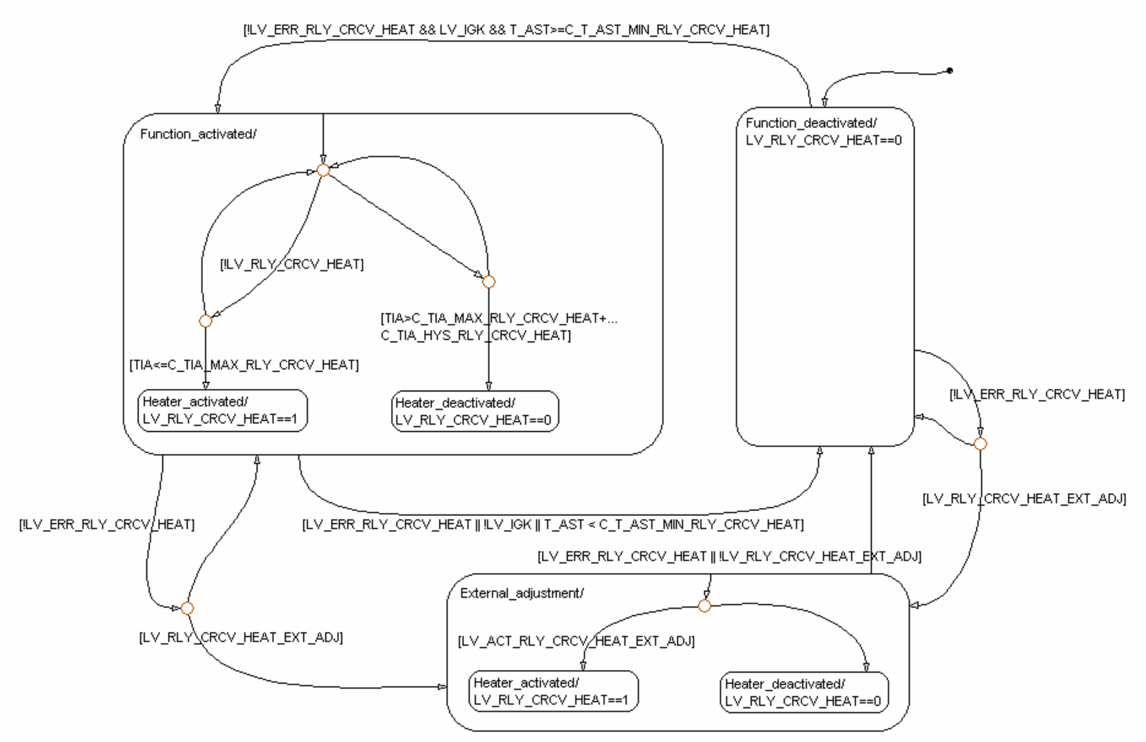

Formula section:

(redundant information to signal flow diagram - only for a better understanding)

External adjustment:

If(1) LV_ERR_RLY_CRCV_HEAT = 0
Then(1) **If(2)** LV_RLY_CRCV_HEAT_EXT_ADJ = 1
Then(2)
If(3) LV_ACT_RLY_CRCV_HEAT_EXT_ADJ = 1
Then(3) LV_RLY_CRCV_HEAT = 1
Else(3) LV_RLY_CRCV_HEAT = 0
Else(2) either stay in the actual operation mode or (if external adjustment was activated before) firstly deactivate function and check if it has to be reactivated again
Else(1) Function is deactivated
ACTION_INFR_SetCRCVHEAT(IN < LV_RLY_CRCV_HEAT >**)**

"Normal" operation:

If(1) LV_ERR_RLY_CRCV_HEAT = 0 **and**
LV_IGK = 1 **and**
T_AST >= C_T_AST_MIN_RLY_CRCV_HEAT
Then(1)
If(2) LV_RLY_CRCV_HEAT = 0
Then(2)

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If(3) TIA <= C_TIA_MAX_RLY_CRCV_HEAT
Then(3) LV_RLY_CRCV_HEAT = 1
Else(2)
If(4) TIA > C_TIA_MAX_RLY_CRCV_HEAT + C_TIA_HYS_RLY_CRCV_HEAT
Then(4) LV_RLY_CRCV_HEAT = 0
Else(1) Function is deactivated
ACTION_INFR_SetCRCVHEAT(IN < LV_RLY_CRCV_HEAT >**)**

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9.53 Fuel research octane number statistical quantification

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_STC_RON_HIGH	O/V/S	0... FFFFH	0... 65535	1	-
Statistical counter for high quality fuel.					
CTR_STC_RON_LOW	O/V/S	0... FFFFH	0... 65535	1	-
Statistical counter for low quality fuel.					
CTR_STC_RON_MEDIUM	O/V/S	0... FFFFH	0... 65535	1	-
Statistical counter for medium quality fuel.					
DIST_RON_STC [NC_NR_RON_KWP]	O/V/S	0... FFFFH	0... 524280	8	km
Distance covered by vehicle after last refuel for tester.					
LV_RON_STC_DEACT	V	0... 1H	0 ...1	1	-
RON statistic deactivation flag (0 = no activation so far, 1 = deactivated)					
STATE_RON [NC_NR_RON_KWP]	O/V/S	0... 3H	0 ...3	1	-
Fuel quality after last refuel for tester (0 = undefined, 1 = low, 2 = medium, 3 = high).					
STATE_RON_TMP	V	0... 3H	0 ...3	1	-
Fuel quality after last refuel, temporary value (0 = undefined, 1 = low, 2 = medium, 3 = high).					

Input data:

DIST_KWP {p. 1183}	FAC_RON {p. 798}	IGA_MV_ADJ_KNK_RON {p. 8304}	KNK_CTL_DIS {p. 1952}
LC_AD_CLR_STC_RON {p. 527}	LV_REFU {p. 5966}	LV_RON_STC_CLR_KWP {p. 7483}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_RON_LOW	V	0... FFH	0 ...1	0.00392156	-
Upper limit for low quality fuel based on FAC_RON.					
C_FAC_RON_MEDIUM	V	0... FFH	0 ...1	0.00392156	-
Upper limit for medium quality fuel based on FAC_RON.					
C_IGA_MV_ADJ_KNK_RON_LOW	V	FE0C... 258H	-50 ...60	0.1	°CRK
Upper limit for low quality fuel based on IGA_MV_ADJ_KNK_RON.					
C_IGA_MV_ADJ_KNK_RON_MEDIUM	V	FE0C... 258H	-50 ...60	0.1	°CRK
Upper limit for medium quality fuel based on IGA_MV_ADJ_KNK_RON.					
LC_IGA_MV_ADJ_KNK_RON_SEL	V	0... 1H	0 ...1	1	-
Switch to select input for RON quantification (0 = FAC_RON, 1 = IGA_MV_ADJ_KNK_RON)					
LC_RON_STC_ENA	V	0... 1H	0 ...1	1	-
Switch to enable RON quantification functionality (0 = disabled, 1 = enabled)					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_RON_KWP	-	1... FFH	1... 255	1	-
Number of data to be sent to tester.					

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General information

9.53.1 Calculation of statistical data

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General information:

This functionality provides a statistical quantification of the fuel quality, or RON, used in the vehicle over a long period of time. In addition, the fuel quality and the covered distance at the last five refuels is captured. This information can be accessed via a workshop tester and it provides the engineer/mechanic with information that could assist in analysing customer complaints hinting towards poor driveability etc. This functionality requires the detection of a refuel (LV_REFU = 1) which is provided by the DMTL module, hence the functionality is only operable in vehicles with DMTL.
The parameter used for the statistical analysis is, depending on system architecture, either IGA_MV_ADJ_KNK_RON or FAC_RON (= DZW_ANNM or F_OCTAN respectively, obtained from BMW layer). The parameter to be used is configurable via the switch LC_IGA_MV_ADJ_KNK_RON_SEL. A low-, medium- and high RON-range is configurable via calibratable constants. Each time a vehicle refuelling is detected, IGA_MV_ADJ_KNK_RON or FAC_RON is allocated to the applicable range and the corresponding statistical counter is incremented. At the same time the covered distance is captured. The three RON-range statistical counters together with the last five captured RON-ranges with corresponding covered distance are provided to the workshop tester via diagnostic communication.

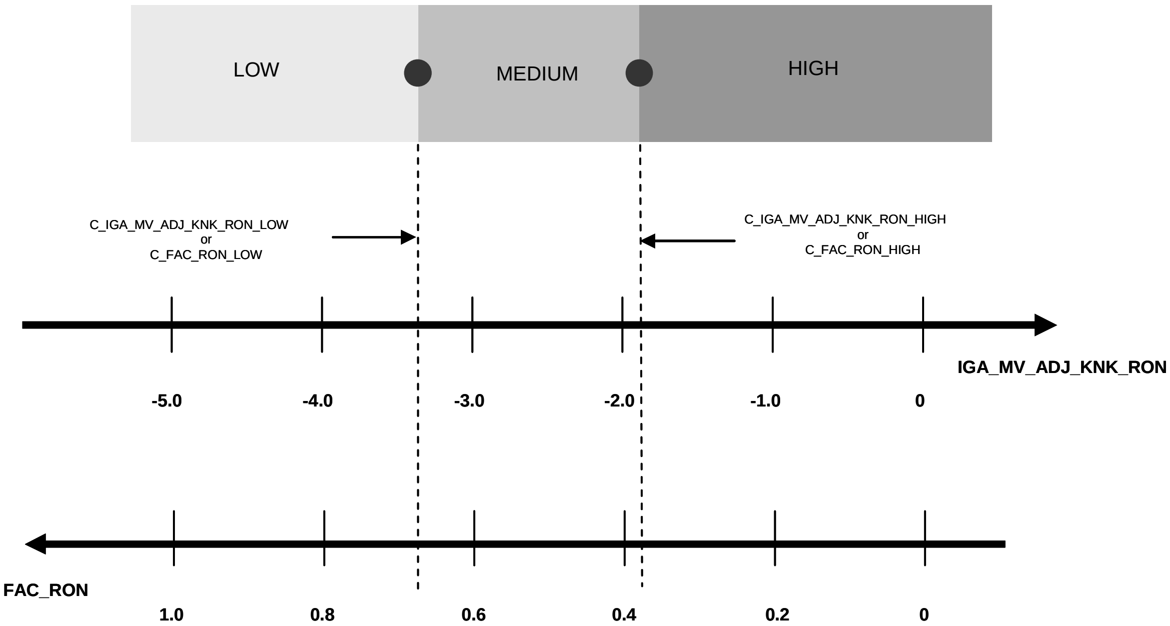

Figure 9.53.1:

Application conditions:

Initialisation:

```
All 0 at ECU reset, except:
CTR_STC_RON_xx                  from NVMY.
STATE_RON[NC_NR_RON_KWP]        from NVMY.
DIST_RON_STC[NC_NR_RON_KWP]     from NVMY.
Non-volatile data are initialized with 0 at first run of new
ECU or in case of NVRAM error.  Otherwise they are reprogramming-proo
```

Activation: `LC_RON_STC_ENA = 1` **and** `// at end-of-refuelling detection.`
`LV_REFU = 1`

Deactivation: `LV_RON_STC_DEACT = 1`

Recurrence: `1000ms`

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Function description:

Formula section:

NC_NR_RON_KWP = 5

// *Calculation of applicable fuel quality range:*

```
If(1)    KNK_CTL_DIS == 0
Then(1)  If(2)    LC_IGA_MV_ADJ_KNK_RON_SEL = 1
         Then(2)  If(3)    IGA_MV_ADJ_KNK_RON < C_IGA_MV_ADJ_KNK_RON_LOW
                  Then(3)  STATE_RON_TMP = 1
                  Else(3)  If(4)    IGA_MV_ADJ_KNK_RON < ...
                                    C_IGA_MV_ADJ_KNK_RON_MEDIUM
                           Then(4)  STATE_RON_TMP = 2
                           Else(4)  STATE_RON_TMP = 3
                           Endif(4)
                  Endif(3)
         Else(2)  If(3)    FAC_RON > C_FAC_RON_LOW
                  Then(3)  STATE_RON_TMP = 1
                  Else(3)  If(4)    FAC_RON > C_FAC_RON_MEDIUM
                           Then(4)  STATE_RON_TMP = 2
                           Else(4)  STATE_RON_TMP = 3
                           Endif(4)
                  Endif(3)
         Endif(2)
Else(1)  STATE_RON_TMP = 0
Endif(1)
```

// *Increment of fuel quality range statistical counters:*

```
If            STATE_RON_TMP = 1
Then          CTR_STC_RON_LOW ++
Endif
If            STATE_RON_TMP = 2
Then          CTR_STC_RON_MEDIUM ++
Endif
If            STATE_RON_TMP = 3
Then          CTR_STC_RON_HIGH ++
Endif
```

// *Capture of last five instances of fuel quality range and covered distance:*

```
STATE_RON[1] = STATE_RON[2]
........
STATE_RON[NC_NR_RON_KWP] = STATE_RON_TMP


DIST_RON_STC[1] = DIST_RON_STC[2]
........
DIST_RON_STC[NC_NR_RON_KWP] = DIST_KWP
```

// *Deactivation of RON statistical calculation:*

```
LV_RON_STC_DEACT = 1
```

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9.53.2 Reset of statistical data

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General information:

All non-volatile-data are **reprogramming proof,** i.e. they are NOT reset when the ECU is reprogrammed. However, they can be reset by application tool or workshop tester, via LC_AD_CLR_STC_RON or LV_RON_STC_CLR_KWP respectively.

Application conditions:

Initialisation: -

Activation: LC_RON_STC_ENA = 1 **and** LV_IGK = 1

Deactivation: -

Recurrence: 1000ms

Function description:

Formula section:

```
If      LC_AD_CLR_STC_RON = 1                   or
        LV_RON_STC_CLR_KWP = 1
Then    CTR_STC_RON_xx                                    =  0
        STATE_RON[NC_NR_RON_KWP] (Whole array)            = 0
        DIST_RON_STC[NC_NR_RON_KWP] (Whole array)         = 0
Endif
```

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9.54 Sweeping technology

Input data:

KWP_IO_VIN	LV_AUTH_L3_ENA {p. 7482}	LV_ECU_SLA {p. 800}	LV_LOCK_IMOB
SERIAL_NUMBER [ ]	STATE_IMOB_2_ERR	VIN_CAN [NC_VIN_CAN_LEN] {p. 1582}	

9.54.1 SWT-Module

Outputs:

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STATE_KWP_IMOB_STORE_K_EWS_ENA	O	0...FFH	0...255	1	[-]
State calculation and storage of K_EWS4					
PTR_FSC_CONFIG_EWS4	O	0..FFFFFFFFH	0..4294967295	1	[-]
u8-Pointer in FSC to specific EWS functions					
rs_FSC_ews4_A[100]	O	0...FFH[100]	0..255[100]	1	[-]
EEPROM Buffer, store in NVMY (IMOB FSC first 100Byte)					
cs_ee_FSC_ews4_A[100]	O	0...FFH[100]	0..255[100]	1	[-]
EEPROM Buffer, read from NVMY(IMOB FSC first 100Byte)					
FSC_XMAX_WR[200]	O/S	0...FFH[200]	0..255[200]	1	[-]
EEPROM Buffer, store in NVMY (Vmax /Pmax FSC 200Byte)					
FSC_XMAX_RD[200]	O	0...FFH[200]	0..255[200]	1	[-]
EEPROM Buffer, read from NVMY (Vmax/Pmax FSC 200Byte)					
SWT_FSC_XMAX_STATUS	V	0..FFH	0..255	1	[-]
Status of stored FSC in EEPROM					
LOC_IMOB_FSC.*VERSION LOC_IMOB_FSC.*SWID_TYPE LOC_IMOB_FSC.*SWID LOC_IMOB_FSC.*SUPPLIER_NR LOC_IMOB_FSC.*REQUESTER_TYPE LOC_IMOB_FSC.*ORDER_NR LOC_IMOB_FSC.*REQUESTER_ID LOC_IMOB_FSC.*INDIVIDUAL_ATTR_TYPE LOC_IMOB_FSC-*INDIVIDUAL_ATTR LOC_IMOB_FSC.*VALIDITY LOC_IMOB_FSC.*FSCS_ID LOC_IMOB_FSC.*DATE LOC_IMOB_FSC.*EXTENDED LOC_IMOB_FSC.*SIGNATURE	-	0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH	0..255 0..255 0..255 0..255 0..255 0..255 0..255 0..255 0..255 0..255 0..255 0..255 0..255 0..255	1	[-]
Struct of pointer to IMOB FSC Field definitions					
LOC_VMAX_FSC.*SIZE LOC_VMAX_FSC.*STATUS LOC_VMAX_FSC.*VERSION LOC_VMAX_FSC.*SWID_TYPE LOC_VMAX_FSC.*SWID LOC_VMAX_FSC.*SUPPLIER_NR LOC_VMAX_FSC.*REQUESTER_TYPE LOC_VMAX_FSC.*ORDER_NR LOC_VMAX_FSC.*REQUESTER_ID LOC_VMAX_FSC.*INDIVIDUAL_ATTR_TYPE LOC_VMAX_FSC-*INDIVIDUAL_ATTR LOC_VMAX_FSC.*VALIDITY LOC_VMAX_FSC.*FSCS_ID LOC_VMAX_FSC.*DATE LOC_VMAX_FSC.*EXTENDED LOC_VMAX_FSC.*SIGNATURE	-	0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH	0..255 0..255 0..255 0..255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255	1	[-]
Struct of pointer to VMAX FSC Field definitions read from EEPROM					

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LOC_VMAX_DIAG_FSC.*SIZE LOC_VMAX_ DIAG_FSC.*STATUS LOC_VMAX_ DIAG_FSC.*VERSION LOC_VMAX_ DIAG_FSC.*SWID_TYPE LOC_VMAX_ DIAG_FSC.*SWID LOC_VMAX_ DIAG_FSC.*SUPPLIER_NR LOC_VMAX_ DIAG_FSC.*REQUESTER_TYPE LOC_VMAX_ DIAG_FSC.*ORDER_NR LOC_VMAX_ DIAG_FSC.*REQUESTER_ID LOC_VMAX_ DIAG_FSC.*INDIVIDUAL_ATTR_TYPE LOC_VMAX_ DIAG_FSC-*INDIVIDUAL_ATTR LOC_VMAX_ DIAG_FSC.*VALIDITY LOC_VMAX_ DIAG_FSC.*FSCS_ID LOC_VMAX_ DIAG_FSC.*DATE LOC_VMAX_ DIAG_FSC.*EXTENDED LOC_VMAX_ DIAG_FSC.*SIGNATURE	-	0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH	0..255 0..255 0..255 0..255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255	1	[-]
Struct of pointer to VMAX FSC Field definitions read from Diagnosis					
LOC_PMAX_FSC.*SIZE LOC_PMAX_FSC.*STATUS LOC_PMAX_FSC.*VERSION LOC_PMAX_FSC.*SWID_TYPE LOC_PMAX_FSC.*SWID LOC_PMAX_FSC.*SUPPLIER_NR LOC_PMAX_FSC.*REQUESTER_TYPE LOC_PMAX_FSC.*ORDER_NR LOC_PMAX_FSC.*REQUESTER_ID LOC_PMAX_FSC.*INDIVIDUAL_ATTR_TYPE LOC_PMAX_FSC-*INDIVIDUAL_ATTR LOC_PMAX_FSC.*VALIDITY LOC_PMAX_FSC.*FSCS_ID LOC_PMAX_FSC.*DATE LOC_PMAX_FSC.*EXTENDED LOC_PMAX_FSC.*SIGNATURE	-	0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH	0..255 0..255 0..255 0..255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255	1	[-]
Struct of pointer to PMAX FSC Field definitions read from EEPROM					
LOC_PMAX_DIAG_FSC.*SIZE LOC_PMAX_ DIAG_FSC.*STATUS LOC_PMAX_ DIAG_FSC.*VERSION LOC_PMAX_ DIAG_FSC.*SWID_TYPE LOC_PMAX_ DIAG_FSC.*SWID LOC_PMAX_ DIAG_FSC.*SUPPLIER_NR LOC_PMAX_ DIAG_FSC.*REQUESTER_TYPE LOC_PMAX_ DIAG_FSC.*ORDER_NR LOC_PMAX_ DIAG_FSC.*REQUESTER_ID LOC_PMAX_ DIAG_FSC.*INDIVIDUAL_ATTR_TYPE LOC_PMAX_ DIAG_FSC-*INDIVIDUAL_ATTR LOC_PMAX_ DIAG_FSC.*VALIDITY LOC_PMAX_ DIAG_FSC.*FSCS_ID LOC_PMAX_ DIAG_FSC.*DATE LOC_PMAX_ DIAG_FSC.*EXTENDED LOC_PMAX_ DIAG_FSC.*SIGNATURE	-	0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH 0..FFH	0..255 0..255 0..255 0..255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255 0.. 255	1	[-]
Struct of pointer to PMAX FSC Field definitions read from Diagnosis					
LOC_FSC_BYTES_RCV	-	0..FFFFH	0..65535	1	[-]
Counter of received bytes by KWP messages					
LOC_FSC_EXP_LEN	-	0..FFFFH	0..65535	1	[-]
Expected length in bytes of complete message					
LOC_SWT_FSC_BUF[292]	-	0..FFH[292]	0..255[292]	1	[-]
Internal Buffer for complete FSC					
LOC_SWT_FSC_SIG_BUF[196]	-	0..FFH[196]	0..255[196]	1	[-]
Internal Buffer for IMOB FSC Sig Reversed					
LV_SWT_CHK_FSC_ENA	-	0..1H	0..1	1	[-]
Flag which makes ACTION_SWT_ChkFsc( ) executable without L3 Authentication.					

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TMP_U8_FSC_HASH_MD5 [16]	-	0..FFH	0..255	1	[-]
Temporary MD5 Result of FSC header					
STATE_SWT_CHK_FSC	V	0..FFH	0..255	1	[-]
State of the acual FSC calculation Check					
SWT_CALC_CYCLE_COUNT	-	0..FFH	0..255	1	[-]
calculation of x cycles during one function call					
LV_SWT_VMAX_ENA	O/V	0..1H	0..1	1	[-]
Flag shows if V MAX functionality is activated					
LV_SWT_PMAX_ENA	O/V	0..1H	0..1	1	[-]
Flag shows if P MAX functionality is activated					
LV_SWT_CHK_VMAX_FINISHED	V	0..1H	0..1	1	[-]
Flag shows if Periodical Check of VMAX FSC is finished					
LV_SWT_CHK_PMAX_FINISHED	O/V	0..1H	0..1	1	[-]
Flag shows if Periodical Check of PMAX FSC is finished					
TMP_U32_FSC_CHK[33]	-	0..FFFFFFFFH	0..4294967295	1	[-]
Result of signature check 1x FSC-signature + 4 Byte length (132 Byte)					
SWT_CRYPTO_SIG_BUFFER[65]	-	0..FFFFFFFFH	0..4294967295	1	[-]
Buffer for CR_A_NewAaMExp which stores 2x FSC-signature + 4Byte length (260 Byte)					
LV_SWT_FSC_PARSED	-	0..1H	0..1	1	[-]
Flag shows if EEPROM FSC is parsed					
LOC_SWID_KWP_FIRST_MSG	-	0...FFFFFFFFH	0..4294967295	1	[-]
Delivered SWID in SET_LEN message					
VIN_CAN_NVMY_WR[7]	O/S	0...FFH[7]	0..255[7]	1	[-]
Store short VIN in NVMY which is received from CAS					
VIN_CAN_NVMY_RD[7]	O/S	0...FFH[7]	0..255[7]	1	[-]
Read short VIN from NVMY which is received from CAS					

LV_AUTH_L3_ENA has to be calculated before every use.

9.54.1.1 Calibration Data

LC_SWT_CHK_VIN_CAS_ENA	1	0...1H	0...1	1	[-]
enable the check of VIN CAS: during "FSC_CHK" the VIN from CAS will be compared with VIN ECU (dataset)					
LC_SWT_CHK_FSC_STATUS_DENIED_ENA	1	0...1H	0...1	1	[-]
enable the check FSC in state denied					
C_SWT_SWID_APPNO	1	0...FFFFH	0...65535	1	[-]
application number which is part of the SWID					

Initialisation of calibration data:

LC_SWT_CHK_VIN_CAS_ENA = 1;
LC_SWT_CHK_FSC_STATUS_DENIED_ENA = 0;
C_SWT_SWID_APPNO = 0;

Exported actions:

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ACTION_SWT_SwidToCallid(IN<32bit SWID>, OUT<16bit CALL ID>)
Converts a 32bit SWID representation to a 16 bit CALL ID representation
ACTION_SWT_CallidToSwid(IN<16bit CALL ID>, OUT<32bit SWID>)
Converts a 16bit SWID representation to a 32 bit CALL ID representation
ACTION_SWT_SetFscLen(IN<32bit SWID>, IN<FSC_LEN>, OUT<SWT Returncode>)
Used by KWP to Set the complete length of the message Input Parameter: SWID: Software ID of the FSC which will be delivered FSC_LEN: Total Length of the FSC wihich will be delivered Output Parameter: SWT Returncode: **0x00:** Processing successfully; *) **0xFF:** Unknown failure; **0xFE:** SWID not in ECU/Invalid SWID; *) **0xD9:** No L3 authentication; **0xD6:** Wrong Parameter; *) **0xD3:** No free space for storing FSC *) used at Immobilizer FSC, too
ACTION_SWT_RcvFsc(IN<32bit SWID>, IN<u8ptr FSC>, IN<FRAME_LEN>, OUT<SWT Returncode>)
Used by KWP and UDS to overgive the FSC to the SWT Interface. Contains the complete FSC by calling from UDS. By calling from KWP the Action is called for every delivered segment. The Immobilizer FSC will be saved here temporary only in RAM. After successfully check "ACTION_SWT_ChkFsc", this informations will be stored in EEPROM and Flash. All other FSC will be stored here immediately into EEPROM without "Signature Check". The FSC-Status will be set to: **0x00**:nicht vorhanden; **0x01**:eingespielt; Input Parameter: SWID: Software ID of the FSC which will be delivered FSC: u8 Pointer to the beginning of the FSC segment FRAME_LEN: Total Length of the FSC Segment Output Parameter: SWT Returncode: **0x00:** Processing successfully; *) **0xFF:** Unknown failure; **0xFE:** SWID not in ECU/Invalid SWID; *) (KWP must send back 0xD6) **0xF8:** Invalid FSC Date; **0xE0:** Flash write error; **0xD9:** No L3 authentication; **0xD6:** Wrong Parameter; *) **0xD3:** No free space for storing FSC; **0xD1:** parser structure wrong / (IMOB FSC: Wrong); *) used at Immobilizer FSC, too
ACTION_SWT_ChkFsc(IN<32bit SWID>, OUT<SWT Returncode>)

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Checks an overgiven FSC.Immobilizer FSC: After successfully check, this information will be stored in EEPROM and Flash. All other FSC are already stored in EEPROM and will be checked here. The information about this check will be stored in EEPROM: **0x02**:akzeptiert; **0x03**:abgelehnt;0x00:nicht vorhanden; 0x01:eingespielt; 0x04:storniert; Input Parameter: SWID: Software ID of the FSC was delivered by ACTION_SWT_StrFSc and needs to be checked Output Parameter: SWT Returncode: **0x00:** Processing successfully; *) **0xFF:** Unknown failure; **0xFE:** SWID not in ECU/Invalid SWID; *) **0xFC:** wrong SWID inside FSC; **0xF9:** Signature invalid;*) **0xF8:** Invalid FSC Date; **) **0xF6:** FSC is not available; **0xF5:** FSC is rejected; **0xF4:** FSC is cancelled; **0xDF:** Flash read error; *) **0xDE:** VIN check failed **0xD9:** No L3 authentication; **0xD2:** VIN can not be found in ECU; (VIN is 0x00...) **0xD1:** IMOB FSC: Wrong; **) *) used at Immobilizer FSC, too **) used at Immobilizer FSC only
ACTION_SWT_GetSodtwareIdFunc(OUT<u8ptr NUMBER_OF_SWID>, OUT<SWID>, OUT<SWT Returncode>)
Returns all SWID's which are available in this SW (without IMOB-SWID) Input: Parameter: none Output Parameter: NumberOfSwids: SWID: Software ID's of the FSC which are available SWT Returncode: **0x00:** Processing successfully; **0xFF:** Unknown failure; **0xD6:** Wrong Parameter
ACTION_SWT_GetStatus(IN<32bit SWID>, OUT<u8ptr STATUS>, OUT<SWT Returncode>)

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Returns the status of the FSC which is selected by the SWID (without IMOB-SWID)
<u>Input: Parameter:</u>
SWID: Software ID of the FSC which status should be checked
<u>Output Parameter:</u>
Status: Status of the stored FSC:
0x00:nicht vorhanden; **0x01**:eingespielt; **0x02**:akzeptiert; **0x03**:abgelehnt; **0x04**:storniert
SWT Returncode:
0x00: Processing successfully;
0xFF: Unknown failure; (also used by Flash read error)
0xFE: SWID not in ECU/Invalid SWID; (KWP must send back 0xFF only if all requests are invalid)

ACTION_SWT_DisableFsc(IN<32bit SWID>, OUT<SWT Returncode>)

Reverse an valid FSC (without IMOB-FSC)
The information about the disabled FSC will be stored in EEPROM: **0x04**:storniert;
<u>Input: Parameter:</u>
SWID: Software ID of the FSC which status should be checked
<u>Output Parameter:</u>
SWT Returncode:
0x00: Processing successfully;
0xFF: Unknown failure; (also used by Flash read/write error)
0xFE: SWID not in ECU/Invalid SWID;
0xF6: FSC is not available;
0xF4: FSC is already disabled;
0xD9: No L3 authentication;

ACTION_SWT_GetFscLen(IN<32bit SWID>, OUT<u8ptr LENGTH>, OUT<SWT Returncode>)

Returns the length of the FSC which is selected by the SWID (without IMOB-SWID)
<u>Input: Parameter:</u>
SWID: Software ID of the FSC which length should be checked
<u>Output Parameter:</u>
<u>Length:</u> Length of the selected FSC
SWT Returncode:
0x00: Processing successfully;
0xFF: Unknown failure;
0xFE: SWID not in ECU/Invalid SWID;
0xF6: FSC is not available;
0xDF: Flash read error;

ACTION_SWT_GetFsc(IN<32bit SWID>, OUT<u8ptr FSC>, OUT<SWT Returncode>)

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Returns the complete FSC which is selected by the SWID (without IMOB-SWID)
Input: Parameter:
SWID: Software ID of the FSC which should be read
Output Parameter:
FSC: Freischaltcode (Header + Signature)
SWT Returncode:
0x00: Processing successfully;
0xFF: Unknown failure;
0xFE: SWID not in ECU/Invalid SWID; (KWP must send back **0xD6:** Wrong Parameter)
0xD6: Wrong Parameter; (also used for "FSC is not available")

ACTION_SWT_GetVin(OUT<u8ptr VIN>, OUT<SWT Returncode>)

Returns the Vehical Identification Number (Fahrgestellnummer)
Input: Parameter:
none
Output Parameter:
VIN: Vehical Identification Number (7 Byte)
SWT Returncode:
0x00: Processing successfully;
0xFF: Unknown failure;

ACTION_SWT_SetVin(IN<u8ptr VIN>, OUT<SWT Returncode>)

This action is simulating the storage of a new "VIN" into the ECU
Input: Parameter:
VIN: Vehical Identification Number (7 Byte)
Output Parameter:
SWT Returncode:
0x00: Processing successfully;
0xFF: Unknown failure;
0xE0: Flash write error; (VIN in ECU is not the received VIN)
0xD9: No L3 authentication;
0xD6: Wrong Parameter

ACTION_IMOB_ WrNvmyFscEws4A( )
Stores a IMOB FSC in EEPROM
ACTION_IMOB_ChkSigFsc( )
Checks if a IMOB FSC Signature is valid
ACTION_INTC_NO_VECH_REQ( )
Trigger CAS to send new VIN over CAN (VIN_CAN)

FSC Format for Parsing FSC

General information:

Fields 1-3 are for all possible FSCs the same;

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Nr	***Field name***	***FSC Offset (byte)***	***Value xx / Analysis: Yes/No***
1	Version	0	IMOB: 0x02: Version 2 SWT: VMAX/PMAX: 0x01 / No
2	SWID Type	1	IMOB: 0x02: Application SWT: VMAX/PMAX: 0x01 / No
3	SWID	2 3 4 5	App Nr Highbyte App Nr Lowbyte Upgrade Index Highbyte Upgrade Index Lowbyte / Yes

Special Format for Immobilizer FSC:

Nr	***Field name***	***FSC Offset (byte)***	
4	SupplierNr	6 7 8 9 10 11 12 13	8 bytes ASCII - not relevant -
5	RequesterType	14	- not relevant -
6	OrderNr	15 16 17 18 19 20 21 22	8 bytes ASCII -not relevant -
7	RequesterID	23 24 25 26 27	5 bytes ASCII - not relevant -
8	IndividualAttributeType	28	0x04:ECUSNR
9	IndividualAttribute	29 30 31 32 33 34 35 36 37	9bytes ASCII serialnumber*
10	Validity	38 39 40 41	-not relevant-
11	FSCS_ID	42 43 44 - 46 47 48 49	-not relevant-

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12	Date	50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67	18 bit Zero terminated ASCII-String e.g."200212312000+0000" YYYYMMDDHHMM+Timezone*
13	Extended	68 69 70 71 72 73 74 75	EWS config byte * EWS config byte * EWS config byte * EWS config byte * 0 0 0 0
14	Signature	76 .. 267	192 bytes Signature

- EWS config byte: 0x00, 0x00,0x00,0x01: secret development key
  0x00, 0x00,0x00,0x02: unlock
  0x00,0x00,0x00,0x00: secret key
- Serialnumber: Always 9 bytes in FSC. Compare with serial number in ECU: Bytes 0..8 for L4, byts Bytes 1..9 for L6
- Date stored in ASCII-values, Format YYYYMMDDHHMMSHHMM, S means: + or - as sign for the Timezone, e.g +0100

Special Format for VMAX /PMAX FSC

Nr	***Field name***	***Length***	***Value xx / Analysis: Yes/No***
4	SupplierNr	8	8 bytes ASCII / No
5	RequesterType	1	0x01: Werk 2Byte requesterID / Yes 0x02: Händler 5Byte requester ID / Yes
6	OrderNr	8	8 bytes ASCII / No
7	RequesterID	2, 5	2 / 5 bytes ASCII /No
8	IndividualAttributeType	1	0x01: VIN / No
9	IndividualAttribute	7	7 bytes VIN / Yes
10	Validity	4	0x01,0x00,0x00,0x00 / No
11	FSCS_ID	8	0xXX..0xXX / No
12	Date		14 bit Zero terminated ASCII-String e.g."200212312000Z" YYYYMMDDHHMMZ* /Yes
13	Extended	1	0x00 / No
14	Signature	128	128 bytes Signature /Yes

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Definitions of SWT returncodes

General information:

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Nr	Return code	Value	Description
	SWT_RC_OK	0x00	- Processing successfully -
	SWT_RC_UNKNOWN_ERROR	0xFF	- Unknown failure -
	SWT_RC_SW_NOT_EXISTENT	0xFE	- SWID not in ECU/Invalid SWID -
	SWT_RC_NOT_ACTIVATED	0xFD	- not used -
	SWT_RC_SWID_CHECK_FAILURE	0xFC	- wrong SWID inside FSC -
	SWT_RC_SWSIG_REJECTED	0xFB	- not used -
	SWT_RC_SWSIG_CHECK_FAILURE	0xFA	- not used -
	SWT_RC_SIG_CHECK_FAILURE	0xF9	-Signature invalid-
	SWT_RC_INVALID_FSC_CREATION_DATE	0xF8	- Invalid FSC Date -
	SWT_RC_WRONG_FSCS_ID_IN_FSC	0xF7	- not used -
	SWT_RC_FSC_NOT_EXISTENT	0xF6	- FSC is not available -
	SWT_RC_FSC_REJECTED	0xF5	- FSC is rejected -
	SWT_RC_FSC_CANCELLED	0xF4	- FSC is cancelled -
	SWT_RC_FSC_CHECK_FAILURE	0xF3	- not used -
	SWT_RC_CERT_NOT_EXISTENT	0xF2	- not used -
	SWT_RC_CERT_REJECTED	0xF1	- not used -
	SWT_RC_ROOT_CERT_NOT_EXISTENT	0xF0	- not used -
	SWT_RC_ROOT_CERT_NOT_READABLE	0xEF	- not used -
	SWT_RC_ROOT_CERT_CORRUPT	0xEE	- not used -
	SWT_RC_ROOT_CERT_REJECTED	0xED	- not used -
	SWT_RC_ROOT_CERT_INVALID	0xEC	- not used -
	SWT_RC_SIGS_CERT_NOT_EXISTENT	0xEB	- not used -
	SWT_RC_SIGS_CERT_NOT_CHECKED	0xEA	- not used -
	SWT_RC_SIGS_CERT_INVALID	0xE9	- not used -
	SWT_RC_SIGS_CERT_CHECK_FAILURE	0xE8	- not used -
	SWT_RC_FSCS_CERT_NOT_EXISTENT	0xE7	- not used -
	SWT_RC_FSCS_CERT_NOT_CHECKED	0xE6	- not used -
	SWT_RC_FSCS_CERT_INVALID	0xE5	- not used -
	SWT_RC_FSCS_CERT_CHECK_FAILURE	0xE4	- not used -
	SWT_RC_WRONG_CERT_CONTENT_VALIDITY	0xE3	- not used -
	SWT_RC_WRONG_CERT_CONTENT_ISSUER	0xE2	- not used -
	SWT_RC_WRONG_CERT_CONTENT_KEYUSAGE	0xE1	- not used -
	SWT_RC_FLASH_WRITE_ERROR	0xE0	- Flash write error -
	SWT_RC_FLASH_READ_ERROR	0xDF	- Flash read error -
	SWT_RC_FGN_CHECK_FAILURE	0xDE	- VIN check failed -
	SWT_RC_FGN_INVALID	0xDD	- VIN not valid -
	SWT_RC_VALIDITY_CHECK_FAILURE	0xDC	- not used -
	SWT_RC_SIGSID_AND_CERT_NOT_COMPATIBLE	0xDB	- not used -
	SWT_RC_BAD_FINGERPRINT	0xDA	- not used -
	SWT_RC_NOT_AUTHENTICATED	0xD9	- No L3 authentication -
	SWT_RC_MISSING_SG_DATA	0xD8	- not used -
	SWT_RC_FSCS_CERT_REJECTED	0xD7	- not used -
	SWT_RC_BAD_PARAM	0xD6	- Wrong Parameter -
	SWT_RC_BAD_FSC_CONTENT	0xD5	- not used -
	SWT_RC_WRONG_CERT_CONTENT_CRIT_ELEM	0xD4	- not used -
	SWT_RC_NO_FREE_SPACE	0xD3	- No free space for storing FSC -
	SWT_RC_FGN_ACCESS_FAILURE	0xD2	- VIN can not be found in ECU -
	SWT_RC_INVALID_FSC	0xD1	- parser structure wrong / IMOB FSC: Wrong - serialnumber-
	SWT_RC_EXTENSION_CHECK_FAILURE	0xD0	- not used -
	SWT_RC_LAST_MSG_NOT_RECEIVED_SFNS	0x12	RC only for UDS/KWP: subFunctionNotSupported
	SWT_RC_CALC_STILL_IN_WORK	0x78	RC only for UDS/KWP: calculation is still in work

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Definition of SWID and CALLID

General information:

The Software ID (SWID) is a 32 bit data type which contains 4 8bit fields. The CALL ID is a 16 bit short format used by KWP which is generated by 2 of the 4 SWID 8bit fields.

Project	*FSC function*	*16 bit CALLID*	*32 bit SWID*
	CALLID_IMOB_DME1 / SWID_IMOB_DME1	Highbyte #1: 0x07 Lowbyte #0: 0x40	AppNr Highbyte #3: 0x00 AppNr Lowbyte #2: **0x07** Upgr Idx Highbyte #1: **0x40** Upgr idx DA #0 : 0x00
	CALLID_IMOB_DME2 / SWID_IMOB_DME2	Highbyte #1: 0x09 Lowbyte #0: 0x12	AppNr Highbyte #3: 0x00 AppNr Lowbyte #2: **0x09** Upgr Idx Highbyte #1: **0x12** Upgr idx DA#0 : 0x00
Used @ MSD85.3 (4DS) only	CALLID_VMAX_DME1 / SWID_VMAX_DME1	Highbyte #1: 0x70 Lowbyte #0: 0x01	AppNr Highbyte #3: 0x00 AppNr Lowbyte #2: **0x70** Upgr Idx Highbyte #1: 0x00 Upgr idx DA #0 : **0x01**
Used @ MSD81 (4DC) only	CALLID_PMAX_DME1 / SWID_PMAX_DME1	Highbyte #1: C_SWT_SWID_APPNO: lobyte Lowbyte #0: 0x01 (Pmax only) or 0x02 (Pmax + Vmax)	AppNr Highbyte #3: C_SWT_SWID_APPNO: highbyte AppNr Lowbyte #2: C_SWT_SWID_APPNO: lobyte Upgr Idx Highbyte #1: 0x00 Upgr idx DA #0 : **0x01 (Pmax only) or 0x02 (Pmax + Vmax)**
Used @ MSD85.1 (4D8) only	CALLID_PMAX_DME1 / SWID_PMAX_DME1	Highbyte #1: 0x85 Lowbyte #0: 0x01	AppNr Highbyte #3: 0x00 AppNr Lowbyte #2: **0x85** Upgr Idx Highbyte #1: 0x00 Upgr idx DA #0 : **0x01**

General parser for VMAX (Data from EEPROM):

TMP_U8_CTR = 0
LOC_VMAX_FSC.SIZE =(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_VMAX_SIZE_LEN /*2BYTE*/
LOC_VMAX_FSC.STATUS =(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_VMAX_STATUS_LEN /*2BYTE*/
LOC_VMAX_FSC.VERSION=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_VMAX_VERSION_LEN /*1BYTE*/
LOC_VMAX_FSC.SWID_TYPE=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_VMAX_SWIDTYPE_LEN /*1BYTE*/
LOC_VMAX_FSC.SWID=(SWT_SWID*)(VOID*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX _SWID_LEN /*4BYTE*/
LOC_VMAX_FSC.SUPPLIER_NR=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_SUPPLIERNR_LEN /*8BYTE*/
LOC_VMAX_FSC.REQUESTER_TYPE=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_REQUESTERTYPE_LEN /*1BYTE*/
LOC_VMAX_FSC.ORDER_NR=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_ORDERNR_LEN /*8BYTE*/
LOC_VMAX_FSC.REQUESTER_ID=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
If(6) LOC_VMAX_FSC.REQUESTER_TYPE = 1
Then(6)TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_REQUSTERID_1_LEN /*2BYTE*/

Else(6) TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_REQUSTERID_2_LEN /*5BYTE*/

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```
Endif(6)
LOC_VMAX_FSC.INDIVIDUAL_ATTR_TYPE=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_INDIV_ATTR_TYPE_LEN /*1BYTE*/
LOC_VMAX_FSC.INDIVIDUAL_ATTR=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_INDIV_ATTR_LEN /*7BYTE*/
LOC_VMAX_FSC.VALIDITY=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_VALIDITY_LEN /*4BYTE*/
LOC_VMAX_FSC.FSCS_ID=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_FSCSID_LEN /*8BYTE*/
LOC_VMAX_FSC.DATE=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_DATE_LEN /*14BYTE*/
LOC_VMAX_FSC.EXTENDED=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_EXTENDED_LEN /*1BYTE*/
LOC_VMAX_FSC.SIGNATURE=(U8*) & FSC_XMAX_RD[TMP_U8_CTR]
LV_SWT_FSC_PARSED = 1
```

General parser for VMAX (Data from Diagnosis):

```
TMP_U8_CTR = 0
LOC_VMAX_DIAG_FSC.VERSION=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_VMAX_VERSION_LEN /*1BYTE*/
LOC_VMAX_DIAG_FSC.SWID_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_VMAX_SWIDTYPE_LEN /*1BYTE*/
LOC_VMAX_DIAG_FSC.SWID=(SWT_SWID*)(VOID*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX _SWID_LEN /*4BYTE*/
LOC_VMAX_DIAG_FSC.SUPPLIER_NR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_SUPPLIERNR_LEN /*8BYTE*/
LOC_VMAX_DIAG_FSC.REQUESTER_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_REQUESTERTYPE_LEN /*1BYTE*/
LOC_VMAX_DIAG_FSC.ORDER_NR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_ORDERNR_LEN /*8BYTE*/
LOC_VMAX_DIAG_FSC.REQUESTER_ID=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
If(6)        LOC_VMAX_DIAG_FSC.REQUESTER_TYPE = 1
Then(6)TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_REQUSTERID_1_LEN   /*2BYTE*/

Else(6)        TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_REQUSTERID_2_LEN   /*5BYTE*/

Endif(6)
LOC_VMAX_DIAG_FSC.INDIVIDUAL_ATTR_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_
CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_INDIV_ATTR_TYPE_LEN /*1BYTE*/
LOC_VMAX_DIAG_FSC.INDIVIDUAL_ATTR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_INDIV_ATTR_LEN /*7BYTE*/
LOC_VMAX_DIAG_FSC.VALIDITY=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_VALIDITY_LEN /*4BYTE*/
LOC_VMAX_DIAG_FSC.FSCS_ID=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_FSCSID_LEN /*8BYTE*/
LOC_VMAX_DIAG_FSC.DATE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_DATE_LEN /*14BYTE*/
LOC_VMAX_DIAG_FSC.EXTENDED=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_VMAX_EXTENDED_LEN /*1BYTE*/
LOC_VMAX_DIAG_FSC.SIGNATURE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
```

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General parser for PMAX (Data from EEPROM):

```
TMP_U8_CTR = 0
LOC_PMAX_FSC.SIZE =(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_PMAX_SIZE_LEN /*2BYTE*/
LOC_PMAX_FSC.STATUS =(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_PMAX_STATUS_LEN /*2BYTE*/
LOC_PMAX_FSC.VERSION=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_PMAX_VERSION_LEN /*1BYTE*/
LOC_PMAX_FSC.SWID_TYPE=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_PMAX_SWIDTYPE_LEN /*1BYTE*/
LOC_PMAX_FSC.SWID=(SWT_SWID*)(VOID*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX _SWID_LEN /*4BYTE*/
LOC_PMAX_FSC.SUPPLIER_NR=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_SUPPLIERNR_LEN /*8BYTE*/
LOC_PMAX_FSC.REQUESTER_TYPE=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_REQUESTERTYPE_LEN /*1BYTE*/
LOC_PMAX_FSC.ORDER_NR=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_ORDERNR_LEN /*8BYTE*/
LOC_PMAX_FSC.REQUESTER_ID=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
If(6)        LOC_PMAX_FSC.REQUESTER_TYPE = 1
 Then(6)TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_REQUSTERID_1_LEN   /*2BYTE*/

Else(6)        TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_REQUSTERID_2_LEN   /*5BYTE*/

Endif(6)
LOC_PMAX_FSC.INDIVIDUAL_ATTR_TYPE=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_INDIV_ATTR_TYPE_LEN /*1BYTE*/
LOC_PMAX_FSC.INDIVIDUAL_ATTR=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_INDIV_ATTR_LEN /*7BYTE*/
LOC_PMAX_FSC.VALIDITY=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_VALIDITY_LEN /*4BYTE*/
LOC_PMAX_FSC.FSCS_ID=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_FSCSID_LEN /*8BYTE*/
LOC_PMAX_FSC.DATE=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_DATE_LEN /*14BYTE*/
LOC_PMAX_FSC.EXTENDED=(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_EXTENDED_LEN /*1BYTE*/
LOC_PMAX_FSC.SIGNATURE=(U8*) & FSC_XMAX_RD[TMP_U8_CTR]
LV_SWT_FSC_PARSED = 1
```

General parser for PMAX (Data from Diagnosis):

```
TMP_U8_CTR = 0
LOC_PMAX_DIAG_FSC.VERSION=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_PMAX_VERSION_LEN /*1BYTE*/
LOC_PMAX_DIAG_FSC.SWID_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_PMAX_SWIDTYPE_LEN /*1BYTE*/
LOC_PMAX_DIAG_FSC.SWID=(SWT_SWID*)(VOID*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX _SWID_LEN /*4BYTE*/
LOC_PMAX_DIAG_FSC.SUPPLIER_NR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_SUPPLIERNR_LEN /*8BYTE*/
LOC_PMAX_DIAG_FSC.REQUESTER_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
```

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```
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_REQUESTERTYPE_LEN /*1BYTE*/
LOC_PMAX_DIAG_FSC.ORDER_NR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_ORDERNR_LEN /*8BYTE*/
LOC_PMAX_DIAG_FSC.REQUESTER_ID=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
If(6)        LOC_PMAX_DIAG_FSC.REQUESTER_TYPE = 1
Then(6)TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_REQUSTERID_1_LEN   /*2BYTE*/

Else(6)        TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_REQUSTERID_2_LEN   /*5BYTE*/

Endif(6)
LOC_PMAX_DIAG_FSC.INDIVIDUAL_ATTR_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_
CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_INDIV_ATTR_TYPE_LEN /*1BYTE*/
LOC_PMAX_DIAG_FSC.INDIVIDUAL_ATTR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_INDIV_ATTR_LEN /*7BYTE*/
LOC_PMAX_DIAG_FSC.VALIDITY=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_VALIDITY_LEN /*4BYTE*/
LOC_PMAX_DIAG_FSC.FSCS_ID=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_FSCSID_LEN /*8BYTE*/
LOC_PMAX_DIAG_FSC.DATE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_DATE_LEN /*14BYTE*/
LOC_PMAX_DIAG_FSC.EXTENDED=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_PMAX_EXTENDED_LEN /*1BYTE*/
LOC_PMAX_DIAG_FSC.SIGNATURE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
```

General parser for IMOB (Data from Diagnosis):

```
TMP_U8_CTR = 0
LOC_IMOB_FSC.VERSION=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_IMOB_VERSION_LEN /*1BYTE*/
LOC_IMOB_FSC.SWID_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR = TMP_U8_CTR + NC_FSC_IMOB_SWIDTYPE_LEN /*1BYTE*/
LOC_IMOB_FSC.SWID=(SWT_SWID*)(VOID*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_SWID_LEN /*4BYTE*/
LOC_IMOB_FSC.SUPPLIER_NR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_SUPPLIERNR_LEN /*8BYTE*/
LOC_IMOB_FSC.REQUESTER_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_REQUESTERTYPE_LEN /*1BYTE*/
LOC_IMOB_FSC.ORDER_NR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_ORDERNR_LEN /*8BYTE*/
LOC_IMOB_FSC.REQUESTER_ID=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_REQUSTERID_LEN /*5BYTE*/
LOC_IMOB_FSC.INDIVIDUAL_ATTR_TYPE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_INDIV_ATTR_TYPE_LEN /*1BYTE*/
LOC_IMOB_FSC.INDIVIDUAL_ATTR=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_INDIV_ATTR_LEN /*9BYTE*/
LOC_IMOB_FSC.VALIDITY=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_VALIDITY_LEN /*4BYTE*/
LOC_IMOB_FSC.FSCS_ID=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_FSCSID_LEN /*8BYTE*/
LOC_IMOB_FSC.DATE=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_DATE_LEN /*18BYTE*/
```

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LOC_IMOB_FSC.EXTENDED=(U8*)& LOC_SWT_FSC_BUF[TMP_U8_CTR]
TMP_U8_CTR=TMP_U8_CTR+NC_FSC_IMOB_EXTENDED_LEN /*8BYTE*/
LOC_IMOB_FSC.SIGNATURE=(U8*)LOC_SWT_FSC_SIG_BUF

ACTION_SWT_SwidToCallid(IN <32bit SWID>, OUT <16bit CALL ID>)

General Information:

This function converts a 32bit SWID into a 16bit CALLID for KWP_Frames.
32bit SWID is seperated in Byte 0(LSB)...Byte 3(MSB)
16bit CALLID is seperated in Byte 0(LSB)...Byte 1(MSB)

Formula section:

If SWID == *Swid definition for Imob DME1* **OR**
SWID == *Swid definition for Imob DME2*
Then
/* Immobilizer only: Upgrade Index is switched here */
CALLID Byte 0 (Low Byte) = SWID Byte 1 (Upgrade Index HIGHBYTE)
CALLID Byte 1 (High Byte) = SWID Byte 2 (AppNr. Low Byte)
Else /* Standard SWID like described in SWT Classic Light */
CALLID Byte 0 (Low Byte) = SWID Byte 0 (Upgrade index DA)
CALLID Byte 1 (High Byte) = SWID Byte 2 (AppNr. Low Byte)
Endif

ACTION_SWT_CallidToSwid(IN <16bit CALL ID>, OUT <32bit SWID>)

General Information:

This function converts a 16bit CALLID from KWP_Frames into a 32bit SWID.
32bit SWID is seperated in Byte 0(LSB)...Byte 3(MSB)
16bit CALLID is seperated in Byte 0(LSB)...Byte 1(MSB)

Formula section:

If CALLID == *CALLID definition for Imob DME1* **OR**
CALLID == *CALLID definition for Imob DME2*
Then /* Immobilizer FSC only: Upgrade Index is switched here */
SWID Byte 0 = 0x0
SWID Byte 1 = CALLID Byte 0
SWID Byte 2 = CALLID Byte 1
SWID Byte 3 = 0x0

Else /* for all other FSC */
SWID Byte 0 = CALLID Byte 0
SWID Byte 1 = 0x0
SWID Byte 2 = CALLID Byte 1
SWID Byte 3 = 0x0

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Endif

ACTION_SWT_SetFscLen(IN <32bit SWID>, <FSC_LEN>,OUT <SWT Returncode>)

General Information:

This action sets the expeted FSC length at the SWT_Interface. It needs to be called only if the FSC is transmitted via KWP Frames (L4) because the FSC is delivered in segments. This function stores the expected message length and its SWID to the SWT Interface.

Returnvalues are defined in the action tables.

Formula section:

LOC_FSC_BYTES_RCV=0

If FSC_LEN> NC_SIZE_FSC_BUFFER (296 bytes)
Then
LOC_FSC_EXP_LEN = 0
LOC_SWID_KWP_FIRST_MSG = 0
exit with Error Code SWT_RC_BAD_PARAM
Endif
If(1) LV_ECU_SLA /* slave ecu */
Then(1)**If**(2) SWID == *Swid definition for Imob DME2*
Then(2)LOC_FSC_EXP_LEN=FSC_LEN
LOC_SWID_KWP_FIRST_MSG = SWID
exit with Return Code SWT_RC_OK **Else**(2) LOC_FSC_EXP_LEN = 0
LOC_SWID_KWP_FIRST_MSG = 0
exit with Error Code SWT_RC_SW_NOT_EXISTENT
Endif(2)
Else(1) /* master ecu */
If(3) SWID == *Swid definition for Imob DME1*
Then(3)LOC_FSC_EXP_LEN=FSC_LEN
LOC_SWID_KWP_FIRST_MSG = SWID
exit with Return Code SWT_RC_OK
Else If(3) (SWID == Swid definition for Vmax only and NC_SWT_MOD defined for V
only) **OR**
(SWID == Swid definition Pmax and NC_SWT_MOD defined for Pmax + opt. Vmax)
/* Initialisation is needed in case of EEPROM error at startup
(callback routine was called) */
LV_SWT_FSC_WR_FINISHED = 0
If(4) (LV_AUTH_L3_ENA)
/*Level3 Authentication*/
Then(4)**If**(5) FSC_LEN < BUFFER FOR FSC IN EEPROM (200Byte)
Then(5)LOC_FSC_EXP_LEN=FSC_LEN
LOC_SWID_KWP_FIRST_MSG = SWID

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```
                    exit with  Return Code SWT_RC_OK
                Else(5)        LOC_FSC_EXP_LEN = 0
                    LOC_SWID_KWP_FIRST_MSG = 0
                    exit with Error Code SWT_RC_NO_FREE_SPACE
                Endif(5)
            Else(4)        LOC_FSC_EXP_LEN = 0
                LOC_SWID_KWP_FIRST_MSG = 0
                exit with Error Code   SWT_RC_NOT_AUTHENTICATED
            Endif(4)
        Else(3)
            LOC_FSC_EXP_LEN = 0
            LOC_SWID_KWP_FIRST_MSG = 0
            exit with Error Code SWT_RC_SW_NOT_EXISTENT
        Endif(3)
Endif(1)
```

ACTION_SWT_RcvFsc(IN <32bit SWID>, <u8ptr FSC>, <FSC_FRAME_LEN>, OUT <SWT Returncode>)

General Information:

IMOB FSC:This action stores the given FSC in RAM or returns an Error code. For KWP_frames this ACTION is called for every segment.

It will return: SWT_RC_OK if sucessfull
SWT_RC_SW_NOT_EXISTENT if invalid SWID
SWT_RC_BAD_PARAM if FRAME_LEN is invalid

Formula section:

STATE_KWP_IMOB_STORE_K_EWS_ENA=0

```
If(1)          UDS   is active
Then(1)If(2)      LV_ECU_SLA   /* SLAVE ECU */
        Then(2)If(3)         SWID == Swid definition for Imob DME2
            Then(3)If(4)         FSC_FRAME_LEN<= NC_SIZE_FSC_BUFFER (296 bytes)
                Then(4)STATE_KWP_IMOB_STORE_K_EWS_ENA=1
                    LOC_SWT_FSC_BUF = FSC
                    exit with  Return Code SWT_RC_OK
                Else(4)
                exit with Error Code SWT_RC_BAD_PARAM
                Endif(4)
            Else(3)        exit with Error Code SWT_RC_SW_NOT_EXISTENT
            Endif(3)
        Else(2)        /* master ecu */
            If(3)         SWID == Swid definition for Imob DME1
            Then(3)If(4)         FSC_FRAME_LEN<= NC_SIZE_FSC_BUFFER
                Then(4)STATE_KWP_IMOB_STORE_K_EWS_ENA=1
                    LOC_SWT_FSC_BUF = FSC //COPY FRAME_LEN BYTESTO BUFFER

                    exit with  Return Code SWT_RC_OK
```

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```
                                Else(4)
                                exit with Error Code SWT_RC_BAD_PARAM
                                Endif(4)
                        Else(3)          exit with Error Code SWT_RC_SW_NOT_EXISTENT
                        Endif(3)
                Endif(2)
Endif(1)

If (1)KWP is active
Then(1)If(2)   LOC_SWID_KWP_FIRST_MSG==SWID
                Then(2)   If(3)   SWID == Swid definition for Imob DME1
                        Then(3) If(4)   LOC_FSC_BYTES_RCV+FSC_FRAME_LEN >
                                                        LOC_FSC_EXP_LEN
                                Then(4) exit with Error Code SWT_RC_BAD_PARAM
                                Else(4)          set the storage position of loc_swt_fsc_buf
                                        to a offset of loc_fsc_bytes_rcv
                                        FOR i=0 to FSC_FRAME_LEN; i++
                                        LOC_SWT_FSC_BUF[i+LOC_FSC_BYTES_RCV]
                                        = FSC[i]
                                        ENDFOR
                                        LOC_FSC_BYTES_RCV =
                                        LOC_FSC_BYTES_RCV + FSC_FRAME_LEN
                                        IfLOC_FSC_BYTES_RCV=LOC_FSC_EXP_LEN
                                        Then
                                        /* Enable Check Diag */
                                        STATE_KWP_IMOB_STORE_K_EWS_ENA=1
                                        Endif
                                        exit with  Return Code SWT_RC_OK
                                Endif(4)
                                Else If(3) (SWID == Swid definition for   Vmax only
                                                and NC_SWT_MOD defined for   Vmax only   ) OR
                                               (SWID == Swid definition Pmax
                                               and NC_SWT_MOD defined for   Pmax + opt. Vmax )
                                        If(A)   (!LV_SWT_FSC_WR_IN_WORK)
                                        Then  (A)
                                         If(B)   (LV_SWT_FSC_WR_FINISHED & &   (LOC_FSC_EXP_LEN >
0))

                                        Then(B)          LV_SWT_FSC_WR_FINISHED = 0;
                                                If(C)            LV_FSC_XMAX_WR_OK
                                                Then(C)     SWT_FSC_XMAX_STATUS=1 /*eingespiel*/
                                                        exit with  Return Code SWT_RC_OK
                                                 Else(C)          exit with Error Code SWT_RC_FLASH_WRITE_
ERROR

                                                Endif(C)
                                        Else(B)
                                       If(4)   LOC_FSC_BYTES_RCV+FSC_FRAME_LEN > LOC_FSC_EXP_
LEN

                                        Then(4) exit with Error Code SWT_RC_BAD_PARAM
                                        Else(4)          set the storage position of loc_swt_fsc_buf
                                                to a offset of loc_fsc_bytes_rcv
                                                FOR i=0 to FSC_FRAME_LEN; i++
                                                LOC_SWT_FSC_BUF[i+LOC_FSC_BYTES_RCV] = FSC[i]
```

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ENDFOR
LOC_FSC_BYTES_RCV =
LOC_FSC_BYTES_RCV + FSC_FRAME_LEN
If(5)(LOC_FSC_BYTES_RCV == LOC_FSC_EXP_LEN)
Then(5)
/* FSC is complete received */
If(6) (LV_AUTH_L3_ENA) /*Level3 Authentication*/
Then(6)
If(7) LOC_FSC_BYTES_RCV < BUFFER FOR FSC IN EEPROM (200Byte)
Then(7)
If(8) NC_SWT_MOD defined for VMAX
Then(8)
Call general parser for VMAX (EEPROM);
/* Read DATE FROM STORED FSC IN EEPROM */
If(9) (LOC_VMAX_FSC.SIZE == 188 **and** VMAX_FSC.REQUESTER_TYPE == 1 /*Werk*/)
Then(9) /* FSC structure is correct */
Else If(9) (LOC_VMAX_FSC.SIZE == 191 **and** VMAX_FSC.REQUESTER_TYPE == 2 /*Händler*/)
Then(9) /* FSC structure is correct */
Else(9) /*No or wrong FSC in EEPROM: No Date is available*/
LOC_VMAX_FSC.DATE = 0x00000000000000;
Endif(9)
/* Read DATE FROM RECEIVED DIAG MESSAGE */
Call general parser for VMAX (Diagnosis);
If(10) (LOC_FSC_EXP_LEN == 188 **and** VMAX_DIAG_FSC.REQUESTER_TYPE == 1)
Then(10) /* FSC structure is correct */
Else If(10) (LOC_FSC_EXP_LEN == 191 **and** VMAX_DIAG_FSC.REQUESTER_TYPE == 2)
Then(10) /* FSC structure is correct */
Else(10) *exit with Error Code SWT_RC_INVALID_FSC*
Endif(10)
If(D)
(LOC_VMAX_FSC.STATUS = 0X04/* DISABLED*/
AND (LOC_VMAX_DIAG_FSC.DATE
is valid and is newer LOC_VMAX_FSC.DATE))
OR
(LOC_VMAX_FSC.STATUS != 0X04/* DISABLED*/
AND(LOC_VMAX_DIAG_FSC.DATE
is valid and is (newer or equal) than
LOC_VMAX_FSC.DATE **))**
Then(D)
/* copy the Lenghth to Buffer for EEPROM writing */
FSC_XMAX_WR[0] = LOC_FSC_EXP_LEN
FSC_XMAX_WR[1] = 0
FSC_XMAX_WR[2] = 1 /* FSC Status: "eingespielt" */
FSC_XMAX_WR[3] = 0
/* copy complete FSC (188 Byte or 191 Byte) to Buffer for EEPROM writing */
FSC_XMAX_WR[4... LOC_FSC_EXP_LEN +3] = SWT_FSC_BUF[0...LOC_FSC_EXP_LEN -1]

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/*start store FSC in EEPROM */
ACTION_SWT_WrNvmyFscXMAX( )
exit with ErrorCode SWT_RC_CALC_STILL_IN_WORK

Else(D)*exit with ErrorCode* SWT_RC_INVALID_FSC_CREATION_DATE
Endif(D)

Else If(8) NC_SWT_MOD defined for Pmax + opt. Vmax
Call general parser for PMAX (EEPROM);
/* Read DATE FROM STORED FSC IN EEPROM */
If(E) (LOC_PMAX_FSC.SIZE == 188 **and** PMAX_FSC.REQUESTER_TYPE == 1 /*Werk*/)
Then(E) /* FSC structure is correct */
Else If(E) (LOC_PMAX_FSC.SIZE == 191 **and** PMAX_FSC.REQUESTER_TYPE == 2 /*Händler*/)
Then(E) /* FSC structure is correct */
Else(E) /*No or wrong FSC in EEPROM: No Date is available*/
LOC_PMAX_FSC.DATE = 0x00000000000000;
Endif(E)
/* Read DATE FROM RECEIVED DIAG MESSAGE */
Call general parser for PMAX (Diagnosis);
If(F) (LOC_FSC_EXP_LEN == 188 **and** PMAX_DIAG_FSC.REQUESTER_TYPE == 1)
Then(F) /* FSC structure is correct */
Else If(F) (LOC_FSC_EXP_LEN == 191 **and** PMAX_DIAG_FSC.REQUESTER_TYPE == 2)
Then(F) /* FSC structure is correct */
Else(F) *exit with Error Code SWT_RC_INVALID_FSC*
Endif(F)
If(H) (*SWID received as function parameter == SWID of the FSC to store*)
Then(H) /* SWIDs are equal */
Else(H) *exit with Error Code SWT_RC_INVALID_FSC*
If(G) (LOC_PMAX_FSC.STATUS = 0X04/* DISABLED*/

AND (LOC_PMAX_DIAG_FSC.DATE
is valid and is newer LOC_PMAX_FSC.DATE))
OR
(LOC_PMAX_FSC.STATUS != 0X04/* DISABLED*/
AND(LOC_PMAX_DIAG_FSC.DATE
is valid and is (newer or equal) than
LOC_PMAX_FSC.DATE **))**

Then(G)
/* copy the Lenghth to Buffer for EEPROM writing */
FSC_XMAX_WR[0] = LOC_FSC_EXP_LEN
FSC_XMAX_WR[1] = 0
FSC_XMAX_WR[2] = 1 /* FSC Status: "eingespielt" */
FSC_XMAX_WR[3] = 0
/* copy complete FSC (188 Byte or 191 Byte) to Buffer for EEPROM writing */

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FSC_XMAX_WR[4... LOC_FSC_EXP_LEN +3] = SWT_FSC_BUF[0...LOC_FSC_EXP_LEN -1]
/*start store FSC in EEPROM */
ACTION_SWT_WrNvmyFscXMAX( )
exit with ErrorCode SWT_RC_CALC_STILL_IN_WORK

Else(G)*exit with ErrorCode* SWT_RC_INVALID_FSC_CREATION_DATE
Endif(G)
Else(8) exit with Error Code unknown error
Endif(8)
Else(7) *exit with Error Code SWT_RC_NO_FREE_SPACE*
Endif(7)
Else(6) *exit with Error Code SWT_RC_NOT_AUTHENTICATED*
Endif(6)
Endif(5) *exit with Return Code SWT_RC_OK*
Endif(4)
Endif(B)
Else(A) *exit with Error Code SWT_CALC_STILL_IN_WORK*
Endif(A)
Else(3)*exit with Error Code SWT_RC_SW_NOT_EXISTENT*
Endif(3)
Else(2)*exit with Error Code SWT_RC_SW_NOT_EXISTENT*
Endif(2)
Endif(1)

ACTION_SWT_ChkFsc (IN <32bit SWID>,OUT <SWT Returncode>)

General Information:

IMOB SWT:

This action checks the delivered FSC by valid serial_number, FSC creation date, SWID and enables the storage of the FSC into EEPROM and Flash.
General SWT:
This action checks the delivered FSC by valid VIN and SWID.
The Vatiable "LV_FSC_XMAX_RD_OK" is defined in "anvmswt.c" which doesn't need a specification.

Formula section:

If(1) SWID == *Swid definition for Imob DME1* **OR**
SWID == *Swid definition for Imob DME2*
Then(1)**If**(2) STATE_KWP_IMOB_STORE_K_EWS_ENA=1
Then(2)**If**(3) **NOT**(STATE_IMOB_2_ERR & MASK_ERR_SYM_1)
exit with value of subroutine: specific immobilzer check (see below)
Else(3) *exit with Error Code SWT_RC_FLASH_READ_ERROR*
Endif(3)
Else(2) *exit with Error Code SWT_RC_LAST_MSG_NOT_RECEIVED_SFNS*
Endif(2)
Else **If**(1) (SWID == Swid definition for Vmax only and NC_SWT_MOD defined for Vmax only)
Then(1) *exit with value of subroutine: specific vmax check (see below)*

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ElseIf(1) (SWID == Swid definition Pmax and NC_SWT_MOD defined for Pmax + opt. Vmax)
Then(1) *exit with value of subroutine: specific pmax check (see below)*
Else(1) *exit with Error Code SWT_RC_SW_NOT_EXISTENT*
Endif(1)

Subroutine: Store FSC Status in EEPROM

/* copy the Lenghth to Buffer for EEPROM writing */
FSC_XMAX_WR[0] = FSC_XMAX_RD[0]
FSC_XMAX_WR[1] = 0
FSC_XMAX_WR[2] = SWT_FSC_XMAX_STATUS /* new FSC Status*/
FSC_XMAX_WR[3] = 0
/* copy complete FSC (188 Byte or 191 Byte) to Buffer for EEPROM writing */
FSC_XMAX_WR[4... 199] = FSC_XMAX_RD [4...199]
/*store FSC in EEPROM */
ACTION_SWT_WrNvmyFscVMAX( )
/* New Status is needed for FSC_XMAX_RD too */
FSC_XMAX_RD[2] = SWT_FSC_XMAX_STATUS /* new FSC Status */

Subroutine: Specific checks for Immobilizer FSC

TMP_U8PTR_FSC_DATE = cs_ee_FSC_ews4_A #Byte 50-67

copy sig in reverse order + lengthbyte
/* NC_IMOB_SIG_BUF_LEN 192 Byte */
/* NC_SIZE_STREAM_FSC_LEN_BYTE 4 Byte */
/* NC_IMOB_SIG_BUF_LEN = NC_IMOB_FSC_SIG_LEN +NC_SIZE_STREAM_FSC_LEN_BYTE */

FOR TMP_U8_CTR=0 to NC_IMOB_FSC_SIG_LEN; TMP_U8_CTR++ //192 byte
LOC_SWT_FSC_SIG_BUF[NC_IMOB_SIG_BUF_LEN-1-TMP_U8_CTR] = LOC_SWT_FSC_BUF[NC_IMOB_FSC_HEADER_LEN+TMP_U8_CTR]
ENDFOR

LOC_SWT_FSC_SIG_BUF[0]=48 /* 192 BYTE = 48X32BIT */
LOC_SWT_FSC_SIG_BUF[1]=0
LOC_SWT_FSC_SIG_BUF[2]=0
LOC_SWT_FSC_SIG_BUF[3]=0

Call general parser for IMOB (Diagnosis);

If(1) SWID == LOC_IMOB_FSC.SWID
Then(1)**If**(2) (LOC_IMOB_FSC.DATE*is valid and is newer than* TMP_U8PTR_FSC_DATE)

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```
                    OR TMP_U8PTR_FSC_DATE is invalid*          // see date representation above
          Then(2)If(3)          LOC_IMOB_FSC.INDIVIDUAL_ATTR_TYPE==0x04                          Then(3)
If(4)
                              LOC_IMOB_FSC.INDIVIDUAL_ATTR==SERIAL_NUMBER                          Then(4)
If(5)          ( ACTION_IMOB_ChkSigFsc
                                     (loc_swt_fsc_buf,loc_imob_fsc.signature) ==1 )
                                     Then(5) PTR_FSC_CONFIG_EWS4=
                                            LOC_IMOB_FSC.EXTENDED+3
                                            //copy first 100 bytes
                                            RS_FSC_EWS4_A=LOC_SWT_FSC_BUF
                                            ACTION_IMOB_WrNvmyFscEws4A
                                            /* ENABLE STORING IN FLASH */
                                            STATE_KWP_IMOB_STORE_K_EWS_ENA=2
                                             exit with Return Code SWT_RC_OK
                                     Else(5)          exit with Error Code
                                             SWT_RC_SIG_CHECK_FAILURE
                                     Endif(5)
                              Else(4)          exit with Error Code SWT_RC_INVALID_FSC;
                              Endif(4)
                    Else(3)          exit with Error Code SWT_RC_INVALID_FSC;
                    Endif(3)
          Else(2)          exit with Error Code   SWT_RC_INVALID_FSC_CREATION_DATE
          Endif(2)
Else(1)   exit with Error Code   SWT_RC_SW_NOT_EXISTENT
Endif(1)
```

*Remark:
IMOB-FSC:
A Date is valid if the 18 byte representation contains only reasonable ASCII-Chars and the resulting Date is between 01.01.1997 and 31.12.2499
SWT-FSC:
A Date is valid if the 14 byte representation contains only reasonable ASCII-Chars and the resulting Date is between 01.01.1997 and 31.12.2499

Subroutine: Specific checks für VMAX

```
If(1)          (LV_AUTH_L3_ENA or (LV_SWT_CHK_FSC_ENA)) /*Level3 Authentication*/
          Then(1)          /* Read FSC from EEPROM */
           If(3)   ( STATE_SWT_CHK_FSC == 0)
           Then(3) /* Start FSC Header Check*/
                    If(4)          (LV_FSC_XMAX_RD_OK)
                    Then(4) /* FSC is restored correct from EEPROM */
                    Call general parser for VMAX;
                    Else(4) exit with Error Code  SWT_RC_FLASH_READ_ERROR
                    Endif(4)
                    /* Check if FSC is valid and stored in EEPROM */
                    If(7) (LOC_VMAX_FSC.STATUS == 0X00) /*nicht vorhanden*/
                    Then(7)/* No FSC is stored in EEPROM */
                              SWT_FSC_XMAX_STATUS = 0x00 /*nicht vorhanden*/
                              exit with Error Code SWT_RC_FSC_NOT_EXISTENT
                    Else If(7) (LOC_VMAX_FSC.STATUS = 0X01 /*eingespielt*/
                    Then(7)   /*CHECK OK*/
```

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```
        SWT_FSC_XMAX_STATUS = 0x01 /*eingespielt*/
Else If(7) LOC_VMAX_FSC.STATUS = 0X02 /*akzeptiert*/
Then(7)/*CHECK OK*/
        SWT_FSC_XMAX_STATUS = 0x02 /*akzeptiert*/
Else If(7)  (LOC_VMAX_FSC.STATUS == 0X03) /*abgelehnt*/
Then(7)/* FSC is rejected */
        SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
        If(8)          (LC_SWT_CHK_FSC_STATUS_DENIED_ENA == 1)
        Then(8)    exit with Error Code SWT_RC_FSC_REJECTED
        Else(8)    /* check also FSC in status denied */
        Endif(8)
Else If(7)  (LOC_VMAX_FSC.STATUS == 0X04) /*storniert*/
Then(7)/* FSC is cancelled */
        SWT_FSC_XMAX_STATUS = 0x04 /*storniert*/
        exit with Error Code SWT_RC_FSC_CANCELLED
Else(7)          /* invalid FSC */
        SWT_FSC_XMAX_STATUS = 0x00 /*nicht vorhanden*/
        exit with Error Code SWT_RC_UNKNOWN_ERROR
Endif(7)

/* check if SWID inside FSC which is stored in EEPROM is correct*/
If(5)           (LOC_VMAX_FSC.SWID == Swid definition for   Vmax only )
Then(5)   /*CHECK OK*/
Else(5)SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
        call "Store FSC Status in EEPROM"
        LV_SWT_VMAX_ENA = 0;
        exit with Error Code  SWT_RC_SWID_CHECK_FAILURE
Endif(5)

/* Check if Requester-Type is correct */
If(8) (LOC_VMAX_FSC.REQUESTER_TYPE == 1 OR LOC_VMAX_FSC.REQUESTER_
TYPE == 2)
Then(8)            /*CHECK OK*/
Else(8)SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
        call "Store FSC Status in EEPROM"
        LV_SWT_VMAX_ENA = 0;
        exit with Error Code SWT_RC_UNKNOWN_ERROR
Endif(8)

/* Check if   "individual_attr_type" is set to VIN short (FGN kurz) */
If(9) (LOC_VMAX_FSC.INDIVIDUAL_ATTR_TYPE == 1)
Then(9)           /*CHECK OK*/
Else(9)SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
        call "Store FSC Status in EEPROM"
        LV_SWT_VMAX_ENA = 0;
        exit with Error Code SWT_RC_UNKNOWN_ERROR
Endif(9)

/* Check if VIN is stored correct in ECU */
If(A) (kwp_io_vin[10..16] != 0x00,00,00,00,00,00,00)
Then(A)           /*CHECK OK*/
Else(A)SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
```

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```
                    call "Store FSC Status in EEPROM"
                    LV_SWT_VMAX_ENA = 0;
                    exit with Error Code SWT_RC_FGN_ACCESS_FAILURE
            Endif(A)

            /* Compare VIN FSC with VIN-ECU (VIN which is stored in Dataset) (kwp_io_vin[10..16])
*/
            If(B)       (LOC_VMAX_FSC.INDIVIDUAL_ATTR[0..6] ==
io_vin[NC_KWP_IO_VIN_2_LEN..NC_KWP_IO_VIN_2_LEN+6] )
            Then(B)  /* Compare VIN-ECU (VIN which is stored in Dataset) with VIN CAS */
                    If(C)       ( LC_SWT_CHK_VIN_CAS_ENA == 1 )
                    Then(C) If(D)       ( VIN_CAN_NVMY_RD[0..6] ==
                         kwp_io_vin[NC_KWP_IO_VIN_2_LEN..NC_KWP_IO_VIN_2_LEN+6]
)
                       Then(D) /*CHECK OK*/
                       Else(D)  exit with Error Code SWT_RC_FGN_CHECK_FAILURE
                          SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
                          call "Store FSC Status in EEPROM"
                          LV_SWT_VMAX_ENA = 0;
                       Endif(D)
                    Else(C)  /*CHECK OK*/
                    Endif(C)
            Else(B) exit with Error Code SWT_RC_FGN_CHECK_FAILURE
                    SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
                    call "Store FSC Status in EEPROM"
                    LV_SWT_VMAX_ENA = 0;
            Endif(B)
            Copy sig in reverse order + lengthbyte:
            /* NC_XMAX_SIG_ LEN   128 Byte */
            /* NC_SIZE_STREAM_FSC_LEN_BYTE 4 Byte */
            /* NC_XMAX_SIG_BUF_LEN   = NC_XMAX_FSC_SIG_LEN +                    /
* NC_SIZE_STREAM_FSC_LEN_BYTE */
            copy lengthbyte
            LOC_SWT_FSC_SIG_BUF[0]=32   /* 128 BYTE = 32X32BIT */
            LOC_SWT_FSC_SIG_BUF[1]=0
            LOC_SWT_FSC_SIG_BUF[2]=0
            LOC_SWT_FSC_SIG_BUF[3]=0
            /* reverse Signature*/
            FOR TMP_U8_CTR=0 to NC_XMAX_FSC_SIG_LEN-1; TMP_U8_CTR++ //128 byte
            LOC_SWT_FSC_SIG_BUF[NC_XMAX_SIG_BUF_LEN-1-TMP_U8_CTR] =          LOC_
VMAX_FSC.SIGNATURE+TMP_U8_CTR
            ENDFOR
            STATE_SWT_CHK_FSC = 1; /* start signature check */
        Else(3) /*do nothing */
        Endif(3)

            If(4)  (LV_SWT_FSC_PARSED == 0)
            Then(4)        STATE_SWT_CHK_FSC = 0
                exit with Error Code SWT_RC_UNKNOWN_ERROR
       Endif(4)

        If(A)  ( STATE_SWT_CHK_FSC == 1)
        Then(A) /* Calculation is still in work */
```


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```
                    exit with Error Code  SWT_RC_CALC_STILL_IN_WORK
        Else If(A) ( STATE_SWT_CHK_FSC == 2)
        Then(A) /* Calculation is still in work */
                         exit with Error Code  SWT_RC_CALC_STILL_IN_WORK
        Else If(A) ( STATE_SWT_CHK_FSC == 3)
        Then(A) /* SIGNATURE CHECK SUCCESFULL */
                SWT_FSC_XMAX_STATUS = 0x02 /*akzeptiert*/
                If(D)           (SWT_FSC_XMAX_STATUS != LOC_VMAX_FSC.STATUS )
                Then(D) /* FSC status has changed -> store new status in EEPROM */
                call "Store FSC Status in EEPROM"
                Else(D)           /*Nothing to store*/
                Endif(D)
                STATE_SWT_CHK_FSC == 0; /* reset state*/
                 exit with Return Code SWT_RC_OK
        Else If(A) ( STATE_SWT_CHK_FSC == 4)
        Then(A) /* SIGNATURE CHECK FAILED */
                SWT_FSC_XMAX_STATUS = 0x03 /*abgelehnt*/
                If(E)           (SWT_FSC_XMAX_STATUS!= LOC_VMAX_FSC.STATUS )
                Then(E) /* FSC status has changed -> store new status in EEPROM */
                call "Store FSC Status in EEPROM"
                Else(E)           /*Nothing to store*/
                Endif(E)
                STATE_SWT_CHK_FSC == 0; /* reset state*/
                exit with Error Code  SWT_RC_SIG_CHECK_FAILURE
        Else(A) /* STATE NOT POSSIBLE */
                STATE_SWT_CHK_FSC == 0; /* reset state*/
                exit with Error Code SWT_RC_UNKNOWN_ERROR
        Endif(A)
       Else(1)         exit with Error Code  SWT_RC_NOT_AUTHENTICATED
Endif(1)
```

Subroutine: Specific checks für PMAX

```
If(1)          (LV_AUTH_L3_ENA or (LV_SWT_CHK_FSC_ENA)) /*Level3 Authentication*/
       Then(1)            /* Read FSC from EEPROM */
        If(3)   ( STATE_SWT_CHK_FSC == 0)
        Then(3) /* Start FSC Header Check*/
              If(4)           (LV_FSC_XMAX_RD_OK)
              Then(4) /* FSC is restored correct from EEPROM */
              Call general parser for PMAX;
              Else(4) exit with Error Code  SWT_RC_FLASH_READ_ERROR
              Endif(4)
              /* Check if FSC is valid and stored in EEPROM */
              If(7) (LOC_PMAX_FSC.STATUS == 0X00) /*nicht vorhanden*/
              Then(7)/* No FSC is stored in EEPROM */
                     SWT_FSC_XMAX_STATUS = 0x00 /*nicht vorhanden*/
                     exit with Error Code SWT_RC_FSC_NOT_EXISTENT
              Else If(7) (LOC_PMAX_FSC.STATUS = 0X01 /*eingespielt*/
              Then(7)   /*CHECK OK*/
                     SWT_FSC_XMAX_STATUS = 0x01 /*eingespielt*/
              Else If(7) LOC_PMAX_FSC.STATUS = 0X02 /*akzeptiert*/
              Then(7)/*CHECK OK*/
```

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```
            SWT_FSC_XMAX_STATUS = 0x02 /*akzeptiert*/
Else If(7)  (LOC_PMAX_FSC.STATUS == 0X03) /*abgelehnt*/
Then(7)/* FSC is rejected */
            SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
            If(8)          (LC_SWT_CHK_FSC_STATUS_DENIED_ENA == 1)
            Then(8)     exit with Error Code SWT_RC_FSC_REJECTED
            Else(8)     /* check also FSC in status denied */
            Endif(8)
Else If(7)  (LOC_PMAX_FSC.STATUS == 0X04) /*storniert*/
Then(7)/* FSC is cancelled */
            SWT_FSC_XMAX_STATUS = 0x04 /*storniert*/
            exit with Error Code SWT_RC_FSC_CANCELLED
Else(7)          /* invalid FSC */
            SWT_FSC_XMAX_STATUS = 0x00 /*nicht vorhanden*/
            exit with Error Code SWT_RC_UNKNOWN_ERROR
Endif(7)

/* check if SWID inside FSC which is stored in EEPROM is correct*/
If(5)          (LOC_PMAX_FSC.SWID == Swid definition Pmax)
Then(5)   /*CHECK OK*/
Else(5)SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
            call "Store FSC Status in EEPROM"
            LV_SWT_PMAX_ENA = 0;
            exit with Error Code  SWT_RC_SWID_CHECK_FAILURE
Endif(5)

/* Check if Requester-Type is correct */
If(8) (LOC_PMAX_FSC.REQUESTER_TYPE == 1 OR LOC_PMAX_FSC.REQUESTER_
TYPE == 2)

Then(8)          /*CHECK OK*/
Else(8)SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
            call "Store FSC Status in EEPROM"
            LV_SWT_PMAX_ENA = 0;
            exit with Error Code SWT_RC_UNKNOWN_ERROR
Endif(8)

/* Check if   "individual_attr_type" is set to VIN short (FGN kurz) */
If(9) (LOC_PMAX_FSC.INDIVIDUAL_ATTR_TYPE == 1)
Then(9)          /*CHECK OK*/
Else(9)SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
            call "Store FSC Status in EEPROM"
            LV_SWT_PMAX_ENA = 0;
            exit with Error Code SWT_RC_UNKNOWN_ERROR
Endif(9)

/* Check if VIN is stored correct in ECU */
If(A) (kwp_io_vin[10..16] != 0x00,00,00,00,00,00,00)
Then(A)          /*CHECK OK*/
Else(A)SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
            call "Store FSC Status in EEPROM"
            LV_SWT_PMAX_ENA = 0;
            exit with Error Code SWT_RC_FGN_ACCESS_FAILURE
```

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```
Endif(A)

/* Compare VIN FSC with VIN-ECU (VIN which is stored in Dataset) (kwp_io_vin[10..16])
*/
If(B)           (LOC_PMAX_FSC.INDIVIDUAL_ATTR[0..6] ==
io_vin[NC_KWP_IO_VIN_2_LEN..NC_KWP_IO_VIN_2_LEN+6] )
Then(B)   /* Compare VIN-ECU (VIN which is stored in Dataset) with VIN CAS */
        If(C)           ( LC_SWT_CHK_VIN_CAS_ENA == 1 )
        Then(C) If(D)           ( VIN_CAN_NVMY_RD[0..6] ==
                    kwp_io_vin[NC_KWP_IO_VIN_2_LEN..NC_KWP_IO_VIN_2_LEN+6]
)
                Then(D) /*CHECK OK*/
                Else(D)   exit with Error Code  SWT_RC_FGN_CHECK_FAILURE
                     SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
                     call "Store FSC Status in EEPROM"
                     LV_SWT_PMAX_ENA = 0;
                Endif(D)
        Else(C)   /*CHECK OK*/
        Endif(C)
Else(B) exit with Error Code SWT_RC_FGN_CHECK_FAILURE
        SWT_FSC_XMAX_STATUS = 0x03 /*rejected*/
        call "Store FSC Status in EEPROM"
        LV_SWT_PMAX_ENA = 0;
Endif(B)
Copy sig in reverse order + lengthbyte:
/* NC_XMAX_SIG_ LEN    128 Byte */
/* NC_SIZE_STREAM_FSC_LEN_BYTE 4 Byte */
/* NC_XMAX_SIG_BUF_LEN   = NC_XMAX_FSC_SIG_LEN +                /
* NC_SIZE_STREAM_FSC_LEN_BYTE */
copy lengthbyte
LOC_SWT_FSC_SIG_BUF[0]=32   /* 128 BYTE = 32X32BIT */
LOC_SWT_FSC_SIG_BUF[1]=0
LOC_SWT_FSC_SIG_BUF[2]=0
LOC_SWT_FSC_SIG_BUF[3]=0
/* reverse Signature*/
FOR TMP_U8_CTR=0 to NC_XMAX_FSC_SIG_LEN-1; TMP_U8_CTR++ //128 byte
LOC_SWT_FSC_SIG_BUF[NC_XMAX_SIG_BUF_LEN-1-TMP_U8_CTR] =          LOC_
PMAX_FSC.SIGNATURE+TMP_U8_CTR
ENDFOR
STATE_SWT_CHK_FSC = 1; /* start signature check */
Else(3) /*do nothing */
Endif(3)

If(4)  (LV_SWT_FSC_PARSED == 0)
Then(4)           STATE_SWT_CHK_FSC = 0
      exit with Error Code SWT_RC_UNKNOWN_ERROR
Endif(4)

If(A)   ( STATE_SWT_CHK_FSC == 1)
Then(A) /* Calculation is still in work */
        exit with Error Code  SWT_RC_CALC_STILL_IN_WORK
Else If(A) ( STATE_SWT_CHK_FSC == 2)
Then(A) /* Calculation is still in work */
```

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exit with Error Code SWT_RC_CALC_STILL_IN_WORK
Else If(A) **(STATE_SWT_CHK_FSC == 3)**
Then(A) /* SIGNATURE CHECK SUCCESFULL */
SWT_FSC_XMAX_STATUS = 0x02 /*akzeptiert*/
If(D) (SWT_FSC_XMAX_STATUS!= LOC_PMAX_FSC.STATUS)
Then(D) /* FSC status has changed -> store new status in EEPROM */
call "Store FSC Status in EEPROM"
Else(D) /*Nothing to store*/
Endif(D)
STATE_SWT_CHK_FSC == 0; /* reset state*/
exit with Return Code SWT_RC_OK
Else If(A) **(STATE_SWT_CHK_FSC == 4)**
Then(A) /* SIGNATURE CHECK FAILED */
SWT_FSC_XMAX_STATUS = 0x03 /*abgelehnt*/
If(E) (SWT_FSC_XMAX_STATUS!= LOC_PMAX_FSC.STATUS)
Then(E) /* FSC status has changed -> store new status in EEPROM */
call "Store FSC Status in EEPROM"
Else(E) /*Nothing to store*/
Endif(E)
STATE_SWT_CHK_FSC == 0; /* reset state*/
exit with Error Code SWT_RC_SIG_CHECK_FAILURE
Else(A) /* STATE NOT POSSIBLE */
STATE_SWT_CHK_FSC == 0; /* reset state*/
exit with Error Code SWT_RC_UNKNOWN_ERROR
Endif(A)
Else(1) *exit with Error Code SWT_RC_NOT_AUTHENTICATED*
Endif(1)

FUNCTION_FOR_SIGNATUR_CHECK

Recurrence: *5 ms*
Activation: *every ECU state*
Deactivation: NC_SWT_MOD: No VMAX and No PMAX functionality

General Information:

This Function is checking the FSC signature
Base for CR_A_NewAaMExp is the signature from the FSC (last 128byte of FSC)
The result is compared with the MD5-hashed FSC, excluded signature.
Attention: The Cryptofunction "CR_A_NewAaMExp" is used over a long time (ms), during this time it is not allowed to called this function a second time (e.g. for DH-KF-Calculation). At the moment there is no locking mechanism implemented, because projects with DH-KF-Calculation are not using VMAX, PMAX).

Formula section:

If(1) ((STATE_SWT_CHK_FSC == 1 || STATE_SWT_CHK_FSC == 2)
& & LV_SWT_FSC_PARSED ==1)
Then(1) **If**(2) (STATE_SWT_CHK_FSC == 1)
Then(2) /* First calculation: Calcultate MD5 of FSC-data */

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```
CR_C_md5init( );
If(3) NC_SWT_MOD defined for   Vmax only
 CR_C_md5hash(
 (u16 *) 0,
 (u8 *) LOC_VMAX_FSC.VERSION,   /* set Pointer to start of FSC */
 (u32) (LOC_VMAX_FSC.SIZE - 128), /*FSC-data lenghth:(e.g. 60 or 63 Byte)*/
 (s8 *) 0      );
 Else If(3)NC_SWT_MOD defined for   Pmax + opt. Vmax
    CR_C_md5hash(
 (u16 *) 0,
 (u8 *) LOC_PMAX_FSC.VERSION,   /* set Pointer to start of FSC */
 (u32) (LOC_PMAX_FSC.SIZE - 128), /*FSC-data lenghth:(e.g. 60 or 63 Byte)*/
 (s8 *) 0      );
 Else(3) /* should not be reached */
 Endif(3)
CR_C_md5end( (u8 *)& TMP_U8_FSC_HASH_MD5[0] ) /*MD5 Result */
SWT_CALC_CYCLE_COUNT = 6;
STATE_SWT_CHK_FSC = 2;
/* Initialize Cryptofunction returncode */
    TMP_S8_CR_C_RC = CR_C_RC_NF; /* initialize tmp_s8_cr_c_rc */
Else If(2) ( STATE_SWT_CHK_FSC == 2)
Then(2)           If(3)          (LV_ES == 0)
            Then(3) /*Engine is Running*/
                  SWT_CALC_CYCLE_COUNT = 1;
            Else(3)
                  SWT_CALC_CYCLE_COUNT = 6;
            End If(3)

            /* Second calculation:  Calculate "MOD EXP" of FSC-signature */
               If(4)   (TMP_S8_CR_C_RC == CR_C_RC_NF)
            Then(4)
          TMP_S8_CR_C_RC = CR_A_NewAaMExp(
                SWT_CALC_CYCLE_COUNT,          /* CycleCount intr.          */
LOC_SWT_FSC_SIG_BUF,    /* Basis: swt_getSignaturOffset() */
E_SIG_VMAX,                        /* Exponent:   (given by BMW)    */
TMP_U32_FSC_CHK,                            /* Result:                         */
           N_SIG_VMAX, /* Modulus:   (given by BMW)  */
SWT_CRYPTO_SIG_BUFFER,                       /* Buffer                       */
SWT_PSTATE[CR_DEF_AA_MEXP_STATESIZE_TOTAL] /*Actual State */
              );
            Else(4)
           If(5)          (TMP_S8_CR_C_RC == CR_C_RC_OK )
           Then(5)
                    Compare result of first calculation with result of second calculation:
                    If(6)          (TMP_U8_FSC_HASH_MD5[15...0] !=
U32_FSC_CHK(u32) [0...3]
                          (byte[0...15])(+1 u32 offset, excluding length information) )
                    Then(6) STATE_SWT_CHK_FSC = 4; /*Signature is not valid*/
                          LV_SWT_VMAX_ENA = 0;
                          LV_SWT_PMAX_ENA = 0;
                    Else(6) STATE_SWT_CHK_FSC = 3; /*Signature is valid*/
                       If(7) NC_SWT_MOD defined for   Vmax only
```

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Then(7) LV_SWT_VMAX_ENA = 1;
Else If(7)NC_SWT_MOD defined for Pmax + opt. Vmax
Then(7)
4D8 project: LV_SWT_PMAX_ENA = 1;
All other projects (default):
If(8)Upgrade Index of SWID = 0x01
SWT_PMAX_ENA = 1
LV_SWT_VMAX_ENA = 0
Else **If**(9)Upgrade Index of SWID = 0x02
LV_SWT_PMAX_ENA = 1
LV_SWT_VMAX_ENA = 1
Else(9) LV_SWT_PMAX_ENA = 0
LV_SWT_VMAX_ENA = 0
Endif(7)
Endif(6)
Else(5) /* Calculation is still in work */
Endif(5)
Endif(4)
Else(2) /* not possible*/
Endif(2)
Else(1) /* do nothing */
Endif(1)

ACTION_SWT_GetSoftwareIdFunc(OUT<u8ptr NUMBER_OF_SWID>, OUT<SWID>, OUT<SWT Returncode>)

Deactivation: NC_SWT_MOD: No VMAX and No PMAX functionality

General Information:

This action returns all defined SWID's (except IMOB SWID).

Formula section:

NUMBER_OF_SWID = 0x00;

If(1) NC_SWT_MOD defined for Vmax only
Then(1)
NUMBER_OF_SWID = NUMBER_OF_SWID +1;
SWID= SWID_VMAX_DME1
Prepare Outbuffer for next SWID
return code SWT_RC_OK **Else**(1)
Endif(1)

If(2)) NC_SWT_MOD defined for Pmax + opt. Vmax
Then(2)
NUMBER_OF_SWID = NUMBER_OF_SWID +1;
SWID= SWID_PMAX_DME1

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Prepare Outbuffer for next SWID
return code SWT_RC_OK **Else**(2) *return code* SWT_RC_UNKNOWN_ERROR**Endif**(2)

ACTION_SWT_GetStatus(IN<32bit SWID>, OUT<u8ptr STATUS>, OUT<SWT Returncode>)

Deactivation: NC_SWT_MOD: No VMAX and No PMAX functionality

General Information:

This action returns the "STATUS" of the selected FSC-SWID.

Formula section:

If(1) (SWID == Swid definition for Vmax only **and** NC_SWT_MOD defined for Vmax only) **OR**
(SWID == Swid definition Pmax **and** NC_SWT_MOD defined for Pmax + opt. Vmax)

Then(1) **If**(2) (LV_FSC_XMAX_RD_OK)
Then(2) /* FSC is restored correct from EEPROM */
If(3) SWID == Swid definition for Vmax only
Then(3) **Call general parser for VMAX (EEPROM);**
STATUS = LOC_VMAX_FSC.STATUS;
exit with Return Code SWT_RC_OK
Else If(3)SWID == Swid definition Pmax
Then(3) **Call general parser for PMAX (EEPROM);**
STATUS = LOC_PMAX_FSC.STATUS;
exit with Return Code SWT_RC_OK
Else(3) /* should not be reached*/
Endif(3)

Else(2) /*BMW: instead of Flash Read ERROR UNKOWN ERROR must send back */
exit with Error Code SWT_RC_UNKNOWN_ERROR
Endif(2)
Else(1) *exit with Error Code SWT_RC_SW_NOT_EXISTENT*
Endif(1)

ACTION_SWT_DisableFsc(IN<32bit SWID>, OUT<SWT Returncode>)

Deactivation: NC_SWT_MOD: No VMAX and No PMAX functionality

General Information:

This action is disabling the selected FSC-SWID

Formula section:

TMP_STATUS = 0

If(1) (SWID == Swid definition for Vmax only **and** NC_SWT_MOD defined for Vmax only) **OR**

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(SWID == Swid definition Pmax **and** NC_SWT_MOD defined for Pmax + opt. Vmax)

Then(1) **If**(2) (LV_AUTH_L3_ENA) /*Level3 Authentication*/
Then(2) **If**(3) (LV_FSC_XMAX_RD_OK)
Then(3) /* FSC is restored correct from EEPROM */
If(4) SWID == Swid definition for Vmax only DME1
Then(4) **Call general parser for VMAX (EEPROM);**
TMP_STATUS = LOC_VMAX_FSC.STATUS;
Else If(4)SWID == Swid definition Pmax
Then(4) **Call general parser for PMAX (EEPROM);**
TMP_STATUS = LOC_PMAX_FSC.STATUS;
Else(4) exit with Error Code SWT_RC_UNKOWN_ERROR
Endif(4)
If(5) (TMP_STATUS == 0)
Then(5) *exit with Error Code* SWT_RC_FSC_NOT_EXISTENT
Else If(5) (TMP_STATUS == 4)
Then(5) *exit with Error Code* SWT_RC_FSC_CANCELLED
Else If(5) **(**TMP_STATUS == 1 **OR** TMP_STATUS == 2 **OR**
TMP_STATUS == 3 **)**
Then(5)
FSC_XMAX_WR[0..199] = FSC_XMAX_RD[0.199]
FSC_XMAX_WR[2] = 4;
/*store FSC with new status in EEPROM */
ACTION_SWT_WrNvmyFscXMAX( )
SWT_FSC_XMAX_STATUS = 0x04 /* canceled */
LV_SWT_VMAX_ENA = 0; /* deactivate VMAX_ENA */
LV_SWT_PMAX_ENA = 0; /* deactivate PMAX_ENA */
exit with Return Code SWT_RC_OK
Else(5) *exit with Error Code* SWT_RC_UNKNOWN_ERROR
Endif(5)
Else(3) *exit with Error Code* SWT_RC_FLASH_READ_ERROR
Endif(3)
Else(2) *exit with Error Code SWT_RC_NOT_AUTHENTICATED*
Endif(2)
Else(1) *exit with Error Code SWT_RC_SW_NOT_EXISTENT*
Endif(1)

ACTION_SWT_GetFscLen(IN<32bit SWID>, OUT<u8ptr LENGTH>, OUT<SWT Returncode>)

Deactivation: NC_SWT_MOD: No VMAX and No PMAX functionality

General Information:

This action returns the "SIZE" of the selected FSC-SWID.

Formula section:

If(1) (SWID == Swid definition for Vmax only **and** NC_SWT_MOD defined for Vmax only) **OR**
(SWID == Swid definition Pmax **and** NC_SWT_MOD defined for Pmax + opt. Vmax)

Then(1) /* Read FSC from EEPROM */
If(2) (LV_FSC_XMAX_RD_OK)

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Then(2) /* FSC is restored correct from EEPROM */
TMP_U8_CTR = 0
If(4) SWID == Swid definition for Vmax only
Then(4) LOC_VMAX_FSC.SIZE =(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
If(5) (LOC_VMAX_FSC.SIZE != 0)
Then(5) LENGTH =LOC_VMAX_FSC.SIZE
exit with Return Code SWT_RC_OK
Else(5) *exit with Error Code* SWT_RC_FSC_NOT_EXISTENT
Endif(5)
Else If(4)SWID == Swid definition Pmax
Then(4)
LOC_PMAX_FSC.SIZE =(U8*)& FSC_XMAX_RD[TMP_U8_CTR]
If(5) (LOC_PMAX_FSC.SIZE != 0)
Then(5) LENGTH =LOC_PMAX_FSC.SIZE
exit with Return Code SWT_RC_OK
Else(5) *exit with Error Code* SWT_RC_FSC_NOT_EXISTENT
Endif(5)
Else(4) exit with Error Code SWT_RC_UNKOWN_ERROR
Endif(4)
Else(2) *exit with Error Code* SWT_RC_FLASH_READ_ERROR
Endif(2)
Else(1) *exit with Error Code SWT_RC_SW_NOT_EXISTENT*
Endif(1)

ACTION_SWT_GetFsc(IN<32bit SWID>, OUT<u8ptr FSC>, OUT<SWT Returncode>)

Deactivation: NC_SWT_MOD: No VMAX and No PMAX functionality

General Information:

This action returns the "FSC" of the selected FSC-SWID.

Formula section:

If(1) (SWID == Swid definition for Vmax only **and** NC_SWT_MOD defined for Vmax only) **OR** (SWID == Swid definition Pmax **and** NC_SWT_MOD defined for Pmax + opt. Vmax)

Then(1) /* Read FSC from EEPROM */
If(2) (LV_FSC_XMAX_RD_OK)
Then(2) /* FSC is restored correct from EEPROM */
If(3) SWID == Swid definition for Vmax only
Then(3) **Call general parser for VMAX (EEPROM);**
If(4) (LOC_VMAX_FSC.SIZE != 0)
Then(4) FSC[0..196] = FSC_XMAX_RD[4..200]
exit with Return Code SWT_RC_OK
Else(4) *exit with Error Code* SWT_RC_FSC_NOT_EXISTENT
Endif(4)
Else If(3)SWID == Swid definition Pmax
Then(3) **Call general parser for PMAX (EEPROM);**
If(4) (LOC_PMAX_FSC.SIZE != 0)
Then(4) FSC[0..196] = FSC_XMAX_RD[4..200]

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exit with Return Code SWT_RC_OK
Else(4) *exit with Error Code* SWT_RC_FSC_NOT_EXISTENT
Endif(4)
Else(3) exit with Error Code SWT_RC_UNKOWN_ERROR
Endif(3)

Else(2) *exit with Error Code* SWT_RC_FLASH_READ_ERROR
Endif(2)
Else(1) *exit with Error Code SWT_RC_SW_NOT_EXISTENT*
Endif(1)

ACTION_SWT_GetVin(OUT<u8ptr VIN>, OUT<SWT Returncode>)

Deactivation: NC_SWT_MOD: No VMAX and No PMAX functionality

General Information:

This action returns the "VIN" of the ECU
It doesn't matter if VIN is stored correct in ECU. This will not be checked here.
If VIN is 0x00,00,00,00,00,00,00 this value must be send back.

Formula section:

VIN = kwp_io_vin[10..16];

exit with Return Code SWT_RC_OK

ACTION_SWT_SetVin(IN<u8ptr VIN>, OUT<SWT Returncode>)

Deactivation: NC_SWT_MOD: No VMAX and No PMAX functionality

General Information:

This action is simulating the storage of a new "VIN" into the ECU
It doesn't matter if VIN is stored correct in ECU. This will not be checked here.

Formula section:

If(1) (LV_AUTH_L3_ENA) /* Level3 Authentication */
Then(1)
If(2) (VIN == kwp_io_vin[10..16])
Then(2) /*CHECK OK*/
exit with Return Code SWT_RC_OK
Else(2) *exit with Error Code* SWT_RC_FLASH_WRITE_ERROR
Endif(2)

Else(1) *exit with Error Code SWT_RC_NOT_AUTHENTICATED*

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Endif(1)

PERIODICAL_SIGNATUR_CHECK VMAX:

Recurrence: *5 ms*
Activation: *every ECU state*
Deactivation: NC_SWT_MOD: No VMAX functionality

General Information:

This Function is starting the FSC signature check one time after reset

Formula section:

If(1) (!LV_SWT_CHK_VMAX_FINISHED)
Then(1)
LV_SWT_CHK_FSC_ENA = 1; /* enable CHK_FSC without L3 authentication */
TMP_U8 = **ACTION_SWT_ChkFsc(SWID_VMAX_DME1)**
If(2) (TMP_U8 == SWT_RC_CALC_STILL_IN_WORK)
Then(2) /* Calculation is still in work */
Else(2)LV_SWT_CHK_VMAX_FINISHED == 1;
LV_SWT_CHK_FSC_ENA = 0; /* disable CHK_FSC without L3 authentication */
Endif(2)
Endif(1)

PERIODICAL_SIGNATUR_CHECK PMAX:

Recurrence: *5 ms*
Activation: *every ECU state*
Deactivation: NC_SWT_MOD: No PMAX functionality

General Information:

This Function is starting the FSC signature check one time after reset

Formula section:

If(1) (!LV_SWT_CHK_PMAX_FINISHED)
Then(1)
LV_SWT_CHK_FSC_ENA = 1; /* enable CHK_FSC without L3 authentication */
TMP_U8 = **ACTION_SWT_ChkFsc(SWID_PMAX_DME1)** /* hint: The SWID is different between the projects (e.g. 4DC /4D8) */
If(2) (TMP_U8 == SWT_RC_CALC_STILL_IN_WORK)
Then(2) /* Calculation is still in work */
Else(2)LV_SWT_CHK_PMAX_FINISHED == 1;
LV_SWT_CHK_FSC_ENA = 0; /* disable CHK_FSC without L3 authentication */
Endif(2)
Endif(1)

ACTION_SWT_WrNvmyFscXMAX( )

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General Information:

/* This Action is only a locally defined function which is triggered by functioncall */

Formula section:

If(1) (!LV_SWT_FSC_WR_IN_WORK)
Then(1) ***Start EEPROM Storage***
LV_SWT_FSC_WR_IN_WORK = 1;
LV_SWT_FSC_WR_FINISHED = 0;
Endif(1)

/* EEPROM Storage is finshed when Callback-Function is called in anvmswt.c*/
If(2) *("EEPROM Storage finished")*
Then(2) LV_SWT_FSC_WR_FINISHED = 1;
LV_SWT_FSC_WR_IN_WORK = 0;
If(3) *("Storage successfull")*
Then(3) FSC_XMAX_RD[0..199] = FSC_XMAX_WR[0..199]
LV_FSC_XMAX_WR_OK = 1;
LV_FSC_XMAX_RD_OK = 1;
Else(3) LV_FSC_XMAX_WR_OK = 0;
Endif(3)
Endif(2)

ACTION_SWT_WrNvmyVIN_CAN( )

General Information:

/* This Action is only a locally defined function which is triggered by functioncall */

Formula section:

If(1) (!LV_SWT_VIN_CAN_WR_IN_WORK)
Then(1) VIN_CAN_NVMY_WR[0..6] = VIN_CAN[0..6]
Start EEPROM Storage
LV_SWT_VIN_CAN_WR_IN_WORK = 1;
LV_SWT_VIN_CAN_WR_FINISHED = 0;
Else(1) /* nothing to do */
Endif(1)

/* EEPROM Storage is finshed when Callback-Function is called in anvmswt.c*/
If(2) *("EEPROM Storage finished")*
Then(2) LV_SWT_VIN_CAN_WR_FINISHED = 1;
LV_SWT_VIN_CAN_WR_IN_WORK = 0;
If(3) *("Storage successfull")*
Then(3) VIN_CAN_NVMY_RD[0..6] = VIN_CAN_NVMY_WR[0..6]
LV_SWT_VIN_CAN_WR_OK = 1;
LV_SWT_VIN_CAN_RD_OK = 1;
Else(3) LV_SWT_VIN_CAN_WR_OK = 0;
Endif(3)
Endif(2)

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FUNCTION_FOR_VIN_STORAGE

Recurrence: *100 ms*
Activation: *every ECU state*
Deactivation: NC_SWT_MOD: No VMAX and No PMAX functionality

General Information:

This Function is storing the VIN which is received from CAS into EEPROM

Formula section:

If(1) (VIN_CAN[0..6] != 0x00,00,00,00,00,00,00)
Then(1)
    If(2) (VIN_CAN[0..6] != VIN_CAN_NVMY_RD[0..6])
    Then(2) /* store only changed VIN into CAN */
     If(3) (!LV_LOCK_IMOB)
     Then(3) /* store only new VIN into EEPROM if IMOB is authenticated */
      ACTION_SWT_WrNvmyVIN_CAN( )
     Else(3) /* nothing to do */
     Endif(3)
    Else(2) /* nothing to do */
    Endif(2)
Else(1)
     Trigger CAS to send the VIN again:
     ACTION_INTC_NO_VECH_REQ( )
Endif(1)
NC_SWT_MOD is now defined in 17106601.00x; (x >= .00C)

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A - Diagnosis and Emergency Operation

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A.1 Charge air temperature sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TIA_TCHA_UP	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom TIA_TCHA_UP					
LV_CDN_DIAG_TIA_TCHA_UP	V	0... 1H	0 ...1	1	-
Diagnosis condition TIA_TCHA_UP					
LV_END_DIAG_TIA_TCHA_UP	O/V	0... 1H	0 ...1	1	-
End of Diagnosis cycle TIA_TCHA_UP					
LV_ERR_TIA_TCHA_UP	O/V	0... 1H	0 ...1	1	-
Electrical TIA_TCHA_UP error					

Input data:

C_T_DLY_TIA_DIAG {p. 4195}	LV_IGK {p. 906}	LV_VAR_TCHA {p. 656}	NC_IDX_DIAG_TIA_TCHA_UP
T_AST_DIAG {p. 1766}	VP_TIA_TCHA {p. 1226}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TIA_TCHA_UP	-	0... FFH	0... 255	1	-
Anti bounce increment					
C_ABC_MAX_TIA_TCHA_UP	-	1... FFH	1... 255	1	-
Anti bounce maximum					
C_VP_TIA_TCHA_UP_MAX_DIAG	-	0... 7FFFH	0... 4.99984741	15.25879e3	V
TIA threshold for short to ground TIA_TCHA_UP diagnosis					
C_VP_TIA_TCHA_UP_MIN_DIAG	-	0... 7FFFH	0... 4.99984741	15.25879e3	V
TIA threshold for short to VB or line break TIA_TCHA_UP diagnosis					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

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Function Description

General information:
The purpose of the diagnosis shall be to detect electrical faults as defined by OBD I requirements. The input signal is analog from a NTC located at the Mass air flow meter.
Description:
Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> Short circuit to Vbatt or open load        (= SYM_0)
 │ │ └───> Short circuit to GND                  (= SYM_1)
 │ └─────> -                                     (= SYM_2)
 └───────> -                                     (= SYM_3)
```

Function Description

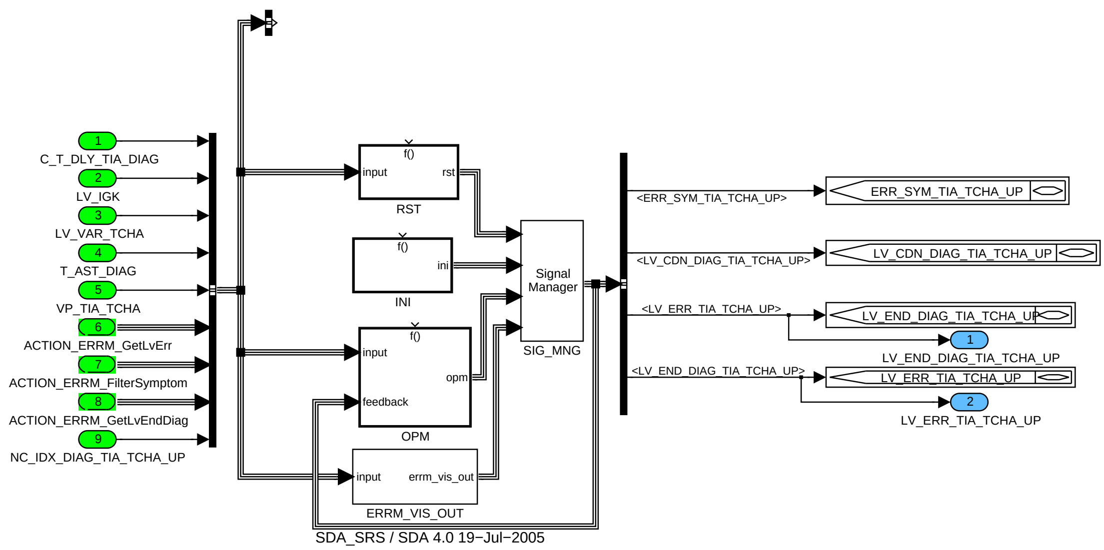

Figure A.1.1: AIRT_MA0C8

A.1.1 Initialisation at system event RESET and IGKON

Initialisation

LV_ERR_TIA_TCHA_UP is initialised.

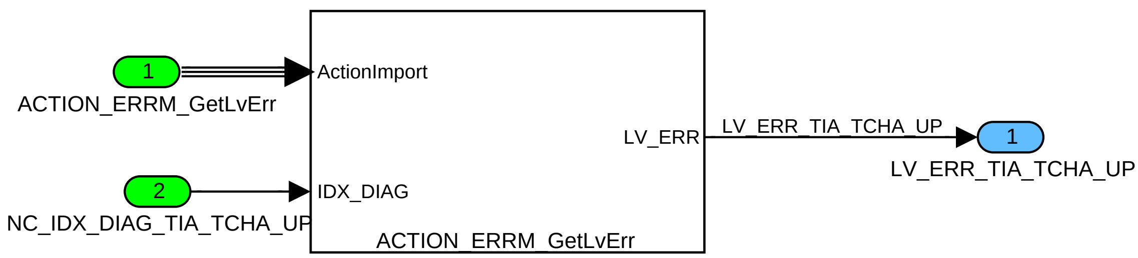

Figure A.1.2: AIRT_MA0C8/RST/INI

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A.1.2 At deactivation

At deactivation LV_END_DIAG_TIA_TCHA_UP is initialised to 1.

Figure A.1.3: AIRT_MA0C8/INI

A.1.3 Formula section

Diagnosis

Short circuit to ground , short circuit to Vbatt or open load are detected.

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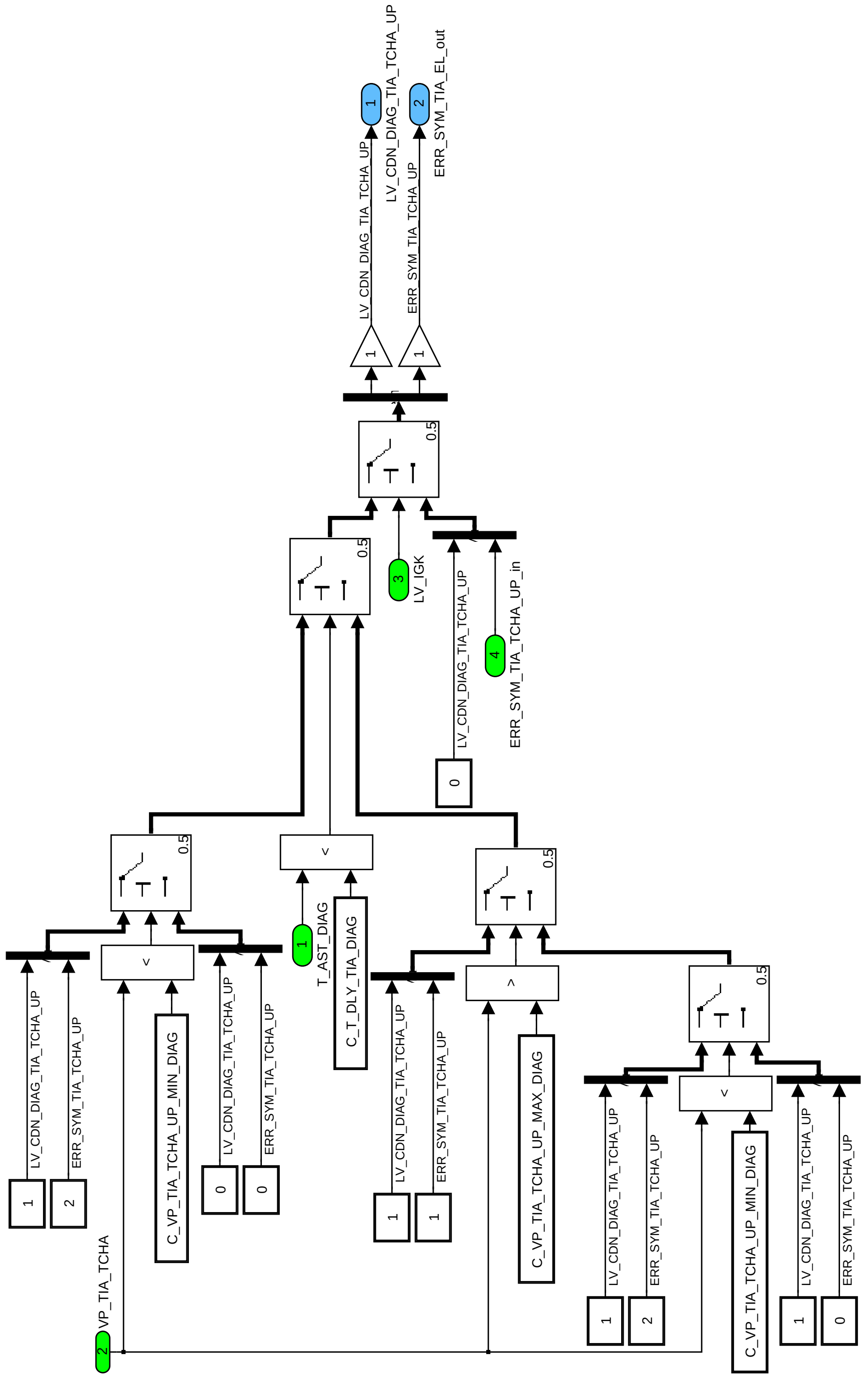

Figure A.1.4: AIRT_MA0C8/OPM/DIAG

ERRM interface

Calculation of present error and end of diagnosis. LV_ERR_TIA_TCHA_UP and LV_END_DIAG_TIA_TCHA_UP are calculated by error management.

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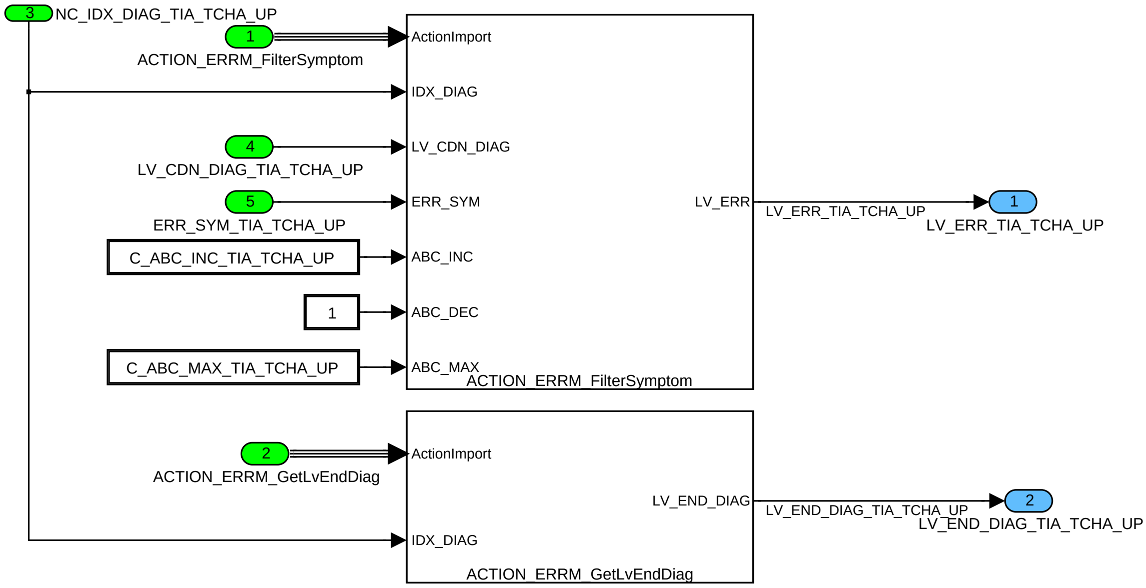

Figure A.1.5: AIRT_MA0C8/OPM/ERRM_IF

A.1.4 Visual mode output calculation

Error symptom and condition calculation

ERR_SYM_TIA_TCHA_UP and LV_CDN_DIAG_TIA_TCHA_UP are calculated by error managerment in visual mode.

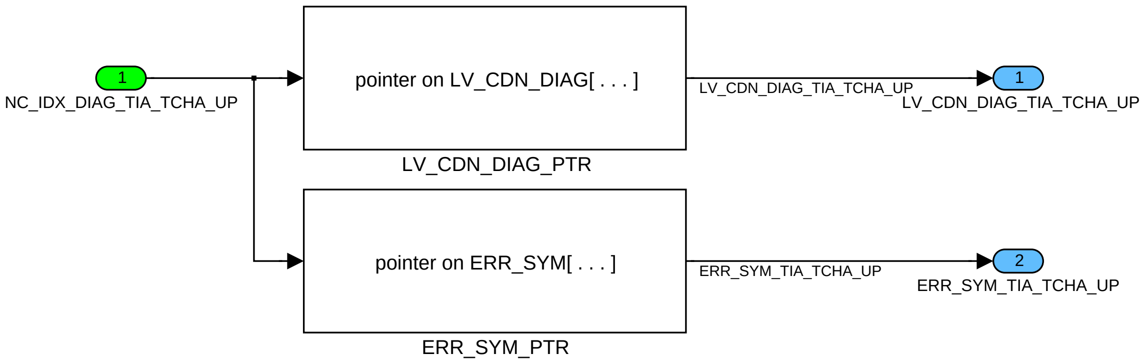

Figure A.1.6: AIRT_MA0C8/ERRM_VIS_OUT/SUB_CLC

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A.2 Intake air temperature sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TIA_EL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom TIA_EL					
ERR_SYM_TIA_GRD	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom TIA gradient					
LV_CDN_DIAG_TIA_EL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition TIA_EL					
LV_CDN_DIAG_TIA_GRD	O/V	0... 1H	0 ...1	1	-
Diagnosis condition TIA gradient					
LV_END_DIAG_TIA_EL	O/V	0... 1H	0 ...1	1	-
End of Diagnosis cycle TIA_EL					
LV_END_DIAG_TIA_GRD	O/V	0... 1H	0 ...1	1	-
End of Diagnosis cycle TIA_GRD					
LV_ERR_TIA_EL	O/V	0... 1H	0 ...1	1	-
Electrical TIA error					
LV_ERR_TIA_GRD	O/V	0... 1H	0 ...1	1	-
Boolean for intake air temperature signal gradient error					

Input data:

LV_IGK {p. 906}	LV_INH_DIAG_TIA_EL {p. 4200}	LV_INH_DIAG_TIA_GRD {p. 4200}	NC_IDX_DIAG_TIA_EL
NC_IDX_DIAG_TIA_GRD	T_AST_DIAG {p. 1766}	TAM {p. 1579}	TCO {p. 1100}
TIA_MES {p. 1226}	VP_TIA {p. 1226}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_TIA_GRD	-	0... FFH	0... 255	1	-
Anti-bounce decrement					
C_ABC_INC_TIA_EL	-	0... FFH	0... 255	1	-
Anti-bounce increment					
C_ABC_INC_TIA_GRD	-	0... FFH	0... 255	1	-
Anti-bounce increment					
C_ABC_MAX_TIA_EL	-	1... FFH	1... 255	1	-
Anti-bounce maximum					
C_ABC_MAX_TIA_GRD	-	1... FFH	1... 255	1	-
Anti-bounce maximum					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_TIA_DIAG	-	0... FFFFH	0... 32767.5	0.5	s
Delay time for diagnosis activation					
C_T_DLY_TIA_GRD	-	0... FFFFH	0... 32767.5	0.5	s
Delay time for intake air temperature gradient					
C_TIA_MAX_DIAG_GRD_1	-	0... FEH	0... 190.5	0.75	°C
Maximum intake temperature gradient for TIA diagnosis part 1					
C_TIA_MAX_DIAG_GRD_2	-	0... FEH	0... 190.5	0.75	°C
Maximum intake temperature gradient for TIA diagnosis part 2					
C_TIA_RNG_TCO_DIAG_H	-	0... FEH	-48... 142.5	0.75	°C
High range for the detection of engine at cold operating temperature					
C_TIA_RNG_TCO_DIAG_L	-	0... FEH	-48... 142.5	0.75	°C
Low range for the detection of engine at cold operating temperature					
C_TIA_RNG_TCO_DIAG_THD	-	0... FEH	-48... 142.5	0.75	°C
Threshold range for the detection of tuning manipulation					
C_VP_TIA_MAX_DIAG	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
upper threshold for range check of VP_TIA					
C_VP_TIA_MIN_DIAG	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
lower threshold for range check of VP_TIA					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

General Information

General information:
The purpose of the diagnosis shall be to detect electrical faults as defined by OBD I requirements. The input signal is analog from a NTC.
Description:
Error symptoms are defined for this diagnosis function as:

> Short circuit to Vbatt or open load (= SYM_0)
> Short circuit to GND (= SYM_1)
> - (= SYM_2)
> - (= SYM_3)

Application Conditions

Initialization: RST, IGKON
Recurrence: 100MS
Activation: always
Deactivation: never

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Function description

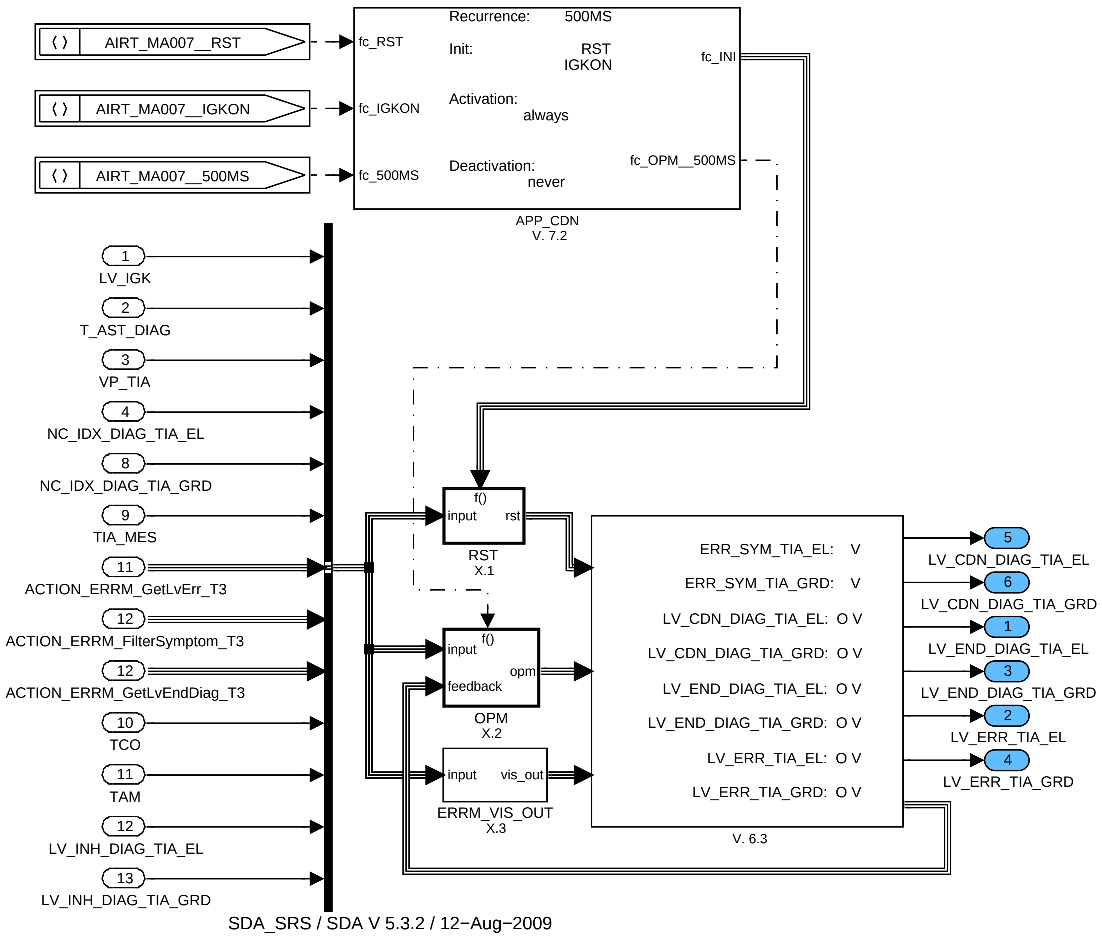

Figure A.2.1: :

A.2.1 Reset

A.2.1.1 Calculation at reset

All output data are according to ABC configuration "STD_INI"

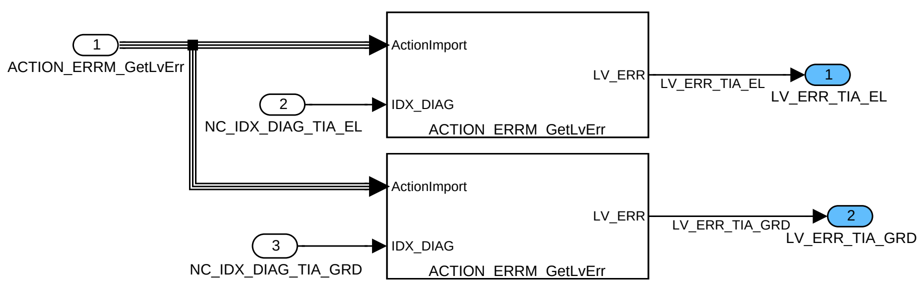

Figure A.2.2: :

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A.2.2 Formula section

A.2.2.1 Diagnosis

A.2.2.1.1 Electrical diagnosis

Short circuit to ground, short circuit to battery or open load can be detected

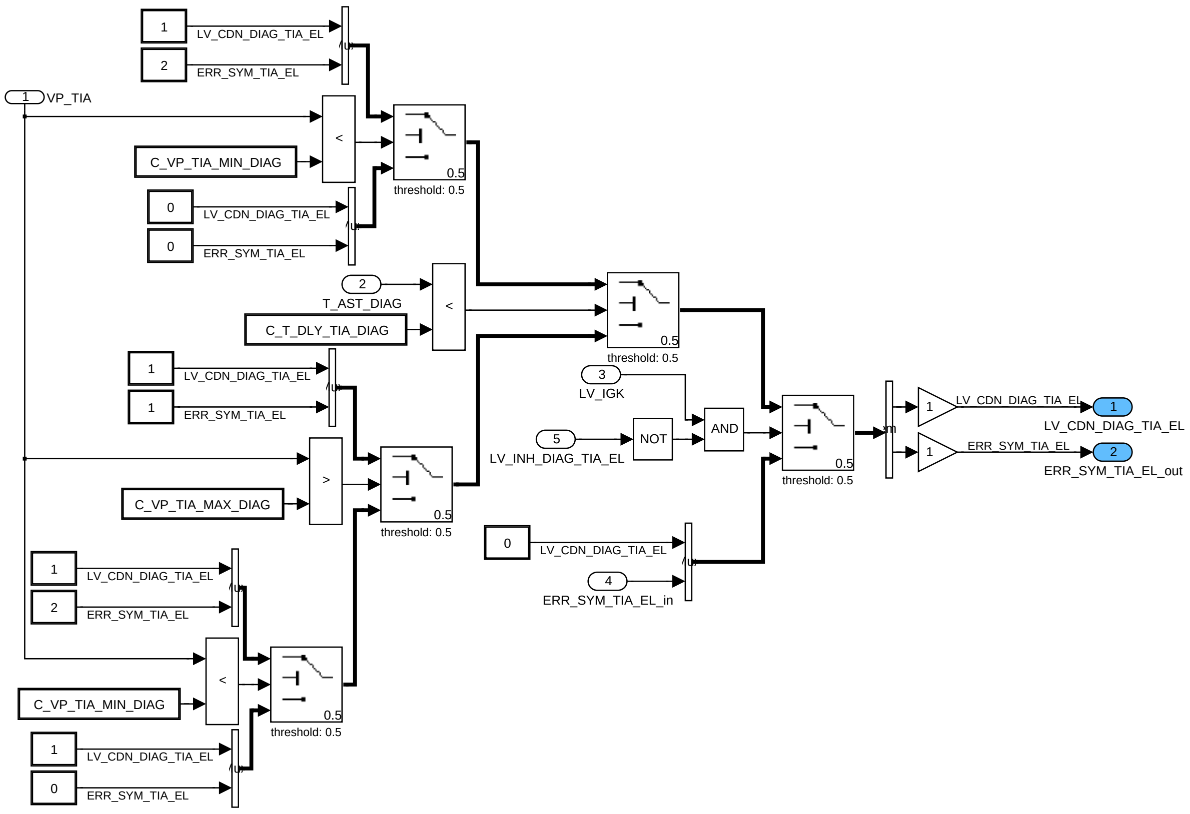

Figure A.2.3: :

A.2.2.1.2 Intake air temperature signal gradient diagnosis

The purpose of the signal gradient diagnosis is to detect a not plausible gradient on the intake air temperature signal. The monitoring is based on a comparison between the actual and the last intake air temperature value. The symptom of the error code is handled by anti-bouncing.
Error-symptoms are defined to this diagnosis function as following:

> (= SYM_0)
> (= SYM_1)
> -Intake air temperature range check error (= SYM_2)
> -Intake air temperature signal gradient error (= SYM_3)

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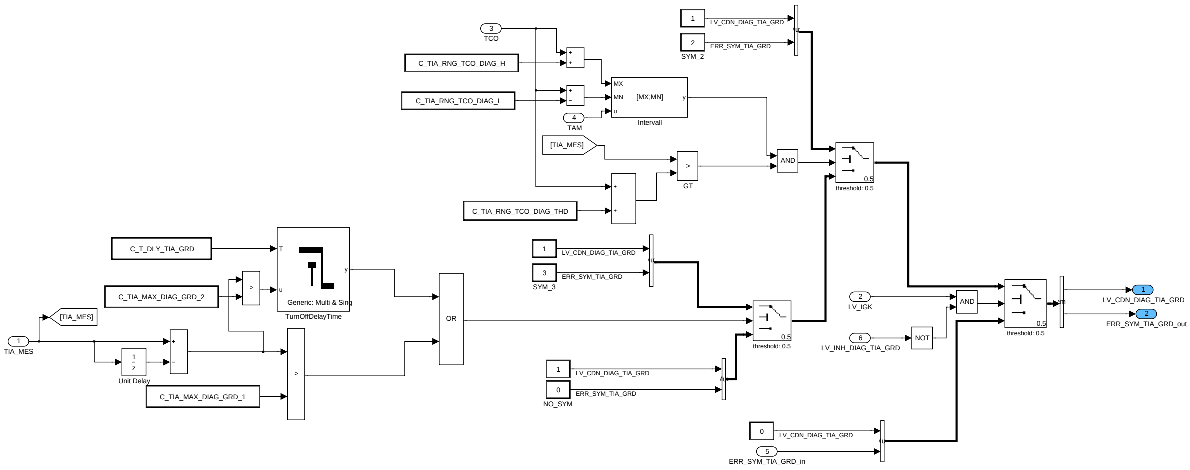

Figure A.2.4: :

A.2.2.2 ERRM_IF

A.2.2.2.1 ERRM inteface

Calculation of present error and of diagnosis LV_ERR_TIA_EL and LV_END_DIAG_TIA_EL are calculed here by error management

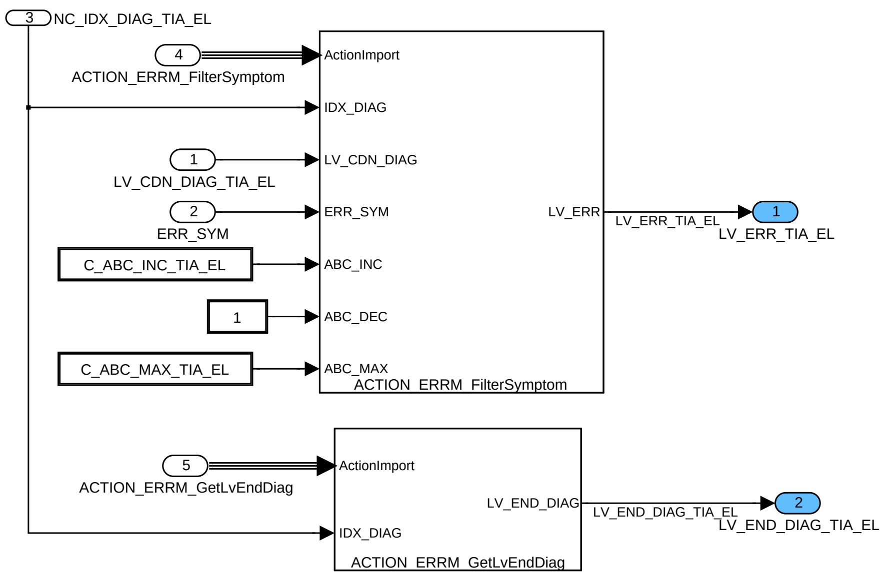

Figure A.2.5: :

A.2.2.2.2 ERRM interface

Calculation of present error and of diagnosis LV_ERR_TIA_GRD and LV_END_DIAG_TIA_GRD are calculed here by error management

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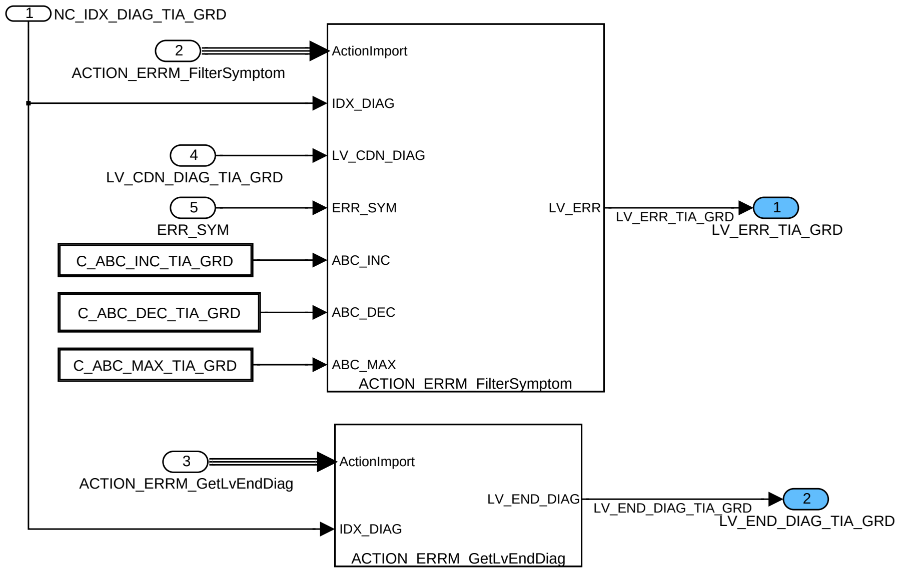

Figure A.2.6: :

A.2.3 ERRM_VIS_OUT

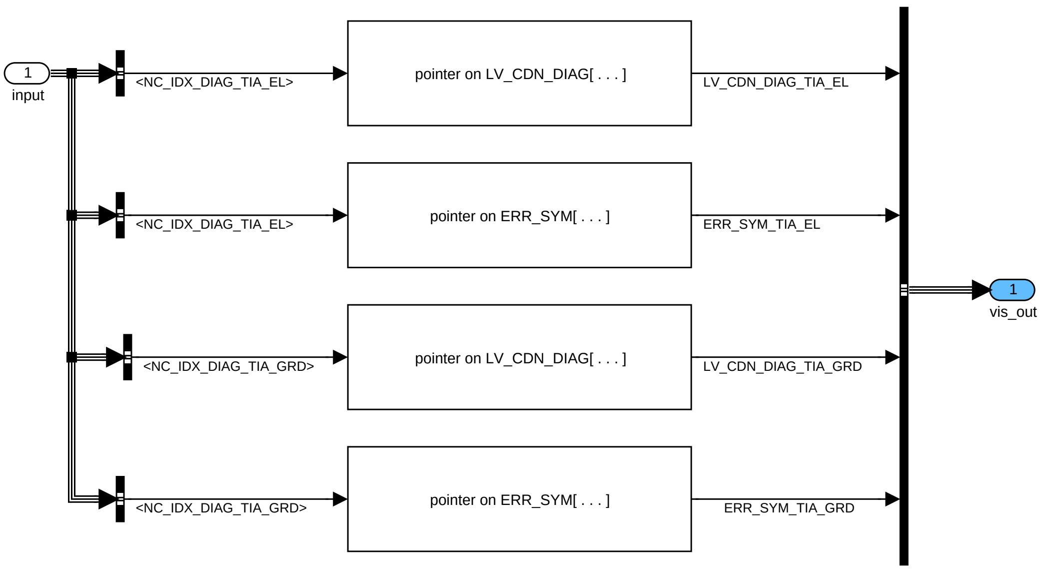

Figure A.2.7: :

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A.3 Intake air temperature sensor diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_TIA	O/V	0... 1H	0 ...1	1	-
TIA error present					
LV_INH_DIAG_TIA_EL	O/V	0... 1H	0 ...1	1	-
Inhibition flag for the diagnosis of TIA_EL					
LV_INH_DIAG_TIA_GRD	O/V	0... 1H	0 ...1	1	-
Inhibition flag for the diagnosis of TIA_GRD					

Input data:

LV_ERR_BN_T_ICL {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_COM_2_BOFF {p. 801}	LV_ERR_COM_2_TAM_ ICL
LV_ERR_TAM_CAN {p. 5076}	LV_ERR_TAM_PLAUS {p. 5076}	LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}
LV_ERR_TCO_PLAUS {p. 5682}	LV_ERR_TCO_STUCK {p. 5691}	LV_ERR_TCO_STUCK_ RNG {p. 5675}	LV_ERR_TIA_EL {p. 4194}
LV_ERR_TIA_GRD {p. 4194}	LV_ERR_TIA_PLAUS {p. 5093}	LV_IGK {p. 906}	

General information:

General information:
The global error flag LV_ERR_TIA can be used for inhibition. It is set if a electrical or a plausibility TIA error occur.

Application conditions:

Initialisation:	`RST, CLRFMY, IGKON`
Recurrence:	`500MS`
Activation:	`LV_IGK == 1`
Deactivation:	`never`

Function description:

Formula section:

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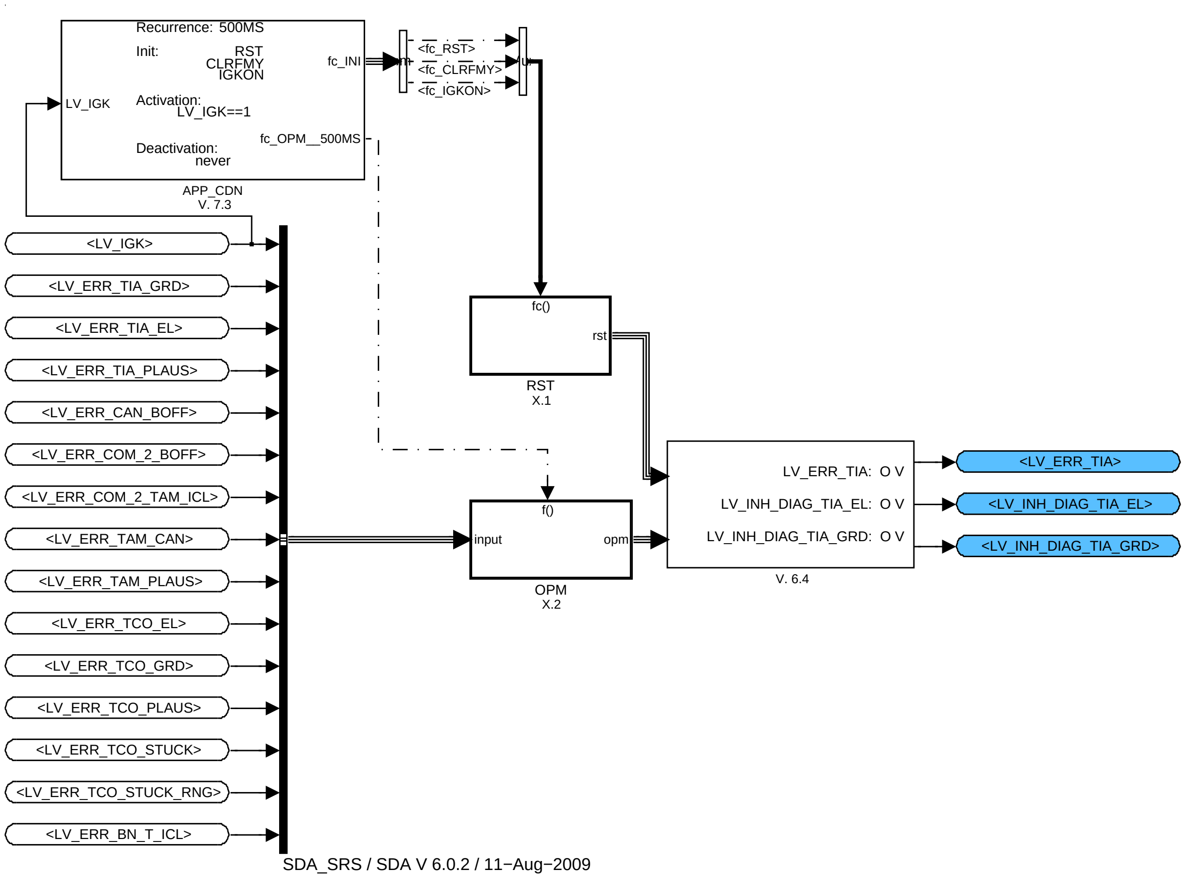

Figure A.3.1: :

A.3.1 Initilisation of LV_ERR_TIA

LV_ERR_TIA is initialised to 0.

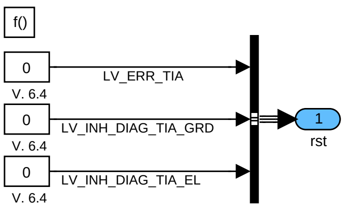

Figure A.3.2: :

A.3.2 Formula Section

Output is calculated at 500ms recurrence.

A.3.2.1 Calculation of LV_ERR_TIA

If LV_ERR_TIA_PLAUS or LV_ERR_TIA_EL or LV_ERR_TIA_GRD is set, then LV_ERR_TIA flag is set.

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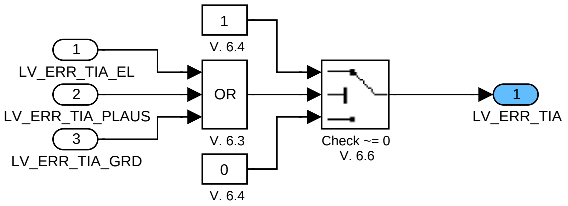

Figure A.3.3: :

A.3.2.2 Calculation of LV_INH_DIAG_TIA_GRD

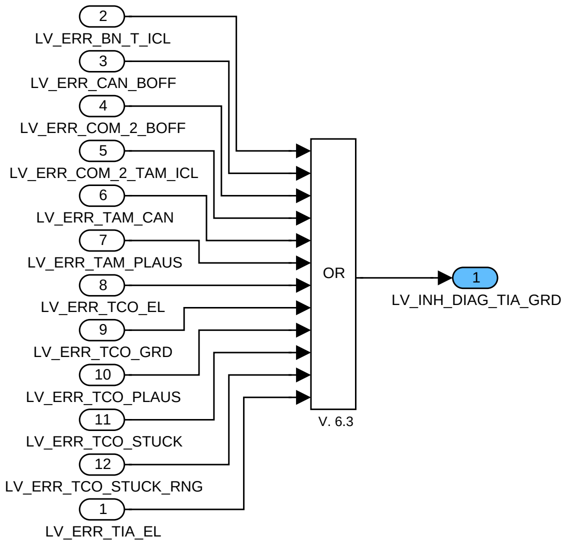

Figure A.3.4: :

A.3.2.3 Calculation of LV_INH_DIAG_TIA_EL

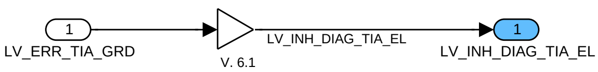

Figure A.3.5: :

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A.4 Recirculation flap diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_RFP_DR	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of RFP_DR bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
ERR_DIAG_RFP_DR	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for RFP_DR(only parameter)					
ERR_SYM_RFP_DR	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom recirculation flap driver					
LV_CDN_DIAG_RFP_DR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition recirculation flap driver fullyfied					
LV_END_DIAG_RFP_DR	O/V	0... 1H	0 ...1	1	-
End of diagnosis recirculation flap driver reached					
LV_ERR_RFP_DR	O/V	0... 1H	0 ...1	1	-
recirculation flap driver error detected					
LV_INH_DIAG_RFP_DR	O/V	0... 1H	0 ...1	1	-
recirculation flap driver diagnosis inhibition activ					

Input data:

LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}	LV_VAR_TCHA {p. 656}
RFPPWM {p. 8140}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_RFP_DR	-	0... FFH	0... 255	1	-
Debounce counter increment - recirculation flap driver					
C_ABC_MAX_RFP_DR	-	1... FFH	1... 255	1	-
Debounce counter maximum value - recirculation flap driver					
C_RFP_DR_PWM_DIAG_MAX_SCG	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Maximum threshold for SCG diagnosis window recirculation flap driver					
C_RFP_DR_PWM_DIAG_MIN_OC	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Minimum threshold for OC diagnosis window recirculation flap driver					
C_RFP_DR_PWM_DIAG_MIN_SCB	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Minimum threshold for SCB diagnosis window recirculation flap driver					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

FUNCTION DESCRIPTION:

General information:

The purpose of the diagnosis is to detect electrical faults in the recirculation flap.
The input signal is a modulated control pulse (PWM).

Description:

For error detection algorithm see “Electrical diagnosis of powerstage outputs ATIC39”.
The diagnosis condition calculation is done according **“Open range”** duty cycle, thus a definition of the PWM diagnosis windows is neccessary (see calibration data).

Error-symptoms are defined to this diagnosis function as following :

```
┌─┬─┬─┬─┐
 │ │ │ └─> Short circuit to VBatt        (= SYM_0)
 │ │ └───> Short circuit to GND          (= SYM_1)
 │ └─────> Open load                     (= SYM_2)
 └───────> -                             (= SYM_3)
```

Application conditions

Initialisation: according Filter-type **MPL_STD_INI**
(reset of variables at LV_IGK 0 -> 1 or ECU reset)

Recurrence: 100ms

Activation: *LV_VAR_TCHA = 1*

Deactivation:
```
If    LV_VAR_TCHA = 0
 Then  LV_END_DIAG_RFP_DR = 1
  Endif
```

Formula section:

If diagnosis is not inhibited (LV_INH_DIAG_RFP_DR = 0) the diagnosis conditions are set according infrastructure information: CDN_DIAG_RFP_DR.
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_RFP_DR.

Failure debouncing and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_RFP_DR and ERR_DIAG_RFP_DR.

This algorithm determines:
ERR_SYM_RFP_DR (detected error symptom)
LV_ERR_RFP_DR (Error flag for debounced error)
LV_CDN_DIAG_RFP_DR (Diagnosis condition information)

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LV_END_DIAG_RFP_DR (End of diagnosis information)

Diagnosis inhibition:

IF LV_IGK = 1 **AND**
LV_CDN_VB_OBD1 = 1 **AND**
LV_ERR_SPI_MPS = 0
THEN LV_INH_DIAG_RFP_DR = 0
ELSE LV_INH_DIAG_RFP_DR = 1
ENDIF

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A.5 Waste gate electrical diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_WG_1_DR	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of WG_1_DR bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_WG_2_DR	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of WG_2_DR bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
ERR_DIAG_WG_1_DR	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for WG_1_DR (only parameter)					
ERR_DIAG_WG_2_DR	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for WG_2_DR (only parameter)					
ERR_SYM_WG_1_DR	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom Waste gate driver cylinder bank 1					
ERR_SYM_WG_2_DR	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom Waste gate driver					
LV_CDN_DIAG_WG_1_DR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition Waste gate driver cylinder bank 1					
LV_CDN_DIAG_WG_2_DR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition Waste gate driver cylinder bank 2					
LV_END_DIAG_WG_1_DR	O/V	0... 1H	0 ...1	1	-
End of diagnosis Waste gate driver cylinder bank 1					
LV_END_DIAG_WG_2_DR	O/V	0... 1H	0 ...1	1	-
End of diagnosis Waste gate driver cylinder bank 2					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_WG_1_DR	O/V	0... 1H	0 ...1	1	-
Waste gate driver error cylinder bank 1 detected					
LV_ERR_WG_2_DR	O/V	0... 1H	0 ...1	1	-
Waste gate driver error cylinder bank 2 detected					
LV_INH_DIAG_WG_1_DR	O/V	0... 1H	0 ...1	1	-
Waste gate driver diagnosis inhibition cylinder bank 1					
LV_INH_DIAG_WG_2_DR	O/V	0... 1H	0 ...1	1	-
Waste gate driver diagnosis inhibition cylinder bank 2					

Input data:

LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}	LV_VAR_TCHA {p. 656}
WGPWM [NC_CBK_EX_NR] {p. 8140}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_WG_DR	-	0... FFH	0... 255	1	-
Debounce counter increment - Waste gate 1					
C_ABC_MAX_WG_DR	-	1... FFH	1... 255	1	-
Debounce counter maximum value - Waste gate					
C_WG_DR_PWM_DIAG_MAX_SCG	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Maximum threshold for SCG diagnosis window					
C_WG_DR_PWM_DIAG_MIN_OC	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Minimum threshold for OC diagnosis window					
C_WG_DR_PWM_DIAG_MIN_SCB	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Minimum threshold for SCB diagnosis window					

FUNCTION DESCRIPTION:

General information:

The purpose of the diagnosis is to detect electrical faults in the waste gate. There are one for each exhaust bank (x = 1 or 2). All calibration data will be copyed into SW internal CBK spezific calibration data. Example:
C_ABC_INC_WG_DR = C_ABC_INC_WG_1_DR = C_ABC_INC_WG_2_DR
The input signal is a modulated control pulse (PWM).

Description:

For error detection algorithm see “Electrical diagnosis of powerstage outputs ATIC39”.
The diagnosis condition calculation is done according **“Open range”** duty cycle, thus a definition of the PWM diagnosis windows is neccessary (see calibration data).

Error-symptoms are defined to this diagnosis function as following :

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```
|_|_|_|_|
 | | | └─> Short circuit to VBatt            (= SYM_0)
 | | └───> Short circuit to GND              (= SYM_1)
 | └─────> Open load                         (= SYM_2)
 └───────> -                                 (= SYM_3)
```

Application conditions

Initialisation: according Filter-type **MPL_STD_INI**
(reset of variables at LV_IGK 0 -> 1 or ECU reset)

Recurrence: 100ms

Activation: LV_VAR_TCHA =1 at every engine operating state

Deactivation:

```
If      LV_VAR_TCHA =0
  Then  LV_END_DIAG_WG_X_DR = 1
  Endif
```

Formula section:

If diagnosis is not inhibited (LV_INH_DIAG_WG_X_DR = 0) the diagnosis conditions are set according infrastructure information: CDN_DIAG_WG_X_DR.
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_WG_X_DR.

Failure debouncing and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_WG_X_DR and ERR_DIAG_WG_X_DR.

This algorithm determines:

ERR_SYM_WG_X_DR	(detected error symptom)
LV_ERR_WG_X_DR	(Error flag for debounced error)
CDN_DIAG_WG_X_DR	(Diagnosis condition information)
LV_END_DIAG_WG_X_DR	(End of diagnosis information)

Diagnosis inhibition:

```
IF      LV_IGK = 1              AND
        LV_CDN_VB_OBD1 = 1      AND
        LV_ERR_SPI_MPS = 0
THEN    LV_INH_DIAG_WG_X_DR = 0
ELSE    LV_INH_DIAG_WG_X_DR = 1
ENDIF
```

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A.6 Brake switch diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_IM_BLS_PLAUS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BLS					
ERR_SYM_IM_BTS_PLAUS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BTS					
LV_BLS_EDGE	V	0... 1H	0 ...1	1	-
LV_BLS_EDGE					
LV_BRAKE_DET	O/V	0... 1H	0 ...1	1	-
LV_IM_BLS or _BTS detected					
LV_BTS_EDGE	V	0... 1H	0 ...1	1	-
LV_BTS_EDGE					
LV_CDN_DIAG_IM_BLS_PLAUS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BLS					
LV_CDN_DIAG_IM_BTS_PLAUS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BTS					
LV_END_DIAG_IM_BLS_PLAUS	O/V	0... 1H	0 ...1	1	-
End of Diagnosis BLS					
LV_END_DIAG_IM_BTS_PLAUS	O/V	0... 1H	0 ...1	1	-
End of Diagnosis BTS					
LV_ERR_BLS_PLAUS	O/V	0... 1H	0 ...1	1	-
Brake plausibility information flag					
LV_ERR_IM_BLS_PLAUS	O/V	0... 1H	0 ...1	1	-
BLS plausibility error BLS					
LV_ERR_IM_BTS_PLAUS	O/V	0... 1H	0 ...1	1	-
BTS plausibility error flag					
T_BTS_PLAUS	V	0... FFFFH	0... 6553.5	0.1	s
T_BTS_PLAUS					

Input data:

LV_CDN_VB_MIN_DIAG {p. 1185}	LV_IGK {p. 906}	LV_IM_BLS {p. 852}	LV_IM_BTS {p. 852}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_IM_BLS_PLAUS	-	0... FFH	0... 255	1	-
BLS debounce counter increment					
C_ABC_INC_IM_BTS_PLAUS	-	0... FFH	0... 255	1	-
BTS debounce counter increment					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_IM_BLS_PLAUS	-	1... FFH	1... 255	1	-
BLS debounce counter maximum value					
C_ABC_MAX_IM_BTS_PLAUS	-	1... FFH	1... 255	1	-
BTS debounce counter maximum value, error debounce					
C_T_BTS_PLAUS_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Maximum value of the time counter for debounce					

FUNCTION DESCRIPTION:

General information:

In principle both brake light switch and brake test switch must be active at each braking. An edge mismatch between the brake light switch and brake test switch signal of +/- 20 µs can occur. A defective BTS is therefore detected by means of the following function.

Description:

The following errors can be detected:

- BLS implausible

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> -                                  (= SYM_0)
 │ │ └───> -                                  (= SYM_1)
 │ └─────> -                                  (= SYM_2)
 └───────> LV_IM_BLS not plausible            (= SYM_3)
```

- BTS implausible

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> -                                  (= SYM_0)
 │ │ └───> -                                  (= SYM_1)
 │ └─────> -                                  (= SYM_2)
 └───────> - LV_IM_BTS not plausible          (= SYM_3)
```

Application conditions

Initialisation: *according filter type:* **"STD-INI"**

Recurrence: *100 ms (note: the formula section is not calculated during the first recurrence, when the activation conditions are fulfilled for the first time)*

Activation: *LV_CDN_VB_MIN_DIAG = 1* ***and*** *LV_IGK = 1*

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Formula section:

LV_BLS_EDGE = 0
If LV_IM_BLS = 01 or LV_IM_BLS = 10
Then LV_BLS_EDGE = 1
Endif

LV_BTS_EDGE = 0
If LV_IM_BTS = 01 or LV_IM_BTS = 10
Then LV_BTS_EDGE = 1
Endif

```
If(1) LV_BTS_EDGE = LV_BLS_EDGE
Then(1)
        If(2) LV_IM_BLS = LV_IM_BTS
        Then(2)
                If(2.1) LV_BLS_EDGE = 1 and LV_BTS_EDGE = 1
                Then(2.1)
                        Reset timer T_BTS_PLAUS
                        LV_CDN_DIAG_IM_BLS_PLAUS = 1
                        ERR_SYM_IM_BLS_PLAUS = "NO_SYM"
                        (error flag reset by the error manager)

                        LV_CDN_DIAG_IM_BTS_PLAUS = 1
                        ERR_SYM_IM_BTS_PLAUS = "NO_SYM"
                        (error flag reset by the error manager)
                Endif(2.1)
        Else(2)
                If(3) CTR_ABC_IM_BLS_PLAUS > 0
                Then(3)
                        Reset timer T_BTS_PLAUS
                        LV_CDN_DIAG_IM_BLS_PLAUS = 1
                        ERR_SYM_IM_BLS_PLAUS = "SYM_3"
                        (error flag set by the error manager)
                Else(3)
                        LV_CDN_DIAG_IM_BLS_PLAUS = 0
                        ERR_SYM_IM_BLS_PLAUS = "NO_SYM"
                Endif(3)
                If(4) CTR_ABC_IM_BTS_PLAUS > 0
                Then(4)
                        Reset timer T_BTS_PLAUS
                        LV_CDN_DIAG_IM_BTS_PLAUS = 1
                        ERR_SYM_IM_BTS_PLAUS = "SYM_3"
                        (error flag set by the error manager)
                Else(4)
                        LV_CDN_DIAG_IM_BTS_PLAUS = 0
                    ERR_SYM_IM_BTS_PLAUS = "NO_SYM"
                        If(5) ERR_SYM_IM_BLS_PLAUS = "NO_SYM"
```

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```
                    Then(5)
                        If(6) T_BTS_PLAUS > C_T_BTS_PLAUS_MAX
                        Then(6)
                            If(7) LV_IM_BLS = 1
                            Then(7)
                                Reset timer T_BTS_PLAUS
                                LV_CDN_DIAG_IM_BLS_PLAUS = 1
                                ERR_SYM_IM_BLS_PLAUS = "SYM_3"
                                (error flag set by the error manager)

                                 LV_CDN_DIAG_IM_BTS_PLAUS = 0
                                ERR_SYM_IM_BTS_PLAUS = "NO_SYM"
                            Else(7)
                                Reset timer T_BTS_PLAUS
                                LV_CDN_DIAG_IM_BTS_PLAUS = 1
                                ERR_SYM_IM_BTS_PLAUS = "SYM_3"
                                (error flag set by the error manager)

                                 LV_CDN_DIAG_IM_BLS_PLAUS = 0
                                ERR_SYM_IM_BLS_PLAUS = "NO_SYM"
                            Endif(7)
                        Else(6)
                            Increment timer T_BTS_PLAUS
                        Endif(6)
                  Endif(5)
                Endif(4)
            Endif(2)
Else(1)
            If(10) LV_BLS_EDGE = 0
            Then(10)
                LV_CDN_DIAG_IM_BLS_PLAUS = 1
                ERR_SYM_IM_BLS_PLAUS = "SYM_3"
                (error flag set by the error manager)

              LV_CDN_DIAG_IM_BTS_PLAUS = 0
              ERR_SYM_IM_BTS_PLAUS = "NO_SYM"
            Else(10)
                LV_CDN_DIAG_IM_BTS_PLAUS = 1
                ERR_SYM_IM_BTS_PLAUS = "SYM_3"
                (error flag set by the error manager)

                LV_CDN_DIAG_IM_BLS_PLAUS = 0
                ERR_SYM_IM_BLS_PLAUS = "NO_SYM"
   Endif(10)
Endif(1)
```

Brake switch error detection:

IF LV_ERR_IM_BLS_PLAUS = 1 **or**
LV_ERR_IM_BTS_PLAUS = 1
Then LV_ERR_BLS_PLAUS = 1
Else LV_ERR_BLS_PLAUS = 0
Endif

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A.6.1 Brake detection

Description:

A brake operation is detected if brake light switch or brake test switch is engaged.

Application conditions

Initialisation: *0*

Recurrence: *10 ms*

Activation: *in all operating states*

Formula section:

If LV_IM_BLS = 1 **or** LV_IM_BTS = 1
Then LV_BRAKE_DET = 1
Else LV_BRAKE_DET = 0
Endif

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A.7 Pedal value sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_C_T_VS_BRAKE_MAX	V	0... FFH	0... 2.55	0.01	s
Delay timer for vehicle speed in PVS_BLS_BTS_PLAUS					
CTR_PVS_BLS_NOT_PLAUS_ACT	V	0... FFH	0... 255	1	-
Counter plausibility error PVS /Brake recognized without error entry					
ERR_SYM_PVS_1	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom PVS					
ERR_SYM_PVS_2	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom PVS					
ERR_SYM_PVS_BLS_NOT_PLAUS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom Plausibility error PVS /Brake					
ERR_SYM_PVS_DOUBLE	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom PVS DOUBLE					
ERR_SYM_PVS_RATIO	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom PVS_RATIO					
ERR_SYM_V_REF_1	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom PVS V_REF					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_V_REF_2	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom PVS V_REF					
LV_CDN_DIAG_PVS_1	O/V	0... 1H	0 ...1	1	-
Diagnosis condition PVS					
LV_CDN_DIAG_PVS_2	O/V	0... 1H	0 ...1	1	-
Diagnosis condition PVS					
LV_CDN_DIAG_PVS_BLS_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition Plausibility error PVS /Brake					
LV_CDN_DIAG_PVS_DOUBLE	O/V	0... 1H	0 ...1	1	-
Diagnosis condition PVS DOUBLE					
LV_CDN_DIAG_PVS_RATIO	O/V	0... 1H	0 ...1	1	-
Diagnosis condition PVS_RATIO					
LV_CDN_DIAG_V_REF_1	O/V	0... 1H	0 ...1	1	-
Diagnosis condition PVS V_REF					
LV_CDN_DIAG_V_REF_2	O/V	0... 1H	0 ...1	1	-
Diagnosis condition PVS V_REF					
LV_CDN_VS_VLD_1	V	0... 1H	0 ...1	1	-
Logical value for VS condition for PVS_BLS_BTS_PLAUS					
LV_CDN_VS_VLD_2	V	0... 1H	0 ...1	1	-
Logical value for brake pressure condition for PVS_BLS_BTS_PLAUS					
LV_DET_ERR_PVS	V	0... 1H	0 ...1	1	-
Logical value (set, if a PVS-error is present)					
LV_DET_NOT_PLAUS_ACT	O/V	0... 1H	0 ...1	1	-
PV_AV /Brake signal current not plausible					
LV_DYN_LIM_1_ACT	O/V	0... 1H	0 ...1	1	-
Limited dynamic 1 is active /passive					
LV_DYN_LIM_2_ACT	O/V	0... 1H	0 ...1	1	-
Limited dynamic 2 is active /passive					
LV_END_DIAG_PVS_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis PVS					
LV_END_DIAG_PVS_2	O/V	0... 1H	0 ...1	1	-
End of diagnosis PVS					
LV_END_DIAG_PVS_BLS_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
End of diagnosis Plausibility error PVS /Brake					
LV_END_DIAG_PVS_DOUBLE	O/V	0... 1H	0 ...1	1	-
End of diagnosis PVS DOUBLE					
LV_END_DIAG_PVS_RATIO	O/V	0... 1H	0 ...1	1	-
End of diagnosis PVS_RATIO					
LV_END_DIAG_V_REF_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis PVS V_REF					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_V_REF_2	O/V	0... 1H	0 ...1	1	-
End of diagnosis PVS V_REF					
LV_ERR_PVS	O/V	0... 1H	0 ...1	1	-
Global PVS system error					
LV_ERR_PVS_1	O/V	0... 1H	0 ...1	1	-
Global PVS system error					
LV_ERR_PVS_2	O/V	0... 1H	0 ...1	1	-
Global PVS system error					
LV_ERR_PVS_BLS_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
Plausibility error PVS /Brake recognized with error entry					
LV_ERR_PVS_DOUBLE	O/V	0... 1H	0 ...1	1	-
Present error PVS DOUBLE					
LV_ERR_PVS_RATIO	O/V	0... 1H	0 ...1	1	-
Present error PVS_RATIO					
LV_ERR_V_REF_1	O/V	0... 1H	0 ...1	1	-
Present error PVS V_REF					
LV_ERR_V_REF_2	O/V	0... 1H	0 ...1	1	-
Present error PVS V_REF					
LV_MTC_LIH_ACT	O/V	0... 1H	0 ...1	1	-
Limited dynamic speed limit demand					
LV_N_SP_IS_LIH_ACT	O/V	0... 1H	0 ...1	1	-
Locical value for LIH idle speed setpoint					
LV_PV_AV_LIM_ACT	O/V	0... 1H	0 ...1	1	-
Logical value for PV_AV over threshold for PVS_BLS_BTS_PLAUS					
LV_PVS_BLS_NOT_PLAUS_ACT	O/V	0... 1H	0 ...1	1	-
Plausibility error PVS /Brake recognized without error entry					
PV_AV_MAX_BRAKE_DET	O/V	0... FFH	0... 99.60937	0.390625	%
PV_AV_MAX_BRAKE_DET					
STATE_PVS_DIAG	O/V	0H 1H 2H 4H 8H 10H 20H 40H 80H	PVS_NO_ ERROR PVS_LIH_ PRED PVS_LIH_1 PVS_LIH_2 PVS_LIH_MIN PVS_DBL_ ERROR PVS_LIH_BLS PVS_LIH_1_ PRED PVS_LIH_2_ PRED	-	-
Status of PVS-diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Input data:

BRAKE_PRS {p. 1561}	LV_BRAKE_DET {p. 4209}	LV_ERR_BLS_PLAUS {p. 4209}	LV_IGK {p. 906}
LV_IM_BLS {p. 852}	LV_IM_BTS {p. 852}	N {p. 1525}	PV_AV {p. 1269}
STATE_BRAKE_PRS {p. 1571}	V_PVS_1 {p. 831}	V_PVS_2 {p. 831}	VCC_PVS_1 {p. 831}
VCC_PVS_2 {p. 832}	VS {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_PVS_1	-	0... FFH	0... 255	1	-
Anti-bounce increment value					
C_ABC_INC_PVS_2	-	0... FFH	0... 255	1	-
Anti-bounce increment value					
C_ABC_INC_PVS_BLS_NOT_PLAUS	-	0... FFH	0... 255	1	-
PVS_BLS_BTS_PLAUS counter increment value					
C_ABC_INC_PVS_RATIO	-	0... FFH	0... 255	1	-
Anti-bounce increment value					
C_ABC_INC_V_REF_1	-	0... FFH	0... 255	1	-
Anti-bounce increment value (x=1,2)					
C_ABC_INC_V_REF_2	-	0... FFH	0... 255	1	-
Anti-bounce increment value (x=1,2)					
C_ABC_MAX_PVS_1	-	1... FFH	1... 255	1	-
Anti-bounce maximum value					
C_ABC_MAX_PVS_2	-	1... FFH	1... 255	1	-
Anti-bounce maximum value					
C_ABC_MAX_PVS_BLS_NOT_PLAUS	-	1... FFH	1... 255	1	-
PVS_BLS_BTS_PLAUS counter maximum value					
C_ABC_MAX_PVS_RATIO	-	1... FFH	1... 255	1	-
Anti-bounce maximum value					
C_ABC_MAX_V_REF_1	-	1... FFH	1... 255	1	-
Anti-bounce maximum value (x=1,2)					
C_ABC_MAX_V_REF_2	-	1... FFH	1... 255	1	-
Anti-bounce maximum value (x=1,2)					
C_N_MAX_BRAKE	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for ABC in PVS_BLS_BTS_PLAUS					
C_PV_AV_BRAKE_MAX	-	0... FFH	0... 99.60937	0.390625	%
Maximum PV_AV threshold for PVS_BLS_BTS_PLAUS					
C_PV_AV_BRAKE_MIN	-	0... FFH	0... 99.60937	0.390625	%
Minimum PV_AV threshold for PVS_BLS_BTS_PLAUS					
C_PVS_BLS_BTS_PLAUS_CONF	-	0... 2H	0 ...2	1	-
Enable bit for plausibility check;					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_IS_PVS_ERR	-	0... FFH	0... 2.55	0.01	s
Minimum idle dwell time in error cases					
C_T_THD_VS_BRAKE_MAX	-	0... FFH	0... 2.55	0.01	s
Delay timer threshold for vehicle speed in PVS_BLS_BTS_PLAUS					
C_V_PVS_MAX_DIAG_1	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upper diagnosis threshold					
C_V_PVS_MAX_DIAG_2	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upper diagnosis threshold					
C_V_PVS_MIN_DIAG_1	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lower diagnosis threshold					
C_V_PVS_MIN_DIAG_2	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lower diagnosis threshold					
C_V_PVS_MIN_DIAG_MIN_1	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upper diagnosis threshold for switching from faulty channel to error-free					
C_V_PVS_MIN_DIAG_MIN_2	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upper diagnosis threshold for switching from faulty channel to error-free					
C_VCC_DIF_PVS	-	0... 3FFH	0... 9.9902	9.7656e-3	V
max. permissible variance of the supply voltage of 10V					
C_VS_BRAKE_MAX	-	0... FFH	0... 255	1	km/h
Maximum VS threshold for PVS_BLS_BTS_PLAUS					
C_VS_BRAKE_MIN	-	0... FFH	0... 255	1	km/h
Minimum VS threshold for PVS_BLS_BTS_PLAUS					
C_VS_MAX_BRAKE	-	0... FFH	0... 255	1	km/h
Maximum VS threshold for PVS_BLS_BTS_PLAUS					
IP_PV_AV_MAX_BRAKE_PRS_AT	-	0... FFH	0... 99.60937	0.390625	%
LDPM_BRAKE_PRS_IP_PV_AV_MAX	5	0... FFH	0... 255	1	bar
PV_AV limit for brake pressure for automatic gearbox					
IP_PV_AV_MAX_BRAKE_PRS_MT	-	0... FFH	0... 99.60937	0.390625	%
LDPM_BRAKE_PRS_IP_PV_AV_MAX	5	0... FFH	0... 255	1	bar
PV_AV limit for brake pressure for manual gearbox					
IP_PV_AV_MAX_BRAKE_VS	-	0... FFH	0... 99.60937	0.390625	%
LDP_VS_IP_PV_AV_MAX_BRAKE	5	0... FFH	0... 255	1	km/h
PV_AV limit for VS					
IP_PVS_RATIO_HYS	-	0... 3FFH	0... 4.99511	4.8828e-3	V
LDP_V_PVS_MIN	2	0... 3FFH	0... 4.99511	4.8828e-3	V
permissible variance of the PVS-values					
LC_BRAKE_PRS	-	0... 1H	0 ...1	1	-
Switch to enable brake pressure monitoring for plausibility check					

FUNCTION DESCRIPTION:

General information:

The following diagnosis are performed:

- Diagnosis of sensor-supply voltage VCC_PVS_i
- PVS-synchronization control (RATIO-Check)
- Signal range check low and high (SRCL, SRCH)
- PVS double error
- Plausibility between brake /PVS

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A.7.1 Global PVS system error LV_ERR_PVS

Description:

The global error LV_ERR_PVS is set if at least one PVS error is set.

Application conditions

Initialisation: *0 at LV_IGK 0->1* ***or*** *reset*

Recurrence: *10ms*

Activation: *LV_IGK = 1*

Formula section:

If LV_ERR_V_REF_x = 1 *// 1 or 2*
or LV_ERR_PVS_x = 1
or LV_ERR_PVS_RATIO = 1
Then LV_ERR_PVS = 1
Else LV_ERR_PVS = 0
Endif

A.7.2 Diagnosis of sensor-supply voltage VCC_PVS_i

General information:

The PVS sensor supply voltage 5V [Range 0...9.9902 V] is compared with the measured actual supply voltage every 10 ms (forming differences).
x = 1 and 2

Description:

If diagnosis condition is reached and error symptom is detected ERR_SYM_V_REF_i is set. After the debounce LV_ERR_V_REF_1 (at error channel 1), LV_ERR_V_REF_2 (at error channel 2) are set. The faulty channel is not evaluated during this driving cycle.
Remark:
During the debounce time (ERR_SYM_V_REF_x = SYM_3) the PV_AV value is limited upwards to the last valid PVS-value (see chapter 4 "Determination of accelerator pedal value").

Error-symptoms are defined to this diagnosis function as following :

```
┌─┬─┬─┬─┐
│ │ │ └─> -                                  (= SYM_0)
│ │ └───> -                                  (= SYM_1)
│ └─────> -                                  (= SYM_2)
└───────> PVS - Voltage controller faulty    (= SYM_3)
```

Application conditions

Initialisation: *all 0 at LV_IGK 0->1* ***or*** *reset*

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Recurrence: *10ms*

Activation:
```
If        LV_IGK = 1                and
    LV_ERR_V_REF_x = 0
   Then        LV_CDN_DIAG_V_REF_x = 1
Else       LV_CDN_DIAG_V_REF_x = 0
Endif
```

Formula section:

Error detection PVS-Channel:
If(1) | 5V - VCC_PVS_x | > C_VCC_DIF_PVS
Then(1) ERR_SYM_V_REF_x = SYM_3
Set ofLV_ERR_V_REF_1 (or 2) and LV_ERR_PVS:
If(2) ABC counter reaches max
// CTR_ABC_V_REF_x >= C_ABC_MAX_V_REF_x
Then(2) LV_ERR_V_REF_x = 1 *// set for this DC*
Endif(2)
Else(1) ERR_SYM_V_REF_x = NO_SYM
Endif(2)

Calculation end of diagnosis
LV_END_DIAG_V_REF_x is calculated by error management

A.7.3 PVS-synchronization control (RATIO-Check)

Description:

In order to have an error free system the pedal value sensor voltages V_PVS_x may not deviate more than IP_PVS_RATIO_HYS (V_PVS_2 must be doubled!) from each other. The smaller PVS-voltage serves as a break point for the characteristic curve.
The RATIO-Check is then only carried out if both channels are error - free.
ERR_SYM_PVS_RATIO is set when the error conditions are present; after debounce the error bit LV_ ERR_PVS_RATIO is set.
During the debounce time (ERR_SYM_PVS_RATIO = SYM_3) the PV_AV value is limited upwards to the last valid PVS-value (see chapter 4 "Determination of accelerator pedal value").
Error-symptoms are defined to this diagnosis function as following :

```
 ┌─┬─┬─┬─┐
 └─┴─┴─┴─┘
 │  │  │  └─> -                              (= SYM_0)
 │  │  └────> -                              (= SYM_1)
 │  └───────> -                              (= SYM_2)
 └──────────> PVS voltages not plausible     (= SYM_3)
```

Application conditions

Initialisation: *all 0 at LV_IGK 0->1* ***or*** *reset*

Recurrence: *10ms*

Activation:
```
If        LV_IGK = 1                and
    LV_ERR_PVS = 0              and
   Then        LV_CDN_DIAG_PVS_RATIO = 1
Else       LV_CDN_DIAG_PVS_RATIO = 0
Endif
```

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Formula section:

Error detection:

```
V_PVS_MIN  =  Min(V_PVS_1, 2 * V_PVS_2)
If(1)                    | V_PVS_1 - (2 * V_PVS_2) |  >  IP_PVS_RATIO_HYS__V_PVS_MIN
Then(1)          ERR_SYM_PVS_RATIO = SYM_3
Set ofLV_ERR_PVS_RATIO and LV_ERR_PVS:
   If(2)                    ABC counter reaches max
                                  // CTR_ABC_PVS_RATIO   >=  C_ABC_MAX_PVS_RATIO
   Then(2)          LV_ERR_PVS_RATIO =            1          // set for this DC
   Endif(2)
Else(1)          ERR_SYM_PVS_RATIO = NO_SYM
Endif(1)
```

Calculation end of diagnosis

LV_END_DIAG_PVS_RATIO is calculated by error management

A.7.4 Signal-Range-Check (High: SRCH /Low: SRCL)

General information:

Both diagnosis are only performed if the channel is not debounced as faulty (x = 1 and 2).

- The **SRCH** diagnosis is to detect a short to Vbatt error.
- The **SRCL** diagnosis is to detect a short to Ground /open load error.

Description:

SRCH diagnosis:

The sensor voltage must lie below the permissible voltage limits (C_V_PVS_MAX_DIAG_x) for an error-free system. ERR_SYM_PVS_x is set while the error symptom is present, the bits LV_ERR_PVS_X are set after debounce. The channel x is no longer evaluated during this driving cycle.

SRCL diagnosis:

The sensor voltage must lie upper the permissible voltage limits (C_V_PVS_MIN_DIAG_x) for an error-free system. ERR_SYM_PVS_x is set while the error symptom is present, the bits LV_ERR_PVS_X are set after debounce. The channel x is no longer evaluated during this driving cycle.

Remark:

During the debounce time (ERR_SYM_PVS_x = SYM_0 or SYM_1) and while error conditions are true the PV_AV value is limited upwards to the last valid PVS-value (see chapter 4 "Determination of accelerator pedal value").

Error-symptoms are defined to this diagnosis function as following :

```
 |_|_|_|_|
 | | | └─> Short circuit to Vbatt             (= SYM_0)
 | | └───> Short circuit to GND or open load (= SYM_1)
 | └─────> -                                 (= SYM_2)
 └───────> -                                 (= SYM_3)
```

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Application conditions

Initialisation: *all 0 at LV_IGK 0->1* ***or*** *reset*

Recurrence: *10ms*

Activation:

```
If        LV_IGK = 1                          and
    LV_ERR_PVS_x = 0                      and
    LV_ERR_V_REF_x = 0
   Then           LV_CDN_DIAG_PVS_x = 1
Else        LV_CDN_DIAG_PVS_x = 0
Endif
```

Formula section:

Short circuit to Vbatt:
If(1) V_PVS_x > C_V_PVS_MAX_DIAG_x (X = 1,2)
Then(1) ERR_SYM_PVS_x = SYM_0
Short circuit to GND or open load
Else(1)If(2) V_PVS_x < C_V_PVS_MIN_DIAG_x
Then(2) ERR_SYM_PVS_x = SYM_1
PVS voltage is in valid range
Else(2) ERR_SYM_PVS_x = NO_SYM
Endif(2)
Endif(1)

Calculation end of diagnosis and present failure
LV_ERR_PVS_x and LV_END_DIAG_PVS_x are calculated by error management

A.7.5 PVS - Double error

Description:

In order to illuminate the MIL if both PVS channels are detected as faulty there is a seperate error flag LV_ERR_PVS_DOUBLE (all other PVS errors shall be calibrated as non - MIL relevant).
If a channel is already detected as faulty (through sensor supply, SRCH, SRCL) and afterwards another sensor error appears, then the system goes into the PVS limp home for this driving cycle (see limited dynamic 2).
Error-symptoms are defined to this diagnosis function as following :

```
 _______________
|___|___|___|___|
 |   |   |   └──> -                            (= SYM_0)
 |   |   └──────> -                            (= SYM_1)
 |   └──────────> -                            (= SYM_2)
 └──────────────> PVS - Double error           (= SYM_3)
```

Application conditions

Initialisation: *all 0 at LV_IGK 0->1* ***or*** *reset*

Recurrence: *10ms*

Activation:

```
If        LV_IGK = 1                          and
    LV_ERR_PVS_DOUBLE = 0
   Then          LV_CDN_DIAG_PVS_DOUBLE = 1
        LV_END_DIAG_PVS_DOUBLE = 1
Else        LV_CDN_DIAG_PVS_DOUBLE = 0
Endif
```

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Formula section:

```
If      [ LV_ERR_V_REF_1 = 1        or
        LV_ERR_PVS_1 = 1      ]     and
        [ LV_ERR_V_REF_2 = 1        or
        LV_ERR_PVS_2 = 1 ]
Then    ERR_SYM_PVS_DOUBLE = SYM_3
        LV_ERR_PVS_DOUBLE = 1              //set direct
Endif
```

A.7.6 Plausibility between PVS signal and brake detection

General information:

This function is to detect a mechanical stucking PVS sensor or a break actuation while the gas pedal is already activated.
The diagnosis algorithm can be configured with C_PVS_BLS_BTS_PLAUS_CONF:

1. Function is disabled
2. Function is enabled but no error entry
3. Function is enabled with error entry

Description:

Error detection is based on a plausibility check brake/pedal value.
LV_PVS_BLS_NOT_PLAUS_ACT is using the same debounce calibration data like LV_ERR_PVS_BLS_NOT_PLAUS but without error entry.
If the configuration is switched within the active engine run after an active error was present then the error is not reseted until the error memory is cleared.

Error-symptoms are defined to this diagnosis function as following :

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │  │  │  └> -                          (= SYM_0)
 │  │  └───> -                          (= SYM_1)
 │  └──────> -                          (= SYM_2)
 └─────────> PVS to Brake not plausible (= SYM_3)
```

Application conditions

Initialisation: *at LV_IGK 0->1* ***or*** *reset* ***or*** *at clearing error memory:PV_AV_MAX_BRAKE_DET = 100%, all other output 0*

Recurrence: 10 ms

Activation:

```
If        C_PVS_BLS_BTS_PLAUS_CONF = 0      or
    LV_IGK = 0
 Then         Function is disabled      and
         PV_AV_MAX_BRAKE_DET = 100%     and
         LV_CDN_DIAG_PVS_BLS_NOT_PLAUS  =  0
 Else         function is active
Endif
```

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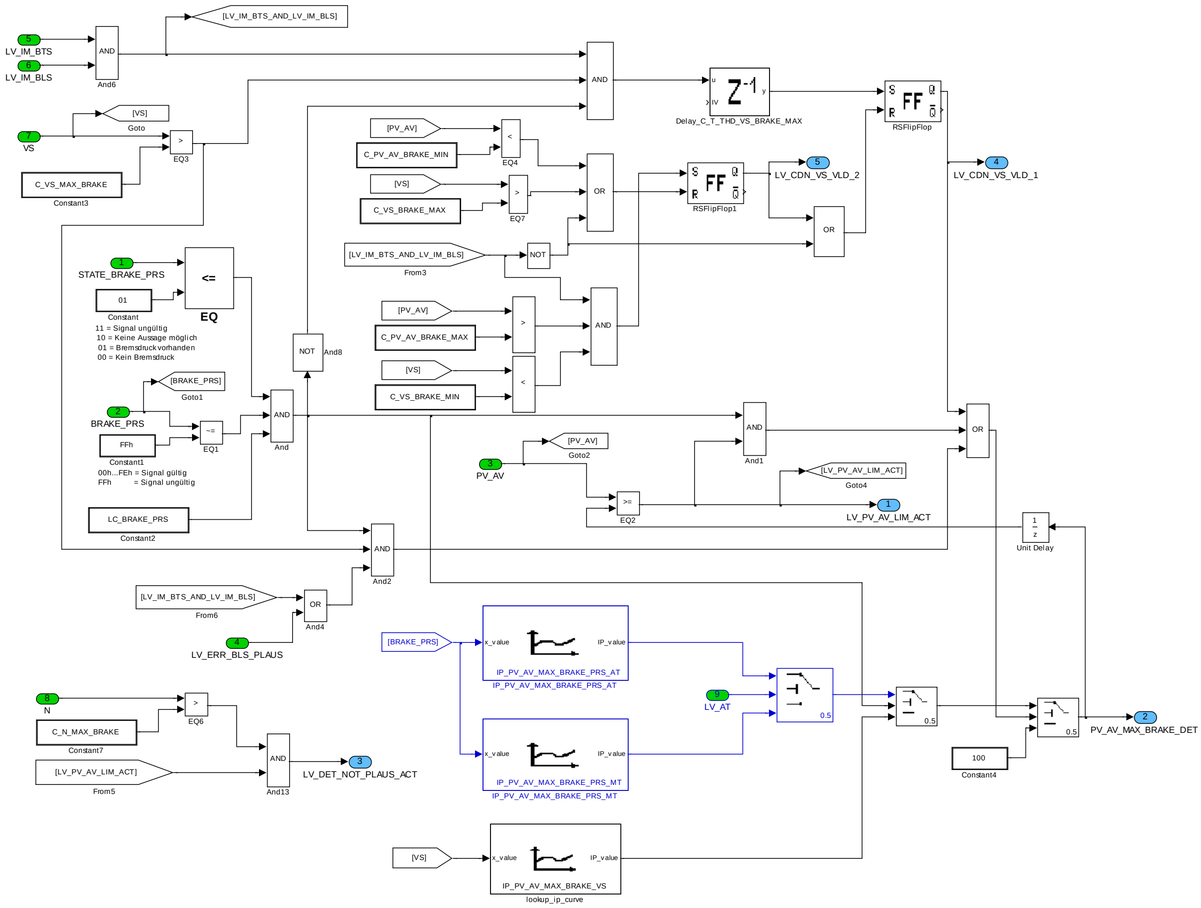
Formula section:



Not Plaus Activation

IF(1) LV_DET_NOT_PLAUS_ACT = 1
IF(2) C_PVS_BLS_BTS_PLAUS_CONF = 2
THEN(2) LV_CDN_DIAG_PVS_BLS_NOT_PLAUS = 1
ERR_SYM_PVS_BLS_NOT_PLAUS = SYM_3
Debounce of LV_ERR_PVS_BLS_NOT_PLAUS
ENDIF(2)

IF(3) C_PVS_BLS_BTS_PLAUS_CONF = 1
THEN(3)LV_CDN_DIAG_PVS_BLS_NOT_PLAUS = 0
CTR_PVS_BLS_NOT_PLAUS_ACTn =
CTR_PVS_BLS_NOT_PLAUS_ACTn-1 +
C_ABC_INC_PVS_BLS_NOT_PLAUS
IF(4) CTR_PVS_BLS_NOT_PLAUS_ACT >=
C_ABC_MAX_PVS_BLS_NOT_PLAUS
THEN(4) LV_PVS_BLS_NOT_PLAUS_ACT = 1
ENDIF(4)
ENDIF(3)
ELSE(1)
IF(5)[(LV_ERR_PVS_BLS_NOT_PLAUS = 0 **and**

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LV_PVS_BLS_NOT_PLAUS_ACT = 0) **or**
((LV_ERR_PVS_BLS_NOT_PLAUS = 1 **or**
LV_PVS_BLS_NOT_PLAUS_ACT = 1) **and**
LV_PV_AV_LIM_ACT = 0)]
THEN(5)
IF(6) C_PVS_BLS_BTS_PLAUS_CONF = 2
THEN(6) LV_CDN_DIAG_PVS_BLS_NOT_PLAUS = 1
ERR_SYM_PVS_BLS_NOT_PLAUS = NO_SYM
LV_ERR_PVS_BLS_NOT_PLAUS = 0
The debounce counters are reset to 0.
ENDIF(6)
IF(7) C_PVS_BLS_BTS_PLAUS_CONF = 1
THEN(7) LV_CDN_DIAG_PVS_BLS_NOT_PLAUS = 0
CTR_PVS_BLS_NOT_PLAUS_ACT = 0
LV_PVS_BLS_NOT_PLAUS_ACT = 0
ENDIF(7)
ELSE(5)
IF(8) C_PVS_BLS_BTS_PLAUS_CONF = 2
THEN(8) LV_CDN_DIAG_PVS_BLS_NOT_PLAUS = 1
ERR_SYM_PVS_BLS_NOT_PLAUS = NO_SYM
ENDIF(8)
IF(9) C_PVS_BLS_BTS_PLAUS_CONF = 1
THEN(9) LV_CDN_DIAG_PVS_BLS_NOT_PLAUS = 0
IF(10) CTR_PVS_BLS_NOT_PLAUS_ACT = 0
THEN(10) LV_PVS_BLS_NOT_PLAUS_ACT = 0
ENDIF(10)
ENDIF(9)
ENDIF(1)

Calculation end of diagnosis
LV_END_DIAG_PVS_BLS_NOT_PLAUS is calculated by error management

A.7.7 Pedal value sensor limp home

General information:

Depending if there is a ratio or single or double PVS error, different limp homes are applied.

PVS_LIH_PRED: Is active during debounce - time is active. The pedal value is frozen in rising direction.

PVS_LIH_x_PRED: Is active if only one channel is detected as faulty and the remaining channel was not in idle detection range for a calibratable time. Pedal value is 0.

PV_LIH_x: Is active if only one channel is detected as faulty and the remaining channel was in idle detection range for a calibratable time. Limited dynamic 1 is applied (= Lower engine speed limitation and if brake or brake error is active then pedal value is 0).

PVS_LIH_MIN: Is active if ratio error is present. Pedal value is selected as a MIN-selection.

PVS_DBL_ERROR: Is active if both channels are detected as faulty or with a present ratio error and a high range error of the observed (=MIN) channel. Limited dynamic 2 is applied (= pedal value is 0,

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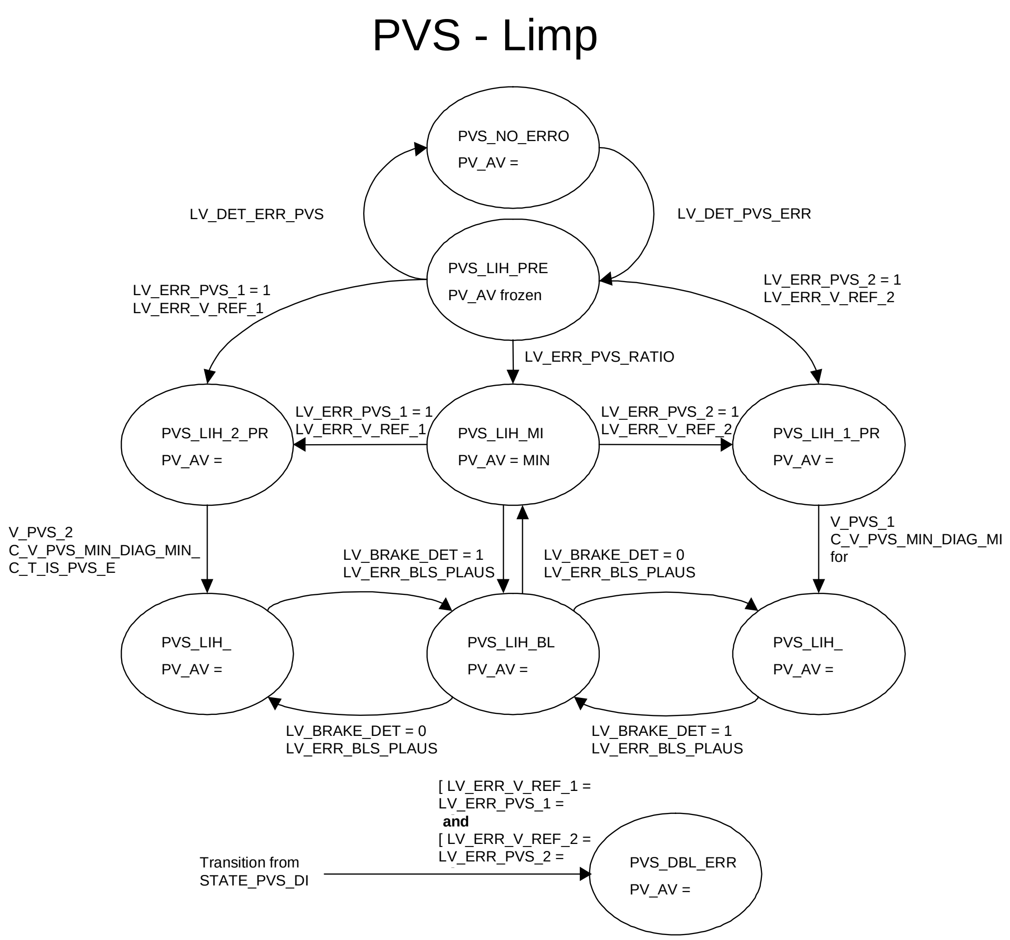
Idle speed with a higher idle speed setpoint. If brake or brake error is active then the normal idle speed setpoint is applied).

PVS_LIH_BLS: Is active if limited dynamic 1 or 2 is active and brake is detected or brake failure is present. Then pedal value is 0

Signal flow diagram:



A.7.7.1 PVS limp-home limited dynamic 1

Description:

The dynamic of the vehicle is limited in order secure controlled vehicle reactions and adequately longer reaction times for the driver when **one** of the both PVS-channels are detected as faulty.
When brake activity or an brake error is detected a lower engine speed limitation is active.
If the error memory is cleared the limp home LV_DYN_LIM_1_ACT is set to 0 as well.

Formula section:

If(1) STATE_PVS_DIAG = PVS_LIH_1 **or**
PVS_LIH_2 **or**
PVS_LIH_MIN **or**

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PVS_LIH_1_PRED **or**
PVS_LIH_2_PRED **or**
PVS_LIH_BLS

Then(1) LV_DYN_LIM_1_ACT = 1
If (2) STATE_PVS_DIAG = PVS_LIH_BLS
Then (2) LV_MTC_LIH_ACT = 1 *//Limp home engine speed limit*

Else (2) LV_MTC_LIH_ACT = 0
Endif (2)
Else(1) LV_DYN_LIM_1_ACT = 0
Endif (1)

A.7.7.2 PVS limp-home limited dynamic 2

Description:

The dynamic of the vehicle is limited in order secure controlled vehicle reactions and adequately longer reaction times for the driver when **both** channels are detected as faulty.
If an error free pedal value sensor signal is no longer present Limited dynamic 2 is set.
With the Limited dynamic 2 the vehicle is more handicaped than with Limited dynamic 1, the vehicle is driven by two idle speed setpoints.
If the error memory is cleared the limp home LV_DYN_LIM_2_ACT is set to 0 as well.

Formula section:

If(1) STATE_PVS_DIAG = PVS_DOUBLE_ERROR
Then(1) LV_DYN_LIM_2_ACT = 1
LV_MTC_LIH_ACT = 1 (see Engine speed limit coordination)
If(2) LV_BRAKE_DET = 1 **or**
LV_ERR_BLS_PLAUS = 1
Then(2) LV_N_SP_IS_LIH_ACT = 0 *(PV_AV = 0)*
Else(2) LV_N_SP_IS_LIH_ACT = 1
Endif(2)
Else(1) LV_DYN_LIM_2_ACT = 1
Endif (1)

A.7.7.3 Determination of STATE_PVS_DIAG

Description:

The PVS Value selection (See also: Determination of accelerator pedal value, Value selection) and the PVS-Limp home determination is based on the status value: STATE_PVS_DIAG.

Formula section:

Status of non-debounced PVS_error
If ERR_SYM_V_REF_1 (and 2) = NO_SYM **and**
ERR_SYM_PVS_1 (and 2) = NO_SYM **and**
ERR_SYM_PVS_RATIO = NO_SYM
Then LV_DET_ERR_PVS = 0
Else LV_DET_ERR_PVS = 1
Endif

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```
STATE_PVS_DIAG = PVS_NO_ERROR
If      LV_ERR_V_REF_1/2 = 0                        and             // no detected and
present failures
   LV_ERR_PVS_1/2 = 0                    and
   LV_ERR_PVS_RATIO = 0                       and
   LV_DET_ERR_PVS = 0
Then
   STATE_PVS_DIAG = PVS_NO_ERROR
Endif

STATE_PVS_DIAG = PVS_LIH_PRED
If      LV_ERR_PVS = 0                                 and
   LV_DET_ERR_PVS = 1
Then
   STATE_PVS_DIAG = PVS_LIH_PRED
Endif

STATE_PVS_DIAG = PVS_LIH_1_PRED /PVS_LIH_1
If      LV_ERR_V_REF_2 = 1          or
   LV_ERR_PVS_2 = 1
Then
   STATE_PVS_DIAG = PVS_LIH_1_PRED
   If      V_PVS_1 < C_V_PVS_MIN_DIAG_MIN_1
   Then        decrement T_IS_PVS_ERR timer
               If        T_IS_PVS_ERR = 0
                  Then        STATE_PVS_DIAG = PVS_LIH_1
                  Endif
   Else        T_IS_PVS_ERR = C_T_IS_PVS_ERR
   Endif
Endif

STATE_PVS_DIAG = PVS_LIH_2_PRED /PVS_LIH_2
If      LV_ERR_V_REF_1 = 1          or
   LV_ERR_PVS_1 = 1
Then
   STATE_PVS_DIAG = PVS_LIH_2_PRED
   If      V_PVS_2 < C_V_PVS_MIN_DIAG_MIN_2
   Then        decrement T_IS_PVS_ERR timer
               If        T_IS_PVS_ERR = 0
                  Then        STATE_PVS_DIAG = PVS_LIH_2
                  Endif
   Else        T_IS_PVS_ERR = C_T_IS_PVS_ERR
   Endif
Endif

STATE_PVS_DIAG = PVS_LIH_MIN
If      LV_ERR_PVS_RATIO = 1
Then
```

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STATE_PVS_DIAG = PVS_LIH_MIN
Endif

STATE_PVS_DIAG = PVS_DBL_ERROR
If LV_ERR_PVS_DOUBLE = 1
Then
STATE_PVS_DIAG = PVS_DBL_ERROR
Endif

STATE_PVS_DIAG = PVS_LIH_BLS
If(1) STATE_PVS_DIAG = PVS_LIH_1 **or** PVS_LIH_2 **or** PVS_LIH_MIN
Then (1)
If (2) LV_BRAKE_DET = 1 **or**
LV_ERR_BLS_PLAUS = 1
Then (2) STATE_PVS_DIAG = PVS_LIH_BLS
Endif (2)
Endif (1)

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A.8 ECU reset service

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LIH_ACT	V	0... FFFFH	0... 65535	1	-
0H = kein E-GAS-Notlauf /AF50H = E-Gas-Notlauf aktiv (gespeichert im resetfesten Bereich)					
LV_N_LIM_REQ_RST_CHK	O/V	0... 1H	0 ...1	1	-
Logical variable to set engine speed limitation after ECU reset					

Input data:

LV_ERR_TQI_N_MAX_ MON {p. 6917}	LV_IGK {p. 906}	LV_MTC_LIH_ACT {p. 4216}	LV_N_LIM_REQ_MON {p. 6877}
LV_TPS_MTC_N_LIM {p. 4982}			

FUNCTION DESCRIPTION:

General information:

If ETC-Limp home is active, performance is limited for the driver. After a reset of the ECU this limitation of performance is lost from one second to another. To prevent this dangerous situation the word LIH_ ACT is saved to reset independant memory every 100 ms. This special part of memory is not deleted in case of warm reset (LV_WARM_RST = 1). In case of cold reset (LV_WARM_RST = 0) even information in this reset resistant memory is lost.
While initializing the ECU the word LIH_ACT is been read out of the reset resistant memory. If it is set, LV_N_LIM_REQ_RST_CHK is set to 1 for the current driving cycle. At transition LV_IGK = 1 0 or if the failure memory is been deleted, LV_N_LIM_REQ_RST_CHK and LIH_ACT are reset to 0.

Application Conditions:
Recurrence: 100ms

Initialisation:
at reset (but not in case of warm-reset LV_WARM_RST = 1) **OR**
at transition LV_IGK = 1 0 **OR**
after clearing failure memory

LV_N_LIM_REQ_RST_CHK = 0
LIH_ACT = 0

The following initialization is only used after warm-reset (LV_WARM_RST = 1):
IF after warm-reset LIH_ACT = AF50 hex (44880 dec)
(read after warm-reset from reset resistant memory)

THEN LV_N_LIM_REQ_RST_CHK = 1
(to be written only once while initializing ECU)

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ELSE LV_N_LIM_REQ_RST_CHK = 0
(to be written only once while initializing ECU)

ENDIF.

Activation:
LV_IGK = 1

Deactivation:
LV_IGK = 0

Formula section:

IF LV_TPS_MTC_N_LIM = 1 **OR** *// ETC-LIH request*
LV_MTC_LIH_ACT = 1 **OR** *// PVS-LIH request*
LV_N_LIM_REQ_MON = 1 **OR** *// MON-LIH request*
LV_ERR_TQI_N_MAX_MON = 1 **OR**
LV_N_LIM_REQ_RST_CHK = 1

THEN LIH_ACT = AF50 hex (44880 dec)
(to be written to reset resistant memory every 100ms)

ELSE LIH_ACT = 0 (to be written to reset resistant memory every 100ms)

ENDIF.

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A.9 ECU selftest

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_ECU_CKS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected Symptom ECU					
ERR_SYM_ECU_NVMY	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected Symptom ECU					
ERR_SYM_ECU_RAM	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected Symptom ECU RAM					
LV_CDN_DIAG_ECU_CKS	O/V	0... 1H	0 ...1	1	-
ECU Diagnosis active (=1)					
LV_CDN_DIAG_ECU_NVMY	O/V	0... 1H	0 ...1	1	-
ECU Diagnosis active (=1)					
LV_CDN_DIAG_ECU_RAM	O/V	0... 1H	0 ...1	1	-
ECU Diagnosis RAM active (=1)					
LV_END_DIAG_ECU_CKS	O/V	0... 1H	0 ...1	1	-
End of ECU Diagnosis					
LV_END_DIAG_ECU_NVMY	O/V	0... 1H	0 ...1	1	-
End of ECU Diagnosis					
LV_END_DIAG_ECU_RAM	O/V	0... 1H	0 ...1	1	-
End of ECU Diagnosis RAM					
LV_ERR_ECU_CKS	O/V	0... 1H	0 ...1	1	-
Present ECU checksum error					
LV_ERR_ECU_NVMY	O/V	0... 1H	0 ...1	1	-
Present ECU NVMY error					
LV_ERR_ECU_RAM	O/V	0... 1H	0 ...1	1	-
Present ECU RAM error					
PWL_KRAM_SAVE	-	0... FFH	0... 255	1	-
status of PWL					
PWL_KRAM_SAVE_CPL	-	0... FFH	0... 255	1	-
complement of status of PWL					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Input data:

C_VB_MIN_OBD1 {p. 1186}	ECU_STATE {p. 1091}	LV_WARM_RST {p. 560}	PWL_LOCK_CDN {p. 3776}
V_IGK {p. 1185}			

FUNCTION DESCRIPTION:

General information:

The purpose of the test is the check of differents memories (RAM, Flash, NVMY).

Remark:

- If failures are detected there are not-defined system reactions possible!
- If there is a failure in the Boot-software it it possible to have a passive ECU without error entry.

A.9.1 Flash test

Description:

The following three areas are checked by calculating the checksum:

- Boot software
- Applicative software
- Calibration data

For error healing one diagnosis cyle is necessary. If there is only transition key-ON /key OFF without end of diagnosis is reached then the error remains active.

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
│ │ │ └─> Error in Boot - SW                  (= SYM_0)
│ │ └───> Error in Applic - SW                (= SYM_1)
│ └─────> Error in Calibration data range     (= SYM_2)
└───────> -                                   (= SYM_3)
```

Application conditions

Initialisation: *all 0 at reset* ***or*** *clearing error memory*

Recurrence: *Boot software test is applied once, recurrency of applicative software and calibration data test is depending on length of each test (some minutes possible).*

Activation: at system start up after ignition-key-ON (applicative software and calibration-data test remains active for the engine run)

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Formula section:

Setting of condition diag.
LV_CDN_DIAG_ECU_CKS = 1 at reset
Error detection
If one error symptom is detected
Then ERR_SYM_ECU_CKS = SYM_0 **or** SYM_1 **or** SYM_2
LV_ERR_ECU_CKS = 1 *//no debounce*
LV_END_DIAG_ECU_CKS = 1
Else ERR_SYM_ECU_CKS = NO_SYM
LV_ERR_ECU_CKS = 0
Endif
End of diagnosis with no error detection
after finishing each test once: LV_END_DIAG_ECU_CKS = 1

A.9.2 RAM test

Description:

The following two areas are tested by ECU internal test routine:

- Internal - RAM
- Timing processing unit - RAM
- External -RAM

Error symptoms are defined for this diagnosis function as:

```
|_|_|_|_|
 | | | └─> RAM error          (= SYM_0)
 | | └───> -                  (= SYM_1)
 | └─────> -                  (= SYM_2)
 └───────> -                  (= SYM_3)
```

Remark: LV_ERR_ECU_RAM will only deliver a valid result if Level 3 (processor monitoring) is not implemented yet. Otherwise Level 3 will detect a failed RAM-test thru LV_ERR_MON_3 and the corresponding symptom: ERR_SYM_MON_3 = SYM_1 (RAM error on MC).

Application conditions

Initialisation: *all 0 at reset* ***or*** *clearing error memory*

Recurrence: *once*

Activation: *at reset*

Formula section:

Setting of condition diag.
LV_CDN_DIAG_ECU_RAM = 1 at reset
Error detection
If one error symptom is detected *(RAM test error detected by L1)*
Then ERR_SYM_ECU_RAM = SYM_0

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LV_ERR_ECU_RAM = 1 *(error is set for this engine run, no debounce)*
LV_END_DIAG_ECU_RAM = 1
Else after finishing each test once LV_END_DIAG_ECU_RAM = 1
Endif

A.9.3 NVMY test

Description:

The NVMY blocks are restored after each reset during the initialization phase after start up.
If one block is detected as faulty (see “Non volatile data” in chapter Basic SW general operation) only this datas are initialized.

Error symptoms are defined for this diagnosis function as:

```
□□□□
│ │ │ └─> NVMY error        (= SYM_0)
│ │ └───> -                 (= SYM_1)
│ └─────> -                 (= SYM_2)
└───────> -                 (= SYM_3)
```

Application conditions

Initialisation: *all 0 at reset* ***or*** *clearing error memory*
Recurrence: *40 ms (see formula section)*
Activation: *at reset*

Formula section:

at reset:

Error detection
If V_IGK < C_VB_MIN_OBD1 **or**
[LV_WARM_RST = 1 **and**
PWL_KRAM_SAVE == complement of PWL_KRAM_SAVE_CPL **and**
PWL_KRAM_SAVE = only BIT NVMY is set **]**
Then no diagnosis
Else LV_CDN_DIAG_ECU_NVMY = 1
If error symptom is detected
Then ERR_SYM_ECU_NVMY = SYM_0
LV_ERR_ECU_NVMY = 1 */*error is set for this engine run no debounce*/*
LV_END_DIAG_ECU_NVMY = 1
Else after finishing the test once LV_END_DIAG_ECU_NVMY = 1
Endif
LV_CDN_DIAG_ECU_NVMY = 0 *//reset to 0 after call of FMY*
Endif

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40ms:

If (ECU_STATE == WAKE_UP **or**
ECU_STATE == PWL) **and**
T_PWL >= C_T_MIN_PWL **and**
PWL_LOCK_CDN Bit NVMY is set
Then LV_ECU_NVMY_LOCK = 1
Endif
If LV_ECU_NVMY_LOCK = 1
Then PWL_KRAM_SAVE = PWL_LOCK_CDN
PWL_KRAM_SAVE_CPL = complement of PWL_LOCK_CDN
Endif

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A.10 ECU temperature diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TECU	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom TECU diagnosis					
LV_CDN_DIAG_TECU	O/V	0... 1H	0 ...1	1	-
Diagnosis condition TECU diagnosis					
LV_END_DIAG_TECU	O/V	0... 1H	0 ...1	1	-
End of diagnosis TECU diagnosis					
LV_ERR_TECU	O/V	0... 1H	0 ...1	1	-
TECU error flag					

Input data:

LV_IGK {p. 906}	NC_IDX_DIAG_TECU	T_AST_DIAG {p. 1766}	TIA {p. 1226}
VP_TECU {p. 1256}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TECU	-	0... FFH	0... 255	1	-
Anti bounce increment					
C_ABC_MAX_TECU	-	1... FFH	1... 255	1	-
Anti bounce maximum					
C_T_DLY_TECU_DIAG	-	0... FFFFH	0... 32767.5	0.5	s
Delay time for diagnosis activation					
C_TIA_MAX_TECU_DIAG	-	0... FEH	0... 142.5	0.75	°C
TIA threshold TECU diagnosis					
C_VP_TECU_MAX_DIAG	-	0... 7FFFH	0... 4.99984741	15.25879e3	V
TECU_MES threshold for short to VB or line break TECU diagnosis					
C_VP_TECU_MIN_DIAG	-	0... 7FFFH	0... 4.99984741	15.25879e3	V
TECU_MES threshold for short to ground TECU diagnosis					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetErrSym (**IN**<IDX_DIAG>,**OUT**<ERR_SYM>)
ACTION_ERRM_GetLvCdnDiag (**IN**<IDX_DIAG>,**OUT**<LV_CDN_DIAG>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

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FUNCTION DESCRIPTION:

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The purpose of the diagnosis shall be to detect electrical faults as defined by OBD I requirements. The input signal is analog from a NTC.
Description:
Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> Short circuit to Vbatt or open load    (= SYM_0)
 │ │ └───> Short circuit to GND                   (= SYM_1)
 │ └─────> -                                      (= SYM_2)
 └───────> -                                      (= SYM_3)
```

Application Condition

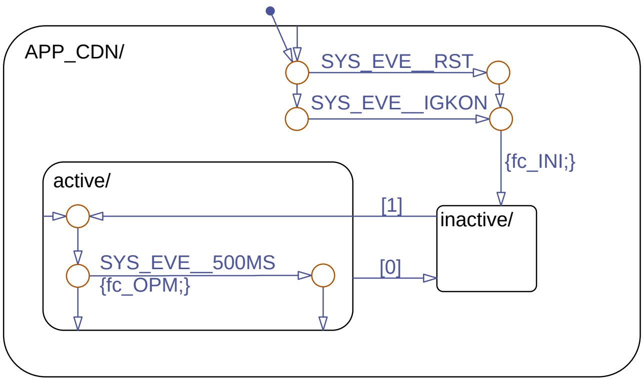

Figure A.10.1: ECOP_MA0BI/APP_CDN/Chart

Function Description

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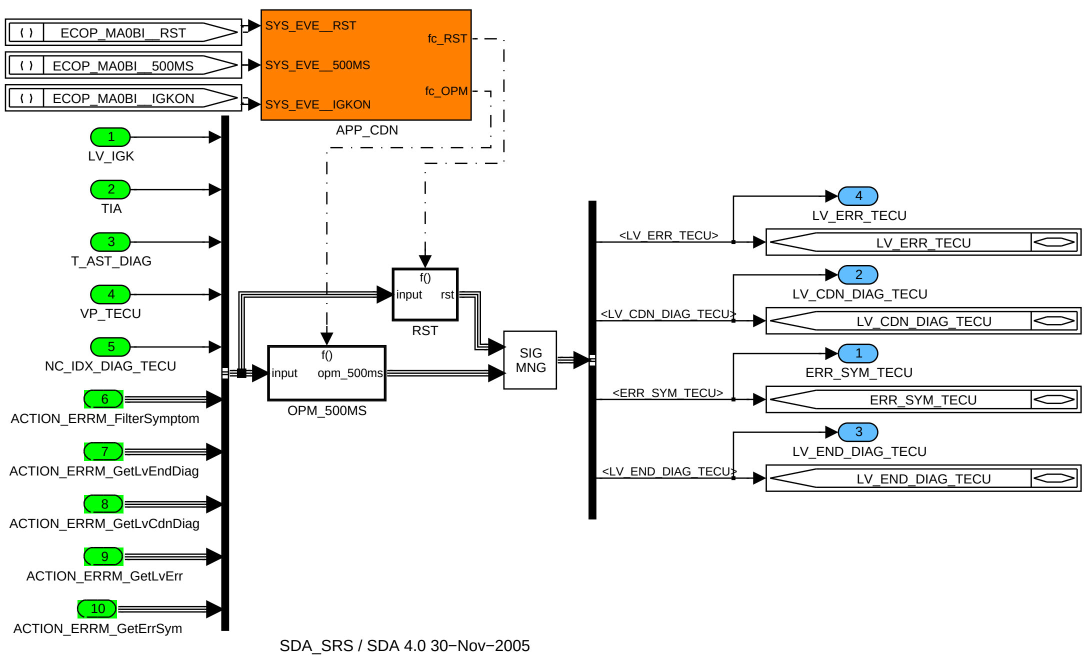

Figure A.10.2: ECOP_MA0BI

A.10.1 Initilisation

According ABC configuration **STD_INI**
ABC datas are initialized at transition LV_IGK 0>1)

Initialisation

Initialisation at system event RESET and IGKON.

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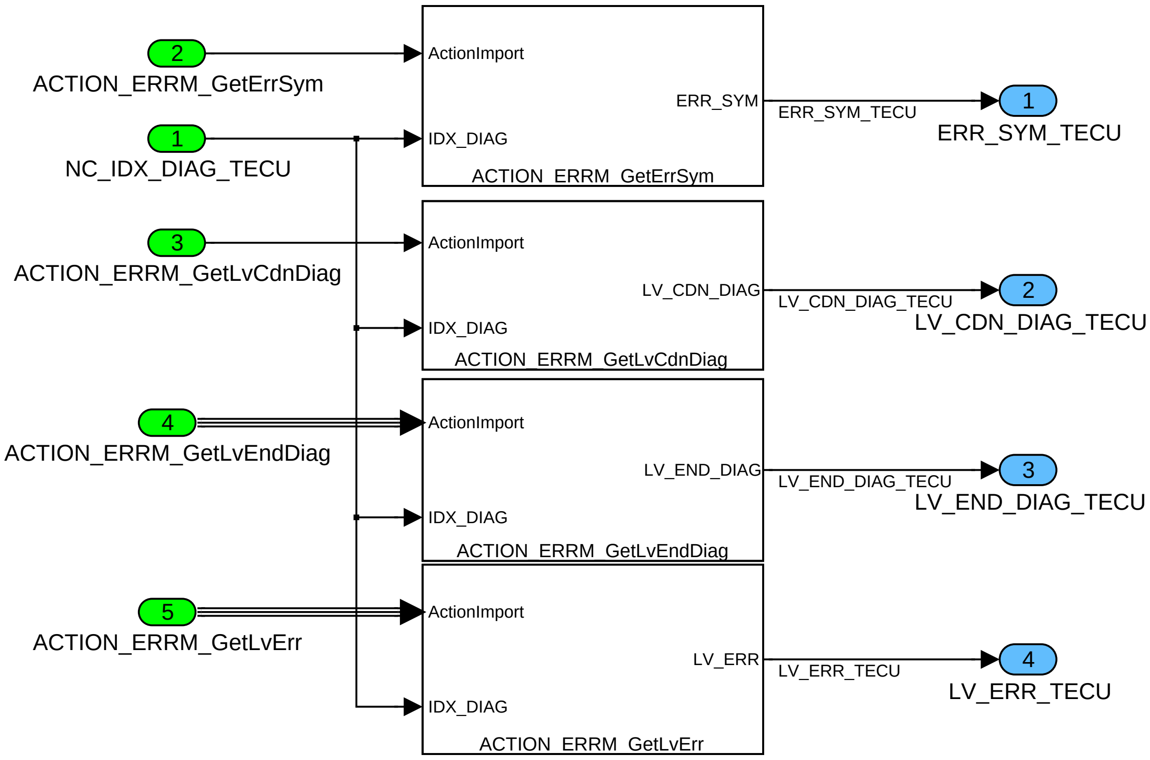

Figure A.10.3: ECOP_MA0BI/RST/CLC

A.10.2 Formula Section

Activation Condition Check

If LV_IGK =1 then the error symptoms are calculated and if false Diagnosis bit is set to 0.

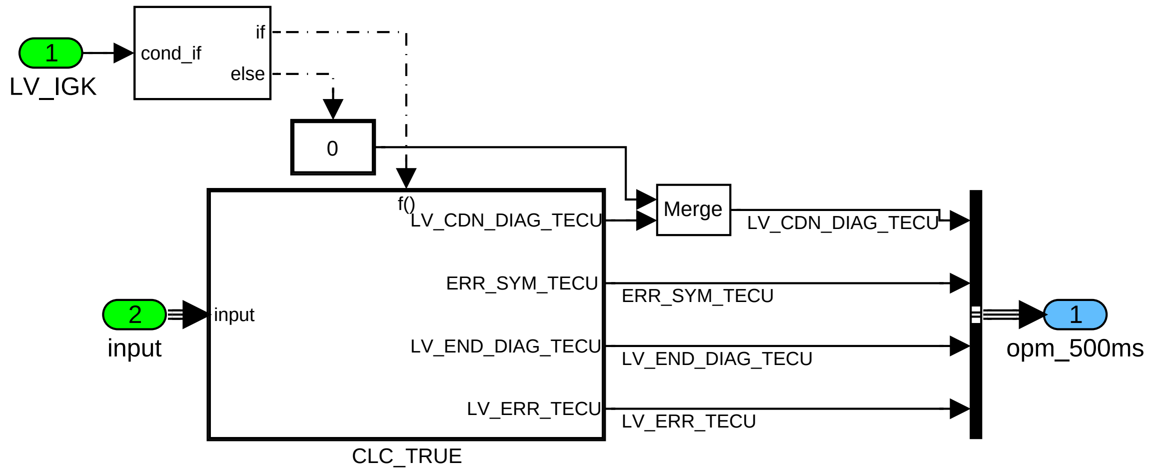

Figure A.10.4: ECOP_MA0BI/OPM_500MS/CLC

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Calculation of Error Management Variables

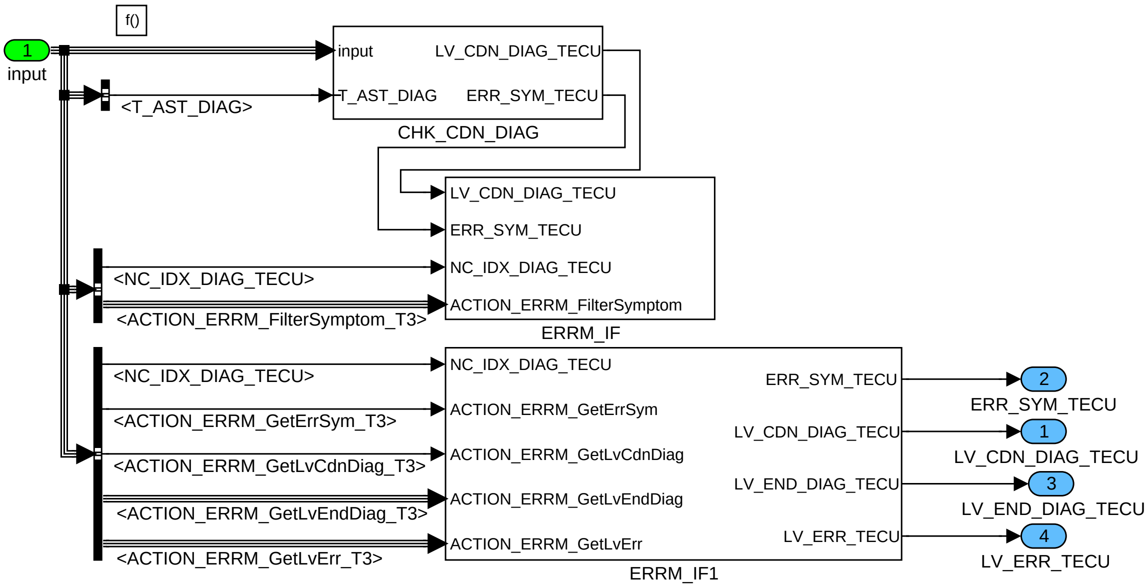

Figure A.10.5: ECOP_MA0BI/OPM_500MS/CLC/CLC_TRUE

Check Condition

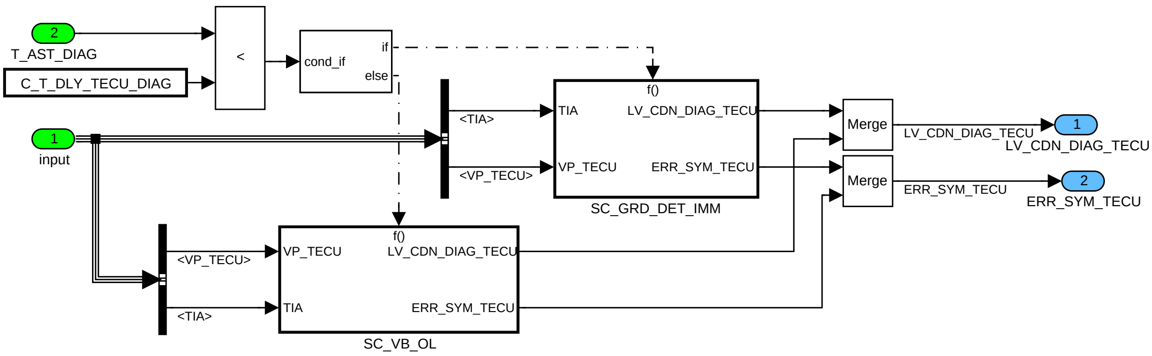

Figure A.10.6: ECOP_MA0BI/OPM_500MS/CLC/CLC_TRUE/CHK_CDN_DIAG

Short circuit to ground can be detected immediately:

ERR_SYM and LV_CDN are calculated in this subsystem

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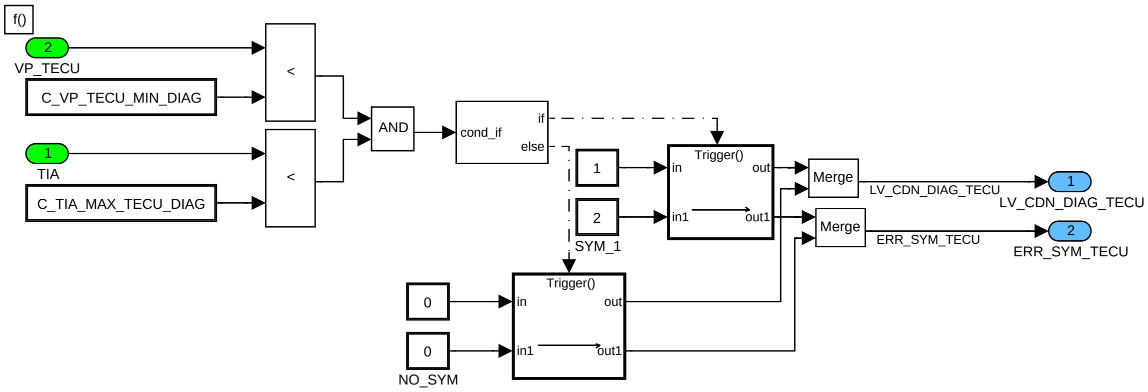

Figure A.10.7: ECOP_MA0BI/OPM_500MS/CLC/CLC_TRUE/CHK_CDN_DIAG/SC_GRD_DET_IMM

Short circuit to VBatt or open load:

ERR_SYM and LV_CDN are calculated in this subsystem

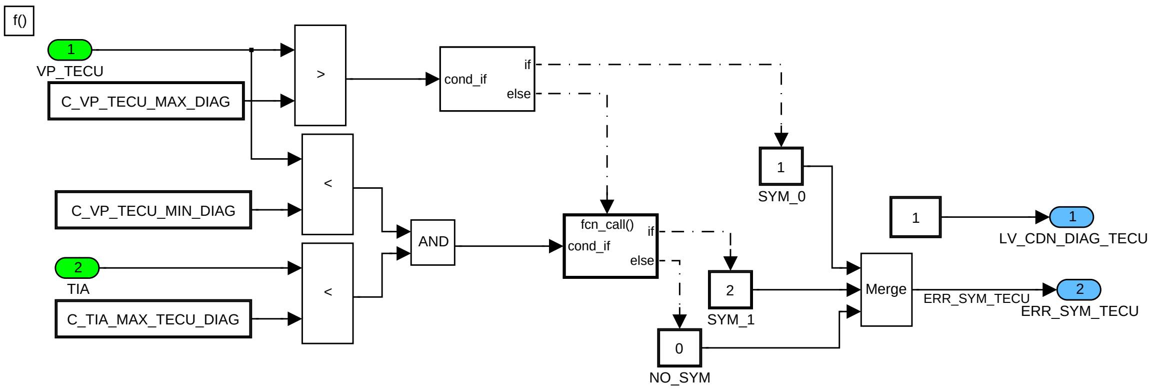

Figure A.10.8: ECOP_MA0BI/OPM_500MS/CLC/CLC_TRUE/CHK_CDN_DIAG/SC_VB_OL

Storage of LV_ERR

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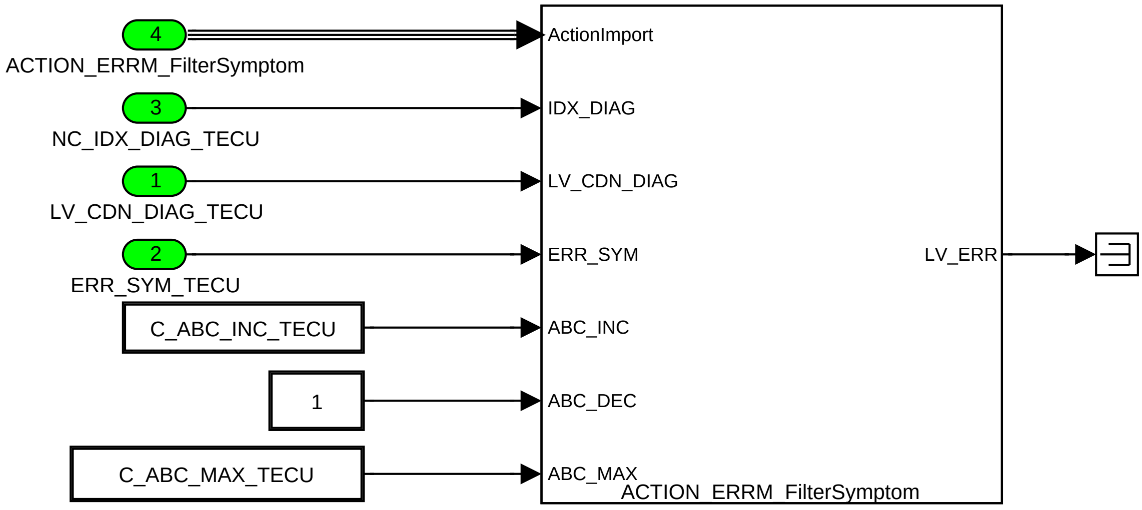

Figure A.10.9: ECOP_MA0BI/OPM_500MS/CLC/CLC_TRUE/ERRM_IF

Storage of Error Management Varables

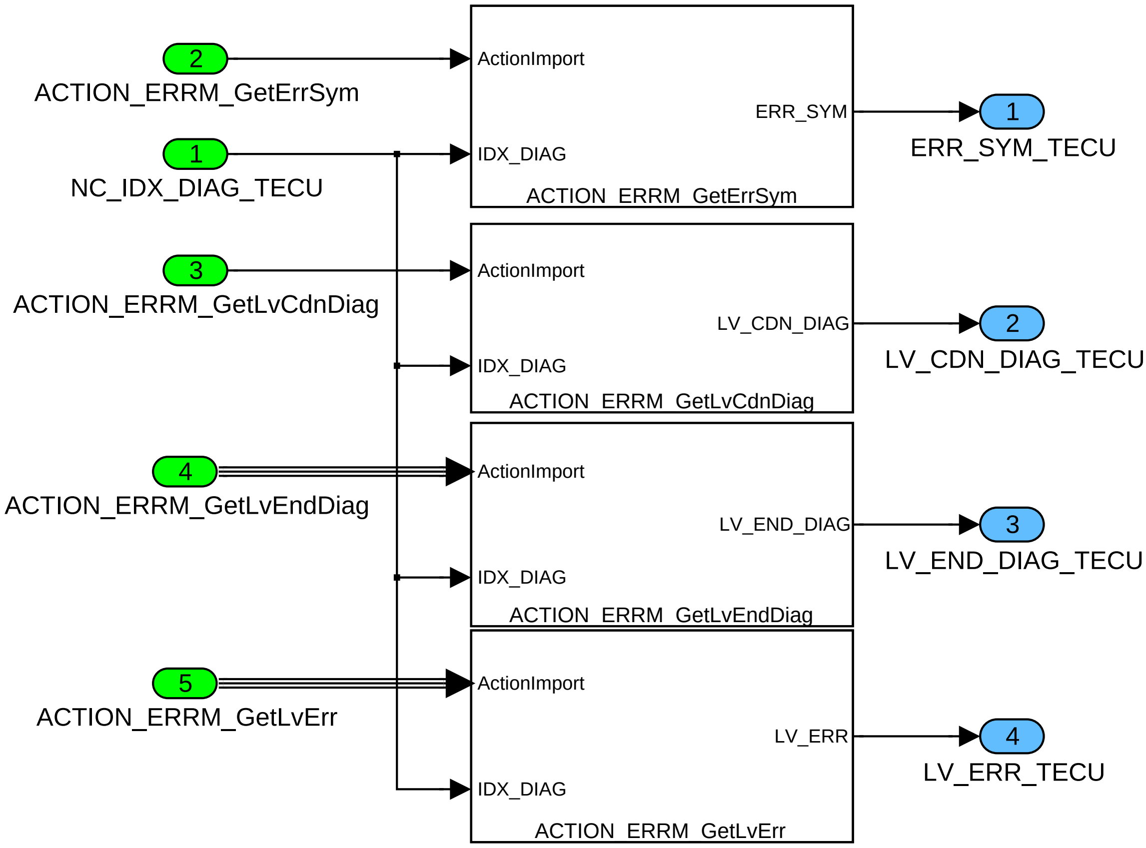

Figure A.10.10: ECOP_MA0BI/OPM_500MS/CLC/CLC_TRUE/ERRM_IF1

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A.11 Microcontroller communication diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_SPI_KNK	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		3H	SYM_0, SYM_1		
		4H	SYM_2		
		5H	SYM_0, SYM_2		
		6H	SYM_1, SYM_2		
		7H	SYM_0, SYM_1, SYM_2		
		8H	SYM_3		
		9H	SYM_0, SYM_3		
		AH	SYM_1, SYM_3		
		BH	SYM_0, SYM_1, SYM_3		
		CH	SYM_2, SYM_3		
		DH	SYM_0, SYM_2, SYM_3		
		EH	SYM_1, SYM_2, SYM_3		
		FH	SYM_0, SYM_1, SYM_2, SYM_3		
Detected symptom SPI-busdiagnosis for Knock sensor					
ERR_SYM_SPI_MPS	O/V	0H	NO_SYM	-	-
		1H	SYM_0		
		2H	SYM_1		
		3H	SYM_0, SYM_1		
		4H	SYM_2		
		5H	SYM_0, SYM_2		
		6H	SYM_1, SYM_2		
		7H	SYM_0, SYM_1, SYM_2		
		8H	SYM_3		
		9H	SYM_0, SYM_3		
		AH	SYM_1, SYM_3		
		BH	SYM_0, SYM_1, SYM_3		
		CH	SYM_2, SYM_3		
		DH	SYM_0, SYM_2, SYM_3		
		EH	SYM_1, SYM_2, SYM_3		
		FH	SYM_0, SYM_1, SYM_2, SYM_3		
Detected symptom SPI-busdiagnosis for Multi-powerstage					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_SPI_KNK	O/V	0... 1H	0 ...1	1	-
Diagnosis condition SPI-bus for Knock sensor					
LV_CDN_DIAG_SPI_MPS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition SPI-bus for Multi-powerstage					
LV_END_DIAG_SPI_KNK	O/V	0... 1H	0 ...1	1	-
End of diagnosis SPI-bus for Knock sensor					
LV_END_DIAG_SPI_MPS	O/V	0... 1H	0 ...1	1	-
End of diagnosis SPI-bus for Multi-powerstage					
LV_ERR_SPI_KNK	O/V	0... 1H	0 ...1	1	-
Present failure SPI-bus diagnosis for Knock sensor					
LV_ERR_SPI_MPS	O/V	0... 1H	0 ...1	1	-
Present failure SPI-bus diagnosis for Multi-powerstage					

Input data:

LV_IGK {p. 906}	N_32 {p. 1525}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_SPI_KNK	-	0... FFH	0... 255	1	-
Anti bounce increment SPI_KNK diagnosis					
C_ABC_INC_SPI_MPS	-	0... FFH	0... 255	1	-
Anti bounce increment SPI_MPS diagnosis					
C_ABC_MAX_SPI_KNK	-	1... FFH	1... 255	1	-
Anti bounce maximum SPI_KNK diagnosis					
C_ABC_MAX_SPI_MPS	-	1... FFH	1... 255	1	-
Anti bounce maximum SPI_MPS diagnosis					

A.11.1 SPI-Bus diagnosis for Multiple powerstage

Description:

Error-symptoms are defined to this diagnosis function as following :

```
|   |   |   └> -              (= SYM_0)
|   |   └───> -               (= SYM_1)
|   └───────> SPI bus off     (=SYM_2)
└───────────> -               (=SYM_3)
```

Application conditions

Initialization : `all 0 at LV_IGK 0->1 or reset`

Activation: *at every engine states*
Recurrency : 10 ms

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Formula section:

Diagnosis conditon:
LV_CDN_DIAG_SPI_MPS = 1
Error detection
IF BSW detects SPI bus error
THEN ERR_SYM_SPI_MPS = SYM_2 *//LV_ERR_SPI_MPS is set after debounce*
ELSE ERR_SYM_SPI_MPS = NO_SYM *//LV_ERR_SPI_MPS is reset after rebounce*
ENDIF
End of diagnosis:
LV_END_DIAG_SPI_MPS is calculated by error management if diagnosis condition is active.

A.11.2 SPI-Bus diagnosis for knock sensor

Description:

Error-symptoms are defined to this diagnosis function as following :

```
 ┌─┬─┬─┬─┐
 │ │ │ └─> -              (= SYM_0)
 │ │ └───> -              (= SYM_1)
 │ └─────> SPI bus off    (=SYM_2)
 └───────> -              (=SYM_3)
```

Application conditions

Initialization : all 0 at LV_IGK 0->1 or reset

Activation: N_32 > 320 (1/ min)
Recurrency : 100 ms

Formula section:

Diagnosis conditon:
LV_CDN_DIAG_SPI_KNK = 1
Error detection
IF BSW detects SPI bus error
THEN ERR_SYM_SPI_KNK = SYM_2 *//LV_ERR_SPI_KNK is set after debounce*
ELSE ERR_SYM_SPI_KNK = NO_SYM *//LV_ERR_SPI_KNK is reset after rebounce*
ENDIF
End of diagnosis:
LV_END_DIAG_SPI_KNK is calculated by error management if diagnosis condition is active.

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A.12 O2 sensor (bin, down) heater circuit diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibit flag for downstream oxygen sensor heater OBDI diagnosis					

Input data:

LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_SPI_MPS {p. 4245}	LV_LS_DOWN_OBD_1_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_ST_END {p. 1720}
NC_CBK_EX_NR {p. 1829}			

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Description:

The diagnosis is inhibited due to low battery voltage, present error or if sensors are not learnt.

Application conditions

Initialisation: *LV_INH_DIAG_LSH_DOWN[i] = 1 at reset*

Recurrence: *The function shall be carried out once every 100 ms.*

Activation: *LV_ST_END = 1*

Deactivation: *LV_ST_END = 0 , set LV_INH_DIAG_LSH_DOWN[i] = 1*

Formula section:

If LV_CDN_VB_OBD1 = 0 **or**
LV_ERR_SPI_MPS = 1 **or**
LV_LS_DOWN_OBD_1_MAN_DEAC[i] = 1
Then LV_INH_DIAG_LSH_DOWN[i] = 1
Else LV_INH_DIAG_LSH_DOWN[i] = 0
Endif

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A.13 O2 sensor (bin, down) heater circuit diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_LSH_DOWN [NC_CBK_EX_NR]	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of downstream heater diagnosis OBD I					
ERR_DIAG_LSH_DOWN [NC_CBK_EX_NR]	V	0H 1H 2H 4H	NO_SYM SYM_0 SYM_1 SYM_2	-	-
Raw value of error symptom for downstream heater diagnosis OBD I					
ERR_SYM_LSH_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for downstream heater diagnosis OBD I filterd with CDN_DIAG_LSH_DOWN					
LV_CDN_DIAG_LSH_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Diagnosis condition for downstream heater diagnosis OBD I					
LV_END_DIAG_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of diagnosis for downstream heater diagnosis OBD I					
LV_ERR_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Error flag for downstream heater diagnosis OBD I after debouncing					

Input data:

LSHPWM_DOWN [NC_CBK_EX_NR] {p. 2421}	LV_IGK {p. 906}	LV_INH_DIAG_LSH_ DOWN [NC_CBK_EX_NR] {p. 4247}	LV_VB_CDN_OBD_1 {p. 1046}
NC_CBK_EX_NR {p. 1829}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	TEG_DYN_LS_DOWN [NC_CBK_EX_NR] {p. 1007}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_LSH_DOWN	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_LSH_DOWN	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_LSHPWM_MAX_DIAG_LSH_DOWN	-	0... FFH	0... 99.60937	0.390625	%
Maximum O2-Sensor heater duty cycle to perform the electrical diagnosis					
C_LSHPWM_MIN_DIAG_LSH_DOWN	-	0... FFH	0... 99.60937	0.390625	%
Minimum O2-Sensor heater duty cycle to perform the electrical diagnosis					
C_TEG_DYN_MIN_DIAG_LSH_DOWN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum exhaust gas temperature threshold to permit SCP to set fault during LSH power rise state					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_LSH_DOWN	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (typical 2)					

Import actions:

ACTION_ERRM_FilterMulticondition (**IN**<XX>,**IN**<CDN_DIAG_>,**XX**>,<IN<>,**ERR_DIAG_XX**>,<IN>,<C_ABC_INC_XX>,**IN**<C_ABC_MAX_XX>,**OUT**<LV_ERR_XX>)
ACTION_INFR_GetElDiagLshDown (**IN**<i>,**OUT**<cdn_diag>,**OUT**<err_diag>)

Error treatment:

Diagnostic XX	**Symptom description**	**Symptom**	**Filter type**
Downstream oxygen sensor heater OBDI diagnosis	*Short circuit to battery*	*SYM_0*	*MPL_STD_INI*
	Short circuit to GND	*SYM_1*	
LSH_DOWN[i]	*Open circuit*	*SYM_2*	
	4th symptom description	*SYM_3*	

FUNCTION DESCRIPTION:

General information:

The purpose of the diagnosis is to detect electrical faults as defined by OBD I requirements.

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.
All symptoms of the current error code are handeled by anti-bouncing.
We assume that only one symptom of an error code can be active at the same time.

Description:

The error detection is effected via the ECU hardware.
The purpose of the diagnosis shall be to detect electrical faults within the oxygen sensor heater circuit as defined by OBD I requirements.
Error-symptoms and conditions: are defined to this diagnosis function as following

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```
 ┌─┬─┬─┬─┐
 │ │ │ │ │
 └─┴─┴─┴─┘
  |  |  |  └─> Short circuit to battery (SCP)      (= SYM_0)
  |  |  └────> Short circuit to ground (SCG)       (= SYM_1)
  |  └───────> Open circuit                (OC)    (= SYM_2)
  └──────────> -                                   (= SYM_3)
```

The function is intended for use in a hardware configuration where the heater driver shall carry out the electrical fault diagnosis and provide the electrical status via status flags.

1. *Short circuit to Vbatt by Over-temperature **or** Overcurrent* (**SCP**)
2. *Short circuit to GND* (SCG)
3. *Open load* (**OC**)

The heater drivers named are capable of detecting an **OC** and **SCP** fault when in the ON state and only capable of detecting a SCG fault in the OFF state. As the heater power is controlled by a PWM signal, the driver will be placed alternately in an ON and then OFF state.
The diagnosis shall be activated should the following conditions be met:

- Engine leaving the engine start state as denoted by LV_IGK = 1
- Battery voltage falls between pre-set thresholds to protect against false errors at battery voltage extremes as indicated by **LV_VB_CDN_OBD_1**.
- CDN depending on duty cycle of LSHPWM_DOWN[i]
- Inhibit flag not set (LV_INH_DIAG_LSH_DOWN[i])

In exceptionally rare extreme environmental conditions for certain system configurations, it is possible that the heater driver may be driven into over-temperature during initial oxygen sensor heating. In this case, the driver automatically turns off the output stage in self-protection and sets the **SCP** electrical fault bit. In order to mask an incorrect oxygen sensor heater **SCP** fault, the function shall only allow the **SCP** to set a fault during the initial heater phase, if the exhaust gas temperature has exceeded a pre-determined calibrateable threshold.
The oxygen sensor heater fault detection shall be debounced by use of an anti-bounce counter. This shall be handled by the Dynamic Error Management.
Each of the above listed faults shall be described individually below:
Otherwise the diagnosis has to be suppressed (CDN_DIAG_LSH_DOWN[i] = 0). This is managed within the Diagnosis condition calculation.

Application conditions

Initialization: `at reset CDN_DIAG_LSHDOWN[i] = 0,`
`ERR_DIAG_LSH_DOWN[i] = 0`
`All other variables are initialized according filter type`

Activation : -

Deactivation: -

Recurrence: 100 ms

NOTE: The heater PWM frequency shall be at least 2 times faster than the diagnosis frequency to ensure that an oversampling effect does not occur!

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Formula section:

If **LV_IGK** = 1
And **LV_VB_CDN_OBD_1** = 1
and LV_INH_DIAG_LSH_DOWN[i] = 0
then
Usage of the diagnosis information (failure symptoms (raw value) **ERR_DIAG_LSH_DOWN[i]** and basic diagnosis conditions **CDN_DIAG_LSH_DOWN[i]**) received from the infrastructure:
ACTION_INFR_GetElDiagLshDown(IN <i>, **OUT**<CDN_DIAG_LSH_DOWN[i]>, **OUT**<ERR_DIAG_LSH_DOWN[i]>**)**

Basic diagnosis conditions are set according infrastructure information: CDN_DIAG_LSH_DOWN[i].
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_LSH_DOWN[i].

If Activation conditions are met for the NC_PSD_DLY_LSH_DOWN recurrence
Then
If LSHPWM_DOWN[i] < C_LSHPWM_MIN_DIAG_LSH_DOWN
or [(STATE_LSH_DOWN[i] = LSH_POW_RISE
or STATE_LSH_DOWN[i] = LSH_POW_RED)
and TEG_DYN_LS_DOWN[i] < C_TEG_DYN_MIN_DIAG_LSH_DOWN]
then bit 0 of CDN_DIAG_LSH_DOWN[i] = 0 *(**SCP** can not be detected))*
endif
If LSHPWM_DOWN[i] > C_LSHPWM_MAX_DIAG_LSH_DOWN
then bit 1 of CDN_DIAG_LSH_DOWN[i] = 0 *(**SCG** can not be detected)*
endif
If LSHPWM_DOWN[i] < C_LSHPWM_MIN_DIAG_LSH_DOWN
or LSHPWM_DOWN[i] > C_LSHPWM_MAX_DIAG_LSH_DOWN
then bit 2 of CDN_DIAG_LSH_DOWN[i] = 0 *(**OC** can not be detected)*
endif
Else
CDN_DIAG_LSH_DOWN[i] = 0
Endif
Else
CDN_DIAG_LSH_DOWN[i] = 0
endif

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_LSH_DOWN[i] and ERR_DIAG_LSH_DOWN[i].
ACTION_ERRM_FilterMulticondition(IN <*XX*>, IN< CDN_DIAG_LSH_DOWN[i]>, IN< ERR_DIAG_LSH_DOWN[i]>, IN <C_ABC_INC_LSH_DOWN>, IN <C_ABC_MAX_LSH_DOWN>, OUT<LV_ERR_LSH_DOWN[i]>)

This algorithm determines:
ERR_SYM_LSH_DOWN[i] (= raw value ERR_DIAG_LSH_DOWN[i] filtered with CDN_DIAG_LSH_DOWN[i], detected error symptom for lambda sensor heater upstream [i] diagnosis)
LV_ERR_ LSH_DOWN[i] (Error flag for debounced error of for lambda sensor heater upstream [i])
LV_CDN_DIAG_ LSH_DOWN[i] (Diagnosis condition information)
LV_END_DIAG_ LSH_DOWN[i] (End of diagnosis information)

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A.14 O2 sensor (bin, down) signal circuit diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_FL_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for downstream FL diagnosis not met					
LV_INH_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for downstream open line diagnosis not met					
LV_INH_DIAG_PUC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for downstream PUC diagnosis not met					
LV_INH_DIAG_RBM_OC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for RBM of downstream OC diagnosis not met					
LV_INH_DIAG_RBM_PUC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating application conditions for RBM of downstream PUC diagnosis not met					
LV_INH_DIAG_RBM_SCG_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for RBM of downstream SCG diagnosis not met					
LV_INH_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for downstream SCG diagnosis not met					
LV_INH_DIAG_SCP_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating project specific application conditions for downstream short to plus diagnosis not met					
STATE_RBM_OC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of downstream lambda sensor open-circuit diagnosis with RBM statistics					
STATE_RBM_PUC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of PUC_LS_DOWN monitor with the Rate-Based Monitoring statistics					
STATE_RBM_SCG_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of downstream lambda sensor short-to-ground diagnosis with RBM statistics					

Input data:

LC_DIAG_PUE_ACT_LS_ DOWN {p. 5191}	LV_DIAG_ACT_REQ_LS_ DOWN [NC_CBK_EX_NR] {p. 4266}	LV_END_DIAG_OC_LS_ DOWN [NC_CBK_EX_NR] {p. 4266}	LV_END_DIAG_PUC_LS_ DOWN [NC_CBK_EX_NR] {p. 4275}
LV_END_DIAG_SCG_LS_ DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}
LV_ERR_CHG_LS_DOWN {p. 5388}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_ERR_CRK_PLAUS {p. 4446}

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LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FTL_MIN {p. 4762}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}
LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}
LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ERR_LSH_LSL_UP [NC_CBK_EX_NR] {p. 5276}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}
LV_ERR_MAF {p. 4815}	LV_ERR_MAP_DIP_PLAUS {p. 1062}	LV_ERR_MAP_DIP_SENS {p. 4824}	LV_ERR_MAP_DIP_SHIFT {p. 4824}
LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_PLAUS {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}
LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}	LV_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}	LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}
LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}
LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5152}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4447}
LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS {p. 4982}

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LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR] {p. 2463}
LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR] {p. 2463}	LV_IGK {p. 906}	LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LS_DOWN_OBD_1_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}
LV_VAR_LSH_DOWN {p. 656}	LV_VB_CDN_OBD_1 {p. 1046}	NC_CBK_EX_NR {p. 1829}	R_IT_LS_DOWN [NC_CBK_EX_NR] {p. 1364}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_FL_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter increment for FL plausibility					
C_ABC_INC_OC_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter increment for open line electrical check					
C_ABC_INC_PUC_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter increment for PUC plausibility					
C_ABC_INC_SCG_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter increment for short to ground electrical check					
C_ABC_INC_SCP_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter increment for short to plus electrical check					
C_ABC_MAX_FL_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter maximum for FL plausibility					
C_ABC_MAX_OC_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter maximum for open line electrical check					
C_ABC_MAX_PUC_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter maximum for PUC plausibility					
C_ABC_MAX_SCG_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter maximum for short to ground electrical check					
C_ABC_MAX_SCP_LS_DOWN	-	0... FFH	0... 255	1	-
Debounce counter maximum for short to plus electrical check					

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)
ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)
ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

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FUNCTION DESCRIPTION:

General information:

According the exhaust gas system the variables shall be defined from [i]=1 to NC_CBK_EX_NR.

Application conditions

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Initialisation:

```
at every transition LV_IGK = 0 -> 1or reset all variables
shall be reset to 0, except STATE_RBM_PUC_LS_DOWN[i] //for
init of this variable see section below
 LV_INH_DIAG_FL_LS_DOWN[i] = 0
 LV_INH_DIAG_OC_LS_DOWN[i] = 0
 LV_INH_DIAG_PUC_LS_DOWN[i] = 0
 LV_INH_DIAG_SCG_LS_DOWN[i] = 0
 LV_INH_DIAG_SCP_LS_DOWN[i] = 0
 LV_INH_DIAG_RBM_PUC_LS_DOWN [i] = 0
 LV_INH_DIAG_RBM_OC_LS_DOWN[i]  =  0
 LV_INH_DIAG_RBM_SCG_LS_DOWN[i]  =  0

at every transition LV_IGK = 1 -> 0
 LV_INH_DIAG_FL_LS_DOWN[i] = 1
 LV_INH_DIAG_OC_LS_DOWN[i] = 1
 LV_INH_DIAG_PUC_LS_DOWN[i] = 1
 LV_INH_DIAG_SCG_LS_DOWN[i] = 1
 LV_INH_DIAG_SCP_LS_DOWN[i] = 1
```

Recurrence: *100 ms*

Activation: *LV_IGK = 1* ***and*** *LV_VAR_LSH_DOWN = 1*

Deactivation: *LV_IGK = 0* ***or*** *LV_VAR_LSH_DOWN = 0*

Formula section:

Calculation of LV_INH_DIAG_OC_LS_DOWN[i]

If LV_ERR_LSH_DOWN[i] **or**
LV_ERR_SCG_LS_DOWN[i] **or**
LV_ERR_SCP_LS_DOWN[] **or**
LV_ERR_OBD_LSH_DOWN[i] **or**
(i = 1 **and**
[LV_ERR_MIS[0] **or**
LV_ERR_MIS[2] **or**
LV_ERR_MIS[4]
]) **or**
(i = 2 **and**
[LV_ERR_MIS[1] **or**
LV_ERR_MIS[3] **or**
LV_ERR_MIS[5]
])
then LV_INH_DIAG_RBM_OC_LS_DOWN[i] = 1
else LV_INH_DIAG_RBM_OC_LS_DOWN[i] = 0
endif

If LV_INH_DIAG_RBM_OC_LS_DOWN[i] = 1 **or**
LV_VB_CDN_OBD_1 = 0 **or**
LV_LS_DOWN_OBD_1_MAN_DEAC[i]
then LV_INH_DIAG_OC_LS_DOWN[i] = 1
else LV_INH_DIAG_OC_LS_DOWN[i] = 0
endif

Calculation of LV_INH_DIAG_PUC_LS_DOWN[i]

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```
If      LV_ERR_CHG_LS_DOWN                    or
  LV_ERR_CHG_LS_UP                            or
  LV_ERR_DIAGCPS                              or
  LV_ERR_EL_CPS                               or
  LV_ERR_FUP                                  or
  LV_ERR_FUP_MFP_PLAUS                        or
  LV_ERR_FUP_ORNG                             or
  LV_ERR_FUP_ST                               or
  LV_ERR_H_PRS_SYS                            or
  LV_ERR_MAF = 1                              or
  LV_ERR_MAP_PLAUS = 1                        or
  LV_ERR_MAP_TPS_PLAUS = 1                    or
  LV_ERR_VCV                                  or
    LV_ERR_AIR_LSL_UP[i]          or LV_ERR_CHK_LS_DOWN[i]          or
  LV_ERR_CTL_LSL_UP[i]                        or
  LV_ERR_DELTA_I_LAM[i]                       or
    LV_ERR_DYN_VLD_LS_UP[i]       or
    LV_ERR_EL_LSL_UP[i]           or
  LV_ERR_FSD [i]                              or
    LV_ERR_FSD_LAM_LIM[i]         or
    LV_ERR_LSH_DOWN[i]            or
  LV_ERR_LSH_UP[i]                            or
  LV_ERR_LSL_UP_IF[i]                         or
  LV_ERR_OBD_LSH_DOWN[i]                      or
  LV_ERR_OBD_VLD_LSH_UP[i]                    or
  LV_ERR_OC_LS_DOWN[i]                        or
  LV_ERR_OC_LSL_UP[i]                         or
  LV_ERR_OFS_LSL_UP[i]                        or
  LV_ERR_PUC_VLD_LS_UP[i]                     or
  [LV_ERR_PUE_LS_DOWN[i]          and
  LC_DIAG_PUE_ACT_LS_DOWN = 1]                or
  LV_ERR_SCG_LS_DOWN[i]                       or
  LV_ERR_SCP_LS_DOWN[i]                       or
    LV_ERR_SHIFT_AFL_LSL_UP[i]    or
    LV_ERR_SHIFT_AFR_LSL_UP[i]    or
  LV_ERR_SWT_LS_DOWN[i]                       or
  LV_ERR_TTIP_MES_LSH_UP[i]                   or
  LV_ERR_VLS_DOWN_DIF[i]                      or
      (i = 1                                  and
          [       LV_ERR_IV[0]          or
          LV_ERR_IV[2]       or
          LV_ERR_IV[4]
  ])                                          or
  (i = 2                                      and
            [     LV_ERR_IV[1]          or
          LV_ERR_IV[3]       or
          LV_ERR_IV[5]
  ])

then      LV_INH_DIAG_RBM_PUC_LS_DOWN[i]  =  1
else      LV_INH_DIAG_RBM_PUC_LS_DOWN[i]  =  0
endif
```

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If LV_INH_DIAG_RBM_PUC_LS_DOWN [i] **or**
LV_LS_DOWN_OBD_1_MAN_DEAC [i] **or**
LV_VB_CDN_OBD_1 = 0 **or**
R_IT_LS_DOWN[i] > C_R_IT_MAX_DIAG_MPL_LS_DOWN

Then LV_INH_DIAG_PUC_LS_DOWN = 1
else LV_INH_DIAG_PUC_LS_DOWN = 0

Calculation of LV_INH_DIAG_FL_LS_DOWN[i]

IF LV_LS_DOWN_OBD_1_MAN_DEAC[i] **OR**

- LV_ERR_AMP **OR**
- LV_ERR_AMP_PLAUS **OR**
- LV_ERR_CHG_LS_DOWN **OR**
- LV_ERR_CHG_LS_UP **OR**
- LV_ERR_CRK_PLAUS **OR**
- LV_ERR_CRK_SYN **OR**
- LV_ERR_CRK_TOOTH **OR**
- LV_ERR_CRK_TOOTH_PER **OR**
- LV_ERR_DIAGCPS **OR**
- LV_ERR_EL_CPS **OR**
- LV_ERR_FTL_MIN **OR**
- LV_ERR_FUP **OR**
- LV_ERR_FUP_MFP_PLAUS **OR**
- LV_ERR_FUP_ORNG **OR**
- LV_ERR_FUP_ST **OR**
- LV_ERR_H_PRS_SYS **OR**
- LV_ERR_IVVT **OR**
- LV_ERR_LOAD_TPS_PLAUS **OR**
- LV_ERR_MAF **OR**
- LV_ERR_MAP_DIP_PLAUS **OR**
- LV_ERR_MAP_DIP_SENS **OR**
- LV_ERR_MAP_DIP_SHIFT **OR**
- LV_ERR_MAP_TPS_PLAUS **OR**
- LV_ERR_MTC_CTL_2 **OR**
- LV_ERR_MTC_CTL_3 **OR**
- LV_ERR_MTC_DR **OR**
- LV_ERR_TPS **OR**
- LV_ERR_VCV **OR**
- LV_ERR_FSD[i] **OR**
- LV_ERR_FSD_LAM_LIM[i] **OR**
- LV_ERR_AIR_LSL_UP[i] **OR**
- LV_ERR_CHK_LS_DOWN[i] **OR**
- LV_ERR_CTL_LSL_UP[i] **OR**
- LV_ERR_DELTA_I_LAM[i] **OR**
- LV_ERR_DYN_VLD_LS_UP[i] **OR**
- LV_ERR_EL_LSL_UP[i] **OR**
- LV_ERR_LSH_DOWN[i] **OR**
- LV_ERR_LSH_LSL_UP[i] **OR**
- LV_ERR_LSH_UP[i] **OR**
- LV_ERR_LSL_UP_IF[i] **OR**

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- LV_ERR_OBD_LSH_DOWN[i] **OR**
- LV_ERR_OBD_VLD_LSH_UP[i] **OR**
- LV_ERR_OC_LS_DOWN[i] **OR**
- LV_ERR_OC_LSL_UP[i] **OR**
- LV_ERR_OFS_LSL_UP[i] **OR**
- LV_ERR_PUC_LS_DOWN[i] **OR**
- LV_ERR_PUC_VLD_LS_UP[i] **OR**
- **[**LV_ERR_PUE_LS_DOWN[i]
  and LC_DIAG_PUE_ACT_LS_DOWN = 1**]** **OR**
- LV_ERR_SCG_LS_DOWN[i] **OR**
- LV_ERR_SCP_LS_DOWN[i] **OR**
- LV_ERR_SHIFT_AFL_LSL_UP[i] **OR**
- LV_ERR_SHIFT_AFR_LSL_UP[i] **OR**
- LV_ERR_SWT_LS_DOWN[i] **OR**
- LV_ERR_TTIP_MES_LSH_UP[i] **OR**
- LV_ERR_VLS_DOWN_DIF[i] **OR**
- LV_ERR_PER_CAM_EX_1 **OR**
- LV_ERR_PER_CAM_IN_1 **OR**
- LV_ERR_PLAUS_CAM_EX_1 **OR**
- LV_ERR_PLAUS_CAM_IN_1 **OR**
- LV_ERR_REF_CRK_CAM_EX_1 **OR**
- LV_ERR_REF_CRK_CAM_IN_1 **OR**
- LV_ERR_SYN_CAM_EX_1 **OR**
- LV_ERR_SYN_CAM_IN_1 **OR**
- LV_ERR_SYN_CRK_CAM_EX_1 **OR**
- LV_ERR_SYN_CRK_CAM_IN_1 **OR**
- LV_ERR_TOOTH_OFF_EX_1 **OR**
- LV_ERR_TOOTH_OFF_IN_1 **OR**
- (i = 1 **AND**
  [LV_ERR_IV[0] **OR**
  LV_ERR_IV[2] **OR**
  LV_ERR_IV[4] **OR**
  LV_ERR_MIS[0] **OR**
  LV_ERR_MIS[2] **OR**
  LV_ERR_MIS[4]
  ]) **OR**
- (i = 2 **AND**
  [LV_ERR_IV[1] **OR**
  LV_ERR_IV[3] **OR**
  LV_ERR_IV[5] **OR**
  LV_ERR_MIS[1] **OR**
  LV_ERR_MIS[3] **OR**
  LV_ERR_MIS[5]
  ]) **OR**
- LV_VB_CDN_OBD_1 = 0

then LV_INH_DIAG_FL_LS_DOWN[i] = 1
else LV_INH_DIAG_FL_LS_DOWN[i] = 0
endif

Calculation of LV_INH_DIAG_SCG_LS_DOWN[i]

If LV_ERR_CHG_LS_DOWN **OR**

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LV_ERR_CHK_LS_DOWN[i] **OR**
LV_ERR_DELTA_I_LAM[i] **OR**
LV_ERR_LSH_DOWN[i] **OR**
LV_ERR_OBD_LSH_DOWN[i] **OR**
LV_ERR_OC_LS_DOWN[i] **OR**
LV_ERR_PUC_LS_DOWN[i] **OR**
[LV_ERR_PUE_LS_DOWN[i] **OR**
and LC_DIAG_PUE_ACT_LS_DOWN = 1**]**
LV_ERR_SCP_LS_DOWN[i] **OR**
LV_ERR_SWT_LS_DOWN[i] **OR**
LV_ERR_VLS_DOWN_DIF[i] **OR**
then LV_INH_DIAG_RBM_SCG_LS_DOWN[i] = 1
else LV_INH_DIAG_RBM_SCG_LS_DOWN[i] = 0
endif

If LV_INH_DIAG_RBM_SCG_LS_DOWN[i] = 1 **OR**
[LV_DIAG_ACT_REQ_LS_DOWN[i] = 0 **and**
(LV_LAM_LSCL[i] = 0 **or**
LV_FAC_LAM_LIM_MIN[i] **or**
LV_ FAC_LAM_LIM_MAX[i]**)]** **OR**
LV_VB_CDN_OBD_1 = 0 **OR**
LV_LS_DOWN_OBD_1_MAN_DEAC[i]
then LV_INH_DIAG_SCG_LS_DOWN[i] = 1
else LV_INH_DIAG_SCG_LS_DOWN[i] = 0
endif

Calculation of LV_INH_DIAG_SCP_LS_DOWN[i]

If LV_LS_DOWN_OBD_1_MAN_DEAC[i] **or**
LV_ERR_LSH_DOWN[i] **or**
LV_ERR_OBD_LSH_DOWN[i] **or**
LV_ERR_OC_LS_DOWN[i] **or**
LV_ERR_SCG_LS_DOWN[i] **or**
LV_VB_CDN_OBD_1 = 0

then LV_INH_DIAG_SCP_LS_DOWN[i] = 1
else LV_INH_DIAG_SCP_LS_DOWN[i] = 0
endif

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Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurence	Failure class A/B
Downstream Oxygen Sensor Signal	*Short to ground (bank 1/2)*	*0*	*see table of failires*			100ms	
SCG_LS_DOWN[i]							
Diagnosis	**Symptom**	**Nr**	**P-Code/ Failure**	**P-Code/ Symptom**	**Hardware config**	**Recurence**	**Failure class A/B**
Downstream Oxygen Sensor Signal	*Short to plus (bank 1/2)*	*0*	*see table of failires*			100ms	
SCP_LS_DOWN[i]							
Diagnosis	**Symptom**	**Nr**	**P-Code/ Failure**	**P-Code/ Symptom**	**Hardware config**	**Recurence**	**Failure class A/B**
Downstream Oxygen Sensor Signal	*Open line (bank 1/2)*	*0*	*see table of failires*			100ms	
OC_LS_DOWN[i]							
Diagnosis	**Symptom**	**Nr**	**P-Code/ Failure**	**P-Code/ Symptom**	**Hardware config**	**Recurence**	**Failure class A/B**
Downstream Oxygen Sensor Signal Plausibility	*Signal plausibility fault (bank 1/2)*	*3*	*see table of failires*			100ms	
PUC_LS_DOWN[i]							
Diagnosis	**Symptom**	**Nr**	**P-Code/ Failure**	**P-Code/ Symptom**	**Hardware config**	**Recurence**	**Failure class A/B**
Downstream Oxygen Sensor Signal Plausibility	*Signal plausibility fault (bank 1/2)*	*3*	*see table of failires*			100ms	
FL_LS_DOWN[i]							

A.14.1 Interface for Rate - Based - Monitoring

FUNCTION DESCRIPTION:

General information:

With this module the interface between the PUC_LS_DOWN[i] monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_PUC_LS_DOWN[i] data.
Within STATE_RBM_PUC_LS_DOWN[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

Application conditions

Initialisation: *at ECU reset:*
bit 0, bit 1 and bit 2 of STATE_RBM_ PUC_LS_DOWN[i] = 0
LV_DC 0 ->1 transition:
bit 0 and bit 1 of STATE_RBM_ PUC_LS_DOWN [i] = 0
on failure memory reset:

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bit 1 of STATE_RBM_ PUC_LS_DOWN [i] = 0

Recurrence: 1 s

Activation: LV_DC = 1

Formula section:

At LV_DC 0 ->1 transition
bit 2 of STATE_RBM_ PUC_LS_DOWN [i] = 1
The pending status of the following failures has to be checked only once :

Dependence	**Error**			
	LV_ERR_CHG_LS_DOWN	LV_ERR_CHG_LS_UP	LV_ERR_DIAGCPS	LV_ERR_EL_CPS
	LV_ERR_FUP	LV_ERR_FUP_MFP_PLAUS	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST
	LV_ERR_H_PRS_SYS	LV_ERR_MAF_FRQ_EL	LV_ERR_MAF_FRQ_GRD	LV_ERR_MAF_FRQ_RNG
	LV_ERR_MAP_PLAUS	LV_ERR_MAP_TPS_PLAUS	LV_ERR_VCV	
NC_CBK_EX_NR	LV_ERR_FSD[i]	LV_ERR_FSD_LAM_LIM[i]	LV_ERR_AIR_LSL_UP[NC_CBK_EX_NR]	LV_ERR_CHK_LS_DOWN[NC_CBK_EX_NR]
	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DELTA_I_LAM[NC_CBK_EX_NR]	LV_ERR_DYN_VLD_LS_UP[i]	LV_ERR_EL_LSL_UP[i]
	LV_ERR_LSH_DOWN[NC_CBK_EX_NR]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]	LV_ERR_OBD_LSH_DOWN[NC_CBK_EX_NR]
	LV_ERR_OBD_VLD_LSH_UP[i]	LV_ERR_OC_LS_DOWN[NC_CBK_EX_NR]	LV_ERR_OC_LSL_UP[i]	LV_ERR_OFS_LSL_UP[i]
	LV_ERR_PUC_VLD_LS_UP[i]	LV_ERR_SCG_LS_DOWN[NC_CBK_EX_NR]	LV_ERR_SCP_LS_DOWN[NC_CBK_EX_NR]	LV_ERR_SHIFT_AFL_LSL_UP[i]
	LV_ERR_SHIFT_AFR_LSL_UP[i]	LV_ERR_SWT_LS_DOWN[NC_CBK_EX_NR]	LV_ERR_TTIP_MES_LSH_UP[NC_CBK_EX_NR]	LV_ERR_VLS_DOWN_DIF[NC_CBK_EX_NR]
NC_CBK_EX_NR **and** LC_DIAG_PUE_ACT_LS_DOWN = 1	LV_ERR_PUE_LS_DOWN[NC_CBK_EX_NR]			

Figure A.14.1: For NC_CBK_EX_NR= i = 1

NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	

Figure A.14.2: For NC_CBK_EX_NR= i = 2

NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	

If(1) { CPU optimization at LV_DC 0 ->1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }

Then(1)

While bit 1 of STATE_RBM_ PUC_LS_DOWN [i] = 0 **do**
with each XX failure of the above list except LV_ERR_PUE_LS_DOWN (depending on configuration, see below):
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status

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Then(2) bit 1 of STATE_RBM_PUC_LS_DOWN[i] = 1
Endif(2)
For LV_ERR_PUE_LS_DOWN, do the following instead:
If LC_DIAG_PUE_ACT_LS_DOWN = 1
then
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<CALL>)
If(3) XX has a pending status
Then(3) bit 1 of STATE_RBM_PUC_LS_DOWN[i] = 1
Endif(3)
Endif(2)

Endwhile
Else(1) { the dynamic failure memory is empty } No action
Endif(1)

Every 1 s :
If bit 0 of STATE_RBM_PUC_LS_DOWN [i] = 0
Then
If LV_END_DIAG_PUC_LS_DOWN [i] = 1
Then bit 0 of STATE_RBM_PUC_LS_DOWN[i] = 1
Endif
Endif

If bit 1 of STATE_RBM_ PUC_LS_DOWN [i] = 0
Then
If LV_INH_DIAG_RBM_ PUC_LS_DOWN [i] = 1
Then bit 1 of STATE_RBM_ PUC_LS_DOWN [i] = 1
Endif
Endif

A.14.2 Interface for Rate - Based - Monitoring SCG_LS_DOWN[i]

FUNCTION DESCRIPTION:

General information:

With this module the interface between the SCG_LS_DOWN[i] monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_SCG_LS_DOWN[i] data.
Within STATE_RBM_SCG_LS_DOWN[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

Application conditions

Initialisation: *at ECU reset:*
bit 0, bit 1 and bit 2 of STATE_RBM_SCG_LS_DOWN[i] = 0
LV_DC 0 ->1 transition:

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```
    bit 0 and bit 1 of STATE_RBM_SCG_LS_DOWN[i] = 0
on failure memory reset:
    bit 1 of STATE_RBM_SCG_LS_DOWN[i] = 0
```

Recurrence: 1 s

Activation: LV_DC = 1

Formula section:

At LV_DC 0 ->1 transition
bit 2 of STATE_RBM_SCG_LS_DOWN[i] = 1
The pending status of the following failures has to be checked only once:

Dependence	Error			
	LV_ERR_CHG_LS_DOWN			
NC_CBK_EX_NR	LV_ERR_CHK_LS_DOWN[i]	LV_ERR_DELTA_I_LAM[i]	LV_ERR_LSH_DOWN[i]	LV_ERR_OBD_LSH_DOWN[i]
	LV_ERR_OC_LS_DOWN[i]	LV_ERR_PUC_LS_DOWN[i]	LV_ERR_SCP_LS_DOWN[i]	LV_ERR_SWT_LS_DOWN[i]
	LV_ERR_VLS_DOWN_DIF[i]			
NC_CBK_EX_NR **and** LC_DIAG_PUE_ACT_LS_DOWN = 1	LV_ERR_PUE_LS_DOWN[i]			

If(1) { CPU optimization at LV_DC 0 ->1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }
Then(1)
While bit 1 of STATE_RBM_SCG_LS_DOWN[i] = 0 **do**
with each XX failure of the above list (depending on configuration, see below) except LV_ERR_PUE_LS_DOWN:
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2) bit 1 of STATE_RBM_SCG_LS_DOWN[i] = 1
Endif(2)
For LV_ERR_PUE_LS_DOWN[i], do the following instead:
If LC_DIAG_PUE_ACT_LS_DOWN = 1
then
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<CALL>)
If(3) XX has a pending status
Then(3) bit 1 of STATE_RBM_SCG_LS_DOWN[i] = 1
Endif(3)
Endif(2)
Endwhile
Else(1) { the dynamic failure memory is empty } No action
Endif(1)

Every 1 s :
If bit 0 of STATE_RBM_SCG_LS_DOWN[i] = 0
Then

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If LV_END_DIAG_SCG_LS_DOWN[i] = 1
Then bit 0 of STATE_RBM_SCG_LS_DOWN[i] = 1
Endif
Endif

If bit 1 of STATE_RBM_SCG_LS_DOWN[i] = 0
Then
If LV_INH_DIAG_RBM_SCG_LS_DOWN[i] = 1
Then bit 1 of STATE_RBM_SCG_LS_DOWN[i] = 1
Endif
Endif

A.14.3 Interface for Rate - Based - Monitoring OC_LS_DOWN[i]

FUNCTION DESCRIPTION:

General information:

With this module the interface between the OC_LS_DOWN[i] monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_OC_LS_DOWN[i] data.
Within STATE_RBM_OC_LS_DOWN[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

Application conditions

Initialisation:
at ECU reset:
bit 0, bit 1 and bit 2 of STATE_RBM_OC_LS_DOWN[i] = 0
LV_DC 0 ->1 transition:
bit 0 and bit 1 of STATE_RBM_OC_LS_DOWN[i] = 0
on failure memory reset:
bit 1 of STATE_RBM_OC_LS_DOWN[i] = 0

Recurrence: 1 s

Activation: LV_DC = 1

Formula section:

At LV_DC 0 ->1 transition
bit 2 of STATE_RBM_OC_LS_DOWN[i] = 1
The pending status of the following failures has to be checked only once:

Dependence	Error			
NC_CBK_EX_NR	LV_ERR_LSH_DOWN[i]	LV_ERR_OBD_LSH_DOWN[i]	LV_ERR_SCG_LS_DOWN[i]	LV_ERR_SCP_LS_DOWN[i]

For i = 1

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NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	

For i = 2

NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	

If(1) { CPU optimization at LV_DC 0 ->1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }
Then(1)
While bit 1 of STATE_RBM_OC_LS_DOWN[i] = 0 **do**
with each XX failure of the above list (depending on configuration, see below):
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2) bit 1 of STATE_RBM_OC_LS_DOWN[i] = 1
Endwhile
Else(1) { the dynamic failure memory is empty } No action
Endif(1)

Every 1 s :
If bit 0 of STATE_RBM_OC_LS_DOWN[i] = 0
Then
If LV_END_DIAG_OC_LS_DOWN[i] = 1
Then bit 0 of STATE_RBM_OC_LS_DOWN[i] = 1
Endif
Endif
If bit 1 of STATE_RBM_OC_LS_DOWN [i] = 0
Then
If LV_INH_DIAG_RBM_OC_LS_DOWN[i] = 1
Then bit 1 of STATE_RBM_OC_LS_DOWN[i] = 1
Endif
Endif

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A.15 O2 sensor (bin, down) signal circuit diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_R_UPD_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Value of handshake counter for last valid resistance value used for diagnosis					
CTR_R_UPD_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Value of handshake counter for last valid resistance value used for short circuit to ground diagnosis					
CTR_SYM_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Detection time for SCG					
ERR_SYM_OC_LS_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Variable indicating an open circuit fault is currently present on downstream oxygen sensor signal					
ERR_SYM_SCG_LS_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Boolean symptom flag, short to ground fault currently present on downstream oxygen sensor signal					
ERR_SYM_SCP_LS_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Boolean symptom flag, short to plus fault currently present on downstream oxygen sensor signal					
LV_CDN_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status conditions of downstream oxygen sensor open circuit diagnosis					
LV_CDN_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status conditions of oxygen sensor short to ground downstream diagnosis					
LV_CDN_DIAG_SCP_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status conditions of oxygen sensor short to plus downstream diagnosis					
LV_DIAG_ACT_REQ_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request for starting the downstream sensor active plausibility check					
LV_END_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Bit to indicate end of downstream oxygen sensor open circuit diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Bit to indicate end of short to ground downstream oxygen sensor signal diagnosis					
LV_END_DIAG_SCP_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Bit to indicate end of short to plus downstream oxygen sensor signal diagnosis					
LV_ERR_EL_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean error flag, electrical fault currently present on downstream oxygen sensor signal					
LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean error flag, open circuit fault currently present on downstream oxygen sensor signal					
LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean error flag, short to ground fault currently present on downstream oxygen sensor signal					
LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean error flag, short to plus fault currently present on downstream oxygen sensor signal					
LV_R_IT_VLD_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Valid conditions of resistance of downstream oxygen sensor open circuit diagnosis					
LV_T_CDN_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status conditions of VLS range for the downstream oxygen sensor open circuit diagnosis					
T_ACT_PLS_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Delay time for final diagnosis activation					
T_ACT_PLS_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Delay time for final diagnosis activation					
T_CDN_DIAG_OC_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Detection time for status OC before diagnosis					

Input data:

CTR_CYCNR_R_IT_LS_ DOWN_VLD [NC_CBK_EX_NR] {p. 1364}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_DIAG_CYC_END_LS_ DOWN [NC_CBK_EX_NR] {p. 5388}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}
LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_IGK {p. 906}
LV_INH_DIAG_OC_LS_ DOWN [NC_CBK_EX_NR] {p. 4252}	LV_INH_DIAG_SCG_LS_ DOWN [NC_CBK_EX_NR] {p. 4252}	LV_INH_DIAG_SCP_LS_ DOWN [NC_CBK_EX_NR] {p. 4252}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}
MAF_KGH {p. 1195}	NC_CBK_EX_NR {p. 1829}	R_IT_LS_DOWN [NC_CBK_EX_NR] {p. 1364}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}
TEG_DYN_LS_DOWN [NC_CBK_EX_NR] {p. 1007}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}		

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_MIN_DIAG_SCG_LS_DOWN	-	0... FFH	0... 255	1	-
Minimum duration required for continious low VLS_DOWN[i] detection					
C_MAF_KGH_MIN_DIAG_SCG_LS_DOWN	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Minimum MAF_KGH flow required for continious low VLS_DOWN[i] detection					
C_R_IT_MAX_DIAG_SCG_LS_DOWN	-	0... FFFFH	0... 65535	1	ohm
Maximum resistance threshold oxygen sensor internal resistance during short to ground sensor					
C_R_IT_MIN_DIAG_OC_LS_DOWN	-	0... FFFFH	0... 65535	1	ohm
Minimum resistance threshold oxygen sensor internal resistance during open circuit sensor					
C_T_CDN_DIAG_OC_LS_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum required duration where voltage lies outside of the limits for operable sensor to detect fault					
C_T_DLY_DIAG_OC_LS_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum required duration where voltage lies outside of the limits for operable sensor to detect fault					
C_T_DLY_DIAG_SCG_LS_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum duration required for low VLS_DOWN[i] detection					
C_TEG_DYN_MIN_DIAG_OC_LS_DOWN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum requested exhaust gas temperature for diagnosis					
C_VLS_AFL_THD_DIAG_OC_LS_DOWN	-	0... 3FFH	0... 4.99511	4.88e-3	V
Oxygen sensor voltage-lean mixture threshold for diagnosis					
C_VLS_AFR_THD_DIAG_OC_LS_DOWN	-	0... 3FFH	0... 4.99511	4.88e-3	V
Oxygen sensor voltage-rich mixture threshold for diagnosis					
C_VLS_THD_DIAG_SCG_LS_DOWN	-	0... 3FFH	0... 4.99511	4.88e-3	V
Oxygen sensor voltage threshold under which short to GND may be present					
C_VLS_THD_DIAG_SCP_LS_DOWN	-	0... 3FFH	0... 4.99511	4.88e-3	V
Oxygen sensor voltage threshold over which short to Vbatt present					
LC_DIAG_ACT_CHK_INH	-	0... 1H	0 ...1	1	-
Inhibition bit for the triggered active diagnosis					

Error treatment:

Diagnostic XX	Symptom description	Symptom	Filter type
SCG_LS_DOWN[NC_CBK_EX_NR]	short circuit to ground bank i	SYM_1	MEM

Diagnostic XX	Symptom description	Symptom	Filter type
SCP_LS_DOWN[NC_CBK_EX_NR]	short circuit to plus bank i	SYM_0	MEM

Diagnostic XX	Symptom description	Symptom	Filter type
OC_LS_DOWN[NC_CBK_EX_NR]	Open circuit bank i	SYM_2	MEM

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FUNCTION DESCRIPTION:

General information:

According the exhaust gas system shall the variables be defined for [i]=1 to NC_CBK_EX_NR.

The VLS_DOWN[i] value used for diagnosis purposes shall not be affected should the sensor be "pumped". The value prior to pumping shall be used until the sensor returns to normal operation (no pumping).
Once an electrical fault has been detected and debounced, the plausibility diagnosis shall not be carried out until the electrical fault has been diagnosed as being no longer present. The electrical diagnosis shall remain unaffected by the state of the plausibility diagnosis.
Once an electrical fault has been diagnosed and debounced, the application assistances (Functions that are defined to be affected by the state of the oxygen sensor signal) shall remain active for the remainder of the driving cycle. The restarting of the affected functions during the next driving cycle shall be carried out according to the project philosophy.
The measurement of the oxygen sensor voltage shall not be affected by the detection of a signal fault unless explicitly deactivated.

Description:

The oxygen sensor signal electrical diagnosis shall detect the following faults:

1. Short circuit of the oxygen sensor signal line to GND
2. Short circuit of the oxygen sensor signal line to Vbatt
3. Open circuit (line break) in the connection to oxygen sensor element

Each fault may set the boolean flag (LV_ERR_SCG_LS_DOWN[i]; LV_ERR_SCP_LS_DOWN[i]; LV_ERR_OC_LS_DOWN[i]) to signal that the particular fault is currently active. Should one of the electrical fault flags (A-C) be set, then a global error flag (LV_ERR_EL_LS_DOWN[i]) shall be set to indicate that an electrical fault currently exists on the particular oxygen sensor.
Each of the above listed erro shall be described individually in further detail below.

Application conditions

Initialisation: `all variables shall be initialised to 0 with LV_IGK = 0 -> 1 or reset or at clearing the error memory`

Recurrence: `100ms`

Activation:
If LV_IGK = 1
Deactivation:
If LV_IGK = 0

Formula section:

If LV_ERR_SCG_LS_DOWN[i] = 1
or LV_ERR_SCP_LS_DOWN[i] = 1
or LV_ERR_OC_LS_DOWN[i] = 1
then LV_ERR_EL_LS_DOWN[i] = 1
else LV_ERR_EL_LS_DOWN[i] = 0
endif

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A.15.1 Short circuit of oxygen sensor signal to GND.

Description:

According the exhaust gas system shall the variables be defined for [i]=1 to NC_CBK_EX_NR.

In order to determine the electrical fault, short circuit to GND, the oxygen sensor signal voltage is compared to a calibrateable threshold (C_VLS_THD_DIAG_SCG_LS_DOWN) in conjunction with certain activation conditions.
Should a hard short to GND (i.e. approx. 0 Ω) exist on the oxygen sensor signal line, the signal voltage will tend to 0 V. This condition may also occur should the air-fuel mixture (AFR) become lean due to a fault in the injection system, due to an air leak, intentional or not, or due to a normal operating conditions. Hence the following additional fault conditions shall be required:
The ignition key shall be determined to be on (LV_IGK = 1) and the appropriate inhibit flag shall not be set (LV_INH_DIAG_SCG_LS_DOWN[i]).
Each time that timer T_ACT_PLS_DIAG_SCG_LS_DOWN[i] exceeded the minimum duration (C_T_DLY_DIAG_SCG_LS_DOWN) for the first time, e.g. first time after engine start or after timer T_ACT_PLS_DIAG_SCG_LS_DOWN[i] has been reset, the CTR_R_UPD_DIAG_SCG_LS_DOWN[I] shall be updated once only with the value CTR_CYCNR_R_IT_LS_DOWN_VLD[i]. This shall ensure that only new internal resistance values be used for diagnosis purposes that have been determined since all the activation conditions have been met.
It shall be determined whether a new internal resistance has been determined by comparing the contents of counter CTR_R_UPD_DIAG_SCG_LS_DOWN[i] with that of CTR_CYCNR_R_IT_LS_DOWN_VLD[i]. Should the counters be unequal, then a new value is available and CTR_R_UPD_DIAG_SCG_LS_DOWN[i] shall be updated with CTR_CYCNR_R_IT_LS_DOWN_VLD[i]. If this conditions and all the above conditions be met, the diagnosis shall be considered to be active.
Should the diagnosis be determined to be active, the oxygen sensor signal voltage shall be compared to the threshold. Should the voltage fall below the threshold and the resistance condition R_IT_LS_DOWN[i] less than threshold be met, a pre - detection counter is incremented. The counter is reset to 0 if the above mentioned conditions are no more fulfilled. If the pre - detection counter counter reached the maximum value then the active check is triggered or if finished the error “Short to GND” is detected. Additionally the triggered active diagnosis can be switched of with LC_DIAG_ACT_CHK_INH = 1.

Application conditions

Initialisation: `all variables shall be initialised to 0 with LV_IGK = 0 -> 1 or reset or at clearing the error memory`

Recurrence: `T_SAMPLE = 100ms`

Activation /Deactivation:

If^0 LV_IGK = 1
and LV_INH_DIAG_SCG_LS_DOWN[i] = 0
and LV_CAT_PURGE_ACT[i] = 0
and MAF_KGH > C_MAF_KGH_MIN_DIAG_SCG_LS_DOWN
then^0 **If**^{1} T_ACT_PLS_DIAG_SCG_LS_DOWN[i] C_T_DLY_DIAG_SCG_LS_DOWN
  then^1 *One-off update* CTR_R_UPD_DIAG_SCG_LS_DOWN[i]
    If^2 CTR_CYCNR_R_IT_LS_DOWN_VLD[i] ≠ CTR_R_UPD_DIAG_SCG_LS_DOWN[i]
    Then^2 *“Diagnosis available”*
      LV_CDN_DIAG_SCG_LS_DOWN[i] = 1
      CTR_R_UPD_DIAG_SCG_LS_DOWN[i] = CTR_CYCNR_R_IT_LS_DOWN_VLD[i]
    Else^2 *“Diagnosis NOT available”*
      LV_CDN_DIAG_SCG_LS_DOWN[i] = 0

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Endif^{2}
Else^{1} LV_CDN_DIAG_SCG_LS_DOWN[i] = 0
T_ACT_PLS_DIAG_SCG_LS_DOWN[i] =
T_ACT_PLS_DIAG_SCG_LS_DOWN[i] + T_SAMPLE
Endif^{1}
Else^{0} *"Diagnosis NOT available"*
T_ACT_PLS_DIAG_SCG_LS_DOWN[i] = 0
CTR_SYM_DIAG_SCG_LS_DOWN[I] = 0
LV_CDN_DIAG_SCG_LS_DOWN[i] = 0
LV_DIAG_ACT_REQ_LS_DOWN[i] = 0

endif^{0}

Formula section:

IF^{0} LV_CDN_DIAG_SCG_LS_DOWN[i] = 1
THEN^{0} **If**^{1} VLS_DOWN[i] $<$ C_VLS_THD_DIAG_SCG_LS_DOWN
and R_IT_LS_DOWN[i] $<$ C_R_IT_MAX_DIAG_SCG_LS_DOWN
then^{1} **IF**^{2} CTR_SYM_DIAG_SCG_LS_DOWN[i] $>$ C_CTR_MIN_DIAG_SCG_LS_DOWN
THEN^{2} **If**^{3} LV_DIAG_CYC_END_LS_DOWN[i] = 1 *Active check finished*
or LC_DIAG_ACT_CHK_INH = 1
then^{3}
LV_DIAG_ACT_REQ_LS_DOWN[i] = 0
ERR_SYM_SCG_LS_DOWN[i] = SYM_1
% Error management automatically increment ABC counter
else^{3}
LV_DIAG_ACT_REQ_LS_DOWN[i] = 1 *Request active check*
endif^{3}
ELSE^{2} CTR_SYM_DIAG_SCG_LS_DOWN[i] =
CTR_SYM_DIAG_SCG_LS_DOWN[i] +1
ERR_SYM_SCG_LS_DOWN[i] = NO_SYM
% Error management automatically decrement ABC counter
ENDIF^{2}
else^{1} LV_DIAG_ACT_REQ_LS_DOWN[i] = 0
% Error management automatically decrement ABC counter
ERR_SYM_SCG_LS_DOWN[i] = NO_SYM
CTR_SYM_DIAG_SCG_LS_DOWN[i] = 0
endif^{1}
ENDIF^{0}

A.15.2 Short circuit of oxygen sensor signal to VBATT

Description:

According the exhaust gas system shall the variables be defined for [i]=1 to NC_CBK_EX_NR.

Should a hard short to Vbatt (i.e. approx. 0 Ω) exist on the oxygen sensor signal line, the signal voltage will tend to Vbatt and the analogue digital converter value will tend to 5 V. This effect does not occur under normal conditions as the sensor delivers typically 1 V for rich AFR at the sensor location and may be used for short to Vbatt detection.

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In order to determine the electrical fault, short circuit to Vbatt, the oxygen sensor signal voltage (VLS_DOWN[i]) is compared to a calibrateable threshold (C_VLS_THD_DIAG_SCP_LS_DOWN) in conjunction with the herein mentioned activation conditions.
The ignition key shall be determined to be on (LV_IGK = 1) and the appropriate inhibit flag shall not be set (LV_INH_DIAG_SCP_LS_DOWN[i]).
Should the oxygen signal voltage exceed the said threshold, a signal short to Vbatt shall be determined to be present and the debounce counter shall be incremented otherwise the debounce counter shall be decremented.
The error flag LV_ERR_SCP_LS_DOWN[i] shall be set once the anti-bounce counter has reached its maximum value and reset should the anti-bounce counter reach 0.

Application conditions

Initialisation: *all variables shall be initialised to 0 with LV_IGK = 0 -> 1 or reset or at clearing the error memory*

Recurrence: *100ms*

Activation /Deactivation:

If LV_IGK = 1
and LV_INH_DIAG_SCP_LS_DOWN[i] = 0
then ***"Diagnosis available"***
LV_CDN_DIAG_SCP_LS_DOWN[i] = 1
else ***"Diagnosis NOT available"***
LV_CDN_DIAG_SCP_LS_DOWN[i] = 0
endif

Formula section:

If LV_CDN_DIAG_SCP_LS_DOWN[i] = 1
then **If** VLS_DOWN[i] > C_VLS_THD_DIAG_SCP_LS_DOWN
then ***"Short to Vbatt fault present"***
% Error management automatically increment ABC counter
ERR_SYM_SCP_LS_DOWN[i] = SYM_0 *%SHORT TO PLUS*

else ERR_SYM_SCP_LS_DOWN[i] = "NO_SYM"
% Error management automatically decrement ABC counter
endif
endif

A.15.3 Open circuit (line break) in connection to oxygen sensor element.

Description:

According the exhaust gas system shall the variables be defined for [i]=1 to NC_CBK_EX_NR.

Should a complete open circuit occur in the oxygen sensor signal or return line, the measured voltage at the input to the microcontroller will tend to the voltage determined by the operative readiness potential divider (approx. 450 mV) and the measured internal resistance will be abnormally high.
In order to determine an open circuit electrical fault, the oxygen sensor internal resistance (R_IT_LS_DOWN[i]) is compared to a calibrateable threshold (C_R_IT_MIN_DIAG_OC_LS_DOWN) in conjunction with certain activation conditions shown below:
The ignition key shall be determined to be on (LV_IGK = 1) and the appropriate inhibit flag shall not be set (LV_INH_DIAG_OC_LS_DOWN[i]).

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The sensor shall be determined to be in a state of operative readiness (LV_LS_DOWN_READY[i] = 1, possibly thorough forced activation) and the temperature operating conditions of the sensor shall be determined to be sufficient to permit normal operation, i.e. No fault shall be determined to be present in the appropriate downstream oxygen sensor heater (LV_ERR_LSH_DOWN[i] = 0) or if so that the operating temperature be determined to be sufficient for sensor operability (TEG_DYN_LS_DOWN[i] > C_TEG_DYN_MIN_DIAG_OC_LS_DOWN), and the appropriate heater shall be determined to being controlled normally (STATE_LSH_DOWN[i] = LSH_POW_CTL).

Should the above initial conditions be met, a timer (T_ACT_PLS_DIAG_OC_LS_DOWN[i]) shall be incremented. Should the conditions no longer be met, both timers shall be reset and flag LV_T_CDN_DIAG_OC_LS_DOWN[i] reset.

The oxygen sensor signal shall be determined to lie in a calibrateable voltage band (C_VLS_AFL_THD_DIAG_OC_LS_DOWN < VLS_DOWN[i] < C_VLS_AFR_THD_DIAG_OC_LS_DOWN).

Should the above listed pre-activation conditions be determined to have been met, a timer T_CDN_DIAG_OC_LS_DOWN[i] shall be started. The timer shall be required to equal or exceed a minimum calibrateable duration (C_T_CDN_DIAG_OC_LS_DOWN). When no longer met, T_CDN_DIAG_OC_LS_DOWN[i] and LV_T_CDN_DIAG_OC_LS_DOWN[i] shall be reset.

Each time that the T_CDN_DIAG_OC_LS_DOWN[i] has exceeded the minimum duration for the first time, e.g. first time after engine start or after the T_CDN_DIAG_OC_LS_DOWN[i] has been reset, the CTR_R_UPD_DIAG_OC_LS_DOWN[i] shall be updated once only with the value CTR_CYCNR_R_IT_LS_DOWN_VLD[i]. This shall ensure that only new internal resistance values be used for diagnosis purposes that have been determined since all the activation conditions have been met.

It shall be determined whether a new internal resistance has been determined by comparing the contents of counter CTR_R_UPD_DIAG_OC_LS_DOWN[i] with that of CTR_CYCNR_R_IT_LS_DOWN_VLD[i]. Should the counters be unequal, then a new value is available and CTR_R_UPD_DIAG_OC_LS_DOWN[i] shall be updated with CTR_CYCNR_R_IT_LS_DOWN_VLD[i] and a flag LV_R_IT_VLD_DIAG_OC_LS_DOWN[I] be set, thus indicating that the voltage lies within the set band and that a new resistance value is available.

If either LV_T_CDN_DIAG_OC_LS_DOWN[i] is set or T_ACT_PLS_DIAG_OC_LS_DOWN[i] equals or exceeds threshold C_T_DLY_DIAG_OC_LS_DOWN, the diagnosis shall be considered to be available.

Should the diagnosis be determined to be available and the condition LV_R_IT_VLD_DIAG_OC_LS_DOWN[I] has been met, the oxygen sensor internal resistance shall be compared to the said threshold. Should the resistance exceed the threshold, a signal open circuit shall be determined to be present and the debounce counter shall be incremented otherwise the debounce counter shall be decremented.

The error flag LV_ERR_OC_LS_DOWN[i] shall be set once the anti-bounce counter has reached its maximum and reset should the anti-bounce counter reach 0.

Application conditions

Initialisation: *all variables shall be initialised to 0 with LV_IGK = 0 -> 1 or reset or at clearing the error memory*

Recurrence: T_SAMPLE = *100ms*

Activation /Deactivation:

If LV_IGK = 1
and LV_INH_DIAG_OC_LS_DOWN[i] = 0
and LV_LS_DOWN_READY[i] = 1
and (LV_ERR_LSH_DOWN[i] = 0
or TEG_DYN_LS_DOWN[i] > C_TEG_DYN_MIN_DIAG_OC_LS_DOWN)
and STATE_LSH_DOWN[i] = LSH_POW_CTL
then

T_ACT_PLS_DIAG_OC_LS_DOWN[i] = T_ACT_PLS_DIAG_OC_LS_DOWN[i] +

T_SAMPLE

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```
        One-off update  CTR_R_UPD_DIAG_OC_LS_DOWN[i]
        If CTR_CYCNR_R_IT_LS_DOWN_VLD[i] ≠ CTR_R_UPD_DIAG_OC_LS_DOWN[i]
        then    CTR_R_UPD_DIAG_OC_LS_DOWN[i]
                                        = CTR_CYCNR_R_IT_LS_DOWN_VLD[i]
                LV_R_IT_VLD_DIAG_OC_LS_DOWN[I] = 1
       else     LV_R_IT_VLD_DIAG_OC_LS_DOWN[I] = 0
       endif
  If        C_VLS_AFL_THD_DIAG_OC_LS_DOWN < VLS_DOWN[i]
                     < C_VLS_AFR_THD_DIAG_OC_LS_DOWN
  then
                If       T_CDN_DIAG_OC_LS_DOWN[i]   C_T_CDN_DIAG_OC_LS_DOWN
                then    LV_T_CDN_DIAG_OC_LS_DOWN[i] = 1
                else    LV_T_CDN_DIAG_OC_LS_DOWN[i] = 0
                        T_CDN_DIAG_OC_LS_DOWN[i] =
                                T_CDN_DIAG_OC_LS_DOWN[i] + T_SAMPLE
                endif
       else     T_CDN_DIAG_OC_LS_DOWN[i] = 0
                LV_T_CDN_DIAG_OC_LS_DOWN[i] = 0
  endif
else           T_CDN_DIAG_OC_LS_DOWN[i] = 0
                T_ACT_PLS_DIAG_OC_LS_DOWN[i] = 0
                LV_R_IT_VLD_DIAG_OC_LS_DOWN[i] = 0
                LV_T_CDN_DIAG_OC_LS_DOWN[i] = 0
endif
If              (T_ACT_PLS_DIAG_OC_LS_DOWN[i]   C_T_DLY_DIAG_OC_LS_DOWN
or              LV_T_CDN_DIAG_OC_LS_DOWN[i] = 1)
and             LV_R_IT_VLD_DIAG_OC_LS_DOWN[i] = 1
then           "Diagnosis available"
                LV_CDN_DIAG_OC_LS_DOWN[i] = 1
else           "Diagnosis NOT available"
                LV_CDN_DIAG_OC_LS_DOWN[i] = 0
endif
```

NOTE: The variable CTR_CYCNR_R_VLS_DOWN_DIAG_i shall be updated with the current value of the input variable CTR_CYCNR_R_IT_LS_DOWN_VLD[i] on each occasion that the TIMER_3 exceeds the minimum for the first time. For further function calls where the TIMER_3 condition is met, the one-off update shall not be carried out. This shall continue until the TIMER_3 condition is no longer met.

Formula section:

```
If              LV_CDN_DIAG_OC_LS_DOWN[i] = 1
then           If       R_IT_LS_DOWN[i] > C_R_IT_MIN_DIAG_OC_LS_DOWN
                and     LV_T_CDN_DIAG_OC_LS_DOWN[i] = 1
                then    "Open circuit fault present"
                        % Error management automatically iccrement ABC counter
                          ERR_SYM_OC_LS_DOWN[i] = sym_2   %"OPEN LINE"

                else    ERR_SYM_OC_LS_DOWN[i] = "NO_SYM"
                        % Error management automatically decrement ABC counter
                endif
endif
```

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A.16 O2 sensor (bin, down) signal range diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_FL_LS_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Boolean error flag, fault currently present on downstream oxygen sensor signal					
ERR_SYM_PUC_LS_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Boolean error flag, fault currently present on downstream oxygen sensor signal					
LV_CDN_DIAG_FL_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status conditions of oxygen sensor downstream diagnosis					
LV_CDN_DIAG_PUC_LS_DOWN [NC_CBK_EX_NR]	O/V	0H 1H	PASSIVE ACTIVE	-	-
Status conditions of oxygen sensor downstream diagnosis					
LV_DIAG_CDN_PLAUS_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag, plausibility check on downstream oxygen sensor signal possible					
LV_DIAG_PUC_CHG_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Reminder flag for fuel cut off was active					
LV_END_DIAG_FL_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Bit to indicate end of complete downstream oxygen sensor signal diagnosis					
LV_END_DIAG_PUC_LS_DOWN [NC_CBK_EX_NR]	O/V	0H 1H	PASSIVE ACTIVE	-	-
Bit to indicate end of complete downstream oxygen sensor signal diagnosis					
LV_ERR_FL_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean error flag, FL plausibility fault currently present on downstream oxygen sensor signal					
LV_ERR_PLAUS_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag, error plausibility check on downstream oxygen sensor signal					
LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR]	O/V	0H 1H	PASSIVE ACTIVE	-	-
Boolean error flag, PUC plausibility fault currently present on downstream oxygen sensor signal					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VLS_DOWN_PUC_AFR_VLD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable indicating that rich voltage threshold has been exceeded before entering PUC phase					
MAF_INT_FL [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1820.42	0.0277778	g
integral of air mass flow while FL active					
MAF_INT_PUC_ACT_OLD	-	0... FFFFH	0... 2912.66666	0.0444444	g
MAF integral during PUC from previous recurrence					
MAF_INT_PUC_NOT_LS_DOWN_DIAG [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.66666	0.0444444	g
MAF integral out of PUC in case of certain load threshold exceeded					
VLS_DOWN_PUC_ERR [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Last VLS_DOWN value not plausible for PUC conditions					
VLS_DOWN_PUC_OK [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Last VLS_DOWN value satisfying PUC plausibility					
VLS_DOWN_PUC_PLAUS_VLD [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
VLS_DOWN[i] value before entering fuel-cut phase					
VLS_DOWN_PUC_SAVE [NC_CBK_EX_NR]	O/V/S	0... 3FFH	0... 4.99511	4.8828e-3	V
Mode 6 value describing last VLS_DOWN PUC plausibility result					

Input data:

LV_DIAG_CDN_PLAUS_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_EL_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_FL_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}
LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_FL {p. 1759}	LV_IGK {p. 906}	LV_INH_DIAG_FL_LS_DOWN [NC_CBK_EX_NR] {p. 4252}
LV_INH_DIAG_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4252}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_PUC {p. 1720}	LV_ST_END {p. 1720}
MAF_CYL {p. 8277}	MAF_INT_FL [NC_CBK_EX_NR] {p. 4276}	MAF_INT_PUC_ACT {p. 2942}	MAF_KGH {p. 1195}
NC_CBK_EX_NR {p. 1829}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_UP [NC_CBK_EX_NR] {p. 1341}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_MAF_INT_LS_DOWN_DIAG	-	0... FFH	0... 31.875	0.125	-
Factor for impact of fuel cut off phase to the sensor temperature					
C_MAF_INT_MAX_DIAG_FL_LS_DOWN	-	0... FFFFH	0... 1820.42	0.0277778	g
Maximum threshold for MAF integral to end downstream FL signal plausibility					
C_MAF_INT_MAX_DIAG_PUC_LS_DOWN	-	0... FFFFH	0... 2912.66666	44.4e-3	g
Maximum threshold for MAF integral to end downstream PUC signal plausibility					
C_MAF_INT_MIN_DIAG_FL_LS_DOWN	-	0... FFFFH	0... 1820.42	0.0277778	g
Minimum threshold for MAF integral required to start downstream FL signal plausibility					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_INT_MIN_DIAG_PUC_LS_DOWN	-	0... FFFFH	0... 2912.66666	44.4e-3	g
Minimum threshold for MAF integral required to start downstream PUC signal plausibility					
C_MAF_INT_PUC_NOT_LS_DOWN_DIAG	-	0... FFFFH	0... 2912.66666	44.4e-3	g
Minimum threshold for MAF integral out of PUC required to start downstream PUC signal plausibility					
C_MAF_KGH_MIN_LS_DOWN_DIAG	-	0... FFFFH	0... 2047.96875	31.25e-3	kg/h
Minimum MAF_KGH to start MAF integral					
C_VLS_DOWN_PUC_AFR_VLD	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Rich voltage monitoring threshold between fuel-cut phases					
C_VLS_DOWN_PUC_PLAUS_VLD	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Rich voltage threshold for activation of PUC plausibility diagnosis					
C_VLS_MAX_DIAG_FL_LS_DOWN	-	0... 3FFH	0... 4.99511	4.8828e-3	V
VLS voltage threshold for FL fault detection					
C_VLS_MIN_DIAG_PUC_LS_DOWN	-	0... 3FFH	0... 4.99511	4.88e-3	V
VLS voltage threshold for PUC fault detection					
C_VLS_UP_MAX_MAF_INT_AFR	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upstream maximum VLS to enable MAF_INT_AFR integration					
C_VLS_UP_MIN_MAF_INT_AFR	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upstream minimum VLS to enable MAF_INT_AFR integration					
LC_MAF_INT_FL_CDN_AFR	-	0... 1H	0 ...1	1	-
Flag to indicate that upstream rich signal instead of LV_FL should enable the MAF_INT_FL integral					

Error treatment:

Diagnostic XX	Symptom description	Symptom	Filter type
PUC_LS_DOWN[NC_CBK_EX_NR]	Signal high during fuel cut off	SYM_3	MEM

Diagnostic XX	Symptom description	Symptom	Filter type
FL_LS_DOWN[NC_CBK_EX_NR]	Signal low during full load	SYM_3	MEM

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FUNCTION DESCRIPTION:

General information:

Due to possible oxygen sensor defects (e.g. reference air poisoning) or faults in the injection system (e.g. leaking fuel injector), the oxygen sensor may not provide the expected lean or rich AFR signal level during overrun fuel cut-off (PUC) or full load (FL) condition. Hence, the oxygen sensor signal shall be checked for plausibility during this engine operating states.

Description:

If the following conditions are met, then the general conditions for plausibility check are determined to be present:

1. Ignition key shall be determined to be on (LV_IGK = 1)
2. No electrical oxygen sensor fault shall be determined to be present on the sensor being diagnosed (LV_ERR_EL_LS_DOWN[i] = 0).
3. Sensor shall be in a state of operative readiness (LV_LS_DOWN_READY[i] =1).
4. The sensor shall be determined to be at operating temperature (STATE_LSH_DOWN[i] = LSH_POW_CTL & LV_ERR_LSH_DOWN[i] = 0).

The corresponding flag LV_DIAG_CDN_PLAUS_LS_DOWN[i] shall then be set.

For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Application conditions

Initialisation:

At the transition LV_IGK = 0 -> 1, reset or clearing the error memory, reset of all variables and bits to 0

Recurrence: **T_sample 10 ms**

Activation /Deactivation:

If LV_IGK = 1
and LV_ERR_EL_LS_DOWN[i] = 0
and LV_LS_DOWN_READY[i] = 1
and LV_ERR_LSH_DOWN[i] = 0
and STATE_LSH_DOWN[i] = LSH_POW_CTL
then **Diagnosis available**
LV_DIAG_CDN_PLAUS_LS_DOWN[i] = 1
else **Diagnosis NOT available**
LV_DIAG_CDN_PLAUS_LS_DOWN[i] = 0
endif

Formula section:

If LV_ERR_PUC_LS_DOWN[i] = 1
or LV_ERR_FL_LS_DOWN[i] = 1
then LV_ERR_PLAUS_LS_DOWN[i] = 1
else LV_ERR_PLAUS_LS_DOWN[i] = 0
endif

A.16.1 Overrun fuel cut-off (PUC) oxygen sensor signal plausibility

FUNCTION DESCRIPTION:

General information:

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Description:

Should the oxygen sensor signal voltage (VLS_DOWN[i]) exceed the calibrateable thresholds (C_VLS_MIN_DIAG_PUC_LS_DOWN) during engine operating state PUC and the following additional conditions are met, then a fault shall be determined to be present:

1. The appropriate inhibit flag shall not be set (LV_INH_DIAG_PUC_LS_DOWN[i]).
2. Plausibility check set to be possible (LV_DIAG_CDN_PLAUS_LS_DOWN[i] = 1)
3. The PUC state (LV_PUC = 1) shall be determined to be stable, as determined by comparing the mass air flow integral calculated after activation (MAF_INT_PUC_ACT) with the threshold range (C_MAF_INT_MIN_VLS_DOWN_DIAG; C_MAF_INT_MAX_VLS_DOWN_DIAG).
4. The energy transfer from the exhaust gas to the oxygen sensor shall exceed the calibratable threshold (C_MAF_INT_PUC_NOT_LS_DOWN_DIAG).
5. The reset of the MAF integral from the last fuel cut off phase must have taken place before activating the diagnosis. Otherwise there is a risk to set the conditions to 1 right at the beginning of the fuel cut off phase. At this time, the lambda sensor voltage downstream is still high and the error symptom would be set for one recurrence.
6. Prior to the PUC phase the VLS_DOWN[i] must have exceeded the voltage thresholds C_VLS_DOWN_PUC_PLAUS_VLD and C_VLS_DOWN_PUC_AFR_VLD.

The error flag LV_ERR_PUC_LS_DOWN[i] shall be set once the anti-bounce counter has reached its maximum value and reset should the anti-bounce counter reach 0.

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Correlation between MAF integrals MAF_INT_PUC_ACT, MAF_INT_PUC_ACT_OLD and MAF_INT_PUC_NOT_LS_DOWN_DIAG and diagnosis activation :

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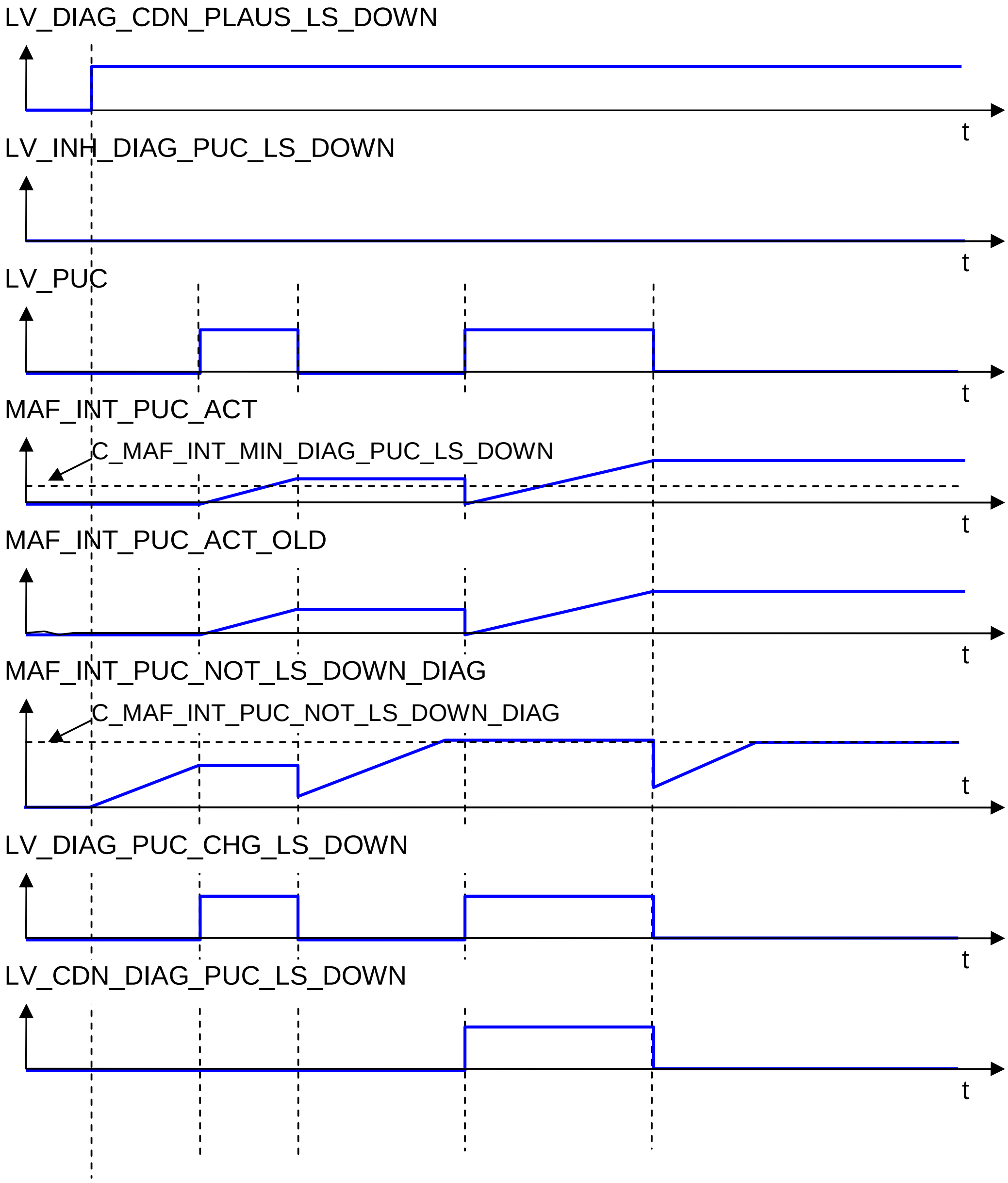

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Application conditions

Initialisation:

At the transition LV_IGK = 0 -> 1, reset or clearing the error memory, reset of all variables and bits to 0, except VLS_DOWN_PUC_SAVE. VLS_UP_PUC_SAVE[i] shall be initialised to 0 at new ECU and in case of NVMY checksum errors.

Recurrence: **T_sample 100ms**

Activation /Deactivation: -

Formula section:

Conditions to start the downstream lambda sensor signal observation

If (1) LV_PUC = 0
And(1) VLS_DOWN[i] > C_VLS_DOWN_PUC_AFR_VLD
Then(1) LV_VLS_DOWN_PUC_AFR_VLD[i] = 1
Elseif(1) LV_PUC = 1 - -> 0
Then(1) LV_VLS_DOWN_PUC_AFR_VLD[i] = 0
Endif(1)
If(1) LV_PUC = 0 - -> 1
Then(1) VLS_DOWN_PUC_PLAUS_VLD[i] = VLS_DOWN[i]
Endif(1)

If(1) LV_DIAG_CDN_PLAUS_LS_DOWN[i] = 1
And(1) LV_INH_DIAG_PUC_LS_DOWN[i] = 0
And(1) LV_PUC = 1
Then(1) LV_DIAG_PUC_CHG_LS_DOWN[i] = 1
If(2) C_MAF_INT_MAX_DIAG_PUC_LS_DOWN > MAF_INT_PUC_ACT > C_MAF_INT_MIN_DIAG_PUC_LS_DOWN
And(2) MAF_INT_PUC_NOT_LS_DOWN_DIAG[i] >= C_MAF_INT_PUC_NOT_LS_DOWN_DIAG

% diagnosis active after a certain energy transfer out of fuel cut off
And(2) MAF_INT_PUC_ACT > MAF_INT_PUC_ACT_OLD
% MAF integral during PUC from last DC must be reset before starting the diagnosis
And(2) VLS_DOWN_PUC_PLAUS_VLD[i] > C_VLS_DOWN_PUC_PLAUS_VLD
And(2) LV_VLS_DOWN_PUC_AFR_VLD[i] = 1

Then(2) **Diagnosis available**
LV_CDN_DIAG_PUC_LS_DOWN[i] = 1
Else(2) **Diagnosis NOT available**
LV_CDN_DIAG_PUC_LS_DOWN[i] = 0
Endif(2)
Else(1) LV_CDN_DIAG_PUC_LS_DOWN[i] = 0
VLS_DOWN_PUC_PLAUS_VLD[i] = 0
If(2a) LV_PUC = 0
And(2a) LV_DIAG_CDN_PLAUS_LS_DOWN[i] = 1
And(2a) LV_INH_DIAG_PUC_LS_DOWN[i] = 0
And(2a) MAF_KGH > C_MAF_KGH_MIN_LS_DOWN_DIAG
Then(2a)
If(3a) LV_DIAG_PUC_CHG_LS_DOWN[i] = 1 (fuel cut off was active)
Then(3a) MAF_INT_PUC_NOT_LS_DOWN_DIAG[i]$_N$ = MAF_INT_PUC_NOT_LS_DOWN_DIAG[i]$_{N-1}$ - C_FAC_MAF_INT_LS_DOWN_DIAG * MAF_INT_PUC_ACT
LV_DIAG_PUC_CHG_LS_DOWN[i] = 0
Endif(3a)
If(3b) MAF_INT_PUC_NOT_LS_DOWN_DIAG[i] <= C_MAF_INT_PUC_NOT_LS_DOWN_DIAG
Then(3b) MAF_INT_PUC_NOT_LS_DOWN_DIAG[i]$_N$ = MAF_INT_PUC_NOT_LS_DOWN_DIAG[i]$_{N-1}$ + MAF_KGH* T_SAMPLE[ms] * 1/3600[(g*h) /(kg*ms)]

Else(3b) MAF_INT_PUC_NOT_LS_DOWN_DIAG[i]$_N$ = MAF_INT_PUC_NOT_LS_DOWN_DIAG[i]$_{N-1}$
Endif(3b)
Endif(2a)
Endif(1)

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MAF_INT_PUC_ACT_OLD = MAF_INT_PUC_ACT

Conditions to start debouncing

If LV_CDN_DIAG_PUC_LS_DOWN[i] = 1
then **If** VLS_DOWN[i] > C_VLS_MIN_DIAG_PUC_LS_DOWN
then ***PUC signal plausibility fault present***
ERR_SYM_PUC_LS_DOWN[i] = sym_3 */"PUC PLAUSIBILITY ERROR"*
/Error Manager shall debounce this symptom
VLS_DOWN_PUC_ERR[i] = VLS_DOWN[i]
else
ERR_SYM_PUC_LS_DOWN[i] = "*NO_SYM"*
/Error Manager shall decrement the debounce counter
VLS_DOWN_PUC_OK[i] = VLS_DOWN[i]
endif
endif
% At this point, update of the ERRM shall be completed.
% In the following part, ***current*** *values of LV_END_DIAG_PUC_LS_DOWN[i] and LV_ERR_PUC_LS_DOWN[i]*
% (after updating ERRM with the diagnostic result of this recurrence) shall be used:

if LV_END_DIAG_PUC_LS_DOWN[i] = 1
then
if LV_ERR_PUC_LS_DOWN[i] = 1
then
VLS_DOWN_PUC_SAVE[i] = VLS_DOWN_PUC_ERR[i]
else
VLS_DOWN_PUC_SAVE[i] = VLS_DOWN_PUC_OK[i]
endif
endif

A.16.2 Full load (FL) oxygen sensor signal plausibility

FUNCTION DESCRIPTION:

General information:

Description:

Should the oxygen sensor signal voltage (VLS_DOWN[i]) exceed the calibrateable thresholds (C_VLS_MAX_DIAG_FL_LS_DOWN) during engine operating state FL and the following additional conditions are met, then a fault shall be determined to be present:

1. The appropriate inhibit flag shall not be set (LV_INH_DIAG_FL_LS_DOWN[i]).
2. Plausibility check set to be possible (LV_DIAG_CDN_PLAUS_LS_DOWN[i] = 1)
3. The FL state (LV_FL = 1) shall be determined to be stable, as determined by comparing the mass air flow integral calculated after activation (MAF_INT_FL[i]) with the threshold range (C_MAF_INT_MIN_DIAG_FL_LS_DOWN; C_MAF_INT_MAX_DIAG_FL_LS_DOWN).

The error flag LV_ERR_FL_LS_DOWN[i] shall be set once the anti-bounce counter has reached its maximum value and reset should the anti-bounce counter reach 0.

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The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Application conditions

Initialisation:
At the transition LV_IGK = 0 -> 1, reset or clearing the error memory, reset of all variables and bits to 0

Recurrence: **T_sample 100ms**

Activation /Deactivation:
If LV_DIAG_CDN_PLAUS_LS_DOWN[i] = 1
and LV_INH_DIAG_FL_LS_DOWN[i] = 0
and C_MAF_INT_MAX_DIAG_FL_LS_DOWN > MAF_INT_FL[i] > C_MAF_INT_MIN_DIAG_FL_LS_DOWN
then **Diagnosis available**
LV_CDN_DIAG_FL_LS_DOWN[i] = 1
else **Diagnosis NOT available**
LV_CDN_DIAG_FL_LS_DOWN[i] = 0
endif

Formula section:

If LV_CDN_DIAG_FL_LS_DOWN[i] = 1
then **If** VLS_DOWN[i] < C_VLS_MAX_DIAG_FL_LS_DOWN
then ***FL signal plausibility fault present***
ERR_SYM_FL_LS_DOWN[i] = sym_3 /"*FL PLAUSIBILITY ERROR*"
/Error Manager shall debounce this symptom
else
ERR_SYM_FL_LS_DOWN[i] = "*NO_SYM*"
/Error Manager shall decrement the debounce counter
endif
endif

A.16.3 Calculation of MAF_INT_FL

FUNCTION DESCRIPTION:

General information:

Description:

The calculation of MAF_INT_FL[i]expires in 20ms raster as long as either the operation status FL is fulfilled or VLS_UP[i] indicates rich conditions, depending on the setting of LC_MAF_INT_FL_CDN_AFR. The integral is calculated even when the application conditions for the plausibility check function

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are not fulfilled. MAF_INT_FL[i] is limited to the maximum value if necessary in case of a longer FL (or rich) phase.
The value of MAF_INT_FL[i] should reset to 0 if the transition LV_FL = 1 -> 0 takes place resp. if VLS_UP[i] no longer indicates rich.

Remarks:
Although the upstream sensor signal is used here if LC_MAF_INT_FL_CDN_AFR = 1, the calculation is still usable for both linear and binary upstream sensors. Only one of the calibrateable VLS_UP limits should be calibrated for a given type: the upper limit for linear sensors, and the lower limit for binary sensors. The other one is not meaningful and should be set to the physical limit.

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Application conditions

Initialisation:
At the transition LV_IGK = 0 -> 1 or reset reset of all variables and bits to 0

Recurrence: **Tsample = 20ms**

Activation /Deactivation:
If LV_ST_END = 1
then *calculation enabled*
else *calculation disabled*
endif

Formula section:

If (LC_MAF_INT_FL_CDN_AFR = 0 **and** LV_FL = 1) **or**
(LC_MAF_INT_FL_CDN_AFR = 1 **and**
VLS_UP[i] = C_VLS_UP_MIN_MAF_INT_AFR **and**
VLS_UP[i] = C_VLS_UP_MAX_MAF_INT_AFR)
then
MAF_INT_FL[i]$_n$ [g] = MAF_INT_FL[i]$_{n-1}$ [g] + MAF_CYL * T_SAMPLE [ms] * 1/3600 [(g*h) / (kg*ms)]
else
MAF_INT_FL[i] = 0
endif

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A.17 O2 sensor (lin, up) controller SPI diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DELTA_LSL_UP_IF [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Increment of error counter since initialization respectively since last increment of error counter					
CTR_ERR_SAVE_DIAG_LSL_UP_IF [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Number of communication errors during the WRAF sensor controller initialization					
ERR_SYM_LSL_UP_IF [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symtom of CJ120 WRAF sensor controller					
LV_CDN_DIAG_LSL_UP_IF [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Conditions to run diagnosis of CJ120 WRAF sensor controller are fullfiled					
LV_END_DIAG_LSL_UP_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Diagnostic of CJ120 WRAF sensor controller available					
LV_ERR_LSL_UP_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Present error in the CJ120 WRAF sensor controller					

Input data:

CTR_ERR_LSL_IF_SPI_WR [NC_CBK_EX_NR] {p. 955}	LV_IGK {p. 906}	LV_INH_DIAG_LSL_UP_IF [NC_CBK_EX_NR] {p. 4288}	LV_LSL_IF_SPI_RST_END [NC_CBK_EX_NR] {p. 1313}
NC_CBK_EX_NR {p. 1829}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_MAX_SPI_COM_LSL_UP [NC_CBK_EX_NR]	-	0... FFH	0... 255	1	-
Max. allowed number of SPI comunication errors					
C_T_END_DIAG_LSL_UP_IF [NC_CBK_EX_NR]	-	0... FFFFH	0... 655.35	0.01	s
Time to diagnostic availability					
C_T_RST_MAX_DIAG_LSL_UP_IF [NC_CBK_EX_NR]	-	0... FFFFH	0... 655.35	0.01	s
Max. waiting time for the initialization of the WRAF sensor controller					

Error treatment:

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Diagnostic XX	Symptom description	Symptom	Filter type
LSL_UP_IF[NC_CBK_EX_NR]	wrong initialisation of WRAF Sensor controller	SYM_0	NO
	SPI communication error	SYM_1	

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

This function shall detect an error during the initialization and/or operation of a WRAF sensor controller which uses a SPI comunication, like the CJ120 or ATIC42. For this task informations from the Basic Software (BSW) concerning the initialization and the communication between ASW and the controller are used to judge if the ASIC works properly.

After an ECU reset, the WRAF sensor controller is started and the diagnosis determines the time until the initialization of the ASIC has been performed (LV_LSL_IF_SPI_RST_END[i] = 1). If this doesnt happen after a certain time (C_T_RST_MAX_DIAG_LSL_UP_IF[I]) an error is present and the flag LV_ERR_LSL_UP_IF[i] shall be set. If the initialization occurs successfully, the difference is checked between the present error counter (CTR_ERR_LSL_IF_SPI_WR[i]) and the stored value of this error counter (CTR_ERR_SAVE_DIAG_LSL_UP_IF[i], stored at ECU reset, LV_IGK switch from 0 -> 1 or at clearing error memory and also after each function call in case that a difference between both counters was found). If there is a difference, another counter is incremented.
If this counter is bigger than a threshold, a SPI communication error is entered.

In any case the flag LV_ERR_LSL_UP_IF[i] = 1 the operation of the WRAF sensor shall be inhibited.

Application conditions

Initialisation:
```
At transition LV_IGK = 0 -> 1, at clearing error memory or at ECU re
LV_ERR_LSL_UP_IF[i] = 0
LV_END_DIAG_LSL_UP_IF[i] = 0
ERR_SYM_LSL_UP_IF[i] = 0
CTR_DELTA_LSL_UP_IF[i] = 0
CTR_ERR_SAVE_DIAG_LSL_UP_IF[i] = CTR_ERR_LSL_IF_SPI_WR[i]
Start TIMER_1 and TIMER_2
```

Recurrence:
```
The function shall run every 10 ms
```

Activation:
```
At LV_IGK=1 & LV_INH_DIAG_LSL_UP_IF[i]=0 the function shall
be started and  LV_CDN_DIAG_LSL_UP_IF[i] = 1
```

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Deactivation:
The deactivation occures if the activation conditions above are not fulfilled.

Formula section:

If LV_LSL_IF_SPI_RST_END[i] = 1 */init. of WRAF sensor controller done successfully*
Then
Stop TIMER_1

If CTR_ERR_LSL_IF_SPI_WR[i] =! CTR_ERR_SAVE_DIAG_LSL_UP_IF[i]
then CTR_DELTA_LSL_UP_IF[i]$_n$ = CTR_DELTA_LSL_UP_IF[i]$_{n-1}$+ 1
CTR_ERR_SAVE_DIAG_LSL_UP_IF[i] = CTR_ERR_LSL_IF_SPI_WR[i]

If CTR_DELTA_LSL_UP_IF[i] $>$ C_CTR_MAX_SPI_COM_LSL_UP[I]
Then
ERR_SYM_LSL_UP_IF[i] = sym_1
LV_ERR_LSL_UP_IF[i] = 1
LV_END_DIAG_LSL_UP_IF[i] = 1
Endif
Else
If TIMER_1 $>$ C_T_RST_MAX_DIAG_LSL_UP_IF[I]
Then
ERR_SYM_LSL_UP_IF[i] = sym_0 */no init. of WRAF sensor controller done*
LV_ERR_LSL_UP_IF[i] = 1
LV_END_DIAG_LSL_UP_IF[i] = 1
Else
Increment TIMER_1
Endif
Endif

If LV_END_DIAG_LSL_UP_IF[i] = 0
Then
If TIMER_2 $<$ C_T_END_DIAG_LSL_UP_IF[I]
Then Increment TIMER_2
Else
LV_END_DIAG_LSL_UP_IF[i] = 1 /for the diagnosis readines
Stop TIMER_2
Endif
Endif

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A.18 O2 sensor (lin, up) controller SPI diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_LSL_UP_IF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibit diagnosis					

Input data:

LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}
LV_LS_UP_OBD_1_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	NC_CBK_EX_NR {p. 1829}		

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

This function shall set the inhibit bit LV_INH_DIAG_LSL_UP_IF[i] in case an electrical fault of the WRAF sensor. In this case, i.e., when LV_ERR_EL_LSL_UP[I] = 1, the communication between sensor and ASIC is stopped, therefore doesn t makes sense to run the ASIC diagnosis.

Application conditions

Initialisation:
At the transition LV_IGK = 0 -> 1
LV_INH_DIAG_LSL_UP_IF[i] = 0

Recurrence:
Every 10 ms

Activation:
At LV_IGK = 1

Deactivation:
If LV_ERR_LSL_UP_IF[i] = 1

Formula section:

If LV_ERR_EL_LSL_UP[I] = 1

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or LV_ERR_SPI_MPS = 1
or LV_LS_UP_OBD_1_MAN_DEAC[i] = 1
Then
LV_INH_DIAG_LSL_UP_IF[i] = 1
Endif

A.18.1 Configuration Data

Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurence	Failure class A/B
WRAF Sensor Controller Diagnosis	*Sym_0*	*0*	P 0606	--	---		See table of failures
	Sym_1	*1*		--			
IF_LSL_UP[i]							

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A.19 O2 sensor (lin, up) signal circuit diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_EL_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "HW-Based Diagnosis"					
LV_IPLSL_DIAG_INH_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "HW-Based Diagnosis with the CJ120"					

Input data:

LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_IGK {p. 906}	LV_LS_UP_OBD_1_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}
STATE_LSL_IF_SPI_RD [NC_CBK_EX_NR] {p. 956}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_DIAG_EL_LSL_UP	-	0... FFH	0... 255	1	-
Increment of OBD-I Diagnosis debouncer counter					
C_ABC_MAX_DIAG_EL_LSL_UP	-	1... FFH	1... 255	1	-
Maximum threshold of OBD-I Diagnosis debouncer counter					

A.19.1 Application Incidences of Electrical Fault Detection

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Application conditions:

Initialization:
The flag shall be initialized as follow during the transition LV_IGK = 0 to 1.
LV_INH_DIAG_EL_LSL_UP[i] = 0

Recurrence:
The function shall be carried out once every 10ms.

Activation:

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Transition LV_IGK = 0 ->1

Deactivation:
Transition LV_IGK = 1 ->0. LV_INH_DIAG_EL_LSL_UP[i] shall be set to 1.

Formula section:

If LV_CDN_VB_OBD1 = 0 **or**
LV_ERR_LSL_UP_IF[i] = 1 **or**
LV_LS_UP_OBD_1_MAN_DEAC[i] = 1 **or**
LV_ERR_OFS_LSL_UP[i] = 1 **or**
LV_ERR_CTL_LSL_UP[i] = 1 **or**
STATE_LSL_IF_SPI_RD[i] *bit* LSL_ENA = 0
Then
LV_INH_DIAG_EL_LSL_UP[i] = 1
Else
LV_INH_DIAG_EL_LSL_UP[i] = 0
Endif

Application assistances:

The following list shows the influenced functions if a failure is detected.
Direct error reactions:
The following functions have to be direct deactivated:

- catalyst efficiency diagnosis
- diagnosis of the canister purge system (flow rate diagnosis)
- secondary air diagnosis (flow rate)
- secondary air valve diagnosis (mechanical)
- secondary air pump
- upstream oxygen sensor temperature acquisition
- WRAF Sensor controller diagnosis
- WRAF Sensor Plausibility Diagnosis
- WRAF Sensor dynamic diagnosis
- WRAF Sensor not mounted diagnosis
- WRAF Sensor plausibility diagnosis during PUC
- WRAF Sensor false start diagnosis
- WRAF Sensor heater coupling diagnosis
- WRAF Sensor OBD2 heater diagnosis

The following function has to be activated :

- canister purge function (min. operation)

Diagnostic XX	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
EL_LSL_UP[NC_CBK_EX_NR]	Short Circuit to Plus	*SYM_0*					MIL_ON / LAW_M	CARB _LS
	Short Circuit to Ground	*SYM_1*						

A.19.2 DTC are defined in the table of failures

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A.19.3 WRAF Sensor Pump Current Controller Diagnosis

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Application conditions:

Initialization:
The flag shall be initialized as follow during the transition LV_IGK = 0 to 1.
LV_IPLSL_DIAG_INH_LSL_UP[i] = 0

Recurrence:
The function shall be carried out once every 10ms.

Activation:
Transition LV_IGK = 0 ->1

Deactivation:
Transition LV_IGK = 1 ->0. LV_IPLSL_DIAG_INH_LSL_UP[i] shall be set to 1.

Formula section:

If LV_CDN_VB_OBD1 = 0
Then
LV_IPLSL_DIAG_INH_LSL_UP[i] = 1
Else
LV_IPLSL_DIAG_INH_LSL_UP[i] = 0
Endif

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A.20 O2 sensor (lin, up) signal circuit diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_IPLSL_SYM_DIAG_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Error debounce counter					
ERR_SYM_EL_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom of electrical failure on the upstream WRAF sensor					
IPLSL_SYM_DIAG_LSL_UP [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the WRAF sensor Pump Current Controller Diagnosis					
LV_CDN_DIAG_EL_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H	PASSIVE ACTIVE	-	-
Condtions to run the electrical diagnosis of the upstream WRAF sensor					
LV_DIAG_ACT_EL_LSL_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical Value for diagnosis active (=1) or not (=0)					
LV_DIAG_IPLSL_CDN_LSL_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Conditions to run the WRAF sensor Pump Current Controller Diagnosis					
LV_DIAG_IPLSL_SYM_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Pump Current Controller in Limitation for too long time					
LV_END_DIAG_EL_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Result of present diagnostis status is valid					
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced diagnosis value caused by an OBD-I error at the WRAF-Sensor					
LV_LSL_UP_SPI_COM_INH [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibit bit for the SPI-communication related to electrical diagnosis on BSW level					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_ERR_EL_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H AH	NO_FAULT SCG_LINE_ RCD SCG_LINE_ VIP SCG_LINE_VG SCG_LINE_VN SCG SCBAT_LINE_ RCD SCBAT_LINE_ VIP SCBAT_LINE_ VG SCBAT_LINE_ VN SCBAT	-	-
State to distinguish the OBD-I failures					
T_DLY_DIAG_EL_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Delay timer to start the electrical failure diagnosis					

Input data:

ERR_SYM_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LC_ICPLSL_ACT {p. 2355}	LV_ES {p. 1720}
LV_ICPLSL_ENA_LSL_IF [NC_CBK_EX_NR] {p. 2351}	LV_IGK {p. 906}	LV_INH_DIAG_EL_LSL_UP [NC_CBK_EX_NR] {p. 4290}	LV_IPLSL_CTL_ENA_LSL_IF [NC_CBK_EX_NR] {p. 2351}
LV_IPLSL_DIAG_INH_LSL_UP [NC_CBK_EX_NR] {p. 4290}	LV_LSL_IF_SPI_RST_END [NC_CBK_EX_NR] {p. 1313}	LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}
STATE_ERR_IPLSL [NC_CBK_EX_NR] {p. 955}	STATE_ERR_VGLSL [NC_CBK_EX_NR] {p. 955}	STATE_ERR_VIPLSL [NC_CBK_EX_NR] {p. 955}	STATE_ERR_VNLSL [NC_CBK_EX_NR] {p. 955}
STATE_ERR_VRCLSL [NC_CBK_EX_NR] {p. 955}	STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	STATE_SYM_OBD_LSL_LSH_UP [NC_CBK_EX_NR] {p. 5439}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_IPLSL_SYM_DIAG_LSL_UP	-	0... FFFFH	0... 65535	1	-
Max. error debounce counter					
C_LAMB_SP_AFL_IPLSL_DIAG_LSL_UP	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Min. lean lambda set point to activate the IP diagnosis					
C_LAMB_SP_AFR_IPLSL_DIAG_LSL_UP	-	0... 7FFFH	0... 31.99902	976.999e-6	-
Max. rich lambda set point to activate the IP diagnosis					
C_T_DLY_DIAG_EL_LSL_UP	-	0... FFFFH	0... 655.35	0.01	s
Time delay to start the electrical failure diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_IPLSL_SYM_DIAG_LSL_UP	-	0... 1H	0 ...1	1	-
Logical variable to force IPLSL symptom flag (only for test purpose)					

Error treatment:

Diagnostic XX	Symptom description	Symptom	Filter type
EL_LSL_UP[i]	Short to plus	SYM_0	MEM
	Short to ground	SYM_1	

A.20.1 HW-based Diagnosis with the ATIC42 (WRAF Sensor Controller)

FUNCTION DESCRIPTION:

General information:

This function shall debounce OBD-I errors at the Wide Range Air/Fuel (WRAF) Sensor detected by the ATIC42 and define a variable containing the diagnosis register of the controller.

If the error is recognised as debounced, the function shall generate an error flag and inhibit the SPI-communication between basic software (BSW) and ATIC42. This is necessary, because in case an electrical failure, the ATIC42 disconnect and reconnect all the PINs of the sensor by itself every recurrence of the BSW, by reading of the Diagnosis-register. This is harmful for the sensor and must be prevented.

According the exhaust gas system the variable shall be defined from [i]=1 to NC_CBK_EX_NR.

Error Symptoms are defined as follows:

```
[ | | | ]
 |  |  |  └─> Short circuit to battery "SCP" ( = SYM_0)
 |  |  └───> Short circuit to Ground "SCG"      ( = SYM_1)
 |  └──────> (not used)
 └─────────> (not used)
```

Application conditions

Initialisation:

The following variables, related to the diagnosis manager shall be initialized according to the filter type MEM .

(all 0 at LV_IGK 0->1 or at ECU reset or clearing error memory)

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LV_ERR_EL_LSL_UP[i] = 0
LV_CDN_DIAG_EL_LSL_UP[i] = 0
LV_END_DIAG_EL_LSL_UP[i] = 0
ERR_SYM_EL_LSL_UP[i] = NO_SYM

The following data shall be set to 0 at LV_IGK 0->1 or at ECU reset or at clearing error memory

STATE_ERR_EL_LSL_UP[i] = No Fault
LV_LSL_UP_SPI_COM_INH[i] = 0
T_DLY_DIAG_EL_LSL_UP[i] = 0

Recurrence:
The function shall be carried out once every 10ms.

Activation /Deactivation:
If
LV_ST_END = 1 **and**
LV_ES = 0 **and**
LV_ERR_EL_LSL_UP[i] = 0 **and**
LV_LSL_IF_SPI_RST_END[i] = 1 **and**
LV_INH_DIAG_EL_LSL_UP[i] = 0
Then
LV_DIAG_ACT_EL_LSL_UP[i] = 1
The diagnosis shall be carried out
Else
LV_ DIAG_ACT_EL_LSL_UP[i] = 0
The diagnosis shall be deactivated
Endif

Formula section:

The variable STATE_ERR_EL_LSL_UP[i] is usefull during the development phase of the ASIC and shall be built up by the failure-bits STATE_ERR_VNLSL[i], STATE_ERR_VGLSL[i], STATE_ERR_VIPLSL[i], STATE_ERR_VRCLSL[i], delivered from the BSW. This variable shall have one of the following values according to the following table:

STATE_ERR_ VRCLSL[i]	STATE_ERR_ VIPLSL[i]	STATE_ERR_ VGLSL[i]	STATE_ERR_ VNLSL[i]	Value for STATE_ERR_ EL_LSL_UP
0	0	0	0	0H
1	0	0	0	1H
0	**1**	0	0	2H
0	0	**1**	0	3H
0	0	0	**1**	4H
“1” in more then one Variable				5H
2	0	0	0	6H
0	**2**	0	0	7H
0	0	**2**	0	8H
0	0	0	**2**	9H
“2” in more then one Variable				AH

Setting the symptoms:

If (1) LV_DIAG_ACT_EL_LSL_UP[i] = 1

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Then (1)
If (2) T_DLY_DIAG_EL_LSL_UP[i] > C_T_DLY_DIAG_EL_LSL_UP
Then
LV_CDN_DIAG_EL_LSL_UP[i] = 1
If (3) 1H ≤ STATE_ERR_EL_LSL_UP[i] ≤ 5H
Then (3)
ERR_SYM_EL_LSL_UP[i] = sym_1 */% Short to ground*
Else (3)
If (4)
6H ≤ STATE_ERR_EL_LSL_UP[i] ≤ AH
Then (4)
ERR_SYM_EL_LSL_UP[i] = sym_0 */% Short to plus*
Else (4)
ERR_SYM_EL_LSL_UP[i] = NO_SYM */% no symptom*
Endif (4)
Endif (3)
Else (2)
Increment T_DLY_DIAG_EL_LSL_UP[i]
Endif (2)
Endif (1)

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

Apply filter on current symptoms
If filtering result available (after debounce)
then
LV_ERR_EL_LSL_UP[i] = filtering result
LV_END_DIAG_EL_LSL_UP[i] = 1
Delivery of the result to the Error Management
Endif

LV_LSL_UP_SPI_COM_INH[i] = LV_ERR_EL_LSL_UP[i]

A.20.2 WRAF Sensor Pump Current Controller Diagnosis

FUNCTION DESCRIPTION:

General information:

This function shall monitor the *pump current controller* inside the WRAF sensor controller ATIC42 in order to protect the oxygen sensor against operation with high pump current (Ip) during excessive time which can be harmfull to the sensor.

High pump current for long time is allowed only during the warm up phase of the WRAF sensor, when its ceramic temperature not high enough, but the Ip controller activaton is needed to detect the sensor operability as fast as possible. To avoid false error messages this function shall run only after the sensor heater achieves its steady state after the warm up phase, when it starts to work in closed loop.

To avoid any double diagnostic it shall be monitored if no sensor electrical failure exists (short circuit to ground or to battery voltage) or if the heater management works properly. In both cases it is possible due to a failure to flow a high Ip current through the sensor. Similarly it must be asked if the sensor requires an *reference air pump current* and in positive case, if this is active.

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If a *pump current controller* failure symptom is detected, the use of the sensor is not more possible and the lambda controller shall be deactivated immediately. Should this symptom be completely debounced, the sensor shall not be used for any purpose during the current driving cycle and also the *pump current controller* shall be deactivated in order to avoid any sensor damage.

Description:

This diagnosis serves to debounce the information concerning the conditions of the *pump current controller* which *is* the delivered by the ATIC42 via its Basic Software.
As long as the Ip current is at their bounds, which is defined *per* hardware [1], the ATIC42 limits the *pump current controller* output and writes in a warning message in its diagnosis register, indicating that Ip current is too low or too high. The Basic Software dedicated to the ATIC42 reads out every 10 ms the diagnosis register and save this information in the variable STATE_ERR_IPLSL[i]. This shall be evaluated here and in failure case the symptom debounced.

[1] For more informations please see the ATIC42 specification.

Application conditions

Initialisation: At the transition LV_IGK = 0 -> 1, by ECU-reset or at clearing the error memory shall all variables be reseted.

Recurrence: The function shall be carried out once every 100ms.
Note: Altough the variable STATE_ERR_IPLSL[i] is updated every 10 ms, it is not necessary to evaluate it so frequently. The decision to stop the Ip controller must not be done with a resolution of miliseconds but seconds. It can be taken advantage to that point allowing to filter transient Ip-controller conditions.

Activation /Deactivation:

If **(**LAMB_SP[i] < C_LAMB_SP_AFR_IPLSL_DIAG_LSL_UP or
LAMB_SP[i] > C_LAMB_SP_AFL_IPLSL_DIAG_LSL_UP**)** **and**

LV_IPLSL_CTL_ENA_LSL_IF[i] = 1 **and**
(Ip controller active)
LV_IPLSL_DIAG_INH_LSL_UP[i] = 0 **and**
(no restriction to run this diagnosis)
ERR_SYM_EL_LSL_UP[i] = NO SYM **and**
(no sensor electrical failure)
STATE_LSH_UP[i] = LSH_POW_CTL **and**
(sensor is heated properly)
STATE_SYM_OBD_LSL_LSH_UP[i] = NO SYM **and**
(no sensor under- or overheating)
[LV_ICPLSL_ENA_LSL_IF[i] = 1 or
(LV_ICPLSL_ENA_LSL_IF[i] = 0 and LC_ICPLSL_ACT = 0)]
(ref. Air is properly pumped if it is needed)
then
LV_DIAG_IPLSL_CDN_LSL_UP[i] = 1
(activate this function)
else
LV_DIAG_IPLSL_CDN_LSL_UP[i] = 0
(deactivate this function)
endif

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Formula section:

If STATE_ERR_IPLSL[i] = current high
Then
IPLSL_SYM_DIAG_LSL_UP[i] = sym_0
Else
If STATE_ERR_IPLSL[i] = current low
Then
IPLSL_SYM_DIAG_LSL_UP[i] = sym_1
Else
IPLSL_SYM_DIAG_LSL_UP[i] = no sym
Endif
Endif

% Debouncing error symptom
If IPLSL_SYM_DIAG_LSL_UP[i] $\neq$ no_symptom
Then
If CTR_IPLSL_SYM_DIAG_LSL_UP[i] $>$ C_CTR_IPLSL_SYM_DIAG_LSL_UP
Then
LV_DIAG_IPLSL_SYM_LSL_UP[i] = 1
Else
Increment CTR_IPLSL_SYM_DIAG_LSL_UP[i]
Endif
Else
LV_DIAG_IPLSL_SYM_LSL_UP[i] = LC_IPLSL_SYM_DIAG_LSL_UP
CTR_IPLSL_SYM_DIAG_LSL_UP[i] = 0
Endif

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A.21 O2 sensor (lin, up) open circuit diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom indicating open circuit failure in one of the lines was detected					
LAMB_SP_DELTA_OC_LSL_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	-32... 31.99902	976.599e-6	-
Lambda setpoint ramp increment for active part of linear sensor open circuit check					
LAMB_SP_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Requested lambda setpoint for active part of linear sensor open circuit check					
LV_CDN_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Bit indicating the necessary conditions to run the diagnosis are fullfiled					
LV_DIAG_OC_IF_OSC_DI_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request stop oscillator used to determine sensor internal resistance					
LV_END_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Bit indicating the diagnostic is valid					
LV_ERR_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced open circuit failure detected					
LV_VLS_UP_AFS_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Bit indicating LSL stoichiometric voltage					
LV_VLS_UP_MIN_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Bit indicating LSL undervoltage					
STATE_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H	PASSIVE ACTIVE END	-	-
Status of the LSL Open Circuit Diagnosis					
T_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer to finish OC diagnosis in case of OBD2 upstream heater error symptom active and conditions for plausibility diagnosis fulfilled					
T_DIAG_OC_RST_LAMB_SP_REQ [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time to finish the active check for OC in VIP /VG					
T_DIAG_OC_RST_OSC_DI [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time to reactivate oscillator for upstream tip temperature measurement					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_VLS_UP_AFS_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for lambda signal being in stoichiometric band while it shouldn't					
T_VLS_UP_MIN_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for LSL signal under voltage					
T_WAIT_SYM_OBD_2_LSH_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Waiting time to check if OBD2 upstream heater error is present (to distinguish OC on Vip from Vg)					

Input data:

LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_DIAG_ACT_END_LSL_UP [NC_CBK_EX_NR] {p. 5237}	LV_DIAG_ACT_SHO_CDN_LSL_UP [NC_CBK_EX_NR] {p. 5237}	LV_DIAG_ACT_SYM_LSL_UP [NC_CBK_EX_NR] {p. 5237}
LV_DIAG_EOL_END_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_DIAG_OBD_CDN_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_DIAG_OBD_END_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_DIAG_OBD_SYM_LSH_UP [NC_CBK_EX_NR] {p. 5438}
LV_DIAG_PUC_END_LSL_UP [NC_CBK_EX_NR] {p. 5297}	LV_DIAG_PUC_SYM_LSL_UP [NC_CBK_EX_NR] {p. 5297}	LV_DIAG_RAW_ACT_END_LSL_UP [NC_CBK_EX_NR] {p. 5237}	LV_DIAG_RAW_ACT_SYM_LSL_UP [NC_CBK_EX_NR] {p. 5237}
LV_ES {p. 1720}	LV_IGK {p. 906}	LV_INH_DIAG_OC_LSL_UP [NC_CBK_EX_NR] {p. 4309}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}
LV_R_IT_OSC_ENA_LSL_IF [NC_CBK_EX_NR] {p. 1320}	NC_CBK_EX_NR {p. 1829}	STATE_SYM_DIAG_PUC_LSL_UP [NC_CBK_EX_NR] {p. 5297}	VLS_UP_DIAG [NC_CBK_EX_NR] {p. 2315}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_SP_MAX_DIAG_OC_LSL_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Upper end of blind region for lambda setpoint for active test for open circuit in VG /VIP					
C_LAMB_SP_MIN_DIAG_OC_LSL_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lower end of blind region for lambda setpoint for active test for open circuit in VG /VIP					
C_LAMB_SP_OC_CHK_LSL_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda setpoint target for active test for open circuit in VG /VIP					
C_LAMB_SP_STEP_OC_CHK_LSL_UP	-	1... FFH	1... 255	1	-
Number of recurrences to achieve the desired lambda set point during open-circuit check					
C_T_DIAG_OC_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Timer to finish OC diagnosis in case of OBD2 upstream heater error symptom active and conditions for plausibility diagnosis fulfilled					
C_T_DIAG_OC_RST_OSC_DI	-	0... FFFFH	0... 6553.5	0.1	s
Time to reactivate oscillator for upstream tip temperature measurement					
C_T_VLS_UP_MIN_DIAG_OC_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Max time to debounce open circuit in VN or VG symptom					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_WAIT_SYM_OBD_2_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Waiting time to check if OBD2 upstream heater error is present (to distinguish OC on Vip from Vg)					
C_VLS_UP_DIAG_MIN_OC_LSL_UP	-	8000... 7FFFH	-160... 159.99511	4.8828e-3	V
LSL undervoltage threshold					
C_VLS_UP_MAX_OC_AFS_LSL_UP	-	8000... 7FFFH	-160... 159.99511	4.8828e-3	V
LSL stoichiometric voltage upper threshold					
C_VLS_UP_MIN_OC_AFS_LSL_UP	-	8000... 7FFFH	-160... 159.99511	4.8828e-3	V
LSL stoichiometric voltage lower threshold					
LC_DIAG_PUC_END_MAN_LSL_UP	-	0... 1H	0 ...1	1	-
Boolean switch to bypass activation of LV_DIAG_PUC_END_LSL_UP[i]					

Error treatment:

Diagnostic XX	Symptom description	Symptom	Filter type
OC_LSL_UP[NC_CBK_EX_NR]	Open Circuit on Nernst Cell (Vn)	SYM_0	NO
	Open Circuit on Virtual Ground (Vg)	SYM_1	
	Open Circuit on Pump Cell (Vip)	SYM_2	
	Open Circuit on comp. resistor (Vrc)	SYM_3	

FUNCTION DESCRIPTION:

General information:

This function shall use some debounced OBD2 lambda sensor faults to evaluate if an open circuit in any of the four electric lines (VN, VG, VIP and VRc) is present. The matrix below shows reaction of sensor/controller to each open line.

Open Circuit on Line	Measured Sensor Temp	Lambda Sensor
VN	V_Ri = 5 V (Ttip = 560 °C)	U_Lambda = 0 V (for NTK sensor only if R_I oscillator is turned off)
VG	V_Ri = 0 V (Ttip = 880 °C) (only applicable for some senosor types)	U_Lambda = 2.0 V (sensor stuck)
VIP	V_Ri plausible	U_Lambda = 2.0 V (sensor stuck)
VRc	V_Ri plausible	U_Lambda > 4.8 V in air

This function shall run only if at least one of the following diagnoses has set its readiness bit: Activity Check, Plausibility during PUC and Sensor Heater OBD2. The function shall go to the state = “active” if one of the above diagnoses debounced a fault.

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The end flag for this diagnosis is set if all the related diagnosis functions have set their end flags or after changing to the STATE “end” with detection of an open circuit error.

OC in the VN line (LSU and ZFAS-Ux sensors) or VG line (ZFAS-Ux only) cause an OBD2 heater symptom. Therefore an OC error is assumed if a heater symptom is accompanied by other indications of these OC errors. For OC in VN, a very low VLS_UP_DIAG[i] will occur (for ZFAS-Ux, only if the Ri measurement oscillator is turned off), while for OC in VG this value will be around 2.0V (i.e. stuck at lambda=1). These conditions are tested with an open loop lambda setpoint shift requested here, monitoring of VLS_UP_DIAG[i] is coordinated with the detection of shifted lambda setpoint and disabled Ri measurement oscillator. If the lambda shift request is not fulfilled, the diagnosis looks for an activity symptom instead to decide if the VG/VIP line is open, but this probably takes much more time.

If VLS_UP_DIAG[i] is stuck at 2.0V, as detected by the PUC plausibility or activity diagnoses, OC in VG or VIP may be present. In ZFAS-Ux sensors, OC in VG would also cause a heater symptom, so further fault isolation is possible using T_WAIT_SYM_OBD_2_LSH_UP[i] to wait for this symptom. If C_T_WAIT_SYM_OBD_2_LSH_UP is set to 0, all faults causing VLS_UP_DIAG[i]= 2.0V are regarded as OC in VIP, even if the test was triggered by an OBD2 heater symptom.

Quite independently, OC in VRC shows up as a VLS_H_OC symptom in the PUC plausibility diagnosis and is consumed here. It will be overridden however by any other OC fault.

If any open circuit symptom could be detected the flag LV_ERR_OC_LSL_UP[i] shall be set to 1.

If two separate catalyst systems are concerned, then
    i = 1, for cylinder bank 1
    i = 2, for cylinder bank 2,
else
    i = 1.

Description:

Application conditions

Initialisation: `At LV_IGK = 0 to 1, reset` **`or`** `at clearing error memory:` `Reset all variables`

Recurrence: `This function shall run every 100 ms.`

Activation /Deactivation:

If (LV_DIAG_ACT_END_LSL_UP[i] = 1 **or**
  LV_DIAG_OBD_END_LSH_UP[i] = 1 **or**
  LV_DIAG_PUC_END_LSL_UP[i] = 1)
and LV_INH_DIAG_OC_LSL_UP[i] = 0
and LV_IPLSL_VLD[i] = 1
then
  LV_CDN_DIAG_OC_LSL_UP[i] = 1
  % activate function (= carry out formula section)
else
  LV_CDN_DIAG_OC_LSL_UP[i] = 0
  LAMB_SP_DIAG_OC_LSL_UP[i] = 0
  LV_DIAG_OC_IF_OSC_DI_LSL_UP[i] = 0
  % deactivate function
endif

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Formula section:

%Readiness bit setting in case no failure is present
If *% during normal driving cycle*
{ LV_DIAG_OBD_SYM_LSH_UP[i] = 0 &
LV_DIAG_ACT_SYM_LSL_UP[i] = 0 &
LV_DIAG_PUC_SYM_LSL_UP[i] = 0 &
LV_DIAG_ACT_END_LSL_UP[i] = 1 &
LV_DIAG_OBD_END_LSH_UP[i] = 1 &
(LV_DIAG_PUC_END_LSL_UP[i] = 1 or LC_DIAG_PUC_END_MAN_LSL_UP = 1) &
LV_END_DIAG_OC_LSL_UP[i] = 0 **}**
Or *% during EOL test*
{ LV_DIAG_EOL_END_LS_UP_DOWN[i] = 1 & LV_DIAG_PUC_END_LSL_UP[i] = 1 **}**
Then
ERR_SYM_OC_LSL_UP[i] = NO_SYM
LV_END_DIAG_OC_LSL_UP[i] = 1
Endif

DEFINITION OF THE STATES

State “PASSIVE”

Action:

None

Transition to other states

Condition 1: to state “ACTIVE”

If LV_DIAG_OBD_SYM_LSH_UP[i] = 1 **or**
LV_DIAG_ACT_SYM_LSL_UP[i] = 1 **or**
LV_DIAG_PUC_SYM_LSL_UP[i] = 1
then
STATE_DIAG_OC_LSL_UP[i] = “ACTIVE”
endif

State “ACTIVE”

Action:

%Waiting timer for a heater OBD diagnostic
If ((LV_DIAG_ACT_SYM_LSL_UP[i] = 1 **or** LV_DIAG_PUC_SYM_LSL_UP[i] = 1)
and LV_DIAG_OBD_CDN_LSH_UP[i] = 1)
then
increment T_WAIT_SYM_OBD_2_LSH_UP[i]
endif

% If a heater OBD2 symptom is present, turn off Ri oscillator and check sensor signal

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% with an active lambda shift.
If(1) LV_DIAG_OBD_SYM_LSH_UP[i] = 1
then
% Check for additional symptoms of OC faults.
% Request to turn off Ri oscillator, if the test has not timed out:
If(2a) T_DIAG_OC_RST_OSC_DI[i] < C_T_DIAG_OC_RST_OSC_DI
then
LV_DIAG_OC_IF_OSC_DI_LSL_UP[i] = 1
Else
LV_DIAG_OC_IF_OSC_DI_LSL_UP[i] = 0
Endif(2a)
% If Ri oscillator is off, do test for Vn symptom
If(2b) LV_R_IT_OSC_ENA_LSL_IF[i] = 0
then
increment T_DIAG_OC_RST_OSC_DI[i]
If(3b) VLS_UP_DIAG[i] < C_VLS_UP_DIAG_MIN_OC_LSL_UP
then % VLS_UP_DIAG symptom for OC@VN
If(4b) T_VLS_UP_MIN_DIAG_OC_LSL_UP[i] >= C_T_VLS_UP_MIN_DIAG_OC_LSL_UP
then
LV_VLS_UP_MIN_DIAG_OC_LSL_UP[i] = 1
Else
increment T_VLS_UP_MIN_DIAG_OC_LSL_UP[i]
Endif (4b)
Else (3a)
reset T_VLS_UP_MIN_DIAG_OC_LSL_UP[i]
Endif (3b)
Endif (2b)
%Request lambda setpoint shift, if the test has not timed out:
If(2c) T_DIAG_OC_RST_LAMB_SP_REQ[i] < C_T_DIAG_OC_RST_OSC_DI
then
execute Section "Moving Lambda setpoint"
Else
LAMB_SP_DIAG_OC_LSL_UP[i] = 0
Endif(2c)
% If lambda setpoint is shifted far enough, check for open loop test symptom of OC@VG/VIP
If(2d) (C_LAMB_SP_MAX_DIAG_OC_LSL_UP < LAMB_SP[i] **or**
LAMB_SP[i] < C_LAMB_SP_MIN_DIAG_OC_LSL_UP)
then
increment T_DIAG_OC_RST_LAMB_SP_REQ[i]
If(3d) C_VLS_UP_MIN_OC_AFS_LSL_UP < VLS_UP_DIAG[i] **and**
VLS_UP_DIAG[i] < C_VLS_UP_MAX_OC_AFS_LSL_UP
then
If(4d) T_VLS_UP_AFS_DIAG_OC_LSL_UP[i] >= C_T_VLS_UP_MIN_DIAG_OC_LSL_UP
then
LV_VLS_UP_AFS_DIAG_OC_LSL_UP[i] = 1
Else (4d)
increment T_VLS_UP_AFS_DIAG_OC_LSL_UP[i]
Endif (4d)
Endif (3d)
Endif (2d)
% if sensor is active, there cannot be an OC in VG/VIP, even if the lambda setpoint is not shifted

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If(2e) C_VLS_UP_MIN_OC_AFS_LSL_UP >= VLS_UP_DIAG[i] **or**
VLS_UP_DIAG[i] >= C_VLS_UP_MAX_OC_AFS_LSL_UP
then
reset T_VLS_UP_AFS_DIAG_OC_LSL_UP[i]
Endif (2e)
% abort open loop if lambda setpoint shift did not occur and activity test would have seen the fault
% T_DIAG_OC_LSL_UP approximates the time until the activity diagnosis would come to its final decision.
If (2f) LV_DIAG_ACT_SHO_CDN_LSL_UP[i] = 1
then
increment T_DIAG_OC_LSL_UP[i]
Else
reset T_DIAG_OC_LSL_UP[i]
Endif (2f)
Endif (1)

Transition to other states

Condition 2: ***to state "END"*** *(Open Circ in line Vn detected)*

If LV_DIAG_OBD_SYM_LSH_UP[i] = 1 **and**
LV_VLS_UP_MIN_DIAG_OC_LSL_UP[i] = 1
then
STATE_DIAG_OC_LSL_UP[i] = "END"
ERR_SYM_OC_LSL_UP[i] = "SYM_0" /Open Circ in UN"
endif

Condition 3: ***to state "END"*** *(Open Circ in line VIP detected)*

If (T_WAIT_SYM_OBD_2_LSH_UP[i] ≥ C_T_WAIT_SYM_OBD_2_LSH_UP) **and**
(LV_DIAG_ACT_SYM_LSL_UP[i] = 1 **or**
LV_VLS_UP_AFS_DIAG_OC_LSL_UP[i] = 1 **or**
(LV_DIAG_PUC_SYM_LSL_UP[i] = 1 **and**
STATE_DIAG_PUC_LSL_UP[i] = "VLS_AFS_OC"))
then
% wait if OBD2 upstream heater error symptom is present - to distinguish between OC on Vip and Vg.
% Only applicable for some sensor types, for others the timer limit should be set zero so that all pump
% circuit faults are presented as OC in VIP.
STATE_DIAG_OC_LSL_UP[i] = "END"
ERR_SYM_OC_LSL_UP[i] = "SYM_2" / Open Circ in VIP"
Endif

Condition 4: ***to state "END"*** *(Open Circ in line VG detected)*

If LV_DIAG_OBD_SYM_LSH_UP[i] = 1 **and**
(LV_VLS_UP_AFS_DIAG_OC_LSL_UP[i] = 1 **or**
LV_DIAG_ACT_SYM_LSL_UP[i] = 1 **or**
(LV_DIAG_PUC_SYM_LSL_UP[i] = 1 **&**
STATE_SYM_DIAG_PUC_LSL_UP[i] = "VLS_AFS_OC"))
then
STATE_DIAG_OC_LSL_UP[i] = "END"
ERR_SYM_OC_LSL_UP[i] = "SYM_1" /Open Circ in VG"

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endif

Condition 5: to state "END" *(Open Circ in line VRc detected)*

If LV_DIAG_PUC_SYM_LSL_UP[i] = 1 **and**
STATE_SYM_DIAG_PUC_LSL_UP[i] = "VLS_H_OC"
then
STATE_DIAG_OC_LSL_UP[i] = "END"
ERR_SYM_OC_LSL_UP[i] = "SYM_3" /Open Circ in VRc
endif

Condition 6: to state "end"
% finish diagnosis with "no open circuit error found"
% catch timeouts and secondary symptoms which are proven absent
If (LV_DIAG_OBD_SYM_LSH_UP[i] = 1 **and**
T_DIAG_OC_RST_OSC_DI[i] > C_T_DIAG_OC_RST_OSC_DI **and**
(T_DIAG_OC_RST_LAMB_SP_REQ[i] > C_T_DIAG_OC_RST_OSC_DI **or**
T_DIAG_OC_LSL_UP[i] > C_T_DIAG_OC_LSL_UP))
% Heater symptom present, but additional symptoms of OC in VN or VG proven to be absent.
% This means the heater symptom is caused by a real weak heater.
or
T_WAIT_SYM_OBD_2_LSH_UP[i] > C_T_WAIT_SYM_OBD_2_LSH_UP
% Diagnosis triggered by something other than OBD2 LSH and no other condition applied
% Should happen only if Plaus/PUC triggered the OC test with a symptom of VLS_L
then
STATE_DIAG_OC_LSL_UP[i] = "END"
ERR_SYM_OC_LSL_UP[i] = "NO_SYM"
Endif

Transition action for all change from State active to end (Conditions 2 to 6)

If ERR_SYM_OC_LSL_UP[i] = "NO_SYM"
then
LV_ERR_OC_LSL_UP[i] = 0
else
LV_ERR_OC_LSL_UP[i] = 1
endif
LV_END_DIAG_OC_LSL_UP[i] = 1

State "end"

Action:

% clean up.
T_WAIT_SYM_OBD_2_LSH_UP[i] = 0
T_DIAG_OC_LSL_UP[i] = 0
T_DIAG_OC_RST_OSC_DI[i] = 0
T_DIAG_OC_RST_LAMB_SP_REQ[i] = 0
T_VLS_UP_MIN_DIAG_OC_LSL_UP[i] = 0
T_VLS_UP_AFS_DIAG_OC_LSL_UP[i] = 0
LAMB_SP_DIAG_OC_LSL_UP[i] = 0

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LV_DIAG_OC_IF_OSC_DI_LSL_UP[i] = 0

Transition to other states

% return to passive state.
If ERR_SYM_OC_LSL_UP[i] = "NO_SYM"
then
STATE_DIAG_OC_LSL_UP[i] = "PASSIVE"
endif

Section "Moving Lambda setpoint"

This section shall produce a lambda set point that will be forwarded as a request to the lambda setpoint coordination.

% if currently not active, then determine the ramp
If LAMB_SP_DIAG_OC_LSL_UP[i] = 0
then
LAMB_SP_DELTA_OC_LSL_UP[i] = (C_LAMB_SP_OC_CHK_LSL_UP - LAMB_SP[i]) /C_LAMB_SP_STEP_OC_CHK_LSL_UP
if LAMB_SP_DELTA_OC_LSL_UP[i] = 0
then
if C_LAMB_SP_OC_CHK_LSL_UP >= LAMB_SP[i]
then
LAMB_SP_DELTA_OC_LSL_UP[i] = +1H
Else
LAMB_SP_DELTA_OC_LSL_UP[i] = -1H
endif
endif
LAMB_SP_DIAG_OC_LSL_UP[i] = LAMB_SP[i]
endif
% move the set point
increment LAMB_SP_DIAG_OC_LSL_UP[i] *with* LAMB_SP_DELTA_OC_LSL_UP[i]
if (LAMB_SP_DELTA_OC_LSL_UP[i] > 0 **and**
LAMB_SP_DIAG_OC_LSL_UP[i] > C_LAMB_SP_OC_CHK_LSL_UP)
or (LAMB_SP_DELTA_OC_LSL_UP[i] < 0 **and**
LAMB_SP_DIAG_OC_LSL_UP[i] < C_LAMB_SP_OC_CHK_LSL_UP)
Then
LAMB_SP_DIAG_OC_LSL_UP[i] = C_LAMB_SP_OC_CHK_LSL_UP
endif

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A.22 O2 sensor (lin, up) open circuit diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "Open Circuit Diagnosis"					
LV_INH_DIAG_RBM_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of RBM of "Open Circuit Diagnosis" by malfunction					
STATE_RBM_OC_LSL_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of OC_LSL_UP[NC_CBK_EX_NR] monitor with the Rate-Based Monitoring statistics					

Input data:

LV_END_DIAG_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}
LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}
LV_ERR_MAP_TPS_PLAUS {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}
LV_ERR_MTC_DR {p. 5002}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}
LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_IGK {p. 906}
LV_LS_UP_OBD_1_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_VB_CDN_OBD_2 {p. 1046}	NC_CBK_EX_NR {p. 1829}	

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Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

Error treatment:

Diagnostic OC_LSL_UP[i]	**Symptoms**	**Ref.**	**DTC Symptom CARB**	**DTC Symptom Customer**	**DTC Global CARB**	**DTC Global Customer**	**Failure class A/B**	**Readiness code**
Detection of Open Circuit	Open Circuit on Vn	*SYM_0*					MIL_ON / LAW_L	CARB_LS
	Open Circuit on Vg	*SYM_1*						
	Open Circuit on Vip	*SYM_2*						
	Open Circuit on Vrc	*SYM_3*						

DTCs are defined in the table of failures.

A.22.1 General

Application conditions

Initialization: At transition LV_IGK = 0 -> 1 or ECU reset LV_INH_DIAG_OC_LSL_UP[i] = 0, LV_INH_DIAG_RBM_OC_LSL_UP[i] = 0.
at every transition LV_IGK = 1->0 LV_INH_DIAG_OC_LSL_UP[i] = 1

Recurrence:
```
If    NC_4D4 = true  (SW Variant = 5  MSD80 4Cyl.)
  then   100 ms
  else   10 ms
  endIf
```

Activation: *LV_IGK = 1*

Deactivation: *LV_IGK = 0*

Formula section:

The following part shall be carried out once every 10ms:

If LV_ERR_CHG_LS_UP = 1 **OR**
LV_ERR_DIAGCPS = 1 **OR**
LV_ERR_EL_CPS = 1 **OR**
LV_ERR_FUP = 1 **OR**
LV_ERR_FUP_MFP_PLAUS = 1 **OR**
LV_ERR_FUP_ORNG = 1 **OR**
LV_ERR_FUP_ST = 1 **OR**
LV_ERR_H_PRS_SYS = 1 **OR**
LV_ERR_LOAD_TPS_PLAUS = 1 **OR**
LV_ERR_MAF = 1 **OR**
LV_ERR_MAP_PLAUS = 1 **OR**
LV_ERR_MAP_TPS_PLAUS = 1 **OR**
LV_ERR_MTC_CTL_2 = 1 **OR**

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LV_ERR_MTC_CTL_3 = 1 **OR**
LV_ERR_MTC_DR = 1 **OR**
LV_ERR_TPS = 1 **OR**
LV_ERR_VCV = 1 **OR**
LV_ERR_AIR_LSL_UP[i] = 1 **OR** LV_ERR_CTL_LSL_UP[i] = 1 **OR**
LV_ERR_DELTA_I_LAM[i] = 1 **OR**
LV_ERR_DYN_VLD_LS_UP[i] = 1 **OR**
LV_ERR_EL_LSL_UP[i] = 1 **OR**
LV_ERR_LSH_UP[i] = 1 **OR**
LV_ERR_LSL_UP_IF[i] = 1 **OR**
LV_ERR_OFS_LSL_UP[i] = 1 **OR**
LV_ERR_SHIFT_AFL_LSL_UP[i] = 1 **OR**
LV_ERR_SHIFT_AFR_LSL_UP[i] = 1 **OR**
LV_ERR_VLS_DOWN_DIF[i] =1 **OR**
(i = 1 **AND**
[LV_ERR_IV[0] **OR**
LV_ERR_IV[2] **OR**
LV_ERR_IV[4] **OR**
LV_ERR_MIS[0] **OR**
LV_ERR_MIS[2] **OR**
LV_ERR_MIS[4]
]) **OR**
(i = 2 **AND**
[LV_ERR_IV[1] **OR**
LV_ERR_IV[3] **OR**
LV_ERR_IV[5] **OR**
LV_ERR_MIS[1] **OR**
LV_ERR_MIS[3] **OR**
LV_ERR_MIS[5]
]) **OR**

Then
LV_INH_DIAG_RBM_OC_LSL_UP[i] = 1
Else
LV_INH_DIAG_RBM_OC_LSL_UP[i] = 0
Endif

If LV_INH_DIAG_RBM_OC_LSL_UP[i] = 1 **OR**
LV_LS_UP_OBD_1_MAN_DEAC[i] = 1 **OR**
LV_VB_CDN_OBD_2 = 0

Then
LV_INH_DIAG_OC_LSL_UP[i] = 1
Else
LV_INH_DIAG_OC_LSL_UP[i] = 0
Endif

A.22.1.1 Interface for Rate - Based - Monitoring OC_LSL_UP[I]

FUNCTION DESCRIPTION:

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General information:

With this module the interface between the OC_LSL_UP[i] monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_OC_LSL_UP[i] data.
Within STATE_RBM_OC_LSL_UP[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)
  (not valid for catalyst diagnosis)

Application conditions

Initialisation:

```
at ECU reset:
    bit 0, bit 1 and bit 2 of STATE_RBM_OC_LSL_UP[i] = 0
LV_DC 0 → 1 transition:
     bit 0 and bit 1 of STATE_RBM_OC_LSL_UP[i] = 0
on failure memory reset:
    bit 1 of STATE_RBM_OC_LSL_UP[i] = 0
```

Recurrence: 1 s

Activation: LV_DC = 1

Formula section:

At LV_DC 0 → 1 transition
bit 2 of STATE_RBM_OC_LSL_UP[i] = 1
The pending status of the following failures has to be checked only once :

Dependence	Error			
	LV_ERR_CHG_LS_UP	LV_ERR_DIAGCPS	LV_ERR_EL_CPS	LV_ERR_FUP
	LV_ERR_FUP_MFP_PLAUS	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS
	LV_ERR_LOAD_TPS_PLAUS	LV_ERR_MAP_PLAUS	LV_ERR_MAP_TPS_PLAUS	LV_ERR_MTC_CTL_2
	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR	LV_ERR_TPS_1	LV_ERR_TPS_2
	LV_ERR_TPS_AD	LV_ERR_TPS_AD_BOL	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2
	LV_ERR_TPS_RATIO	LV_ERR_TPS_ST_CHK_2	LV_ERR_VCV	
NC_CBK_EX_NR	LV_ERR_AIR_LSL_UP[i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DELTA_I_LAM[i]	LV_ERR_DYN_VLD_LS_UP[i]
	LV_ERR_EL_LSL_UP[i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]	LV_ERR_OFS_LSL_UP[i]
	LV_ERR_SHIFT_AFR_LSL_UP[i]	LV_ERR_SHIFT_AFL_LSL_UP[i]	LV_ERR_VLS_DOWN_DIF[i]	

Figure A.22.1: For k = 1 to NC_MAF_NR (= for any i // or)

NC_MAF_NR	LV_ERR_MAF_FRQ_EL[k]	LV_ERR_MAF_FRQ_GRD[k]	LV_ERR_MAF_FRQ_RNG[k]	

Figure A.22.2: For NC_CBK_EX_NR = i = 1

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NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

Figure A.22.3: For NC_CBK_EX_NR = i = 2

NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

If(1) { CPU optimization at LV_DC 0 → 1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn't empty }
Then(1)
While bit 1 of STATE_RBM_OC_LSL_UP[i] = 0 **do**
with each XX failure of the above list (depending on configuration, see below):
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2) bit 1 of STATE_RBM_OC_LSL_UP[i] = 1
Endif(2)
Endwhile
Else(1) { the dynamic failure memory is empty } No action
Endif(1)

Every 1 s :
If bit 0 of STATE_RBM_ OC_LSL_UP[i] = 0
Then
If LV_END_DIAG_OC_LSL_UP[i] = 1
Then bit 0 of STATE_RBM_OC_LSL_UP[i] = 1
Endif
Endif

If bit 1 of STATE_RBM_OC_LSL_UP[i] = 0
Then
If LV_INH_DIAG_RBM_OC_LSL_UP[i] = 1
Then bit 1 of STATE_RBM_OC_LSL_UP[i] = 1
Endif
Endif

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A.23 O2 sensor (up) heater circuit diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibit flag for upstream oxygen sensor heater OBDI diagnosis					

Input data:

LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_SPI_MPS {p. 4245}	LV_LS_UP_OBD_1_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_ST_END {p. 1720}
NC_CBK_EX_NR {p. 1829}			

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
 i = 1, for exhaust cylinder bank 1
 i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
 i = 1, for single exhaust cylinder bank.

Description:

The diagnosis is inhibited due to low battery voltage, present error or if sensors are not learnt.

Application conditions

Initialisation: *LV_INH_DIAG_LSH_UP[i] = 1 at reset*

Recurrence: The function shall be carried out once every 100 ms.

Activation: *LV_ST_END = 1*

Deactivation: *LV_ST_END = 0 , set LV_INH_DIAG_LSH_UP[i] = 1*

Formula section:

```
If      LV_CDN_VB_OBD1 = 0              or
        LV_ERR_SPI_MPS = 1              or
        LV_LS_UP_OBD_1_MAN_DEAC[i] = 1     //sensors not learnt
Then    LV_INH_DIAG_LSH_UP[i] = 1
Else    LV_INH_DIAG_LSH_UP[i] = 0
Endif
```

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A.24 O2 sensor (up) heater circuit diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_LSH_UP [NC_CBK_EX_NR]	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of upstream heater diagnosis OBD I					
ERR_DIAG_LSH_UP [NC_CBK_EX_NR]	V	0H 1H 2H 4H	NO_SYM SYM_0 SYM_1 SYM_2	-	-
Raw value of error symptom for upstream heater diagnosis OBD I					
ERR_SYM_LSH_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for upstream heater diagnosis OBD I filterd with CDN_DIAG_LSH_UP					
LV_CDN_DIAG_LSH_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Diagnosis condition for upstream heater diagnosis OBD 1					
LV_END_DIAG_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of diagnosis for upstream heater diagnosis OBD I					
LV_ERR_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Error flag for upstream heater diagnosis OBD I after debouncing					
LV_LSH_SCG_ACT_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that debounce for upstream heater OBDI SCG diagnosis active					

Input data:

LSHPWM_UP [NC_CBK_EX_NR] {p. 2385}	LV_IGK {p. 906}	LV_INH_DIAG_LSH_UP [NC_CBK_EX_NR] {p. 4314}	LV_VB_CDN_OBD_1 {p. 1046}
NC_CBK_EX_NR {p. 1829}	STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	TEG_DYN_LS_UP [NC_CBK_EX_NR] {p. 1008}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_LSH_UP	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_LSH_UP	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_LSHPWM_MAX_DIAG_LSH_UP	-	0... FFH	0... 99.60937	0.390625	%
Maximum O2-Sensor heater duty cycle to perform the electrical diagnosis					
C_LSHPWM_MIN_DIAG_LSH_UP	-	0... FFH	0... 99.60937	0.390625	%
Minimum O2-Sensor heater duty cycle to perform the electrical diagnosis					
C_TEG_DYN_MIN_DIAG_LSH_UP	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum exhaust gas temperature threshold to permit SCP to set fault during LSH power rise state					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_LSH_UP	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (typical 2)					

Import actions:

ACTION_ERRM_FilterMulticondition (**IN**<XX>,**IN**<CDN_DIAG_>,**XX**>,<IN<>,**ERR_DIAG_XX**>,<IN>,<C_ABC_INC_XX>,**IN**<C_ABC_MAX_XX>,**OUT**<LV_ERR_XX>)
ACTION_INFR_GetElDiagLshUp (**IN**<i>,**OUT**<cdn_diag>,**OUT**<err_diag>)

Error treatment:

Diagnostic XX	Symptom description	Symptom	Filter type
Downstream oxygen sensor heater OBDI diagnosis	*Short circuit to battery*	*SYM_0*	*MPL_STD_INI*
	Short circuit to GND	*SYM_1*	
LSH_UP[i]	*Open circuit*	*SYM_2*	
	4th symptom description	*SYM_3*	

FUNCTION DESCRIPTION:

General information:

The purpose of the diagnosis is to detect electrical faults as defined by OBD I requirements.

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
 i = 1, for exhaust cylinder bank 1
 i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
 i = 1, for single exhaust cylinder bank.

All symptoms of the current error code are handeled by anti-bouncing.
We assume that only one symptom of an error code can be active at the same time.

Description:

The error detection is effected via the ECU hardware.
The purpose of the diagnosis shall be to detect electrical faults within the oxygen sensor heater circuit as defined by OBD I requirements.
Error-symptoms and conditions: are defined to this diagnosis function as following

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```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │  │  │  └─> Short circuit to battery (SCP)      (= SYM_0)
 │  │  └───> Short circuit to ground (SCG)      (= SYM_1)
 │  └─────> Open circuit       (OC)             (= SYM_2)
 └───────> -                                   (= SYM_3)
```

The function is intended for use in a hardware configuration where the heater driver shall carry out the electrical fault diagnosis and provide the electrical status via status flags.

1. *Short circuit to Vbatt by Over-temperature **or** Overcurrent* (**SCP**)
2. *Short circuit to GND* (SCG)
3. *Open load* (**OC**)

The heater drivers named are capable of detecting an **OC** and **SCP** fault when in the ON state and only capable of detecting a SCG fault in the OFF state. As the heater power is controlled by a PWM signal, the driver will be placed alternately in an ON and then OFF state.
The diagnosis shall be activated should the following conditions be met:

- Engine leaving the engine start state as denoted by LV_IGK = 1
- Battery voltage falls between pre-set thresholds to protect against false errors at battery voltage extremes as indicated by **LV_VB_CDN_OBD_1**.
- CDN depending on duty cycle of LSHPWM_UP[i]
- Inhibit flag not set (LV_INH_DIAG_LSH_UP[i])

In exceptionally rare extreme environmental conditions for certain system configurations, it is possible that the heater driver may be driven into over-temperature during initial oxygen sensor heating. In this case, the driver automatically turns off the output stage in self-protection and sets the **SCP** electrical fault bit. In order to mask an incorrect oxygen sensor heater **SCP** fault, the function shall only allow the **SCP** to set a fault during the initial heater phase, if the exhaust gas temperature has exceeded a pre-determined calibrateable threshold.
The oxygen sensor heater fault detection shall be debounced by use of an anti-bounce counter. This shall be handled by the Dynamic Error Management.
Each of the above listed faults shall be described individually below:
Otherwise the diagnosis has to be suppressed (CDN_DIAG_LSH_UP[i] = 0). This is managed within the Diagnosis condition calculation.

Application conditions

Initialization: `at reset CDN_DIAG_LSH_UP[i] = 0, ERR_DIAG_LSH_UP[i] = 0`
`All other variables are initialized according filter type`

Activation : –

Deactivation: –

Recurrence: `100 ms`

NOTE: The heater PWM frequency shall be at least 2 times faster than the diagnosis frequency to ensure that an oversampling effect does not occur!

Formula section:

If LV_IGK = 1
and **LV_VB_CDN_OBD_1** = 1

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and LV_INH_DIAG_LSH_UP[i] = 0
then

Usage of the diagnosis information (failure symptoms (raw value) **ERR_DIAG_LSH_UP[i]** and basic diagnosis conditions **CDN_DIAG_LSH_UP[i]**) received from the infrastructure:
ACTION_INFR_GetElDiagLshUp(IN <i>, **OUT**<CDN_DIAG_LSH_UP[i]>, **OUT**<ERR_DIAG_LSH_UP[i]>**)**

Basic diagnosis conditions are set according infrastructure information: CDN_DIAG_LSH_UP[i].
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_LSH_UP[i].

If Activation conditions are met for the NC_PSD_DLY_LSH_UP recurrence
Then
If LSHPWM_UP[i] < C_LSHPWM_MIN_DIAG_LSH_UP
or [(STATE_LSH_UP[i] = LSH_POW_RISE
or STATE_LSH_UP[i] = LSH_POW_RED)
and TEG_DYN_LS_UP[i]< C_TEG_DYN_MIN_DIAG_LSH_UP]
then bit 0 of CDN_DIAG_LSH_UP[i] = 0 *(**SCP** can not be detected))*
endif
If LSHPWM_UP[i] > C_LSHPWM_MAX_DIAG_LSH_UP
then bit 1 of CDN_DIAG_LSH_UP[i] = 0 *(**SCG** can not be detected)*
endif
if LSHPWM_UP[i] < C_LSHPWM_MIN_DIAG_LSH_UP
or LSHPWM_UP[i] > C_LSHPWM_MAX_DIAG_LSH_UP
then bit 2 of CDN_DIAG_LSH_UP[i] = 0 *(**OC** can not be detected)*
endif
Else
CDN_DIAG_LSH_UP[i] = 0
Endif
Else
CDN_DIAG_LSH_UP[i] = 0
endif

Error Symptom calculation (raw value from I/O SW)

If bit 1 of ERR_DIAG_LSH_UP[i] = 1
then LV_LSH_SCG_ACT_LSH_UP[i] = 1
endif

If *abc-counter* = 0
then LV_LSH_SCG_ACT_LSH_UP[i] = 0
endif

For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_LSH_UP[i] and ERR_DIAG_LSH_UP[i].
ACTION_ERRM_FilterMulticondition(IN <*XX*>, IN< CDN_DIAG_LSH_UP[i]>, IN< ERR_DIAG_LSH_UP[i]>, IN <C_ABC_INC_LSH_UP>, IN <C_ABC_MAX_LSH_UP>, OUT<LV_ERR_LSH_UP[i]>)

This algorithm determines:
ERR_SYM_LSH_UP[i] (= raw value ERR_DIAG_LSH_UP[i] filtered with CDN_DIAG_LSH_UP[i], detected error symptom for lambda sensor heater upstream [i] diagnosis)
LV_ERR_ LSH_UP[i] (Error flag for debounced error of for lambda sensor heater upstream [i])

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LV_CDN_DIAG_ LSH_UP[i] (Diagnosis condition information)
LV_END_DIAG_ LSH_UP[i] (End of diagnosis information)

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A.25 Actuator adaptation and diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DIAG_ACR_AD	V	0... FFH	0... 255	1	-
Diagnostic counter used at the continuously BOL adaptation					
CTR_DLY_ACR_AD	V	0... FFH	0... 255	1	-
Delay counter for the activation of the actuator adaptation					
ERR_SYM_ACR_AD	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the actuator adaptation					
FAC_ACR_SLOP	O/V/S	0... FFFFH	0... 99.9984741	0.001526	%/V
Signal slop of the actuator measuring system					
LV_CDN_DIAG_ACR_AD	V	0... 1H	0 ...1	1	-
Logical variable is set, if the diagnosis condition for actuator adaptation is fulfilled					
LV_END_DIAG_ACR_AD	V	0... 1H	0 ...1	1	-
Logical variable is set, if end of diagnosis condition for the actuator adaptation is fulfilled					
LV_ERR_ACR_AD	O/V	0... 1H	0 ...1	1	-
Logical variable is set, if an adaptation error occurs					
LV_INH_ACR_CTL_AD	O/V	0... 1H	0 ...1	1	-
Logical variable to inhibit actuator position control					
LV_OPG_SP_AD_ACR	O/V	0... 1H	0 ...1	1	-
Logical variable indicates a setpoint request for the actuator adaptation					
OPG_SP_AD_ACR	O/V	0... FFFH	0... 99.9755859	0.02441	%
Actuator adaptation setpoint request for actuator position control					
STATE_ACR_AD	O/V	0H 1H 2H 3H 4H 5H	ACR_AD_INIT ACR_AD_BOL ACR_GO_TOL ACR_AD_TOL ACR_GO_BOL ACR_AD_END	-	-
Variable indicate the state of the key on actuator adaptation					
V_ACR_AD_BOL	O/V/S	0... 3FFH	0... 4.99511719	0.00488	V
Adaptation value for the lower mechanical stop of the actuator valve					
V_ACR_AD_BOL_0	V/S	0... 3FFH	0... 4.99511719	0.00488	V
Adaptation value for the lower mechanical stop after first adaptation					
V_ACR_AD_TOL	O/V/S	0... 3FFH	0... 4.99511719	0.00488	V
Adaptation value for the upper mechanical stop					

Input data:

LV_ACR_AD_ACT {p. 4333}	LV_ACR_AD_REQ {p. 4333}	LV_INH_ACR_AD {p. 4333}	LV_INH_ACR_AD_BOL {p. 4333}
V_ACR {p. 1097}			

Calibration data:

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_ACR_AD	-	0... FFH	0... 0.99609375	0.003906	-
Correlation constant for the determination of the actuator adaptation value					
C_CTR_ACR_AD	-	0... FFH	0... 255	1	-
Maximum time for the adaptation of the lower mechanical stop					
C_CTR_DIAG_ACR_AD	-	0... FFH	0... 255	1	-
Diagnosis counter threshold for the adaptation of the lower mechanical stop					
C_CTR_DIAG_END_ACR_AD	-	0... FFH	0... 255	1	-
Constant to define the end of diagnosis of the continuously BOL adaptation					
C_CTR_DLY_ACR_AD	-	0... FFH	0... 255	1	-
Delay time before adaptation of the lower and upper mechanical stop will be started					
C_CTR_DLY_ACR_AD_MAX	-	0... FFH	0... 255	1	-
Delay counter for the activation of the actuator adaptation					
C_CTR_DLY_ACR_AD_TOL	-	0... FFH	0... 255	1	-
End of diagnosis counter for the actuator adaptation					
C_FAC_ACR_SLOP	-	0... FFFFH	0... 99.9984741	0.001526	%/V
Signal slop of the actuator measuring system					
C_OPG_SP_AD_LGRD	-	0... FFFH	0... 99.9755859	0.02441	%
Change limitation for the adaptation of the upper mechanical stop					
C_OPG_SP_MAX_AD_ACR	-	0... FFFH	0... 99.9755859	0.02441	%
Start setpoint for the adaptation of the upper mechanical stop					
C_V_ACR_AD_BOL_INI	-	0... 3FFH	0... 4.99511719	0.00488	V
Initialisation value for the adaptation value of the lower mechanical stop					
C_V_ACR_AD_BOL_MAX	-	0... 3FFH	0... 4.99511719	0.00488	V
Upper limit for the plausibility check of the adaptation value for the lower mechanical stop					
C_V_ACR_AD_BOL_MIN	-	0... 3FFH	0... 4.99511719	0.00488	V
Lower limit for the plausibility check of the adaptation value for the lower mechanical stop					
C_V_ACR_AD_CHK_CTL	-	0... 3FFH	0... 4.99511719	0.00488	V
Threshold for the actuator function check during the upper mechanical stop adaptation					
C_V_ACR_AD_TOL_INI	-	0... 3FFH	0... 4.99511719	0.00488	V
Initialisation value of the upper mechanical stop					
C_V_ACR_AD_TOL_MAX	-	0... 3FFH	0... 4.99511719	0.00488	V
Upper limit for the plausibility check of the adaptation value for the upper mechanical stop					
C_V_ACR_AD_TOL_MIN	-	0... 3FFH	0... 4.99511719	0.00488	V
Lower limit for the plausibility check of the adaptation value for the upper mechanical stop					
LC_FAC_ACR_SLOP_AD_ENA	-	0... 1H	0 ...1	1	-
Logical constant to enable the adaptation of the upper mechanical stop					

Import actions:

ACTION_ERRM_NoFilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_LV_ERR_SET>,**IN**<PRM_LV_ERR_RST>,**IN**<PRM_LV_END_DIAG>,**OUT**<PRM_LV_ERR>)

General information

The actuator valve position is determined by a measuring system. In order to reduce measurement inaccuracy, the sensor signal voltage is referenced to its sensor supply voltage. The electrical value of the lower and upper mechanical stop depends on the actuator characteristic, the actuator temperature and the valve coking therefore the electrical valve characteristic has to be learnt. After the actuator

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adaptation the adaptation values of the lower, the upper mechanical stop and the sensor slope are stored at the end of the driving cycle as "nonvolatile".

Application Condition

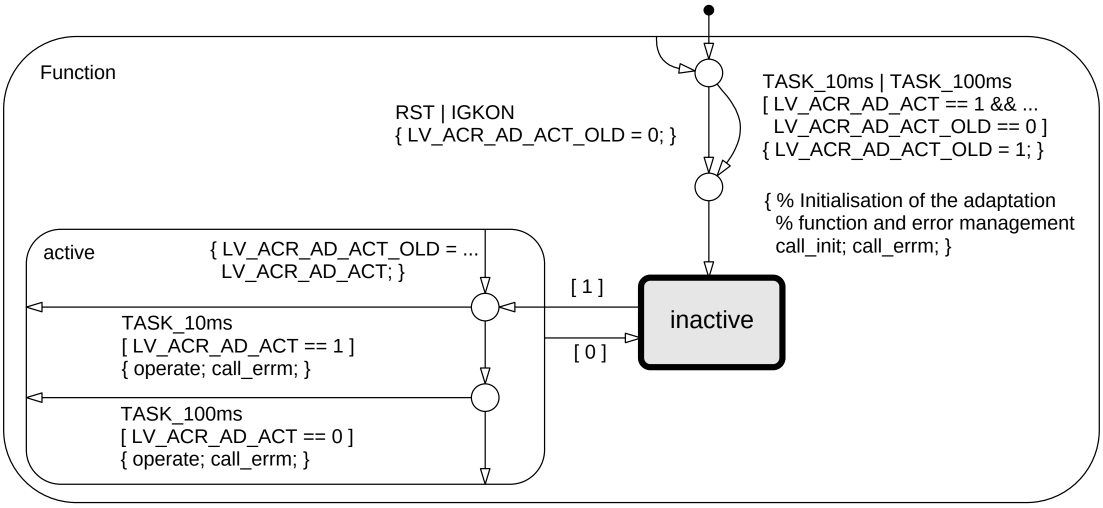

Figure A.25.1: ACRC_adaptation_and_diagnosis/APP_CDN/APP_CDN

Function Description

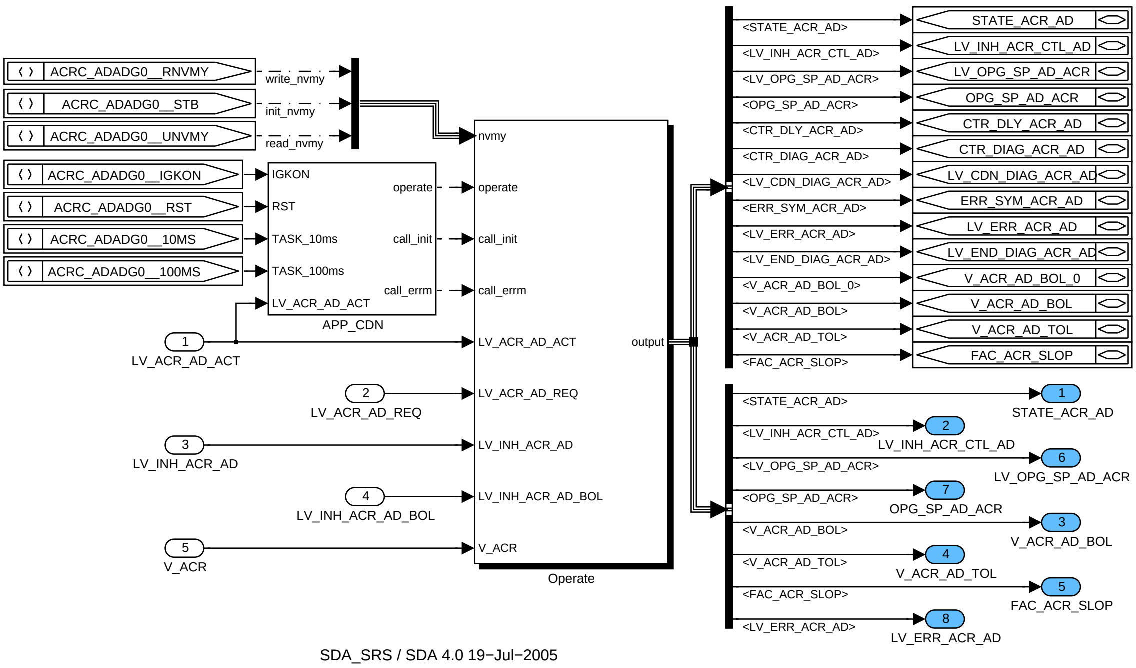

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Figure A.25.2: ACRC_adaptation_and_diagnosis

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A.25.1 Adaptation functionalities

The adaptation functionality consists of a complete adaptation of the actuator valve and a continuously adaptation only for the lower mechanical valve stop. The adaptation algorithms are controlled by the variable LV_ACR_AD_ACT and the related inhibition conditions. The variables are provided in corresponding application incidence module.

After the reset of the functionality a complete adaptation of the actuator valve is started if the variable LV_ACR_AD_ACT has been set otherwise the continuously adaptation of the lower mechanical stop will be performed.

The adaptation module contain own diagnostic functions for the check of the adaptation values and the correct function of the actuator valve.

Error symptoms for the actuator adaptation are defined as follows :

SYM_0 - Adaptation conditions not fulfilled
SYM_1 - Lower adaptation value outside range
SYM_2 - Adaptation position not reached
SYM_3 - Upper adaptation value outside range

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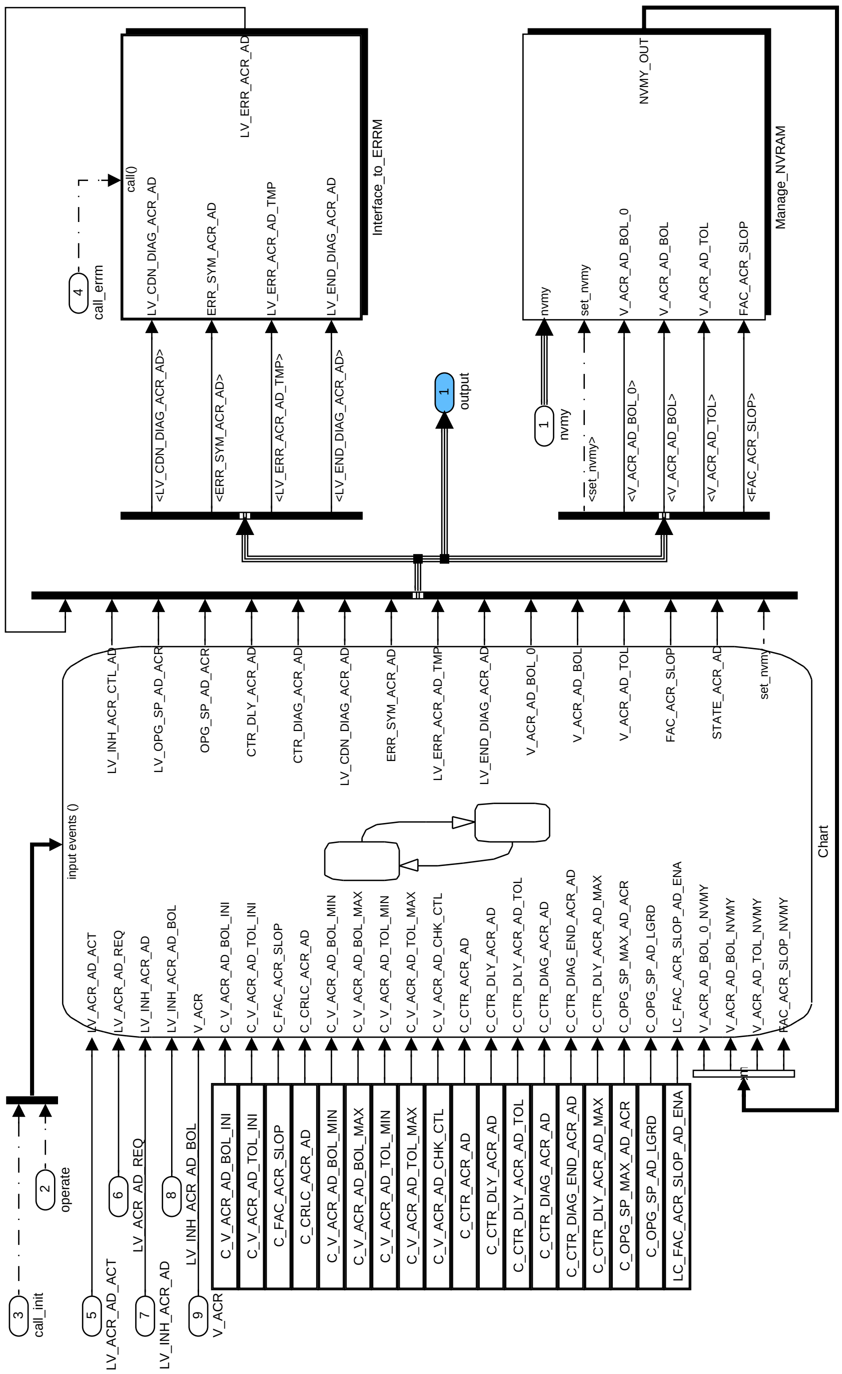

Figure A.25.3: ACRC_adaptation_and_diagnosis/Operate

State machine of the actuator adaptation

The state flow diagram of the actuator adaptation functionality contains the complete and the continuously adaptation functionality. The state machine is reset with a new reset event generated by the application conditions that means the functionality will be restarted on the default transition dependent on LV_ACR_AD_ACT.

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The inhibition variable LV_INH_ACR_AD of the adaptation function is only check after the initialisation state has been finished. If the inhibition variable is set during the check then an error entry will be performed.

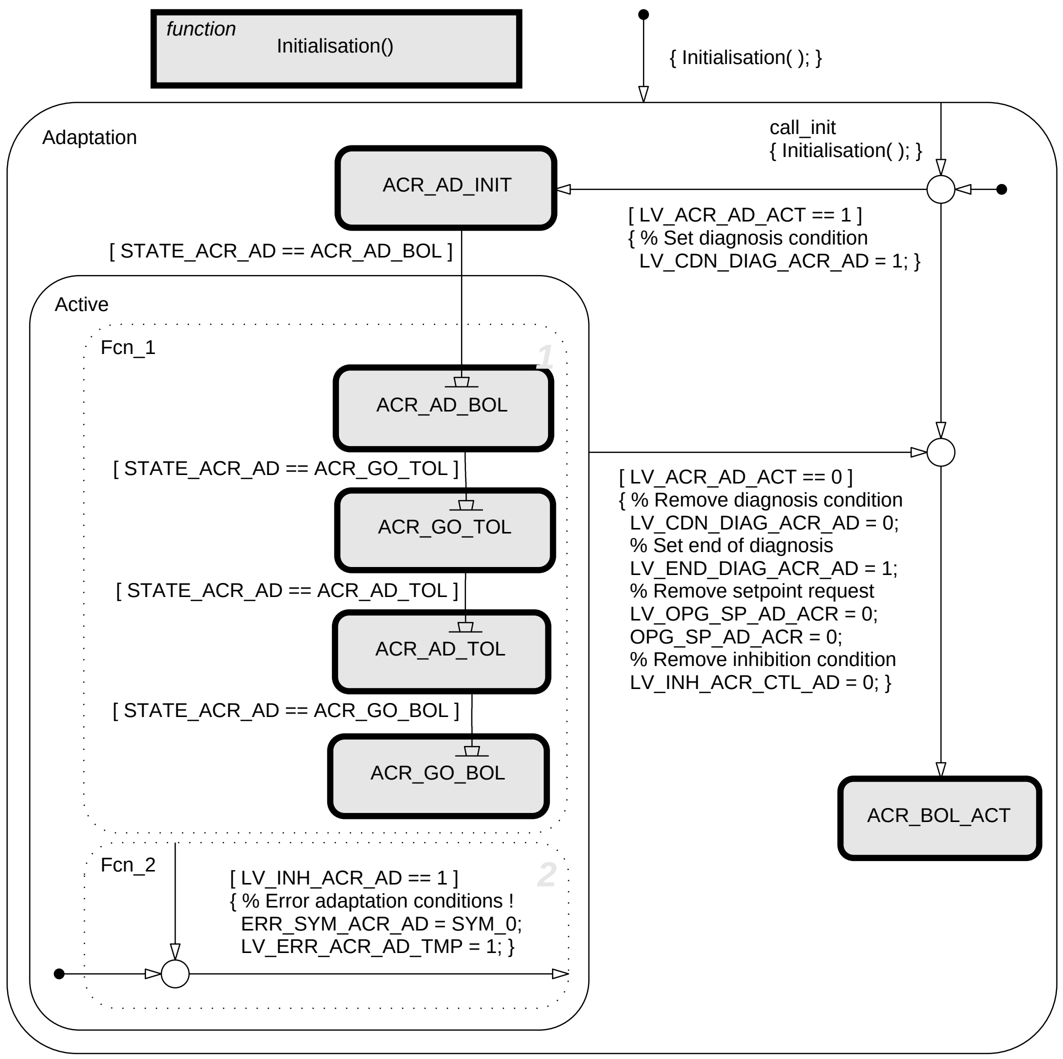

Figure A.25.4: ACRC_adaptation_and_diagnosis/Operate/Chart

Initialisation function

The following function is used for the initialisation of the actuator adaptation. The function is called from the application condition module and shall initialise the adaptation values, the used error and auxiliary values.

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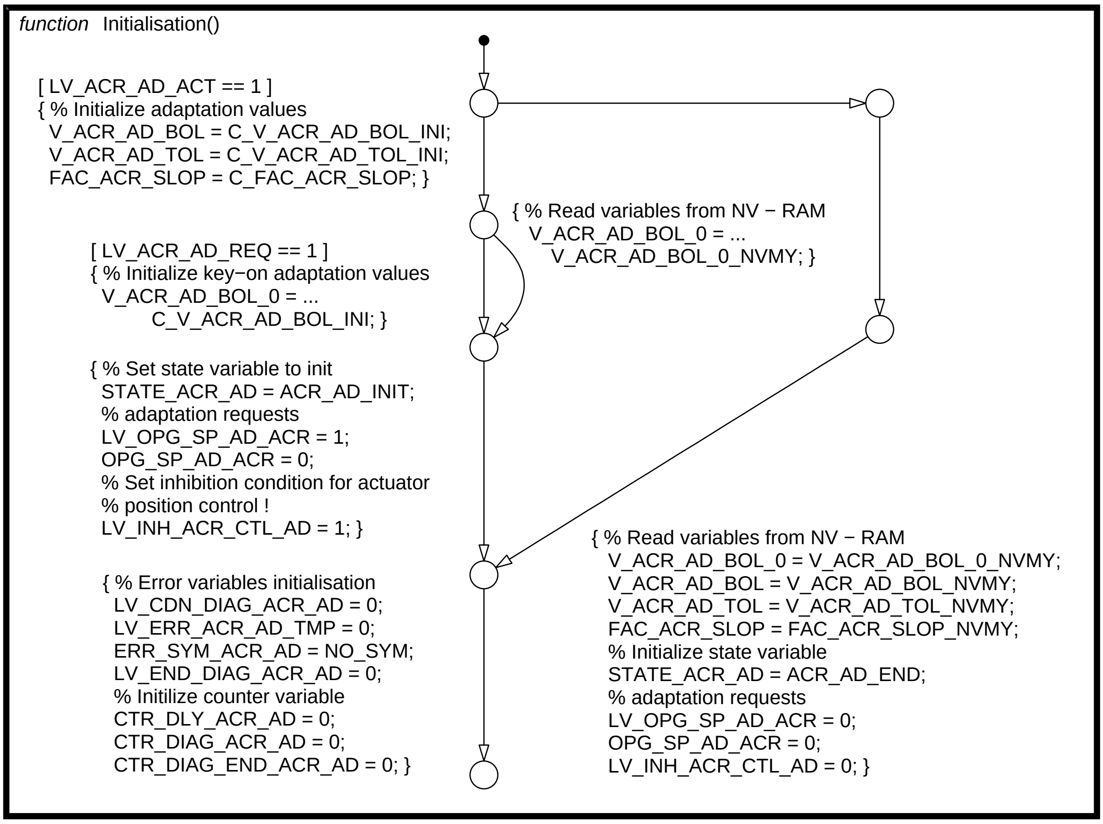

Figure A.25.5: ACRC_adaptation_and_diagnosis/Operate/Chart/Initialisation

Initialisation state of the actuator adaptation

At the start of the actuator adaptation the following initialisation function is necessary. During the initialisation state the adaptation waits a defined time for valid adaptation conditions.

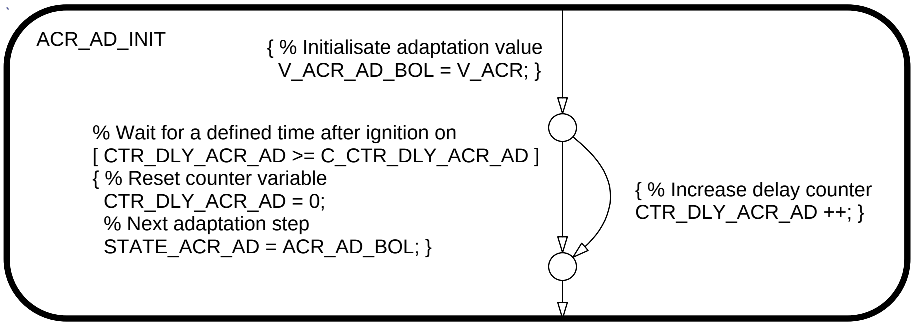

Figure A.25.6: ACRC_adaptation_and_diagnosis/Operate/Chart/Adaptation/ACR_AD_INIT

Adaptation of the lower mechanical stop

In the following state the lower mechanical stop of the actuator valve is learnt. The adaptation value is determined as moving mean value of the sensor signal voltage. The corresponding correlation constant

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C_CRLC_ARC_AD defines the calculation of the adaptation value. The adaptation is performed only for a defined adaptation time to get a valid adaptation value. At the end of the algorithm the adaptation value is check of validity. If the adaptation value is outside of the valid range than an error entry will be performed.
Additionally the further adaptation functionality, the adaptation of the upper mechanical stop, can be chosen via configuration data LC_FAC_ACR_SLOP_AD_ENA. If the constant is set then the upper mechanical stop and the sensor slope will be learnt, otherwise the adaptation will be finished and the initialisation values will be used !

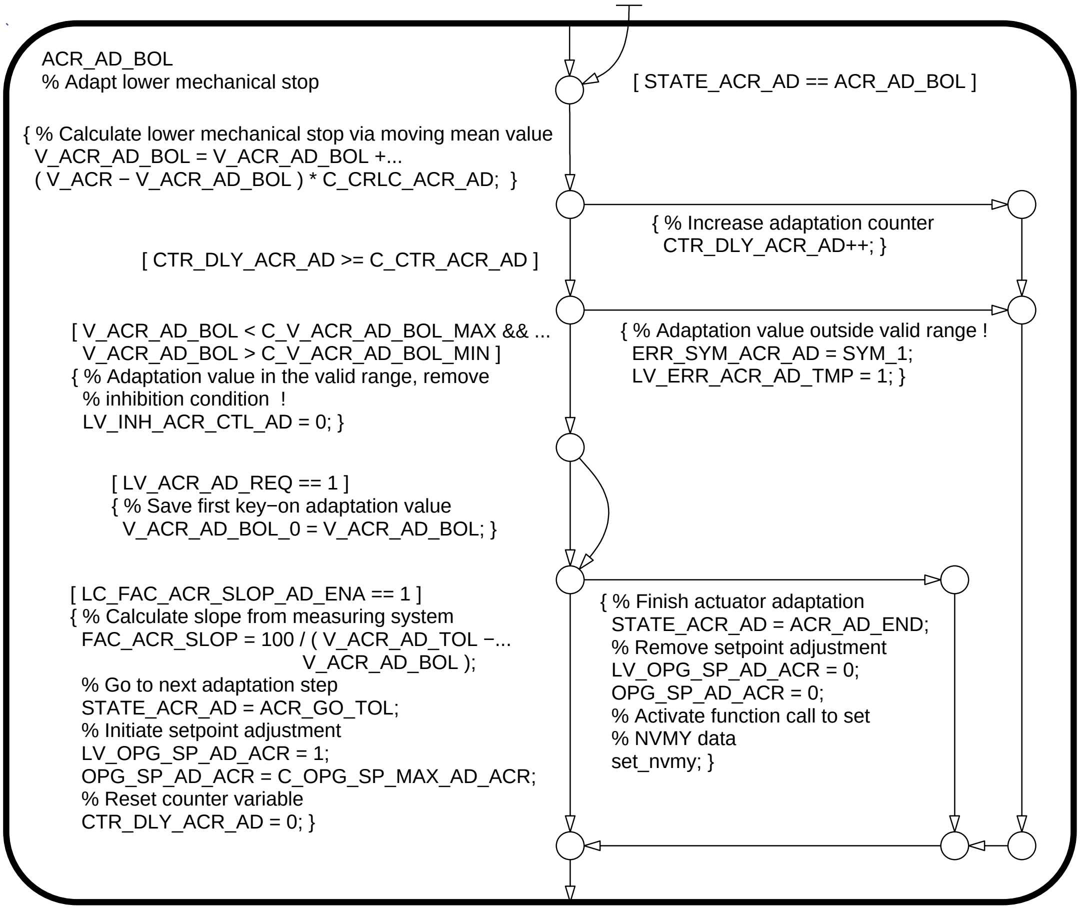

Figure A.25.7: ACRC_adaptation_and_diagnosis/Operate/Chart/Adaptation/Active/ACR_AD_BOL

Drive actuator in the upper mechanical stop

The following state drives the actuator valve in the upper mechanical stop via setpoint adjustment. At first the setpoint for closedloop position control is set to a defined start value and the power stage is switched on. Afterwards the setpoint is increased via change limitation to 100 %.
Additionally the state checks the correct function of the closedloop position control system. If the setpoint is set to 100 % then the actuator valve must exceed a diagnostic threshold otherwise an adaptation error is indicated and the adaptation is stopped.

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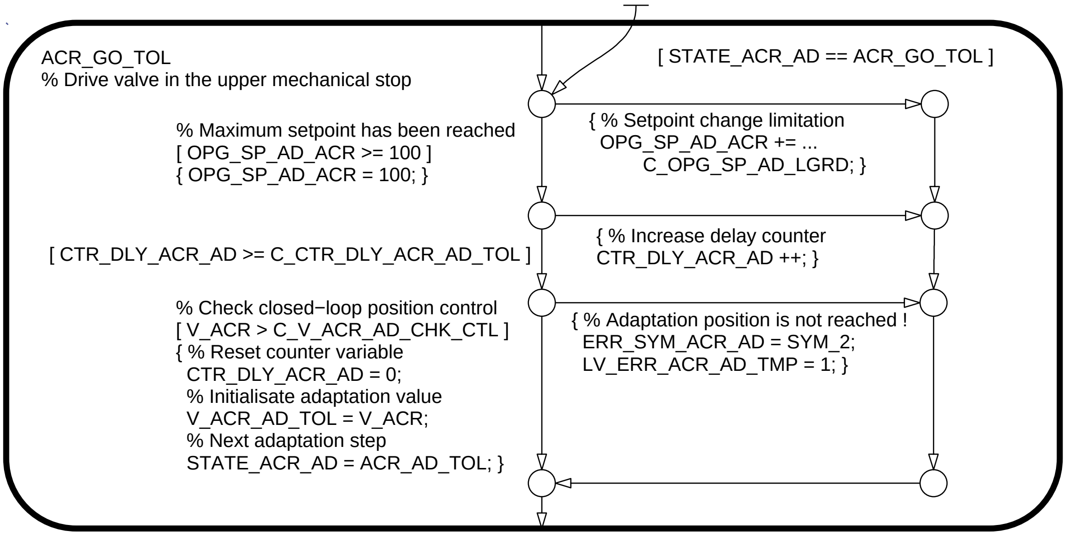

Figure A.25.8: ACRC_adaptation_and_diagnosis/Operate/Chart/Adaptation/Active/ACR_GO_TOL

Adaptation of the upper mechanical stop

In the next adaptation state the upper mechanical stop of the actuator valve is learnt. The adaptation value of the upper mechanical stop is determined as moving mean value of the sensor signal voltage. The corresponding correlation constant C_CRLC_ARC_AD defines the calculation of the adaptation value. The adaptation is performed only for a defined adaptation time to get a valid adaptation value. At the end of the algorithm the adaptation value of the upper mechanical stop is check of validity. If the adaptation value is outside of the valid range than an error entry will be performed.

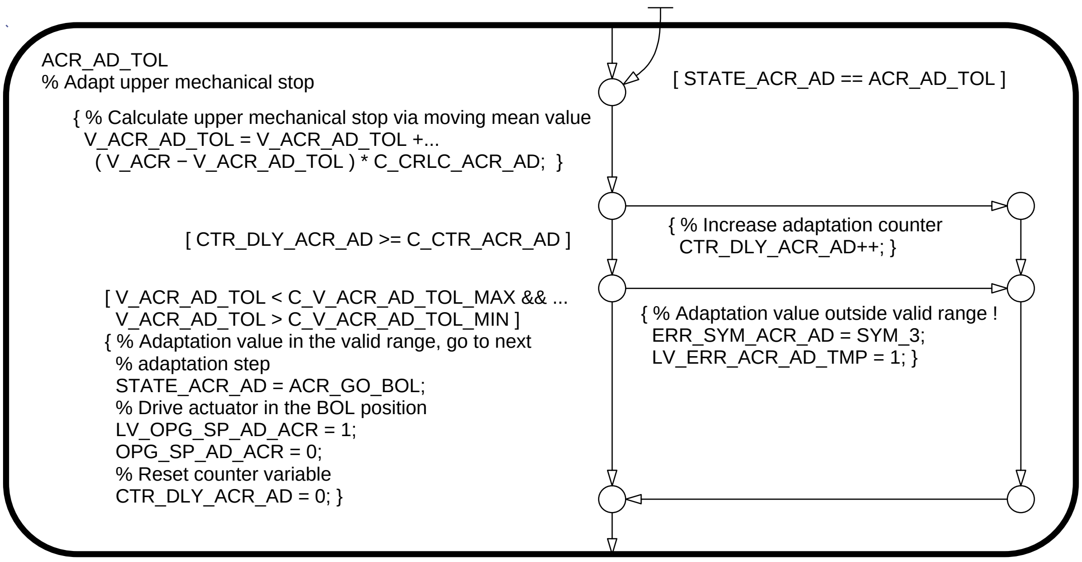

Figure A.25.9: ACRC_adaptation_and_diagnosis/Operate/Chart/Adaptation/Active/ACR_AD_TOL

Finish actuator adaptation

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The last state of the adaptation shall drive the actuator valve in the lower mechanical stop and calculate the sensor signal slop of the measuring system. The adaptation state will be left if a defined waiting time is elapsed.

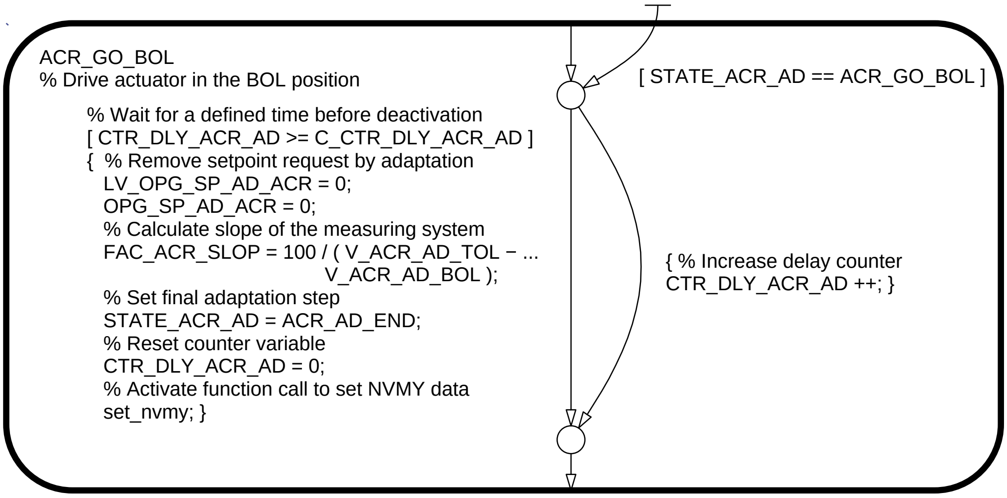

Figure A.25.10: ACRC_adaptation_and_diagnosis/Operate/Chart/Adaptation/Active/ACR_GO_BOL

Continuously adaptation of the lower mechanical stop

If the actuator valve is in closing position, then the adaptation of the lower mechanical stop will be started after a defined delay time. A closed actuator valve is indicated by the state variable STATE_ACR_CTL of the position control software. The adaptation value is determined as moving mean value of the sensor signal voltage. The corresponding correlation constant C_CRLC_ARC_AD defines the calculation of the adaptation value.
At the end of the algorithm the adaptation value is check of validity. If the adaptation value is outside of the valid range than an error entry will be performed.

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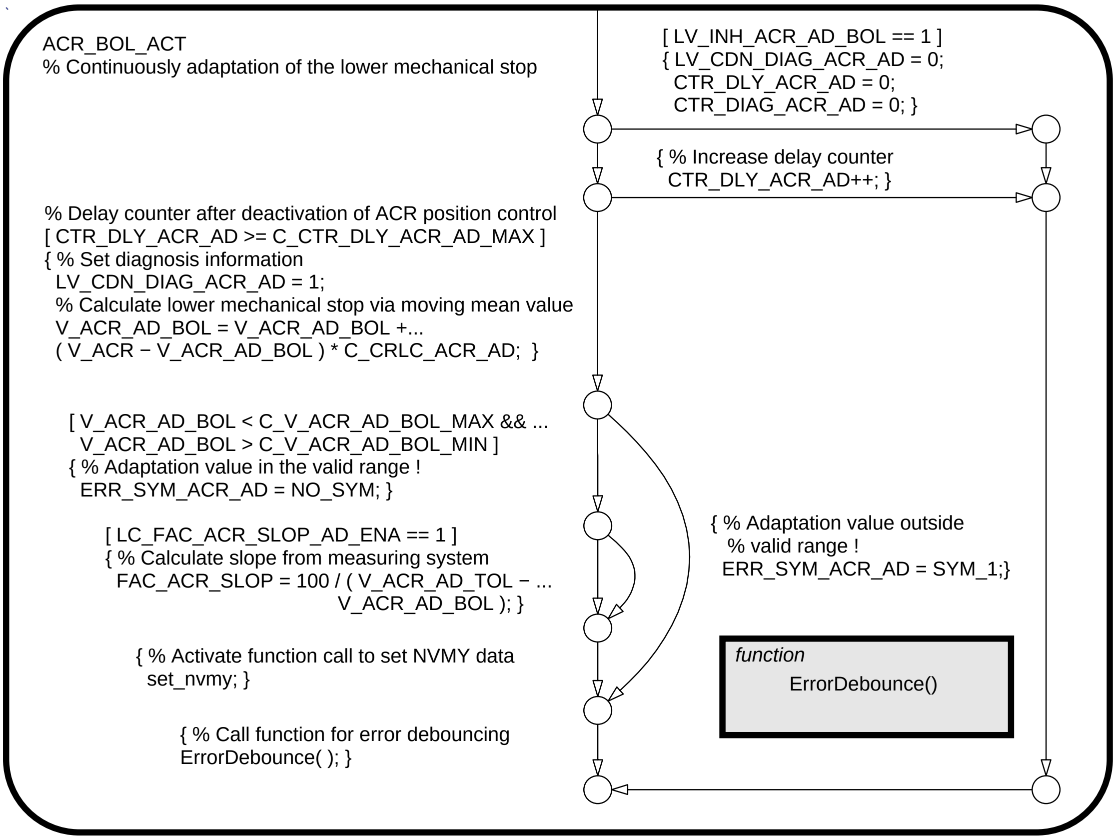

Figure A.25.11: ACRC_adaptation_and_diagnosis/Operate/Chart/Adaptation/ACR_BOL_ACT

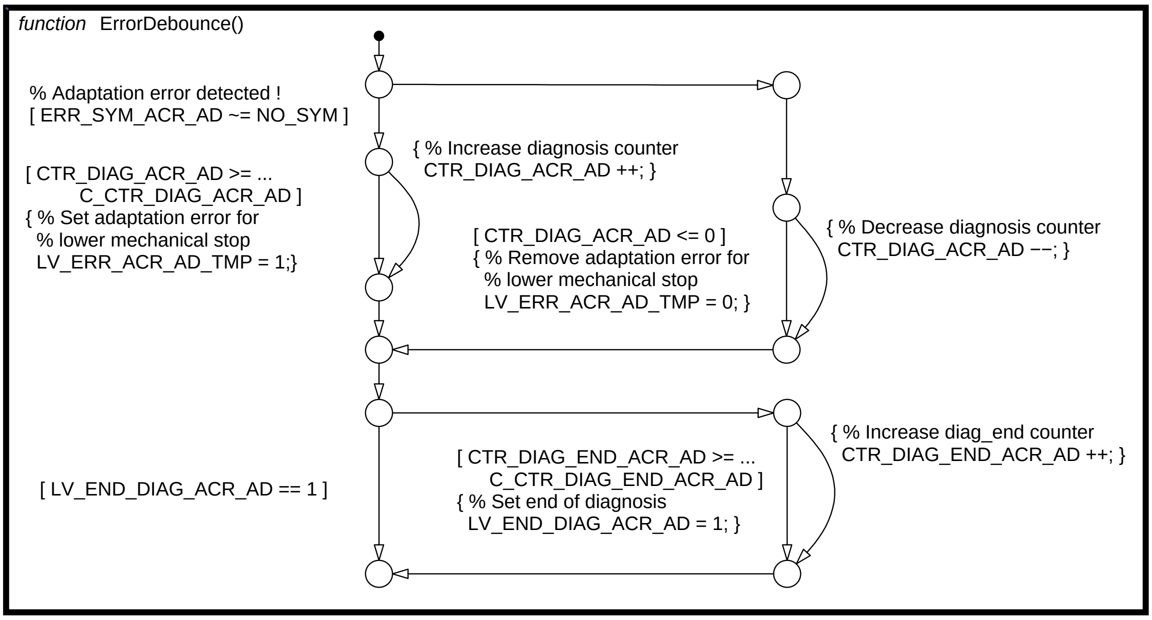

Figure A.25.12:
ACRC_adaptation_and_diagnosis/Operate/Chart/Adaptation/ACR_BOL_ACT/ErrorDebounce

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Interface to the error management

The following algorithm set the detected error and the end of diagnosis information according the diagnostic result and delivers the result to Error Management.

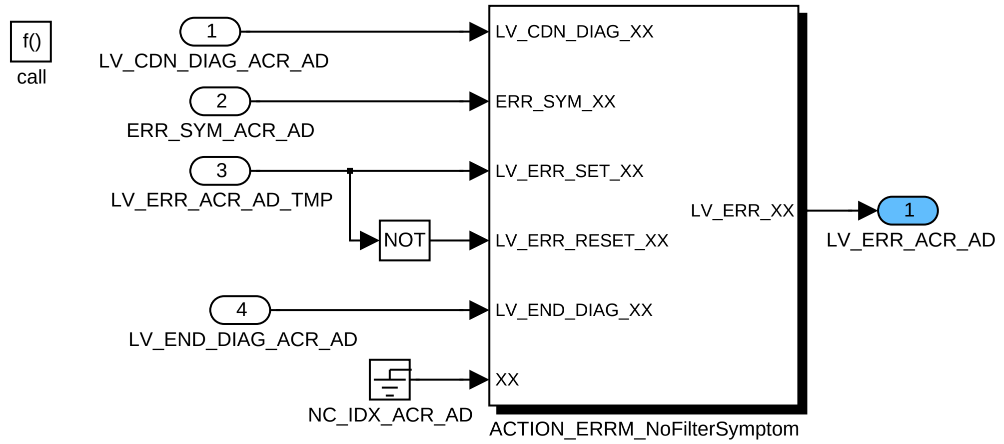

Figure A.25.13: ACRC_adaptation_and_diagnosis/Operate/Interface_to_ERRM

Manage non volatile variables

The last section describes the data handling of variables defined in the non-volatile memory. Three function calls are available for the initialisation, the readout and the update of the non-volatile memory. A special feature has been implemented for the data update. New adaptation values are only stored for an error free system and a successful adaptation end. Otherwise the last valid adaptation values will be used again for the NVRAM update!

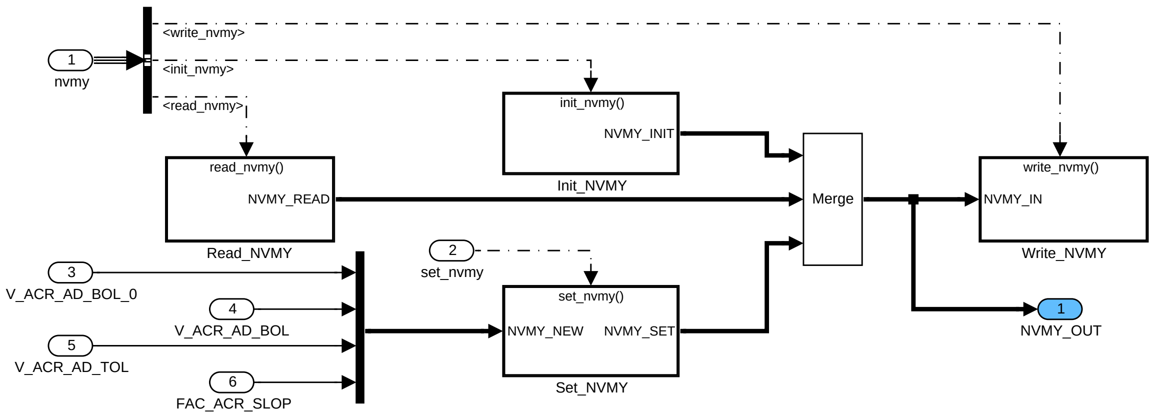

Figure A.25.14: ACRC_adaptation_and_diagnosis/Operate/Manage_NVRAM

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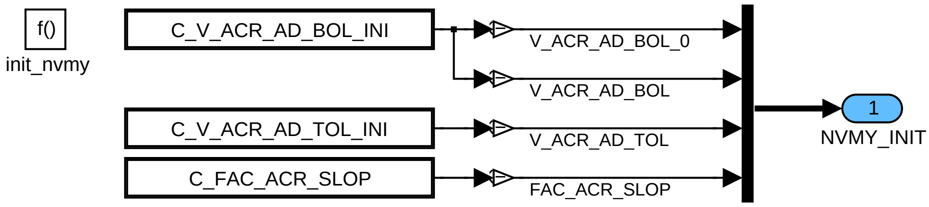

Figure A.25.15: ACRC_adaptation_and_diagnosis/Operate/Manage_NVRAM/Init_NVMY

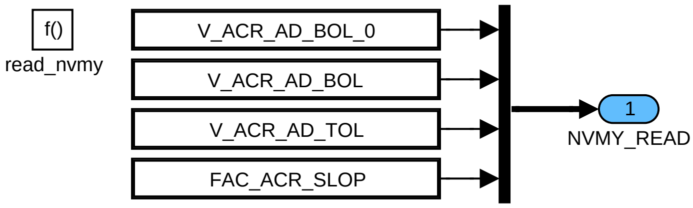

Figure A.25.16: ACRC_adaptation_and_diagnosis/Operate/Manage_NVRAM/Read_NVMY

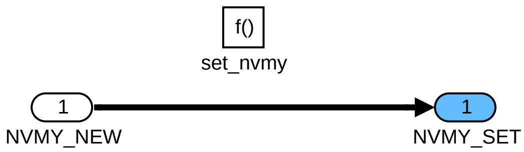

Figure A.25.17: ACRC_adaptation_and_diagnosis/Operate/Manage_NVRAM/Set_NVMY

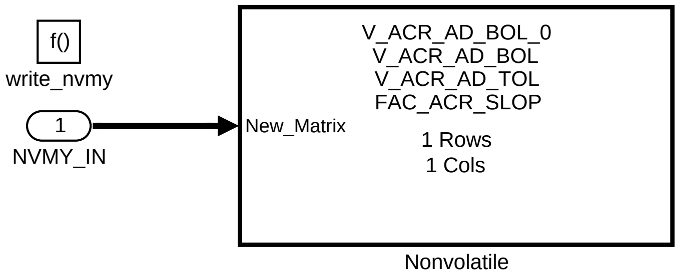

Figure A.25.18: ACRC_adaptation_and_diagnosis/Operate/Manage_NVRAM/Write_NVMY

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A.26 Actuator adaptation and diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACR_AD_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable to indicate an active actuator adaptation					
LV_ACR_AD_POP_INH	V	0... 1H	0 ...1	1	-
Logical variable to inhibit the actuator adaptation for post operating phase during IGKON					
LV_ACR_AD_REQ	O/V/S	0... 1H	0 ...1	1	-
Logical variable to indicate an actuator adaptation request					
LV_INH_ACR_AD	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the actuator adaptation and diagnosis					
LV_INH_ACR_AD_BOL	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the countinuous actuator adaptation and diagnosis					

Input data:

LV_ERR_ACR_AD {p. 4320}	LV_ES {p. 1720}	LV_IGK {p. 906}	LV_PWM_ACR_OFF_REQ {p. 4345}
STATE_ACR_AD {p. 4320}	STATE_ACR_CTL {p. 3587}	TCO {p. 1100}	VB {p. 1185}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ACR_AD_TCO_MIN	-	0... FEH	0... 142.5	0.75	°C
Temperature threshold for the activation of the actuator adaptation					
C_ACR_AD_VB_MIN	-	0... FFH	0... 25.8984375	0.1015625	V
Battery voltage threshold for the activation of the actuator adaptation					
LC_ACR_AD_POP_ENA	-	0... 1H	0 ...1	1	-
Logical variable to enable the actuator adaptation in the post operating phase					
LC_ACR_AD_REQ	-	0... 1H	0 ...1	1	-
Logical variable to set a new adaptation request					

Error treatment:

Diagnostic ACR_AD	Symptom description	Symptom	Filter type
ACR actuator adaptation and diagnosis	*Adaptation conditions not fulfilled*	*SYM_0*	*NO*
	BOL adaptation value outside range	*SYM_1*	
	Could not reached TOL position	*SYM_2*	
	TOL adaptation value outside range	*SYM_3*	

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General information

This module describes the coordination of the actuator adaptation with corresponding diagnosis functions. The actuator adaptation can be split in a standard adaptation during IGKON and post operation phase and a continuously adaptation only for the adaptation of the lower mechanical stop. Separate inhibition conditions for the described adaptations are available.

Application Condition

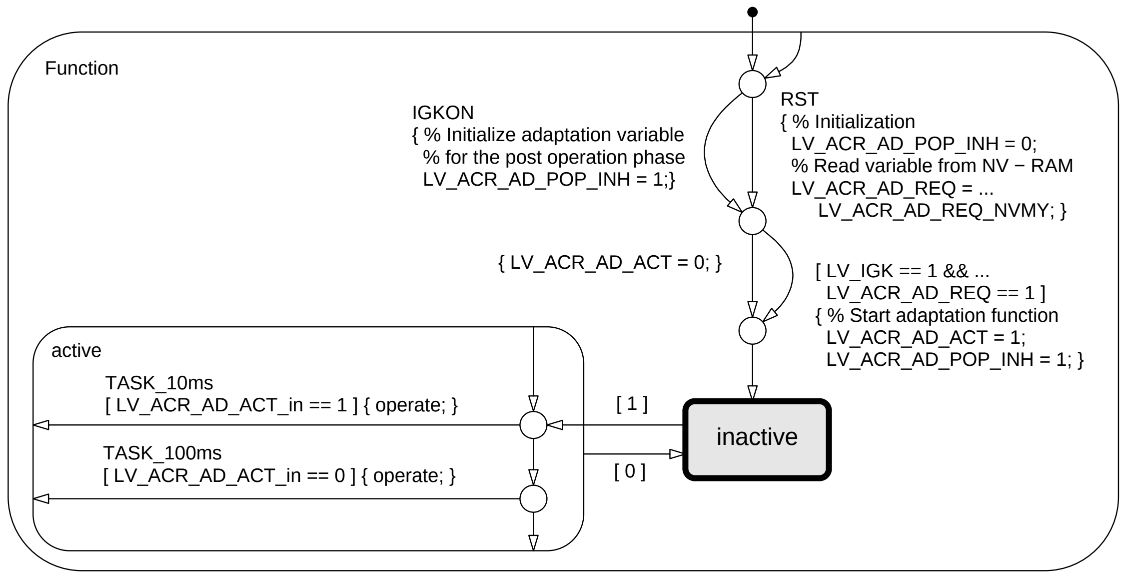

Figure A.26.1: ACRC_adaptation_and_diagnosis_ai/APP_CDN/APP_CDN

Function Description

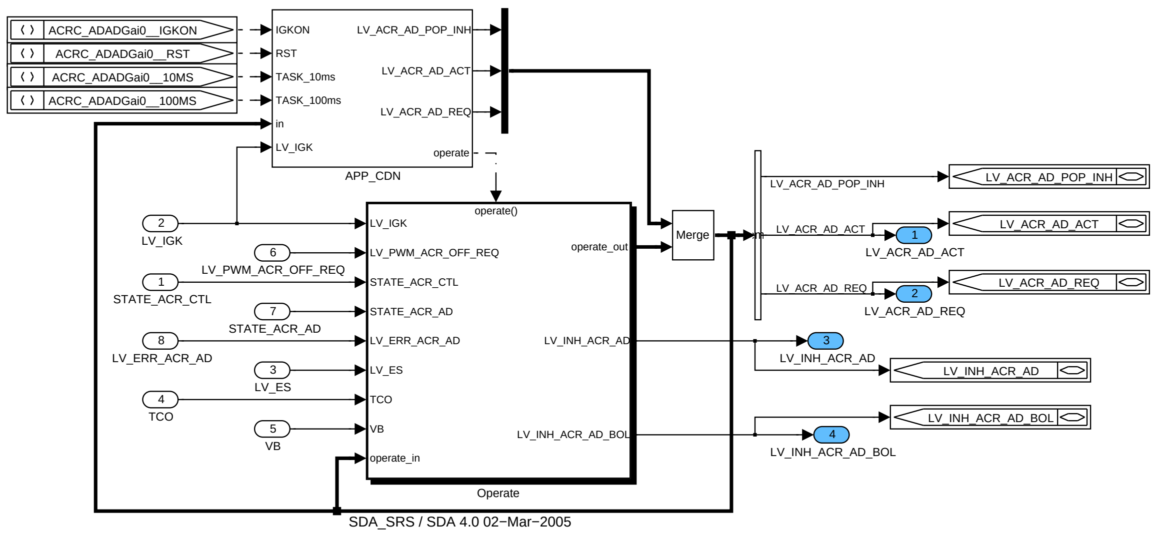

Figure A.26.2: ACRC_adaptation_and_diagnosis_ai

A.26.1 Coordination of the adaptation functionality

The adaptation request LV_ACR_AD_REQ is checked every time the control unit is switched on. If an adaptation is requested then a "first key on" adaptation will be performed with LV_ACR_AD_ACT = 1. The actuator adaptation is necessary in the following cases:

- In initial start (first engine run or control unit exchange), that means no adaptation values are stored in the non volatile memory
- Check sum error (NVMY - error) is current

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- Adaptation request bit LV_ACR_AD_REQ is set

Each of these points ends with a new adaptation request. After the activation of the "key on" actuator adaptation the corresponding inhibition condition will be checked continuously.

A second part of the adaptation functionality is the actuator adaptation in the post operating phase. After ignition off and engine stop the corresponding inhibition variable is once checked. If all activation conditions are fulfilled then the actuator adaptation will be started, the inhibition variable is **not** checked during the adaptation to avoid possible error entries.

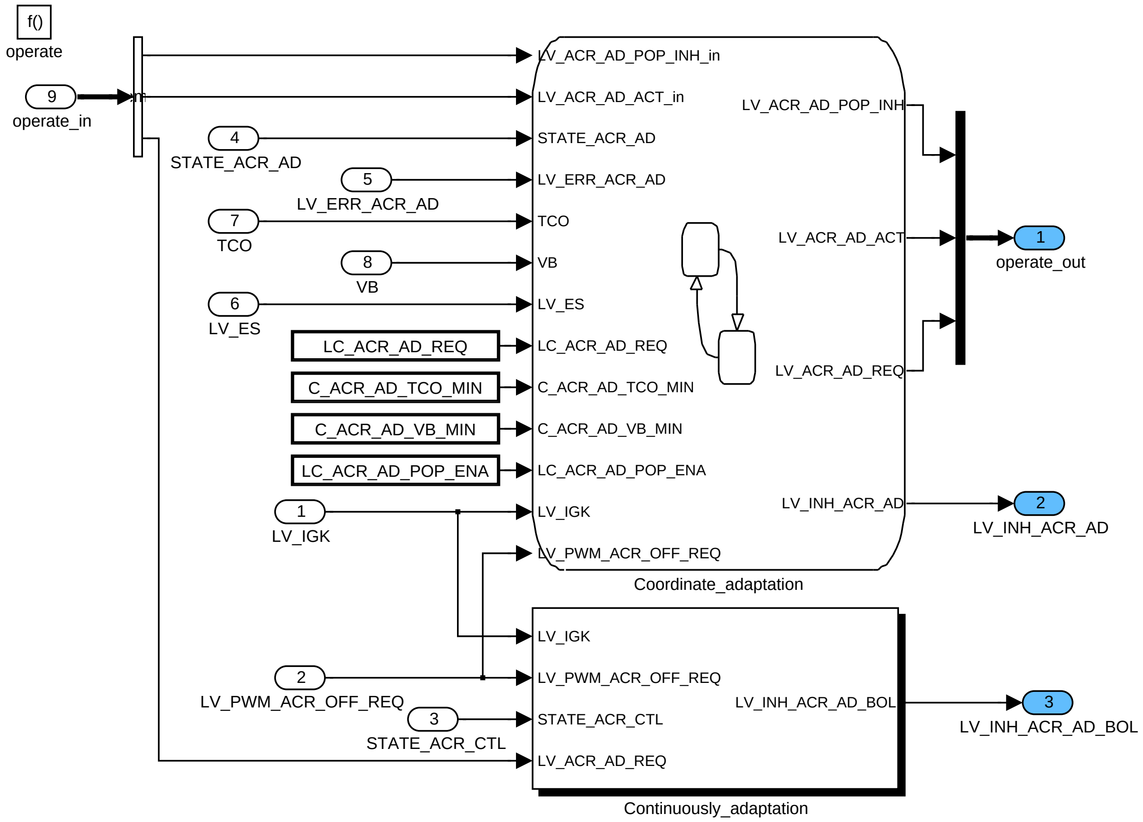

Figure A.26.3: ACRC_adaptation_and_diagnosis_ai/Operate

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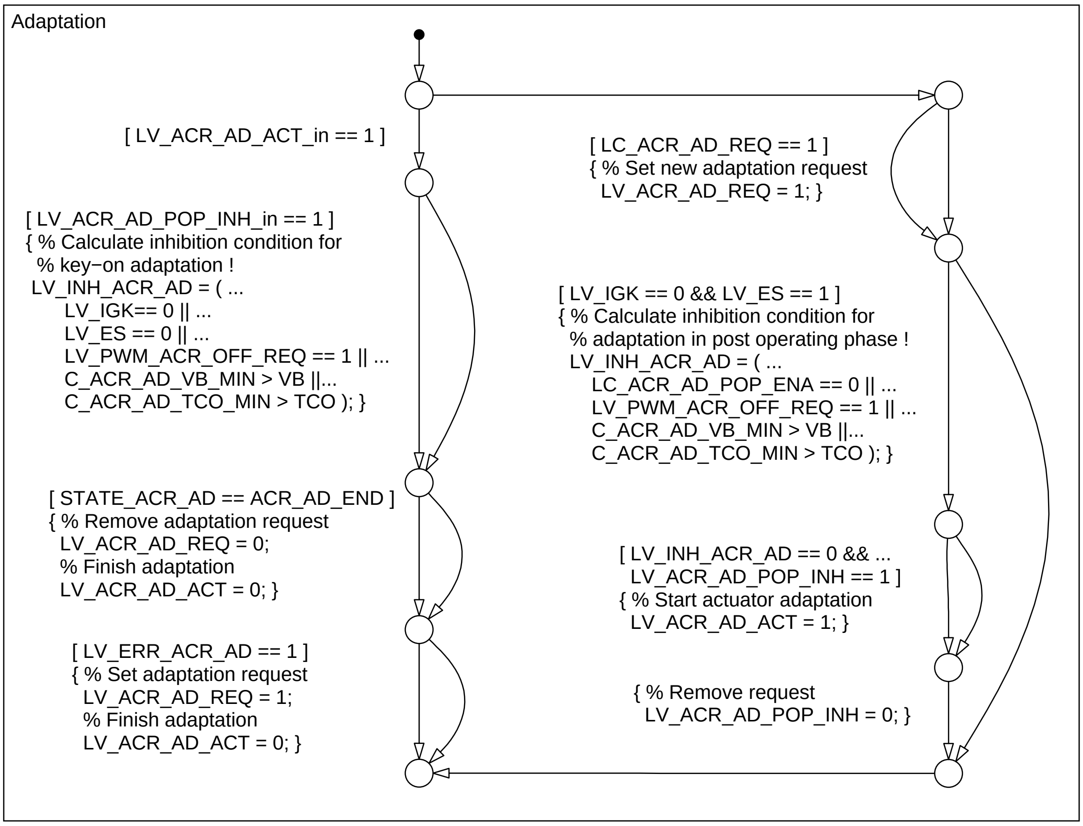

Figure A.26.4: ACRC_adaptation_and_diagnosis_ai/Operate/Coordinate_adaptation

Inhibition condition for the continuous BOL adaptation

This chapter describes the inhibition condition of the continuously adaptation for the lower mechanical stop.

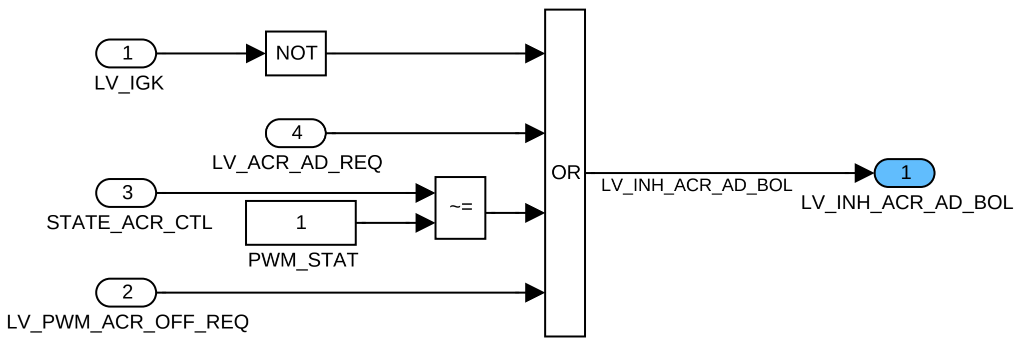

Figure A.26.5: ACRC_adaptation_and_diagnosis_ai/Operate/Continuously_adaptation

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A.27 Actuator diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DIAG_ACR_CTL	O/V	0... FFH	0... 255	1	-
Anti bounce counter for the actuator diagnosis					
ERR_SYM_ACR_CTL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the actuator diagnosis					
LV_CDN_DIAG_ACR_CTL	V	0... 1H	0 ...1	1	-
Diagnosis condition for the actuator diagnosis					
LV_END_DIAG_ACR_CTL	V	0... 1H	0 ...1	1	-
End of diagnosis information for the actuator diagnosis					
LV_ERR_ACR_CTL	O/V	0... 1H	0 ...1	1	-
Present failure for the actuator diagnosis after the error debounce					
OPG_DIF_ACR_ERR_MAX	V	0... FFFH	0... 99.9755859	0.024414	%
Maximum admissible control deviation of the closed loop position control system					
OPG_SP_ACR_FIL	V	0... FFFH	0... 99.9755859	0.024414	%
Actuator valve position setpoint after filtering by low pass first order					
OPG_SP_ACR_GRD	V	F000... FFFH	0... 99.97559	0.024414	%
Gradient of the actuator valve position setpoint determined by low pass first order					
PWM_ACR_MMV	V	0... 7FFFH	0... 99.9969482	0.003052	%
Moving mean value of the actuator position controller output					

Input data:

LV_INH_DIAG_ACR_CTL {p. 4343}	OPG_DIF_ACR {p. 3580}	OPG_SP_ACR {p. 3573}	PWM_ACR {p. 3580}
VB_MMV {p. 1185}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_ACR_CTL	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the actuator diagnosis					
C_ABC_INC_ACR_CTL	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the actuator diagnosis					
C_ABC_MAX_ACR_CTL	-	1... FFH	1... 255	1	-
Maximum value for anti bounce counter for the actuator diagnosis					
C_CRLC_OPG_SP_ACR	-	0... FFFFH	0... 0.99998474	152.59e3	-
Correlation constant for filtering of OPG_SP_ACR					
C_CRLC_PWM_ACR	-	0... FFFFH	0... 0.99998474	1.52589 5	-
Correlation constant for filtering of PWM_ACR					
C_PWM_ACR_MAX_DIAG	-	0... 7FFFH	0... 99.9969482	0.003052	%
Maximum permitted PWM output of the ACR position controller					
C_VB_MIN_PWM_ACR_DIAG	-	0... FFH	0... 25.8984375	0.1015625	V
Threshold depend on battery voltage for the activation of the PWM_ACR monitoring					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_OPG_DIF_ACR_ERR_MAX	-	0... FFFH	0... 99.9755859	0.024414	%
LDP_OPG_SP_ACR_GRD_ABSV_IP_OPG	4	0... FFFH	0... 99.9755859	0.024414	%
Maximum admissible control deviation dependent on the actuator valve setpoint gradient					

Import actions:

ACTION_ERRM_NoFilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_LV_ERR_SET>,**IN**<PRM_LV_ERR_RST>,**IN**<PRM_LV_END_DIAG>,**OUT**<PRM_LV_ERR>)

General information

The task of this diagnosis is to detect an actuator valve error or a jammed actuator. The diagnostic observes the control deviation of the closedloop position control system dependent on the gradient of the actuator valve position setpoint.
Additionally the position controller output is monitored by this diagnostic function. If the moving mean value of PWM_ACR exceeds a defined threshold than an error will be indicated. The calculation of the moving mean value is done by an low pass filter first order.

Application Condition

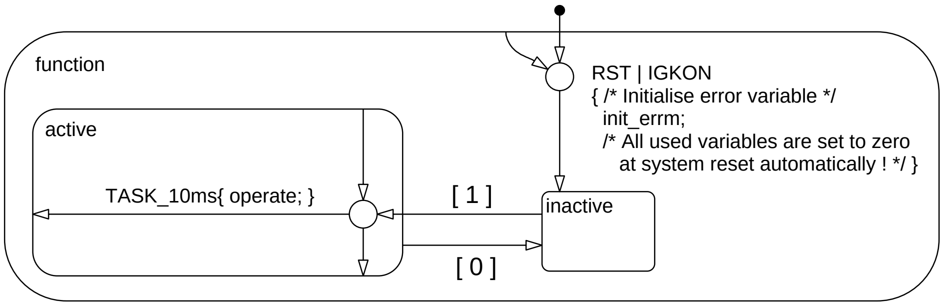

Figure A.27.1: ACRC_actuator_diagnosis/APP_CDN/APP_CDN

Function Description

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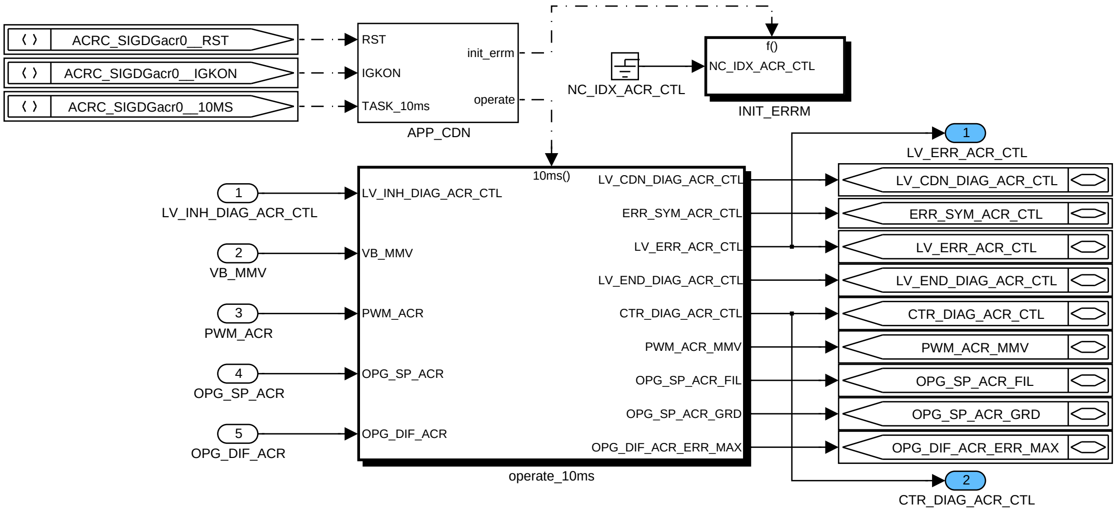

Figure A.27.2: ACRC_actuator_diagnosis

A.27.1 Monitoring of the actuator valve function

The antibounce of the error detection is done at the end of the module without generic debounce algorithm. The increment and decrement value of the implemented algorithm can be calibrated.

The following error symptoms can be distinguished:

PWM error of the closed loop position control system

System deviation outside the admissible range

Error symptoms are defined to this diagnosis function as following:

SYM_0 - System deviation outside range

SYM_1 - PWM_ACR outside range

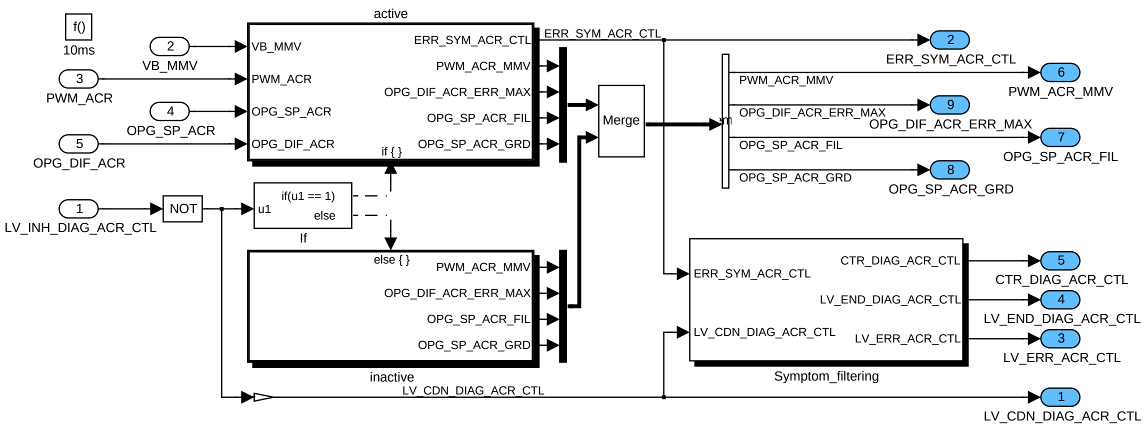

Figure A.27.3: ACRC_actuator_diagnosis/operate_10ms

Actuator failure detection

This chapter calculates the admissible error of the control deviation and the moving mean value of the position controller output, after than the error symptom determination will be performed !

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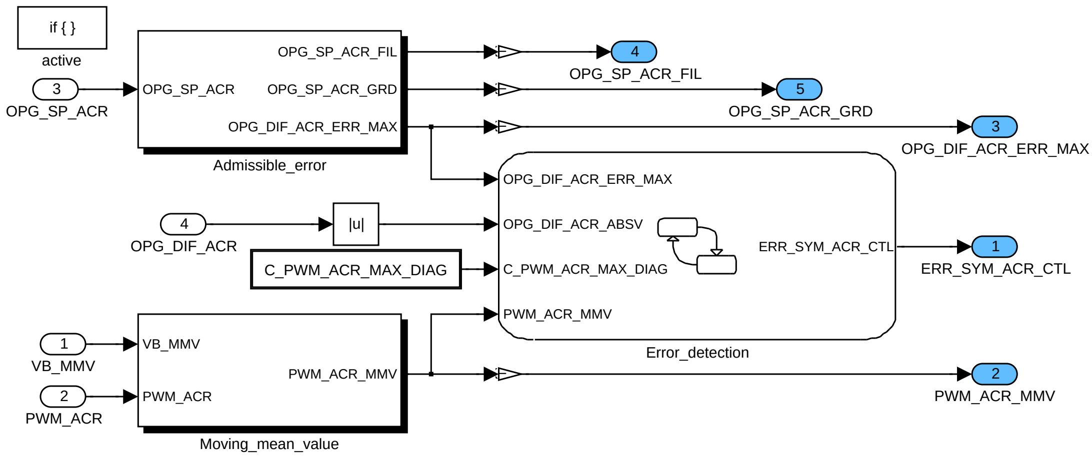

Figure A.27.4: ACRC_actuator_diagnosis/operate_10ms/active

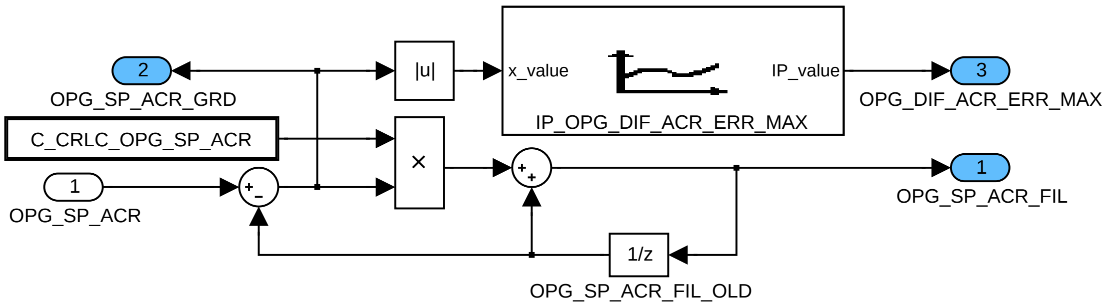

Figure A.27.5: ACRC_actuator_diagnosis/operate_10ms/active/Admissible_error

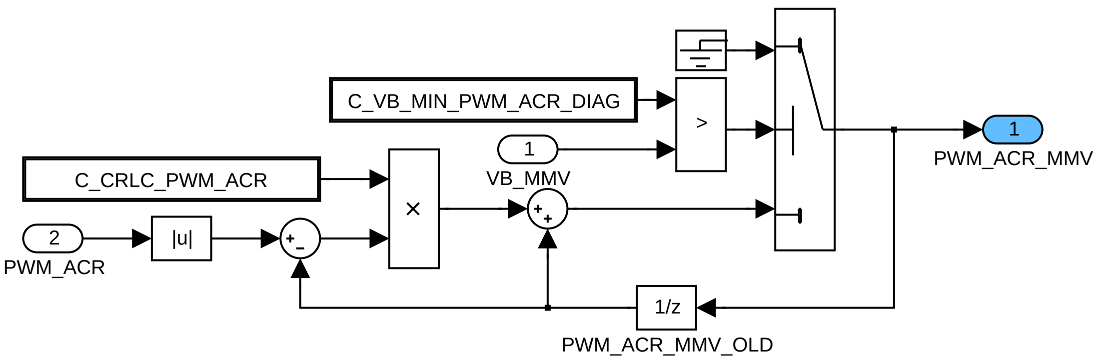

Figure A.27.6: ACRC_actuator_diagnosis/operate_10ms/active/Moving_mean_value

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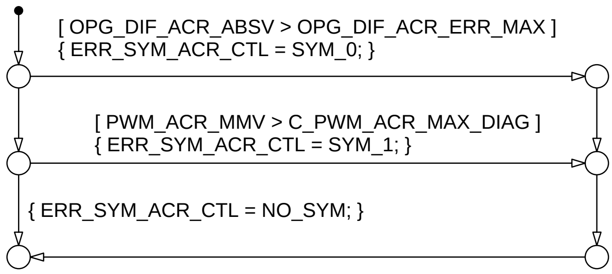

Figure A.27.7: ACRC_actuator_diagnosis/operate_10ms/active/Error_detection

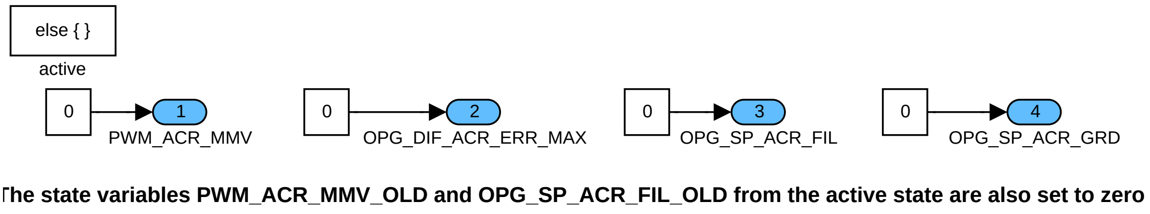

Figure A.27.8: ACRC_actuator_diagnosis/operate_10ms/inactive

Error symptom filtering

Finally the antibounce algorithm for the determined error symptoms and the end of diagnosis information are calculated. In case of errors the debounced error variable can be set for the driving cycle with the corresponding inhibition condition.

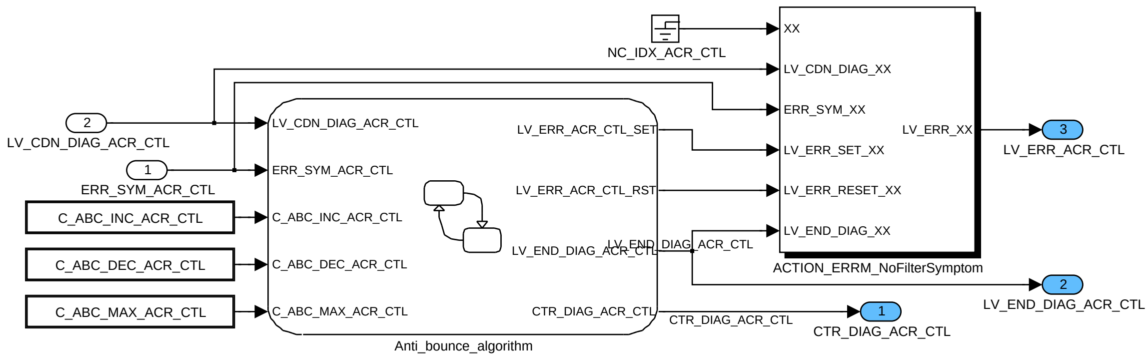

Figure A.27.9: ACRC_actuator_diagnosis/operate_10ms/Symptom_filtering

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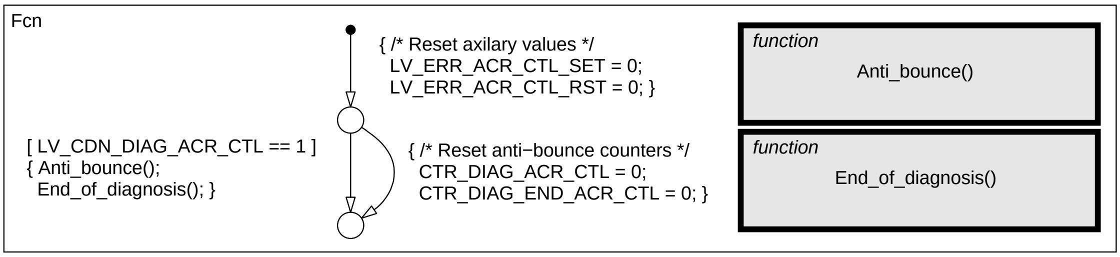

Figure A.27.10: ACRC_actuator_diagnosis/operate_10ms/Symptom_filtering/Anti_bounce_algorithm

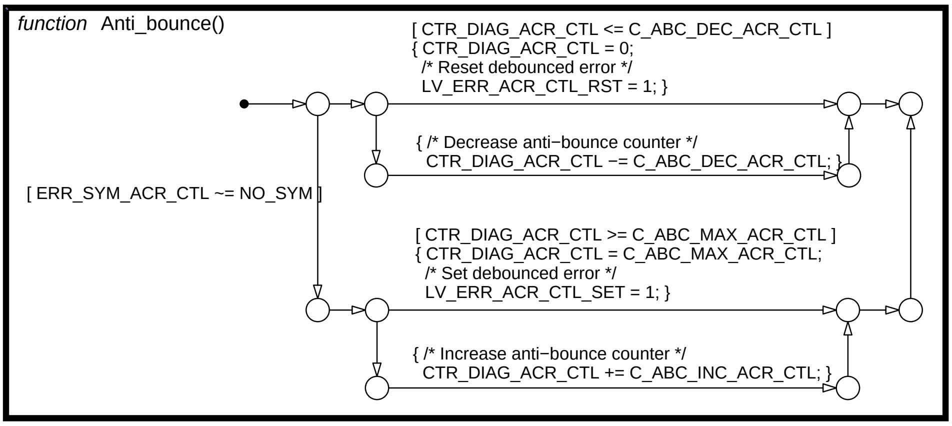

Figure A.27.11:
ACRC_actuator_diagnosis/operate_10ms/Symptom_filtering/Anti_bounce_algorithm/Fcn/Anti_bounce

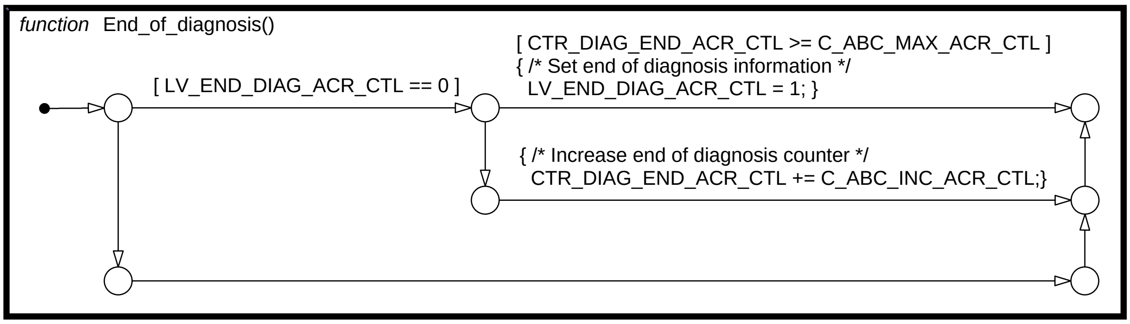

Figure A.27.12: ACRC_actuator_diagnosis/operate_10ms/Symptom_filtering/Anti_bounce_algorithm/
Fcn/End_of_diagnosis

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A.28 Actuator diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_ACR_CTL	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the actuator diagnosis					

Input data:

LV_ACR_AD_ACT {p. 4333}	LV_IGK {p. 906}	STATE_ACR_CTL {p. 3587}	

Error treatment:

Diagnostic ACR_CTL	Symptom description	Symptom	Filter type
ACR actuator diagnosis	*System deviation outside range*	*SYM_0*	*NO*
	Output position controller outside range	*SYM_1*	
	not used	*SYM_2*	
	not used	*SYM_3*	

General information

The flag LV_INH_DIAG_ACR_CTL permits to deactivate the corresponding diagnostic.

Application Condition

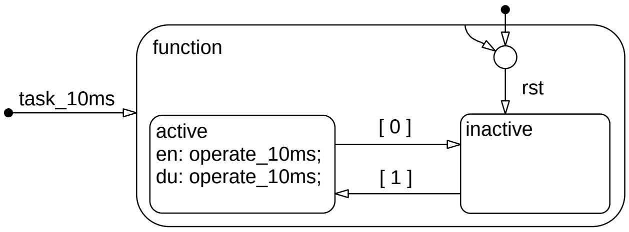

Figure A.28.1: ACRC_actuator_diagnosis_ai/APP_CDN/APP_CDN

Function Description

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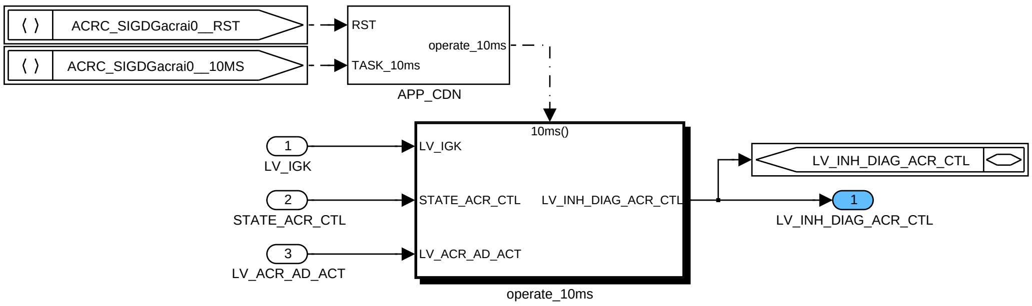

Figure A.28.2: ACRC_actuator_diagnosis_ai

A.28.1 Setting of the inhibition condition

This chapter describes the inhibition condition for the actuator diagnosis.

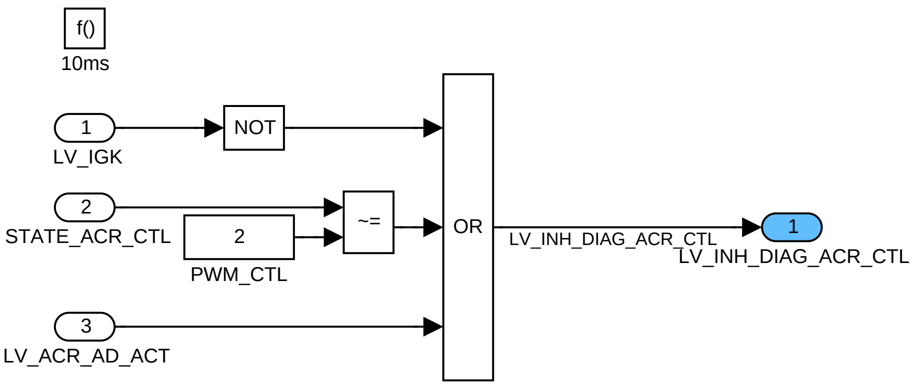

Figure A.28.3: ACRC_actuator_diagnosis_ai/operate_10ms

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A.29 Actuator limp home management

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_OPG_ACR_INI_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable requests the replacement value for actuator signal acquisition					
LV_PWM_ACR_OFF_REQ	O/V	0... 1H	0 ...1	1	-
ACR position control deactivation requested from monitoring level 1					

Input data:

LV_ERR_ACR_AD {p. 4320}	LV_ERR_ACR_CTL {p. 4337}	LV_ERR_ACR_DR {p. 4347}	LV_ERR_SENS_ACR {p. 4352}
LV_ERR_VCC_ACR {p. 4355}			

General information

The limp home management monitors the diagnostic functions of the closed-loop actuator control system. In case of monitoring level 1 errors the limp home function requests the deactivation of the power stage and actuator position control. The following diagnostic functions for ACRC position control are available:

- ACRC position sensor diagnosis
- ACRC power stage diagnosis
- ACRC actuator diagnosis
- ACRC adaptation diagnosis

Application Condition

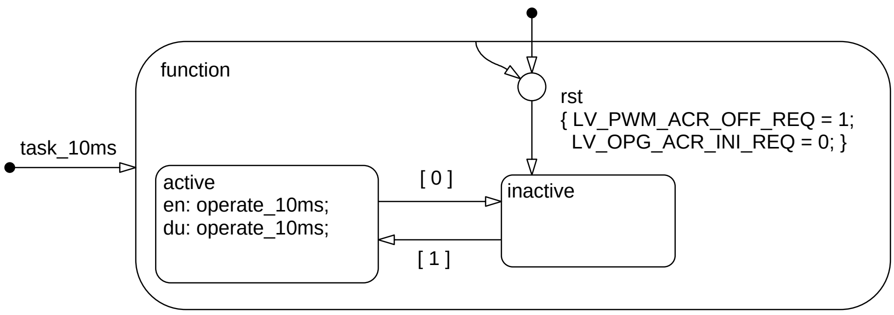

Figure A.29.1: ACRC_limp_home_management/APP_CDN/APP_CDN

Function Description

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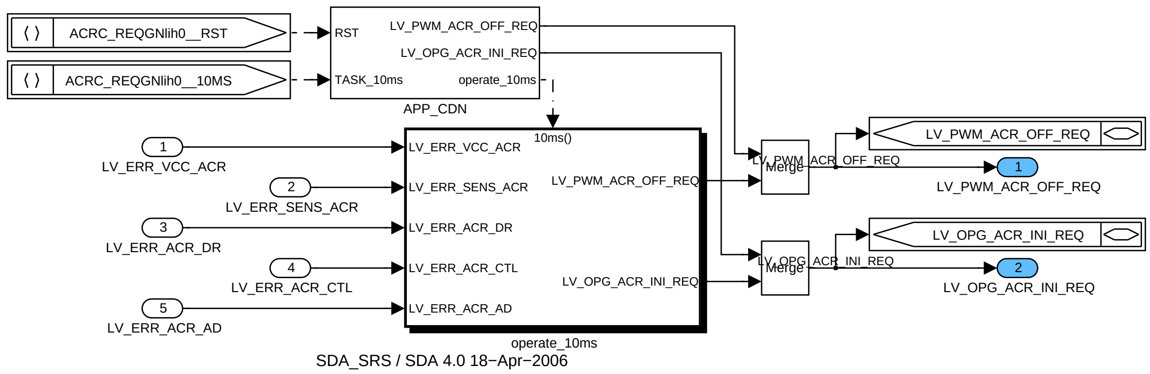

Figure A.29.2: ACRC_LIMP_HOME_MANAGEMENT

A.29.1 Calculate switch-off request for ACR power stage

The following section calculates the power stage deactivation request with monitoring level 1 errors. Additionally the request for the replacement value of the sensor signal acquisition is determined.

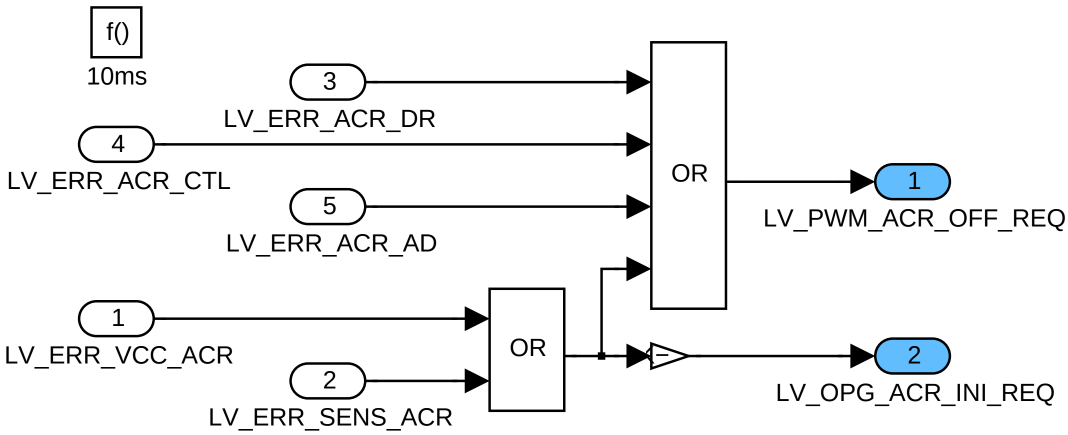

Figure A.29.3: ACRC_LIMP_HOME_MANAGEMENT/OPERATE_10MS

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A.30 Actuator power stage diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_ACR_DR	V	0H 1H	NO_SYM SYM_0	-	-
Error symptom for the power stage diagnosis					
LV_CDN_DIAG_ACR_DR	V	0... 1H	0 ...1	1	-
Diagnosis condition for power stage diagnosis					
LV_END_DIAG_ACR_DR	V	0... 1H	0 ...1	1	-
End of diagnosis information for the power stage diagnosis					
LV_ERR_ACR_DR	O/V	0... 1H	0 ...1	1	-
Present failure for power stage diagnosis after error debounce					

Input data:

LV_INH_DIAG_ACR_DR {p. 4350}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_ACR_DR	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the power stage diagnosis					
C_ABC_MAX_ACR_DR	-	1... FFH	1... 255	1	-
Maximum value for anti bounce counter for the power stage diagnosis					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_INFR_GetElDiagAcrDr (**OUT**<Lv_state_acr_dr>)

General information

The used power stage is an intelligent full HBridge, designed for the control of DC and stepper motors in safety critical applications and under extreme environmental conditions. The HBridge is protected against overtemperature, short circuits and has an under voltage lockout for all supply voltages (main DC power supply). All malfunctions cause the output stages to go tristate.
In this application the power stage is implemented in the status flag mode, that means indicated errors can not be distinguished by the software. The following errors can be detected only by the power stage:
Undervoltage /Overcurrent /Overtemperature /hardware disabled manually
Errorsymptoms are defined to this diagnosis function as following:
SYM_0 ACR power stage error

Application Condition

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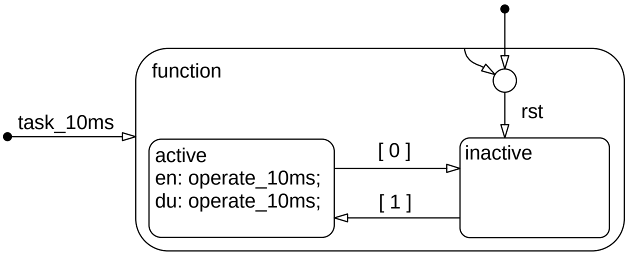
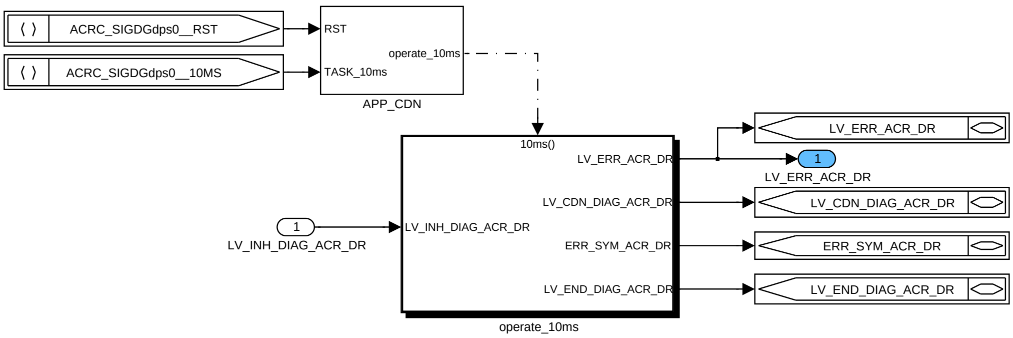


ACRC_power_stage_diagnosis/APP_CDN/APP_CDN

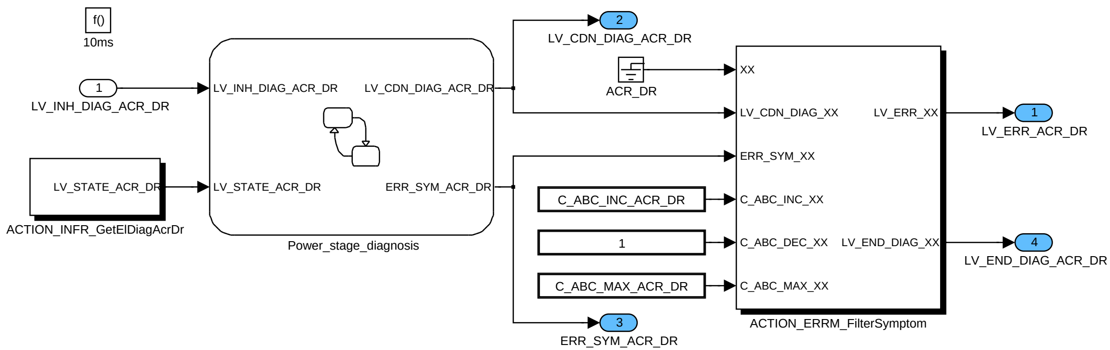
Function Description



ACRC_power_stage_diagnosis

A.30.1 Power stage diagnosis

The status flag information from the power stage is read out with an infrastructure action at the beginning of the function and the antibounce filter algorithm from the generic error management is called as action at the end of the module.



ACRC_power_stage_diagnosis/operate_10ms

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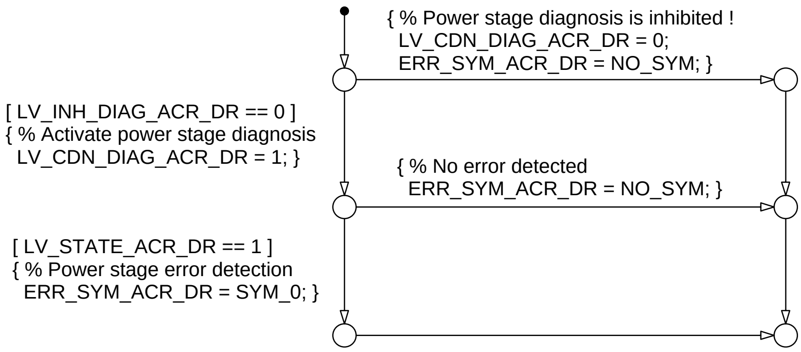

ACRC_power_stage_diagnosis/operate_10ms/Power_stage_diagnosis

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A.31 Actuator power stage diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_ACR_DR	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the power stage diagnosis					

Input data:

LV_IGK {p. 906}	STATE_ACR_CTL {p. 3587}	VB {p. 1185}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VB_MIN_ACR_DR_DIAG	-	0... FFH	0... 25.8984	0.10156	V
Minimum threshold for the activation/deactivation of the power stage diagnosis					

Error treatment:

Diagnostic ACR_DR	**Symptom description**	**Symptom**	**Filter type**
ACR power stage diagnosis	*ACR power stage error*	*SYM_0*	**STD_INI**
	not used	*SYM_1*	
	not used	*SYM_2*	
	not used	*SYM_3*	

General information

The flag LV_INH_DIAG_ACR_DR permits to deactivate the corresponding diagnostic.

Application Condition

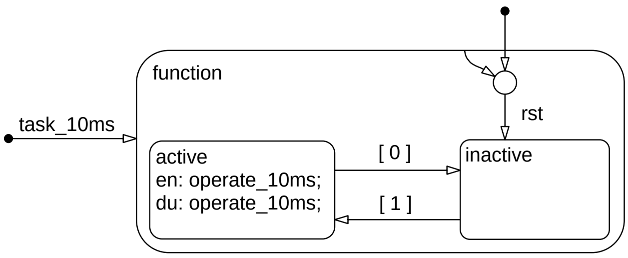

Figure A.31.1: ACRC_power_stage_diag_SF_ai/APP_CDN/APP_CDN

Function Description

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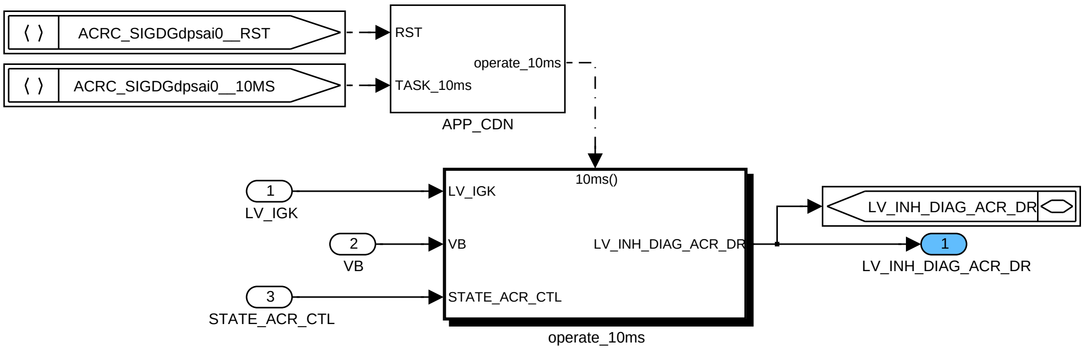

Figure A.31.2: ACRC_power_stage_diag_SF_ai

A.31.1 Setting of the inhibition condition

This chapter describes the inhibition conditions for the power stage diagnosis.

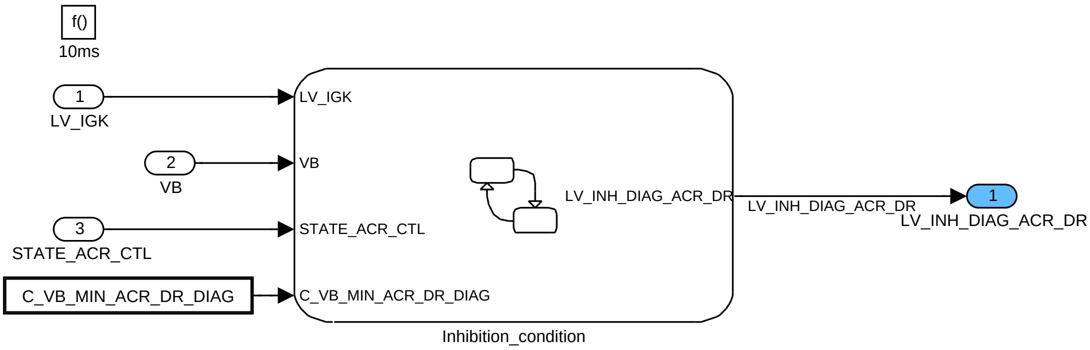

Figure A.31.3: ACRC_power_stage_diag_SF_ai/operate_10ms

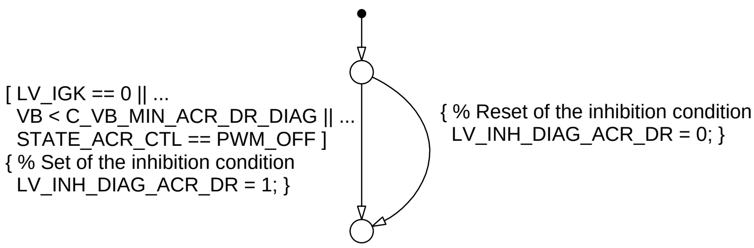

Figure A.31.4: ACRC_power_stage_diag_SF_ai/operate_10ms/Inhibition_condition

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A.32 Actuator position sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_SENS_ACR	O/V	0H 1H 2H	NO_SYM SYM_0 SYM_1	-	-
Error symptom for sensor signal range check					
LV_CDN_DIAG_SENS_ACR	V	0... 1H	0 ...1	1	-
Diagnosis condition for sensor signal range check					
LV_END_DIAG_SENS_ACR	V	0... 1H	0 ...1	1	-
End of diagnosis information for sensor signal range check					
LV_ERR_SENS_ACR	O/V	0... 1H	0 ...1	1	-
Present failure for sensor signal range check after error debounce					

Input data:

LV_INH_DIAG_SENS_ACR {p. 4355}	V_ACR {p. 1097}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_SENS_ACR	-	0... FFH	0... 255	1	-
Anti bounce counter increment for signal range check					
C_ABC_MAX_SENS_ACR	-	1... FFH	1... 255	1	-
Maximum value for anti bounce counter for signal range check					
C_V_MAX_SENS_ACR	-	0... 3FFH	0... 4.995117	0.00488	V
Upper diagnostic threshold for the signal range check					
C_V_MIN_SENS_ACR	-	0... 3FFH	0... 4.995117	0.00488	V
Lower diagnostic threshold for the signal range check					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)

General information

This diagnosis function is used to monitor the admissible input voltage range of the actuator valve position sensor system. The diagnostic is able to detect short circuit to battery, open circuit and short circuit to ground for the position sensor input according to the pull resistor at the input of the AD - converter.

Error symptoms are defined to this function as following:

SYM_0 Short circuit to battery or open load
SYM_1 Short circuit to ground

Application Condition

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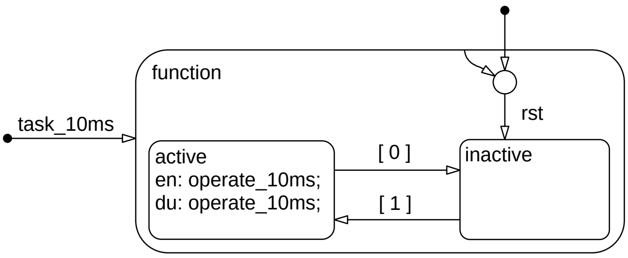
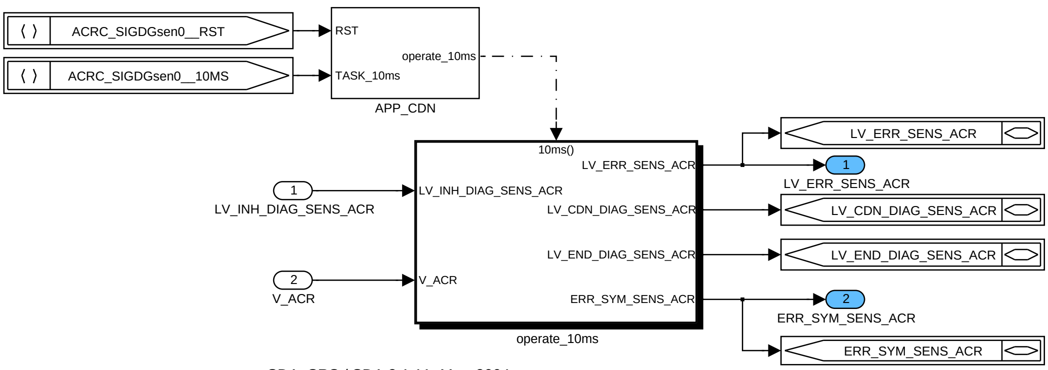


ACRC_position_sensor_diagnosis/APP_CDN/APP_CDN

Function Description



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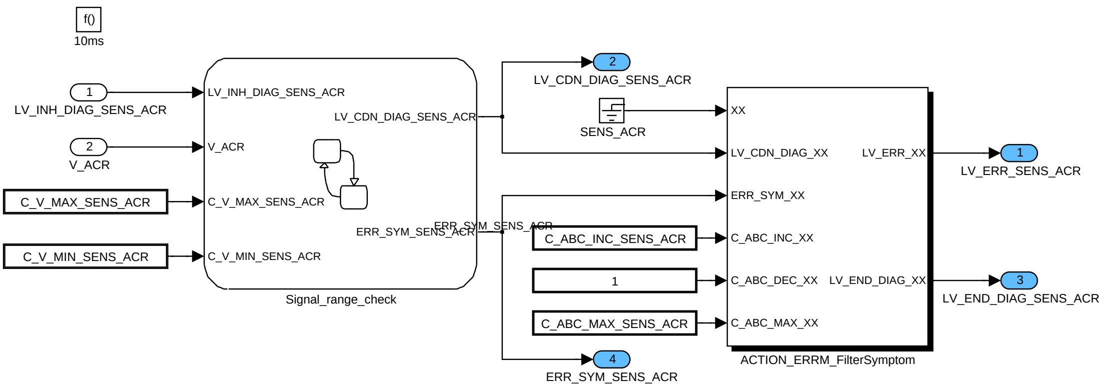
ACRC_position_sensor_diagnosis

A.32.1 Sensor signal range check

The antibounce filter algorithm from the generic error management is called at the end of the module.



ACRC_position_sensor_diagnosis/operate_10ms

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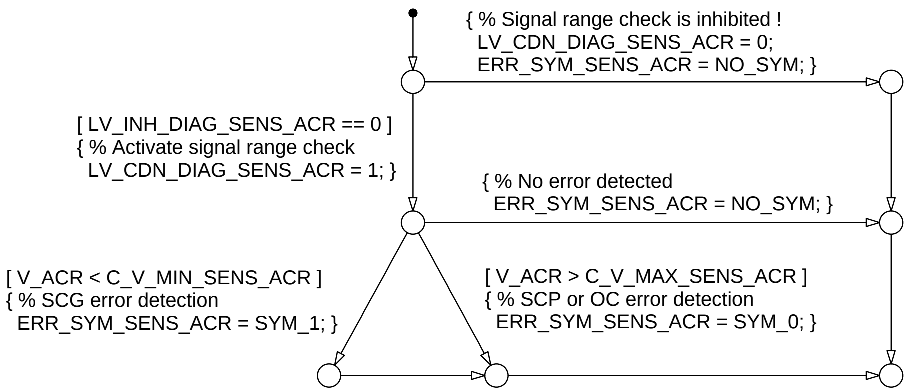

ACRC_position_sensor_diagnosis/operate_10ms/Signal_range_check

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A.33 Actuator position sensor diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_VCC_ACR	O/V	0... 1H	0 ...1	1	-
Actuator sensor supply voltage error, variable is not supported by ERRM					
LV_INH_DIAG_SENS_ACR	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the position sensor range check					

Input data:

LV_ERR_V_REF_1 {p. 4216}	LV_IGK {p. 906}		

Error treatment:

Diagnostic SENS_ACR	Symptom description	Symptom	Filter type
ACRC position sensor diagnosis	*Short circuit to battery or open load*	*SYM_0*	**STD_INI**
	Short circuit to ground	*SYM_1*	
	not used	*SYM_2*	
	not used	*SYM_3*	

General information

The flag LV_INH_DIAG_SENS_ACR permit to deactivate the corresponding diagnostic. As projects have different diagnosis information for actuator valve position sensor supply voltage, several error treatments are possible:
If there are no Information available, the error bit is set to 0 generally.

LV_ERR_VCC_ACR = 0

Otherwise the information bit has to be set to LV_ERR_VCC_ACR respectively.

Application Condition

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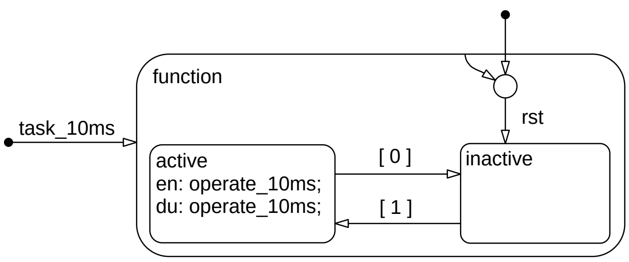
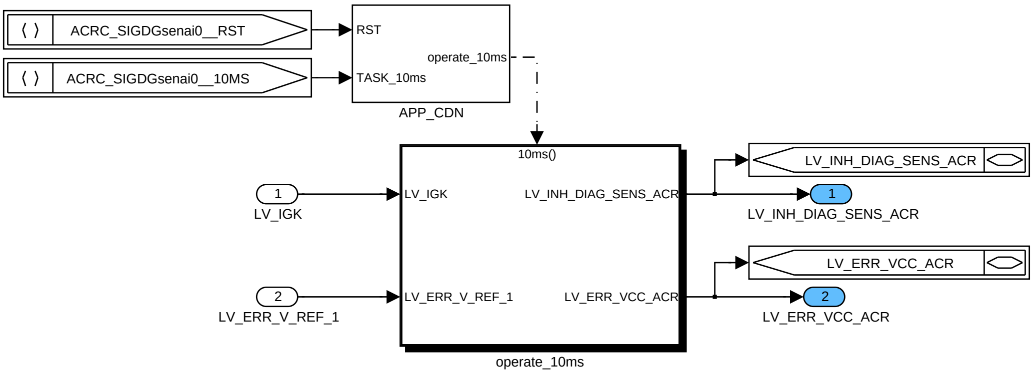


ACRC_position_sensor_diagnosis_ai/APP_CDN/APP_CDN

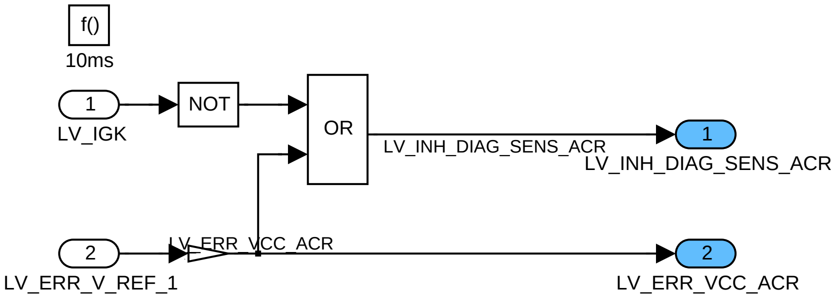
Function Description



ACRC_position_sensor_diagnosis_ai

A.33.1 Setting of the inhibition condition

This chapter describes the inhibition conditions for the sensor range check .



ACRC_position_sensor_diagnosis_ai/operate_10ms

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A.34 Oil pressure switch diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_POIL_DR	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of POIL_DR bit 0: diagnosis condition for symptom SYM_0 bit 1: diagnosis condition for symptom SYM_1 bit 2: diagnosis condition for symptom SYM_2 bit 3: diagnosis condition for symptom SYM_3					
ERR_DIAG_POIL_DR	-	0... 7H	0 ...7	1	-
Raw value of error symptom for POIL_DR (only parameter) bit 0: Set, if raw value of error symptom SCP (SYM_0) is set bit 1: Set, if raw value of error symptom SCG (SYM_1) is set bit 2: Set, if raw value of error symptom OC (SYM_2) is set (all combinations are possible)					
ERR_SYM_POIL_DR_SCG	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom for engine-oil pressure valve powerstage error SCG					
ERR_SYM_POIL_SWI	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptoms oil pressure switch					
LV_CDN_DIAG_POIL_DR_SCG	V	0... 1H	0 ...1	1	-
Boolean for engine-oil pressure valve powerstage error SCG diagnosis conditions					
LV_CDN_DIAG_POIL_SWI	O/V	0... 1H	0 ...1	1	-
Status of diagnosis oil pressure switch					
LV_END_DIAG_POIL_DR_SCG	V	0... 1H	0 ...1	1	-
Boolean for end of engine-oil pressure valve powerstage error SCG diagnosis					
LV_END_DIAG_POIL_SWI	O/V	0... 1H	0 ...1	1	-
End of diagnosis oil pressure switch					
LV_ERR_POIL_DR	O/V	0... 1H	0 ...1	1	-
Engine-oil pressure valve powerstage error					
LV_ERR_POIL_DR_SCG	O/V	0... 1H	0 ...1	1	-
Engine-oil pressure valve powerstage error SCG					
LV_ERR_POIL_SWI	O/V/S	0... 1H	0 ...1	1	-
Error oil pressure switch					
T_POIL_SWI_PWL	O/V	0... 3EH	0... 6.2	0.1	s
Timer for oil pressure inclination after engine stop					

Input data:

ECU_STATE {p. 1091}	LC_POIL_CTL_ENA {p. 903}	LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_SPI_MPS {p. 4245}
LV_IGK {p. 906}	LV_POIL_SWI {p. 903}	POIL_PWM {p. 8203}	TOIL {p. 8204}

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_POIL_DR	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_INC_POIL_DR_SCG	-	0... FFH	0... 255	1	-
Antibounce counter increment engine-oil pressure valve powerstage error SCG					
C_ABC_INC_POIL_SWI	-	0... FFH	0... 255	1	-
Anti bounce increment value, POIL_SWI					
C_ABC_MAX_POIL_DR	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_ABC_MAX_POIL_DR_SCG	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter engine-oil pressure valve powerstage error SCG					
C_ABC_MAX_POIL_SWI	-	1... FFH	1... 255	1	-
Anti-bounce max. value, POIL_SWI					
C_PWM_POIL_DR_MAX_DIAG_SCG	-	0... FFH	0... 99.609375	0.391	%
Maximum threshold for SCG diagnosis window					
C_PWM_POIL_DR_MIN_DIAG_OC	-	0... FFH	0... 99.609375	0.391	%
Minimum threshold for OC diagnosis window					
C_PWM_POIL_DR_MIN_DIAG_SCP	-	0... FFH	0... 99.609375	0.391	%
Minimum threshold for SCP diagnosis window					
C_T_POIL_SWI_PWL	-	0... 3EH	0... 6.2	0.1	s
Time for oil pressure inclination					
C_TOIL_POIL_SWI_MAX_DIAG	-	0... C8H	-40 ...160	1	°C
Maximum diagnosis threshold TOIL					
C_TOIL_POIL_SWI_MIN_DIAG	-	0... C8H	-40 ...160	1	°C
Minimum diagnosis threshold TOIL					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_POIL_DR	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (= 2)					

Import actions:

ACTION_ERRM_FilterMulticondition (**IN**<XX>,**IN**<CDN_DIAG_>,**XX**>,<IN<>,**ERR_DIAG_XX**>,<IN>,<C_ABC_INC_XX>,**IN**<C_ABC_MAX_XX>,**OUT**<LV_ERR_XX>)
ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>,**IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)
ACTION_INFR_GetElDiagPoil_dr (**OUT**<Cdn_diag_Poil_dr>,**OUT**<Err_diag_Poil_dr>)

Error treatment:

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Diagnostic **POIL_DR**	**Symptom description**	**Symptom**	**Filter type**
Driver diagnosis of oil pressure actuator	SCP	*SYM_0*	*MPL_STD_INI*
	SCG	*SYM_1*	
	OC	*SYM_2*	

Diagnostic **POIL_DR_SCG**	**Symptom description**	**Symptom**	**Filter type**
Driver diagnosis of oil pressure actuator only for shortcut to plus	-	SYM_0	MEM
	SCG	SYM_1	
	-	SYM_2	
	-	SYM_3	

Note :

- The data ERR_SYM_POIL_DR, LV_END_DIAG_POIL_DR and LV_CDN_DIAG_POIL_DR are not present in the output data table, because they are not used by other functions. Despite they are provided by the error management and are always visible.

Note :

ACTION_INFR_GetElDiagPoil_dr() is defined in the IRS (Infrastructure requirement specification)

FUNCTION DESCRIPTION:

General information:

The oil pressure actuator is driven by the ECU via an output driver. The failure detection is done by ECU Hardware.

The purpose of the diagnosis is to detect electrical faults as defined by OBD I requirements.

Description:

After activation conditions are met, the diagnosis activation is delayed for NC_PSD_DLY_POIL_DR executions, to avoid the usage of wrong infrastructure information.

Error-symptoms and conditions: are defined to this diagnosis function as following

```
□□□□
| | | └─> Short circuit to battery (SCP)        (= SYM_0)
| | └───> Short circuit to ground (SCG)         (= SYM_1)
| └─────> Open circuit  (OC)                    (= SYM_2)
└───────> -                                     (= SYM_3)
```

Application conditions

Initialisation:

```
at transition LV_IGK 0 - -> 1:
  LV_ERR_POIL_DR,
  ERR_SYM_POIL_DR,
```

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```
LV_END_DIAG_POIL_DR
(according filter-type)
Set delay counter for NC_PSD_DLY_POIL_DR
at reset:
CDN_DIAG_POIL_DR = 0,
LV_ERR_POIL_DR = 0 and
ERR_SYM_POIL_DR = 0,
LV_CDN_DIAG_POIL_DR = 0,
LV_END_DIAG_POIL_DR = 0,
(according filter-type)
Set delay counter for NC_PSD_DLY_POIL_DR
```

Recurrence: *100 ms*

Activation: LV_IGK = 1 **and** LC_POIL_CTL_ENA = 1 **and** LV_ERR_SPI_MPS = 0

Deactivation: *LV_IGK = 0* ***or*** *LC_POIL_CTL_ENA = 0* ***or*** *LV_ERR_SPI_MPS = 1*

Formula section:

If LV_IGK = 1 **and**
LV_CDN_VB_OBD1 = 1
Then
Usage of the diagnosis information (failure symptoms (raw value) ERR_DIAG_POIL_DR and basic diagnosis conditions CDN_DIAG_POIL_DR) received from the infrastructure:
ACTION_INFR_GetElDiagPoil_dr (OUT<Cdn_diag_poil_dr>, OUT<Err_diag_poil_dr>)

Basic diagnosis conditions are set according infrastructure information: CDN_DIAG_POIL_DR
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_POIL_DR

If Activation conditions are met for the NC_PSD_DLY_POIL_DR recurrence of the diagnosis
Then *{ Additional diagnosis conditions }*
If C_PWM_POIL_DR_MIN_DIAG_SCP > POIL_PWM
then bit 0 of CDN_DIAG_POIL_DR = 0 *{Diagnosis of SCP not possible }*
Endif
If POIL_PWM > C_PWM_POIL_DR_MAX_DIAG_SCG
then bit 1 of CDN_DIAG_POIL_DR = 0 *{Diagnosis of SCG not possible }*
Endif
If POIL_PWM < C_PWM_POIL_DR_MIN_DIAG_OC
Or POIL_PWM > C_PWM_POIL_DR_MAX_DIAG_SCG
then bit 2 of CDN_DIAG_POIL_DR = 0 *{Diagnosis of OC not possible }*
Endif
Else CDN_DIAG_POIL_DR = 0
Endif
Else
CDN_DIAG_POIL_DR = 0
Endif

Failure filtering and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_POIL_DR and ERR_DIAG_POIL_DR.

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ACTION_ERRM_FilterMulticondition (IN<POIL_DR>, IN<CDN_DIAG_POIL_DR>, IN<ERR_DIAG_POIL_DR>, IN<C_ABC_INC_POIL_DR>, IN<C_ABC_MAX_POIL_DR>, OUT<LV_ERR_POIL_DR>)
This algorithm determines:

ERR_DIAG_POIL_DR (detected error symptom for POIL_DR diagnosis)
LV_ERR_POIL_DR (Error flag for debounced error of POIL_DR)
LV_CDN_DIAG_POIL_DR (Diagnosis condition information)
LV_END_DIAG_POIL_DR (End of diagnosis information)

A.34.1 Electrical diagnosis of oil pressure actuator for shortcut to ground (SCG)

FUNCTION DESCRIPTION:

General information:

In case of an electrical failure caused by a shortcut to ground (SCG) a special failure - reaction and a different warning - lamp (EML) - handling is necessary (caused by low oil - pressure the engine speed will be limited at 3000 rpm). Due to the need of a separate C_ERR_CLAS for this symptom of LV_ERR_POIL_DR it will be copied on LV_ERR_POIL_DR_SCG.

Error-symptoms and conditions: are defined to this diagnosis function as following

```
|_|_|_|_|
 | | | └> -                                  (= SYM_0)
 | | └──> Short circuit to ground (SCG)      (= SYM_1)
 | └────> -                                  (= SYM_2)
 └──────> -                                  (= SYM_3)
```

Application conditions

Initialisation: all output data according ABC configuration **"MEM"**
// LV_IGK 0->1 ***or*** *reset* ***or*** *at clearing error memory*
This action initialized the diagnostic result according the filtering
ACTION_ERRM_GetLvErr(IN<NC_IDX_DIAG_ POIL_DR_SCG >, OUT<LV_ERR_POIL_DR_SCG>)

Recurrence: *100 ms*

Activation: LV_IGK = 1 **and** LC_POIL_CTL_ENA = 1 **and** LV_ERR_SPI_MPS = 0

Deactivation: *LV_IGK = 0* ***or*** *LC_POIL_CTL_ENA = 0* ***or*** *LV_ERR_SPI_MPS = 1*

Formula section:

LV_CDN_DIAG_POIL_DR_SCG = LV_CDN_DIAG_POIL_DR
If ERR_SYM_POIL_DR = SYM_1
Then ERR_SYM_POIL_DR_SCG = SYM_1
Else ERR_SYM_POIL_DR_SCG = NO_SYM
Endif

For failure and error management treatment the anti-bounce mechanism is called with the parameters LV_CDN_DIAG_POIL_DR_SCG and ERR_SYM_POIL_DR_SCG.

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ACTION_ERRM_FilterSymptom (IN< POIL_DR_SCG >, IN< LV_CDN_DIAG_POIL_DR_SCG >, IN< ERR_SYM_POIL_DR_SCG >, IN< C_ABC_INC_POIL_DR_SCG >, IN< C_ABC_MAX_POIL_DR_SCG >,
IN< 1 >, OUT< LV_ERR_POIL_DR_SCG >)
This algorithm determines LV_ERR_POIL_DR_SCG and LV_END_DIAG_POIL_DR_SCG and delivers the result to Error Management.

A.34.2 Oil pressure switch diagnosis

FUNCTION DESCRIPTION:

General information:

Due to the ECU recognizing the oil pressure as “ok” during “switch open”, a diagnosis of the oil pressure switch is required in order to detect a fallen off plug (open load).

Description:

Error symptoms are defined to this diagnosis function as following:

```
|_|_|_|_|
 | | | └─>                          (= SYM_0)
 | | └───>                          (= SYM_1)
 | └─────> Open Load                (= SYM_2)
 └───────> -                        (= SYM_3)
```

Signal flow diagram:

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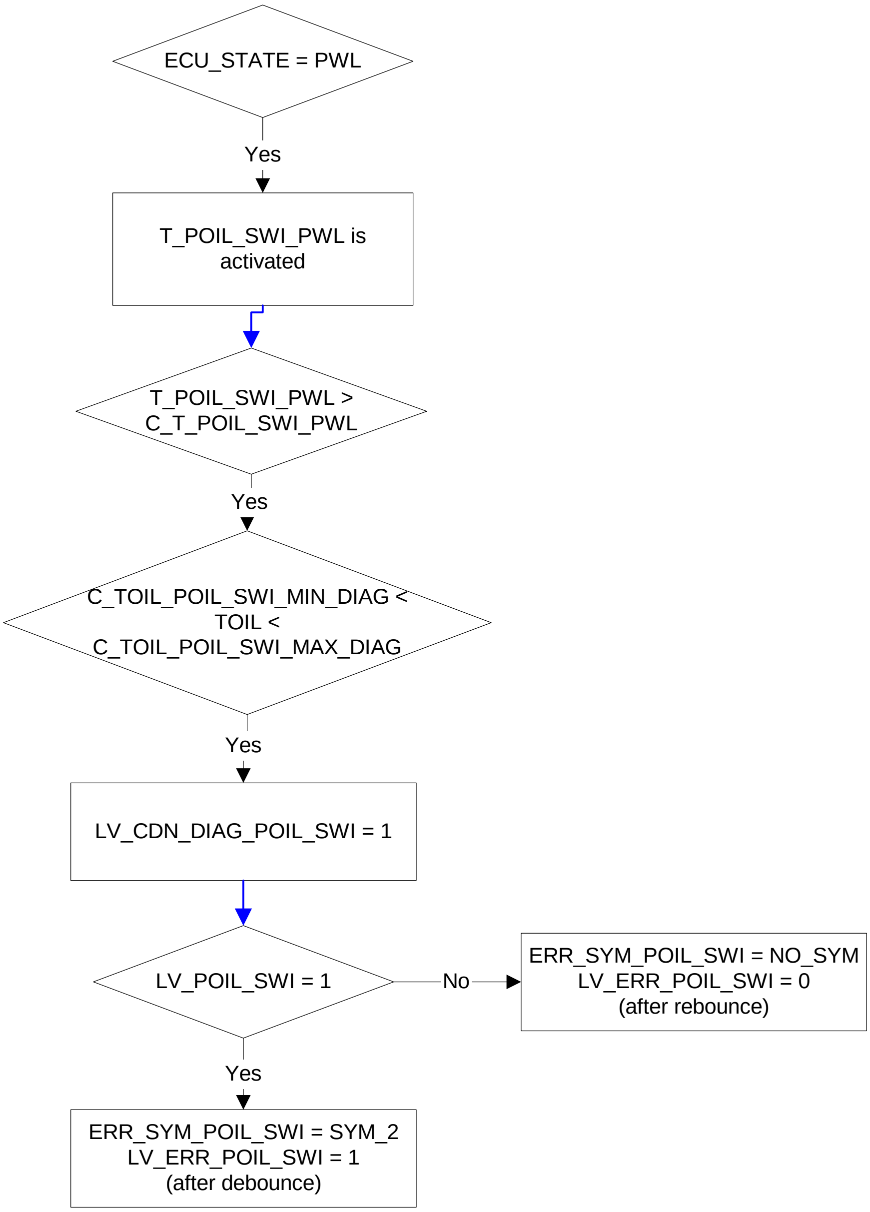

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Application conditions

Initialisation: according ERRM Type **"STD"** *(restored out from NVMY)*
at LV_IGK 0 → 1 **or** at reset: T_POIL_SWI_PWL = 0

Recurrence: 100 ms
Activation: LV_END_DIAG_POIL_SWI = 0 **and** ECU_STATE = PWL **and**
LC_POIL_CTL_ENA = 0

Deactivation: LV_END_DIAG_POIL_SWI = 1 **or**

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end of power-latch phase **or** LC_POIL_CTL_ENA = 1

Formula section:

The diagnosis shall be performed during the power-latch-phase until LV_END_DIAG_POIL_SWI = 1 or the end of power latch phase is reached.

IF (1) ECU_STATE = PWL
THEN (1) Timer T_POIL_SWI_PWL starts
    IF (2) T_POIL_SWI_PWL > C_T_POIL_SWI_PWL
    THEN (2) **IF (3)** C_TOIL_POIL_SWI_MIN_DIAG < TOIL < C_TOIL_POIL_SWI_MAX_DIAG
        THEN (3) LV_CDN_DIAG_POIL_SWI = 1
            IF (4) LV_POIL_SWI = 1
            THEN (4) ERR_SYM_POIL_SWI = SYM_2
                LV_ERR_POIL_SWI = 1 (after debounce)
            ELSE (4) ERR_SYM_POIL_SWI = NO_SYM
                LV_ERR_POIL_SWI = 0 (after rebounce)
            ENDIF (4)
        ENDIF (3)
    ENDIF (2)
ENDIF (1)

End of diagnosis calculation LV_END_DIAG_POIL_SWI:

- see chapter "Anti-bounce Algorithm: Calculation of the end of diagnosis"

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A.35 Oil sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_SENS_POIL	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom of oil pressure sensor					
LV_CDN_DIAG_SENS_POIL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition of oil pressure sensor					
LV_END_DIAG_SENS_POIL	O/V	0... 1H	0 ...1	1	-
End of diagnosis of oil pressure sensor					
LV_ERR_SENS_POIL	O/V	0... 1H	0 ...1	1	-
Oil pressure sensor error present					

Input data:

LC_POIL_CTL_ENA {p. 903}	LV_IGK {p. 906}	V_POIL {p. 831}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_POIL	-	0... FFH	0... 255	1	-
Anti - bounce counter increment					
C_ABC_MAX_POIL	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter					
C_V_POIL_MAX_DIAG	-	0... 3FFH	0... 4.99511	4.883e-3	V
Maximum diagnostic value for the oil pressure sensor signal					
C_V_POIL_MIN_DIAG	-	0... 3FFH	0... 4.99511	4.883e-3	V
Minimum diagnostic value for the oil pressure sensor signal					

FUNCTION DESCRIPTION:

General information:

The purpose of the diagnosis shall be to detect electrical faults as defined by OBD I requirements. The signal of the oil pressure sensor on the A/D-input of the microcontroller is checked.

Description:

Error-symtoms are defined to this diagnosis function as following :

```
|_|_|_|_|
 | | | └─> Signal line short to battery voltage or 5 V power supply (= SYM_0)
 | | └───> Signal line short to ground or open load                (= SYM_1)
 | └─────> -                                                         (= SYM_2)
 └───────> -                                                         (= SYM_3)
```

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Application conditions

Initialization: all 0 at LV_IGK 0 - ->1 **or** reset

Recurrence: 100ms

Activation:
```
If      LV_IGK = 1    and    LC_POIL_CTL_ENA = 1
Then  LV_CDN_DIAG_SENS_POIL = 1
Else   LV_CDN_DIAG_SENS_POIL = 0
Endif
```

Deactivation: LV_IGK = 0 **or** LC_POIL_CTL_ENA = 0

Formula section:

Short circuit to VBatt or 5 V power supply:
If V_POIL > C_V_POIL_MAX_DIAG
Then ERR_SYM_SENS_POIL = SYM_0
Short circuit to ground or open load:
Else **If** V_POIL < C_V_POIL_MIN_DIAG
Then ERR_SYM_SENS_POIL = SYM_1
Else ERR_SYM_SENS_POIL = NO_SYM
Endif
Endif
Calculation of present error and end of diagnosis:
LV_ERR_SENS_POIL and LV_END_DIAG_SENS_POIL is calculated by the error management.

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A.36 Engine roughness diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_SEG_AD_ER	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of ER segment time adaptive values					
ERR_SYM_T_SEG_ER	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of segment time adaptive values					
LV_CDN_DIAG_SEG_AD_ER	V	0... 1H	0 ...1	1	-
Diagnosis condition of ER segment time adaptive values					
LV_CDN_DIAG_T_SEG_ER	V	0... 1H	0 ...1	1	-
Diagnosis condition of segment time adaptive values					
LV_END_DIAG_SEG_AD_ER	V	0... 1H	0 ...1	1	-
Diagnosis end of ER segment time adaptive values					
LV_END_DIAG_T_SEG_ER	V	0... 1H	0 ...1	1	-
Diagnosis end of segment time adaptive values					
LV_ERR_SEG_AD_ER	O/V	0... 1H	0 ...1	1	-
Present failure for ER segment time adaptive values					
LV_ERR_T_SEG_ER	O/V	0... 1H	0 ...1	1	-
Present failure for segment time adaptive values					

Input data:

LV_DC {p. 5746}	LV_INH_DIAG_SEG_AD_ER {p. 4371}	LV_INH_DIAG_T_SEG_ER {p. 4371}	LV_INH_MIS_CRK {p. 4432}
LV_SEG_AD_AVL_ER {p. 1473}	LV_SEG_AD_ER {p. 1473}	LV_SEG_AD_LIM_ER {p. 1473}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_SEG_AD_ER	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_INC_T_SEG_ER	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_SEG_AD_ER	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_ABC_MAX_T_SEG_ER	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
LC_CDN_DIAG_SEG_AD_ER	-	0... 1H	0 ...1	1	-
Diagnosis condition mode of ER segment time adaptive values					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Error treatment:

Diagnosis T_SEG_ER	Symptom	Nr	ABC type
Engine roughness segment time acquisition	-	*0*	STD_INI
	Missing/Adding 1 tooth or more on engine roughness segment acquisition	*1*	
		2	
T_SEG_ER		*3*	

Diagnosis SEG_AD_ER	Symptom	Nr	ABC type
ER segment adaptation values at the limit	-	*0*	STD_INI
	ER segment adaptation values at the limit	*1*	
		2	
SEG_AD_ER		*3*	

A.36.1 Engine roughness segment time acquisition error

FUNCTION DESCRIPTION:

The purpose of this error is to diagnose synchronisation errors on engine roughness segments measurement.
An error symptom *Missing/Adding 1 tooth or more on engine roughness segment acquisition* is detected when a crankshaft synchronisation error caused by 1 or 2 missing/additional tooth occurs on one crankshaft revolution.

Application conditions

Initialisation: *at ECU reset or KEY OFF/ KEY ON event*
LV_CDN_DIAG_T_SEG_ER = 0
ERR_SYM_T_SEG_ER = *Refer to filtering configuration for the initialisation value*
LV_ERR_T_SEG_ER = *Refer to filtering configuration for the initialisation value*
LV_END_DIAG_T_SEG_ER = *Refer to filtering configuration for the initialisation value*

Recurrence: each 360°Crk at segment task

Activation/Deactivation:

```
If      LV_DC = 1
And     LV_INH_DIAG_T_SEG_ER = 0
Then    LV_CDN_DIAG_T_SEG_ER = 1          diagnosis is active
Else    LV_CDN_DIAG_T_SEG_ER = 0          diagnosis is passive
```

EndIf

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Formula section:

Error detection

If LV_INH_MIS_CRK = 1
Then ERR_SYM_T_SEG_ER = SYM_1
(symptom "Missing/Adding 1 or 2 teeth on engine roughness segment acquisition" is active, ABC counter starts to increment)
LV_ERR_T_SEG_ER = 1 *(after anti-bounce)*
Else ERR_SYM_T_SEG_ER = NO_SYM
(no symptom is declared, ABC counter starts to decrement)
LV_ERR_T_SEG_ER = 0 *(after anti-bounce)*
EndIf

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

A.36.2 Engine roughness segment adaptive values out of range error

Description:

The purpose is to diagnose the ER segment adaptive values.
If during or at the end of the segment adaptive values learning process *(LV_SEG_AD_ER = 1 or LV_SEG_AD_ER = 1 -> 0)*, at least one of the engine roughness segment adaptation values is at the limit (LV_SEG_AD_LIM_ER = 1), the error symptom SEG_AD_ER engine roughness segment adaptation values at the limit is detected.

Application conditions

Initialisation:

```
at ECU reset or KEY OFF/ KEY ON event
LV_CDN_DIAG_SEG_AD_ER = 0
ERR_SYM_SEG_AD_ER = Refer to filtering configuration for the initialisation value
LV_ERR_SEG_AD_ER = Refer to filtering configuration for the initialisation value
LV_END_DIAG_SEG_AD_ER = Refer to filtering configuration for the initialisation value
```

Recurrence:

```
segment task
```

Activation/Deactivaton:

```
If     [ ( LV_SEG_AD_ER = 1 -> 0 And LC_CDN_DIAG_SEG_AD_ER = 0 )
Or       ( LV_SEG_AD_ER = 1 And LC_CDN_DIAG_SEG_AD_ER = 1 ) ]
And      LV_SEG_AD_AVL_ER = 1            // adaptive values available
And      LV_INH_DIAG_SEG_AD_ER = 0       // no application fade-out
Then     LV_CDN_DIAG_SEG_AD_ER = 1       // diagnosis is active
Else     LV_CDN_DIAG_SEG_AD_ER = 0       // diagnosis is passive
```

EndIf

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Formula section:

Error detection

If LV_SEG_AD_LIM_ER = 1 *// adaptive values at the limit*

Then ERR_SYM_SEG_AD_ER = SYM_1

(symptom "ER segment time adaptive values at the limit" is active, ABC counter starts to increment)

LV_ERR_SEG_AD_ER = 1 *(after anti-bounce)*

Else ERR_SYM_SEG_AD_ER = NO_SYM

(no symptom is declared, ABC counter starts to decrement)

LV_ERR_SEG_AD_ER = 0 *(after anti-bounce)*

EndIf

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A.37 Engine roughness diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_SEG_AD_ER	O/V	0... 1H	0 ...1	1	-
Specific conditions to inhabit Engine roughness segment adaptive values diagnosis					
LV_INH_DIAG_T_SEG_ER	O/V	0... 1H	0 ...1	1	-
Specific conditions to inhibit Engine roughness segment time acquisition diagnosis					

Input data:

LV_DC {p. 5746}	LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CRK_PLAUS {p. 4446}
LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}	LV_ERR_MAF_FRQ_EL [NC_MAF_NR] {p. 4815}
LV_ERR_MAF_FRQ_GRD [NC_MAF_NR] {p. 4815}	LV_ERR_MAF_FRQ_RNG [NC_MAF_NR] {p. 4815}	LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}
LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}
LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}
LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_IGK {p. 906}	NC_MAF_NR {p. 834}
NC_NR_CAM_CBK {p. 1507}	NC_NR_CBK_IVVT {p. 604}		

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General information:

In this module the project specific inhibition conditions for the engine roughness diagnosis are defined.

Application conditions

Initialization: *0 at reset or Key Off to On*

Recurrence: *Every segment*

Activation: *LV_DC = 1*

Formula section:

Inhibition of SEG_AD_ER diagnosis:

```
If          LV_IGK= 0
    Or      LV_ERR_CRK_PLAUS = 1
    Or      LV_ERR_CRK_SYN = 1
    Or      LV_ERR_CRK_TOOTH = 1
    Or      LV_ERR_CRK_TOOTH_PER = 1
    Or      LV_ERR_MEC_IVVT_EX = 1
    Or      LV_ERR_MEC_IVVT_IN = 1
    Or      LV_ERR_MTC_CTL_2 = 1
    Or      LV_ERR_MTC_CTL_3 = 1
    Or      LV_ERR_MTC_DR = 1
    Or      LV_ERR_PER_CAM_EX[0] = 1
    Or      LV_ERR_PER_CAM_IN[0] = 1
    Or      LV_ERR_PLAUS_CAM_EX[0] = 1
    Or      LV_ERR_PLAUS_CAM_IN[0] = 1
    Or      LV_ERR_REF_CRK_CAM_EX[0] = 1
    Or      LV_ERR_REF_CRK_CAM_IN[0] = 1
    Or      LV_ERR_SLV_IVVT_EX = 1
    Or      LV_ERR_SLV_IVVT_IN = 1
    Or      LV_ERR_SYN_CAM_EX[0] = 1
    Or      LV_ERR_SYN_CAM_IN[0] = 1
    Or      LV_ERR_SYN_CRK_CAM_EX[0] = 1
    Or      LV_ERR_SYN_CRK_CAM_IN[0] = 1
    Or      LV_ERR_TOOTH_OFF_EX[0] = 1
    Or      LV_ERR_TOOTH_OFF_IN[0] = 1
     #if    NC_NR_CAM_CBK = 2
       Or   LV_ERR_PER_CAM_EX[1] = 1
          Or      LV_ERR_PER_CAM_IN[1] = 1
          Or      LV_ERR_PLAUS_CAM_EX[1] = 1
          Or      LV_ERR_PLAUS_CAM_IN[1] = 1
          Or      LV_ERR_REF_CRK_CAM_EX[1] = 1
          Or      LV_ERR_REF_CRK_CAM_IN[1] = 1
          Or      LV_ERR_SYN_CAM_EX[1] = 1
          Or      LV_ERR_SYN_CAM_IN[1] = 1
          Or      LV_ERR_SYN_CRK_CAM_EX[1] = 1
          Or      LV_ERR_SYN_CRK_CAM_IN[1] = 1
          Or      LV_ERR_TOOTH_OFF_EX[1] = 1
          Or      LV_ERR_TOOTH_OFF_IN[1] = 1
     #endif
    Or      LV_ERR_TPS = 1
    Or      LV_ERR_TPS_1 = 1
    Or      LV_ERR_TPS_2 = 1
    Or      LV_ERR_TPS_AD = 1
    Or      LV_ERR_TPS_AD_BOL = 1
    Or      LV_ERR_TPS_MAF_1 = 1
    Or      LV_ERR_TPS_MAF_2 = 1
    Or      LV_ERR_TPS_RATIO = 1
    Or      LV_ERR_TPS_ST_CHK_2 = 1
 Or         LV_ERR_CAM_CST_IVVT_IN[0] = 1
 Or         LV_ERR_CAM_CST_IVVT_EX[0] = 1
```

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```
        #if     NC_NR_CBK_IVVT = 2
        Or          LV_ERR_CAM_CST_IVVT_IN[1] = 1
        Or          LV_ERR_CAM_CST_IVVT_EX[1] = 1
        #endif
Then        LV_INH_DIAG_SEG_AD_ER = 1
Else        LV_INH_DIAG_SEG_AD_ER = 0
Endif
```

Inhibition of T_SEG_ER diagnosis:

```
If                  LV_IGK= 0
      Or            LV_ERR_CRK_PLAUS = 1
      Or            LV_ERR_CRK_SYN = 1
      Or            LV_ERR_CRK_TOOTH = 1
      Or            LV_ERR_CRK_TOOTH_PER = 1
      Or            LV_ERR_MAF_FRQ_EL[0] = 1
      Or            LV_ERR_MAF_FRQ_GRD[0] = 1
      Or            LV_ERR_MAF_FRQ_RNG[0] = 1
        #if     NC_MAF_NR = 2
             Or             LV_ERR_MAF_FRQ_EL[1] = 1
      Or     LV_ERR_MAF_FRQ_GRD[1] = 1
      Or     LV_ERR_MAF_FRQ_RNG[1] = 1
        #endif
      Or            LV_ERR_MEC_IVVT_EX = 1
      Or            LV_ERR_MEC_IVVT_IN = 1
      Or            LV_ERR_PER_CAM_EX[0] = 1
      Or            LV_ERR_PER_CAM_IN[0] = 1
      Or            LV_ERR_PLAUS_CAM_EX[0] = 1
      Or            LV_ERR_PLAUS_CAM_IN[0] = 1
      Or            LV_ERR_REF_CRK_CAM_EX[0] = 1
      Or            LV_ERR_REF_CRK_CAM_IN[0] = 1
      Or            LV_ERR_SLV_IVVT_EX = 1
      Or            LV_ERR_SLV_IVVT_IN = 1
      Or            LV_ERR_SYN_CAM_EX[0] = 1
      Or            LV_ERR_SYN_CAM_IN[0] = 1
      Or            LV_ERR_SYN_CRK_CAM_EX[0] = 1
      Or            LV_ERR_SYN_CRK_CAM_IN[0] = 1
      Or            LV_ERR_TOOTH_OFF_EX[0] = 1
      Or            LV_ERR_TOOTH_OFF_IN[0] = 1
        #if     NC_NR_CAM_CBK = 2
          Or    LV_ERR_PER_CAM_EX[1] = 1
              Or            LV_ERR_PER_CAM_IN[1] = 1
              Or            LV_ERR_PLAUS_CAM_EX[1] = 1
              Or            LV_ERR_PLAUS_CAM_IN[1] = 1
              Or            LV_ERR_REF_CRK_CAM_EX[1] = 1
              Or            LV_ERR_REF_CRK_CAM_IN[1] = 1
              Or            LV_ERR_SYN_CAM_EX[1] = 1
              Or            LV_ERR_SYN_CAM_IN[1] = 1
              Or            LV_ERR_SYN_CRK_CAM_EX[1] = 1
              Or            LV_ERR_SYN_CRK_CAM_IN[1] = 1
              Or            LV_ERR_TOOTH_OFF_EX[1] = 1
              Or            LV_ERR_TOOTH_OFF_IN[1] = 1
        #endif
```

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```
            Or          LV_ERR_TPS_1 = 1
            Or          LV_ERR_TPS_2 = 1
            Or          LV_ERR_TPS_AD = 1
            Or          LV_ERR_TPS_AD_BOL = 1
            Or          LV_ERR_TPS_MAF_1 = 1
            Or          LV_ERR_TPS_MAF_2 = 1
            Or          LV_ERR_TPS_RATIO = 1
            Or          LV_ERR_TPS_ST_CHK_2 = 1
    Or          LV_ERR_CAM_CST_IVVT_IN[0] = 1
    Or          LV_ERR_CAM_CST_IVVT_EX[0] = 1
              #if     NC_NR_CBK_IVVT = 2
              Or          LV_ERR_CAM_CST_IVVT_IN[1] = 1
              Or          LV_ERR_CAM_CST_IVVT_EX[1] = 1
              #endif
Then            LV_INH_DIAG_T_SEG_ER = 1
Else            LV_INH_DIAG_T_SEG_ER = 0
Endif
```

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A.38 Idle diagnosis engine roughness

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ER_MMV_IS_DIAG [NC_CYL_NR]	O/V	8000... 7FFFH	-8... 7.99975585938	244.141e-6	-
Filtered engine roughness value cylinder individual, x = 0 ... 5					

Input data:

ER_CYL [NC_CYL_NR] {p. 1454}	LV_IS {p. 1720}	MAF_HB {p. 805}	N {p. 1525}
NC_CYL_NR {p. 1526}	SEG_NR_ER {p. 1454}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_IS_ER_DIAG	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for calculating the ER diagnostic values					
IP_THD_IS_ER_DIAG__N__MAF	V	1... 7FFFH	-1... -32767	-1	µs
LDP_N__THD_IS_ER_DIAG	4	0... 1FE0H	0... 8160	1	rpm
LDP_MAF__THD_IS_ER_DIAG	4	0... FFH	0... 1389	5.4470588	mg/stk
ER reference value for ER diagnosis					

General Information

Conclusions on the combustion quality of a cylinder can be drawn by monitoring the crankshaft acceleration. This can be used in the workshop for diagnostic purposes.
The cylinder individual engine roughness values ER_CYL[NC_CYL_NR], which are determined for misfire diagnosis, are taken, related to a TCO- and operating point-dependent threshold and then smoothed by moving mean value calculation.
The 6 diagnostic values are transferred to the workshop tester via K-line. If an ER diagnostic value exceeds a determined threshold, it can be assumed that the corresponding cylinder has a malfunction.

Application Conditions

Initialization: RST
Recurrence: SEG
Activation: LV_IS==1
Deactivation: never

Function description

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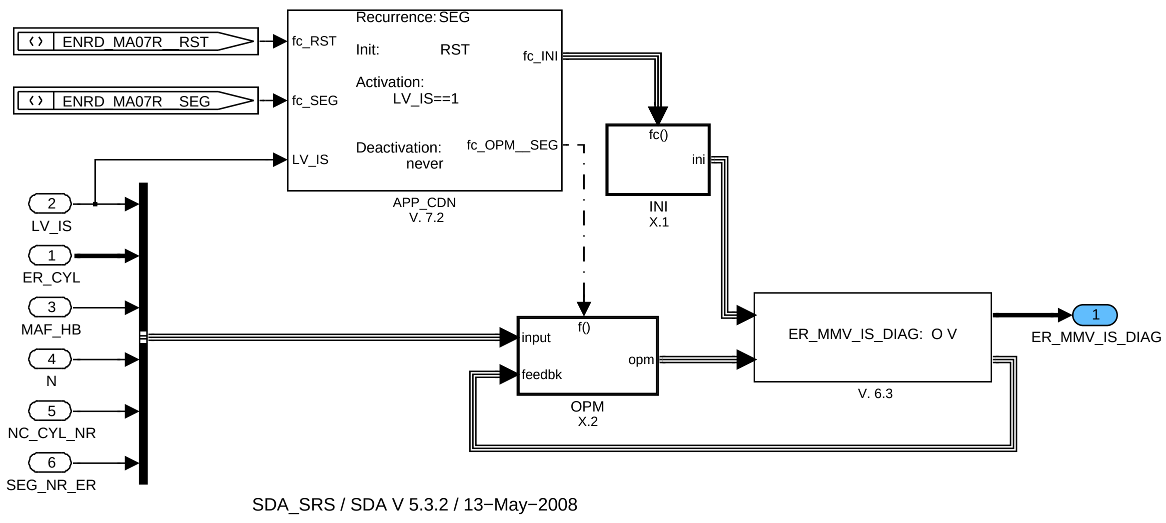

Figure A.38.1: : Path: ENRD_MA07R

A.38.1 Initialization

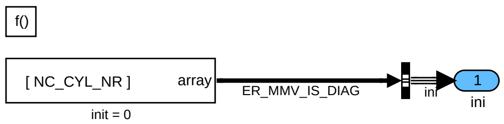

Figure A.38.2: : Path: ENRD_MA07R/INI

A.38.2 Formula section

A.38.2.1 Calculation of filtered engine roughness value

ER_MMV_IS_DIAG is calculated here.

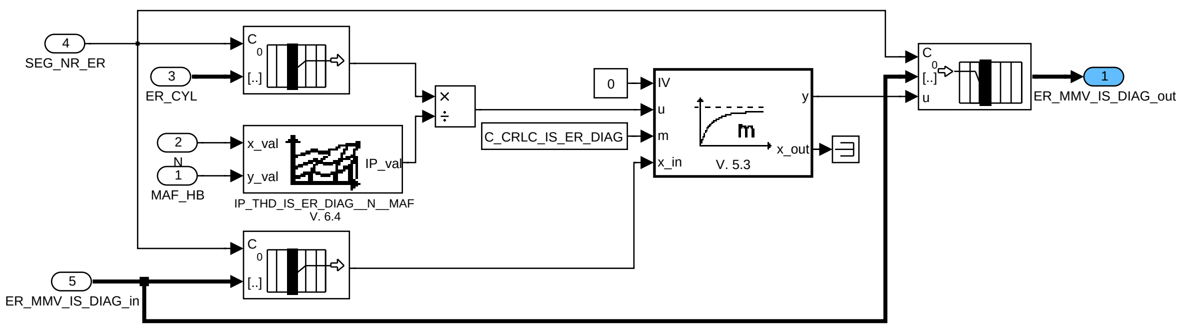

Figure A.38.3: : Path: ENRD_MA07R/OPM/OPM

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A.39 Idle speed control diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_ISC	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error sympton idle speed control diagnosis					
ERR_SYM_ISC_CST	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error sympton idle speed control diagnosis at coldstart					
LV_CDN_DIAG_ISC	O/V	0... 1H	0 ...1	1	-
Diagnosis conditions fulfilled					
LV_CDN_DIAG_ISC_CST	O/V	0... 1H	0 ...1	1	-
Diagnosis conditions fulfilled idle speed at coldstart					
LV_CDN_ISC_CST_CLU	V	0... 1H	0 ...1	1	-
Diagnosis conditions for valid TQ_AV for diagnosis					
LV_END_DIAG_ISC	V	0... 1H	0 ...1	1	-
Diagnosis done completely at least one time					
LV_END_DIAG_ISC_CST	V	0... 1H	0 ...1	1	-
Diagnosis at coldstart done completely at least one time					
LV_ERR_ISC	O/V	0... 1H	0 ...1	1	-
Boolean for fault memory Idle Control System: Unplausible Speed					
LV_ERR_ISC_CST	O/V	0... 1H	0 ...1	1	-
Boolean for fault memory Idle Control System: Unplausible speed at coldstart					
N_DIF_MAX_DIAG_ISC_CST	V	0... 1FE0H	0... 8160	1	rpm
Upper engine speed deviation of idle speed control diagnosis at coldstart					
N_DIF_MIN_DIAG_ISC_CST	V	0... 1FE0H	0... 8160	1	rpm
Lower engine speed deviation of idle speed control diagnosis at coldstart					
T_INH_ISC_DIAG_AST	V	0... FFH	0... 25.5	0.1	s
Time delay for diagnosis activation after start					
T_ISC_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
Time delay for diagnosis activation					

Input data:

FLOW_CPS {p. 3635}	LV_ACCOUT_RLY {p. 3589}	LV_AST_END {p. 2100}	LV_AT {p. 654}
LV_CDN_VB_OBD2 {p. 1185}	LV_CH_N_SP_IS {p. 1775}	LV_DRI {p. 1302}	LV_IGK {p. 906}
LV_INH_DIAG_ISC {p. 4392}	LV_IS {p. 1720}	LV_MTC_CUR_OFF {p. 6565}	LV_REQ_ISC {p. 3501}
LV_ST_END {p. 1720}	LV_VAR_TCT {p. 656}	MAF_HB {p. 805}	N {p. 1525}
N_SP_IS {p. 1122}	NC_IDX_DIAG_ISC	NC_IDX_DIAG_ISC_CST	T_AST {p. 1766}
TCO {p. 1100}	TCO_ST {p. 1100}	TQ_AV {p. 6656}	VS {p. 1176}

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Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetErrSym (**IN**<IDX_DIAG>,**OUT**<ERR_SYM>)
ACTION_ERRM_GetLvCdnDiag (**IN**<IDX_DIAG>,**OUT**<LV_CDN_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

0.03125 Calibration data:

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Name	Dim	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_ISC	1	0...FFH	0...255	1	-
Anti-bounce counter decrement for idle speed Plausibility check					
C_ABC_DEC_ISC_CST	1	0...FFH	0...255	1	-
Anti-bounce counter decrement for idle speed Plausibility check at coldstart					
C_ABC_INC_ISC	1	0...FFH	0...255	1	-
Anti-bounce counter increment for idle speed Plausibility check					
C_ABC_INC_ISC_CST	1	0...FFH	0...255	1	-
Anti-bounce counter increment for idle speed Plausibility check at coldstart					
C_ABC_MAX_ISC	1	1...FFH	1...255	1	-
Maximum value of the anti-bounce counter for idle speed Plausibility check					
C_ABC_MAX_ISC_CST	1	1...FFH	1...255	1	-
Maximum value of the anti-bounce counter for idle speed Plausibility check at coldstart					
C_FLOW_CPS_MAX_DIAG_ISC	1	0...FFFFH	0...7.99987793	1.2207E-4	kg/h
Maximum canister purge fuel flow from CPS to cylinder to perform idle speed plausibility check					
C_MAF_MAX_DIAG_ISC	1	0...FFH	0...1.389E+3	5.44705882	mg/stk
Maximum mass air flow to perform idle speed Plausibility check					
C_N_DIF_MAX_DIAG_ISC	1	0...1FE0H	0...8.16E+3	1	rpm
Maximum deviation above nominal idle speed					
C_N_DIF_MIN_DIAG_ISC	1	0...1FE0H	0...8.16E+3	1	rpm
Maximum deviation below nominal idle speed					
C_TCO_MIN_ISC	1	0...FEH	-48...142.5	0.75	°C
Min TCO threshold for idle speed diagnosis					
C_TCO_MIN_ISC_CST	1	0...FEH	-48...142.5	0.75	°C
Min TCO threshold for idle speed diagnosis at coldstart					
C_TQ_AV_MAX_DIAG_ISC_CST_AT	1	8000...7FFFH	-1.024E+3 ... 1.02397E+3	0.03125	Nm
Actual engine torque max level for ISC_CST diagnosis for automatic transmission					
C_TQ_AV_MAX_DIAG_ISC_CST_MT	1	8000...7FFFH	-1.024E+3 ... 1.02397E+3	0.03125	Nm
Actual engine torque max level for ISC_CST diagnosis for manual transmission					
C_TQ_AV_MAX_DIAG_ISC_CST_TCT	1	8000...7FFFH	-1.024E+3 ... 1.02397E+3	0.03125	Nm
Actual engine torque max level for ISC_CST diagnosis for automatic transmission					
C_T_DLY_ISC_DIAG	1	0...FFFFH	0...6.5535E+3	0.1	s
Time delay for diagnosis activation					
LC_INH_DIAG_ISC_MAN	1	0...1H	0...1	1	-
Flag for manual inhibitation of ISC diagnosis					
LC_T_INH_ISC_DIAG_AST	1	0...1H	0...1	1	-
Switch for inhibitation of activation timer after start of ISC diagnosis					
IP_FAC_DIF_DIAG_ISC_CST	6	0...FFH	0...1.9921875	0.0078125	-
LDP_T_AST_IP_FAC_DIAG_ISC_CST	6	0...FFFFH	0...6.5535E+3	0.1	[s]
Influence of time after start for limits of idle speed controller diagnosis at coldstart					
IP_T_INH_ISC_DIAG_AST	6	0...FFH	0...25.5	0.1	s
LDP_TCO_ST_IP_T_INH_ISC_DIAG	6	0...FEH	-48...142.5	0.75	[°C]
Initialization for activation timer of idle speed diagnosis after start					
IP_N_DIF_MAX_DIAG_ISC_CST	6x6	0...1FE0H	0...8.16E+3	1	rpm
LDP_TCO_IP_DIAG_ISC_CST	6	0...FEH	-48...142.5	0.75	[°C]
LDP_TCO_ST_IP_DIAG_ISC_CST	6	0...FEH	-48...142.5	0.75	[°C]
Upper engine speed deviation for limits idle speed control diagnosis at coldstart					
IP_N_DIF_MIN_DIAG_ISC_CST	6x6	0...1FE0H	0...8.16E+3	1	rpm
LDP_TCO_IP_DIAG_ISC_CST	6	0...FEH	-48...142.5	0.75	[°C]
LDP_TCO_ST_IP_DIAG_ISC_CST	6	0...FEH	-48...142.5	0.75	[°C]
Lower engine speed deviation for limits idle speed control diagnosis at coldstart					

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Function description

Application Condition

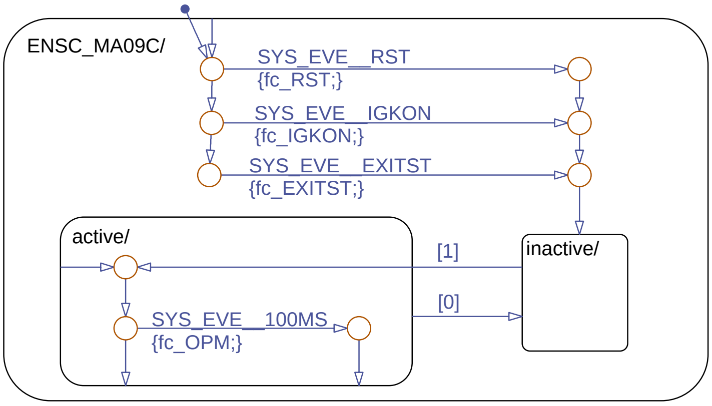

Figure A.39.1: ENSC_MA09C/APP_CDN/Chart

Function Description

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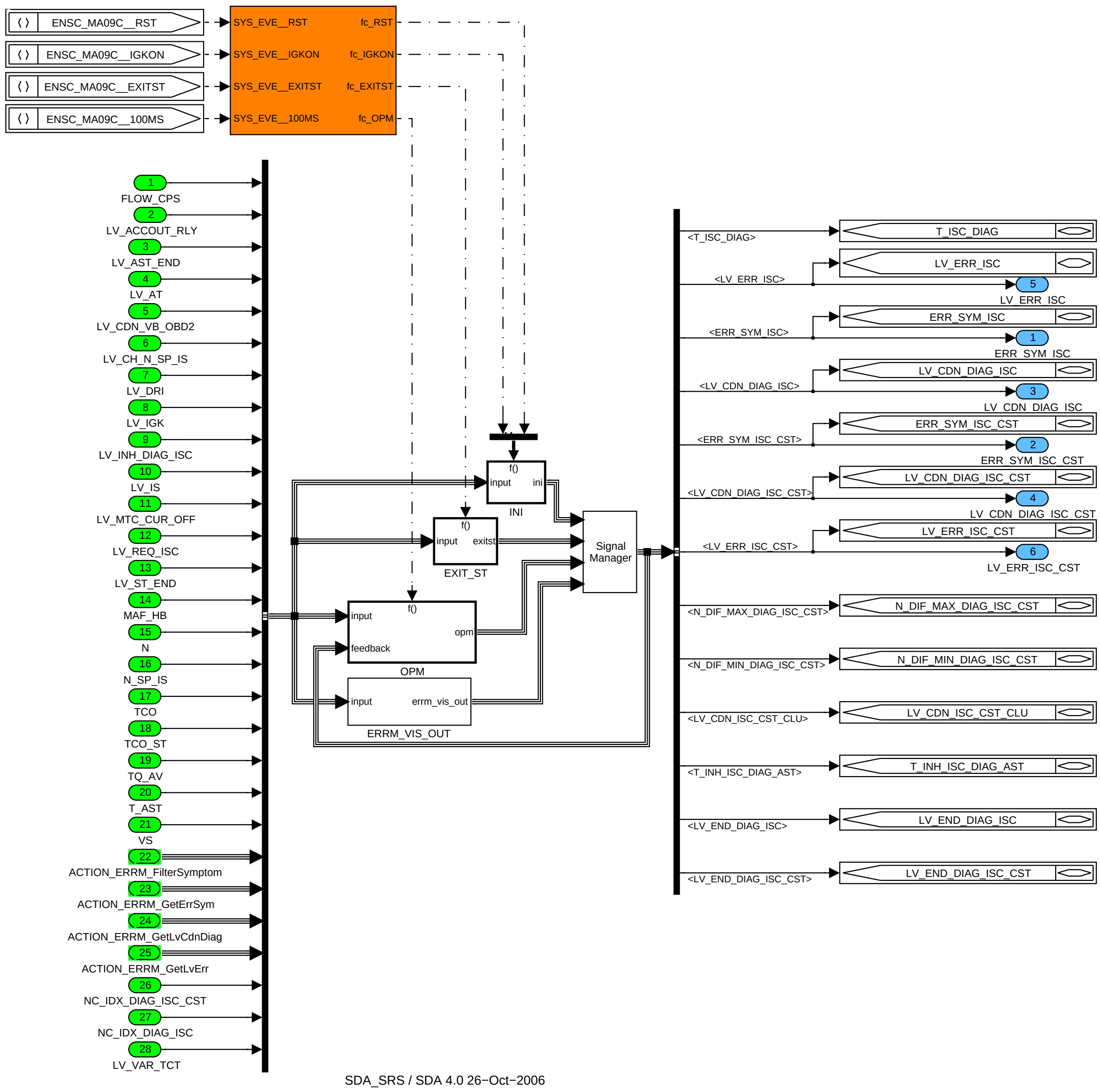

Figure A.39.2: ENSC_MA09C

A.39.1 Initialisation at system event reset.

Initialisation V/O mode ERRM variable at system reset

according ABC type **"STD_INI"** + **"DEC_CAL"**
(0 at LV_IGK 0->1 or reset, calibratable decrement)
All the V/O mode ERRM variable are initialised according to the ERRM template.

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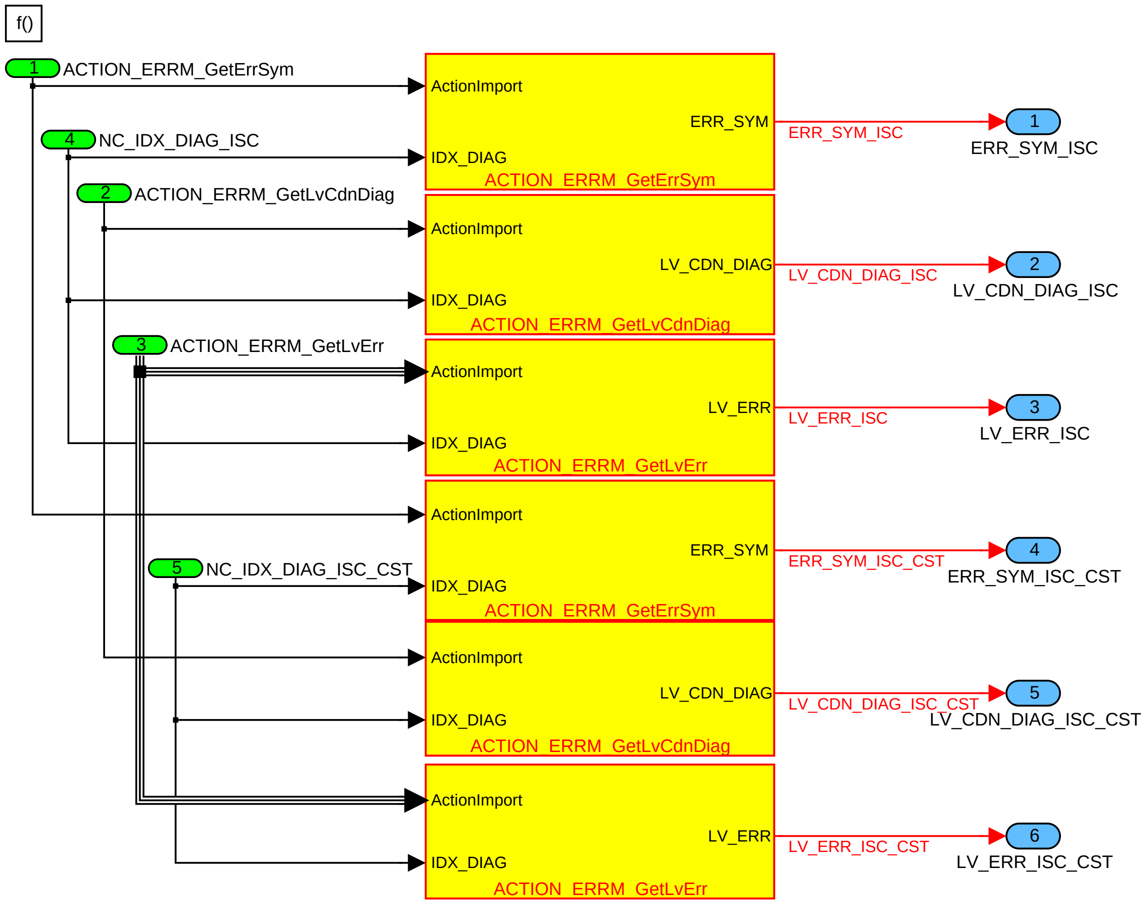

Figure A.39.3: ENSC_MA09C/INI/INI_1

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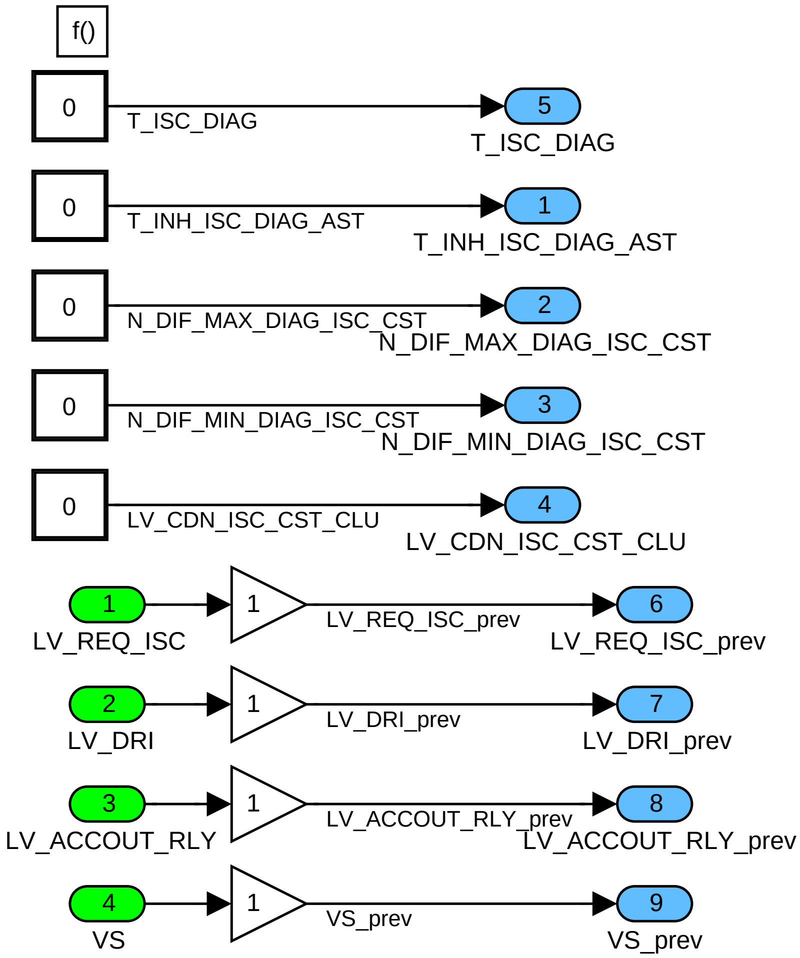

Figure A.39.4: ENSC_MA09C/INI/INI_2

A.39.2 Condition check at EXIT_ST system event

Condition check when the transition of LV_ST_END 0 - -> 1 and calculation of variable T_INH_ISC_DIAG_AST

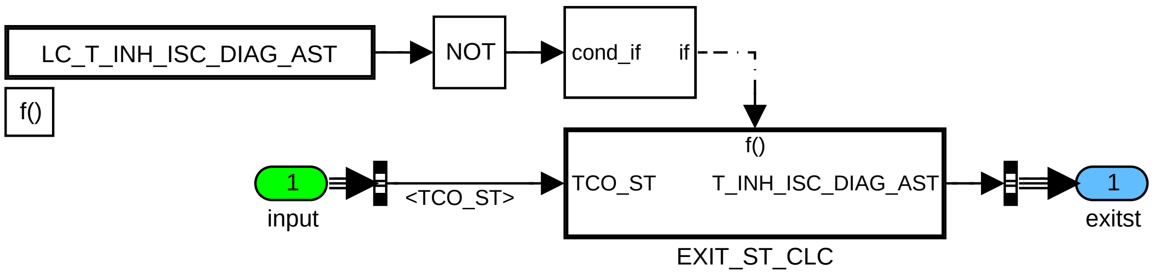

Figure A.39.5: ENSC_MA09C/EXIT_ST

Calculation of T_INH_ISC_DIAG_AST

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T_INH_ISC_DIAG_AST is calculated using IP Curve IP_T_INH_ISC_DIAG_AST with TCO_ST as input.

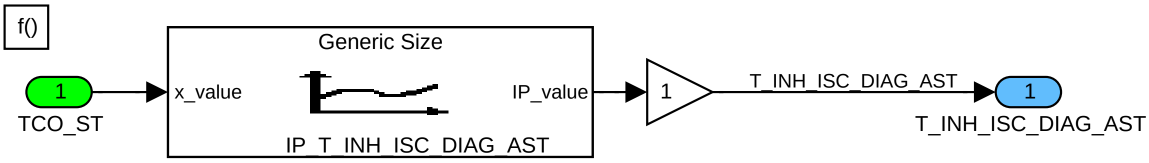

Figure A.39.6: ENSC_MA09C/EXIT_ST/EXIT_ST_CLC

A.39.3 Plausibility check

FUNCTION DESCRIPTION:
General information:

Engine speed deviation from the nominal engine speed is monitored either the vehicle is stopped and the throttle is settled after closing or after engine start. Due to different engine operating characteristics the coldstart-monitoring is performed by using limits depending on the temperature of cooling water and time after start.

If the difference to the nominal idle speed keeps too high or too low in spite of an activated idle speed controller, an idle speed control plausibility error is detected.

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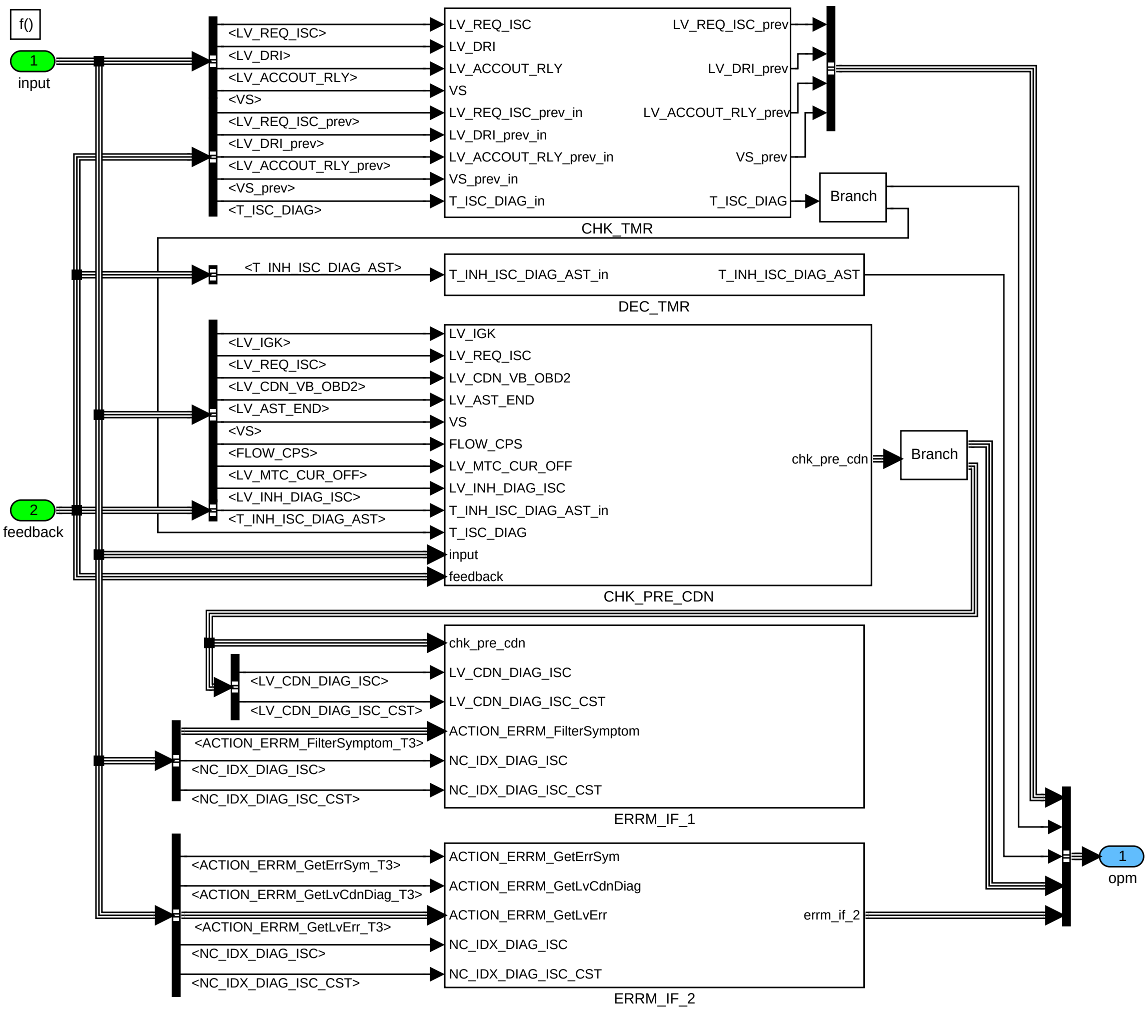

Figure A.39.7: ENSC_MA09C/OPM

Calculation of timer T_ISC_DIAG

The following timer is used for delaying the activation of the diagnosis algorithm when the idle speed controller is activated or speed is possibly excited due to strong disturbances such as ACC or drive train engaging (in order to prevent a diagnosis at high, normal speed deviations):

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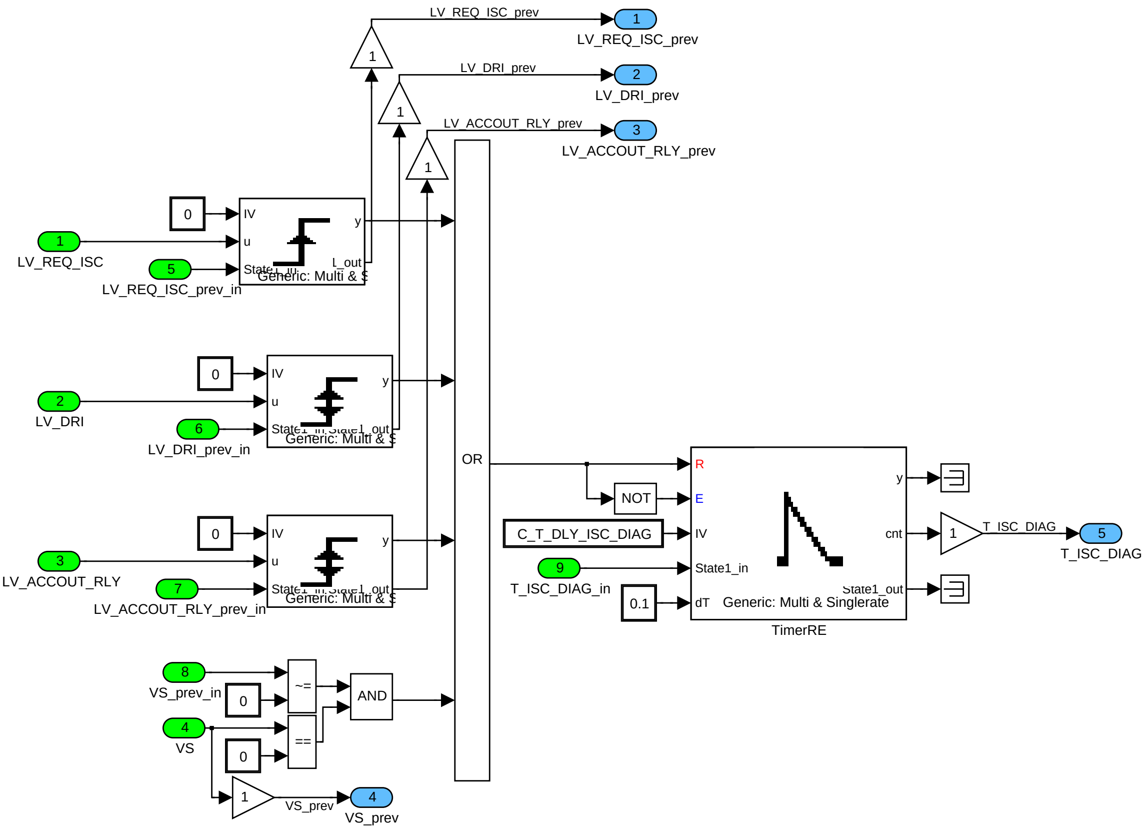

Figure A.39.8: ENSC_MA09C/OPM/CHK_TMR

Calculation of timer T_INH_ISC_DIAG_AST

Timer is already initialised at system event EXITST. Here the timer starts decrementing.

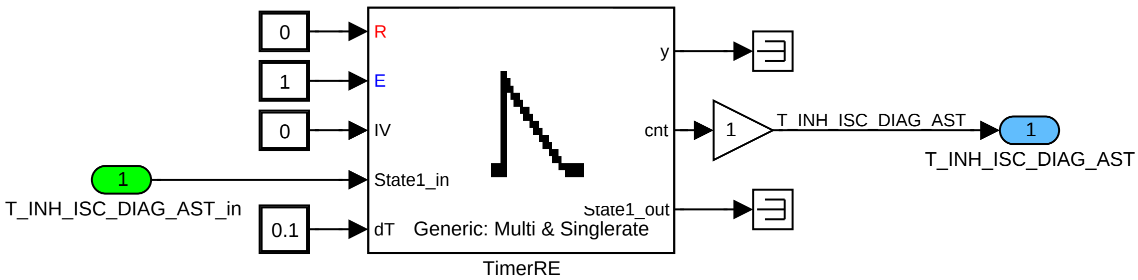

Figure A.39.9: ENSC_MA09C/OPM/DEC_TMR

Checking of pre-condition

The plausibility diagnosis is performed only if the pre conditions are fulfilled

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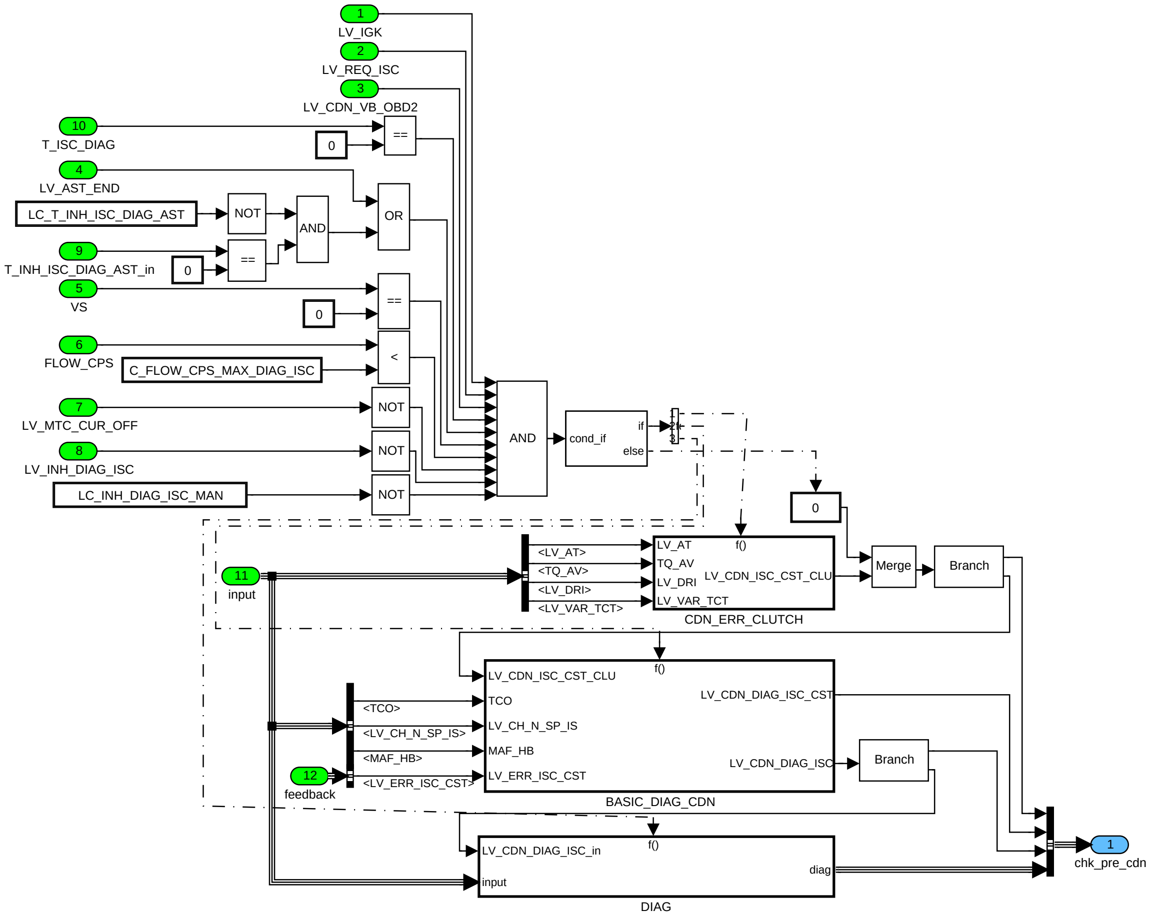

Figure A.39.10: ENSC_MA09C/OPM/CHK_PRE_CDN

Condition to check clutch error

Condition to prevent error in case of clutch use

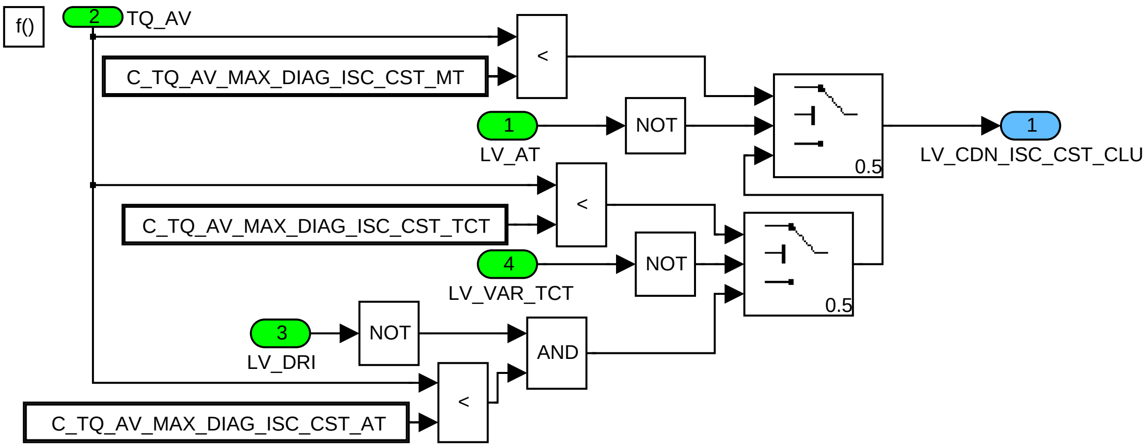

Figure A.39.11: ENSC_MA09C/OPM/CHK_PRE_CDN/CDN_ERR_CLUTCH

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Calculation of ERRM condition check

Calculation LV_CDN_DIAG_ISC and LV_CDN_DIAG_ISC_CST is done here for diagnosis calculation part. of ERRM.

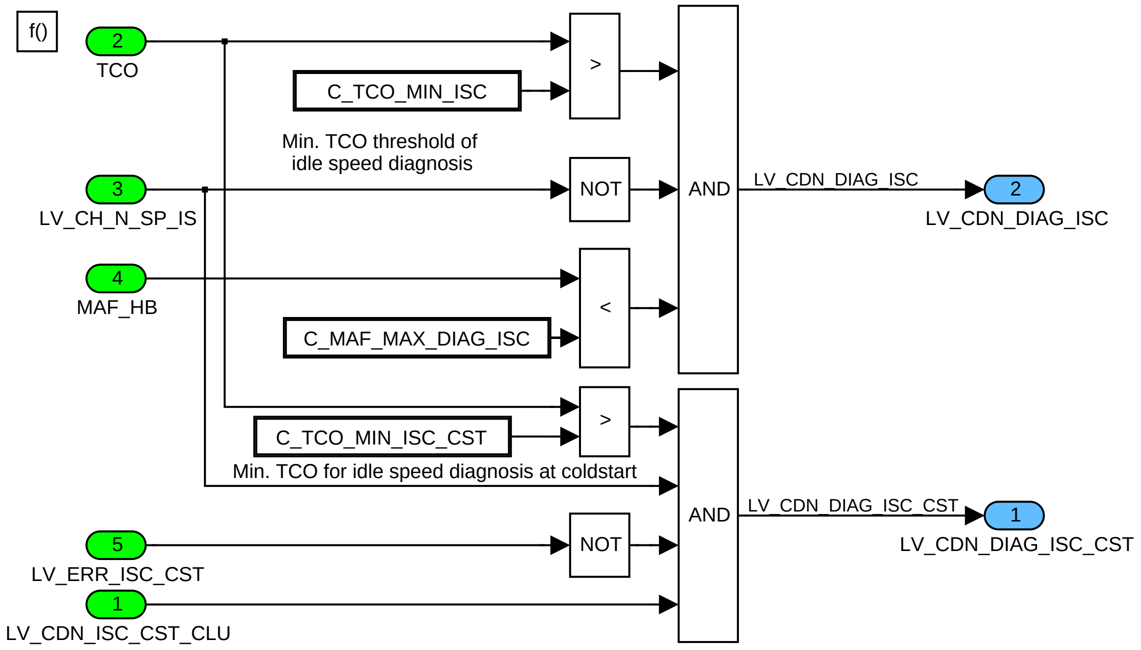

Figure A.39.12: ENSC_MA09C/OPM/CHK_PRE_CDN/BASIC_DIAG_CDN

ERRM diagnosis

Diagnosis at warmstart

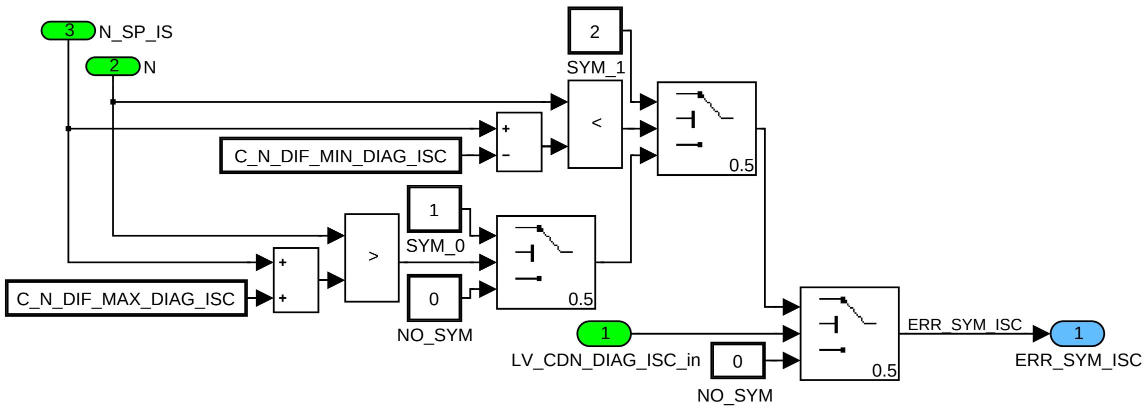

Figure A.39.13: ENSC_MA09C/OPM/CHK_PRE_CDN/DIAG/WARMSTART

Diagnosis at coldstart

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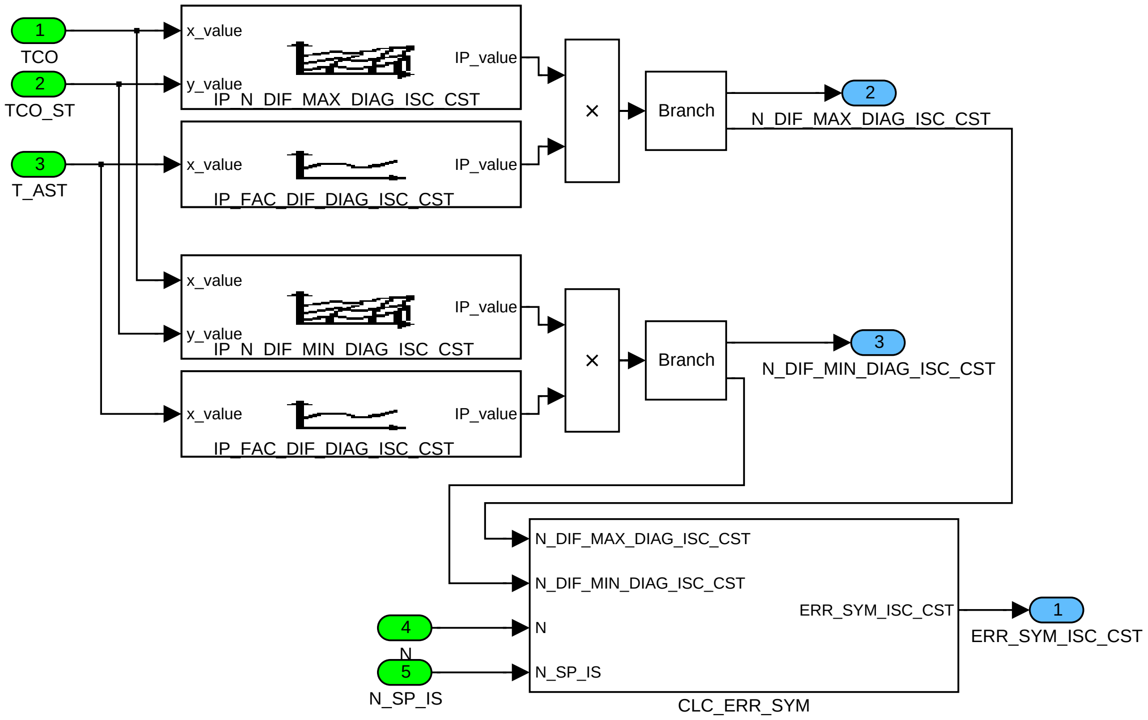

Figure A.39.14: ENSC_MA09C/OPM/CHK_PRE_CDN/DIAG/COLDSTART

Calculation of ERR_SYM_ISC_CST

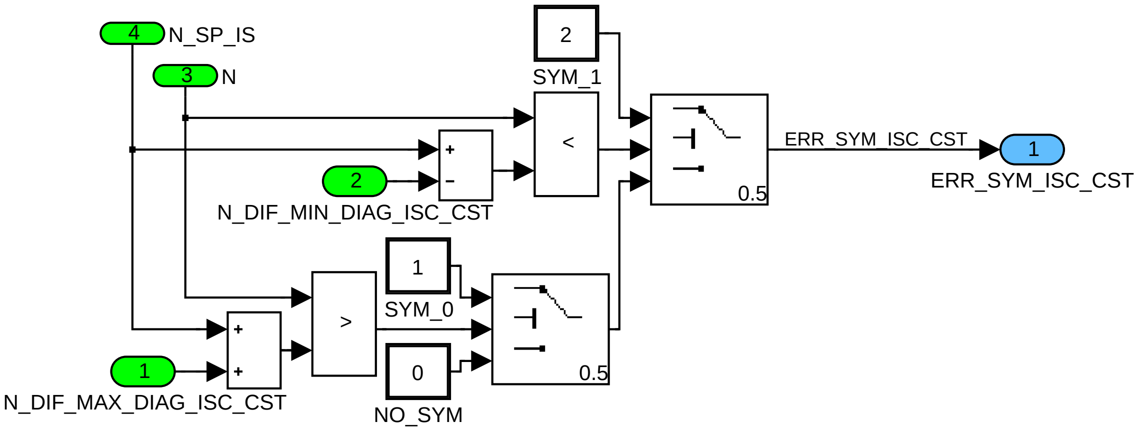

Figure A.39.15: ENSC_MA09C/OPM/CHK_PRE_CDN/DIAG/COLDSTART/CLC_ERR_SYM

ERRM interface 1

LV_ERR_ISC and LV_ERR_ISC_CST are terminated since they are in V/O mode. They will be calculated using the ERRM standard template for V/O mode ERRM variable.

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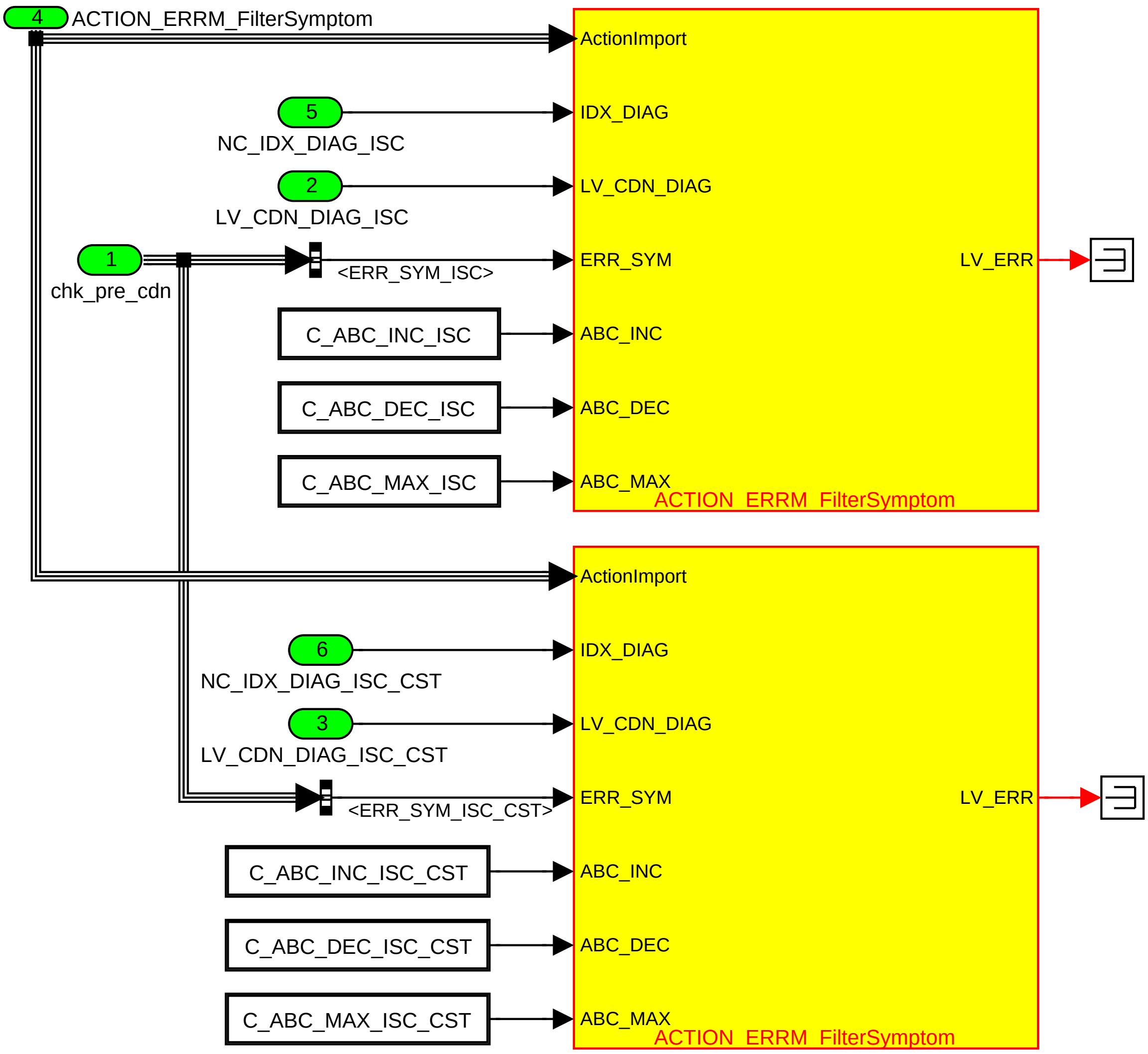

Figure A.39.16: ENSC_MA09C/OPM/ERRM_IF_1

ERRM interface to calculate V/O mode ERRM variables.

V/O mode ERRM variables are calculated here.

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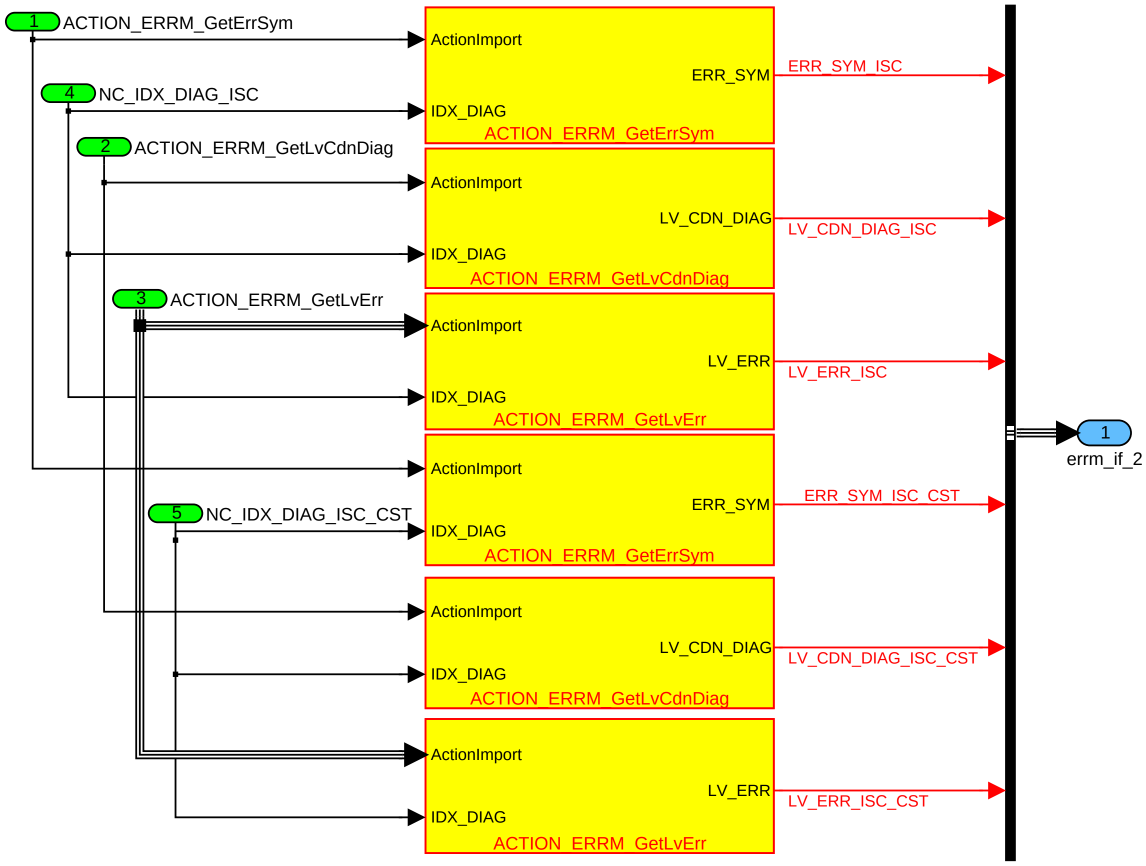

Figure A.39.17: ENSC_MA09C/OPM/ERRM_IF_2

A.39.4 Visual mode output

Visual mode output is calculated here.

Calculation of LV_END_DIAG_ISC and LV_END_DIAG_ISC_CST using ERRM visual mode template

Calculation of LV_END_DIAG_ISC and LV_END_DIAG_ISC_CST is done here.

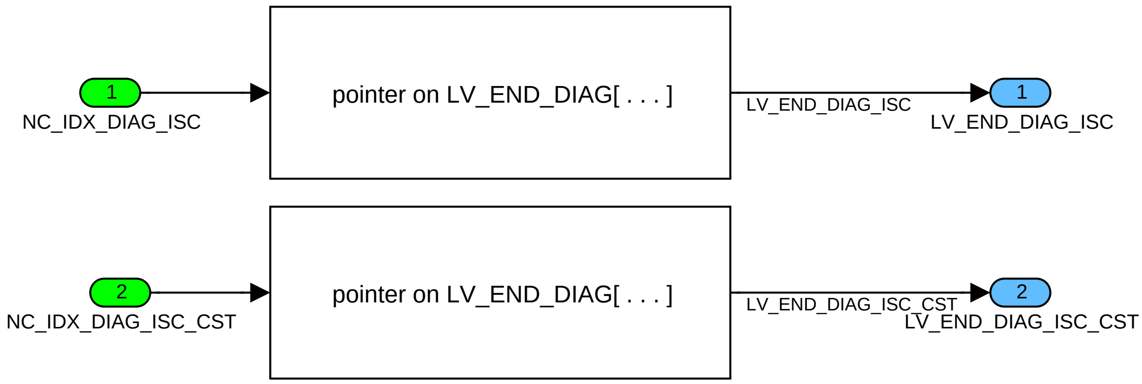

Figure A.39.18: ENSC_MA09C/ERRM_VIS_OUT/CLC_VIS_OUT

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A.40 Idle speed control diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_ISC	O/V	0... 1H	0 ...1	1	-
Flag for inhibitation of the Idle Speed Control Diagnosis					
LV_INH_DIAG_RBM_ISC	O/V	0... 1H	0 ...1	1	-
Flag for inhibitation of the Idle Speed Control Diagnosis if there is a OBD failure					
LV_MAF_SP_TQI_DYW_DIAG_ISC	O/V	0... 1H	0 ...1	1	-
Indication for limited dynamic condition - functional check ISC					
LV_T_MIN_IS_CH_CST	O/V	0... 1H	0 ...1	1	-
Boolean variable indicating minimum time in idle speed during catalyst heating					
MAF_SP_TQI_MMV_DIAG_ISC	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Moving mean value of MAF_SP_TQI (RAM cell) - functional check ISC					
STATE_RBM_ISC	O/V	0... 7H	0 ...7	1	-
Interface of ISC monitor with the Rate-Based Monitoring statisticsBit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1)Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1)Bit 2: individual RBM conditio					
STATE_RBM_ISC_CST	O/V	0... 7H	0 ...7	1	-
Interface of ISC_CST monitor with Rate-Based Monitoring statisticsBit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1)Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1)Bit 2: individual RBM conditio					
T_DLY_MAF_SP_TQI_DIAG_ISC	O/V	0... FFH	0... 25.5	0.1	s
Actual deactivation time after drop of limited dynamic condition					
T_IS_CH_CST	O/V	0... FFH	0... 25.5	0.1	s
Accumulated time in idle speed during CH					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CH_N_SP_IS {p. 1775}	LV_DC {p. 5746}	LV_END_DIAG_ISC {p. 4377}
LV_END_DIAG_ISC_CST {p. 4377}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT] {p. 1061}
LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CUS {p. 1042}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_DIAGCPS {p. 5926}
LV_ERR_EL_CPS {p. 4708}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_MAF {p. 4815}
LV_ERR_MAP_DIP_PLAUS {p. 1062}	LV_ERR_MAP_DIP_SENS {p. 4824}	LV_ERR_MAP_DIP_SHIFT {p. 4824}	LV_ERR_MAP_TPS_PLAUS {p. 1062}
LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}	LV_ERR_PVS_DOUBLE {p. 4216}	LV_ERR_SLV_IVVT_EX {p. 4627}
LV_ERR_SLV_IVVT_IN {p. 4627}	LV_ERR_TPS {p. 4982}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}

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LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_1 {p. 4951}	LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_VCV {p. 4729}
LV_ERR_VS {p. 5021}	LV_IGK {p. 906}	LV_IS {p. 1720}	LV_ST_END {p. 1720}
LV_TQ_ISC_I_TQ_PSTE {p. 3440}	MAF_SP_TQI {p. 8390}	NC_IDX_DIAG_AMP	NC_IDX_DIAG_AMP_PLAUS
NC_IDX_DIAG_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT]	NC_IDX_DIAG_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT]	NC_IDX_DIAG_CHG_LS_UP	NC_IDX_DIAG_CRK_PLAUS
NC_IDX_DIAG_CRK_SYN	NC_IDX_DIAG_CRK_TOOTH	NC_IDX_DIAG_CRK_TOOTH_PER	NC_IDX_DIAG_DIAGCPS
NC_IDX_DIAG_EL_CPS	NC_IDX_DIAG_FUP	NC_IDX_DIAG_FUP_MFP_PLAUS	NC_IDX_DIAG_FUP_ORNG
NC_IDX_DIAG_FUP_ST	NC_IDX_DIAG_H_PRS_SYS {p. 989}	NC_IDX_DIAG_LOAD_TPS_PLAUS	NC_IDX_DIAG_MAF
NC_IDX_DIAG_MAP_DIP_PLAUS	NC_IDX_DIAG_MAP_DIP_SENS	NC_IDX_DIAG_MAP_DIP_SHIFT	NC_IDX_DIAG_MEC_IVVT_EX [NC_NR_CBK_IVVT]
NC_IDX_DIAG_MEC_IVVT_IN [NC_NR_CBK_IVVT]	NC_IDX_DIAG_MTC_CTL_2	NC_IDX_DIAG_MTC_CTL_3	NC_IDX_DIAG_MTC_DR
NC_IDX_DIAG_PER_CAM_EX_1	NC_IDX_DIAG_PER_CAM_IN_1	NC_IDX_DIAG_PLAUS_CAM_EX_1	NC_IDX_DIAG_PLAUS_CAM_IN_1
NC_IDX_DIAG_PVS_DOUBLE	NC_IDX_DIAG_REF_CRK_CAM_EX_1	NC_IDX_DIAG_REF_CRK_CAM_IN_1	NC_IDX_DIAG_SLV_IVVT_EX [NC_NR_CBK_IVVT]
NC_IDX_DIAG_SLV_IVVT_IN [NC_NR_CBK_IVVT]	NC_IDX_DIAG_SYN_CAM_EX_1	NC_IDX_DIAG_SYN_CAM_IN_1	NC_IDX_DIAG_SYN_CRK_CAM_EX_1
NC_IDX_DIAG_SYN_CRK_CAM_IN_1	NC_IDX_DIAG_TOOTH_OFF_EX_1	NC_IDX_DIAG_TOOTH_OFF_IN_1	NC_IDX_DIAG_TPS_1
NC_IDX_DIAG_TPS_2	NC_IDX_DIAG_TPS_AD	NC_IDX_DIAG_TPS_AD_BOL	NC_IDX_DIAG_TPS_MAF_1
NC_IDX_DIAG_TPS_MAF_2	NC_IDX_DIAG_TPS_RATIO	NC_IDX_DIAG_TPS_ST_CHK_2	NC_IDX_DIAG_VCV
NC_IDX_DIAG_VS {p. 5024}	NC_NR_CBK_IVVT {p. 604}	STATE_CH {p. 1777}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_MAF_SP_TQI_DIAG_ISC	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation constant for calculation of MAF_SP_TQI_MMV_DIAG_ISC					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_MAF_SP_TQI_DIAG_ISC_CST	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation constant of MAF_SP_TQI_MMV_DIAG_ISC during coldstart monitoring					
C_MAF_SP_TQI_DYW_DIAG_ISC	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Dynamic window around MAF_SP_TQI_MMV_DIAG_ISC					
C_MAF_SP_TQI_DYW_DIAG_ISC_CST	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Dynamic window around MAF_SP_TQI_MMV_DIAG_ISC at coldstart					
C_T_DLY_MAF_SP_TQI_DIAG_ISC	-	0... FFH	0... 25.5	0.1	s
Deactivation time after drop of limited dynamic					
C_T_IS_RBM_ISC	-	0... FFH	0... 25.5	0.1	s
RBM Diagnose threshold for the time since state idle active					

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

Overview

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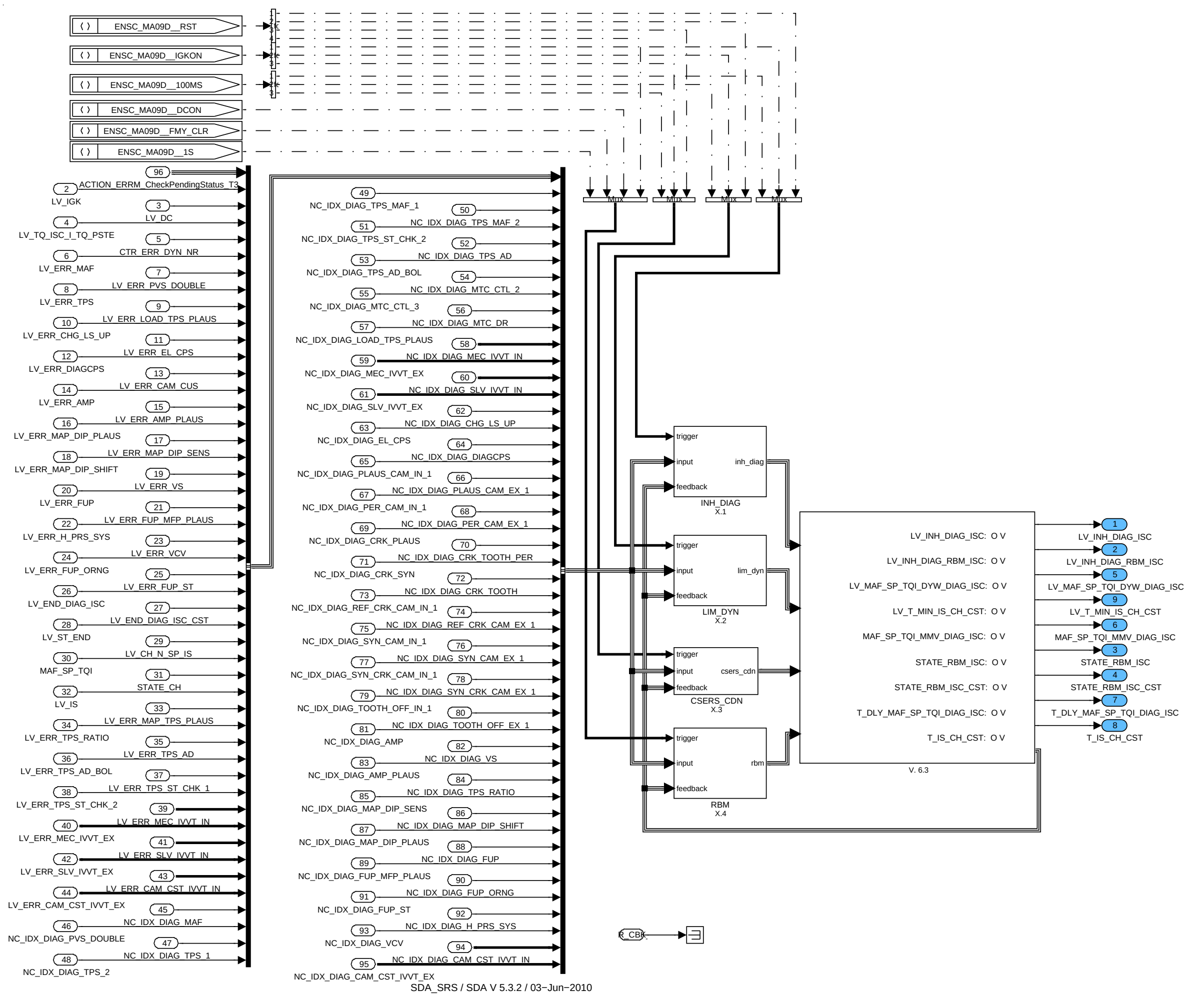

Figure A.40.1: :

General Information

A.40.1 Inhibition of diagnoses

Description:
If one of the following components fail, the ISC diagnoses function is stopped by LV_INH_DIAG_ISC = 1. The RBM of ISC diagnoses is stopped by
LV_INH_DIAG_RBM_ISC = 1.

Application Conditions

Initialization: RST, IGKON
Recurrence: 100MS
Activation: LV_IGK==1
Deactivation: never

Function description

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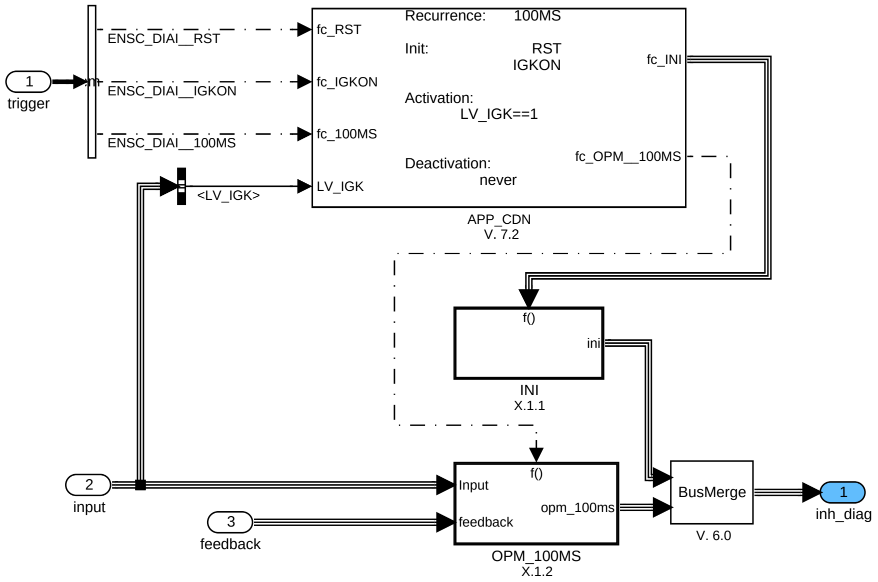

Figure A.40.2: :

A.40.1.1 Initialization at Reset and Ignition Key off to on

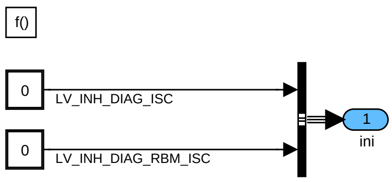

Figure A.40.3: :

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A.40.1.2 Calculation at 100ms recurrence

A.40.1.2.1 Inhibition due to OBD1 error

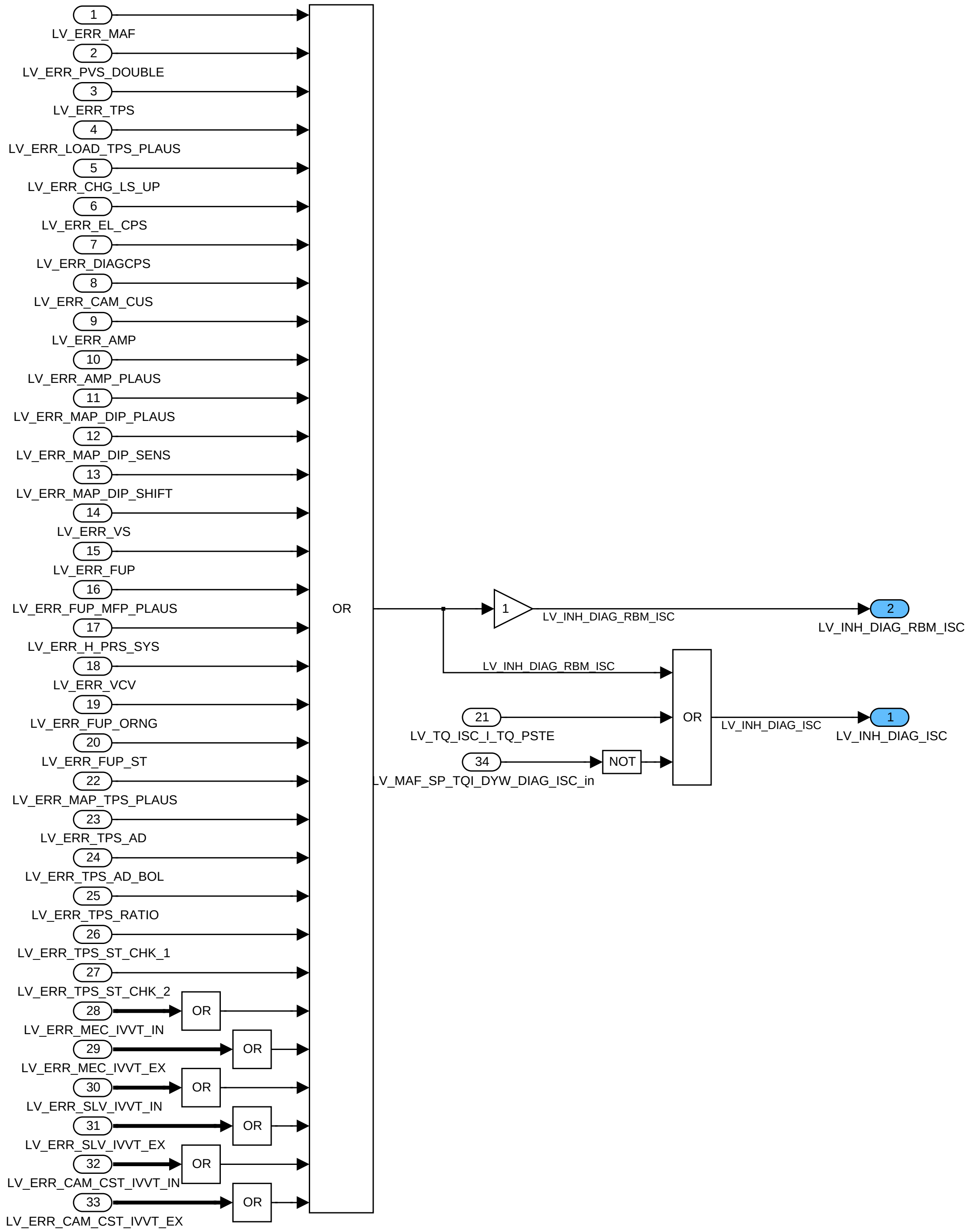

Figure A.40.4: :

A.40.2 Limited dynamic condition LV_MAF_SP_TQI_DYW_DIAG_ISC

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Application Conditions

Initialization: RST, IGKON
Recurrence: 100MS
Activation: LV_ST_END==1
Deactivation: LV_ST_END==0

Function description

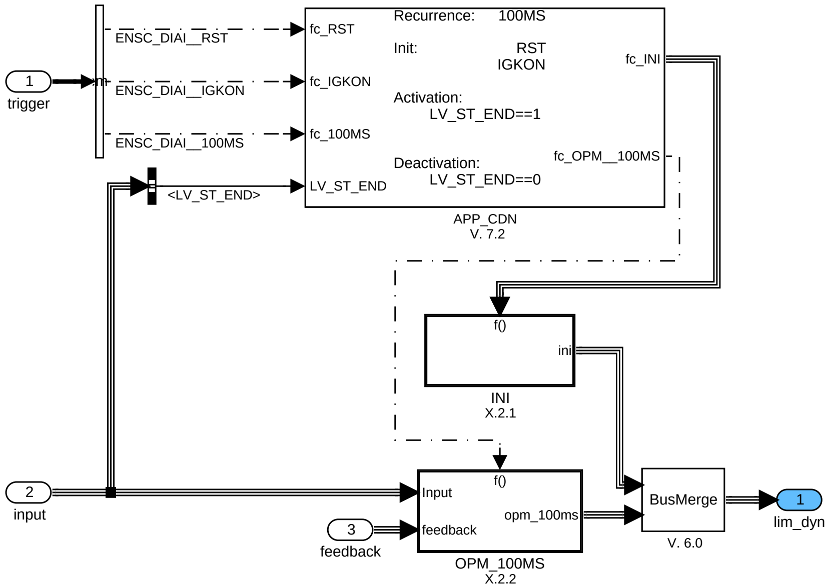

Figure A.40.5: :

A.40.2.1 Initialization at Reset and Ignition Key off to on

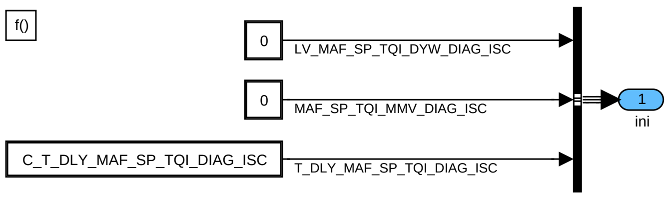

Figure A.40.6: :

A.40.2.2 Calculation at 100ms recurrence

Calculation of MAF_SP_TQI_MMV_DIAG_ISC:

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A.40.2.2.1 No title given

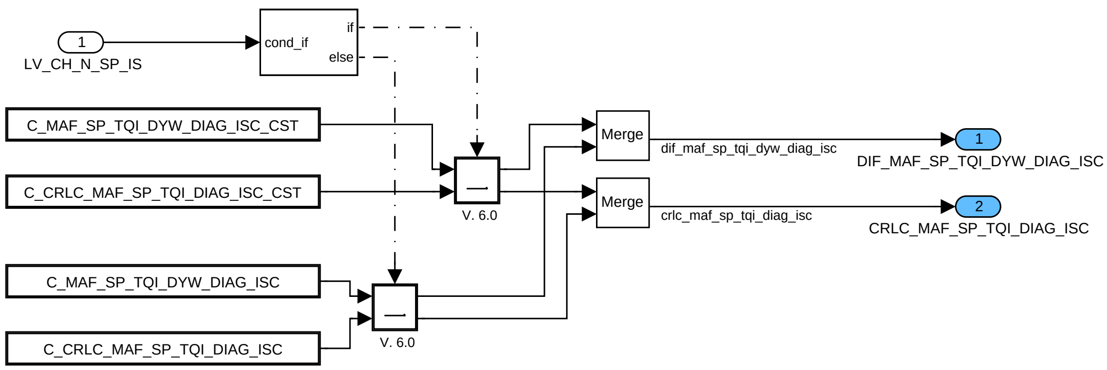

Figure A.40.7: :

A.40.2.2.2 No title given

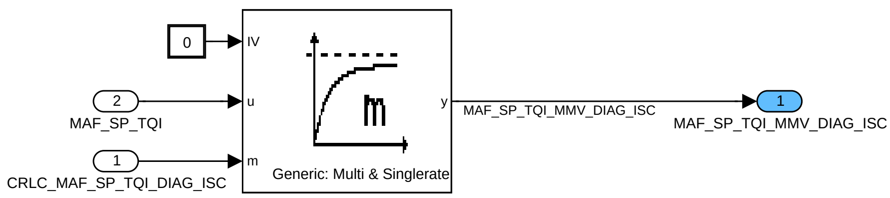

Figure A.40.8: :

A.40.2.2.3 No title given

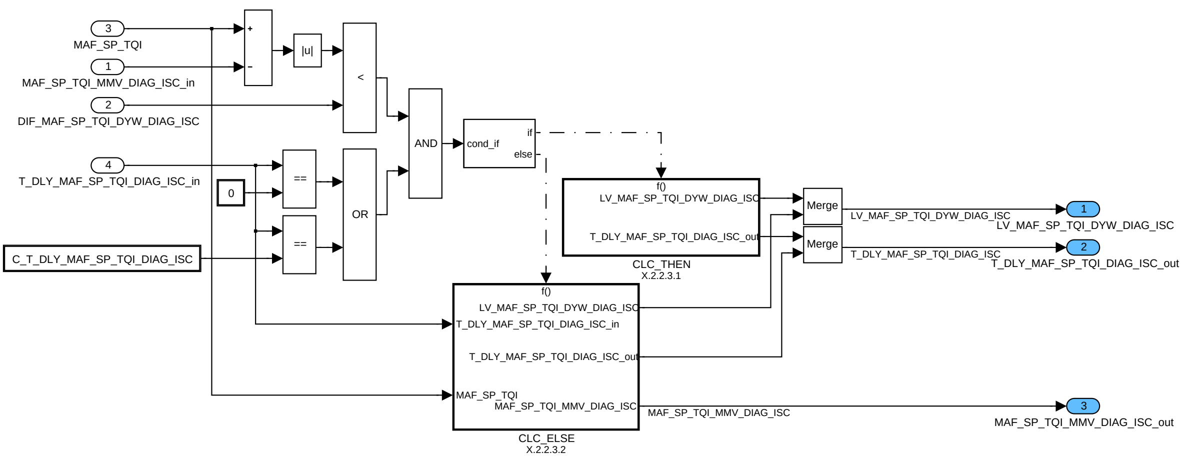

Figure A.40.9: :

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A.40.2.2.3.1 No title given

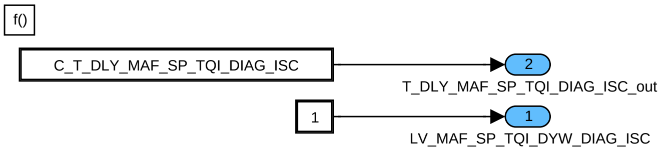

Figure A.40.10: :

A.40.2.2.3.2 No title given

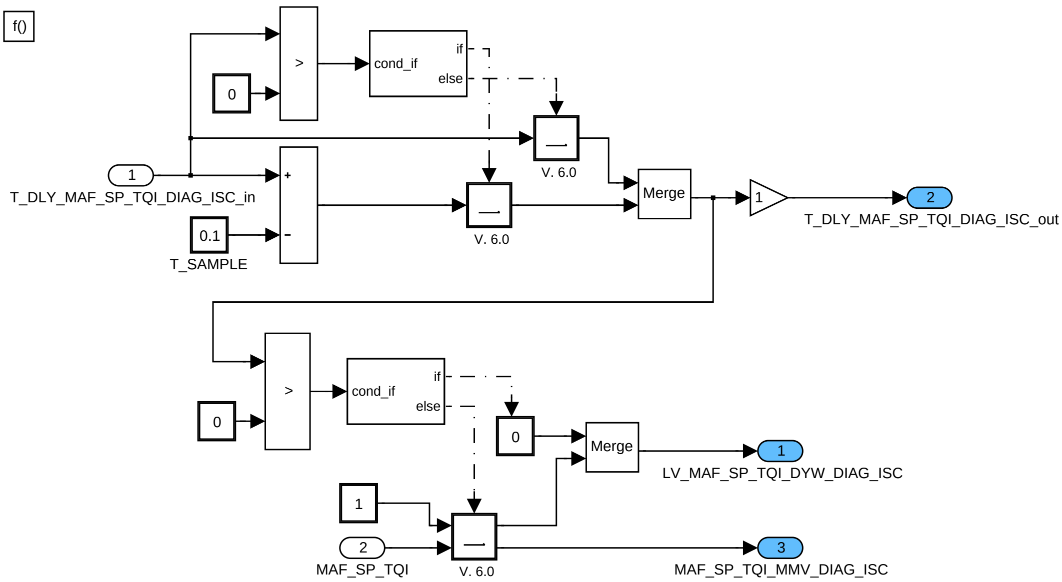

Figure A.40.11: :

A.40.3 Calculation of STATE_RBM_ISC_CST denominator individual condition.

Application Conditions

Initialization: RST, IGKON
Recurrence: 100MS
Activation: LV_IGK==1 & LV_T_MIN_IS_CH_CST==0
Deactivation: LV_IGK==0 | LV_T_MIN_IS_CH_CST==1

Function description

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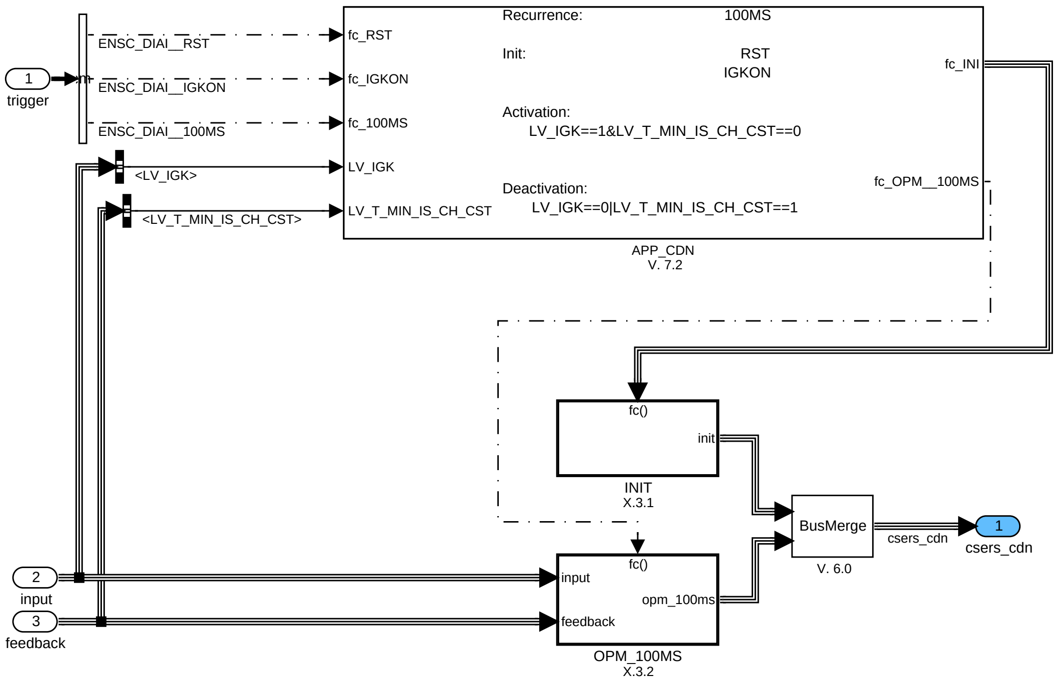

Figure A.40.12: :

A.40.3.1 Initialization

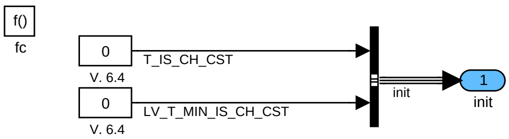

Figure A.40.13: :

A.40.3.2 Calculation at 100 ms recurrence

A.40.3.2.1 Calculation

For the special CSERS denomination of the idle speed control diagnosis under cold start conditions the accumulated time in state "catalyst heating" in keeping with "cold start idle speed setpoint active" is calculated here. The timer is only reset with the start of a new driving cycle.

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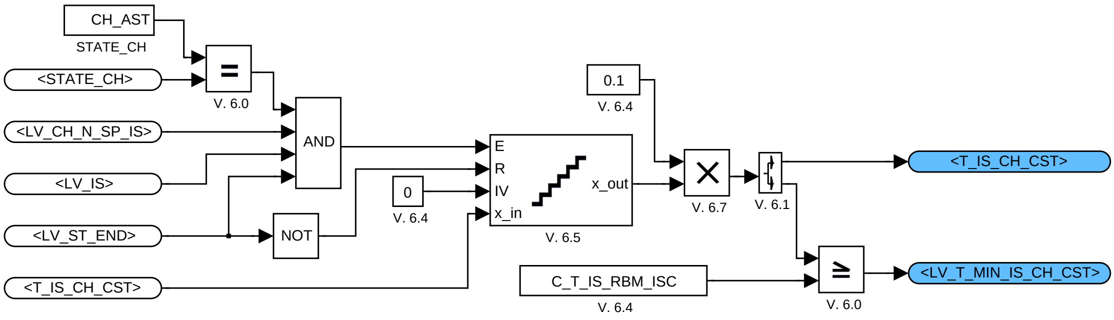

Figure A.40.14: :

A.40.4 Interface for Rate - Based - Monitoring

General Information:
With this module the interface between the ISC /ISC_CST monitor and the rate based monitoring statistics is defined with STATE_RBM_ISC /STATE_RBM_ISC_CST data. Within STATE_RBM_ISC /ISC_CST, three different information are defined:
Conditions for monitoring are met long enough to detect manipulation (bit 0) (no intrusive operation, no short trip)
Monitor disabled because of system malfunction (bit 1) (depending on failure status: pending)
Monitor individual RBM conditions encountered within this DC(bit 2) (not valid for ISC daignosis)

Application Conditions

Initialization: RST, CLRFMY, DCON
Recurrence: 1S
Activation: LV_DC==1
Deactivation: LV_DC==0

Function description

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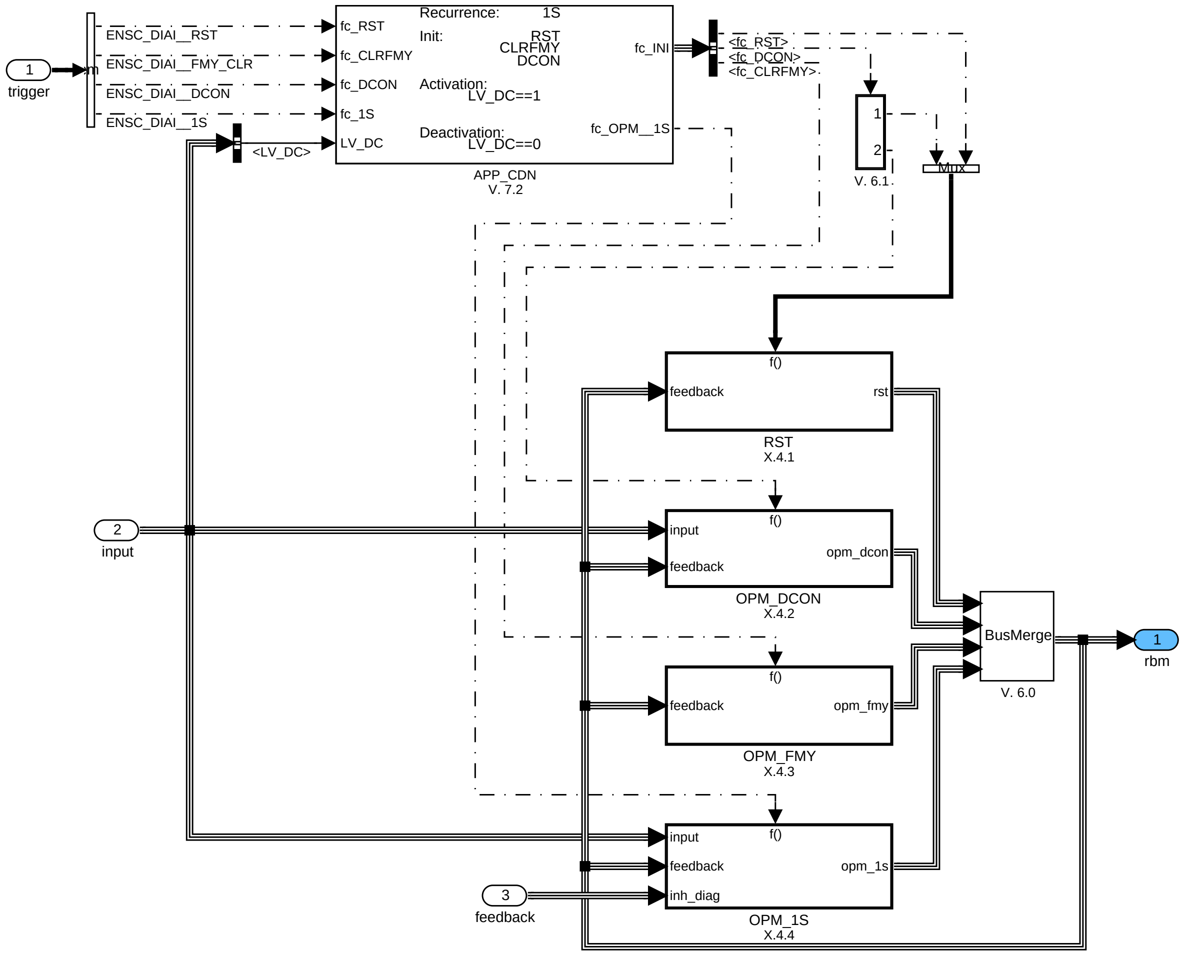

Figure A.40.15: :

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A.40.4.1 Initialization at Reset

A.40.4.1.1 No title given

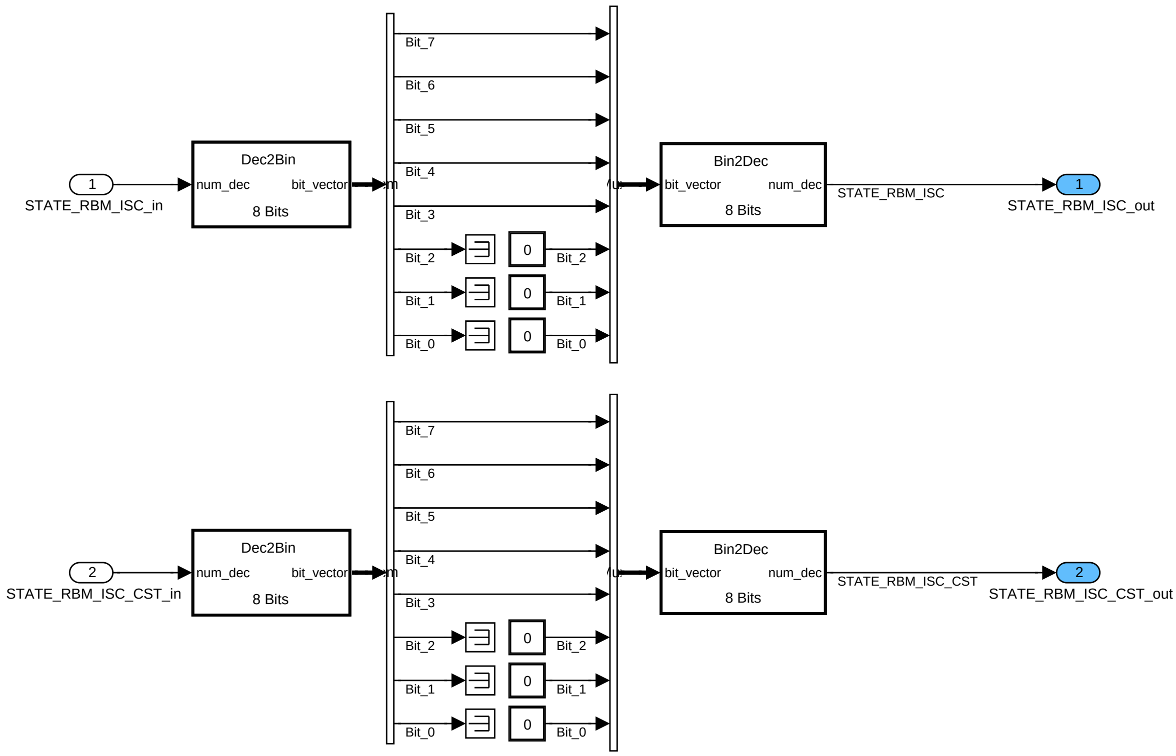

Figure A.40.16: :

A.40.4.2 At LV_DC 0 to 1 transition

The pending status of the following failures has to be checked only once :

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LV_ERR_MAF	LV_ERR_PVS_DOUBLE	LV_ERR_TPS_1	LV_ERR_TPS_2
LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_ST_CHK_2	LV_ERR_TPS_AD
LV_ERR_TPS_AD_BOL	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR
LV_ERR_LOAD_TPS_PLAUS	LV_ERR_MEC_IVVT_IN	LV_ERR_MEC_IVVT_EX	LV_ERR_SLV_IVVT_IN
LV_ERR_SLV_IVVT_EX	LV_ERR_CHG_LS_UP	LV_ERR_EL_CPS	LV_ERR_DIAGCPS
LV_ERR_PLAUS_CAM_IN_1	LV_ERR_PLAUS_CAM_EX_1	LV_ERR_PER_CAM_IN_1	LV_ERR_PER_CAM_EX_1
LV_ERR_CRK_PLAUS	LV_ERR_CRK_TOOTH_PER	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH
LV_ERR_REF_CRK_CAM_IN_1	LV_ERR_REF_CRK_CAM_EX_1	LV_ERR_SYN_CAM_IN_1	LV_ERR_SYN_CAM_EX_1
LV_ERR_SYN_CRK_CAM_IN_1	LV_ERR_SYN_CRK_CAM_EX_1	LV_ERR_TOOTH_OFF_IN_1	LV_ERR_TOOTH_OFF_EX_1
LV_ERR_AMP	LV_ERR_VS	LV_ERR_AMP_PLAUS	LV_ERR_TPS_RATIO
LV_ERR_MAP_DIP_SENS	LV_ERR_MAP_DIP_SHIFT	LV_ERR_MAP_DIP_PLAUS	LV_ERR_FUP
LV_ERR_FUP_MFP_PLAUS	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS
LV_ERR_VCV	LV_ERR_MAP_TPS_PLAUS	LV_ERR_CAM_CST_IVVT_IN	LV_ERR_CAM_CST_IVVT_EX

A.40.4.2.1 No title given

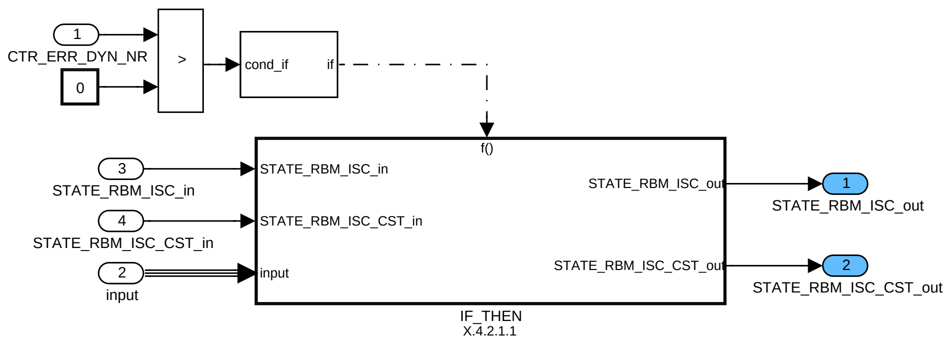

Figure A.40.17: :

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A.40.4.2.1.1 No title given

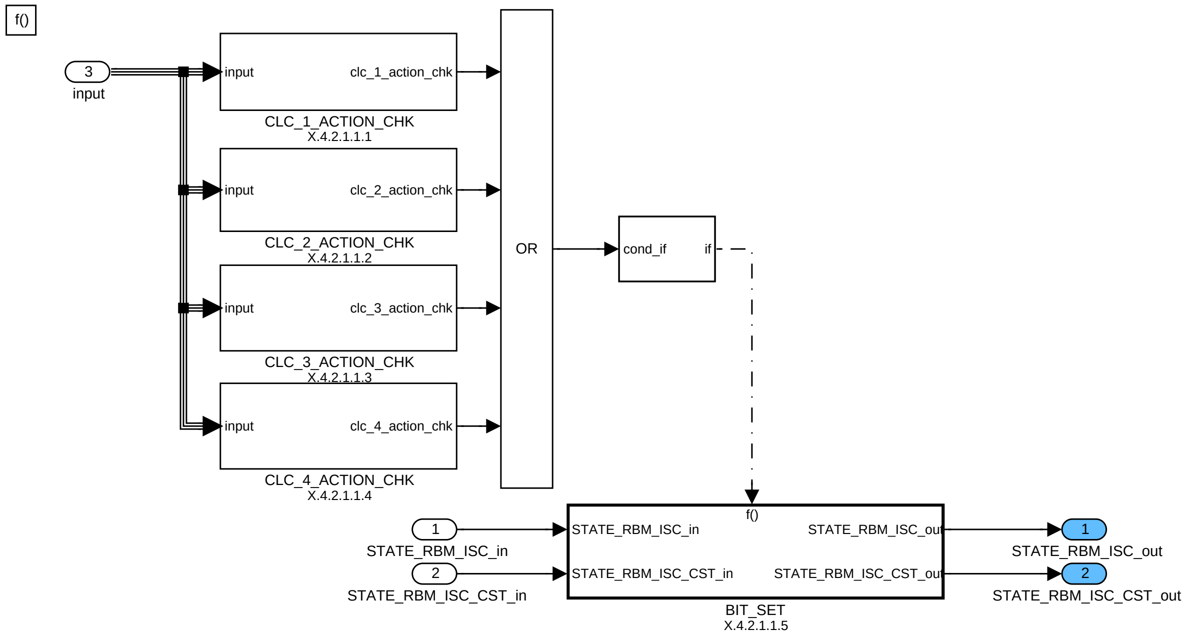

Figure A.40.18: :

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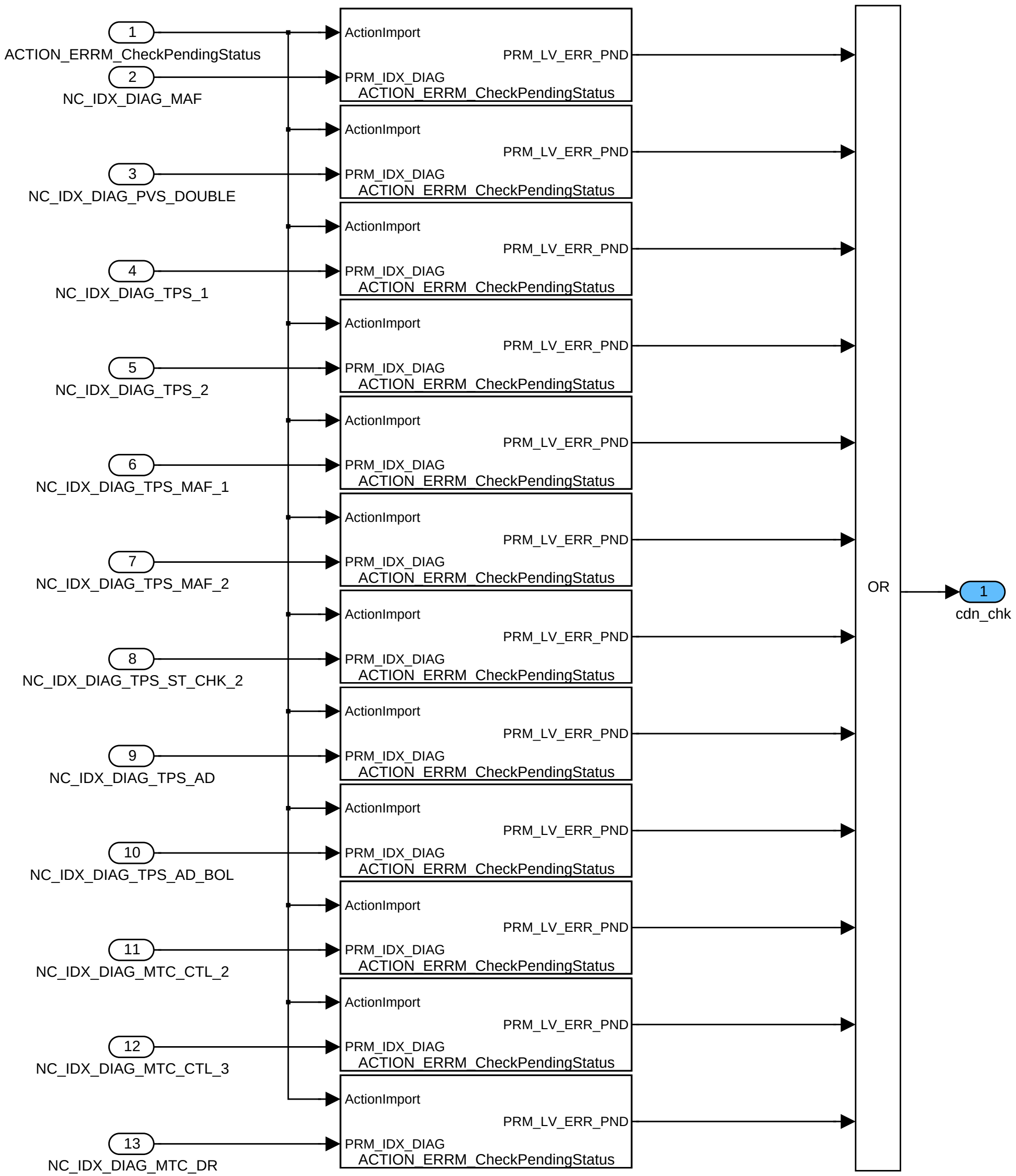
A.40.4.2.1.1.1 No title given

A.40.4.2.1.1.1.1 No title given



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A.40.4.2.1.1.2 No title given

A.40.4.2.1.1.2.1 No title given

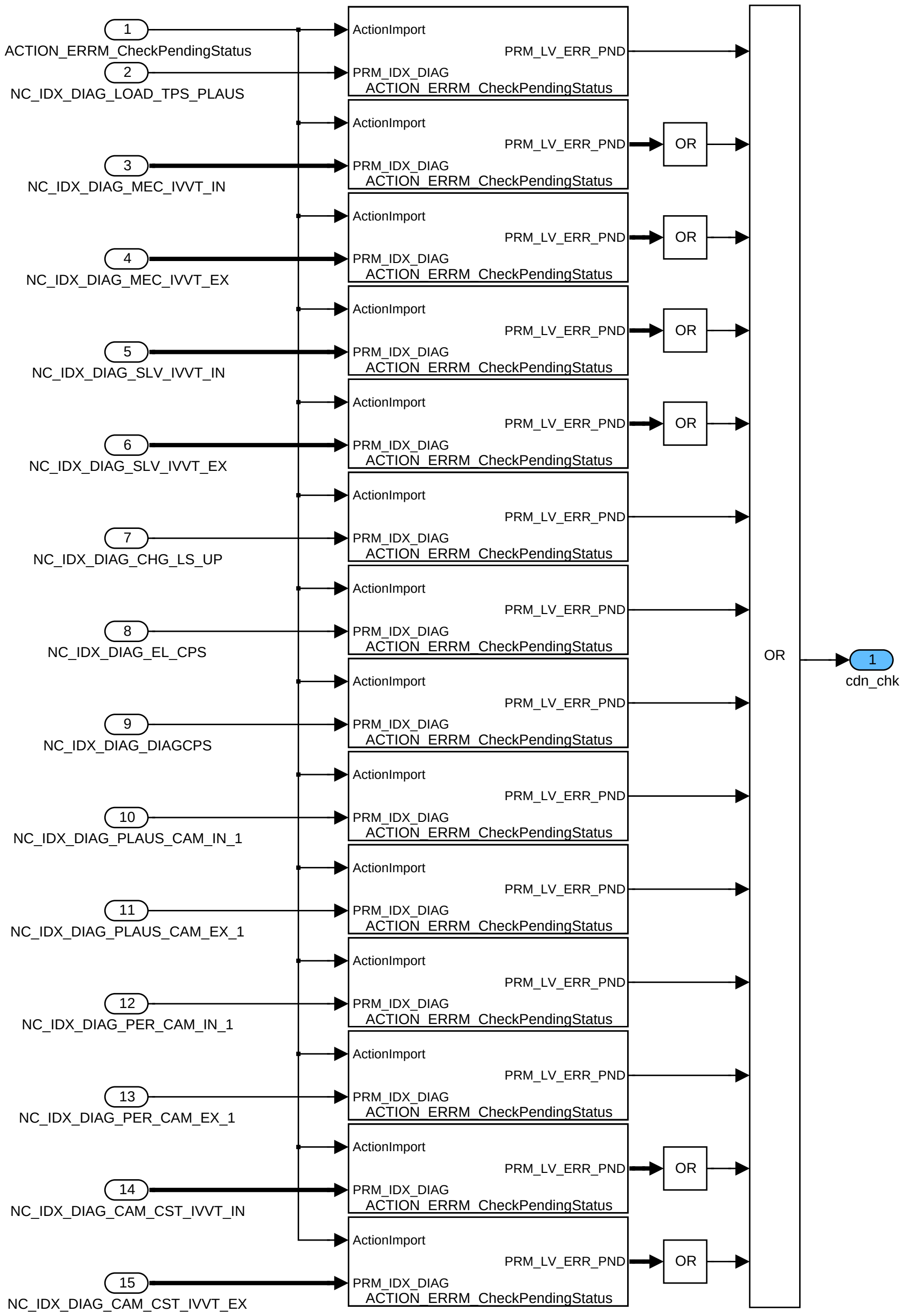

Figure A.40.20: :

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A.40.4.2.1.1.3 No title given

A.40.4.2.1.1.3.1 No title given

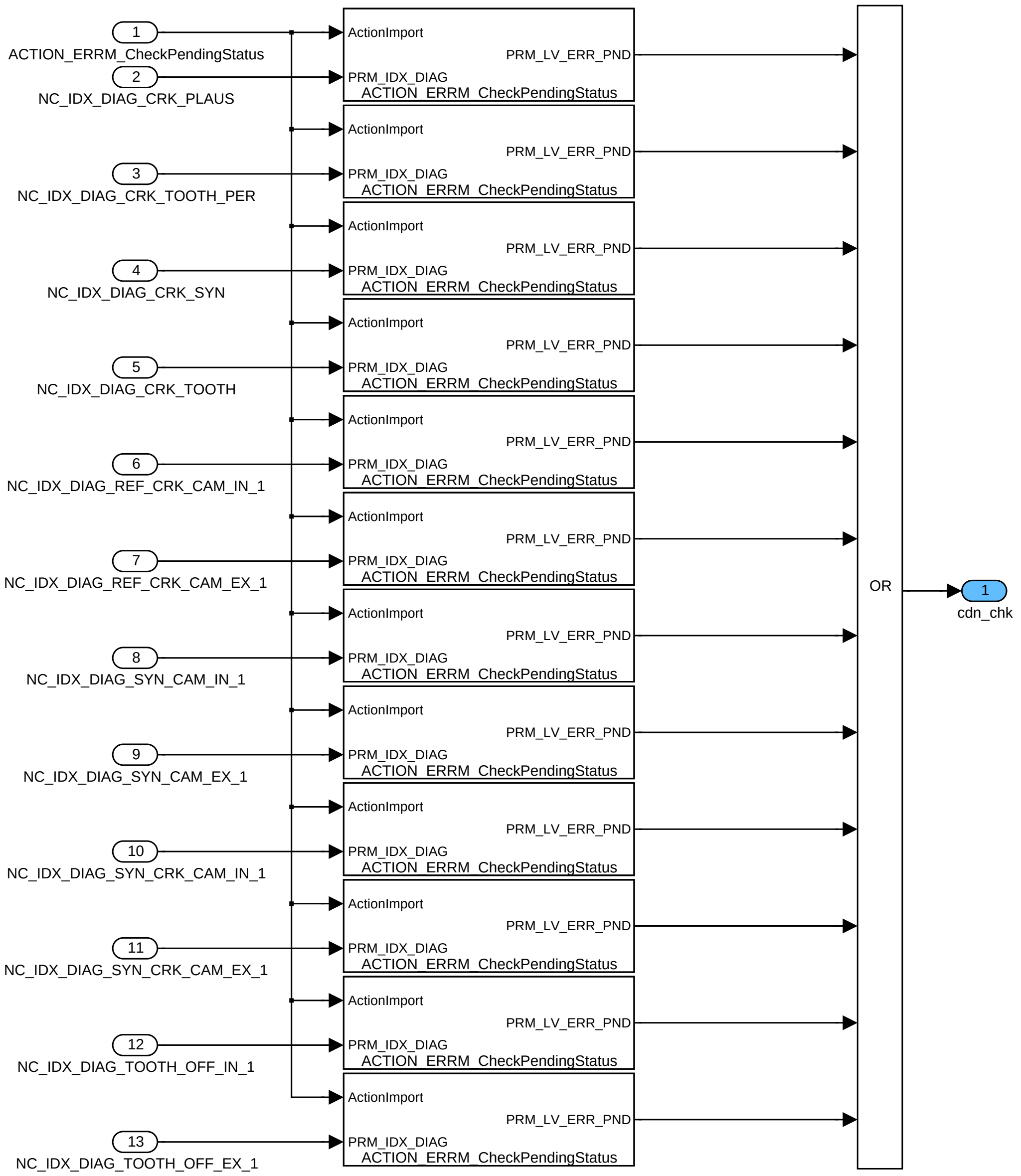

Figure A.40.21: :

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A.40.4.2.1.1.4 No title given

A.40.4.2.1.1.4.1 No title given

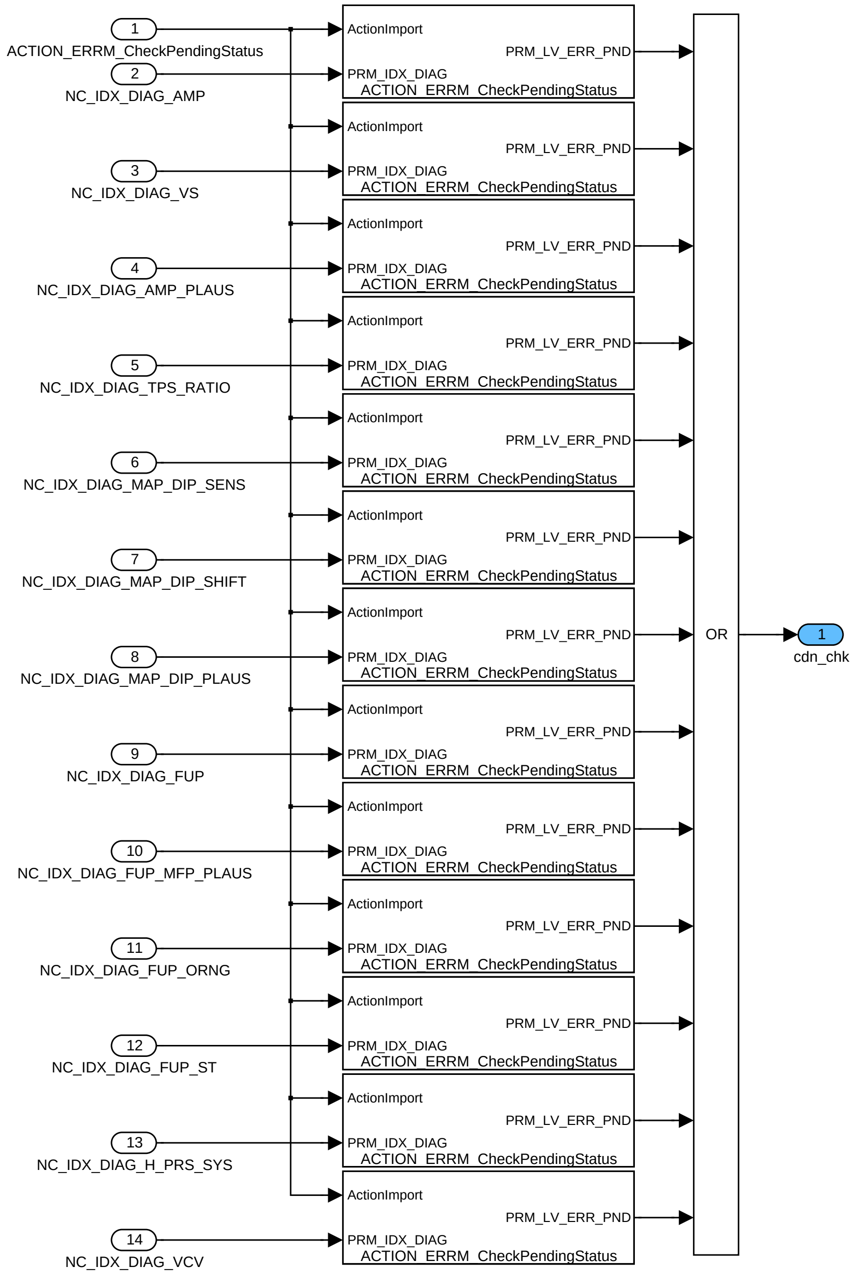

Figure A.40.22: :

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A.40.4.2.1.1.5 No title given

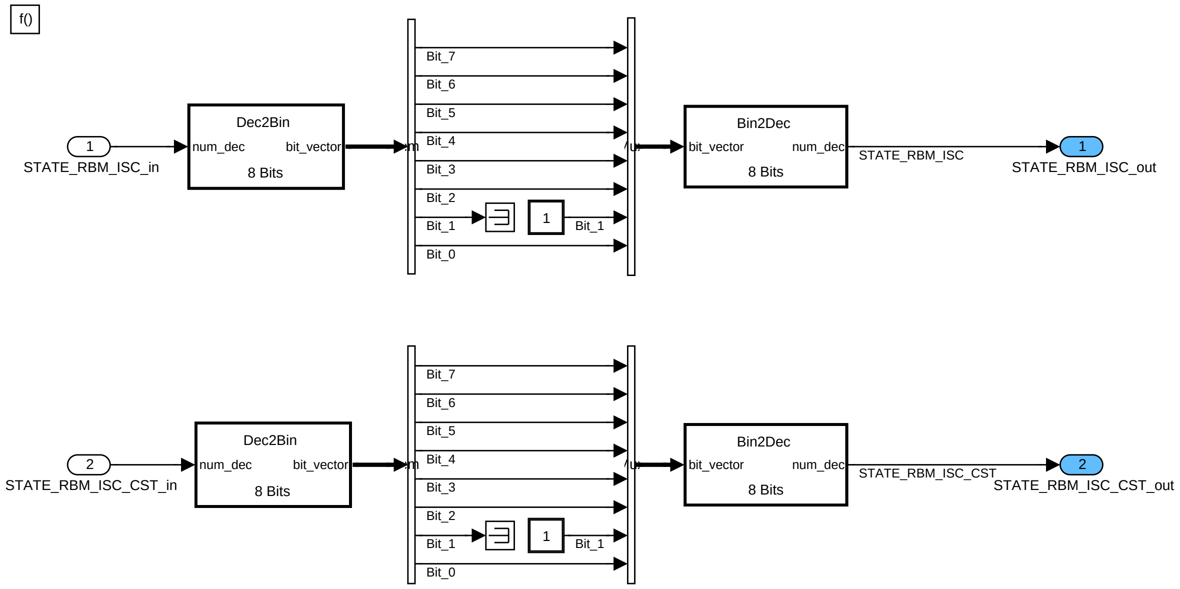

Figure A.40.23: :

A.40.4.3 Initialization at LV_DC 0 to 1 transition

A.40.4.3.1 No title given

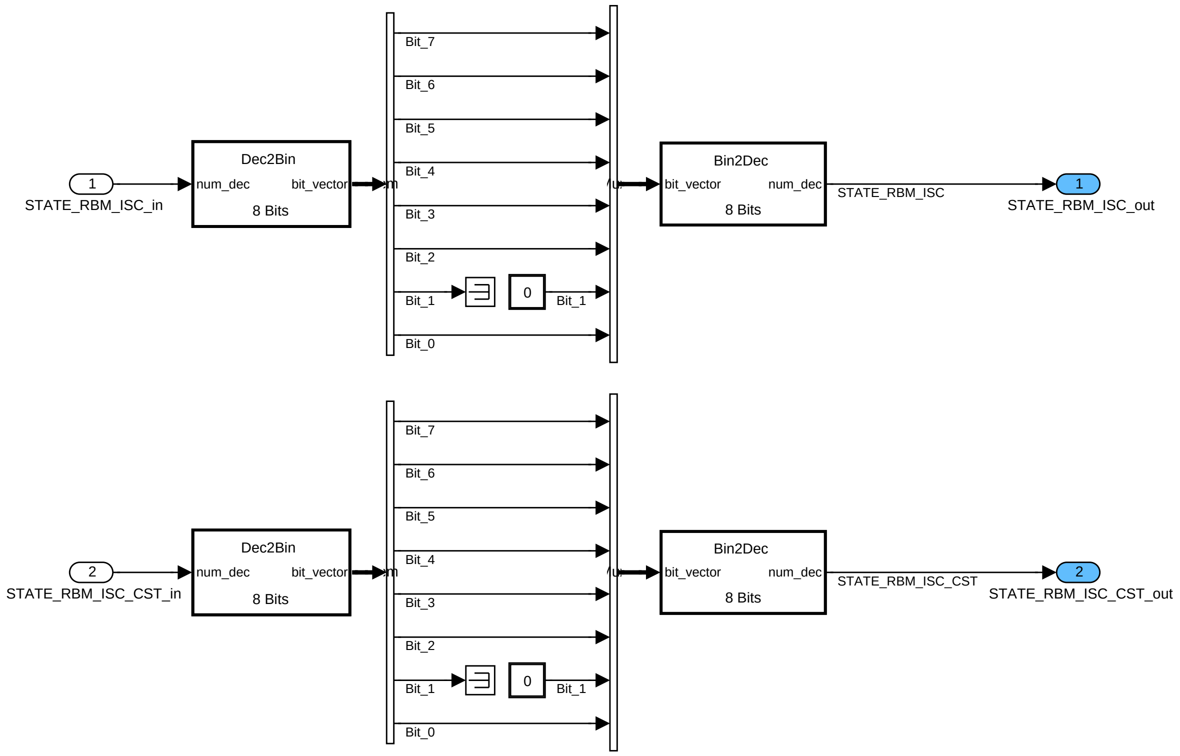

Figure A.40.24: :

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A.40.4.4 Calculation at 1s recurrence

A.40.4.4.1 No title given

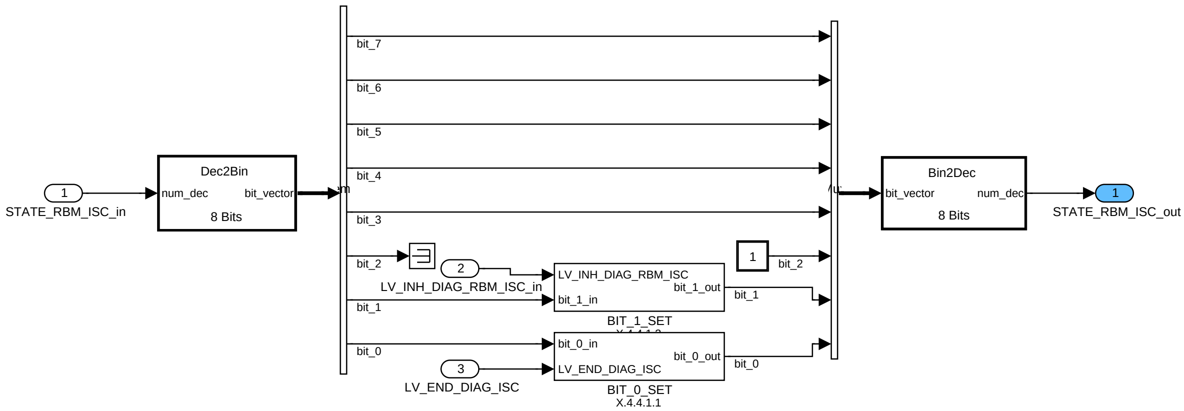

Figure A.40.25: :

A.40.4.4.1.1 No title given

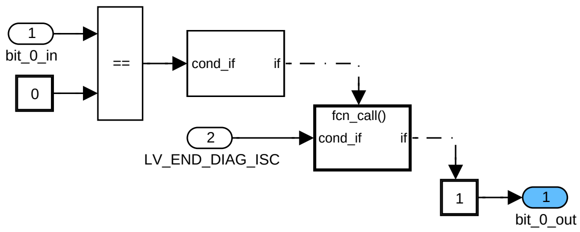

Figure A.40.26: :

A.40.4.4.1.2 No title given

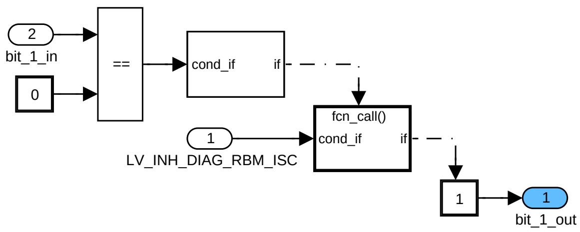

Figure A.40.27: :

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A.40.4.4.2 No title given

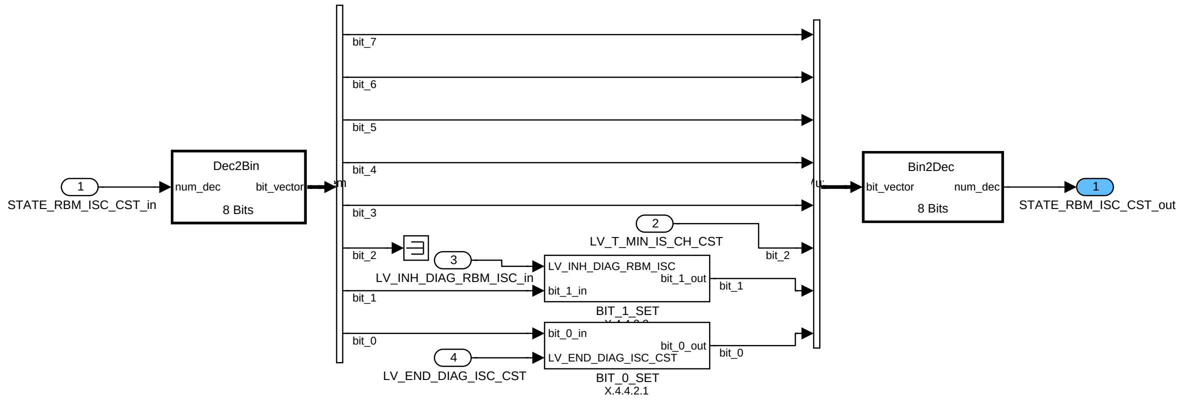

Figure A.40.28: :

A.40.4.4.2.1 No title given

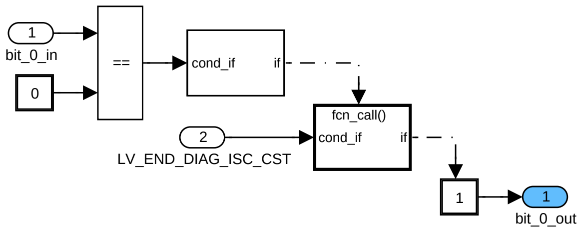

Figure A.40.29: :

A.40.4.4.2.2 No title given

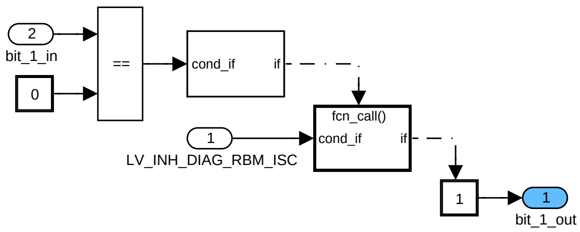

Figure A.40.30: :

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A.41 Camshaft diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_EXT_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Failure on exhaust camshaft sensor due to external issue					
LV_ERR_EXT_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Failure on intake camshaft sensor due to external issue					
LV_INH_DIAG_EXT_PER_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft period diagnosis (exhaust)					
LV_INH_DIAG_EXT_PER_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft period diagnosis (intake)					
LV_INH_DIAG_EXT_PLAUS_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft sensor plausibility diagnosis (exhaust)					
LV_INH_DIAG_EXT_PLAUS_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft sensor plausibility diagnosis (intake)					
LV_INH_DIAG_EXT_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft position diagnosis (exhaust)					
LV_INH_DIAG_EXT_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft position diagnosis (intake)					
LV_INH_DIAG_EXT_SYN_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft self-synchronization diagnosis (exhaust)					
LV_INH_DIAG_EXT_SYN_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft self-synchronization diagnosis (intake)					
LV_INH_DIAG_EXT_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft sensor diagnosis for crankshaft synchronization (exhaust)					
LV_INH_DIAG_EXT_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the camshaft sensor diagnosis for crankshaft synchronization (intake)					
LV_INH_DIAG_EXT_TOOTH_OFF_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the one-tooth-off diagnosis (exhaust i)					
LV_INH_DIAG_EXT_TOOTH_OFF_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the one-tooth-off diagnosis (intake i)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_RBM_TOOTH_OFF_EX [NC_NR_CAM_CBK]	O/V	0... 7H	0 ...7	1	-
Interface of TOOTH_OFF_EX monitor with the Rate-Based Monitoring statistics					
STATE_RBM_TOOTH_OFF_IN [NC_NR_CAM_CBK]	O/V	0... 7H	0 ...7	1	-
Interface of TOOTH_OFF_IN monitor with the Rate-Based Monitoring statistics					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_DC {p. 5746}	LV_END_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_END_DIAG_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}
LV_INH_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4456}	LV_INH_DIAG_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4456}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_DIAG_PER_CAM_EX	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for exhaust camshaft segment period diagnosis					
C_ABC_INC_DIAG_PER_CAM_IN	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for intake camshaft segment period diagnosis					
C_ABC_INC_DIAG_REF_CRK_CAM_EX	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for exhaust camshaft position diagnosis					
C_ABC_INC_DIAG_REF_CRK_CAM_IN	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for intake camshaft position diagnosis					
C_ABC_INC_DIAG_SYN_CAM_EX	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for exhaust camshaft synchronization diagnosis					
C_ABC_INC_DIAG_SYN_CAM_IN	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for intake camshaft synchronization diagnosis					
C_ABC_INC_DIAG_TOOTH_OFF_EX	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for exhaust one-tooth-off diagnosis					
C_ABC_INC_DIAG_TOOTH_OFF_IN	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for intake one-tooth-off diagnosis					
C_ABC_MAX_DIAG_PER_CAM_EX	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for exhaust camshaft segment period diagnosis					
C_ABC_MAX_DIAG_PER_CAM_IN	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for intake camshaft segment period diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_DIAG_REF_CRK_CAM_EX	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for exhaust camshaft position diagnosis					
C_ABC_MAX_DIAG_REF_CRK_CAM_IN	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for intake camshaft position diagnosis					
C_ABC_MAX_DIAG_SYN_CAM_EX	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for exhaust camshaft synchronization diagnosis					
C_ABC_MAX_DIAG_SYN_CAM_IN	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for intake camshaft synchronization diagnosis					
C_ABC_MAX_DIAG_TOOTH_OFF_EX	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for exhaust one-tooth-off diagnosis					
C_ABC_MAX_DIAG_TOOTH_OFF_IN	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for intake one-tooth-off diagnosis					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_PER_CAM_EX [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for PER_CAM_EX diagnosis					
NC_IDX_DIAG_PER_CAM_IN [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for PER_CAM_IN diagnosis					
NC_IDX_DIAG_PLAUS_CAM_EX [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for PLAUS_CAM_EX diagnosis					
NC_IDX_DIAG_PLAUS_CAM_IN [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for PLAUS_CAM_IN diagnosis					
NC_IDX_DIAG_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for REF_CRK_CAM_EX diagnosis					
NC_IDX_DIAG_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for REF_CRK_CAM_IN diagnosis					
NC_IDX_DIAG_SYN_CAM_EX [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for SYN_CAM_EX diagnosis					
NC_IDX_DIAG_SYN_CAM_IN [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for SYN_CAM_IN diagnosis					
NC_IDX_DIAG_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for SYN_CRK_CAM_EX diagnosis					
NC_IDX_DIAG_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for SYN_CRK_CAM_IN diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for TOOTH_OFF_EX diagnosis					
NC_IDX_DIAG_TOOTH_OFF_IN [NC_NR_CAM_CBK]	-	0... FFFFH	0... 65535	1	-
Failure index for TOOTH_OFF_IN diagnosis					

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

Error treatment:

Diagnostic Camshaft sensor	Symptom description	Symptom	Filter type
Camshaft segment period diagnosis for intake	*PER_CAM_IN*	*SYM_0*	*MEM*
		SYM_1	
		SYM_2	
		SYM_3	
Camshaft segment period diagnosis for exhaust	*PER_CAM_EX*	*SYM_0*	*MEM*
		SYM_1	
		SYM_2	
		SYM_3	
Camshaft synchronization diagnosis for intake	*SYN_CAM_IN*	*SYM_0*	*MEM*
		SYM_1	
		SYM_2	
		SYM_3	
Camshaft synchronization diagnosis for exhaust	*SYN_CAM_EX*	*SYM_0*	*MEM*
		SYM_1	
		SYM_2	
		SYM_3	
Camshaft position diagnosis for intake	*REF_CRK_CAM_IN*	*SYM_0*	*MEM*
		SYM_1	
		SYM_2	
		SYM_3	
Camshaft position diagnosis for exhaust	*REF_CRK_CAM_EX*	*SYM_0*	*MEM*
		SYM_1	
		SYM_2	
		SYM_3	
One-tooth-off diagnosis for intake	*TOOTH_OFF*	*SYM_0*	*MEM*
		SYM_1	
		SYM_2	
		SYM_3	
One-tooth-off diagnosis for exhaust	*TOOTH_OFF*	*SYM_0*	*MEM*
		SYM_1	
		SYM_2	
		SYM_3	

Note:
For filter type definition of PLAUS_CAM_IN(EX) and SYN_CRK_CAM_IN(EX) see subchapters "Camshaft sensor plausibility diagnosis" and " Camshaft Sensor Diagnosis for Crankshaft Synchronization"

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A.41.1 External Inhibitions and filter type definitions

FUNCTION DESCRIPTION:

General information:

The flags LV_INH_DIAG_EXT_... allow to deactivate the corresponding diagnostic.

Application conditions

Initialisation:	`At reset : all = 0`
Recurrence:	`once at reset`
Activation:	`-/ -`
Deactivation:	`When the activation condition is not fulfilled`

Formula section:

LV_INH_DIAG_EXT_PER_CAM_IN(EX)[i] = 0
LV_INH_DIAG_EXT_SYN_CAM_IN(EX)[i] = 0
LV_INH_DIAG_EXT_REF_CRK_CAM_IN(EX)[i] = 0
LV_INH_DIAG_EXT_PLAUS_CAM_IN(EX)[i] = 0
LV_INH_DIAG_EXT_SYN_CRK_CAM_IN(EX)[i] = 0
LV_INH_DIAG_EXT_TOOTH_OFF_IN(EX)[i] = 0
LV_ERR_EXT_CAM_IN(EX)[i] = 0

A.41.2 Interface of TOOTH_OFF_IN/EX error for Rate-based-monitoring

FUNCTION DESCRIPTION:

General information:

With this module the interface between the TOOTH_OFF_IN/EX[i] monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_TOOTH_OFF_IN/EX[i] data.
Within STATE_RBM_TOOTH_OFF_IN/EX[i] , three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)
  (not valid for TOOTH_OFF_IN/EX[i] diagnosis)

***Remark**: Calculation must be made seperate for ..._EX[i]   and ..._IN[i]*

Application conditions:

Initialisation :
at LV_DC 0 $\rightarrow$ 1 transition :

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bit 0 and bit 1 of STATE_RBM_TOOTH_OFF_IN/EX[i] = 0
bit 2 of STATE_RBM_TOOTH_OFF_IN/EX[i] = 1
on failure memory reset :
bit 1 of STATE_RBM_TOOTH_OFF_IN/EX[i] = 0

Recurrence: 1 s

Activation: LV_DC 0 → 1 transition **and** LV_DC = 1

Formula section:

At LV_DC 0 → 1 transition

The pending status of the following failures has to be checked only once :
LV_ERR_SYN_CAM_IN/EX[i]
LV_ERR_PER_CAM_IN/EX[i]
LV_ERR_PLAUS_CAM_IN/EX[i]
LV_ERR_SYN_CRK_CAM_IN/EX[i]
LV_ERR_REF_CRK_CAM_IN/EX[i]

```
If(1)       { CPU optimization at LV_DC 0 → 1 transition }
              CTR_ERR_DYN_NR <> 0    { the dynamic failure memory isn't empty }
Then(1)
              While bit 1 of STATE_RBM_TOOTH_OFF_IN/EX[i] = 0 do
                    with each XX failure of the above list :
                    ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

                    If(2)       XX has a pending status
                    Then(2)        bit 1 of STATE_RBM_TOOTH_OFF_IN/EX[i] = 1
                    Endif(2)
              Endwhile
Else(1)     { the dynamic failure memory is empty }
              No action
Endif(1)
```

Every 1 s :

```
If     bit 0 of STATE_RBM_TOOTH_OFF_IN/EX[i] = 0
Then         If      LV_END_DIAG_TOOTH_OFF_IN/EX[i] = 1
             Then    bit 0 of STATE_RBM_TOOTH_OFF_IN/EX[i] = 1
             Endif
Endif

If     bit 1 of STATE_RBM_TOOTH_OFF_IN/EX[i] = 0
Then
             If      LV_INH_DIAG_TOOTH_OFF_IN/EX[i] = 1
             Then    bit 1 of STATE_RBM_TOOTH_OFF_IN/EX[i] = 1
             Endif
Endif
```

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A.42 Camshaft position diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the exhaust camshaft i position diagnosis					
ERR_SYM_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the intake camshaft i position diagnosis					
ERR_SYM_TOOTH_OFF_EX [NC_NR_CAM_CBK]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the exhaust i one-tooth-off diagnosis					
ERR_SYM_TOOTH_OFF_IN [NC_NR_CAM_CBK]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the intake i one-tooth-off diagnosis					
LV_CDN_DIAG_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition for exhaust camshaft i					
LV_CDN_DIAG_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition for intake camshaft i					
LV_CDN_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
One-tooth-off diagnosis condition for exhaust camshaft i					
LV_CDN_DIAG_TOOTH_OFF_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
One-tooth-off diagnosis condition for intake camshaft i					
LV_END_DIAG_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of exhaust camshaft i position diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of intake camshaft i position diagnosis					
LV_END_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of exhaust camshaft i one-tooth-off diagnosis					
LV_END_DIAG_TOOTH_OFF_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of intake camshaft i one-tooth-off diagnosis					
LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	O/V	0H 1H	PASSIVE ACTIVE	-	-
Present exhaust camshaft i failure reference violation					
LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	O/V	0H 1H	PASSIVE ACTIVE	-	-
Present intake camshaft i failure reference violation					
LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK]	O/V	0H 1H	PASSIVE ACTIVE	-	-
Present exhaust camshaft i one-tooth-off failure					
LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK]	O/V	0H 1H	PASSIVE ACTIVE	-	-
Present intake camshaft i one-tooth-off failure					

Input data:

CAM_PSN_LST_REF_AD_EX [NC_NR_CAM_CBK] {p. 1533}	CAM_PSN_LST_REF_AD_IN [NC_NR_CAM_CBK] {p. 1533}	LV_INH_DIAG_ENSD {p. 4455}	LV_INH_DIAG_EXT_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4414}
LV_INH_DIAG_EXT_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_EXT_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_EXT_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4455}
LV_INH_DIAG_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4455}	LV_INH_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4456}	LV_INH_DIAG_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4456}	LV_TOOTH_OFF_DET_ENA_EX [NC_NR_CAM_CBK] {p. 1533}
LV_TOOTH_OFF_DET_ENA_IN [NC_NR_CAM_CBK] {p. 1533}	LV_VLD_PSN_CAM_EX [NC_NR_CAM_CBK] {p. 872}	LV_VLD_PSN_CAM_IN [NC_NR_CAM_CBK] {p. 872}	PSN_EDGE_AD_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK] {p. 1534}
PSN_EDGE_AD_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK] {p. 1534}			

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TOL_REF_CRK_CAM_EX	-	0... 1FFH	0... 31.9375	0.0625	°CRK
Reference position tolerance range for exhaust camshaft					
C_TOL_REF_CRK_CAM_IN	-	0... 1FFH	0... 31.9375	0.0625	°CRK
Reference position tolerance range for intake camshaft					

Error treatment:

See Appl. Inc.
See Appl. Inc.

A.42.1 Camshaft Position diagnosis

FUNCTION DESCRIPTION:

General information:

The purpose of the function is to detect when the camshaft reference position is outside of the designed range relative to the engine position from crankshaft. This allows to detect engine misbuilds (wrong assembly of the valve train), camshaft drive defects, or sensor failures that are not detected by the normal signal diagnosis.
i = 1...NC_NR_CAM_CBK z = 0...NC_NR_EDGE_CAM_IN/EX

Description:

Error-symptoms are defined for this diagnostic function as following:

```
□□□□
| | | └─> Camshaft to crankshaft reference violated "REF_CRK_CAM"   (= SYM_0)
| | └───> (not used)                                               (= SYM_1)
| └─────> (not used)                                               (= SYM_2)
└───────> (not used)                                               (= SYM_3)
```

Application conditions

Initialisation:

LV_CDN_DIAG_REF_CRK_CAM_IN(EX)[i] = *Refer to filtering configuration for the initialisation value*
LV_END_DIAG_REF_CRK_CAM_IN(EX)[i] = *Refer to filtering configuration for the initialisation value*
LV_ERR_REF_CRK_CAM_IN(EX)[i] = *Refer to filtering configuration for the initialisation value*
ERR_SYM_REF_CRK_CAM_IN(EX)[i] = *Refer to filtering configuration for the initialisation value*

Recurrence: every update of the camshaft edge position adaptation values PSN_EDGE_AD_CAM_IN(EX)[z][i]

Activation: LV_VLD_PSN_CAM_IN(EX)[i] = 1

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And LV_INH_DIAG_REF_CRK_CAM_IN(EX)[i] = 0
And LV_INH_DIAG_EXT_REF_CRK_CAM_IN(EX)[i] = 0
And LV_INH_DIAG_ENSD = 0

When the activation conditions are fulfilled then LV_CDN_DIAG_REF_CRK_CAM_IN(EX)[i] = 1.

Deactivation:
When the activation conditions are not fulfilled then LV_CDN_DIAG_REF_CRK_CAM_IN(EX)[i] = 0

Formula Section

Symptoms calculation:
If PSN_EDGE_AD_CAM_IN(EX)[z][i] < - C_TOL_REF_CRK_CAM_IN(EX)
or
PSN_EDGE_AD_CAM_IN(EX)[z][i] > C_TOL_REF_CRK_CAM_IN(EX)
Then ERR_SYM_REF_CRK_CAM_IN(EX)[i] = SYM_0 {Detection of symptom REF_CRK_CAM}
Else ERR_SYM_REF_CRK_CAM_IN(EX)[i] = NO_SYM
Endif
Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.
Filtering :
apply filter on current symptoms
If filtering result available (after debounce)
then
LV_ERR_REF_CRK_CAM_IN(EX)[i] = filtering result
LV_END_DIAG_REF_CRK_CAM_IN(EX)[i] = 1
Deliver the result to Error Management
Endif

A.42.2 One-tooth-off diagnosis

FUNCTION DESCRIPTION:

General information:

The purpose of the function is to detect a sudden drift is the camshaft position.

i = 1...NC_NR_CAM_CBK z = 0...NC_NR_EDGE_CAM_IN/EX

Description:

Error-symptoms are defined for this diagnostic function as following:

```
 |_|_|_|_|
 | | | └─> Sudden drift "ONE_TOOTH_OFF"     (= SYM_0)
 | | └───> (not used)                       (= SYM_1)
 | └─────> (not used)                       (= SYM_2)
 └───────> (not used)                       (= SYM_3)
```

Application conditions

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Initialisation:
LV_CDN_DIAG_TOOTH_OFF_IN(EX)[i] = *Refer to filtering configuration for the initialisation value*
LV_END_DIAG_TOOTH_OFF_IN(EX)[i] = *Refer to filtering configuration for the initialisation value*
LV_ERR_TOOTH_OFF_IN(EX)[i] = *Refer to filtering configuration for the initialisation value*
ERR_SYM_TOOTH_OFF_IN(EX)[i] = *Refer to filtering configuration for the initialisation value*

Recurrence: at LV_TOOTH_OFF_DET_ENA_IN(EX)[i] 0 to 1 transition

Activation: And LV_INH_DIAG_TOOTH_OFF_IN(EX)[i] = 0
And LV_INH_DIAG_EXT_TOOTH_OFF_IN(EX)[i] = 0
And LV_INH_DIAG_ENSD = 0
When the activation conditions are fulfilled then LV_CDN_DIAG_TOOTH_OFF_IN(EX)[i] = 1.

Deactivation:
When the activation conditions are not fulfilled then LV_CDN_DIAG_TOOTH_OFF_IN(EX)[i] = 0

Formula Section

Symptoms calculation:
If CAM_PSN_LST_REF_AD_IN(EX)[i] = PSN_EDGE_AD_CAM_IN(EX)[1][i]
Then ERR_SYM_TOOTH_OFF_IN(EX)[i] = NO_SYM
Else ERR_SYM_TOOTH_OFF_IN(EX)[i] = SYM_0 {Detection of symptom ONE_TOOTH_OFF}
Endif

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.
Filtering :
apply filter on current symptoms
If filtering result available (after debounce)
then
LV_ERR_ TOOTH_OFF_IN(EX)[i] = filtering result
LV_END_DIAG_ TOOTH_OFF_IN(EX)[i] = 1
Deliver the result to Error Management
Endif
For filter-type-linked calibrations: see Appl. Inc.

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A.43 Camshaft sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_PER_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the failure camshaft period too short					
ERR_SYM_PER_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the failure camshaft period too short					
ERR_SYM_SYN_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the exhaust camshaft i sensor diagnosis					
ERR_SYM_SYN_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the intake camshaft i sensor diagnosis					
LV_CDN_DIAG_PER_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition					
LV_CDN_DIAG_PER_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition					
LV_CDN_DIAG_SYN_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition for exhaust camshaft i					
LV_CDN_DIAG_SYN_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition for intake camshaft i					
LV_END_DIAG_PER_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of the failure camshaft period too short					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_PER_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of the failure camshaft period too short					
LV_END_DIAG_SYN_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of exhaust camshaft i sensor diagnosis					
LV_END_DIAG_SYN_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of intake camshaft i sensor diagnosis					
LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK]	O/V/S	0H 1H	PASSIVE ACTIVE	-	-
Present failure camshaft period too short					
LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK]	O/V/S	0H 1H	PASSIVE ACTIVE	-	-
Present failure camshaft period too short					
LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK]	O/V/S	0H 1H	PASSIVE ACTIVE	-	-
Present exhaust camshaft i failure sensor out of range					
LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK]	O/V/S	0H 1H	PASSIVE ACTIVE	-	-
Present intake camshaft i sensor failure					

Input data:

LV_ACT_CAM_EX [NC_NR_CAM_CBK] {p. 1505}	LV_ACT_CAM_IN [NC_NR_CAM_CBK] {p. 1505}	LV_INH_DIAG_ENSD {p. 4455}	LV_INH_DIAG_EXT_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4414}
LV_INH_DIAG_EXT_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_EXT_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_EXT_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4455}
LV_INH_DIAG_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4455}	LV_INH_DIAG_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4456}	LV_INH_DIAG_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4456}	LV_ORNG_PER_CAM_EX [NC_NR_CAM_CBK] {p. 871}
LV_ORNG_PER_CAM_IN [NC_NR_CAM_CBK] {p. 871}	LV_ORNG_RATIO_CAM_EX [NC_NR_CAM_CBK] {p. 871}	LV_ORNG_RATIO_CAM_IN [NC_NR_CAM_CBK] {p. 871}	

Error treatment:

See Appl. Inc.
See Appl. Inc.

A.43.1 Camshaft Segment Period Diagnosis

FUNCTION DESCRIPTION:

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General information:

Camshaft signal acquisition validates the segment period by minimum limits derived from the maximum engine speed. The diagnostic state indicates when a segment period was too short, e.g. due to supplementary signal transitions. The camshaft signal acquisition will filter out such signal transitions as far as possible. If there are too many additional pulses however, the camshaft signal acquisition may not be able to synchronize any more, or the accuracy of camshaft position measurement may be degraded.
i = 1...NC_NR_CAM_CBK

Description:

Error-symptoms are defined for this diagnostic function as following:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> Camshaft segment period too short "CAM_PER"     (= SYM_0)
 │ │ └───> (not used)                                      (= SYM_1)
 │ └─────> (not used)                                      (= SYM_2)
 └───────> (not used)                                      (= SYM_3)
```

Application conditions

Initialisation:
LV_CDN_DIAG_PER_CAM_IN(EX)[i] = *Refer to filtering configuration for the initialisation value*
LV_END_DIAG_PER_CAM_IN(EX)[i] = *Refer to filtering configuration for the initialisation value*
LV_ERR_PER_CAM_IN(EX)[i] = *Refer to filtering configuration for the initialisation value*
ERR_SYM_PER_CAM_IN(EX)[i] = *Refer to filtering configuration for the initialisation value*

Recurrence: *every camshaft signal edge*

Activation: LV_ACT_CAM_IN(EX)[i] = 1
And LV_INH_DIAG_PER_CAM_IN(EX)[i] = 0
And LV_INH_DIAG_EXT_PER_CAM_IN(EX)[i] = 0
And LV_INH_DIAG_ENSD = 0
When the activation conditions are fulfilled then LV_CDN_DIAG_PER_CAM_IN(EX)[i] = 1

Deactivation:
When the activation conditions are not fulfilled then *LV_CDN_DIAG_PER_CAM_IN(EX)[i] = 0*

Formula section:

Symptoms calculation:
If LV_ORNG_PER_CAM_IN(EX)[i] = 1
Then ERR_SYM_PER_CAM_IN(EX)[i] = SYM_0 {detection of symptom CAM_PER]
Else ERR_SYM_PER_CAM_IN(EX)[i] = NO_SYM
Endif
LV_ORNG_PER_CAM_IN(EX)[i] is reset after reading.

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Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

Filtering:

Apply filter on current symptoms

If filtering result available (after debounce)

Then

LV_ERR_PER_CAM_IN(EX)[i] = filtering result

LV_END_DIAG_PER_CAM_IN(EX)[i] = 1

Deliver the result to Error Management

Endif

A.43.2 Camshaft Synchronization Diagnosis

FUNCTION DESCRIPTION:

General information:

The purpose of the function is to detect camshaft sensor failure. Each time the camshaft signal synchronization algorithm fails, it will set the diagnostic flag LV_ORNG_RATIO_CAM_IN(EX)[i] for the appropriate camshaft.

The camshaft signal acquisition will filter out supplementary signal transitions as far as possible. If there are too many additional pulses however, the camshaft signal acquisition will not be able to synchronize any more. Synchronization may also be impossible due to missing or inaccurate signal transitions of the sensor.

i = 1...NC_NR_CAM_CBK

Description:

Error-symptoms are defined for this diagnostic function as following:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> Camshaft synchronization failure "SYNC_LOSS"    (= SYM_0)
 │ │ └───> (not used)                                      (= SYM_1)
 │ └─────> (not used)                                      (= SYM_2)
 └───────> (not used)                                      (= SYM_3)
```

Application conditions

Initialisation:

LV_CDN_DIAG_SYN_CAM_IN(EX)[i] = *Refer to filtering configuration for the initialisation value*

LV_END_DIAG_SYN_CAM_IN(EX)[i] = *Refer to filtering configuration for the initialisation value*

LV_ERR_SYN_CAM_IN(EX)[i] = *Refer to filtering configuration for the initialisation value*

ERR_SYM_SYN_CAM_IN(EX)[i] = *Refer to filtering configuration for the initialisation value*

Recurrence: *every camshaft signal edge*

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Activation: LV_ACT_CAM_IN(EX)[i] = 1
And LV_INH_DIAG_SYN_CAM_IN(EX)[i] = 0
And LV_INH_DIAG_EXT_SYN_CAM_IN(EX)[i] = 0
And LV_INH_DIAG_ENSD = 0
When activation conditions are fulfilled then LV_CDN_DIAG_SYN_CAM_IN(EX)[i] = 1.

Deactivation:
When activation conditions are not fulfilled then LV_CDN_DIAG_SYN_CAM_IN(EX)[i] = 0.

Formula section:

Symptoms calculation:
If LV_ORNG_RATIO_CAM_IN(EX)[i] = 1
Then ERR_SYM_SYN_CAM_IN(EX)[i] = SYM_0 {Detection of symptom SYNC_LOSS}
Else ERR_SYM_SYN_CAM_IN(EX)[i] = NO_SYM
Endif
Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.
Filtering:
Apply filter on current symptoms
If filtering result available (after debounce)
Then
LV_ERR_SYN_CAM_IN(EX)[i] = filtering result
LV_END_DIAG_SYN_CAM_IN(EX)[i] = 1
Deliver the result to Error Management
Endif
See Appl. Inc.

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A.44 Crankshaft sensor circuit diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_CRK_OC	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom of the crankshaft sensor failure open or short circuit					
LV_CDN_DIAG_CRK_OC	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition					
LV_END_DIAG_CRK_OC	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis result available					
LV_ERR_CRK_OC	O/V	0H 1H	PASSIVE ACTIVE	-	-
Crankshaft sensor failure open or short circuit present					

Input data:

LV_IGK {p. 906}	LV_INH_DIAG_CRK_OC {p. 4455}	LV_INH_DIAG_EXT_CRK_OC {p. 4439}	N_32 {p. 1525}

FUNCTION DESCRIPTION:

General information:

This dummy file replaces the MCPS circuit diagnosis for systems with ACPS. A circuit diagnosis for ACPS is not considered neceessary, since with any of the three lines open or short-circuited, the signal will be constantly high or low. The failure will then be detected by the functional diagnosis.

Application conditions

Activation:

```
LV_IGK = 1
     And LV_INH_DIAG_CRK_OC = 0
     And LV_INH_DIAG_EXT_CRK_OC = 0
```

When the activation condition is fulfilled then LV_CDN_DIAG_CRK_OC = 1.
Desactivation:
When the activation condition is not fulfilled then LV_CDN_DIAG_CRK_OC = 0.

Formula section:

ERR_SYM_CRK_OC = 0
LV_ERR_CRK_OC = 0
LV_END_DIAG_CRK_OC = 1

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A.45 Crankshaft sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_CRK_SYN	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the crankshaft failure with loss of synchronization					
ERR_SYM_CRK_TOOTH	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the crankshaft failure tooth number error					
ERR_SYM_CRK_TOOTH_PER	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the crankshaft failure implausible tooth period					
LV_CDN_DIAG_CRK_SYN	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition for crankshaft diagnosis with loss of synchronization					
LV_CDN_DIAG_CRK_TOOTH	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition					
LV_CDN_DIAG_CRK_TOOTH_PER	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition for crankshaft diagnosis of implausible tooth period					
LV_END_DIAG_CRK_SYN	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of crankshaft diagnosis with loss of synchronization					
LV_END_DIAG_CRK_TOOTH	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of crankshaft tooth number error					
LV_END_DIAG_CRK_TOOTH_PER	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of crankshaft diagnosis implausible tooth period					
LV_ERR_CRK_SYN	O/V	0H 1H	PASSIVE ACTIVE	-	-
Present crankshaft failure with loss of synchronization					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_CRK_TOOTH	O/V	0H 1H	PASSIVE ACTIVE	-	-
Present crankshaft failure tooth number error					
LV_ERR_CRK_TOOTH_PER	O/V	0H 1H	PASSIVE ACTIVE	-	-
Present crankshaft failure tooth number error					
LV_INH_MIS_CRK	O/V	0... 1H	0 ...1	1	-
Inhibition of misfire detection with crankshaft tooth number error					

Input data:

LV_CRK_SYN {p. 853}	LV_INH_DIAG_CRK_SYN {p. 4455}	LV_INH_DIAG_CRK_ TOOTH {p. 4455}	LV_INH_DIAG_CRK_ TOOTH_PER {p. 4455}
LV_INH_DIAG_ENSD {p. 4455}	LV_INH_DIAG_EXT_CRK_ SYN {p. 4439}	LV_INH_DIAG_EXT_CRK_ TOOTH {p. 4439}	LV_INH_DIAG_EXT_CRK_ TOOTH_PER {p. 4439}
LV_LIH_ERR_CRK {p. 1505}	LV_LOST_SYN_CRK {p. 853}	LV_ORNG_NR_TOOTH_ CRK {p. 853}	LV_ORNG_TOOTH_PER_ CRK {p. 853}
LV_RUN_ENG {p. 1505}	LV_STOP_ENG {p. 1505}	N_32 {p. 1525}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_32_MAX_DIAG_CRK_TOOTH	-	0... FFH	0... 8160	32	rpm
Maximum engine speed to enable tooth number diagnosis					

Error treatment:

See Appl. Inc.
See Appl. Inc.
See Appl. Inc.

General information:

The purpose of the function is to detect failures on the crankshaft signal while the system is synchronized.
The diagnosis is divided in three different parts: tooth number error, implausible tooth period, and loss of synchronization on crankshaft signal.

A.45.1 Crankshaft Sensor Diagnosis with Tooth Number Error

FUNCTION DESCRIPTION:

General information:

The number of teeth per crankshaft revolution is monitored by the crankshaft signal acquisition. The algorithm may tolerate a number of missing/additional teeth per revolution without loosing synchronization,

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depending on the used target wheel and on configuration data. The bit LV_ORNG_NR_TOOTH_CRK indicates wrong tooth number during the most recent crankshaft revolution.
If a tooth was missing or added during one revolution, then all variables based on teeth counting will be produced with an error. This concerns for example spark advance, segment time, misfire segments, camshaft position, etc. The purpose of the function is to provide information when the crankshaft signal is inaccurate, in order to take the necessary actions.

Description:

Error-symptoms are defined for this diagnostic function as following:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> Incorrect crankshaft tooth number "TOOTH_NUMBER"     (= SYM_0)
 │ │ └───> (not used)                                           (= SYM_1)
 │ └─────> (not used)                                           (= SYM_2)
 └───────> (not used)                                           (= SYM_3)
```

Application conditions

Initialisation:

LV_CDN_DIAG_CRK_TOOTH = *Refer to filtering configuration for the initialisation value*
LV_END_DIAG_CRK_TOOTH = *Refer to filtering configuration for the initialisation value*
LV_ERR_CRK_TOOTH = *Refer to filtering configuration for the initialisation value*
ERR_SYM_CRK_TOOTH = *Refer to filtering configuration for the initialisation value*

Recurrence: *once per crankshaft revolution, after detection of the reference gap, except in the first revolution after synchronization*

Activation: LV_CRK_SYN = 1
And LV_INH_DIAG_CRK_TOOTH = 0
And LV_INH_DIAG_EXT_CRK_TOOTH = 0
And LV_INH_DIAG_ENSD = 0
And N_32 > C_N_32_MAX_DIAG_CRK_TOOTH
When the activation conditions are fulfilled then LV_CDN_DIAG_CRK_TOOTH = 1.
Deactivation:
When the activation conditions are not fulfilled then LV_CDN_DIAG_CRK_TOOTH = 0.

Formula Section

Symptoms calculation:
If LV_ORNG_NR_TOOTH_CRK = 0
Then ERR_SYM_CRK_TOOTH = NO_SYM
Else ERR_SYM_CRK_TOOTH = "SYM_0" {Detection of symptom TOOTH_NUMBER}
Endif
Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.
Filtering:

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Apply filter on current symptoms
If filtering result available (after debounce)
Then
LV_ERR_CRK_TOOTH = filtering result
LV_END_DIAG_CRK_TOOTH = 1
Deliver the result to Error Management
Endif

<u>**Calculation of missing/added tooth information for misfire**</u>

Initialisation:
LV_INH_MIS_CRK = 0 at reset and at engine stalling (LV_STOP_ENG transition from 0 to 1).

Recurrence: once per crankshaft revolution, after detection of the reference gap, except in the first revolution after synchronization

Activation: LV_CRK_SYN = 1

Deactivation: LV_CRK_SYN = 0

<u>**Formula Section**</u>

<u>Symptoms calculation:</u>
If LV_ORNG_NR_TOOTH_CRK = 0
Then LV_INH_MIS_CRK = 0
Else LV_INH_MIS_CRK = 1
Endif
LV_ORNG_NR_TOOTH_CRK is reset after reading at the reference gap

A.45.2 Crankshaft Sensor Diagnosis with implausible Tooth Period

<u>**FUNCTION DESCRIPTION:**</u>

<u>**General information:**</u>

Crankshaft signal acquisition validates the tooth period by limits derived from the current engine speed. Before synchronization, LV_ORNG_TOOTH_PER_CRK indicates implausible gradient of the tooth period. This flag is also set if a reference gap occurs during valid teeth phase or when the first reference gap cannot be detected.
After synchronization, LV_ORNG_TOOTH_PER_CRK is set if spikes are detected outside the crankshaft window acceptance window.

<u>**Description:**</u>

Error-symptoms are defined for this diagnostic function as following:

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```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘

 │ │ │ └─> Implausible crankshaft tooth period "TOOTH_PERIOD"   (= SYM_0)
 │ │ └───> (not used)                                            (= SYM_1)
 │ └─────> (not used)                                            (= SYM_2)
 └───────> (not used)                                            (= SYM_3)
```

Application conditions

Initialisation:

LV_CDN_DIAG_CRK_TOOTH_PER = *Refer to filtering configuration for the initialisation value*
LV_END_DIAG_CRK_TOOTH_PER = *Refer to filtering configuration for the initialisation value*
LV_ERR_CRK_TOOTH_PER = *Refer to filtering configuration for the initialisation value*
ERR_SYM_CRK_TOOTH_PER = *Refer to filtering configuration for the initialisation value*

Recurrence: if LV_CRK_SYN = 1:every reference gap
If LV_CRK_SYN = 0: when LV_ORNG_TOOTH_PER_CRK is set

Activation: LV_RUN_ENG= 1
And LV_LIH_ERR_CRK = 0
And LV_INH_DIAG_CRK_TOOTH_PER = 0
And LV_INH_DIAG_EXT_CRK_TOOTH_PER = 0
And LV_INH_DIAG_ENSD = 0
When the activation conditions are fulfilled then LV_CDN_DIAG_CRK_TOOTH_PER = 1.

Deactivation:
When the activation conditions are not fulfilled then LV_CDN_DIAG_CRK_TOOTH_PER = 0.

Formula Section

Symptoms calculation:
Before crankshaft synchronization (LV_CRK_SYN = 0)
If LV_ORNG_TOOTH_PER_CRK = 0
Then ERR_SYM_CRK_TOOTH_PER = NO_SYM
Else ERR_SYM_CRK_TOOTH_PER = SYM_0" {Detection of symptom TOOTH_PERIOD}
Endif
After crankshaft synchronization (LV_CRK_SYN = 1)
If LV_ORNG_TOOTH_PER_CRK = 1 set at a tooth event or end of tolerance window
Then ERR_SYM_CRK_TOOTH_PER = SYM_0" {Detection of symptom TOOTH_PERIOD}
Endif
LV_ORNG_TOOTH_PER_CRK is reset after reading
If LV_ORNG_TOOTH_PER_CRK = 0 at the reference gap
Then ERR_SYM_CRK_TOOTH_PER = NO_SYM
Endif
Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

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Filtering:
Apply filter on current symptoms
If filtering result available (after debounce)
Then
LV_ERR_CRK_TOOTH_PER = filtering result
LV_END_DIAG_CRK_TOOTH_PER = 1
Deliver the result to Error Management
Endif

A.45.3 Crankshaft Sensor Diagnosis with Loss of Synchronization

FUNCTION DESCRIPTION:

General information:

The purpose of the function is to detect crankshaft failure when the system looses synchronization on the crankshaft signal.
Synchronization will be lost if the reference gap is not detected at the correct position plus/minus a tolerance of missing/additional teeth, depending on the used target wheel and on configuration data.
If the signal fails completely (no more crankshaft signal edges are detected), then no error will be detected by this diagnosis, since the condition is similar to stopped engine. A failure then may be detected by the crankshaft sensor plausibility diagnosis (e.g. test against the camshaft signal).

Description:

Error-symptoms are defined for this diagnostic function as following:

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```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> Loss of synchronization "SYNC_LOSS"          (= SYM_0)
 │ │ └───> (not used)                                   (= SYM_1)
 │ └─────> (not used)                                   (= SYM_2)
 └───────> (not used)                                   (= SYM_3)
```

Application conditions:

Initialisation:

LV_CDN_DIAG_CRK_SYN = *Refer to filtering configuration for the initialisation value*
LV_END_DIAG_CRK_SYN = *Refer to filtering configuration for the initialisation value*
LV_ERR_CRK_SYN = *Refer to filtering configuration for the initialisation value*
ERR_SYM_CRK_SYN = *Refer to filtering configuration for the initialisation value*

Recurrence: *once per crankshaft revolution, after the reference gap, except in the first revolution after synchronization, or when the bit LV_LOST_SYN_CRK is set.*

Activation: LV_CRK_SYN = 1
And LV_INH_DIAG_CRK_SYN = 0
And LV_INH_DIAG_EXT_CRK_SYN = 0
And LV_INH_DIAG_ENSD = 0

When activation conditions are fulfilled then LV_CDN_DIAG_CRK_SYN = 1.

Deactivation:

When activation conditions not are fulfilled then LV_CDN_DIAG_CRK_SYN = 0.

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Formula Section

Symptoms calculation:
If LV_LOST_SYN_CRK = 0
Then ERR_SYM_CRK_SYN = NO_SYM
Else ERR_SYM_CRK_SYN = SYM_0" {Detection of symptom SYNC_LOSS}
Endif
Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.
Filtering:
Apply filter on current symptoms
If filtering result available (after debounce)
Then
LV_ERR_CRK_SYN = filtering result
LV_END_DIAG_CRK_SYN = 1
Deliver the result to Error Management

Endif

For filter-type-linked calibrations: see Appl. Inc.

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A.46 Crankshaft sensor diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_EXT_CRK_OC	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the crankshaft sensor circuit diagnosis					
LV_INH_DIAG_EXT_CRK_PLAUS	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the diagnosis of crankshaft sensor					
LV_INH_DIAG_EXT_CRK_SYN	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the crankshaft sensor diagnosis with loss of synchronization					
LV_INH_DIAG_EXT_CRK_TOOTH	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the crankshaft sensor diagnosis with tooth number error					
LV_INH_DIAG_EXT_CRK_TOOTH_PER	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the crankshaft sensor diagnosis with implausible tooth period					

Input data:

LV_ERR_CRK_OC {p. 4430}	LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}
LV_ERR_CRK_TOOTH_PER {p. 4432}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_DIAG_CRK_OC	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for crankshaft sensor circuit diagnosis					
C_ABC_INC_DIAG_CRK_SYN	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for crankshaft diagnosis with loss of synchronization					
C_ABC_INC_DIAG_CRK_TOOTH	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for crankshaft tooth number diagnosis					
C_ABC_INC_DIAG_CRK_TOOTH_PER	-	0... FFH	0... 255	1	-
Anti-bounce counter increment for crankshaft tooth period diagnosis					
C_ABC_MAX_DIAG_CRK_OC	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for crankshaft sensor circuit diagnosis					
C_ABC_MAX_DIAG_CRK_SYN	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for crankshaft diagnosis with loss of synchronization					
C_ABC_MAX_DIAG_CRK_TOOTH	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for crankshaft tooth number diagnosis					
C_ABC_MAX_DIAG_CRK_TOOTH_PER	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum for crankshaft tooth period diagnosis					

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Error treatment:

Diagnostic Crankshaft sensor	Symptom description	Symptom	Filter type
Crankshaft sensor diagnosis with tooth number error	*TOOTH_NUMBER*	*SYM_0*	*MEM*
		SYM_1	
		SYM_2	
		SYM_3	

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Filter types compatibility:

Filter Type	Compatibility	Remark
STD	NO	
STD_INI	YES	
MEM	YES	Prefered solution
MEM_INI	NO	
DEC_CAL	NO	
STC	YES	
NO_FIL	NO	

Figure A.46.1: Diagnosis /Failure Flag

Diagnosis / Failure Flag	**Symptom**		**DTC**
Crankshaft sensor tooth number diagnosis	Bit 0	Additional or missing teeth per crankshaft revolution	P0370
	Bit 1	unused	
	Bit 2	unused	
LV_ERR_CRK_TOOTH	Bit 3	unused	

Diagnostic **Crankshaft sensor**	**Symptom description**	**Symptom**	**Filter type**
Crankshaft sensor diagnosis with implausible tooth period error	*TOOTH_PERIOD*	*SYM_0*	*MEM*
		SYM_1	
		SYM_2	
		SYM_3	

Filter types compatibility:

Filter Type	Compatibility	Remark
STD	NO	
STD_INI	YES	
MEM	YES	Prefered solution
MEM_INI	NO	
DEC_CAL	NO	
STC	YES	
NO_FIL	NO	

Figure A.46.2: Diagnosis /Failure Flag

Diagnosis / Failure Flag	**Symptom**		**DTC**
Crankshaft sensor tooth period diagnosis	Bit 0	Crankshaft tooth period implausible	P0370
	Bit 1	unused	
	Bit 2	unused	
LV_ERR_CRK_TOOTH_PER	Bit 3	unused	

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Diagnostic **Crankshaft sensor**	**Symptom description**	**Symptom**	**Filter type**
Crankshaft sensor diagnosis with loss of synchronization	*SYNC_LOSS*	*SYM_0*	*MEM*
		SYM_1	
		SYM_2	
		SYM_3	

Filter types compatibility:

Filter Type	Compatibility	Remark
STD	NO	
STD_INI	NO	
MEM	YES	Prefered solution
MEM_INI	NO	
DEC_CAL	NO	
STC	NO	
NO_FIL	NO	

Figure A.46.3: Diagnosis /Failure Flag

Diagnosis / Failure Flag	**Symptom**		**DTC**
Crankshaft sensor synchronization diagnosis	Bit 0	Loss of crankshaft synchronization	P0370
	Bit 1	unused	
	Bit 2	unused	
LV_ERR_CRK_SYN	Bit 3	unused	

Diagnostic **Crankshaft sensor circuit**	**Symptom description**	**Symptom**	**Filter type**
Magnetic crankshaft position sensor	*OPEN / SHORT CIRCUIT*	*SYM_0*	*STD_INI*
		SYM_1	
		SYM_2	
		SYM_3	

Filter types compatibility:

Filter Type	Compatibility	Remark
STD	NO	
STD_INI	YES	Prefered solution
MEM	YES	
MEM_INI	NO	
DEC_CAL	NO	
STC	YES	
NO_FIL	NO	

Figure A.46.4: Diagnosis /Failure Flag

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Diagnosis / Failure Flag	Symptom		DTC
Crankshaft sensor Circuit diagnosis	Bit 0	open/short circuit	P0335
	Bit 1	unused	
	Bit 2	unused	
LV_ERR_CRK_OC	Bit 3	unused	

A.46.1 Crankshaft Sensor Diagnosis with Tooth Number Error

FUNCTION DESCRIPTION:

General information:

The flag LV_INH_DIAG_EXT_CRK_TOOTH allows to deactivate the corresponding diagnostic.

Application conditions:

Initialisation:
At reset event : LV_INH_DIAG_EXT_CRK_TOOTH= 0

Recurrence:
Application incidence recurrence = once at reset

Activation:
-/-

Deactivation:
When the activation condition is not fulfilled

Formula section:

LV_INH_DIAG_EXT_CRK_TOOTH = 0

A.46.2 Crankshaft Sensor Diagnosis with implausible Tooth Period

FUNCTION DESCRIPTION:

General information:

The flag LV_INH_DIAG_EXT_CRK_TOOTH_PER allows to deactivate the corresponding diagnostic.

Application conditions:

Initialisation:
At reset event : LV_INH_DIAG_EXT_CRK_TOOTH_PER= 0

Recurrence:
Application incidence recurrence = once at reset

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Activation:
-/-

Deactivation:
When the activation condition is not fulfilled

Formula section:

LV_INH_DIAG_EXT_CRK_TOOTH_PER = 0

A.46.3 Crankshaft Sensor Diagnosis with Loss of Synchronization

FUNCTION DESCRIPTION:

General information:

The flag LV_INH_DIAG_EXT_CRK_SYN allows to deactivate the corresponding diagnostic.

Application conditions:

Initialisation:
At reset event : LV_INH_DIAG_EXT_CRK_SYN = 0

Recurrence:
Application incidence recurrence = once at reset

Activation:
-/-

Deactivation:
When the activation condition is not fulfilled

Formula section:

LV_INH_DIAG_EXT_CRK_SYN = 0

A.46.4 Crankshaft Sensor Circuit Diagnosis (Appl. Inc.)

FUNCTION DESCRIPTION:

General information:

The flag LV_INH_DIAG_EXT_CRK_OC allows to deactivate the corresponding diagnostic.

Application conditions:

Initialisation:
At reset event : LV_INH_DIAG_EXT_CRK_OC = 0

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Recurrence:
Application incidence recurrence = once at reset

Activation:
-/-

Deactivation:
When the activation condition is not fulfilled

Formula section:

LV_INH_DIAG_EXT_CRK_OC = 0

A.46.5 Crankshaft Sensor Plausibility Diagnosis (Appl. Inc.)

A.46.5.1 Diagnosis of crankshaft sensor

FUNCTION DESCRIPTION:

General information:

The flag LV_INH_DIAG_EXT_CRK_PLAUS allows to deactivate the corresponding diagnostic.

Application conditions:

Initialisation:
At reset event : LV_INH_DIAG_EXT_CRK_PLAUS = 0

Recurrence:
Application incidence recurrence = once at reset

Activation:
-/-

Deactivation:
When the activation condition is not fulfilled

Formula section:

LV_INH_DIAG_EXT_CRK_PLAUS = 0

Diagnosis / Failure Flag	Symptom		DTC
Crankshaft sensor plausibility diagnosis	Bit 0	Signal Missing	P0374
	Bit 1	Signal Implausible	P0373
	Bit 2	unused	
LV_ERR_CRK_PLAUS	Bit 3	unused	

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A.47 Crankshaft sensor plausibility diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CYC_ENG_PLAUS_CAM_EX [NC_NR_CAM_CBK]	V	0... FFH	0... 255	1	-
Engine cycle counter for camshaft signal plausibility diagnosis					
CTR_CYC_ENG_PLAUS_CAM_IN [NC_NR_CAM_CBK]	V	0... FFH	0... 255	1	-
Engine cycle counter for camshaft signal plausibility diagnosis					
CTR_ORNG_CAM_SYN_CRK	V	0... FFH	0... 255	1	-
Failure counter to detect camshaft error for crankshaft synchronization					
ERR_SYM_CRK_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the crankshaft failure synchronization impossible					
ERR_SYM_PLAUS_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the camshaft failure synchronization impossible					
ERR_SYM_PLAUS_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the camshaft failure synchronization impossible					
ERR_SYM_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symtoms of the exhaust camshaft diagnosis for crankshaft synchronization					
ERR_SYM_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symtoms of the intake camshaft diagnosis for crankshaft synchronization					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_CRK_PLAUS	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition					
LV_CDN_DIAG_PLAUS_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition					
LV_CDN_DIAG_PLAUS_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition					
LV_CDN_DIAG_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition					
LV_CDN_DIAG_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Diagnosis condition					
LV_END_DIAG_CRK_PLAUS	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of crankshaft signal diagnosis synchronization impossible					
LV_END_DIAG_PLAUS_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of camshaft signal diagnosis synchronization impossible					
LV_END_DIAG_PLAUS_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of camshaft signal diagnosis synchronization impossible					
LV_END_DIAG_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of exhaust camshaft diagnosis for crankshaft synchronization					
LV_END_DIAG_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	V	0H 1H	PASSIVE ACTIVE	-	-
Result available of intake camshaft diagnosis for crankshaft synchronization					
LV_ERR_CRK_PLAUS	O/V	0H 1H	PASSIVE ACTIVE	-	-
Present crankshaft failure synchronization impossible					
LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK]	O/V/S	0H 1H	PASSIVE ACTIVE	-	-
Present camshaft failure synchronization impossible					
LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK]	O/V/S	0H 1H	PASSIVE ACTIVE	-	-
Present camshaft failure synchronization impossible					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	O/V/S	0H 1H	PASSIVE ACTIVE	-	-
Present exhaust camshaft failure for crankshaft synchronization					
LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	O/V/S	0H 1H	PASSIVE ACTIVE	-	-
Present intake camshaft failure for crankshaft synchronization					

Input data:

CTR_EDGE_CAM_EX [NC_NR_CAM_CBK] {p. 871}	CTR_EDGE_CAM_IN [NC_NR_CAM_CBK] {p. 871}	LV_ACT_CRK {p. 1505}	LV_ACT_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 1505}
LV_ACT_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 1505}	LV_AD_END_CAM_EX [NC_NR_CAM_CBK] {p. 1533}	LV_AD_END_CAM_IN [NC_NR_CAM_CBK] {p. 1533}	LV_CRK_MISS_RUN_ENG {p. 1505}
LV_CRK_SYN {p. 853}	LV_FIRST_VLD_TOOTH {p. 1505}	LV_IGK {p. 906}	LV_INH_DIAG_CRK_PLAUS {p. 4455}
LV_INH_DIAG_ENSD {p. 4455}	LV_INH_DIAG_EXT_CRK_PLAUS {p. 4439}	LV_INH_DIAG_EXT_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_EXT_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4414}
LV_INH_DIAG_EXT_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_EXT_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4414}	LV_INH_DIAG_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4455}	LV_INH_DIAG_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4455}
LV_INH_DIAG_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4456}	LV_INH_DIAG_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4456}	LV_ORNG_CAM_SYN_CRK {p. 871}	LV_STOP_ENG {p. 1505}
LV_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 872}	LV_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 872}	LV_SYN_VLD {p. 1506}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_ORNG_CAM_SYN_CRK_MAX	-	0... FFH	0... 255	1	-
Failure count to detect camshaft error for crankshaft synchronization					
C_NR_CYC_ENG_PLAUS_CAM_MAX	-	0... 7FH	0... 127	1	-
Number of engine cycles to detect camshaft plausibility error					
C_NR_EDGE_CAM_EX_SYN_CRK_MAX	-	1... FFH	1... 255	1	-
Number of exhaust camshaft signal edges to detect crankshaft plausibility error before synchronization					
C_NR_EDGE_CAM_IN_SYN_CRK_MAX	-	1... FFH	1... 255	1	-
Number of intake camshaft signal edges to detect crankshaft plausibility error before synchronization					
LC_CAM_ERR_ENA_VVT	-	0... 1H	0 ...1	1	-
Switch to enable camshaft error debouncing for VVT reactivation					
LC_CTR_DEC_PLAUS_CAM	-	0... 1H	0 ...1	1	-
Switch to enable camshaft plausibility debouncing					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Error treatment:

Diagnostic Crankshaft sensor	Symptom description	Symptom	Filter type
Crankshaft sensor	*SIGNAL MISSING*	*SYM_0*	*NO*
	SIGNAL IMPLAUSIBLE	*SYM_1*	
		SYM_2	
		SYM_3	

NB: The filter type for this diagnosis can not be configured, it behaves as a MEM filter.

Diagnostic Camshaft sensor plausability	Symptom description	Symptom	Filter type
Camshaft sensor plausability diagnosis for intake	*SIGNAL MISSING*	*SYM_0*	*NO*
		SYM_1	
		SYM_2	
		SYM_3	
Camshaft sensor plausability diagnosis for exhaust	*SIGNAL MISSING*	*SYM_0*	*NO*
		SYM_1	
		SYM_2	
		SYM_3	

NB: The filter type for this diagnosis can not be configured, but it behaves as a MEM if LC_CTR_DEC_PLAUS_CAM = 0, and as a STD_INI if LC_CTR_DEC_PLAUS_CAM = 1

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Diagnostic Camshaft sensor diagnosis for crankshaft synchronization	Symptom description	Symptom	Filter type
Camshaft sensor diagnosis for crankshaft synchronization on intake	*SIGNAL INVALID*	*SYM_0*	*NO*
		SYM_1	
		SYM_2	
		SYM_3	
Camshaft sensor diagnosis for crankshaft synchronization on exhaust	*SIGNAL INVALID*	*SYM_0*	*NO*
		SYM_1	
		SYM_2	
		SYM_3	

NB: The filter type for this diagnosis can not be configured, but it behaves as a MEM if LC_CAM_ERR_ENA_VVT = 0, and as a STD_INI if LC_CAM_ERR_ENA_VVT = 1

A.47.1 Diagnosis of crankshaft sensor

FUNCTION DESCRIPTION:

General information:

The purpose of the function is to detect a failure if synchronization on crankshaft signal cannot be achieved.
One of the available camshaft signals is selected for crankshaft synchronization by setting one of the flags LV_ACT_SYN_CRK_CAM_IN[i] in the engine position control function. The signal edge counter of that camshaft is observed while the crankshaft is not synchronized. If the count reaches a calibrated number, and the system is still not synchronized with the crankshaft signal, then crankshaft sensor plausibility error is set without further debouncing. If valid crankshaft teeth have already been detected, the symptom will be implausible signal , otherwise it will be missing signal .
i = 1...NC_NR_CAM_CBK

Description:

Error-symptoms are defined to this diagnostic function as following:

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```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │  │  │  └─> Signal missing          (= SYM_0)
 │  │  └────> Signal implausible      (= SYM_1)
 │  └───────> (not used)              (= SYM_2)
 └──────────> (not used)              (= SYM_3)
```

Application conditions:

Initialisation:
LV_CDN_DIAG_CRK_PLAUS = 0 at reset
LV_END_DIAG_CRK_PLAUS = 0 at reset
ERR_SYM_CRK_PLAUS = NO_SYM at reset
LV_ERR_CRK_PLAUS = 0 at reset
Recurrence: every update of CTR_EDGE_CAM_IN(EX)[i]
And
0 to 1 transition of LV_STOP_ENG

Activation: LV_ACT_CRK = 1
And LV_INH_DIAG_CRK_PLAUS = 0
And LV_INH_DIAG_EXT_CRK_PLAUS = 0
And LV_INH_DIAG_ENSD = 0
When the activation condition is fulfilled then LV_CDN_DIAG_CRK_PLAUS = 1.

Deactivation:
When the activation condition is not fulfilled then LV_CDN_DIAG_CRK_PLAUS = 0.

Formula Section

Symptoms calculation:

If LV_STOP_ENG = 1
And
LV_CRK_MISS_RUN_ENG = 1
Then ERR_SYM_CRK_PLAUS = "SYM_0"
{Crankshaft signal missing but engine is still turning}
else
If LV_CRK_SYN = 0
and CTR_EDGE_CAM_IN(EX)[i] > C_NR_EDGE_CAM_IN(EX)_SYN_CRK_MAX
Then **If** LV_FIRST_VLD_TOOTH = 1
Then ERR_SYM_CRK_PLAUS = SYM_1"
{Detection of symptom SIGNAL IMPLAUSIBLE}
Else ERR_SYM_CRK_PLAUS = SYM_0"
{Detection of symptom SIGNAL MISSING}
Endif
LV_ERR_CRK_PLAUS = 1
LV_END_DIAG_CRK_PLAUS = 1

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Endif
Endif

LV_ERR_CRK_PLAUS and ERR_SYM_CRK_PLAUS are reset to initialization value at 0 to 1 transition of LV_IGK.

If LV_CRK_SYN = 1
Then LV_END_DIAG_CRK_PLAUS = 1
LV_ERR_CRK_PLAUS = 0
ERR_SYM_CRK_PLAUS = NO_SYM
Deliver the result to Error Management
Endif

A.47.2 Camshaft sensor plausibility diagnosis

FUNCTION DESCRIPTION:

General information:

The functional camshaft diagnosis cannot detect a failure when a camshaft sensor delivers no signal at all. Missing signal will be detected if the camshaft edge counter is not incremented at least once per engine cycle.
i = 1...NC_NR_CAM_CBK

Description:

Error-symptoms are defined to this diagnostic function as following:

```
┌─┬─┬─┬─┐

└─┴─┴─┴─┘

 │ │ │ └─> Signal missing     (= SYM_0)
 │ │ └───> (not used)         (= SYM_1)
 │ └─────> (not used)         (= SYM_2)
 └───────> (not used)         (= SYM_3)
```

Application conditions:

Initialisation:
LV_CDN_DIAG_PLAUS_CAM_IN(EX)[i] = 0 at reset
LV_END_DIAG_PLAUS_CAM_IN(EX)[i] = 0 at reset
ERR_SYM_PLAUS_CAM_IN(EX)[i] = NO_SYM at reset
LV_ERR_PLAUS_CAM_IN(EX)[i] = 0 at reset
CTR_CYC_ENG_PLAUS_CAM_IN(EX)[i] = C_NR_CYC_ENG_PLAUS_CAM_MAX at reset
Recurrence: once per engine cycle (two crankshaft revolutions), at any phasing i.e. on crankshaft revolution which was on-going at engine synchronization

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Activation: LV_CRK_SYN = 1
And LV_INH_DIAG_PLAUS_CAM_IN(EX)[i] = 0
And LV_INH_DIAG_EXT_PLAUS_CAM_IN(EX)[i] = 0
And LV_INH_DIAG_ENSD = 0
And C_NR_CYC_ENG_PLAUS_CAM_MAX ? 0

When the activation condition is fulfilled then LV_CDN_DIAG_PLAUS_CAM_IN(EX)[i] =1.

Deactivation:
When the activation condition is not fulfilled then LV_CDN_DIAG_PLAUS_CAM_IN(EX)[i] = 0.

Formula Section

Symptoms calculation:

If CTR_EDGE_CAM_IN(EX)[i]n = CTR_EDGE_CAM_IN(EX)[i]n-1
Then ERR_SYM_PLAUS_CAM_IN(EX)[i] = SYM_0" {SIGNAL MISSING}
increment CTR_CYC_ENG_PLAUS_CAM_IN(EX)[i]
Else ERR_SYM_PLAUS_CAM_IN(EX)[i] = NO_SYM
decrement CTR_CYC_ENG_PLAUS_CAM_IN(EX)[i]
Endif
CTR_EDGE_CAM_IN(EX)[i]n-1 will be initialized to zero at engine stop detection.

If CTR_CYC_ENG_PLAUS_CAM_IN(EX)[i] = 2*C_NR_CYC_ENG_PLAUS_CAM_MAX
Then LV_ERR_PLAUS_CAM_IN(EX)[i] = 1
LV_END_DIAG_PLAUS_CAM_IN(EX)[i] = 1
reset CTR_CYC_ENG_PLAUS_CAM_IN(EX)[i] (to C_NR_CYC_ENG_PLAUS_CAM_MAX)

Deliver the result to Error Management
Else **If** CTR_CYC_ENG_PLAUS_CAM_IN(EX)[i] =0
Then **If** LC_CTR_DEC_PLAUS_CAM = 1
Then LV_ERR_PLAUS_CAM_IN(EX)[i] = 0
Endif
LV_END_DIAG_PLAUS_CAM_IN(EX)[i] = 1
reset CTR_CYC_ENG_PLAUS_CAM_IN(EX)[i] (to C_NR_CYC_ENG_PLAUS_CAM_MAX)
Deliver the result to Error Management
Endif
Endif

LV_ERR_PLAUS_CAM_IN(EX)[i] , ERR_SYM_PLAUS_CAM_IN(EX)[i] and CTR_CYC_ENG_PLAUS_CAM_IN(EX)[i] are reset to initialization value at 0 to 1 transition of LV_IGK.

If LV_SYN_CAM_IN(EX)[i] = 1
Then **If** LC_CTR_DEC_PLAUS_CAM = 1
Then LV_ERR_PLAUS_CAM_IN(EX)[i] = 0
Endif
LV_END_DIAG_PLAUS_CAM_IN(EX)[i] = 1
ERR_SYM_PLAUS_CAM_IN(EX)[i] = NO_SYM
reset CTR_CYC_ENG_PLAUS_CAM_IN(EX)[i] (to C_NR_CYC_ENG_PLAUS_CAM_MAX)

Deliver the result to Error Management
Endif

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A.47.3 Camshaft Sensor Diagnosis for Crankshaft Synchronization

FUNCTION DESCRIPTION:

General information:

The purpose of the function is to detect a failure of the camshaft information for crankshaft synchronization.
Up to four camshaft signals may be available in the system (intake and/or exhaust on one or two cylinder banks). The Engine Position Control selects one camshaft for synchronization by activating the corresponding operating mode. The camshaft signal acquisition will indicate camshaft signal out of range for crankshaft synchronization by setting LV_ORNG_CAM_SYN_CRK, which has to be reset by the diagnosis after treatment. A counter is incremented at every recurrence if LV_ORNG_CAM_SYN_CRK is set. The error is detected when the counter reaches a calibrated maximum.
i = 1...NC_NR_CAM_CBK

Description:

Error-symptoms are defined to this diagnostic function as following:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> Camshaft signal  not valid for crankshaft synchronization     (= SYM_0)
 │ │ └───> (not used)                                                    (= SYM_1)
 │ └─────> (not used)                                                    (= SYM_2)
 └───────> (not used)                                                    (= SYM_3)
```

Application conditions:

Initialisation:
LV_CDN_DIAG_SYN_CRK_CAM_IN(EX)[i] = 0 at reset
LV_END_DIAG_SYN_CRK_CAM_IN(EX)[i] = 0 at reset
ERR_SYM_SYN_CRK_CAM_IN(EX)[i] = NO_SYM at reset
LV_ERR_SYN_CRK_CAM_IN(EX)[i] = 0 at reset
Recurrence: every crankshaft reference gap and every camshaft edge
Activation: LV_ACT_CRK = 1
And LV_INH_DIAG_SYN_CRK_CAM_IN(EX)[i] = 0
And LV_INH_DIAG_EXT_SYN_CRK_CAM_IN(EX)[i] = 0
And LV_INH_DIAG_ENSD = 0

When the activation condition is fulfilled then LV_CDN_DIAG_SYN_CRK_CAM_IN(EX)[i] = 1

Deactivation:
When the activation condition is not fulfilled then LV_CDN_DIAG_SYN_CRK_CAM_IN(EX)[i] = 0.

Formula Section

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Symptoms calculation:

For LV_ACT_SYN_CRK_CAM_IN(EX)[i] = 1 (camshaft sensor currently selected for synchronization):

if LV_ORNG_CAM_SYN_CRK = 0
then ERR_SYM_SYN_CRK_CAM_IN(EX)[i] = NO_SYM
else ERR_SYM_SYN_CRK_CAM_IN(EX)[i] = SYM_0" {SIGNAL INVALID}
increment CTR_ORNG_CAM_SYN_CRK
endif

if CTR_ORNG_CAM_SYN_CRK > C_CTR_ORNG_CAM_SYN_CRK_MAX
then LV_ERR_SYN_CRK_CAM_IN(EX)[i] = 1
LV_END_DIAG_SYN_CRK_CAM_IN(EX)[i] = 1
Deliver the result to Error Management
reset CTR_ORNG_CAM_SYN_CRK
endif

if LV_SYN_VLD = 1
then LV_END_DIAG_SYN_CRK_CAM_IN(EX)[i] = 1
ERR_SYM_SYN_CRK_CAM_IN(EX)[i] = NO_SYM
LV_ERR_SYN_CRK_CAM_IN(EX)[i] = 0
Deliver the result to Error Management
reset CTR_ORNG_CAM_SYN_CRK
endif

For LV_ACT_SYN_CRK_CAM_IN(EX)[i] = 0 (camshaft sensor currently **not** selected for cam/crk synchronization):

if LV_SYN_CAM_IN(EX)[i] = 1
And
LV_AD_END_CAM_IN(EX)[i] = 1
then ERR_SYM_SYN_CRK_CAM_IN(EX)[i] = NO_SYM
If LC_CAM_ERR_ENA_VVT = 1
Then LV_ERR_SYN_CRK_CAM_IN(EX)[i] = 0
LV_END_DIAG_SYN_CRK_CAM_IN(EX)[i] = 1
Deliver the result to Error Management
Endif
endif

LV_ERR_SYN_CRK_CAM_IN(EX)[i], ERR_SYM_SYN_CRK_CAM_IN(EX)[i] and CTR_ORNG_CAM_SYN_CRK are reset to initialization value at 0 to 1 transition of LV_IGK.

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A.48 Engine position and speed diagnosis manager

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Failure of exhaust camshaft sensor i					
LV_ERR_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Failure of intake camshaft sensor i					
LV_ERR_CAM_TOT	O/V	0... 1H	0 ...1	1	-
Failure of at least one camshaft sensor on a camshaft with IVVT actuator					
LV_ERR_CRK	O/V	0... 1H	0 ...1	1	-
Crankshaft sensor failure					
LV_IGN_INJ_LOCK_REQ	O/V	0... 1H	0 ...1	1	-
Request to lock ignition and/or injection due to backwards rotation detection					
LV_INH_DIAG_CRK_OC	O/V	0... 1H	0 ...1	1	-
Inhibition of Crankshaft sensor circuit diagnosis					
LV_INH_DIAG_CRK_PLAUS	O/V	0... 1H	0 ...1	1	-
Inhibition of Crankshaft sensor plausibility diagnosis					
LV_INH_DIAG_CRK_SYN	O/V	0... 1H	0 ...1	1	-
Inhibition of Crankshaft sensor synchronization diagnosis					
LV_INH_DIAG_CRK_TOOTH	O/V	0... 1H	0 ...1	1	-
Inhibition of Crankshaft sensor tooth number diagnosis					
LV_INH_DIAG_CRK_TOOTH_PER	O/V	0... 1H	0 ...1	1	-
Inhibition of Crankshaft sensor tooth period diagnosis					
LV_INH_DIAG_ENSD	O/V	0... 1H	0 ...1	1	-
Inhibition of cam/crk diagnosis during fail safe delay					
LV_INH_DIAG_PER_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of exhaust camshaft i period diagnosis					
LV_INH_DIAG_PER_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of intake camshaft i period diagnosis					
LV_INH_DIAG_PLAUS_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of exhaust camshaft i plausibility diagnosis					
LV_INH_DIAG_PLAUS_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of intake camshaft i plausibility diagnosis					
LV_INH_DIAG_REF_CRK_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of exhaust camshaft i position diagnosis					
LV_INH_DIAG_REF_CRK_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of intake camshaft i position diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_SYN_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of exhaust camshaft i synchronization diagnosis					
LV_INH_DIAG_SYN_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of intake camshaft i synchronization diagnosis					
LV_INH_DIAG_SYN_CRK_CAM_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of exhaust camshaft sensor diagnosis for crankshaft synchronization					
LV_INH_DIAG_SYN_CRK_CAM_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of intake camshaft sensor diagnosis for crankshaft synchronization					
LV_INH_DIAG_TOOTH_OFF_EX [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of exhaust camshaft i one-tooth-off diagnosis					
LV_INH_DIAG_TOOTH_OFF_IN [NC_NR_CAM_CBK]	O/V	0... 1H	0 ...1	1	-
Inhibition of exhaust camshaft i one-tooth-off diagnosis					

Input data:

LC_NOT_ADJ_CAM_IVVT_EX [NC_NR_CBK_IVVT] {p. 8400}	LC_NOT_ADJ_CAM_IVVT_IN [NC_NR_CBK_IVVT] {p. 8400}	LV_ENG_BACK_CFM {p. 1505}	LV_ENG_BACK_DET {p. 1505}
LV_ERR_CRK_OC {p. 4430}	LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}
LV_ERR_CRK_TOOTH_PER {p. 4432}	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_IGK {p. 906}	LV_ORNG_CAM_SYN_CRK {p. 871}	LV_ORNG_TOOTH_PER_CRK {p. 853}
LV_STOP_ENG {p. 1505}	LV_SYN_ENG {p. 1506}	LV_SYN_VLD {p. 1506}	N_TOOTH {p. 1525}
NC_NR_CAM_CBK {p. 1507}	NLC_IVVT_EX {p. 8400}	NLC_IVVT_IN {p. 8401}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_NOT_REST	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for cam/crk diagnosis deactivation					
C_T_DLY_REST_IGK	-	0... FFH	0... 2550	10	ms
Delay time for diagnosis reactivation after key-off at low engine speed					
C_T_DLY_REST_STALL	-	0... FFFFH	0... 655350	10	ms
Delay time for diagnosis reactivation after engine stalling					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MAX_INH_DIAG_ENSD	-	0... FFFFH	0... 655350	10	ms
Maximum delay before reactivating diagnosis after engine backwards rotation confirmation					
C_T_MIN_INH_DIAG_ENSD	-	0... FFFFH	0... 655350	10	ms
Minimum delay before reactivating diagnosis in case of key off to on after engine backwards rotation confirmation					
LC_ENG_BACK_INH	-	0... 1H	0 ...1	1	-
Inhibition of engine backwards rotation detection					

A.48.1 Calculation of Fail Safe Delay

General information:

Calculation of the time delay to inhibit cam/crk diagnosis when there is a risk of reverse engine rotation.

Application conditions

Initialisation: `no initialization value.`

Recurrence: `10ms` **and** `1 to 0 transition of LV_IGK`

Activation: `no condition`

Deactivation: `no condition`

Formula section:

If LV_IGK = 0 **And** LV_INH_DIAG_ENSD = 0
Then *check N_TOOTH every 10ms*
If 0 < N_TOOTH < C_N_NOT_REST
Then *Inhibition of all diagnosis functions except sensor circuit diagnosis*
LV_INH_DIAG_ENSD = 1
Wait for a time C_T_DLY_REST_IGK
LV_INH_DIAG_ENSD = 0
Endif
Endif

If LV_STOP_ENG = 1 And LV_ENG_BACK_DET = 0
/* to be checked before LV_ENG_BACK_DET reset on LV_STOP_ENG transition */
And
/* don t activate fail safe delay if cam/crk synchronization is out of range */
LV_ORNG_CAM_SYN_CRK = 0
And
/* don't activate fail safe delay if tooth period is out of range */
LV_ORNG_TOOTH_PER_CRK = 0
And
LV_INH_DIAG_ENSD = 0
Then **If** 0 < N_TOOTH < C_N_NOT_REST
(N_TOOTH: most recently calculated engine speed)
Then *Inhibition of all diagnosis functions except sensor circuit diagnosis*
LV_INH_DIAG_ENSD = 1
Wait for a time C_T_DLY_REST_STALL

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Stop timer C_T_DLY_REST_STALL at 0 to 1 transition of LV_IGK
LV_INH_DIAG_ENSD = 0

Endif

Endif

A.48.2 Diagnosis general inhibition in case of engine backwards rotation detection

General information:

Inhibits cam/crk diagnosis when a reverse engine rotation has been detected until confirmation/nullification.

Application conditions

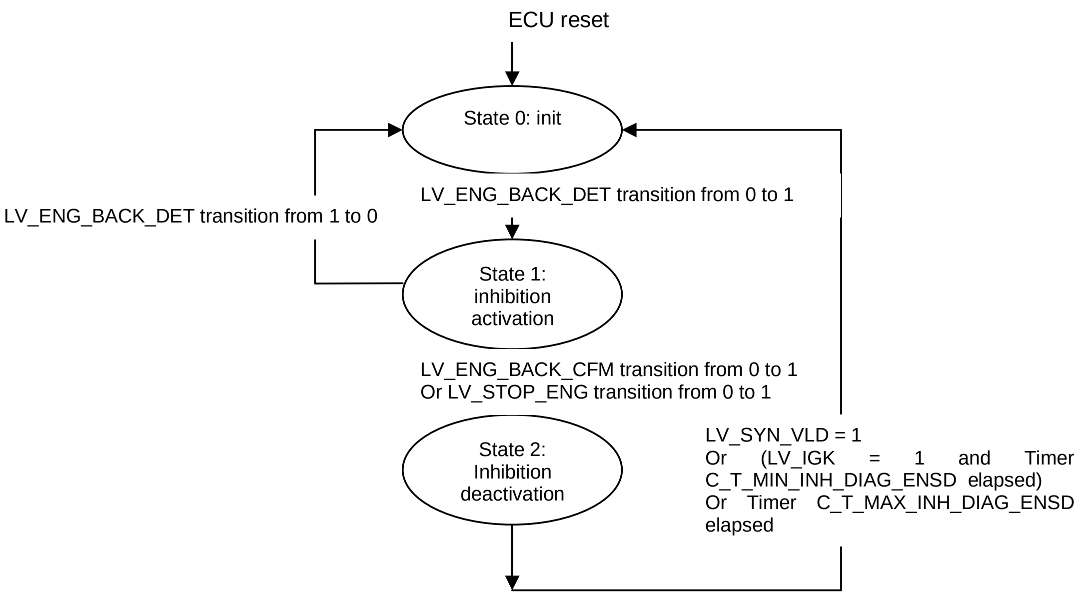
Initialisation: no initialization value.

Recurrence: 10ms **and** transition from 1 to 0 of LV_IGK **and** every update of LV_ENG_BACK_DET or LV_ENG_BACK_CFM **and** transition from 0 to 1 of LV_SYN_VLD **and** transition from 0 to 1 of LV_STOP_ENG

Activation: LC_ENG_BACK_INH = 0

Deactivation: when application conditions are not fulfilled

Formula section:



State 0: Initialisation

Input conditions:

External event : ECU reset

From state 1: LV_ENG_BACK_DET transition from 1 to 0

From state 2: LV_SYN_VLD = 1

Or (LV_IGK = 1 and timer C_T_MIN_INH_DIAG_ENSD elapsed)

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Or timer C_T_MAX_INH_DIAG_ENSD elapsed

Output conditions:

To state 1: LV_ENG_BACK_DET transition from 0 to 1
And Timer C_T_DLY_REST_IGK stopped

Action in the state:

Set timer to C_T_MIN_INH_DIAG_ENSD
Set timer to C_T_MAX_INH_DIAG_ENSD

Transition action:

None

State 1: Inhibition activation

Input conditions:

From state 0: LV_ENG_BACK_DET transition from 0 to 1

Output conditions:

To state 0: ECU reset
Or LV_ENG_BACK_DET transition from 1 to 0

To state 2: LV_ENG_BACK_CFM transition from 0 to 1
Or LV_STOP_ENG transition from 0 to 1

Action in the state:

LV_INH_DIAG_ENSD = 1
LV_IGN_INJ_LOCK_REQ = 1
Stop timer C_T_MIN_INH_DIAG_ENSD if on-going
Stop timer C_T_MAX_INH_DIAG_ENSD if on-going

Transition action:

To state 0: LV_INH_DIAG_ENSD = 0
LV_IGN_INJ_LOCK_REQ = 0

To State 2: Start timer C_T_MAX_INH_DIAG_ENSD
Start timer C_T_MIN_INH_DIAG_ENSD if LV_IGK = 0

State 2: Inhibition deactivation

Input conditions:

From state 1: LV_ENG_BACK_CFM transition from 0 to 1
Or LV_STOP_ENG transition from 0 to 1

Output conditions:

To state 0: ECU reset
Or LV_SYN_VLD = 1
Or (LV_IGK = 1 and timer C_T_MIN_INH_DIAG_ENSD elapsed)
Or timer C_T_MAX_INH_DIAG_ENSD elapsed

Action in the state:

Start timer C_T_MIN_INH_DIAG_ENSD on transition of LV_IGK from 1 to 0

Transition action:

To state 0: LV_INH_DIAG_ENSD = 0
LV_IGN_INJ_LOCK_REQ = 0

Remark: if C_T_MIN_INH_DIAG_ENSD = 0, then timer is started at transition of LV_IGK from 1 to 0 and considered as elapsed immediately.

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A.48.3 Diagnosis Manager

General information:

One purpose of the diagnosis manager is to provide a summary of diagnostic information, in order to facilitate taking the necessary actions in case of a failure, e.g. switch to limp-home mode. The corresponding outputs are crankshaft limp-home request a general camshaft error flag for IVVT, and a general camshaft error for synchronization.
The other purpose is to avoid getting multiple error codes and freeze frames for the same failure. The corresponding outputs are the inhibit flags for the various diagnosis functions.
i = 1...NC_NR_CAM_CBK

Application conditions

Initialisation: `no initialization value.`

Recurrence:
```
every change in the error flags of one of the diagnostic functions
Or
when error memory is cleared
Or
At key 0 to 1 transition
```

Activation:

Deactivation:

Formula section:

LV_ERR_CRK

LV_ERR_CRK = 1 **if** LV_ERR_CRK_SYN = 1 **or** LV_ERR_CRK_TOOTH_PER = 1 **or** LV_ERR_CRK_TOOTH = 1 **or** LV_ERR_CRK_PLAUS = 1 **or** LV_ERR_CRK_OC = 1

LV_ERR_CRK = 0 **if** LV_ERR_CRK_SYN = 0 **and** LV_ERR_CRK_TOOTH_PER = 0 **and** LV_ERR_CRK_TOOTH = 0 **and** LV_ERR_CRK_PLAUS = 0 **and** LV_ERR_CRK_OC = 0.

If LV_ERR_CRK = 1, all other diagnoses on the crankshaft signal will be inhibited via the interfaces LV_INH_DIAG_CRK_SYN, LV_INH_DIAG_CRK_TOOTH, LV_INH_DIAG_CRK_TOOTH_PER, LV_INH_DIAG_CRK_PLAUS and LV_INH_DIAG_CRK_OC, except the one that detected the failure.

LV_ERR_CAM_IN(EX)[i]

LV_ERR_CAM_IN(EX)[i] = 1 **if** LV_ERR_SYN_CAM_IN(EX)[i] = 1 **or** LV_ERR_PER_CAM_IN(EX)[i] = 1 **or** LV_ERR_PLAUS_CAM_IN(EX)[i] = 1 **or** LV_ERR_REF_CRK_CAM_IN(EX)[i] = 1 **or** LV_ERR_SYN_CRK_CAM_IN(EX)[i] = 1 **or** LV_ERR_TOOTH_OFF_IN(EX)[i] = 1.

LV_ERR_CAM_IN(EX)[i] = 0 **if** LV_ERR_SYN_CAM_IN(EX)[i] = 0 **and** LV_ERR_PER_CAM_IN(EX)[i] = 0 **and** LV_ERR_PLAUS_CAM_IN(EX)[i] = 0 **and** LV_ERR_REF_CRK_CAM_IN(EX)[i] = 0 **and** LV_ERR_SYN_CRK_CAM_IN(EX)[i] = 0 **and** LV_ERR_TOOTH_OFF_IN(EX)[i] = 0.

If LV_ERR_CAM_IN(EX)[i] = 1, other diagnoses on the same camshaft signal will be inhibited via the interfaces LV_INH_DIAG_SYN_CAM_IN(EX)[i], LV_INH_DIAG_PER_CAM_IN(EX)[i], LV_INH_DIAG_PLAUS_CAM_IN(EX)[i], LV_INH_DIAG_REF_CRK_CAM_IN(EX)[i] and LV_INH_DIAG_TOOTH_OFF_IN(EX)[i], except the one that detected the failure.

LV_ERR_CAM_TOT

VVT actuators existing in the system are given by a logical combination of the configuration data NLC_IVVT_IN(EX) and the calibration data LC_NOT_ADJ_CAM_IVVT_IN(EX)[i].

LV_ERR_CAM_TOT = 1 if LV_ERR_CAM_IN(EX)[i] = 1 for one of the sensors on camshafts with IVVT actuator.

LV_ERR_CAM_TOT = 0 if LV_ERR_CAM_IN(EX)[i] = 0 for all sensors on camshafts with IVVT actuator.

A.48.4 Inhibition of camshaft sensor diagnosis for crankshaft synchronization

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General information:

Calculation of the inhibition flag of camshaft sensor diagnosis for crankshaft synchronization in case of possible reverse rotation.
I = 1...NC_NR_CAM_CBK

Application conditions

Initialisation: LV_INH_DIAG_SYN_CRK_CAM_IN(EX)[i] = 0 at ECU reset **and** 0 to 1 transition of LV_IGK

Recurrence: 10ms **and** transition from 0 to 1 of LV_STOP_ENG **and** transition from 0 to 1 of LV_SYN_VLD

Activation: –

Deactivation: –

Formula section:

If LV_SYN_ENG = 0
  And LC_ENG_BACK_INH = 0
    And LV_INH_DIAG_ENSD = 0
  And 0 < N_TOOTH < C_N_NOT_REST
    And LV_ORNG_TOOTH_PER_CRK = 1
Then LV_INH_DIAG_SYN_CRK_CAM_IN(EX)[i] = 1
Endif

If LV_SYN_VLD = 1
Then LV_INH_DIAG_SYN_CRK_CAM_IN(EX)[i] = 0
Endif

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A.49 Engine overspeed detection diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_KM_N_MAX	O/V/S	0... FFFFH	0... 655350	10	km
km counter at highest event					
CTR_N_MAX	O/V/S	0... FFH	0... 255	1	-
event frequency counter					
GEAR_EF_N_MAX	O/V/S	0... FFH	0... 255	1	-
Gear ratio at highest event					
LV_CS_N_MAX	O/V/S	0... 1H	0 ...1	1	-
Clutch switch detection at highest event					
N_GRD_N_MAX	O/V/S	80... 7FH	-4096 ...4064	32	rpm/s
Engine speed gradient at highest event					
N_MAX	O/V/S	0... 1FE0H	0... 8160	1	rpm
highest engine speed reached					
NR_PAT_SCC_N_MAX	O/V/S	0... FFH	0... 255	1	-
Selected index of fuel cut off pattern at highest event					
PV_AV_N_MAX	O/V/S	0... FFH	0... 99.609375	0.390625	%
Pedal value at highest event					
T_N_MAX	O/V/S	0... FFFFH	0... 6553.5	0.1	s
Time sum at highest event					
T_SUM_N_MAX	O/V/S	0... FFFFH	0... 6553.5	0.1	s
Time sum of all events maximum engine speed reached					
TRT_N_MAX	O/V/S	0... FFFFFFFFH	0... 119.304647083e3	27.7777e-6	h
total running time in case of maximum engine speed reached					
VS_N_MAX	O/V/S	0... FFH	0... 255	1	km/h
Vehicle speed at highest event					

Input data:

CTR_KM_CAN {p. 1563}	GEAR_EF {p. 1302}	LV_CS {p. 8394}	LV_N_MAX {p. 3779}
LV_VS_MAX {p. 1148}	N {p. 1525}	N_GRD {p. 1525}	NR_PAT_SCC {p. 6665}
PV_AV {p. 1269}	TRT {p. 1504}	VS {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_LIM_MIN	V	0... 1FE0H	0... 8160	1	rpm
engine speed threshold for overreving event					

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General information

This function is for detection of an overreving event and with non-volatile storage of environmental datas if triggered.

Description:

An overreving event starts at exceeding the engine speed C_N_LIM_MIN and active engine speed limitation (LV_N_MAX = 1).

At each overreving event, the event frequency counter CTR_N_MAX is incremented by 1. The timer T_SUM_N_MAX is always incremented at every active event and remains at the maximum value if reached. The timer T_N_TMP recorded the duration of each event and is used for the T_N_MAX calculation (= the duration with the highest event)

The remaining environmental data are stored at the first event but will be only overritten if the new event has a higher engine speed then the old one. At the end of a driving cylce the datas are stored in NVMY.

Application conditions:

Initialisation: `all data restored out of NVMY`

Activation: **at [** `LV_N_MAX = 1` **and** `LV_VS_MAX = 0` **]**

Deactivation: **at** `LV_N_MAX = 0`

Recurrence: `segment synchronous`

Function description:

Formula section:

determination of event-frequency-counter :

```
if      N > C_N_LIM_MIN
then    CTR_N_MAX = CTR_N_MAX + 1     ( only once per trigger )
else    CTR_N_MAX = CTR_N_MAX
endif
```

determination of total time :

```
if      N > C_N_LIM_MIN
then    starts timer T_SUM_N_MAX    (always incremented, remains at
                                      FFFFH  if reached)
else    stop timer T_SUM_N_MAX
endif
```

determination of individual time per event :

```
if      N > C_N_LIM_MIN
then    T_N_TMP ++
        N_MAX_TMP = MAX [ N ]
elseif       N_MAX_TMP > N_MAX     //stored in NVMY or stored at last event
    then     T_N_MAX = T_N_TMP     //update
    else     T_N_MAX = T_N_MAX     //unchanged
    endif
    T_N_TMP = 0         //reset
    N_MAX_TMP = 0       //reset
endif
```

determination of environmental data at first event :

```
if      N > C_N_LIM_MIN
then    N_MAX                      = N
        TRT_N_MAX                  = TRT
        CTR_KM_N_MAX               = CTR_KM_CAN
```

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```
        N_GRD_N_MAX                = N_GRD
        VS_N_MAX                   = VS
        PV_AV_N_MAX                = PV_AV
        GEAR_EF_N_MAX              = GEAR_EF
        LV_CS_N_MAX                = LV_CS
        NR_PAT_SCC_N_MAX           = NR_PAT_SCC
endif
```

determination of environmental data at the next events:

```
if      N > C_N_LIM_MIN     and
        N > N_MAX                 (stored in NVMY or stored at last event)
then    update of all environmental data:
        N_MAX                      = N
        TRT_N_MAX                  = TRT
        CTR_KM_N_MAX               = CTR_KM_CAN
        N_GRD_N_MAX                = N_GRD
        VS_N_MAX                   = VS
        PV_AV_N_MAX                = PV_AV
        GEAR_EF_N_MAX              = GEAR_EF
        LV_CS_N_MAX                = LV_CS
        NR_PAT_SCC_N_MAX           = NR_PAT_SCC
else    old values remains unchanged:
        N_MAX                      = N_MAX
        TRT_N_MAX                  = TRT_N_MAX
        CTR_KM_N_MAX               = CTR_KM_N_MAX
        N_GRD_N_MAX                = N_GRD_N_MAX
        VS_N_MAX                   = VS_N_MAX
        PV_AV_N_MAX                = PV_AV_N_MAX
        GEAR_EF_N_MAX              = GEAR_EF_N_MAX
        LV_CS_N_MAX                = LV_CS_N_MAX
        NR_PAT_SCC_N_MAX           = NR_PAT_SCC_N_MAX
endif
```

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A.50 Engine stop function diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_T_ES	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom of engine off duration error					
ERR_SYM_T_ES_DIAG_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom of engine off duration error for diagnosis 1					
ERR_SYM_T_ES_DIAG_2	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom of engine off duration error for diagnosis 2					
ERR_SYM_T_ES_DIAG_3	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom of engine off duration error diagnosis 3					
ERR_SYM_T_ES_TCO_FAST	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom of engine off duration error for diagnosis "TCO_FAST"					
ERR_SYM_T_ES_TCO_SLOW	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom of engine off duration error for diagnosis "TCO SLOW"					
LV_CDN_DIAG_T_ES	O/V	0... 1H	0 ...1	1	-
Diagnosis condition of engine off duration error					
LV_CDN_DIAG_T_ES_DIAG_1	V	0... 1H	0 ...1	1	-
Conditions for engine off plausibility diagnosis 1 fulfilled					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_T_ES_DIAG_1_CUS	V	0... 1H	0 ...1	1	-
Customer condition for diagnosis 1 fulfilled (diagnosis 1 unlocked)					
LV_CDN_DIAG_T_ES_DIAG_2	V	0... 1H	0 ...1	1	-
Conditions for engine off plausibility diagnosis 2 fulfilled					
LV_CDN_DIAG_T_ES_DIAG_3	V	0... 1H	0 ...1	1	-
Conditions for engine off plausibility diagnosis 3 fulfilled					
LV_CDN_DIAG_T_ES_TCO_FAST	V	0... 1H	0 ...1	1	-
Conditions for engine off plausibility diagnosis "TCO FAST" fulfilled					
LV_CDN_DIAG_T_ES_TCO_SLOW	V	0... 1H	0 ...1	1	-
Conditions for engine off plausibility diagnosis "TCO SLOW" fulfilled					
LV_END_DIAG_T_ES	O/V	0... 1H	0 ...1	1	-
End of diagnosis of engine off duration error					
LV_END_DIAG_T_ES_DIAG_1	O/V	0... 1H	0 ...1	1	-
End of plausibility diagnosis 1 of engine off duration error					
LV_END_DIAG_T_ES_DIAG_2	O/V	0... 1H	0 ...1	1	-
End of plausibility diagnosis 2 of engine off duration error					
LV_END_DIAG_T_ES_DIAG_3	O/V	0... 1H	0 ...1	1	-
End of plausibility diagnosis 3 of engine off duration error					
LV_END_DIAG_T_ES_TCO_FAST	O/V	0... 1H	0 ...1	1	-
End of plausibility diagnosis "TCO FAST" of engine off duration error					
LV_END_DIAG_T_ES_TCO_SLOW	O/V	0... 1H	0 ...1	1	-
End of plausibility diagnosis "TCO SLOW" of engine off duration error					
LV_ERR_T_ES	O/V	0... 1H	0 ...1	1	-
Engine off duration error					
LV_ERR_T_ES_DIAG_1	V	0... 1H	0 ...1	1	-
Engine off duration error diagnosis 1					
LV_ERR_T_ES_DIAG_2	V	0... 1H	0 ...1	1	-
Engine off duration error diagnosis 2					
LV_ERR_T_ES_DIAG_3	V	0... 1H	0 ...1	1	-
Engine off duration error diagnosis 3					
LV_ERR_T_ES_TCO_FAST	O/V	0... 1H	0 ...1	1	-
Engine off duration error diagnosis "TCO_FAST"					
LV_ERR_T_ES_TCO_SLOW	O/V	0... 1H	0 ...1	1	-
Engine off duration error "TCO SLOW"					
LV_IGK_DLY	V	0... 1H	0 ...1	1	-
End of first delay time after ignition on reached					
LV_IGK_DLY_2	V	0... 1H	0 ...1	1	-
End of second delay time after ignition on reached					
LV_IGK_DLY_3	V	0... 1H	0 ...1	1	-
End of third delay time after ignition on reached					
LV_PWL_ACT_MEM	V	0... 1H	0 ...1	1	-
Bit indicationg that PWL was active before					
LV_T_ES_CUS_DIAG_2	V	0... 1H	0 ...1	1	-
Comparison timer of diagnosis 2 initialized					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_T_ES_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
T_ES not plausible - interface to T_ES consuming functions					
T_CDN_T_ES_DIAG_2	V	0... FFFFFFFFH	0... 4294967295	1	s
Time counter - condition for diagnois 2 fulfilled					
T_ES_CUS_DIAG_1	V	0... FFFFFFFFH	0... 4294967295	1	s
Comparison timer for engine off plausibility diagnosis 1					
T_ES_CUS_DIAG_2	V	0... FFFFFFFFH	0... 4294967295	1	s
Comparison timer for engine off plausibility diagnosis 2					
T_ES_CUS_DIAG_3	V	0... FFFFFFFFH	0... 4294967295	1	s
Comparison timer for engine off plausibility diagnosis 3					
T_ES_CUS_ST_DIAG	V	0... FFFFH	0... 65535	1	min
Engine off duration time at start of driving cycle					
T_ES_CUS_TCO_FAST_DIAG_MAX	V	0... FFFFH	0... 65535	1	min
Calculated maximum engine off time for TCO_FAST diagnosis.					
T_ES_CUS_TCO_SLOW_DIAG_MIN	V	0... FFFFH	0... 65535	1	min
Calculated minimum engine off time for TCO_SLOW diagnosis.					
T_IGK_DLY	V	0... 9F6H	0... 255	0.1	s
First delay time after ignition on					
T_IGK_DLY_2	V	0... 9F6H	0... 255	0.1	s
Second delay time after ignition on					
T_IGK_DLY_3	V	0... 9F6H	0... 255	0.1	s
Third delay time after ignition on					
TCO_ST_DIAG_TMP	V	0... FEH	-48... 142.5	0.75	°C
TCO at start of driving cycle					
TCO_STOP_DIAG_TMP	V	0... FEH	-48... 142.5	0.75	°C
TCO at end of last driving cycle					
TCO_STOP_ST	V	0... FEH	0... 190.5	0.75	°C
TCO_STOP - TCO_ST					
TCO_STOP_TAM	V	0... FEH	0... 190.5	0.75	°C
TCO_STOP -TAM					

Input data:

LV_CDN_VB_OBD2 {p. 1185}	LV_END_DIAG_TCO_ STUCK {p. 5691}	LV_ENG_EXT_HEAT {p. 800}	LV_IGK {p. 906}
LV_INH_DIAG_T_ES {p. 4477}	LV_INH_DIAG_T_ES_ TCO_FAST {p. 4477}	LV_INH_DIAG_T_ES_ TCO_SLOW {p. 4477}	LV_PWL_ACT {p. 3776}
LV_T_REL_CAN_REG {p. 1567}	T_ES_CUS {p. 1444}	T_REL_CAN_2 {p. 1579}	T_REL_CAN_ES {p. 1444}
T_REL_CAN_ES_2 {p. 1444}	TAM_ST {p. 1214}	TCO {p. 1100}	TCO_ST {p. 1100}
TCO_STOP {p. 1100}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_T_ES	-	0... FFH	0... 255	1	-
Debounce counter increment - T_ES diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_T_ES_DIAG_1	-	0... FFH	0... 255	1	-
Debounce counter increment - T_ES diagnosis 1					
C_ABC_INC_T_ES_DIAG_2	-	0... FFH	0... 255	1	-
Debounce counter increment - T_ES diagnosis 2					
C_ABC_INC_T_ES_DIAG_3	-	0... FFH	0... 255	1	-
Debounce counter increment - T_ES diagnosis 3					
C_ABC_INC_T_ES_TCO_FAST	-	0... FFH	0... 255	1	-
Debounce counter increment - T_ES diagnosis "TCO FAST"					
C_ABC_INC_T_ES_TCO_SLOW	-	0... FFH	0... 255	1	-
Debounce counter increment - T_ES diagnosis "TCO SLOW"					
C_ABC_MAX_T_ES	-	1... FFH	1... 255	1	-
Debounce counter maximum value -T_ES diagnosis					
C_ABC_MAX_T_ES_DIAG_1	-	1... FFH	1... 255	1	-
Debounce counter maximum value -T_ES diagnosis 1					
C_ABC_MAX_T_ES_DIAG_2	-	1... FFH	1... 255	1	-
Debounce counter maximum value -T_ES diagnosis 2					
C_ABC_MAX_T_ES_DIAG_3	-	1... FFH	1... 255	1	-
Debounce counter maximum value -T_ES diagnosis 3					
C_ABC_MAX_T_ES_TCO_FAST	-	1... FFH	1... 255	1	-
Debounce counter maximum value -T_ES diagnosis "TCO FAST"					
C_ABC_MAX_T_ES_TCO_SLOW	-	1... FFH	1... 255	1	-
Debounce counter maximum value -T_ES diagnosis "TCO SLOW"					
C_T_CDN_T_ES_DIAG_2	-	0... FFFFFFFFH	0... 4294967295	1	s
treshold for time condition diagnosis 2 is set					
C_T_ES_DIAG_FAST_MAX	-	0... FFFFH	0... 65535	1	min
Maximum T_ES threshold for T_ES diagnosis "TCO_FAST"					
C_T_ES_DIAG_FAST_MIN	-	0... FFFFH	0... 65535	1	min
Minimum T_ES threshold for T_ES diagnosis "TCO_FAST"					
C_T_ES_DIAG_MIN	-	0... FFFFH	0... 65535	1	min
Minimum T_ES for T_ES diagnosis "TCO SLOW/FAST"					
C_T_ES_DIAG_SLOW_MAX	-	0... FFFFH	0... 65535	1	min
Maximum T_ES threshold for T_ES diagnosis "TCO_SLOW"					
C_T_ES_DIF_MAX_IGN_ON	-	0... FFFFH	-32768 ...32767	1	s
Maximal deviation between saved engine off time and engine time when ignition on					
C_T_IGK_DLY	-	0... 9F6H	0... 255	0.1	s
Treshold to finish the first delay time after ignition on					
C_T_IGK_DLY_2	-	0... 9F6H	0... 255	0.1	s
Treshold to finish the second delay time after ignition on					
C_T_IGK_DLY_3	-	0... 9F6H	0... 255	0.1	s
Treshold to finish the third delay time after ignition on					
C_T_REL_DIF_MAX_ENG_ON	-	0... FFFFH	-32768 ...32767	1	s
Maximal difference (absolute value) between instrument cluster timer and ECU timer during engine running					
C_T_REL_DIF_MAX_PWL	-	0... FFFFH	-32768 ...32767	1	s
Maximal difference (absolute value) between instrument cluster timer and ECU timer at out from PWL					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_ST_T_ES_DIAG_MIN	-	0... FEH	-48... 142.5	0.75	°C
Minimum TCO_ST value for T_ES diagnosis "TCO SLOW/FAST"					
C_TCO_STOP_T_ES_DIAG_MIN	-	0... FEH	-48... 142.5	0.75	°C
Minimum TCO_STOP value for T_ES diagnosis "TCO SLOW/FAST"					
C_TCO_T_ES_DIAG_FAST_MAX	-	0... FEH	0... 190.5	0.75	°C
Maximum TCO_STOP_ST threshold for T_ES diagnosis "TCO_FAST"					
C_TCO_T_ES_DIAG_SLOW_MIN	-	0... FEH	0... 190.5	0.75	°C
Minimum TCO_STOP_ST threshold for T_ES diagnosis "TCO_SLOW"					
IP_T_ES_TCO_FAST_DIAG	V	0... FFFFH	0... 65535	1	min
LDP_TCO_STOP_START_FAST	6	0... FEH	0... 190.5	0.75	°C
LDP_TCO_STOP_TAM_FAST	6	0... FEH	0... 190.5	0.75	°C
threshold for maximum T_ES for "TCO check FAST" diagnosis					
IP_T_ES_TCO_SLOW_DIAG	V	0... FFFFH	0... 65535	1	min
LDP_TCO_STOP_START_SLOW	6	0... FEH	0... 190.5	0.75	°C
LDP_TCO_STOP_TAM_SLOW	6	0... FEH	0... 190.5	0.75	°C
threshold for minimum T_ES for "TCO check SLOW" diagnosis					
LC_T_ES_DIAG_1_SWI	-	0... 1H	0 ...1	1	-
Switch for additional lock condition for diagnosis 1					
LC_T_ES_DIAG_1_SWI_2	-	0... 1H	0 ...1	1	-
Switch for ERRM call - T_ES diagnosis					

Error treatment:

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Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Engine Off duration diagnosis	T_ES	-	0	STD_INI	CC
		-	1		
		CAN signal unplausible	2		
		-	3		

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Engine Off duration diagnosis	T_ES_DIAG_1	-	0	STD_INI	CC
		-	1		
		-	2		
		CAN signal unplausible	3		

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Engine Off duration diagnosis	T_ES_DIAG_2	-	0	STD_INI	CC
		-	1		
		-	2		
		CAN signal unplausible	3		

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Engine Off duration diagnosis	T_ES_DIAG_3	-	0	STD_INI	CC
		-	1		
		-	2		
		CAN signal unplausible	3		

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Engine Off duration diagnosis	T_ES_TCO_SLOW	-	0	STD_INI	CC
		-	1		
		-	2		
		T_ES unplausible (too fast)	3		

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Engine Off duration diagnosis	T_ES_TCO_FAST	-	0	STD_INI	CC
		-	1		
		-	2		
		T_ES unplausible (too slow)	3		

Fields information (For more information refers to Error Management file Table of Failure) :

- ABC Type : STD_INI, STD, MEM, MEM_INI, DEC_CAL, STC, NO, MPL_STD_INI
- CARB Class : MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO.

A.50.1 Diagnosis algorithm

FUNCTION DESCRIPTION:

General information:

The engine off duration should be monitored concerning legislation requirements. Three different diagnosis are carried out concerning the time signal from CAN (LV_ERR_T_ES is set in error case). Two

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different diagnosis ensure The plausibility of T_ES to TCO and TAM. (LV_ERR_T_ES_TCO_SLOW or LV_ERR_T_ES_TCO_FAST are set in error case)

Application conditions

Initialization: according ERRM initialization type **"STD_INI"**

```
At reset:          LV_IGK_DLY = 0
          LV_IGK_DLY_2 = 0
LV_IGK_DLY_3 = 0
     T_IGK_DLY = 0
     T_IGK_DLY_2 = 0
     T_IGK_DLY_3 = 0
     T_CDN _T_ES_DIAG_2 = 0
     LV_T_ES_CUS_DIAG_2 = 0
          T_ES_CUS_DIAG_1 = 0
     T_ES_CUS_DIAG_2 = 0
     T_ES_CUS_DIAG_3 = 0
     LV_CDN_DIAG_T_ES = 0
     LV_CDN_DIAG_T_ES_DIAG_1 = 0
     LV_CDN_DIAG_T_ES_DIAG_2 = 0
     LV_CDN_DIAG_T_ES_DIAG_3 = 0
     LV_CDN_DIAG_T_ES_TCO_SLOW = 0
     LV_CDN_DIAG_T_ES_TCO_FAST = 0
     LV_CDN_DIAG_T_ES_DIAG_1_CUS = 1
     LV_T_ES_NOT_PLAUS = 0
     T_ES_CUS_TCO_SLOW_DIAG_MIN = 0
     T_ES_CUS_TCO_FAST_DIAG_MAX = 0
  At system-event DCON:
     TCO_STOP_DIAG_TMP = TCO_STOP
     TCO_ST_DIAG_TMP = TCO_ST
     TCO_STOP_ST = TCO_STOP - TCO_ST
     TCO_STOP_TAM = TCO_STOP - TAM_ST
     T_ES_CUS_ST_DIAG = T_ES_CUS
```

Recurrence: *100 ms*

Activation: allways

Formula section:

Set of LV_T_ES_NOT_PLAUS

LV_T_ES_NOT_PLAUS is set as soon as LV_ERR_T_ES or LV_ERR_T_ES_XXX is set.
Please note: the switch LC_T_ES_DIAG_1_SWI_2 is used to either link the error bits LV_ERR_T_ES_1 and _2 with an 'and' or an 'or' when it is set to 0 or 1 respectively.

If(1) LV_ERR_T_ES = 1 **or**
LV_ERR_T_ES_TCO_SLOW =1 **or**
LV_ERR_T_ES_TCO_FAST =1 **or**
LV_ERR_T_ES_DIAG_3 = 1 **or**
(LC_T_ES_DIAG_1_SWI_2 = 1 **and**
(LV_ERR_T_ES_DIAG_1 = 1 **or**
LV_ERR_T_ES_DIAG_2 = 1)) **or**
(LC_T_ES_DIAG_1_SWI_2 = 0 **and**
LV_ERR_T_ES_DIAG_1 = 1 **and**
LV_ERR_T_ES_DIAG_2 = 1)
Then(1) LV_T_ES_NOT_PLAUS = 1
Else(1) LV_T_ES_NOT_PLAUS = 0
Endif(1)

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Calculation of T_IGK_DLY (Delaytime after Ignition on)

Three different delay times after ignition on for plausibility diagnosis 1 /diagnosis TCO SLOW/FAST , plausibility diagnosis 2 and plausibility diagnosis 3 can be calibrated

```
If(1)            LV_IGK = 1        and       LV_IGK_DLY = 0
Then(1)        T_IGK_DLY = T_IGK_DLY + 100ms
      If(2)            T_IGK_DLY > C_T_IGK_DLY
  Then(2)        LV_IGK_DLY = 1
  Else(2)        LV_IGK_DLY = 0
  Endif(2)
Endif(1)

If(3)            LV_IGK = 1        and       LV_IGK_DLY_2 = 0
Then(3)        T_IGK_DLY_2 = T_IGK_DLY_2 + 100ms
      If(4)            T_IGK_DLY_2 > C_T_IGK_DLY_2
  Then(4)        LV_IGK_DLY_2 = 1
  Else(4)        LV_IGK_DLY_2 = 0
  Endif(4)
Endif(3)

If(5)            exit PWL
Then(5)         LV_PWL_ACT_MEM = 1   // indicating that PWL was active before
Endif(5)

If(6)            LV_PWL_ACT_MEM = 1        and       LV_IGK_DLY_3 = 0
Then(6)        T_IGK_DLY_3 = T_IGK_DLY_3 + 100ms
      If(7)            T_IGK_DLY_3 > C_T_IGK_DLY_3
  Then(7)        LV_IGK_DLY_3 = 1        and
                 LV_PWL_ACT_MEM = 0
  Else(7)        LV_IGK_DLY_3 = 0
  Endif(7)
Endif(6)
```

Reset of Delay Times for Diagnosis 2 and Diagnosis 3

If Ignition Key is switched off the delay-timer for diagnosis 2 and diagnosis 3 are reset to 0.
Also The Comparison timer of diagnosis 2 is initialized again after switching IGK to 1 by setting LV_T_ES_CUS_DIAG_2 = 0 in Case of IGK 1- ->0.

```
If(1)            LV_IGK= 1- ->0
Then(1)        LV_IGK_DLY_2 = 0
                T_IGK_DLY_2 = 0
                LV_T_ES_CUS_DIAG_2 = 0
             T_CDN _T_ES_DIAG_2 = 0
                LV_IGK_DLY_3 = 0
                T_IGK_DLY_3 = 0
                LV_PWL_ACT_MEM = 0
Endif(1)
```

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Initialization of timers after Delay time

If(2) LV_IGK_DLY = 0 - -> 1
Then(2) T_ES_CUS_DIAG_1 = T_REL_CAN_2
Endif(2)

Additional diagnosis - TCO:

Diagnosis of T_ES Plausibility with TCO and TAM.
This additional diagnosis has no influence on LV_ERR_T_ES. In an error case LV_ERR_T_ES_TCO_SLOW or LV_ERR_T_ES_TCO_FAST are set.

If(1) LV_ST_END = 1 **and**
LV_IGK_DLY = 1 **and**
LV_CDN_VB_OBD2 = 1 **and**
LV_T_REL_CAN_REG = 1 **and**
T_ES_CUS_ST_DIAG > C_T_ES_DIAG_MIN **and**
TCO_ST_DIAG_TMP > C_TCO_ST_T_ES_DIAG_MIN **and**
TCO_STOP_DIAG_TMP > C_TCO_STOP_T_ES_DIAG_MIN **and**
LV_ENG_EXT_HEAT = 0
// diagnosis is carried out once

Then(1)
If(2) T_ES_CUS_ST_DIAG < C_T_ES_DIAG_SLOW_MAX **and**
TCO_STOP_ST > C_TCO_T_ES_DIAG_SLOW_MIN **and**
LV_END_DIAG_TCO_STUCK = 1 **and**
LV_END_DIAG_T_ES_TCO_SLOW = 0 **and**
LV_INH_DIAG_T_ES_TCO_SLOW = 0
Then(2) LV_CDN_DIAG_T_ES_TCO_SLOW = 1
T_ES_CUS_TCO_SLOW_DIAG_MIN =
IP_T_ES_TCO_SLOW_DIAG(TCO_STOP_ST,
TCO_STOP_TAM)
If(3) T_ES_CUS_ST_DIAG < T_ES_CUS_TCO_SLOW_DIAG_MIN
Then(3) ERR_SYM_T_ES_TCO_SLOW = SYM_3
Else(3) ERR_SYM_T_ES_TCO_SLOW = NO_SYM
Endif(3)
Else(2) LV_CDN_DIAG_T_ES_TCO_SLOW = 0
Endif(2)
If(2) T_ES_CUS_ST_DIAG > C_T_ES_DIAG_FAST_MIN **and**
T_ES_CUS_ST_DIAG <C_T_ES_DIAG_FAST_MAX **and**
TCO_STOP_ST < C_TCO_T_ES_DIAG_FAST_MAX **and**
LV_END_DIAG_T_ES_TCO_FAST = 0 **and**
LV_INH_DIAG_T_ES_TCO_FAST = 0
Then(2) LV_CDN_DIAG_T_ES_TCO_FAST = 1
T_ES_CUS_TCO_FAST_DIAG_MAX =
IP_T_ES_TCO_FAST_DIAG (TCO_STOP_ST, TCO_STOP_TAM)
If(3) T_ES_CUS_ST_DIAG > T_ES_CUS_TCO_FAST_DIAG_MAX
Then(3) ERR_SYM_T_ES_ TCO_FAST = SYM_3
Else(3) ERR_SYM_T_ES_ TCO_FAST = NO_SYM
Endif(3)

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Else(2) LV_CDN_DIAG_T_ES_TCO_FAST = 0
Endif(2)

Else(1) LV_CDN_DIAG_T_ES_TCO_FAST = 0
LV_CDN_DIAG_T_ES_TCO_SLOW = 0
Endif(1)

Plausibility diagnosis 1: at start after keep alive Mode

IF(1) LC_T_ES_DIAG_1_SWI = 1 // switch for advanced Condition
Then(1) LV_CDN_DIAG_T_ES_DIAG_1_CUS = 0 // diagnosis 1 is locked
Endif(1)

If(1) LV_IGK_DLY = 0- ->1 **and** // diagnosis is carried ot once
LV_CDN_VB_OBD2 = 1 **and**
LV_T_REL_CAN_REG = 1 **and**
LV_INH_DIAG_T_ES = 0 **and**
LV_CDN_DIAG_T_ES_DIAG_1_CUS = 1

Then(1) LV_CDN_DIAG_T_ES_DIAG_1 = 1

If(2) (T_ES_CUS_DIAG_1 - T_REL_CAN_ES_2) < C_T_ES_DIF_MAX_IGN_ON
Then(2) ERR_SYM_T_ES_DIAG_1 = SYM_3
Else(2) ERR_SYM_T_ES_DIAG_1 = NO_SYM

Else(1) LV_CDN_DIAG_T_ES_DIAG_1 = 0
Endif(1)

Plausibility diagnosis 2: during engine running

If(1) LV_IGK_DLY_2 = 1 **and**
LV_CDN_VB_OBD2 = 1 **and**
LV_T_REL_CAN_REG = 1 **and**
LV_INH_DIAG_T_ES = 0 **and**
T_CDN _T_ES_DIAG_2 < C_T_CDN _T_ES_DIAG_2
Then(1)
If(2) LV_T_ES_CUS_DIAG_2 = 0 //Flag for saving of T_ES_CUS_DIAG_2
Then(2) T_ES_CUS_DIAG_2 = T_REL_CAN_2 **and**
LV_T_ES_CUS_DIAG_2 = 1
Else(2) T_ES_CUS_DIAG_2 = T_ES_CUS_DIAG_2 + 0,1 s
T_CDN _T_ES_DIAG_2 = T_CDN _T_ES_DIAG_2 + 0,1s
LV_CDN_DIAG_T_ES_DIAG_2 = 1

If(3) |T_ES_CUS_DIAG_2 - T_REL_CAN_2| >= C_T_REL_DIF_MAX_ENG_ON
Then(3) ERR_SYM_T_ES_DIAG_2 = SYM_3
Else(3) ERR_SYM_T_ES_DIAG_2 = NO_SYM
Endif (3)

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```
  Endif(2)
Else(1)        LV_T_ES_CUS_DIAG_2 = 0
                LV_CDN_DIAG_T_ES_DIAG_2 = 0
Endif(1)
```

Plausibility diagnosis 3: at restart during keep alive mode

// diagnosis will run once at transition from power latch to ignition on.

```
If(1)              LV_PWL_ACT: 0 - ->1
Then(1)        T_ES_CUS_DIAG_3 = T_REL_CAN_2
Endif(1)

If(2)          LV_IGK=0 and LV_PWL_ACT=1
Then(2)        T_ES_CUS_DIAG_3 = T_ES_CUS_DIAG_3 + 0,1 s
Endif(2)

If(3)              LV_IGK_DLY_3 = 0 - ->1            and
           LV_IGK = 1                          and
                LV_PWL_ACT   = 0                   and
           LV_T_REL_CAN_REG = 1             and
                LV_CDN_VB_OBD2 = 1            and
                LV_INH_DIAG_T_ES = 0

Then(3)        LV_CDN_DIAG_T_ES_DIAG_3 =1
      If(4)     | T_ES_CUS_DIAG_3 - T_REL_CAN_2 + T_IGK_DLY_3 | >= C_T_REL_DIF_MAX_PWL

            Then(4)          ERR_SYM_T_ES_DIAG_3 = SYM_3
            Else(4)          ERR_SYM_T_ES_DIAG_3 = NO_SYM
  Endif(4)
Else(3)        LV_CDN_DIAG_T_ES_DIAG_3 =0
EndIf(3)
```

Error management call

```
IF(1)          LV_CDN_DIAG_T_ES_DIAG_1 = 1            or
               LV_CDN_DIAG_T_ES_DIAG_2 = 1            or
               LV_CDN_DIAG_T_ES_DIAG_3 = 1
Then(1)        LV_CDN_DIAG_T_ES = 1
Else(1)        LV_CDN_DIAG_T_ES = 0
Endif(1)


IF(1)  LC_T_ES_DIAG_1_SWI_2 = 1
Then(1)
            If(2)       LV_ERR_T_ES_DIAG_1 = 1          or
                            LV_ERR_T_ES_DIAG_2 = 1                    or
                            LV_ERR_T_ES_DIAG_3 = 1
  Then(2)          ERR_SYM_T_ES = SYM_2
  Else(2)          If(3)                 ERR_SYM_T_ES = SYM_2
                        Then(3)          ERR_SYM_T_ES = NO_SYM
  Endif(2)
```

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Else(1)
If(4) (LV_ERR_T_ES_DIAG_1 = 1 **and** LV_ERR_T_ES_DIAG_2 = 1) **or**
LV_ERR_T_ES_DIAG_3 = 1
Then(4) ERR_SYM_T_ES = SYM_2
Else(4) **If(3)** ERR_SYM_T_ES = SYM_2
Then(3) ERR_SYM_T_ES = NO_SYM
Endif(3)
Endif(4)
Endif(1)

The following algorithm determines LV_ERR_T_ES and delivers the result to Error Management.
If a symptom was detected, the antibounce counter is increased by C_ABC_INC_T_ES. If the counter reaches C_ABC_MAX_T_ES, the error flag LV_ERR_T_ES is set. If no symptom detected, the antibounce counter is decreased and the error flag is resetted.

ACTION_ERRM_FilterSymptom (IN < NC_IDX_DIAG_T_ES >, IN< LV_CDN_DIAG_T_ES >, IN< ERR_SYM_T_ES >, IN< C_ABC_INC_T_ES >, IN< C_ABC_MAX_T_ES >, IN< 1 >, OUT<LV_ERR_T_ES >

The following algorithm determines LV_ERR_T_ES_XXX and delivers the result to Error Management.
If a symptom was detected, the antibounce counter is increased by C_ABC_INC_T_ES. If the counter reaches C_ABC_MAX_T_ES_XXX, the error flag LV_ERR_T_ES_XXX is set. If no symptom detected, the antibounce counter is decreased and the error flag is resetted.

ACTION_ERRM_FilterSymptom (IN < NC_IDX_DIAG_T_ES_DIAG_1 >, IN< LV_CDN_DIAG_T_ES_DIAG_1 >, IN< ERR_SYM_T_ES_DIAG_1 >, IN< C_ABC_INC_T_ES_DIAG_1 >, IN< C_ABC_MAX_T_ES_DIAG_1 >, IN< 1 >, OUT<LV_ERR_T_ES_DIAG_1 >)

ACTION_ERRM_FilterSymptom (IN < NC_IDX_DIAG_T_ES_DIAG_2 >, IN< LV_CDN_DIAG_T_ES_DIAG_2 >, IN< ERR_SYM_T_ES_DIAG_2 >, IN< C_ABC_INC_T_ES_DIAG_2 >, IN< C_ABC_MAX_T_ES_DIAG_2 >, IN< 1 >, OUT<LV_ERR_T_ES_DIAG_2 >)

ACTION_ERRM_FilterSymptom (IN < NC_IDX_DIAG_T_ES_DIAG_3 >, IN< LV_CDN_DIAG_T_ES_DIAG_3 >, IN< ERR_SYM_T_ES_DIAG_3 >, IN< C_ABC_INC_T_ES_DIAG_3 >, IN< C_ABC_MAX_T_ES_DIAG_3 >, IN< 1 >, OUT<LV_ERR_T_ES_DIAG_3 >)

ACTION_ERRM_FilterSymptom (IN < NC_IDX_DIAG_T_ES_TCO_SLOW >, IN< LV_CDN_DIAG_T_ES_TCO_SLOW >, IN< ERR_SYM_T_ES_TCO_SLOW >, IN< C_ABC_INC_T_ES_TCO_SLOW >, IN< C_ABC_MAX_T_ES_TCO_SLOW >, IN< 1 >, OUT<LV_ERR_T_ES_TCO_SLOW >)

ACTION_ERRM_FilterSymptom (IN < NC_IDX_DIAG_T_ES_TCO_FAST >, IN< LV_CDN_DIAG_T_ES_TCO_FAST >, IN< ERR_SYM_T_ES_TCO_FAST >, IN< C_ABC_INC_T_ES_TCO_FAST>, IN< C_ABC_MAX_T_ES_TCO_FAST >, IN< 1 >, OUT<LV_ERR_T_ES_TCO_FAST >)

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A.51 Engine stop function diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_T_ES	O/V	0... 1H	0 ...1	1	-
Flag for inhibition off engine of duration diagnosis.					
LV_INH_DIAG_T_ES_TCO_FAST	O/V	0... 1H	0 ...1	1	-
Flag for inhibition of engine off duration diagnosis TCO_FAST.					
LV_INH_DIAG_T_ES_TCO_SLOW	O/V	0... 1H	0 ...1	1	-
Flag for inhibition of engine off duration diagnosis TCO_SLOW.					
STATE_RBM_T_ES	O/V	0... 7H	0 ...7	1	-
Interface of T_ES monitor with the Rate-Based Monitoring statistics					
STATE_RBM_T_ES_TCO_FAST	O/V	0... 7H	0 ...7	1	-
Interface of T_ES_TCO_FAST monitor with the Rate-Based Monitoring statistics					
STATE_RBM_T_ES_TCO_SLOW	O/V	0... 7H	0 ...7	1	-
Interface of T_ES_TCO_SLOW monitor with the Rate-Based Monitoring statistics					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_DC {p. 5746}	LV_END_DIAG_T_ES {p. 4466}	LV_END_DIAG_T_ES_DIAG_1 {p. 4466}
LV_END_DIAG_T_ES_DIAG_2 {p. 4466}	LV_END_DIAG_T_ES_DIAG_3 {p. 4466}	LV_END_DIAG_T_ES_TCO_FAST {p. 4466}	LV_END_DIAG_T_ES_TCO_SLOW {p. 4466}
LV_ERR_BN_T_ICL {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_COM_2_BOFF {p. 801}	LV_ERR_COM_2_T_ICL {p. 801}
LV_ERR_COM_2_TAM_ICL	LV_ERR_ECU_NVMY {p. 4232}	LV_ERR_T_ES {p. 4466}	LV_ERR_T_ES_TCO_FAST {p. 4466}
LV_ERR_T_ES_TCO_SLOW {p. 4466}	LV_ERR_TAM_CAN {p. 5076}	LV_ERR_TAM_PLAUS {p. 5076}	LV_ERR_TCO_EL {p. 4496}
LV_ERR_TCO_GRD {p. 4496}	LV_ERR_TCO_PLAUS {p. 5682}	LV_ERR_TCO_STUCK {p. 5691}	LV_ERR_TCO_STUCK_RNG {p. 5675}
NC_IDX_DIAG_BN_T_ICL	NC_IDX_DIAG_CAN_BOFF	NC_IDX_DIAG_COM_2_BOFF	NC_IDX_DIAG_COM_2_T_ICL
NC_IDX_DIAG_COM_2_TAM_ICL	NC_IDX_DIAG_ECU_NVMY	NC_IDX_DIAG_T_ES	NC_IDX_DIAG_T_ES_TCO_FAST
NC_IDX_DIAG_T_ES_TCO_SLOW	NC_IDX_DIAG_TAM_CAN	NC_IDX_DIAG_TAM_PLAUS	NC_IDX_DIAG_TCO_EL
NC_IDX_DIAG_TCO_GRD	NC_IDX_DIAG_TCO_PLAUS	NC_IDX_DIAG_TCO_STUCK	NC_IDX_DIAG_TCO_STUCK_RNG

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_T_ES_DIAG_1_RBM_SWI	-	0... 1H	0 ...1	1	-
Switch to change the calculation logic for bit0 of STATE_RBM_T_ES.					

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

General information:

The calculation STATE_RBM_T_ES is based on the status of the 3 plausibility checks with the internal ECU-timer. In addition, two further RBM-ratios are calculated, namely STATE_RBM_T_ES_TCO_SLOW and STATE_RBM_T_ES_TCO_FAST.

Application conditions:

Initialisation:	`RST, DCON, CLRFMY, IGKON`
Recurrence:	`1S, 100MS`
Activation:	`1S: LV_DC==1 100MS: always`
Deactivation:	`if activation not true`

Function description:

Formula section:

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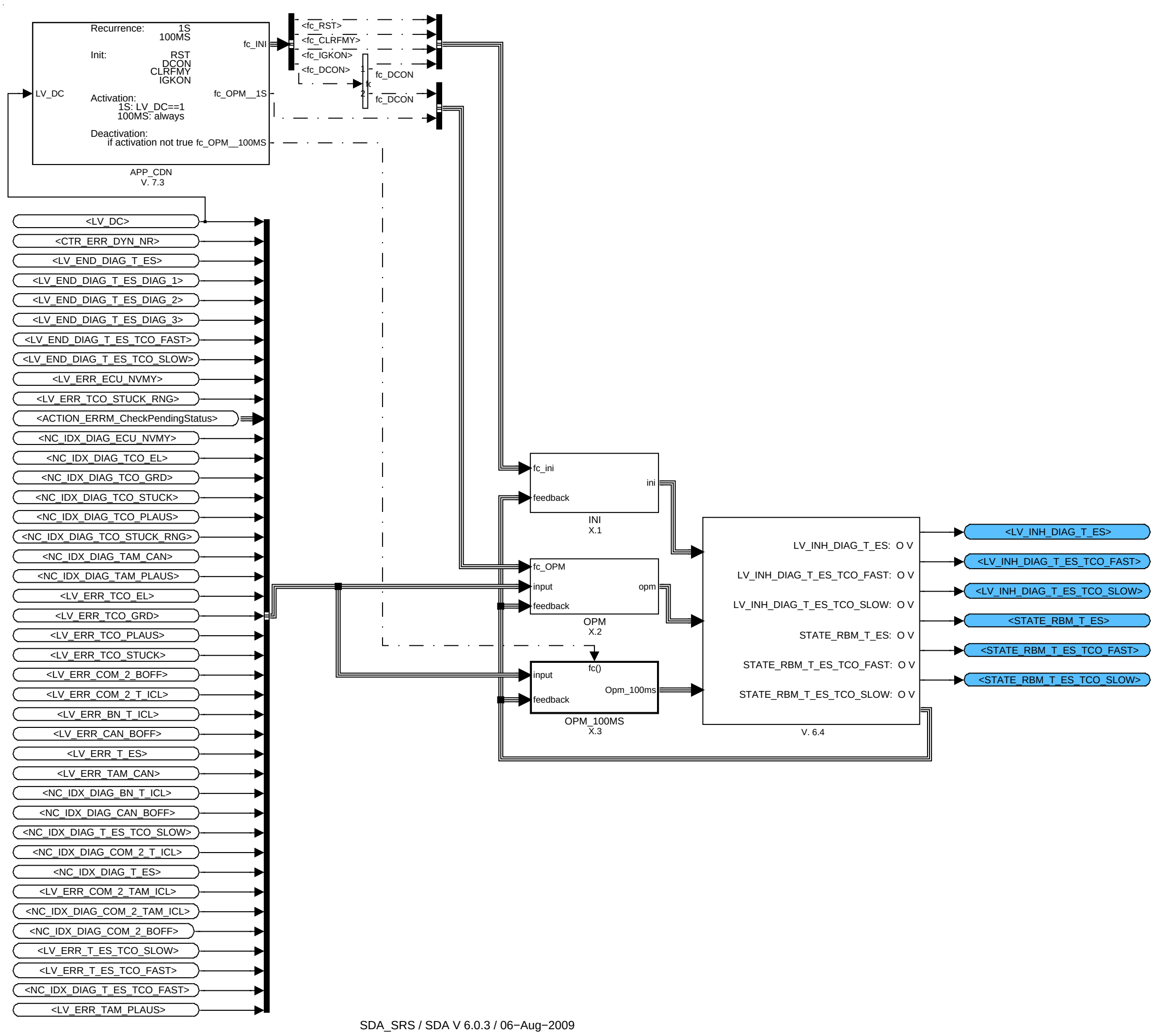

Figure A.51.1: :

A.51.1 Initialization

A.51.1.1 Initialization at RST

All variables are reset to zero.

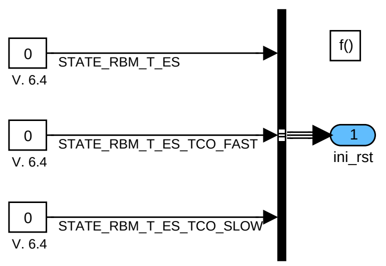

Figure A.51.2: :

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A.51.1.2 Initialization at DCON

at LV_DC 0 - -> 1 transition:
bit 0, bit 1 and bit 2 of STATE_RBM_T_ES = 0
bit 0, bit 1 and bit 2 of STATE_RBM_T_ES_TCO_FAST = 0
bit 0, bit 1 and bit 2 of STATE_RBM_T_ES_TCO_SLOW = 0

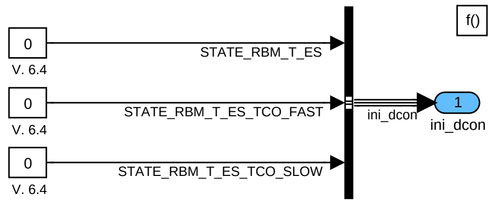

Figure A.51.3: :

A.51.1.3 Initialization at CLRFMY

on failure memory reset :
bit 1 of STATE_RBM_T_ES = 0
bit 1 of STATE_RBM_T_ES_TCO_FAST = 0
bit 1 of STATE_RBM_T_ES_TCO_SLOW = 0

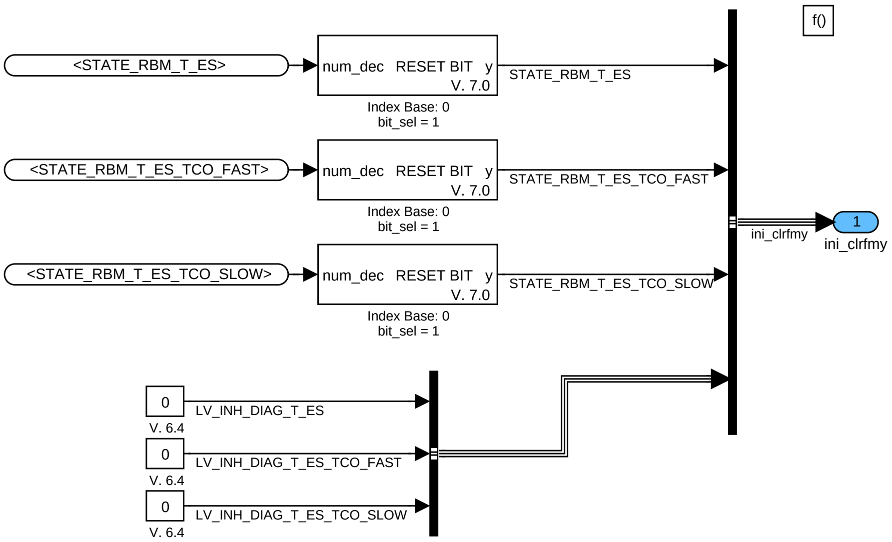

Figure A.51.4: :

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A.51.1.4 Initialization at RST or LV_IGK 0->1

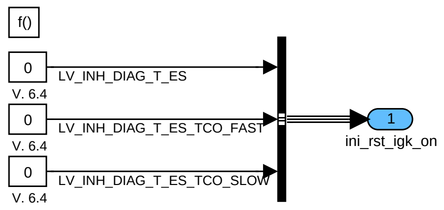

Figure A.51.5: :

A.51.2 Formula section

A.51.2.1 Calculation of STATE_RBM_T_ES

With this module the interface between the T_ES monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_T_ES data. With the switch LC_T_ES_DIAG_1_RBM_SWI, the calculation logic of bit0 of STATE_RBM_T_ES based on the END-flags of T_ES_DIAG_1, T_ES_DIAG_2 and T_ES_DIAG_3 can be changed.

Within STATE_RBM_T_ES, three different information are defined:
- Conditions for monitoring are met long enough to detect malfunction (bit 0)
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)
(depending on failure status: pending)
- Monitor indiv. RBM conditions encountered within this DC (bit 2 not valid for T_ES)

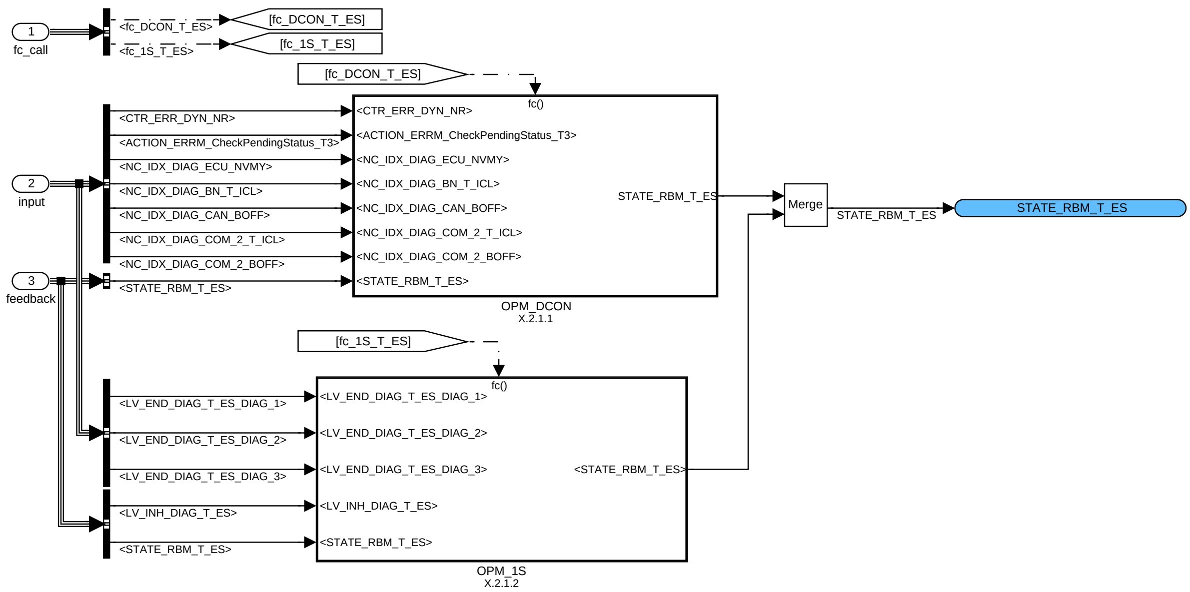

Figure A.51.6: :

A.51.2.1.1 Operation at DCON

At LV_DC 0 - -> 1 transition
The pending status of the following failures has to be checked only once :

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LV_ERR_ECU_NVMY	LV_ERR_BN_T_ICL	LV_ERR_CAN_BOFF	LV_ERR_COM_2_BOFF
LV_ERR_COM_2_T_ICL			

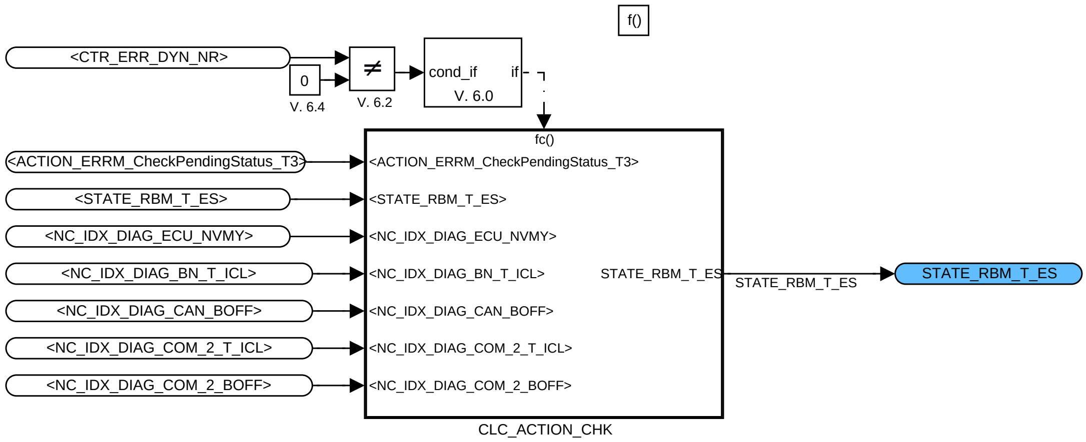

Figure A.51.7: :

A.51.2.1.1.1 Assignment of STATE_RBM_T_ES

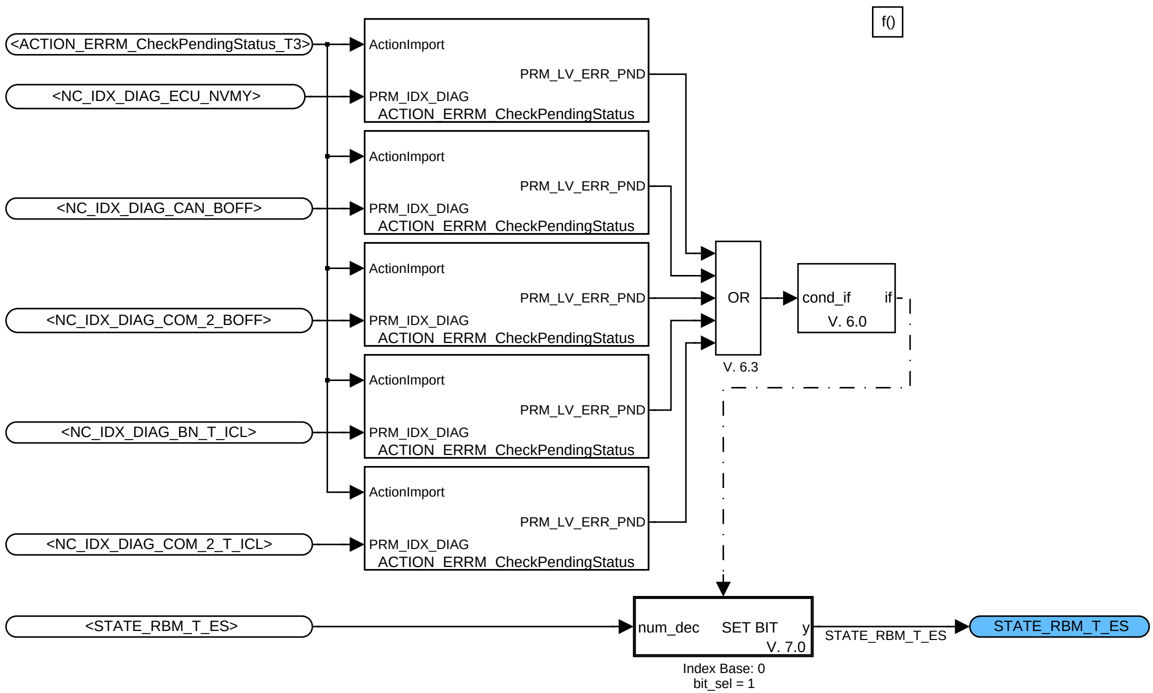

Figure A.51.8: :

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A.51.2.1.2 Operation at 1S recurrence

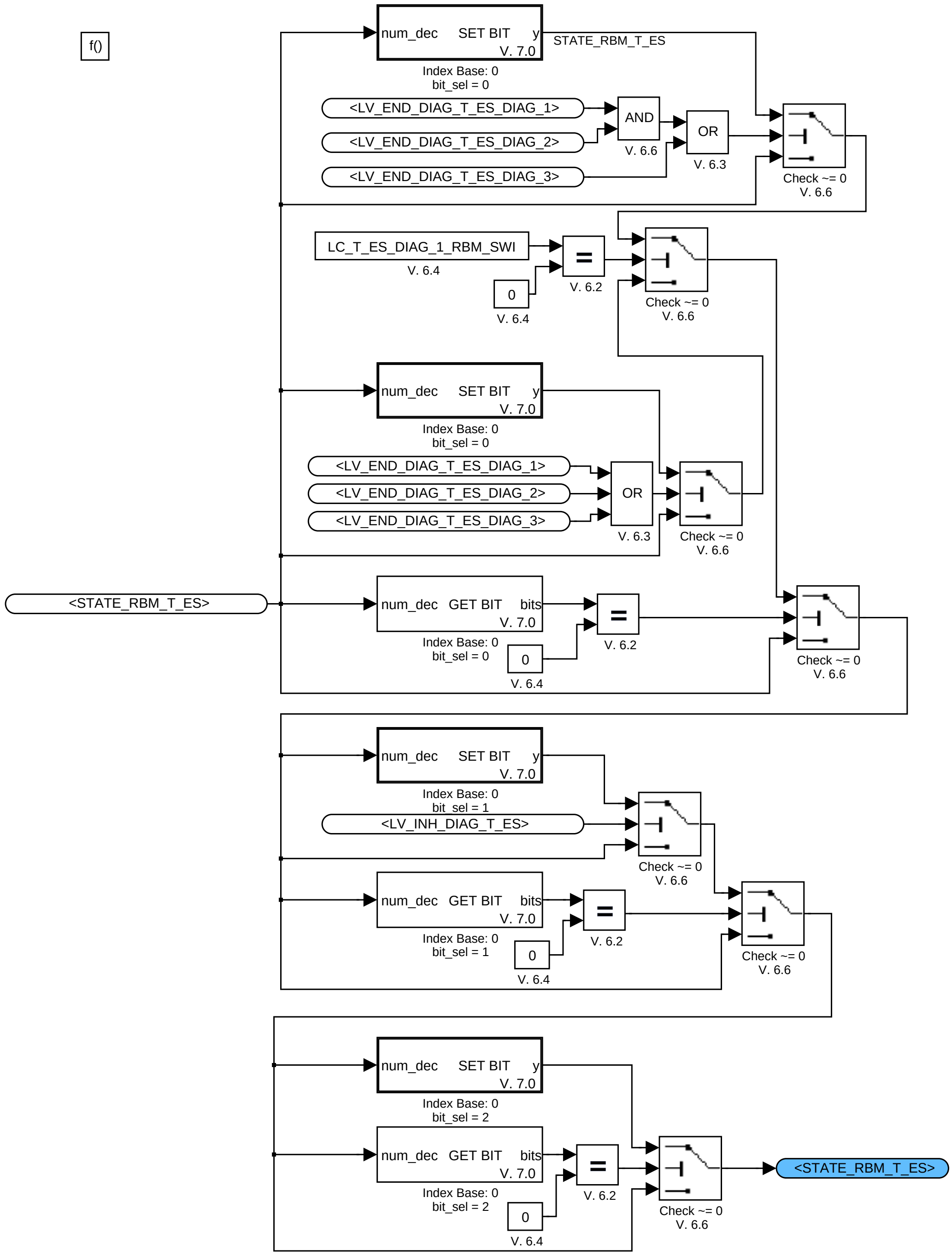

Figure A.51.9: :

A.51.2.2 Calculation of STATE_RBM_T_ES_TCO_FAST

With this module the interface between the T_ES_TCO_FAST monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_T_ES_TCO_FAST data.

Within STATE_RBM_T_ES, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)

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(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)
(depending on failure status: pending)
- Monitor indiv. RBM conditions encountered within this DC (bit 2 not valid for T_ES_TCO_FAST)

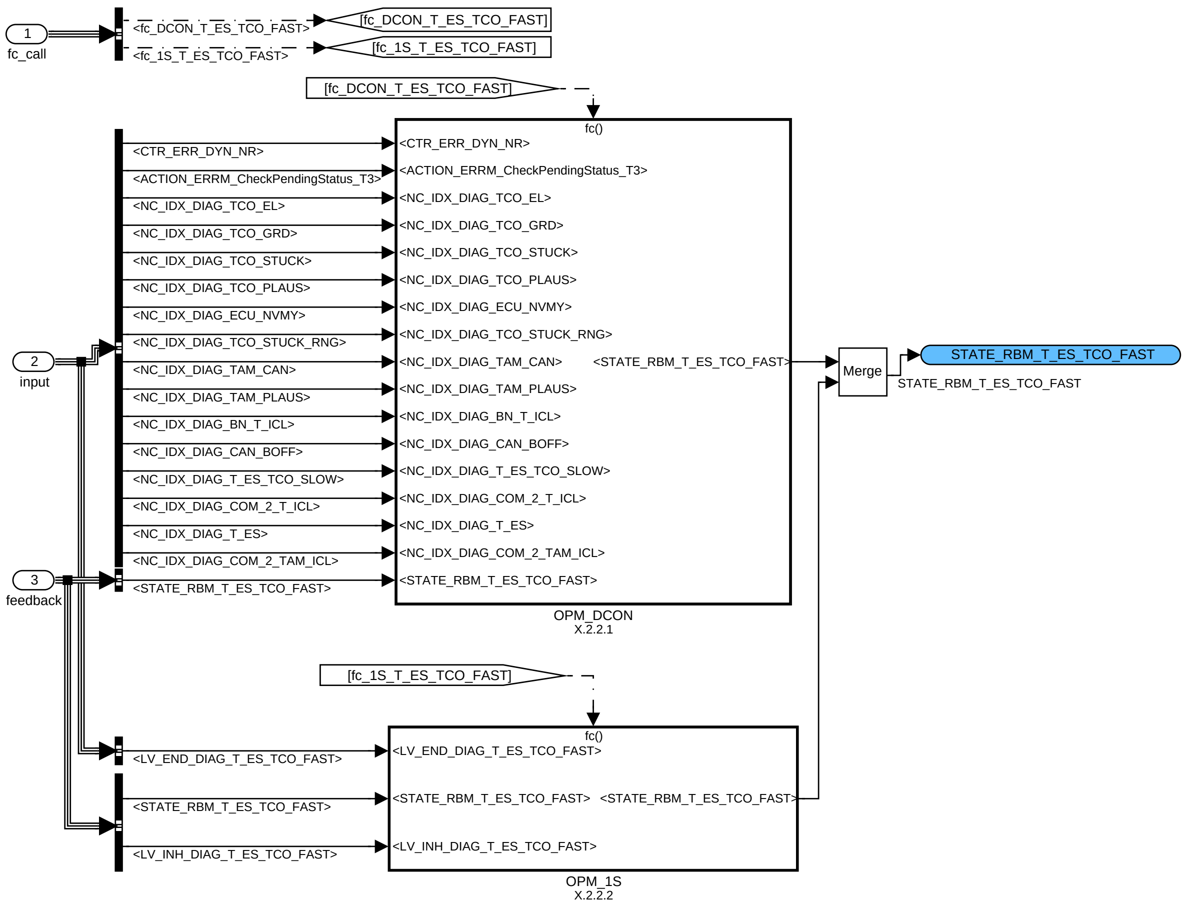

Figure A.51.10: :

A.51.2.2.1 Operation at DCON

At LV_DC 0 - -> 1 transition
The pending status of the following failures has to be checked only once :

LV_ERR_ECU_NVMY	LV_ERR_TCO_EL	LV_ERR_TCO_GRD	LV_ERR_TCO_PLAUS
LV_ERR_TCO_STUCK_RNG	LV_ERR_TCO_STUCK	LV_ERR_TAM_CAN	LV_ERR_TAM_PLAUS
LV_ERR_T_ES	LV_ERR_CAN_BOFF	LV_ERR_BN_T_ICL	LV_ERR_COM_2_T_ICL
LV_ERR_T_ES_TCO_SLOW	LV_ERR_COM_2_TAM_ICL		

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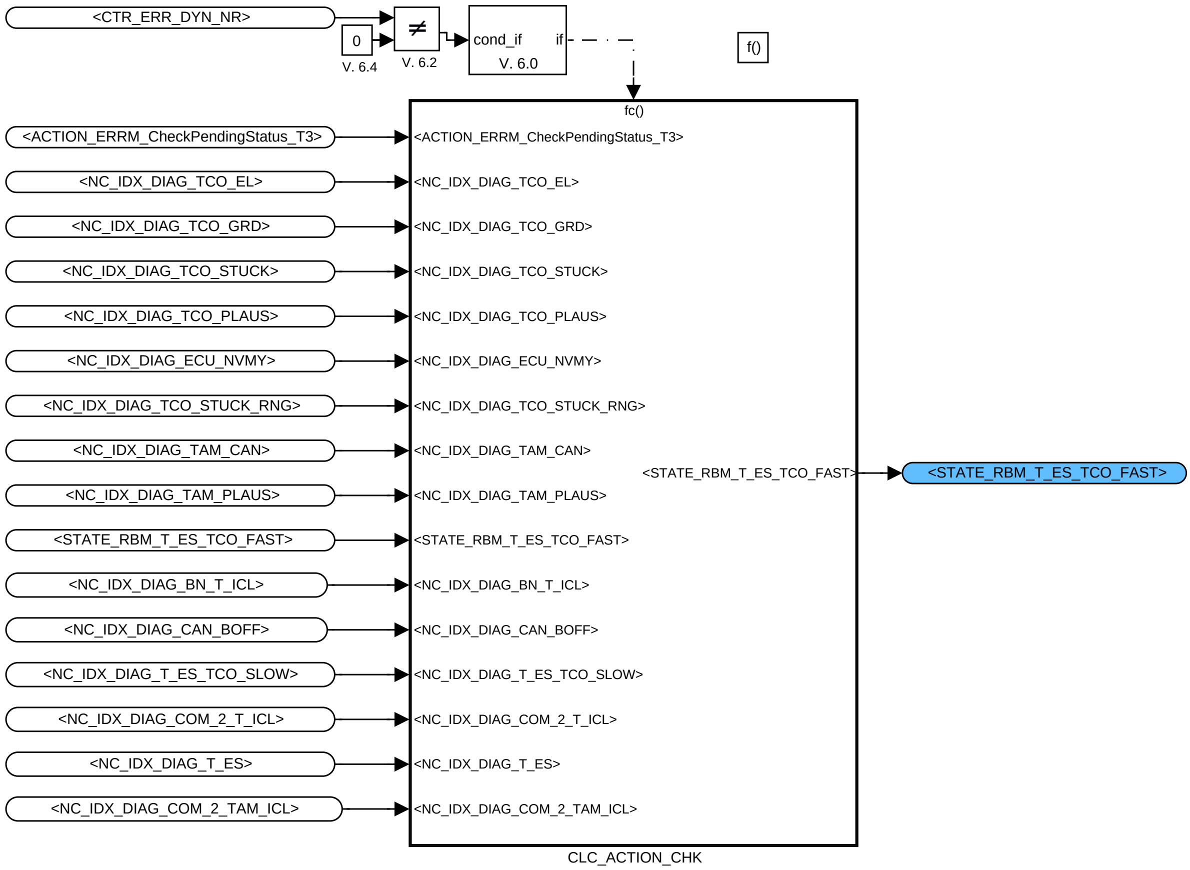

Figure A.51.11: :

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A.51.2.2.1.1 Assignment of STATE_RBM_T_ES_TCO_FAST

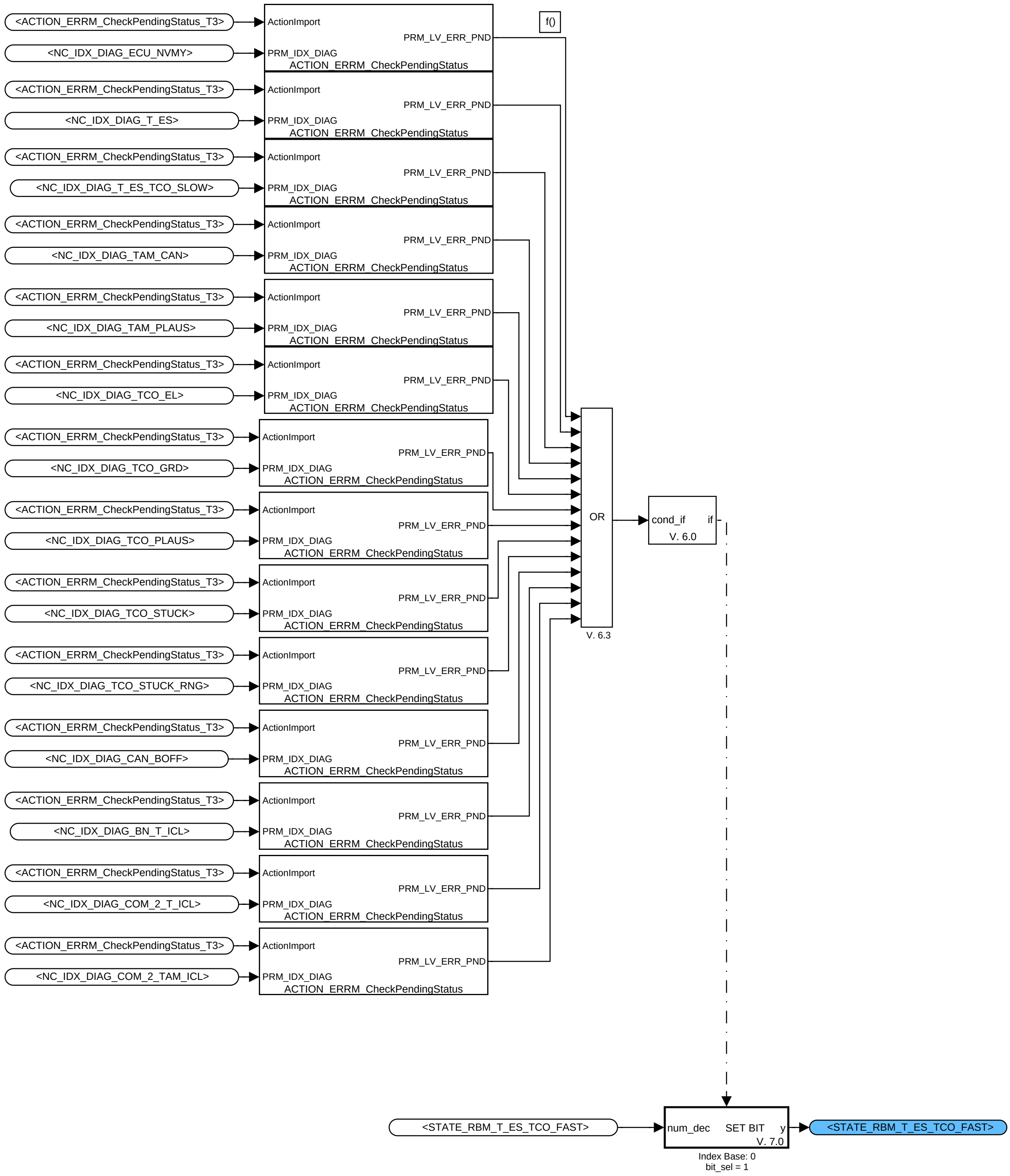

Figure A.51.12: :

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A.51.2.2.2 Operation at 1S recurrence

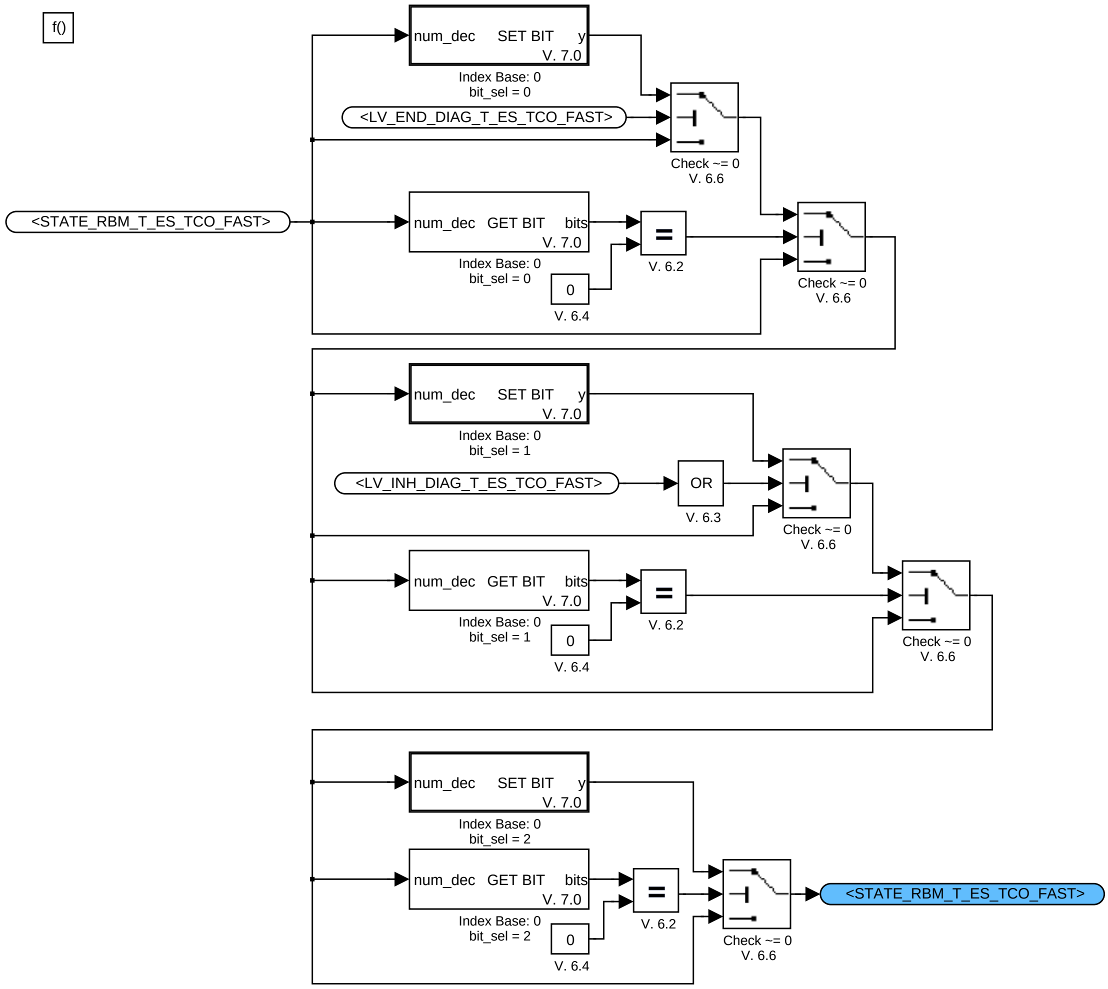

Figure A.51.13: :

A.51.2.3 Calculation of STATE_RBM_T_ES_TCO_SLOW

With this module the interface between the T_ES_TCO_SLOW monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_T_ES_TCO_SLOW data.

Within STATE_RBM_T_ES, three different information are defined:
- Conditions for monitoring are met long enough to detect malfunction (bit 0)
(no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)
(depending on failure status: pending)
- Monitor indiv. RBM conditions encountered within this DC (bit 2 not valid for T_ES)

A.51.2.3.1 Operation at DCON

At LV_DC 0 - ->1 transition
The pending status of the following failures has to be checked only once :

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LV_ERR_ECU_NVMY	LV_ERR_TCO_EL	LV_ERR_TCO_GRD	LV_ERR_TCO_PLAUS
LV_ERR_TCO_STUCK_RNG	LV_ERR_TCO_STUCK	LV_ERR_TAM_CAN	LV_ERR_TAM_PLAUS
LV_ERR_T_ES	LV_ERR_CAN_BOFF	LV_ERR_BN_T_ICL	LV_ERR_COM_2_T_ICL
LV_ERR_T_ES_TCO_FAST	LV_ERR_COM_2_TAM_ICL		

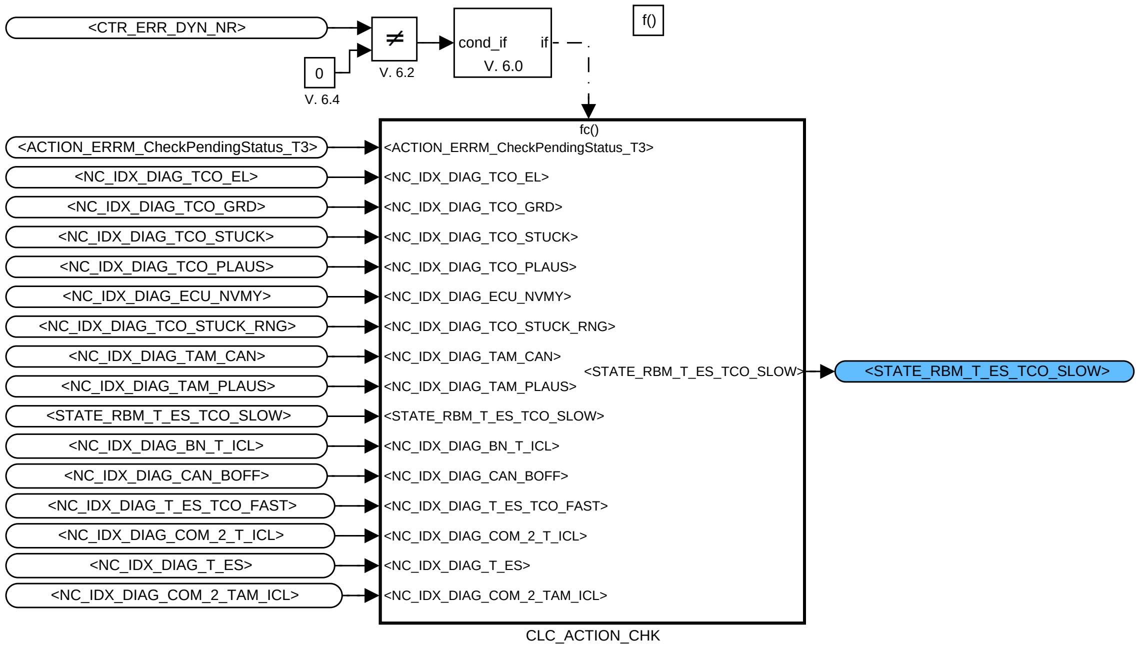

Figure A.51.14: :

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A.51.2.3.1.1 Assignment of STATE_RBM_T_ES_TCO_SLOW

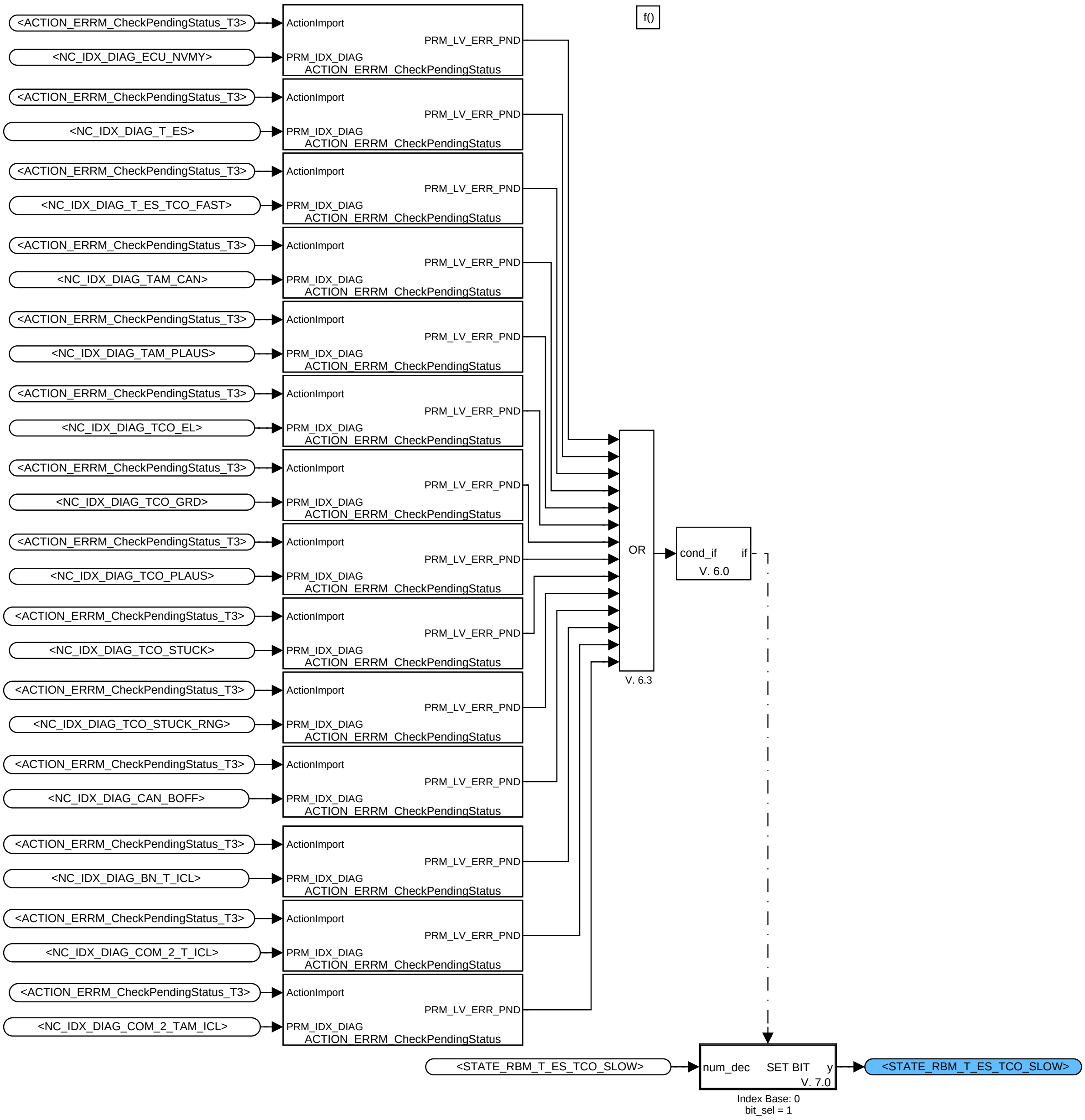

Figure A.51.15: :

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A.51.2.3.2 Operation at 1S recurrence

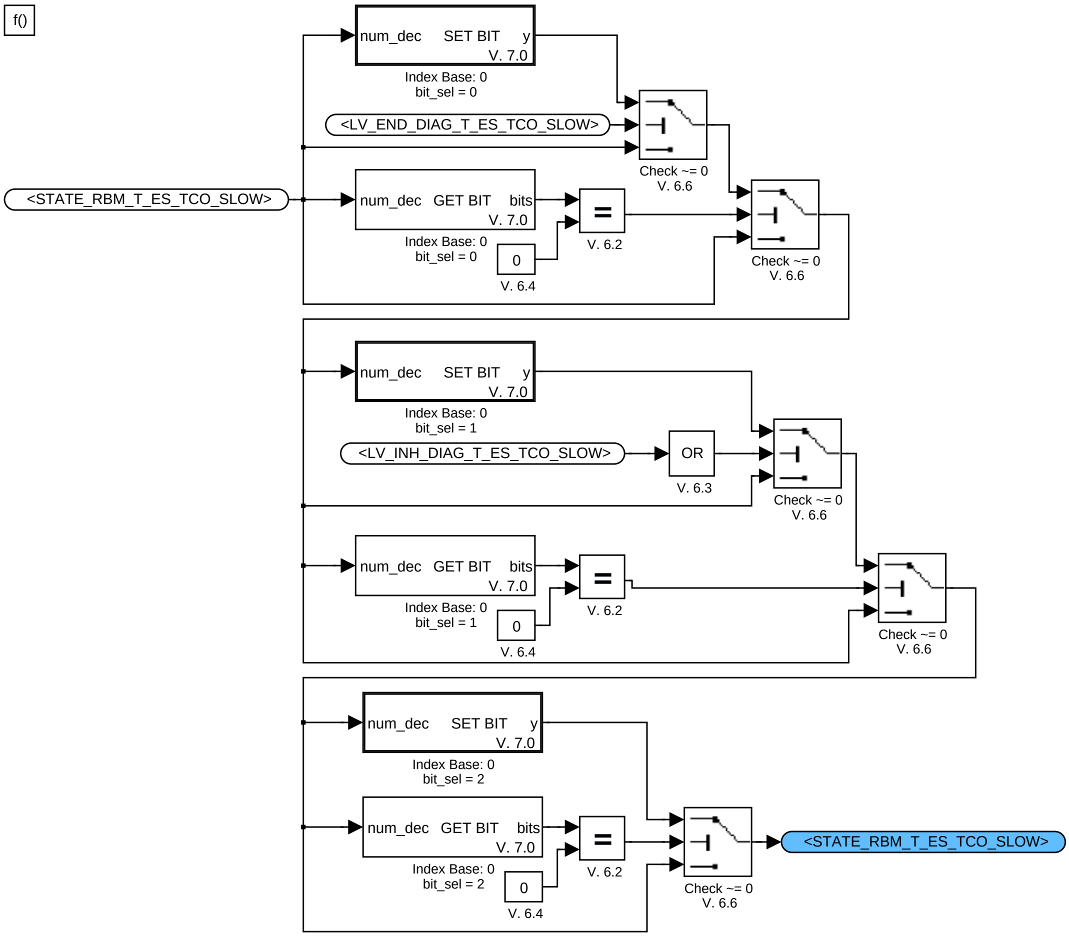

Figure A.51.16: :

A.51.3 Inhibition of diagnosis

Depending on the project specific requirements, the engine off duration diagnosis and the engine off duration plausibilisation with TCO can be inhibited by setting the flags LV_INH_DIAG_T_ES and LV_ INH_DIAG_T_ES_TCO_SLOW/FAST respectively.

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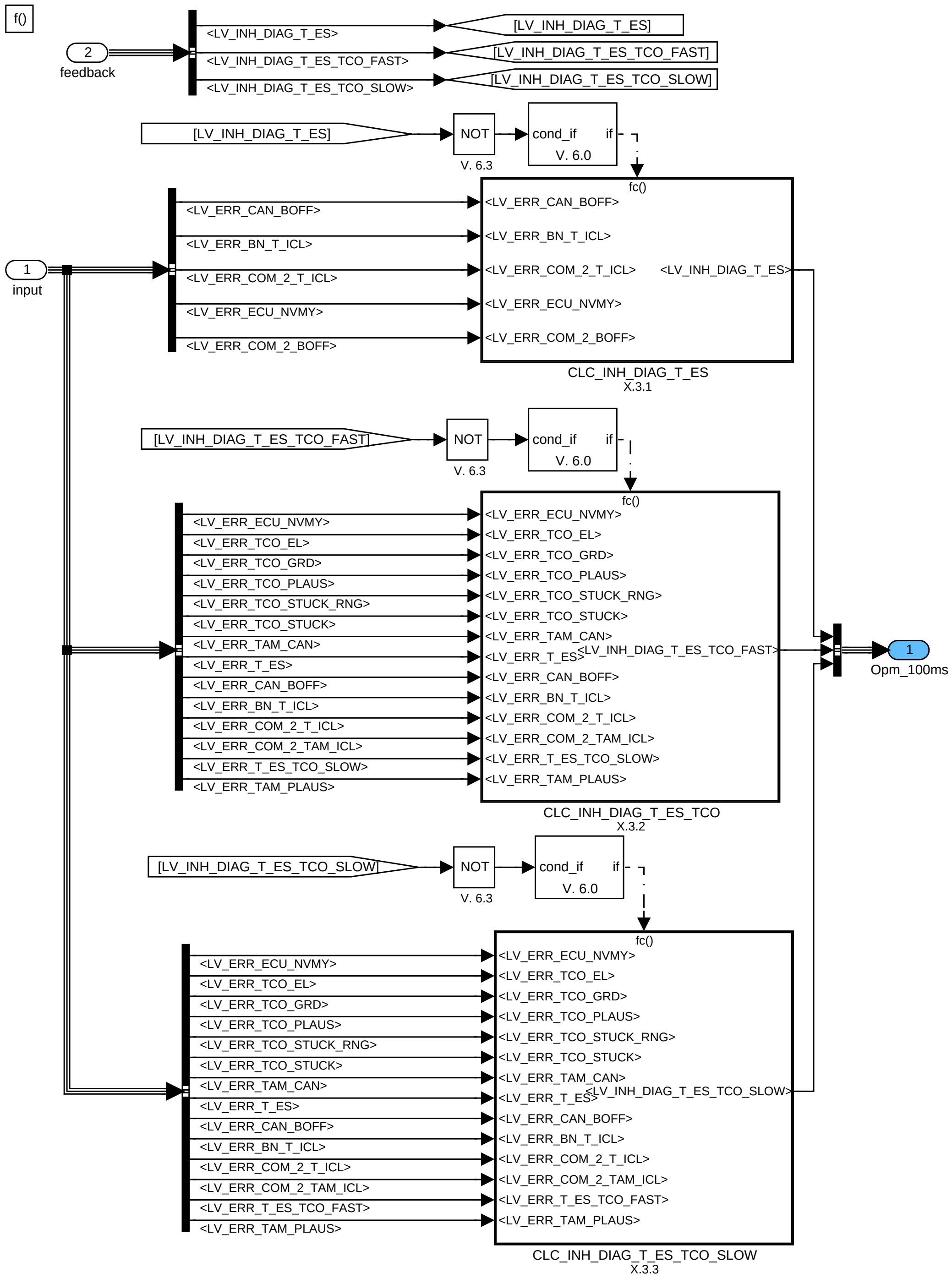

Figure A.51.17: :

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A.51.3.1 Inhibition of T_ES diagnosis via LV_INH_DIAG_T_ES

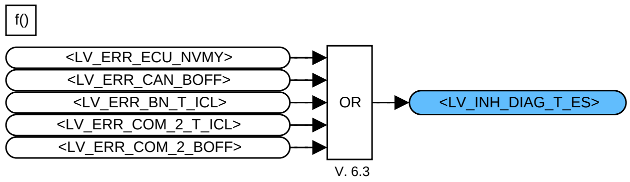

Figure A.51.18: :

A.51.3.2 Inhibition of T_ES_TCO_FAST diagnosis via LV_INH_DIAG_T_ES_TCO_FAST

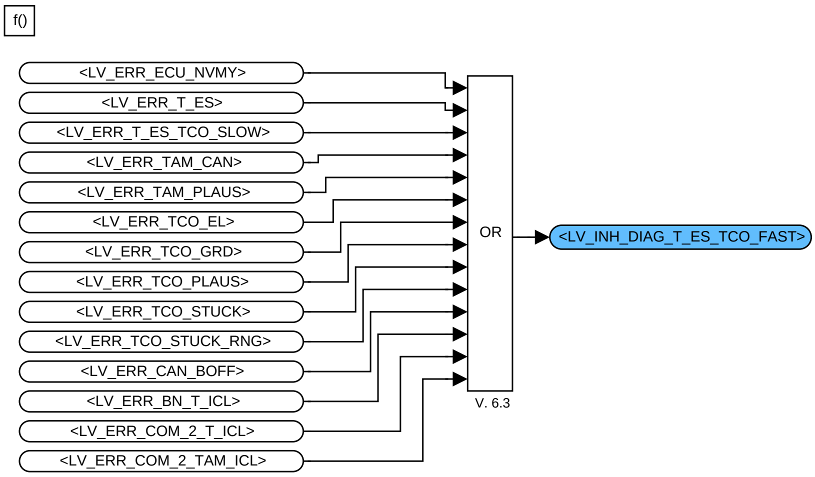

Figure A.51.19: :

A.51.3.3 Inhibition of T_ES_TCO_SLOW diagnosis via LV_INH_DIAG_T_ES_TCO_SLOW

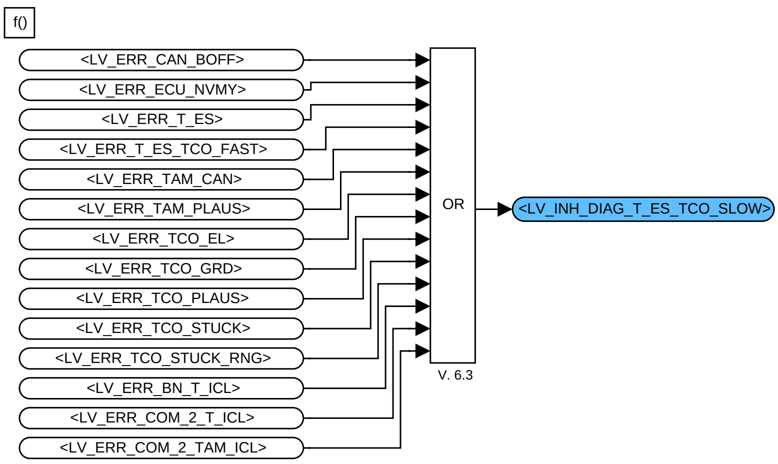

Figure A.51.20: :

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A.52 Coolant temperature diagnosis interface

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_ENA_RATIO_T_AST	V	0... 1H	0 ...1	1	-
Boolean for ratio time after engine start enable condition					
RATIO_T_IS_AST	O/V	0... FFH	0... 99.609	0.3906	%
Idle speed activation time in percent since engine start					
RATIO_T_LOAD_MIN_AST	O/V	0... FFH	0... 99.609	0.3906	%
"Minimum load" time in percent since engine start					
RATIO_T_PUC_AST	O/V	0... FFH	0... 99.609	0.3906	%
"Trailing throttle fuel cut-off" activation time in percent since engine start					
RATIO_T_VS_MAX_AST	O/V	0... FFH	0... 99.609	0.3906	%
"Maximum vehicle speed " time in percent since engine start					
RATIO_T_VS_MIN_AST	O/V	0... FFH	0... 99.609	0.3906	%
"Minimum vehicle speed " time in percent since engine start					
T_DIAG_AST	O/V	0... FFFFH	0... 65535	1	s
Time after engine start for diagnosis functions					
T_IS_AST	V	0... FFFFH	0... 65535	1	s
Idle speed activation time since engine start					
T_LOAD_MIN_AST	V	0... FFFFH	0... 65535	1	s
"Minimum load" time since engine start					
T_PUC_AST	V	0... FFFFH	0... 65535	1	s
"Trailing throttle fuel cut-off" activation time since engine start					
T_VS_MAX_AST	V	0... FFFFH	0... 65535	1	s
"Maximum vehicle speed " time since engine start					
T_VS_MIN_AST	V	0... FFFFH	0... 65535	1	s
"Minimum vehicle speed " time since engine start					

Input data:

LV_IS {p. 1720}	LV_PUC {p. 1720}	MAF_KGH {p. 1195}	TAM {p. 1579}
VS {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VS_THD_VS_MAX_AST	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed threshold for high vehicle speed period calculation after start					
C_VS_THD_VS_MIN_AST	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed threshold for low vehicle speed period calculation after start					
IP_MAF_KGH_LOAD_MIN_AST	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_TAM_IP_MAF_KGH_LOAD_MIN_AST	4	0... FEH	-48... 142.5	0.75	°C
Ambient temperature dependent minimum engine load threshold for low load period calculation after start					

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FUNCTION DESCRIPTION:

General information:

The coolant temperature increase after engine start is most dependent on the ambient- and the engine operating conditions. To avoid monitoring failures within the diagnosis functions related to the coolant temperature behaviour, the influence of critical engine driving conditions must be taken into consideration. To allow a comparison to the time elapsed since engine start, the activation time of the critical driving conditions are calculated in percent of the elapsed time. The percentage values are used in several diagnosis functions to cancel monitoring in order to avoid failures.

Application conditions

Initialisation at Exit start (EXIT_ST): LV_CDN_ENA_RATIO_T_AST = 1
all other output data are set to 0 [phys]

Initialisation at Engine run to Engine stop (ERU_to_ES): LV_CDN_ENA_RATIO_T_AST = 0
T_DIAG_AST = 0 s

Recurrence: *1000 ms*

Activation: *LV_CDN_ENA_RATIO_T_AST = 1*

Deactivation: *LV_CDN_ENA_RATIO_T_AST = 0*

Formula section:

Calculation of the after start time for diagnosis functions:
If T_DIAG_AST < 65535 s
then T_DIAG_AST(n) = T_DIAG_AST(n-1) + 1 s
else T_DIAG_AST(n) = T_DIAG_AST(n-1)
endif

Calculation of the "idle speed" period after start:
If LV_IS = 1
then T_IS_AST(n) = T_IS_AST(n-1) + 1 s
else T_IS_AST(n) = T_IS_AST(n-1)
endif
RATIO_T_IS_AST = (T_IS_AST /T_DIAG_AST) * 100 %

Calculation of the " trailing throttle fuel cut-off " period after start:
If LV_PUC = 1
then T_PUC_AST(n) = T_PUC_AST(n-1) + 1 s
else T_PUC_AST(n) = T_PUC_AST(n-1)
endif
RATIO_T_PUC_AST = (T_PUC_AST /T_DIAG_AST) * 100 %

Calculation of the "low load" period after start:
If MAF_KGH <= IP_MAF_KGH_LOAD_MIN_AST
then T_LOAD_MIN_AST(n) = T_LOAD_MIN_AST(n-1) + 1 s
else T_LOAD_MIN_AST(n) = T_LOAD_MIN_AST(n-1)
endif
RATIO_T_LOAD_MIN_AST = (T_LOAD_MIN_AST /T_DIAG_AST) * 100 %

Calculation of the "low vehicle speed" period after start:
If VS <= C_VS_THD_VS_MIN_AST
then T_VS_MIN_AST(n) = T_VS_MIN_AST(n-1) + 1 s
else T_VS_MIN_AST(n) = T_VS_MIN_AST(n-1)
endif
RATIO_T_VS_MIN_AST = (T_VS_MIN_AST /T_DIAG_AST) * 100 %

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Calculation of the "high vehicle speed" period after start:

If VS > C_VS_THD_VS_MAX_AST
then T_VS_MAX_AST(n) = T_VS_MAX_AST(n-1) + 1 s
else T_VS_MAX_AST(n) = T_VS_MAX_AST(n-1)
endif

RATIO_T_VS_MAX_AST = (T_VS_MAX_AST /T_DIAG_AST) * 100 %

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A.53 Coolant temperature sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TCO_EL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom for coolant temperature signal range error					
ERR_SYM_TCO_GRD	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom for coolant temperature signal gradient error					
LV_CDN_DIAG_TCO_EL	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature signal range diagnosis conditions					
LV_CDN_DIAG_TCO_GRD	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature signal gradient diagnosis conditions					
LV_CDN_ENA_TCO_PREL	V	0... 1H	0 ...1	1	-
Boolean for preliminary coolant temperature error enable conditions					
LV_END_DIAG_TCO_EL	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature signal range diagnosis					
LV_END_DIAG_TCO_GRD	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature signal gradient diagnosis					
LV_ERR_TCO	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on coolant temperature acquisition					
LV_ERR_TCO_EL	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature signal range error					
LV_ERR_TCO_GRD	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature signal gradient error					
LV_ERR_TCO_PREL	O/V	0... 1H	0 ...1	1	-
Boolean for preliminary error currently present on coolant temperature acquisition					
LV_ERR_TCO_PREL_DET	V/S	0... 1H	0 ...1	1	-
Boolean for preliminary error present on coolant temperature acquisition during driving cycle					

Input data:

CTR_ABC_TCO_EL	CTR_ABC_TCO_GRD	LV_CDN_VB_MIN_DIAG {p. 1185}	LV_ERR_TCO_PLAUS {p. 5682}
LV_ERR_TCO_STUCK {p. 5691}	LV_ERR_TCO_STUCK_RNG {p. 5675}	LV_IGK {p. 906}	LV_INH_DIAG_TCO_EL {p. 4502}
LV_INH_DIAG_TCO_GRD {p. 4502}	NC_NR_TCO_SENS {p. 576}	T_DIAG_AST {p. 4493}	TCO_MES {p. 1100}
TIA_THR {p. 984}	VP_TCO [NC_NR_TCO_SENS] {p. 1100}		

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_ABC_THD_TCO_PREL	-	0... FFH	0... 255	1	-
Threshold for anti-bounce counter value for preliminary coolant temperature error detection					
C_T_AST_MIN_DIAG_TCO_EL	-	0... FFFFH	0... 65535	1	s
Minimum time delay after start for the coolant temperature electrical diagnosis					
C_TCO_MES_GRD_MAX_DIAG_TCO_GRD	-	0... FEH	0... 190.5	0.75	°C
Maximum coolant temperature gradient for the coolant temperature gradient diagnosis					
C_TIA_THR_MIN_DIAG_TCO_EL	-	0... FEH	-48... 142.5	0.75	°C
Minimum intake air temperature value for the coolant temperature electrical diagnosis					
C_VP_TCO_MAX_DIAG_TCO_EL	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Maximum raw sensor signal voltage for the coolant temperature electrical diagnosis					
C_VP_TCO_MIN_DIAG_TCO_EL	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Minimum raw sensor signal voltage for the coolant temperature electrical diagnosis					

FUNCTION DESCRIPTION:

General information:

The purpose of the diagnosis function is to detect electrical failures as defined by OBD I and OBD II requirements. The coolant temperature raw sensor voltage (VP_TCO[0]) is measured with use of an 10bit A/D converter by the ECU hardware. The modified sensor signal is converted then into a measured temperature value (TCO_MES). Each by the ECU hardware measured raw sensor value is checked as well as the converted temperature signal.

Application conditions:

See separate chapters:

A.53.1 Global coolant temperature failure

FUNCTION DESCRIPTION:

General information:

A global coolant temperature error is set without debounce as soon as an electrical-, or signal gradient-, or stuck signal-, or plausibility- error is detected. All separate diagnosis functions are performed all the time if the diagnosis conditions are fulfilled. The deactivation of diagnosis functions with use of configuration switches is not possible.
In addition a preliminary coolant temperature error is set as soon as debouncing of an electrical-, or signal gradient- symptom occurs. The preliminary coolant temperature error will be stored in the non-volatile memory during the ECU's self-holding phase to be available at the beginning of the next driving cycle.

Application conditions:

Initialisation at Reset:

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LV_ERR_TCO = 0
LV_CDN_ENA_TCO_PREL = 1
LV_ERR_TCO_PREL = LV_ERR_TCO_PREL_DET *(NVMY)*
LV_ERR_TCO_PREL_DET = LV_ERR_TCO_PREL_DET *(NVMY)*
(NVMY: stored in the non-volatile memory)

Initialisation at Engine stop to Engine run (ES_to_ERU):
LV_ERR_TCO_PREL_DET = 0
LV_CDN_ENA_TCO_PREL = 0

Initialisation at Engine stop
LV_CDN_ENA_TCO_PREL = 1

Initialisation at FMY clear:
LV_ERR_TCO = 0
LV_ERR_TCO_PREL = 0
LV_ERR_TCO_PREL_DET = 0

Recurrence: 100 ms
Activation: at every engine operating state

Formula section:

If LV_ERR_TCO_EL = 1 **or**
LV_ERR_TCO_GRD = 1 **or**
LV_ERR_TCO_STUCK = 1 **or**
LV_ERR_TCO_STUCK_RNG = 1 **or**
LV_ERR_TCO_PLAUS = 1 **or**
then LV_ERR_TCO = 1 (without debounce)
else LV_ERR_TCO = 0
endif

A.53.1.1 Preliminary coolant temperature failure at engine stop

Application conditions

Recurrence: *100 ms*
Activation: *LV_CDN_ENA_TCO_PREL = 1*
Deactivation: *LV_CDN_ENA_TCO_PREL = 0*

Formula section:

If CTR_ABC_TCO_EL > 0 **or**
CTR_ABC_TCO_GRD > 0 **or**
LV_ERR_TCO_PREL_DET = 1
then LV_ERR_TCO_PREL = 1 (without debounce)
else LV_ERR_TCO_PREL = 0
endif

A.53.1.2 Preliminary coolant temperature failure at engine run

Application conditions

Recurrence: *100 ms*

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Activation: *LV_CDN_ENA_TCO_PREL = 0*

Deactivation: *LV_CDN_ENA_TCO_PREL = 1*

Formula section:

If	CTR_ABC_TCO_EL	> C_CTR_ABC_THD_TCO_PREL	**or**
	CTR_ABC_TCO_GRD	> C_CTR_ABC_THD_TCO_PREL	
then	LV_ERR_TCO_PREL_DET	= 1	(irrevocable for current driving cycle)
endif			

If	CTR_ABC_TCO_EL	> 0	**or**
	CTR_ABC_TCO_GRD	> 0	**or**
then	LV_ERR_TCO_PREL	= 1	(without debounce)
else	LV_ERR_TCO_PREL	= 0	
endif			

A.53.2 Coolant temperature signal range diagnosis (TCO_EL)

FUNCTION DESCRIPTION:

General information:

The purpose of the signal range- or electrical diagnosis is to detect electrical errors in the input circuit of the coolant temperature sensor. The analog sensor input signal is converted into a digital value with use of an A/D converter. All symptoms of the error code are handled by anti-bouncing. Only one symptom can be active at a time.

Description:

Error-symptoms are defined to this diagnosis function as following:

```
 |_|_|_|_|
  | | | └─> Short circuit to  Vbatt or Open Circuit "SCP_OC"   (= SYM_0)
  | | └───> Short circuit to Ground "SCG"                       (= SYM_1)
  | └─────> (not used)                                          (= SYM_2)
  └───────> (not used)                                          (= SYM_3)
```

Application conditions:

Initialisation:

LV_ERR_TCO_EL	=	*Refer to filtering configuration for the initialisation*
LV_END_DIAG_TCO_EL	=	*Refer to filtering configuration for the initialisation*
LV_CDN_DIAG_TCO_EL	=	*Refer to filtering configuration for the initialisation*
ERR_SYM_TCO_EL	=	*Refer to filtering configuration for the initialisation*

Recurrence: 100 ms

Activation: LV_IGK = 1 **and**
LV_CDN_VB_MIN_DIAG = 1 **and**
LV_INH_DIAG_TCO_EL = 0

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Deactivation: Activation condition not true
At Deactivation: LV_CDN_DIAG_TCO_EL = 0

Formula section:

Error detection:

```
if (1)            VP_TCO[0] < C_VP_TCO_MIN_DIAG_TCO_EL
                   // coolant temperature sensor voltage signal (VP_TCO[0])
then (1)          (error detection "Short circuit to GND")
                   LV_CDN_DIAG_TCO_EL = 1
                  ERR_SYM_TCO_EL = "SYM_1"
                  LV_ERR_TCO_EL = 1                          (after debounce)
else (1)
  if (2)          VP_TCO[0] > C_VP_TCO_MAX_DIAG_TCO_EL
                  // coolant temperature sensor voltage signal (VP_TCO[0])
     then (2)     (error detection "Short circuit to Vbatt or open load" possible)
         if (3)   TIA_THR >= C_TIA_THR_MIN_DIAG_TCO_EL
                  or
                  TIA_THR < C_TIA_THR_MIN_DIAG_TCO_EL            and
                  T_DIAG_AST > C_T_AST_MIN_DIAG_TCO_EL
         then (3) LV_CDN_DIAG_TCO_EL = 1
                  ERR_SYM_TCO_EL = "SYM_0"
                  LV_ERR_TCO_EL = 1                      (after debounce)
         else (3) LV_CDN_DIAG_TCO_EL = 0
         endif (3)
  else (2)        LV_CDN_DIAG_TCO_EL = 1
                  ERR_SYM_TCO_EL = "NO_SYM"
                  LV_ERR_TCO_EL = 0                          (after rebounce)
     endif (2)
endif (1)
```

End of diagnosis:
For the calculation of LV_END_DIAG_TCO_EL see "Anti-bounce Algorithm, calculation of the end of diagnosis".

A.53.3 Coolant temperature signal gradient diagnosis (TCO_GRD)

FUNCTION DESCRIPTION:

General information:

The purpose of the signal gradient diagnosis is to detect a not plausible gradient on the measured coolant temperature sensor signal. The monitoring is based on a comparison between the actual measured and the last measure coolant temperature value. The symptom of the error code is handled by anti-bouncing.

Description:

Error-symptoms are defined to this diagnosis function as following:

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```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> -                                             (= SYM_0)
 │ │ └───> -                                             (= SYM_1)
 │ └─────> -                                             (= SYM_2)
 └───────> Coolant temperature signal gradient error     (= SYM_3)
```

Application conditions

Initialisation: LV_ERR_TCO_GRD = *Refer to filtering configuration for the initialisation*
LV_END_DIAG_TCO_GRD = *Refer to filtering configuration for the initialisation*
LV_CDN_DIAG_TCO_GRD = *Refer to filtering configuration for the initialisation*
ERR_SYM_TCO_GRD = *Refer to filtering configuration for the initialisation*

Recurrence: *100 ms*

Activation:
If LV_IGK = 1 **and**
LV_CDN_VB_MIN_DIAG = 1 **and**
LV_INH_DIAG_TCO_GRD = 0
then LV_CDN_DIAG_TCO_GRD = 1
else LV_CDN_DIAG_TCO_GRD = 0

endif

Formula section:

Error detection:
If I TCO_MES(n-1) - TCO_MES(n) I > C_TCO_MES_GRD_MAX_DIAG_TCO_GRD
then ERR_SYM_TCO_GRD = “SYM_3”
LV_ERR_TCO_GRD = 1 *(after debounce)*
else ERR_SYM_TCO_GRD = “NO_SYM”
LV_ERR_TCO_GRD = 0 *(after rebounce)*
endif

End of diagnosis:
For the calculation of LV_END_DIAG_TCO_GRD see “Anti-bounce Algorithm, calculation of the end of diagnosis”.

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A.54 Coolant temperature sensor diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_RBM_TCO_STUCK	V	0... 1H	0 ...1	1	-
Boolean for temperature stuck signal diagnosis inhibit due to OBD error					
LV_INH_DIAG_TCO_EL	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature signal range diagnosis inhibit					
LV_INH_DIAG_TCO_GRD	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature signal gradient diagnosis inhibit					
LV_INH_DIAG_TCO_STUCK	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature stuck signal diagnosis inhibit					
STATE_RBM_TCO_STUCK	O/V	0... 7H	0 ...7	1	-
Interface of TCO_STUCK monitor with the Rate-Based Monitoring statistics					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CDN_CST_RBM {p. 5870}	LV_DC {p. 5746}	LV_END_DIAG_TCO_STUCK {p. 5691}
LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}	LV_ERR_TCO_PLAUS {p. 5682}	LV_ERR_TCO_STUCK_RNG {p. 5675}
LV_ERR_TIA {p. 4200}	LV_IGK {p. 906}	LV_ST_END {p. 1720}	

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

Error treatment:

Error debounce:
Debounce counter increment: C_ABC_INC_TCO_EL
Debounce counter maximum value: C_ABC_MAX_TCO_EL

Diagnosis Configuration
ERRM configuration for LV_ERR_TCO_EL is "**STD_INI**" *//all 0 at LV_IGK 0->1 or reset*
Error debounce:
Debounce counter increment: C_ABC_INC_TCO_GRD
Debounce counter maximum value: C_ABC_MAX_TCO_GRD

Diagnosis Configuration
ERRM configuration for LV_ERR_TCO_GRD is "**MEM**" *//error is set irreversible*
Error debounce:
no debounce

Diagnosis Configuration
Initialization LV_ERR_TCO_STUCK is managed by function, thus configuration is "**NO**"

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FUNCTION DESCRIPTION:

General information:

Task of the coolant temperature sensor diagnosis (Appl. Inc.) is to allow the projects to adapt their specific requirements to generic coolant temperature sensor diagnosis. The setting of the interface output variables have to be provided by the projects.

Application conditions

Initialisation: *see separate chapter*

Recurrence: *see separate chapter*

Activation: *at every engine operating state*

Deactivation: –

A.54.1 Coolant temperature signal range diagnosis - interface parameter

FUNCTION DESCRIPTION:

General information:

Depending on project specific requirements, the electrical diagnosis of the main coolant temperature sensor can be inhibited by setting of LV_INH_DIAG_TCO_EL.

Application conditions

Initialisation:
```
If Reset or Transition: LV_IGK = 0 -> LV_IGK = 1
then LV_INH_DIAG_TCO_EL = 0
endif
```

Recurrence: *100 ms*

Activation: *LV_IGK = 1*

Deactivation: *LV_IGK = 0*

Formula section:

IF LV_ERR_TIA = 1
THEN LV_INH_DIAG_TCO_EL = 1
ELSE LV_INH_DIAG_TCO_EL = 0
ENDIF

A.54.2 Coolant temperature signal gradient diagnosis - interface parameter

FUNCTION DESCRIPTION:

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General information:

Depending on project specific requirements, the signal gradient diagnosis of the main coolant temperature sensor can be inhibited by setting of LV_INH_DIAG_TCO_GRD.

Application conditions

Initialisation: `If Reset or Transition: LV_IGK = 0 -> LV_IGK = 1`
`then LV_INH_DIAG_TCO_GRD = 0`
`endif`

Recurrence: *100 ms*

Activation: *LV_IGK = 1*

Deactivation: *LV_IGK = 0*

Formula section:

If LV_ERR_TCO_EL = 1 **or**
LV_ERR_TCO_STUCK = 1 **or**
LV_ERR_TCO_PLAUS = 1 **or**
LV_ERR_TCO_STUCK_RNG = 1
then LV_INH_DIAG_TCO_GRD = 1
else LV_INH_DIAG_TCO_GRD = 0
endif

A.54.3 Coolant temperature signal stuck diagnosis - interface parameter

FUNCTION DESCRIPTION:

General information:

Depending on project specific requirements, the signal stuck diagnosis of the main coolant temperature sensor can be inhibited by setting of LV_INH_DIAG_TCO_STUCK.

Application conditions

Initialisation: `at RESET or LV_IGK = 0 -> 1 or FMY clear:`
`LV_INH_DIAG_TCO_STUCK = 0`
`LV_INH_DIAG_RBM_TCO_STUCK = 0`

Recurrence: *1000 ms*

Activation: LV_ST_END = 1
(Calculation of the TCO stuck diagnosis interface parameter enabled)

Deactivation: LV_ST_END = 0
(Calculation of the TCO stuck diagnosis interface parameter disabled)

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Formula section:

If LV_ERR_TCO_EL = 1 **or**
LV_ERR_TCO_GRD = 1 **or**
LV_ERR_TCO_STUCK_RNG = 1 **or**
LV_ERR_TCO_PLAUS = 1
then LV_INH_DIAG_RBM_TCO_STUCK = 1
endif

If LV_INH_DIAG_RBM_TCO_STUCK = 1 **or**
LV_IGK = 0 **or**
LV_DC = 0
then LV_INH_DIAG_TCO_STUCK = 1
endif

A.54.4 Interface for Rate - Based - Monitoring

FUNCTION DESCRIPTION:

General information:

With this module the interface between the TCO_STUCK monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_TCO_STUCK data.
Within STATE_RBM_TCO_STUCK, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

Application conditions:

Initialisation :
at ECU reset :
bit 0, bit 1 and bit 2 of STATE_RBM_TCO_STUCK = 0
at LV_DC 0 1 transition :
bit 0, bit 1 and bit 2 of STATE_RBM_TCO_STUCK = 0
on failure memory reset :
bit 1 of STATE_RBM_TCO_STUCK = 0
Recurrence: 1 s
Activation: LV_DC = 1

Formula section:

At LV_DC 0 1 transition
The pending status of the following failures has to be checked only once :

LV_ERR_TCO_EL	LV_ERR_TCO_PLAUS	LV_ERR_TCO_GRD	LV_ERR_TCO_STUCK_RNG

If(1) { CPU optimization at LV_DC 0 1 transition }

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CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }
Then(1)
While bit 1 of STATE_RBM_TCO_STUCK = 0 **do**
with each XX failure of the above list :
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2) bit 1 of STATE_RBM_TCO_STUCK = 1
Endif(2)
Endwhile
Else(1)
{ the dynamic failure memory is empty }
No action
Endif(1)
Every 1 s :
If bit 0 of STATE_RBM_TCO_STUCK = 0
Then
If LV_END_DIAG_TCO_STUCK = 1
Then bit 0 of STATE_RBM_TCO_STUCK = 1
Endif
Endif
If bit 1 of STATE_RBM_TCO_STUCK = 0
Then
If LV_INH_DIAG_RBM_TCO_STUCK = 1
Then bit 1 of STATE_RBM_TCO_STUCK = 1
Endif
Endif
If bit 2 of STATE_RBM_TCO_STUCK = 0
Then
If LV_CDN_CST_RBM = 1
Then bit 2 of STATE_RBM_TCO_STUCK = 1
Endif
Endif

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A.55 Cooling fan diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_ECFPWM_FB [NC_ECF_NR]	V	0... FFH	0... 255	1	-
Antibounce counter for ECF failure feedback diagnosis.					
CDN_DIAG_ECF_EL	V	0... FFH	0... 255	1	-
Diagnosis condition for each symptom					
CDN_DIAG_ECFPWM_BAS [NC_ECF_NR]	O/V	0... 7H	0 ...7	1	-
Primary diagnosis condition read from the infrastructure for each symptom of ECFPWMbit 0: diagnosis condition for symptom SYM_0 (SCP)bit 1: diagnosis condition for symptom SYM_1 (SCG)bit 2: diagnosis condition for symptom SYM_2 (OC)					
ERR_DIAG_ECFPWM [NC_ECF_NR]	O/V	0... 7H	0 ...7	1	-
Raw value of error symptom for ECFPWM detected on interface ECU and ECF control unitbit 0: diagnosis condition for symptom SYM_0 (SCP)bit 1: diagnosis condition for symptom SYM_1 (SCG)bit 2: diagnosis condition for symptom SYM_2 (OC)					
ERR_ECFPWM_FB [NC_ECF_NR]	O/V	0... FFH	0... 255	1	-
The failure status of the failure feedback coming from the ECF control unit00H: no failure feedback01H: failure 1 detected by ECF control unitFFH: init value /feedback possibleThe values 01H are only valid, if LV_ECFPWM_FB_VLD[x] = 1, else the f					
ERR_SYM_ECF_EL [NC_ECF_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom for electronic controlled cooling fan signal range error					
ERR_SYM_ECFPWM_FB [NC_ECF_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom ECF failure feedback diagnosis.					
LV_CDN_DIAG_ECF_EL [NC_ECF_NR]	V	0... 1H	0 ...1	1	-
Boolean for electronic controlled cooling fan signal range diagnosis conditions					
LV_CDN_DIAG_ECFPWM_FB [NC_ECF_NR]	V	0... 1H	0 ...1	1	-
Diagnosis condition ECF failure feedback diagnosis.					
LV_ECFPWM_FB_VLD [NC_ECF_NR]	O/V	0... 1H	0 ...1	1	-
If LV_ECFPWM_FB_VLD[x] = 1 the failure number ERR_ECFPWM_FB[x] (01H) is valid					
LV_END_DIAG_ECF_EL [NC_ECF_NR]	V	0... 1H	0 ...1	1	-
Boolean for end of electronic controlled cooling fan signal range diagnosis					
LV_END_DIAG_ECFPWM_FB [NC_ECF_NR]	V	0... 1H	0 ...1	1	-
End of diagnosis ECF failure feedback diagnosis.					
LV_ERR_ECF_EL [NC_ECF_NR]	O/V	0... 1H	0 ...1	1	-
Boolean for electronic controlled cooling fan signal range error					
LV_ERR_ECFPWM_FB [NC_ECF_NR]	O/V	0... 1H	0 ...1	1	-
Error currently present, indicated by failure feedback from ECF control unit.					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_ACT_ECFPWM_FB [NC_ECF_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time with ECFPWM[NC_ECF_NR] > C_EFPPWM_MIN_FB[NC_ECF_NR] necessary to have failure feedback from ECF control unit					
T_ECFPWM_FB [NC_ECF_NR]	V	0... FFH	0... 25.5	0.1	s
Timer counting tlow for failure feedback recognition					

Input data:

CDN_DIAG_ECFPWM_BAS [NC_ECF_NR] {p. 4507}	ECFPWM [NC_ECF_NR] {p. 3596}	ERR_DIAG_ECFPWM [NC_ECF_NR] {p. 4507}	ERR_ECFPWM_FB [NC_ECF_NR] {p. 4507}
LV_CDN_VB_MIN_DIAG {p. 1185}	LV_ECFPWM_FB_VLD [NC_ECF_NR] {p. 4507}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}
NC_ECF_NR {p. 576}	TAM {p. 1579}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_ECFPWM_FB [NC_ECF_NR]	-	1... FFH	1... 255	1	-
If C_ABC_ECFPWM_FB[x] times sequentially a failure feedback for the same failure is detected, the failure LV_ERR_ECFPWM_FB[x] is set.					
C_ABC_INC_ECF_EL	-	0... FFH	0... 255	1	-
Debounce counter increment ECF diagnosis					
C_ABC_MAX_ECF_EL	-	1... FFH	1... 255	1	-
Debounce counter maximum value - ECF diagnosis					
C_ECFPWM_DIAG_MAX [NC_ECF_NR]	-	0... FFH	0... 99.60937	0.390625	%
Maximum duty cycle threshold of ECF_EL for electrical ECF diagnosis					
C_ECFPWM_DIAG_MIN [NC_ECF_NR]	-	0... FFH	0... 99.60937	0.390625	%
Minimum duty cycle threshold of ECF_EL for electrical ECF diagnosis					
C_ECFPWM_MIN_FB [NC_ECF_NR]	-	0... FFH	0... 99.60937	0.390625	%
Minimum duty cycle of ECFPWM to have a failure feedback from ECF control unit					
C_T_ACT_ECFPWM_FB [NC_ECF_NR]	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time necessary to have failure feedback from ECF control unit					
C_T_ECFPWM_FB_MAX [NC_ECF_NR]	-	0... FFH	0... 25.5	0.1	s
Time range necessary for identification of failure feedback maximal value					
C_T_ECFPWM_FB_MIN [NC_ECF_NR]	-	0... FFH	0... 25.5	0.1	s
Time range necessary for identification of failure feedback minimal value					
C_TAM_MIN_ECFPWM_FB_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Minimum TAM for enabling ECFPWM_FB-diagnosis					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_ECF_EL	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (typical 2)					

Import actions:

Continued on next page

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ACTION_ERRM_FilterMulticondition (**IN**<XX>,**IN**<CDN_DIAG_>,**XX**>,<IN<>,**ERR_DIAG_XX**>,<IN>,<C_ABC_INC_XX>,**IN**<C_ABC_MAX_XX>,**OUT**<LV_ERR_XX>)

Error treatment:

Diagnostic ECF_EL[NC_ECF_NR]	**Symptom description**	**Symptom**	**Filter type**
ECF _EL[NC_ECF_NR] Diagnostic	*SCP*	*SYM_0*	*MPL_STD_INI*
	SCG	*SYM_1*	
	OC	*SYM_2*	

Diagnostic ECFPWM_ERR_FB[NC_ECF_NR]	**Symptom description**	**Symptom**	**Filter type**
failure feedback diagnosis of ECF control unit	see description	*SYM_0*	*NO*
		SYM_1	
		SYM_2	
		SYM_3	

A.55.1 Diagnostic information from infrastructure

FUNCTION DESCRIPTION:

Description:

The ECF control unit is controlled by a PWM signal line driven by the ATIC 39. The driver can distinguish between three symptoms: Short circuit to Vbatt , Short circuit to GND and Open Load .
This function reads the failure information (ERR_DIAG_ECFPWM[x]) from the infrastructure.
The [x] is the placeholder for [NC_ECF_NR].

Application conditions

Initialisation: reset or transition LV_IGK off - -> on or reset of failure memory
CDN_DIAG_ECFPWM_BAS[x] = 0
ERR_DIAG_ECFPWM[x] = 0

Recurrence: *100ms*

Activation: *every ECU state*

Formula section:

Usage of the diagnosis information (failure symptoms (raw value) ERR_DIAG_ECFPWM[x] and diagnosis conditions CDN_DIAG_ECFPWM_BAS[x]) received from the infrastructure:

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Diagnosis conditions are set according infrastructure info.: CDN_DIAG_ECFPWM_BAS[x]
Failure symptoms are set according infrastructure info.: ERR_DIAG_ECFPWM[x]

A.55.2 ECF control unit: Failure feedback recognition

FUNCTION DESCRIPTION:

If a failure is detected from the ECF control unit, a failure feedback is send to the ECU by pulling the signal line (interface ECU to the ECF control unit) to ground in a definited pattern. The time t_{low} is a identification for the failure.

Description:

If a failure is detected from the ECF control unit, a failure feedback is send to the ECU by pulling the signal line (interface ECU to the ECF control unit) to ground in a definited pattern. The time t_{low} is a identification for the failure.
For the recognition of the failure feedback the information, if a failure short circuit to ground is detected on the signal line between ECU and ECF control unit is used.

Application conditions

Initialisation: reset or transition LV_IGK off - -> on or reset of failure memory
ERR_ECFPWM_FB[x] = FFH
T_ECFPWM_FB[x] = 0
LV_ECFPWM_FB_VLD[x] = 0

Recurrence: *100ms*

Activation: LV_CDN_VB_MIN_DIAG = 1 **and**
LV_ERR_SPI_MPS= 0

Deactivation: at deactivation function is initialized one time

Formula section:

LV_ECFPWM_FB_VLD[x] = 0
If bit 1 of ERR_DIAG_ECFPWM[x] = 1 (SCG detected by HW)
Then T_ECFPWM_FB[x] = T_ECFPWM_FB[x] + 100ms
ERR_ECFPWM_FB[x] = FFH (failure feedback possible)
If C_T_ECFPWM_FB_MAX[x] T_ECFPWM_FB[x]
(T_ECFPWM_FB[x] out of range for FB)
Then ERR_ECFPWM_FB[x]= 00H
Endif
Else **If** C_T_ECFPWM_FB_MIN[x] T_ECFPWM_FB[x] C_T_ECFPWM_FB_MAX[x]
Then failure feedback detected
ERR_ECFPWM_FB[x] = 01H
LV_ECFPWM_FB_VLD[x] = 1
Else no failure feedback possible
ERR_ECFPWM_FB[x] = 00H
Endif
T_ECFPWM_FB[x] = 0
Endif

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A.55.3 Electrical diagnosis of ECF

FUNCTION DESCRIPTION:

General information:

The purpose is to diagnose the signal from the driver, which controls the electrical cooling fan.
The input signal is a modulated control pulse (PWM).

Description:

The driver can distinguish between three symptoms: Short circuit to Vbatt , Short circuit to GND and Open Load . The diagnosis of all these symptoms is possible at the same time in the duty cycle range C_ECFPWM_DIAG_MIN[[x] ... C_ECFPWM_DIAG_MAX[x].
The error detection algorithm in this function for short circuit to GND is respecting the status of the failure feedback recognition (ERR_ECFPWM_FB[x]). The failure, detected by the HW, is delivered from the infrastructure ERR_DIAG_ECFPWM[x].

Error-symptoms: are defined to this diagnosis function as following

```
 ┌─┬─┬─┬─┐
 │ │ │ │ │
 └─┴─┴─┴─┘
  │  │  │  └─> Short circuit to Vbatt          (= SYM_0)
  │  │  └────> Short circuit to GND            (= SYM_1)
  │  └───────> Open load                       (= SYM_2)
  └──────────> -                               (= SYM_3)
```

Application conditions

Initialization: according filter-type: MPL_STD_INI

Recurrence: 100ms

Activation: activation in all engine states

Formula section:

If LV_CDN_VB_MIN_DIAG = 1
and LV_ERR_SPI_MPS= 0
Then **If** Activation conditions are met for the NC_PSD_DLY_ECF_EL recurrence
and C_ECFPWM_DIAG_MIN[x] ECFPWM[NC_ECF_NR] C_ECFPWM_DIAG_MAX[x]

and ERR_ECFPWM_FB[x] = 00H (no failure feedback possible)
Then CDN_DIAG_ECF_EL[x] = CDN_DIAG_ECFPWM_BAS[x]
ERR_DIAG_ECFPWM[x] is used for debounce mechanism
Else CDN_DIAG_ECF_EL[x] = 0 (diagnosis not possible)
Endif
Else CDN_DIAG_ECF_EL[x] = 0
Endif

Failure filtering and error management treatment:

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For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_ECF_EL[x] and ERR_DIAG_ECFPWM[x].

ACTION_ERRM_FilterMulticondition (IN<ECF_EL[x]>, IN<CDN_DIAG_ECF_EL[x] >, IN<ERR_DIAG_ECFPWM[x] >, IN<C_ABC_INC_ECF_EL[x] >, IN<C_ABC_INC_ECF_EL[x]>, OUT< LV_ERR_ECF_EL[X] >, SYNCRONIZATION<CALL>)

This algorithm determines:

ERR_SYM_ECF_EL[x] (detected error symptom for ECF diagnosis)
LV_ERR_ECF_EL[x] (Error flag for debounced error of ECF)
LV_CDN_DIAG_ECF_EL[x] (Diagnosis condition information)
LV_END_DIAG_ECF_EL[x] (End of diagnosis information)

A.55.4 ECF control unit: Failure feedback diagnosis

FUNCTION DESCRIPTION:

General information:

If a failure is detected by the ECF control unit, a failure feedback is send to the ECU.

Description:

According the possible failure feedback from the ECF control unit (defined by ERR_ECFPWM_FB[x] and LV_ECFPWM_FB_VLD[x]), the diagnosis is managing the following failure: LV_ERR_ECFPWM_FB[x].

Error-symptoms of failure LV_ERR_ECFPWM_FB[x]:

```
 □□□□
 | | | └─> not used                               (= SYM_0)
 | | └───> not used                               (= SYM_1)
 | └─────> not used                               (= SYM_2)
 └───────> problem on ECF control unit detected   (= SYM_3)
```

Application conditions

Initialization: reset *or transition LV_IGK off - -> on* or reset of failure memory
all output = 0

Recurrence: 100ms

Activation: activation in all engine states

Formula section:

If LV_CDN_VB_MIN_DIAG =1 **and**

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```
        LV_ERR_SPI_MPS= 0
Then        LV_CDN_DIAG_ECFPWM_FB[x] = 1
            If          ECFPWM[x] > C_ECFPWM_MIN_FB[x]
            Then            T_ACT_ECFPWM_FB[x] = T_ACT_ECFPWM_FB[x] +100ms
                        T_ACT_ECFPWM_FB[x] is limited to 6553.5s
            Endif
            If          LV_ERR_ECFPWM_FB[x] = 0
            Then            If          LV_ECFPWM_FB_VLD[x] = 1
                                (valid failure feedback information available)          and
                                TAM > C_TAM_MIN_ECFPWM_FB_DIAG_TH
                    Then            ERR_SYM_ECFPWM_FB[x] = SYM_3
                                ABC_ECFPWM_FB[x] = ABC_ECFPWM_FB[x] + 1
                                If          ABC_ECFPWM_FB[x]   C_ABC_ECFPWM_FB[x]
                                    Then            LV_ERR_ECFPWM_FB[x] = 1
                                                LV_END_DIAG_ECFPWM_FB[x] = 1
                        Endif
                    Else            If          ERR_ECFPWM_FB[x] = 0          (no failure feedback de-
            tected)
                                Then            ERR_SYM_ECFPWM_FB[x] = 0
                                //please note:  the LV_CDN_DIAG_ECFPWM_FB [x] should not be re-
                    set
                                        If          T_ACT_ECFPWM_FB[x]
                                                C_T_ACT_ECFPWM_FB[x]
                                        Then            LV_END_DIAG_ECFPWM_FB[x] = 1
                                        Endif
                                Endif
                    Endif
            Else            LV_CDN_DIAG_ECFPWM_FB[x] = 0
          Endif
Else        LV_CDN_DIAG_ECFPWM_FB[x] = 0
Endif
```

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A.56 Electronically controlled radiator shutter diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_ECRAS_EL	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of ECRAS_ELbit 0: diagnosis condition for symptom SYM_0 (SCP)bit 1: diagnosis condition for symptom SYM_1 (SCG)bit 2: diagnosis condition for symptom SYM_2 (OC)					
CDN_DIAG_ECRASPWM_BAS	O	0... 7H	0 ...7	1	-
Primary diagnosis condition read from the infrastructure for each symptom of ECRASPWMbit 0: diagnosis condition for symptom SYM_0 (SCP)bit 1: diagnosis condition for symptom SYM_1 (SCG)bit 2: diagnosis condition for symptom SYM_2 (OC)					
CTR_ECRAS_DOWN_DET	V	0... FFH	0... 255	1	-
Counter for detecting ECRAS_DOWN					
ERR_DIAG_ECRASPWM	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for ECRASPWM detected on interface ECU and ECRAS control unitbit 0: diagnosis condition for symptom SYM_0 (SCP)bit 1: diagnosis condition for symptom SYM_1 (SCG)bit 2: diagnosis condition for symptom SYM_2 (OC)					
ERR_ECRASPWM_FB	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
The failure status of the failure feedback coming from the ECRAS control unit 00H: no failure feedback01H: failure 1 detected by ECRAS control unit FFH: init value /feedback p					
ERR_SYM_ECRAS_DOWN_FB	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom ECRAS_DOWN failure feedback diagnosis.					
ERR_SYM_ECRAS_EL	V	0... 4H	0 ...4	1	-
Error symptom ECRAS diagnosis					
ERR_SYM_ECRAS_UP_FB	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom ECRAS_UP failure feedback diagnosis.					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_ECRAS_DOWN_FB	V	0... 1H	0 ...1	1	-
Diagnosis condition ECRAS_DOWN failure feedback diagnosis.					
LV_CDN_DIAG_ECRAS_EL	V	0... 1H	0 ...1	1	-
Diagnosis condition ECRAS diagnosis					
LV_CDN_DIAG_ECRAS_UP_FB	V	0... 1H	0 ...1	1	-
Diagnosis condition ECRAS_UP failure feedback diagnosis.					
LV_DIAG_ECRAS	O/V	0... 1H	0 ...1	1	-
Diagnosis mode of ECRAS control unit activated (10% PWM)					
LV_DIAG_ECRAS_END	O/V	0... 1H	0 ...1	1	-
Diagnosis mode feedback of ECRAS control unit received (diagnosis ability of ECRAS detected)					
LV_DIAG_ECRAS_ERR_END	O/V	0... 1H	0 ...1	1	-
Diagnosis mode feedback of ECRAS control unit not received (diagnosis ability of ECRAS not detected)					
LV_ECRAS_DOWN_DET_ACT	O/V	0... 1H	0 ...1	1	-
Bit indicating learning of ECRAS_DOWN					
LV_ECRAS_DOWN_DET_RST	V	0... 1H	0 ...1	1	-
Reset learning of ECRAS_DOWN					
LV_ECRAS_DOWN_DET_SET	O/V/S	0... 1H	0 ...1	1	-
Diagnosis /learning of ECRAS_DOWN run through one-time					
LV_ECRAS_FB_DET	V	0... 1H	0 ...1	1	-
Change from short circuit to ground to normal PWM signal detected (bit 1 ERR_DIAG_ECRASPWM 1->0)					
LV_ECRAS_FB_DIAG	V	0... 1H	0 ...1	1	-
Feedback of ECRAS control unit or timeout detected					
LV_EDGE_ECRAS_DOWN	V	0... 1H	0 ...1	1	-
Detected change in LV_ECRAS_DOWN_1					
LV_EDGE_ECRAS_UP	V	0... 1H	0 ...1	1	-
Detected change in LV_ECRAS_UP_1					
LV_END_DIAG_ECRAS_DOWN_FB	O/V	0... 1H	0 ...1	1	-
End of diagnosis ECRAS_DOWN failure feedback diagnosis.					
LV_END_DIAG_ECRAS_EL	O/V	0... 1H	0 ...1	1	-
End of diagnosis ECRAS diagnosis					
LV_END_DIAG_ECRAS_UP_FB	O/V	0... 1H	0 ...1	1	-
End of diagnosis ECRAS_UP failure feedback diagnosis.					
LV_ERR_ECRAS	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on ECRAS command signal.					
LV_ERR_ECRAS_DOWN_FB	O/V	0... 1H	0 ...1	1	-
ECRAS_DOWN error currently present, indicated by failure feedback from ECRAS control unit.					
LV_ERR_ECRAS_EL	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on ECRAS command signal					
LV_ERR_ECRAS_UP_FB	O/V	0... 1H	0 ...1	1	-
ECRAS_UP error currently present, indicated by failure feedback from ECRAS control unit.					
LV_INTR_DIAG_ECRAS_EL	O/V	0... 1H	0 ...1	1	-
Boolean for irreverible interrupt of ECRAS_EL diagnosis					
LV_VAR_ECRAS_DOWN	O/V/S	0... 1H	0 ...1	1	-
ECRAS_DOWN flap of ECRAS system detected (2 flap system)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_ECRAS_FB	V	0H 1H 2H 3H 4H 5H 6H undef:1H undef:2H undef3588d42970-2668123d31H	NO_FB DIAG_ABILITY EL_ERR_UP MEC_ERR_UP EL_ERR_ DOWN EL_ERR_UP_ AND_DOWN MEC_ERR_ UP_ AND_EL_ERR_ DOWN undef	-	-
State of the received feedback from ECRAS control unit					
T_DIAG_ECRAS	V	0... FFH	0... 25.5	0.1	s
Timer for waiting of answer of ECRAS control unit					
T_ECRAS_DOWN_DET	V	0... FFH	0... 25.5	0.1	s
Timer for learning of ECRAS_DOWN					
T_ECRAS_DOWN_DET_NEG	V	0... FFH	0... 25.5	0.1	s
Timer indicating time since start of short circuit to ground phase of ECRASPWM					
T_ECRAS_DOWN_DET_POS	V	0... FFH	0... 25.5	0.1	s
Timer indicating time since start of normal ECRASPWM signal (no SCG)					
T_ECRASPWM_FB	V	0... FFH	0... 25.5	0.1	s
Timer counting tlow for failure feedback recognition					

Input data:

ECRASPWM {p. 3863}	LV_ACT_ECRAS_EOL_EXT_ADJ {p. 7763}	LV_CDN_VB_MIN_DIAG {p. 1185}	LV_ECRAS_DOWN_1 {p. 3863}
LV_ECRAS_UP_1 {p. 3863}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}	LV_ST_END {p. 1720}
LV_VAR_ECRAS_UP {p. 655}	VS {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_ECRAS_DOWN_FB	-	0... FFH	0... 255	1	-
anti bounce counter increment for ECRAS_DOWN diagnosis					
C_ABC_INC_ECRAS_EL	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_INC_ECRAS_UP_FB	-	0... FFH	0... 255	1	-
anti bounce counter increment for ECRAS_UP diagnosis					
C_ABC_MAX_ECRAS_DOWN_FB	-	1... FFH	1... 255	1	-
maximal value of anti bounce counter for ECRAS_DOWN diagnosis					
C_ABC_MAX_ECRAS_EL	-	1... FFH	1... 255	1	-
C_ABC_MAX_ECRAS_EL					
C_ABC_MAX_ECRAS_UP_FB	-	1... FFH	1... 255	1	-
maximal value of anti bounce counter for ECRAS_UP diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_ECRAS_DOWN_DET	-	0... FFH	0... 255	1	-
Counter threshold for detection of ECRAS_DOWN					
C_ECRASPWM_DIAG_MAX_SCG	-	0... FFH	0... 99.60937	0.390625	%
C_ECRASPWM_DIAG_MAX_SCG					
C_ECRASPWM_DIAG_MIN_OC	-	0... FFH	0... 99.60937	0.390625	%
C_ECRASPWM_DIAG_MIN_OC					
C_ECRASPWM_DIAG_MIN_SCP	-	0... FFH	0... 99.60937	0.390625	%
C_ECRASPWM_DIAG_MIN_SCP					
C_T_DIAG_ECRAS	-	0... FFH	0... 25.5	0.1	s
Maximum waiting time for answer of ECRAS control unit					
C_T_ECRAS_DOWN_DET	-	0... FFH	0... 25.5	0.1	s
Time window for diagnosis /learning of ECRAS_DOWN					
C_T_ECRASPWM_FB_MAX	-	0... FFH	0... 25.5	0.1	s
C_T_ECRASPWM_FB_MAX					
C_T_ECRASPWM_FB_MAX_1	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'diagnosis ability', max value					
C_T_ECRASPWM_FB_MAX_2	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'elctrical failure ECRAS_UP', max value					
C_T_ECRASPWM_FB_MAX_3	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'mechanical failure ECRAS_UP', max value					
C_T_ECRASPWM_FB_MAX_4	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'electrical failure ECRAS_DOWN', max value					
C_T_ECRASPWM_FB_MAX_5	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'electrical failure ECRAS_UP/_DOWN', max value					
C_T_ECRASPWM_FB_MAX_6	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'mech. failure ECRAS_UP, el. ECRAS_DOWN', max value					
C_T_ECRASPWM_FB_MIN_1	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'diagnosis ability', min value					
C_T_ECRASPWM_FB_MIN_2	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'elctrical failure ECRAS_UP', min value					
C_T_ECRASPWM_FB_MIN_3	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'mechanical failure ECRAS_UP', min value					
C_T_ECRASPWM_FB_MIN_4	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'electrical failure ECRAS_DOWN', min value					
C_T_ECRASPWM_FB_MIN_5	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'electrical failure ECRAS_UP/_DOWN', min value					
C_T_ECRASPWM_FB_MIN_6	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback 'mech. failure ECRAS_UP, el. ECRAS_DOWN', min value					
C_T_MAX_ECRAS_DOWN_DET	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback SCG or normal PWM, max value					
C_T_MIN_ECRAS_DOWN_DET	-	0... FFH	0... 25.5	0.1	s
Time range for identification of the ECRAS feedback SCG or normal PWM, min value					
C_VS_MAX_ECRAS_DIAG	-	0... FFH	0... 255	1	km/h
Maximum VS treshold for deactivation for electrical ECRAS diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_ECRAS_EL	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (typical 2)					

Import actions:

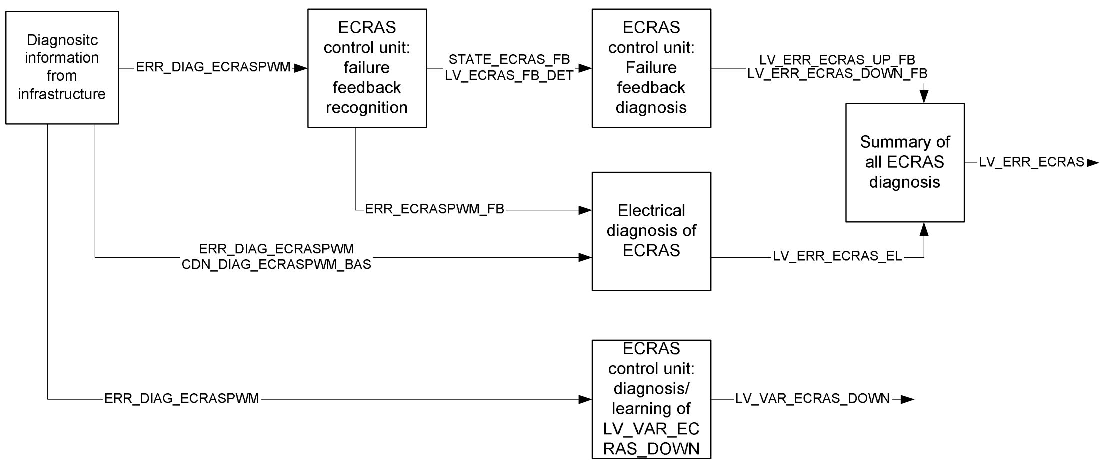
ACTION_ERRM_FilterMulticondition (**IN**<XX>,**IN**<CDN_DIAG_>,**XX**>,<IN<>,**ERR_DIAG_XX**>,<IN>,<C_ABC_INC_XX>,**IN**<C_ABC_MAX_XX>,**OUT**<LV_ERR_XX>)

Error treatment:

Diagnostic ECRAS_EL	Symptom description	Symptom	Filter type
ECRAS _EL Diagnostic	*SCP*	*SYM_0*	*MPL_STD_INI*
	SCG	*SYM_1*	
	OC	*SYM_2*	

General information:

This modul consists of 6 parts. The parts and their correlation is described in the figure below. The diagnostic information from the infrastructure is used for detection of feedback from the ECRAS control unit and for the electrical diagnosis. The information from the infrastructure is also used for the diagnosis /learning of the ECRAS variant with the second flap (LV_VAR_ECRAS_DOWN). The recognised feedbacks from the ECRAS control unit are processed by the failure feedback diagnosis.



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A.56.1 Summary of all ECRAS diagnosis

FUNCTION DESCRIPTION:

Description:

This function shall summarize all ECRAS failures in one flag only.

Application conditions

Initialisation: reset **or** reset of failure memory **or** LV_IGK = 0 -> 1 all = 0

Recurrence: *100ms*

Activation: *LV_VAR_ECRAS_UP = 1*

Formula section:

If LV_ERR_ECRAS_EL = 1 **or**
LV_ERR_ECRAS_UP_FB = 1 **or**
LV_ERR_ECRAS_DOWN_FB = 1
Then LV_ERR_ECRAS = 1
Else LV_ERR_ECRAS = 0
Endif

A.56.2 Diagnostic information from infrastructure

FUNCTION DESCRIPTION:

Description:

The ECRAS control unit is controlled by a PWM signal line driven by the ATIC 39. This driver is able to distinguish between three symptoms: Short circuit to Vbatt , Short circuit to GND and Open Load .

This function shall reads the failure information (ERR_DIAG_ECRASPWM) delivered from the infrastructure (basic software).

Application conditions

Initialisation: reset **or** reset of failure memory **or** LV_IGK = 0 -> 1 all = 0

Recurrence: *100ms*

Activation: *LV_VAR_ECRAS_UP = 1*

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Formula section:

Usage of the diagnosis information (failure symptoms (raw value) ERR_DIAG_ECRASPWM and diagnosis conditions CDN_DIAG_ECRASPWM_BAS) received from the infrastructure:

Diagnosis conditions are set according infrastructure info.: CDN_DIAG_ECRASPWM_BAS
Failure symptoms are set according infrastructure info.: ERR_DIAG_ECRASPWM

A.56.3 ECRAS control unit: Failure feedback recognition

FUNCTION DESCRIPTION:

Description:

If a failure is detected from the ECRAS control unit, a failure feedback is send to the ECU by pulling the signal line (interface ECU to the ECRAS control unit) to ground in a definited pattern. The time t_{low} is a identification for the failure. Depending on t_{low} a specific failure is identified and set in STATE_ECRAS_FB.
For the recognition of the failure feedback the information, if a failure short circuit to ground is detected on the signal line between ECU and ECRAS control unit is used.

Application conditions

Initialisation: `reset` **or** `reset of failure memory` **or** `LV_IGK = 0 -> 1`
`ERR_ECRASPWM_FB = FFH, all others = 0`

Recurrence: *100ms*

Activation: `LV_CDN_VB_MIN_DIAG = 1` **and**
`LV_ERR_SPI_MPS= 0` **and**
`LV_VAR_ECRAS_UP = 1` **and**
`LV_IGK = 1`

Deactivation: `at deactivation function is initialized one time`

Formula section:

STATE_ECRAS_FB = 0H
LV_ECRAS_FB_DET = 0

If bit 1 of ERR_DIAG_ECRASPWM = 1 (SCG detected by HW)
Then T_ECRASPWM_FB = T_ECRASPWM_FB + 100ms
ERR_ECRASPWM_FB = FFH *(ECRAS ECU failure possible)*
If T_ECRASPWM_FB > C_T_ECRASPWM_FB_MAX
(T_ECRASPWM_FB out of range for FB, C_T_ECRASPWM_FB_MAX should be > than C_ T_ECRASPWM_FB_MAX_6, DIAG_EL will be enabled)
Then ERR_ECRASPWM_FB = 00H
Endif
Else **If** T_ECRASPWM_FB > 0 *//change from SCG to normal detected*
then LV_ECRAS_FB_DET = 1
endif
If C_T_ECRASPWM_FB_MIN_1 T_ECRASPWM_FB
C_T_ECRASPWM_FB_MAX_1
Then *ECRAS feedback detected: diagnosis abilityof ECRAS*

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ERR_ECRASPWM_FB = 01H
STATE_ECRAS_FB = 01H
Elseif C_T_ECRASPWM_FB_MIN_2 T_ECRASPWM_FB C_T_ECRASPWM_FB_MAX_2
Then *ECRAS feedback detected: elctrical failure ECRAS_UP*
ERR_ECRASPWM_FB = 01H
STATE_ECRAS_FB = 02H
Elseif C_T_ECRASPWM_FB_MIN_3 T_ECRASPWM_FB C_T_ECRASPWM_FB_MAX_3
Then *ECRAS feedback detected: mechanical failure ECRAS_UP*
ERR_ECRASPWM_FB = 01H
STATE_ECRAS_FB = 03H
Elseif C_T_ECRASPWM_FB_MIN_4 T_ECRASPWM_FB C_T_ECRASPWM_FB_MAX_4
Then *ECRAS feedback detected: electrical failure ECRAS_DOWN*
ERR_ECRASPWM_FB = 01H
STATE_ECRAS_FB = 04H
Elseif C_T_ECRASPWM_FB_MIN_5 T_ECRASPWM_FB C_T_ECRASPWM_FB_MAX_5
Then *ECRAS feedback detected: elctrical failure ECRAS_UP/_DOWN*
ERR_ECRASPWM_FB = 01H
STATE_ECRAS_FB = 05H
Elseif C_T_ECRASPWM_FB_MIN_6 T_ECRASPWM_FB C_T_ECRASPWM_FB_MAX_6
Then *ECRAS feedb. detected: mech. failure ECRAS_UP, elctr. ECRAS_DOWN*
ERR_ECRASPWM_FB = 01H
STATE_ECRAS_FB = 06H
Else *no ECRAS ECU failure possible*
ERR_ECRASPWM_FB = 00H
Endif
T_ECRASPWM_FB = 0
Endif

A.56.4 Electrical diagnosis of ECRAS

FUNCTION DESCRIPTION:

General information:

The purpose is to diagnose the signal from the driver, which controls the electrical cooling fan.
The input signal is a modulated control pulse (PWM).

Description:

The driver can distinguish between three symptoms: Short circuit to Vbatt , Short circuit to GND and Open Load .
The error detection algorithm in this function for short circuit to GND is respecting the status of the failure feedback recognition (ERR_ECRASPWM_FB). The failure, detected by the HW, is delivered from the infrastructure ERR_DIAG_ECRASPWM .

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Error-symptoms: are defined to this diagnosis function as following

```
┌─┬─┬─┬─┐
│ │ │ │ │
└─┴─┴─┴─┘
 │  │  │  └─> Short circuit to Vbatt          (= SYM_0)
 │  │  └────> Short circuit to GND            (= SYM_1)
 │  └───────> Open load                       (= SYM_2)
 └──────────> -                               (= SYM_3)
```

Application conditions

Initialization: according filter-type: **MPL_STD_INI**
LV_INTR_DIAG_ECRAS_EL = 0 at LV_IGK 0->1 **or** reset **or** clear FMY

Recurrence: 100ms

Activation: LV_VAR_ECRAS_UP = 1

Deactivation: if LV_INTR_DIAG_ECRAS_EL = 1, set CDN_DIAG_ECRAS_EL = 0
if LV_VAR_ECRAS_UP = 0, set LV_END_DIAG_ECRAS_EL = 1

Formula section:

If VS >= C_VS_MAX_ECRAS_DIAG
Then LV_INTR_DIAG_ECRAS_EL = 1 *//remains active until next initialization*
Endif

If LV_CDN_VB_MIN_DIAG = 1
and LV_ERR_SPI_MPS= 0
and LV_IGK = 1
Then

Note: The failure symptoms ERR_SYM_ECRAS_EL and the diagnosis conditions CDN_DIAG_ECRAS_EL (raw values) shall be set according infrastructure information ERR_DIAG_ECRASPWM and CDN_DIAG_ECRASPWM_BAS.

If Activation conditions are met for the NC_PSD_DLY_ECRAS_EL recurrence
And ERR_ECRASPWM_FB = 00h
Then

{ Additional diagnosis conditions }
If ECRASPWM < C_ECRASPWM_DIAG_MIN_SCP
{ condition that disables the SYM_0 detection }
Then
bit 0 of CDN_DIAG_ECRAS_EL = 0 *{ Diagnosis of SCP is not possible }*
Endif
If ECRASPWM > C_ECRASPWM_DIAG_MAX_SCG
{ condition that disables the SYM_1 detection }
Then
bit 1 of CDN_DIAG_ECRAS_EL = 0 *{ Diagnosis of SCG is not possible }*
Endif
If ECRASPWM < C_ECRASPWM_DIAG_MIN_OC
or ECRASPWM > C_ECRASPWM_DIAG_MAX_SCG
{ conditions that disable the SYM_2 detection }

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Then
bit 2 of CDN_DIAG_ECRAS_EL = 0 *{ Diagnosis of OC is not possible }*
Endif
Else
CDN_DIAG_ECRAS_EL = 0
Endif
Else
CDN_DIAG_ECRAS_EL = 0
Endif

Failure filtering and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_ECRAS_EL and ERR_DIAG_ECRASPWM .
ACTION_ERRM_FilterMulticondition (IN<ECRAS_EL >,
IN<CDN_DIAG_ECRAS_EL >,
IN<ERR_DIAG_ECRASPWM >, IN<C_ABC_INC_ECRAS_EL >, IN<C_ABC_MAX_ECRAS_EL >,
OUT< LV_ERR_ECRAS_EL >,
SYNCRONIZATION<CALL>)

This algorithm determines:
ERR_SYM_ECRAS_EL (detected error symptom for ECRAS diagnosis)
LV_ERR_ECRAS_EL (Error flag for debounced error of ECRAS)
LV_CDN_DIAG_ECRAS_EL (Diagnosis condition information)
LV_END_DIAG_ECRAS_EL (End of diagnosis information)

A.56.5 ECRAS control unit: Failure feedback diagnosis

FUNCTION DESCRIPTION:

General information:

If a failure is detected by the ECRAS control unit (ECRAS_UP), a failure feedback is send to the ECU and recognized.

Description:

According the possible failure feedback from the ECRAS control unit (defined by ERR_ECRASPWM_FB and STATE_ECRAS_FB), the diagnosis is managing the following failure: LV_ERR_ECRAS_UP_FB, LV_ERR_ECRAS_DOWN_FB. Additional the diagnosis ability of the ECRAS control unit will be diagnosed (LV_DIAG_ECRAS / _END).

Error-symptoms of failure LV_ERR_ECRAS_UP_FB :

```
|_|_|_|_|
 | | | └─> electrical failure        (= SYM_0)
 | | └───> mechanical failure        (= SYM_1)
 | └─────> not used                  (= SYM_2)
 └───────> no answer of ECRAS        (= SYM_3)
```

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Error-symptoms of failure LV_ERR_ECRAS_DOWN_FB :

```
□□□□
│ │ │ └─> electrical failure          (= SYM_0)
│ │ └───> not used                    (= SYM_1)
│ └─────> not used                    (= SYM_2)
└───────> not used                    (= SYM_3)
```

Application conditions

Initialization: *according filter type* ***STD_INI,*** *all others = 0 at reset* ***or*** *reset of failure memory* ***or*** *LV_IGK = 0 -> 1*

Recurrence: 100ms

Activation: LV_VAR_ECRAS_UP = 1 **and** (ERR_SYM_ECRAS_UP_FB != SYM_3 **or** LV_ERR_ECRAS_UP_FB =0)

Deactivation: if LV_VAR_ECRAS_UP=0, set LV_END_DIAG_ECRAS_UP_FB = 1 and LV_END_DIAG_ECRAS_DOWN_FB = 1
if (LV_ERR_ECRAS_UP_FB = 1 and ERR_SYM_ECRAS_UP_FB = Sym_3), set LV_CDN_DIAG_ECRAS_UP_FB = 0 and LV_CDN_DIAG_ECRAS_DOWN_FB = 0

Formula section:

IF LV_CDN_VB_MIN_DIAG = 1 **and**
LV_ERR_SPI_MPS= 0 **and**
LV_ERR_ECRAS_EL = 0 **and**
LV_IGK = 1
THEN
if LV_ECRAS_UP_1 0 -> 1 **or** 1 -> 0
then LV_EDGE_ECRAS_UP = 1
endif

if LV_ECRAS_DOWN_1 0 -> 1 **or** 1 -> 0
then LV_EDGE_ECRAS_DOWN = 1
endif

// activated diagnosis-mode of ECRAS_UP (PWM = 10%)
if (LV_ACT_ECRAS_EOL_EXT_ADJ = 1 **or** LV_ST_END = 1)
and LV_DIAG_ECRAS_END = 0 **and** LV_DIAG_ECRAS_ERR_END = 0
and LV_EDGE_ECRAS_UP = 0 **and** LV_EDGE_ECRAS_DOWN = 0
then LV_DIAG_ECRAS = 1
endif

// calculating timer
if LV_DIAG_ECRAS = 1 **or** LV_EDGE_ECRAS_UP = 1 **or**
LV_EDGE_ECRAS_DOWN = 1

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```
   then     T_DIAG_ECRAS = T_DIAG_ECRAS + 100ms
   endif

// setting feedback diagnosis enabled -> required to set LV_CDN_DIAG_XXX
   if     LV_ECRAS_FB_DET = 1   or   T_DIAG_ECRAS >= C_T_DIAG_ECRAS
   then     LV_ECRAS_FB_DIAG = 1
   else     LV_ECRAS_FB_DIAG = 0
   endif

// setting of the diagnosis conditions
   if     LV_ECRAS_FB_DIAG = 1          and
   (LV_EDGE_ECRAS_UP = 1   or  LV_DIAG_ECRAS = 1)
then          LV_CDN_DIAG_ECRAS_UP_FB = 1
else          LV_CDN_DIAG_ECRAS_UP_FB = 0
endif
if          LV_ECRAS_FB_DIAG = 1                          and
             LV_EDGE_ECRAS_DOWN = 1                      and
             LV_ERR_ECRAS_UP_FB = 0
then          LV_CDN_DIAG_ECRAS_DOWN_FB = 1
else          LV_CDN_DIAG_ECRAS_DOWN_FB = 0
endif

   //setting LV_DIAG_ECRAS_END if diagnosis mode of ECRAS_UP successful and setting of LV_
   DIAG_ECRAS_ERR_END if diagnosis mode was not successful
if          LV_DIAG_ECRAS = 1 and  LV_ECRAS_FB_DIAG= 1
then          if          STATE_ECRAS_FB = 01H
            then          LV_DIAG_ECRAS_END = 1
             else     LV_DIAG_ECRAS_ERR_END = 1
             endif
endif

// diagnosis LV_ERR_ECRAS_UP_FB
if          LV_CDN_DIAG_ECRAS_UP_FB = 1
then          if          LV_DIAG_ECRAS = 0   and  (STATE_ECRAS_FB = 02H   or
                     STATE_ECRAS_FB = 05H)
                then          ERR_SYM_ECRAS_UP_FB = SYM_0          (debouncing by ERRM)
             elseif     LV_DIAG_ECRAS = 0   and  (STATE_ECRAS_FB = 03H   or
                     STATE_ECRAS_FB = 06H)
                then          ERR_SYM_ECRAS_UP_FB = SYM_1          (debouncing by ERRM)
                elseif          LV_DIAG_ECRAS = 1   and   T_DIAG_ECRAS >= C_T_DIAG_ECRAS
                then          if          C_ABC_INC_ECRAS_UP_FB > 0
                     then          ERR_SYM_ECRAS_UP_FB = SYM_3   CTR_ABC_ECRAS_UP_FB=
                     C_ABC_MAX_ECRAS_UP_FB
                               (-> thus LV_ERR_ECRAS_UP_FB will be set by ERRM)
                     else          ERR_SYM_ECRAS_UP_FB = SYM_3   (debouncing by ERRM)
                     endif
                else          ERR_SYM_ECRAS_UP_FB = NO_SYM          (debouncing by ERRM)
                endif
endif
// LV_ERR_ECRAS_UP_FB and LV_END_DIAG_ECRAS_UP_FB set by ERRM

// diagnosis LV_ERR_ECRAS_DOWN_FB
```

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```
if        LV_CDN_DIAG_ECRAS_DOWN_FB = 1
  then    if    STATE_ECRAS_FB = 04H     or
          STATE_ECRAS_FB = 05H     or
                 STATE_ECRAS_FB = 06H
          then        if        LV_VAR_ECRAS_DOWN = 1
                      then        ERR_SYM_ECRAS_DOWN_FB = SYM_0 (debouncing by ERRM)
                      else        ERR_SYM_ECRAS_DOWN_FB = NO_SYM (debounc. by ERRM)
                      endif
                      LV_ECRAS_DOWN_DET_RST = 0
              else        ERR_SYM_ECRAS_DOWN_FB = NO_SYM   (debouncing by ERRM)
                      if        LV_VAR_ECRAS_DOWN = 0
                  then        LV_ECRAS_DOWN_DET_RST = 1
                  else        LV_ECRAS_DOWN_DET_RST = 0
                  endif
              endif
else      LV_ECRAS_DOWN_DET_RST = 0
endif
// LV_ERR_ECRAS_DOWN_FB and LV_END_DIAG_ECRAS_DOWN_FB set by ERRM

// reseting of values in case of feedback diagnosis -> calculated at last in this modul !
   if        LV_ECRAS_FB_DIAG = 1
then      LV_EDGE_ECRAS_UP        = 0
            LV_EDGE_ECRAS_DOWN          = 0
            LV_DIAG_ECRAS               = 0
            T_DIAG_ECRAS                = 0
endif
ENDIF
```

A.56.6 ECRAS control unit: diagnosis/detecting of LV_VAR_ECRAS_DOWN

FUNCTION DESCRIPTION:

Description:

If an ECRAS control unit is detected (LV_VAR_ECRAS_UP) a learn algorithm /diagnosis for the variant LV_VAR_ECRAS_DOWN will be start once. LV_VAR_ECRAS_DOWN will be recognised by a pattern of short circiuit to ground and normal phases of the ECRASPWM signal set by the ECRAS control unit. For this mode the ECRAS control unit has to be driven by an ECRASPWM of 90% (learnig mode - see Calculation of ECRASPWM).

Application conditions

Initialisation: *all = 0 at reset* ***or*** *LV_IGK 0->1, except LV_ECRAS_DOWN_DET_SET and LV_VAR_ECRAS_DOWN from NVMY LV_ECRAS_DOWN_DET_SET = 0 and LV_VAR_ECRAS_DOWN = 0 at LC_AD_CLR_VAR 01*

Recurrence: *100 ms*

Activation: LV_CDN_VB_MIN_DIAG = 1 and
LV_IGK = 1

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Formula section:

IF LV_VAR_ECRAS_UP = 1
//setting and resetting of LV_ECRAS_DOWN_DET_SET
if T_ECRAS_DOWN_DET >= C_T_ECRAS_DOWN_DET
then LV_ECRAS_DOWN_DET_SET = 1
elseif LV_ECRAS_DOWN_DET_RST = 1
then LV_ECRAS_DOWN_DET_SET = 0
endif

// enabling of learning of LV_VAR_ECRAS_DOWN
if LV_ECRAS_DOWN_DET_SET = 0 **and**
LV_VAR_ECRAS_DOWN = 0
then LV_ECRAS_DOWN_DET_ACT = 1
T_ECRAS_DOWN_DET = T_ECRAS_DOWN_DET + 100 ms
else LV_ECRAS_DOWN_DET_ACT = 0
T_ECRAS_DOWN_DET = 0
CTR_ECRAS_DOWN_DET = 0
endif

if LV_ECRAS_DOWN_DET_ACT = 1
then *// detect change SCG <- -> normal PWM and set counter if correct pattern*
if (bit 1 of ERR_DIAG_ECRASPWM 0 -> 1 **and**
C_T_MIN_ECRAS_DOWN_DET < T_ECRAS_DOWN_DET_POS
< C_T_MAX_ECRAS_DOWN_DET)
or
(bit 1 of ERR_DIAG_ECRASPWM 1 -> 0 **and**
C_T_MIN_ECRAS_DOWN_DET < T_ECRAS_DOWN_DET_NEG
< C_T_MAX_ECRAS_DOWN_DET)
then CTR_ECRAS_DOWN_DET = CTR_ECRAS_DOWN_DET + 1
else *CTR_ECRAS_DOWN_DET unchanged*
endif

// Variant LV_VAR_ECRAS_DOWN recognised
if CTR_ECRAS_DOWN_DET >= C_CTR_ECRAS_DOWN_DET
then LV_VAR_ECRAS_DOWN = 1
else *LV_VAR_ECRAS_DOWN unchanged*
endif

// calculate time since start of SCG phase (T_ECRAS_DOWN_DET_NEG)
if bit 1 of ERR_DIAG_ECRASPWM = 1 **and**
[(T_ECRAS_DOWN_DET_NEG = 0 **and** *//cdn for first entry*
CTR_ECRAS_DOWN_DET = 0) **or**
T_ECRAS_DOWN_DET_NEG > 0 **or**
C_T_MIN_ECRAS_DOWN_DET < T_ECRAS_DOWN_DET_POS
< C_T_MAX_ECRAS_DOWN_DET]
then T_ECRAS_DOWN_DET_NEG = T_ECRAS_DOWN_DET_NEG +
100 ms
T_ECRAS_DOWN_DET_POS = 0 s
endif

// calculate time since start of normal PWM (T_ECRAS_DOWN_DET_POS)
if bit 1 of ERR_DIAG_ECRASPWM = 0 **and**

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(T_ECRAS_DOWN_DET_POS $>$ 0 **or**
C_T_MIN_ECRAS_DOWN_DET $<$ T_ECRAS_DOWN_DET_NEG
$<$ C_T_MAX_ECRAS_DOWN_DET)
then T_ECRAS_DOWN_DET_POS = T_ECRAS_DOWN_DET_POS + 100 ms
T_ECRAS_DOWN_DET_NEG = 0 s
endif
endif
ELSE
LV_VAR_ECRAS_DOWN = 0
LV_ECRAS_DOWN_DET_SET = 0
T_ECRAS_DOWN_DET_NEG = 0 s
T_ECRAS_DOWN_DET_POS = 0 s
CTR_ECRAS_DOWN_DET = 0
T_ECRAS_DOWN_DET = 0
ENDIF

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A.57 Electronically controlled thermostat diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_ECT_EL	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of ECT bit 0: diagnosis condition for symptom SYM_0 bit 1: diagnosis condition for symptom SYM_1 bit 2: diagnosis condition for symptom SYM_2					
ERR_DIAG_ECT_EL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for ECT (only parameter)					
ERR_SYM_ECT_EL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for ECT (only parameter) - SCG					
ERR_SYM_ECT_EL_OC	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom for electrical thermostat open circuit error.					
ERR_SYM_ECT_EL_SCP	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom for electrical thermostat short circuit to battery error.					
LV_CDN_DIAG_ECT_EL	V	0... 1H	0 ...1	1	-
Boolean for electrical thermostat short circuit to ground diagnosis conditions.					
LV_CDN_DIAG_ECT_EL_OC	V	0... 1H	0 ...1	1	-
Boolean for electrical thermostat open circuit diagnosis conditions.					
LV_CDN_DIAG_ECT_EL_SCP	V	0... 1H	0 ...1	1	-
Boolean for electrical thermostat short circuit to battery diagnosis conditions.					
LV_END_DIAG_ECT_EL	V	0... 1H	0 ...1	1	-
Boolean for end of electrical thermostat diagnosis - SCG					
LV_END_DIAG_ECT_EL_OC	V	0... 1H	0 ...1	1	-
Boolean for end electrical thermostat open circuit diagnosis.					
LV_END_DIAG_ECT_EL_SCP	V	0... 1H	0 ...1	1	-
Boolean for end of electrical thermostat short circuit to battery diagnosis.					
LV_ERR_ECT	O/V	0... 1H	0 ...1	1	-
Boolean for electronic controlled thermostat error					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_ECT_EL	O/V	0... 1H	0 ...1	1	-
ECT Electrical error detected - SCG					
LV_ERR_ECT_EL_OC	O/V	0... 1H	0 ...1	1	-
Boolean electrical thermostat open circuit error.					
LV_ERR_ECT_EL_SCP	O/V	0... 1H	0 ...1	1	-
Boolean electrical thermostat short circuit to battery error.					

Input data:

ECTPWM {p. 3858}	LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_ECT_MEC {p. 1045}	LV_IGK {p. 906}
LV_INH_DIAG_ECT_EL {p. 4535}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_ECT_EL	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_INC_ECT_EL_OC	-	0... FFH	0... 255	1	-
Antibounce counter increment, electronical controlled thermostat diagnosis					
C_ABC_INC_ECT_EL_SCP	-	0... FFH	0... 255	1	-
Antibounce counter increment, electronical controlled thermostat diagnosis					
C_ABC_MAX_ECT_EL	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_ABC_MAX_ECT_EL_OC	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter, electronical controlled thermostat diagnosis					
C_ABC_MAX_ECT_EL_SCP	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter, electronical controlled thermostat diagnosis					
C_ECT_EL_PWM_DIAG_MAX_SCG	-	0... FFH	0... 99.60937	0.390625	%
Maximum threshold for SCG diagnosis window					
C_ECT_EL_PWM_DIAG_MIN_OC	-	0... FFH	0... 99.60937	0.390625	%
Minimum threshold for OC diagnosis window					
C_ECT_EL_PWM_DIAG_MIN_SCP	-	0... FFH	0... 99.60937	0.390625	%
Minimum threshold for SCP diagnosis window					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_ECT_EL	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (typical 2)					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)

Error treatment:

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Diagnostic Instance		Symptoms		ABC type	CARB class
Description	**Name (XX)**	**Description**	**Nr**		
Short to plus of electronical controlled thermostat	*ECT_EL_SCP*	*SCP*	0	STD_INI	CC
		-	1		
		-	2		
		-	3		
Diagnostic Instance		**Symptoms**		**ABC type**	**CARB class**
Description	**Name (XX)**	**Description**	**Nr**		
Short to ground of electronical controlled thermostat	*ECT_EL*	-	0	STD_INI	CC
		SCG	1		
		-	2		
		-	3		
Diagnostic Instance		**Symptoms**		**ABC type**	**CARB class**
Description	**Name (XX)**	**Description**	**Nr**		
Open circuit of electronical controlled thermostat	*ECT_EL_OC*	-	0	STD_INI	CC
		-	1		
		OC	2		
		-	3		

Fields information (For more information refers to Error Management file "Table of Failure") :

- ABC Type : STD_INI, STD, MEM, MEM_INI, DEC_CAL, STC, NO, MPL_STD_INI
- CARB Class : MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO.

FUNCTION DESCRIPTION:

General information:

A global electronically controlled thermostat error (LV_ERR_ECT) is set without debounce as soon as SCG (LV_ERR_ECT_EL) or a mechanical (LV_ERR_ECT_MEC) thermostat failure is detected. The activation of the mechanical thermostat diagnosis (ECT rationality check) is not configurable with a configuration switch. Both, the electrical- and mechanical thermostat diagnosis function are performed if the vehicle is equipped with an electrically controlled thermostat.

Application conditions

Initialisation at Reset: *LV_ERR_ECT = 0*

Recurrence: *500 ms*

Activation: *at every engine operating state*

Deactivation: –

Formula section:

```
If      LV_ERR_ECT_EL = 1          or
        LV_ERR_ECT_MEC = 1
then    LV_ERR_ECT = 1             (without debounce)
else    LV_ERR_ECT = 0
endif
```

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A.57.1 ECT diagnosis (Electrical diagnostic with PWM output - - Multicondition filter)

FUNCTION DESCRIPTION:

General information:

The ECT is driven by the ECU via an output driver. The failure detection is done by ECU Hardware. The purpose of the diagnosis is to detect electrical faults as defined by OBD I requirements.

Description:

The purpose is to perform the electrical diagnosis of the ECT actuator. 3 symptoms are distinguished, each having its own error location:

Error-symptoms and conditions: are defined to this diagnosis function as following

```
□□□□
| | | └> Short circuit to battery "SCP"        (= SYM_0)
| | └──> (not used)                            (= SYM_1)
| └────> (not used)                            (= SYM_2)
└──────> (not used)                            (= SYM_3)

□□□□
| | | └> (not used)                            (= SYM_0)
| | └──> Short circuit to Ground "SCG"         (= SYM_1)
| └────> (not used)                            (= SYM_2)
└──────> (not used)                            (= SYM_3)

□□□□
| | | └> (not used)                            (= SYM_0)
| | └──> (not used)                            (= SYM_1)
| └────> Open Circuit "OC"                     (= SYM_2)
└──────> (not used)                            (= SYM_3)
```

Application conditions

Initialisation: all ERRM data are initialized according to Filter-type.
At Reset: CDN_DIAG_ECT_EL = 0

Recurrence: *500 ms*

Activation: every engine operating state

Deactivation: –

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Formula section:

Usage of the diagnosis information (failure symptoms (raw value) ERR_DIAG_ECT_EL and diagnosis conditions CDN_DIAG_ECT_EL) received from the infrastructure:

Diagnosis conditions are set according infrastructure information: CDN_DIAG_ECT_EL
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_ECT_EL

```
If      LV_IGK = 1                              (Activation conditions)
and LV_CDN_VB_OBD1 = 1
and LV_INH_DIAG_ECT_EL = 0
Then
            If      Activation conditions are met for the NC_PSD_DLY_ECT_EL recurrence
            Then    Additional diagnosis conditions:
                    If      bit 0 of CDN_DIAG_ECT_EL = 1      (info from infrastructure)
                            and     C_ECT_EL_PWM_DIAG_MIN_SCP <= ECTPWM
                    then
                            bit 0 of CDN_DIAG_ECT_EL  = 1     (Diagnosis of SCP possible)
                    Endif
                    If      bit 1 of CDN_DIAG_ECT_EL = 1      (info from infrastructure)
                            and     ECTPWM <= C_ECT_EL_PWM_DIAG_MAX_SCG
                    then
                            bit 1 of CDN_DIAG_ECT_EL = 1      (Diagnosis of SCG possible)
                    Endif
                    If      bit 2 of CDN_DIAG_ECT_EL = 1      (info from infrastructure)
                            and     C_ECT_EL_PWM_DIAG_MIN_OC <= ECTPWM <= C_ECT_EL_
                            PWM_DIAG_MAX_SCG
                    then
                            bit 2 of CDN_DIAG_ECT_EL  = 1     (Diagnosis of OC possible)
                    Endif
            Else
                    CDN_DIAG_ECT_EL = 0
            Endif
Else
            CDN_DIAG_ECT_EL = 0
Endif


If          bit 0 of CDN_DIAG_ECT_EL = 1      //SCP
Then        LV_CDN_DIAG_ECT_EL_SCP = 1
Else        LV_CDN_DIAG_ECT_EL_SCP = 0
Endif
If          bit 1 of CDN_DIAG_ECT_EL = 1      //SCG
Then        LV_CDN_DIAG_ECT_EL = 1
Else        LV_CDN_DIAG_ECT_EL = 0
Endif
If          bit 2 of CDN_DIAG_ECT_EL = 1      //OC
Then        LV_CDN_DIAG_ECT_EL_OC = 1
Else        LV_CDN_DIAG_ECT_EL_OC = 0
Endif
If          bit 0 of ERR_DIAG_ECT_EL = 1      //SCP
Then        ERR_SYM_ECT_EL_SCP = SYM_0
Else        ERR_SYM_ECT_EL_SCP = NO_SYM
Endif
If          bit 1 of ERR_DIAG_ECT_EL = 1      //SCG
Then        ERR_SYM_ECT_EL = SYM_1
```

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Else ERR_SYM_ECT_EL = NO_SYM
Endif
If bit 2 of ERR_DIAG_ECT_EL = 1 //OC
Then ERR_SYM_ECT_EL_OC = SYM_2
Else ERR_SYM_ECT_EL_OC = NO_SYM
Endif
LV_ERR_ECT_EL(_XX) and LV_END_DIAG_ECT_EL(_XX) are calculated by error management.

Failure filtering and error management treatment:
For failure and error management treatment the anti-bounce mechanisms are called with the parameters ERR_SYM_ECT_EL(_XX) and LV_CDN_DIAG_ECT_EL(_XX).
ACTION_ERRM_FilterSymptom (IN<ECT_EL_XX>, IN<LV_CDN_DIAG_ECT_EL(_XX)>,
IN<LV_ERR_ECT_EL(_XX)>, IN<C_ABC_INC_ECT_EL(_XX)>, IN<C_ABC_MAX_ECT_EL(_XX)>,
OUT< LV_ERR_ECT_EL(_XX)>, SYNCRONIZATION<CALL>)

This algorithm determines:
ERR_SYM_ECT_EL(_XX) (detected error symptom for ECT diagnosis)
LV_ERR_ECT_EL(_XX) (Error flag for debounced error of ECT)
LV_CDN_DIAG_ECT_EL(_XX) (Diagnosis condition information)
LV_END_DIAG_ECT_EL(_XX) (End of diagnosis information)

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A.58 Electronically controlled thermostat diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_ECT_EL	O/V	0... 1H	0 ...1	1	-
Boolean for electronically controlled thermostat signal range diagnosis inhibit					

Input data:

LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}		

FUNCTION DESCRIPTION:

General information:

Depending on project specific requirements, the electrical diagnosis of the electronically controlled thermostat can be inhibited by setting of LV_INH_DIAG_ECT_EL.

Application conditions

Initialisation: `0 at LV_IGK 0->1 or Reset`

Recurrence: `500 ms`

Activation: `at every engine operating state`

Deactivation: –

Formula section:

IF LV_ERR_SPI_MPS = 0
THEN LV_INH_DIAG_ECT_EL = 0
ELSE LV_INH_DIAG_ECT_EL = 1
ENDIF

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A.59 Electronically controlled water pump diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_CWP_COM_PLAUS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error-symptoms electrical waterpump communication					
ERR_SYM_CWP_INT_OFF	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symtom CWP shut down error triggered by internal CWP errors					
ERR_SYM_CWP_PLAUS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error-symptoms electrical waterpump					
ERR_SYM_CWP_PWR	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error-sym. electrical waterpump power					
LV_CDN_DIAG_CWP_COM_PLAUS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition electrical waterpump communication					
LV_CDN_DIAG_CWP_INT_OFF	O/V	0... 1H	0 ...1	1	-
Condition diagnosis CWP internal error					
LV_CDN_DIAG_CWP_PLAUS	O/V	0... 1H	0 ...1	1	-
Condition diagnosis waterpump plausibility error					
LV_CDN_DIAG_CWP_PWR	O/V	0... 1H	0 ...1	1	-
Condition diagnosis elektrical waterpump internal error					
LV_CWP_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
Waterpump speed stages out of range					
LV_CWP_OFF	O/V	0... 1H	0 ...1	1	-
Shut down of the CWP triggered by internal CWP errors, set after delay time					
LV_CWP_TMP_OFF	O/V	0... 1H	0 ...1	1	-
Temporary shut down of the CWP triggered by internal CWP errors					
LV_END_DIAG_CWP_COM_PLAUS	O/V	0... 1H	0 ...1	1	-
End diag flag of Plausibility error electrical waterpump communication					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_CWP_INT_OFF	O/V	0... 1H	0 ...1	1	-
End diag flag for diagnosis CWP internal error					
LV_END_DIAG_CWP_PLAUS	O/V	0... 1H	0 ...1	1	-
End diag flag of Plausibility error electrical waterpump					
LV_END_DIAG_CWP_PWR	O/V	0... 1H	0 ...1	1	-
End of CWP PWR diagnosis					
LV_ERR_CWP_COM_PLAUS	O/V	0... 1H	0 ...1	1	-
Plausibility error electrical waterpump communication					
LV_ERR_CWP_INT_OFF	O/V	0... 1H	0 ...1	1	-
CWP shut down error triggered by internal CWP errors					
LV_ERR_CWP_PLAUS	O/V	0... 1H	0 ...1	1	-
Plausibility error electrical waterpump					
LV_ERR_CWP_PWR	O/V	0... 1H	0 ...1	1	-
Logical value for CWP PWR error					
N_REL_CWP_DIF	O/V	0... FFH	0... 255	1	-
Difference of actual waterpump speed range to setpiont					
REL_CWP_PWR	O/V	0... FFH	0... 99.609375	0.390625	%
relative CWP power (reduced power)					
STATE_CWP_INT	O/V	0... AH	0... 10	1	-
internal operating states of the CWP					
STATE_CWP_INT_MODE	V	0... 5H	0 ...5	1	-
Transition of internal operating states of the CWP					
T_CWP_4	V	0... FFH	0... 25.5	0.1	s
Time delay before the transition to power reduced operation is performed due to voltage supply too low					
T_CWP_5	V	0... FFH	0... 25.5	0.1	s
Time delay before the transition to power reduced operation is performed due to electronics temp. too high					
T_CWP_CDN_DIAG_INT_OFF	V	0... FFH	0... 25.5	0.1	s
Time delay after the CDN Diag Flag can be set if no error is present - -> End Diag Flag set by error Manag.					
T_CWP_CDN_DIAG_PWR	V	0... FFH	0... 25.5	0.1	s
Time delay after the CDN Diag Flag can be set if no error is present - -> End Diag Flag set by error Manag.					
T_CWP_DIF	V	0... FFH	0... 25.5	0.1	s
Timer for CWP speed monitoring					
T_CWP_DIF_END_DIAG	V	0... FFH	0... 25.5	0.1	s
Timer for CWP speed monitoring End Diag detection					
T_CWP_LOCK	V	0... FFH	0... 25.5	0.1	s
Time delay before the error management is triggered by the internal error "Current consumption too high"					
T_CWP_TEMP_HIGH	V	0... FFH	0... 25.5	0.1	s
Time delay before the error management is triggered by the internal error "Electronic temp. too high"					
T_CWP_VCC_PLAUS	V	0... FFH	0... 25.5	0.1	s
Time delay before the error management is triggered by the internal error "Supply voltage too high"					

Input data:

LV_ALTER_ERR_EL {p. 4094}	LV_ALTER_ERR_MEC {p. 4094}	LV_ALTER_ERR_TEMP {p. 4094}	LV_CDN_VB_MIN_DIAG {p. 1185}
LV_CWP_BLOCK_DEAC {p. 4094}	LV_CWP_HW_LIH_IN_CHK {p. 4094}	LV_CWP_LOCK {p. 4094}	LV_CWP_PRE_LOCK {p. 4094}

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LV_CWP_TEMP_HIGH {p. 4094}	LV_CWP_VCC_PLAUS {p. 4094}	LV_ERR_BSD {p. 4834}	LV_ERR_CWP_COM {p. 4834}
LV_ES {p. 1720}	LV_IGK {p. 906}	LV_N_MON_CWP_DEAC {p. 4095}	LV_ST {p. 1720}
N_REL_CWP {p. 4095}	N_REL_CWP_SP {p. 8225}	NC_IDX_DIAG_CWP_COM_PLAUS	NC_IDX_DIAG_CWP_INT_OFF
NC_IDX_DIAG_CWP_PLAUS	NC_IDX_DIAG_CWP_PWR	TCO {p. 1100}	TEMP_EL_CWP {p. 4096}
V_CWP {p. 4096}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_CWP_CHK_INP	-	0... FFH	0... 255	1	-
Anti-bounce increment for LV_ERR_CWP_COM_PLAUS					
C_ABC_INC_CWP_INT_OFF	-	0... FFH	0... 255	1	-
CWP internal Diagnosis increment					
C_ABC_INC_CWP_PWR	-	0... FFH	0... 255	1	-
CWP internal Diagnosis increment					
C_ABC_MAX_CWP_CHK_INP	-	1... FFH	1... 255	1	-
number of timeouts for antibounce of LV_ERR_CWP_COM_PLAUS					
C_ABC_MAX_CWP_INT_OFF	-	1... FFH	1... 255	1	-
Debounce threshold for internal shut off errors CWP					
C_ABC_MAX_CWP_PWR	-	1... FFH	1... 255	1	-
Diagnosis increment					
C_N_REL_CWP_DIF_MAX	-	0... FFH	0... 255	1	-
Max- control deviation threshold for ratio speed stages diagnosis					
C_N_REL_CWP_HYS	-	0... FFH	0... 255	1	-
Ratio speed stages hysteresis					
C_N_REL_CWP_SP_THD_MIN	-	0... FFH	0... 255	1	-
Minimum CWP speed above the voltage monitoring is activated					
C_T_CWP_DIF_MAX	-	0... FFH	0... 25.5	0.1	s
Timer Threshold CWP speed monitoring (Timer: T_CWP)					
C_T_CWP_LOCK_MAX	-	0... FFH	0... 25.5	0.1	s
Timer threshold for internal CWP error "current consumption too high"					
C_T_CWP_TEMP_HIGH_MAX	-	0... FFH	0... 25.5	0.1	s
Timer threshold for internal CWP error "Electronic temperature too high"					
C_T_CWP_VCC_PLAUS_MAX	-	0... FFH	0... 25.5	0.1	s
Timer threshold for internal CWP error "Supply voltage too high"					
C_T_TEMP_EL_CWP_THD_1	-	0... FFH	0... 25.5	0.1	s
timer threshold (for first transition condition "E")					
C_T_TEMP_EL_CWP_THD_2	-	0... FFH	0... 25.5	0.1	s
timer threshold (for second transition condition "E")					
C_T_V_CWP_MAX_DIAG	-	0... FFH	0... 25.5	0.1	s
timer threshold (for transition condition "G")					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_CWP_REL_MIN_DIAG	-	0... FEH	-48... 142.5	0.75	°C
TCO min threshold to enable CWP speed monitoring					
C_TEMP_EL_CWP_HYS	-	0... FFH	-50 ...205	1	°C
Electronics CWP temperature hysteresis					
C_TEMP_EL_CWP_MAX_THD_1	-	0... FFH	-50 ...205	1	°C
first power reduction threshold temperature CWP electronics					
C_TEMP_EL_CWP_MAX_THD_2	-	0... FFH	-50 ...205	1	°C
second power reduction threshold temperature CWP electronics					
C_V_CWP_HYS	-	0... FFH	0... 25.5	0.1	V
voltage hysteresis					
C_V_CWP_MIN_DIAG_IT	-	0... FFH	0... 25.5	0.1	V
Min threshold voltage CWP to enable CWP internal state					
C_V_CWP_MIN_DIAG_MON	-	0... FFH	0... 25.5	0.1	V
Min threshold voltage CWP to enable CWP speed monitoring					
ID_REL_CWP_PWR	-	0... FFH	0... 99.609375	0.390625	%
LDP_STATE_CWP_INT	11	0... AH	0... 10	1	-
power reducuction of the CWP					
LC_SWI_CWP_INP	-	0... 1H	0 ...1	1	-
switch between LV_IGK and LV_CDN_VB_MIN_DIAG					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetErrSym (**IN**<IDX_DIAG>,**OUT**<ERR_SYM>)
ACTION_ERRM_GetLvCdnDiag (**IN**<IDX_DIAG>,**OUT**<LV_CDN_DIAG>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_NoFilterReset (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_NoFilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_LV_ERR_SET>,**IN**<PRM_LV_ERR_RST>,**IN**<PRM_LV_END_DIAG>,**OUT**<PRM_LV_ERR>)

General information:

Application conditions:

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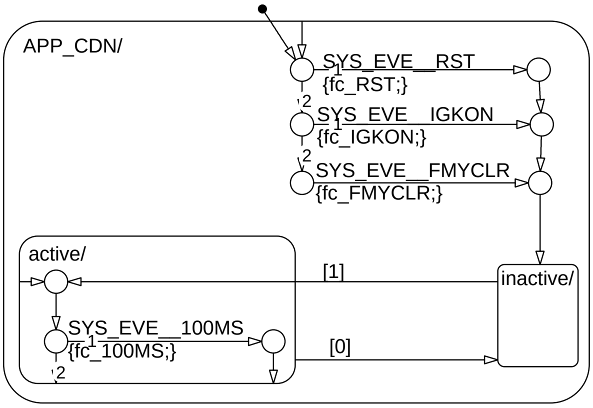

Figure A.59.1: :

Function description:

Formula section:

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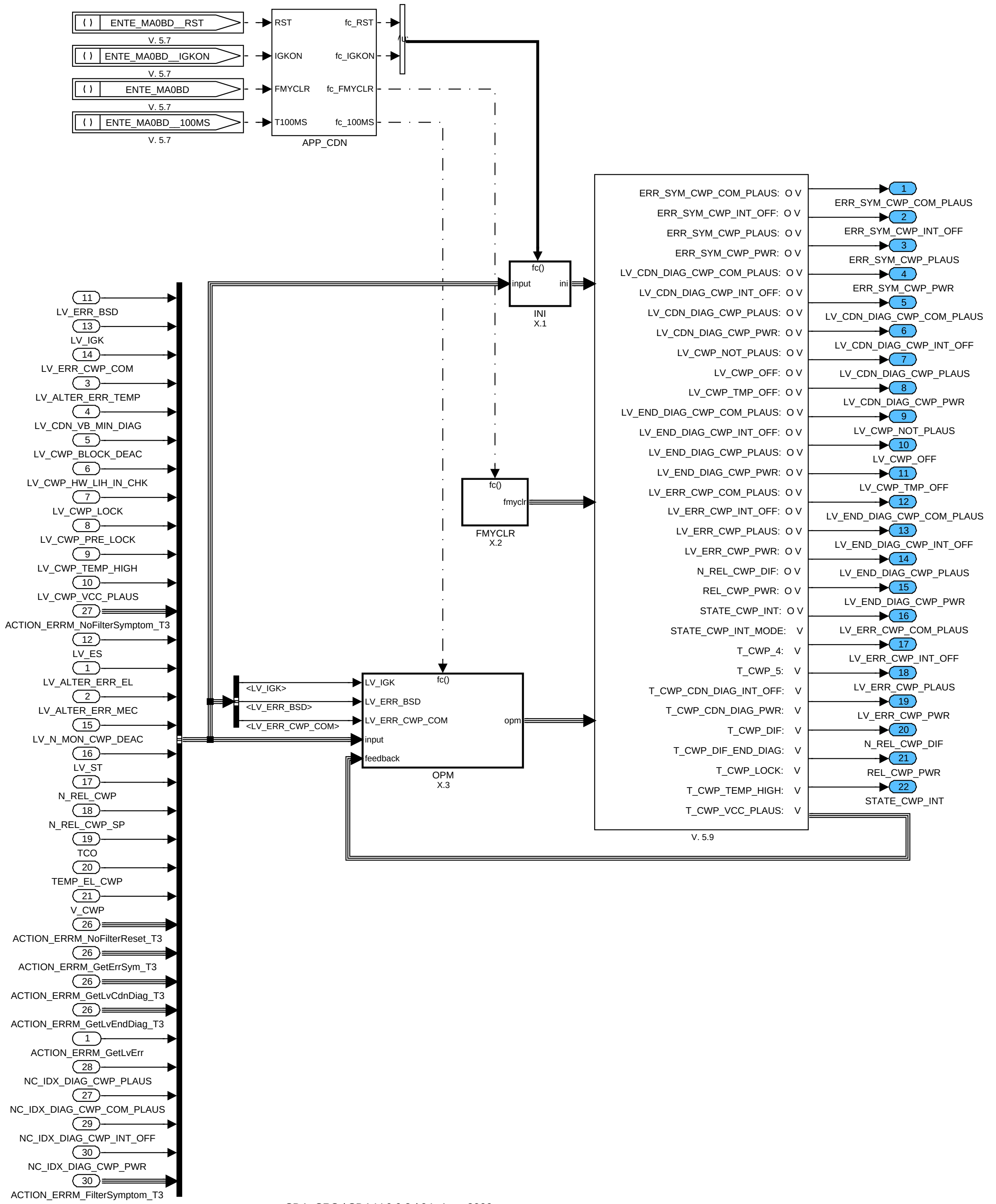

SDA_SRS / SDA V 6.0.3 / 04−Aug−2009

Figure A.59.2: :

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A.59.1 Initialization during event Reset or LV_IGK 0-> 1

A.59.1.1 Initialization during Electrical controlled water pump speed monitoring (filter type NO_FIL)

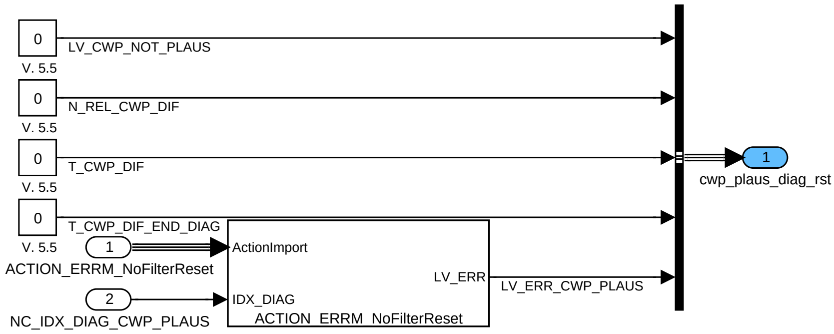

Figure A.59.3: :

A.59.1.2 Initialization during Water pump internal shut off errors

According ABC filter Type STD_INI; all other output data are set to 0at LV_IGK 0->1 or reset

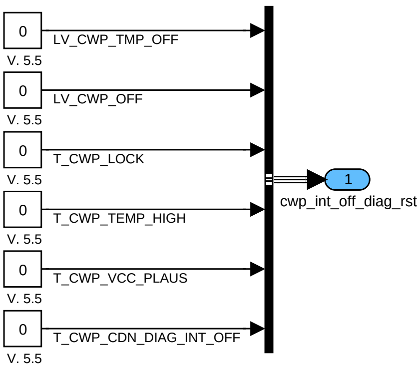

Figure A.59.4: :

A.59.1.3 Initialization during Electrical controlled water pump Power Reduction Monitoring and water pump internal state

According ABC filter Type STD_INI; all other output data are set to 0at LV_IGK 0->1 or reset

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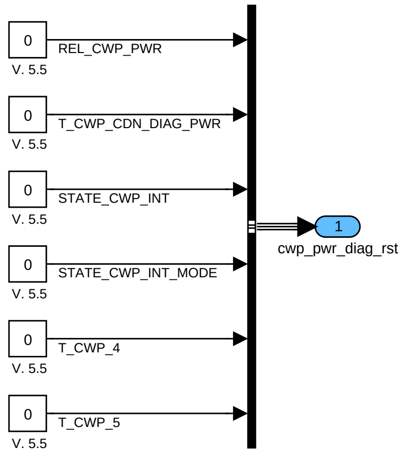

Figure A.59.5: :

A.59.2 Initalization at clearing error memory

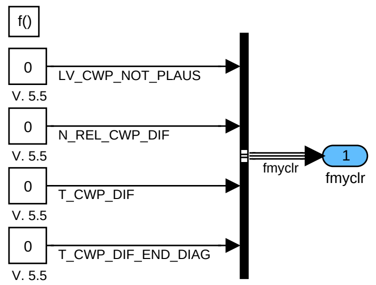

Figure A.59.6: :

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A.59.3 Formula section

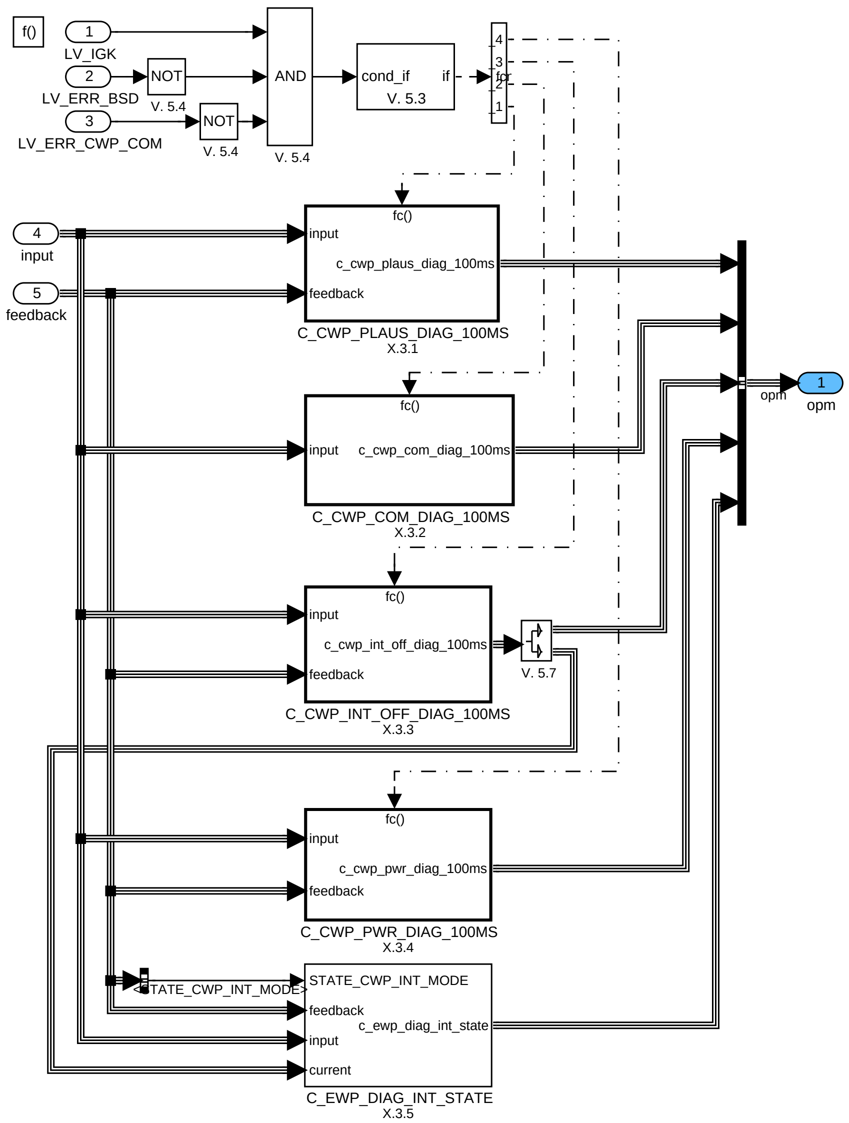

Figure A.59.7: :

A.59.3.1 Electrical controlled water pump speed monitoring

Description:
This diagnosis function is the inteface between BSD driver and waterpump controller.

Error-symptoms are defined to this diagnosis function as following :

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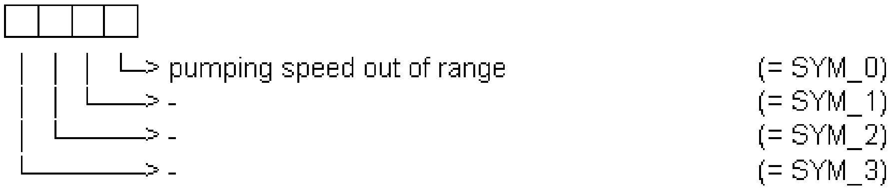

Figure A.59.8: :

A.59.3.1.1 Evaluation of diagnostic condition

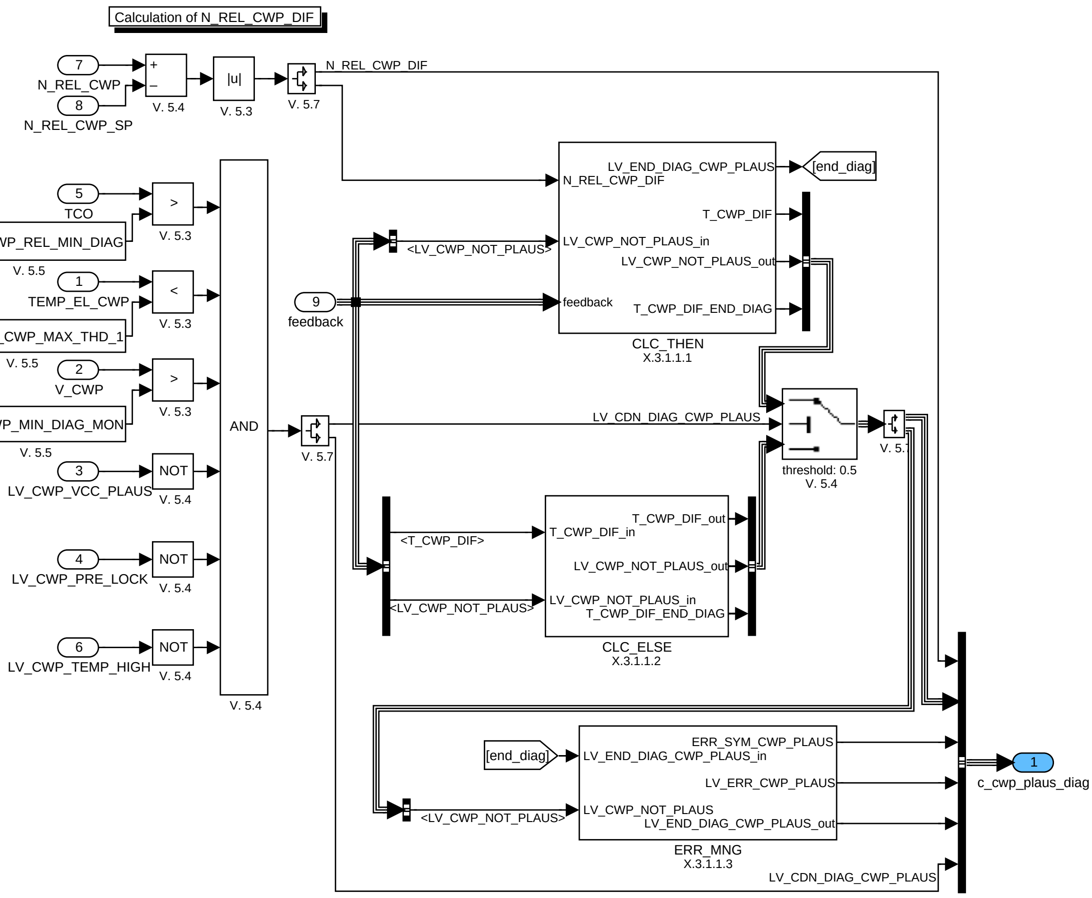

Figure A.59.9: :

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A.59.3.1.1.1 Ratio detection

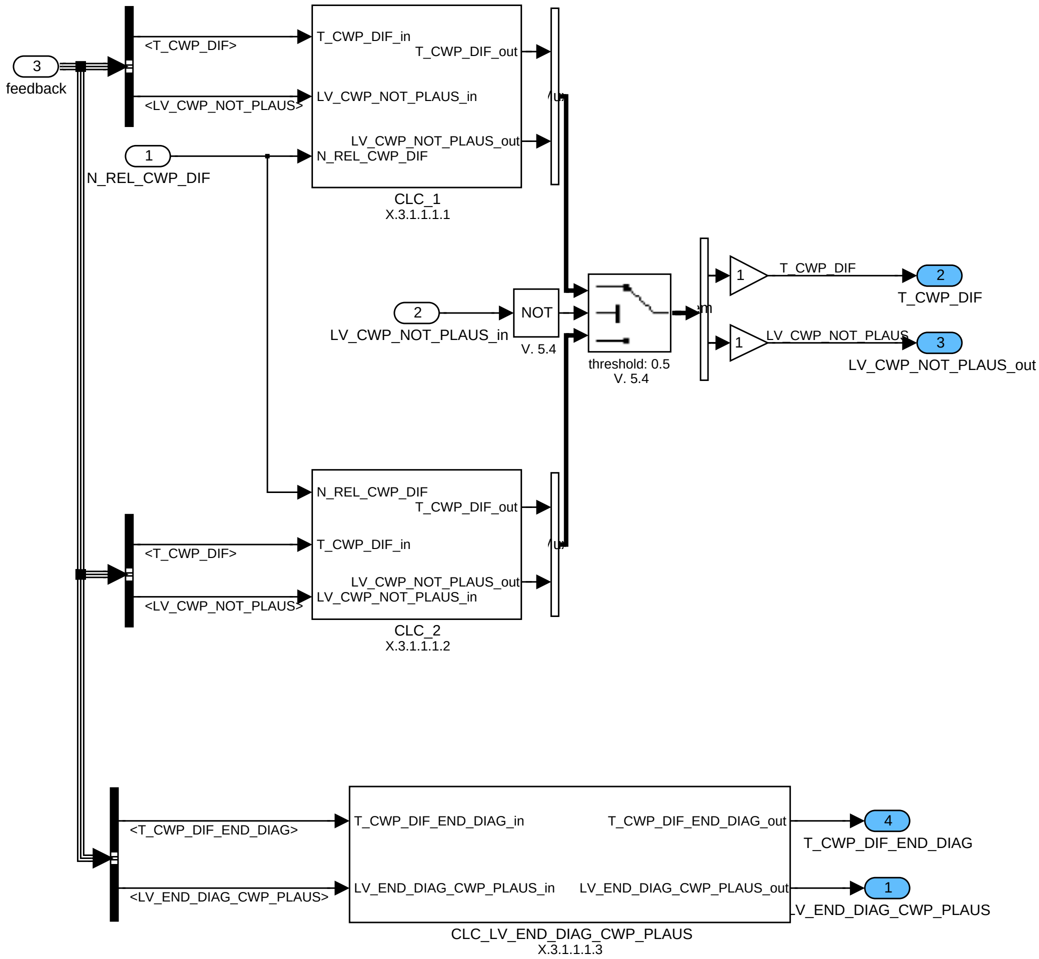

Figure A.59.10: :

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A.59.3.1.1.1.1 Timer for CWP speed monitoring when Water pump speed stages within the range.

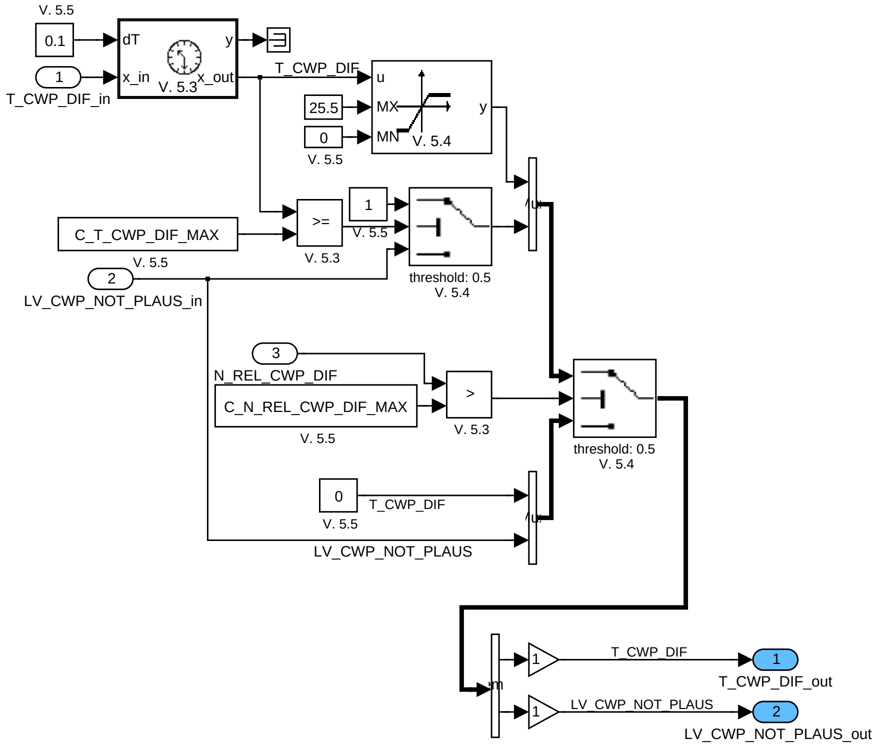

Figure A.59.11: :

A.59.3.1.1.1.2 Timer for CWP speed monitoring when Water pump speed stages out of range

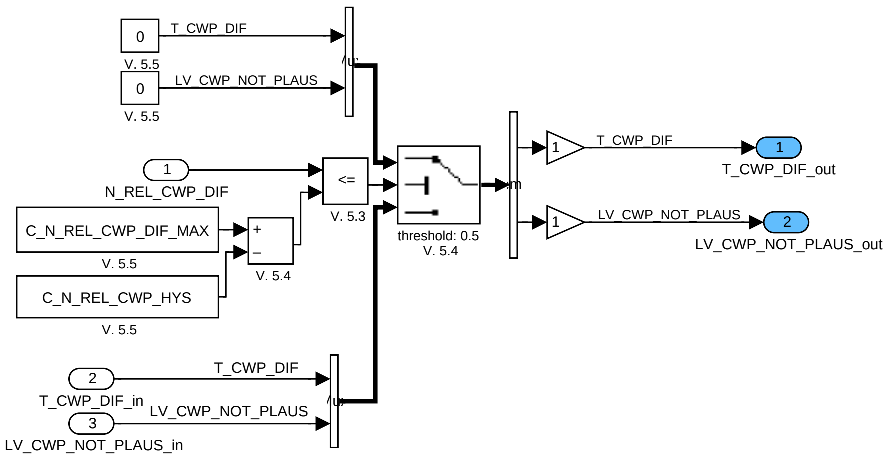

Figure A.59.12: :

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A.59.3.1.1.1.3 Calculate LV_END_DIAG_CWP_PLAUS

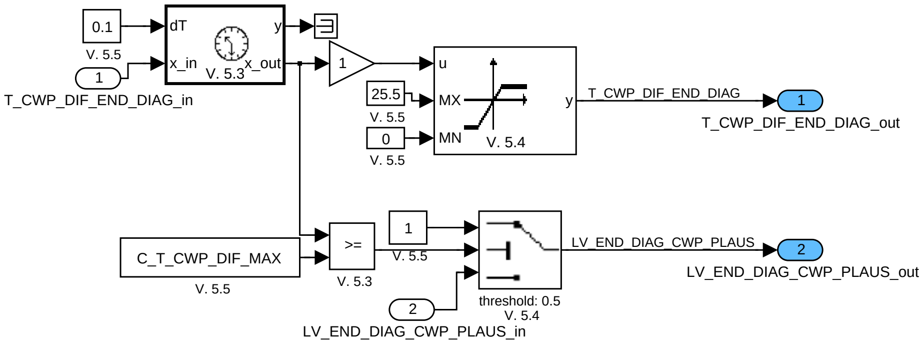

Figure A.59.13: :

A.59.3.1.1.2 Reset Timer for CWP speed monitoring End diag detection when LV_END_DIAG_CWP_PLAUS is zero

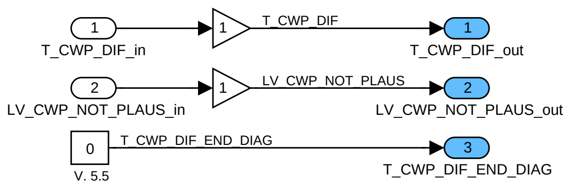

Figure A.59.14: :

A.59.3.1.1.3 Error Management

Plausibility error electrical water pump

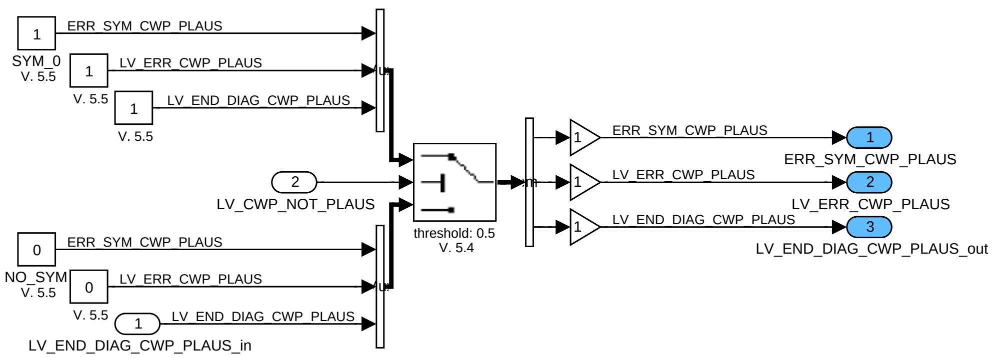

Figure A.59.15: :

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A.59.3.1.2 Interface to ERRM

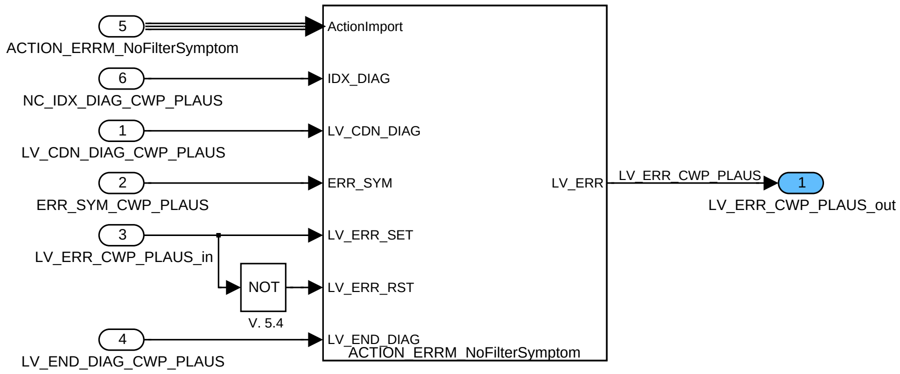

Figure A.59.16: :

A.59.3.2 Diagnosis of hardware input line for Limp Home Operation of CWP

General information:

This function detects an error in the hardware line for Limp Home Operation of the CWP.
A hardware signal is connected to the CWP to activate the limp home mode of the CWP in case of a BSD communication error. To detect the correct functionality of the hardware signal line, the CWP state is submitted to the ECU (EWM_ERR_3). The ECU compares the state of the LV_IGK or LV_CDN_VB_MIN_DIAG (dependend on a switch LC_SWI_CWP_INP) with the state of EWM_ERR3 register (LV_CWP_HW_LIH_IN_CHK). For no compliance a plausibility failure is set.

Description:

Error-symptoms are defined to this diagnosis function as following :

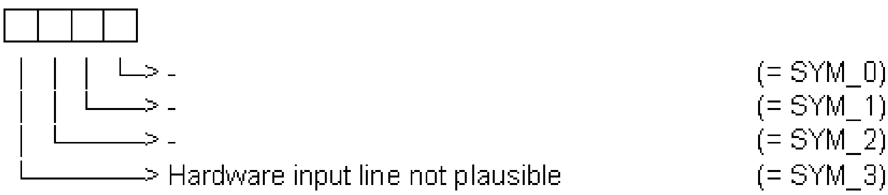

Figure A.59.17: :

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A.59.3.2.1 Symptom determination and evaluation of diagnostic condition

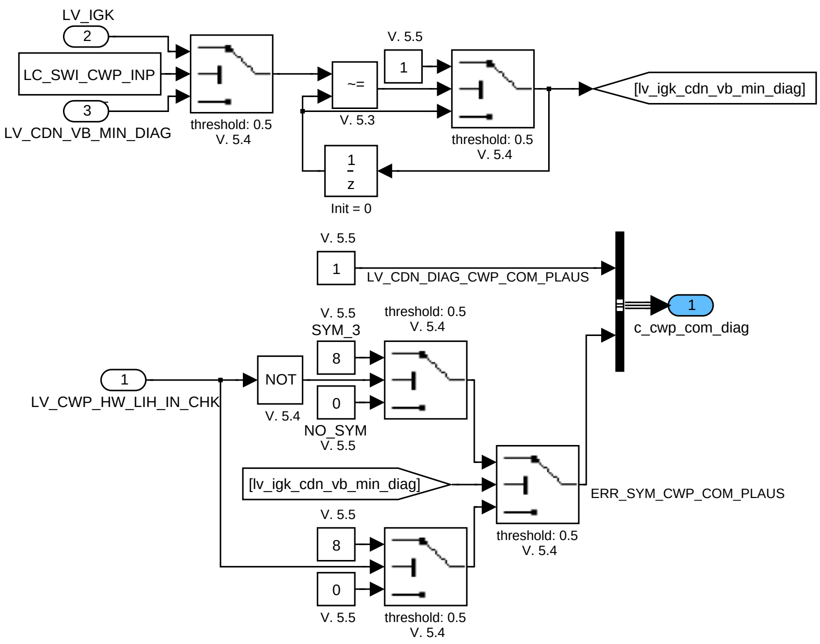

Figure A.59.18: :

A.59.3.2.2 Interface to ERRM

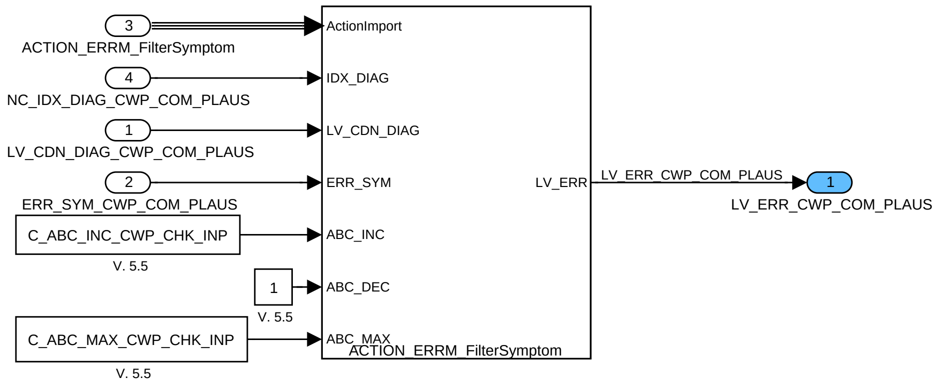

Figure A.59.19: :

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A.59.3.2.3 ERRM call and update for LV_END_DIAG and ERR_SYM by calling ERRM Actions

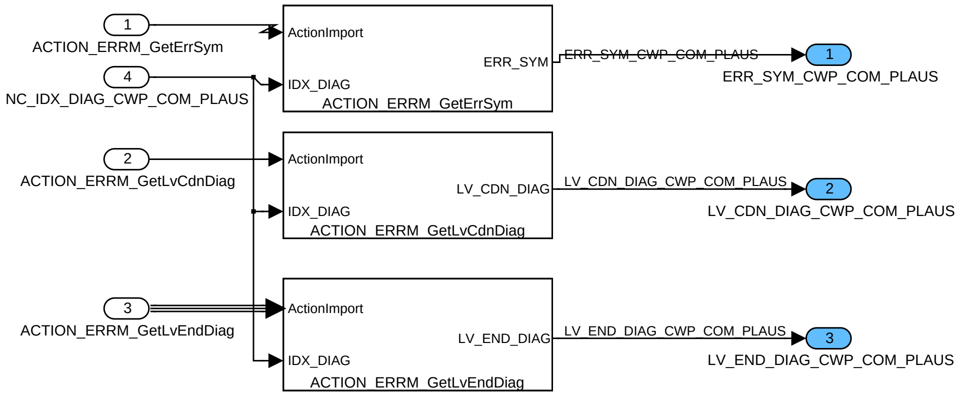

Figure A.59.20: :

A.59.3.3 Waterpump internal shut off errors

FUNCTION DESCRIPTION:

Description:

Error-symptoms are defined to this diagnosis function as following :

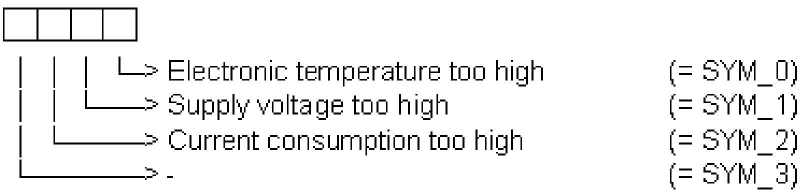

Figure A.59.21: :

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A.59.3.3.1 Evaluation of diagnostic condition

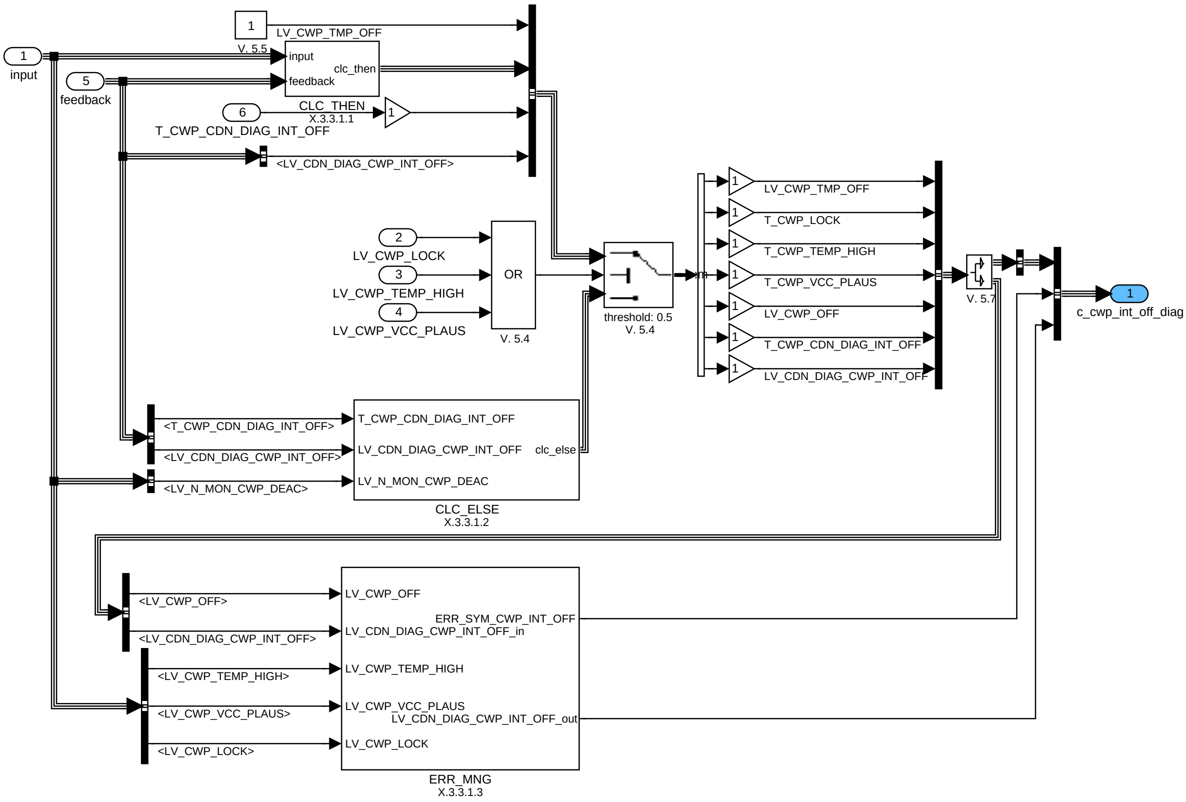

Figure A.59.22: :

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A.59.3.3.1.1 The following calculation is based on the diagnostic condition

A.59.3.3.1.1.1 Current consumption too high, CWP blocked

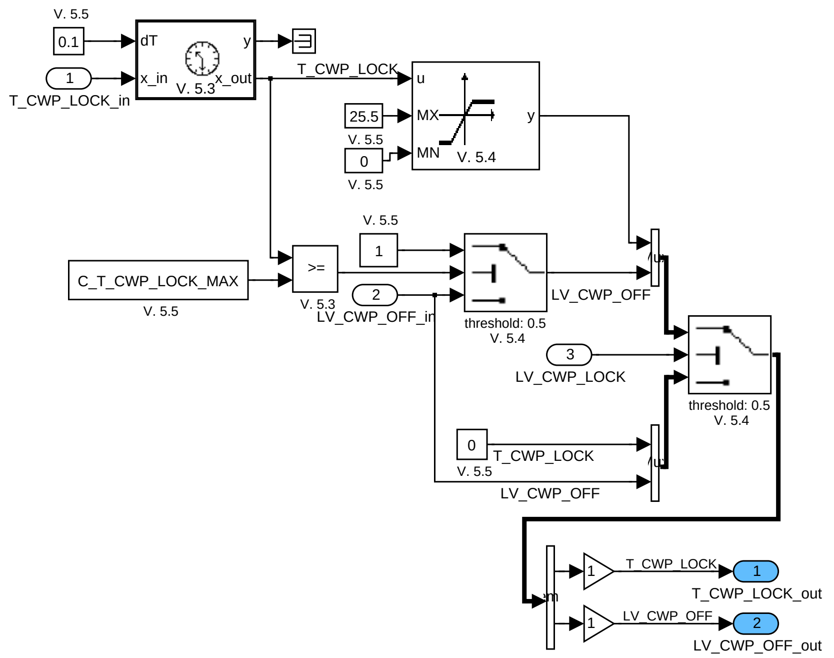

Figure A.59.23: :

A.59.3.3.1.1.2 Electronics CWP temperature too high

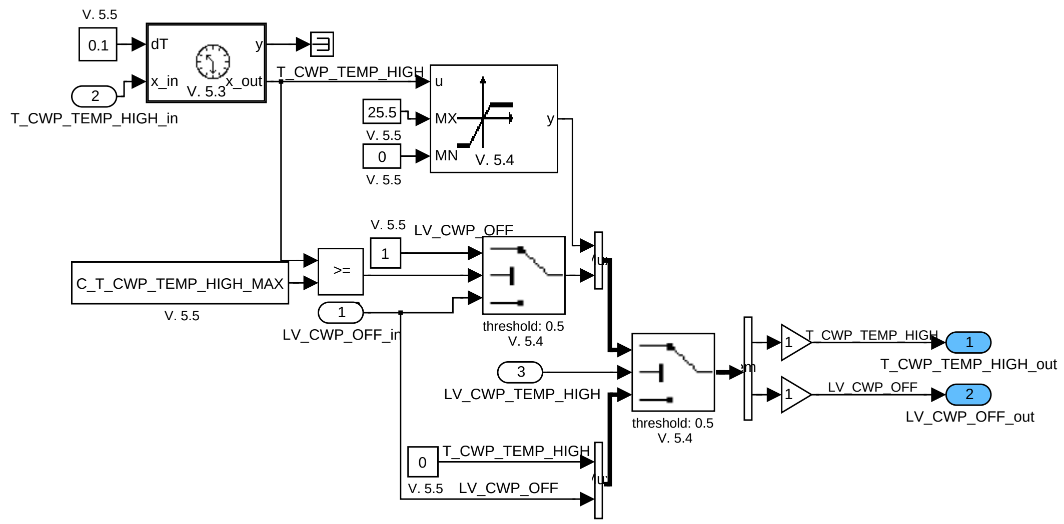

Figure A.59.24: :

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A.59.3.3.1.1.3 Supply voltage CWP too high

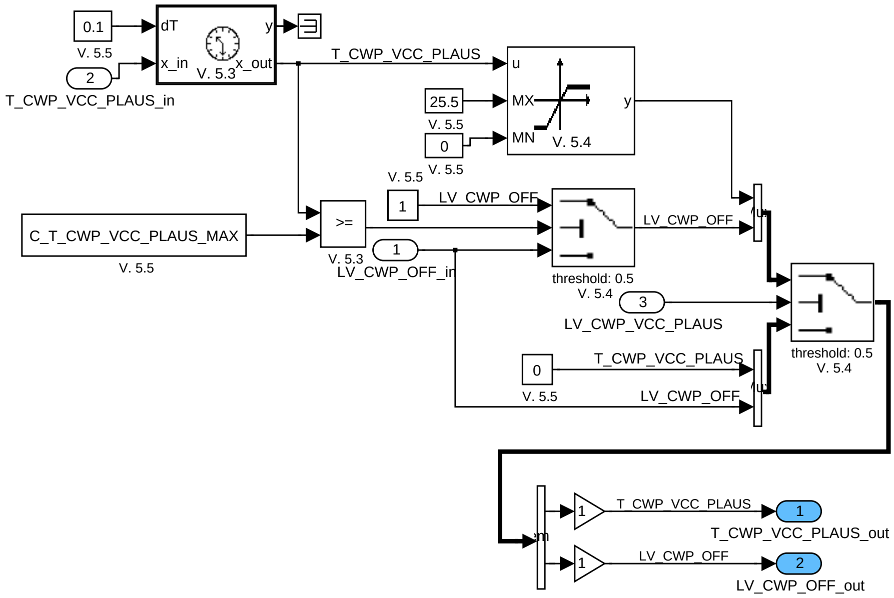

Figure A.59.25: :

A.59.3.3.1.2 The following variables are reset when the diagnosis condition is zero

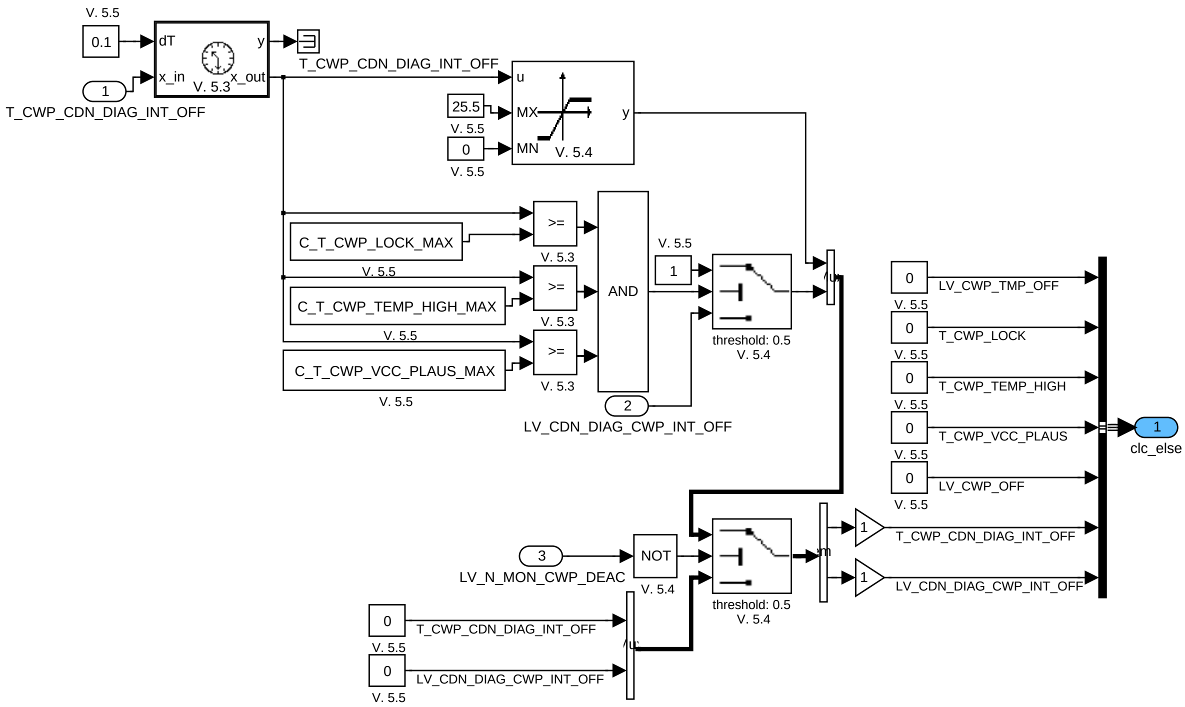

Figure A.59.26: :

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A.59.3.3.1.3 Error management

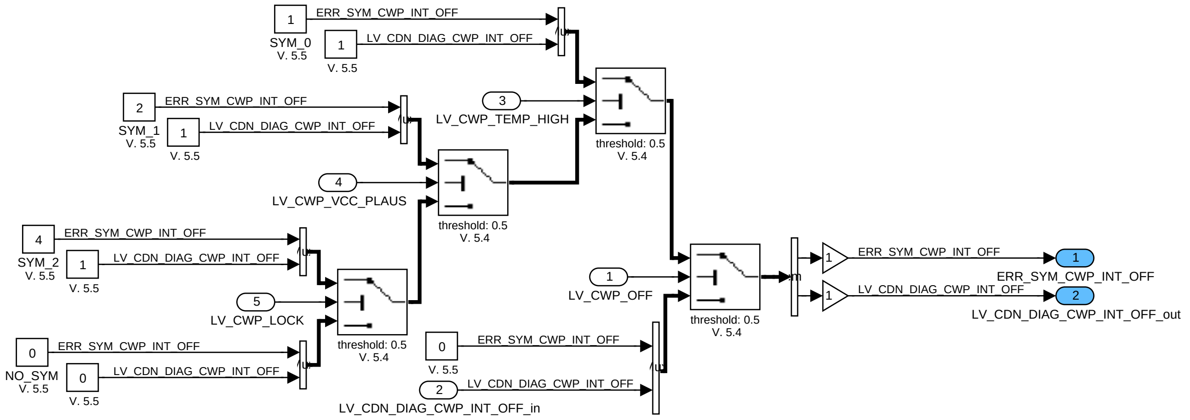

Figure A.59.27: :

A.59.3.3.2 Interface to ERRM

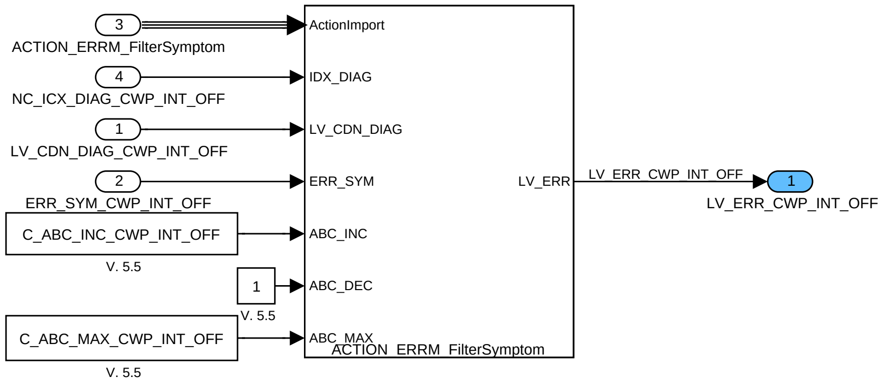

Figure A.59.28: :

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A.59.3.3.3 ERRM call and update for LV_END_DIAG and ERR_SYM by calling ERRM Actions

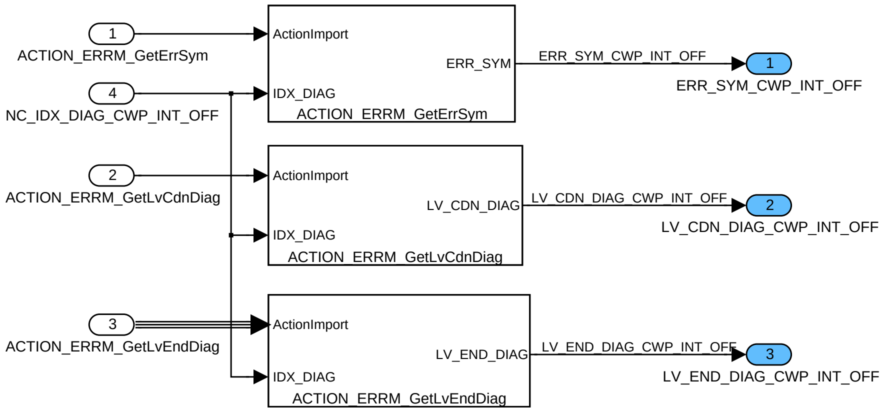

Figure A.59.29: :

A.59.3.4 Electrical controlled water pump Power Reduction Monitoring

FUNCTION DESCRIPTION:

This function monitors the power reduction modes of the coolant water pump.

General information:

If the operating conditions of the electrical coolant water pump deviates from the normal conditions the output power of the pump will be reduced by the power management. Depending on the actual state a calibratible power setpoint is given. The state is determined separately by a state machine.

Description:

This diagnosis function is the inteface between BSD driver and waterpump controller.

Error-symptoms are defined to this diagnosis function as following :

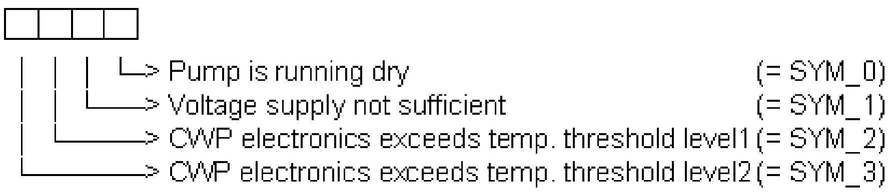

Figure A.59.30: :

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A.59.3.4.1 Symptom determination

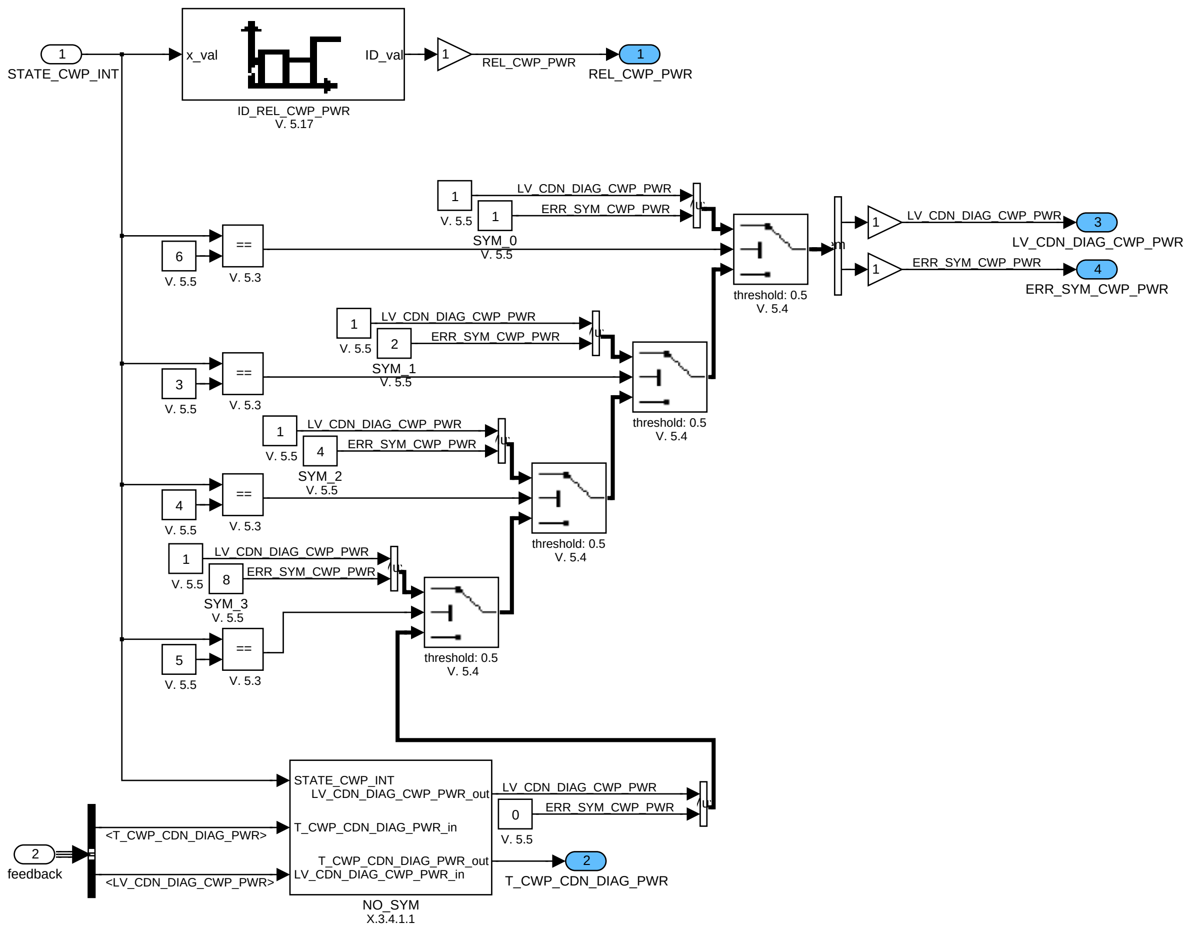

Figure A.59.31: :

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A.59.3.4.1.1 Set of LV_CDN_DIAG_CWP_PWR in case of no error

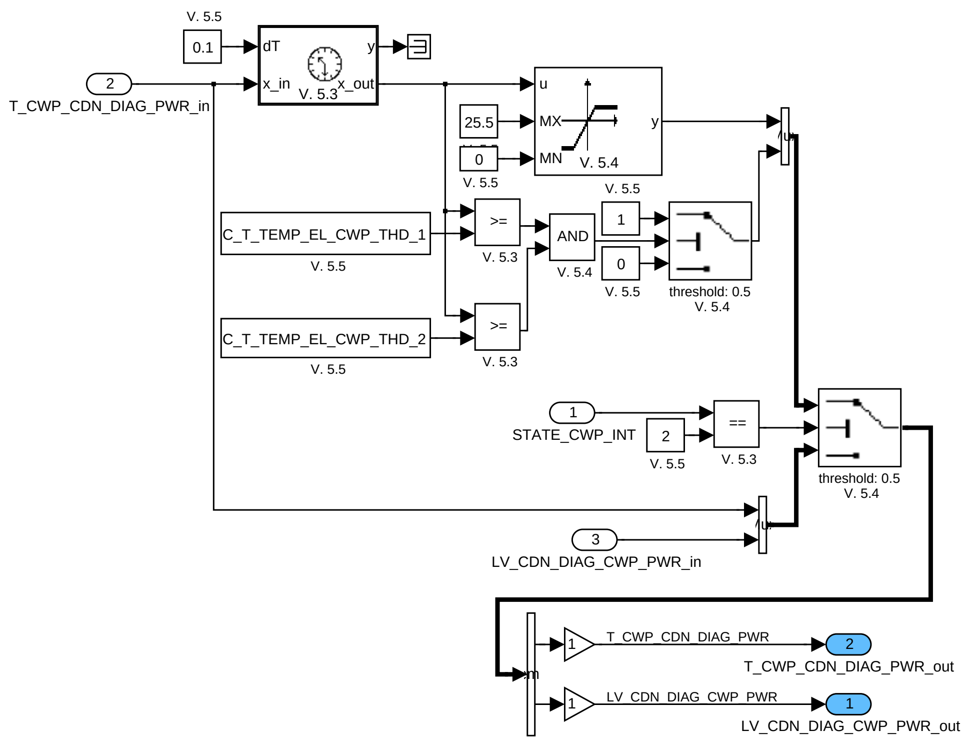

Figure A.59.32: :

A.59.3.4.2 Interface to ERRM

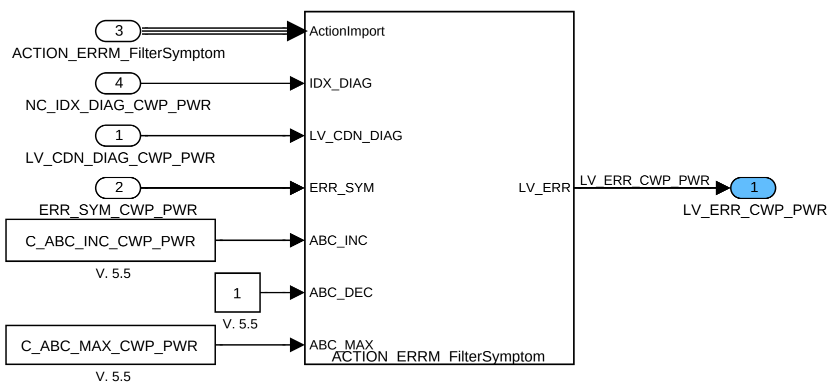

Figure A.59.33: :

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A.59.3.4.3 ERRM call and update for LV_END_DIAG and ERR_SYM by calling ERRM Actions

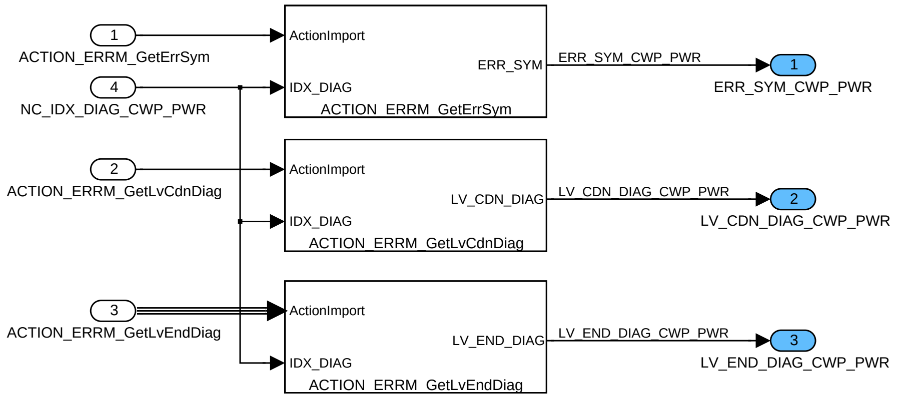

Figure A.59.34: :

A.59.3.5 Waterpump internal state

FUNCTION DESCRIPTION:

This state machine determines the operation mode of the coolant water pump. By distinguishing several operation modes a specific diagnosis of the CWP at different states is possible.

General information:

After initialization some transition conditions must be fulfilled to change from one state to the other.

Operating State of the CWP STATE_CWP_INT (controlled internally in the CWP electronics):

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STATE_CWP_INT	Operating state of the CWP	Addition explanations concerning the operating State
0	initialization	Pump is initialized, not ready to operate
1	normal operation mode open loop control	No speed monitoring active (speed setpoint= actual speed) LV_N_MON_CWP_DEAC = 1
2	normal operation mode closed loop control	Speed Monitoring active, closed loop controlled operation LV_N_MON_CWP_DEAC = 0
3	power reduced mode	Power reduced operation due to low voltage supply Voltage suppy potetially not sufficient to achieve the required speed setpoint
4	power reduced mode	Power reduced operation due to high CWP electronics temperature (level 1) Pump is not able the achieve the required speed setpoint
5	power reduced mode	Power reduced operation due to high CWP electronics temperature (level 2) Pump is not able the achieve the required speed setpoint
6	pump running dry	Pump is running dry and limits threfore the max speed
7	temporary shut-off	High current consumption detected; automatic de-blocking disabled; max. 3 restarts are executed before permanent shut off
8	temporary shut-off	High current consumption detected; automatic de-blocking enabled; pump tries to de-block itself
9	permanent shut-off	Pump deactivates itself; possible reasons: - Voltage supply too high - Current consumption too high - CWP electronics temperature too high
10	unplausible operation	Actual pump speed deviates to desired pump speed; diagnosis active above opening temp. of the thermostat and voltage supply sufficient only

Figure A.59.35: :

Signal flow diagram:

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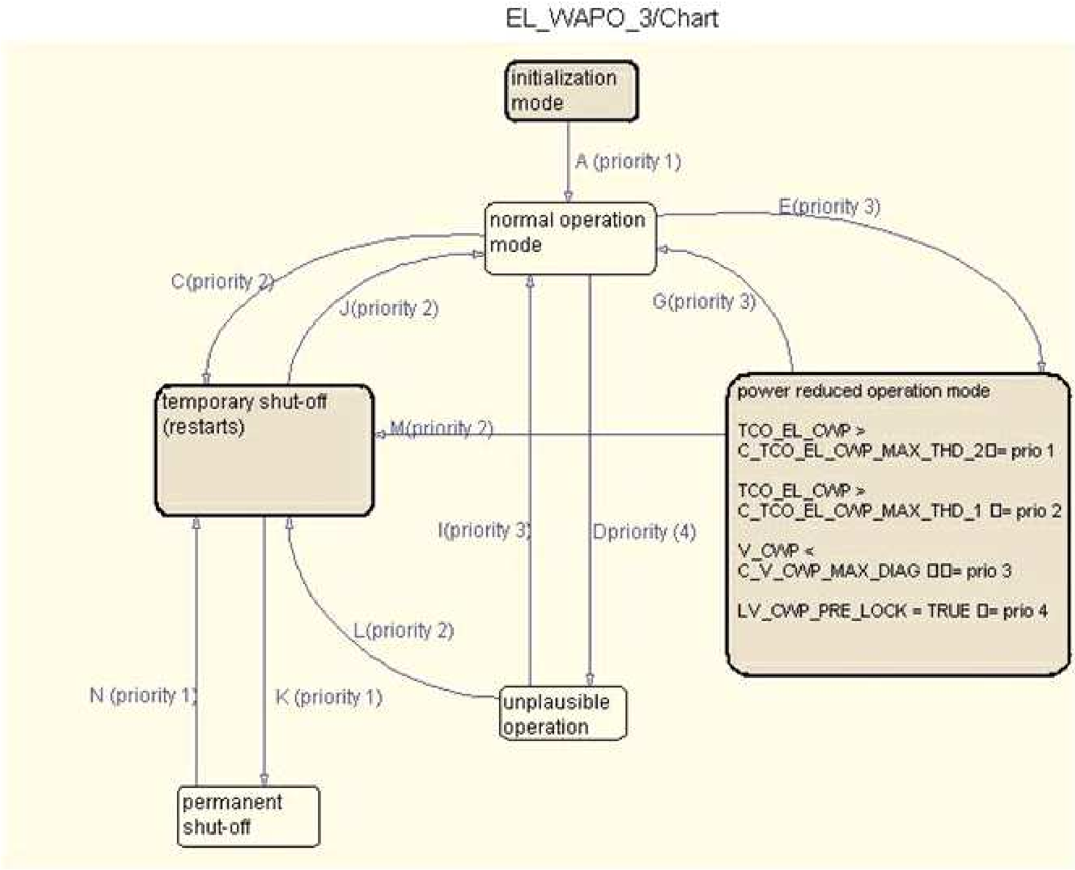

Figure A.59.36: :

Additional conditions to determine the correct state:

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State	**additional condition**	**STATE_CWP_INT**
initialization	non	0
normal operation mode	LV_N_MON_CWP_DEAC = true LV_N_MON_CWP_DEAC = false	1 2
power reduced mode	TEMP_EL_CWP > C_TEMP_EL_CWP_MAX_THD_2 TEMP_EL_CWP > C_TEMP_EL_CWP_MAX_THD_1 V_CWP < C_V_CWP_MIN_DIAG_IT LV_CWP_PRE_LOCK = true ***Internal 'Change Modus' conditions:*** **If** TEMP_EL_CWP > C_TEMP_EL_CWP_MAX_THD_2 **Then** STATE_CWP_INT = 5 **Else If** TEMP_EL_CWP > C_TEMP_EL_CWP_MAX_THD_1 **Then** STATE_CWP_INT = 4 **Else If** V_CWP < C_V_CWP_MIN_DIAG_IT **Then** STATE_CWP_INT = 3 **Else If** LV_CWP_PRE_LOCK = 1 **Then** STATE_CWP_INT = 6 **Else If** T_CWP_5 < C_T_V_CWP_MAX_DIAG **Then** keep actual state STATE_CWP_INT **Endif** **Endif** **Endif** **Endif** **Endif**	5 = prio 1 4 = prio 2 3 = prio 3 6 = prio 4
unplausible operation	Non Reset timer T_CWP_4 and T_CWP_5	10
temporary shut-off	Reset timer T_CWP_4 and T_CWP_5 (LV_CWP_TMP_OFF = true **and** LV_CWP_BLOCK_DEAC = false) (LV_CWP_TMP_OFF = true **and** LV_CWP_BLOCK_DEAC = true)	 7 8
permanent shut-off	non	9

Figure A.59.37: :

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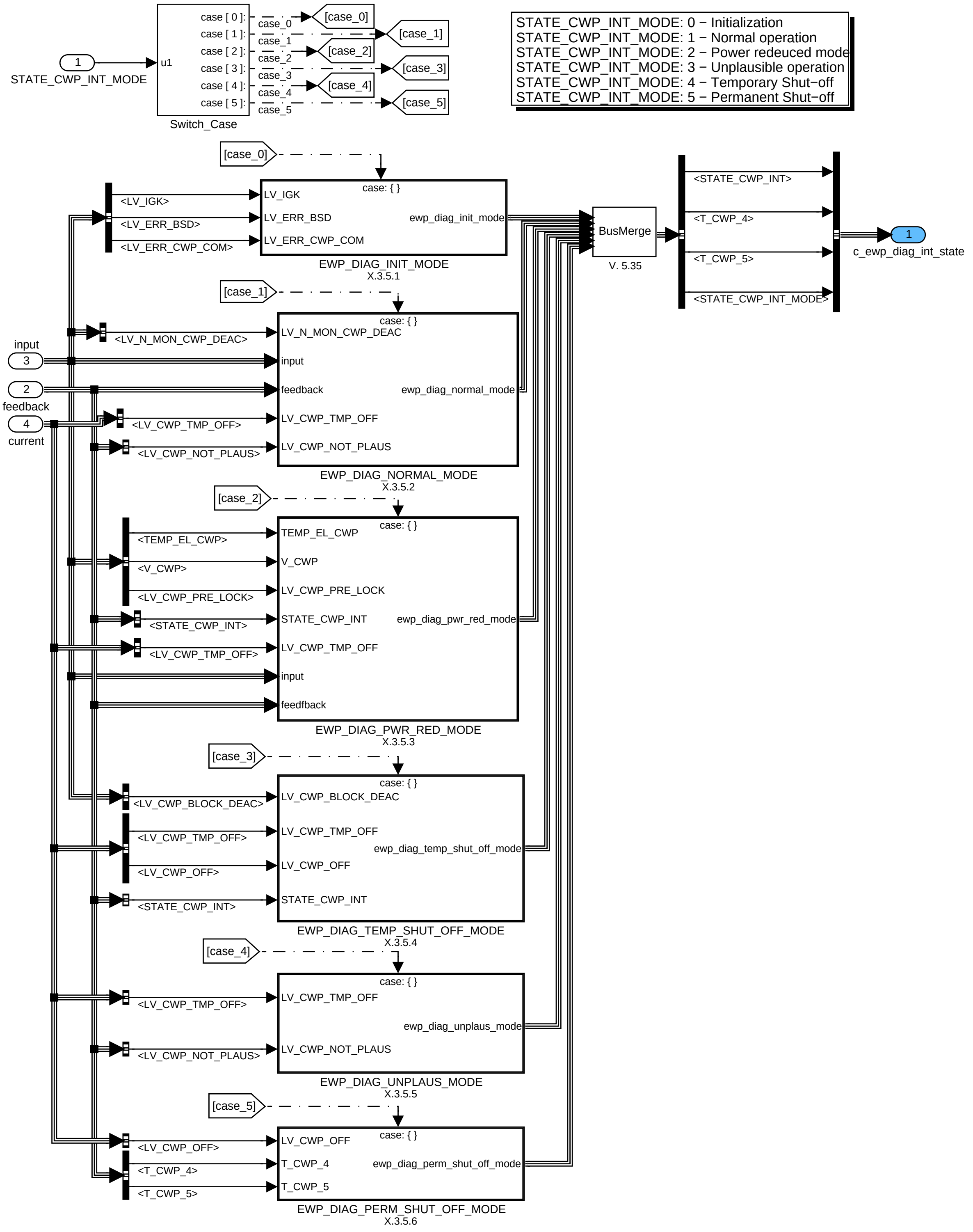

Figure A.59.38: :

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A.59.3.5.1 Pump is initialized, not ready to operate

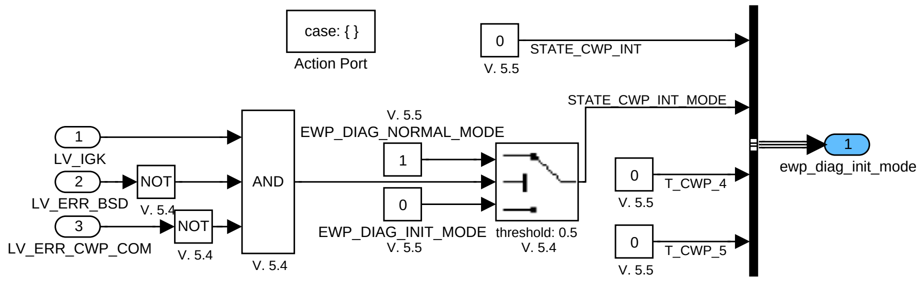

Figure A.59.39: :

A.59.3.5.2 Normal operation mode

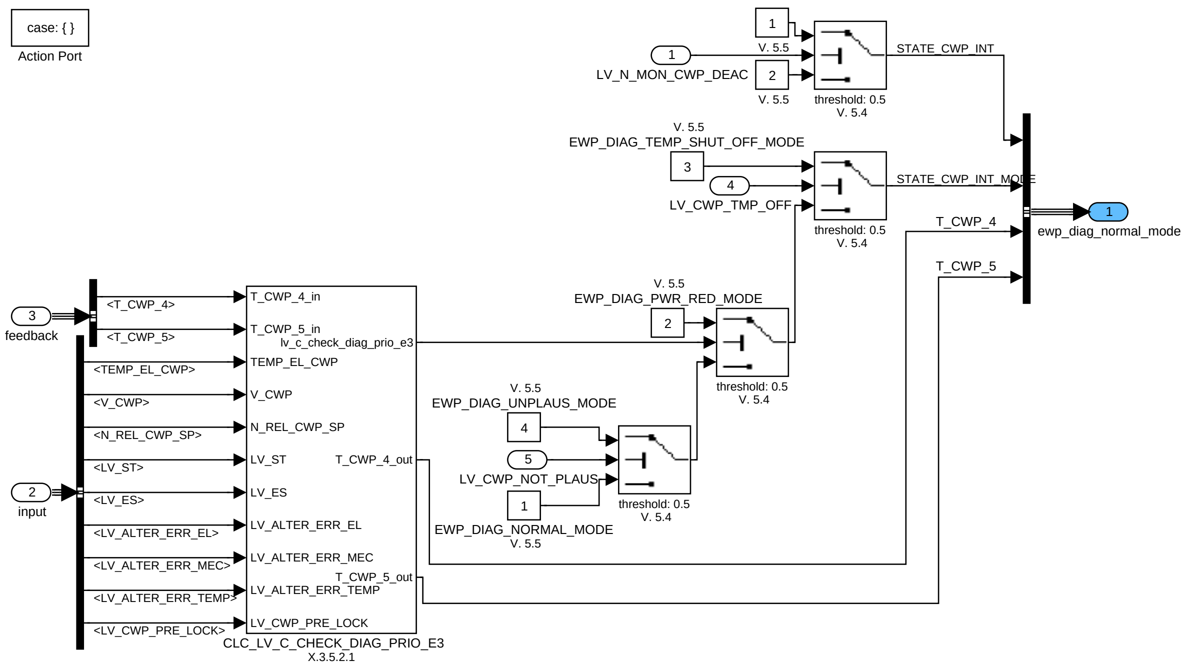

Figure A.59.40: :

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A.59.3.5.2.1 Check for Transition condition

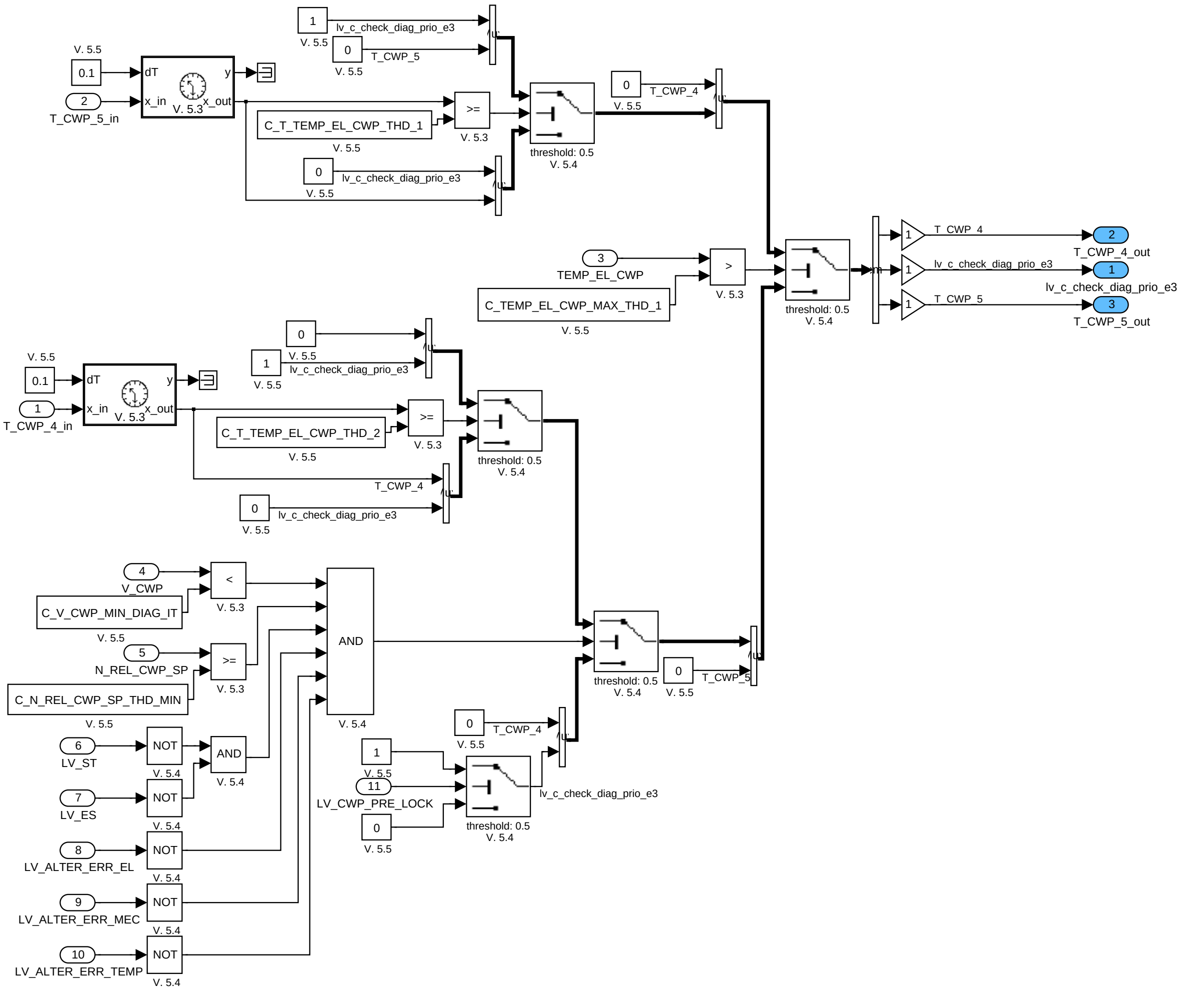

Figure A.59.41: :

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A.59.3.5.3 Power reduced mode

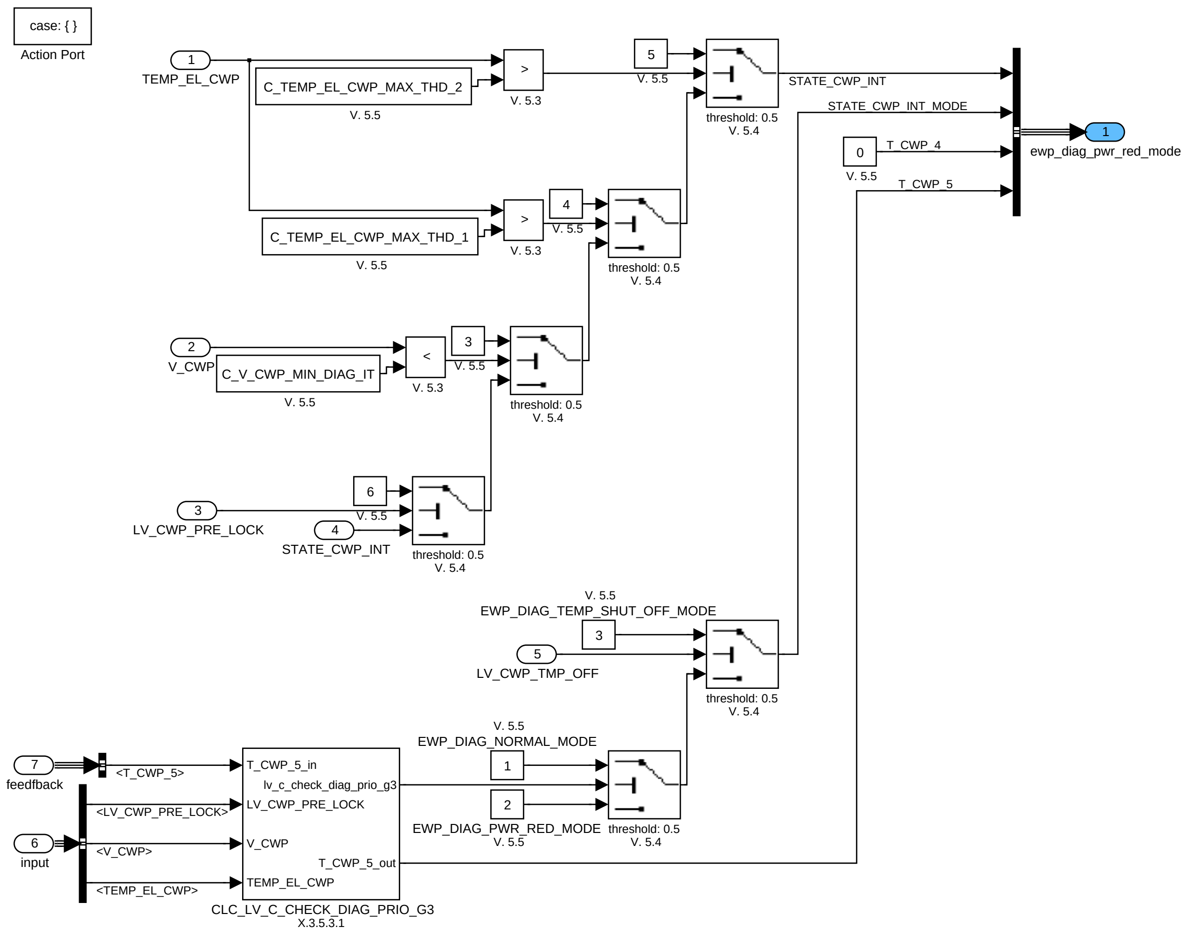

Figure A.59.42: :

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A.59.3.5.3.1 Transition condition

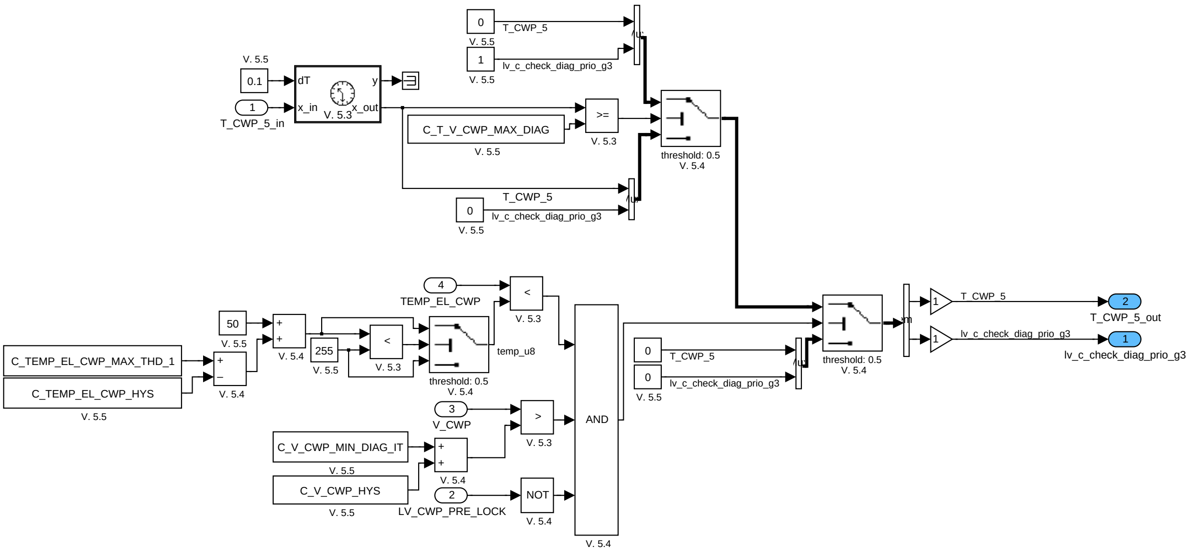

Figure A.59.43: :

A.59.3.5.4 Temporary shut-off mode

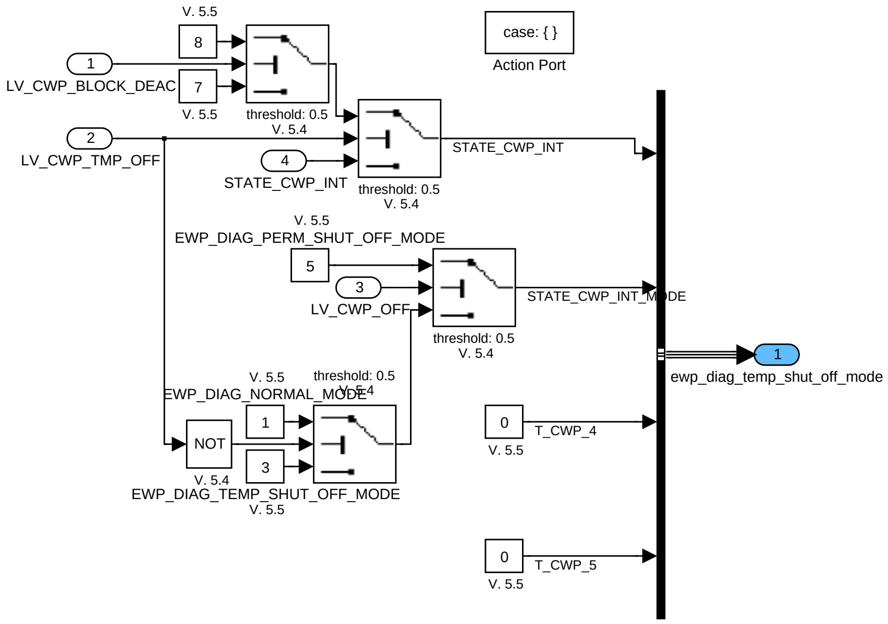

Figure A.59.44: :

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A.59.3.5.5 Unplausible operation

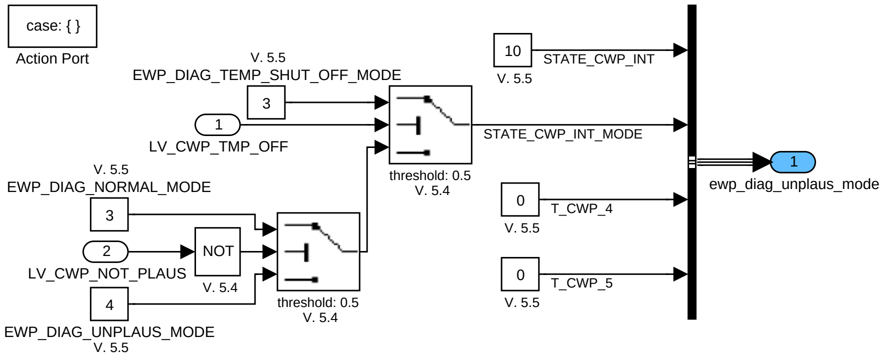

Figure A.59.45: -:

A.59.3.5.6 Permanent shut-off mode

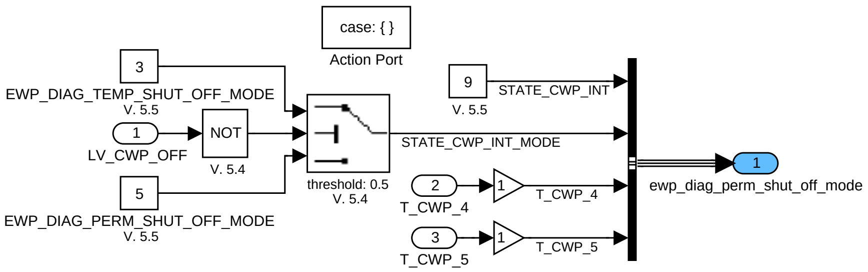

Figure A.59.46: :

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A.60 Radiator shutter diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_RAS	O/V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom					
ERR_DIAG_RAS	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for RAS (only parameter)					
ERR_SYM_RAS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom Radiator Shutter (= Sound Flap) diagnosis					
LV_CDN_DIAG_RAS	V	0... 1H	0 ...1	1	-
Diagnosis condition RAS power stage diagnosis					
LV_END_DIAG_RAS	V	0... 1H	0 ...1	1	-
End of Radiator Shutter (= Sound Flap) diagnosis					
LV_ERR_RAS	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on Radiator Shutter (= Sound Flap) command signal					

Input data:

LC_RAS_ACT {p. 3594}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}	LV_RAS_OUT {p. 3594}
LV_VB_CDN_OBD_1 {p. 1046}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_RAS	-	0... FFH	0... 255	1	-
Debounce counter increment Radiator Shutter power stage diagnosis					
C_ABC_MAX_RAS	-	1... FFH	1... 255	1	-
Debounce counter maximum value Radiator Shutter power stage diagnosis					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_RAS	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (= 2)					

Import actions:

ACTION_ERRM_FilterMulticondition (**IN**<XX>,**IN**<CDN_DIAG_>,**XX**>,<IN<>,**ERR_DIAG_XX**>,<IN>,<C_ABC_INC_XX>,**IN**<C_ABC_MAX_XX>,**OUT**<LV_ERR_XX>)

Continued on next page

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ACTION_INFR_GetElDiagRas (**OUT**<Cdn_diag_ras_out_el>,**OUT**<Err_diag_ras_out_el>)

Error treatment:

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	**Name (XX)**	**Description**	**Nr**		
Radiator shutter	RAS	Short circuit to Vbatt SCP	0	MPL_STD_INI	CC
		Short circuit to Ground SCG	1		
		Open Circuit OC	2		
		-	3		

Possible configuration for ABC type and CARB class (see also "Table of Failure")
ABC Type: STD_INI, STD, MEM, MEM_INI, DEC_CAL, STC, NO, MPL_STD_INI
CARB Class: MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO

FUNCTION DESCRIPTION:

General information:

The RAS is driven by the ECU via an output driver. The failure detection is done by ECU Hardware. The purpose of the diagnosis is to detect electrical faults as defined by OBD I requirements. The RAS can be switched on or off (no PWM-signal).

Description:

The purpose is to perform the electrical diagnosis of the RAS actuator. 3 symptoms are distinguished:

Application conditions

Initialisation: ERRM variables are initialized according Filter-type.
At Reset: All 0
Set delay counter for NC_PSD_DLY_RAS

Recurrence: *100ms*

Activation: LV_IGK = 1 **and** LC_RAS_ACT= 1

Deactivation: LV_IGK = 0 **or** LC_RAS_ACT= 0

Formula section:

If LV_ERR_SPI_MPS = 0
and LV_VB_CDN_OBD_1 = 1
Then
Usage of the diagnosis information (failure symptoms (raw value) ERR_DIAG_RAS and diagnosis conditions CDN_DIAG_RAS) received from the infrastructure:
ACTION_INFR_GetElDiagRas (OUT<CDN_DIAG_RAS>, OUT<ERR_DIAG_RAS>)

Basic diagnosis conditions are set according to infrastructure information: CDN_DIAG_RAS
Failure symptoms (raw value) are set according to infrastructure information: ERR_DIAG_ RAS

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If Activation conditions are met for the NC_PSD_DLY_RAS recurrence
Then
{ No additional diagnosis conditions are necessary }
Else
CDN_DIAG_RAS = 0
Endif
Else
CDN_DIAG_RAS = 0
Endif

Failure filtering and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_RAS and ERR_DIAG_RAS.
ACTION_ERRM_FilterMulticondition (IN<RAS_OUT>, IN<CDN_DIAG_RAS>,
IN<ERR_DIAG_RAS>, IN<C_ABC_INC_RAS>, IN<C_ABC_MAX_RAS>,
OUT< LV_ERR_RAS>)

This algorithm determines:

ERR_SYM_RAS	(detected error symptom for RAS diagnosis)
LV_ERR_RAS	(Error flag for debounced error of RAS)
LV_CDN_DIAG_RAS	(Diagnosis condition information)
LV_END_DIAG_RAS	(End of diagnosis information)

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A.61 Coolant temperature sensor (radiator outlet) diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TCO_2_EL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom for coolant temperature (radiator outlet) signal range error					
ERR_SYM_TCO_2_GRD	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom for coolant temperature (radiator outlet) signal gradient error					
LV_CDN_DIAG_TCO_2_EL	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal range diagnosis conditions					
LV_CDN_DIAG_TCO_2_GRD	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal gradient diagnosis conditions					
LV_CDN_ENA_TCO_2_PREL	V	0... 1H	0 ...1	1	-
Boolean for preliminary coolant temperature (radiator outlet) error enable conditions					
LV_END_DIAG_TCO_2_EL	V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature (radiator outlet) signal range diagnosis					
LV_END_DIAG_TCO_2_GRD	V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature (radiator outlet) signal gradient diagnosis					
LV_ERR_TCO_2	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on coolant temperature (radiator outlet) acquisition					
LV_ERR_TCO_2_EL	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal range error					
LV_ERR_TCO_2_GRD	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal gradient error					
LV_ERR_TCO_2_PREL	O/V	0... 1H	0 ...1	1	-
Boolean for preliminary error currently present on coolant temperature (radiator outlet) acquisition					
LV_ERR_TCO_2_PREL_DET	V/S	0... 1H	0 ...1	1	-
Boolean for preliminary error present on coolant temperature (radiator outlet) acquisition during driving cycle					

Input data:

CTR_ABC_TCO_2_EL	CTR_ABC_TCO_2_GRD	LV_CDN_VB_MIN_DIAG {p. 1185}	LV_ERR_TCO_2_PLAUS {p. 5666}
LV_IGK {p. 906}	LV_INH_DIAG_TCO_2_EL {p. 4578}	LV_INH_DIAG_TCO_2_GRD {p. 4578}	NC_NR_TCO_SENS {p. 576}
T_DIAG_AST {p. 4493}	TCO_2_MES {p. 1218}	TIA_THR {p. 984}	VP_TCO [NC_NR_TCO_SENS] {p. 1100}

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_ABC_THD_TCO_2_PREL	-	0... FFH	0... 255	1	-
Threshold for anti-bounce counter value for preliminary coolant temperature (radiator outlet) error detection					
C_T_AST_MIN_DIAG_TCO_2_EL	-	0... FFFFH	0... 65535	1	s
Minimum time delay after start for the coolant temperature (radiator outlet) electrical diagnosis					
C_TCO_2_MES_GRD_MAX_DIAG_TCO_2	-	0... FEH	0... 190.5	0.75	°C
Maximum coolant temperature gradient for the coolant temperature (radiator outlet) gradient diagnosis					
C_TIA_THR_MIN_DIAG_TCO_2_EL	-	0... FEH	-48... 142.5	0.75	°C
Minimum intake air temperature value for the coolant temperature (radiator outlet) electrical diagnosis					
C_VP_TCO_2_MAX_DIAG_TCO_2_EL	-	0... 7FFFH	0... 4.999847412	153e-6	V
Maximum raw sensor signal voltage for the coolant temperature (radiator outlet) electrical diagnosis					
C_VP_TCO_2_MIN_DIAG_TCO_2_EL	-	0... 7FFFH	0... 4.999847412	153e-6	V
Minimum raw sensor signal voltage for the coolant temperature (radiator outlet) electrical diagnosis					

FUNCTION DESCRIPTION:

General information:

The purpose of the diagnosis function is to detect electrical failures as defined by OBD I requirements. The coolant temperature (radiator outlet) raw sensor voltage (VP_TCO [1]) is measured with use of an 10bit A/D converter by the ECU hardware. The modified sensor signal is converted then into a measured temperature value at radiator outlet. Each by the ECU hardware measured raw sensor value is checked as well as the converted temperature signal.
A global coolant temperature (radiator outlet) error is set without debounce as soon as an electrical- or signal gradient- or coolant temperature (radiator outlet) plausibility error is detected. All separate diagnosis functions are performed all the time if the diagnosis conditions are fulfilled. The deactivation of diagnosis functions with use of configuration switches is not possible.
In addition a preliminary coolant temperature (radiator outlet) error is set as soon as debouncing of an electrical-, or signal gradient- symptom occurs. The preliminary coolant temperature (radiator outlet) error will be stored in the non-volatile memory during the ECU s self-holding phase to be available at the beginning of the next driving cycle.

Application conditions:

Initialisation at Reset:

LV_ERR_TCO_2 = 0
LV_CDN_ENA_TCO_2_PREL = 1
LV_ERR_TCO_2_PREL = LV_ERR_TCO_2_PREL_DET *(NVMY)*
LV_ERR_TCO_2_PREL_DET = LV_ERR_TCO_2_PREL_DET *(NVMY)*
(NVMY: stored in the non-volatile memory)

Initialisation at Engine stop to Engine run (ES_to_ERU):

LV_ERR_TCO_2_PREL_DET = 0
LV_CDN_ENA_TCO_2_PREL = 0

Initialisation at FMY clear:

LV_ERR_TCO_2 = 0
LV_ERR_TCO_2_PREL = 0

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LV_ERR_TCO_2_PREL_DET = 0

Recurrence: 100 ms

Activation: at every engine operating state

Deactivation: -

Formula section:

If LV_ERR_TCO_2_EL = 1 **or**
LV_ERR_TCO_2_GRD = 1 **or**
LV_ERR_TCO_2_PLAUS = 1
then LV_ERR_TCO_2 = 1 (without debounce)
else LV_ERR_TCO_2 = 0
endif

A.61.1 Preliminary coolant temperature (radiator outlet) failure (at ES after RESET)

Application conditions

Recurrence: *100 ms*

Activation: *LV_CDN_ENA_TCO_2_PREL = 1*

Deactivation: *LV_CDN_ENA_TCO_2_PREL = 0*

Formula section:

If CTR_ABC_TCO_2_EL > 0 **or**
CTR_ABC_TCO_2_GRD > 0 **or**
LV_ERR_TCO_2_PREL_DET = 1
then LV_ERR_TCO_2_PREL = 1 (without debounce)
else LV_ERR_TCO_2_PREL = 0
endif

A.61.2 Preliminary coolant temperature failure (at ERU /at ES after ERU_to_ES)

Application conditions

Recurrence: *100 ms*

Activation: *LV_CDN_ENA_TCO_2_PREL = 0*

Deactivation: *LV_CDN_ENA_TCO_2_PREL = 1*

Formula section:

If CTR_ABC_TCO_2_EL > C_CTR_ABC_THD_TCO_2_PREL **or**
CTR_ABC_TCO_2_GRD > C_CTR_ABC_THD_TCO_2_PREL **or**
LV_ERR_TCO_2_PLAUS = 1
then LV_ERR_TCO_2_PREL_DET = 1 (irrevocable for current driving cycle)

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endif

If CTR_ABC_TCO_2_EL > 0 **or**
CTR_ABC_TCO_2_GRD > 0 **or**
LV_ERR_TCO_2_PLAUS = 1 **or**
then LV_ERR_TCO_2_PREL = 1 (without debounce)
else LV_ERR_TCO_2_PREL = 0
endif

A.61.3 Coolant temperature (radiator outlet) signal range diagnosis

FUNCTION DESCRIPTION:

General information:

The purpose of the signal range- or electrical diagnosis is to detect electrical errors in the input circuit of the coolant temperature (radiator outlet) sensor. The analog sensor input signal is converted into a digital value with use of an A/D converter. All symptoms of the error code are handled by anti-bouncing. Only one symptom can be active at a time.

Description:

Error-symptoms are defined to this diagnosis function as following:

```
□□□□
| | | └─> Short circuit to  Vbatt or Open Circuit “SCP_OC”     (= SYM_0)
| | └───> Short circuit to Ground “SCG”                        (= SYM_1)
| └─────> (not used)                                           (= SYM_2)
└───────> (not used)                                           (= SYM_3)
```

Application conditions

Initialisation:
LV_ERR_TCO_2_EL = *Refer to filtering configuration for the initialisation*
LV_END_DIAG_TCO_2_EL = *Refer to filtering configuration for the initialisation*

LV_CDN_DIAG_TCO_2_EL = *Refer to filtering configuration for the initialisation*

ERR_SYM_TCO_2_EL = *Refer to filtering configuration for the initialisation*
Recurrence: *100 ms*
Activation: LV_IGK = 1 **and**
LV_CDN_VB_MIN_DIAG = 1 **and**
LV_INH_DIAG_TCO_2_EL = 0

Deactivation: Activation condition not true
At deactivation: LV_CDN_DIAG_TCO_2_EL = 0

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Formula section:

Error detection:

```
if (1)              VP_TCO[1] < C_VP_TCO_2_MIN_DIAG_TCO_2_EL
                      // coolant temperature sensor (radiator outlet) voltage signal (VP_TCO[1])
then (1)              (error detection   Short circuit to GND )
                    LV_CDN_DIAG_TCO_2_EL = 1
                    ERR_SYM_TCO_2_EL =   SYM_1
                    LV_ERR_TCO_2_EL = 1                         (after debounce)
else (1)
        if (2)              VP_TCO[1] > C_VP_TCO_2_MAX_DIAG_TCO_2_EL
                      // coolant temperature sensor (radiator outlet) voltage signal (VP_TCO[1])
        then (2)      (error detection   Short circuit to Vbatt or open load   possible)
          if (3)      TIA_THR >= C_TIA_THR_MIN_DIAG_TCO_2_EL
                      or
                      TIA_THR < C_TIA_THR_MIN_DIAG_TCO_2_EL        and
                      T_DIAG_AST > C_T_AST_MIN_DIAG_TCO_2_EL
          then (3)       LV_CDN_DIAG_TCO_2_EL = 1
                      ERR_SYM_TCO_2_EL =   SYM_0
                      LV_ERR_TCO_2_EL = 1                       (after debounce)
          else (3)       LV_CDN_DIAG_TCO_2_EL = 0
          endif (3)
  else (2)          LV_CDN_DIAG_TCO_2_EL = 1
                    ERR_SYM_TCO_2_EL =   NO_SYM
                    LV_ERR_TCO2_EL = 0                          (after rebounce)
  endif (2)
endif (1)
```

End of diagnosis:

For the calculation of LV_END_DIAG_TCO_2_EL see Anti-bounce Algorithm, calculation of the end of diagnosis .

A.61.4 Coolant temperature (radiator outlet) signal gradient diagnosis

FUNCTION DESCRIPTION:

General information:

The purpose of the signal gradient diagnosis is to detect a not plausible gradient on the measured coolant temperature (radiator outlet) sensor signal. The monitoring is based on a comparison between the actual measured and the last measured coolant temperature value at radiator outlet. The symptom of the error code is handled by anti-bouncing.

Description:

Error-symptoms are defined to this diagnosis function as following:

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```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> -                                            (= SYM_0)
 │ │ └───> -                                            (= SYM_1)
 │ └─────> -                                            (= SYM_2)
 └───────> Coolant temperature signal gradient error    (= SYM_3)
```

Application conditions

Initialisation:
LV_ERR_TCO_2_GRD = *Refer to filtering configuration for the initialisation*

LV_END_DIAG_TCO_2_GRD = *Refer to filtering configuration for the initialisation*

LV_CDN_DIAG_TCO_2_GRD = *Refer to filtering configuration for the initialisation*

ERR_SYM_TCO_2_GRD = *Refer to filtering configuration for the initialisation*

Recurrence: *100 ms*

Activation:

```
If      LV_IGK = 1                       and
        LV_CDN_VB_MIN_DIAG = 1           and
        LV_INH_DIAG_TCO_2_GRD = 0
then    LV_CDN_DIAG_TCO_2_GRD = 1
else    LV_CDN_DIAG_TCO_2_GRD = 0
```

endif

Deactivation: Activation condition not true

Formula section:

Error detection:
If | TCO_2_MES(n-1) - TCO_2_MES(n) | > C_TCO_2_MES_GRD_MAX_DIAG_TCO_2
then ERR_SYM_TCO_2_GRD = SYM_3
LV_ERR_TCO_2_GRD = 1 *(after debounce)*
else ERR_SYM_TCO_2_GRD = NO_SYM
LV_ERR_TCO_2_GRD = 0 *(after rebounce)*
endif

End of diagnosis:
For the calculation of LV_END_DIAG_TCO_2_GRD see Anti-bounce Algorithm, calculation of the end of diagnosis .

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A.62 Coolant temperature sensor (radiator outlet) diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_TCO_2_EL	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal range diagnosis inhibit					
LV_INH_DIAG_TCO_2_GRD	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal gradient diagnosis inhibit					

Input data:

LV_ERR_TCO_2_EL {p. 4572}	LV_IGK {p. 906}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TCO_2_EL	-	0... FFH	0... 255	1	-
Debounce counter increment value for the coolant temperature (radiator outlet) sensor electrical diagnosis					
C_ABC_INC_TCO_2_GRD	-	0... FFH	0... 255	1	-
Debounce counter increment value for the coolant temperature (radiator outlet) sensor gradient diagnosis					
C_ABC_MAX_TCO_2_EL	-	1... FFH	1... 255	1	-
Debounce counter maximum value for the coolant temperature (radiator outlet) sensor electrical diagnosis					
C_ABC_MAX_TCO_2_GRD	-	1... FFH	1... 255	1	-
Debounce counter maximum value for the coolant temperature (radiator outlet) sensor gradient diagnosis					

Error treatment:

Error debounce:
Debounce counter increment: C_ABC_INC_TCO_2_EL
Debounce counter maximum value: C_ABC_MAX_TCO_2_EL

Diagnosis Configuration
ERRM configuration for LV_ERR_TCO_2_EL is "**STD_INI**" *//all 0 at LV_IGK 0->1 or reset*
Error debounce:
Debounce counter increment: C_ABC_INC_TCO_2_GRD
Debounce counter maximum value: C_ABC_MAX_TCO_2_GRD

Diagnosis Configuration:
ERRM configuration for LV_ERR_TCO_2_GRD is "**MEM**" *//error is set irreversible*

FUNCTION DESCRIPTION:

General information:

Task of the coolant temperature (radiator outlet) sensor diagnosis (Appl. Inc.) is to allow the projects to adapt their specific requirements to generic coolant temperature (radiator outlet) sensor diagnosis. The setting of the interface output variables have to be provided by the projects.

Application conditions

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Initialisation: *see separate chapter*

Recurrence: *1000 ms*

Activation: *at every engine operating state*

Deactivation: –

A.62.1 Coolant temperature (radiator outlet) signal range diagnosis - interface parameter

FUNCTION DESCRIPTION:

General information:

Depending on project specific requirements, the electrical- or signal range diagnosis of the coolant temperature sensor at radiator outlet can be inhibited by setting of the logical variable LV_INH_DIAG_TCO_2_EL.

Application conditions

Initialisation:

```
If Reset or Transition: LV_IGK = 0 -> LV_IGK = 1
then LV_INH_DIAG_TCO_2_EL = 0
endif
```

Recurrence: *1000 ms*

Activation: *at every engine operating state*

Deactivation: –

Formula section:

LV_INH_DIAG_TCO_2_EL = 0

A.62.2 Coolant temperature (radiator outlet) signal gradient diagnosis - interface parameter

FUNCTION DESCRIPTION:

General information:

Depending on project specific requirements, the signal gradient diagnosis of the coolant temperature sensor at radiator outlet can be inhibited by setting of the logical value LV_INH_DIAG_TCO_2_GRD.

Application conditions

Initialisation:

```
If Reset or Transition: LV_IGK = 0 -> LV_IGK = 1
then LV_INH_DIAG_TCO_2_GRD = 0
```

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endif

Recurrence: 1000 ms

Activation: at every engine operating state

Deactivation: -

Formula section:

If LV_ERR_TCO_2_EL = 1
Then LV_INH_DIAG_TCO_2_GRD = 1
Else LV_INH_DIAG_TCO_2_GRD = 0
Endif

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A.63 Debounce algorithm

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ABC_END_DIAG_XX	V	0... FFH	0... 255	1	-
Counter for end of diagnosis XX generation					
CTR_ABC_XX	O/V/S	0... FFH	0... 255	1	-
anti bounce counter of diagnosis XX					
ERR_SYM_PREV_XX	-	0... FH	0... 15	1	-
Previous value of ERR_SYM_XX when the diagnosis conditions are fulfilled					
ERR_SYM_XX	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
For each symptom : status of failure (set to 1 when failure symptom detected)					
LV_CDN_DIAG_XX	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled)					
LV_END_DIAG_XX	V	0... 1H	0 ...1	1	-
Diagnostic done completely at least one time					

Input data:

LV_ABC_INH {p. 4610}	LV_DC {p. 5746}	LV_IGK {p. 906}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_XX	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement for XX diagnosis					
C_ABC_INC_XX	-	0... FFH	0... 255	1	-
XX diagnosis anti-bounce counter increment (for anti-bounce filtering) or frequency counter maximum value (for statistical filtering)					
C_ABC_MAX_XX	-	1... FFH	1... 255	1	-
XX diagnosis anti-bounce counter maximum value (for anti-bounce filtering) or threshold of period counter for failure detection (for statistical filtering)					
LC_ABC_BENCH	-	0... 1H	0 ...1	1	-
Logical constant to manage the anti-bounce bench mode					
LC_ERR_DET_UPD	-	0... 1H	0 ...1	1	-
Logical constant to manage some functionality as the visualisation of the sporadic error					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ABC_CONF_FCT_DIAG_XX	-	0... FFH	0... 255	1	-
Anti-bounce algorithm configuration of each XX diagnosis					
NLC_ABC_INI_DC_END_DIAG	-	0... 1H	0 ...1	1	-
Initialisation of LV_END_DIAG_XX at LV_DC transition or not					
NLC_BENCH_MODE	-	0... 1H	0 ...1	1	-
Bench mode configuration (0: the bench mode is removed, max CPU optimisation is reached)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Remark : The present failure and the anti-bounce counter may be saved or not (see ‘Calculation of the Anti-bounce’)

A.63.1 Import Actions

#IF NC_ERR_DET_UPD = 1
ACTION_ERRM_UpdErrDet (IN<XX>)
This action indicates each occurrence of the detected error
#ENDIF

A.63.2 Export Actions

Name
ACTION_ERRM_FilterSymptom(IN< XX >, IN< lv_cdn_diag_XX >, IN< err_sym_XX >, IN< C_ABC_INC_XX >, IN< C_ABC_DEC_XX >, IN< C_ABC_MAX_XX >, OUT< LV_ERR_XX >)
This action computes the elementary anti-bounce filter for one failure treatment and returns filter result
ACTION_ERRM_NoFilterSymptom(IN< XX >, IN< lv_cdn_diag_XX >, IN< err_sym_XX >, IN< lv_err_set_XX >, IN< lv_err_reset_XX >, IN< lv_end_diag_XX >, OUT< LV_ERR_XX >)
This action computes the elementary treatment case no filtering is used
ACTION_ERRM_AbcFilterSymptomEnd(IN< XX >, IN< C_ABC_MAX_XX>, OUT< LV_ERR_XX >)
This action erases diagnostic failure and sets the end of diagnostic in case of antibounce filter type
ACTION_ERRM_NoFilterSymptomEnd(IN< XX >, OUT< LV_ERR_XX >)
This action erases diagnostic failure and sets the end of diagnostic in case of no filter
ACTION_ERRM_AbcFilterReset(IN< XX >, OUT< LV_ERR_XX >)
This action resets data filter in case of antibounce filter type
ACTION_ERRM_NoFilterReset(IN< XX >, OUT< LV_ERR_XX >)
This action resets data filter in case of no filter
ACTION_ERRM_GetLvErr(IN< XX >, OUT< LV_ERR_XX >)
This action is used to get LV_ERR_XX value
ACTION_ERRM_GetLvEndDiag(IN< XX >, OUT< LV_END_DIAG_XX >)
This action is used to get LV_END_DIAG_XX value
ACTION_ERRM_GetLvCdnDiag(IN< XX >, OUT< LV_CDN_DIAG_XX >)
This action is used to get LV_CDN_DIAG_XX value
ACTION_ERRM_GetErrSym(IN< XX >, OUT< ERR_SYM_XX >)
This action is used to get ERR_SYM_XX value

ERR_SYM_XX is defined like output data for each diagnosis as following :

Name	Mode	Hex. Limits	Phys. Limits	Resol.	Unit
ERR_SYM_XX	O/V	0..0FH	All combination	1	-
		0H	NO_SYM		
		1H	SYM_0		
		2H	SYM_1		
		4H	SYM_2		
		8H	SYM_3		
		FH	BENCH_MODE		
Symptom : failure without filtering of diagnosis XX					

It is possible to combine several symptoms.

FUNCTION DESCRIPTION:

General information:

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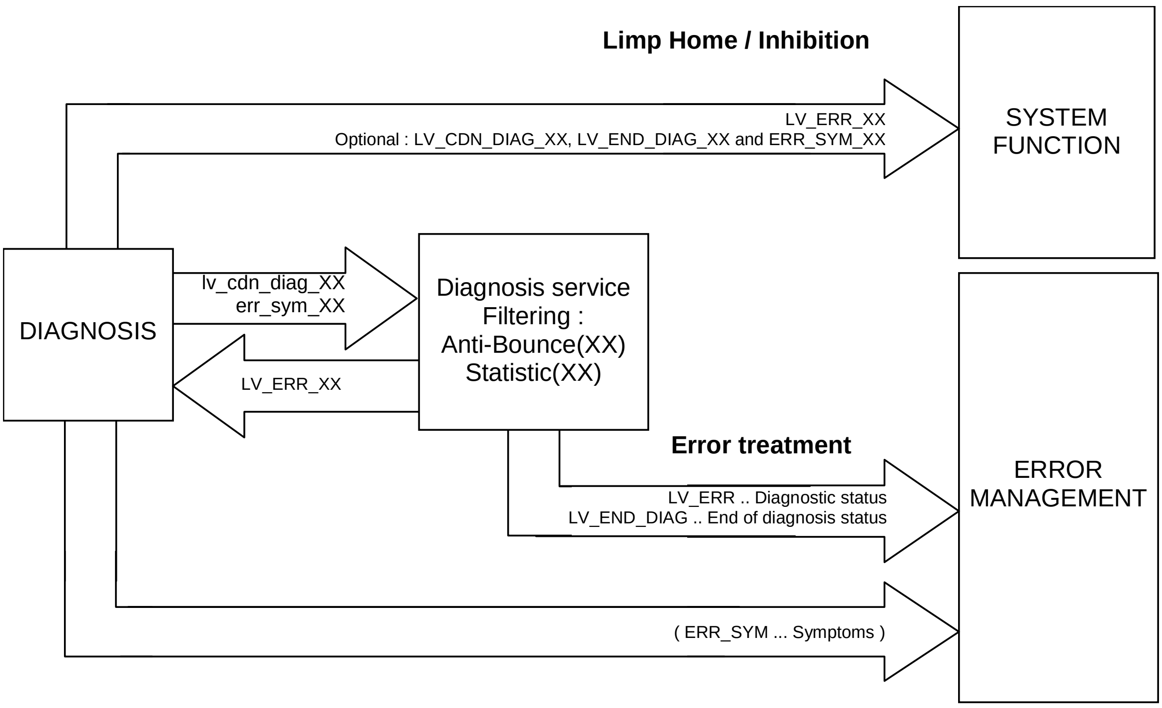
The filtering algorithm (anti-bounce or statistic) is used usually for the simple diagnosis (e.g. : usually OBD1 diagnosis). If there is another need, diagnosis manages itself the filtering and the end of diagnosis (e.g. : usually OBD2 diagnosis).
The filtering is used to filter the detected failure. The failure becomes present after filtering.
The end of diagnosis definition is realised after a time defined as the minimum time to detect a present failure.
The filtering algorithm (anti-bounce or statistic) uses one counter to check failure detection threshold and one counter to manage the end of diagnosis (Diagnostic result available).
Filter choice selection : according to the diagnostic filtering configuration the filtering algorithm used is the anti-bounce filtering (NLC_ABC_STC_XX = 0) or the standard statistical filtering (NLC_ABC_STC_ XX=1)
Signal flow diagram :

Diagnosis with an anti-bounce algorithm :



Diagnosis without anti-bounce algorithm :

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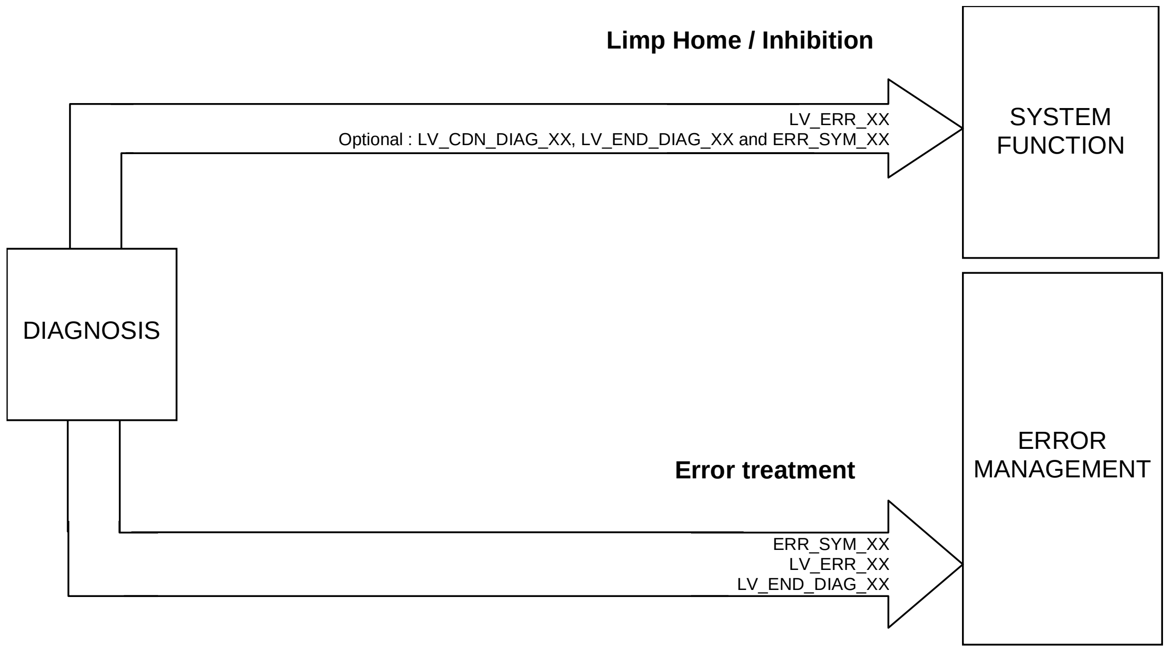
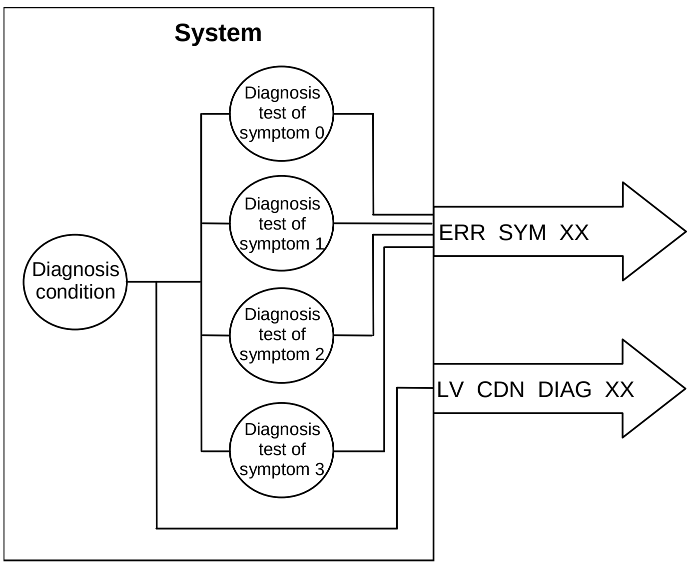


<u>The symptoms are evaluated when diagnosis conditions are fulfilled :</u>



A.63.3 Initialisation of anti-bounce, statistical and multi-conditions filters

This paragraph is dedicated to the initialisation of main data, at the following events:

- ECU reset
- LV_IGK 0 → 1 transition before the end of the power-latch phase
- LV_DC 1 → 0 transition

A.63.3.1 At ECU reset

<u>*Management of NVMY*</u>

If NVMY not corrupted **and** not first ECU power-up

Then

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CTR_ABC_ XX is restored from NVMY
LV_ERR_XX is restored from NVMY
ERR_SYM_XX is restored from NVMY
Else
CTR_ABC_ XX = 0
LV_ERR_XX = 0
ERR_SYM_XX = 0
Endif

LV_CDN_DIAG_XX = 0
CTR_ABC_END_DIAG_XX = 0
LV_END_DIAG_XX = 0

If NLC_ABC_NOT_SAVE_XX = 1
Then
{ case of STD_INI, MEM and STC configurations }
CTR_ABC_XX = 0
LV_ERR_XX = 0
ERR_SYM_XX = 0
Endif

Configuration evaluation
If NLC_ABC_INI_VALUE_XX = 1
Then
{ case of MEM_INI configuration }
If LV_ERR_XX = 1
Then
CTR_ABC_XX = C_ABC_MAX_XX - C_ABC_INC_XX
Else
CTR_ABC_XX = 0
Endif
LV_ERR_XX = 0
ERR_SYM_XX = 0
Endif

A.63.3.2 At LV_IGK 0 ? 1 transition, without ECU reset

If NLC_ABC_NOT_SAVE_XX = 1 **and** NLC_ABC_INI_IGK_XX = 1
Then
CTR_ABC_ XX = 0
LV_ERR_XX = 0
ERR_SYM_XX = 0
Endif

LV_CDN_DIAG_XX = 0

If NLC_ABC_NOT_SAVE_XX = 0
and NLC_ABC_INI_VALUE_XX = 1
and NLC_ABC_INI_IGK_XX = 1
Then
{ case of MEM_INI configuration }
If LV_ERR_XX = 1
Then

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CTR_ABC_XX = C_ABC_MAX_XX - C_ABC_INC_XX
Else
CTR_ABC_XX = 0
Endif
LV_ERR_XX = 0
ERR_SYM_XX = 0
Endif

If NLC_ABC_INI_DC_END_DIAG = 0
Then
CTR_ABC_END_DIAG_XX = 0
LV_END_DIAG_XX = 0
Endif

A.63.3.3 At LV_DC 1 ? 0 transition

If NLC_ABC_INI_DC_END_DIAG = 1
Then
CTR_ABC_END_DIAG_XX = 0
LV_END_DIAG_XX = 0
Endif

If LV_ERR_XX = 0 **and** NLC_ABC_INI_VALUE_XX = 0
Then
{ all cases excepted MEM_INI configuration }
CTR_ABC_XX = 0
ERR_SYM_XX = 0
Endif

A.63.4 Recurrence

The recurrence is always managed by the diagnosis recurrence.

A.63.5 Filtering algorithm description

A.63.5.1 Description:

Syntax : ACTION_ERRM_FilterSymptom(IN<XX>, IN<lv_cdn_diag_XX>, IN< err_sym_xx>, IN<C_ABC_INC_XX>, IN<C_ABC_DEC_XX>,IN<C_ABC_MAX_XX>, OUT<LV_ERR_XX>)
Parameter(in) : XX Type: index to identify the Diagnostic
lv_cdn_diag_XX Type: Diagnostic condition
err_sym_XX Status of failure
C_ABC_INC_XX Anti-bounce counter increment
C_ABC_DEC_XX Anti-bounce counter decrement
C_ABC_MAX_XX Maximum value of anti-bounce counter
Parameter(out) : LV_ERR_XX Type: Boolean (=1 when failure)
Short Description : This action returns the filter result on symptoms detected at each diagnostic recurrence

A.63.5.2 Antibounce algorithm filtering type

A.63.5.2.1 Calculation of the anti-bounce counter

Description:

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Anti-bounce operation:

If the system failure is detected and the diagnosis conditions are fulfilled (LV_CDN_DIAG_XX = 1) then the failure is detected (ERR_SYM_XX 0) and the anti-bounce counter is incremented. In this case an action is called to manage some functionality (eg : to visualise the sporadic error of all diagnosis using this anti-bounce algorithm).

If the system failure isn't detected and the diagnosis conditions are fulfilled (LV_CDN_DIAG_XX = 1) then the failure isn't detected (ERR_SYM_XX = 0) and the anti-bounce counter is decremented.

If the diagnosis conditions aren't fulfilled (LV_CDN_DIAG_XX = 0) then the detected failure is unchanged (ERR_SYM_XX(N) = ERR_SYM_XX(N-1)) and the anti-bounce counter is unchanged.

The present failure is set when the anti-bounce counter has reached its MAX (unequal to zero).

The configuration allows:

- to save or not the present failure and the anti-bounce counter
- to initialise or not the present failure and the anti-bounce counter at transition LV_IGK 0 → 1
- to manage the decrement of the anti-bounce counter or not (the anti-bounce counter remains at the maximum value)
- to calibrate or not the decrement of the anti-bounce counter.

Anti-bounce bench mode:

To make easier the development phase, it may be interesting to force the LV_ERR_XX flag (present failure) and the associated symptoms in order to free the diagnosis and to test only the error management and/or the application incidence (limp home or inhibition) associated to the present failure. This mode is active only if the LC_ABC_BENCH and NLC_BENCH_MODE flags are set.

To set LV_ERR_XX to one and ERR_SYM_XX = FH (all detected error symptoms) :
Set the C_ABC_INC_XX calibration to the maximum value (FFH).
To set LV_ERR_XX to zero and ERR_SYM_XX = 0 (no detected error symptom) :
Set the C_ABC_INC_XX calibration to zero.
Note:
In this mode, the diagnosis condition (LV_CDN_DIAG_XX) and the end of diagnosis (LV_END_DIAG_XX) are set to 1 (LV_CDN_DIAG_XX = 1 means the ERR_SYM_XX is valid and LV_END_DIAG_XX = 1 means the LV_ERR_XX flag is valid).

Anti-bounce inhibition:

For specific needs, the anti-bounce filtering calculation (anti-bounce operation and anti-bounce bench mode) may be inhibited, with LV_ABC_INH inhibition flag.

Signal flow diagram:

1 -The anti-bounce counter may be decremented (NLC_ABC_NOT_DEC_XX = 0):

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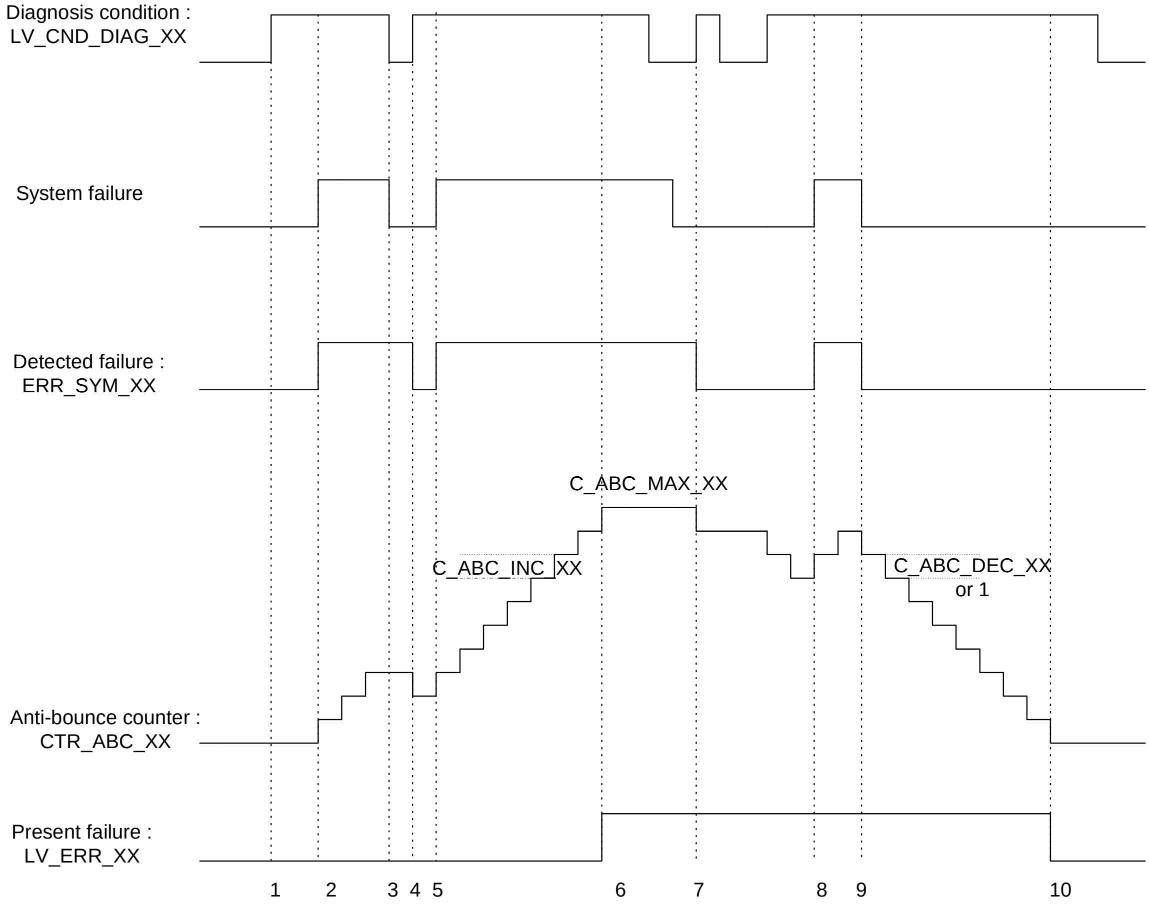

1: The diagnosis conditions are fulfilled
but the failure isn't detected
LV_CDN_DIAG_XX = 1,
ERR_SYM_XX = 0.

CTR_ABC_XX remains at the value 0.
LV_ERR_XX = 0.

2: The diagnosis conditions are fulfilled
and the failure is detected.
LV_CDN_DIAG_XX = 1,
ERR_SYM_XX <> 0.

CTR_ABC_XX = 0 + C_ABC_INC_XX
LV_ERR_XX = 0.

3: The diagnosis conditions aren't fulfilled
and the failure remains detected.
LV_CDN_DIAG_XX = 0,
ERR_SYM_XX <> 0.

CTR_ABC_XX is frozen
LV_ERR_XX = 0.

.

4: The diagnosis conditions are fulfilled again
and the failure is no more detected.
LV_CDN_DIAG_XX = 1,
ERR_SYM_XX = 0.

CTR_ABC_XX =
CTR_ABC_XX - decrement
LV_ERR_XX = 0.

5: The diagnosis conditions are still fulfilled
and the failure is detected again

CTR_ABC_XX =

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LV_CDN_DIAG_XX = 1, CTR_ABC_XX + C_ABC_INC_XX
ERR_SYM_XX <> 0. LV_ERR_XX = 0.

6: The diagnosis conditions are still fulfilled,
the failure is still detected
and the failure becomes present. CTR_ABC_XX = C_ABC_MAX_XX
LV_CDN_DIAG_XX = 1, LV_ERR_XX = 1.
ERR_SYM_XX <> 0.

7: The diagnosis conditions are fulfilled,
the failure isn't detected
and the failure remains present. CTR_ABC_XX =
LV_CDN_DIAG_XX = 1, CTR_ABC_XX - decrement
ERR_SYM_XX = 0. LV_ERR_XX = 1.

8: The diagnosis conditions are still fulfilled,
the failure is detected again
and the failure remains present. CTR_ABC_XX =
LV_CDN_DIAG_XX = 1, CTR_ABC_XX + C_ABC_INC_XX
ERR_SYM_XX <> 0. LV_ERR_XX = 1.

9: The diagnosis conditions are still fulfilled,
the failure isn't detected
and the failure remains present. CTR_ABC_XX =
LV_CDN_DIAG_XX = 1, CTR_ABC_XX - decrement
ERR_SYM_XX = 0. LV_ERR_XX = 1.

10: The diagnosis conditions are still fulfilled,
the failure isn't detected
and the failure is no more present. CTR_ABC_XX = 0
LV_CDN_DIAG_XX = 1, LV_ERR_XX = 0.
ERR_SYM_XX = 0.

Remark

- Decrement value = 1 if NLC_ABC_CAL_DEC_XX bit = 0
- Decrement value = C_ABC_DEC_XX if NLC_ABC_CAL_DEC_XX bit = 1.

2-The anti-bounce counter isn't decremented (NLC_ABC_NOT_DEC_XX = 1):

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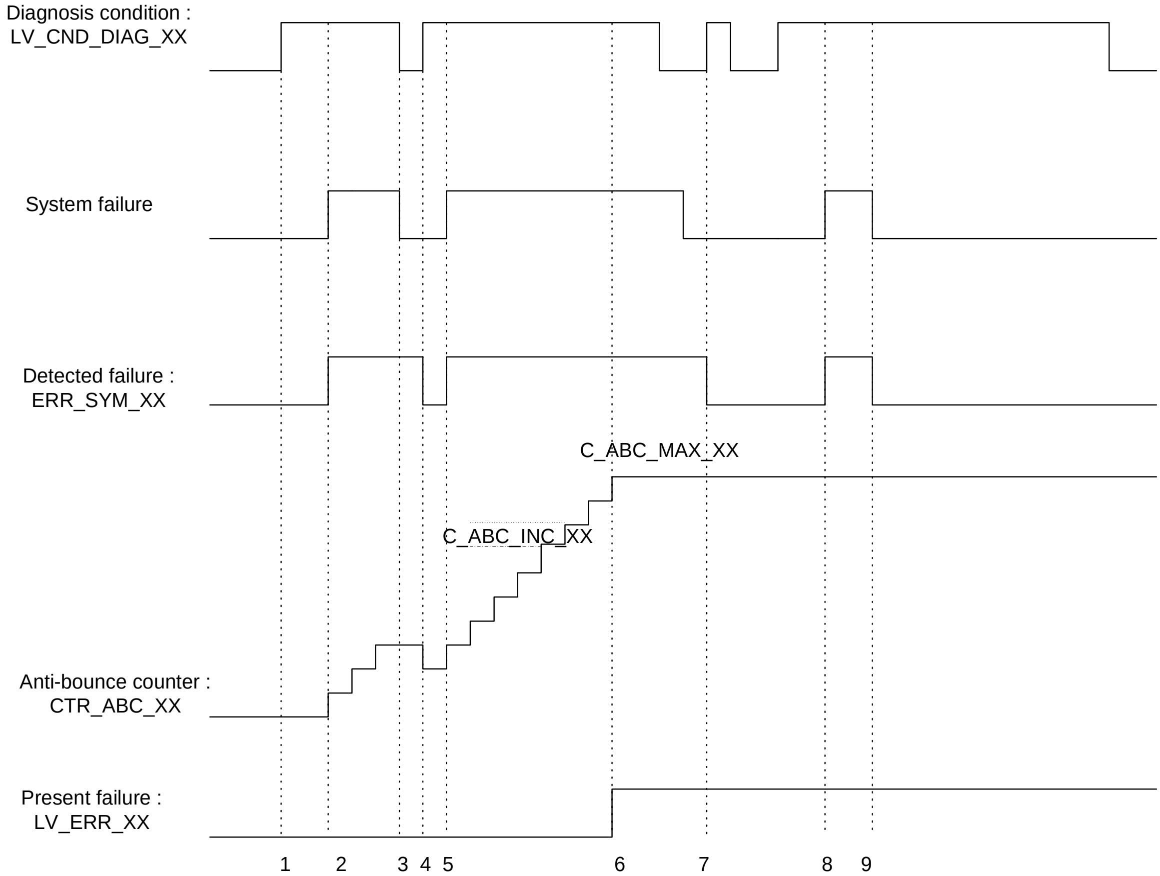

1: The diagnosis conditions are fulfilled
but the failure isn't detected
LV_CDN_DIAG_XX = 1,
ERR_SYM_XX = 0.

CTR_ABC_XX remains at the value 0.
LV_ERR_XX = 0.

2: The diagnosis conditions are fulfilled
and the failure is detected.
LV_CDN_DIAG_XX = 1,
ERR_SYM_XX <> 0.

CTR_ABC_XX = 0 + C_ABC_INC_XX
LV_ERR_XX = 0.

3: The diagnosis conditions aren't fulfilled
and the failure remains detected.
LV_CDN_DIAG_XX = 0,
ERR_SYM_XX <> 0.

CTR_ABC_XX is frozen
LV_ERR_XX = 0.

4: The diagnosis conditions are fulfilled again
and the failure is no more detected.
LV_CDN_DIAG_XX = 1,
ERR_SYM_XX = 0.

CTR_ABC_XX =
CTR_ABC_XX - decrement
LV_ERR_XX = 0.

5: The diagnosis conditions are still fulfilled
and the failure is detected again
LV_CDN_DIAG_XX = 1,

CTR_ABC_XX =
CTR_ABC_XX + C_ABC_INC_XX

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ERR_SYM_XX <> 0. LV_ERR_XX = 0.

6: The diagnosis conditions are still fulfilled,
the failure is still detected
and the failure becomes present. CTR_ABC_XX = C_ABC_MAX_XX
LV_CDN_DIAG_XX = 1, LV_ERR_XX = 1.
ERR_SYM_XX <> 0.

7: The diagnosis conditions are fulfilled,
the failure isn't detected
and the failure remains present. CTR_ABC_XX = C_ABC_MAX_XX
LV_CDN_DIAG_XX = 1, (counter not decrement)
ERR_SYM_XX = 0. LV_ERR_XX = 1.
.

8: The diagnosis conditions are still fulfilled,
the failure is detected again
and the failure remains present. CTR_ABC_XX = C_ABC_MAX_XX
LV_CDN_DIAG_XX = 1, LV_ERR_XX = 1.
ERR_SYM_XX <> 0.
.

.9: The diagnosis conditions are still fulfilled,
the failure isn't detected
and the failure remains present. CTR_ABC_XX = C_ABC_MAX_XX
LV_CDN_DIAG_XX = 1, (counter not decrement)
ERR_SYM_XX = 0. LV_ERR_XX = 1.

Remark

- Decrement value = 1 if NLC_ABC_CAL_DEC_XX bit = 0
- Decrement value = C_ABC_DEC_XX if NLC_ABC_CAL_DEC_XX bit = 1.

Application conditions

Initialization: *See "Initialisation of anti-bounce, statistical and multi-conditions filters" paragraph*

Recurrence: *The recurrence is managed by the diagnosis.*

Activation: The activation is managed by the diagnosis for the anti-bounce operation or the anti-bounce bench mode.

Deactivation: *LV_ABC_INH = 1*

Formula section:

Anti-bounce bench mode :

If(1) (LC_ABC_BENCH = 1 **and** NLC_BENCH_MODE=1) **and** ((C_ABC_INC_XX = 0) **or** (C_ABC_INC_XX = FFH))
Then(1)
If(2) C_ABC_INC_XX = 0
Then(2)
ERR_SYM_XX = 0
LV_ERR_XX = 0

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CTR_ABC_XX = 0
Else(2) **If(3)** C_ABC_INC_XX = FFH
Then(3)
ERR_SYM_XX = 0FH
LV_ERR_XX = 1
CTR_ABC_XX = C_ABC_MAX_XX
Endif(3)
Endif(2)
Endif(1)

Anti-bounce operation (not in bench mode) :
If(1a) (LV_CDN_DIAG_XX = 1) **and not**((LC_ABC_BENCH = 1 **and** NLC_BENCH_MODE=1) **and** ((C_ABC_INC_XX = 0) **or** (C_ABC_INC_XX = FFH)))
Then(1a)
If(1b) C_ABC_INC_XX = 0 *{ component XX not available }*
Then(1b)
{ the diagnosis result is forced to 'no error' }
ERR_SYM_XX = 0
LV_ERR_XX = 0
CTR_ABC_XX = 0
Else(1b)
If(2) ERR_SYM_XX <> 0
Then(2)
{ at each detected error, a treatment shall be done }
If(3a) NC_ERR_DET_UPD = 1
and LC_ERR_DET_UPD=1
Then(3a)
ACTION_ERRM_UpdErrDet(IN<XX>,
SYNCHRONIZATION<CALL>)
Endif(3a)
If(3b) CTR_ABC_XX <> C_ABC_MAX_XX
Then(3b)
CTR_ABC_XX = CTR_ABC_XX + C_ABC_INC_XX
If(4) CTR_ABC_XX >= C_ABC_MAX_XX
Then(4)
LV_ERR_XX = 1
CTR_ABC_XX = C_ABC_MAX_XX
Endif(4)
Endif(3b)
Else(2)
If(3) (NLC_ABC_NOT_DEC_XX = 0 **OR** LV_ERR_XX = 0)
Then(3)
If(4) CTR_ABC_XX <> 0
Then(4) **If(5)** NLC_ABC_CAL_DEC_XX = 0
Then(5)
(without calibratable decrement)
CTR_ABC_XX = CTR_ABC_XX - 1
If(6) CTR_ABC_XX = 0
Then(6)

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LV_ERR_XX = 0
Endif(6)
Else(5)
(with calibratable decrement)
CTR_ABC_XX = (CTR_ABC_
XX - C_ABC_DEC_XX)
If(6) CTR_ABC_XX
<= 0
Then(6)
LV_ERR_XX = 0
CTR_ABC_XX = 0
Endif(6)
Endif(5)
Endif(4)
Endif(3)
Endif(2)
Endif(1b)
Endif(1a)

A.63.5.2.2 Calculation of the end of diagnosis

Description:

The end of diagnosis definition is set after a time defined like being the time necessary to evaluate the failure (present or not).

Signal flow diagram:

End of diagnosis algorithm illustration in standard case :

The end of diagnosis counter is reset at each transition of the detected failure.

When the failure becomes present : the end of diagnosis is set.

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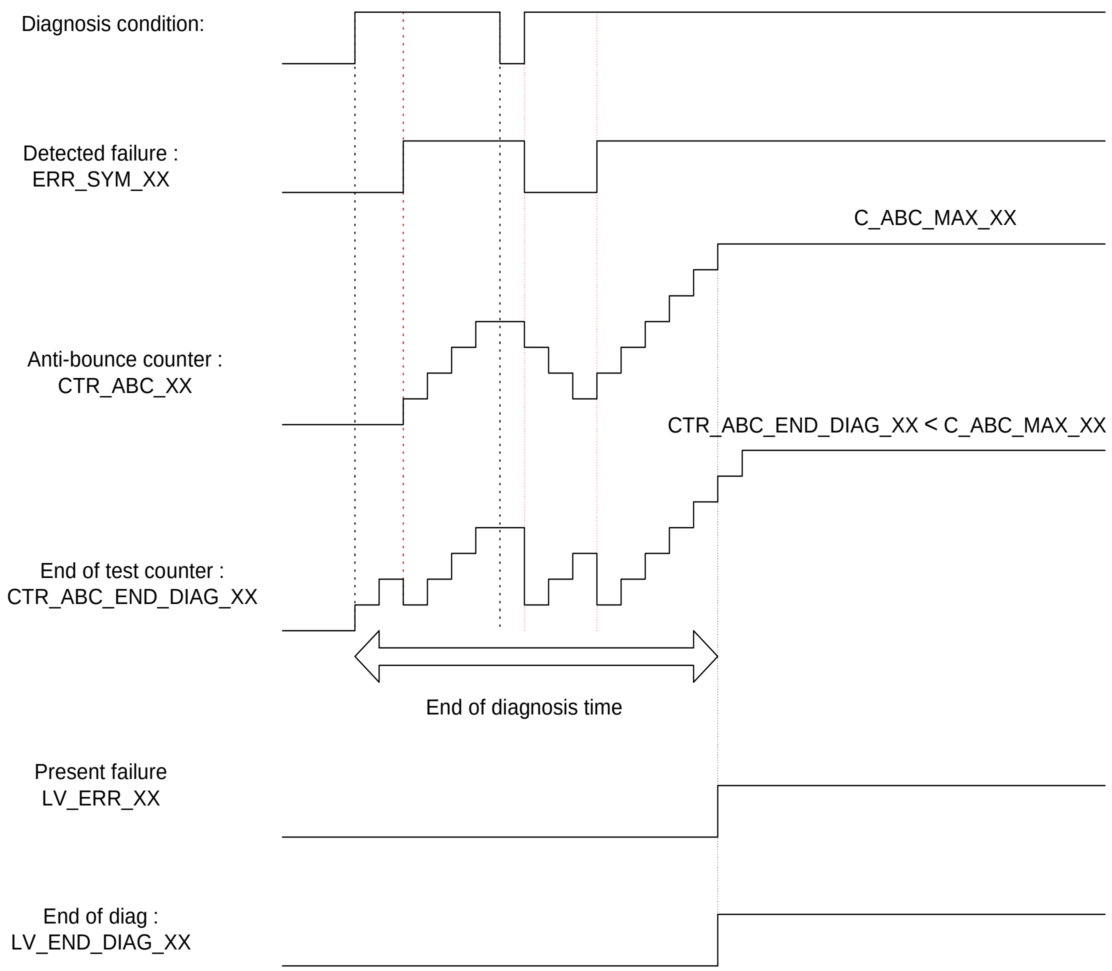

The detected failure will disappear and the anti-bounce counter won't reach the maximum value then the failure won't become present.

The end of diagnosis counter is reset at each transition of the detected failure.

When the detected failure is stable : the end of diagnosis counter is incremented until the maximum value while the diagnosis conditions are fulfilled.

When the end of diagnosis counter has reached the maximum value : the end of diagnosis is set.

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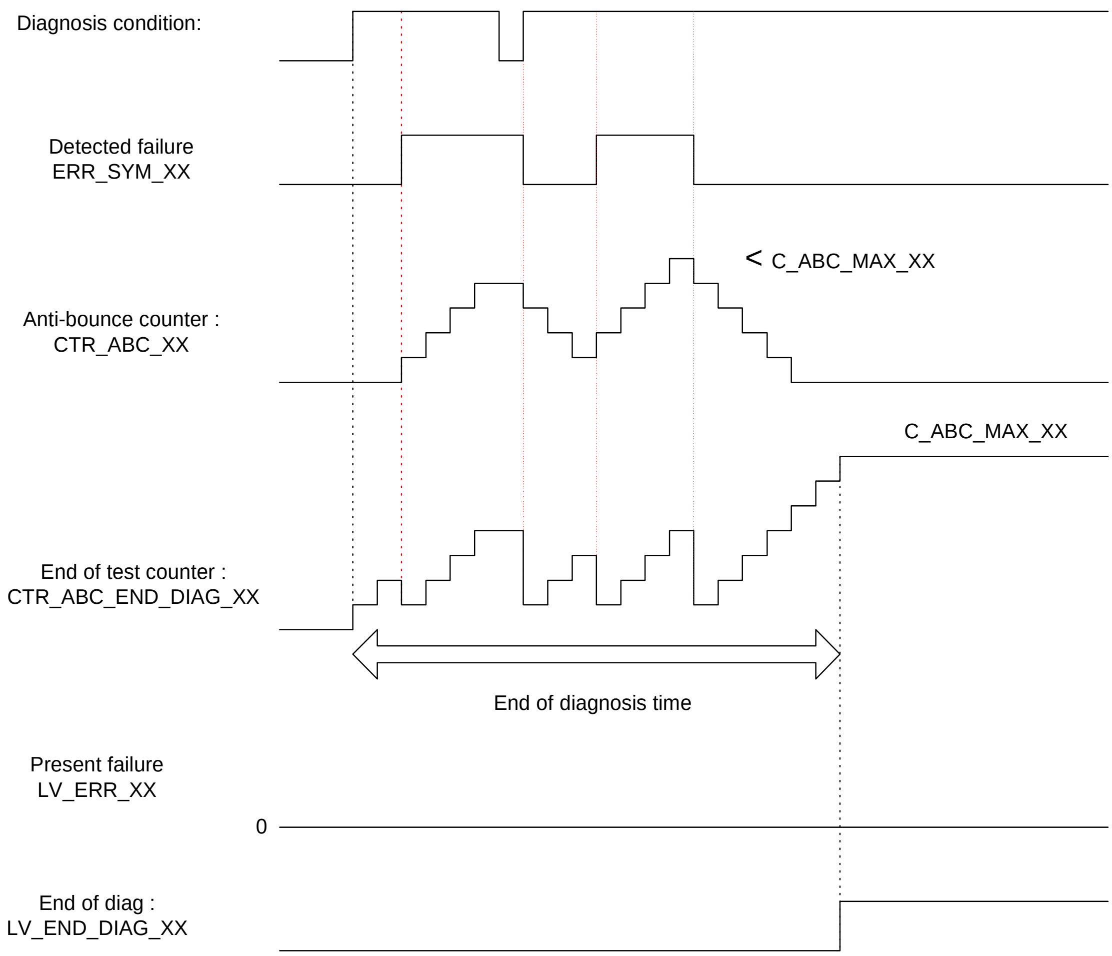

End of diagnosis algorithm illustration in case of reset event :

After the reset event, the detected failure remains present (stable) : the end of diagnosis counter is incremented until the maximum value while the diagnosis conditions are fulfilled.
When the end of diagnosis counter has reached the maximum value : the end of diagnosis is set.
The failure has been present and remains present after reset.

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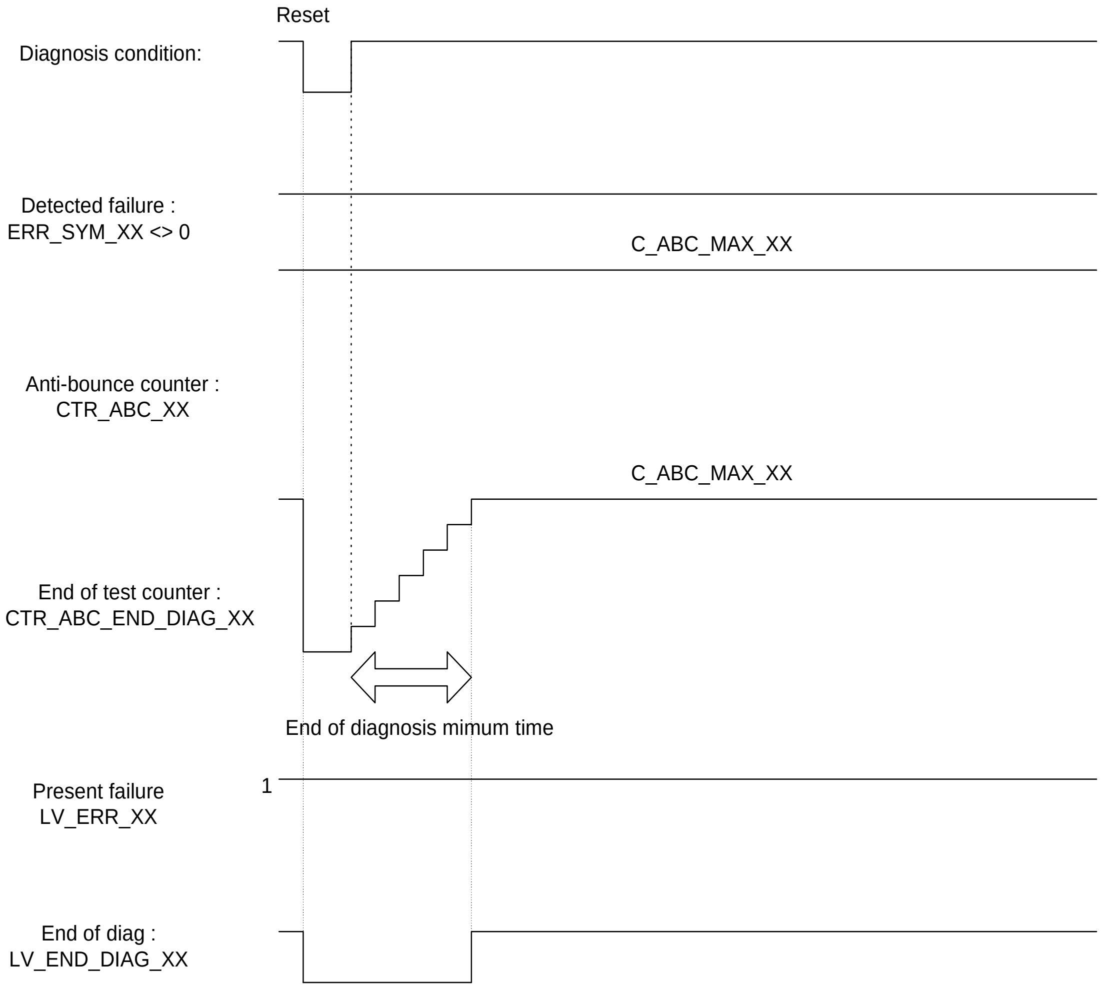

Before the reset, the failure was detected until the failure became present.

After the reset, the detected failure appears during a glitch so the end of diagnosis counter is reset at each transition of the detected failure,

When the detected failure disappears after all (stable) then

- the present failure disappears
- the end of diagnosis counter is incremented until the maximum value while the diagnosis conditions are fulfilled.

When the end of diagnosis counter has reached the maximum value : the end of diagnosis is set.

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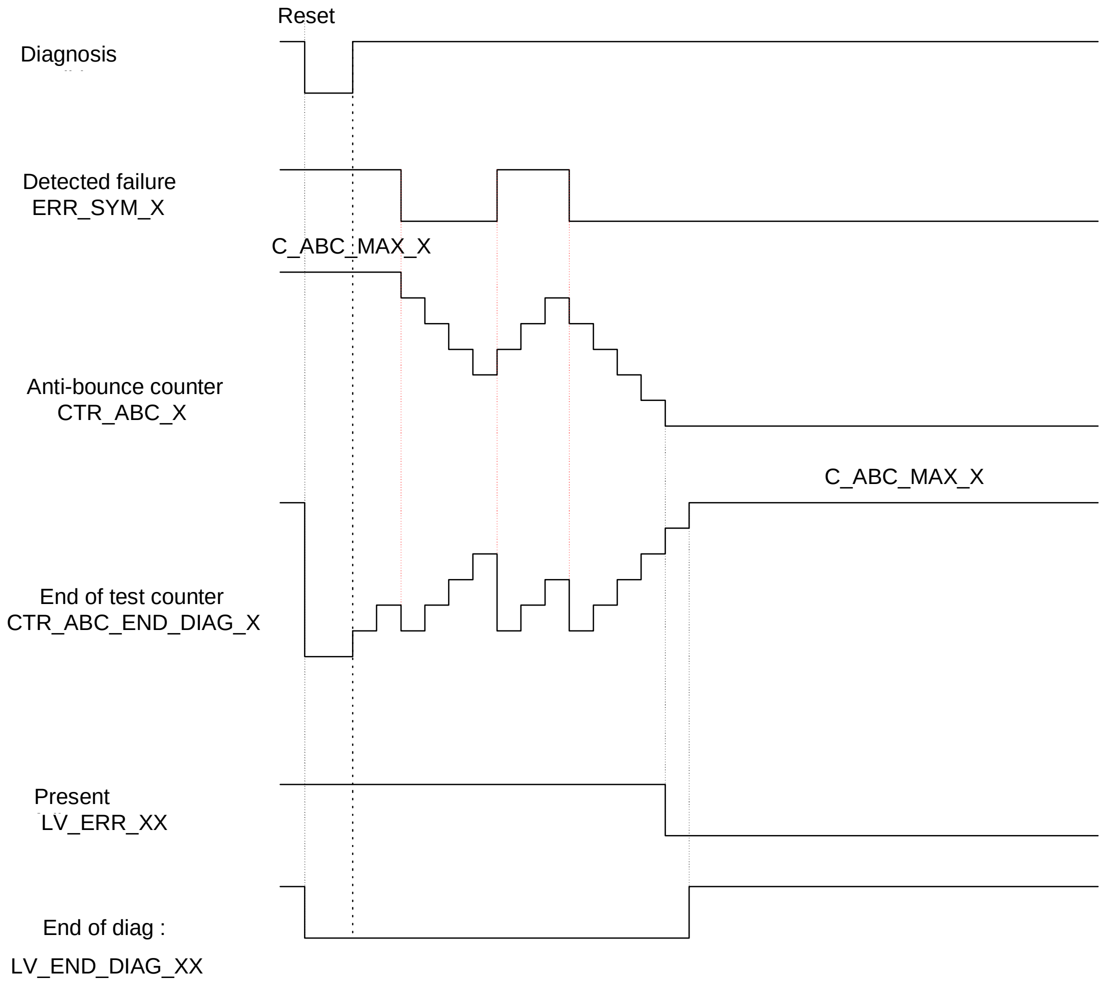

<u>End of diagnosis algorithm illustration when the time to reach the end of diagnosis is minimum</u>

The failure isn't detected (stable) : the end of diagnosis counter is incremented until the maximum value while the diagnosis conditions are fulfilled.
When the end of diagnosis counter has reached the maximum value : the end of diagnosis is set.
The end of diagnosis appears after the minimum time (the detected failure doesn't appear).

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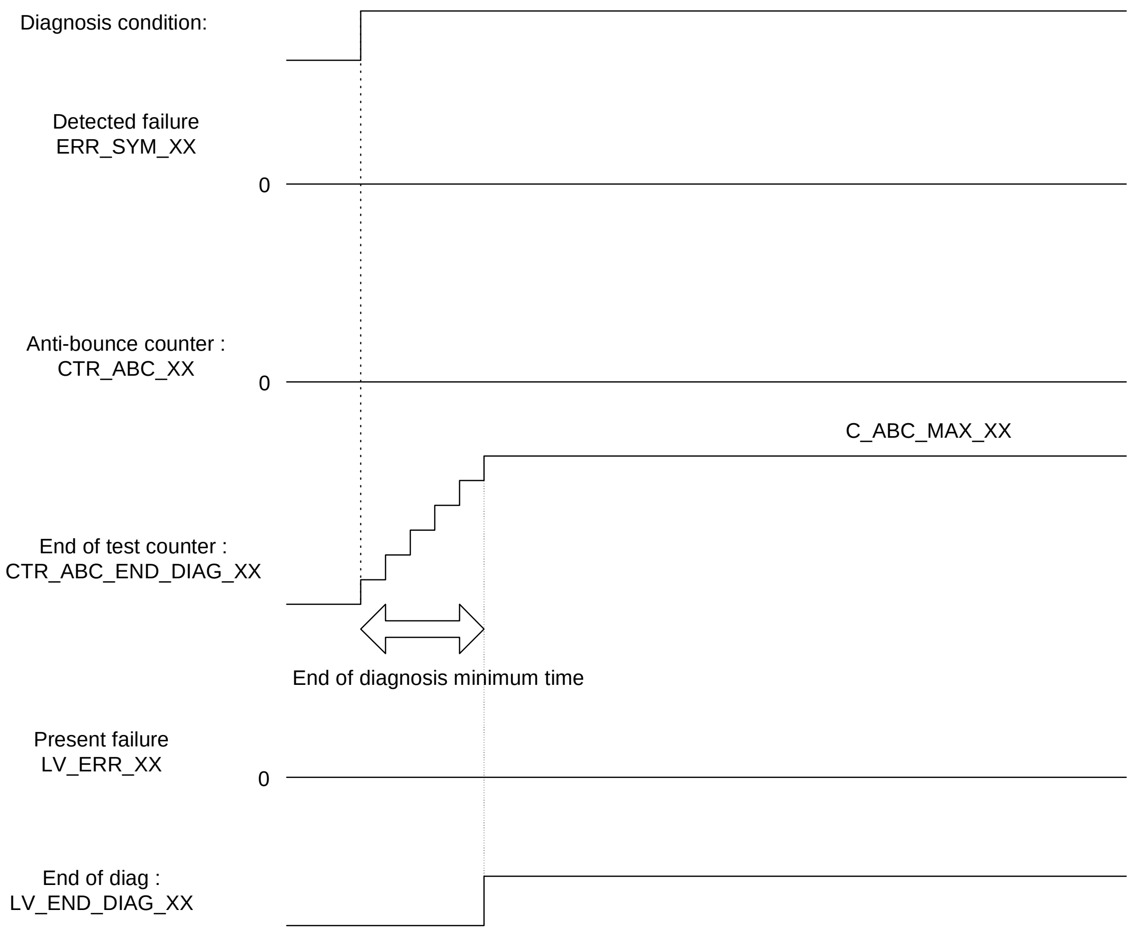

The failure is detected unchangingly (stable) : the end of diagnosis counter is incremented until the maximum value while the diagnosis conditions are fulfilled.
When the failure becomes present : the end of diagnosis is set.
The end of diagnosis and the failure appears after the minimum time (the detected failure is permanent).

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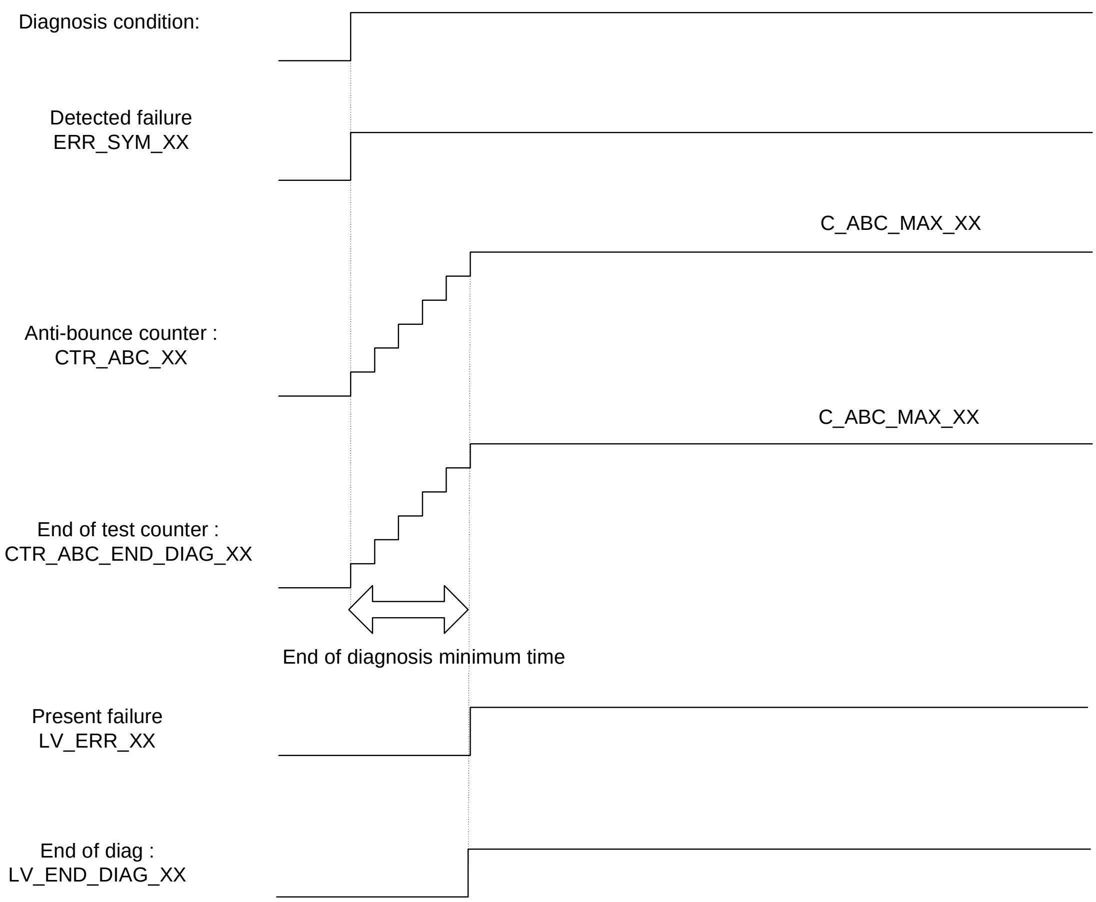

Application conditions

Initialization: *See "Initialisation of anti-bounce, statistical and multi-conditions filters" paragraph*

Recurrence: *The recurrence is managed by the diagnosis.*

Activation: The activation is managed by the diagnosis for the anti-bounce operation or the anti-bounce bench mode.

Deactivation: –

Formula section:

If(0) LV_ABC_INH = 0 *{No inhibition of anti-bounce filtering}*
Then(0)

End of diagnosis in the bench mode:

If(1) (LC_ABC_BENCH = 1 **and** NLC_BENCH_MODE=1) **and** ((C_ABC_INC_XX = 0) **or** (C_ABC_INC_XX = FFH))
Then(1)

LV_CDN_DIAG_XX = 1
LV_END_DIAG_XX = 1

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CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX

End of diagnosis in the normal mode:

Else(1)

If(2) C_ABC_INC_XX = 0 *{ component XX not available }*

Then(2)

LV_END_DIAG_XX = 0

CTR_ABC_END_DIAG_XX = 0

Else(2)

If(3a) (LV_CDN_DIAG_XX = 1) **and** (LV_END_DIAG_XX = 0)

Then(3a) If(4a) ((ERR_SYM_PREV_XX 0) **and** (ERR_SYM_XX = 0))

or ((ERR_SYM__PREV_XX = 0) **and** (ERR_SYM_XX 0))

Then(4a)

CTR_ABC_END_DIAG_XX = 0

Endif(4a)

If(4b) (ERR_SYM_XX 0)

Then(4b)

CTR_ABC_END_DIAG_XX = (CTR_ABC_END_DIAG_XX+ C_ABC_INC_XX)

Else(4b)

If(5) (NLC_ABC_CAL_DEC_XX = 0)

Then(5)

CTR_ABC_END_DIAG_XX = (CTR_ABC_END_DIAG_XX + 1)

Else(5)

CTR_ABC_END_DIAG_XX = (CTR_ABC_END_DIAG_XX + C_ABC_DEC_XX)

Endif(5)

Endif(4b)

If(4c) CTR_ABC_END_DIAG_XX >= C_ABC_MAX_XX

Then(4c) LV_END_DIAG_XX = 1

CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX

Endif(4c)

ERR_SYM_PREV_XX = ERR_SYM_XX

Endif(3a)

If(3b) LV_ERR_XX 0 → 1

Then(3b) LV_END_DIAG_XX = 1

Endif(3b)

Endif(2)

Endif(1)

Else(0)

{Inhibition of anti-bounce filtering}

If(1) (LV_CDN_DIAG_XX = 1

or

((LC_ABC_BENCH = 1 **and** NLC_BENCH_MODE=1)

and (C_ABC_INC_XX = 0) **or** (C_ABC_INC_XX = FFH))

Then(1)

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{ERR_SYM_PREV_XX is updated at each diagnosis recurrence even during the inhibition, so that when the inhibition is removed ERR_SYM_PREV_XX is updated with the value calculated at the last diagnosis recurrence of the inhibition phase.}

ERR_SYM_PREV_XX = ERR_SYM_XX

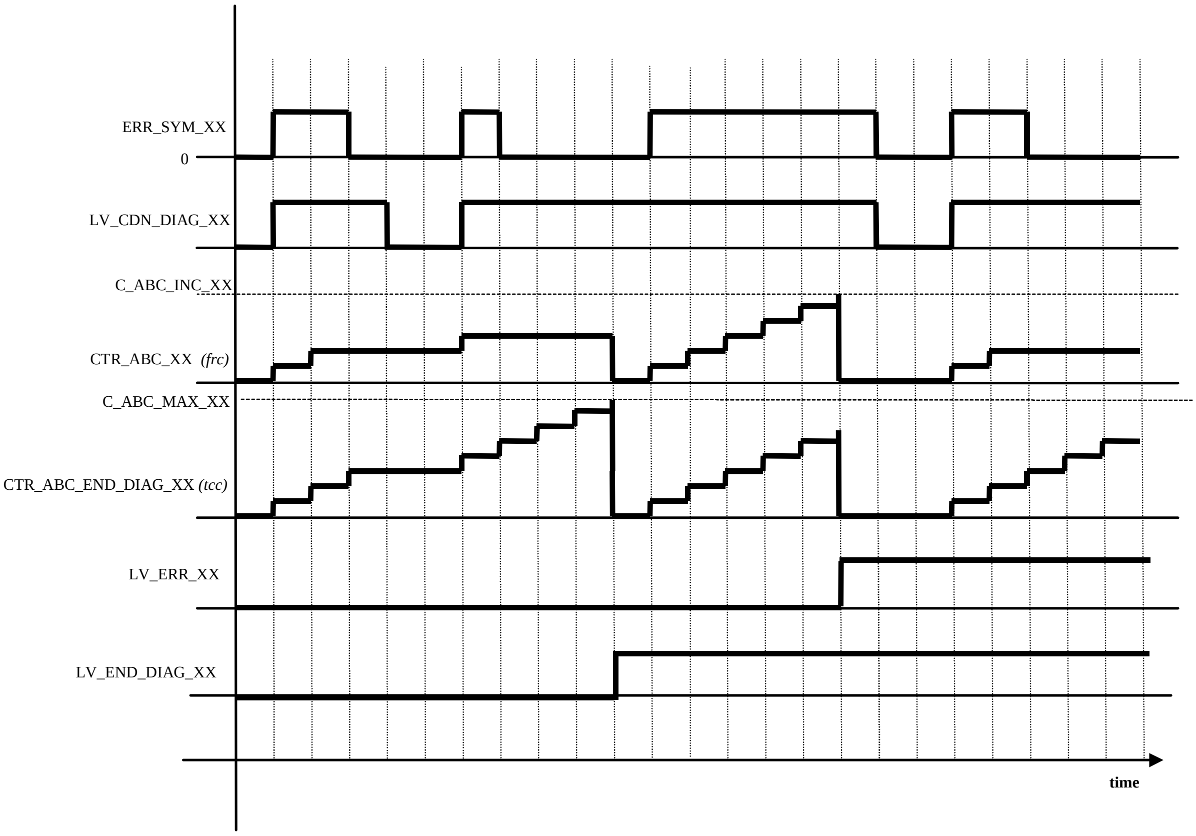
Endif(1)

Endif(0)

A.63.5.3 Standard statistical filtering type

General information:

The purpose is to make an error detection by statistical evaluation.
An error is only detected, if a symptom is active for C_ABC_INC_XX times within the test period C_ABC_MAX XX, with test symptom condition fulfilled (LV_CDN_DIAG_XX = 1).



In this chapter,

- the data CTR_ABC_XX represents the frequency counter
- the calibration C_ABC_INC_XX represents the maximum for frequency counter of the processed symptom
- the data CTR_ABC_END_DIAG_XX represents the period counter increment
- the calibration C_ABC_MAX_XX represents the maximum for test counter of the processed symptom

The calibration C_ABC_MAX_XX must be greater than C_ABC_INC_XX.

Formula section:

Anti-bounce in the bench mode :

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```
If              (LC_ABC_BENCH = 1 and NLC_BENCH_MODE=1)
          and
          ((C_ABC_INC_XX = 0) or (C_ABC_INC_XX = FFH))
Then
          If        C_ABC_INC_XX = 0
                 Then
                ERR_SYM_XX = 0
                    LV_ERR_XX = 0
                    CTR_ABC_XX = 0
             Else
                If        C_ABC_INC_XX = FFH
                    Then
                         ERR_SYM_XX = 0FH
                         LV_ERR_XX = 1
                         CTR_ABC_XX = C_ABC_INC_XX
                    Endif
             Endif
Endif
```

Frequency counter increment:

```
If              LV_CDN_DIAG_XX = 1
          and ERR_SYM_XX   0
          and C_ABC_INC_XX   0
Then
          If        NC_ERR_DET_UPD = 1
                and LC_ERR_DET_UPD = 1
          Then
                ACTION_ERRM_UpdErrDet( IN<XX>, SYNCHRONIZATION<CALL> )
          Endif
          CTR_ABC_XX = CTR_ABC_XX + 1
Endif
```

Period counter increment:

```
If              LV_CDN_DIAG_XX = 1
Then
          CTR_ABC_END_DIAG_XX = CTR_ABC_END_DIAG_XX + 1
Endif
```

Detection of the error state for the current symptom:

```
If              CTR_ABC_XX >= C_ABC_INC_XX
Then
          LV_ERR_XX = 1
          { The current symptom is entered to failure memory }
Endif
```

Detection of the error free symptom:

```
If              CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX
       and CTR_ABC_XX < C_ABC_INC_XX
Then
          LV_ERR_XX = 0
Endif
```

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End of the diagnostic period for statistic symptom:

If CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX
or CTR_ABC_XX = C_ABC_INC_XX
Then
CTR_ABC_XX = 0
CTR_ABC_END_DIAG_XX = 0
{ End of diagnostic period for statistic symptom is reached }
LV_END_DIAG_XX=1
Endif

A.63.6 Description for ACTION_ERRM_NoFilterSymptom :

Syntax : ACTION_ERRM_NoFilterSymptom(IN<XX>, IN<lv_cdn_diag_XX>, IN<err_sym_XX>, IN<lv_err_set_XX>, IN<lv_err_reset_XX>, IN<lv_end_diag_XX>, OUT<LV_ERR_XX>)

Parameter(in) : XX Type: index to identify the Diagnostic
lv_cdn_diag_XX Type: Diagnostic condition
err_sym_XX Status of failure
lv_err_set_XX Type: Boolean to set the failure
lv_err_reset_XX Type: Boolean to reset the failure
lv_end_diag_XX Type: Boolean (=1 when result available)
Parameter(out) : LV_ERR_XX Type: Boolean (=1 when failure)
Short Description : This action returns the result on symptoms detected at each diagnostic recurrence, when no filter is used.

A.63.7 System Description:

This action is used in case of diagnostics which don't need any filtering will use the “NO type” filter.
LV_ERR_XX is managed as a **STD** anti-bounce filtering type (saved in NVMY at end of power latch, ...).

LV_END_DIAG_XX is managed by error management (reset at DC transition, ...).
ERR_SYM_XX is updated at each diagnostic recurrence, to fulfil the diagnostic result.

Formula section :

If LV_ABC_INH = 0 *{No inhibition of anti-bounce filtering}*
Then
If lv_end_diag_XX = 1
Then
LV_END_DIAG_XX = 1
Endif

If lv_err_set_XX = 1
Then
LV_ERR_XX = 1
Endif

If lv_err_reset_XX = 1
Then
LV_ERR_XX = 0
Endif

If lv_cdn_diag_XX =1

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Then
LV_CDN_DIAG_XX = 1
ERR_SYM_XX = err_sym_xx
Else
LV_CDN_DIAG_XX = 0
{ ERR_SYM_XX is unchanged }
Endif
Endif

A.63.8 Description for ACTION_ERRM_AbcFilterSymptomEnd:

Syntax: ACTION_ERRM_AbcFilterSymptomEnd(IN<XX>, IN< C_ABC_MAX_XX>, OUT< LV_ERR_XX >)
Parameter(in): XX Type: index to identify the Diagnostic
C_ABC_MAX_XX Maximum value of anti-bounce counter
Parameter(out): LV_ERR_XX Type: Boolean
Short Description: This action erases diagnostic failure and sets immediately the end of diagnostic information in case of anti-bounce filter (STD, STD_INI, STC, MEM and MEM_INI)

Formula section :

If LV_ABC_INH = 0 *{No inhibition of anti-bounce filtering}*
Then
LV_CDN_DIAG_XX = 1
ERR_SYM_XX = NO_SYM
LV_ERR_XX = 0
CTR_ABC_XX = 0
LV_END_DIAG_XX = 1
CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX
Endif

A.63.9 Description for ACTION_ERRM_NoFilterSymptomEnd:

Syntax: ACTION_ERRM_NoFilterSymptomEnd(IN<XX>, OUT<LV_ERR_XX>)
Parameter(in): XX Type: index to identify the Diagnostic
Parameter(out): LV_ERR_XX Type: Boolean
Short Description: This action erases diagnostic failure and sets immediately the end of diagnostic information in case of no filter (NO)

Formula section :

If LV_ABC_INH = 0 *{No inhibition of anti-bounce filtering}*
Then
LV_CDN_DIAG_XX = 1
ERR_SYM_XX = NO_SYM
LV_ERR_XX = 0
LV_END_DIAG_XX = 1
Endif

A.63.10 Description for ACTION_ERRM_AbcFilterReset:

Syntax: ACTION_ERRM_AbcFilterReset(IN<XX>, OUT<LV_ERR_XX>)
Parameter(in): XX Type: index to identify the Diagnostic

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Parameter(out): LV_ERR_XX Type: Boolean
Short Description: This action resets data filter in case of ABC filter type

Formula section :

If LV_ABC_INH = 0 *{No inhibition of anti-bounce filtering}*
Then
LV_CDN_DIAG_XX = 0
ERR_SYM_XX = NO_SYM
LV_ERR_XX = 0
CTR_ABC_XX = 0
LV_END_DIAG_XX is unchanged
CTR_ABC_END_DIAG_XX is unchanged
Endif

A.63.11 Description for ACTION_ERRM_NoFilterReset:

Syntax: ACTION_ERRM_NoFilterReset(IN<XX>, OUT<LV_ERR_XX>)
Parameter(in): XX Type: index to identify the Diagnostic
Parameter(out): LV_ERR_XX Type: Boolean
Short Description: This action resets data filter in case of no filter usage

Formula section :

If LV_ABC_INH = 0 *{No inhibition of anti-bounce filtering}*
Then
LV_CDN_DIAG_XX = 0
ERR_SYM_XX = NO_SYM
LV_ERR_XX = 0
LV_END_DIAG_XX is unchanged
Endif

A.63.12 Description for ACTION_ERRM_GetLvErr:

Syntax: ACTION_ERRM_GetLvErr(IN<XX>, OUT<LV_ERR_XX>)
Parameter(in): XX Type: index to identify the Diagnostic
Parameter(out): LV_ERR_XX Type: Boolean
Short Description: This action returns the failure status for the diagnostic XX.

Formula section :

LV_ERR_XX = failure status for the diagnostic XX

A.63.13 Description for ACTION_ERRM_GetLvEndDiag:

Syntax: ACTION_ERRM_GetLvEndDiag(IN<XX>, OUT<LV_END_DIAG_XX>)
Parameter(in): XX Type: index to identify the Diagnostic
Parameter(out): LV_END_DIAG_XX Type: Boolean
Short Description: This action returns the end of diagnostic flag for the diagnostic XX.

Formula section :

LV_END_DIAG_XX = end of diagnostic flag for the diagnostic XX

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A.63.14 Description for ACTION_ERRM_GetLvCdnDiag:

Syntax: ACTION_ERRM_GetLvCdnDiag(IN<XX>, OUT<LV_CDN_DIAG_XX>)
Parameter(in): XX Type: index to identify the Diagnostic
Parameter(out): LV_CDN_DIAG_XX Type: Boolean
Short Description: This action returns the condition status for the diagnostic XX.

Formula section :

LV_CDN_DIAG_XX = condition status for the diagnostic XX

A.63.15 Description for ACTION_ERRM_GetErrSym:

Syntax: ACTION_ERRM_GetErrSym(IN<XX>, OUT<ERR_SYM_XX>)
Parameter(in): XX Type: index to identify the Diagnostic
Parameter(out): ERR_SYM_XX Status of failure
Short Description: This action returns the symptoms for the diagnostic XX.

Formula section :

ERR_SYM_XX = symptoms for the diagnostic XX

A.63.16 CPU load optimisation mechanisms

General information:

This section describes the mechanism of optimisation. The principle is to suspend the filter algorithm execution when it is not necessary.

Formula section:

If NLC_BENCH_MODE = 0
Then
{ the bench mode isn't available whatever LC_ABC_BENCH value }
the CPU load is reduced
Else
{ the bench mode is available if LC_ABC_BENCH = 1 }
less CPU load reduction than with NLC_BENCH_MODE = 0
Endif

Case 1 : the diagnostic uses an anti-bounce filtering algorithm
If LV_ERR_XX = 0
and LV_END_DIAG_XX = 1
and ERR_SYM_XX = 0
and CTR_ABC_XX = 0
Then
{ it is not necessary to call the Error Management (including the filtering) }
LV_END_DIAG_XX = 1 *{ unchanged }*
LV_ERR_XX = 0 *{ unchanged }*
Endif

Case 2 : the diagnostic doesn't use an anti-bounce filtering algorithm
If (LV_ERR_XX = 0 **and** LV_END_DIAG_XX = 1 **and** ERR_SYM_XX = 0)
Then

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{ it is not necessary to call the Error Management }
LV_END_DIAG_XX = 1 *{ unchanged }*
LV_ERR_XX = 0 *{ unchanged }*

Endif

A.63.17 Synchronisation between Anti-bounce algorithm and Error Management

General information:

This section describes the mechanism of synchronisation of the failure filtering with the Error Management core. The principle is to call the Error Management upon events.

LV_END_DIAG_XX 0 → 1 transition
LV_ERR_XX 0 → 1 transition
LV_ERR_XX 1 → 0 transition

This mechanism is followed whatever the filter (type STD, STD_INI, DEC_CAL, MEM, MEM_INI, STC) but also for diagnoses which don't use any filter (type NO).

A.63.18 Configuration and calibration data

NC_ABC_CONF_FCT_DIAG_XX :

```
bit 0 : NLC_ABC_NOT_SAVE_XX
bit 1 : NLC_ABC_INI_IGK_XX
bit 2 : NLC_ABC_INI_VALUE_XX
bit 3 : NLC_ABC_NOT_DEC_XX
bit 4 : NLC_ABC_CAL_DEC_XX
bit 5 : NLC_ABC_STC_XX
bit 6 : Not used
bit 7 : Not used
```

Bits definition

- NLC_ABC_NOT_SAVE_XX : if this bit is set to 0 the anti-bounce context (CTR_ABC_XX and LV_ERR_XX) is saved at the end of power latch, only when the failure is in dynamic memory, and restored at the event Reset.

Limitation : the saved configuration is only available if the NVMY manager take into account the filter environment data (LV_ERR_XX, CTR_ABC_XX).

- NLC_ABC_INI_IGK_XX : LV_ERR_XX and CTR_ABC_XX are reset at the transition LV_IGK 0 -> 1 and at the event reset.

- NLC_ABC_INI_VALUE_XX : if this bit is set to 1 then the anti-bounce counter is initialised with C_ABC_MAX_XX - C_ABC_INC_XX if there was a failure between the last and this initialisation (NLC_ABC_NOT_SAVE_XX = 0 to test the failure before this initialisation) else the anti-bounce counter is initialised with 0 value.

- NLC_ABC_NOT_DEC_XX : if this bit is set to 0 then the anti-bounce counter can be decremented if the condition for decrement are fulfilled. If this bit is set to 1 then the anti-bounce counter can be decremented if the condition for decrement are fulfilled until the anti-bounce counter hasn't reached the maximum value; when the anti-bounce counter has reached the maximum value then the anti-bounce counter and the failure remains (the anti-bounce counter can be decremented anymore) until a transition LV_IGK 0 → 1 or reset following the NLC_ABC_INI_IGK_XX bit configuration (If the NLC_ABC_NOT_DEC_XX bit is set to 1 then NLC_ABC_NOT_SAVE_XX must be set to 1).

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- NLC_ABC_CAL_DEC_XX : if this bit is set then the anti-bounce decrement is calibratable, the calibration is named C_ABC_DEC_XX else the anti-bounce decrement is equal to 1 and there isn't calibration.
- NLC_ABC_STC_XX : if this bit is set then the filter used is the statistical filter else the filter used is the anti-bounce filter (Standard configuration).

Predefined filter type :

	NLC_ABC_STC_XX	NLC_ABC_CAL_DEC_XX	NLC_ABC_NOT_DEC_XX	NLC_ABC_INI_VALUE_XX	NLC_ABC_INI_IGK_XX	NLC_ABC_NOT_SAVE_XX
STD_INI	0	0	0	0	1	1
STD	0	0	0	0	0	0
MEM	0	0	1	0	1	1
MEM_INI	0	0	1	1	1	0
DEC_CAL	0	1	0	0	0	0
STC	1	0	0	0	1	1
NO	0	0	0	0	0	0

The **standard configuration with initialisation (STD_INI)** is NC_ABC_CONF_FCT_DIAG_XX = 3H (default configuration)
The data CTR_ABC_XX and LV_ERR_XX are reset at the transition LV_IGK 0 → 1 and reset (NLC_ABC_NOT_SAVE_XX = 1, NLC_ABC_INI_IGK_XX = 1) and the anti-bounce counter is initialised to 0 value (NLC_ABC_INI_VALUE_XX = 0).
The anti-bounce counter may be decremented (NLC_ABC_NOT_DEC_XX = 0).
The decrement value is equal to 1 (NLC_ABC_CAL_DEC_XX = 0).
The filter used is the Anti-bounce (NLC_ABC_STC_XX = 0).

The **statistical configuration (STC)** is NC_ABC_CONF_FCT_DIAG_XX = 23H
The data CTR_ABC_XX and LV_ERR_XX are reset at the transition LV_IGK 0 → 1 and reset (NLC_ABC_NOT_SAVE_XX = 1, NLC_ABC_INI_IGK_XX = 1) and the frequency counter (CTR_ABC_XX) is initialised to 0 value (NLC_ABC_INI_VALUE_XX = 0).
The filter used is the statistical (NLC_ABC_STC_XX = 1).

The **standard configuration (STD)** is NC_ABC_CONF_FCT_DIAG_XX = 0H
The data CTR_ABC_XX and LV_ERR_XX are saved (NLC_ABC_NOT_SAVE_XX = 0, NLC_ABC_INI_IGK_XX = 0, NLC_ABC_INI_VALUE_XX = 0).
The anti-bounce counter may be decrement (NLC_ABC_NOT_DEC_XX = 0).
The decrement value is equal to 1 (NLC_ABC_CAL_DEC_XX = 0).

The **memory configuration (MEM)** is NC_ABC_CONF_FCT_DIAG_XX = BH

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The data CTR_ABC_XX and LV_ERR_XX are reset at the transition LV_IGK 0 → 1 and reset (NLC_ABC_NOT_SAVE_XX = 1, NLC_ABC_INI_IGK_XX = 1) and the anti-bounce counter is initialised to 0 value (NLC_ABC_INI_VALUE_XX = 0).
The anti-bounce counter can be decremented if the condition for decrement are fulfilled until the anti-bounce counter hasn't reached the maximum value; when the anti-bounce counter has reached the maximum value then the anti-bounce counter and the failure remains until a transition LV_IGK 0 → 1 or reset (NLC_ABC_NOT_DEC_XX = 1).
The decrement value is equal to 1 (NLC_ABC_CAL_DEC_XX = 0).

The **memory configuration (MEM_INI)** is NC_ABC_CONF_FCT_DIAG_XX = EH
The data CTR_ABC_XX and LV_ERR_XX are initialised at the transition LV_IGK 0 → 1 and reset (NLC_ABC_INI_IGK_XX = 1). The anti-bounce counter is initialised to the C_ABC_MAX_XX - C_ABC_INC_XX value (NLC_ABC_INI_VALUE_XX = 1) only if there was a failure between the last and this initialisation (NLC_ABC_NOT_SAVE_XX = 0 to test the failure before this initialisation) else the anti-bounce counter is initialised with 0 value. The data LV_ERR_XX is initialised with 0 value.
The anti-bounce counter can be decremented if the condition for decrement are fulfilled until the anti-bounce counter hasn't reached the maximum value; when the anti-bounce counter has reached the maximum value then the anti-bounce counter and the failure remains until a transition LV_IGK 0 → 1 or reset (NLC_ABC_NOT_DEC_XX = 1).
The decrement value is equal to 1 (NLC_ABC_CAL_DEC_XX = 0).

The **decrement calibratable configuration (DEC_CAL)** is set with NC_ABC_CONF_FCT_DIAG_XX = 10H
The data CTR_ABC_XX and LV_ERR_XX are saved (NLC_ABC_NOT_SAVE_XX = 0, NLC_ABC_INI_IGK_XX = 0, NLC_ABC_INI_VALUE_XX = 0).
The anti-bounce counter may be decrement (NLC_ABC_NOT_DEC_XX = 0).
The decrement value is calibratable (NLC_ABC_CAL_DEC_XX = 1).

The standard configuration is NLC_ABC_INI_DC_END_DIAG = 0 and NC_ERR_DET_UPD = 0 (default configuration).
Some functionalities (e.g. : to visualise the sporadic error of all diagnosis using this anti-bounce algorithm) aren't used when the failure is detected.
Remark :
The standard calibration is LC_ABC_BENCH = 0 **and** NLC_BENCH_MODE=0 (default calibration) then the bench mode isn't managed.
If the diagnosis doesn't manage calibratable decrement then the C_ABC_DEC_XX calibration isn't defined in calibration data (NLC_ABC_CAL_DEC_XX = 0).
Configuration detailed description:
NLC_ABC_INI_DC_END_DIAG
1 : Initialisation of LV_END_DIAG_XX at LV_DC 1→0 transition
0 : Initialisation of LV_END_DIAG_XX at LV_IGK 0→1 transition or ECU reset

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A.64 Debounce algorithm (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ERR_INTM_NR	V	0... FFH	0... 255	1	-
Number of failures stored in intermittent failure array					
ERR_INTM_CTR_FRC [NC_NR_ERR_INTM]	V/S	0... FFH	0... 255	1	-
Frequency of reappearence of failure stored in ERR_INTM_DIAG_INST					
ERR_INTM_DIAG_INST [NC_NR_ERR_INTM]	V/S	0... FFFFH	0... 65535	1	-
Array of diagnosis instances with intermittent failure					
LV_ABC_INH	O/V	0... 1H	0 ...1	1	-
Anti-bounce filterings inhibition					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_ERR_INTM	-	1... FFH	1... 255	1	-
Maximum number of diagnosis instances to be listed in ERR_INTM_DIAG_INST					

Action definition

ACTION_ERRM_InhibitFiltering (**IN**<InhibitFilter>)	Mode: O
This action shall be used to inhibit anti-bounce filtering calculations	

FUNCTION DESCRIPTION:

General information:

Intermittent failures are neither visualized nor stored with the following configuration :
NLC_ERR_DET_UPD = 00h

Application conditions

Initialisation:
```
ERR_INTM_DIAG_INST[0...NC_NR_ERR_INTM -1] = 0
ERR_INTM_CTR_FRC[0...NC_NR_ERR_INTM -1] = 0
CTR_ERR_INTM_NR = 0
```

Recurrence: -

Activation: *at ECU reset*

Formula section:

No action to be performed with this configuration.

A.64.1 Anti-bounce filtering inhibition

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Description:

In addition, LV_ABC_INH flag must be securised to avoid any undesired inhibition.
To avoid failure recording during specific ECU phases (e.g. reprogramming,...), diagnoses are inhibited.
To realize this inhibition, anti-bounce filtering calculations are frozen.
This inhibition is generally used during reprogramming phase.

Syntax: ACTION_ERRM_InhibitFiltering (IN <InhibitFilter>)
Parameter(in): InhibitFilter filter inhibition
Parameter(out: No parameter
Short Description: This API permits to activate or deactivate the anti-bounce calculation.

Application conditions

Initialisation:
```
at ECU reset
  LV_ABC_INH = 0
(default value :  Anti-bounce calculation is not inhibited)
```

Recurrence: -

Activation: *at action request*

Formula section:

LV_ABC_INH = 0

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A.65 Diagnostic filter algorithms

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A.66 Diagnostic filter algorithms (Appl. Inc.)

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A.67 Electrical diagnosis of power stage outputs

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_XX	-	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom for XX					
ERR_DIAG_XX	-	0... 7H	0 ...7	1	-
Diagnosis symptom (raw value) for each symptom for XX					

Input data:

CDN_DIAG_XX {p. 4614}	ERR_DIAG_XX {p. 4614}	LV_IGK {p. 906}	LV_INH_DIAG_XX
XXPWM			

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY	-	0... FFH	0... 255	1	-
The diagnosis is reactivated after (LV_INH_DIAG_XX 1->0 or CDN_DIAG_XX >0 (depending on case)) and LV_IGK 0->1 and reset and FMY reset after NC_PSD_DLY recurrences.					

Import actions:

ACTION_ERRM_FilterMulticondition (**IN**<XX>,**IN**<CDN_DIAG_>,**XX**>,<IN<>,**ERR_DIAG_XX**>,<IN>,<C_ABC_INC_XX>,**IN**<C_ABC_MAX_XX>,**OUT**<LV_ERR_XX>)
ACTION_ERRM_FilterMulticondition (**IN**<XX>,**IN**<CDN_DIAG_>,**XX**>,<IN<>,**ERR_DIAG_XX**>,<IN>,<C_ABC_INC_XX>,**IN**<C_ABC_MAX_XX>,**OUT**<LV_ERR_XX>)
ACTION_ERRM_FilterMulticondition (**IN**<XX>,**IN**<CDN_DIAG_>,**XX**>,<IN<>,**ERR_DIAG_XX**>,<IN>,<C_ABC_INC_XX>,**IN**<C_ABC_MAX_XX>,**OUT**<LV_ERR_XX>)

FUNCTION DESCRIPTION:

General information:

In this function description the electrical diagnosis of power stage outputs is specified. Because of the possibility of different hardware configurations, the specification is splited into three parts plus one common part for the symptom debounce and error management treatment.

- Diagnosis of static outputs (e.g. relays)
- Diagnosis of pwm outputs (e.g. VVT actuator)
- Diagnosis of special outputs (other hardware configurations)

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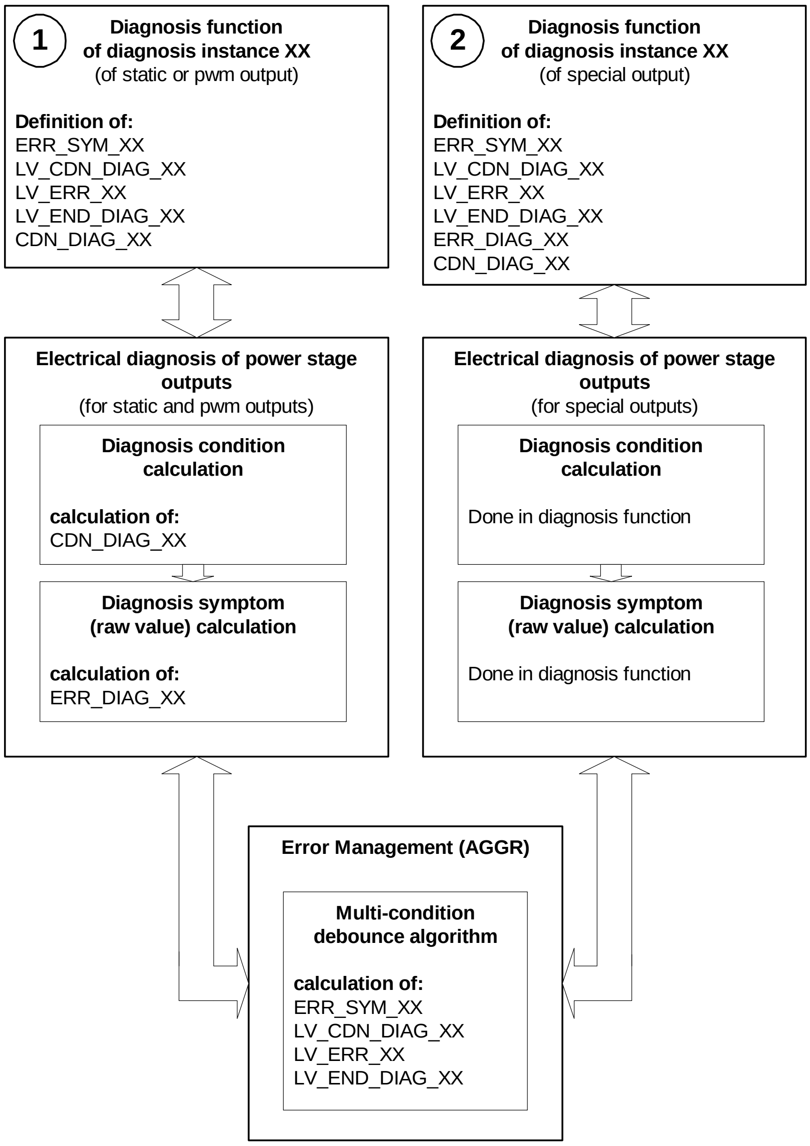

According these three different kind of driver outputs the management of the electrical diagnosis is different between static/pwm outputs and special outputs (see previous picture case 1 and 2).
For all types of these diagnoses three main calculations must be done:

- Diagnosis condition calculation
- Diagnosis symptom (raw value) calculation
- anti-bounce mechanism with error management treatments

In the following chapter these treatments are described.

A.67.1 Diagnosis of static outputs

General information:

The purpose is to diagnose electrical errors detected by the hardware for static outputs. The signal is controlled by the ATIC 39.
The driver can distinguish between three symptoms: ‘Short to battery’ SCB, ‘Short to ground’ SCG and ‘Open circuit’ OC.

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Description:

By the diagnosis condition calculation the information given by the BSW ('Diagnosis of symptom ... is valid') that shows, that a diagnosis of a symptom was possible, since the last recurrence of the diagnosis function, is displayed for each symptom within the value CDN_DIAG_XX.
The information of the failure symptom is also delivered by the BSW ('Failure symptom ... detected by HW'). According this information the diagnosis symptom (raw value) calculation is performed to set ERR_DIAG_XX.
The calculation of LV_ERR_XX, LV_CDN_DIAG_XX, ERR_SYM_XX and LV_END_DIAG_XX is done in the Multi-condition debounce algorithm (part of Error Management AGGR).

Application conditions

Initialization: –

Recurrence: –

Activation:
```
every ECU state
reactivation in the NC_PSD_DLY recurrence after LV_INH_DIAG_
XX 1->0 and LV_IGK 0->1 and reset and FMY reset
```

Deactivation:
```
LV_INH_DIAG_XX = 1
 at deactivation:  CDN_DIAG_XX = 0
```

Formula section:

Diagnosis condition calculation:
CDN_DIAG_XX = 0

Diagnosis condition calculation for symptom 'Short to battery' SCB:
If 'Diagnosis of symptom SCB is valid' (BSW information)
Then bit 0 of CDN_DIAG_XX = 1
Endif

Diagnosis condition calculation for symptom 'Short to ground' SCG:
If 'Diagnosis of symptom SCG is valid' (BSW information)
Then bit 1 of CDN_DIAG_XX = 1
Endif

Diagnosis condition calculation for symptom 'Open circuit' OC:
If 'Diagnosis of symptom OC is valid' (BSW information)
Then bit 2 of CDN_DIAG_XX = 1
Endif

Diagnosis symptom (raw value) calculation:
Symptom calculation for 'Short to battery' SCB:
If 'Failure symptom SCB detected by HW' (BSW information)
Then bit 0 of ERR_DIAG_XX = 1
Else bit 0 of ERR_DIAG_XX = 0
Endif

Symptom calculation for 'Short to ground' SCG:
If 'Failure symptom SCG detected by HW' (BSW information)
Then bit 1 of ERR_DIAG_XX = 1
Else bit 1 of ERR_DIAG_XX = 0

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Endif

Symptom calculation for 'Open circuit' OC:

If 'Failure symptom OC detected by HW' (BSW information)
Then bit 2 of ERR_DIAG_XX = 1
Else bit 2 of ERR_DIAG_XX = 0
Endif

ACTION_ERRM_FilterMulticondition (*XX*, CDN_DIAG_XX, ERR_DIAG_XX, LV_END_DIAG_XX, LV_ERR_XX, LV_CDN_DIAG_XX, ERR_SYM_XX)
Remark: For failure debouncing and error management treatment the algorithm Multi-condition debounce algorithm (part of Error Management AGGR) is used with the parameters CDN_DIAG_XX and ERR_DIAG_XX.

A.67.2 Diagnosis of PWM outputs

FUNCTION DESCRIPTION:

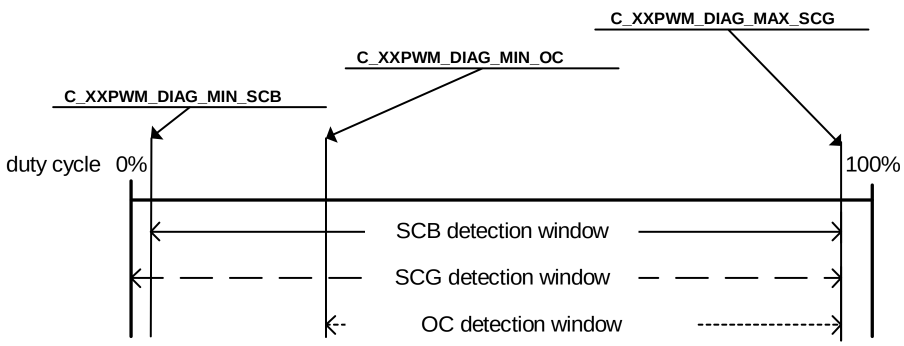
General information:

The purpose is to diagnose electrical errors detected by the hardware for PWM outputs. The signal is controlled by ATIC39.
The driver can distinguish between three symptoms: 'Short to battery' SCB, 'Short to ground' SCG and 'Open circuit' OC.

Because of the different filter times for SCB, SCG and OC detection, the diagnosis window, where a symptom can be detected, is defined for each symptom. A diagnosis window is defined by a minimum and a maximum duty cycle of the PWM signal controlled by the output of the driver.
SCB diagnosis window:
C_XXPWM_DIAG_MIN_SCB <- – – – –> C_XXPWM_DIAG_MAX_SCG

SCG diagnosis window:
0 <- – – – –> C_XXPWM_DIAG_MAX_SCG

OC diagnosis window:
C_XXPWM_DIAG_MIN_OC <- – – – –> C_XXPWM_DIAG_MAX_SCG



For some diagnosis it's not necessary to define different diagnosis windows for each symptom. This is possible for all diagnosis, where a limitation of the duty cycle range is made within the function which controls the corresponding output. The limitation must be made in this way, that a diagnosis of all three

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symptoms can always (if LV_INH_DIAG_XX= 0) be made (CDN_DIAG_XX = 7H, LV_CDN_DIAG_XX = 1).

These two possibilities of a diagnosis condition calculation are described in the following chapter. It's distinguished between a "open range" (different diagnosis windows for each symptom necessary) and a "limited" duty cycle calculation.

A.67.2.1 Diagnosis condition calculation

A.67.2.1.1 Open range duty cycle

Description:

For an output with an "open range" duty cycle range, a diagnosis result of a symptom can be considered as valid, if the duty cycle of the PWM output was in the right window at least one time between two calculations of the diagnosis function and not only if diagnosis function is called. To have a better reflection of this behavior, the diagnosis condition is calculated independently of the diagnosis function.
If the recurrence of the 'diagnosis condition' calculation is the same like the 'symptom' calculation, the 'diagnosis condition' calculation must be treated after the 'symptom' calculation to have a new diagnosis condition CDN_DIAG_XX information of the following diagnosis window for the next symptom calculation.

Application conditions

Initialization: -

Recurrence: -

Activation: every ECU state
reactivation in the NC_PSD_DLY recurrence after LV_INH_DIAG_XX 1->0 and LV_IGK 0->1 and reset and FMY reset

Deactivation: LV_INH_DIAG_XX = 1
at deactivation CDN_DIAG_XX = 0

Formula section:

Diagnosis window calculation:

If 0 <= XXPWM < C_XXPWM_DIAG_MIN_SCB
Then bit 1 of CDN_DIAG_XX = 1
Diagnosis of SCG is valid

Else **If** XXPWM < C_XXPWM_DIAG_MIN_OC
Then bit 0 and bit 1 of CDN_DIAG_XX = 1
Diagnosis of SCB, SCG is valid

Else **If** XXPWM <= C_XXPWM_DIAG_MAX_SCG
Then bit 0, bit 1 and bit 2 of CDN_DIAG_XX = 1
Diagnosis of SCB, SCG and OC is valid
Endif
Endif
Endif

A.67.2.1.2 Limited duty cycle

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Description:

For an output with a “limited” duty cycle range, the diagnosis result of a symptom can always be considered as valid, because of the current duty cycle. It only can be invalid because special conditions managed by the BSW.

Application conditions

Initialization: –

Recurrence: –

Activation: every ECU state
reactivation in the NC_PSD_DLY recurrence after LV_INH_DIAG_XX 1->0 and LV_IGK 0->1 and reset and FMY reset

Deactivation: LV_INH_DIAG_XX = 1
at deactivation: CDN_DIAG_XX = 0

Formula section:

bit 0, bit 1 and bit 2 of CDN_DIAG_XX = 1
Diagnosis of SCB, SCG and OC is valid

A.67.2.2 Diagnosis symptom (raw value) calculation

FUNCTION DESCRIPTION:

Application conditions

Initialization: –

Recurrence: –

Activation: every ECU state
reactivation in the NC_PSD_DLY recurrence after LV_INH_DIAG_XX 1->0 and LV_IGK 0->1 and reset and FMY reset

Deactivation: *LV_INH_DIAG_XX = 1*

Formula section:

Symptom calculation for ‘Short to battery’ SCB:
If ‘Failure symptom SCB detected by HW’ (BSW information)
Then bit 0 of ERR_DIAG_XX = 1
Else bit 0 of ERR_DIAG_XX = 0
Endif

Symptom calculation for ‘Short to ground’ SCG:
If ‘Failure symptom SCG detected by HW’ (BSW information)
Then bit 1 of ERR_DIAG_XX = 1
Else bit 1 of ERR_DIAG_XX = 0
Endif

Symptom calculation for ‘Open circuit’ OC:

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If ‘Failure symptom OC detected by HW’ (BSW information)
Then bit 2 of ERR_DIAG_XX = 1
Else bit 2 of ERR_DIAG_XX = 0
Endif

Diagnosis condition from BSW verification:
Diagnosis condition calculation for symptom ‘Short to battery’ SCB:
If ‘Diagnosis of symptom SCB is not valid’ (BSW information)
Then bit 0 of CDN_DIAG_XX = 0
Endif
Diagnosis condition calculation for symptom ‘Short to ground’ SCG:
If ‘Diagnosis of symptom SCG is not valid’ (BSW information)
Then bit 0 of CDN_DIAG_XX = 0
Endif

Diagnosis condition calculation for symptom ‘Open circuit’ OC:
If ‘Diagnosis of symptom OC is not valid’ (BSW information)
Then bit 0 of CDN_DIAG_XX = 0
Endif

ACTION_ERRM_FilterMulticondition (*XX*, CDN_DIAG_XX, ERR_DIAG_XX, LV_END_DIAG_XX, LV_ERR_XX, LV_CDN_DIAG_XX, ERR_SYM_XX)
Remark: For failure debouncing and error management treatment the algorithm Multi-condition debounce algorithm (part of Error Management AGGR) is used with the parameters CDN_DIAG_XX and ERR_DIAG_XX.
CDN_DIAG_XX = 0 (after failure debouncing and error management treatment)

A.67.3 Diagnosis of special outputs

General information:

The purpose is to diagnose electrical errors detected by the hardware for special outputs. Special outputs are outputs, which cannot be treated like “normal” static or pwm outputs, like described in the previous chapters.

Description:

The diagnosis condition calculation for the driver output is done in the diagnosis function of the diagnosis instance XX. It’s displayed for each symptom within the value CDN_DIAG_XX. Also the diagnosis symptom (raw value) calculation (ERR_DIAG_XX) is performed in the diagnosis function for special outputs.
The calculation of LV_ERR_XX, LV_CDN_DIAG_XX, ERR_SYM_XX and LV_END_DIAG_XX is done in the Multi-condition debounce algorithm (part of Error Management AGGR).

Application conditions

Initialization: –

Recurrence: –

Activation:
```
every ECU state
reactivation in the NC_PSD_DLY recurrence after CDN_DIAG_XX
> 0 and LV_IGK 0->1 and reset and FMY reset
```

Deactivation: –

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Formula section:

Diagnosis condition /Diagnosis symptom (raw value) calculation:
CDN_DIAG_XX and ERR_DIAG_XX are calculated in the diagnosis function.

ACTION_ERRM_FilterMulticondition (*XX*, CDN_DIAG_XX, ERR_DIAG_XX, LV_END_DIAG_XX, LV_ERR_XX, LV_CDN_DIAG_XX, ERR_SYM_XX)
Remark: For failure debouncing and error management treatment the algorithm Multi-condition debounce algorithm (part of Error Management AGGR) is used with the parameters CDN_DIAG_XX and ERR_DIAG_XX.

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A.68 Electrical diagnosis of power stage outputs (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_DMTLH	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of DMTLH bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_EBOX_CFA	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of EBOX_CFA bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_EF	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of EF bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_RLY_ACCOUT	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of RLY_ACCOUT bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_RLY_CRCV_HEAT	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of RLY_CRCV_HEAT bit 0: diagnosis condition for symptom SCP (SYM_0)bit 1: diagnosis condition for symptom SCG (SYM_1)bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_RLY_DMTL_PUMP	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of DMTL_PUMP bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_RLY_DMTLS	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of DMTLS bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_RLY_ST	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of RLY_ST bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_SLV_IVVT_EX	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of SLV_IVVT_EX bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_SLV_IVVT_IN	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of SLV_IVVT_IN bit 0: diagnosis condition for symptom SCP (SYM_0) bit 1: diagnosis condition for symptom SCG (SYM_1) bit 2: diagnosis condition for symptom OC (SYM_2)					
ERR_DIAG_DMTLH	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for DMTLH (only parameter)					
ERR_DIAG_EBOX_CFA	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for EBOX_CFA (only parameter)					
ERR_DIAG_EF	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for EF (only parameter)					
ERR_DIAG_RLY_ACCOUT	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for RLY_ACCOUT (only parameter)					
ERR_DIAG_RLY_CRCV_HEAT	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for RLY_CRCV_HEAT (only parameter)					
ERR_DIAG_RLY_DMTL_PUMP	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for DMTL_PUMP (only parameter)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_DIAG_RLY_DMTLS	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for DMTLS (only parameter)					
ERR_DIAG_RLY_ST	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for RLY_ST (only parameter)					
ERR_DIAG_SLV_IVVT_EX	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for SLV_IVVT_EX (only parameter)					
ERR_DIAG_SLV_IVVT_IN	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for SLV_IVVT_IN (only parameter)					
ERR_SYM_DMTL_PUMP	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom DMTL_PUMP diagnosis					
ERR_SYM_DMTLH	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom DMTLH diagnosis					
ERR_SYM_DMTLS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom DMTLS diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_EBOX_CFA	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom EBOX_CFA diagnosis					
ERR_SYM_EF	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom EFdiagnosis					
ERR_SYM_RLY_ACCOUT	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom RLY_ACCOUT diagnosis					
ERR_SYM_RLY_CRCV_HEAT	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom CRCV_HEAT					
ERR_SYM_RLY_ST	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom RLY_ST diagnosis					
ERR_SYM_SLV_IVVT_EX	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom SLV_IVVT_EX_i					
ERR_SYM_SLV_IVVT_IN	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom SLV_IVVT_IN_i					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_DMTL_PUMP	O/V	0... 1H	0 ...1	1	-
Diagnosis condition DMTL_PUMP diagnosis					
LV_CDN_DIAG_DMTLH	O/V	0... 1H	0 ...1	1	-
Diagnosis condition DMTLH diagnosis					
LV_CDN_DIAG_DMTLS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition DMTLS diagnosis					
LV_CDN_DIAG_EBOX_CFA	O/V	0... 1H	0 ...1	1	-
Diagnosis condition EBOX_CFA diagnosis					
LV_CDN_DIAG_EF	O/V	0... 1H	0 ...1	1	-
Diagnosis condition EF diagnosis					
LV_CDN_DIAG_RLY_ACCOUT	O/V	0... 1H	0 ...1	1	-
Diagnosis condition RLY_ACCOUT diagnosis					
LV_CDN_DIAG_RLY_CRCV_HEAT	O/V	0... 1H	0 ...1	1	-
Diagnosis condition CRCV_HEAT					
LV_CDN_DIAG_RLY_ST	O/V	0... 1H	0 ...1	1	-
Diagnosis condition RLY_ST diagnosis					
LV_CDN_DIAG_SLV_IVVT_EX	O/V	0... 1H	0 ...1	1	-
Diagnosis condition SLV_IVVT_EX_i					
LV_CDN_DIAG_SLV_IVVT_IN	O/V	0... 1H	0 ...1	1	-
Diagnosis condition SLV_IVVT_IN_i					
LV_END_DIAG_DMTL_PUMP	O/V	0... 1H	0 ...1	1	-
End of diagnosis DMTL_PUMP diagnosis					
LV_END_DIAG_DMTLH	O/V	0... 1H	0 ...1	1	-
End of diagnosis DMTLH diagnosis					
LV_END_DIAG_DMTLS	O/V	0... 1H	0 ...1	1	-
End of diagnosis DMTLS diagnosis					
LV_END_DIAG_EBOX_CFA	O/V	0... 1H	0 ...1	1	-
End of diagnosis EBOX_CFA diagnosis					
LV_END_DIAG_EF	O/V	0... 1H	0 ...1	1	-
End of diagnosis EF diagnosis					
LV_END_DIAG_RLY_ACCOUT	O/V	0... 1H	0 ...1	1	-
End of diagnosis RLY_ACCOUT diagnosis					
LV_END_DIAG_RLY_CRCV_HEAT	O/V	0... 1H	0 ...1	1	-
End of CRCV_HEAT diagnosis					
LV_END_DIAG_RLY_ST	O/V	0... 1H	0 ...1	1	-
End of diagnosis RLY_ST diagnosis					
LV_END_DIAG_SLV_IVVT_EX	O/V	0... 1H	0 ...1	1	-
End of SLV_IVVT_EX_i diagnosis					
LV_END_DIAG_SLV_IVVT_IN	O/V	0... 1H	0 ...1	1	-
End of SLV_IVVT_IN_i diagnosis					
LV_ERR_DMTL_PUMP	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on DMTL_PUMP command signal.					
LV_ERR_DMTLH	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on DMTLH command signal.					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_DMTLS	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on DMTLS command signal.					
LV_ERR_EBOX_CFA	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on EBOX_CFA command signal.					
LV_ERR_EF	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on EF command signal.					
LV_ERR_RLY_ACCOUT	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on RLY_ACCOUT command signal.					
LV_ERR_RLY_CRCV_HEAT	O/V	0... 1H	0 ...1	1	-
Logical value for CRCV_HEAT error					
LV_ERR_RLY_ST	O/V	0... 1H	0 ...1	1	-
Status of starter output diagnosis.					
LV_ERR_SLV_IVVT_EX	O/V	0... 1H	0 ...1	1	-
Error flag solenoid valve of exhaust camshaft i					
LV_ERR_SLV_IVVT_IN	O/V	0... 1H	0 ...1	1	-
Error flag solenoid valve of inlet camshaft i					
LV_INH_DIAG_DMTL_PUMP	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition DMTLH_PUMP diagnosis					
LV_INH_DIAG_DMTLH	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition DMTLH diagnosis					
LV_INH_DIAG_DMTLS	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition DMTLS diagnosis					
LV_INH_DIAG_EBOX_CFA	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition EBOX_CFA diagnosis					
LV_INH_DIAG_EF	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition EF diagnosis					
LV_INH_DIAG_RLY_ACCOUT	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition RLY_ACCOUT diagnosis					
LV_INH_DIAG_RLY_CRCV_HEAT	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition RLY_CRCV_HEAT diagnosis					
LV_INH_DIAG_RLY_ST	O/V	0... 1H	0 ...1	1	-
Inhibition of diagnosis RLY_ST diagnosis					
LV_INH_DIAG_SLV_IVVT_EX	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition IVVT_EX					
LV_INH_DIAG_SLV_IVVT_IN	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition IVVT_IN					
T_V_DMTL_MAX_DIAG	V	0... FFH	0... 2.55	0.01	s
SCB detection timer					

Input data:

ECU_STATE {p. 1091}	IVVTPWM_0 {p. 915}	IVVTPWM_1 {p. 915}	LV_CDN_VB_MIN_DIAG {p. 1185}
LV_CDN_VB_OBD1 {p. 1185}	LV_CONF_DMTL {p. 654}	LV_DMTL_PUMP {p. 5963}	LV_ERR_SPI_MPS {p. 4245}
LV_IGK {p. 906}	LV_ST_END {p. 1720}	LV_VAR_ACIN {p. 655}	LV_VAR_EBOX_CFA {p. 655}
LV_VAR_EF {p. 655}	LV_VAR_RLY_ACCOUT {p. 656}	LV_VAR_RLY_ST {p. 656}	V_DMTL

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_DMTL_PUMP	-	0... FFH	0... 255	1	-
Debounce counter increment DMTL_PUMP diagnosis					
C_ABC_INC_DMTLH	-	0... FFH	0... 255	1	-
Debounce counter increment DMTLH diagnosis					
C_ABC_INC_DMTLS	-	0... FFH	0... 255	1	-
Debounce counter increment DMTLS diagnosis					
C_ABC_INC_EBOX_CFA	-	0... FFH	0... 255	1	-
Debounce counter increment EBOX_CFA diagnosis					
C_ABC_INC_EF	-	0... FFH	0... 255	1	-
Debounce counter increment - EF diagnosis					
C_ABC_INC_RLY_ACCOUT	-	0... FFH	0... 255	1	-
Debounce counter increment RLY_ACCOUT diagnosis					
C_ABC_INC_RLY_CRCV_HEAT	-	0... FFH	0... 255	1	-
Debounce counter increment CRCV_HEAT					
C_ABC_INC_RLY_ST	-	0... FFH	0... 255	1	-
Anti-bounce increment value					
C_ABC_INC_SLV_IVVT	-	0... FFH	0... 255	1	-
Debounce counter increment - VANOS diagnosis magnetic valve					
C_ABC_MAX_DMTL_PUMP	-	1... FFH	1... 255	1	-
Debounce counter maximum value - DMTL_PUMP diagnosis					
C_ABC_MAX_DMTLH	-	1... FFH	1... 255	1	-
Debounce counter maximum value - DMTLH diagnosis					
C_ABC_MAX_DMTLS	-	1... FFH	1... 255	1	-
Debounce counter maximum value - DMTLS diagnosis					
C_ABC_MAX_EBOX_CFA	-	1... FFH	1... 255	1	-
Debounce counter maximum value - EBOX_CFA diagnosis					
C_ABC_MAX_EF	-	1... FFH	1... 255	1	-
Debounce counter maximum value - EF diagnosis					
C_ABC_MAX_RLY_ACCOUT	-	1... FFH	1... 255	1	-
Debounce counter maximum value - RLY_ACCOUT diagnosis					
C_ABC_MAX_RLY_CRCV_HEAT	-	1... FFH	1... 255	1	-
Debounce counter maximum value CRCV_HEAT					
C_ABC_MAX_RLY_ST	-	1... FFH	1... 255	1	-
Anti-bounce maximum value					
C_ABC_MAX_SLV_IVVT	-	1... FFH	1... 255	1	-
Debounce counter maximum value - VANOS diagnosis magnetic valves					
C_SLV_IVVT_PWM_DIAG_MAX_SCG	-	0... FFFFH	0... 99.99847	1.53e-3	%
Maximum threshold for SCG diagnosis window					
C_SLV_IVVT_PWM_DIAG_MIN_OC	-	0... FFFFH	0... 99.99847	1.53e-3	%
Minimum threshold for OC diagnosis window					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_SLV_IVVT_PWM_DIAG_MIN_SCB	-	0... FFFFH	0... 99.99847	1.53e-3	%
Minimum threshold for SCB diagnosis window					
C_T_V_DMTL_MAX_DIAG	-	0... FFH	0... 2.55	0.01	s
Time threshold for SCB detection					
C_V_DMTL_MAX_DIAG	-	0... 3FFH	0... 4.99511	4.88e-3	V
Threshold for SCB detection					

General information:

This specification defines all output-data and calibration data for all ATIC39 powerstage diagnosis as well as specific functions like limp home which are not covered by the generic ATIC39 basic algorithm for static and PWM outputs
Remark:
For all static outputs a minimum switch-on time of 50ms for error symptom detection is necessary.

A.68.1 Diagnosis of static outputs

A.68.1.1 Crankcase ventilation heater relay diagnosis (LV_ERR_RLY_CRCV_HEAT)

FUNCTION DESCRIPTION:

General information:

The purpose is to diagnose the signal from the driver which controls the crankcase ventilation heater relay.

Description:

For error detection algorithm see “Electrical diagnosis of powerstage outputs ATIC39”.

Error-symptoms are defined to this diagnosis function as following :

```
□□□□
| | | └─> Short circuit to Vbatt        (= SYM_0)
| | └───> Short circuit to GND          (= SYM_1)
| └─────> Open load                     (=SYM_2)
└───────> -                             (=SYM_3)
```

Application conditions

Initialisation: according Filter-type **MPL_STD_INI**
(reset of variables at LV_IGK 0 -> 1 or ECU reset)

Recurrence: 1000ms

Activation: LV_IGK = 1

Deactivation: LV_IGK = 0

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Formula section:

If diagnosis is not inhibited (LV_INH_DIAG_RLY_CRCV_HEAT = 0) the diagnosis conditions are set according infrastructure information: CDN_DIAG_RLY_CRCV_HEAT.
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_RLY_CRCV_HEAT.

Failure debouncing and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_RLY_CRCV_HEAT and ERR_DIAG_RLY_CRCV_HEAT.

This algorithm determines:

ERR_SYM_RLY_CRCV_HEAT	(Detected error symptom)
LV_ERR_RLY_CRCV_HEAT	(Error flag for debounced error)
LV_CDN_DIAG_RLY_CRCV_HEAT	(Diagnosis condition information)
LV_END_DIAG_RLY_CRCV_HEAT	(End of diagnosis information)

Diagnosis inhibition:
If LV_IGK = 1 **and**
LV_CDN_VB_MIN_DIAG = 1 **and**
LV_ERR_SPI_MPS = 0

Then LV_INH_DIAG_RLY_CRCV_HEAT = 0
Else LV_INH_DIAG_RLY_CRCV_HEAT = 1
Endif

A.68.1.2 Air condition compressor relay diagnosis (LV_ERR_RLY_ACCOUT)

FUNCTION DESCRIPTION:

General information:

The purpose is to diagnose the signal from the driver which controls the air condition relay signal.
The diagnosis is only active if “Vehicle with ACC” is learnt.

Description:

For error detection algorithm see “Electrical diagnosis of powerstage outputs ATIC39”.

Error-symptoms are defined to this diagnosis function as following :

```
 |_|_|_|_|
  | | | └─> Short circuit to Vbatt        (= SYM_0)
  | | └───> Short circuit to GND          (= SYM_1)
  | └─────> Open load                     (=SYM_2)
  └───────> -                             (=SYM_3)
```

Application conditions

Initialisation: according Filter-type **MPL_STD_INI**

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(reset of variables at LV_IGK 0 -> 1 or ECU reset)

Recurrence: 1s

Activation: LV_VAR_RLY_ACCOUT = 1 **AND**
LV_VAR_ACIN = 1

Formula section:

If diagnosis is not inhibited (LV_INH_DIAG_RLY_ACCOUT = 0) the diagnosis conditions are set according infrastructure information: CDN_DIAG_RLY_ACCOUT .
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_RLY_ACCOUT.

Failure debouncing and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG RLY_ACCOUT and ERR_DIAG_RLY_ACCOUT.

This algorithm determines:
ERR_SYM_RLY_ACCOUT (Detected error symptom)
LV_ERR_RLY_ACCOUT (Error flag for debounced error)
LV_CDN_DIAG_RLY_ACCOUT (Diagnosis condition information)
LV_END_DIAG_RLY_ACCOUT (End of diagnosis information)

Diagnosis inhibition:
IF LV_IGK = 1 **AND**
LV_CDN_VB_MIN_DIAG = 1 **AND**
LV_ERR_SPI_MPS = 0
THEN LV_INH_DIAG_RLY_ACCOUT = 0
ELSE LV_INH_DIAG_RLY_ACCOUT = 1
ENDIF

A.68.1.3 DMTL change over valve diagnosis (LV_ERR_DMTLS)

FUNCTION DESCRIPTION:

General information:

The purpose is to diagnose the signal from the driver which controls the DMTL valve.
The diagnosis is only activated if DMTL is configurated.

Description:

For error detection algorithm see “Electrical diagnosis of powerstage outputs ATIC39”.

Error-symptoms are defined to this diagnosis function as following :

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```
 ┌─┬─┬─┬─┐
 │ │ │ └─> Short circuit to Vbatt       (= SYM_0)
 │ │ └───> Short circuit to GND         (= SYM_1)
 │ └─────> Open load                    (=SYM_2)
 └───────> -                            (=SYM_3)
```

Application conditions

Initialisation: according Filter-type **MPL_STD_INI**
(reset of variables at LV_IGK 0 -> 1 or ECU reset)

Recurrence: 100ms

Activation: LV_CONF_DMTL = 1

Formula section:

If diagnosis is not inhibited (LV_INH_DIAG_DMTLS = 0) the diagnosis conditions are set according infrastructure information: CDN_DIAG_DMTLS.
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_DMTLS.

Failure debouncing and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_DMTLS and ERR_DIAG_DMTLS.

This algorithm determines:
ERR_SYM_DMTLS (detected error symptom)
LV_ERR_DMTLS (Error flag for debounced error)
LV_CDN_DIAG_DMTLS (Diagnosis condition information)
LV_END_DIAG_DMTLS (End of diagnosis information)

Diagnosis inhibition:
IF LV_CDN_VB_OBD1 = 1 **AND**
LV_ERR_SPI_MPS = 0 **AND**
ECU_STATE =! WAKE_UP
THEN LV_INH_DIAG_DMTLS = 0
ELSE LV_INH_DIAG_DMTLS = 1
ENDIF

A.68.1.4 DMTL pump diagnosis (LV_ERR_DMTL_PUMP)

FUNCTION DESCRIPTION:

General information:

The purpose is to diagnose the signal from the driver which controls the DMTL pump.
The diagnosis is only activated if DMTL is configurated.

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Description:

For error detection algorithm see “Electrical diagnosis of powerstage outputs ATIC39”.

Remark:
Due to hardware conditions and overtemperature protection for shunt resistor (max. time for SCB is 50ms) the SCB detection is only possible with monitoring the voltage V_DMTL.

Error-symptoms are defined to this diagnosis function as following :

```
┌─┬─┬─┬─┐
│ │ │ └─> Short circuit to Vbatt          (= SYM_0)
│ │ └───> Short circuit to GND            (= SYM_1)
│ └─────> Open load                       (=SYM_2)
└───────> -                               (=SYM_3)
```

Application conditions

Initialisation: `according Filter-type` **`MPL_STD_INI`**
(reset of variables at LV_IGK 0 -> 1 or ECU reset)

Recurrence: `100ms for SCG/ OL detection`
`10ms for SCB detection`

Activation: *LV_CONF_DMTL = 1*

Formula section:

If diagnosis is not inhibited (LV_INH_DIAG_DMTL_PUMP = 0) the diagnosis conditions are set according infrastructure information: CDN_DIAG_DMTL_PUMP.
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_DMTL_PUMP.

Failure debouncing and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_DMTL_PUMP and ERR_DIAG_DMTL_PUMP.

This algorithm determines:

ERR_SYM_DMTL_PUMP	(Detected error symptom)
LV_ERR_DMTL_PUMP	(Error flag for debounced error)
LV_CDN_DIAG_DMTL_PUMP	(Diagnosis condition information)
LV_END_DIAG_DMTL_PUMP	(End of diagnosis information)

Diagnosis inhibition:
IF LV_CDN_VB_OBD1 = 0 **OR**
LV_ERR_SPI_MPS = 1 **OR**
ECU_STATE = WAKE_UP **OR**
ERR_SYM_DMTL_PUMP = SYM_0
THEN LV_INH_DIAG_DMTL_PUMP = 1
ELSE LV_INH_DIAG_DMTL_PUMP = 0
ENDIF

Detection of SCB:
IF(1) LV_DMTL_PUMP = 1 *//Pump is switched on*
THEN(1)IF(2) V_DMTL > C_V_DMTL_MAX_DIAG

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THEN(2)IF(3) T_V_DMTL_MAX_DIAG >= C_T_V_DMTL_MAX_DIAG
THEN(3) ERR_SYM_DMTL_PUMP = SYM_0
LV_ERR_DMTL_PUMP = 1 (set with
CTR_ABC_DMTL_PUMP = C_ABC_MAX_DMTL_PUMP)
LV_ERR_DMTL_PUMP = 1
LV_END_DIAG_DMTL_DUMP = 1
DMTL_PUMP pin is switched off by hardware immediately,
diagnosis is inhibited until next initialization
ELSE(3) T_V_DMTL_MAX_DIAG ++
ENDIF(3)
ELSE(2) T_V_DMTL_MAX_DIAG - -
ENDIF(2)
ELSE(1) normal diagnosis algorithm OL/SCG
ENDIF(1)

A.68.1.5 DMTL heater diagnosis (LV_ERR_DMTLH)

FUNCTION DESCRIPTION:

General information:

The purpose is to diagnose the signal from the driver which controls the DMTL heater.
The diagnosis is only activated if DMTL is configurated.

Description:

For error detection algorithm see “Electrical diagnosis of powerstage outputs ATIC39”.

Error-symptoms are defined to this diagnosis function as following :

```
|_|_|_|_|
 | | | └─> Short circuit to Vbatt          (= SYM_0)
 | | └───> Short circuit to GND           (= SYM_1)
 | └─────> Open load                      (=SYM_2)
 └───────> -                              (=SYM_3)
```

Application conditions

Initialisation: according Filter-type **MPL_STD_INI**
(reset of variables at LV_IGK 0 -> 1 or ECU reset)

Recurrence: 1s

Activation: LV_CONF_DMTL = 1

Formula section:

If diagnosis is not inhibited (LV_INH_DIAG_DMTLH = 0) the diagnosis conditions are set according infrastructure information: CDN_DIAG_DMTLH.
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_DMTLH.

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Failure debouncing and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_DMTLH and ERR_DIAG_DMTLH.

This algorithm determines:
ERR_SYM_DMTLH (detected error symptom)
LV_ERR_DMTLH (Error flag for debounced error)
LV_CDN_DIAG_DMTLH (Diagnosis condition information)
LV_END_DIAG_DMTLH (End of diagnosis information)

Diagnosis inhibition:
IF LV_CDN_VB_OBD1 = 1 **AND**
LV_ERR_SPI_MPS = 0 **AND**
ECU_STATE =! WAKE_UP
THEN LV_INH_DIAG_DMTLH = 0
ELSE LV_INH_DIAG_DMTLH = 1
ENDIF

A.68.1.6 E-box cooling fan diagnosis (LV_ERR_EBOX_CFA)

FUNCTION DESCRIPTION:

General information:

The purpose is to diagnose the signal from the driver which controls the EBOX cooling fan.
The input signal is modulated control pulse (PWM).

Description:

For error detection algorithm see “Electrical diagnosis of powerstage outputs ATIC39”.

Error-symptoms are defined to this diagnosis function as following :

```
[ | | | ]
 | | | └─> Short circuit to Vbatt        (= SYM_0)
 | | └───> Short circuit to GND          (= SYM_1)
 | └─────> Open load                     (=SYM_2)
 └───────> -                             (=SYM_3)
```

Application conditions

Initialisation: according Filter-type **MPL_STD_INI**
(reset of variables at LV_IGK 0 -> 1 or ECU reset)

Recurrence: 1s

Activation: LV_VAR_EBOX_CFA = 1

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Formula section:

If diagnosis is not inhibited (LV_INH_DIAG_EBOX_CFA = 0) the diagnosis conditions are set according infrastructure information: CDN_DIAG_EBOX_CFA.
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_EBOX_CFA.

Failure debouncing and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_EBOX_CFA and ERR_DIAG_EBOX_CFA.

This algorithm determines:
ERR_SYM_EBOX_CFA (detected error symptom)
LV_ERR_EBOX_CFA (Error flag for debounced error)
LV_CDN_DIAG_EBOX_CFA (Diagnosis condition information)
LV_END_DIAG_EBOX_CFA (End of diagnosis information)

Diagnosis inhibition:
IF LV_IGK = 1 **AND**
LV_CDN_VB_MIN_DIAG = 1 **AND**
LV_ERR_SPI_MPS = 0
THEN LV_INH_DIAG_EBOX_CFA = 0
ELSE LV_INH_DIAG_EBOX_CFA = 1
ENDIF

A.68.1.7 Exhaust flap diagnosis (LV_ERR_EF)

FUNCTION DESCRIPTION:

General information:

The purpose is to diagnose the exhaust flag signal from the driver which controls the exhaust flap.

Description:

For error detection algorithm see “Electrical diagnosis of powerstage outputs ATIC39”.

Error-symptoms are defined to this diagnosis function as following :

```
┌─┬─┬─┬─┐
│ │ │ │
│ │ │ └─> Short circuit to Vbatt      (= SYM_0)
│ │ └───> Short circuit to GND        (= SYM_1)
│ └─────> Open load                   (=SYM_2)
└───────> -                           (=SYM_3)
```

Application conditions

Initialisation: according Filter-type **MPL_STD_INI**
(reset of variables at LV_IGK 0 -> 1 or ECU reset)

Recurrence: 1s

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Activation: `LV_VAR_EF = 1`

Formula section:

If diagnosis is not inhibited (LV_INH_DIAG_EF = 0) the diagnosis conditions are set according infrastructure information: CDN_DIAG_EF.
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_EF.

Failure debouncing and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_EF and ERR_DIAG_EF.

This algorithm determines:

ERR_SYM_EF	(Detected error symptom)
LV_ERR_EF	(Error flag for debounced error)
LV_CDN_DIAG_EF	(Diagnosis condition information)
LV_END_DIAG_EF	(End of diagnosis information)

Diagnosis inhibition:

IF LV_IGK = 1 **AND**
LV_CDN_VB_MIN_DIAG = 1 **AND**
LV_ERR_SPI_MPS = 0
THEN LV_INH_DIAG_EF = 0
ELSE LV_INH_DIAG_EF = 1
ENDIF

A.68.1.8 Starter relay output diagnosis (LV_ERR_RLY_ST)

FUNCTION DESCRIPTION:

General information:

The purpose is to diagnose the starter signal from the driver which switches the output signal for the CAS - ECU. This diagnosis detects electrical faults as defined by OBD I requirements. The diagnosis is only performed if the variant "BN2000" is enabled.

Description:

For error detection algorithm see "Electrical diagnosis of powerstage outputs ATIC39"

Error-symptoms are defined to this diagnosis function as following :

```
 [ | | | ]
  |  |  |  └─> Short circuit to Vbatt        (= SYM_0)
  |  |  └───> Short circuit to GND           (= SYM_1)
  |  └─────> Open load                       (= SYM_2)
  └───────> -                                (= SYM_3)
```

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Application conditions

Initialisation: `according Filter-type` **`MPL_STD_INI`**
`(reset of variables at LV_IGK 0 -> 1 or ECU reset)`

Recurrence: `50ms in case of LV_ST_END = 0`
`1000ms in case of LV_ST_END = 1`

Activation: *`LV_VAR_RLY_ST = 1`*

Formula section:

If diagnosis is not inhibited (LV_INH_DIAG_RLY_ST = 0) the diagnosis conditions are set according infrastructure information: CDN_DIAG_RLY_ST.
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_RLY_ST.

Failure debouncing and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_RLY_ST and ERR_DIAG_RLY_ST.

This algorithm determines:

ERR_SYM_RLY_ST	(detected error symptom)
LV_ERR_RLY_ST	(Error flag for debounced error)
LV_CDN_DIAG_RLY_ST	(Diagnosis condition information)
LV_END_DIAG_RLY_ST	(End of diagnosis information)

Diagnosis inhibition:
IF LV_IGK = 1 **AND**
LV_CDN_VB_OBD1 = 1 **AND**
LV_ERR_SPI_MPS = 0
THEN LV_INH_DIAG_RLY_ST = 0
ELSE LV_INH_DIAG_RLY_ST = 1
ENDIF

A.68.2 Diagnosis of PWM outputs

A.68.2.1 IVVT solenoid valve diagnosis (LV_ERR_SLV_IVVT_IN /EX)

FUNCTION DESCRIPTION:

General information:

The purpose of the diagnosis is to detect electrical faults in the IVVT unit.
The input signal is a modulated control pulse (PWM).

Description:

For error detection algorithm see “Electrical diagnosis of powerstage outputs ATIC39”.
The diagnosis condition calculation is done according **“Open range”** duty cycle, thus a definition of the PWM diagnosis windows is neccessary (see calibration data).

Error-symptoms are defined to this diagnosis function as following :

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```
┌─┬─┬─┬─┐
│ │ │ │
│ │ │ └─> Short circuit to VBatt          (= SYM_0)
│ │ └───> Short circuit to GND            (= SYM_1)
│ └─────> Open load                       (= SYM_2)
└───────> -                               (= SYM_3)
```

Application conditions

Initialisation: according Filter-type **MPL_STD_INI**
(reset of variables at LV_IGK 0 -> 1 or ECU reset)

Recurrence: 100ms

Activation: at every engine operating state

Formula section:

If diagnosis is not inhibited (LV_INH_DIAG_SLV_IVVT_IN/EX = 0) the diagnosis conditions are set according infrastructure information: CDN_DIAG_SLV_IVVT_IN/EX.
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_SLV_IVVT_IN/EX .

Failure debouncing and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_SLV_IVVT_IN/EX and ERR_DIAG_SLV_IVVT_IN/EX.

This algorithm determines:
ERR_SYM_SLV_IVVT_IN/EX (detected error symptom)
LV_ERR_SLV_IVVT_IN/EX (Error flag for debounced error)
LV_CDN_DIAG_SLV_IVVT_IN/EX (Diagnosis condition information)
LV_END_DIAG_SLV_IVVT_IN/EX (End of diagnosis information)
Diagnosis inhibition:
IF LV_IGK = 1 **AND**
LV_CDN_VB_OBD1 = 1 **AND**
LV_ERR_SPI_MPS = 0
THEN LV_INH_DIAG_SLV_IVVT_IN/EX = 0
ELSE LV_INH_DIAG_SLV_IVVT_IN/EX = 1
ENDIF

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A.69 Multi condition debounce algorithm

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_PREV_XX	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Diagnostic condition of last failure symptom					
CTR_ABC_END_DIAG_XX	O/V	0... FFH	0... 255	1	-
Counter for end of diagnosis XX generation					
CTR_ABC_XX	O/V/S	0... FFH	0... 255	1	-
anti bounce counter of diagnosis XX					

Input data:

LC_ABC_BENCH {p. 4581}	LC_ERR_DET_UPD {p. 4581}	LV_ABC_INH {p. 4610}	LV_IGK {p. 906}
NC_ABC_CONF_FCT_DIAG_XX {p. 4581}	NC_ERR_DET_UPD {p. 645}	NLC_ABC_INI_DC_END_DIAG {p. 4581}	NLC_BENCH_MODE {p. 4581}

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_SYM_XX	-	1... FH	1... 15	1	-
Available symptom for diagnostic XXSymptom 0 and 1 available : 03HSymptom 0 ,1 and 2 available : 07H (typical value)Symptom 0,1,2 and 3 available : 0FH					

Action definition

ACTION_ERRM_FilterMulticonditio (**IN**<PRM_IDX_DIAG>,**IN**<PRM_CDN_DIAG>,**IN**<PRM_ERR_DIAG>,**IN**<PRM_ABC_INC>,**IN**<PRM_ABC_MAX>,**OUT**<PRM_LV_ERR>)	Mode: O
This action compute the elementary antibounce filter for one failure treatment and return filter result.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_IDX_DIAG	in	0... FFFFH	0... 65535	1	-
Diagnostic symptom instance.					
PRM_CDN_DIAG	in	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of SAP; bit 0: Set, if diagnosis condition for symptom SCP is fulfilled; bit 1: Set, if diagnosis condition for symptom SCG is fulfilled; bit 2: Set, if diagnosis condition for symptom OC is fulfilled					
PRM_ERR_DIAG	in	0... 7H	0 ...7	1	-
Raw value of error symptom for SAP; bit 0: Set, if raw value of error symptom SCP is set; bit 1: Set, if raw value of error symptom SCG is set; bit 2: Set, if raw value of error symptom OC is set					
PRM_ABC_INC	in	0... FFH	0... 255	1	-
Anti bounce increment					
PRM_ABC_MAX	in	0... FFH	0... 255	1	-
Anti-bounce maximum					
PRM_LV_ERR	out	0... 1H	0 ...1	1	-
Error flag for diagnostic instance					

ACTION_ERRM_MultiFilterReset (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR>)	Mode: O

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This action resets data filter in case of antibounce filter type					
Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_IDX_DIAG	in	0... FFFFH	0... 65535	1	-
Diagnostic symptom instance.					
PRM_LV_ERR	out	0... 1H	0 ...1	1	-
Error flag for diagnostic instance					

ACTION_ERRM_MultiFilterSymEnd (**IN**<PRM_IDX_DIAG>,**IN**<PRM_ABC_MAX>,**OUT**<PRM_LV_ERR>)					Mode: O
This action returns the filter result on symptoms detected at each diagnostic recurrence					
Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_IDX_DIAG	in	0... FFFFH	0... 65535	1	-
Diagnostic symptom instance.					
PRM_ABC_MAX	in	0... FFH	0... 255	1	-
Anti-bounce maximum					
PRM_LV_ERR	out	0... 1H	0 ...1	1	-
Error flag for diagnostic instance					

General information

Import actions:

#IF NC_ERR_DET_UPD = 1 and NLC_ENA_MULTI_CDN = 1
ACTION_ERRM_UpdErrDet (IN<XX>)
This action indicates each occurrence of the detected error
#ENDIF

According the diagnosis condition information CDN_DIAG_XX and the diagnosis symptom (raw value) information the symptom calculation ERR_SYM_XX is performed. Then the failure symptom is debounced to set the present failure LV_ERR_XX.

A special readiness calculation is done to set the end of diagnosis information. LV_END_DIAG_XX is set only if there was enough time to make a diagnosis of all symptoms or a failure gets present.

Note:

To set the LV_END_DIAG_XX is necessary to have the conditions for all symptoms at the same time for a given time.

Restrictions:

In case of multiple symptoms at the same time, only one symptom will be taken into account according the following priority rule: SYM_0 ==> SYM_3 ; Priority max ==> Priority Min

Only the last symptom present will be taken into account in this algorithm, so in case of symptom change, only the last symptom will be used to increment and decrement the counters.

Application conditions:

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Initialisation:

```
At ECU reset and LV_IGK 0 → 1 transition
CDN_DIAG_PREV_XX  = 0

Other data initialization
    ERR_SYM_XX = Refer to "Antibounce algorithms" chapter

    for initialization
    CTR_ABC_XX = Refer to "Antibounce algorithms" chapter

    for initialization
    LV_ERR_XX = Refer to "Antibounce algorithms" chapter
    for initialization
    CTR_ABC_END_DIAG_XX = Refer to "Antibounce algorithms"

    chapter for initialization
```

Activation: –

Deactivation: –

Recurrence: –

Function description:

Formula section:

A.69.1 Multi-condition anti-bounce filter algorithm description

Description for ACTION_ERRM_FilterMulticondition:

Syntax : ACTION_ERRM_FilterMulticondition (IN<XX>, IN<CDN_DIAG_XX>, IN<ERR_DIAG_XX>, IN<C_ABC_INC_XX>, IN<C_ABC_MAX_XX>, OUT<LV_ERR_XX>)

Parameter(in):	XX	Type: index to identify the Diagnostic
	CDN_DIAG_XX	Type: Byte carrier (Each symptom condition)
	ERR_DIAG_XX	Type: Byte carrier (Raw value symptom)
	C_ABC_INC_XX	Type: Calibration byte for the increment value
	C_ABC_MAX_XX	Type: Calibration byte for the maximum value
Parameter(out):	LV_ERR_XX	Type: Boolean (=1 when failure)

Short Description: This action returns information necessary for the diagnostic and the error management.

Formula section:

```
Anti-bounce bench mode :

If(0) LV_ABC_INH = 0
Then
If(1) (LC_ABC_BENCH = 1  and  NLC_BENCH_MODE=1) and  ((C_ABC_INC_XX = 0) or  (C_
ABC_INC_XX = FFH))
Then(1)
        If(2)  C_ABC_INC_XX = 0
        Then(2)
```

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```
                    {Case force no failure}
                    LV_ERR_XX = 0
                    ERR_SYM_XX =  0
                    CTR_ABC_XX = 0
                    LV_END_DIAG_XX = 1
                    CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX
        Else(2)
                    If(3) C_ABC_INC_XX = FFH
                    Then(3)
                          {Forced failure}
                          LV_ERR_XX = 1
                          ERR_SYM_XX = 0Fh
                          CTR_ABC_XX = C_ABC_MAX_XX
                          LV_END_DIAG_XX = 1
                          CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX
                    Endif(3)
        Endif(2)
Endif(1)
Symptom calculation:

{Erase not available bit}
CDN_DIAG_XX = CDN_DIAG_XX and  NC_NR_SYM_XX
ERR_DIAG_XX = ERR_DIAG_XX and  NC_NR_SYM_XX

If(1)   CDN_DIAG_XX ≠ 0  {Diagnosis of at least one symptom is valid}
Symptom SYM_0 calculation:
Then(1)
        If(2)   bit 0 of CDN_DIAG_XX = 1
                and
                bit 0 of ERR_DIAG_XX = 1
        Then(2)
                ERR_SYM_XX = 1H
                {Memorization of last failure symptom number}
                CDN_DIAG_PREV_XX = 1H
Symptom SYM_1 calculation:
        Else(2)
           If(3) bit 1 of CDN_DIAG_XX = 1
                 and
                 bit 1 of ERR_DIAG_XX = 1
           Then(3)
                 ERR_SYM_XX = 2H
                 {Memorization of last failure symptom number}
                 CDN_DIAG_PREV_XX = 2H
Symptom SYM_2 calculation:
           Else(3)
                 If(4)     bit 2 of CDN_DIAG_XX = 1
                           and
                           bit 2 of ERR_DIAG_XX = 1
                 Then(4)
                           ERR_SYM_XX = 4H
                           {Memorization of last failure symptom number}
                           CDN_DIAG_PREV_XX = 4H
Symptom SYM_3 calculation:
                 Else(4)
                    If(5)  bit 3 of CDN_DIAG_XX = 1
                           and
                           bit 3 of ERR_DIAG_XX = 1
                    Then(5)
                           ERR_SYM_XX = 8H
                           {Memorization of last failure symptom number}
                           CDN_DIAG_PREV_XX = 8H
```

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```
Symptom calculation for 'No symptom detected':
                    Else(5)
                        If     bit 0 of CDN_DIAG_XX = 1
                        Then
                               bit 0 of ERR_SYM_XX = 0
                        Endif
                        If     bit 1 of CDN_DIAG_XX = 1
                        Then
                               bit 1 of ERR_SYM_XX = 0
                        Endif
                        If     bit 2 of CDN_DIAG_XX = 1
                        Then
                               bit 2 of ERR_SYM_XX = 0
                        Endif
                        If     bit 3 of CDN_DIAG_XX = 1
                        Then
                               bit 3 of ERR_SYM_XX = 0
                        Endif
                    Endif(5)
                 Endif(4)
           Endif(3)
        Endif(2)
Endif(1)
If(1)   (CDN_DIAG_PREV_XX = 0 and CDN_DIAG_XX ≠ 0)
        or   (bit 0 of CDN_DIAG_PREV_XX = 1 and bit 0 of CDN_DIAG_XX = 1)
        or   (bit 1 of CDN_DIAG_PREV_XX = 1 and bit 1 of CDN_DIAG_XX = 1)
        or   (bit 2 of CDN_DIAG_PREV_XX = 1 and bit 2 of CDN_DIAG_XX = 1)
        or   (bit 3 of CDN_DIAG_PREV_XX = 1 and bit 3 of CDN_DIAG_XX = 1)
Then(1)
        LV_CDN_DIAG_XX = 1
Else(1)
        {Anti-bounce value is frozen}
        LV_CDN_DIAG_XX = 0
Endif(1)


Anti-bounce of diagnosis instance XX:
If(1)   LV_CDN_DIAG_XX = 1

Incrementation of antibounce:
Then(1)
        If(2a)  ERR_SYM_XX ≠ 0
        Then(2a) If  C_ABC_INC_XX ≠ 0
                Then { at each detected error, a treatment may be done }
                     If     NC_ERR_DET_UPD = 1  and LC_ERR_DET_UPD = 1
                     Then
                            ACTION_ERRM_UpdErrDet(IN<XX>,
                            SYNCHRONIZATION<CALL>)
                     Endif

                     If     CTR_ABC_XX ≠ C_ABC_MAX_XX
                     Then
                            CTR_ABC_XX = CTR_ABC_XX + C_ABC_INC_XX
                            If     CTR_ABC_XX ≥ C_ABC_MAX_XX
                            Then
                                   LV_ERR_XX = 1
                                   CTR_ABC_XX = C_ABC_MAX_XX
                            Endif
                     Endif
                Endif
        Else (2a)
```

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```
                    If      CTR_ABC_XX ≠ 0
                    Then
                            {Decrementation of antibounce}
                            CTR_ABC_XX = CTR_ABC_XX - 1
                            If      CTR_ABC_XX = 0     { minimum value }
                            Then
                              LV_ERR_XX = 0
                              {Reset of last failure symptom memorized}
                              CDN_DIAG_PREV_XX = 0H
                            Endif
                    Endif
        Endif(2a)

Readiness calculation for diagnosis instance XX:
        If(2b)  CTR_ABC_END_DIAG_XX < C_ABC_MAX_XX

End of diagnosis is set, if failure gets present:
        Then(2b) If     LV_ERR_XX = 1      { failure XX is present }
                 Then   LV_END_DIAG_XX = 1
                        CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX

End of diagnosis is set, if all symptoms can be detected after a specified time:
                 Else
                        {Check if all symptoms can be detected if all
                        significant bit 0, bit 1, bit 2 and bit 3 of
                        CDN_DIAG_XX = 1 }
                        If   CDN_DIAG_XX = NC_NR_SYM_XX
                             and
                             ERR_SYM_XX = 0
                       Then
                             CTR_ABC_END_DIAG_XX = CTR_ABC_END_DIAG_XX
                                                   + C_ABC_INC_XX
                             If    CTR_ABC_END_DIAG_XX ≥ C_ABC_MAX_XX
                             Then
                                   CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX
                                   LV_END_DIAG_XX = 1
                             Endif
                       Else
                             {Check if a failure is detected}
                             If     ERR_SYM_XX ≠ 0
                             Then
                                    CTR_ABC_END_DIAG_XX = 0
                             Endif
                       Endif
                 Endif
        Endif(2b)
Endif(1)

Endif(0)
```

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A.69.2 Description for ACTION_ERRM_MultiFilterSymEnd :

Syntax: ACTION_ERRM_MultiFilterSymEnd(IN<XX>, IN<C_ABC_MAX_XX>, OUT<LV_ERR_XX>)

Parameter(in): XX Type: index to identify the Diagnostic
C_ABC_MAX_XX Type: Calibration byte for the maximum value

Parameter(out): LV_ERR_XX Type: Boolean

Short Description: This action erases diagnostic failure and sets immediately the end of diagnostic information in case of multi-conditions filter (MPL_STD_INI)

Formula section :

```
LV_CDN_DIAG_XX = 1
ERR_SYM_XX = NO_SYM
LV_ERR_XX = 0
CTR_ABC_XX = 0
LV_END_DIAG_XX = 1
CTR_ABC_END_DIAG_XX = C_ABC_MAX_XX
```

A.69.3 Description for ACTION_ERRM_MultiFilterReset:

Syntax: ACTION_ERRM_MultiFilterReset(IN<XX>, OUT<LV_ERR_XX>)

Parameter(in): XX Type: index to identify the Diagnostic

Parameter(out): LV_ERR_XX Type: Boolean

Short Description: This action resets data filter in case of Multiconditions filter type

Formula section :

```
LV_CDN_DIAG_XX = 0
ERR_SYM_XX = NO_SYM
LV_ERR_XX = 0
CTR_ABC_XX = 0
LV_END_DIAG_XX is unchanged
CTR_ABC_END_DIAG_XX is unchanged
```

A.69.4 Synchronization between multi-condition algorithm & Error Management

This section describes the mechanism of synchronisation of the failure filtering with the Error Management core. The principle is to call the Error Management upon events.

LV_END_DIAG_XX 0 → 1 transition
LV_ERR_XX 0 → 1 transition
LV_ERR_XX 1 → 0 transition

A.69.5 Mechanism for CPU load optimisation

This section describes the mechanism of optimisation. The principle is to suspend the filter algorithm execution when is not necessary. When the bench mode is used for a diagnostic XX the mechanism of CPU load optimisation is disabled for this instance.

Formula section:

```
If      LV_ERR_XX = 0
        and LV_END_DIAG_XX = 1
```

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```
        and   ERR_SYM_XX = 0
        and   CTR_ABC_XX = 0
Then
    It is not necessary to call error management (including filtering)
    LV_END_DIAG_XX = 1      {unchanged}
    LV_ERR_XX = 0           {unchanged}
Endif
```

A.69.6 Configuration data

Configuration data detailed description:

Symptoms 0 and 1 available: 03H
Symptoms 0, 1 and 2 available: 07H (typical value)
Symptoms 0, 1, 2 and 3 available: 0FH

Predefined filter type:

	NLC_ ABC_ STC_XX	NLC_ ABC_ CAL_ DEC_ XX	NLC_ ABC_ NOT_ DEC_ XX	NLC_ ABC_ INI_ VALUE_ XX	NLC_ ABC_ INI_ IGK_XX	NLC_ ABC_ NOT_ SAVE_ XX
MPL_STD_INI	0	0	0	0	1	1

The **standard configuration with initialisation (MPL_STD_INI)** is NC_ABC_CONF_FCT_DIAG_XX = 3H (default configuration)

The data CTR_ABC_XX and LV_ERR_XX are Reset at the transition LV_IGK 0 → 1 and Reset (NLC_ABC_NOT_SAVE_XX = 1, NLC_ABC_INI_IGK_XX = 1) and the anti-bounce counter is initialised to 0 value (NLC_ABC_INI_VALUE_XX = 0).

The anti-bounce counter may be decremented (NLC_ABC_NOT_DEC_XX = 0).
The decrement value is equal to 1 (NLC_ABC_CAL_DEC_XX = 0).
The filter used is the Anti-bounce (NLC_ABC_STC_XX = 0).

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A.70 Table of failures

FUNCTION DESCRIPTION:

General information:

This specification is automatic generated out from SW and Dataset.
Listing of all implemented diagnosis instances (LV_ERR_xx) including all calibration data (proposal) like error class (C_ERR_CLAS_xx), Environmental data (ID_ERR_ENVD_xx), Trouble codes (ID_ERR_DTC_xx).

Remark:
All diagnosis instances marked with grey colour do have a missing calibration !

A.70.1 Calibration part (sorted by alphabetic order)

Made from dataset file 3KBIJHZA auf XKC0S gemischt [E93_N54_DKG_LEV_240KW] mit Vorbedatung_BMW_30Mar11_1+LEV2_1

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Diagnostic Instance	Diagnostic Trouble Code			Failure	ENVD	
Name(xx)	DTC	Info	Nr.	class		Nr.
ACK_IGK_OFF			"SYM0"	0x11	0x11	0
			"SYM1"		0x0C	1
			"SYM2"		0x6A	2
			"SYM3"		0x23	3
			"GLOBAL"			
	0x2BA2		"DTC"			
ACR_AD	0x3045		"SYM0"	0x00	0xFC	0
	0x3046		"SYM1"		0xF7	1
	0x3048		"SYM2"		0x3C	2
	0x3047		"SYM3"		0xFD	3
			"GLOBAL"			
	0x2A0F		"DTC"			
ACR_CTL	0x3043		"SYM0"	0x00	0xFC	0
	0x3044		"SYM1"		0xF7	1
			"SYM2"		0x3C	2
			"SYM3"		0xFD	3
			"GLOBAL"			
	0x2A0E		"DTC"			
ACR_DR	0x0487		"SYM0"	0x00	0xFC	0
			"SYM1"		0xF7	1
			"SYM2"		0x3C	2
			"SYM3"		0xFD	3
			"GLOBAL"			
	0x2A0D		"DTC"			
AEB_0	0x0A16		"SYM0"	0x11	0x8B	0
	0x0A15		"SYM1"		0x0C	1
	0x0A14		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2FAB		"DTC"			
AEB_1	0x0AB8		"SYM0"	0x00	0x8B	0
	0x0AB7		"SYM1"		0x0C	1
	0x0AB6		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2FAC		"DTC"			
AIR_LSL_UP_1	0x2414		"SYM0"	0x56	0x8B	0
			"SYM1"		0x49	1
			"SYM2"		0x45	2
			"SYM3"		0x8C	3
			"GLOBAL"			
	0x2C3B		"DTC"			
AIR_LSL_UP_2	0x2415		"SYM0"	0x56	0x8B	0

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			"SYM1"		0x4B	1
			"SYM2"		0x48	2
			"SYM3"		0x8F	3
			"GLOBAL"			
	0x2C3C		"DTC"			
ALTER_BN	0x160C		"SYM0"	0x11	0x11	0
	0x160D		"SYM1"		0x6A	1
	0x160E		"SYM2"		0x98	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2DEB		"DTC"			
ALTER_BN_BAT			"SYM0"	0x11	0x68	0
	0x160A		"SYM1"		0x69	1
			"SYM2"		0x6A	2
	0x160B		"SYM3"		0xA8	3
			"GLOBAL"			
	0x2DEC		"DTC"			
ALTER_BN_RGN			"SYM0"	0x11	0x6B	0
			"SYM1"		0x6C	1
			"SYM2"		0x6E	2
	0x160F		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2DED		"DTC"			
ALTER_COM			"SYM0"	0x11	0x8B	0
			"SYM1"		0x35	1
	0xD132		"SYM2"		0x42	2
			"SYM3"		0x15	3
			"GLOBAL"			
	0x2E98		"DTC"			
AMP	0x2229		"SYM0"	0x56	0x21	0
	0x2228		"SYM1"		0x34	1
			"SYM2"		0x70	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2F76		"DTC"			
AMP_PLAUS	0x11CB		"SYM0"	0x56	0x34	0
	0x0129		"SYM1"		0x70	1
			"SYM2"		0x33	2
			"SYM3"		0x24	3
			"GLOBAL"			
	0x2F77		"DTC"			
AMP_PLAUS_CUS			"SYM0"	0x56	0x34	0
			"SYM1"		0x0B	1
			"SYM2"		0xDD	2
	0x129C		"SYM3"		0xDE	3
			"GLOBAL"			

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	0x2F79		"DTC"			
BAT_SENS	0x150A		"SYM0"	0x11	0x7C	0
			"SYM1"		0x24	1
	0x150B		"SYM2"		0x6A	2
	0x150C		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2E8B		"DTC"			
BAT_SENS_IT	0x150D		"SYM0"	0x11	0x7C	0
			"SYM1"		0x24	1
	0x150E		"SYM2"		0x6A	2
	0x150F		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2E8C		"DTC"			
BAT_SENS_IT_EL	0x151A		"SYM0"	0x11	0x7C	0
			"SYM1"		0x24	1
	0x151C		"SYM2"		0x6A	2
	0x151B		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2E8D		"DTC"			
BN_ACC			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
	0xD12C		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDA9		"DTC"			
BN_ANG_PSTE			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
	0xD120		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDA1		"DTC"			
BN_ARS			"SYM0"	0x11	0x11	0
	0xD123		"SYM1"		0x21	1
	0xD124		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDA4		"DTC"			
BN_CAS			"SYM0"	0x11	0x11	0
	0xD11D		"SYM1"		0x21	1
	0xD11E		"SYM2"		0x3C	2
	0xD11F		"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDA0		"DTC"			
BN_CDN_DOOR			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
	0xD13A		"SYM2"		0x3C	2

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			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDB1		"DTC"			
BN_DHL_CTL			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDBE		"DTC"			
BN_EFP			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
	0xD128		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDA6		"DTC"			
BN_EFP_CRASH			"SYM0"	0x11	0x0D	0
			"SYM1"		0x3C	1
	0xD12D		"SYM2"		0x11	2
			"SYM3"		0x32	3
			"GLOBAL"			
	0xCDAA		"DTC"			
BN_ETCU			"SYM0"	0x56	0x11	0
			"SYM1"		0x21	1
	0xD11A		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCD9D		"DTC"			
BN_ETCU_2			"SYM0"	0x11	0x0D	0
			"SYM1"		0x3C	1
	0xD11B		"SYM2"		0x11	2
			"SYM3"		0x32	3
			"GLOBAL"			
	0xCD9E		"DTC"			
BN_ETCU_3			"SYM0"	0x11	0x11	0
	0xD161		"SYM1"		0x21	1
	0xD160		"SYM2"		0x3C	2
	0xD162		"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDB4		"DTC"			
BN_ETCU_DISP			"SYM0"	0x11	0x0D	0
			"SYM1"		0x3C	1
	0xD13E		"SYM2"		0x11	2
			"SYM3"		0x32	3
			"GLOBAL"			
	0xCDB0		"DTC"			
BN_GEAR_REV			"SYM0"	0x11	0x11	0

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			"SYM1"		0x21	1
	0xD129		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDA7		"DTC"			
BN_ICL			"SYM0"	0x56	0x11	0
	0xD12A		"SYM1"		0x21	1
	0xD12B		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDA8		"DTC"			
BN_KM_ICL			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
	0xD11C		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCD9F		"DTC"			
BN_LDM			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
	0xD13D		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDAD		"DTC"			
BN_LTG_HDLP_L			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
	0xD134		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDAB		"DTC"			
BN_MSW			"SYM0"	0x11	0x11	0
	0xD102		"SYM1"		0x21	1
	0xD103		"SYM2"		0x3C	2
	0xD104		"SYM3"		0x7C	3
			"GLOBAL"			
	0xCD95		"DTC"			
BN_PBR			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDB9		"DTC"			
BN_POW_GEN			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
	0xD122		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			

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	0xCDA3		"DTC"			
BN_POW_VB			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
	0xD121		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDA2		"DTC"			
BN_REQ_PBR			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDBA		"DTC"			
BN_SPT_SWI			"SYM0"	0x00	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDBD		"DTC"			
BN_STAT_TCT			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDC3		"DTC"			
BN_T_CLK			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
	0xD13C		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDAE		"DTC"			
BN_T_ICL			"SYM0"	0x56	0x11	0
			"SYM1"		0x21	1
	0xD101		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCD94		"DTC"			
BN_TCS			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
	0xD126		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDA5		"DTC"			
BN_TQ_AMT			"SYM0"	0x00	0x11	0
	0xD111		"SYM1"		0x21	1
	0xD112		"SYM2"		0x3C	2

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	0xD113		"SYM3"		0x7C	3
			"GLOBAL"			
	0xCD9A		"DTC"			
BN_TQ_DCC			"SYM0"	0x11	0x11	0
	0xD105		"SYM1"		0x21	1
	0xD106		"SYM2"		0x3C	2
	0xD107		"SYM3"		0x7C	3
			"GLOBAL"			
	0xCD96		"DTC"			
BN_TQ_ETCU			"SYM0"	0x56	0x11	0
	0xD10E		"SYM1"		0x21	1
	0xD10F		"SYM2"		0x3C	2
	0xD110		"SYM3"		0x7C	3
			"GLOBAL"			
	0xCD99		"DTC"			
BN_TQ_PBR			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDC2		"DTC"			
BN_TQ_PSTE_2			"SYM0"	0x11	0x11	0
	0xD108		"SYM1"		0x21	1
	0xD109		"SYM2"		0x3C	2
	0xD10A		"SYM3"		0x7C	3
			"GLOBAL"			
	0xCD97		"DTC"			
BN_TQ_PSTE_3			"SYM0"	0x11	0x11	0
	0xD108		"SYM1"		0x21	1
	0xD109		"SYM2"		0x3C	2
	0xD10A		"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDB3		"DTC"			
BN_TQ_TCS			"SYM0"	0x11	0x11	0
	0xD10B		"SYM1"		0x21	1
	0xD10C		"SYM2"		0x3C	2
	0xD10D		"SYM3"		0x7C	3
			"GLOBAL"			
	0xCD98		"DTC"			
BN_TQ_TCT			"SYM0"	0x00	0x11	0
	0xD10E		"SYM1"		0x21	1
	0xD10F		"SYM2"		0x3C	2
	0xD110		"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDB8		"DTC"			
BN_TRL			"SYM0"	0x11	0x11	0

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			"SYM1"		0x21	1
	0xC137		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCDAF		"DTC"			
BN_VEH_MOD			"SYM0"	0x11	0x11	0
	0xD114		"SYM1"		0x21	1
	0xD115		"SYM2"		0x3C	2
	0xD116		"SYM3"		0x7C	3
			"GLOBAL"			
	0xCD9B		"DTC"			
BN_VS_TCS			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
	0xD118		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCD9C		"DTC"			
BN_WHEEL_CAN			"SYM0"	0x56	0x0C	0
			"SYM1"		0x0D	1
	0xD16D		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x3179		"DTC"			
BSD			"SYM0"	0x11	0x11	0
			"SYM1"		0x3C	1
	0xD19D		"SYM2"		0x67	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2E7C		"DTC"			
CAM_CST_IVVT_EX_1			"SYM0"	0x56	0x11	0
			"SYM1"		0x1F	1
			"SYM2"		0x7C	2
	0x054B		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A7A		"DTC"			
CAM_CST_IVVT_IN_1			"SYM0"	0x56	0x11	0
			"SYM1"		0x1F	1
			"SYM2"		0x7C	2
	0x052B		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A7C		"DTC"			
CAN_BOFF			"SYM0"	0x56	0x11	0
			"SYM1"		0x32	1
	0x3202		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			

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	0xCD87		"DTC"			
CAT_DIAG_1	0x0420		"SYM0"	0x56	0x11	0
	0x0420		"SYM1"		0x18	1
			"SYM2"		0x1F	2
			"SYM3"		0x1E	3
			"GLOBAL"			
	0x29F4		"DTC"			
CAT_DIAG_2	0x0430		"SYM0"	0x56	0x11	0
	0x0430		"SYM1"		0x18	1
			"SYM2"		0x1F	2
			"SYM3"		0x1E	3
			"GLOBAL"			
	0x29F5		"DTC"			
CAT_DIAG_AFL_1	0x140F		"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2A26		"DTC"			
CAT_DIAG_AFL_2	0x141F		"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2A27		"DTC"			
CAT_DIAG_SUM_1			"SYM0"	0x00	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x29F6		"DTC"			
CAT_DIAG_SUM_2			"SYM0"	0x00	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x29F7		"DTC"			
CHG_LS_DOWN			"SYM0"	0x56	0x1F	0
			"SYM1"		0x8B	1
			"SYM2"		0x49	2
	0x0041		"SYM3"		0x4B	3
			"GLOBAL"			
	0x2C6A		"DTC"			
CHG_LS_UP			"SYM0"	0x56	0x05	0
			"SYM1"		0x8B	1
			"SYM2"		0x45	2

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	0x0040		"SYM3"		0x48	3
			"GLOBAL"			
	0x2C24		"DTC"			
CHK_FUC	0x0455		"SYM0"	0x00	0x3B	0
			"SYM1"		0x59	1
			"SYM2"		0x5B	2
			"SYM3"		0x8D	3
			"GLOBAL"			
	0x2A1B		"DTC"			
CHK_LS_DOWN_1	0x2271		"SYM0"	0x56	0x45	0
	0x2270		"SYM1"		0x5C	1
			"SYM2"		0x11	2
			"SYM3"		0x49	3
			"GLOBAL"			
	0x2C6B		"DTC"			
CHK_LS_DOWN_2	0x2273		"SYM0"	0x56	0x48	0
	0x2272		"SYM1"		0x5D	1
			"SYM2"		0x11	2
			"SYM3"		0x4B	3
			"GLOBAL"			
	0x2C6C		"DTC"			
COM_GB			"SYM0"	0x11	0x11	0
			"SYM1"		0x14	1
			"SYM2"		0x32	2
			"SYM3"		0x0D	3
			"GLOBAL"			
	0x2E7F		"DTC"			
CONV_MON_1			"SYM0"	0x58	0xB8	0
			"SYM1"		0x47	1
			"SYM2"		0x54	2
	0x16CE		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2D5C		"DTC"			
CRK_PLAUS	0x0335		"SYM0"	0x58	0x11	0
	0x0336		"SYM1"		0x32	1
			"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A94		"DTC"			
CRK_SYN	0x138F		"SYM0"	0x58	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A95		"DTC"			
CRK_TOOTH	0x0370		"SYM0"	0x58	0x11	0

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			"SYM1"		0x32	1
			"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A96		"DTC"			
CRK_TOOTH_PER	0x0370		"SYM0"	0x58	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A97		"DTC"			
CRU_INH_MON_1	0x16A6		"SYM0"	0x11	0xC4	0
	0x16B4		"SYM1"		0x0D	1
	0x166A		"SYM2"		0xB7	2
			"SYM3"		0x81	3
			"GLOBAL"			
	0x2D50		"DTC"			
CS	0x0832		"SYM0"	0x11	0x11	0
	0x0831		"SYM1"		0x0D	1
			"SYM2"		0x32	2
			"SYM3"		0x18	3
			"GLOBAL"			
	0x2F67		"DTC"			
CSERS_INJ	0x1210		"SYM0"	0x56	0x04	0
			"SYM1"		0x05	1
			"SYM2"		0x0C	2
			"SYM3"		0xEF	3
			"GLOBAL"			
	0x2E62		"DTC"			
CTL_LSL_UP_1	0x2627		"SYM0"	0x00	0x45	0
	0x2628		"SYM1"		0x71	1
	0x2246		"SYM2"		0x8C	2
			"SYM3"		0x01	3
			"GLOBAL"			
	0x2C45		"DTC"			
CTL_LSL_UP_2	0x2630		"SYM0"	0x00	0x48	0
	0x2631		"SYM1"		0x73	1
	0x2250		"SYM2"		0x8F	2
			"SYM3"		0x01	3
			"GLOBAL"			
	0x2C46		"DTC"			
CWP_COM			"SYM0"	0x11	0x11	0
			"SYM1"		0x05	1
			"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			

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	0x2E84		"DTC"			
CWP_COM_PLAUS			"SYM0"	0x11	0x11	0
			"SYM1"		0x05	1
			"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2E85		"DTC"			
CWP_INT_OFF	0x15D1		"SYM0"	0x11	0x05	0
	0x15D2		"SYM1"		0xE9	1
			"SYM2"		0xEC	2
			"SYM3"		0xED	3
			"GLOBAL"			
	0x2E82		"DTC"			
CWP_PLAUS	0x15D0		"SYM0"	0x11	0x05	0
			"SYM1"		0xE9	1
			"SYM2"		0xEA	2
			"SYM3"		0xEB	3
			"GLOBAL"			
	0x2E81		"DTC"			
CWP_PWR			"SYM0"	0x11	0x05	0
	0x15D5		"SYM1"		0xE9	1
	0x15D6		"SYM2"		0xEC	2
	0x15D7		"SYM3"		0xEE	3
			"GLOBAL"			
	0x2E83		"DTC"			
CYL_BAL_ER_0			"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x3070		"DTC"			
CYL_BAL_ER_1			"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x3074		"DTC"			
CYL_BAL_ER_2			"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x3072		"DTC"			
CYL_BAL_ER_3			"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2

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			"SYM3"		0x7C	3
			"GLOBAL"			
	0x3075		"DTC"			
CYL_BAL_ER_4			"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x3071		"DTC"			
CYL_BAL_ER_5			"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x3073		"DTC"			
CYL_BAL_LAM_0			"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x307C		"DTC"			
CYL_BAL_LAM_1			"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x3080		"DTC"			
CYL_BAL_LAM_2			"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x307E		"DTC"			
CYL_BAL_LAM_3			"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x3081		"DTC"			
CYL_BAL_LAM_4			"SYM0"	0x00	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x307D		"DTC"			
CYL_BAL_LAM_5			"SYM0"	0x00	0x0D	0

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			"SYM1"		0x11	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x307F		"DTC"			
DCC			"SYM0"	0x11	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x32	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2DBE		"DTC"			
DELTA_I_LAM_1	0x2097		"SYM0"	0x76	0x49	0
	0x2096		"SYM1"		0x45	1
			"SYM2"		0x78	2
			"SYM3"		0xF5	3
			"GLOBAL"			
	0x2C31		"DTC"			
DELTA_I_LAM_2	0x2099		"SYM0"	0x76	0x4B	0
	0x2098		"SYM1"		0x48	1
			"SYM2"		0x79	2
			"SYM3"		0xF6	3
			"GLOBAL"			
	0x2C32		"DTC"			
DIAGCPS			"SYM0"	0x56	0x1F	0
			"SYM1"		0x18	1
	0x110E		"SYM2"		0x11	2
	0x0440		"SYM3"		0x4D	3
			"GLOBAL"			
	0x2A1A		"DTC"			
DMTL_MAX	0x1449		"SYM0"	0x56	0x11	0
			"SYM1"		0x3B	1
			"SYM2"		0x59	2
			"SYM3"		0x5A	3
			"GLOBAL"			
	0x2B3A		"DTC"			
DMTL_MIN			"SYM0"	0x56	0x11	0
	0x1448		"SYM1"		0x3B	1
			"SYM2"		0x59	2
			"SYM3"		0x5A	3
			"GLOBAL"			
	0x2B3B		"DTC"			
DMTL_PLAUS			"SYM0"	0x56	0x11	0
			"SYM1"		0x3B	1
			"SYM2"		0x59	2
	0x1447		"SYM3"		0x5A	3
			"GLOBAL"			

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	0x2B3D		"DTC"			
DMTL_PUMP	0x2402		"SYM0"	0x56	0x34	0
	0x2401		"SYM1"		0x74	1
	0x2400		"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A13		"DTC"			
DMTL_SIG			"SYM0"	0x56	0x11	0
			"SYM1"		0x3B	1
	0x1434		"SYM2"		0x59	2
			"SYM3"		0x5A	3
			"GLOBAL"			
	0x2B3C		"DTC"			
DMTLH	0x240C		"SYM0"	0x56	0x34	0
	0x240B		"SYM1"		0x74	1
	0x240A		"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A18		"DTC"			
DMTLS	0x2420		"SYM0"	0x56	0x34	0
	0x2419		"SYM1"		0x74	1
	0x2418		"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A12		"DTC"			
DUR_IGC_MPL			"SYM0"	0x11	0x05	0
			"SYM1"		0x3C	1
			"SYM2"		0x11	2
	0x1383		"SYM3"		0x32	3
			"GLOBAL"			
	0x2E77		"DTC"			
DYN_VLD_LS_UP_1			"SYM0"	0x56	0x71	0
	0x0133		"SYM1"		0x45	1
			"SYM2"		0x30	2
			"SYM3"		0x8C	3
			"GLOBAL"			
	0x2C39		"DTC"			
DYN_VLD_LS_UP_2			"SYM0"	0x56	0x73	0
	0x0153		"SYM1"		0x48	1
			"SYM2"		0x31	2
			"SYM3"		0x8F	3
			"GLOBAL"			
	0x2C3A		"DTC"			
EBOX_CFA	0x3226		"SYM0"	0x11	0x11	0
	0x3227		"SYM1"		0x1E	1
	0x3228		"SYM2"		0x21	2

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			"SYM3"		0x0D	3
			"GLOBAL"			
	0x2F71		"DTC"			
ECF_EL_1	0x0692		"SYM0"	0x11	0x20	0
	0x0691		"SYM1"		0x7F	1
	0x0480		"SYM2"		0x32	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2EFE		"DTC"			
ECFPWM_FB_1			"SYM0"	0x11	0x24	0
			"SYM1"		0x7F	1
			"SYM2"		0x3C	2
	0x14C0		"SYM3"		0x20	3
			"GLOBAL"			
	0x2EFF		"DTC"			
ECRAS_DOWN_FB	0x14C6		"SYM0"	0x11	0x3C	0
			"SYM1"		0x24	1
			"SYM2"		0xD2	2
			"SYM3"		0xD3	3
			"GLOBAL"			
	0x2F10		"DTC"			
ECRAS_EL	0x300A		"SYM0"	0x11	0x11	0
	0x300B		"SYM1"		0x0D	1
	0x300C		"SYM2"		0x3C	2
			"SYM3"		0x80	3
			"GLOBAL"			
	0x2F0D		"DTC"			
ECRAS_UP_FB	0x14C5		"SYM0"	0x11	0x3C	0
	0x14C4		"SYM1"		0x24	1
			"SYM2"		0xD2	2
	0xD130		"SYM3"		0xD3	3
			"GLOBAL"			
	0x2F11		"DTC"			
ECT_EL			"SYM0"	0x56	0x1F	0
	0x0598		"SYM1"		0x20	1
			"SYM2"		0x32	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2EF5		"DTC"			
ECT_EL_OC			"SYM0"	0x56	0x1F	0
			"SYM1"		0x20	1
	0x0597		"SYM2"		0x32	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2EF7		"DTC"			
ECT_EL_SCP	0x0599		"SYM0"	0x56	0x1F	0

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			"SYM1"		0x20	1
			"SYM2"		0x32	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2EF8		"DTC"			
ECU_CKS	0x16A0		"SYM0"	0x99	0x11	0
	0x16A1		"SYM1"		0x21	1
	0x16A2		"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2AB3		"DTC"			
ECU_NVMY	0x16A3		"SYM0"	0x56	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2AB4		"DTC"			
ECU_RAM	0x0604		"SYM0"	0x56	0x11	0
	0x0604		"SYM1"		0x21	1
			"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2AB2		"DTC"			
EF	0x0478		"SYM0"	0x11	0x0D	0
	0x0477		"SYM1"		0x8B	1
	0x0475		"SYM2"		0xAD	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2F6C		"DTC"			
EFF_IGA_CST_IS	0x050B		"SYM0"	0x56	0x11	0
			"SYM1"		0x0E	1
			"SYM2"		0x1F	2
			"SYM3"		0x04	3
			"GLOBAL"			
	0x2E7A		"DTC"			
EFF_IGA_CST_PL	0x13EA		"SYM0"	0x33	0x11	0
			"SYM1"		0x0E	1
			"SYM2"		0x1F	2
			"SYM3"		0x04	3
			"GLOBAL"			
	0x2E7B		"DTC"			
EFP	0x1214		"SYM0"	0x00	0x32	0
	0x1215		"SYM1"		0x3C	1
	0x1216		"SYM2"		0x7C	2
	0x1217		"SYM3"		0xAF	3
			"GLOBAL"			

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	0x2AAE		"DTC"			
EFP_CRASH			"SYM0"	0x11	0x32	0
			"SYM1"		0x3C	1
	0x213F		"SYM2"		0x7C	2
			"SYM3"		0xAF	3
			"GLOBAL"			
	0x2AAD		"DTC"			
EFPPWM_PLAUS	0x10C4		"SYM0"	0x11	0xF3	0
	0x10C5		"SYM1"		0x11	1
	0x10C6		"SYM2"		0x3C	2
			"SYM3"		0xBA	3
			"GLOBAL"			
	0x2AAF		"DTC"			
EGRV_PSN_PLAUS			"SYM0"	0x00	0x0C	0
			"SYM1"		0xF7	1
			"SYM2"		0x0B	2
			"SYM3"		0xE2	3
			"GLOBAL"			
	0x2A0C		"DTC"			
EGY_MIN			"SYM0"	0x11	0x0D	0
			"SYM1"		0x3C	1
			"SYM2"		0x11	2
			"SYM3"		0x32	3
			"GLOBAL"			
	0x2FC6		"DTC"			
EGY_MIN_2			"SYM0"	0x11	0x11	0
	0x15A9		"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2FC7		"DTC"			
EL_CPS	0x0459		"SYM0"	0x56	0x11	0
	0x0458		"SYM1"		0x32	1
	0x0444		"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A19		"DTC"			
EL_LSL_UP_1	0x0132		"SYM0"	0x56	0x37	0
	0x0131		"SYM1"		0x15	1
			"SYM2"		0x45	2
			"SYM3"		0x27	3
			"GLOBAL"			
	0x2C3F		"DTC"			
EL_LSL_UP_2	0x0152		"SYM0"	0x56	0x38	0
	0x0151		"SYM1"		0x15	1
			"SYM2"		0x48	2

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			"SYM3"		0x28	3
			"GLOBAL"			
	0x2C40		"DTC"			
ER_STRAT			"SYM0"	0x00	0x1F	0
			"SYM1"		0x11	1
			"SYM2"		0xD1	2
			"SYM3"		0x0D	3
			"GLOBAL"			
	0x3104		"DTC"			
ER_STRAT_WUP			"SYM0"	0x00	0x1F	0
			"SYM1"		0x11	1
			"SYM2"		0xD1	2
			"SYM3"		0x0D	3
			"GLOBAL"			
	0x3105		"DTC"			
FL_LS_DOWN_1			"SYM0"	0x00	0x96	0
			"SYM1"		0x49	1
			"SYM2"		0x16	2
	0x1204		"SYM3"		0x45	3
			"GLOBAL"			
	0x2C6F		"DTC"			
FL_LS_DOWN_2			"SYM0"	0x00	0x97	0
			"SYM1"		0x4B	1
			"SYM2"		0x16	2
	0x1205		"SYM3"		0x48	3
			"GLOBAL"			
	0x2C70		"DTC"			
FSD_1			"SYM0"	0x76	0x0C	0
			"SYM1"		0x0B	1
	0x0171		"SYM2"		0x13	2
	0x0172		"SYM3"		0xE0	3
			"GLOBAL"			
	0x29E0		"DTC"			
FSD_2			"SYM0"	0x76	0x0C	0
			"SYM1"		0x0B	1
	0x0174		"SYM2"		0x13	2
	0x0175		"SYM3"		0xE0	3
			"GLOBAL"			
	0x29E1		"DTC"			
FSD_H_RNG_1	0x2192		"SYM0"	0x01	0x0C	0
	0x2191		"SYM1"		0x0B	1
			"SYM2"		0x13	2
			"SYM3"		0xE0	3
			"GLOBAL"			
	0x29E5		"DTC"			
FSD_H_RNG_2	0x2194		"SYM0"	0x01	0x0C	0

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	0x2193		"SYM1"		0x0B	1
			"SYM2"		0x13	2
			"SYM3"		0xE0	3
			"GLOBAL"			
	0x29E6		"DTC"			
FSD_LAM_LIM_1	0x0171		"SYM0"	0x76	0x0C	0
	0x0172		"SYM1"		0x0B	1
			"SYM2"		0x13	2
			"SYM3"		0xE0	3
			"GLOBAL"			
	0x2A2B		"DTC"			
FSD_LAM_LIM_2	0x0174		"SYM0"	0x76	0x0C	0
	0x0175		"SYM1"		0x0B	1
			"SYM2"		0x13	2
			"SYM3"		0xE0	3
			"GLOBAL"			
	0x2A2C		"DTC"			
FTL_LE_CAN	0x0463		"SYM0"	0x33	0x0E	0
	0x0462		"SYM1"		0x16	1
			"SYM2"		0x39	2
	0x1407		"SYM3"		0x61	3
			"GLOBAL"			
	0x2DE4		"DTC"			
FTL_MIN	0x142E		"SYM0"	0x58	0x1F	0
	0x142F		"SYM1"		0x18	1
			"SYM2"		0x11	2
	0x140E		"SYM3"		0x3B	3
			"GLOBAL"			
	0x29DC		"DTC"			
FTL_OBD			"SYM0"	0x33	0x0E	0
			"SYM1"		0x16	1
			"SYM2"		0x39	2
	0x144B		"SYM3"		0x61	3
			"GLOBAL"			
	0x2A22		"DTC"			
FTL_RI_CAN	0x2068		"SYM0"	0x33	0x0E	0
	0x2067		"SYM1"		0x16	1
			"SYM2"		0x39	2
	0x1408		"SYM3"		0x61	3
			"GLOBAL"			
	0x2DE5		"DTC"			
FUP	0x0193		"SYM0"	0x58	0x11	0
	0x0192		"SYM1"		0xF0	1
			"SYM2"		0xF4	2
			"SYM3"		0xEF	3
			"GLOBAL"			

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	0x29E2		"DTC"			
FUP_CH	0x15DE		"SYM0"	0x56	0x11	0
	0x15DF		"SYM1"		0x1F	1
			"SYM2"		0xEF	2
			"SYM3"		0xF3	3
			"GLOBAL"			
	0x2B2C		"DTC"			
FUP_EFP	0x2542		"SYM0"	0x11	0x11	0
	0x2541		"SYM1"		0xF4	1
			"SYM2"		0xF3	2
			"SYM3"		0x3B	3
			"GLOBAL"			
	0x29F3		"DTC"			
FUP_EFP_NOT_PLAUS	0x2540		"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2A29		"DTC"			
FUP_MFP_PLAUS	0x10ED		"SYM0"	0x58	0xF0	0
	0x10EE		"SYM1"		0xF2	1
			"SYM2"		0x55	2
			"SYM3"		0x56	3
			"GLOBAL"			
	0x29F1		"DTC"			
FUP_ORNG	0x303A		"SYM0"	0x00	0xF0	0
	0x303A		"SYM1"		0x11	1
	0x303C		"SYM2"		0xF2	2
			"SYM3"		0xBA	3
			"GLOBAL"			
	0x2FC0		"DTC"			
FUP_ST_DLY			"SYM0"	0x01	0x11	0
			"SYM1"		0xF0	1
			"SYM2"		0x25	2
			"SYM3"		0x33	3
			"GLOBAL"			
	0x2FDA		"DTC"			
FUP_ST_H_PRS			"SYM0"	0x01	0x76	0
			"SYM1"		0x77	1
			"SYM2"		0xF3	2
			"SYM3"		0x82	3
			"GLOBAL"			
	0x2FCA		"DTC"			
FUP_ST_NO_RISE			"SYM0"	0x01	0xF0	0
			"SYM1"		0x11	1
			"SYM2"		0x82	2

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			"SYM3"		0x25	3
			"GLOBAL"			
	0x2FDB		"DTC"			
FUP_STOP			"SYM0"	0x11	0xF0	0
			"SYM1"		0xF2	1
			"SYM2"		0x11	2
			"SYM3"		0x32	3
			"GLOBAL"			
	0x2FBE		"DTC"			
GEN	0x0A3B		"SYM0"	0x11	0x44	0
	0x324A		"SYM1"		0x87	1
	0x0620		"SYM2"		0x98	2
	0x3223		"SYM3"		0x15	3
			"GLOBAL"			
	0x2E97		"DTC"			
GEN_CLC_V_NOT_PLAUS	0x325A		"SYM0"	0x11	0x57	0
			"SYM1"		0x87	1
			"SYM2"		0x98	2
			"SYM3"		0x15	3
			"GLOBAL"			
	0x2ECE		"DTC"			
GEN_CTL_NOT_PLAUS	0x324E		"SYM0"	0x11	0x72	0
			"SYM1"		0x35	1
			"SYM2"		0x42	2
			"SYM3"		0x15	3
			"GLOBAL"			
	0x2ED2		"DTC"			
GEN_DIAG	0x3255		"SYM0"	0x11	0x8B	0
			"SYM1"		0x32	1
			"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2E96		"DTC"			
GEN_EL	0x0620		"SYM0"	0x11	0x57	0
			"SYM1"		0x87	1
			"SYM2"		0x98	2
			"SYM3"		0x15	3
			"GLOBAL"			
	0x2ECD		"DTC"			
GEN_H_TEMP	0x0A3B		"SYM0"	0x11	0x44	0
			"SYM1"		0x87	1
			"SYM2"		0x57	2
			"SYM3"		0x13	3
			"GLOBAL"			
	0x2ECF		"DTC"			

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GEN_H_TEMP_CLC	0x324C		"SYM0"	0x11	0x44	0
			"SYM1"		0x87	1
			"SYM2"		0x57	2
			"SYM3"		0x13	3
			"GLOBAL"			
	0x2ED0		"DTC"			
GEN_MEC	0x3223		"SYM0"	0x11	0x8B	0
			"SYM1"		0x87	1
			"SYM2"		0x98	2
			"SYM3"		0x15	3
			"GLOBAL"			
	0x2ED1		"DTC"			
GEN_MSG_LOST	0xD132		"SYM0"	0x11	0x8B	0
			"SYM1"		0x35	1
			"SYM2"		0x42	2
			"SYM3"		0x15	3
			"GLOBAL"			
	0x2ECC		"DTC"			
GEN_TYP_NOT_PLAUS	0x324A		"SYM0"	0x11	0x8B	0
			"SYM1"		0x35	1
			"SYM2"		0x42	2
			"SYM3"		0x15	3
			"GLOBAL"			
	0x2ED3		"DTC"			
GS			"SYM0"	0x01	0x32	0
			"SYM1"		0x81	1
			"SYM2"		0x7C	2
	0x0700		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2AD0		"DTC"			
H_PRS_SYS_PRE			"SYM0"	0x00	0x00	0
			"SYM1"		0x00	1
			"SYM2"		0x00	2
			"SYM3"		0x00	3
			"GLOBAL"			
			"DTC"			
IGC_SCG_0			"SYM0"	0x11	0x05	0
	0x1301		"SYM1"		0x3C	1
			"SYM2"		0x11	2
			"SYM3"		0xB1	3
			"GLOBAL"			
	0x2E18		"DTC"			
IGC_SCG_1			"SYM0"	0x11	0x05	0
	0x1305		"SYM1"		0x3C	1
			"SYM2"		0x11	2
			"SYM3"		0xB2	3

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			"GLOBAL"			
	0x2E1C		"DTC"			
IGC_SCG_2			"SYM0"	0x11	0x05	0
	0x1303		"SYM1"		0x3C	1
			"SYM2"		0x11	2
			"SYM3"		0xB3	3
			"GLOBAL"			
	0x2E1A		"DTC"			
IGC_SCG_3			"SYM0"	0x11	0x05	0
	0x1306		"SYM1"		0x3C	1
			"SYM2"		0x11	2
			"SYM3"		0xB4	3
			"GLOBAL"			
	0x2E1D		"DTC"			
IGC_SCG_4			"SYM0"	0x11	0x05	0
	0x1302		"SYM1"		0x3C	1
			"SYM2"		0x11	2
			"SYM3"		0xB5	3
			"GLOBAL"			
	0x2E19		"DTC"			
IGC_SCG_5			"SYM0"	0x11	0x05	0
	0x1304		"SYM1"		0x3C	1
			"SYM2"		0x11	2
			"SYM3"		0xB6	3
			"GLOBAL"			
	0x2E1B		"DTC"			
IGC_SCP_0	0x2301		"SYM0"	0x11	0x05	0
			"SYM1"		0x3C	1
			"SYM2"		0x11	2
			"SYM3"		0xB1	3
			"GLOBAL"			
	0x30A0		"DTC"			
IGC_SCP_1	0x2313		"SYM0"	0x11	0x05	0
			"SYM1"		0x3C	1
			"SYM2"		0x11	2
			"SYM3"		0xB2	3
			"GLOBAL"			
	0x30A4		"DTC"			
IGC_SCP_2	0x2307		"SYM0"	0x11	0x05	0
			"SYM1"		0x3C	1
			"SYM2"		0x11	2
			"SYM3"		0xB3	3
			"GLOBAL"			
	0x30A2		"DTC"			
IGC_SCP_3	0x2316		"SYM0"	0x11	0x05	0
			"SYM1"		0x3C	1

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			"SYM2"		0x11	2
			"SYM3"		0xB4	3
			"GLOBAL"			
	0x30A5		"DTC"			
IGC_SCP_4	0x2304		"SYM0"	0x11	0x05	0
			"SYM1"		0x3C	1
			"SYM2"		0x11	2
			"SYM3"		0xB5	3
			"GLOBAL"			
	0x30A1		"DTC"			
IGC_SCP_5	0x2310		"SYM0"	0x11	0x05	0
			"SYM1"		0x3C	1
			"SYM2"		0x11	2
			"SYM3"		0xB6	3
			"GLOBAL"			
	0x30A3		"DTC"			
IM_BLS_PLAUS			"SYM0"	0x11	0xCE	0
			"SYM1"		0xB7	1
			"SYM2"		0x7C	2
	0x0571		"SYM3"		0x4A	3
			"GLOBAL"			
	0x2F63		"DTC"			
IM_BTS_PLAUS			"SYM0"	0x11	0xCE	0
			"SYM1"		0xB7	1
			"SYM2"		0x7C	2
	0x0703		"SYM3"		0x4A	3
			"GLOBAL"			
	0x2F64		"DTC"			
IMOB_0			"SYM0"	0x11	0x11	0
	0x1667		"SYM1"		0x3C	1
			"SYM2"		0x7C	2
	0x16CF		"SYM3"		0x21	3
			"GLOBAL"			
	0x2F49		"DTC"			
IMOB_1	0x165A		"SYM0"	0x11	0x11	0
	0x1660		"SYM1"		0x3C	1
	0x1661		"SYM2"		0x7C	2
	0x165B		"SYM3"		0x21	3
			"GLOBAL"			
	0x2F4A		"DTC"			
IMOB_2	0x165C		"SYM0"	0x11	0x11	0
	0x165D		"SYM1"		0x3C	1
	0x1668		"SYM2"		0x7C	2
	0x165E		"SYM3"		0x21	3
			"GLOBAL"			
	0x2F4B		"DTC"			

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IMOB_3			"SYM0"	0x11	0x11	0
	0xD166		"SYM1"		0x3C	1
	0xC167		"SYM2"		0x7C	2
			"SYM3"		0x21	3
			"GLOBAL"			
	0x2F4C		"DTC"			
ISC	0x0507		"SYM0"	0x56	0x11	0
	0x0506		"SYM1"		0x12	1
			"SYM2"		0x13	2
			"SYM3"		0x14	3
			"GLOBAL"			
	0x2ADF		"DTC"			
ISC_CST	0x1562		"SYM0"	0x56	0x11	0
	0x1561		"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2AE0		"DTC"			
IV_0	0x0201		"SYM0"	0x58	0x11	0
	0x310B		"SYM1"		0x1F	1
	0x310B		"SYM2"		0x32	2
	0x0201		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2E30		"DTC"			
IV_1	0x0205		"SYM0"	0x58	0x11	0
	0x312B		"SYM1"		0x1F	1
	0x312B		"SYM2"		0x32	2
	0x0205		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2E34		"DTC"			
IV_2	0x0203		"SYM0"	0x58	0x11	0
	0x311B		"SYM1"		0x1F	1
	0x311B		"SYM2"		0x32	2
	0x0203		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2E32		"DTC"			
IV_3	0x0206		"SYM0"	0x58	0x11	0
	0x312E		"SYM1"		0x1F	1
	0x312E		"SYM2"		0x32	2
	0x0206		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2E35		"DTC"			
IV_4	0x0202		"SYM0"	0x58	0x11	0
	0x310E		"SYM1"		0x1F	1
	0x310E		"SYM2"		0x32	2
	0x0202		"SYM3"		0x3C	3

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			"GLOBAL"			
	0x2E31		"DTC"			
IV_5	0x0204		"SYM0"	0x58	0x11	0
	0x311E		"SYM1"		0x1F	1
	0x311E		"SYM2"		0x32	2
	0x0204		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2E33		"DTC"			
IV_SC_0	0x3149		"SYM0"	0x11	0x11	0
	0x3102		"SYM1"		0x1F	1
	0x3150		"SYM2"		0x32	2
	0x3101		"SYM3"		0x3C	3
			"GLOBAL"			
	0x30AC		"DTC"			
IV_SC_1	0x3161		"SYM0"	0x11	0x11	0
	0x3118		"SYM1"		0x1F	1
	0x3162		"SYM2"		0x32	2
	0x3117		"SYM3"		0x3C	3
			"GLOBAL"			
	0x30B0		"DTC"			
IV_SC_2	0x3155		"SYM0"	0x11	0x11	0
	0x3110		"SYM1"		0x1F	1
	0x3156		"SYM2"		0x32	2
	0x3109		"SYM3"		0x3C	3
			"GLOBAL"			
	0x30AE		"DTC"			
IV_SC_3	0x3164		"SYM0"	0x11	0x11	0
	0x3122		"SYM1"		0x1F	1
	0x3165		"SYM2"		0x32	2
	0x3121		"SYM3"		0x3C	3
			"GLOBAL"			
	0x30B1		"DTC"			
IV_SC_4	0x3152		"SYM0"	0x11	0x11	0
	0x3106		"SYM1"		0x1F	1
	0x3153		"SYM2"		0x32	2
	0x3105		"SYM3"		0x3C	3
			"GLOBAL"			
	0x30AD		"DTC"			
IV_SC_5	0x3158		"SYM0"	0x11	0x11	0
	0x3114		"SYM1"		0x1F	1
	0x3159		"SYM2"		0x32	2
	0x3113		"SYM3"		0x3C	3
			"GLOBAL"			
	0x30AF		"DTC"			
KNK_PRE_0			"SYM0"	0x01	0x11	0
			"SYM1"		0x13	1

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		"SYM2"		0x1E	2
	0x13A0	"SYM3"		0x1F	3
		"GLOBAL"			
	0x30ED	"DTC"			
KNK_PRE_1		"SYM0"	0x01	0x11	0
		"SYM1"		0x13	1
		"SYM2"		0x1E	2
	0x13A4	"SYM3"		0x1F	3
		"GLOBAL"			
	0x30F1	"DTC"			
KNK_PRE_2		"SYM0"	0x01	0x11	0
		"SYM1"		0x13	1
		"SYM2"		0x1E	2
	0x13A2	"SYM3"		0x1F	3
		"GLOBAL"			
	0x30EF	"DTC"			
KNK_PRE_3		"SYM0"	0x01	0x11	0
		"SYM1"		0x13	1
		"SYM2"		0x1E	2
	0x13A5	"SYM3"		0x1F	3
		"GLOBAL"			
	0x30F2	"DTC"			
KNK_PRE_4		"SYM0"	0x01	0x11	0
		"SYM1"		0x13	1
		"SYM2"		0x1E	2
	0x13A1	"SYM3"		0x1F	3
		"GLOBAL"			
	0x30EE	"DTC"			
KNK_PRE_5		"SYM0"	0x01	0x11	0
		"SYM1"		0x13	1
		"SYM2"		0x1E	2
	0x13A3	"SYM3"		0x1F	3
		"GLOBAL"			
	0x30F0	"DTC"			
KNKS_1	0x0328	"SYM0"	0x58	0x11	0
	0x0327	"SYM1"		0x12	1
		"SYM2"		0x83	2
	0x0326	"SYM3"		0x85	3
		"GLOBAL"			
	0x2E68	"DTC"			
KNKS_2	0x1328	"SYM0"	0x58	0x11	0
	0x1327	"SYM1"		0x12	1
		"SYM2"		0x86	2
	0x135B	"SYM3"		0x88	3
		"GLOBAL"			
	0x2E69	"DTC"			

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L_PRS_SYS	0x008B		"SYM0"	0x11	0xF3	0
	0x3095		"SYM1"		0x11	1
	0x008A		"SYM2"		0x3C	2
			"SYM3"		0xBA	3
			"GLOBAL"			
	0x2A2D		"DTC"			
LAM_AD_CUS_1			"SYM0"	0x56	0x11	0
	0x119D		"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2E74		"DTC"			
LAM_AD_CUS_2			"SYM0"	0x56	0x11	0
	0x119E		"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2E75		"DTC"			
LDM	0x166B		"SYM0"	0x11	0x11	0
			"SYM1"		0x13	1
			"SYM2"		0x32	2
	0x166C		"SYM3"		0x91	3
			"GLOBAL"			
	0x2DC0		"DTC"			
LOAD_TPS_PLAUS	0x00BD		"SYM0"	0x00	0x0C	0
	0x00BC		"SYM1"		0x12	1
			"SYM2"		0x58	2
			"SYM3"		0x89	3
			"GLOBAL"			
	0x2D06		"DTC"			
LOCAN_BOFF			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
	0x3205		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0xCD8B		"DTC"			
LSH_DOWN_1	0x0038		"SYM0"	0x56	0x96	0
	0x0037		"SYM1"		0x5C	1
	0x0036		"SYM2"		0x49	2
			"SYM3"		0x29	3
			"GLOBAL"			
	0x2C9E		"DTC"			
LSH_DOWN_2	0x0058		"SYM0"	0x56	0x97	0
	0x0057		"SYM1"		0x5D	1
	0x0056		"SYM2"		0x4B	2
			"SYM3"		0x2A	3

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			"GLOBAL"			
	0x2C9F		"DTC"			
LSH_LSL_UP_1	0x2231		"SYM0"	0x00	0x15	0
			"SYM1"		0x45	1
			"SYM2"		0x3B	2
			"SYM3"		0x8C	3
			"GLOBAL"			
	0x2C37		"DTC"			
LSH_LSL_UP_2	0x2234		"SYM0"	0x00	0x15	0
			"SYM1"		0x48	1
			"SYM2"		0x3B	2
			"SYM3"		0x8F	3
			"GLOBAL"			
	0x2C38		"DTC"			
LSH_UP_1	0x0032		"SYM0"	0x56	0x8C	0
	0x0031		"SYM1"		0x8B	1
	0x0030		"SYM2"		0x15	2
			"SYM3"		0x27	3
			"GLOBAL"			
	0x2C9C		"DTC"			
LSH_UP_2	0x0052		"SYM0"	0x56	0x8F	0
	0x0051		"SYM1"		0x8B	1
	0x0050		"SYM2"		0x15	2
			"SYM3"		0x28	3
			"GLOBAL"			
	0x2C9D		"DTC"			
LSL_UP_IF_1	0x3024		"SYM0"	0x56	0x9B	0
	0x3022		"SYM1"		0x2C	1
			"SYM2"		0x45	2
			"SYM3"		0x15	3
			"GLOBAL"			
	0x2C41		"DTC"			
LSL_UP_IF_2	0x3025		"SYM0"	0x56	0x9C	0
	0x3023		"SYM1"		0x2D	1
			"SYM2"		0x48	2
			"SYM3"		0x15	3
			"GLOBAL"			
	0x2C42		"DTC"			
MAF			"SYM0"	0x00	0xAE	0
			"SYM1"		0x11	1
			"SYM2"		0x58	2
			"SYM3"		0x1E	3
			"GLOBAL"			
	0x2D0F		"DTC"			
MAF_FRQ_EL_0	0x0100		"SYM0"	0x00	0x12	0
	0x00BD		"SYM1"		0x18	1

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			"SYM2"		0x0C	2
			"SYM3"		0x0F	3
			"GLOBAL"			
	0x2D27		"DTC"			
MAF_FRQ_GRD_0			"SYM0"	0x00	0x12	0
			"SYM1"		0x18	1
			"SYM2"		0x0C	2
			"SYM3"		0x0F	3
			"GLOBAL"			
	0x2D17		"DTC"			
MAF_FRQ_RNG_0	0x00BC		"SYM0"	0x00	0x12	0
			"SYM1"		0x18	1
			"SYM2"		0x0C	2
			"SYM3"		0x0F	3
			"GLOBAL"			
	0x2D15		"DTC"			
MAF_LAMB_MAX			"SYM0"	0x01	0x11	0
			"SYM1"		0xDD	1
			"SYM2"		0x06	2
			"SYM3"		0x07	3
			"GLOBAL"			
	0x2D18		"DTC"			
MAP_DIP_PLAUS			"SYM0"	0x00	0x11	0
			"SYM1"		0x26	1
			"SYM2"		0x0B	2
			"SYM3"		0x13	3
			"GLOBAL"			
	0x2D34		"DTC"			
MAP_DIP_SENS	0x0108		"SYM0"	0x56	0x0B	0
	0x0107		"SYM1"		0x11	1
			"SYM2"		0x1F	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2D33		"DTC"			
MAP_DIP_SHIFT			"SYM0"	0x00	0x1E	0
			"SYM1"		0x1F	1
			"SYM2"		0x0B	2
	0x119C		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2D35		"DTC"			
MAP_PLAUS			"SYM0"	0x56	0x34	0
			"SYM1"		0x0B	1
			"SYM2"		0xDD	2
	0x129B		"SYM3"		0xDE	3
			"GLOBAL"			
	0x2D2B		"DTC"			

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MAP_TPS_PLAUS	0x112F		"SYM0"	0x56	0x11	0
	0x112E		"SYM1"		0x26	1
			"SYM2"		0x0B	2
			"SYM3"		0x13	3
			"GLOBAL"			
	0x2D2E		"DTC"			
MEC_IVVT_EX			"SYM0"	0x58	0x11	0
			"SYM1"		0x1C	1
			"SYM2"		0x1D	2
	0x0015		"SYM3"		0x1F	3
			"GLOBAL"			
	0x2A87		"DTC"			
MEC_IVVT_IN			"SYM0"	0x58	0x11	0
			"SYM1"		0x1A	1
			"SYM2"		0x1B	2
	0x0012		"SYM3"		0x1F	3
			"GLOBAL"			
	0x2A82		"DTC"			
MFF_MON_1			"SYM0"	0x58	0xC2	0
			"SYM1"		0x18	1
			"SYM2"		0x0A	2
	0x323F		"SYM3"		0xA7	3
			"GLOBAL"			
	0x2D60		"DTC"			
MIS_0	0x0301		"SYM0"	0x76	0x1F	0
	0x0301		"SYM1"		0xE5	1
	0x0301		"SYM2"		0x11	2
			"SYM3"		0x06	3
			"GLOBAL"			
	0x29CD		"DTC"			
MIS_1	0x0305		"SYM0"	0x76	0x1F	0
	0x0305		"SYM1"		0xE5	1
	0x0305		"SYM2"		0x11	2
			"SYM3"		0x08	3
			"GLOBAL"			
	0x29D1		"DTC"			
MIS_2	0x0303		"SYM0"	0x76	0x1F	0
	0x0303		"SYM1"		0xE5	1
	0x0303		"SYM2"		0x11	2
			"SYM3"		0x06	3
			"GLOBAL"			
	0x29CF		"DTC"			
MIS_3	0x0306		"SYM0"	0x76	0x1F	0
	0x0306		"SYM1"		0xE5	1
	0x0306		"SYM2"		0x11	2
			"SYM3"		0x08	3

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			"GLOBAL"			
	0x29D2		"DTC"			
MIS_4	0x0302		"SYM0"	0x76	0x1F	0
	0x0302		"SYM1"		0xE5	1
	0x0302		"SYM2"		0x11	2
			"SYM3"		0x06	3
			"GLOBAL"			
	0x29CE		"DTC"			
MIS_5	0x0304		"SYM0"	0x76	0x1F	0
	0x0304		"SYM1"		0xE5	1
	0x0304		"SYM2"		0x11	2
			"SYM3"		0x08	3
			"GLOBAL"			
	0x29D0		"DTC"			
MIS_FTL_L			"SYM0"	0x11	0xF0	0
	0x0313		"SYM1"		0x6D	1
			"SYM2"		0x34	2
			"SYM3"		0x3B	3
			"GLOBAL"			
	0x29D9		"DTC"			
MIS_MPL	0x0300		"SYM0"	0x56	0x24	0
	0x0300		"SYM1"		0xF0	1
	0x0300		"SYM2"		0x3C	2
	0x0300		"SYM3"		0x6D	3
			"GLOBAL"			
	0x29CC		"DTC"			
MON_3	0x0605		"SYM0"	0x11	0xD9	0
	0x0604		"SYM1"		0xDA	1
	0x0606		"SYM2"		0xAA	2
	0x060C		"SYM3"		0xA9	3
			"GLOBAL"			
	0x2D67		"DTC"			
MSW_2			"SYM0"	0x11	0x0D	0
			"SYM1"		0x7A	1
			"SYM2"		0x32	2
	0x1576		"SYM3"		0x7C	3
			"GLOBAL"			
	0x2DB5		"DTC"			
MSW_3			"SYM0"	0x11	0x0D	0
			"SYM1"		0x7A	1
			"SYM2"		0x32	2
	0x1563		"SYM3"		0x7C	3
			"GLOBAL"			
	0x2DB6		"DTC"			
MSW_TOG			"SYM0"	0x11	0x0D	0
			"SYM1"		0x7A	1

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			"SYM2"		0x32	2
	0x155A		"SYM3"		0x7C	3
			"GLOBAL"			
	0x2DB7		"DTC"			
MTC_CTL_1	0x1638		"SYM0"	0x58	0x58	0
			"SYM1"		0x3F	1
			"SYM2"		0x43	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2CEC		"DTC"			
MTC_CTL_2	0x1639		"SYM0"	0x58	0x58	0
			"SYM1"		0x3F	1
			"SYM2"		0x43	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2CED		"DTC"			
MTC_CTL_3	0x11AA		"SYM0"	0x58	0x58	0
			"SYM1"		0x3F	1
			"SYM2"		0x43	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2CEE		"DTC"			
MTC_DR			"SYM0"	0x58	0x58	0
			"SYM1"		0x3F	1
	0x061F		"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2CEF		"DTC"			
N_32_MON_1			"SYM0"	0x58	0x11	0
			"SYM1"		0xB8	1
			"SYM2"		0xC0	2
	0x16A9		"SYM3"		0x32	3
			"GLOBAL"			
	0x2D52		"DTC"			
N_MAX_DRIV_REQ			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2F91		"DTC"			
N_MAX_HOMS			"SYM0"	0x00	0x8B	0
			"SYM1"		0x0C	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2B00		"DTC"			

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N_WHEEL_FN_LE			"SYM0"	0x56	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x15	2
	0x15B8		"SYM3"		0x81	3
			"GLOBAL"			
	0x2FE5		"DTC"			
N_WHEEL_FN_RI			"SYM0"	0x56	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x15	2
	0x15B9		"SYM3"		0x81	3
			"GLOBAL"			
	0x2FE7		"DTC"			
N_WHEEL_RE_LE			"SYM0"	0x56	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x15	2
	0x15C8		"SYM3"		0x81	3
			"GLOBAL"			
	0x2FE4		"DTC"			
N_WHEEL_RE_RI			"SYM0"	0x56	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x15	2
	0x15C9		"SYM3"		0x81	3
			"GLOBAL"			
	0x2FE6		"DTC"			
NEUT_PSN_GB_LRN			"SYM0"	0x00	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2FD0		"DTC"			
NEUT_PSN_GB_PLAUS			"SYM0"	0x00	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2FCF		"DTC"			
NOX_SENS_1			"SYM0"	0x00	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2EB0		"DTC"			
NOX_SENS_2			"SYM0"	0x00	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3

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			"GLOBAL"			
	0x2EB1		"DTC"			
NS_ACT_1	0x2201		"SYM0"	0x01	0xA2	0
			"SYM1"		0xA1	1
			"SYM2"		0xA3	2
			"SYM3"		0x10	3
			"GLOBAL"			
	0x30D6		"DTC"			
NS_AFR_1	0x123C		"SYM0"	0x01	0xA3	0
	0x123D		"SYM1"		0xA1	1
	0x123E		"SYM2"		0x89	2
			"SYM3"		0xA2	3
			"GLOBAL"			
	0x30D8		"DTC"			
NS_AVL_1	0x124C		"SYM0"	0x01	0xA4	0
	0x124D		"SYM1"		0x36	1
			"SYM2"		0xA2	2
			"SYM3"		0x10	3
			"GLOBAL"			
	0x30DA		"DTC"			
NS_GAIN_1			"SYM0"	0x01	0xA4	0
			"SYM1"		0xA1	1
			"SYM2"		0xA6	2
			"SYM3"		0xA5	3
			"GLOBAL"			
	0x2AFE		"DTC"			
NS_HTP_1	0x125A		"SYM0"	0x01	0xA4	0
	0x125B		"SYM1"		0x8B	1
	0x125C		"SYM2"		0x0F	2
			"SYM3"		0x6A	3
			"GLOBAL"			
	0x30DC		"DTC"			
NS_LSL_UP_DOWN_1	0x126A		"SYM0"	0x01	0xA2	0
			"SYM1"		0x89	1
			"SYM2"		0x8A	2
			"SYM3"		0xA3	3
			"GLOBAL"			
	0x30DE		"DTC"			
NS_OBD_1_HTP_1			"SYM0"	0x01	0x10	0
			"SYM1"		0x32	1
	0x2205		"SYM2"		0x53	2
	0x121C		"SYM3"		0xA4	3
			"GLOBAL"			
	0x2B05		"DTC"			
NS_OBD_1_LAMB_1			"SYM0"	0x01	0x10	0
			"SYM1"		0x32	1

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	0x121E		"SYM2"		0x53	2
	0x121F		"SYM3"		0xA4	3
			"GLOBAL"			
	0x2B06		"DTC"			
NS_OBD_1_NOX_1			"SYM0"	0x01	0x10	0
			"SYM1"		0x32	1
	0x2200		"SYM2"		0x53	2
	0x122C		"SYM3"		0xA4	3
			"GLOBAL"			
	0x2B07		"DTC"			
NS_OBD_1_VLS_1			"SYM0"	0x01	0x10	0
			"SYM1"		0x32	1
	0x122E		"SYM2"		0x53	2
	0x122F		"SYM3"		0xA4	3
			"GLOBAL"			
	0x2AFB		"DTC"			
NS_OFS_1	0x126C		"SYM0"	0x01	0x10	0
			"SYM1"		0xA6	1
			"SYM2"		0x9E	2
			"SYM3"		0xA5	3
			"GLOBAL"			
	0x30E0		"DTC"			
NS_PUC_1	0x126E		"SYM0"	0x01	0x49	0
	0x126F		"SYM1"		0xA1	1
	0x127B		"SYM2"		0xA6	2
	0x127A		"SYM3"		0xA3	3
			"GLOBAL"			
	0x30E2		"DTC"			
NS_SHIFT_1			"SYM0"	0x11	0xE3	0
			"SYM1"		0xD1	1
			"SYM2"		0x49	2
			"SYM3"		0x4B	3
			"GLOBAL"			
	0x2AEC		"DTC"			
NS_STOP_1	0x128A		"SYM0"	0x01	0x49	0
	0x128B		"SYM1"		0xA3	1
			"SYM2"		0x4B	2
			"SYM3"		0x10	3
			"GLOBAL"			
	0x30E4		"DTC"			
NS_VERS_1			"SYM0"	0x11	0x4A	0
			"SYM1"		0x32	1
			"SYM2"		0x1F	2
			"SYM3"		0x8B	3
			"GLOBAL"			
	0x2AED		"DTC"			

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NS_VLS_DYN_1	0x128E		"SYM0"	0x01	0xA2	0
			"SYM1"		0x4B	1
			"SYM2"		0xA1	2
			"SYM3"		0x10	3
			"GLOBAL"			
	0x30E6		"DTC"			
NT_AGI	0x2000		"SYM0"	0x01	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x30E9		"DTC"			
NT_SO2P			"SYM0"	0x00	0xA5	0
			"SYM1"		0xA6	1
			"SYM2"		0x9E	2
			"SYM3"		0xA0	3
			"GLOBAL"			
	0x30EA		"DTC"			
OBD_LSH_DOWN_1	0x0141		"SYM0"	0x56	0x96	0
			"SYM1"		0x5C	1
			"SYM2"		0x29	2
			"SYM3"		0x49	3
			"GLOBAL"			
	0x2CA8		"DTC"			
OBD_LSH_DOWN_2	0x0161		"SYM0"	0x56	0x97	0
			"SYM1"		0x5D	1
			"SYM2"		0x2A	2
			"SYM3"		0x4B	3
			"GLOBAL"			
	0x2CA9		"DTC"			
OBD_VLD_LSH_UP_1	0x3026		"SYM0"	0x56	0x94	0
			"SYM1"		0x15	1
	0x165F		"SYM2"		0x27	2
			"SYM3"		0x8C	3
			"GLOBAL"			
	0x2CA6		"DTC"			
OBD_VLD_LSH_UP_2	0x3027		"SYM0"	0x56	0x95	0
			"SYM1"		0x15	1
	0x166F		"SYM2"		0x28	2
			"SYM3"		0x8F	3
			"GLOBAL"			
	0x2CA7		"DTC"			
OC_LS_DOWN_1			"SYM0"	0x56	0x96	0
			"SYM1"		0x5C	1
	0x0136		"SYM2"		0x49	2
			"SYM3"		0x8B	3

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			"GLOBAL"			
	0x2C77		"DTC"			
OC_LS_DOWN_2			"SYM0"	0x56	0x97	0
			"SYM1"		0x5D	1
	0x0156		"SYM2"		0x4B	2
			"SYM3"		0x8B	3
			"GLOBAL"			
	0x2C78		"DTC"			
OC_LSL_UP_1	0x2243		"SYM0"	0x56	0x71	0
	0x112C		"SYM1"		0x9B	1
	0x112C		"SYM2"		0x45	2
	0x2626		"SYM3"		0x8C	3
			"GLOBAL"			
	0x2C3D		"DTC"			
OC_LSL_UP_2	0x2247		"SYM0"	0x56	0x73	0
	0x112D		"SYM1"		0x9C	1
	0x112D		"SYM2"		0x48	2
	0x2629		"SYM3"		0x8F	3
			"GLOBAL"			
	0x2C3E		"DTC"			
OFS_LSL_UP_1			"SYM0"	0x00	0x9B	0
			"SYM1"		0x8B	1
			"SYM2"		0x21	2
			"SYM3"		0x15	3
			"GLOBAL"			
	0x2C43		"DTC"			
OFS_LSL_UP_2			"SYM0"	0x00	0x9C	0
			"SYM1"		0x8B	1
			"SYM2"		0x21	2
			"SYM3"		0x15	3
			"GLOBAL"			
	0x2C44		"DTC"			
PBK_IV_1	0x10A5		"SYM0"	0x58	0x11	0
	0x10A6		"SYM1"		0x1F	1
	0x10A7		"SYM2"		0x32	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x30BA		"DTC"			
PBK_IV_2	0x10A8		"SYM0"	0x58	0x11	0
	0x10A9		"SYM1"		0x1F	1
	0x10AA		"SYM2"		0x32	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x30BB		"DTC"			
PER_CAM_EX_1	0x130A		"SYM0"	0x58	0x11	0
			"SYM1"		0x32	1

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			"SYM2"		0x22	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2AA3		"DTC"			
PER_CAM_IN_1	0x1300		"SYM0"	0x58	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0x22	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2AA2		"DTC"			
PLAUS_CAM_EX_1	0x0365		"SYM0"	0x58	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0x22	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2AA1		"DTC"			
PLAUS_CAM_IN_1	0x0340		"SYM0"	0x58	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0x22	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2AA0		"DTC"			
PLAUS_IGK_3	0x15B0		"SYM0"	0x11	0x11	0
	0x15B1		"SYM1"		0x32	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2ACA		"DTC"			
PLAUS_IGK_BN	0x15B0		"SYM0"	0x11	0x11	0
	0x15B1		"SYM1"		0x32	1
	0x15B2		"SYM2"		0x3C	2
	0x15B3		"SYM3"		0x7C	3
			"GLOBAL"			
	0x2DC3		"DTC"			
PLAUS_IV_CAL			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x30BE		"DTC"			
POIL_CTL_DYN	0x159E		"SYM0"	0x00	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x30C0		"DTC"			

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POIL_CTL_MEC	0x15A1		"SYM0"	0x00	0x11	0
	0x15A2		"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x30C4		"DTC"			
POIL_CTL_STAT	0x159F		"SYM0"	0x00	0x11	0
	0x15A0		"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x30C1		"DTC"			
POIL_DR	0x15EC		"SYM0"	0x00	0x11	0
	0x15EB		"SYM1"		0x22	1
	0x15EA		"SYM2"		0x6F	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x30C2		"DTC"			
POIL_DR_SCG			"SYM0"	0x00	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x30C9		"DTC"			
POIL_PUMP	0x15A3		"SYM0"	0x00	0x11	0
	0x0524		"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x30C5		"DTC"			
POIL_SENS_PLAUS	0x15A6		"SYM0"	0x00	0x11	0
	0x15A7		"SYM1"		0x21	1
			"SYM2"		0x3C	2
	0x0521		"SYM3"		0x7C	3
			"GLOBAL"			
	0x30C6		"DTC"			
POIL_SWI			"SYM0"	0x11	0x11	0
			"SYM1"		0x22	1
	0x0520		"SYM2"		0x1F	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2F7B		"DTC"			
POIL_SYS	0x15A5		"SYM0"	0x00	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3

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			"GLOBAL"			
	0x30C7		"DTC"			
PUC_LS_DOWN_1			"SYM0"	0x56	0x96	0
			"SYM1"		0x5C	1
			"SYM2"		0x49	2
	0x013E		"SYM3"		0x45	3
			"GLOBAL"			
	0x2C7B		"DTC"			
PUC_LS_DOWN_2			"SYM0"	0x56	0x97	0
			"SYM1"		0x5D	1
			"SYM2"		0x4B	2
	0x014A		"SYM3"		0x48	3
			"GLOBAL"			
	0x2C7C		"DTC"			
PUC_VLD_LS_UP_1	0x2297		"SYM0"	0x56	0x0B	0
			"SYM1"		0x45	1
			"SYM2"		0x7D	2
			"SYM3"		0x8C	3
			"GLOBAL"			
	0x2C2D		"DTC"			
PUC_VLD_LS_UP_2	0x2298		"SYM0"	0x56	0x0B	0
			"SYM1"		0x48	1
			"SYM2"		0x7E	2
			"SYM3"		0x8F	3
			"GLOBAL"			
	0x2C2E		"DTC"			
PUE_LS_DOWN_1			"SYM0"	0x56	0x96	0
			"SYM1"		0x5C	1
			"SYM2"		0x06	2
	0x013B		"SYM3"		0x49	3
			"GLOBAL"			
	0x2C79		"DTC"			
PUE_LS_DOWN_2			"SYM0"	0x56	0x97	0
			"SYM1"		0x5D	1
			"SYM2"		0x08	2
	0x013D		"SYM3"		0x4B	3
			"GLOBAL"			
	0x2C7A		"DTC"			
PUT_EL	0x0238		"SYM0"	0x58	0x11	0
	0x0237		"SYM1"		0xDD	1
			"SYM2"		0x58	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2ABC		"DTC"			
PUT_PLAUS			"SYM0"	0x58	0x34	0
			"SYM1"		0x0B	1

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			"SYM2"		0xDD	2
	0x129A		"SYM3"		0xDE	3
			"GLOBAL"			
	0x2ABD		"DTC"			
PVS_1	0x2123		"SYM0"	0x22	0x46	0
	0x2122		"SYM1"		0x47	1
			"SYM2"		0x43	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2D1B		"DTC"			
PVS_2	0x2128		"SYM0"	0x22	0x46	0
	0x2127		"SYM1"		0x47	1
			"SYM2"		0x54	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2D1C		"DTC"			
PVS_BLS_NOT_PLAUS			"SYM0"	0x11	0xB7	0
			"SYM1"		0x0D	1
			"SYM2"		0x14	2
	0x2299		"SYM3"		0xCE	3
			"GLOBAL"			
	0x2F8F		"DTC"			
PVS_DOUBLE			"SYM0"	0x58	0x43	0
			"SYM1"		0x54	1
			"SYM2"		0x46	2
	0x1224		"SYM3"		0x47	3
			"GLOBAL"			
	0x2D1F		"DTC"			
PVS_MON_1			"SYM0"	0x58	0xC4	0
			"SYM1"		0xB9	1
			"SYM2"		0xE7	2
	0x16B0		"SYM3"		0xE8	3
			"GLOBAL"			
	0x2D55		"DTC"			
PVS_RATIO			"SYM0"	0x22	0x46	0
			"SYM1"		0x47	1
			"SYM2"		0x43	2
	0x2138		"SYM3"		0x14	3
			"GLOBAL"			
	0x2D20		"DTC"			
QOIL_COM			"SYM0"	0x11	0x11	0
			"SYM1"		0x0D	1
	0x252A		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2EA1		"DTC"			

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QOIL_SENS	0x1586		"SYM0"	0x11	0x11	0
	0x1587		"SYM1"		0x32	1
	0x1521		"SYM2"		0x7C	2
	0x15B4		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2E9F		"DTC"			
RAS			"SYM0"	0x11	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2F5E		"DTC"			
REF_CRK_CAM_EX_1	0x13B6		"SYM0"	0x58	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0x22	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A99		"DTC"			
REF_CRK_CAM_IN_1	0x13B4		"SYM0"	0x58	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0x22	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A98		"DTC"			
RFP_DR	0x0035		"SYM0"	0x00	0x11	0
	0x0034		"SYM1"		0x1F	1
	0x0033		"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x30CA		"DTC"			
RLY_ACCOUT	0x0647		"SYM0"	0x11	0x11	0
	0x0646		"SYM1"		0x0D	1
	0x0645		"SYM2"		0x1F	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2F12		"DTC"			
RLY_CRCV_HEAT	0x053C		"SYM0"	0x11	0x24	0
	0x053B		"SYM1"		0x3A	1
	0x053A		"SYM2"		0x8B	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2AE4		"DTC"			
RLY_MAIN	0x0687		"SYM0"	0x11	0x8B	0
	0x0686		"SYM1"		0x4A	1
			"SYM2"		0x7C	2
			"SYM3"		0x3C	3

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			"GLOBAL"			
	0x2ACB		"DTC"			
RLY_MAIN_DLY	0x16C5		"SYM0"	0x11	0x43	0
			"SYM1"		0x4A	1
			"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2ACC		"DTC"			
RLY_MTC_HEAT	0x167B		"SYM0"	0x11	0x8B	0
	0x167C		"SYM1"		0x0C	1
	0x167D		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2D0B		"DTC"			
RLY_ST	0x0512		"SYM0"	0x11	0x8B	0
	0x0512		"SYM1"		0x4A	1
	0x0512		"SYM2"		0x53	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2F58		"DTC"			
ROUGH_LEAK	0x0442		"SYM0"	0x56	0x3B	0
			"SYM1"		0x59	1
			"SYM2"		0x5A	2
			"SYM3"		0x8D	3
			"GLOBAL"			
	0x2A15		"DTC"			
SCG_LS_DOWN_1			"SYM0"	0x56	0x96	0
	0x0137		"SYM1"		0x5C	1
			"SYM2"		0x49	2
			"SYM3"		0x8B	3
			"GLOBAL"			
	0x2C75		"DTC"			
SCG_LS_DOWN_2			"SYM0"	0x56	0x97	0
	0x0157		"SYM1"		0x5D	1
			"SYM2"		0x4B	2
			"SYM3"		0x8B	3
			"GLOBAL"			
	0x2C76		"DTC"			
SCP_LS_DOWN_1	0x0138		"SYM0"	0x56	0x96	0
			"SYM1"		0x5C	1
			"SYM2"		0x49	2
			"SYM3"		0x8B	3
			"GLOBAL"			
	0x2C73		"DTC"			
SCP_LS_DOWN_2	0x0158		"SYM0"	0x56	0x97	0
			"SYM1"		0x5D	1

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			"SYM2"		0x4B	2
			"SYM3"		0x8B	3
			"GLOBAL"			
	0x2C74		"DTC"			
SEG_AD_ER			"SYM0"	0x56	0x11	0
	0x1396		"SYM1"		0x3C	1
			"SYM2"		0xF8	2
			"SYM3"		0xF9	3
			"GLOBAL"			
	0x29DA		"DTC"			
SENS_ACR	0x040A		"SYM0"	0x00	0xFC	0
	0x040C		"SYM1"		0xF7	1
			"SYM2"		0xE4	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2A10		"DTC"			
SENS_BAT_SMT_COM			"SYM0"	0x11	0x7C	0
			"SYM1"		0x24	1
	0x150B		"SYM2"		0x6A	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2E8E		"DTC"			
SENS_POIL	0x0523		"SYM0"	0x00	0x0D	0
	0x0522		"SYM1"		0x11	1
			"SYM2"		0x22	2
			"SYM3"		0x6F	3
			"GLOBAL"			
	0x30C3		"DTC"			
SHIFT_AFL_LSL_UP_1	0x2195		"SYM0"	0x56	0x8C	0
			"SYM1"		0x49	1
			"SYM2"		0x71	2
			"SYM3"		0x45	3
			"GLOBAL"			
	0x2C27		"DTC"			
SHIFT_AFL_LSL_UP_2	0x2197		"SYM0"	0x56	0x8F	0
			"SYM1"		0x4B	1
			"SYM2"		0x73	2
			"SYM3"		0x48	3
			"GLOBAL"			
	0x2C28		"DTC"			
SHIFT_AFR_LSL_UP_1	0x2196		"SYM0"	0x56	0x8C	0
			"SYM1"		0x49	1
			"SYM2"		0x71	2
			"SYM3"		0x45	3
			"GLOBAL"			
	0x2C2B		"DTC"			

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SHIFT_AFR_LSL_UP_2	0x2198		"SYM0"	0x56	0x8F	0
			"SYM1"		0x4B	1
			"SYM2"		0x73	2
			"SYM3"		0x48	3
			"GLOBAL"			
	0x2C2C		"DTC"			
SLV_IVVT_EX	0x2091		"SYM0"	0x58	0x11	0
	0x2090		"SYM1"		0x32	1
	0x0013		"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A85		"DTC"			
SLV_IVVT_IN	0x2089		"SYM0"	0x58	0x11	0
	0x2088		"SYM1"		0x32	1
	0x0010		"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A80		"DTC"			
SMALL_LEAK			"SYM0"	0x56	0x3B	0
	0x0456		"SYM1"		0x11	1
			"SYM2"		0x5B	2
			"SYM3"		0x8D	3
			"GLOBAL"			
	0x2B28		"DTC"			
SOF	0x15AC		"SYM0"	0x00	0x11	0
	0x15AD		"SYM1"		0x0D	1
	0x15AE		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2AC1		"DTC"			
SOF_REQ	0x1540		"SYM0"	0x11	0x11	0
	0x1541		"SYM1"		0x0D	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2AC6		"DTC"			
SPI_KNK			"SYM0"	0x58	0x11	0
			"SYM1"		0x21	1
	0x16A4		"SYM2"		0x7C	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2AB5		"DTC"			
SPI_MPS			"SYM0"	0x56	0x11	0
			"SYM1"		0x21	1
	0x16A5		"SYM2"		0x7C	2
			"SYM3"		0x3C	3

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			"GLOBAL"			
	0x2AB6		"DTC"			
SWI_AFS_MON			"SYM0"	0x11	0xFE	0
			"SYM1"		0x2E	1
			"SYM2"		0x2F	2
			"SYM3"		0x9D	3
			"GLOBAL"			
	0x2D64		"DTC"			
SWT_LS_DOWN_1			"SYM0"	0x56	0x96	0
			"SYM1"		0x5C	1
			"SYM2"		0x10	2
	0x013A		"SYM3"		0x49	3
			"GLOBAL"			
	0x2C6D		"DTC"			
SWT_LS_DOWN_2			"SYM0"	0x56	0x97	0
			"SYM1"		0x5D	1
			"SYM2"		0x10	2
	0x013C		"SYM3"		0x4B	3
			"GLOBAL"			
	0x2C6E		"DTC"			
SYN_CAM_EX_1	0x13B2		"SYM0"	0x58	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0x22	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A9F		"DTC"			
SYN_CAM_IN_1	0x13B0		"SYM0"	0x58	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0x22	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A9E		"DTC"			
SYN_CRK_CAM_EX_1	0x0017		"SYM0"	0x22	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0x22	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A9B		"DTC"			
SYN_CRK_CAM_IN_1	0x0016		"SYM0"	0x58	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0x22	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2A9A		"DTC"			
T_ES			"SYM0"	0x56	0x11	0
			"SYM1"		0x32	1

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	0x2610		"SYM2"		0x82	2
			"SYM3"		0x23	3
			"GLOBAL"			
	0x2F81		"DTC"			
T_ES_DIAG_1			"SYM0"	0x00	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0x82	2
			"SYM3"		0x23	3
			"GLOBAL"			
	0x2F82		"DTC"			
T_ES_DIAG_2			"SYM0"	0x11	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0x82	2
			"SYM3"		0x23	3
			"GLOBAL"			
	0x2F83		"DTC"			
T_ES_DIAG_3			"SYM0"	0x11	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0x82	2
			"SYM3"		0x23	3
			"GLOBAL"			
	0x2F84		"DTC"			
T_ES_TCO_FAST			"SYM0"	0x56	0x11	0
			"SYM1"		0x33	1
			"SYM2"		0x82	2
	0x15E9		"SYM3"		0x23	3
			"GLOBAL"			
	0x2F7F		"DTC"			
T_ES_TCO_SLOW			"SYM0"	0x56	0x11	0
			"SYM1"		0x33	1
			"SYM2"		0x82	2
	0x15E8		"SYM3"		0x23	3
			"GLOBAL"			
	0x2F7E		"DTC"			
T_SEG_ER			"SYM0"	0x11	0x11	0
	0x0370		"SYM1"		0x1F	1
			"SYM2"		0x18	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x29DB		"DTC"			
TAM_CAN	0x0073		"SYM0"	0x56	0x24	0
	0x0072		"SYM1"		0x33	1
	0x110F		"SYM2"		0x1E	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2F9A		"DTC"			

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TAM_PLAUS			"SYM0"	0x56	0x24	0
			"SYM1"		0x33	1
			"SYM2"		0x82	2
	0x10EC		"SYM3"		0x20	3
			"GLOBAL"			
	0x2F99		"DTC"			
TCHA_LEAK			"SYM0"	0x00	0x34	0
			"SYM1"		0x24	1
			"SYM2"		0xDD	2
	0x15AA		"SYM3"		0x0C	3
			"GLOBAL"			
	0x30FC		"DTC"			
TCHA_PRS_CTL			"SYM0"	0x22	0x34	0
			"SYM1"		0x24	1
			"SYM2"		0xDD	2
	0x1260		"SYM3"		0x0C	3
			"GLOBAL"			
	0x3100		"DTC"			
TCHA_PRS_DIF			"SYM0"	0x00	0x34	0
			"SYM1"		0x24	1
			"SYM2"		0xDD	2
			"SYM3"		0x0C	3
			"GLOBAL"			
	0x30FD		"DTC"			
TCHA_PRS_HIGH			"SYM0"	0x22	0x34	0
			"SYM1"		0x24	1
			"SYM2"		0xDD	2
	0x0234		"SYM3"		0x0C	3
			"GLOBAL"			
	0x30FE		"DTC"			
TCHA_PRS_LOW			"SYM0"	0x22	0x34	0
			"SYM1"		0x24	1
			"SYM2"		0xDD	2
	0x0299		"SYM3"		0x0C	3
			"GLOBAL"			
	0x30FF		"DTC"			
TCHA_SYS_1			"SYM0"	0x00	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x3101		"DTC"			
TCO_2_EL	0x00B4		"SYM0"	0x00	0x52	0
	0x00B3		"SYM1"		0x20	1
			"SYM2"		0x24	2
			"SYM3"		0x1E	3

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			"GLOBAL"			
	0x2EEA		"DTC"			
TCO_2_GRD			"SYM0"	0x00	0x20	0
			"SYM1"		0x1F	1
			"SYM2"		0x24	2
	0x00B2		"SYM3"		0xEA	3
			"GLOBAL"			
	0x2EEB		"DTC"			
TCO_2_PLAUS	0x3196		"SYM0"	0x00	0x20	0
			"SYM1"		0x82	1
			"SYM2"		0x1F	2
	0x3195		"SYM3"		0x32	3
			"GLOBAL"			
	0x2EEC		"DTC"			
TCO_EL	0x0118		"SYM0"	0x56	0x50	0
	0x0117		"SYM1"		0x1F	1
			"SYM2"		0x24	2
			"SYM3"		0x1E	3
			"GLOBAL"			
	0x2EE0		"DTC"			
TCO_GRD			"SYM0"	0x56	0x1F	0
			"SYM1"		0x20	1
			"SYM2"		0x24	2
	0x0116		"SYM3"		0x7F	3
			"GLOBAL"			
	0x2EE3		"DTC"			
TCO_PLAUS			"SYM0"	0x00	0x1F	0
			"SYM1"		0x20	1
			"SYM2"		0x3C	2
	0x0125		"SYM3"		0xEC	3
			"GLOBAL"			
	0x2EE1		"DTC"			
TCO_STUCK			"SYM0"	0x56	0x1F	0
			"SYM1"		0x20	1
			"SYM2"		0x24	2
	0x316B		"SYM3"		0x82	3
			"GLOBAL"			
	0x2EE2		"DTC"			
TCO_STUCK_RNG			"SYM0"	0x56	0x23	0
			"SYM1"		0x82	1
			"SYM2"		0x3A	2
	0x316A		"SYM3"		0x33	3
			"GLOBAL"			
	0x2EE6		"DTC"			
TECU	0x0669		"SYM0"	0x11	0x41	0
	0x0668		"SYM1"		0x21	1

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			"SYM2"		0x24	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2F85		"DTC"			
TEG_PCAT_DOWN	0x0546		"SYM0"	0x01	0x11	0
	0x0545		"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2C87		"DTC"			
TH			"SYM0"	0x56	0x24	0
			"SYM1"		0x82	1
			"SYM2"		0x20	2
	0x0128		"SYM3"		0x11	3
			"GLOBAL"			
	0x2EF4		"DTC"			
TIA_EL	0x007D		"SYM0"	0x58	0x51	0
	0x007C		"SYM1"		0x1E	1
			"SYM2"		0x24	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2F13		"DTC"			
TIA_GRD			"SYM0"	0x58	0x1E	0
			"SYM1"		0x13	1
	0x10D0		"SYM2"		0x24	2
	0x007B		"SYM3"		0x1F	3
			"GLOBAL"			
	0x2F30		"DTC"			
TIA_PLAUS	0x10B0		"SYM0"	0x58	0x1E	0
	0x10B1		"SYM1"		0x3A	1
			"SYM2"		0x24	2
	0x10B8		"SYM3"		0x1F	3
			"GLOBAL"			
	0x2F15		"DTC"			
TIA_TCHA_UP	0x104E		"SYM0"	0x00	0x51	0
	0x104F		"SYM1"		0x1E	1
			"SYM2"		0x24	2
			"SYM3"		0xD5	3
			"GLOBAL"			
	0x2F0A		"DTC"			
TOIL_LEVEL			"SYM0"	0x11	0x11	0
	0x250F		"SYM1"		0x21	1
	0x250A		"SYM2"		0x3C	2
	0x250B		"SYM3"		0x7C	3
			"GLOBAL"			
	0x2F9E		"DTC"			

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TOOTH_OFF_EX_1	0x13BC		"SYM0"	0x58	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0x22	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2AA5		"DTC"			
TOOTH_OFF_IN_1	0x13BA		"SYM0"	0x58	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0x22	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2AA4		"DTC"			
TOUT_NOX_SENS_1			"SYM0"	0x00	0x11	0
			"SYM1"		0x21	1
	0xC29D		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2EAE		"DTC"			
TOUT_NOX_SENS_2			"SYM0"	0x00	0x11	0
			"SYM1"		0x21	1
	0xC29E		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2EAF		"DTC"			
TPS			"SYM0"	0x58	0x11	0
			"SYM1"		0x1E	1
	0x110D		"SYM2"		0x1F	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2D09		"DTC"			
TPS_1	0x0123		"SYM0"	0x58	0x4E	0
	0x0122		"SYM1"		0x4C	1
			"SYM2"		0x43	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2CF9		"DTC"			
TPS_2	0x0223		"SYM0"	0x58	0x4E	0
	0x0222		"SYM1"		0x4C	1
			"SYM2"		0x43	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2CFA		"DTC"			
TPS_AD	0x1632		"SYM0"	0x58	0x4E	0
	0x1633		"SYM1"		0x4C	1
	0x1694		"SYM2"		0xB0	2
	0x16BC		"SYM3"		0x3C	3

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			"GLOBAL"			
	0x2CFB		"DTC"			
TPS_AD_BOL	0x1635		"SYM0"	0x58	0x4E	0
			"SYM1"		0x4C	1
			"SYM2"		0x43	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2CFE		"DTC"			
TPS_JAM_DET	0x164E		"SYM0"	0x00	0x8B	0
	0x164F		"SYM1"		0x0C	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2D0C		"DTC"			
TPS_MAF_1			"SYM0"	0x58	0xAB	0
			"SYM1"		0xE4	1
			"SYM2"		0x4C	2
	0x1141		"SYM3"		0x4E	3
			"GLOBAL"			
	0x2CF6		"DTC"			
TPS_MAF_2			"SYM0"	0x58	0xAC	0
			"SYM1"		0xE4	1
			"SYM2"		0x4C	2
	0x1162		"SYM3"		0x4E	3
			"GLOBAL"			
	0x2CF7		"DTC"			
TPS_MON_1			"SYM0"	0x58	0x58	0
			"SYM1"		0xB8	1
			"SYM2"		0x4E	2
	0x060E		"SYM3"		0x4C	3
			"GLOBAL"			
	0x2D61		"DTC"			
TPS_RATIO			"SYM0"	0x58	0x4E	0
			"SYM1"		0x4C	1
			"SYM2"		0x43	2
	0x115F		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2D07		"DTC"			
TPS_ST_CHK_1	0x1675		"SYM0"	0x11	0x4E	0
			"SYM1"		0x4C	1
			"SYM2"		0x43	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2CFD		"DTC"			
TPS_ST_CHK_2	0x16BA		"SYM0"	0x58	0x4E	0
	0x169A		"SYM1"		0x4C	1

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			"SYM2"		0x43	2
			"SYM3"		0x3C	3
			"GLOBAL"			
	0x2CFC		"DTC"			
TQ_CST	0x1559		"SYM0"	0x00	0x11	0
			"SYM1"		0x21	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2AE1		"DTC"			
TQ_DIF_ISC_MON_1			"SYM0"	0x58	0xC3	0
			"SYM1"		0xC7	1
	0x16B1		"SYM2"		0xC8	2
	0x16B2		"SYM3"		0xCA	3
			"GLOBAL"			
	0x2D56		"DTC"			
TQ_EXT_MON_1	0x16B3		"SYM0"	0x11	0x81	0
			"SYM1"		0xBF	1
	0x16B5		"SYM2"		0x93	2
	0x16B6		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2D57		"DTC"			
TQ_REQ_CAN			"SYM0"	0x01	0x11	0
			"SYM1"		0x2B	1
			"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2DC5		"DTC"			
TQ_REQ_MON_1	0x16B7		"SYM0"	0x58	0xD4	0
	0x16B8		"SYM1"		0xD6	1
	0x16B9		"SYM2"		0xCD	2
			"SYM3"		0x32	3
			"GLOBAL"			
	0x2D58		"DTC"			
TQI_AV_MON_1			"SYM0"	0x58	0xB8	0
			"SYM1"		0xCF	1
			"SYM2"		0xD0	2
	0x16C1		"SYM3"		0x75	3
			"GLOBAL"			
	0x2D59		"DTC"			
TQI_LIM			"SYM0"	0x11	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0xCF	2
			"SYM3"		0xD1	3
			"GLOBAL"			
	0x2D5A		"DTC"			

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TQI_N_MAX_MON_1			"SYM0"	0x58	0xC5	0
			"SYM1"		0xC6	1
			"SYM2"		0xDB	2
	0x16C2		"SYM3"		0xDC	3
			"GLOBAL"			
	0x2D53		"DTC"			
TTIP_MES_LSH_UP_1	0x3026		"SYM0"	0x56	0x94	0
			"SYM1"		0x15	1
	0x165F		"SYM2"		0x27	2
			"SYM3"		0x45	3
			"GLOBAL"			
	0x2CAA		"DTC"			
TTIP_MES_LSH_UP_2	0x3027		"SYM0"	0x56	0x95	0
			"SYM1"		0x15	1
	0x166F		"SYM2"		0x28	2
			"SYM3"		0x48	3
			"GLOBAL"			
	0x2CAB		"DTC"			
V_REF_1			"SYM0"	0x58	0x43	0
			"SYM1"		0x54	1
			"SYM2"		0x46	2
	0x164C		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2D1D		"DTC"			
V_REF_2			"SYM0"	0x58	0x43	0
			"SYM1"		0x54	1
			"SYM2"		0x47	2
	0x1625		"SYM3"		0x3C	3
			"GLOBAL"			
	0x2D1E		"DTC"			
VAR_COD			"SYM0"	0x11	0x11	0
			"SYM1"		0x3C	1
	0x3287		"SYM2"		0x7C	2
	0x3239		"SYM3"		0x8B	3
			"GLOBAL"			
	0x2FA3		"DTC"			
VCV	0x0004		"SYM0"	0x58	0xF2	0
	0x0003		"SYM1"		0xF0	1
	0x0001		"SYM2"		0xE4	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2FBC		"DTC"			
VCV_PLAUS			"SYM0"	0x00	0xF0	0
			"SYM1"		0x11	1
			"SYM2"		0xF2	2
			"SYM3"		0xBA	3

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			"GLOBAL"			
	0x2FC3		"DTC"			
VEH_POW_VAR			"SYM0"	0x11	0x11	0
			"SYM1"		0x3C	1
			"SYM2"		0x7C	2
			"SYM3"		0x8B	3
			"GLOBAL"			
	0x2FA4		"DTC"			
VIM_1_EL	0x0662		"SYM0"	0x11	0x11	0
	0x0661		"SYM1"		0x0D	1
	0x1511		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2AA8		"DTC"			
VIM_2_EL	0x0662		"SYM0"	0x11	0x11	0
	0x0661		"SYM1"		0x0D	1
	0x1511		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2AA9		"DTC"			
VIM_PLAUS			"SYM0"	0x11	0x11	0
			"SYM1"		0x1F	1
			"SYM2"		0x32	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x2AAA		"DTC"			
VIMPWM_1_FB			"SYM0"	0x11	0x3C	0
			"SYM1"		0x0C	1
			"SYM2"		0x18	2
	0x14C2		"SYM3"		0x24	3
			"GLOBAL"			
	0x2AAB		"DTC"			
VIMPWM_2_FB			"SYM0"	0x11	0x3C	0
			"SYM1"		0x0C	1
			"SYM2"		0x18	2
	0x14C3		"SYM3"		0x24	3
			"GLOBAL"			
	0x2AAC		"DTC"			
VLS_DOWN_DIF_1	0x114A		"SYM0"	0x56	0x49	0
	0x114B		"SYM1"		0x45	1
			"SYM2"		0x78	2
			"SYM3"		0xF5	3
			"GLOBAL"			
	0x2C7E		"DTC"			
VLS_DOWN_DIF_2	0x114C		"SYM0"	0x56	0x4B	0
	0x114D		"SYM1"		0x48	1

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			"SYM2"		0x79	2
			"SYM3"		0xF6	3
			"GLOBAL"			
	0x2C7F		"DTC"			
VS			"SYM0"	0x56	0x11	0
			"SYM1"		0x32	1
	0x1505		"SYM2"		0xD1	2
			"SYM3"		0x81	3
			"GLOBAL"			
	0x2F5F		"DTC"			
VS_BOL			"SYM0"	0x11	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0xD1	2
			"SYM3"		0x81	3
			"GLOBAL"			
	0x2F56		"DTC"			
VS_GRD			"SYM0"	0x11	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0xD1	2
			"SYM3"		0x81	3
			"GLOBAL"			
	0x2F57		"DTC"			
VS_PLAUS_POW			"SYM0"	0x11	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0xD1	2
			"SYM3"		0x81	3
			"GLOBAL"			
	0x2F5D		"DTC"			
VS_PLAUS_STUCK			"SYM0"	0x11	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0xD1	2
			"SYM3"		0x81	3
			"GLOBAL"			
	0x2F5B		"DTC"			
VS_TOL			"SYM0"	0x11	0x11	0
			"SYM1"		0x32	1
			"SYM2"		0xD1	2
			"SYM3"		0x81	3
			"GLOBAL"			
	0x2F5C		"DTC"			
WARM_RST	0x0602		"SYM0"	0x01	0x67	0
			"SYM1"		0x3D	1
	0x1640		"SYM2"		0x3E	2
	0x1615		"SYM3"		0x40	3
			"GLOBAL"			
	0x2D5F		"DTC"			

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WG_1_DR	0x0246		"SYM0"	0x22	0x11	0
	0x0245		"SYM1"		0x1F	1
	0x0243		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x30CF		"DTC"			
WG_2_DR	0x0250		"SYM0"	0x22	0x11	0
	0x0249		"SYM1"		0x1F	1
	0x0247		"SYM2"		0x3C	2
			"SYM3"		0x7C	3
			"GLOBAL"			
	0x30D0		"DTC"			
WHEEL_GRD_FR_LE	0x15DA		"SYM0"	0x56	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x15	2
			"SYM3"		0xE5	3
			"GLOBAL"			
	0x2F52		"DTC"			
WHEEL_GRD_FR_RI	0x15DB		"SYM0"	0x56	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x15	2
			"SYM3"		0xE5	3
			"GLOBAL"			
	0x2F53		"DTC"			
WHEEL_GRD_RE_LE	0x15DC		"SYM0"	0x56	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x15	2
			"SYM3"		0xE5	3
			"GLOBAL"			
	0x2F54		"DTC"			
WHEEL_GRD_RE_RI	0x15DD		"SYM0"	0x56	0x0D	0
			"SYM1"		0x11	1
			"SYM2"		0x15	2
			"SYM3"		0xE5	3
			"GLOBAL"			
	0x2F55		"DTC"			

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A.71 Canister purge valve diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_EL_CPS	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of CPS; bit 0: diagnosis condition for symptom SYM_0; bit 1: diagnosis condition for symptom SYM_1; bit 2: diagnosis condition for symptom SYM_2					
CPPWM_LIH	O/V	0... FFH	0... 99.60937	0.390625	%
PWM signal for CPS opening limp home value					
ERR_DIAG_EL_CPS	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for CPS (only parameter)					
ERR_SYM_EL_CPS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the failure					
LV_ERR_EL_CPS	O/V/S	0... 1H	0 ...1	1	-
Logical value for present electrical canister purge valve failure					

Input data:

CPPWM_CPS {p. 3749}	LV_IGK {p. 906}	LV_INH_DIAG_EL_CPS {p. 4712}	LV_ST {p. 1720}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_EL_CPS_DIAG	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_EL_CPS_DIAG	-	0... FFH	0... 255	1	-
Maximum value for antibounce counter					
C_CPPWM_DIAG_MAX_SCG	-	0... FFH	0... 99.60937	0.390625	%
Maximum threshold for SCG diagnosis window					
C_CPPWM_DIAG_MIN_OC	-	0... FFH	0... 99.60937	0.390625	%
Minimum threshold for OC diagnosis window					
C_CPPWM_DIAG_MIN_SCP	-	0... FFH	0... 99.60937	0.390625	%
Minimum threshold for SCP diagnosis window					
C_CPPWM_SUB_DIAG_1	-	0... FFH	0... 99.60937	0.390625	%
cppwm substitute when SCG failure					
C_CPPWM_SUB_DIAG_2	-	0... FFH	0... 99.60937	0.390625	%
cppwm substitute when SCB or OL failure					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_CPS	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (typical 2)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Import actions:

ACTION_ERRM_FilterMulticondition	(**IN**<XX>,**IN**<CDN_DIAG_>,**XX**>,<IN<>,**ERR_DIAG_XX**>,<IN>,<C_ABC_INC_XX>,**IN**<C_ABC_MAX_XX>,**OUT**<LV_ERR_XX>)
ACTION_INFR_GetElDiagCPS	(**OUT**<CDN_DIAG_EL_CPS>,**OUT**<ERR_DIAG_EL_CPS>)

Error treatment:

Diagnostic CPS	Symptom description	Symptom	Filter type
CPS Diagnostic	*SCP*	*SYM_0*	*MPL_STD_INI*
	SCG	*SYM_1*	
	OC	*SYM_2*	

General information:

The CPS is driven by the ECU via an output driver. The failure detection is done by ECU Hardware.
The purpose of the diagnosis is
The purpose is to perform the electrical diagnosis of the CPS actuator to detect electrical faults as defined by OBD I requirements. Three symptoms are distinguished:

Error-symptoms and conditions: are defined to this diagnosis function as following

```
 □□□□
 | | | └─> Short circuit to battery (SCP)      (= SYM_0)
 | | └───> Short circuit to ground (SCG)       (= SYM_1)
 | └─────> Open circuit (OC)                   (= SYM_2)
 └───────> Not used                            (= SYM_3)
```

Application conditions

Initialisation: `LV_ERR_EL_CPS is initialized according filter-type.`
`at reset: CDN_DIAG_EL_CPS = 0`

Recurrence: *100ms*

Activation: –

Deactivation: –

Formula section:

// Usage of the diagnosis information (failure symptoms (raw value) ERR_DIAG_EL_CPS and diagnosis conditions CDN_DIAG_EL_CPS) received from the infrastructure:

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ACTION_INFR_GetElDiagCPS (OUT<CDN_DIAG_EL_CPS>, OUT<ERR_DIAG_EL_CPS>, SYNCRONIZATION<CALL>)

// Diagnosis conditions are set according infrastructure information: CDN_DIAG_EL_CPS. Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_EL_CPS

if LV_IGK = 1
and LV_ST = 0

and LV_INH_DIAG_EL_CPS = 0
then **if** activation conditions are met for NC_PSD_DLY_CPS recurrencies
then // additional diagnosis conditions
// conditions that disable SCP detection
if CPPWM_CPS < C_CPPWM_DIAG_MIN_SCP
then bit 0 of CDN_DIAG_EL_CPS = 0 // diagnosis of SCP is not possible
endif

// conditions that disable SCG detection
if CPPWM_CPS > C_CPPWM_DIAG_MAX_SCG
then bit 1 of CDN_DIAG_EL_CPS = 0 // diagnosis of SCG is not possible
endif

// conditions that disable OC detection
if CPPWM_CPS < C_CPPWM_DIAG_MIN_OC
or CPPWM_CPS > C_CPPWM_DIAG_MAX_SCG
then bit 2 of CDN_DIAG_EL_CPS = 0 // diagnosis of OC is not possible
endif
else CDN_DIAG_EL_CPS = 0
else CDN_DIAG_EL_CPS = 0
endif

// Failure filtering and error management treatment
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_EL_CPS and ERR_DIAG_EL_CPS; this algorithm determines:

- ERR_SYM_EL_CPS (detected error symptom for CPS diagnosis)
- LV_ERR_EL_CPS (Error flag for debounced error of CPS)
- LV_CDN_DIAG_EL_CPS (Diagnosis condition information)
- LV_END_DIAG_EL_CPS (End of diagnosis information)

ACTION_ERRM_FilterMulticondition (IN<*CPS*>, IN<CDN_DIAG_EL_CPS>, IN<ERR_DIAG_EL_CPS>, IN<C_ABC_INC_EL_CPS_DIAG>, IN<C_ABC_MAX_EL_CPS_DIAG>, OUT< LV_ERR_CPS>, SYNCRONIZATION<CALL>)

// Limp-home value
if LV_ERR_EL_CPS = 1
then **case selection on** ERR_SYM_EL_CPS
SCG: CPPWM_LIH = C_CPPWM_SUB_DIAG_1
SCP, OC: CPPWM_LIH = C_CPPWM_SUB_DIAG_2
NO_SYM: CPPWM_LIH = CPPWM_LIH$_{n-1}$
end case selection
else CPPWM_LIH = 0
endif

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end

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A.72 Canister purge valve diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_EL_CPS	O/V	0... 1H	0 ...1	1	-
Inhibits canister purge valve diagnosis					

Input data:

LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}	

General information:

This chapter describes the canister purge valve diagnosis inhibition.

Application conditions

Initialisation: `LV_INH_DIAG_EL_CPS = 0 at LV_IGK = 0->1 or reset`

Recurrence: `100 ms & every transition of an error flag.`

Activation: `at every engine operating state`

Deactivation: `- -`

Formula section:

If LV_IGK = 1 **and**
LV_CDN_VB_OBD1 = 1 **and**
LV_ERR_SPI_MPS = 0
Then LV_INH_DIAG_EL_CPS = 0
Else LV_INH_DIAG_EL_CPS = 1
Endif

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A.73 Exhaust gas temperature sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_SAMPLE_ACT_TEG_SENS_DIAG	V	0... FFFFH	0... 65535	1	-
Sample counter for continuous temperature sensor diagnosis					
CTR_TEG_SENS_DIAG_SUM	V	0... FFFFH	0... 65535	1	-
Sum counter for wehgting factors for continuous TEG diagnosis					
CTR_TQ_MIN_TEG_SENS_DIAG	V	0... FFFFH	0... 65535	1	-
Counter to control the temperature sensor diagnosis activation and deactivation					
CTR_TQ_MIN_TEG_SENS_DIAG_1	V	0... FFFFH	0... 65535	1	-
Counter to control the temperature sensor continuous diagnosis activation and deactivation					
ERR_SYM_TEG_PCAT_DOWN	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the diagnostic instance TEG_PCAT_DOWN					
LV_CDN_DIAG_TEG_PCAT_DOWN	O/V	0... 1H	0 ...1	1	-
Condition for diagnostic of temperature sensor downstream catalyst					
LV_END_DIAG_TEG_PCAT_DOWN	O/V	0... 1H	0 ...1	1	-
End of diagnostics of the temperature sensor downstream catalyst					
LV_ERR_PREL_TEG_PCAT_DOWN	O/V	0... 1H	0 ...1	1	-
Temp. after precatalyst antibouce flag					
LV_ERR_TEG_PCAT_DOWN	O/V	0... 1H	0 ...1	1	-
Temp. after precatalyst error flag					
LV_TEG_SENS_DIAG_RLS	V	0... 1H	0 ...1	1	-
Release temperatur sensor diagnosis flag					
RATE_SAMPLE_STC_TEG_SENS_DIAG [32]	V	0... FFFFH	0... 65535	1	-
Number of samples per calibrated time interval for continuous TEG diagnosis					

Input data:

LV_IGK {p. 906}	LV_VAR_TCHA {p. 656}	N {p. 1525}	STATE_ENG {p. 1720}
T_AST_DIAG {p. 1766}	TAM {p. 1579}	TEG_CAT_DOWN_MDL {p. 8236}	TQ_AV {p. 6656}
VP_TEG_PCAT_DOWN {p. 1253}	VS {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TEG_PCAT_DOWN	-	0... FFH	0... 255	1	-
Debounce counter increment TEG Diagnosis					
C_ABC_MAX_TEG_PCAT_DOWN	-	1... FFH	1... 255	1	-
Debounce counter maximum TEG Diagnosis					
C_CTR_CYC_TEG_SENS_DIAG_1	-	0... 20H	0... 32	1	-
Number of cycles for sum calculating for continuous TEG diagnosis					
C_CTR_MIN_TQ_MIN_TEG_SENS_DIAG	-	0... FFFFH	0... 65535	1	-
Minimum counter value for temperature sensor diagnosis dependent on TQ					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TEG_SENS_DIAG [32]	-	0... 80H	0 ...1	0.0078125	-
Array for wehgting factor for continuous TEG diagnosis					
C_N_MIN_TEG_SENS_DIAG_1	-	0... 1FE0H	0... 8160	1	rpm
Minimum requested engine speed for counter activation for continuous TEG diagnosis					
C_RATE_SAMPLE_MIN_TEG_SENS_DIAG	-	0... FFFFH	0... 65535	1	-
Min number of samples per calibrated time interval for continuous TEG sensor diagnosis					
C_RATE_SAMPLE_TEG_SENS_DIAG_1	-	0... 400H	0... 10240	10	-
Number of samples for save cycle for continuous TEG diagnosis					
C_T_AST_MIN_TEG_SENS_DIAG	-	0... FFFFH	0... 32767.5	0.5	s
Minimum time delay after start for exhaust gas temperature sensor diagnosis					
C_TEMP_THD_TEG_SENS_DIAG_1	-	0... 400H	0... 1024	1	°C
Exhaust gas temperature threshold for activation of TEG sensor diagnosis					
C_TQ_MIN_TEG_SENS_DIAG	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
calibratable threshold as minimum requested torque for activating diagnosis of exhaust gas temperature sensors					
C_TQ_MIN_TEG_SENS_DIAG_1	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min. requested torque for counter activating for continuous TEG diagnosis					
C_VP_TEG_MES_GRD_MAX	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Maximum voltage gradient threshold for error detection					
C_VP_TEG_PCAT_DOWN_DIAG_MAX	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Maximum voltage threshold for error detection					
C_VP_TEG_PCAT_DOWN_DIAG_MIN	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Minimum voltage threshold for error detection					
C_VP_TEG_SENS_ACT_DIAG	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Exhaust gas temperature sensor signal voltage threshold for activation of diagnosis of TEG sensors					
C_VS_MIN_TEG_SENS_DIAG	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for activating diagnosis of exhaust gas temperature sensors					
IP_CTR_TQ_MIN_TEG_SENS_DIAG	-	0... FFFFH	0... 65535	1	-
LDP_TAM_IP_CTR_TQ_MIN_TEG_SENS	8	0... FEH	-48... 142.5	0.75	°C
Max value from sum. counter for TQ_AV check for continuous TEG diagnosis					

FUNCTION DESCRIPTION:

General information:

The purpose of the diagnosis shall be to detect electrical faults as defined by OBD I requirements.
VP_TEG_PCAT_DOWN is monitored for invalid gradients and values (see also exhaust gas temperature in chapter system variables).
The diagnosis for "short circuit to Vbatt or open load" is only performed:

- either by reaching a certain voltage on the pin or after a calibrateable time after start or counter for activation of diagnosis reached calibrateable value
- and at the moment of diagnosis additional conditions are fullfilled

This functionality shell prevent a wrong failure detection due to too low sensor temperatures, i.e. at cold start.

Description:

Error-symptoms are defined to this diagnosis function as following:

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```
 ┌─┬─┬─┬─┐
 │ │ │ │ │
 └─┴─┴─┴─┘
  │ │ │ └─> Short circuit to Vbatt or Open load     (= SYM_0)
  │ │ └───> Short circuit to GND                    (= SYM_1)
  │ └─────> -                                       (= SYM_2)
  └───────> -                                       (= SYM_3)
```

Application conditions

Initialization: according configuration MEM
(0 at LV_IGK 0->1 or reset)

Recurrence: 100ms

Activation: **see formula section**

Formula section:

If(1) LV_IGK = 1
Then(1) CTR_SAMPLE_ACT_TEG_SENS_DIAG++
If(2) TQ_AV> C_TQ_MIN_TEG_SENS_DIAG_1
and N > C_N_MIN_TEG_SENS_DIAG_1
Then(2) CTR_TQ_MIN_TEG_SENS_DIAG_1++
Endif(2)
If(3) CTR_SAMPLE_ACT_TEG_SENS_DIAG >= C_RATE_SAMPLE_TEG_SENS_DIAG_1
Then(3)
For(3) (x = 31; x = 1; x - -)
{RATE_SAMPLE_STC_TEG_SENS_DIAG[x] =
RATE_SAMPLE_STC_TEG_SENS_DIAG[x-1] }

RATE_SAMPLE_STC_TEG_SENS_DIAG[0] = CTR_TQ_MIN_TEG_SENS_DIAG_1
CTR_TQ_MIN_TEG_SENS_DIAG_1 = 0
CTR_SAMPLE_ACT_TEG_SENS_DIAG = 0
Endif(3)

Short circuit to GND:
If(4a) VP_TEG_PCAT_DOWN < C_VP_TEG_PCAT_DOWN_DIAG_MIN
and LV_VAR_TCHA = 0
Then(4a) LV_CDN_DIAG_TEG_PCAT_DOWN = 1
LV_ERR_PREL_TEG_PCAT_DOWN = 1
ERR_SYM_TEG_PCAT_DOWN = SYM_1

Else(4a) LV_CDN_DIAG_TEG_PCAT_DOWN = 0
Endif(4a)

Short circuit to Vbatt or Open load:
If(4b) LV_TEG_SENS_DIAG_RLS = 0
and CTR_TQ_MIN_TEG_SENS_DIAG < C_CTR_MIN_TQ_MIN_TEG_SENS_DIAG | *calculation of counter for*
and TQ_AV >= C_TQ_MIN_TEG_SENS_DIAG | *activation of*
and VS >= C_VS_MIN_TEG_SENS_DIAG | *diagnosis*

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```
      and      LV_VAR_TCHA = 0
Then(4b)           CTR_TQ_MIN_TEG_SENS_DIAG++
Else(4b)           freeze CTR_TQ_MIN_TEG_SENS_DIAG
Endif(4b)
If(4c)         LV_TEG_SENS_DIAG_RLS = 0
Then(4c)
If(4d)         CTR_TQ_MIN_TEG_SENS_DIAG >=

C_CTR_MIN_TQ_MIN_TEG_SENS_DIAG
         or
                   (VP_TEG_PCAT_DOWN  <  C_VP_TEG_SENS_ACT_DIAG  and
                   T_AST_DIAG  >= C_T_AST_MIN_TEG_SENS_DIAG)
Then(4d)           LV_TEG_SENS_DIAG_RLS = 1
Endif(4d)
Endif(4c)
If(4e)         LV_TEG_SENS_DIAG_RLS = 1
Then4(e)           LV_CDN_DIAG_TEG_PCAT_DOWN = 1
                   CTR_TQ_MIN_TEG_SENS_DIAG = 0
                   CTR_TEG_SENS_DIAG_SUM = 0
              For(4e)          (x = 1; x <= C_CTR_CYC_TEG_SENS_DIAG_1; x++)
              { CTR_TEG_SENS_DIAG_SUM = CTR_TEG_SENS_DIAG_SUM + C_FAC_TEG_SENS_
              DIAG[x-1] * RATE_SAMPLE_STC_TEG_SENS_DIAG[x-1] }
      If(5)                VP_TEG_PCAT_DOWN  >  C_VP_TEG_PCAT_DOWN_DIAG_MAX
      Then(5)
              If(6)          (CTR_TEG_SENS_DIAG_SUM > IP_CTR_TQ_MIN_TEG_SENS_DIAG
              and             STATE_ENG != PUC
              and            RATE_SAMPLE_STC_TEG_SENS_DIAG[0] >
                        C_RATE_SAMPLE_MIN_TEG_SENS_DIAG)
              or
                        TEG_CAT_DOWN_MDL[1] > C_TEMP_THD_TEG_SENS_DIAG_1

               Then(6) LV_ERR_PREL_TEG_PCAT_DOWN = 1
                                   ERR_SYM_TEG_PCAT_DOWN = SYM_0
                                   LV_ERR_TEG_PCAT_DOWN = 1
               Endif(6)
      Else(5)                    ERR_SYM_TEG_PCAT_DOWN = NO_SYM
                            LV_ERR_PREL_TEG_PCAT_DOWN = 0
  Endif(5)
Else(4e)           LV_CDN_DIAG_TEG_PCAT_DOWN = 0
Endif(4e)
```

Calculation of the gradient control

```
If (4f)        I VP_TEG_PCAT_DOWN(n) - VP_TEG_PCAT_DOWN(n-1) I  >  C_VP_TEG_MES_
GRD_MAX
Then (4f)          LV_ERR_PREL_TEG_PCAT_DOWN = 1
Endif (4f)

Endif(1)
```

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A.74 Fuel pressure sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_FUP	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom FUP sensor					
LV_CDN_DIAG_FUP	V	0... 1H	0 ...1	1	-
Status od diagnosis for FUP sensor					
LV_END_DIAG_FUP	V	0... 1H	0 ...1	1	-
End of diagnosis for FUP sensor diagnosis					
LV_ERR_FUP	O/V	0... 1H	0 ...1	1	-
FUP sensor error detected					

Input data:

LV_IGK {p. 906}	LV_INH_DIAG_FUP {p. 4720}	N_32 {p. 1525}	V_FUP_MV {p. 1283}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_FUP	-	0... FFH	0... 255	1	-
Increment debounce counter					
C_ABC_MAX_FUP	-	1... FFH	1... 255	1	-
Maximum value debounce counter					
C_N_32_FUP_DIAG_MAX	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for FUP diagnosis					
C_V_FUP_MV_MAX_DIAG	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Threshold value V_FUP_MV to detect Short circuit in signal wire to VB					
C_V_FUP_MV_MIN_DIAG	-	0... 7FFFH	0... 4.99984	152.6e-6	V
Threshold value V_FUP_MV to detect Short circuit in signal wire to ground or wire break					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)

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FUNCTION DESCRIPTION:

General Information:
Analog input signal in the A/D-Input from the Microprocessor.

Description

Error-symtoms are defined to this diagnosis function as following :

```
┌─┬─┬─┬─┐
 │ │ │ └─> Short circuit in signal wire to VB or wire break    (= SYM_0)
 │ │ └───> Short circuit in signal wire to ground              (= SYM_1)
 │ └─────> -                                                   (= SYM_2)
 └───────> -                                                   (= SYM_3)
```

Remark: Calculation of LV_END_DIAG_FUP see generic calculation “End of diagnosis” in anti bounce algorithm.

Application conditions

Initialization:

LV_CDN_DIAG_FUP = *Refer to filtering configuration for the initialisation value*
LV_END_DIAG_FUP = *Refer to filtering configuration for the initialisation value*
LV_ERR_FUP = *Refer to filtering configuration for the initialisation value*
ERR_SYM_FUP = *Refer to filtering configuration for the initialisation value*

Recurrence: 40 ms

Activation:

```
        if      LV_IGK = 1 AND LV_ INH_DIAG_FUP = 0
                AND N_32 <= C_N_32_FUP_DIAG_MAX
        Then    LV_CDN_DIAG_FUP = 1
                (diagnosis is active)
        else    LV_CDN_DIAG_FUP = 0
                (diagnosis is inactive)
        endif
```

Deactivation:
When the activation condition is not fulfilled then LV_CDN_DIAG_FUP = 0.

Formula section:

```
{ SYM_0 : Short circuit in signal wire to VB or wire break }
If        V_FUP_MV > C_V_FUP_MV_MAX_DIAG
then
   ERR_SYM_ FUP = SYM_0                          { Symptom SCP or OC is active }
else
   { SYM_1 : Short circuit in signal wire to ground }
   If        V_FUP_MV < C_V_FUP_MV_MIN_DIAG
   then
             ERR_SYM_ FUP = SYM_1                { Symptom SCG is active }
   else
             ERR_SYM_FUP = NO_SYM                { No failure has been detected }
        endif

endif
```

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

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For failure and error management treatment the anti-bounce mechanism is called with the parameters LV_CDN_DIAG_FUP and ERR_SYM_FUP.
ACTION_ERRM_FilterSymptom (IN< FUP >, IN< LV_CDN_DIAG_FUP >,
IN< ERR_SYM_FUP >, IN< C_ABC_INC_FUP >, IN< 1 >,
IN< C_ABC_MAX_FUP >, OUT< LV_ERR_FUP >)
This algorithm determines LV_ERR_FUP and LV_END_DIAG_FUP and delivers the result to Error Management.

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A.75 Fuel pressure sensor diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_FUP	O/V	0... 1H	0 ...1	1	-
Inhibition bit for the fuel pressure sensor diagnosis					

Input data:

LV_IGK {p. 906}			

Error treatment:

Diagnostic FUP	Symptom description	Symptom	Filter type
Fuel pressure sensor diagnosis with short circuit signal wire to VB or to ground or wire break	*SCP_OC*	*SYM_0*	STD
	SCG	*SYM_1*	

FUNCTION DESCRIPTION:

General Information:
Depending on certain conditions the fuel pressure sensor diagnosis must be inhibited.

Application conditions

Initialization (at reset and LV_IGK = 0- -> 1): `LV_INH_DIAG_FUP = 0`

Recurrence: `40 ms`

Activation:
LV_IGK = 1

Deactivation:
When the activation condition is not fulfilled

Formula section:

LV_INH_DIAG_FUP = 0

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A.76 Fuel pump low pressure diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_EFP	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom EFP diagnosis					
ERR_SYM_EFP_CRASH	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom CRASH_EFP diagnosis					
LV_CDN_DIAG_EFP	O/V	0... 1H	0 ...1	1	-
Diagnosis condition EFP diagnosis					
LV_CDN_DIAG_EFP_CRASH	O/V	0... 1H	0 ...1	1	-
Diagnosis condition CRASH_EFP diagnosis					
LV_END_DIAG_EFP	O/V	0... 1H	0 ...1	1	-
End of Diagnosis EFP diagnosis					
LV_END_DIAG_EFP_CRASH	O/V	0... 1H	0 ...1	1	-
End of Diagnosis CRASH_EFP diagnosis					
LV_ERR_EFP	O/V	0... 1H	0 ...1	1	-
Logical variable error in case of EFP-error (selfdiagnosis EFP via CAN)					
LV_ERR_EFP_CRASH	O/V	0... 1H	0 ...1	1	-
logical variable error in case of crash switch off EFP					

Input data:

CONF_SWI_EFP_OUT {p. 654}	LV_CDN_VB_CAN_DIAG {p. 1185}	LV_ECU_SLA {p. 800}	LV_ERR_BN_EFP {p. 4869}
LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_COM_3_BOFF {p. 801}	LV_ERR_COM_3_EFP {p. 801}	LV_ERR_LOCAN_BOFF {p. 4846}
LV_IGK {p. 906}	LV_VAR_BN {p. 655}	LV_VAR_BN_EFP {p. 655}	NC_IDX_DIAG_EFP
NC_IDX_DIAG_EFP_CRASH	STATE_DIAG_EFP {p. 1573}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_EFP	-	0... FFH	0... 255	1	-
Increment of EFP-error					
C_ABC_INC_EFP_CRASH	-	0... FFH	0... 255	1	-
Increment of EFP-error					
C_ABC_MAX_EFP	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter of diagnostic instance EFP					
C_ABC_MAX_EFP_CRASH	-	1... FFH	1... 255	1	-
MAX-threshold EFP-error					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetErrSym (**IN**<IDX_DIAG>,**OUT**<ERR_SYM>)
ACTION_ERRM_GetLvCdnDiag (**IN**<IDX_DIAG>,**OUT**<LV_CDN_DIAG>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

General Information

The EKP sends diagnosis-information to the DME via CAN-bus, the following diagnoses are defined:
EFP Selfdiagnosis
EFP switch off in case of vehicle crash

Description:
Error symptoms are defined for this diagnosis function as:

Diagnostic EFP	**Symptom description**	**Symptom**	**Filter type**
EFP Selfdiagnosis	*Symptom rpm to high (N_high)*	*SYM_0*	*STD_INI*
	Symptom rpm to low (N_low)	*SYM_1*	
	Symptom limp home mode (LIH)	*SYM_2*	
	Symptom high temperature (Temp)	*SYM_3*	

Application Conditions

Initialization: RST, IGKON, CLRFMY
Recurrence: 1S
Activation: LV_ECU_SLA==0
Deactivation: if activation not true

Function description

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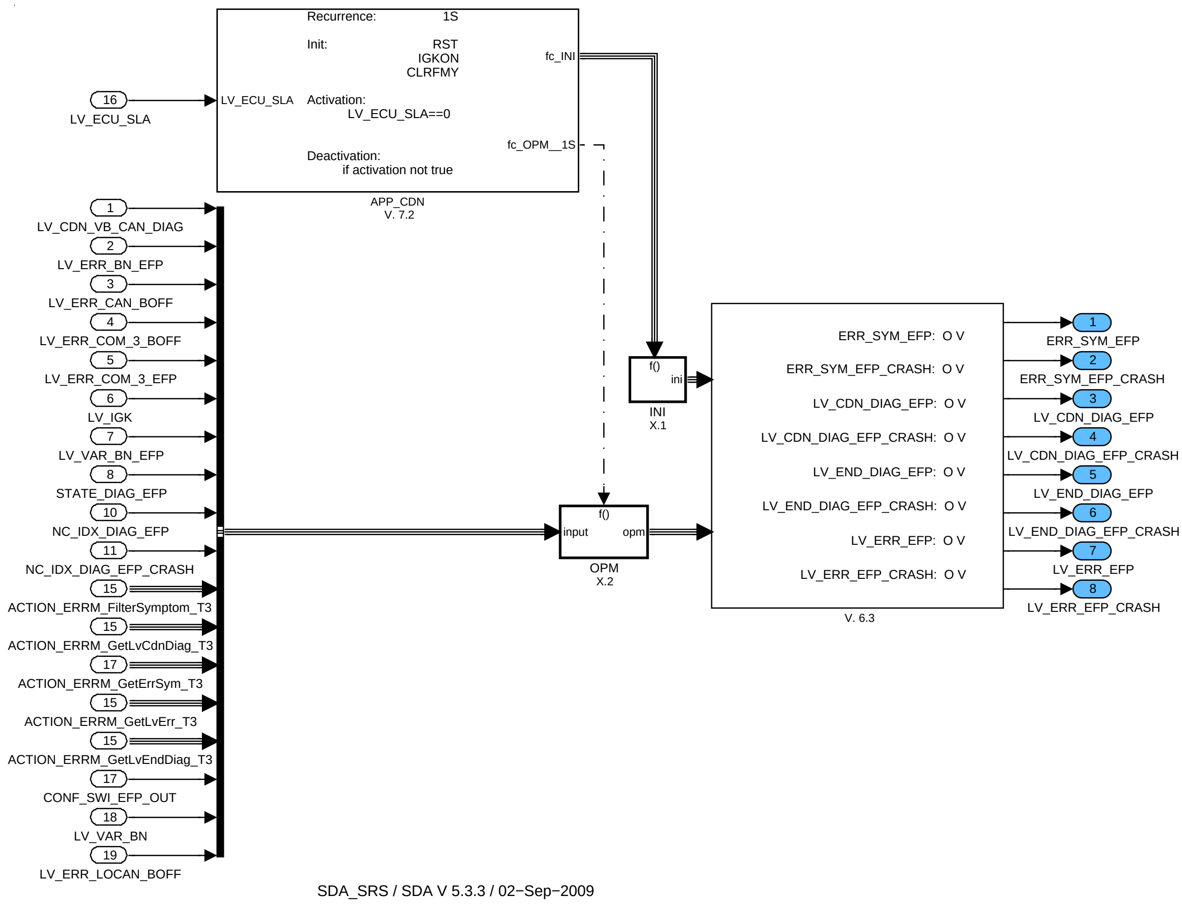

Figure A.76.1: : Path: FUSL_MA01C

A.76.1 All 0 at transition LV_IGK 0->1 or reset or at clearing error memory

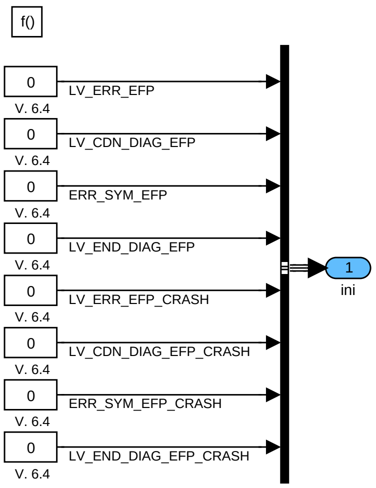

Figure A.76.2: : Path: FUSL_MA01C/INI

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A.76.2 Formula section

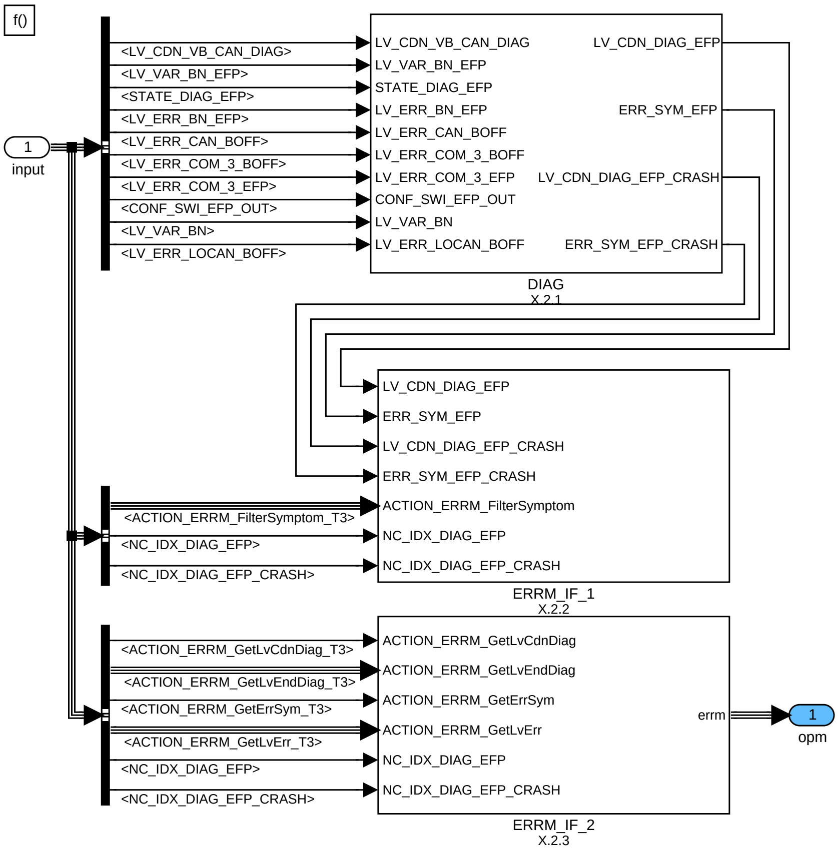

Figure A.76.3: : Path: FUSL_MA01C/OPM

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A.76.2.1 Diagnosis calculation

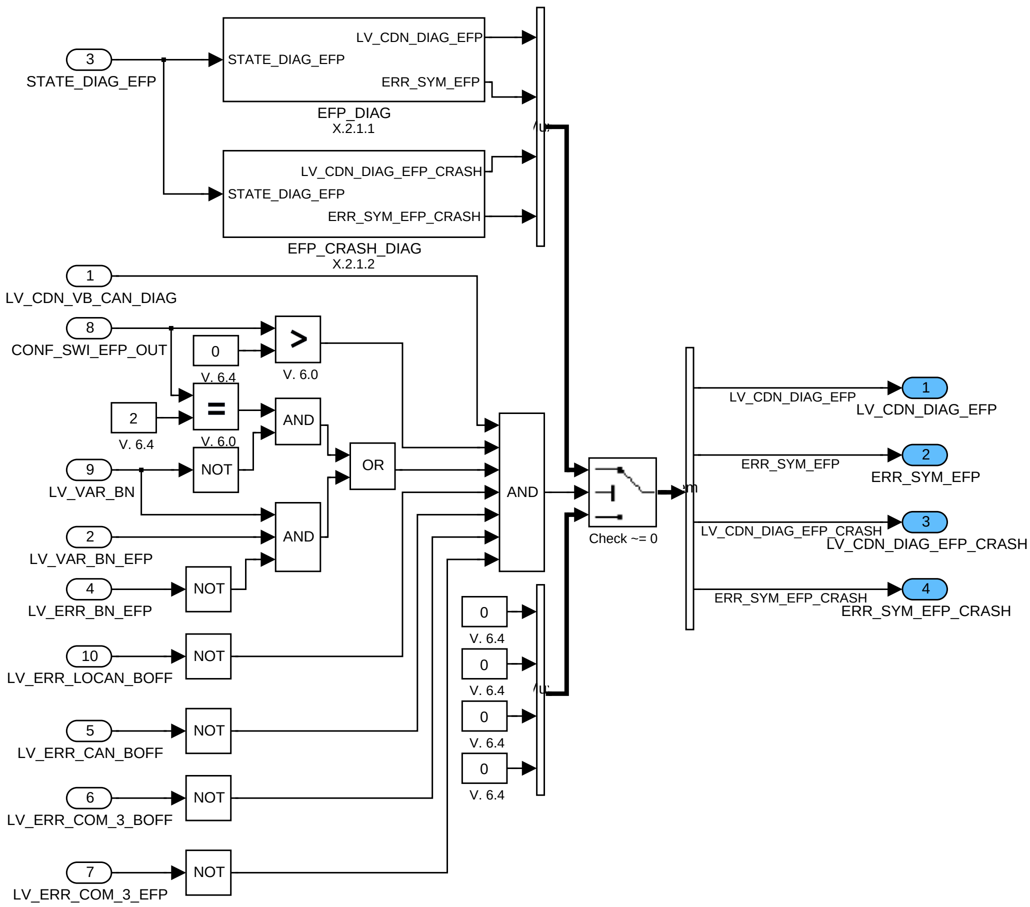

Figure A.76.4: :   Path: FUSL_MA01C/OPM/DIAG

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A.76.2.1.1 EFP selfdiagnosis

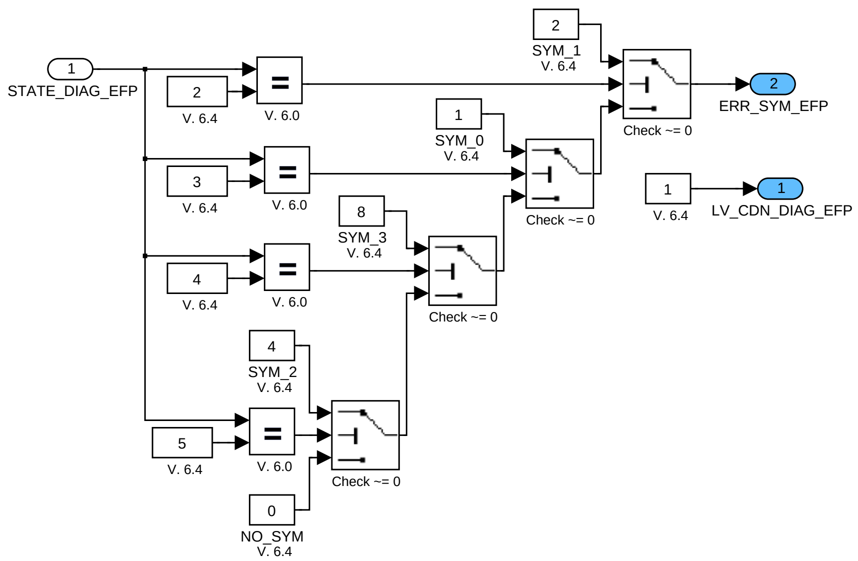

Figure A.76.5: : Path: FUSL_MA01C/OPM/DIAG/EFP_DIAG

A.76.2.1.2 EFP switch off in case off vehicle crash

Description:
Error symptoms are defined for this diagnosis function as:

Diagnostic EFP_CRASH	**Symptom description**	**Symptom**	**Filter type**
EFP switch off in case of vehicle crash	*Symptom switch off due to vehicle crash*	*SYM_2*	*STD_INI*

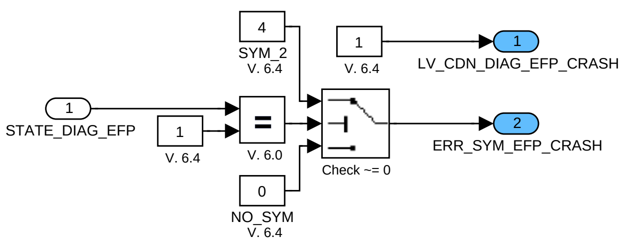

Figure A.76.6: : Path: FUSL_MA01C/OPM/DIAG/EFP_CRASH_DIAG

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A.76.2.2 Error management

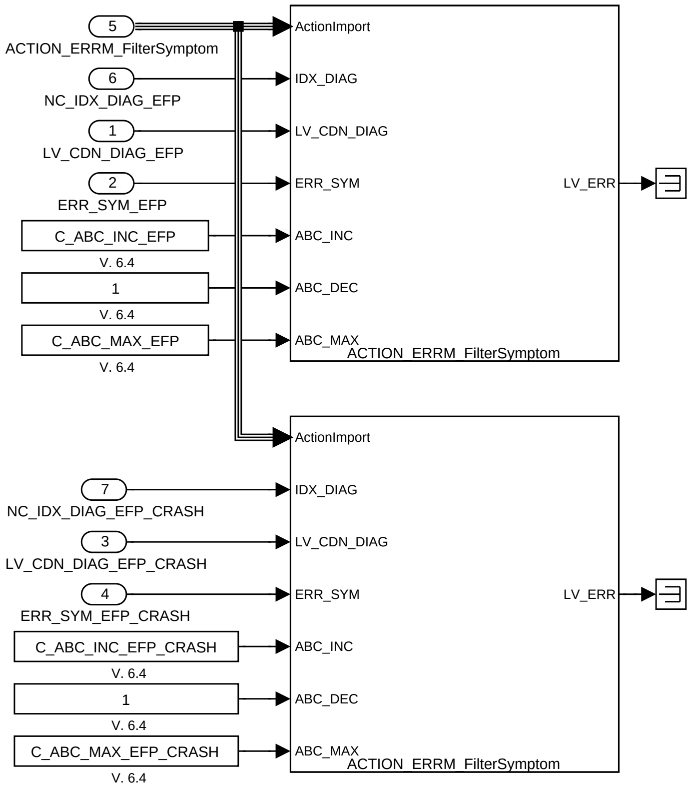

Figure A.76.7: : Path: FUSL_MA01C/OPM/ERRM_IF_1

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A.76.2.3 ERRM output

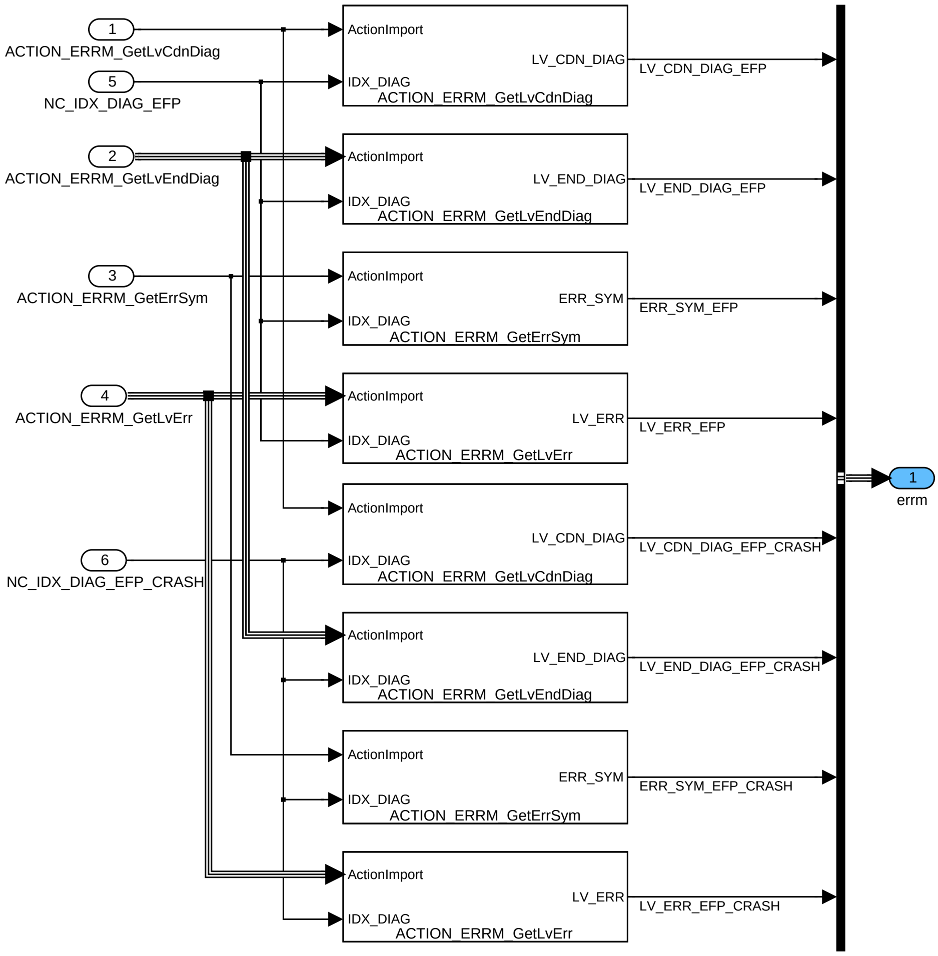

Figure A.76.8: : Path: FUSL_MA01C/OPM/ERRM_IF_2

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A.77 Fuel pressure power stage diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_VCV	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of VCV bit 0: diagnosis condition for symptom SYM_0 bit 1: diagnosis condition for symptom SYM_1 bit 2: diagnosis condition for symptom SYM_2 bit 3: diagnosis condition for symptom SYM_3					
ERR_DIAG_VCV	-	0... 7H	0 ...7	1	-
Raw value of error symptom for VCV (only parameter) bit 0: Set, if raw value of error symptom SCP (SYM_0) is set bit 1: Set, if raw value of error symptom SCG (SYM_1) is set bit 2: Set, if raw value of error symptom OC (SYM_2) is set (all combinations are possible)					
LV_ERR_VCV	O/V	0... 1H	0 ...1	1	-
Present failure: failure after filtering of diagnosis VCV					

Input data:

LV_CDN_VB_OBD1 {p. 1185}	LV_IGK {p. 906}	LV_INH_DIAG_VCV {p. 4732}	PWM_VCV {p. 3955}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_VCV	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_VCV	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_PWM_VCV_MAX_DIAG_SCG	-	0... FFH	0... 99.609375	0.391	%
Maximum threshold for SCG diagnosis window					
C_PWM_VCV_MIN_DIAG_OC	-	0... FFH	0... 99.609375	0.391	%
Minimum threshold for OC diagnosis window					
C_PWM_VCV_MIN_DIAG_SCP	-	0... FFH	0... 99.609375	0.391	%
Minimum threshold for SCP diagnosis window					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_VCV	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (= 2)					

Import actions:

ACTION_ERRM_FilterMulticondition (**IN**<XX>,**IN**<CDN_DIAG_>,**XX**>,<IN<>,**ERR_DIAG_XX**>,<IN>,<C_ABC_INC_XX>,**IN**<C_ABC_MAX_XX>,**OUT**<LV_ERR_XX>)
ACTION_INFR_GetElDiagVcv (**OUT**<Cdn_diag_vcv>,**OUT**<Err_diag_vcv>)

Error treatment:

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Diagnostic **VCV**	**Symptom description**	**Symptom**	**Filter type**
Diagnostic description	*SCP*	*SYM_0*	*MPL_STD_INI*
	SCG	*SYM_1*	
	OC	*SYM_2*	

Note :

- The data ERR_SYM_VCV, LV_END_DIAG_VCV and LV_CDN_DIAG_VCV are not present in output data, because they are not used by other functions. Despite the data are not present in output these data are provided in error management and always visible.

Note :
ACTION_INFR_GetElDiagVcv() is defined in the IRS (Infrastructure requirement specification)

FUNCTION DESCRIPTION:

General information:

The Volume controlled valve (VCV) is driven by the ECU via an output driver. The failure detection is done by ECU Hardware.
The purpose of the diagnosis is to detect electrical faults as defined by OBD I requirements.

Description:

After activation conditions are met, the diagnosis activation is delayed for NC_PSD_DLY_VCV executions, to avoid the usage of wrong infrastructure information.
Error-symptoms and conditions: are defined to this diagnosis function as following

```
 | | | └─> Short circuit to battery (SCP)      (= SYM_0)
 | | └───> Short circuit to ground (SCG)       (= SYM_1)
 | └─────> Open circuit        (OC)                (= SYM_2)
 └───────> -                                   (= SYM_3)
```

Application conditions

Initialisation:

```
at transition lv_igk 0->1:
   LV_ERR_VCV = 0 and
   ERR_SYM_VCV,
   LV_END_DIAG_VCV
   (according Filter-type)
   Set delay counter for NC_PSD_DLY_VCV
   at reset:
   CDN_DIAG_VCV = 0,
   LV_ERR_VCV = 0 and
   ERR_SYM_VCV = 0,
   LV_CDN_DIAG_VCV = 0,
```

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```
LV_END_DIAG_VCV = 0,
(according Filter-type)
Set delay counter for NC_PSD_DLY_VCV
```

Recurrence: *100 ms*

Activation: –

Deactivation: *When the activation condition is not fulfilled*

Formula section:

If LV_IGK = 1
and LV_CDN_VB_OBD1 = 1
and LV_INH_DIAG_VCV = 0
Then
Usage of the diagnosis information (failure symptoms (raw value) ERR_DIAG_VCV and basic diagnosis conditions CDN_DIAG_VCV) received from the infrastructure:
ACTION_INFR_GetElDiagVcv (OUT<Cdn_diag_vcv>, OUT<Err_diag_vcv>)

Basic diagnosis conditions are set according infrastructure information: CDN_DIAG_VCV
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_VCV

If Activation conditions are met for the NC_PSD_DLY_VCV recurrence of the diagnosis
Then { *Additional diagnosis conditions* }
If C_PWM_VCV_MIN_DIAG_SCP > PWM_VCV
then bit 0 of CDN_DIAG_VCV = 0 {*Diagnosis of SCP not possible* }
Endif
If PWM_VCV > C_PWM_VCV_MAX_DIAG_SCG
then bit 1 of CDN_DIAG_VCV = 0 { *Diagnosis of SCG not possible* }
Endif
If PWM_VCV < C_PWM_VCV_MIN_DIAG_OC
Or PWM_VCV > C_PWM_VCV_MAX_DIAG_SCG
then bit 2 of CDN_DIAG_VCV = 0 { *Diagnosis of OC not possible* }
Endif
Else CDN_DIAG_VCV = 0
Endif
Else
CDN_DIAG_VCV = 0
Endif

Failure filtering and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_VCV and ERR_DIAG_VCV.
ACTION_ERRM_FilterMulticondition (IN<*VCV*>, IN<CDN_DIAG_VCV>, IN<ERR_DIAG_VCV>, IN<C_ABC_INC_VCV>, IN<C_ABC_MAX_VCV>, OUT<LV_ERR_VCV>)
This algorithm determines:
ERR_SYM_VCV (detected error symptom for VCV diagnosis)
LV_ERR_VCV (Error flag for debounced error of VCV)
LV_CDN_DIAG_VCV (Diagnosis condition information)
LV_END_DIAG_VCV (End of diagnosis information)

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A.78 Fuel pressure power stage diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_VCV	O/V	0... 1H	0 ...1	1	-
Inhibition bit for the fuel pressure actuator diagnosis					

FUNCTION DESCRIPTION:

General information:

Depending on certain conditions the fuel pressure actuator diagnosis must be inhibited.

Application conditions

Initialisation (at reset and ignition key off to on): `LV_INH_DIAG_VCV = 0`

Recurrence: `100 ms`

Formua section:

LV_INH_DIAG_VCV = 0

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A.79 Fuel pressure sensor diagnosis for low pressure

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_FUP_EFP	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom FUP sensor					
LV_CDN_DIAG_FUP_EFP	V	0... 1H	0 ...1	1	-
Status od diagnosis for FUP sensor					
LV_EFP_MIN_PLAUS_DIAG	V	0... 1H	0 ...1	1	-
Flag indicating that the timer threshold for T_EFPPWM_MIN_PLAUS_DIAG has been reached					
LV_END_DIAG_FUP_EFP	O/V	0... 1H	0 ...1	1	-
End of diagnosis for FUP sensor diagnosis					
LV_ERR_FUP_EFP	O/V	0... 1H	0 ...1	1	-
FUP sensor error detected					
T_EFP_EFPPWM_MAX_PLAUS_DIAG	V	0... FFFFH	0... 655.35	0.01	s
Timer for activation of SYM_3 detection					
T_EFP_EFPPWM_MIN_PLAUS_DIAG	V	0... FFFFH	0... 655.35	0.01	s
Timer for activation of SYM_3 detection					
T_FUP_EFP_OFS_NOT_PLAUS	V	0... FFFFH	0... 655.35	0.01	s
Remaining time of allowed fuel pressure deviation for plausibility check (high resolution counter for 10ms calculation)					
V_FUP_EFP_DIF_PLAUS_DIAG	V	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Difference of minimum and maximum value of V_EFP_FUP_MV during plausibility diagnosis					
V_FUP_EFP_MAX_PLAUS_DIAG	V	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Maximum value of V_FUP_EFP_MV during EFP plausibility diagnosis					
V_FUP_EFP_MIN_PLAUS_DIAG	V	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Minimum value of V_FUP_EFP_MV during EFP plausibility diagnosis					

Input data:

EFPPWM {p. 3796}	FUP_EFP_MES {p. 1290}	FUP_EFP_SP {p. 3792}	LV_ECU_SLA {p. 800}
LV_END_DIAG_FUP_EFP_COPL {p. 4743}	LV_ERR_FUP_EFP_COPL {p. 4743}	LV_IGK {p. 906}	LV_INH_DIAG_FUP_EFP {p. 4743}
LV_PUC {p. 1720}	LV_ST_END {p. 1720}	NC_STATE_ECU_MST_SLA {p. 806}	V_FUP_EFP_MV {p. 1290}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_FUP_EFP	-	0... FFH	0... 255	1	-
Increment debounce counter					
C_ABC_MAX_FUP_EFP	-	1... FFH	1... 255	1	-
Maximum value debounce counter					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EFPPWM_MAX_NOT_PLAUS	-	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Maximum electric fuel pump speed for FUP_EFP_OFS_NOT_PLAUS diagnosis					
C_EFPPWM_MAX_PLAUS_DIAG	-	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Maximum electric fuel pump speed threshold to to start EPF plausibility diagnosis using V_FUP_EFP_MV					
C_EFPPWM_MIN_PLAUS_DIAG	-	0... FFFFH	0... 99.9984741211	1.52588e-3	%
Minimum electric fuel pump speed threshold to to start EPF plausibility diagnosis using V_FUP_EFP_MV					
C_FUP_EFP_MAX_NOT_PLAUS	-	0... FFFFH	0... 173888	2.6533608	hPa
Upper limit of fuel pressure range for plausibility check					
C_FUP_EFP_MIN_NOT_PLAUS	-	0... FFFFH	0... 173888	2.6533608	hPa
Lower limit of fuel pressure range for plausibility check					
C_T_EFP_EFPPWM_MAX_PLAUS_DIAG	-	0... FFFFH	0... 655.35	0.01	s
Timer threshold for SYS_3 detection					
C_T_EFP_EFPPWM_MIN_PLAUS_DIAG	-	0... FFFFH	0... 655.35	0.01	s
Timer theshold for SYS_3 detection					
C_T_FUP_EFP_OFS_NOT_PLAUS	-	0... FFFFH	0... 655.35	0.01	s
Maximum time of allowed fuel pressure deviation for plausibility check (high range counter for 10ms calculation)					
C_V_FUP_EFP_DIF_PLAUS_DIAG	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Absolute threshold of MIN/MAX difference of V_FUP_EFP_MV during EFP plausibility diagnosis					
C_V_FUP_EFP_MV_MAX_DIAG	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Threshold value V_FUP_EFP_MV to detect Short circuit in signal wire to VB					
C_V_FUP_EFP_MV_MIN_DIAG	-	0... 7FFFH	0... 4.99984741211	152.588e-6	V
Threshold value V_FUP_EFP_MV to detect Short circuit in signal wire to ground or wire break					
LC_USE_FUP_EFP_SP_PLAUS_DIAG	-	0... 1H	0 ...1	1	-
Calibratable activation flag of calculation of EFP plausibility diagnosis using FUP_EFP_SP					
LC_USE_V_FUP_EFP_DIF_PLAUS_DIAG	-	0... 1H	0 ...1	1	-
Calibratable activation flag of calculation of EFP plausibility diagnosis using V_FUP_EFP_MV					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_FUP_EFP	-	1... FFH	1... 255	1	-
Diagnosis index for FUP_EFP					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetErrSym (**IN**<IDX_DIAG>,**OUT**<ERR_SYM>)
ACTION_ERRM_GetLvCdnDiag (**IN**<IDX_DIAG>,**OUT**<LV_CDN_DIAG>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

Continued on next page

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ACTION_ERRM_NoFilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_LV_ERR_SET>,**IN**<PRM_LV_ERR_RST>,**IN**<PRM_LV_END_DIAG>,**OUT**<PRM_LV_ERR>)

General information:

Analog input signal to the A/D-Input of the Microprocessor.

Possible configuration for ABC type and CARB class (see also Table of Failure)
ABC Type: STD_INI, STD, MEM, MEM_INI, DEC_CAL, STC, NO, MPL_STD_INI
CARB Class: MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO

Remark: Calculation of LV_END_DIAG_FUP_EFP see generic calculation End of diagnosis in anti bounce algorithm.

In case of slave ECU (LV_ECU_SLA = 1) the error management interface information (LV_END_DIAG_FUP_EFP, LV_ERR_FUP_EFP) is imported from master ECU and used for the calculation of the error information on the slave ECU.
The slave ECU will set or reset the error without antibounce filtering (different Error Management call in comparison to master ECU)

Application conditions:

Initialisation:	`RST, IGKON, CLRFMY`
Recurrence:	`10MS`
Activation:	`always`
Deactivation:	`never`

Function description:

Formula section:

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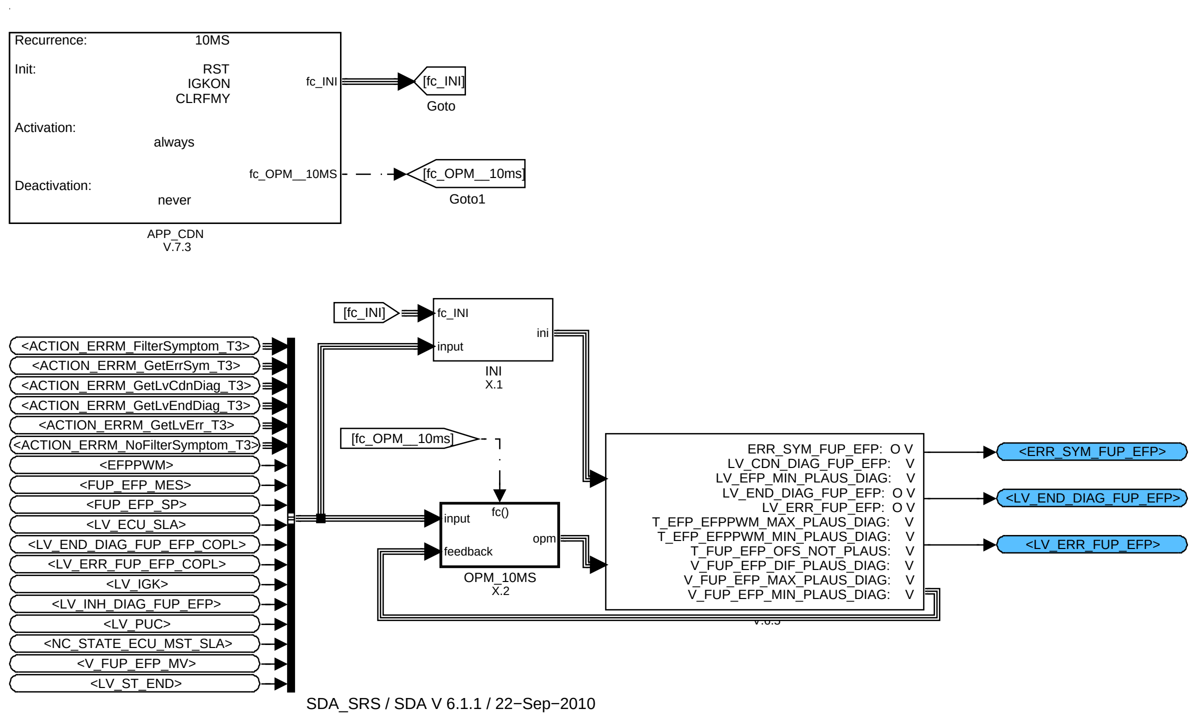

Figure A.79.1: :

A.79.1 Initialization

A.79.1.1 Initialisation of diagnostic data

In this subsystem all data that has to be reset at failure clearance is initialised.

A.79.1.2 Initialization of the error managment interfaces according to antibounce mechanism "STD_INI"

The timer T_FUP_EFP_OFS_NOT_PLAUS is initialised with it's calibration value at ECU-reset.

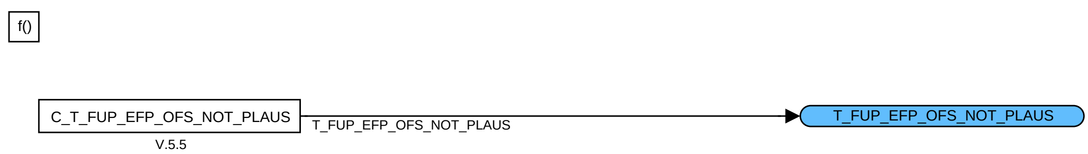

Figure A.79.2: :

A.79.2 Formula section

In case of master-/slave-ECU-configuration the failure evaluation (subsystem CLC) is not done at the slave-ECU. Here, the failure is received from the master-ECU as LV_ERR_FUP_EFP_COPL for further treatment at error management.

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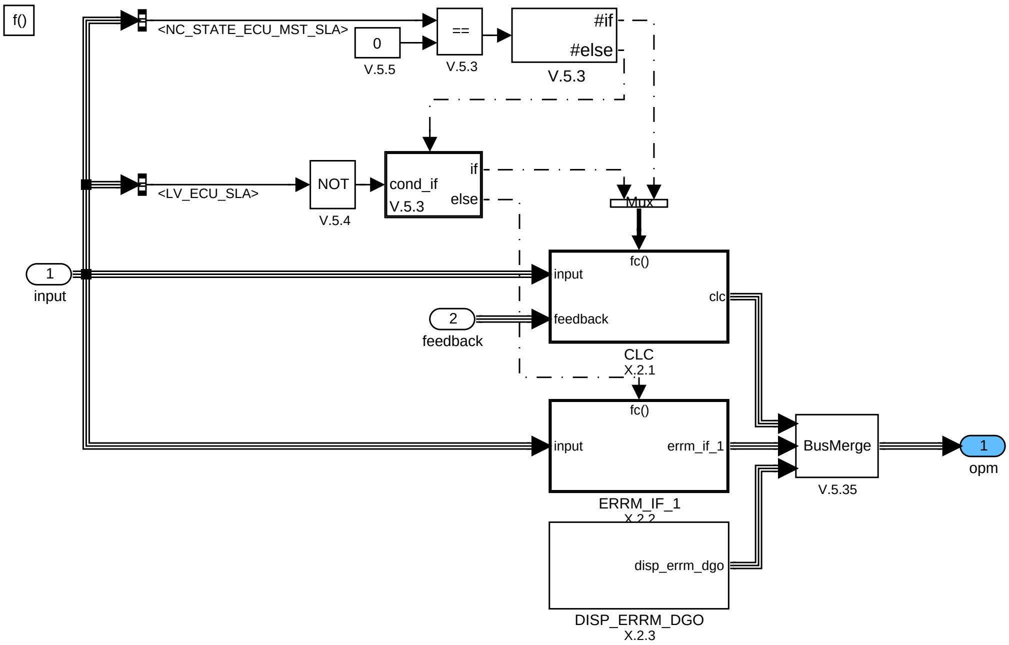

Figure A.79.3: :

A.79.2.1 Calculation on master ECU

A.79.2.1.1 Evaluation of diagnostic condition on master ECU

In case no symptom concerning a signal wire problem is detected, the LV_CDN_DIAG is delayed for the time C_T_FUP_EFP_OFS_NOT_PLAUS. This is the same time the symptom ’open line in ground wire’ needs for being detected.

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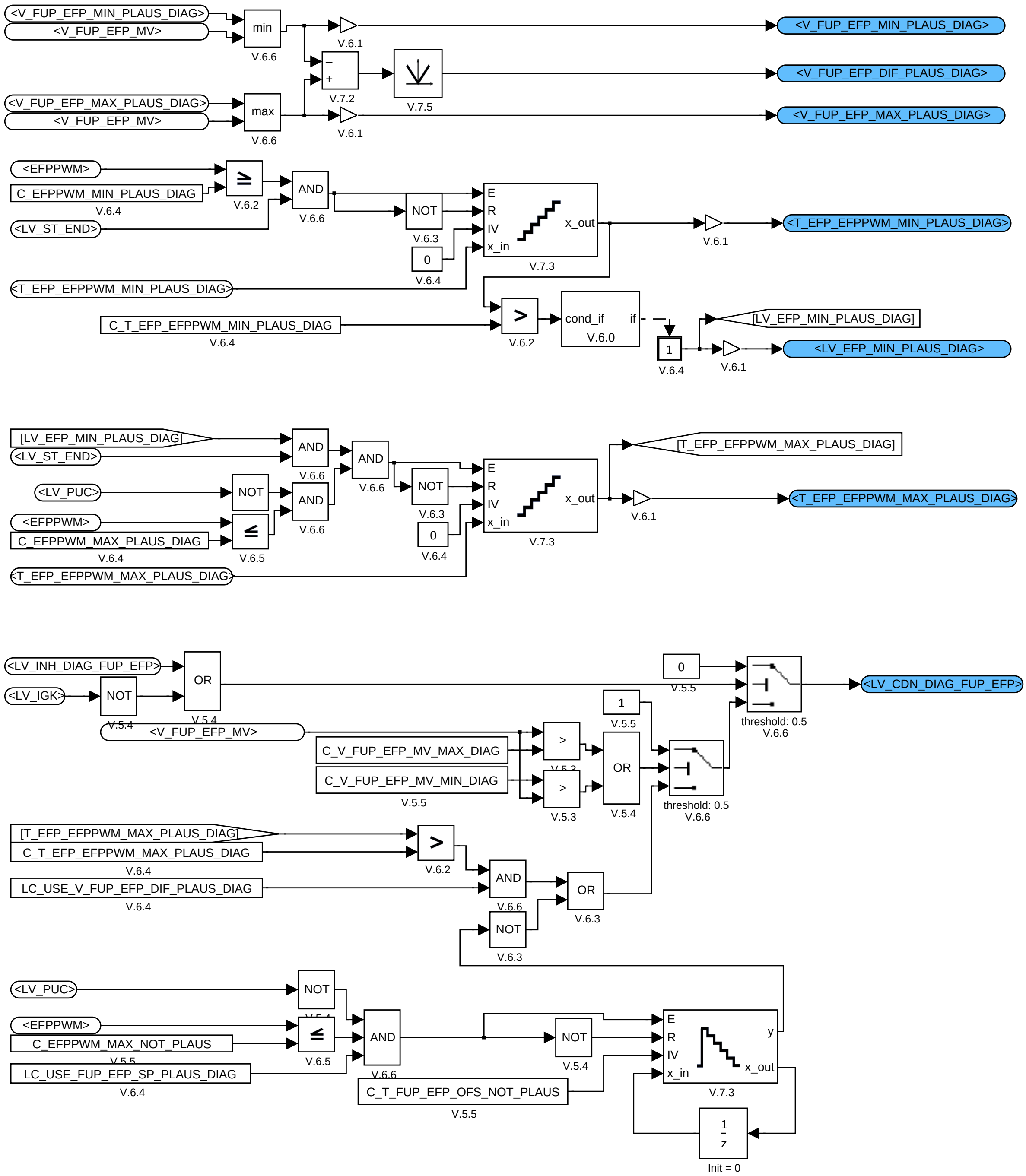

Figure A.79.4: :

A.79.2.1.2 Symptom determination on master ECU

Short circuit or open line in signal wire lead to very low or very high signal voltage. This is detected by comparison of the signal voltage with according thresholds.

In case the ground wire of the sensor is broken, the signal voltage is approx. 3.6 V, which is -alone- a plausible value. But as this value is no more connected to the real fuel pressure, the pressure controler will not be able to adjust the measured FUP_EFP to it's setpoint. So if this failure occurs, the FUP_EFP_MES will take a defined value corresponding 3.6 V and a deviation to the FUP_EFP_SP cannot be eliminated by the FUP_EFP controler. This is enquired by the error symptom SYM_3.

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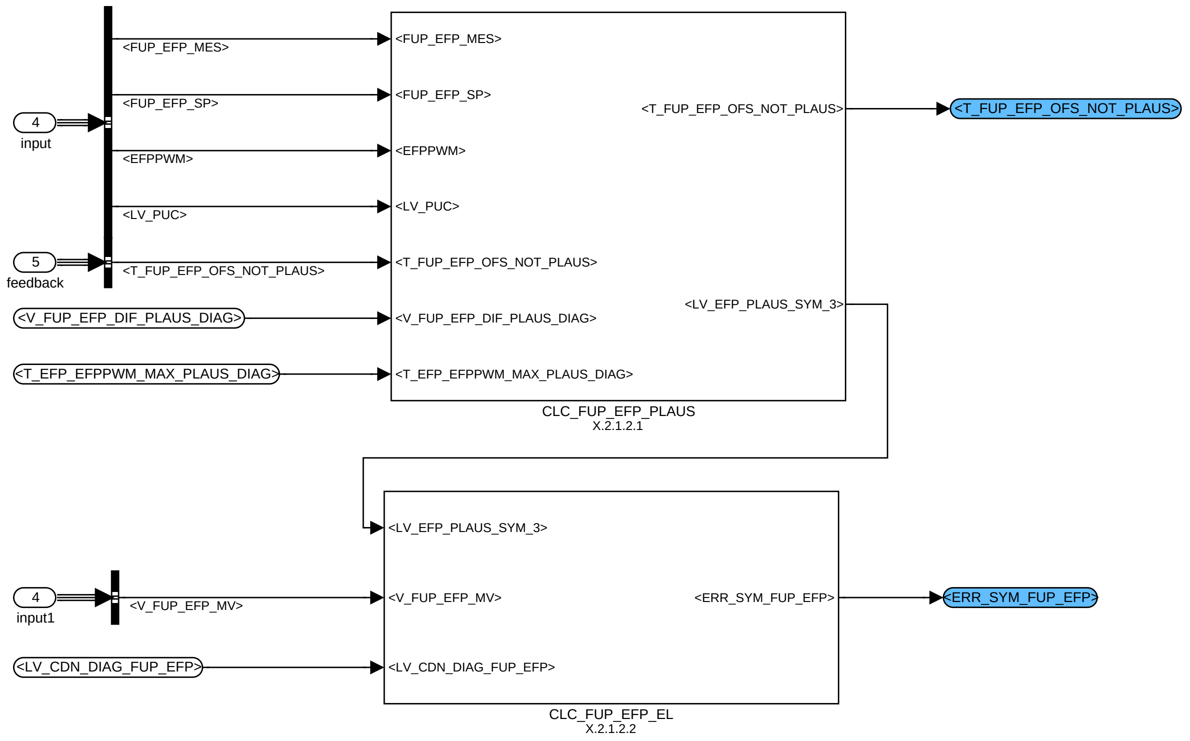

Figure A.79.5: :

A.79.2.1.2.1 Evaluation of plausibility diagnosis

In case the ground wire of the sensor is broken, the signal voltage is approx. 3.6 V, which is -alone- a plausible value. But as this value is no more connected to the real fuel pressure, the pressure controler will not be able to adjust the measured FUP_EFP to it's setpoint. So if this failure occurs, the FUP_EFP_MES will take a defined value corresponding 3.6 V and a deviation to the FUP_EFP_SP cannot be eliminated by the FUP_EFP controler. This is enquired by the error symptom SYM_3.

Additionally the plausibility of the sensor signal can be determined by checking the sensor dynamics after start. If the difference between minimum and maximum of the sensor mean value over a certain time does not exeed a calibratable threshold it is assumed that the sensor is hanging.

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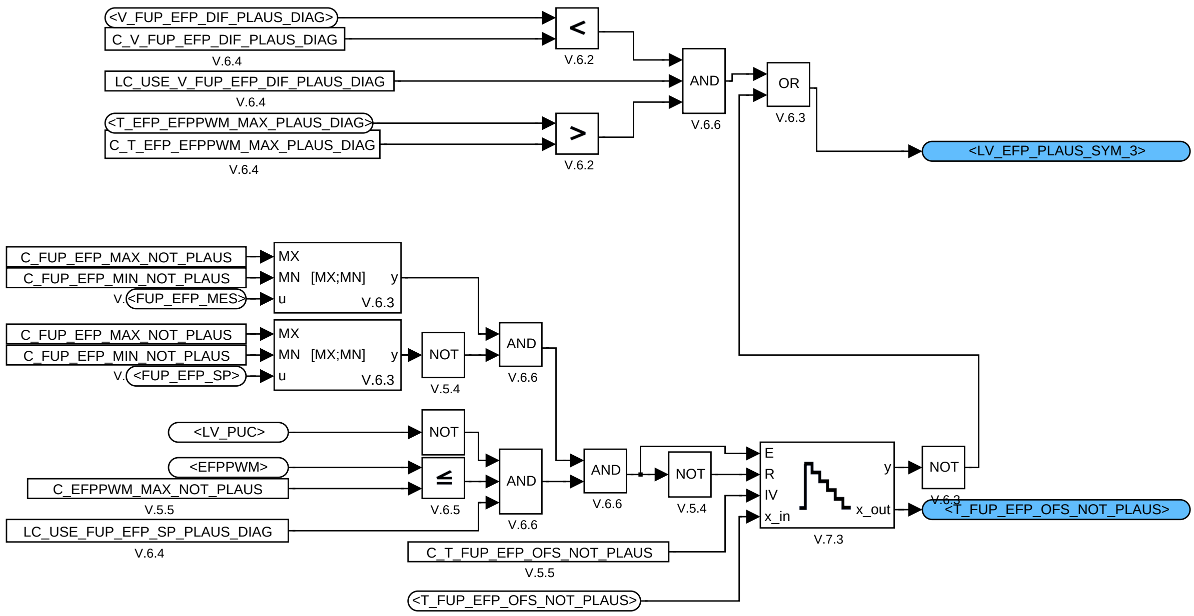

Figure A.79.6: :

A.79.2.1.2.2 Electrical diagnosis and determination of error symptom

Short circuit or open line in signal wire lead to very low or very high signal voltage. This is detected by comparison of the signal voltage with according thresholds. The electrical symptoms have a higher priority then the plausibility diagnosis symptom SYM_3.

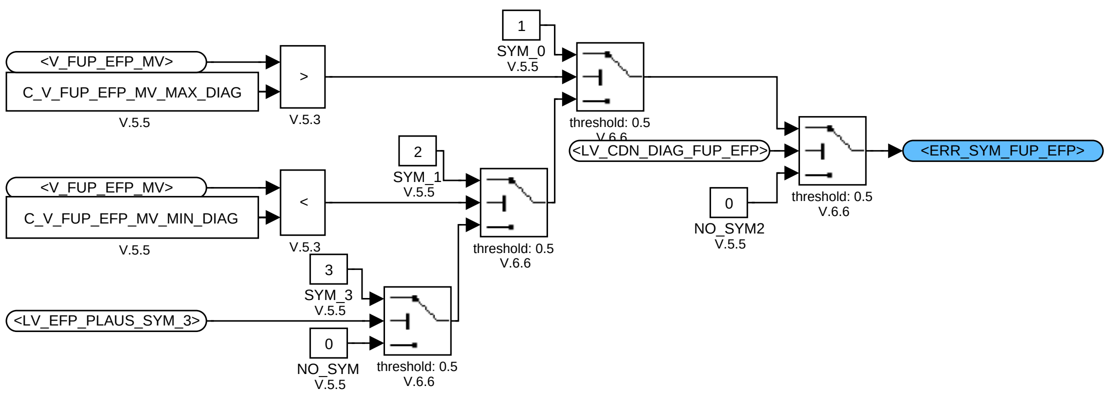

Figure A.79.7: :

A.79.2.1.3 Interface to ERRM on master ECU

A.79.2.1.3.1 Interface to ERRM on master ECU

Calculation of present error and end of diagnosis:
LV_ERR_FUP_EFP and LV_END DIAG_FUP_EFP is calculated by error management.

Antibouncing of the error symptom with calibrateable parameters C_ABC_INC... and C_ABC_MAX....

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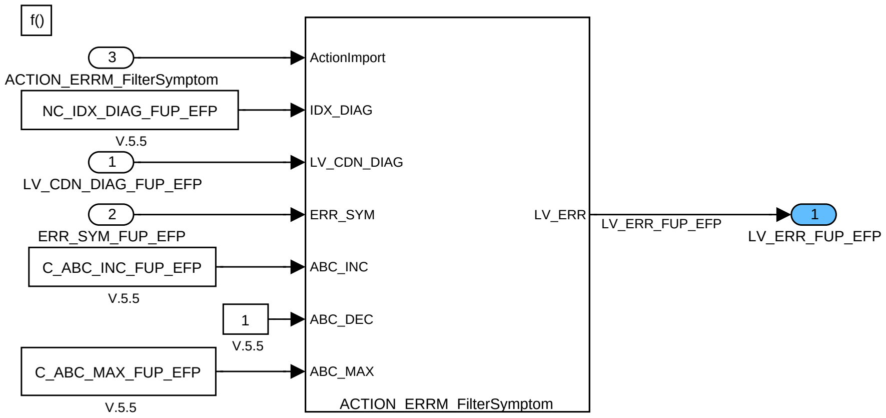

Figure A.79.8: :

A.79.2.1.3.2 Calculation of ERRM variables on master ECU

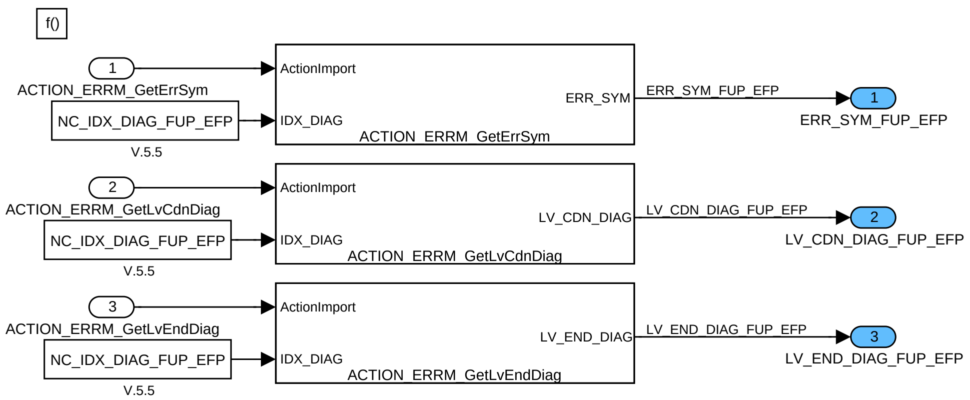

Figure A.79.9: :

A.79.2.2 Interface to ERRM on slave ECU

A.79.2.2.1 Interface to ERRM on slave ECU

Calculation of present error and end of diagnosis:
LV_ERR_FUP_EFP and LV_END DIAG_FUP_EFP is calculated by error management.

No Antibouncing of the error symptom, because the slave ECU inherits error symptom from master ECU.

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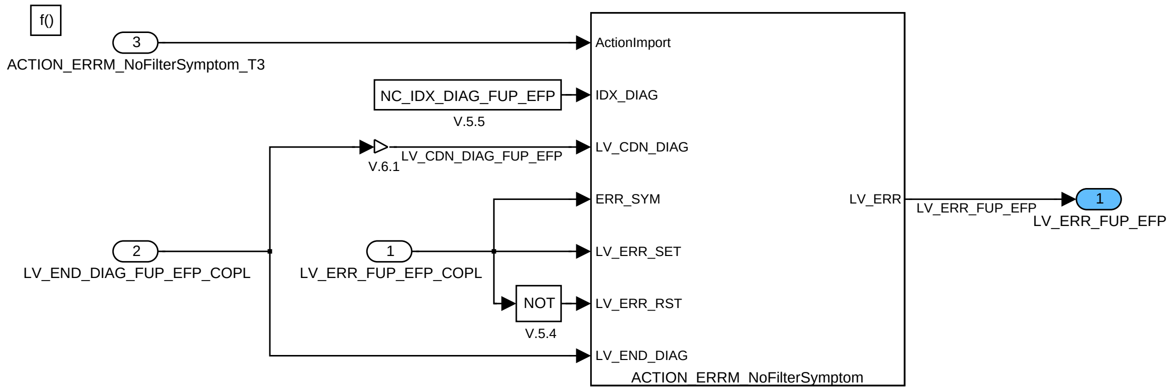

Figure A.79.10: :

A.79.2.2.2 Calculation of ERRM variables on slave ECU

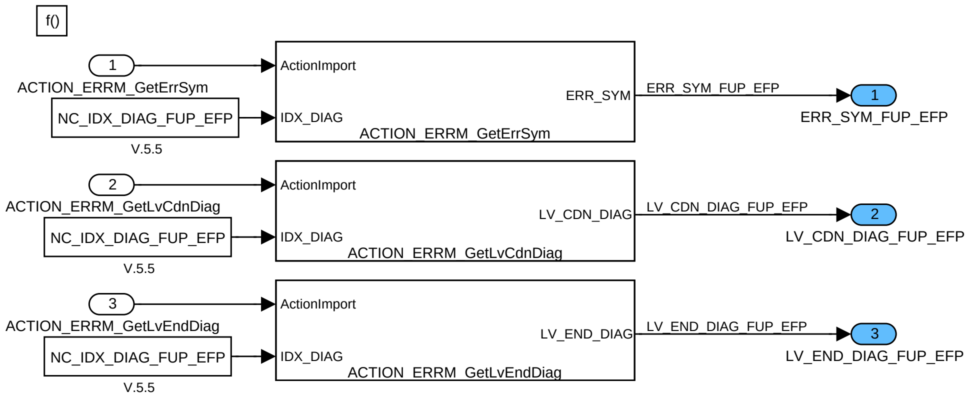

Figure A.79.11: :

A.79.2.3 DISP_ERRM_DGO

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A.80 Fuel pressure sensor diagnosis for low pressure (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_FUP_EFP_COPL	O/V	0... 1H	0 ...1	1	-
End of diagnosis for FUP sensor diagnosis get from ECU coupling					
LV_ERR_FUP_EFP_COPL	O/V	0... 1H	0 ...1	1	-
FUP sensor error detected get from ECU coupling					
LV_INH_DIAG_FUP_EFP	O/V	0... 1H	0 ...1	1	-
Inhibition bit for the fuel pressure sensor diagnosis (low pressure circuit)					

Input data:

LV_FUP_LIH_HOM_VCV_ OPEN_REQ {p. 4001}	LV_IGK {p. 906}		

Error treatment:

Diagnostic instance		Symptoms		ABC Type	CARB class
Description	Name(XX)	Description	Nr		
Electrical and plausibility diagnosis	FUP_EFP	Short circuit in signal wire to VB	0	STD_INI	CC
		Short circuit signal wire to ground or signal wire break	1		
		-	2		
		Open line in ground wire	3		

Fields information (For more information refer to Error Management file "Table of Failure")

- ABC Type : STD_INI, STD_MEM, MEM_INI, DEC_CAL, STC, NO, MPL_STD_INI
- CARB Class : MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO

* For ERRM 4.7 the CARB class is configured/calibrated inside the failure class module.

General information:

General Information:
Depending on certain conditions the fuel pressure sensor diagnosis for the low pressure system must be inhibited.

Application conditions:

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Initialisation:	`RST, IGKON`
Recurrence:	`100MS`
Activation:	`LV_IGK==1`
Deactivation:	`LV_IGK==0`

Function description:

Formula section:

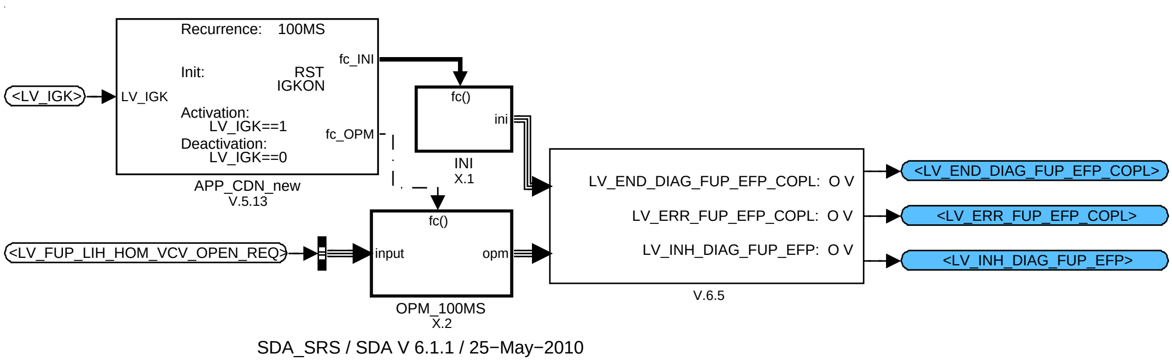

Figure A.80.1: :

A.80.1 Initialization at Reset and IGKON

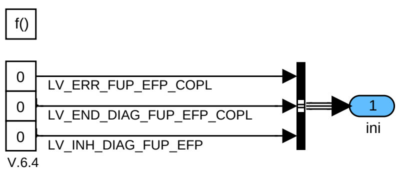

Figure A.80.2: :

A.80.2 Formula section

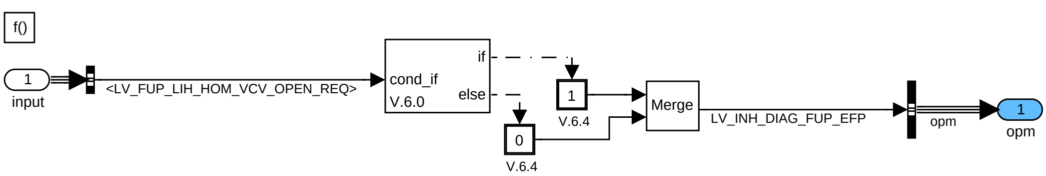

Figure A.80.3: :

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A.81 Fuel tank level input signal diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_FTL_LE_CAN	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error					
ERR_SYM_FTL_OBD	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error					
ERR_SYM_FTL_RI_CAN	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error					
LV_CDN_DIAG_FTL_LE_CAN	O/V	0... 1H	0 ...1	1	-
Diagnosis condition					
LV_CDN_DIAG_FTL_OBD	O/V	0... 1H	0 ...1	1	-
Diagnosis condition					
LV_CDN_DIAG_FTL_RI_CAN	O/V	0... 1H	0 ...1	1	-
Diagnosis condition					
LV_END_DIAG_FTL_LE_CAN	O/V	0... 1H	0 ...1	1	-
End of Diagnosis					
LV_END_DIAG_FTL_OBD	O/V	0... 1H	0 ...1	1	-
End of Diagnosis					
LV_END_DIAG_FTL_RI_CAN	O/V	0... 1H	0 ...1	1	-
End of Diagnosis					
LV_ERR_FTL_LE_CAN	O/V	0... 1H	0 ...1	1	-
error flag for left (second) fuel tank level					
LV_ERR_FTL_OBD	O/V	0... 1H	0 ...1	1	-
error flag fuel tank level					
LV_ERR_FTL_RI_CAN	O/V	0... 1H	0 ...1	1	-
error flag for right (first) fuel tank level					

Input data:

C_CONF_DMTL {p. 658}	LV_ECU_SLA {p. 800}	LV_ERR_FTL_OBD_COPL	LV_ERR_FTL_PLAUS {p. 5965}
LV_ERR_TOUT_ICL_7 {p. 802}	LV_ES {p. 1720}	LV_FTL_DIAG {p. 5966}	LV_FTL_LE_CAN_ERR {p. 1565}
LV_FTL_RI_CAN_ERR {p. 1565}	LV_FTL_TOT_CAN_ERR {p. 1565}	LV_IGK {p. 906}	LV_ST {p. 1720}

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LV_STATE_ERR_CAN_TOUT {p. 1567}	NC_IDX_DIAG_FTL_LE_CAN	NC_IDX_DIAG_FTL_RI_CAN	NC_STATE_ECU_MST_SLA {p. 806}
STATE_ERR_SYM_FTL_LE_CAN {p. 1573}	STATE_ERR_SYM_FTL_RI_CAN {p. 1573}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_FTL_LE_CAN	-	0... FFH	0... 255	1	-
Increment for debouncing diagnosis					
C_ABC_INC_FTL_RI_CAN	-	0... FFH	0... 255	1	-
Increment for debouncing diagnosis					
C_ABC_MAX_FTL_LE_CAN	-	1... FFH	1... 255	1	-
Max threshold for diagnosis					
C_ABC_MAX_FTL_RI_CAN	-	1... FFH	1... 255	1	-
Max threshold for diagnosis					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)

General information:

Application conditions:

Initialisation: IGKON, RST, CLRFMY
Recurrence: 1S
Activation: always
Deactivation: never

Function description:

Formula section:

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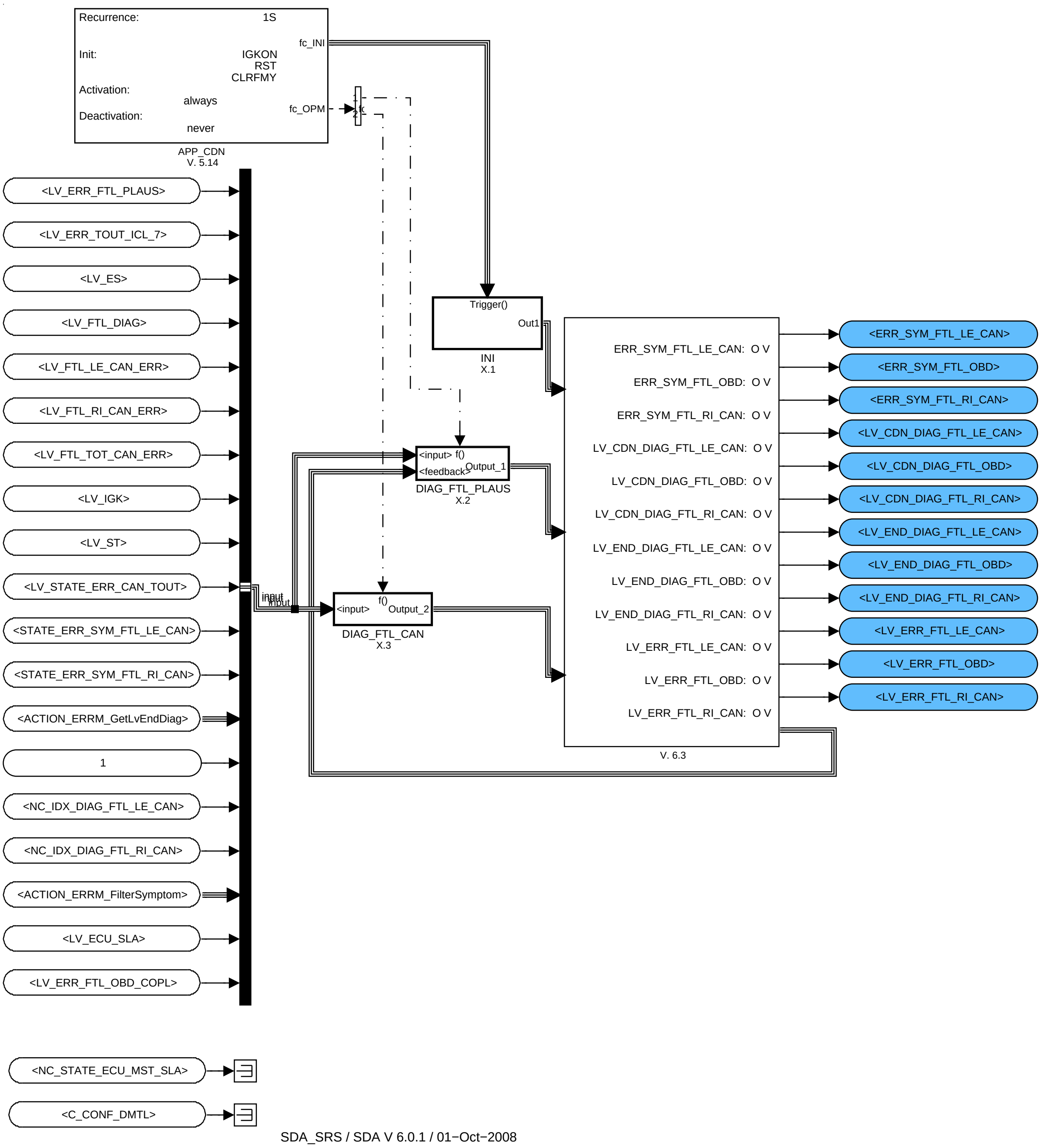

Figure A.81.1: :

A.81.1 Initialisation

CAN related errors are initialised as per std_ini.

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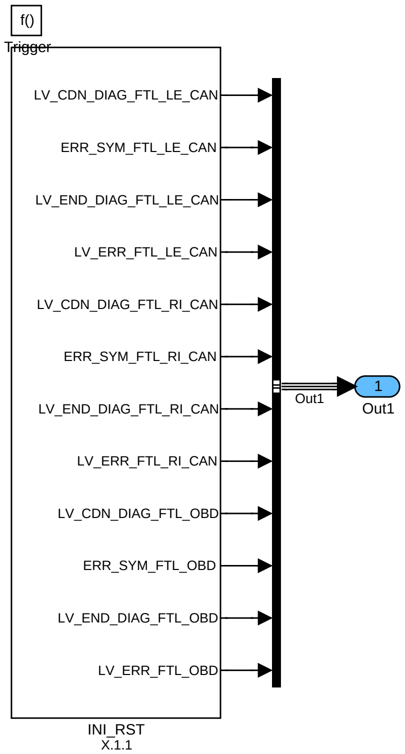

Figure A.81.2: :

A.81.1.1 Initialisation at Reset, LV_IGK = 0(1 or at Clear FMY

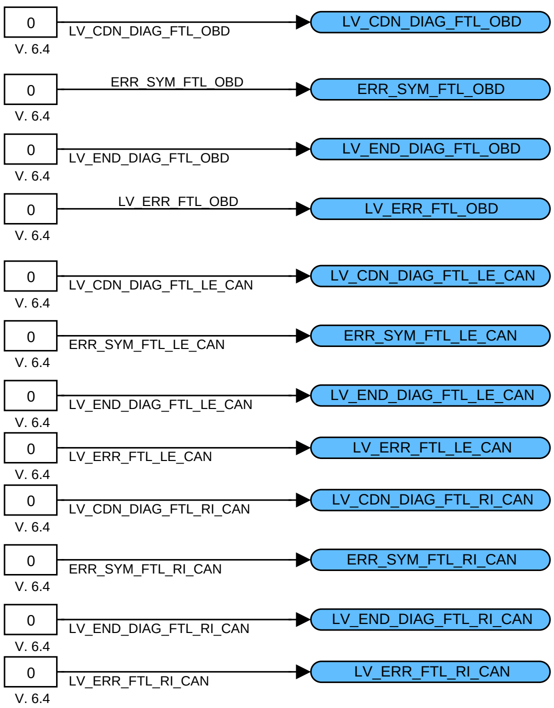

Figure A.81.3: :

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A.81.2 Fuel tank level (Plausibility error)

General information:
This diagnosis is for collecting the failure bit of the fuel tank level plausibility function.
In case of Slave ECU (LV_ECU_SLA = 1) the error management interface information (LV_ERR_FTL_OBD) is imported from the Master ECU and used for the calculation of the error information on the Slave ECU.
The Slave will set or reset the error without antibounce filtering (different Error Management call compared to Master).
Description:
Error-symptoms are defined to this diagnosis function as following :

```
| | | └─> -                          (= SYM_0)
| | └───> -                          (= SYM_1)
| └─────> -                          (= SYM_2)
└───────> FTL plausibility error     (= SYM_3)
```

Figure A.81.4: :

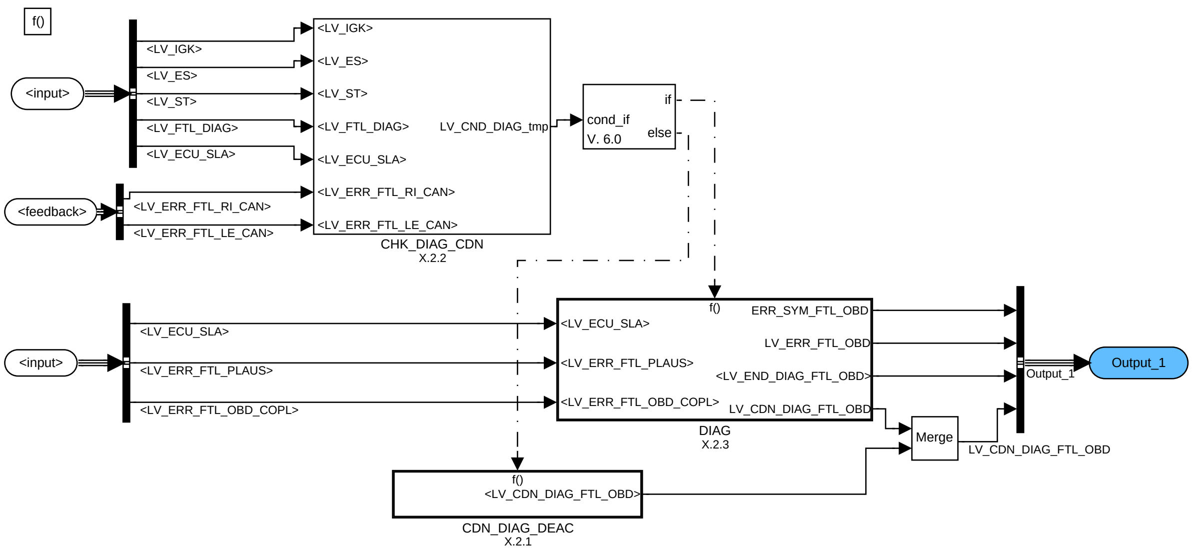

Figure A.81.5: :

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A.81.2.1 Diagnosis Deactivation

Figure A.81.6: :

A.81.2.2 Calculation of Activation Condition

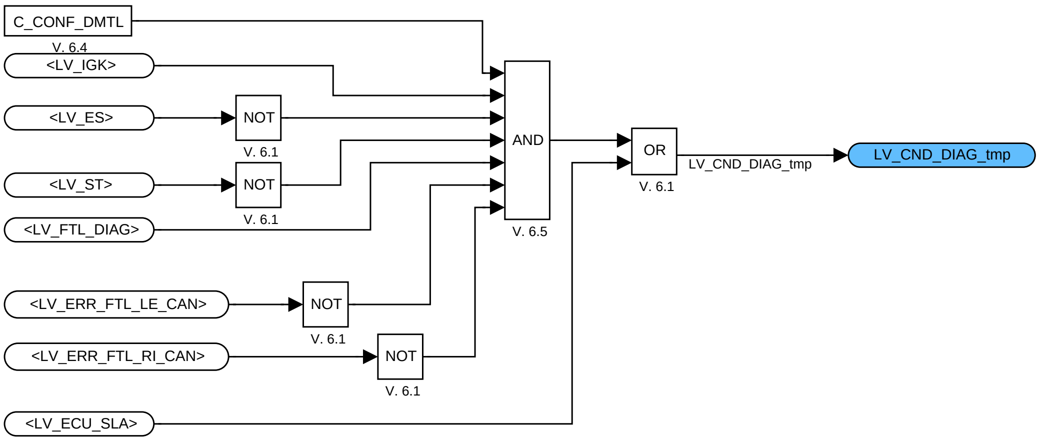

Figure A.81.7: :

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A.81.2.3 Diagnosis during Activation

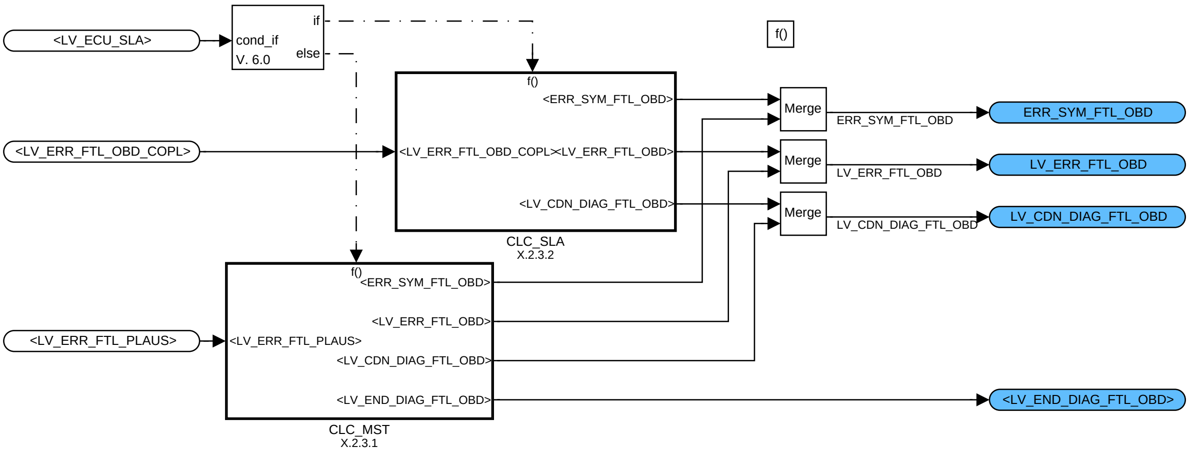

Figure A.81.8: :

A.81.2.3.1 Calculations on non-Master/Slave systems or on Master ECU

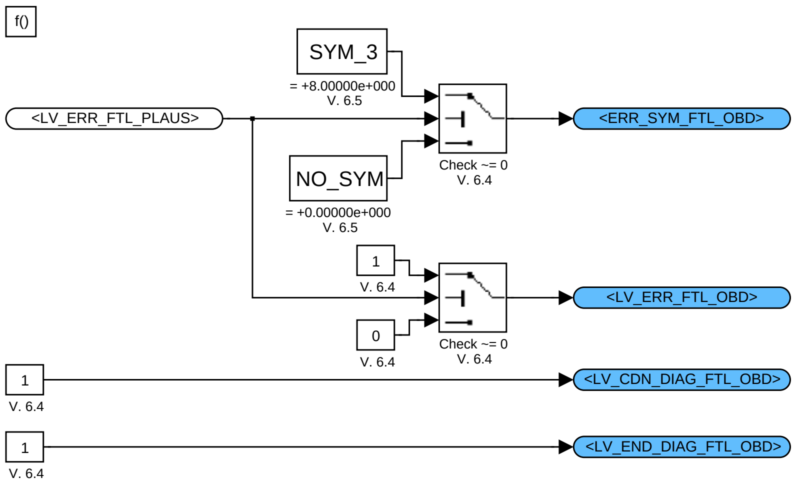

Figure A.81.9: :

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A.81.2.3.2 FUTL diagnosis only for Master/Slave Systems

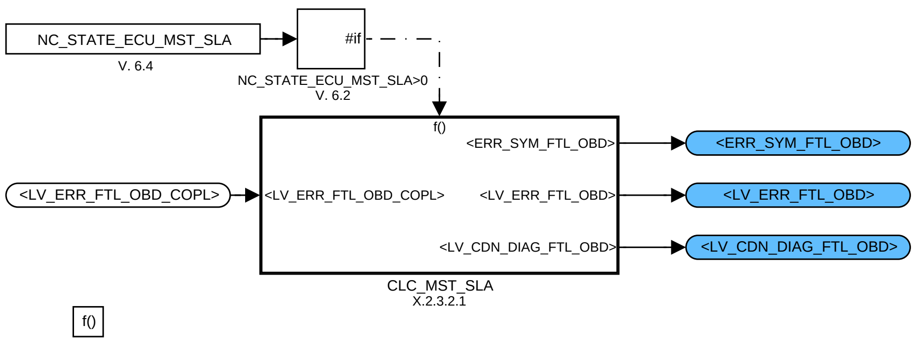

Figure A.81.10: :

A.81.2.3.2.1 Calculations on slave ECU

ERR_SYM_FTL_OBD is always set to Symptom 0 at Slave regardless of symptom at Master.
LV_ERR_FTL_OBD is set immediately without anti-bounce filtering.

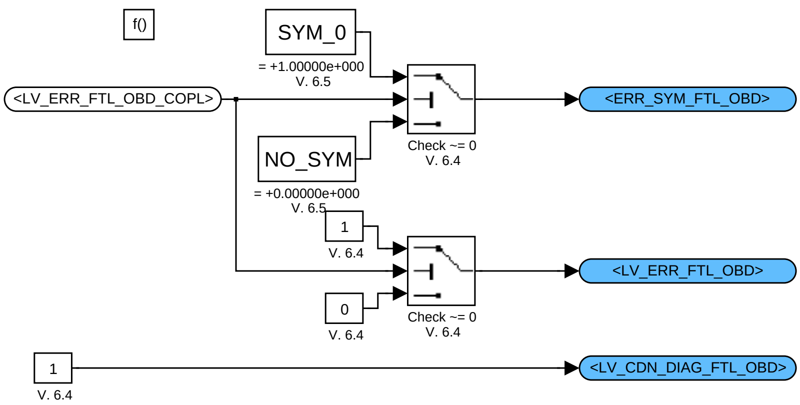

Figure A.81.11: :

A.81.3 Fuel tank level (CAN error)

General information:
This diagnosis is for collecting the failure bits for LV_ERR_FTL_LE_CAN and LV_ERR_FTL_RI_CAN from CAN (Kombi).
Description:
Error-symptoms are defined for LV_ERR_FTL_LE_CAN and LV_ERR_FTL_RI_CAN diagnosis function as following :

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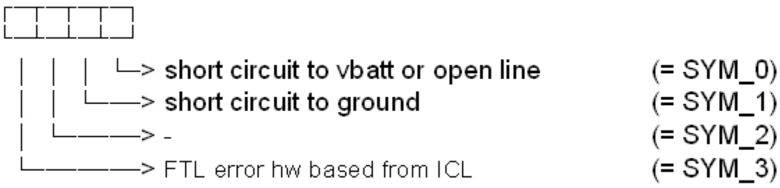

Figure A.81.12: :

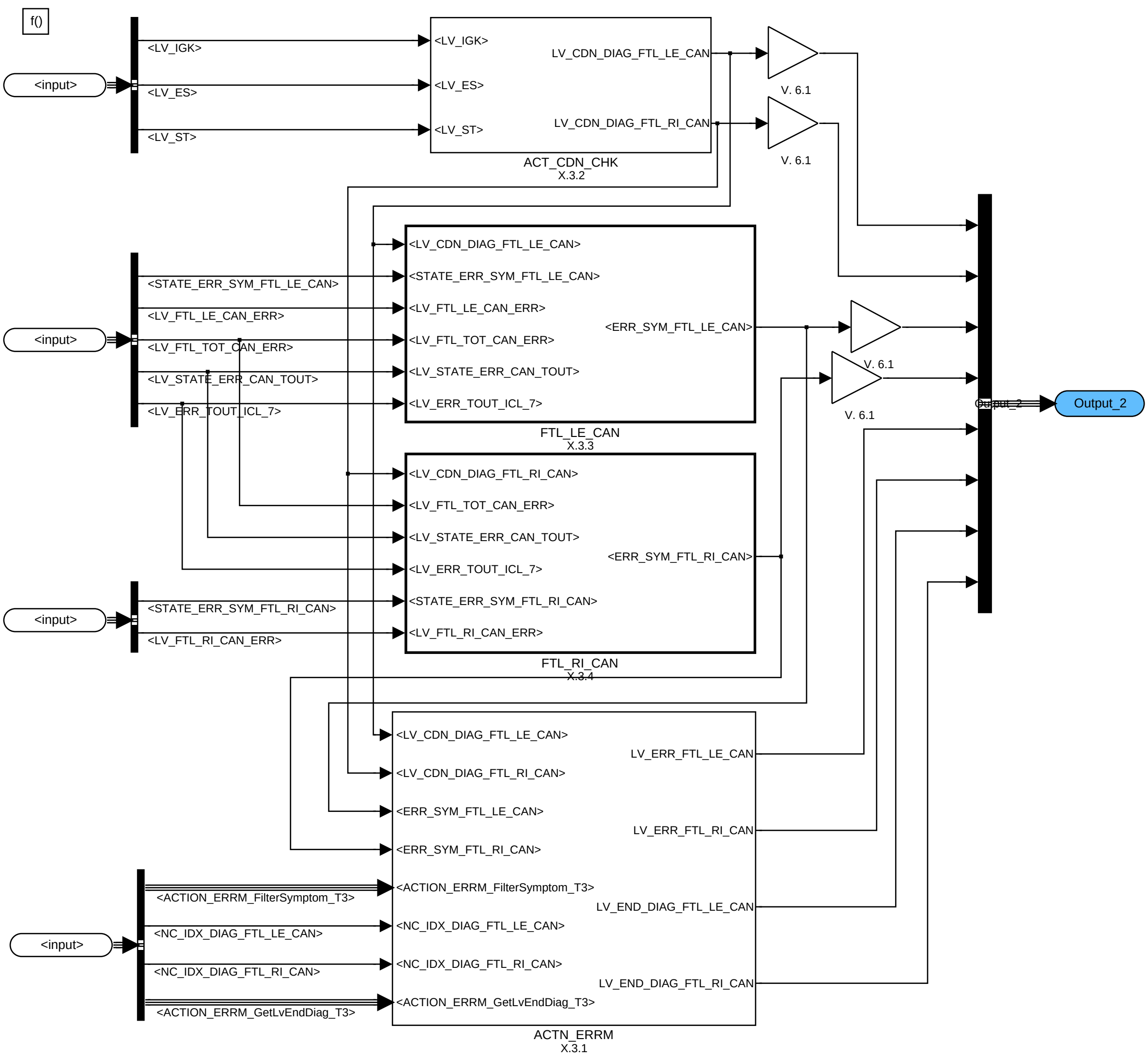

Figure A.81.13: :

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A.81.3.1 Calculation of LV_ERR_FTL_LE_CAN, LV_ERR_FTL_RI_CAN, LV_END_DIAG_FTL_LE_CAN and LV_END_DIAG_FTL_RI_CAN

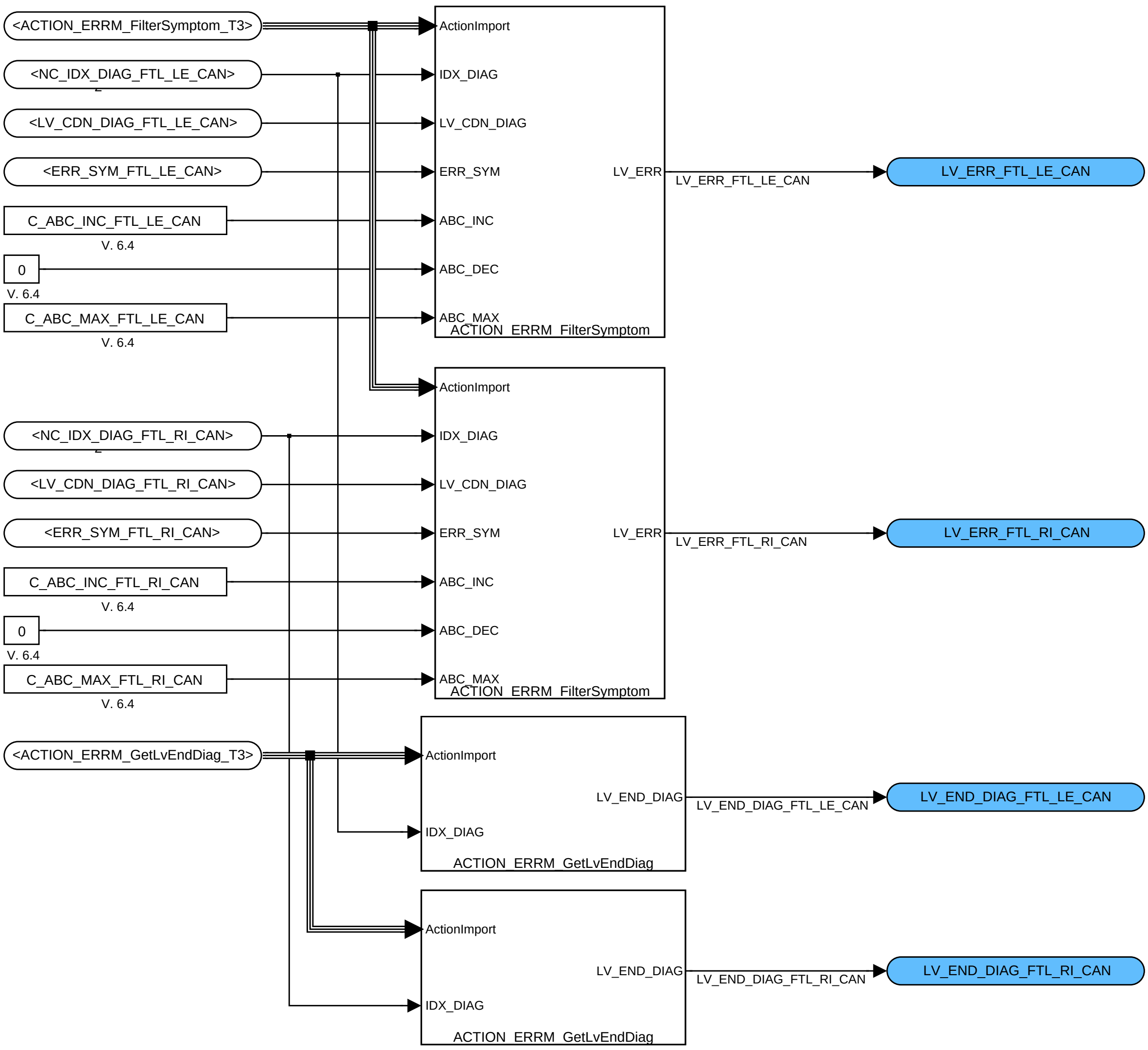

Figure A.81.14: :

A.81.3.2 Activation condition

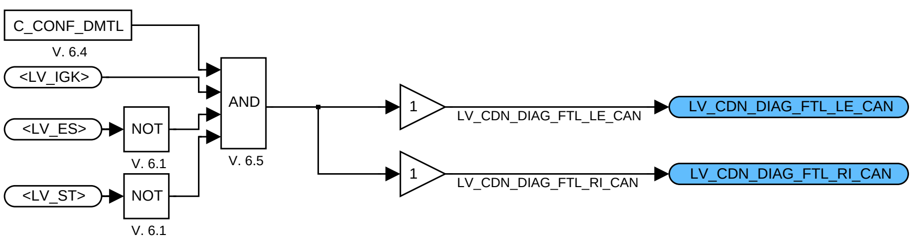

Figure A.81.15: :

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A.81.3.3 Condition for calculation of ERR_SYM_FTL_LE_CAN

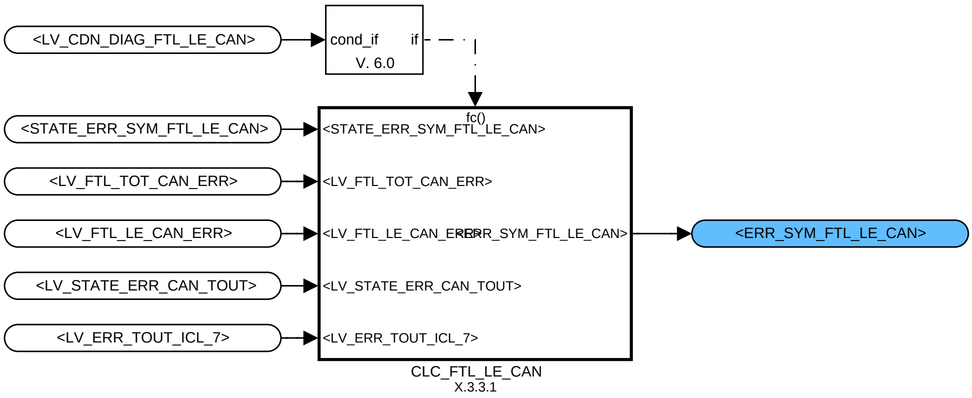

Figure A.81.16: :

A.81.3.3.1 Calculation of ERR_SYM_FTL_LE_CAN

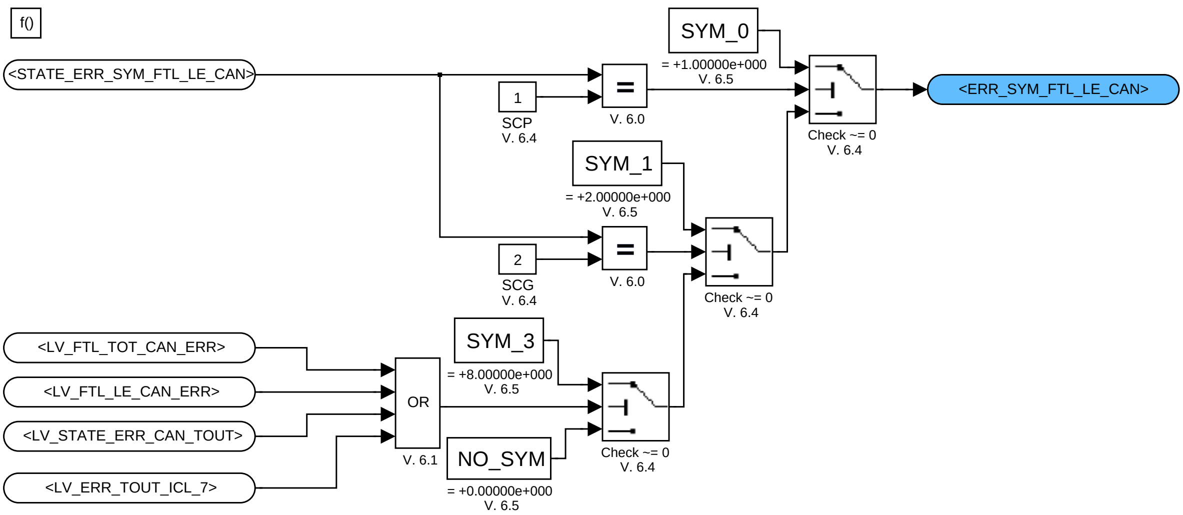

Figure A.81.17: :

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A.81.3.4 Condition for calculation of ERR_SYM_FTL_RI_CAN

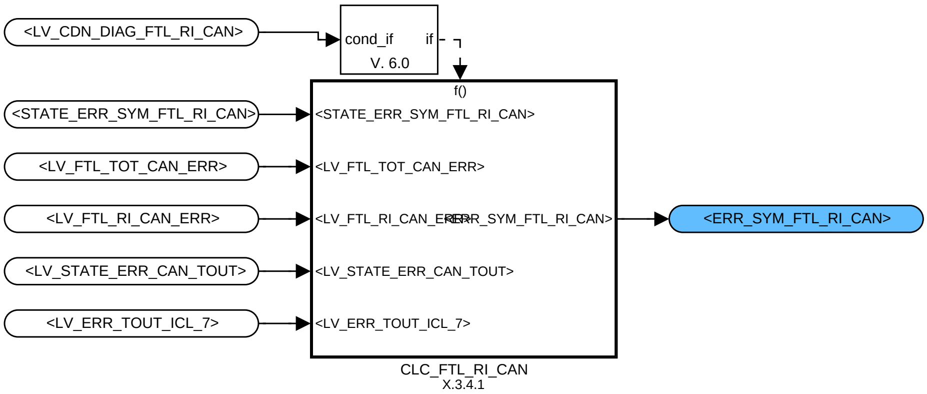

Figure A.81.18: :

A.81.3.4.1 Calculation of ERR_SYM_FTL_RI_CAN

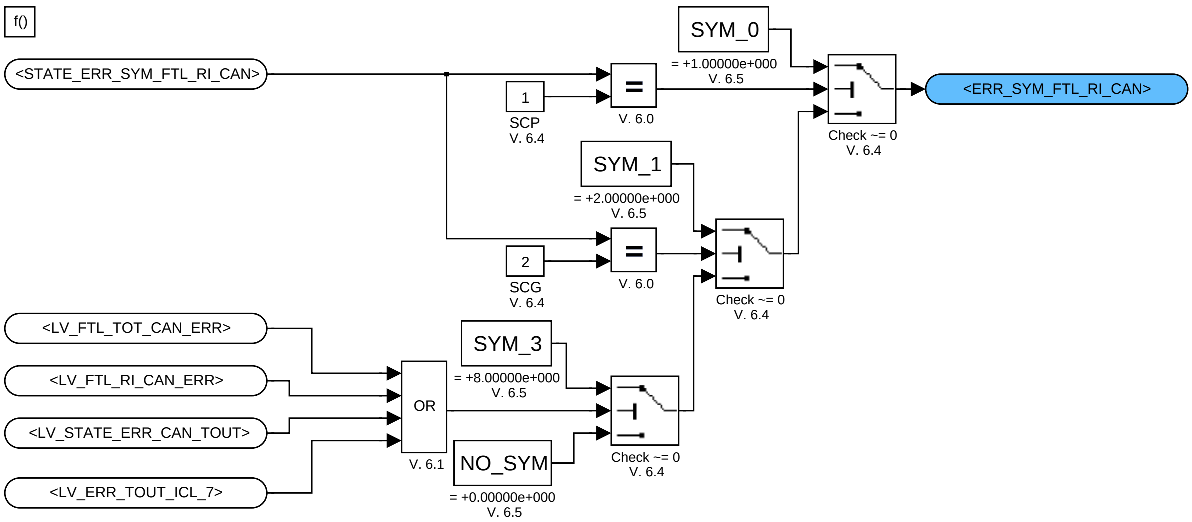

Figure A.81.19: :

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A.82 Fuel tank level input signal diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_FTL_OBD	O/V	0... 1H	0 ...1	1	-
Inhibition of FTL_OBD diagnosis					
LV_INH_DIAG_RBM_FTL_OBD	V	0... 1H	0 ...1	1	-
Inhibition of RBM for FTL diagnosis					
STATE_RBM_FTL_OBD	O/V	0... 7H	0 ...7	1	-
Interface of FTL_OBD monitor with the Rate-Based Monitoring statistics					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_DC {p. 5746}	LV_ECU_SLA {p. 800}	LV_END_DIAG_FTL_OBD {p. 4745}
LV_ERR_FTL_LE_CAN {p. 4745}	LV_ERR_FTL_RI_CAN {p. 4745}	NC_IDX_DIAG_FTL_LE_CAN	NC_IDX_DIAG_FTL_RI_CAN

General information:

General information:
With this module the interface between the FTL_OBD monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_FTL_OBD data. The inhibition of FTL_OBD diagnosis is also calculated in this module.
Within STATE_RBM_FTL_OBD, three different information are defined:
Conditions for monitoring are met long enough to detect malfunction (bit 0)
(no intrusive operation, no short trip)
Monitor disabled because of system malfunction (bit 1)
(depending on failure status: pending)
Monitor individual RBM conditions encountered within this DC (bit 2)
(not valid for FTL_OBD diagnosis)

Application conditions:

Initialisation: `CLRFMY, DCON, RST`
Recurrence: `1S`
Activation: `always`
Deactivation: `never`

Function description:

Formula section:

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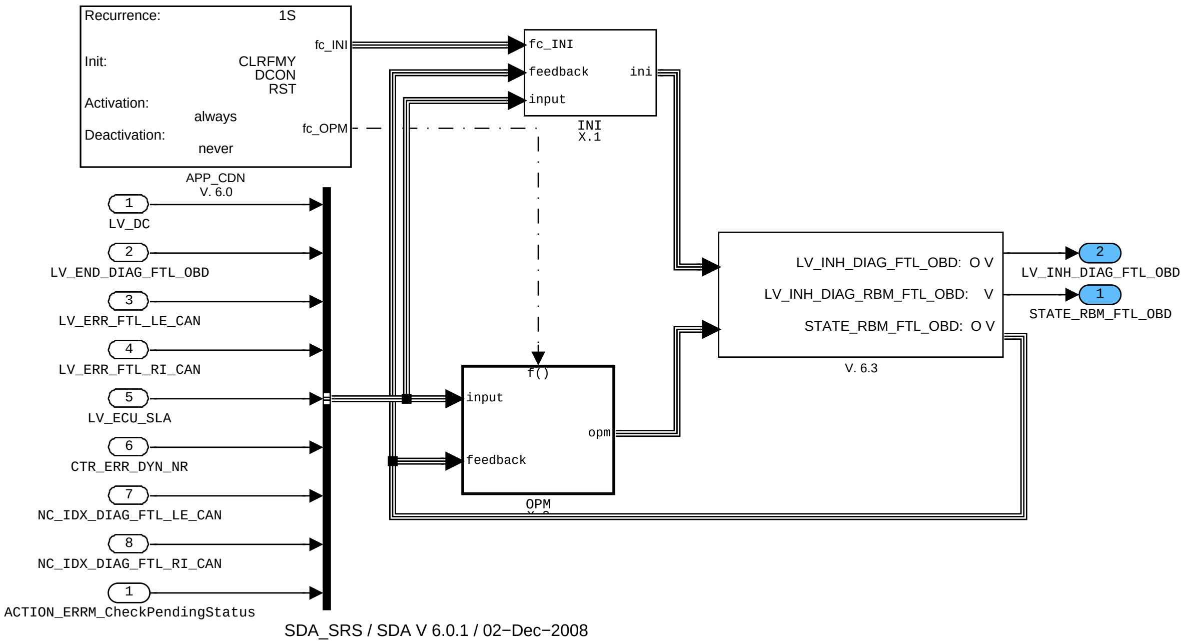

Figure A.82.1: :

A.82.1 Initialization

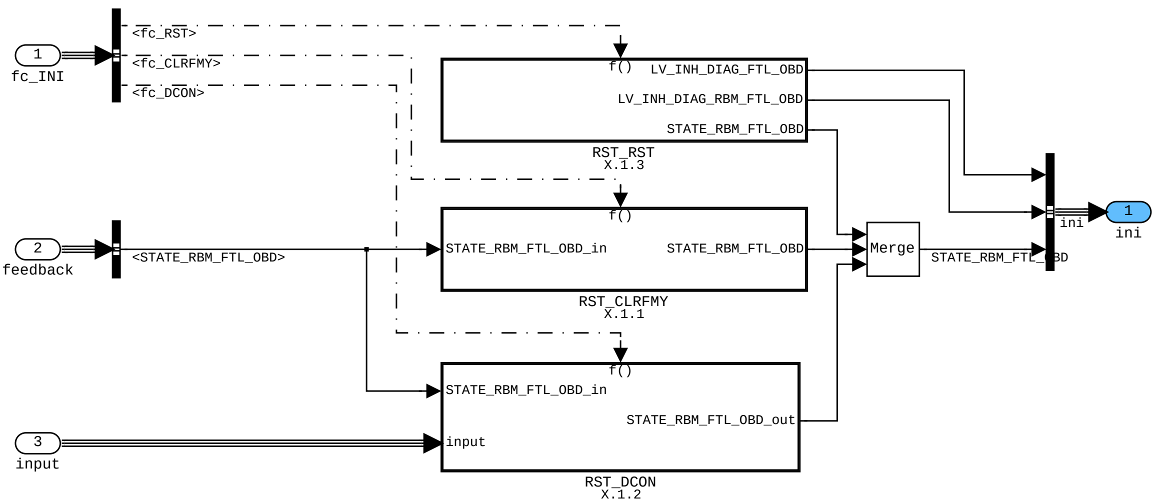

Figure A.82.2: :

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A.82.1.1 Initialization at Failure Memory Clear

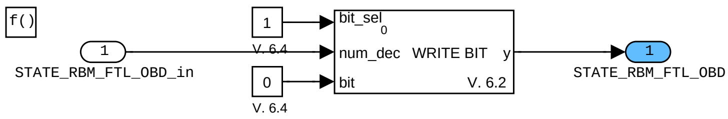

Figure A.82.3: :

A.82.1.2 Initialization at Driving Cycle OFF to ON

If some failures are pending, the inhibition bit of STATE_RBM_FTL_OBD is set.

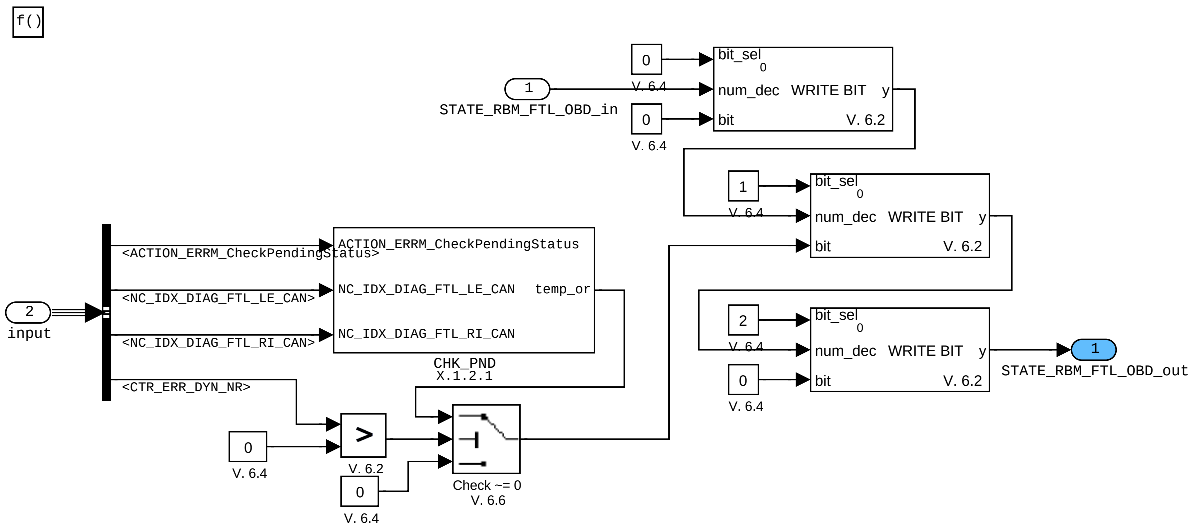

Figure A.82.4: :

A.82.1.2.1 Calculation of failures pending status

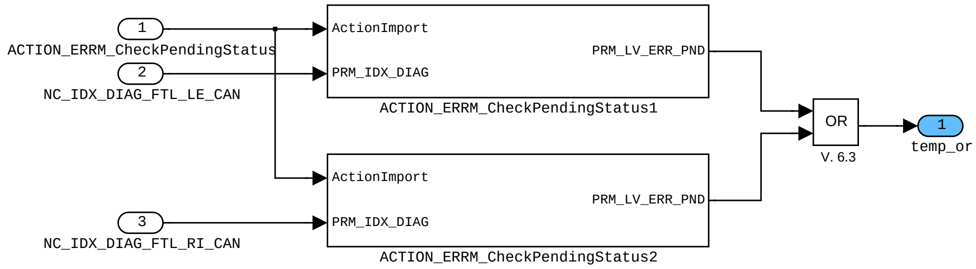

Figure A.82.5: :

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A.82.1.3 Initialization at Reset

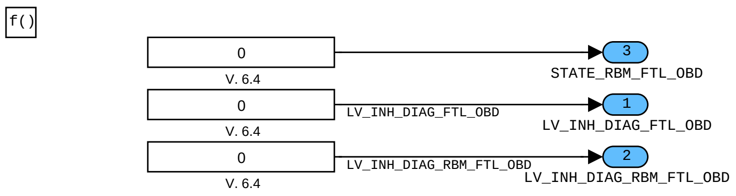

Figure A.82.6: :

A.82.2 Formula Section

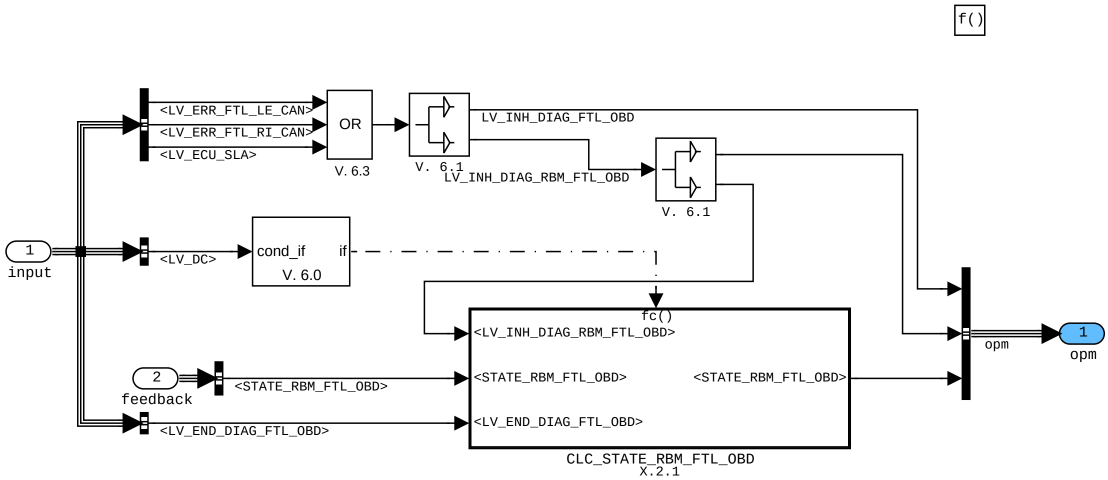

Figure A.82.7: :

A.82.2.1 Calculation of STATE_RBM_FTL_OBD

Interface of FTL_OBD monitor with the Rate-Based Monitoring statistics
Bit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1)
Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1)
Bit 2: individual RBM conditions of the monitor were encountered within this DC (bit 2 = 1)

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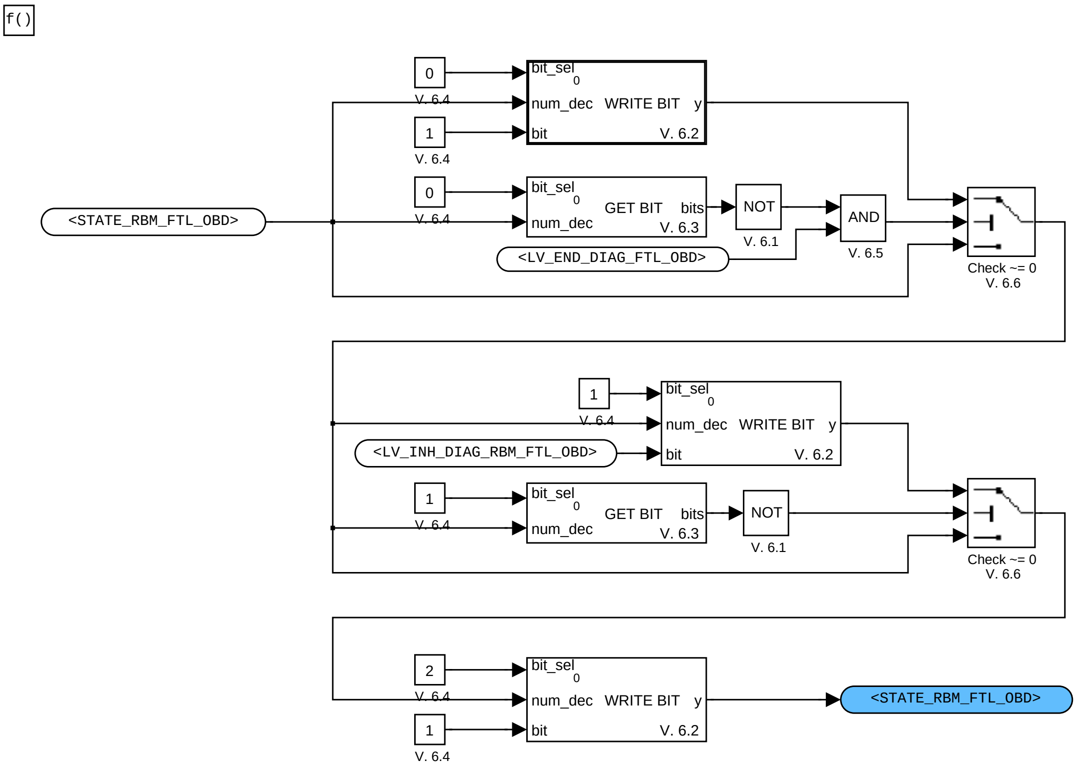

Figure A.82.8: :

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A.83 Fuel reserve signal diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ABC_FTL_MIN	V	0... FFH	0... 255	1	-
Debounce counter					
CTR_FTL_MIN_ACT	V	0... FFFFH	0... 65535	1	-
Pre counter FTL events					
ER_FTL_MIN	V	8000... 7FFFH	-32768 ...32767	1	µs
Engine roughness for FTL_MIN diagnosis					
ERR_SYM_FTL_MIN	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptome					
FTL_LE_MMV	V	0... 7FH	0... 127	1	l
Moving mean value of FTL_LE					
FTL_LE_MMV_H_RES	V	0... 7F00H	0... 127	3.9062e-3	l
Moving mean value of FTL_LE with high resolution					
FTL_RI_MMV	V	0... 7FH	0... 127	1	l
Moving mean value of FTL_RI					
FTL_RI_MMV_H_RES	V	0... 7F00H	0... 127	3.9062e-3	l
Moving mean value of FTL_RI with high resolution					
INH_IV_FTL_MIN	O/V	0... FFH	0... 255	1	-
Bit coded inhbit condition cylinder selective for fuel tank low level					
LV_CDN_DIAG_FTL_MIN	V	0... 1H	0 ...1	1	-
Condition diag					
LV_END_DIAG_FTL_MIN	V	0... 1H	0 ...1	1	-
End of diagnosis					
LV_ERR_FTL_MIN	O/V	0... 1H	0 ...1	1	-
Fuel tank level low Injection intervention					
LV_ERR_FUP_DIAG_ACT_HPRS	V	0... 1H	0 ...1	1	-
Logical variable indicating the use of error flags for diagnosis condition in High Pressure System					
LV_ERR_FUP_DIAG_ACT_LPRS	V	0... 1H	0 ...1	1	-
Logical variable indicating the use of error flags for diagnosis condition in Low Pressure System					
LV_FTL_LE_RE_ACT	V	0... 1H	0 ...1	1	-
Flag indicating left and right side of tank below theshold					
LV_FTL_MIN_ACT	V	0... 1H	0 ...1	1	-
Activation conditions for Diagnosis passed					
LV_FUP_AVL_DIAG_TMP	V	0... 1H	0 ...1	1	-
Logical variable indicating fuel pressure falls below a threshold of the FTL diagnosis					
LV_LAMB_PLAUS_FTL_MIN_DIAG_TMP	V	0... 1H	0 ...1	1	-
Logical variable indicating an unplausible lambda signal for FTL diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
RATIO_FTL	V	0... FFFFH	0... 0.99998	15.3e-6	-
Ratio of counter					
RATIO_FTL_INI	V	0... FFFFH	0... 0.99998	15.3e-6	-
Ratio of initialisation counter					
STATE_ERR_FTL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
State Defining the Source of the Error symptom					
T_DIAG_FTL_MIN	V	0... FFH	0... 25.5	0.1	s
Timer to stop ERR_SYM_FTL_MIN = SYM_0 diagnosis and reset inhibit flag					

Input data:

ER {p. 1454}	FAC_LAM_LIM [NC_CBK_EX_NR] {p. 2461}	FTL_LE {p. 1564}	FTL_RI {p. 1564}
FUP {p. 1283}	FUP_EFP {p. 1290}	FUP_SP {p. 3868}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}
LAMB_SP_FIL_HOM [NC_CBK_EX_NR] {p. 2462}	LAMB_SP_MV	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_CHG_LS_UP {p. 5416}
LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_EFP {p. 4733}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}
LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_TPS_PLAUS {p. 1062}
LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}
LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}
LV_ES {p. 1720}	LV_FUP_LIH_HOM_REQ {p. 4001}	LV_FUP_LIH_HOM_VCV_OPEN_REQ {p. 4001}	LV_FUP_LIH_L_PRS_CTL_REQ {p. 4001}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_LAMB_LS_UP_VLD [NC_CBK_EX_NR] {p. 2352}	LV_PUC {p. 1720}
OPM_AV {p. 8137}	T_AST {p. 1766}	TEG_DYN {p. 8236}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_FTL_MIN	-	0... FFH	0... 255	1	-
Decrement					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_FTL_MIN	-	0... FFH	0... 255	1	-
Increment					
C_ABC_MAX_FTL_MIN	-	1... FFH	1... 255	1	-
Maximum					
C_CRLC_FTL_MMV	-	0... FFH	0... 0.99609	3.9063e-3	-
Correlation constant for calculation of moving mean value of FTL_LE/RI_MMV					
C_CTR_FTL_MAX	-	0... FFFFH	0... 65535	1	-
Maximum of increments					
C_FAC_LAM_FTL_MIN	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Threshold of limited value of lambda controller output for FTL diagnosis					
C_FAC_RATIO_FTL_INI_MAX	-	0... FFFFH	0... 655.35	0.01	-
Correction factor					
C_FAC_RATIO_FTL_INI_MIN	-	0... FFFFH	0... 655.35	0.01	-
Correction factor					
C_FTL_MIN_DIAG_HYS	-	0... 7FH	0... 127	1	l
Hysteresis					
C_FTL_MIN_DIAG_LE	-	0... 7FH	0... 127	1	l
Threshold fuel level left					
C_FTL_MIN_DIAG_RI	-	0... 7FH	0... 127	1	l
Threshold fuel revel right					
C_FTL_RATIO_MAX	-	8000... 7FFFH	-32768 ...32767	1	µs
Maximum of increments					
C_FUP_DIF_FTL_MAX	-	0... FFFFH	0... 347776	5.3067216	hPa
Fuel Pressure Difference Maximum for FTL diagnosis					
C_FUP_EFP_DIAG_FTL_MIN	-	0... FFFFH	0... 173888	2.6533608	hPa
Fuel pressure of low pressure threshold for FTL diagnosis					
C_INH_IV_FTL_MIN	-	0... FFH	0... 255	1	-
Bitmask of inhibit cylinders					
C_LAMB_DIF_FIL_MAX	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Threshold of lambda difference for FTL diagnosis					
C_T_FTL_PUC_MAX	-	0... FFH	0... 25.5	0.1	s
Maximum for Timer to stop ERR_SYM_FTL_MIN = SYM_0 diagnosis					
C_T_INH_IV_FTL_MAX	-	0... FFH	0... 25.5	0.1	s
Maximum for Timer to reset cylinder inhibition due to cross reaction with other inhibit flags					
C_TEG_DYN_FTL_HYS	-	0... 7FF0H	0... 2047	0.0625	°C
Temperature hysteresis					
C_TEG_DYN_FTL_MIN	-	0... 7FF0H	0... 2047	0.0625	°C
Temperture threshold					
IP_FUP_DIAG_FTL_MIN	-	0... FFFFH	0... 347776	5.3067216	hPa
LDP_N_32_FUP_DIAG_FTL_MIN	4	0... FFH	0... 8160	32	rpm
Fuel pressure threshold for FTL diagnosis					
IP_T_AST_FTL_ACT	-	0... FFFFH	0... 6553.5	0.1	s
LDP_TEMP_CAT_T_AST_FTL_ACT	4	0... FFFFH	-33... 990.98437	0.015625	°C
Wait time after start to activate diag_ftl_min					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_ER_FTL_MIN_ACT	-	0... 1H	0 ...1	1	-
Logical constant indicating the use of engine roughness flags for diagnosis condition					
LC_ERR_FUP_DIAG_ACT_HPRS	-	0... 1H	0 ...1	1	-
Logical constant indicating the use of error flags for diagnosis condition at High Pressure					
LC_ERR_FUP_DIAG_ACT_LPRS	-	0... 1H	0 ...1	1	-
Logical constant indicating the use of error flags for diagnosis condition at Low Pressure					
LC_FTL_MIN_ES_INI_INH	-	0... 1H	0 ...1	1	-
Inhibition of FTL_MIN diagnosis initialization at engine restart event					
LC_LAMB_PLAUS_FTL_MIN_DIAG	-	0... 1H	0 ...1	1	-
Logical constant indicating the non plausible lambda signal for FTL diagnosis					
LC_STATE_FTL_MIN_ENA	-	0... 1H	0 ...1	1	-
Function enable condition					

A.83.1 Activation of Diagnosis

Description:

Application conditions

Initialisation: at reset **or** (LV_IGK = 0->1 **and** LV_ES = 0)**:** LV_FTL_MIN_ACT = 0

Recurrence: *100 ms*

Activation: always

Deactivation: otherwise

Formula section:

IF LV_IGK == 1 **and**
LV_ES == 0 **and**
LV_ERR_MAF == 0 **and**
LV_ERR_LOAD_TPS_PLAUS == 0 **and**
LV_ERR_CHG_LS_UP == 0 **and**
LV_ERR_OFS_LSL_UP[0] == 0 **and**
LV_ERR_OFS_LSL_UP[1] == 0 **and**
LV_ERR_CTL_LSL_UP[0] == 0 **and**
LV_ERR_CTL_LSL_UP[1] == 0 **and**
LV_ERR_MAP_TPS_PLAUS == 0 **and**
LV_ERR_AIR_LSL_UP[0] == 0 **and**
LV_ERR_AIR_LSL_UP[1] == 0 **and**
LV_ERR_DELTA_I_LAM[0] == 0 **and**
LV_ERR_DELTA_I_LAM[1] == 0 **and**
LV_ERR_DYN_VLD_LS_UP[0] == 0 **and**
LV_ERR_DYN_VLD_LS_UP[1] == 0 **and**
LV_ERR_EL_LSL_UP[0] == 0 **and**
LV_ERR_EL_LSL_UP[1] == 0 **and**
LV_ERR_LSH_UP[0] == 0 **and**
LV_ERR_LSH_UP[1] == 0 **and**

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LV_ERR_LSL_UP_IF[0] == 0 **and**
LV_ERR_LSL_UP_IF[1] == 0 **and**
LV_ERR_OBD_VLD_LSH_UP[0] == 0 **and**
LV_ERR_OBD_VLD_LSH_UP[1] == 0 **and**
LV_ERR_OC_LSL_UP[0] == 0 **and**
LV_ERR_OC_LSL_UP[1] == 0 **and**
LV_ERR_PUC_VLD_LS_UP[0] == 0 **and**
LV_ERR_PUC_VLD_LS_UP[1] == 0 **and**
LV_ERR_SHIFT_AFL_LSL_UP[0] == 0 **and**
LV_ERR_SHIFT_AFL_LSL_UP[1] == 0 **and**
LV_ERR_SHIFT_AFR_LSL_UP[0] == 0 **and**
LV_ERR_SHIFT_AFR_LSL_UP[1] == 0 **and**
LV_ERR_TTIP_MES_LSH_UP[0] == 0 **and**
LV_ERR_TTIP_MES_LSH_UP[1] == 0 **and**
LV_ERR_VLS_DOWN_DIF[0] == 0 **and**
LV_ERR_VLS_DOWN_DIF[1] == 0 **and**
T_AST > IP_T_AST_FTL_ACT

THEN LV_FTL_MIN_ACT = 1

ELSE LV_FTL_MIN_ACT = 0
ENDIF

A.83.2 Diagnosis Function

General information:

The intention of this diagnosis is to deteced a fuel level getting empty. An analysis is done based on the two chambers fuel level of the fuel tank.

Application conditions

Initialisation: **at** reset **or** LV_IGK 0 to 1 **or** (LV_ES 1 to 0 **and** LC_FTL_MIN_ES_INI_INH=0)
LV_ERR_FTL_MIN, RATIO_FTL, RATIO_FTL_INI, LV_CDN_DIAG_ FTL_MIN, CTR_FTL_MIN_ACT, ER_FTL_MIN, ERR_SYM_FTL_MIN, LV_LAMB_PLAUS_FTL_MIN_DIAG_TMP, LV_FUP_AVL_DIAG_TMP, LV_FTL_LE_RE_ACT
all with 0 physical
FTL_RI_MMV = *FTL_RI*
FTL_RI_MMV_H_RES = *FTL_RI*
FTL_LE_MMV = *FTL_LE*
FTL_LE_MMV_H_RES = *FTL_LE*

Recurrence: 100ms

Activation: LV_FTL_MIN_ACT =1 **and** LV_ERR_FTL_MIN = 0

Deactivation: LV_FTL_MIN_ACT = 0 **or** LV_ERR_FTL_MIN = 1

Description:

Error-symptoms are defined to this diagnosis function as following :

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```
□□□□
 | | | └─> low pressure intervention in high pressure system      (= SYM_0)
 | | └──> low pressure intervention in low pressure system        (= SYM_1)
 | └────> -                                                       (= SYM_2)
 └──────> low fuel level intervention                             (= SYM_3)
```

Formula section:

Reset of variables on FMY_clear:
If(1) failure memory is cleared
THEN(1) LV_LAMB_PLAUS_FTL_MIN_DIAG_TMP = 0
LV_FUP_AVL_DIAG_TMP = 0
STATE_ERR_FTL = 0
ENDIF(1)

Timer Setting to stop SYM_0 detection:
IF(1) LV_PUC = 1->0 (Flank from 1 to 0)
THEN(1) T_DIAG_FTL_MIN = C_T_FTL_PUC_MAX
ENDIF(1)

Lambda plausibility condition:
IF(1) LC_LAMB_PLAUS_FTL_MIN_DIAG = 1 **and** OPM_AV = 2H ('AFS' = HOM)
and LV_PUC = 0
THEN(1) **IF(2)** {[(LV_LAMB_LS_UP_VLD[0] = 1 **and**
LAMB_LS_UP[0] - LAMB_SP_FIL_HOM[0] >
C_LAMB_DIF_FIL_MAX) **or**
(LV_LAMB_LS_UP_VLD[1] = 1 **and**
LAMB_LS_UP[1] - LAMB_SP_FIL_HOM[1] >
C_LAMB_DIF_FIL_MAX)]

or

[(LV_LAM_LSCL[0] = 1 **and**
LV_LAM_STOP[0] = 0 **and**
FAC_LAM_LIM[1] > C_FAC_LAM_FTL_MIN) **or**
(LV_LAM_LSCL[1] = 1 **and**
LV_LAM_STOP[1] = 0 **and**
FAC_LAM_LIM[2] > C_FAC_LAM_FTL_MIN)]}

and

T_DIAG_FTL_MIN = 0
THEN(2) LV_LAMB_PLAUS_FTL_MIN_DIAG_TMP = 1
ELSE(2) LV_LAMB_PLAUS_FTL_MIN_DIAG_TMP = 0
ENDIF(2)
ELSE(1) LV_LAMB_PLAUS_FTL_MIN_DIAG_TMP = 0
ENDIF(1)

High Pressure Condition:
IF(1) LC_ERR_FUP_DIAG_ACT_HPRS = 1
THEN(1) **IF(2)** LV_ERR_FUP_MFP_PLAUS = 0 **and**
LV_ERR_FUP = 0

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THEN(2) LV_ERR_FUP_DIAG_ACT_HPRS = 1
ELSE(2) LV_ERR_FUP_DIAG_ACT_HPRS = 0
ENDIF(2)
ELSE(1) LV_ERR_FUP_DIAG_ACT_HPRS = 0
ENDIF(1)

Low Pressure Condition:
IF(1) LC_ERR_FUP_DIAG_ACT_LPRS = 1
THEN(1) **IF(2)** LV_ERR_FUP_EFP = 0
THEN(2) LV_ERR_FUP_DIAG_ACT_LPRS = 1
ELSE(2) LV_ERR_FUP_DIAG_ACT_LPRS = 0
ENDIF(2)
ELSE(1) LV_ERR_FUP_DIAG_ACT_LPRS = 0
ENDIF(1)

Individual Tank Levels Condition:
Right:
IF(1) FTL_RI - FTL_RI_MMV > 0
THEN(1) FTL_RI_MMV_H_RES = FTL_RI
FTL_RI_MMV = FTL_RI_MMV_H_RES
ELSE(1) FTL_RI_MMV_H_RES = FTL_RI_MMV_H_RES + (FTL_RI - FTL_RI_MMV_H_RES) * C_CRLC_FTL_MMV
FTL_RI_MMV = FTL_RI_MMV_H_RES
ENDIF(1)
Left:
IF(1) FTL_LE - FTL_LE_MMV > 0
THEN(1) FTL_LE_MMV_H_RES = FTL_LE
FTL_LE_MMV = FTL_LE_MMV_H_RES
ELSE(1) FTL_LE_MMV_H_RES = FTL_LE_MMV_H_RES + (FTL_LE - FTL_LE_MMV_H_RES) * C_CRLC_FTL_MMV
FTL_LE_MMV = FTL_LE_MMV_H_RES
ENDIF(1)

Empty Tank Decision based on tank level condition:
IF(1a) LC_STATE_FTL_MIN_ENA == 1 **and**
FTL_LE_MMV < = C_FTL_MIN_DIAG_LE **and**
FTL_RI_MMV < = C_FTL_MIN_DIAG_RI **and**
TEG_DYN => C_TEG_DYN_FTL_MIN
THEN(1a) LV_FTL_LE_RE_ACT = 1

ELSEIF(1b) FTL_LE_MMV > C_FTL_MIN_DIAG_LE + C_FTL_MIN_DIAG_HYS **or**
FTL_RI_MMV > C_FTL_MIN_DIAG_RI+ C_FTL_MIN_DIAG_HYS **or**
TEG_DYN < C_TEG_DYN_FTL_MIN - C_TEG_DYN_FTL_HYS
THEN(1b) LV_FTL_LE_RE_ACT = 0

ELSE(1) LV_FTL_LE_RE_ACT(n) = LV_FTL_LE_RE_ACT(n-1)

ENDIF(1)

Error Decision:

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```
IF(1)        OPM_AV = 2H   ('AFS' = HOM)
THEN(1)
     IF(2)             LV_FTL_LE_RE_ACT = 1                        and
                       (STATE_ERR_FTL = SYM_0                      or
                       STATE_ERR_FTL = SYM_1)                      and
                           LV_FUP_AVL_DIAG_TMP = 1                 and
                           LV_LAMB_PLAUS_FTL_MIN_DIAG_TMP = 1
     THEN(2)        LV_FUP_AVL_DIAG_TMP = 1
                    STATE_ERR_FTL = SYM_3
     ELSE(2)
            IF(3)           FUP_SP - FUP > C_FUP_DIF_FTL_MAX              and
                            FUP < IP_FUP_DIAG_FTL_MIN                     and
                            LV_ERR_FUP_DIAG_ACT_HPRS = 1                  and
                            LV_LAMB_PLAUS_FTL_MIN_DIAG_TMP = 1
            THEN(3)        LV_FUP_AVL_DIAG_TMP = 1
                           STATE_ERR_FTL = SYM_0
            ELSE(3)
                   IF(4)           FUP_EFP < C_FUP_EFP_DIAG_FTL_MIN         and
                               LV_ERR_FUP_DIAG_ACT_HPRS = 0                 and
                                 LV_ERR_FUP_DIAG_ACT_LPRS = 1               and
                                 LV_LAMB_PLAUS_FTL_MIN_DIAG_TMP = 1
                   THEN(4)       LV_FUP_AVL_DIAG_TMP = 1
                               STATE_ERR_FTL = SYM_1
                      ELSE(4)        LV_FUP_AVL_DIAG_TMP = 0
                               STATE_ERR_FTL= NO_SYM
                 ENDIF(4)
            ENDIF(3)
   ENDIF(2)
ELSE(1)     LV_FUP_AVL_DIAG_TMP(n) = LV_FUP_AVL_DIAG_TMP(n-1)
ENDIF(1)
```

Error Setting:

```
IF(0)     LC_ER_FTL_MIN_ACT = 1
THEN(0)
IF(1)          LV_FUP_AVL_DIAG_TMP = 1
THEN(1)   LV_CDN_DIAG_FTL_MIN = 0
       IF (2)    RATIO_FTL_INI == 0
     Then(2)          IF (3)   CTR_FTL_MIN_ACT < C_CTR_FTL_MAX
            Then(3)          CTR_FTL_MIN_ACT = CTR_FTL_MIN_ACT + 1
                            ER_FTL_MIN  = ER_FTL_MIN + abs(ER)
            ELSE(3)     RATIO_FTL_INI = ER_FTL_MIN /C_FTL_RATIO_MAX
                             CTR_FTL_MIN_ACT = 0
                             ER_FTL_MIN = 0
            Endif(3)
     ELSE(2)
        IF(3)           CTR_FTL_MIN_ACT < C_CTR_FTL_MAX
        Then(3)        CTR_FTL_MIN_ACT = CTR_FTL_MIN_ACT + 1
                         ER_FTL_MIN  = ER_FTL_MIN + abs(ER)
        ELSE(3)       RATIO_FTL   = ER_FTL_MIN /C_FTL_RATIO_MAX
             IF(4)     RATIO_FTL > RATIO_FTL_INI * C_FAC_RATIO_FTL_INI_MAX     or
                    RATIO_FTL < RATIO_FTL_INI * C_FAC_RATIO_FTL_INI_MIN
             Then(4)          LV_CDN_DIAG_FTL_MIN = 1
```

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```
                    IF(5)    STATE_ERR_FTL = SYM_0
                    THEN(5)       ERR_SYM_FTL_MIN = SYM_0

                    ELSEIF(5)     STATE_ERR_FTL = SYM_1
                    THEN(5)       ERR_SYM_FTL_MIN = SYM_1

                    ELSEIF(5)     STATE_ERR_FTL = SYM_3
                    THEN(5)       ERR_SYM_FTL_MIN = SYM_3

                    ELSE(5)       ERR_SYM_FTL_MIN = NO_SYM
                    ENDIF(5)
                  CTR_FTL_MIN_ACT = 0
                  ER_FTL_MIN = 0
                  debounce LV_ERR_FTL_MIN
                  C_ABC_INC_FTL_MIN; C_ABC_MAX_FTL_MIN
          Else(4)       reset    ER_FTL_MIN = 0
                  CTR_FTL_MIN_ACT = 0
          Endif(4)
      Endif(3)
    Endif(2)
ELSE(1)    LV_CDN_DIAG_FTL_MIN = 1
           ERR_SYM_FTL_MIN = NO_SYM
           Rebounce with C_ABC_DEC_FTL_MIN
           RATIO_FTL_INI =   RATIO_FTL = 0;
           ER_FTL_MIN = 0
           CTR_FTL_MIN_ACT = 0
Endif(1)
ELSE(0)
  IF(1)         LV_FUP_AVL_DIAG_TMP = 1
  THEN(1)
          IF(2)    STATE_ERR_FTL = SYM_0
           THEN(2)       ERR_SYM_FTL_MIN = SYM_0
                           LV_CDN_DIAG_FTL_MIN = 1
                         debounce LV_ERR_FTL_MIN
                  C_ABC_INC_FTL_MIN; C_ABC_MAX_FTL_MIN

           ELSEIF(2)     STATE_ERR_FTL = SYM_1
           THEN(2)       ERR_SYM_FTL_MIN = SYM_1
                           LV_CDN_DIAG_FTL_MIN = 1
                         debounce LV_ERR_FTL_MIN
                  C_ABC_INC_FTL_MIN; C_ABC_MAX_FTL_MIN

           ELSEIF(2)     STATE_ERR_FTL = SYM_3
           THEN(2)       ERR_SYM_FTL_MIN = SYM_3
                           LV_CDN_DIAG_FTL_MIN = 1
                         debounce LV_ERR_FTL_MIN
                  C_ABC_INC_FTL_MIN; C_ABC_MAX_FTL_MIN

           ENDIF(2)
    ELSE(1)        ERR_SYM_FTL_MIN = NO_SYM
                    LV_CDN_DIAG_FTL_MIN = 1
                    Rebounce with C_ABC_DEC_FTL_MIN
```

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ENDIF(1)
ENDIF(0)

A.83.3 Inhibition Flag

Application conditions

Initialisation: INH_IV_FTL_MIN = 0 ; T_DIAG_FTL_MIN = 0

Recurrence: 100ms

Activation: LV_IGK ==1

Deactivation: LV_IGK ==0

Formula section:

Timer Setting to stop SYM_0 detection:
Decrement T_DIAG_FTL_MIN
IF (1a) LV_ERR_FTL_MIN = 1 **and**
STATE_ERR_FTL = SYM_0 **and**
(
LV_FUP_LIH_L_PRS_CTL_REQ = 1 **or**
LV_FUP_LIH_HOM_VCV_OPEN_REQ = 1 **or**
LV_FUP_LIH_HOM_REQ = 1
) **and**
T_DIAG_FTL_MIN = 0
THEN(1a) INH_IV_FTL_MIN = 00H
ELSEIF (1b) LV_ERR_FTL_MIN = 1
THEN(1b) INH_IV_FTL_MIN = C_INH_IV_FTL_MIN
IF(2a) STATE_ERR_FTL = SYM_0 **and**
LV_FUP_LIH_L_PRS_CTL_REQ = 0 **and**
LV_FUP_LIH_HOM_VCV_OPEN_REQ = 0 **and**
LV_FUP_LIH_HOM_REQ = 0
THEN(2a) T_DIAG_FTL_MIN = C_ T_INH_IV_FTL_MAX
ENDIF(2a)
ELSE(1b) INH_IV_FTL_MIN = 00H
"BIT mask for selection of cylinder to inhibit"
ENDIF(1b)

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A.84 Ignition diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_DUR_IGC_MPL	V	0H 8H	NO_SYM SYM_3	-	-
Symptom of the ignition coil failure : open load on all cylinders					
ERR_SYM_IGC_SCG [NC_CYL_NR]	V	0H 2H	NO_SYM SYM_1	-	-
Symptom of the ignition coil failure primary short circuit ground					
ERR_SYM_IGC_SCP [NC_CYL_NR]	V	0H 1H	NO_SYM SYM_0	-	-
Symptom of the ignition coil failure primary short circuit plus					
IGC_DIAG_MIS	O/V	0... FFH	0... 255	1	-
Non filtered error information for misfire detection					
LV_CDN_DIAG_DUR_IGC_MPL	V	0H 1H	Passive Active	-	-
Diagnosis condition bit for open load on all cylinders					
LV_CDN_DIAG_IGC_SCG [NC_CYL_NR]	V	0H 1H	Passive Active	-	-
Ignition diagnosis condition for short circuit to ground					
LV_CDN_DIAG_IGC_SCP [NC_CYL_NR]	O/V	0H 1H	Passive Active	-	-
Ignition diagnosis condition for short circuit plus					
LV_END_DIAG_DUR_IGC_MPL	V	0H 1H	Passive Active	-	-
Result of ignition diagnosis : open load on all cylinders					
LV_END_DIAG_IGC_SCG [NC_CYL_NR]	V	0H 1H	Passive Active	-	-
Result of ignition diagnosis for SCG					
LV_END_DIAG_IGC_SCP [NC_CYL_NR]	V	0H 1H	Passive Active	-	-
Result of ignition diagnosis for SCP					
LV_ERR_DUR_IGC_MPL	O/V	0H 1H	Passive Active	-	-
Ignition coil failure : open load on all cylinders					
LV_ERR_IGC	O/V	0... 1H	0 ...1	1	-
OR of every failure every 100 ms					
LV_ERR_IGC_SCG [NC_CYL_NR]	O/V	0H 1H	Passive Active	-	-
ignition coil failure primary short circuit ground					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_IGC_SCP [NC_CYL_NR]	O/V	0H 1H	Passive Active	-	-
Ignition coil failure short circuit plus					
LV_INH_IGC [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition for ignition system of cylinder x					
LV_INH_INJ_DIAG_IGC	O/V	0... 1H	0 ...1	1	-
Flag to inhibit injection on all cylinders due to lost ignition coil supply					

Input data:

IGC_x_EXT_ADJ {p. 798}	LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_CAM {p. 1505}	LV_ES {p. 1720}
LV_IGC_x_EXT_ADJ {p. 803}	LV_IGK {p. 906}	LV_INH_DIAG_DUR_IGC_MPL {p. 4780}	LV_INH_DIAG_IGC_SCG {p. 4780}
LV_INH_DIAG_IGC_SCP {p. 4780}	LV_SCG_IGC [NC_CYL_NR] {p. 920}	LV_SCP_IGC [NC_CYL_NR] {p. 920}	LV_ST {p. 1720}
N_32 {p. 1525}	NC_CYL_NR {p. 1526}	TCO {p. 1100}	TD_AD [NC_CYL_NR] {p. 932}
TD_IGC [NC_CYL_NR] {p. 1876}	V_DUR_IGC [NC_CYL_NR] {p. 920}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_IGC_SCP	-	0... FFH	0... 255	1	-
Value of anti-bounce counter after regeneration cycle Typical value for debug = 128					
C_ESB_IGN_CUT_DIAG	-	0... 01H	0 ...1	1	-
C_ESB_IGN_CUT_DIAG = 1 will inhibit the function Typical value for debug = 0					
C_IGA_OFF_CYCNR_HLD	-	0... FFH	0... 255	1	-
Duration for regeneration cycle Recurrence number; coil has been switched off Typical value for debug = 16					
C_N_32_MIN_OL_SCG_IGC_DIAG	-	0... FFH	0... 8160	32	Rpm
Min engine speed for condition diagnosis OL/SCG Typical value for debug = 500 rpm					
C_N_32_MIN_SCP_IGC_DIAG	-	0... FFH	0... 8160	32	Rpm
Min engine speed for condition diagnosis SCP Typical value for debug = 500 rpm					
C_SUM_IGC_SCP	-	0... FFH	0... 255	1	-
Number of cycles before switching off the coil until reset Typical value for debug = 255					
C_TCO_MIN_IGC_DIAG	-	0... FEH	-48... 142.5	0.75	°C
Min Temperature for condition diagnosis OL & SCG Typical value for debug = 20 ° (emission cycle starting)					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IGC_DLY	-	0... FFH	0... 255	1	-
Number of recurrence after engine start, which had to pass by to activate the diagnosis value =16					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IGN_DIAG_TYP	-	0... FFH	0... 255	1	-

ATM46 = 01H
ATIC29 = 02H
SHUNT (not supported today)
Typical value for debug = ATIC29

FUNCTION DESCRIPTION:

General information:

The purpose of this diagnosis function is to detect all major failures, which can happen between ECU output and ignition coils.
This function is adaptable on every engine but the type of spark plugs and ignition coils must be taken into account.
The diagnosis is performed separate for each ignition coil. The feedback signal from the specific ignition coil (following the firing order) is evaluated by the microcontroller.

A.84.1 Short circuit to plus: SCP

Description:

In some hardware driver the ignition power stage is not protected against short circuit to ground and they are not able to withstand an overload current for a long time so it is necessary to switch off the power stage by software.
For ignition coil actuator tests purpose, the SCP diagnostic function has to be enabled, activated and monitored upon the tests requests
The same case and comments (see before) apply here also.
The Ignition output diagnosis function detects short circuit to battery and sets LV_IGC_SCP[x]. It cuts off the ignition driver after a delay time which is defined in the IGBT Protection function. In the ignition diagnosis function the error is debounced.

Application conditions

Normal Engine Running mode

Initialization: *all ERRM output data according Filter type (see Applic. Inc.), all other output data 0 at reset*

Recurrence:

```
If  NC_IGN_DIAG_TYP =ATM46 every segment
If  NC_IGN_DIAG_TYP =ATIC29 every 100 ms
```

Activation:

```
If      LV_INH_IGC[x] = 0
And     LV_ERR_CAM = 0
And     N_32 > C_N_32_MIN_SCP_IGC_DIAG
And     LV_INH_DIAG_IGC_SCP = 0
And     if    NC_IGN_DIAG_TYP =ATIC29
Failure information for current cylinder
from ATIC29 is valid
        Endif
Then    LV_CDN_DIAG_IGC_SCP[x] = 1
Else    LV_CDN_DIAG_IGC_SCP[x] = 0
Endif
```

Ignition Actuator Tests mode

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Initialisation:

```
all output variables of the function have to be set to 0 at
reset ECU
                    (except saved error flag)
```

Recurrence:

```
if      NC_IGN_DIAG_TYP =ATM46
        On transition of IGC_x_EXT_ADJ from 1 to 0
       for reading the SCP failure status
```

Activation:

```
For              x = 0 to NC_CYL_NR - 1
    If               LV_INH_IGC[x]  = 0
    And     LV_ERR_CAM = 0
      [And    LV_ES          = 1         // Actuator tests activation
          And      LV_IGK        = 1
          And      LV_IGC_x_EXT_ADJ = 1]
    Then          LV_CDN_DIAG_IGC_SCP[x]  = 1
    Else           LV_CDN_DIAG_IGC_SCP[x]  = 0
    Endif
EndFor
```

Formula section:

If LV_CDN_DIAG_IGC_SCP =1
Then **If** LV_SCP_IGC[x] = 1
Then ERR_SYM_IGC_SCP[x] = SYM_0
Else ERR_SYM_IGC_SCP[x] = NO_SYM
Else No action on the antibounce counter
Endif

Debounce:

Anti - bounce counter increment: according ABC type
Maximum value of anti - bounce counter: according ABC type
If LV_CDN_DIAG_IGC_SCP[x] =1
Then **If** ERR_SYM_IGC_SCP[x] = SYM_0
Then the antibounce counter is started according ABC type
Else The antibounce counter is decremented according ABC type
Endif
Endif

Ignition cut off conditions:

If C_ABC_MAX_IGC_SCP delay is reached
Then LV_INH_IGC[x] = 1
Endif

Ignition restart after cut off:

To regenerate the power stage the diagnosis will be switched off (LV_INH_IGC[x] = 1) for C_IGA_OFF_CYCNR_HLD recurrence number (see graphic, failure reaction in case of error).
After the refreshing cycle the debounce counter is set to C_ABC_IGC_SCP (see graphic below) and the ignition will be switched on to test the operating stage again. In case of error it will be debounced again.
This procedure is executed C_SUM_IGC_SCP times before the coil is absolutely switched off, until reset for ATM46 not for ATIC29

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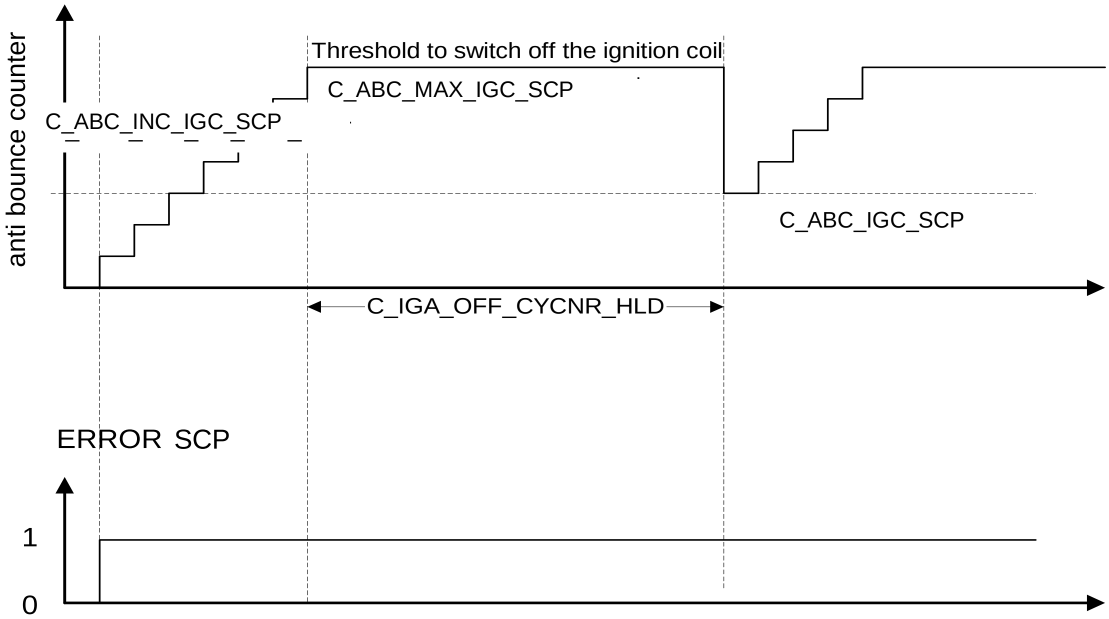
In next engine cycle the error is kept present. To take sure that the vehicle is able to restart the ignition will be switched on, till the diagnosis conditions are fulfilled and the diagnosis restarts.

Failure reaction in case of error



Application hint:

Some driver as ATM46 does not cut itself in case of SCP failure. For better Driver protection The counter threshold C_ABC_IGC_SCP mustn't exceed 4 cycles For the same reason the counter C_ABC_MAX_IGC_SCP must be set below 12 cycles.

The function can be disabled by the 'enable byte' C_ESB_IGN_CUT_DIAG.

A.84.2 SCG diagnosis

Description

The diagnosis is based on SCG information from the ignition output diagnosis function.
Please note that this diagnosis is valid also for Open Load detection.

Application conditions

Initialisation: all ERRM output data according Filter type (see Applic. Inc.), all other output data 0 at reset

Recurrence: *if NC_IGN_DIAG_TYP =ATM46 every segment*
if NC_IGN_DIAG_TYP =ATIC29 every 100 ms

Activation:

```
If      LV_ES = 0
And     LV_ST = 0
And     N_32 > C_N_32_MIN_OL_SCG_IGC_DIAG
And     TCO > C_TCO_MIN_IGC_DIAG
And     LV_INH_IGC[x] = 0
And     LV_ERR_CAM = 0
And     No low voltage battery (LV_CDN_VB_OBD1 = 1)
And     Counter Number of recurrence > NC_IGC_DLY
And     LV_INH_DIAG_IGC_SCG = 0
And     if      NC_IGN_DIAG_TYP =ATIC29
```

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```
Failure information for current cylinder
from ATIC29 is valid
       endif
 Then   LV_CDN_DIAG_IGC_SCG[x] =1
 Else    LV_CDN_DIAG_IGC_SCG[x] = 0
   Endif
```

Formula section:

If LV_CDN_DIAG_IGC_SCG[x] =1
Then **If** LV_SCG_IGC[x] = 1
Then ERR_SYM_IGC_SCG[x] = SYM_1
Else ERR_SYM_IGC_SCG[x] = NO_SYM
Endif
Else No action on the antibounce counter
Endif

Debounce:

Anti - bounce counter increment: C_ABC_INC_IGC_SCG

Maximum value of anti - bounce counter: C_ABC_MAX_IGC_SCG

If LV_CDN_DIAG_IGC_SCG[x] =1
Then **If** ERR_SYM_IGC_SCG[x] = SYM_1
Then the antibouce SCG counter is started according ABC type
Else The antibounce SCG counter is decremented according ABC type
Endif
Endif

A.84.3 Loss of power supply for all ignition coils

Description:

If all flags V_DUR_IGC[x] are equal to 0 at the same time it is assumed that the power supply for all ignition coils is lost or damaged. in this case LV_ERR_DUR_IGC_MPL is set.

Application conditions

Initialisation: according ABC type
LV_INH_INJ_DIAG_IGC = 0 at LV_IGK 0 - ->1 or reset or clearing FMY

Recurrence: every segment

Activation:
If LV_ES = 0
And LV_ST = 0
And LV_IGK = 1
And LV_INH_DIAG_DUR_IGC_MPL = 0
Then LV_CDN_DIAG_DUR_IGC_MPL = 1
Else LV_CDN_DIAG_DUR_IGC_MPL = 0
Endif

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Formula section:

```
If      LV_CDN_DIAG_DUR_IGC_MPL =1
Then    If     all V_DUR_IGC[x] = 0 ms          // for all cylinders

        Then   ERR_SYM_DUR_IGC_MPL =  SYM_3
               If     LV_ERR_DUR_IGC_MPL = 1
               Then   LV_INH_INJ_DIAG_IGC = 1
               Endif
        Else   ERR_SYM_DUR_IGC_MPL = NO_SYM
               LV_INH_INJ_DIAG_IGC = 0
        Endif
Else    No action on the antibounce counter
Endif
```

LV_ERR_DUR_IGC_MPL and LV_END_DIAG_DUR_IGC_MPL are calculated by error management.

A.84.4 Or of ignition failure

Initialisation: output variable has to be set to "0" at reset
Recurrence: **If** NC_IGN_DIAG_TYP =ATM46 every segment
If NC_IGN_DIAG_TYP =ATIC29 every 100 ms

Activation:

Formula section:

LV_ERR_IGC = LV_ERR_IGC_SCP[x] **OR** LV_ERR_IGC_SCG[x]

A.84.5 Unfiltered ignition error information for misfire detection

Application conditions

Initialisation: IGC_DIAG_MIS = 0 at reset ECU

Recurrence: **If** NC_IGN_DIAG_TYP =ATM46 every segment
If NC_IGN_DIAG_TYP =ATIC29 every 100 ms

Formula section:

```
If      LV_SCP_IGC[x]        = 1
Or      LV_SCG_IGC[x]        = 1
Then    set the bit for the actual cylinder in IGC_DIAG_MIS = 1
Else    reset the bit for the actual cylinder in IGC_DIAG_MIS = 0
Endif
```

Description:

The error information of the ignition system should not be filtered. The different error detections are linked by a wired "OR". As soon as an ignition error is detected the information should be available as output cylinder individually in the byte IGC_DIAG_MIS.
IGC_DIAG_MIS

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Bit Low to high	4 cylinder	5 cylinder	6 cylinder	8 cylinder
0	Cyl 0	Cyl 0	Cyl 0	Cyl 0
1	Cyl 1	Cyl 1	Cyl 1	Cyl 1
2	Cyl 2	Cyl 2	Cyl 2	Cyl 2
3	Cyl 3	Cyl 3	Cyl 3	Cyl 3
4		Cyl 4	Cyl 4	Cyl 4
5			Cyl 5	Cyl 5
6				Cyl 6
7				Cyl 7

Note: typical value for debug is proposed for default value of the Calibration

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A.85 Ignition diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INH_IV_IGC	O/V	0... FFH	0... 255	1	-
Injection cut off					
LV_INH_DIAG_DUR_IGC_MPL	O/V	0... 1H	0 ...1	1	-
Inhibition condition for diagnosis of open load on all cylinders					
LV_INH_DIAG_IGC_OL	O/V	0... 1H	0 ...1	1	-
Inhibition condition for open load for ignition diagnosis					
LV_INH_DIAG_IGC_SCG	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the short circuit to ground for ignition diagnosis					
LV_INH_DIAG_IGC_SCP	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the short circuit plus for ignition diagnosis					

Input data:

LV_CDN_VB_OBD2 {p. 1185}	LV_ERR_CRK {p. 4455}	LV_ERR_TCO {p. 4496}	LV_IGK {p. 906}
LV_INH_IGC [NC_CYL_NR] {p. 4773}	LV_INH_INJ_DIAG_IGC {p. 4773}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_DUR_IGC_MPL	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the ignition system diagnosis multiple open loadTypical value for debug = 5					
C_ABC_INC_DUR_IGC_MPL	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the ignition system diagnosis multiple open loadTypical value for debug = 5					
C_ABC_INC_IGC_OL	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the ignition system diagnosis OL Typical value for debug = 5					
C_ABC_INC_IGC_SCG	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the ignition system diagnosis SCG Typical value for debug = 5					
C_ABC_INC_IGC_SCP	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the ignition system diagnosis SCPTypical value for debug = 5					
C_ABC_MAX_DUR_IGC_MPL	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter for the ignition system diagnosis multiple open loadTypical value for debug = 255					
C_ABC_MAX_IGC_OL	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter for the ignition system diagnosis OLTypical value for debug = 255					
C_ABC_MAX_IGC_SCG	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter for the ignition system diagnosis SCGTypical value for debug = 255					
C_ABC_MAX_IGC_SCP	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter for the ignition system diagnosis to switch off the coilTypical value for debug = 255					

Error treatment:

Diagnosis	Symptom	SYM	ABC type
Ignition diagnosis for SCP	SCP	*SYM_0*	STD_INI
LV_ERR_IGC_SCP			

Figure A.85.1: Diagnosis

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Diagnosis	Symptom	SYM	ABC type
Ignition diagnosis for OL and SCG	OL	*SYM_2*	STD_INI
	SCG	*SYM_1*	
LV_ERR_IGC_OL LV_ERR_IGC_SCG			

Figure A.85.2: Diagnosis

Diagnosis	Symptom	SYM	ABC type
Ignition diagnosis for OL on all cylinders	MPL_OL	*SYM_3*	STD_INI + DEC_CAL
LV_ERR_DUR_IGC_MP L			

A.85.1 IGBT protection

Description:

To protect the catalyst in case of ignition driver cut off it is necessary to shut off the injection of the concerning cylinder as well.

Recurrence: Segment Synchronous

Formula section:

Shut off injection sequence of IGBT protection:

if LV_INH_INJ_DIAG_IGC = 1
then set all bits in INH_IV_IGC
else reset all bits in INH_IV_IGC
  for x = 0 to NC_CYL_NR-1
    if LV_INH_IGC[x] = 1
    then set bit x in INH_IV_IGC
    else reset bit x in INH_IV_IGC
    endif
  endfor
endif

A.85.2 Inhibition flags for ignition diagnosis

Description:

Application conditions

Initialisation:
```
At reset event :
LV_INH_DIAG_IGC_SCP = 0
```

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```
LV_INH_DIAG_IGC_SCG = 0
LV_INH_DIAG_IGC_OL = 0
LV_INH_DIAG_DUR_IGC_MPL =0
```

Recurrence: *10 ms*

Activation:

Deactivation:

Formula section:

if LV_IGK = 1 **and**
LV_ERR_TCO = 0 **and**
LV_ERR_CRK = 0

then LV_INH_DIAG_IGC_SCP = 0
else LV_INH_DIAG_IGC_SCP = 1
endif

if LV_CDN_VB_OBD2 = 1 **and**
LV_ERR_TCO = 0 **and**
LV_ERR_CRK = 0
then LV_INH_DIAG_IGC_OL = 0
else LV_INH_DIAG_IGC_OL = 1
endif
LV_INH_DIAG_IGC_SCG = LV_INH_DIAG_IGC_OL

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A.86 Immobilizer diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_IMOB_1	O/V	0... FFH	0... 255	1	-
Condition bit coded for each sym					
CDN_DIAG_IMOB_3	O/V	0... FFH	0... 255	1	-
Condition bit coded for each sym					
ERR_SYM_IMOB_0	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
For each symptom : status of failure (set to 1 when failure symptom detected)					
ERR_SYM_IMOB_1	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
For each symptom : status of failure (set to 1 when failure symptom detected)					
ERR_SYM_IMOB_2	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
For each symptom : status of failure (set to 1 when failure symptom detected)					
ERR_SYM_IMOB_3	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
For each symptom : status of failure (set to 1 when failure symptom detected)					
LV_CDN_DIAG_IMOB_0	O/V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled)					
LV_CDN_DIAG_IMOB_1	O/V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled)					
LV_CDN_DIAG_IMOB_2	O/V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled)					
LV_CDN_DIAG_IMOB_3	O/V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled)					
LV_END_DIAG_IMOB_0	O/V	0... 1H	0 ...1	1	-
Diagnostic performed at least one time					
LV_END_DIAG_IMOB_1	O/V	0... 1H	0 ...1	1	-
Diagnostic performed at least one time					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_IMOB_2	O/V	0... 1H	0 ...1	1	-
Diagnostic performed at least one time					
LV_END_DIAG_IMOB_3	O/V	0... 1H	0 ...1	1	-
Diagnostic performed at least one time					
LV_ERR_IMOB_0	O/V	0... 1H	0 ...1	1	-
Present failure in IMOB manipulation after filtering					
LV_ERR_IMOB_1	O/V	0... 1H	0 ...1	1	-
Present failure in IMOB CAS BUS after filtering					
LV_ERR_IMOB_2	O/V	0... 1H	0 ...1	1	-
Present failure in IMOB data storage after filtering					
LV_ERR_IMOB_3	O/V	0... 1H	0 ...1	1	-
Present failure in IMOB CAN BUS after filtering					

Input data:

LV_IGK {p. 906}	LV_VAR_BN {p. 655}	PWL_LOCK_CDN {p. 3776}	STATE_CAN_DNM_D
STATE_IMOB_0_ERR	STATE_IMOB_2_ERR		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_IMOB_0	-	0... FFH	0... 255	1	-
Antibounce counter decrement					
C_ABC_DEC_IMOB_1	-	0... FFH	0... 255	1	-
Antibounce counter decrement					
C_ABC_DEC_IMOB_3	-	0... FFH	0... 255	1	-
Antibounce counter decrement					
C_ABC_INC_IMOB_0	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_INC_IMOB_1	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_INC_IMOB_2	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_INC_IMOB_3	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_IMOB_0	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_ABC_MAX_IMOB_1	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_ABC_MAX_IMOB_2	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_ABC_MAX_IMOB_3	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					

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Action definition

ACTION_IMOB_DIAG_ERR_1 (CDN_IMOB,<SYM_IMOB>)	Mode: O

ACTION_IMOB_DIAG_ERR_3 (CDN_IMOB,<SYM_IMOB>)	Mode: O

Error treatment:

Diagnostic IMOB_0	Symptom description	Symptom	Filter type
manipulation	not used	*SYM_0*	STD_INI
	no secrete key	*SYM_1*	
	not used	*SYM_2*	
	response does not match	*SYM_3*	

Diagnostic IMOB_2	Symptom description	Symptom	Filter type
Data storage	No storage for secrete key avl.	*SYM_0*	STD_INI
	read/write FSC (nvm error)	*SYM_1*	
	Read error secrete key (2of3)	*SYM_2*	
	Spare for checksum error (later)	*SYM_3*	

Diagnostic IMOB_1	Symptom description	Symptom	Filter type
Kbus	Open line	*SYM_0*	STD
	Frame error (type_ews/st_ews)	*SYM_1*	
	Time out data	*SYM_2*	
	CRC error	*SYM_3*	

Diagnostic IMOB_3	Symptom description	Symptom	Filter type
CAN	Not used	*SYM_0*	STD
	Frame error (type_ews/st_ews)	*SYM_1*	
	Time out data	*SYM_2*	
	Not used	*SYM_3*	

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General information:

IMOB diagnosis is performed to provide error-symptom-information by setting of LV_ERR_IMOB_i and entry in error memory in case of ECU-blocking/error detection.

Defined in non-public specification:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LOCK_IMOB	V/O	0...1H	0...1	1	[-]
LV indicates locking of IGN and INJ by IMOB					
INH_IV_IMOB	V/O	0...FFH	0...255	1	[-]
Locking request for INJ by IMOB					

FUNCTION DESCRIPTION:

This diagnosis calculates the error LV_ERR_IMOB_0

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Imob: Manipulation

Application conditions

Initialisation:
```
LV_CDN_DIAG_IMOB_0  = STD_INI
LV_END_DIAG_IMOB_0  = STD_INI
LV_ERR_IMOB_0  = STD_INI
ERR_SYM_IMOB_0 = STD_INI
```

when LV_IGK changes from 01 or at reset:

Recurrence: 100ms

Activation/Deactivation:
IF LV_IGK = 1 then
THEN LV_CDN_DIAG_IMOB_0 = 1
ELSE LV_CDN_DIAG_IMOB_0 = 0
ENDIF

Formula section:

Symptoms calculation:

Error state of STATE_IMOB_0_ERR equal to ERR_SYM
Error set after debounce.
End of diag calculation see ERRM

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

FUNCTION DESCRIPTION:

This diagnosis calculates the error LV_ERR_IMOB_2
Imob: Data storage

Application conditions

Initialization:
```
LV_CDN_DIAG_IMOB_2 = STD_INI
LV_END_DIAG_IMOB_2  = STD_INI
LV_ERR_IMOB_2  = STD_INI
ERR_SYM_IMOB_2 = STD_INI
```

when LV_IGK changes from 01 or at reset:

Recurrence: 100ms

Activation/Deactivation:
IF LV_IGK = 1 then
THEN LV_CDN_DIAG_IMOB_2 = 1
ELSE LV_CDN_DIAG_IMOB_2 = 0
ENDIF

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Formula section:

Symptoms calculation:

Error state of STATE_IMOB_2_ERR equal to ERR_SYM
Error set after debounce.
End of diag calculation see ERRM

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

Exported Interface: ACTION_IMOB_DIAG_ERR_1(CDN_IMOB, SYM_IMOB)

FUNCTION DESCRIPTION:

This diagnosis calculates the error LV_ERR_IMOB_1
Imob: KBUS Diagnosis
Note: Diagnosis is **not** initialized at KL15 0->1 because diagnosis is already active at ecu_state = wakeup

Application conditions

Initialization:

all at 0 only at reset:
LV_CDN_DIAG_IMOB_1 = STD = 0
LV_END_DIAG_IMOB_1 = STD = 0
LV_ERR_IMOB_1 = STD = 0
ERR_SYM_IMOB_1 = STD = 0

Activation/Deactivation:
LV_VAR_BN = 0 **or** (STATE_CAN_DNM_D > 0 and PWL_LOCK_CDN[BN2000] = 1)

Recurrence: at call ACTION_IMOB_DIAG_ERR_1(CDN_IMOB, SYM_IMOB)

Symptoms calculation:
Error state of ERRM: ERR_SYM equal to SYM_IMOB
If SYM_IMOB = END_DIAG
Then LV_END_DIAG_IMOB_1 = 1 (set immediatly)
Else
If SYM_IMOB > 0
Then LV_CDN_DIAG_IMOB_1 = 1
ERR_SYM_IMOB_1= SYM_IMOB
LV_ERR_IMOB_1 = 1 (after debounce)
Else **If** (CDN_IMOB & ERR_SYM_IMOB_1) = true **or**
ERR_SYM_IMOB_1 = NO_SYM
Then LV_CDN_DIAG_IMOB_1 = 1
healing only of cdn fits to err_sym **once**
ERR_SYM_IMOB_1= NO_SYM
LV_ERR_IMOB_1 = 0 (after debounce)
Else LV_CDN_DIAG_IMOB_1 = 0 (freeze healing)
Endif
Endif

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Endif
Error state of ERRM: ERR_SYM = SYM_IMOB
CDN_DIAG_IMOB_1 = CDN_IMOB
Error set after debounce.

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

Exported Interface: ACTION_IMOB_DIAG_ERR_3(CDN_IMOB, SYM_IMOB)

FUNCTION DESCRIPTION:

This diagnosis calculates the error LV_ERR_IMOB_3
Imob: CAN Diagnosis
Note: Diagnosis is **not** initialized at KL15 0->1 because diagnosis is already active at ecu_state = wakeup

Application conditions

Initialisation:
all at 0 only at reset:
LV_CDN_DIAG_IMOB_3 = STD = 0
LV_END_DIAG_IMOB_3 = STD = 0
LV_ERR_IMOB_3 = STD = 0
ERR_SYM_IMOB_3 = STD = 0

Activation/Deactivation:
LV_VAR_BN = 0 **or** (STATE_CAN_DNM_D > 0 and PWL_LOCK_CDN[BN2000] = 1)

Recurrence: at call ACTION_IMOB_DIAG_ERR_3(CDN_IMOB, SYM_IMOB)

Formula section:

Symptoms calculation:
Error state of ERRM: ERR_SYM equal to SYM_IMOB
If SYM_IMOB = END_DIAG
Then LV_END_DIAG_IMOB_3 = 1 (set immediatly)
Else
    If SYM_IMOB > 0
    Then LV_CDN_DIAG_IMOB_3 = 1
        ERR_SYM_IMOB_3 = SYM_IMOB
        LV_ERR_IMOB_3 = 1 (after debounce)
    Else **If** (CDN_IMOB & ERR_SYM_IMOB_3) = true **or**
            ERR_SYM_IMOB_3 = NO_SYM
        Then LV_CDN_DIAG_IMOB_3 = 1
            healing only of cdn fits to err_sym **once**
            ERR_SYM_IMOB_3= NO_SYM
            LV_ERR_IMOB_3 = 0 (after debounce)
        Else LV_CDN_DIAG_IMOB_3 = 0 (freeze healing)
        Endif
    Endif
Endif

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Error state of ERRM: ERR_SYM = SYM_IMOB
CDN_DIAG_IMOB_3 = CDN_IMOB
Error set after debounce.
End of diag calculation:
Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

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A.87 Injector classification programming diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_PLAUS_IV_CAL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom PLAUS_IV_CAL					
LF_ERR_PLAUS_IV_EGY_CAL	O/V	0... FFFFH	0... 65535	1	-
cylinder individuell bit coded not plausible injector valve coding values "Energie" (1 - not plausible, 0 - plausible)					
LF_ERR_PLAUS_IV_MFF_CAL	O/V	0... FFFFH	0... 65535	1	-
cylinder individuell bit coded not plausible injector valve coding values "Kleinmenge" (1 - not plausible, 0 - plausible)					
LV_CDN_DIAG_PLAUS_IV_CAL	V	0... 1H	0 ...1	1	-
Diagnosis condition PLAUS_IV_CAL					
LV_END_DIAG_PLAUS_IV_CAL	V	0... 1H	0 ...1	1	-
End of Diagnosis PLAUS_IV_CAL					
LV_ERR_PLAUS_IV_CAL	O/V	0... 1H	0 ...1	1	-
Flag that indicates at least one injector coding is not plausible					

Input data:

EGY_SP_IV_EXT_ADJ [NC_CYL_NR] {p. 7679}	LV_IGK {p. 906}	LV_ST_END {p. 1720}	MFF_ABSV_IV_EXT_ADJ [NC_CYL_NR] {p. 7681}
N {p. 1525}	NC_CYL_NR {p. 1526}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_PLAUS_IV_CAL	-	0... FFH	0... 255	1	-
Debounce counter increment injection valve programming plausibility diagnosis (default: 1)					
C_ABC_MAX_PLAUS_IV_CAL	-	1... FFH	1... 255	1	-
Debounce counter maximum value injection valve programming plausibility diagnosis (default: 1)					
C_EGY_SP_IV_CAL_MAX	-	0... FFFFH	0... 255	3.8911e-3	mJ
maximal value for plausible injectoe programming value "Energie""					
C_EGY_SP_IV_CAL_MIN	-	0... FFFFH	0... 255	3.8911e-3	mJ
minimal value for plausible injector programming value "Energie"					
C_MFF_ABS_IV_CAL_MAX	-	0... FFFFH	0... 1389	0.0211948	mg/stk
maximal value for plausible injector programming value "Kleinmenge"					
C_MFF_ABS_IV_CAL_MIN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
minimal value for plausible injector programming value "Kleinmenge"					
C_N_MIN_PLAUS_IV_VAL	-	0... 1FE0H	0... 8160	1	rpm
minimum of engine speed for injec tion valve programming plausibility diagnosis					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)

Continued on next page

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ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

Error treatment:

Diagnostic **GS**	**Symptom description**	**Symptom**	**Filter type**
Injector programming plausibility diagnosis	-	*SYM_0*	STD_INI
	-	*SYM_1*	
	"Energie"-programming value for at least ore cylinder is not plausible	*SYM_2*	
	"Kleinmengen"-programming value for at least ore cylinder is not plausible	*SYM_3*	

A.87.1 Checking plausiblity of injector programming value "Kleinmenge"

FUNCTION DESCRIPTION:

General information:

Goal of this chapter is to check the plausiblity of injector programming value "Kleinmenge".

Application conditions

Initialisation at reset: *first calculation*

Recurrence: *1 s*

Activation: *at every engine operating state*

Deactivation: –

Formula section:

```
For i = 0 to (NC_CYL_NR -1)
do
        if MFF_ABSV_IV_EXT_ADJ[i] < C_MFF_ABS_IV_CAL_MIN
           or
           MFF_ABSV_IV_EXT_ADJ[i] > C_MFF_ABS_IV_CAL_MAX
        then
                set bit i of LF_ERR_PLAUS_IV_MFF_CAL to "1"
        else
                reset bit i of LF_ERR_PLAUS_IV_MFF_CAL to "0"
        endif
endfor
```

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A.87.2 Checking plausiblity of injector programming value "Energie"

FUNCTION DESCRIPTION:

General information:

Goal of this chapter is to check the plausiblity of injector programming value "Energie".

Application conditions

Initialisation at reset: *first calculation*

Recurrence: *1 s*

Activation: *at every engine operating state*

Deactivation: –

Formula section:

```
For i = 0 to (NC_CYL_NR -1)
do
        if  EGY_SP_IV_EXT_ADJ[i] < C_EGY_SP_IV_CAL_MIN
            or
            EGY_SP_IV_EXT_ADJ[i] > C_EGY_SP_IV_CAL_MAX
        then
                  set bit i of LF_ERR_PLAUS_IV_EGY_CAL to "1"
        else
                reset bit i of LF_ERR_PLAUS_IV_EGY_CAL to "0"
        endif
endfor
```

A.87.3 Error detection for injector programming plausibility

FUNCTION DESCRIPTION:

General information:

The flag LV_ERR_PLAUS_IV_CAL indicates an at least one not plausible injector programming values. That occurs if injector programming was not done by testerservice or at least one written value by testerservice is out of allowed range.

Description:

Error-symptoms are defined to this diagnosis function as following :

```
 _______________
|   |   |   |   |
 |  |  |  └─>-                              (= SYM_0)
 |  |  └───>-                               (= SYM_1)
 |  └─────> unplausible Energie             (= SYM_2)
 └───────> unplausible Kleinmenge           (= SYM_3)
```

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Application conditions:

Initialisation: all output data according ABC configuration "**STD_INI**"
// LV_IGK 0->1 ***or*** *reset* ***or*** *at clearing error memory*
This action initialized the diagnostic result according the filtering configuration :
ACTION_ERRM_GetLvErr(IN<NC_IDX_DIAG_GS>, OUT<LV_ERR_GS>)

```
Activation:      if      LV_IGK = 1 and LV_ST_END = 0
                 then    LV_CDN_DIAG_PLAUS_IV_CAL = 1
                 endif
Deactivation:    if      LV_IGK = 0   or   LV_ST_END = 1
                 then    LV_CDN_DIAG_PLAUS_IV_CAL = 0
                 endif
Recurrence:      10ms
```

Formula section:

```
if(1)          LF_ERR_PLAUS_IV_EGY_CAL =   0
       and     LF_ERR_PLAUS_IV_MFF_CAL   = 0
then(1)        ERR_SYM_PLAUS_IV_CAL =   NO_SYM
 else(1)
       if(2)     N   >=   C_N_MIN_PLAUS_IV_VAL
                 if(3)              LF_ERR_PLAUS_IV_EGY_CAL <> 0
                 then(3)            ERR_SYM_PLAUS_IV_CAL =   SYM_2
                 elseif(3)          LF_ERR_PLAUS_IV_MFF_CAL <> 0
                 then(3)            ERR_SYM_PLAUS_IV_CAL =   SYM_3
                 endif(3)
       endif(2)
endif(1)
```

For failure and error management treatment the anti-bounce mechanism is called with the parameters LV_CDN_DIAG_PLAUS_IV_CAL and ERR_SYM_PLAUS_IV_CAL.

```
ACTION_ERRM_FilterSymptom
      ( IN< GS >,
        IN< LV_CDN_DIAG_GS >,
      IN< ERR_SYM_GS >,
        IN< C_ABC_INC_GS >,
        IN< 1 >,
      IN< C_ABC_MAX_GS >,
        OUT< LV_ERR_GS >
   )
```

This algorithm determines LV_ERR_PLAUS_IV_CAL and LV_END_DIAG_PLAUS_IV_CAL and delivers the result to Error Management.

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A.88 Injection valve power stage diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INH_PBK_IV_DIAG_ERR	O/V	0... FFH	0... 255	1	-
Cylinder shut off request from injection valve power stage diagnosis (cylinder allocated)					
INJ_DR_PBK_IV_REF [NC_PBK_IV_NR]	O/V	0... FFH	0... 255	1	-
Assignment between logical cylinders and injection power banks (power bank individual)					
LV_ERR_PBK_IV_LST_CYC	O/V/S	0... 1H	0 ...1	1	-
Flag that indicates if a debounced injection valve power stage error is present at the end of the driving cycle					
LV_INH_DIAG_PBK_IV	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the injection valve power stage diagnosis					

Input data:

ERR_SYM_PBK_IV [NC_PBK_IV_NR] {p. 4797}	LV_ERR_TMP_MU_MC {p. 7072}	LV_IGK {p. 906}	LV_INJ_OFF_TMR_INJ_ ENA {p. 7158}
LV_MC_SOPC_INH_DI {p. 7186}	NC_CYL_NR {p. 1526}	NC_IDX_CYL_PBK_IV_ REF [NC_CYL_NR] {p. 626}	NC_PBK_IV_NR {p. 628}
NC_STATE_PBK_IV_ST_ TRIM_ERR {p. 4798}	STATE_ERR_PBK_IV {p. 4797}	STATE_ERR_SYM_PBK_ IV_ST [NC_PBK_IV_NR] {p. 4797}	STATE_PBK_IV_INI {p. 2040}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_DIAG_INH_PBK_IV_ERR_ENA	-	0... 1H	0 ...1	1	-
Flag to enable inhibition of cylinders due to injection power bank errors					
LC_DIAG_INH_PBK_IV_ERR_ST_ENA	-	0... 1H	0 ...1	1	-
Flag to enable inhibition of cylinders due to injection power bank start up errors					

FUNCTION DESCRIPTION:

General information:

The flag LV_INH_DIAG_PBK_IV deactivates (freezes) the power stage online diagnostic of all injection valve drivers.

If a de-bounced injector error is present at the end of the driving cycle (LV_ERR_PBK_IV = 1), the flag LV_ERR_PBK_IV_LST_CYC is set and is stored in the non-volatile memory.

The variable INJ_DR_PBK_IV_REF[NC_PBK_IV_NR] represents an inhibit pattern, which inhibits all cylinders assigned to the injection power bank revered to by the array index.

A.88.1 Calculation of INJ_DR_PBK_IV_REF[NC_PBK_IV_NR]

Application conditions

Activation: `every engine state`

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Deactivation: –

Initialisation: –

Recurrence: `only once at reset`

Formula section:

The variable INJ_DR_PBK_IV_REF[p] represents an inhibit pattern where all cylinders on bank m are inhibited (corresponding bits are set to 1) due to injection power bank errors.

Initial value:
FOR p = 0 **TO** NC_PBK_IV_NR - 1 **DO**
INJ_DR_PBK_IV_REF[p] = 0
ENDFOR

Calculation of INJ_DR_PBK_IV_REF[NC_PBK_IV_NR]:
FOR x = 0 **TO** NC_CYL_NR - 1 **DO**
Bit x of INJ_DR_PBK_IV_REF[NC_IDX_CYL_PBK_IV_REF[x]] = 1
ENDFOR

A.88.2 Calculation of LV_INH_DIAG_PBK_IV

Application conditions

Activation: *(LV_IGK = 1) AND (STATE_PBK_IV_INI = "INIT_FINISHED")*

Deactivation: –

Initialisation: `at reset, at transition of LV_IGK 0 -> 1 DO:`
`LV_INH_DIAG_PBK_IV = 1`
`INH_PBK_IV_DIAG_ERR = 0`

Recurrence: `segment synchronous`

Formula section:

(1a)IF LV_MC_SOPC_INH_DI = 1
OR LV_ERR_TMP_MU_MC = 1
OR LV_INJ_OFF_TMR_INJ_ENA = 0
(1a)THEN
LV_INH_DIAG_PBK_IV = 1
(1a)ELSE
LV_INH_DIAG_PBK_IV = 0
(1a)ENDIF

(1)IF STATE_ERR_PBK_IV $\neq$ 0
(1)THEN
(1)FOR p = 0 **TO** NC_PBK_IV_NR - 1 **DO**
(2)IF (Bit p of STATE_ERR_PBK_IV = 1)
AND (ERR_SYM_PBK_IV[p] **BitwiseAND** SYM_0 = SYM_0)
AND (STATE_ERR_SYM_PBK_IV_ST[p] $\neq$
NC_STATE_PBK_IV_ST_TRIM_ERR) // do not switch off injection
if only a trim pulse error occurred during power stage initialization.

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AND (LC_DIAG_INH_PBK_IV_ERR_ST_ENA = 1)
(2)THEN
INH_PBK_IV_DIAG_ERR = INH_PBK_IV_DIAG_ERR **BitwiseOR** INJ_DR_PBK_IV_REF[p]
(2)ENDIF
(3)IF (Bit p of STATE_ERR_PBK_IV = 1)
AND (ERR_SYM_PBK_IV[p] $\neq$ SYM_0)
AND (LC_DIAG_INH_PBK_IV_ERR_ENA = 1)
(3)THEN
INH_PBK_IV_DIAG_ERR = INH_PBK_IV_DIAG_ERR **BitwiseOR** INJ_DR_PBK_IV_REF[p]
(3)ENDIF
(1)ENDFOR
(1)ELSE
INH_PBK_IV_DIAG_ERR = 0
(1)ENDIF

A.88.3 Calculation of LV_ERR_PBK_IV_LST_CYC

Application conditions

Activation: *LV_IGK = 1 → 0*
Deactivation: –
Initialisation: –
Recurrence: only once at LV_IGK = 1 → 0

Formula section:

(1) IF
STATE_ERR_PBK_IV $\neq$ 0
(1) THEN
LV_ERR_PBK_IV_LST_CYC = 1
(1) ELSE
LV_ERR_PBK_IV_LST_CYC = 0
(1) ENDIF

Note: In case of “checksum error” after power latch or reset the flag LV_ERR_PBK_IV_LST_CYC has to be set to zero.

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A.89 Injection valve power stage diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_PBK_IV [NC_PBK_IV_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Diagnosis condition for each error symptom of injection valve power stage bank					
ERR_DIAG_PBK_IV [NC_PBK_IV_NR]	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for injection valve power stage bank					
ERR_SYM_PBK_IV [NC_PBK_IV_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for injection valve power stage bank filtered with CDN_DIAG_PBK_IV					
LV_CDN_DIAG_PBK_IV [NC_PBK_IV_NR]	V	0... 1H	0 ...1	1	-
Diagnosis condition for injection valve power stage bank					
LV_END_DIAG_PBK_IV [NC_PBK_IV_NR]	V	0... 1H	0 ...1	1	-
End of diagnosis for injection valve power stage bank					
LV_ERR_PBK_IV [NC_PBK_IV_NR]	V	0... 1H	0 ...1	1	-
Error flag for injection valve power stage bank errors derived from STATE_ERR_PBK_IV (only for display)					
STATE_DIAG_PBK_IV	O/V	0... FFH	0... 255	1	-
Error pattern without debouncing for all injection valve power stages					
STATE_ERR_PBK_IV	O/V	0... FFH	0... 255	1	-
Error pattern after debouncing for all injection valve power stages					
STATE_ERR_SYM_PBK_IV [NC_PBK_IV_NR]	O/V	0... FFH	0... 255	1	-
Detailed error symptom information of injection valve power stages, ATIC bank individual					
STATE_ERR_SYM_PBK_IV_ST [NC_PBK_IV_NR]	O/V	0... FFH	0... 255	1	-
Detailed error symptom information of injection valve power stages during startup phase, ATIC bank individual					

Input data:

CDN_DIAG_PBK_IV_RAW [NC_PBK_IV_NR] {p. 2035}	LV_ES {p. 1720}	LV_IGK {p. 906}	LV_INH_DIAG_PBK_IV {p. 4794}
NC_PBK_IV_NR {p. 628}	SEG_NR {p. 1525}	STATE_ERR_PBK_IV_ RAW [NC_PBK_IV_NR] {p. 2039}	STATE_ERR_PBK_IV_ST_ RAW [NC_PBK_IV_NR] {p. 2040}
STATE_PBK_IV_INI {p. 2040}			

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_PBK_IV	-	0... FFH	0... 255	1	-
Anti-bounce increment value for injection valve power stage diagnosis					
C_ABC_MAX_PBK_IV	-	1... FFH	1... 255	1	-
Anti-bounce maximum value for injection valve power stage diagnosis					
C_STATE_ERR_SYM_PBK_IV_INH	-	0... FFH	0... 255	1	-
Manual inhibition pattern for injection valve power stage online diagnosis symptom (bit x = 1, diagnosis symptom will be inhibited)					
C_STATE_ERR_SYM_PBK_IV_ST_INH	-	0... FFH	0... 255	1	-
Manual inhibition pattern for injection valve power stage startup diagnosis symptom (bit x = 1, diagnosis symptom will be inhibited)					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_STATE_PBK_IV_ST_TRIM_ERR	-	0... FFH	0... 255	1	-
Start up error byte when only a trim pulse error occurred during injection power stage start up.					

Import actions:

ACTION_ERRM_FilterMulticondition (**IN**<XX>,**IN**<CDN_DIAG_>,**XX**>,<IN<>,**ERR_DIAG_XX**>,<IN>,<C_ABC_INC_XX>,**IN**<C_ABC_MAX_XX>,**OUT**<LV_ERR_XX>)

Error treatment:

Diagnosis	Symptom	Nr	ABC type
Injection valves power stage diagnosis	*Power stage startup error*	*0*	MPL_STD_INI
	Power stage online error	*1*	
	Power stage internal clock error	*2*	
PBK_IV[p]			

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Overview

The purpose of the injection valve power stage diagnosis is to detect electrical faults of used ATIC drivers. STATE_ERR_PBK_IV is the general error state after de-bouncing for limp-home reactions.

All symptoms of the current error code are handled by anti-bouncing.
We assume that only one symptom of an error code can be active at the same time.

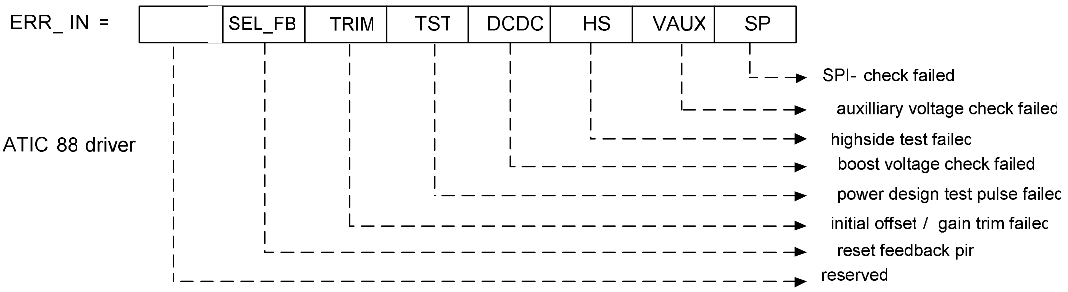
The error detection is effected via the ECU hardware.

Please Note:

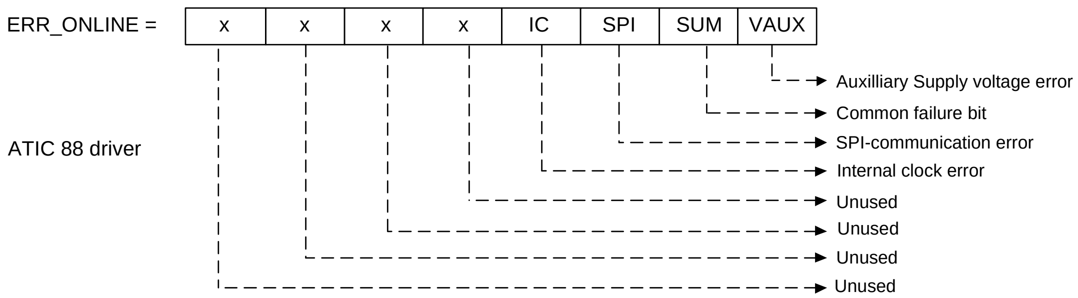
A valid diagnosis of all failures can only be detected when the injector was operated at least one time since the last changes and the filter times are observed.

FUNCTION DESCRIPTION:

Structure of the initialization error byte (STATE_ERR_SYM_PBK_IV_ST):



Structure of the online error byte (STATE_ERR_SYM_PBK_IV):



Application conditions

Activation : (LV_IGK = 1) **AND** (STATE_PBK_IV_INI = "INIT_FINISHED")

Deactivation:

```
at transition of LV_IGK 1 -> 0 DO:
LV_CDN_DIAG_PBK_IV[NC_PBK_IV_NR] = 0
CDN_DIAG_PBK_IV[NC_PBK_IV_NR] = NO_SYM
```

Initialization:

```
at reset , at transition of LV_IGK 0 -> 1 and at global clearing
of failure memory DO:
STATE_DIAG_PBK_IV = 0
STATE_ERR_PBK_IV = 0
STATE_ERR_SYM_PBK_IV[NC_PBK_IV_NR] = 0
STATE_ERR_SYM_PBK_IV_ST[NC_PBK_IV_NR] = 0
all other output data according filter type by ERRM
```

Recurrence:

```
LV_ES = 0:  segment synchronous
       LV_ES = 1:        10 ms
```

Formula section:

A.89.1 Common injection valve power stage diagnosis operations

(1) FOR p = 0 **TO** (NC_PBK_IV_NR -1) **DO:**

Error Condition calculation:

(1) IF (LV_INH_DIAG_PBK_IV = 0)

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AND
(LV_ES = 0)
AND
(SEG_NR = 0)
(1) THEN
CDN_DIAG_PBK_IV[p] = NO_SYM
(2) IF (CDN_DIAG_PBK_IV_RAW[p] **AND** 0x08) = 0x08 ...bitwise
(2) THEN
CDN_DIAG_PBK_IV[p] = SYM_2
(2) ENDIF
(3) IF (CDN_DIAG_PBK_IV_RAW[p] **AND** 0x05) ≠ 0 ...bitwise
(3) THEN
CDN_DIAG_PBK_IV[p] = CDN_DIAG_PBK_IV[p] **OR** SYM_1 ...bitwise
(3) ENDIF
STATE_ERR_SYM_PBK_IV[p] = STATE_ERR_PBK_IV_RAW[p]
AND CDN_DIAG_PBK_IV_RAW[p] ...bitwise
AND NOT(C_STATE_ERR_SYM_PBK_IV_INH) ...bitwise
(1) ELSE
CDN_DIAG_PBK_IV[p] = NO_SYM
(1) ENDIF
CDN_DIAG_PBK_IV[p] = CDN_DIAG_PBK_IV[p] **OR** SYM_0 ...bitwise
STATE_ERR_SYM_PBK_IV_ST[p] = STATE_ERR_PBK_IV_ST_RAW[p]
AND NOT(C_STATE_ERR_SYM_PBK_IV_ST_INH) ...bitwise

Error Symptom calculation:

ERR_DIAG_PBK_IV[p] = NO_SYM
(4) IF STATE_ERR_SYM_PBK_IV_ST[p] ≠ 0
(4) THEN
ERR_DIAG_PBK_IV[x] = SYM_0
’Power stage startup error’ detected
(4) ENDIF
(5) IF (STATE_ERR_SYM_PBK_IV[p] **AND** 0x08) = 0x08 ...bitwise
(5) THEN
ERR_DIAG_PBK_IV[x] = ERR_DIAG_PBK_IV[x] **OR** SYM_2 ...bitwise
’Power stage internal clock error’ detected
(5) ENDIF
(6) IF (STATE_ERR_SYM_PBK_IV[p] **AND** 0x05) ≠ 0 ...bitwise
(6) THEN
ERR_DIAG_PBK_IV[x] = ERR_DIAG_PBK_IV[x] **OR** SYM_1 ...bitwise
’Power stage online error’ detected
(6) ENDIF

Error Symptom debouncing:

ACTION_ERRM_FilterMulticondition (PBK_IV[p], CDN_DIAG_PBK_IV[p], ERR_DIAG_PBK_IV[p], LV_END_DIAG_PBK_IV[p], LV_ERR_PBK_IV[p], LV_CDN_DIAG_PBK_IV[p], ERR_SYM_PBK_IV[p])
Note: For failure debouncing and error management treatment the multicondition debounce algorithm (part of Error Management AGGR) is used with the parameters CDN_DIAG_PBK_IV[p] and ERR_DIAG_PBK_IV[p].
This algorithm determines:
ERR_SYM_PBK_IV[p] (= raw value ERR_DIAG_PBK_IV[p] filtered with CDN_DIAG_PBK_IV[x])
and

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LV_ERR_PBK_IV[p] *(Error flag for debounced error of injection valve power stage [p])*
and
LV_CDN_DIAG_PBK_IV[p]
and
LV_END_DIAG_PBK_IV[p]

Calculation of STATE_DIAG_PBK_IV:
(7) IF ERR_SYM_PBK_IV[p] <> 0
(7) THEN Bit p of STATE_DIAG_PBK_IV = 1
(7) ELSE Bit p of STATE_DIAG_PBK_IV = 0
(7) ENDIF

Calculation of STATE_ERR_PBK_IV:
Bit p of STATE_ERR_PBK_IV = LV_ERR_PBK_IV[p]

(1) ENDFOR

A.89.2 Definition of NCs

For ATIC88 projects, following definition is valid:
NC_STATE_PBK_IV_ST_TRIM_ERR = 0x20 (hex value)
Note: This bit mask refers to the "TRIM" error bit within the "ERR_INI" error byte!

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A.90 Injection valve diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_IV [NC_CYL_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Diagnosis condition for each symptom of injector [x]					
ERR_DIAG_IV [NC_CYL_NR]	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for injector [x]					
ERR_SYM_IV [NC_CYL_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for injector [x] filtered with CDN_DIAG_IV [NC_CYL_NR]					
ERR_SYM_IV_SC [NC_CYL_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Short circuit detailed error symptom for injector [x]					
ERR_SYM_IV_SC_TMP [NC_CYL_NR]	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Short circuit detailed error symptom for temporary calculations					
LV_CDN_DIAG_IV [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Diagnosis condition for injector [x]					
LV_CDN_DIAG_IV_SC [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Short circuit detailed error diagnosis condition for injector [x]					
LV_END_DIAG_IV [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
End of diagnosis for injector [x]					
LV_END_DIAG_IV_SC [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
End of short circuit detailed error diagnosis for injector [x]					
LV_ERR_IV [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Error flag for IVx derived from STATE_ERR_IV (only for display)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_IV_SC [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Error flag for indication of a detailed short circuit error information (only for display)					
NR_CYL_DIAG_IV	V	0... 7H	0 ...7	1	-
Number of the logical cylinder, which has done its injection valve diagnosis cycle					
NR_CYL_INJ_BAS_DIAG_IV_TMP	-	0... 7H	0 ...7	1	-
Temporary number of the current cylinder, which has reached its CRK_INJ_BAS[x]-Event					
NR_CYL_INJ_BAS_PREV_DIAG_IV_TMP	-	0... 7H	0 ...7	1	-
Temporary number of the previous cylinder, which had reached its CRK_INJ_BAS[x]-Event					
STATE_DIAG_IV	O/V	0... FFH	0... 255	1	-
Error pattern without debouncing for all injectors					
STATE_ERR_IV	O/V	0... FFH	0... 255	1	-
Error pattern after debouncing for all injectors					
STATE_ERR_IV_CYL [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Detailed error information of injection valve, cylinder individual					
STATE_ERR_IV_CYL_TMP [NC_CYL_NR]	-	0... FFH	0... 255	1	-
Temporary detailed error information of injection valve, cylinder individual					

Input data:

CDN_DIAG_IV_RAW [NC_CYL_NR] {p. 2035}	CTR_ABC_IV [NC_CYL_NR]	LV_CDN_VB_OBD1 {p. 1185}	LV_ES {p. 1720}
LV_IGK {p. 906}	LV_INH_DIAG_IV {p. 4810}	N_32 {p. 1525}	NC_CYL_NR {p. 1526}
NR_CYL_INJ_BAS {p. 2039}	NR_CYL_INJ_BAS_PREV {p. 2039}	STATE_ERR_IV_CYL_RAW [NC_CYL_NR] {p. 2039}	TI_1_MES [NC_CYL_NR] {p. 2040}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_IV	-	0... FFH	0... 255	1	-
Anti-bounce increment value					
C_ABC_MAX_IV	-	1... FFH	1... 255	1	-
Anti-bounce maximum value					
C_INH_DIAG_IV_SWI_MAN	-	0... FFH	0... 255	1	-
Manual switch pattern for cylinder individual inhibition of injection valve diagnosis (bit x = 1, diagnosis of cylinder x will be inhibited)					
C_N_CDN_DIAG_IV_FL_THD	-	0... FFH	0... 8160	32	rpm
Threshold disable diagnosis at full load					
C_TI_THD_INH_DIAG_IV	-	0... FFFFH	0... 65.535	0.001	ms
Injection time threshold below the IV diagnosis will be inhibited					
LC_DIAG_INH_IV_SC	-	0... 1H	0 ...1	1	-
Switch to disable the detailed injection valve short circuit diagnosis.					

Import actions:

ACTION_ERRM_FilterMulticondition	(**IN**<XX>,**IN**<CDN_DIAG_>,**XX**>,<IN<>,**ERR_DIAG_XX**>,<IN>,<C_ABC_INC_XX>,**IN**<C_ABC_MAX_XX>,**OUT**<LV_ERR_XX>)
ACTION_ERRM_NoFilterSymptom	(**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_LV_ERR_SET>,**IN**<PRM_LV_ERR_RST>,**IN**<PRM_LV_END_DIAG>,**OUT**<PRM_LV_ERR>)

Error treatment:

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Diagnosis	Symptom	Nr	ABC type
Injection valve diagnosis	*Open circuit (OC)*	*0*	MPL_STD_INI
	Short circuit (SC)	*1*	
	High side to low side short circuit (HL)	*2*	
	Open circuit at charged injector (OCC)	*3*	
IV[x]			

Figure A.90.1: Diagnosis

Diagnosis	Symptom	Nr	ABC type
Injection valve diagnosis short circuit detailed	*High side to ground short circuit (HG)*	*0*	NO_FIL
	Low side to battery short circuit (LB)	*1*	
	High side to battery short circuit (HB)	*2*	
	Low side to ground short circuit (LG)	*3*	
IV_SC[x]			

Overview

The purpose of the diagnosis is to detect electrical faults.
STATE_ERR_IV is the general error state after de-bouncing for limp-home reactions.

All symptoms of the current error code are handled by anti-bouncing.
We assume that only one symptom of an error code can be active at the same time.

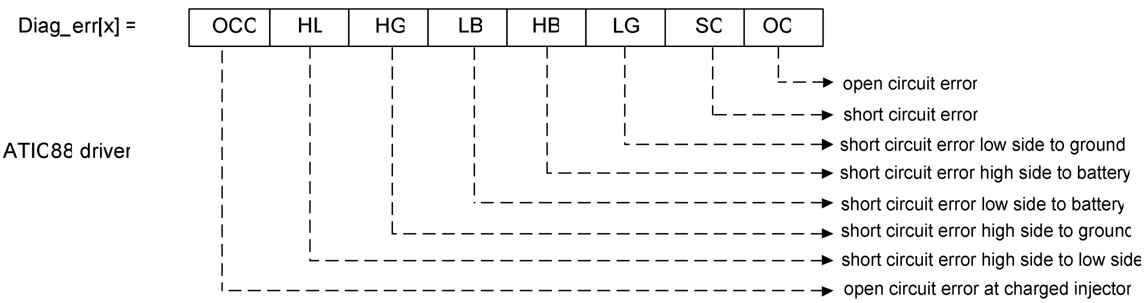
The error detection is effected via the ECU hardware.

Please Note:

A valid diagnosis of all failures can only be detected when the injector was operated at least one time since the last changes and the filter times are observed.

FUNCTION DESCRIPTION:

Structure of the injection valve error byte (STATE_ERR_IV_CYL):



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Application conditions

Activation : `LV_IGK = 1`

Deactivation:

```
at transition of LV_IGK 1 -> 0 DO:
LV_CDN_DIAG_IV[NC_CYL_NR] = 0
LV_CDN_DIAG_IV_SC[NC_CYL_NR] = 0
CDN_DIAG_IV[x] = 0
```

Initialization:

```
at reset , at transition of LV_IGK 0 -> 1 and at global clearing
of failure memory DO:
STATE_DIAG_IV = 0
STATE_ERR_IV = 0
STATE_ERR_IV_CYL[NC_CYL_NR] = 0
LV_ERR_IV_SC[NC_CYL_NR] = 0
ERR_SYM_IV_SC[NC_CYL_NR] = NO_SYM
LV_CDN_DIAG_IV_SC[NC_CYL_NR] = 0
LV_END_DIAG_IV_SC[NC_CYL_NR] = 0
all other output data according filter type by ERRM
```

Recurrence:

```
segment synchronous
```

Formula section:

A.90.1 Electrical Injection Valve Diagnosis - selection of the current cylinder number

Determine the previous cylinder:
NR_CYL_INJ_BAS_PREV_DIAG_IV_TMP = NR_CYL_INJ_BAS_PREV
Determine the current cylinder:
NR_CYL_INJ_BAS_DIAG_IV_TMP = NR_CYL_INJ_BAS
Check cylinder numbers under consideration of re-entrance capability:
(1) IF NR_CYL_INJ_BAS_ PREV_DIAG_IV_TMP ≠ NR_CYL_INJ_BAS_PREV
(1) THEN
NR_CYL_INJ_BAS_PREV_DIAG_IV_TMP = NR_CYL_INJ_BAS_PREV
NR_CYL_INJ_BAS_DIAG_IV_TMP = NR_CYL_INJ_BAS
(1) ENDIF

A.90.2 Electrical Injection Valve Diagnosis - diagnosis routine call

(1) IF NR_CYL_DIAG_IV = NR_CYL_INJ_BAS_DIAG_IV_TMP
(1) THEN
Nothing to do! The last diagnosis cycle is equal to the current.
(1) ELSE
Diagnosis Cycle has to be done:
(1) IF NR_CYL_DIAG_IV ≠ NR_CYL_INJ_BAS_PREV_DIAG_IV_TMP
(1) THEN
Diagnosis Cycle has to be done for the previous cylinder, because its missing:
EXECUTE "1.3 Common Diagnosis Operations" for cylinder x = NR_CYL_INJ_BAS_PREV_DIAG_IV_TMP
(1) ENDIF
Diagnosis Cycle has to be done for the current cylinder:
EXECUTE "1.3 Common Diagnosis Operations" for cylinder x = NR_CYL_INJ_BAS_DIAG_IV_TMP

Update cylinder number of the done diagnosis cycle:
NR_CYL_DIAG_IV = NR_CYL_INJ_BAS_DIAG_IV_TMP
(1) ENDIF

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A.90.3 Common Diagnosis Operations

This section works like a subroutine call in C-code programs
Note! x represents the current assigned active cylinder number from calling section.

(1) IF (LV_INH_DIAG_IV = 0)
AND
(LV_CDN_VB_OBD1 = 1)
AND
(LV_ES = 0)
AND
(TI_1_MES[x] >= C_TI_THD_INH_DIAG_IV)
AND
(N_32 < C_N_CDN_DIAG_IV_FL_THD)
AND
(Bit x of C_INH_DIAG_IV_SWI_MAN = 0)

(1) THEN
Valid diagnosis conditions:
CDN_DIAG_IV[x] = CDN_DIAG_IV_RAW[x]
STATE_ERR_IV_CYL_TMP[x] = STATE_ERR_IV_CYL_RAW[x] **AND** CDN_DIAG_IV[x] ... bitwise
STATE_ERR_IV_CYL[x] = (STATE_ERR_IV_CYL[x]
OR STATE_ERR_IV_CYL_TMP[x]) ... bitwise
AND 0xFF ... bitwise
CDN_DIAG_IV[x] = (CDN_DIAG_IV[x] **AND** 0x03) ... bitwise
(5) IF (CDN_DIAG_IV[x] = SYM_1) (SC-Error detectable)
OR
(CDN_DIAG_IV[x] = (SYM_1 **OR** SYM_0)) ... bitwise
(5) THEN
CDN_DIAG_IV[x] = CDN_DIAG_IV[x] **OR** SYM_2 ... bitwise
(5) ENDIF
(6) IF (CDN_DIAG_IV[x] = SYM_0) (OC-Error detectable)
OR
(CDN_DIAG_IV[x] = (SYM_1 **OR** SYM_0)) ... bitwise
(6) THEN
CDN_DIAG_IV[x] = CDN_DIAG_IV[x] **OR** SYM_3 ... bitwise
(6) ENDIF
(1) ELSE
CDN_DIAG_IV[x] = 0
STATE_ERR_IV_CYL_TMP[x] = 0
(1) ENDIF

Error Symptom calculation (raw value from I/O SW)

ERR_DIAG_IV[x] = 0
(7) IF (STATE_ERR_IV_CYL_TMP[x] **AND** 0xFF) $\neq$ 0
(7) THEN
(8) IF (STATE_ERR_IV_CYL[x] **AND** 0x7E) $\neq$ 0
(8) THEN
(9) IF (STATE_ERR_IV_CYL[x] **AND** 0x40) $\neq$ 0
(9) THEN
ERR_DIAG_IV[x] = SYM_2 HL-Error detected

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(9) ELSE
ERR_DIAG_IV[x] = SYM_1 SC-Error detected
(9) ENDIF
(8) ELSE
(10) IF (STATE_ERR_IV_CYL[x] **AND** 0x80) $\neq$ 0
(10) THEN
ERR_DIAG_IV[x] = SYM_3 OCC-Error detected
(10) ELSE
ERR_DIAG_IV[x] = SYM_0 OC-Error detected
(10) ENDIF
(8) ENDIF
(7) ENDIF
ACTION_ERRM_FilterMulticondition (IV[x], CDN_DIAG_IV[x], ERR_DIAG_IV[x], LV_END_DIAG_IV[x], LV_ERR_IV[x], LV_CDN_DIAG_IV[x], ERR_SYM_IV[x])

Note: For failure debouncing and error management treatment the multicondition debounce algorithm (part of Error Management AGGR) is used with the parameters CDN_DIAG_IV[x] and ERR_DIAG_IV[x].
This algorithm determines:
ERR_SYM_IV [x] (= raw value ERR_DIAG_IV [x] filtered with CDN_DIAG_IV [x])
and
LV_ERR_IV [x] (Error flag for debounced error of Injector [x])
and
LV_CDN_DIAG_IV [x]
and
LV_END_DIAG_IV [x]

Calculation of STATE_DIAG_IV:
(11) IF ERR_SYM_IV [x] <> 0
(11) THEN Bit x of STATE_DIAG_IV = 1
(11) ELSE Bit x of STATE_DIAG_IV = 0
(11) ENDIF

Calculation of STATE_ERR_IV:
Bit x of STATE_ERR_IV = LV_ERR_IV [x]

Calculation of detailed SC error information:
(12) IF LV_ERR_IV[x] 0 $\rightarrow$ 1 **AND** LC_DIAG_INH_IV_SC = 0
(12) THEN
(13) IF Bit HG of STATE_ERR_IV_CYL[x] is set
(13) THEN
ERR_SYM_IV_SC_TMP = SYM_0 (HG-Error detected)
(13) ELSE
(14) IF Bit LB of STATE_ERR_IV_CYL[x] is set
(14) THEN
ERR_SYM_IV_SC_TMP = SYM_1 (LB-Error detected)
(14) ELSE
(15) IF Bit HB of STATE_ERR_IV_CYL[x] is set
(15) THEN
ERR_SYM_IV_SC_TMP = SYM_2 (HB-Error detected)
(15) ELSE
(16) IF Bit LG of STATE_ERR_IV_CYL[x] is set

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```
                (16) THEN
                    ERR_SYM_IV_SC_TMP = SYM_3 (LG-Error detected)
                (16) ELSE
                    ERR_SYM_IV_SC_TMP = NO_SYM (Not a detailed SC-Error was detected
                                                or HL-Error was detected)
                (16) ENDIF
            (15) ENDIF
        (14) ENDIF
    (13) ENDIF
    ERR_SYM_IV_SC[x] = ERR_SYM_IV_SC_TMP
    (17) IF ERR_SYM_IV_SC_TMP = NO_SYM
    (17) THEN
        ACTION_ERRM_NoFilterSymptom( IN< IV_SC >,
        IN< LV_CDN_DIAG_IV[x] >, IN <ERR_SYM_IV_SC[x] >,
        IN< lv_err_set_IV_SC = 0>, IN< lv_err_reset_IV_SC = 1>,
        IN< LV_END_DIAG_IV[x] >, OUT< LV_ERR_IV_SC> )
    (17) ELSE
        ACTION_ERRM_NoFilterSymptom( IN< IV_SC >,
        IN< LV_CDN_DIAG_IV[x] >, IN <ERR_SYM_IV_SC[x] >,
        IN< lv_err_set_IV_SC = 1>, IN< lv_err_reset_IV_SC = 0>,
        IN< LV_END_DIAG_IV[x] >, OUT< LV_ERR_IV_SC> )
    (17) ENDIF
(12) ENDIF

(18) IF LV_ERR_IV[x] 1 → 0
(18) THEN
    ERR_SYM_IV_SC[x] = NO_SYM
    ACTION_ERRM_NoFilterSymptom( IN< IV_SC >,
    IN< LV_CDN_DIAG_IV[x] >, IN <ERR_SYM_IV_SC[x] >,
    IN< lv_err_set_IV_SC = 0>, IN< lv_err_reset_IV_SC = 1>,
    IN< LV_END_DIAG_IV[x] >, OUT< LV_ERR_IV_SC> )
(18) ENDIF


(19) IF LV_ERR_IV[x] stays unchanged
(19) THEN
    ACTION_ERRM_NoFilterSymptom( IN< IV_SC >,
    IN< LV_CDN_DIAG_IV[x] >, IN <ERR_SYM_IV_SC[x] >,
    IN< lv_err_set_IV_SC = 0>, IN< lv_err_reset_IV_SC = 0>,
    IN< LV_END_DIAG_IV[x] >, OUT< LV_ERR_IV_SC> )
(19) ENDIF


(18) IF CTR_ABC_IV[x] = 0
(18) THEN
    STATE_ERR_IV_CYL[x] = 0
(18) ENDIF
```

Note: CTR_ABC_IV is realized with an ERRM action!

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Please Note! Synchronization of LV_CDN_DIAG_IV_SC[x] with LV_CDN_DIAG_IV[x] and LV_END_DIAG_IV_SC[x] with LV_END_DIAG_IV[x] by parameter passing to ACTION_ERRM_NoFilterSymptom.

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A.91 Injection valve diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INH_IV_DIAG_ERR	O/V	0... FFH	0... 255	1	-
Cylinder shut off request from injection valve diagnosis (cylinder allocated)					
INJ_DR_CYL_REF [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Assignment between logical cylinders and injector drivers					
LV_ERR_IV_LST_CYC	O/V/S	0... 1H	0 ...1	1	-
Flag that indicates if a debounced injector error is present at the end of the driving cycle					
LV_INH_DIAG_IV	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the IV diagnostic					

Input data:

ERR_SYM_IV [NC_CYL_NR] {p. 4802}	LV_ERR_MU_MC {p. 7072}	LV_ERR_SPI_MPS {p. 4245}	LV_ERR_TMP_MU_MC {p. 7072}
LV_IGK {p. 906}	LV_INJ_OFF_TMR_INJ_ENA {p. 7158}	LV_MC_SOPC_INH_DI {p. 7186}	NC_CYL_NR {p. 1526}
NC_IDX_CYL_PBK_IV_REF [NC_CYL_NR] {p. 626}	STATE_ERR_IV {p. 4803}	TCO {p. 1100}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_THD_INH_DIAG_IV	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold below which the injector diagnosis is inhibited					
LC_INH_IV_DIAG_ERR_ENA	-	0... 1H	0 ...1	1	-
Manual switch for activation of INH_IV_DIAG_ERR					

FUNCTION DESCRIPTION:

General information:

The flag LV_INH_DIAG_IV deactivates (freezes) the power stage diagnostic of all injection valves.

The injector diagnosis has to be deactivated in case of:

- TCO is below the threshold C_TCO_THD_INH_DIAG_IV

If a de-bounced injector error is present at the end of the driving cycle (LV_ERR_IV = 1), the flag LV_ERR_IV_LST_CYC is set and is stored in the permanent RAM.

A.91.1 Calculation of INJ_DR_CYL_REF[NC_CYL_NR]

Application conditions

Activation: *every engine state*

Deactivation: –

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Initialisation: –

Recurrence: only once at reset

Formula section:

The variable INJ_DR_CYL_REF[x] represents an inhibit pattern where all cylinders on the same bank as cylinder x are inhibited (corresponding bits are set to 1) due to injection valve errors.

Calculation of INJ_DR_CYL_REF[NC_CYL_NR]:
Note: m reveres to the injection power stage bank within this loop

```
FOR x = 0 TO NC_CYL_NR - 1 DO
   INJ_DR_CYL_REF[x] = 0
   m = NC_IDX_CYL_PBK_IV_REF[x]
   FOR y = 0 TO NC_CYL_NR - 1 DO
            IF NC_IDX_CYL_PBK_IV_REF[y] = m   // cylinder y is on bank m
            THEN
                     Bit y of INJ_DR_CYL_REF[x] = 1
            ENDIF
   ENDFOR
ENDFOR
```

A.91.2 Calculation of LV_INH_DIAG_IV

Application conditions

Activation: *every engine state*

Deactivation: –

Initialisation: at reset: LV_INH_DIAG_IV = 1

Recurrence: segment synchronous and 'at first valid tooth'

Formula section:

```
(1)IF TCO < C_TCO_THD_INH_DIAG_IV
   OR LV_MC_SOPC_INH_DI = 1
      OR LV_ERR_TMP_MU_MC = 1
         OR LV_ERR_MU_MC = 1
         OR LV_ERR_SPI_MPS = 1
      OR LV_INJ_OFF_TMR_INJ_ENA = 0
(1)THEN
   LV_INH_DIAG_IV = 1
(1)ELSE
   LV_INH_DIAG_IV = 0
(1)ENDIF
```

A.91.3 Calculation of LV_ERR_IV_LST_CYC

Application conditions

Activation: *LV_IGK = 1 → 0*

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Deactivation: –

Initialisation: –

Recurrence: only once at LV_IGK = 1 → 0

Formula section:

(1) IF
STATE_ERR_IV ≠ 0
(1) THEN
LV_ERR_IV_LST_CYC = 1
(1) ELSE
LV_ERR_IV_LST_CYC = 0
(1) ENDIF

Note: In case of "checksum error" after power latch or reset the flag LV_ERR_IV_LST_CYC has to be set to zero.

A.91.4 Shut off request from injection valve diagnosis

General information:

In this chapter the diagnosis information for ATIC 63 PIEZO driver will be analysed. In the case of a short circuit error (SC) except the case of a high side to low side short circuit error (HL) all the injectors, which are connected to the same injection driver have to be switched off to prevent wrong fuel mass on not affected injection valves. In the case of an OC or HL error only the injector with a diagnosed error has to be switched off.

Application conditions

Activation: *LV_IGK = 1*

Deactivation: –

Initialisation: at reset, at transition of LV_IGK 0 -> 1 and at global clearing of failure memory DO:
INH_IV_DIAG_ERR = 0

Recurrence: segment synchronous
Note: The chapter 1.4 Shut off request from injection valve diagnosis has to be calculated after the module "Injection valve diagnosis".

Formula section:

(1) IF (STATE_ERR_IV ≠ 0) **AND** (LC_INH_IV_DIAG_ERR_ENA = 1)
(1) THEN
INH_IV_DIAG_ERR = STATE_ERR_IV
(Switch off all injectors with an error symptom)
(1) FOR x = 0 **TO** (NC_CYL_NR -1) **DO:**
(2) IF (Bit x of STATE_ERR_IV = 1) **AND** (ERR_SYM_IV[x] = 'SC-Error')
(Check if a short circuit error (without HL-error) was detected)
(2) THEN
(Switch off all the injectors which are connected to the same driver additionally)

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INH_IV_DIAG_ERR = INH_IV_DIAG_ERR **OR** INJ_DR_CYL_REF[x] ...bit-wise

(2) END IF

(1) END FOR

(1) ELSE

INH_IV_DIAG_ERR = 0

(1) ENDIF

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A.92 Air mass flow sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_TCC_T_PER_MAF_FRQ_EL [NC_MAF_NR]	O/V	0... FFH	0... 255	1	-
TCC counter for diagnositic instance MAF_FRQ_EL[NC_MAF_NR]					
ERR_SYM_MAF	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom MAF					
ERR_SYM_MAF_FRQ_EL [NC_MAF_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
error symptoms of diagnostic instance MAF_FRQ_EL[NC_MAF_NR]					
ERR_SYM_MAF_FRQ_GRD [NC_MAF_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
error symptoms of diagnostic instance MAF_FRQ_GRD[NC_MAF_NR]					
ERR_SYM_MAF_FRQ_RNG [NC_MAF_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
error symptoms of diagnostic instance MAF_FRQ_RNG[NC_MAF_NR]					
LV_CDN_DIAG_MAF	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MAF diagnosis					
LV_CDN_DIAG_MAF_FRQ_EL [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
Condition flag for diagnostic instance MAF_FRQ_EL[NC_MAF_NR]					
LV_CDN_DIAG_MAF_FRQ_GRD [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
Condition flag for diagnostic instance MAF_FRQ_GRD[NC_MAF_NR]					
LV_CDN_DIAG_MAF_FRQ_RNG [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
Condition flag for diagnostic instance MAF_FRQ_RNG[NC_MAF_NR]					
LV_END_DIAG_MAF	O/V	0... 1H	0 ...1	1	-
End of Diagnosis MAF					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_MAF_FRQ_EL [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
end flag for diagnostic instance MAF_FRQ_EL[NC_MAF_NR]					
LV_END_DIAG_MAF_FRQ_GRD [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
end flag for diagnostic instance MAF_FRQ_GRD_j					
LV_END_DIAG_MAF_FRQ_RNG [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
end flag for diagnostic instance MAF_FRQ_RNG[NC_MAF_NR]					
LV_ERR_MAF	O/V	0... 1H	0 ...1	1	-
MAF sensor error detected					
LV_ERR_MAF_FRQ_EL [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
error flag for MAF electrical diagnosis					
LV_ERR_MAF_FRQ_GRD [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
error flag for gradient check of T_PER_MAF_FRQ_BAS[NC_MAF_NR]					
LV_ERR_MAF_FRQ_RNG [NC_MAF_NR]	O/V	0... 1H	0 ...1	1	-
error flag for range check of T_PER_MAF_FRQ_BAS[NC_MAF_NR]					

Input data:

CTR_MAF_FRQ_KGH_SUM [NC_MAF_NR] {p. 833}	CTR_T_PER_MAF_FRQ_GRD [NC_MAF_NR] {p. 833}	CTR_T_PER_MAF_FRQ_RNG [NC_MAF_NR] {p. 833}	FAC_MAF_REL {p. 8277}
LV_CDN_VB_OBD1 {p. 1185}	LV_CTR_T_PER_MAF_FRQ_EL [NC_MAF_NR] {p. 833}	LV_CTR_T_PER_MAF_FRQ_SENS [NC_MAF_NR] {p. 833}	LV_IGK {p. 906}
LV_ST_END {p. 1720}	LV_VAR_MAF {p. 656}	N {p. 1525}	NC_MAF_NR {p. 834}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_MAF	-	0... FFH	0... 255	1	-
Anti-bounce increment value					
C_ABC_INC_MAF_FRQ_EL [NC_MAF_NR]	-	0... FFH	0... 255	1	-
anti bounce counter increment for diagnosis instance MAF_FRQ_EL[NC_MAF_NR]					
C_ABC_INC_MAF_FRQ_GRD [NC_MAF_NR]	-	0... FFH	0... 255	1	-
anti bounce counter increment for diagnosis instance MAF_FRQ_GRD_j					
C_ABC_INC_MAF_FRQ_RNG [NC_MAF_NR]	-	0... FFH	0... 255	1	-
anti bounce counter increment for diagnosis instance MAF_FRQ_RNG[NC_MAF_NR]					
C_ABC_MAX_MAF	-	1... FFH	1... 255	1	-
Anti-bounce maximum value					
C_ABC_MAX_MAF_FRQ_EL [NC_MAF_NR]	-	1... FFH	1... 255	1	-
anti bounce counter maximum value for diagnosis instance MAF_FRQ_EL[NC_MAF_NR]					
C_ABC_MAX_MAF_FRQ_GRD [NC_MAF_NR]	-	1... FFH	1... 255	1	-
anti bounce counter maximum value for diagnosis instance MAF_FRQ_GRD_j					
C_ABC_MAX_MAF_FRQ_RNG [NC_MAF_NR]	-	1... FFH	1... 255	1	-
anti bounce counter maximum value for diagnosis instance MAF_FRQ_RNG[NC_MAF_NR]					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_TCC_T_PER_MAF_FRQ_EL	-	0... FFH	0... 255	1	-
threshold for TCC counter for diagnositic instance MAF_FRQ_EL[NC_MAF_NR]					
C_FAC_MAF_REL_THD_MAF_RNG_MIN	-	0... BB8H	0... 300	0.1	%
min. relative cylinder filling for enable the MAF_FRQ_RNG diagnosis					
C_N_THD_MAF_FRQ_RNG_MIN	-	0... 1FE0H	0... 8160	1	rpm
min. N threshold for enable the MAF_FRQ_RNG diagnosis					
C_RATIO_T_PER_MAF_FRQ_GRD_DIAG	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
maximum acceptable percentage of exceeding gradients for T_PER_MAF_FRQ_SUM_j per ms					
C_RATIO_T_PER_MAF_FRQ_RNG_DIAG	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
maximum acceptable percentage of out of range T_PER_MAF_FRQ_SUM[NC_MAF_NR] per ms					

FUNCTION DESCRIPTION:

The whole electrical diagnostic feature for frequential MAF sensor consists of four parts:
The error detection itself is done within the signal acquisition. Every 1 ms the mean period time per ms of mass air flow sensor (T_PER_MAF_FRQ_BAS[NC_MAF_NR]) is evaluated. Whenever an error is detected (per ms) the corresponding counter (CTR_T_PER_MAF_FRQ_RNG[NC_MAF_NR] or CTR_T_PER_MAF_FRQ_GRD[NC_MAF_NR]) gets incremented and this value itself is neglected.
Here in the diagnostic function these summed up error counters as well as the summed up counter for valid values per segment (CTR_MAF_FRQ_KGH_SUM[NC_MAF_NR]) are evaluated at the end of each segment.

A.92.1 Frequential MAF Sensor: Period Range Check per ms

General information:

The diagnosis described in this section is performed for each MAF sensor separately [NC_MAF_NR].
The purpose is to check the range of the mean period time per ms of mass air flow sensor (T_PER_MAF_FRQ_BAS[NC_MAF_NR]). The diagnostic instance consists of the following symptom:

- SYM_0: MAF-sensor-[NC_MAF_NR]: mean period time per ms exceeding limit

MAF_FRQ_RNG[NC_MAF_NR]

Description:

Activation **If** LV_VAR_MAF = 1
then if LV_IGK = 1 **and**
LV_CDN_VB_OBD1 = 1 **and**
LV_ST_END = 1 **and**
N > C_N_THD_MAF_FRQ_RNG_MIN **and**
FAC_MAF_REL > C_FAC_MAF_REL_THD_MAF_RNG_MIN
Then LV_CDN_DIAG_MAF_FRQ_RNG[NC_MAF_NR] = 1
Else LV_CDN_DIAG_MAF_FRQ_RNG[NC_MAF_NR] = 0
endif
else LV_END_DIAG_MAF_FRQ_RNG[NC_MAF_NR] = 1
LV_CDN_DIAG_MAF_FRQ_RNG[NC_MAF_NR] = 0
Endif

Initialization: STD_INI
Recurrence: every segment

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Formula section:

If LV_CDN_DIAG_MAF_FRQ_RNG[NC_MAF_NR] = 1
then if
[CTR_T_PER_MAF_FRQ_RNG[NC_MAF_NR] /
(CTR_MAF_FRQ_KGH_SUM[NC_MAF_NR] + CTR_T_PER_MAF_FRQ_RNG[NC_MAF_NR] + CTR_T_PER_MAF_FRQ_GRD[NC_MAF_NR])]
> C_RATIO_T_PER_MAF_FRQ_RNG_DIAG **AND**
LV_CTR_T_PER_MAF_FRQ_SENS[NC_MAF_NR] = 0 **AND**
LV_CTR_T_PER_MAF_FRQ_EL[NC_MAF_NR] = 0
then ERR_SYM_MAF_FRQ_RNG[NC_MAF_NR] = SYM_0
else ERR_SYM_MAF_FRQ_RNG[NC_MAF_NR] = NO_SYM
endif
endif

Calculation end of diagnosis
LV_END_DIAG_MAF_FRQ_RNG[NC_MAF_NR] is calculated by error management if diagnosis is active.

A.92.2 Frequential MAF Sensor: Gradient Check per ms

General information:

The diagnosis described in this section is performed for each MAF sensor separately (j = 0 ... NC_MAF_NR - 1).
Purpose is to check the gradient of consecutively measured mean period times per ms (absolute value) of mass air flow sensor (T_PER_MAF_FRQ_BAS[NC_MAF_NR]). This allows to detect a completely unplausible increase or decrease of it caused by a loose contact. The diagnostic instance consists of the following error symptom:

- SYM_0: MAF-sensor-[NC_MAF_NR]: unplausible gradient of mean period time per ms
  MAF_FRQ_GRD[NC_MAF_NR]

Description:

Activation **If** LV_VAR_MAF = 1
then **if** LV_IGK = 1 **and**
LV_CDN_VB_OBD1 = 1 **and**
LV_ST_END = 1
Then LV_CDN_DIAG_MAF_FRQ_GRD[NC_MAF_NR] = 1
Else LV_CDN_DIAG_MAF_FRQ_GRD[NC_MAF_NR] = 0
endif
else LV_END_DIAG_MAF_FRQ_GRD[NC_MAF_NR] = 1
LV_CDN_DIAG_MAF_FRQ_GRD[NC_MAF_NR] = 0
Endif

Initialization: STD_INI
Recurrence: every segment

Formula section:

If LV_CDN_DIAG_MAF_FRQ_GRD[NC_MAF_NR] = 1

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then **if**
[CTR_T_PER_MAF_FRQ_GRD[NC_MAF_NR] /
(CTR_MAF_FRQ_KGH_SUM[NC_MAF_NR] + CTR_T_PER_MAF_FRQ_RNG[NC_MAF_NR] +
CTR_T_PER_MAF_FRQ_GRD[NC_MAF_NR])]
$>$ C_RATIO_T_PER_MAF_FRQ_GRD_DIAG **AND**
LV_CTR_T_PER_MAF_FRQ_SENS[NC_MAF_NR] = 0 **AND**
LV_CTR_T_PER_MAF_FRQ_EL[NC_MAF_NR] = 0
then ERR_SYM_MAF_FRQ_GRD[NC_MAF_NR] = SYM_0
else ERR_SYM_MAF_FRQ_GRD[NC_MAF_NR] = NO_SYM
endif
endif

Calculation end of diagnosis

LV_END_DIAG_MAF_FRQ_GRD[NC_MAF_NR] is calculated by error management if diagnosis is active.

A.92.3 MAF electrical diagnosis

General information:

The diagnosis described in this section is performed for each MAF sensor separately (j = 0 ... NC_MAF_NR - 1).
Purpose is to recognize a problem due to an electrical error (SCG, SCB of open line) of the mass air flow sensor (within the sensor on the wiring harness) or a self diagnosis problem is recognized. The diagnostic instance consists of the following error symptom:

- SYM_0: MAF-sensor-[NC_MAF_NR]: electrical fault
- SYM_1: 'MAF-sensor-[NC_MAF_NR]: sensor error recognized

Activation **If** LV_VAR_MAF = 1
then **if** LV_IGK = 1 **and**
LV_CDN_VB_OBD1 = 1 **and**
LV_ST_END = 1
Then LV_CDN_DIAG_MAF_FRQ_EL[NC_MAF_NR] = 1
Else LV_CDN_DIAG_MAF_FRQ_EL[NC_MAF_NR] = 0
endif
else LV_END_DIAG_MAF_FRQ_EL[NC_MAF_NR] = 1
LV_CDN_DIAG_MAF_FRQ_EL[NC_MAF_NR] = 0
Endif

Initialization: STD_INI
Recurrence: every segment

Formula section:

If LV_CDN_DIAG_MAF_FRQ_EL[NC_MAF_NR] = 1
then **if** LV_CTR_T_PER_MAF_FRQ_EL[NC_MAF_NR] = 1
then CTR_TCC_T_PER_MAF_FRQ_EL[NC_MAF_NR] ++
Else CTR_TCC_T_PER_MAF_FRQ_EL[NC_MAF_NR] = 0
Endif
If CTR_TCC_T_PER_MAF_FRQ_EL[NC_MAF_NR] $>$
C_CTR_TCC_T_PER_MAF_FRQ_EL
then ERR_SYM_MAF_FRQ_EL[NC_MAF_NR] = SYM_0
else if LV_CTR_T_PER_MAF_FRQ_SENS[NC_MAF_NR] = 1

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then ERR_SYM_MAF_FRQ_EL[NC_MAF_NR] = SYM_1
else ERR_SYM_MAF_FRQ_EL[NC_MAF_NR] = NO_SYM
endif
endif
endif

Calculation end of diagnosis

LV_END_DIAG_MAF_FRQ_EL[NC_MAF_NR] is calculated by error management if diagnosis is active.

A.92.4 Global error instance

Activation **If** LV_VAR_MAF = 1
then **If** LV_ST_END = 1 **and**
LV_IGK = 1 **and**
LV_CDN_VB_OBD1 = 1
then LV_CDN_DIAG_MAF = 1
else LV_CDN_DIAG_MAF = 0
endif
else LV_END_DIAG_MAF = 1
LV_CDN_DIAG_MAF = 0
endif

Initialization: STD_INI
Recurrence: every segment

Formula section:

If LV_CDN_DIAG_MAF = 1 // only frequency MAF //
Then **If** LV_ERR_MAF_FRQ_RNG[NC_MAF_NR] = 1
Then ERR_SYM_MAF = SYM_0
LV_ERR_MAF = 1
Else **If** LV_ERR_MAF_FRQ_GRD[NC_MAF_NR] = 1
Then ERR_SYM_MAF = SYM_1
LV_ERR_MAF = 1
Else **If** LV_ERR_MAF_FRQ_EL[NC_MAF_NR] = 1
Then ERR_SYM_MAF = SYM_2
LV_ERR_MAF = 1
Else ERR_SYM_MAF = NO_SYM
LV_ERR_MAF = 0
Endif // no longer failure sympton of analog MAF treated //
Endif
Endif
Endif

Calculation end of diagnosis

LV_END_DIAG_MAF is calculated by error management if diagnosis is active.

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A.93 Air mass flow sensor diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_MAF	O/V	0... 1H	0 ...1	1	-
Inhibition of MAF diagnosis					
LV_MAF_BLS_DIAG	O/V	0... 1H	0 ...1	1	-
MAF error and brake is active					
STATE_RBM_MAF	O/V	0... 7H	0 ...7	1	-
Interface of MAF monitor with the Rate-Based Monitoring statistics Bit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1) Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1) Bit 2: individual RBM conditions of the monitor were encountered within this DC (bit 2 = 1)					

Input data:

LV_BRAKE_DET {p. 4209}	LV_DC {p. 5746}	LV_END_DIAG_MAF {p. 4814}	LV_ERR_BLS_PLAUS {p. 4209}
LV_ERR_MAF {p. 4815}	LV_VAR_MAF {p. 656}		

General information:

LV_MAF_BLS_DIAG is used by engine speed limit coordination and torque request at clutch.

Application conditions

Initialisation: *0 at reset*

Recurrence: *10ms*

Activation: *LV_VAR_MAF = 1*

Deactivation: *LV_VAR_MAF = 0*

Formula section:

LV_INH_DIAG_MAF = 0

If LV_ERR_MAF = 1 **and**
[LV_BRAKE_DET = 1 **or**
LV_ERR_BLS_PLAUS = 1]
Then LV_MAF_BLS_DIAG = 1
Else LV_MAF_BLS_DIAG = 0
Endif

A.93.1 Interface for Rate - Based - Monitoring

FUNCTION DESCRIPTION:

General information:

With this module the interface between the MAF monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_MAF data.

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Within STATE_RBM_MAF, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)
  (not valid for MAF diagnosis)

Application conditions:

Initialisation :
at LV_DC 0 1 transition :
bit 0, bit 1 and bit 2 of STATE_RBM_MAF = 0
on failure memory reset :
bit 1 of STATE_RBM_MAF = 0
Recurrence: 1 s
Activation: LV_DC 0 1 transition **and** LV_DC = 1

Formula section:

Bit 0:
If bit 0 of STATE_RBM_MAF = 0
then
if LV_END_DIAG_MAF = 1
then bit 0 of STATE_RBM_MAF = 1
endif
endif

Bit 1:
bit 1 of STATE_RBM_MAF = 0

Bit 2:
bit 2 of STATE_RBM_MAF = 1

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A.94 Ambient pressure sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_AMP	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom AMP					
LV_CDN_DIAG_AMP	O/V	0... 1H	0 ...1	1	-
Diagnosis condition AMP					
LV_END_DIAG_AMP	O/V	0... 1H	0 ...1	1	-
End of Diagnosis AMP					
LV_ERR_AMP	O/V	0... 1H	0 ...1	1	-
AMP error present					

Input data:

LV_ES {p. 1720}	LV_IGK {p. 906}	LV_ST {p. 1720}	V_AMP {p. 831}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_AMP	-	0... FFH	0... 255	1	-
Anti - bounce counter increment					
C_ABC_MAX_AMP	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter					
C_V_AMP_MAX_DIAG	-	0... 3FFH	0... 4.99511	4.88e-3	V
Maximum diagnostic value for the ambient pressure value					
C_V_AMP_MIN_DIAG	-	0... 3FFH	0... 4.99511	4.88e-3	V
Minimum diagnostic value for the ambient pressure value					

FUNCTION DESCRIPTION:

General information:

The purpose of the diagnosis shall be to detect electrical faults as defined by OBD I requirements.
The signal of the altitude pressure sensor on the A/D-input of the microcontroller is checked.

Description:

Error-symtoms are defined to this diagnosis function as following :

```
 ┌─┬─┬─┬─┐
 │ │ │ └─> Signal Line Short to Battery Voltage or Open load   (= SYM_0)
 │ │ └───> Signal Line Short to Ground                         (= SYM_1)
 │ └─────> -                                                   (= SYM_2)
 └───────> -                                                   (= SYM_3)
```

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Application conditions

Initialization: `all 0 at LV_IGK 0->1` **or** `reset`

Recurrence: `100ms`

Activation

```
If        LV_IGK = 1          and
          LV_ES = 0           and
          LV_ST = 0
Then      LV_CDN_DIAG_AMP = 1
Else      LV_CDN_DIAG_AMP = 0
Endif
```

Formula section:

Short circuit to VBatt or open load
If V_AMP > C_V_AMP_MAX_DIAG
Then ERR_SYM_AMP = SYM_0
Short circuit to ground
ElseIf V_AMP < C_V_AMP_MIN_DIAG
Then ERR_SYM_AMP = SYM_1
Else ERR_SYM_AMP = NO_SYM
Endif
Calculation of present error and end of diagnosis:
LV_ERR_AMP and LV_END_DIAG_AMP is calculated by error management

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A.95 Manifold air pressure sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_MAP_DIP_SENS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom MAP_DIP sensor					
ERR_SYM_MAP_DIP_SHIFT	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom MAP_DIP sensor					
LV_CDN_DIAG_MAP_DIP_SENS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MAP_DIP sensor					
LV_CDN_DIAG_MAP_DIP_SHIFT	O	0... 1H	0 ...1	1	-
Diagnosis condition MAP_DIP sensor					
LV_END_DIAG_MAP_DIP_SENS	O/V	0... 1H	0 ...1	1	-
End of Diagnosis MAP_DIP sensor					
LV_END_DIAG_MAP_DIP_SHIFT	O	0... 1H	0 ...1	1	-
End of Diagnosis MAP_DIP sensor					
LV_ERR_MAP_DIP_SENS	O/V	0... 1H	0 ...1	1	-
MAP_DIP sensor error present					
LV_ERR_MAP_DIP_SHIFT	O	0... 1H	0 ...1	1	-
MAP_DIP sensor error present					

Input data:

C_TPS_V_MAP_AD_MIN {p. 1199}	ECU_STATE {p. 1091}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_MAP_TPS_PLAUS {p. 1062}
LV_ERR_TPS {p. 4982}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_ST_CHK_2 {p. 4951}
LV_ES {p. 1720}	LV_IGK {p. 906}	LV_ST {p. 1720}	TPS_AV {p. 1169}
V_MAP {p. 1198}	V_MAP_DIF {p. 1198}	V_MAP_DIF_VLD {p. 1198}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_MAP_DIP_SENS	-	0... FFH	0... 255	1	-
Anti - bounce counter increment					
C_ABC_INC_MAP_DIP_SHIFT	-	0... FFH	0... 255	1	-
Anti - bounce counter increment					
C_ABC_MAX_MAP_DIP_SENS	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter					
C_ABC_MAX_MAP_DIP_SHIFT	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_MAP_BAS_MAX_DIAG	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Maximum diagnostic value for the manifold differential pressure value					
C_V_MAP_BAS_MIN_DIAG	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Minimum diagnostic value for the manifold differential pressure value					

A.95.1 Electrical diagnosis

FUNCTION DESCRIPTION:

General information:

The purpose of the diagnosis shall be to detect electrical faults as defined by OBD I requirements.
The signal of the manifold differential pressure sensor on the A/D-input of the microcontroller is checked.

Description:

Error-symtoms are defined to this diagnosis function as following :

```
□□□□
│ │ │ └──→ Signal Line Short to Battery Voltage or Open load    (= SYM_0)
│ │ └────→ Signal Line Short to Ground                          (= SYM_1)
│ └──────→ -                                                    (= SYM_2)
└────────→ -                                                    (= SYM_3)
```

Application conditions

Initialization: according ABC type **STD_INI** (all 0 at LV_IGK 0→1 or at reset)

Recurrence: 100ms

Activation

```
If     LV_IGK = 1        and
       LV_ES = 0         and
       LV_ST = 0
Then   LV_CDN_DIAG_MAP_DIP_SENS = 1
Else   LV_CDN_DIAG_MAP_DIP_SENS = 0
Endif
```

Formula section:

Short circuit to VBatt or open load
If V_MAP > C_V_MAP_BAS_MAX_DIAG
Then ERR_SYM_MAP_DIP_SENS = SYM_0
Short circuit to ground
ElseIf V_MAP < C_V_MAP_BAS_MIN_DIAG
Then ERR_SYM_MAP_DIP_SENS = SYM_1
Else ERR_SYM_MAP_DIP_SENS = NO_SYM
Endif

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Calculation of present error and end of diagnosis:
LV_ERR_MAP_DIP_SENS and LV_END_DIAG_MAP_DIP_SENS is calculated by error management.

A.95.2 Plausibility diagnosis

FUNCTION DESCRIPTION:

General information:

The purpose of the diagnosis shall be to detect an unplausible shift of the sensor characteristic. The deviation and the maximum allowed deviation from the nominal curve are determined by the module "Pressure Variables (MAP-Sensor) /Adaptation of sensor characteristic".

Description:

Error-symtoms are defined to this diagnosis function as following :

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─→ -                                   (= SYM_0)
 │ │ └───→ -                                   (= SYM_1)
 │ └─────→ -                                   (= SYM_2)
 └───────→ signal offset out of limit          (= SYM_3)
```

Application conditions

Initialization: according ABC type **STD** (init. from nonvolatile error memory)

Recurrence: 100ms

Activation

```
If    ECU_STATE                    = PWL    and
      TPS_AV  C_TPS_V_MAP_AD_MIN   and
      LV_ERR_TPS                   = 0      and
      LV_ERR_MAP_DIP_SENS          = 0      and
LV_ERR_TPS_AD                      = 0      and

LV_ERR_TPS_AD_BOL                  = 0      and

LV_ERR_TPS_ST_CHK_2                = 0      and

LV_ERR_LOAD_TPS_PLAUS = 0                   and
      LV_ERR_MAP_TPS_PLAUS         = 0
Then  LV_CDN_DIAG_MAP_DIP_SHIFT = 1
Else  LV_CDN_DIAG_MAP_DIP_SHIFT = 0
Endif
```

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Formula section:

If | V_MAP_DIF | > V_MAP_DIF_VLD
then ERR_SYM_MAP_DIP_SHIFT = SYM_3
else ERR_SYM_MAP_DIP_SHIFT = NO_SYM
endif

Calculation of present error and end of diagnosis:
LV_ERR_MAP_DIP_SHIFT and LV_END_DIAG_MAP_DIP_SHIFT is calculated by error management.

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A.96 Pressure up throttle sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_PUT_EL	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom electrical PUT sensor					
LV_CDN_DIAG_PUT_EL	O/V	0... 1H	0 ...1	1	-
Status of diagnosis for electrical PUT sensor					
LV_END_DIAG_PUT_EL	O/V	0... 1H	0 ...1	1	-
End of pressure up throttle sensor diagnosis					
LV_ERR_PUT_EL	O/V	0... 1H	0 ...1	1	-
electrical PUT sensor error detected					

Input data:

LV_VAR_TCHA {p. 656}	LV_VB_CDN_OBD_1 {p. 1046}	V_PUT {p. 1198}	V_PUT_MV_MAX_DIAG {p. 4830}
V_PUT_MV_MIN_DIAG {p. 4830}			

FUNCTION DESCRIPTION:

General Information:
Analog input signal in the A/D-Input from the Microprocessor.

Description

Error-symtoms are defined to this diagnosis function as following :

```
┌─┬─┬─┬─┐
│ │ │ └─> Circuit high input        (= SYM_0)
│ │ └───> Circuiit low input        (= SYM_1)
│ └─────> -                         (= SYM_2)
└───────> -                         (= SYM_3)
```

Remark: Calculation of LV_END_DIAG_PUT see generic calculation “End of diagnosis” in anti bounce algorithm.

Application conditions

Activation: LV_VAR_TCHA = 1

Deactivation:

```
If          LV_VAR_TCHA = 0
   Then  LV_END_DIAG_PUT_EL = 1
   Endif
```

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Initialization: –

Calcualtion recurrence: `10ms`

Formula section:

if LV_VB_CDN_OBD_1 = 1
then LV_CDN_DIAG_PUT_EL = 1 (diagnosis is active)
else LV_CDN_DIAG_PUT_EL = 0 (diagnosis inactive)
- – -
If V_PUT > V_PUT_MV_MAX_DIAG
Then **Symptom "Circuit high input" is active, anti-bounce counter increment**
ERR_SYM_ PUT_EL = 1H
LV_ERR_PUT_EL= 1 (after debounce)
//Short circuit to battery or open circuit//
Else

If V_PUT < V_PUT_MV_MIN_DIAG
Then **Symptom "Circuit low input" is active, anti-bounce counter increment**
ERR_SYM_ PUT_EL = 2H
LV_ERR_PUT_EL= 1 (after debounce)
//Short circuit to ground//

Else **Symptom "Circuit high input" and "Circuit low input" are inactive, anti-bounce counter decrement**
ERR_SYM_PUT_EL = 0H
LV_ERR_PUT_EL = 0 (after debounce)

Endif

Endif

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A.97 Pressure up throttle sensor diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_PUT_DIAG_ENG_RUN	-	0... 1H	0 ...1	1	-
thresholds for running engine were once written function must no longer be calculated					
V_PUT_MV_MAX_DIAG	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold value of V_PUT_MV to detect Short circuit in signal wire to VB					
V_PUT_MV_MIN_DIAG	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold value of V_PUT_MV to detect Short circuit in signal wire to earth or wire break					

Input data:

LV_ES {p. 1720}	LV_VAR_TCHA {p. 656}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_PUT_EL	-	0... FFH	0... 255	1	-
Increment debounce counter					
C_ABC_MAX_PUT_EL	-	1... FFH	1... 255	1	-
Maximum value debounce counter					
C_V_PUT_MV_MAX_DIAG	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold value V_PUT_MV to detect Short circuit in signal wire to VB					
C_V_PUT_MV_MAX_DIAG_ES	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold value V_PUT_MV to detect Short circuit in signal wire to VB for engine Stop					
C_V_PUT_MV_MIN_DIAG	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold value V_PUT_MV to detect Short circuit in signal wire to earth or wire break					
C_V_PUT_MV_MIN_DIAG_ES	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold value V_PUT_MV to detect Short circuit in signal wire to earth or wire break for engine Stop					

Error treatment:

Error debounce:

– Debounce counter increment: C_ABC_INC_PUT_EL
– Debounce counter decrement: 1
– Debounce counter maximum value: C_ABC_MAX_PUT_EL

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FUNCTION DESCRIPTION:

General Information:
Defined the thresholds to detect either Short circuit in signal wire to battery or Short circuit in signal wire to earth or wire break. PUT = Pressure upstream throttle

Application conditions

Activation : `LV_VAR_TCHA = 1 and LV_PUT_DIAG_ENG_RUN = 0`
Deactivation: `LV_PUT_DIAG_ENG_RUN = 1`
Initialization: `LV_PUT_DIAG_ENG_RUN = 0 at reset`

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Calcualtion recurrence: `10ms`

Formula section:

If LV_PUT_DIAG_ENG_RUN = 0 and LV_ES = 0
Then LV_PUT_DIAG_ENG_RUN = 1
Short circuit in signal wire to VB:
V_PUT_MV_MAX_DIAG = C_V_PUT_MV_MAX_DIAG
Short circuit in signal wire to earth or wire break:
V_PUT_MV_MIN_DIAG = C_V_PUT_MV_MIN_DIAG
else *thresholds for not running engine*
V_PUT_MV_MAX_DIAG = C_V_PUT_MV_MAX_DIAG_ES
V_PUT_MV_MIN_DIAG = C_V_PUT_MV_MIN_DIAG_ES

Endif

Configuration of diagnostic syntoms :

Diagnosis	Symptom	Nr	ABC type
Pressure upstream throttle sensor diagnosis with short circuit signal wire to VB	Short circuit in signal wire to VB	*0*	MEM
Pressure upstream throttle sensor diagnosis short circuit in signal wire to earth or wire break	short circuit in signal wire to earth or wire break	*1*	MEM

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A.98 Bit serial data line communication

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ABC_ALTER_COM	V	0... FFH	0... 255	1	-
Anti-bounce counter for alternator BSD communication error					
CTR_ABC_CWP_COM	V	0... FFH	0... 255	1	-
Anti-bounce counter for electrical coolant water pump BSD communication error					
CTR_ABC_QOIL_COM	V	0... FFH	0... 255	1	-
Anti-bounce counter for oil quality sensor (QLT) BSD communication error					
CTR_ABC_SENS_BAT_SMT_COM	O/V	0... FFH	0... 255	1	-
Anti-bounce counter for intelligent battery sensor (IBS) BSD communication error					
CTR_END_DIAG_ALTER_COM	V	0... FFH	0... 255	1	-
Counter for End of diagnosis condition detection for alternator BSD communication error					
CTR_END_DIAG_CWP_COM	V	0... FFH	0... 255	1	-
Counter for End of diagnosis condition detection for electrical coolant water pump BSD communication error					
CTR_END_DIAG_QOIL_COM	V	0... FFH	0... 255	1	-
Counter for End of diagnosis condition detection for oil quality sensor (QLT) BSD communication error					
CTR_END_DIAG_SENS_BAT_SMT_COM	V	0... FFH	0... 255	1	-
Counter for End of diagnosis condition detection for intelligent battery sensor (IBS) BSD communication error					
CTR_MSG_ALTER_COM_DIAG	V	0... FFH	0... 255	1	-
Counter of faulty alternator transmitting slots					
CTR_MSG_ALTER_COM_STOP	O/V	0... FFFFH	0... 65535	1	-
Interrupt counter to stop the communictation to the alternator					
CTR_MSG_CWP_COM_DIAG	V	0... FFH	0... 255	1	-
Counter of faulty electrical coolant water pump transmitting slots					
CTR_MSG_CWP_COM_STOP	O/V	0... FFFFH	0... 65535	1	-
Interrupt counter to stop the communictation to the electrical coolant water pump					
CTR_MSG_QOIL_COM_DIAG	V	0... FFH	0... 255	1	-
Counter of faulty oil quality sensor (QLT) transmitting slots					
CTR_MSG_QOIL_COM_STOP	O/V	0... FFFFH	0... 65535	1	-
Interrupt counter to stop the communictation to the oil quality sensor (QLT)					
CTR_MSG_SENS_BAT_SMT_COM_DIAG	O/V	0... FFH	0... 255	1	-
Counter of faulty intelligent battery sensor (IBS) transmitting slots					
CTR_MSG_SENS_BAT_SMT_COM_STOP	O/V	0... FFFFH	0... 65535	1	-
Interrupt counter to stop the communictation to the intelligent battery sensor (IBS)					
ERR_SYM_ALTER_COM	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom for alternator BSD communication error					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_BSD	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BSD					
ERR_SYM_CWP_COM	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom for electrical coolant water pump BSD communication error					
ERR_SYM_QOIL_COM	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom for oil quality sensor (QLT) BSD communication error					
ERR_SYM_SENS_BAT_SMT_COM	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom for intelligent battery sensor (IBS) BSD communication error					
LV_CDN_DIAG_ALTER_COM	O/V	0... 1H	0 ...1	1	-
Diagnosis condition for alternator BSD communication error					
LV_CDN_DIAG_BSD	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BSD diagnosis					
LV_CDN_DIAG_CWP_COM	O/V	0... 1H	0 ...1	1	-
Diagnosis condition for electrical coolant water pump BSD communication error					
LV_CDN_DIAG_QOIL_COM	O/V	0... 1H	0 ...1	1	-
Diagnosis condition for oil quality sensor (QLT) BSD communication error					
LV_CDN_DIAG_SENS_BAT_SMT_COM	O/V	0... 1H	0 ...1	1	-
Diagnosis condition for intelligent battery sensor (IBS) BSD communication error					
LV_END_DIAG_ALTER_COM	O/V	0... 1H	0 ...1	1	-
End of diagnosis condition for alternator BSD communication error					
LV_END_DIAG_BSD	O/V	0... 1H	0 ...1	1	-
End of BSD - Diagnosis					
LV_END_DIAG_CWP_COM	O/V	0... 1H	0 ...1	1	-
End of diagnosis condition for electrical coolant water pump BSD communication error					
LV_END_DIAG_QOIL_COM	O/V	0... 1H	0 ...1	1	-
End of diagnosis condition for oil quality sensor (QLT) BSD communication error					
LV_END_DIAG_SENS_BAT_SMT_COM	O/V	0... 1H	0 ...1	1	-
End of diagnosis condition for intelligent battery sensor (IBS) BSD communication error					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_ALTER_COM	O/V	0... 1H	0 ...1	1	-
Logical variable for alternator BSD communication error					
LV_ERR_BSD	O/V	0... 1H	0 ...1	1	-
logical variable for BSD error					
LV_ERR_CWP_COM	O/V	0... 1H	0 ...1	1	-
Logical variable for electrical coolant water pump BSD communication error					
LV_ERR_QOIL_COM	O/V	0... 1H	0 ...1	1	-
Logical variable for oil quality sensor (QLT) BSD communication error					
LV_ERR_SENS_BAT_SMT_COM	O/V	0... 1H	0 ...1	1	-
Logical variable for intelligent battery sensor (IBS) BSD communication error					
LV_INH_CWP_DIAG	O/V	0... 1H	0 ...1	1	-
Flag to freeze the CWP diagnosis in case a non-acknowledge of the BSD component CWP occurred					
LV_MSG_ALTER_COM_STOP	V	0... 1H	0 ...1	1	-
Flag indication that the communication stop counter of the device alternator <>0					
LV_MSG_CWP_COM_STOP	V	0... 1H	0 ...1	1	-
Flag indication that the communication stop counter of the device el. Coolant water pump <>0					
LV_MSG_QOIL_COM_STOP	V	0... 1H	0 ...1	1	-
Flag indication that the communication stop counter of the device oil quality sensor <>0					
LV_MSG_SENS_BAT_SMT_COM_STOP	V	0... 1H	0 ...1	1	-
Flag indication that the communication stop counter of the device intelligent battery sensor <>0					
STATE_BSD_MSG_COM_STOP	O/V	0... FFH	0... 255	1	-
Status of the communication STOP counter to the BSD devices					

Input data:

LV_CDN_VB_MIN_DIAG {p. 1185}	LV_IGK {p. 906}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_ALTER_COM	-	0... FFH	0... 255	1	-
Anti-bounce counter increment - diagnosis BSD communication to alternater					
C_ABC_INC_BSD	-	0... FFH	0... 255	1	-
anti bounce counter increment - diagnosis BSD					
C_ABC_INC_CWP_COM	-	0... FFH	0... 255	1	-
Anti-bounce counter increment - diagnosis BSD communication to electrical coolant water pump					
C_ABC_INC_QOIL_COM	-	0... FFH	0... 255	1	-
Anti-bounce counter increment - diagnosis BSD communication to oil quality sensor					
C_ABC_INC_SENS_BAT_SMT_COM	-	0... FFH	0... 255	1	-
Anti-bounce counter increment - diagnosis BSD communication to intelligent battery sensor					
C_ABC_MAX_ALTER_COM	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum value - diagnosis BSD communication to alternater					
C_ABC_MAX_BSD	-	1... FFH	1... 255	1	-
anti bounce counter maximum value - diagnosis BSD					
C_ABC_MAX_CWP_COM	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum value - diagnosis BSD communication to electrical coolant water pump					
C_ABC_MAX_QOIL_COM	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum value - diagnosis BSD communication to oil quality sensor					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_SENS_BAT_SMT_COM	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum value - diagnosis BSD communication to intelligent battery sensor					
C_CTR_MAX_ALTER_COM_STOP	-	0... FFFFH	0... 65535	1	-
Time out threshold for counter of alternator transmitting slots					
C_CTR_MAX_CWP_COM_STOP	-	0... FFFFH	0... 65535	1	-
Number of time out transmitting slots for electrical coolant water pump					
C_CTR_MAX_MSG_ALTER_COM	-	0... FFH	0... 255	1	-
Threshold for counter of faulty alternator transmitting slots					
C_CTR_MAX_MSG_CWP_COM	-	0... FFH	0... 255	1	-
Threshold for counter of faulty electrical coolant water pump transmitting slots					
C_CTR_MAX_MSG_QOIL_COM	-	0... FFH	0... 255	1	-
Threshold for counter of faulty oil quality sensor transmitting slots					
C_CTR_MAX_MSG_SENS_BAT_SMT_COM	-	0... FFH	0... 255	1	-
Threshold for counter of faulty intelligent battery sensor transmitting slots					
C_CTR_MAX_QOIL_COM_STOP	-	0... FFFFH	0... 65535	1	-
Number of time out transmitting slots for oil quality sensor					
C_CTR_MAX_SENS_BAT_SMT_COM_STOP	-	0... FFFFH	0... 65535	1	-
Number of time out transmitting slots for intelligent battery sensor					
C_CTR_THD_MSG_CWP_COM_DIAG	-	0... FFH	0... 255	1	-
Threshold to disable the functional CWP diagnosis in case a problem with the interface BSD is present					

Action definition

ACTION_AGGR_SetBsdGlobalCom (**IN**<CTR_BSD_CPT_COM_OK>)	Mode: O
Action which delivers at the end of the BSD scheduling timing table the status of the communication of all BSD components of the list (counter = 0 ; no communication occured at all)	

ACTION_AGGR_SetBsdSingleCom (**IN**<STATE_BSD_CPT>,**IN**<STATE_BSD_COM>)	Mode: O
Action which delivers at the end of the BSD timing slot the status of the communication of the actual BSD device of the scheduling list	

A.98.1 Global BSD Error - No communication to any of the BSD components

Description for actions:

ACTION_COMS_*SetBsdGlobalCom _COM* (<CTR_BSD_CPT_COM_OK>)					
Action which delivers at the end of the BSD timing table the status of the communication of all BSD devices of the list; number of successful communications for one scheduling timing list cycle					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
CTR_BSD_CPT_COM_OK	IN	0...FFH	0...255	1	-
Number of the ‘ok’ communications per total scheduling timing list cycle of the BSD devices					

FUNCTION DESCRIPTION:

General information:

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This diagnosis is to detect a malfunction in the BSD-line (**B**it-**S**erial-**D**ata transfer). There could be several components be connected to the BSD bus (alternator, intelligent battery sensor, oil quality sensor, electrical coolant water pump).
The diagnosis works with the help of basic software information. To detect an error symptom it is necessary to have a data tranfer before, thus the information is stored until the next recurreny of the diagnosis. The error symptoms are set exclusive per data transfer.
There is a certain scheduling defined to serve the several components via BSD bus. In total for one complete cycle (defined in the BSD scheduling timing table) several time slots have to be passed after a decision can be made wether the communication to at least one BSD component has successfully been passed. Is there no positve acknowegde from none of the BSD components, the counter CTR_BSD_CPT_COM_OK = 0 is indicating a global communication.
Each component is linked to certain time slots.
In general each component can be either configered by a calibration switch (must component; e.g. alternater, electrical coolant water pump, oil quality sensor) or can be learnt (intelligent battery sensor).

Description:

As soon as the communication via BSD has been started the ECU expects in all time slots correct messages (positive acknowledge). In case none of the messages have been received the global BSD error is set after debounce followed by inhibiting of the individual BSD communication errors.
After the error has been detected, the BSD timing coordinator is still serving the BSD components in the hope that the problem which disturbed the global communication disapears.

The error symptom detection is made out of basic software information BIOS_BSD_xx:
If one of the following error symptoms are detected:

- To less Bits were received (*BIOS_BSD_TOO_FEW_BITS_ERR* is set)
- To many Bits were received (*BIOS_BSD_TOO_MANY_BITS_ERR* is set)
- At least one data-bit was not inside the puls (*BIOS_BSD_BIT_LVL_ERR* is set)
- Receiver send NAK (*BIOS_BSD_ACK_ERR* is set)
- Receiver does not respond (*BIOS_BSD_SLAVE_TO_ERR* is set)
- One of the parity-bits in the data frame is wrong (*BIOS_BSD_PARITY_ERR* is set)
- Period of last measured bit was not o.k. (*BIOS_BSD_PER_ERR* is set)

then the error symptom BSD signal error is set to active.

For error symptom calculation (*ERR_SYM_BSD*) the symptom position is:

```
|_|_|_|_|
 | | | └─> -                  (= SYM_0)
 | | └───> -                  (= SYM_1)
 | └─────> BSD signal error   (= SYM_2)
 └───────> -                  (= SYM_3)
```

Application conditions

Initialisation: `all 0 at LV_IGK 0->1` **or** `at reset`

Recurrence: *Function called after each communication block (see BSD timing table)*

Activation: **If** `LV_CDN_VB_MIN_DIAG = 1 and`
`Communication on BSD started`

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```
Then      LV_CDN_DIAG_BSD = 1
Else      LV_CDN_DIAG_BSD = 0
Endif
```

Error management:

If LV_CDN_DIAG_BSD = 1
Then If CTR_BSD_CPT_COM_OK = 0 *//no BSD com occured at all conf. CPT*
Then ERR_SYM_BSD = SYM_2 *//Error symptom detected, ABC increments*
Else ERR_SYM_BSD = NO_SYM *//No error symptom detected, ABC decrements*
Endif
Endif

Remark: LV_ERR_BSD and LV_END_DIAG_BSD are calculated by error management if diagnosis is active.

A.98.2 Single BSD component errors (ALTER, QOIL, CWP, SENS_BAT_SMT)

Description for actions:

ACTION_COMS_*SetBsdSingleCom* (<STATE_BSD_CPT>,<STATE_BSD_COM>)					
Action which delivers at the end of the BSD timing slot the status of the communication of the actual BSD device of the scheduling list					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
STATE_BSD_CPT	IN	0...FFH	0...255	1	-
BSD device, which communicates actually with the ECU via BSD					
STATE_BSD_COM	IN	0...FFH	0...255	1	-
Status of the communication to the BSD devices (faulty /o.k.)					

FUNCTION DESCRIPTION:

General information:

In addition to the global diagnosis of the BSD communication a selective diagnosis for each individual BSD component (alternator, intelligent battery sensor, oil quality sensor, electrical coolant water pump) is performed. There are several counters introduced to control the diagnosis. A counter (CTR_MSG_xxx_COM_DIAG) which monitors the transmitting slot of each individual component is incremented as soon as a faulty transmitting slot has been detected by the BSW (symptoms of the error please see Global BSD Error - No communication to any of the BSD components). In case of a faulty transmitting slot (no positive acknowledge) has been detected the next corresponding transmitting slot is served by a 22 synchronisation pulse phase and an incrementation of the counter CTR_MSG_xxx_COM_DIAG by 1+1 (1 for the missing acknowledge and 1 for the 22 synchronisation pulses).
The 22 synchronisation pulse phase is followed by new communication trial in the transmitting slot of the corresponding component determined by the timing coordinator. In case of a positive acknowledge the counter CTR_MSG_xxx_COM_DIAG is decremted by 2, otherwise it is proceeded as decribed above.
As soon as the counter CTR_MSG_xxx_COM_DIAG exceeds the threshold C_CTR_MAX_MSG_xxx_COM, a break for certain transmitting time slots can be applied by starting the counter CTR_MSG_xxx_COM_STOP (displayed in the flags LV_MSG_xxx_COM_STOP) in combination with the call of the anti-bounce algorithm of the error management and resetting the counter CTR_MSG_xxx_COM_DIAG after

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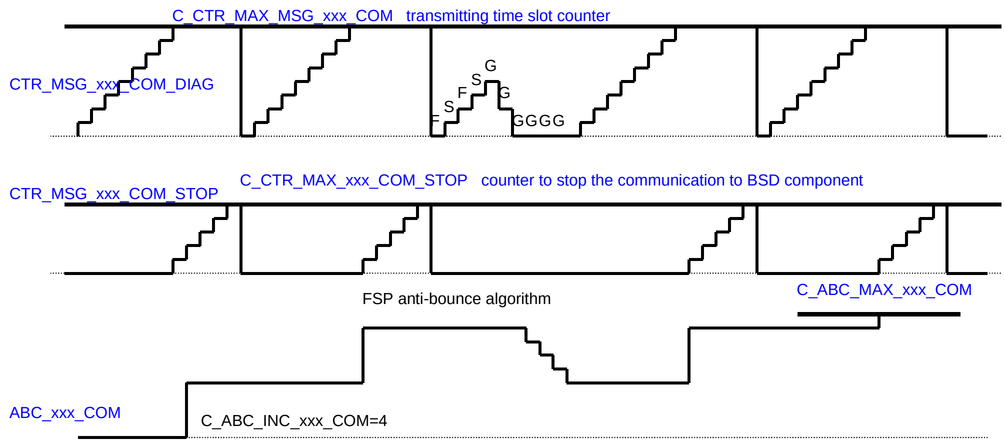
the counter CTR_MSG_xxx_COM_STOP has reached the threshold C_CTR_MAX_xxx_COM_STOP. The counter CTR_MSG_xxx_COM_STOP is incremented in each corresponding transmitting time slot until the threshold C_CTR_MAX_xxx_COM_STOP has been reached. During this period the timing coordinator does not serve the corresponding component. After the break in the communication to the corresponding component has elapsed (C_CTR_MAX_xxx_COM_STOP reached) the next test cycle is started as described above. This occurs until the error has been debounced by the anti-bounce algorithm. After the debounce of the error the component is no longer served in this driving cycle by the timing coordinator.
If the counter threshold C_CTR_MAX_xxx_COM_STOP to stop the communication to the corresponding BSD component is calibrated to = 0, no break of the communication occurs.
Special treatment if the counter threshold is calibrated to C_CTR_MAX_xxx_COM_STOP = FFFFH. In that case no break of the communication occurs and the component is served although the error has been detected.

With xxx: ALTER - alternator
CWP - electrical coolant water pump
QOIL - oil quality sensor (QLT)
SENS_BAT_SMT - intelligent battery sensor (IBS)

Description:



F -- faulty
G -- good
S -- 22 sync. pulse

Application conditions

Initialisation: *all 0 at LV_IGK 0->1* ***or*** *at reset*

Recurrence: *Function called after each communication time slot (see BSD timing table)*

Activation:

```
If      LV_CDN_VB_MIN_DIAG = 1            and
        Communication on BSD started      and
        LV_ERR_BSD = 0
Then    LV_CDN_DIAG_xxx_COM = 1
Else    LV_CDN_DIAG_xxx_COM = 0
Endif
```

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Formula section:

```
If          STATE_BSD_CPT = 0H          // time slot for SENS_BAT_SMT was active//
         CTR_END_DIAG_SENS_BAT_SMT_COM++          // END_DIAG in case no error//
Then
    If          C_CTR_MAX_SENS_BAT_SMT_COM_STOP<> FFFFH
    Then
       If         CTR_END_DIAG_SENS_BAT_SMT_COM =
                 ((C_CTR_MAX_MSG_SENS_BAT_SMT_COM +
                  C_CTR_MAX_SENS_BAT_SMT_COM_STOP)
                 (C_ABC_MAX_SENS_BAT_SMT_COM /
                  C_ABC_INC_SENS_BAT_SMT_COM ))
       Then         LV_END_DIAG_SENS_BAT_SMT_COM = 1
       Endif
    Else
       If         CTR_END_DIAG_SENS_BAT_SMT_COM =
                 C_CTR_MAX_MSG_SENS_BAT_SMT_COM
                 (C_ABC_MAX_SENS_BAT_SMT_COM /
                  C_ABC_INC_SENS_BAT_SMT_COM )
       Then         LV_END_DIAG_SENS_BAT_SMT_COM = 1
       Endif
    Endif
    If          STATE_BSD_COM = FFH      // time out for SENS_BAT_SMT is active//
    Then            CTR_MSG_SENS_BAT_SMT_COM_DIAG =
                CTR_MSG_SENS_BAT_SMT_COM_DIAG
               CTR_MSG_SENS_BAT_SMT_COM_STOP++
               //Communication passive during time slot to SENS_BAT_COM //
               LV_MSG_SENS_BAT_SMT_COM_STOP == 1
          If            CTR_MSG_SENS_BAT_SMT_COM_STOP =
                    C_CTR_MAX_SENS_BAT_SMT_COM_STOP
          Then            reset CTR_MSG_SENS_BAT_SMT_COM_DIAG == 0
               reset CTR_MSG_SENS_BAT_SMT_COM_STOP == 0
               reset LV_MSG_SENS_BAT_SMT_COM_STOP == 0
          Endif
    Else
        If          STATE_BSD_COM = 1H            // no acknowledge from SENS_BAT_SMT//
        Then            CTR_MSG_SENS_BAT_SMT_COM_DIAG++
          If          CTR_MSG_SENS_BAT_SMT_COM_DIAG =
                        C_CTR_MAX_MSG_SENS_BAT_SMT_COM
          //Error symptom detected, ABC increments//
          Then            ERR_SYM_SENS_BAT_SMT_COM = SYM_2
                    CTR_ABC_SENS_BAT_SMT_COM=
                        CTR_ABC_SENS_BAT_SMT_COM +
                      C_ABC_INC_SENS_BAT_SMT_COM
                    Limitation to C_ABC_MAX_SENS_BAT_SMT_COM
            If            CTR_ABC_SENS_BAT_SMT_COM =
                      C_ABC_MAX_SENS_BAT_SMT_COM
Then LV_ERR_SENS_BAT_SMT_COM == 1
        LV_END_DIAG_SENS_BAT_SMT_COM == 1
Endif
            If          C_CTR_MAX_SENS_BAT_SMT_COM_STOP<> (FFFFH or 0H)
            Then             CTR_MSG_SENS_BAT_SMT_COM_STOP++
```

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```
//Communication passive during time slot to SENS_BAT_COM //
LV_MSG_SENS_BAT_SMT_COM_STOP == 1
 If         CTR_MSG_SENS_BAT_SMT_COM_STOP =
     C_CTR_MAX_SENS_BAT_SMT_COM_STOP
Then         reset CTR_MSG_SENS_BAT_SMT_COM_DIAG == 0
     reset CTR_MSG_SENS_BAT_SMT_COM_STOP == 0
     reset LV_MSG_SENS_BAT_SMT_COM_STOP == 0
Endif
  Else      If       CTR_ABC_SENS_BAT_SMT_COM <
                C_ABC_MAX_SENS_BAT_SMT_COM
        Then            reset CTR_MSG_SENS_BAT_SMT_COM_DIAG == 0
        Else
        Endif
  Endif
 Endif
Else          CTR_MSG_SENS_BAT_SMT_COM_DIAG =
               CTR_MSG_SENS_BAT_SMT_COM_DIAG - 2
 If           CTR_MSG_SENS_BAT_SMT_COM_DIAG = 0
 //Error symptom detected, ABC decrements//
 Then            ERR_SYM_SENS_BAT_SMT_COM = NO_SYM
        CTR_ABC_SENS_BAT_SMT_COM=
        CTR_ABC_SENS_BAT_SMT_COM - 1
  If             CTR_ABC_SENS_BAT_SMT_COM = 0
Then LV_ERR_SENS_BAT_SMT_COM == 0
Endif
 Endif
Endif
Endif
Else      If      STATE_BSD_CPT = 3H      // time slot for CWP was active//
        CTR_END_DIAG_CWP_COM++                          // END_DIAG in case
no error//
    Then
      If          C_CTR_MAX_CWP_COM_STOP<> FFFFH
       Then
     If          CTR_END_DIAG_CWP_COM =
           ((C_CTR_MAX_MSG_CWP_COM +
            C_CTR_MAX_CWP_COM_STOP)
           (C_ABC_MAX_CWP_COM /
            C_ABC_INC_CWP_COM ))
     Then           LV_END_DIAG_CWP_COM = 1
     Endif
      Else
     If          CTR_END_DIAG_CWP_COM =
           C_CTR_MAX_MSG_CWP_COM
           (C_ABC_MAX_CWP_COM /
            C_ABC_INC_CWP_COM )
     Then           LV_END_DIAG_CWP_COM = 1
     Endif
      Endif
      If          STATE_BSD_COM = FFH          // time out for CWP is active//
      Then          CTR_MSG_CWP_COM_DIAG =
        CTR_MSG_CWP_COM_DIAG
```

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```
                LV_INH_CWP_DIAG = 1                              // time out CWP is active; no func.
Diag.//
              CTR_MSG_CWP_COM_STOP++
              //Communication passive during time slot to CWP //
              LV_MSG_CWP_COM_STOP == 1
            If          CTR_MSG_CWP_COM_STOP =
                    C_CTR_MAX_CWP_COM_STOP
            Then            reset CTR_MSG_CWP_COM_DIAG == 0
                    reset CTR_MSG_CWP_COM_STOP == 0
                    reset LV_MSG_CWP_COM_STOP == 0
            Endif
            Else
           If          STATE_BSD_COM = 8H             // no acknowledge from CWP//
           Then            CTR_MSG_CWP_COM_DIAG++
             If          CTR_MSG_CWP_COM_DIAG
                         C_CTR_THD_MSG_CWP_COM_DIAG
             Then              LV_INH_CWP_DIAG = 1               //CWP com.  BSD disturbed; no func.
Diag.//
             Endif
             If          CTR_MSG_CWP_COM_DIAG =
                         C_CTR_MAX_MSG_CWP_COM
             //Error symptom detected, ABC increments//
             Then              ERR_SYM_CWP_COM = SYM_2
                         CTR_ABC_CWP_COM=
                          CTR_ABC_CWP_COM +
                           C_ABC_INC_CWP_COM
                         Limitation to C_ABC_MAX_CWP_COM
              If              CTR_ABC_CWP_COM =
                          C_ABC_MAX_CWP_COM
                  Then          LV_ERR_CWP_COM == 1
            LV_END_DIAG_CWP_COM == 1
           Endif
              If          C_CTR_MAX_CWP_COM_STOP<> (FFFFH or 0H)
              Then              CTR_MSG_CWP_COM_STOP++
                    //Communication passive during time slot to CWP//
                    LV_MSG_CWP_COM_STOP == 1
               If          CTR_MSG_CWP_COM_STOP =
                           C_CTR_MAX_CWP_COM_STOP
               Then                reset CTR_MSG_CWP_COM_DIAG == 0
                    reset CTR_MSG_CWP_COM_STOP == 0
                    reset LV_MSG_CWP_COM_STOP == 0
                     reset LV_INH_CWP_DIAG == 0                     //reset com.  disturbance
bit.//
               Endif
              Else         If         CTR_ABC_CWP_COM <
                                C_ABC_MAX_CWP_COM
                   Then                   reset CTR_MSG_CWP_COM_DIAG == 0
                   Else
                      Endif
              Endif
             Endif
           Else          CTR_MSG_CWP_COM_DIAG =
```

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```
                    CTR_MSG_CWP_COM_DIAG - 2
        If          CTR_MSG_CWP_COM_DIAG <
                C_CTR_THD_MSG_CWP_COM_DIAG
        Then            LV_INH_CWP_DIAG = 0            //reset com. disturbance bit.//
        Endif
        If          CTR_MSG_CWP_COM_DIAG = 0
        //Error symptom detected, ABC decrements//
        Then            ERR_SYM_CWP_COM = NO_SYM
                CTR_ABC_CWP_COM=
                CTR_ABC_CWP_COM - 1
          If            CTR_ABC_CWP_COM = 0
              Then          LV_ERR_CWP_COM == 0
        Endif
        Endif
      Endif
      Endif
    Else      If      STATE_BSD_CPT = 4H                    // time slot for QOIL was
active//
              CTR_END_DIAG_QOIL_COM++                       // END_DIAG in case
no error//
      Then
       If          C_CTR_MAX_QOIL_COM_STOP<> FFFFH
           Then
         If         CTR_END_DIAG_QOIL_COM =
              ((C_CTR_MAX_MSG_QOIL_COM +
               C_CTR_MAX_QOIL_COM_STOP)
              (C_ABC_MAX_QOIL_COM /
               C_ABC_INC_QOIL_COM ))
         Then            LV_END_DIAG_QOIL_COM = 1
         Endif
       Else
         If              CTR_END_DIAG_QOIL_COM =
              C_CTR_MAX_MSG_QOIL_COM
              (C_ABC_MAX_QOIL_COM /
               C_ABC_INC_QOIL_COM )
         Then            LV_END_DIAG_QOIL_COM = 1
         Endif
       Endif
       If           STATE_BSD_COM = FFH           // time out for QOIL is active//
       Then             CTR_MSG_QOIL_COM_DIAG =
              CTR_MSG_QOIL_COM_DIAG
             CTR_MSG_QOIL_COM_STOP++
             //Communication passive during time slot to QOIL //
             LV_MSG_QOIL_COM_STOP == 1
         If              CTR_MSG_QOIL_COM_STOP =
                   C_CTR_MAX_QOIL_COM_STOP
         Then              reset CTR_MSG_QOIL_COM_DIAG == 0
                   reset CTR_MSG_QOIL_COM_STOP == 0
                   reset LV_MSG_QOIL_COM_STOP == 0
         Endif
       Else
         If          STATE_BSD_COM = 10H              // no acknowledge from QOIL//
```

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```
Then        CTR_MSG_QOIL_COM_DIAG++
    If        CTR_MSG_QOIL_COM_DIAG =
          C_CTR_MAX_MSG_QOIL_COM
  //Error symptom detected, ABC increments//
  Then              ERR_SYM_QOIL_COM = SYM_2
                CTR_ABC_QOIL_COM=
               CTR_ABC_QOIL_COM +
                C_ABC_INC_QOIL_COM
                    Limitation to C_ABC_MAX_QOIL_COM
   If               CTR_ABC_QOIL_COM =
          C_ABC_MAX_QOIL_COM
    Then         LV_ERR_QOIL_COM == 1
  LV_END_DIAG_QOIL_COM == 1
 Endif
   If        C_CTR_MAX_QOIL_COM_STOP<> (FFFFH or 0H)
   Then                CTR_MSG_QOIL_STOP++
       //Communication passive during time slot to QOIL//
       LV_MSG_QOIL_COM_STOP == 1
    If        CTR_MSG_QOIL_STOP =
        C_CTR_MAX_QOIL_COM_STOP
    Then                reset CTR_MSG_QOIL_COM_DIAG == 0
        reset CTR_MSG_QOIL_COM_STOP == 0
        reset LV_MSG_QOIL_COM_STOP == 0
    Endif
   Else       If        CTR_ABC_QOIL_COM <
                C_ABC_MAX_QOIL_COM
      Then                  reset CTR_MSG_QOIL_COM_DIAG == 0
      Else
      Endif
   Endif
  Endif
Else        CTR_MSG_QOIL_COM_DIAG =
             CTR_MSG_QOIL_COM_DIAG - 2
  If        CTR_MSG_QOIL_COM_DIAG = 0
  //Error symptom detected, ABC decrements//
  Then              ERR_SYM_QOIL_COM = NO_SYM
      CTR_ABC_QOIL_COM=
          CTR_ABC_QOIL_COM - 1
   If               CTR_ABC_QOIL_COM = 0
      Then        LV_ERR_QOIL_COM == 0
 Endif
  Endif
Endif
Endif
Else      If       STATE_BSD_CPT = 6H                // time slot for ALTER was active//
                   CTR_END_DIAG_ALTER_COM++          // END_DIAG in case no error//
Then
  If        C_CTR_MAX_ALTER_COM_STOP<> FFFFH
   Then
    If        CTR_END_DIAG_ALTER_COM =
```

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```
                ((C_CTR_MAX_MSG_ALTER_COM +
                 C_CTR_MAX_ALTER_COM_STOP)
                (C_ABC_MAX_ALTER_COM /
                 C_ABC_INC_ALTER_COM ))
   Then                      LV_END_DIAG_ALTER_COM = 1
   Endif
Else
   If                  CTR_END_DIAG_ALTER_COM =
                C_CTR_MAX_MSG_ALTER_COM
                (C_ABC_MAX_ALTER_COM /
                 C_ABC_INC_ALTER_COM )
   Then                      LV_END_DIAG_ALTER_COM = 1
   Endif
Endif
If          STATE_BSD_COM = FFH                    // time out for ALTER is active//
Then            CTR_MSG_ALTER_COM_DIAG =
          CTR_MSG_ALTER_COM_DIAG
        CTR_MSG_ALTER_COM_STOP++
        //Communication passive during time slot to ALTER //
        LV_MSG_ ALTER _COM_STOP == 1
   If                  CTR_MSG_ ALTER _COM_STOP =
              C_CTR_MAX_ ALTER _COM_STOP
   Then                      reset CTR_MSG_ ALTER _COM_DIAG == 0
              reset CTR_MSG_ ALTER _COM_STOP == 0
              reset LV_MSG_ ALTER _COM_STOP == 0
   Endif
Else
 If           STATE_BSD_COM = 40H                    // no acknowledge from ALTER//
 Then            CTR_MSG_ALTER_COM_DIAG++
               If          CTR_MSG_ALTER_COM_DIAG =
              C_CTR_MAX_MSG_ALTER_COM
        //Error symptom detected, ABC increments//
        Then                       ERR_SYM_ALTER_COM = SYM_2
               CTR_ABC_ALTER_COM=
                     CTR_ABC_ALTER_COM +
                      C_ABC_INC_ALTER_COM
                    Limitation to C_ABC_MAX_ALTER_COM
         If                        CTR_ABC_ALTER_COM =
                   C_ABC_MAX_ALTER_COM
          Then                 LV_ERR_ALTER_COM == 1
        LV_END_DIAG_ALTER_COM == 1
         Endif
         If           C_CTR_MAX_ALTER_COM_STOP<> (FFFFH or 0H)
         Then                         CTR_MSG_ALTER_STOP++
                //Communication passive during time slot to ALTER//
                LV_MSG_ALTER_COM_STOP == 1
          If          CTR_MSG_ALTER_STOP =
                   C_CTR_MAX_ALTER_COM_STOP
          Then                           reset CTR_MSG_ALTER_COM_DIAG == 0
                   reset CTR_MSG_ALTER_COM_STOP == 0
                   reset LV_MSG_ALTER_COM_STOP == 0
          Endif
```

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```
                    Else      If        CTR_ABC_ALTER_COM <
                                   C_ABC_MAX_ALTER_COM
                         Then                     reset CTR_MSG_ALTER_COM_DIAG == 0
                         Else
                         Endif
                    Endif
                   Endif
               Else         CTR_MSG_ALTER_COM_DIAG =
                            CTR_MSG_ALTER_COM_DIAG - 2
                   If                   CTR_MSG_ALTER_COM_DIAG = 0
                   //Error symptom detected, ABC decrements//
                   Then                     ERR_SYM_ALTER_COM = NO_SYM
                        CTR_ABC_QOIL_COM=
                             CTR_ABC_QOIL_COM - 1
                     If                     CTR_ABC_QOIL_COM = 0
                        Then                LV_ERR_QOIL_COM == 0
                   Endif

                   Endif
               Endif
           Endif
       Endif
     Endif
Endif
```

With:
STATE_BSD_MSG_COM_STOP = LV_MSG_xxx_COM_STOP

STATE_BSD_CPT	STATE_BSD_MSG_COM_STOP
0H --SENS_BAT_SMT-intelligent battery sensor	1H = LV_MSG_SENS_BAT_SMT_COM_STOP=1
3H -- CWP- electrical coolant water pump	2H = LV_MSG_CWP_COM_STOP = 1
4H - QOIL - oil quality sensor (QLT)	4H = LV_MSG_QOIL_COM_STOP = 1
6H -- ALTER - alternator	8H = LV_MSG_ALTER_COM_STOP = 1

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A.99 CAN bus off diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_CAN_BOFF	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom CAN_BOFF					
ERR_SYM_LOCAN_BOFF	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom Boff diagnosis LOCAN					
LV_CDN_DIAG_CAN_BOFF	O/V	0... 1H	0 ...1	1	-
Diagnosis condition CAN_BOFF					
LV_CDN_DIAG_LOCAN_BOFF	O/V	0... 1H	0 ...1	1	-
Diagnosis condition LOCAN Boff diagnosis					
LV_END_DIAG_CAN_BOFF	O/V	0... 1H	0 ...1	1	-
End of Diagnosis CAN_BOFF					
LV_END_DIAG_LOCAN_BOFF	O/V	0... 1H	0 ...1	1	-
End of Diagnosis Boff diagnosis LOCAN					
LV_ERR_CAN_BOFF	O/V	0... 1H	0 ...1	1	-
Present error CAN bus off					
LV_ERR_LOCAN_BOFF	O/V	0... 1H	0 ...1	1	-
Present error LOCAN bus off					

Input data:

LV_CDN_VB_CAN_DIAG {p. 1185}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_CAN_BOFF	-	0... FFH	0... 255	1	-
Anti-Bounce counter increment for CAN diagnosis "Can Bus off detected by CAN"					
C_ABC_INC_LOCAN_BOFF	-	0... FFH	0... 255	1	-
Anti bounce counter increment - diagnosis of LOCAN bus on /off					
C_ABC_MAX_CAN_BOFF	-	1... FFH	1... 255	1	-
Anti-Bounce counter maximum for CAN diagnosis "CAN Bus off detected by CAN"					
C_ABC_MAX_LOCAN_BOFF	-	1... FFH	1... 255	1	-
Anti bounce counter maximum value - diagnosis of LOCAN bus on /off					

A.99.1 PT-CAN bus off diagnosis

FUNCTION DESCRIPTION

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General information:

This diagnosis is working for BN2000 and CAN11H.

Description:

From CPU- CAN- controller a message is sent if CAN bus is on or off (internal). This diagnosis takes place every 10 ms at all engine operating states with ignition key on.
If CAN bus off is active the anti bounce counter is incremented by C_ABC_INC_CAN_BOFF. If the anti bounce counter reaches the calibratable threshold C_ABC_MAX_CAN_BOFF then the error bit LV_ERR_CAN_BOFF is set to 1.

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │  │  │  └─> -                                        (= SYM_0)
 │  │  └───> -                                         (= SYM_1)
 │  └─────> CAN bus off controller                     (= SYM_2)
 └───────> -                                           (= SYM_3)
```

Application conditions

Initialisation: *STD_INI*

Recurrence: *10 ms*

Activation:

```
If    LV_CDN_VB_CAN_DIAG = 1
  Then   LV_CDN_DIAG_CAN_BOFF = 1
Else   LV_CDN_DIAG_CAN_BOFF = 0
Endif
```

Formula section:

Detection of error symptom

If CAN bus off = active
Then ERR_SYM_CAN_BOFF = SYM_2
LV_ERR_CAN_BOFF = 1 *(after debounce)*
Else ERR_SYM_ CAN_BOFF = NO_SYM
LV_ERR_CAN_BOFF = 0 *(after rebounce)*
Endif

Calculation end of diagnosis
LV_END_DIAG_CAN_BOFF is calculated by error management

A.99.2 LOCAN bus off diagnosis

FUNCTION DESCRIPTION

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General information:

This diagnosis is working for LOCAN applications like EFP - control or NOX - sensors.

Description:

From CPU hardware a message is sent if CAN bus is on or off (internal). This diagnosis takes place every 10 ms at all engine operating states with ignition key on.
If CAN bus off is active the anti bounce counter is incremented by C_ABC_INC_LOCAN_BOFF. If the anti bounce counter reaches the calibratable threshold C_ABC_MAX_LOCAN_BOFF then the error bit LV_ERR_LOCAN_BOFF is set to 1.

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │  │  │  └─> -                              (= SYM_0)
 │  │  └───> -                               (= SYM_1)
 │  └─────> LOCAN bus off                    (= SYM_2)
 └───────> LOCAN TxWARN or RxWARN            (= SYM_3)
```

Application conditions

Initialisation: *STD_INI*

Recurrence: *10 ms*

Activation:

```
If      LV_CDN_VB_CAN_DIAG = 1
  Then  LV_CDN_DIAG_LOCAN_BOFF = 1
Else    LV_CDN_DIAG_LOCAN_BOFF = 0
Endif
```

Formula section:

Detection of error symptom

If LOCAN bus off = active
Then ERR_SYM_LOCAN_BOFF = SYM_2
LV_ERR_LOCAN_BOFF = 1 *(after debounce)*
Else ERR_SYM_ LOCAN_BOFF = NO_SYM
LV_ERR_LOCAN_BOFF = 0 *(after rebounce)*
EndIf

Calculation end of diagnosis
LV_END_DIAG_LOCAN_BOFF is calculated by error management

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A.100 CAN functional diagnosis electronic transmission control unit

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_COM_GB	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom for diagnosis					
LV_CDN_DIAG_COM_GB	V	0... 1H	0 ...1	1	-
condition bit for diagnosis					
LV_END_DIAG_COM_GB	V	0... 1H	0 ...1	1	-
end bit for diagnosis					
LV_ERR_COM_GB	O/V	0... 1H	0 ...1	1	-
Error indicating problem in communication from gearbox to engine management					

Input data:

LV_ERR_BN_ETCU {p. 4870}	LV_ERR_BN_ETCU_2 {p. 4870}	LV_ERR_BN_ETCU_3 {p. 4870}	LV_ERR_BN_STAT_TCT {p. 4870}
LV_ERR_BN_TQ_ETCU {p. 4871}	LV_ERR_BN_TQ_TCT {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_TOUT_ETCU_1 {p. 802}
LV_ERR_TOUT_ETCU_2 {p. 802}	LV_IGK {p. 906}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_COM_GB	-	0... FFH	0... 255	1	-
diagnosis decrement					
C_ABC_INC_COM_GB	-	0... FFH	0... 255	1	-
diagnosis increment					
C_ABC_MAX_COM_GB	-	1... FFH	1... 255	1	-
diagnosis error threshold					

Error treatment:

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Error indicating problem in communication from gearbox to engine management	COM_GB	-	0	STD_INI	CC
		-	1		
		communication error	2		
		-	3		

Possible configuration for ABC type and CARB class (see also “Table of Failure”)
ABC Type: STD_INI, STD, MEM, MEM_INI, DEC_CAL, STC, NO, MPL_STD_INI
CARB Class: MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO

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FUNCTION DESCRIPTION:

This diagnosis checks if the communication path from gearbox control unit to engine control unit is disturbed. If this is detected an ERRM entry is done.

Application conditions

Initialisation: ***STD_INI***

Recurrence: *1 s*

Activation: *LV_IGK = 1, at deactivation set LV_CDN_DIAG_COM_GB = 0*

Formula section:

LV_CDN_DIAG_COM_GB = 1
If LV_ERR_BN_ETCU = 1 **or**
LV_ERR_BN_ETCU_2 = 1 **or**
LV_ERR_BN_ETCU_3 = 1 **or**
LV_ERR_BN_TQ_ETCU = 1 **or**
LV_ERR_BN_TQ_TCT = 1 **or**
LV_ERR_BN_STAT_TCT = 1 **or**
LV_ERR_CAN_BOFF = 1 **or**
LV_ERR_TOUT_ETCU_1 = 1 **or**
LV_ERR_TOUT_ETCU_2 = 1
then ERR_SYM_COM_GB = SYM_2
else ERR_SYM_COM_GB = NO_SYM
endif

Calculation of the end of diagnosis and LV_ERR_xxx:
LV_END_DIAG_COM_GB and LV_ERR_COM_GB calculated by ERRM

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A.101 Internal CAN diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ABC_TQ_REQ_CAN	O/V	0... FFH	0... 255	1	-
anti-bounce counter of TQ-request via CAN					
ERR_SYM_TQ_REQ_CAN	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
detected symptom of TQ-request via CAN					
LV_CDN_DIAG_TQ_REQ_CAN	O/V	0... 1H	0 ...1	1	-
condition of TQ-request via CAN					
LV_END_DIAG_TQ_REQ_CAN	O/V	0... 1H	0 ...1	1	-
end of diagnosis of TQ-request via CAN					
LV_ERR_TQ_REQ_CAN	O/V	0... 1H	0 ...1	1	-
Torque request via CAN not plausible					
STATE_TQ_CAN_PLAUS	O/V	0... FFH	0... 255	1	-
State indicating which ECU is rejected due to TQ-plausibility-error via CAN					

Input data:

ECU_STATE {p. 1091}	LV_CDN_VB_BN_DIAG {p. 1185}	LV_ERR_SYM_TQ_DCC_CS {p. 1710}	STATE_TQ_AMT_PLAUS {p. 809}
STATE_TQ_ARS_PLAUS {p. 6650}	STATE_TQ_DCC_PLAUS {p. 6731}	STATE_TQ_ETCU_PLAUS {p. 6718}	STATE_TQ_PSTE_2_PLAUS {p. 6621}
STATE_TQ_PSTE_3_PLAUS {p. 6621}	STATE_TQ_TCS_PLAUS {p. 6741}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TQ_REQ_CAN	-	0... FFH	0... 255	1	-
Anti bounce increment value, TQ-plausibility via CAN					
C_ABC_MAX_TQ_REQ_CAN	-	1... FFH	1... 255	1	-
Anti-bounce max. value, TQ-plausibility via CAN					
C_STATE_TQ_CAN_PLAUS_ENA	-	0... FFH	0... 255	1	-
Mask for selective enabling of diagnoses					
LC_TQ_CAN_PLAUS_INFO	-	0... 1H	0 ...1	1	-
LC for selective information of diagnosis					

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FUNCTION DESCRIPTION:

General information:

The torque functionality detects if the torque requests via CAN are not plausible.

As a consequence of that further torque requests of the respective control unit are rejected. The purpose of this diagnosis is to provide the information when a ECU is rejected by error-entry in the FMY. Through environmental data (STATE_TQ_CAN_PLAUS) the information is given which ECU has been rejected.
Additional there is the possibility to calibrate via LC_TQ_CAN_PLAUS which failure of the respective ECU lead to the error entry.

If a torque-plausibility-error is detected by the torque calculation (STATE_TQ_xxx_PLAUS =) the error symptom is set and the anti bounce counter is incremented by C_ABC_INC_TQ_REQ_CAN. If the plausibility error is not present any longer, the anti bounce counter is decremented.

Application conditions

Initialisation:
```
according ERRM initialization type "STD_INI"
  //reset at LV_IGK 0->1 or reset
```

Recurrence:
```
10 ms
```

Activation:
```
If     LV_CDN_VB_BN_DIAG = 1           and
           LV_ES   = 0
  Then   LV_CDN_DIAG_TQ_REQ_CAN = 1
```

Deactivation:
```
If     LV_CDN_VB_BN_DIAG = 0           or
           LV_ES   = 1                  or
       ECU_STATE = PWL
  Then   LV_CDN_DIAG_TQ_REQ_CAN = 0
  Endif
```

Formula section:

IF Bit x of STATE_TQ_xxx_PLAUS is set **and**
Bit x of C_STATE_TQ_CAN_PLAUS is set **and**
Depending on LC_TQ_CAN_PLAUS_INFO
// - -> see below

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STATE_TQ_xxx_PLAUS	Bits [0...15]	Condition	C_STATE_TQ_CAN_PLAUS_ENA Bits [0...7]	Condition	LC_TQ_CAN_PLAUS_INFO	Action	STATE_TQ_CAN_PLAUS Bits [0...7]
STATE_TQ_TCS_PLAUS	2	&&	**0**	&&	**x**	**=**	Bit 0 (= dez 1)
STATE_TQ_AMT_PLAUS	3	&&	**1**	&&	**x**	**=**	Bit 1 (= dez 2)
STATE_TQ_ETCU_PLAUS	2,3	&&	**2**	&&	**0**	**=**	Bit 2 (= dez 4)
	2	&&		&&	**1**	**=**	Bits 2+0 (= dez 5)
	3	&&		&&	**1**	**=**	Bits 2+1 (= dez 6)
STATE_TQ_DCC_PLAUS	5	&&	**3**	&&	**x**	**=**	Bit 3 (= dez 8)
STATE_TQ_ARS_PLAUS	2,3	&&	**4**	&&	**0**	**=**	Bit 4 (= dez 16)
	2	&&		&&	**1**	**=**	Bits 4+0 (= dez 17)
	3	&&		&&	**1**	**=**	Bits 4+1 (= dez 18)
STATE_TQ_PSTE_2_PLAUS	0,1,2	&&	**5**	&&	**0**	**=**	Bit 5 (= dez 32)
	0	&&		&&	**1**	**=**	Bits 5+0 (= dez 33)
	1	&&		&&	**1**	**=**	Bits 5+1 (= dez 34)
	2	&&		&&	**1**	**=**	Bits 5+1+0 (= dez 35)
LV_ERR_SYM_TQ_DCC_CS	-	&&	**6**	&&	**x**	**=**	Bit 6 (= dez 64)
STATE_TQ_PSTE_3_PLAUS	0,1	&&	**7**	&&	**0**	**=**	Bit 7 (= dez 128)
	0	&&		&&	**1**	**=**	Bits 7 + 0 (= dez 129)
	1	&&		&&	**1**	**=**	Bits 7 + 1 (= dez 130)

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Steuergerät	DSC	SMG	EGS	ACC	ARS	AFS	ACC-HS	EHB3

THEN Bit x of STATE_TQ_CAN_PLAUS is set
ERR_SYM_TQ_REQ_CAN = SYM_3
LV_ERR_TQ_REQ_CAN = 1 after debounce
ELSE ERR_SYM_TQ_REQ_CAN = NO_SYM
LV_ERR_TQ_REQ_CAN = 0 after rebounce
ENDIF

End of diagnosis calculation LV_END_DIAG_TQ_REQ_CAN:

- see chapter “Anti-bounce Algorithm: Calculation of the end of diagnosis”

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A.102 Local CAN diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CYC_CTR_NOX_SENS_i_DIAG	V	0... FFH	0... 255	1	-
counter of not received NOX_SENS_i messages					
LV_ERR_TOUT_NOX_SENS [_i]	O/V	0... 1H	0 ...1	1	-
logical variable timeout error CAN message NOX_SENS_i (NOX_SENS - sensor bank i)					
Masked Variable [_i]	O/V	0... 1H	0 ...1	1	-
Diagnosis condition NOX_SENS_i					
Masked Variable [_i]	O/V	0H 4H	NO_SYM SYM_3	-	-
Detected Symptom NOX_SENS_i					
Masked Variable [_i]	O/V	0... 1H	0 ...1	1	-
End of diagnosis NOX_SENS_i					

Input data:

LV_CDN_VB_CAN_DIAG {p. 1185}	LV_ERR_LOCAN_BOFF {p. 4846}	LV_IGK {p. 906}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TOUT_NOX_SENS	-	0... FFH	0... 255	1	-
anti bounce counter increment - diagnosis of timeout CAN message NOX_SENS					
C_ABC_MAX_TOUT_NOX_SENS	-	1... FFH	1... 255	1	-
anti bounce counter maximum value - diagnosis of timeout CAN message NOX_SENS					
C_NOX_SENS_CYCNR_MAX	-	1... FFH	1... 255	1	-
maximum number of missing NOX_SENS messages for error debounce counter increment					

FUNCTION DESCRIPTION

General information:

The following CAN diagnosis are defined:

- Timeout CAN messages NOX

A.102.1 Timeout CAN messages NOX

Description:

The counter CYC_CTR_NOX_SENS_i_DIAG are always incremented if the CAN messages NOX_SENS_i have not been received. The counter are set to 0 if a CAN message NOX_SENS_i has been received or if the counter has reached his maximum value C_NOX_SENS_CYCNR_MAX.
If these counters have reached the calibratable threshold C_NOX_SENS_CYCNR_MAX and there is no CAN message NOX_SENS_i then the error symptom is set and the anti bounce counter is incremented by C_ABC_INC_TOUT_NOX_SENS. If a CAN message NOX_SENS_i is received, the anti bounce counter is decremented. If the anti bounce counter has reached his maximum value C_ABC_MAX_TOUT_NOX_SENS the timeout error CAN message NOX_SENS (LV_ERR_TOUT_NOX_SENS_i) is set.

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Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
│ │ │ └─> -                                (= SYM_0)
│ │ └───> -                                (= SYM_1)
│ └─────> Timeout signal NOX_SENS_i        (= SYM_2)
└───────> -                                (= SYM_3)
```

Application conditions

Initialisation: all 0 at Transition LV_IGK 0->1 or reset or at clearing error memory

Recurrence: *10 ms*

Activation:

```
If      LV_CDN_VB_CAN_DIAG =  1       and
    NOX-message has been received via LoCAN at least for once
and
    LV_ERR_LOCAN_BOFF = 0
    Then      LV_CDN_DIAG_TOUT_NOX_SENS_i = 1
 Else      LV_CDN_DIAG_TOUT_NOX_SENS_i = 0
 Endif
```

Formula section:

Calculation of time-out counter

If no CAN message NOX_SENS_i received

Then CYC_CTR_NOX_SENS_i_DIAG $_N$ = CYC_CTR_NOX_SENS_i_DIAG $_{N-1}$ +1

Else CYC_CTR_NOX_SENS_i_DIAG = 0 *(reset)*

EndIf

Detection of error symptom

If(1) CYC_CTR_NOX_SENS_i_DIAG = C_NOX_SENS_CYCNR_MAX

Then(1) CYC_CTR_NOX_SENS_i_DIAG = 0 *(reset)*

If(2) no CAN message NOX_SENS_i is received

Then(2) ERR_SYM_TOUT_NOX_SENS_i = SYM_2 *Timeout is detected*

ABC counter starts to increment

LV_ERR_TOUT_NOX_SENS_i = 1 *(after debounce)*

Else(2) ERR_SYM_TOUT_NOX_SENS_i = NO_SYM

ABC counter starts to decrement

LV_ERR_TOUT_NOX_SENS_i = 0 *(after rebounce)*

EndIf(2)

EndIf(1)

Calculation end of diagnosis

LV_END_DIAG_TOUT_NOX_SENS_i is calculated by error management

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A.103 PT-CAN diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DIAG_CKS_CAS	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_ETCU	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_ETCU_3	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_LDM	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_MSW	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_REQ_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_TQ_AMT	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_TQ_DCC	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_TQ_ETCU	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_TQ_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_TQ_PSTE_2	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_TQ_PSTE_3	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_TQ_TCS	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_TQ_TCT	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_CKS_VEH_MOD	V	0... FFH	0... 255	1	-
Diagnosis counter for checksum counter error symptom detection					
CTR_DIAG_TCC_CAN_ARS	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_CAS	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_ETCU	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_ETCU_3	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DIAG_TCC_CAN_ICL	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_LDM	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_MSW	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_REQ_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_SPT_SWI	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_T_CLK	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_TQ_AMT	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_TQ_DCC	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_TQ_ETCU	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_TQ_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_TQ_PSTE_2	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_TQ_PSTE_3	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_TQ_TCS	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_TQ_TCT	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TCC_CAN_VEH_MOD	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TOUT_ACC	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_ANG_PSTE	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_ARS	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_CAS	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_CDN_DOOR	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_DHL_CTL	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DIAG_TOUT_EFP	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_EFP_CRASH	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_ETCU	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_ETCU_2	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_ETCU_3	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_ETCU_DISP	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_GEAR_REV	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_ICL	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_KM_ICL	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_LDM	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_LTG_HDLP_L	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_MSW	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_POW_GEN	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_POW_VB	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_REQ_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_SPT_SWI	V	0... FFH	0... 255	1	-
Diagnosis counter for alive-counter error symptom detection					
CTR_DIAG_TOUT_STAT_TCT	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_T_CLK	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_T_ICL	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TCS	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TQ_AMT	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DIAG_TOUT_TQ_DCC	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TQ_ETCU	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TQ_PBR	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TQ_PSTE_2	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TQ_PSTE_3	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TQ_TCS	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TQ_TCT	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_TRL	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_VEH_MOD	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_VS_TCS	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
CTR_DIAG_TOUT_WHEEL_CAN	V	0... FFH	0... 255	1	-
Diagnosis counter for timeout counter error symptom detection					
ERR_SYM_BN_ACC	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_ANG_PSTE	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_ARS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_BN_CAS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_CDN_DOOR	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_DHL_CTL	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_EFP	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_EFP_CRASH	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_ETCU	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_ETCU_2	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_BN_ETCU_3	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_ETCU_DISP	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_GEAR_REV	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_ICL	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_KM_ICL	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_LDM	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_LTG_HDLP_L	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_BN_MSW	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_PBR	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_POW_GEN	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_POW_VB	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_REQ_PBR	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_SPT_SWI	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom Communication on CAN diagnosis(Mdrive message)					
ERR_SYM_BN_STAT_TCT	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_BN_T_CLK	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_T_ICL	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TCS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TQ_AMT	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TQ_DCC	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TQ_ETCU	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TQ_PBR	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_BN_TQ_PSTE_2	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TQ_PSTE_3	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TQ_TCS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TQ_TCT	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_TRL	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_VEH_MOD	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
ERR_SYM_BN_VS_TCS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_BN_WHEEL_CAN	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom BN2000 diagnosis					
LV_CDN_DIAG_BN_ACC	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_ANG_PSTE	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_ARS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_CAS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_CDN_DOOR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_DHL_CTL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_EFP	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_EFP_CRASH	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_ETCU	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_ETCU_2	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_ETCU_3	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_ETCU_DISP	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_GEAR_REV	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_ICL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_KM_ICL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_LDM	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_LTG_HDLP_L	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_MSW	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_PBR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_BN_POW_GEN	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_POW_VB	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_REQ_PBR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_SPT_SWI	O/V	0... 1H	0 ...1	1	-
Diagnosis condition Communication on CAN diagnosis(Mdrive message)					
LV_CDN_DIAG_BN_STAT_TCT	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_T_CLK	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_T_ICL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TCS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TQ_AMT	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TQ_DCC	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TQ_ETCU	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TQ_PBR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TQ_PSTE_2	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TQ_PSTE_3	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TQ_TCS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TQ_TCT	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_TRL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_VEH_MOD	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_VS_TCS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_CDN_DIAG_BN_WHEEL_CAN	V	0... 1H	0 ...1	1	-
Diagnosis condition BN2000 diagnosis					
LV_END_DIAG_BN_ACC	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_ANG_PSTE	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_BN_ARS	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_CAS	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_CDN_DOOR	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_DHL_CTL	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_EFP	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_EFP_CRASH	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_ETCU	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_ETCU_2	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_ETCU_3	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_ETCU_DISP	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_GEAR_REV	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_ICL	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_KM_ICL	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_LDM	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_LTG_HDLP_L	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_MSW	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_PBR	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_POW_GEN	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_POW_VB	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_REQ_PBR	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_SPT_SWI	O/V	0... 1H	0 ...1	1	-
End of diagnosis Communication on CAN diagnosis(Mdrive message)					
LV_END_DIAG_BN_STAT_TCT	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_BN_T_CLK	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_T_ICL	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TCS	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TQ_AMT	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TQ_DCC	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TQ_ETCU	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TQ_PBR	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TQ_PSTE_2	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TQ_PSTE_3	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TQ_TCS	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TQ_TCT	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_TRL	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_VEH_MOD	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_VS_TCS	O/V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_END_DIAG_BN_WHEEL_CAN	V	0... 1H	0 ...1	1	-
End of diagnosis BN2000 diagnosis					
LV_ERR_BN_ACC	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_ANG_PSTE	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_ARS	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_CAS	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_CDN_DOOR	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_DHL_CTL	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_EFP	O/V	0... 1H	0 ...1	1	-
Present error BN2000					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_BN_EFP_CRASH	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_ETCU	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_ETCU_2	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_ETCU_3	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_ETCU_DISP	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_GEAR_REV	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_ICL	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_KM_ICL	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_LDM	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_LTG_HDLP_L	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_MSW	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_PBR	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_POW_GEN	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_POW_VB	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_REQ_PBR	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_SPT_SWI	O/V	0... 1H	0 ...1	1	-
Present error communication on PT-CAN					
LV_ERR_BN_STAT_TCT	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_T_CLK	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_T_ICL	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TCS	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TQ_AMT	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TQ_DCC	O/V	0... 1H	0 ...1	1	-
Present error BN2000					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_BN_TQ_ETCU	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TQ_PBR	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TQ_PSTE_2	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TQ_PSTE_3	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TQ_TCS	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TQ_TCT	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_TRL	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_VEH_MOD	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_VS_TCS	O/V	0... 1H	0 ...1	1	-
Present error BN2000					
LV_ERR_BN_WHEEL_CAN	O/V	0... 1H	0 ...1	1	-
Present error BN2000					

Input data:

C_T_DET_VAR_CAN {p. 658}	CKS_CAN_ETCU_3 {p. 1561}	CKS_CAN_PBR {p. 1561}	CKS_CAN_REQ_PBR {p. 1561}
CKS_CAN_TQ_PBR {p. 1561}	CKS_CLC_ETCU_3 {p. 1562}	CKS_CLC_PBR {p. 1562}	CKS_CLC_REQ_PBR {p. 1562}
CKS_CLC_TQ_PBR {p. 1562}	LV_AT {p. 654}	LV_VAR_4WD {p. 655}	LV_VAR_ACIN {p. 655}
LV_VAR_AMT {p. 655}	LV_VAR_ARS {p. 655}	LV_VAR_BN_EFP {p. 655}	LV_VAR_BN_GEAR_REV {p. 655}
LV_VAR_BN_LDM {p. 655}	LV_VAR_BN_LTG_HDLP_L {p. 655}	LV_VAR_BN_MSW {p. 655}	LV_VAR_BN_TRL {p. 655}
LV_VAR_DCC {p. 655}	LV_VAR_EFP_CRASH {p. 655}	LV_VAR_ETCU {p. 655}	LV_VAR_ETCU_3 {p. 655}
LV_VAR_ICL {p. 656}	LV_VAR_PBR {p. 656}	LV_VAR_PSTE {p. 656}	LV_VAR_PSTE_2 {p. 656}
LV_VAR_PSTE_3 {p. 656}	LV_VAR_SPT_SWI {p. 656}	LV_VAR_TCT {p. 656}	LV_VAR_TQ_PBR {p. 656}
LV_VAR_VEH {p. 656}	LV_VAR_VEH_MOD {p. 1568}	TCC_CAN_BN_SPT_SWI	TCC_CAN_ETCU_3 {p. 1580}
TCC_CAN_PBR {p. 1580}	TCC_CAN_REQ_PBR {p. 1580}	TCC_CAN_TQ_PBR {p. 1580}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_BN_ACC	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_ANG_PSTE	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_ARS	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_BN_CAS	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_CDN_DOOR	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_DHL_CTL	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_EFP	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_EFP_CRASH	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_ETCU	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_ETCU_2	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_ETCU_3	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_ETCU_DISP	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_GEAR_REV	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_ICL	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_KM_ICL	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_LDM	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_LTG_HDLP_L	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_MSW	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_PBR	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_POW_GEN	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_POW_VB	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_REQ_PBR	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_SPT_SWI	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement Communication on PT-CAN diagnosis (Mdrive message)					
C_ABC_DEC_BN_STAT_TCT	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_T_CLK	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_BN_T_ICL	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TCS	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TQ_AMT	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TQ_DCC	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TQ_ETCU	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TQ_PBR	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TQ_PSTE_2	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TQ_PSTE_3	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TQ_TCS	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TQ_TCT	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_TRL	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_VEH_MOD	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_VS_TCS	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_DEC_BN_WHEEL_CAN	-	0... FFH	0... 255	1	-
Anti-bounce counter decrement BN2000 diagnosis					
C_ABC_INC_BN_ACC	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_ANG_PSTE	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_ARS	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_CAS	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_CDN_DOOR	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_DHL_CTL	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_EFP	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_EFP_CRASH	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_BN_ETCU	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_ETCU_2	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_ETCU_3	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_ETCU_DISP	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_GEAR_REV	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_ICL	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_KM_ICL	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_LDM	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_LTG_HDLP_L	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_MSW	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_PBR	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_POW_GEN	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_POW_VB	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_REQ_PBR	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_SPT_SWI	-	0... FFH	0... 255	1	-
Anti-bounce counter increment Communication PT-CAN diagnosis (Mdrive message)					
C_ABC_INC_BN_STAT_TCT	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_T_CLK	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_T_ICL	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TCS	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TQ_AMT	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TQ_DCC	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TQ_ETCU	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_BN_TQ_PBR	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TQ_PSTE_2	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TQ_PSTE_3	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TQ_TCS	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TQ_TCT	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_TRL	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_VEH_MOD	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_VS_TCS	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_INC_BN_WHEEL_CAN	-	0... FFH	0... 255	1	-
Anti-bounce counter increment BN2000 diagnosis					
C_ABC_MAX_BN_ACC	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_ANG_PSTE	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_ARS	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_CAS	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_CDN_DOOR	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_DHL_CTL	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_EFP	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_EFP_CRASH	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_ETCU	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_ETCU_2	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_ETCU_3	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_ETCU_DISP	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_GEAR_REV	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_BN_ICL	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_KM_ICL	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_LDM	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_LTG_HDLP_L	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_MSW	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_PBR	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_POW_GEN	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_POW_VB	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_REQ_PBR	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_SPT_SWI	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum Communication PT-CAN diagnosis (Mdrive message)					
C_ABC_MAX_BN_STAT_TCT	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_T_CLK	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_T_ICL	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TCS	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TQ_AMT	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TQ_DCC	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TQ_ETCU	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TQ_PBR	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TQ_PSTE_2	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TQ_PSTE_3	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TQ_TCS	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_TQ_TCT	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_BN_TRL	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_VEH_MOD	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_VS_TCS	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_ABC_MAX_BN_WHEEL_CAN	-	1... FFH	1... 255	1	-
Anti-bounce counter maximum BN2000 diagnosis					
C_CTR_DIAG_CKS_MAX_CAS	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message CAS					
C_CTR_DIAG_CKS_MAX_ETCU	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message ETCU					
C_CTR_DIAG_CKS_MAX_ETCU_3	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message ETCU_3					
C_CTR_DIAG_CKS_MAX_LDM	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message LDM					
C_CTR_DIAG_CKS_MAX_MSW	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message MSW					
C_CTR_DIAG_CKS_MAX_PBR	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message PBR					
C_CTR_DIAG_CKS_MAX_REQ_PBR	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message REQ_PBR					
C_CTR_DIAG_CKS_MAX_TQ_AMT	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message TQ_AMT					
C_CTR_DIAG_CKS_MAX_TQ_DCC	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message TQ_DCC					
C_CTR_DIAG_CKS_MAX_TQ_ETCU	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message TQ_ETCU					
C_CTR_DIAG_CKS_MAX_TQ_PBR	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message ETCU_3					
C_CTR_DIAG_CKS_MAX_TQ_PSTE_2	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message TQ_PSTE_2					
C_CTR_DIAG_CKS_MAX_TQ_PSTE_3	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message TQ_PSTE_3					
C_CTR_DIAG_CKS_MAX_TQ_TCS	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message TQ_TCS					
C_CTR_DIAG_CKS_MAX_TQ_TCT	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message TQ_TCT					
C_CTR_DIAG_CKS_MAX_VEH_MOD	-	0... FFH	0... 255	1	-
Maximum number of wrong Checksum calculation events before error detection of message VEH_MOD					
C_CTR_DIAG_TCC_CAN_MAX_ARS	-	0... FFH	0... 255	1	-
Maximum number of wrong ATCC_CANe counrt events before error detection of message ARS					
C_CTR_DIAG_TCC_CAN_MAX_CAS	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN counrt events before error detection of message CAS					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DIAG_TCC_CAN_MAX_ETCU	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN counrt events before error detection of message ETCU_3					
C_CTR_DIAG_TCC_CAN_MAX_ETCU_3	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN counrt events before error detection of message ETCU_3					
C_CTR_DIAG_TCC_CAN_MAX_ICL	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN counrt events before error detection of message ICL					
C_CTR_DIAG_TCC_CAN_MAX_LDM	-	0... FFH	0... 255	1	-
Maximum number of wrong LDM_CAN counrt events before error detection of message LDM					
C_CTR_DIAG_TCC_CAN_MAX_MSW	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN counrt events before error detection of message MSW					
C_CTR_DIAG_TCC_CAN_MAX_PBR	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN counter events before error detection of message PBR					
C_CTR_DIAG_TCC_CAN_MAX_REQ_PBR	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN counter events before error detection of message REQ_PBR					
C_CTR_DIAG_TCC_CAN_MAX_SPT_SWI	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC count events before error detection of message BN_SPT_SWI					
C_CTR_DIAG_TCC_CAN_MAX_T_CLK	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN counrt events before error detection of message T_CLK					
C_CTR_DIAG_TCC_CAN_MAX_TQ_AMT	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN counrt events before error detection of message TQ_AMT					
C_CTR_DIAG_TCC_CAN_MAX_TQ_DCC	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN counrt events before error detection of message TQ_DCC					
C_CTR_DIAG_TCC_CAN_MAX_TQ_ETCU	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN counrt events before error detection of message TQ_ETCU					
C_CTR_DIAG_TCC_CAN_MAX_TQ_PBR	-	0... FFH	0... 255	1	-
Maximum number of wrong alive counter events for error debounce counter increment					
C_CTR_DIAG_TCC_CAN_MAX_TQ_PSTE_2	-	0... FFH	0... 255	1	-
Maximum number of wrong ATCC_CANe counrt events before error detection of message TQ_PSTE_2					
C_CTR_DIAG_TCC_CAN_MAX_TQ_PSTE_3	-	0... FFH	0... 255	1	-
Maximum number of wrong ATCC_CANe counrt events before error detection of message TQ_PSTE_3					
C_CTR_DIAG_TCC_CAN_MAX_TQ_TCS	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN counrt events before error detection of message TQ_TCS					
C_CTR_DIAG_TCC_CAN_MAX_TQ_TCT	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN counrt events before error detection of message TQ_TCT					
C_CTR_DIAG_TCC_CAN_MAX_VEH_MOD	-	0... FFH	0... 255	1	-
Maximum number of wrong TCC_CAN counrt events before error detection of message VEH_MOD					
C_CTR_DIAG_TOUT_MAX_ACC	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message ACC					
C_CTR_DIAG_TOUT_MAX_ANG_PSTE	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message ANG_PSTE					
C_CTR_DIAG_TOUT_MAX_ARS	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message ARS					
C_CTR_DIAG_TOUT_MAX_CAS	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message CAS					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DIAG_TOUT_MAX_CDN_DOOR	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message CDN_DOOR					
C_CTR_DIAG_TOUT_MAX_DHL_CTL	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message DHL_CTL					
C_CTR_DIAG_TOUT_MAX_EFP	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message EFP					
C_CTR_DIAG_TOUT_MAX_EFP_CRASH	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message EFP_CRASH					
C_CTR_DIAG_TOUT_MAX_ETCU	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message ETCU					
C_CTR_DIAG_TOUT_MAX_ETCU_2	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message ETCU_2					
C_CTR_DIAG_TOUT_MAX_ETCU_3	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message ETCU_3					
C_CTR_DIAG_TOUT_MAX_ETCU_DISP	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message ETCU_DISP					
C_CTR_DIAG_TOUT_MAX_GEAR_REV	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message GEAR_REV					
C_CTR_DIAG_TOUT_MAX_ICL	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message ICL					
C_CTR_DIAG_TOUT_MAX_KM_ICL	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message KM_ICL					
C_CTR_DIAG_TOUT_MAX_LDM	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message LDM					
C_CTR_DIAG_TOUT_MAX_LTG_HDLP_L	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message LTG_HDLP_L					
C_CTR_DIAG_TOUT_MAX_MSW	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message MSW					
C_CTR_DIAG_TOUT_MAX_PBR	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message PBR					
C_CTR_DIAG_TOUT_MAX_POW_GEN	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message POW_GEN					
C_CTR_DIAG_TOUT_MAX_POW_VB	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message POW_VB					
C_CTR_DIAG_TOUT_MAX_REQ_PBR	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message REQ_PBR					
C_CTR_DIAG_TOUT_MAX_SPT_SWI	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message BN_SPT_SWI					
C_CTR_DIAG_TOUT_MAX_STAT_TCT	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message ACC					
C_CTR_DIAG_TOUT_MAX_T_CLK	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message T_CLK					
C_CTR_DIAG_TOUT_MAX_T_ICL	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message ICL					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DIAG_TOUT_MAX_TCS	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message TCS					
C_CTR_DIAG_TOUT_MAX_TQ_AMT	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message TQ_AMT					
C_CTR_DIAG_TOUT_MAX_TQ_DCC	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message TQ_DCC					
C_CTR_DIAG_TOUT_MAX_TQ_ETCU	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message TQ_ETCU					
C_CTR_DIAG_TOUT_MAX_TQ_PBR	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message ACC					
C_CTR_DIAG_TOUT_MAX_TQ_PSTE_2	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message TQ_PSTE_2					
C_CTR_DIAG_TOUT_MAX_TQ_PSTE_3	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message TQ_PSTE_3					
C_CTR_DIAG_TOUT_MAX_TQ_TCS	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message TQ_TCS					
C_CTR_DIAG_TOUT_MAX_TQ_TCT	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message TQ_TCT					
C_CTR_DIAG_TOUT_MAX_TRL	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message TRL					
C_CTR_DIAG_TOUT_MAX_VEH_MOD	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message VEH_MOD					
C_CTR_DIAG_TOUT_MAX_VS_TCS	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message VS_TCS					
C_CTR_DIAG_TOUT_MAX_WHEEL_CAN	-	0... FFH	0... 255	1	-
Maximum number of missing messeges events before error detection of message WHEEL_CAN					

A.103.1 Table of BN2000 diagnosis

FUNCTION DESCRIPTION:

General information:

This chapter is for the definition of all ERRM relevant output - data using the general BN2000 diagnosis algoritm.

The CAN diagnosis for BN input messages are only enabled if the variant has been recognized. In case of a modul (e.g. Kombi) which is not a variant but implemented in every vehicle the diagnosis is always enabled.

A.103.1.1 Diagnosis ACC module (Distance cruise control)

A.103.1.1.1 DREHMOMENT_ANF_ACC (LV_ERR_BN_TQ_DCC)

General information:

See general BN2000 diagnosis algorithm

Application conditions

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Activation: `LV_VAR_DCC = 1`

Description:

Error symptoms are defined for this diagnosis function as:

```
□□□□
|  |  |  └> -                                      (= SYM_0)
|  |  └——> Alive counter did not count              (= SYM_1)
|  └————> Timeout                                  (= SYM_2)
└——————> Sent checksum ≠ calculated checksum        (= SYM_3)
```

A.103.1.2 Diagnosis ARS module

A.103.1.2.1 STAT_ARS (LV_ERR_BN_ARS)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: `LV_VAR_ARS = 1`

Description:

Error symptoms are defined for this diagnosis function as:

```
□□□□
|  |  |  └> -                                      (= SYM_0)
|  |  └——> Alive counter did not count              (= SYM_1)
|  └————> Timeout                                  (= SYM_2)
└——————> -                                          (= SYM_3)
```

A.103.1.3 Diagnosis AFS module (Active front steering)

A.103.1.3.1 DREHMOMENT_ANF_AFS (LV_ERR_BN_TQ_PSTE_2)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: `LV_VAR_PSTE_2 = 1`

Description:

Error symptoms are defined for this diagnosis function as:

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```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> -                                  (= SYM_0)
 │ │ └───> Alive counter did not count        (= SYM_1)
 │ └─────> Timeout                            (= SYM_2)
 └───────> Sent checksum ≠ calculated checksum (= SYM_3)
```

A.103.1.4 Diagnosis EHB module (Electro-hydraulic brake)

A.103.1.4.1 DREHMOMENT_ANF_STE (LV_ERR_BN_TQ_PSTE_3)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *LV_VAR_PSTE_3 = 1*

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> -                                  (= SYM_0)
 │ │ └───> Alive counter did not count        (= SYM_1)
 │ └─────> Timeout                            (= SYM_2)
 └───────> Sent checksum ≠ calculated checksum (= SYM_3)
```

A.103.1.5 Diagnosis EMF module (Electro-mechanical parke brake)

A.103.1.5.1 STELLANF_EMF (LV_ERR_BN_REQ_PBR)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation:

```
LV_VAR_PBR = 1
//set LV_END in case of not learnt variant:
if          LV_VAR_PBR = 0
then        LV_END_DIAG_BN_REQ_PBR = 1
endif
```

Description:

Error symptoms are defined for this diagnosis function as:

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```
┌─┬─┬─┬─┐
│ │ │ └─> -                                      (= SYM_0)
│ │ └───> Alive counter did not count            (= SYM_1)
│ └─────> Timeout                                (= SYM_2)
└───────> Sent checksum ≠ calculated checksum    (= SYM_3)
```

A.103.1.5.2 STATUS_EMF (LV_ERR_BN_PBR)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation:

```
LV_VAR_PBR = 1
//set LV_END in case of not learnt variant:
if          LV_VAR_PBR = 0
then    LV_END_DIAG_BN_PBR = 1
endif
```

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
│ │ │ └─> -                                      (= SYM_0)
│ │ └───> Alive counter did not count            (= SYM_1)
│ └─────> Timeout                                (= SYM_2)
└───────> Sent checksum ≠ calculated checksum    (= SYM_3)
```

A.103.1.5.3 ST_RQ_EMF (LV_ERR_BN_TQ_PBR)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation:

```
LV_VAR_TQ_PBR = 1
//set LV_END in case of not learnt variant:
if          LV_VAR_TQ_PBR = 0
then    LV_END_DIAG_BN_TQ_PBR  = 1
endif
```

Description:

Error symptoms are defined for this diagnosis function as:

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```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │  │  │  └─> -                                    (= SYM_0)
 │  │  └───> Alive counter did not count            (= SYM_1)
 │  └─────> Timeout                                (= SYM_2)
 └───────> Sent checksum ≠ calculated checksum     (= SYM_3)
```

A.103.1.6 Diagnosis CAS (Car-access-system)

A.103.1.6.1 Klemmenstatus (LV_ERR_BN_CAS)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *in every engine operating state*

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │  │  │  └─> -                                    (= SYM_0)
 │  │  └───> Alive counter did not count            (= SYM_1)
 │  └─────> Timeout                                (= SYM_2)
 └───────> Sent checksum ≠ calculated checksum     (= SYM_3)
```

A.103.1.6.2 Fahrzeugmodus (LV_ERR_BN_VEH_MOD)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *LV_VAR_VEH_MOD = 1*

Description:

Error symptoms are defined for this diagnosis function as:

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```
□□□□
│ │ │ └─> -                                        (= SYM_0)
│ │ └───> Alive counter did not count              (= SYM_1)
│ └─────> Timeout                                  (= SYM_2)
└───────> Sent checksum ≠ calculated checksum      (= SYM_3)
```

A.103.1.6.3 STAT_ZV_KLAPPEN (LV_ERR_BN_CDN_DOOR)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *in every engine operating state*

Description:

Error symptoms are defined for this diagnosis function as:

```
□□□□
│ │ │ └─> -                                        (= SYM_0)
│ │ └───> -                                        (= SYM_1)
│ └─────> Timeout                                  (= SYM_2)
└───────> -                                        (= SYM_3)
```

A.103.1.7 Diagnosis DSC - modul (Traction control system)

A.103.1.7.1 DREHMOMENT_ANF_DSC (LV_ERR_BN_TQ_TCS)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *in every engine operating state*

Description:

Error symptoms are defined for this diagnosis function as:

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```
┌─┬─┬─┬─┐
│ │ │ │
│ │ │ └─> -                                          (= SYM_0)
│ │ └───> Alive counter did not count                (= SYM_1)
│ └─────> Timeout                                    (= SYM_2)
└───────> Sent checksum ≠ calculated checksum        (= SYM_3)
```

A.103.1.7.2 GESCHWINDIGKEIT (LV_ERR_BN_VS_TCS)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: `in every engine operating state`

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
│ │ │ │
│ │ │ └─> -             (= SYM_0)
│ │ └───> -             (= SYM_1)
│ └─────> Timeout       (= SYM_2)
└───────> -             (= SYM_3)
```

A.103.1.7.3 GESCHWINDIGKEIT_RAD (LV_ERR_BN_WHEEL_CAN)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: `in every engine operating state`

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
│ │ │ │
│ │ │ └─> -             (= SYM_0)
│ │ └───> -             (= SYM_1)
│ └─────> Timeout       (= SYM_2)
└───────> -             (= SYM_3)
```

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A.103.1.7.4 STAT_DSC (LV_ERR_BN_TCS)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: `in every engine operating state`

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
│ │ │ │ └─> -                         (= SYM_0)
│ │ └───> -                           (= SYM_1)
│ └─────> Timeout                     (= SYM_2)
└───────> -                           (= SYM_3)
```

A.103.1.8 Diagnosis EGS (Electronic transmission control unit)

A.103.1.8.1 DREHMOMENT_ANF_EGS (LV_ERR_BN_TQ_ETCU)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation:

```
LV_AT = 1
If          LV_AT = 0
(AT not learnt if C_T_DET_VAR_CAN elapsed after LV_IGK 0  1)
Then     LV_END_DIAG_BN_TQ_ETCU = 1  (set for readiness)
 Endif
```

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
│ │ │ │ └─> -                                    (= SYM_0)
│ │ └───> Alive counter did not count            (= SYM_1)
│ └─────> Timeout                                (= SYM_2)
└───────> Sent checksum ≠ calculated checksum    (= SYM_3)
```

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A.103.1.9 Diagnosis SSG module (Automated manual transmission)

A.103.1.9.1 DREHMOMENT_ANF_SSG (LV_ERR_BN_TQ_AMT)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation:

```
LV_VAR_AMT = 1
If    LV_VAR_AMT = 0
(AMT not learnt if C_T_DET_VAR_CAN elapsed after LV_IGK 0  1)
Then      LV_END_DIAG_BN_TQ_AMT = 1    (set for readiness)
 Endif
```

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> -                                  (= SYM_0)
 │ │ └───> Alive counter did not count        (= SYM_1)
 │ └─────> Timeout                            (= SYM_2)
 └───────> Sent checksum ≠ calculated checksum (= SYM_3)
```

A.103.1.10 Diagnosis DKG module (Twin clutch transmission)

A.103.1.10.1 DREHMOMENT_ANF_DKG (LV_ERR_BN_TQ_TCT)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation:

```
LV_VAR_TCT = 1
If    LV_VAR_TCT = 0
(TCT not learnt if C_T_DET_VAR_CAN elapsed after LV_IGK 0  1)
Then      LV_END_DIAG_BN_TQ_TCT = 1    (set for readiness)
 Endif
```

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> -                                  (= SYM_0)
 │ │ └───> Alive counter did not count        (= SYM_1)
 │ └─────> Timeout                            (= SYM_2)
 └───────> Sent checksum ≠ calculated checksum (= SYM_3)
```

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A.103.1.10.2 ST_DKG (LV_ERR_BN_STAT_TCT)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation:

```
LV_VAR_TCT = 1
If    LV_VAR_TCT = 0
(TCT not learnt if C_T_DET_VAR_CAN elapsed after LV_IGK 0  1)
Then      LV_END_DIAG_BN_STAT_TCT = 1  (set for readiness)
 Endif
```

Description:

Error symptoms are defined for this diagnosis function as:

```
┌┬┬┬┐
└┴┴┴┘
 │ │ │ └─> -                                      (= SYM_0)
 │ │ └───> -                                      (= SYM_1)
 │ └─────> Timeout                                (= SYM_2)
 └───────> -                                      (= SYM_3)
```

A.103.1.11 Transmission data (from transmisssion units)

A.103.1.11.1 GETRIEBEDATEN (LV_ERR_BN_ETCU)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation:

```
LV_VAR_ETCU = 1
If          LV_VAR_ETCU = 0
Then      LV_END_DIAG_BN_ETCU = 1      (set for readiness)
 Endif
```

Description:

Error symptoms are defined for this diagnosis function as:

```
┌┬┬┬┐
└┴┴┴┘
 │ │ │ └─> -                                      (= SYM_0)
 │ │ └───> Alive counter did not count            (= SYM_1)
 │ └─────> Timeout                                (= SYM_2)
 └───────> Sent checksum ≠ calculated checksum    (= SYM_3)
```

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A.103.1.11.2 GETRIEBEDATEN_2 (LV_ERR_BN_ETCU_2)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation:

```
LV_AT = 1  or  LV_VAR_TCT = 1
If          LV_AT = 0   and  LV_VAR_TCT = 0
Then      LV_END_DIAG_BN_ETCU_2 = 1    (set for readiness)
 Endif
```

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> -                                  (= SYM_0)
 │ │ └───> -                                  (= SYM_1)
 │ └─────> Timeout                            (= SYM_2)
 └───────> -                                  (= SYM_3)
```

A.103.1.11.3 GETRIEBEDATEN_3 (LV_ERR_BN_ETCU_3)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation:

```
LV_VAR_ETCU_3 = 1
//set LV_END in case of not learnt variant:
if                LV_VAR_ETCU_3 = 0
then        LV_END_DIAG_BN_ETCU_3 = 1
endif
```

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> -                                  (= SYM_0)
 │ │ └───> Alive counter did not count        (= SYM_1)
 │ └─────> Timeout                            (= SYM_2)
 └───────> Sent checksum ≠ calculated checksum (= SYM_3)
```

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A.103.1.11.4 ANZEIGE_GETRIEBEDATEN (LV_ERR_BN_ETCU_DISP)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation:

```
LV_AT = 1 or  LV_VAR_TCT = 1
If          LV_AT = 0  and  LV_VAR_TCT = 0
Then      LV_END_DIAG_BN_ETCU_DISP = 1       (set for readiness)
 Endif
```

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
│ │ │ │
│ │ │ └─> -                                (= SYM_0)
│ │ └───> -                                (= SYM_1)
│ └─────> Timeout                          (= SYM_2)
└───────> -                                (= SYM_3)
```

A.103.1.12 Diagnosis IHKA

A.103.1.12.1 WÄRMASTROM_KLIMA (LV_ERR_BN_ACC)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *LV_VAR_ACIN = 1*

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
│ │ │ │
│ │ │ └─> -                                (= SYM_0)
│ │ └───> -                                (= SYM_1)
│ └─────> Timeout                          (= SYM_2)
└───────> -                                (= SYM_3)
```

A.103.1.13 Diagnosis KOMBI

A.103.1.13.1 A_TEMP_RELATIVZEIT (LV_ERR_BN_T_ICL)

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General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *LV_VAR_ICL = 1*

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> -                         (= SYM_0)
 │ │ └───> -                         (= SYM_1)
 │ └─────> Timeout                   (= SYM_2)
 └───────> -                         (= SYM_3)
```

A.103.1.13.2 KILOMETERSTAND (LV_ERR_BN_KM_ICL)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *LV_VAR_ICL = 1*

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> -                         (= SYM_0)
 │ │ └───> -                         (= SYM_1)
 │ └─────> Timeout                   (= SYM_2)
 └───────> -                         (= SYM_3)
```

A.103.1.13.3 STAT_KOMBI (LV_ERR_BN_ICL)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *LV_VAR_ICL = 1*

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Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
  │  │  │  └─> -                                    (= SYM_0)
  │  │  └────> Alive counter did not count          (= SYM_1)
  │  └───────> Timeout                              (= SYM_2)
  └──────────> -                                    (= SYM_3)
```

A.103.1.13.4 UHRZEIT_DATUM (LV_ERR_BN_T_CLK)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *LV_VAR_ICL = 1*

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
  │  │  │  └─> -                                    (= SYM_0)
  │  │  └────> -                                    (= SYM_1)
  │  └───────> Timeout                              (= SYM_2)
  └──────────> -                                    (= SYM_3)
```

A.103.1.14 Diagnosis Power modul

A.103.1.14.1 POWERMGMT_BATTERIESPANNUNG (LV_ERR_BN_POW_VB)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *LV_VAR_VEH = 1*

Description:

Error symptoms are defined for this diagnosis function as:

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```
□□□□
| | | └> -              (= SYM_0)
| | └──> -              (= SYM_1)
| └────> Timeout        (= SYM_2)
└──────> -              (= SYM_3)
```

A.103.1.14.2 POWERMGMT_LADESPANNUNG (LV_ERR_BN_POW_GEN)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *LV_VAR_VEH = 1*

Description:

Error symptoms are defined for this diagnosis function as:

```
□□□□
| | | └> -              (= SYM_0)
| | └──> -              (= SYM_1)
| └────> Timeout        (= SYM_2)
└──────> -              (= SYM_3)
```

A.103.1.15 Diagnosis SZ Lenksäule

A.103.1.15.1 BEDIENUNG_TEMPOMAT (LV_ERR_BN_MSW)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *LV_VAR_BN_MSW = 1*

Description:

Error symptoms are defined for this diagnosis function as:

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```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> -                                    (= SYM_0)
 │ │ └───> Alive counter did not count           (= SYM_1)
 │ └─────> Timeout                               (= SYM_2)
 └───────> Sent checksum ≠ calculated checksum   (= SYM_3)
```

A.103.1.15.2 LENKRADWINKEL (LV_ERR_BN_ANG_PSTE)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *LV_VAR_PSTE = 1*

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> -         (= SYM_0)
 │ │ └───> -         (= SYM_1)
 │ └─────> Timeout   (= SYM_2)
 └───────> -         (= SYM_3)
```

A.103.1.16 Diagnosis EKP

A.103.1.16.1 STAT_EKP(LV_ERR_BN_EFP)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *LV_VAR_BN_EFP = 1*

Description:

Error symptoms are defined for this diagnosis function as:

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```
┌─┬─┬─┬─┐
│ │ │ │ │
└─┴─┴─┴─┘
 │ │ │ └> -                       (= SYM_0)
 │ │ └───> -                      (= SYM_1)
 │ └─────> Timeout                (= SYM_2)
 └───────> -                      (= SYM_3)
```

A.103.1.17 Diagnosis K_CAN: LM

A.103.1.17.1 STAT_GANG_RUECKWAERTS (LV_ERR_BN_GEAR_REV)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *LV_VAR_BN_GEAR_REV = 1*

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
│ │ │ │ │
└─┴─┴─┴─┘
 │ │ │ └> -                       (= SYM_0)
 │ │ └───> -                      (= SYM_1)
 │ └─────> Timeout                (= SYM_2)
 └───────> -                      (= SYM_3)
```

A.103.1.17.2 LAMPENZUSTAND (LV_ERR_BN_LTG_HDLP_L)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *LV_VAR_BN_LTG_HDLP_L = 1*

Description:

Error symptoms are defined for this diagnosis function as:

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```
┌─┬─┬─┬─┐
│ │ │ │
│ │ │ └─> -                                  (= SYM_0)
│ │ └───> -                                  (= SYM_1)
│ └─────> Timeout                            (= SYM_2)
└───────> -                                  (= SYM_3)
```

A.103.1.17.3 STAT_ANHAENGER (LV_ERR_BN_TRL)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *LV_VAR_BN_TRL = 1*

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
│ │ │ │
│ │ │ └─> -                                  (= SYM_0)
│ │ └───> -                                  (= SYM_1)
│ └─────> Timeout                            (= SYM_2)
└───────> -                                  (= SYM_3)
```

A.103.1.18 Diagnosis LDM

A.103.1.18.1 ANFORDERUNG_RADM_ANTRIEBSTRANG (LV_ERR_BN_LDM)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *LV_VAR_BN_LDM = 1*

Description:

Error symptoms are defined for this diagnosis function as:

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```
┌─┬─┬─┬─┐
│ │ │ │ │
└─┴─┴─┴─┘
 │  │  │  └─> -                                      (= SYM_0)
 │  │  └────> -                                      (= SYM_1)
 │  └───────> Timeout                                (= SYM_2)
 └──────────> -                                      (= SYM_3)
```

A.103.1.19 Diagnosis EKP-Crashabschaltung

A.103.1.19.1 Steuerung EKP-Crashabschaltung (LV_ERR_BN_EFP_CRASH)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation: *LV_VAR_EFP_CRASH = 1*

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
│ │ │ │ │
└─┴─┴─┴─┘
 │  │  │  └─> -                                      (= SYM_0)
 │  │  └────> -                                      (= SYM_1)
 │  └───────> Timeout                                (= SYM_2)
 └──────────> -                                      (= SYM_3)
```

A.103.1.20 Diagnosis DXC

A.103.1.20.1 SOLL_MOM_ANF (LV_ERR_BN_DHL_CTL)

General information:

See general BN2000 diagnosis algorithm

Application conditions

Activation:

```
LV_VAR_4WD = 1
       If      LV_VAR_4WD = 0
 Then   LV_END_DIAG_BN_DHL_CTL = 1   (set for readiness)
 Endif
```

Description:

Error symptoms are defined for this diagnosis function as:

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```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> -                                    (= SYM_0)
 │ │ └───> -                                    (= SYM_1)
 │ └─────> Timeout                              (= SYM_2)
 └───────> -                                    (= SYM_3)
```

A.103.1.21 Diagnosis M-DRIVE

A.103.1.21.1 BEDIENUNG_MDRV (LV_ERR_BN_SPT_SWI)

 # IF (NC_SPORT_SZL != 0) // Compiler switch for deactivation of functionality

Application conditions

Initialisation: *STD_INI, all others = 0*

Recurrence: *1s*

Activation: *LV_VAR_SPT_SWI = 1*

Description:

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> -
 │ │ └───> Alive counter didn´t count           (= SYM_1)
 │ └─────> Timeout                              (= SYM_2)
 └───────> -
```

#ENDIF

A.103.2 BN2000 diagnosis algorithm

FUNCTION DESCRIPTION:

General information:

All diagnosis are only activated if the variant BN2000 is valid (LV_VAR_BN = 1).
For the diagnosis each message is monitored.

XXX is the variable for each different input message (see “CAN messages BN2000, Enable condition for BN2000 diagnosis).

Description:

The following symptoms can be detected:

- Alive counter did not count
- Timeout of the message
- Sent checksum is not equal to the calculated checksum of the message

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For detailed information of Alive-counter, checksum calculation and timeout see (see “CAN messages BN2000).

If symptom “Timeout” is detected (counter CTR_DIAG_TOUT_XXX ≠ 0), the remaining symptom detection is inhibited.

If C_CTR_DIAG_TOUT/CKS/TCC_CAN_MAX_XXX are calibrated to 0 then the diagnosis of the symptom TOUT/CKS/TCC_CAN is inhibited.

Error symptoms are defined for this diagnosis function as:

```
┌─┬─┬─┬─┐
│ │ │ │ └> -                                    (= SYM_0)
│ │ └───> Alive counter did not count          (= SYM_1)
│ └─────> Timeout                              (= SYM_2)
└───────> Sent checksum ≠ calculated checksum  (= SYM_3)
```

<u>**Application conditions**</u>

Initialisation: *all 0 at LV_IGK 0->1* **or** *reset* **or** *at clearing error memory*

Recurrence: *each message is diagnosed*

Activation:
```
If        Diagnosis is enabled       (learnt/ calibrated
etc..., see "CAN messages
                                      BN2000, enable condition
for BN2000 diagnosis).
Then If        LV_WAKE_UP                  = 1          and
 LV_CDN_VB_BN_DIAG           = 1          and
 LV_ERR_CAN_BOFF             = 0          and
 LV_VAR_BN                   = 1          and
 Then        LV_CDN_DIAG_BN_XXX        = 1
 Else        LV_CDN_DIAG_BN_XXX        = 0
 Endif
Else      LV_CDN_DIAG_BN_XXX    = 0
```

Endif

Deactivation:

If XXX = TQ_DCC *(Diagnosis of TQ_DCC message)*
Then **If** LV_ERR_BN_XXX = 1 **and**
ERR_SYM_BN_XXX = SYM_1/SYM_3
Then LV_CDN_DIAG_BN_XXX = 0 *(for this DC!)*
Endif
Endif

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Formula section:

Error detection alive counter:

If(1) CTR_DIAG_TOUT_XXX = 0 **and**
CTR_DIAG_CKS_xxx = 0 **and**
C_CTR_DIAG_TCC_CAN_MAX_XXX ≠ 0
Then If(2) TCC_CAN_XXX n = TCC_CAN_XXX n-1 **or**
TCC_CAN_XXX = FH
Then(2) CTR_DIAG_TCC_CAN_XXX n = CTR_DIAG_TCC_CAN_XXX n-1 + 1
If(3) CTR_DIAG_TCC_CAN_XXX >= C_CTR_DIAG_TCC_CAN_MAX_XXX
Then(3) Error symptom "Alive-counter" is active
ERR_SYM_BN_XXX = SYM_1
anti-bounce increment per C_ABC_INC_BN_XXX
LV_ERR_BN_XXX = 1 after debounce
Endif(3)
Else(2) CTR_DIAG_TCC_CAN_XXX = 0
Error symptom "Alive-counter" is passive
ERR_SYM_BN_XXX = NO_SYM
anti-bounce decrement per C_ABC_DEC_BN_XXX
LV_ERR_BN_XXX = 0 after rebounce
Endif(2)
Else(1) No error detection
Endif(1)

Error detection "Checksum is wrong":

If(1) CTR_DIAG_TOUT_XXX = 0 **and**
C_CTR_DIAG_CKS_MAX_XXX ≠ 0
Then If(2) CKS_CAN_XXX ≠ CKS_CLC_XXX *(sent ≠ calculated)*
Then(2) CTR_DIAG_CKS_XXX n = CTR_DIAG_CKS_XXX n-1 + 1
If(3) CTR_DIAG_CKS_XXX >= C_CTR_DIAG_CKS_MAX_XXX
Then(3) Error symptom "Calculated checksum ≠ sent checksum" is active
ERR_SYM_BN_XXX = SYM_3
anti-bounce increment per C_ABC_INC_BN_XXX
LV_ERR_BN_XXX = 1 after debounce
Endif(3)
Else(2) CTR_DIAG_CKS_XXX = 0
Error symptom "Calculated checksum ≠ sent checksum" is passive,
ERR_SYM_BN_XXX = NO_SYM
anti-bounce decrement per C_ABC_DEC_BN_XXX
LV_ERR_BN_XXX = 0 after rebounce
Endif(2)
Else(1) No error detection
Endif(1)

Error detection "Timeout":

If(1) C_CTR_DIAG_TOUT_MAX_XXX ≠ 0
ThenIf(2) no BN2000 message XXX is received
Then(2) CTR_DIAG_TOUT_XXX n = CTR_DIAG_TOUT_XXX n-1 + 1
If(3) CTR_DIAG_TOUT_XXX >= C_CTR_DIAG_TOUT_MAX_XXX
Then(3) Error symptom "Timeout" is active
ERR_SYM_BN_XXX = SYM_2
anti-bounce increment per C_ABC_INC_BN_XXX
LV_ERR_BN_XXX = 1 after debounce
Else(3)

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Endif(3)
Else(2) CTR_DIAG_TOUT_XXX = 0
Error symptom “Timeout” is passive,
ERR_SYM_BN_XXX = NO_SYM
anti-bounce decrement per C_ABC_DEC_BN_XXX
LV_ERR_BN_XXX = 0 after rebounce
Endif(2)
Else(1) No error detection
Endif(1)

Calculation of the end of diagnosis:
For calculation of LV_END_DIAG_BN_XXX see “Anti-bounce algorithm, calculation of the end of diagnosis
Configuration of Anti-bounce
NC_ABC_CONF_FCT_DIAG_XX = 19H (Not saved, INI at LV_IGK, CTR_ABC_.. = 0 at INI, Calibratable decrement)

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A.104 Knock sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CYCNR_DYW_KNKS_DIAG [NC_NR_SENS_KNK]	V	0... FFH	0... 255	1	seg
Cycle counter for Master -algorithm (knock sensor diagnosis)					
CYCNR_INT_KNKS_DIAG [NC_NR_SENS_KNK]	V	0... FFH	0... 255	1	seg
Cycle counter Slave - algorithm (knock sensor diagnosis)					
DYW_KNKS_DIAG [NC_NR_SENS_KNK]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Bandwidth knock signal to noise level					
ERR_SYM_KNKS [NC_NR_SENS_KNK]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom KNKS					
LV_CDN_DIAG_KNKS [NC_NR_SENS_KNK]	O/V	0... 1H	0 ...1	1	-
Boolean for knock sensor 2 error currently active					
LV_END_DIAG_KNKS [NC_NR_SENS_KNK]	O/V	0... 1H	0 ...1	1	-
End of diagnosis KNKS					
LV_ERR_KNKS [NC_NR_SENS_KNK]	O/V	0... 1H	0 ...1	1	-
Boolean for knock sensor 1 error currently active					
V_INT_KNKS_DIAG [NC_NR_SENS_KNK]	V	0... FFFFH	0... 319.99511	4.8828e-3	V
Integrator value of bandwidth output voltage of the knock sensor					

Input data:

KNKS [NC_CYL_NR] {p. 849}	KNKS_1_DIAG {p. 1961}	KNKS_2_DIAG {p. 1961}	LV_DC {p. 5746}
LV_INH_DIAG_KNKS {p. 4908}	LV_KNK_CTL_ENA {p. 1961}	LV_PU {p. 1720}	LV_PUC {p. 1720}
MAF {p. 8277}	MFF_SP_MV {p. 2151}	N_32 {p. 1525}	NC_KNKS_CONF {p. 1967}
NC_NR_SENS_KNK	NL [NC_CYL_NR] {p. 1962}	USE_SW_VER {p. 605}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_KNKS	-	0... FFH	0... 255	1	-
Anti-bounce increment value					
C_ABC_MAX_KNKS	-	1... FFH	1... 255	1	-
Anti-bounce maximum value					
C_CYCNR_KNKS_DIAG	-	0... FFH	0... 255	1	seg
Number of cycles (f(KNKS_DIAG[NC_CBK_EX_NR)) for the Master-Slave knock sensor diagnosis					
C_MAF_MIN_KNKS_DIAG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower engine load treshold for knock sensor diagnosis					
C_MFF_MIN_KNKS_DIAG	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Lower engine load treshold for knock sensor diagnosis based on MFF					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_MIN_KNKS_DIAG	-	0... FFH	0... 8160	32	rpm
Lower engine speed treshold for knock sensor diagnosis					
C_NL_MAX_DIAG	-	0... FFH	0... 4.98046	0.0195312	V
Maximum noise level threshold					
C_NL_MIN_DIAG	-	0... FFH	0... 4.98046	0.0195312	V
Minimum noise level threshold					
IP_DYW_MIN_KNKS_DIAG	-	0... 3FFH	0... 4.99511	4.8828e-3	V
LDPM_N_32_KNKS_DIAG	6	0... FFH	0... 8160	32	rpm
Bandwidth threshold to detect the error via the ’Master Algorithm’					
IP_V_INT_KNKS_DIAG	-	0... FFFFH	0... 319.99511	4.8828e-3	V
LDPM_N_32_KNKS_DIAG	6	0... FFH	0... 8160	32	rpm
Integrator voltage threshold to detect the error via the ’Slave Algorithm’					

FUNCTION DESCRIPTION:

The array NC_CBK_EX_NR refers to sensor number (0 is KNKS_1; 1 is KNKS_2).

General information:

The task of the function "knock sensor diagnosis" lies in the input signal monitoring of the respective knock sensor.

The sensor signal is checked continuously regarding plausibility. This is done by observation of the signal noise value NL[NC_CYL_NR] (’Range Check’) and with two algorithms (Master - and Slave - Algorithm). The bandwidth (DYW_KNKS_DIAG) of the signal will be observed with these two algorithms. Both algorithms have to indicate the same system condition before the debounce counter is started.

The debounce counter will be called up every 720 °KW. The three test algorithms will be called up segment synchronously which will be done under consideration of the configuration values NC_KNKS_CONF (which knock sensor "hears" which cylinder), KNKS_1_DIAG and KNKS_2_DIAG (which cylinder will be taken for which knock sensor regarding diagnosis).

Range Check

In the range check a test will be done to find out if the output signal of the knock-IC is in the allowed working range between the calibratable minimum fault detection threshold and maximum fault detection threshold. A fault case is given if the minimum threshold is fallen-below or the maximum limit is exceeded. The ERR_SYM_KNKS is set when one (or more) of the monitored signals infringe a fault threshold.

Master -Algorithm

In the master-algorithm the bandwidth of the signal (DYW_KNKS_DIAG = NL[NC_CYL_NR] - KNKS[NC_CYL_NR] will be calculated for the concerned cylinder which is allocated to the concerned knock sensor regarding diagnosis purposes. The calculated bandwidth will be compared to the calibrated threshold value IP_DYW_MIN_KNKS_DIAG.

At short circuit against ground or VB as well as a broken signal line the bandwidth of the signal does not exceed the threshold value. In this case the counter CYCNR_DYW_KNKS_DIAG will be incremented in each monitored segment.

As soon as the bandwidth of the sensor signal exceeds the value IP_DYW_MIN_KNKS_DIAG again and LV_ERR_KNKS is not set the value will be reset again. In the case of LV_ERR_KNKS already set the value CYCNR_DYW_KNKS_DIAG will be decremented by 5 units.

If the counter reaches the value C_CYCNR_KNKS_DIAG a failure of the knock sensor will be set if the ’slave’-algorithm confirms this failure. When a failure has already debounced the SYM_3 is set as long as the counter of the master-algorithm is above 5. This is to delay the failure recovery.

The counter will be reset at transition LV_CDN_DIAG_KNKS = 0=>1.

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Slave -Algorithm

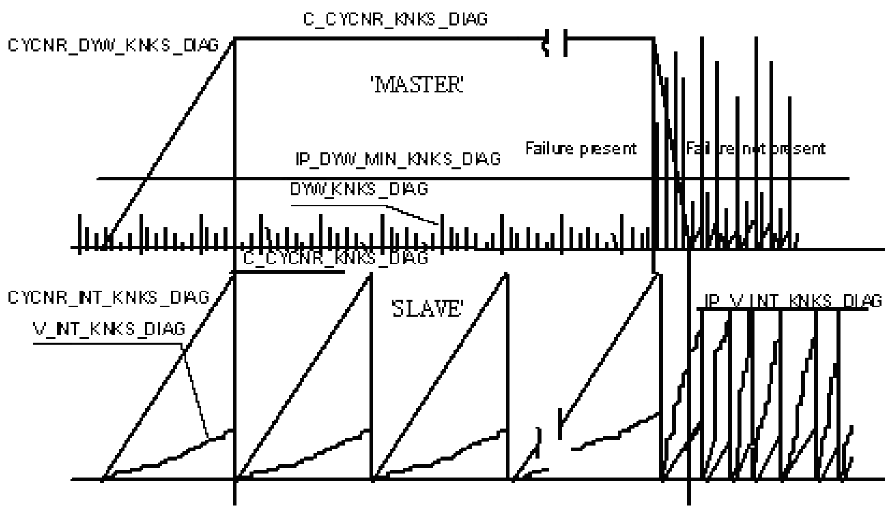
In the slave-algorithm the bandwidth of the sensor signal will also be used as an input signal. It will be recorded in its chronological process and will be integrated by means of an appropriate integration method. The calculated integral value V_INT_KNKS_DIAG will be compared to the threshold value IP_V_INT_KNKS_DIAG.

As soon as the threshold value is reached or exceeded the counter CYCNR_INT_KNKS_DIAG will be reset. Otherwise it will be incremented by '1' in each monitored segment. When the counter reaches the value C_CYCNR_KNKS_DIAG the sensor failure will be confirmed through the slave-algorithm and value CYCNR_INT_KNKS_DIAG and value V_INT_KNKS_DIAG reset to 0.

The counter will be reset at transition LV_CDN_DIAG_KNKS = 0=>1.

If a sensor failure is recognized by both algorithms the debounce will get started.

Description:



Application conditions

Initialisation:

at reset **or** LV_IGK = 0->1 **or** clearing FMY:
all = 0, except:
LV_ERR_KNKS[NC_NR_SENS_KNK] **and**
CTR_ABC_KNKS[NC_NR_SENS_KNK] are initialised from FMY
(according STD filter type)

Recurrence:

Signal range check and Master- Slave- Algorithm: segment
Error management: each 720 °KW

Activation:

If LV_KNK_CTL_ENA = 1 **and**
LV_PU = 0 **and**
LV_PUC = 0 **and**
[((USE_SW_VER = NC_MSV70 **or**
USE_SW_VER = NC_MSS70 **or**
USE_SW_VER = NC_MSV80)
and MAF > C_MAF_MIN_KNKS_DIAG)
or
((USE_SW_VER = NC_MSD70 **or**
USE_SW_VER = NC_MSD81 **or**
USE_SW_VER = NC_MSD87 **or**

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```
USE_SW_VER = NC_MSD70 or
USE_SW_VER = NC_MSD85 )
and  MFF_SP_MV > C_MFF_MIN_KNKS_DIAG) ]
                                       and
          N_32 > C_N_MIN_KNKS_DIAG      and
          LV_INH_DIAG_KNKS = 0
     Then       LV_CDN_DIAG_KNKS = 1
          Transition LV_CDN_DIAG_KNKS =0-> 1
          CYCNR_INT_KNKS_DIAG[NC_CBK_EX_NR] = 0;
          CYCNR_DYW_KNKS_DIAG[NC_CBK_EX_NR] = 0;
          V_INT_KNKS_DIAG[NC_CBK_EX_NR] = 0;
     Else       LV_CDN_DIAG_KNKS = 0
```

Formula section:

Master-Algorithm
DYW_KNKS_DIAG[i] = NLx - KNKS[x]

If DYW_KNKS_DIAG[i] > IP_DYW_MIN_KNKS_DIAG **or**
DYW_KNKS_DIAG[i]$_{n-1}$ > IP_DYW_MIN_KNKS_DIAG
Then **If** LV_ERR_KNKS[i] = 1 **and**
CYCNR_DYW_KNKS_DIAG[i] > 5
Then CYCNR_DYW_KNKS_DIAG[i]$_n$ = CYCNR_DYW_KNKS_DIAG[i]$_{n-1}$ -5
Else CYCNR_DYW_KNKS_DIAG[i] = 0
Endif
Else **If** CYCNR_DYW_KNKS_DIAG[i] < C_CYCNR_KNKS_DIAG
Then CYCNR_DYW_KNKS_DIAG[i]$_n$ = CYCNR_DYW_KNKS_DIAG[i]$_{n-1}$ + 1
Endif
Endif

Slave-Algorithm
V_INT_KNKS_DIAG[i] = V_INT_KNKS_DIAG[i] $_{n-1}$ + DYW_KNKS_DIAG[i]
CYCNR_INT_KNKS_DIAG[i]$_n$ = CYCNR_INT_KNKS_DIAG[i]$_{n-1}$+1

If CYCNR_INT_KNKS_DIAG[i]$_n$ C_CYCNR_KNKS_DIAG
Then CYCNR_INT_KNKS_DIAG[i]$_n$ = 0
V_INT_KNKS_DIAG[i]$_n$ = 0
Else **If** V_INT_KNKS_DIAG[i]$_{n-1}$ IP_V_INT_KNKS_DIAG
Then CYCNR_INT_KNKS_DIAG[i]$_n$ = 0
V_INT_KNKS_DIAG[i]$_n$ = 0
Endif
Endif

Signal range check and anti bounce
If NL[x] >C_NL_MAX_DIAG *\/*at least one signal is above threshold*\/*
Then ERR_SYM_KNKS[i] = SYM_0 *\/*signal too high*\/*
Else **If** NL[x] < C_NL_MIN_DIAG *\/*at least one signal is below threshold*\/*
Then ERR_SYM_KNKS[i] = SYM_1 *\/*signal too low*\/*
Else **If** **(** CYCNR_DYW_KNKS_DIAG[i] C_CYCNR_KNKS_DIAG **and**
CYCNR_INT_KNKS_DIAG[i] C_CYCNR_KNKS_DIAG **) or**
(CYCNR_DYW_KNKS_DIAG[i] 5 **and**
LV_ERR_KNKS[i] = 1 **)**
Then ERR_SYM_KNKS[i] = SYM_3 *\/*signal implausible*\/*

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```
                Else        ERR_SYM_KNKS[i] = NO_SYM              /*signal ok*/
                Endif
        Endif
Endif
```

The bit **LV_ERR_KNKS** will be set after debounce through the error management.
The bit **LV_END_DIAG_KNKS** will be set through the error management when after the last start of the diagnosis (normally it will be done only at the beginning of a Driving Cycle) the error debounce or the failure recovery would have been taken place.

Error-symptoms are defined to this diagnosis function as following :

```
 |_|_|_|_|
  |  |  |  └─> Noise level above valid range          (= SYM_0)
  |  |  └────> Noise level below valid range          (= SYM_1)
  |  └───────> -                                      (= SYM_2)
  └──────────> Knock sensor signal not plausible      (= SYM_3)
                   (Master-Slave)
```

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A.105 Knock sensor diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_KNKS	O/V	0... 1H	0 ...1	1	-
Flag to inhibit the knock sensor diagnosis					

Input data:

LV_ERR_SPI_KNK {p. 4245}			

FUNCTION DESCRIPTION:

General information:

This application incidences give the possibility to define customer specific conditions for inhibiting the diagnosis of knock sensors.

Application conditions

Initialisation: *LV_INH_DIAG_KNKS = 1 at Reset*

Recurrence: *like diagnosis*

Activation: *LV_IGK = 1*

Formula section:

If LV_ERR_SPI_KNK = 1
Then LV_INH_DIAG_KNKS = 1
Else LV_INH_DIAG_KNKS = 0
Endif

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A.106 Pre ignition diagnosis via knock control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ABC_KNK_PRE_DIAG [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Customer specific antibounce counter for knock control pre-ignition detection diagnosis					
ERR_SYM_KNK_PRE [NC_CYL_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom knock control pre-ignition cylinder shut off					
LV_CDN_DIAG_KNK_PRE [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Diagnosis condition knock control pre-ignition cylinder shut off					
LV_END_DIAG_KNK_PRE [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Diagnosis knock control pre-ignition cylinder shut off done at least one time					
LV_ERR_KNK_PRE [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Error caused by knock control pre-ignition cylinder shut off					

Input data:

CYL_ID_KNK {p. 1960}	LV_KNK_CTL_PRE_ENA {p. 1961}	LV_KNK_PRE_DET {p. 1962}	N_32 {p. 1525}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_KNK_PRE	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_KNK_PRE	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_ABC_MAX_KNK_PRE_DIAG	-	1... FFH	1... 255	1	-
Maximum value for customer specific antibounce counter					
IP_ABC_INC_KNK_PRE_DIAG	-	0... FFH	0... 255	1	-
LDP_N_32_ABC_INC_KNK_PRE_DIAG	4	0... FFH	0... 8160	32	rpm
Customer specific antibounce counter increment					

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Error treatment:

For each cylinder a separate fault location is used
symptoms for cylinder[NC_CYL_NR]

Diagnostic KNK_PRE	Symptom description	Symptom	Filter type
knock control pre-ignition cylinder shut off *cylinder[NC_CYL_NR]*		-	STD_INI
		-	
		-	
	knock control pre-ignition cylinder shut off	*SYM_3*	

FUNCTION DESCRIPTION:

General information:

Workshops must be able to get information about cylinder shut off caused by pre-ignition detection e.g. in case of engine damages.

Description:

For error management failures on single cylinders should be set after a certain number of detected Pre-Ignitions by knock control.
The fault is detected by the error management.

Application conditions

Initialisation:
```
according filter type 'STD_INI'
         (ERR_SYM_KNK_PRE[0 to NC_CYL_NR-1] = NO_SYM,
         LV_ERR_KNK_PRE[0 to NC_CYL_NR-1] = 0, ...)
         (clear general failure memory variables)
 according filter type 'STD_INI'
         CTR_ABC_KNK_PRE_DIAG[0 to NC_CYL_NR-1] = 0
         tmp_err_sym_knk_pre[0 to NC_CYL_NR-1] = NO_SYM
         (clear individual detection delay counter and temporary
failure symptom also, e.g.  at failure memory reset)
```

Recurrence:
```
segment synchronous (analogous knock control)
 every 720° CRK for the individual cylinder - update for cylinder
x
 only in the corresponding segment, where injection shut off
bit could change
```

Activation:
```
If            LV_KNK_CTL_PRE_ENA = 1
       Then      LV_CDN_DIAG_KNK_PRE[CYL_ID_KNK] = 1
```

Deactivation:
```
If            LV_KNK_CTL_PRE_ENA = 0
       Then      LV_CDN_DIAG_KNK_PRE[CYL_ID_KNK] = 0
```

Formula section:

If LV_KNK_PRE_DET = 1
Then CTR_ABC_KNK_PRE_DIAG[CYL_ID_KNK] =
CTR_ABC_KNK_PRE_DIAG[CYL_ID_KNK] + IP_ABC_INC_KNK_PRE_DIAG(N_32)
If CTR_ABC_KNK_PRE_DIAG[CYL_ID_KNK] >=
C_ABC_MAX_KNK_PRE_DIAG
Then ERR_SYM_KNK_PRE[CYL_ID_KNK] = SYM_3
Endif
Endif
The debounce algorithm is realized by a customized functionality.
Because of that C_ABC_INC_KNK_PRE must be set >= C_ABC_MAX_KNK_PRE.
The bits LV_ERR_xx and LV_END_DIAG_xx are set by the error management after debounce.
N.B.: CYL_ID_KNK represents, where the corresponding cylinder is evaluated by the module 'Knock Control'

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Failure reaction:

handled by LV_KNK_PRE_DET

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A.107 Sound flap diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_SOF	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of SOF bit 0 : diagnosis condition for symptom SCP (SYM_0) bit 1 : diagnosis condition for symptom SCG (SYM_1) bit 1 : diagnosis condition for symptom OC (SYM_2)					
ERR_DIAG_SOF	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for SOF (only parameter)					
ERR_SYM_SOF	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error					
ERR_SYM_SOF_REQ	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error					
LV_CDN_DIAG_SOF	O/V	0... 1H	0 ...1	1	-
Diagnosis condition					
LV_CDN_DIAG_SOF_REQ	O/V	0... 1H	0 ...1	1	-
Diagnosis condition					
LV_END_DIAG_SOF	O/V	0... 1H	0 ...1	1	-
End of Diagnosis					
LV_END_DIAG_SOF_REQ	O/V	0... 1H	0 ...1	1	-
End of Diagnosis					
LV_ERR_SOF	O/V	0... 1H	0 ...1	1	-
Error flag sound-flap					
LV_ERR_SOF_REQ	O/V	0... 1H	0 ...1	1	-
Error flag sport-mode switch request					
LV_INH_DIAG_SOF	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition SOF diagnosis					

Input data:

CONF_SOF_SWI {p. 654}	LV_CDN_VB_MIN_DIAG {p. 1185}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}
LV_VAR_BN {p. 655}	LV_VAR_SOF {p. 656}	V_SOF_SWI {p. 831}	

Calibration data:

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_SOF	-	0... FFH	0... 255	1	-
Debounce counter increment - SOF diagnosis					
C_ABC_INC_SOF_REQ	-	0... FFH	0... 255	1	-
-					
C_ABC_MAX_SOF	-	1... FFH	1... 255	1	-
Debounce counter maximum value - SOF diagnosis					
C_ABC_MAX_SOF_REQ	-	1... FFH	1... 255	1	-
-					
C_V_SOF_SWI_MAX	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Input voltage treshold max					
C_V_SOF_SWI_MIN	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Input voltage treshold min					

A.107.1 Input signal (sport switch) range check

FUNCTION DESCRIPTION:

General information:

This diagnosis is for checking the range of input signal voltage from the sport-mode-switch.

Description:

Error-symptoms are defined to this diagnosis function as following :

```
┌─┬─┬─┬─┐
│ │ │ │ │
└─┴─┴─┴─┘
 |  |  |  └─> Short circuit to Ubatt or line break   (= SYM_0)
 |  |  └───> Short circuit to ground                 (= SYM_1)
 |  └──────> -                                       (= SYM_2)
 └─────────> -                                       (= SYM_3)
```

Application conditions

Initialisation: *at reset or LV_IGK = 0 1 all 0*

Recurrence: *10 ms*

Activation:

```
If        LV_VAR_BN = 0                  and
LV_IGK = 1                and
 CONF_SOF_SWI > 0          and
 LV_ERR_SOF_REQ = 0
Then         LV_CDN_DIAG_SOF_REQ = 1
Else         LV_CDN_DIAG_SOF_REQ = 0
Endif
```

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Formula section:

Short circuit to ground:

If V_SOF_SWI < C_V_SOF_SWI_MIN **AND**
CONF_SOF_SWI = 1
Then ERR_SYM_SOF_REQ = SYM_1
LV_ERR_SOF_REQ = 1 *(after debounce)*
Endif

Short circuit to Ubatt or open line:

If V_SOF_SWI > C_V_SOF_SWI_MAX
Then ERR_SYM_SOF_REQ = SYM_0
LV_ERR_SOF_REQ = 1 *(after debounce)*
Endif

Calculation of end of diagnosis:

For calculation of LV_END_DIAG_SOF_REQ see Anti-bounce - algorithmus, calculation of the end of diagnosis .

A.107.2 Sound flap diagnosis (LV_ERR_SOF)

FUNCTION DESCRIPTION:

General information:

The purpose is to diagnose the sound flap signal from the driver which controls the sound flap. Diagnosis is only done if variant sound flap is choosen.

Description:

For error detection algorithm see "Electrical diagnosis of powerstage outputs ATIC39".
(Static control of PIN)

```
|_|_|_|_|
 | | | └─> Short circuit to Vbatt      (= SYM_0)
 | | └───> Short circuit to ground     (= SYM_1)
 | └─────> Open load                   (= SYM_2)
 └───────> -                           (= SYM_3)
```

Application conditions

Initialisation: according Filter-type **MPL_STD_INI**
(reset of variables at LV_IGK = 0 1 or ECU reset)

Recurrence: *100ms*

Activation: *LV_VAR_SOF = 1*

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Formula section:

If diagnosis is not inhibited (LV_INH_DIAG_SOF = 1) the diagnosis conditions are set according infrastructure information: CDN_DIAG_SOF.
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_SOF.

Failure debouncing and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_SOF and ERR_DIAG_SOF
This algorithm determines:
ERR_SYM_SOF (Detected error symptom)
LV_ERR_SOF (Error flag for debounced error)
LV_CDN_DIAG_SOF (Diagnosis condition information)
LV_END_DIAG_SOF (End of diagnosis information)

Diagnosis inhibition:

```
IF      LV_IGK = 1                  AND
        LV_CDN_VB_MIN_DIAG = 1      AND
        LV_ERR_SPI_MPS = 0
THEN    LV_INH_DIAG_SOF = 0
ELSE    LV_INH_DIAG_SOF = 1
ENDIF
```

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A.108 NOx sensor OBDI diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NS_OBD_1_HTP [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of NOx sensor OBD I - heater diagnosis					
ERR_SYM_NS_OBD_1_LAMB [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of NOx sensor OBD I - linear Lambda circuit diagnosis					
ERR_SYM_NS_OBD_1_NOX [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of NOx sensor OBD I - NOx circuit diagnosis					
ERR_SYM_NS_OBD_1_VLS [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of NOx sensor OBD I - binary Lambda circuit diagnosis					
LV_CDN_DIAG_NS_OBD_1 [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection at NOx sensor OBD I diagnosis					
LV_END_DIAG_NS_OBD_1_HTP [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I - heater diagnosis is completed at least one time					
LV_END_DIAG_NS_OBD_1_LAMB [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I - linear Lambda circuit diagnosis is completed at least one time					
LV_END_DIAG_NS_OBD_1_NOX [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I - NOx circuit diagnosis is completed at least one time					
LV_END_DIAG_NS_OBD_1_VLS [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I - binary Lambda circuit diagnosis is completed at least one time					
LV_ERR_NS_OBD_1 [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I failure is present after filtering					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_NS_OBD_1_HTP [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I - heater failure is present after filtering					
LV_ERR_NS_OBD_1_LAMB [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I - linear Lambda circuit failure is present after filtering					
LV_ERR_NS_OBD_1_NOX [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I - NOx circuit failure is present after filtering					
LV_ERR_NS_OBD_1_VLS [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor OBD I - binary Lambda circuit failure is present after filtering					

Input data:

ERR_NS [NC_NOX_SENS_CONF] {p. 1380}	LV_ERR_NS_CAN_BOFF {p. 991}	LV_ERR_NS_CAN_MSG_LOST [NC_NOX_SENS_CONF] {p. 991}	LV_INH_DIAG_NS_OBD_1 [NC_NOX_SENS_CONF] {p. 4921}
LV_ST_END {p. 1720}	NC_NOX_SENS_CONF {p. 643}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_NS_OBD_1_HTP	-	0... FFH	0... 255	1	-
Anti-bounce counter increment of NOx sensor OBD I - heater diagnosis					
C_ABC_INC_NS_OBD_1_LAMB	-	0... FFH	0... 255	1	-
Anti-bounce counter increment of NOx sensor OBD I - linear Lambda circuit diagnosis					
C_ABC_INC_NS_OBD_1_NOX	-	0... FFH	0... 255	1	-
Anti-bounce counter increment of NOx sensor OBD I - NOx circuit diagnosis					
C_ABC_INC_NS_OBD_1_VLS	-	0... FFH	0... 255	1	-
Anti-bounce counter increment of NOx sensor OBD I - binary Lambda circuit diagnosis					
C_ABC_MAX_NS_OBD_1_HTP	-	0... FFH	0... 255	1	-
Maximum value of anti-bounce counter for NOx sensor OBD I - heater diagnosis					
C_ABC_MAX_NS_OBD_1_LAMB	-	0... FFH	0... 255	1	-
Maximum value of anti-bounce counter for NOx sensor OBD I - linear Lambda circuit diagnosis					
C_ABC_MAX_NS_OBD_1_NOX	-	0... FFH	0... 255	1	-
Maximum value of anti-bounce counter for NOx sensor OBD I - NOx circuit diagnosis					
C_ABC_MAX_NS_OBD_1_VLS	-	0... FFH	0... 255	1	-
Maximum value of anti-bounce counter for NOx sensor OBD I - binary Lambda circuit diagnosis					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)

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FUNCTION DESCRIPTION:

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General information:

The NOx sensor has an own Electronic Control Unit (ECU), which monitors the cable connection between sensor element and sensor ECU on electrical faults like open circuits or short circuits. The actual monitoring result/the actual diagnosis result is cyclic transmitted to the EMS by the CAN messages, which include the sensor measurement signals.
The purpose of this diagnosis is to evaluate the cyclic received sensor ECU diagnosis result. If the sensor ECU reports an electrical fault (OBDI error between sensor element and sensor ECU) then this error is debounced and stored within error memory by use of standard error memory algorithm.
At ERR_SYM_NS_OBD_1_HTP, ERR_SYM_NS_OBD_1_NOX, ERR_SYM_NS_OBD_1_LAMB and ERR_SYM_NS_OBD_1_VLS combinations of error symptoms are possible (0...0x0F).
The following table describes the meaning of NOx sensor status byte:
Remark: The meaning of NOx sensor error byte was copied from NOx sensor specification of sensor manufacturer. If the sensor manufacturer makes a change at sensor error byte meaning, then this specification will not be updated!

NOx sensor error byte: ERR_NS[i]								
B7	B6	B5	B4	B3	B2	B1	B0	Function
0	0	0	0	0	0	0	0	no failure detected
							1	open wire at heater circuit
						1		open wire at NOx circuit
					1			open wire at linear Lambda circuit
				1				open wire at binary Lambda circuit
			1					short circuit at heater circuit
		1						short circuit at NOx circuit
	1							short circuit at linear Lambda circuit
1								short circuit at binary Lambda circuit

Specific diagnostic information to the project are defined in chapters Diagnostic general information or application incidence (EOL, DTC, error code number, symptom number...).

Description:

Error-symptoms of heater diagnosis are defined as following:

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```
□□□□
| | | └─> (not used)                              (= SYM_0)
| | └───> (not used)                              (= SYM_1)
| └─────> open circuit at heater                  (= SYM_2)
└───────> short circuit at heater                 (= SYM_3)
```

Error-symptoms of NOx circuit diagnosis are defined as following:

```
□□□□
| | | └─> (not used)                              (= SYM_0)
| | └───> (not used)                              (= SYM_1)
| └─────> open circuit at NOx circuit             (= SYM_2)
└───────> short circuit at NOx circuit            (= SYM_3)
```

Error-symptoms of linear Lambda circuit diagnosis are defined as following:

```
□□□□
| | | └─> (not used)                              (= SYM_0)
| | └───> (not used)                              (= SYM_1)
| └─────> open circuit at linear Lambda circuit   (= SYM_2)
└───────> short circuit at linear Lambda circuit  (= SYM_3)
```

Error-symptoms of binary Lambda circuit diagnosis are defined as following:

```
□□□□
| | | └─> (not used)                              (= SYM_0)
| | └───> (not used)                              (= SYM_1)
| └─────> open circuit at binary Lambda circuit   (= SYM_2)
└───────> short circuit at binary Lambda circuit  (= SYM_3)
```

Application conditions

Initialisation:

at reset:
LV_CDN_DIAG_NS_OBD_1[i] = 0
LV_ERR_NS_OBD_1[i] = 0
ERR_SYM_NS_OBD_1_HTP[i] = *Refer to filtering configuration for the initialisation value*
LV_ERR_NS_OBD_1_HTP[i] = *Refer to filtering configuration for the initialisation value*
LV_END_DIAG_NS_OBD_1_HTP[i] = *Refer to filtering configuration for the initialisation value*
ERR_SYM_NS_OBD_1_NOX[i] = *Refer to filtering configuration for the initialisation value*
LV_ERR_NS_OBD_1_NOX[i] = *Refer to filtering configuration for the initialisation value*
LV_END_DIAG_NS_OBD_1_NOX[i] = *Refer to filtering configuration for the initialisation value*
ERR_SYM_NS_OBD_1_LAMB[i] = *Refer to filtering configuration for the initialisation value*
LV_ERR_NS_OBD_1_LAMB[i] = *Refer to filtering configuration for the initialisation value*

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LV_END_DIAG_NS_OBD_1_LAMB[i] = Refer to filtering configuration for the initialisation value
ERR_SYM_NS_OBD_1_VLS[i] = Refer to filtering configuration for the initialisation value
LV_ERR_NS_OBD_1_VLS[i] = Refer to filtering configuration for the initialisation value
LV_END_DIAG_NS_OBD_1_VLS[i] = Refer to filtering configuration for the initialisation value
at activation:
LV_CDN_DIAG_NS_OBD_1[i] = 1
at deactivation:
LV_CDN_DIAG_NS_OBD_1[i] = 0

Recurrence: *10ms*

Activation: *LV_ST_END = 1* ***AND***
LV_ERR_NS_CAN_BOFF = 0 ***AND***
LV_ERR_NS_CAN_MSG_LOST[i] = 0 ***AND***
LV_INH_DIAG_NS_OBD_1[i] = 0

Deactivation: *if any activation condition is not fulfilled*

Formula section:

Heater circuit failures:

if Bit B0 of ERR_NS[i] = 1
then ERR_SYM_NS_OBD_1_HTP[i] = **set bit** SYM_2 of ERR_SYM_NS_OBD_1_HTP[i]
else ERR_SYM_NS_OBD_1_HTP[i] = **reset bit** SYM_2 of ERR_SYM_NS_OBD_1_HTP[i]
endif
if Bit B4 of ERR_NS[i] = 1
then ERR_SYM_NS_OBD_1_HTP[i] = **set bit** SYM_3 of ERR_SYM_NS_OBD_1_HTP[i]
else ERR_SYM_NS_OBD_1_HTP[i] = **reset bit** SYM_3 of ERR_SYM_NS_OBD_1_HTP[i]
endif

For failure and error management treatment the anti-bounce mechanism is called:
ACTION_ERRM_FilterSymptom(IN<NS_OBD_1_HTP[i]>, IN<LV_CDN_DIAG_NS_OBD_1[i]>, IN<ERR_SYM_NS_OBD_1_HTP[i]>, IN<C_ABC_INC_NS_OBD_1_HTP>, IN<1>, IN<C_ABC_MAX_NS_OBD_1_HTP>, OUT<LV_ERR_NS_OBD_1_HTP[i]>)

NOx circuit failures:

if Bit B1 of ERR_NS[i] = 1
then ERR_SYM_NS_OBD_1_NOX[i] = **set bit** SYM_2 of ERR_SYM_NS_OBD_1_NOX[i]
else ERR_SYM_NS_OBD_1_NOX[i] = **reset bit** SYM_2 of ERR_SYM_NS_OBD_1_NOX[i]
endif
if Bit B5 of ERR_NS[i] = 1
then ERR_SYM_NS_OBD_1_NOX[i] = **set bit** SYM_3 of ERR_SYM_NS_OBD_1_NOX[i]
else ERR_SYM_NS_OBD_1_NOX[i] = **reset bit** SYM_3 of ERR_SYM_NS_OBD_1_NOX[i]
endif

For failure and error management treatment the anti-bounce mechanism is called:
ACTION_ERRM_FilterSymptom(IN<NS_OBD_1_NOX[i]>, IN<LV_CDN_DIAG_NS_OBD_1[i]>, IN<ERR_SYM_NS_OBD_1_NOX[i]>, IN<C_ABC_INC_NS_OBD_1_NOX>, IN<1>, IN<C_ABC_MAX_NS_OBD_1_NOX>, OUT<LV_ERR_NS_OBD_1_NOX[i]>)

Linear Lambda circuit failures:

if Bit B2 of ERR_NS[i] = 1
then ERR_SYM_NS_OBD_1_LAMB[i] = **set bit** SYM_2 of ERR_SYM_NS_OBD_1_LAMB[i]
else ERR_SYM_NS_OBD_1_LAMB[i] = **reset bit** SYM_2 of ERR_SYM_NS_OBD_1_LAMB[i]

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endif
if Bit B6 of ERR_NS[i] = 1
then ERR_SYM_NS_OBD_1_LAMB[i] = **set bit** SYM_3 of ERR_SYM_NS_OBD_1_LAMB[i]
else ERR_SYM_NS_OBD_1_LAMB[i] = **reset bit** SYM_3 of ERR_SYM_NS_OBD_1_LAMB[i]
endif

For failure and error management treatment the anti-bounce mechanism is called:
ACTION_ERRM_FilterSymptom(IN<NS_OBD_1_LAMB[i]>, IN<LV_CDN_DIAG_NS_OBD_1[i]>, IN<ERR_SYM_NS_OBD_1_LAMB[i]>, IN<C_ABC_INC_NS_OBD_1_LAMB>, IN<1>, IN<C_ABC_MAX_NS_OBD_1_LAMB>, OUT<LV_ERR_NS_OBD_1_LAMB[i]>)

Binary Lambda circuit failures:

if Bit B3 of ERR_NS[i] = 1
then ERR_SYM_NS_OBD_1_VLS[i] = **set bit** SYM_2 of ERR_SYM_NS_OBD_1_VLS[i]
else ERR_SYM_NS_OBD_1_VLS[i] = **reset bit** SYM_2 of ERR_SYM_NS_OBD_1_VLS[i]
endif
if Bit B7 of ERR_NS[i] = 1
then ERR_SYM_NS_OBD_1_VLS[i] = **set bit** SYM_3 of ERR_SYM_NS_OBD_1_VLS[i]
else ERR_SYM_NS_OBD_1_VLS[i] = **reset bit** SYM_3 of ERR_SYM_NS_OBD_1_VLS[i]
endif

For failure and error management treatment the anti-bounce mechanism is called:
ACTION_ERRM_FilterSymptom(IN<NS_OBD_1_VLS[i]>, IN<LV_CDN_DIAG_NS_OBD_1[i]>, IN<ERR_SYM_NS_OBD_1_VLS[i]>, IN<C_ABC_INC_NS_OBD_1_VLS>, IN<1>, IN<C_ABC_MAX_NS_OBD_1_VLS>, OUT<LV_ERR_NS_OBD_1_VLS[i]>)

Summarise of failures:

if LV_ERR_NS_OBD_1_HTP[i] = 1 **OR**
LV_ERR_NS_OBD_1_NOX[i] = 1 **OR**
LV_ERR_NS_OBD_1_LAMB[i] = 1 **OR**
LV_ERR_NS_OBD_1_VLS[i] = 1
then LV_ERR_NS_OBD_1[i] = 1
else LV_ERR_NS_OBD_1[i] = 0
endif

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A.109 NOx sensor OBDI diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_NS_OBD_1 [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor OBD I diagnosis					

Input data:

LV_CDN_VB_CAN_DIAG {p. 1185}	LV_ST_END {p. 1720}	LV_VAR_NOX {p. 656}	NC_NOX_SENS_CONF {p. 643}

Error treatment:

Diagnostic NS_OBD_1_ HTP[i]	Symptom description	Symptom	Filter type
NOx sensor OBDI - heater diagnosis	(not used)	SYM_0	STD_INI
	(not used)	SYM_1	
	open circuit at heater	SYM_2	
	short circuit at heater	SYM_3	

Figure A.109.1: Diagnostic

Diagnostic NS_OBD_1_ HTP[i]	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NOx sensor OBDI - heater diagnosis	(not used)	*SYM_0*						
	(not used)	*SYM_1*						
	open circuit at heater	*SYM_2*						
	short circuit at heater	*SYM_3*						

Figure A.109.2: Diagnostic

Diagnostic NS_OBD_1_ NOX[i]	Symptom description	Symptom	Filter type
NOx sensor OBDI - NOx circuit diagnosis	(not used)	SYM_0	STD_INI
	(not used)	SYM_1	
	open circuit at NOx circuit	SYM_2	
	short circuit at NOx circuit	SYM_3	

Figure A.109.3: Diagnostic

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Diagnostic NS_OBD_1_ NOX[i]	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NOx sensor OBDI - NOx circuit diagnosis	(not used)	*SYM_0*						
	(not used)	*SYM_1*						
	open circuit at NOx circuit	*SYM_2*						
	short circuit at NOx circuit	*SYM_3*						

Figure A.109.4: Diagnostic

Diagnostic NS_OBD_1_ LAMB[i]	Symptom description	Symptom	Filter type
NOx sensor OBDI - linear Lambda circuit diagnosis	(not used)	SYM_0	STD_INI
	(not used)	SYM_1	
	open circuit at linear Lambda circuit	SYM_2	
	short circuit at linear Lambda circuit	SYM_3	

Figure A.109.5: Diagnostic

Diagnostic NS_OBD_1_ LAMB[i]	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NOx sensor OBDI - linear Lambda circuit diagnosis	(not used)	*SYM_0*						
	(not used)	*SYM_1*						
	open circuit at linear Lambda circuit	*SYM_2*						
	short circuit at linear Lambda circuit	*SYM_3*						

Figure A.109.6: Diagnostic

Diagnostic NS_OBD_1_ VLS[i]	Symptom description	Symptom	Filter type
NOx sensor OBDI - binary Lambda circuit diagnosis	(not used)	SYM_0	STD_INI
	(not used)	SYM_1	
	open circuit at binary Lambda circuit	SYM_2	
	short circuit at binary Lambda circuit	SYM_3	

Figure A.109.7: Diagnostic

Diagnostic NS_OBD_1_ VLS[i]	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NOx sensor OBDI - binary Lambda circuit diagnosis	(not used)	*SYM_0*						
	(not used)	*SYM_1*						
	open circuit at binary Lambda circuit	*SYM_2*						
	short circuit at binary Lambda circuit	*SYM_3*						

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A.109.1 Inhibition of NOx sensor error byte evaluation

FUNCTION DESCRIPTION:

General information:

The flag LV_INH_DIAG_NS_OBD_1[i] allows to inhibit the NOx sensor OBDI diagnosis, which evaluates the NOx sensor error byte.

Application conditions

Initialisation: at reset, at deactivation: LV_INH_DIAG_NS_OBD_1[i] = 1

Recurrence: *100ms*

Activation: *LV_ST_END = 1*

Deactivation: *LV_ST_END = 0*

Formula section:

if *(NOx message has not been received via LOCAN at least for once - LV_VAR_NOX)*

LV_VAR_NOX = 0 **OR**

LV_CDN_VB_CAN_DIAG = 0

then LV_INH_DIAG_NS_OBD_1[i] = 1

else LV_INH_DIAG_NS_OBD_1[i] = 0

endif

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A.110 Alternator power management diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DIAG_GEN_DIAG	V	0... 200H	0... 512	1	-
Diagnosis counter for fulfilled diagnosis values					
CTR_REF_GEN_DIAG	V	0... 200H	0... 512	1	-
Reference counter for diagnosis result					
ERR_SYM_GEN_DIAG	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptoms generator diagnosis					
LV_CDN_DIAG_GEN_DIAG	O/V	0... 1H	0 ...1	1	-
Status of diagnosis generator diagnosis					
LV_END_DIAG_GEN_DIAG	O/V	0... 1H	0 ...1	1	-
End of diagnosis generator diagnosis					
LV_ERR_GEN_DIAG	O/V	0... 1H	0 ...1	1	-
Error generator diagnosis					

Input data:

LV_ALTER_SWI_OFF {p. 8368}	LV_ERR_BSD {p. 4834}	LV_IGK {p. 906}	LV_ST_END {p. 1720}
LV_VB_JUMP {p. 1185}	POW_REL_ALTER_CLC {p. 8368}	T_AST {p. 1766}	VB_MES {p. 845}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_GEN_DIAG	-	0... FFH	0... 255	1	-
Anti-bounce increment value					
C_ABC_MAX_GEN_DIAG	-	1... FFH	1... 255	1	-
Anti-bounce maximum value					
C_DFFGEN_THD_MAX	-	0... FFH	0... 99.60937	0.390625	%
Max. DF-diagnosis threshold for generator diagnosis					
C_DFFGEN_THD_MIN	-	0... FFH	0... 99.60937	0.390625	%
Min. DF-diagnosis threshold for generator diagnosis					
C_PERC_GEN_DIAG_VB_MAX	-	0... FFFFH	0... 99.99847	1.53e-3	%
Percentage of battery voltage values within diagnosis range					
C_T_AST_GEN_DIAG_OFF	-	0... FFFFH	0... 6553.5	0.1	s
End of generator diagnosis T_AST					
C_T_AST_GEN_DIAG_ON	-	0... FFFFH	0... 6553.5	0.1	s
Begin of generator diagnosis T_AST					
C_VB_MES_GEN_DIAG_THD	-	0... 3FFH	0... 28.7055	28.1e-3	V
Battery voltage diagnosis threshold					
C_VB_MES_GEN_DIAG_THD_MAX	-	0... 3FFH	0... 28.7055	28.1e-3	V
Max. battery voltage threshold for diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

General information:

The diagnosis is implemented to check, that the alternator has surely made an under excitation for several seconds after start end.

Application conditions

Initialisation: *all 0 at LV_IGK 0->1* ***or*** *reset* ***or*** *at clearing error memory*

Recurrence: *100 ms*

Activation: For alternator 1: LV_IGK = 1 and LV_ST_END = 1 and LV_ALTER_SWI_OFF = 1 and LV_ERR_BSD = 0

Deactivation: LV_END_DIAG_GEN_DIAG = 1

Formula section:

If C_T_AST_GEN_DIAG_ON < T_AST C_T_AST_GEN_DIAG_OFF **AND**
LV_VB_JUMP = 0 **AND**
! (VB_MES > C_VB_MES_GEN_DIAG_THD_MAX **AND**
C_DFFGEN_THD_MIN < POW_REL_ALTER_CLC < C_DFFGEN_THD_MAX)
Then CTR_REF_GEN_DIAG ++
If VB_MES < C_VB_MES_GEN_DIAG_THD
Then CTR_DIAG_GEN_DIAG ++
Endif
Endif

If T_AST C_T_AST_GEN_DIAG_OFF
Then LV_CDN_DIAG_GEN_DIAG = 1
If (VB_MES > C_VB_MES_GEN_DIAG_THD_MAX **AND**
(C_DFFGEN_THD_MAX POW_REL_ALTER_CLC **OR**
POW_REL_ALTER_CLC C_DFFGEN_THD_MIN)) **AND**

CTR_REF_GEN_DIAG = !0 **AND**
(CTR_DIAG_GEN_DIAG /CTR_REF_GEN_DIAG) * 100 % <
C_PERC_GEN_DIAG_VB_MAX
Then ERR_SYM_GEN_DIAG = SYM_0
LV_ERR_GEN_DIAG = 1 (after debounce)
Else ERR_SYM_GEN_DIAG = NO_SYM
LV_ERR_GEN_DIAG = 0 (after rebounce)
Endif
Endif

End of diagnosis calculation LV_END_DIAG_GEN_DIAG = 1:
see chapter Anti - bounce Algorithm: Calculation of the end of diagnosis

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A.111 Energy spare mode diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_EGY_MIN	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom EGY_MIN					
ERR_SYM_EGY_MIN_2	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom EGY_MIN for transportation mode					
LV_CDN_DIAG_EGY_MIN	V	0... 1H	0 ...1	1	-
Diagnosis condition EGY_MIN					
LV_CDN_DIAG_EGY_MIN_2	V	0... 1H	0 ...1	1	-
Diagnosis condition EGY_MIN for transportation mode					
LV_END_DIAG_EGY_MIN	V	0... 1H	0 ...1	1	-
End of Diagnosis EGY_MIN					
LV_END_DIAG_EGY_MIN_2	V	0... 1H	0 ...1	1	-
End of Diagnosis EGY_MIN for transportation mode					
LV_ERR_EGY_MIN	O/V	0... 1H	0 ...1	1	-
Energy spare mode (EGY_MIN - Energiesparmodus) error flag					
LV_ERR_EGY_MIN_2	O/V	0... 1H	0 ...1	1	-
Energy spare mode (EGY_MIN - Energiesparmodus) error flag for transportation mode					

Input data:

LV_IGK {p. 906}	STATE_EGY_MIN_KWP {p. 7483}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_EGY_MIN_DIAG	-	0... 1H	0 ...1	1	-
Activation of energy spare mode diagnosis					
LC_EGY_MIN_DIAG_2	-	0... 1H	0 ...1	1	-
Activation of energy spare mode diagnosis for transportation mode					

Error treatment:

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Energy spare mode for production and garage mode (EGY_MIN - Energiesparmodus) error flag	EGY_MIN	Fertigungsmodus	0	NO	CC
			1		
		Werkstattmodus	2		
			3		

Possible configuration for ABC type and CARB class (see also “Table of Failure”)

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ABC Type: STD_INI, STD, MEM, MEM_INI, DEC_CAL, STC, NO, MPL_STD_INI
CARB Class: MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Energy spare mode for transportation mode (EGY_MIN_2 - Energiesparmodus) error flag	EGY_MIN_2		0	NO	CC
		Transportmodus	1		
			2		
			3		

Possible configuration for ABC type and CARB class (see also "Table of Failure")
ABC Type: STD_INI, STD, MEM, MEM_INI, DEC_CAL, STC, NO, MPL_STD_INI
CARB Class: MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO

A.111.1 LV_ERR_EGY_MIN for production and garage mode

FUNCTION DESCRIPTION:

General information:

The purpose of the diagnosis shall be to detect an activated energy spare mode. There are different energy spare modes. In this chapter the production and the garage mode are treated.

Application conditions

Initialisation:
```
all 0 at LV_IGK 0 -> 1 or  reset
 LV_END_DIAG_EGY_MIN is initialized by ERRM
```

Recurrence: *1s*

Activation:
```
If          LV_IGK = 1 and  LC_EGY_MIN_DIAG = 1
 Then       LV_CDN_DIAG_EGY_MIN = 1
 Endif
```

Deactivation:
```
If          LV_IGK = 0 or  LC_EGY_MIN_DIAG = 0
 Then       LV_CDN_DIAG_EGY_MIN = 0
 Endif
```

Formula section:

If STATE_EGY_MIN_KWP = 0 **or** STATE_EGY_MIN_KWP = 2
Then LV_ERR_EGY_MIN = 0
ERR_SYM_EGY_MIN = NO_SYM
Else LV_ERR_EGY_MIN = 1
If STATE_EGY_MIN_KWP = 1
Then ERR_SYM_EGY_MIN = SYM_0
Elseif STATE_EGY_MIN_KWP = 3
Then ERR_SYM_EGY_MIN = SYM_2
Endif
Endif
LV_END_DIAG_EGY_MIN = 1

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A.111.2 LV_ERR_EGY_MIN_2 for transportation mode

FUNCTION DESCRIPTION:

General information:

The purpose of the diagnosis shall be to detect an activated energy spare mode. There are different energy spare modes. In this chapter the transportation mode is treated.

Application conditions

Initialisation: all 0 at LV_IGK 0 -> 1 **or** reset
LV_END_DIAG_EGY_MIN_2 is initialized by ERRM

Recurrence: *1s*

Activation:
```
If      LV_IGK = 1 and  LC_EGY_MIN_DIAG_2 = 1
Then    LV_CDN_DIAG_EGY_MIN_2 = 1
Endif
```

Deactivation:
```
If      LV_IGK = 0 or  LC_EGY_MIN_DIAG_2 = 0
Then    LV_CDN_DIAG_EGY_MIN_2 = 0
Endif
```

Formula section:

If STATE_EGY_MIN_KWP = 2
Then LV_ERR_EGY_MIN_2 = 1
ERR_SYM_EGY_MIN_2 = SYM_1
Else LV_ERR_EGY_MIN_2 = 0
ERR_SYM_EGY_MIN_2 = NO_SYM
Endif

LV_END_DIAG_EGY_MIN_2 = 1

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A.112 Key position diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_PLAUS_IGK_3	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
detected error symtom on KL15-3					
ERR_SYM_PLAUS_IGK_BN	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
detected error symtom					
LV_CDN_DIAG_PLAUS_IGK_3	V	0... 1H	0 ...1	1	-
diagnosis condition					
LV_CDN_DIAG_PLAUS_IGK_BN	V	0... 1H	0 ...1	1	-
diagnosis condition					
LV_END_DIAG_PLAUS_IGK_3	O/V	0... 1H	0 ...1	1	-
end of diagnosis of KL15-3					
LV_END_DIAG_PLAUS_IGK_BN	O/V	0... 1H	0 ...1	1	-
end of diagnosis					
LV_ERR_PLAUS_IGK_3	O/V	0... 1H	0 ...1	1	-
plausibility error of IGK-signal 15-3 to signal IGK-WUP					
LV_ERR_PLAUS_IGK_BN	O/V	0... 1H	0 ...1	1	-
plausibility error of IGK-signal from CAN/HW					

Input data:

LV_MU_IGN_KEY {p. 7135}	LV_VAR_BN {p. 655}	LV_VAR_L6 {p. 805}	STATE_PLAUS_IGK_BN {p. 906}
VB {p. 1185}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_PLAUS_IGK_3	-	0... FFH	0... 255	1	-
Debounce counter increment - igk-signal 15-3 plausibility diagnosis					
C_ABC_INC_PLAUS_IGK_BN	-	0... FFH	0... 255	1	-
Debounce counter increment - igk-signal plausibility diagnosis					
C_ABC_MAX_PLAUS_IGK_3	-	1... FFH	1... 255	1	-
Debounce counter max. value - igk-signal 15-3 plausibility diagnosis					
C_ABC_MAX_PLAUS_IGK_BN	-	1... FFH	1... 255	1	-
Debounce counter max. value - igk-signal plausibility diagnosis					
C_VB_MIN_IGK_DIAG	-	0... FFH	0... 25.89843	0.1015625	V
VB threshold for de-/activation of IGK-diagnosis					

Import actions:

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ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)

Error treatment:

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
plausibility error of IGK-signal from CAN/HW	PLAUS_IGK_BN	SCB	0	STD_INI	CC
		SCG	1		
		CAS error	2		
		CAS-plausibility error	3		

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
plausibility error of IGK-signal KL15-3	PLAUS_IGK_3	SCB	0	STD_INI	CC
		SCG, OL	1		
		-	2		
		-	3		

A.112.1 Plausibility check between signal from CAn and HW-signal

FUNCTION DESCRIPTION:

Description:

For BN2000-vehicles there are two possibilities of getting the LV_IGK-signal:

1. via CAN (from the control unit CAS)
2. via HW-signal (“Weckleitung”)

In order to detect a CAS error or a HW-error (e.g. shortcut to ground) a plausibility check has to be done between CAN-signal and HW-signal. SYM_0, SYM_1 and SYM_3 are debounced with the recurrence of Klemmenstatus or Klemmen message. SYM_2 is debounced with the recurrence of 10 ms (no message with Klemmen informnation available).

Application conditions

Initialisation: *all 0 at reset*

Recurrence: *10ms*

Activation:

```
if          LV_VAR_BN = 1
Then     if       (VB > = C_VB_MIN_IGK_DIAG)
      then     LV_CDN_DIAG_PLAUS_IGK_BN = 1
      endif
       Else      LV_CDN_DIAG_PLAUS_IGK_BN = 0
       Endif
```

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Deactivation:

```
if        (VB < C_VB_MIN_IGK_DIAG)      or
     at   State bus sleep
then      LV_CDN_DIAG_PLAUS_IGK_BN = 0
endif
```

Formula section:

IF STATE_PLAUS_IGK_BN = 0H **and**
Klemmen or Klemmenstatus message from CAS received
THEN ERR_SYM_PLAUS_IGK_BN = NO_SYM
LV_ERR_PLAUS_IGK_BN = 0 after rebounce
ELSEIF STATE_PLAUS_IGK_BN = 1H
THEN ERR_SYM_PLAUS_IGK_BN = SYM_0 **//SCB, Master CAN**
LV_ERR_PLAUS_IGK_BN = 1 after debounce
ELSEIF STATE_PLAUS_IGK_BN = 2H
THEN ERR_SYM_PLAUS_IGK_BN = SYM_1 **//SCG, Master CAN**
LV_ERR_PLAUS_IGK_BN = 1 after debounce
ELSEIF STATE_PLAUS_IGK_BN = 4H
THEN ERR_SYM_PLAUS_IGK_BN = SYM_2 **//CAS error, Master HW**
LV_ERR_PLAUS_IGK_BN = 1 after debounce
ELSEIF STATE_PLAUS_IGK_BN = 8H
LV_ERR_PLAUS_IGK_BN = 1 after debounce
THEN ERR_SYM_PLAUS_IGK_BN = SYM_3 **// CAN-signal not plausible**
ENDIF

For calculation of condition-diagnosis-bit and end of diagnosis-bit LV_END_DIAG_PLAUS_IGK_BN see “Anti-bounce - algorithmus, calculation of the end of diagnosis”

For failure and error management treatment the anti-bounce mechanism is called :
ACTION_ERRM_FilterSymptom(IN<NC_IDX_DIAG_PLAUS_IGK_BN>, IN<LV_CDN_DIAG_PLAUS_IGK_ BN >, IN<ERR_SYM_PLAUS_IGK_ BN >, IN<ABC_INC_PLAUS_IGK_ BN >, IN<1>, IN<ABC_MAX_PLAUS_IGK_ BN >, OUT<LV_ERR_ PLAUS_IGK_ BN >)

A.112.2 Diagnosis of KL15-3 with plausibility check to the signals from CAN and HW-signal KL15-WUP

FUNCTION DESCRIPTION:

Description:

The HW-signal KL15-3 is redundant to the Kl15WUP, but the engine won’t start if KL15-3 is not available. To make the reason of a non starting engine in the case of a missing KL15-3-line visible, a diagnosis for the signal is necessary.
To detect a error at the input KL15-3, a plausibility check to the Kl15WUP and the CAN-singal has to be done.
SYM_0, SYM_1 are debounced with the recurrence of Klemmenstatus or Klemmen message).

Application conditions

Initialisation: *all 0 at reset*

Recurrence: *10ms*

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Activation:

```
If          LV_VAR_BN = 1      or
       LV_VAR_L6 = 1
Then    if       (VB > = C_VB_MIN_IGK_DIAG) and
          STATE_PLAUS_IGK_BN = 0
     then    LV_CDN_DIAG_PLAUS_IGK_3 = 1
     endif
      Else      LV_CDN_DIAG_PLAUS_IGK_3 = 0
      Endif
```

Deactivation:

```
If              (VB < C_VB_MIN_IGK_DIAG)       or
      at     State bus sleep     or
      STATE_PLAUS_IGK_BN =!  0
 then        LV_CDN_DIAG_PLAUS_IGK_3 = 0
 endif
```

Formula section:

If STATE_PLAUS_IGK_BN = 0
Then
  If LV_IGK = 1
  Then
    If LV_MU_IGN_KEY = 1 *// Pin KL15_3 is high*
    Then ERR_SYM_PLAUS_IGK_3 = NO_SYM
      // LV_ERR_PLAUS_IGK_3 = 0 after debounce
    Else ERR_SYM_PLAUS_IGK_3 = SYM_1 *// SCG or OL*
      // LV_ERR_PLAUS_IGK_3 = 1 after debounce
    Endif
  Else
    If LV_MU_IGN_KEY = 0 *// Pin KL15_3 is low*
    Then ERR_SYM_PLAUS_IGK_3 = NO_SYM
      // LV_ERR_PLAUS_IGK_3 = 0 after debounce
    Else ERR_SYM_PLAUS_IGK_3 = SYM_0 *// SCB*
      // LV_ERR_PLAUS_IGK_3 = 1 after debounce
    Endif
  Endif
Else LV_CDN_DIAG_PLAUS_IGK_3 = 0
Endif

For failure and error management treatment the anti-bounce mechanism is called :
ACTION_ERRM_FilterSymptom(IN<NC_IDX_DIAG_PLAUS_IGK_3>, IN<LV_CDN_DIAG_PLAUS_IGK_3>, IN<ERR_SYM_PLAUS_IGK_3>, IN<ABC_INC_PLAUS_IGK_3>, IN<1>, IN<ABC_MAX_PLAUS_IGK_3>, OUT<LV_ERR_ PLAUS_IGK_3>)

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A.113 Main relay diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_RLY_MAIN	-	0... 7H	0 ...7	1	-
Diagnosis condition for each syptom of RLY_MAIN bit 0: diagnosis condition for symptom SCP (SYM_0) bit1: diagnosis condition for symptom SCPG(SYM_1) bit2 diagnosis condition for symptom OC (SYM_2)					
CTR_DIAG_RLY_MAIN_DLY	V	0... FFH	0... 255	1	-
Debounce counter - main relay diagnosis for "switch on" diagnosis					
CTR_END_DIAG_RLY_MAIN_DLY	V	0... FFH	0... 255	1	-
counter for END_DIAG - main relay diagnosis for "switch on" diagnosis					
ERR_RLY_MAIN	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for RLY_MAIN (only Parameter)					
ERR_SYM_RLY_MAIN	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom RLY_MAIN					
ERR_SYM_RLY_MAIN_DLY	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom RLY_MAIN_DLY					
LV_CDN_DIAG_RLY_MAIN	O/V	0... 1H	0 ...1	1	-
Diagnosis condition RLY_MAIN					
LV_CDN_DIAG_RLY_MAIN_DLY	O/V	0... 1H	0 ...1	1	-
Diagnosis condition RLY_MAIN_DLY					
LV_DIAG_END_RLY_MAIN_DLY	O/V	0... 1H	0 ...1	1	-
End of Diagnosis RLY_MAIN_DLY (flag not for error management)					
LV_END_DIAG_RLY_MAIN	O/V	0... 1H	0 ...1	1	-
End of Diagnosis RLY_MAIN					
LV_END_DIAG_RLY_MAIN_DLY	O/V	0... 1H	0 ...1	1	-
End of Diagnosis RLY_MAIN_DLY					
LV_ERR_RLY_MAIN	O/V	0... 1H	0 ...1	1	-
Boolean for error detected at the main relay.					
LV_ERR_RLY_MAIN_DLY	O/V	0... 1H	0 ...1	1	-
Error detected switch on relay					
LV_RLY_MAIN_DLY_ERR	O/V	0... 1H	0 ...1	1	-
Error detected switch on relay (flag not for error management)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_DLY_RLY_MAIN_DIAG	O/V	0... FFH	0... 2550	10	ms
delay Timer for the diagnosis to allow switching of the relay					
T_RLY_MAIN_DIAG	V	0... FFH	0... 2550	10	ms
Time window to perform the main relay diagnosis.					

Input data:

LV_IGK {p. 906}	LV_RLY_MAIN {p. 3772}	LV_VAR_L6 {p. 805}	PWL_LOCK_CDN {p. 3776}
V_IGK {p. 1185}	VB {p. 1185}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_RLY_MAIN	-	0... FFH	0... 255	1	-
Debounce counter increment - RLY_MAIN diagnosis					
C_ABC_MAX_RLY_MAIN	-	1... FFH	1... 255	1	-
Debounce counter maximum value - RLY_MAIN diagnosis					
C_CTR_INC_DIAG_RLY_MAIN_DLY	V	0... FFH	0... 255	1	-
Debounce counter increment - main relay "too slow" diagnosis					
C_CTR_INC_END_DIAG_RLY_MAIN_DLY	V	0... FFH	0... 255	1	-
counter increment for END_DIAG - main relay "too slow" diagnosis					
C_CTR_MAX_DIAG_RLY_MAIN_DLY	V	1... FFH	1... 255	1	-
Debounce counter maximum value - main relay "too slow" diagnosis					
C_CTR_MAX_END_DIAG_RLY_MAIN_DLY	V	1... FFH	1... 255	1	-
counter maximum value for END_DIAG - main relay "too slow" diagnosis					
C_T_DLY_RLY_MAIN_DIAG	-	0... FFH	0... 2550	10	ms
Delay Time for the diagnosis to allow switching of the relay.					
C_T_RLY_MAIN_DIAG	-	0... FFH	0... 2550	10	ms
Time window to perform the main relay diagnosis					
C_V_IGK_RLY_MAIN_DIAG	-	0... FFH	0... 25.8984375	0.1015625	V
voltage threshold for detection of main relay on.					
C_VB_RLY_MAIN_DIAG	-	0... FFH	0... 25.8984375	0.1015625	V
voltage threshold for detection of battery voltage present.					
C_VB_RLY_MAIN_DLY_DIAG	V	0... FFH	0... 25.8984375	0.1015625	V
Voltage threshold for main relay "too slow" diagnosis					

Import actions:

ACTION_INFR_GetElDiagRlyMain (**OUT**<PRM_CDN_DIAG_RLY_MAIN>,**OUT**<PRM_ERR_RLY_MAIN>)

Error treatment

Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
RLY_MAIN	Main relay has not switched off	0			STD_INI	CC
Main relay "switch on" /"switched off" diagnosis	Main relay has not switched on	1				

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Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
		2				
		3				

Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
RLY_MAIN_DLY	Main relay hasn't switched before predrive check	0			NO	CC
Main relay "switched on too slow" diagnosis for pre-drive check		1				
		2				
		3				

General information

The Main Relay Diagnosis is performed to detect if the Main Relay has switched and remains on after Key-On and if it has switched off after the Power Latch Phase

A.113.1 Main relay "switch on" /"switched off" diagnosis

General information:

Description:

The diagnosis is delayed for C_T_DLY_RLY_MAIN_DIAG to allow the relay to switch on/off. After this the actual VB is compared with a diagnostic threshold. If the error conditions are fulfilled the error is debounced.

If an error is detected after the Power Latch Phase the ECU is switched off after T_RLY_MAIN_DIAG has elapsed.

Error-symptoms are defined to this diagnosis function as following :

```
 ┌─┬─┬─┬─┐
 │ │ │ │ │
 └─┴─┴─┴─┘
  |  |  |  └─> Main relays has not switched off      (= SYM_0)
  |  |  └────> Main relays has not switched on       (= SYM_1)
  |  └───────> -                                     (= SYM_2)
  └──────────> -                                     (= SYM_3)
```

Figure A.113.1:

Application conditions:

Initialisation: `all 0 at LV_IGK 0->1 or reset or at clearing error memory`

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	but T_RLY_MAIN_DIAG is calculated as described below
Activation:	see Formula section
Deactivation:	-
Recurrence:	The application recurrence for the Diagnosis is 10 ms; The "Main Relay Off"-Detection is performed only once after power latch.

Function description:

Formula section:

Detection if Main Relay is on during Key-On

Call I/O Power-Stage-Diagnosis (Short to Ubatt) and ignore return value in order to restart the Power-Stage after shut off due to short circuit to battery

//this is done to try to wake up the power stage after instable battery voltage

```
ACTION_INFR_GetElDiagRlyMain (OUT<cdn_diag_rly_main>, OUT<err_rly_main>)

If(1)   LV_RLY_MAIN = 1              and
        LV_END_DIAG_RLY_MAIN = 0     and
        V_IGK   >  C_V_IGK_RLY_MAIN_DIAG
            //direct connection to the battery,
            to ensure a battery voltage that would be able to switch the relay

Then(1)     wait time: C_T_DLY_RLY_MAIN_DIAG
            //time to allow the relay to switch, set only once.  For continuos
            diagnosis set to 0
   If(2)        C_T_DLY_RLY_MAIN_DIAG     has run out //if started, see above
   Then(2)      LV_CDN_DIAG_RLY_MAIN = 1
      If(3)        VB   <   C_VB_RLY_MAIN_DIAG
                   //connection to battery via main relay
      Then(3)      ERR_SYM_RLY_MAIN = SYM_1
                   LV_ERR_RLY_MAIN = 1        //after debounce
      Else(3)      ERR_SYM_RLY_MAIN = NO_SYM
                   LV_ERR_RLY_MAIN = 0        //after rebounce
                   //error can only be reset with LV_IGK 0->1 because
                   diagnosis doesn't run after an error has been detected !
      Endif(3)
   Else(2)         C_T_DLY_RLY_MAIN_DIAG          //is still running
   Endif(2)
Else(1)    LV_CDN_DIAG_RLY_MAIN = 0             //no Diagnosis
Endif(1)

If LV_VAR_L6 = 0
Then      set lock condition once to extend power latch phase (PWL_LOCK_CDN)
Endif
// because the OFF-diagnosis is used only in L4 projects, the PWL_LOCK_CDN should
be set only in L4 projecs.
```

Calculation end of diagnosis

LV_END_DIAG_RLY_MAIN is calculated by error management after diagnosis is active

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Detection if Main Relay is off after Power Latch Phase:

```
If(1)       LV_RLY_MAIN = 0 and LV_VAR_L6 = 0  // no Relay-OFF-diagnosis at L6
Then(1)     LV_END_DIAG_RLY_MAIN = 0
            LV_ERR_RLY_MAIN = 0 //reset of error to be able to set it with
                                 new symptom
            start time:    C_T_DLY_RLY_MAIN_DIAG
            //time to allow the relay to switch
   If(2)        PWL_LOCK_CDN is set and
                C_T_DLY_RLY_MAIN_DIAG has run out
   Then(2)      start  T_RLY_MAIN_DIAG  for  C_T_RLY_MAIN_DIAG
               (start the time window during  the diagnosis is performed)
      If(3)         T_RLY_MAIN_DIAG  is still running
      Then(3)        LV_CDN_DIAG_RLY_MAIN = 1
        If(4)         VB   >  C_VB_RLY_MAIN_DIAG
                      //connection to battery via main relay
        Then(4)       ERR_SYM_RLY_MAIN = SYM_0
                      LV_ERR_RLY_MAIN = 1           //after debounce
        Else(4)       ERR_SYM_RLY_MAIN = NO_SYM
                      LV_ERR_RLY_MAIN = 0           //after rebounce
        Endif(4)
      Else(3)       LV_CDN_DIAG_RLY_MAIN = 0
                    erase lock condition for power latch phase (PWL_LOCK_CDN)
   Else(2)      T_RLY_MAIN_DIAG = 0                 //reset
                LV_CDN_DIAG_RLY_MAIN = 0            //no switched off Diagnosis
   Endif(2)
Else(1)    LV_CDN_DIAG_RLY_MAIN = 0                 //no Diagnosis
Endif(1)
```

A.113.2 Main relay “switched on too slow” diagnosis for pre-drive check

General information:

Description:

The main relay diagnosis is performed at reset to detect if the main relay has been switched on within the correct timing. This diagnostic is comparable to main relay switch on, but is separated for having faster reaction time.

Once no failure has been found, diagnosis is then disabled.

The diagnosis starts after LV_IGK 0->1. After this the actual VB is compared with a diagnostic threshold. If the error conditions are fulfilled the error is debounced.

Error-symptoms are defined to this diagnosis function as following :

```
 _______________
|___|___|___|___|
  |   |   |   └─> Main relay hasn't switched before predrive check (= SYM_0)
  |   |   └───> -                                                  (= SYM_1)
  |   └─────> -                                                    (= SYM_2)
  └───────> -                                                      (= SYM_3)
```

Figure A.113.2:

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Application conditions:

Initialisation:
```
ERRM data according filter type:  NO
At reset :       LV_CDN_DIAG_RLY_MAIN_DLY =  0
               LV_ERR_RLY_MAIN_DLY = 0
               ERR_SYM_RLY_MAIN_DLY = NO_SYM
               CTR_END_DIAG_RLY_MAIN_DLY = 0
               CTR_DIAG_RLY_MAIN_DLY = 0
               LV_DIAG_END_RLY_MAIN_DLY = 0
               LV_RLY_MAIN_DLY_ERR = 0
At clearing FMY:  reset of FMY variables according ERRM
```

Activation: LV_IGK = 1

Deactivation: LV_DIAG_END_RLY_MAIN_DLY = 1 **and** LV_RLY_MAIN_DLY_ERR = 0
set LV_CDN_DIAG_RLY_MAIN_DLY = 0

Recurrence: 10 ms

Function description:

Formula section:

```
If(1)  LV_RLY_MAIN = 1
Then(1)
      LV_CDN_DIAG_RLY_MAIN_DLY = 1

      If(2)     VB >= C_VB_RLY_MAIN_DLY_DIAG
                (connection to battery via main relay)
      Then(2)   ERR_SYM_RLY_MAIN_DLY = NO_SYM
                CTR_END_DIAG_RLY_MAIN_DLY = CTR_END_DIAG_RLY_MAIN_DLY +
                                            C_CTR_INC_END_DIAG_RLY_MAIN_DLY
         If(3a)   CTR_END_DIAG_RLY_MAIN_DLY >= C_CTR_MAX_END_DIAG_RLY_MAIN_DLY
         Then(3a)   LV_END_DIAG_RLY_MAIN_DLY = 1
                    LV_DIAG_END_RLY_MAIN_DLY = 1
                    LV_ERR_RLY_MAIN_DLY = 0
                    LV_RLY_MAIN_DLY_ERR = 0
         Endif(3a)
      Else(2)
          If(3b)  V_IGK  >  C_V_IGK_RLY_MAIN_DIAG
          Then(3b) ERR_SYM_RLY_MAIN_DLY  = SYM_0
                   CTR_DIAG_RLY_MAIN_DLY = CTR_DIAG_RLY_MAIN_DLY +
                                           C_CTR_INC_DIAG_RLY_MAIN_DL
             If(4)   CTR_DIAG_RLY_MAIN_DLY >= C_CTR_MAX_DIAG_RLY_MAIN_DLY
             Then(4) LV_END_DIAG_RLY_MAIN_DLY = 1
                     LV_DIAG_END_RLY_MAIN_DLY = 1
                     LV_ERR_RLY_MAIN_DLY = 1
                     LV_RLY_MAIN_DLY_ERR = 1
                     CTR_END_DIAG_RLY_MAIN_DLY = 0
            Endif(4)
          Endif(3b)
      Endif(2)
Else(1)
     LV_CDN_DIAG_RLY_MAIN_DLY = 0
Endif(1)
```

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A.114 Main relay diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_ACK_IGK_OFF	V	0... 7H	0 ...7	1	-
Diagnosis condition ACK_IGK_OFF for each symptom					
ERR_DIAG_ACK_IGK_OFF	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for ACK_IGK_OFF (only parameter)					
ERR_SYM_ACK_IGK_OFF	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom ACK_IGK_OFF power stage diagnosis					
LV_CDN_DIAG_ACK_IGK_OFF	V	0... 1H	0 ...1	1	-
Diagnosis condition ACK_IGK_OFF power stage diagnosis					
LV_END_DIAG_ACK_IGK_OFF	V	0... 1H	0 ...1	1	-
End of diagnosis ACK_IGK_OFF power stage diagnosis					
LV_ERR_ACK_IGK_OFF	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on ACK_IGK_OFF power stage					

Input data:

LC_IGK_OFF_ACK {p. 3772}	LV_CDN_VB_OBD1 {p. 1185}	LV_IGK {p. 906}	LV_IGK_OFF_ACK {p. 3772}
LV_IGK_OFF_ACK_ENA {p. 7680}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_ACK_IGK_OFF	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_ACK_IGK_OFF	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_ACK_IGK_OFF	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (= 2)					

Import actions:

ACTION_ERRM_FilterMulticondition (**IN**<XX>,**IN**<CDN_DIAG_>,**XX**>,<IN<>,**ERR_DIAG_XX**>,<IN>,<C_ABC_INC_XX>,**IN**<C_ABC_MAX_XX>,**OUT**<LV_ERR_XX>)

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ACTION_INFR_GetElDiagIGK_OFF (**OUT**<Cdn_diag_ack_igk_off>,**OUT**<Err_diag_ack_igk_off>)

Note :
ACTION_INFR_GetElDiagIGK_OFF(), ACTION_INFR_SetElDiagIGK_OFF() are defined in the IRS (Infrastructure requirement specification)

FUNCTION DESCRIPTION:

General information:

The HW line acknowledge IGK off /starter relay for start stop automatic (STST) is driven by the ECU via an output driver. The failure detection is done by ECU Hardware.
The purpose of the diagnosis is to detect electrical faults as defined by OBD I requirements.

Description:

After activation conditions are met, the diagnosis activation is delayed for NC_PSD_DLY_ACK_IGK_OFF executions, to avoid the usage of wrong infrastructure information.
Error-symptoms and conditions: are defined to this diagnosis function as following

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	**Name**	**Description**	**Nr**		
HW line acknowledge IGK_OFF / starter relay for start stop automatic (STST)	ACK_IGK_OFF	Sym 0 Short circuit to battery (SCP)	0	MPL_STD_INI	CC
		Sym 1 Short circuit to ground (SCG)	1		
		Sym 2 Open circuit (OC)	2		
		Sym 3 -	3		

Application conditions

Initialisation:
```
at transition LV_IGK 0 - -> 1:
  Set delay counter for NC_PSD_DLY_ACK_IGK_OFF
  at reset:
  Set delay counter for NC_PSD_DLY_ACK_IGK_OFF
```

Recurrence:
```
If      LV_IGK_OFF_ACK = 0
   then    100 ms
   else     20ms
 endif
```

Activation: `LC_IGK_OFF_ACK = 1  and  LV_IGK_OFF_ACK_ENA = 1`

Deactivation: *`LC_IGK_OFF_ACK  = 0 or  LV_IGK_OFF_ACK_ENA = 0`*

Formula section:

If LV_IGK = 1 **and**
LV_CDN_VB_OBD1 = 1
Then
Usage of the diagnosis information (failure symptoms (raw value) ERR_DIAG_ACK_IGK_OFF and basic diagnosis conditions CDN_DIAG_ACK_IGK_OFF) received from the infrastructure:

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ACTION_INFR_GetElDiagIGK_OFF (OUT<Cdn_diag_ack_igk_off>, OUT<Err_diag_ack_igk_off>)

Basic diagnosis conditions are set according infrastructure information: CDN_DIAG_ACK_IGK_OFF
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_ACK_IGK_OFF

If Activation conditions are met for the NC_PSD_DLY_ACK_IGK_OFF recurrence of the diagnosis
Then *[CDN_DIAG_ACK_IGK_OFF valid from Infrastructure]*
Else CDN_DIAG_ACK_IGK_OFF = 0
Endif

Else
CDN_DIAG_ACK_IGK_OFF = 0
Endif

Failure filtering and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_ACK_IGK_OFF and ERR_DIAG_ACK_IGK_OFF.
ACTION_ERRM_FilterMulticondition (IN<ACK_IGK_OFF>, IN<CDN_DIAG_ACK_IGK_OFF>, IN<ERR_DIAG_ACK_IGK_OFF>, IN<C_ABC_INC_ACK_IGK_OFF>, IN<C_ABC_MAX_ACK_IGK_OFF>, OUT<LV_ERR_ACK_IGK_OFF>)
This algorithm determines:

ERR_DIAG_ACK_IGK_OFF	(detected error symptom for ACK_IGK_OFF diagnosis)
LV_ERR_ACK_IGK_OFF	(Error flag for debounced error of ACK_IGK_OFF)
LV_CDN_DIAG_ACK_IGK_OFF	(Diagnosis condition information)
LV_END_DIAG_ACK_IGK_OFF	(End of diagnosis information)

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A.115 Active engine brackets diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_AEB [NC_AEB_NR]	V	0... 7H	0 ...7	1	-
Diagnosis condition AEB for each symptom					
ERR_DIAG_AEB [NC_AEB_NR]	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for AEB (only parameter)					
ERR_SYM_AEB [NC_AEB_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom AEB power stage diagnosis					
LV_CDN_DIAG_AEB [NC_AEB_NR]	O/V	0... 1H	0 ...1	1	-
Diagnosis condition AEB power stage diagnosis					
LV_END_DIAG_AEB [NC_AEB_NR]	O/V	0... 1H	0 ...1	1	-
End of diagnosis AEB power stage diagnosis					
LV_ERR_AEB [NC_AEB_NR]	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on AEB[i] power stage					

Input data:

LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}	LV_VAR_AEB {p. 655}	LV_VB_CDN_OBD_1 {p. 1046}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_AEB	-	0... FFH	0... 255	1	-
Debounce counter increment AEB[i] power stage diagnosis					
C_ABC_MAX_AEB	-	1... FFH	1... 255	1	-
Debounce counter maximum value AEB[i] power stage diagnosis					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_AEB_NR	-	0... 2H	0 ...2	1	-
Number of active engine brackets					
NC_PSD_DLY_AEB	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (= 2)					

Import actions:

ACTION_ERRM_FilterMulticondition (**IN**<XX>,**IN**<CDN_DIAG_>,**XX**>,<IN<>,**ERR_DIAG_XX**>,<IN>,<C_ABC_INC_XX>,**IN**<C_ABC_MAX_XX>,**OUT**<LV_ERR_XX>)

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ACTION_INFR_GetElDiagAEB (**OUT**<CDN_DIAG_XX>,**OUT**<ERR_DIAG_XX>)

Error treatment:

Diagnostic AEB	Symptom description	Symptom	Filter type
Active engine bracket Diagnostic	*SCP*	*SYM_0*	*MPL_STD_INI*
	SCG	*SYM_1*	
	OC	*SYM_2*	

FUNCTION DESCRIPTION:

General information:

The AEB is driven by the ECU via an output driver. The failure detection is done by ECU Hardware. The purpose of the diagnosis is to detect electrical faults as defined by OBD I requirements. The AEB can be switched on or off (no PWM-signal).

Description:

The purpose is to perform the electrical diagnosis of the AEB actuator. 3 symptoms are distinguished:

Error-symptoms and conditions: are defined to this diagnosis function as following

```
□□□□
│ │ │ └─> Short circuit to battery (SCP)      (= SYM_0)
│ │ └───> Short circuit to ground (SCG)       (= SYM_1)
│ └─────> Open circuit (OC)                   (= SYM_2)
└───────> Not used                            (= SYM_3)
```

Application conditions

Initialisation: ERRM variables are initialized according Filter-type.
At Reset: CDN_DIAG_AEB = 0

Recurrence: *100ms*

Activation: LV_IGK = 1 **and** LV_VAR_AEB = 1

Deactivation: LV_IGK = 0 **or** LV_VAR_AEB = 0

Formula section:

If LV_ERR_SPI_MPS = 0
and LV_CDN_VB_OBD_1 = 1

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and LV_IGK = 1

Then

Usage of the diagnosis information (failure symptoms (raw value) ERR_DIAG_AEB and diagnosis conditions CDN_DIAG_AEB) received from the infrastructure:
ACTION_INFR_GetElDiagAEB (OUT<CDN_DIAG_AEB>, OUT<ERR_DIAG_AEB>)

Basic diagnosis conditions are set according infrastructure information: CDN_DIAG_AEB
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_AEB

If Activation conditions are met for the NC_PSD_DLY_AEB recurrence
Then
{ No additional diagnosis conditions are necessary }
Else
CDN_DIAG_AEB = 0
Endif
Else
CDN_DIAG_AEB = 0
Endif

Failure filtering and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_AEB and ERR_DIAG_AEB.
ACTION_ERRM_FilterMulticondition (IN<*AEB*>, IN<CDN_DIAG_AEB>,
IN<ERR_DIAG_AEB>, IN<C_ABC_INC_AEB>, IN<C_ABC_MAX_AEB>,
OUT< LV_ERR_AEB>)

This algorithm determines:

ERR_SYM_AEB	(detected error symptom for AEB diagnosis)
LV_ERR_AEB	(Error flag for debounced error of AEB)
LV_CDN_DIAG_AEB	(Diagnosis condition information)
LV_END_DIAG_AEB	(End of diagnosis information)

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A.116 Variant coding diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ABC_VEH_POW_VAR	V	0... FFH	0... 255	1	-
antibounce counter error of wrong or unknown power variant					
ERR_SYM_VAR_COD	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
symptoms of variant coding error					
ERR_SYM_VEH_POW_VAR	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom wrong or unknown power variant					
LV_CDN_DIAG_VAR_COD	O/V	0... 1H	0 ...1	1	-
condition for diagnosis of variant coding					
LV_CDN_DIAG_VEH_POW_VAR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition wrong or unknown power variant					
LV_END_DIAG_VAR_COD	O/V	0... 1H	0 ...1	1	-
diagnosis of variant coding ended					
LV_END_DIAG_VEH_POW_VAR	O/V	0... 1H	0 ...1	1	-
End of diagnosis wrong or unknown power variant					
LV_ERR_VAR_COD	O/V/S	0... 1H	0 ...1	1	-
Configuration variant coding error					
LV_ERR_VEH_POW_VAR	O/V	0... 1H	0 ...1	1	-
Present error of wrong or unknown power variant					
LV_POW_CLAS_VEH_CAN_REQ	O/V	0... 1H	0 ...1	1	-
LV to request CAN signal "vehicle type"					
T_POW_CLAS_VEH_CAN_REQ	V	0... FFH	0... 25.5	0.1	s
time since request of CAN signal "vehicle type"					
T_VEH_POW_VAR_ACT	V	0... FFH	0... 25.5	0.1	s
time since function "check of power variant" activation					

Input data:

LV_ERR_CAN_BOFF {p. 4846}	LV_IGK {p. 906}	LV_POW_CLAS_VEH_CAN_RCV {p. 1567}	LV_SWT_CHK_PMAX_FINISHED
LV_SWT_PMAX_ENA	LV_VAR_BN {p. 655}	POW_CONF_IDX_EXT_REQ {p. 7682}	STATE_POW_CLAS_VEH {p. 1575}
VIN_SHO [7] {p. 7541}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_POW_CLAS_VEH_ERR	-	1... FFH	1... 255	1	-
number of timeouts for antibounce of LV_ERR_VEH_POW_VAR					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_IDX_COD_CONV	-	0... FFH	0... 255	1	-
BMW coding index to disable check of successful BMW coding of variants via KWP					
C_STATE_POW_CLAS_VEH	-	0... 3H	0 ...3	1	-
calibrated status vehicle power class					
C_T_MAX_POW_CLAS_VEH_CAN_RCV	-	0... FFH	0... 25.5	0.1	s
timeout for receiving LV_POW_CLAS_VEH_CAN_RCV					
C_T_MIN_POW_CLAS_VEH_CAN_REQ	-	0... FFH	0... 25.5	0.1	s
delay time before check of power variant coding					
LC_VEH_POW_VAR_ERR_DIS	-	0... 1H	0 ...1	1	-
Logical constant to disable check of power variant coding					
LC_VEH_POW_VAR_TUN_ERR_DIS	-	0... 1H	0 ...1	1	-
Logical constant to disable check of tuning variant via SWT					

A.116.1 Diagnosis of successful BMW coding of variants via KWP

FUNCTION DESCRIPTION:

General information:

If not disabled by C_IDX_COD_CONV, this function checks the successful BMW coding of variants via KWP. Therefore the CAL-ID (identifier of the calibration- dataset) which is actual programmed in Flash memory is compared with the CAL-ID in the E2PROM. The CAL-ID is written to E2PROM memory only by receiving the tester command $3B_90 - Kurze Fahrgestellnummer schreiben. The receiving of this command is interpreted as successful coding.
If the two Call-IDs are not equal, a error is written into error memory. This error can only be erased by clearing the error memory.

Description:

Error symptoms are defined for this diagnosis function as:

- → - (= SYM_0)
- → - (= SYM_1)
- → Coding data in E2PROM lost (= SYM_2)
- → New calibration data might not be plausible (= SYM_3)

Application conditions

Initialisation: `all output data are set to 0 at clearing error memory`

Recurrence: `1000 ms`

Activation: `LV_IGK = 1` **and** `LV_ERR_VAR_COD = 0`

Deactivation: `not activation`

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Formula section:

If(1) C_IDX_COD_CONV $>$ 0
then(1) LV_CDN_DIAG_VAR_COD = 1
LV_END_DIAG_VAR_COD = 1
if(2) (all elements of VIN_SHO[7] (in RAM) = 0 **or** FFh) **OR**
CRC failure E2PROM
then(2) LV_ERR_VAR_COD = 1
ERR_SYM_VAR_COD = SYM_2
else(2) **if**(3) CAL-ID in Flash memory CAL-ID in E2PROM
then(3) LV_ERR_VAR_COD = 1
ERR_SYM_VAR_COD = SYM_3
endif(3)
endif(2)
endif(1)

A.116.2 Diagnosis of incorrect engine power variant

General information:

If not disabled by LC_VEH_POW_VAR_(TUN_)ERR_DIS = 1, this function checks the plausibility of the programmed (tuning) engine power variant.

Description:

Error symptoms are defined for this diagnosis function as:

Bit	Symptom	
0	-	(= SYM_0)
1	Tuning protection (SWT) intervention active	(= SYM_1)
2	Timeout CAN signal	(= SYM_2)
3	Programmed engine power variants are not identical	(= SYM_3)

Application conditions

Initialisation: *according ABC filter Type* ***MEM;*** *all other output data are set to 0*
at LV_IGK 01 ***or*** *reset* ***or*** *at clearing error memory*

Recurrence: 100 ms

Activation: LV_IGK = 1

Deactivation: not activation

Formula section:

// General engine power variant check
If(0) LV_ERR_CAN_BOFF = 0
then(0)
If(1) LC_VEH_POW_VAR_ERR_DIS = 0
then(1) T_VEH_POW_VAR_ACT = T_VEH_POW_VAR_ACT$_{n-1}$ + 100 ms ,

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limited to 25.5 s
LV_CDN_DIAG_VEH_POW_VAR = 1
if(2) T_VEH_POW_VAR_ACT C_T_MIN_POW_CLAS_VEH_CAN_REQ
then(2)
if(2a) LV_VAR_BN = 0
then(2a)
if(2b) C_STATE_POW_CLAS_VEH POW_CONF_IDX_EXT_REQ
then(2b) ERR_SYM_VEH_POW_VAR = SYM_3
LV_ERR_VEH_POW_VAR = 1
LV_END_DIAG_VEH_POW_VAR = 1
else(2b)
ERR_SYM_VEH_POW_VAR = NO_SYM
LV_END_DIAG_VEH_POW_VAR = 1
endif(2b)
else(2a)
if(3) LV_POW_CLAS_VEH_CAN_RCV = 1
then(3)
if(4a) STATE_POW_CLAS_VEH POW_CONF_IDX_EXT_REQ
then(4a) ERR_SYM_VEH_POW_VAR = SYM_3
LV_ERR_VEH_POW_VAR = 1
LV_END_DIAG_VEH_POW_VAR = 1
else(4a)
if(5) STATE_POW_CLAS_VEH C_STATE_POW_CLAS_VEH
then(5) ERR_SYM_VEH_POW_VAR = SYM_3
LV_ERR_VEH_POW_VAR = 1
LV_END_DIAG_VEH_POW_VAR = 1
else(5)
ERR_SYM_VEH_POW_VAR = NO_SYM
LV_END_DIAG_VEH_POW_VAR = 1
endif(5)
endif(4a)
else(3)
if(4b) T_POW_CLAS_VEH_CAN_REQ = C_T_MAX_POW_CLAS_VEH_CAN_RCV
then(4b) ERR_SYM_VEH_POW_VAR = SYM_2
CTR_ABC_VEH_POW_VAR = CTR_ABC_VEH_POW_VAR$_{n-1}$ + 1
T_POW_CLAS_VEH_CAN_REQ = 0
LV_POW_CLAS_VEH_CAN_REQ = 0
if(6) CTR_ABC_VEH_POW_VAR = C_ABC_MAX_POW_CLAS_VEH_ERR
then(6) LV_ERR_VEH_POW_VAR = 1
LV_END_DIAG_VEH_POW_VAR = 1
endif(6)
else(4b) LV_POW_CLAS_VEH_CAN_REQ = 1
T_POW_CLAS_VEH_CAN_REQ = T_POW_CLAS_VEH_CAN_REQ$_{n-1}$
+ 100 ms
endif(4b)
endif(3)
endif(2a)
endif(2)
endif(1)
endif(0)

// Tuning engine power variant check

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```
If(0)            LC_VEH_POW_VAR_TUN_ERR_DIS = 0
then(0)      LV_CDN_DIAG_VEH_POW_VAR  =  1
              if(1)           LV_SWT_CHK_PMAX_FINISHED = 1
          then(1)    LV_END_DIAG_VEH_POW_VAR  =  1     // Calculation of flag is done by
   error mangement
                  if(2)           LV_SWT_PMAX_ENA = 0
                  then(2)       ERR_SYM_VEH_POW_VAR  =  SYM_1
                                LV_ERR_VEH_POW_VAR  =  1

                  endif(2)
              endif(1)
endif(0)
```

// No call of error management after calculation of general engine power variant check, but after calulation of tuning engine power variant check

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A.117 Electronic throttle control actuator adaptation diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ST_CHK_CHK_LIH_1_ERR	O/V/S	0... FFFFH	0... 65535	1	-
Start check check limp home 1 not passed					
CTR_ST_CHK_CHK_LIH_1_READY	O/V/S	0... FFFFH	0... 65535	1	-
Start check check limp home 1 passed					
ERR_SYM_TPS_AD	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom TPS_AD					
ERR_SYM_TPS_AD_BOL	V	0H 1H	NO_SYM SYM_0	-	-
Detected error symptom TPS_AD_BOL					
ERR_SYM_TPS_ST_CHK_1	V	0H 1H	NO_SYM SYM_0	-	-
Detected error symptom TPS_ST_CHK_1					
ERR_SYM_TPS_ST_CHK_2	V	0H 1H 2H	NO_SYM SYM_0 SYM_1	-	-
Detected error symptom TPS_ST_CHK_2					
INH_IV_TPS_AD	O	0... FFH	0... 255	1	-
Logical variable to inhibit injection and ignition during TPS adaptation					
LV_CDN_DIAG_TPS_AD	V	0... 1H	0 ...1	1	-
Logic variable data if diagnosis conditions TPS_AD are fulfilled					
LV_CDN_DIAG_TPS_AD_BOL	V	0... 1H	0 ...1	1	-
Logic variable data if diagnosis conditions TPS_AD_BOL are fulfilled					
LV_CDN_DIAG_TPS_ST_CHK_1	V	0... 1H	0 ...1	1	-
Logic variable data if diagnosis conditions TPS_ST_CHK_1 are fulfilled					
LV_CDN_DIAG_TPS_ST_CHK_2	V	0... 1H	0 ...1	1	-
Logic variable data if diagnosis conditions TPS_ST_CHK_2 are fulfilled					
LV_END_DIAG_TPS_AD	V	0... 1H	0 ...1	1	-
Logic variable data if end of diagnosis TPS_AD is reached					
LV_END_DIAG_TPS_AD_BOL	V	0... 1H	0 ...1	1	-
Logic variable data if end of diagnosis TPS_AD_BOL is reached					
LV_END_DIAG_TPS_ST_CHK_1	V	0... 1H	0 ...1	1	-
Logic variable data if end of diagnosis TPS_ST_CHK_1 is reached					
LV_END_DIAG_TPS_ST_CHK_2	V	0... 1H	0 ...1	1	-
Logic variable data if end of diagnosis TPS_ST_CHK_2 is reached					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_TPS_AD	O/V	0... 1H	0 ...1	1	-
TPS-error-bit (Adaptation)					
LV_ERR_TPS_AD_BOL	O/V	0... 1H	0 ...1	1	-
Error bit (set if the continuous adaptation of MEC_BOL not passed)					
LV_ERR_TPS_ST_CHK_1	O/V	0... 1H	0 ...1	1	-
TPS error bit (Return spring test)					
LV_ERR_TPS_ST_CHK_2	O/V	0... 1H	0 ...1	1	-
TPS error bit (Return spring test)					
LV_N_LIM_TPS_AD	O/V	0... 1H	0 ...1	1	-
Demand ETC-LIMP-HOME-2 (EMB)					
LV_TPS_AD_ACT	O/V	0... 1H	0 ...1	1	-
TPS Adaptation activ/passiv					
LV_TPS_AD_CUR_OFF	O/V	0... 1H	0 ...1	1	-
Logical variable to switch of the ETC controller during TPS adaptation					
LV_TPS_AD_DIAG_CUR_OFF	O/V	0... 1H	0 ...1	1	-
Demand ETC-LIMP-HOME-1					
LV_TPS_AD_REQ	O/V/S	0... 1H	0 ...1	1	-
Demand TPS-adaptation					
LV_TPS_ST_BOL_END	V	0... 1H	0 ...1	1	-
MEC_BOL check in ST_BOL routine finished					
TPS_AD_SLOP_GAIN_1	O/V/S	0... FFFFH	0... 7.99987	122e-6	-
Adaptation value of the amplification factor of amplified poti 1					
TPS_AD_STEP	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H AH BH	ST_LIH_1 ST_UP_POS ST_LIH_2 ST_BOL ST_END AD_LIH_1 AD_UP_POS AD_LIH_2 AD_LOW_ STOP AD_GO_LIH AD_LIH_3 AD_END	-	-
Steps of throttle adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TPS_LIH_1	O/V/S	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Limp home position of the throttle valve of TPS-Poti 1					
TPS_LIH_2	O/V/S	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Limp home position of the throttle valve of TPS-Poti 2					
TPS_LIH_INI	O/V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Limp home position of the throttle valve - initialization value					
TPS_SP_AD	O/V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Throttle position setpoint during adaptation					
V_TPS_AD_BOL_GAIN_1	V	0... 3FFH	0... 4.99511	4.88e-3	V
Adaptation value for the lower mechanical stop of the amplification poti 1					
V_TPS_AD_EL_BOL_1	O/V/S	0... 3FFH	0... 4.99511	4.88e-3	V
Adaptation value for the lower stop, TPS-channel 1					
V_TPS_AD_EL_BOL_2	O/V/S	0... 3FFH	0... 4.99511	4.88e-3	V
Adaptation value for the lower stop, TPS-channel 2					
V_TPS_AD_LIH_1	O/V/S	0... 3FFH	0... 4.99511	4.88e-3	V
Adaptation value for the limp home position, TPS-channel 1					
V_TPS_AD_LIH_2	O/V/S	0... 3FFH	0... 4.99511	4.88e-3	V
Adaptation value for the limp home position, TPS-channel 2					
V_TPS_AD_OFS_GAIN_1	O/V/S	FE00... 200H	-2.5 ...2.5	4.88e-3	V
Adaptation value of the amplification offset of of amplified poti 1					
V_TPS_AD_TOL_1	V	0... 3FFH	0... 4.99511	4.88e-3	V
Non-amplified upper adaptation value for the adaptation of amplified of TPS-channel 1					
V_TPS_AD_TOL_GAIN_1	V	0... 3FFH	0... 4.99511	4.88e-3	V
Amplified upper adaptation value for the adaptation of amplified of TPS-channel 1					

Input data:

LV_ERR_MTC_CTL_1 {p. 4977}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}
LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_V_REF_1 {p. 4216}
LV_IGK {p. 906}	LV_MTC_CUR_OFF {p. 6565}	LV_ST {p. 1720}	N {p. 1525}
STATE_ETC_LIH {p. 4982}	TCO {p. 1100}	TIA {p. 1226}	TPS_AV {p. 1169}
TPS_LIH {p. 1169}	V_TPS_1 {p. 831}	V_TPS_2 {p. 831}	V_TPS_GAIN_1 {p. 986}
VB {p. 1185}	VS {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_MAX_TPS_AD	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for adaptation					
C_T_DYW_TPS_LIH_CHK	-	0... FFH	0... 1.275	0.005	s
Time period for Dynamic window around Limp Home					
C_T_MAX_ST_BOL	-	0... FFH	0... 1.275	0.005	s
Maximum time for adaptation of BOL position during Start Check					
C_T_MAX_TPS_AD	-	0... FFH	0... 1.275	0.005	s
Maximum time for adaptation of the LIH and BOL position					
C_T_MAX_TPS_LIH_CHK	-	0... FFH	0... 1.275	0.005	s
Maximum time for Limp Home recognition					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MAX_TPS_SP_RST_CHK	-	0... FFH	0... 1.275	0.005	s
Maximum time to reach the position C_TPS_SP_RST_CHK					
C_T_TPS_AD_HYS	-	0... FFH	0... 1.275	0.005	s
Time period for hysteresis band to adaptation					
C_T_TPS_AV_RST_CHK	-	0... FFH	0... 1.275	0.005	s
Time condition for deactivating the position controller					
C_T_TPS_ST_BOL_HYS	-	0... FFH	0... 1.275	0.005	s
Time period for hysteresis band to adaptation of BOL position during Start Check					
C_TCO_MAX_TPS_AD	-	0... FEH	-48... 142.5	0.75	°C
Max. TCO threshold for TPS adaptation					
C_TCO_MIN_TPS_AD	-	0... FEH	-48... 142.5	0.75	°C
Min. TCO threshold for TPS adaptation					
C_TIA_MIN_TPS_AD	-	0... FEH	-48... 142.5	0.75	°C
TIA threshold for TPS adaptation					
C_TPS_AD_SLOP_GAIN_INI_1	-	0... FFFFH	0... 7.99987	122e-6	-
Nominal value of the amplification slope of amplified poti 1					
C_TPS_AV_RST_CHK	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Threshold for activating the position controller					
C_TPS_SP_BOL_LGRD	-	1... FFH undef:1H	7.29414E-03 ...1.86000	-	°TPS/5ms
Change limitation for stopping the lower position					
C_TPS_SP_RST_CHK	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
TPS_SP for testing the retracting spring					
C_TPS_SP_RST_CHK_BAS	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
TPS_SP for testing the retracting spring					
C_TPS_SP_RST_CHK_HYS	-	1... FFH undef:1H	7.29414E-03 ...1.86000	-	°TPS
Hysteresis of C_TPS_SP_RST_CHK					
C_TPS_SP_RST_CHK_LGRD	-	1... FFH undef:1H	7.29414E-03 ...1.86000	-	°TPS/5ms
Change limitation for stopping the position C_TPS_SP_RST_CHK					
C_TPS_SP_SPR_CHK_UP	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
TPS_SP for GO_LIH position					
C_V_TPS_AD_BOL_INI_1	-	0... FFH	0... 4.998	19.5e-3	V
Start value for the adaptation value lower start (Poti 1)					
C_V_TPS_AD_BOL_INI_2	-	0... FFH	0... 4.998	19.5e-3	V
Start value for the adaptation value lower start (Poti 2)					
C_V_TPS_AD_HYS	-	0... FFH	0... 1.2	4.88e-3	V
Hysteresis band for adaptation value determination					
C_V_TPS_AD_OFS_GAIN_INI_1	-	FE00... 200H	-2.5 ...2.5	4.88e-3	V
Nominal value of the amplification offset of amplified poti 1					
C_V_TPS_AD_WIN_2_BOL	-	0... FFH	0... 2.49023	9.77e-3	V
Adaptation window size (+/-) for continousliy mec BOL adaptation of lower stop					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_TPS_AD_WIN_BOL	-	0... FFH	0... 2.49023	9.77e-3	V
Adaptation window size (+/-) for adaptation of lower stop					
C_V_TPS_AD_WIN_LIH	-	0... FFH	0... 2.49023	9.77e-3	V
Adaptation window size (+/-) for adaptation of the Limp Home position					
C_V_TPS_LIH_CHK_HYS	-	0... FFH	0... 1.2	4.88e-3	V
Admissible tolerance on checking the limp home position					
C_V_TPS_SP_BOL_1	-	0... FFH	0... 4.998	19.5e-3	V
lower limit for plausibility check of the adaptation value lower stop TPS_1					
C_V_TPS_SP_BOL_2	-	0... FFH	0... 4.998	19.5e-3	V
upper limit for plausibility check of the adaptation value lower stop TPS_1					
C_V_TPS_SP_LIH_1	-	0... FFH	0... 4.998	19.5e-3	V
Set point of the limp home position voltage value channel 1					
C_V_TPS_SP_LIH_2	-	0... FFH	0... 4.998	19.5e-3	V
Set point of the limp home position voltage value channel 2					
C_VB_MIN_TPS_AD	-	0... FFH	0... 25.89843	0.1015625	V
VB threshold for ETC adaptation					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_VS_MAX_TPS_AD	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed treshold for adaptation					

FUNCTION DESCRIPTION:

General information:

The throttle position is determined by a two-channeled sensor system (contact potentiometer). Both channels deliver inverse dispersing voltage signals. In order to reduce the measurement inaccuracy, the two signal voltages will be referenced to their supply voltage. After the initial engine start and component change the characteristic Potentiometer value is learnt within an adaptation routine. The value for the lower stop is stored at the end of the driving cycle in the non-volatile memory.

A plausibilization unit monitors both sensor signals, as well as the belonging supply voltage and from them establishes the system state of the THR-position acquisition (undisturbed, disturbed, THR-position not recognizable). From the voltages of both TPS-channels, the THR-position for each channel is determined, taking into consideration the adaptation values for the lower stop. Based on the determined state of the system, the resulting THR-position is determined by the individual values. In case of a disturbance of the position acquisition (LV_ERR_TPS_x 0, see chapter TPS diagnosis), the selection of the position is conducted from one of the two TPS-channels - respectively, in case of a complete collapse, the THR-control is switched off (limp home).

Application conditions

Initialisation: all error memory outputs are initialized with 0 (LV_ERR_..., LV_CDN_DIAG_..., ERR_SYM_..., LV_END_DIAG_...)
LV_TPS_ST_BOL_END = 0 at transition LV_IGK 0 → 1
remaining outputs see chapters

Recurrence: *5ms*

Activation: *see Chapters*

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Signal flow diagram:

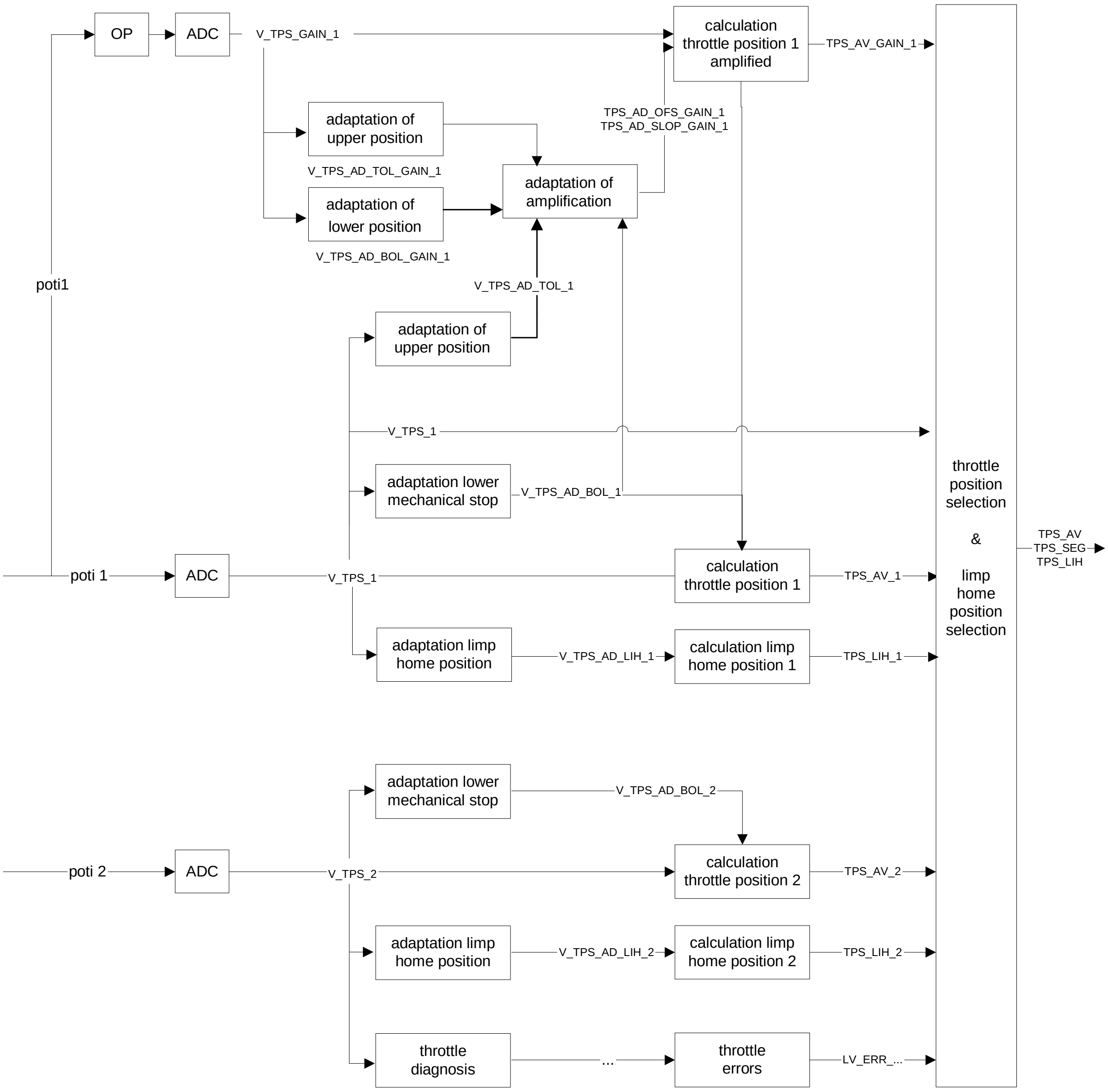

Figure A.117.1: : Overview of the functions of the TPS-position acquisition

A.117.1 Algorithm of adaptation and start-check

Description:

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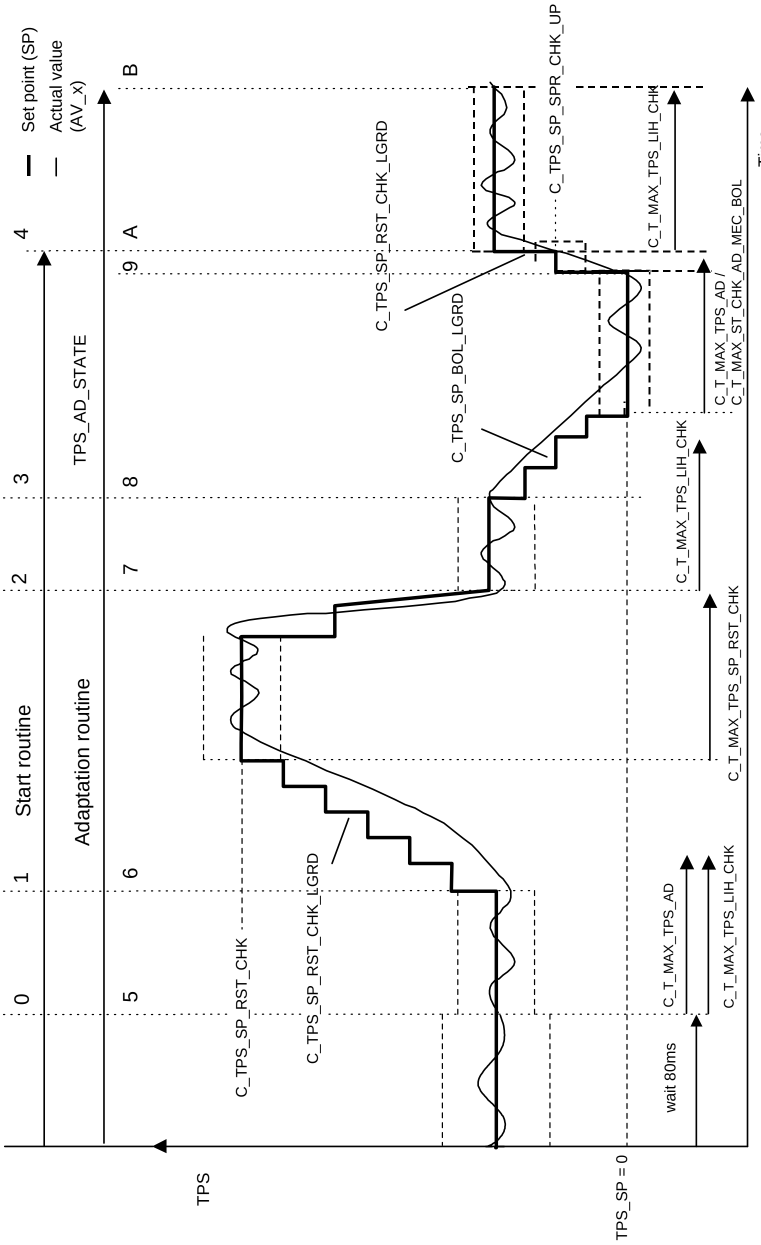
The acquisition of the throttle position includes two sections: the start-check routine and adaptation routine. The start-check routine is a kind of slightly reduced adaptation routine with own thresholds and the possibility to be aborted after a first LIH-check by engine start. It is carried out at every switch on the engine control unit. In the case engine is started before start routine is finished, old adaption values for the lower mechanical stop are used. The adaptation routine starts only if the adaptation is requested.



TPS_AD_STEP	Start Routine
0	ST_LIH_1
1	ST_UP_POS
2	ST_LIH_2
3	ST_BOL
4	ST_END

TPS_AD_STEP	Adaptation Routine
5	AD_LIH_1
6	AD_UP_POS
7	AD_LIH_2
8	AD_LOW_STOP
9	AD_GO_LIH
A	AD_LIH_3
B	AD_END

Fig. 2 Time conditions of start-check / adaption routine

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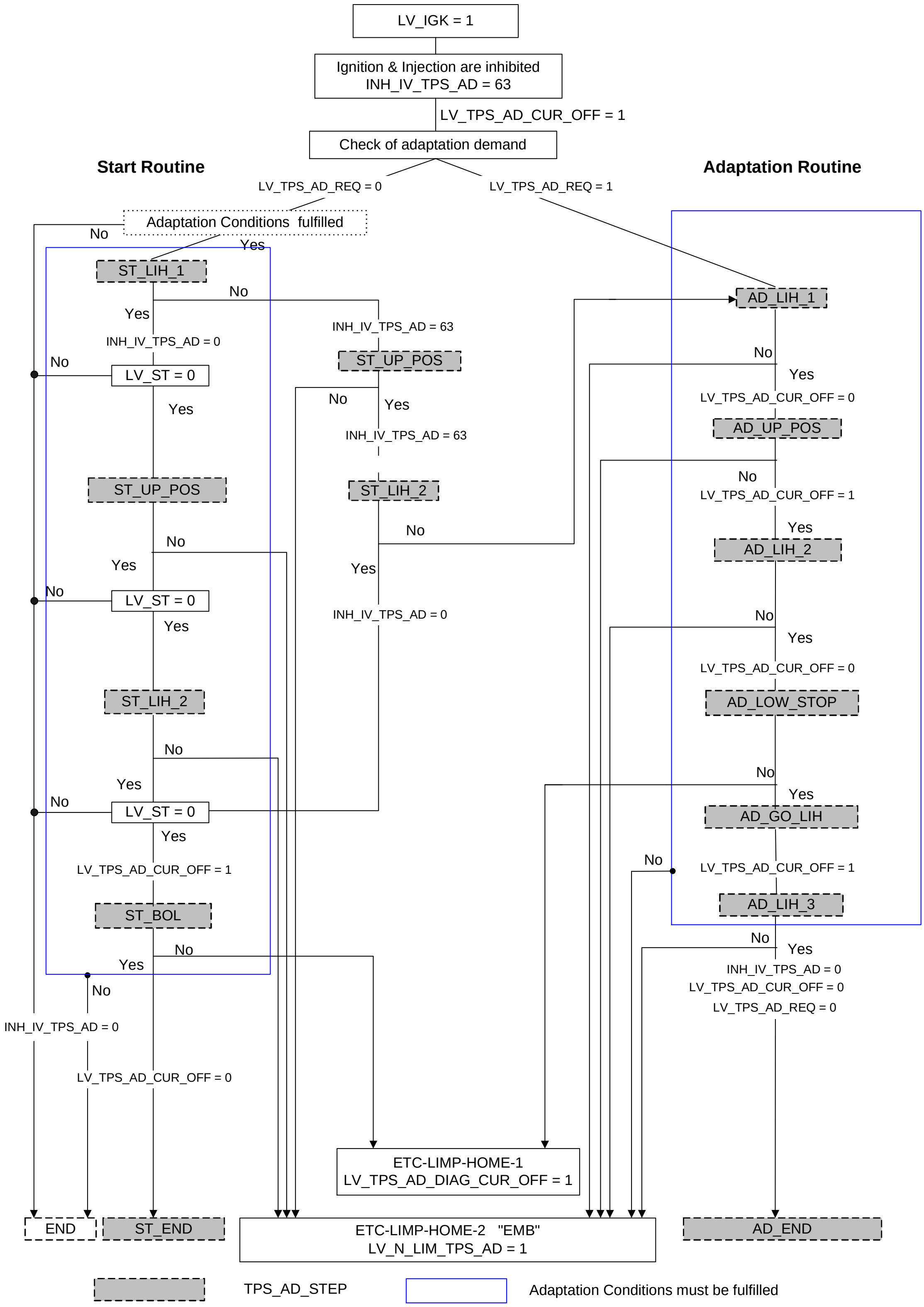

Fig. 3 Algorithm of Adaptation and Start-check

The Algorithm shows the reactions in passed and not passed conditions of both routines.

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A.117.2 Initialization

General information:

The delivered voltage from the TPS-poti is a measurement for the throttle position. Because of the electrical and the mechanical tolerances, the characteristic potentiometer values must be adapted. The adaptation and diagnosis of the Poti-voltages for the lower mechanical stops and Limp Home (LIH) occurs within a set routine. By learning and checking of the Limp Home position it delivers information whether there has been an exchange in the throttle actuator. The adapted lower mechanical stop and the upper check position are used as a reference point for the calculation of the throttle valve position. The upper mechanical stop is not learned. During the adaptation phase no limitations of the THR-setpoint are active. The learned value for the lower stop and the upper position is stored at the end of the driving cycle as non-volatile .

Formula section:

At the beginning of the adaptation (either 1^{st} adaptation at end of line or adaptation requested by failed start check) the values are described with the following EEPROM- and Default-values:
Default (only if adaptation requested LV_TPS_AD_REQ = 1):

V_TPS_AD_LIH_1 = C_V_TPS_SP_LIH_1
V_TPS_AD_LIH_2 = C_V_TPS_SP_LIH_2
V_TPS_AD_EL_BOL_1 = C_V_TPS_AD_BOL_INI_1
V_TPS_AD_EL_BOL_2 = C_V_TPS_AD_BOL_INI_2
TPS_AD_SLOP_GAIN_1 = C_TPS_AD_SLOP_GAIN_INI_1
V_TPS_AD_OFS_GAIN_1 = C_V_TPS_AD_OFS_GAIN_INI_1
TPS_LIH_1 = TPS_LIH_2= TPS_SP_AD = TPS_LIH_INI

Always:

TPS_LIH_INI = C_TPS_SLOP /2 * (C_V_TPS_SP_LIH_1- C_V_TPS_AD_BOL_INI_1- C_V_TPS_SP_LIH_2+ C_V_TPS_AD_BOL_INI_2)
TPS_SP_AD = TPS_LIH_1

A.117.3 Calculation of ERRM output variables

A.117.3.1 Diagnosis condition definition

Description:

The diagnosis condition for LV_ERR_TPS_AD is true as long as the adaptation routine is active.
The diagnosis condition for LV_ERR_TPS_ST_CHK_1 is true if TPS_AD_STEP = ST_LIH_2.
The diagnosis condition for LV_ERR_TPS_ST_CHK_2 is true if TPS_AD_STEP = ST_UP_POS **or** ST_LIH_2.
The diagnosis condition for LV_ERR_TPS_AD_BOL is true if TPS_AD_STEP = ST_BOL.

Formula section:

If TPS_AD_STEP = 5H **or** 6H **or** 7H **or** 8H **or** 9H **or** AH
Then LV_CDN_DIAG_TPS_AD = 1
Else LV_CDN_DIAG_TPS_AD = 0
Endif
If TPS_AD_STEP = 1H or 2H
Then LV_CDN_DIAG_TPS_ST_CHK_2 = 1
Else LV_CDN_DIAG_TPS_ST_CHK_2 = 0

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Endif
If TPS_AD_STEP = 2H
Then LV_CDN_DIAG_TPS_ST_CHK_1 = 1
Else LV_CDN_DIAG_TPS_ST_CHK_1 = 0
Endif
If TPS_AD_STEP = 3H
Then LV_CDN_DIAG_TPS_AD_BOL = 1
Else LV_CDN_DIAG_TPS_AD_BOL = 0

Endif

A.117.3.2 Error symptom definition

Description:

Error symtoms are defined for this diagnosis as:

Adaptation routine
TPS_AD

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```
□□□□
| | | └─> Adaptation conditions exceeded                              (= SYM_0)
| | └───> Voltage value at LIH-adaptation outside range               (= SYM_1)
| └─────> Spring-test and CHK_LIH not passed                          (= SYM_2)
└───────> Adaptation values - lower mechanical stop - outside range   (= SYM_3)
```

Start routine

TPS_ST_CHK_1

```
□□□□
| | | └─> New TPS adaptation necessary    (= SYM_0)
| | └───> -                               (= SYM_1)
| └─────> -                               (= SYM_2)
└───────> -                               (= SYM_3)
```

TPS_ST_CHK_2

```
□□□□
| | | └─> Spring-test not passed          (= SYM_0)
| | └───> ST_LIH_2 not passed             (= SYM_1)
| └─────> -                               (= SYM_2)
└───────> -                               (= SYM_3)
```

TPS_AD_BOL

```
□□□□
| | | └─> MEC_BOL adaptation not passed   (= SYM_0)
| | └───>-                                (= SYM_1)
| └─────> -                               (= SYM_2)
└───────> -                               (= SYM_3)
```

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A.117.3.3 Calculation end of diagnosis

Description:

The end of diagnosis in errorfree case is set on the end of Start-check/Adaptation or latest if a error is set.

Formula section:

Calculation end of diagnosis in error case
If LV_ERR_TPS_XY = 1 (XY = AD **or** ST_CHK_1 **or** ST_CHK_2 **or** AD_BOL)
Then LV_END_DIAG_TPS_XY = 1
Calculation end of diagnosis in errorfree case
Else **If** TPS_AD_STEP = ST_END
Then LV_END_DIAG_TPS_ST_CHK_1 = 1
LV_END_DIAG_TPS_ST_CHK_2 = 1

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```
                LV_END_DIAG_TPS_AD_BOL = 1
        Endif
          If        TPS_AD_STEP = AD_END            or
                    LV_TPS_AD_REQ = 0
        Then        LV_END_DIAG_TPS_AD = 1
        Endif
Endif
```

A.117.4 Requests to activate the adaptation-routine or start-check

Description

After the control unit is switched on the activation bit for start-check or adaptation is set (LV_TPS_AD_ACT=1).

If the adaptation request LV_TPS_AD_REQ is set then the adaptation-routine will start otherwise the start-routine is activated.

Conditions for setting LV_TPS_AD_REQ:

- In initial start (first engine run or control unit exchange), that means no adaptation values are stored in the non volatile memory
- After a component exchange , if the poti values are lie outside the tolerance window
- Check sum error is current
- Initiated by the tester
- Adaptation demand requested by diagnosis e.g. if adaptation or start-check was failled

Formula section:

```
If              Adaptation request is active
Then        LV_TPS_AD_REQ = 1
Endif

If              LV_IGK 0->1
Then        LV_TPS_AD_ACT = 1              //activation bit for adaptation or start-check
              LV_TPS_AD_CUR_OFF = 1               //request to switch off ETC
            INH_IV_TPS_AD = 63             //inhibition of injection
      If                  LV_TPS_AD_REQ = 0
      Then                   Start routine
                     TPS_AD_STEP = ST_LIH_1
  Else                     Start of adaptation routine
                     TPS_AD_STEP = AD_LIH_1
  Endif
Endif
```

A.117.4.1 Monitoring of adaptation or start-check conditions

Description:

To get a plausible battery voltage the check of conditions for adaptation or start-check is delayed 80 ms after control unit is switched on.
If the conditions are exceeded the routine (adaptation or start-check) is stopped, injection will be re-leased.

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If the conditions are exceeded during the adaptation routine then:

- Error Adaptations conditions exceeded is set
- ETC limp home 2 EMB is activated
- New adaptation in the next driving cycle is requested

If the conditions are exceeded during the start check routine, it will be ignored without error entry.

Formula section:

```
If(1)        LV_TPS_AD_ACT = 1          and        //Adaptation or Start-check is active
             time delay of 80ms after LV_IGK = 1 is ellapsed
Then(1)
  If(2)      LV_IGK = 0                               or
             VB  <  C_VB_MIN_TPS_AD                   or
             N  >  C_N_MAX_TPS_AD                     or
             VS  >  2km/h (NC_VS_MAX_TPS_AD)          or
             TIA  ≤ C_TIA_MIN_TPS_AD                  or
             TCO  ≤  C_TCO_MIN_TPS_AD                 or
             TCO  ≥  C_TCO_MAX_TPS_AD                 or
             LV_ERR_V_REF_1 = 1                       or
             LV_ERR_TPS_1 = 1                         or
             LV_ERR_TPS_2 = 1                         or
             LV_ERR_TPS_RATIO = 1                     or
             LV_ERR_MTC_CTL_1 = 1                     or
             LV_ERR_MTC_CTL_2 = 1                     or
             LV_ERR_MTC_CTL_3 = 1                     or
             LV_ERR_MTC_DR = 1

  Then(2)    If(3)          INH_IV_TPS_AD = 63
                            and
                            TPS_AD_STEP = 1H or 2H
               Then(3)      LV_TPS_AD_ACT = 1
                            //Value remains; start routine continues; adaptation conditions for
                            failed ST_LIH_1 ignorred
               Else(3)      LV_TPS_AD_ACT = 0
                            //Stopping the TPS adaptation /start-check
                 If(4)          TPS_AD_STEP = 5H or 6H or 7H or 8H or 9H or AH
                                //Adaptation routine is active
                      Then(4)   ERR_SYM_TPS_AD = SYM_0
                                //Adaptation conditions exceeded
                                LV_ERR_TPS_AD = 1
                                LV_TPS_AD_REQ = 1
                                //New TPS adaptation necessary
                                LV_N_LIM_TPS_AD = 1
                                //ETC-LIMP-HOME-2 is requested
                      Endif(4)
                      INH_IV_TPS_AD = 0           //Activate injection
             Endif(3)
  Else(2)    continue adaptation or start-check
  Endif(2)
Endif(1)
```

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A.117.5 Start check routine

General information:

The Start-check routine includes:

- First limp home check and Adaptation of the Limp Home Position
- Limp home spring test
- Second limp home check
- Adaption of lower mechanical stop

A.117.5.1 First Check of Limp Home position at Start routine (ST_LIH_1)

Description:

When checking the Limp Home position the throttle valve is staying without current hold by spring power in the Limp Home position. The actual sensor-signals are compared with their adaptations in the non-volatile memory.
If the actual voltage values during the time interval are outside the hysteresis (Fig. 4) then no agreement is recognised and a new adaptation is necessary or an engine start must be cancelled (Fig. 3).

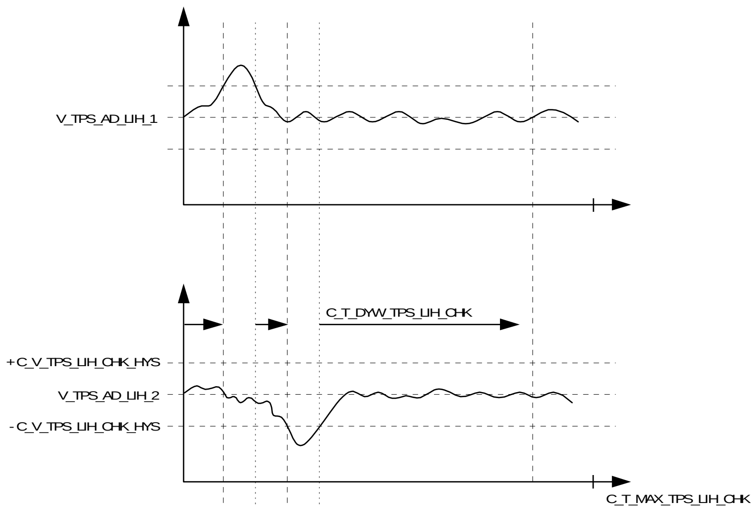

Figure A.117.2: Checking the Limp Home position (CHK_LIH)

Formula section:

TPS_AD_STEP = ST_LIH_1

LIH Check:

IF(1) LV_TPS_AD_ACT = 1 **and**
LV_MTC_CUR_OFF = 1 **and**
LV_TPS_AD_REQ = 0

Then(1) Start Time: C_T_MAX_TPS_LIH_CHK
If(2) T< C_T_MAX_TPS_LIH_CHK
Then (2) Start Time:C_T_DYW_TPS_LIH_CHK
IF(3) V_TPS_X - V_TPS_AD_LIH_x C_V_TPS_LIH_CHK_HYS (X = Poti 1, 2)

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and within the interval: C_T_DYW_TPS_LIH_CHK
Then(3) "Check Limp home ok"
CTR_ST_CHK_CHK_LIH_1_READY is incremented once
TPS_AD_STEP = ST_UP_POS
LV_TPS_AD_CUR_OFF = 0
INH_IV_TPS_AD = 0
Else(3) start **"Then (2)"** again
Else(2) CTR_ST_CHK_CHK_LIH_1_ERR is incremented once
TPS_AD_STEP = ST_UP_POS
Ignition and injection remains deactivated
LV_TPS_AD_CUR_OFF = 0
Else(1) INH_IV_TPS_AD = 0
Endif

Limp Home position:

Calculation of limp home positions right after CHK_LIH_1. A synchronized TPS_LIH is necessary for the Throttle catch function:

TPS_LIH_1 = (V_TPS_AD_LIH_1 - V_TPS_AD_EL_BOL_1) * C_TPS_SLOP
TPS_LIH_2 = (V_TPS_AD_EL_BOL_2 - V_TPS_AD_LIH_2) * C_TPS_SLOP
0° TPS_LIH_x C_TPS_MAX

Continuously LIH AD:

The Continuously limp home adaptation is calculated parallel to the first Limp home check.
If the first Limp home Check is passed then the engine start is not locked any more and the start routine is going on with or without successfully adaptation.

IF(1) LV_TPS_AD_ACT = 1 **and**
LV_MTC_CUR_OFF = 1 **and**
LV_TPS_AD_REQ = 0 **and**
"LIH CHECK 1 active":
INH_IV_TPS_AD = 63 **and**
TPS_AD_STEP = ST_LIH_1

Then(1) Start Time:C_T_TPS_AD_HYS
IF(2) Within the interval: C_T_TPS_AD_HYS **and**
V_TPS _x_{1+n} - V_TPS _x_1 C_V_TPS_AD_HYS (n=1,2;3;...)

Then(2) IF(3) $\left| \frac{V\_TPS\_x_1 + V\_TPS\_x_{END}}{2} - C\_V\_TPS\_SP\_LIH\_x \right|$

C_V_TPS_AD_WIN_LIH

Then(3) $V\_TPS\_AD\_LIH\_x = \frac{V\_TPS\_x_1 + V\_TPS\_x_{END}}{2}$

Else (3) IF(4) $\frac{V\_TPS\_x_1 + V\_TPS\_x_{END}}{2} > C\_V\_TPS\_AD\_WIN\_LIH +$

C_V_TPS_SP_LIH_x

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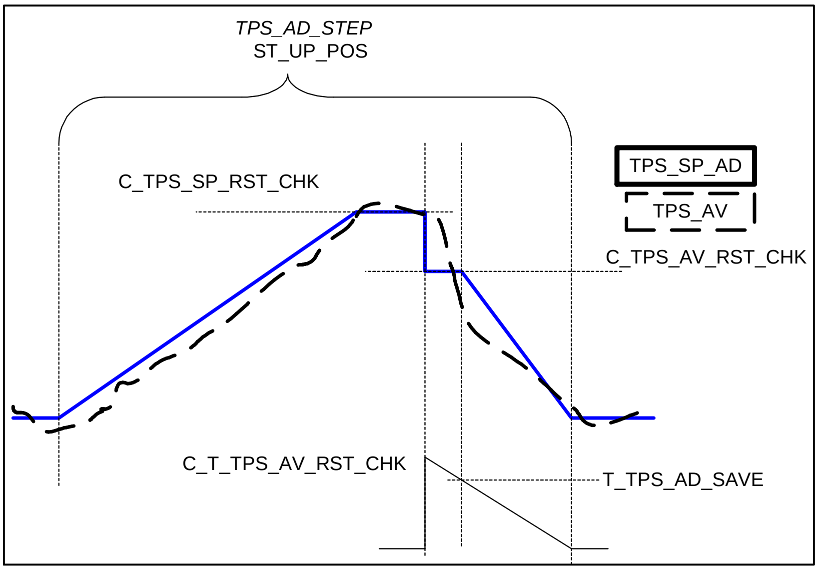
Then (4) V_TPS_AD_LIH_x = C_V_TPS_AD_WIN_LIH + C_V_TPS_SP_LIH_x
Else (4) V_TPS_AD_LIH_x =C_V_TPS_SP_LIH_x - C_V_TPS_AD_WIN_LIH
Else(2) start **"Then (1)"** again
Else(1) continue with the old adaptation values
Endif

A.117.5.2 Spring Test at the Start routine (ST_UP_POS)

Description:

Out of the Limp home position the throttle position setpoint is increased using the changing limitation until the setpoint for testing the retracting spring is reached. Now a timer is started. The actual value of the throttle position has to reach the setpoint within the hysteresis within a limit maximum of time.
Regarding certain cases with closed throttle at the limp home position it is necessary to switch on the position controller near the lower mechanical stop to prevent that the throttle is going into the lower mechanical stop with high acceleration.

Signal flow diagram:



Formula section:

TPS_AD_STEP = ST_UP_POS
IF(1) LV_TPS_AD_ACT = 1 **and**
LV_TPS_AD_REQ = 0 **and**
(LV_ST = 0 **or**
INH_IV_TPS_AD = 63) *// ST_LIH_1 not passed*
Then(1)
If(2) LV_TPS_AD_CUR_OFF = 0 **and**
LV_MTC_CUR_OFF = 1 *// request to switch on ETC is not fulfilled*
Then(2) *// no further action*

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Else(2)

begin TPS_SP_AD + C_TPS_SP_RST_CHK_LGRD

until TPS_SP_AD C_TPS_SP_RST_CHK_BAS

Start time: C_T_MAX_TPS_SP_RST_CHK

If(3) T< C_T_MAX_TPS_SP_RST_CHK **and**

TPS_AV - C_TPS_SP_RST_CHK_BAS

C_TPS_SP_RST_CHK_HYS

Then(3) LV_TPS_AD_CUR_OFF = 1

TPS_SP_AD = C_TPS_AV_RST_CHK

Start Timer T_TPS_AD$_{(dec)}$ = C_T_TPS_AV_RST_CHK

- -

If(4) T_TPS_AD$_{(dec)}$> 0

Then(4) **If(5)** TPS_AV<= C_TPS_AV_RST_CHK; *#1*

Then(5) LV_TPS_AD_CUR_OFF = 0

TPS_SP_AD = TPS_SP_AD -

((C_TPS_AV_RST_CHK - TPS_LIH) * 5ms /

T_TPS_AD_SAVE)

Else(5) go to If(4)

Endif(5)

#1: At transition from TPS_AV > C_TPS_AV_RST_CHK to TPS_AV <= C_TPS_AV_RST_CHK a snap shot is done of T_TPS_AD into T_TPS_AD_SAVE.

Else(4) LV_TPS_AD_CUR_OFF = 1

Endif(4)

- -

TPS_AD_STEP = ST_LIH_2

Else(3) LV_N_LIM_TPS_AD = 1 *//ETC-LIMP-HOME-2*

ERR_SYM_TPS_ST_CHK_2 = SYM_0 *// Spring-test not passed*

LV_ERR_TPS_ST_CHK_2 = 1

Endif(2)

Else(1) LV_TPS_AD_CUR_OFF = 0

Endif(1)

A.117.5.3 Second Check of Limp Home position at Start routine (ST_LIH_2)

Description:

After the return spring test follows a check of limp home position again. Depending on the result of the test the start routine is finished, starts the adaptation routine or goes to security fuel cut off.

Formula section:

TPS_AD_STEP = ST_LIH_2

IF(1) LV_TPS_AD_ACT = 1 **and**

LV_MTC_CUR_OFF = 1 **and**

LV_TPS_AD_REQ = 0 **and**

(LV_ST = 0 **or**

INH_IV_TPS_AD = 63) *// ST_LIH_1 not passed*

Then(1) Start Time: C_T_MAX_TPS_LIH_CHK

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If(2) T< C_T_MAX_TPS_LIH_CHK
Then (2) Start Time: C_T_DYW_TPS_LIH_CHK
IF(3)V_TPS_X - V_TPS_AD_LIH_x C_V_TPS_LIH_CHK_HYS (X = Poti 1, 2) **and**
within the interval: C_T_DYW_TPS_LIH_CHK
Then(3) INH_IV_TPS_AD = 0
LV_TPS_AD_CUR_OFF = 0
TPS_AD_STEP = ST_BOL
Else(3) goto IF (2)
Else (2) If(4) INH_IV_TPS_AD = 0
Then(4) ERR_SYM_TPS_ST_CHK_2 = SYM_1 CHK_LIH not passed
LV_ERR_TPS_ST_CHK_2 = 1
LV_N_LIM_TPS_AD =1 (ETC-LIMP-HOME-2)
Else (4) ERR_SYM_TPS_ST_CHK_1 = SYM_0
New TPS adaptation necessary
LV_ERR_TPS_ST_CHK_1 = 1
LV_TPS_AD_REQ = 1
TPS_AD_STEP = AD_LIH_1
Else(1) LV_TPS_AD_CUR_OFF = 0
Endif(1)

A.117.5.4 Adaption of lower mechanical stop and limp home spring test opening at Start routine (ST_BOL)

Description:

During a complete start check (not aborted by a quick start), the lower mechanical stop is learnt. After successful adaptation, the adaptation values V_TPS_AD_EL_BOL_1/2 are saved in the non-volatile memory. If the adaptation is not completed successfully (e.g. abnormal termination due to violation of the activation conditions), the adaptation value learnt last remains valid.
During adaptation, all voltage values must be within the adaptation window V_TPS_AD_EL_BOL_X C_V_TPS_AD_WIN_2_BOL; otherwise LV_ERR_TPS_AD_BOL is set.
A hysteresis band C_V_TPS_AD_HYS is placed around the first detected value (pots 1 and 2). If all values are within this hysteresis band during the adjustable time C_T_TPS_AD_HYS, the adaptation values are determined from the first and last value each (Fig. 6). If the value of a pot is outside of the hysteresis band, the operation is re-started for the two pots. The learning algorithm is limited by the maximum time C_T_MAX_ST_CHK_AD_MEC_BOL.

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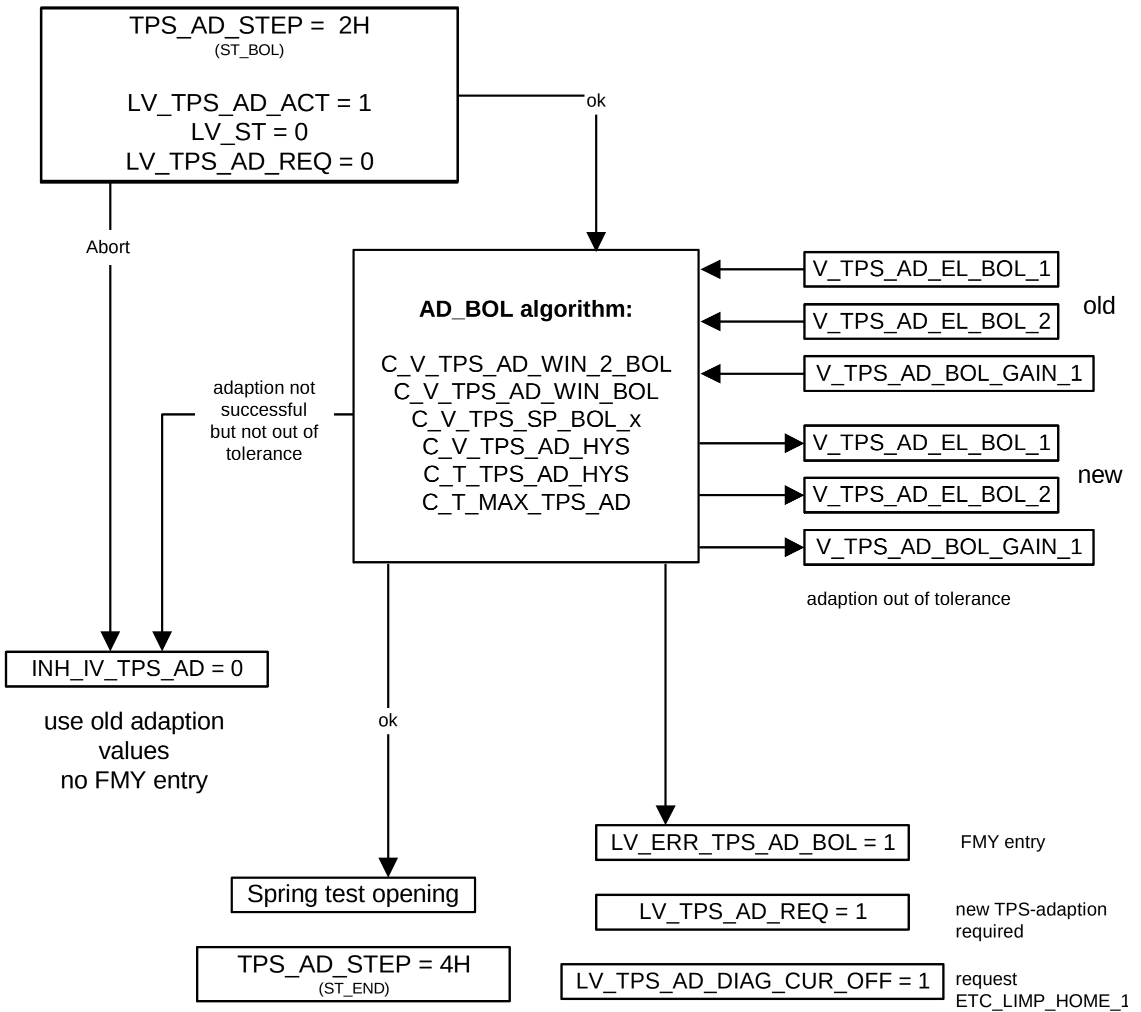

Signal flow diagram:

Formula section:

TPS_AD_STEP = ST_BOL

IF(1) LV_TPS_AD_ACT = 1 **and**
LV_ST = 0 **and**
LV_TPS_AD_REQ = 0

Then(1)

If(2) LV_TPS_ST_BOL_END = 0

Then(2)

If(3) TPS_SP_AD $>$ 0

Then(3) TPS_SP_AD = TPS_SP_AD$_{(n-1)}$ - C_TPS_SP_BOL_LGRD

Else(3)

Start time: C_T_MAX_ST_BOL

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If(4) V_TPS _x - C_V_TPS_SP_BOL _x $>$ C_V_TPS_AD_WIN_BOL

or

V_TPS _x - V_TPS_AD_EL_BOL _x$>$ C_V_TPS_AD_WIN_2_BOL

Then(4)

If(5) T $\geq$ C_T_MAX_ST_BOL

Then(5) ERR_SYM_TPS_AD_BOL = SYM_0

//MEC_BOL adaptation not passed

LV_ERR_TPS_AD_BOL = 1

LV_TPS_AD_REQ = 1

//New TPS adaptation necessary

LV_TPS_AD_DIAG_CUR_OFF = 1

//ETC-LIMP-HOME-1 demand

LV_TPS_AD_ACT = 0

Else(5) reset timer C_T_TPS_ST_BOL_HYS

Endif(5)

Else(4) continue MEC BOL Adaptation

Endif(4)

If(6) T $<$ C_T_MAX_ST_BOL

Then(6)

If(7) Within the interval: C_T_TPS_ST_BOL_HYS

and

V_TPS_x1+n - V_TPS_ x1 C_V_TPS_AD_HYS (n=1,2;3;...)

Then(7)

V_TPS_AD_EL_BOL_x =

$$\frac{V\_TPS\_x_1 + V\_TPS\_x_{END}}{2}$$

V_TPS_AD_BOL_GAIN_1 =

$$\frac{V\_TP1\_GAIN\_1_1 + V\_TPS\_GAIN\_1_{END}}{2}$$

LV_TPS_ST_BOL_END = 1

Else(7) go to If(6)

Else (6) adaptation remains the last valid values

LV_TPS_ST_BOL_END = 1

Endif (6)

Endif(3)

Else(2)

If8) TPS_SP_AD $<$ C_TPS_SP_SPR_CHK_UP

Then(8) TPS_SP_AD = TPS_SP_AD$_{(n-1)}$ + C_TPS_SP_RST_CHK_LGRD

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Else(8)

LV_TPS_AD_CUR_OFF = 1
TPS_SP_AD = TPS_LIH_INI
TPS_AD_STEP = ST_END
// Second Limp Home Check in case of not successfull adaptation of lower stop

Else (1) INH_IV_TPS_AD = 0
LV_TPS_AD_CUR_OFF = 0

Endif (1)

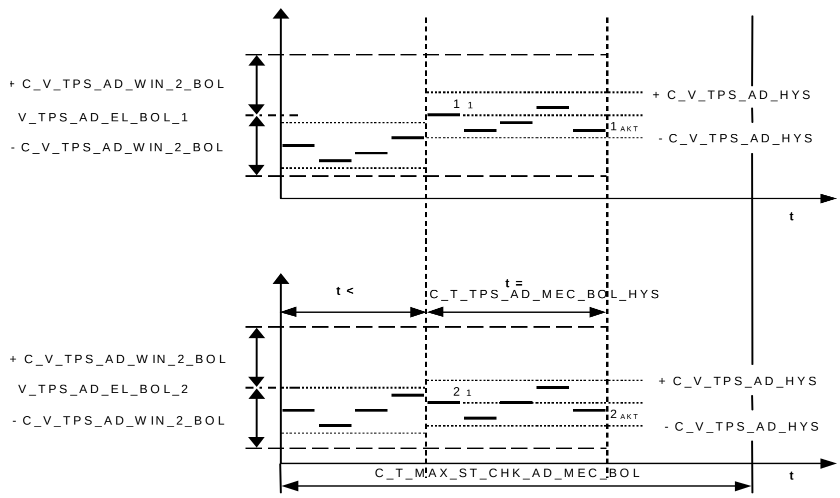

Figure A.117.3: Determination of the adaptation values in case of MEC_BOL adaptation during start routine

A.117.6 Adaptation routine

General information:

The Adaption routine includes:

- Limp home check and Adaptation of Limp Home Position
- Limp home spring test closing and adaptation of upper position
- Limp home check
- Limp home spring test opening and Adaptation of lower mechanical stop
- Limp home check

A.117.6.1 Adaption of Limp Home position at Adaption routine (AD_LIH_1)

Description:

The first step is the adaptation of the Limp Home position. The actuator is without current and is forced by the spring power in the limp home position.

The learning of the adaptation value depict the algorithm in Fig. 6. During the adaptation all the voltage values must be in the adaptation windows. A hysteresis band is set up around each of the first recorded values (poti 1 and 2). If all the values lie in this hysteresis band during an adjustable time then the

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adaptation values are determined from each first and last value. If the Poti-value lies outside the hysteresis band then the process is newly started for both Poti's. The learning algorithm is limited by the maximum time. This procedure is the same for the Limp home position and the lower mechanical stop. Just the calibration values are different.
An error memory entry occurs only at the adaptation after ECU-first initialisation not at the continuous LIH-adaptation. An error is detected if the adaptation could not be carried out during the max. time C_T_MAX_TPS_AD.

Formula section:

TPS_AD_STEP = AD_LIH_1
Start time: C_T_MAX_TPS_AD
If (1) V_TPS _x - C_V_TPS_SP_LIH_x) C_V_TPS_AD_WIN_LIH)
Then(1) If(2)T $<$ C_T_MAX_TPS_AD
Then(2) Start Time:C_T_TPS_AD_HYS
IF(3) Within the interval: C_T_TPS_AD_HYS **and**

V_TPS _x_{1+n} - V_TPS _x_1 C_V_TPS_AD_HYS) (n=1,2;3;...)
Then(3)

$$V\_TPS\_AD\_LIH\_x = \frac{V\_TPS\_x_1 + V\_TPS\_x_{END}}{2}$$

LV_TPS_AD_CUR_OFF = 0
TPS_AD_STEP = AD_UP_POS
Else(3) goto If (2)
Else(2) goto Else (1)
Else(1) ERR_SYM_TPS_AD = SYM_1 Voltage value at LIH-adaptation outside range
LV_ERR_TPS_AD = 1
LV_TPS_AD_ACT = 0 (Stopping the TPS adaptation)
LV_N_LIM_TPS_AD = 1 (ETC-LIMP-HOME-2)
LV_TPS_AD_REQ = 1 (New TPS adaptation nesecarry)
INH_IV_TPS_AD = 0 (Activate ignition and injection)
Endif

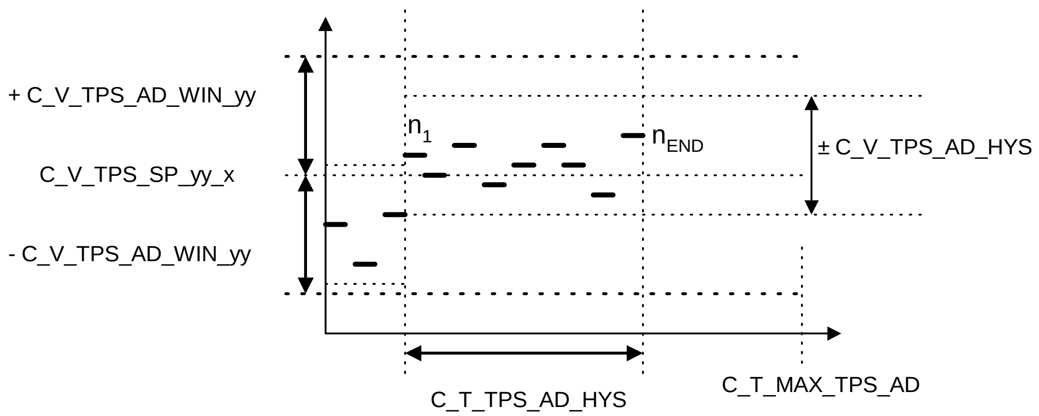

Figure A.117.4: Determining the adaptation value (AD_yy)yy correspond to LIH or BOL
x correspond to poti 1 or 2

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A.117.6.2 Spring test at the adaptation routine (AD_UP_POS)

Description:

After passing the check of limp home position the adaptation routine goes on with the spring test. Out of the Limp home position the throttle position set point is increased using the changing limitation until the set point for testing the retracting spring is reached. Now a timer is started. The actual value of the throttle position has to reach the set point within the hysteresis and a limit of time. Then the upper position will be adapted and the throttle is returning currentless.

Formula section:

TPS_AD_STEP = AD_UP_POS
begin TPS_SP_AD + C_TPS_SP_RST_CHK_LGRD
until TPS_SP_AD C_TPS_SP_RST_CHK
Start Time : C_T_MAX_TPS_SP_RST_CHK
If(1) TPS_AV - C_TPS_SP_RST_CHK C_TPS_SP_RST_CHK_HYS) **and**
T $<$ C_T_MAX_TPS_SP_RST_CHK
Then(1) Start time C_T_MAX_TPS_AD
IF(2) T $<$ C_T_MAX_TPS_AD
Then(2)
If(3) Within the interval: C_T_TPS_AD_HYS **and**
V_TPS_1$_{1+n}$ - V_TPS_1$_{1}$ C_V_TPS_AD_HYS (n=1,2;3;...)
Then(3)
New calculation of upper value of amplified poti 1

$$V\_TPS\_AD\_TOL\_1 = \frac{V\_TPS\_1_1 + V\_TPS\_1_{END}}{2}$$

$$V\_TPS\_AD\_TOL\_GAIN\_1 = \frac{V\_TPS\_GAIN\_1_1 + V\_TPS\_GAIN\_1_{END}}{2}$$

LV_TPS_AD_CUR_OFF = 1
TPS_SP_AD = C_TPS_AV_RST_CHK
- -
Start Timer T_TPS_AD$_{(dec)}$ = C_T_TPS_AV_RST_CHK
If T_TPS_AD$_{(dec)} > 0$
If TPS_AV<= C_TPS_AV_RST_CHK; *#1*
Then LV_TPS_AD_CUR_OFF = 0
TPS_SP_AD = TPS_SP_AD -
((C_TPS_AV_RST_CHK - TPS_LIH) * 5ms /
T_TPS_AD_SAVE)
endif
Else LV_TPS_AD_CUR_OFF = 1
Endif
#1: At transition from TPS_AV $>$ C_TPS_AV_RST_CHK to TPS_AV $<$= C_TPS_AV_RST_CHK a snap shot is done of T_TPS_AD into T_TPS_AD_SAVE.
- -
TPS_AD_STEP = AD_LIH_2
Else(3) goto If (2)
Else(2) goto Else (1)

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Else(1) ERR_SYM_TPS_AD = SYM_2 Spring test and CHK_LIH not passed
LV_ERR_TPS_AD = 1
LV_TPS_AD_ACT = 0 (Stopping the TPS adaptation)
LV_N_LIM_TPS_AD = 1 (ETC-LIMP-HOME-2,)
LV_TPS_AD_REQ = 1 (New TPS adaptation nesecarry)
INH_IV_TPS_AD = 0 (Activate ignition and injection)
Endi

A.117.6.3 Second Check of Limp Home position at Adaptation routine (AD_LIH_2)

Description:

After the return spring test the adaptation routine repeats the ckeck of limp home position.

Formula section:

TPS_AD_STEP = AD_LIH_2
Start time: C_T_MAX_TPS_LIH_CHK
If(1) T <C_T_MAX_TPS_LIH_CHK
Then(1)
If(2) within the interval: C_T_DYW_TPS_LIH_CHK **and**
V_TPS_x - V_TPS_AD_LIH_x C_V_TPS_LIH_CHK_HYS (X = Poti 1, 2)
Then(2) LV_TPS_AD_CUT_OFF = 0
TPS_AD_STEP = AD_LOW_STOP
Else(2) goto If (1)
Else(1) ERR_SYM_TPS_AD = SYM_2 Spring test and CHK_LIH not passed
LV_ERR_TPS_AD = 1
LV_TPS_AD_ACT = 0 (Stopping the TPS adaptation)
LV_N_LIM_TPS_AD = 1 (ETC-LIMP-HOME-2,)
LV_TPS_AD_REQ = 1 (New TPS adaptation nesecarry)
INH_IV_TPS_AD = 0 (Activate ignition and injection)
Endif

A.117.6.4 Adaptation of lower mechanical stop during adaption routine (AD_LOW_STOP)

Description:

As soon as the mechanical stop is reached, the described adaptation algorithm in Fig. 7, is triggered. The scanned data is used for both, calculation of the lower mechanical /electrical stop and for the amplification characteristic. After the adaptation of the lower stop and calculated amplification the throttle at the electrical stop opens a small angle in relation to the mechanical stop. This is necessary to prevent a chock.

Formula section:

TPS_AD_STEP = AD_LOW_STOP
Begin TPS_SP_AD - C_TPS_SP_BOL_LGRD
Until TPS_SP_AD = 0
Start Time: C_T_MAX_TPS_AD
If(1) V_TPS _x - C_V_TPS_SP_BOL _x C_V_TPS_AD_WIN_BOL)
Then(1)

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If(2) T $<$ C_T_MAX_TPS_AD

Then(2)

IF(3) Within the interval: C_T_TPS_AD_HYS **and**

V_TPS_x$_{1+n}$ - V_TPS_ x$_1$ C_V_TPS_AD_HYS (n=1,2;3;...)

Then(3)

$$V\_TPS\_AD\_EL\_BOL\_x = \frac{V\_TPS\_x_1 + V\_TPS\_x_{END}}{2}$$

$$V\_TPS\_AD\_BOL\_GAIN\_1 = \frac{V\_TP1\_GAIN\_1_1 + V\_TPS\_GAIN\_1_{END}}{2}$$

slope of amplifaction of amplified poti 1:

$$TPS\_AD\_SLOP\_GAIN\_1 = \frac{V\_TPS\_AD\_TOL\_GAIN\_1 - V\_TPS\_AD\_BOL\_GAIN\_1}{V\_TPS\_AD\_TOL\_1 - V\_TPS\_AD\_EL\_BOL\_1}$$

offset of amplifaction of amplified poti 1:

V_TPS_AD_OFS_GAIN_1 = V_TPS_AD_BOL_GAIN_1 - V_TPS AD_EL_BOL_1 * TPS_AD_SLOP_GAIN _1

TPS_AD_STEP = AD_GO_LIH

Else(3) go to If(2)

Else(2) go to else(1)

Else (1) ERR_SYM_TPS_AD = SYM_3

Adaptation value - lower mechanical stop - outside range

LV_ERR_TPS_AD = 1

LV_TPS_AD_ACT = 0 (Stopping the TPS adaptation)

LV_TPS_AD_DIAG_CUR_OFF = 1 (ETC-LIMP-HOME-1 demand)

LV_TPS_AD_REQ = 1 (New TPS adaptation necessary)

INH_IV_TPS_AD = 0 (Activate ignition and injection)

Endif

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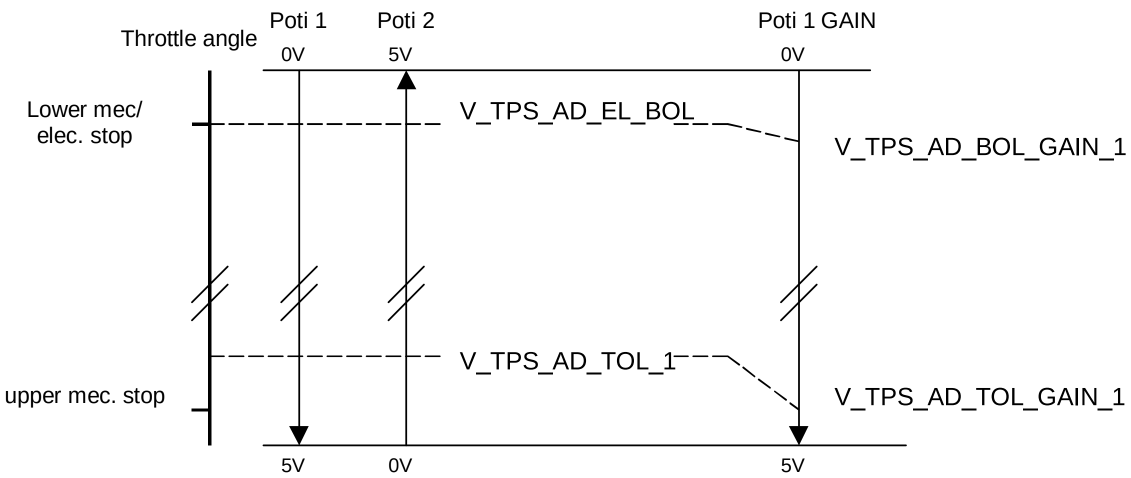

Figure A.117.5: Fig 7. Definition of the adaptation positions

A.117.6.5 Limp home spring Test opening (AD_GO_LIH)

Description:

After finish the lower adaptation the MTC opens the throttle using the change limitation until the nominal values for current cut off is reached. As from that position the spring returns the throttle currentless to the Limp Home position and carries through the Limp Home Check again, because it is possible that the throttle itself clamps at the mechanical stop.

Formula section:

TPS_AD_STEP = AD_GO_LIH
begin
TPS_SP_AD + C_TPS_SP_RST_CHK_LGRD
until TPS_SP_AD C_TPS_SP_SPR_CHK_UP
LV_TPS_AD_CUR_OFF = 1
TPS_SP_AD = TPS_LIH_INI
TPS_AD_STEP = AD_LIH_3
Third Limp Home Check

A.117.6.6 Third Check of Limp Home position at Adaptation routine (AD_LIH_3)

Description:

After the spring test at the lower stop follows the check of limp home position again. Now the adaptation routine is finished. Depending on the passed test the adaptation request is cancelled.

Formula section:

TPS_AD_STEP = AD_LIH_3
Start time: C_T_MAX_TPS_LIH_CHK
If(1) T < C_T_MAX_TPS_LIH_CHK

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Then(1) Start Time: C_T_DYW_TPS_LIH_CHK

If(2) within the interval: C_T_DYW_TPS_LIH_CHK **and**

V_TPS_X -V_TPS_AD_LIH_x C_V_TPS_LIH_CHK_HYS (X = Poti 1, 2)

Then(2) LV_TPS_AD_CUR_OFF = 0

INH_IV_TPS_AD =0

TPS_AD_STEP = AD_END

Else (2) go to If (1)

Else (1) ERR_SYM_TPS_AD = SYM_2 Spring test and CHK_LIH not passed

LV_ERR_TPS_AD = 1

LV_TPS_AD_ACT = 0 (Stopping the TPS adaptation)

LV_TPS_AD_REQ = 1 (New TPS adaptation necessary)

LV_N_LIM_TPS_AD = 1 (ETC-LIMP-HOME-2)

INH_IV_TPS_AD = 0 (Activate ignition and injection)

Endif

Limp Home position:

TPS_LIH_1 = (V_TPS_AD_LIH_1 - V_TPS_AD_EL_BOL_1) * C_TPS_SLOP

TPS_LIH_2 = (V_TPS_AD_EL_BOL_2 - V_TPS_AD_LIH_2) * C_TPS_SLOP

0° TPS_LIH_x C_TPS_MAX

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A.118 Electronic throttle control actuator diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_MTC_CTL_1	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom MTC_CTL_1					
ERR_SYM_MTC_CTL_2	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom MTC_CTL_2					
ERR_SYM_MTC_CTL_3	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom MTC_CTL_3					
LV_CDN_DIAG_MTC_CTL_1	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MTC_CTL_1					
LV_CDN_DIAG_MTC_CTL_2	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MTC_CTL_2					
LV_CDN_DIAG_MTC_CTL_3	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MTC_CTL_3					
LV_END_DIAG_MTC_CTL_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis MTC_CTL_1					
LV_END_DIAG_MTC_CTL_2	O/V	0... 1H	0 ...1	1	-
End of diagnosis MTC_CTL_2					
LV_END_DIAG_MTC_CTL_3	O/V	0... 1H	0 ...1	1	-
End of diagnosis MTC_CTL_3					
LV_ERR_MTC_CTL_1	O/V	0... 1H	0 ...1	1	-
Logical variable (set. if a MTCPWM error is present)					
LV_ERR_MTC_CTL_2	O/V	0... 1H	0 ...1	1	-
Logical variable (set. if a MTCPWM error is present)					
LV_ERR_MTC_CTL_3	O/V	0... 1H	0 ...1	1	-
Logical variable (set. if a control difference error is present)					
T_MTCPWM_PI_DIAG	O/V	0... FFH	0... 2.55	0.01	s
Debounce timer for MTCPWM error					

Input data:

LV_ES {p. 1720}	LV_IGK {p. 906}	LV_MTC_CUR_OFF {p. 6565}	LV_ST {p. 1720}
LV_TPS_AD_ACT {p. 4951}	LV_TPS_SP_EXT_ADJ {p. 7435}	LV_TPS_SP_JAM {p. 6531}	MTCPWM {p. 6546}

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STATE_ETC_LIH {p. 4982}	TPS_DIF {p. 6546}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MTCPWM_PI_MAX_DIAG	-	0... 7FFFH	0... 99.99694	3.05e-3	%
Diagnosis threshold for MTCPWM					
C_T_MTCPWM_PI_DIAG	-	0... FFH	0... 2.55	0.01	s
Tolerance time MTCPWM-error					
C_T_MTCPWM_PI_DIAG_CUR_OFF	-	0... FFH	0... 2.55	0.01	s
Time threshold for end break-away					
C_T_TPS_DIF_DIAG	-	0... FFH	0... 2.55	0.01	s
Tolerance time control variance					
C_TPS_DIF_MAX_DIAG	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Maximum permissible control variance					

FUNCTION DESCRIPTION:

General information:

This diagnosis is to detect a throttle valve error or a jammed actuator.

The following diagnosis are performed:

- Pulse width modulation check
- Control difference check

Description:

Pulse width modulation check:

If the given pulse width modulation signal MTCPWM exceeds the position controller permissible maximum value C_MTCPWM_PI_MAX_DIAG for longer than C_T_MTCPWM_PI_DIAG then the error is detected and a reversible limp home is applied.

If the pulse width modulation signal lies below the threshold C_MTCPWM_PI_MAX_DIAG as long as T < C_T_MTCPWM_PI_DIAG_CUR_OFF then the jammed throttle valve could break free (LV_ERR_MTC_CTL_1 is reset to 0) and the reversible limp home is passive.

If the pulse width modulation signal lies below the threshold C_MTCPWM_PI_MAX_DIAG for longer then C_T_MTCPWM_PI_DIAG_CUR_OFF then a irreversible limp home is applied (Throttle is switched off).

Error symptoms are defined to this diagnosis as:
MTC_CTL_1

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```
□□□□
 |  |  |  └─> MTC; pulse width modulation <1s exceeded     (= SYM_0)
 |  |  └────> -                                             (= SYM_1)
 |  └───────> -                                             (= SYM_2)
 └──────────> -                                             (= SYM_3)
```

MTC_CTL_2

```
□□□□
 |  |  |  └─> MTC; pulse width modulation >1s exceeded     (= SYM_0)
 |  |  └────> -                                             (= SYM_1)
 |  └───────> -                                             (= SYM_2)
 └──────────> -                                             (= SYM_3)
```

Checking the control difference
If the throttle valve control difference TPS_DIF exceeds the permissible maximum value C_TPS_DIF_MAX_DIAG for longer than C_T_TPS_DIF_DIAG then a error is detected and a irreversible limp home is applied (Throttle is switched off).

Error symptoms are defined to this diagnosis as:

MTC_CTL_3

```
□□□□
 |  |  |  └─> MTC; control difference check     (= SYM_0)
 |  |  └────> -                                  (= SYM_1)
 |  └───────> -                                  (= SYM_2)
 └──────────> -                                  (= SYM_3)
```

Application conditions

Initialisation: `all 0 at LV_IGK 0->1` **or** `reset`

Recurrence: `10ms`

Activation:

```
If        LV_IGK = 1
  and     LV_ST = 0
  and     (LV_ES = 0   or   LV_TPS_SP_EXT_ADJ = 1)
  and     LV_TPS_AD_ACT = 0
  and     LV_MTC_CUR_OFF = 0
  and     STATE_ETC_LIH <> 10H
  and     LV_TPS_SP_JAM = 0
Then      LV_CDN_DIAG_MTC_CTL_n = 1      (n = 1,2,3)
Else      Deactivation:
   LV_CDN_DIAG_MTC_CTL_n = 0
Endif
```

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Formula section:

Pulse width modulation check:

```
If(1)                     LV_CDN_DIAG_MTC_CTL_1/2 = 1          //both
Then(1)If(2)          | MTCPWM |   C_MTCPWM_PI_MAX_DIAG
  Then(2)         T_MTCPWM_PI_DIAG++
            If(3)      T_MTCPWM_PI_DIAG > C_T_MTCPWM_PI_DIAG
            Then(3)If(4)          T_MTCPWM_PI_DIAG < ...
                                          C_T_MTCPWM_PI_DIAG_CUR_OFF
                   Then(4)        ERR_SYM_MTC_CTL_1 = SYM_0
                                   LV_ERR_MTC_CTL_1 = 1     //set direct
                   Else(4)        ERR_SYM_MTC_CTL_2 = SYM_0
                               LV_ERR_MTC_CTL_2 = 1    //set direct for this DC
                                   ERR_SYM_MTC_CTL_1 = NO_SYM
                                   LV_ERR_MTC_CTL_1 = 0     /reset
                   Endif(4)
            Else(3)          Timer is still running
            Endif(3)
  Else(2)          T_MTCPWM_PI_DIAG = 0
                     ERR_SYM_MTC_CTL_1 = NO_SYM
                       LV_ERR_MTC_CTL_1 = 0
  Endif(2)
Else(1)       T_MTCPWM_PI_DIAG = 0
Endif(1)
```

End of diagnosis pulse width modulation check:

```
If              LV_CDN_DIAG_MTC_CTL_1/2 = 1           //both
Then          Start Timer
  If                  Timer   > C_T_MTCPWM_PI_DIAG
  Then               LV_END_DIAG_MTC_CTL_1 = 1
     If                   Timer >= C_T_MTCPWM_PI_DIAG_CUR_OFF
  Then               LV_END_DIAG_MTC_CTL_2 = 1
  Endif
Else          Reset timer to 0
Endif
```

Checking the control difference

```
If(1)                     LV_CDN_DIAG_MTC_CTL_3 = 1
Then(1)If(2)          TPS_DIF > C_TPS_DIF_MAX_DIAG
  Then(2)         Start Timer
            If(3)              Timer   > C_T_TPS_DIF_DIAG
            Then(3)        ERR_SYM_MTC_CTL_3 = SYM_0
                             LV_ERR_MTC_CTL_3 = 1              //set direct for this DC
            Endif(2)
  Else(2)          Reset Timer to 0
  Endif(2)
Else(1)       Reset Timer to 0
Endif(1)
```

End of diagnosis pulse width modulation check:

```
If              LV_CDN_DIAG_MTC_CTL_3 = 1
Then          Start Timer
  If                  Timer   > C_T_TPS_DIF_DIAG
  Then               LV_END_DIAG_MTC_CTL_3 = 1
     Endif
```

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Else Reset Timer to 0
Endif

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A.119 Electronic throttle control limp home management

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TPS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom					
LV_CDN_DIAG_TPS	V	0... 1H	0 ...1	1	-
Diagnosis condition					
LV_END_DIAG_TPS	V	0... 1H	0 ...1	1	-
End of Diagnosis					
LV_ERR_TPS	O/V	0... 1H	0 ...1	1	-
Logical variable, set if one TPS channel is identified as faulty or a ETC-Limp-Home is active					
LV_MTC_CUR_OFF_REQ	O/V	0... 1H	0 ...1	1	-
ETC without power request					
LV_MTC_LIH_CUR_OFF	O/V	0... 1H	0 ...1	1	-
ETC-LIMP-HOME-1					
LV_N_LIM_ETC_LIH	O/V	0... 1H	0 ...1	1	-
ETC-LIMP-HOME-2 (SAS)					
LV_N_LIM_ETC_LIH_REV	O/V	0... 1H	0 ...1	1	-
ETC-LIMP-HOME-3 (Reversible)					
LV_TPS_MTC_N_LIM	O/V	0... 1H	0 ...1	1	-
Logical variable, set if LIH engine speed limitation is required					
STATE_ETC_LIH	O/V	0H 1H 2H 4H 8H	ETC_NO_LIH ETC_LIH_1 ETC_LIH_2_ REV ETC_LIH_2 ETC_LIH_3	-	-
Status ETC Limp-Home					
STATE_TPS_DIAG	O/V	0H 1H 2H 4H 8H	TPS_NO_ ERROR TPS_LIH_1 TPS_LIH_2 TPS_LIH_MAX TPS_DBL_ ERROR	-	-
Status TPS Diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Input data:

C_T_DYW_TPS_LIH_CHK {p. 4952}	C_T_MAX_TPS_LIH_CHK {p. 4952}	C_V_TPS_LIH_CHK_HYS {p. 4954}	LV_CT {p. 1442}
LV_DET_ERR_TPS_RATIO {p. 4990}	LV_ERR_MTC_CTL_1 {p. 4977}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}
LV_ERR_MTC_DR {p. 5002}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_MAF_1 {p. 4990}
LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_V_REF_1 {p. 4216}	LV_IGK {p. 906}	LV_N_LIM_TPS_AD {p. 4951}
LV_TPS_AD_DIAG_CUR_OFF {p. 4951}	V_TPS_1 {p. 831}	V_TPS_2 {p. 831}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TPS	-	0... FFH	0... 255	1	-
Anti-bounce increment					
C_ABC_MAX_TPS	-	1... FFH	1... 255	1	-
Anti-bounce maximum					

FUNCTION DESCRIPTION:

General information:

The following TPS/ETC-Limp Home system reactions are defined:

- **TPS-EMERGENCY-MAX** *(STATE_TPS_DIAG = TPS_LIH_MAX)*
- **TPS-EMERGENCY-X** *(STATE_TPS_DIAG = TPS_LIH_X)*
- **ETC-LIMP-HOME-1** *(STATE_ETC_LIH = ETC_LIH_1)*
- **ETC-LIMP-HOME-2-REV** *(STATE_ETC_LIH = ETC_LIH_2_REV)*
- **ETC-LIMP-HOME-2 (SAS)** *(STATE_ETC_LIH = ETC_LIH_2)*
- **ETC-LIMP-HOME-3** *(STATE_ETC_LIH = ETC_LIH_3)*

All **ETC-LIMP-HOME-..** have a higher priority then all **TPS-EMERGENCY-..**

Application conditions

Initialization: `all outputs = 0 at LV_IGK 0->1 or reset or at clearing error memory`
`LV_ERR_TPS according ABC type` **`STD_INI`**

Recurrence: `5ms`

Activation: `LV_IGK = 1`

Deactivation: `LV_IGK = 0 (set LV_CDN_DIAG_TPS = 0)`

Signal flow diagram:

TPS /ETC Limp Home Manager

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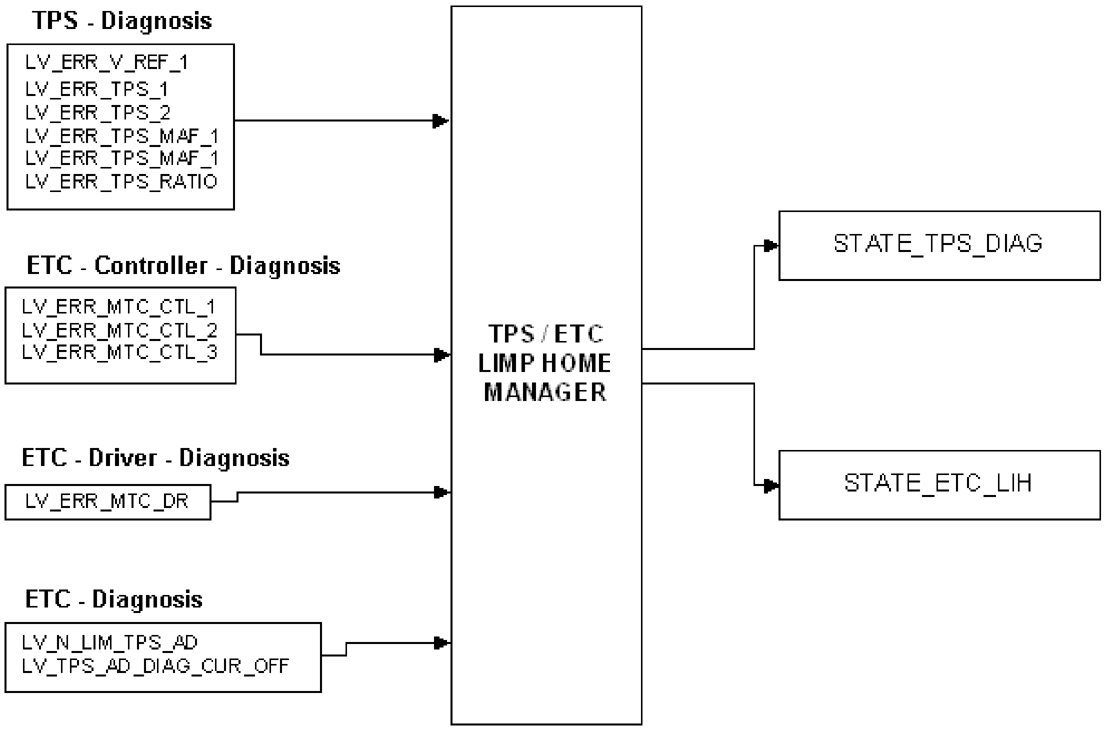
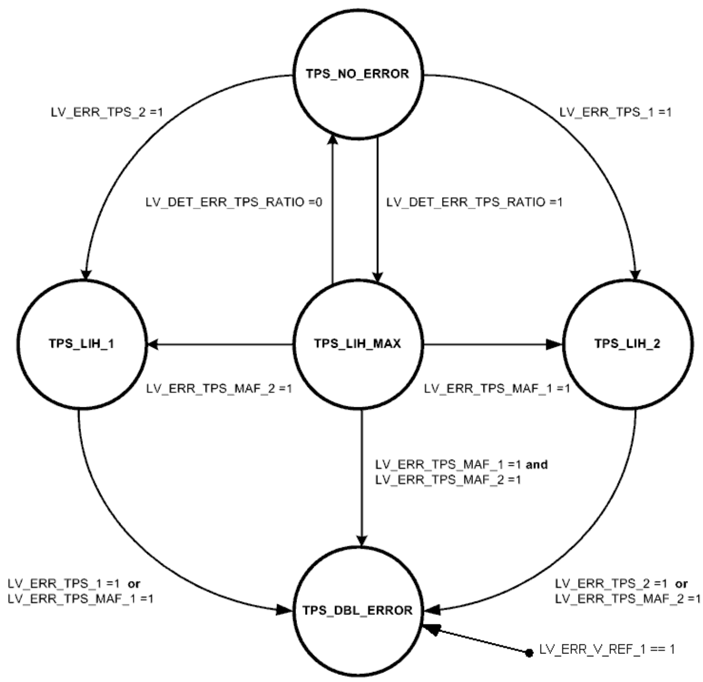


Signal flow diagram:

STATE_TPS_DIAG



Signal flow diagram:

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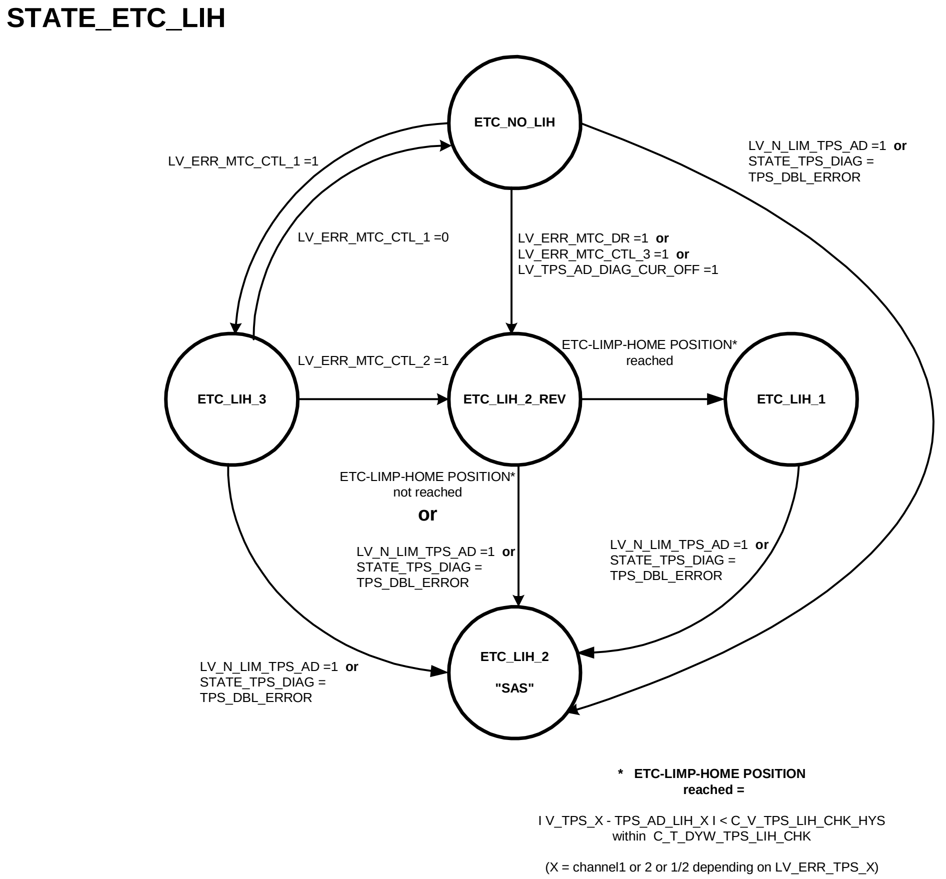

A.119.1 TPS-EMERGENCY-MAX

(STATE_TPS_DIAG = TPS_LIH_MAX)

Description:

If TPS-Emergency MAX is activ, there is a maximum selection between the two channels (see Determination of the Throttle Position).

Formula section:

If LV_DET_ERR_TPS_RATIO = 1
Then STATE_TPS_DIAG = TPS_LIH_MAX
Endif

A.119.2 TPS-EMERGENCY-X

(STATE_TPS_DIAG = TPS_LIH_X)

Description:

If one TPS channel (=Y) is detected as faulty then TPS-EMERGENCY-X is active.
If TPS-EMERGENCY-X is active, the throttle position acqusition is done with a leading Poti-X (see Acqusition of the throttle position).

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Formula section:

If LV_ERR_TPS_Y = 1 **or**
LV_ERR_TPS_MAF_Y = 1
Then STATE_TPS_DIAG = TPS_LIH_X
Endif
Idle speed demand:
If STATE_TPS_DIAG = TPS_LIH_X **and**
LV_CT = 1
Then LV_TPS_MTC_N_LIM = 1 (see Engine speed limit coordination)
Endif

A.119.3 ETC-LIMP-HOME-1 /ETC-LIMP-HOME-2-REV

(STATE_ETC_LIH = ETC_LIH_1) /(STATE_ETC_LIH = ETC_LIH_2_REV)

Description:

ETC-LIMP-HOME-1 is demanded by the ETC diagnosis (see Engine throttle diagnosis and adaptation) and the ETC driver diagnosis.

During ETC-LIMP-HOME-1 the following limp home measures are defined:

- Throttle valve without power (hold by spring power in the Limp-Home position)
- Engine speed limitation in limp home mode (with considering the drivers request)

ETC-LIMP-HOME-2-REV is initiated reversible until the ETC-Limp Home throttle position (for calibration data and additional information see: Check of the Limp-Home position in chapter Engine throttle diagnosis and adaptation) has been safely reached.
If the Limp-Home Position is reached ETC-LIMP-HOME-1 is set, if not ETC-LIMP-HOME-2 is set.

During ETC-LIMP-HOME-2_REV the following limp home measures are defined:

- Throttle valve without power (hold by spring power in the Limp-Home position)
- Engine speed limitation in limp home mode (without considering the drivers request)

Formula section:

Activation condition of ETC-LIMP-HOME-1:
If(1) [STATE_ETC_LIH = ETC_NO_LIH **and**
LV_ERR_MTC_DR = 1 **or**
LV_ERR_MTC_CTL_3 = 1 **or**
LV_TPS_AD_DIAG_CUR_OFF = 1]
Or
[STATE_ETC_LIH = ETC_LIH_3 **and**
LV_ERR_MTC_CTL_2 = 1
Then(1)
Activation of ETC-LIMP-HOME-2-REV:
STATE_ETC_LIH = ETC_LIH_2_REV
LV_MTC_CUR_OFF_REQ = 1 (ETC without power request)
LV_N_LIM_ETC_LIH = 1
LV_TPS_MTC_N_LIM = 1 (see Engine speed limit coordination)
Check of Limp Home position:
Start Time: C_T_MAX_TPS_LIH_CHK
IF(2) T < C_T_MAX_TPS_LIH_CHK **and**
IV_TPS_X - V_TPS_AD_LIH_XI < C_V_TPS_LIH_CHK_HYS

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Within the interval: C_T_DYW_TPS_LIH_CHK

Activation of ETC-LIMP-HOME-1/Deactivation of ETC-LIMP-HOME-2-REV:

Then(2) Check limp home ok
STATE_ETC_LIH = ETC_LIH_1
LV_MTC_LIH_CUR_OFF = 1
LV_N_LIM_ETC_LIH = 0
LV_TPS_MTC_N_LIM = 0

Activation of ETC-LIMP-HOME-2:

Else(2) STATE_ETC_LIH = ETC_LIH_2
Endif(2)
Else(1) STATE_ETC_LIH = ETC_NO_LIH
Endif(1)

A.119.4 ETC-LIMP-HOME-2 (SAS)

(STATE_ETC_LIH = ETC_LIH_2)

Description:

ETC-LIMP-HOME-2 (German abbreviation: SAS = Sicherheitsschubabschalten) is demanded by the ETC diagnosis (see Engine throttle diagnosis and adaptation) and/or the TPS diagnosis (if both TPS channels are faulty). ETC-LIMP-HOME-2 is set unreversible for the engine run.
During ETC-LIMP-HOME-2 the following limp home measures are defined:

- Throttle valve without power (hold by spring power in the Limp-Home position)
- Engine speed limitation in limp home mode (without considering the drivers request)

Formula section:

Activation of ETC-LIMP-HOME-2:

If STATE_ETC_LIH = ETC_NO_LIH **or**
STATE_ETC_LIH = ETC_LIH_1 **or**
STATE_ETC_LIH = ETC_LIH_2_REV **or**
STATE_ETC_LIH = ETC_LIH_3
and
LV_N_LIM_TPS_AD **or**
LV_ERR_V_REF_1 = 1 **or**
[LV_ERR_TPS_1 = 1 **and**
LV_ERR_TPS_2 = 1] **or**
[LV_ERR_TPS_MAF_1 = 1 **and**
LV_ERR_TPS_MAF_2 = 1] **or**
[LV_ERR_TPS_X = 1 **and**
LV_ERR_TPS_MAF_Y = 1]
Then STATE_ETC_LIH = ETC_LIH_2
LV_N_LIM_ETC_LIH = 1
LV_MTC_CUR_OFF_REQ = 1 (ETC without power request)
LV_TPS_MTC_N_LIM = 1 (see Engine speed limit coordination)
Endif

A.119.5 ETC-LIMP-HOME-3

(STATE_ETC_LIH = ETC_LIH_3)

Description:

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ETC-LIMP-HOME-3 is demanded by the ETC position controller diagnosis (see Engine throttle diagnosis and adaptation). ETC-LIMP-HOME-3 is set reversible for the engine run.
During ETC-LIMP-HOME-3 the following limp home measures are defined:

- Engine speed limitation in limp home mode (without considering the drivers request)

Formula section:

Activation of ETC-LIMP-HOME-3:

If STATE_ETC_LIH = ETC_NO_LIH **and**
LV_ERR_MTC_CTL_1 = 1
Then STATE_ETC_LIH = ETC_LIH_3
LV_N_LIM_ETC_LIH_REV = 1
LV_TPS_MTC_N_LIM = 1 (see Engine speed limit coordination)
Else STATE_ETC_LIH = ETC_NO_LIH
Endif

A.119.6 Calculation of LV_ERR_TPS

Description:

LV_ERR_TPS is used for MIL activation and inhibition of functions. The error is set depending the present status of ETC limp-home (combination of operation-mode and present TPS errors).

Formula section:

LV_CDN_DIAG_TPS = 1
If STATE_ETC_LIH = ETC_LIH_1 **or**
STATE_ETC_LIH = ETC_LIH_2_REV **or**
STATE_ETC_LIH = ETC_LIH_2
Then ERR_SYM_TPS = SYM_2
Else ERR_SYM_TPS = NO_SYM
Endif
LV_ERR_TPS, LV_END_DIAG_TPS is calculated by error management.

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A.120 Electronic throttle control position sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TPS_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom TPS1 diagnosis					
ERR_SYM_TPS_2	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom TPS2 diagnosis					
ERR_SYM_TPS_MAF_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom TPS_MAF 1					
ERR_SYM_TPS_MAF_2	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom TPS_MAF 1					
ERR_SYM_TPS_RATIO	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom TPS_RATIO diagnosis					
LV_CDN_DIAG_TPS_1	V	0... 1H	0 ...1	1	-
Electrical TPS 1 diagnosis condition					
LV_CDN_DIAG_TPS_2	V	0... 1H	0 ...1	1	-
Electrical TPS 2 diagnosis condition					
LV_CDN_DIAG_TPS_MAF_1	V	0... 1H	0 ...1	1	-
Diagnosis condition TPS_MAF 1					
LV_CDN_DIAG_TPS_MAF_2	V	0... 1H	0 ...1	1	-
Diagnosis condition TPS_MAF 2					
LV_CDN_DIAG_TPS_RATIO	V	0... 1H	0 ...1	1	-
Diagnosis condition TPS_RATIO diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DET_ERR_TPS_RATIO	O/V	0... 1H	0 ...1	1	-
Logic variable set if TPS_RATIO error is detected					
LV_END_DIAG_TPS_1	V	0... 1H	0 ...1	1	-
End of diagnosis TPS1 diagnosis					
LV_END_DIAG_TPS_2	V	0... 1H	0 ...1	1	-
End of diagnosis TPS2 diagnosis					
LV_END_DIAG_TPS_MAF_1	V	0... 1H	0 ...1	1	-
End of diagnosis TPS_MAF 1					
LV_END_DIAG_TPS_MAF_2	V	0... 1H	0 ...1	1	-
End of diagnosis TPS_MAF 2					
LV_END_DIAG_TPS_RATIO	O/V	0... 1H	0 ...1	1	-
End of diagnosis TPS_RATIO diagnosis					
LV_ERR_TPS_1	O/V	0... 1H	0 ...1	1	-
Electrical TPS error, channel 1					
LV_ERR_TPS_2	O/V	0... 1H	0 ...1	1	-
Electrical error TPS channel 2					
LV_ERR_TPS_MAF_1	O/V	0... 1H	0 ...1	1	-
TPS channel 1 is not plausible to MAF					
LV_ERR_TPS_MAF_2	O/V	0... 1H	0 ...1	1	-
TPS channel 2 is not plausible to MAF					
LV_ERR_TPS_RATIO	O/V	0... 1H	0 ...1	1	-
Logic variable set if TPS_RATIO error is present					
T_DLY_TPS_DIAG_REQ_HOM_ACT	V	0... FFH	0... 1.275	0.005	s
Delay timer to check the HOM mode after active TPS error					
T_MAX_TPS_DIF_DIAG	V	0... FFH	0... 1.275	0.005	s
Integration timer for plausibility check in case of single channel error					
T_TPS_DIF_INT	-	0... FFH	0... 1.275	0.005	s
Integration timer for deviation between measured and calculated DK value					
TPS_DIF_DIAG_1	V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Difference between measured TPS_AV_1 and modelled TPS_SUB_DIAG					
TPS_DIF_DIAG_2	V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Difference between measured TPS_AV_2 and modelled TPS_SUB_DIAG					
TPS_DIF_DIAG_COR_1	O/V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Corrected value of TPS_DIF_DIAG_1					
TPS_DIF_DIAG_COR_2	O/V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Corrected value of TPS_DIF_DIAG_2					
TPS_DIF_DIAG_COR_MMV_1	V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Filtered corrected value of TPS_DIF_DIAG_COR_1					
TPS_DIF_DIAG_COR_MMV_2	V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Filtered corrected value of TPS_DIF_DIAG_COR_2					
TPS_SUM_DIF_DIAG_COR_1	O/V	0... FFFFH	0... 32767.5	0.5	°TPS
Integrated value of TPS_DIF_DIAG_COR_1					
TPS_SUM_DIF_DIAG_COR_1_OLD	-	0... FFFFH	0... 32767.5	0.5	°TPS
Old value of TPS_SUM_DIF_DIAG_COR_1					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TPS_SUM_DIF_DIAG_COR_2	O/V	0... FFFFH	0... 32767.5	0.5	°TPS
Integrated value of TPS_DIF_DIAG_COR_2					
TPS_SUM_DIF_DIAG_COR_2_OLD	-	0... FFFFH	0... 32767.5	0.5	°TPS
Old value of TPS_SUM_DIF_DIAG_COR_2					

Input data:

LV_ERR_V_REF_1 {p. 4216}	LV_HOM_ACT {p. 8136}	LV_IGK {p. 906}	LV_ST_END {p. 1720}
LV_TPS_SUB_DIAG_ERR {p. 5000}	LV_TPS_SUB_DIAG_NOT_VLD {p. 8277}	STATE_TPS_DIAG {p. 4982}	TPS_AV_1 {p. 1169}
TPS_AV_2 {p. 1169}	TPS_SUB_DIAG {p. 8377}	V_TPS_1 {p. 831}	V_TPS_2 {p. 831}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TPS_1	-	0... FFH	0... 255	1	-
Anti-bounce increment value TPS diagnosis					
C_ABC_INC_TPS_2	-	0... FFH	0... 255	1	-
Anti-bounce increment value TPS diagnosis					
C_ABC_INC_TPS_RATIO	-	0... FFH	0... 255	1	-
Anti-bounce increment value TPS ratio diagnosis					
C_ABC_MAX_TPS_1	-	1... FFH	1... 255	1	-
Anti-bounce maximum value TPS diagnosis					
C_ABC_MAX_TPS_2	-	1... FFH	1... 255	1	-
Anti-bounce maximum value TPS diagnosis					
C_ABC_MAX_TPS_RATIO	-	1... FFH	1... 255	1	-
Anti-bounce maximum value TPS ratio diagnosis					
C_T_DLY_TPS_DIAG_REQ_HOM_ACT	-	0... FFH	0... 1.275	0.005	s
Delay timer to check the HOM mode after active TPS error					
C_T_MAX_TPS_DIF_DIAG	-	0... FFH	0... 1.275	0.005	s
Integration time for plausibility check in case of single chanel error					
C_T_TPS_DIF_INT	-	0... FFH	0... 1.275	0.005	s
Integration time for deviation between measured and calculated DK value					
C_TPS_DIF_DIAG_COR_MMV_MAX	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Threshold of max. deviation of filtered TPS difference value					
C_TPS_SUB_CRLC_DIF	-	0... FFFFH	0 ...1	15.3e-6	-
Correlation constant for filtering of error (second error)					
C_TPS_SUM_DIF_DIAG_COR_MAX	-	0... FFFFH	0... 32767.5	0.5	°TPS
Threshold of integrated corrected max. difference of measured and modelled TPS value					
C_V_TPS_MAX_DIAG_1	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upper diagnostic voltage TPS 1					
C_V_TPS_MAX_DIAG_2	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Upper diagnostic voltage TPS 2					
C_V_TPS_MIN_DIAG_1	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lower diagnostic voltage TPS 1					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_TPS_MIN_DIAG_2	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lower diagnostic voltage TPS 2					
C_V_TPS_RATIO_HYS	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Admissible deviation of DK angle					
IP_FAC_TPS_DIF_1	V	0... FFH	0... 1.99218	0.0078125	-
LDP_N_IP_FAC_TPS_DIF_1	8	0... 1FE0H	0... 8160	1	rpm
LDP_MAF_SP_TQI_IP_FAC_TPS_DIF_1	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Factor 1 for TPS_DIF_DIAG calculation					
IP_FAC_TPS_DIF_2	-	0... FFH	0... 1.99218	0.0078125	-
LDP_PQ_SP_IP_FAC_TPS_DIF_2	6	0... FFFFH	0... 0.99998	15.3e-6	-
Factor 2 for TPS_DIF_DIAG calculation					
LC_USE_TPS_MAF_DIAG	-	0... 1H	0 ...1	1	-
Locical value to switch off TPS_MAF diagnosis (MSV70 = 0, MSD70 = 1)					

A.120.1 Diagnosis of the admissible voltage ranges V_TPS_1 /V_TPS_2

FUNCTION DESCRIPTION:

Description:

In the case of an error-free system, the potentiometer voltages must be within admissible limits. The following errors symptoms can be distinguished:

ERR_SYM_TPS_1:

```
 ┌─┬─┬─┬─┐
 │ │ │ └─> Short circuit to Vbatt or Open load    (= SYM_0)
 │ │ └───> Short circuit to Ground                (= SYM_1)
 │ └─────> -                                      (= SYM_2)
 └───────> -                                      (= SYM_3)
```

ERR_SYM_TPS_2:

```
 ┌─┬─┬─┬─┐
 │ │ │ └─> Short circuit to Vbatt                 (= SYM_0)
 │ │ └───> Short circuit to Ground or Open load   (= SYM_1)
 │ └─────> -                                      (= SYM_2)
 └───────> -                                      (= SYM_3)
```

Application conditions

Initialisation: according filtertype **STD_INI** *(all 0 at LV_IGK 0->1 or reset)*

Recurrence: 5ms

Activation:

```
If          LV_IGK = 1              and
   LV_ERR_V_REF_1 = 0        and
   LV_ERR_TPS_1/ 2 = 0        and
```

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```
Then          LV_CDN_DIAG_TPS_1/ 2 = 1
Else           LV_CDN_DIAG_TPS_1/ 2 = 0
Endif
```

Formula section:

Calculation End of Diagnosis:
For calculation of LV_END_DIAG_TPS_1/2 see Anti-bounce algorithm, calculation of the end of diagnosis .
Error detection TPS_1 short circuit to ground:
If V_TPS_1 < C_V_TPS_MIN_DIAG_1
Then ERR_SYM_TPS_1 = SYM_1
LV_ERR_TPS_1 = 1 *//after debounce, remains active until next initialization*

Error detection TPS_1 short circuit to Vbatt or open load:
ElseIf V_TPS_1 > C_V_TPS_MAX_DIAG_1
Then ERR_SYM_TPS_1 = SYM_0
LV_ERR_TPS_1 = 1 *//after debounce, remains active until next initialization*

Else ERR_SYM_TPS_1 = NO_SYM
Endif
Error detection TPS_2 short circuit to ground or open load:
If V_TPS_2 < C_V_TPS_MIN_DIAG_2
Then ERR_SYM_TPS_2 = SYM_1
LV_ERR_TPS_2 = 1 *//after debounce, remains active until next initialization*

Error detection TPS_2 short circuit to VBatt:
ElseIf V_TPS_2 > C_V_TPS_MAX_DIAG_2
Then ERR_SYM_TPS_2 = SYM_0
LV_ERR_TPS_2 = 1 *//after debounce, remains active until next initialization*
Else ERR_SYM_TPS_2 = NO_SYM
Endif

A.120.2 Ratio - check between TPS values V_TPS_1 /V_TPS_2

FUNCTION DESCRIPTION:

General information:

In the case of an error-free system, the Poti-voltages V_TPS_1 and V_TPS_2 must not differ by more than C_V_TPS_RATIO_HYS. The voltage V_TPS_2 is inverted in order to carry out the channel comparison.

Description:

If the threshold C_V_TPS_RATIO_HYS is exceeded, the TPS_RATIO error will be debounced.
Error symptoms are defined for this diagnosis function as:

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```
□□□□
 |  |  |  └─> -                                (= SYM_0)
 |  |  └────> -                                (= SYM_1)
 |  └───────> -                                (= SYM_2)
 └──────────> TPS - Ratio exeeded              (= SYM_3)
```

Application conditions

Initialisation: *according filter type* ***STD_INI***

Recurrence: *5ms*

Activation:

```
If          LV_IGK = 1
  and   LV_ST_END = 1
  and   LV_ERR_V_REF_1 = 0
  and   LV_ERR_TPS_1/ 2 = 0    both channels must be errorfree
 and       LV_ERR_TPS_MAF_1/ 2 = 0
 Then              LV_CDN_DIAG_TPS_RATIO = 1
 Else              LV_CDN_DIAG_TPS_RATIO = 0
     LV_DET_ERR_TPS_RATIO = 0
 Endif
```

Formula section:

If | V_TPS_1 - (5[V] - V_TPS_2) | > C_V_TPS_RATIO_HYS

Then ERR_SYM_TPS_RATIO = SYM_3 *//anti bounce increment*

LV_DET_ERR_TPS_RATIO = 1

Else ERR_SYM_TPS_RATIO = NO_SYM *//anti bounce decrement*

LV_DET_ERR_TPS_RATIO = 0

Endif

LV_ERR_TPS_RATIO , LV_END_DIAG_TPS_RATIO is calculated by error management

A.120.3 TPS /TPS_SUB_DIAG plausibility check after RATIO-error is detected

FUNCTION DESCRIPTION:

General information:

This function is only performed if calibrated LC_USE_MAF_TPS_DIAG = 1.
If RATIO error is detected the algorithm is used to decide if channel one or two or both are not plausible.
It is based on the modelled TPS value TPS_SUB_DIAG.
X = channel 1 and 2

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Description:

Detection of TPS fist error:
The integration is done for C_T_TPS_DIF_INT if diagnosis conditions are active.
TPS_DIF_DIAG_X is the difference between the mesured value TPS_AV_X and the modelled TPS value TPS_SUB_DIAG.
TPS_DIF_DIAG_COR_X is the corrected value based on N, MAF_SP_TQI, PQ.
TPS_SUM_DIF_DIAG_COR_X is the integrated value of TPS_DIF_DIAG_COR_X.
Depending on TPS_SUM_DIF_DIAG_COR_X channel one or two or both are set as not plausible and the diagnosis is switched off.
The plausibility check cannot be performed if TPS_SUB_DIAG cannot be calculated in the right way because an active lambda-sensor fault or a load-sensor fault.
In this case, the two channels are declared as faulty when LV_DET_ERR_TPS_RATIO is set for C_T_TPS_DIF_INT.

Continuous TPS /TPS_SUB_DIAG monitoring for single channel
In the case of one channel is diagnosed as faulty, a plausibility check for the remaining channel to the other one is no longer possible. In this case, the substitute value TPS_DIF_DIAG_COR_X is used for the plausibility check while the engine is running. The difference between the measured TPS_AV value and the substitute value TPS is normalized and the mean value is established with a correlation constant.
The plausibility check cannot be performed when a mass air flow signal is missing; in this case, the channel is declared as faulty.
Error symptom definition see TPS-FIRST-ERROR diagnosis.

Check of the combustion mode with active TPS error
In order to perform the first /second error diagnosis the combustion-mode must be homogeneous, thus there’s a delay timer which runs after a present Ratio /Single TPS error.
If the timer is elapsed without active HOM mode, a TPS double fault is set and the throttle is switched off.

Error symptoms are defined for this diagnosis function as:

ERR_SYM_TPS_MAF_1:

```
 _______________
|___|___|___|___|
 |   |   |   └──> -                           (= SYM_0)
 |   |   └──────> -                           (= SYM_1)
 |   └──────────> -                           (= SYM_2)
 └──────────────> TPS1 is not plausible       (= SYM_3)
```

ERR_SYM_TPS_MAF_2:

```
 _______________
|___|___|___|___|
 |   |   |   └──> -                           (= SYM_0)
 |   |   └──────> -                           (= SYM_1)
 |   └──────────> -                           (= SYM_2)
 └──────────────> TPS2 is not plausible       (= SYM_3)
```

Application conditions

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Initialisation: *all 0 at LV_IGK 0->1* ***or*** *reset* ***or*** *clearing error memory*

Recurrence: *5ms*

Activation:
LC_USE_MAF_TPS_DIAG = 1 **and**
STATE_TPS_DIAG = ! TPS_DBL_ERROR

Deactivation:
LC_USE_MAF_TPS_DIAG = 0 **or**
STATE_TPS_DIAG = TPS_DBL_ERROR
set LV_CDN_DIAG_TPS_MAF_1/ 2 = 0

Formula section:

```
If(1)               LV_IGK = 1
    and     LV_ST_END = 1
  and         LV_TPS_SUB_DIAG_NOT_VLD = 0          //TPS_SUB_DIAG not valid
  and         LV_HOM_ACT = 1
Then(1)          //Main condition for Integration active

TPS_DIF_DIAG_X = Difference between measured and model value
TPS_DIF_DIAG_1 = ABS [ TPS_AV_1 - TPS_SUB_DIAG ]
TPS_DIF_DIAG_2 = ABS [ TPS_AV_2 - TPS_SUB_DIAG ]
TPS_DIF_DIAG_COR_X = Corrected difference value depending load /engine speed
TPS_DIF_DIAG_COR_1 = TPS_DIF_DIAG_1 *
                                   IP_FAC_TPS_DIF_1__N__MAF_SP_TQI *
                                   IP_FAC_TPS_DIF_2__PQ_SP
TPS_DIF_DIAG_COR_2 = TPS_DIF_DIAG_2 *
                                   IP_FAC_TPS_DIF_1__N__MAF_SP_TQI *
                                   IP_FAC_TPS_DIF_2__PQ_SP
  If(2) //any TPS error active?
  (LV_ERR_TPS_1 = 0 and LV_ERR_TPS_MAF_1 = 0)          or
  (LV_ERR_TPS_2 = 0 and LV_ERR_TPS_MAF_2 = 0)
  Then(2)
          If(3)
            (LV_ERR_TPS_1 = 1 or LV_ERR_TPS_MAF_1 = 1)     //TPS_1 faulty
            Then(3)
            LV_CDN_DIAG_TPS_MAF_2 = 1
            Call "calculation TPS_DIF_DIAG_COR_MMV_2"
                    If(4)
                    LV_TPS_SUB_DIAG_ERR = 1
                    Then(4)
                    ERR_SYM_TPS_MAF_2 = SYM_3
                    LV_ERR_TPS_MAF_2 = 1
                    LV_END_DIAG_TPS_MAF_2 = 1
                    Elseif (4)
                    (LV_TPS_SUB_DIAG_ERR = 0 and
                    TPS_DIF_DIAG_COR_MMV_2 > C_TPS_DIF_DIAG_COR_MMV_MAX)
                    Then(4)
                            If(5)
                            T_MAX_TPS_DIF_DIAG < C_T_MAX_TPS_DIF_DIAG
                            Then(5)
                            T_MAX_TPS_DIF_DIAG++                  //count debounce time

                            Else(5)
```

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```
                    ERR_SYM_TPS_MAF_2 = SYM_3
                    LV_ERR_TPS_MAF_2 = 1
                    LV_END_DIAG_TPS_MAF_2 = 1
                    Endif(5)
                Else(4)
                T_MAX_TPS_DIF_DIAG - -
            Endif(4)
    Elseif(3)
    (LV_ERR_TPS_2 = 1 or LV_ERR_TPS_MAF_2 = 1)      //TPS_2 faulty
    Then(3)
    LV_CDN_DIAG_TPS_MAF_1 = 1
    Call "calculation TPS_DIF_DIAG_COR_MMV_1"
            If(4b)
            LV_TPS_SUB_DIAG_ERR = 1
            Then(4b)
            ERR_SYM_TPS_MAF_1 = SYM_3
            LV_ERR_TPS_MAF_1 = 1
            LV_END_DIAG_TPS_MAF_1 = 1
            Elseif(4b)
            (LV_TPS_SUB_DIAG_ERR = 0 and
            TPS_DIF_DIAG_COR_MMV_1 > C_TPS_DIF_DIAG_COR_MMV_MAX)
            Then(4b)
                    If(5b)
                    T_MAX_TPS_DIF_DIAG < C_T_MAX_TPS_DIF_DIAG
                    Then(5b)
                    T_MAX_TPS_DIF_DIAG ++                  //count debounce time

                    Else(5b)
                    ERR_SYM_TPS_MAF_1 = SYM_3
                    LV_ERR_TPS_MAF_1 = 1
                    LV_END_DIAG_TPS_MAF_1 = 1
                    Endif(5b)
            Else(4)
                T_MAX_TPS_DIF_DIAG - -
            Endif(4b)
        Else(3)
    Call " First error detection"
    Endif(3)
Else(2) Double TPS error, no diagnosis
Endif(2)
Else(1)//reset
T_TPS_DIF_INT   = 0
TPS_SUM_DIF_DIAG_COR_1 = 0
TPS_SUM_DIF_DIAG_COR_2 = 0
TPS_SUM_DIF_DIAG_COR_1_OLD = 0
TPS_SUM_DIF_DIAG_COR_2_OLD = 0
TPS_DIF_DIAG_COR_1 = 0
TPS_DIF_DIAG_COR_2 = 0
TPS_DIF_DIAG_1 = 0
TPS_DIF_DIAG_2 = 0
T_MAX_TPS_DIF_DIAG = 0
```

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Endif(1)

A.120.3.1 Calculation of TPS_DIF_DIAG_COR_MMV_x = Filtered value

TPS_DIF_DIAG_COR_MMV_x(n) = TPS_DIF_DIAG_COR_MMV_x(n-1) +
[TPS_DIF_DIAG_COR_x - TPS_DIF_DIAG_COR_MMV_x(n-1)] *
C_TPS_SUB_CLRC_DIF

A.120.3.2 First error detection

If(1)
LV_DET_ERR_TPS_RATIO = 1
Then(1)
LV_CDN_DIAG_TPS_MAF_1 = 1
LV_CDN_DIAG_TPS_MAF_2 = 1
If(2)
T_TPS_DIF_INT < C_T_TPS_DIF_INT *//INT timer not elapsed*
Then(2)
Integration timer T_TPS_DIF_INT + + *//count INT timer*
TPS_SUM_DIF_DIAG_COR_1=TPS_SUM_DIF_DIAG_COR_1_OLD + TPS_DIF_DIAG_COR_1
TPS_SUM_DIF_DIAG_COR_2=TPS_SUM_DIF_DIAG_COR_2_OLD + TPS_DIF_DIAG_COR_2
If(3)
LV_TPS_SUB_DIAG_ERR = 1
Then(3)
ERR_SYM_TPS_MAF_1 = SYM_3
LV_ERR_TPS_MAF_1 = 1
LV_END_DIAG_TPS_MAF_1 = 1
ERR_SYM_TPS_MAF_2 = SYM_3
LV_ERR_TPS_MAF_2 = 1
LV_END_DIAG_TPS_MAF_2 = 1
Else(3)
If(4) *//integrated value reached thereshold*
TPS_SUM_DIF_DIAG_COR_1 >C_TPS_SUM_DIF_DIAG_COR_MAX
Then(4)
ERR_SYM_TPS_MAF_1 = SYM_3
LV_ERR_TPS_MAF_1 = 1
LV_END_DIAG_TPS_MAF_1 = 1
If(5) *// integrated value reached thereshold*
TPS_SUM_DIF_DIAG_COR_2 >C_TPS_SUM_DIF_DIAG_COR_MAX
Then(5)
ERR_SYM_TPS_MAF_2 = SYM_3
LV_ERR_TPS_MAF_2 = 1
LV_END_DIAG_TPS_MAF_2 = 1
Else(2) *//Timer ellapsed*
If(6)
LV_TPS_SUB_DIAG_ERR = 1
Then(6)
ERR_SYM_TPS_MAF_1 = SYM_3
LV_ERR_TPS_MAF_1 = 1
LV_END_DIAG_TPS_MAF_1 = 1
ERR_SYM_TPS_MAF_2 = SYM_3
LV_ERR_TPS_MAF_2 = 1

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```
                    LV_END_DIAG_TPS_MAF_2 = 1
                    If(7)
                    TPS_SUM_DIF_DIAG_COR_1 ≥ TPS_SUM_DIF_DIAG_COR_2
                    Then(7)
                    ERR_SYM_TPS_MAF_1 = SYM_3
                    LV_ERR_TPS_MAF_1 = 1
                    LV_END_DIAG_TPS_MAF_1 = 1
                    Else(7)
                    ERR_SYM_TPS_MAF_2 = SYM_3
                    LV_ERR_TPS_MAF_2 = 1
                    LV_END_DIAG_TPS_MAF_2 = 1
                    Endif
                  Else(3a)
Else(1) // set end of diagnosis
  If(8)                LV_END_DIAG_TPS_MAF_X = 0               //both
  Then(8)          LV_CDN_DIAG_TPS_MAF_X = 1                //both
                         LV_END_DIAG_TPS_MAF_X = 1                //both
  Else(8)          // Ratio symptom   no more detected, reset variables
                         LV_CDN_DIAG_TPS_MAF_X = 0                //both
                         T_TPS_DIF_INT   = 0
                         TPS_SUM_DIF_DIAG_COR_1_OLD = 0
                         TPS_SUM_DIF_DIAG_COR_2_OLD = 0
  Endif(8)
Endif(1)
```

A.120.3.3 Check of the combustion mode with active TPS error

```
If                  LV_DET_ERR_TPS_RATIO = 1          or
                   LV_ERR_TPS_1 = 1                  or
                   LV_ERR_TPS_2 = 1                  or
                   LV_ERR_TPS_MAF_1 = 1              or
                   LV_ERR_TPS_MAF_2 = 1

Then            T_DLY_TPS_DIAG_REQ_HOM_ACT ++
        If          T_DLY_TPS_DIAG_REQ_HOM_ACT>=C_T_DLY_TPS_DIAG_REQ_HOM_ACT
                   and
                   LV_HOM_ACT = 0
  Then          LV_CDN_DIAG_TPS_MAF_1/2 = 1                 //both
                ERR_SYM_TPS_MAF_1/2 = SYM_3
                LV_ERR_TPS_MAF_1/2 = 1
                LV_END_DIAG_TPS_MAF_1/2 = 1
        Endif
Else            T_DLY_TPS_DIAG_REQ_HOM_ACT = 0
Endif
```

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A.121 Electronic throttle control position sensor diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_TPS_SUB_DIAG_ERR	O/V	0... 1H	0 ...1	1	-
TPS_SUB_DIAG is not valid due to present component error					

Input data:

LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_DIP_SENS {p. 4824}
LV_ERR_MAP_DIP_SHIFT {p. 4824}	LV_IGK {p. 906}	LV_ST_END {p. 1720}	LV_VAR_MAF {p. 656}
NC_CBK_EX_NR {p. 1829}			

A.121.1 Calculation of LV_TPS_SUB_DIAG_ERR

Description:

TPS_SUB_DIAG is the modelled TPS value calculated out of the measured lambda and the intake manifold model. With a present component error this calculation is no more possible, thus both TPS channels are set as faulty.

Application conditions

Initialisation: *0 atreset*

Recurrence: *5ms*

Activation: *LV_ST_END = 1*

Formula section:

LV_TPS_SUB_DIAG_ERR = 0
If *//OBD1 error, valid for all variants*
LV_ERR_AMP = 1 **or**
LV_ERR_AMP_PLAUS = 1 **or**
LV_ERR_MAP_DIP_SENS = 1 **or**
LV_ERR_MAP_DIP_SHIFT = 1
Then
LV_TPS_SUB_DIAG_ERR = 1
ElseIf *//HFM error, valid if equiped*
LV_VAR_MAF = 1
Then **If** LV_ERR_MAF = 1
Then LV_TPS_SUB_DIAG_ERR = 1
Endif
Else **If** LV_ERR_DIAGCPS = 1 **or**
LV_ERR_EL_CPS = 1

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```
        Then        LV_TPS_SUB_DIAG_ERR = 1
      Else        If        [ NC_CBK_EX_NR = 2                          and
                          ( LV_ERR_FSD[1] = 1                       and
                            LV_ERR_LS_UP[2] = 1)                    or
                          ( LV_ERR_FSD[2] = 1                       and
                            LV_ERR_LS_UP[1] = 1)                    or
                          LV_ERR_FSD[NC_CBK_EX_NR] = 1              or        //both
                          LV_ERR_LS_UP[NC_CBK_EX_NR] = 1 ]                    //both
                Then        LV_TPS_SUB_DIAG_ERR = 1
            Else        If        NC_CBK_EX_NR = 1                            and
                              LV_ERR_FSD[1] = 1                       or
                              LV_ERR_LS_UP[1] = 1
                    Then        LV_TPS_SUB_DIAG_ERR = 1
                  Endif
            Endif
      Endif
Endif
```

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A.122 Electronic throttle control power stage diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_MTC_DR	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom MTC_DR					
LV_CDN_DIAG_MTC_DR	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MTC_DR					
LV_END_DIAG_MTC_DR	O/V	0... 1H	0 ...1	1	-
End of Diagnosis MTC_DR					
LV_ERR_MTC_DR	O/V	0... 1H	0 ...1	1	-
MTC_DR error present					

Input data:

BIOS_HBR_FAULT_ STATUS_MTC	LV_ES {p. 1720}	LV_IGK {p. 906}	LV_MTC_CUR_OFF {p. 6565}
LV_ST {p. 1720}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_MTC_DR	-	0... FFH	0... 255	1	-
Debounce counter increment, MTC driver diagnosis					
C_ABC_MAX_MTC_DR	-	1... FFH	1... 255	1	-
Debounce counter maximum value, MTC driver diagnosis					

FUNCTION DESCRIPTION:

General information:

Error detection is effected via the ECU hardware (MTC H-Bridge IC).

Description:

The following errors symptoms (Error state BIOS_HBR_FAULT_STATUS_MTC is delievered from the basic software) can be distinguished:

- Undervoltage
- Overcurrent
- Overtemperature

Error-symptoms are defined to this diagnosis function as following:

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```
┌─┬─┬─┬─┐
│ │ │ │ │
└─┴─┴─┴─┘
 │ │ │ └─> -                              (= SYM_0)
 │ │ └───> -                              (= SYM_1)
 │ └─────> ETC - driver is faulty         (= SYM_2)
 └───────> -                              (= SYM_3)
```

Application conditions

Initialisation: `all 0 at LV_IGK 0->1` **`or`** `reset`

Recurrence: `5ms`

Activation:

If LV_IGK = 1 **and**
LV_ES = 0 **and**
LV_ST = 0 **and**
LV_MTC_CUR_OFF = 0 *//Position controller has power*
Then LV_CDN_DIAG_MTC_DR = 1
Else LV_CDN_DIAG_MTC_DR = 0
Endif

Formula section:

If BIOS_HBR_FAULT_STATUS_MTC = 1
Then ERR_SYM_MTC_DR = SYM_2
LV_ERR_MTC_DR = 1 *//after debounce*
Else ERR_SYM_MTC_DR = NO_SYM
LV_ERR_MTC_DR = 0 *//after rebounce*
Endif

Calculation end of diagnosis:
LV_END_DIAG_MTC_DR is calculated by error management

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A.123 Mass air flow trottle control diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_RLY_MTC_HEAT	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of RLY_MTC_HEAT bit 0: diagnosis condition for symptom SCP (SYM_0)bit 1: diagnosis condition for symptom SCG (SYM_1)bit 2: diagnosis condition for symptom OC (SYM_2)					
ERR_DIAG_RLY_MTC_HEAT	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for RLY_MTC_HEAT (only parameter)					
ERR_SYM_RLY_MTC_HEAT	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom MTC_HEAT of power stage					
LV_CDN_DIAG_RLY_MTC_HEAT	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MTC_HEAT of power stage					
LV_END_DIAG_RLY_MTC_HEAT	O/V	0... 1H	0 ...1	1	-
End of MTC_HEAT power stage diagnosis					
LV_ERR_RLY_MTC_HEAT	O/V	0... 1H	0 ...1	1	-
Logical value for MTC_HEAT error of power stage					
LV_INH_DIAG_RLY_MTC_HEAT	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition RLY_MTC_HEAT diagnosis					

Input data:

LV_CDN_VB_MIN_DIAG {p. 1185}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_RLY_MTC_HEAT	-	0... FFH	0... 255	1	-
Debounce counter increment MTC_HEAT					
C_ABC_MAX_RLY_MTC_HEAT	-	1... FFH	1... 255	1	-
Debounce counter maximum value MTC_HEAT					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_RLY_MTC_HEAT	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (= 2)					

Import actions:

Continued on next page

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ACTION_ERRM_FilterMulticondition (**IN**<XX>,**IN**<CDN_DIAG_>,**XX**>,<IN<>,**ERR_DIAG_XX**>,<IN>,<C_ABC_INC_XX>,**IN**<C_ABC_MAX_XX>,**OUT**<LV_ERR_XX>)	
ACTION_INFR_GetElDiagMTCHEAT (**OUT**<Cdn_diag_rly_mtc_heat>,**OUT**<Err_diag_rly_mtc_heat>)	

Error treatment:

Diagnostic **RLY_MTC_HEAT**	**Symptom description**	**Symptom**	**Filter type**
Diagnostic description	*SCP*	*SYM_0*	*MPL_STD_INI*
	SCG	*SYM_1*	
	OC	*SYM_2*	

Note : ACTION_INFR_GetElDiagMTCHEAT() is defined in the IRS (Infrastructure requirement specification AGGR THRO)

FUNCTION DESCRIPTION:

General information:

The signal from the driver which controls the throttle housing heater relay is diagnosed. The relay is driven by the ECU via an output driver. The failure detection is done by ECU Hardware and given to ASW. The purpose of the diagnosis is based on the detection of electrical faults as defined by OBD I requirements.

Description:

After activation conditions are met, the diagnosis activation is delayed for NC_PSD_DLY_RLY_MTC_HEAT executions, to avoid the usage of wrong infrastructure information. The error detection algorithm operates the electrical diagnosis of powerstage outputs of ATIC39.

Error-symptoms are defined to this diagnosis function as following :

```
 |_|_|_|_|
  |  |  |  └-> Short circuit to Vbatt(SCP)        (= SYM_0)
  |  |  └----> Short circuit to GND(SCG)          (= SYM_1)
  |  └-------> Open load(OC)                      (=SYM_2)
  └----------> -                                  (=SYM_3)
```

Application conditions

Initialisation: according Filter-type **MPL_STD_INI**
(reset of variables at LV_IGK 0 -> 1 or ECU reset)
Set delay counter for NC_PSD_DLY_RLY_MTC_HEAT

Recurrence: 100 ms

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Activation: LV_IGK = 1

Deactivation: LV_IGK = 0

Formula section:

If diagnosis is not inhibited (LV_INH_DIAG_RLY_MTC_HEAT = 0) the diagnosis conditions are set according infrastructure information: CDN_DIAG_RLY_MTC_HEAT.
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_RLY_MTC_HEAT.

Failure debouncing and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_RLY_MTC_HEAT and ERR_DIAG_RLY_MTC_HEAT.

ACTION_ERRM_FilterMulticondition (IN<RLY_MTC_HEAT>, IN<CDN_DIAG_RLY_MTC_HEAT>, IN<ERR_DIAG_RLY_MTC_HEAT>, IN<C_ABC_INC_RLY_MTC_HEAT>, IN<C_ABC_MAX_RLY_MTC_HEAT>, OUT<LV_ERR_RLY_MTC_HEAT>)

This algorithm determines:
ERR_SYM_RLY_MTC_HEAT (Detected error symptom)
LV_ERR_RLY_MTC_HEAT (Error flag for debounced error)
LV_CDN_DIAG_RLY_MTC_HEAT (Diagnosis condition information)
LV_END_DIAG_RLY_MTC_HEAT (End of diagnosis information)
Diagnosis inhibition:
If LV_IGK = 1 **and**
LV_CDN_VB_MIN_DIAG = 1 **and**
LV_ERR_SPI_MPS = 0
Then LV_INH_DIAG_RLY_MTC_HEAT = 0
Else LV_INH_DIAG_RLY_MTC_HEAT = 1
Endif

If LV_INH_DIAG_RLY_MTC_HEAT = 0

Then
Usage of the diagnosis information (failure symptoms (raw value) ERR_DIAG_RLY_MTC_HEAT and basic diagnosis conditions CDN_DIAG_RLY_MTC_HEAT) received from the infrastructure:

ACTION_INFR_GetElDiagMTCHEAT (OUT<Cdn_diag_rly_mtc_heat>, OUT<Err_diag_rly_mtc_heat>)

Basic diagnosis conditions are set according infrastructure information: CDN_DIAG_RLY_MTC_HEAT
Failure symptoms (raw value) are set according infrastructure information: ERR_DIAG_RLY_MTC_HEAT

If Activation conditions are met for the NC_PSD_DLY_RLY_MTC_HEAT recurrence of the diagnosis
Then *[CDN_DIAG_RLY_MTC_HEAT valid from Infrastructure]*
Else CDN_DIAG_RLY_MTC_HEAT = 0
Endif
Else
CDN_DIAG_RLY_MTC_HEAT = 0
Endif

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A.124 Mass air flow trottle control diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_RBM_TPS	O/V	0... 7H	0 ...7	1	-
Interface of TPS monitor with the Rate-Based Monitoring statistics					

Input data:

LV_END_DIAG_MTC_ CTL_3 {p. 4977}	LV_END_DIAG_TPS_AD {p. 4950}	LV_END_DIAG_TPS_AD_ BOL {p. 4950}	

FUNCTION DESCRIPTION:

General information:

With this module the interface between the TPS monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_TPS data.
Within STATE_RBM_TPS, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
- Monitor disabled because of system malfunction (bit 1, not valid for TPS)
- Monitor indiv. RBM conditions encountered within this DC (bit 2 not valid for TPS)

Application conditions:

Initialisation :
at LV_DC 0 1 transition :
bit 0, bit 1 and bit 2 of STATE_RBM_TPS = 0
on failure memory reset :
bit 1 of STATE_RBM_TPS = 0
Recurrence: 1 s
Activation: LV_DC 0 1 transition **and** LV_DC = 1

Formula section:

If bit 0 of STATE_RBM_TPS = 0
Then **If** LV_END_DIAG_MTC_CTL_3 = 1 **and**
LV_END_DIAG_TPS_AD_BOL = 1 **and**
LV_END_DIAG_TPS_AD = 1
Then bit 0 of STATE_RBM_TPS = 1
Endif
Endif
bit 2 of STATE_RBM_TPS = 1 (no individual RBM conditions)

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A.125 Torque request for safety diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ABC_TQI_REQ_LIM	O/V	0... FFFF H	0... 65535	1	-
counter for torque request for safety is active					
LV_ERR_TQI_LIM	O/V	0... 1H	0 ...1	1	-
Error flag torque request for safety is active					

Input data:

LV_ES {p. 1720}	LV_IGK {p. 906}	LV_MTC_CUR_OFF {p. 6565}	LV_TQ_LIM_INTV {p. 6692}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TQI_LIM	-	0... FF H	0... 255	1	-
increment counter for torque request for safety					
C_ABC_MAX_TQI_LIM	-	0... FFFF H	0... 65535	1	-
maximum counter for torque request for safety					

FUNCTION DESCRIPTION:

General information:

The objective of this function is to determine the number of intervention actions concerning the torque request for safety and to set the failure table entry depending on LV_ERR_TQI_LIM if the counter exceeds a calibratable threshold.
The monitoring level generates a desired indicated torque TQI_SP_MON. If the actual torque TQI_REF_IGA_LAMB exceeds this value for more than a calibratable threshold a torque demand for the slow and the fast path is generated. The flag LV_TQ_LIM_INTV shows whether this torque intervention is active or not (see chapter D - "Torque request for safety").
LV_ERR_TQI_LIM.

Description:

The counter is initialized with zero for ECU reset, ignition key off, engine starts and engine stops. Otherwize it is incremented, if LV_TQ_LIM_INTV is active.

Application conditions

Activation: LV_IGK = 1 **and** LV_ES = 0 **and** LV_MTC_CUR_OFF = 0

Deactivation: *LV_MTC_CUR_OFF == 1*

Initialization: 0
by: ECU reset
OR LV_IGK == 0
OR LV_ES == 1

Recurrence: 100 ms

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Formula section:

IF LV_TQ_LIM_INTV == 1
THEN LV_ERR_TQI_LIM = 1 after debounce
ELSE the debounce counter (CTR_ABC_TQI_LIM) is set to 0.
ENDIF

Description:

Error-symptoms are defined to this diagnosis function as following:

```
□□□□
| | | └> -                                      (= SYM_0)
| | └──> -                                      (= SYM_1)
| └────> -                                      (= SYM_2)
└──────> -    Engine Torque implausible         (= SYM_3)
```

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A.126 Automatic gear shift signal diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_GS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom GS					
LV_CDN_DIAG_GS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition GS					
LV_END_DIAG_GS	O/V	0... 1H	0 ...1	1	-
End of diagnosis cycle GS diagnosis					
LV_ERR_GS	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on GS					
STATE_DIAG_GS	O/V	0... FFH	0... 255	1	-
Satus of GS diagnosis for feedback to gearbox					

Input data:

LV_AT {p. 654}	LV_CDN_VB_OBD1 {p. 1185}	LV_DC {p. 5746}	LV_DC_RBM {p. 5858}
LV_ERR_CFM [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_MEM_XX {p. 5767}	LV_IGK {p. 906}	LV_MIL_REQ_ETCU {p. 1566}
LV_VAR_BN {p. 655}	LV_VAR_TCT {p. 656}	LV_WUP_CYC {p. 5746}	STATE_ETCU_OBD {p. 1574}
WAL_CONF_XX {p. 5811}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_GS	-	0... FFH	0... 255	1	-
Anti bounce decrement for GS diagnosis					
C_ABC_INC_GS	-	0... FFH	0... 255	1	-
Anti bounce increment for GS diagnosis					
C_ABC_MAX_GS	-	1... FFH	1... 255	1	-
Anti bounce maximum for GS diagnosis					
LC_ETCU_FRF	-	0... 1H	0 ...1	1	-
Logical constant for storing freeze frame for ETCU (1 = FRF stored for ETCU)					
LC_VAR_GS_EOBD	-	0... 1H	0 ...1	1	-
Logical constant for variant EOBD (=1) or US (=0)					

Import actions:

ACTION_ERRM_ReadFrfByDtc (**IN**<PRM_TYPEOFFF>,**IN**<PRM_FFIDENTIFIER>,**IN**<PRM_DTCIDENTIFIER>,**IN**<PRM_LEVELOFDTC>,**INOUT**<PRM_FRF>,**OUT**<PRM_RESULTFRF>)

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FUNCTION DESCRIPTION:

General information:

The diagnosis is performed for AT or TCT vehicles in order to manage the OBD requirement which is defined by law (MIL activation and Freeze - frame storage).
Depending of CAN 12H /11H and TCT/AT and LC_ETCU_FRF the diagnosis is performed in a different way.

Description:

- Request of Gearbox to ECU: STATE_ETCU_OBD
- Response from ECU to Gearbox: STATE_DIAG_GS

Calculation of STATE_DIAG_GS (only first 3 bits, only valid for LC_ETCU_FRF = 1):

	Case 1	**Case 2**	**Case 3**	**Case 4**
Init	No FRF **000**	FRF not from GS **001**	FRF from GS **010**	FRF from GS **010**
Event	GS error	GS error	OBD error	OBD error with higher prior (FSD / MSF)
Result	FRF from GS **010**	FRF not from GS **001**	FRF from GS **010**	FRF from OBD error **001** (next DC)

Application conditions

Initialisation: according ABC configuration **"STD_INI"** + NLC_ABC_CAL_DEC_GS = 1
STATE_DIAG_GS = 0 at LV_IGK 0->1 **or** reset **or** at clearing error memory

Recurrence: *10ms*

Activation:

```
If    (LV_AT = 1 or  LV_VAR_TCT = 1)   and
       LV_CDN_VB_OBD1 = 1
  Then  LV_CDN_DIAG_GS = 1
  Else   LV_CDN_DIAG_GS = 0
 Endif
Dectivation:        If     LV_AT = 0 and  LV_VAR_TCT = 0
 Then  LV_END_DIAG_GS = 1     //always set for readiness CARB_CC
     LV_CDN_DIAG_GS = 0
 Endif
```

Formula section:

Calculation of STATE_DIAG_GS
If(1) LC_ETCU_FRF = 1
Then(1)
If LV_ERR_MEM_GS = 0 **and**
LV_ERR_GS = 0
ThenIf at least one LV_ERR_CFM[NC_NR_ERR_DYN]= 1 **and**
Bit 4 of WAL_CONF_XX of this error is calibrated
Then **If** LV_VAR_BN = 0
Then STATE_DIAG_GS = set bit (001 - - -) *//FRF stored for OBD error, 11H*
Else STATE_DIAG_GS = set bit (001 - -) *//FRF stored for OBD error, 12H*
Endif
Else **If** LV_VAR_BN = 0

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```
                 Then   STATE_DIAG_GS = set bit  ( 000 - - - )   //no FRF stored, 11H
                 Else   STATE_DIAG_GS = set bit  ( 000 - - )   //no FRF stored, 12H
                 Endif
ElseIf         LV_ERR_GS   0->1      and                //request from EGS to store GS error
                 LV_ERR_MEM_GS (n-1) = 0              //not stored yet
Then           If        at least one LV_ERR_CFM[NC_NR_ERR_DYN] (n-1) = 1    and
                         Bit 4 of WAL_CONF_XX of this error is calibrated
                 Then    If        LV_VAR_BN = 0
                         Then   STATE_DIAG_GS = set bit  ( 001 - - - ) //FRF stored for OBD error, 11H
                         Else   STATE_DIAG_GS = set bit  ( 001 - - ) //FRF stored for OBD error, 12H
                         Endif
                 Else    If        LV_VAR_BN = 0
                          Then  STATE_DIAG_GS = set bit   (010 - - - )   //FRF stored for GS, 11H
                                Call of error memory to store LV_ERR_GS
                          Else  STATE_DIAG_GS = set bit   (010 - - )   //FRF stored for GS, 12H
                                Call of error memory to store LV_ERR_GS
                         Endif
                 Endif
ElseIf         LV_IGK 0->1 or reset
   Then    ACTION_ERRM_ReadFrfByDtc
                 If        Resp XX = GS           //FRF still stored for LV_ERR_GS
                 Then    If        LV_VAR_BN = 0
                         Then   STATE_DIAG_GS = set bits ( 010 - - - )    //FRF stored for GS, 11H
                         Else   STATE_DIAG_GS = set bits ( 010 - - )    //FRF stored for GS, 12H
                          Endif
                 Else    If        LV_VAR_BN = 0
                         Then   STATE_DIAG_GS = set bit  ( 001 - - - ) //FRF stored for OBD error, 11H
                         Else   STATE_DIAG_GS = set bit  ( 001 - - )  //FRF stored for OBD error, 12H
                         Endif
Else           no change of bits x in STATE_DIAG_GS (xxx - - )
Endif
Else(1)        If        LV_VAR_BN = 0
                 Then   STATE_DIAG_GS = set bit  ( 000 - - - ) //no FRF at all
                 Else   STATE_DIAG_GS = set bit  ( 000 - - )  //no FRF at all
                 Endif
Endif(1)

If     LV_DC = 1
ThenIf        LV_VAR_BN = 0
   Then  STATE_DIAG_GS = set bit  ( - - - 1 - - )   //Driving cycle active, 11H
   Else  STATE_DIAG_GS = set bit  ( - - - 1 - )   //Driving cycle active, 12H
   Endif
Endif

If     LV_WUP_CYC = 1
ThenIf        LV_VAR_BN = 0
      Then  STATE_DIAG_GS = set bit  (- - - - - 1 )   //Warm-up cycle active, 11H
   Else  STATE_DIAG_GS = set bit  (- - - - 1 )   //Warm-up cycle active, 12H
   Endif
Endif

If     LV_DC_RBM = 1
```

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ThenIf LV_VAR_BN = 0
Then STATE_DIAG_GS = set bit (- - - - 1-) *//RBM cycle active, 11H*
Endif
Endif
// Remark: in case of LV_VAR_BN = 1 the information of LV_DC_RBM is transmitted via CAN in a separate signal, not within STATE_DIAG_GS; for detailled information see CAN-messages BN2000

Calculation of STATE_ETCU_OBD
If(0) LV_VAR_TCT = 0
Then(0)
If(1a) LC_ETCU_FRF = 1
Then(1a)
If(1b) LC_VAR_GS_EOBD = 0
Then(1b) **If(2)**LV_AT = 1
Calculation is done for - EGS - Configuration US-market
Then(2)If STATE_ETCU_OBD = 0110 **or** 0100
Then ERR_SYM_GS = SYM_3
Anti-bounce counter increments, set LV_ERR_GS after debounce
Elseif STATE_ETCU_OBD = 0000 **or** 0010
Then ERR_SYM_GS = NO_SYM
Anti-bounce counter decrements with calibratable decrement,
reset LV_ERR_GS after debounce
Else no change
Endif

Endif(2)
Else(1b) **If(2a)** LV_AT = 1
Calculation is done for - EGS - Configuration EOBD
Then(2a)If STATE_ETCU_OBD = 0010
Then ERR_SYM_GS = SYM_3
Anti-bounce counter increments, set LV_ERR_GS after debounce
Elseif STATE_ETCU_OBD = 0000
Then ERR_SYM_GS = NO_SYM
Anti-bounce counter decrements with calibratable decrement,
reset LV_ERR_GS after debounce
Else no change
Endif
Endif(2a)
Endif(1b)
Else(1a)
If LV_AT = 1
Calculation is done for - EGS
Then **If** STATE_ETCU_OBD = 0100
Then ERR_SYM_GS = SYM_3
Anti-bounce counter increments, set LV_ERR_GS after debounce
Elseif STATE_ETCU_OBD = 0000
Then ERR_SYM_GS = NO_SYM
Anti-bounce counter decrements with calibratable decrement,
reset LV_ERR_GS after debounce
Else no change
Endif

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Endif
Endif(1a)
Else(0)
If LV_MIL_REQ_ETCU = 1
Then ERR_SYM_GS = SYM_3
Anti-bounce counter increments,
set LV_ERR_GS after debounce
Else ERR_SYM_GS = NO_SYM
Anti-bounce counter decrements with calibratable decrement,
reset LV_ERR_GS after debounce
Endif
Endif(0)

For the calculation of the LV_END_DIAG_GS, see "Anti-bounce-Algorithm, calculation of the end of diagnosis"

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A.127 Clutch switch diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_CS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected CS Symptom					
LV_CDN_DIAG_CS	O/V	0... 1H	0 ...1	1	-
Diagnosis condition CS					
LV_CS_DIAG	V	0... 1H	0 ...1	1	-
Flag set when vehicle was stopped = pre-condition for diagnosis cycle					
LV_CS_SWI	V	0... 1H	0 ...1	1	-
Flag set when CS change its state					
LV_END_DIAG_CS	O/V	0... 1H	0 ...1	1	-
End of CS diagnosis					
LV_ERR_CS	O/V	0... 1H	0 ...1	1	-
Active CS error					
T_MIN_MAF_CS_DIAG	V	0... FFH	0... 255	1	s
Minimum diagnosis time for MAF condition					

Input data:

C_VS_MIN_RUN {p. 1177}	LV_AT {p. 654}	LV_ERR_VS {p. 5021}	LV_ES {p. 1720}
LV_IGK {p. 906}	LV_IM_CS_PN {p. 852}	LV_ST {p. 1720}	LV_VAR_TCT {p. 656}
MAF {p. 8277}	N_32 {p. 1525}	VS {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_CS	-	0... FFH	0... 255	1	-
Anti bouce increment CS diagnosis					
C_ABC_MAX_CS	-	1... FFH	1... 255	1	-
Anti bouce maximum CS diagnosis					
C_MAF_CS_DIAG	-	0... FFFFH	0... 1389	21.2e-3	mg/stk
MAF threshold for error detection					
C_N_32_CS_DIAG	-	0... FFH	0... 8160	32	rpm
N32 threshold for error detection					
C_T_MIN_MAF_CS_DIAG	-	0... FFH	0... 255	1	s
Minimum diagnosis time for MAF condition					
C_VS_CS_DIAG	-	0... FFH	0... 255	1	km/h
Speed threshold for activation of diagnosis cycle					

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FUNCTION DESCRIPTION:

General information:

This module performs the diagnosis of the clutch switch. This is valid only in case of manual transmission.

The diagnosis is based on the verification of the presence of the expected clutch action to shift the gears necessary to bring the vehicle to a certain speed. It is highly improbable that the vehicle is accelerated several consecutive times to a certain speed with the clutch always depressed or never depressed.

Description:

If there s a a change in LV_IM_CS_PN, the CS is diagnosed as error-free and the diagnosis is switched off if end of diagnosis is reached.
If there s no change in LV_IM_CS_PN then each time the vehicle is stopped, the diagnosis is enabled. Until the vehicle gets to a certain speed, LV_IM_CS_PN is monitored for value change (clutch pedal actuation). If, for several times (Anti bounce is inrementing by one inrement per diagnosis cycle) the vehicle gets to speed and the clutch switch state has never changed (always 0 or 1) then a failure is recognized.
Depending of status LV_IM_CS_PN 0/1 at beginning of monitoring period there is the symtom OL/SCB or SCG.

Application conditions

Initialisation: *according filter type:* **"STD-INI"**, *all other outputs 0 at LV_IGK 0->1* ***or*** *reset* ***or*** *at clearing error memory*

Recurrence: 1s (10 ms for LV_IM_CS_PN detection)
Activation:
If LV_IGK = 0 **or**
LV_ES = 1 **or**
LV_ST = 1 **or**
LV_AT = 1 **or**
LV_VAR_TCT = 1 **or**
LV_END_DIAG_CS = 1 **or**
LV_ERR_VS = 1 *// VS error*
Then Function passive LV_CDN_DIAG_CS is reset to 0
Else Function active
Endif

Formula section:

LV_CDN_DIAG_CS = 0
Errorfree case: CS activitation detected:
If LV_IM_CS_PN switched once from 1 to 0 **or** 0 to 1 (managed each 10 ms)
Then LV_CDN_DIAG_CS = 1
ERR_SYM_CS = NO_SYM
LV_CS_SWI = 1
LV_END_DIAG_CS = 1 *Calculated by error management*
Else
Error case: High vahicle speed without CS activation
If VS ≤ C_VS_MIN_RUN *Init when vehicle is stopped*
Then LV_CS_DIAG = 1
Else **If** VS > C_VS_CS_DIAG **and**
MAF > C_MAF_CS_DIAG **and** *above zero no load line*
N_32 > C_N_32_CS_DIAG *out of idle speed*
Then increment T_MIN_MAF_CS_DIAG
If T_MIN_MAF_CS_DIAG >= C_T_MIN_MAF_CS_DIAG **and**
LV_CS_SWI = 0 **and** *the clutch did not switched*
LV_CS_DIAG = 1 *vehicle was stopped*

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Then LV_CDN_DIAG_CS = 1
If LV_IM_CS_PN = 1
Then ERR_SYM_CS = SYM_0
If LV_IM_CS_PN = 0
Then ERR_SYM_CS = SYM_1
Endif
LV_CS_DIAG = 0
// vehicle must stop again before next diagnosis CTR_ABC_CSn =CTR_ABC_CSn-1 + C_ABC_INC_CS only once
Else no Action
Endif
Else T_MIN_MAF_CS_DIAG = 0 *reset*
Endif
End if
Endif

Calculation of LV_END_DIAG_CS and LV_ERR_CS

LV_ERR_CS Calculated by error management : CTR_ABC_CS reach maximum
LV_END_DIAG_CS Calculated by error management

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A.128 Clutch switch diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_RBM_CS	O/V	0... 7H	0 ...7	1	-
Interface of CS monitor with the Rate-Based Monitoring statisticsBit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1)Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1)Bit 2: individual RBM condition					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_AT {p. 654}	LV_DC {p. 5746}	LV_END_DIAG_CS {p. 5015}
LV_ERR_VS {p. 5021}	LV_VAR_TCT {p. 656}		

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

FUNCTION DESCRIPTION:

General information:

With this module the interface between the CS monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_CS data.
Within STATE_RBM_CS, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)
  (not valid for CS diagnosis)

Application conditions:

Initialisation :
at LV_DC 0   1 transition :
bit 0, bit 1 and bit 2 of STATE_RBM_CS = 0
on failure memory reset :
bit 1 of STATE_RBM_CS = 0
Recurrence: 1 s
Activation: LV_DC 0   1 transition **and** LV_DC = 1

Formula section:

At LV_DC 0   1 transition
The pending status of the following failures has to be checked only once :

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LV_ERR_VS			

If(1) { CPU optimization at LV_DC 0   1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }
Then(1)
While bit 1 of STATE_RBM_CS = 0 **do**
with each XX failure of the above list :
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2)
bit 1 of STATE_RBM_CS = 1
Endif(2)
Endwhile
Else(1)
{ the dynamic failure memory is empty }
No action
Endif(1)
Every 1 s :
If bit 0 of STATE_RBM_CS = 0
Then **If** LV_END_DIAG_CS = 1 **or**
LV_AT = 1 **or**
LV_VAR_TCT = 1
Then bit 0 of STATE_RBM_CS = 1
Endif
Endif
If bit 1 of STATE_RBM_CS = 0
Then
If LV_ERR_VS = 1
Then bit 1 of STATE_RBM_CS = 1
Endif
Endif
bit 2 of STATE_RBM_CS = 1

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A.129 Vehicle speed signal diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_VS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected Symptom VS					
ERR_SYM_VS_BOL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
For each symptom: status of failure (set to 1 when failure symptom detected) for VS_BOL					
ERR_SYM_VS_GRD	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
For each symptom: status of failure (set to 1 when failure symptom detected) for VS_GRD					
ERR_SYM_VS_PLAUS_POW	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected Symptom VS_PLAUS_POW					
ERR_SYM_VS_PLAUS_STUCK	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
For each symptom: status of failure (set to 1 when failure symptom detected) for VS_PLAUS_STUCK					
ERR_SYM_VS_TOL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
For each symptom: status of failure (set to 1 when failure symptom detected) for VS_TOL					
LV_CDN_DIAG_VS	V	0... 1H	0 ...1	1	-
VS Diagnosis active (=1)					
LV_CDN_DIAG_VS_BOL	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled) for VS_BOL					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_VS_GRD	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled) for VS_GRD					
LV_CDN_DIAG_VS_PLAUS_POW	V	0... 1H	0 ...1	1	-
VS_PLAUS_POW Diagnosis active (=1)					
LV_CDN_DIAG_VS_PLAUS_STUCK	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled) for VS_PLAUS_STUCK					
LV_CDN_DIAG_VS_TOL	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled) for VS_TOL					
LV_END_DIAG_VS	O/V	0... 1H	0 ...1	1	-
End of VS Diagnosis					
LV_END_DIAG_VS_BOL	V	0... 1H	0 ...1	1	-
Diagnostic done completely at least one time for VS_BOL					
LV_END_DIAG_VS_GRD	V	0... 1H	0 ...1	1	-
Diagnostic done completely at least one time for VS_GRD					
LV_END_DIAG_VS_PLAUS_POW	O/V	0... 1H	0 ...1	1	-
End of VS_PLAUS_POW Diagnosis					
LV_END_DIAG_VS_PLAUS_STUCK	V	0... 1H	0 ...1	1	-
Diagnostic done completely at least one time for VS_PLAUS_STUCK					
LV_END_DIAG_VS_TOL	V	0... 1H	0 ...1	1	-
Diagnostic done completely at least one time for VS_TOL					
LV_ERR_SET_VS_PLAUS_POW	V	0... 1H	0 ...1	1	-
Boolean to set the symptom for no filter					
LV_ERR_VS	O/V	0... 1H	0 ...1	1	-
VS sensor error bit					
LV_ERR_VS_BOL	V	0... 1H	0 ...1	1	-
Present failure after filtering of diagnostic VS_BOL					
LV_ERR_VS_GRD	V	0... 1H	0 ...1	1	-
Present failure after filtering of diagnostic VS_GRD					
LV_ERR_VS_PLAUS	O/V	0... 1H	0 ...1	1	-
VS plaus sensor error bit					
LV_ERR_VS_PLAUS_POW	V	0... 1H	0 ...1	1	-
VS_PLAUS_POW sensor error bit					
LV_ERR_VS_PLAUS_STUCK	V	0... 1H	0 ...1	1	-
Present failure after filtering of diagnostic VS_PLAUS_STUCK					
LV_ERR_VS_TOL	V	0... 1H	0 ...1	1	-
Present failure after filtering of diagnostic VS_TOL					
LV_VS_BOL	V	0... 1H	0 ...1	1	-
VS_BOL Diagnosis active (=1)					
LV_VS_STUCK	V	0... 1H	0 ...1	1	-
VS_STUCK diagnosis active(=1)					
T_VS_BOL	V	0... FFH	0... 25.5	0.1	s
Debounce counter for diagnosis of VS_BOL					
T_VS_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
Time counter for error detection					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_VS_END_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
Time counter for end of diagnosis					
T_VS_STUCK	V	0... FFH	0... 25.5	0.1	s
Debounce counter for start of diagnosis for VS_PLAUS_STUCK					

Input data:

LV_AT {p. 654}	LV_ERR_COM_1_BOFF {p. 800}	LV_ERR_COM_1_ST_UP {p. 800}	LV_ERR_COM_1_VS {p. 800}
LV_ES {p. 1720}	LV_IGK {p. 906}	LV_LDM_ACT {p. 6615}	LV_ST_END {p. 1720}
N {p. 1525}	N_WHEEL_RE_LE {p. 806}	N_WHEEL_RE_RI {p. 806}	PV_AV {p. 1269}
STATE_CC {p. 1571}	STATE_CC_ETCU	STATE_ENG {p. 1720}	STATE_VEH_ROLL_CDN {p. 809}
T_AST {p. 1766}	TQ_AV {p. 6656}	VS {p. 1176}	VS_HIGH_RES {p. 811}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_VS	V	0... FFH	0... 255	1	-
ABC Increment value for VS diagnosis					
C_ABC_INC_VS_BOL	V	0... FFH	0... 255	1	-
Anti bounce counter increment of diagnostic instance VS_BOL					
C_ABC_INC_VS_GRD	V	0... FFH	0... 255	1	-
Anti bounce counter increment of diagnostic instance VS_GRD					
C_ABC_INC_VS_PLAUS_STUCK	V	0... FFH	0... 255	1	-
Anti bounce counter increment of diagnostic instance VS_PLAUS_STUCK					
C_ABC_INC_VS_TOL	V	0... FFH	0... 255	1	-
Anti bounce counter increment of diagnostic instance VS_TOL					
C_ABC_MAX_VS	V	1... FFH	1... 255	1	-
ABC Maximum value for VS diagnosis					
C_ABC_MAX_VS_BOL	V	1... FFH	1... 255	1	-
Maximum value for anti bounce counter of diagnostic instance VS_BOL					
C_ABC_MAX_VS_GRD	V	1... FFH	1... 255	1	-
Maximum value for anti bounce counter of diagnostic instance VS_GRD					
C_ABC_MAX_VS_PLAUS_STUCK	V	1... FFH	1... 255	1	-
Maximum value for anti bounce counter of diagnostic instance VS_PLAUS_STUCK					
C_ABC_MAX_VS_TOL	V	1... FFH	1... 255	1	-
Maximum value for anti bounce counter of diagnostic instance VS_TOL					
C_N_VS_MIN_DIAG_AT	V	0... 1FE0H	0... 8160	1	rpm
Engine speed condition - vehicle speed diagnosis, AT vehicle					
C_N_VS_MIN_DIAG_MT	V	0... 1FE0H	0... 8160	1	rpm
Engine speed condition - vehicle speed diagnosis, MT vehicle					
C_N_WHEEL_MAX_DIF	V	8000... 7FFFH	-512... 511.984375	0.015625	rad/s
maximum difference between rear wheels on the roller test bench					
C_PV_AV_MAX_VS_GRD	V	0... FFH	0... 99.609375	0.390625	%
Maximum Pedal Value for Vehicle speed gradient diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_PV_AV_MIN_VS_GRD	V	0... FFH	0... 99.609375	0.390625	%
Minimum Pedal Value for Vehicle speed gradient diagnosis					
C_SEL_ENG_STATE_AT	V	1... 5H	1 ...5	1	-
Engine state selection for VS_BOL diagnosis for AT					
C_SEL_ENG_STATE_MT	V	1... 5H	1 ...5	1	-
Engine state selection for VS_BOL diagnosis for MT					
C_T_MAX_VS_BOL_AT	V	0... FFH	0... 25.5	0.1	s
Max. counter of VS_BOL diagnosis for AT					
C_T_MAX_VS_BOL_MT	V	0... FFH	0... 25.5	0.1	s
Max. counter of VS_BOL diagnosis for MT					
C_T_MAX_VS_STUCK_AT	V	0... FFH	0... 25.5	0.1	s
Max. counter for diagnosis of VS stuck signal with AT					
C_T_MAX_VS_STUCK_MT	V	0... FFH	0... 25.5	0.1	s
Max. counter for diagnosis of VS stuck signal with MT					
C_T_VS_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
Time counter for error detection					
C_T_VS_MIN_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
Time condition - vehicle speed diagnosis					
C_THD_N_VS_PLAUS_AT	V	0... 1FE0H	0... 8160	1	rpm
Threshold for the engine speed change for VS diagnosis with AT					
C_THD_N_VS_PLAUS_MT	V	0... 1FE0H	0... 8160	1	rpm
Threshold for the engine speed change for VS diagnosis with MT					
C_THD_TQ_AV_VS_PLAUS_AT	V	0... FFH	0... 510	2	Nm
Threshold for change in the actual torque at clutch for VS diagnosis with AT					
C_THD_TQ_AV_VS_PLAUS_MT	V	0... FFH	0... 510	2	Nm
Threshold for change in the actual torque at clutch for VS diagnosis with MT					
C_TQ_AV_MAX_VS_GRD	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum Actual Torque required for Vehicle speed gradient diagnosis					
C_TQ_AV_MIN_VS_GRD	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Minimum Actual Torque required for Vehicle speed gradient diagnosis					
C_TQ_AV_VS_MIN_DIAG_AT	V	0... FFH	0... 510	2	Nm
TQ_AV condition - vehicle speed diagnosis, AT vehicle					
C_TQ_AV_VS_MIN_DIAG_MT	V	0... FFH	0... 510	2	Nm
TQ_AV condition - vehicle speed diagnosis, MT vehicle					
C_VS_BOL_MIN_DIAG	V	0... FFH	0... 255	1	km/h
Minimum vehicle speed to start VS_BOL diagnosis					
C_VS_MAX_ERR_PUC_AT	V	0... FFH	0... 255	1	km/h
VS-Schwelle, bei der beim Unterschreiten in PU/PUC ein Fehler eingetragen wird for AT					
C_VS_MAX_ERR_PUC_MT	V	0... FFH	0... 255	1	km/h
VS-Schwelle, bei der beim Unterschreiten in PU/PUC ein Fehler eingetragen wird for MT					
C_VS_MAX_GRD	V	0... 7FFFH	0... 327.67	0.01	km/h
Maximum gradient threshold for vehicle speed variation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VS_MAX_WIN	V	0... 7FFFH	0... 327.67	0.01	km/h
Maximum threshold window for vehicle speed variation					
C_VS_MIN_DIAG_GRD	V	0... FFH	0... 255	1	km/h
Speed threshold to enable the diagnosis					
C_VS_MIN_GRD	V	0... 7FFFH	0... 327.67	0.01	km/h
Minimum gradient threshold for vehicle speed variation					
C_VS_MIN_WIN	V	0... 7FFFH	0... 327.67	0.01	km/h
Minimum threshold window for vehicle speed variation					
C_VS_TOL_DIAG	V	0... 7FFFH	0... 327.67	0.01	km/h
Plausible maximum speed threshold for top limit speed error detection					
CLF_VS_PLAUS_ENA	V	0... FFH	0... 255	1	-
Bit-wise enabling of Vehicle speed plausibility diagnosis (0:Plausibility check, 1:Top limit check, 2:Bottom limit check,3.:Gradient check, 4:Stuck signal check enabled)					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_VS	-	0... FFFFH	0... 65535	1	-
ERRM diagnosis identifier of vehicle speed diagnosis					
NC_IDX_DIAG_VS_BOL	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance VS_BOL					
NC_IDX_DIAG_VS_GRD	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance VS_GRD					
NC_IDX_DIAG_VS_PLAUS_POW	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostics instance VS_PLAUS_POW					
NC_IDX_DIAG_VS_PLAUS_STUCK	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance VS_PLAUS_STUCK					
NC_IDX_DIAG_VS_TOL	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance VS_TOL					

Error treatment

Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
NC_IDX_DIAG_VS_PLAUS_POW	-	0			NO_FIL	CC
Failure index for diagnostics instance VS_PLAUS_POW	-	1				
	-	2				
	Vehicle speed not plausible	3				

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Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
NC_IDX_DIAG_VS_TOL	Vehicle speed top limit implausible	0			MEM	CC
Failure index for diagnostic instance VS_TOL		1				
		2				
		3				

Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
NC_IDX_DIAG_VS_BOL	Vehicle speed bottom limit implausible	0			MEM	CC
Failure index for diagnostic instance VS_BOL		1				
		2				
		3				

Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
NC_IDX_DIAG_VS_GRD	Vehicle speed gradient implausible	0			MEM	CC
Failure index for diagnostic instance VS_GRD		1				
		2				
		3				

Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
NC_IDX_DIAG_VS_PLAUS_STUCK	Vehicle speed frozen	0			MEM	CC
Failure index for diagnostic instance VS_PLAUS_STUCK		1				
		2				
		3				

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Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
NC_IDX_DIAG_VS	-	0			STD_INI	CC
ERRM diagnosis identifier of vehicle speed diagnosis	-	1				
	no vehicle speed signal	2				
	-	3				

General information

A.129.1 Plausibility check of VS signal

General information:

An vehicle speed signal error is detected if at calibratable engine speed-, mass air flow- and time thresholds the vehicle speed signal VS = 0. Depending if the vehicle is MT /AT different calibration data a applied (If LV_AT = 1 then _AT are used, else _MT are used).

If (vehicle speed VS = 0 **or** testbenchdetection with different rotation at the rearwheels) **and** engine speed N >= C_N_VS_MIN_DIAG_AT /_MT **and** (converterclutch is closed **or** manual-gearbox) **and** actual torque TQ_AV >= C_TQ_AV_VS_MIN_DIAG_AT /_MT the time counter T_VS_DIAG is started. The vehicle speed signal error bit LV_ERR_VS_PLAUS is set to 1 **if** T_VS_DIAG >= C_T_VS_MIN_DIAG.

Application conditions:

Initialisation:

```
The configuration is NO_FIL
(=> all 0 at LV_IGK 0->1 or  reset or  clearing error memory)
LV_CDN_DIAG_VS_PLAUS_POW = 0
LV_ERR_SET_VS_PLAUS_POW  = 0
ERR_SYM_VS_PLAUS_POW     = 0
LV_END_DIAG_VS_PLAUS_POW = 0
T_VS_DIAG                = 0
T_VS_END_DIAG            = 0


At reset:
This action erases filter data :
ACTION_ERRM_NoFilterReset( IN<NC_IDX_DIAG_VS_PLAUS_POW >,
OUT< LV_ERR_VS_PLAUS_POW >)
```

Activation:

```
LV_IGK              = 1  and
LV_ERR_VS_PLAUS     = 0  and
CLF_VS_PLAUS_ENA bit 0 = 1
```

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Deactivation: When activation not met
Following should be updated during de-activation
LV_CDN_DIAG_VS_PLAUS_POW = 0
ERR_SYM_VS_PLAUS_POW = NO_SYM

Recurrence: 100 ms

Function description:

Formula section:

```
Timer start:

If   N >= C_N_VS_MIN_DIAG_AT /  _MT           and
     (STATE_CC = 2 or LV_AT = 0)             and
     TQ_AV >= C_TQ_AV_VS_MIN_DIAG_AT / _MT   and
     LV_INH_DIAG_VS_PLAUS = 0
Then
     If(2) VS = 0                            or
          (STATE_VEH_ROLL_CDN = 4            and
          |N_WHEEL_RE_LE - N_WHEEL_RE_RI | > C_N_WHEEL_MAX_DIF)
     Then(2)
          T_VS_END_DIAG = 0
          If  T_VS_DIAG < C_T_VS_DIAG
          Then
               LV_CDN_DIAG_VS_PLAUS_POW = 0
               T_VS_DIAG++
          Else
               LV_CDN_DIAG_VS_PLAUS_POW = 1
               ERR_SYM_VS_PLAUS_POW     = SYM_3
               LV_END_DIAG_VS_PLAUS_POW = 1
               LV_ERR_SET_VS_PLAUS_POW  = 1
//Once the LV_ERR_VS_PLAUS_POW is set, should be reset only LV_IGK 0- ->1
          Endif
     Else(2)
          T_VS_DIAG = 0
          ERR_SYM_VS_PLAUS_POW      = NO_SYM
          If  T_VS_END_DIAG < C_T_VS_DIAG
          Then
               LV_CDN_DIAG_VS_PLAUS_POW = 0
               T_VS_END_DIAG++
          Else
               LV_CDN_DIAG_VS_PLAUS_POW = 1
                            LV_ERR_SET_VS_PLAUS_POW  = 0
               LV_END_DIAG_VS_PLAUS_POW = 1
          Endif
     Endif(2)
Else
     LV_CDN_DIAG_VS_PLAUS_POW = 0
     ERR_SYM_VS_PLAUS_POW     = NO_SYM
     T_VS_DIAG                = 0
     T_VS_END_DIAG            = 0
Endif

For error management treatment the following action is called:
ACTION_ERRM_NoFilterSymptom(IN< NC_IDX_DIAG_VS_PLAUS_POW >,
IN<LV_CDN_DIAG_VS_PLAUS_POW >, IN<ERR_SYM_VS_PLAUS_POW >,
IN< LV_ERR_SET_VS_PLAUS_POW >, IN< 0 >, IN<LV_END_DIAG_VS_PLAUS_POW>, OUT<
LV_ERR_VS_PLAUS_POW > )
```

A.129.2 Top limit check of the vehicle speed signal, ’VS_TOL’

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General information:

A range check is carried out to determine if the vehicle speed exceeds the plausible maximum threshold. As such the diagnosis instance VS_TOL contains one error symptom:

- Signal out of range **VS_TOL**

The general error treatment is described in the chapters “ABC algorithm” and “Dynamic Error Management”: environmental data, DTC, error classes (priority assignment, lamp management), communication interface, etc..

Application conditions:

Initialisation: The configuration is MEM
(=> all 0 at LV_IGK 0->1 or reset or clearing error memory)

Activation:
```
LV_IGK              = 1 and
LV_ERR_VS_PLAUS     = 0 and
CLF_VS_PLAUS_ENA bit 1 = 1
```

Deactivation: When activation condition does not met

```
Following should be updated during de-activation
LV_CDN_DIAG_VS_TOL = 0
ERR_SYM_VS_TOL     = NO_SYM
```

Recurrence: 100 ms

Function description:

Formula section:

```
If  VS > 0
Then
    LV_CDN_DIAG_VS_TOL = 1
    If  VS_HIGH_RES > C_VS_TOL_DIAG
    Then
        ERR_SYM_VS_TOL = SYM_0
    Else
        ERR_SYM_VS_TOL = NO_SYM
    Endif
Else
    LV_CDN_DIAG_VS_TOL = 0
Endif
```

For failure and error management treatment the anti-bounce mechanism is called :

```
ACTION_ERRM_FilterSymptom(IN< NC_IDX_DIAG_VS_TOL >,
IN< LV_CDN_DIAG_VS_TOL>, IN< ERR_SYM_VS_TOL >, IN< C_ABC_INC_VS_TOL >, IN<
1 >, IN< C_ABC_MAX_VS_TOL >, OUT< LV_ERR_VS_TOL > )
```

A.129.3 Bottom Limit check of the vehicle speed signal, ’VS_BOL’

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General information:

A plausibility check is carried out to determine if the observed vehicle speed is plausible for the given engine conditions (PU or PUC mode). In the engine states PU or PUC the vehicle speed may not be below calibratable threshold. As such the diagnosis instance VS_BOL contains one error symptom:

- BOL check in PU/PUC mode fails **VS_BOL**

The general error treatment is described in the chapters “ABC algorithm” and “Dynamic Error Management”: environmental data, DTC, error classes (priority assignment, lamp management), communication interface, etc..

Application conditions:

Initialisation:
```
The configuration is MEM
(=> all 0 at LV_IGK 0->1 or reset or clearing error memory)
Except:  LV_VS_BOL = 1
```

Activation:
```
LV_IGK                  = 1 and
LV_ERR_VS_PLAUS         = 0 and
VS > C_VS_BOL_MIN_DIAG   and
CLF_VS_PLAUS_ENA bit 2 = 1
```

Deactivation:
```
When activation condition does not met

Following should be updated during de-activation
LV_CDN_DIAG_VS_BOL = 0
ERR_SYM_VS_BOL      = NO_SYM
```

Recurrence:
```
100 ms
```

Function description:

Formula section:

```
If    Case 1:  C_SEL_ENG_STATE_MT/ _AT = 1
    STATE_ENG = "PU"

    Case 2:  C_SEL_ENG_STATE_MT/ _AT = 2
    STATE_ENG = "PUC"

    Case 3:  C_SEL_ENG_STATE_MT/ _AT = 3
    STATE_ENG = "PU" OR
    STATE_ENG = "PUC"
Then
    If  T_VS_BOL < C_T_MAX_VS_BOL_AT/ _MT //Separate cal for AT/ MT
    Then
        LV_CDN_DIAG_VS_BOL = 0
        T_VS_BOL++
        If  VS >  C_VS_MAX_ERR_PUC_AT/ _MT  //Separate cal for AT/ MT
        Then
             LV_VS_BOL = 0
        Endif
    Else
        LV_CDN_DIAG_VS_BOL = 1
        If  LV_VS_BOL = 1
```

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```
        Then
            ERR_SYM_VS_BOL     = SYM_0
        Else
            ERR_SYM_VS_BOL     = NO_SYM
       Endif
       T_VS_BOL = 0
       LV_VS_BOL = 1
    Endif
Else
    LV_CDN_DIAG_VS_BOL = 0
    ERR_SYM_VS_BOL = NO_SYM
    T_VS_BOL = 0
    LV_VS_BOL = 1
Endif
```

For failure and error management treatment the anti-bounce mechanism is called :

```
ACTION_ERRM_FilterSymptom( IN< NC_IDX_DIAG_VS_BOL >,
IN< LV_CDN_DIAG_VS_BOL >, IN< ERR_SYM_VS_BOL >, IN< C_ABC_INC_VS_BOL >,
IN< 1 >, IN< C_ABC_MAX_VS_BOL >, OUT< LV_ERR_VS_BOL > )
```

A.129.4 Gradient check for vehicle speed signal ’VS_GRD’

General information:

A speed gradient check is carried out, if speed changes for more than C_VS_MAX_GRD within 100ms. It will be calibrated to a value which is physically not possible to reach with the acceleration of the vehicle. So if the value is ever reached, it means we have a problem with the speed signal.

- Unrealistic gradient signal **VS_GRD**

The general error treatment is described in the chapters “ABC algorithm” and “Dynamic Error Management”: environmental data, DTC, error classes (priority assignment, lamp management), communication interface, etc..

Application conditions:

Initialisation: The configuration is **MEM**
(=> all 0 at LV_IGK 0->1 or reset or clearing error memory)

VS_HIGH_RES_TMP = 0

Activation:
LV_IGK = 1 **and**
LV_ERR_VS_PLAUS = 0 **and**
CLF_VS_PLAUS_ENA bit 3 = 1

Deactivation: When activation condition does not met

Following should be updated during de-activation
LV_CDN_DIAG_VS_GRD = 0
ERR_SYM_VS_GRD = NO_SYM

Recurrence: 100 ms

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Function description:

Formula section:

```
If  VS > C_VS_MIN_DIAG_GRD      and
    TQ_AV > C_TQ_AV_MIN_VS_GRD  and
    TQ_AV < C_TQ_AV_MAX_VS_GRD and
    PV_AV > C_PV_AV_MIN_VS_GRD  and
    PV_AV < C_PV_AV_MAX_VS_GRD
Then
    LV_CDN_DIAG_VS_GRD = 1
Else
    LV_CDN_DIAG_VS_GRD = 0
Endif

If  LV_CDN_DIAG_VS_GRD = 1
Then
    If  VS_HIGH_RES  > VS_HIGH_RES_TMP + C_VS_MAX_GRD or
        VS_HIGH_RES < VS_HIGH_RES_TMP - C_VS_MIN_GRD
    Then
        ERR_SYM_VS_GRD  = SYM_0
    Else
        ERR_SYM_VS_GRD  = NO_SYM
    Endif
Endif
VS_HIGH_RES_TMP = VS_HIGH_RES (memorize vehicle speed in temporary variable)

For failure and error management treatment the anti-bounce mechanism is called
:

ACTION_ERRM_FilterSymptom( IN< NC_IDX_DIAG_VS_GRD >, IN< LV_CDN_DIAG_VS_GRD
>, IN< ERR_SYM_VS_GRD >, IN< C_ABC_INC_VS_GRD >, IN< 1 >,
IN< C_ABC_MAX_VS_GRD >, OUT< LV_ERR_VS_GRD > )
```

A.129.5 Plausibility check for stuck vehicle speed signal 'VS_PLAUS_STUCK'

General information:

A plausibility check for vehicle speed stuck signal is carried out with reference to engine load change. When there is a significant change of engine load, but vehicle speed signal lies within a small calibratable window for calibratable duration and once the counter elapses without speed change vehicle speed signal will be declared as stuck.

- Vehicle speed stuck signal **VS_PLAUS_STUCK**

The general error treatment is described in the chapters “ABC algorithm” and “Dynamic Error Management”: environmental data, DTC, error classes (priority assignment, lamp management), communication interface, etc..

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Application conditions:

Initialisation:

```
The configuration is MEM
(=> all 0 at LV_IGK 0->1 or reset or clearing error memory)

N0        = 0
TQ_AV0  = 0
VS_HIGH_RES0= 0
T_VS_STUCK   = 0
LV_VS_STUCK = 1
```

Activation:

```
LV_IGK                    = 1 and
LV_ERR_VS_PLAUS           = 0 and
LV_ST_END                 = 1 and
T_AST >= C_T_VS_MIN_DIAG    and
CLF_VS_PLAUS_ENA bit 4      = 1
```

Deactivation:

```
When activation condition does not met

Following should be updated during de-activation
LV_CDN_DIAG_VS_PLAUS_STUCK = 0
ERR_SYM_VS_PLAUS_STUCK     = NO_SYM
```

Recurrence: 100 ms

Function description:

Formula section:

```
If  LV_ES                  = 0 and
    LV_INH_DIAG_VS_PLAUS = 0  and
    LV_LDM_ACT             = 0 and
    VS_HIGH_RES             > 0 and
    (STATE_CC = 2H(CLOSED) or LV_AT = 0)
Then
    If  |N -N0| >= C_THD_N_VS_PLAUS_AT/ _MT  and     //Separate cal for AT/ MT
        TQ_AV-TQ_AV0| >= C_THD_TQ_AV_VS_PLAUS_AT/ _MT
    Then
        If  T_VS_STUCK < C_T_MAX_VS_STUCK_AT/ _MT
        Then
            LV_CDN_DIAG_VS_PLAUS_STUCK = 0
            T_VS_STUCK ++
            If VS_HIGH_RES >  VS_HIGH_RES0  + C_VS_MAX_WIN or
               VS_HIGH_RES <  VS_HIGH_RES0  - C_VS_MIN_WIN
                                           //speed change detected
            Then  LV_VS_STUCK = 0
            Endif
        Else
            LV_CDN_DIAG_VS_PLAUS_STUCK = 1
            If  LV_VS_STUCK = 1
            Then
                ERR_SYM_VS_PLAUS_STUCK = SYM_0
            Else
                ERR_SYM_VS_PLAUS_STUCK = NO_SYM
            Endif
            T_VS_STUCK = 0 (restart diagnosis)
```

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```
        Endif
    Else
        LV_CDN_DIAG_VS_PLAUS_STUCK = 0
        ERR_SYM_VS_PLAUS_STUCK     = NO_SYM
        T_VS_STUCK                 = 0 (restart diagnosis)
    Endif
Else
    LV_CDN_DIAG_VS_PLAUS_STUCK = 0
    ERR_SYM_VS_PLAUS_STUCK = NO_SYM
    T_VS_STUCK = 0
Endif

ACTION_ERRM_FilterSymptom( IN< NC_IDX_DIAG_VS_PLAUS_STUCK >,
IN<LV_CDN_DIAG_VS_PLAUS_STUCK>,IN< ERR_SYM_VS_PLAUS_STUCK >,
IN<C_ABC_INC_VS_PLAUS_STUCK>, IN< 1>,
IN<C_ABC_MAX_VS_PLAUS_STUCK>, OUT<LV_ERR_VS_PLAUS_STUCK > )

If   T_VS_STUCK    = 0 (restart diagnosis)
Then N0            = N
     TQ_AV0        = TQ_AV
     VS_HIGH_RES0  = VS_HIGH_RES
     LV_VS_STUCK   = 1
Endif
```

A.129.6 Emission relevant VS error or missing Flexray signal

General information:

LV_ERR_VS is set if no VS signal is available from ECU-PIN (L4-Projects) or flexray (L6-Projects)

Application conditions:

Initialisation: The configuration is **STD_INI**
(=> all 0 at LV_IGK 0->1 ***or*** *reset* ***or*** *clearing error memory)*

Activation: LV_IGK = 1

Deactivation: When activation condition does not met

Following should be updated during de-activation
LV_CDN_DIAG_VS = 0
ERR_SYM_VS   = NO_SYM

Recurrence: 100 ms

Function description:

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Formula section:

```
If   ((LV_END_DIAG_VS_PLAUS_POW   = 1 or CLF_VS_PLAUS_ENA bit 0 = 0)  and
     (LV_END_DIAG_VS_TOL          = 1 or CLF_VS_PLAUS_ENA bit 1 = 0)  and
     (LV_END_DIAG_VS_BOL          = 1 or CLF_VS_PLAUS_ENA bit 2 = 0)  and
     (LV_END_DIAG_VS_GRD          = 1 or CLF_VS_PLAUS_ENA bit 3 = 0)  and
     (LV_END_DIAG_VS_PLAUS_STUCK = 1  or CLF_VS_PLAUS_ENA bit 4 = 0))  or
     LV_ERR_VS_PLAUS_POW          = 1 or
     LV_ERR_VS_TOL                = 1 or
     LV_ERR_VS_BOL                = 1 or
     LV_ERR_VS_GRD                = 1 or
     LV_ERR_VS_PLAUS_STUCK        = 1  or
     LV_ERR_COM_1_VS              = 1 or
     LV_ERR_COM_1_BOFF            = 1 or
     LV_ERR_COM_1_ST_UP           = 1
Then
     LV_CDN_DIAG_VS = 1
Else
     LV_CDN_DIAG_VS = 0
Endif

If   LV_CDN_DIAG_VS = 1              AND
     (LV_ERR_VS_PLAUS_POW         = 1 or
     LV_ERR_VS_TOL               = 1 or
     LV_ERR_VS_BOL               = 1 or
     LV_ERR_VS_GRD               = 1 or
     LV_ERR_VS_PLAUS_STUCK       = 1  or
     LV_ERR_COM_1_VS             = 1 or
     LV_ERR_COM_1_BOFF           = 1 or
     LV_ERR_COM_1_ST_UP          = 1 )
Then
     LV_ERR_VS_PLAUS             = 1
     ERR_SYM_VS                  = SYM_2
Else
     LV_ERR_VS_PLAUS             = 0
     ERR_SYM_VS                  = NO_SYM
Endif
```

For failure and error management treatment the anti-bounce mechanism is called :

```
ACTION_ERRM_FilterSymptom( IN< NC_IDX_DIAG_VS >, IN< LV_CDN_DIAG_VS >,
IN< ERR_SYM_VS >, IN< C_ABC_INC_VS >, IN< 1 >,IN< C_ABC_MAX_VS >,
OUT< LV_ERR_VS > )
```

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A.130 Vehicle speed signal diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_VS_PLAUS	O/V	0... 1H	0 ...1	1	-
Activation condition for VS_PLAUS diagnosis					
STATE_RBM_VS_PLAUS	O/V	0... 7H	0 ...7	1	-
RBM interface for VS_PLAUS diagnosis					

Input data:

LV_DC {p. 5746}	LV_END_DIAG_VS {p. 5021}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}
LV_ERR_AMP_PLAUS_CUS {p. 1061}	LV_ERR_CAM_CST_IVVT_EX_1	LV_ERR_CAM_CST_IVVT_EX_2	LV_ERR_CAM_CST_IVVT_IN_1
LV_ERR_CAM_CST_IVVT_IN_2	LV_ERR_CAM_EX_1	LV_ERR_CAM_EX_2	LV_ERR_CAM_IN_2
LV_ERR_CONV_MON_1 {p. 6858}	LV_ERR_CRK {p. 4455}	LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}
LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_ETC_CTL_1	LV_ERR_ETC_CTL_2	LV_ERR_ETC_DR_1	LV_ERR_ETC_DR_2
LV_ERR_ETC_PWM_1	LV_ERR_ETC_PWM_2	LV_ERR_HFM_SELF_DIAG_0	LV_ERR_HFM_SELF_DIAG_1
LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_LOAD_TPS_PLAUS_1	LV_ERR_LOAD_TPS_PLAUS_2
LV_ERR_MAF {p. 4815}	LV_ERR_MAF_FRQ_EL_0	LV_ERR_MAF_FRQ_EL_1	LV_ERR_MAF_FRQ_GRD_0
LV_ERR_MAF_FRQ_RNG_0	LV_ERR_MAF_FRQ_RNG_1	LV_ERR_MAP {p. 982}	LV_ERR_MAP_DIP_PLAUS {p. 1062}
LV_ERR_MAP_SENS_1	LV_ERR_MAP_SENS_2	LV_ERR_MAP_TPS_PLAUS {p. 1062}	LV_ERR_MAP_TPS_PLAUS_1
LV_ERR_MAP_TPS_PLAUS_2	LV_ERR_MEC_IVVT_EX_0	LV_ERR_MEC_IVVT_EX_1	LV_ERR_MEC_IVVT_EX_2
LV_ERR_MEC_IVVT_IN_0	LV_ERR_MEC_IVVT_IN_1	LV_ERR_MEC_IVVT_IN_2	LV_ERR_MFF_MON_1 {p. 6859}
LV_ERR_N_32_MON_1 {p. 6859}	LV_ERR_PER_CAM_EX_1	LV_ERR_PER_CAM_EX_2	LV_ERR_PER_CAM_IN_1

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LV_ERR_PER_CAM_IN_2	LV_ERR_PLAUS_CAM_EX_1	LV_ERR_PLAUS_CAM_EX_2	LV_ERR_PLAUS_CAM_IN_1
LV_ERR_PLAUS_CAM_IN_2	LV_ERR_PUT_EL {p. 4828}	LV_ERR_PUT_EL_1	LV_ERR_REF_CRK_CAM_EX_1
LV_ERR_REF_CRK_CAM_EX_2	LV_ERR_REF_CRK_CAM_IN_1	LV_ERR_REF_CRK_CAM_IN_2	LV_ERR_SLV_IVVT_EX_0
LV_ERR_SLV_IVVT_EX_1	LV_ERR_SLV_IVVT_EX_2	LV_ERR_SLV_IVVT_IN_0	LV_ERR_SLV_IVVT_IN_1
LV_ERR_SLV_IVVT_IN_2	LV_ERR_SYN_CAM_EX_1	LV_ERR_SYN_CAM_EX_2	LV_ERR_SYN_CAM_IN_1
LV_ERR_SYN_CAM_IN_2	LV_ERR_SYN_CRK_CAM_EX_1	LV_ERR_SYN_CRK_CAM_EX_2	LV_ERR_SYN_CRK_CAM_IN_1
LV_ERR_SYN_CRK_CAM_IN_2	LV_ERR_TCO {p. 4496}	LV_ERR_TCO_2 {p. 4572}	LV_ERR_TIA {p. 4200}
LV_ERR_TIA_IM_EL_2	LV_ERR_TIA_MES_PLAUS_1	LV_ERR_TIA_MES_PLAUS_2	LV_ERR_TIA_PWM_EL_1
LV_ERR_TIA_PWM_EL_2	LV_ERR_TIA_THR_MES_PLAUS_1	LV_ERR_TIA_THR_MES_PLAUS_2	LV_ERR_TOOTH_OFF_EX_1
LV_ERR_TOOTH_OFF_EX_2	LV_ERR_TOOTH_OFF_IN_1	LV_ERR_TOOTH_OFF_IN_2	LV_ERR_TPS {p. 4982}
LV_ERR_TPS_1_1	LV_ERR_TPS_1_2	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_2_1
LV_ERR_TPS_2_2	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_1	LV_ERR_TPS_AD_2
LV_ERR_TPS_AD_SPR_1	LV_ERR_TPS_AD_SPR_2	LV_ERR_TPS_MAF_1_1	LV_ERR_TPS_MAF_1_2
LV_ERR_TPS_MAF_2_1	LV_ERR_TPS_MAF_2_2	LV_ERR_TPS_RATIO_1	LV_ERR_TPS_RATIO_2
LV_ERR_TPS_ST_CHK_1 {p. 4951}	LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_TQ_EXT_MON_1 {p. 6859}	LV_ERR_TQ_REQ_MON_1 {p. 6859}
LV_ERR_TQI_AV_MON_1 {p. 6859}	LV_ERR_TQI_N_MAX_MON_1 {p. 6859}	LV_ERR_VS_BOL {p. 5021}	LV_ERR_VS_GRD {p. 5021}
LV_ERR_VS_PLAUS_STUCK {p. 5021}	LV_ERR_VS_TOL {p. 5021}	NC_NR_VS_DIAG	

General information

The below table describes the value to which NC_NR_VS_DIAG needs to be configured for the various projects inside non implemented specification(anonimpl.h) for the respective project.

Project	Value of NC_NR_VS_DIAG
4DB	1
4DS	2
4D8	3

Continued on next page

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4D9	4
4V6	5
4DC	6
4V5	7
4D6	8
4D2	9

A.130.1 Interface for Rate - Based - Monitoring

General information:

With this module the interface between the VS_PLAUS monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_VS_PLAUS data.
Within STATE_RBM_VS_PLAUS, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)
  (depending on failure status: pending)
- Monitor individual RBM conditions encountered within this DC (bit 2)
  (not valid for VS_PLAUS diagnosis)

Application conditions:

Initialisation: at LV_DC 0 -> 1 transition :
bit 0, bit 1 and bit 2 of STATE_RBM_VS_PLAUS = 0
on failure memory reset :
bit 1 of STATE_RBM_VS_PLAUS = 0

Activation: LV_DC 0 -> 1 transition and LV_DC = 1

Deactivation: -

Recurrence: 1 s

Function description:

Formula section:

```
If (NC_NR_VS_DIAG == 1   or       // NC for 4DB
    NC_NR_VS_DIAG == 2   or       // NC for 4DS
    NC_NR_VS_DIAG == 3   or       // NC for 4D8
    NC_NR_VS_DIAG == 4   or       // NC for 4D9
    NC_NR_VS_DIAG == 5   or       // NC for 4V6
    NC_NR_VS_DIAG == 6   or       // NC for 4DC
    NC_NR_VS_DIAG == 7   or       // NC for 4V5
    NC_NR_VS_DIAG == 8   or       // NC for 4D6
    NC_NR_VS_DIAG == 9)           // NC for 4D2
Then
    Bit 0:
    If bit 0 of STATE_RBM_VS_PLAUS = 0
```


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```
    Then
        If  LV_END_DIAG_VS = 1
        Then
            bit 0 of STATE_RBM_VS_PLAUS = 1
        Endif
    Endif
    Bit 1:
    At LV_DC 0 ®  1 transition
    The pending status of the respective failures for each project has
    to be checked only once :
    // The failures have been defined in the VS_PLAUS diagnosis
    If { CPU optimization at LV_DC 0 -> 1 transition }
    CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn't   empty }
    Then
        While  bit 1 of STATE_RBM_VS_PLAUS = 0
        do with each XX failure of the corresponding project :
        ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>,
        SYNCHRONIZATION<CALL>)
            If  XX has a pending status
            Then bit 1 of STATE_RBM_VS_PLAUS = 1
            Endif
        Endwhile
    Else    { the dynamic failure memory is empty }
            No action
     Endif
    // The below calculation for bit 1 will happen at each activation
    If  bit 1 of STATE_RBM_VS_PLAUS = 0
    Then
        If  LV_INH_DIAG_VS_PLAUS =1
        Then   bit  1 of  STATE_RBM_VS_PLAUS =1
        Endif
    Endif
    Bit 2:
    bit 2 of STATE_RBM_VS_PLAUS = 1
Endif
```

A.130.2 VS_PLAUS - Diagnosis

General information:

VS_PLAUS-diagnosis is used to detect whether the VS-signal is plausible:
An vehicle speed signal error is detected if at calibratable engine speed-, mass air flow- and time thresholds the vehicle speed signal VS = 0. Depending if the vehicle is MT /AT different calibration data a applied (If LV_AT = 1 then _AT are used, else _MT are used).

Application conditions:

Initialisation: At LV_IGK 0->1 **or** reset **or** clearing error memory:
LV_INH_DIAG_VS_PLAUS = 0

Activation: LV_IGK = 1

Deactivation: -

Recurrence: 100 ms (to be called before VS_PLAUS-diagnosis)

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Function description:

Formula section:

```
If (NC_NR_VS_DIAG == 1   or      // NC for 4DB
    NC_NR_VS_DIAG == 2   or      // NC for 4DS
    NC_NR_VS_DIAG == 3   or      // NC for 4D8
    NC_NR_VS_DIAG == 4   or      // NC for 4D9
    NC_NR_VS_DIAG == 5   or      // NC for 4V6
    NC_NR_VS_DIAG == 6   or      // NC for 4DC
    NC_NR_VS_DIAG == 7   or      // NC for 4V5
    NC_NR_VS_DIAG == 8   or      // NC for 4D6
    NC_NR_VS_DIAG == 9)          // NC for 4D2

        LV_ERR_CAM_CST_IVVT_EX_1 = 1        or
        LV_ERR_CAM_CST_IVVT_IN_1 = 1        or
        LV_ERR_CONV_MON_1 = 1               or
        LV_ERR_CRK_PLAUS = 1                or
        LV_ERR_CRK_SYN = 1                  or
        LV_ERR_CRK_TOOTH = 1                or
        LV_ERR_CRK_TOOTH_PER = 1            or
        LV_ERR_MAF_FRQ_EL_0 = 1             or
        LV_ERR_MAF_FRQ_RNG_0 = 1            or
        LV_ERR_N_32_MON_1 = 1               or
        LV_ERR_REF_CRK_CAM_EX_1 = 1         or
        LV_ERR_REF_CRK_CAM_IN_1 = 1         or
        LV_ERR_SYN_CRK_CAM_EX_1 = 1         or
        LV_ERR_SYN_CRK_CAM_IN_1 = 1         or
        LV_ERR_TQ_EXT_MON_1 = 1             or
        LV_ERR_TQ_REQ_MON_1 = 1             or
        LV_ERR_TQI_AV_MON_1 = 1             or
        LV_ERR_TQI_N_MAX_MON_1 = 1          or
        LV_ERR_VS_BOL = 1                   or
        LV_ERR_VS_GRD = 1                   or
        LV_ERR_VS_PLAUS_STUCK = 1           or
        LV_ERR_VS_TOL = 1                   or

If (NC_NR_VS_DIAG == 1   or      // NC for 4DB
    NC_NR_VS_DIAG == 2   or      // NC for 4DS
    NC_NR_VS_DIAG == 3   or      // NC for 4D8
    NC_NR_VS_DIAG == 4)          // NC for 4D9

        LV_ERR_CAM_CST_IVVT_EX_2 = 1     or
        LV_ERR_CAM_CST_IVVT_IN_2 = 1     or
        LV_ERR_ETC_CTL_1 = 1             or
        LV_ERR_ETC_CTL_2 = 1             or
        LV_ERR_ETC_DR_1 = 1              or
        LV_ERR_ETC_DR_2 = 1              or
        LV_ERR_ETC_PWM_1 = 1             or
        LV_ERR_ETC_PWM_2 = 1             or
        LV_ERR_HFM_SELF_DIAG_0 = 1       or
```

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```
        LV_ERR_HFM_SELF_DIAG_1 = 1      or
        LV_ERR_LOAD_TPS_PLAUS_1 = 1     or
        LV_ERR_LOAD_TPS_PLAUS_2 = 1     or
        LV_ERR_MAF_FRQ_EL_1 = 1         or
        LV_ERR_MAF_FRQ_RNG_1 = 1        or
        LV_ERR_MAP_DIP_PLAUS = 1        or
        LV_ERR_MAP_SENS_1 = 1           or
        LV_ERR_MAP_SENS_2 = 1           or
        LV_ERR_MAP_TPS_PLAUS_1 = 1      or
        LV_ERR_MAP_TPS_PLAUS_2 = 1      or
        LV_ERR_MEC_IVVT_EX_1 = 1        or
        LV_ERR_MEC_IVVT_EX_2 = 1        or
        LV_ERR_MEC_IVVT_IN_1 = 1        or
        LV_ERR_MEC_IVVT_IN_2 = 1        or
        LV_ERR_MFF_MON_1 = 1            or
        LV_ERR_REF_CRK_CAM_EX_2 = 1     or
        LV_ERR_REF_CRK_CAM_IN_2 = 1     or
        LV_ERR_SLV_IVVT_EX_1 = 1        or
        LV_ERR_SLV_IVVT_EX_2 = 1        or
        LV_ERR_SLV_IVVT_IN_1 = 1        or
        LV_ERR_SLV_IVVT_IN_2 = 1        or
        LV_ERR_SYN_CRK_CAM_EX_2 = 1     or
        LV_ERR_SYN_CRK_CAM_IN_2 = 1     or
        LV_ERR_TPS_1_1 = 1              or
        LV_ERR_TPS_1_2 = 1              or
        LV_ERR_TPS_2_1 = 1              or
        LV_ERR_TPS_2_2 = 1              or
        LV_ERR_TPS_AD_1 = 1             or
        LV_ERR_TPS_AD_2 = 1             or
        LV_ERR_TPS_AD_SPR_1 = 1         or
        LV_ERR_TPS_AD_SPR_2 = 1         or
        LV_ERR_TPS_MAF_1_1 = 1          or
        LV_ERR_TPS_MAF_1_2 = 1          or
        LV_ERR_TPS_MAF_2_1 = 1          or
        LV_ERR_TPS_MAF_2_2 = 1          or
        LV_ERR_TPS_RATIO_1 = 1          or
        LV_ERR_TPS_RATIO_2 = 1          or
        LV_ERR_TPS_ST_CHK_1 = 1         or
        LV_ERR_TPS_ST_CHK_2 = 1
    Endif

If (NC_NR_VS_DIAG == 5   or      // NC for 4V6
    NC_NR_VS_DIAG == 6   or      // NC for 4DC
    NC_NR_VS_DIAG == 7   or      // NC for 4V5
    NC_NR_VS_DIAG == 8)          // NC for 4D6

        LV_ERR_LOAD_TPS_PLAUS = 1       or
        LV_ERR_MAF_FRQ_GRD_0 = 1        or
        LV_ERR_MAP_DIP_PLAUS = 1        or
        LV_ERR_MEC_IVVT_EX = 1          or
        LV_ERR_MEC_IVVT_IN = 1          or
        LV_ERR_MTC_CTL_2 = 1            or
```

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```
        LV_ERR_MTC_CTL_3  =  1            or
        LV_ERR_MTC_DR  =  1               or
        LV_ERR_SLV_IVVT_EX  =  1          or
        LV_ERR_SLV_IVVT_IN  =  1          or
        LV_ERR_TPS  =  1                  or
        LV_ERR_TPS_1  =  1                or
        LV_ERR_TPS_2  =  1                or
        LV_ERR_TPS_AD  =  1               or
        LV_ERR_TPS_AD_BOL  =  1           or
        LV_ERR_TPS_MAF_1  =  1            or
        LV_ERR_TPS_MAF_2  =  1            or
        LV_ERR_TPS_RATIO  =  1            or
        LV_ERR_TPS_ST_CHK_1  =  1         or
        LV_ERR_TPS_ST_CHK_2  =  1
Endif

If (NC_NR_VS_DIAG ==5)          //NC for 4V6
                                //Functional content of 17A00603

 LV_ERR_MAF = 1 or
 LV_ERR_MAP_TPS_PLAUS = 1 or
Endif
If (NC_NR_VS_DIAG == 1   or      // NC for 4DB
    NC_NR_VS_DIAG == 4   or      // NC for 4D9
    NC_NR_VS_DIAG == 5   or      // NC for 4V6
    NC_NR_VS_DIAG == 8   or      // NC for 4D6
    NC_NR_VS_DIAG == 9)          // NC for 4D2

        LV_ERR_COM_1_BOFF  =  1       or
        LV_ERR_COM_1_ST_UP  =  1      or
        LV_ERR_COM_1_VS     =  1
Endif

If (NC_NR_VS_DIAG == 6   or      // NC for 4DC
    NC_NR_VS_DIAG == 8)          // NC for 4D6

        LV_ERR_MAP_TPS_PLAUS  =  1       or
        LV_ERR_MFF_MON_1  =  1
Endif
If (NC_NR_VS_DIAG == 9)          // NC for 4D2

        LV_ERR_ETC_CTL  =  1          or
        LV_ERR_ETC_DR  =  1           or
        LV_ERR_ETC_PWM  =  1          or
        LV_ERR_HFM_SELF_DIAG_0  =  1     or
        LV_ERR_LOAD_TPS_PLAUS  =  1      or
        LV_ERR_MAP_SENS_1  =  1       or
        LV_ERR_MAP_TPS_PLAUS  =  1     or
        LV_ERR_MEC_IVVT_EX_1  =  1     or
        LV_ERR_MEC_IVVT_IN_1  =  1     or
        LV_ERR_MFF_MON_1  =  1         or
        LV_ERR_SLV_IVVT_EX_1  =  1     or
```

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LV_ERR_SLV_IVVT_IN_1 = 1 **or**
LV_ERR_TPS = 1 **or**
LV_ERR_TPS_1 = 1 **or**
LV_ERR_TPS_2 = 1 **or**
LV_ERR_TPS_AD = 1 **or**
LV_ERR_TPS_AD_SPR = 1 **or**
LV_ERR_TPS_MAF_1 = 1 **or**
LV_ERR_TPS_MAF_2 = 1 **or**
LV_ERR_TPS_RATIO = 1 **or**
LV_ERR_TPS_ST_CHK = 1
Endif
Then LV_INH_DIAG_VS_PLAUS = 1
Else LV_INH_DIAG_VS_PLAUS = 0
Endif

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A.131 Wheel speed sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_N_WHEEL_FN_LE	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom of signal diagnosis for front left wheel speed sensor					
ERR_SYM_N_WHEEL_FN_RI	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom of signal diagnosis for front right wheel speed sensor					
ERR_SYM_N_WHEEL_RE_LE	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom of signal diagnosis for rear left wheel speed sensor					
ERR_SYM_N_WHEEL_RE_RI	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom of signal diagnosis for rear right wheel speed sensor					
LV_CDN_DIAG_N_WHEEL_FN_LE	V	0... 1H	0 ...1	1	-
Condition for front left wheel speed sensordiagnosis					
LV_CDN_DIAG_N_WHEEL_FN_RI	V	0... 1H	0 ...1	1	-
Condition for front right wheel speed sensor diagnosis					
LV_CDN_DIAG_N_WHEEL_RE_LE	V	0... 1H	0 ...1	1	-
Condition for rear left wheel speed sensor diagnosis					
LV_CDN_DIAG_N_WHEEL_RE_RI	V	0... 1H	0 ...1	1	-
Condition for rear right wheel speed sensor diagnosis					
LV_END_DIAG_N_WHEEL_FN_LE	V	0... 1H	0 ...1	1	-
End of diagnosis for front left wheel speed sensor					
LV_END_DIAG_N_WHEEL_FN_RI	V	0... 1H	0 ...1	1	-
End of diagnosis for front right wheel speed sensor					
LV_END_DIAG_N_WHEEL_RE_LE	V	0... 1H	0 ...1	1	-
End of diagnosis for rear left wheel speed sensor					
LV_END_DIAG_N_WHEEL_RE_RI	V	0... 1H	0 ...1	1	-
End of diagnosis for rear right wheel speed sensor					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_N_WHEEL_FN_LE	O/V	0... 1H	0 ...1	1	-
Error flag for invalid wheel speed signal					
LV_ERR_N_WHEEL_FN_RI	O/V	0... 1H	0 ...1	1	-
Error flag for invalid wheel speed signal					
LV_ERR_N_WHEEL_RE_LE	O/V	0... 1H	0 ...1	1	-
Error flag for invalid wheel speed signal					
LV_ERR_N_WHEEL_RE_RI	O/V	0... 1H	0 ...1	1	-
Error flag for invalid wheel speed signal					
T_AST_ENA_N_WHEEL_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
Delay timer after engine start phase end for wheel speed sensor diagnosis					

Input data:

LV_CDN_VB_BN_DIAG {p. 1185}	LV_ERR_BN_TCS {p. 4870}	LV_ERR_BN_WHEEL_ CAN {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}
LV_ERR_COM_1_BOFF {p. 800}	LV_ERR_COM_1_ST_UP {p. 800}	LV_ERR_COM_1_WHEEL_ TCS	LV_IGK {p. 906}
LV_ST_END {p. 1720}	LV_WHEEL_CAN_FN_LE_ ERR {p. 1568}	LV_WHEEL_CAN_FN_RI_ ERR {p. 1568}	LV_WHEEL_CAN_RE_LE_ ERR {p. 1568}
LV_WHEEL_CAN_RE_RI_ ERR {p. 1568}	STATE_N_WHEEL_FN_LE	STATE_N_WHEEL_FN_RI	STATE_N_WHEEL_RE_LE
STATE_N_WHEEL_RE_RI	STATE_TCS_CAN {p. 1577}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_N_WHEEL_FN_LE	V	0... FFH	0... 255	1	-
Anti bounce counter decrement for front left wheel speed sensor diagnostics					
C_ABC_DEC_N_WHEEL_FN_RI	V	0... FFH	0... 255	1	-
Anti bounce counter decrement for front right wheel speed sensor diagnostics					
C_ABC_DEC_N_WHEEL_RE_LE	V	0... FFH	0... 255	1	-
Anti bounce counter decrement for rear left wheel speed sensor diagnostics					
C_ABC_DEC_N_WHEEL_RE_RI	V	0... FFH	0... 255	1	-
Anti bounce counter decrement for rear right wheel speed sensor diagnostics					
C_ABC_INC_N_WHEEL_FN_LE	V	0... FFH	0... 255	1	-
Anti bounce counter increment for front left wheel speed sensor diagnostics					
C_ABC_INC_N_WHEEL_FN_RI	V	0... FFH	0... 255	1	-
Anti bounce counter increment for front right wheel speed sensor diagnostics					
C_ABC_INC_N_WHEEL_RE_LE	V	0... FFH	0... 255	1	-
Anti bounce counter increment for rear left wheel speed sensor diagnostics					
C_ABC_INC_N_WHEEL_RE_RI	V	0... FFH	0... 255	1	-
Anti bounce counter increment for rear right wheel speed sensor diagnostics					
C_ABC_MAX_N_WHEEL_FN_LE	V	1... FFH	1... 255	1	-
Anti bounce counter threshold value for front left wheel speed sensor diagnostics					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_N_WHEEL_FN_RI	V	1... FFH	1... 255	1	-
Anti bounce counter threshold value for front right wheel speed sensor diagnostics					
C_ABC_MAX_N_WHEEL_RE_LE	V	1... FFH	1... 255	1	-
Anti bounce counter threshold value for rear left wheel speed sensor diagnostics					
C_ABC_MAX_N_WHEEL_RE_RI	V	1... FFH	1... 255	1	-
Anti bounce counter threshold value for rear right wheel speed sensor diagnostics					
C_T_AST_ENA_N_WHEEL_DIAG_MAX	V	0... FFFFH	0... 6553.5	0.1	s
Calibrating data for wait time between start and diagnosis enable for wheel speed sensor					
CLF_N_WHEEL_DIAG_EL	V	0... FH	0... 15	1	-
Calibration data to map wheel speed sensor electrical fault to error symptom					
CLF_N_WHEEL_DIAG_NO_ERR	V	0... FH	0... 15	1	-
Calibration data to map wheel speed sensor error healing symptom					
CLF_N_WHEEL_DIAG_OC	V	0... FH	0... 15	1	-
Calibration data to map wheel speed sensor open circuit diagnosis error to error symptom					
CLF_N_WHEEL_DIAG_SCG	V	0... FH	0... 15	1	-
Calibration data to map wheel speed senso short circuit to ground diagnosis error to error symptom					
CLF_N_WHEEL_DIAG_SCP	V	0... FH	0... 15	1	-
Calibration data to map wheel speed senso short circuit to positive diagnosis error to error symptom					
LC_N_WHEEL_EL	V	0... 1H	0 ...1	1	-
Activate electrical fault symptom calculation for wheel speed sensor					
LC_N_WHEEL_OC	V	0... 1H	0 ...1	1	-
Activate open circuit symptom calculation for wheel speed sensor					
LC_N_WHEEL_SCG	V	0... 1H	0 ...1	1	-
Activate short circuit to ground symptom calculation for wheel speed sensor					
LC_N_WHEEL_SCP	V	0... 1H	0 ...1	1	-
Activate short circuit to positive symptom calculation for wheel speed sensor					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_N_WHEEL_FN_LE	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance N_WHEEL_FN_LE					
NC_IDX_DIAG_N_WHEEL_FN_RI	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance N_WHEEL_FN_RI					
NC_IDX_DIAG_N_WHEEL_RE_LE	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance N_WHEEL_RE_LE					
NC_IDX_DIAG_N_WHEEL_RE_RI	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance N_WHEEL_RE_RI					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)

Error treatment

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Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
NC_IDX_DIAG_N_WHEEL_FN_LE	Front-left wheel speed sensor short circuit to battery	0			STD_INI	CC
Failure index for diagnostic instance N_WHEEL_FN_LE	Front-left wheel speed sensor short circuit to ground	1				
	Front-left wheel speed sensor open circuit	2				
	Front-left wheel speed sensor electrical fault	3				

Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
NC_IDX_DIAG_N_WHEEL_FN_RI	Front-right wheel speed sensor short circuit to battery	0			STD_INI	CC
Failure index for diagnostic instance N_WHEEL_FN_RI	Front-right wheel speed sensor short circuit to ground	1				
	Front-right wheel speed sensor open circuit	2				
	Front-right wheel speed sensor electrical fault	3				

Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
NC_IDX_DIAG_N_WHEEL_RE_LE	Rear-left wheel speed sensor short circuit to battery	0			STD_INI	CC
Failure index for diagnostic instance N_WHEEL_RE_LE	Rear-left wheel speed sensor short circuit to ground	1				
	Rear-left wheel speed sensor open circuit	2				
	Rear-left wheel speed sensor electrical fault	3				

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Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
NC_IDX_DIAG_N_WHEEL_RE_RI	Rear-right wheel speed sensor short circuit to battery	0			STD_INI	CC
Failure index for diagnostic instance N_WHEEL_RE_RI	Rear-right wheel speed sensor short circuit to ground	1				
	Rear-right wheel speed sensor open circuit	2				
	Rear-right wheel speed sensor electrical fault	3				

Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
NC_IDX_DIAG_N_WHEEL_FN_LE	not used	0			STD_INI	CC
Failure index for diagnostic instance N_WHEEL_FN_LE	not used	1				
	not used	2				
	Front-left wheel speed sensor fault	3				

Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
NC_IDX_DIAG_N_WHEEL_FN_RI	not used	0			STD_INI	CC
Failure index for diagnostic instance N_WHEEL_FN_RI	not used	1				
	not used	2				
	Front-right wheel speed sensor fault	3				

Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
NC_IDX_DIAG_N_WHEEL_RE_LE	not used	0			STD_INI	CC

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Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
Failure index for diagnostic instance N_WHEEL_RE_LE	not used	1				
	not used	2				
	Rear-left wheel speed sensor fault	3				

Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
NC_IDX_DIAG_N_WHEEL_RE_RI	not used	0			STD_INI	CC
Failure index for diagnostic instance N_WHEEL_RE_RI	not used	1				
	not used	2				
	Rear-right wheel speed sensor fault	3				

General information

Note: In the above Error treatment table the first 4 diagnostic instances (NC_IDX's) are for BN2020 (L6 variant) and the last 4 diagnostic instances (NC_IDX's) are for BN2000 (L4 variant).

For BN2020(L6):
The electrical diagnosis is performed using the STATE_N_WHEEL_XX_YY, which contain, amongst other information, the error status of each individual wheel speed sensor obtained via flexray. For each wheel speed sensor, the 4-bit information contained in STATE_N_WHEEL_XX_YY can be allocated freely to 1 of the 4 error symptoms using the calibratable bitfield CLF_N_WHEEL_DIAG_xxx (e.g:xxx = SCP or SCG, or OC or EL) . Each error symptom can be activated or deactivated using the switches LC_N_WHEEL_xxx. For error healing, one additonal, 4-bit value of STATE_N_WHEEL_XX_YY can be calibrated using CLF_N_WHEEL_DIAG_NO_ERR.

For BN2000(L4):
The electrical diagnosis is performed using the error flags LV_WHEEL_CAN_XX_YY_ERR, which contain the error information of each individual wheel speed sensor obtained via CAN. An error is detected when LV_WHEEL_CAN_XX_YY_ERR = 1 and at the same time the DSC-status STATE_TCS_CAN = 2, meaning DSC has detected an electrical defect

//*For code optimization use FOR loop with common activation conditions for all the four wheel diagnosis and capture different wheel specific information via common variable*//

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Note: The electrical diagnosis strategy for all four individual wheel speed sensors is same and there will be a single algorithm for all the four wheel speed sensors as below with respective wheel information designated by XX_YY.

XX_YY has following diagnostic instances with XX = FN or RE and YY = LE or RI
- FN_LE (Front left wheel speed sensor)
- FN_RI (Front right wheel speed sensor)
- RE_LE (Rear left wheel speed sensor)
- RE_RI (Rear right wheel speed sensor)

Application conditions:

Initialisation: The configuration is STD_INI
(=> all 0 at LV_IGK 0->1 or reset or clearing error memory)

At LV_IGK 0->1 or reset:
T_AST_ENA_N_WHEEL_DIAG = C_T_AST_ENA_N_WHEEL_DIAG_MAX

Activation: LV_IGK = 1

Deactivation: When activation condition does not met

Following should be updated during de-activation
LV_CDN_DIAG_N_WHEEL_XX_YY = 0

Recurrence: 100 ms

Function description:

Formula section:

```
If  LV_ST_END = 1
Then     T_AST_ENA_N_WHEEL_DIAG- -
    //timer T_AST_ENA_N_WHEEL_DIAG decrement to zero
Else
    Do nothing
End

#IF  (USE_L6 == ACTIVE)// Compiler switch for BN2020(Signal from Flexray)
#THEN

    Condition calculation:

    If  LV_CDN_VB_BN_DIAG       = 1 AND
        LV_ERR_COM_1_BOFF       = 0 AND
        LV_ERR_COM_1_ST_UP      = 0 AND
        LV_ERR_COM_1_WHEEL_TCS  = 0 AND
        T_AST_ENA_N_WHEEL_DIAG  = 0 AND
        (((STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_SCP)AND  LC_N_WHEEL_SCP)OR
        (( STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_SCG)AND  LC_N_WHEEL_SCG)OR
        (( STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_OC) AND  LC_N_WHEEL_OC) OR
        (  STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_NO_ERR)                OR
        (( STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_EL) AND LC_N_WHEEL_EL))
    Then
        LV_CDN_DIAG_N_WHEEL_XX_YY = 1
    Else
        LV_CDN_DIAG_N_WHEEL_XX_YY = 0
```

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```
    Endif

    Symptom calculation:

    If  LV_CDN_DIAG_N_WHEEL_XX_YY = 1
    Then
        If  STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_SCP             //SCP
        Then
            ERR_SYM_N_WHEEL_XX_YY = SYM_0
        Else
            If  STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_SCG         //SCG
            Then
                ERR_SYM_N_WHEEL_XX_YY = SYM_1
            Else
                If  STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_OC      //OC
                Then
                    ERR_SYM_N_WHEEL_XX_YY = SYM_2
                Else
                    If  STATE_N_WHEEL_XX_YY = CLF_N_WHEEL_DIAG_EL  //EL
                    Then
                        ERR_SYM_N_WHEEL_XX_YY = SYM_3
                    Else
                        ERR_SYM_N_WHEEL_XX_YY = NO_SYM
                    Endif
                Endif
            Endif
        Endif
    Endif

#ELSE // Compiler switch for BN2000(Signal from CAN)

    Condition calculation:

    If  LV_CDN_VB_BN_DIAG       = 1    AND
        LV_ERR_CAN_BOFF         = 0    AND
        LV_ERR_BN_WHEEL_CAN     = 0    AND
        LV_ERR_BN_TCS           = 0    AND
        T_AST_ENA_N_WHEEL_DIAG = 0
    Then
        LV_CDN_DIAG_N_WHEEL_XX_YY = 1
    Else
        LV_CDN_DIAG_N_WHEEL_XX_YY = 0
    Endif

    Symptom calculation:

    If  LV_CDN_DIAG_N_WHEEL_XX_YY = 1
    Then
        If  LV_WHEEL_CAN_XX_YY_ERR = 1   AND
            STATE_TCS_CAN            = 2
        Then
            ERR_SYM_N_WHEEL_XX_YY = SYM_3
        Else
            ERR_SYM_N_WHEEL_XX_YY = NO_SYM
        Endif
    Endif
#ENDIF
```

For failure and error management treatment the anti-bounce mechanism is called :

```
ACTION_ERRM_FilterSymptom( IN< NC_IDX_DIAG_N_WHEEL_XX_YY >,
IN< LV_CDN_DIAG_N_WHEEL_XX_YY >, IN< ERR_SYM_N_WHEEL_XX_YY >,
IN< C_ABC_INC_N_WHEEL_XX_YY >, IN< C_ABC_DEC_N_WHEEL_XX_YY >,
IN< C_ABC_MAX_N_WHEEL_XX_YY >, OUT< LV_ERR_N_WHEEL_XX_YY > )
```

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A.132 Cruise control device diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_DCC	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptoms DCC error reversible/irreversible					
LV_CDN_DIAG_DCC	O/V	0... 1H	0 ...1	1	-
Status of diagnosis DCC error reversible/irreversible					
LV_DCC_OFF_ECU	O/V	0... 1H	0 ...1	1	-
Irreversible DCC error					
LV_END_DIAG_DCC	O/V	0... 1H	0 ...1	1	-
End of diagnosis DCC error reversible/irreversible					
LV_ERR_DCC	O/V	0... 1H	0 ...1	1	-
DCC error reversible/irreversible					
T_DCC_BRAKE_DET	V	0... FFH	0... 2.55	0.01	s
Brake delay timer					

Input data:

ERR_SYM_BN_TQ_DCC {p. 4864}	LV_BRAKE_DET {p. 4209}	LV_DCC_OFF_ACK {p. 1565}	LV_DI_TQ_REQ_CAN_MPI_GDI {p. 800}
LV_ERR_BLS_PLAUS {p. 4209}	LV_ERR_BN_TQ_DCC {p. 4870}	LV_ERR_CRK {p. 4455}	LV_ERR_CS {p. 5015}
LV_ERR_PVS {p. 4216}	LV_IGK {p. 906}	LV_TQI_REQ_CAN_INH {p. 6687}	LV_VAR_DCC {p. 655}
STATE_DCC_INTV {p. 1572}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_DCC	-	0... FFH	0... 255	1	-
Increment counter					
C_ABC_MAX_DCC	-	1... FFH	1... 255	1	-
Maximum counter					
C_T_MAX_BRAKE_DET_DCC	-	0... FFH	0... 2.55	0.01	s
Maximum Brake delay timer					

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FUNCTION DESCRIPTION:

General information:

At implausible DCC messages, e.g. timeout errors, or ECU internal errors a reversible or irreversible error is detected and reflect to the DCC Unit. This should be confirmed by the DCC switch-off flag LV_DCC_OFF_ACK. Only if the switch-off is confirmed by DCC the reversible DCC error is reset. This is necessary for a safety communication between ECU and DCC.

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Description:

The following symptoms can be detected:

```
┌─┬─┬─┬─┐
│ │ │ └─> DCC irreverible off          (= SYM_0)
│ │ └───> DCC reversible off           (= SYM_1)
│ └─────> -                            (= SYM_2)
└───────> -                            (= SYM_3)
```

Application conditions

Initialisation: all 0 at LV_IGK 0->1 **or** reset **or** at clearing error memory

Recurrence: 10 ms

Activation:
If LV_VAR_DCC = 1 **and**
LV_IGK= 1
Then LV_CDN_DIAG_DCC = 1

Deactivation:
If LV_VAR_DCC = 0 **or**
LV_IGK = 0 **or**
[LV_ERR_DCC = 1 **and**
ERR_SYM_DCC = SYM_0]
Then LV_CDN_DIAG_DCC = 0
Endif

Formula section:

Calculation of error condition brake detection for setting irrversible error
If LV_BRAKE_DET = 1
Then $T\_DCC\_BRAKE\_DET_n$ = $T\_DCC\_BRAKE\_DET_{n-1}$ + 10 ms
Else $T\_DCC\_BRAKE\_DET_n$ =0 ms
Endif

Calculation of irrversible error
If [LV_ERR_BN_TQ_DCC = 1 **and** *//ONLY ALIVE AND CHECKSUM ERROR*
ERR_SYM_BN_TQ_DCC = SYM_1 **or** SYM_3] **or**
LV_TQI_REQ_CAN_INH = 1 **or**
LV_ERR_PVS = 1 **or**
[(T_DCC_BRAKE_DET > C_T_MAX_BRAKE_DET_DCC) and STATE_DCC_INTV == 01H]
Then ERR_SYM_DCC = SYM_0 *//symptom irreversible DCC error*
// LV_ERR_DCC = 1 set after debounce by error management, set for this DC

Calculation of reversible error
ElseIf (LV_ERR_BN_TQ_DCC = 1 **and** ERR_SYM_BN_TQ_DCC = SYM_2) **or**
//only timeout
LV_ERR_BLS_PLAUS = 1 **or**
LV_ERR_CRK = 1 **or**
LV_ERR_CS = 1 **or**
LV_DI_TQ_REQ_CAN_MPI_GDI = 1

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Then ERR_SYM_DCC = SYM_1 *//symptom reversible DCC error*
// LV_ERR_DCC = 1 set after debounce by error management
Else **If** LV_ERR_DCC = 0 *//not debounced yet*
Then ERR_SYM_DCC = NO_SYM
debounce counter reset to 0 *//reset CTR_ABC_DCC to 0*
//no rebouncing!
Else **If** LV_DCC_OFF_ACK = 1
Then ERR_SYM_DCC = NO_SYM
LV_ERR_DCC = 0 *//reset error and CTR_ABC_DCC to 0*
debounce counter reset to 0 *//no rebouncing!*
Else ERR_SYM_DCC = old value (SYM_0 or SYM_1)
Endif
Endif
Endif

Calculation of LV_DCC_OFF_ECU

If LV_ERR_DCC = 1
Then LV_DCC_OFF_ECU = 1
ElseIf LV_DCC_OFF_ACK = 1
Then LV_DCC_OFF_ECU = 0
Else unchanged
Endif

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A.133 IPM diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_LDM	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptoms LDM error reversible/irreversible					
LV_CDN_DIAG_LDM	O/V	0... 1H	0 ...1	1	-
Status of diagnosis LDM error reversible/irreversible					
LV_END_DIAG_LDM	O/V	0... 1H	0 ...1	1	-
End of diagnosis LDM error reversible/irreversible					
LV_ERR_LDM	O/V	0... 1H	0 ...1	1	-
LDM error reversible/irreversible					
LV_LDM_BRAKE_PLAUS_ERR	O/V	0... 1H	0 ...1	1	-
Conditions for enabling LDM not plausible					
LV_LDM_ENA_PLAUS_ERR	O/V	0... 1H	0 ...1	1	-
Conditions for enabling LDM not plausible					
LV_LDM_OFF_ECU	O/V	0... 1H	0 ...1	1	-
Irreversible LDM error					
LV_LDM_OFF_ECU_1	V	0... 1H	0 ...1	1	-
LDM Irreversible off					
LV_LDM_OFF_ECU_2	V	0... 1H	0 ...1	1	-
LDM reversible off					
T_LDM_BRAKE_DET	V	0... FFH	0... 2.55	0.01	s
Brake delay timer					

Input data:

LV_BRAKE_DET {p. 4209}	LV_DI_TQ_REQ_CAN_MPI_GDI {p. 800}	LV_ERR_BLS_PLAUS {p. 4209}	LV_ERR_BN_LDM {p. 4870}
LV_ERR_CRK {p. 4455}	LV_ERR_CS {p. 5015}	LV_ERR_PVS {p. 4216}	LV_ETCU_DISABLE_CAN {p. 6718}
LV_IGK {p. 906}	LV_LDM_CAN_INI {p. 1566}	LV_TQ_WHEEL_LDM_REQ {p. 1568}	LV_TQI_REQ_CAN_INH {p. 6687}
LV_VAR_BN_LDM {p. 655}	STATE_LDM {p. 1575}	STATE_LDM_INTV {p. 1575}	

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_LDM	-	0... FFH	0... 255	1	-
Increment counter					
C_ABC_MAX_LDM	-	1... FFH	1... 255	1	-
Maximum counter					
C_T_MAX_BRAKE_DET_LDM	-	0... FFH	0... 2.55	0.01	s
Maximum Brake delay timer					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LDM_ENA_PLAUS_ERR	-	0... 1H	0 ...1	1	-
LC for enabling diagnosis due to plausibility error					

FUNCTION DESCRIPTION:

General information:

At implausible LDM messages, e.g. timeout errors, or ECU internal errors a reversible or irreversible error is detected and reflect to the LDM Unit.

Description:

The following symptoms can be detected:

```
┌─┬─┬─┬─┐
│ │ │ └─> LDM Brake plausibility error    (= SYM_0)
│ │ └───> -                              (= SYM_1)
│ └─────> -                              (= SYM_2)
└───────> LDM plausibility error         (= SYM_3)
```

Application conditions

Initialisation: `all 0 at LV_IGK 0->1` **or** `reset` **or** `at clearing error memory`

Recurrence: `10 ms`

Activation:

```
If    LV_VAR_BN_LDM = 1          and
      LV_IGK= 1                  and
      LV_LDM_OFF_ECU_1 = 0       and
      LV_LDM_CAN_INI = 0
Then  LV_CDN_DIAG_LDM = 1
```

Deactivation:

```
If    LV_VAR_BN_LDM = 0     or
      LV_IGK = 0            or
      LV_LDM_OFF_ECU_1 = 1  or
      LV_LDM_CAN_INI = 1
Then  LV_CDN_DIAG_LDM = 0
Endif
```

Formula section:

Calculation of error condition “brake detection” for setting irrversible error

If LV_BRAKE_DET = 1

Then $T\_LDM\_BRAKE\_DET_n$ = $T\_LDM\_BRAKE\_DET_{n-1}$ + 10 ms

Else $T\_LDM\_BRAKE\_DET_n$ =0 ms

Endif

Calculation of error condition “brake detection ldm not plausible” for setting irrversible error

If [(T_LDM_BRAKE_DET $>$ C_T_MAX_BRAKE_DET_LDM) and

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```
                STATE_LDM_INTV == 01H ]
Then          LV_LDM_BRAKE_PLAUS_ERR = 1
Else          LV_LDM_BRAKE_PLAUS_ERR = 0
Endif
```

Calculation of error condition “enable conditions not plausible” for setting irrversible error

```
If              (STATE_LDM ! = 1or 2 or 3 or 4        and
                LV_TQ_WHEEL_LDM_REQ = 1)
Then          LV_LDM_ENA_PLAUS_ERR = 1
Else          LV_LDM_ENA_PLAUS_ERR = 0
Endif
```

Calculation of error

```
If              LV_LDM_BRAKE_PLAUS_ERR = 1
Then          ERR_SYM_LDM = SYM_0
                LV_ERR_LDM = 1
              // LV_ERR_LDM = 1 set after debounce by error management, set for this DC
ElseIf        LV_LDM_ENA_PLAUS_ERR = 1                  and
                LC_LDM_ENA_PLAUS_ERR = 1
Then          ERR_SYM_LDM = SYM_3
                LV_ERR_LDM = 1
              // LV_ERR_LDM = 1 set after debounce by error management
Else          If        LV_ERR_LDM = 0                 //not debounced yet
                Then    ERR_SYM_LDM = NO_SYM           //debounce counter reset to 0
               Else     ERR_SYM_LDM   = NO_SYM
                         LV_ERR_LDM = 0                 //after rebounce
               Endif
Endif
```

Calculation of LDM irrversible off

```
If                [ LV_ERR_BN_LDM   = 1 and                //ONLY ALIVE AND CHECKSUM ER-
ROR
                ERR_SYM_BN_LDM   = SYM_1 or SYM_3 ]                          or
                LV_TQI_REQ_CAN_INH      =      1                          or
             LV_ERR_PVS          =      1                                or
                LV_ERR_LDM          =         1
Then          LV_LDM_OFF_ECU_1 = 1             //LDM   irreversible off
```

Calculation of reversible off

```
ElseIf        ( LV_ERR_BN_LDM   = 1 and   ERR_SYM_BN_LDM          = SYM_2 ) or
                                                    //only timeout
                LV_ETCU_DISABLE_CAN     = 1                               or
                LV_ERR_BLS_PLAUS        = 1                               or
                LV_ERR_CS              = 1                               or
                LV_ERR_CRK               = 1                               or
                LV_DI_TQ_REQ_CAN_MPI_GDI = 1

Then          LV_LDM_OFF_ECU_2          = 1     //LDM reversible LDM off
Else          LV_LDM_ÓFF_ECU_2          = 0
Endif
```

Calculation of LV_LDM_OFF_ECU

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If LV_LDM_OFF_ECU_1 = 1 **or**
LV_LDM_OFF_ECU_2 = 1
Then LV_LDM_OFF_ECU = 1
Else LV_LDM_OFF_ECU = 0
Endif

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A.134 Multi function steering wheel diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_MSW_2	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error					
ERR_SYM_MSW_3	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error					
ERR_SYM_MSW_TOG	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error					
LV_CDN_DIAG_MSW_2	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MSW_2					
LV_CDN_DIAG_MSW_3	O/V	0... 1H	0 ...1	1	-
Diagnosis condition MSW_3					
LV_CDN_DIAG_MSW_TOG	O/V	0... 1H	0 ...1	1	-
Diagnosis condition TOG					
LV_END_DIAG_MSW_2	O/V	0... 1H	0 ...1	1	-
End of Diagnosis MSW_2					
LV_END_DIAG_MSW_3	O/V	0... 1H	0 ...1	1	-
End of Diagnosis MSW_3					
LV_END_DIAG_MSW_TOG	O/V	0... 1H	0 ...1	1	-
End of Diagnosis TOG					
LV_ERR_MSW_2	O/V	0... 1H	0 ...1	1	-
Redundant coding of the signal-error MSW_2					
LV_ERR_MSW_3	O/V	0... 1H	0 ...1	1	-
Toggle switch test-error MSW_3					
LV_ERR_MSW_TOG	O/V	0... 1H	0 ...1	1	-
Toggle bit monitoring-error TOG					
LV_MSW_MSG_VLD	O	0... 1H	0 ...1	1	-
Flag for MSW message is valid					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_MSW_DATA	O	1H 3H 25H 49H 91H	NONE TIP_DOWN OFF TIP_UP RESUME	-	-
State MSW data					

Input data:

BIOS_CRU_DATA {p. 942}	BIOS_CRU_TOG {p. 942}	BIOS_LV_CRU_ERR	C_T_READY_CRU {p. 7221}
LV_IGK {p. 906}	LV_VAR_BN_MSW {p. 655}	LV_VAR_MSW {p. 656}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_MSW_2	-	0... FFH	0... 255	1	-
Debounce counter increment - MSW diagnosis					
C_ABC_INC_MSW_3	-	0... FFH	0... 255	1	-
Debounce counter increment - MSW diagnosis					
C_ABC_INC_MSW_TOG	-	0... FFH	0... 255	1	-
Debounce counter increment - Toggle bit monitoring					
C_ABC_MAX_MSW_2	-	1... FFH	1... 255	1	-
Debounce counter maximum value - MSW diagnosis					
C_ABC_MAX_MSW_3	-	1... FFH	1... 255	1	-
Debounce counter maximum value - MSW diagnosis					
C_ABC_MAX_MSW_TOG	-	1... FFH	1... 255	1	-
Debounce counter maximum value - Toggle bit monitoring					
C_T_MAX_MSW_BIT_DIAG	-	0... FFH	0... 2550	10	ms
Max. diagnostic threshold - Toggle bit monitoring					
C_T_MIN_MSW_BIT_DIAG	-	0... FFH	0... 2550	10	ms
Min. diagnostic threshold - Toggle bit monitoring					
C_VB_MIN_MSW_DIAG	-	0... FFH	0... 25.89843	0.1015625	V
Min. battery voltage for MSW diagnosis					

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FUNCTION DESCRIPTION:

General information:

In this function the diagnosis of the relevant signals from the MSW for the cruise control is made. The following error can be distinguished:

- Redundant coding of the signal
- Toggle switch test
- Toggle bit monitoring

Application conditions

Initialisation: *all 0 at LV_IGK 0->1 or reset*

Recurrence: *see diagnosis*

Activation:

```
If            V_IGK  >  C_VB_MIN_MSW_DIAG
 and       Time since  V_IGK > C_VB_MIN_MSW_DIAG  greater
than  C_T_READY_CRU
 and       LV_VAR_MSW = 1
 and       LV_VAR_BN_MSW = 0
```

A.134.1 Determination of STATE_MSW_DATA /LV_MSW_MSG_VLD

Description:

The datas are used for function cruise control.

Formula section:

Calculation of LV_MSW_MSG_VLD:
If a single message is valid (no ERR_SYM_... is active, BIOS_LV_CRU_ERR = 0)
Then LV_MSW_MSG_VLD = 1
Else LV_MSW_MSG_VLD = 0
Endif
Calculation of STATE_MSW_DATA:
STATE_MSW_DATA = (range converted) BIOS_CRU_DATA

A.134.2 Redundant coding check of the signal (LV_ERR_MSW_2)

Application conditions

Recurrence:

```
80ms
 = every four equal messages plus delay time due to different
recurrency
 [ 4 x (15ms + Delay)]
```

Description:

Error-symptoms are defined to this diagnosis function as following :

```
[ | | | ]
 |  |  |  └─> -                    (= SYM_0)
 |  |  └────> -                    (= SYM_1)
 |  └───────> -                    (= SYM_2)
 └──────────> Signal implausible   (= SYM_3)
```

Formula section:

Calculation of diagnosis condition:
If at least one of the bits for WA, S/B or OFF is active in BIOS_CRU_DATA
Then LV_CDN_DIAG_MSW_2 = 1
Error detection and plausibility:
If Redundant coding is infringed (see "Supplementary functions" chapter, CRU)
Then ERR_SYM_MSW_2 = SYM_3
// LV_ERR_MSW_2 = 1 after debounce by error management

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Else ERR_SYM_MSW_2 = NO_SYM
// LV_ERR_MSW_2 = 0 *after rebounce by error management*
Endif
Else LV_CDN_DIAG_MSW_2 = 0
Endif
Calculation end of diagnosis:
LV_END_DIAG_MSW_2 is calculated by error management if diagnosis condition is true.

A.134.3 Toggle switch test (LV_ERR_MSW_3)

Application conditions

Recurrence:
```
80ms
 = every four equal messages plus delay time due to different
recurrency
 [ 4 x (15ms + Delay)]
```

Description:

The toggle switch condition is checked for each new message (BIOS_CRU_DATA) in which S/B or VE are active. If this is infringed, the preceding message remains valid.

Error-symptoms are defined to this diagnosis function as following :

```
□□□□
| | | └─> -                        (= SYM_0)
| | └───> -                        (= SYM_1)
| └─────> -                        (= SYM_2)
└───────> Rocker switch defect     (= SYM_3)
```

Formula section:

Calculation of diagnosis condition:
If S/B or VE is active in BIOS_CRU_DATA
Then LV_CDN_DIAG_MSW_3 = 1
Error detection and plausibility:
If S/B and VE are simultaneously active
Then ERR_SYM_MSW_3 = SYM_3
// LV_ERR_MSW_3 = 1 *after debounce by error management*
Else ERR_SYM_MSW_3 = NO_SYM
// LV_ERR_MSW_3 = 0 *after rebounce by error management*
Endif
Else LV_CDN_DIAG_MSW_3 = 0
Endif
Calculation end of diagnosis:
LV_END_DIAG_MSW_3 is calculated by error management if diagnosis condition is true.

A.134.4 Toggle bit monitoring (LV_ERR_MSW_TOG)

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Application conditions

Recurrence: `each change of toggle bit (error free: about 0.5s)`

Description:

The diagnosis condition is set latest if C_T_MAX_MSW_BIT_DIAG is reached, after this the diagnosis condition is on and T_TOG (time between two state changes of the toggle bit BIOS_CRU_TOG) is checked for MIN and MAX time at each new message.

If C_T_MAX_MSW_BIT_DIAG is reached without toggle bit change the error LV_ERR_MSW_TOG is set directly without debounce.

If toggle bit change is faster C_T_MIN_MSW_BIT_DIAG then the error symptom ERR_SYM_MSW_TOG is set and the anti-bounce is inrementing.

Error-symptoms are defined to this diagnosis function as following :

```
┌─┬─┬─┬─┐
│ │ │ └─┘
│ │ │  └──> -                                  (= SYM_0)
│ │ └─────> -                                  (= SYM_1)
│ └───────> -                                  (= SYM_2)
└─────────> Toggle-bit period is wrong         (= SYM_3)
```

Formula section:

Error detection and plausibility:
T_TOG is incrementing (10ms steps) and reseted at every toggle bit change

If a full toggle bit cycle is received
Then LV_CDN_DIAG_MSW_TOG = 1
  If T_TOG $\leq$ C_T_MIN_MSW_BIT_DIAG
  Then ERR_SYM_MSW_TOG = SYM_3
    // LV_ERR_MSW_TOG = 1 after debounce by error management
  Else ERR_SYM_MSW_TOG = NO_SYM
    // LV_ERR_MSW_TOG = 0 after rebounce by error management
  Endif
ElseIf T_TOG > C_T_MAX_MSW_BIT_DIAG
  Then LV_CDN_DIAG_MSW_TOG = 1
    ERR_SYM_MSW_TOG = SYM_3
    LV_ERR_MSW_TOG = 1
    //set directly without debounce, Anti-bounce counter is set to max value
  Else no change
  Endif
Endif

Calculation end of diagnosis:
LV_END_DIAG_MSW_TOG is calculated by error management if diagnosis condition is true.

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A.135 Variable intake manifold diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_VIMPWM_1_FB	-	0... FFH	0... 255	1	-
Antibounce counter for DISA failure feedback diagnosis.					
ABC_VIMPWM_2_FB	-	0... FFH	0... 255	1	-
Antibounce counter for DISA failure feedback diagnosis.					
CDN_DIAG_VIM_1_BAS	O	0... 7H	0 ...7	1	-
Primary diagnosis condition read from the infrastructure for each symptom of VIM bit 0: diagnosis condition for symptom SYM_0 (SCP) bit 1: diagnosis condition for symptom SYM_1 (SCG) bit 2: diagnosis condition for symptom SYM_2 (OC)					
CDN_DIAG_VIM_1_EL	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of VIM_1bit 0: diagnosis condition for symptom SCP (SYM_0)bit 1: diagnosis condition for symptom SCG (SYM_1)bit 2: diagnosis condition for symptom OC (SYM_2)					
CDN_DIAG_VIM_2_BAS	O	0... 7H	0 ...7	1	-
Primary diagnosis condition read from the infrastructure for each symptom of VIM bit 0: diagnosis condition for symptom SYM_0 (SCP) bit 1: diagnosis condition for symptom SYM_1 (SCG) bit 2: diagnosis condition for symptom SYM_2 (OC)					
CDN_DIAG_VIM_2_EL	V	0... 7H	0 ...7	1	-
Diagnosis condition for each symptom of VIM_2bit 0: diagnosis condition for symptom SCP (SYM_0)bit 1: diagnosis condition for symptom SCG (SYM_1)bit 2: diagnosis condition for symptom OC (SYM_2)					
CTR_VIMPWM_1_EDGE	O/V/S	0... FFFFFFH	0... 16777215	1	-
counter detection switch flap 1					
CTR_VIMPWM_2_EDGE	O/V/S	0... FFFFFFH	0... 16777215	1	-
counter detection switch flap 2					
ERR_DIAG_VIM_1	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for VIM_1 (only parameter)					
ERR_DIAG_VIM_2	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Raw value of error symptom for VIM_2 (only parameter)					
ERR_SYM_VIM_1_EL	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom VIM_1 diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_VIM_2_EL	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom VIM_2 diagnosis					
ERR_SYM_VIMPWM_1_FB	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom DISA failure feedback diagnosis.					
ERR_SYM_VIMPWM_2_FB	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom DISA failure feedback diagnosis.					
ERR_VIMPWM_1_FB	O/V	0... FFH	0... 255	1	-
00H: no failure feedback01H: failure 1 detected by control unitFFH: init value /feedback possibleThe values 01H are only valid, if LV_VIMPWM_1_FB_VLD = 1, else the failure is only supposed.					
ERR_VIMPWM_2_FB	O/V	0... FFH	0... 255	1	-
00H: no failure feedback01H: failure 1 detected by control unitFFH: init value /feedback possibleThe values 01H are only valid, if LV_VIMPWM_2_FB_VLD = 1, else the failure is only supposed.					
LV_CDN_DIAG_VIM_1_EL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition VIM_1 diagnosis					
LV_CDN_DIAG_VIM_2_EL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition VIM_2 diagnosis					
LV_CDN_DIAG_VIMPWM_1_FB	V	0... 1H	0 ...1	1	-
Diagnosis condition DISA failure feedback diagnosis.					
LV_CDN_DIAG_VIMPWM_2_FB	V	0... 1H	0 ...1	1	-
Diagnosis condition DISA failure feedback diagnosis.					
LV_EDGE_DIAG_VIM_1	V	0... 1H	0 ...1	1	-
DISA switch ready (Flap 1)					
LV_EDGE_DIAG_VIM_2	V	0... 1H	0 ...1	1	-
DISA switch ready (Flap 2)					
LV_EDGE_VIM_1	V	0... 1H	0 ...1	1	-
DISA switch (Flap 1)					
LV_EDGE_VIM_2	V	0... 1H	0 ...1	1	-
DISA switch (Flap 2)					
LV_END_DIAG_VIM_1_EL	O/V	0... 1H	0 ...1	1	-
End of diagnosis VIM_1 diagnosis					
LV_END_DIAG_VIM_2_EL	O/V	0... 1H	0 ...1	1	-
End of diagnosis VIM_2 diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_VIMPWM_1_FB	V	0... 1H	0 ...1	1	-
End of diagnosis DISA failure feedback diagnosis.					
LV_END_DIAG_VIMPWM_2_FB	V	0... 1H	0 ...1	1	-
End of diagnosis DISA failure feedback diagnosis.					
LV_ERR_VIM_1	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on VIM_1 (VIM_H) signal.					
LV_ERR_VIM_1_EL	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on VIM_1 (VIM_H) signal.					
LV_ERR_VIM_2	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on VIM_2 (VIM_L) signal.					
LV_ERR_VIM_2_EL	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on VIM_2 (VIM_L) signal.					
LV_ERR_VIMPWM_1_FB	O/V	0... 1H	0 ...1	1	-
Error currently present, indicated by failure feedback from DISA control unit.					
LV_ERR_VIMPWM_2_FB	O/V	0... 1H	0 ...1	1	-
Error currently present, indicated by failure feedback from DISA control unit.					
LV_INH_DIAG_VIM_1_EL	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition VIM_1 diagnosis					
LV_INH_DIAG_VIM_2_EL	O/V	0... 1H	0 ...1	1	-
Diagnosis inhibition VIM_2 diagnosis					
LV_VIMPWM_1_FB_VLD	O/V	0... 1H	0 ...1	1	-
If LV_VIMPWM_1_FB_VLD = 1 the failure number ERR_VIMPWM_1_FB (01H) is valid					
LV_VIMPWM_2_FB_VLD	O/V	0... 1H	0 ...1	1	-
If LV_VIMPWM_2_FB_VLD = 1 the failure number ERR_VIMPWM_2_FB (01H) is valid					
T_ACT_VIMPWM_1_FB	-	0... FFFFH	0... 6553.5	0.1	s
Time with VIMPWM_1 > C_VIMPWM_MIN_FB necessary to have failure feedback from DISA control unit					
T_ACT_VIMPWM_2_FB	-	0... FFFFH	0... 6553.5	0.1	s
Time with VIMPWM_2 > C_VIMPWM_MIN_FB necessary to have failure feedback from DISA control unit					
T_DIAG_VIMPWM_1_FB	V	0... FFFFH	0... 6553.5	0.1	s
feedback timer to allow decrement after switch (Flap 1)					
T_DIAG_VIMPWM_2_FB	V	0... FFFFH	0... 6553.5	0.1	s
feedback timer to allow decrement after switch (Flap 2)					
T_VIMPWM_1_FB	V	0... FFH	0... 25.5	0.1	s
Timer counting tlow for failure feedback recognition					
T_VIMPWM_2_FB	-	0... FFH	0... 25.5	0.1	s
Timer counting tlow for failure feedback recognition					

Input data:

LV_CDN_VB_MIN_DIAG {p. 1185}	LV_CDN_VB_OBD1 {p. 1185}	LV_ERR_SPI_MPS {p. 4245}	LV_IGK {p. 906}
LV_VIM_1 {p. 3622}	LV_VIM_2 {p. 3622}	N_32 {p. 1525}	VIMPWM_1 {p. 3622}
VIMPWM_2 {p. 3622}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_VIMPWM_1_FB	-	0... FFH	0... 255	1	-
ABC Decrement for VIMPWM_1_FB Diagnosis					
C_ABC_DEC_VIMPWM_2_FB	-	0... FFH	0... 255	1	-
ABC Decrement for VIMPWM_2_FB Diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_VIM_1_EL	-	0... FFH	0... 255	1	-
Debounce counter increment VIM_1 diagnosis					
C_ABC_INC_VIM_2_EL	-	0... FFH	0... 255	1	-
Debounce counter increment VIM_2 diagnosis					
C_ABC_INC_VIMPWM_1_FB	-	0... FFH	0... 255	1	-
ABC Increment for VIMPWM_1_FB Diagnosis					
C_ABC_INC_VIMPWM_2_FB	-	0... FFH	0... 255	1	-
ABC Increment for VIMPWM_2_FB Diagnosis					
C_ABC_MAX_VIM_1_EL	-	1... FFH	1... 255	1	-
Debounce counter maximum value VIM_1 diagnosis					
C_ABC_MAX_VIM_2_EL	-	1... FFH	1... 255	1	-
Debounce counter maximum value VIM_2 diagnosis					
C_ABC_MAX_VIMPWM_1_FB	-	1... FFH	1... 255	1	-
ABC Maximum for VIMPWM_1_FB Diagnosis					
C_ABC_MAX_VIMPWM_2_FB	-	1... FFH	1... 255	1	-
ABC Maximum for VIMPWM_2_FB Diagnosis					
C_N_MAX_ERR_VIM_FB	-	0... FFH	0... 8160	32	rpm
Engine speed threshold, no VIM feedback error above					
C_T_ACT_VIMPWM_1_FB	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time necessary to have failure feedback from DISA control unit					
C_T_ACT_VIMPWM_2_FB	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time necessary to have failure feedback from DISA control unit					
C_T_DIAG_VIMPWM_1_FB	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time necessary after switch to allow decrement (Flap 1)					
C_T_DIAG_VIMPWM_2_FB	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time necessary after switch to allow decrement (Flap 2)					
C_T_VIMPWM_1_FB_MAX	-	0... FFH	0... 25.5	0.1	s
Time range necessary for identification of failure feedback maximal value					
C_T_VIMPWM_1_FB_MIN	-	0... FFH	0... 25.5	0.1	s
Time range necessary for identification of failure feedback minimal value					
C_T_VIMPWM_2_FB_MAX	-	0... FFH	0... 25.5	0.1	s
Time range necessary for identification of failure feedback maximal value					
C_T_VIMPWM_2_FB_MIN	-	0... FFH	0... 25.5	0.1	s
Time range necessary for identification of failure feedback minimal value					
C_VIM_PWM_DIAG_MAX_SCG	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
Maximum threshold for SCG diagnosis window					
C_VIM_PWM_DIAG_MIN_OC	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
Minimum threshold for OC diagnosis window					
C_VIM_PWM_DIAG_MIN_SCP	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
Minimum threshold for SCB diagnosis window					
C_VIMPWM_1_MIN_FB	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
Minimum duty cycle of VIMPWM_1 to have a failure feedback from DISA control unit					
C_VIMPWM_2_MIN_FB	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
Minimum duty cycle of VIMPWM_2 to have a failure feedback from DISA control unit					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_PSD_DLY_VIM_EL	-	1... FH	1... 15	1	-
Number of recurrences with diagnosis deactivation after diagnosis activation conditions are met (typical 2)					

Import actions:

ACTION_ERRM_FilterMulticondition (**IN**<XX>,**IN**<CDN_DIAG_>,**XX**>,<IN<>,**ERR_DIAG_XX**>,<IN>,<C_ABC_INC_XX>,**IN**<C_ABC_MAX_XX>,**OUT**<LV_ERR_XX>)

A.135.1 Summary of all VIM diagnosis

FUNCTION DESCRIPTION:

This function shall summarize all VIM failures in one flag only for each VIM.

Description:

Application conditions

Initialisation: reset **or** FMY reset **or** LV_IGK = 0 -> 1
LV_ERR_VIM_1 = 0
LV_ERR_VIM_2 = 0

Recurrence: 100ms

Activation: every ECU state

Formula section:

If LV_ERR_VIM_1_EL = 1 or LV_ERR_VIMPWM_1_FB = 1
Then LV_ERR_VIM_1 = 1
Else LV_ERR_VIM_1 = 0
Endif

If LV_ERR_VIM_2_EL = 1 or LV_ERR_VIMPWM_2_FB = 1
Then LV_ERR_VIM_2 = 1
Else LV_ERR_VIM_2 = 0
Endif

A.135.2 Diagnostic information from infrastructure

FUNCTION DESCRIPTION:

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Description:

The DISA control unit is controlled by a PWM signal line driven by the ATIC 39. The driver can distinguish between three symptoms: 'Short circuit to Vbatt', 'Short circuit to GND' and 'Open Load'.
This function reads the failure information (ERR_DIAG_VIM_1/2) from the infrastructure.

Application conditions

Initialisation: `reset` **or** `reset of failure memory` **or** `LV_IGK = 0 -> 1`
`CDN_DIAG_VIM_1_BAS = 0`
`CDN_DIAG_VIM_2_BAS = 0`
`ERR_DIAG_VIM_1 = 0`
`ERR_DIAG_VIM_2 = 0`

Recurrence: `100ms`

Activation: `every ECU state`

Formula section:

Usage of the diagnosis information (failure symptoms (raw value) ERR_DIAG_VIM_1/2 and diagnosis conditions CDN_DIAG_VIM_1_BAS/2_BAS received from the infrastructure:

Diagnosis conditions are set according infrastructure info.: CDN_DIAG_VIM_1_BAS/2_BAS
Failure symptoms are set according infrastructure info.: ERR_DIAG_VIM_1/2

A.135.3 Failure feedback recognition of VIM

FUNCTION DESCRIPTION:

If a failure is detected from the DISA control unit, a failure feedback is send to the ECU by pulling the signal line (interface ECU to the DISA control unit) to ground in a defined pattern. The time t_{low} is an identification for the failure.

Description:

For the recognition of the failure feedback the information, if a failure "short circuit to ground" is detected on the signal line between ECU and DISA control unit is used.

Application conditions

Initialisation: `at reset` **or** `FMY reset` **or** `LV_IGK = 0 -> 1`
`ERR_VIMPWM_1_FB = FFH`
`ERR_VIMPWM_2_FB = FFH`
`T_VIMPWM_1_FB = 0`
`T_VIMPWM_2_FB = 0`
`LV_VIMPWM_1_FB_VLD = 0`
`LV_VIMPWM_2_FB_VLD = 0`

Recurrence: `100ms`
FB-Diagnosis has to be calculated ***after*** *VIM-Powerstage-Diagnosis*

Activation: `LV_IGK = 1` **and**
`LV_CDN_VB_MIN_DIAG = 1` **and**
$N\_32 \leq C\_N\_MAX\_ERR\_VIM\_FB$ **and**
`LV_ERR_SPI_MPS = 0`

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Deactivation: not activation
at deactivation function is initialized
one time

Formula section:

LV_VIMPWM_1_FB_VLD = 0

If ERR_DIAG_VIM_1 = 2 *(SCG detected by Powerstage-diagnosis)*
Then T_VIMPWM_1_FB = T_VIMPWM_1_FB + 100ms
ERR_VIMPWM_1_FB = FFH *(failure feedback possible)*
If T_VIMPWM_1_FB > C_T_VIMPWM_1_FB_MAX
(T_VIMPWM_1_FB out of range for FB)
Then ERR_VIMPWM_1_FB = 00H
Endif
Else
If C_T_VIMPWM_1_FB_MIN ≤ T_VIMPWM_1_FB ≤ C_T_VIMPWM_1_FB_MAX
Then *failure feedback detected*
ERR_VIMPWM_1_FB = 01H
LV_VIMPWM_1_FB_VLD = 1
Else *no failure feedback possible*
ERR_VIMPWM_1_FB = 00H
Endif
T_VIMPWM_1_FB = 0
Endif

The same calculation is done for all ...VIMPWM_2...-outputs.

A.135.4 Electrical diagnosis of VIM (LV_ERR_VIM_1 /2_EL)

FUNCTION DESCRIPTION:

General information:

The purpose is to diagnose the electrical signal from the two drivers which controls the VIM.

Description:

The driver can distinguish between three symptoms: ‘Short circuit to Vbatt’, ‘Short circuit to GND’ and ‘Open Load’.
The error detection algorithm in this function for “short circuit to GND” is respecting the status of the failure feedback recognition (ERR_VIMPWM_1_FB and ERR_VIMPWM_2_FB). The failure, detected by the HW, is delivered from the infrastructure ERR_DIAG_VIM_1 and ERR_DIAG_VIM_2.

Error-symptoms: are defined to this diagnosis function as following :

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```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │  │  │  └─> Short circuit to Vbatt          (= SYM_0)
 │  │  └───> Short circuit to GND             (= SYM_1)
 │  └─────> Open load                         (=SYM_2)
 └───────> -                                  (=SYM_3)
```

Application conditions

Initialisation: according Filter-type **MPL_STD_INI**
(reset of variables at LV_IGK 0 -> 1 or ECU reset)
LV_ERR_VIM_1_EL = 0
LV_ERR_VIM_2_EL = 0
CDN_DIAG_VIM_1_EL = 0
CDN_DIAG_VIM_2_EL = 0
ERR_SYM_VIM_1_EL = 0
ERR_SYM_VIM_2_EL = 0
LV_INH_DIAG_VIM_1_EL = 0
LV_INH_DIAG_VIM_2_EL = 0

Recurrence: 100ms

Activation: at every engine operating state

Formula section:

Diagnosis inhibition:

If LV_IGK = 1 **and**
LV_CDN_VB_OBD1 = 1 **and**
LV_ERR_SPI_MPS = 0
Then LV_INH_DIAG_VIM_1_EL = 0
Else LV_INH_DIAG_VIM_1_EL = 1
Endif

If LV_INH_DIAG_VIM_1_EL = 0
Then

Note: The failure symptoms ERR_SYM_VIM_1_EL and the diagnosis conditions CDN_DIAG_VIM_1_EL (raw values) shall be set according infrastructure information ERR_DIAG_VIM_1 and CDN_DIAG_VIM_1_BAS.

If Activation conditions are met for the NC_PSD_DLY_VIM_EL recurrence
And ERR_VIMPWM_1_FB = 00h
Then

{ Additional diagnosis conditions }
If VIMPWM_1 < C_VIM_PWM_DIAG_MIN_SCP
{ condition that disables the SYM_0 detection }
Then
bit 0 of CDN_DIAG_VIM_1_EL = 0 *{ Diagnosis of SCP is not possible }*
Endif
If VIMPWM_1 > C_VIM_PWM_DIAG_MAX_SCG
{ condition that disables the SYM_1 detection }
Then
bit 1 of CDN_DIAG_VIM_1_EL = 0 *{ Diagnosis of SCG is not possible }*

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Endif
If VIMPWM_1 < C_VIM_PWM_DIAG_MIN_OC
or VIMPWM_1 > C_VIM_PWM_DIAG_MAX_SCG
{ conditions that disable the SYM_2 detection }
Then
bit 2 of CDN_DIAG_VIM_1_EL = 0 *{ Diagnosis of OC is not possible }*
Endif
Else
CDN_DIAG_VIM_1_EL = 0
Endif
Else
CDN_DIAG_VIM_1_EL = 0
Endif
The same calculation is done for all ...VIMPWM_2...-outputs.

Failure debouncing and error management treatment:
For failure and error management treatment the anti-bounce mechanism is called with the parameters CDN_DIAG_VIM_1/2_EL and ERR_DIAG_VIM_1/2.

ACTION_ERRM_FilterMulticondition (IN<VIMPWM_1/2_EL>,
IN<CDN_DIAG_VIM_1/2_EL>,
IN<ERR_DIAG_VIM_1/2>,
IN<C_ABC_INC_VIM_1/2_EL>, IN<C_ABC_MAX_VIM_1/2_EL>,
OUT< LV_ERR_VIM_1/2_EL>,
SYNCRONIZATION<CALL>)

This algorithm determines:
ERR_SYM_VIM_1/2_EL (detected error symptom)
LV_ERR_VIM_1/2_EL (Error flag for debounced error)
LV_CDN_DIAG_VIM_1/2_EL (Diagnosis condition information)
LV_END_DIAG_VIM_1/2_EL (End of diagnosis information)

A.135.5 Feedback diagnosis of VIM

FUNCTION DESCRIPTION:

General information:

If a failure is detected by the DISA control unit, a failure feedback is send to the ECU.

Description:

According the possible failure feedback from the DISA control unit (defined by ERR_VIMPWM_1/2_FB and LV_VIMPWM_1/2_FB_VLD), the diagnosis is managing the following failure: LV_ERR_VIMPWM_1/2_FB.

Error-symptoms of failure LV_ERR_VIMPWM_1/2_FB:

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```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 |  |  |  └─> not used                                  (= SYM_0)
 |  |  └───> not used                                  (= SYM_1)
 |  └─────> not used                                  (= SYM_2)
 └───────> problem on DISA control unit detected       (= SYM_3)
```

Application conditions

Initialization: at reset **or** FMY reset **or** LV_IGK = 0 -> 1
at NVRAM error CTR_VIMPWM_1_EDGE and CTR_VIMPWM_2_EDGE are set to 0

Remark:

CTR_VIMPWM_1_EDGE and CTR_VIMPWM_2_EDGE are lifetime counter, the are not initialized at SW version change!

according filter-type NO_FIL
T_ACT_VIMPWM_1_FB = 0
T_ACT_VIMPWM_2_FB = 0
T_DIAG_VIMPWM_1_FB = 0
T_DIAG_VIMPWM_2_FB = 0
ABC_VIMPWM_1_FB = 0
ABC_VIMPWM_2_FB = 0
LV_EDGE_VIM_1 = 0
LV_EDGE_VIM_2 = 0
LV_EDGE_DIAG_VIM_1 = 0
LV_EDGE_DIAG_VIM_2 = 0
LV_ERR_VIMPWM_1_FB = 0
LV_ERR_VIMPWM_2_FB = 0
LV_CDN_DIAG_VIMPWM_1_FB = 0
LV_CDN_DIAG_VIMPWM_2_FB = 0
ERR_SYM_VIMPWM_1_FB = 0
ERR_SYM_VIMPWM_1_FB = 0

Recurrence: 100ms

Activation: LV_CDN_VB_MIN_DIAG = 1 **and** LV_ERR_SPI_MPS = 0

Deactivation: LV_CDN_VB_MIN_DIAG = 0 **or** LV_ERR_SPI_MPS = 1
at deactivation: LV_CDN_DIAG_VIMPWM_1/2_FB = 0

Formula section:

LV_CDN_DIAG_VIMPWM_1_FB = 1

If VIMPWM_1 > C_VIMPWM_1_MIN_FB
Then T_ACT_VIMPWM_1_FB = T_ACT_VIMPWM_1_FB +100ms
T_ACT_VIMPWM_1_FB is limited to 6553.5s
Endif

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```
If(1) LV_VIM_1   01 or 10                          // Disa switchs
Then(1)      LV_EDGE_VIM_1 = 1                     // Switch detection
              T_DIAG_VIMPWM_1_FB = 0                   // Timer feedback re-set
                  If(2) C_ABC_INC_VIMPWM_1_FB > 0         // diagnosis activ /Disa available
              Then(2) CTR_VIMPWM_1_EDGE + 1          // counter increments irreversible
              Endif(2)                               //(reso/range FFFFFFh, 16777215 dec.)
Else(1)      If(3) LV_EDGE_VIM_1 = 1 and ERR_VIMPWM_1_FB = 0
                                                        // switch without failure feedback
              Then(3) T_DIAG_VIMPWM_1_FB = T_DIAG_VIMPWM_1_FB +100ms
                                                        // start feedback timer
              Else(3) T_DIAG_VIMPWM_1_FB = 0           // reset feedbacktimer
              Endif(3)
Endif(1)

If(4) T_DIAG_VIMPWM_1_FB >= C_T_DIAG_VIMPWM_1_FB// Timer limit (ca. 6 sek)
Then(4)      LV_EDGE_DIAG_VIM_1 = 1                       // Switch ready
              LV_EDGE_VIM_1 = 0                            // re-set switch-detection
Else(4)      LV_EDGE_DIAG_VIM_1 = 0
Endif(4)

If     LV_ERR_VIMPWM_1_FB = 0
Then         If LV_VIMPWM_1_FB_VLD = 1 (valid failure feedback information available)
              Then   ERR_SYM_VIMPWM_1_FB   =   SYM_3
                      LV_EDGE_VIM_1 = 0
                      ABC_VIMPWM_1_FB = ABC_VIMPWM_1_FB
                                                + C_ABC_INC_VIMPWM_1_FB
                       If         ABC_VIMPWM_1_FB   C_ABC_MAX_VIMPWM_1_FB
                       Then    LV_ERR_VIMPWM_1_FB = 1
                              LV_END_DIAG_VIMPWM_1_FB = 1
                       Endif
              Else    If         ERR_VIMPWM_1_FB = 0      (no failure feedback detected)
                      Then   ERR_SYM_VIMPWM_1_FB   =   0
                              If LV_EDGE_DIAG_VIM_1 = 1
                              Then ABC_VIMPWM_1_FB = ABC_VIMPWM_1_FB
                                                     - C_ABC_DEC_VIMPWM_1_FB
                              Endif
                              If         T_ACT_VIMPWM_1_FB   C_T_ACT_VIMPWM_1_FB
                              Then   LV_END_DIAG_VIMPWM_1_FB   =   1
                              Endif
                      Endif
              Endif
Endif
```

The same calculations are done for all ...VIMPWM_2...-outputs.

Diagnostic symptoms:

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Diagnostic **VIMPWM_1/2_ERR_FB**	**Symptom description**	**Symptom**	**Filter type**
failure feedback diagnosis of DISA control unit	see description	*SYM_0*	*NO*
		SYM_1	
		SYM_2	
		SYM_3	

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B - OBD II functions

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B.1 Ambient air temperature plausibility diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TAM_CAN	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom TAM_CAN diagnosis					
ERR_SYM_TAM_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom TAM_PLAUS					
LV_CDN_DIAG_TAM_CAN	V	0... 1H	0 ...1	1	-
Diagnosis condition TAM_CAN					
LV_CDN_DIAG_TAM_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis condition TAM_PLAUS					
LV_CDN_RBM_TAM_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis condition for RBM statistics TAM_PLAUS					
LV_CNL_DIAG_TAM_PLAUS	V	0... 1H	0 ...1	1	-
Irreversible stop of diagnosis TAM_PLAUS					
LV_DET_ERR_TAM_PLAUS	V	0... 1H	0 ...1	1	-
TAM-plaus error is detected but not validated					
LV_END_DIAG_TAM_CAN	V	0... 1H	0 ...1	1	-
End of Diagnosis cycle TAM_CAN					
LV_END_DIAG_TAM_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis cycle TAM_PLAUS					
LV_END_RBM_TAM_PLAUS	O/V	0... 1H	0 ...1	1	-
End of diagnosis cycle TAM_PLAUS for RBM statistics					
LV_ERR_TAM	O/V	0... 1H	0 ...1	1	-
Present failure on TIA sensor(s) which might affect temperature TAM					
LV_ERR_TAM_CAN	O/V	0... 1H	0 ...1	1	-
Boolean for error currently present on TAM sensor					
LV_ERR_TAM_PLAUS	O/V	0... 1H	0 ...1	1	-
TAM sensor signal is not plausible					
LV_VS_CDN_TAM_ERR	V	0... 1H	0 ...1	1	-
Bit information of status vehicle was driven with speed to validate the diagnosis result					
T_TAM_DIF_DIAG	V	0... FFH	0... 25.5	0.1	s
Timer for anti-bounce the temperature difference					
T_VS_MIN_VLD_TAM_ERR	V	0... FFFFH	0... 6553.5	0.1	s
Timer of vehicle speed period					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TAM_DIF_DIAG	V	0... FEH	0... 190.5	0.75	°C
TAM difference to detect a TAM error					
TAM_DIF_MAX_DIAG	V	0... FEH	-48... 142.5	0.75	°C
Maximum reached TAM in diagnosis cycle					
TAM_DIF_MIN_DIAG	V	0... FEH	-48... 142.5	0.75	°C
Minimum reached TAM in diagnosis cycle					
TAM_DIF_PLAUS	V	0... FEH	0... 190.5	0.75	°C
TAM difference to detect a moving signal					

Input data:

LV_DIAG_CDN_TAM_ PLAUS {p. 5083}	LV_ERR_BN_T_ICL {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_COM_2_BOFF {p. 801}
LV_ERR_COM_2_TAM_ ICL	LV_ERR_TOUT_ICL_3 {p. 802}	LV_ERR_TOUT_ICL_7 {p. 802}	LV_IGK {p. 906}
LV_INH_DIAG_TAM_ PLAUS {p. 5083}	LV_ST_END {p. 1720}	LV_STATE_ERR_CAN_ TOUT {p. 1567}	LV_TAM_CAN_ERR {p. 1567}
LV_VAR_TCO_2 {p. 656}	STATE_ERR_SYM_TAM_ CAN {p. 1573}	T_AST {p. 1766}	T_ES_CUS {p. 1444}
TAM {p. 1579}	TAM_ST {p. 1214}	TAM_STOP {p. 1214}	TCO {p. 1100}
TCO_2 {p. 1218}	TCO_2_ST {p. 1218}	TCO_ST {p. 1100}	TIA {p. 1226}
VS {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TAM_CAN	-	0... FFH	0... 255	1	-
Anti-bounce increment TAM_CAN diagnosis					
C_ABC_MAX_TAM_CAN	-	1... FFH	1... 255	1	-
Anti-bounce maximum TAM_CAN diagnosis					
C_T_AST_MAX_TAM_DIAG	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time after start to deactivate the diagnosis condition					
C_T_ES_MIN_TAM_DIAG	-	0... FFFFH	0... 65535	1	min
Minimum engine stop time to activate the diagnosis condition					
C_T_TAM_DIF_MAX_ERR	-	0... FFH	0... 25.5	0.1	s
Anti bounce time to detect a TAM error					
C_T_VS_MIN_VLD_TAM_ERR	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time perid of vehicle with speed					
C_TAM_DIF_MAX_ERR	-	0... FEH	0... 190.5	0.75	°C
Temperature difference to detect a TAM error					
C_TAM_DIF_PLAUS_MIN	-	0... FEH	0... 190.5	0.75	°C
Minimum TAM difference to detect a moving signal during engine run					
C_TAM_DIF_ST_END	-	0... FEH	0... 190.5	0.75	°C
Minimum TAM difference to detect a moving signal after start					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TAM_MAX_TAM_DIAG	-	0... FEH	-48... 142.5	0.75	°C
Maximum ambient temperature to activate the diagnosis condition					
C_TAM_MIN_TAM_DIAG	-	0... FEH	-48... 142.5	0.75	°C
Minimum ambient temperature to activate the diagnosis condition					
C_TCO_2_ST_MIN_TAM_DIAG	-	0... FEH	-48... 142.5	0.75	°C
Minimum exhaust engine cooling temperature to activate the diagnosis condition					
C_TCO_2_TIA_DIF_MAX	-	0... FEH	0... 190.5	0.75	°C
Maximum deviation between TCO_2 and TIA to start TAM_PLAUS diagnosis					
C_TCO_ST_MIN_TAM_DIAG	-	0... FEH	-48... 142.5	0.75	°C
Minimum engine cooling temperature to activate the diagnosis condition					
C_TCO_TIA_DIF_MAX	-	0... FEH	0... 190.5	0.75	°C
Maximum deviation between TCO and TIA to start TAM_PLAUS diagnosis					
C_VS_MIN_VLD_TAM_ERR	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed to count time period for error validation					

B.1.1 Global TAM system error (LV_ERR_TAM)

General information:

The global error flag LV_ERR_TAM can be used for inhibition. It is set if a CAN or a plausibility TIA error occure.

Application conditions

Initialisation: *0 at reset*

Recurrence: *100ms*

Activation: *LV_IGK = 1*

Formula section:

If LV_ERR_TAM_CAN = 1 **or** LV_ERR_TAM_PLAUS = 1
Then LV_ERR_TAM = 1
Else LV_ERR_TAM = 0
Endif

B.1.2 CAN based TAM - signal diagnosis (LV_ERR_TAM_CAN)

General information:

The purpose of the diagnosis shall be to detect electrical faults as defined by OBD I requirements. The input signals are from CAN.

Description:

Error symptoms are defined for this diagnosis function as:

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```
□□□□
| | | └─> short circuit to vbatt or open line     (= SYM_0)
| | └───> short circuit to ground                 (= SYM_1)
| └─────> signal error                            (= SYM_2)
└───────> -                                       (= SYM_3)
```

Application conditions

Initialization: according ABC configuration **STD_INI**
(ABC datas are initialized at transition LV_IGK 0->1)

Recurrence: 100 ms

Activation: LV_IGK = 1

Formula section:

```
LV_CDN_DIAG_TAM_CAN = 1
ERR_SYM_TAM_CAN = NO_SYM
If          LV_ERR_CAN_BOFF          = 0   and
            LV_ERR_COM_2_BOFF        = 0   and
            LV_ERR_TOUT_ICL_7        = 0   and
            LV_STATE_ERR_CAN_TOUT    = 0   and
          STATE_ERR_SYM_TAM_CAN = SCP      // error symptom get from CAN
Then      ERR_SYM_TAM_CAN = SYM_0
Elseif      LV_ERR_CAN_BOFF          = 0   and
            LV_ERR_COM_2_BOFF        = 0   and
            LV_ERR_TOUT_ICL_7        = 0   and
            LV_STATE_ERR_CAN_TOUT    = 0   and
          STATE_ERR_SYM_TAM_CAN = SCG      // error symptom get from CAN
Then      ERR_SYM_TAM_CAN = SYM_1
Elseif      LV_TAM_CAN_ERR           = 1   and
            LV_ERR_TOUT_ICL_3        = 0   and
            LV_ERR_BN_T_ICL          = 0   and
            LV_ERR_CAN_BOFF          = 0   and
            LV_ERR_COM_2_TAM_ICL     = 0   and
            LV_ERR_COM_2_BOFF        = 0
Then      ERR_SYM_TAM_CAN = SYM_2
Endif
```

Calculation of present error and end of diagnosis:
LV_ERR_TAM_CAN and LV_END_DIAG_TAM_CAN are calculated by error management

B.1.3 Ambient temperature sensor plausibility check (LV_ERR_TAM_PLAUS)

FUNCTION DESCRIPTION:

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General information:

This diagnosis is performed in order to detect a stucking or not plausible TAM signal which cannot be detected by electrical range diagnosis.

Description:

Diagnosis condition:
The diagnosis should only be activated:

- after a long engine stop time, e.g. > 10h in order to get similar temperatures of TAM /TIA /TCO_2 or TCO (depending on variant coding LV_VAR_TCO_2)
- if TAM is in a "critical" range e.g. fade out temperature of other OBD2 diagnosis
- just after start to avoid warming-up effects, e.g. within 5 s
- not in cold environment, because it's not requested by law

If these conditions are not fulfilled the diagnosis is switched off if C_T_AST_MAX_TAM_DIAG is elapsed after start.

Error detection
The TAM_PLAUS error is detected if the temperature-difference TAM_DIF_DIAG is over the threshold C_TAM_DIF_MAX_ERR for the anti-bounce time C_T_TAM_DIF_MAX_ERR.

End of diagnosis cycle with positive result
The positive diagnosis result is based on the monitoring of the alteration of TAM at and can be reached even if a error is detected or the validation phase is running.

- Just after start, comparing the start and stop temperature
- During warm up phase

If a alteration is detected the diagnosis is finished.
Error validation
The validation is only performed if all el. diagnosis for TIA /TCO_2 or TCO and finished (LV_DIAG_CDN_TAM_PLAUS = 1) and the vehicle was driven with a certain vehicle speed
(C_VS_MIN_VLD_TAM_ERR for C_T_VS_MIN_VLD_TAM_ERR).
If both conditions are true and a error was detected then the error LV_ERR_TAM_PLAUS is set for this driving cylce and the diagnosis is switched off.

Application conditions

Initialisation: 0 at LV_IGK 0->1 **or** reset **or** at clearing error memory
TAM_DIF_MAX / MIN_DIAG = TAM_ST
at LV_ST_END = 1 **or** reset **or** at clearing error memory

Recurrence: *100ms*

Activation: *LV_ST_END = 1*

Deactivation: LV_END_DIAG_TAM_PLAUS = 1 **or**
LV_INH_DIAG_TAM_PLAUS = 1 **or**
LV_CNL_DIAG_TAM_PLAUS = 1
(set LV_CDN_DIAG_TAM_PLAUS = 0 at deactivation)

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Formula section:

Calculation of TAM_DIF_PLAUS to end the diagnosis
TAM_DIF_MAX_DIAG = MAX [TAM, TAM_DIF_MAX_DIAG(n-1)]
TAM_DIF_MIN_DIAG = MIN [TAM, TAM_DIF_MIN_DIAG(n-1)]
TAM_DIF_PLAUS = ABS (TAM_DIF_MAX_DIAG - TAM_DIF_MIN_DIAG)
If TAM_DIF_PLAUS > C_TAM_DIF_PLAUS_MIN **or** *//e.g. 3°C*
ABS (TAM_STOP - TAM_ST) > C_TAM_DIF_ST_END *//e.g. 5°C*
Then LV_CDN_DIAG_TAM_PLAUS = 1
LV_END_DIAG_TAM_PLAUS = 1
Endif
Calculation of diagnosis condition /error detection
If(1) T_AST < C_T_AST_MAX_TAM_DIAG **and** *//e.g. 5s*
LV_DET_ERR_TAM_PLAUS = 0
Then(1)
If(2) T_ES_CUS > C_T_ES_MIN_TAM_DIAG **and** *//e.g. >10h*
[TAM > C_TAM_MAX_TAM_DIAG **or** *//e.g. >35°C or < -10°C*
TAM < C_TAM_MIN_TAM_DIAG]
Then(2) *// conditions to calculate TAM_DIF_DIAG fulfilled*
If(3) LV_VAR_TCO_2 = 1
Then(3)
If(4)
TCO_2_ST > C_TCO_2_ST_MIN_TAM_DIAG **and** *//e.g. > -7°C*
ABS[TCO_2 - TIA] < C_TCO_2_TIA_DIF_MAX **and** *//e.g. < 10°C*
Then(4)
LV_CDN_RBM_TAM_PLAUS = 1
TAM_DIF_DIAG = ABS [(TIA + TCO_2) * 0.5 - TAM]
Else(4)
TAM_DIF_DIAG = TAM_DIF_DIAG *//freeze*
Endif(4)
Else(3)
If(4a)
TCO_ST > C_TCO_ST_MIN_TAM_DIAG **and** *//e.g. > -7°C*
ABS[TCO - TIA] < C_TCO_TIA_DIF_MAX **and** *//e.g. < 10°C*
Then(4a)
LV_CDN_RBM_TAM_PLAUS = 1
TAM_DIF_DIAG = ABS [(TIA + TCO) * 0.5 - TAM]
Else(4a)
TAM_DIF_DIAG = TAM_DIF_DIAG *//freeze*
Endif(4a)
Endif(3)
Endif(2)
Else(1) **If** LV_DET_ERR_TAM_PLAUS = 0 **and**
LV_CDN_RBM_TAM_PLAUS = 0
Then LV_CNL_DIAG_TAM_PLAUS = 1 *//deactivation of diagnosis*
Else stop diagnosis condition calculation, waiting for LV_END_DIAG_TAM_PLAUS
Endif
Endif(1)
Calculation of debounce-timer for error detection
If TAM_DIF_DIAG > C_TAM_DIF_MAX_ERR
Then T_TAM_DIF_DIAG ++

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```
        If      T_TAM_DIF_DIAG > C_T_TAM_DIF_MAX_ERR        //e.g.1s
        Then        LV_DET_ERR_TAM_PLAUS = 1
        Endif
Else        T_TAM_DIF_DIAG - -
Endif
```

Calculation of minimum time period of vehicle with speed

```
If              VS > C_VS_MIN_VLD_TAM_ERR                    //e.g. 50km/h
Then        T_VS_MIN_VLD_TAM_ERR ++
        If              T_VS_MIN_VLD_TAM_ERR > C_T_VS_MIN_VLD_TAM_ERR
        Then                LV_VS_CDN_TAM_ERR = 1
        Endif
Else        T_VS_MIN_VLD_TAM_ERR = T_VS_MIN_VLD_TAM_ERR        //freeze
Endif
```

End of diagnosis cycle

```
If              LV_DIAG_CDN_TAM_PLAUS = 1       and      //TIA /TCO_2 or TCO signal
is valid
            LV_VS_CDN_TAM_ERR = 1                        //Vehicle was driven
Then        LV_CDN_DIAG_TAM_PLAUS = 1
            ERR_SYM_TAM_PLAUS = NO_SYM
            LV_END_DIAG_TAM_PLAUS = 1
            LV_END_RBM_TAM_PLAUS = 1
        If          LV_DET_ERR_TAM_PLAUS = 1
        Then        ERR_SYM_TAM_PLAUS = SYM_3
                      LV_ERR_TAM_PLAUS = 1
        Endif
Endif
```

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B.2 Ambient air temperature plausibility diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_CDN_TAM_PLAUS	O/V	0... 1H	0 ...1	1	-
Flag for status all TCO /TCO_2 diagnosis cycle are finished					
LV_INH_DIAG_TAM_PLAUS	O/V	0... 1H	0 ...1	1	-
Inhibition of TAM plaus diagnosis due to present error					
STATE_RBM_TAM_PLAUS	O/V	0... 7H	0 ...7	1	-
Interface of TAM_PLAUS monitor with the Rate-Based Monitoring statisticsBit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1)Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1)Bit 2: individual RBM co					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CDN_CST_RBM {p. 5870}	LV_DC {p. 5746}	LV_END_DIAG_TCO_2_EL {p. 4572}
LV_END_DIAG_TCO_2_GRD {p. 4572}	LV_END_DIAG_TCO_EL {p. 4496}	LV_END_DIAG_TCO_GRD {p. 4496}	LV_END_DIAG_TIA_EL {p. 4194}
LV_END_RBM_TAM_PLAUS {p. 5076}	LV_ERR_BN_T_ICL {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_COM_2_BOFF {p. 801}
LV_ERR_COM_2_T_ICL {p. 801}	LV_ERR_COM_2_TAM_ICL	LV_ERR_T_ES {p. 4466}	LV_ERR_TAM_CAN {p. 5076}
LV_ERR_TCO {p. 4496}	LV_ERR_TIA {p. 4200}	LV_ERR_VS {p. 5021}	LV_IGK {p. 906}
LV_ST_END {p. 1720}	LV_VAR_TCO_2 {p. 656}	NC_IDX_DIAG_BN_T_ICL	NC_IDX_DIAG_CAN_BOFF
NC_IDX_DIAG_COM_2_BOFF	NC_IDX_DIAG_COM_2_T_ICL	NC_IDX_DIAG_COM_2_TAM_ICL	NC_IDX_DIAG_T_ES
NC_IDX_DIAG_TAM_CAN	NC_IDX_DIAG_TCO_EL	NC_IDX_DIAG_TCO_GRD	NC_IDX_DIAG_TCO_PLAUS
NC_IDX_DIAG_TCO_STUCK	NC_IDX_DIAG_TCO_STUCK_RNG	NC_IDX_DIAG_TIA_EL	NC_IDX_DIAG_TIA_GRD
NC_IDX_DIAG_TIA_PLAUS	NC_IDX_DIAG_VS {p. 5024}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_INH_DIAG_TAM_PLAUS	-	0... 1H	0 ...1	1	-
Switch to shut off the TAM plaus diagnosis (=1)					

Import actions:

Continued on next page

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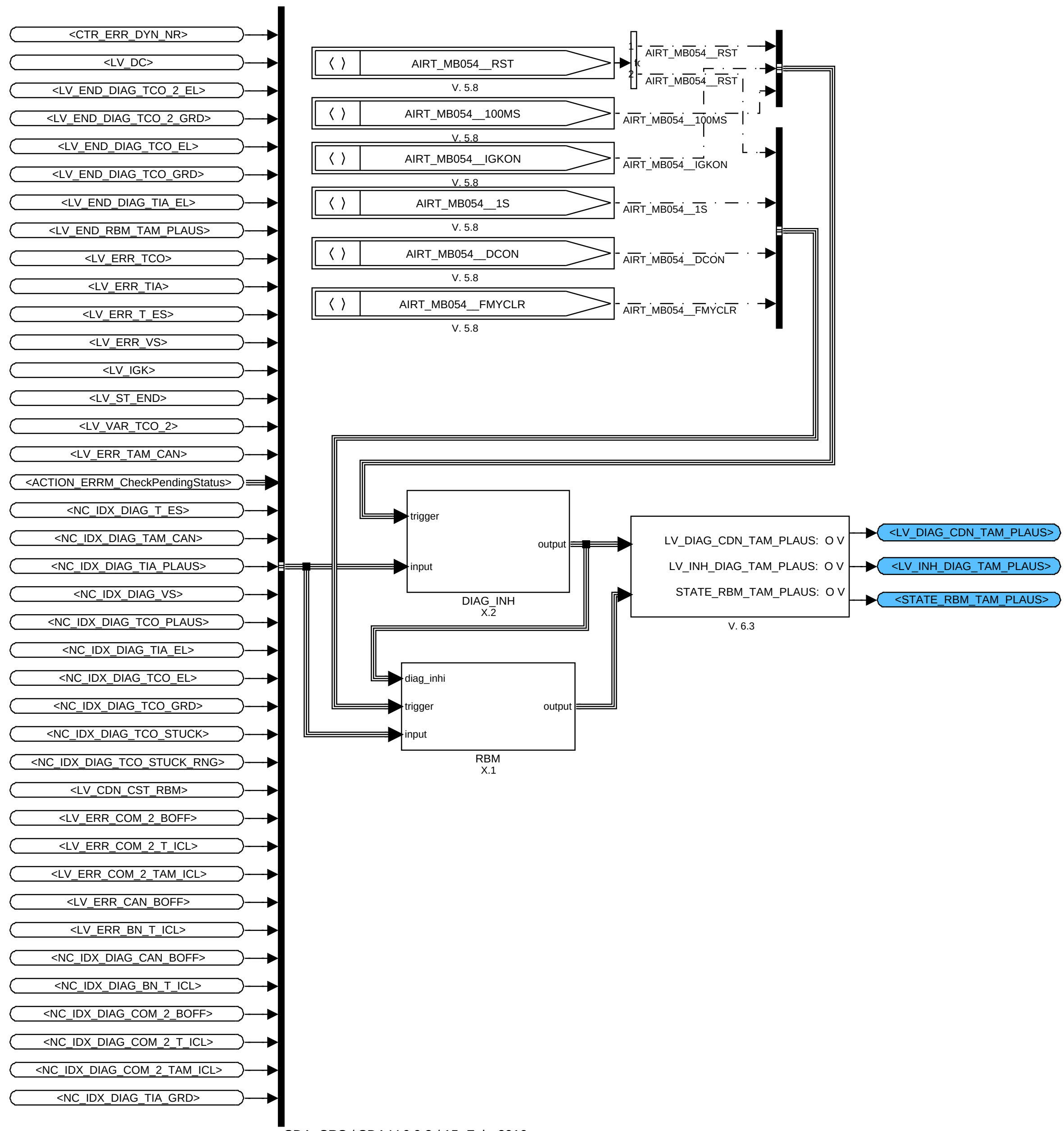
ACTION_ERRM_CheckPendingStatus (IN<PRM_IDX_DIAG>,OUT<PRM_LV_ERR_PND>)

General information:

Signal flow diagram:



SDA_SRS / SDA V 6.0.3 / 15−Feb−2010

Figure B.2.1: :

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B.2.1 Interface for Rate - Based - Monitoring

General information:

General information:
With this module the interface between the TAM_PLAUS monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_TAM_PLAUS data.
Within STATE_RBM_TAM_PLAUS, three different information are defined:
Conditions for monitoring are met long enough to detect malfunction (bit 0)
(no intrusive operation, no short trip)
Monitor disabled because of system malfunction (bit 1)
(depending on failure status: pending)

Application conditions:

Initialisation:	`RST`
Recurrence:	`DCON, FMYCLR, 1S`
Activation:	`always`
Deactivation:	`never`

Function description:

Formula section:

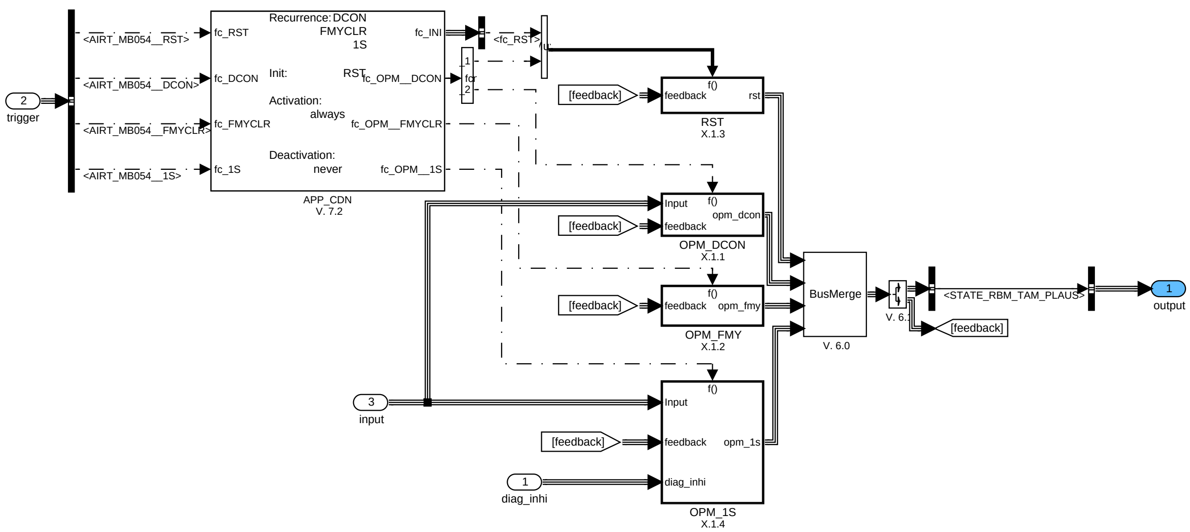

Figure B.2.2: :

B.2.1.1 Formula Section for SYSTEM EVENT DCON

B.2.1.1.1 If_Then

All the calculation within formula section will be done when this block is triggered. The pending status check function will be called if CTR_ERR_DYN_NR is greater than zero.

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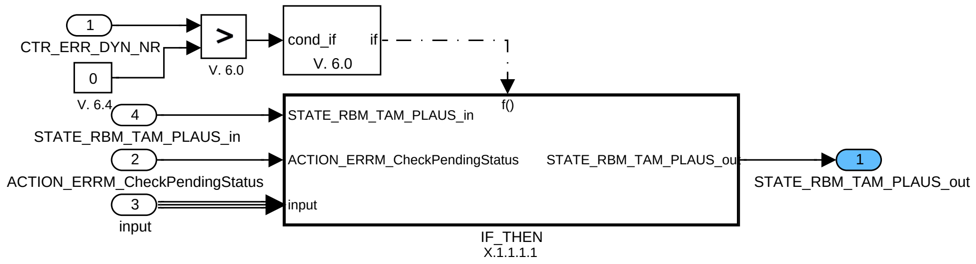

Figure B.2.3: :

B.2.1.1.1.1 IF_THEN/IF_THEN

B.2.1.1.1.1.1 Bit 1_Reset

If the failure is present bit 1 of STATE_RBM_TAM_PLAUS is reset to zero.

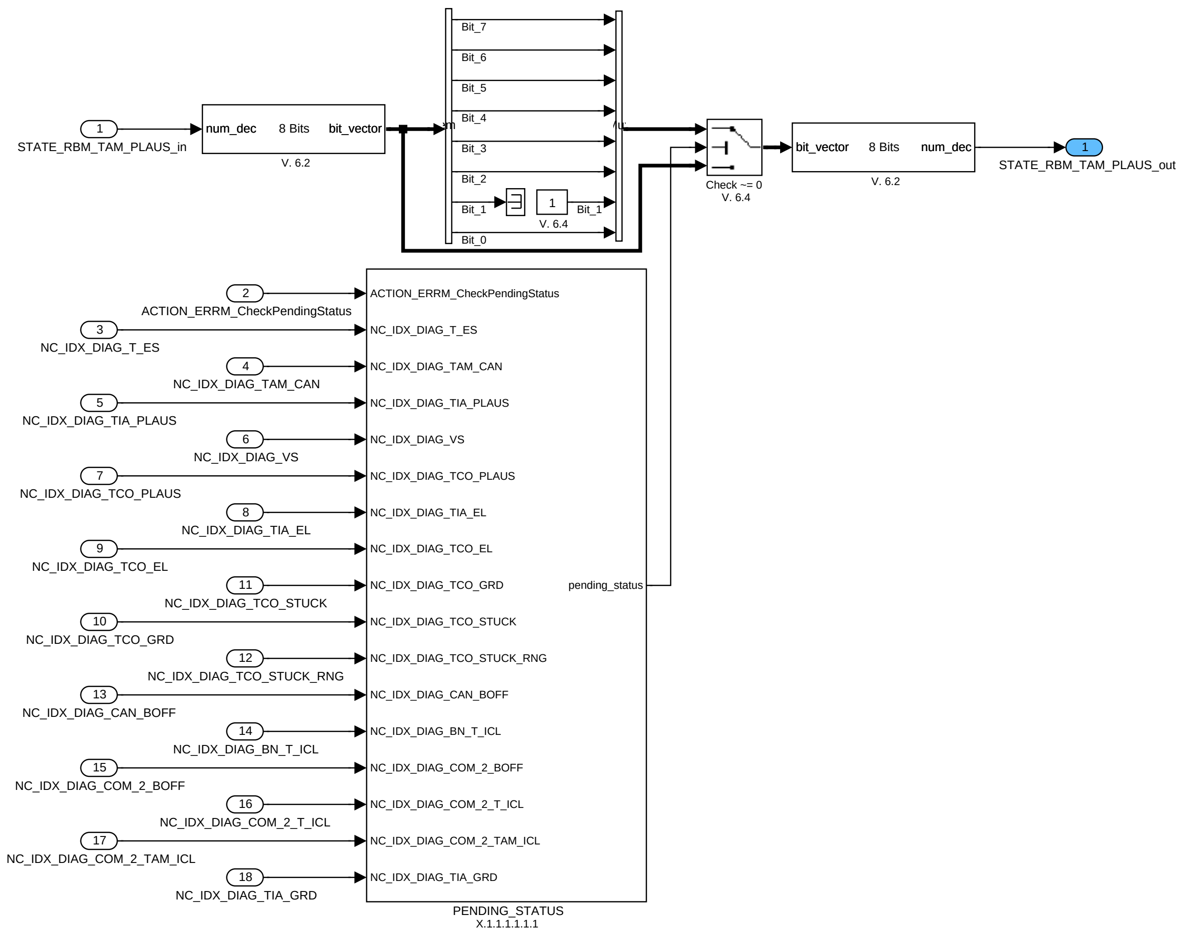

Figure B.2.4: :

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B.2.1.1.1.1.1.1 Pending_Status Check

This API shall be used to verify if a failure stored in the dynamic memory has the pending status or not. When it is impossible to determine if the fault is pending or not (failure not store because the dynamic memory is full), this failure should be considered as pending anyway.

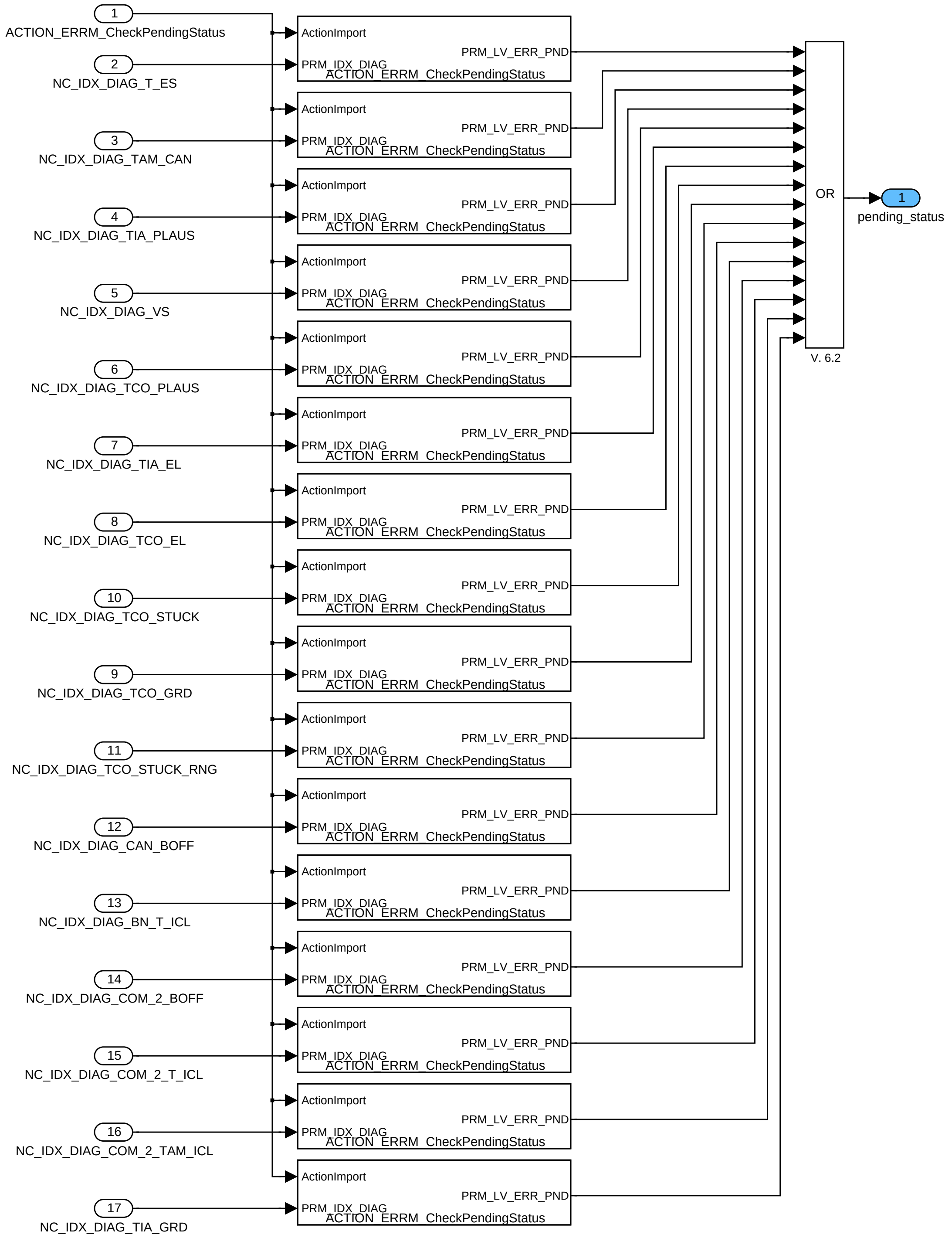

Figure B.2.5: :

B.2.1.2 Reset at FMY_CLR EVENT

On failure memory reset the bit 1 of STATE_RBM_TAM_PLAUS.

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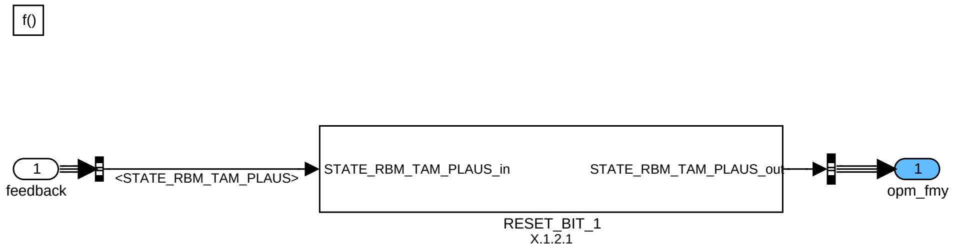

Figure B.2.6: :

B.2.1.2.1 Reset of Bit-1

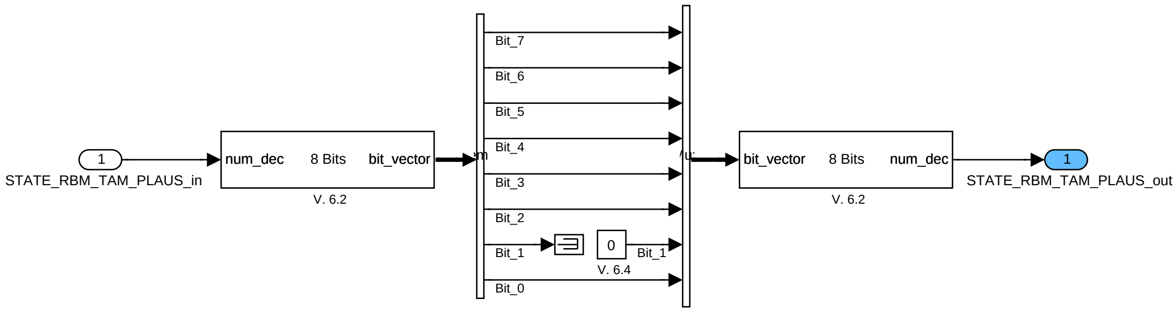

Figure B.2.7: :

B.2.1.3 Initialization at DCON

At 0->1 transition of LV_DC, the bit 0, bit 1 and bit 2 of STATE_RBM_TAM_PLAUS are reset to zero.

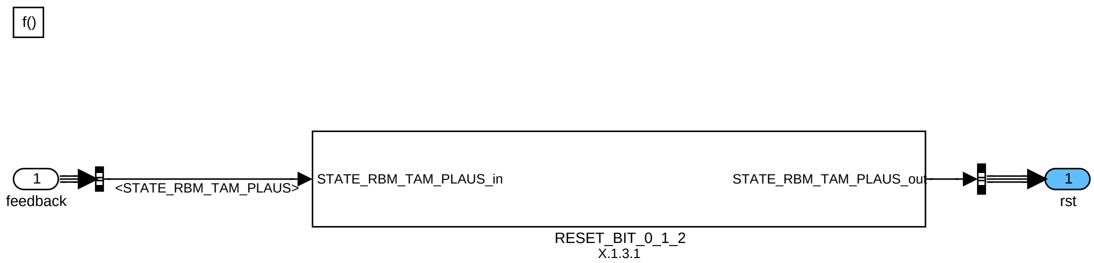

Figure B.2.8: :

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B.2.1.3.1 Reset of Bit-0,1,2

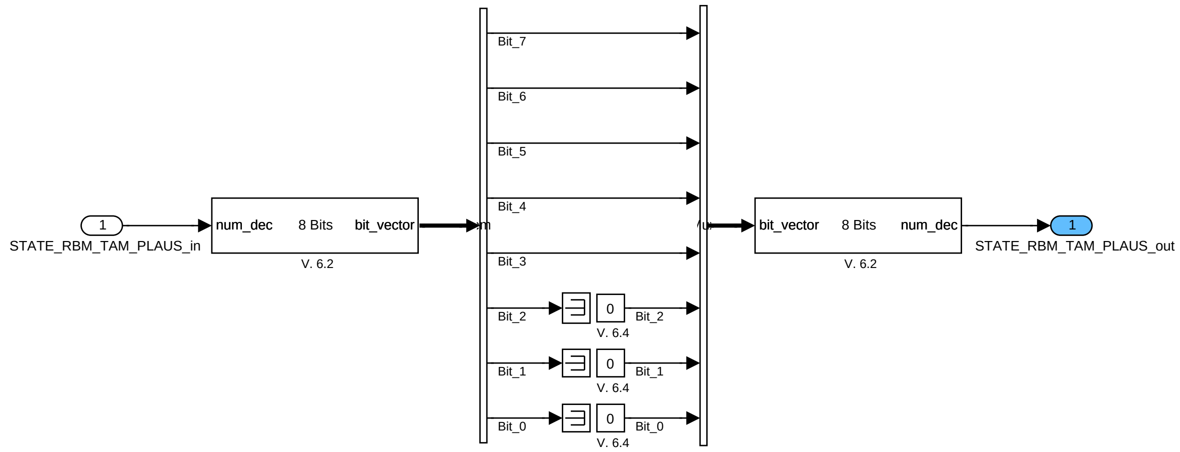

Figure B.2.9: :

B.2.1.4 Formula Section for SYSTEM EVENT 1S

B.2.1.4.1 Calculation at DC on

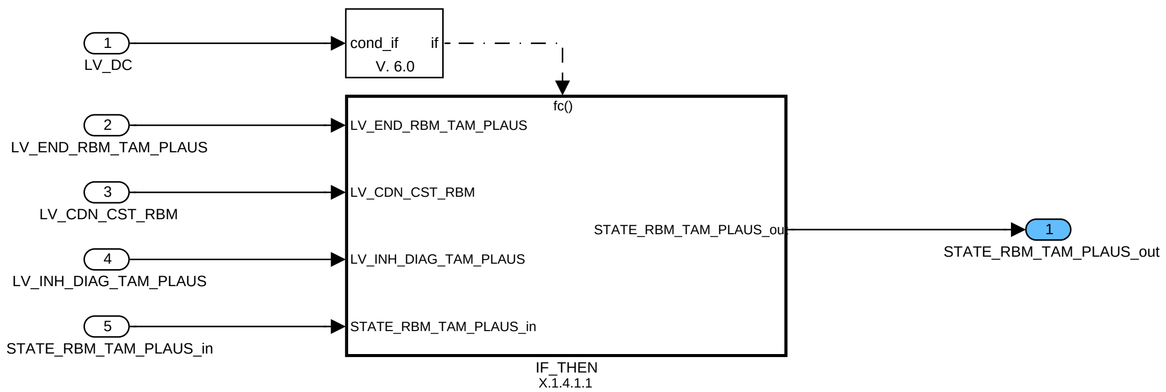

Figure B.2.10: :

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B.2.1.4.1.1 Calculation of Bit-0,1,2

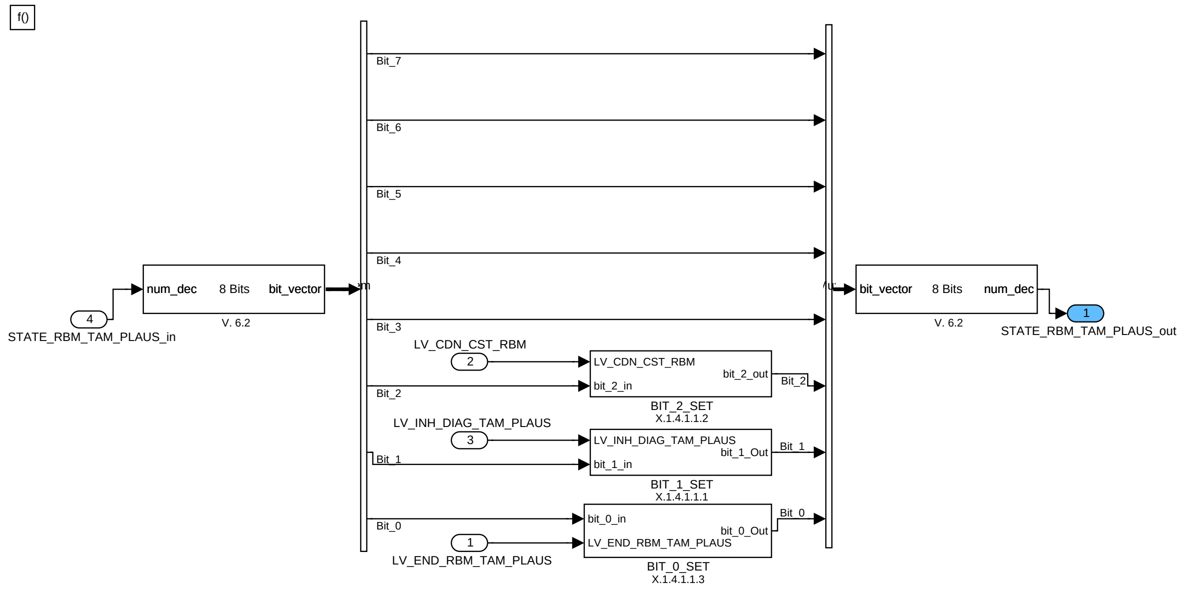

Figure B.2.11: :

B.2.1.4.1.1.1 Bit-1 set

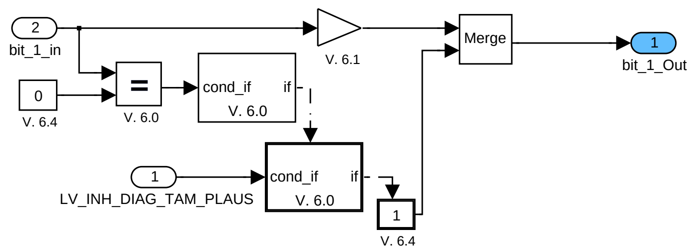

Figure B.2.12: :

B.2.1.4.1.1.2 Bit-2 set

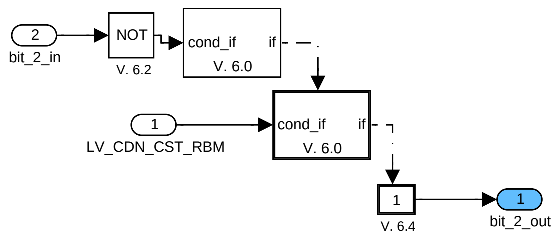

Figure B.2.13: :

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B.2.1.4.1.1.3 Bit-0 set

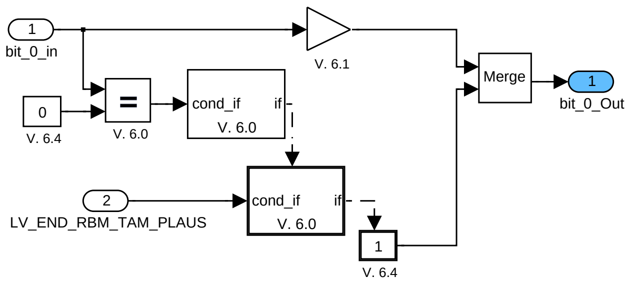

Figure B.2.14: :

B.2.2 Inhibition of diagnosis

General information:

Application conditions:

Initialisation:	`RST, IGKON`
Recurrence:	`100MS`
Activation:	`LV_ST_END && !LV_INH_DIAG_TAM_PLAUS`
Deactivation:	`never`

Function description:

Formula section:

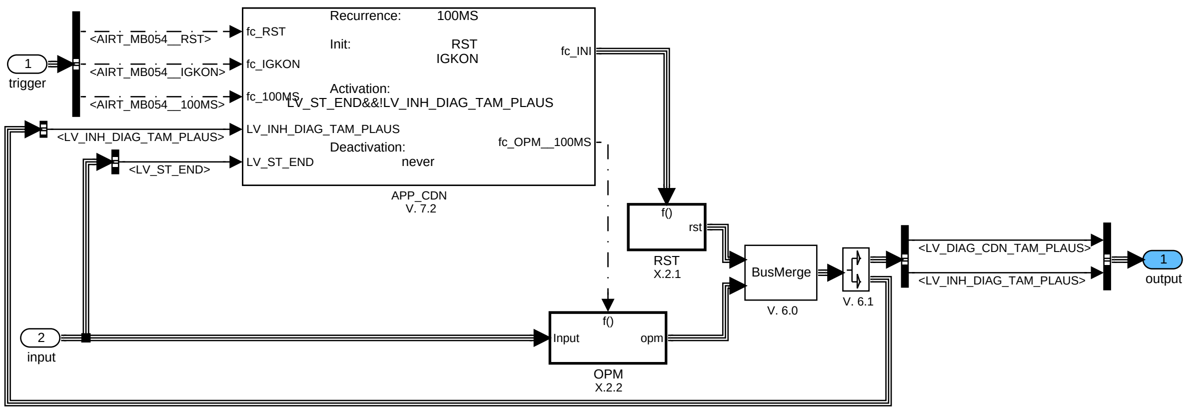

Figure B.2.15: :

B.2.2.1 Initialization

The output variables are reset to zero.

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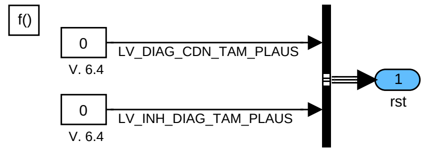

Figure B.2.16: :

B.2.2.2 Formula Section

B.2.2.2.1 Calculation

All the calculation within formula section will be done when this block is triggered. The output variables will be set to one if the respective conditions are true.

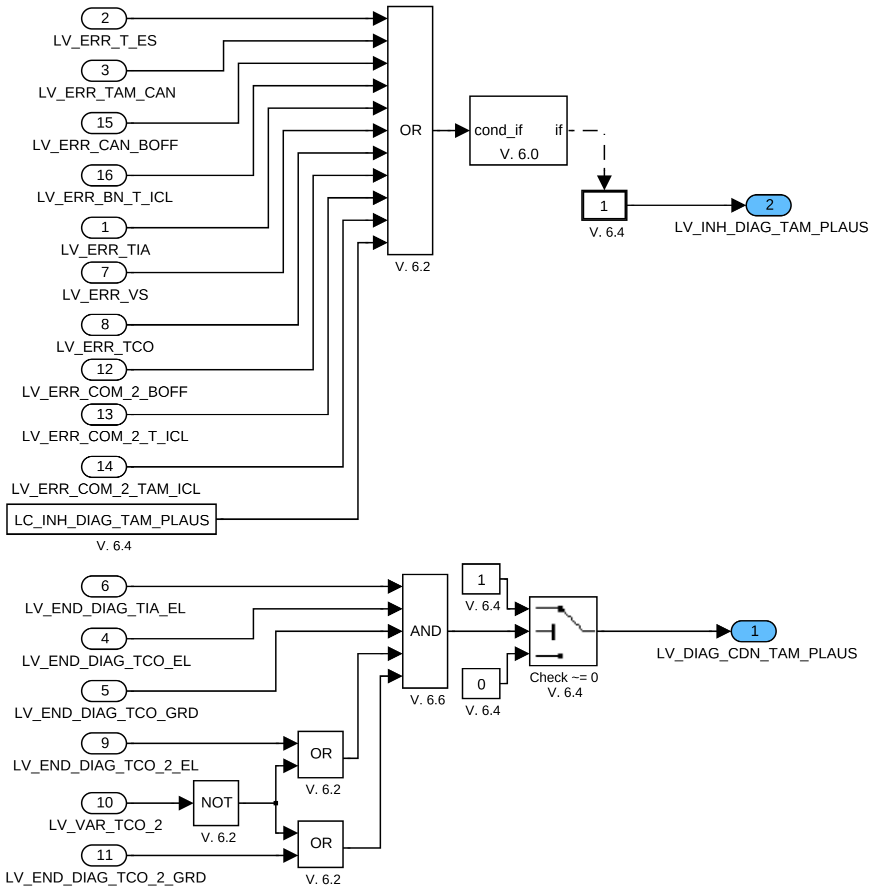

Figure B.2.17: :

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B.3 Intake air temperature plausibility diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_IS_CDN_TIA_PLAUS	V	0... FFH	0... 255	1	-
Cycle counter for T_IS condition					
ERR_SYM_TIA_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom TIA_PLAUS					
LV_CDN_DIAG_TIA_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis condition TIA_PLAUS					
LV_DIF_CDN_TIA_PLAUS_DIAG	V	0... 1H	0 ...1	1	-
Flag indicating that TIA signal was moving					
LV_END_DIAG_TIA_PLAUS	O/V	0... 1H	0 ...1	1	-
End of diagnosis cycle TIA_PLAUS					
LV_ERR_TIA_PLAUS	O/V	0... 1H	0 ...1	1	-
temperature air sensor plausibility error					
LV_IS_CDN_TIA_PLAUS_DIAG	V	0... 1H	0 ...1	1	-
Flag indicating that vehicle idle condition is reached					
LV_LOAD_IS_CDN_TIA_PLAUS	V	0... 1H	0 ...1	1	-
Flag indicating that vehicle was driven with high load to enter in idle condition					
LV_VS_CDN_TIA_PLAUS_DIAG	V	0... 1H	0 ...1	1	-
Flag indicating that vehicle speed condition is reached					
T_IS_TIA_PLAUS_DIAG	V	0... FFFFH	0... 32767.5	0.5	s
Time period - vehicle is driven in Idle					
T_LOAD_IS_CDN_TIA_PLAUS	V	0... FFFFH	0... 32767.5	0.5	s
Time period - vehicle is driven with high load					
T_VS_TIA_PLAUS_DIAG	V	0... FFFFH	0... 32767.5	0.5	s
Time period - vehicle is driven with certain speed					
TIA_DIF_DIAG	V	0... FEH	0... 190.5	0.75	°C
Difference between TIA and TIA_ST					
TIA_DIF_MAX_DIAG	V	0... FEH	-48... 142.5	0.75	°C
Maximum reached TIA					
TIA_DIF_MIN_DIAG	V	0... FEH	-48... 142.5	0.75	°C
Minimum reached TIA					
TIA_PLAUS_MAX_DIAG	V	0... FEH	-48... 142.5	0.75	°C
Maximum expected TIA					
TIA_PLAUS_MIN_DIAG	V	0... FEH	-48... 142.5	0.75	°C
Minimum expected TIA					

Input data:

LV_END_DIAG_TIA_EL {p. 4194}	LV_IGK {p. 906}	LV_INH_DIAG_TIA_PLAUS {p. 5103}	LV_IS {p. 1720}
MAF {p. 8277}	NC_IDX_DIAG_TIA_PLAUS	T_AST_DIAG {p. 1766}	TAM {p. 1579}

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TAM_ST {p. 1214}	TCO {p. 1100}	TIA_MES {p. 1226}	VS {p. 1176}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TIA_PLAUS	-	0... FFH	0... 255	1	-
Anti bounce increment TIA_PLAUS diagnosis					
C_ABC_MAX_TIA_PLAUS	-	1... FFH	1... 255	1	-
Anti bounce maximum TIA_PLAUS diagnosis					
C_CTR_IS_CDN_TIA_PLAUS	-	0... FFH	0... 255	1	-
Number of valid IS conditions cycles					
C_MAF_MIN_INT_CDN_TIA_PLAUS	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Threshold MAF to enable MAF_CYL integral					
C_T_LOAD_IS_CDN_TIA_PLAUS	-	0... FFFFH	0... 32767.5	0.5	s
Threshold for load timer to enter IS condition					
C_T_VS_MIN_TIA_PLAUS_DIAG	-	0... FFFFH	0... 32767.5	0.5	s
Minimum time period with a certain vehicle speed to expect a moving TIA signal					
C_TAM_MAX_TIA_PLAUS_DIAG	-	0... FEH	-48... 142.5	0.75	°C
Maximum ambient temperture to activate the diagnosis condition					
C_TAM_MIN_TIA_PLAUS_DIAG	-	0... FEH	-48... 142.5	0.75	°C
Minimum ambient temperture to activate the diagnosis condition					
C_TCO_MIN_IS_CDN_TIA_PLAUS	-	0... FEH	-48... 142.5	0.75	°C
TIA offset to MAX/MIN range to detect a error					
C_TIA_DIF_DIAG	-	0... FEH	0... 190.5	0.75	°C
Minimum temperature difference to detect a non-stucking TIA signal					
C_TIA_PLAUS_DIF_ERR	-	0... FEH	0... 190.5	0.75	°C
TIA offset to MAX/MIN range to detect a error					
C_VS_MAX_IS_CDN_TIA_PLAUS	-	0... FFH	0... 255	1	km/h
Maximum VS for valid IS condition					
C_VS_MIN_TIA_PLAUS_DIAG	-	0... FFH	0... 255	1	km/h
Minimum VS for valid VS conditon cycle					
ID_T_IS_MIN_TIA_PLAUS_DIAG	-	0... FFFFH	0... 32767.5	0.5	s
LDP_TAM_TIA_PLAUS_DIAG	4	0... FEH	-48... 142.5	0.75	°C
Minimum time period in IDLE to expect a moving TIA signal					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)

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General information:

General information:
This diagnosis is performed in order to detect a stucking or not plausible TIA_MESsignal which cannot be detected by electrical range diagnosis.
Description:
The diagnosis can be inhibited in cold conditions (If TAM_ST <= C_TAM_MIN_TIA_PLAUS_DIAG).
The error detection is based on two different diagnosis:

Plausible range detection:
The plausible TIA_MESmust be between TCO and TAM. If TIA_MESis outside of the range plus offset the error symptom MAX/MIN is set and the error is debounced.

Stucking signal:
If the vehicle was driven with a certain vehicle speed for a calibratable time (cool down of hot TIA_MES) or vehicle was in IDLE for a calibratable time and cycles (hot up of cold TIA_MES) and the TIA_MESsignal was not moving then a stucking TIA_MESsignal is detected and the error is debounced.

Error symptoms are defined for this diagnosis function as:

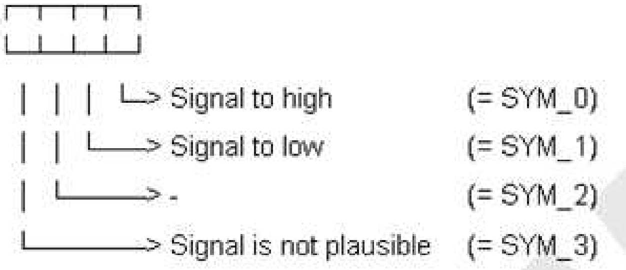

Figure B.3.1: :

Application conditions:

Initialisation:	`RST, IGKON, DCON, CLRFMY, Deactivation`
Recurrence:	`500MS`
Activation:	`LV_DIAG_ACT_tmp`
Deactivation:	`if activation not true`

Function description:

Formula section:

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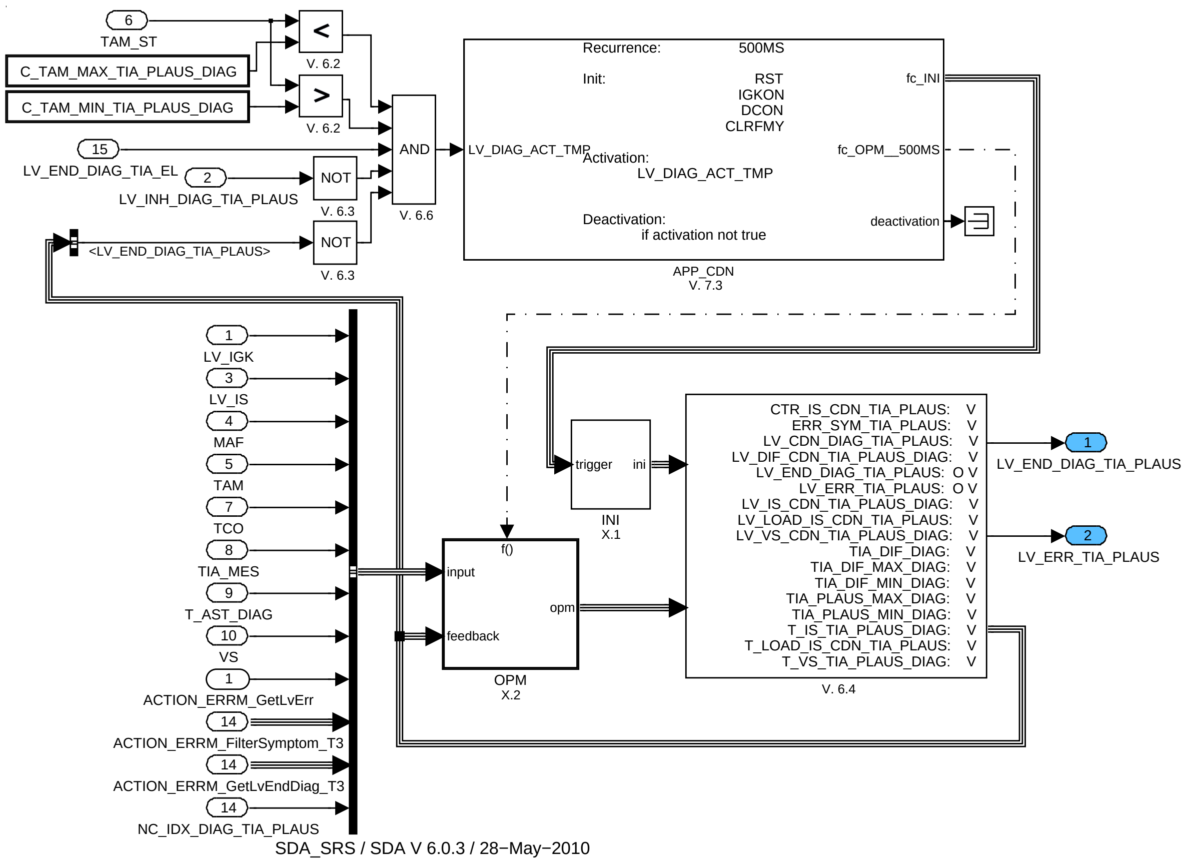

Figure B.3.2: :

B.3.1 Initialisations

B.3.1.1 Inititialisation at DCON or Reset or Clearing-Error-Memory

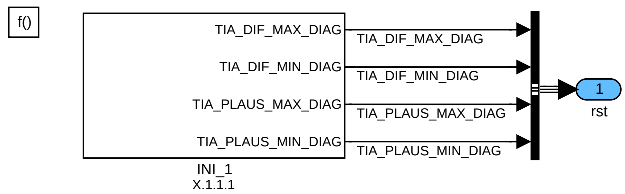

Figure B.3.3: :

B.3.1.1.1 Initialisation

Initialisation of TIA_DIF_MAX/MIN_DIAG and TIA_PLAUS_MAX/MIN_DIAG.

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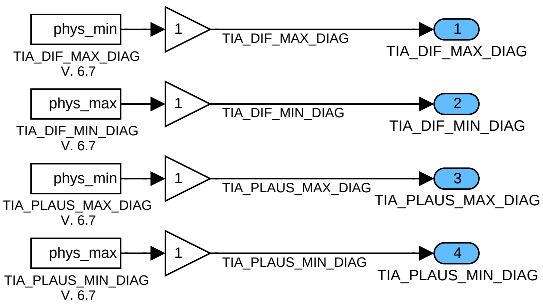

Figure B.3.4: :

B.3.1.2 Initialisation at IGKON or Reset or Clearing-Error-Memory

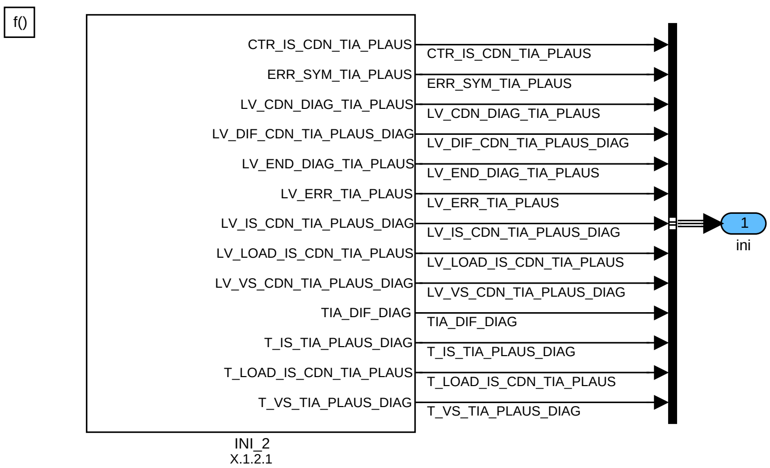

Figure B.3.5: :

B.3.1.2.1 Initialisation

All variables except TIA_DIF_MAX/MIN_DIAG and TIA_PLAUS_MAX/MIN_DIAG are initialised

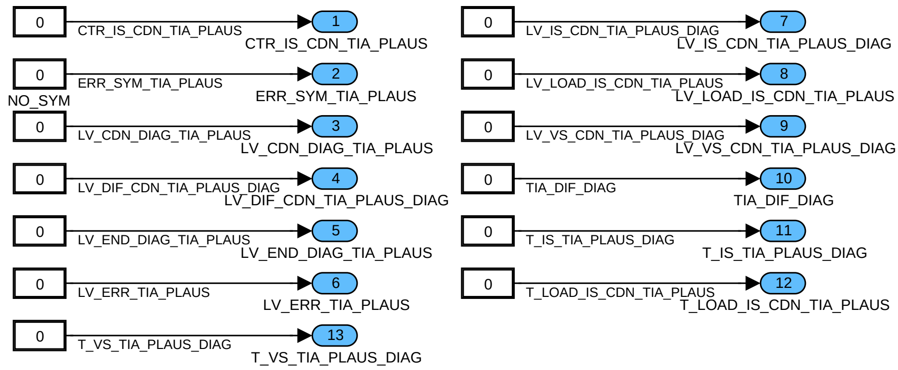

Figure B.3.6: :

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B.3.1.3 Resetting the value of LV_CDN_DIAG_TIA_PLAUS at deactivation

LV_CDN_DIAG_TIA_PLAUS value is set to 0 when Inhibition bit or LV_END_DIAG_TIA_PLAUS bit goes low.

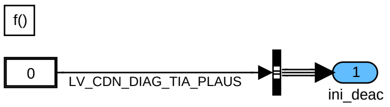

Figure B.3.7: :

B.3.2 Formula section

B.3.2.1 Calculation of TIA_PLAUS_MAX/MIN_DIAG and TIA_DIF_MAX/MIN_DIAG

B.3.2.1.1 Calculation

Calculation of TIA_PLAUS_MAX/MIN_DIAG and TIA_DIF_MAX/MIN_DIAG from the inputs TIA,TAM and TCO and past value of TIA_PLAUS_MAX/MIN_DIAG and TIA_DIF_MAX/MIN_DIAG.

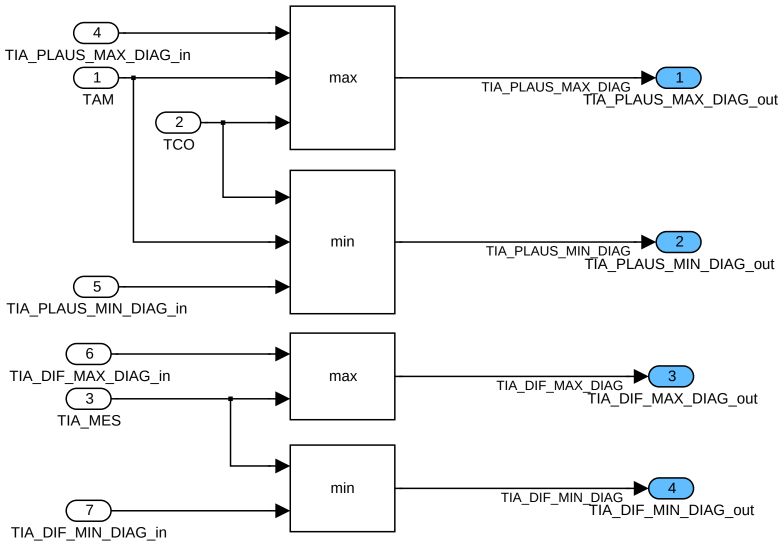

Figure B.3.8: :

B.3.2.2 Calculation of TIA_DIF_DIAG

B.3.2.2.1 Calculation of the TIA_DIF_DIAG for stucking detection

Calculation of the TIA_DIF_DIAG for stucking detection. If TIA_DIF_DIAG is greater than C_TIA_DIF_DIAG (e.g. 3°C) LV_DIF_CDN_TIA_PLAUS_DIAG is set to 1 (set irreversible)

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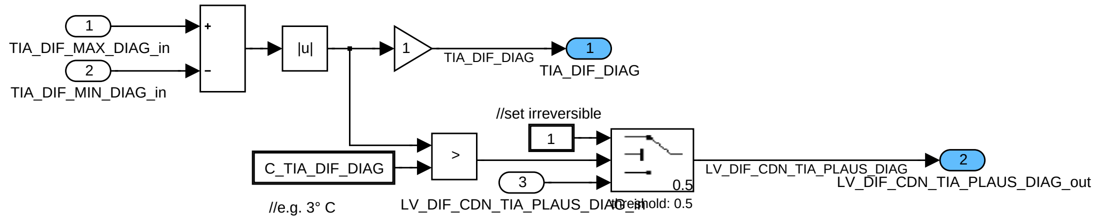

Figure B.3.9: :

B.3.2.3 Calculation at vehicle speed (VS)

B.3.2.3.1 Calculation of time period when vehicle is moving(Vehicle with speed)

When VS is greater then C_VS_MIN_TIA_PLAUS_DIAG (e.g. 40km/h) then timer (T_VS_TIA_PLAUS_DIAG) starts incrementing and if T_VS_CDN_TIA_PLAUS_DIAG is greater than threshold for load timer ,C_T_VS_MIN_TIA_PLAUS_DIAG (e.g. 180 s) then LV_VS_CDN_TIA_PLAUS_DIAG is set to 1(set irreversible). If VS is less than minimum VS then timer is reset.

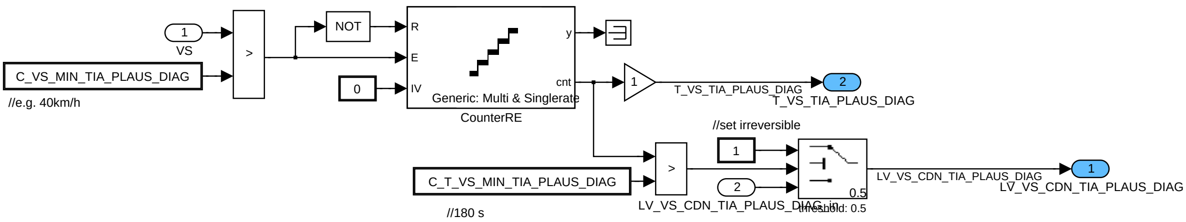

Figure B.3.10: :

B.3.2.4 Calculation at idle speed condition

B.3.2.4.1 Calculation of load timer to enter in idle speed condition

If MAF is greater than C_MAF_MIN_INT_CDN_TIA_PLAUS (e.g. 200 mg/stk), time period of the vehicle driven with high load (T_LOAD_IS_CDN_TIA_PLAUS) and flag indication that vehicle was driven with high load to enter in idle condition (LV_LOAD_IS_CDN_TIA_PLAUS) is calculated.

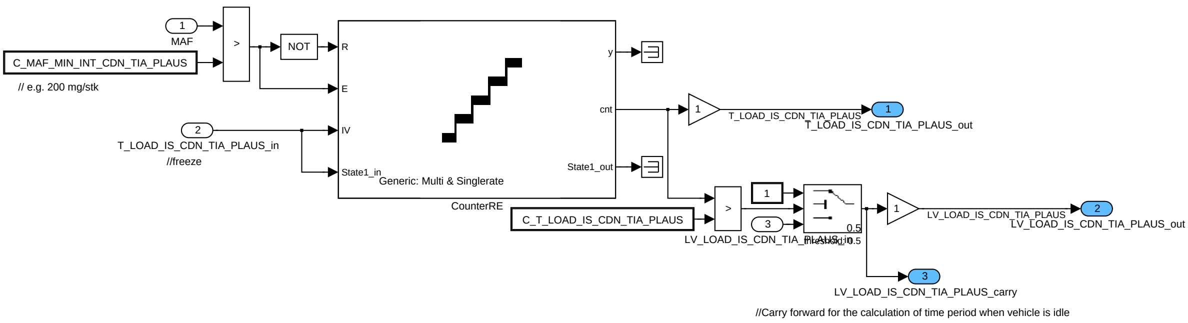

Figure B.3.11: :

B.3.2.5 Calculation at vehicle idle

B.3.2.5.1 Condition check for LV_VS_CDN_TIA_PLAUS_DIAG

Calculation starts when LV_VS_CDN_TIA_PLAUS_DIAG is 1.

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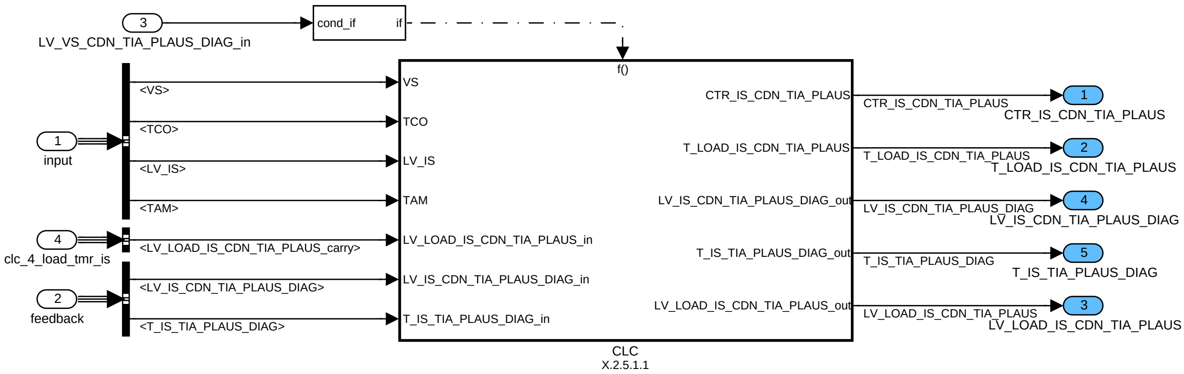

Figure B.3.12: :

B.3.2.5.1.1 Condition check and Calculation of T_IS_TIA_PLAUS_DIAG

If LV_IS is true and VS is greater than maximum VS, C_VS_MAX_IS_CDN_TIA_PLAUS (e.g. 3km/h) and coolant temperature is greater than TIA offset to detect error, C_TCO_MIN_IS_CDN_TIA_PLAUS (e.g. 85 C) and LV_LOAD_IS_CDN_TIA_PLAUS is true, then timer, T_IS_TIA_PLAUS_DIAG increment else resets. If the timer value exceeds the threshold value evaluated from ID map (e.g. 20s), then also the timer resets.

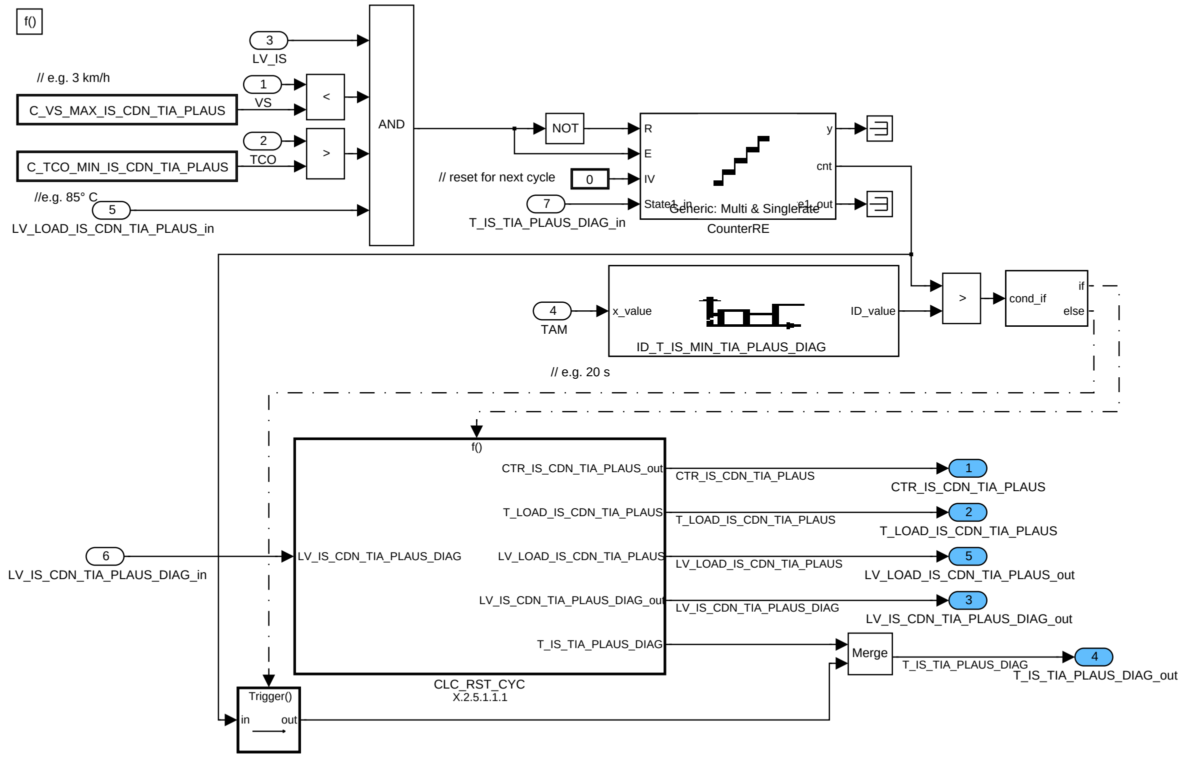

Figure B.3.13: :

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B.3.2.5.1.1.1 Calculation of reset for next cycle

T_IS_TIA_PLAUS_DIAG, T_LOAD_IS_CDN_TIA_PLAUS, LV_LOAD_IS_CDN_TIA_PLAUS are reset to 0. If the incremented value of cycle counter for T_IS condition (CTR_IS_CDN_TIA_PLAUS) is greater than number of valid IS condition cycles (C_CTR_IS_CDN_TIA_PLAUS) then LV_IS_CDN_TIA_PLAUS_DIAG is set to 1(set irreversible).

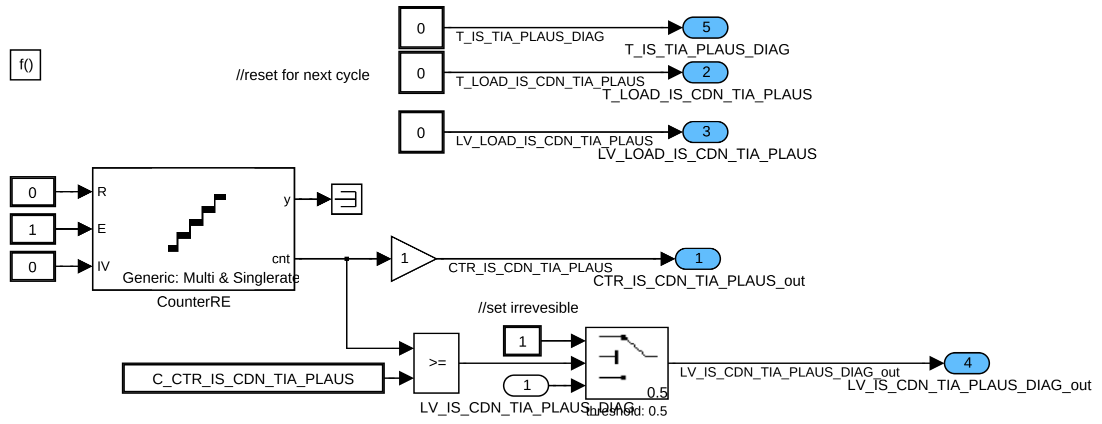

Figure B.3.14: :

B.3.2.6 ERRM diagnosis and interface

B.3.2.6.1 ERRM diagnosis

Signal to high, signal to low and signal is not plausible error symptoms are calculated here.

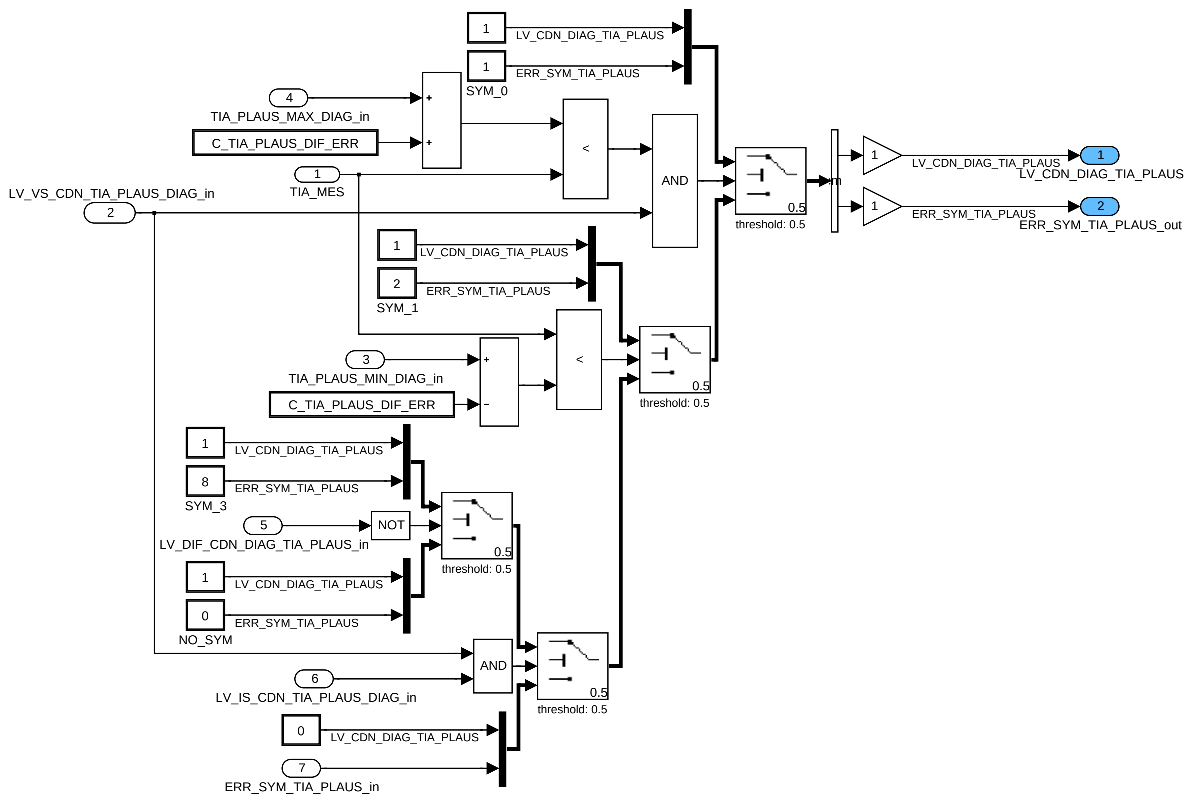

Figure B.3.15: :

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B.3.2.6.2 ERRM interface

LV_ERR_TIA_PLAUS and LV_END_DIAG_TIA_PLAUS are calculated.

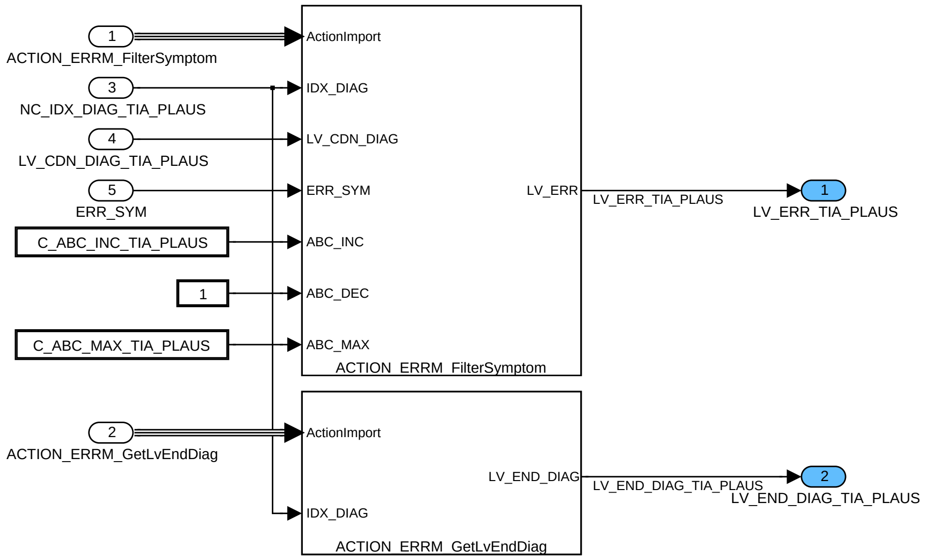

Figure B.3.16: :

B.3.2.7 Visual mode ouputs

LV_CDN_DIAG_TIA_PLAUS and ERR_SYM_TIA_PLAUS are calculated.

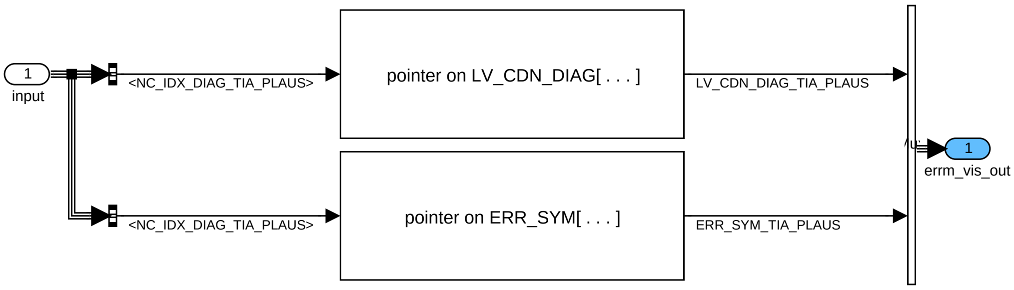

Figure B.3.17: :

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B.4 Intake air temperature plausibility diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_TIA_PLAUS	O/V	0... 1H	0 ...1	1	-
Inhibition of TIA PLAUS diagnosis					
STATE_RBM_TIA_PLAUS	O/V	0... 7H	0 ...7	1	-
Interface of TIA_PLAUS monitor with the Rate-Based Monitoring statisticsBit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1)Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1)Bit 2: individual RBM co					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CDN_CST_RBM {p. 5870}	LV_DC {p. 5746}	LV_END_DIAG_TIA_PLAUS {p. 5093}
LV_ERR_BN_T_ICL {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_COM_2_BOFF {p. 801}	LV_ERR_COM_2_TAM_ICL
LV_ERR_TAM_CAN {p. 5076}	LV_ERR_TAM_PLAUS {p. 5076}	LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}
LV_ERR_TCO_PLAUS {p. 5682}	LV_ERR_TCO_STUCK {p. 5691}	LV_ERR_TCO_STUCK_RNG {p. 5675}	LV_ERR_TIA {p. 4200}
LV_ERR_VS {p. 5021}	LV_IGK {p. 906}	LV_ST_END {p. 1720}	NC_IDX_DIAG_BN_T_ICL
NC_IDX_DIAG_CAN_BOFF	NC_IDX_DIAG_COM_2_BOFF	NC_IDX_DIAG_COM_2_TAM_ICL	NC_IDX_DIAG_TAM_CAN
NC_IDX_DIAG_TAM_PLAUS	NC_IDX_DIAG_TCO_EL	NC_IDX_DIAG_TCO_GRD	NC_IDX_DIAG_TCO_PLAUS
NC_IDX_DIAG_TCO_STUCK	NC_IDX_DIAG_TCO_STUCK_RNG	NC_IDX_DIAG_TIA_EL	NC_IDX_DIAG_TIA_GRD
NC_IDX_DIAG_VS {p. 5024}			

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

Overview

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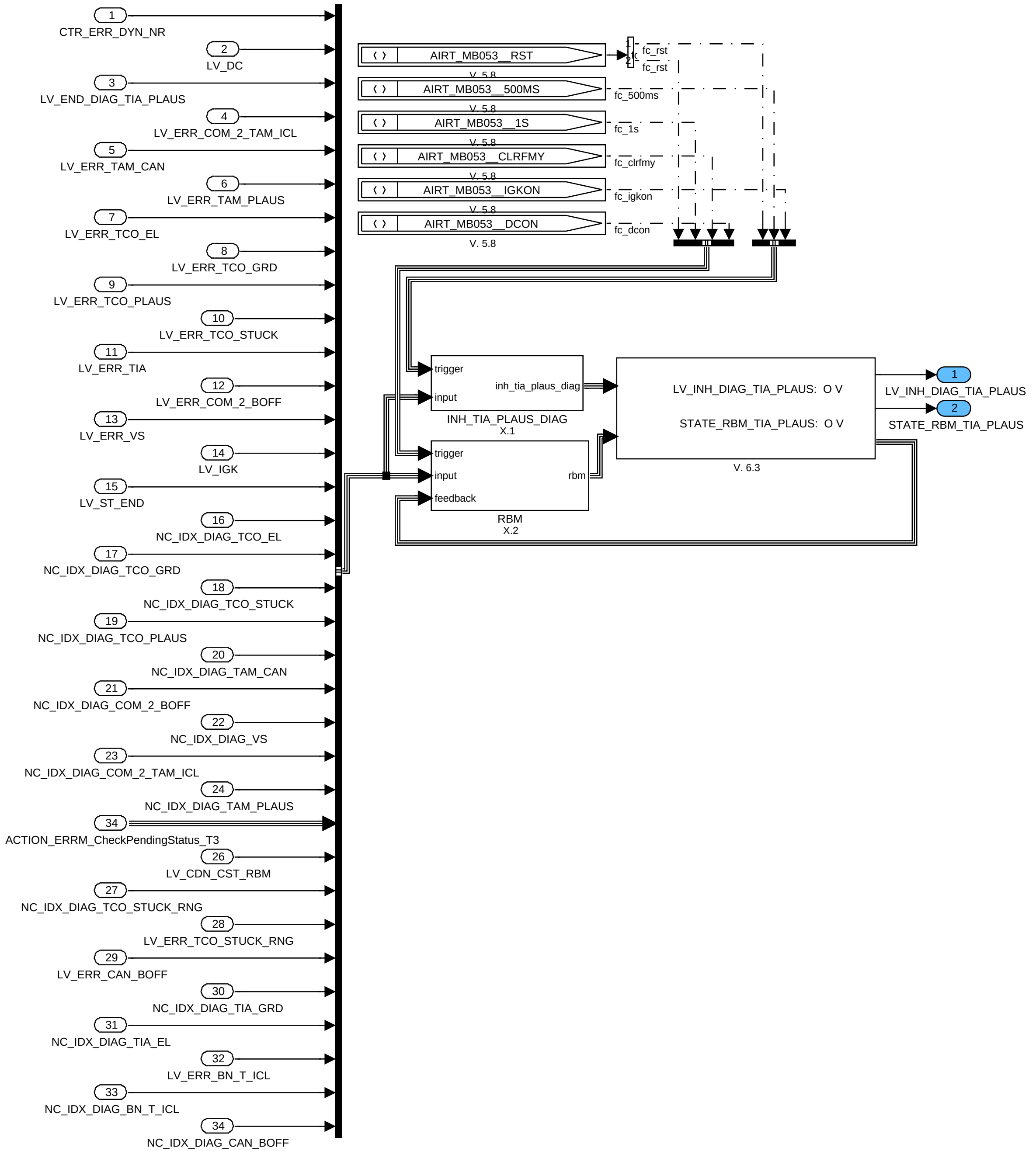

SDA_SRS / SDA V 5.3.2 / 11−Aug−2009

Figure B.4.1: :

General Information

B.4.1 Inhibition of TIA_PLAUS diagnosis due to present error

General information:
Inhibiton flag to inhibit the TIA_PLAUS diagnosis because of present error.

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Application Conditions

Initialization: RST, IGKON
Recurrence: 500MS
Activation: LV_ST_END==1 & & LV_END_DIAG_TIA_PLAUS==0
Deactivation: LV_END_DIAG_TIA_PLAUS==1

Function description

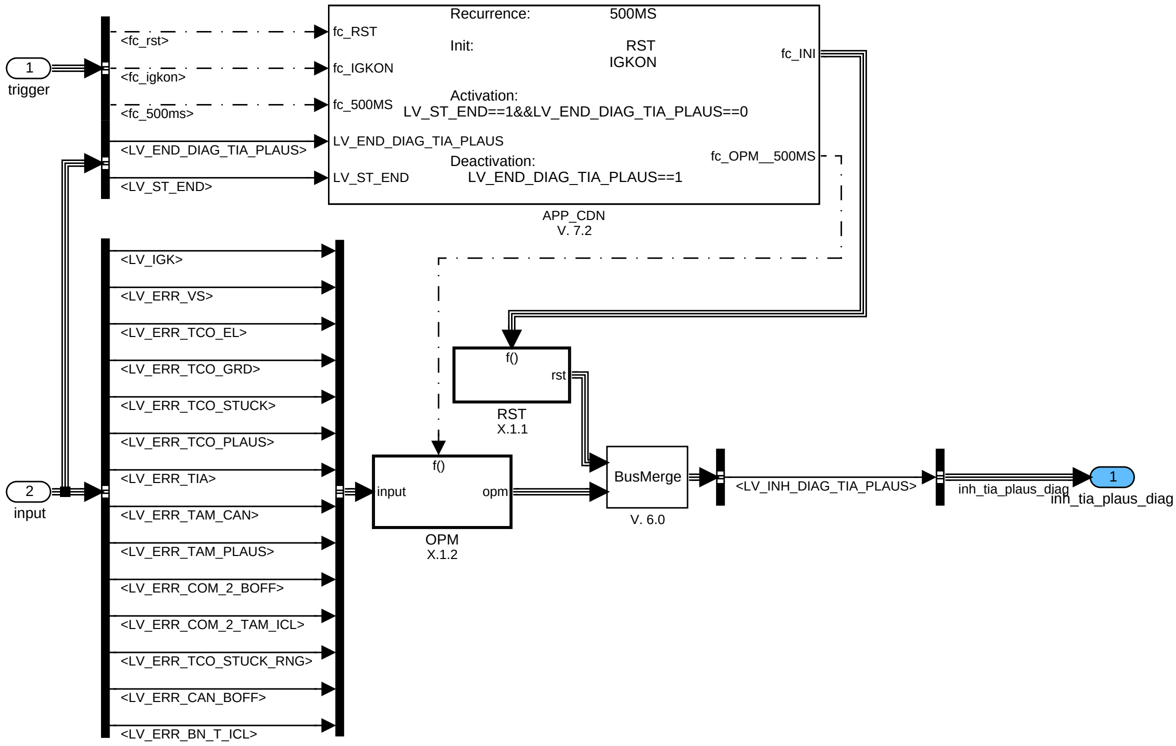

Figure B.4.2: :

B.4.1.1 Initialisation

Initialisation of LV_INH_DIAG_TIA_PLAUS

Figure B.4.3: :

B.4.1.2 Formula Section

B.4.1.2.1 Calculation of LV_INH_DIAG_TIA_PLAUS

Ireversible inhibition of diagnosis. LV_INH_DIAG_TIA_PLAUS bit is set to 1, if any one of the inputs is 1.

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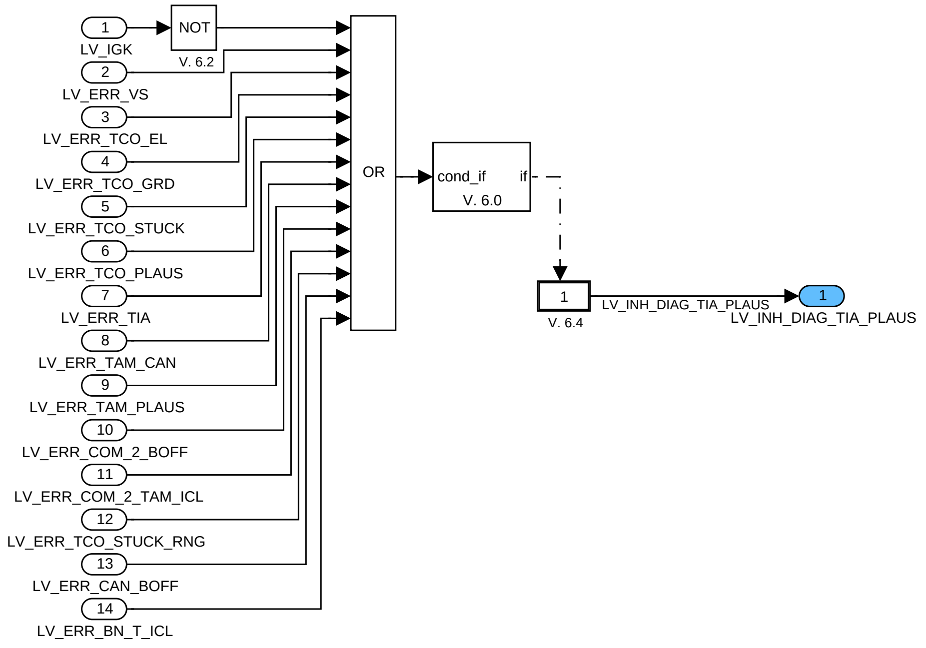

Figure B.4.4: :

B.4.2 Interface for Rate - Based - Monitoring

General information:
With this module the interface between the TIA_PLAUS monitor and the RateBased Monitoring statistics is defined with STATE_RBM_TIA_PLAUS data.
Within STATE_RBM_TIA_PLAUS, three different information are defined:
Conditions for monitoring are met long enough to detect malfunction (bit 0)
(no intrusive operation, no short trip)
Monitor disabled because of system malfunction (bit 1)
(depending on failure status: pending)
Monitor individual RBM conditions encountered within this DC (bit 2)
(not valid for TIA_PLAUS diagnosis)

Application Conditions

Initialization: RST, CLRFMY, DCON
Recurrence: 1S
Activation: always
Deactivation: never

Function description

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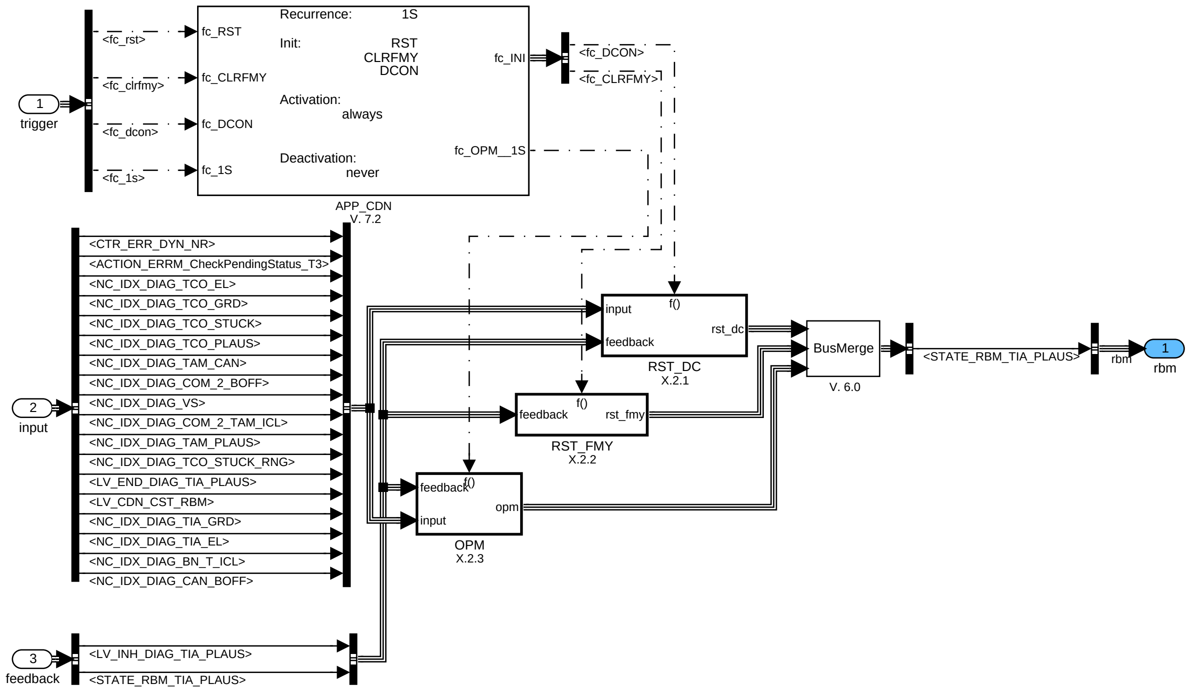

Figure B.4.5: :

B.4.2.1 Formula Section at reset on driving cycle on

B.4.2.1.1 Initialisation at DCON

Bits 0, 1 and 2 of STATE_RBM_TIA_PLAUS are reset to 0, whenever there is transition of LV_DC from 0 to 1.

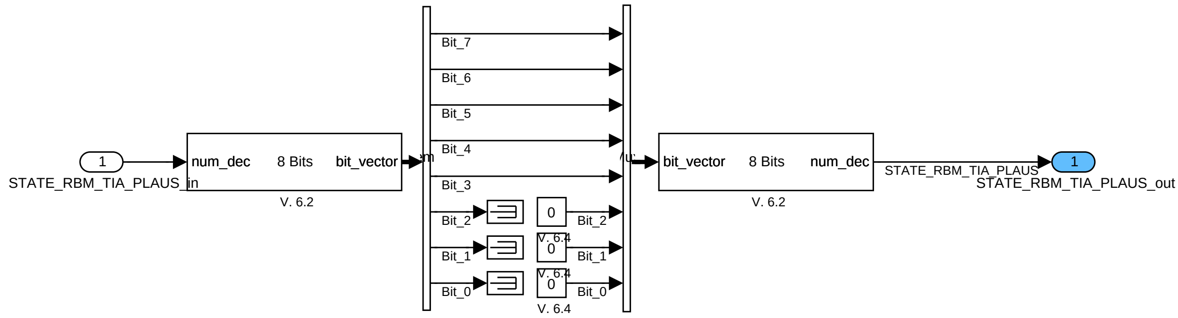

Figure B.4.6: :

B.4.2.1.2 Condition check for CTR_ERR_DYN_NR

Activation condition at LV_DC transition from 0 to 1 and the dynamic failure memory is not empty(CTR_ ERR_DYN_NR is not equal to 0)

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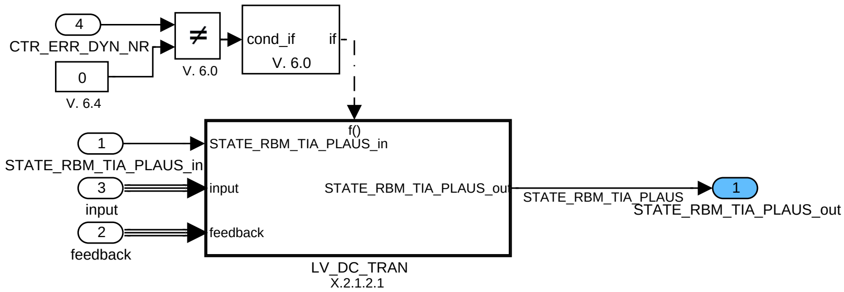

Figure B.4.7: :

B.4.2.1.2.1 Condition check for bit 1 of STATE_RBM_TIA_PLAUS

While bit 1 of STATE_RBM_TIA_PLAUS is 0 the pending status for each of the failure will be checked.

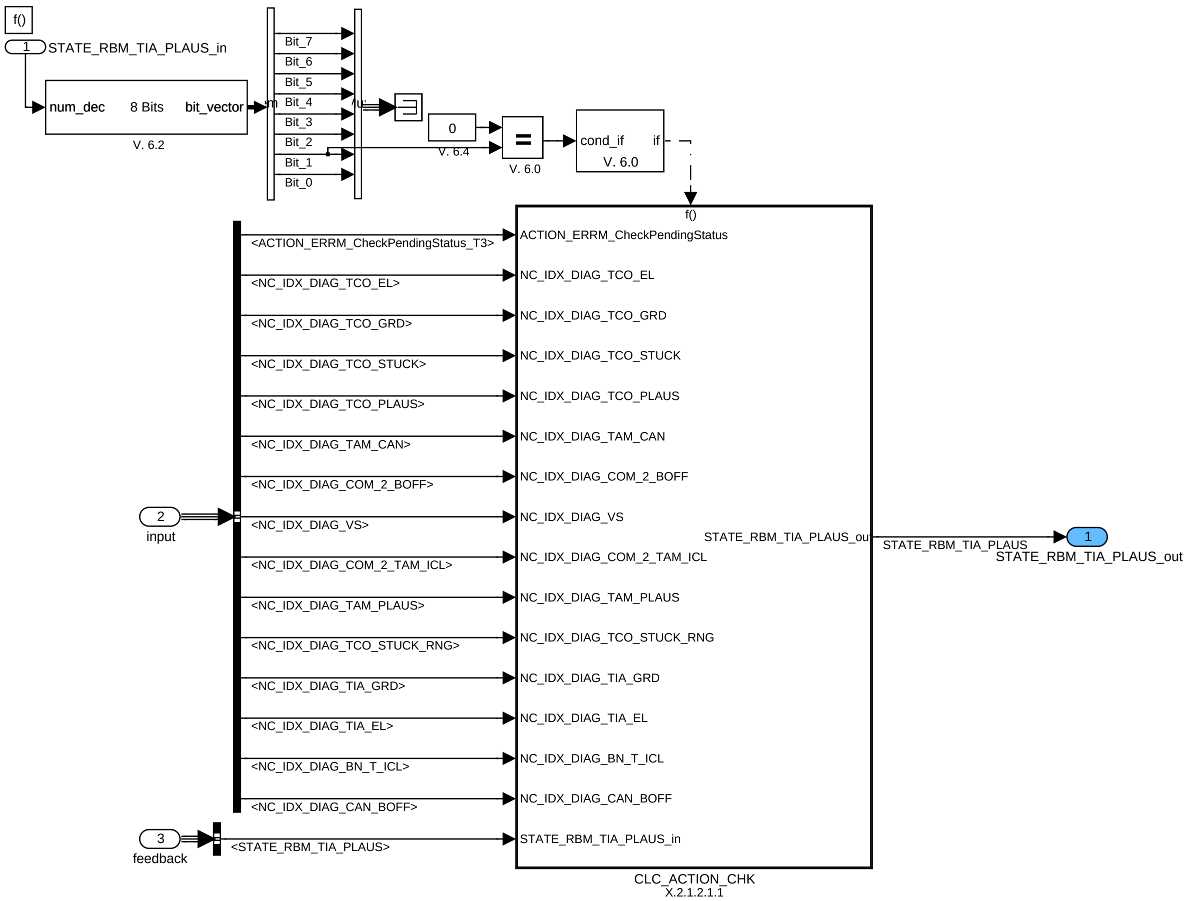

Figure B.4.8: :

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B.4.2.1.2.1.1 Pending status check

Pending status for each of the failure is checked using Check Pending Status Action call from ERRM.

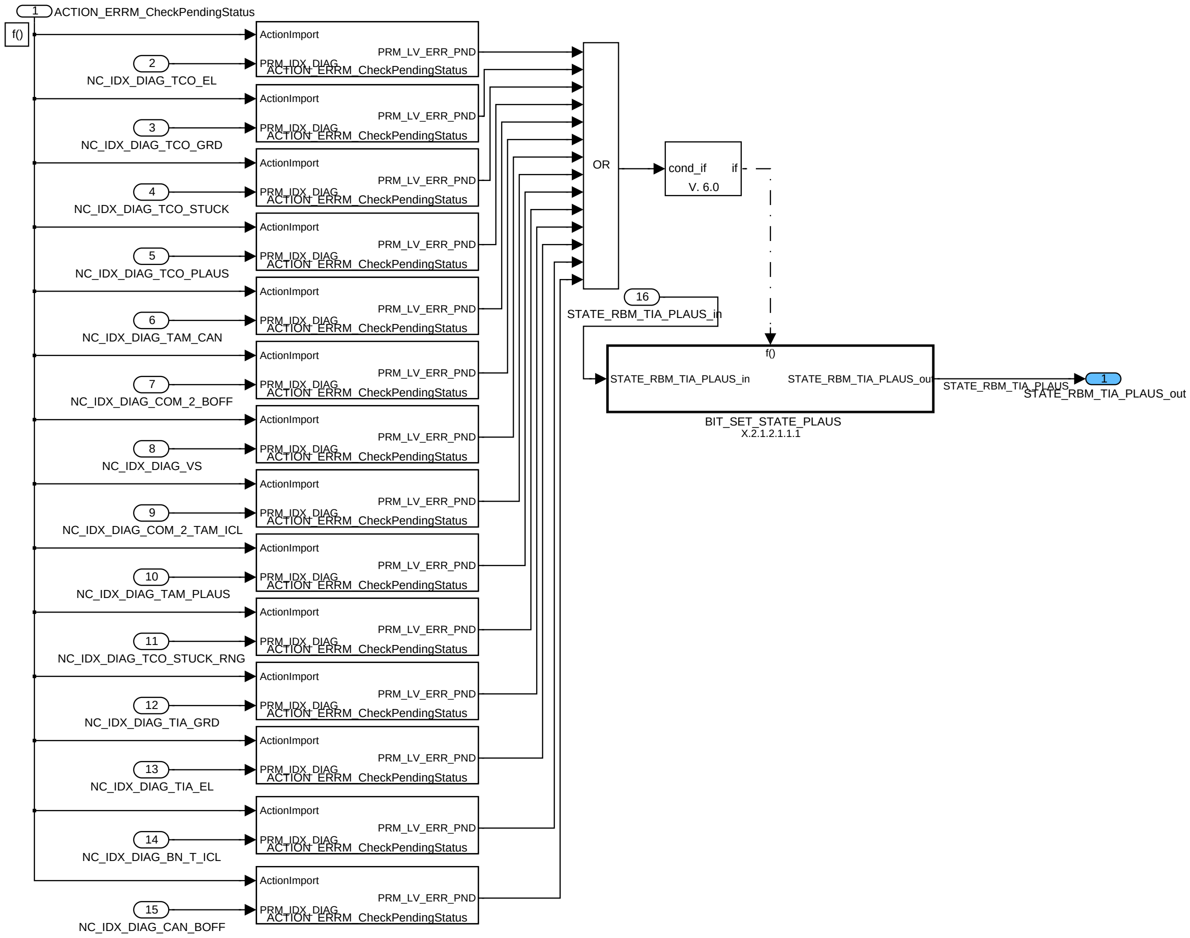

Figure B.4.9: :

B.4.2.1.2.1.1.1 Bit 1 setting for STATE_RBM_TIA_PLAUS

If any of the failures has pending status the bit 1 of STATE_RBM_TIA_PLAUS will be set to 1

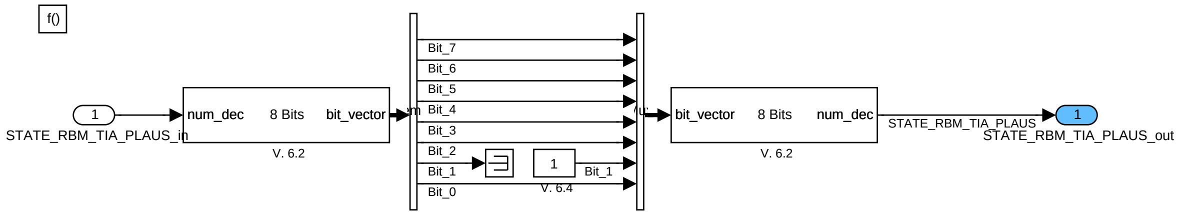

Figure B.4.10: :

B.4.2.2 Initialisation at Failure Memory Reset

B.4.2.2.1 Initialisation at Failure Memory Reset

Bit 1 of STATE_RBM_TIA_PLAUS is reset to 0 whenever there is Failure Memory reset event.

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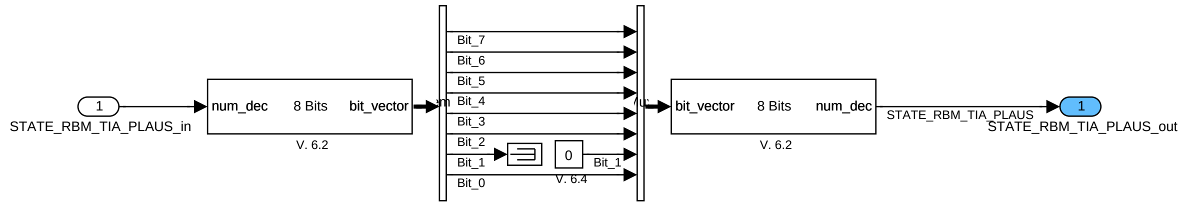

Figure B.4.11: :

B.4.2.3 Formula section for 1 second recurrence

B.4.2.3.1 Bit set operation

Calculation of status of bits 0, 1 and 2 of STATE_RBM_TIA_PLAUS at 1 second recurrence.
If bit 0 of STATE_RBM_TIA_PLAUS is 0 and LV_END_DIAG_TIA_PLAUS is 1 then bit 0 of STATE_RBM_TIA_PLAUS is set to 1.
If bit 1 of STATE_RBM_TIA_PLAUS is 0 and LV_INH_DIAG_TIA_PLAUS is 1 then bit 1 of STATE_RBM_TIA_PLAUS is set to 1
If bit 2 of STATE_RBM_TIA_PLAUS is 0 and LV_CDN_CST_RBM is 1 then bit 2 of STATE_RBM_TIA_PLAUS is set to 1

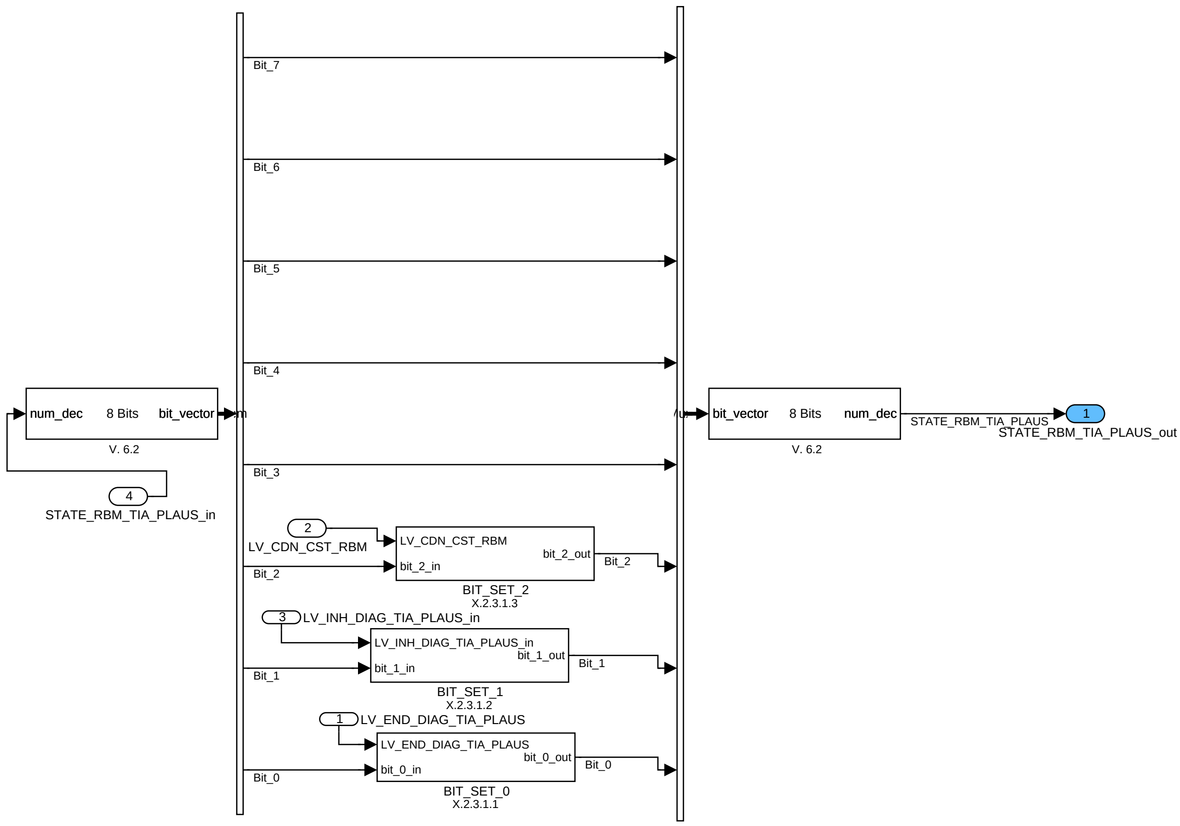

Figure B.4.12: :

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B.4.2.3.1.1 BIT_SET_0

Bit 0 of STATE_RBM_TIA_PLAUS is set to 1, if bit 0 of STATE_RBM_TIA_PLAUS is 0 and LV_END_DIAG_TIA_PLAUS is 1

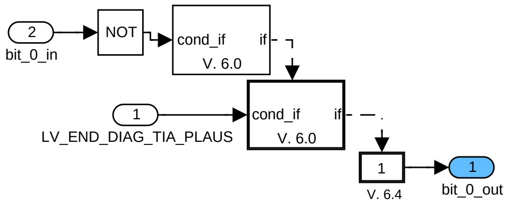

Figure B.4.13: :

B.4.2.3.1.2 BIT_SET_1

Bit 1 of STATE_RBM_TIA_PLAUS is set to 1, if bit 0 of STATE_RBM_TIA_PLAUS is 0 and LV_INH_DIAG_TIA_PLAUS is 1

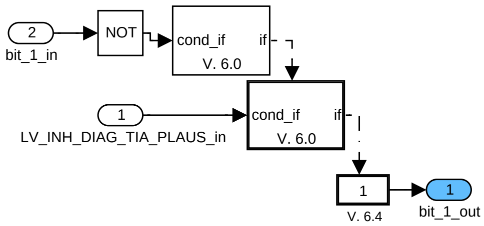

Figure B.4.14: :

B.4.2.3.1.3 BIT_SET_2

If bit 2 of STATE_RBM_TIA_PLAUS is 0 and LV_CDN_CST_RBM is 1 then bit 2 of STATE_RBM_TIA_PLAUS is set to 1.

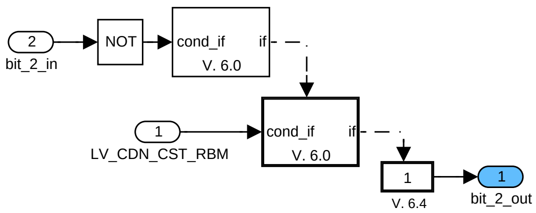

Figure B.4.15: :

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B.5 Cylinder balancing OBDII diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ERR_OBD_DIAG_CYL_BAL_ER	O/V/S	0... FFH	0... 255	1	-
Anti-bounce-counter for detected error up to current driving cycle (output of CYBL_ER concerned)					
CTR_ERR_OBD_DIAG_CYL_BAL_LAM [NC_CBK_EX_NR]	O/V/S	0... FFH	0... 255	1	-
Anti-bounce-counter for detected error up to current driving cycle (output of CILC concerned)					
ERR_SYM_CYL_BAL_ER [NC_CYL_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure symptom - output of CYBL_ER concerned					
ERR_SYM_CYL_BAL_LAM [NC_CYL_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure symptom - output of CILC concerned					
LV_CDN_DIAG_CYL_BAL_ER [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Diagnosis conditions - output of CYBL_ER concerned					
LV_CDN_DIAG_CYL_BAL_LAM [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
Diagnosis condition - output of CILC concerned					
LV_END_DIAG_CYL_BAL_ER [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
End of first diagnosis cycle - output of CYBL_ER concerned					
LV_END_DIAG_CYL_BAL_LAM [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
End of first diagnosis cycle - output of CILC concerned					
LV_END_DIAG_WIN_CYL_BAL_ER [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
End of diagnosis cycle for similar conditions window - output of CYBL_ER concerned					
LV_END_DIAG_WIN_CYL_BAL_LAM [NC_CYL_NR]	V	0... 1H	0 ...1	1	-
End of diagnosis cycle for similar conditions window - output of CILC concerned					
LV_ERR_CYL_BAL_ER [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Cylinder balancing error detected - output of CYBL_ER concerned					
LV_ERR_CYL_BAL_LAM [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Cylinder balancing error detected - output of CILC concerned					
LV_ERR_REF_CYL_BAL_ER	V	0... 1H	0 ...1	1	-
Reference flag indicating the CYBL_ER - error was occurred at least once for the current driving cycle					
LV_ERR_REF_CYL_BAL_LAM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Reference flag indicating the CILC - error was occurred at least once for the current driving cycle					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_OBD_DIAG_CYL_BAL_ER	O/V	0... 1H	0 ...1	1	-
Inhibit flag for CYBL_ER - cylinder balancing error detected over several driving cycles					
LV_INH_OBD_DIAG_CYL_BAL_LAM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibit flag for CILC - cylinder balancing error detected over several driving cycles					
T_SUM_CYL_BAL_ER_LIM_MAX [NC_CYL_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for detected diagnosis limit - upper limit of CYBL_ER concerned					
T_SUM_CYL_BAL_ER_LIM_MIN [NC_CYL_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for detected diagnosis limit - lower limit of CYBL_ER concerned					
T_SUM_CYL_BAL_LAM_LIM_MAX [NC_CYL_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for detected diagnosis limit - upper limit of CILC concerned					
T_SUM_CYL_BAL_LAM_LIM_MIN [NC_CYL_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for detected diagnosis limit - lower limit of CILC concerned					
T_SUM_END_DIAG_WIN_CYL_BAL_ER [NC_CYL_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for the diagnosis window - output of CYBL_ER concerned					
T_SUM_END_DIAG_WIN_CYL_LAM [NC_CYL_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for the diagnosis window - output of CILC concerned					
T_SUM_RST_CYL_BAL_ER [NC_CYL_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer to update the diagnosis window - output of CYBL_ER concerned					
T_SUM_RST_CYL_BAL_LAM [NC_CYL_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer to update the diagnosis window - output of CILC concerned					

Input data:

FAC_LAM_CYL_SEL_ ADJ_H_RNG [NC_CYL_NR] {p. 2731}	FAC_LAM_CYL_SEL_ ADJ_L_RNG [NC_CYL_NR] {p. 2731}	LF_LS_CBK_EX_LAM_ CYL_SEL_CONF {p. 2864}	LV_CTR_CYL_BAL_RST_ EXT {p. 7482}
LV_DC {p. 5746}	LV_IGK {p. 906}	LV_MFF_ADD_ER_BAL_ OBD_MAX_NEG [NC_CYL_NR] {p. 3269}	LV_MFF_ADD_ER_BAL_ OBD_MAX_POS [NC_CYL_NR] {p. 3269}
LV_MFF_FAC_ER_BAL_ OBD_MAX_NEG [NC_CYL_NR] {p. 3298}	LV_MFF_FAC_ER_BAL_ OBD_MAX_POS [NC_CYL_NR] {p. 3298}	LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}
NC_CYL_NR {p. 1526}	STATE_CTL_TI_ER_BAL {p. 4006}	STATE_DELTA_CRK_CYL_ LAM [NC_CBK_EX_NR] {p. 2839}	STATE_LAM_CYL_SEL_ ADJ [NC_CBK_EX_NR] {p. 2733}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DEC_ERR_OBD_DIAG_CYL_BAL	-	0... FFH	0... 255	1	-
Decrement constant of anti-bounce-counter					
C_CTR_INC_ERR_OBD_DIAG_CYL_BAL	-	0... FFH	0... 255	1	-
Increment constant of anti-bounce-counter					
C_CTR_MAX_CYL_BAL_ER_ERR	-	1... FFH	1... 255	1	-
Threshold of anti-bounce-counter to set the inhibit flag for CYBL_ER					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_MAX_CYL_BAL_LAM_ERR	-	1... FFH	1... 255	1	-
Threshold of anti-bounce-counter to set the inhibit flag for cylinder individual lambda control					
C_FAC_LAM_CYL_SEL_ADJ_DIAG_MAX	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Upper diagnosis limit of the cylinder individual nominal-adaptation correction factor					
C_FAC_LAM_CYL_SEL_ADJ_DIAG_MIN	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Lower diagnosis limit of the cylinder individual nominal-adaptation correction factor					
C_T_SUM_MIN_CYL_BAL_LIM	-	1... FFFFH	0.1... 6553.5	0.1	s
Minimum run-off time for error detection					
C_T_SUM_RST_MAX_CYL_BAL	-	1... FFFFH	0.1... 6553.5	0.1	s
Diagnosis time interval					
C_T_SUM_THD_CYL_BAL_LIM	-	1... FFFFH	0.1... 6553.5	0.1	s
Time threshold to set the error flag					
LC_CTR_ERR_OBD_DIAG_CYL_BAL	-	0... 1H	0 ...1	1	-
Anti-bounce-counter reset					

Error treatment:

Diagnostic CYL_BAL_LAM[x]	Symptom description	Symptom	Filter type
Detected failure symptom - output of CILC concerned	*minimum diagnosis limit of cylinder individual lambda control reached*	*SYM_0*	*NO*
	maximum diagnosis limit of cylinder individual lambda control reached	*SYM_1*	
	not used	*SYM_2*	
	not used	*SYM_3*	

Figure B.5.1: Diagnostic

Diagnostic CYL_BAL_ER[x]	Symptom description	Symptom	Filter type
Detected failure symptom - output of CYBL_ER concerned	*minimum diagnosis limit of CYBL_ER reached*	*SYM_0*	*NO*
	maximum diagnosis limit of CYBL_ER reached	*SYM_1*	
	not used	*SYM_2*	
	not used	*SYM_3*	

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FUNCTION DESCRIPTION:

General information:

The objective function of cylinder balancing diagnosis is monitoring the output of cylinder individual lambda control in homogenous engine operation and output of cylinder balancing via engine roughness in stratified or homogenous-stratified engine operation mode. Breaking the diagnosis limits for a long

time, which may have been caused by injector- failures, shall be diagnosed by cylinder balancing diagnosis. The failure allocation is cylinder selective. In case of failure detection for one of the cylinders the failure symptom of remaining cylinders shall be checked. Should the run-off time of any cylinder be over the minimum threshold, the concerned cylinder has to be detected as defect. Should the output of cylinder individual lambda control be concerned, the diagnosis shall be executed for all of the exhaust-bank-related cylinders (1.2, 1.4.1,1.5, 1.6.1,1.7.1.1).
The diagnosis shall be executed for all of the cylinders if the output of cylinder balancing via engine roughness is concerned (1.2, 1.4.2, 1.5, 1.6.2, 1.7.2).

Description of index "[i]" and "[x]":

x: logical cylinder
*use **NC_CYL_NR**: number of engine cylinders - index "[x]"*
*use **LF_LS_CBK_EX_LAM_CYL_SEL_CONF**: pattern for allocation of physical cylinders to exhaust bank - index "[i]*

Signal flow diagram:

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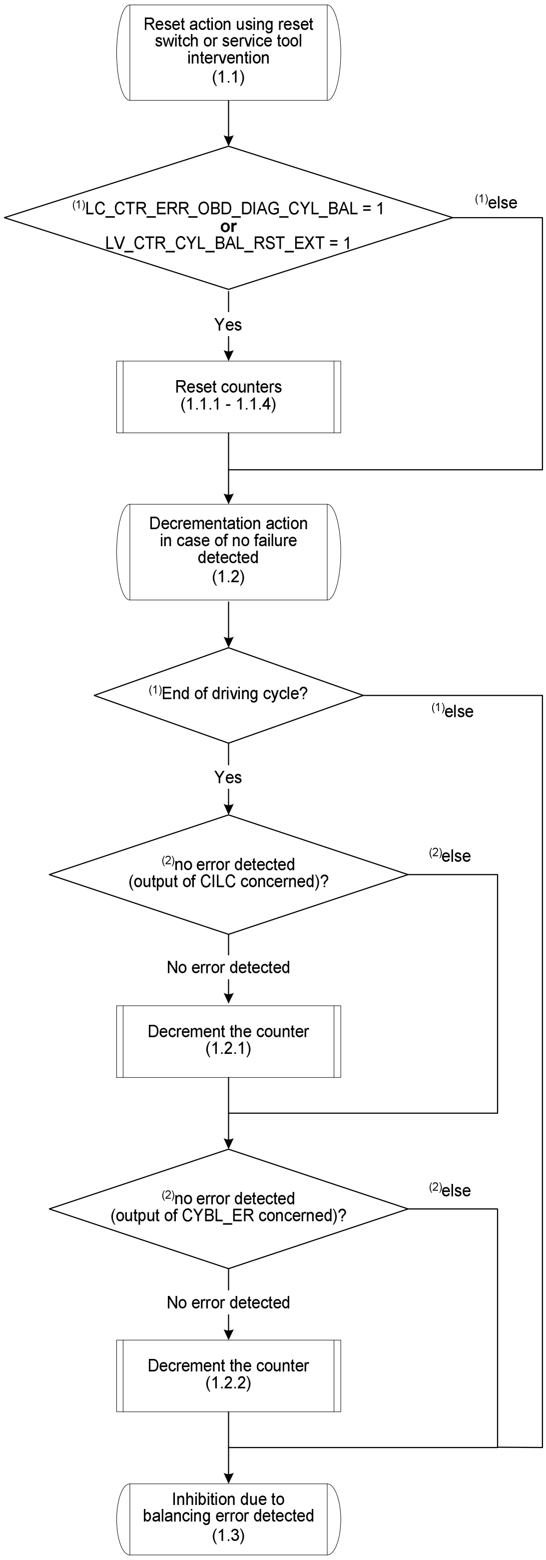

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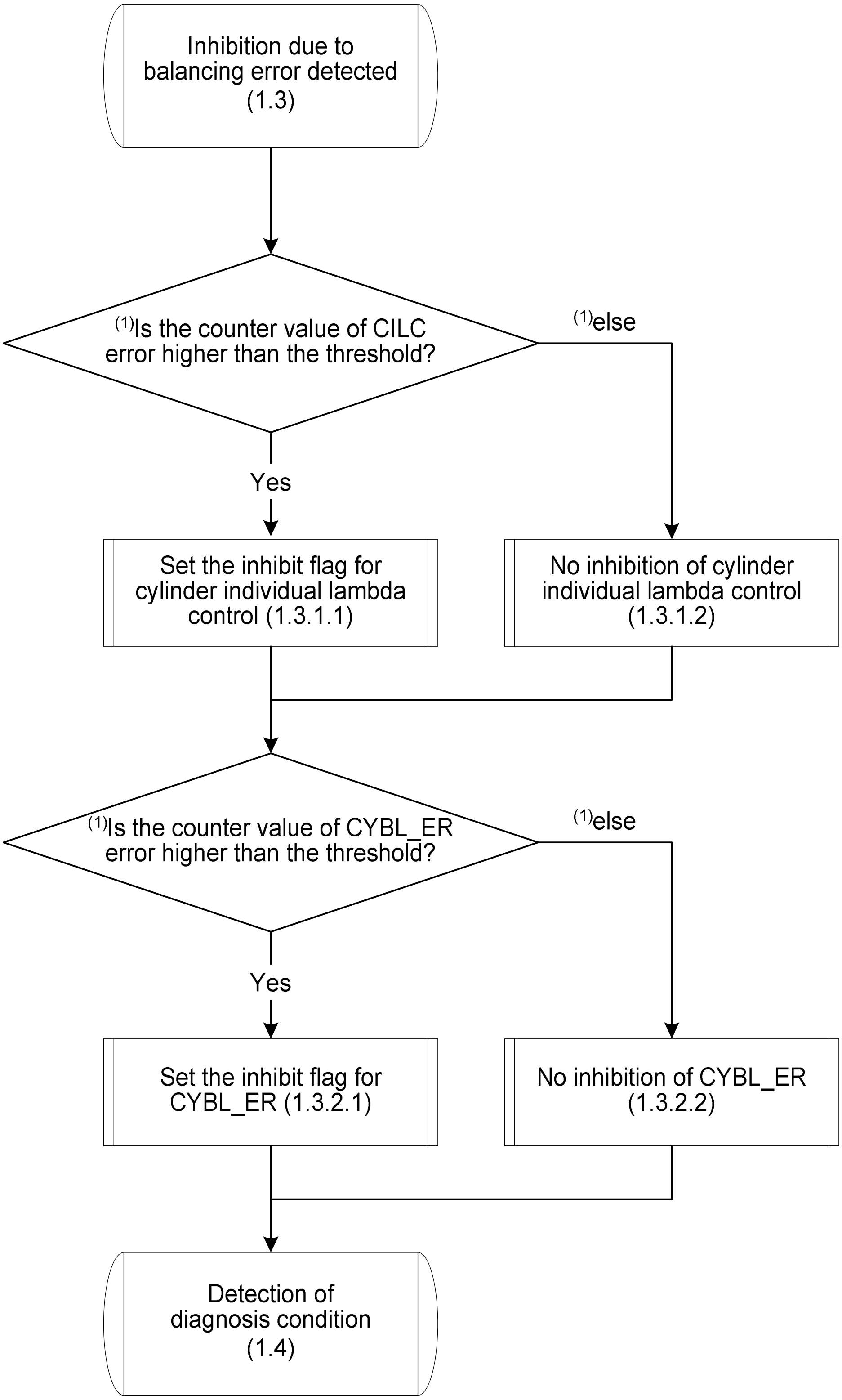

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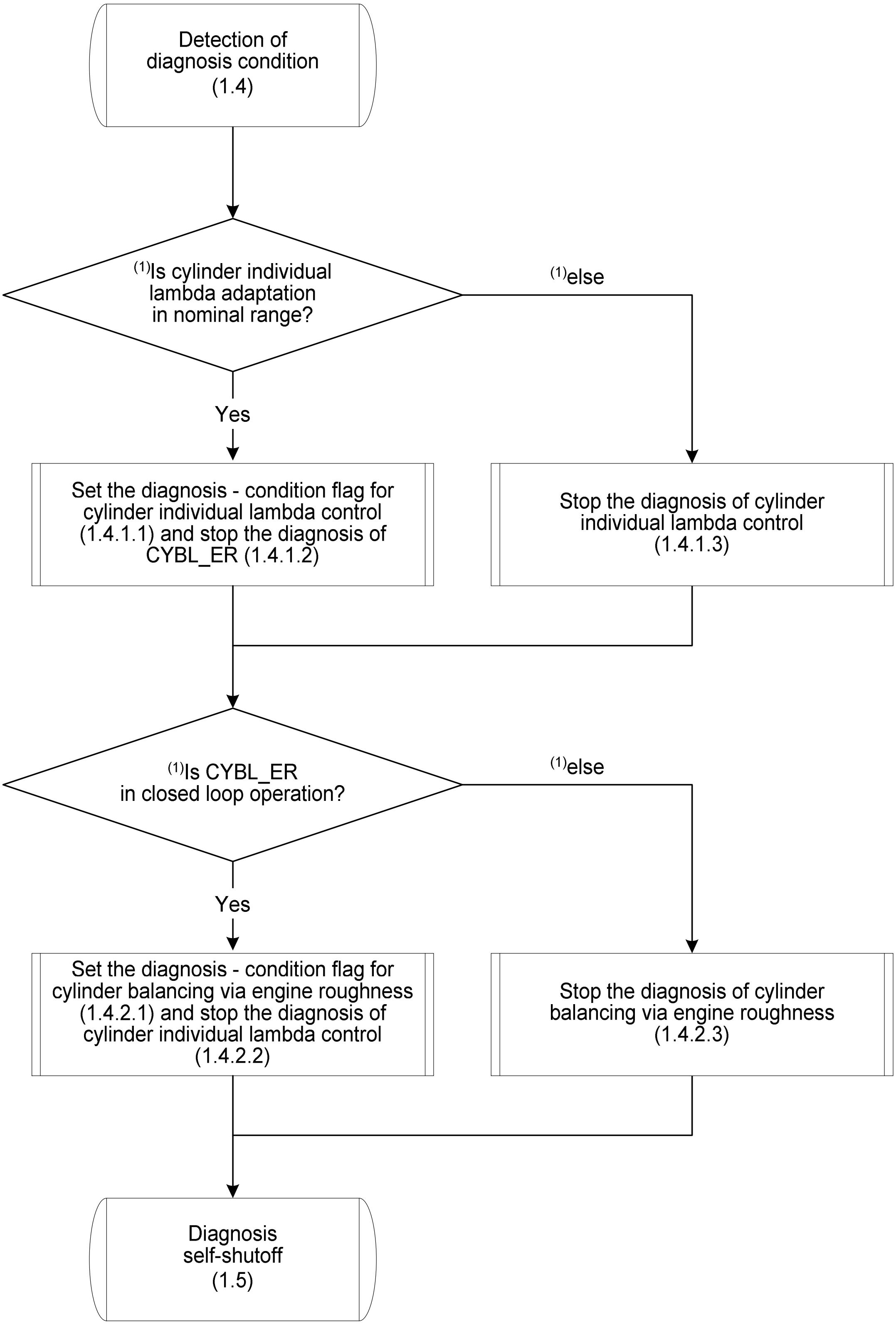

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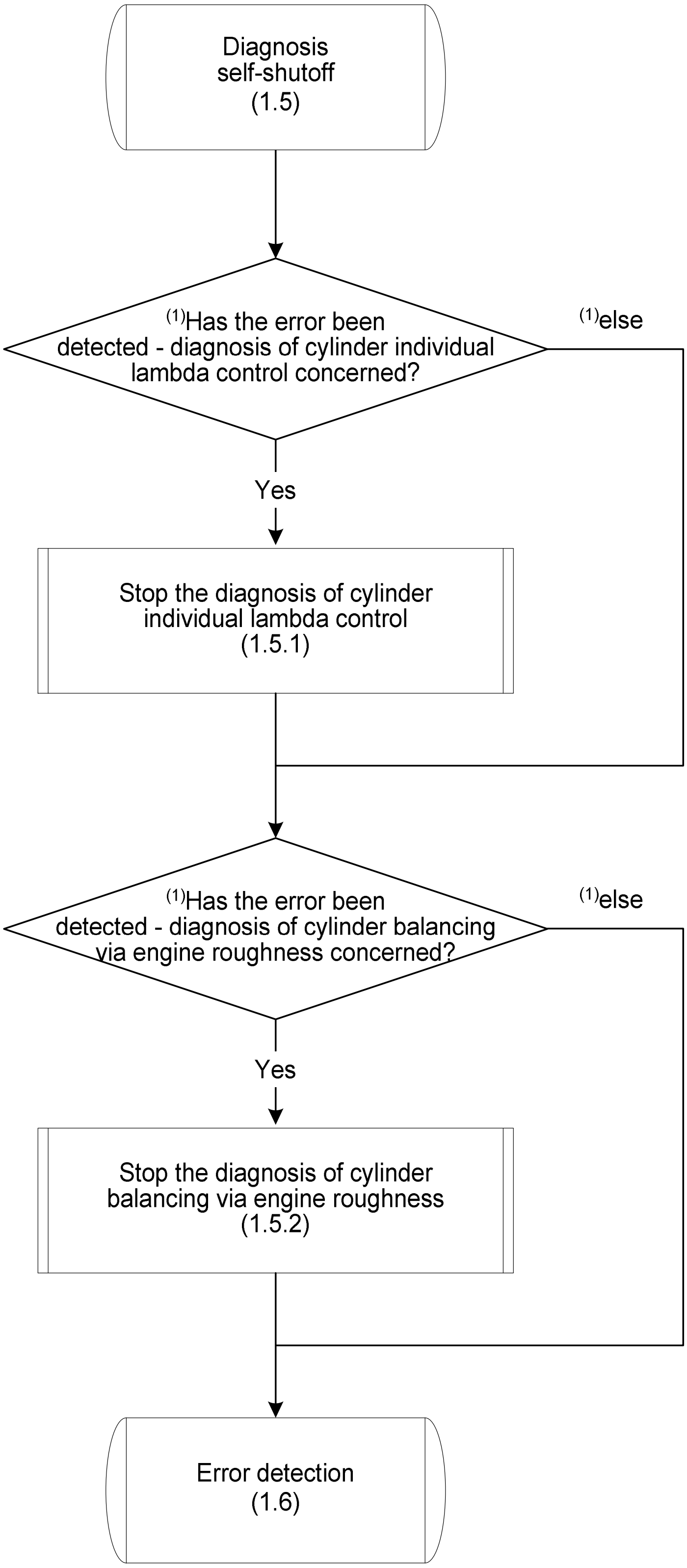

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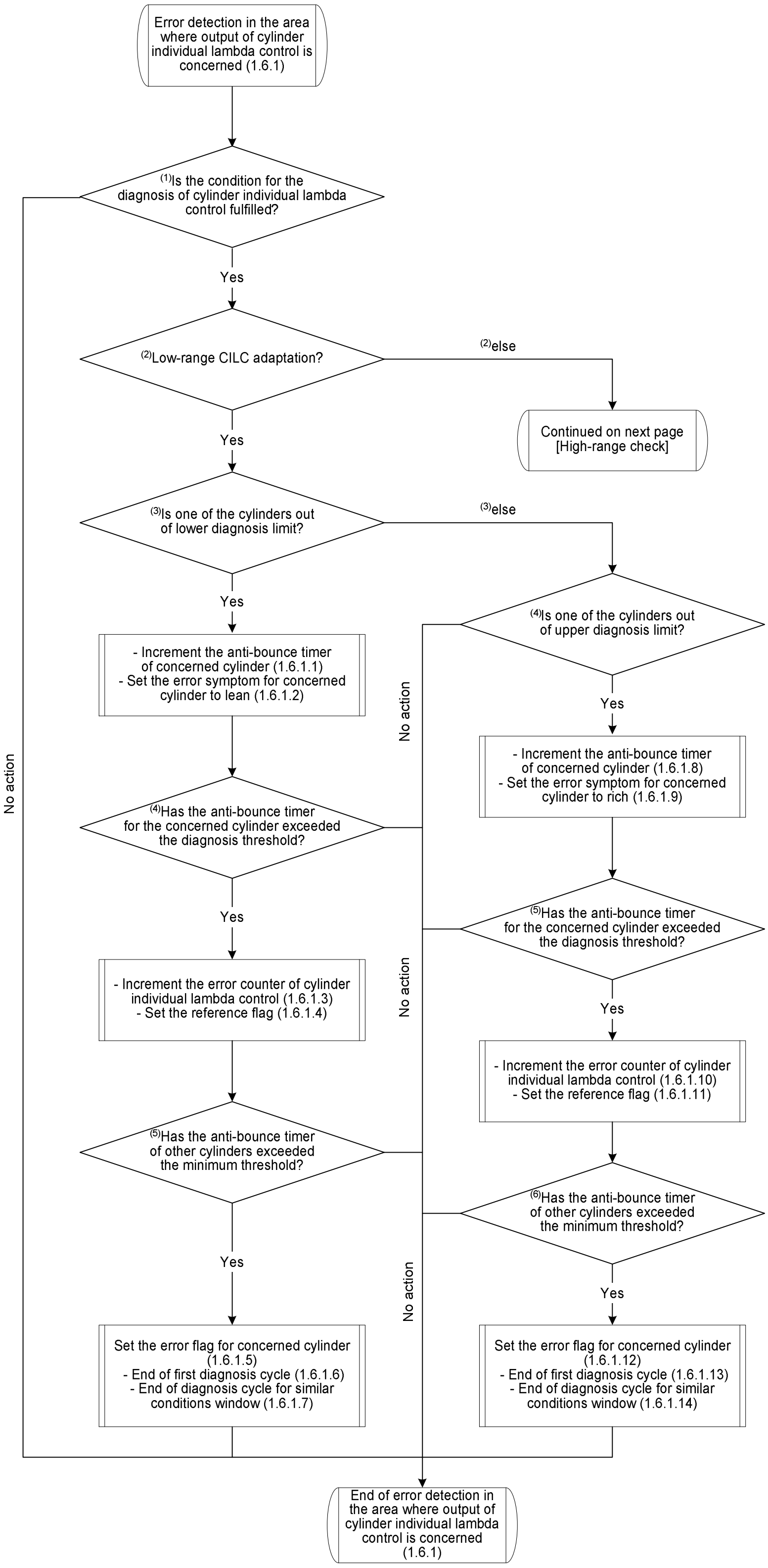

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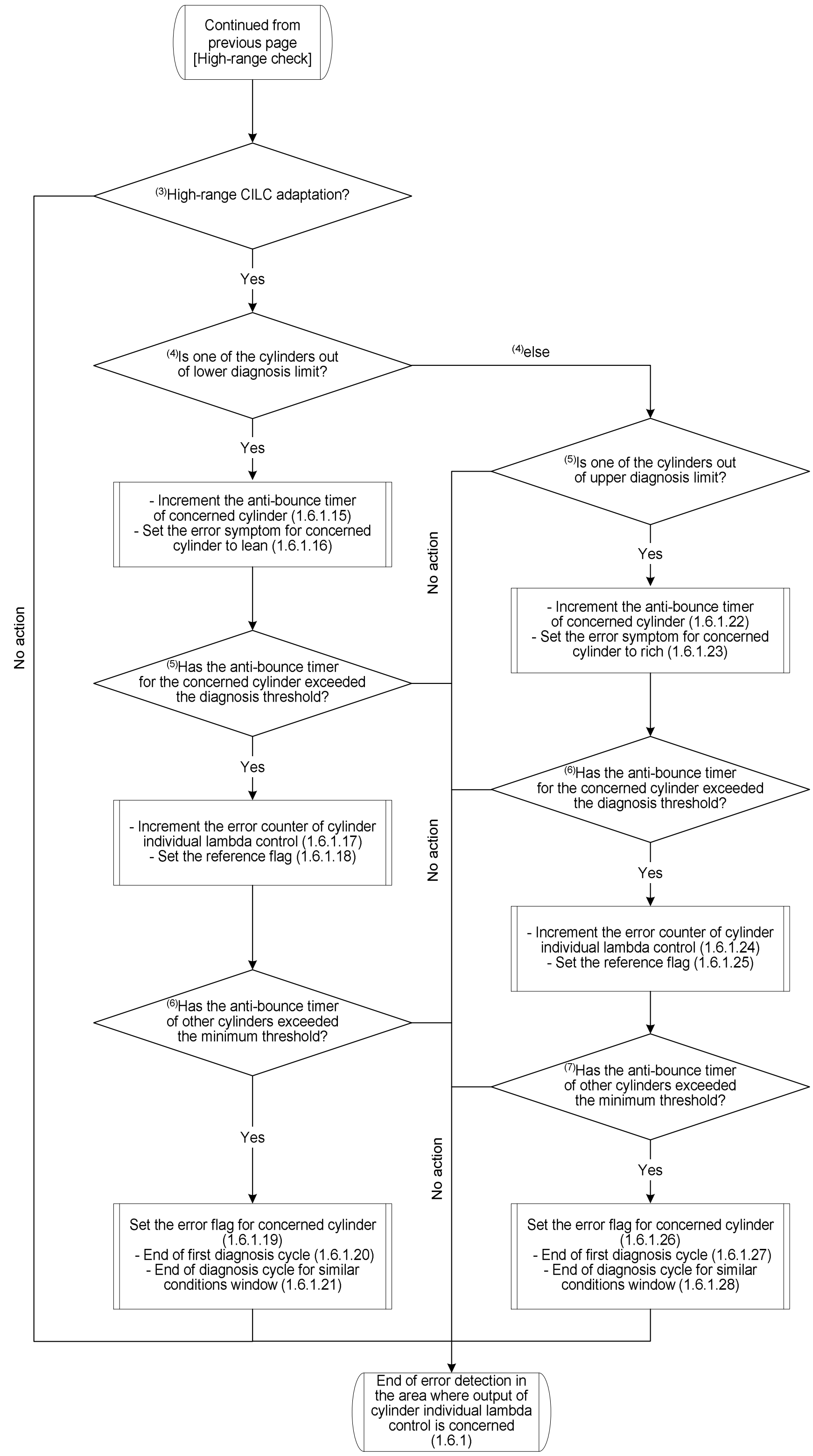

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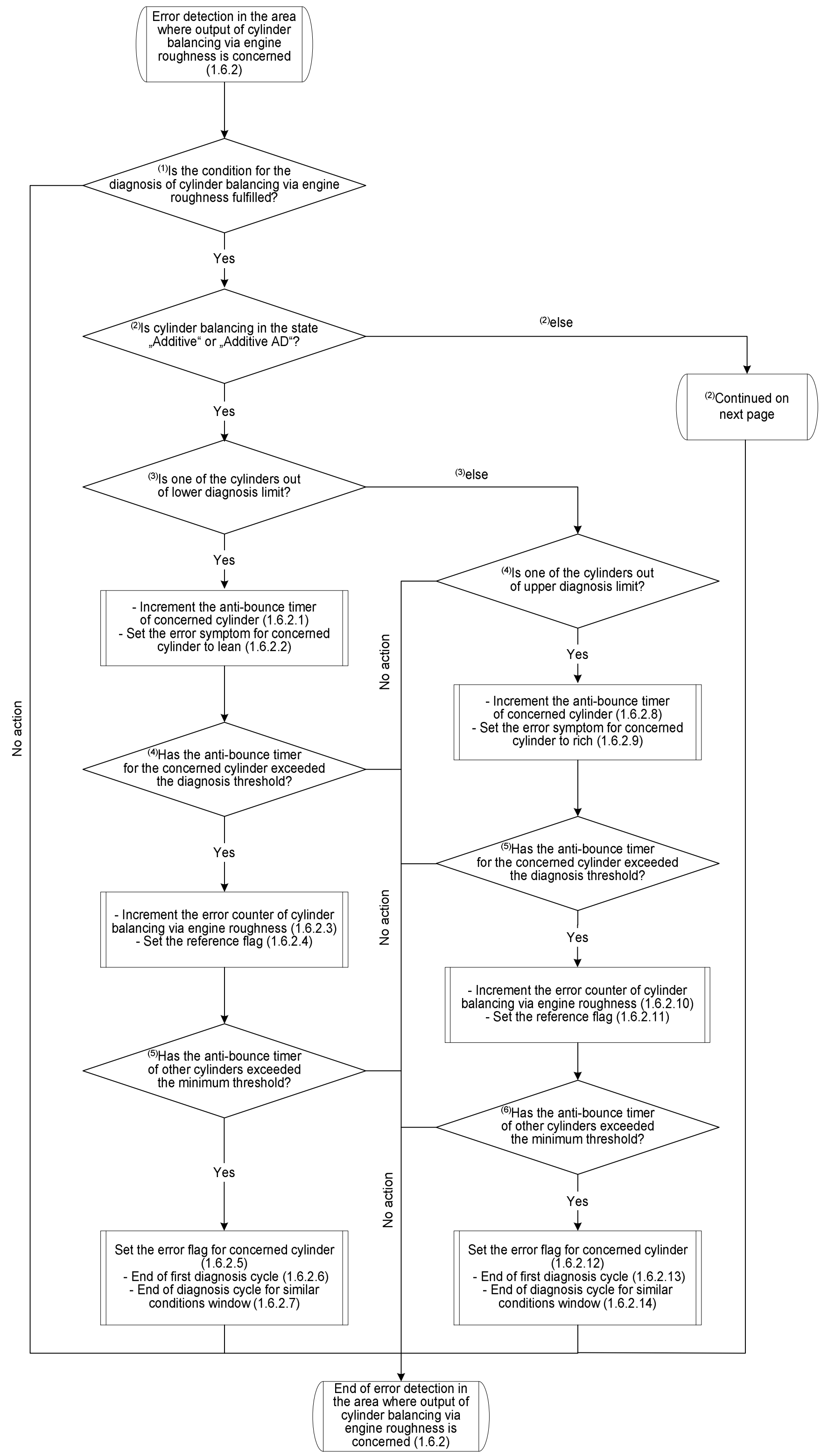

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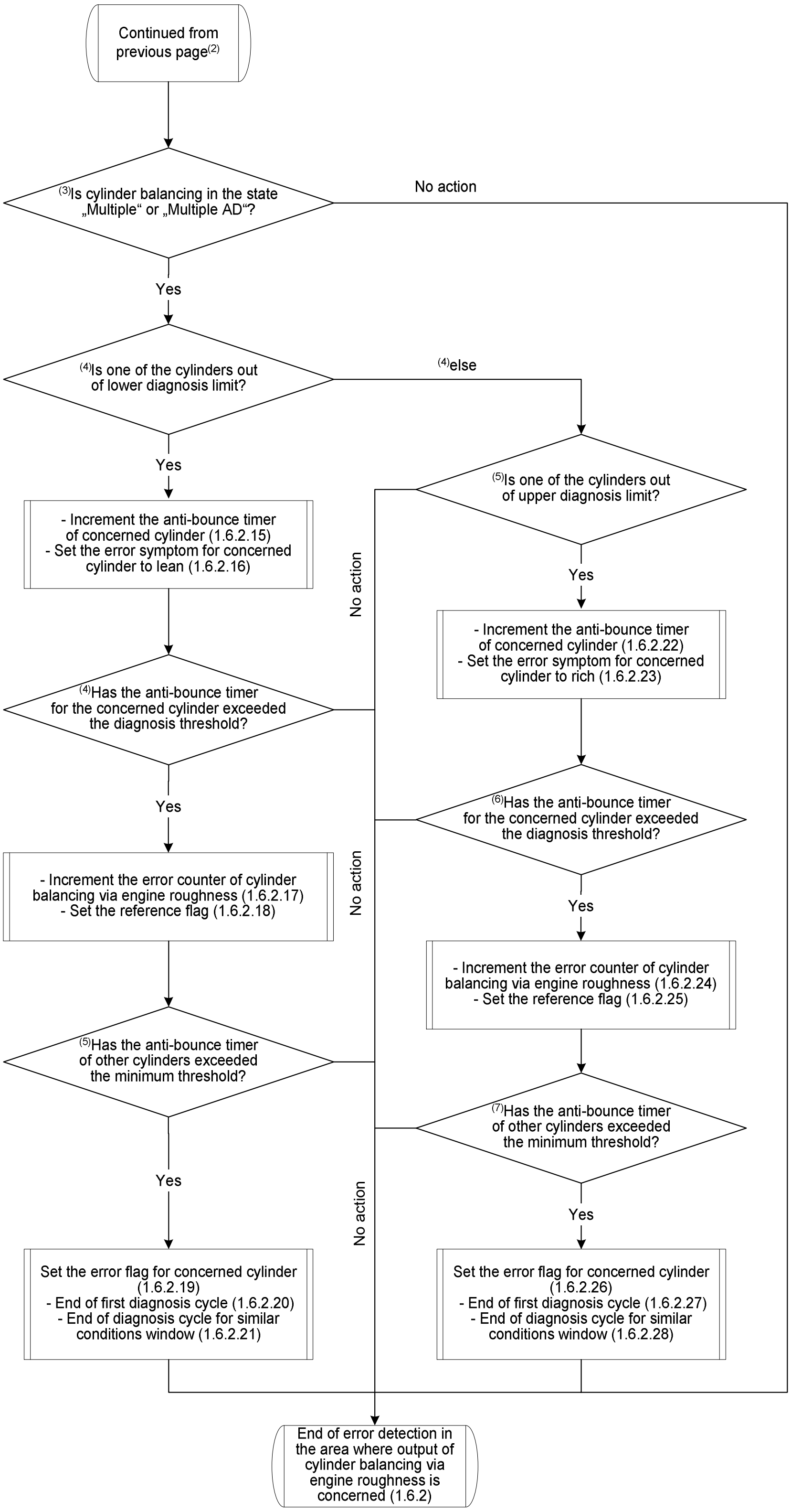

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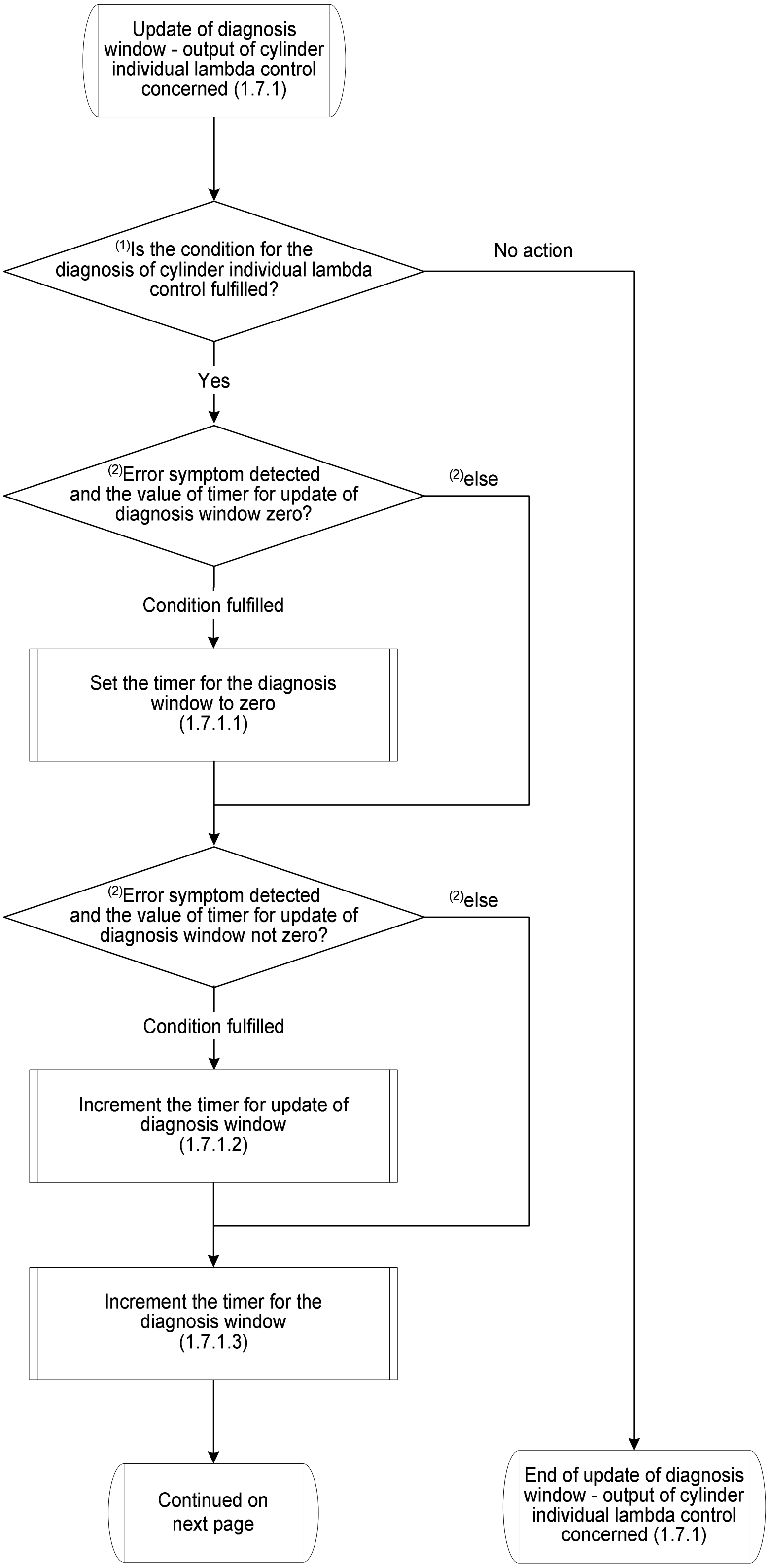

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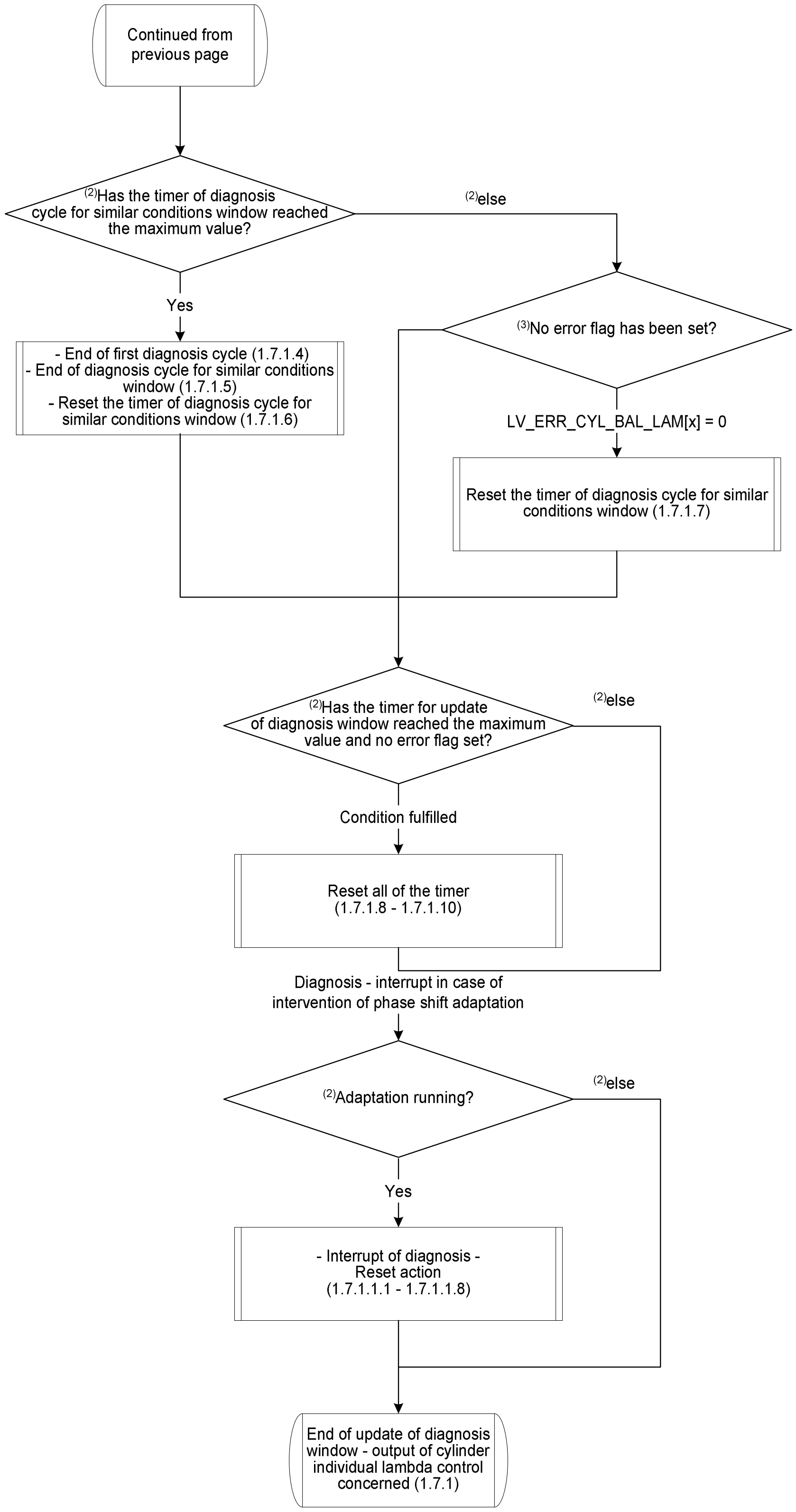

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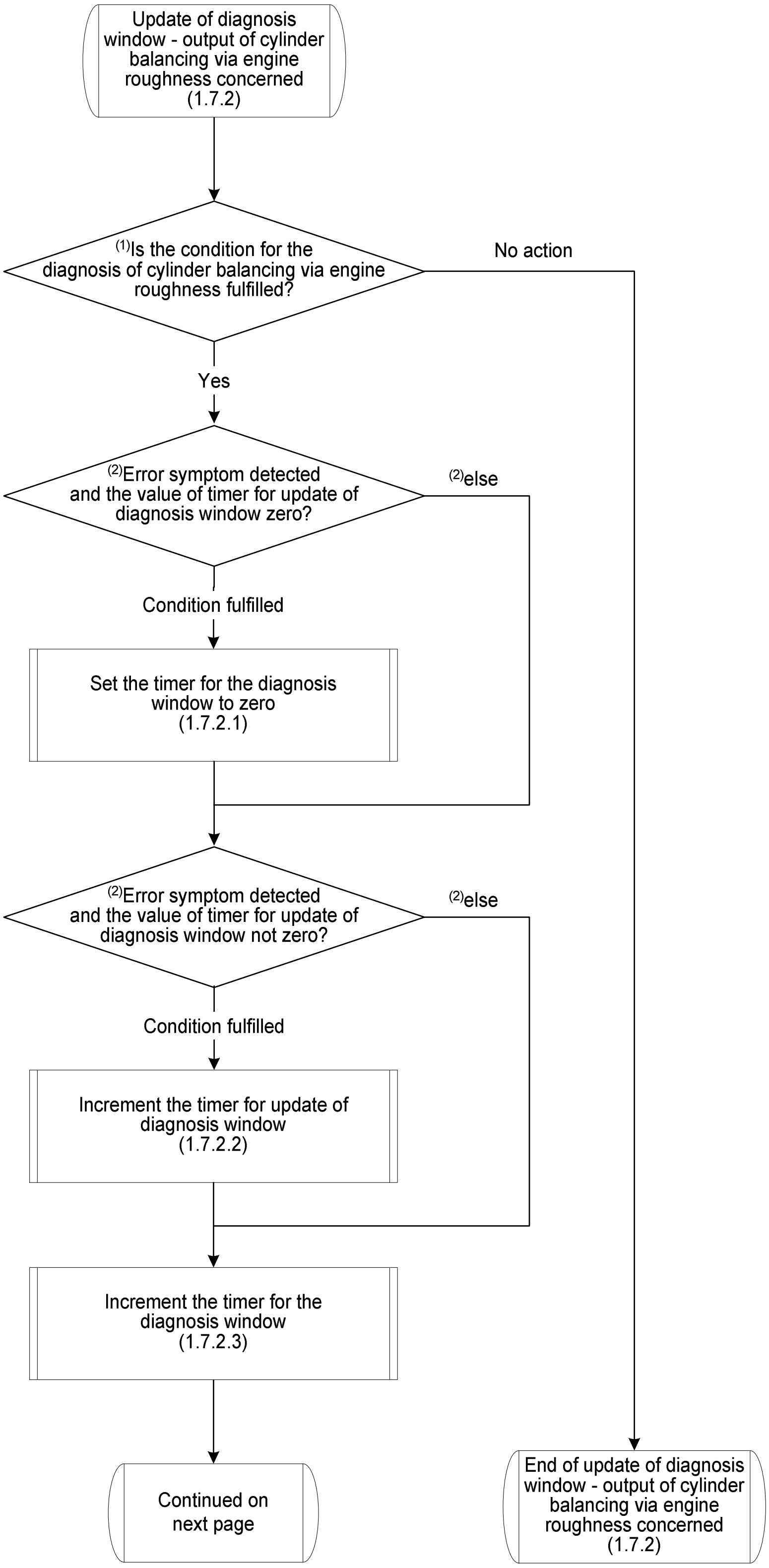

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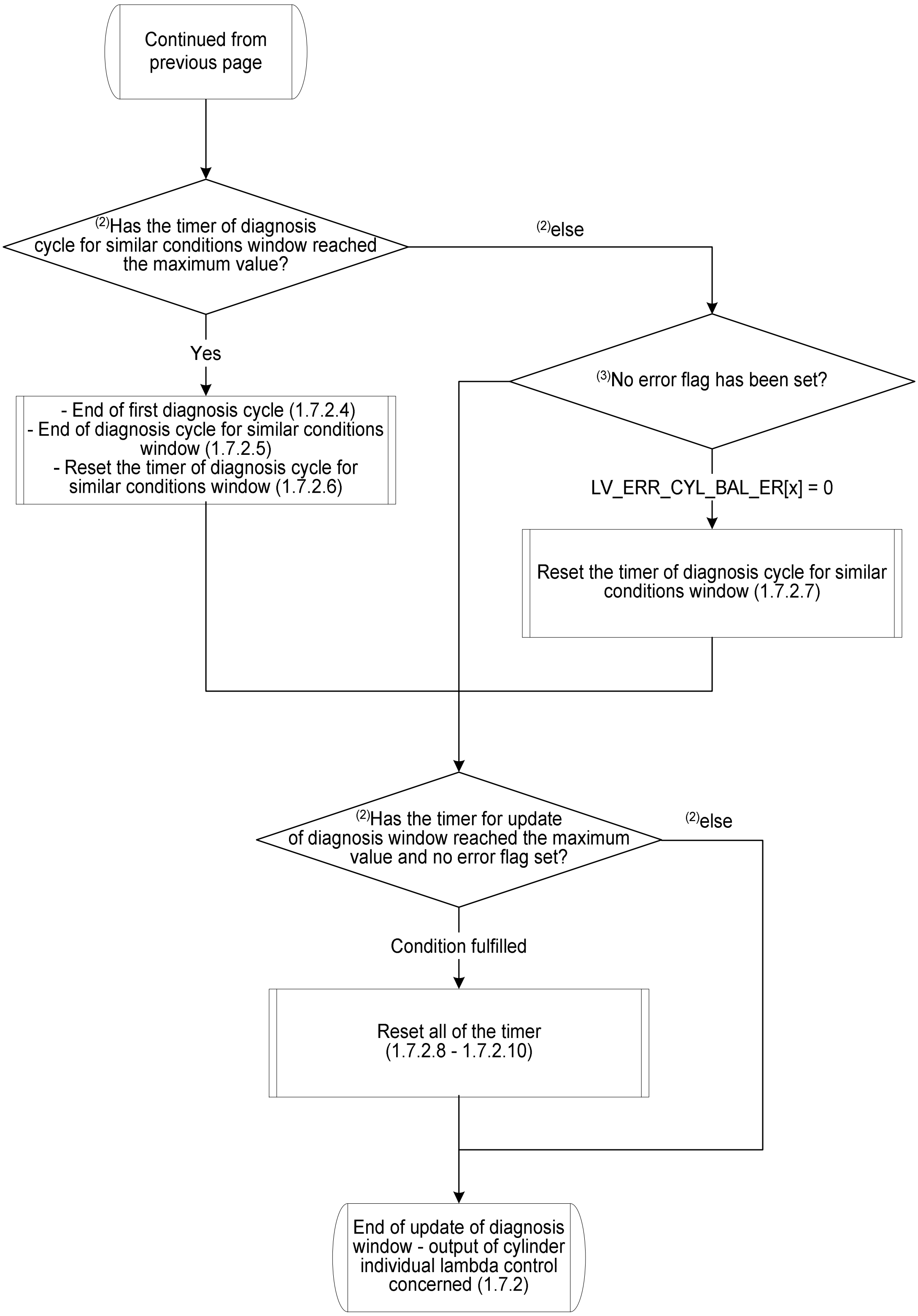

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Application conditions

Initialization:

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at reset, LV_IGK = 0 1 and clear error memory:
LV_CDN_DIAG_CYL_BAL_LAM[x] = 0
LV_CDN_DIAG_CYL_BAL_ER[x] = 0
ERR_SYM_CYL_BAL_LAM[x] = 0
ERR_SYM_CYL_BAL_ER[x] = 0
LV_ERR_CYL_BAL_LAM[x] = 0
LV_ERR_CYL_BAL_ER[x] = 0
T_SUM_CYL_BAL_LAM_LIM_MIN[x] = 0
T_SUM_CYL_BAL_LAM_LIM_MAX[x] = 0
T_SUM_CYL_BAL_ER_LIM_MIN[x] = 0
T_SUM_CYL_BAL_ER_LIM_MAX[x] = 0
T_SUM_RST_CYL_BAL_LAM[x] = 0
T_SUM_RST_CYL_BAL_ER[x] = 0
T_SUM_END_DIAG_WIN_CYL_LAM[x] = 0
T_SUM_END_DIAG_WIN_CYL_BAL_ER[x] = 0
LV_INH_OBD_DIAG_CYL_BAL_LAM[i] = 0
LV_INH_OBD_DIAG_CYL_BAL_ER = 0
LV_ERR_REF_CYL_BAL_LAM[i] = 0
LV_ERR_REF_CYL_BAL_ER = 0

At E2PROM - failure:**
CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] = 0
CTR_ERR_OBD_DIAG_CYL_BAL_ER = 0

Recurrence:
100 ms

Activation:
LV_ST_END = 1

Deactivation:
-

Formula section:

B.5.1 Reset action using reset switch or service tool intervention

if(1) (LC_CTR_ERR_OBD_DIAG_CYL_BAL = 1 **or** LV_CTR_CYL_BAL_RST_EXT = 1)
then

CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] = 0 **(1.1.1)**

CTR_ERR_OBD_DIAG_CYL_BAL_ER = 0 **(1.1.2)**

LV_ERR_REF_CYL_BAL_LAM[i] = 0 **(1.1.3)**

LV_ERR_REF_CYL_BAL_ER = 0 **(1.1.4)**

endif(1)

B.5.2 Decrement action in case of no failure detected

if(1) LV_DC 1   0

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then
if(2) (LV_ERR_CYL_BAL_LAM[x] = 0 **and** CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] > 0)
[*Remark: the cylinder selective error flag shall be assigned to the corresponding exhaust bank (index x -> index i)*]
then
CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] = CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] - C_CTR_DEC_ERR_OBD_DIAG_CYL_BAL
[*Remark: the counter shall be decremented only once per recurrence*] **(1.2.1)**
endif(2)

if(2) (LV_ERR_CYL_BAL_ER[x] = 0 **and** CTR_ERR_OBD_DIAG_CYL_BAL_ER > 0)
then
CTR_ERR_OBD_DIAG_CYL_BAL_ER = CTR_ERR_OBD_DIAG_CYL_BAL_ER - C_CTR_DEC_ERR_OBD_DIAG_CYL_BAL
[*Remark: the counter shall be decremented only once per recurrence*] **(1.2.2)**
endif(2)
endif(1)

B.5.3 Inhibition due to balancing error detected

B.5.3.1 Inhibition of cylinder individual lambda control

if(1) CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] C_CTR_MAX_CYL_BAL_LAM_ERR
then
LV_INH_OBD_DIAG_CYL_BAL_LAM[i] = 1 **(1.3.1.1)**
else(1)
LV_INH_OBD_DIAG_CYL_BAL_LAM[i] = 0 **(1.3.1.2)**
endif(1)

B.5.3.2 Inhibition of CYBL_ER

if(1) CTR_ERR_OBD_DIAG_CYL_BAL_ER C_CTR_MAX_CYL_BAL_ER_ERR
then
LV_INH_OBD_DIAG_CYL_BAL_ER = 1 **(1.3.2.1)**
else(1)
LV_INH_OBD_DIAG_CYL_BAL_ER = 0 **(1.3.2.2)**
endif(1)

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B.5.4 Diagnosis condition

B.5.4.1 Diagnosis condition - output of cylinder individual lambda control concerned

if(1) (STATE_LAM_CYL_SEL_ADJ[i] = 4 ' ADJ_NOM_L_RNG' **or** STATE_LAM_CYL_SEL_ADJ[i] = 5 ' ADJ_NOM_H_RNG')

[*Remark: the exhaust bank based calculation shall be executed for all of the exhaust-bank-related cylinders (index i -> index x)* - **(1.4.1.1)** and **(1.4.1.3)**]

then

LV_CDN_DIAG_CYL_BAL_LAM[x] = 1

[*Remark: the calculation shall be executed for all of the exhaust-bank-related cylinders (index i -> index x)*] **(1.4.1.1)**

LV_CDN_DIAG_CYL_BAL_ER[x] = 0

[*Remark: the calculation shall be executed for all of the cylinders (index x)*] **(1.4.1.2)**

else(1)

LV_CDN_DIAG_CYL_BAL_LAM[x] = 0

[*Remark: the calculation shall be executed for all of the exhaust-bank-related cylinders (index i -> index x)*] **(1.4.1.3)**

endif(1)

B.5.4.2 Diagnosis condition - output of CYBL_ER concerned

if(1) STATE_CTL_TI_ER_BAL   0

then

LV_CDN_DIAG_CYL_BAL_ER[x] = 1

[*Remark: the calculation shall be executed for all of the cylinders (index x)*] **(1.4.2.1)**

LV_CDN_DIAG_CYL_BAL_LAM[x] = 0

[*Remark: the calculation shall be executed for all of the cylinders (index x)*] **(1.4.2.2)**

else(1)

LV_CDN_DIAG_CYL_BAL_ER[x] = 0

[*Remark: the calculation shall be executed for all of the cylinders (index x)*] **(1.4.2.3)**

endif(1)

B.5.5 Diagnosis self-shutoff

if(1) LV_ERR_CYL_BAL_LAM[x] = 1

then

LV_CDN_DIAG_CYL_BAL_LAM[x] = 0

[*Remark: the calculation shall be executed for all of the exhaust-bank-related cylinders (index i -> index x)*] **(1.5.1)**

endif(1)

if(1) LV_ERR_CYL_BAL_ER[x] = 1

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then
LV_CDN_DIAG_CYL_BAL_ER[x] = 0
[*Remark: the calculation shall be executed for all of the cylinders (index x)*] **(1.5.2)**
endif(1)

B.5.6 Error detection

B.5.6.1 Error detection in the area where the cylinder individual lambda adaptation is concerned

if(1) LV_CDN_DIAG_CYL_BAL_LAM[x] = 1
then
if(2) STATE_LAM_CYL_SEL_ADJ[i] = 4 ' ADJ_NOM_L_RNG'
[*Remark: the exhaust bank based calculation shall be executed for all of the exhaust-bank-related cylinders (index i -> index x)* - **(1.6.1.1)** - **(1.6.1.14)**]
then
if(3) FAC_LAM_CYL_SEL_ADJ_L_RNG[x] < C_FAC_LAM_CYL_SEL_ADJ_DIAG_MIN
then
increment (T_SUM_CYL_BAL_LAM_LIM_MIN[x]) **(1.6.1.1)**
ERR_SYM_CYL_BAL_LAM[x] = 1 'SYM_0' **(1.6.1.2)**
if(4) T_SUM_CYL_BAL_LAM_LIM_MIN[x] > C_T_SUM_THD_CYL_BAL_LIM
then
if(5) LV_ERR_REF_CYL_BAL_LAM[i] = 0
then
CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] = CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] + C_CTR_INC_ERR_OBD_DIAG_CYL_BAL **(1.6.1.3)**
LV_ERR_REF_CYL_BAL_LAM[i] = 1 **(1.6.1.4)**
endif(5)
for(5) j(x) = 1 : Number of cylinders per exhaust bank
if(6) **[**(T_SUM_CYL_BAL_LAM_LIM_MIN[x] > C_T_SUM_MIN_CYL_BAL_LIM) **or** (T_SUM_CYL_BAL_LAM_LIM_MAX[x] > C_T_SUM_MIN_CYL_BAL_LIM)**]**
then
LV_ERR_CYL_BAL_LAM[x] = 1 **(1.6.1.5)**
LV_END_DIAG_CYL_BAL_LAM[x] = 1 **(1.6.1.6)**
LV_END_DIAG_WIN_CYL_BAL_LAM[x] = 1 **(1.6.1.7)**

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endif$^{(6)}$
endfor$^{(5)}$
endif$^{(4)}$
else$^{(3)}$
if$^{(4)}$ FAC_LAM_CYL_SEL_ADJ_L_RNG[x] $>$ C_FAC_LAM_CYL_SEL_ADJ_DIAG_
MAX
then
increment (T_SUM_CYL_BAL_LAM_LIM_MAX[x])
(1.6.1.8)
ERR_SYM_CYL_BAL_LAM[x] = 2 'SYM_1'
(1.6.1.9)
if$^{(5)}$ T_SUM_CYL_BAL_LAM_LIM_MAX[x] $>$ C_T_SUM_THD_CYL_BAL_LIM
then
if$^{(6)}$ LV_ERR_REF_CYL_BAL_LAM[i] = 0
then
CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] = CTR_ERR_OBD_DIAG_CYL_BAL_
LAM[i] +
C_CTR_INC_ERR_OBD_DIAG_CYL_
BAL
(1.6.1.10)
LV_ERR_REF_CYL_BAL_LAM[i] = 1
(1.6.1.11)
endif$^{(6)}$
for$^{(6)}$ j(x) = 1 : Number of cylinders per exhaust bank
if$^{(7)}$ **[**(T_SUM_CYL_BAL_LAM_LIM_MIN[x] $>$ C_T_SUM_MIN_CYL_BAL_LIM) **or** (T_SUM_CYL_BAL_LAM_LIM_MAX[x]
$>$
C_T_SUM_MIN_CYL_BAL_LIM)**]**
then
LV_ERR_CYL_BAL_LAM[x] = 1
(1.6.1.12)
LV_END_DIAG_CYL_BAL_LAM[x] = 1
(1.6.1.13)
LV_END_DIAG_WIN_CYL_BAL_LAM[x] = 1
(1.6.1.14)
endif$^{(7)}$
endfor$^{(6)}$
endif$^{(5)}$
endif$^{(4)}$
endif$^{(3)}$
else$^{(2)}$
if$^{(3)}$ STATE_LAM_CYL_SEL_ADJ[i] = 5 ' ADJ_NOM_H_RNG'
[*Remark: the exhaust bank based calculation shall be executed for all of the exhaust-bank-related cylinders (index i -> index x)* - **(1.6.1.15)** - **(1.6.1.28)**]
then
if$^{(4)}$ FAC_LAM_CYL_SEL_ADJ_H_RNG[x] $<$

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C_FAC_LAM_CYL_SEL_ADJ_DIAG_
MIN
then
increment (T_SUM_CYL_BAL_LAM_LIM_MIN[x])
(1.6.1.15)
ERR_SYM_CYL_BAL_LAM[x] = 1 'SYM_0'
(1.6.1.16)
if$^{(5)}$ T_SUM_CYL_BAL_LAM_LIM_MIN[x] $>$
C_T_SUM_THD_CYL_BAL_LIM
then
if$^{(6)}$ LV_ERR_REF_CYL_BAL_LAM[i] = 0
then
CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] =
CTR_ERR_OBD_DIAG_CYL_BAL_
LAM[i] +
C_CTR_INC_ERR_OBD_DIAG_CYL_
BAL
(1.6.1.17)
LV_ERR_REF_CYL_BAL_LAM[i] = 1
(1.6.1.18)
endif$^{(6)}$
for$^{(6)}$ j(x) = 1 : Number of cylinders per exhaust bank
if$^{(7)}$ **[**(T_SUM_CYL_BAL_LAM_LIM_MIN[x] $>$
C_T_SUM_MIN_CYL_BAL_LIM) **or**
(T_SUM_CYL_BAL_LAM_LIM_MAX[x]
$>$
C_T_SUM_MIN_CYL_BAL_LIM)**]**
then
LV_ERR_CYL_BAL_LAM[x] = 1
(1.6.1.19)
LV_END_DIAG_CYL_BAL_LAM[x] = 1
(1.6.1.20)
LV_END_DIAG_WIN_CYL_BAL_LAM[x] = 1
(1.6.1.21)
endif$^{(7)}$
endfor$^{(6)}$
endif$^{(5)}$
else$^{(4)}$
if$^{(5)}$ FAC_LAM_CYL_SEL_ADJ_H_RNG[x] $>$
C_FAC_LAM_CYL_SEL_ADJ_DIAG_
MAX
then
increment (T_SUM_CYL_BAL_LAM_LIM_MAX[x])
(1.6.1.22)
ERR_SYM_CYL_BAL_LAM[x] = 2 'SYM_1'
(1.6.1.23)
if$^{(6)}$ T_SUM_CYL_BAL_LAM_LIM_MAX[x] $>$
C_T_SUM_THD_CYL_BAL_LIM
then
if$^{(7)}$ LV_ERR_REF_CYL_BAL_LAM[i] = 0
then
CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] =

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CTR_ERR_OBD_DIAG_CYL_BAL_LAM[i] + C_CTR_INC_ERR_OBD_DIAG_CYL_BAL **(1.6.1.24)**

LV_ERR_REF_CYL_BAL_LAM[i] = 1 **(1.6.1.25)**

endif$^{(7)}$

for$^{(7)}$ j(x) = 1 : Number of cylinders per exhaust bank

if$^{(8)}$ **[**(T_SUM_CYL_BAL_LAM_LIM_MIN[x] $>$ C_T_SUM_MIN_CYL_BAL_LIM) **or** (T_SUM_CYL_BAL_LAM_LIM_MAX[x] $>$ C_T_SUM_MIN_CYL_BAL_LIM)**]**

then

LV_ERR_CYL_BAL_LAM[x] = 1 **(1.6.1.26)**

LV_END_DIAG_CYL_BAL_LAM[x] = 1 **(1.6.1.27)**

LV_END_DIAG_WIN_CYL_BAL_LAM[x] = 1 **(1.6.1.28)**

endif$^{(8)}$

endfor$^{(7)}$

endif$^{(6)}$

endif$^{(5)}$

endif$^{(4)}$

endif$^{(3)}$

endif$^{(2)}$

endif$^{(1)}$

B.5.6.2 Error detection in the area where output of CYBL_ER is concerned

if$^{(1)}$ LV_CDN_DIAG_CYL_BAL_ER[x] = 1

[*Remark: the calculation shall be executed for all of the cylinders (index x) -* **(1.6.2.1) - (1.6.2.28)**]

then

if$^{(2)}$ (STATE_CTL_TI_ER_BAL = 1 **or** STATE_CTL_TI_ER_BAL = 2)

then

if$^{(3)}$ LV_MFF_ADD_ER_BAL_OBD_MAX_NEG[x] = 1

then

increment (T_SUM_CYL_BAL_ER_LIM_MIN[x]) **(1.6.2.1)**

ERR_SYM_CYL_BAL_ER[x] = 1 'SYM_0' **(1.6.2.2)**

if$^{(4)}$ T_SUM_CYL_BAL_ER_LIM_MIN[x] $>$ C_T_SUM_THD_CYL_BAL_LIM

then

if$^{(5)}$ LV_ERR_REF_CYL_BAL_ER = 0

then

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CTR_ERR_OBD_DIAG_CYL_BAL_ER =
CTR_ERR_OBD_DIAG_CYL_BAL_
ER +
C_CTR_INC_ERR_OBD_DIAG_CYL_
BAL
(1.6.2.3)
LV_ERR_REF_CYL_BAL_ER = 1
(1.6.2.4)
endif(5)
for(5) j(x) = 1 : Number of cylinders
if(6) **[**(T_SUM_CYL_BAL_ER_LIM_MIN[x] $>$
C_T_SUM_MIN_CYL_BAL_LIM) **or**
(T_SUM_CYL_BAL_ER_LIM_MAX[x]
$>$
C_T_SUM_MIN_CYL_BAL_LIM)**]**
then
LV_ERR_CYL_BAL_ER[x] = 1
(1.6.2.5)
LV_END_DIAG_CYL_BAL_ER[x] = 1
(1.6.2.6)
LV_END_DIAG_WIN_CYL_BAL_ER[x] = 1
(1.6.2.7)
endif(6)
endfor(5)
endif(4)
else(3)
if(4) LV_MFF_ADD_ER_BAL_OBD_MAX_POS[x] = 1
then
increment (T_SUM_CYL_BAL_ER_LIM_MAX[x])
(1.6.2.8)
ERR_SYM_CYL_BAL_ER[x] = 2 'SYM_1'
(1.6.2.9)
if(5) T_SUM_CYL_BAL_ER_LIM_MAX[x] $>$
C_T_SUM_THD_CYL_BAL_LIM
then
if(6) LV_ERR_REF_CYL_BAL_ER = 0
then
CTR_ERR_OBD_DIAG_CYL_BAL_ER =
CTR_ERR_OBD_DIAG_CYL_BAL_
ER +
C_CTR_INC_ERR_OBD_DIAG_CYL_
BAL
(1.6.2.10)
LV_ERR_REF_CYL_BAL_ER = 1
(1.6.2.11)
endif(6)
for(6) j(x) = 1 : Number of cylinders
if(7) **[**(T_SUM_CYL_BAL_ER_LIM_MIN[x] $>$
C_T_SUM_MIN_CYL_BAL_LIM) **or**
(T_SUM_CYL_BAL_ER_LIM_MAX[x]
$>$
C_T_SUM_MIN_CYL_BAL_LIM)**]**
then

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LV_ERR_CYL_BAL_ER[x] = 1
(1.6.2.12)
LV_END_DIAG_CYL_BAL_ER[x] = 1
(1.6.2.13)
LV_END_DIAG_WIN_CYL_BAL_ER[x] = 1
(1.6.2.14)
endif(7)
endfor(6)
endif(5)
endif(4)
endif(3)
else(2)
if(3) (STATE_CTL_TI_ER_BAL = 3 **or** STATE_CTL_TI_ER_BAL = 4)
then
if(4) LV_MFF_FAC_ER_BAL_OBD_MAX_NEG[x] = 1
then
increment (T_SUM_CYL_BAL_ER_LIM_MIN[x])
(1.6.2.15)
ERR_SYM_CYL_BAL_ER[x] = 1 'SYM_0'
(1.6.2.16)
if(5) T_SUM_CYL_BAL_ER_LIM_MIN[x] > C_T_SUM_THD_CYL_BAL_LIM
then
if(6) LV_ERR_REF_CYL_BAL_ER = 0
then
CTR_ERR_OBD_DIAG_CYL_BAL_ER = CTR_ERR_OBD_DIAG_CYL_BAL_ER + C_CTR_INC_ERR_OBD_DIAG_CYL_BAL
(1.6.2.17)
LV_ERR_REF_CYL_BAL_ER = 1
(1.6.2.18)
endif(6)
for(6) j(x) = 1 : Number of cylinders
if(7) **[**(T_SUM_CYL_BAL_ER_LIM_MIN[x] > C_T_SUM_MIN_CYL_BAL_LIM) **or** (T_SUM_CYL_BAL_ER_LIM_MAX[x] > C_T_SUM_MIN_CYL_BAL_LIM)**]**
then
LV_ERR_CYL_BAL_ER[x] = 1
(1.6.2.19)
LV_END_DIAG_CYL_BAL_ER[x] = 1
(1.6.2.20)
LV_END_DIAG_WIN_CYL_BAL_ER[x] = 1
(1.6.2.21)
endif(7)
endfor(6)
endif(5)
else(4)
if(5) LV_MFF_FAC_ER_BAL_OBD_MAX_POS[x] = 1

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then
increment (T_SUM_CYL_BAL_ER_LIM_MAX[x])
(1.6.2.22)
ERR_SYM_CYL_BAL_ER[x] = 2 'SYM_1'
(1.6.2.23)
if$^{(6)}$ T_SUM_CYL_BAL_ER_LIM_MAX[x] $>$
C_T_SUM_THD_CYL_BAL_LIM
then
if$^{(7)}$ LV_ERR_REF_CYL_BAL_ER = 0
then
CTR_ERR_OBD_DIAG_CYL_BAL_ER =
CTR_ERR_OBD_DIAG_CYL_BAL_
ER +
C_CTR_INC_ERR_OBD_DIAG_CYL_
BAL
(1.6.2.24)
LV_ERR_REF_CYL_BAL_ER = 1
(1.6.2.25)
endif$^{(7)}$
for$^{(7)}$ j(x) = 1 : Number of cylinders
if$^{(8)}$ **[**(T_SUM_CYL_BAL_ER_LIM_MIN[x] $>$
C_T_SUM_MIN_CYL_BAL_LIM) **or**
(T_SUM_CYL_BAL_ER_LIM_MAX[x]
$>$
C_T_SUM_MIN_CYL_BAL_LIM)**]**
then
LV_ERR_CYL_BAL_ER[x] = 1
(1.6.2.26)
LV_END_DIAG_CYL_BAL_ER[x] = 1
(1.6.2.27)
LV_END_DIAG_WIN_CYL_BAL_
ER[x] = 1
(1.6.2.28)
endif$^{(8)}$
endfor$^{(7)}$
endif$^{(6)}$
endif$^{(5)}$
endif$^{(4)}$
endif$^{(3)}$
endif$^{(2)}$
endif$^{(1)}$

B.5.7 Update of diagnosis window

B.5.7.1 Update of diagnosis window - output of cylinder individual lambda control concerned

if$^{(1)}$ LV_CDN_DIAG_CYL_BAL_LAM[x] = 1
[*Remark: the calculation shall be executed for all of the cylinders (index x)* - **(1.7.1.1)** - **(1.7.1.10)**]
then
if$^{(2)}$ (ERR_SYM_CYL_BAL_LAM[x] $>$ 0 **and** T_SUM_RST_CYL_BAL_LAM[x] = 0)
then

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T_SUM_END_DIAG_WIN_CYL_LAM[x] = 0
(1.7.1.1)

endif(2)
if(2) (ERR_SYM_CYL_BAL_LAM[x] $>$ 0 **or** T_SUM_RST_CYL_BAL_LAM[x] $>$ 0)
then
increment (T_SUM_RST_CYL_BAL_LAM[x])
(1.7.1.2)

endif(2)
increment (T_SUM_END_DIAG_WIN_CYL_LAM[x])
(1.7.1.3)

if(2) T_SUM_END_DIAG_WIN_CYL_LAM[x] = C_T_SUM_RST_MAX_CYL_BAL
then
LV_END_DIAG_CYL_BAL_LAM[x] = 1
(1.7.1.4)

LV_END_DIAG_WIN_CYL_BAL_LAM[x] = 1
(1.7.1.5)

T_SUM_END_DIAG_WIN_CYL_LAM[x] = 0
(1.7.1.6)

else(2)
if(3) LV_ERR_CYL_BAL_LAM[x] = 0
then
LV_END_DIAG_WIN_CYL_BAL_LAM[x] = 0
(1.7.1.7)

endif(3)
endif(2)
if(2) (T_SUM_RST_CYL_BAL_LAM[x] = C_T_SUM_RST_MAX_CYL_BAL **and** LV_ERR_CYL_BAL_LAM[x] = 0)
then
T_SUM_CYL_BAL_LAM_LIM_MIN[x] = 0
(1.7.1.8)

T_SUM_CYL_BAL_LAM_LIM_MAX[x] = 0
(1.7.1.9)

T_SUM_RST_CYL_BAL_LAM[x] = 0
(1.7.1.10)

endif(2)

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B.5.7.1.1 Diagnosis- interrupt in case of intervention of phase shift adaptation

if(2) (STATE_DELTA_CRK_CYL_LAM[i] = 3 'AD_INI' **or** STATE_DELTA_CRK_CYL_LAM[i] = 4 'AD_DEC' **or** STATE_DELTA_CRK_CYL_LAM[i] = 5 'AD_INC') [*Remark: the exhaust bank based calculation shall be executed for all of the exhaust-bank-related cylinders (index i -> index x)* - **(1.7.1.1.1)** - **(1.7.1.1.8)**]
then
T_SUM_CYL_BAL_LAM_LIM_MIN[x] = 0
(1.7.1.1.1)

T_SUM_CYL_BAL_LAM_LIM_MAX[x] = 0
(1.7.1.1.2)

T_SUM_RST_CYL_BAL_LAM[x] = 0

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(1.7.1.1.3)

T_SUM_END_DIAG_WIN_CYL_LAM[x] = 0
(1.7.1.1.4)

LV_END_DIAG_CYL_BAL_LAM[x] = 0
(1.7.1.1.5)

LV_END_DIAG_WIN_CYL_BAL_LAM[x] = 0
(1.7.1.1.6)

LV_ERR_CYL_BAL_LAM[x] = 0
(1.7.1.1.7)

ERR_SYM_CYL_BAL_LAM[x] = 0 ’NO_SYM’
(1.7.1.1.8)

endif$^{(2)}$
endif$^{(1)}$

B.5.7.2 Update of diagnosis window - output of CYBL_ER concerned

if$^{(1)}$ LV_CDN_DIAG_CYL_BAL_ER[x] = 1
[*Remark: the calculation shall be executed for all of the cylinders (index x) -* **(1.7.2.1)** - **(1.7.2.10)**]
then

if$^{(2)}$ (ERR_SYM_CYL_BAL_ER[x] $>$ 0 **and** T_SUM_RST_CYL_BAL_ER[x] = 0)
then

T_SUM_END_DIAG_WIN_CYL_BAL_ER[x] = 0
(1.7.2.1)

endif$^{(2)}$
if$^{(2)}$ (ERR_SYM_CYL_BAL_ER[x] $>$ 0 **or** T_SUM_RST_CYL_BAL_ER[x] $>$ 0)
then

increment (T_SUM_RST_CYL_BAL_ER[x])
(1.7.2.2)

endif$^{(2)}$
increment (T_SUM_END_DIAG_WIN_CYL_BAL_ER[x])
(1.7.2.3)

if$^{(2)}$ T_SUM_END_DIAG_WIN_CYL_BAL_ER[x] = C_T_SUM_RST_MAX_CYL_BAL
then

LV_END_DIAG_CYL_BAL_ER[x] = 1
(1.7.2.4)

LV_END_DIAG_WIN_CYL_BAL_ER[x] = 1
(1.7.2.5)

T_SUM_END_DIAG_WIN_CYL_BAL_ER[x] = 0
(1.7.2.6)

else$^{(2)}$

if$^{(3)}$ LV_ERR_CYL_BAL_ER[x] = 0
then

LV_END_DIAG_WIN_CYL_BAL_ER[x] = 0
(1.7.2.7)

endif$^{(3)}$
endif$^{(2)}$
if$^{(2)}$ (T_SUM_RST_CYL_BAL_ER[x] = C_T_SUM_RST_MAX_CYL_BAL **and** LV_ERR_CYL_BAL_ER[x] = 0)
then

T_SUM_CYL_BAL_ER_LIM_MIN[x] = 0
(1.7.2.8)

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T_SUM_CYL_BAL_ER_LIM_MAX[x] = 0 **(1.7.2.9)**

T_SUM_RST_CYL_BAL_ER[x] = 0 **(1.7.2.10)**

endif$^{(2)}$
endif$^{(1)}$

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B.6 Cylinder individual lambda control monitoring

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_LAM_CYL_SEL [_i]	O/V	0... 1H	0 ...1	1	-
CILC error detected over several driving cycles					

Input data:

LV_ES {p. 1720}	LV_INH_OBD_DIAG_CYL_BAL_LAM [NC_CBK_EX_NR] {p. 5113}	LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}

FUNCTION DESCRIPTION:

General information:

Variable assignment

Description of index "_i":

*use **NC_LAMB_REF**: pattern for allocation of physical cylinders to exhaust bank - index "_i or [i]"*

Remark:

index "_i" is equivalent to "[i]"

Application conditions

Initialization:
at reset, LV_IGK = 0 1 and clear error memory:

LV_ERR_LAM_CYL_SEL_i = 0

Recurrence:
T_SAMPLE = 100 ms

Activation:
- LV_ST_END = 1

Deactivation:
- LV_ES = 1

Formula section:

LV_ERR_LAM_CYL_SEL_i = LV_INH_OBD_DIAG_CYL_BAL_LAM[i]

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B.7 O2 sensor (bin, down) dynamic diagnosis after NOx CAT regeneration

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_END_DIAG_RGN_NT_LS_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for end bit calculation					
CTR_SYM_DIAG_RGN_NT_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter for internal anti-bounce of error symptom					
LV_DIAG_ACT_RGN_NT_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable indicating that diagnosis conditions are fulfilled					
LV_DIAG_RGN_NT_LS_DOWN_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End bit for monitoring lean to rich switching times after Nox cat regeneration					
LV_DIAG_RGN_NT_LS_DOWN_ERR [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced diagnosis result for monitoring lean to rich switching times after Nox cat regeneration					
MAF_INT_RGN_NT_END [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.66666	0.0444444	g
Mass air flow which has passed since last regeneration cycle					
MAF_INT_RGN_NT_S_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.66666	0.0444444	g
Mass air flow which has passed since activation of stratified mode					
T_RGN_NT_END [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Time which has passed after leaving last regeneration cycle					
VLS_DOWN_RGN_NT_DIF [NC_CBK_EX_NR]	V	FC00... 3FFH	-5... 4.99511	4.8828e-3	V
Measured Voltage difference used for error detection					
VLS_DOWN_RGN_NT_END [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Maximum monitor sensor voltage during last regeneration phase of NOx trap, Bank i (i=1.2)					
VLS_DOWN_RGN_NT_MAX_TMP [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Temporary maximum monitor sensor voltage during MAF integral calculation in stratified mode					
VLS_DOWN_RGN_NT_MES_SAE [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 7.99987	122.1e-6	V
Test value for diagnosis result evaluation for mode 6 communication					
VLS_DOWN_RGN_NT_MIN_END [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Minimum monitor sensor voltage during MAF integral calculation in stratified mode					
VLS_DOWN_RGN_NT_MIN_SAE [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 7.99987	122.1e-6	V
Minimum voltage threshold for diagnosis result evaluation for mode 6 communication					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VLS_DOWN_RGN_NT_MIN_TMP [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.99511	4.8828e-3	V
Temporary minimum monitor sensor voltage during MAF integral calculation in stratified mode					

Input data:

LV_IGK {p. 906}	LV_INH_DIAG_RGN_NT_ LS_DOWN [NC_CBK_EX_NR] {p. 5148}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_NT_RGN_REQ {p. 996}
LV_NT_RGN_REQ_AD {p. 996}	LV_S_ACT {p. 8137}	MAF_KGH {p. 1195}	NC_CBK_EX_NR {p. 1829}
STATE_RGN [NC_CBK_EX_NR] {p. 2885}	TCO {p. 1100}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_END_DIAG_RGN_NT_LS_DOWN	-	0... FFH	0... 255	1	-
Counter threshold for setting of diagnosis end bit					
C_CTR_INC_DIAG_RGN_NT_LS_DOWN	-	0... FFH	0... 255	1	-
Counter increment for present error symptom					
C_CTR_SYM_MAX_RGN_NT_LS_DOWN	-	0... FFFFH	0... 65535	1	-
Threshold for detection of downstream sensor dynamic error after NOx cat regeneration					
C_MAF_INT_RGN_NT_END	-	0... FFFFH	0... 2912.66666	0.0444444	g
Mass air flow which has passed since last regeneration cycle					
C_MAF_INT_RGN_NT_S_ACT	-	0... FFFFH	0... 2912.66666	0.0444444	g
Mass air flow which has passed since activation of stratified mode					
C_MAF_MAX_DIAG_RGN_NT_LS_DOWN	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Maximum mass air flow for activation of RGN_NT_LS_DOWN[i] diagnosis					
C_MAF_MIN_DIAG_RGN_NT_LS_DOWN	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Minimum mass air flow for activation of RGN_NT_LS_DOWN[i] diagnosis					
C_T_RGN_NT_END	-	0... FFFFH	0... 1310.7	0.02	s
Threshold for time which has passed after leaving last regeneration cycle					
C_TCO_MIN_DIAG_RGN_NT_LS_DOWN	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature for activation of RGN_NT_LS_DOWN[i] diagnosis					
C_TEMP_MIN_DIAG_RGN_NT_LS_DOWN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Catalyst temperature threshold for activation of RGN_NT_LS_DOWN[i] diagnosis					
C_VLS_DOWN_RGN_NT_DIF_THD	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Measured Voltage difference used for error detection					
C_VLS_MIN_DIAG_RGN_LS_DOWN	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Minimum voltage during regeneration phase to enable diagnosis					
LC_STATE_RGN_L_AMPL_DEAC	-	0... 1H	0 ...1	1	-
Logical calibration data to skip check of STATE_RGN[i] depending on regeneration strategy					

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FUNCTION DESCRIPTION:

General information:

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The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

With level monitoring of the monitor sensor after leaving regeneration phase of NOx trap unplausible voltage values can be detected and a plausibility check of the sensor can be made.

Description:

If the general conditions for activating the diagnostic function are fulfilled and if during a regeneration phase either the state STATE_RGN[i] is set to L_AMPL or LC_STATE_RGN_L_AMPL_DEAC = 1 (withdrawal of monitoring STATE_RGN[i] depending on regeneration strategy) the lambda probe voltage and its previous value shall be stored.

Upon leaving the regeneration phase the previously measured voltage shall be compared to the threshold which, when exceeded, allows to activate the diagnosis as indicated by LV_DIAG_ACT_RGN_NT_LS_DOWN[i] = 1. Additionally the timer T_RGN_NT_END[i] and the mass air flow integral MAF_INT_RGN_NT_END[i] are calculated until the next stratified combustion mode is activated.

Provided that the stratified mode is activated before the timer T_RGN_NT_END[i] or the MAF integral MAF_INT_RGN_NT_END[i] exceed their respective threshold values monitoring the lambda probe voltage after leaving the regeneration phase shall be started and the MAF integral MAF_INT_RGN_NT_S_ACT[i] shall be calculated. After exceeding the MAF integral threshold C_MAF_INT_RGN_NT_S_ACT, i.e. if the stratified mode has been active long enough, the voltage difference between leaving the regeneration phase and exceeding the MAF integral threshold shall be calculated as expressed by VLS_DOWN_RGN_NT_DIF[i].

Comparison of the voltage difference to a threshold value allows to recognize a sensor malfunction. Each time the voltage comparison is made the counter for end of diagnosis recognition shall be increased. Provided that the measured voltage difference does not exceed its respective threshold C_VLS_DOWN_RGN_NT_DIF_THD the symptom counter CTR_SYM_DIAG_RGN_NT_LS_DOWN[i] shall be incremented by the calibratable increment C_CTR_INC_DIAG_RGN_NT_LS_DOWN and decremented otherwise with a decrement of 1.
The final diagnosis result is drawn after the end cycle counter has reached the calibratable minimum number of necessary diagnostic cycles C_CTR_END_DIAG_RGN_NT_LS_DOWN. In this case the end indication flag shall be set and the error indication flag shall be set following an n-out-of-m statistical evaluation for the case that the symptom counter has exceeded the corresponding threshold C_CTR_SYM_MAX_RGN_NT_ LS_DOWN. The result shall not be transmitted to the ERRM directly, since another diagnosis is expected to include it in its error and end state considerations.

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Error-symptoms and conditions:

```
□□□□
| | | └─> (not used)                                     (= SYM_0)
| | └───> (not used)                                     (= SYM_1)
| └─────> (not used)                                     (= SYM_2)
└───────> (lean voltage not reached after NOx cat. regeneration)  (= SYM_3)
```


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Application conditions:

Initialisation:
At reset or the transition of LV_IGK = 0 -> 1 or at clearing the error memory all variables shall be reset to 0, except VLS_DOWN_RGN_NT_MES_SAE[i] and VLS_DOWN_RGN_NT_ MIN_SAE[i].
Initialisation in case of new ECU and NVMY checksum errors:
VLS_DOWN_RGN_NT_MES_SAE[i] = 0V
Initialisation in case of reset:
VLS_DOWN_RGN_NT_MIN_SAE[i] = C_VLS_DOWN_RGN_NT_DIF_THD

Recurrence: 20 ms
Activation: At any engine operating state

Formula section:

Check diagnosis availability

```
If          LV_INH_DIAG_RGN_NT_LS_DOWN[i] = 0
and           LV_DIAG_RGN_NT_LS_DOWN_END[i] = 0
and           TCO > C_TCO_MIN_DIAG_RGN_NT_LS_DOWN
and           LV_LS_DOWN_READY[i] = 1
and           C_MAF_MIN_DIAG_RGN_NT_LS_DOWN <= MAF_KGH
                          <= C_MAF_MAX_DIAG_RGN_NT_LS_DOWN
and           TEMP_CAT_DYN_MDL[i] > C_TEMP_MIN_DIAG_RGN_NT_LS_DOWN
then     % diagnosis available
           if        LV_NT_RGN_REQ = 0 -> 1
         then       VLS_DOWN_RGN_NT_END[i] = 0        % reinitialize for a new cycle
           endif
         if        LV_NT_RGN_REQ = 1
         and         (STATE_RGN[i] = L_AMPL
         or         LC_STATE_RGN_L_AMPL_DEAC = 1)
         and         LV_NT_RGN_REQ_AD = 0
         then         VLS_DOWN_RGN_NT_END[i] =
                    MAX (VLS_DOWN[i](n-1), VLS_DOWN_RGN_NT_END[i])
         endif
         if        LV_NT_RGN_REQ = 1 -> 0
         and         VLS_DOWN_RGN_NT_END[i] > C_VLS_MIN_DIAG_RGN_LS_DOWN
           then         VLS_DOWN_RGN_NT_MIN_END[i] = physical maximum limit
                  LV_DIAG_ACT_RGN_NT_LS_DOWN[i] = 1
                     diagnosis available
           endif
else     % diagnosis not available
         LV_DIAG_ACT_RGN_NT_LS_DOWN[i] = 0
           VLS_DOWN_RGN_NT_END[i] = 0
         VLS_DOWN_RGN_NT_DIF[i] = 0
           MAF_INT_RGN_NT_END[i] = 0
         MAF_INT_RGN_NT_S_ACT[i] = 0
           T_RGN_NT_END[i] = 0
endif
```

Conditions for activation of diagnosis fulfilled

```
If          LV_DIAG_ACT_RGN_NT_LS_DOWN[i] = 1
then     if          LV_S_ACT = 0
         then        Check if stratified mode activated in time
```

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MAF_INT_RGN_NT_S_ACT[i] = 0
if (MAF_INT_RGN_NT_END[i] C_MAF_INT_RGN_NT_END
or T_RGN_NT_END[i] C_T_RGN_NT_END)
then LV_DIAG_ACT_RGN_NT_LS_DOWN[i] = 0
MAF_INT_RGN_NT_END[i] = 0
T_RGN_NT_END[i] = 0
VLS_DOWN_RGN_NT_END[i] = 0
else MAF_INT_RGN_NT_END[i] =
MAF_INT_RGN_NT_END[i] + MAF_KGH * 0.02/3.6
T_RGN_NT_END[i] = T_RGN_NT_END[i] + T_SAMPLE
endif
else *Monitoring of lambda probe voltage after NOx catalyst regeneration*
MAF_INT_RGN_NT_END[i] = 0
T_RGN_NT_END[i] = 0
if MAF_INT_RGN_NT_S_ACT[i] $>$ C_MAF_INT_RGN_NT_S_ACT
then VLS_DOWN_RGN_NT_DIF[i] = VLS_DOWN_RGN_NT_END[i] -
VLS_DOWN_RGN_NT_MIN_END[i]
LV_DIAG_ACT_RGN_NT_LS_DOWN[i] = 0
CTR_END_DIAG_RGN_NT_LS_DOWN[i] =
CTR_END_DIAG_RGN_NT_LS_DOWN[i] + 1
VLS_DOWN_RGN_NT_END[i] = 0
MAF_INT_RGN_NT_S_ACT[i] = 0
If VLS_DOWN_RGN_NT_DIF[i] $<$
C_VLS_DOWN_RGN_NT_DIF_THD
then CTR_SYM_DIAG_RGN_NT_LS_DOWN[i] =
CTR_SYM_DIAG_RGN_NT_LS_DOWN[i] +
C_CTR_INC_DIAG_RGN_NT_LS_DOWN
VLS_DOWN_RGN_NT_MIN_TMP[i] =
VLS_DOWN_RGN_NT_DIF[i]
else CTR_SYM_DIAG_RGN_NT_LS_DOWN[i] =
CTR_SYM_DIAG_RGN_NT_LS_DOWN[i] - 1
VLS_DOWN_RGN_NT_MAX_TMP[i] =
VLS_DOWN_RGN_NT_DIF[i]
endif
else MAF_INT_RGN_NT_S_ACT[i] =
MAF_INT_RGN_NT_S_ACT[i] + MAF_KGH * 0.02/3.6
VLS_DOWN_RGN_NT_MIN_END[i] =
MIN(VLS_DOWN[i], VLS_DOWN_RGN_NT_MIN_END[i]$_{n-1}$)
endif
endif
endif
Evaluation of final diagnosis result
If CTR_END_DIAG_RGN_NT_LS_DOWN[i]
C_CTR_END_DIAG_RGN_NT_LS_DOWN
then LV_DIAG_RGN_NT_LS_DOWN_END[i] = 1
if CTR_SYM_DIAG_RGN_NT_LS_DOWN[i]
C_CTR_SYM_MAX_RGN_NT_LS_DOWN
then
LV_DIAG_RGN_NT_LS_DOWN_ERR[i] = 1
VLS_DOWN_RGN_NT_MES_SAE[i] = VLS_DOWN_RGN_NT_MIN_TMP[i]
else
LV_DIAG_RGN_NT_LS_DOWN_ERR[i] = 0

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```
                VLS_DOWN_RGN_NT_MES_SAE[i] = VLS_DOWN_RGN_NT_MAX_TMP[i]
            endif
endif
```

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B.8 O2 sensor (bin, down) dynamic diagnosis after NOx CAT reg. (Appl.Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_RGN_NT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable indicating inhibition of downstream oxygen sensor diagnosis after NOx cat regeneration					

Input data:

LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CUS {p. 1042}	LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}
LV_ERR_CHG_LS_DOWN {p. 5388}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CRK {p. 4455}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_EL_CPS {p. 4708}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}
LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_IVVT {p. 1062}
LV_ERR_MAF {p. 4815}	LV_ERR_MAP_DIP_ PLAUS {p. 1062}	LV_ERR_MAP_DIP_SENS {p. 4824}	LV_ERR_MAP_DIP_SHIFT {p. 4824}
LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_MEC_OPEN_ CPS {p. 1001}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_SLV_IVVT_IN {p. 4627}
LV_ERR_TCO {p. 4496}	LV_ERR_TPS {p. 4982}	LV_ERR_TTIP_MES_LSH_ UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}
LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_LS_DOWN_OBD_2_ MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_MIS_STATE_A {p. 6238}	LV_MIS_STATE_B {p. 6238}
NC_CBK_EX_NR {p. 1829}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_INH_DIAG_RGN_NT_LS_DOWN [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Manual deactivation of the RGN_NT_LS_DOWN diagnosis (when = 1)					

1.1. Calculation of inhibition for diagnosis

FUNCTION DESCRIPTION:

General information:

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The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Application conditions

Initialization: *at reset all variables shall be initialized with 1*

```
At the transition LV_IGK = 0 -> 1 or ECU-Reset:
LV_INH_DIAG_RGN_NT_LS_DOWN[i] = 0
At the transition LV_IGK = 1 -> 0
LV_INH_DIAG_RGN_NT_LS_DOWN[i] = 1
```

Recurrence: 20 ms

Activation: *LV_IGK = 1*

Deactivation: LV_IGK = 0

Formula section:

IF LV_ERR_LS_DOWN[i] = 1 **OR**
LV_ERR_FSD[i] = 1 **OR**
LV_ERR_MAF = 1 **OR**
LV_ERR_MAP_DIP_SENS = 1 **OR**
LV_ERR_MAP_DIP_PLAUS = 1 **OR**
LV_ERR_MAP_DIP_SHIFT = 1 **OR**
LV_ERR_CHG_LS_UP = 1 **OR**
LV_ERR_DIAGCPS = 1 **OR**
LV_MIS_STATE_A = 1 **OR**
LV_MIS_STATE_B = 1 **OR**
LV_ERR_CRK = 1 **OR**
LV_ERR_CAM_CUS = 1 **OR**
LV_ERR_AMP = 1 **OR**
LV_ERR_AMP_PLAUS = 1 **OR**
LV_ERR_DELTA_I_LAM[i] = 1 **OR**
LV_ERR_VLS_DOWN_DIF[i] = 1 **OR**
LV_ERR_FSD_LAM_LIM[i] = 1 **OR**
LV_ERR_FUP = 1 **OR**
LV_ERR_FUP_MFP_PLAUS = 1 **OR**
LV_ERR_H_PRS_SYS = 1 **OR**
LV_ERR_VCV = 1 **OR**
LV_ERR_CHG_LS_DOWN = 1 **OR**
LV_ERR_FUP_ORNG = 1 **OR**
LV_ERR_FUP_ST = 1 **OR**
LV_ERR_TTIP_MES_LSH_UP[i] = 1 **OR**
LV_ERR_IV[x] = 1 (x = 0,2,4 for Bank1; x=1,3,5 for Bank2) **OR**
LV_ERR_IVVT = 1 **OR**
LV_ERR_CAT_DIAG[i] = 1 **OR**
LV_ERR_EL_CPS = 1 **OR**
LV_ERR_MEC_OPEN_CPS = 1 **OR**
LV_ERR_TCO = 1 **OR**

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LV_ERR_TPS = 1 **OR**
LV_LS_DOWN_OBD_2_MAN_DEAC[i] = 1 **OR**
LC_INH_DIAG_RGN_NT_LS_DOWN[i] = 1 **OR**
LV_ERR_SLV_IVVT_IN = 1 **OR**
LV_ERR_OFS_LSL_UP[i] = 1 **OR**
LV_ERR_CTL_LSL_UP[i] = 1 **OR**
LV_ERR_MAP_TPS_PLAUS = 1
THEN
LV_INH_DIAG_RGN_NT_LS_DOWN[i] = 1
ELSE
LV_INH_DIAG_RGN_NT_LS_DOWN[i] = 0
ENDIF

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B.9 O2 sensor (bin, down) dynamic diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CYCNR_SWT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 1.99218	0.0078125	-
Average of weighted CTR_SWT_ACT_LS_DOWN[NC_CBK_EX_NR], Bank i					
CTR_QUO_SUM_SWT_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 511.99219	0.0078125	-
Sum of weighted CTR_SWT_ACT_LS_DOWN[NC_CBK_EX_NR], Bank i					
CTR_QUO_SWT_LS_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 1.99218	0.0078125	-
weighted value of CTR_SWT_ACT_LS_DOWN[NC_CBK_EX_NR]					
CTR_QUO_SWT_LS_DOWN_MAX [NC_CBK_EX_NR]	V	0... FFH	0... 1.99218	0.0078125	-
Maximum measured weighted value of CTR_SWT_ACT_LS_DOWN[NC_CBK_EX_NR]					
CTR_QUO_SWT_LS_DOWN_MIN [NC_CBK_EX_NR]	V	0... FFH	0... 1.99218	0.0078125	-
Minimum measured weighted value of CTR_SWT_ACT_LS_DOWN[NC_CBK_EX_NR]					
CTR_QUO_SWT_RBM_LS_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 1.99218	0.0078125	-
weighted value of CTR_SWT_ACT_RBM_LS_DOWN[NC_CBK_EX_NR] for RBM purpose					
CTR_SAVE_SWT_LS_DOWN [NC_CBK_EX_NR]	O/V/S	0... FFH	0... 1.99218	0.0078125	-
Mean value of the ratio between the monitor sensor switching time and the threshold value for scantool					
CTR_SWT_ACT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 5100	20	ms
Cycle counter for switching time determination, Bank i					
CTR_SWT_ACT_RBM_LS_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 5100	20	ms
Cycle counter for RBM switching time determination, Bank i					
CTR_SWT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Number of valid switching times from rich to lean					
ERR_SYM_SWT_LS_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Determined error of the switching time diagnosis					
LV_CDN_DIAG_SWT_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status of permission for diagnosis of switching time check					
LV_DIAG_MPL_CDN_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status of general activation conditions for diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_SWT_LS_DOWN_S_ENA [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Conditions for SWT diagnosis after rich-lean combustion mode transition fulfilled					
LV_END_DIAG_SWT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
bit to indicate end of switching time diagnosis					
LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Error bit of the switching time diagnosis					
LV_SWT_DIAG_VLD_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Validity bit of the current switching time check					
MAF_INT_LAMB_AFR_SWT_S_ENA [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.66666	0.0444444	g
Air mass with definite rich conditions for stratified SWT diagnosis (upstream lambda criterion)					
MAF_INT_S_MAX_SWT_S [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.66666	0.0444444	g
Air mass after entering lean combustion mode for stratified SWT diagnosis					
MAF_INT_VLS_AFR_SWT_S_ENA [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.66666	0.0444444	g
Air mass with definite rich conditions for stratified SWT diagnosis (downstream lambda criterion)					
MAF_KGH_MIN_PUC	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Minimum value of MAF_KGH while switching time calculation					
T_LAMB_NOT_AFR_SWT_S_ENA [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Time after leaving definite rich conditions for stratified SWT diagnosis (upstream lambda criterion)					
T_VLS_NOT_AFR_SWT_S_ENA [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Time after leaving definite rich conditions for stratified SWT diagnosis (downstream lambda criterion)					
VLS_DOWN_TRAN_PUC [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Monitor sensor voltage on activating the trailing throttle fuel cut-off, Bank i					

Input data:

LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LAMB_SP_FIL_S [NC_CBK_EX_NR] {p. 2462}	LV_DIAG_RGN_NT_LS_DOWN_END [NC_CBK_EX_NR] {p. 5142}	LV_DIAG_RGN_NT_LS_DOWN_ERR [NC_CBK_EX_NR] {p. 5142}
LV_END_DIAG_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}	LV_IGK {p. 906}	LV_INH_DIAG_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5160}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}
LV_PUC {p. 1720}	LV_S_ACT {p. 8137}	MAF_INT_PUC_ACT {p. 2942}	MAF_INT_PUC_NOT_ACT {p. 2942}
MAF_KGH {p. 1195}	NC_CBK_EX_NR {p. 1829}	TCO {p. 1100}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}
VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VS {p. 1176}		

Calibration data:

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_SWT_DIAG_LS_DOWN	-	0... FFH	0... 255	1	-
Condition for the start of the lambda sensor switching time check					
C_CTR_SWT_LS_DOWN	-	0... FFH	0... 1.99218	0.0078125	-
Diagnostic threshold for CTR_CYCNR_SWT_LS_DOWN[NC_CBK_EX_NR]					
C_FAC_VLS_MAX_DIAG_SWT_LS_DOWN	-	0... FFH	0... 0.99609	3.9063e-3	-
Reduction factor for start of switching time determination					
C_FAC_VLS_MIN_DIAG_SWT_LS_DOWN	-	0... FFH	0... 0.99609	3.9063e-3	-
Reduction factor for end of switching time determination					
C_LAMB_SP_AFR_MAX_SWT_S	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Maximum lambda to determine rich conditions for stratified SWT diagnosis (upstream lambda criterion)					
C_LAMB_SP_MIN_AFL_SWT_S	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Minimum upstream lambda at the moment of signal transition to validate a switching time measurement					
C_MAF_INT_MIN_LAMB_AFR_SWT_S	-	0... FFFFH	0... 2912.66666	0.0444444	g
Minimum air mass to determine rich conditions for stratified SWT diagnosis (upstream lambda criterion)					
C_MAF_INT_MIN_VLS_AFR_SWT_S	-	0... FFFFH	0... 2912.66666	0.0444444	g
Minimum air mass to determine rich conditions for stratified SWT diagnosis (downstream lambda criterion)					
C_MAF_INT_S_MAX_SWT_S	-	0... FFFFH	0... 2912.66666	0.0444444	g
Air mass limit after which diagnosis cycle is aborted if no signal transition occured					
C_MAF_PUC_MAX_DIAG_SWT_LS_DOWN	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Mass air flow threshold for diagnosis of the switching times					
C_MAF_PUC_MIN_DIAG_SWT_LS_DOWN	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Mass air flow threshold for diagnosis of the switching times					
C_T_MAX_LAMB_NOT_AFR_SWT_S [NC_CBK_EX_NR]	-	0... FFFFH	0... 1310.7	0.02	s
Maximum time after leaving rich conditions for stratified SWT diagnosis (upstream lambda criterion)					
C_T_MAX_VLS_NOT_AFR_SWT_S	-	0... FFFFH	0... 1310.7	0.02	s
Maximum time after leaving rich conditions for stratified SWT diagnosis (downstream lambda criterion)					
C_TCO_MIN_DIAG_MPL_LS_DOWN	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature for diagnosis of the monitor sensors					
C_TEMP_CAT_MIN_DIAG_MPL_LS_DOWN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Catalyst temperature threshold for diagnosis of the monitor sensors					
C_VLS_DOWN_AFR_MIN_SWT_S	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Minimum signal to determine rich conditions for stratified SWT diagnosis (downstream lambda criterion)					
C_VLS_HYS_DIAG_SWT_LS_DOWN	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Monitor sensor voltage hysteresis					
C_VLS_PUC_MIN_DIAG_SWT_LS_DOWN	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Voltage threshold for monitor sensor diagnosis					
C_VS_MAX_DIAG_MPL_LS_DOWN	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for diagnosis of the monitor sensors					
C_VS_MIN_DIAG_MPL_LS_DOWN	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed for diagnosis of the monitor sensors					
IP_FAC_CYCNR_MAX_LS_DOWN_ACT	-	0... FFH	0... 5100	20	ms
LDP_MAF_KGH_IP_FAC_LS_DOWN	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
Weighting factor for CTR_SWT_ACT_LS_DOWN[NC_CBK_EX_NR]					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_DIAG_SWT_LS_DOWN_S_ENA	-	0... 1H	0 ...1	1	-
Logical calibration data for activating downstream SWT diagnosis on rich-lean combustion mode transistions					
LC_SWT_LS_DOWN_MV	-	0... 1H	0 ...1	1	-
Logical calibration data for activation of mean value evaluation of switching time diagnosis					

FUNCTION DESCRIPTION:

General information:

The monitor sensor diagnosis consists of three separate tests. These tests are carried out at the beginning or at the end of the pull fuel cut-off (PUC) or after switching from stoichiometric to lean combustion. In detail there are the tests monitoring of the rich-lean switching time, monitoring of the signal voltage transition during PUC or after switching to lean combustion and monitoring of the signal voltage motion after PUC, the last one being complemented by an alternative function providing the error flags LV_DIAG_RGN_NT_LS_DOWN_ERR[i] and the completition flags LV_DIAG_RGN_NT_LS_DOWN_END[i]. The purpose of these tests is the recognition of emission relevant sensor errors caused by changes in the sensor behaviour or by electrical errors like open circuits.

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
  i = 1, for exhaust cylinder bank 1
  i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
  i = 1, for single exhaust cylinder bank.

Application conditions:

Initialisation:
If At LV_IGK 0->1 **or** reset **or**at clearing error memory
then reset of all variables and bits to 0
endif

Recurrence: *20 ms*
Activation /Deactivation:

If TCO > C_TCO_MIN_DIAG_MPL_LS_DOWN
and LV_LS_DOWN_READY[i] = 1
(Operating readiness of the monitor sensor must be detected)
and C_VS_MIN_DIAG_MPL_LS_DOWN ≤ VS
≤ C_VS_MAX_DIAG_MPL_LS_DOWN
(Vehicle speed in range)
and TEMP_CAT_DYN_MDL[i] > C_TEMP_CAT_MIN_DIAG_MPL_LS_DOWN
(Catalytic converter at operating temperature)
then
LV_DIAG_MPL_CDN_LS_DOWN[i] = 1
Else
LV_DIAG_MPL_CDN_LS_DOWN[i] = 0
endif

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If LV_DIAG_MPL_CDN_LS_DOWN[i] = 1
and (LV_END_DIAG_PUE_LS_DOWN[i] = 0
or LV_END_DIAG_SWT_LS_DOWN[i] = 0)
then
LV_DIAG_MPL_CDN_LS_DOWN[i] = 1
else
LV_DIAG_MPL_CDN_LS_DOWN[i] = 0
endif

B.9.1 Monitoring the rich-lean switching times in the trailing throttle fuel cut-off

FUNCTION DESCRIPTION:

General information:

Changes in the dynamic behaviour of the monitor sensor can be detected by the recognition of the rich-lean switching time after fuel cut-off or after changing the combustion mode from homogenous mode to stratified mode.

Description:

After detection of the PUC engine operating state, the rich-lean switching time of the lambda sensor is determined and weighted depending upon the mass air flow in the intake system. The functioning of the sensor is diagnosed by comparison of the mean value of the weighted switching time with a limit. The functioning is guaranteed in this test if the switching time is below the limit.
The switching time diagnosis shall be finished for the current driving cycle, if C_CTR_SWT_DIAG_LS_DOWN valid switching times are calculated or if the alternative function indicates its completition via LV_DIAG_RGN_NT_LS_DOWN_END[i] = 1. Whenever one of the two functions completes, its diagnostic result is used for the current driving cycle and the result of the other function is ignored.
The rich-lean switching time of the sensor is determined in defined ranges of the mass air flow. A prerequisite for performing the diagnosis is that the voltage of the monitor sensor at the time of activating the trailing throttle fuel cut-off VLS_DOWN_TRAN_PUC[i] is above the threshold C_VLS_PUC_MIN_DIAG_SWT_LS_DOWN. The voltage value of the sensor at the time of trailing throttle fuel cut-off VLS_DOWN_TRAN_PUC[i] is required for the calculation of the dynamic limits for switching point determination and must be stored for the diagnostic period.
If the sensor voltage drops below the value C_FAC_VLS_MAX_DIAG_SWT_LS_DOWN * VLS_DOWN_TRAN_PUC[i], the switching time determination starts and the cycle counter CTR_SWT_ACT_LS_DOWN[i] has to be started. The counting process is ended if the limit C_FAC_VLS_MIN_DIAG_SWT_LS_DOWN * VLS_DOWN_TRAN_PUC[i] is exceeded downwards. The value of the cycle counter CTR_SWT_ACT_LS_DOWN[i] is a measure of the rich-lean switching time of the monitor sensor.
If a rich peak which exceeds C_VLS_HYS_DIAG_SWT_LS_DOWN occurs during determination of the switching time, its determination is interrupted and the relevant switching time is no longer further processed. The determination of the sensor switching times must also be interrupted if PUC is left.
Simultaneously to incrementation of CTR_SWT_ACT_LS_DOWN[i] the counter CTR_SWT_ACT_RBM_LS_DOWN[i] shall be incremented until the corresponding ratio CTR_QUO_SWT_RBM_LS_DOWN[i] exceeds the threshold for a defective lambda probe C_CTR_SWT_LS_DOWN. After this condition has been fulfilled the valid cycle counter CTR_SWT_LS_DOWN[i] shall be incremented. This procedure ensures that within each diagnostic cycle and after completion of the required total number of diagnostic cycles a probe malfunction can be detected as is demanded by ARB.
A valid value of the switching times for the monitor sensor must be weighted depending upon the minimum value for the mass flow during the determination of the switching time of the lambda sensor

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MAF_KGH_MIN_PUC. The weighting factor is determined via the map IP_FAC_CYCNR_MAX_LS_DOWN_ACT.
If for the determined switching time of the monitor sensor doesn't exceed the limit the sensor is diagnosed as functioning, otherwise as malfunctioning. Depending on LC_SWT_LS_DOWN_MV the average value of the switching time determination or the respective minimum value shall be evaluated. The minimum or maximum measured diagnosis values are saved for the scantool SAE 1979 accordingly.

Application conditions:

Initialisation:
If At LV_IGK 0->1 **or** reset **or**at clearing error memory
then reset of all variables and bits to 0, except:
MAF_KGH_MIN_PUC = *"max phys. limit"*
CTR_SAVE_SWT_LS_DOWN[i] which shall be initialized with its saved
Value. Reset only at clearing error memory.
CTR_QUO_SWT_LS_DOWN_MIN[i] which shall be initialized with its maximum value
endif

Recurrence: *20 ms*
Activation /Deactivation:
If ((LV_DIAG_MPL_CDN_LS_DOWN[i] =1
and LV_INH_DIAG_SWT_LS_DOWN[i] = 0)
or LV_DIAG_RGN_NT_LS_DOWN_END[i] = 1)
and LV_END_DIAG_SWT_LS_DOWN[i] = 0
then LV_CDN_DIAG_SWT_LS_DOWN[i] =1
else LV_CDN_DIAG_SWT_LS_DOWN[i] =0
(switching time check disabled)
VLS_DOWN_TRAN_PUC[i] = 0
LV_SWT_DIAG_VLD_LS_DOWN[i] = 0
CTR_SWT_ACT_LS_DOWN[i] = 0
CTR_SWT_ACT_RBM_LS_DOWN[i] = 0
MAF_KGH_MIN_PUC = *"max phys. limit"*
LV_DIAG_SWT_LS_DOWN_S_ENA[i] = 0
endif

Formula section:

% Ensure that either upstream or downstream sensor indicates rich conditions for a minimum contiguous air
% mass integral. After such conditions, leaner conditions are allowed for a limited time. The upstream criterion
% is preferred, because a slow downstream sensor could make it hard to detect short rich phases, thus
% inhibiting its own detection. Fuel cut is a blocking criterion on its own, because lambda setpoint is
% not a reliable indicator in this condition.
If LV_PUC = 0
then **If** LAMB_SP[i]$_n$ $<$ C_LAMB_SP_AFR_MAX_SWT_S
then **If** LAMB_SP[i]$_{n-1}$ $>$= C_LAMB_SP_AFR_MAX_SWT_S
then reset MAF_INT_LAMB_AFR_SWT_S_ENA[i]
endif
MAF_INT_LAMB_AFR_SWT_S_ENA[i] + MAF_KGH * 0.02/3.6
reset T_LAMB_NOT_AFR_SWT_S_ENA[i]
else increment T_LAMB_NOT_AFR_SWT_S_ENA[i]

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```
                  if        T_LAMB_NOT_AFR_SWT_S_ENA[i] >=
                            C_T_MAX_LAMB_NOT_AFR_SWT_S[NC_CBK_EX_NR]
                  then      reset MAF_INT_LAMB_AFR_SWT_S_ENA[i]
                  endif
          endif
          If        VLS_DOWN[i]_n > C_VLS_DOWN_AFR_MIN_SWT_S
          then      If        VLS_DOWN[i]_(n-1) <= C_VLS_DOWN_AFR_MIN_SWT_S
                  then      reset MAF_INT_VLS_AFR_SWT_S_ENA[i]
                  endif
          then      MAF_INT_VLS_AFR_SWT_S_ENA[i] + MAF_KGH * 0.02/3.6
                  reset T_VLS_NOT_AFR_SWT_S_ENA[i]
          else      increment T_VLS_NOT_AFR_SWT_S_ENA[i]
                  if        T_VLS_NOT_AFR_SWT_S_ENA[i] >=
                            C_T_MAX_VLS_NOT_AFR_SWT_S
                  then      reset MAF_INT_VLS_AFR_SWT_S_ENA[i]
                  endif
          endif
else      reset MAF_INT_VLS_AFR_SWT_S_ENA[i]
          reset MAF_INT_LAMB_AFR_SWT_S_ENA[i]
endif
If        MAF_INT_VLS_AFR_SWT_S_ENA[i] > C_MAF_INT_MIN_VLS_AFR_SWT_S
or        MAF_INT_LAMB_AFR_SWT_S_ENA[i] > C_MAF_INT_MIN_LAMB_AFR_SWT_S
then      LV_DIAG_SWT_LS_DOWN_S_ENA[i] = 1
endif
If              (LV_PUC = 0 -> 1          and          LV_S_ACT = 0)
then      VLS_DOWN_TRAN_PUC[i] = VLS_DOWN[i]
endif
% Check whether stable rich conditions have been reached before transition to lean combustion mode and
% calculate a lean air mass integral for the last lean combustion period.
If              LV_S_ACT = 0->1
then      If        LC_DIAG_SWT_LS_DOWN_S_ENA = 1
          and       LV_DIAG_SWT_LS_DOWN_S_ENA[i] = 1
          then      VLS_DOWN_TRAN_PUC[i] = VLS_DOWN[i]
          else      VLS_DOWN_TRAN_PUC[i] = 0
          endif
          reset MAF_INT_S_MAX_SWT_S[i]
          LV_DIAG_SWT_LS_DOWN_S_ENA[i] = 0
endif
If              LV_S_ACT = 1
then      MAF_INT_S_MAX_SWT_S[i] + MAF_KGH * 0.02/3.6
endif
% Lean combustion is an alternate way to start the diagnosis, if apropriate conditions are met (see above)
% In lean mode, stop the diagnosis if the sensor does not show the lean transition after a certain air
% mass consumption.
% Additionally, require a lean enough upstream lambda when the downstream transition occurs to ensure
% that the signal does not float around at stoichiometric.   If upstream is too rich, abort the current cycle.
If              (LV_PUC = 1
or               (LV_S_ACT = 1 and LC_DIAG_SWT_LS_DOWN_S_ENA = 1 and
                 MAF_INT_S_MAX_SWT_S[i] < C_MAF_INT_S_MAX_SWT_S))
```

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and VLS_DOWN_TRAN_PUC[i]   C_VLS_PUC_MIN_DIAG_SWT_LS_DOWN
and C_MAF_PUC_MIN_DIAG_SWT_LS_DOWN $<$ MAF_KGH
$<$ C_MAF_PUC_MAX_DIAG_SWT_LS_DOWN
and (VLS_DOWN[i]$_n$ $<$ VLS_DOWN[i]$_{n-1}$ + C_VLS_HYS_DIAG_SWT_LS_DOWN
or (LV_S_ACT = 1 **and** VLS_DOWN[i] $>=$
C_FAC_VLS_MAX_DIAG_SWT_LS_DOWN * VLS_DOWN_TRAN_PUC[i]))
% allow rising signal for stratified case, if it occurs before start of SWT measurement
then **If** VLS_DOWN[i]$<$C_FAC_VLS_MAX_DIAG_SWT_LS_DOWN *
VLS_DOWN_TRAN_PUC[i]
then *increment* CTR_SWT_ACT_RBM_LS_DOWN[i]
If C_FAC_VLS_MIN_DIAG_SWT_LS_DOWN *
VLS_DOWN_TRAN_PUC[i] $<$ VLS_DOWN[i]
then *increment* CTR_SWT_ACT_LS_DOWN[i]
MAF_KGH_MIN_PUC = MIN(MAF_KGH; MAF_KGH_MIN_PUC)
else *freeze* CTR_SWT_ACT_LS_DOWN[i]
MAF_KGH_MIN_PUC$_N$ = MAF_KGH_MIN_PUC$_{N-1}$
CTR_QUO_SWT_RBM_LS_DOWN[i] =
CTR_SWT_ACT_RBM_LS_DOWN[i] /
IP_FAC_CYCNR_MAX_LS_DOWN_ACT
If (CTR_QUO_SWT_RBM_LS_DOWN[i] $>=$
C_CTR_SWT_LS_DOWN)
and LV_SWT_DIAG_VLD_LS_DOWN[i] = 0
then LV_SWT_DIAG_VLD_LS_DOWN[i] = 1
increment CTR_SWT_LS_DOWN[i]
CTR_QUO_SWT_LS_DOWN[i] =
CTR_SWT_ACT_LS_DOWN[i] /
IP_FAC_CYCNR_MAX_LS_DOWN_ACT
CTR_QUO_SWT_LS_DOWN_MIN[i] =
MIN(CTR_QUO_SWT_LS_DOWN_MIN[i],
CTR_QUO_SWT_LS_DOWN[i])
CTR_QUO_SWT_LS_DOWN_MAX[i] =
MAX(CTR_QUO_SWT_LS_DOWN_MAX[i],
CTR_QUO_SWT_LS_DOWN[i])
CTR_QUO_SUM_SWT_LS_DOWN[i] =
CTR_QUO_SUM_SWT_LS_DOWN[i] +
CTR_QUO_SWT_LS_DOWN[i]
CTR_CYCNR_SWT_LS_DOWN[i] =
CTR_QUO_SUM_SWT_LS_DOWN[i] /
CTR_SWT_LS_DOWN[i]
endif
endif
If (LV_PUC = 0
and LAMB_SP_FIL_S $<$ C_LAMB_SP_MIN_AFL_SWT_S)
then VLS_DOWN_TRAN_PUC[i] = 0
endif
endif
else VLS_DOWN_TRAN_PUC[i] = 0
LV_SWT_DIAG_VLD_LS_DOWN[i] = 0
CTR_SWT_ACT_LS_DOWN[i] = 0
CTR_SWT_ACT_RBM_LS_DOWN[i] = 0
MAF_KGH_MIN_PUC = *"max phys. limit"*
endif

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```
If        CTR_SWT_LS_DOWN[i] ≥ C_CTR_SWT_DIAG_LS_DOWN
then      If    (CTR_CYCNR_SWT_LS_DOWN[i] < C_CTR_SWT_LS_DOWN
                and    LC_SWT_LS_DOWN_MV = 1)
          or    (CTR_QUO_SWT_LS_DOWN_MIN[i]<C_CTR_SWT_LS_DOWN
          and    LC_SWT_LS_DOWN_MV = 0)
                then    LV_ERR_SWT_LS_DOWN[i] = 0
                   ERR_SYM_SWT_LS_DOWN[i] = "NO_SYM"
                   CTR_SAVE_SWT_LS_DOWN[i] = CTR_QUO_SWT_LS_DOWN_MIN[i]
          else    LV_ERR_SWT_LS_DOWN[i] = 1
                  ERR_SYM_SWT_LS_DOWN[i] = " SYM _3"
                  CTR_SAVE_SWT_LS_DOWN[i] = CTR_QUO_SWT_LS_DOWN_MAX[i]
                endif
          LV_END_DIAG_SWT_LS_DOWN[i] = 1
else
                if      LV_DIAG_RGN_NT_LS_DOWN_END[i] = 1
                then
                        if      LV_DIAG_RGN_NT_LS_DOWN_ERR[i] = 0
                        then    LV_ERR_SWT_LS_DOWN[i] = 0
                           ERR_SYM_SWT_LS_DOWN[i] = "NO_SYM"
                        else    LV_ERR_SWT_LS_DOWN[i] = 1
                           ERR_SYM_SWT_LS_DOWN[i] = "SYM_2"
                        Endif
                        LV_END_DIAG_SWT_LS_DOWN[i] = 1
                else    % Switching time diagnosis going on
                endif
endif
```

Filtering :

Apply filter on current symptoms

If filtering result available (after internal debounce; see Appl. Inc. ABC type: No)

Delivery the result to Error Management

Endif

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B.10 O2 sensor (bin, down) dynamic diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_RBM_SWT_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating inhibition of RBM for lambda sensor switching time diagnosis downstream					
LV_INH_DIAG_SWT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating inhibition of lambda sensor switching time diagnosis downstream					
STATE_RBM_SWT_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 7H	0 ...7	1	-
Interface of SWT_LS_DOWN monitor with the Rate-Based Monitoring statistics					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_DC {p. 5746}	LV_END_DIAG_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}
LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT] {p. 1061}
LV_ERR_CHG_LS_DOWN {p. 5388}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_ERR_CRK_PLAUS {p. 4446}
LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FUP {p. 4717}
LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}
LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}
LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}
LV_ERR_MAP_TPS_PLAUS {p. 1062}	LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}
LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}	LV_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}

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LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS {p. 4982}
LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}
LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_2 {p. 4951}
LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_IGK {p. 906}
LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_MTC_CUR_OFF {p. 6565}	LV_VB_CDN_OBD_2 {p. 1046}	NC_CBK_EX_NR {p. 1829}
NC_CYL_NR {p. 1526}	NC_NR_CAM_CBK {p. 1507}	NC_NR_CBK_IVVT {p. 604}	R_IT_LS_DOWN [NC_CBK_EX_NR] {p. 1364}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_R_IT_MAX_DIAG_MPL_LS_DOWN	V	0... FFFFH	0... 65535	1	Ohm
Maximum allowed internal resistance of the downstream sensor for downstream dynamic diagnosis					
LC_INH_DIAG_SWT_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Manual deactivation of the SWT diagnosis (when = 1)					
LC_INH_LS_DOWN_MAN_DEAC	V	0... 1H	0 ...1	1	-
Manual deactivation of inhibit conditions (when = 1)					

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

Error treatment

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Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
SWT_LS_DOWN		0			NO	
Oxygen sensor downstream rich lean switch time check		1				
		2				
	SYM_3	3				

General information

B.10.1 Inhibition of diagnosis of the monitor sensors

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then

i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

It must be considered that there is one pump and also one exhaust line pro cylinder bank. Therefore NC_CBK_EX_NR and NC_CBK_HPP_NR can be considered in the code as equivalent.

If one of the below mentioned conditions is not fulfilled, the inhibit bit interrupts the downstream oxygen sensor diagnosis.

Application conditions:

Initialisation:
```
at every transition LV_IGK = 0 -> 1or reset all variables
shall be reset to 0, except STATE_RBM_SWT_LS_DOWN[i] //for
init of this variable see section below

at every transition LV_IGK = 1 -> 0
LV_INH_DIAG_SWT_LS_DOWN[NC_CBK_EX_NR] = 1
```

Activation: `LV_IGK = 1`

Deactivation: `LV_IGK = 0`

Recurrence: `100 ms`

Function description:

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Formula section:

```
If      LV_ERR_AMP = 1                                    or
        LV_ERR_AMP_PLAUS = 1                              or
        LV_ERR_CHG_LS_DOWN = 1                            or
        LV_ERR_CHG_LS_UP = 1                              or
        LV_ERR_CRK_PLAUS = 1                              or
        LV_ERR_CRK_SYN = 1                                or
        LV_ERR_CRK_TOOTH = 1                              or
        LV_ERR_CRK_TOOTH_PER = 1                          or
        LV_ERR_DIAGCPS = 1                                or
        LV_ERR_EL_CPS = 1                                 or
        LV_ERR_FUP = 1                                    or
        LV_ERR_FUP_MFP_PLAUS = 1                          or
        LV_ERR_FUP_ORNG = 1                               or
        LV_ERR_FUP_ST = 1                                 or
        LV_ERR_H_PRS_SYS = 1                              or
        LV_ERR_IVVT = 1                                   or
        LV_ERR_LOAD_TPS_PLAUS = 1                         or
        LV_ERR_MAF = 1                                    or
        LV_ERR_MAP_PLAUS = 1                              or
        LV_ERR_MAP_TPS_PLAUS = 1                          or
        LV_ERR_MTC_CTL_2 = 1                              or
        LV_ERR_MTC_CTL_3 = 1                              or
        LV_ERR_MTC_DR = 1                                 or
        LV_ERR_TPS = 1                                    or
        LV_ERR_VCV = 1                                    or
        LV_ERR_AIR_LSL_UP[i] = 1                          or
        LV_ERR_CHK_LS_DOWN[i] = 1                         or
        LV_ERR_CTL_LSL_UP_[i] = 1                         or
        LV_ERR_DELTA_I_LAM[i] = 1                         or
        LV_ERR_DYN_VLD_LS_UP[i] = 1                       or
        LV_ERR_EL_LSL_UP[i] = 1                           or
        LV_ERR_FSD[i] = 1                                 or
        LV_ERR_FSD_LAM_LIM[i] = 1                         or
        LV_ERR_LSH_DOWN[i] = 1                            or
        LV_ERR_LSH_UP[i] = 1                              or
        LV_ERR_LSL_UP_IF[i] = 1                           or
        LV_ERR_OBD_LSH_DOWN[i] = 1                        or
        LV_ERR_OBD_VLD_LSH_UP[i] = 1                      or
        LV_ERR_OC_LS_DOWN[i] = 1                          or
        LV_ERR_OC_LSL_UP[i] = 1                           or
        LV_ERR_OFS_LSL_UP[i] = 1                          or
        LV_ERR_PUC_LS_DOWN[i] = 1                         or
        LV_ERR_PUC_VLD_LS_UP[i] = 1                       or
        LV_ERR_SCG_LS_DOWN[i] = 1                         or
        LV_ERR_SCP_LS_DOWN[i] = 1                         or
        LV_ERR_SHIFT_AFL_LSL_UP[i] = 1                    or
        LV_ERR_SHIFT_AFR_LSL_UP[i] = 1                    or
        LV_ERR_TTIP_MES_LSH_UP[i] = 1                     or
        LV_ERR_VLS_DOWN_DIF[i] = 1                        or
        (i = 1                                            AND
         [LV_ERR_IV[0]                                    or
          LV_ERR_IV[2]                                    or
          LV_ERR_IV[4]                                    or
          LV_ERR_MIS[0]                                   or
          LV_ERR_MIS[2]                                   or
          LV_ERR_MIS[4] ])                                or
        (i = 2                                            AND
         [ LV_ERR_IV[1]                                   or
           LV_ERR_IV[3]                                   or
```

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```
          LV_ERR_IV[5]                                              or
          LV_ERR_MIS[1]                                             or
          LV_ERR_MIS[3]                                             or
          LV_ERR_MIS[5]   ])                                        or
        LV_ERR_PER_CAM_EX[y] = 1         y = 1 for i= 1,2           or
        LV_ERR_PER_CAM_IN[y] = 1         y = 1 for i= 1,2           or
        LV_ERR_PLAUS_CAM_EX[y] = 1       y = 1 for i= 1,2           or
        LV_ERR_PLAUS_CAM_IN[y] = 1       y = 1 for i= 1,2           or
        LV_ERR_REF_CRK_CAM_EX[y] = 1     y = 1 for i= 1,2           or
        LV_ERR_REF_CRK_CAM_IN[y] = 1     y = 1 for i= 1,2           or
        LV_ERR_SYN_CAM_EX[y] = 1         y = 1 for i= 1,2           or
        LV_ERR_SYN_CAM_IN[y] = 1         y = 1 for i= 1,2           or
        LV_ERR_SYN_CRK_CAM_IN[y] = 1     y = 1 for i= 1,2           or
        LV_ERR_TOOTH_OFF_EX[y] = 1       y = 1 for i= 1,2           or
        LV_ERR_TOOTH_OFF_IN[y] = 1       y = 1 for i= 1,2
then           LV_INH_DIAG_RBM_SWT_LS_DOWN[NC_CBK_EX_NR] = 1
else           LV_INH_DIAG_RBM_SWT_LS_DOWN[NC_CBK_EX_NR] = 0
endif

 If             ((LV_INH_DIAG_RBM_SWT_LS_DOWN [i] = 1     or
                 R_IT_LS_DOWN[i] > C_R_IT_MAX_DIAG_MPL_LS_DOWN          or
                 LV_VB_CDN_OBD_2 = 0              or
                 LV_LS_UP_OBD_2_MAN_DEAC[i] = 1)  and
                 LC_INH_LS_DOWN_MAN_DEAC = 0)     or
                 LC_INH_DIAG_SWT_LS_DOWN[i] = 1
then              LV_INH_DIAG_SWT_LS_DOWN[i] = 1
else             LV_INH_DIAG_SWT_LS_DOWN[i] = 0
endif
```

B.10.2 RBM – Interface for monitor sensor diagnosis

General information:

With this module the interface between the SWT_LS_DOWN[i] monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_SWT_LS_DOWN[i] data.
Within STATE_RBM_SWT_LS_DOWN[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)
  (depending on failure status: pending)
- Monitor individual RBM conditions encountered within this DC (bit 2)
  (not valid for SWT_LS_DOWN[i] diagnosis)

Application conditions:

Initialisation:
```
at ECU reset all bits of STATE_RBM_SWT_LS_DOWN[i] shall be
initialized with 0
at LV_DC 0 ->1 transition :
   bit 0 and bit 1 of STATE_RBM_SWT_LS_DOWN[i]  = 0
   bit 2 of STATE_RBM_SWT_LS_DOWN[i]  = 1
on failure memory reset :
   bit 1 of STATE_RBM_SWT_LS_DOWN[i] = 0
```

Activation: LV_DC 0 -> 1 transition **and** LV_DC = 1

Deactivation: –

Recurrence: 1 s

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Function description:

Formula section:

At LV_DC 0 -> 1 transition

The pending status of the following failures has to be checked only once :

Dependence	Error			
	LV_ERR_AMP	LV_ERR_AMP_PLAUS	LV_ERR_CHG_LS_DOWN	LV_ERR_CHG_LS_UP
	LV_ERR_CRK_PLAUS	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH	LV_ERR_CRK_TOOTH_PER
	LV_ERR_DIAGCPS	LV_ERR_EL_CPS	LV_ERR_FUP	LV_ERR_FUP_MFP_PLAUS
	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS	LV_ERR_LOAD_TPS_PLAUS
	LV_ERR_MAF_FRQ_EL	LV_ERR_MAF_FRQ_GRD	LV_ERR_MAF_FRQ_RNG	LV_ERR_MAP_PLAUS
	LV_ERR_MAP_TPS_PLAUS	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR
	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD	LV_ERR_TPS_AD_BOL
	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATIO	LV_ERR_TPS_ST_CHK_2
	LV_ERR_VCV			
NC_CBK_EX_NR	LV_ERR_AIR_LSL_UP [i]	LV_ERR_CHK_LS_DOWN [i]	LV_ERR_CTL_LSL_UP [i]	LV_ERR_DELTA_I_LAM [i]
	LV_ERR_DYN_VLD_LS_UP [i]	LV_ERR_EL_LSL_UP[i]	LV_ERR_FSD [i]	LV_ERR_FSD_LAM_LIM [i]
	LV_ERR_LSH_DOWN [i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]	LV_ERR_OBD_VLD_LSH_UP [i]
	LV_ERR_OBD_LSH_DOWN [i]	LV_ERR_OC_LS_DOWN [i]	LV_ERR_OC_LSL_UP [i]	LV_ERR_OFS_LSL_UP [i]
	LV_ERR_PUC_LS_DOWN [i]	LV_ERR_PUC_VLD_LS_UP [i]	LV_ERR_SCG_LS_DOWN [i]	LV_ERR_SCP_LS_DOWN [i]
	LV_ERR_SHIFT_AFL_LSL_UP [i]	LV_ERR_SHIFT_AFR_LSL_UP [i]	LV_ERR_TTIP_MES_LSH_UP [i]	LV_ERR_VLS_DOWN_DIF [i]

for any i

NC_NR_CAM_CBK	LV_ERR_PER_CAM_EX[1]	LV_ERR_PER_CAM_IN[1]	LV_ERR_PLAUS_CAM_EX[1]	LV_ERR_PLAUS_CAM_IN[1]
	LV_ERR_REF_CRK_CAM_EX[1]	LV_ERR_REF_CRK_CAM_IN[1]	LV_ERR_SYN_CAM_EX[1]	LV_ERR_SYN_CAM_IN[1]
	LV_ERR_SYN_CRK_CAM_IN[1]	LV_ERR_TOOTH_OFF_IN[1]	LV_ERR_TOOTH_OFF_EX[1]	

Continued on next page

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For x = 1 to NC_NR_CBK_IVVT (= for any i // or)

NC_NR_CBK_ IVVT	LV_ERR_CAM_CST_ IVVT_EX[x]	LV_ERR_CAM_CST_ IVVT_IN[x]	LV_ERR_MEC_IVVT_ EX[x]	LV_ERR_MEC_IVVT_ IN[x]
	LV_ERR_SLV_IVVT_EX[x]	LV_ERR_SLV_IVVT_IN[x]		

For NC_CBK_EX_NR = i = 1

NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

For NC_CBK_EX_NR = i = 2

NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

```
If(1)
      { CPU optimization at LV_DC 0 -> 1 transition }
      CTR_ERR_DYN_NR <> 0
                        { the dynamic failure memory isn't empty }
Then(1)
       While   bit 1 of STATE_RBM_SWT_LS_DOWN[i] = 0 do
               with each XX failure of the above list (depending on configuration, see below):
               ACTION_ERRM_CheckPendingStatus(IN<XX>,
               OUT<PendingStatus>,SYNCHRONIZATION<CALL>)

               If(2)
                        XX has a pending status
               Then(2)   bit 1 of  STATE_RBM_SWT_LS_DOWN[i] = 1
               Endif(2)
       Endwhile
Else(1)
      { the dynamic failure memory is empty }     No action
Endif(1)
```

Every 1 s :

```
If     bit 0 of STATE_RBM_SWT_LS_DOWN[i]  = 0
Then
       If     LV_END_DIAG_SWT_LS_DOWN[i] = 1
       Then   bit 0 of STATE_RBM_SWT_LS_DOWN[i]  = 1
       Endif
Endif
```

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```
If      bit 1 of STATE_RBM_SWT_LS_DOWN[i] = 0
Then
        If      LV_INH_DIAG_RBM_SWT_LS_DOWN[i]= 1
        Then    bit 1 of STATE_RBM_SWT_LS_DOWN[i] = 1
        Endif
Endif
```

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B.11 O2 sensor (bin, down) gradient monitoring

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_NR_DIAG_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V/S	0... 3FFH	0... 1023	1	-
Counter for completed gradient monitoring diagnosis					
CTR_NR_DIAG_PUE_LS_DOWN_OLD [NC_CBK_EX_NR]	V	0... 3FFH	0... 1023	1	-
Counter for completed gradient monitoring diagnosis - old value					
CTR_PUC_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for number of valid fuel cut-off phases					
CTR_PUC_PUE_LS_DOWN_OLD [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for number of valid fuel cut-off phases - old value					
ERR_SYM_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom of pull end plausibility					
FAC_COR_PUE_LS_DOWN	V	0... FFH	0... 3.984375	0.015625	-
Correction facor for the gradient					
LAMB_MMV_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Moving mean value of lambda signal value of the WRAF sensor					
LAMB_SP_ADD_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFFH	0... 0.249939	61.0352e-6	-
Additional value of lambda setpoint for catalyst enrichment function					
LV_CAT_PURGE_ACT_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable to indicate an active catalyst purge after fuel cut-off phase					
LV_CDN_DIAG_TMP_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Temporary status condition for gradient monitoring of oxygen sensor downstream					
LV_CTR_CHK_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status condition indicating that fuel cut-off phase has been present					
LV_DIAG_ACT_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable to indicate the activation of the diagnosis					
LV_DIAG_CDN_RST_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable to reset the condition flags					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_CLC_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status flag for gradient calculation					
LV_DIAG_RST_WIN_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable to reset the window condition flag					
LV_DIAG_VLD_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable indicating that fuel cut-off phase and time after fuel cut-off were long enough					
LV_DIAG_WIN_CDN_1_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable to indicate the status of the window condition					
LV_DIAG_WIN_CDN_2_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable to indicate the status of the window condition					
LV_DIAG_WIN_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable to indicate the status of the window condition					
LV_END_DIAG_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Bit to indicate end of pull end plausibility diagnosis					
LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced diagnosis result of pull end plausibility					
LV_VLS_DOWN_PUE_CAT_PURGE [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical variable to indicate that a catalyst purge phase has been present					
MAF_INT_PUC_NOT_ACT_OLD [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.66666667	0.0444444	g
Air mass flow integral out of pull cut off phase - old value					
MAF_KGH_MMV_PUE_LS_DOWN	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Moving mean value of mass air flow, measured per segment					
N_MMV_PUE_LS_DOWN	V	0... 1FE0H	0... 8160	1	rpm
Moving mean value of the engine speed					
T_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... 639CH	0... 255	0.01	s
Timer to limit the length of the change from lean to rich					
T_R_IT_PUE_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Timer to ensure a valid measurement of the internal resistant of the oxygen sensor downstream					
VLS_DOWN_PUE_BOL_SAE [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-65536 ...65534	2	mV/s
Service 06h - min test limit: EGCP system diagnosis - - lean to rich					
VLS_DOWN_PUE_DRV1_MMV [NC_CBK_EX_NR]	V	8000... 7FFFH	-65536 ...65534	2	mV/s
Gradient calculated with the correction factor					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VLS_DOWN_PUE_DYN_VLD [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-65536 ...65534	2	mV/s
Output of the relevant gradient for the Cat-Diagnosis					
VLS_DOWN_PUE_MMV [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-65536 ...65534	2	mV/s
Moving mean value of gradient monitoring					
VLS_DOWN_PUE_OLD [NC_CBK_EX_NR]	V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Downstream sensor voltage measured - old value					
VLS_DOWN_PUE_PUC_GRD [NC_CBK_EX_NR]	V	8000... 7FFFH	-65536 ...65534	2	mV/s
Valid gradient after fuel cut-off phases of downstream oxygen sensor voltage from lean to rich					
VLS_DOWN_PUE_PUC_MAX [NC_CBK_EX_NR]	V	8000... 7FFFH	-65536 ...65534	2	mV/s
Maximum gradient after fuel cut-off phases of downstream oxygen sensor voltage from lean to rich					
VLS_DOWN_PUE_PUC_MAX_OLD [NC_CBK_EX_NR]	V	8000... 7FFFH	-65536 ...65534	2	mV/s
Maximum gradient after fuel cut-off phases of downstream oxygen sensor voltage from lean to rich - old value					
VLS_DOWN_PUE_PUC_MIN [NC_CBK_EX_NR]	V	8000... 7FFFH	-65536 ...65534	2	mV/s
Minimum gradient after fuel cut-off phases of downstream oxygen sensor voltage from lean to rich					
VLS_DOWN_PUE_PUC_MIN_OLD [NC_CBK_EX_NR]	V	8000... 7FFFH	-65536 ...65534	2	mV/s
Minimum gradient after fuel cut-off phases of downstream oxygen sensor voltage from lean to rich - old value					
VLS_DOWN_PUE_SAE [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-65536 ...65534	2	mV/s
Service 06h - test value: EGCP system diagnosis - - lean to rich					
VLS_DOWN_PUE_SAVE_MAX [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-65536 ...65534	2	mV/s
Saved maximum gradient of oxygen sensor downstream of all driving cycles					
VLS_DOWN_PUE_SAVE_MIN [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-65536 ...65534	2	mV/s
Saved minimum gradient of oxygen sensor downstream of all driving cycles					
VLS_DOWN_PUE_STD [NC_CBK_EX_NR]	O/V/S	0... FFFFFFFFH	0 ...	128e-6	(V/s)**2
Squared standard deviation of gradient monitoring					
VLS_DOWN_PUE_TOL_SAE [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-65536 ...65534	2	mV/s
Service 06h - max test limit: EGCP system diagnosis - - lean to rich					

Input data:

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_INH_DIAG_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5190}
LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_PUC {p. 1720}	MAF_INT_PUC_ACT {p. 2942}	MAF_INT_PUC_NOT_ACT {p. 2942}
MAF_KGH {p. 1195}	N {p. 1525}	NC_CBK_EX_NR {p. 1829}	R_IT_LS_DOWN [NC_CBK_EX_NR] {p. 1364}

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T_SAMPLE_R_IT_LS_DOWN [NC_CBK_EX_NR] {p. 1364}	TEG_DYN_LS_DOWN [NC_CBK_EX_NR] {p. 1007}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}
VLS_DOWN_DRV1_MMV [NC_CBK_EX_NR] {p. 2409}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LAMB_PUE_LS_DOWN	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation constant for lambda signal value of the WRAF sensor					
C_CRLC_MAF_PUE_LS_DOWN	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation constant for mass air flow					
C_CRLC_N_PUE_LS_DOWN	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation constant for engine speed					
C_CTR_PUE_LS_DOWN_MIN	-	0... FFH	1... 256	1	-
Minimum fuel cut-off phases to get a gradient of the oxygen sensor downstream voltage					
C_LAMB_MMV_PUE_MAX	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Maximum threshold for lambda signal value of the WRAF sensor					
C_LAMB_MMV_PUE_MIN	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Minimum threshold for lambda signal value of the WRAF sensor					
C_LAMB_SP_ADD_PUE_LS_DOWN	-	0... FFFH	0... 0.249939	61.0352e-6	-
Additional value of lambda setpoint for catalyst enrichment function					
C_LAMB_SP_PUE_MAX	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Maximum value of lambda setpoint for a valid gradient calculation					
C_MAF_INT_PUC_ACT_PUE_MIN	-	0... FFFFH	0... 2912.66666667	0.0444444	g
Threshold for air mass flow integral during fuel cut off phase					
C_MAF_INT_PUC_NOT_ACT_MAX	-	0... FFFFH	0... 2912.66666667	0.0444444	g
Maximum threshold for air mass flow integral out of pull cut off phase					
C_MAF_INT_PUC_NOT_ACT_MIN	-	0... FFFFH	0... 2912.66666667	0.0444444	g
Minimum threshold for air mass flow integral out of pull cut off phase					
C_MAF_KGH_PUE_LS_DOWN_MIN	-	0... FFFFH	0... 1023.984375	0.015625	kg/h
Threshold of total air mass flow for activation conditions					
C_R_IT_PUE_LS_DOWN_MAX	-	0... FFFFH	0... 65535	1	Ohm
Threshold of Internal resistance of downstream oxygen sensor for activation conditions					
C_T_PUE_LS_DOWN_MIN	-	0... 639CH	0... 255	0.01	s
Threshold for the timer to limit the length of the change from lean to rich					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_R_IT_PUE_LS_DOWN_MAX	-	0... FFFFH	0... 655.35	0.01	s
Threshold for time measured between internal resistance samples					
C_T_R_PUE_LS_DOWN_MAX	-	0... FFFFH	0... 655.35	0.01	s
Threshold for the timer of internal resistant calculation (oxygen sensor downstream)					
C_TEG_DYN_PUE_LS_DOWN_MAX	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Maximum threshold for exhaust gas temperatures at the lambda sensor downstream catalyst					
C_TEG_DYN_PUE_LS_DOWN_MIN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum threshold for exhaust gas temperatures at the lambda sensor downstream catalyst					
C_TEMP_CAT_DYN_PUE_LS_DOWN_MAX	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Maximum threshold for modelled catalyst temperature under dynamic conditions					
C_TEMP_CAT_DYN_PUE_LS_DOWN_MIN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum threshold for modelled catalyst temperature under dynamic conditions					
C_VLS_DOWN_PUE_CAT_PURGE	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Threshold for oxygen sensor downstream voltage after cat purge					
C_VLS_DOWN_PUE_HYS	-	0... FFFFH	-5... 4.99984741211	152.588e-6	V
Calibrateable hysteresis for the analysis of continuous rising downstream voltage					
C_VLS_DOWN_PUE_MAX_MIN	-	8000... 7FFFH	-65536 ...65534	2	mV/s
Minimum threshold of maximum gradient for oxygen sensor fault detection					
C_VLS_DOWN_PUE_MAX_TOL	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Threshold for oxygen sensor downstream voltage					
C_VLS_DOWN_PUE_MIN_MIN	-	8000... 7FFFH	-65536 ...65534	2	mV/s
Minimum threshold of minimum gradient for oxygen sensor fault detection					
C_VLS_DOWN_PUE_PUC_BOL	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Minimum oxygen sensor downstream voltage for windows monitoring					
C_VLS_DOWN_PUE_PUC_TOL	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Maximum oxygen sensor downstream voltage for windows monitoring					
C_VLS_DOWN_PUE_WIN	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Window voltage of oxygen sensor downstream for gradient monitoring					
IP_VLS_DOWN_PUE	V	0... FFH	0... 12.75	0.05	-
LDP_MAF_KGH_PUE_LS_DOWN	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_LAMB_LS_UP	8	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Correction factor for gradient calculation of oxygen sensor downstream voltage					

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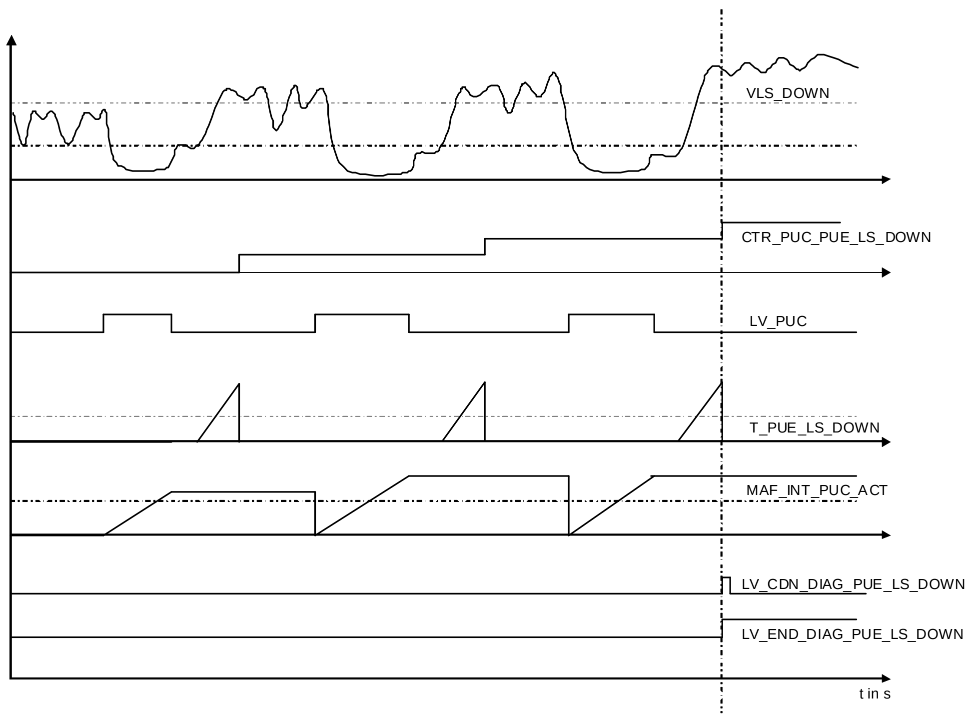
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_VLS_DOWN_PUE_N	-	0... FFH	0... 12.75	0.05	-
LDP_N_PUE_LS_DOWN	8	0... 1FE0H	0... 8160	1	rpm
Correction factor for gradient calculation of oxygen sensor downstream voltage					
LC_DIAG_PUE_LS_DOWN	-	0... 1H	0 ...1	1	-
Switch to lock the diagnosis in combination with the end flag					
LC_VLS_DOWN_MMV	-	0... 1H	0 ...1	1	-
Switch to activate the calculation of the gradient s mean value					
LC_VLS_DOWN_PUE_CON	-	0... 1H	0 ...1	1	-
Switch to analyse only gradients of continuous rising downstream voltage					
LC_VLS_DOWN_PUE_PUC_MIN	-	0... 1H	0 ...1	1	-
Switch to analyse minimum gradients of fuel cut-off phases of oxygen sensor downstream voltage					
LC_VLS_DOWN_PUE_STC_CLR	-	0... 1H	0 ...1	1	-
Switch to clear the lablels of the statistical analysis					

General Information

The downstream oxygen sensor is used for several tasks where signal dynamics is critical, e.g. trim control, catalyst purge, or monitoring of the catalyst performance. If the sensor response to a lean to rich transition is slow, these functions may not operate properly and diagnoses may produce wrong results. Therefore the sensor signal is monitored for sufficient dynamics.



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FUNCTION DESCRIPTION:

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The diagnosis runs once per driving cycle (adjustable by LC) and monitors the gradient of the downstream oxygen sensor voltage (VLS_DOWN). For the diagnosis to run, the sensor must be ready, no inhibitions must be indicated and the sensor voltage must be in a plausible range.

The function tests if the sensor signal changes fast enough by evaluating the gradient after removal of high-frequency noise. To ensure that a result is produced only if enough signal dynamics can be expected, a certain number of suitable fuel cut phases must occur before the diagnosis finishes. A "suitable fuel cut phase" is long enough to ensure a lean catalyst, and enough gas has passed afterwards to purge the catalyst. Both criteria can be calibrated in terms of air mass integrals and a timer.
The overall maximum and/or minimum of the signal gradient is calculated until the condition of the diagnosis has been determined. At that moment, the value is compared against a threshold, and if it is high enough, the sensor passes diagnosis, otherwise it fails. At the same time the relevant gradient and the thresholds are stored for mode06 output.

The following Flowchart is a short overview of the characteristic of the diagnosis.

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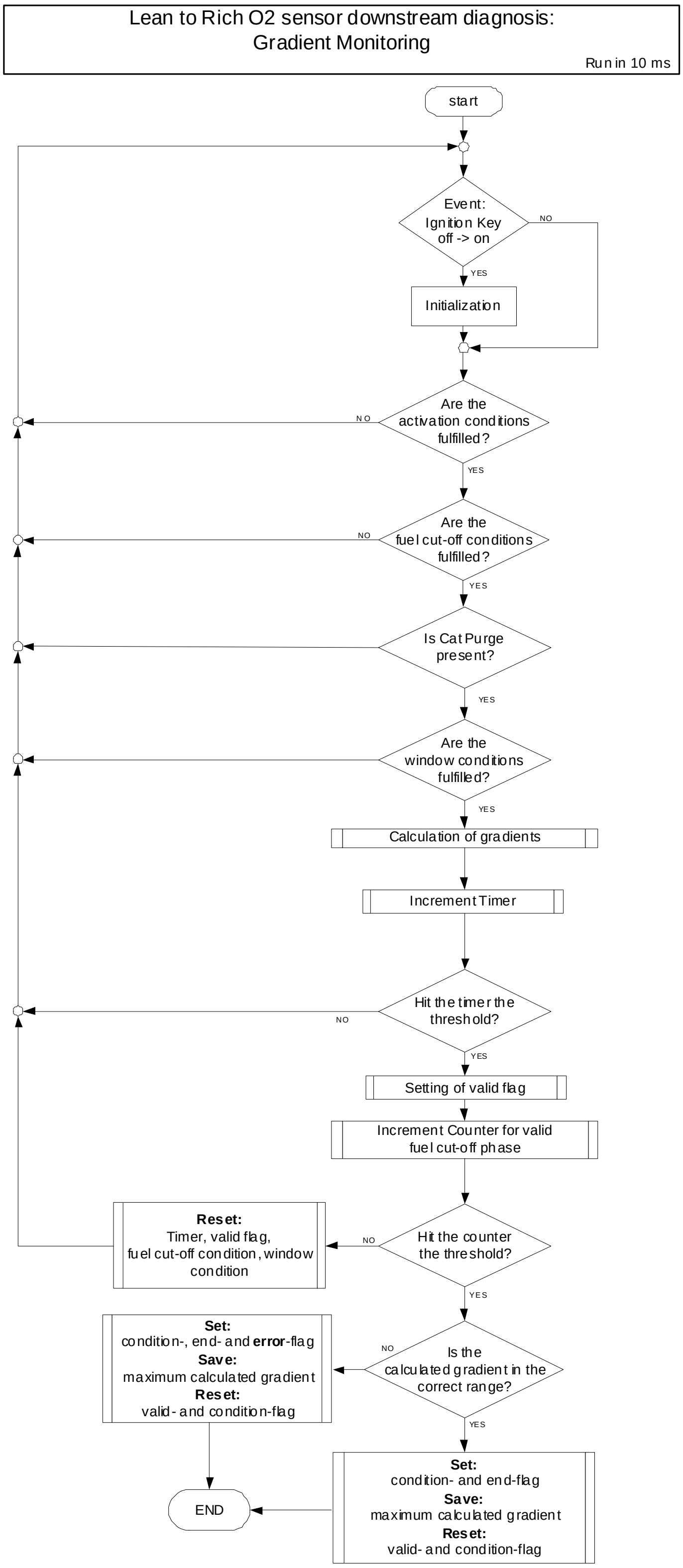

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Application Conditions

Initialization: CLRFMY, IGKON, RST
Recurrence: 10MS

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Activation: always
Deactivation: never

Function description

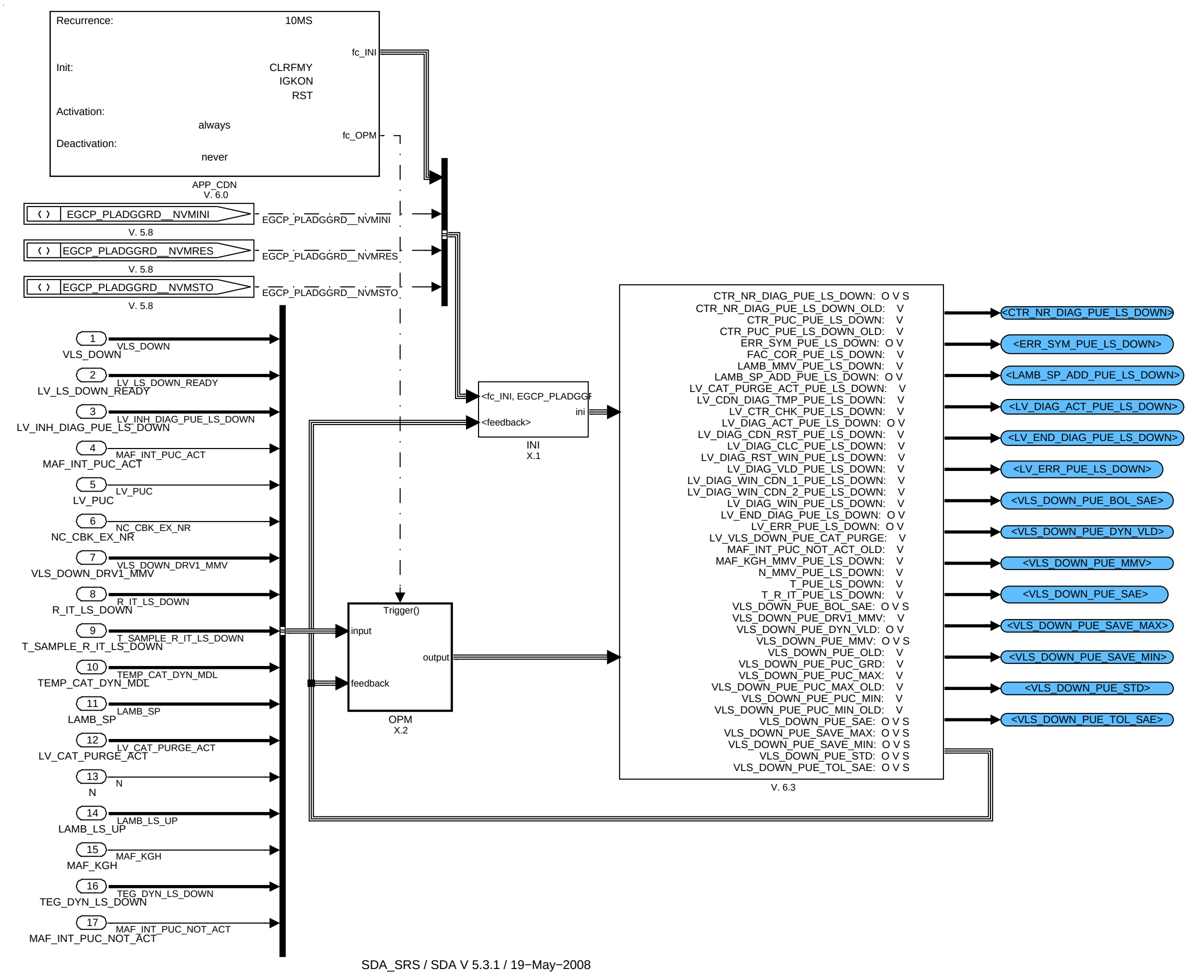

Figure B.11.1: :

B.11.1 Initialization

Initialization of (normal) variables, non-volatile memory variables and variables that are directly linked to error manager is described.
Initialization of variables takes place at ignition key on and reset.
The variables saved in the non-volatile memory are reset in case the error memory is cleared and by initializing the NVMY.
Variables that are directly linked with the error manager are initialized according to related error manager routines (ACTION_ERRM).

B.11.1.1 Synchronization with ERRM at clear failure memory and reset of Mode06 Label

Synchronisation between LV_ERR_PUE_LS_DOWN, LV_END_DIAG_PUE_LS_DOWN and ERR_SYM_PUE_LS_DOWN and its result from ERRM is done using action ACTION_ERRM_GetLvErr(),ACTION_ERRM_GetLvEnd() and ACTION_ERRM_GetErrSym() at clear failure memory.

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ACTION_ERRM_GetLvErr(IN <IDX_DIAG>, OUT <LV_ERR>)
Action that returns the status of the debounced failure
ACTION_ERRM_GetErrSym(IN <IDX_DIAG>, OUT <ERR_SYM>)
Action that returns the symptom of the failure
ACTION_ERRM_GetLvEndDiag(IN <IDX_DIAG>, OUT <LV_END_DIAG>)
Action that returns the status of the failure availability

B.11.1.2 Initialization at reset, ignition key on and clear failure memory

ACTION_ERRM_NoFilterReset(IN <IDX_DIAG>, OUT <LV_ERR>)
This action resets data filter in case of no filter usage
ACTION_ERRM_GetErrSym(IN <IDX_DIAG>, OUT <ERR_SYM>)
Action that returns the symptom of the failure
ACTION_ERRM_GetLvEndDiag(IN <IDX_DIAG>, OUT <LV_END_DIAG>)
Action that returns the status of the failure availability

B.11.1.3 Initialization of non volatile memory

B.11.1.4 Restore of non volatile memory

B.11.2 Formula Section (Recurrence 10ms)

B.11.2.1 Calculation of Moving Mean Values

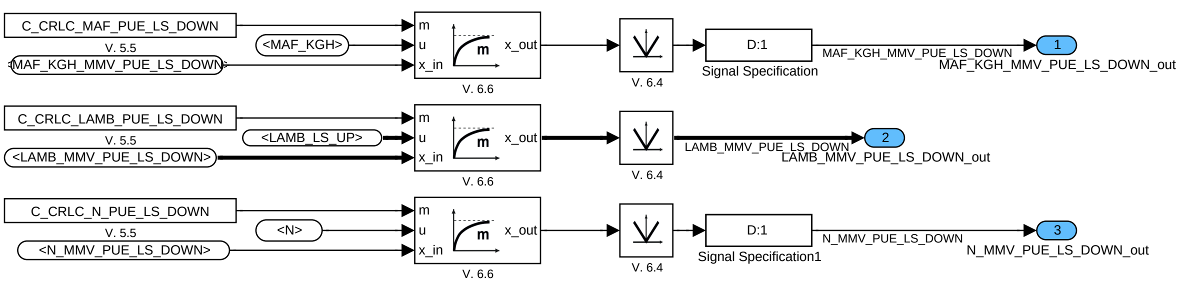

Figure B.11.2: :

B.11.2.2 Calculation of Signals for all Cylinder Banks

For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR=2) then
i=1, for exhaust cylinder bank 1
i=2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR=1)

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i=1, for single exhaust cylinder bank.
i = 1 to NC_CBK_EX_NR

B.11.2.2.1 Calculation for Activation or Deactivation of Diagnosis

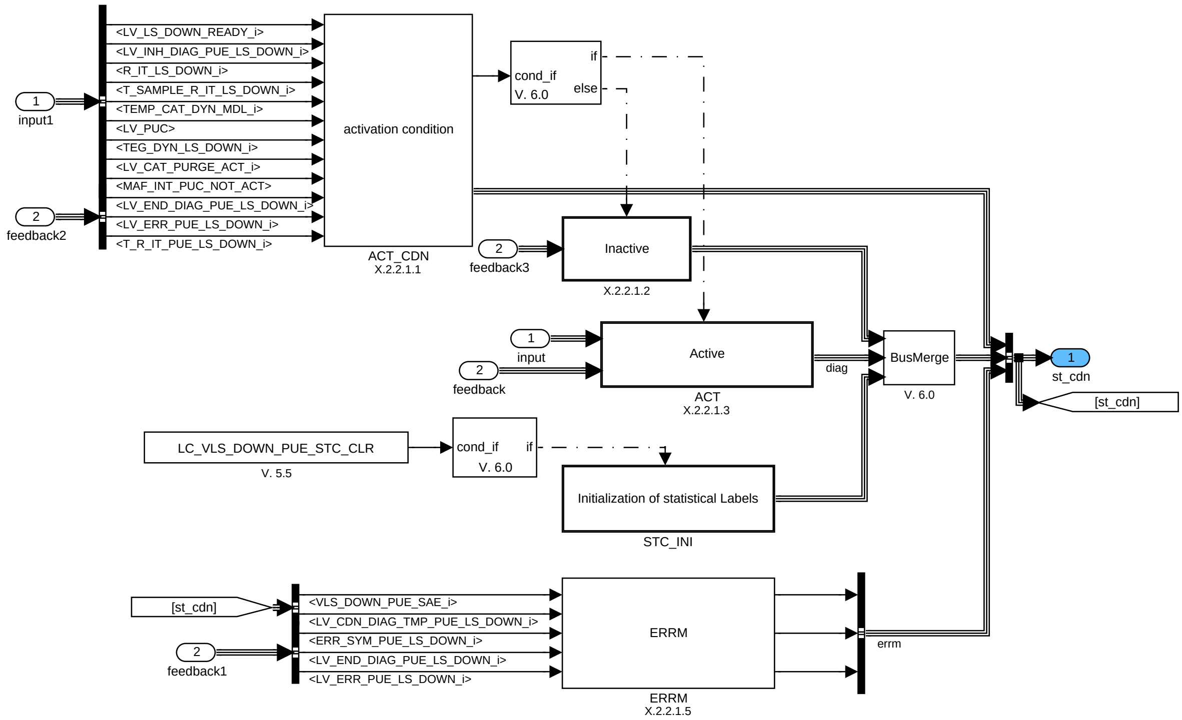

Figure B.11.3: :

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B.11.2.2.1.1 ACT_CDN: Calculation of Activation Condition

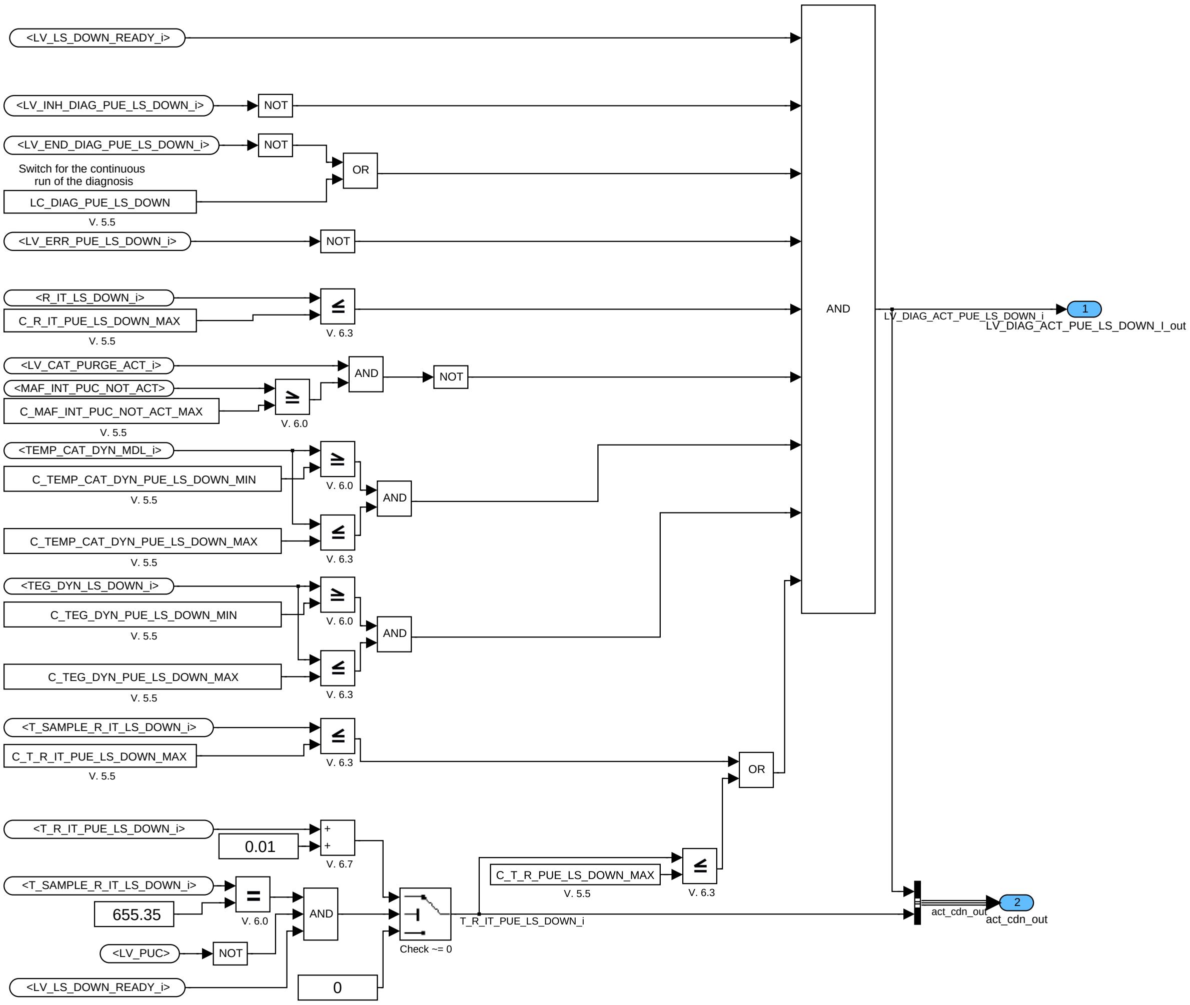

Figure B.11.4: :

B.11.2.2.1.2 Inactive

The Diagnosis is inactive and the condition flags and timer should be reset.

B.11.2.2.1.3 Active

The Diagnosis should be activated to calculate and analyse the gradients of the oxygen sensor.

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B.11.2.2.1.3.1 Calculation of Gradients and of Condition flags for the Analysis of the Gradients

B.11.2.2.1.3.1.1 PUC_CDN: Calculation of Fuel Cut-Off Condition

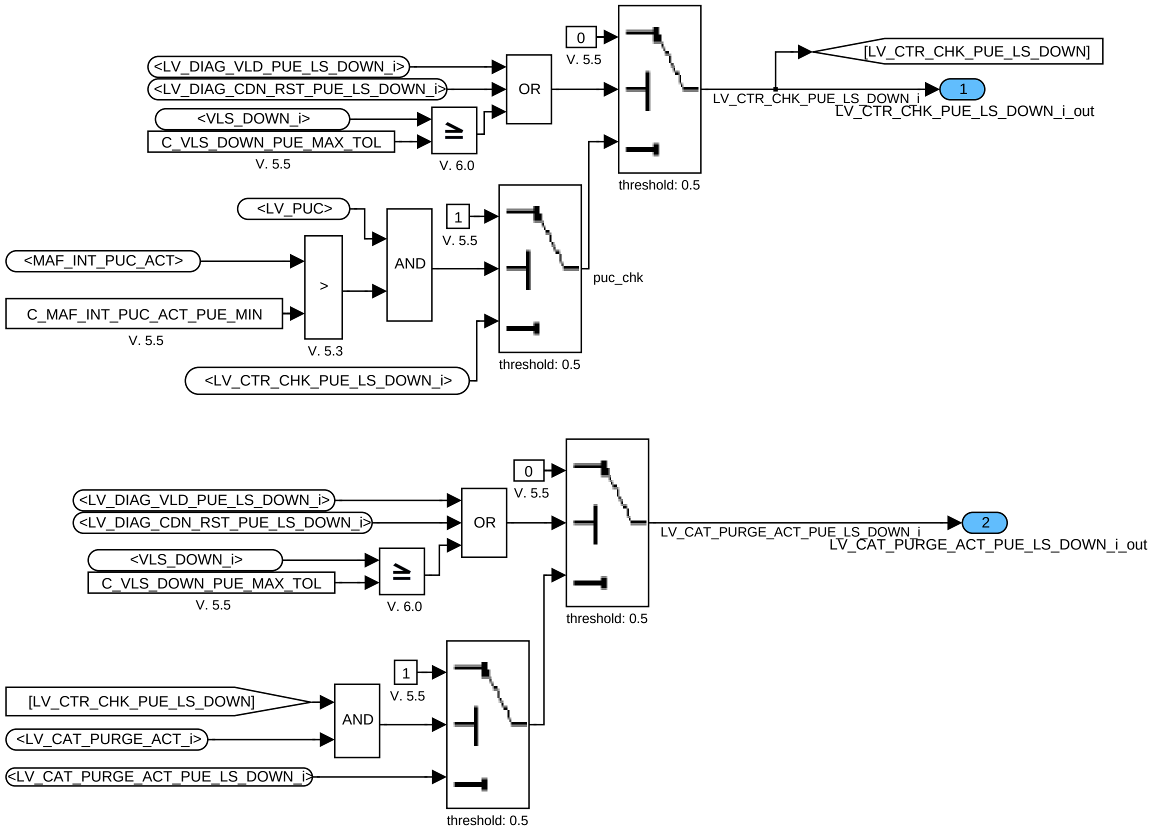

Figure B.11.5: :

B.11.2.2.1.3.1.2 Calculation of Reset flag

Monitoring of constant rising oxygen sensor downstream voltage, lambda setpoint and lambda signal upstream.

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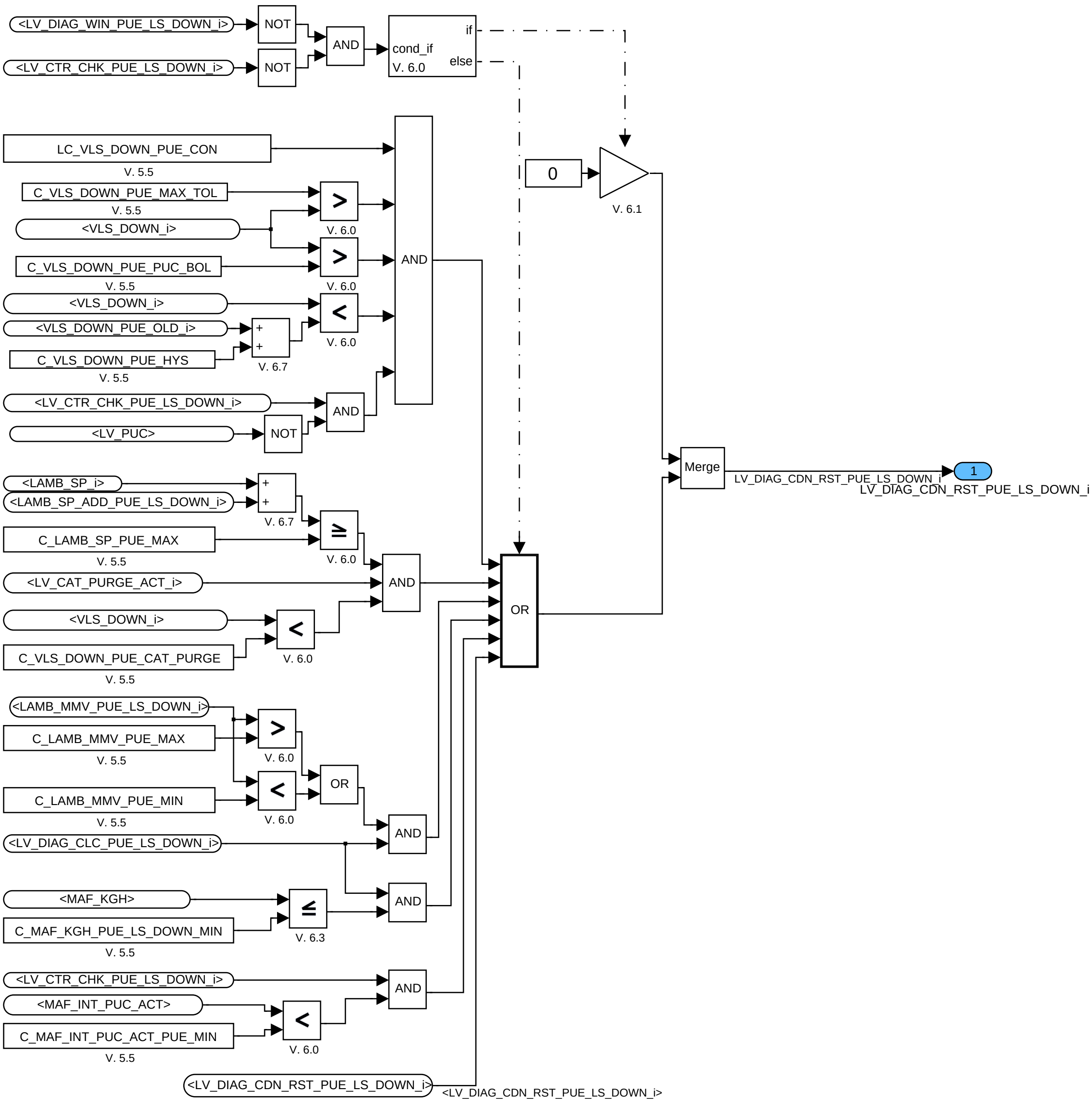

Figure B.11.6: :

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B.11.2.2.1.3.1.3 WIN_CDN: Calculation of Window Condition

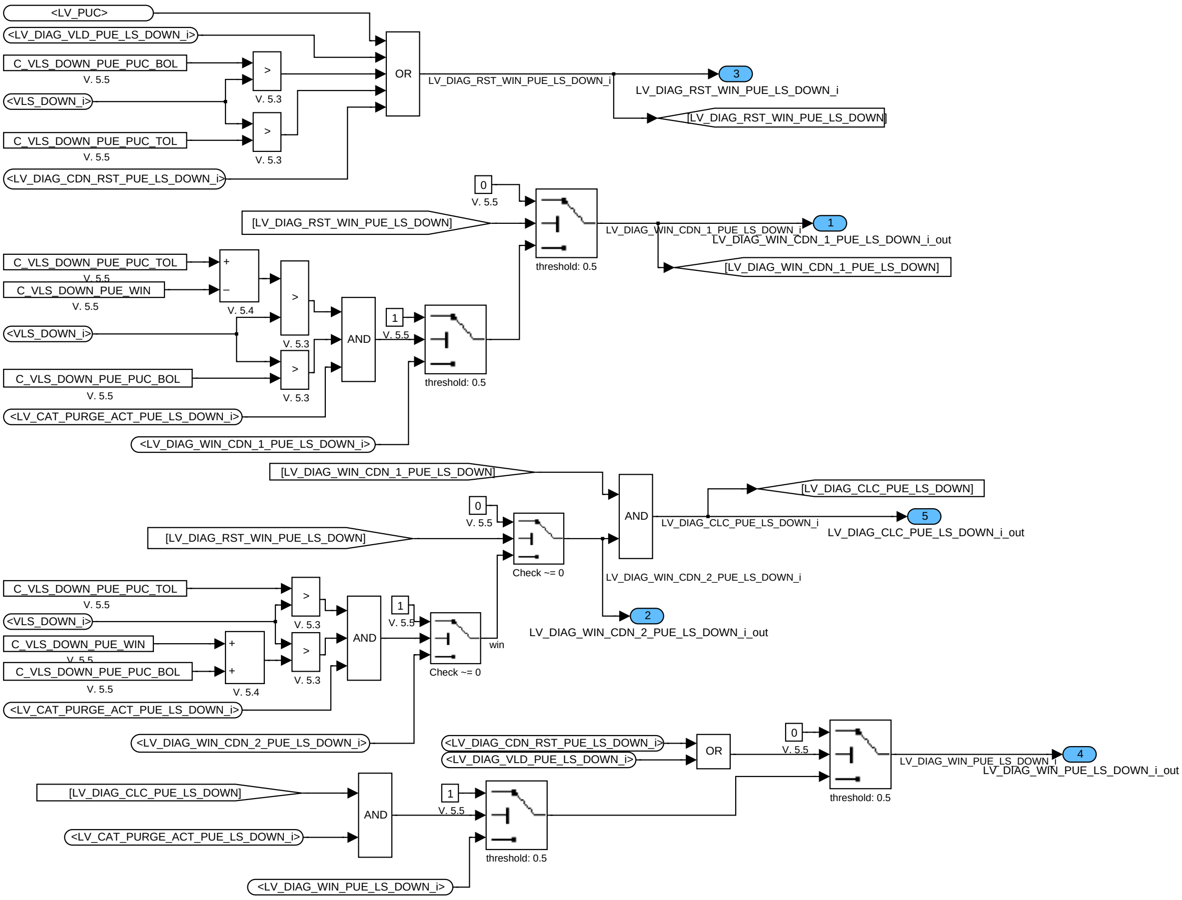

Figure B.11.7: :

B.11.2.2.1.3.1.4 Calculation of gradients

B.11.2.2.1.3.1.4.1 CLC_DRV1_MMV: Calculation of Correction Factor for the Gradient

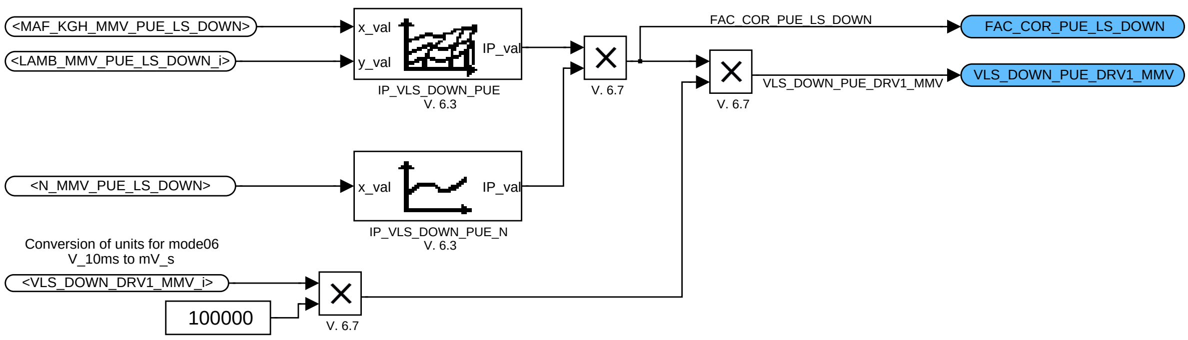

Figure B.11.8: :

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B.11.2.2.1.3.1.4.2 MAX_PUE: Calculation of the Maximum Gradient

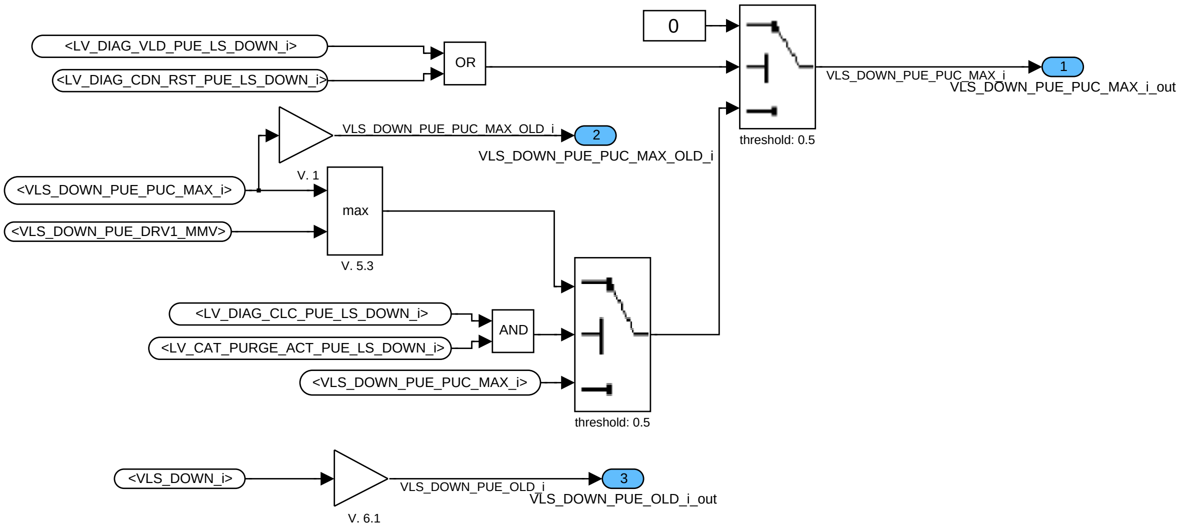

Figure B.11.9: :

B.11.2.2.1.3.1.4.3 MIN_PUE: Calculation of the Minimum Gradient

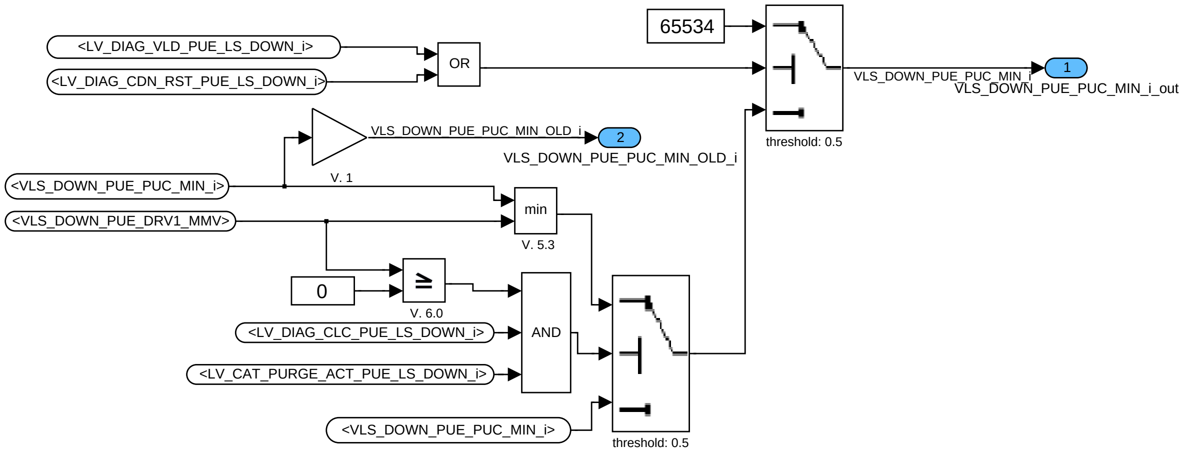

Figure B.11.10: :

B.11.2.2.1.3.1.5 STORE_PREV_FRF: Prestored Freeze Frame

Every calculated gradient will be checked against a threshold and at a fault the Prestore Freeze Frame will be triggered.

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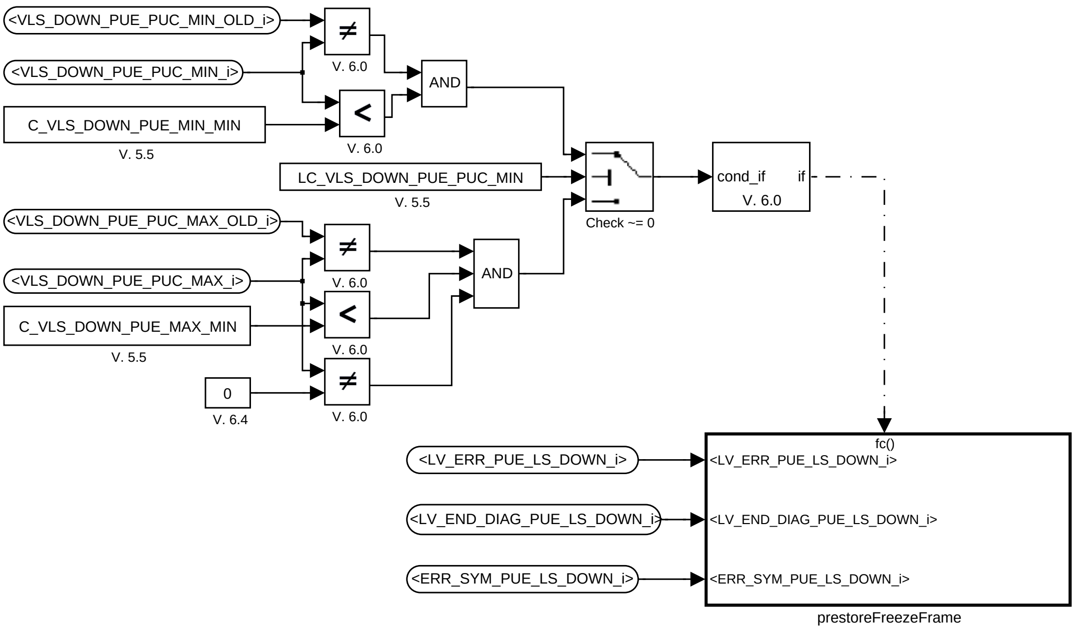

Figure B.11.11: :

B.11.2.2.1.3.2 Check of Condition

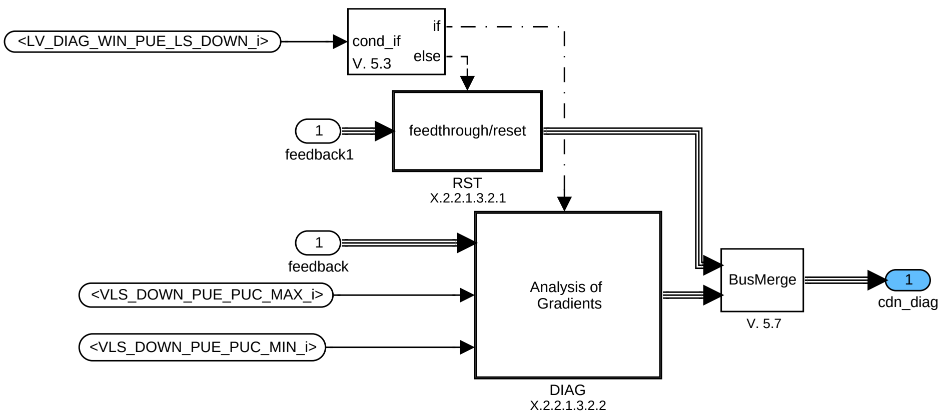

Figure B.11.12: :

B.11.2.2.1.3.2.1 Reset

B.11.2.2.1.3.2.2 DIAG: Calculation of Diagnosis Mode06 and Output for Cat-Diagnosis

B.11.2.2.1.3.2.2.1 Calculation of Variables

The timer limits the period of the change from lean to rich after a valid fuel cut-off phase. By crossing the threshold the valid flag would be set and the counter increments. After adjustable fuel cut-off phases a result should be available.

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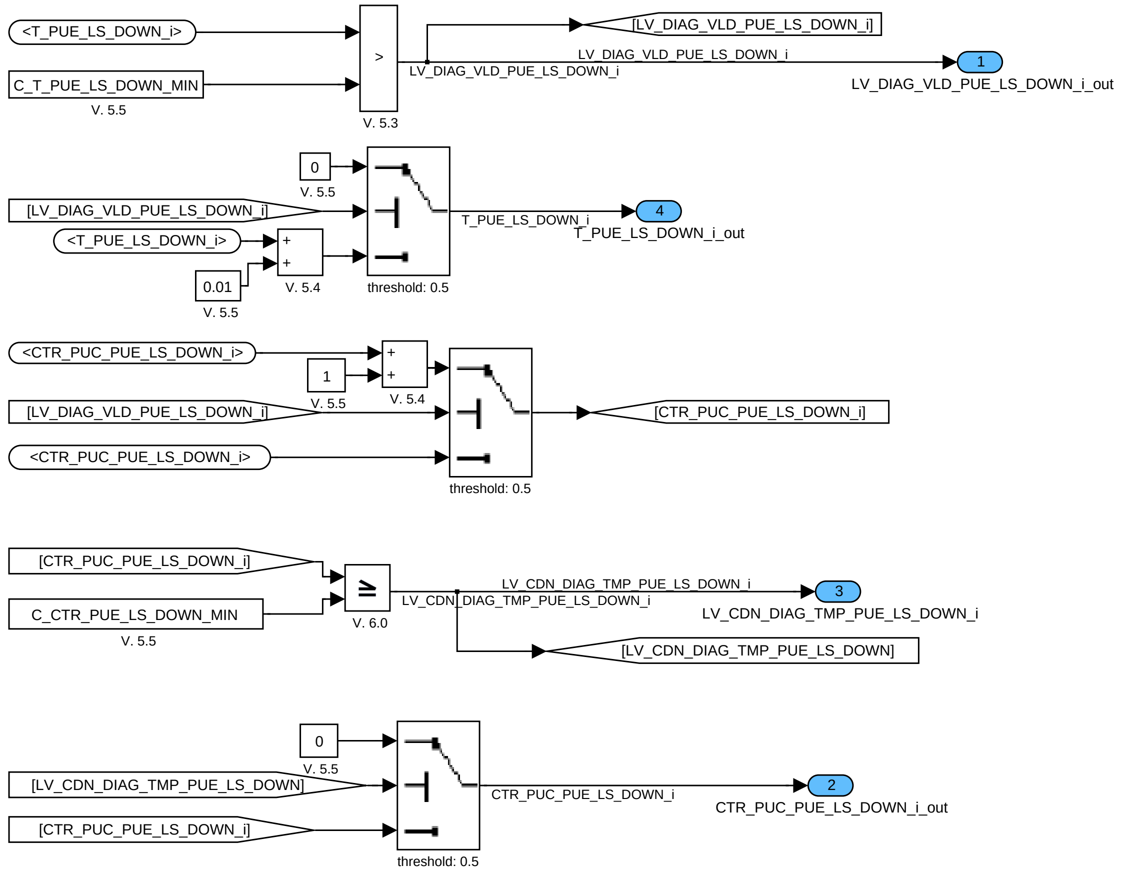

Figure B.11.13: :

B.11.2.2.1.3.2.2.2 Mean Value of the Gradient

The switch LC_VLS_DOWN_MMV allows to choose the mean value or the minimum/maximum of the gradient.

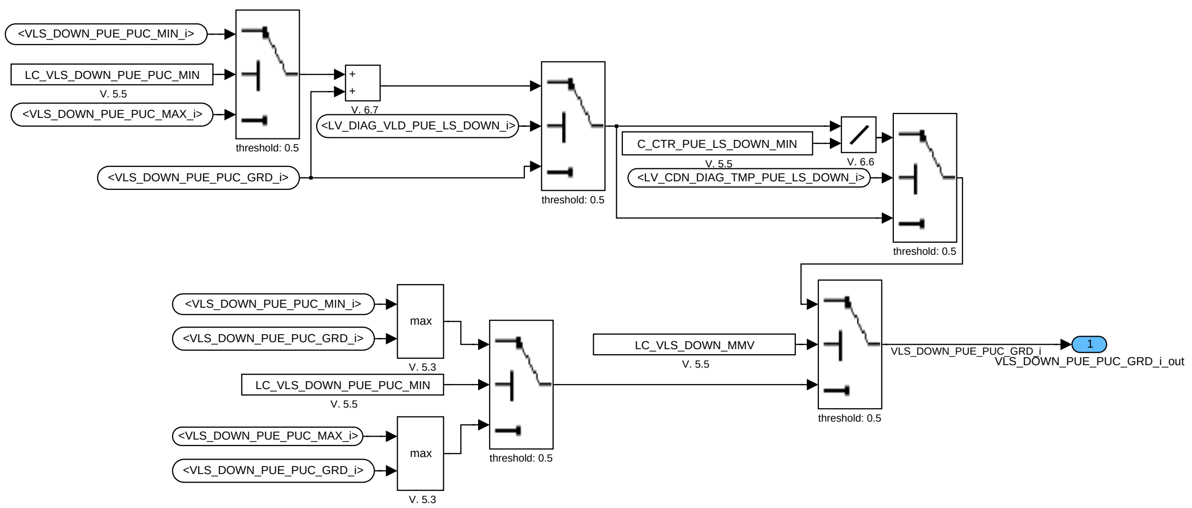

Figure B.11.14: :

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B.11.2.2.1.3.2.2.3 Mode06

The calculated gradient (test value) and limits will be saved (independently of ’good case’ or ’bad case’).

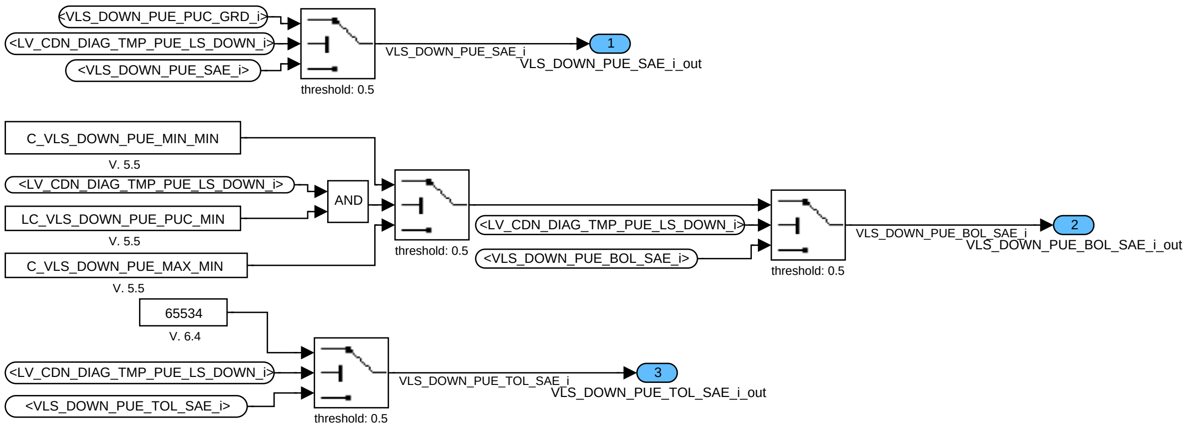

Figure B.11.15: :

B.11.2.2.1.3.2.2.4 Calculation of the Output for Cat-Diagnosis

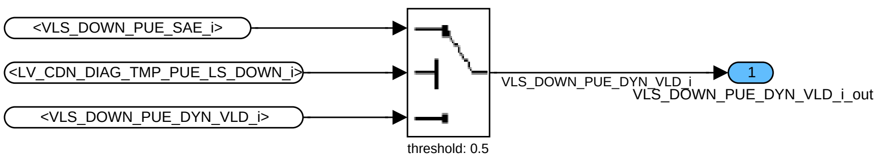

Figure B.11.16: :

B.11.2.2.1.3.2.2.5 Reset of Gradient Mean Value

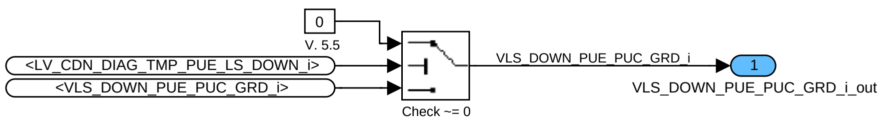

Figure B.11.17: :

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B.11.2.2.1.3.3 Statistical Calculation of Diagnosis Cycle

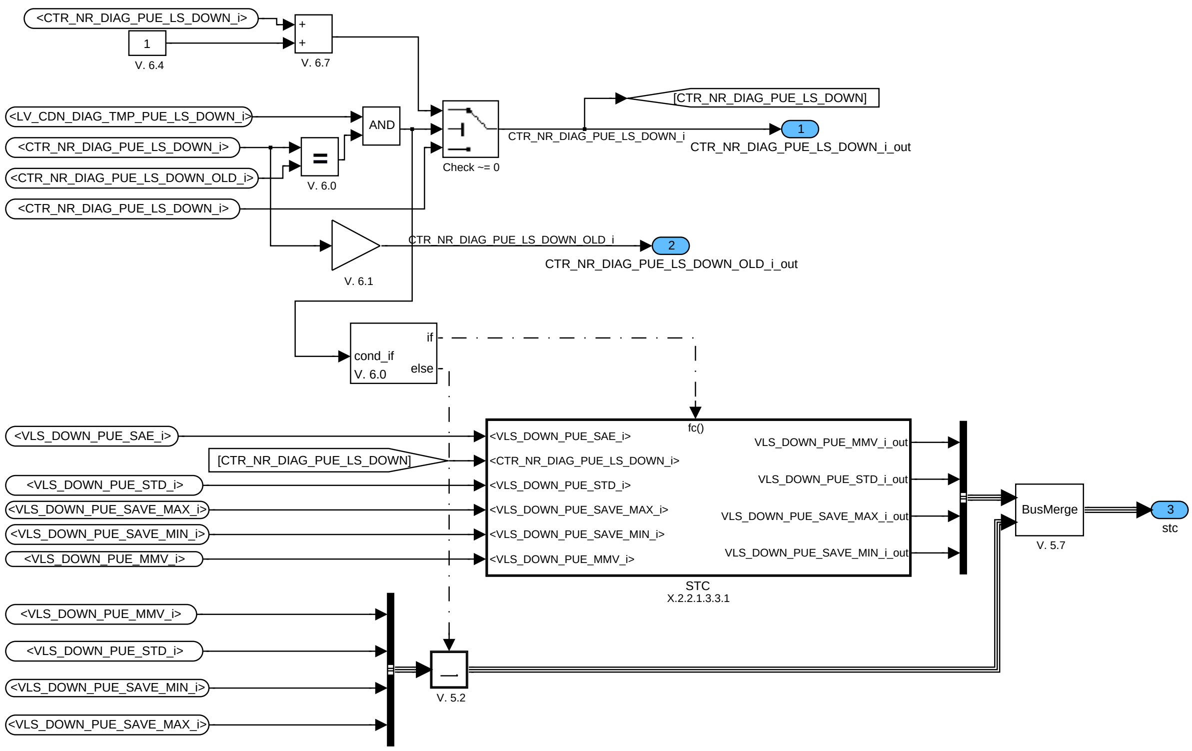

Figure B.11.18: :

B.11.2.2.1.3.3.1 Statistical Calculation

Calculation of mean value and standard deviation.
Evaluation of maximum and minimum calculated gradients of all driving cycles and diagnosis runs.
A reset could be done by the switch LC_VLS_DOWN_PUE_STC_CLR.

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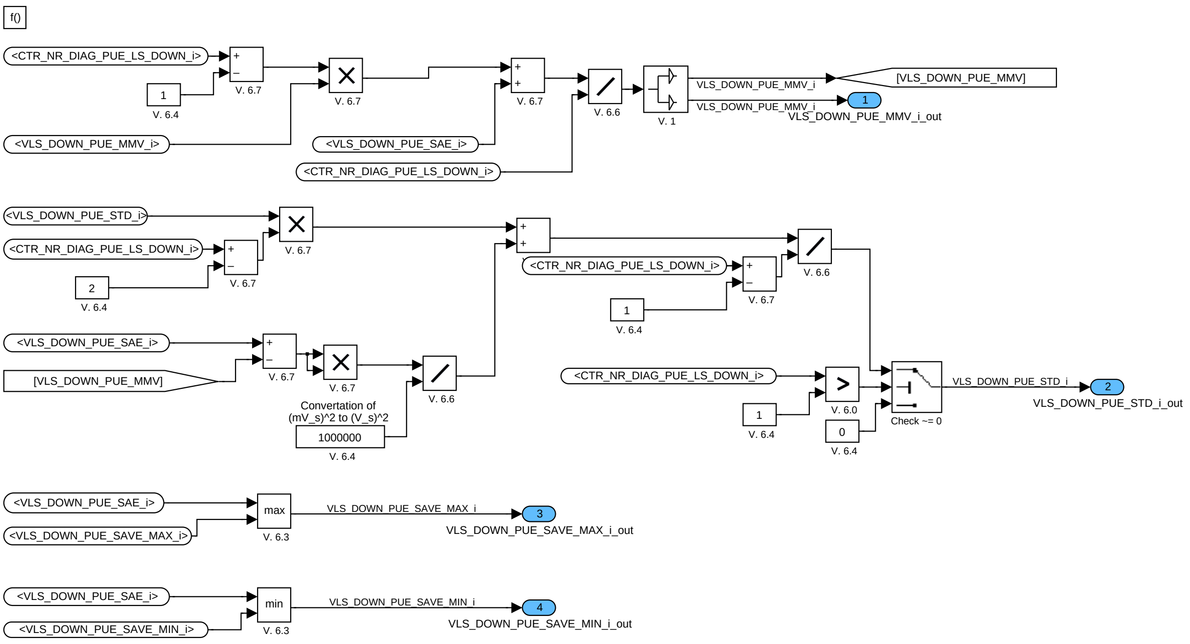

Figure B.11.19: :

B.11.2.2.1.3.4 Calculation of value for catalyst enrichment function

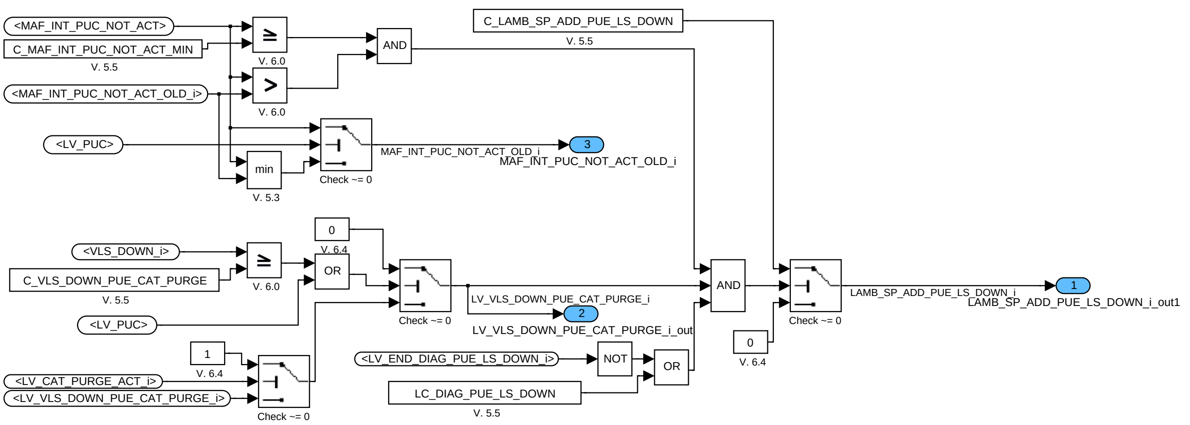

Figure B.11.20: :

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B.11.2.2.1.4 Calculation of ERRM relevant Labels and ERRM Interface

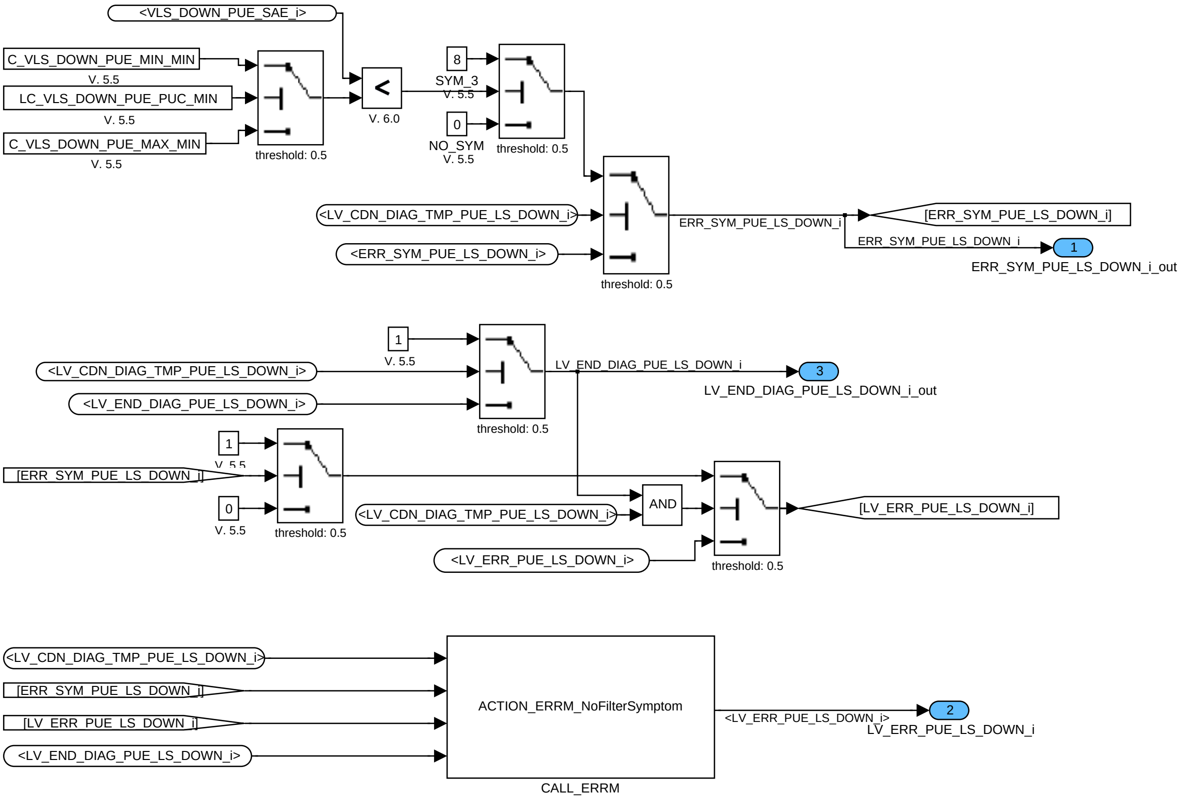

Figure B.11.21: :

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B.12 O2 sensor (bin, down) gradient monitoring (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating inhibition of lambda sensor PUC-end diagnosis downstream					
LV_INH_DIAG_RBM_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating inhibition of RBM for lambda sensor PUC-end diagnosis downstream					
STATE_RBM_PUE_LS_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of PUE_LS_DOWN monitor with the Rate-Based Monitoring statistics					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_DC {p. 5746}	LV_END_DIAG_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}
LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT] {p. 1061}
LV_ERR_CHG_LS_DOWN {p. 5388}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_ERR_CRK_PLAUS {p. 4446}
LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FUP {p. 4717}
LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}
LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}
LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}
LV_ERR_MAP_TPS_PLAUS {p. 1062}	LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}
LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}	LV_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_DIAG_PUE_ACT_LS_DOWN	O	0... 1H	0 ...1	1	-
Switch to set the PUE Diagnosis active or inactive					

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

Error treatment

Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
PUE_LS_DOWN[1]		0				LS

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Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
O2 sensor gradient monitoring, bank 1, sensor 1		1				
		2				
	O2 sensor dynamic malfunction, bank 1, sensor 1	3				

Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
PUE_LS_DOWN [2]		0				CC
O2 sensor gradient monitoring, bank 2, sensor 1		1				
		2				
	O2 sensor dynamic malfunction, bank 2, sensor 1	3				

General information

B.12.1 Inhibition of oxygen sensor downstream gradient monitoring

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then

i = 1, for exhaust cylinder bank 1

i = 2, for exhaust cylinder bank 2

otherwise (NC_CBK_EX_NR = 1)

i = 1, for single exhaust cylinder bank.

This function shall evaluate the application conditions applicable to the oxygen sensor gradient monitoring lean to rich and provide the result in a single boolean flag. This flag shall represent the interface to the main diagnosis function. Additionally the inhibition bit for Rate Based Monitoring is evaluated.

Description:
The oxygen sensor gradient monitoring lean to rich shall be ihibited if one of the following listed errors was recognized:

- LV_ERR_LS_DOWN (LV_ERR_SCG_LS_DOWN, LV_ERR_SCP_LS_DOWN, LV_ERR_OC_LS_DOWN, LV_ERR_CHK_LS_DOWN, LV_ERR_PUC_LS_DOWN, LV_ERR_LSH_DOWN , LV_ERR_OBD_LSH_DOWN, LV_ERR_CHG_LS_DOWN) is a system error flag and has influence on the oxygen sensor downstream readiness.
- LV_ERR_LS_UP is a system error flag of the oxygen sensor upstream. The upstream sensor produce the LAMB_LS_UP which shall be in the correct range to activate the gradient monitoring diagnosis.

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Application conditions:

Initialisation: The following variables shall be initialised at reset and at the ignition key transition on (i.e. LV_IGK = 0 → 1):
LV_INH_DIAG_PUE_LS_DOWN[i] = 0
LV_INH_DIAG_RBM_PUE_LS_DOWN[i] = 0

Activation: LV_IGK = 1

Deactivation: LV_IGK = 0

Recurrence: The function shall be carried out once every 10 ms

Function description:

Formula section:

```
If    LV_ERR_AMP = 1                                   or
      LV_ERR_AMP_PLAUS = 1                             or
      LV_ERR_CHG_LS_DOWN = 1                           or
      LV_ERR_CHG_LS_UP = 1                             or
      LV_ERR_CRK_PLAUS = 1                             or
      LV_ERR_CRK_SYN = 1                               or
      LV_ERR_CRK_TOOTH = 1                             or
      LV_ERR_CRK_TOOTH_PER = 1                         or
      LV_ERR_DIAGCPS = 1                               or
      LV_ERR_EL_CPS = 1                                or
      LV_ERR_FUP = 1                                   or
      LV_ERR_FUP_MFP_PLAUS = 1                         or
      LV_ERR_FUP_ORNG = 1                              or
      LV_ERR_FUP_ST = 1                                or
      LV_ERR_H_PRS_SYS = 1                             or
      LV_ERR_IVVT = 1                                  or
      LV_ERR_LOAD_TPS_PLAUS = 1                        or
      LV_ERR_MAF = 1                                   or
      LV_ERR_MAP_PLAUS = 1                             or
      LV_ERR_MAP_TPS_PLAUS = 1                         or
      LV_ERR_MTC_CTL_2 = 1                             or
      LV_ERR_MTC_CTL_3 = 1                             or
      LV_ERR_MTC_DR = 1                                or
      LV_ERR_TPS = 1                                   or
      LV_ERR_VCV = 1                                   or
      LV_ERR_AIR_LSL_UP [i] = 1                        or
      LV_ERR_CHK_LS_DOWN[i] = 1                        or
      LV_ERR_CTL_LSL_UP[i] = 1                         or
      LV_ERR_DELTA_I_LAM[i] = 1                        or
      LV_ERR_DYN_VLD_LS_UP[i] = 1                      or
      LV_ERR_EL_LSL_UP[i] = 1                          or
      LV_ERR_FSD[i] = 1                                or
      LV_ERR_FSD_LAM_LIM[i] = 1                        or
      LV_ERR_LSH_DOWN[i] = 1                           or
      LV_ERR_LSH_UP[i] = 1                             or
      LV_ERR_LSL_UP_IF[i] = 1                          or
      LV_ERR_OBD_LSH_DOWN[i] = 1                       or
      LV_ERR_OBD_VLD_LSH_UP[i] = 1                     or
      LV_ERR_OC_LS_DOWN[i] = 1                         or
      LV_ERR_OC_LSL_UP[i] = 1                          or
```

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```
    LV_ERR_OFS_LSL_UP[i] = 1                                          or
    LV_ERR_PUC_LS_DOWN[i] = 1                                         or
    LV_ERR_PUC_VLD_LS_UP[i] = 1                                       or
    LV_ERR_SCG_LS_DOWN[i] = 1                                         or
    LV_ERR_SCP_LS_DOWN[i] = 1                                         or
    LV_ERR_SHIFT_AFL_LSL_UP[i] = 1                                    or
    LV_ERR_SHIFT_AFR_LSL_UP[i] = 1                                    or
    LV_ERR_TTIP_MES_LSH_UP[i] = 1                                     or
    LV_ERR_VLS_DOWN_DIF[i] = 1                                        or
    (i = 1                                                            and
     [  LV_ERR_IV[0]                                                   or
       LV_ERR_IV[2]                                                   or
       LV_ERR_IV[4]                                                   or
       LV_ERR_MIS[0]                                                  or
       LV_ERR_MIS[2]                                                  or
       LV_ERR_MIS[4]])                                                or
    (i = 2                                                            and
     [  LV_ERR_IV[1]                                                   or
       LV_ERR_IV[3]                                                   or
       LV_ERR_IV[5]                                                   or
       LV_ERR_MIS[1]                                                  or
       LV_ERR_MIS[3]                                                  or
       LV_ERR_MIS[5]        ])                                        or
    LV_ERR_PER_CAM_EX[y] = 1          y = 1 for i= 1,2                or
    LV_ERR_PER_CAM_IN[y] = 1          y = 1 for i= 1,2                or
    LV_ERR_PLAUS_CAM_EX[y] = 1        y = 1 for i= 1,2                or
    LV_ERR_PLAUS_CAM_IN[y] = 1        y = 1 for i= 1,2                or
    LV_ERR_REF_CRK_CAM_EX[y] = 1      y = 1 for i= 1,2                or
    LV_ERR_REF_CRK_CAM_IN[y] = 1      y = 1 for i= 1,2                or
    LV_ERR_SYN_CAM_EX[y] = 1          y = 1 for i= 1,2                or
    LV_ERR_SYN_CAM_IN[y] = 1          y = 1 for i= 1,2                or
    LV_ERR_SYN_CRK_CAM_IN[y] = 1      y = 1 for i= 1,2                or
    LV_ERR_TOOTH_OFF_EX[y] = 1        y = 1 for i= 1,2                or
    LV_ERR_TOOTH_OFF_IN[y] = 1        y = 1 for i= 1,2

then     LV_INH_DIAG_RBM_PUE_LS_DOWN[i] = 1
else     LV_INH_DIAG_RBM_PUE_LS_DOWN[i] = 0
endif

If  LV_INH_DIAG_RBM_PUE_LS_DOWN [i] = 1  or
    LV_ST_END = 0    or
    LV_VB_CDN_OBD_2 = 0    or
    LV_LS_UP_OBD_2_MAN_DEAC[i] = 1
then
         LV_INH_DIAG_PUE_LS_DOWN [i] = 1
else
         LV_INH_DIAG_PUE_LS_DOWN [i] = 0
endif
```

B.12.2 Interface for Rate Based Monitoring

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General information:

With this module the interface between the PUE_LS_DOWN[i] monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_PUE_LS_DOWN[i] data.
Within STATE_RBM_PUE_LS_DOWN[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0) (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1) (depending on failure status: pending)
- Monitor individual RBM conditions encountered within this DC (bit 2)

Application conditions:

Initialisation:

```
at ECU reset :
        bit 0, bit 1 and bit 2 of STATE_RBM_PUE_LS_DOWN[i]
= 0
at LV_DC 0 → 1 transition :
        bit 0 and bit 1 of STATE_RBM_PUE_LS_DOWN[i] = 0
on failure memory reset :
        bit 1 of STATE_RBM_PUE_LS_DOWN[i]= 0
```

Activation: `LV_DC = 1`

Deactivation: -

Recurrence: `1 s`

Function description:

Formula section:

At LV_DC 0 →1 transition

`bit 2 of STATE_RBM_PUE_LS_DOWN[i] = 1`

The pending status of the following failures has to be checked only once:

Dependence	Error			
	LV_ERR_AMP	LV_ERR_AMP_PLAUS	LV_ERR_CHG_LS_DOWN	LV_ERR_CHG_LS_UP
	LV_ERR_CRK_PLAUS	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH	LV_ERR_CRK_TOOTH_ PER
	LV_ERR_DIAGCPS	LV_ERR_EL_CPS	LV_ERR_FUP	LV_ERR_FUP_MFP_ PLAUS
	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS	LV_ERR_LOAD_TPS_ PLAUS

Continued on next page

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	LV_ERR_MAF_FRQ_EL	LV_ERR_MAF_FRQ_GRD	LV_ERR_MAF_FRQ_RNG	LV_ERR_MAP_PLAUS
	LV_ERR_MAP_TPS_ PLAUS	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR
	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD	LV_ERR_TPS_AD_BOL
	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATIO	LV_ERR_TPS_ST_CHK_ 2
	LV_ERR_VCV			
NC_CBK_EX_NR	LV_ERR_AIR_LSL_UP [i]	LV_ERR_CHK_LS_DOWN [i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DELTA_I_LAM [i]
	LV_ERR_DYN_VLD_LS_ UP [i]	LV_ERR_EL_LSL_UP[i]	LV_ERR_FSD[i]	LV_ERR_FSD_LAM_ LIM[i]
	LV_ERR_LSH_DOWN [i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]	LV_ERR_OBD_LSH_ DOWN [i]
	LV_ERR_OBD_VLD_LSH_ UP [i]	LV_ERR_OC_LS_DOWN [i]	LV_ERR_OC_LSL_UP [i]	LV_ERR_OFS_LSL_UP [i]
	LV_ERR_PUC_LS_DOWN [i]	LV_ERR_PUC_VLD_LS_ UP [i]	LV_ERR_SCG_LS_DOWN [i]	LV_ERR_SCP_LS_ DOWN [i]
	LV_ERR_SHIFT_AFL_ LSL_UP [i]	LV_ERR_SHIFT_AFR_ LSL_UP [i]	LV_ERR_TTIP_MES_ LSH_UP [i]	LV_ERR_VLS_DOWN_ DIF [i]

for any i

NC_NR_CAM_ CBK	LV_ERR_PER_CAM_EX[1]	LV_ERR_PER_CAM_IN[1]	LV_ERR_PLAUS_CAM_ EX[1]	LV_ERR_PLAUS_CAM_ IN[1]
	LV_ERR_REF_CRK_ CAM_EX[1]	LV_ERR_REF_CRK_CAM_IN[1]	LV_ERR_SYN_CAM_EX[1]	LV_ERR_SYN_CAM_ IN[1]
	LV_ERR_SYN_CRK_ CAM_IN[1]	LV_ERR_TOOTH_OFF_IN[1]	LV_ERR_TOOTH_OFF_ EX[1]	

x = 1 to NC_NR_CBK_IVVT (= for any i // or)

NC_NR_CBK_ IVVT	LV_ERR_CAM_CST_ IVVT_EX[x]	LV_ERR_CAM_CST_ IVVT_IN[x]	LV_ERR_MEC_IVVT_ EX[x]	LV_ERR_MEC_IVVT_ IN[x]
	LV_ERR_SLV_IVVT_EX[x]	LV_ERR_SLV_IVVT_IN[x]		

For NC_CBK_EX_NR = i = 1

NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[4]	LV_ERR_MIS[4]		

For NC_CBK_EX_NR = i = 2

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NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

```
If(1)
        { CPU optimization at LV_DC 0 → 1 transition }
        CTR_ERR_DYN_NR <> 0
                          { the dynamic failure memory isn't empty }
Then(1)
      While    bit 1 of STATE_RBM_PUE_LS_DOWN[i] = 0 do
               with each XX failure of the above list :
               ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>,
               SYNCHRONIZATION<CALL>)
               If(2)       XX has a pending status
               Then(2)     bit 1 of STATE_RBM_PUE_LS_DOWN[i] = 1
               Endif(2)
      Endwhile
Else(1)
        { the dynamic failure memory is empty } No action
Endif(1)
```

Every 1 s :

```
If      bit 0 of STATE_RBM_PUE_LS_DOWN[i] = 0
Then
        If      LV_END_DIAG_PUE_LS_DOWN[i] = 1
        Then    bit 0 of STATE_RBM_PUE_LS_DOWN[i] = 1
        Endif
Endif

If      bit 1 of STATE_RBM_PUE_LS_DOWN[i] = 0
Then
        If      LV_INH_DIAG_RBM_PUE_LS_DOWN[i] = 1   OR
                LC_DIAG_PUE_ACT_LS_DOWN = 0
        Then
                bit 1 of STATE_RBM_PUE_LS_DOWN[i] = 1
        Endif
Endif
```

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B.13 O2 sensor (bin, down) heater diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CYCNR_R_IT_OBD_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Value of handshake counter for last valid resistance value used for diagnosis					
ERR_SYM_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Variable indicating status of each symptom, updated each recurrence & at diagnosis completion					
LV_CDN_DIAG_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that conditions for diagnosis met					
LV_END_DIAG_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that diagnosis has been completed					
LV_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that fault is present and has been debounced					
POW_INT_MIN_OBD_LSH_DOWN_TMP	-	0... FFFFH	0... 65535	1	J
Minimum required cooling energy required at downstream sensor prior to checking Ri threshold					
POW_INT_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	J
Integral indicates measure of cooling energy of exhaust gas at sensor location					
R_IT_H_MES_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	Ohm
Latest measured downstream oxygen sensor internal resistance value for error case, mode 6 information					
R_IT_H_REF_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	Ohm
Latest reference value for measured internal resistance downstream in error case, mode 6 information					
R_IT_L_MES_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	Ohm
Latest measured downstream oxygen sensor internal resistance value for no error case, mode 6 information					
R_IT_L_REF_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	Ohm
Latest reference value for measured internal resistance downstream in error case, mode 6 information					
R_IT_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 65535	1	Ohm
Most current downstream oxygen sensor internal resistance used for diagnosis cycle, Mode 6 information					
R_IT_THD_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 65535	1	Ohm
Threshold for most current downstream oxygen sensor internal resistance used for diagnosis cycle, Mode 6 information					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0H 1H 2H 3H 4H 5H 6H 7H 8H	DIAG_OFF DIAG_INIT LS_READY OBD1_DLY OBD1_CHK TEG_THD POW_INT DIAG_ACT DIAG_END	-	-
Indicates current phase of oxygen sensor heater OBDII diagnosis					
T_DLY_OBD_LSH_DOWN_TMP	-	0... FFH	0... 255	1	s
Minimum delay time prior to checking status of OBDI heater /signal faults					
TCC_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0... 3FFH	0... 1023	1	-
Number of faults detected during valid diagnosis cycles					
TCC_THD_ERR_OBD_LSH_DOWN_TMP	-	0... 3FFH	0... 1023	1	-
Fault detection threshold for determination of defective heater					
TCC_THD_OBD_LSH_DOWN_TMP	-	0... 3FFH	0... 1023	1	-
Number of valid downstream LSH OBDII diagnosis cycles after which statistic evaluation is carried out					
TCC_VLD_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0... 3FFH	0... 1023	1	-
Number of completed valid diagnosis cycles					
TEMP_DIF_OBD_LSH_DOWN [NC_CBK_EX_NR]	V	0... 7FFH	0... 2047	1	K
Indicates difference in temperature between set operating temperature & exhaust gas at sensor location					

Input data:

CTR_CYCNR_R_IT_LS_DOWN_VLD [NC_CBK_EX_NR] {p. 1364}	LSHPWM_DOWN [NC_CBK_EX_NR] {p. 2421}	LV_DIAG_EOL_END_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_DIAG_EOL_REQ_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5210}
LV_ERR_EL_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_IGK {p. 906}
LV_INH_DIAG_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5210}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_ST_END {p. 1720}	LV_VB_CDN_OBD_2 {p. 1046}
MAF_KGH {p. 1195}	NC_CBK_EX_NR {p. 1829}	NC_STATE_LSL_UP_IF {p. 651}	R_IT_LS_DOWN [NC_CBK_EX_NR] {p. 1364}
R_IT_MDL_LS_DOWN_NEW [NC_CBK_EX_NR] {p. 1364}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	TEG_DYN_LS_DOWN [NC_CBK_EX_NR] {p. 1007}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LSHPWM_MAX_LSH_DOWN	-	0... FFH	0... 99.60937	0.390625	%
Maximum permitted heater effective voltage PWM for downstream LSH OBDII diagnosis					
C_LSHPWM_MIN_LSH_DOWN	-	0... FFH	0... 99.60937	0.390625	%
Minimum permitted heater effective voltage PWM for downstream LSH OBDII diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_POW_INT_MIN_OBD_LSH_DOWN	-	0... FFFFH	0... 65535	1	J
Measure of minimum required cooling energy required at downstream sensor prior to checking Ri threshold					
C_POW_INT_MIN_OBD_LSH_DOWN_EOL	-	0... FFFFH	0... 65535	1	J
Measure of minimum required cooling energy required at downstream sensor prior to checking Ri threshold when EOL test required					
C_T_DLY_OBD_LSH_DOWN	-	0... FFH	0... 255	1	s
Minimum delay prior to checking status of OBDI heater /signal faults					
C_T_DLY_OBD_LSH_DOWN_EOL	-	0... FFH	0... 255	1	s
Minimum delay prior to checking status of OBDI heater /signal faults when EOL test required					
C_TCC_THD_ERR_OBD_LSH_DOWN	-	0... 3FFH	0... 1023	1	-
Fault detection threshold, when exceeded, heater is determined to be defective during driving cycle					
C_TCC_THD_ERR_OBD_LSH_DOWN_EOL	-	0... 3FFH	0... 1023	1	-
Fault detection threshold, when exceeded, heater is determined to be defective during driving cycle when EOL test required					
C_TCC_THD_OBD_LSH_DOWN	-	0... 3FFH	0... 1023	1	-
Number of valid downstream LSH OBDII diagnosis cycles over which statistic evaluation to be carried out					
C_TCC_THD_OBD_LSH_DOWN_EOL	-	0... 3FFH	0... 1023	1	-
Number of valid downstream LSH OBDII diagnosis cycles over which statistic evaluation to be carried out when EOL test required					
C_TEG_DYN_MAX_OBD_LSH_DOWN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Temperature threshold under which downstream LSH OBDII diagnosis activated					
C_TEMP_SP_OBD_LSH_DOWN	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Set temperature for downstream LSH operation used to generate power integral					
IP_FAC_MAF_OBD_LSH_DOWN	-	0... FFH	0... 15.9375	0.0625	J/K
LDPM_MAF_KGH_3_EGCP	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
Factor reflecting forced convection influence of cooling area, gas velocity and heat transfer coefficient					
IP_R_IT_THD_OBD_LSH_DOWN	-	0... FFFFH	0... 65535	1	Ohm
LDP_R_IT_LS_DOWN_NEW_LSH_DOWN	4	0... FFFFH	0... 65535	1	Ohm
Internal resistance threshold, when exceeded, heater is determined to be defective for current diagnosis cycle; including reference to modelled value for new sensor					
LC_DIAG_EOL_END_LSH_DOWN [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Locigal calibration data to enforce end of diagnosis when EOL test has passed					

Error treatment:

Diagnostic XX	Symptom description	Symptom	Filter type
OBD_LSH_DOWN[NC_CBK_EX_NR]	*Heater fault*	SYM_0	NO

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FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.

For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Signal flow diagram:

Activation conditions:

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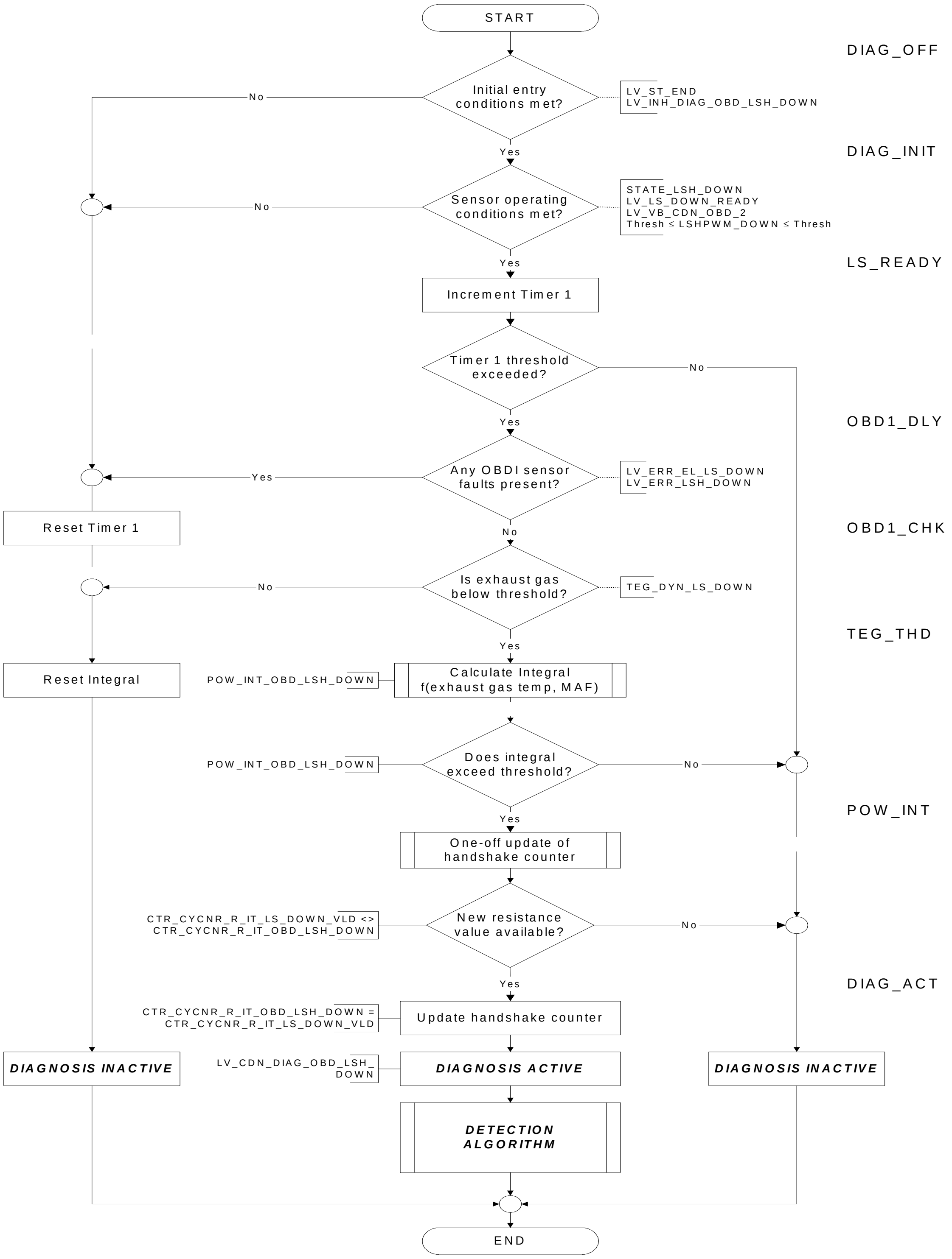

Detection Algorithm:

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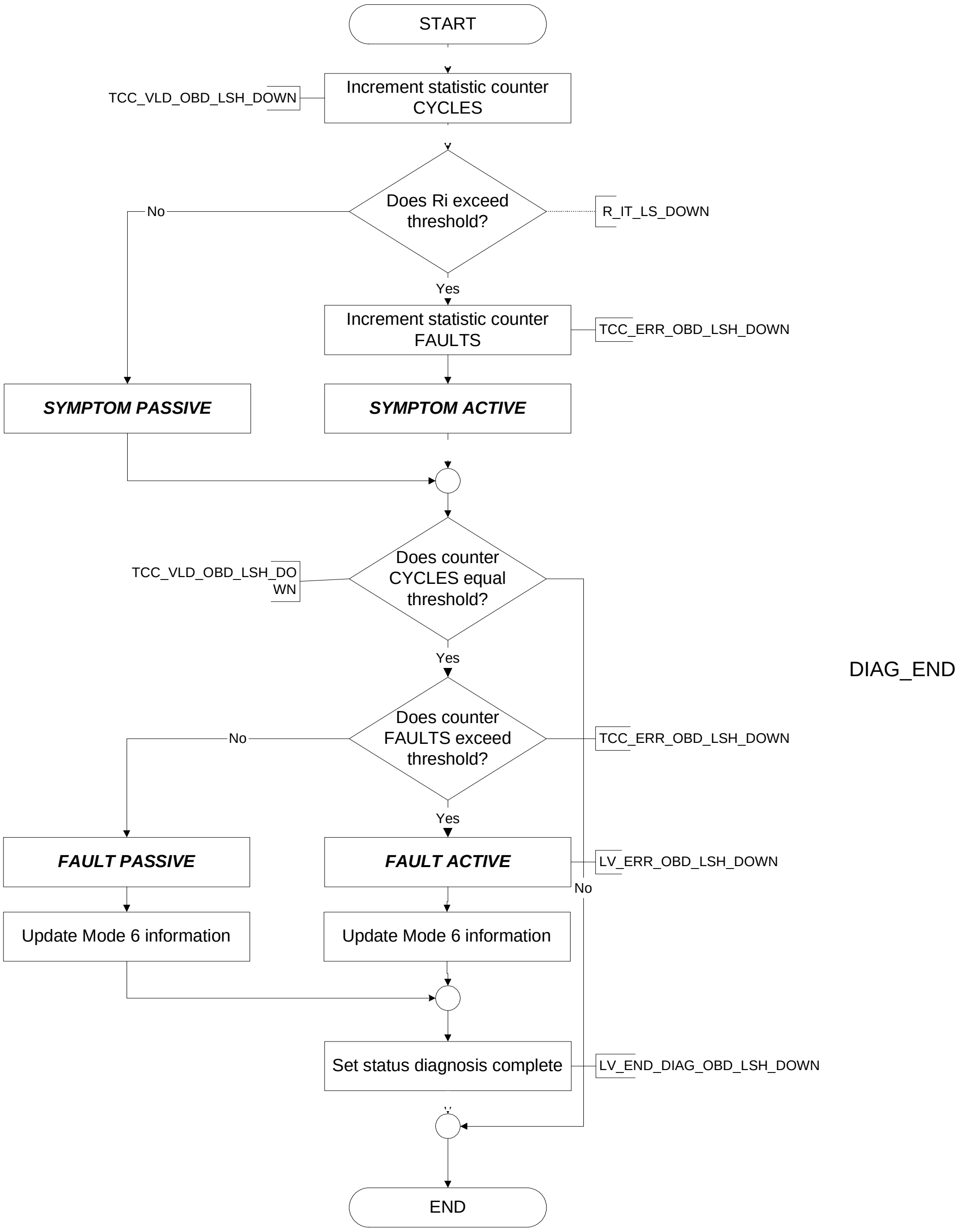

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Description:

The downstream oxygen sensor heater circuit shall detect any loss in heater power that would cause a drop in the sensor operating temperature, thereby possibly causing exhaust gas emissions to rise above the applicable standards or prevent the sensor signal from being used as a diagnostic system monitoring device.
Losses in heater power may occur due to, for example, ageing of the heater element, defective wiring, increased heater cct. connector contact resistance, defective heater driver etc.
The hereafter mentioned diagnosis strategy is based on the comparison of the oxygen sensor internal resistance to an absolute threshold during operating conditions where the exhaust gas temperature has been determined to be sufficiently low as to cause the sensor ceramic temperature to fall outside normal operating levels, in cases where a power is insufficient.

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The functionality of the diagnosis may be described in further detail below:
The initial diagnosis application condition; LV_ST_END shall ensure that the engine is running and has left the start phase but not yet entered the engine stop phase, LV_INH_DIAG_OBD_LSH_DOWN[i] shall ensure that the project specific application conditions (Application Incidences) have been met and LV_END_DIAG_OBD_LSH_DOWN[i] shall ensure that the diagnosis only be carried out once per driving cycle.
In order to ensure that the sensor has reached its normal operating temperature, the heater management state STATE_LSH_DOWN[i] shall be determined to be in the open loop control state LSH_POW_CTL, the sensor shall be determined to be in a state of operative readiness via LV_LS_DOWN_READY[i], the battery voltage VB shall be in a range determined to be fit for carrying out OBD2 diagnosis shown by LV_VB_CDN_OBD_2 and the heater duty-cycle LSHPWM_DOWN[i] shall be determined to be within calibrateable range C_LSHPWM_MIN_LSH_DOWN & C_LSHPWM_MAX_LSH_DOWN.
Should the above initial and operative conditions have been determined to be met, a timer, denoted herein as *TIMER_1*, shall be started. The timer shall run until the threshold T_DLY_OBD_LSH_DOWN_TMP is equalled or exceeded. Once this delay has passed, the status of the OBDI error bits LV_ERR_EL_LS_DOWN[i] & LV_ERR_LSH_DOWN[i] shall be read to ensure that no signal electrical or plausibility faults and no heater electrical faults are present in the sensor cct. under test. The delay shall ensure that sufficient time passes to permit completion of the OBDI monitoring prior to the start of OBDII monitoring.
Should no OBDI faults be present, the modelled exhaust gas temperature TEG_DYN_LS_DOWN[i] shall be compared to a calibrateable threshold C_TEG_DYN_MAX_OBD_LSH_DOWN. Due tolerances in the determination of the sensor internal resistance and in the case of a functional heater, the maximum resistance value may be given by a minimum tolerance sensor at a much lower temperature than for a maximum tolerance sensor at a higher temperature. Therefore, in the case of diagnosis based on an absolute internal resistance threshold, a certain temperature tolerance exists. The above mentioned temperature threshold shall lie below the minimum temperature determined from analysis of the internal resistance tolerances and be sufficient to cool the sensor ceramic element to below normal operating conditions, in the case of a heater fault.
Should the exhaust gas temperature be determined to equal or fall below the threshold, the monitoring strategy shall ensure that the sensor be cooled sufficiently long by the exhaust gas to enable differentiation between a functional and non-functional heater cct. (The time required is dependent on the thermal capacity of the system at the sensor location and the forced convection cooling of the sensor location). This shall be achieved by integrating the heat flux of the forced convection thermal transfer between sensor and exhaust gas, this being a measure for the cooling energy of the exhaust gas. The heat flux shall be calculated by determining the difference between the typical set sensor operating temperature C_TEMP_SP_OBD_LSH_DOWN and the modelled exhaust gas temperature TEG_DYN_LS_DOWN[i] and multiplying the result by the factor IP_FAC_MAF_OBD_LSH_DOWN representing the heat transfer coefficient and surface area concerned in the thermal transfer. As the heat transfer coefficient is a function of the velocity of the exhaust gas, the factor shall be mapped and dependent on the current mass airflow MAF_KGH.
The resultant integral POW_INT_OBD_LSH_DOWN[i] shall be compared to the threshold POW_INT_MIN_OBD_LSH_DOWN_TMP. Each time that the threshold be exceeded for the first time, e.g. first time after engine start or after the power integral has been reset, the CTR_CYCNR_R_IT_OBD_LS_DOWN[i] shall be updated once only with the value CTR_CYCNR_R_IT_LS_DOWN_VLD[i]. This shall ensure that only new internal resistance values be used for diagnosis purposes that have been determined since all the activation conditions have been met.
It shall be determined whether a new internal resistance has been determined by comparing the contents of counter CTR_CYCNR_R_IT_OBD_LS_DOWN[i] with that of CTR_CYCNR_R_IT_LS_DOWN_VLD[i]. Should the counters be unequal, then a new value is available and CTR_CYCNR_R_IT_OBD_LS_DOWN[i] shall be updated with CTR_CYCNR_R_IT_LS_DOWN_VLD[i]. If this conditions and all the above conditions be met, LV_CDN_DIAG_OBD_LSH_DOWN[i] shall be set and the diagnosis shall be considered to be active and the current monitoring cycle valid.
Once the current monitoring cycle has been determined to be valid, a counter TCC_VLD_OBD_LSH_DOWN[i] shall be incremented, denoting the number of valid monitoring cycles carried out to date. The internal resistance R_IT_LS_DOWN[i] shall be compared to a calibrateable threshold IP_R_IT_THD_OBD_LSH_DOWN according to modelled tip temperature of a new sensor (including safety margin).

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Should the resistance equal or exceed the threshold, a heater fault shall be determined to be present in the current cycle and a counter TCC_ERR_OBD_LSH_DOWN[i] shall be incremented, denoting the number of heater faults within the valid monitoring cycles carried out to date.

In order to comply with OBDII requirements, the current R_IT_LS_DOWN[i] value used shall be made available to an external tester. This information is Mode 6 information. Hence once the comparison to the threshold has been carried out, the latest measured internal resistance and threshold values (R_IT_L_MES_OBD_LSH_DOWN[i] and R_IT_L_REF_OBD_LSH_DOWN[i]) shall be copied to the respective Mode 6 interface variables R_IT_OBD_LS_DOWN[i] and R_IT_THD_OBD_LSH_DOWN[i] for the no error case. In the error case the variables R_IT_H_MES_OBD_LSH_DOWN[i] and R_IT_H_REF_OBD_LSH_DOWN[i] shall be handed out.

Once the number of valid monitoring cycles TCC_THD_OBD_LSH_DOWN_TMP has been determined to have been carried out, the diagnosis shall carry out a n-out-of-m statistical evaluation of the results. Should the number of determined heater faults exceed the threshold TCC_THD_ERR_OBD_LSH_DOWN_TMP, the oxygen sensor heater under test shall be considered to be faulty for the current driving cycle and flag LV_ERR_OBD_LSH_DOWN[i] shall be set.

If the number of faults does not exceed the threshold, LV_ERR_OBD_LSH_DOWN[i] shall be reset.

Once the statistical evaluation has been carried out, no further monitoring cycles shall be executed in the remaining driving cycle. This is achieved by setting LV_END_DIAG_OBD_LSH_DOWN[i].

Should, according to project philosophy, the diagnosis be activated for an end of line (EOL) test, specific threshold conditions for the diagnosis delay timer, the power integral, the required number of test and error indicating cycles may be chosen to shorten the time until recognition of diagnosis end.

NOTES:

1. The integral POW_INT_OBD_LSH_DOWN[i] shall be reset to 0 should the exhaust gas temperature exceed the applicable threshold. This would cause the sensor to be re-heated from the exhaust gas once again and a certain delay would be required prior to the sensor being cooled long enough to permit valid diagnosis to occur.
2. The timer *TIMER_1* and integral POW_INT_OBD_LSH_DOWN[i] shall be reset should any of the initial entry or operative readiness conditions no longer be met or an OBDI fault be detected in the sensor under test. This may cause the sensor to leave its normal operating conditions and the OBDII diagnosis shall be required to start from the beginning as the sensor operating conditions would require time to stabilise should the conditions be met again.
3. The statistic counters TCC_VLD_OBD_LSH_DOWN[i] and TCC_ERR_OBD_LSH_DOWN[i] shall not be reset by changing conditions and therefore shall only increment or remain frozen during any given monitoring cycle. The counters shall only be reset at the beginning of a new driving cycle.
4. Projects that provide for an internal statistical error management shall use their internal error management and apply this wherever reference to TCC_VLD_OBD_LSH_DOWN[i], TCC_ERR_OBD_LSH_DOWN[i], TCC_THD_OBD_LSH_DOWN_TMP & TCC_THD_ERR_OBD_LSH_DOWN_TMP is made.
5. The variable STATE_OBD_LSH_DOWN[i] shall indicate, at the end of the each monitoring cycle, the status of the diagnosis within that cycle. The following correlation of variable content to description shall apply:

0:	DIAG_OFF	Initialisation state; no conditions met
1:	DIAG_INIT	Initial conditions & application incidences met only
2:	LS_READY	Sensor operatively ready conditions met + 1,
3:	OBD1_DLY	OBDI monitoring completion delay exceeded + 1 & 2
4:	OBD1_CHK	No OBDI faults present +1, 2 & 3
5:	TEG_THD	Exhaust gas below threshold + 1, 2, 3 & 4
6:	POW_INT	Power integral exceeded + 1,2,3,4 & 5
7:	DIAG_ACT	***Diagnosis detection active***
8:	DIAG_END	***Diagnosis detection complete***

Application conditions

Initialisation:

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The following variables shall be initialised at reset, at the transition ignition key on (i.e. LV_IGK = 0 -> 1) and at clearing the error memory:

LV_CDN_DIAG_OBD_LSH_DOWN[i] = 0
ERR_SYM_OBD_LSH_DOWN[i] = 0
LV_ERR_OBD_LSH_DOWN[i] = 0
LV_END_DIAG_OBD_LSH_DOWN[i] = 0
STATE_OBD_LSH_DOWN[i] = 0
TEMP_DIF_OBD_LSH_DOWN[i] = 0
POW_INT_OBD_LSH_DOWN[i] = 0
TCC_VLD_OBD_LSH_DOWN[i] = 0
TCC_ERR_OBD_LSH_DOWN[i] = 0
CTR_CYCNR_R_IT_OBD_LS_DOWN[i] = 0
R_IT_L_MES_OBD_LSH_DOWN[i] = 0
R_IT_L_REF_OBD_LSH_DOWN[i] = 0
R_IT_H_MES_OBD_LSH_DOWN[i] = 0
R_IT_H_REF_OBD_LSH_DOWN[i] = 0

Reset *TIMER_1*

R_IT_OBD_LSH_DOWN[i] and R_IT_THD_OBD_LSH_DOWN[i] shall be initialised with the last value from the previous driving cycle stored in non-volatile memory after RESET.

NOTE: TIMER_1 refers to a program specific timer and is not intended to represent a variable name!

Recurrence:

The OBDII oxygen sensor heater diagnosis shall be carried out once per driving cycle. The diagnosis shall require a number of monitoring cycles to be carried out to permit statistical evaluation of the results. These monitoring cycles shall occur every 1 s, until a calibrateable number of valid diagnosis cycles has been exceeded.

Once this threshold has been completed, the OBDII oxygen sensor heater diagnosis shall no longer be carried out until a new driving cycle is initiated.

Should an OBDII heater fault be detected, the application assistances (Functions that are defined to be affected by the state of the oxygen sensor signal) shall remain active for the remainder of the driving cycle. The restarting of the affected functions during the next driving cycle shall be carried out according to the project philosophy.

Activation:

```
If      (LV_ST_END = 1) &
        (LV_INH_DIAG_OBD_LSH_DOWN[i] = 0)
then    If          LV_DIAG_EOL_REQ_OBD_LSH_DOWN[i] = 0
        then T_DLY_OBD_LSH_DOWN_TMP = C_T_DLY_OBD_LSH_DOWN
             POW_INT_MIN_OBD_LSH_DOWN_TMP =
                                   C_POW_INT_MIN_OBD_LSH_DOWN
             TCC_THD_OBD_LSH_DOWN_TMP = C_TCC_THD_OBD_LSH_DOWN
             TCC_THD_ERR_OBD_LSH_DOWN_TMP =
                                   C_TCC_THD_ERR_OBD_LSH_DOWN
        else   T_DLY_OBD_LSH_DOWN_TMP = C_T_DLY_OBD_LSH_DOWN_EOL
             POW_INT_MIN_OBD_LSH_DOWN_TMP =
                                   C_POW_INT_MIN_OBD_LSH_DOWN_EOL
             TCC_THD_OBD_LSH_DOWN_TMP = C_TCC_THD_OBD_LSH_DOWN_EOL
             TCC_THD_ERR_OBD_LSH_DOWN_TMP =
                                   C_TCC_THD_ERR_OBD_LSH_DOWN_EOL
        endif
        If          (LV_LS_DOWN_READY[i] = 1) &
             (STATE_LSH_DOWN[i] = LSH_POW_CTL) &
             (LV_VB_CDN_OBD_2 = 1) &
```

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```
                (C_LSHPWM_MIN_LSH_DOWN   LSHPWM_DOWN[i]) &
                (LSHPWM_DOWN[i]   C_LSHPWM_MAX_LSH_DOWN)
        then    Increment TIMER_1
                If     (TIMER_1   T_DLY_OBD_LSH_DOWN_TMP)
                then   If     (LV_ERR_EL_LS_DOWN[i] = 0) &
                              (LV_ERR_LSH_DOWN[i] = 0)
                       then   If     (TEG_DYN_LS_DOWN[i]
                                     C_TEG_DYN_MAX_OBD_LSH_DOWN)
                              then   Calculate POW_INT_OBD_LSH_DOWN[i]
                                     If (POW_INT_OBD_LSH_DOWN[i]
                                        POW_INT_MIN_OBD_LSH_DOWN_TMP)
                                     then   One-off update CTR_CYCNR_R_IT_OBD_LS_DOWN[i]
                                            % see note below
                                            If     (CTR_CYCNR_R_IT_LS_DOWN_VLD[i] <>
                                                   CTR_CYCNR_R_IT_OBD_LS_DOWN[i])
                                            then   LV_CDN_DIAG_OBD_LSH_DOWN[i] = 1
                                                   CTR_CYCNR_R_IT_OBD_LS_DOWN[i] =
                                                   CTR_CYCNR_R_IT_LS_DOWN_VLD[i]
                                                   Diagnosis detection active
                                            else   STATE_OBD_LSH_DOWN[i] = POW_INT
                                                   LV_CDN_DIAG_OBD_LSH_DOWN[i] = 0
                                            endif
                                     else   STATE_OBD_LSH_DOWN[i] = TEG_THD
                                            LV_CDN_DIAG_OBD_LSH_DOWN[i] = 0
                                     endif
                              else   STATE_OBD_LSH_DOWN[i] = OBD1_CHK
                                     Reset POW_INT_OBD_LSH_DOWN[i]
                                     LV_CDN_DIAG_OBD_LSH_DOWN[i] = 0
                              endif
                       else   STATE_OBD_LSH_DOWN[i] = OBD1_DLY
                              Reset TIMER_1
                              Reset POW_INT_OBD_LSH_DOWN[i]
                              LV_CDN_DIAG_OBD_LSH_DOWN[i] = 0
                       endif
                else   STATE_OBD_LSH_DOWN[i] = LS_READY
                       LV_CDN_DIAG_OBD_LSH_DOWN[i] = 0
                endif
        else    STATE_OBD_LSH_DOWN[i] = DIAG_INIT
                Reset TIMER_1
                Reset POW_INT_OBD_LSH_DOWN[i]
                LV_CDN_DIAG_OBD_LSH_DOWN[i] = 0
        endif
else    STATE_OBD_LSH_DOWN[i] = DIAG_OFF
        Reset TIMER_1
        Reset POW_INT_OBD_LSH_DOWN[i]
        LV_CDN_DIAG_OBD_LSH_DOWN[i] = 0
endif.
```

Deactivation:

```
If      (LV_END_DIAG_OBD_LSH_DOWN[i] = 1)
then    Diagnosis detection complete
endif.
```

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NOTES: The state variable STATE_OBD_LSH_DOWN[i] *shall only be validated at the completion of the current monitoring cycle, i.e. the state should not vary within the current 1 s monitoring cycle, but indicate at the end of the current cycle , the last state reached, dependant upon the branches.*
The variable CTR_CYCNR_R_IT_OBD_LS_DOWN[i] shall be updated with the current value of the input variable CTR_CYCNR_R_IT_LS_DOWN_VLD[i] on each occasion that the integral POW_INT_OBD_LSH_DOWN[i] exceeds the threshold for the first time. For further function calls where the integral condition is met, the one-off update shall not be carried out. This shall continue until the integral condition is no longer met.

Formula section:

Calculation of cooling energy integral:
Determine difference between typical sensor operating temperature and exhaust gas temperature:

TEMP_DIF_OBD_LSH_DOWN[i] = (C_TEMP_SP_OBD_LSH_DOWN - TEG_DYN_LS_DOWN[i])
(NOTE: Resolution of temperature difference is reduced from 0.0625 °C, resolution of the individual temperature variables, to 1 °C; The difference shall be limited to provide only positive values, i.e.   0)

The integral of heat flux (in Watts) provides a measure for the total cooling energy of the exhaust gas (in Joules):

POW_INT_OBD_LSH_DOWN[i]$_{(n)}$ = (POW_INT_OBD_LSH_DOWN[i]$_{(n-1)}$ + TEMP_DIF_OBD_LSH_DOWN[i] * IP_FAC_MAF_OBD_LSH_DOWN)
(NOTE: Integral shall be limited to its maximum hex limit, i.e. FFFFH or 65535 digits, to prevent overflow.)

Detection: (Assumes   Diagnosis detection active)
also NOTE D above!
Increment TCC_VLD_OBD_LSH_DOWN[i]
If (R_IT_LS_DOWN[i]   IP_R_IT_THD_OBD_LSH_DOWN)
then **Symptom   Oxygen sensor heater fault, bank i   active**
ERR_SYM_OBD_LSH_DOWN[i] = "SYM_0"
R_IT_H_MES_OBD_LSH_DOWN[i] = R_IT_LS_DOWN[i]
R_IT_H_REF_OBD_LSH_DOWN[i] = IP_R_IT_THD_OBD_LSH_DOWN
Increment TCC_ERR_OBD_LSH_DOWN[i]
else **Symptom   Oxygen sensor heater fault, bank i   passive**
ERR_SYM_OBD_LSH_DOWN[i] = "NO_SYM"
R_IT_L_MES_OBD_LSH_DOWN[i] = R_IT_LS_DOWN[i]
R_IT_L_REF_OBD_LSH_DOWN[i] = IP_R_IT_THD_OBD_LSH_DOWN
endif.
If (TCC_VLD_OBD_LSH_DOWN[i]   TCC_THD_OBD_LSH_DOWN_TMP)
then STATE_OBD_LSH_DOWN[i] = DIAG_END
If (TCC_ERR_OBD_LSH_DOWN[i]   TCC_THD_ERR_OBD_LSH_DOWN_TMP)
then **Symptom   Oxygen sensor heater fault, bank i   active**
LV_ERR_OBD_LSH_DOWN[i] = 1
ERR_SYM_OBD_LSH_DOWN[i] = " SYM_0"
R_IT_OBD_LSH_DOWN[i] = R_IT_H_MES_OBD_LSH_DOWN[i]
R_IT_THD_OBD_LSH_DOWN[i] = R_IT_H_REF_OBD_LSH_DOWN[i]
else **Symptom   Oxygen sensor heater fault, bank i   passive**
LV_ERR_OBD_LSH_DOWN[i] = 0
ERR_SYM_OBD_LSH_DOWN[i] = "NO_SYM"
R_IT_OBD_LSH_DOWN[i] = R_IT_L_MES_OBD_LSH_DOWN[i]

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R_IT_THD_OBD_LSH_DOWN[i] = R_IT_L_REF_OBD_LSH_DOWN[i]
endif
else STATE_OBD_LSH_DOWN[i] = DIAG_ACT
endif.

The diagnosis end bit shall be calculated each recurrence independently on STATE_OBD_LSH_DOWN[i] until diagnosis deactivation:

If STATE_OBD_LSH_DOWN[i] = DIAG_END
or ... **#If** NC_STATE_LSL_UP_IF > 0
#then **...** (LV_DIAG_EOL_END_LS_UP_DOWN[i] = 1
and LC_DIAG_EOL_END_LSH_DOWN[i] = 1
and LV_ERR_LS_DOWN[i] = 0)
#endif
then LV_END_DIAG_OBD_LSH_DOWN[i] = 1
endif

See also NOTE D above!

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B.14 O2 sensor (bin, down) heater diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_EOL_REQ_OBD_LSH_DOWN [NC_CBK_EX_NR]	O	0... 1H	0 ...1	1	-
Logical variable indicating requested EOL test for downstream heater diagnosis					
LV_INH_DIAG_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean inhibit flag for O2 sensor heater OBDII monitoring					
LV_INH_DIAG_RBM_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to inhibit rate based monitoring for oxygen sensor heater OBDII diagnosis					
STATE_RBM_OBD_LSH_DOWN [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of OBD_LSH_DOWN monitor with the Rate-Based Monitoring statistics					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CDN_VB_OBD2 {p. 1185}	LV_DC {p. 5746}	LV_END_DIAG_OBD_ LSH_DOWN [NC_CBK_EX_NR] {p. 5198}
LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}
LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_IGK {p. 906}	LV_ST_END {p. 1720}	LV_VAR_LSH_DOWN {p. 656}
NC_CBK_EX_NR {p. 1829}	TCO {p. 1100}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_MIN_OBD2_LSH_DOWN	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold for OBD2 heater diagnosis downstream					

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

B.14.1 1.1. Inhibition of diagnosis

FUNCTION DESCRIPTION:

General information:

LV_INH_DIAG_OBD_LSH_DOWN[NC_CBK_EX_NR] represents the influence by errors/conditions de-activating the O2 heater diagnosis. Additionally the interfaces for Rate Based Monitoring RBM are provided.

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The calculation shall be done for all exhaust cylinder banks. For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then

i = 1 for exhaust cylinder bank 1
i = 2 for exhaust cylinder bank 2

otherwise (NC_CBK_EX_NR = 1)

i = 1 for single exhaust cylinder bank.

Application conditions

Initialisation: *0 at LV_IGK = 0→1 or at reset*

Recurrence: *1 s*

Activation: *LV_ST_END = 1*

Deactivation: *LV_ST_END = 0*

Formula section:

If LV_ERR_LSH_DOWN[i] = 1
or LV_ERR_SCP_LS_DOWN[i] = 1
or LV_ERR_SCG_LS_DOWN[i] = 1
or LV_ERR_OC_LS_DOWN[i] = 1
or LV_ERR_CHK_LS_DOWN[i] = 1

then LV_INH_DIAG_RBM_OBD_LSH_DOWN[i] = 1
else LV_INH_DIAG_RBM_OBD_LSH_DOWN[i] = 0
endif

If LV_VAR_LSH_DOWN = 0
or LV_CDN_VB_OBD2 = 0
or TCO < C_TCO_MIN_OBD2_LSH_DOWN
or LV_INH_DIAG_RBM_OBD_LSH_DOWN[i] = 1
or LV_LS_DOWN_OBD_2_MAN_DEAC[i] = 1
then LV_INH_DIAG_OBD_LSH_DOWN[i] = 1
else LV_INH_DIAG_OBD_LSH_DOWN[i] = 0
endif

LV_DIAG_EOL_REQ_OBD_LSH_DOWN[i] = 0

B.14.2 1.2. Interface for Rate Based Monitoring

FUNCTION DESCRIPTION:

General information:

With this module the interface between the OBD_LSH_DOWN[i] monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_OBD_LSH_DOWN[i] data.
Within STATE_RBM_OBD_LSH_DOWN[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0) (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1) (depending on failure status: pending)

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- Monitor individual RBM conditions encountered within this DC (bit 2)

Application conditions:

Initialisation :
at ECU reset : bit 0, bit 1 and bit 2 of STATE_RBM_OBD_LSH_DOWN[i] = 0
at LV_DC 0 → 1 transition : bit 0 and bit 1 of STATE_RBM_OBD_LSH_DOWN[i] = 0
on failure memory reset : bit 1 of STATE_RBM_OBD_LSH_DOWN[i] = 0

Recurrence: 1 s
Activation: LV_DC = 1

Formula section:

At LV_DC 0 → 1 transition

bit 2 of STATE_RBM_OBD_LSH_DOWN[i] = 1

The pending status of the following failures has to be checked only once:

LV_ERR_LSH_DOWN[NC_CBK_EX_NR]
LV_ERR_SCP_LS_DOWN[NC_CBK_EX_NR]
LV_ERR_SCG_LS_DOWN[NC_CBK_EX_NR]
LV_ERR_OC_LS_DOWN[NC_CBK_EX_NR]
LV_ERR_CHK_LS_DOWN[NC_CBK_EX_NR]

If(1) { CPU optimization at LV_DC 0 → 1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn't empty }
Then(1)
While bit 1 of STATE_RBM_OBD_LSH_DOWN[i] = 0 **do**
with all XX failures of the above list

ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2)
bit 1 of STATE_RBM_OBD_LSH_DOWN[i] = 1
Endif(2)
Endwhile
Else(1)
{ the dynamic failure memory is empty }
No action
Endif(1)

Every 1 s :
If (bit 0 of STATE_RBM_OBD_LSH_DOWN[i] = 0 **and**
LV_END_DIAG_OBD_LSH_DOWN[i] = 1)
Then bit 0 of STATE_RBM_OBD_LSH_DOWN[i] = 1
Endif

If (bit 1 of STATE_RBM_OBD_LSH_DOWN[i] = 0 **and**
LV_INH_DIAG_RBM_OBD_LSH_DOWN[i] = 1)

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Then bit 1 of STATE_RBM_OBD_LSH_DOWN[i] = 1
Endif

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B.15 O2 sensor (bin, down) oscillation diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_OSC_CHK [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
lambda setpoint requested by oscillation check for downstream lambda sensor					
LV_END_DIAG_OSC_CHK [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of oscillation diagnosis for downstream sensor					
LV_ERR_OSC_CHK [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced failure of oscillation diagnosis for downstream sensor					

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Description:

This is a stub module to provide signals consumed in other EGCP modules.

Application conditions

Initialisation: *The output shall be set to the following values, which are never changed:*
LV_ERR_OSC_CHK[i] = 0
LV_END_DIAG_OSC_CHK[i] = 1
LAMB_SP_OSC_CHK[i] = 0

Recurrence: *not applicable*

Activation: not applicable

Formula section:

- This function does not execute any actions or calculations. -

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B.16 O2 sensor fuel trim diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_DELTA_I_LAM [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom of trim controller limit error					
ERR_SYM_LAM_ADJ [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptoms of the lambda trim control errors					
ERR_SYM_VLS_DOWN_DIF [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom of trim controller deviation error					
LAM_MMV_VLS_DIF_DLY_LDC [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
floating mean value for limited lambda deviation					
LAMB_DELTA_I_SAVE_DIAG [NC_CBK_EX_NR]	O/V/S	F800... 800H	-0.125 ...0.125	61e-6	-
I-share from trim controller - to be transmitted to the Scan Tool mode06					
LV_CDN_DIAG_DELTA_I_LAM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean Flag to indicate the activation of trim controller limit diagnosis					
LV_CDN_DIAG_VLS_DOWN_DIF [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean Flag to indicate the activation of trim controller deviation diagnosis					
LV_DET_SYM_EVE_DELTA_I_LAM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Bit for second time counter DELTA_I_LAM (T_SUM_END_READY_DELTA_I_LAM[i])					
LV_END_DIAG_DELTA_I_LAM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
First cycle of trim controller limit diagnosis finished					
LV_END_DIAG_LAM_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Diagnostic cycle for lambda trim control complete					
LV_END_DIAG_VLS_DOWN_DIF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Trim controller deviation diagnosis available					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_WIN_DELTA_I_LAM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of diagnosis cycle for similar conditions window					
LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Trim controller limit error					
LV_ERR_LAM_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status diagnostic result of lambda trim control					
LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Trim controller deviation error					
LV_VLS_DIF_DLY_LDC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status limited dynamic for the function "Monitoring Trim Controller Deviation"					
LV_VLS_DIF_DLY_LDC_LAM_MV [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status limited dynamic FAC_LAM_MV					
LV_VLS_DIF_DLY_LDC_MAF	V	0... 1H	0 ...1	1	-
Status limited dynamic MAF					
LV_VLS_DIF_DLY_LDC_N	V	0... 1H	0 ...1	1	-
Status limited dynamic N					
MAF_INT_OPM_STAT	V	0... FFFFH	0... 1820.41666	0.0277778	g
Integral to start trim controller deviation diagnosis after changing in homogeneous combustion mode					
MAF_INT_RST_VLS_DOWN_DIF_DIAG [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666	0.0277778	g
Integral to start a new diagnostic cycle and to set the end flag					
MAF_INT_VLS_DIF_DLY_LDC [NC_CBK_EX_NR]	V	0... FFFFH	0... 1389	0.0211948	g
integral of mass air flow since limited dynamic conditions fulfilled					
MAF_INT_VLS_DIF_DLY_MAX [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral for upper VLS_DIF_DLY deviation					
MAF_INT_VLS_DIF_DLY_MIN [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral for lower VLS_DIF_DLY deviation					
MAF_MMV_VLS_DIF_DLY_LDC	V	0... FFFFH	0... 1389	0.0211948	mg/stk
floating mean value for limited MAF					
N_MMV_VLS_DIF_DLY_LDC	V	0... 1FE0H	0... 8160	1	rpm
floating mean value for limited engine speed					
T_SUM_END_DIAG_WIN_DELTA_I_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time counter to set LV_END_DIAG_WIN_DELTA_I_LAM[i] for similar conditions window					
T_SUM_END_READY_DELTA_I_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Second time counter to set LV_END_DIAG_DELTA_I_LAM[i]					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_SUM_MAX_DELTA_I_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Total duration over C_LAMB_DELTA_I_MAX_DIAG					
T_SUM_MIN_DELTA_I_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Total duration over C_LAMB_DELTA_I_MIN_DIAG					
T_SUM_RST_DELTA_I_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Time counter to reset T_SUM_MAX_DELTA_I_LAM[i] and T_SUM_MIN_DELTA_I_LAM[i].					

Input data:

EFF_CAT_DIAG [NC_CBK_EX_NR] {p. 5535}	FAC_LAM_MV {p. 1014}	LAMB_DELTA_AD_LAM_ADJ [NC_CBK_EX_NR] {p. 2622}	LAMB_DELTA_I_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}
LV_CP_RAMP_OPEN_ACT {p. 3636}	LV_DIAG_EOL_END_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_ES {p. 1720}	LV_IGK {p. 906}
LV_INH_DIAG_DLY_LAM [NC_CBK_EX_NR] {p. 5229}	LV_LAM_ADJ_I_ACT [NC_CBK_EX_NR] {p. 2589}	LV_LAM_ADJ_P_ACT [NC_CBK_EX_NR] {p. 2589}	LV_ST_END {p. 1720}
MAF {p. 8277}	MAF_CYL {p. 8277}	MAF_KGH {p. 1195}	N {p. 1525}
NC_CBK_EX_NR {p. 1829}	OPM_AV {p. 8137}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CAT_DIAG_MAX_DELTA_I_LAM [NC_CBK_EX_NR]	-	0... FFH	0... 1.99218	0.0078125	-
Maximum threshold for catalyst diagnosis result to perform the diagnosis					
C_DEAC_DIAG_LAM_ADJ	-	0... FFH	0... 255	1	-
Bit vector for override of individual end flags in summary end flag LV_END_DIAG_LAM_ADJ					
C_LAM_MV_CRLC_LDC_VLS_DIF_DLY	-	0... FFFFH	0... 0.99998	15.3e-6	-
correlation constant floating mean value calculation lambda					
C_LAM_MV_LDC_VLS_DIF_DLY	-	0... FFFFH	0... 99.99847	1.5259e-3	%
threshold limited dynamic lambda					
C_LAMB_DELTA_I_MAX_DIAG	-	F800... 800H	-0.125 ...0.125	61e-6	-
Maximum limit of LAMB_DELTA_I_LAM_ADJ[i] + LAMB_DELTA_AD_LAM_ADJ[i]					
C_LAMB_DELTA_I_MIN_DIAG	-	F800... 800H	-0.125 ...0.125	61e-6	-
Minimum limit of LAMB_DELTA_I_LAM_ADJ[i] + LAMB_DELTA_AD_LAM_ADJ[i]					
C_MAF_CRLC_LDC_VLS_DIF_DLY	-	0... FFFFH	0... 0.99998	15.3e-6	-
correlation constant floating mean value calculation MAF					
C_MAF_INT_MIN_VLS_DIF_DLY_LDC [NC_CBK_EX_NR]	-	0... FFFFH	0... 1389	0.0211948	g
Maximum value of the mass air flow integral after limited dynamic conditions were fulfilled					
C_MAF_INT_OPM_STAT	-	0... FFFFH	0... 1820.41666	0.0277778	g
Minimum value of mass air flow after changing in homogeneous combustion mode to allow diagnosis (VLS_DOWN_DIF)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_INT_RST_VLS_DOWN_DIF_DIAG [NC_CBK_EX_NR]	-	0... FFFFH	0... 1820.41666	0.0277778	g
Threshold for integral to start a new diagnostic cycle and to set the end flag					
C_MAF_INT_VLS_DIF_DLY_MAX [NC_CBK_EX_NR]	-	0... FFFFH	0... 1820.41666	0.0277778	g
Maximum MAF integral of VLS_DIF_DLY deviation (lean side)					
C_MAF_INT_VLS_DIF_DLY_MIN [NC_CBK_EX_NR]	-	0... FFFFH	0... 1820.41666	0.0277778	g
Maximum MAF integral of VLS_DIF_DLY deviation (rich side)					
C_MAF_LDC_VLS_DIF_DLY	-	0... FFFFH	0... 1389	0.0211948	mg/stk
threshold limited dynamic engine MAF					
C_N_CRLC_LDC_VLS_DIF_DLY	-	0... FFFFH	0... 0.99998	15.3e-6	-
correlation constant floating mean value calculation engine speed					
C_N_LDC_VLS_DIF_DLY	-	0... 1FE0H	0... 8160	1	rpm
threshold limited dynamic engine speed					
C_T_SUM_MAX_ERR_DELTA_I_LAM [NC_CBK_EX_NR]	-	0... FFFFH	0... 6553.5	0.1	s
Time counter for maximum time of trim control over limit to set LV_END_DIAG_DELTA_I_LAM[i]					
C_T_SUM_MAX_MAX_DELTA_I_LAM [NC_CBK_EX_NR]	-	0... FFFFH	0... 6553.5	0.1	s
Duration of T_SUM_MAX_DELTA_I_LAM[i] to detect an error					
C_T_SUM_MIN_MAX_DELTA_I_LAM [NC_CBK_EX_NR]	-	0... FFFFH	0... 6553.5	0.1	s
Duration of T_SUM_MIN_DELTA_I_LAM[i] to detect an error					
C_T_SUM_READY_DELTA_I_LAM [NC_CBK_EX_NR]	-	0... FFFFH	0... 6553.5	0.1	s
Time counter for end of diagnosis					
C_T_SUM_RST_MAX_DELTA_I_LAM [NC_CBK_EX_NR]	-	0... FFFFH	0... 6553.5	0.1	s
Time counter to reset T_SUM_MIN/MAX_DELTA_I_LAM[i]					
C_VLS_DOWN_MAX_DIAG_LAM_ADJ [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Rich limit for VLS_DOWN for trim control diagnosis					
C_VLS_DOWN_MIN_DIAG_LAM_ADJ [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lean limit for VLS_DOWN for trim control diagnosis					

Import actions:

ACTION_ERRM_NoFilterReset (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_NoFilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_LV_ERR_SET>,**IN**<PRM_LV_ERR_RST>,**IN**<PRM_LV_END_DIAG>,**OUT**<PRM_LV_ERR>)

Error treatment:

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Diagnosis	Symptom	Nr	ABC type
Dynamic fuel trim I-share	*AF too RICH*	*0*	NO
	AF too LEAN	*1*	
DELTA_I_LAM[i]			

Figure B.16.1: Diagnosis

Diagnosis	Symptom	Nr	ABC type
Trim controller deviation	*AF too RICH*	*0*	NO
	AF too LEAN	*1*	
VLS_DOWN_DIF[i]			

FUNCTION DESCRIPTION:

General information:

This function shall summarize the results of both dynamic fuel trim diagnosis specified in this module. Although this function has variable names which are according to the error management naming convention, it does not include an interface to the error manager.
Error Symptoms are defined as follows:

```
┌─┬─┬─┬─┐
 │  │  │  └─> AF too RICH     ( = SYM_0)
 │  │  └────> AF too LEAN     ( = SYM_1)
 │  └───────> (not used)
 └──────────> (not used)
```

Application conditions

Initialisation: *At transition LV_IGK = 0 to 1, ECU reset or at clearing error memory reset all variables to zero, except for the following:*
T_SUM_RST_DELTA_I_LAM[i] = C_T_SUM_RST_MAX_DELTA_I_LAM[i]
T_SUM_END_DIAG_WIN_DELTA_I_LAM[i] = C_T_SUM_RST_MAX_DELTA_I_LAM[i]
T_SUM_END_READY_DELTA_I_LAM[i] = C_T_SUM_READY_DELTA_I_LAM[i]
LAMB_DELTA_I_SAVE_DIAG[i] shall not be initialized

Recurrence: 100 ms

Activation: –

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Formula section:

```
If      LV_ERR_DELTA_I_LAM[i]= 1 orLV_ERR_VLS_DOWN_DIF[i]= 1
Then
  If(ERR_SYM_DELTA_I_LAM[i] =   SYM_0   &
          ERR_SYM_VLS_DOWN_DIF[i] <>   SYM_1 )
  Or(ERR_SYM_DELTA_I_LAM[i] <>   SYM_1   &
          ERR_SYM_VLS_DOWN_DIF[i] =   SYM_0 )
  Then
            LV_ERR_LAM_ADJ[i]   = 1
            ERR_SYM_LAM_ADJ[i] =   SYM_0
     Else
               If(ERR_SYM_DELTA_I_LAM[i] =   SYM_1   &
               ERR_SYM_VLS_DOWN_DIF[i] <>   SYM_0 )
               Or(ERR_SYM_DELTA_I_LAM[i] <>   SYM_0   &
               ERR_SYM_VLS_DOWN_DIF[i] =   SYM_1 )
               Then
                    LV_ERR_LAM_ADJ[i]   = 1
                    ERR_SYM_LAM_ADJ[i] =   SYM_1
               Else
                    ERR_SYM_LAM_ADJ[i] =   NO_SYM
               Endif
  Endif
Endif
```

```
If        ((LV_END_DIAG_DELTA_I_LAM[i] = 1 or C_DEAC_DIAG_LAM_ADJ.bit0 = 1)
and           (LV_END_DIAG_VLS_DOWN_DIF[i] = 1 or C_DEAC_DIAG_LAM_ADJ.bit1 = 1))
OR          LV_ERR_DELTA_I_LAM[i] = 1
OR          LV_ERR_VLS_DOWN_DIF[i] = 1
OR          LV_DIAG_EOL_END_LS_UP_DOWN[i] = 1
Then
           LV_END_DIAG_LAM_ADJ[i] = 1
Endif
```

B.16.1 Monitoring trim controller I-Share

FUNCTION DESCRIPTION:

General information:

To fulfil the legal requirements of the OBDII lambda sensor diagnosis, the trim of the lambda control by the lambda sensor signal downstream of the catalytic converter must be monitored in addition to the diagnosis of the lambda sensor upstream of the catalytic converter. In the case of a trim control error, a plausibility check is performed to assign the faulty behavior to the control sensor or the monitoring sensor.
Faulty behavior of the lambda sensors upstream or downstream from the catalytic converter exists if one of the emission components exceeds the standard emissions in the emission test cycle by a certain factor.

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Error Symptoms are defined as follows:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 |  |  |  └─> AF too RICH     ( = SYM_0)
 |  |  └────> AF too LEAN     ( = SYM_1)
 |  └───────> (not used)
 └──────────> (not used)
```

Application conditions:

Initialisation: - - (see first chapter) - -
ACTION_ERRM_NoFilterReset(IN<NC_IDX_DIAG_ DELTA_I_LAM[i]>, OUT<LV_ERR_ DELTA_I_LAM[i]>)

Recurrence: 100ms

Activation /Deactivation:

If LV_INH_DIAG_DLY_LAM[i] = 0
and LV_CP_RAMP_OPEN_ACT = 0
and LV_LAM_ADJ_I_ACT[i] = 1
and LV_ERR_DELTA_I_LAM[i] = 0
and C_LAMB_DELTA_I_MAX_DIAG > C_LAMB_DELTA_I_MIN_DIAG
then LV_CDN_DIAG_DELTA_I_LAM[i] = 1
diagnosis enabled
else LV_CDN_DIAG_DELTA_I_LAM[i] = 0
diagnosis disabled
endif

Description:

B.16.2 Reset of time counters and set of end of diagnosis flags

After a calibrateable time during which the diagnosis has been activated and no error has been set, the timers for detection of too rich or lean system are reset or respectively reinitialised for the next diagnosis check. This must be done e.g. to avoid to sum up intermittend failures over a too long period.
Beside the items mentioned above the end of diagnosis flag can be set by two different time counters also. (T_SUM_END_DIAG_WIN_DELTA_I_LAM[i] and T_SUM_END_READY_DELTA_I_LAM[i])
After a calibrateable time during which the diagnosis has been activated the end of diagnosis flag is set. The flag of temporary end of diagnosis is a trigger for the similar conditions check and therefore always set after every completed DELTA_I_LAM cycle check (reset next recurrence).
At engine stop all time counters are reset respectively reinitialised.

Formula section:

If LV_CDN_DIAG_DELTA_I_LAM[i] = 1
then *% Reset of time counters and set of end of diagnosis flags*
If ERR_SYM_DELTA_I_LAM[i] = SYM_0 **or** SYM_1
and T_SUM_RST_DELTA_I_LAM[i] = C_T_SUM_RST_MAX_DELTA_I_LAM[i]

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then T_SUM_END_DIAG_WIN_DELTA_I_LAM[i] =
C_T_SUM_RST_MAX_DELTA_I_LAM[i]
T_SUM_END_READY_DELTA_I_LAM[i] =
C_T_SUM_READY_DELTA_I_LAM[i]
endif
If ERR_SYM_DELTA_I_LAM[i] = SYM_0 **or** SYM_1
or T_SUM_RST_DELTA_I_LAM[i]   C_T_SUM_RST_MAX_DELTA_I_LAM[i]
then decrement T_SUM_RST_DELTA_I_LAM[i]
endif
decrement T_SUM_END_DIAG_WIN_DELTA_I_LAM[i]
If T_SUM_END_DIAG_WIN_DELTA_I_LAM[i] = 0
then LV_END_DIAG_WIN_DELTA_I_LAM[i] = 1
LV_END_DIAG_DELTA_I_LAM[i] = 1
T_SUM_END_DIAG_WIN_DELTA_I_LAM[i] =
C_T_SUM_RST_MAX_DELTA_I_LAM[i]
else LV_END_DIAG_WIN_DELTA_I_LAM[i] = 0
endif
If T_SUM_MAX_DELTA_I_LAM[i] > C_T_SUM_MAX_ERR_DELTA_I_LAM[i] **or**
T_SUM_MIN_DELTA_I_LAM[i] > C_T_SUM_MAX_ERR_DELTA_I_LAM[i]
then LV_DET_SYM_EVE_DELTA_I_LAM[i] = 1
else LV_DET_SYM_EVE_DELTA_I_LAM[i] = 0
endif
decrement T_SUM_END_READY_DELTA_I_LAM[i]
If T_SUM_END_READY_DELTA_I_LAM[i] = 0
and LV_DET_SYM_EVE_DELTA_I_LAM[i] = 0
and LV_END_DIAG_DELTA_I_LAM[i] = 0
then LV_END_DIAG_DELTA_I_LAM[i] = 1
LV_END_DIAG_WIN_DELTA_I_LAM[i] = 1
T_SUM_END_DIAG_WIN_DELTA_I_LAM[i] =
T_SUM_RST_MAX_DELTA_I_LAM[i]
endif
If T_SUM_RST_DELTA_I_LAM[i] = 0
and LV_ERR_DELTA_I_LAM[i] = 0
then T_SUM_MAX_DELTA_I_LAM[i] = 0
T_SUM_MIN_DELTA_I_LAM[i] = 0
T_SUM_RST_DELTA_I_LAM[i] = C_T_SUM_RST_MAX_DELTA_I_LAM[i]
endif
else freezeT_SUM_RST_DELTA_I_LAM[i]
freeze T_SUM_END_DIAG_WIN_DELTA_I_LAM[i]
freeze T_SUM_END_READY_DELTA_I_LAM[i]
LV_END_DIAG_WIN_DELTA_I_LAM[i] = 0
If LV_ES = 1
then T_SUM_MAX_DELTA_I_LAM[i] = 0
T_SUM_MIN_DELTA_I_LAM[i] = 0
T_SUM_RST_DELTA_I_LAM[i] = C_T_SUM_RST_MAX_DELTA_I_LAM[i]
T_SUM_END_DIAG_WIN_DELTA_I_LAM[i] =
C_T_SUM_RST_MAX_DELTA_I_LAM[i]
T_SUM_END_READY_DELTA_I_LAM[i] =
C_T_SUM_READY_DELTA_I_LAM[i]
endif
endif

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B.16.3 Error detection for rich/lean A/F ratio deviation

If the total amount of I-share of the trim controller (LAMB_DELTA_I_LAM_ADJ[i] + LAMB_DELTA_AD_LAM_ADJ[i]) exceeds the diagnostic threshold C_LAMB_DELTA_I_MAX/MIN_DIAG[i], T_SUM_MAX/MIN_DELTA_I_LAM[i] is incremented as long as the diagnostic threshold is exceeded. If (LAMB_DELTA_I_LAM_ADJ[i] + LAMB_DELTA_AD_LAM_ADJ[i]) falls below the diagnostic threshold, then T_SUM_MAX/MIN_DELTA_I_LAM[i] is stopped. A failure is detected as soon as T_SUM_MAX/MIN_DELTA_I_LAM[i] is above the threshold C_T_SUM_MAX/MIN_MAX_DELTA_I_LAM[i]. Incrementation restarts, if the I-share of the trim controller exceeds the limit again.
If the engine is stopped the time counters shall be reset.

```
If        LV_CDN_DIAG_DELTA_I_LAM[i] = 1
then         % Error detection for rich/lean A/F ratio deviation
             If          ( LAMB_DELTA_I_LAM_ADJ[i] + LAMB_DELTA_AD_LAM_ADJ[i] ) >
                                                      C_LAMB_DELTA_I_MAX_DIAG
             then           increment T_SUM_MAX_DELTA_I_LAM[i]
                        ERR_SYM_DELTA_I_LAM[i] =   SYM_1            /AF too LEAN
             else    freeze T_SUM_MAX_DELTA_I_LAM[i]
                 If        ( LAMB_DELTA_I_LAM_ADJ[i] +
                  LAMB_DELTA_AD_LAM_ADJ[i] ) <C_LAMB_DELTA_I_MIN_DIAG
                      then         increment T_SUM_MIN_DELTA_I_LAM[i]
                           ERR_SYM_DELTA_I_LAM[i] =   SYM_0           /AF too RICH
                      else         freeze T_SUM_MIN_DELTA_I_LAM[i]
                           ERR_SYM_DELTA_I_LAM[i] =   NO_SYM     /no Symptom
                      endif
             endif
             If             T_SUM_MAX_DELTA_I_LAM[i] >
                                  C_T_SUM_MAX_MAX_DELTA_I_LAM[i]
        or              T_SUM_MIN_DELTA_I_LAM[i] >
                                 C_T_SUM_MIN_MAX_DELTA_I_LAM[i]
             then   LV_ERR_DELTA_I_LAM[i] = 1
                     LV_END_DIAG_DELTA_I_LAM[i] = 1
                    LV_END_DIAG_WIN_DELTA_I_LAM[i] = 1
                      LAMB_DELTA_I_SAVE_DIAG[i] = ( LAMB_DELTA_I_LAM_ADJ[i] +
                                              LAMB_DELTA_AD_LAM_ADJ[i] )
             endif
else
         freeze ERR_SYM_DELTA_I_LAM[i]
         freeze T_SUM_MAX_DELTA_I_LAM[i]
         freeze T_SUM_MIN_DELTA_I_LAM[i]
endif

If        LV_END_DIAG_DELTA_I_LAM[i] = 0 -> 1
then LAMB_DELTA_I_SAVE_DIAG[i] = ( LAMB_DELTA_I_LAM_ADJ[i] + LAMB_DELTA_AD_LAM_ADJ[i] )
endif
```

For failure and error management treatment the anti-bounce mechanism is called :
% if LV_ERR_XX=1 then LV_ERR_SET=1 or if LV_ERR_XX=0 then LV_ERR_RST=1
ACTION_ERRM_NoFilterSymptom(IN<NC_IDX_DIAG_DELTA_I_LAM[i]>, IN<LV_CDN_DIAG_DELTA_I_LAM[i]>, IN< ERR_SYM_DELTA_I_LAM[i] >, IN< LV_ERR_SET_DELTA_I_LAM [i] >, IN<LV_ERR_RST_DELTA_I_LAM[i]>, IN<LV_END_DIAG_DELTA_I_LAM[i]>, OUT<LV_ERR_DELTA_I_LAM[i]>)

Application hint: the data for each individual bank should fulfill the following conditions
1. C_T_SUM_RST_MAX_DELTA_I_LAM >> C_T_SUM_READY_DELTA_I_LAM

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2. C_T_SUM_MIN_MAX_DELTA_I_LAM and C_T_SUM_MAX_MAX_DELTA_I_LAM >> C_T_SUM_MAX_ERR_DELTA_I_LAM

B.16.4 Monitoring of trim controller deviation

FUNCTION DESCRIPTION:

General information:

In order to get a fast decision of error location in case of oxygen sensor failure, trim controller input signal is monitored. Insufficient trim control over long period can be obtained out of this function. In conjunction with activity check of the up- and downstream sensors it is decided which sensor is damaged (up- or downstream).

Description:

The downstream sensor signal deviation to setpoint (VLS_DIF_LAM_ADJ[i]) is observed during trim controller diagnosis phase. This implements the activation of trim control.
If VLS_DIF_LAM_ADJ[i] exceeds either maximum or minimum voltage thresholds corresponding MAF integrals are started. As long as the diagnostic threshold is exceeded the MAF integral is incremented, else it is stopped. A failure is detected as soon as the MAF integral exceeds the threshold (MAF_INT_VLS_DIF_DLY_MAX/MIN). Then symptom flag LV_ERR_VLS_DOWN_DIF[i] and the corresponding symptom (MIN or MAX) are set.
MAF_INT_RST_VLS_DOWN_DIF_DIAG[i] is incremented if no end flag is set so far, or if a symptom was detected at least once in the current diagnostic cycle, it seves two purposes: It causes a "good" diagnostic result if no symptom is detected after sufficient time has elapsed, and it aborts and restarts the diagnosis if a symptom was present, but occurs only rarely (e.g. due to dynamic driving conditions).

Error Symptoms are defined as follows:

```
 _______________
|   |   |   |   |
 |   |   |   └─> AF too RICH     ( = SYM_0)
 |   |   └─────> AF too LEAN     ( = SYM_1)
 |   └─────────> (not used)
 └─────────────> (not used)
```

Application conditions

Initialisation: – – (see first chapter) – –
ACTION_ERRM_NoFilterReset(IN< NC_IDX_DIAG_VLS_DOWN_DIF[i]>, OUT<LV_ERR_ VLS_DOWN_DIF[i]>)

Recurrence: *100ms*

Activation:

If OPM_AV$_n$ <> OPM_AV$_{n-1}$
then MAF_INT_OPM_STAT = C_MAF_INT_OPM_STAT
else MAF_INT_OPM_STATn =
MAF_INT_OPM_STATn-1
- MAF_KGH* T_SAMPLE [ms] * 1/3600 [(g*h) /(kg*ms)]
endif

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If LV_INH_DIAG_DLY_LAM[i] = 0
and LV_CP_RAMP_OPEN_ACT = 0
and LV_LAM_ADJ_P_ACT[i] = 1
and LV_VLS_DIF_DLY_LDC[i] = 1
and EFF_CAT_DIAG[i] <= C_CAT_DIAG_MAX_DELTA_I_LAM[i]
and MAF_INT_OPM_STAT = 0
then
LV_CDN_DIAG_VLS_DOWN_DIF[i] = 1
diagnosis enabled
else
LV_CDN_DIAG_VLS_DOWN_DIF[i] = 0
diagnosis disabled
freeze all variables
endif

Formula section:

If (1)MAF_INT_RST_VLS_DOWN_DIF_DIAG[i] $<$ C_MAF_INT_RST_VLS_DOWN_DIF_DIAG[i]
then (1) *% current diag cycle not too long without result*
If (2a) VLS_DOWN[i] $\leq$ C_VLS_DOWN_MIN_DIAG_LAM_ADJ[i]
then (2a) *% too lean after catalyst*
ERR_SYM_VLS_DOWN_DIF[i] = SYM_1 /AF too LEAN
If (3a) MAF_INT_VLS_DIF_DLY_MAX[i] $>$ C_MAF_INT_VLS_DIF_DLY_MAX[i]
then (3a) *% symptom present long enough - store the error*
LV_ERR_VLS_DOWN_DIF[i] = 1
LV_END_DIAG_VLS_DOWN_DIF[i] = 1
else (3b) *% symptom present - set the symptom and count up, but don't store an error*
MAF_INT_VLS_DIF_DLY_MAX[i]$_n$ =
MAF_INT_VLS_DIF_DLY_MAX[i]$_{n-1}$ +
MAF_CYL* T_SAMPLE [ms] * 1/3600 [(g*h) /(kg*ms)]
endif (3a/b)
else (2b) *% not too lean after catalyst - do not touch the lean case, but check if it's too rich*
freeze MAF_INT_VLS_DIF_DLY_MAX[i]
if (3b) VLS_DOWN[i] $\geq$ C_VLS_DOWN_MAX_DIAG_LAM_ADJ[i]
then (3b) *% too rich after catalyst*
ERR_SYM_VLS_DOWN_DIF[i] = SYM_0 /AF too RICH
If (4a) MAF_INT_VLS_DIF_DLY_MIN[i] $>$ C_MAF_INT_VLS_DIF_DLY_MIN[i]
then (4a) *% symptom present long enough - store the error*
LV_ERR_VLS_DOWN_DIF[i] = 1
LV_END_DIAG_VLS_DOWN_DIF[i] = 1
else (4b) *% symptom present - set the symptom and count up, but don't store an error*
MAF_INT_VLS_DIF_DLY_MIN[i]$_n$ = MAF_INT_VLS_DIF_DLY_MIN[i]$_{n-1}$ +
MAF_CYL* T_SAMPLE [ms] * 1/3600 [(g*h) /(kg*ms)]
endif (4a/b)
else (3b) *% not too lean and not too rich - set the symptom (counting is done below)*
freeze MAF_INT_VLS_DIF_DLY_MIN[i]
If (4c) LV_ERR_VLS_DOWN_DIF[i] = 0
Then (4c)

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ERR_SYM_VLS_DOWN_DIF[i] = NO_SYM
endif (4c)
endif (3a/b)
endif (2a/b)
% count a MAF integral to generate an end flag for the good case.
If (2c) LV_END_DIAG_VLS_DOWN_DIF[i] = 0
or MAF_INT_RST_VLS_DOWN_DIF_DIAG[i] $>$ 0
or ERR_SYM_VLS_DOWN_DIF[i] $<>$ NO_SYM
then (2c)
MAF_INT_RST_VLS_DOWN_DIF_DIAG[i]$_n$ =
MAF_INT_RST_VLS_DOWN_DIF_DIAG[i]$_{n-1}$ + MAF_
CYL* T_SAMPLE [ms] * 1/3600 [(g*h) /(kg*ms)]
else (2d)
freeze MAF_INT_RST_VLS_DOWN_DIF_DIAG[i]
endif (2c/d)
else (1)
% running too long without coming to an end. Cancel a running diagnosis cycle by resetting the MAF integrals (assuming a symptom is either not present at all or intermittent but rare). Also indicate a "good" diag result, if no end was reached so far.
MAF_INT_RST_VLS_DOWN_DIF_DIAG[i] = 0
MAF_INT_VLS_DIF_DLY_MIN[i] = 0
MAF_INT_VLS_DIF_DLY_MAX[i] = 0
If (2e) LV_END_DIAG_VLS_DOWN_DIF[i] = 0
then (2e)
LV_END_DIAG_VLS_DOWN_DIF[i] = 1
LV_ERR_VLS_DOWN_DIF[i] = 0
ERR_SYM_VLS_DOWN_DIF[i] = NO_SYM
endif (2e)
endif (1)

For failure and error management treatment the anti-bounce mechanism is called :
% if LV_ERR_XX=1 then LV_ERR_SET=1 or if LV_ERR_XX=0 then LV_ERR_RST=1
ACTION_ERRM_NoFilterSymptom(IN$<$NC_IDX_DIAG_VLS_DOWN_DIF[i]$>$, IN$<$LV_CDN_DIAG_VLS_DOWN_DIF[i]$>$, IN$<$ ERR_SYM_VLS_DOWN_DIF[i] $>$, IN$<$ LV_ERR_SET_VLS_DOWN_DIF[i] $>$, IN$<$LV_ERR_RST_VLS_DOWN_DIF[i]$>$, IN$<$LV_END_DIAG_VLS_DOWN_DIF[i]$>$, OUT$<$LV_ERR_VLS_DOWN_DIF[i]$>$)

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B.16.5 Limited dynamic for the function Monitoring the Trim Controller Deviation

FUNCTION DESCRIPTION:

General information:

As it is specified in the function Monitoring Trim Controller Deviation contained in this module, this shall be carried out every time the Trim Controller P-share is beeing calculated. This is active most of the time to maintain the the air fuel ratio inside the catalyst window also if any deviation happens. Under such unstable condition its not proper to carry out the trim controller diagnosis and this shall be inhibit until the system achieves the steady state. This shall be facilitated by the present function which shall summarize informations concerning the dynamic of engine speed, mass air flow and air fuel ratio.

Description:

The floating mean value N_MMV_VLS_DIF_DLY_LDC is computed using the averaging constant C_N_CRLC_LDC_VLS_DIF_DLY. The limited dynamics condition only exist while the engine speed N lies within the dynamics window around N_MMV_VLS_DIF_DLY_LDC.
If the above limited dynamics condition is violated, the floating mean value N_MMV_VLS_DIF_DLY_LDC is set to the current engine speed in order to reach the limited dynamics condition faster:

The floating mean value MAF_MMV_VLS_DIF_DLY_LDC is computed using the averaging constant C_MAF_CRLC_LDC_VLS_DIF_DLY. The limited dynamics condition only exist while the air mass MAF stays within the dynamics window around MAF_MMV_VLS_DIF_DLY_LDC. If the above limited dynamics condition is violated, the floating mean value MAF_MMV_VLS_DIF_DLY_LDC is set to the current air-mass value in order to reach the limited dynamics condition faster:

The floating mean value LAM_MMV_VLS_DIF_DLY_LDC[i] is computed using the averaging constant C_LAM_MV_CRLC_LDC_VLS_DIF_DLY. The limited dynamics condition continues to exist while the mean oxygen value FAC_LAM_MV[i] stays within the dynamics window around LAM_MMV_VLS_DIF_DLY_LDC[i]. If the above limited dynamics condition is violated, the floating mean value LAM_MMV_VLS_DIF_DLY_LDC[i] is set to the current mean oxygen value in order to reach the limited dynamics condition faster.

Application conditions

Initialisation: `- - (see first chapter) -`

Recurrence: `T_SAMPLE = 100ms`

Activation: `If (LV_IGK = 1 and LV_ST_END = 1)`

Deactivation: *the above conditions are not fullfiled*

```
   Initialization at deactivation:
N_MMV_VLS_DIF_DLY_LDC = N
MAF_MMV_VLS_DIF_DLY_LDC = MAF
LAM_MMV_VLS_DIF_DLY_LDC[i]  = FAC_LAM_MV[i]
```

Formula section:

Limited engine speed (N) dynamics:

N_MMV_VLS_DIF_DLY_LDC =
N_MMV_VLS_DIF_DLY_LDC * (1 - C_N_CRLC_LDC_VLS_DIF_DLY) +
C_N_CRLC_LDC_VLS_DIF_DLY * N

IF | N - N_MMV_VLS_DIF_DLY_LDC | < C_N_LDC_VLS_DIF_DLY
THEN LV_VLS_DIF_DLY_LDC_N = 1
ELSE LV_VLS_DIF_DLY_LDC_N = 0
N_MMV_VLS_DIF_DLY_LDC = N
ENDIF

Limited mass air flow (MAF) dynamics:

MAF_MMV_VLS_DIF_DLY_LDC =
MAF_MMV_VLS_DIF_DLY_LDC * (1 - C_MAF_CRLC_LDC_VLS_DIF_DLY) +
C_MAF_CRLC_LDC_VLS_DIF_DLY * MAF

IF | MAF - MAF_MMV_VLS_DIF_DLY_LDC | < C_MAF_LDC_VLS_DIF_DLY
THEN LV_VLS_DIF_DLY_LDC_MAF = 1

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ELSE LV_VLS_DIF_DLY_LDC_MAF = 0
MAF_MMV_VLS_DIF_DLY_LDC = MAF
ENDIF

Limited mean oxygen value (FAC_LAM_MV[i]) dynamics:
LAM_MMV_VLS_DIF_DLY_LDC[i] =
LAM_MMV_VLS_DIF_DLY_LDC[i] * (1 - C_LAM_MV_CRLC_LDC_VLS_DIF_DLY)
\+ C_LAM_MV_CRLC_LDC_VLS_DIF_DLY * FAC_LAM_MV[i]

IF | FAC_LAM_MV[i] - LAM_MMV_VLS_DIF_DLY_LDC[i] | $<$
C_LAM_MV_LDC_VLS_DIF_DLY
THEN LV_VLS_DIF_DLY_LDC_LAM_MV[i] = 1
ELSE LV_VLS_DIF_DLY_LDC_LAM_MV[i] = 0
LAM_MMV_VLS_DIF_DLY_LDC[i] = FAC_LAM_MV[i]
ENDIF

Summarizing limited dynamic conditions:

IF LV_VLS_DIF_DLY_LDC_N = 1 **AND** LV_VLS_DIF_DLY_LDC_MAF = 1 **AND**
LV_VLS_DIF_DLY_LDC_LAM_MV[i] = 1
THEN
IF MAF_INT_VLS_DIF_DLY_LDC[i] $\leq$ C_MAF_INT_MIN_VLS_DIF_DLY_LDC[i]
THEN
MAF_INT_VLS_DIF_DLY_LDC[i]$_n$ =
MAF_INT_VLS_DIF_DLY_LDC[i]$_{n-1}$
\+ MAF_KGH* T_SAMPLE [ms] * 1/3600 [(g*h) /(kg*ms)]

ELSE
freeze MAF_INT_VLS_DIF_DLY_LDC[i]
LV_VLS_DIF_DLY_LDC[i] = 1
ENDIF
ELSE
LV_VLS_DIF_DLY_LDC[i] = 0
MAF_INT_VLS_DIF_DLY_LDC[i] = 0
ENDIF

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B.17 O2 sensor fuel trim diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_DLY_LAM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the dynamic fuel trim diagnosis					
LV_INH_DIAG_RBM_DLY_LAM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Inhibition of the dynamic fuel trim diagnosis due to failures					
MAF_INT_SCAV_NOT_ACT	V	0... FFFFH	0... 1820.41666	0.0277778	g
Integral to start fuel trim diagnosis after scavenging (Turbo)					
STATE_RBM_VLS_DOWN_DIF [NC_CBK_EX_NR]	O/V	0... 7H	0 ...7	1	-
RBM - Interface of VLS_DOWN_DIF monitor					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LC_DIAG_PUE_ACT_LS_DOWN {p. 5191}	LV_DC {p. 5746}	LV_DIAG_EOL_REQ_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5407}
LV_END_DIAG_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5215}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}
LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}	LV_ERR_CHG_LS_UP {p. 5416}
LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}
LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FTL_MIN {p. 4762}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}
LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}
LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}
LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_PLAUS {p. 1062}
LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}

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LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}	LV_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}	LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}
LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}
LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}
LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5152}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}
LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}
LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}
LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}
LV_ERR_VCV {p. 4729}	LV_IGK {p. 906}	LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_NT_RGN_REQ {p. 996}
LV_VAR_LSH_DOWN {p. 656}	LV_VB_CDN_OBD_2 {p. 1046}	MAF_KGH {p. 1195}	MAF_SCAV_EXT {p. 8278}
N {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_NR_CAM_CBK {p. 1507}
NC_NR_CBK_IVVT {p. 604}	STATE_DIAG_ACT_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5389}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_INT_SCAV_NOT_ACT	-	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral threshold to allow fuel trim diagnosis after scavenging					
C_MAF_SCAV_MAX_INH_DLY_LAM	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Maximum allowed MAF during scavenging to inhibit fuel trim diagnosis					
C_N_MIN_DIAG_DLY_LAM	-	0... 1FE0H	0... 8160	1	rpm
Minimum engine speed to allow fuel trim diagnosis					
LC_INH_DIAG_DLY_LAM [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Manual inhibition of the dynamic fuel trim diagnosis (bank individual)					

Import actions:

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ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

B.17.1 Inhibtion of Dynamic fuel trim diagnosis

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks. For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2), then:

i = 1 for exhaust cylinder bank 1
i = 2 for exhaust cylinder bank 2,

otherwise (NC_CBK_EX_NR = 1)

i = 1 for single exhaust cylinder bank.

Application conditions

Initialisation: at reset all variables shall be set to zero;
at LV_IGK = 0 -> 1 all variables except *STATE_RBM_VLS_DOWN_DIF[i]* shall be set to zero;
at every LV_IGK = 1 -> 0 LV_INH_DIAG_DLY_LAM[i] = 1

Recurrence: *1 s*

Activation: LV_IGK = 1
Dectivation: LV_IGK = 0

Formula section:

If MAF_SCAV_EXT > C_MAF_SCAV_MAX_INH_DLY_LAM
then MAF_INT_SCAV_NOT_ACT = C_MAF_INT_SCAV_NOT_ACT
else MAF_INT_SCAV_NOT_ACTn =
MAF_INT_SCAV_NOT_ACTn-1
- MAF_KGH* T_SAMPLE [ms] * 1/3600 [(g*h) /(kg*ms)]
endif

% Inhibition of the diagnosis during scavenging (especially for turbocharged engines)

If LV_ERR_AMP **or**
LV_ERR_AMP_PLAUS **or**
LV_ERR_CHG_LS_UP **or**
LV_ERR_CRK_PLAUS **or**
LV_ERR_CRK_SYN **or**
LV_ERR_CRK_TOOTH **or**
LV_ERR_CRK_TOOTH_PER **or**
LV_ERR_DIAGCPS **or**
LV_ERR_EL_CPS **or**
LV_ERR_FTL_MIN **or**
LV_ERR_FUP **or**

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LV_ERR_FUP_MFP_PLAUS **or**
LV_ERR_FUP_ORNG **or**
LV_ERR_FUP_ST **or**
LV_ERR_H_PRS_SYS **or**
LV_ERR_IVVT **or**
LV_ERR_LOAD_TPS_PLAUS **or**
LV_ERR_MAF **or**
LV_ERR_MAP_PLAUS **or**
LV_ERR_MAP_TPS_PLAUS **or**
LV_ERR_MTC_CTL_2 **or**
LV_ERR_MTC_CTL_3 **or**
LV_ERR_MTC_DR **or**
LV_ERR_TPS = 1 **or**
LV_ERR_VCV **or**
LV_ERR_AIR_LSL_UP[i] **or** LV_ERR_CAT_DIAG[i]
or
LV_ERR_CTL_LSL_UP[i] **or**
LV_ERR_DYN_VLD_LS_UP[i] **or**
LV_ERR_EL_LSL_UP[i] **or**
LV_ERR_LSH_DOWN[i] **or**
LV_ERR_LSH_UP[i] **or**
LV_ERR_LSL_UP_IF[i] **or**
LV_ERR_OBD_LSH_DOWN[i] **or**
LV_ERR_OBD_VLD_LSH_UP[i] **or**
LV_ERR_OC_LS_DOWN[i] **or**
LV_ERR_OC_LSL_UP[i] **or**
LV_ERR_OFS_LSL_UP[i] **or**
LV_ERR_PUC_LS_DOWN[i] **or**
LV_ERR_PUC_VLD_LS_UP[i] **or**
[LV_ERR_PUE_LS_DOWN[i] **or**
and LC_DIAG_PUE_ACT_LS_DOWN = 1**]**
LV_ERR_SCG_LS_DOWN[i] **or**
LV_ERR_SCP_LS_DOWN[i] **or**
LV_ERR_SWT_LS_DOWN[i] **or**
LV_ERR_TTIP_MES_LSH_UP[i] **or**

(i = 1 **and**
[LV_ERR_IV[0] **or**
LV_ERR_IV[2] **or**
LV_ERR_IV[4] **or**
LV_ERR_MIS[0] **or**
LV_ERR_MIS[2] **or**
LV_ERR_MIS[4]
]) **or**
(i = 2 **and**
[LV_ERR_IV[1] **or**
LV_ERR_IV[3] **or**
LV_ERR_IV[5] **or**
LV_ERR_MIS[1] **or**
LV_ERR_MIS[3] **or**
LV_ERR_MIS[5]
]) **or**

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LV_ERR_PER_CAM_EX[m] *m=1 for i=1,2* **or**
LV_ERR_PER_CAM_IN[m] *m=1 for i=1,2* **or**
LV_ERR_PLAUS_CAM_EX[m] *m=1 for i=1,2* **or**
LV_ERR_PLAUS_CAM_IN[m] *m=1 for i=1,2* **or**
LV_ERR_REF_CRK_CAM_EX[m] 1 *m=1 for i=1,2* **or**
LV_ERR_REF_CRK_CAM_IN[m] *m=1 for i=1,2* **or**
LV_ERR_SYN_CAM_EX[m] *m=1 for i=1,2* **or**
LV_ERR_SYN_CAM_IN[m] *m=1 for i=1,2* **or**
LV_ERR_SYN_CRK_CAM_IN[m] *m=1 for i=1,2* **or**
LV_ERR_TOOTH_OFF_EX[m] *m=1 for i=1,2* **or**
LV_ERR_TOOTH_OFF_IN[m] *m=1 for i=1,2*

then LV_INH_DIAG_RBM_DLY_LAM[i] = 1
else LV_INH_DIAG_RBM_DLY_LAM[i] = 0
endif

If LV_VAR_LSH_DOWN = 1
and LC_INH_DIAG_DLY_LAM[i] = 0
and LV_NT_RGN_REQ = 0
and LV_VB_CDN_OBD_2 = 1
and LV_LS_UP_OBD_2_MAN_DEAC[i] = 0
and LV_INH_DIAG_RBM_DLY_LAM[i] = 0
and STATE_DIAG_ACT_LS_UP_DOWN[i] = PASSIVE **or** CHECK_FINSHED for all i
and LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 0 for all i
and MAF_INT_SCAV_NOT_ACT = 0
and N >= C_N_MIN_DIAG_DLY_LAM

then LV_INH_DIAG_DLY_LAM[i] = 0
else LV_INH_DIAG_DLY_LAM[i] = 1
endif

B.17.2 Interface for Rate - Based - Monitoring

FUNCTION DESCRIPTION:

General information:

With this module the interface between the VLS_DOWN_DIF[i] monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_VLS_DOWN_DIF[i] data.
Within STATE_RBM_VLS_DOWN_DIF[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)
  (not valid for trim diagnosis)

Application conditions

Initialisation:

```
at LV_DC 0 -> 1 transition:
```

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```
        bit 0 , bit 1 of STATE_RBM_VLS_DOWN_DIF[i] = 0
        bit 2 shall be set to 1.
    at ECU reset:
       all bits of STATE_RBM_VLS_DOWN_DIF[i] = 0
```

Recurrence: 1 s

Activation: LV_DC = 1

Formula section:

At LV_DC 0 -> 1 transition

The pending status of the following failures has to be checked only once :

Dependence	Error			
	LV_ERR_AMP	LV_ERR_AMP_PLAUS	LV_ERR_CHG_LS_UP	LV_ERR_CRK_PLAUS
	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH	LV_ERR_CRK_TOOTH_PER	LV_ERR_DIAGCPS
	LV_ERR_EL_CPS	LV_ERR_FTL_MIN	LV_ERR_FUP	LV_ERR_FUP_MFP_PLAUS
	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS	LV_ERR_LOAD_TPS_PLAUS
	LV_ERR_MAF_FRQ_EL	LV_ERR_MAF_FRQ_GRD	LV_ERR_MAF_FRQ_RNG	LV_ERR_MAP_PLAUS
	LV_ERR_MAP_TPS_PLAUS	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR
	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD	LV_ERR_TPS_AD_BOL
	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATIO	LV_ERR_TPS_ST_CHK_2
	LV_ERR_VCV			
NC_CBK_EX_NR	LV_ERR_AIR_LSL_UP[i]	LV_ERR_CAT_DIAG[i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DYN_VLD_LS_UP[i]
	LV_ERR_EL_LSL_UP[i]	LV_ERR_LSH_DOWN[i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]
	LV_ERR_OBD_LSH_DOWN[i]	LV_ERR_OBD_VLD_LSH_UP[i]	LV_ERR_OC_LS_DOWN[i]	LV_ERR_OC_LSL_UP[i]
	LV_ERR_OFS_LSL_UP[i]	LV_ERR_PUC_LS_DOWN[i]	LV_ERR_PUC_VLD_LS_UP[i]	LV_ERR_PUE_LS_DOWN[i]
	LV_ERR_SCG_LS_DOWN[i]	LV_ERR_SCP_LS_DOWN[i]	LV_ERR_SWT_LS_DOWN[i]	LV_ERR_TTIP_MES_LSH_UP[i]

Figure B.17.1: For z = 1 to NC_NR_CBK_IVVT (= for any i // or)

NC_NR_CBK_IVVT	LV_ERR_CAM_CST_IVVT_EX[z]	LV_ERR_CAM_CST_IVVT_IN[z]	LV_ERR_MEC_IVVT_EX[z]	LV_ERR_MEC_IVVT_IN[z]
	LV_ERR_SLV_IVVT_IN[z]	LV_ERR_SLV_IVVT_EX[z]		

Figure B.17.2: For i = 1, 2

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NC_NR_CAM_CBK	LV_ERR_PER_CAM_IN[1]	LV_ERR_PER_CAM_EX[1]	LV_ERR_PLAUS_CAM_EX[1]	LV_ERR_PLAUS_CAM_IN[1]
	LV_ERR_REF_CRK_CAM_EX[1]	LV_ERR_REF_CRK_CAM_IN[1]	LV_ERR_SYN_CAM_EX[1]	LV_ERR_SYN_CAM_IN[1]
	LV_ERR_SYN_CRK_CAM_IN[1]	LV_ERR_TOOTH_OFF_EX[1]	LV_ERR_TOOTH_OFF_IN[1]	

Figure B.17.3: For NC_CBK_EX_NR = i =1

NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

Figure B.17.4: For NC_CBK_EX_NR = i = 2

NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

If(1) { CPU optimization at LV_DC 0 -> 1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }
Then(1)
While bit 1 of STATE_RBM_VLS_DOWN_DIF[i] = 0 **do**
with each XX failure of the above list except LV_ERR_PUE_LS_DOWN (depending on configuration, see below):
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2) bit 1 of STATE_RBM_VLS_DOWN_DIF[i] = 1
Endif(2)
For LV_ERR_PUE_LS_DOWN, do the following instead:
If LC_DIAG_PUE_ACT_LS_DOWN = 1
then
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<CALL>)
If(3) XX has a pending status
Then(3) bit 1 of STATE_RBM_VLS_DOWN_DIF[i] = 1
Endif(3)
Endif(2)
Endwhile
Else(1) { the dynamic failure memory is empty } No action
Endif(1)
Every 1 s :
If bit 0 of STATE_RBM_VLS_DOWN_DIF[i] = 0
Then
If LV_END_DIAG_VLS_DOWN_DIF[i] = 1
Then bit 0 of STATE_RBM_VLS_DOWN_DIF[i] = 1
Endif
Endif
If bit 1 of STATE_RBM_VLS_DOWN_DIF[i] = 0
Then
If LV_INH_DIAG_RBM_DLY_LAM[i] = 1

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Then bit 1 of STATE_RBM_VLS_DOWN_DIF[i] = 1
Endif
Endif

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B.18 O2 sensor (lin, up) activity diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_END_ACT_LSL_UP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter to have valid diagnostic result from the no-activity check (second part)					
CTR_LAMB_DE_INT_ACT_LSL_UP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter of forced stimulation periods					
CTR_RAW_ACT_END_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter to have valid diagnostic result from the no-activity check (first part)					
CTR_RAW_ACT_SYM_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter to set the raw symptom of sensor no-activity check (first part)					
CTR_SYM_ACT_LSL_UP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Debounce counter of the sensor non-activity symptom					
LAMB_DE_INT_ACT_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 63.99902	976.599e-6	-
Cumulating value of the lambda deviation					
LAMB_DE_LSL [NC_CBK_EX_NR]	V	0... FFFFH	0... 63.99902	976.599e-6	-
Deviation of the instantaneous lambda value from the mean moving value					
LAMB_DE_TOT_ACT_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 63.99902	976.599e-6	-
Total cumulated lambda deviation					
LAMB_MMV_ACT_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda moving mean value during the time the forced stimulation is active					
LV_DIAG_ACT_CDN_LSL_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating the conditions to activate the second test for sensor non-activity are fulfilled					
LV_DIAG_ACT_END_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating end of detailed test of no-activity check (from second test)					
LV_DIAG_ACT_SHO_CDN_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the short term conditions to activate the second test for sensor non-activity are fulfilled					
LV_DIAG_ACT_SYM_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating a detected poor upstream sensor activity (from second test)					
LV_DIAG_RAW_ACT_END_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating end of raw symptom test of no-activity check (from first test)					
LV_DIAG_RAW_ACT_SYM_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating a detected raw symptom of sensor non-activity (from first test)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Input data:

FAC_DIAG_DYN_LSL_UP [NC_CBK_EX_NR] {p. 5345}	FAC_MV_DIAG_DYN_LSL_UP [NC_CBK_EX_NR] {p. 5346}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP_DE_PLS {p. 2958}
LV_AFL [NC_CBK_EX_NR] {p. 2439}	LV_DIAG_ACT_INH_LSL_UP [NC_CBK_EX_NR] {p. 5245}	LV_IGK {p. 906}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}
LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_VLS_UP_VLD [NC_CBK_EX_NR] {p. 1341}	MAF_KGH {p. 1195}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	T_SUM_AFL_AFR_CYC [NC_CBK_EX_NR] {p. 2439}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}
VLS_UP_DIAG [NC_CBK_EX_NR] {p. 2315}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_ACT_LSL_UP	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation factor for the moving mean value					
C_CTR_LAMB_DE_INT_ACT_LSL_UP	-	0... FFH	0... 255	1	-
Number of forced stimulation periods to calculate the total cumulated lambda deviation					
C_CTR_RAW_ACT_END_LSL_UP	-	0... FFFFH	0... 65535	1	-
Counter threshold to have valid diagnostic result from the no-activity check (first part)					
C_CTR_RAW_ACT_RST_LSL_UP	-	0... FFFFH	0... 65535	1	-
Counter threshold to reset symptom counter if raw symptom has disappeared					
C_CTR_RAW_ACT_SYM_LSL_UP	-	0... FFFFH	0... 65535	1	-
Counter threshold to set the raw symptom flag of the no-activity check (first part)					
C_CTR_SYM_DEC_ACT_LSL_UP	-	0... FFH	0... 255	1	-
Counter decrement to set the sensor non-activity symptom flag					
C_CTR_SYM_INC_ACT_LSL_UP	-	0... FFH	0... 255	1	-
Counter increment to set the sensor non-activity symptom flag					
C_CTR_SYM_MAX_ACT_LSL_UP	-	0... FFH	0... 255	1	-
Counter threshold to set the sensor non-activity symptom flag					
C_FAC_DYN_INT_ACT_LSL_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Relative sensor signal damping admitted to monitor the sensor activity(see WRAF Sensor Dynamic Diagnosis)					
C_LAMB_DE_TOT_ACT_LSL_UP	-	0... FFFFH	0... 63.99902	976.599e-6	-
Threshold of the total cumulated lambda deviation to debounce the sensor non-activity symptom					
C_LAMB_SP_DE_PLS_ACT_LSL_UP	-	0... 7FFH	0... 0.12493	61e-6	-
Lower forced stimulation amplitude admitted to monitor the sensor activity					
C_MAF_KGH_MIN_ACT_LSL_UP	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Lower mass airflow in Kg/h admitted to monitor the sensor activity					
C_N_MIN_ACT_LSL_UP	-	0... FFH	0... 8160	32	rpm
Lower engine speed admitted to monitor the sensor activity					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_SUM_AFL_AFR_ACT_LSL_UP	-	0... FFFFH	0... 655.35	0.01	s
Lower forced stimulation period admitted to monitor the sensor activity					
C_VLS_UP_AFS_MAX_PLAUS_LSL_UP	-	8000... 7FFFH	-160... 159.99511	4.8828e-3	V
Upper limit of upstream sensor signal window to detect the sensor non-activity					
C_VLS_UP_AFS_MIN_PLAUS_LSL_UP	-	8000... 7FFFH	-160... 159.99511	4.8828e-3	V
Lower limit of upstream sensor signal window to detect the sensor non-activity					
ID_CTR_INC_RAW_ACT_LSL_UP	-	0... FFH	0... 255	1	-
LDP_MAF_KGH_ID_CTR_ACT_LSL_UP	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
Counter increment to detect raw symptom of upstream sensor non-activity					
ID_LAMB_GAIN_LS_UP_DYN	-	0... FFH	0... 31.875	0.125	-
LDP_FAC_DIAG_DYN_LSL_UP_ID_LAMB	8	0... 400H	0 ...1	976.599e-6	-
Gain factor to consider an aged linear lambda sensor					
ID_LAMB_GAIN_VLS_DOWN	-	0... FFH	0... 1.99218	0.0078125	-
LDP_VLS_DOWN_ID_LAMB_GAIN	8	0... 3FFH	0... 4.99511	4.8828e-3	V
Gain/Damping factor to calculate LAMB_DE_INT_ACT_LSL_UP to double-check with VLS_DOWN					

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
  i = 1, for exhaust cylinder bank 1
  i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
    i = 1, for single exhaust cylinder bank.

This function shall facilitate the upstream sensor non-activity detection, which can be caused by a extremely cold sensors or an open circuit some ATIC42 or CJ125 lines.

Description:

In the first part of this test the sensor is assumed to have no activity if VLS_UP_DIAG remains stuck in a tight band around stoichiometric values. If this is true for C_CTR_RAW_ACT_SYM_LSL_UP recurrences, then the raw symptom flag LV_DIAG_RAW_ACT_SYM_LSL_UP is set.
Rate Based Monitoring (RBM) requires similar time spans for the diagnosis to come to an end with or without a failure present. Therefore, if VLS_UP_DIAG is not within the mentioned band (thus a failure is unlikely) the counter CTR_RAW_ACT_END_LSL_UP is incremented until the threshold C_CTR_RAW_ACT_END_LSL_UP is reached. At this point the end flag LV_DIAG_RAW_ACT_END_LSL_UP is set. VLS_UP_DIAG of a faultless sensor might pass through or come to lie within the critical band. In these cases the end counter is frozen and the incrementation is resumed, once the critical band is left again.
In the failure case CTR_RAW_ACT_SYM_LSL_UP is incremented until the threshold C_CTR_RAW_ACT_SYM_LSL_UP is reached, where the end flag and the raw symptom flag are set at the same instance. In case of intermittent faults, excursion from the critical band should not lead to an immediate reset of the raw symptom flag. Therefore, the raw symptom flag is taken back only if the raw symptom counter drops below C_CTR_RAW_ACT_RST_LSL_UP.

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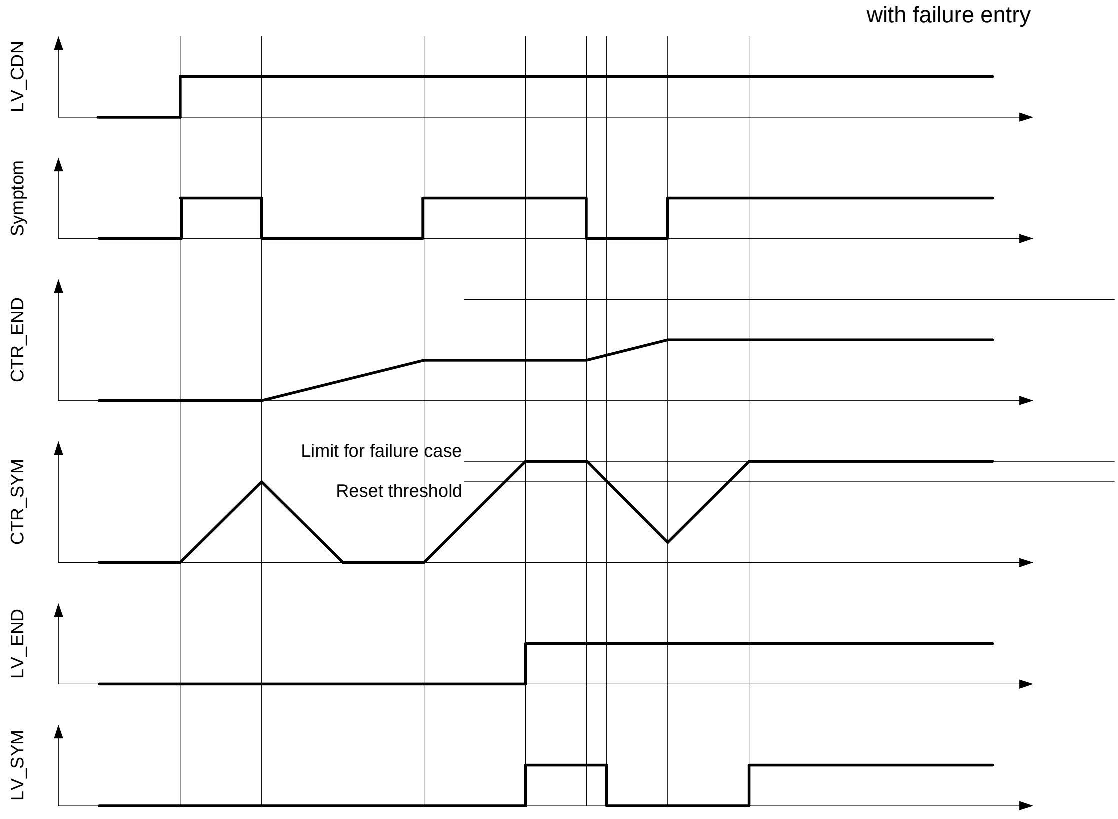

Figure B.18.1: : Basic principle of debounce algorithm for first part of activity check (LV_DIAG_RAW_ACT_END/SYM_LSL_UP)

The second part is started once the first part has come to an end and the following conditions are met: The forced stimulation is active and additionally engine speed, engine load, amplitude and period of the forced stimulation are sufficient to provoke the fluctuation of the sensor output. If these conditions are fulfilled then the following procedure is carried out. The difference between LAMB_LS_UP[i] and the moving mean value LAMB_MMV_ACT_LSL_UP[i] is calculated and integrated. After C_CTR_LAMB_DE_INT_ACT_LSL_UP forced stimulation periods the result is saved in the variable LAMB_DE_TOT_ACT_LSL_UP[i].

While integrating the difference between LAMB_LS_UP[i] and the moving mean value two different gain factors are taken into account. First, ID_LAMB_GAIN_LS_UP_DYN considers an aged sensor. Second, with ID_LAMB_GAIN_VLS_DOWN the speed of integration is reduced, if VLS_DOWN[i] shows either very rich or very lean conditions. The background here is that the combination of an upstream signal near stoichiometry and a very rich or very lean downstream signal strongly points to a not active upstream signal.

If the value of the deviation integral after C_CTR_LAMB_DE_INT_ACT_LSL_UP forced stimulation cycles is lower than the threshold C_LAMB_DE_TOT_ACT_LSL_UP, then the symptom counter shall be incremented, otherwise it shall be decremented. If the symptom counter has achieved the maximum C_CTR_SYM_MAX_ACT_LSL_UP cycles, then the symptom flag LV_DIAG_ACT_SYM_LSL_UP[i] is set, indicating that the sensor activity is very poor. This flag shall trigger the Open Circuit Diagnosis to narrow down the source of the failure. To have a valid end flag in case of a faultless sensor the counter C_CTR_END_ACT_LSL_UP is incremented once the end flag of the first part is set and no raw symptom was detected. The end flag of the Activity Check is set when the end counter reaches the sum of both loops needed for the fault detection.

Application conditions

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Initialisation: At the transition LV_IGK = 0 to 1, reset or at clearing error memory reset all variables.
At the transition LV_DIAG_ACT_CDN_LSL_UP[i] = 0 -> 1 initialize as follow:
CTR_SYM_ACT_LSL_UP[i] = 0
CTR_END_ACT_LSL_UP[i] = 0
CTR_RAW_ACT_SYM_LSL_UP[i] = 0
CTR_RAW_ACT_END_LSL_UP[i] = 0
CTR_LAMB_DE_INT_ACT_LSL_UP[i] = 0
LAMB_DE_INT_ACT_LSL_UP[i] = 0
LAMB_DE_TOT_ACT_LSL_UP[i] = 0
LAMB_MMV_ACT_LSL_UP[i] = 1

Recurrence: *20 ms*

Activation:
LV_ST_END = 1
Deactivation:
LV_ST_END = 0

Formula section:

IF [LV_IPLSL_VLD[i] = 1 **OR** (LV_IPLSL_VLD[i] = 0 **AND** LV_VLS_UP_VLD[i] = 0)]
AND LV_DIAG_ACT_INH_LSL_UP[i] = 0
AND FAC_MV_DIAG_DYN_LSL_UP[i] < C_FAC_DYN_INT_ACT_LSL_UP
THEN
LV_DIAG_ACT_CDN_LSL_UP[i] = 1
ELSE
LV_DIAG_ACT_CDN_LSL_UP[i] = 0
ENDIF

% First Part: Fast detection of no sensor activity
% counter management

IF(1b) LV_DIAG_ACT_CDN_LSL_UP[i] = 1
IF(2a) VLS_UP_DIAG[i] < C_VLS_UP_AFS_MIN_PLAUS_LSL_UP
OR(2a) VLS_UP_DIAG[i] > C_VLS_UP_AFS_MAX_PLAUS_LSL_UP
THEN(2a) *% no raw symptom is present*
IF(3a) CTR_RAW_ACT_END_LSL_UP[i] < C_CTR_RAW_ACT_END_LSL_UP
THEN(3a)
increment CTR_RAW_ACT_END_LSL_UP[i] *with* ID_CTR_INC_RAW_ACT_LSL_UP
ENDIF(3a)
decrement CTR_RAW_ACT_SYM_LSL_UP[i] *with* ID_CTR_INC_RAW_ACT_LSL_UP
ELSE(2a) *% raw symptom is present*
IF(3b) CTR_RAW_ACT_SYM_LSL_UP[i] < C_CTR_RAW_ACT_SYM_LSL_UP
THEN(3b)
increment CTR_RAW_ACT_SYM_LSL_UP[i] *with* ID_CTR_INC_RAW_ACT_LSL_UP
ENDIF(3b)
ENDIF(2a)

% end flag and symptom flag management
% diagnosis has come to an end without any raw symptom present
IF(2b) CTR_RAW_ACT_END_LSL_UP[i] >= C_CTR_RAW_ACT_END_LSL_UP
THEN(2b)

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```
        LV_DIAG_RAW_ACT_END_LSL_UP[i] = 1
    END(2b)
    % raw symptom is detected and sensor non-activity detailed check is triggered
    IF(2c) CTR_RAW_ACT_SYM_LSL_UP[i] >= C_CTR_RAW_ACT_SYM_LSL_UP
    THEN(2c)
        LV_DIAG_RAW_ACT_SYM_LSL_UP[i] = 1
        LV_DIAG_RAW_ACT_END_LSL_UP[i] = 1
    ELSEIF(2c)
        % short excursion from critical window should not lead to an immediate reset of the raw symp-
        tom flag
        CTR_RAW_ACT_SYM_LSL_UP[i] < C_CTR_RAW_ACT_RST_LSL_UP
    THEN(2c)
        LV_DIAG_RAW_ACT_SYM_LSL_UP[i] = 0
    END(2c)
END(1a)

    %   Second Part: Monitoring upstream sensor integral deviation
    % Checking the long term conditions enabling the integral deviation monitor
IF(1b) LV_DIAG_ACT_CDN_LSL_UP[i] = 1 AND LV_DIAG_RAW_ACT_END_LSL_UP[i] = 1
THEN(1b)
    % Checking the short term conditions enabling the integral deviation monitor
    IF(2d)    LV_LAMB_PLS_ACT[i] = 1
    AND(2d)         T_SUM_AFL_AFR_CYC[i] > C_T_SUM_AFL_AFR_ACT_LSL_UP
    AND(2d)         LAMB_SP_DE_PLS > C_LAMB_SP_DE_PLS_ACT_LSL_UP
    AND(2d)         MAF_KGH > C_MAF_KGH_MIN_ACT_LSL_UP
    AND(2d)          N_32 > C_N_MIN_ACT_LSL_UP
    AND(2d)         LV_LS_DOWN_READY[i] = 1
    THEN(2d)
            LV_DIAG_ACT_SHO_CDN_LSL_UP[i] = 1
    ELSE(2d)
            LV_DIAG_ACT_SHO_CDN_LSL_UP[i] = 0
    ENDIF(2d)

    % reset counter
    IF(2e)    LV_DIAG_RAW_ACT_SYM_LSL_UP[i] 0 -> 1
    OR(2e)  LV_DIAG_RAW_ACT_SYM_LSL_UP[i] 1 -> 0
    THEN(2e)
        reset CTR_LAMB_DE_INT_ACT_LSL_UP[i]
        reset  CTR_SYM_ACT_LSL_UP[i]
        reset LV_DIAG_ACT_SYM_LSL_UP[i]
        reset  LAMB_DE_INT_ACT_LSL_UP[i]
    ENDIF(2e)

    % activation of the integral deviation monitor
  LAMB_MMV_ACT_LSL_UP[i] (new) =
            LAMB_MMV_ACT_LSL_UP[i] (old) * (1-C_CRLC_ACT_LSL_UP) +
            C_CRLC_ACT_LSL_UP * LAMB_LS_UP[i]

  IF  (2f)    LV_DIAG_ACT_SHO_CDN_LSL_UP[i] = 1
  THEN (2f)
        IF(3f) LV_AFL[i] = 0 -> 1
        THEN(3f)
```

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```
IF(4f) LV_DIAG_RAW_ACT_SYM_LSL_UP[i] = 0
THEN(4f)          % no raw symptom present => no failure case
        IF(5f) CTR_END_ACT_LSL_UP[i] <
                    (C_CTR_LAMB_DE_INT_ACT_LSL_UP + 1) *
                    C_CTR_SYM_MAX_ACT_LSL_UP/C_CTR_SYM_INC_ACT_LSL_
UP
                % to mirror the time span needed to detect a sensor with no activity,
        the  time delay of the first part has to be considered here, too (RBM require
        ment).
                THEN(5f)
                        increment CTR_END_ACT_LSL_UP[i]
        ELSE(5f)
                        LV_DIAG_ACT_END_LSL_UP = 1
        ENDIF(5f)
ELSE(4f) % raw symptom present => failure case
        % freeze CTR_END_ACT_LSL_UP[i]
        IF(5g) CTR_LAMB_DE_INT_ACT_LSL_UP[i] <
                C_CTR_LAMB_DE_INT_ACT_LSL_UP
        THEN(5g)
                        increment CTR_LAMB_DE_INT_ACT_LSL_UP[i]
        ELSE(5g)
                % analysis of the deviation integral is only performed after the raw symptom
                is constantly present for C_CTR_LAMB_DE_INT_ACT_LSL + 1 times.
                        LAMB_DE_TOT_ACT_LSL_UP[i] = LAMB_DE_INT_ACT_LSL_
UP[i]
                LAMB_DE_INT_ACT_LSL_UP[i] = 0
                CTR_LAMB_DE_INT_ACT_LSL_UP[i] = 0
                IF(6f)  LAMB_DE_TOT_ACT_LSL_UP[i]  ≤
                                C_LAMB_DE_TOT_ACT_LSL_UP
                THEN(6f) % deviation integral is low => possible failure
                        IF(7f) CTR_SYM_ACT_LSL_UP[i] <
                                C_CTR_SYM_MAX_ACT_LSL_UP
                        THEN(7f)
                                increment CTR_SYM_ACT_LSL_UP[i] with
                                C_CTR_SYM_INC_ACT_LSL_UP
                        ENDIF(7f)
                ELSE(6f) %deviation integral is sufficiently high => failure unlikely
                        IF(7g) CTR_SYM_ACT_LSL_UP[i] >
                                C_CTR_SYM_DEC_ACT_LSL_UP
                        THEN(7g)
                                decrement CTR_SYM_ACT_LSL_UP[i] with
                                C_CTR_SYM_DEC_ACT_LSL_UP
                        ENDIF(7g)
                ENDIF(6f)
                IF(6g)    CTR_SYM_ACT_LSL_UP[i] <=                    C_
                CTR_SYM_DEC_ACT_LSL_UP
                THEN(6g)
                        LV_DIAG_ACT_SYM_LSL_UP[i] = 0
                ELSEIF(6g) CTR_SYM_ACT_LSL_UP[i] >=                   C_
                CTR_SYM_MAX_ACT_LSL_UP
                        LV_DIAG_ACT_SYM_LSL_UP[i] = 1
                        LV_DIAG_ACT_END_LSL_UP[i] = 1
                ENDIF(6g)
```

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ENDIF(5g)
ENDIF(4f)
ELSE(3f)
LAMB_DE_LSL[i] = | LAMB_LS_UP[i] - LAMB_MMV_ACT_LSL_UP[i] |
LAMB_DE_INT_ACT_LSL_UP[i] (new) = LAMB_DE_INT_ACT_LSL_UP[i](old) +
LAMB_DE_LSL[i] * ID_LAMB_GAIN_VLS_DOWN * ID_LAMB_GAIN_LS_UP_DYN
ENDIF(3f)
ELSE(2f) *%short term conditions for activation of the integral deviation monitor not fulfilled*
Freeze CTR_LAMB_DE_INT_ACT_LSL_UP[i]
Freeze LAMB_DE_INT_ACT_LSL_UP[i]
ENDIF(2f)
ENDIF(1b)

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B.19 O2 sensor (lin, up) activity diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_ACT_INH_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "Activity Diagnosis"					

Input data:

LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}
LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}	LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}
LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}
LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_PLAUS {p. 1062}
LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}
LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_TPS {p. 4982}
LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_IGK {p. 906}	LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}
LV_N_LIM_ETC_LIH {p. 4982}	NC_CBK_EX_NR {p. 1829}		

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FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
  i = 1, for exhaust cylinder bank 1
  i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
    i = 1, for single exhaust cylinder bank.

Application conditions

Initialisation: at every transition LV_IGK = 0 -> 1or reset all variables shall be reset to 0.

at every transition LV_IGK = 1 -> 0 LV_DIAG_ACT_INH_LSL_UP[i] = 1

Recurrence: The functions shall be carried out once every 1s.

Activation:
LV_IGK = 1
Deactivation:
LV_IGK = 0

Formula Section:

This function has to be deactivated, if at least one of the following errors /special modes is active.

IF LV_LS_UP_OBD_2_MAN_DEAC[i] = 1 **OR**
LV_N_LIM_ETC_LIH = 1 **OR**
LV_ERR_CHG_LS_UP = 1 **OR**
LV_ERR_DIAGCPS = 1 **OR**
LV_ERR_EL_CPS = 1 **OR**
LV_ERR_FUP = 1 **OR**
LV_ERR_FUP_MFP_PLAUS = 1 **OR**
LV_ERR_FUP_ORNG = 1 **OR**
LV_ERR_FUP_ST = 1 **OR**
LV_ERR_H_PRS_SYS = 1 **OR**
LV_ERR_LOAD_TPS_PLAUS = 1 **OR**
LV_ERR_MAF = 1 **OR**
LV_ERR_MAP_PLAUS = 1 **OR**
LV_ERR_MAP_TPS_PLAUS = 1 **OR**
LV_ERR_MTC_CTL_2 = 1 **OR**
LV_ERR_MTC_CTL_3 = 1 **OR**
LV_ERR_MTC_DR = 1 **OR**
LV_ERR_TPS = 1 **OR**
LV_ERR_VCV = 1 **OR**
LV_ERR_AIR_LSL_UP[i] = 1 **OR**
LV_ERR_CTL_LSL_UP[i] = 1 **OR**
LV_ERR_DELTA_I_LAM[i] = 1 **OR**
LV_ERR_DYN_VLD_LS_UP[i] = 1 **OR**
LV_ERR_EL_LSL_UP[i] = 1 **OR**
LV_ERR_LSH_UP[i] = 1 **OR**
LV_ERR_LSL_UP_IF[i] = 1 **OR**
LV_ERR_OFS_LSL_UP[i] = 1 **OR**
LV_ERR_SHIFT_AFL_LSL_UP[i] = 1 **OR**
LV_ERR_SHIFT_AFR_LSL_UP[i] = 1 **OR**
LV_ERR_VLS_DOWN_DIF[i] =1 **OR**
(i = 1 **AND**
[LV_ERR_IV[0] **OR**
LV_ERR_IV[2] **OR**
LV_ERR_IV[4] **OR**
LV_ERR_MIS[0] **OR**
LV_ERR_MIS[2] **OR**
LV_ERR_MIS[4]
]) **OR**
(i = 2 **AND**
[LV_ERR_IV[1] **OR**
LV_ERR_IV[3] **OR**

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```
            LV_ERR_IV[5]          OR
            LV_ERR_MIS[1]         OR
            LV_ERR_MIS[3]         OR
            LV_ERR_MIS[5]
    ])
```

THEN
LV_DIAG_ACT_INH_LSL_UP[i] = 1
ELSE
LV_DIAG_ACT_INH_LSL_UP[i]= 0
ENDIF

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B.20 O2 sensor (lin, up) controller offset diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_CTL_LSL_UP [NC_CBK_EX_NR]	V	0... FH	0... 15	1	-
Condtions to run the pump current controller diagnosis for the WRAF sensor controller					
CTR_OFS_ADJ_CMPL [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
number of completed offset adjustments					
ERR_DIAG_CTL_LSL_UP [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom of pump current controller fault on the upstream WRAF sensor controller					
ERR_SYM_OFS_LSL_UP [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom of offset correction error on the upstream WRAF sensor					
LV_CDN_DIAG_OFS_LSL_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Condtions to run the offset diagnosis of the upstream WRAF sensor controller					
LV_END_DIAG_CTL_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End flag of the pump current controller diagnosis for WRAF sensor controller					
LV_END_DIAG_OFS_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Result of present diagnostis status is valid					
LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced result of pump current controller diagnosis					
LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced diagnosis value caused by an offset correction error of the WRAF Sensor controller					
LV_LSL_OFS_ADJ_DIAG_OFS_OLD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Value of LV_LS_OFS_ADJ_ACT from last recurrence of the WRAF controller offset diagnosis					
T_DIAG_ACT_OFS [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
time offset adjustment is active					

Input data:

CDN_DIAG_CTL_LSL_DI [NC_CBK_EX_NR] {p. 5255}	CDN_DIAG_CTL_LSL_INH [NC_CBK_EX_NR] {p. 5255}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_ICPLSL_ENA_LSL_IF [NC_CBK_EX_NR] {p. 2351}
LV_IGK {p. 906}	LV_INH_DIAG_OFS_LSL [NC_CBK_EX_NR] {p. 5255}	LV_IPLSL_CTL_ENA_LSL_IF [NC_CBK_EX_NR] {p. 2351}	LV_IPLSL_CTL_ENA_PLS_ACT [NC_CBK_EX_NR] {p. 2351}
LV_LSL_OFS_ADJ_ACT [NC_CBK_EX_NR] {p. 2313}	LV_TTIP_MES_VLD_LS_UP [NC_CBK_EX_NR] {p. 1320}	LV_VLS_OFS_ADJ_CMPL [NC_CBK_EX_NR] {p. 2314}	LV_VLS_OFS_LIM_LSL [NC_CBK_EX_NR] {p. 2314}

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LV_VLS_OFS_LIM_LSL_L_GAIN [NC_CBK_EX_NR] {p. 2314}	LV_VNLSL_LIM [NC_CBK_EX_NR] {p. 955}	LV_VPLSL_LIM [NC_CBK_EX_NR] {p. 955}	NC_CBK_EX_NR {p. 1829}
STATE_ERR_IPLSL [NC_CBK_EX_NR] {p. 955}	TTIP_MES_LS_UP [NC_CBK_EX_NR] {p. 1321}	VLS_UP_DIAG [NC_CBK_EX_NR] {p. 2315}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_DIAG_CTL_LSL_UP [NC_CBK_EX_NR]	-	0... FFH	0... 255	1	-
Antibounce counter increment of pump current controller diagnosis					
C_ABC_INC_DIAG_OFS_LSL_UP [NC_CBK_EX_NR]	-	0... FFH	0... 255	1	-
Antibounce counter increment of offset adjustment diagnosis					
C_ABC_MAX_DIAG_CTL_LSL_UP [NC_CBK_EX_NR]	-	1... FFH	1... 255	1	-
Maximumvalue for antibounce counter of pump current controller diagnosis					
C_ABC_MAX_DIAG_OFS_LSL_UP [NC_CBK_EX_NR]	-	1... FFH	1... 255	1	-
Maximumvalue for antibounce counter of offset adjustment diagnosis					
C_LAMB_SP_MAX_DIAG_CTL_LSL_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Maximum lambda setpoint to execute pump current controller diagnosis					
C_LAMB_SP_MIN_DIAG_CTL_LSL_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Minimum lambda setpoint to execute pump current controller diagnosis					
C_T_DIAG_ACT_OFS_MAX	-	0... FFFFH	0... 655.35	0.01	s
Maximum allowed duration of offset adjustment					
C_TTIP_MAX_DIAG_CTL_LSL_UP	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Maximum sensor tip temperature to allow pump current controller diagnosis					
C_TTIP_MIN_DIAG_CTL_LSL_UP	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Minimum sensor tip temperature to allow pump current controller diagnosis					
C_VLS_UP_MAX_DIAG_CTL_LSL_UP	-	8000... 7FFFH	-160... 159.99511	4.8828e-3	V
Upper end of blind spot for pump current controller diagnosis					
C_VLS_UP_MIN_DIAG_CTL_LSL_UP	-	8000... 7FFFH	-160... 159.99511	4.8828e-3	V
Lower end of blind spot for pump current controller diagnosis					

Import actions:

ACTION_ERRM_FilterMulticonditio (**IN**<PRM_IDX_DIAG>,**IN**<PRM_CDN_DIAG>,**IN**<PRM_ERR_DIAG>,**IN**<PRM_ABC_INC>, **IN**<PRM_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

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Error treatment:

Diagnostic OFS_LSL_UP[i]	Symptom description	Symptom	Filter type
Diagnostic description	limitation of offset correction in low gain	SYM_0	STD_INI
	limitation of offset in high gain	SYM_1	
	maximum duration of offset correction exeeded	SYM_2	

Figure B.20.1: Diagnostic

Diagnostic CTL_LSL_UP[i]	Symptom description	Symptom	Filter type
Diagnostic description	Pump current limitation	SYM_0	MPL_STD_INI
	Pump voltage limitation	SYM_1	
	Reference pump current cutoff because of VN overvoltage	SYM_2	

FUNCTION DESCRIPTION:

Application conditions

Initialisation:

At reset and LV_IGK 0 → 1 transition, do the following synchronization with ERRM:
```
ACTION_ERRM_GetLvErr (  in   OFS_LSL_UP_i,
                                out     LV_ERR_OFS_LSL_UP[i])
ACTION_ERRM_GetLvEndDiag ( in OFS_LSL_UP_i,
                                out     LV_END_DIAG_OFS_LSL_
UP[i])
ACTION_ERRM_GetLvErr (  in   CTL_LSL_UP_i,
                                out     LV_ERR_CTL_LSL_UP[i])
ACTION_ERRM_GetLvEndDiag ( in CTL_LSL_UP_i,
                                out     LV_END_DIAG_CTL_LSL_
UP[i])
```
When clearing the error memory, all ERRM related data shall be reset to 0.

Additionally, the following initialization shall be done on all these occasions:
```
CDN_DIAG_CTL_LSL_UP[i] = 0
ERR_DIAG_CTL_LSL_UP[i] = 0
CTR_OFS_ADJ_CMPL[i] = 0
T_DIAG_ACT_OFS[i] = 0
LV_LSL_OFS_ADJ_DIAG_OFS_OLD[i] = 0
```

For activation conditions and recurrences see the individual function blocks.

B.20.1 WRAF Controller Offset Diagnosis

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General information:

This part of the function shall check the performance of the offset adjustment carried out by the WRAF controller. The measured offset should fall within a calibrateable band, and the time taken by an offset adjustment should be shorter than a calibrateable upper limit.
Error Symptoms are defined as follows:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> Limitation of offset correction in low gain            ( = SYM_0)
 │ │ └───> Limitation of offset correction in high gain           ( = SYM_1)
 │ └─────> Exceeded maximum duration of offset correction         ( = SYM_2)
 └───────> (not used)
```

Recurrence:

The function shall be carried out once every 10ms.

Activation: LV_INH_DIAG_OFS_LSL[i] = 0 **and**
(LV_LSL_OFS_ADJ_DIAG_OFS_OLD[i] = 1 **or**
LV_LSL_OFS_ADJ_ACT[i] = 1)

Formula section:

If(*1*) LV_LSL_OFS_ADJ_ACT[i] = 1
then(*1*) *Increment* T_DIAG_ACT_OFS[i]
else(*1*) *Reset* T_DIAG_ACT_OFS[i]
endif(*1*)
LV_LSL_OFS_ADJ_DIAG_OFS_OLD[i] = LV_LSL_OFS_ADJ_ACT[i]

Setting the symptoms:

if (*1*) LV_VLS_OFS_ADJ_CMPL[i] 0 -> 1
then (*1*) LV_CDN_DIAG_OFS_LSL_UP[i] = 1
Reset T_DIAG_ACT_OFS[i]
Increment CTR_OFS_ADJ_CMPL[i]
if (*2*) LV_VLS_OFS_LIM_LSL_L_GAIN[i] = 1
then (*2*) ERR_SYM_OFS_LSL_UP[i] = SYM_0 % "offset correction limitation low gain"
elseif (*2*) LV_VLS_OFS_LIM_LSL[i] = 1
then (*2*) ERR_SYM_OFS_LSL_UP[i] = SYM_1 % "offset correction limitation high gain"
else (*2*) ERR_SYM_OFS_LSL_UP[i] = NO_SYM % "offset correction works normal"
endif (*2*)
elseif (*1*) T_DIAG_ACT_OFS[i] >= C_T_DIAG_ACT_OFS_MAX
then (1) LV_CDN_DIAG_OFS_LSL_UP[i] = 1
ERR_SYM_OFS_LSL_UP[i] = SYM_2 % "offset correction maximum duration exceeded"
else (*1*) LV_CDN_DIAG_OFS_LSL_UP[i] = 0
endif (*1*)

Symptoms are **unchanged** if condition for doing symptom detection is not fulfilled.

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Calling the generic error management for anti-bounce filtering and update of the outputs:

```
ACTION_ERRM_FilterSymptom (      in    OFS_LSL_UP_i,
                                 in    LV_CDN_DIAG_OFS_LSL_UP[i],
                                 in    ERR_SYM_OFS_LSL_UP[i],
                                 in    C_ABC_INC_DIAG_OFS_LSL_UP[i],
                                 in    1,
                                 in    C_ABC_MAX_DIAG_OFS_LSL_UP[i],
                                 out   LV_ERR_OFS_LSL_UP[i])
ACTION_ERRM_GetLvEndDiag (       in    OFS_LSL_UP_i,
                                 out   LV_END_DIAG_OFS_LSL_UP[i])
```

B.20.2 WRAF Controller Limitation Diagnosis

General information:

This part of the function shall check the performance of the pump current controller and (if used) the reference pump current generator in the WRAF sensor controller. For this, the pump current, pump voltage and nernst overvoltage diagnostic flags read out from the controller by the BSW are checked.
Since the flags are also set if there is an open circuit in one or more of the sensor lines, the diagnosis must only operate under conditions that exclude an open circuit. Hence the checks for tip temperature and VLS_UP_DIAG limits.
To disable monitoring for the individual flags based on driving conditions, the corresponding bit in CDN_DIAG_CTL_LSL_INH[i] should be set. To turn off a monitor permanently, the bit in CDN_DIAG_CTL_LSL_DI[i] must be set instead, otherwise the diagnosis end bit will never be set.

Error Symptoms are defined as follows:

```
[ | | | ]
 |  |  |  └─> Limitation of pump current                                  ( = SYM_0)
 |  |  └────> Limitation of pump voltage                                  ( = SYM_1)
 |  └───────> VN voltage too high for reference pump current generation   ( = SYM_2)
 └──────────> (not used)
```

Recurrence:

The function shall be carried out once every 10ms.

Activation: LV_IPLSL_CTL_ENA_LSL_IF[i] = 1 **and**
(CDN_DIAG_CTL_LSL_INH[i].bit_x = 0 and
CDN_DIAG_CTL_LSL_DI[i].bit_x = 0) for any x = 0...2

Formula section:

If LV_IPLSL_CTL_ENA_PLS_ACT[i] = 0
and C_LAMB_SP_MIN_DIAG_CTL_LSL_UP <= LAMB_SP[i]
and LAMB_SP[i] <= C_LAMB_SP_MAX_DIAG_CTL_LSL_UP
and LV_TTIP_MES_VLD_LS_UP[i]
and TTIP_MES_LS_UP[i] > C_TTIP_MIN_DIAG_CTL_LSL_UP
and C_TTIP_MAX_DIAG_CTL_LSL_UP > TTIP_MES_LS_UP[i]
and (VLS_UP_DIAG[i] < C_VLS_UP_MIN_DIAG_CTL_LSL_UP
or C_VLS_UP_MAX_DIAG_CTL_LSL_UP < VLS_UP_DIAG[i])

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then (1)
% Exclude conditions that may indicate open circuit faults to avoid false CTL_LSL_UP entries.
If CDN_DIAG_CTL_LSL_DI[i].bit_0 = 0
and STATE_ERR_IPLSL [i] != NO_SYM
then (2a)
Set "SYM_0" in ERR_DIAG_CTL_LSL_UP[i]
%pump current above limits allowed by hardware
Else (2a)
Clear "SYM_0" in ERR_DIAG_CTL_LSL_UP[i]
%pump current OK
Endif (2a)

If CDN_DIAG_CTL_LSL_DI[i].bit_1 = 0
and LV_VPLSL_LIM[i] = 1
then (2b)
Set "SYM_1 in ERR_DIAG_CTL_LSL_UP[i]"
%pump voltage above limits allowed by hardware
Else (2b)
Clear "SYM_1" in ERR_DIAG_CTL_LSL_UP[i]
%pump voltage OK
Endif (2b)

If CDN_DIAG_CTL_LSL_DI[i].bit_2 = 0
and LV_VNLSL_LIM[i] = 1
and LV_ICPLSL_ENA_LSL_IF[i] = 1
then (2c)
Set "SYM_2" in ERR_DIAG_CTL_LSL_UP[i]
%voltage at VN too high for correct generation of reference pump current
Else (2c)
Clear "SYM_2" in ERR_DIAG_CTL_LSL_UP[i]
%voltage at VN OK
Endif (2c)
% now generate the conditions for the ERRM multi-condition filter call. Bits 0, 1 and 2 in
% CDN_DIAG_CTL_LSL_DI/INH[i] correspond to the condition for SYM_0, SYM_1
% and SYM_2 respectively, as denoted by the suffix _x below.
If CDN_DIAG_CTL_LSL_DI[i].bit_x = 1
or CDN_DIAG_CTL_LSL_INH[i].bit_x = 0
then (2d)
Diagnostic conditions for SYM_x are fulfilled
Else (2d)
Diagnostic conditions for SYM_x are not fulfilled
Endif (2d)
Else (1)
%no diagnostic result is available
Diagnostic conditions for SYM_0, SYM_1 and SYM_2 not fulfilled
Endif (1)

Calling the generic error management for anti-bounce filtering and update of the outputs:
ACTION_ERRM_FilterMulticonditio (in CTL_LSL_UP_i,
in CDN_DIAG_CTL_LSL_UP[i],
in ERR_DIAG_CTL_LSL_UP[i],
in C_ABC_INC_DIAG_CTL_LSL_UP[i],
in C_ABC_MAX_DIAG_CTL_LSL_UP[i],
out LV_ERR_CTL_LSL_UP[i])

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ACTION_ERRM_GetLvEndDiag (in CTL_LSL_UP_i,
out LV_END_DIAG_CTL_LSL_UP[i])

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B.21 O2 sensor (lin, up) controller offset diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CDN_DIAG_CTL_LSL_DI [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Permanently disabled monitors for the pump current controller diagnosis					
CDN_DIAG_CTL_LSL_INH [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Temporarily inhibited monitors for the pump current controller diagnosis					
LV_INH_DIAG_CTL_LSL_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Inhibition condition for the pump current controller diagnosis					
LV_INH_DIAG_OFS_LSL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the Offset adjustment diagnosis					

Input data:

LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FTL_MIN {p. 4762}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}
LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}
LV_VB_CDN_OBD_2 {p. 1046}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CDN_DIAG_CTL_LSL_DI	-	0... FFH	0... 255	1	-
Constant for permanently disable monitors for the pump current controller diagnosis					

Error treatment:

Diagnostic XX	Symptoms	Ref.	DTC Symptom SAE	DTC Symptom Customer	DTC Global SAE	DTC Global Customer	Failure class A/B	Readiness code
Diagnostic description	1st symptom description	SYM_0			P2A00			CARB_LS
	2nd symptom description	SYM_1			P2A01			
	3rd symptom description	SYM_2						

Figure B.21.1: Diagnostic

Diagnostic XX	Symptoms	Ref.	DTC Symptom SAE	DTC Symptom Customer	DTC Global SAE	DTC Global Customer	Failure class A/B	Readiness code
Diagnostic description	1st symptom description	SYM_0			P21xx			CARB_LS
	2nd symptom description	SYM_1			P21xx			
	3rd symptom description	SYM_2						

Fields information (For more information refer to Error Management file Table of Failure) :

- DTC Symptom : give for each symptom the corresponding DTC. According to the configuration one or two fields are possible (In our table one is for CARB the other for customer)

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- DTC Global : recommended DTC value, it may be the code defined by the law. According to the configuration two fields are possible (In our table one is for CARB the other for customer)
- Failure class parameter for calibrating the behaviour of the Error management for this failure. The failure class values are described in Error management aggregate.
- Readiness code : put the corresponding readiness group code.

FUNCTION DESCRIPTION:

General information:

The flag LV_INH_DIAG_OFS_LSL allows to deactivate the corresponding diagnostic.

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Description:

Application conditions:

Initialisation:
The following data shall be set to 0 at LV_IGK 0->1 or at ECU reset or at clearing error memory:
LV_INH_DIAG_OFS_LSL[i] = 0
LV_INH_DIAG_CTL_LSL_UP[i] = 0
CDN_DIAG_CTL_LSL_DI[i] = C_CDN_DIAG_CTL_LSL_DI
CDN_DIAG_CTL_LSL_INH[i] = 0

The following data shall be set to 1 at LV_IGK 1->0:
LV_INH_DIAG_OFS_LSL[i] = 1
LV_INH_DIAG_CTL_LSL_UP[i] = 1

Recurrence: 10ms

Activation: LV_IGK = 1

Deactivation: LV_IGK = 0

Formula section:

```
IF      LV_LS_UP_OBD_2_MAN_DEAC[i] = 1     OR
        LV_VB_CDN_OBD_2 = 0                OR
        LV_ERR_LSL_UP_IF[i] = 1            OR
        LV_ERR_EL_LSL_UP[i] = 1
THEN    LV_INH_DIAG_OFS_LSL[i] = 1
ELSE    LV_INH_DIAG_OFS_LSL[i] = 0
ENDIF
```

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If LV_LS_UP_OBD_2_MAN_DEAC[i] = 1 **OR**
LV_VB_CDN_OBD_2 = 0 **OR**
LV_ERR_FTL_MIN = 1 **OR**
LV_ERR_EL_LSL_UP[i] = 1 **OR**
LV_ERR_LSL_UP_IF[i] = 1 **OR**
LV_ERR_OFS_LSL_UP[i] = 1 **OR**
LV_ERR_OBD_VLD_LSH_UP[i] = 1 **OR**
LV_ERR_OC_LSL_UP[i] = 1 **OR**
LV_ERR_LSH_UP[i] = 1
then
LV_INH_DIAG_CTL_LSL_UP[i] = 1
Else
LV_INH_DIAG_CTL_LSL_UP[i] = 0
Edif

If LV_INH_DIAG_CTL_LSL_UP[i] = 1
then
% inhibition may be changed dynamically here.
% Disable flags should never be changed, since this would fake a premature end of the diagnosis!
CDN_DIAG_CTL_LSL_INH[i] = 00000111_{bin}
ELSE
CDN_DIAG_CTL_LSL_INH[i] = 0
Endif

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B.22 O2 sensor (lin,up) delay diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_AFL_AFR_CYC_DLY [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter of single AFL/AFR cycles					
CTR_AFL_AFR_CYC_DLY_MMV [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter of AFL/AFR cycle series					
CTR_DLY_DIAG_ACT_CDN_DYN	V	0... FFH	0... 255	1	-
Counter for deleay of activation due to dynamic conditions					
FAC_DLY_DIAG_LSL [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	-
Single O2L factor					
FAC_DLY_DIAG_LSL_AMPL_MV [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	-
Average amplitude of the diagnosis factor					
FAC_DLY_DIAG_LSL_MAX [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	-
Maximal delay factor over complete diagnosis					
FAC_DLY_DIAG_LSL_MAX_MV [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	-
Average maximal diagnosis factor over more AFL/AFR series					
FAC_DLY_DIAG_LSL_MIN_MV [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	-
Average minimal diagnosis factor over more AFL/AFR series					
FAC_DLY_DIAG_LSL_OUT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Linear sensor signal delay diagnosis final value					
FAC_DLY_DIAG_TMP_MAX [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	-
Maximal diagnosis factor over defined number AFL/AFR cycles (serie)					
FAC_DLY_DIAG_TMP_MAX_SUM [NC_CBK_EX_NR]	V	8000... 7FFFH	-400... 399.987792969	0.012207	-
Sum of maximal diagnosis factor over defined number AFL/AFR cycles (series)					
FAC_DLY_DIAG_TMP_MIN [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	-
Minimal diagnosis factor over defined number AFL/AFR cycles (series)					
FAC_DLY_DIAG_TMP_MIN_SUM [NC_CBK_EX_NR]	V	8000... 7FFFH	-400... 399.987792969	0.012207	-
Sum of minimal diagnosis factor over defined number AFL/AFR cycles (series)					
FAC_LAM_TMP_MMV_DIAG [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Filtered selected controller output for the diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DLY_DIAG_ACT_CDN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation condition for the linear sensor signal delay diagnosis					
LV_DLY_DIAG_ACT_CDN_DYN	V	0... 1H	0 ...1	1	-
Dynamic activation condition for the linear sensor signal delay diagnosis					
LV_DLY_DIAG_ACT_CDN_STAT	V	0... 1H	0 ...1	1	-
Static activation condition for the linear sensor signal delay diagnosis					
LV_DLY_DIAG_REQ_LAM_GAIN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request for switch of lambda controller parameters for linear lambda sensor delay diagnosis					
LV_DLY_END_LSL_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Indicator of finished linear sensor signal delay diagnosis					
LV_FAC_DLY_DIAG_MIN_MAX_RST [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for reset of the single MIN/MAX values at calculation of the amplitude					
MAF_KGH_INT_LAM_GAIN_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.66666667	0.0444444	g
MAF_KGH integral for delay of the diagnosis after switch to according controller parameters					
MAF_KGH_LIM_DYN_DLY_ABS	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Absolute value of the MAF limited dynamic					
MAF_KGH_LIM_DYN_DLY_MMV	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Filtered MAF_KGH signal					
N_32_LIM_DYN_DLY_ABS	V	0... FFH	0... 8160	32	rpm
Absolute value of the engine speed limited dynamic					
N_LIM_DYN_DLY_MMV	V	0... 1FE0H	0... 8160	1	rpm
Filtered engine speed for limited dynamic					
O2L_OUT_INT_DLY_DIAG_LSL [NC_CBK_EX_NR]	V	0... FFFFH	0... 20.93479	319.444e-6	g
O2 loading actual value					
T_DLY_ACT_DIAG_LAM_GAIN_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Delay timer of activation of the diagnosis after switch to required lambda controller parameters					
TQI_AV_LIM_DYN_DLY_ABS	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Absolute value of the TQI_AV limited dynamic					
TQI_AV_LIM_DYN_DLY_MMV	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Filtered TQI_AV signal					

Input data:

FAC_LAM_OUT [NC_CBK_EX_NR] {p. 2462}	FAC_LAM_P_LIM [NC_CBK_EX_NR] {p. 2462}	LV_DIAG_EOL_DYN_LS_UP [NC_CBK_EX_NR] {p. 5377}	LV_DLY_DIAG_ACT_LAM_GAIN {p. 5348}
LV_INH_SENS_DLY_DIAG [NC_CBK_EX_NR] {p. 5377}	MAF_FG_CYL {p. 1212}	MAF_KGH {p. 1195}	N {p. 1525}
NC_CBK_EX_NR {p. 1829}	STATE_LAMB_PLS_DET_VALUE {p. 2958}	TQI_AV {p. 981}	VS {p. 1176}

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FAC_LAM_MMV_DIAG	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for controller output filtering for diagnosis					
C_CRLC_MAF_LIM_DYN_DLY	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for MAF filtering					
C_CRLC_N_32_LIM_DYN_DLY	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for engine speed filtering					
C_CRLC_TQI_LIM_DYN_DLY	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for torque value filtering					
C_CTR_AFL_AFR_CYC_DLY	-	0... FFFFH	0... 65535	1	-
Number of single AFL/AFR cycles for single diagnosis value calculation					
C_CTR_AFL_AFR_CYC_DLY_MV	-	0... FFH	0... 255	1	-
Number of AFL/AFR cycle series for average diagnosis value calculation					
C_CTR_LDC_SENS_DIAG_ACT	-	0... FFH	0... 255	1	-
Delay for setting of the limited dynamic conditions once the conditions are true					
C_MAF_KGH_INT_LAM_GAIN_ACT	-	0... FFFFH	0... 2912.66666667	0.0444444	g
Maximum MAF_KGH integral for delay of the diagnosis after switch to according controller parameters					
C_MAF_KGH_INT_LAM_GAIN_ACT_EOL	-	0... FFFFH	0... 2912.66666667	0.0444444	g
Maximum MAF_KGH integral for delay of the diagnosis after switch to according controller parameters at EOL					
C_MAF_KGH_NOM_O2L_INT	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Normalization of the O2L integral regarding MAF_KGH					
C_MAF_THD_LDC_DLY	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
MAF threshold for limited dynamic check					
C_MAF_THD_MAX_DLY	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Upper MAF threshold for activation of the diagnosis					
C_MAF_THD_MIN_DLY	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Lower MAF threshold for activation of the diagnosis					
C_N_32_THD_LDC_DLY	-	0... FFH	0... 8160	32	rpm
N_32 threshold for limited dynamic check					
C_N_32_THD_MAX_DLY	-	0... FFH	0... 8160	32	rpm
Upper N_32 threshold for activation of the diagnosis					
C_N_32_THD_MIN_DLY	-	0... FFH	0... 8160	32	rpm
Lower N_32 threshold for activation of the diagnosis					
C_O2L_OUT_INT_DLY_DIAG_LSL_MAX	-	0... FFFFH	0... 20.93479	319.444e-6	g
Maximum O2 integral to stop the diagnosis earlier and set an error					
C_STATE_DIAG_DET_SEL_DYN	-	0... FFH	0... 255	1	-
Selection of the diagnosis method to set the error flag					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_FAC_LAM_SEL_DYN	-	0... FFH	0... 255	1	-
Selection of the diagnosed signal					
C_STATE_PLS_DET_SEL_DYN	-	0... FFH	0... 255	1	-
Selection of the acivation window for the diagnosis regarding forced stimulation					
C_T_DLY_ACT_LAM_GAIN_ACT	-	0... FFFFH	0... 655.35	0.01	s
Maximum delay of activation of the diagnosis after switch to required lambda controller parameters					
C_T_DLY_ACT_LAM_GAIN_ACT_EOL	-	0... FFFFH	0... 655.35	0.01	s
Maximum delay of activation of the diagnosis after switch to required lambda controller parameters at EOL					
C_TQI_THD_LDC_DLY	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque threshold for limited dynamic check					
C_VS_THD_MIN_DLY	-	0... FFH	0... 255	1	km/h
Lower VS threshold for activation of the diagnosis					
IP_FAC_OPP_FAC_DLY_DIAG	V	0... FFFFH	0... 3.99993896484	61.0352e-6	-
LDP_MAF_KGH_IP_FAC_OPP_DLY_DIAG	6	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_N_IP_FAC_OPP_DLY_DIAG	6	0... 1FE0H	0... 8160	1	rpm
Correction factor depending on operating point					
LC_SWI_SIG_CLC_DIAG	-	0... 1H	0 ...1	1	-
Switch to the controller output signal for calculation of MIN/MAX and amplitude					

General information:

This diagnosis is necessary to recognize delays (especially pure phase shift) of the linear lambda sensor accordingly to OBD requirements.
For the diagnosis the lambda controller output is used. The bigger the oscillations of the signal, bigger will be the diagnosis value.

The diagnosis is covering two concepts:
Evaluation of the integral of the controller output deviation, the integral is representing quasi oxygen loading of the catalyst, which is representing directly the emissions increasing
Evaluation of the absolute amplitude of the controller output

Choice between both these concepts can be done using the LC_SWI_SIG_CLC_DIAG.

Calculation of the O2L integral principle, evaluation of the diagnosed signal when the activation conditions are fulfilled:

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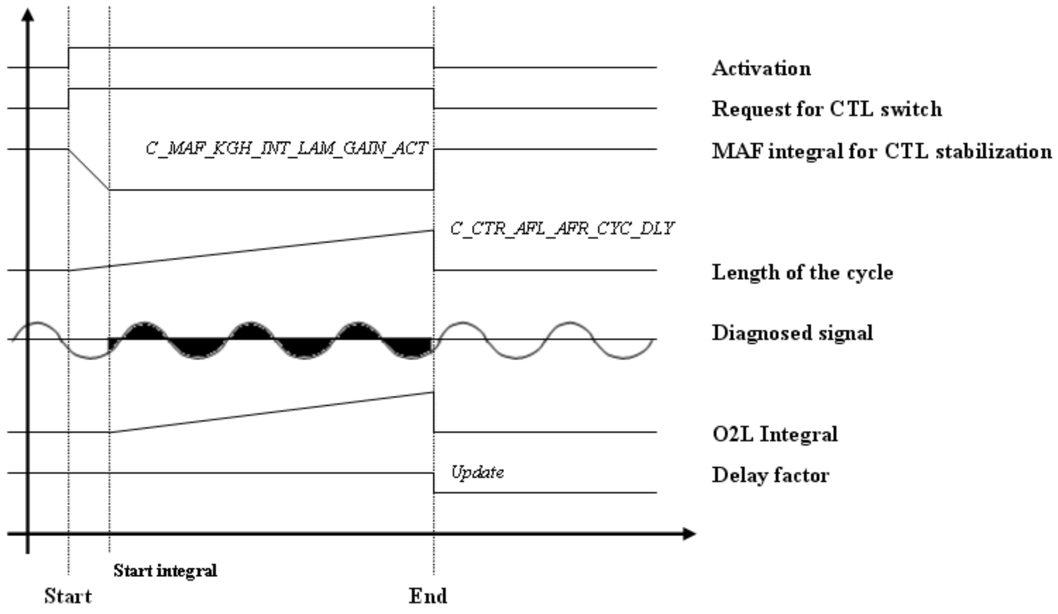

Figure B.22.1: :

Behavior of the single and mean value counters (the Y-axis is different for both counters):

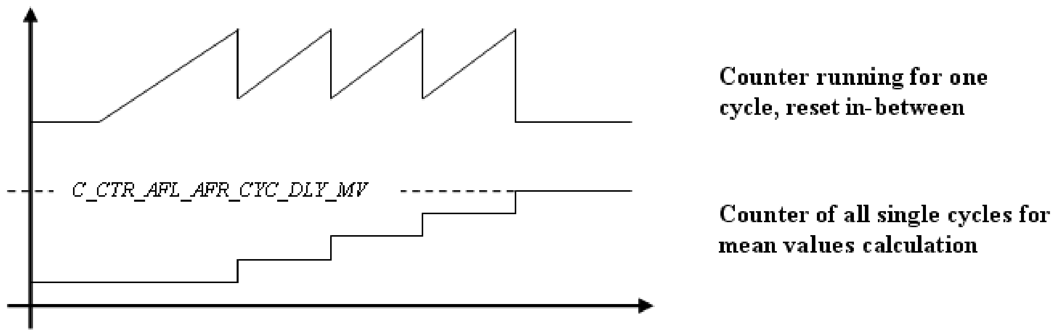

Figure B.22.2: :

Update of the values for calculation of the factor:

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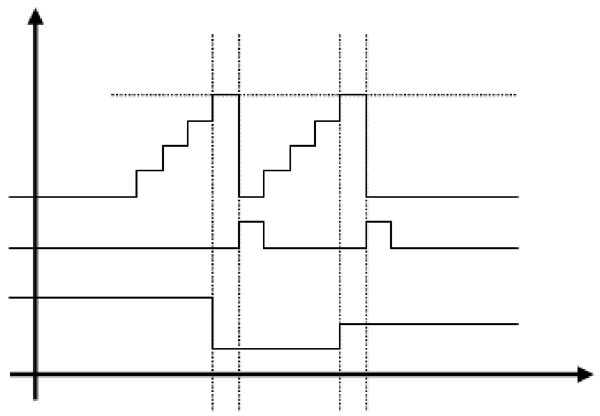

Figure B.22.3: :

Initialization of the MIN/MAX temporary values for both concepts:

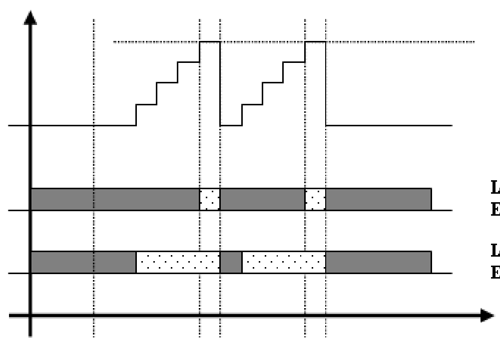

Figure B.22.4: :

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Application conditions:

Initialisation:	`RST, CLRFMY, IGKON`
Recurrence:	`20MS`
Activation:	`always`
Deactivation:	`if activation not true`

Function description:

Formula section:

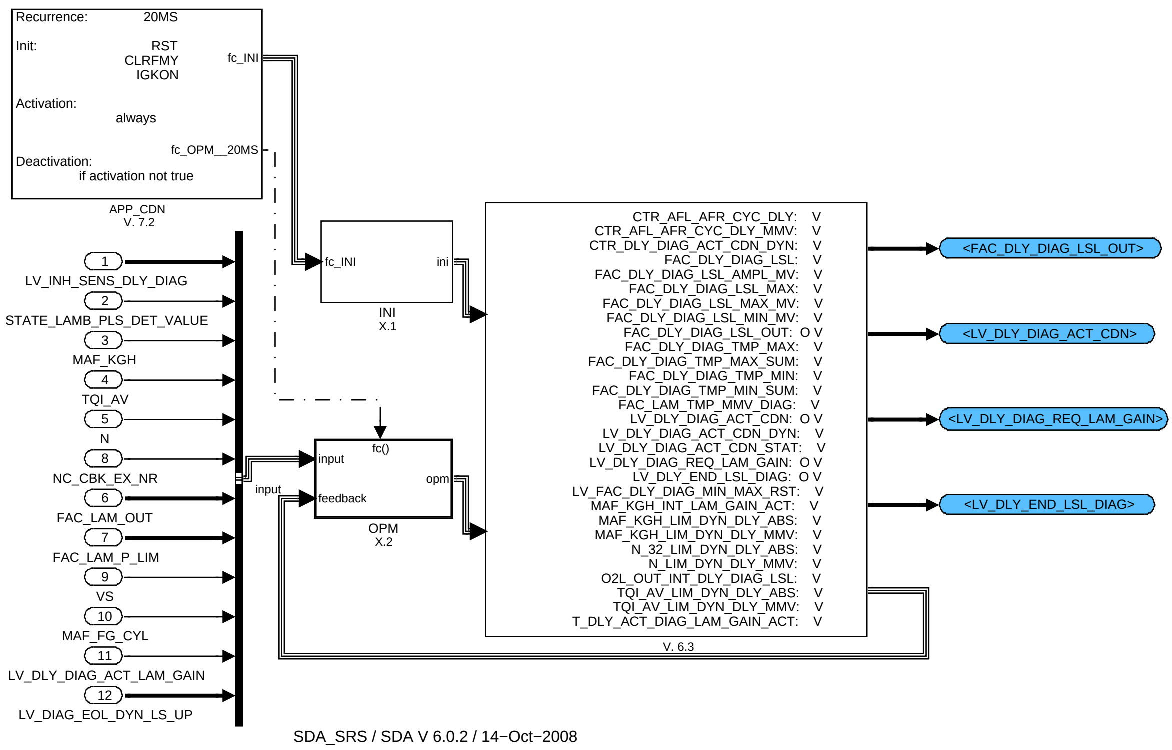

Figure B.22.5: :

B.22.1 INITIALIZATION at RESET, IGKON and CLRFMY

All variables are initialized by "0"

FUNCTION DESCRIPTION

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B.22.2 Calculation of the activation conditions

B.22.2.1 Calculation of the static conditions

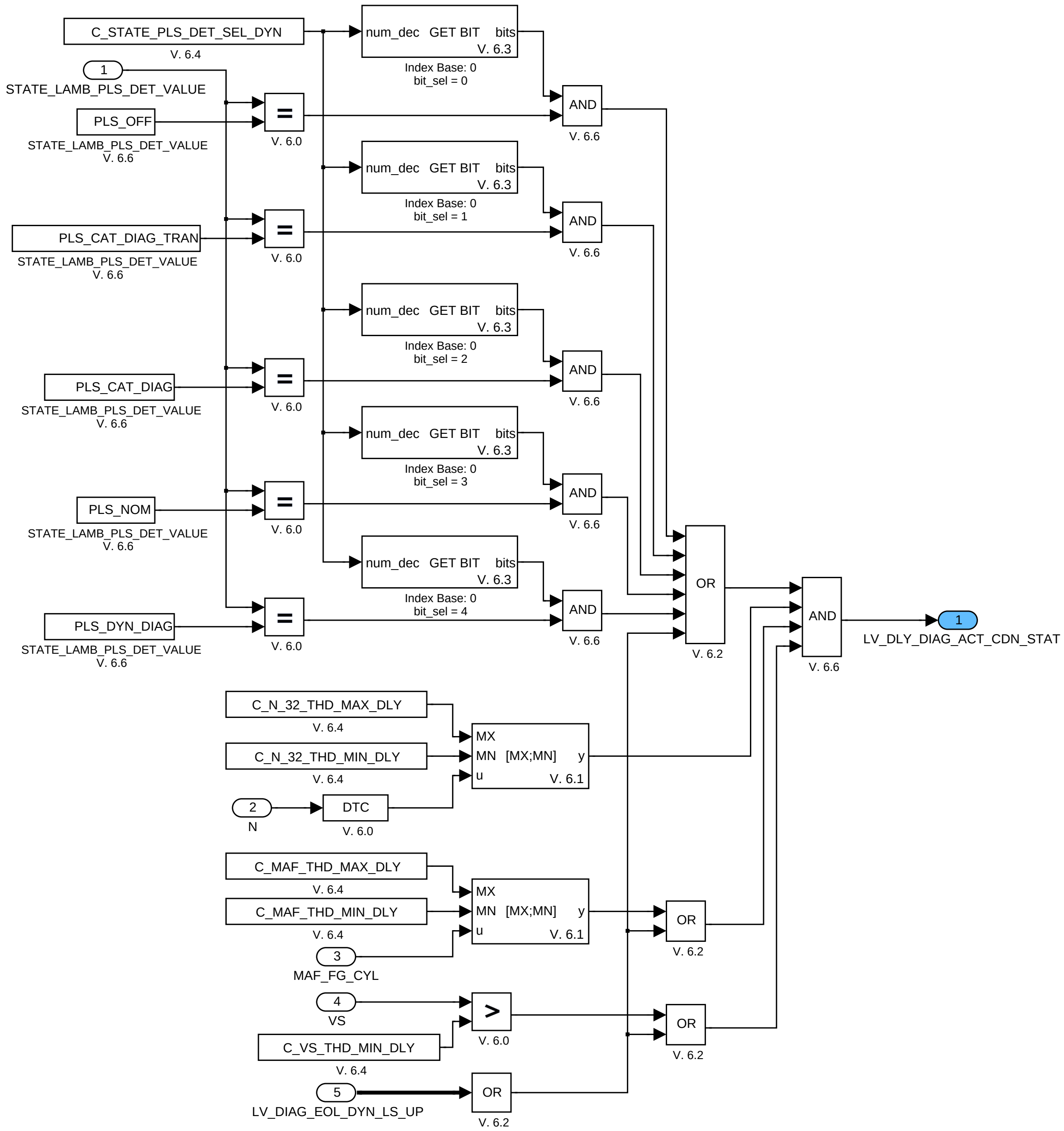

Figure B.22.6: :

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B.22.2.2 Calculation of the dynamic conditions

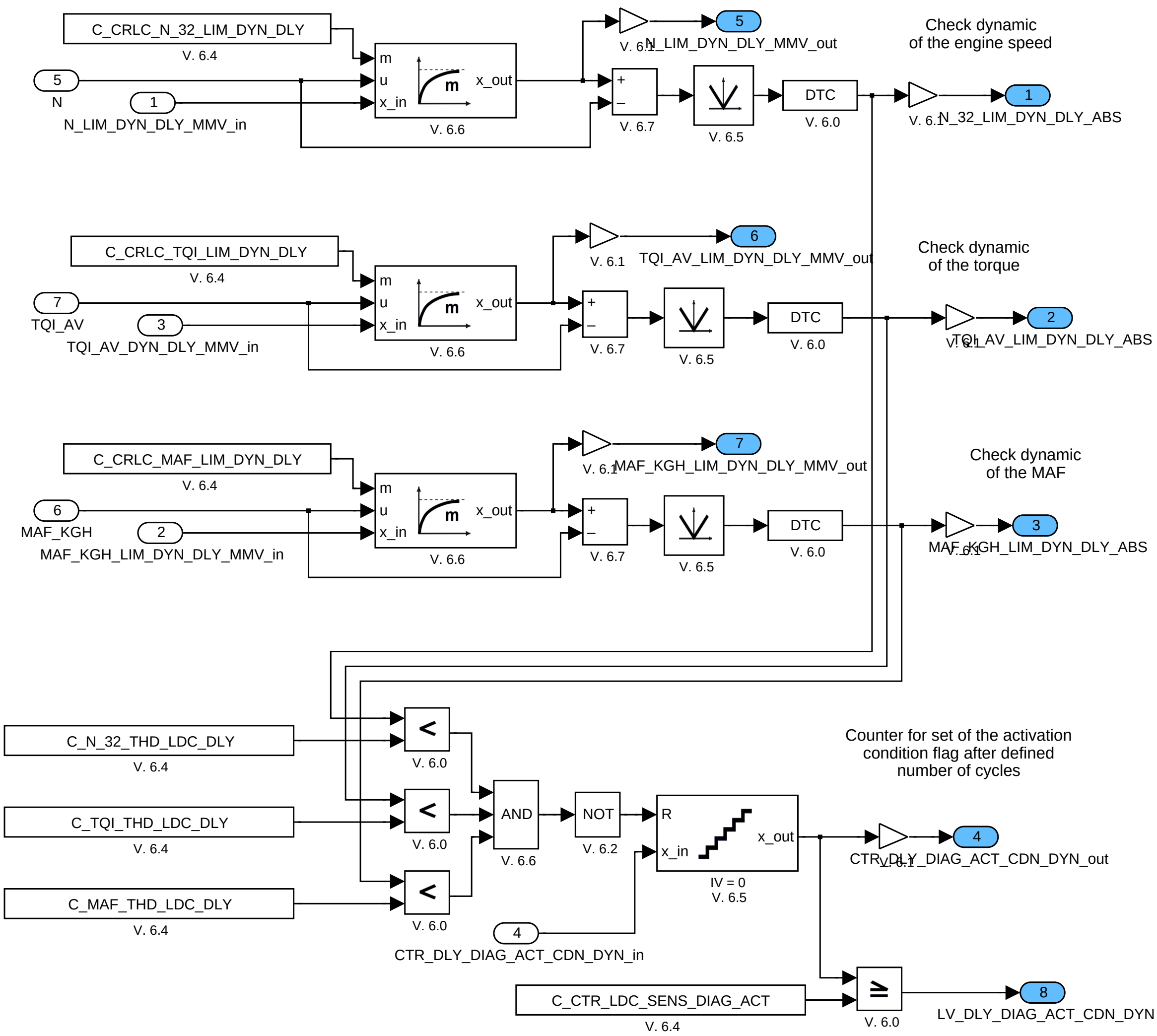

Figure B.22.7: :

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B.22.3 Introduction multiple bank system

B.22.3.1 Calculation of the diagnosis value

B.22.3.1.1 Calculation of the static and dynamic activation conditions

B.22.3.1.1.1 Check of the static and dynamic activation conditions

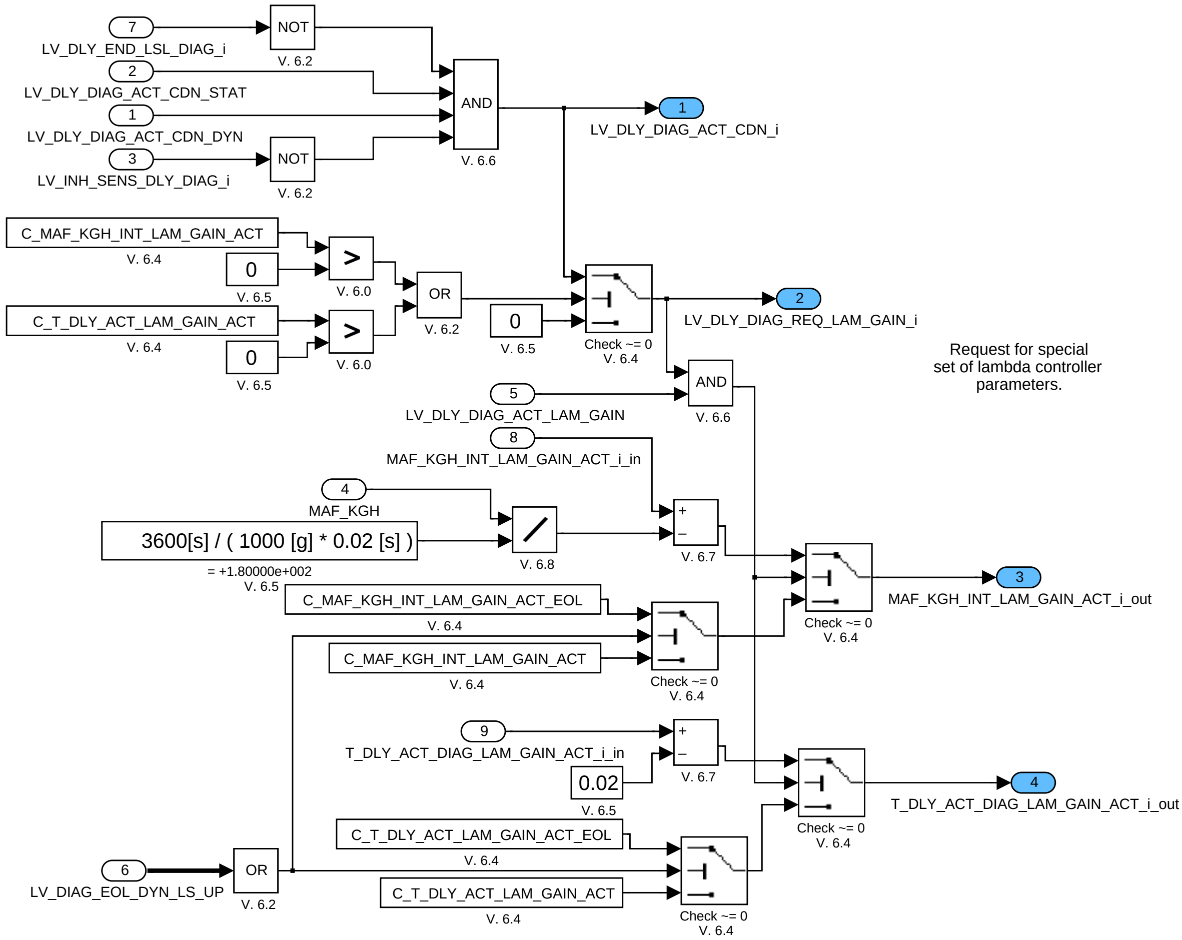

Figure B.22.8: :

B.22.3.1.2 Selection of the signal for the diagnosis

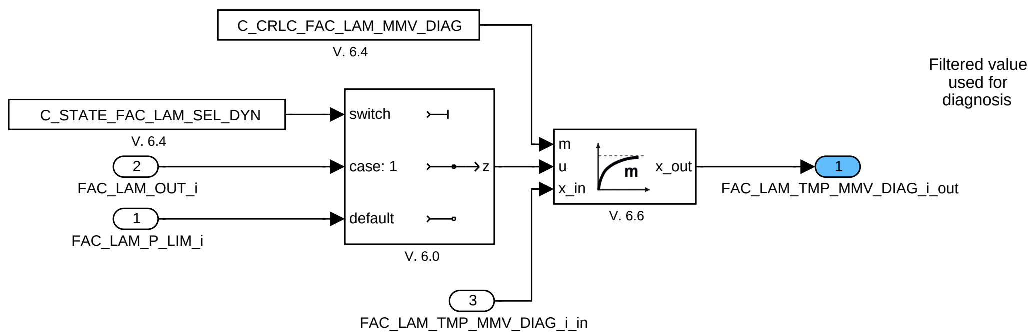

Figure B.22.9: :

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B.22.3.1.3 Check conditions for calculation of the diagnosis value

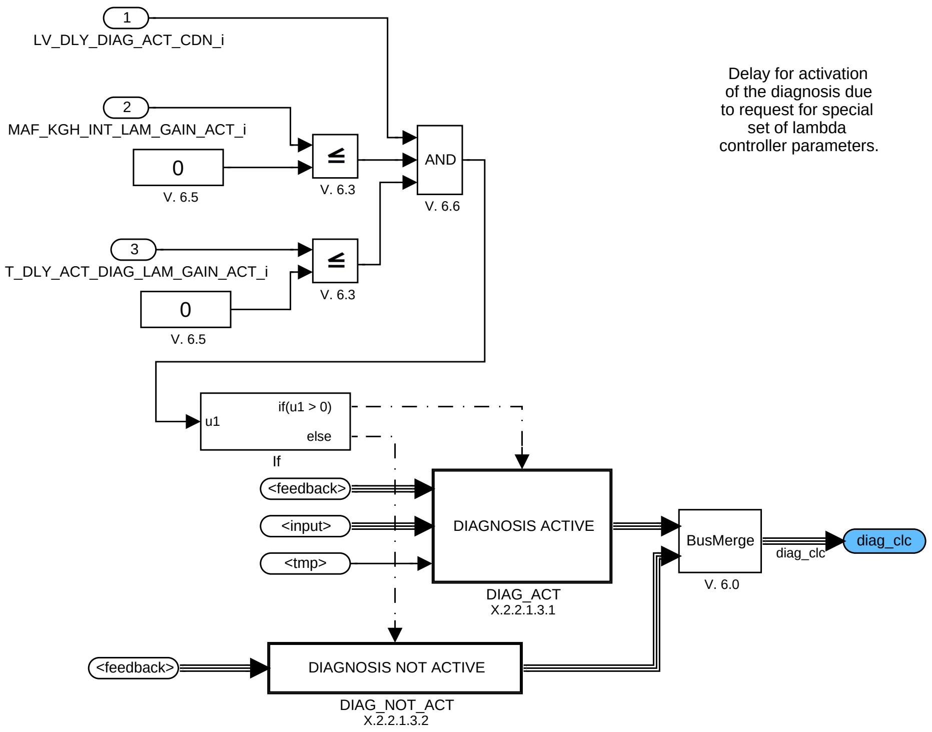

Figure B.22.10: :

B.22.3.1.3.1 DIAGNOSIS ACTIVE

B.22.3.1.3.1.1 Calculation of a counter of the single AFL/AFR cycles

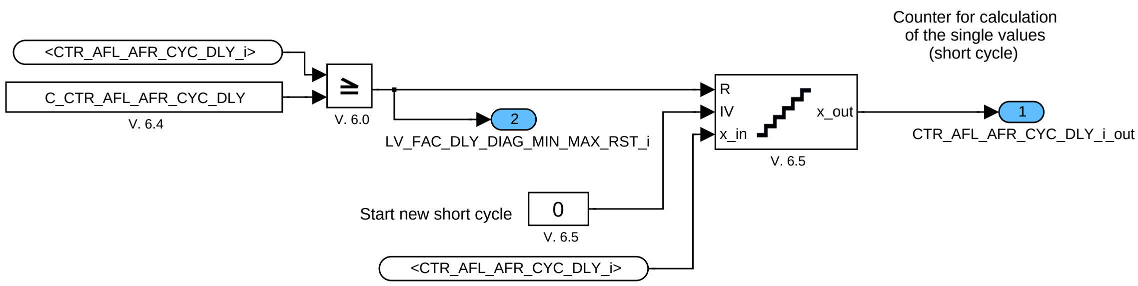

Figure B.22.11: :

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B.22.3.1.3.1.2 Calculation of the O2 integrals and ratio

B.22.3.1.3.1.2.1 Calculation of the pre-controlled and real O2 integral

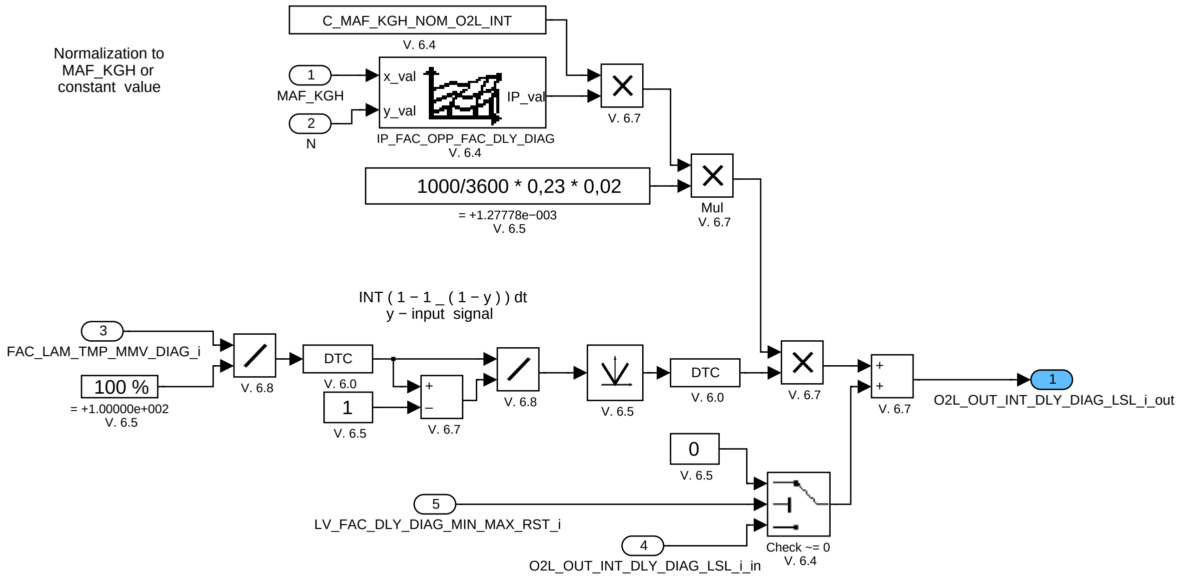

Figure B.22.12: :

B.22.3.1.3.1.2.2 Calculation of the ratio between pre-controlled and real O2 integrals

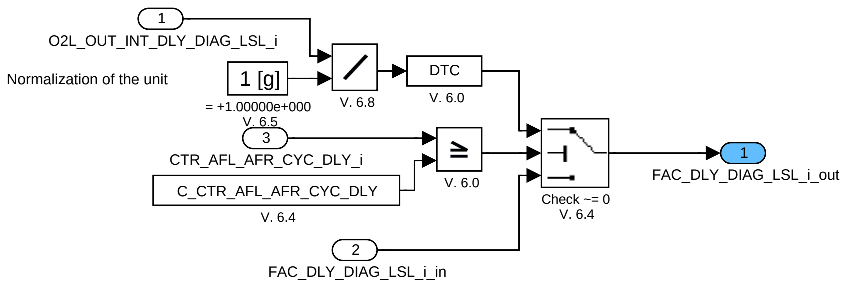

Figure B.22.13: :

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B.22.3.1.3.1.3 Calculation of the minimum, maximum and amplitude of the diagnosed signal

B.22.3.1.3.1.3.1 Single minimum and maximum of defined number of cycles

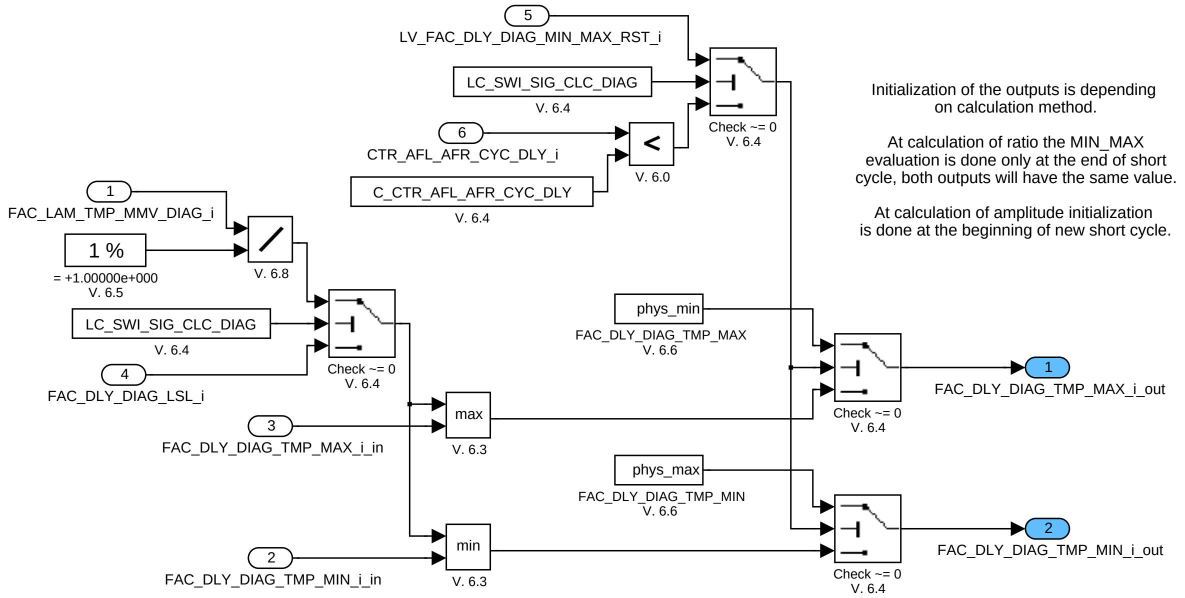

Figure B.22.14: :

B.22.3.1.3.1.3.2 Check counter for calculation of the mean values

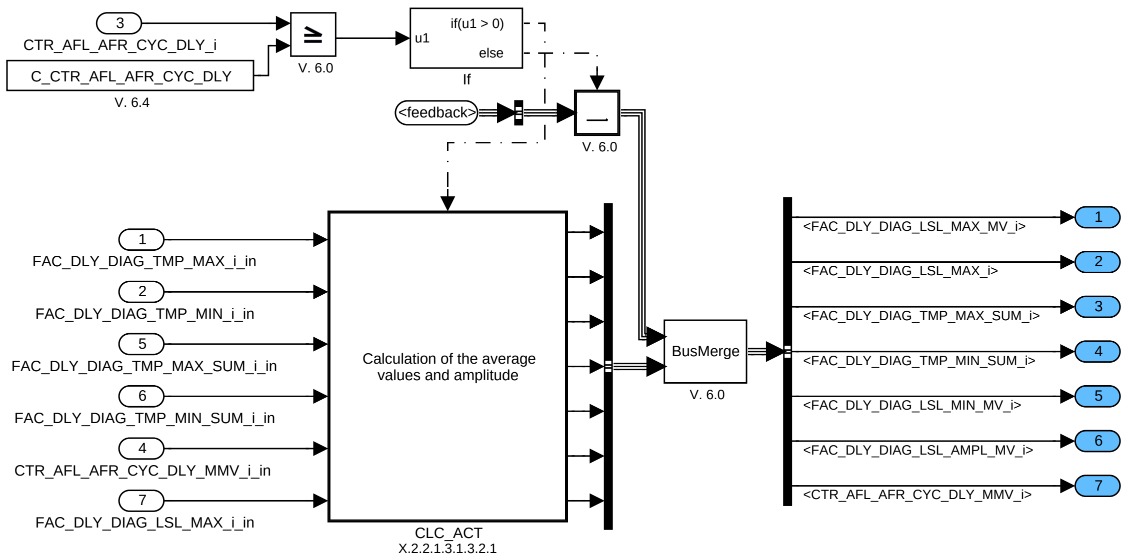

Figure B.22.15: :

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B.22.3.1.3.1.3.2.1 Calculation of the mean values of minimum and maximum and calculation of the amplitude

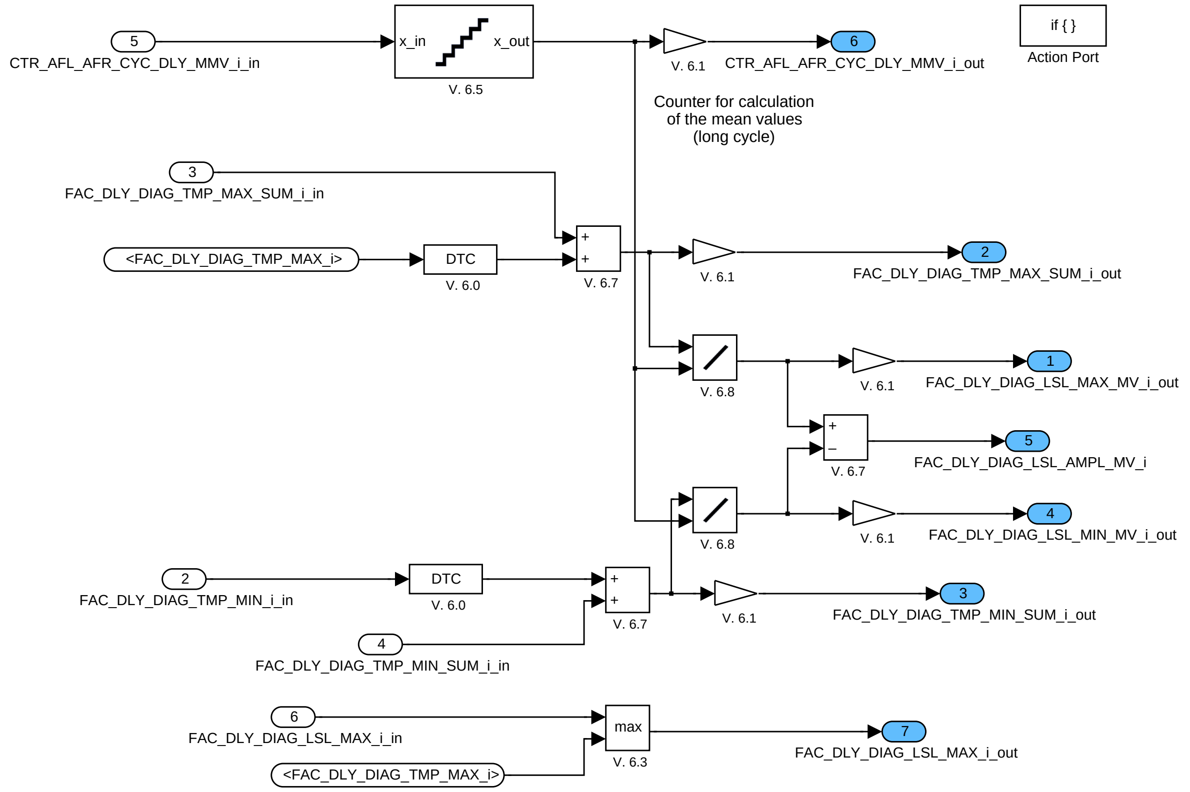

Figure B.22.16: :

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B.22.3.1.3.1.4 Determination of the diagnosis value

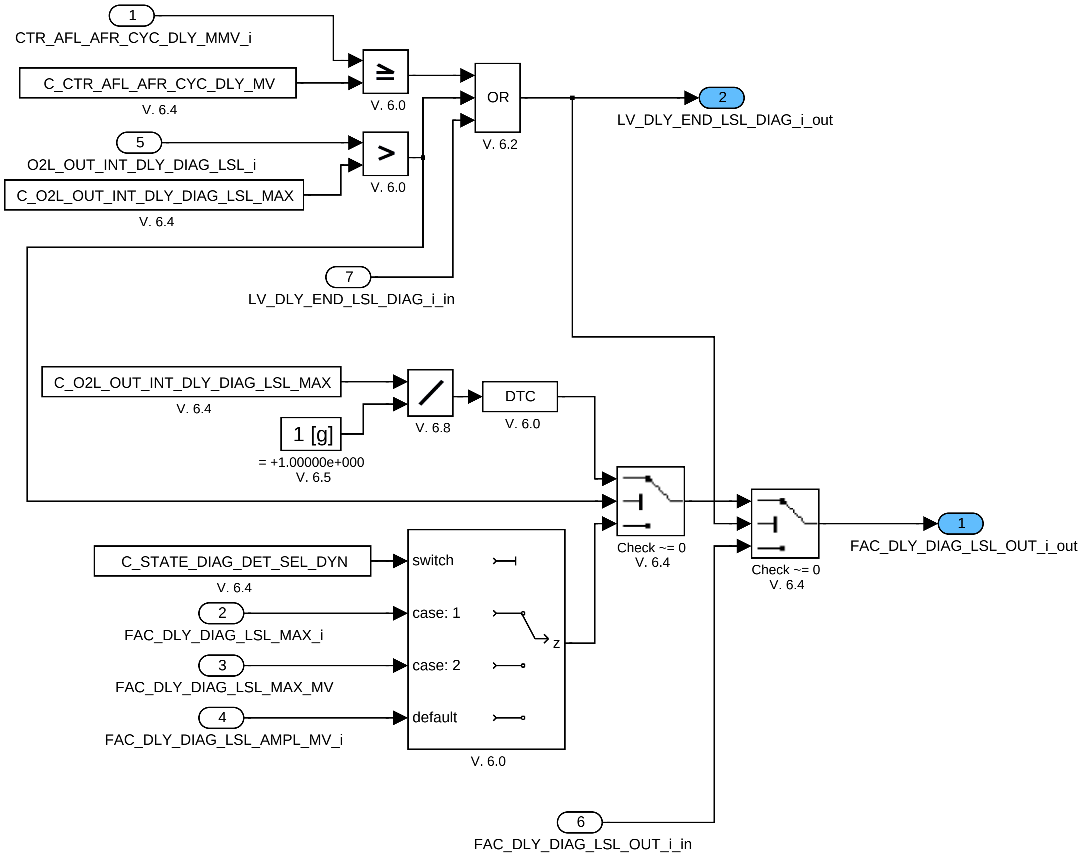

Figure B.22.17: :

B.22.3.1.3.2 DIAGNOSIS NOT ACTIVE

B.22.3.1.3.2.1 Initialization and deactivation of the diagnosis

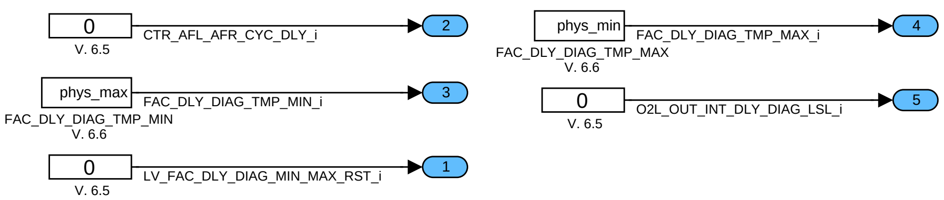

Figure B.22.18: :

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B.23 O2 sensor (lin, up) heater coupling diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_LSH_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "Diagnosis of the Heater Coupling in the Sensor Signal"					
LV_LSL_DIAG_LSH_LSL_UP_DEAC	O/V	0... 1H	0 ...1	1	-
Manual deactivation of "Diagnosis of the Heater Coupling in the Sensor Signal					

Input data:

LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}
LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}
LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}
LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VB_FB_0 {p. 802}	LV_ERR_VB_FB_1 {p. 802}	LV_ERR_VB_FB_2 {p. 802}
LV_ERR_VB_FB_3 {p. 802}	LV_ERR_VB_FB_INJ	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_VAR_VVL {p. 805}
NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LSL_DIAG_LSH_LSL_UP_DEAC	-	0... 1H	0 ...1	1	-
Logical calibration data for manual deactivation of heater coupling diagnosis					

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Application conditions

Recurrence: `100 ms.`

Initialisation: `0, at LV_IGK = 0 to 1 or ECU-Reset:`

Activation: `LV_ST_END = 1`

Deactivation: `LV_ST_END = 0`

Description:
The function Diagnosis of the Heater Coupling in the Sensor Signal has to be deactivated, if at least one of the following errors /special modes

Formula section:

```
IF        LV_ERR_CHG_LS_UP = 1                          OR
          LV_ERR_AIR_LSL_UP[i] = 1                      OR
          LV_ERR_CTL_LSL_UP[i] = 1                      OR
          LV_ERR_DELTA_I_LAM[i] = 1                     OR
          LV_ERR_DYN_VLD_LS_UP[i] = 1                   OR
          LV_ERR_EL_LSL_UP[i] = 1                       OR
          LV_ERR_LSH_UP[i] = 1                          OR
          LV_ERR_LSL_UP_IF[i] = 1                       OR
          LV_ERR_OBD_VLD_LSH_UP[i] = 1                  OR
             LV_ERR_OC_LSL_UP[i] = 1                    OR
          LV_ERR_OFS_LSL_UP[i] = 1                      OR
          LV_ERR_PUC_VLD_LS_UP[i] = 1                   OR
             LV_ERR_SHIFT_AFL_LSL_UP[i] = 1             OR
             LV_ERR_SHIFT_AFR_LSL_UP[i] = 1             OR
          LV_ERR_VLS_DOWN_DIF[i] = 1                    OR
          (i =1                                         AND
                   [      LV_ERR_IV[0] = 1              OR
                   LV_ERR_IV[2] = 1                     OR
                   LV_ERR_IV[4] = 1                     OR
              LV_ERR_MIS[0] = 1                         OR
                   LV_ERR_MIS[2] = 1                    OR
                   LV_ERR_MIS[4] = 1
          ])                                            OR
          (i =2                    AND
                   [      LV_ERR_IV[1] = 1              OR
                   LV_ERR_IV[3] = 1                     OR
                   LV_ERR_IV[5] = 1                     OR
              LV_ERR_MIS[1] = 1                         OR
                   LV_ERR_MIS[3] = 1                    OR
                   LV_ERR_MIS[5] = 1
             ])                                         OR

          (LV_VAR_VVL = 0          AND
          LV_ERR_TTIP_MES_LSH_UP[i] = 1)     OR    //for MSD87_6

          (LV_VAR_VVL = 1                               AND
          [LV_ERR_VB_FB_0 = 1                           OR
          LV_ERR_VB_FB_1 = 1                            OR
          LV_ERR_VB_FB_2 = 1                            OR
          LV_ERR_VB_FB_3 = 1                            OR
          LV_ERR_VB_FB_INJ = 1])                              //for MSV90

THEN
   LV_INH_DIAG_LSH_LSL_UP[i] = 1
ELSE
   LV_INH_DIAG_LSH_LSL_UP[i] = 0
ENDIF
```

LV_LSL_DIAG_LSH_LSL_UP_DEAC = LC_LSL_DIAG_LSH_LSL_UP_DEAC

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Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurence	Failure class A/B
Diagnosis of the heater coupling in the sensor signal	*Symptom detected*	*0*	P0130 / P0150	P2231 / P2234	--		LAMP CARB_M
LSH_LSL_UP[i]							

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B.24 O2 sensor (lin, up) heater coupling diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_SYM_DIAG_LSH_LSL_UP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter of forced stimulation periods with a present symptom					
CYCNR_DIAG_LSH_LSL_UP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter of forced stimulation periods investigated					
ERR_SYM_LSH_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom of the heater coupling diagnosis					
LAMB_DELTA_FALL [NC_CBK_EX_NR]	V	8000... 7FFFH	-2... 1.99993	61e-6	-
Variation of lambda value before and after lshpwm signal falling edge					
LAMB_DELTA_FALL_LPF [NC_CBK_EX_NR]	V	8000... 7FFFH	-2... 1.99993	61e-6	-
Mean value for heater coupling (falling edge)					
LAMB_DELTA_RISE [NC_CBK_EX_NR]	V	8000... 7FFFH	-2... 1.99993	61e-6	-
Variation of lambda value before and after lshpwm signal rising edge					
LAMB_DELTA_RISE_LPF [NC_CBK_EX_NR]	V	8000... 7FFFH	-2... 1.99993	61e-6	-
Mean value for heater coupling (rising edge)					
LAMB_SYN_LSHPWM_FALL [NC_CBK_EX_NR]	V	0... 7FFFH	0... 1.99993	61e-6	-
Lambda value acquied after lshpwm signal falling edge					
LAMB_SYN_LSHPWM_RISE [NC_CBK_EX_NR]	V	0... 7FFFH	0... 1.99993	61e-6	-
Lambda value acquied after lshpwm signal rising edge					
LV_CDN_DIAG_LSH_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Heater coupling diagnosis condition					
LV_END_DIAG_LSH_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating a valid diagnostic is available					
LV_ERR_LSH_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced heater coupling failure					
MAF_INT_DIAG_LSH_LSL_UP	V	0... FFFFH	0... 1820.41666	0.0277778	g
Integral of the air flow, for the activation of the heater coupling diagnosis					
T_DLY_TRIG_LSH_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 0.255	0.001	s
Time delay for acquisition of oxygen sensor signal and lambda model					

Input data:

IP_LAMB_LS_UP {p. 2317}	LAMB_SP_DE_PLS {p. 2958}	LAMB_SP_FIL_DELTA_FALL [NC_CBK_EX_NR] {p. 970}	LAMB_SP_FIL_DELTA_RISE [NC_CBK_EX_NR] {p. 970}
LSHPWM_UP [NC_CBK_EX_NR] {p. 2385}	LV_IGK {p. 906}	LV_INH_DIAG_LSH_LSL_UP [NC_CBK_EX_NR] {p. 5273}	LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}

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LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_LDC_LAM_ADJ [NC_CBK_EX_NR] {p. 2613}	LV_LS_UP_READY [NC_CBK_EX_NR] {p. 2335}	LV_LSL_DIAG_LSH_LSL_UP_DEAC {p. 5273}
LV_PUC {p. 1720}	MAF_KGH {p. 1195}	NC_CBK_EX_NR {p. 1829}	T_SUM_AFL_AFR_CYC [NC_CBK_EX_NR] {p. 2439}
TEG_DYN_LS_UP [NC_CBK_EX_NR] {p. 1008}	VLS_UP_DELTA_FALL [NC_CBK_EX_NR] {p. 970}	VLS_UP_DELTA_RISE [NC_CBK_EX_NR] {p. 970}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LPF_FALL_DIAG_LSH_LSL_UP	-	0... FFH	0... 0.99609	3.91e-3	-
Filter constant for Fall					
C_CRLC_LPF_RISE_DIAG_LSH_LSL_UP	-	0... FFH	0... 0.99609	3.91e-3	-
Filter constant for Rise					
C_CTR_SYM_DIAG_LSH_LSL_UP	-	0... FFH	0... 255	1	-
Limit value of the diagnosis results to diagnose the heater coupling					
C_CYCNR_MAX_DIAG_LSH_LSL_UP	-	0... FFH	0... 255	1	-
Quantity of valid diagnosis values in one function cycle					
C_LAMB_DELTA_LPF_THD	-	0... 7FFFH	0... 1.99993	61e-6	-
Threshold for the maximum transition of the sensor signal					
C_LAMB_SP_DE_DIAG_LSH_LSL_UP	-	0... 7FH	0... 0.12402	976.999e-6	-
Maximum value of the forced excitation amplitude to activate the diagnosis					
C_LSHPWM_MAX_DIAG_LSH_LSL_UP	-	0... FFH	0... 99.60937	0.390625	%
maximum heater PWM value allowed to carry out the heater coupling diagnosis					
C_LSHPWM_MIN_DIAG_LSH_LSL_UP	-	0... FFH	0... 99.60937	0.390625	%
minimum heater PWM value allowed to carry out the heater coupling diagnosis					
C_MAF_INT_DIAG_LSH_LSL_UP	-	0... FFFFH	0... 1820.41666	0.0277778	g
Threshold for the activation of the MAF-Integral					
C_T_AFL_AFR_DIAG_LSH_LSL_UP	-	0... FFFFH	0... 655.35	0.01	s
Threshold of the MAF-Integral to activate the heater-coupling diagnosis					
C_TEG_MIN_DIAG_LSH_LSL_UP	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum value of the exhaust temperature to activate the function					
IP_T_DLY_TRIG_LSH_UP	-	0... FFH	0... 0.255	0.001	s
LDP_LSHPWM_UP_IP_T_DLY_ACQ_VLS	4	0... FFH	0... 99.60937	0.390625	%
Time delay to trigger oxygen sensor signal and lambda model					

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Error treatment:

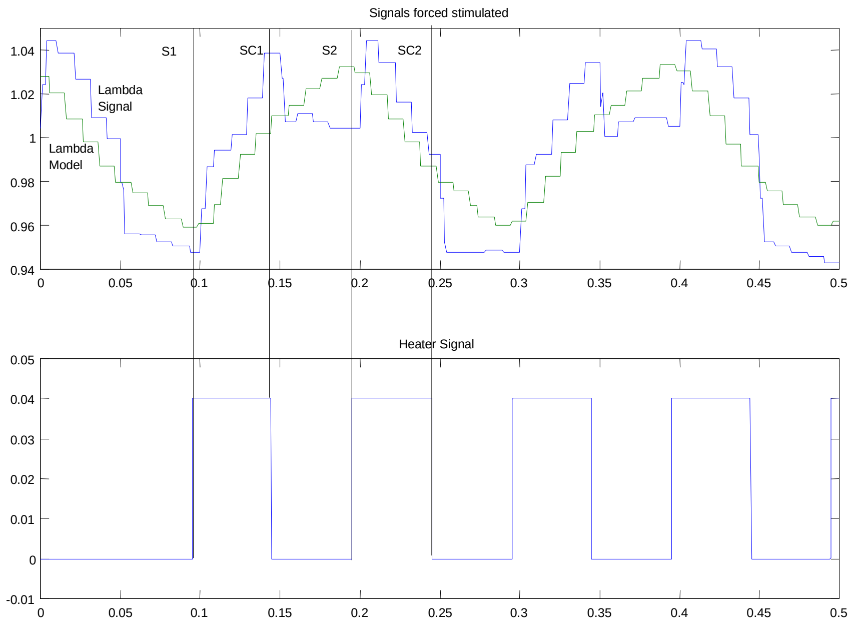
Diagnosis	Symptom	Nr	ABC type
Diagnosis of the heater coupling in the sensor signal *LSH_LSL_UP[NC_CBK_EX_NR]*	Heater Coupling Failure Symptom	*0*	NO

FUNCTION DESCRIPTION:

General information:

The diagnosis of heater coupling on the sensor signal shall detect an increase in the leakage current from heater to sensor circuit, which can be originated by the reduction of insulation resistance, and causes a crosstalk from the heater signal to the sensor circuit. Due to the heater coupling the measured signal of the wide range A/F sensor is perturbed and the lambda regulation influenced. The diagnosis criterion is the difference in the slope between measured sensor signal and model synchronised with the rising and falling edges of the heater PWM-signal. This is showed in the following picture, where a heater frequence of 10 Hz is admitted.

Sx … sampling of the Lambda value
SCx … sampling of the Lambda value and handover from Basic software



The values LAMB_SP_FIL_DELTA_FALL[i], LAMB_SP_FIL_DELTA_RISE[i], VLS_UP_DELTA_RISE[i] and VLS_UP_DELTA_FALL[i] are delivered from the BASIC-Software and represent the lambda model and the oxygen sensor voltage values acquired synchronised with the rising and falling edges of the heater PWM-signal.

Description:

At the beginning of every diagnosis period, the counter CTR_SYM_DIAG_LSH_LSL_UP[i] and the cycle counter CYCNR_DIAG_LSH_LSL_UP[i] shall be initialised by 0 .
After the hand over of VLS_UP_DELTA_RISE[i], VLS_UP_DELTA_FALL[i], LAMB_SP_FIL_DELTA_RISE[i] and LAMB_SP_FIL_DELTA_FALL[i] from the Basic-software (at the time SCx) this function has to start with the calculation of LAMB_DELTA_RISE/FALL[i].
For a better separation of the forced stimulation and the heater coupling (the forced stimulation has the same symptom as the heater coupling), it is necessary to include the sensor signal model in the diagnosis calculation. This will be realised by a subtraction from the relative deviation of the sensor signal model $((?_{SC1} - ?_{S1})_{model})$ and the relative deviation of sensor signal $((?_{SC1} - ?_{S1})_{meas})$. This results gets absolute value. Then it will be filtered by a first order lag element (for mean value). This values will be named to LAMB_DELTA_RISE_LPF[i] (calculated at time point S1 and SC1) and LAMB_DELTA_FALL_LPF[i] $((?_{SC1} - ?_{S2})_{model} - (?_{SC1} - ?_{S2})_{meas})$.

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This values will be compared with the threshold C_LAMB_DELTA_LPF_THD. Is the calculated value higher than the threshold, the error-counter (CTR_SYM_DIAG_LSH_LSL_UP[i]) will be incremented by 1 .
After a resumption of the diagnosis it must be guaranteed that LAMB_DELTA_FALL_LPF[i] contains a current value. If LAMB_DELTA_FALL_LPF[i] and LAMB_DELTA_RISE_LPF[i] are measured, then the cycle counter CYCNR_DIAG_LSH_LSL_UP[i] shall be incremented. If the necessary quantity of diagnosis for one cycle has been carried out, i.e. if CYCNR_DIAG_LSH_LSL_UP[i] > C_CYCNR_MAX_DIAG_LSH_LSL_UP is valid, the diagnosis result must be determined.

By the comparison of the diagnosis results to the limit value, the heater coupling is diagnosed, i.e. if CTR_SYM_DIAG_LSH_LSL_UP[i] > C_CTR_SYM_DIAG_LSH_LSL_UP is true, a heater coupling (ERR_SYM_LSH_LSL_UP[i] = 1) is recognised. If no error is diagnosed, than ERR_SYM_LSH_LSL_UP[i] = 0 is valid. After the reaching of the required number of diagnosis steps C_CYCNR_MAX_DIAG_LSH_LSL_UP, a new diagnosis cycle is started.
If an error could be detected, then the error flag LV_ERR_LSH_LSL_UP[i] = 1 is set, otherwise LV_ERR_LSH_LSL_UP[i] is set to 0.

Remark: The range of lambda sensor heater duty cycle must be limited, through the sampling of the wide range A/F sensor signal with an period of 10 ms. A heater coupling recognitionis possible only in a range of 15% up to 85% of the duty cycle.
At the function reactivation after LV_PUC=1 the MAF-integral shall be calculated. If the MAF-integral exceeds a defined threshold the heater coupling diagnosis starts.

Application conditions:

Initialisation:

At LV_IGK = 0 to 1, reset or at clearing error memory:
  CYCNR_DIAG_LSH_LSL_UP[i] = 0
  CTR_SYM_DIAG_LSH_LSL_UP[i] = 0
  MAF_INT_DIAG_LSH_LSL_UP = C_MAF_INT_DIAG_LSH_LSL_UP
  LV_ERR_LSH_LSL_UP[i] = 0
LV_CDN_DIAG_LSH_LSL_UP[i] = 0
LV_END_DIAG_LSH_LSL_UP[i] = 0
ERR_SYM_ LSH_LSL_UP[i] = NO SYMPTOM
LV_ERR_ LSH_LSL_UP[i] = 0
  LAMB_DELTA_RISE[i] = 0
  LAMB_DELTA_FALL[i] = 0
  LAMB_DELTA_RISE_LPF[i] = 0
  LAMB_DELTA_FALL_LPF[i] = 0
  LAMB_SYN_LSHPWM_RISE[i] = 0
  LAMB_SYN_LSHPWM_FALL[i] = 0
  T_DLY_TRIG_LSH_UP[i] = 0

Recurrence: 20 ms.

Activation:

IF LV_PUC = 0
AND LV_LSL_DIAG_LSH_LSL_UP_DEAC = 0
THEN
  IF MAF_INT_DIAG_LSH_LSL_UP < C_MAF_INT_DIAG_LSH_LSL_UP **THEN**
    calculate MAF-integral
  ELSE

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IF LV_LAM_STOP[i]= 0 **AND**
LV_LDC_LAM_ADJ[i] = 1 **AND**
LV_LS_UP_READY[i] = 1 **AND**
TEG_DYN_LS_UP[I] > C_TEG_MIN_DIAG_LSH_LSL_UP **AND**
LV_INH_DIAG_LSH_LSL_UP[i] = 0 **AND**

{ (LAMB_SP_DE_PLS < C_LAMB_SP_DE_DIAG_LSH_LSL_UP &
T_SUM_AFL_AFR_CYC[i] < C_T_AFL_AFR_DIAG_LSH_LSL_UP)
OR
LV_LAMB_PLS_ACT[i] = 0 } **AND**

C_LSHPWM_MIN_DIAG_LSH_LSL_UP LSHPWM_UP[i]
C_LSHPWM_MAX_DIAG_LSH_LSL_UP
THEN
LV_CDN_DIAG_LSH_LSL_UP[i] = 1
/activate function
ELSE
LV_CDN_DIAG_LSH_LSL_UP[i] = 0
/deactivate function
LAMB_DELTA_RISE_LPF[i] = 0
LAMB_DELTA_FALL_LPF[i] = 0
ENDIF
ENDIF
ELSE
MAF_INT_DIAG_LSH_LSL_UP = 0
LAMB_DELTA_RISE_LPF[i] = 0
LAMB_DELTA_FALL_LPF[i] = 0
ENDIF

Formula section:

1. Calculation of the MAF-integral:

Recurrence: The MAF-Integral calculation shall be incremented every T_SAMPLE =100 ms.

MAF_INT_DIAG_LSH_LSL_UP$_N$ = MAF_INT_DIAG_LSH_LSL_UP$_{N-1}$ + MAF_KGH * T_SAMPLE [ms] * 1/3600 [(g*h) /(kg*ms)]

1. Monitoring the electrical coupling between heater PWM and sensor signal

Recurrence: Every time the BSW hands over new values, i.e. if one of the conditions below is true:

IF(1) LAMB_SP_FIL_DELTA_FALL[i]$_N$? LAMB_SP_FIL_DELTA_FALL[i]$_{N-1}$
OR(1) VLS_UP_DELTA_FALL[i]$_N$? VLS_UP_DELTA_FALL[i]$_{N-1}$
THEN(1)
increment CYCNR_DIAG_LSH_LSL_UP[i]

% Determination of the lambda value synchronized with the heater PWM
LAMB_SYN_LSHPWM_RISE[i] = IP_LAMB_LS_UP(VLS_UP_DELTA_RISE[i])
LAMB_SYN_LSHPWM_FALL[i] = IP_LAMB_LS_UP(VLS_UP_DELTA_FALL[i])
Note:
1) Before the determination of LAMB_SYN_LSHPWM_RISE[i], please adapt the resolution of VLS_UP_DELTA_RISE[i] to the axis of IP_LAMB_LS_UP . The analogous shall be done to LAMB_SYN_LSHPWM_FALL[i].

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2) The Map IP_LAMB_LS_UP is used in other functions, i.e. any changes in this map will influence other functions.
3) At the first function call the values of LAMB_DELTA_RISE/FALL should not be calculated because at this time no old values (N-1) are avaliable.

LAMB_DELTA_RISE[i]$_N$ = (LAMB_SP_FIL_DELTA_FALL[i]$_N$ - LAMB_SP_FIL_DELTA_RISE[i]$_N$) -
(LAMB_SYN_LSHPWM_FALL[i]$_N$ - LAMB_SYN_LSHPWM_RISE[i]$_N$)

LAMB_DELTA_FALL[i]$_N$ = (LAMB_SP_FIL_DELTA_FALL[i]$_{N-1}$ - LAMB_SP_FIL_DELTA_RISE[i]$_N$) -
(LAMB_SYN_LSHPWM_FALL[i]$_{N-1}$ - LAMB_SYN_LSHPWM_RISE[i]$_N$)

LAMB_DELTA_RISE_LPF[i]$_N$ = LAMB_DELTA_RISE_LPF[i]$_{N-1}$
+ (LAMB_DELTA_RISE[i]$_{N-1}$ - LAMB_DELTA_RISE_LPF[i]$_{N-1}$)
* C_CRLC_LPF_RISE_DIAG_LSH_LSL_UP

LAMB_DELTA_FALL_LPF[i]$_N$ = LAMB_DELTA_FALL_LPF[i]$_{N-1}$
+ (LAMB_DELTA_FALL[i]$_N$ - LAMB_DELTA_FALL_LPF[i]$_{N-1}$)
* C_CRLC_LPF_FALL_DIAG_LSH_LSL_UP

IF abs(LAMB_DELTA_RISE_LPF[i]) **OR** abs(LAMB_DELTA_FALL_LPF[i]) $>$
C_LAMB_DELTA_LPF_THD
THEN
increment CTR_SYM_DIAG_LSH_LSL_UP[i]
ENDIF

IF CYCNR_DIAG_LSH_LSL_UP[i] $>$ C_CYCNR_MAX_DIAG_LSH_LSL_UP
THEN
IF CTR_SYM_DIAG_LSH_LSL_UP[i] $>$ C_CTR_SYM_DIAG_LSH_LSL_UP
THEN
ERR_SYM_ LSH_LSL_UP[i] = Sym_0
LV_ERR_LSH_LSL_UP[i] = 1
LV_END_DIAG_LSH_LSL_UP[i] = 1
ELSE
ERR_SYM_LSH_LSL_UP[i] = NO SYMPTOM
LV_END_DIAG_LSH_LSL_UP[i]= 1
ENDIF
CYCNR_DIAG_LSH_LSL_UP[i] = 0
CTR_SYM_DIAG_LSH_LSL_UP[i] = 0
ENDIF

% Adjusting the acquisition delay of sensor signal VLS_UP[i] and the modeled sensor signal
% LAMB_SP_FIL_HOM[i]

T_DLY_TRIG_LSH_UP[i] = IP_T_DLY_TRIG_LSH_UP (LSHPWM_UP[i])

ENDIF(1)

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B.25 O2 sensor (lin, up) not mounted diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_AIR_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
diagnosis symptom of upstream sensor signal monitoring					
LV_CDN_DIAG_AIR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Diagnosis condition					
LV_END_DIAG_AIR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Result of diagnosis exist					
LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced diagnosis result of upstream sensor signal monitoring					
T_END_DIAG_AIR_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer to have a diagnostic available					
T_SYM_DIAG_AIR_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer to debounce an error					

Input data:

LV_DIAG_EOL_END_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_FL {p. 1759}	LV_IGK {p. 906}	LV_INH_DIAG_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5285}
LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	LV_PL {p. 1720}	NC_CBK_EX_NR {p. 1829}	VLS_UP_DIAG [NC_CBK_EX_NR] {p. 2315}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_END_DIAG_AIR_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time to have a diagnostic available					
C_T_SYM_DIAG_AIR_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time filter to detect a symptom					
C_VLS_UP_DIAG_MAX_AIR_LSL_UP	-	8000... 7FFFH	-160... 159.99511	4.8828e-3	V
Upstream sensor signal max. threshold during engine operation (PUC excepted)					

Error treatment:

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Diagnostic XX	Symptom description	Symptom	Filter type
AIR_LSL_UP[NC_CBK_EX_NR]	Sensor on air	SYM_0	NO

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Description:

This function shall detect a mechanically not attached sensor to the exhaust gas pipe. To do this the WRAF sensor output signal must be monitored during the engine operation , when power is generated. This shall be done by comparing the sensor signal VLS_UP_DIAG[i] with a threshold.
The function shall be activated during Partial Load or Full Load, if the sensor was recognised as operable, i.e. LV_IPLSL_VLD[i] = 1. A symptom shall be detected if the engine runs, i.e. it generates power, and at the same time the sensor signal is very high, indicating a very lean combustion mixture.

Initialisation:
At LV_IGK = 0 to 1, reset **or**at clearing error memory reset all variables.

Recurrence:
The function shall be carried out every 100 ms.

Activation:
IF
LV_IPLSL_VLD[i] = 1 **AND**
(LV_PL = 1 OR LV_FL = 1) **AND**
LV_INH_DIAG_AIR_LSL_UP[i] = 0
THEN
LV_CDN_DIAG_AIR_LSL_UP[i] = 1
/activate function
ELSE
LV_CDN_DIAG_AIR_LSL_UP[i] = 0
/deactivate function
ENDIF

Formula section:

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```
IF   VLS_UP_DIAG[i]   > C_VLS_UP_DIAG_MAX_AIR_LSL_UP
THEN
          ERR_SYM_AIR_LSL_UP[i]   =   SYM_0
  IF T_SYM_DIAG_AIR_LSL_UP[i] >   C_T_SYM_DIAG_AIR_LSL_UP
          THEN
               LV_ERR_AIR_LSL_UP[i]     = 1
               LV_END_DIAG_AIR_LSL_UP[i]        = 1
  ELSE
                   Increment T_SYM_DIAG_AIR_LSL_UP[i]
  ENDIF
ELSE
          ERR_SYM_AIR_LSL_UP[i]   =   NO_SYM
  T_SYM_DIAG_AIR_LSL_UP[i] = 0
ENDIF
```

Minimum time to have a valid diagnostic available

```
IF(a)LV_END_DIAG_AIR_LSL_UP[i]   = 0
THEN(a)
      IF(b)     T_END_DIAG_AIR_LSL_UP[i] > C_T_END_DIAG_AIR_LSL_UP
                   OR(b)LV_DIAG_EOL_END_LS_UP_DOWN[i] = 1
      THEN(b)
               LV_END_DIAG_AIR_LSL_UP[i]   = 1
          ELSE(b)
               Increment T_END_DIAG_AIR_LSL_UP[i]
          ENDIF(b)
ENDIF(a)
```

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B.26 O2 sensor (lin, up) not mounted diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_EOL_AIR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation of short trip for upstream sensor signal monitoring					
LV_DIAG_EOL_AIR_LSL_UP_DC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical Value as reminder for End of Line test within this driving cycle					
LV_INH_DIAG_AIR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "Monitoring Upstream Sensor Signal "					
LV_INH_DIAG_RBM_AIR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of Rate Based Monitoring of Monitoring Upstream Sensor Signal by malfunction					
STATE_RBM_AIR_LSL_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of AIR_LSL_UP [NC_CBK_EX_NR] monitor with the Rate-Based Monitoring statistics					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CDN_VB_OBD2 {p. 1185}	LV_DC {p. 5746}	LV_END_DIAG_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}
LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT] {p. 1061}
LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}
LV_ERR_EL_CPS {p. 4708}	LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}
LV_ERR_FTL_MIN {p. 4762}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}
LV_ERR_LSH_LSL_UP [NC_CBK_EX_NR] {p. 5276}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}
LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_PLAUS {p. 1062}	LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}
LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}

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LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}
LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}
LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}
LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}	LV_HOM_ACT {p. 8136}
LV_IGK {p. 906}	LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_SCC [NC_CBK_EX_NR] {p. 2295}	NC_CBK_EX_NR {p. 1829}
NC_CYL_NR {p. 1526}	NC_NR_CBK_IVVT {p. 604}	STATE_ERR_IV {p. 4803}	

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Application conditions

Initialisation: at every transition LV_IGK = 0->1or reset all variables shall be reset to 0.
at every transition LV_IGK = 1->0
LV_INH_DIAG_AIR_LSL_UP[NC_CBK_EX_NR] = 1

Recurrence: *the functions shall be carried out once every 1s.*

Activation: *LV_IGK = 1*

Deactivation: *LV_IGK = 0*

Formula section:

This function has to be deactivated, if at least one of the following errors /special modes is active.

IF

- LV_ERR_AMP = 1 **OR**
- LV_ERR_AMP_PLAUS = 1 **OR**
- LV_ERR_CHG_LS_UP = 1 **OR**

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- LV_ERR_DIAGCPS = 1 **OR**
- LV_ERR_EL_CPS = 1 **OR**
- LV_ERR_FTL_MIN = 1 **OR**
- LV_ERR_FUP = 1 **OR**
- LV_ERR_FUP_MFP_PLAUS = 1 **OR**
- LV_ERR_FUP_ORNG = 1 **OR**
- LV_ERR_FUP_ST = 1 **OR**
- LV_ERR_H_PRS_SYS = 1 **OR**
- LV_ERR_IVVT = 1 **OR**
- LV_ERR_LOAD_TPS_PLAUS = 1 **OR**
- LV_ERR_MAF = 1 **OR**
- LV_ERR_MAP_PLAUS = 1 **OR**
- LV_ERR_MAP_TPS_PLAUS = 1 **OR**
- LV_ERR_MTC_CTL_2 = 1 **OR**
- LV_ERR_MTC_CTL_3 = 1 **OR**
- LV_ERR_MTC_DR = 1 **OR**
- LV_ERR_TPS = 1 **OR**
- LV_ERR_VCV = 1 **OR**
- LV_ERR_CTL_LSL_UP[i] = 1 **OR**
- LV_ERR_DYN_VLD_LS_UP[i]= 1 **OR**
- LV_ERR_EL_LSL_UP[i]= 1 **OR**
- LV_ERR_FSD[i] = 1 **OR**
- LV_ERR_FSD_LAM_LIM[i] = 1 **OR**
- LV_ERR_LSH_LSL_UP[i] = 1 **OR**
- LV_ERR_LSH_UP[i]= 1 **OR**
- LV_ERR_LSL_UP_IF[i]= 1 **OR**
- LV_ERR_OBD_VLD_LSH_UP[i] = 1 **OR**
- LV_ERR_OC_LSL_UP[i]= 1 **OR**
- LV_ERR_OFS_LSL_UP[i] = 1 **OR**
- LV_ERR_PUC_VLD_LS_UP[i]= 1 **OR**
- LV_ERR_SHIFT_AFL_LSL_UP[i]= 1 **OR**
- LV_ERR_SHIFT_AFR_LSL_UP[i]= 1 **OR**
- LV_ERR_TTIP_MES_LSH_UP[i] = 1 **OR**
- (i = 1 **AND**

  [LV_ERR_IV[0] **OR**
  LV_ERR_IV[2] **OR**
  LV_ERR_IV[4] **OR**
  LV_ERR_MIS[0] **OR**
  LV_ERR_MIS[2] **OR**
  LV_ERR_MIS[4]
  ]) **OR**
- (i = 2 **AND**

  [LV_ERR_IV[1] **OR**
  LV_ERR_IV[3] **OR**
  LV_ERR_IV[5] **OR**
  LV_ERR_MIS[1] **OR**
  LV_ERR_MIS[3] **OR**
  LV_ERR_MIS[5]
  ]) **OR**

THEN LV_INH_DIAG_RBM_AIR_LSL_UP[i]= 1
ELSE LV_INH_DIAG_RBM_AIR_LSL_UP [i]= 0

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ENDIF

IF LV_LS_UP_OBD_2_MAN_DEAC[i] = 1 **OR**
- LV_INH_DIAG_RBM_AIR_LSL_UP[i]= 1 **OR**
- LV_CDN_VB_OBD2 = 0 **OR**
- LV_SCC[NC_CBK_EX_NR] = 1 **OR**
- LV_HOM_ACT = 0

THEN LV_INH_DIAG_AIR_LSL_UP[i]= 1
ELSE LV_INH_DIAG_AIR_LSL_UP[i]= 0
ENDIF

Data :

Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurence	Failure class A/B
Monitoring upstream sensor	*Sym_0*	*0*	*see table of failires*	*ee table of ailires*	--		NO_LAMP CARB_M
AIR_LSL_UP[i]							

B.26.1 Interface for Rate - Based - Monitoring AIR_LSL_UP[i]

FUNCTION DESCRIPTION:

General information:

With this module the interface between the AIR_LSL_UP[i] monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_AIR_LSL_UP[i] data.
Within STATE_RBM_AIR_LSL_UP[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)
  (not valid for catalyst diagnosis)

Application conditions

Initialisation:

```
at ECU reset:
    bit 0, bit 1 and bit 2 of STATE_RBM_AIR_LSL_UP[i] = 0
         LV_DIAG_EOL_AIR_LSL_UP_DC[i] = 0
LV_DC 0   1 transition:
     bit 0 and bit 1 of STATE_RBM_AIR_LSL_UP[i] = 0
         LV_DIAG_EOL_AIR_LSL_UP_DC[i] = 0
on failure memory reset:
    bit 1 of STATE_RBM_STATE_RBM_AIR_LSL_UP[i] = 0
         LV_DIAG_EOL_AIR_LSL_UP_DC[i] = 0
```

Recurrence: 1 s

Activation: LV_DC = 1

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Formula section:

At LV_DC 0 -> 1 transition
bit 2 of STATE_RBM_AIR_LSL_UP[i] = 1
The pending status of the following failures has to be checked only once :

Dependence	Error			
	LV_ERR_AMP	LV_ERR_AMP_PLAUS	LV_ERR_CHG_LS_UP	LV_ERR_DIAGCPS
	LV_ERR_EL_CPS	LV_ERR_FTL_MIN	LV_ERR_FUP	LV_ERR_FUP_MFP_PLAUS
	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS	LV_ERR_LOAD_TPS_PLAUS
	LV_ERR_MAF_FRQ_EL	LV_ERR_MAF_FRQ_GRD	LV_ERR_MAF_FRQ_RNG	LV_ERR_MAP_PLAUS
	LV_ERR_MAP_TPS_PLAUS	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR
	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD	LV_ERR_TPS_AD_BOL
	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATIO	LV_ERR_TPS_ST_CHK_2
	LV_ERR_VCV			
NC_CBK_EX_NR	LV_ERR_FSD[i]	LV_ERR_FSD_LAM_LIM[i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DYN_VLD_LS_UP[i]
	LV_ERR_EL_LSL_UP[i]	LV_ERR_LSH_LSL_UP[i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]
	LV_ERR_OBD_VLD_LSH_UP[i]	LV_ERR_OC_LSL_UP[i]	LV_ERR_OFS_LSL_UP[i]	LV_ERR_PUC_VLD_LS_UP[i]
	LV_ERR_SHIFT_AFL_LSL_UP[i]	LV_ERR_SHIFT_AFR_LSL_UP[i]	LV_ERR_TTIP_MES_LSH_UP[i]	

Figure B.26.1: For x = 1 to NC_NR_CBK_IVVT (= for any i // or)

NC_NR_CBK_IVVT	LV_ERR_CAM_CST_IVVT_EX[x]	LV_ERR_CAM_CST_IVVT_IN[x]	LV_ERR_MEC_IVVT_EX[x]	LV_ERR_MEC_IVVT_IN[x]
	LV_ERR_SLV_IVVT_EX[x]	LV_ERR_SLV_IVVT_IN[x]		

Figure B.26.2: For i = 1

NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

Figure B.26.3: For i = 2

NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

If(1) { CPU optimization at LV_DC 0 -> 1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }
Then(1)
While bit 1 of STATE_RBM_AIR_LSL_UP[i] = 0 **do**

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with each XX failure of the above list (depending on configuration, see below):
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2) bit 1 of STATE_RBM_AIR_LSL_UP[i] = 1
Endif(2)
Endwhile
Else(1) { the dynamic failure memory is empty } No action
Endif(1)

Every 1 s :
If LV_DIAG_EOL_AIR_LSL_UP[i] = 1
Then LV_DIAG_EOL_AIR_LSL_UP_DC[i] = 1
Endif

If bit 0 of STATE_RBM_AIR_LSL_UP[i] = 0
Then
If LV_END_DIAG_AIR_LSL_UP[i] = 1 **and**
LV_DIAG_EOL_AIR_LSL_UP_DC[i] = 0
Then bit 0 of STATE_RBM_AIR_LSL_UP[i] = 1
Endif
Endif

If bit 1 of STATE_RBM_AIR_LSL_UP[i] = 0
Then
If LV_INH_DIAG_RBM_AIR_LSL_UP[i] = 1
Then bit 1 of STATE_RBM_AIR_LSL_UP[i] = 1
Endif
Endif

B.26.2 Activation of short trip Monitoring AIR_LSL_UP[i]

FUNCTION DESCRIPTION:

General information:

Not yet defined

Application conditions

Initialisation: `LV_DIAG_EOL_AIR_LSL_UP[i] = 0` *(never changed)*

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B.27 O2 sensor (lin, up) PUC plausibility diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_EOL_PUC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation of short trip for Monitoring Upstream Sensor during PUC					
LV_INH_DIAG_PUC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "Monitoring Upstream Sensor Signal during PUC"					
LV_INH_DIAG_RBM_PUC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of Monitoring Upstream Sensor Signal during PUC by other failures					
STATE_RBM_PUC_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of PUC_VLD_LS_UP[NC_CBK_EX_NR] monitor with the Rate-Based Monitoring statistics					

Input data:

LV_END_DIAG_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}
LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}
LV_ERR_MAP_TPS_PLAUS {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}
LV_ERR_MTC_DR {p. 5002}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}
LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_IGK {p. 906}

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LV_LS_UP_OBD_1_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_VB_CDN_OBD_2 {p. 1046}	NC_CBK_EX_NR {p. 1829}	

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Application conditions

Initialisation: at every transition LV_IGK = 0->1or reset all variables shall be reset to 0.
at every transition LV_IGK = 1->0
LV_INH_DIAG_PUC_LSL_UP[NC_CBK_EX_NR] = 1

Recurrence: *the functions shall be carried out once every 100ms.*

Activation: *LV_IGK = 1*

Deactivation: *LV_IGK = 0*

Formula section:

This function has to be deactivated, if at least one of the following errors /special modes is active.
IF

LV_ERR_CHG_LS_UP = 1 **OR**
LV_ERR_DIAGCPS = 1 **OR**
LV_ERR_EL_CPS = 1 **OR**
LV_ERR_FUP = 1 **OR**
LV_ERR_FUP_MFP_PLAUS = 1 **OR**
LV_ERR_FUP_ORNG = 1 **OR**
LV_ERR_FUP_ST = 1 **OR**
LV_ERR_H_PRS_SYS = 1 **OR**
LV_ERR_LOAD_TPS_PLAUS = 1 **OR**
LV_ERR_MAF = 1 **OR**
LV_ERR_MAP_PLAUS = 1 **OR**
LV_ERR_MAP_TPS_PLAUS = 1 **OR**
LV_ERR_MTC_CTL_2 = 1 **OR**
LV_ERR_MTC_CTL_3 = 1 **OR**
LV_ERR_MTC_DR = 1 **OR**
LV_ERR_TPS = 1 **OR**
LV_ERR_VCV = 1 **OR**

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LV_ERR_AIR_LSL_UP[i] = 1 **OR** LV_ERR_CTL_LSL_UP[i] = 1 **OR**
LV_ERR_DELTA_I_LAM[i] = 1 **OR**
LV_ERR_DYN_VLD_LS_UP[i] = 1 **OR**
LV_ERR_EL_LSL_UP[i] = 1 **OR**
LV_ERR_LSH_UP[i] = 1 **OR**
LV_ERR_LSL_UP_IF[i] = 1 **OR**
LV_ERR_OFS_LSL_UP[i] = 1 **OR**
LV_ERR_SHIFT_AFL_LSL_UP[i] = 1 **OR**
LV_ERR_SHIFT_AFR_LSL_UP[i] = 1 **OR**
LV_ERR_VLS_DOWN_DIF[i] =1 **OR**
(i = 1 **AND**
[LV_ERR_IV[0] **OR**
LV_ERR_IV[2] **OR**
LV_ERR_IV[4] **OR**
LV_ERR_MIS[0] **OR**
LV_ERR_MIS[2] **OR**
LV_ERR_MIS[4]
]) **OR**
(i = 2 **AND**
[LV_ERR_IV[1] **OR**
LV_ERR_IV[3] **OR**
LV_ERR_IV[5] **OR**
LV_ERR_MIS[1] **OR**
LV_ERR_MIS[3] **OR**
LV_ERR_MIS[5]
])

THEN LV_INH_DIAG_RBM_PUC_LSL_UP[i] = 1
ELSE LV_INH_DIAG_RBM_PUC_LSL_UP[i] = 0
ENDIF

IF LV_LS_UP_OBD_2_MAN_DEAC[i] = 1 **OR**
LV_CDN_VB_OBD2 = 0 **OR**
LV_INH_DIAG_RBM_PUC_LSL_UP[i] = 1

THEN LV_INH_DIAG_PUC_LSL_UP[i] = 1
ELSE LV_INH_DIAG_PUC_LSL_UP[i] = 0
ENDIF

B.27.1 Activation of short trip for Monitoring Upstream Sensor during PUC

FUNCTION DESCRIPTION:

General information:

Not yet defined

Application conditions

Initialisation: `LV_DIAG_EOL_PUC_LSL_UP[i] = 0` *(never changed)*

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Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurence	Failure class A/B
WRAF Sensor diagnosis during PUC	*Sym_0*	*0*	*see table of failires*	*ee table of ailires*	--		See Table of failure
PUC_VLD_LS_UP[i]							

B.27.1.1 Interface for Rate - Based - Monitoring PUC_VLD_LS_UP[I]

FUNCTION DESCRIPTION:

General information:

With this module the interface between the PUC_VLD_LS_UP[i] monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_PUC_VLD_LS_UP[i] data.
Within STATE_RBM_PUC_VLD_LS_UP[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)
  (not valid for PUC_VLD_LS_UP[i] diagnosis)

Application conditions

Initialisation:

at ECU reset:
bit 0, bit 1 and bit 2 of STATE_RBM_PUC_VLD_LS_UP[i] = 0
LV_DC 0 → 1 transition:
bit 0 and bit 1 of STATE_RBM_PUC_VLD_LS_UP[i] = 0
on failure memory reset:
bit 1 of STATE_RBM_PUC_VLD_LS_UP[i] = 0

Recurrence: 1 s

Activation: LV_DC = 1

Formula section:

At LV_DC 0 → 1 transition
bit 2 of STATE_RBM_PUC_VLD_LS_UP[i] = 1
The pending status of the following failures has to be checked only once :

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Dependence	Error			
	LV_ERR_CHG_LS_UP	LV_ERR_DIAGCPS	LV_ERR_EL_CPS	LV_ERR_FUP
	LV_ERR_FUP_MFP_PLAUS	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS
	LV_ERR_LOAD_TPS_PLAUS	LV_ERR_MAP_PLAUS	LV_ERR_MAP_TPS_PLAUS	LV_ERR_MTC_CTL_2
	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR	LV_ERR_TPS_1	LV_ERR_TPS_2
	LV_ERR_TPS_AD	LV_ERR_TPS_AD_BOL	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2
	LV_ERR_TPS_RATIO	LV_ERR_TPS_ST_CHK_2	LV_ERR_VCV	
NC_CBK_EX_NR	LV_ERR_AIR_LSL_UP[i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DELTA_I_LAM[i]	LV_ERR_DYN_VLD_LS_UP[i]
	LV_ERR_EL_LSL_UP[i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]	LV_ERR_OFS_LSL_UP[i]
	LV_ERR_SHIFT_AFR_LSL_UP[i]	LV_ERR_SHIFT_AFL_LSL_UP[i]	LV_ERR_VLS_DOWN_DIF[i]	

Figure B.27.1: For k = 1 to NC_MAF_NR (= for any i // or)

NC_MAF_NR	LV_ERR_MAF_FRQ_EL[k]	LV_ERR_MAF_FRQ_GRD[k]	LV_ERR_MAF_FRQ_RNG[k]	

Figure B.27.2: For NC_CBK_EX_NR = i = 1

NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

Figure B.27.3: For NC_CBK_EX_NR = i = 2

NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

If(1) { CPU optimization at LV_DC 0 → 1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn't empty }
Then(1)
While bit 1 of STATE_RBM_PUC_VLD_LS_UP[i] = 0 **do**
with each XX failure of the above list (depending on configuration, see below):
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2) bit 1 of STATE_RBM_PUC_VLD_LS_UP[i] = 1
Endif(2)
Endwhile
Else(1) { the dynamic failure memory is empty } No action
Endif(1)

Every 1 s :
If bit 0 of STATE_RBM_ PUC_VLD_LS_UP[i] = 0
Then
If LV_END_DIAG_PUC_VLD_LS_UP[i] = 1
Then bit 0 of STATE_RBM_PUC_VLD_LS_UP[i] = 1

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Endif
Endif

If bit 1 of STATE_RBM_PUC_VLD_LS_UP[i] = 0
Then
If LV_INH_DIAG_RBM_PUC_LSL_UP[i] = 1
Then bit 1 of STATE_RBM_PUC_VLD_LS_UP[i] = 1
Endif
Endif

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B.28 O2 sensor (lin, up) PUC plausibility diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_PUC_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
symptom of signal plausibility from the upstream sensor during PUC					
LV_CDN_DIAG_PUC_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Diagnosis condition for error symptom of signal plausibility of upstream sensor during PUC					
LV_DIAG_CDN_PUC_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Diagnosis condition					
LV_DIAG_PUC_END_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Result of diagnosis exist					
LV_DIAG_PUC_SYM_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced failure symptom of the signal plausibility from the upstream sensor during PUC					
LV_END_DIAG_PUC_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of diagnosis of signal plausibility from the upstream sensor during PUC					
LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced failure of the signal plausibility from the upstream sensor during PUC					
MAF_INT_PUC_ACT_OLD_DIAG_PUC	V	0... FFFFH	0... 2912.66666667	0.0444444	g
MAF integral during PUC from previous recurrence					
STATE_SYM_DIAG_PUC_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H	VLS_OK VLS_L VLS_H_OC VLS_AFS_OC	-	-
Symptom of the signal plausibility from the upstream sensor during PUC					
T_DIAG_END_PUC_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer to have a diagnostic available					
T_DIAG_SYM_PUC_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Symptom debouncer timer					
T_DLY_DIAG_PUC_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Delay Time to activate the diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_MAX_DIAG_END_PUC_LSL_UP	V	0... FFFFH	0... 6553.5	0.1	s
Time to set the end bit					
T_MAX_DIAG_SYM_PUC_LSL_UP	V	0... FFFFH	0... 6553.5	0.1	s
Symptom debouncer time					
T_MAX_DLY_DIAG_PUC_LSL_UP	V	0... FFFFH	0... 6553.5	0.1	s
Maximimum delay time to activate the diagnosis					
VLS_UP_DIAG_SAVE_PUC_LSL_UP [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-160... 159.995117188	4.88281e-3	V
Upstream sensor voltage - value used during the diagnosis and transmitted to the Scan Tool in mode06					

Input data:

LV_DIAG_EOL_PUC_LSL_UP [NC_CBK_EX_NR] {p. 5291}	LV_IGK {p. 906}	LV_INH_DIAG_PUC_LSL_UP [NC_CBK_EX_NR] {p. 5291}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}
LV_PUC {p. 1720}	MAF_INT_PUC_ACT {p. 2942}	NC_CBK_EX_NR {p. 1829}	NC_IDX_DIAG_PUC_VLD_LS_UP [NC_CBK_EX_NR]
STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	TEG_DYN_LS_UP [NC_CBK_EX_NR] {p. 1008}	VLS_UP_DIAG [NC_CBK_EX_NR] {p. 2315}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DIAG_END_EOL_PUC_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time to have a diagnostic available (EOL test)					
C_T_DIAG_END_PUC_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time to have a diagnostic available					
C_T_DIAG_SYM_EOL_PUC_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time filter to detect a symptom (EOL test)					
C_T_DIAG_SYM_PUC_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time filter to detect a symptom					
C_T_DLY_DIAG_EOL_PUC_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Waiting time after beginning of PUC to test sensor signal (EOL test)					
C_T_DLY_DIAG_PUC_LSL_UP	-	0... FFFFH	0... 6553.5	0.1	s
Waiting time after beginning of PUC to test sensor signal					
C_TEG_MIN_DIAG_PUC_LSL_UP	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum admissible exhaust gas temperature in PUC					
C_VLS_UP_DIAG_AFS_PUC_LSL_UP	-	8000... 7FFFH	-160... 159.995117188	4.88281e-3	V
Upstream sensor output voltage in PUC corresponding to Open Circuit on WRAF Sensor					
C_VLS_UP_DIAG_MAX_PUC_LSL_UP	-	8000... 7FFFH	-160... 159.995117188	4.88281e-3	V
Upstream sensor output voltage in PUC corresponding to Open Circuit on WRAF Sensor					
C_VLS_UP_DIAG_MIN_PUC_LSL_UP	-	8000... 7FFFH	-160... 159.995117188	4.88281e-3	V
Minimum admissible upstream sensor output voltage in PUC					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Import actions:

ACTION_ERRM_NoFilterReset (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_NoFilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_LV_ERR_SET>,**IN**<PRM_LV_ERR_RST>,**IN**<PRM_LV_END_DIAG>,**OUT**<PRM_LV_ERR>)

General information:

General information:
The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Description:

This function shall test the plausibility of the upstream sensor signal during the Pull Fuel Cut-off phase (PUC).

Three symptoms are distinguished:

VLS_H_OC indicates too high sensor voltage due to open circuit on sensor pin VRC (compensative resistance)

VLS_AFS_OC indicates very low sensor voltage near offset value of measurement circuit. The reason for a voltage drop down to offset value is either a open circuit on sensor pin VIP or VG.

VLS_L indicates that voltage is too low, but still above offset value. The reason for such a voltage drop may be poisoning or ageing of the lambda sensor.

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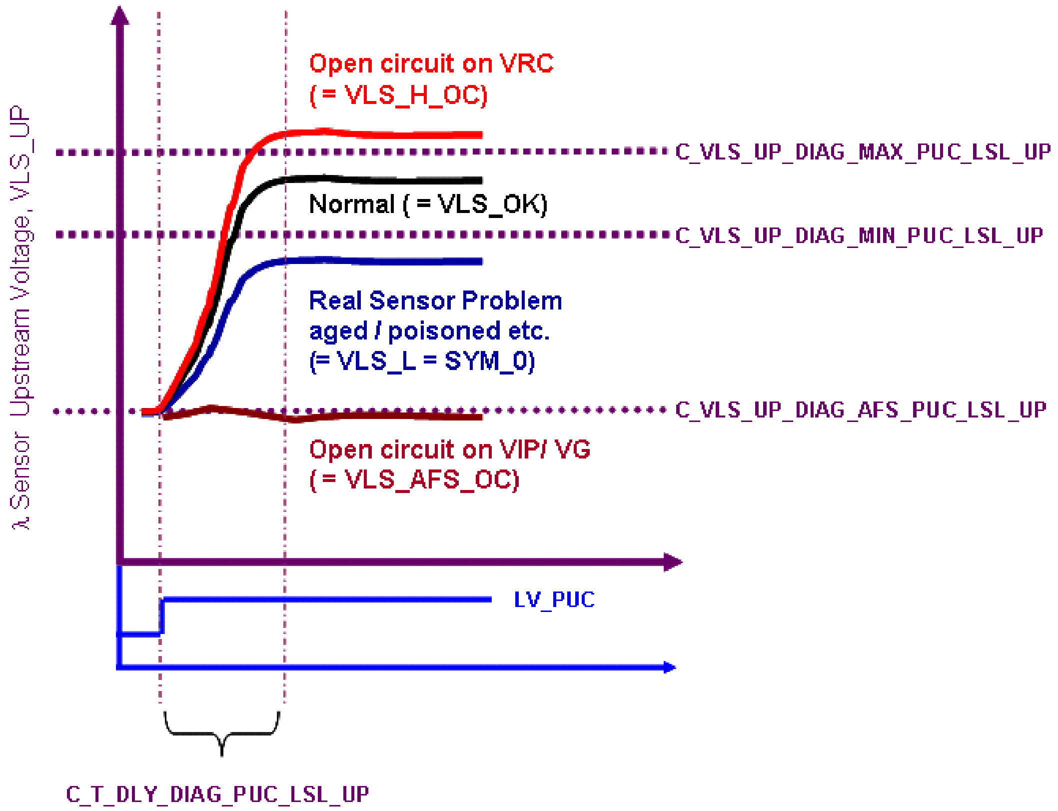

Figure B.28.1: :

If an open circuit of one of the sensor pins is detected (VLS_H_OC or VLS_AFS_OC), this information is not sent directly to the error management. Instead of this, the information is sent to the function "O2 sensor (lin) open circuit diagnosis" (A0J0). In this function the results of several diagnoses are collected and a clear identification of the open pin is done (pin-pointing). The communication to error management is done by the function "O2 sensor (lin) open circuit diagnosis in this case.

In case of detected failure VLS_L the information is transferred directly to the error management.

The variable VLS_UP_DIAG_SAVE_PUC_LSL_UP[i] contains the sensor voltage at the moment a failure is detected. It retains its value until an updated one is present. It is reset only in case the Error Management memory is deleted.

Application conditions:

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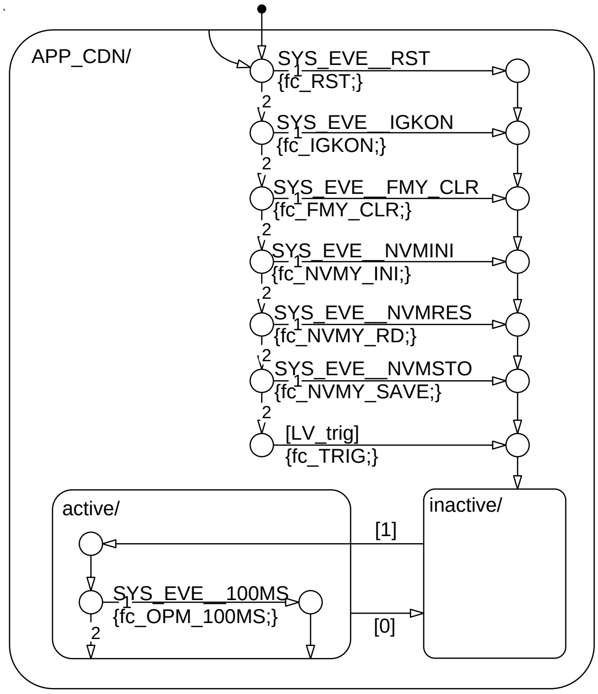

Figure B.28.2: :

Function description:

Formula section:

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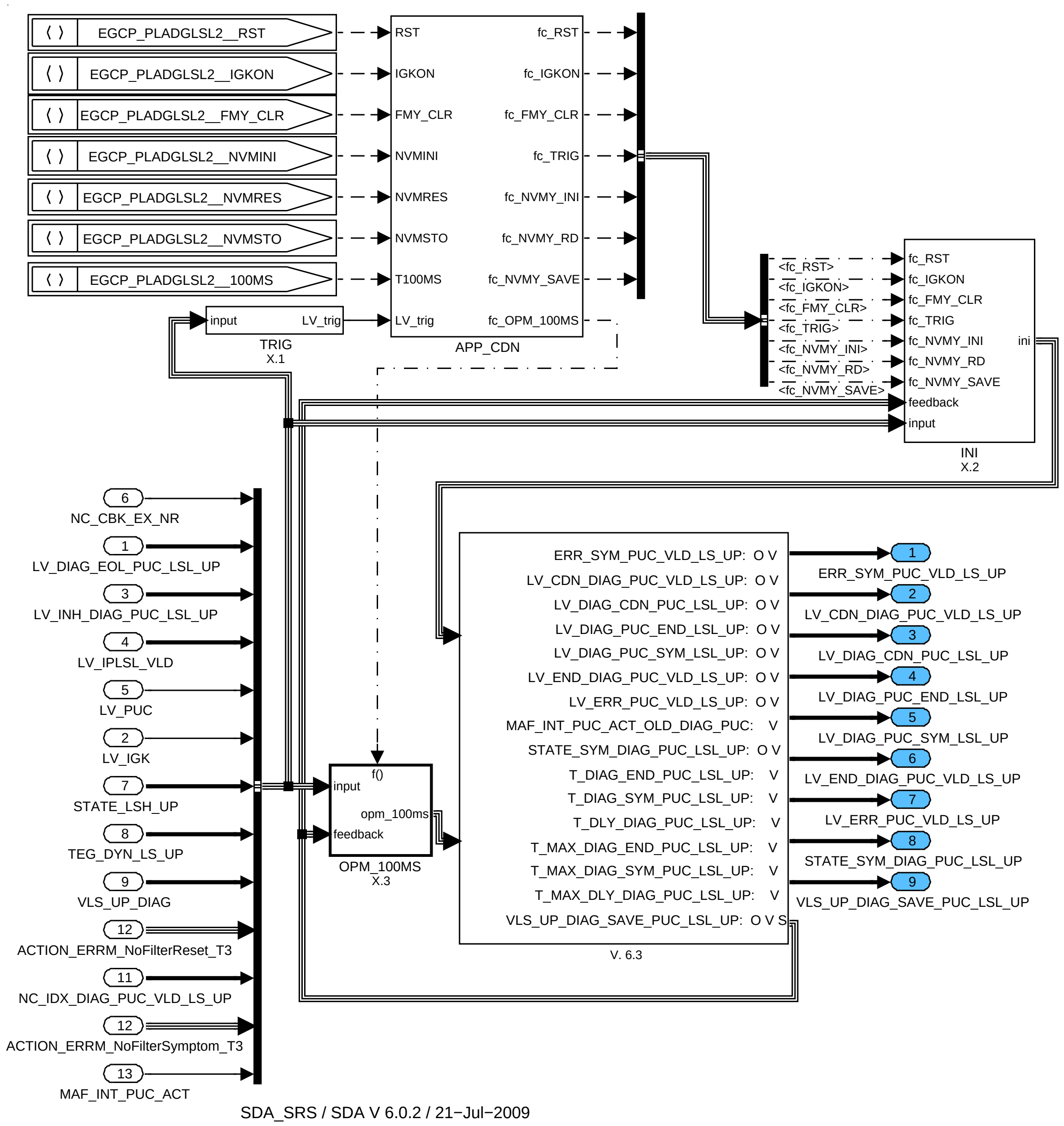

Figure B.28.3: :

B.28.1 Subsystem TRIG: Calculation of special initialization condition

In the subsystem TRIG a trigger (LV_trig) for variable initialisation is calculated, which is not supported by standard function calls.

B.28.1.1 Calculation of special initialisation condition:

New Initialization of variables shall take place in case of LV_DIAG_EOL_PUC_LSL_UP 0->1.
The toggling of this variable indicates the beginning of an End-of-line (EOL) test.
The output variable LV_trig is an additional input for the Application conditions (APP_CDN) next to the standard function calls which are provided by the SW-system environment.

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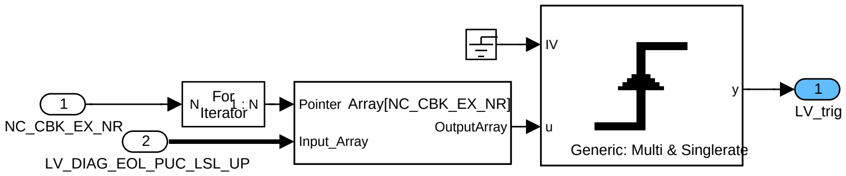

Figure B.28.4: :

B.28.2 INITIALIZATION: Initialization of normal and non-volatile memory variables

Initialization of (normal) variables, non-volatile memory variables and variables that are directly linked to error manager is described.
Initialization of variables takes place at LV_IGK = 0 to 1, reset, LV_DIAG_EOL_PUC_LSL = 0 to 1 (LV_trig) and at clearing error memory.
The variables saved in the non-volatile memory are reset only in case the error memory is cleared.
Variables that are directly linked with the Error manager are initialized according to related error manager routines (ACTION_ERRM).

B.28.2.1 Initialization at RESET

All "normal" variables are initialized with "0"
The ERRM variables are initialized accordingly to filter type

B.28.2.2 Handling NVMY data

B.28.2.2.1 Initialization of NVMY data

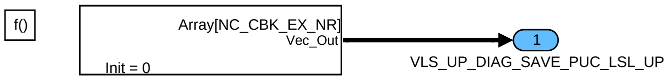

Figure B.28.5: :

B.28.3 Formula section of PUC plausibility diagnosis

B.28.3.1 Introduction multiple bank system

B.28.3.1.1 Check of activation conditions and main calculations

B.28.3.1.1.1 Calculation of activation (condition) flag for the diagnosis

The diagnosis is activated, if fuel cut off is indicated, sensor is active, exhaust gas temperature is below threshold, tip temperature of lambda sensor is controlled and no project specific inhibitions are active.

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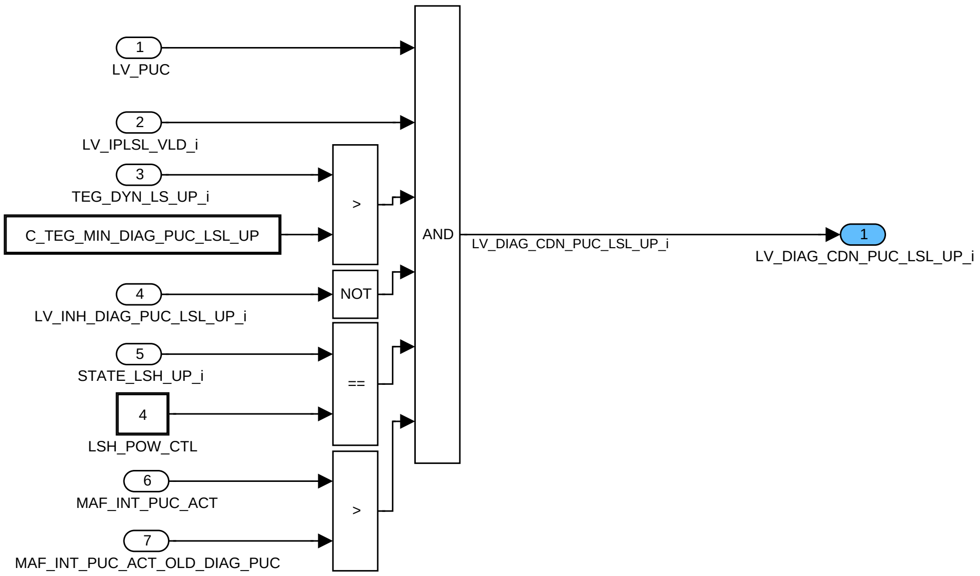

Figure B.28.6: :

B.28.3.1.1.2 Check of the activation conditions for diagnosis

ACT: the LV_DIAG_CDN_PUC_LSL_UP is true
DEAC: the LV_DIAG_CDN_PUC_LSL_UP is false
The calculation at ACT and DEAC are specified in next figures

B.28.3.1.1.2.1 ACT: activation condition for diagnosis true

Content:
Initialization of delay timers

B.28.3.1.1.2.1.1 Calculation of maximal thresholds for delay timers

The bit LV_DIAG_EOL_PUC_LSL_UP indicates, that End-of-line test (EOL) is active. The function gives the possibility to use different calibration data for standard case and EOL. This may become necessary, if only very short PUC-phases are available during EOL.

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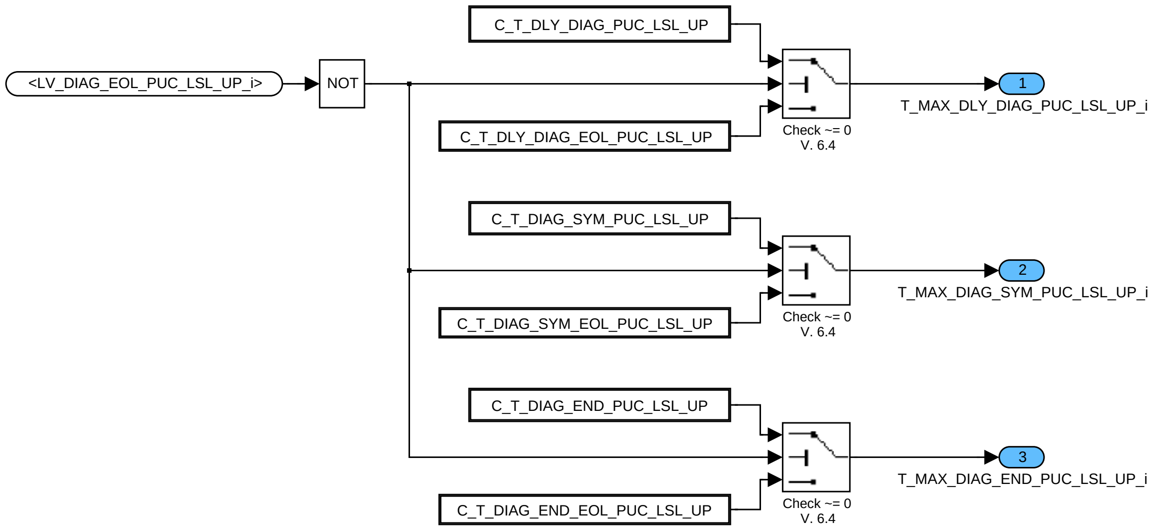

Figure B.28.7: :

B.28.3.1.1.2.1.2 Start and check of delay timer, initialization of diagnosis (DIAG)

As soon as activation conditions for diagnosis are fulfilled, the delay-timer T_DLY_DIAG_PUC_LSL_UP is started.
If the delay timer has exceeded, the calculations for the diagnosis are triggered.

DIAG: calculation of diagnosis result

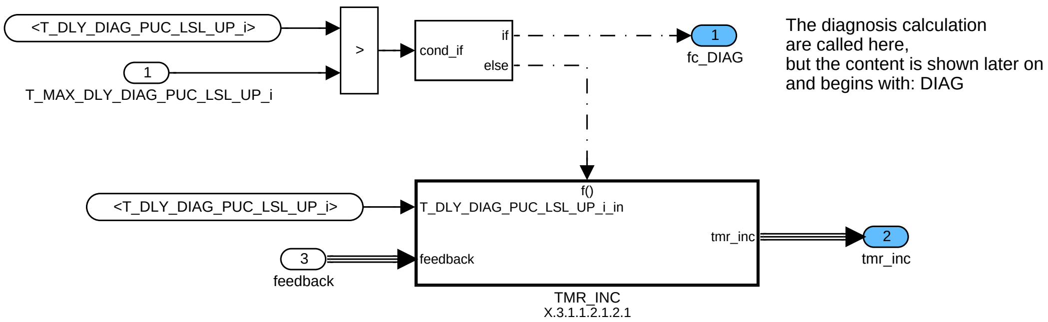

Figure B.28.8: :

B.28.3.1.1.2.1.2.1 Condition false

B.28.3.1.1.2.1.2.1.1 Increment of delay timer

As long as delay timer is below calibrated threshold, increment of timer takes place. The bit LV_CDN_DIAG_PUC_VLD_LSL_UP is set to 0 and inhibits the start of diagnosis.

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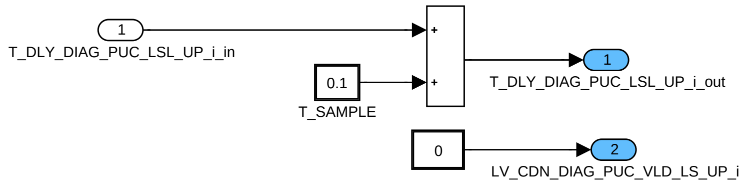

Figure B.28.9: :

B.28.3.1.1.2.2 DEAC: activation condition for diagnosis false

B.28.3.1.1.2.2.1 Deactivate diagnosis

If the activation conditions for the diagnosis are not fulfilled, both condition-bits are reset.

If an symptom has been already detected and de-bounced, STATE_SYM_DIAG_PUC_LSL_UP is frozen to actual value.
Otherwise STATE_SYM_DIAG_PUC_LSL_UP is set to "VLS_OK"
(for the cases : 1) Symptom has never been indicated. 2) symptom is indicated, but de-bounce has not yet been completed, because interrupt by revoke of activation conditions took place)

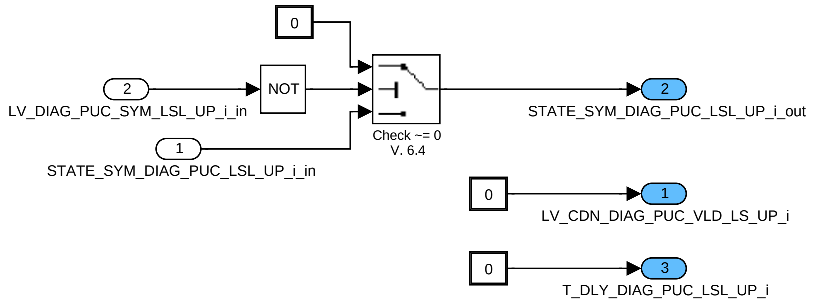

Figure B.28.10: :

B.28.3.1.1.3 DIAG: calculation of diagnosis result

If activation conditions are fulfilled, and the delay timer has passed, the calculations for the PUC plausibility diagnosis take place.
The principal of diagnosis is shown in the signal flow diagram below.
Please note that the diagram gives only an overview about the signal flow. Not all calculations are included in the diagram !

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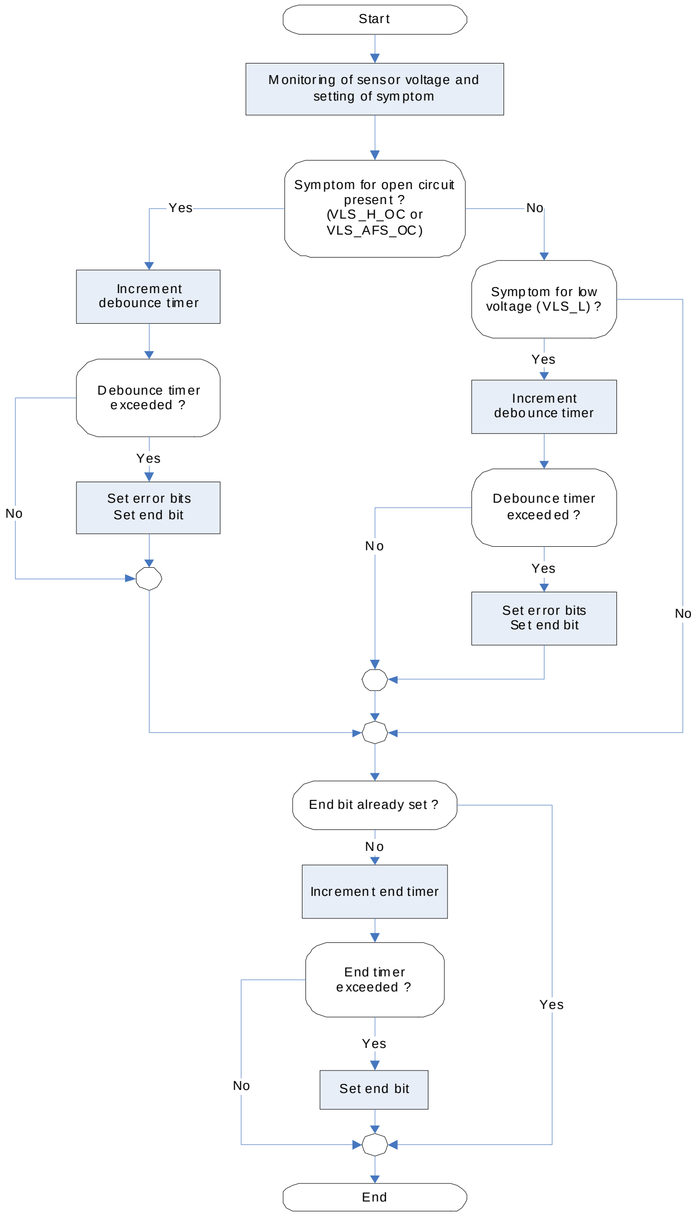

Figure B.28.11: :

B.28.3.1.1.3.1 DIAG: Monitoring of sensor voltage (setting of symptoms)

If activation conditions are fulfilled and the delay timer has passed, the monitoring of the sensor voltage signal starts. STATE_SYM_DIAG_PUC_LSL_UP is set according to measured voltage.

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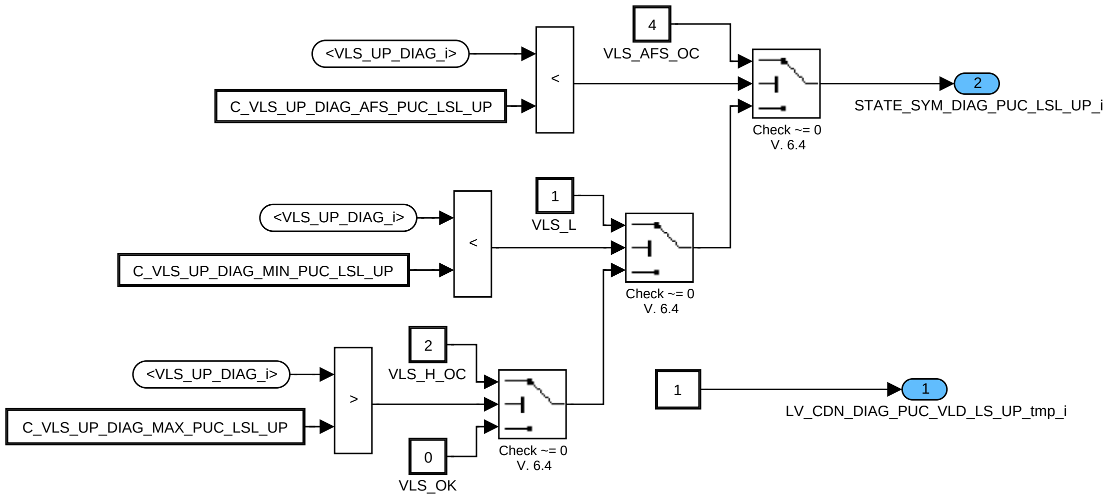

Figure B.28.12: :

B.28.3.1.1.3.2 DIAG: Distinguish symptoms according linkage to Error manager

The symptoms VLS_L and VLS_OK are directly linked to Error Management. The symptoms VLS_AFS_OC and VLS_H_OC are not directly linked to Error Management. Instead of this, they are linked to the function "O2 sensor (lin) open circuit diagnosis" (A0J0).
Because of this difference, different subsystems are called depending on the value of STATE_SYM_DIAG_PUC_LSL_UP.

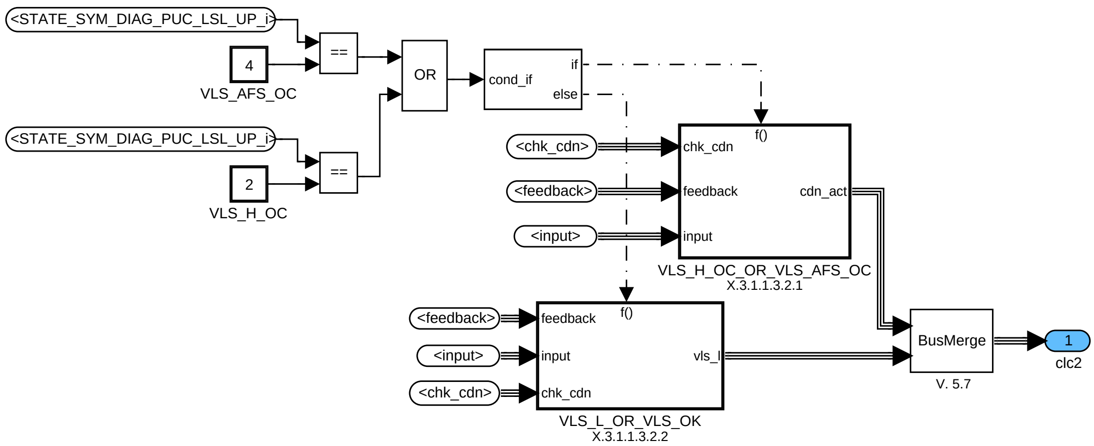

Figure B.28.13: :

B.28.3.1.1.3.2.1 Distinguish symptoms linked to Error manager: condition true

B.28.3.1.1.3.2.1.1 Calculation for Symptoms VLS_AFS_OC and VLS_H_OC

As long as the symptom VLS_AFS_OC or VLS_H_OC is fulfilled, the debounce timer is incremented.
If the de-bounce timer exceeds the calibrated thresholds, the symptom bit and the end bits are set (this information is send to the function "O2 sensor (lin) open circuit diagnosis" (A0J0)).
The actual output voltage of the sensor is stored in the non-volatile memory.

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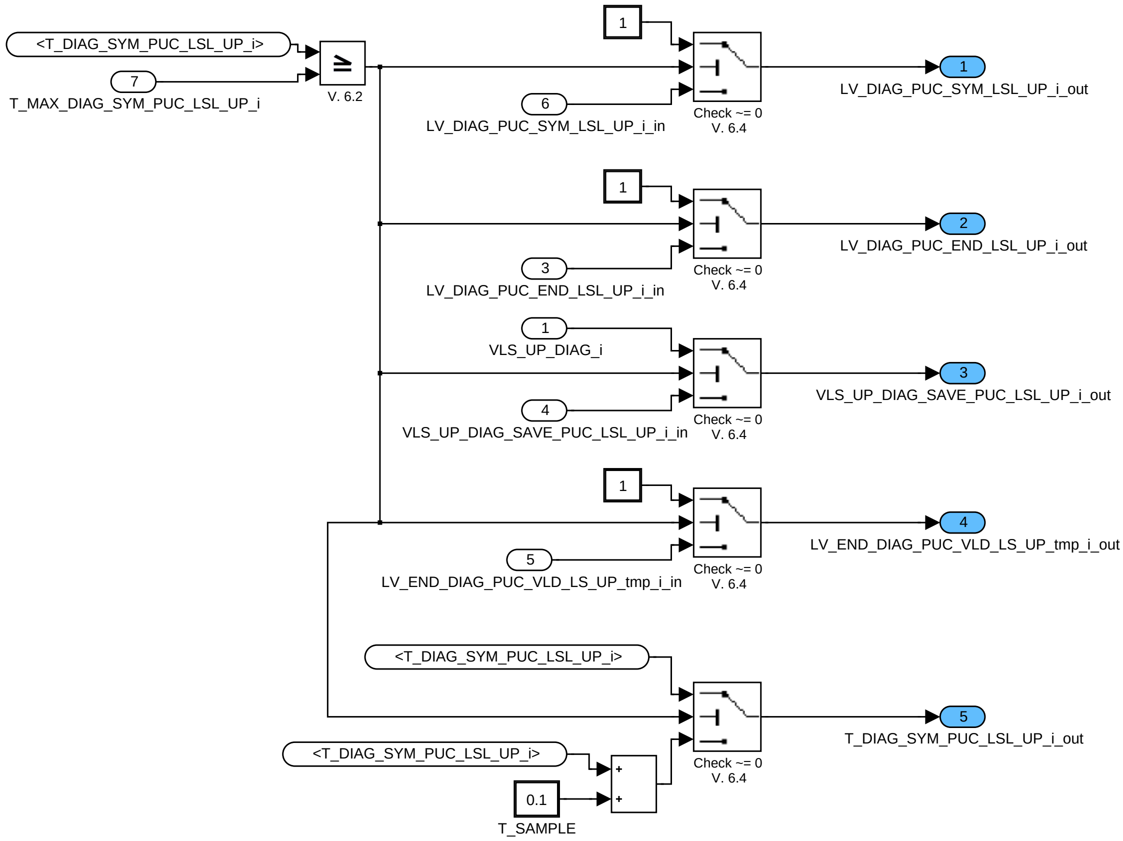

Figure B.28.14: :

B.28.3.1.1.3.2.2 Distinguish symptoms linked to Error manager: condition false

B.28.3.1.1.3.2.2.1 Check of symptoms linked to ERRM

This calculation is only done, if neither symptom VLS_H_OC nor VLS_AFS_OCS is active.
The remaining possible states are VLS_L and VLS_OK. The variable STATE_SYM_DIAG_PUC_LSL_UP is checked and different calculations are triggered.

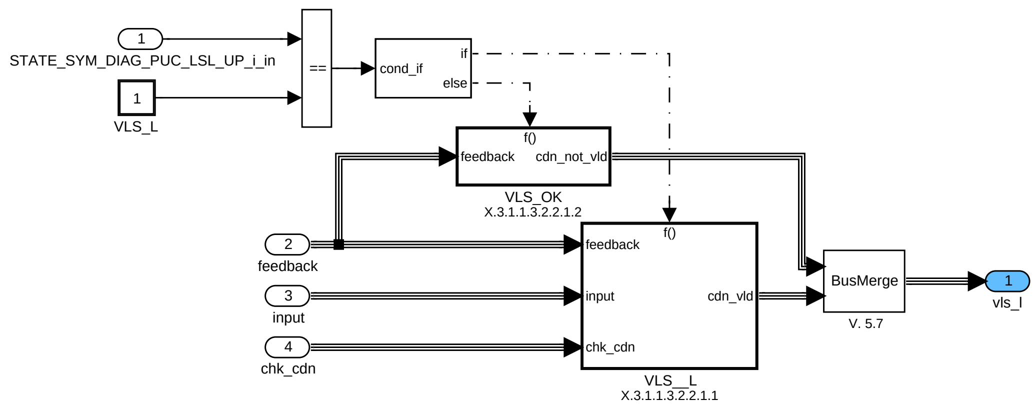

Figure B.28.15: :

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B.28.3.1.1.3.2.2.1.1 Check of symptoms linked to ERRM: condition true

B.28.3.1.1.3.2.2.1.1.1 De-bouncing and setting of failure for symptom VLS_L

The de-bounce counter T_DIAG_SYM_PUC_LSL_UP is increased until the calibrated threshold is reached. The actual sensor voltage is stored in the non-volatile memory and the failure is transferred to Error management by setting of the corresponding variables.

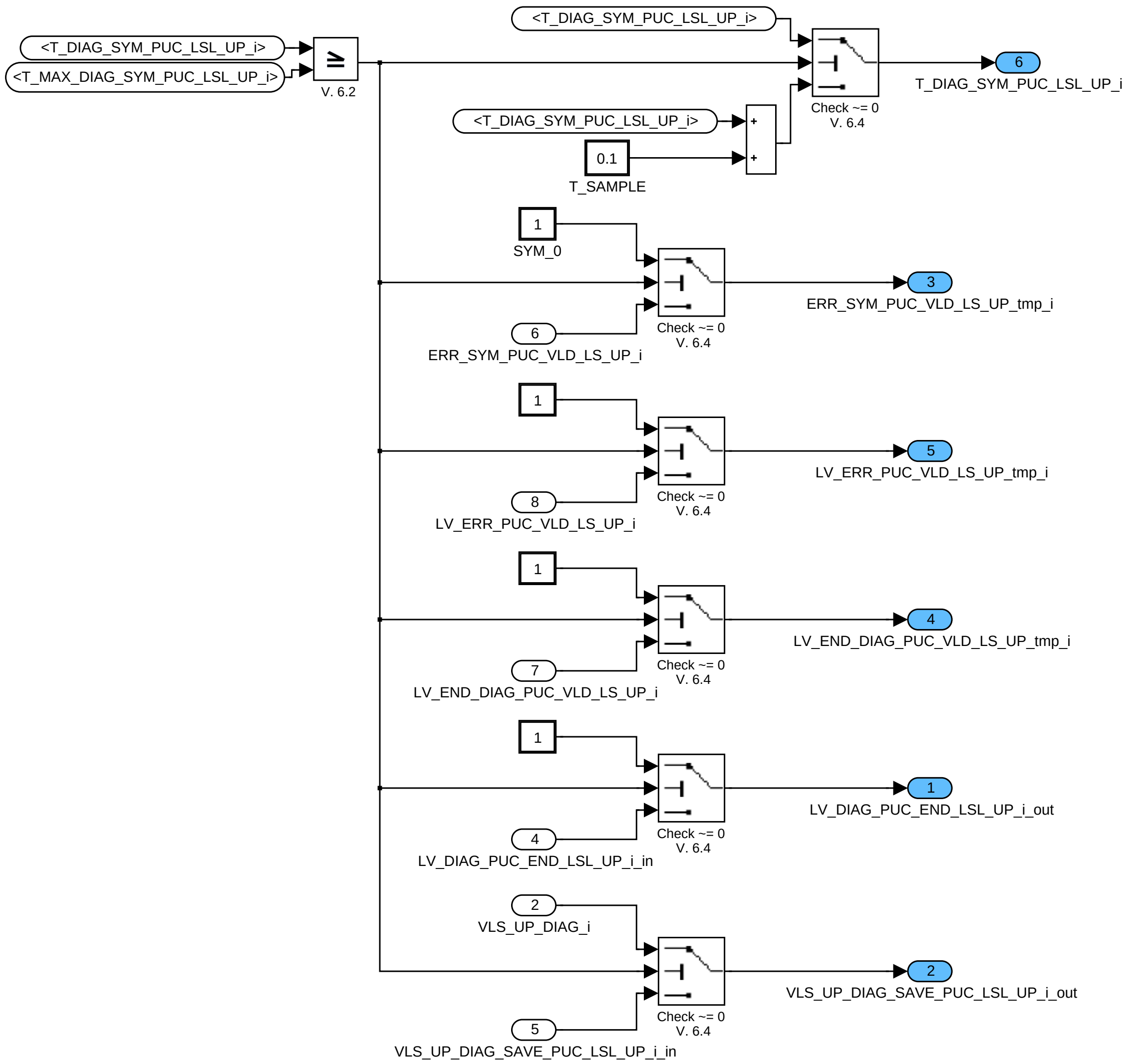

Figure B.28.16: :

B.28.3.1.1.3.2.2.1.2 Check of symptoms linked to ERRM: condition false

B.28.3.1.1.3.2.2.1.2.1 Calculation in case of symptom VLS_OK

As soon as symptom is VLS_OK (sensor voltage within allowed band) the debounce timer is set to zero.

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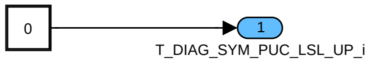

Figure B.28.17: :

B.28.3.1.1.3.3 DIAG: Timer for setting the End-bit: Conditions for timer increment

If the End-bit(s) of the diagnosis is set already, no further calculations are done in this subsystem.
If the End-bit(s) are not set, the End-timer of the diagnosis is increased and checked against a calibrated threshold (in subsystem CDN_VLD).

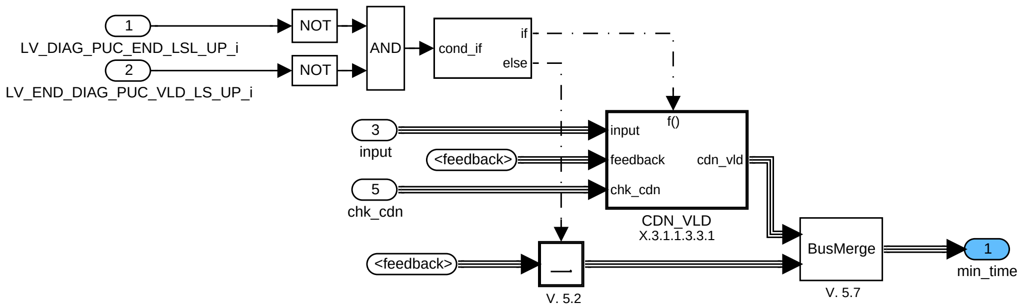

Figure B.28.18: :

B.28.3.1.1.3.3.1 Conditions for timer increment valid

B.28.3.1.1.3.3.1.1 Timer increment and setting of End-bit

The End-timer is increased and compared with a calibrated threshold. If the threshold is reached, the end-bit(s) of the diagnosis are set. (The error-bit remains unchanged, this means = 0)
This is the usual way for setting the end-bit (VLS_OK).
In the failure case (VLS_H_OC, VLS_AFS_OC, VLS_L) end bit is set by on different path together with error-bit.

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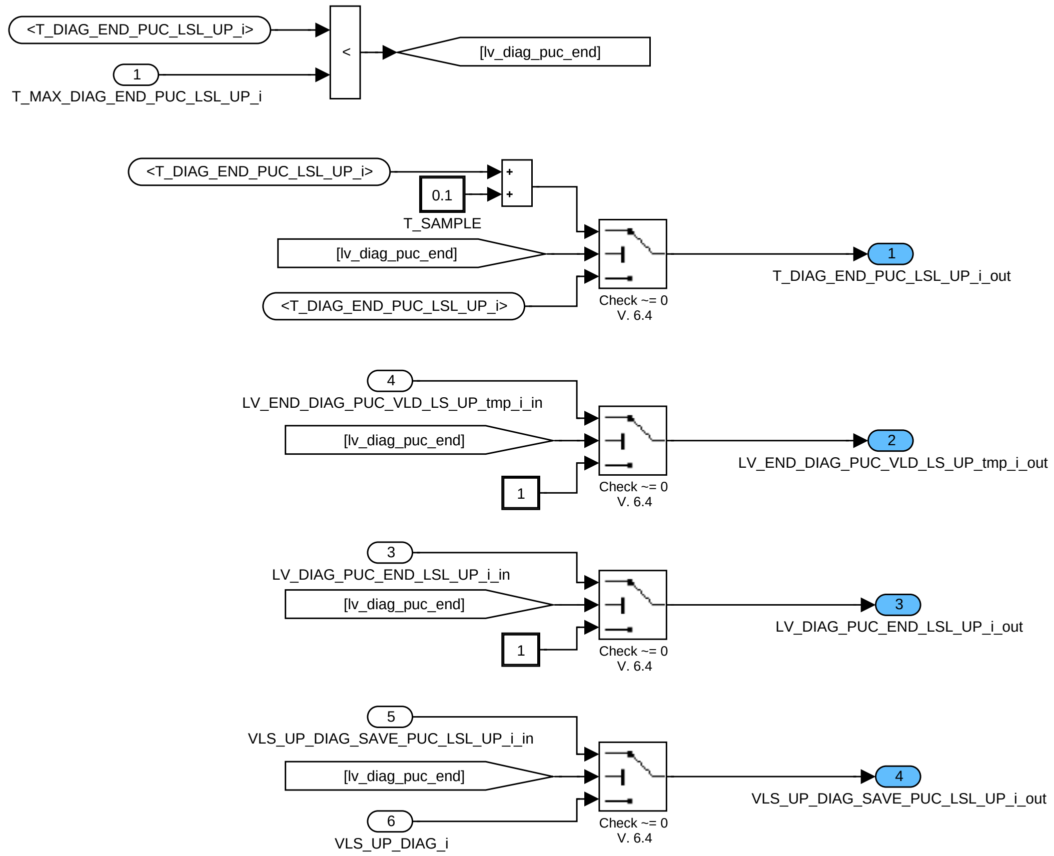

Figure B.28.19: :

B.28.3.1.1.4 Connection to Error manager for setting of failure

Synchronisation with error management is done every recurrence.

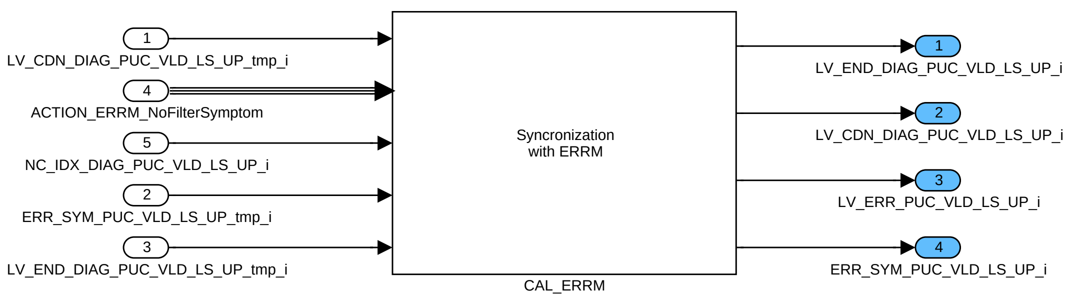

Figure B.28.20: :

B.28.3.2 Calculation of Mass Air Flow Integral to detect a short interruption of a Fuel Cut-Off Phase

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B.29 O2 sensor (lin, up) dynamic diagnosis after NOx CAT regeneration

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CONC_O2_CLC_DIAG_DYN_S [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 1.99993896	610.352e3	-
O2 concentration derived from lambda value of sensor model					
CONC_O2_CLC_DIAG_DYN_S_ST [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 1.99993896	610.352e3	-
O2 concentration from sensor model at the last transition out of homogenous combustion mode					
CONC_O2_CLC_INT_DIAG_DYN_S [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 1.99993896	610.352e3	-
integral of modelled O2 concentration in stratified dynamics diagnosis					
CONC_O2_DIF_INT_DIAG_DYN_S [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 1.99993896	610.352e3	-
integral of the difference between modelled and measured O2 concentration in stratified dynamics diagnosis					
CONC_O2_MES_DIAG_DYN_S [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 1.99993896	610.352e3	-
O2 concentration derived from measured lambda value from sensor					
CONC_O2_MES_DIAG_DYN_S_ST [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 1.99993896	610.352e3	-
measured O2 concentration at time of last transition out of homogenous combustion mode					
CONC_O2_MES_MAX_DIAG_DYN_S [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 1.99993896	610.352e3	-
measured O2 concentration at time of last transition out of homogenous combustion mode					
CTR_DIAG_DYN_S_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
number of valid diagnostic samples in the current driving cycle					
FAC_MV_DIAG_DYN_S_LSL_UP [NC_CBK_EX_NR]	O/V	8000... 7FFFH	0... 127.996094	0.00390625	-
final diagnostic value of stratified dynamics diagnosis					
FAC_SUM_DIAG_DYN_S_LSL_UP [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	0... 8388610	0.00390625	-
sum of all diagnostic values for stratified dynamics diagnosis sampled in the current driving cycle					
FAC_VALUE_DIAG_DYN_S_LSL_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 127.996094	0.00390625	-
last sample of stratified dynamics diagnosis value					
LV_DIAG_DYN_S_LSL_UP_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End flag from stratified combustion lambda sensor dynamics diagnosis					
LV_DIAG_DYN_S_LSL_UP_ERR [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
error signalization from stratified dynamics diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_DYN_S_LSL_UP_SAMPLE [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
signals that a new diagnostic sample should be calculated and included into the average					
LV_DIAG_DYN_S_LSL_UP_STOP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
signals that the diagnosis shall sleep until reactivated by another homogenous combustion phase					
MAF_INT_DIAG_DYN_S_ACT [NC_CBK_EX_NR]	V	0... FFFFH	0... 2912.67	0.04444444	g
MAF integral since transition out of homogenous combustion mode					
STATE_SYM_DIAG_DYN_S_LSL_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
error symptom from stratified dynamics diagnosis					

Input data:

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP_FIL_S [NC_CBK_EX_NR] {p. 2462}	LV_DIAG_DYN_S_SWI_ CMB {p. 5332}	LV_HOM_ACT {p. 8136}
LV_INH_DYN_DIAG_S_ LSL_UP [NC_CBK_EX_NR] {p. 5332}	MAF_CYL {p. 8277}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}
TQI_SP_S {p. 8391}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CONC_O2_CLC_HOM_MAX_DYN_S	-	8000... 7FFFH	0... 1.99993896	610.352e3	-
maximum allowable modelled O2 concentration for stratified dynamics diagnosis					
C_CONC_O2_DIF_MAX_DIAG_DYN_S	-	8000... 7FFFH	0... 1.99993896	610.352e3	-
maximum allowable difference between measured and modelled O2 concentration for stratified dynamics diagnosis					
C_CONC_O2_DIF_ST_MAX_DIAG_DYN_S	-	8000... 7FFFH	0... 1.99993896	610.352e3	-
maximum difference between measured and modelled O2 concentration to allow stratified dynamics diagnosis					
C_CONC_O2_MES_DEC_MAX_DYN_S	-	8000... 7FFFH	0... 1.99993896	610.352e3	-
maximum allowable difference between measured and modelled O2 concentration for stratified dynamics diagnosis					
C_CTR_DIAG_DYN_S_LSL_UP	-	0... FFH	0... 255	1	-
Number of valid regeneration cycles needed for averaging in stratified dynamics diagnosis					
C_FAC_CONC_O2_COR_DIAG_DYN_S	-	0... FFH	0... 1.9921875	0.0078125	-
scaling factor in stratified dynamics diagnosis for correction of measured O2 concentration					
C_FAC_DIAG_DYN_S_LSL_UP_MAX	-	8000... 7FFFH	0... 127.996094	0.00390625	-
maximum dynamics characterization value from stratified diagnosis allowable for a "good" lambda sensor					
C_MAF_INT_END_DIAG_DYN_S	-	0... FFFFH	0... 2912.67	0.04444444	g
air mass integral after end of regeneration phase after which to one diagnosis cycle ends					
C_MAF_INT_ST_DIAG_DYN_S	-	0... FFFFH	0... 2912.67	0.04444444	g
air mass integral to wait for before starting integration of differences in stratified dynamics diagnosis					
C_N_MAX_STOP_DIAG_DYN_S	-	0... FFH	0... 8160	32	rpm
maximum engine speed to conduct stratified dynamics diagnosis					
C_N_MIN_STOP_DIAG_DYN_S	-	0... FFH	0... 8160	32	rpm
minimum engine speed to conduct stratified dynamics diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQI_MAX_DIAG_DYN_S	-	8000... 7FFFH	0... 1023.97	0.03125	Nm
maximum torque request allowable for stratified dynamics diagnosis					
C_TQI_MIN_DIAG_DYN_S	-	8000... 7FFFH	0... 1023.97	0.03125	Nm
minimum torque request allowable for stratified dynamics diagnosis					
IP_FAC_COR_CONC_O2_DIF_DYN_HOMS	-	0... FFH	0... 0.06225586	24.41409e3	-
LDPM_N_32_LS_UP_DYN	8	0... FFH	0... 8160	32	rpm
LDP_TQI_SP_S_IP_CONC_O2_DYN_S	8	0... FFFFH	0... 1023.97	0.03125	Nm
weighting factor for dynamics diagnosis result					
IP_FAC_COR_CONC_O2_DIF_DYN_S	-	0... FFH	0... 0.06225586	24.41409e3	-
LDPM_N_32_LS_UP_DYN	8	0... FFH	0... 8160	32	rpm
LDP_TQI_SP_S_IP_CONC_O2_DYN_S	8	0... FFFFH	0... 1023.97	0.03125	Nm
weighting factor for dynamics diagnosis result					
LC_DIAG_DYN_S_LSL_UP_MOD	-	0... 1H	0 ...1	1	-
switch between integral and difference as basis for dynamics diagnosis					

B.29.1 EGCP_PLADGLSL6

This is an alternative diagnosis for the sensor dynamics of WRAF sensors in stratified combustion engines. It expects NOx trap regeneration or other short phases of homogenous combustion in a normally stratified or other lean engine operation. The function interprets the transition from homogenous to stratified mode as a steplike input to the sensor and monitors the sensor's signal response as it rises from around lambda=1 to higher values (typically above lambda=2).
The difference between this response and the modelled behaviour of a good sensor is integrated, start and end of the integral can be calibrated in terms of a MAF integral to focus on the parts of the signal trace that show large and reproducible differences between new and aged sensors. To get more even weighting of differences in the high and low lambda ranges, the modelled and measured lambda values are transformed into O_2 concentrations and the integrals are calculated with these concentrations. A map is used to correct for influences of mass air flow and engine speed on the sensor response.

Application Condition

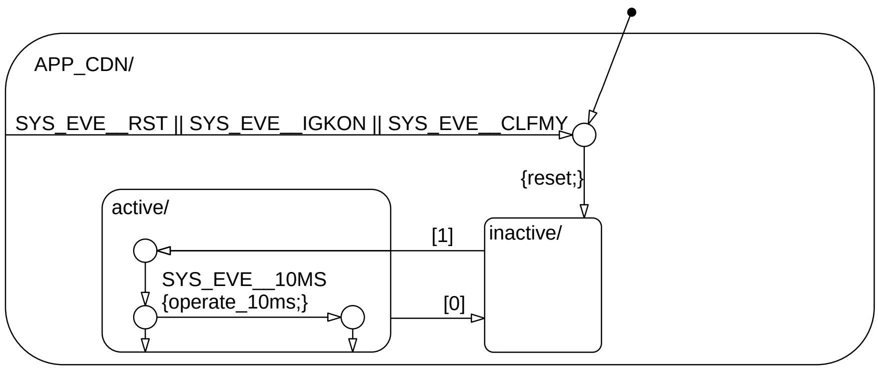

Figure B.29.1: EGCP_PLADGLSL6/APP_CDN/Chart

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Function Description

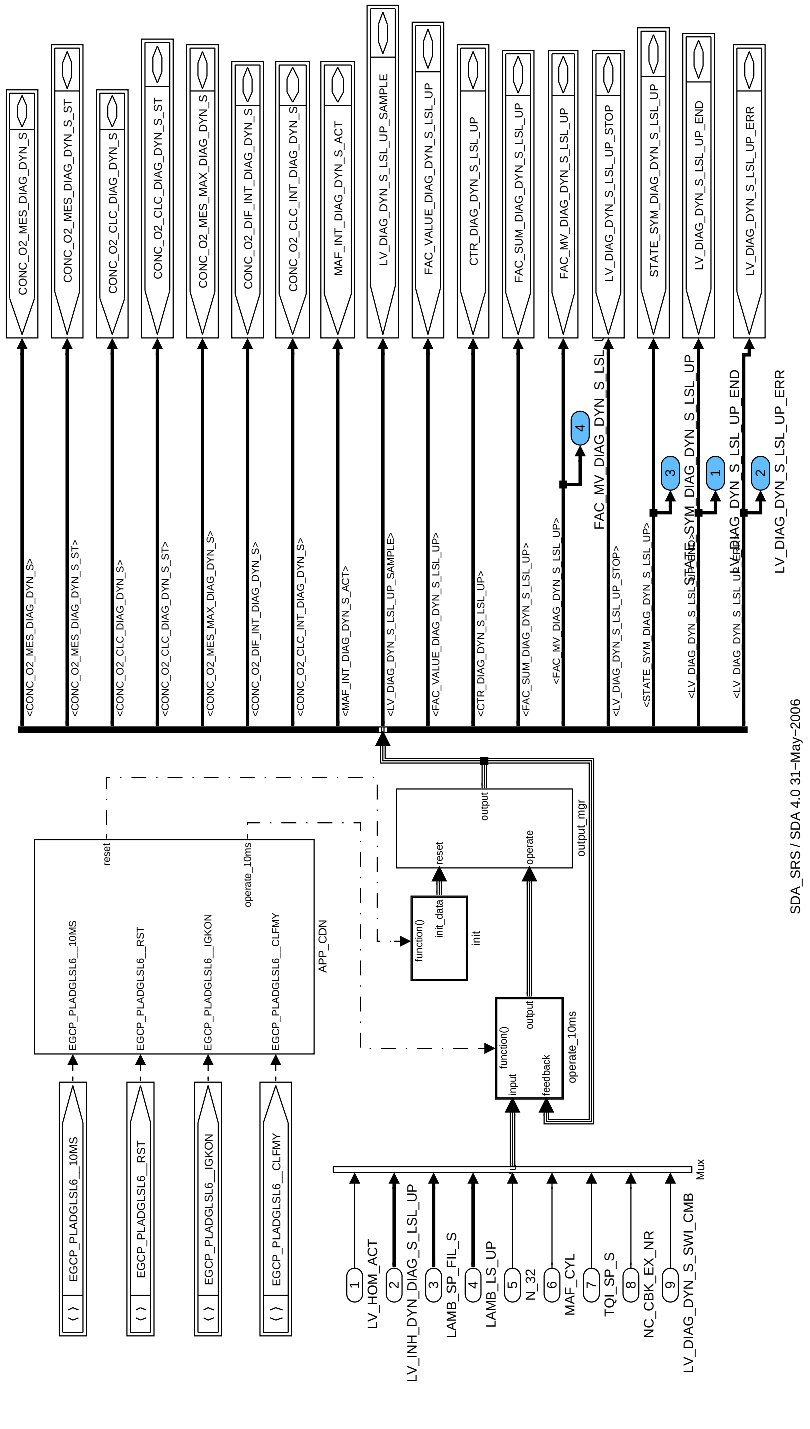

Figure B.29.2: EGCP_PLADGLSL6

B.29.1.1 EGCP_PLADGLSL6/INIT

Initialization of the online data takes place at reset, when clearing the error memory and at the beginning of a driving cycle.

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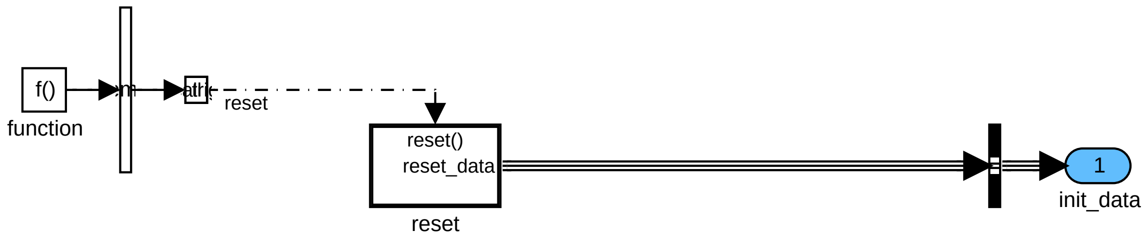

Figure B.29.3: EGCP_PLADGLSL6/init

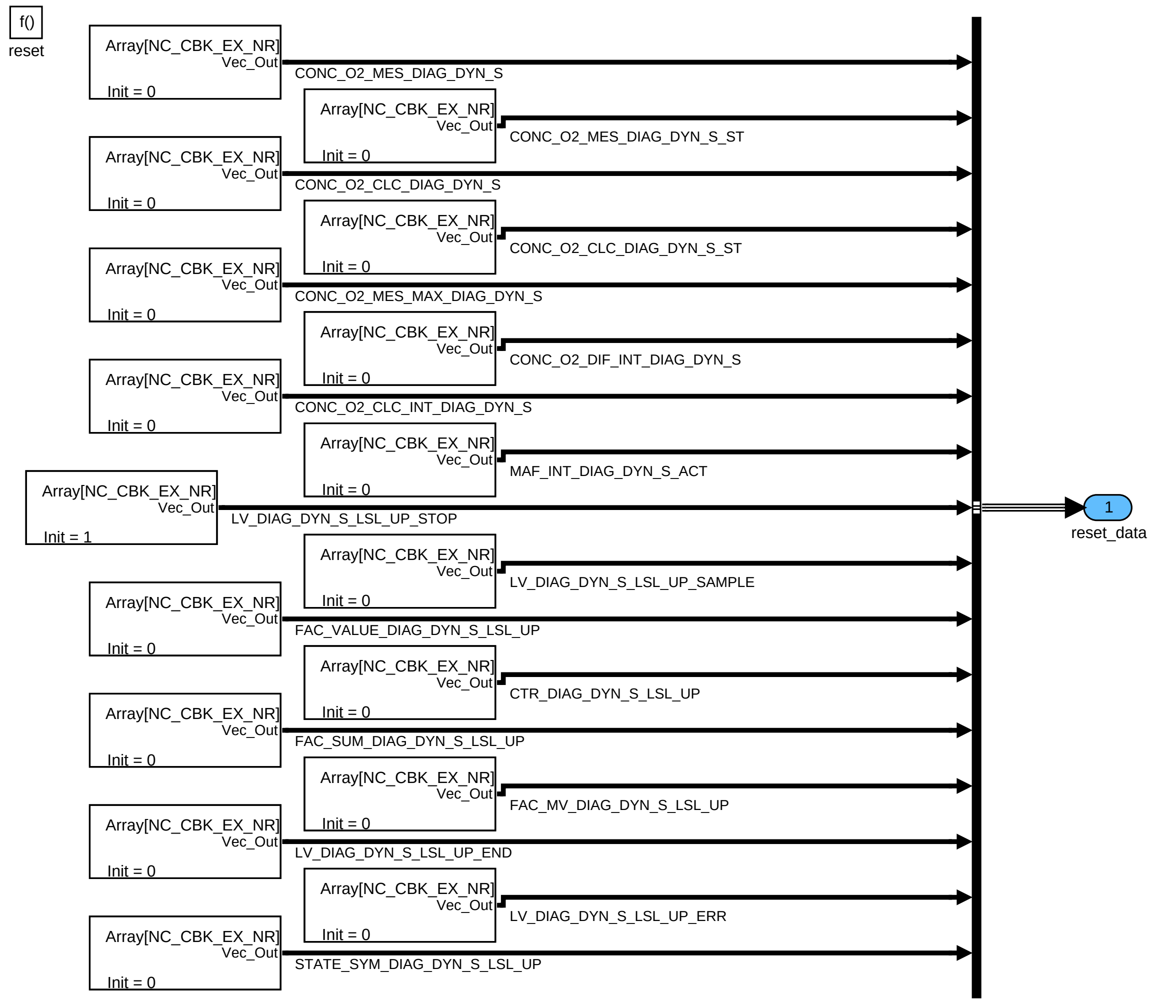

Figure B.29.4: EGCP_PLADGLSL6/init/reset

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B.29.1.2 SUBFUNCTION: operate_10ms

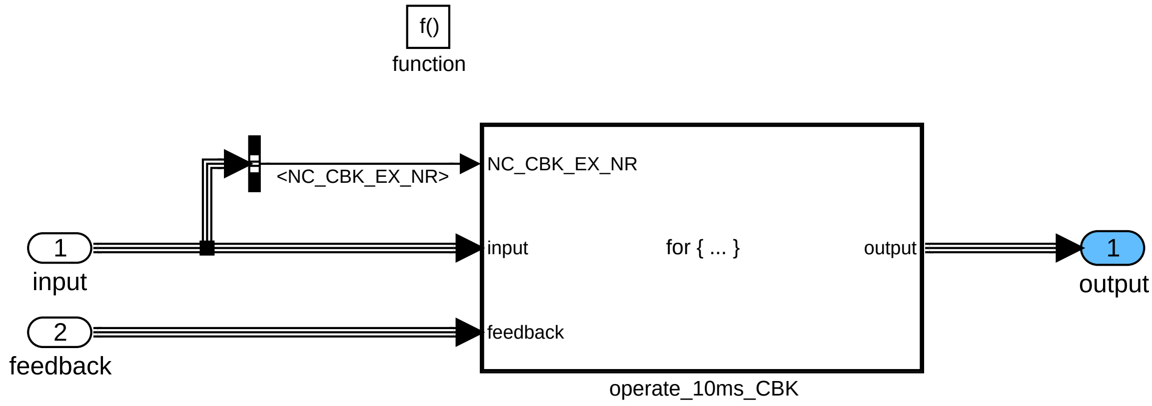

Figure B.29.5: EGCP_PLADGLSL6/operate_10ms

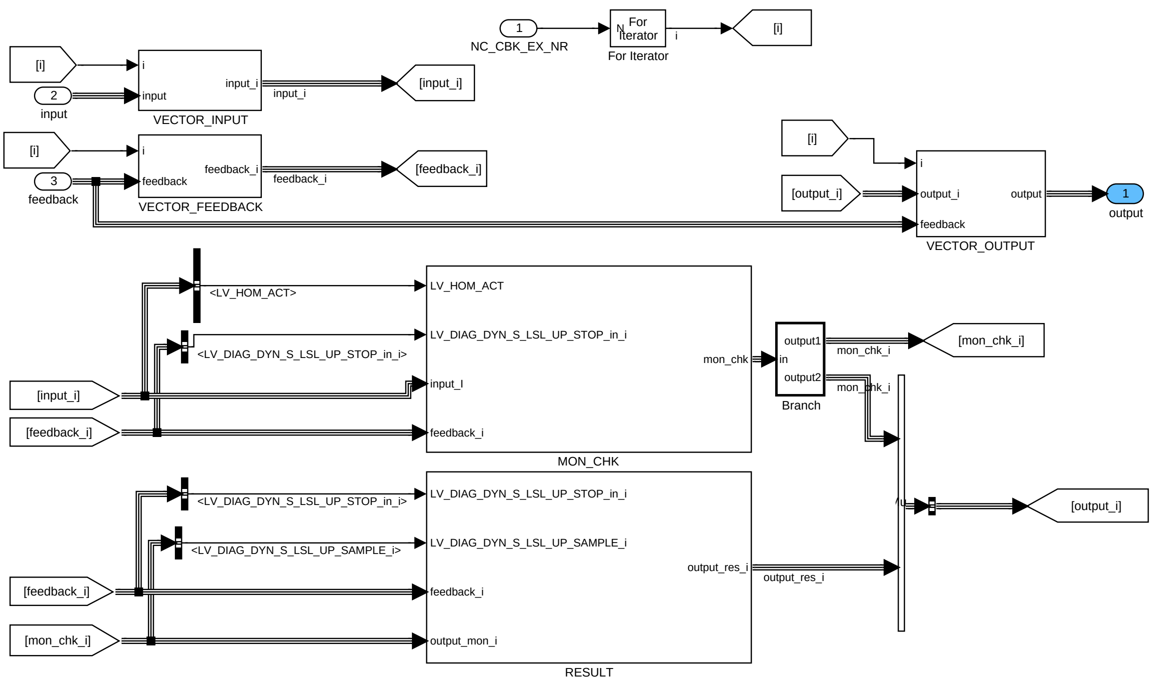

Figure B.29.6: EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK

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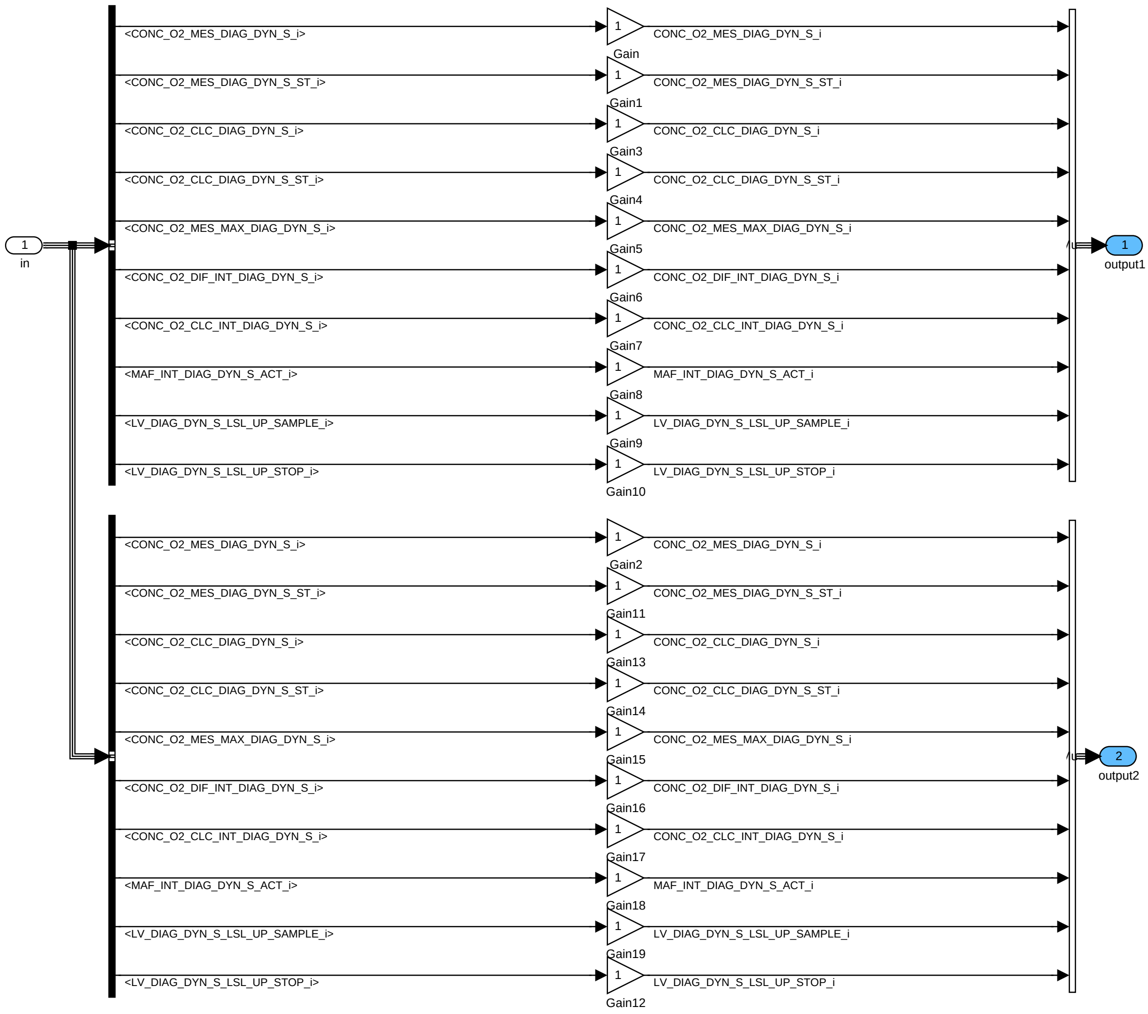

Figure B.29.7: EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/Branch

EGCP_PLADGLSL6/OPERATE_10MS/OPERATE_10MS_CBK/MON_CHK

This is the first part of the diagnosis, which continuously monitors the WRAF sensor signal and calculates several integrals (see below for further explanation). It starts if the engine is running in homogenous combustion mode and continues into the start of the following phase of stratified combustion until aborted or finished.

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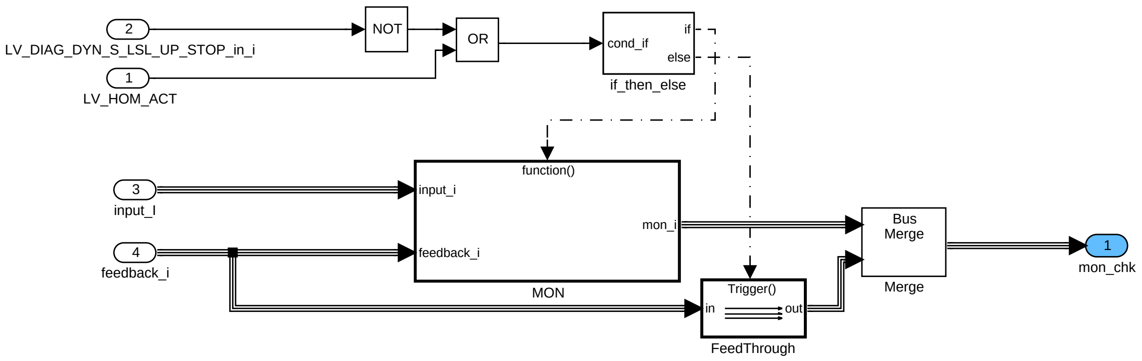

Figure B.29.8: EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/MON_CHK

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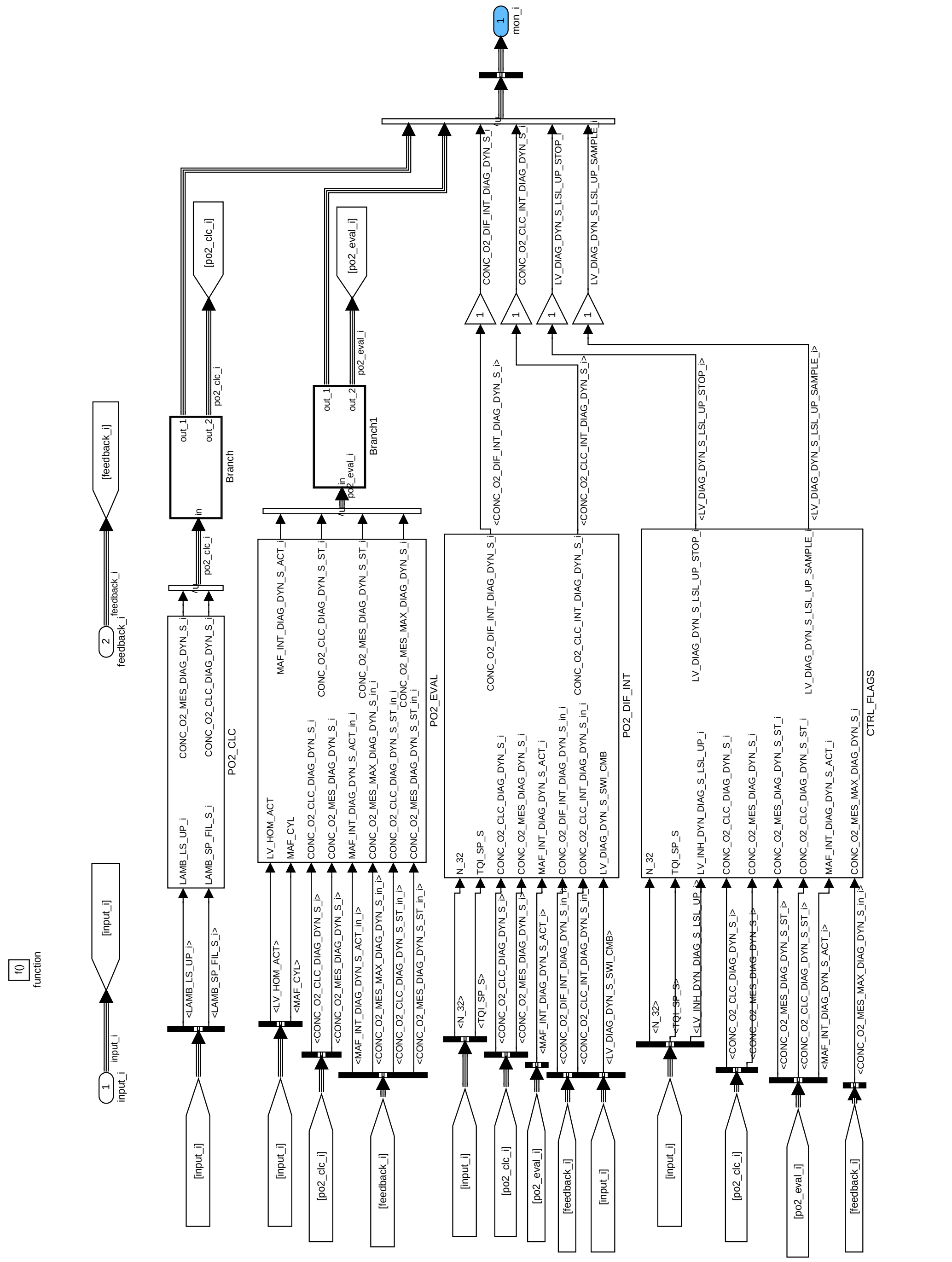

Figure B.29.9: EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/MON_CHK/MON

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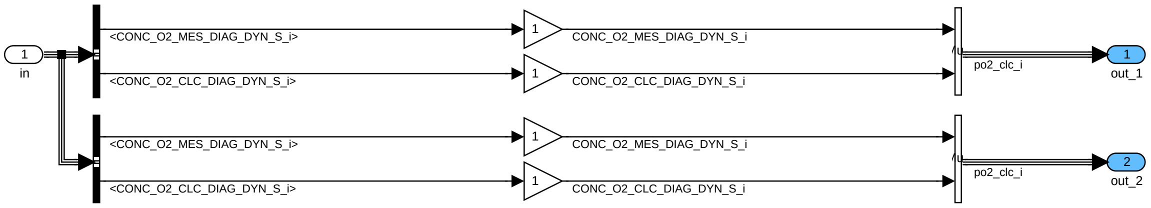

Figure B.29.10: EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/MON_CHK/MON/Branch

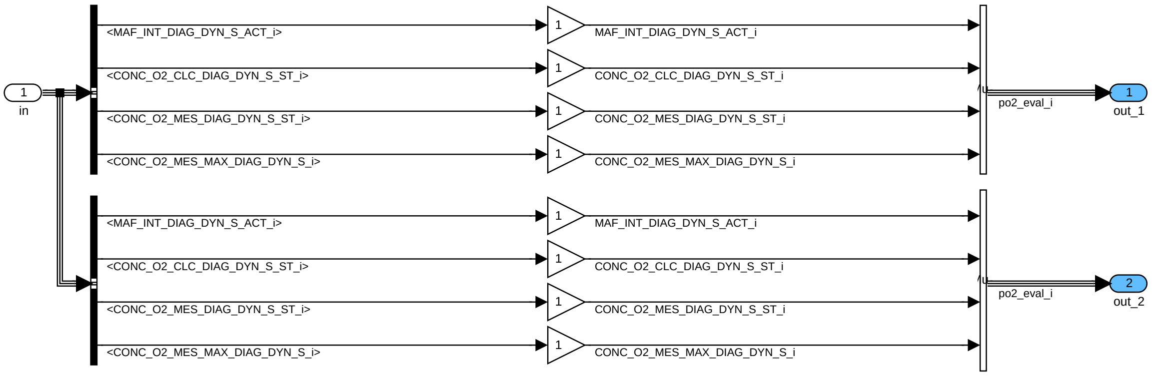

Figure B.29.11: EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/MON_CHK/MON/Branch1

EGCP_PLADGLSL6/OPERATE_10MS/OPERATE_10MS_CBK/MON_CHK/MON/CTRL_FLAGS

This section shall generate two flags. LV_DIAG_DYN_S_LSL_UP_SAMPLE[i] triggers the calculation of a result at the end of the current diagnostic cycle. It will be set to 1 in the last recurrence before the function deactivates itself, and reset to 0 at the start of the next cycle.
LV_DIAG_DYN_S_LSL_UP_STOP[i] is expected to be set to 0 during a homogenous combustion phase to indicate that a diagnostic cycle can be started at the next transition to stratified combustion. It will be set to 1 if the cycle should be stopped, either because a result is available or because required conditions are not fulfilled anymore.

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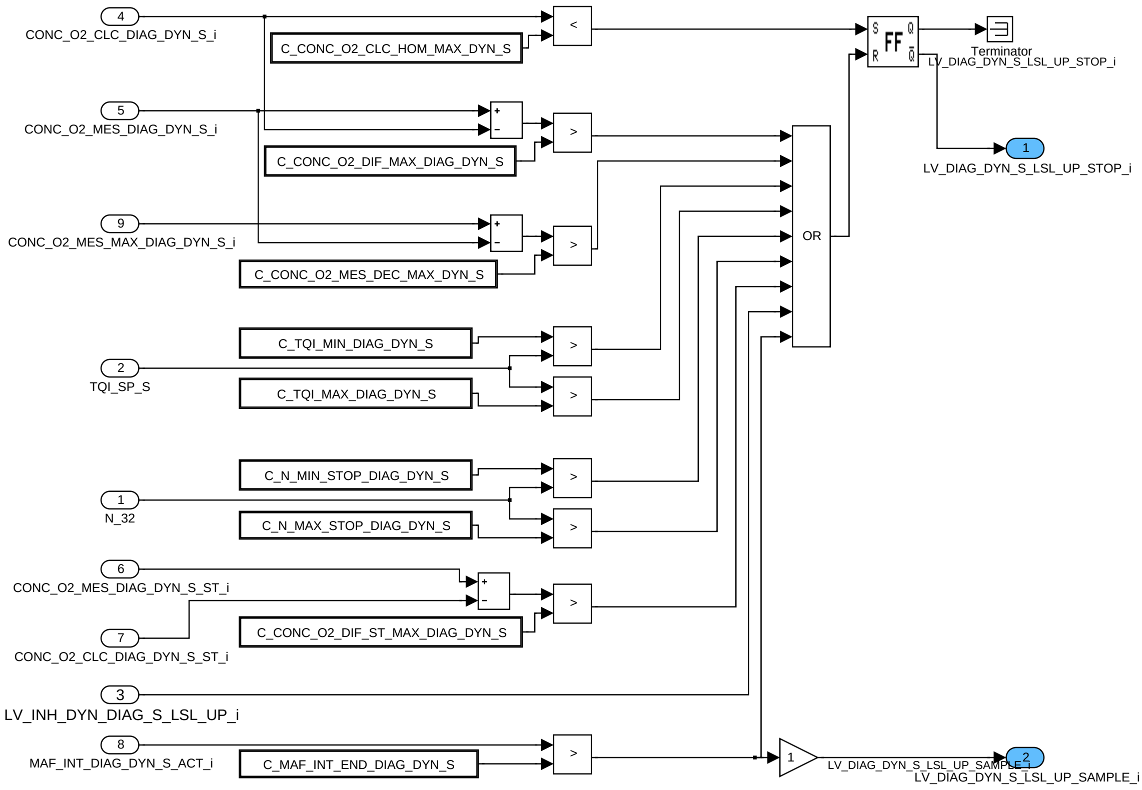

Figure B.29.12:
EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/MON_CHK/MON/CTRL_FLAGS

EGCP_PLADGLSL6/OPERATE_10MS/OPERATE_10MS_CBK/MON_CHK/MON/PO2_CLC

This block calculates the O2 concentrations CONC_O2_MES_DIAG_DYN_S[i] from LAMB_LS_UP[i] and CONC_O2_CLC_DIAG_DYN_S[i] from LAMB_SP_FIL_S[i]. CONC_O2_MES_DIAG_DYN_S[i] can be scaled with a constant factor to improve diagnostic results for good sensors. The CONC_O2 values are used throughout the diagnosis because accuracy and dynamics are more similar across the different lambda ranges than for lambda itself.

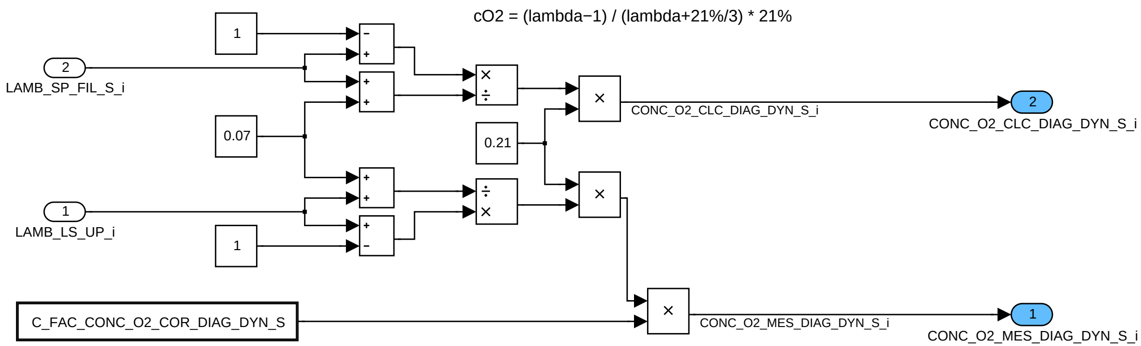

Figure B.29.13: EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/MON_CHK/MON/PO2_CLC

EGCP_PLADGLSL6/OPERATE_10MS/OPERATE_10MS_CBK/MON_CHK/MON/PO2_DIF_INT

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Here, two integrals are produced which are used to calculate the diagnostic value. In CONC_O2_DIF_INT_DIAG_DYN_S[i] integrates the differences between modelled and measured O2 concentration, while CONC_O2_CLC_INT_DIAG_DYN_S[i] integrates the modelled oxygen concentration itself.
Both integrals start only after a calibrateable air mass has passed since the homogenous combustion mode was left. This can be used to avoid signal features shortly after the transition and to focus the diagnostic value on parts of the signal trace that show large and clear deviations between a modelled (fast) and a slow sensor. The integrals are stopped implicitly by calculating a result from them once after a certain air mass was consumed by the engine. After this, the function deactivates itself until the engine enters homogenous combustion mode again.

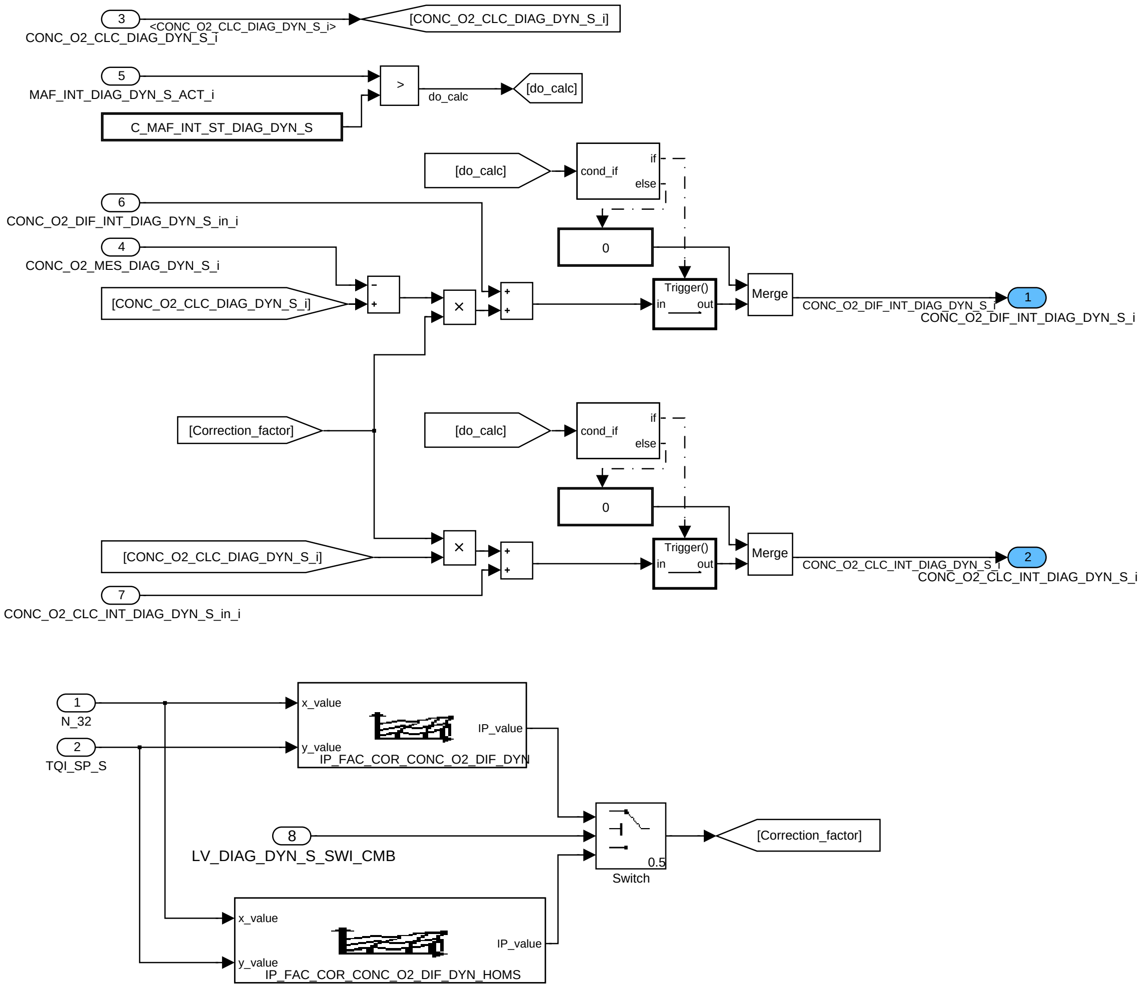

Figure B.29.14:
EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/MON_CHK/MON/PO2_DIF_INT

EGCP_PLADGLSL6/OPERATE_10MS/OPERATE_10MS_CBK/MON_CHK/MON/PO2_EVAL

Here, a mass flow integral is calculated, which starts at the transition out of homogenous combustion and governs start and end points for the calculation of the diagnostic value. CONC_O2_MES_DIAG_DYN_S_ST[i] and CONC_O2_CLC_DIAG_DYN_S_ST[i] receive the values of CONC_O2_MES_DIAG_DYN_S[i] and CONC_O2_CLC_DIAG_DYN_S[i] at the time of the transition, they are used to calculate and validate the diagnostic result of the current transition. CONC_O2_MES_MAX_DIAG_DYN_S[i] is the highest O2 concentration found in the current diagnostic cycle, it is used in validation of the result.

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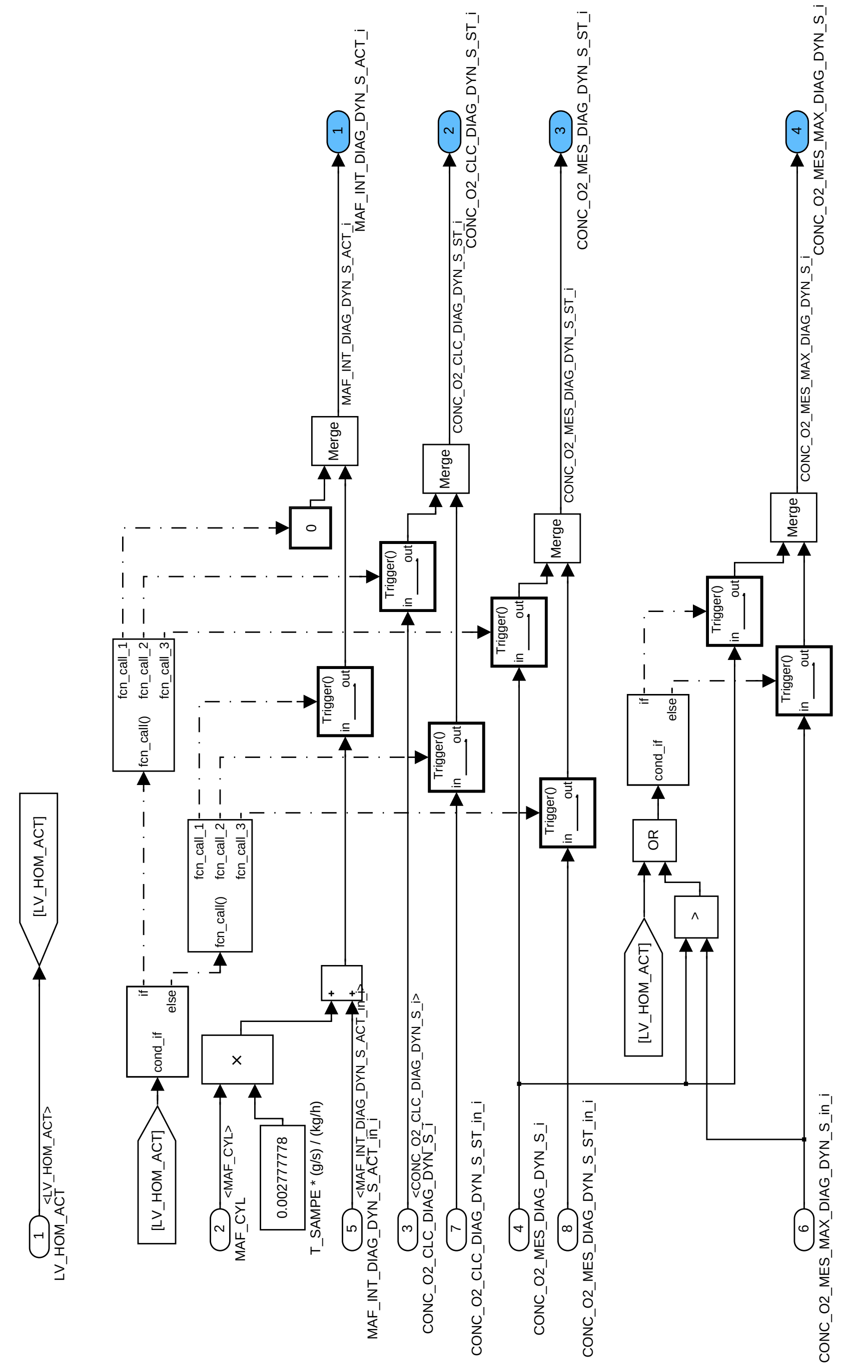

Figure B.29.15: EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/MON_CHK/MON/PO2_EVAL

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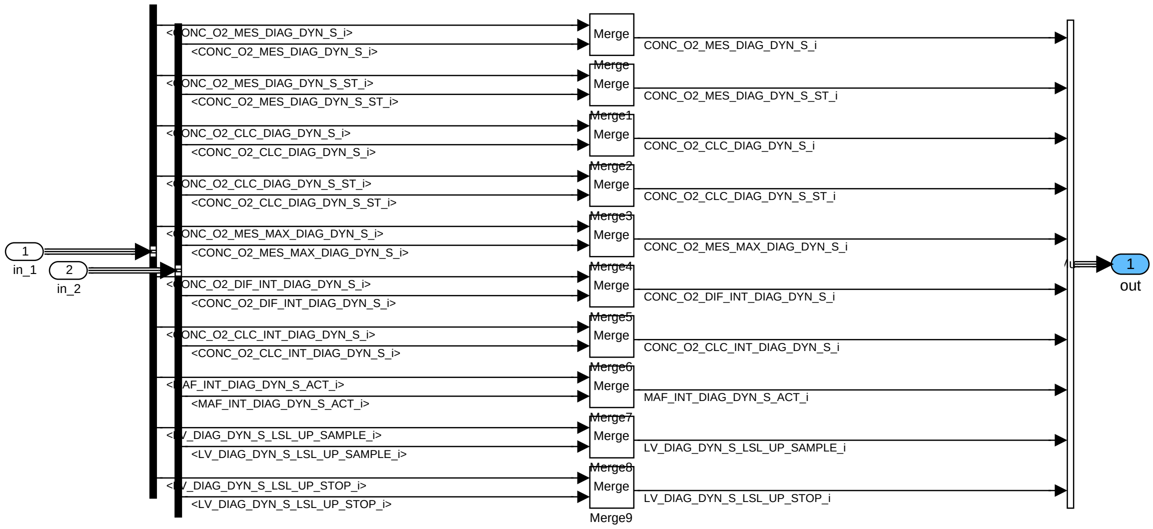

Figure B.29.16: EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/MON_CHK/Merge

EGCP_PLADGLSL6/OPERATE_10MS/OPERATE_10MS_CBK/RESULT

The logic shown here triggers the calculation of a result once after a diagnostic cycle has completed successfully.

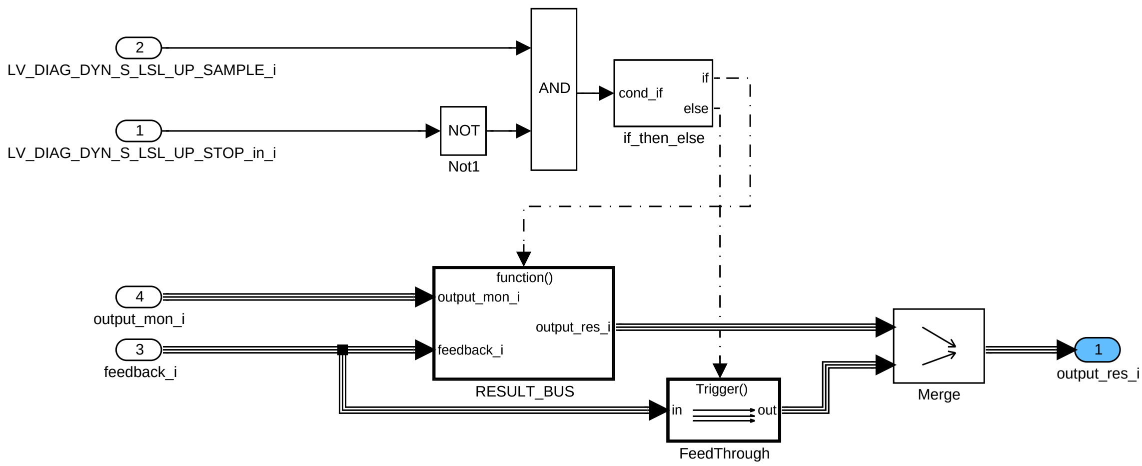

Figure B.29.17: EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/RESULT

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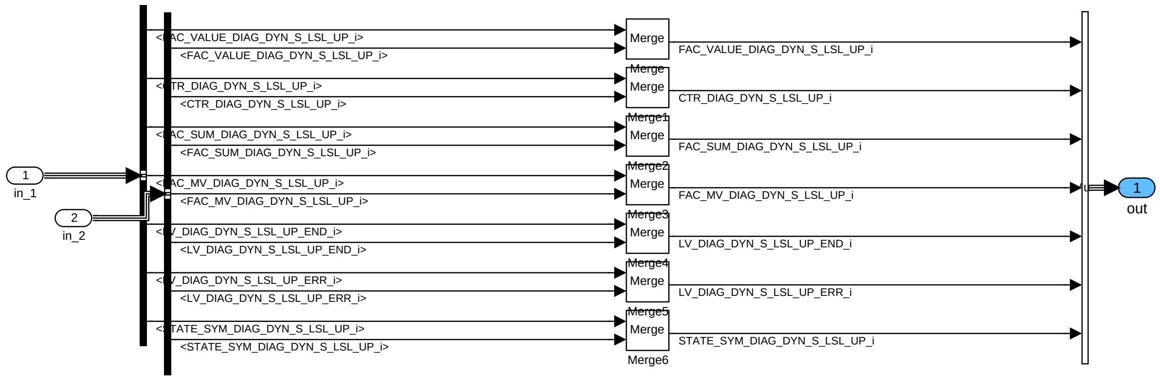

Figure B.29.18: EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/RESULT/Merge

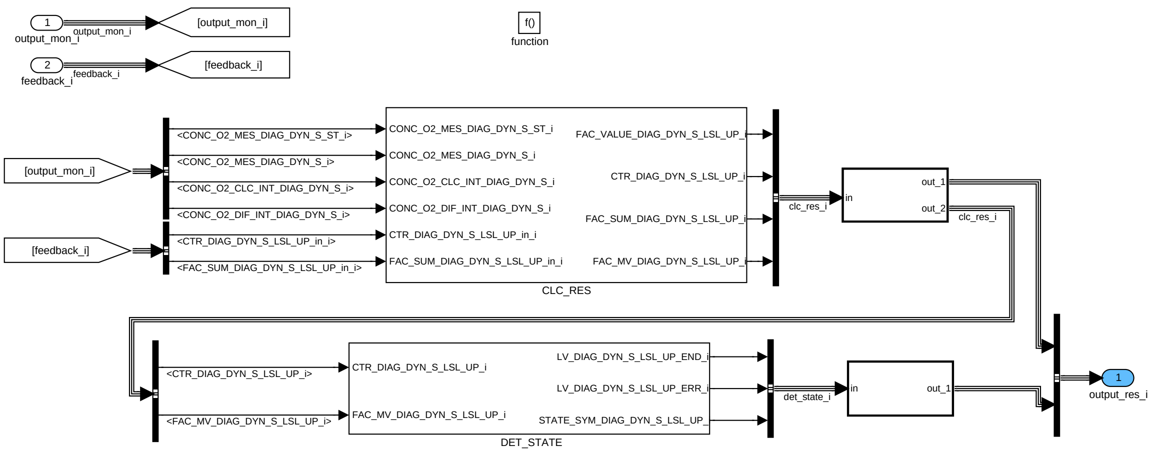

Figure B.29.19: EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/RESULT/RESULT_BUS

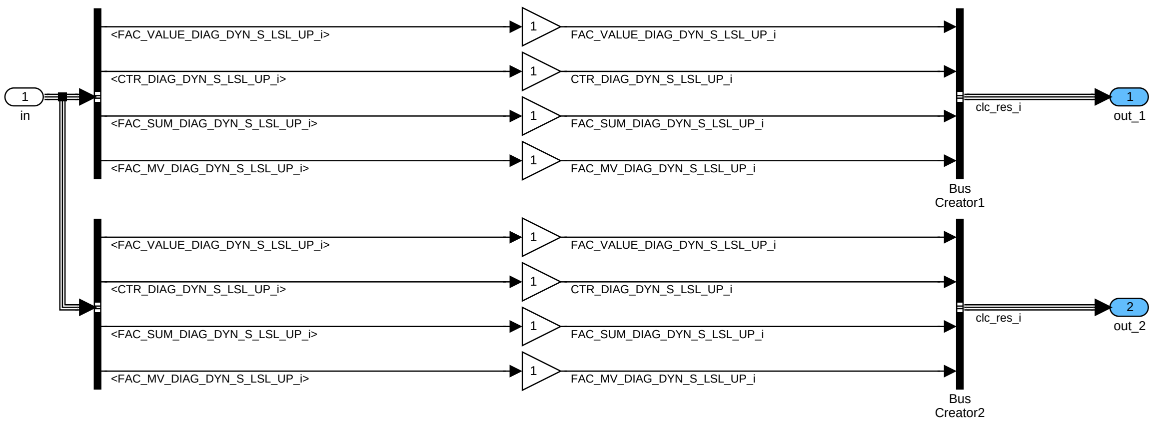

Figure B.29.20:
EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/RESULT/RESULT_BUS/Branch

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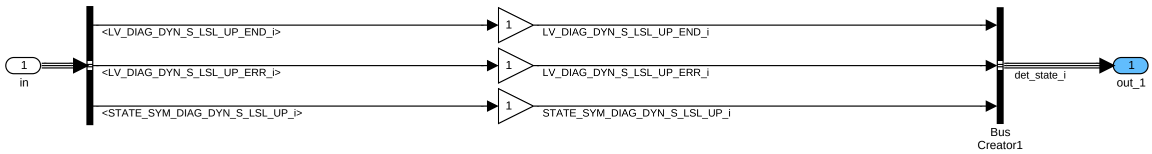

Figure B.29.21:
EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/RESULT/RESULT_BUS/Branch1

EGCP_PLADGLSL6/OPERATE_10MS/OPERATE_10MS_CBK/RESULT/RESULT_BUS/CLC_RES

The result of one single diagnostic cycle is calculated in one of two ways and stored in FAC_VALUE_DIAG_DYN_S_LSL_UP[i]. It resembles the difference between modelled (i.e. "good") and actual sensor response to the lambda change in the transition from homogenous to lean combustion. If LC_DIAG_DYN_S_LSL_UP_MOD = 1, the difference is normalized to the signal change of the sensor and resembles the time constant of the sensor response. Otherwise it is normalized to the integrated signal change in the model, which makes the result more stable for slow sensors.
FAC_MV_DIAG_DYN_S_LSL_UP[i] is a cumulated average for the current driving cycle, whic is the basis for the decision whether the sensor is good or not.

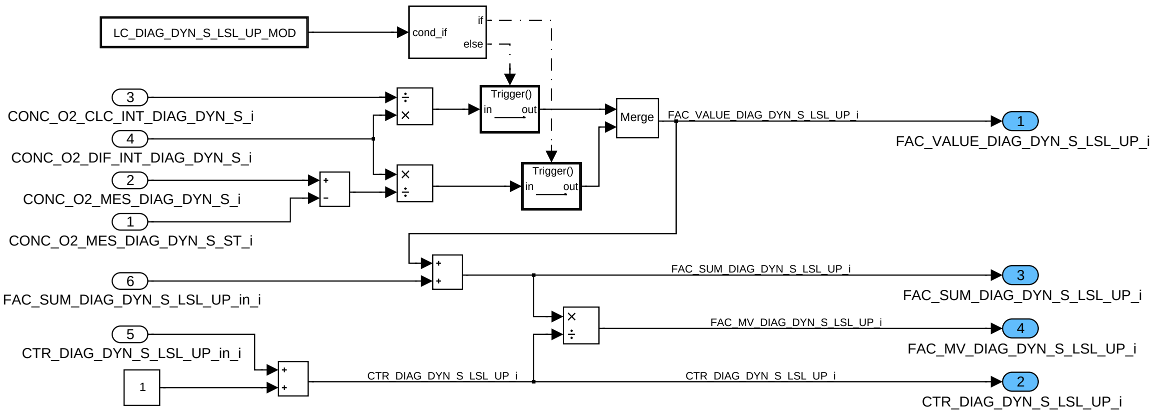

Figure B.29.22:
EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/RESULT/RESULT_BUS/CLC_RES

EGCP_PLADGLSL6/OPERATE_10MS/OPERATE_10MS_CBK/RESULT/RESULT_BUS/DET_STATE

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The block determines the diagnostic decision. With every cycle, the good/bad status in LV_DIAG_DYN_S_LSL_UP_ERR[i] and STATE_SYM_DIAG_DYN_S_LSL_UP[i] is updated, and if enough cycles have been completed, the end of diagnosis is indicated via LV_DIAG_DYN_S_LSL_UP_END[i]. This information is not transmitted to the error memory directly.

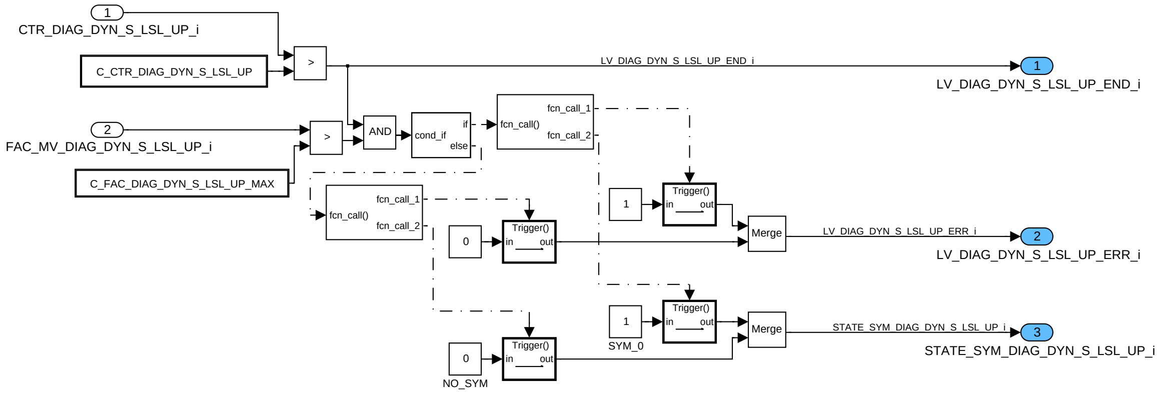

Figure B.29.23: EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/RESULT/RESULT_BUS/DET_STATE

EGCP_PLADGLSL6/OPERATE_10MS/OPERATE_10MS_CBK/VECTOR_FEEDBACK

This block selects required values from the last recurrence into a vector used in the functions for the current cylinder bank.

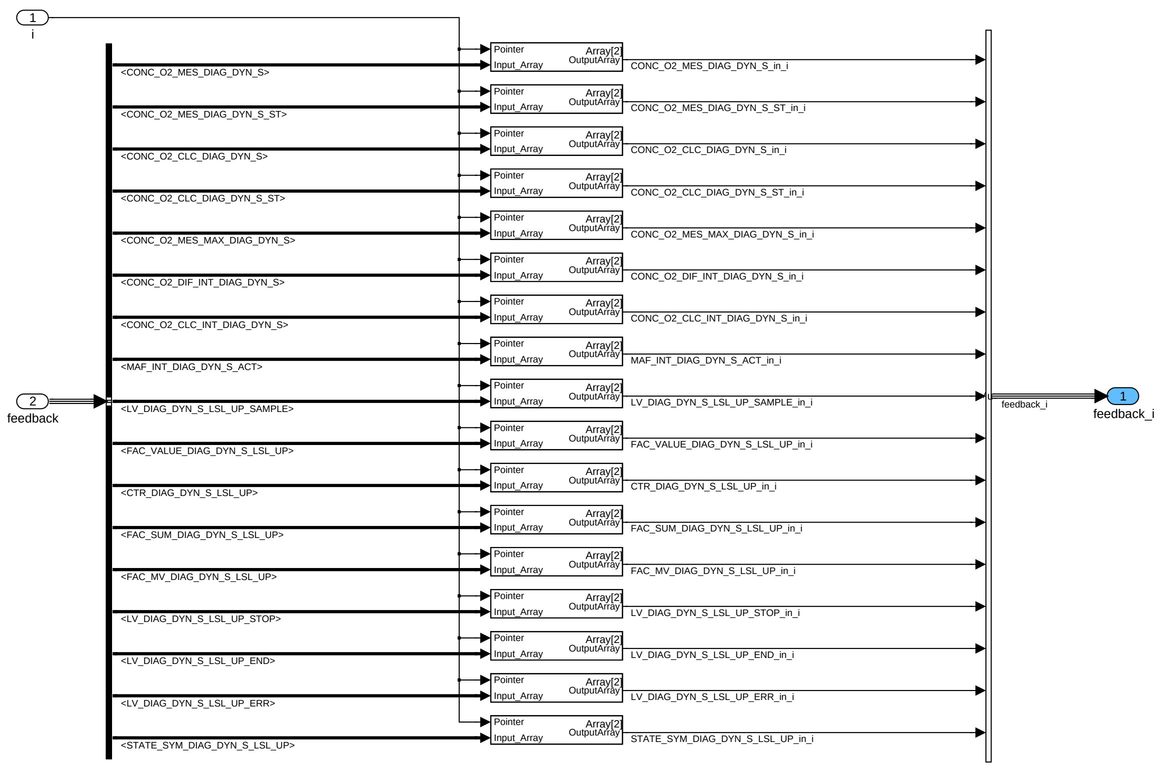

Figure B.29.24: EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/VECTOR_FEEDBACK

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EGCP_PLADGLSL6/OPERATE_10MS/OPERATE_10MS_CBK/VECTOR_INPUT

The result of this block is a vector with the current input needed for the cylinder bank to be calculated.

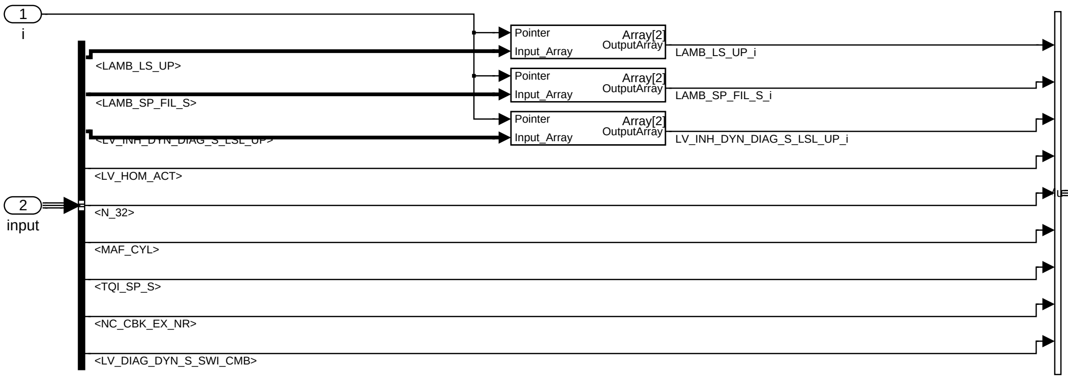

Figure B.29.25: EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/VECTOR_INPUT

EGCP_PLADGLSL6/OPERATE_10MS/OPERATE_10MS_CBK/VECTOR_OUTPUT

The output block assembles the model output vector from the results for the individual cylinder banks.

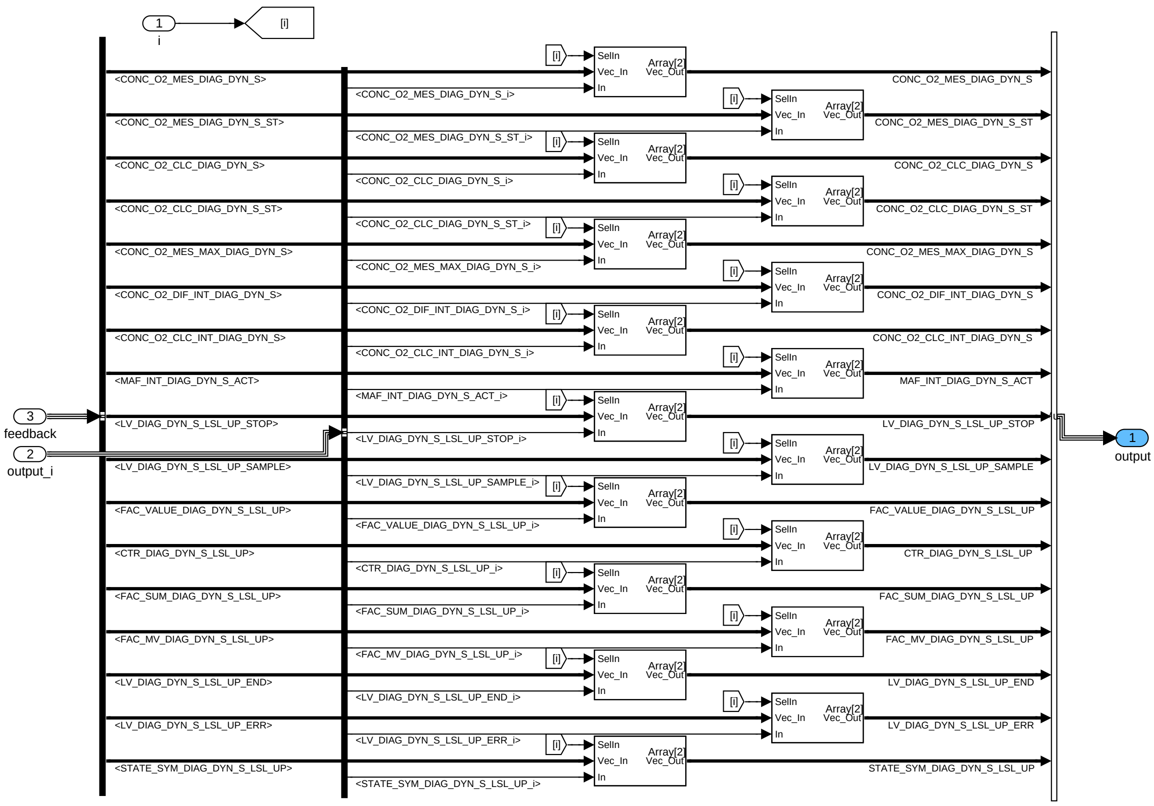

Figure B.29.26: EGCP_PLADGLSL6/operate_10ms/operate_10ms_CBK/VECTOR_OUTPUT

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B.29.1.3 EGCP_PLADGLSL6/OUTPUT_MGR

The output manager merges the results of init and operate blocks into the functions' output vector.

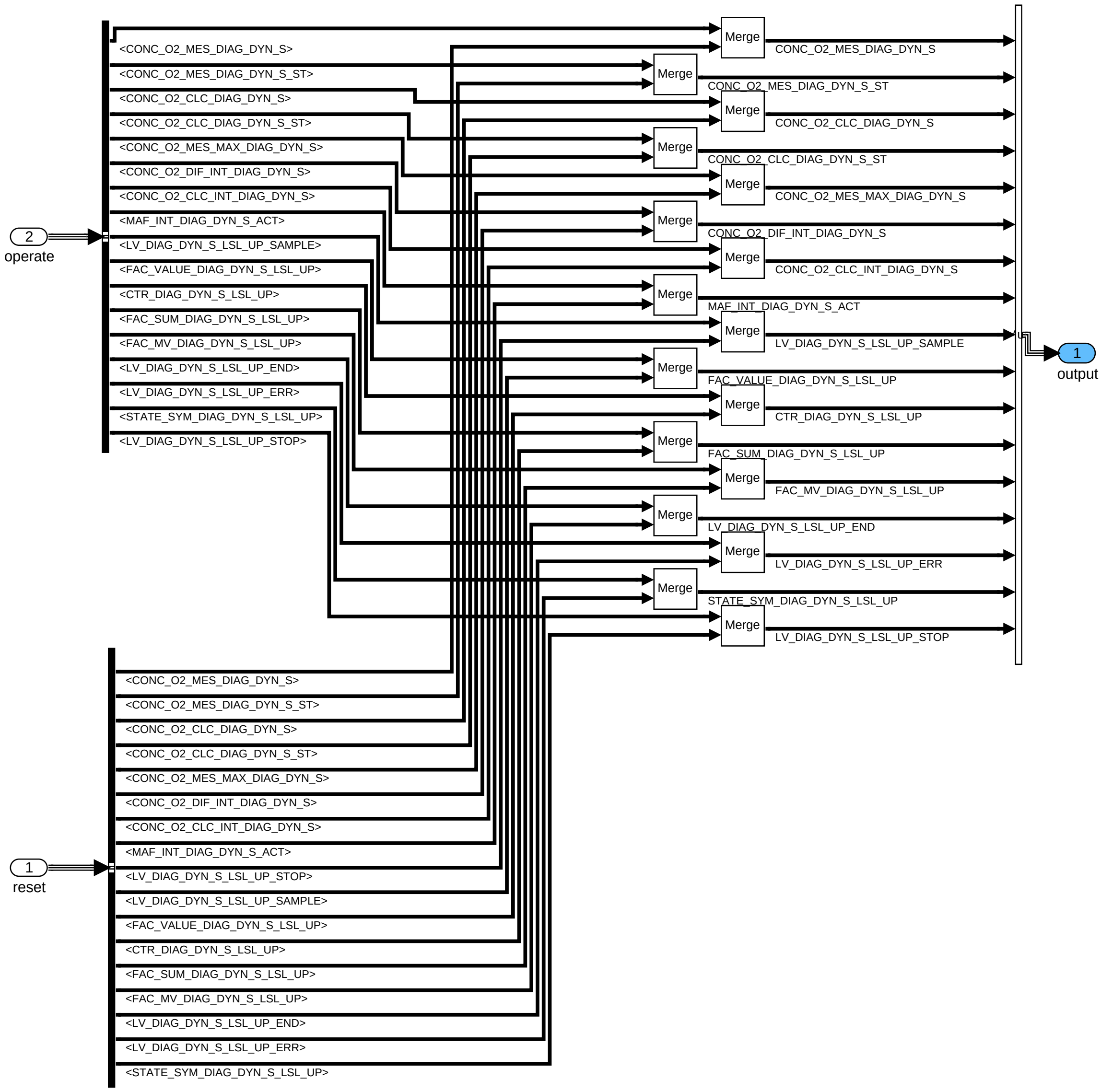

Figure B.29.27: EGCP_PLADGLSL6/output_mgr

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B.30 O2 sensor (lin, up) dynamic diagnosis after NOx CAT reg. (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_DYN_S_SWI_CMB	O/V	0... 1H	0 ...1	1	-
Logical variable to switch weighting factor depending on cumbustion mode					
LV_INH_DYN_DIAG_S_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition of linear lambda sensor dynamic diagnosis for stratified combustion					

Input data:

LV_DIAG_DYN_INH_LSL_UP [NC_CBK_EX_NR] {p. 5377}	LV_END_DIAG_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_MAP_TPS_PLAUS {p. 1062}
LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_SLV_IVVT_IN {p. 4627}	LV_IGK {p. 906}	LV_ST_END {p. 1720}
OPM_AV {p. 8137}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DIAG_DYN_INH_CMB_TRAN	-	0... 3H	0 ...3	1	-
Inhibition of DYN_DIAG due to switching combustion mode					
LC_INH_DYN_DIAG_S_LSL_UP [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Manual inhibition of WRAF sensor dynamic diagnosis in stratified operation					

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

With C_DIAG_DYN_INH_CMB_TRAN the diagnosis can be interrupted due to switching of the combustion mode.

Interruption in case of:
Switching CBM from AFL to S and C_DIAG_DYN_INH_CMB_TRAN = 1
Switching CBM from S to AFL and C_DIAG_DYN_INH_CMB_TRAN = 2
Switching CBM from S to AFL and AFL to S and C_DIAG_DYN_INH_CMB_TRAN = 3

Application conditions

Initialisation: At transition LV_IGK = 0 -> 1 or reset LV_INH_DYN_DIAG_S_LSL_UP[i] shall be set to 1.

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Recurrence: 20ms.

Activation: -

Formula section:

If LV_ST_END = 0 **or**
LV_IGK = 0 **or**
LV_ERR_SLV_IVVT_IN = 1 **or**
LV_ERR_OFS_LSL_UP[i] = 1 **or**
LV_ERR_CTL_LSL_UP[i] = 1 **or**
LV_ERR_MAP_TPS_PLAUS = 1 **or**
LV_DIAG_DYN_INH_LSL_UP[i] = 1 **or**
LV_END_DIAG_DYN_VLD_LS_UP[i] = 1 **or**
LC_INH_DYN_DIAG_S_LSL_UP[i] = 1 **or**
(OPM_AV = 3h - ->1h **and**
C_DIAG_DYN_INH_CMB_TRAN = 1**)** **or**
(OPM_AV = 1h - -> 3h **and**
C_DIAG_DYN_INH_CMB_TRAN = 2**)** **or**
((OPM_AV = 3h - -> 1h **or**
OPM_AV = 1h - -> 3h**)** **and**
C_DIAG_DYN_INH_CMB_TRAN = 3**))**

% Inhibitions are the same as for homogenous dynamics diagnosis, plus inhibition of stratified mode
% and manual deactivation.

Then
LV_INH_DYN_DIAG_S_LSL_UP[i] = 1
Else
LV_INH_DYN_DIAG_S_LSL_UP[i] = 0
Endif

If OPM_AV = 3h
% Engine runs in mode AFL

Then
LV_DIAG_DYN_S_SWI_CMB = 0
Else
LV_DIAG_DYN_S_SWI_CMB = 1
Endif

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B.31 O2 sensor (lin, up) characteristic line diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
WRAF Sensor characteristic line shift to lean SYMPTOM detected					
ERR_SYM_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
WRAF Sensor characteristic line shift to rich SYMPTOM detected					
LV_CDN_DIAG_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Condition to run the Diagnosis WRAF Sensor characteristic line shift to lean					
LV_CDN_DIAG_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Condition to run the Diagnosis WRAF Sensor characteristic line shift to rich					
LV_END_DIAG_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Diagnostic available for the WRAF Sensor characteristic line shift to lean					
LV_END_DIAG_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Diagnostic available for the WRAF Sensor characteristic line shift to rich					
LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
WRAF Sensor characteristic line shift to lean ERROR detected					
LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
WRAF Sensor characteristic line shift to rich ERROR detected					
LV_T_DLY_DIAG_SHIFT_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End flag of the shift down diagnosis in the no failure case (RBM purpose)					
T_DLY_DIAG_SHIFT_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Delay timer for the end flag of the shift down diagnosis in the no failure case (RBM purpose)					

Input data:

LV_DIAG_AFL_CHK_SYM_LSL_UP [NC_CBK_EX_NR] {p. 5388}	LV_DIAG_AFR_CHK_SYM_LSL_UP [NC_CBK_EX_NR] {p. 5388}	LV_DIAG_EOL_END_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_DIAG_PLAUS_END_LSL_UP [NC_CBK_EX_NR] {p. 5422}
LV_DIAG_PLAUS_SYM_LSL_UP [NC_CBK_EX_NR] {p. 5422}	LV_END_DIAG_LAM_ADJ [NC_CBK_EX_NR] {p. 5215}	LV_ERR_LAM_ADJ [NC_CBK_EX_NR] {p. 5216}	LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR] {p. 2463}

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LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR] {p. 2463}	LV_IGK {p. 906}	LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}
NC_IDX_DIAG_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR]	NC_IDX_DIAG_SHIFT_AFR_LSL_UP	STATE_DIAG_ACT_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5389}	STATE_SYM_DIAG_PLAUS_LSL_UP [NC_CBK_EX_NR] {p. 5422}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DLY_DIAG_SHIFT_DOWN [NC_CBK_EX_NR]	-	0... FFFFH	0... 6553.5	0.1	s
Threshold for the "end flag" delay timer in the no failure case					

Import actions:

ACTION_ERRM_NoFilterReset (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_NoFilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_LV_ERR_SET>,**IN**<PRM_LV_ERR_RST>,**IN**<PRM_LV_END_DIAG>,**OUT**<PRM_LV_ERR>)

Error treatment:

Diagnostic XX	Symptom description	Symptom	Filter type
SHIFT_AFL_LSL_UP[i]	Characteristic Line Shift to Lean	SYM_0	NO
SHIFT_AFR_LSL_UP[i]	Characteristic Line Shift to Rich	SYM_0	NO

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B.31.1 Delay time calculation after finishing fuel trim diagnosis without failure

FUNCTION DESCRIPTION:

General information:

This function shall deliver information in the no failure case, indicating that the sensor characteristic shift down diagnosis could have finished in the failure case.

Application conditions

Initialisation:

At LV_IGK = 0 to 1, reset **or**at clearing error memory:

T_DLY_DIAG_SHIFT_DOWN[i] = 0
LV_T_DLY_DIAG_SHIFT_DOWN[i] = 0

Recurrence:
The function should be carried out once every 100 ms.

Activation /Deactivation:
The function will be carried out in case of
LV_ST_END = 1

Formula section:

```
    If    T_DLY_DIAG_SHIFT_DOWN[i] >= C_T_DLY_DIAG_SHIFT_DOWN[i]
    then     LV_T_DLY_DIAG_SHIFT_DOWN[i] = 1
else          If          LV_END_DIAG_LAM_ADJ[i] = 1
              and          LV_ERR_LAM_ADJ[i] = 0
              then      increment T_DLY_DIAG_SHIFT_DOWN[i]
              endif
endif
```

B.31.2 Sensor Characteristic Line Shift to Lean (CSD)

FUNCTION DESCRIPTION:

General information:

This function shall deliver information indicating that the sensor characteristic line has a shift to lean **(CSD)**, which shall be done by summarizing all similar failure symptoms of this kind.

It is assumed such deviation from the nominal behavior can be occur due to the poisoning of sensor reference air channel with fuel, but also due to a leak current inside the sensor, a very low reference air pump current (used in some types of wide range oxygen sensors) or a relatively high impedance short circuit to the battery voltage or ground in one of the four sensor lines.

In dependence of the shift strengh that are three different paths followed by this function:

1. Strong shift to lean: lambda controller go to its limit and the plausibility check recognises this error.
2. Middle strong shift to lean: the trim controller goes to its limit but the lambda controller not, the trim controller deviation diagnosis recognises that the system has a problem and the active test detects that the problem is in the upstream sensor, this showing a characteristic line shift to lean.
3. Mild shift to lean: the trim controller goes to its limit but the lambda controller not. The trim controller **I**-share runs to its limit, whereas the trim ctr. deviation diagnosis are not able to recognise that the system has a problem. The trim ctr **I**-share diagnosis triggers the active test which detects that the problem is in the upstream sensor, this showing a characteristic line shift to lean.

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Application conditions

Initialisation:
At LV_IGK = 0 to 1, reset **or**at clearing error memory:

ACTION_ERRM_NoFilterReset(IN<NC_IDX_DIAG_SHIFT_AFL_LSL_UP[i]>,

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OUT<LV_ERR_SHIFT_AFL_LSL_UP[i]>)

Recurrence:
The function should be carried out once every 100 ms.

Activation /Deactivation:
The diagnosis will be carried out
If LV_ST_END = 1 and LV_ERR_SHIFT_AFL_LSL_UP[i] = 0
Then
LV_CDN_DIAG_SHIFT_AFL_LSL_UP[i] = 1 */activation*
Else
LV_CDN_DIAG_SHIFT_AFL_LSL_UP[i] = 0 */deactivation*
Endif

Formula section:

IF LV_DIAG_AFR_CHK_SYM_LSL_UP[i] = 1
% failure detected during active test
OR
LV_DIAG_PLAUS_SYM_LSL_UP[i] = 1 **&**
STATE_SYM_DIAG_PLAUS_LSL_UP[i] = SYM_1 **&**
LV_FAC_LAM_LIM_MAX[i] = 1
% failure detected trhrough plausibility test and lambda ctr. in limitation
THEN
LV_ERR_SHIFT_AFL_LSL_UP[i] = 1
ERR_SYM_SHIFT_AFL_LSL_UP[i] = SYM_0
LV_END_DIAG_SHIFT_AFL_LSL_UP[i] = 1
ELSE
% normal driving cycle, no error detected
IF (LV_T_DLY_DIAG_SHIFT_DOWN[i] = 1
OR STATE_DIAG_ACT_LS_UP_DOWN[i] = "check finished")
AND LV_DIAG_PLAUS_END_LSL_UP[i] = 1
THEN LV_END_DIAG_SHIFT_AFL_LSL_UP[i] = 1
ELSE
% EOL Test, no error detected
IF LV_DIAG_EOL_END_LS_UP_DOWN[i] = 1
THEN
LV_END_DIAG_SHIFT_AFL_LSL_UP[i] = 1
ENDIF
ENDIF
ENDIF

For failure and error management treatment the anti-bounce mechanism is called :
% if LV_ERR_XX=1 then LV_ERR_SET=1 or if LV_ERR_XX=0 then LV_ERR_RST=1
ACTION_ERRM_NoFilterSymptom(IN<NC_IDX_DIAG_SHIFT_AFL_LSL_UP[i]>, IN<LV_CDN_DIAG_SHIFT_AFL_LSL_UP[i]>, IN< ERR_SYM_SHIFT_AFL_LSL_UP[i] >, IN< LV_ERR_SET_SHIFT_AFL_LSL_UP[i] >, IN<LV_ERR_RST_SHIFT_AFL_LSL_UP[i]>, IN<LV_END_DIAG_SHIFT_AFL_LSL_UP[i]>, OUT<LV_ERR_SHIFT_AFL_LSL_UP[i]>)

B.31.3 Sensor Characteristic Line Shift to Rich

FUNCTION DESCRIPTION:

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General information:

This function shall deliver information indicating that the sensor characteristic line has a shift to rich, which shall be done by summarizing all similar failure symptoms of this kind.

It is assumed such deviation from the nominal behavior can be occur due to a leak current inside the sensor, as well as a relatively high impedance short circuit to the battery voltage or ground in one of the four sensor lines.

In dependence of the shift strengh there are three different paths followed by this function:

1. Strong shift to rich: lambda controller go to its limit and the plausibility check recognises this error.
2. Middle strong shift to rich: the trim controller goes to its limit but the lambda controller not: The trim controller deviation diagnosis recognises that the system has a problem and the active test detects that the problem is in the upstream sensor showing a characteristic line shift to rich.
3. Mild shift to rich: the trim controller goes to its limit but the lambda controller not. The trim controller I-share runs to its limit, whereas the trim ctr. deviation diagnosis are not able to recognise that the system has a problem. The trim ctr I-share diagnosis triggers the active test which detects that the problem is in the upstream sensor, this showing a characteristic line shift to rich.

Application conditions

Initialisation:

At LV_IGK = 0 to 1, reset **or**at clearing error memory:

ACTION_ERRM_NoFilterReset(IN< NC_IDX_DIAG_SHIFT_AFR_LSL_UP[i]>,
OUT<LV_ERR_SHIFT_AFR_LSL_UP[i]>)

Recurrence:

The function should be carried out once every 100 ms.

Activation /Deactivation:

The diagnosis will be carried out
If LV_ST_END = 1 and LV_ERR_SHIFT_AFR_LSL_UP[i] = 0
Then
LV_CDN_DIAG_SHIFT_AFR_LSL_UP[i] = 1 *\/activation*
Else
LV_CDN_DIAG_SHIFT_AFR_LSL_UP[i] = 0 *\/deactivation*
Endif

Formula section:

IF LV_DIAG_AFL_CHK_SYM_LSL_UP[i] = 1
% failure detected during active test
OR
LV_DIAG_PLAUS_SYM_LSL_UP[i] = 1 **&**
STATE_SYM_DIAG_PLAUS_LSL_UP[i] = "SYM_0 **&**
LV_FAC_LAM_LIM_MIN[i] = 1
% failure detected through plausibility test. No open circuit failure detected.
THEN
LV_ERR_SHIFT_AFR_LSL_UP[i] = 1
ERR_SYM_SHIFT_AFR_LSL_UP[i] = SYM_0
LV_END_DIAG_SHIFT_AFR_LSL_UP[i] = 1

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```
ELSE
  % normal driving cycle, no error detected

    IF     (LV_T_DLY_DIAG_SHIFT_DOWN[i] = 1
  OR          STATE_DIAG_ACT_LS_UP_DOWN[i] = "check finished" )
  AND          LV_DIAG_PLAUS_END_LSL_UP[i] = 1
  THEN          LV_END_DIAG_SHIFT_AFR_LSL_UP[i] = 1
    ELSE
        % EOL Test, no error detected
        IF LV_DIAG_EOL_END_LS_UP_DOWN[i] = 1
        THEN
            LV_END_DIAG_SHIFT_AFR_LSL_UP[i] = 1
        ENDIF

  ENDIF
ENDIF
```

For failure and error management treatment the anti-bounce mechanism is called :

% if LV_ERR_XX=1 then LV_ERR_SET=1 or if LV_ERR_XX=0 then LV_ERR_RST=1

ACTION_ERRM_NoFilterSymptom(IN<NC_IDX_DIAG_SHIFT_AFR_LSL_UP[i]>, IN<LV_CDN_DIAG_SHIFT_AFR_LSL_UP[i]>, IN< ERR_SYM_SHIFT_AFR_LSL_UP[i] >, IN< LV_ERR_SET_SHIFT_AFR_LSL_UP[i] >, IN<LV_ERR_RST_SHIFT_AFR_LSL_UP[i]>, IN<LV_END_DIAG_SHIFT_AFR_LSL_UP[i]>, OUT<LV_ERR_SHIFT_AFR_LSL_UP[i]>)

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B.32 O2 sensor (lin, up) characteristic line diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_RBM_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of SHIFT_AFL_LSL_UP[NC_CBK_EX_NR] monitor with the Rate-Based Monitoring statisticsBit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1)Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1)Bit					
STATE_RBM_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of SHIFT_AFR_LSL_UP[NC_CBK_EX_NR] monitor with the Rate-Based Monitoring statisticsBit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1)Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1)Bit					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LC_DIAG_PUE_ACT_LS_DOWN {p. 5191}	LV_END_DIAG_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_END_DIAG_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_IGK {p. 906}	LV_INH_DIAG_RBM_PLAUS_LSL_UP [NC_CBK_EX_NR] {p. 5429}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

B.32.1 Upstream sensor lean/rich - shift diagnosis: Interface for rate - based - monitoring

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

With this module the interface between the SHIFT_AFL_LSL_UP[i] and SHIFT_AFR_LSL_UP[i] monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_SHIFT_AFL_LSL_UP[i] and STATE_RBM_SHIFT_AFR_LSL_UP[i] data.
Within STATE_RBM_SHIFT_AFL/AFR[i], three different informations are defined:

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- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)
  (not valid for lean/rich shift diagnosis)

Application conditions

Initialisation:

```
 at ECU reset:
     bit 0, bit 1 and bit 2 of STATE_RBM_SHIFT_AFL_LSL_UP[i]
= 0
     bit 0, bit 1 and bit 2 of STATE_RBM_SHIFT_AFR_LSL_UP[i]
= 0
 LV_DC = 0 - -> 1 transition:
      bit 0 and bit 1 of STATE_RBM_SHIFT_AFL_LSL_UP[i] = 0
      bit 0 and bit 1 of STATE_RBM_SHIFT_AFR_LSL_UP[i] = 0
     bit 2 of STATE_RBM_SHIFT_AFL_LSL_UP[i] = 1
     bit 2 of STATE_RBM_SHIFT_AFR_LSL_UP[i] = 1
 on failure memory reset:
     bit 1 of STATE_RBM_SHIFT_AFL_LSL_UP[i] = 0
     bit 1 of STATE_RBM_SHIFT_AFR_LSL_UP[i] = 0
```

Recurrence: 1 s

Activation: LV_DC = 1

Deactivation: *LV_DC = 0*

Formula section:

At LV_DC 0 - -> 1 transition

The pending status of the following failures has to be checked only once :

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Dependence	Error			
	LV_ERR_AMP	LV_ERR_AMP_PLAUS	LV_ERR_CHG_LS_UP	LV_ERR_CRK_PLAUS
	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH	LV_ERR_CRK_TOOTH_PER	LV_ERR_DIAGCPS
	LV_ERR_EL_CPS	LV_ERR_FTL_MIN	LV_ERR_FUP	LV_ERR_FUP_MFP_PLAUS
	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS	LV_ERR_LOAD_TPS_PLAUS
	LV_ERR_MAF_FRQ_EL	LV_ERR_MAF_FRQ_GRD	LV_ERR_MAF_FRQ_RNG	LV_ERR_MAP_PLAUS
	LV_ERR_MAP_TPS_PLAUS	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR
	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD	LV_ERR_TPS_AD_BOL
	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATIO	LV_ERR_TPS_ST_CHK_2
	LV_ERR_VCV			
NC_CBK_EX_NR	LV_ERR_AIR_LSL_UP[i]	LV_ERR_CAT_DIAG[i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DYN_VLD_LS_UP[i]
	LV_ERR_EL_LSL_UP[i]	LV_ERR_LSH_DOWN[i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]
	LV_ERR_OBD_LSH_DOWN[i]	LV_ERR_OBD_VLD_LSH_UP[i]	LV_ERR_OC_LS_DOWN[i]	LV_ERR_OC_LSL_UP[i]
	LV_ERR_OFS_LSL_UP[i]	LV_ERR_PUC_LS_DOWN[i]	LV_ERR_PUC_VLD_LS_UP[i]	LV_ERR_PUE_LS_DOWN[i]
	LV_ERR_SCG_LS_DOWN[i]	LV_ERR_SCP_LS_DOWN[i]	LV_ERR_SWT_LS_DOWN[i]	LV_ERR_TTIP_MES_LSH_UP[i]

Figure B.32.1: n = 1 for any i

NC_NR_CBK_IVVT	LV_ERR_CAM_CST_IVVT_EX[n]	LV_ERR_CAM_CST_IVVT_IN[n]	LV_ERR_MEC_IVVT_EX[n]	LV_ERR_MEC_IVVT_IN[n]
	LV_ERR_SLV_IVVT_EX[n]	LV_ERR_SLV_IVVT_IN[n]		

Figure B.32.2: m = 1 for any i

NC_NR_CAM_CBK	LV_ERR_PER_CAM_EX[m]	LV_ERR_PER_CAM_IN[m]	LV_ERR_PLAUS_CAM_EX[m]	_ERR_PLAUS_CAM_IN[m]
	LV_ERR_REF_CRK_CAM_EX[m]	LV_ERR_REF_CRK_CAM_IN[m]	LV_ERR_SYN_CAM_EX[m]	LV_ERR_SYN_CAM_IN[m]
	LV_ERR_SYN_CRK_CAM_IN[m]	LV_ERR_TOOTH_OFF_EX[m]	LV_ERR_TOOTH_OFF_IN[m]	

Figure B.32.3: For NC_CBK_EX_NR = i = 1

NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

Figure B.32.4: For NC_CBK_EX_NR = i = 2

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NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

```
If(1)       { CPU optimization at LV_IGK 0 - -> 1 transition }
            CTR_ERR_DYN_NR <> 0           { the dynamic failure memory isn t empty }
Then(1)
            While        bit 1 of STATE_RBM_SHIFT_AFL_LSL_UP[i] = 0 do
                  with each XX failure of the above list   except LV_ERR_PUE_LS_DOWN   (de-
                  pending on configuration, see below):
                  ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

                  If(2)        XX has a pending status
                   Then(2)          bit 1 of STATE_RBM_SHIFT_AFL_LSL_UP[i] = 1
                   Endif(2)

                  For LV_ERR_PUE_LS_DOWN, do the following instead:
                  If          LC_DIAG_PUE_ACT_LS_DOWN = 1
                  then
                         ACTION_ERRM_CheckPendingStatus(IN<XX>,
                         OUT<PendingStatus>, SYNCHRONIZATION<CALL>)
                         If(3)         XX has a pending status
                          Then(3)          bit 1 of STATE_RBM_SHIFT_AFL_LSL_UP[i] = 1
                          Endif(3)
                   Endif(2)

            Endwhile
            bit 1 of STATE_RBM_SHIFT_AFR_LSL_UP[i] =
                                   bit 1 of STATE_RBM_SHIFT_AFL_LSL_UP[i]
Else(1)        { the dynamic failure memory is empty }          No action
Endif(1)
```

Every 1 s :

```
If        bit 0 of STATE_RBM_SHIFT_AFL_LSL_UP[i] = 0
Then
            If         LV_END_DIAG_SHIFT_AFL_LSL_UP[i] = 1
               Then          bit 0 of STATE_RBM_SHIFT_AFL_LSL_UP[i] = 1
               Endif
Endif

If        bit 0 of STATE_RBM_SHIFT_AFR_LSL_UP[i] = 0
Then
            If         LV_END_DIAG_SHIFT_AFR_LSL_UP[i] = 1
               Then          bit 0 of STATE_RBM_SHIFT_AFR_LSL_UP[i] = 1
               Endif
Endif
If        bit 1 of STATE_RBM_SHIFT_AFL_LSL_UP[i] = 0
Then
            If         LV_INH_DIAG_RBM_PLAUS_LSL_UP[i] = 1
            Then     bit 1 of STATE_RBM_SHIFT_AFL_LSL_UP[i] = 1
               bit 1 of STATE_RBM_SHIFT_AFR_LSL_UP[i] = 1
            Endif
```

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Endif

Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurence	Failure class A/B
O2 Sensor characteristic line shift to rich	See Table of failure	0	See Table of failure	See Table of failure			See Table of failure
SHIFT_AFR_LSL_UP[i]							

Figure B.32.5: Diagnosis

Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurence	Failure class A/B
O2 Sensor characteristic line shift to lean	See Table of failure	0	See Table of failure	See Table of failure			See Table of failure
SHIFT_AFL_LSL_UP[i]							

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B.33 O2 sensor (lin, up) dynamic diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_WAIT_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Number of forced stimulation periods before carrying out amplitude measurements					
CYCNR_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
number of cycles necessary to finish the diagnosis					
CYCNR_DIAG_DYN_LSL_UP_ERR [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Number of diag cycles over threshold during linear lambda dynamic diagnosis					
ERR_SYM_DYN_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom to be transmitted to the error management					
FAC_COMP_MV_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Mean value of normalised asymmetric single factor					
FAC_COMP_MV_DIAG_DYN_SENS_MDL [NC_CBK_EX_NR]	O/V/S	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Dynamic diagnosis asymmetric factor used in lambda controller plant model					
FAC_COMP_SUM_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	80000000... 7FFFFFFFH	-6553.6 ...6553.6	3.05175e-6	-
Summation over all normalised asymmetric single factor					
FAC_COMP_VALUE_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Normalised asymmetric single factor					
FAC_COMP_VALUE_DYN_LSL_UP_TMP [NC_CBK_EX_NR]	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Temporary normalised asymmetric single factor					
FAC_COMP_VALUE_MAX_DYN_LSL_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Maximum of normalised asymmetric single factor					
FAC_COMP_VALUE_MIN_DYN_LSL_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Minimum normalised asymmetric single factor					
FAC_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	O/V/S	0... 400H	0 ...1	976.562e-6	-
Adaption factor to the modeled sensor time constant					
FAC_DIAG_DYN_LSL_UP_ERR [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Normalised single sensor signal amplitude (bad sample for later service 06h output)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_DIAG_DYN_LSL_UP_OK [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Normalised single sensor signal amplitude (good sample for later service 06h output)					
FAC_DLY_DIAG_LSL_TMP [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Scaled result of delay diagnosis (for evaluation and mode$06)					
FAC_DLY_LSL_UP_DIAG_SAE [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 65.535	0.001	-
Service 06h test value of upstream lambda sensor dynamics (effect) diagnosis					
FAC_DLY_LSL_UP_DIAG_TOL_SAE [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 65.535	0.001	-
Service 06h top limit of upstream lambda sensor dynamics (effect) diagnosis					
FAC_DYN_LSL_UP_DIAG_SAE [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 65.535	0.001	-
Service 06h test value of upstream lambda sensor dynamics diagnosis					
FAC_DYN_LSL_UP_DIAG_TOL_SAE [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 65.535	0.001	-
Service 06h top limit of upstream lambda sensor dynamics diagnosis					
FAC_MV_COR_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Temporary mean value of normalised asymmetric single factor (coorected - MAF, N)					
FAC_MV_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Mean value of normalised single sensor signal amplitude					
FAC_MV_SUM_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Temporary mean value of normalised asymmetric single factor					
FAC_SUM_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFFFFFH	0... 4.19430399902e6	976.562e-6	-
Summation over all normalised single sensor signal amplitude					
FAC_VALUE_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Normalised single sensor signal amplitude					
FAC_VALUE_MAX_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Maximum of normalised single sensor signal amplitude					
FAC_VALUE_MIN_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Minimum of normalised single sensor signal amplitude					
LAMB_AMPL_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FH	0... 0.1240234375	976.562e-6	-
carried out single sensor signal amplitude measurement					
LAMB_AMPL_MAX_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FH	0... 0.1240234375	976.562e-6	-
Maximum acceptable carried out single sensor signal amplitude measurement					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_AMPL_MIN_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FH	0... 0.1240234375	976.562e-6	-
Minimum acceptable carried out single sensor signal amplitude measurement					
LAMB_COR_DIAG_DYN_LS_UP [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Upstream lambda, corrected by slow trim control shares					
LAMB_DIF_MAX_DYN_LSL_UP_COMP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Difference between the maximum lambda value of the diagnosis and the real maximum					
LAMB_DIF_MIN_DYN_LSL_UP_COMP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Difference between the minimum lambda value of the diagnosis and the real minimum					
LAMB_LPF_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Lambda value filtered with a Low Pass Filter					
LAMB_LPF_GRD_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	8000... 7FFFH	-3.2... 3.19990234375	97.6562e-6	-
Gradient of the filtered lambda signal					
LAMB_MAX_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Maximum value of the lambda sensor signal (per sample period)					
LAMB_MAX_DIAG_DYN_LSL_UP_COMP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Real maximum value of the lambda sensor signal (per sample period)					
LAMB_MAX_DIAG_DYN_LSL_UP_TMP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Highest signal level seen so far during current lean monitoring period					
LAMB_MAX_DYN_LSL_UP_COMP_TMP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Temporary real maximum value of the lambda sensor signal (per sample period)					
LAMB_MIN_DIAG_DYN_LSL_UP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Minimum value of the lambda sensor signal (per sample period)					
LAMB_MIN_DIAG_DYN_LSL_UP_COMP [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Real minimum value of the lambda sensor signal (per sample period)					
LV_CDN_DIAG_DYN_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating condition of correspondent diagnosis					
LV_CYCNR_DYN_LSL_UP_VLD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Number of carried out single valid amplitude calculation					
LV_DIAG_DYN_CDN_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Diagnosis condition					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_DYN_END_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Result of diagnosis exist					
LV_DIAG_DYN_LSL_UP_CYC_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Indicator for completed minimum amplitude measurement period, trigger for cycle evaluation					
LV_DIAG_DYN_LSL_UP_ENA	V	0... 1H	0 ...1	1	-
Indication that forced stimulation and lambda control are set for amplitude diagnosis					
LV_DIAG_DYN_LSL_UP_LDC_MAF	V	0... 1H	0 ...1	1	-
Indication of low enough MAF dynamics in linear lambda dynamics diagnosis					
LV_DIAG_DYN_LSL_UP_LDC_N	V	0... 1H	0 ...1	1	-
Indication of low enough N dynamics in linear lambda dynamics diagnosis					
LV_DIAG_DYN_LSL_UP_LDC_TQ	V	0... 1H	0 ...1	1	-
Indication of low enough FAC_TQ_REQ dynamics in linear lambda dynamics diagnosis					
LV_DIAG_DYN_SYM_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounce diagnosis value of the sensor dynamics					
LV_DLY_DIAG_ACT_LAM_GAIN	O/V	0... 1H	0 ...1	1	-
Switch of lambda controller parameters for linear lambda sensor delay diagnosis activated					
LV_DLY_ERR_LSL_DIAG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Error indicator of linear sensor signal delay diagnosis					
LV_END_DIAG_DYN_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating end of correspondent diagnosis					
LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the validation of correspondent symptom (transmitted to the error management)					
LV_FAC_COMP_DIAG_DYN_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable to indicate an asymmetric failure					
LV_LAM_ADJ_REQ_DYN_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request dynamic trim controller parameters specific for the WRAF sensor dynamic					
LV_LAMB_PLS_REQ_DYN_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request forced stimulation parameters specific for the WRAF sensor dynamic					
LV_LS_DIAG_MNG_PRIO_CAT_ACT	-	0... 1H	0 ...1	1	-
Intermediate flag indicating cat diag request for forced stimulation					
LV_LS_DIAG_MNG_PRIO_CAT_END	-	0... 1H	0 ...1	1	-
Intermediate flag indicating cat diag completion					
LV_LS_DIAG_MNG_PRIO_DLY_ACT	-	0... 1H	0 ...1	1	-
Intermediate flag indicating dynamic diag (effect diag) request for forced stimulation and lambda control					
LV_LS_DIAG_MNG_PRIO_DLY_END	-	0... 1H	0 ...1	1	-
Intermediate flag indicating dynamic diag (effect diag) completion					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LS_DIAG_MNG_PRIO_DLY_REQ	V	0... 1H	0 ...1	1	-
Request from dynamic (effect) diagnosis for forced stimulation after priorization					
LV_LS_DIAG_MNG_PRIO_DYN_ACT	-	0... 1H	0 ...1	1	-
Intermediate flag indicating dynamic diag (amplitude diag) request for forced stimulation and lambda control					
LV_LS_DIAG_MNG_PRIO_DYN_END	-	0... 1H	0 ...1	1	-
Intermediate flag indicating dynamic diag (amplitude diag) completion					
LV_LS_DIAG_MNG_PRIO_DYN_REQ	V	0... 1H	0 ...1	1	-
Request from dynamic (amplitude) diagnosis for forced stimulation after priorization					
LV_LS_DIAG_REQ_INH_CAT_DIAG	O/V	0... 1H	0 ...1	1	-
Request from diagnosis priority manager to deactivate catalyst diagnosis					
MAF_KGH_MMV_DYN_LSL_UP_LDC	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Moving mean value for LDC					
N_MMV_DYN_LSL_UP_LDC	V	0... 1FE0H	0... 8160	1	rpm
Moving mean value for LDC					
STATE_DYN_DIAG [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H	PASSIVE WAIT ACQUISITION END	-	-
State shows the condition of the forced stimulation					
STATE_LAM_GAIN_REQ_LS_DIAG	O/V	0H 1H 2H	NONE DYN_DIAG DLY_DIAG	-	-
Request for specific lambda controller parameters for lambda sensor diagnoses					
STATE_LAMB_PLS_REQ_LS_DIAG	O/V	0H 1H 2H	NONE DYN_DIAG DLY_DIAG	-	-
Request for forced lambda stimulation for lambda sensor diagnoses					
T_CON_LAMB_AFL_DYN_LS_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer to detect a local maximum to avoid false diagnosis					
T_CON_LAMB_AFR_DYN_LS_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer to detect a local minimum to avoid false diagnosis					
T_DIAG_DYN_LSL_UP_LDC_MAF	V	0... FFH	0... 5.1	0.02	s
Delay timer after MAF dynamics in linear lambda dynamics diagnosis					
T_DYN_DIAG_AFL [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer for maximum amplitude measurement duration after LV_AFL 0 -> 1					
T_DYN_DIAG_AFL_COMP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer for real lambda maximum detection (asymmetric failure detection)					
T_DYN_DIAG_AFL_THD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Start delay limit for maximum amplitude measurement period after LV_AFL 0 -> 1					
T_DYN_DIAG_AFR [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer for maximum amplitude measurement duration after LV_AFL 1 -> 0					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_DYN_DIAG_AFR_COMP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer for real lambda maximum detection (asymmetric failure detection)					
T_DYN_DIAG_AFR_THD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Start delay limit for minimum amplitude measurement period after LV_AFL 1 -> 0					
TQ_MMV_DIAG_DYN_LSL_UP	V	0... FFFFH	0... 1.9999694824218	30.5175e-6	-
Moving mean of FAC_TQ_REQ for limited dynamics in linear lambda dynamics diagnosis					

Input data:

C_FAC_DIAG_DYN_S_LSL_UP_MAX {p. 5314}	FAC_DLY_DIAG_LSL_OUT [NC_CBK_EX_NR] {p. 5258}	FAC_MV_DIAG_DYN_S_LSL_UP [NC_CBK_EX_NR] {p. 5313}	FAC_TQ_REQ {p. 6706}
LAMB_DELTA_AD_LAM_ADJ [NC_CBK_EX_NR] {p. 2622}	LAMB_DELTA_I_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_AFL [NC_CBK_EX_NR] {p. 2439}
LV_CAT_DIAG_ACT_EXT {p. 5377}	LV_CAT_DIAG_END_EXT {p. 5377}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_DIAG_DYN_INH_LSL_UP [NC_CBK_EX_NR] {p. 5377}
LV_DIAG_DYN_S_LSL_UP_END [NC_CBK_EX_NR] {p. 5313}	LV_DIAG_DYN_S_LSL_UP_ERR [NC_CBK_EX_NR] {p. 5313}	LV_DIAG_EOL_DYN_LS_UP [NC_CBK_EX_NR] {p. 5377}	LV_DLY_DIAG_ACT_EXT {p. 5377}
LV_DLY_DIAG_END_EXT {p. 5377}	LV_DLY_DIAG_REQ_LAM_GAIN [NC_CBK_EX_NR] {p. 5259}	LV_DLY_END_LSL_DIAG [NC_CBK_EX_NR] {p. 5259}	LV_DYN_DIAG_ACT_EXT {p. 5377}
LV_DYN_DIAG_END_EXT {p. 5377}	LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR] {p. 2463}	LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR] {p. 2463}	LV_IGK {p. 906}
LV_INH_DIAG_DYN_VLD_LS_UP_ERR [NC_CBK_EX_NR] {p. 5377}	LV_INTR_DIAG_LS_DYN [NC_CBK_EX_NR] {p. 803}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	LV_LAM_GAIN_LS_DIAG {p. 2463}
LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_LAMB_PLS_LS_DIAG {p. 2579}	LV_LS_DIAG_MNG_PRIO_EXT {p. 5377}	LV_LS_DIAG_REQ_INH_CAT_DIAG_EXT {p. 5377}
LV_VLS_DIF_DLY_LDC [NC_CBK_EX_NR] {p. 5216}	MAF {p. 8277}	MAF_HB {p. 805}	MAF_KGH {p. 1195}
N {p. 1525}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_IDX_DIAG_DYN_VLD_LS_UP
STATE_CAT_DIAG [NC_CBK_EX_NR] {p. 5474}	STATE_LAMB_PLS_REQ_LS_DIAG_EXT {p. 5377}		

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LPF_FAC_AD_DYN_LSL_UP	O/V	0... FFH	0... 0.99609375	0.00390625	-
Correlation factor for low pass filtered (sensor time constant) adaptation factor					
C_CRLC_LPF_LAMB_DIAG_DYN_LSL_UP	O/V	0... FFFFH	0... 0.9999847412109	15.2587e-6	-
Correlation factor for low pass filtered lambda value					
C_CTR_WAIT_DIAG_DYN_LSL_UP	O/V	0... FFH	0... 255	1	-
Number of forced stimulation periods during the diagnosis status transition "wait" to "acquisition"					
C_CYCNR_END_DIAG_DYN_LSL_UP	O/V	0... FFH	0... 255	1	-
Number of long term mean values to deliver the sensor dynamic diagnostic					
C_CYCNR_EOL_DIAG_DYN_LSL_UP	O/V	0... FFH	0... 255	1	-
Number of long term mean values to deliver the sensor dynamic diagnostic (EOL test)					
C_CYCNR_MIN_DIAG_DYN_LSL_UP	O/V	0... FFH	0... 255	1	-
Minimum number of short term mean values to calculate the long term mean value					
C_FAC_AD_RST_DIAG_DYN_LSL_UP	O/V	0... FFFFH	0... 65.535	0.001	-
Diagnosis value threshold to reset adaptation of sensor time constant model					
C_FAC_AD_THD_DIAG_DYN_LSL_UP	O/V	0... FFFFH	0... 65.535	0.001	-
Diagnosis value threshold for begin adaptation of sensor time constant model					
C_FAC_COMP_L2R_DIAG_DYN_LSL_UP	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Constant for asymmetric failure detection from L2R					
C_FAC_COMP_L2R_MIN_DYN_LSL_UP	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Minimum threshold to remove the maximum outlier (L2R failure case)					
C_FAC_COMP_NOM_DYN_LSL_UP	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Nominal threshold to remove the minimum or maximum outlier (L2R or R2L good case)					
C_FAC_COMP_NOM_L2R_DYN_LSL_UP	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Nominal minimum threshold to remove the minimum outlier (L2R good case)					
C_FAC_COMP_NOM_R2L_DYN_LSL_UP	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Maximum threshold to remove the maximum outlier (R2L good case)					
C_FAC_COMP_R2L_DIAG_DYN_LSL_UP	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Constant for asymmetric failure detecttion from L2R					
C_FAC_COMP_R2L_MAX_DYN_LSL_UP	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Maximum threshold to remove the minimum outlier (R2L failure case)					
C_FAC_COMP_SENS_MDL_L2R_ACT	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Calibration constant to activate the slow L2R plant model					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_COMP_SENS_MDL_L2R_DEAC	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Calibration constant to deactivate the slow L2R plant model					
C_FAC_COMP_SENS_MDL_R2L_ACT	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Calibration constant to activate the slow R2L plant model					
C_FAC_COMP_SENS_MDL_R2L_DEAC	V	8000... 7FFFH	-32... 31.9990234375	976.562e-6	-
Calibration constant to deactivate the slow R2L plant model					
C_FAC_DLY_DIAG_LSL_THD	O/V	8000... 7FFFH	-50... 49.998474121093	0.00152587	-
Threshold to set the linear sensor signal delay error					
C_FAC_MAF_DYW_NEG_DYN_LSL_UP	V	8000... 7FFFH	-8... 7.999755859375	244.14e-6	-
Calibratable factor for the dynamic engine load deviation					
C_FAC_MIN_LAMB_AMPL_DIAG_DYN	O/V	0... FFH	0... 1.275	0.005	-
Lambda dynamic diagnosis amplitude threshold (fraction of IP_LAMB_AMPL_MIN_DIAG_DYN_LSL_UP) for increased weight of bad diagnostic values					
C_FAC_MV_MAX_DIAG_DYN_LSL_UP	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Average of Lambda dynamic diagnosis diagnostic value, max value					
C_FAC_MV_MIN_DIAG_DYN_LSL_UP	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Average of Lambda dynamic diagnosis diagnostic value, min value					
C_FAC_MV_THD_DIAG_DYN_LSL_UP	O/V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Limited diagnosis value for the error diagnosis					
C_FAC_VALUE_NOT_PLAUS_DIAG_DYN	O/V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Lambda dynamic diagnosis diagostic value increase for signal amplitudes of exactly 0					
C_LAMB_AMPL_MAX_DYN_LSL_UP	O/V	0... 7FH	0... 0.1240234375	976.562e-6	-
Calibration data for adjust the expected amplitude: low range					
C_LAMB_AMPL_MIN_DYN_LSL_UP	O/V	0... 7FH	0... 0.1240234375	976.562e-6	-
Calibration data for adjust the expected amplitude: low range					
C_LAMB_LPF_GRD_MIN_DIAG_DYN	O/V	8000... 7FFFH	-3.2... 3.19990234375	97.6562e-6	-
Minimum lambda signal gradient for search of min/max values in sensor dynamic diagnosis					
C_LAMB_LPF_HYS_DYN_LSL_UP	V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Constant to set the allowed difference between Lambda and MAX/MIN Lambda					
C_LAMB_MAX_DIAG_DYN_LSL_UP	O/V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Highest allowed sensor signal max value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_MIN_DIAG_DYN_LSL_UP	O/V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
Lowest allowed sensor signal min value					
C_MAF_CRLC_DYN_LSL_UP	V	0... FFFFH	0... 0.999985	15.3186e-6	-
Correlation factor for low pass filtered mass air flow					
C_MAF_KGH_MIN_DIAG_DYN	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Minimum air mass flow to activate the lambda sensor dynamic diagnosis					
C_MAF_MAX_DIAG_DYN_LSL_UP	O/V	0... FFFFH	0... 1389	0.02119478	mg/stk
Maximum mass airflow rate to activate the diagnosis function					
C_MAF_MIN_DIAG_DYN_LSL_UP	O/V	0... FFFFH	0... 1389	0.02119478	mg/stk
Minimum mass airflow rate to activate the diagnosis function					
C_N_CRLC_LDC_DYN_LSL_UP	V	0... FFFFH	0... 0.999985	15.3186e-6	-
Correlation factor for low pass filtered engine speed					
C_N_DYW_DIAG_DYN_LSL_UP	O/V	0... 1FE0H	0... 8160	1	rpm
Maximum dynamic engine speed deviation for limited dynamics (linear sensor dynamic diagnosis)					
C_N_MAX_DIAG_DYN_LSL_UP	O/V	0... FFH	0... 8160	32	rpm
Maximum engine speed to activate the diagnosis					
C_N_MIN_DIAG_DYN_LSL_UP	O/V	0... FFH	0... 8160	32	rpm
Minimum engine speed to activate the diagnosis					
C_RATIO_DIAG_DYN_LSL_UP_STC	O/V	0... FFH	0... 0.99609375	0.00390625	-
Maximum ratio of failed diagnostic cycles for statistical evaluation in linear lambda dynamics diagnosis					
C_STATE_PRIO_INH_DIAG_CAT	O/V	0... FFH	0... 255	1	-
Bit vector for priorization of other diagnoses over catalyst diagnosis					
C_STATE_PRIO_INH_DIAG_DLY	O/V	0... FFH	0... 255	1	-
Bit vector for priorization of other diagnoses over lambda sensor dynamic (effect) diagnosis					
C_STATE_PRIO_INH_DIAG_DYN	O/V	0... FFH	0... 255	1	-
Bit vector for priorization of other diagnoses over lambda sensor dynamic (amplitude) diagnosis					
C_T_CON_LAMB_DYN_LS_UP	V	0... FFFFH	0... 1310.7	0.02	s
Constant to set the monitoring time for a local maximum and minimum					
C_TQ_CRLC_DIAG_DYN_LSL_UP	O/V	0... FFFFH	0... 0.9999847412109	15.2587e-6	-
Correlation factor for TQ request limited dynamics in linear lambda dynamics diagnosis					
C_TQ_DYW_DIAG_DYN_LSL_UP	O/V	0... FFFFH	0... 1.9999694824218	30.5175e-6	-
Maximum deviation from MMV for TQ dynamics in linear lambda dynamics diagnosis					
IP_FAC_COMP_DYN_LSL_UP	V	0... FFH	0... 31.875	0.125	-
LDP_FAC_COMP_MV_DYN_LSL_UP	8	0... FFFFH	-32... 31.9990234375	976.562e-6	-
Calculation of the weighting factor for the asymmetric failure detection					
IP_FAC_COMP_VALUE_DYN_LSL_UP	V	0... FFH	0... 12.75	0.05	-
LDPM_N_32_LS_UP_DYN	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_LS_UP_DYN	8	0... FFH	0... 1389	5.44705882	mg/stk
Correction factor for the calculation of asymmetric failure detection					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_SCA_FAC_MV_DIAG_DYN	O/V	0... 7FFFH	0... 31.9990234375	976.562e-6	-
LDP_FAC_MV_DIAG_DYN_S_LSL_UP	4	0... 7FFFH	0... 127.99609	0.00390624	-
Scaling of result from dynamic diagnosis after NoX-cat-regeneration to fit result from dynamic diagnosis (homogen)					
IP_FAC_VALUE_DYN_LSL_UP_COMP	V	0... FFFFH	-32... 31.9990234375	976.562e-6	-
LDP_LAMB_DIF_MAX_DYN_LSL_UP	8	0... 7FFFH	0... 31.99902344	976.562e-6	-
LDP_LAMB_DIF_MIN_DYN_LSL_UP	8	0... 7FFFH	0... 31.99902344	976.562e-6	-
Map to set the dif-ratio factor for the asymmetric failure detection					
IP_LAMB_AMPL_MAX_DYN_LSL_UP	O/V	0... 7FH	0... 0.1240234375	976.562e-6	-
LDPM_N_32_LS_UP_DYN	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_LS_UP_DYN	8	0... FFH	0... 1389	5.44705882	mg/stk
Nominal sensor expected amplitude during the Dynamic Diagnosis Rem.: The same points in LDPM_N_32_2_EGTR and LDPM_MAF_HB_2_EGTR shall be used					
IP_LAMB_AMPL_MIN_DYN_LSL_UP	O/V	0... 7FH	0... 0.1240234375	976.562e-6	-
LDPM_N_32_LS_UP_DYN	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_LS_UP_DYN	8	0... FFH	0... 1389	5.44705882	mg/stk
Limit sensor expected amplitude during the Dynamic Diagnosis Rem.: The same points in LDPM_N_32_2_EGTR and LDPM_MAF_HB_2_EGTR shall be used					
IP_MAF_KGH_DYW_DYN_LSL_UP	V	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDP_MAF_KGH_DYW_DYN_LSL_UP	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
Maximum dynamic engine load deviation for limited dynamics					
IP_T_DIAG_DYN_LSL_UP_LDC_MAF	V	0... FFH	0... 5.1	0.02	s
LDP_MAF_IP_T_DIAG_DYN_LSL_UP	2	0... FFFFH	0... 1389	0.02119478	mg/stk
LDP_VS_IP_T_DIAG_DYN_LSL_UP	2	0... FFH	0... 255	1	km/h
Delay timer after MAF dynamics in linear lambda dynamics diagnosis					
IP_T_DYN_DIAG	O/V	0... FFFFH	0... 1310.7	0.02	s
LDPM_N_32_LS_UP_DYN	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_LS_UP_DYN	8	0... FFH	0... 1389	5.44705882	mg/stk
Amplitude measurement time: same points than in LDPM_N_32_2_EGTR and LDPM_MAF_HB_2_EGTR shall be used					
IP_T_DYN_DIAG_COMP	V	0... FFFFH	0... 1310.7	0.02	s
LDPM_N_32_LS_UP_DYN	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_LS_UP_DYN	8	0... FFH	0... 1389	5.44705882	mg/stk
Real maximum and minimum lambda measurement time					
IP_T_DYN_DIAG_THD [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1310.7	0.02	s
LDPM_N_32_LS_UP_DYN	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_LS_UP_DYN	8	0... FFH	0... 1389	5.44705882	mg/stk
Amplitude measurement start delay of linear lambda dynamics diagnosis					
LC_DIAG_DYN_AFR_DLY_ENA	O/V	0... 1H	0 ...1	1	-
Enable extension of rich minimum search into next lean half period					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_DIAG_DYN_LSL_UP_CAT_SYN	O/V	0... 1H	0 ...1	1	-
Boolean switch to synchronise the dynamic diagnosis with the catalyst efficiency diagnosis					
LC_DIAG_DYN_LSL_UP_DLY_ACT	O/V	0... 1H	0 ...1	1	-
Enable evaluation of delay diagnosis result					
LC_DIAG_DYN_LSL_UP_LAM_OFF	O/V	0... 1H	0 ...1	1	-
Disable check for lambda controller limitation in linear lambda dynamics diagnosis					
LC_DIAG_DYN_LSL_UP_LDC_TQ	O/V	0... 1H	0 ...1	1	-
Enable alternate LDC in linear lambda dynamics diagnosis					
LC_DIAG_DYN_LSL_UP_STC	O/V	0... 1H	0 ...1	1	-
Enable statistical evaluation in linear lambda dynamics diagnosis					
LC_FAC_MV_DIAG_DYN_LSL_UP_UPD	V	0... 1H	0 ...1	1	-
Switch to actualise the mean value of normalised single sensor signal amplitude (= 1)					
LC_LAMB_COR_DIAG_DELTA_LAM_ADJ	V	0... 1H	0 ...1	1	-
Switch for Upstream lambda correction with deltas					
LC_T_CON_DYN_LSL_UP	V	0... 1H	0 ...1	1	-
Switch to freeze or to set the Timer T_CON_DYN_LSL_UP to 0					
LC_T1_AD_DIAG_DYN_LSL_UP	O/V	0... 1H	0 ...1	1	-
Boolean switch to allow the adaptation of the sensor time constant model T1_LSL_UP[i]					

Import actions:

ACTION_ERRM_NoFilterReset (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_NoFilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_LV_ERR_SET>,**IN**<PRM_LV_ERR_RST>,**IN**<PRM_LV_END_DIAG>,**OUT**<PRM_LV_ERR>)

General information

Configuration for diagnostic symptoms:

Diagnostic XX	Symptom description	Symptom	Filter type
DYN_VLD_LS_UP[NC_CBK_EX_NR]	Signal dynamic fault (slow response, delay or phase shift)	SYM_1	NO

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The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

This function shall evaluate the Linear Oxygen Sensor dynamic behaviour once per driving cycle by measuring the sensor output signal damping during the time when the forced stimulation is active with

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the special set of parameters for the Dynamic Diagnosis or for the Catalyst Efficiency Diagnosis. During this time the air-fuel ratio is stimulated with a defined amplitude and period.

The amplitude of the air-fuel oscillation is measured by looking for minimum and maximum signal values in restricted time windows after start of the rich and lean cycles. This amplitude is normalized using the expected amplitudes for new and aged sensors and averaged over a number of measurements. The time window for determination of minimum (or maximum) values starts at the time defined in IP_T_DYN_DIAG_THD after the start of the rich (or lean) cycle, as indicated by LV_AFL edges, and lasts for the time IP_T_DYN_DIAG_COMP. The nominal maximum and minimum lambda value while the Timer T_DYN_DIAG_AFL/AFR is lower than THD and higher 0. The real minimum and maximum (COMP – comparison) is calculated while T_DYN_DIAG_AFL/AFR_COMP $>$ 0 and T_DYN_DIAG_AFL/AFR $<$ THD. The window may extend into the following lean (or rich) cycle, but it is truncated at the end of that cycle. Restriction of the time window makes the diagnosis sensitive to delays in the occurrence of the amplitude maximum and allows focusing on a portion of the signal where the difference between new and aged sensors is high, thus improving over the assessment of only the signal oscillation amplitude. The calculation of a FAC_COMP_VALUE_DIAG_DYN_LSL_UP, done in a map like

$$dif\_ratio = \frac{lamb\_\max\_comp - lamb\_\max}{lamb\_\min - lamb\_\min\_comp}$$

Figure B.33.1:

, shall detect an asymmetric failure earlier by weighting the FAC_MV_DIAG_DYN_LSL_UP[i].
The FAC_COMP_MV_DIAG_DYN_SENS_MDL is an output for the lambda sensor plant model (LACO). The rich to lean or lean to rich transition could be adapted in case of an asymmetric failure to improve the emissions.

Once the diagnosis is active, after every forced stimulation period, the lambda sensor signal amplitude is calculated. This amplitude is normalised versus engine speed and load. After a calibrateable number of normalised amplitude values are available, a mean value is determined. The lambda amplitude mean value is transformed into the relative damping factor FAC_MV_DIAG_DYN_LSL_UP[i] by comparing with the amplitude of a new sensor with the value for the limit aged sensor. Once the relative damping factor FAC_MV_DIAG_DYN_LSL_UP[i] is determined for the current driving cycle, it is compared with a calibrateable threshold to establish a good/bad result.

To make the final decision, results from another diagnosis may be necessary. The results of both diagnoses evaluate different properties of the sensor but share the same symptom. A good result can only be established if both diagnoses have confirmed a good result, but a bad result of any of the diagnoses makes the combined result bad as soon as this result is determined. The other diagnosis is expected to produce the end flag LV_DLY_END_LSL_DIAG[i] and the diagnostic value FAC_DLY_DIAG_LSL_OUT[i], not providing a good/bad result by itself. For historical reasons (to avoid changes in service 06h output), this value is scaled such that the limit to be applied becomes the same as the limit applied to FAC_MV_DIAG_DYN_LSL_UP, and this scaled value is compared to determine the result status of the other diagnosis.

For systems using stratified or other lean combustion modes an alternate diagnosis may be used to evaluate the same sensor dynamic properties as the diagnosis described here. Therefore a good (or bad) result may be established as soon as one of the diagnoses has a result. The alternate diagnosis is expected to supply the error and end flags LV_DIAG_DYN_S_LSL_UP_ERR[i] and LV_DIAG_DYN_S_LSL_UP_END[i] and the diagnostic result FAC_MV_DIAG_DYN_S_LSL_UP[i]. From this result an equivalent FAC_MV_DIAG_DYN_LSL_UP[i] is obtained using IP_FAC_SCA_FAC_MV_DIAG_DYN.

The factor FAC_MV_DIAG_DYN_LSL_UP[i] can also be used to adapt the sensor time constant model T1_LSL_UP[i] for symmetric failure cases by setting the Boolean switch LC_T1_AD_DIAG_DYN_LSL_UP = 1. For asymmetric failure cases the FAC_COMP_MV_DIAG_DYN_SENS_MDL[i] can be used to adapt the plant model for rich to lean or lean to rich transitions with additional time. In that case a simple linear interpolation is done between the time constant for a new sensor and that for the aged

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limit sensor, which are saved in the correspondent maps IP_T1_LSL_UP_AGI_LIM[i] and IP_T1_LSL_UP[i]. For more information please refer to the function specification *Lambda control (Fuel mass).*

To help the calibration of this function a tuning guide is available.

Application conditions:

Initialisation:

At the transition LV_IGK = 0 ->1, by ECU reset, by clearing the Error Memory or by triggering the EOL test (transition LV_DIAG_EOL_DYN_LS_UP[i] = 0 -> 1) initialise the variables as indicated below:

```
FAC_COMP_VALUE_MIN_DYN_LSL_UP[i] = 32
FAC_VALUE_MAX_DIAG_DYN_LSL_UP[i] = 0
FAC_VALUE_MIN_DIAG_DYN_LSL_UP[i] = 32
LAMB_MIN_DIAG_DYN_LSL_UP[i] = 32
LAMB_MIN_DIAG_DYN_LSL_UP_COMP[i] = 32
LV_LS_DIAG_REQ_INH_CAT_DIAG = 1
STATE_DYN_DIAG[i] = "passive"
STATE_LAM_GAIN_REQ_LS_DIAG = NONE
STATE_LAMB_PLS_REQ_LS_DIAG = NONE
T_DYN_DIAG_AFL[i] = 1310.7
T_DYN_DIAG_AFR[i] = 1310.7
TQ_MMV_DIAG_DYN_LSL_UP = FAC_TQ_REQ
```

set the following variables to zero:

```
CTR_WAIT_DIAG_DYN_LSL_UP[i]
CYCNR_DIAG_DYN_LSL_UP[i]
CYCNR_DIAG_DYN_LSL_UP_ERR[i]
FAC_COMP_SUM_DIAG_DYN_LSL_UP[i]
FAC_COMP_VALUE_DIAG_DYN_LSL_UP[i]
FAC_COMP_VALUE_DYN_LSL_UP_TMP[i]
FAC_COMP_VALUE_MAX_DYN_LSL_UP[i]
FAC_DIAG_DYN_LSL_UP_ERR[i]
FAC_DIAG_DYN_LSL_UP_OK[i]
FAC_DLY_DIAG_LSL_TMP[i]
FAC_MV_COR_DIAG_DYN_LSL_UP[i]
FAC_MV_DIAG_DYN_LSL_UP[i]
FAC_MV_SUM_DIAG_DYN_LSL_UP[i]
FAC_SUM_DIAG_DYN_LSL_UP[i]
FAC_VALUE_DIAG_DYN_LSL_UP[i]
LAMB_AMPL_DIAG_DYN_LSL_UP[i]
LAMB_AMPL_MAX_DIAG_DYN_LSL_UP[i]
LAMB_AMPL_MIN_DIAG_DYN_LSL_UP[i]
LAMB_COR_DIAG_DYN_LS_UP[i]
LAMB_DIF_MAX_DYN_LSL_UP_COMP[i]
LAMB_DIF_MIN_DYN_LSL_UP_COMP[i]
LAMB_LPF_DIAG_DYN_LSL_UP[i]
LAMB_LPF_GRD_DIAG_DYN_LSL_UP[i]
LAMB_MAX_DIAG_DYN_LSL_UP[i]
LAMB_MAX_DIAG_DYN_LSL_UP_COMP[i]
LAMB_MAX_DIAG_DYN_LSL_UP_TMP[i]
LAMB_MAX_DYN_LSL_UP_COMP_TMP[i]
LV_CYCNR_DYN_LSL_UP_VLD[i]
LV_DIAG_DYN_CDN_LSL_UP[i]
LV_DIAG_DYN_END_LSL_UP[i]
```

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```
LV_DIAG_DYN_LSL_UP_CYC_END[i]
LV_DIAG_DYN_LSL_UP_ENA
LV_DIAG_DYN_LSL_UP_LDC_MAF
LV_DIAG_DYN_LSL_UP_LDC_N
LV_DIAG_DYN_LSL_UP_LDC_TQ
LV_DIAG_DYN_SYM_LSL_UP[i]
LV_DLY_DIAG_ACT_LAM_GAIN
LV_DLY_ERR_LSL_DIAG[i]
LV_FAC_COMP_DIAG_DYN_UP[i]
LV_LAM_ADJ_REQ_DYN_LSL_UP[i]
LV_LAMB_PLS_REQ_DYN_LSL_UP[i]
LV_LS_DIAG_MNG_PRIO_DLY_REQ
LV_LS_DIAG_MNG_PRIO_DYN_REQ
MAF_KGH_MMV_DYN_LSL_UP_LDC
N_MMV_DYN_LSL_UP_LDC
T_CON_LAMB_AFL_DYN_LS_UP[i]
T_CON_LAMB_AFR_DYN_LS_UP[i]
T_DIAG_DYN_LSL_UP_LDC_MAF
T_DYN_DIAG_AFL_COMP[i]
T_DYN_DIAG_AFL_THD[i]
T_DYN_DIAG_AFR_COMP[i]
T_DYN_DIAG_AFR_THD[i]

call ACTION_ERRM_NoFilterReset
( IN<NC_IDX_DIAG_DYN_VLD_LS_UP[i]>,OUT<LV_ERR_DYN_VLD_LS_
UP[i]>)
At the initialisation of new ECU or at a EEPROM checksum error,
initialize FAC_DIAG_DYN_LSL_UP[i] with 0

At the initialisation of new ECU, at a EEPROM checksum error
or when clearing the Error Memory, initialize the following
variables with 0:

FAC_COMP_MV_DIAG_DYN_LSL_UP[i]
FAC_COMP_MV_DIAG_DYN_SENS_MDL[i]
FAC_DYN_LSL_UP_DIAG_SAE[i]
FAC_DYN_LSL_UP_DIAG_TOL_SAE[i]
FAC_DLY_LSL_UP_DIAG_SAE[i]
FAC_DLY_LSL_UP_DIAG_TOL_SAE[i]
```

Activation:

The activation shall cover chapters 1 and 2 (precalculation and state machine). The dynamic diagnosis manager in chapter 3 and the priority manager in chapter 4 shall not depend on it.

```
TQ_MMV_DIAG_DYN_LSL_UP =
TQ_MMV_DIAG_DYN_LSL_UP * (1-C_TQ_CRLC_DIAG_DYN_LSL_UP) +
FAC_TQ_REQ * C_TQ_CRLC_DIAG_DYN_LSL_UP

If    |TQ_MMV_DIAG_DYN_LSL_UP - FAC_TQ_REQ| <
      C_TQ_DYW_DIAG_DYN_LSL_UP
then  LV_DIAG_DYN_LSL_UP_LDC_TQ = 1
else  LV_DIAG_DYN_LSL_UP_LDC_TQ = 0
endif

%Limited engine speed (N) dynamics:
N_MMV_DYN_LSL_UP_LDC =
N_MMV_DYN_LSL_UP_LDC * (1 - C_N_CRLC_LDC_DYN_LSL_UP) +
```

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```
C_N_CRLC_LDC_DYN_LSL_UP * N

If      |N_MMV_DYN_LSL_UP_LDC - N| <
        C_N_DYW_DIAG_DYN_LSL_UP
then    LV_DIAG_DYN_LSL_UP_LDC_N = 1
else    LV_DIAG_DYN_LSL_UP_LDC_N = 0
endif

%Limited mass air flow (MAF) dynamics:
MAF_KGH_MMV_DYN_LSL_UP_LDC =
MAF_KGH_MMV_DYN_LSL_UP_LDC *
(1 - C_MAF_CRLC_DYN_LSL_UP) +
C_MAF_CRLC_DYN_LSL_UP * MAF_KGH

If      IP_MAF_KGH_DYW_DYN_LSL_UP(MAF_KGH) *
        C_FAC_MAF_DYW_NEG_DYN_LSL_UP <
        MAF_KGH - MAF_KGH_MMV_DYN_LSL_UP_LDC <
        IP_MAF_KGH_DYW_DYN_LSL_UP(MAF_KGH)

% In dependency to mass air flow the thresholds should be
calculated and could be selected different for positive and
negative deviation!
then    T_DIAG_DYN_LSL_UP_LDC_MAF - -

% timer is decremented and limited to 0
    if      T_DIAG_DYN_LSL_UP_LDC_MAF = 0
    then    LV_DIAG_DYN_LSL_UP_LDC_MAF = 1
    else    LV_DIAG_DYN_LSL_UP_LDC_MAF = 0
    endif
else    LV_DIAG_DYN_LSL_UP_LDC_MAF = 0
        T_DIAG_DYN_LSL_UP_LDC_MAF =
        IP_T_DIAG_DYN_LSL_UP_LDC_MAF
endif

LV_DIAG_DYN_CDN_LSL_UP[i] = 0
LV_LAMB_PLS_REQ_DYN_LSL_UP[i] = 0

If(0)      LV_DIAG_EOL_DYN_LS_UP[i] = 1
then
% activation by a short test
           IF      LV_IPLSL_VLD[i] = 1 &
                   LV_LAMB_PLS_ACT[i] = 1 &
                   LV_DIAG_DYN_INH_LSL_UP[i] = 0 &
                   LV_FAC_LAM_LIM_MAX[i] = 0 &
                   LV_FAC_LAM_LIM_MIN[i] = 0
           THEN
                   If      LC_DIAG_DYN_LSL_UP_CAT_SYN = 1
                   then    LV_DIAG_DYN_CDN_LSL_UP[i] = 1
                   else    LV_LAMB_PLS_REQ_DYN_LSL_UP[i] = 1
                           If      LV_DIAG_DYN_LSL_UP_ENA = 1
                           then    LV_DIAG_DYN_CDN_LSL_UP[i] = 1
                           endif
                   endif
           ENDIF
ELSE(0)

% normal diagnosis activation
If(1)      LV_END_DIAG_DYN_VLD_LS_UP[i] = 0 &
           LV_DIAG_DYN_INH_LSL_UP[i] = 0
Then(1)
```

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```
         If(2)    LC_DIAG_DYN_LSL_UP_CAT_SYN = 1

% diagnosis carried out together with the catalyst efficiency
diagnosis
         Then(2)
                  If(3)    STATE_CAT_DIAG[i]  = "passive"
OR
                           (STATE_CAT_DIAG[i] = "END" &
                           CYCNR_DIAG_DYN_LSL_UP[i] <
                           C_CYCNR_MIN_DIAG_DYN_LSL_UP)
                  Then(3)
%  keep passive
                  Else(3)  LV_DIAG_DYN_CDN_LSL_UP[i] = 1
                  Endif(3)
         Else(2)
% diagnosis carried out after or before the catalyst efficiency
diagnosis
                  If(3)    LV_IPLSL_VLD[i] = 1 &
                           LV_LAMB_PLS_ACT[i] = 1 &
                           [(LV_FAC_LAM_LIM_MAX[i] = 0 &
                           LV_FAC_LAM_LIM_MIN[i] = 0) or
                           LC_DIAG_DYN_LSL_UP_LAM_OFF = 1] &

                           C_N_MIN_DIAG_DYN_LSL_UP < N_32
<
                           C_N_MAX_DIAG_DYN_LSL_UP &
                           C_MAF_MIN_DIAG_DYN_LSL_UP < MAF
<
                           C_MAF_MAX_DIAG_DYN_LSL_UP  &
                           C_MAF_KGH_MIN_DIAG_DYN < MAF_KGH
&
                           [(LV_VLS_DIF_DLY_LDC[i] = 1 &
                           LC_DIAG_DYN_LSL_UP_LDC_TQ  = 0) or

                           (LV_DIAG_DYN_LSL_UP_LDC_N = 1 &

                           LV_DIAG_DYN_LSL_UP_LDC_MAF = 1
&
                           LV_DIAG_DYN_LSL_UP_LDC_TQ=1 &
                           LC_DIAG_DYN_LSL_UP_LDC_TQ=1)] &

                           LV_CAT_PURGE_ACT[i] = 0
% catalyst purge function not active
                  Then(3)  LV_LAMB_PLS_REQ_DYN_LSL_UP[i] =
1
                           If    LV_DIAG_DYN_LSL_UP_ENA =
1
                           then  LV_DIAG_DYN_CDN_LSL_UP[i]
= 1
                           endif
                  Endif(3)
          Endif(2)
      Endif(1)
Endif(0)
```

Deactivation: –

Recurrence: 20 ms

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Function description:

Signal flow diagram:

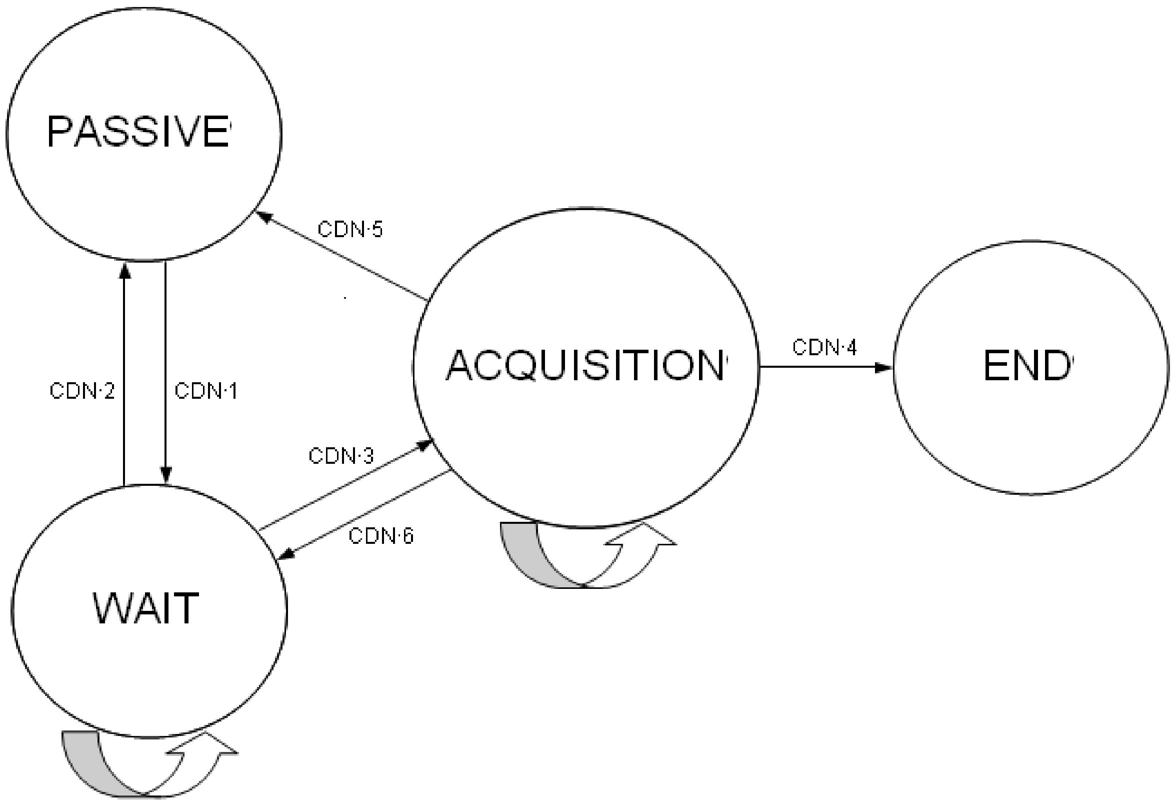

Figure B.33.2:

Formula section:

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B.33.1 PRE-CALCULATIONS

B.33.1.1 FILTERING HIGH FREQUENCE PERTUBATIONS

```
If     LC_LAMB_COR_DIAG_DELTA_LAM_ADJ = 1
then   LAMB_COR_DIAG_DYN_LS_UP[i] = LAMB_LS_UP[i] +
       LAMB_DELTA_I_LAM_ADJ[i] + LAMB_DELTA_AD_LAM_ADJ[i]
else    LAMB_COR_DIAG_DYN_LS_UP[i] = LAMB_LS_UP[i]
endif
LAMB_LPF_DIAG_DYN_LSL_UP[i] (new)   =
LAMB_LPF_DIAG_DYN_LSL_UP[i] (old)*(1-C_CRLC_LPF_LAMB_DIAG_DYN_LSL_UP) +
C_CRLC_LPF_LAMB_DIAG_DYN_LSL_UP *  LAMB_COR_DIAG_DYN_LS_UP[i]
```

B.33.1.2 CALCULATION OF SENSOR SIGNAL MIN and MAX VALUES

```
LAMB_LPF_GRD_DIAG_DYN_LSL_UP[i] =
(LAMB_LPF_DIAG_DYN_LSL_UP[i] (new)  - LAMB_LPF_DIAG_DYN_LSL_UP[i] (old))

If(1)   LV_AFL[i] = 0 -> 1
```


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```
then
    if(2)   T_DYN_DIAG_AFL_COMP[i] > 0
    then    LAMB_MAX_DIAG_DYN_LSL_UP[i] = LAMB_MAX_DIAG_DYN_LSL_UP_TMP[i]
            LAMB_MAX_DIAG_DYN_LSL_UP_TMP[i] = 0
            LAMB_MAX_DIAG_DYN_LSL_UP_COMP[i] =
            LAMB_MAX_DYN_LSL_UP_COMP_TMP[i]
            LAMB_MAX_DYN_LSL_UP_COMP_TMP[i] = 0
    endif(2)
```

Timer decrements after switching to lean

```
    T_DYN_DIAG_AFL[i] = IP_T_DYN_DIAG + IP_T_DYN_DIAG_THD[i]
```

Threshold time doesn't decrement

```
    T_DYN_DIAG_AFL_THD[i] = IP_T_DYN_DIAG
```

Timer decrements after reaching the threshold T_DYN_DIAG_AFL_THD

```
    T_DYN_DIAG_AFL_COMP[i] = IP_T_DYN_DIAG_COMP(N_32, MAF_HB)
```

Timer to detect a local maximum to avoid false diagnosis

```
    T_CON_LAMB_AFL_DYN_LS_UP[i] = C_T_CON_LAMB_DYN_LS_UP
else(1)
   if(2)  T_DYN_DIAG_AFL_COMP[i] = 0.02s (1 step)
   then    LAMB_MAX_DIAG_DYN_LSL_UP[i] =
           LAMB_MAX_DIAG_DYN_LSL_UP_TMP[i]
           LAMB_MAX_DIAG_DYN_LSL_UP_TMP[i] = 0
           LAMB_MAX_DIAG_DYN_LSL_UP_COMP[i] =
           LAMB_MAX_DYN_LSL_UP_COMP_TMP[i]
           LAMB_MAX_DYN_LSL_UP_COMP_TMP[i] = 0
           T_DYN_DIAG_AFL_COMP[i] = 0
    endif(2)
    decrement T_DYN_DIAG_AFL[i]
endif(1)
```

Calculation of temporary diagnosis maximum lambda value

```
If(1)  T_DYN_DIAG_AFL[i] > 0 and
         T_DYN_DIAG_AFL[i] <= T_DYN_DIAG_AFL_THD[I] and
         LAMB_LPF_GRD_DIAG_DYN_LSL_UP[i] > C_LAMB_LPF_GRD_MIN_DIAG_DYN and
         LAMB_MAX_DIAG_DYN_LSL_UP_TMP[i] < LAMB_LPF_DIAG_DYN_LSL_UP[i]
Then     LAMB_MAX_DIAG_DYN_LSL_UP_TMP[i] = LAMB_LPF_DIAG_DYN_LSL_UP[i]
```

/set maximum Lambda value

```
else(1)  freeze LAMB_MAX_DIAG_DYN_LSL_UP_TMP[i]
endif(1)
```

Calculation of the temporary real maximum lambda value

```
If(1)    T_DYN_DIAG_AFL_COMP[i] > 0 and
         T_DYN_DIAG_AFL[i] <= T_DYN_DIAG_AFL_THD[i]
Then     decrement T_DYN_DIAG_AFL_COMP[i]
    If(2)  LAMB_LPF_GRD_DIAG_DYN_LSL_UP[i] > C_LAMB_LPF_GRD_MIN_DIAG_DYN and
            LAMB_MAX_DYN_LSL_UP_COMP_TMP[i] < LAMB_LPF_DIAG_DYN_LSL_UP[i]and
            T_CON_LAMB_AFL_DYN_LS_UP[i] > 0
    Then    LAMB_MAX_DYN_LSL_UP_COMP_TMP[i] = LAMB_LPF_DIAG_DYN_LSL_UP[i]
```

/set maximum Lambda value

```
    else(2)freeze LAMB_MAX_DYN_LSL_UP_COMP_TMP[i]
    endif(2)
endif(1)
```

Timer to detect a local maximum to avoid false diagnosis

```
If(1)    T_DYN_DIAG_AFL_COMP[i] > 0 and
         T_DYN_DIAG_AFL[i] <= T_DYN_DIAG_AFL_THD[i]and
         T_CON_LAMB_AFL_DYN_LS_UP[i] > 0
then
    If(1)     LAMB_MAX_DYN_LSL_UP_COMP_TMP[i] (new)   =
              LAMB_MAX_DYN_LSL_UP_COMP_TMP[i] (old)  and
```

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```
            LAMB_MAX_DYN_LSL_UP_COMP_TMP[i] >=
            LAMB_LPF_DIAG_DYN_LSL_UP[i] + C_LAMB_LPF_HYS_DYN_LSL_UP
    then decrement T_CON_LAMB_AFL_DYN_LS_UP[i]
         elseif(3)   LC_T_CON_DYN_LSL_UP = 0
         then        T_CON_LAMB_AFL_DYN_LS_UP[i] = C_T_CON_LAMB_DYN_LS_UP
         else(3)     freeze T_CON_LAMB_AFL_DYN_LS_UP[i]
         endif(3)
    endif(2)
endif(1)
LV_DIAG_DYN_LSL_UP_CYC_END[i] = 0
If(1)   LV_AFL[i] = 1 -> 0
then
    If(2)  T_DYN_DIAG_AFR_COMP[i] > 0 and
            LC_DIAG_DYN_AFR_DLY_ENA = 1)
    then    LV_DIAG_DYN_LSL_UP_CYC_END[i] = 1
    Endif(2)
```

Timer decrements after switching to rich

```
T_DYN_DIAG_AFR[i] = IP_T_DYN_DIAG + IP_T_DYN_DIAG_THD[i]
```

Threshold time doesn't decrement

```
T_DYN_DIAG_AFR_THD[i] = IP_T_DYN_DIAG
```

additional timer to get the real maximum and minimum and to detect asymmetry

```
T_DYN_DIAG_AFR_COMP[i] = IP_T_DYN_DIAG_COMP(N_32, MAF_HB)
```

Timer to detect a local minimum to avoid false diagnosis

```
T_CON_LAMB_AFR_DYN_LS_UP[i] = C_T_CON_LAMB_DYN_LS_UP
else(1)
    If(2)   T_DYN_DIAG_AFR_COMP[i] = 0.02s (1 step) and
            LC_DIAG_DYN_AFR_DLY_ENA = 1)or
            (LV_AFL[i] = 0 -> 1 and
            LC_DIAG_DYN_AFR_DLY_ENA = 0)
    then    LV_DIAG_DYN_LSL_UP_CYC_END[i] = 1
            T_DYN_DIAG_AFR[i] = 0
            T_DYN_DIAG_AFR_COMP[i] = 0
    Endif(2)
decrement T_DYN_DIAG_AFR[i]
endif(1)
```

Calculation of the diagnosis minimum lambda value

```
If(1)   T_DYN_DIAG_AFR[i] > 0 and
        T_DYN_DIAG_AFR[i] <= T_DYN_DIAG_AFR_THD[i] and
        LAMB_LPF_GRD_DIAG_DYN_LSL_UP[i] < -
        C_LAMB_LPF_GRD_MIN_DIAG_DYN and
        LAMB_MIN_DIAG_DYN_LSL_UP[i] > LAMB_LPF_DIAG_DYN_LSL_UP[i]
then    LAMB_MIN_DIAG_DYN_LSL_UP[i] = LAMB_LPF_DIAG_DYN_LSL_UP[i]
```

/set minimum Lambda value

```
else(1)freeze LAMB_MIN_DIAG_DYN_LSL_UP[i]
endif(1)
```

Calculation of the real minimum lambda value

```
If(1)   T_DYN_DIAG_AFR_COMP[i] > 0 and
        T_DYN_DIAG_AFR[i] <= T_DYN_DIAG_AFR_THD[i]
Then    decrement T_DYN_DIAG_AFR_COMP[i]
    If(2)   LAMB_LPF_GRD_DIAG_DYN_LSL_UP[i] < -
            C_LAMB_LPF_GRD_MIN_DIAG_DYN and
            LAMB_MIN_DIAG_DYN_LSL_UP_COMP[i] >
            LAMB_LPF_DIAG_DYN_LSL_UP[i] and
            T_CON_LAMB_AFR_DYN_LS_UP[i] > 0
    Then    LAMB_MIN_DIAG_DYN_LSL_UP_COMP[i] = LAMB_LPF_DIAG_DYN_LSL_UP[i]
```

set minimum Lambda value

```
    Else(2)   freeze LAMB_MIN_DIAG_DYN_LSL_UP_COMP[i]
```

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```
    endif(2)
endif(1)
```
Timer to detect a local maximum to avoid false diagnosis
```
if(1)   T_DYN_DIAG_AFR_COMP[i] > 0 and
        T_DYN_DIAG_AFR[i]  <= T_DYN_DIAG_AFR_THD[i]and
        T_CON_LAMB_AFR_DYN_LS_UP[i] > 0
Then
    if(2)   LAMB_MIN_DIAG_DYN_LSL_UP_COMP[i] (new)  =
            LAMB_MIN_DIAG_DYN_LSL_UP_COMP[i] (old) and
            LAMB_MIN_DIAG_DYN_LSL_UP_COMP[i] <=
            LAMB_LPF_DIAG_DYN_LSL_UP[i] - C_LAMB_LPF_HYS_DYN_LSL_UP
    then    decrement T_CON_LAMB_AFR_DYN_LS_UP[i]
        elseif(3)   LC_T_CON_DYN_LSL_UP = 0
        Then        T_CON_LAMB_AFR_DYN_LS_UP[i] = C_T_CON_LAMB_DYN_LS_UP
        else(3)     freeze T_CON_LAMB_AFR_DYN_LS_UP[i]
        endif(3)
    endif(2)
endif(1)
```

B.33.2 STATE MACHINE

In the state machine, the transitions shall be handled first and the current state be changed if required. Then the state actions of the new current state shall be executed.

B.33.2.1 STATE_DYN_DIAG[i] = “passive”

Actions: None

Condition 1:
```
from STATE_DYN_DIAG[i] =  "passive" to "wait"
LV_DIAG_DYN_CDN_LSL_UP[i] = 1
```
Transition actions:
```
STATE_DYN_DIAG[i] = "wait"
```

B.33.2.2 STATE_DYN_DIAG[i] = “wait”

Actions:
```
If(1)   LV_AFL[i] = 0 -> 1 &  LC_DIAG_DYN_LSL_UP_CAT_SYN = 0
Then
    If(2)   LV_LAM_ADJ_REQ_DYN_LSL_UP[i] = 0
    Then    LV_LAM_ADJ_REQ_DYN_LSL_UP[i] = 1
```
the current value of the trim controller I-share shall be saved. Moreover its parameters shall be temporarily changed to the one originally defined for the Catalyst Eff. Diag. After the end of the current diagnosis the trim ctr. I-share shall be re-initialised with its old value.
```
    Else(2)   Increment  CTR_WAIT_DIAG_DYN_LSL_UP[i]
    Endif(2)
```
forced stimulation and trim ctr. I-share parameters set by the Catalyst Eff. Diag
```
Endif(1)
LV_CYCNR_DYN_LSL_UP_VLD[i] = 0

If(1)   LV_DIAG_DYN_LSL_UP_CYC_END[i] = 1
Then    LAMB_MAX_DIAG_DYN_LSL_UP_COMP[i] = 0
        LAMB_MIN_DIAG_DYN_LSL_UP_COMP[i] = 32
        LAMB_MAX_DYN_LSL_UP_COMP_TMP[i] = 0
        LAMB_MAX_DIAG_DYN_LSL_UP[i] = 0
        LAMB_MIN_DIAG_DYN_LSL_UP[i] = 32
Endif(1)
```
Condition 2:
```
from  STATE_DYN_DIAG[i] = "wait" to  "passive"
LV_DIAG_DYN_CDN_LSL_UP[i] = 0
```
Transition actions:

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```
STATE_DYN_DIAG[i] = "passive"
LV_LAM_ADJ_REQ_DYN_LSL_UP[i] = 0
CTR_WAIT_DIAG_DYN_LSL_UP[i] = 0
```

Condition 3:

```
from STATE_DYN_DIAG[i] = "wait" to  "acquisition"

[LC_DIAG_DYN_LSL_UP_CAT_SYN = 1  &
STATE_CAT_DIAG = "cyc_lean"  or   "cyc_rich" ] Or
[LC_DIAG_DYN_LSL_UP_CAT_SYN = 0  &
CTR_WAIT_DIAG_DYN_LSL_UP[i] > C_CTR_WAIT_DIAG_DYN_LSL_UP]
```

Transition actions:

```
STATE_DYN_DIAG[i] = "acquisition"
```

B.33.2.3 STATE_DYN_DIAG[i] = "acquisition"

Actions:

```
If(1)  LV_DIAG_DYN_LSL_UP_CYC_END[i] = 1
```

% both lean and rich monitoring cycles have completed

```
Then(1)
    If(2)     LV_CYCNR_DYN_LSL_UP_VLD[i] = 1 &
              LV_INTR_DIAG_LS_DYN[i] = 0 &
              LAMB_MAX_DIAG_DYN_LSL_UP[i]  ≤ C_LAMB_MAX_DIAG_DYN_LSL_UP &
              LAMB_MIN_DIAG_DYN_LSL_UP[i]   ≥  C_LAMB_MIN_DIAG_DYN_LSL_UP
```

Purpose of this test is to avoid any shift in the lambda set point. Narrow calibration of those constants can reduce strongly the number of valid measured amplitudes. Moreover, the current lean/rich cycle must be marked as valid via LV_CYCNR_DYN_LSL_UP_VLD[i].

```
    Then(2)
```

Calculation of the Lambda-Amplitude

```
              LAMB_AMPL_DIAG_DYN_LSL_UP[i] =
              LAMB_MAX_DIAG_DYN_LSL_UP[i] - LAMB_MIN_DIAG_DYN_LSL_UP[i]

              LAMB_AMPL_MIN_DIAG_DYN_LSL_UP[i] =
              IP_LAMB_AMPL_MIN_DYN_LSL_UP - C_LAMB_AMPL_MIN_DYN_LSL_UP

              LAMB_AMPL_MAX_DIAG_DYN_LSL_UP[i] =
              IP_LAMB_AMPL_MAX_DYN_LSL_UP + C_LAMB_AMPL_MAX_DYN_LSL_UP
```

Purpose of this test is, if wanted, to avoid flat line signals or excessive sensor gain. C_LAMB_AMPL_MAX/MIN can be viewed as are amplitude tolerances necessary due to frequent amplitude dispersion.
Calculation of the Lambda-Difference to detect an asymmetric failure

```
              LAMB_DIF_MAX_DYN_LSL_UP_COMP[i]=
              LAMB_MAX_DIAG_DYN_LSL_UP_COMP[i] - LAMB_MAX_DIAG_DYN_LSL_UP[i]

              LAMB_DIF_MIN_DYN_LSL_UP_COMP[i]=
              LAMB_MIN_DIAG_DYN_LSL_UP[i] - LAMB_MIN_DIAG_DYN_LSL_UP_COMP[i]

              If(3)    LAMB_AMPL_MIN_DIAG_DYN_LSL_UP[i] ≤
                       LAMB_AMPL_DIAG_DYN_LSL_UP[i] ≤
                       LAMB_AMPL_MAX_DIAG_DYN_LSL_UP[i]
              Then(3)
                       FAC_VALUE_DIAG_DYN_LSL_UP[i] =
                       (IP_LAMB_AMPL_MAX_DYN_LSL_UP -
                       LAMB_AMPL_DIAG_DYN_LSL_UP[i]) /
                       (IP_LAMB_AMPL_MAX_DYN_LSL_UP -
                       IP_LAMB_AMPL_MIN_DYN_LSL_UP)
                       FAC_COMP_VALUE_DIAG_DYN_LSL_UP[i] =
                       IP_FAC_VALUE_DYN_LSL_UP_COMP
                       (LAMB_DIF_MAX_DYN_LSL_UP_COMP[i],
                       LAMB_DIF_MIN_DYN_LSL_UP_COMP[i])
```

The temporary variable is necessary for the application to know the influence of the different maps!

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```
                  FAC_COMP_VALUE_DYN_LSL_UP_TMP[i] =
                  FAC_COMP_VALUE_DIAG_DYN_LSL_UP[i]
```
Correction of the asymmetric factor with mass air flow and engine speed.
```
                  FAC_COMP_VALUE_DIAG_DYN_LSL_UP[i] =
                  FAC_COMP_VALUE_DIAG_DYN_LSL_UP[i] *
                  IP_FAC_COMP_VALUE_DYN_LSL_UP(N,MAF)
                  If(4)   (LAMB_AMPL_DIAG_DYN_LSL_UP[i] /
                           IP_LAMB_AMPL_MIN_DYN_LSL_UP) <
                           C_FAC_MIN_LAMB_AMPL_DIAG_DYN
                  then
```
emphasize the impact of very low amplitudes to improve error detection with short periods of forced stimulation
```
                          increment  FAC_VALUE_DIAG_DYN_LSL_UP[i] with
                          C_FAC_VALUE_NOT_PLAUS_DIAG_DYN *
                          (1 - LAMB_AMPL_DIAG_DYN_LSL_UP[i]/
                          (IP_LAMB_AMPL_MIN_DYN_LSL_UP *
                          C_FAC_MIN_LAMB_AMPL_DIAG_DYN))
                  endif(4)
                  FAC_SUM_DIAG_DYN_LSL_UP[i] =
                  FAC_SUM_DIAG_DYN_LSL_UP[i] +
                  FAC_VALUE_DIAG_DYN_LSL_UP[i]
                  FAC_COMP_SUM_DIAG_DYN_LSL_UP[i] =
                  FAC_COMP_SUM_DIAG_DYN_LSL_UP[i] +
                  FAC_COMP_VALUE_DIAG_DYN_LSL_UP[i]
```
Number cycles (short-term measurements)

increment CYCNR_DIAG_DYN_LSL_UP[i]

Number of failed cycles for statistical evaluation
```
                  If(4)   (FAC_VALUE_DIAG_DYN_LSL_UP[i] >
                           C_FAC_MV_THD_DIAG_DYN_LSL_UP)
                  then     increment CYCNR_DIAG_DYN_LSL_UP_ERR[i]
                           FAC_DIAG_DYN_LSL_UP_ERR[i] =
                           FAC_VALUE_DIAG_DYN_LSL_UP[i]
                  else(4)  FAC_DIAG_DYN_LSL_UP_OK[i] =
                           FAC_VALUE_DIAG_DYN_LSL_UP[i]
                  endif(4)
             Endif(3)
    Endif(2)
If     FAC_VALUE_DIAG_DYN_LSL_UP[i]  < FAC_VALUE_MIN_DIAG_DYN_LSL_UP[i]
Then   FAC_VALUE_MIN_DIAG_DYN_LSL_UP[i] = FAC_VALUE_DIAG_DYN_LSL_UP[i]
Else   FAC_VALUE_MIN_DIAG_DYN_LSL_UP[i](n)  =
       FAC_VALUE_MIN_DIAG_DYN_LSL_UP[i](n-1)
Endif

If     FAC_VALUE_DIAG_DYN_LSL_UP[i]  > FAC_VALUE_MAX_DIAG_DYN_LSL_UP[i]
Then   FAC_VALUE_MAX_DIAG_DYN_LSL_UP[i] = FAC_VALUE_DIAG_DYN_LSL_UP[i]
Else   FAC_VALUE_MAX_DIAG_DYN_LSL_UP[i](n)  =
       FAC_VALUE_MAX_DIAG_DYN_LSL_UP[i](n-1)
Endif
```
Trailing pointer for the minimum comparison/asymmetric factor
```
If     FAC_COMP_VALUE_DIAG_DYN_LSL_UP[i] < FAC_COMP_VALUE_MIN_DYN_LSL_UP[i]
Then   FAC_COMP_VALUE_MIN_DYN_LSL_UP[i] =  FAC_COMP_VALUE_DIAG_DYN_LSL_UP[i]
Else   FAC_COMP_VALUE_MIN_DYN_LSL_UP[i](n)  =
       FAC_COMP_VALUE_MIN_DYN_LSL_UP[i](n-1)
Endif
```
Trailing pointer for the maximum comparison/asymmetric factor
```
If     FAC_COMP_VALUE_DIAG_DYN_LSL_UP[i] >  FAC_COMP_VALUE_MAX_DYN_LSL_UP[i]
Then   FAC_COMP_VALUE_MAX_DYN_LSL_UP[i] = FAC_COMP_VALUE_DIAG_DYN_LSL_UP[i]
Else   FAC_COMP_VALUE_MAX_DYN_LSL_UP[i](n)  =
       FAC_COMP_VALUE_MAX_DYN_LSL_UP[i](n-1)
Endif
```

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```
LV_CYCNR_DYN_LSL_UP_VLD[i] = 1
LAMB_MAX_DIAG_DYN_LSL_UP[i] = 0
LAMB_MIN_DIAG_DYN_LSL_UP[i] = 32
LAMB_MAX_DIAG_DYN_LSL_UP_COMP = 0
LAMB_MIN_DIAG_DYN_LSL_UP_COMP = 32
Endif(1)
```

Condition 4:

```
from STATE_DYN_DIAG[i] = "acquisition" to  "end"

LV_DIAG_EOL_DYN_LS_UP[i] = 0 &
LC_DIAG_DYN_LSL_UP_CAT_SYN = 1 &
(  CYCNR_DIAG_DYN_LSL_UP[i] ≥ C_CYCNR_END_DIAG_DYN_LSL_UP or
(STATE_CAT_DIAG = "end" &
CYCNR_DIAG_DYN_LSL_UP[i] ≥ C_CYCNR_MIN_DIAG_DYN_LSL_UP) )Or
LV_DIAG_EOL_DYN_LS_UP[i] = 1 &
LC_DIAG_DYN_LSL_UP_CAT_SYN = 1 &
(  CYCNR_DIAG_DYN_LSL_UP[i] ≥ C_CYCNR_EOL_DIAG_DYN_LSL_UP or
(STATE_CAT_DIAG = "end" &
CYCNR_DIAG_DYN_LSL_UP[i] ≥ C_CYCNR_MIN_DIAG_DYN_LSL_UP) )Or
LV_DIAG_EOL_DYN_LS_UP[i] = 0 &
LC_DIAG_DYN_LSL_UP_CAT_SYN = 0 &
CYCNR_DIAG_DYN_LSL_UP[i] ≥ C_CYCNR_END_DIAG_DYN_LSL_UP Or
LV_DIAG_EOL_DYN_LS_UP[i] = 1                    &
CYCNR_DIAG_DYN_LSL_UP[i] ≥ C_CYCNR_EOL_DIAG_DYN_LSL_UP
```

Transition actions:

Diagnosis of sensor dynamic:

```
FAC_MV_DIAG_DYN_LSL_UP[i]  = FAC_SUM_DIAG_DYN_LSL_UP[i] /  CYCNR_DIAG_DYN_LSL_
UP[i]
```

Temporary mean before correction!

```
FAC_MV_SUM_DIAG_DYN_LSL_UP[i] = FAC_MV_DIAG_DYN_LSL_UP[i]
FAC_COMP_MV_DIAG_DYN_LSL_UP[i] = FAC_COMP_SUM_DIAG_DYN_LSL_UP[i] /  CYCNR_DIAG_
DYN_LSL_UP[i]

If     LC_FAC_MV_DIAG_DYN_LSL_UP_UPD= 1 AND
       CYCNR_DIAG_DYN_LSL_UP[i] > 1
Then
    If     FAC_MV_DIAG_DYN_LSL_UP[i] > C_FAC_MV_MAX_DIAG_DYN_LSL_UP AND
           FAC_MV_DIAG_DYN_LSL_UP[i] < C_FAC_MV_MIN_DIAG_DYN_LSL_UP AND
           CYCNR_DIAG_DYN_LSL_UP[i] > 2
```

to erase the min and max outlier the constants above have to be set to phys max and phys min
C_FAC_MV_MAX_DIAG_DYN_LSL_UP = phys-min
C_FAC_MV_MIN_DIAG_DYN_LSL_UP = phys-max

```
    Then   FAC_MV_DIAG_DYN_LSL_UP[i] = (FAC_SUM_DIAG_DYN_LSL_UP[i] -
          FAC_VALUE_MIN_DIAG_DYN_LSL_UP[i] -
          FAC_VALUE_MAX_DIAG_DYN_LSL_UP[i]) /
          (CYCNR_DIAG_DYN_LSL_UP[i] - 2)
    Else
```

bad case, eliminate the min value (outlier)

```
         If     FAC_MV_DIAG_DYN_LSL_UP[i] >
                C_FAC_MV_MAX_DIAG_DYN_LSL_UP
          Then   FAC_MV_DIAG_DYN_LSL_UP[i] = (FAC_SUM_DIAG_DYN_LSL_UP[i] -
VALUE_MIN_DIAG_DYN_LSL_UP[i]) /
                 (CYCNR_DIAG_DYN_LSL_UP[i] - 1)
          Else
```

good case, eliminate the max value (outlier)

```
                 If     FAC_MV_DIAG_DYN_LSL_UP[i] <
                         C_FAC_MV_MIN_DIAG_DYN_LSL_UP
```

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```
                    Then  FAC_MV_DIAG_DYN_LSL_UP[i] =
                          (FAC_SUM_DIAG_DYN_LSL_UP[i] -
                          FAC_VALUE_MAX_DIAG_DYN_LSL_UP[i]) /
                        (CYCNR_DIAG_DYN_LSL_UP[i] - 1)
                    Endif
             Endif
       Endif
Endif
```

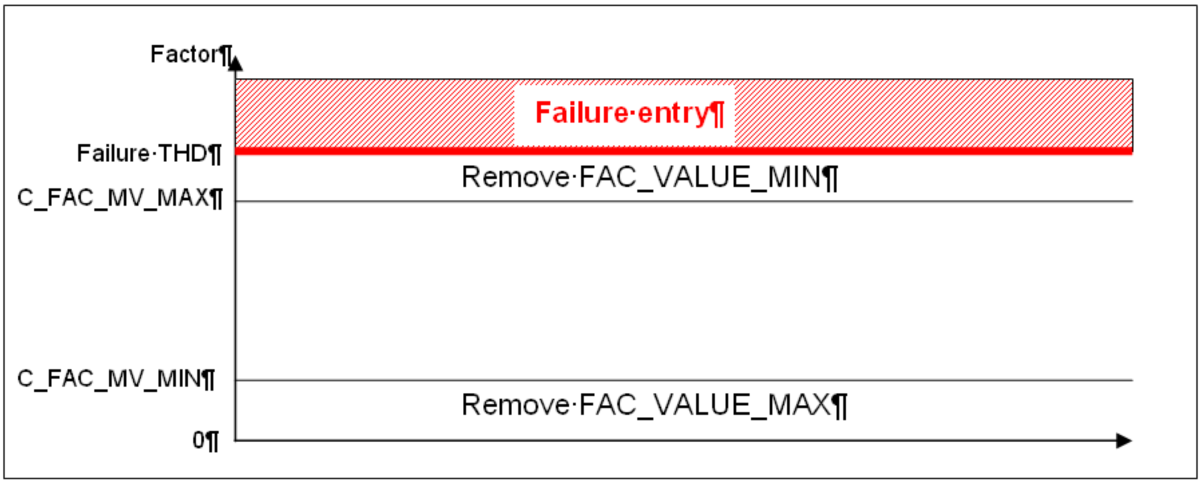

Figure B.33.3:

asymmetric bad case R2L, eliminate the min value (outlier)

```
If      FAC_COMP_MV_DIAG_DYN_LSL_UP[i] > C_FAC_COMP_R2L_MAX_DYN_LSL_UP
Then    FAC_COMP_MV_DIAG_DYN_LSL_UP[i] =(FAC_COMP_SUM_DIAG_DYN_LSL_UP[i] -      FAC_
COMP_VALUE_MIN_DYN_LSL_UP) /  (CYCNR_DIAG_DYN_LSL_UP[i] - 1)
Else
```

asymmetric bad case L2R, eliminate the max value (outlier)

```
        If      FAC_COMP_MV_DIAG_DYN_LSL_UP[i] < C_FAC_COMP_L2R_MIN_DYN_LSL_UP
        Then    FAC_COMP_MV_DIAG_DYN_LSL_UP[i] =
                (FAC_COMP_SUM_DIAG_DYN_LSL_UP[i] -
                FAC_COMP_VALUE_MAX_DYN_LSL_UP) /  (CYCNR_DIAG_DYN_LSL_UP[i] - 1)
        Endif
Endif
```

asymmetric good case R2L, eliminate the max value (outlier)

```
If      C_FAC_COMP_NOM_DYN_LSL_UP < FAC_COMP_MV_DIAG_DYN_LSL_UP[i] <
        C_FAC_COMP_NOM_R2L_DYN_LSL_UP
Then    FAC_COMP_MV_DIAG_DYN_LSL_UP[i] =(FAC_COMP_SUM_DIAG_DYN_LSL_UP[i] -
        FAC_COMP_VALUE_MAX_DYN_LSL_UP) / (CYCNR_DIAG_DYN_LSL_UP[i] - 1)
Else
```

asymmetric good case L2R, eliminate the min value (outlier)

```
        If      C_FAC_COMP_NOM_DYN_LSL_UP > FAC_COMP_MV_DIAG_DYN_LSL_UP[i] >
                C_FAC_COMP_NOM_L2R_DYN_LSL_UP
        Then    FAC_COMP_MV_DIAG_DYN_LSL_UP[i] =
                (FAC_COMP_SUM_DIAG_DYN_LSL_UP[i] -
                FAC_COMP_VALUE_MIN_DYN_LSL_UP) /  (CYCNR_DIAG_DYN_LSL_UP[i] - 1)
        Endif
Endif
```

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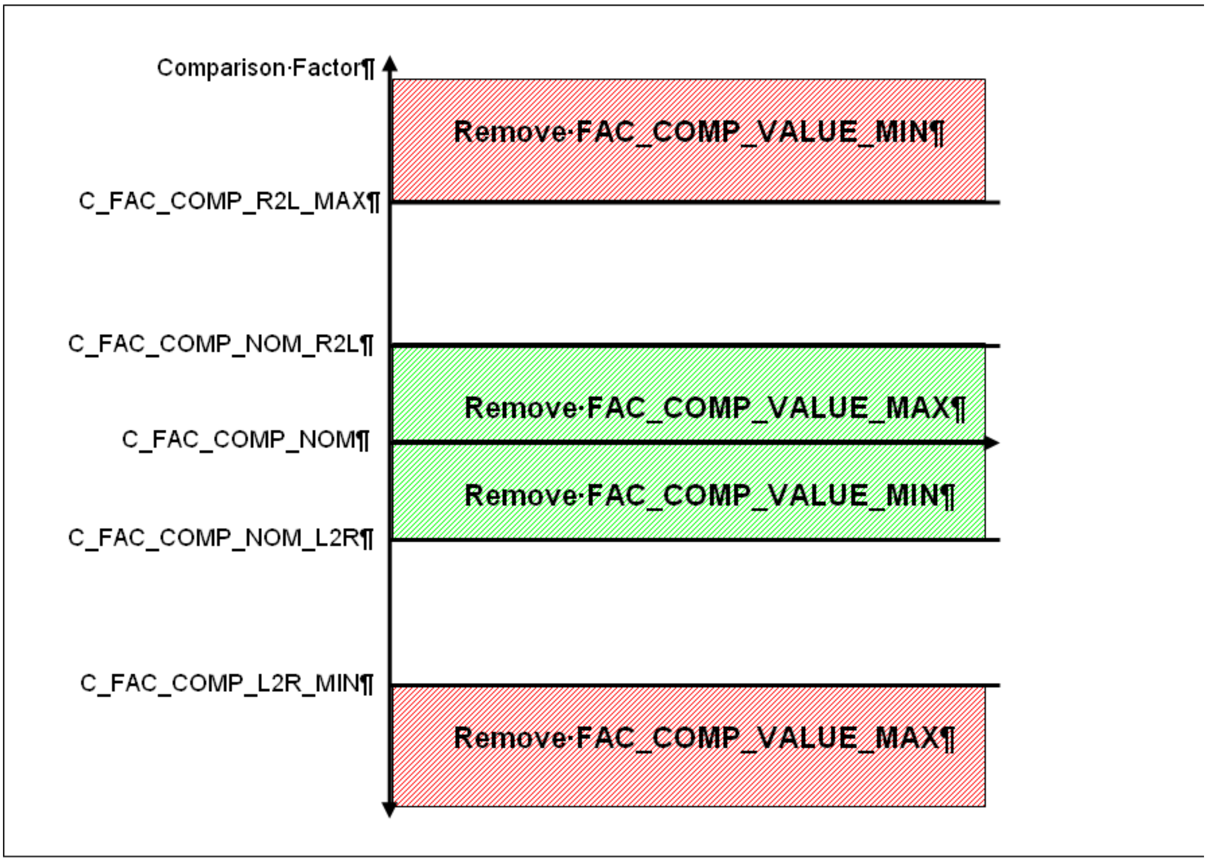

Figure B.33.4:

Temporary mean value after deleting the outlier!

```
FAC_MV_COR_DIAG_DYN_LSL_UP[i] = FAC_MV_DIAG_DYN_LSL_UP[i]
```

Detection of asymmetry

```
If     FAC_COMP_MV_DIAG_DYN_LSL_UP[i] >
       C_FAC_COMP_R2L_DIAG_DYN_LSL_UP OR
       FAC_COMP_MV_DIAG_DYN_LSL_UP[i] <
       C_FAC_COMP_L2R_DIAG_DYN_LSL_UP
Then
```

Correction of factor to detect an asymmetric failure

```
       FAC_MV_DIAG_DYN_LSL_UP[i] = FAC_MV_DIAG_DYN_LSL_UP[i] *
       IP_FAC_COMP_DYN_LSL_UP(FAC_COMP_MV_DIAG_DYN_LSL_UP[i])
       LV_FAC_COMP_DIAG_DYN_UP[i] = 1
Endif
```

Calculation of asymmetric factor to activate and deactivate the slow plant model

```
If     FAC_COMP_MV_DIAG_DYN_LSL_UP[i] > C_FAC_COMP_SENS_MDL_R2L_ACT or
       FAC_COMP_MV_DIAG_DYN_LSL_UP[i] < C_FAC_COMP_SENS_MDL_L2R_ACT
Then   FAC_COMP_MV_DIAG_DYN_SENS_MDL[i] = FAC_COMP_MV_DIAG_DYN_LSL_UP[i]
Else
       If     FAC_COMP_MV_DIAG_DYN_LSL_UP[i] <
              C_FAC_COMP_SENS_MDL_R2L_DEAC and
              FAC_COMP_MV_DIAG_DYN_LSL_UP[i] >
              C_FAC_COMP_SENS_MDL_L2R_DEAC
       Then   FAC_COMP_MV_DIAG_DYN_SENS_MDL[i] = 0
       Else   Freeze  FAC_COMP_MV_DIAG_DYN_SENS_MDL[i]
       Endif
Endif
```

% Check the average and, if enabled, the ratio.

If FAC_MV_DIAG_DYN_LSL_UP[i] $\geq$ C_FAC_MV_THD_DIAG_DYN_LSL_UP **or**

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(LC_DIAG_DYN_LSL_UP_STC = 1 **and**
CYCNR_DIAG_DYN_LSL_UP_ERR[i] /CYCNR_DIAG_DYN_LSL_UP[i] >
C_RATIO_DIAG_DYN_LSL_UP_STC)

Then

% symptom is present

```
    LV_DIAG_DYN_SYM_LSL_UP[i] = 1
Endif
```

% return trim ctr and forced stimulation to their original parameters

```
LV_LAM_ADJ_REQ_DYN_LSL_UP[i] = 0
CTR_WAIT_DIAG_DYN_LSL_UP[i] = 0
STATE_DYN_DIAG[i] = "end"
LV_DIAG_DYN_END_LSL_UP[i] = 1
```

Condition 5:

```
from  STATE_DYN_DIAG[i] = "acquisition" to  "passive"
LV_DIAG_DYN_CDN_LSL_UP[i] = 0
```

Transition actions:

```
STATE_DYN_DIAG[i] = "passive"
LV_LAM_ADJ_REQ_DYN_LSL_UP[i] = 0
CTR_WAIT_DIAG_DYN_LSL_UP[i] = 0
```

Condition 6:

```
from STATE_DYN_DIAG[i] = "acquisition" to  "wait"
LC_DIAG_DYN_LSL_UP_CAT_SYN = 1  &  STATE_CAT_DIAG = "wait"
```

Transition actions:

```
STATE_DYN_DIAG[i] = "wait"
```

B.33.2.4 STATE_DYN_DIAG[i] = "end"

Actions:

none

B.33.3 DYNAMIC DIAGNOSIS MANAGER

This section looks at the state of concurrent diagnoses, it shall not depend on the activation condition of the dynamic diagnosis. There may be two additional monitors that link into the same fault symptom:

	Delay "bad"	Delay "good"	Delay "ongoing"
Dyn "bad"	"bad"	"bad"	"bad"
Dyn "good"	"bad"	"good"	wait for delay
Dyn "ongoing"	"bad"	wait for hom/strat	wait for delay + hom/strat

A delay diagnosis, which looks at some other sensor signal property. If this diagnosis is active, a fault may be determined as soon as either of the diagnoses detect a fault, but a good result is confirmed only by good results of both diagnoses.

	Stratified "bad"	Stratified "good"	Strat. "ongoing"

Continued on next page

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Hom. "bad"	"bad"	"bad"	"bad"
Hom. "good"	"bad"	"good"	"good"
Hom. "ongoing"	"bad"	"good"	wait for at least one of hom/ strat

An alternate dynamic diagnosis for stratified combustion, which evaluates the same properties as the diagnosis described here. If this diagnosis is active, it is just another way to detect good/bad sensor dynamics, so both good and bad sensor dynamics can be confirmed by either of these functions.
On top of this a delay result, as described above, may still be necessary to confirm a good sensor

% Result priority for both fault flag and mode$06 output:
% 1) If dynamic (homogenous or stratified) is bad, set dynamic result, with preference
% for homogenous if both have found a fault at the same time.
% 2) If delay is bad, set delay result.
% 3) If both of delay and at least one of homogenous or stratified dynamic are good,
% set dynamic result. Preference for homogenous, if both dynamic diagnoses
% have finished at this point.

```
LV_CDN_DIAG_DYN_VLD_LS_UP[i] = 0
If(0)     LV_IGK = 1
then
          If(1)    LV_DLY_END_LSL_DIAG[i] 0 - -> 1
          then
```
Scale the provided mode$06 test value such that the limit equals C_FAC_MV_THD_...,
then compare against that threshold to determine fault status. This is done to ensure
consistency with mode$06 and to avoid rounding errors and needs for a new triplet.
```
                 FAC_DLY_DIAG_LSL_TMP[i] = FAC_DLY_DIAG_LSL_OUT[i] *
                 C_FAC_MV_THD_DIAG_DYN_LSL_UP /  C_FAC_DLY_DIAG_LSL_THD
                 If(2)    FAC_DLY_DIAG_LSL_TMP[i] > C_FAC_MV_THD_DIAG_DYN_LSL_UP
                 then     LV_DLY_ERR_LSL_DIAG[i] = 1
                 else(2)  LV_DLY_ERR_LSL_DIAG[i] = 0
                 endif(2)
          Endif(1)

          If(1)    (LV_DIAG_DYN_SYM_LSL_UP[i] = 1 or
                   LV_DIAG_DYN_S_LSL_UP_ERR[i] = 1 ) and
                   LV_ERR_DYN_VLD_LS_UP[i] = 0
          then
```
% No fault yet and dynamic/stratified pair of diagnosis has a fault
```
                 LV_CDN_DIAG_DYN_VLD_LS_UP[i] = 1
                 LV_END_DIAG_DYN_VLD_LS_UP[i] = 1
                 LV_ERR_DYN_VLD_LS_UP[i] = 1
                 ERR_SYM_DYN_VLD_LS_UP[i] = "SYM_1"
          Else(1)
                 If(2)    LV_DLY_ERR_LSL_DIAG[i] = 1 and
                          LV_ERR_DYN_VLD_LS_UP[i] = 0 and
                          LC_DIAG_DYN_LSL_UP_DLY_ACT = 1
                 then
```
No fault yet and delay diagnosis has a fault and is to be included in the result
```
                          LV_CDN_DIAG_DYN_VLD_LS_UP[i] = 1
                          LV_END_DIAG_DYN_VLD_LS_UP[i] = 1
                          LV_ERR_DYN_VLD_LS_UP[i] = 1
                          ERR_SYM_DYN_VLD_LS_UP[i] = "SYM_1"
                 Else(2)
```

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```
If(3)   (LV_DIAG_DYN_END_LSL_UP[i] = 1 or
        LV_DIAG_DYN_S_LSL_UP_END[i] = 1) and
        (LV_DLY_END_LSL_DIAG[i] = 1 or
        LC_DIAG_DYN_LSL_UP_DLY_ACT = 0) and
        LV_END_DIAG_DYN_VLD_LS_UP[i] = 0
then
```

No result yet and both diagnoses have a result (only good cases left)

```
        LV_CDN_DIAG_DYN_VLD_LS_UP[i] = 1
        LV_END_DIAG_DYN_VLD_LS_UP[i] = 1
        LV_ERR_DYN_VLD_LS_UP[i] = 0
        ERR_SYM_DYN_VLD_LS_UP[i] = "NO_SYM"
      Endif(3)
    Endif(2)
Endif(1)

If(1)   (LV_END_DIAG_DYN_VLD_LS_UP[i](n-1) = 0 and
         LV_END_DIAG_DYN_VLD_LS_UP[i](n) = 1) or
        (LV_ERR_DYN_VLD_LS_UP[i](n-1) = 0 and
         LV_ERR_DYN_VLD_LS_UP[i](n) = 1)
then
```

diagnosis just finsihed or just found an error – set or update mode$06

```
    If    LV_DLY_END_LSL_DIAG[i] = 1 and
          LC_DIAG_DYN_LSL_UP_DLY_ACT = 1
    then
```

Delay diagnosis is active and has something – forward into mode$06

```
          FAC_DLY_LSL_UP_DIAG_SAE[i] = FAC_DLY_DIAG_LSL_TMP[i]
          FAC_DLY_LSL_UP_DIAG_TOL_SAE[i] =
                                  C_FAC_MV_THD_DIAG_DYN_LSL_UP
    else
```

Delay diagnosis not complete or not active – remove mode$06 data

```
          FAC_DLY_LSL_UP_DIAG_SAE[i] = 0
          FAC_DLY_LSL_UP_DIAG_TOL_SAE[i] = 0
    endif

If(2)   LV_DIAG_DYN_END_LSL_UP[i] = 1           and
        (LV_DIAG_DYN_S_LSL_UP_ERR[i] = 0 or
         LV_DIAG_DYN_SYM_LSL_UP[i] = 1)
then
```

homogenous dynamic diagnosis has something not conflicting with stratified get appropriate mode$06 from hom. dynamic diagnosis

```
    FAC_DYN_LSL_UP_DIAG_TOL_SAE[i] = C_FAC_MV_THD_DIAG_DYN_LSL_UP
    If(3a)   LV_DIAG_DYN_SYM_LSL_UP[i] = 1
    then
          If(4a)   FAC_MV_DIAG_DYN_LSL_UP[i] >
                   C_FAC_MV_THD_DIAG_DYN_LSL_UP
          then     FAC_DYN_LSL_UP_DIAG_SAE[i] =
                   FAC_MV_DIAG_DYN_LSL_UP[i]
          else(4a) FAC_DYN_LSL_UP_DIAG_SAE[i] =
                   FAC_DIAG_DYN_LSL_UP_ERR[i]
          endif(4a)
    else(3a)
          If(4b)   FAC_MV_DIAG_DYN_LSL_UP[i] <=
                   C_FAC_MV_THD_DIAG_DYN_LSL_UP
          then     FAC_DYN_LSL_UP_DIAG_SAE[i] =
                   FAC_MV_DIAG_DYN_LSL_UP[i]
          else(4b) FAC_DYN_LSL_UP_DIAG_SAE[i] =
                   FAC_DIAG_DYN_LSL_UP_OK[i]
          endif(4b)
    endif(3a)
    else(2)
```

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can't use hom. diagnosis result (because it doesn't exist or is overriden by stratified fault)

```
                If(3b)   LV_DIAG_DYN_S_LSL_UP_END[i] = 1
                then
```

stratified result present – forward it to mode$06 output

```
                      FAC_MV_DIAG_DYN_LSL_UP[i] =
                      IP_FAC_SCA_FAC_MV_DIAG_DYN (FAC_MV_DIAG_DYN_S_LSL_UP)
                      FAC_DYN_LSL_UP_DIAG_SAE[i] = FAC_MV_DIAG_DYN_LSL_UP[i]
                      FAC_DYN_LSL_UP_DIAG_TOL_SAE[i] =
                      IP_FAC_SCA_FAC_MV_DIAG_DYN
                                              (C_FAC_DIAG_DYN_S_LSL_UP_MAX)
                 else(3b)
```

no stratified or homogenous dynamic result – remove mode$06 data

```
                      FAC_DYN_LSL_UP_DIAG_SAE[i] = 0
                      FAC_DYN_LSL_UP_DIAG_TOL_SAE[i] = 0
                 endif(3b)
        endif(2)
        endif(1)
```

Adaptation of sensor time constant:

```
         If(1)    LC_T1_AD_DIAG_DYN_LSL_UP = 1 &
                  LV_DIAG_EOL_DYN_LS_UP[i] = 0 &
                  FAC_DYN_LSL_UP_DIAG_SAE[i] ≥  C_FAC_AD_THD_DIAG_DYN_LSL_UP &
                  LV_CDN_DIAG_DYN_VLD_LS_UP[i] = 1
                                             (current value as set above) &
                  LV_DLY_ERR_LSL_DIAG[i] = 0
         Then(1)
```

update FAC_DIAG_DYN_LSL_UP[i] once if adaptation is enabled, a result is available (as indicated by
the LV_CDN_DIAG flag, which is set once upon completion) and delay is OK.
To be consistent with the physical meaning of this variable, its maximum value shall be less than 1
see Output Table.

```
                  FAC_DIAG_DYN_LSL_UP[i](new)  =
                  FAC_DIAG_DYN_LSL_UP[i](old) + C_CRLC_LPF_FAC_AD_DYN_LSL_UP
                  * (FAC_MV_DIAG_DYN_LSL_UP[i] - FAC_DIAG_DYN_LSL_UP[i](old))
          Else(1)
                  If(2)      FAC_DYN_LSL_UP_DIAG_SAE[i] <
                             C_FAC_AD_RST_DIAG_DYN_LSL_UP
                  Then(2)    FAC_DIAG_DYN_LSL_UP[i](new)= 0
                  Else(2)    FAC_DIAG_DYN_LSL_UP[i]
```

shall retain its value saved in the memory

```
                             FAC_DIAG_DYN_LSL_UP[i](new)  =
                             FAC_DIAG_DYN_LSL_UP[i](old)
                  Endif(2)
         Endif(1)
Endif(0)
```

For failure and error management treatment the anti-bounce mechanism is called :

if LV_ERR_XX=1 then LV_ERR_SET=1 or if LV_ERR_XX=0 then LV_ERR_RST=1

```
ACTION_ERRM_NoFilterSymptom( IN<NC_IDX_DIAG_DYN_VLD_LS_UP[i]>, IN<LV_CDN_DIAG_
DYN_VLD_LS_UP[i]>,  IN< ERR_SYM_DYN_VLD_LS_UP[i] >, IN< LV_ERR_SET_DYN_VLD_
LS_UP[i] >, IN<LV_ERR_RST_DYN_VLD_LS_UP[i]>, IN<LV_END_DIAG_DYN_VLD_LS_UP[i]>,
OUT<LV_ERR_DYN_VLD_LS_UP[i]> )
```

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B.33.4 DIAGNOSIS request coordination

This section shall not fall under the activation conditions but be always active. It coordinates the requests for forced stimulation and lambda control parameters that originate in the delay diagnosis, the dynamic diagnosis and the catalyst diagnosis. Each of these diagnoses may need specific parameters to run, but only one set of parameters may be active at the same time.
This section uses calibrateable bit vectors to determine which diagnosis has priority over another one. Delay and dynamic diagnoses are controlled via enable flags that are set when the diagnosis has requested its parameters and the request coordination has found that these parameters are in effect. Catalyst diagnosis is controlled by an inhibition request.

For every involved diagnosis there is one byte of lock flags, and in this byte there is a pair of bits for each diagnosis. If in C_STATE_PRIO_INH_DIAG_<diag1> the bit <diag2>_ACT (denoted as C_STATE_PRIO_INH_DIAG_<diag1>.<diag2>_ACT) is set, then an FLS request of diagnosis <diag2> locks <diag1>, and if bit <diag2>_END is set, then <diag1> cannot run until <diag2> has completed the parts where a specific FLS is needed. The following structure shall be used for the lock bytes:

Lock flag	Bit value	Meaning
CAT_ACT	2ˆ0 = 1	Inhibit if catalyst diagnosis wants to run
CAT_END	2ˆ1 = 2	Inhibit if catalyst diagnosis is not complete
DYN_ACT	2ˆ2 = 4	Inhibit if dynamic (amplitude) diagnosis wants to run
DYN_END	2ˆ3 = 8	Inhibit if dynamic (amplitude) diagnosis is not complete
DLY_ACT	2ˆ4 = 16	Inhibit if dynamic (effect) diagnosis wants to run
DLY_END	2ˆ5 = 32	Inhibit if dynamic (effect) diagnosis is not complete

The structure shall be the same for all lock bytes even though it doesn't make sense to lock a diagnosis against itself. Bits for the diagnosis itself are ignored. The locking is disabled for EOL mode to give EOL a chance to reorder the diagnosis sequence via inhibit flags from the appl. inc.

If[1a] LV_LS_DIAG_MNG_PRIO_EXT = 0
then
Part 1: helper flags to make the structure of the priority manager more clear and symmetric
For each involved diagnosis there is an indication of the FLS request and of its completion.
All banks existing in the ECU as well as an external request (e.g. from another ECU in a master/slave system) are consulted.

If STATE_CAT_DIAG[i] = "RAMPUP" **or** "CYC_LEAN" **or** "CYC_RICH" for any i
or LV_CAT_DIAG_ACT_EXT = 1
then LV_LS_DIAG_MNG_PRIO_CAT_ACT = 1
else LV_LS_DIAG_MNG_PRIO_CAT_ACT = 0
endif
If STATE_CAT_DIAG[i] = "END" for all i
and LV_CAT_DIAG_END_EXT = 1
then LV_LS_DIAG_MNG_PRIO_CAT_END = 1
else LV_LS_DIAG_MNG_PRIO_CAT_END = 0
endif
If LV_LAMB_PLS_REQ_DYN_LSL_UP[i] = 1 for any i
or LV_DYN_DIAG_ACT_EXT = 1
then LV_LS_DIAG_MNG_PRIO_DYN_ACT = 1
else LV_LS_DIAG_MNG_PRIO_DYN_ACT = 0
endif
If (STATE_DYN_DIAG[i] = "END"
or LV_END_DIAG_DYN_VLD_LS_UP[i] = 1

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or LV_INH_DIAG_DYN_VLD_LS_UP_ERR[i] = 1**)** for all i
and LV_DYN_DIAG_END_EXT = 1
then LV_LS_DIAG_MNG_PRIO_DYN_END = 1
else LV_LS_DIAG_MNG_PRIO_DYN_END = 0
endif
If LV_DLY_DIAG_REQ_LAM_GAIN[i] = 1 for any i
or LV_DLY_DIAG_ACT_EXT = 1
then LV_LS_DIAG_MNG_PRIO_DLY_ACT = 1
else LV_LS_DIAG_MNG_PRIO_DLY_ACT = 0
endif
If **(**LV_DLY_END_LSL_DIAG[i] = 1
or LV_END_DIAG_DYN_VLD_LS_UP[i] = 1
or LV_INH_DIAG_DYN_VLD_LS_UP_ERR[i] = 1**)** for all i
and LV_DLY_DIAG_END_EXT = 1
then LV_LS_DIAG_MNG_PRIO_DLY_END = 1
else LV_LS_DIAG_MNG_PRIO_DLY_END = 0
endif

Part 2: calculate the inhibition out of calibrateable priority rules and (for the EGCP internal diagnoses) the current FLS state.

If ((LV_LS_DIAG_MNG_PRIO_CAT_ACT = 0 **or**
C_STATE_PRIO_INH_DIAG_DLY.CAT_ACT = 0) **and**
(LV_LS_DIAG_MNG_PRIO_DYN_ACT = 0 **or**
C_STATE_PRIO_INH_DIAG_DLY.DYN_ACT = 0) **and**
(LV_LS_DIAG_MNG_PRIO_CAT_END = 1 **or**
C_STATE_PRIO_INH_DIAG_DLY.CAT_END = 0) **and**
(LV_LS_DIAG_MNG_PRIO_DYN_END = 1 **or**
C_STATE_PRIO_INH_DIAG_DLY.DYN_END = 0))
then LV_LS_DIAG_MNG_PRIO_DLY_REQ = LV_LS_DIAG_MNG_PRIO_DLY_ACT
else LV_LS_DIAG_MNG_PRIO_DLY_REQ = 0
endif
If ((LV_LS_DIAG_MNG_PRIO_CAT_ACT = 0 **or**
C_STATE_PRIO_INH_DIAG_DYN.CAT_ACT = 0) **and**
(LV_LS_DIAG_MNG_PRIO_DLY_ACT = 0 **or**
C_STATE_PRIO_INH_DIAG_DYN.DLY_ACT = 0) **and**
(LV_LS_DIAG_MNG_PRIO_CAT_END = 1 **or**
C_STATE_PRIO_INH_DIAG_DYN.CAT_END = 0) **and**
(LV_LS_DIAG_MNG_PRIO_DLY_END = 1 **or**
C_STATE_PRIO_INH_DIAG_DYN.DLY_END = 0))
then LV_LS_DIAG_MNG_PRIO_DYN_REQ = LV_LS_DIAG_MNG_PRIO_DYN_ACT
else LV_LS_DIAG_MNG_PRIO_DYN_REQ = 0
endif
If ((LV_LS_DIAG_MNG_PRIO_DYN_ACT = 0 **or**
C_STATE_PRIO_INH_DIAG_CAT.DYN_ACT = 0) **and**
(LV_LS_DIAG_MNG_PRIO_DLY_ACT = 0 **or**
C_STATE_PRIO_INH_DIAG_CAT.DLY_ACT = 0) **and**
(LV_LS_DIAG_MNG_PRIO_DYN_END = 1 **or**
C_STATE_PRIO_INH_DIAG_CAT.DYN_END = 0) **and**
(LV_LS_DIAG_MNG_PRIO_DLY_END = 1 **or**
C_STATE_PRIO_INH_DIAG_CAT.DLY_END = 0))
then LV_LS_DIAG_REQ_INH_CAT_DIAG = 0
else LV_LS_DIAG_REQ_INH_CAT_DIAG = 1
endif

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Part 3: Calculate the FLS and lambda control requests. Since FLS may be changed or disabled for a variety of reasons, FLS is requested first, and if this request is met, lambda control parameters are requested too.

If^{2a} LV_LS_DIAG_MNG_PRIO_DYN_REQ = 1
then STATE_LAMB_PLS_REQ_LS_DIAG = DYN_DIAG
else^{2a}
If LV_LS_DIAG_MNG_PRIO_DLY_REQ = 1
then STATE_LAMB_PLS_REQ_LS_DIAG = DLY_DIAG
else STATE_LAMB_PLS_REQ_LS_DIAG = NONE
endif
endif^{2a}
else^{1a}
If external priority control is active, just copy the requests
STATE_LAMB_PLS_REQ_LS_DIAG = STATE_LAMB_PLS_REQ_LS_DIAG_EXT
LV_LS_DIAG_REQ_INH_CAT_DIAG = LV_LS_DIAG_REQ_INH_CAT_DIAG_EXT
endif^{1a}

If LV_LAMB_PLS_LS_DIAG = 1
then STATE_LAM_GAIN_REQ_LS_DIAG = STATE_LAMB_PLS_REQ_LS_DIAG
else STATE_LAM_GAIN_REQ_LS_DIAG = NONE
endif
If LV_LAMB_PLS_LS_DIAG = 1
and STATE_LAMB_PLS_REQ_LS_DIAG = DLY_DIAG
and LV_LAM_GAIN_LS_DIAG = 1
and STATE_LAM_GAIN_REQ_LS_DIAG = DLY_DIAG
then LV_DLY_DIAG_ACT_LAM_GAIN = 1
else LV_DLY_DIAG_ACT_LAM_GAIN = 0
endif
If LV_LAMB_PLS_LS_DIAG = 1
and STATE_LAMB_PLS_REQ_LS_DIAG = DYN_DIAG
and LV_LAM_GAIN_LS_DIAG = 1
and STATE_LAM_GAIN_REQ_LS_DIAG = DYN_DIAG
then LV_DIAG_DYN_LSL_UP_ENA = 1
else LV_DIAG_DYN_LSL_UP_ENA = 0
endif

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B.34 O2 sensor (lin, up) dynamic diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CAT_DIAG_ACT_EXT	O	0... 1H	0 ...1	1	-
Summarized catalyst diag activation flag					
LV_CAT_DIAG_END_EXT	O	0... 1H	0 ...1	1	-
Summarized catalyst diag end flag					
LV_DIAG_DYN_INH_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "Diagnosis of the WRAF Sensor Dynamic"					
LV_DIAG_EOL_DYN_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Status variable to activate the short test trip at the end of line					
LV_DIAG_EOL_DYN_LS_UP_DC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Logical Value as reminder for End of Line test within this driving cycle					
LV_DLY_DIAG_ACT_EXT	O	0... 1H	0 ...1	1	-
Summarized dynamic (effect) diag activation flag					
LV_DLY_DIAG_END_EXT	O	0... 1H	0 ...1	1	-
Summarized dynamic (effect) diag end flag					
LV_DYN_DIAG_ACT_EXT	O	0... 1H	0 ...1	1	-
Summarized dynamic (amplitude) diag activation flag					
LV_DYN_DIAG_END_EXT	O	0... 1H	0 ...1	1	-
Summarized dynamic (amplitude) diag end flag					
LV_INH_DIAG_DYN_VLD_LS_UP_ERR [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "Diagnosis of WRAF Sensor Dynamic" by malfunction					
LV_INH_DIAG_LS_UP_DYN_CP	O/V	0... 1H	0 ...1	1	-
Canister Purge Load too high					
LV_INH_DIAG_RBM_DYN_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of Rate Based Monitoring of "Diagnosis of WRAF Sensor Dynamic" by malfunction					
LV_INH_SENS_DLY_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition flag for sensor delay diagnosis					
LV_LS_DIAG_MNG_PRIO_EXT	O	0... 1H	0 ...1	1	-
Activation of exteral diagnosis priority manager override					
LV_LS_DIAG_REQ_INH_CAT_DIAG_EXT	O	0... 1H	0 ...1	1	-
External request from diagnosis priority manager to deactivate catalyst diagnosis					
STATE_LAMB_PLS_REQ_LS_DIAG_EXT	O	0H 1H 2H	NONE DYN_DIAG DLY_DIAG	-	-
External request for forced lambda stimulation for lambda sensor diagnoses					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_RBM_DYN_VLD_LS_UP [NC_CBK_EX_NR]	O/V	0... 7H	0 ...7	1	-
Interface of DYN_VLD_LS_UP					

Input data:

CL_MMV {p. 3698}	CTR_ERR_DYN_NR {p. 5767}	LC_DIAG_PUE_ACT_LS_ DOWN {p. 5191}	LV_CDN_VB_OBD2 {p. 1185}
LV_CL_CLC_AVL {p. 3635}	LV_DC {p. 5746}	LV_DIAG_DYN_END_LSL_ UP [NC_CBK_EX_NR] {p. 5348}	LV_END_DIAG_DYN_ VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}
LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CST_IVVT_ EX [NC_NR_CBK_IVVT] {p. 1061}
LV_ERR_CAM_CST_IVVT_ IN [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CHG_LS_DOWN {p. 5388}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5388}
LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_ PER {p. 4432}
LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FTL_MIN {p. 4762}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}
LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}
LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}
LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}
LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}
LV_ERR_OBD_LSH_ DOWN [NC_CBK_EX_NR] {p. 5198}	LV_ERR_OBD_VLD_LSH_ UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}

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LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}
LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}
LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}
LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5152}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}
LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}
LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}
LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}
LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_ERR_VS {p. 5021}	LV_ERR_VS_PLAUS {p. 5021}
LV_IGK {p. 906}	LV_INH_DLY_DIAG_PRI_MNG [NC_CBK_EX_NR] {p. 803}	LV_INH_DYN_DIAG_PRI_MNG [NC_CBK_EX_NR] {p. 803}	LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}
NC_CBK_EX_NR {p. 1829}	NC_NR_CBK_IVVT {p. 604}	STATE_CP {p. 3637}	TCO {p. 1100}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MMV_LS_UP_DIAG_MAX	V	0... FFFFH	0... 1.9999694824218	30.5175e-6	-
Maximum degree of saturation of the evaporative canister to activate the function					
C_TCO_MIN_DIAG_DYN_LSL_UP	V	0... FEH	-48... 142.5	0.75	°C
Min TCO threshold to enable upstream O2 sensor Dynamic Diag if performed unsync. to cat diag					
LC_DIAG_DYN_CP_ENA	V	0... 1H	0 ...1	1	-
Enable dynamic diagnosis even if canister pruge could be critical					

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

General information

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1

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i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.
i = 1, for single exhaust cylinder bank.

B.34.1 No title given

General information:

Application conditions:

Initialisation:
```
at every transition LV_IGK = 0->1or reset all variables shall
be reset to 0.
at every transition LV_IGK = 1->0 LV_DIAG_DYN_INH_LSL_UP[i]
= 1
Following outputs shall be equal to the given values at all
times:
LV_CAT_DIAG_ACT_EXT = 0
LV_CAT_DIAG_END_EXT = 1
LV_DYN_DIAG_ACT_EXT = 0
LV_DYN_DIAG_END_EXT = 1
LV_DLY_DIAG_ACT_EXT = 0
LV_DLY_DIAG_END_EXT = 1
LV_LS_DIAG_MNG_PRIO_EXT = 0
STATE_LAMB_PLS_REQ_LS_DIAG_EXT  = NONE
LV_LS_DIAG_REQ_INH_CAT_DIAG_EXT = 0
```

Activation: `LV_IGK = 1`

Deactivation: `LV_IGK = 0`

Recurrence: `the functions shall be carried out once every 1s.`

Function description:

Formula section:

The function “Diagnosis of the WRAF Sensor Dynamic” has to be deactivated, if at least one of the following errors is active.

```
IF    LV_ERR_AMP = 1                 OR
      LV_ERR_AMP_PLAUS = 1           OR
      LV_ERR_CHG_LS_DOWN = 1         OR
      LV_ERR_CHG_LS_UP = 1           OR
      LV_ERR_CRK_PLAUS = 1           OR
      LV_ERR_CRK_SYN = 1             OR
      LV_ERR_CRK_TOOTH = 1           OR
      LV_ERR_CRK_TOOTH_PER = 1       OR
      LV_ERR_DIAGCPS = 1             OR
      LV_ERR_EL_CPS = 1              OR
      LV_ERR_FTL_MIN = 1             OR
      LV_ERR_FUP = 1                 OR
```

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```
LV_ERR_FUP_MFP_PLAUS = 1                                     OR
LV_ERR_FUP_ORNG = 1                                          OR
LV_ERR_FUP_ST = 1                                            OR
LV_ERR_H_PRS_SYS = 1                                         OR
LV_ERR_IVVT = 1                                              OR
LV_ERR_LOAD_TPS_PLAUS = 1                                    OR
LV_ERR_MAF = 1                                               OR
LV_ERR_MAP_PLAUS = 1                                         OR
LV_ERR_MAP_TPS_PLAUS = 1                                     OR
LV_ERR_MTC_CTL_2 = 1                                         OR
LV_ERR_MTC_CTL_3 = 1                                         OR
LV_ERR_MTC_DR = 1                                            OR
LV_ERR_TPS = 1                                               OR
LV_ERR_VCV = 1                                               OR
LV_ERR_VS= 1                                                 OR
LV_ERR_VS_PLAUS= 1                                           OR
LV_ERR_AIR_LSL_UP[i]  = 1                                    OR
LV_ERR_CHK_LS_DOWN[i] = 1                                    OR
LV_ERR_CTL_LSL_UP[i] = 1                                     OR
LV_ERR_DELTA_I_LAM = 1                                       OR
LV_ERR_EL_LSL_UP[i] = 1                                      OR
LV_ERR_FSD[i] = 1                                            OR
LV_ERR_FSD_LAM_LIM[i] = 1                                    OR
LV_ERR_LSH_DOWN[i] = 1                                       OR
LV_ERR_LSH_UP[i] = 1                                         OR
LV_ERR_LSL_UP_IF[i] = 1                                      OR
LV_ERR_OBD_LSH_DOWN[i] = 1                                   OR
LV_ERR_OBD_VLD_LSH_UP[i] = 1                                 OR
LV_ERR_OC_LS_DOWN[i] = 1                                     OR
LV_ERR_OC_LSL_UP[i] = 1                                      OR
LV_ERR_OFS_LSL_UP[i] = 1                                     OR
LV_ERR_PUC_LS_DOWN[i] = 1                                    OR
LV_ERR_PUC_VLD_LS_UP[i] = 1                                  OR
[LV_ERR_PUE_LS_DOWN[i]   = 1                                 AND
LC_DIAG_PUE_ACT_LS_DOWN = 1 ]                                OR
LV_ERR_SCG_LS_DOWN[i] = 1                                    OR
LV_ERR_SCP_LS_DOWN[i] = 1                                    OR
LV_ERR_SHIFT_AFL_LSL_UP[i] = 1                               OR
LV_ERR_SHIFT_AFR_LSL_UP[i] = 1                               OR
LV_ERR_SWT_LS_DOWN[i] = 1                                    OR
LV_ERR_TTIP_MES_LSH_UP[i] = 1                                OR
LV_ERR_VLS_DOWN_DIF[i] = 1                                   OR
(i = 1                                                       AND
 [LV_ERR_IV[0]                                               OR
  LV_ERR_IV[2]                                               OR
  LV_ERR_IV[4]                                               OR
  LV_ERR_MIS[0]                                              OR
  LV_ERR_MIS[2]                                              OR
  LV_ERR_MIS[4]])                                            OR
(i = 2                                                       AND
 [LV_ERR_IV[1]                                               OR
  LV_ERR_IV[3]                                               OR
  LV_ERR_IV[5]                                               OR
  LV_ERR_MIS[1]                                              OR
  LV_ERR_MIS[3]                                              OR
  LV_ERR_MIS[5]])                                            OR
LV_ERR_PER_CAM_EX[k] = 1           any k for i=1, 2          OR
LV_ERR_PER_CAM_IN[k] = 1           any k for i=1, 2          OR
LV_ERR_PLAUS_CAM_EX[k] = 1         any k for i=1, 2          OR
LV_ERR_PLAUS_CAM_IN[k] = 1         any k for i=1, 2          OR
LV_ERR_REF_CRK_CAM_EX[k] = 1       any k for i=1, 2          OR
```

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```
            LV_ERR_REF_CRK_CAM_IN[k] = 1       any k for i=1, 2      OR
            LV_ERR_SYN_CAM_EX[k] = 1           any k for i=1, 2      OR
            LV_ERR_SYN_CAM_IN[k] = 1           any k for i=1, 2      OR
            LV_ERR_SYN_CRK_CAM_IN[k] = 1       any k for i=1, 2      OR
            LV_ERR_TOOTH_OFF_IN[k] =1          any k for i=1, 2      OR
            LV_ERR_TOOTH_OFF_EX[k] =1          any k for i=1, 2

THEN        LV_INH_DIAG_RBM_DYN_VLD_LS_UP[i] = 1
            LV_INH_DIAG_DYN_VLD_LS_UP_ERR[i] = 1
ELSE        LV_INH_DIAG_RBM_DYN_VLD_LS_UP[i] = 0
            LV_INH_DIAG_DYN_VLD_LS_UP_ERR[i] = 0
ENDIF
```

% Monitoring Canister Purge

```
IF      LV_DIAG_EOL_DYN_LS_UP[i] = 0
THEN
        % short test not required
        IF     LC_DIAG_DYN_CP_ENA = 1         OR
               STATE_CP = NO_PURGE            OR
               STATE_CP = CP_NOT_ACT          OR
               STATE_CP = WAIT_RAMP_OPEN      OR
               (STATE_CP = MIN_PURGE &  LV_CL_CLC_AVL   = 1)       OR
               (STATE_CP = MAX_PURGE &   CL_MMV ≤ C_CL_MMV_LS_UP_DIAG_MAX)
        THEN        LV_INH_DIAG_LS_UP_DYN_CP   =  0
        ELSE        LV_INH_DIAG_LS_UP_DYN_CP   =  1
        ENDIF
ELSE
        % short test required
        IF    (STATE_CP = MAX_PURGE) &   (CL_MMV ≤ C_CL_MMV_LS_UP_DIAG_MAX)) OR
               STATE_CP = NO_PURGE
        THEN       LV_INH_DIAG_LS_UP_DYN_CP   =  0
        ELSE       LV_INH_DIAG_LS_UP_DYN_CP   =  1
        ENDIF
ENDIF
```

The functions “Diagnosis of the WRAF Sensor Dynamic” and "Delay Diag "have to be deactivated, if at least one of the special modes is active.

```
IF     LV_LS_UP_OBD_2_MAN_DEAC[i]   = 1       OR
       LV_CDN_VB_OBD2 = 0                     OR
       LV_INH_DIAG_RBM_DYN_VLD_LS_UP[i] = 1   OR
       LV_INH_DIAG_LS_UP_DYN_CP = 1
THEN

      // do not active diags
       LV_DIAG_DYN_INH_LSL_UP[i]   =  1
       LV_INH_SENS_DLY_DIAG[i] = 1
ELSE
       IF      (TCO < C_TCO_MIN_DIAG_DYN_LSL_UP)   OR
               LV_DIAG_DYN_END_LSL_UP[i] = 1       OR
               LV_INH_DYN_DIAG_PRI_MNG[i] = 1
       THEN      LV_DIAG_DYN_INH_LSL_UP[i]= 1
       ELSE      LV_DIAG_DYN_INH_LSL_UP[i]= 0
       ENDIF

       IF      LV_END_DIAG_DYN_VLD_LS_UP[i] = 1    OR
               LV_INH_DLY_DIAG_PRI_MNG[i] = 1
       THEN      LV_INH_SENS_DLY_DIAG[i] = 1
       ELSE      LV_INH_SENS_DLY_DIAG[i] = 0
       ENDIF
ENDIF
```

B.34.2 Interface for Rate – Based - Monitoring

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General information:

With this module the interface between the DYN_VLD_LS_UP[i] monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_DYN_VLD_LS_UP[i] data.
Within STATE_RBM_DYN_VLD_LS_UP[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0) (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1) (depending on failure status: pending)
- Monitor individual RBM conditions encountered within this DC (bit 2) (not valid for catalyst diagnosis)

Application conditions:

Initialisation:

```
at ECU reset:
        bit 0, bit 1 and bit 2 of STATE_RBM_DYN_VLD_LS_UP[i]
= 0
        LV_DIAG_EOL_DYN_LS_UP_DC[i] = 0
LV_DC 0 ->1 transition:
        bit 0 and bit 1 of STATE_RBM_DYN_VLD_LS_UP[i] = 0
        LV_DIAG_EOL_DYN_LS_UP_DC[i] = 0
on failure memory reset:
        bit 1 of STATE_RBM_STATE_RBM_DYN_VLD_LS_UP[i] = 0
        LV_DIAG_EOL_DYN_LS_UP_DC[i] = 0
```

Activation: `LV_DC = 1`

Deactivation: `-`

Recurrence: `1 s`

Function description:

Formula section:

At LV_DC 0 ->1 transition

`bit 2 of STATE_RBM_DYN_VLD_LS_UP[i] = 1`

The pending status of the following failures has to be checked only once :

Dependence	Error			
	LV_ERR_AMP	LV_ERR_AMP_PLAUS	LV_ERR_CHG_LS_DOWN	LV_ERR_CHG_LS_UP
	LV_ERR_CRK_PLAUS	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH	LV_ERR_CRK_TOOTH_PER
	LV_ERR_DIAGCPS	LV_ERR_EL_CPS	LV_ERR_FTL_MIN	LV_ERR_FUP

Continued on next page

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	LV_ERR_FUP_MFP_PLAUS	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS
	LV_ERR_LOAD_TPS_PLAUS	LV_ERR_MAF_FRQ_EL	LV_ERR_MAF_FRQ_GRD	LV_ERR_MAF_FRQ_RNG
	LV_ERR_MAP_PLAUS	LV_ERR_MAP_TPS_PLAUS	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3
	LV_ERR_MTC_DR	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD
	LV_ERR_TPS_AD_BOL	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATIO
	LV_ERR_TPS_ST_CHK_2	LV_ERR_VCV	LV_ERR_VS	LV_ERR_VS_PLAUS
NC_CBK_EX_NR	LV_ERR_AIR_LSL_UP[i]	LV_ERR_CHK_LS_DOWN[i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DELTA_I_LAM[i]
	LV_ERR_EL_LSL_UP[i]	LV_ERR_FSD[i]	LV_ERR_FSD_LAM_LIM[i]	LV_ERR_LSH_DOWN[i]
	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]	LV_ERR_OBD_LSH_DOWN[i]	LV_ERR_OBD_VLD_LSH_UP[i]
	LV_ERR_OC_LS_DOWN[i]	LV_ERR_OC_LSL_UP[i]	LV_ERR_OFS_LSL_UP[i]	LV_ERR_PUC_LS_DOWN[i]
	LV_ERR_PUC_VLD_LS_UP[i]	LV_ERR_PUE_LS_DOWN[i]	LV_ERR_SCG_LS_DOWN[i]	LV_ERR_SCP_LS_DOWN[i]
	LV_ERR_SHIFT_AFL_LSL_UP[i]	LV_ERR_SHIFT_AFR_LSL_UP[i]	LV_ERR_SWT_LS_DOWN[i]	LV_ERR_TTIP_MES_LSH_UP[i]
	LV_ERR_VLS_DOWN_DIF[i]			

For k = 1 to NC_NR_CAM_CBK (= for any i // or)

NC_NR_CAM_CBK	LV_ERR_PER_CAM_EX[k]	LV_ERR_PER_CAM_IN[k]	LV_ERR_PLAUS_CAM_EX[k]	LV_ERR_PLAUS_CAM_IN[k]
	LV_ERR_REF_CRK_CAM_EX[k]	LV_ERR_REF_CRK_CAM_IN[k]	LV_ERR_SYN_CAM_EX[k]	LV_ERR_SYN_CAM_IN[k]
	LV_ERR_SYN_CRK_CAM_IN[k]	LV_ERR_TOOTH_OFF_IN[k]	LV_ERR_TOOTH_OFF_EX[k]	

For x = 1 to NC_NR_CBK_IVVT (= for any i // or)

NC_NR_CBK_IVVT	LV_ERR_CAM_CST_IVVT_EX[x]	LV_ERR_CAM_CST_IVVT_IN[x]	LV_ERR_MEC_IVVT_EX[x]	LV_ERR_MEC_IVVT_IN[x]
	LV_ERR_SLV_IVVT_EX[x]	LV_ERR_SLV_IVVT_IN[x]		

For NC_CBK_EX_NR = i = 1

NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

For NC_CBK_EX_NR = i = 2

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NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

```
If(1)
        { CPU optimization at LV_DC 0 ->1 transition }
        CTR_ERR_DYN_NR <> 0
                          { the dynamic failure memory isn't empty }

Then(1)
        While  bit 1 of STATE_RBM_DYN_VLD_LS_UP[i] = 0 do
                with each XX failure of the above list (depending on configuration, see below) except
                LV_ERR_PUE_LS_DOWN:
                ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>,
                SYNCHRONIZATION<CALL>)

                If(2)
                        XX has a pending status
                Then(2)   bit 1 of STATE_RBM_DYN_VLD_LS_UP[i] = 1
                Endif(2)

                For LV_ERR_PUE_LS_DOWN[i], do the following instead:
                If     LC_DIAG_PUE_ACT_LS_DOWN = 1
                then
                        ACTION_ERRM_CheckPendingStatus(IN<XX>,
                        OUT<PendingStatus>, SYNCHRONIZATION<CALL>)

                        If(3)
                                XX has a pending status
                        Then(3)   bit 1 of STATE_RBM_DYN_VLD_LS_UP[i] = 1
                         Endif(3)
                 Endif
        Endwhile
Else(1)
          { the dynamic failure memory is empty } No action
Endif(1)
```

Every 1 s :

```
If          LV_DIAG_EOL_DYN_LS_UP[i] = 1
Then        LV_DIAG_EOL_DYN_LS_UP_DC[i] = 1
Endif

If       bit 0 of STATE_RBM_ DYN_VLD_LS_UP[i] = 0
Then
            If     LV_END_DIAG_DYN_VLD_LS_UP[i] = 1      And
                   LV_DIAG_EOL_DYN_LS_UP_DC[i] = 0
            Then     bit 0 of STATE_RBM_DYN_VLD_LS_UP[i] = 1
            Endif
Endif

If       bit 1 of STATE_RBM_DYN_VLD_LS_UP[i] = 0
Then
            If     LV_INH_DIAG_RBM_DYN_VLD_LS_UP[i] = 1
            Then     bit 1 of STATE_RBM_DYN_VLD_LS_UP[i] = 1
            Endif
Endif
```

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B.34.3 Activation of short trip for WRAF sensor dynamic diagnosis

General information:

Not yet defined

Application conditions:

Initialisation: `LV_DIAG_EOL_DYN_LS_UP[NC_CBK_EX_NR] = 0` *(never changed)*

Activation: –

Deactivation: –

Recurrence: –

Function description:

Formula section:

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B.35 O2 sensor open loop diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_AFL_CHK_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Debounce counter for the lean test					
CTR_AFR_CHK_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Debounce counter for the rich test					
CTR_SUM_RST_AFL_CHK_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Reset counter for the rich active test					
CTR_SUM_RST_AFR_CHK_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Reset counter for the rich active test					
ERR_SYM_CHG_LS_DOWN	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for downstream lambda sensors interchanged					
ERR_SYM_CHK_LS_DOWN [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom in the downstream sensor					
LAMB_SP_BEG_DIAG_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Inicial value of lambda set point					
LAMB_SP_DELTA_LS_UP_DOWN [NC_CBK_EX_NR]	V	8000... 7FFFH	-32... 31.99902	976.599e-6	-
Increment of of lambda set point					
LAMB_SP_DIAG_OPL_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
lambda setpoint requested by open-loop test for upstream and downstream lambda sensors					
LV_CDN_DIAG_CHG_LS_DOWN	V	0... 1H	0 ...1	1	-
Condition to run the diagnosis are fullfiled					
LV_CDN_DIAG_CHK_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Conditions to run active test of downstream sensor fulfilled					
LV_DIAG_ACT_CDN_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Conditions to perform rich/lean check of open loop diag are fulfilled - not relevant for soft check					
LV_DIAG_ACT_CHK_CDN_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Conditions to run active test of upstream sensor fulfilled					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_ACT_CHK_END_LSL_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
End active test of upstream sensor					
LV_DIAG_ACT_END_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag, end of active check of the oxygen sensors					
LV_DIAG_AFL_CDN_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the condition to execute LEAN active check are met					
LV_DIAG_AFL_CHK_SYM_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced failure in the upstream sensor during the LEAN active check					
LV_DIAG_AFL_END_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the end of LEAN active check					
LV_DIAG_AFR_CDN_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the condition to execute RICH active check are met					
LV_DIAG_AFR_CHK_SYM_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced failure in the upstream sensor during the RICH active check					
LV_DIAG_AFR_END_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the end of RICH active check					
LV_DIAG_CYC_END_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of cycle of active test of downstream sensor					
LV_DIAG_EOL_DC_LS_UP_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag indicating eol test was active in this driving cycle.					
LV_DIAG_EOL_END_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag, end of active check of the oxygen sensors (EOL test)					
LV_END_DIAG_CHG_LS_DOWN	V	0... 1H	0 ...1	1	-
End of downstream oxygen sensors interchanged test					
LV_END_DIAG_CHK_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End active test of downstream sensor					
LV_ERR_CHG_LS_DOWN	O/V	0... 1H	0 ...1	1	-
Debounced failure of downstream lambda sensors interchanged					
LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced failure in the downstream sensor					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_DI_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request disable close loop operation of the lambda controller					
LV_LAMB_SP_AFL_REQ_DIAG_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Trigger function to change lambda set point for AFL active plausibility test					
LV_LAMB_SP_AFR_REQ_DIAG_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Trigger function to change lambda set point for AFR active plausibility test					
LV_SYM_AFL_CHK_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Symptom of oxygen sensor downstream too lean in case of 2 bank system during end of line test or sensor interchanged test					
LV_SYM_AFR_CHK_LS_DOWN [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Symptom of oxygen sensor downstream too rich in case of 2 bank system during end of line test or sensor interchanged test					
MAF_INT_DIAG_LS_UP_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666	0.0277778	g
integral of air mass flow while check is active					
STATE_DIAG_ACT_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H undef:1H	PASSIVE RICH_CHECK LEAN_CHECK CHECK_ FINISHED	-	-
State of check of downstream oxygen sensor signal for lambda sensor error manager					
T_AFL_CHK_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Debounce counter for the lean test					
T_AFR_CHK_LS_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Debounce counter for the rich test					
T_DIAG_ACT_AFL_LS_UP_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for plausibility test under lean AF conditions					
T_DIAG_ACT_AFR_LS_UP_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for plausibility test under rich AF conditions					
T_END_DIAG_ACT_LS_DOWN	V	0... FFFFH	0... 6553.5	0.1	s
Timer for the end of the downstream sensor active test in the no failure case					

Input data:

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_DIAG_ACT_INH_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5407}	LV_DIAG_AFR_AFL_INH_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5407}
LV_DIAG_EOL_REQ_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5407}	LV_DIAG_OPL_REQ_CBK [NC_CBK_EX_NR] {p. 5407}	LV_END_DIAG_LAM_ADJ [NC_CBK_EX_NR] {p. 5215}	LV_IGK {p. 906}
LV_INH_DIAG_CHG_LS_DOWN {p. 5407}	LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_ST_END {p. 1720}	MAF_CYL {p. 8277}

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NC_CBK_EX_NR {p. 1829}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_CHK_LSL_UP	-	0... FFH	0... 255	1	-
Increment for debounce algorithmus					
C_ABC_MAX_CHK_LSL_UP	-	0... FFFFH	0... 65535	1	-
Maximum value for debounce algorithmus					
C_CTR_SUM_RST_AFL_CHK_LSL_UP	-	0... FFFFH	0... 65535	1	-
Reset debounce counter for Lean test					
C_CTR_SUM_RST_AFR_CHK_LSL_UP	-	0... FFFFH	0... 65535	1	-
Reset debounce counter for Richt test					
C_LAMB_AFL_MAX_DIAG_LS_UP_DOWN	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Max. lambda set point for lean fault detection					
C_LAMB_AFL_MIN_DIAG_LS_UP_DOWN	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Min. lambda set point for lean fault detection					
C_LAMB_AFL_THD_DIAG_ACT_LSL_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda value threshold for lean fault detection (upstream sensor)					
C_LAMB_AFR_MAX_DIAG_LS_UP_DOWN	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Max. lambda set point for rich fault detection					
C_LAMB_AFR_MIN_DIAG_LS_UP_DOWN	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Min. lambda set point for rich fault detection					
C_LAMB_AFR_THD_DIAG_ACT_LSL_UP	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda value threshold for rich fault detection (upstream sensor)					
C_LAMB_SP_AFL_DIAG_LS_UP_DOWN	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda set point for lean fault detection					
C_LAMB_SP_AFR_DIAG_LS_UP_DOWN	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda set point for rich fault detection					
C_LAMB_SP_STEP_DIAG_LS_UP_DOWN	-	1... FFH	1... 255	1	-
Number of recurrences to achieve the desired lambda set point					
C_MAF_INT_DIAG_LS_UP_DOWN [NC_CBK_EX_NR]	-	0... FFFFH	0... 1820.41666	0.0277778	g
Minimum threshold for MAF integral required to start active test					
C_MAF_INT_EOL_DIAG_LS_UP_DOWN [NC_CBK_EX_NR]	-	0... FFFFH	0... 1820.41666	0.0277778	g
Initialization of MAF integral to reduce required minimum MAF value to start active test					
C_T_DIAG_EOL_LS_UP_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Initialization of timer in case EOL to reduce the required minimum activity test time					
C_T_END_DIAG_ACT_LS_DOWN [NC_CBK_EX_NR]	-	0... FFFFH	0... 6553.5	0.1	s
Timer threshold for the end of the downstream sensor active test in the no failure case					
C_T_MAX_CHK_LS_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Time to debounce the error					
C_T_MAX_DIAG_AFL_LS_UP_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Timer threshold for plausibility test under lean AF conditions					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MAX_DIAG_AFR_LS_UP_DOWN	-	0... FFFFH	0... 6553.5	0.1	s
Timer threshold for plausibility test under rich AF conditions					
C_VLS_AFL_THD_DIAG_ACT_LS_DOWN [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511	4.8828e-3	V
VLS voltage threshold for lean fault detection (downstream sensor)					
C_VLS_AFR_THD_DIAG_ACT_LS_DOWN [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511	4.8828e-3	V
VLS voltage threshold for rich fault detection (downstream sensor)					
LC_DIAG_AUTH_CHK_LS_UP_DOWN	-	0... 1H	0 ...1	1	-
Boolean switch allowing the active test					

B.35.1 State machine

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Due to possible oxygen sensor defects (e.g. reference air poisoning) or faults in the injection system (e.g. leaking fuel injector), the oxygen sensors may not provide the expected lean or rich AF signal level during definite conditions (lean or rich). Hence, the oxygen sensor signals shall be checked for plausibility during this engine operating states. The handling is requested and results are utilized by a separate manager for oxygen sensors error.

Description:

If the following conditions are met, then the conditions for plausibility check at lean conditions are determined to be present:

1. The Fuel Trim Diagnosis has detected an error (transmitted by LV_DIAG_OPL_REQ_CBK[1]).

B. No general inhibition observed (LV_DIAG_ACT_INH_LS_UP_DOWN[i]) and no specific inihibition exists (LV_DIAG_AFR_AFL_INH_LS_UP_DOWN[i]= 0).
C. The lean state shall be determined to be stable, as determined by comparing the mass air flow integral calculated after activation (MAF_INT_DIAG_LS_UP_DOWN[i]) with the threshold range (C_MAF_INT_DIAG_LS_UP_DOWN[i]).
D. The lean condition will be maintained until a timer is elapsed or an error was found on the upstream sensor or in case of a 1 bank system also on the downstream sensor.

The rich check follows always the lean test. The procedure is analogous to the lean check.

In case of a two bank system and finished open loop test on bank 1 and if there was no upstream linear lambda sensor fault detected, the bank 2 will be checked (triggered by LV_DIAG_OPL_REQ_CBK[2] which is set in application incidences).

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In case an EOL test the timers shall be initialized with a non-zero calibrateable value to reduce the minimum required time. The same is valid for the initialization of the MAF integral.

Application conditions

Initialisation:

At LV_IGK = 0 to 1, by reset, by clearing error memory or by triggering the EOL test (LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 0 -> 1; while LV_DIAG_ACT_END_LS_UP_DOWN[i] = 0) initialise the variables as follows:
STATE_DIAG_ACT_LS_UP_DOWN[i] = 0
MAF_INT_DIAG_LS_UP_DOWN[i] = 0
LV_DIAG_ACT_END_LS_UP_DOWN[i] = 0
LV_DIAG_EOL_END_LS_UP_DOWN[i] = 0
LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 0
LV_DIAG_AFR_END_LS_UP_DOWN[i] = 0
LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 0
LV_DIAG_AFL_END_LS_UP_DOWN[i] = 0
LAMB_SP_BEG_DIAG_LS_UP_DOWN[i] = 1
LV_LAMB_SP_AFR_REQ_DIAG_ACT[i] = 0
LV_LAMB_SP_AFL_REQ_DIAG_ACT[i] = 0
T_DIAG_ACT_AFR_LS_UP_DOWN[i] = 0
T_DIAG_ACT_AFL_LS_UP_DOWN[i] = 0
LV_LAM_DI_REQ[i] = 0

Recurrence: *T_SAMPLE* = 100ms

Note:

The functions contained in this module shall be carried out according the following sequence:

1. *active test upstream sensor*
2. *active test downstream sensor*
3. *state machine*

Activation:
LV_ST_END = 1

B.35.1.1 Sequence for check of signal plausibility monitoring (state machine)

The state machine shall remain in its current state and carry out the actions specified to occur within that state once per recurrence unless otherwise specified. The state machine shall only move to another state when one of the conditions has been determined to be met.
The priority of the conditions to change between states shall be defined by the order in which these conditions are listed within the appropiate state as described below.

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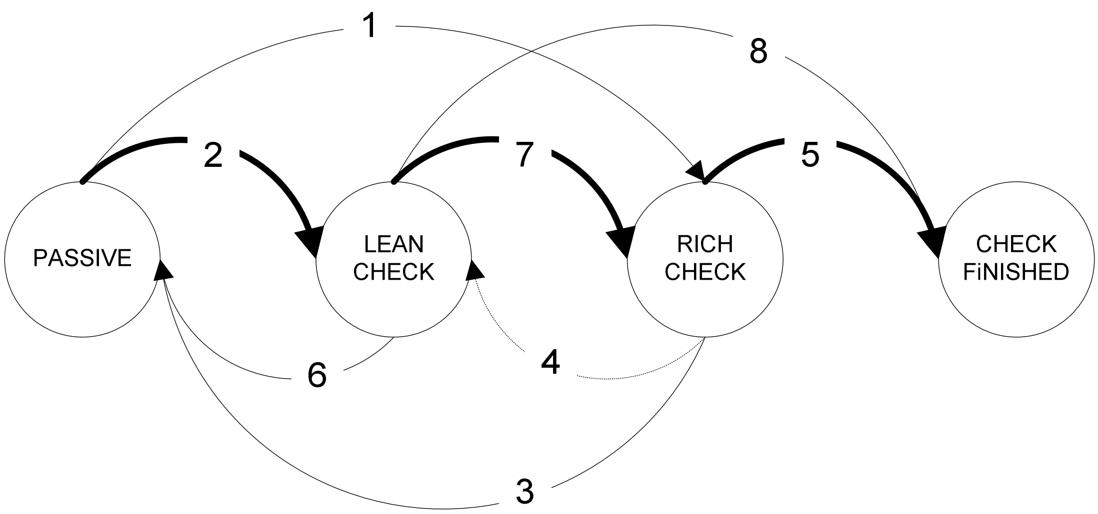

STATE machine diagram:

If LV_DIAG_ACT_INH_LS_UP_DOWN[i] = 0
and LV_DIAG_ACT_END_LS_UP_DOWN[i] = 0
and [(LV_DIAG_OPL_REQ_CBK[i] = 1 & LC_DIAG_AUTH_CHK_LS_UP_DOWN = 1) **or**
LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1 **]**
then
LV_DIAG_ACT_CDN_LS_UP_DOWN[i] = 1
else
LV_DIAG_ACT_CDN_LS_UP_DOWN[i] = 0
endif

B.35.1.2 State "PASSIVE"

Actions:
none

Condition 1: Transition to state "RICH CHECK"
If LV_DIAG_AFR_AFL_INH_LS_UP_DOWN[i] = 0
and LV_DIAG_AFR_END_LS_UP_DOWN[i] = 0
and LV_DIAG_AFL_END_LS_UP_DOWN[i] = 1
and LV_DIAG_ACT_CDN_LS_UP_DOWN[i] = 1
then
STATE_DIAG_ACT_LS_UP_DOWN[i] = "RICH CHECK"
LAMB_SP_BEG_DIAG_LS_UP_DOWN[i] = LAMB_SP[i]
LV_LAMB_SP_AFR_REQ_DIAG_ACT[i] = 1
LV_LAM_DI_REQ[i] = 1
If LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
Then
MAF_INT_DIAG_LS_UP_DOWN[i] = C_MAF_INT_EOL_DIAG_LS_UP_DOWN[i]
T_DIAG_ACT_AFL_LS_UP_DOWN[i] = C_T_DIAG_EOL_LS_UP_DOWN
Else
T_DIAG_ACT_AFL_LS_UP_DOWN[i] = 0
MAF_INT_DIAG_LS_UP_DOWN[i] = 0

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endif
endif

Condition 2: Transition to state "LEAN CHECK"
If LV_DIAG_AFR_AFL_INH_LS_UP_DOWN[i] = 0
and LV_DIAG_AFL_END_LS_UP_DOWN[i] = 0
and **(** LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1 **or**
LV_DIAG_OPL_REQ_CBK[i] = 1 **)**
and LV_DIAG_ACT_CDN_LS_UP_DOWN[i] = 1
then
STATE_DIAG_ACT_LS_UP_DOWN[i] = "LEAN CHECK"
LAMB_SP_BEG_DIAG_LS_UP_DOWN[i] = LAMB_SP[i]
LV_LAMB_SP_AFL_REQ_DIAG_ACT[i] = 1
LV_LAM_DI_REQ[i] = 1 % disable lambda ctr. close loop operation
If LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
Then
MAF_INT_DIAG_LS_UP_DOWN[i] = C_MAF_INT_EOL_DIAG_LS_UP_DOWN[i]
T_DIAG_ACT_AFL_LS_UP_DOWN[i] = C_T_DIAG_EOL_LS_UP_DOWN
Else
T_DIAG_ACT_AFL_LS_UP_DOWN[i] = 0
MAF_INT_DIAG_LS_UP_DOWN[i] = 0
endif
endif

B.35.1.3 State "RICH CHECK"

Description:

The MAF integral runs. After exceeding the calibrateable threshold for MAF the signal voltage is observed and the check is complete. The corresponding diagnosis flag is set in case of not sufficient voltage value.
The calculation of MAF_INT_DIAG_LS_UP_DOWN[i] expires in 100ms raster as long as the operation state is fulfilled. MAF_INT_DIAG_LS_UP_DOWN[i] is limited to the maximum value if necessary in case of a longer rich phase.

Actions:

If LV_LAM_LSCL[i] = 0
and LAMB_SP[i] $>$ C_LAMB_AFR_MIN_DIAG_LS_UP_DOWN
and LAMB_SP[i] $<$ C_LAMB_AFR_MAX_DIAG_LS_UP_DOWN
then
MAF_INT_DIAG_LS_UP_DOWN[i] $_n$ = MAF_INT_DIAG_LS_UP_DOWN[i] $_{n-1}$ + MAF_CYL* T_SAMPLE [ms] * 1/3600 [(g*h) /(kg*ms)]
else
If LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
Then
MAF_INT_DIAG_LS_UP_DOWN[i] = C_MAF_INT_EOL_DIAG_LS_UP_DOWN[i]
else
MAF_INT_DIAG_LS_UP_DOWN[i] = 0
endif
endif

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```
If          MAF_INT_DIAG_LS_UP_DOWN[i]>   C_MAF_INT_DIAG_LS_UP_DOWN[i]
then            keep MAF_INT_DIAG_LS_UP_DOWN[i]
  If             T_DIAG_ACT_AFR_LS_UP_DOWN[i] < C_T_MAX_DIAG_AFR_LS_UP_DOWN
  then        active test runs
                LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 1
                If       LV_ERR_CHK_LS_DOWN[i] = 1
                or   LV_DIAG_AFR_CHK_SYM_LSL_UP[i] = 1
                    then
                         LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 0
                         go to   transition to check finished
                else
                         Increment  T_DIAG_ACT_AFR_LS_UP_DOWN[i]
                endif
          else            active test timed out
                LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 0
                LV_DIAG_AFR_END_LS_UP_DOWN[i] = 1
                keep T_DIAG_ACT_AFR_LS_UP_DOWN[i]

                if      LV_DIAG_AFL_END_LS_UP_DOWN[i] = 1
                    then     go to   transition to check finished
          else      go to   transition to lean check
                    endif
  endif
else
     LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 0
  If             T_DIAG_ACT_AFR_LS_UP_DOWN[i]     < C_T_MAX_DIAG_AFR_LS_UP_DOWN
  Then
               If  LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
               Then
                         T_DIAG_ACT_AFR_LS_UP_DOWN[i]   = C_T_DIAG_EOL_LS_UP_DOWN
               else
                         T_DIAG_ACT_AFR_LS_UP_DOWN[i]   = 0
               endif
          else
                    Keep T_DIAG_ACT_AFR_LS_UP_DOWN[i]
          endif
endif
```

Condition 3: Transition to state "PASSIVE"

```
If  LV_DIAG_AFR_AFL_INH_LS_UP_DOWN[i] = 1
or             LV_DIAG_ACT_CDN_LS_UP_DOWN[i] = 0
then
  LV_LAM_DI_REQ[i] = 0             % re-enable lambda ctr. close loop operation
  LV_LAMB_SP_AFR_REQ_DIAG_ACT[i] = 0
  LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 0
  STATE_DIAG_ACT_LS_UP_DOWN[i] = " PASSIVE"
endif
```

Condition 4: Transition to state "LEAN CHECK"

```
If transition to lean test
then
  MAF_INT_DIAG_LS_UP_DOWN[i] = 0
```

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LV_LAMB_SP_AFR_REQ_DIAG_ACT[i] = 0
LV_LAMB_SP_AFL_REQ_DIAG_ACT[i] = 1
LAMB_SP_BEG_DIAG_LS_UP_DOWN[i] = LAMB_SP[i]
STATE_DIAG_ACT_LS_UP_DOWN[i] = "LEAN CHECK "
endif

Condition 5: Transition to state "CHECK FINISHED"
If*transition to check finished*
Then
LV_LAM_DI_REQ[i] = 0 % re-enable lambda ctr. close loop operation
LV_LAMB_SP_AFR_REQ_DIAG_ACT[i] = 0
LV_DIAG_ACT_END_LS_UP_DOWN[i] = 1
STATE_DIAG_ACT_LS_UP_DOWN[i] = " CHECK FINISHED "
If LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
then
LV_DIAG_EOL_END_LS_UP_DOWN[i] = 1
endif
endif

B.35.1.4 State "LEAN CHECK"

Description:

The MAF integral runs. After exceeding the calibrateable threshold for MAF the signal voltage is observed and the check is complete. The corresponding diagnosis flag is set in case of not sufficient voltage value.
The calculation of MAF_INT_DIAG_LS_UP_DOWN[i] expires in 100ms raster as long as the operation state is fulfilled. MAF_INT_DIAG_LS_UP_DOWN[i] is limited to the maximum value if necessary in case of a longer rich phase.

Actions

If LV_LAM_LSCL[i] = 0
and LAMB_SP[i] $>$ C_LAMB_AFL_MIN_DIAG_LS_UP_DOWN
and LAMB_SP[i] $<$ C_LAMB_AFL_MAX_DIAG_LS_UP_DOWN
then
MAF_INT_DIAG_LS_UP_DOWN[i]$_n$ = MAF_INT_DIAG_LS_UP_DOWN[i]$_{n-1}$ + MAF_CYL * T_SAMPLE [ms] * 1/3600 [(g*h) /(kg*ms)]
else
If LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
Then
MAF_INT_DIAG_LS_UP_DOWN[i] = C_MAF_INT_EOL_DIAG_LS_UP_DOWN[i]
else
MAF_INT_DIAG_LS_UP_DOWN[i] = 0
endif
endif

If MAF_INT_DIAG_LS_UP_DOWN[i] $>$ C_MAF_INT_DIAG_LS_UP_DOWN[i]
then *keep*MAF_INT_DIAG_LS_UP_DOWN[i]
If T_DIAG_ACT_AFL_LS_UP_DOWN[i] $<$ C_T_MAX_DIAG_AFL_LS_UP_DOWN
then *active test runs*
LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 1

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If LV_ERR_CHK_LS_DOWN[i] = 1
or LV_DIAG_AFL_CHK_SYM_LSL_UP[i] = 1
then
LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 0
go to transition to check finished
else
Increment T_DIAG_ACT_AFL_LS_UP_DOWN[i]
endif
else *active test timed out*
LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 0
LV_DIAG_AFL_END_LS_UP_DOWN[i] = 1
keep T_DIAG_ACT_AFL_LS_UP_DOWN[i]

If LV_DIAG_AFR_END_LS_UP_DOWN[i] = 1
then *go to transition to check finished*
else *go to transition to rich check*
endif
endif
else
LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 0
If T_DIAG_ACT_AFL_LS_UP_DOWN[i] < C_T_MAX_DIAG_AFL_LS_UP_DOWN
then
If LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
Then
T_DIAG_ACT_AFL_LS_UP_DOWN[i] = C_T_DIAG_EOL_LS_UP_DOWN
else
T_DIAG_ACT_AFL_LS_UP_DOWN[i] = 0
endif
else
Keep T_DIAG_ACT_AFL_LS_UP_DOWN[i]
endif
endif

Condition 6: Transition to state "PASSIVE"
If LV_DIAG_AFR_AFL_INH_LS_UP_DOWN[i] = 1
or LV_DIAG_ACT_CDN_LS_UP_DOWN[i] = 0
then
LV_LAM_DI_REQ[i] = 0 % re-enable lambda ctr. close loop operation
LV_LAMB_SP_AFL_REQ_DIAG_ACT[i] = 0
LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 0
STATE_DIAG_ACT_LS_UP_DOWN[i] = "PASSIVE"
endif

Condition 7: Transition to state "RICH CHECK"
If *transition to rich test*
then
MAF_INT_DIAG_LS_UP_DOWN[i] = 0
LV_LAMB_SP_AFL_REQ_DIAG_ACT[i] = 0
LV_LAMB_SP_AFR_REQ_DIAG_ACT[i] = 1
LAMB_SP_BEG_DIAG_LS_UP_DOWN[i] = LAMB_SP[i]
STATE_DIAG_ACT_LS_UP_DOWN[i] = " RICH CHECK "
endif

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Condition 8: Transition to state "CHECK FINISHED"
If*transition to check finished*
Then
LV_LAM_DI_REQ[i] = 0 % re-enable lambda ctr. close loop operation
LV_LAMB_SP_AFL_REQ_DIAG_ACT[i] = 0
LV_DIAG_ACT_END_LS_UP_DOWN[i] = 1
STATE_DIAG_ACT_LS_UP_DOWN[i] = "CHECK FINISHED"
If LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
Then
LV_DIAG_EOL_END_LS_UP_DOWN[i] = 1
endif
endif

B.35.1.5 State "CHECK FINISHED"

Action:
none

B.35.2 O2 Sensor (up) open loop diag

FUNCTION DESCRIPTION:

This function shall do a plausibility test of the upstream oxygen sensor after the lambda set point was shifted to rich and/or lean. The failure entry will be done by the O2 Sensor diagnosis management (characteristic shift down diagnosis). Consequently the flags LV_ERR_.... and LV_END_DIAG_... are defined there.

Description:

Application conditions

Initialisation: `At LV_IGK change 0 -> 1, reset or at clearing error memory initialize the variables as follows:`

LV_DIAG_AFR_CHK_SYM_LSL_UP[i] = 0
LV_DIAG_AFL_CHK_SYM_LSL_UP[i] = 0
LV_DIAG_ACT_CHK_CDN_LSL_UP[i] = 0
LV_DIAG_ACT_CHK_END_LSL_UP[i] = 0
CTR_SUM_RST_AFR_CHK_LSL_UP[i] = 0
CTR_SUM_RST_AFL_CHK_LSL_UP[i] = 0
CTR_AFR_CHK_LSL_UP[i] = 0
CTR_AFL_CHK_LSL_UP[i] = 0

Recurrence:
This function shall be carried out every 100 ms.

Activation:

If LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 1 **or** LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 1
then
LV_DIAG_ACT_CHK_CDN_LSL_UP[i] = 1
Activate function

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```
Else
   LV_DIAG_ACT_CHK_CDN_LSL_UP[i] = 0
   Deactivate function
endif
```

Formula section:

```
If   LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 1
And   CTR_SUM_RST_AFR_CHK_LSL_UP[i] < C_CTR_SUM_RST_AFR_CHK_LSL_UP
then
   If          LAMB_LS_UP[i] > C_LAMB_AFR_THD_DIAG_ACT_LSL_UP
   Then
               If   CTR_AFR_CHK_LSL_UP[i] < C_ABC_MAX_CHK_LSL_UP
               Then
                        Increment   CTR_AFR_CHK_LSL_UP[i] with C_ABC_INC_CHK_LSL_UP
               Else
                        LV_DIAG_AFR_CHK_SYM_LSL_UP[i]= 1
                        % sensor shows a shift to lean
                        LV_DIAG_ACT_CHK_END_LSL_UP[i]= 1
               Endif
   Else
               stop CTR_AFR_CHK_LSL_UP[i]
          Endif

          If  CTR_AFR_CHK_LSL_UP[i] > 0
          Then
                    Increment CTR_SUM_RST_AFR_CHK_LSL_UP_i
          Endif
Else
CTR_SUM_RST_AFR_CHK_LSL_UP[i]= 0
CTR_AFR_CHK_LSL_UP[i] = 0
Endif

If          LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 1
And   CTR_SUM_RST_AFL_CHK_LSL_UP[i] < C_CTR_SUM_RST_AFL_CHK_LSL_UP
then
   If          LAMB_LS_UP[i] < C_LAMB_AFL_THD_DIAG_ACT_LSL_UP
   Then
               If   CTR_AFL_CHK_LSL_UP[i] < C_ABC_MAX_CHK_LSL_UP
               Then
                        Increment   CTR_AFL_CHK_LSL_UP[i] with C_ABC_INC_CHK_LSL_UP
               Else
                        LV_DIAG_AFL_CHK_SYM_LSL_UP[i]= 1
                        % sensor shows a shift to lean
                        LV_DIAG_ACT_CHK_END_LSL_UP[i]= 1
               Endif
   Else
               stop CTR_AFL_CHK_LSL_UP[i]
          Endif

          If  CTR_AFL_CHK_LSL_UP[i] > 0
          Then
```

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Increment CTR_SUM_RST_AFL_CHK_LSL_UP[i]
Endif
Else
CTR_SUM_RST_AFL_CHK_LSL_UP[i]= 0
CTR_AFL_CHK_LSL_UP[i] = 0
Endif

B.35.3 O2 sensor (down) open loop diag

FUNCTION DESCRIPTION:

General information:

This function shall do a plausibility test of the downstream oxygen sensor after the lambda set point was shifted to rich and/or lean. Once the test is complete on all cylinder banks, the symptoms are combined to produce appropriate error entries. The evaluation is different for 1 bank and 2 bank systems, more than 2 banks are not supported.
Here the dynamic error managemer is used to set the flags LV_ERR_.... and LV_END_DIAG_.... LV_ DIAG_CYC_END_LS_DOWN[i] is defined as dummy for global interface reasons.

Description:

Error Symptoms are defined as follows:

ERR_SYM_CHK_LS_DOWN

```
|_|_|_|_|
 | | | └─> downstream oxygen sensor too rich        ( = SYM_0)
 | | └───> downstream oxygen sensor too lean        ( = SYM_1)
 | └─────> (not used)                               ( = SYM_2)
 └───────> (not used)                               ( = SYM_3)
```

ERR_SYM_CHG_LS_DOWN

```
|_|_|_|_|
 | | | └─> (not used)                               ( = SYM_0)
 | | └───> (not used)                               ( = SYM_1)
 | └─────> (not used)                               ( = SYM_2)
 └───────> downstream oxygen sensors interchanged   ( = SYM_3)
```

Application conditions

Initialisation: At LV_IGK change 0 -> 1, reset or at clearing error memory initialize the variables as follows:

LV_ERR_CHK_LS_DOWN[i] = 0
ERR_SYM_CHK_LS_DOWN[i] = 0
LV_CDN_DIAG_CHK_LS_DOWN[i] = 0
LV_DIAG_CYC_END_LS_DOWN[i] = 1
LV_END_DIAG_CHK_LS_DOWN[i] = 0
LV_ERR_CHG_LS_DOWN = 0

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ERR_SYM_CHG_LS_DOWN = 0
LV_CDN_DIAG_CHG_LS_DOWN = 0
LV_END_DIAG_CHG_LS_DOWN = 0
T_END_DIAG_ACT_LS_DOWN = 0
LV_SYM_AFL_CHK_LS_DOWN[i] = 0
LV_SYM_AFR_CHK_LS_DOWN[i] = 0
T_AFR_CHK_LS_DOWN[i] = 0
T_AFL_CHK_LS_DOWN[i] = 0
LV_DIAG_EOL_DC_LS_UP_DOWN[i] = 0

Recurrence:
This function shall be carried out every 100 ms.

Activation:

If LV_END_DIAG_LAM_ADJ[i] = 1
or LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
or LV_DIAG_EOL_DC_LS_UP_DOWN[i] = 1
or LV_DIAG_OPL_REQ_CBK[i] = 1 for any i
then
LV_CDN_DIAG_CHK_LS_DOWN[i] = 1

Activate the function
If LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 1
then LV_DIAG_EOL_DC_LS_UP_DOWN[i] = DIAG_EOL_REQ_LS_UP_DOWN[i]
endif
Else
LV_CDN_DIAG_CHK_LS_DOWN[i] = 0
Deactivate the function
Endif

Formula section:

If(1a) LV_INH_DIAG_CHG_LS_DOWN = 0
then(1a)
If(2a) LV_DIAG_ACT_END_LS_UP_DOWN[i] = 0 for any i
% at least one bank still not complete: Symptom acquisition
then(2a)
If(3a) LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 1
then(3a)
If(4a) VLS_DOWN[i] $<$ C_VLS_AFR_THD_DIAG_ACT_LS_DOWN[i]
then(4a)
If(5a) T_AFR_CHK_LS_DOWN[i] $<$ C_T_MAX_CHK_LS_DOWN

then(5a)
Increment T_AFR_CHK_LS_DOWN[i]
else(5b)
LV_SYM_AFL_CHK_LS_DOWN[i] = 1
endif(5a/b)
endif(4a)

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elseif(3b) LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 1
then(3b)
If(4b) VLS_DOWN[i] > C_VLS_AFL_THD_DIAG_ACT_LS_DOWN[i]
then(4b)
If(5c) T_AFL_CHK_LS_DOWN[i] < C_T_MAX_CHK_LS_DOWN[i]

then(5c)
Increment T_AFL_CHK_LS_DOWN[i]
else(5d)
LV_SYM_AFR_CHK_LS_DOWN[i] = 1
endif(5c/d)
endif(4b)
endif(3b)
else(2b)
% check on all banks complete: Symptom evaluation and error flag generation
 # If(3c) (NC_CBK_EX_NR == 2)
 # then(3c) *% 2 banks configuration: check for rich/lean shifts and interchanged symptom*
LV_CDN_DIAG_CHG_LS_DOWN = 1
If(4c) **(** LV_SYM_AFL_CHK_LS_DOWN[1] = 1
and LV_SYM_AFR_CHK_LS_DOWN[2] = 0
and LV_SYM_AFL_CHK_LS_DOWN[2] = 0 **)**
then(4c)
ERR_SYM_CHK_LS_DOWN[1] = SYM_1 *%signal too low bank 1*
LV_ERR_CHK_LS_DOWN[1] = 1
elseif(4d) **(** LV_SYM_AFL_CHK_LS_DOWN[2] = 1
and LV_SYM_AFR_CHK_LS_DOWN[1] = 0
and LV_SYM_AFL_CHK_LS_DOWN[1] = 0 **)**
then(4d)
ERR_SYM_CHK_LS_DOWN[2] = SYM_1 *%signal too low bank 2*
LV_ERR_CHK_LS_DOWN[2] = 1
elseif(4e) **(** LV_SYM_AFR_CHK_LS_DOWN[1] = 1
and LV_SYM_AFR_CHK_LS_DOWN[2] = 0
and LV_SYM_AFL_CHK_LS_DOWN[2] = 0 **)**
then(4e)
ERR_SYM_CHK_LS_DOWN[1] = SYM_0 *%signal too high bank 1*
LV_ERR_CHK_LS_DOWN[1] = 1
elseif(4f) **(** LV_SYM_AFR_CHK_LS_DOWN[2] = 1
and LV_SYM_AFR_CHK_LS_DOWN[1] = 0
and LV_SYM_AFL_CHK_LS_DOWN[1] = 0 **)**
then(4f)
ERR_SYM_CHK_LS_DOWN[2] = SYM_0 *%signal too high bank 2*
LV_ERR_CHK_LS_DOWN[2] = 1
elseif(4g) **((** LV_SYM_AFR_CHK_LS_DOWN[2] = 1
or LV_SYM_AFL_CHK_LS_DOWN[2] = 1 **)**
and **(** LV_SYM_AFR_CHK_LS_DOWN[1] = 1
or LV_SYM_AFL_CHK_LS_DOWN[1] = 1 **))**
then(4g)
ERR_SYM_CHG_LS_DOWN = SYM_3 *%downstream oxygen sensors interchanged*

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```
                    LV_ERR_CHG_LS_DOWN = 1
                else(4h)
                    ERR_SYM_CHK_LS_DOWN[i] =   NO_SYM   for [1] and [2]
                    ERR_SYM_CHG_LS_DOWN = "NO_SYM"
                endif(4c-h)
            # elseif(3d) (NC_CBK_EX_NR == 1)
            # then(3d) % 1 bank configuration: check for rich/lean shifts only
                If(4i) (LV_SYM_AFL_CHK_LS_DOWN[1] = 1)
                then(4i)
                    ERR_SYM_CHK_LS_DOWN[1] =   SYM_1                %signal too low
                    LV_ERR_CHK_LS_DOWN[1] = 1
                elseif(4j) (LV_SYM_AFR_CHK_LS_DOWN[1] = 1)
                then(4j)
                    ERR_SYM_CHK_LS_DOWN[1] =   SYM_0                %signal too high
                    LV_ERR_CHK_LS_DOWN[1] = 1
                endif(4i/j)
            # endif(3c/d)
    endif(2a/b)
else(1b) % LV_INH_DIAG_CHG_LS_DOWN = 1 - downstream interchanged sensors not possible
    If(2c)      LV_DIAG_AFR_CDN_LS_UP_DOWN[i] = 1
    then(2c)
            If(3e)              VLS_DOWN[i] < C_VLS_AFR_THD_DIAG_ACT_LS_DOWN[i]
            then(3e)
                If(4k)              T_AFR_CHK_LS_DOWN[i] < C_T_MAX_CHK_LS_DOWN
                then(4k)
                    Increment T_AFR_CHK_LS_DOWN[i]
                else(4l)
                    LV_SYM_AFL_CHK_LS_DOWN[i] = 1
                    ERR_SYM_CHK_LS_DOWN[i] =   SYM_1                %signal too low
                    LV_ERR_CHK_LS_DOWN[i] = 1
                endif(4k/l)
            endif(3e)
    elseif(2d)      LV_DIAG_AFL_CDN_LS_UP_DOWN[i] = 1
    then(2d)
            If(3f)              VLS_DOWN[i] > C_VLS_AFL_THD_DIAG_ACT_LS_DOWN[i]
            then(3f)
                If(4m)              T_AFL_CHK_LS_DOWN[i] < C_T_MAX_CHK_LS_DOWN
                then(4m)
                    Increment T_AFL_CHK_LS_DOWN[i]
                else(4m)
                    LV_SYM_AFR_CHK_LS_DOWN[i] = 1
                    ERR_SYM_CHK_LS_DOWN[i] =   SYM_0                %signal too high
                    LV_ERR_CHK_LS_DOWN[i] = 1
                endif(4m/n)
            endif(3f)
    endif(2d)
end(1a/b)
```

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End flag generation

```
If          T_END_DIAG_ACT_LS_DOWN[i] >= C_T_END_DIAG_ACT_LS_DOWN[i] for all i
or          LV_DIAG_ACT_END_LS_UP_DOWN[i] = 1 for all i
or          LV_ERR_CHK_LS_DOWN[i] = 1 for any i
```

```
or                LV_ERR_CHG_LS_DOWN = 1
then          LV_END_DIAG_CHG_LS_DOWN = 1
else          %active test was not triggered - no failure case
        If       LV_DIAG_OPL_REQ_CBK[i] = 0 for all i
        and        LV_END_DIAG_LAM_ADJ[i] = 1
        and        LV_DIAG_ACT_INH_LS_UP_DOWN[i] = 0
        and        LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 0

        then        increment T_END_DIAG_ACT_LS_DOWN[i]
        else        freeze T_END_DIAG_ACT_LS_DOWN[i]
        endif
endif

if                LV_END_DIAG_CHG_LS_DOWN = 1
or                  (T_END_DIAG_ACT_LS_DOWN[i] >= C_T_END_DIAG_ACT_LS_DOWN[i]
                and LV_INH_DIAG_CHG_LS_DOWN = 1)
then          LV_END_DIAG_CHK_LS_DOWN[i] = 1
endif
```

Hint: The constant C_T_END_DIAG_ACT_LS_DOWN[i] must be bigger equal 2* (C_T_MAX_DIAG_AFL_LS_UP_DOWN + C_T_MAX_DIAG_AFR_LS_UP_DOWN + maximum time for the MAF integral C_MAF_INT_DIAG_LS_UP_DOWN[i] times 2).
The reason is to be in line with Rate Based Monitoring requirements (duration of diagnosis in the no failure case not shorter than in the failure case).

B.35.4 Moving Lambda Set Point

FUNCTION DESCRIPTION:

This functions shall move the lambda set point to a calibratable value, in order to do a plausibility test with the upstream and the downstream oxygen sensors separately. To avoid a jump in the lambda value and consequently any problem concernig driving confort, the shift in the lambda set point should be done through a ramp function with calibratable slope. The slope is defined as the diference between desired lambda set point and its value before the active test divided by the number of recurrences to achieve the final set point value, which is calibratable.
While the function is moving the lambda set point the flag LV_LAMB_SP_REQ_DIAG_ACT[i] is active (set in module 708A) to import this new value with high priority to the lambda coordination. To avoid any unbounded value of LAMB_SP[i], it s monitored while the movemnt occurs. As bounds for the lambda set point, it is used the desired AFR and AFL calibration data.

Description:

Application conditions

Initialisation:

At LV_IGK = 0 to 1, reset or at clearing error memory initialize all variables as follows:
LAMB_SP_DELTA_LS_UP_DOWN[i] = 0
LAMB_SP_DIAG_OPL_LS_UP_DOWN[i] = 0

Recurrence:
This function shall be carried out every 100 ms.

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Activation:
This function shall be activated when
LV_LAMB_SP_AFR_REQ_DIAG_ACT[i] = 1 **or**
LV_LAMB_SP_AFL_REQ_DIAG_ACT[i] = 1

Otherwise this function shall be deactivated and *LAMB_SP_DIAG_OPL_LS_UP_DOWN[i]* shall be set to zero.

Formula section:

Shift lambda set point to rich
/One-off update by the activation of the rich test
If LV_LAMB_SP_AFR_REQ_DIAG_ACT$_{n-1}$[i] = 0
And LV_LAMB_SP_AFR_REQ_DIAG_ACT$_{n}$[i] = 1
Then //Calc. only for the first time
LAMB_SP_DELTA_LS_UP_DOWN[i] =
(C_LAMB_SP_AFR_DIAG_LS_UP_DOWN **-** LAMB_SP_BEG_DIAG_LS_UP_DOWN[i]) **/** C_LAMB_SP_STEP_DIAG_LS_UP_DOWN
If LAMB_SP_DELTA_LS_UP_DOWN[i] = 0
then
LAMB_SP_DELTA_LS_UP_DOWN[i] = **-** 1H
endif
Update LAMB_SP_DIAG_OPL_LS_UP_DOWN[i] = LAMB_SP_BEG_DIAG_LS_UP_DOWN[i]

Endif

/moving lambda set point
If LV_LAMB_SP_AFR_REQ_DIAG_ACT[i] = 1
then
If LAMB_SP_DIAG_OPL_LS_UP_DOWN[i] $>$ C_LAMB_SP_AFR_DIAG_LS_UP_DOWN
then
increment LAMB_SP_DIAG_OPL_LS_UP_DOWN[i] *with* LAMB_SP_DELTA_LS_UP_DOWN [i]
else
LAMB_SP_DIAG_OPL_LS_UP_DOWN[i] = C_LAMB_SP_AFR_DIAG_LS_UP_DOWN

endif
endif

Shift lambda set point to lean
/One-off update by the activation of the lean test
If LV_LAMB_SP_AFL_REQ_DIAG_ACT$_{n-1}$[i] = 0
And LV_LAMB_SP_AFL_REQ_DIAG_ACT$_{n}$[i] = 1
Then //Calc. only for the first time
LAMB_SP_DELTA_LS_UP_DOWN[i] =
(C_LAMB_SP_AFL_DIAG_LS_UP_DOWN **-** LAMB_SP_BEG_DIAG_LS_UP_DOWN[i]) **/** C_LAMB_SP_STEP_DIAG_LS_UP_DOWN
If LAMB_SP_DELTA_LS_UP_DOWN[i] = 0
then
LAMB_SP_DELTA_LS_UP_DOWN[i] = +1H
endif

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Update LAMB_SP_DIAG_OPL_LS_UP_DOWN[i] = LAMB_SP_BEG_DIAG_LS_UP_DOWN[i]

endif
/moving lambda set point
If LV_LAMB_SP_AFL_REQ_DIAG_ACT[i] = 1
then
If LAMB_SP_DIAG_OPL_LS_UP_DOWN[i] < C_LAMB_SP_AFL_DIAG_LS_UP_DOWN
then
increment LAMB_SP_DIAG_OPL_LS_UP_DOWN[i] with LAMB_SP_DELTA_LS_UP_DOWN[i]
else
LAMB_SP_DIAG_OPL_LS_UP_DOWN[i] = C_LAMB_SP_AFL_DIAG_LS_UP_DOWN

endif
endif

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B.36 O2 sensor open loop diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_ACT_INH_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
General inhibition Oxygen Sensor Active Plausibility Check					
LV_DIAG_ACT_INH_RBM_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibit- flag for RBM for Oxygen Sensor Active Plausibility Check					
LV_DIAG_AFR_AFL_INH_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition of open loop diag while interferring functions are deactivated in failure case					
LV_DIAG_EOL_REQ_LS_UP_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Start EOL active test					
LV_DIAG_OPL_REQ_CBK [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request open loop diagnosis					
LV_INH_DIAG_CHG_LS_DOWN	O/V	0... 1H	0 ...1	1	-
Inhibit diagnosis interchanged downstream sensors					
STATE_RBM_CHK_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 7H	0 ...7	1	-
RBM - Interface of CHK_LS_DOWN monitor					

Input data:

CPPWM {p. 3749}	CTR_ERR_DYN_NR {p. 5767}	LC_DIAG_PUE_ACT_LS_ DOWN {p. 5191}	LV_DC {p. 5746}
LV_DIAG_ACT_END_LS_ UP_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_END_DIAG_CHK_LS_ DOWN [NC_CBK_EX_NR] {p. 5388}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_AMP {p. 4822}
LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CST_IVVT_ EX [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CST_IVVT_ IN [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}
LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}
LV_ERR_CRK_TOOTH_ PER {p. 4432}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}
LV_ERR_DYN_VLD_LS_ UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}	LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FTL_MIN {p. 4762}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}

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NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_NR_CAM_CBK {p. 1507}	NC_NR_CBK_IVVT {p. 604}
NR_CBK_EX {p. 944}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_DIAG_CHG_LS_DOWN_INH	-	0... 1H	0 ...1	1	-
Manual inhibitation of symptom evaluation for downstream sensor interchanged error					

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

FUNCTION DESCRIPTION:

General information:

In this Appl. Incidence the execution order of the AF lean and rich active tests are defined. Also some criteria are defined, which must inhibit each test.
i = 1 ... NC_CBK_EX_NR

Application conditions

Initialisation:

```
If  LV_IGK = 01 or  reset or  clearing the error memory then
 LV_DIAG_ACT_INH_LS_UP_DOWN[i] = 0
 LV_DIAG_AFR_AFL_INH_LS_UP_DOWN[i] = 0
 LV_DIAG_OPL_REQ_CBK[i] = 0
 LV_INH_DIAG_CHG_LS_DOWN = 0
 LV_DIAG_ACT_INH_RBM_LS_UP_DOWN[i] = 0
 LV_DIAG_EOL_REQ_LS_UP_DOWN[i] = 0
 If  LV_IGK = 10
 LV_INH_DIAG_CHG_LS_DOWN = 1
 LV_DIAG_ACT_INH_LS_UP_DOWN[i] = 1
```

Recurrence: *100 ms*

Activation: *LV_IGK = 1*

Deactivation: LV_DIAG_ACT_END_LS_UP_DOWN[i] = 1 orLV_IGK = 0

Formula section:

If the following conditions are true, the active test shall wait until the interferring functions are deactivated in the failure case.

If CPPWM <> 0% *canister purge valve is open*

then LV_DIAG_AFR_AFL_INH_LS_UP_DOWN[i] = 1
else LV_DIAG_AFR_AFL_INH_LS_UP_DOWN[i] = 0
endif

If the following errors/special mode are true the whole function shall be inhibited.

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If

LV_ERR_AMP = 1 **OR**
LV_ERR_AMP_PLAUS = 1 **OR**
LV_ERR_CHG_LS_UP = 1 **OR**
LV_ERR_CRK_PLAUS = 1 **OR**
LV_ERR_CRK_SYN = 1 **OR** LV_ERR_CRK_TOOTH = 1 **OR**

LV_ERR_CRK_TOOTH_PER = 1 **OR**
LV_ERR_DIAGCPS = 1 **OR**
LV_ERR_EL_CPS = 1 **OR**
LV_ERR_FTL_MIN = 1 **OR**
LV_ERR_FUP = 1 **OR**
LV_ERR_FUP_MFP_PLAUS = 1 **OR**
LV_ERR_FUP_ORNG = 1 **OR**
LV_ERR_FUP_ST = 1 **OR**
LV_ERR_H_PRS_SYS = 1 **OR**
LV_ERR_IVVT = 1 **OR**
LV_ERR_LOAD_TPS_PLAUS = 1 **OR**
LV_ERR_MAF = 1 **OR**
LV_ERR_MAP_PLAUS = 1 **OR**
LV_ERR_MAP_TPS_PLAUS = 1 **OR**
LV_ERR_MTC_CTL_2 = 1 **OR**
LV_ERR_MTC_CTL_3 = 1 **OR**
LV_ERR_MTC_DR = 1 **OR**
LV_ERR_TPS = 1 **OR**
LV_ERR_VCV = 1 **OR**
LV_ERR_AIR_LSL_UP[i] = 1 **OR** LV_
ERR_CAT_DIAG[i] = 1 **OR**
LV_ERR_CTL_LSL_UP[i] = 1 **OR**
LV_ERR_DYN_VLD_LS_UP[i] = 1 **OR**
LV_ERR_EL_LSL_UP[i] = 1 **OR**
LV_ERR_LSH_DOWN[i] = 1 **OR**
LV_ERR_LSH_UP[i] = 1 **OR**
LV_ERR_LSL_UP_IF[i] = 1 **OR**
LV_ERR_OBD_LSH_DOWN[i] = 1 **OR**
LV_ERR_OBD_VLD_LSH_UP[i] = 1 **OR**
LV_ERR_OC_LS_DOWN[i] = 1 **OR**
LV_ERR_OC_LSL_UP[i] = 1 **OR**
LV_ERR_OFS_LSL_UP[i] = 1 **OR**
LV_ERR_PUC_LS_DOWN[i] = 1 **OR**
LV_ERR_PUC_VLD_LS_UP[i] = 1 **OR**
[LV_ERR_PUE_LS_DOWN[i] = 1 **OR**
and LC_DIAG_PUE_ACT_LS_DOWN = 1**]**
LV_ERR_SCG_LS_DOWN[i] = 1 **OR**
LV_ERR_SCP_LS_DOWN[i] = 1 **OR**
LV_ERR_SWT_LS_DOWN[i] = 1 **OR**
LV_ERR_TTIP_MES_LSH_UP[i] = 1 **OR**
(i = 1 **AND**
[LV_ERR_IV[0] **OR**
LV_ERR_IV[2] **OR**
LV_ERR_IV[4] **OR**

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LV_ERR_MIS[0] **OR**
LV_ERR_MIS[2] **OR**
LV_ERR_MIS[4]
]) **OR**
(i = 2 **AND**
[LV_ERR_IV[1] **OR**
LV_ERR_IV[3] **OR**
LV_ERR_IV[5] **OR**
LV_ERR_MIS[1] **OR**
LV_ERR_MIS[3] **OR**
LV_ERR_MIS[5]
]) **OR**
LV_ERR_PER_CAM_EX[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_PER_CAM_IN[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_PLAUS_CAM_EX[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_PLAUS_CAM_IN[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_REF_CRK_CAM_EX[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_REF_CRK_CAM_IN[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_SYN_CAM_EX[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_SYN_CAM_IN[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_SYN_CRK_CAM_IN[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_TOOTH_OFF_EX[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_TOOTH_OFF_IN[m] = 1 *m=1 for i=1,2*

then LV_DIAG_ACT_INH_RBM_LS_UP_DOWN[i] = 1
else LV_DIAG_ACT_INH_RBM_LS_UP_DOWN[i] = 0
endif

if LV_DIAG_ACT_INH_RBM_LS_UP_DOWN[i] = 1 **OR**
LV_LS_UP_OBD_2_MAN_DEAC[i] = 1 **OR**
LV_VB_CDN_OBD_2 = 0 *battery voltage is too low* **OR**
LV_PUC = 1 *pull fuel cut off* **OR**

LV_FL = 1 *full load* **OR**

LV_SAV = 1 *secondary air valve active* **OR**

LV_SAP = 1 *secondary air pump active* **OR**

LV_SAWUP = 1 *secondary air is active* **OR**

LV_IND_FCUT = 1 *cylinder cut off is active* **OR**

LV_LAMB_COP_i = 1 *catalyst overheating protection active*

then LV_DIAG_ACT_INH_LS_UP_DOWN[i] = 1
else LV_DIAG_ACT_INH_LS_UP_DOWN[i] = 0
endif

% Inhibitation of symptom evaluation for downstream sensor interchanged error

IF LC_DIAG_CHG_LS_DOWN_INH = 1 **OR**

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```
                LV_LS_UP_OBD_2_MAN_DEAC[2] = 1
THEN          LV_INH_DIAG_CHG_LS_DOWN = 1
ELSE          LV_INH_DIAG_CHG_LS_DOWN = 0
ENDIF

   % Start and control of open loop test

    If     LV_ERR_DELTA_I_LAM[i] = 1      OR
           LV_ERR_VLS_DOWN_DIF[i] = 1     for any i
    Then     LV_DIAG_OPL_REQ_CBK[1] = 1
    Endif

    # If     NC_CBK_EX_NR = 2
    # Then
          If          LV_DIAG_OPL_REQ_CBK[1] = 1                        and
                   (LV_DIAG_ACT_END_LS_UP_DOWN[1] = 1 or NR_CBK_EX = 1)
          Then          LV_DIAG_OPL_REQ_CBK[2] = 1
          Endif
    # Endif

    If     LV_DIAG_ACT_END_LS_UP_DOWN[i] = 1 for all i
    Then     LV_DIAG_OPL_REQ_CBK[i] = 0 for all i
    Endif
```

//reset of LV_DIAG_OPL_REQ_CBK[i] after open loop test to re- enable e.g. stratified combustion

Data :

Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurence	Failure class A/B
Downstream sensors Bank1 and 2 interchanged	See Table of failure		*see table of failires*	*ee table of ailires*	--		See Table of failure
CHG_LS_DOWN		3					

B.36.1 Interface for Rate - Based - Monitoring

FUNCTION DESCRIPTION:

General information:

With this module the interface between the CHK_LS_DOWN[i] monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_CHK_LS_DOWN[i] data.
Within STATE_RBM_CHK_LS_DOWN[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

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(not valid for active- check)

Application conditions

Initialisation:

```
at LV_DC 0  1 transition:
     bit 0 , bit 1 of STATE_RBM_CHK_LS_DOWN[i] = 0
     bit 2 of STATE_RBM_CHK_LS_DOWN[i] = 1
on failure memory reset:
    bit 1 of STATE_RBM_CHK_LS_DOWN[i] = 0
 at ECU reset all bits of STATE_RBM_CHK_LS_DOWN[i] shall be
set to zero.
```

Recurrence: 1 s

Activation: LV_DC = 1

Formula section:

At LV_DC 0 1 transition

The pending status of the following failures has to be checked only once :

Dependence	Error			
	LV_ERR_AMP	LV_ERR_AMP_PLAUS	LV_ERR_CHG_LS_UP	LV_ERR_CRK_PLAUS
	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH	LV_ERR_CRK_TOOTH_PER	LV_ERR_DIAGCPS
	LV_ERR_EL_CPS	LV_ERR_FTL_MIN	LV_ERR_FUP	LV_ERR_FUP_MFP_PLAUS
	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS	LV_ERR_LOAD_TPS_PLAUS
	LV_ERR_MAF_FRQ_EL	LV_ERR_MAF_FRQ_GRD	LV_ERR_MAF_FRQ_RNG	LV_ERR_MAP_PLAUS
	LV_ERR_MAP_TPS_PLAUS	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR
	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD	LV_ERR_TPS_AD_BOL
	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATIO	LV_ERR_TPS_ST_CHK_2
	LV_ERR_VCV			
NC_CBK_EX_NR	LV_ERR_AIR_LSL_UP[i]	LV_ERR_CAT_DIAG[i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DYN_VLD_LS_UP[i]
	LV_ERR_EL_LSL_UP[i]	LV_ERR_LSH_DOWN[i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]
	LV_ERR_OBD_LSH_DOWN[i]	LV_ERR_OBD_VLD_LSH_UP[i]	LV_ERR_OC_LS_DOWN[i]	LV_ERR_OC_LSL_UP[i]
	LV_ERR_OFS_LSL_UP[i]	LV_ERR_PUC_LS_DOWN[i]	LV_ERR_PUC_VLD_LS_UP[i]	LV_ERR_PUE_LS_DOWN[i]
	LV_ERR_SCG_LS_DOWN[i]	LV_ERR_SCP_LS_DOWN[i]	LV_ERR_SWT_LS_DOWN[i]	LV_ERR_TTIP_MES_LSH_UP[i]

Figure B.36.1: For x = 1 to NC_NR_CBK_IVVT (= for any i)

NC_NR_CBK_IVVT	LV_ERR_CAM_CST_IVVT_EX[x]	LV_ERR_CAM_CST_IVVT_IN[x]	LV_ERR_MEC_IVVT_EX[x]	LV_ERR_MEC_IVVT_IN[x]
	LV_ERR_SLV_IVVT_EX[x]	LV_ERR_SLV_IVVT_IN[x]		

Figure B.36.2: m = 1 for all i

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NC_NR_CAM_CBK	LV_ERR_PER_CAM_EX[m]	LV_ERR_PER_CAM_IN[m]	LV_ERR_PLAUS_CAM_EX[m]	_ERR_PLAUS_CAM_IN[m]
	LV_ERR_REF_CRK_CAM_EX[m]	LV_ERR_REF_CRK_CAM_IN[m]	LV_ERR_SYN_CAM_EX[m]	LV_ERR_SYN_CAM_IN[m]
	LV_ERR_SYN_CRK_CAM_IN[m]	LV_ERR_TOOTH_OFF_EX[m]	LV_ERR_TOOTH_OFF_IN[m]	

Figure B.36.3: For NC_CBK_EX_NR = i =1

NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

Figure B.36.4: For NC_CBK_EX_NR = i = 2

NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

If(1) { CPU optimization at LV_DC 0 1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }
Then(1)
While bit 1 of STATE_RBM_CHK_LS_DOWN[i] = 0 **do**
with each XX failure of the above list except LV_ERR_PUE_LS_DOWN (depending on configuration, see below):
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2) bit 1 of STATE_RBM_CHK_LS_DOWN[i] = 1
Endif(2)

For LV_ERR_PUE_LS_DOWN, do the following instead:
If LC_DIAG_PUE_ACT_LS_DOWN = 1
then
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<CALL>)
If(3) XX has a pending status
Then(3) bit 1 of STATE_RBM_CHK_LS_DOWN[i] = 1
Endif(3)
Endif(2)

Endwhile
Else(1) { the dynamic failure memory is empty } No action
Endif(1)

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Every 1 s :
If bit 0 of STATE_RBM_CHK_LS_DOWN[i] = 0
Then
If LV_END_DIAG_CHK_LS_DOWN[i] = 1

```
        Then    bit 0 of STATE_RBM_CHK_LS_DOWN[i] = 1
        Endif
Endif

If      bit 1 of STATE_RBM_CHK_LS_DOWN[i] = 0
Then
        If      LV_DIAG_ACT_INH_RBM_LS_UP_DOWN[i] = 1
        Then        bit 1 of STATE_RBM_CHK_LS_DOWN[i] = 1
        Endif
Endif
```

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B.37 O2 sensor (up, down) interchanged diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_CHG_LS_UP	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom					
LV_CDN_DIAG_CHG_LS_UP	V	0... 1H	0 ...1	1	-
Condition to run the diagnosis are fullfiled					
LV_END_DIAG_CHG_LS_UP	O/V	0... 1H	0 ...1	1	-
Diagnostic available					
LV_ERR_CHG_LS_UP	O/V	0... 1H	0 ...1	1	-
Debounced error: upstream sensor of banks 1and 2 interchanged					
MAF_INT_END_DIAG_CHG_LS_UP	V	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral for end of upstream interchanged sensors detection in no failure case					
MAF_INT_SYM_DIAG_CHG_LS_UP	V	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral for detetction of interchanged upstream sensors					

Input data:

FAC_LAM_LIM [NC_CBK_EX_NR] {p. 2461}	LV_IGK {p. 906}	LV_INH_DIAG_CHG_LS_UP {p. 5420}	LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}
LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_LAM_STOP_SHOPER_CDN [NC_CBK_EX_NR] {p. 5420}	MAF_CYL {p. 8277}	NC_CBK_EX_NR {p. 1829}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_LAM_LIM_MAX_CHG_LS_UP	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Max. Threshold to detect a interchanged sensor					
C_FAC_LAM_LIM_MIN_CHG_LS_UP	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Min. Threshold to detect a interchanged sensor					
C_FAC_NEG_CHG_LS_UP	-	0... FFH	0... 1.99218	0.0078125	-
Gain factor when MAF integral decreased					
C_FAC_POS_CHG_LS_UP	-	0... FFH	0... 1.99218	0.0078125	-
Gain factor when MAF integral is increased					
C_MAF_INT_DIAG_CHG_LS_UP	-	0... FFFFH	0... 1820.41666	0.0277778	g
Max. MAF integral value when ERR_SYM_... ("NO_SYM"					
C_MAF_INT_END_DIAG_CHG_LS_UP	-	0... FFFFH	0... 1820.41666	0.0277778	g
Max. MAF integral value to have a valid diagnostic result					

Error treatment:

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Diagnostic XX	Symptom description	Symptom	Filter type
CHG_LS_UP	1st symptom description	SYM_3	NO

B.37.1 Upstream Sensor Banks 1 and 2

FUNCTION DESCRIPTION:

General information:

This function was written for exhaust gas systems having two banks, where a sensor interchange cannot be avoided by hardware measures. In case the upstream sensors were interchanged it is expected that both lambda signals will drift from the set point in different directions and the lambda controllers achieve their maximum.

A symptom can be detected if the lambda controller correction of one bank crosses the min threshold whereas the other one crosses the max threshold.

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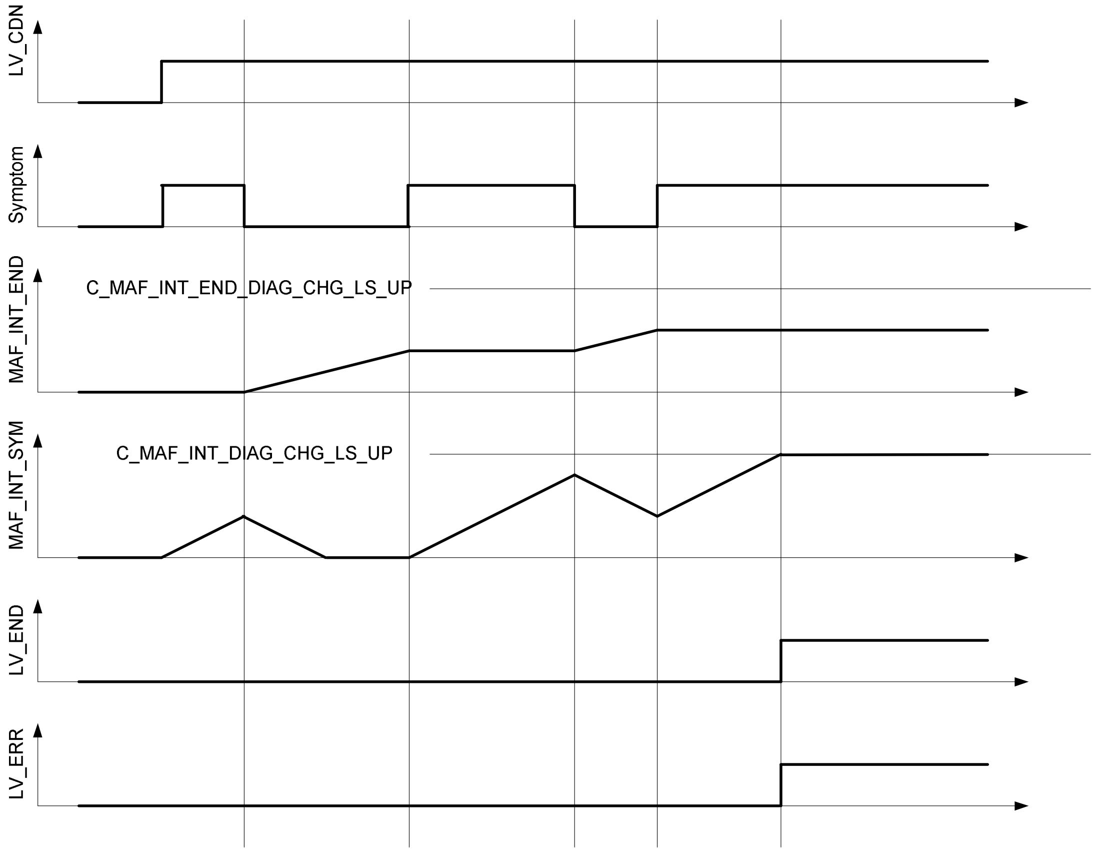

Figure B.37.1: : Basic principle of applied debounce algorithm.

Application conditions

Initialisation: At the transition LV_IGK = 0 -> 1, reset or clearing error memory reset all variables.

Recurrence: This function shall run every T_SAMPLE = 100 ms.

Activation/Deactivation:

IF LV_LAM_LSCL[i] = 1 for all [i]
AND (LV_LAM_STOP[1] = 0 **OR** LV_LAM_STOP_SHO_PER_CDN[1] = 1)
AND (LV_LAM_STOP[2] = 0 **OR** LV_LAM_STOP_SHO_PER_CDN[2] = 1)
AND LV_INH_DIAG_CHG_LS_UP = 0
AND LV_END_DIAG_CHG_LS_UP = 0
THEN
LV_CDN_DIAG_CHG_LS_UP = 1
ELSE
LV_CDN_DIAG_CHG_LS_UP = 0
ENDIF

Formula section:

IF(1a) LV_CDN_DIAG_CHG_LS_UP = 1
THEN(1a)

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IF(2a)
LV_END_DIAG_CHG_LS_UP = 0 **&**
MAF_INT_END_DIAG_CHG_LS_UP $<$ C_MAF_INT_END_DIAG_CHG_LS_UP
THEN(2a)
IF(3a) ERR_SYM_CHG_LS_UP = "NO_SYM"
THEN(3a)
MAF_INT_END_DIAG_CHG_LS_UP $_{n}$ = MAF_INT_END_DIAG_CHG_LS_UP $_{n-1}$ + MAF_CYL* T_SAMPLE [ms] * 1/3600 [(g*h) /(kg*ms)]
ELSE(3a)
MAF_INT_END_DIAG_CHG_LS_UP $_{n}$ = MAF_INT_END_DIAG_CHG_LS_UP $_{n-1}$
ENDIF(3a)
ELSE(2a)
LV_END_DIAG_CHG_LS_UP = 1
ENDIF(2a)

IF(2b)
(FAC_LAM_LIM[1] $>$ C_FAC_LAM_LIM_MAX_CHG_LS_UP &
FAC_LAM_LIM[2] $<$ C_FAC_LAM_LIM_MIN_CHG_LS_UP)
OR(2b)
(FAC_LAM_LIM[1] $<$ C_FAC_LAM_LIM_MIN_CHG_LS_UP &
FAC_LAM_LIM[2] $>$ C_FAC_LAM_LIM_MAX_CHG_LS_UP)
THEN(2b)
ERR_SYM_CHG_LS_UP = SYM_3
IF(3b) MAF_INT_SYM_DIAG_CHG_LS_UP $<$ C_MAF_INT_DIAG_CHG_LS_UP
THEN(3b)
MAF_INT_SYM_DIAG_CHG_LS_UP $_{n}$ = MAF_INT_SYM_DIAG_CHG_LS_UP $_{n-1}$ +
MAF_CYL* C_FAC_POS_CHG_LS_UP *
T_SAMPLE [ms] * 1/3600 [(g*h) /(kg*ms)]
ELSE(3b)
LV_ERR_CHG_LS_UP = 1
LV_END_DIAG_CHG_LS_UP = 1
ENDIF(3b)
ELSE(2b)
ERR_SYM_CHG_LS_UP = NO_SYM
MAF_INT_SYM_DIAG_CHG_LS_UP $_{n}$ = MAF_INT_SYM_DIAG_CHG_LS_UP $_{n-1}$
- MAF_CYL* C_FAC_NEG_CHG_LS_UP * T_SAMPLE [ms]
* 1/3600 [(g*h) /(kg*ms)]
ENDIF(2b)

ELSE(1a)
MAF_INT_SYM_DIAG_CHG_LS_UP = 0
MAF_INT_END_DIAG_CHG_LS_UP = 0
ENDIF(1a)

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B.38 O2 sensor (up, down) interchanged diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_CHG_LS_UP	O/V	0... 1H	0 ...1	1	-
Inhibit diagnosis interchanged upstream sensors					
LV_LAM_STOP_SHO_PER_CDN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
substitute to LV_LAM_STOP_SHO_PER in intechanged signal diagnosis					

Input data:

LV_CDN_VB_OBD2 {p. 1185}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_EL_CPS {p. 4708}	LV_ERR_FTL_MIN {p. 4762}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}
LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}
LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_IGK {p. 906}	LV_LAM_STOP_SHO_PER [NC_CBK_EX_NR] {p. 2448}	LV_LS_UP_OBD_2_MAN_ DEAC [NC_CBK_EX_NR] {p. 5449}
LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_INJ_CONF {p. 626}

B.38.1 Upstream sensor banks 1 and 2

General Information:

The calculation shall be done for all exhaust cylinder banks.

Application conditions

Initialisation:

```
At the transition LV_IGK = 0 -> 1 or ECU-Reset:
LV_INH_DIAG_CHG_LS_UP = 0
LV_LAM_STOP_SHO_PER_CDN[i] = 0
At the transition LV_IGK = 1 -> 0
LV_INH_DIAG_CHG_LS_UP = 1
LV_LAM_STOP_SHO_PER_CDN[i] = 1
```

Recurrence: 100 ms

Activation:

LV_IGK = 1

Deactivation

LV_IGK = 0

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Formula section:

LV_LAM_STOP_SHO_PER_CDN[i] = LV_LAM_STOP_SHO_PER[i]
% prevent frequent deactivation of diagnosis caused by active sensor offset adjustment

IF LV_CDN_VB_OBD2 = 0 **OR**
LV_LS_UP_OBD_2_MAN_DEAC[i] *for any i* **OR**
LV_ERR_IV[k] *for any k* **OR**
LV_ERR_DIAGCPS **OR**
LV_ERR_EL_CPS **OR**
LV_ERR_FTL_MIN **OR**
LV_ERR_FUP **OR**
LV_ERR_FUP_MFP_PLAUS **OR**
LV_ERR_FUP_ORNG **OR**
LV_ERR_FUP_ST **OR**
LV_ERR_H_PRS_SYS **OR**
LV_ERR_MAF **OR**
LV_ERR_MAP_PLAUS **OR**
LV_ERR_MAP_TPS_PLAUS

THEN
LV_INH_DIAG_CHG_LS_UP = 1
ELSE
LV_INH_DIAG_CHG_LS_UP = 0
ENDIF

Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Hardware config	Recurrence	Failure class A/B
Plausibility check of sensor signal	*Symptom detected*	*0*	P040	---	---		NO_LAMP CARB_M
CHG_LS_UP							

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B.39 O2 sensor (up, down) plausibility diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_AFL_SYM_PLAUS_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Oxygen Sensor Plausibility Check - not debounced symptom -SENS_AFL-					
LV_DIAG_AFR_SYM_PLAUS_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Oxygen Sensor Plausibility Check - not debounced symptom "SENS_AFR"					
LV_DIAG_CDN_PLAUS_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Oxygen Sensor Plausibility Check condition					
LV_DIAG_PLAUS_END_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Oxygen Sensor Plausibility Check result available					
LV_DIAG_PLAUS_SYM_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Debounced diagnosis result of the signal plausibility for the wide range A/F sensor					
MAF_END_PLAUS_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral for valid diagnostic result					
MAF_SYM_PLAUS_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral for detection of mutual not plausible sensor signals					
MAF_SYM_RAW_PLAUS_LSL_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral for the plausibility symptom (compensation of the catalyst delay)					
STATE_SYM_DIAG_PLAUS_LSL_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Oxygen Sensor Plausibility Check Symptom					

Input data:

LAMB_DELTA_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_DIAG_PLAUS_INH_ LSL_UP [NC_CBK_EX_NR] {p. 5429}
LV_IGK {p. 906}	LV_IPLSL_VLD [NC_CBK_EX_NR] {p. 2351}	LV_LAMB_SP_AFL_REQ_ DIAG_ACT [NC_CBK_EX_NR] {p. 5389}	LV_LAMB_SP_AFR_REQ_ DIAG_ACT [NC_CBK_EX_NR] {p. 5389}
LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_VLS_DIF_DLY_LDC [NC_CBK_EX_NR] {p. 5216}	MAF_CYL {p. 8277}	MAF_KGH {p. 1195}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	TCO {p. 1100}	TEG_DYN_LS_DOWN [NC_CBK_EX_NR] {p. 1007}

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VLS_DOWN [NC_CBK_EX_NR] {p. 967}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_AFL_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lean-mixture threshold of the upstream sensor voltage					
C_LAMB_AFR_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Rich-mixture threshold of the upstream sensor voltage					
C_MAF_KGH_MAX_DIAG_PLAUS_LSL_UP	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Maximum mass air flow to carry out the plausibility					
C_MAF_KGH_MIN_DIAG_PLAUS_LSL_UP	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Minimum mass air flow to carry out the plausibility					
C_MAF_SYM_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral threshold for detection of mutual not plausible sensor signals					
C_MAF_SYM_RAW_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral threshold for compensation of the catalyst delay					
C_MAF_SYM_RAW_RST_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral threshold for reset of raw symptom					
C_N_MIN_DIAG_PLAUS_LSL_UP	-	0... FFH	0... 8160	32	rpm
Lower engine speed admitted to carry out the plausibility					
C_TCO_MIN_DIAG_PLAUS_LSL_UP	-	0... FEH	-48... 142.5	0.75	°C
Minimum threshold of the cooling-water temperature to activate the function					
C_TEG_MAX_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Maximum temperature of the catalyst to carry out the plausibility					
C_TEG_MIN_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum temperature of the catalyst to carry out the plausibility					
C_VLS_DOWN_AFL_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lean-mixture threshold of the downstream sensor voltage					
C_VLS_DOWN_AFR_PLAUS_LSL_UP [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Rich-mixture threshold of the downstream sensor voltage					

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

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Description:

The plausibility check between the upstream oxygen sensor (WRAF sensor) and the downstream oxygen sensor (binary) signal is done once the expected driving conditions are fulfilled. A non-plausibility symptom detected by this diagnosis indicates that a failure is present in one of both sensors.
Two different symptoms can be detected:

- STATE_SYM_DIAG_PLAUS_LSL_UP[i] = *SYM_0* , if the upstream sensor indicates a rich lambda value, while the downstream sensor signal lean.
- STATE_SYM_DIAG_PLAUS_LSL_UP[i] = *SYM_1* , if the upstream sensor indicates a lean lambda value, while the downstream sensor signal rich.

Once the down- and upstream sensor signals are not mutual plausible first the mass flow integral MAF_SYM_RAW_PLAUS_LSL_UP[i] is calculated to take into account the delay time caused by the oxygen storage capability of the catalyst. If this integral reaches the threshold C_MAF_SYM_RAW_PLAUS_LSL_UP[i] the status in STATE_SYM_DIAG_PLAUS_LSL_UP[i] is set to the respective symptom. If either LV_DIAG_AFR_SYM_PLAUS_LSL_UP[i] or LV_DIAG_AFS_SYM_PLAUS_LSL_UP[i] disappears the MAF integral is decremented. When the integral reaches C_MAF_SYM_RAW_RST_PLAUS_LSL_UP[i] the status flag is taken back.
Second, after STATE_SYM_DIAG_PLAUS_LSL_UP[i] is set to the respective symptom the debounce algorithm is started. If both LV_DIAG_AFR/AFS_SYM_PLAUS_LSL_UP[i] and STATE_SYM_DIAG_PLAUS_LSL_UP[i] are active MAF_SYM_PLAUS_LSL_UP is integrated. In contrast if both symptom indicators are inactive (thus no failure is expected) the integral MAF_END_PLAUS_LSL_UP[i] is integrated. Should the status of flag differ from eachother, then both integrals are frozen. MAF_SYM_PLAUS_LSL_UP is reset when the status of STATE_SYM_DIAG_PLAUS_LSL_UP[i] changes. There is not reset condition for the end integral in order to have a valid end flag also in case of a jittering signal.
LV_DIAG_PLAUS_SYM_LSL_UP[i] is set to one once the symptom integral exceeds C_MAF_SYM_PLAUS_LSL_UP[i] is exceeded. LV_DIAG_PLAUS_END_LSL_UP[i] is set when the end integral exceeds sum of C_MAF_SYM_PLAUS_LSL_UP[i] and C_MAF_SYM_RAW_PLAUS_LSL_UP[i] or when the LV_DIAG_PLAUS_SYM_LSL_UP[i] is set.

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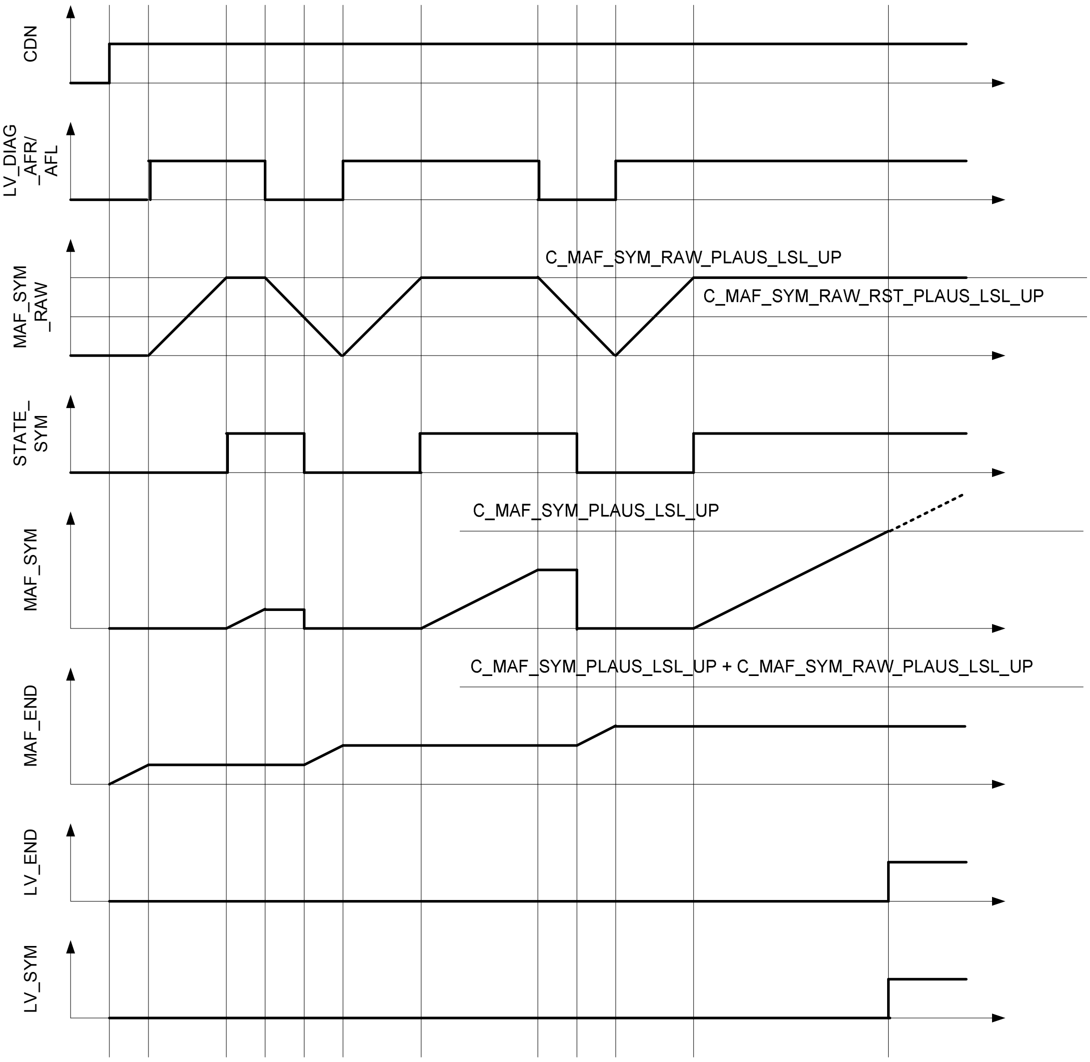

Figure B.39.1: : Basic principle of applied debounce algorithm.

The symptom flag LV_DIAG_PLAUS_SYM_LSL_UP is exported to *Sensor Characteristic Line Shift to Lean* and *Shift to Rich* functions to facilitate the detection of the faulty sensor and failure cause. The calibration of this function is described in its Tunning Guide.

Application conditions:

Initialisation:

At transition LV_IGK = 0 to 1, reset or at clearing error memory resetall variables.

Recurrence: 100 ms

Activation:

IF LV_DIAG_PLAUS_SYM_LSL_UP[i] = 0 **AND**
LV_IPLSL_VLD[i] = 1 **AND**
LV_LS_DOWN_READY[i] = 1 **AND**
LV_LAMB_SP_AFR_REQ_DIAG_ACT[i] = 0 **AND**
LV_LAMB_SP_AFL_REQ_DIAG_ACT[i] = 0 **AND**

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N_32 > C_N_MIN_DIAG_PLAUS_LSL_UP **AND**
C_MAF_KGH_MIN_DIAG_PLAUS_LSL_UP < MAF_KGH <
C_MAF_KGH_MAX_DIAG_PLAUS_LSL_UP **AND**
TCO C_TCO_MIN_DIAG_PLAUS_LSL_UP **AND**
C_TEG_MIN_PLAUS_LSL_UP[i] < TEG_DYN_LS_DOWN[i] <
C_TEG_MAX_PLAUS_LSL_UP[i] **AND**
LV_DIAG_PLAUS_INH_LSL_UP[i] = 0 **AND**
LV_CAT_PURGE_ACT[i] = 0 **AND**
LV_VLS_DIF_DLY_LDC[i] = 1
THEN % activate function
LV_DIAG_CDN_PLAUS_LSL_UP[i] = 1
ELSE % deactivate function
LV_DIAG_CDN_PLAUS_LSL_UP[i] =0
% freeze STATE_SYM_DIAG_PLAUS_LSL_UP[i]
% freeze MAF_SYM_PLAUS_LSL_UP[i]
ENDIF

Formula section:

% Testing signal shift to rich:
IF(1a) VLS_DOWN[i] <= C_VLS_DOWN_AFL_PLAUS_LSL_UP[i]
% downstream sensor signal lean
AND(1a) LAMB_LS_UP[i] + LAMB_DELTA_LAM_ADJ[i] < C_
LAMB_AFR_PLAUS_LSL_UP[i]
% upstream sensor output rich
THEN(1a) LV_DIAG_AFR_SYM_PLAUS_LSL_UP[i] = 1
% upstream sensor probably too rich
ELSE(1a)
% Testing signal shift to lean:
LV_DIAG_AFR_SYM_PLAUS_LSL_UP[i] = 0
IF(2a) VLS_DOWN[i] >= C_VLS_DOWN_AFR_PLAUS_LSL_UP[i]
% downstream sensor signal rich
AND(2a) LAMB_LS_UP[i] + LAMB_DELTA_LAM_ADJ[i] > C_LAMB_AFL_
PLAUS_LSL_UP[i]
% upstream sensor output lean
THEN(2a) LV_DIAG_AFL_SYM_PLAUS_LSL_UP[i] = 1
% upstream sensor probably too lean
ELSE(2a) LV_DIAG_AFL_SYM_PLAUS_LSL_UP[i] = 0
ENDIF(2a)
ENDIF(1a)

% First anti-bouncing filter (to eliminate the catalyst oxygen buffer effect):
IF(1b) LV_DIAG_AFR_SYM_PLAUS_LSL_UP[i] = 1 **OR** LV_
DIAG_AFL_SYM_PLAUS_LSL_UP[i] = 1
THEN(1b)
IF(2b) MAF_SYM_RAW_PLAUS_LSL_UP[i] < C_MAF_SYM_RAW_PLAUS_LSL_UP[i]
THEN(2b)
MAF_SYM_RAW_PLAUS_LSL_UP[i]$_n$ = MAF_SYM_RAW_PLAUS_LSL_UP[i]$_{n-1}$ + MAF_
CYL * T_SAMPLE[ms] * 1/3600 [g*h/(kg*ms)]
ELSE(2b)
IF(3b) LV_DIAG_AFR_SYM_PLAUS_LSL_UP[i] = 1
THEN(3b)

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STATE_SYM_DIAG_PLAUS_LSL_UP[i] = SYM_0
ELSE(3b)
STATE_SYM_DIAG_PLAUS_LSL_UP[i] = SYM_1
ENDIF(3b)
ENDIF(2b)
ELSE(1b)
MAF_SYM_RAW_PLAUS_LSL_UP[i]$_n$ = MAF_SYM_RAW_PLAUS_LSL_UP[i]$_{n-1}$ - MAF_CYL * T_SAMPLE[ms] * 1/3600 [g*h/(kg*ms)]
ENDIF(1b)

IF(1c) MAF_SYM_RAW_PLAUS_LSL_UP[i] <= C_
MAF_SYM_RAW_RST_PLAUS_LSL_UP[i]
THEN(1c)
STATE_SYM_DIAG_PLAUS_LSL_UP[i] = NO_SYM
ENDIF(1c)

<u>% Anti-bounce Counter and minimum time to have a valid diagnostic:</u>
IF(1a)LV_DIAG_AFR_SYM_PLAUS_LSL_UP[i] = 0
AND(1a)LV_DIAG_AFL_SYM_PLAUS_LSL_UP[i] = 0
THEN(1a) % *"raw symptom" not present => no failure case*
IF(2a)STATE_SYM_DIAG_PLAUS_LSL_UP[i] = NO_SYM
THEN(2a)
MAF_END_PLAUS_LSL_UP[i]$_n$ = MAF_END_PLAUS _LSL_UP[i]$_{n-1}$ + MAF_CYL * T_SAMPLE[ms] * 1/3600 [g*h/(kg*ms)]
ELSE(2a)
MAF_END_PLAUS_LSL_UP[i]$_n$ = MAF_END_PLAUS_LSL_UP[i]$_{n-1}$
MAF_SYM_PLAUS_LSL_UP[i]$_n$ = MAF_SYM_PLAUS_LSL_UP[i]$_{n-1}$
ENDIF(2a)
ELSEIF(1a) LV_DIAG_AFR_SYM_PLAUS_LSL_UP[i] = 1
OR(1a)LV_DIAG_AFL_SYM_PLAUS_LSL_UP[i] = 1
THEN(1a) *% "raw symptom" is present => failure case*
IF(2b)STATE_SYM_DIAG_PLAUS_LSL_UP[i] = NO_SYM
THEN(2b) % *symptom flag is not yet set*
MAF_END_PLAUS_LSL_UP[i]$_n$ = MAF_END_PLAUS_LSL_UP[i]$_{n-1}$
MAF_SYM_PLAUS_LSL_UP[i]$_n$ = MAF_SYM_PLAUS_LSL_UP[i]$_{n-1}$
ELSE(2b) *% symptom flag has been set*
MAF_SYM_PLAUS_LSL_UP[i]$_n$ = MAF_SYM_PLAUS_LSL_UP[i]$_{n-1}$ + MAF_CYL * T_SAMPLE[ms] * 1/3600 [g*h/(kg*ms)]
ENDIF(2b)
ENDIF(1a)

% Reset of MAF_SYM_PLAUS_LSL_UP
IF(1b)
STATE_SYM_DIAG_PLAUS_LSL_UP[i]$_n$ <> STATE_SYM_DIAG_PLAUS_LSL_UP[i]$_{n1}$
THEN(1b)
MAF_SYM_PLAUS_LSL_UP[i] = 0
ENDIF(1b)
STATE_SYM_DIAG_PLAUS_LSL_UP[i]$_{n-1}$ = STATE_SYM_DIAG_PLAUS_LSL_UP[i]$_n$

% Failure determination and setting of end flag

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IF(1c) MAF_END_PLAUS_LSL_UP[i] > C_MAF_SYM_PLAUS_LSL_UP[i] + C_
MAF_SYM_RAW_PLAUS_LSL_UP[i]

% To assure time symmetry between good (no failure) case and failure case, for the good case the MAF integral has to reach the sum of the thresholds of the anti-bounce filters.

THEN(1c) % End-Bit is set in case no symptom present

LV_DIAG_PLAUS_END_LSL_UP[i] = 1

ENDIF(1c)

IF(1d) MAF_SYM_PLAUS_LSL_UP[i] > C_MAF_SYM_PLAUS_LSL_UP[i]

THEN(1d) % End-bit is set in case symptom present

LV_DIAG_PLAUS_SYM_LSL_UP[i] = 1

LV_DIAG_PLAUS_END_LSL_UP[i] = 1

ENDIF(1d)

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B.40 O2 sensor (up, down) plausibility diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_PLAUS_INH_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of "Plausibility check of the sensor signal"					
LV_INH_DIAG_RBM_PLAUS_LSL_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Deactivation of Rate Base Monitoring of "Plausibility check of the sensor signal"					

Input data:

LC_DIAG_PUE_ACT_LS_DOWN {p. 5191}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_CDN_VB_OBD2 {p. 1185}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}
LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}	LV_ERR_CHG_LS_UP {p. 5416}
LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}
LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FTL_MIN {p. 4762}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}
LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}
LV_ERR_IVVT {p. 1062}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}
LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_PLAUS {p. 1062}
LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}
LV_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}	LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}
LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}

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LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}
LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5152}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_TPS {p. 4982}	LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}	LV_IGK {p. 906}
LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_NR_CAM_CBK {p. 1507}

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

Application conditions

Initialisation: at every transition LV_IGK = 0->1or reset all variables shall be reset to 0.
at every transition LV_IGK = 1->0
LV_DIAG_PLAUS_INH_LSL_UP[NC_CBK_EX_NR] = 1

Recurrence: *the functions shall be carried out once every 1s.*

Activation: *LV_IGK = 1*

Deactivation: *LV_IGK = 0*

Formula section:

This function has to be deactivated, if at least one of the following errors /special modes is active.

IF

LV_ERR_AMP = 1 **OR**
LV_ERR_AMP_PLAUS = 1 **OR**
LV_ERR_CHG_LS_UP = 1 **OR**
LV_ERR_CRK_PLAUS = 1 **OR**
LV_ERR_CRK_SYN = 1 **OR** LV_ERR_CRK_TOOTH = 1 **OR**

LV_ERR_CRK_TOOTH_PER = 1 **OR**
LV_ERR_DIAGCPS = 1 **OR**
LV_ERR_EL_CPS = 1 **OR**
LV_ERR_FTL_MIN = 1 **OR**
LV_ERR_FUP = 1 **OR**
LV_ERR_FUP_MFP_PLAUS = 1 **OR**

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LV_ERR_FUP_ORNG = 1 OR
LV_ERR_FUP_ST = 1 OR
LV_ERR_H_PRS_SYS = 1 OR
LV_ERR_IVVT = 1 OR
LV_ERR_LOAD_TPS_PLAUS = 1 OR
LV_ERR_MAF = 1 OR
LV_ERR_MAP_PLAUS = 1 OR
LV_ERR_MAP_TPS_PLAUS = 1 OR
LV_ERR_MTC_CTL_2 = 1 OR
LV_ERR_MTC_CTL_3 = 1 OR
LV_ERR_MTC_DR = 1 OR
LV_ERR_TPS = 1 OR
LV_ERR_VCV = 1 OR
LV_ERR_AIR_LSL_UP[i] = 1 OR LV_
ERR_CAT_DIAG [i] = 1 OR
LV_ERR_CTL_LSL_UP[i] = 1 OR
LV_ERR_DYN_VLD_LS_UP[i] = 1 OR
LV_ERR_EL_LSL_UP[i] = 1 OR
LV_ERR_LSH_DOWN[i] = 1 OR
LV_ERR_LSH_UP[i] = 1 OR
LV_ERR_LSL_UP_IF[i] = 1 OR
LV_ERR_OBD_LSH_DOWN[i] = 1 OR
LV_ERR_OBD_VLD_LSH_UP[i] = 1 OR
LV_ERR_OC_LS_DOWN[i] = 1 OR
LV_ERR_OC_LSL_UP[i] = 1 OR
LV_ERR_OFS_LSL_UP[i] = 1 OR
LV_ERR_PUC_LS_DOWN[i] = 1 OR
LV_ERR_PUC_VLD_LS_UP[i] = 1 OR
[LV_ERR_PUE_LS_DOWN[i] = 1 **and**
LC_DIAG_PUE_ACT_LS_DOWN = 1**]** OR
LV_ERR_SCG_LS_DOWN[i] = 1 OR
LV_ERR_SCP_LS_DOWN[i] = 1 OR
LV_ERR_SWT_LS_DOWN[i] = 1 OR
LV_ERR_TTIP_MES_LSH_UP[i] = 1 OR
(i = 1 **AND**
[LV_ERR_IV[0] OR
LV_ERR_IV[2] OR
LV_ERR_IV[4] OR
LV_ERR_MIS[0] OR
LV_ERR_MIS[2] OR
LV_ERR_MIS[4]
]) OR
(i = 2 **AND**
[LV_ERR_IV[1] OR
LV_ERR_IV[3] OR
LV_ERR_IV[5] OR
LV_ERR_MIS[1] OR
LV_ERR_MIS[3] OR
LV_ERR_MIS[5]
]) OR
LV_ERR_PER_CAM_EX[m] = 1 *m=1 for i=1,2* OR
LV_ERR_PER_CAM_IN[m] = 1 *m=1 for i=1,2* OR

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LV_ERR_PLAUS_CAM_EX[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_PLAUS_CAM_IN[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_REF_CRK_CAM_EX[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_REF_CRK_CAM_IN[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_SYN_CAM_EX[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_SYN_CAM_IN[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_SYN_CRK_CAM_IN[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_TOOTH_OFF_EX[m] = 1 *m=1 for i=1,2* **OR**
LV_ERR_TOOTH_OFF_IN[m] = 1 *m=1 for i=1,2*

THEN LV_INH_DIAG_RBM_PLAUS_LSL_UP[NC_CBK_EX_NR] = 1
ELSE LV_INH_DIAG_RBM_PLAUS_LSL_UP[NC_CBK_EX_NR] = 0
ENDIF

IF LV_INH_DIAG_RBM_PLAUS_LSL_UP[NC_CBK_EX_NR] = 1 **OR**
LV_CAT_PURGE_ACT[NC_CBK_EX_NR] = 1 **OR**
LV_CDN_VB_OBD2 = 0 **OR**
LV_LS_UP_OBD_2_MAN_DEAC[NC_CBK_EX_NR] = 1 **OR**
LV_ERR_SHIFT_AFL_LSL_UP[NC_CBK_EX_NR] = 1 **OR**
LV_ERR_SHIFT_AFR_LSL_UP[NC_CBK_EX_NR] = 1 **OR**

THEN LV_DIAG_PLAUS_INH_LSL_UP[NC_CBK_EX_NR] = 1
ELSE LV_DIAG_PLAUS_INH_LSL_UP[NC_CBK_EX_NR] = 0
ENDIF

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B.41 O2 sensor (up) heater plausibility diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_OBD_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean inhibit flag for O2 sensor heater OBDII monitoring					
LV_INH_DIAG_RBM_OBD_LSH_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean inhibit flag for Rate Based Monitoring of O2 sensor heater OBDII diagnosis					
STATE_RBM_OBD_VLD_LSH_UP [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Interface of OBD_VLD_LSH_UP[NC_CBK_EX_NR] monitor with the Rate-Based Monitoring statisticsBit 0: conditions for monitoring are met long enough to detect malfunction (bit 0 = 1)Bit 1: inhibition of the monitor because of system failure(s) (bit 1 = 1)Bit 2					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}
LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}
LV_ERR_MAP_TPS_PLAUS {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}
LV_ERR_MTC_DR {p. 5002}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}
LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_IGK {p. 906}
LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR] {p. 5449}	LV_ST_END {p. 1720}	LV_VAR_LSH_UP {p. 656}	LV_VB_CDN_OBD_2 {p. 1046}

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NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}		

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

B.41.1 Upstream sensor heater OBD2 diagnosis: Inhibition of diagnosis

Description:

This function shall evaluate the application conditions applicable to the oxygen sensor ceramic temperature OBDII monitoring and provide the result in a single boolean flag. This flag shall represent the interface to the main diagnosis function.
The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2), then
i = 1, for cylinder bank 1
i = 2, for cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank 1.

Application conditions

Initialisation: `at every transition LV_IGK = 0 -> 1or reset all variables shall be reset to 0, except STATE_RBM_OBD_VLD_LSH_UP[i]` *//for init of this variable see section below*
`at every transition LV_IGK = 1 -> 0`
`LV_INH_DIAG_OBD_LSH_UP[NC_CBK_EX_NR] = 1`

Recurrence: *1 s*

Activation: `LV_IGK = 1`

Formula section:

If LV_ERR_CHG_LS_UP = 1 **OR**
LV_ERR_DIAGCPS = 1 **OR**
LV_ERR_EL_CPS = 1 **OR**
LV_ERR_FUP = 1 **OR**
LV_ERR_FUP_MFP_PLAUS = 1 **OR**
LV_ERR_FUP_ORNG = 1 **OR**
LV_ERR_FUP_ST = 1 **OR**
LV_ERR_H_PRS_SYS = 1 **OR**
LV_ERR_LOAD_TPS_PLAUS = 1 **OR**
LV_ERR_MAF = 1 **OR**
LV_ERR_MAP_PLAUS = 1 **OR**
LV_ERR_MAP_TPS_PLAUS = 1 **OR**
LV_ERR_MTC_CTL_2 = 1 **OR**
LV_ERR_MTC_CTL_3 = 1 **OR**
LV_ERR_MTC_DR = 1 **OR**
LV_ERR_TPS = 1 **OR**

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```
LV_ERR_VCV = 1                          OR
 LV_ERR_AIR_LSL_UP[i] = 1                          OR
LV_ERR_CTL_LSL_UP[i] = 1                OR
LV_ERR_DELTA_I_LAM[i] = 1               OR
LV_ERR_DYN_VLD_LS_UP[i] = 1               OR
LV_ERR_EL_LSL_UP[i] = 1                 OR
LV_ERR_LSH_UP[i] = 1                  OR
LV_ERR_LSL_UP_IF[i] = 1                 OR
LV_ERR_OFS_LSL_UP[i] = 1                OR
LV_ERR_SHIFT_AFL_LSL_UP[i] = 1            OR
LV_ERR_SHIFT_AFR_LSL_UP[i] = 1            OR
LV_ERR_VLS_DOWN_DIF[i] =1               OR
(i = 1                    AND
            [       LV_ERR_IV[0]                  OR
      LV_ERR_IV[2]             OR
      LV_ERR_IV[4]             OR
      LV_ERR_MIS[0]            OR
      LV_ERR_MIS[2]            OR
      LV_ERR_MIS[4]
])                                                OR
(i = 2                    AND
              [    LV_ERR_IV[1]        OR
      LV_ERR_IV[3]             OR
      LV_ERR_IV[5]             OR
      LV_ERR_MIS[1]            OR
      LV_ERR_MIS[3]            OR
      LV_ERR_MIS[5]
])


then          LV_INH_DIAG_RBM_OBD_LSH_UP[i]  =  1
else          LV_INH_DIAG_RBM_OBD_LSH_UP[i]  =  0
endif

If              LV_LS_UP_OBD_2_MAN_DEAC[i] = 1                                OR
          LV_INH_DIAG_RBM_OBD_LSH_UP[i]  =  1                                 OR
          LV_VB_CDN_OBD_2 = 0                                        OR
          LV_VAR_LSH_UP = 0

then          LV_INH_DIAG_OBD_LSH_UP[i]  =  1
else          LV_INH_DIAG_OBD_LSH_UP[i]  =  0
endif
```

B.41.2 Upstream sensor heater OBD2 diagnosis: Interface for rate - based - monitoring

Description:

With this module the interface between the OBD_VLD_LSH_UP[i] monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_OBD_VLD_LSH_UP[i] data.
Within STATE_RBM_OBD_VLD_LSH_UP[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)

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(no intrusive operation, no short trip)

- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

(not valid for heater diagnosis)

Application conditions

Initialisation:

```
at ECU reset:
    bit 0, bit 1 and bit 2 of STATE_RBM_OBD_VLD_LSH_UP[i]
= 0
LV_DC 0 - -> 1 transition:
     bit 0 and bit 1 of STATE_RBM_OBD_VLD_LSH_UP[i] = 0
    bit 2 of STATE_RBM_OBD_VLD_LSH_UP[i] = 1
on failure memory reset:
    bit 1 of STATE_RBM_OBD_VLD_LSH_UP[i] = 0
```

Recurrence: 1 s

Activation: LV_DC = 1

Formula section:

At LV_DC 0 - ->1 transition

The pending status of the following failures has to be checked only once :

Dependence	Error			
	LV_ERR_CHG_LS_UP	LV_ERR_DIAGCPS	LV_ERR_EL_CPS	LV_ERR_FUP
	LV_ERR_FUP_MFP_PLAUS	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS
	LV_ERR_LOAD_TPS_PLAUS	LV_ERR_MAF_FRQ_EL	LV_ERR_MAF_FRQ_GRD	LV_ERR_MAF_FRQ_RNG
	LV_ERR_MAP_PLAUS	LV_ERR_MAP_TPS_PLAUS	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3
	LV_ERR_MTC_DR	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD
	LV_ERR_TPS_AD_BOL	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATIO
	LV_ERR_TPS_ST_CHK_2	LV_ERR_VCV		
NC_CBK_EX_NR	LV_ERR_AIR_LSL_UP[i]	LV_ERR_CTL_LSL_UP[i]	LV_ERR_DELTA_I_LAM[i]	LV_ERR_DYN_VLD_LS_UP[i]
	LV_ERR_EL_LSL_UP[i]	LV_ERR_LSH_UP[i]	LV_ERR_LSL_UP_IF[i]	LV_ERR_OFS_LSL_UP[i]
	LV_ERR_SHIFT_AFR_LSL_UP[i]	LV_ERR_SHIFT_AFL_LSL_UP[i]	LV_ERR_VLS_DOWN_DIF[i]	

Figure B.41.1: For NC_CBK_EX_NR = i = 1

NC_CYL_NR	LV_ERR_IV[0]	LV_ERR_IV[2]	LV_ERR_IV[4]	LV_ERR_MIS[0]
	LV_ERR_MIS[2]	LV_ERR_MIS[4]		

Figure B.41.2: For NC_CBK_EX_NR = i = 2

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NC_CYL_NR	LV_ERR_IV[1]	LV_ERR_IV[3]	LV_ERR_IV[5]	LV_ERR_MIS[1]
	LV_ERR_MIS[3]	LV_ERR_MIS[5]		

```
If(1)          { CPU optimization at LV_DC 0 - -> 1 transition }
               CTR_ERR_DYN_NR <> 0          { the dynamic failure memory isn t empty }
Then(1)
               While          bit 1 of STATE_RBM_OBD_VLD_LSH_UP[i] = 0 do
                      with each XX failure of the above list   (depending on configuration, see below):
                      ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

                      If(2)          XX has a pending status
                       Then(2)           bit 1 of STATE_RBM_OBD_VLD_LSH_UP[i] = 1
                       Endif(2)
               Endwhile
Else(1)           { the dynamic failure memory is empty }            No action
Endif(1)
```

Every 1 s :

```
If          bit 0 of STATE_RBM_OBD_VLD_LSH_UP[i] = 0
Then
               If          LV_END_DIAG_OBD_VLD_LSH_UP[i] = 1
                   Then             bit 0 of STATE_RBM_OBD_VLD_LSH_UP[i] = 1
                   Endif
Endif
If          bit 1 of STATE_RBM_OBD_VLD_LSH_UP[i] = 0
Then
               If          LV_INH_DIAG_RBM_OBD_LSH_UP[i] = 1
               Then      bit 1 of STATE_RBM_OBD_VLD_LSH_UP[i] = 1
               Endif
Endif
```

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B.42 O2 sensor (up) heater plausibility diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_OBD_VLD_LSH_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom to be transmitted to the error management					
ERR_SYM_TTIP_MES_LSH_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for general tip temperature plausibility					
LV_CDN_DIAG_OBD_VLD_LSH_UP [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Boolean flag indicating condition of correspondent diagnosis					
LV_CDN_DIAG_TTIP_MES_LSH_UP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Boolean flag indicating availability of general tip temperature plausibility diagnosis					
LV_DIAG_OBD_CDN_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that conditions for diagnosis met					
LV_DIAG_OBD_END_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that diagnosis has been completed					
LV_DIAG_OBD_SYM_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that fault is present and has been debounced					
LV_END_DIAG_OBD_VLD_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating end of correspondent diagnosis					
LV_END_DIAG_TTIP_MES_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating end of general tip temperature plausibility diagnosis					
LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the validation of correspondent symptom (transmitted to the error management)					
LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating the validation of general tip temperature plausibility symptom					
LV_LAMB_PLS_REQ_DIAG_LSH_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag requesting exaggerated forced stimulation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_SYM_OBD_LSL_LSH_UP [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H	NO_SYM TTIP_ERR READY_ERR TTIP_MES_ ERR	-	-
Variable indicating status of each symptom, updated each recurrence & at diagnosis completion					
TCC_END_DIAG_OBD_LSH_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter for end flag determination of TTIP_MES diagnosis					
TCC_ERR_OBD_LSH_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Number of diagnosis cycles in which temperature deviation exceeding limits present					
TTIP_LSH_UP_MES_TMP [NC_CBK_EX_NR]	O/V	0... FFFFH	-40... 6513.5	0.1	°C
Temporary storage of sensor temperature for Service06h output.					
TTIP_MES_OBD_LSH_UP_IT [NC_CBK_EX_NR]	O/V/S	0... FFFFH	-40... 6513.5	0.1	°C
internal copy of TTIP_MES_LS_UP to assure same datatype for diagnosis and service 06h output					
TTIP_OBD_LSH_UP_MES_BOL_SAE [NC_CBK_EX_NR]	O/V/S	0... FFFFH	-40... 6513.5	0.1	°C
Service 06h - min value : diagnosis of lambda sensor temperature upstream					
TTIP_OBD_LSH_UP_MES_SAE [NC_CBK_EX_NR]	O/V/S	0... FFFFH	-40... 6513.5	0.1	°C
Service 06h - test value : diagnosis of lambda sensor temperature upstream					
TTIP_OBD_LSH_UP_MES_TOL_SAE [NC_CBK_EX_NR]	O/V/S	0... FFFFH	-40... 6513.5	0.1	°C
Service 06h - max value : diagnosis of lambda sensor temperature upstream					

Input data:

C_TTIP_MIN_LS_UP_ READY {p. 2336}	C_TTIP_THD_IPLSL_ACT_ LS_UP {p. 2354}	LSHPWM_UP [NC_CBK_EX_NR] {p. 2385}	LV_END_DIAG_OC_LSL_ UP [NC_CBK_EX_NR] {p. 4300}
LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_IGK {p. 906}	LV_INH_DIAG_OBD_LSH_ UP [NC_CBK_EX_NR] {p. 5433}	LV_LS_UP_READY [NC_CBK_EX_NR] {p. 2335}
LV_ST_END {p. 1720}	LV_TEMP_DEW_LS_UP [NC_CBK_EX_NR] {p. 1007}	LV_TTIP_MES_VLD_LS_ UP [NC_CBK_EX_NR] {p. 1320}	LV_V_REF_VLD_R_IT_LS_ UP [NC_CBK_EX_NR] {p. 1320}
LV_VB_CDN_OBD_2 {p. 1046}	NC_CBK_EX_NR {p. 1829}	NC_IDX_DIAG_OBD_VLD_ LSH_UP [NC_CBK_EX_NR]	NC_IDX_DIAG_TTIP_ MES_LSH_UP [NC_CBK_EX_NR]
STATE_DIAG_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	T_POW_RISE_LSH_UP [NC_CBK_EX_NR] {p. 2386}	TEG_DYN_LS_UP [NC_CBK_EX_NR] {p. 1008}
TTIP_MES_LS_UP [NC_CBK_EX_NR] {p. 1321}			

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LSHPWM_MIN_LSH_UP	-	0... FFH	0... 99.60937	0.390625	%
Minimum permitted heater effective voltage PWM for upstream LSH OBD2 diagnosis					
C_T_DLY_LS_UP_READY_OBD_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time threshold after heater management start where fault detected, if no full operative readiness observed					
C_T_DLY_POW_CTL_OBD_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Minimum delay prior to checking status of OBD1 heater /signal faults					
C_T_DLY_TTIP_MES_OBD_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time delay after TTIP_ERR_MES symptom valid to set error flag					
C_T_DLY_TTIP_RES_OBD_LSH_UP	-	0... FFFFH	0... 6553.5	0.1	s
Time delay to reset TTIP_ERR_MES timer					
C_TCC_ERR_INC_OBD_LSH_UP	-	0... FFH	0... 255	1	-
Increment of heater fault counter in case that Ttip is below diagnostic threshold					
C_TCC_ERR_INC_OBD_LSH_UP_FAST	-	0... FFH	0... 255	1	-
Fast increment of heater fault counter in case that Ttip is below IP control activation limit					
C_TCC_THD_ERR_OBD_LSH_UP	-	0... FFFFH	0... 65535	1	-
Fault detection threshold, when exceeded, heater is determined to be defective during driving cycle					
C_TEG_DYN_MIN_OBD_LSH_UP	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Minimum exhaust temperature to activate oxygen sensor ceramic temperature diagnosis					
C_TTIP_MAX_OBD_LSH_UP	-	0... FFFFH	-40... 6513.5	0.1	°C
Upper diagnosis threshold for oxygen sensor ceramic temperature					
C_TTIP_MIN_OBD_LSH_UP	-	0... FFFFH	-40... 6513.5	0.1	°C
Lower diagnosis threshold for oxygen sensor ceramic temperature					
LC_OBD_LSH_UP	-	0... 1H	0 ...1	1	-
Logical constant permitting dignosis to be carried out					
LC_OBD_REP_LSH_UP	-	0... 1H	0 ...1	1	-
Logical constant permitting dignosis to be repeated within onde driving cycle					

Import actions:

ACTION_ERRM_NoFilterReset (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_NoFilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_LV_ERR_SET>,**IN**<PRM_LV_ERR_RST>,**IN**<PRM_LV_END_DIAG>,**OUT**<PRM_LV_ERR>)

Error treatment:

Diagnostic XX	**Symptom description**	**Symptom**	**Filter type**
OBD_VLD_LSH_UP[NC_CBK_EX_NR]	“sensor temperature out of range”	SYM_0	NO
	“sensor readiness delayed”	SYM_1	
	“invalid sensor temperature”	SYM_2	

Figure B.42.1: Diagnostic

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Diagnostic XX	Symptom description	Symptom	Filter type
TTIP_MES_LSH_UP [NC_CBK_EX_NR]	“sensor temperature out of range”	SYM_0	NO
	“sensor readiness delayed”	SYM_1	
	“invalid sensor temperature”	SYM_2	

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

This function shall facilitate the detection of oxygen sensor heater failures that would lead to an increase in emissions beyond the thresholds stated in the appropriate regulations. The diagnosis shall be carried out by determining whether the operative readiness of the sensor exceeds a time threshold or whether the measured oxygen sensor ceramic temperature exceeds or falls below set bounds over a number of measurement cycles, defined to be the actions carried out once per recurrence. The latter evaluation over the diagnosis cycle, defined to be after the completion of the set number of monitoring cycles, shall be carried out statistically.

Description:

Deviations in the oxygen sensor ceramic temperature or the oxygen sensor not being operatively ready in a timely manner can lead to an increase in emissions above the applicable standards or prevent the sensor signal from being used as a diagnostic system monitoring device.
The deviations may occur due to, for example, ageing of the heater element, defective wiring, increased heater circuit connector contact resistance, defective heater driver etc.
The hereafter mentioned diagnosis strategy is based on the detection via one of two methods, both cases being emissions relevant. Firstly the time to operative readiness shall be checked and secondly a statistical evaluation of the oxygen sensor ceramic temperature over a pre-defined number of monitoring cycles shall be carried out, whereby if the temperature should fall out of pre-set bounds a calibrateable number of times during the complete diagnosis cycle, a fault shall be detected as being present.
The oxygen sensor ceramic temperature shall be obtained indirectly via the measured internal resistance of the sensor.
The functionality of the diagnosis may be described in further detail below:
The diagnosis shall be carried out at least once per driving cycle or may be permitted to repeat, dependent on the status of flag LC_OBD_REP_LSH_UP. It shall be clear that only the temperature deviation detection method can repeat as the sensor warm-up phase is usually only carried out once per driving cycle. Due to the requirement, that "good" SAE values are only allowed to be written once per driving cycle (after decision only furhter bad case allowed), repeating the diag is restricted possible with bad case only. The diagnosis shall require a number of monitoring cycles to be carried out to permit statistical evaluation of the results. The function may set
The function shall be activated and deactivated dependent on the engine start state, denoted by flag LV_ST_END. Should the function be deactivated, the diagnosis conditions flags LV_DIAG_OBD_CDN_

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LSH_UP[i], LV_CDN_DIAG_OBD_VLD_LSH_UP[i] and LV_CDN_DIAG_TTIP_MES_LSH_UP[i] and the SW internal timer *TIMER_1* shall be reset and the diagnosis shall be considered to be Not Available .

Additional application conditions shall be met prior to permitting monitoring cycles to take place:

- LC_OBD_LSH_UP shall permit the diagnosis to be enabled or disabled from within the calibration system.
- LV_INH_DIAG_OBD_LSH_UP[i] shall facilitate the interfacing of project specific application conditions.
- STATE_LSH_UP[i] shall neither be in LSH_OFF nor LSH_VB_PROT. See following description for explanation.
- VB shall remain within bounds as indicated by LV_VB_CDN_OBD_2. This shall provide the facility to ensure that the battery voltage is sufficient to carry out OBD II diagnosis.
- LSHPWM_UP[i] shall remain above or equal to C_LSHPWM_MIN_LSH_UP. This shall provide the facility to limit the performing of the diagnosis in a region where the sensor temperature can be controlled. No upper limit is given as should the heater become defective then the closed loop heater voltage controller will tend to drive the LSHPWM_UP[i] to its maximum limit.
- The condition (LV_DIAG_OBD_END_LSH_UP[i] = 0 **or** LC_OBD_REP_LSH_UP = 1) shall permit the diagnosis to be carried out once only per driving cycle (LC_OBD_REP_LSH_UP = 0) or continuously over the whole driving cycle (LC_OBD_REP_LSH_UP = 1). Note: Once a good case have been detected, countinious algorithm is only checking symptoms. (No furhter "good SAE values")
- The dew point shall have passed as denoted by LV_TEMP_DEW_LS_UP[i] = 1.

The function shall determine whether the full operative readiness LV_LS_UP_READY[i] has been detected. If not, then the time to operative readiness detection method shall be carried out. Internal TIMER_1 shall be reset, the diagnosis conditions flag LV_DIAG_OBD_CDN_LSH_UP[i] shall be set and the diagnosis shall be declared as being Available . Timer T_POW_RISE_LSH_UP[i] shall be checked against threshold C_T_DLY_LS_UP_READY_OBD_LSH_UP. Should it equal or exceed the threshold then the operative readiness has not been detected in a timely manner and the symptoms shall be set to READY_ERR, fault flag LV_DIAG_OBD_SYM_LSH_UP[i] and the error flags shall be set and the end of diagnosis flags shall be set. Because of writing the SAE values are only allowed once per driving cycle, setting of SAE values, LV_DIAG_OBD_SYM_LSH_UP[i] and LV_DIAG_OBD_END_LSH_UP is only done in case of no Symptom is already present.

In order to meet Mode 6 diagnosis requirements, the current oxygen sensor ceramic temperature shall be stored in TTIP_OBD_LSH_UP_MES_SAE[i]. (This is used for the detection of the full operative readiness and hence may be used to meet the requirements). The Temperature limits come out of the Readyness check module. Therefore the SAE BOL and TOL are set accordingly.

Once the full operative readiness has been detected, further conditions shall be met prior to determining whether the oxygen sensor temperature falls within bounds, i.e. detection method two.

The function shall determine whether a time to operative readiness fault has been detected by observing LV_DIAG_OBD_SYM_LSH_UP. Provided no error symptom is active, the function shall then wait for STATE_LSH_UP[i] to reach LSH_POW_CTL. Additionally the exhaust gas temperature shall exceed the limit C_TEG_DYN_MIN_OBD_LSH_UP to ensure that in long PUC phases sensor cooling does not lead to false error detection. After this condition has been met, the function shall await the delay C_T_DLY_POW_CTL_OBD_LSH_UP. The delay provides the heater controller sufficient time to regulate the ceramic temperature to the set-point. Furthermore, this condition excludes states LSH_VB_PROT & LSH_TEMP_PROT. In both of these states, the heater power is reduced to prevent damage to the sensor. Under such conditions, it cannot be expected that the sensor temperature remain stable and hence OBDII heater diagnosis shall not be carried out in these instances. The SW internal timer used to await the delay shall be reset whenever STATE_LSH_UP[i] is no longer in LSH_POW_CTL or when the other above listed conditions are no longer met.

Additionally LV_TTIP_MES_VLD_LS_UP[i] shall be set, indicating that the ceramic temperature computation is active. This is the case when either the normal operative readiness has been detected via the raw operative readiness and validated via the ceramic temperature or the conditional operative readiness has been detected (forced operative readiness). These conditions permit the use of the measured ceramic temperature (TTIP_MES_LS_UP[i]) and not its initialised value (0 °C), i.e. the system tries to measure the ceramic temperature even if the heater fails sufficiently such that the normal operative

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readiness cannot be detected, where the oscillator used to measure the internal resistance and hence the ceramic temperature is only switched on when the sensor shows raw operative readiness. Note that during ceramic temperature reference measurements, the flag LV_TTIP_MES_VLD_LS_UP[i] will be revoked until the reference measurement cycle has been completed. The latter shall not cause TIMER_1 to be reset.
Once the application conditions have been met, this shall be indicated by setting the flag LV_DIAG_OBD_CDN_LSH_UP[i] and the function shall consider the diagnosis to be Available . Should the conditions not be met, then LV_DIAG_OBD_CDN_LSH_UP[i] shall be reset and the diagnosis shall be considered to be Not Available .
The function shall implement a statistical approach to detect a weak sensor heater: If the temperature is outside calibrateable limits, an error accumulator shall be incremented either with normal steps or with large steps, depending on the temperature being above or below a limit where the sensor is not functional. If the temperature is in range, the accumulator shall be decremented slowly. If the accumulator has reached a limit, the diagnosis shall indicate that an error is present. A second increment-only accumulator shall run in parallel to indicate that the diagnosis is done in the "good" case, i.e. that a fault would have been detected if it was permanently present. The diagnosis shall stop once an error has been detected. For Mode $06 SAE values the temperatures values must be stored. In "good" case (no error) the "TCC_END_DIAG_OBD_LSH_UP" counter reaches the "C_TCC_THD_ERR_OBD_LSH_UP - limit" with the "TCC_ERR_OBD_LSH_UP"-counter still counting; even if the current temperature value is "out of good range". Therefore the last stored good temperature "TTIP_MES_OBD_LSH_UP_IT" must be stored as SAE value. In "bad" case (error/symptom) the "TCC_ERR_OBD_LSH_UP" counter reaches the limit and SAE values as well as Symptom and end flags must be set.

TCC_END_DIAG_OBD_LSH_UP	**TCC_ERR_OBD_LSH_UP**	**Requirement for SAE values**	
Counting	Counting	Do not write	1
Reach calibrated Limit	Counting	Write last valid good TTIP	2
Counting	Reach calibrated Limit	Write TTIP (calibrated limit can only be reached if TTIP is out of Temp-Range)	3
Reach calibrated Limit	Reach calibrated Limit	Dto.	4

If the repeat flag LC_OBD_REP_LSH_UP_i is not set, the diagnosis shall stop as soon as the increment-only accumulator has reached or exceeded the required value and the end flag is set. If not, the diagnosis keeps running, but the result shall not change anymore once an error has been indicated.
If the repeat flag LC_OBD_REP_LSH_UP is set, the diagnosis will:

- stop nevertheless in case of Symptom detected
- run only for Symptom detection in case of finished with good case.

Application conditions:

Initialisation:
The following variables shall be initialised after reset, at the transition of ignition key on (i.e. LV_IGK = 0 -> 1) and upon clearing of the error memory:
STATE_SYM_OBD_LSL_LSH_UP[i] = 0
LV_DIAG_OBD_SYM_LSH_UP[i] = 0
LV_DIAG_OBD_CDN_LSH_UP[i] = 0
LV_DIAG_OBD_END_LSH_UP[i] = 0
LV_LAMB_PLS_REQ_DIAG_LSH_UP[i] = 0
TCC_ERR_OBD_LSH_UP[i] = 0
TCC_END_DIAG_OBD_LSH_UP[i] = 0
ACTION_ERRM_NoFilterReset(IN<NC_IDX_DIAG_ OBD_VLD_LSH_UP[i]>, OUT<LV_ERR_ OBD_VLD_LSH_UP[i]>)
ACTION_ERRM_NoFilterReset(IN<NC_IDX_DIAG_ TTIP_MES_LSH_UP[i]>,

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OUT<LV_ERR_ TTIP_MES_LSH_UP[i]>)

***Reset** all timers*
NOTE: timers refer to internal SW timer and not to output data variable.

Initialisation at clearing error memory (FMY_CLR:) **or in case of EEPROM checksum error or in case of new ECU connection**
The following variable shall be reset **to physical "0"** :

- TTIP_OBD_LSH_UP_MES_BOL_SAE[i]
- TTIP_OBD_LSH_UP_MES_SAE[i]
- TTIP_OBD_LSH_UP_MES_TOL_SAE[i]
- TTIP_MES_OBD_LSH_UP_IT[i]

Recurrence:
The monitoring cycles shall occur every 100 ms providing the conditions are met.

Activation: "in all engine states"

Formula section:

Different datatype definitions can cause inconsistency between diagnosis and Service 06h output. Therefore internal copy is taken, to make sure that diagnosis uses same datatype as Service 06h
TTIP_LSH_UP_MES_TMP[i] = TTIP_MES_LS_UP[i]

If(1) LV_ST_END = 1
and LC_OBD_LSH_UP = 1
and LV_INH_DIAG_OBD_LSH_UP[i] = 0
and STATE_LSH_UP[i] <> LSH_OFF
and STATE_LSH_UP[i] <> LSH_VB_PROT
and STATE_LSH_UP[i] <> LSH_TEMP_PROT
and LV_VB_CDN_OBD_2 = 1
and C_LSHPWM_MIN_LSH_UP LSHPWM_UP[i]
and (LV_DIAG_OBD_END_LSH_UP[i] = 0
or LC_OBD_REP_LSH_UP = 1)
and LV_TEMP_DEW_LS_UP[i] = 1
then(1)
% recognize both errors for delayed readiness
LV_CDN_DIAG_TTIP_MES_LSH_UP[i] = 1
LV_CDN_DIAG_OBD_VLD_LSH_UP[i] = 1
If(2) LV_LS_UP_READY[i] = 0
then(2)*Reset TIMER_1*
LV_DIAG_OBD_CDN_LSH_UP[i] = 1
Diagnosis Available
If(3) T_POW_RISE_LSH_UP[i]
C_T_DLY_LS_UP_READY_OBD_LSH_UP
then(3)STATE_SYM_OBD_LSL_LSH_UP[i] = READY_ERR
Symptom *Oxygen sensor heater fault READY_ERR* **active**
If(4) (LV_DIAG_OBD_SYM_LSH_UP = 0)//set SAE only in case no Symptom up to now
Then(4)
// the SAE value is decremented for 1hex becaue of comparison for setting LV_LS_READY is done
// with "=" and not with ">="

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```
                                TTIP_OBD_LSH_UP_MES_SAE[i] = TTIP_LSH_UP_MES_TMP[i] - 1hex
// limit at hex0
                  // note different datatyp definitions in following assignment !
                  TTIP_OBD_LSH_UP_MES_BOL_SAE[i] = C_TTIP_MIN_LS_UP_READY //type con-
            version!
                  TTIP_OBD_LSH_UP_MES_TOL_SAE[i] = 6513.5; // set to phyical max. limit !
                                LV_DIAG_OBD_SYM_LSH_UP[i] = 1
                                LV_DIAG_OBD_END_LSH_UP[i] = 1
                          endif(4)
                  endif(3)
         else(2)          If(3)          LV_DIAG_OBD_SYM_LSH_UP[i] = 0
                  and            STATE_LSH_UP[i] = LSH_POW_CTL
                  and            TEG_DYN_LS_UP[i] > C_TEG_DYN_MIN_OBD_LSH_UP
                  then(3)increment TIMER_1
                          If(4)          TIMER_1   C_T_DLY_POW_CTL_OBD_LSH_UP
                          then(4)LV_DIAG_OBD_CDN_LSH_UP[i] = 1
                                Diagnosis Available
                                If(5)          LV_TTIP_MES_VLD_LS_UP[i] = 1
                                and            LV_V_REF_VLD_R_IT_LS_UP[i] = 1
                                then(5)
                                      If          TCC_END_DIAG_OBD_LSH_UP[i]
                                            < C_TCC_THD_ERR_OBD_LSH_UP
                                      Then(6a) % don't exceed the threshold
                                            increment TCC_END_DIAG_OBD_LSH_UP[i]
                                            with C_TCC_ERR_INC_OBD_LSH_UP
                                      Endif(6a)
                                     If          (C_TTIP_MAX_OBD_LSH_UP < TTIP_LSH_UP_MES_
TMP[i]
                                      or             TTIP_LSH_UP_MES_TMP[i] < C_TTIP_MIN_OBD_
LSH_UP)
                                      then(6b) % symptom   found.   set state, , push error ctr.
                                             // badcase needs not to be stored.  ...TMP value can be
taken below
                                            STATE_SYM_OBD_LSL_LSH_UP[i] = TTIP_ERR
                                           Symptom  Oxygen sensor heater fault TTIP_ERR   active
                                             If             TTIP_MES_LS_UP[i] < C_TTIP_THD_IPLSL_
ACT_LS_UP
                                           then(7a) % pump current will be off, accelerated error recog-
nition
                                                increment TCC_ERR_OBD_LSH_UP[i]
                                                with C_TCC_ERR_INC_OBD_LSH_UP_FAST
                                                % freeze at upper limit, don't wrap
                                            Else(7a) % normal error recognition
                                                increment TCC_ERR_OBD_LSH_UP[i]
                                                with C_TCC_ERR_INC_OBD_LSH_UP
                                                % freeze at upper limit, don't wrap
                                            Endif(7a)
                                     Else(6b) % no symptom.   clear state, store "good" TTIP, roll back
error ctr.
                                              TTIP_MES_OBD_LSH_UP_IT[i] =TTIP_LSH_UP_MES_
TMP[i];
                                            reset STATE_SYM_OBD_LSL_LSH_UP[i]
```

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Symptom *Oxygen sensor heater fault TTIP_ERR* **passive**

decrement TCC_ERR_OBD_LSH_UP[i]
% freeze at zero limit, don't wrap
Endif(6b)
If (TCC_END_DIAG_OBD_LSH_UP[i] >= C_TCC_THD_ERR_OBD_LSH_UP)

Then(6c) *% we have a result available*
If ((TCC_ERR_OBD_LSH_UP[i] <C_TCC_THD_ERR_OBD_LSH_UP) **and**

(LV_DIAG_OBD_END_LSH_UP == 0) **)**
Then(7)*// good result -> store corresponding SAE values*
LV_DIAG_OBD_END_LSH_UP[i] = 1
TTIP_OBD_LSH_UP_MES_SAE[i] = TTIP_MES_OBD_LSH_UP_IT[i];
TTIP_OBD_LSH_UP_MES_BOL_SAE[i] = C_TTIP_MIN_OBD_LSH_UP;
TTIP_OBD_LSH_UP_MES_TOL_SAE[i] = C_TTIP_MAX_OBD_LSH_UP
Endif(7)
Endif(6c)
If TCC_ERR_OBD_LSH_UP[i] >= C_TCC_THD_ERR_OBD_LSH_UP

Then(6c) *% an error was debounced*
LV_DIAG_OBD_END_LSH_UP[i] = 1
LV_DIAG_OBD_SYM_LSH_UP[i] = 1
// update SAE values in case of error debounced
// Due to LV_DIAG_OBD_SYM_LSH_UP is an entry condition "if(3)" SAEs are set only once.
TTIP_OBD_LSH_UP_MES_SAE[i] = TTIP_LSH_UP_MES_TMP[i]
TTIP_OBD_LSH_UP_MES_BOL_SAE[i] = C_TTIP_MIN_OBD_LSH_UP
TTIP_OBD_LSH_UP_MES_TOL_SAE[i] = C_TTIP_MAX_OBD_LSH_UP
Endif(6c)
else(5) Symptom *Oxygen sensor heater fault TTIP_MES_ERR*
active
STATE_SYM_OBD_LSL_LSH_UP[i] = TTIP_MES_ERR
Increment *TIMER_2*
If(6) *TIMER_2* C_T_DLY_TTIP_MES_OBD_LSH_UP
then(6) LV_DIAG_OBD_SYM_LSH_UP[i] = 1
LV_DIAG_OBD_END_LSH_UP[i] = 1
// due to the fact that this error is caused by another error reason (no temp and R) the
// SAE value shall be at physical 0; cyclic writing of SAE values o.k. here
TTIP_OBD_LSH_UP_MES_SAE[i] = 0 // physical 0
TTIP_OBD_LSH_UP_MES_BOL_SAE[i] = C_TTIP_MIN_OBD_LSH_UP
TTIP_OBD_LSH_UP_MES_TOL_SAE[i] = C_TTIP_MAX_OBD_LSH_UP
endif(6)
endif(5)
If(5) (LV_TTIP_MES_VLD_LS_UP[i] = 1->0
and *Timer_3* = 0)

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or *Timer_3* <> 0
then(5)*Increment* *TIMER_3*
If(6) *TIMER_3* C_T_DLY_TTIP_RES_OBD_LSH_UP
then(7)Reset *TIMER_2*
Reset *TIMER_3*
endif(7)
endif(5)
else(4)*Diagnosis Not Available*
LV_DIAG_OBD_CDN_LSH_UP[i] = 0
endif(4)
else(3) *Reset TIMER_1*
LV_DIAG_OBD_CDN_LSH_UP[i] = 0
Diagnosis Not Available
endif(3)
endif(2)
else(1)
Reset *TIMER_1*
LV_DIAG_OBD_CDN_LSH_UP[i] = 0
% recognize both errors for delayed readiness
LV_CDN_DIAG_TTIP_MES_LSH_UP[i] = 0
LV_CDN_DIAG_OBD_VLD_LSH_UP[i] = 0
Diagnosis Not Available
endif(1)

Symptom Validation
% decide about general error. never reset in one driving cycle
ERR_SYM_TTIP_MES_LSH_UP[i] = STATE_SYM_OBD_LSL_LSH_UP[i]
If LV_DIAG_OBD_END_LSH_UP[i] = 1
then(1b) *% general tip temperature plausibility diagnosis is finished*
LV_END_DIAG_TTIP_MES_LSH_UP[i] = 1
If LV_DIAG_OBD_SYM_LSH_UP[i] = 1
then(2b) % a failure is present
LV_ERR_TTIP_MES_LSH_UP[i] = 1
endif(2b)
endif(1b)
For failure and error management treatment the anti-bounce mechanism is called :
% if LV_ERR_XX=1 then LV_ERR_SET=1 or if LV_ERR_XX=0 then LV_ERR_RST=1
ACTION_ERRM_NoFilterSymptom(IN<NC_IDX_DIAG OBD_VLD_LSH_UP [i]>, IN<LV_CDN_DIAG_OBD_VLD_LSH_UP [i]>, IN< ERR_SYM_ OBD_VLD_LSH_UP [i] >, IN< LV_ERR_SET_ OBD_VLD_LSH_UP [i] >, IN<LV_ERR_RST_ OBD_VLD_LSH_UP [i]>, IN<LV_END_DIAG_ OBD_VLD_LSH_UP [i]>, OUT<LV_ERR_ OBD_VLD_LSH_UP [i]>)

% now, if the OC diagnosis also has a result, decide about real heater error entry.
If LV_END_DIAG_OC_LSL_UP[i] = 1
and STATE_DIAG_OC_LSL_UP[i] <> "active"
then(1c) *%hold back if open circuit debounce is going on*
LV_END_DIAG_OBD_VLD_LSH_UP[i] = 1
If LV_ERR_TTIP_MES_LSH_UP[i] = 0
or LV_ERR_OC_LSL_UP[i] = 1
then(2c) % no failure present or failure is due to an open circuit
LV_ERR_OBD_VLD_LSH_UP[i] = 0
ERR_SYM_OBD_VLD_LSH_UP[i] = No symptom

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else(2c) % a real heater failure is present

LV_ERR_OBD_VLD_LSH_UP[i] = 1

ERR_SYM_OBD_VLD_LSH_UP[i] = STATE_SYM_OBD_LSL_LSH_UP[i]

endif(2c)

endif(1c)

For failure and error management treatment the anti-bounce mechanism is called :

% if LV_ERR_XX=1 then LV_ERR_SET=1 or if LV_ERR_XX=0 then LV_ERR_RST=1

ACTION_ERRM_NoFilterSymptom(IN<NC_IDX_DIAG_TTIP_MES_LSH_UP[i]>, IN<LV_CDN_DIAG_TTIP_MES_LSH_UP[i]>, IN< ERR_SYM_ TTIP_MES_LSH_UP[i] >, IN< LV_ERR_SET_TTIP_MES_LSH_UP[i] >, IN<LV_ERR_RST_TTIP_MES_LSH_UP[i]>, IN<LV_END_DIAG_TTIP_MES_LSH_UP[i]>, OUT<LV_ERR_ TTIP_MES_LSH_UP[i]>)

The calibration of the anti-bounce is defined in the chapter Diagnosis information .

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B.43 O2 sensor (up, down) diagnosis management

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_LS_DOWN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Final diagnostic of the downstream oxygen sensor					
LV_ERR_LS_UP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Final diagnostic of the upstream oxygen sensor					
LV_LS_DOWN_DIAG_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Collecting end flag for the diagnosis functions of the downstream oxygen sensor					
LV_LS_DOWN_OBD_1_MAN_DEAC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable indicating manual deactivation of all OBD1 diagnosis for downstream oxygen sensor					
LV_LS_DOWN_OBD_2_MAN_DEAC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable indicating manual deactivation of all OBD2 diagnosis for downstream oxygen sensor					
LV_LS_UP_DIAG_END [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Sum end bit of upstream oxygen sensor diagnosis functions					
LV_LS_UP_OBD_1_MAN_DEAC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable indicating manual deactivation of all OBD1 diagnosis for upstream oxygen sensor					
LV_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Logical variable indicating manual deactivation of all OBD2 diagnosis for upstream oxygen sensor					

Input data:

LC_DIAG_PUE_ACT_LS_DOWN {p. 5191}	LV_END_DIAG_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_END_DIAG_CHG_LS_DOWN {p. 5388}	LV_END_DIAG_CHG_LS_UP {p. 5416}
LV_END_DIAG_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5388}	LV_END_DIAG_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_END_DIAG_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_END_DIAG_FL_LS_DOWN [NC_CBK_EX_NR] {p. 4275}
LV_END_DIAG_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_END_DIAG_LSH_LSL_UP [NC_CBK_EX_NR] {p. 5276}	LV_END_DIAG_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_END_DIAG_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}
LV_END_DIAG_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}	LV_END_DIAG_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_END_DIAG_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4266}	LV_END_DIAG_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}
LV_END_DIAG_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_END_DIAG_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}	LV_END_DIAG_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}	LV_END_DIAG_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}
LV_END_DIAG_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_END_DIAG_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_END_DIAG_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_END_DIAG_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5152}

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LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_CHG_LS_DOWN {p. 5388}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5388}
LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}	LV_ERR_EL_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}
LV_ERR_LSH_LSL_UP [NC_CBK_EX_NR] {p. 5276}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}
LV_ERR_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_PLAUS_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5297}
LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}	LV_ERR_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5152}
LV_IGK {p. 906}	LV_LS_DOWN_OBD_MAN_DEAC_EXT {p. 5457}	LV_LS_UP_OBD_MAN_DEAC_EXT {p. 5457}	LV_ST_END {p. 1720}
NC_CBK_EX_NR {p. 1829}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NR_END_DIAG_LS_DOWN [NC_CBK_EX_NR]	-	0... FFFFH	0... 65535	1	-
Bit mask to select the consideration of a certain end flag for the final end flag					
C_NR_END_DIAG_LSL_UP [NC_CBK_EX_NR]	-	0... FFFFH	0... 65535	1	-
Bit mask to select the consideration of a certain end flag for the final end flag					
LC_ERR_CHG_LS_DOWN	-	0... 1H	0 ...1	1	-
Allow Sensor Interchanged Fault to be considered as Sensor Failure (in case of 1)					
LC_ERR_CHG_LS_UP	-	0... 1H	0 ...1	1	-
Allow Sensor Interchanged Fault to be considered as Sensor Failure (stops closed loop AF control)					
LC_ERR_DYN_VLD_LS_UP	-	0... 1H	0 ...1	1	-
Allow Sensor Dynamic Fault to be considered as Sensor Failure (stops closed loop AF control)					
LC_LS_DOWN_DIAG_ACT [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Activation bit for downstream oxygen sensor final diagnosis					
LC_LS_DOWN_ERR [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Opportunity for manual setting of LV_ERR_LS_DOWN[i] = 1					
LC_LS_DOWN_OBD_1_MAN_DEAC [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Logical calibration data for manual deactivation of all OBD1 diagnosis for downstream oxygen sensor					
LC_LS_DOWN_OBD_2_MAN_DEAC [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Logical calibration data for manual deactivation of all OBD2 diagnosis for downstream oxygen sensor					
LC_LS_UP_DIAG_ACT [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Activation bit for upstream oxygen sensor final diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_LS_UP_ERR [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Opportunity for manual setting of LV_ERR_LS_UP[i] = 1					
LC_LS_UP_OBD_1_MAN_DEAC [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Logical calibration data for manual deactivation of all OBD1 diagnosis for upstream oxygen sensor					
LC_LS_UP_OBD_2_MAN_DEAC [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Logical calibration data for manual deactivation of all OBD2 diagnosis for upstream oxygen sensor					

B.43.1 Upstream O2 sensor final diagnosis

FUNCTION DESCRIPTION:

General information:

The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR = 2) then
i = 1, for exhaust cylinder bank 1
i = 2, for exhaust cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
i = 1, for single exhaust cylinder bank.

This function shall summarize the diagnostic status of the upstream oxygen sensor delivered from the OBD I & II functions (heater and sensor) through the flag LV_ERR_LS_UP[i].

The ultimate error flag LV_ERR_LS_UP[i] is a component error and no DTC shall be sended to the Error Management.

To reduce the number of variables to be checked by other diagnosis functions, the collecting flag LV_LS_UP_DIAG_END is introduced. It provides the possibility to combine the end flags from almost all the upstream linear lambda sensor diagnosis functions. By a bit mask variable it is calibratable which end flag contributes to the collecting end flag.

Note:
1. If two separate Banks are concerned, then i=1 for cylinder bank 1 and i=2 for cylinder bank 2.

Application conditions

Initialisation:
At LV_IGK = 0 to 1, reset **or**at clearing error memory:

LV_ERR_LS_UP[i] = 0
LV_LS_UP_OBD_1_MAN_DEAC[i] = 0
LV_LS_UP_OBD_2_MAN_DEAC[i] = 0
LV_LS_UP_DIAG_END[i] = 0

Recurrence:
The function should be carried out once every 100 ms.

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Activation/Deactivation:
The diagnosis will be carried out if LV_ST_END = 1

Formula section:

If LV_LS_UP_OBD_MAN_DEAC_EXT = 1
Then LV_LS_UP_OBD_1_MAN_DEAC[i] = 1
LV_LS_UP_OBD_2_MAN_DEAC[i] = 1
Else
LV_LS_UP_OBD_1_MAN_DEAC[i] = LC_LS_UP_OBD_1_MAN_DEAC[i];
LV_LS_UP_OBD_2_MAN_DEAC[i] = LC_LS_UP_OBD_2_MAN_DEAC[i];
Endif

The linear lambda sensor error flag shall be set under the following conditions:

IF
LC_LS_UP_DIAG_ACT[i] = 1 % activation of final diagnosis **AND**
(LV_ERR_EL_LSL_UP[i] = 1 % electrical failure **OR**
LV_ERR_OC_LSL_UP[i] = 1 % open circuit failure **OR**
LV_ERR_LSL_UP_IF[i] = 1 % linear sensor controller failure **OR**

LV_ERR_LSH_UP[i] = 1 % heater electrical failure **OR**
LV_ERR_OBD_VLD_LSH_UP[i] = 1 % heater controller failure **OR**
LV_ERR_LSH_LSL_UP[i] = 1 % heater to sensor signal coupling failure **OR**

LV_ERR_AIR_LSL_UP[i] = 1 % sensor not mounted in exhaust pipe **OR**
LV_ERR_PUC_VLD_LS_UP[i]= 1 % sensor charact. line slope failure **OR**
LV_ERR_SHIFT_AFL_LSL_UP[i]= 1 % sensor charact. line shift to lean failure **OR**
LV_ERR_SHIFT_AFR_LSL_UP[i]= 1 % sensor charact. line shift to rich failure **OR**

LV_ERR_DYN_VLD_LS_UP[i]=1 & LC_ERR_DYN_VLD_LS_UP = 1 **OR**
% sensor dynamic failure (allowed by the project to stop closed loop control)
LV_ERR_CHG_LS_UP =1 & LC_ERR_CHG_LS_UP = 1 **OR**
% sensor interchanged failure (allowed by the project to stop closed loop control)

LC_LS_UP_ERR[i] = 1 **)** % manual activation of lambda sensor error
THEN
LV_ERR_LS_UP[i] = 1
ELSE
LV_ERR_LS_UP[i] = 0
ENDIF

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The general end flag is created according to the following logic:

If the corresponding bit is one, the LV_END_DIAG_XX flag shall be considered for the final end flag.

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Bit position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Bit mask variable (example) C_NR_END_DIAG_LSL_UP[i]	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
	Not used	Not used	Not used	Not used	LV_END_DIAG_CHG_LS_UP	LV_END_DIAG_AIR_LSL_UP[i]	LV_END_DIAG_LSH_LSL_UP[i]	LV_END_DIAG_PUC_VLD_LS_UP[i]	LV_END_DIAG_SHIFT_AFR_LSL_UP[i]	LV_END_DIAG_SHIFT_AFL_LSL_UP[i]	LV_END_DIAG_DYN_VLD_LS_UP[i]	LV_END_DIAG_OBD_VLD_LSH_UP[i]	LV_END_DIAG_LSL_UP_IF[i]	LV_END_DIAG_OC_LSL_UP[i]	LV_END_DIAG_EL_LSL_UP[i]	LV_END_DIAG_LSH_UP[i]

For this proposal, the number would be 0000011111111111 binary = 2047 decimal. All end flags except the one from the interchanged diagnosis must be set to 1 to also set the final end flag to 1.

The bitmask shall be combined with the single end flags as follows:

If [(C_NR_END_DIAG_LSL_UP[i].bit 0 = 0 **or** LV_END_DIAG_LSH_UP[i] = 1)
and
(C_NR_END_DIAG_LSL_UP[i].bit 1 = 0 **or** LV_END_DIAG_EL_LSL_UP[i] = 1)
and
(C_NR_END_DIAG_LSL_UP[i].bit 2 = 0 **or** LV_END_DIAG_OC_LSL_UP[i] = 1)
and
(C_NR_END_DIAG_LSL_UP[i].bit 3 = 0 **or** LV_END_DIAG_LSL_UP_IF[i] = 1)
and
(C_NR_END_DIAG_LSL_UP[i].bit 4 = 0 **or** LV_END_DIAG_OBD_VLD_LSH_UP[i]= 1)
and
(C_NR_END_DIAG_LSL_UP[i].bit 5 = 0 **or** LV_END_DIAG_DYN_VLD_LS_UP[i] = 1)
and
(C_NR_END_DIAG_LSL_UP[i].bit 6 = 0 **or** LV_END_DIAG_SHIFT_AFL_LSL_UP[i]=1)
and
(C_NR_END_DIAG_LSL_UP[i].bit 7 = 0 **or** LV_END_DIAG_SHIFT_AFR_LSL_UP[i]=1)
and
(C_NR_END_DIAG_LSL_UP[i].bit 8 = 0 **or** LV_END_DIAG_PUC_VLD_LS_UP[i] = 1)
and
(C_NR_END_DIAG_LSL_UP[i].bit 9 = 0 **or** LV_END_DIAG_LSH_LSL_UP[i] = 1)
and
(C_NR_END_DIAG_LSL_UP[i].bit 10 = 0 **or** LV_END_DIAG_AIR_LSL_UP[i] = 1)
and
(C_NR_END_DIAG_LSL_UP[i].bit 11 = 0 **or** LV_END_DIAG_CHG_LS_UP = 1)
then
LV_LS_UP_DIAG_END[i] = 1
else
LV_LS_UP_DIAG_END[i] = 0

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endif

B.43.2 Downstream O2 sensor final diagnosis

FUNCTION DESCRIPTION:

General information:

This function shall summarize the diagnostic status of the downstream oxygen sensor delivered from the OBD I & II (heater and sensor) functions through the flag LV_ERR_LS_DOWN[i].

The ultimate error flag LV_ERR_LS_DOWN[i] is a System Error Flag. It should neither be saved in the Error Management nor a DTC code should be given.

To reduce the number of variables to be checked by other diagnosis functions, the collecting flag LV_LS_DOWN_DIAG_END is introduced. It provides the possibility to combine the end flags from almost all the downstream lambda sensor diagnosis functions. By a bit mask variable it is calibratable which end flag contributes to the collecting end flag.

Note:

1. *If two separate Banks are concerned, then i=1 for cylinder bank 1 and i=2 for cylinder bank 2.*

2. The diagnosis for interchanged lambda sensors is not included in the final error and end flag as this is mainly related to the End of Line test or to a final check after a repair in the garage.

Application conditions

Initialisation:

At LV_IGK = 0 to 1, reset **or**at clearing error memory:

LV_ERR_LS_DOWN[i]= 0
LV_LS_DOWN_OBD_1_MAN_DEAC[i] = 0
LV_LS_DOWN_OBD_2_MAN_DEAC[i] = 0
LV_LS_DOWN_DIAG_END[i] = 0

Recurrence:

The function should be carried out once every 100 ms.

Activation /Deactivation:

The diagnosis will be carried out only if LV_ST_END = 1

Formula section:

If LV_LS_DOWN_OBD_MAN_DEAC_EXT = 1
Then LV_LS_DOWN_OBD_1_MAN_DEAC[i] = 1
LV_LS_DOWN_OBD_2_MAN_DEAC[i] = 1
Else
LV_LS_DOWN_OBD_1_MAN_DEAC[i] = LC_LS_DOWN_OBD_1_MAN_DEAC[i]
LV_LS_DOWN_OBD_2_MAN_DEAC[i] = LC_LS_DOWN_OBD_2_MAN_DEAC[i]
Endif

Calculation of sum error bit for downstream oxygen sensor diagnosis

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IF

LC_LS_DOWN_DIAG_ACT[i] = 1 % final diagnosis active

(LV_ERR_EL_LS_DOWN[i]= 1 % electrical failure
LV_ERR_SWT_LS_DOWN[i] = 1 % switching time rich-to-lean failure **OR**
(LV_ERR_PUE_LS_DOWN[i] = 1 % sensor signal after PUC phase failure **AND**
LC_DIAG_PUE_ACT_LS_DOWN**)**
LV_ERR_CHK_LS_DOWN[i] = 1 % error detected by the active test **OR**
LV_ERR_PLAUS_LS_DOWN[i] = 1 % error detected by the passive test **OR**
LV_ERR_LSH_DOWN[i] = 1 % heater electrical failure **OR**
LV_ERR_OBD_LSH_DOWN[i] = 1 % heater obd2 failure **OR**
(LV_ERR_CHG_LS_DOWN = 1 & LC_ERR_CHG_LS_DOWN = 1) **OR**
% sensor interchanged failure
LC_LS_DOWN_ERR[i] = 1 **)** % manual activation of sensor error

THEN
LV_ERR_LS_DOWN[i]= 1
ELSE
LV_ERR_LS_DOWN[i]= 0
ENDIF

The general end flag is created according to the following logic:

If the corresponding bit is one, the LV_END_DIAG_XX flag shall be considered for the final end flag.

Bit position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Bit mask variable (example) C_NR_END_DIAG_LS_DOWN[i]	0	0	0	0	0	0	0	1	1	1	0	1	1	1	1	1
	Not used	Not used	Not used	Not used	Not used	LV_END_DIAG_CHG_LS_DOW	LV_END_DIAG_PUE_LS_DOWN[i]	LV_END_DIAG_SWT_LS_DOWN[i]	LV_END_DIAG_CHK_LS_DOWN[i]	LV_END_DIAG_PUC_LS_DOWN[i]	LV_END_DIAG_FL_LS_DOWN[i]	LV_END_DIAG_OC_LS_DOWN[i]	LV_END_DIAG_SCG_LS_DOWN[i]	LV_END_DIAG_SCP_LS_DOWN[i]	LV_END_DIAG_OBD_LSH_DOWN[i]	LV_END_DIAG_LSH_DOWN[i]

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For this proposal, the number would be 0000000111011111 binary = 479 decimal.

The bitmask shall be combined with the single end flags as follows:

If [(C_NR_END_DIAG_LS_DOWN[i].bit 0 = 0 **or** LV_END_DIAG_LSH_DOWN[i] = 1)

and
(C_NR_END_DIAG_LS_DOWN[i].bit 1 = 0 **or** LV_END_DIAG_OBD_LSH_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 2 = 0 **or** LV_END_DIAG_SCP_LS_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 3 = 0 **or** LV_END_DIAG_SCG_LS_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 4 = 0 **or** LV_END_DIAG_OC_LS_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 5 = 0 **or** LV_END_DIAG_FL_LS_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 6 = 0 **or** LV_END_DIAG_PUC_LS_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 7 = 0 **or** LV_END_DIAG_CHK_LS_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 8 = 0 **or** LV_END_DIAG_SWT_LS_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 9 = 0 **or** LV_END_DIAG_PUE_LS_DOWN[i] = 1)
and
(C_NR_END_DIAG_LS_DOWN[i].bit 10 = 0 **or** LV_END_DIAG_CHG_LS_DOWN = 1)

then
LV_LS_DOWN_DIAG_END[i] = 1
else
LV_LS_DOWN_DIAG_END[i] = 0
endif

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B.44 O2 sensor (up, down) diagnosis management (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LS_DOWN_OBD_MAN_DEAC_EXT	O/V	0... 1H	0 ...1	1	-
Downstream Oxygen Sensor Diagnosis deactivation for all banks					
LV_LS_UP_OBD_MAN_DEAC_EXT	O/V	0... 1H	0 ...1	1	-
Upstream WRAF Sensor Diagnosis deactivation for all banks					

Input data:

LV_VAR_LSH_DOWN {p. 656}	LV_VAR_LSH_UP {p. 656}		

B.44.1 General inhibition of all upstream oxygen sensor diagnosis for systems without lambda-sensors

FUNCTION DESCRIPTION:

General information:

This function serves to be able to deactivate all WRAF Sensor Diagnosis functions with one flag. If the variant "Lambda-sensors" is not learnt then all upstream-diagnosis are inhibited.

Application conditions

Initialisation after reset: LV_LS_UP_OBD_MAN_DEAC_EXT **=!** LV_VAR_LSH_UP

Recurrence: The function should be carried out once every 1000 ms.

Activation: LV_IGK = 1

Deactivation: LV_IGK = 0

Formula section:

LV_LS_UP_OBD_MAN_DEAC_EXT **=!** LV_VAR_LSH_UP

B.44.2 General inhibition of all downstream oxygen sensor diagnosis for systems without lambda-sensors

FUNCTION DESCRIPTION:

General information:

This function serves to be able to deactivate all Downstream Oxygen Sensor Diagnosis functions with one flag. If the variant "Lambda-sensors" is not learnt then all downstream-diagnosis are inhibited.

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Application conditions

Initialisation after reset: LV_LS_DOWN_OBD_MAN_DEAC_EXT **=!** LV_VAR_LSH_DOWN

Recurrence: The function should be carried out once every 1000 ms.

Activation: *LV_IGK = 1*

Deactivation: LV_IGK = 0

Formula section:

LV_LS_DOWN_OBD_MAN_DEAC_EXT **=!** LV_VAR_LSH_DOWN

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B.45 Activation conditions for catalyst efficiency diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CAT_DIAG_CDN_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Activation conditions for O2 sensor and catalyst efficiency diagnosis (OSC method)					
MAF_INT_DLY_CAT_DIAG [NC_CBK_EX_NR]	V	0... FFFFH	0 ...1	0.02222222	g
Air mass flow integral after conditions are fulfilled for catalyst diagnosis activation					

Input data:

AMP_AD {p. 982}	CL_MMV {p. 3698}	LV_CAT_DIAG_REQ_EOL {p. 799}	LV_CAT_LDC [NC_CBK_EX_NR] {p. 5542}
LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_CL_CLC_AVL {p. 3635}	LV_DC {p. 5746}	LV_LAM_ADJ_RNG_VLD_CAT_DIAG [NC_CBK_EX_NR] {p. 1037}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_LAM_STOP [NC_CBK_EX_NR] {p. 1016}	LV_LAMB_PLS_ACT [NC_CBK_EX_NR] {p. 2954}	LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}
LV_SAWUP {p. 804}	MAF {p. 8277}	MAF_CYL {p. 8277}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	STATE_CP {p. 3637}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	TCO {p. 1100}
TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	VS {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_MIN_CAT	-	0... FFFFH	0... 5434	0.08291752	hPa
Min. ambient pressure threshold					
C_CL_MAX_CAT	-	0... FFFFH	0... 1.99996948	305.176e3	-
Maximum canister load to allow catalyst and O2 sensor diagnosis					
C_MAF_HYS_CAT	-	0... FFFFH	0... 1389	0.02119478	mg/stk
hysterese after exceeding MAF_LAM_CAT threshold					
C_MAF_INT_DLY_CAT_DIAG	-	0... FFFFH	0 ...1	0.02222222	g
Air mass flow threshold for cat diag activation after PUC, CL max purge, forced stimulation on, downstream sensor ready					
C_MAF_INT_SW_CAT_DIAG	-	0... FFFFH	0 ...1	0.02222222	g
Air mass flow initial for cat diag activation after MAX to NO_PURGE and back					
C_TCO_MIN_CAT	-	0... FEH	0... 142.5	0.75	°C
Min TCO threshold					
C_TEMP_HYS_CAT	-	0... FFH	0... 1766.85	8	°C
hysteresis after exeeding catayst temperature threshold for catalyst diagnosis activation					
C_TEMP_MAX_CAT	-	0... FFH	0... 1766.85	8	°C
max. catalyst temperature threshold for catalyst diagnosis activation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TEMP_MIN_CAT	-	0... FFH	0... 1766.85	8	°C
min. catalyst temperature threshold for catalyst diagnosis activation					
C_TEMP_MIN_CAT_EOL	-	0... FFH	0... 1766.85	8	°C
min. catalyst temperature threshold for catalyst diagnosis activation in case of EOL test					
C_VS_MAX_CAT	-	0... FFH	0... 255	1	km/h
max. VS threshold					
C_VS_MIN_CAT	-	0... FFH	0... 255	1	km/h
min. VS threshold					
IP_MAF_MAX_CAT	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDPM_N_32_3_EGTR	6	0... FFH	0... 8160	32	rpm
max. MAF threshold for catalyst diagnosis activation					
IP_MAF_MIN_CAT	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDPM_N_32_3_EGTR	6	0... FFH	0... 8160	32	rpm
min. MAF threshold for catalyst diagnosis activation					
LC_CAT_DIAG_CDN_ACT_MAN	-	0... 1H	0 ...1	1	-
flag to set catalyst diagnosis condition manually					

B.45.1 EGTR_FCTDGCEFAC0

This function determines the activation flag LV_CAT_DIAG_CDN_ACT[i] for catalyst efficiency diagnosis (OSC method). This flag can be also be set manually by LC_CAT_DIAG_CDN_ACT_MAN.

The recurrence time is defined by T_SAMPLE in [ms].
NC_CBK_EX_NR defines the number of exhaust banks.
For vector elements, the variable extension _i is used in the model instead of [i] as found in the textual description.

For the calculation of the air mass flow integral the unit conversion:
[g] = [kg/h] * [ms] * [(g*h) /(kg*ms)] /3600
has to be considered.

Application Condition

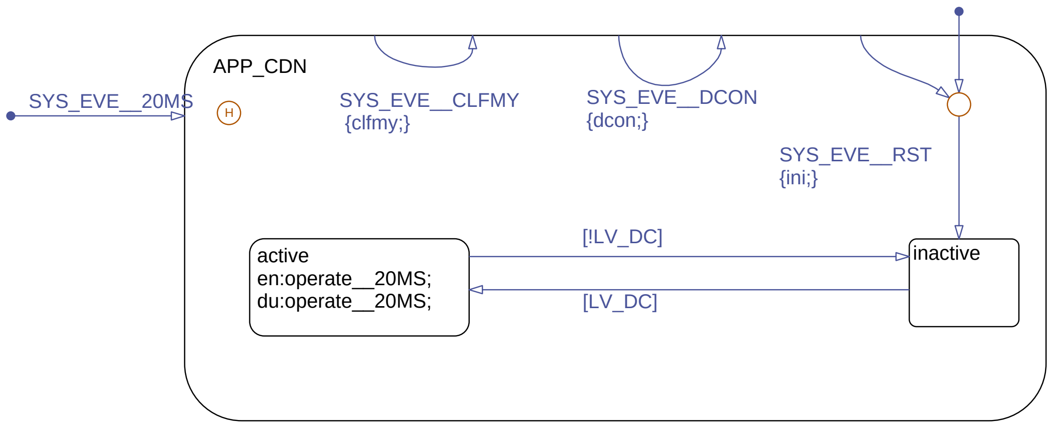

Figure B.45.1: EGTR_FCTDGCEFAC0/APP_CDN/APP_CDN

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Function Description

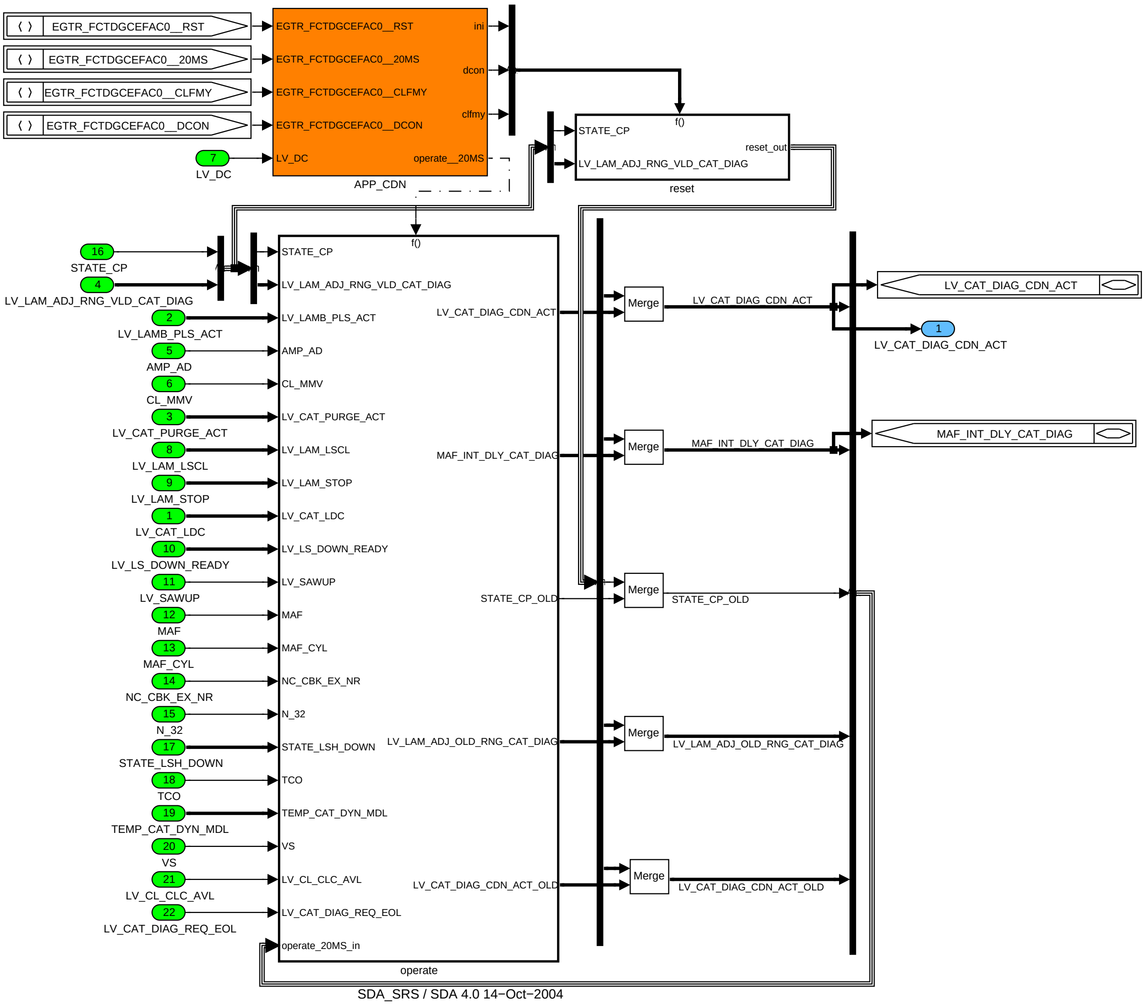

Figure B.45.2: EGTR_FCTDGCEFAC0

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B.45.1.1 SUBFUNCTION: operate

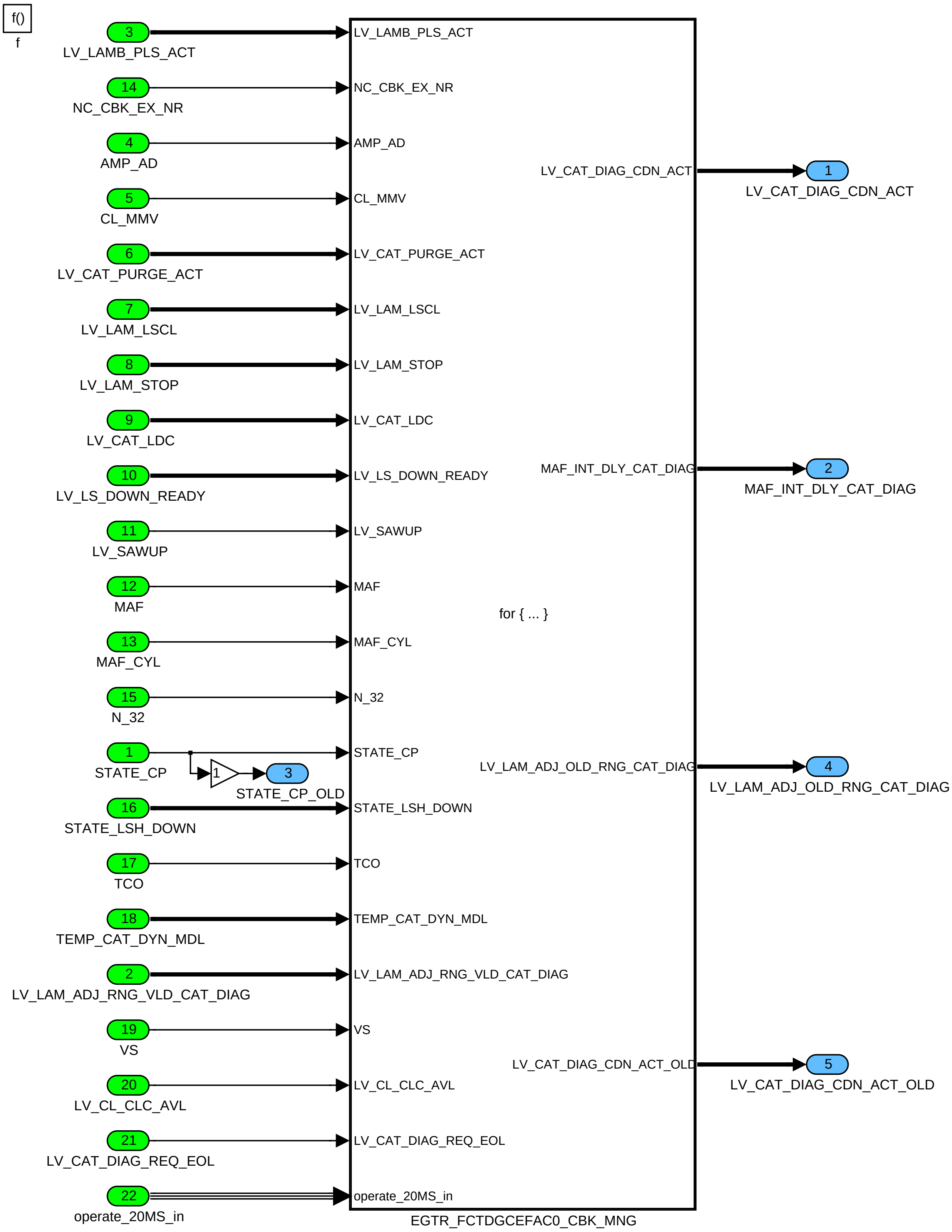

Figure B.45.3: EGTR_FCTDGCEFAC0/operate

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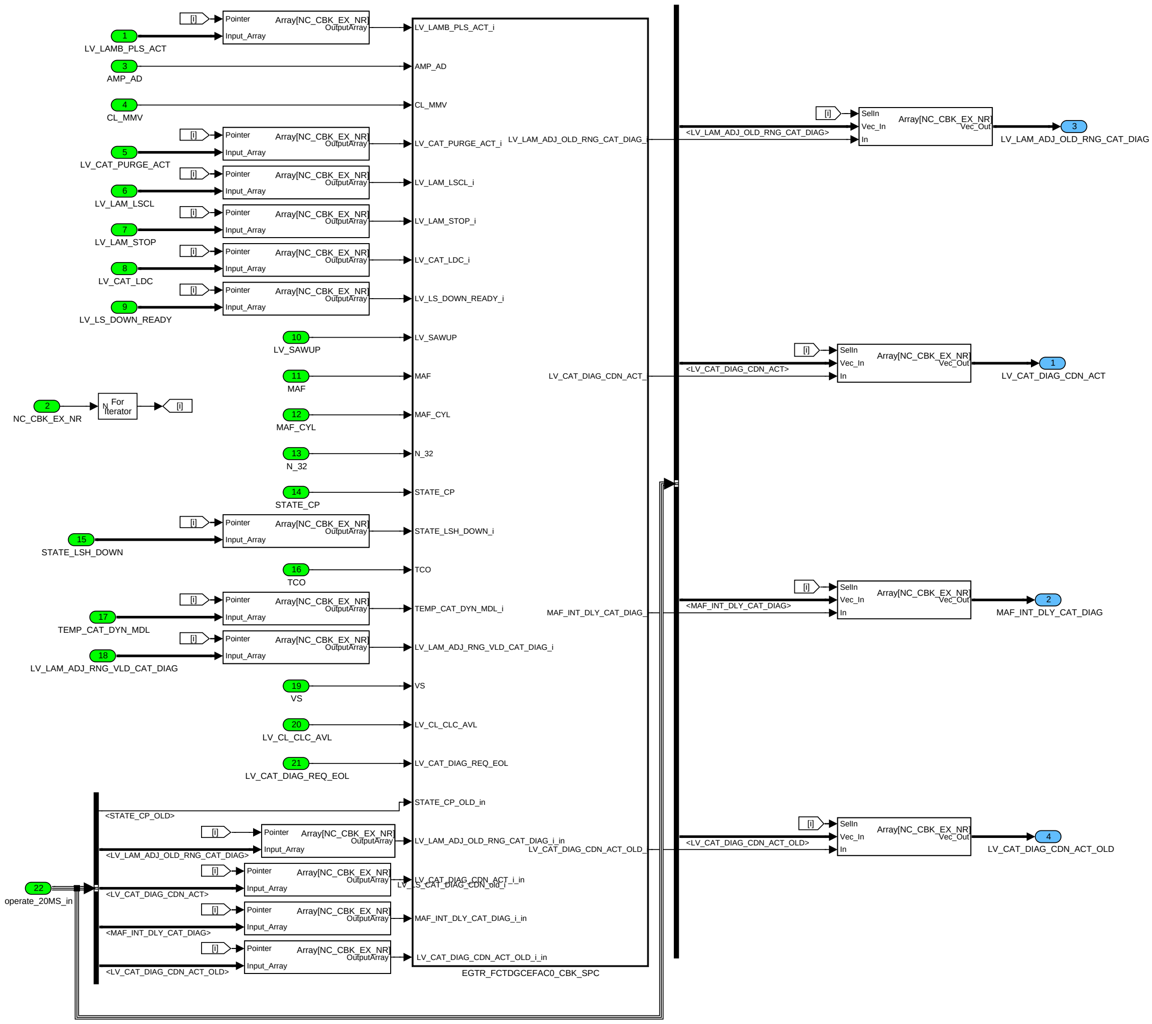

Figure B.45.4: EGTR_FCTDGCEFAC0/operate/EGTR_FCTDGCEFAC0_CBK_MNG

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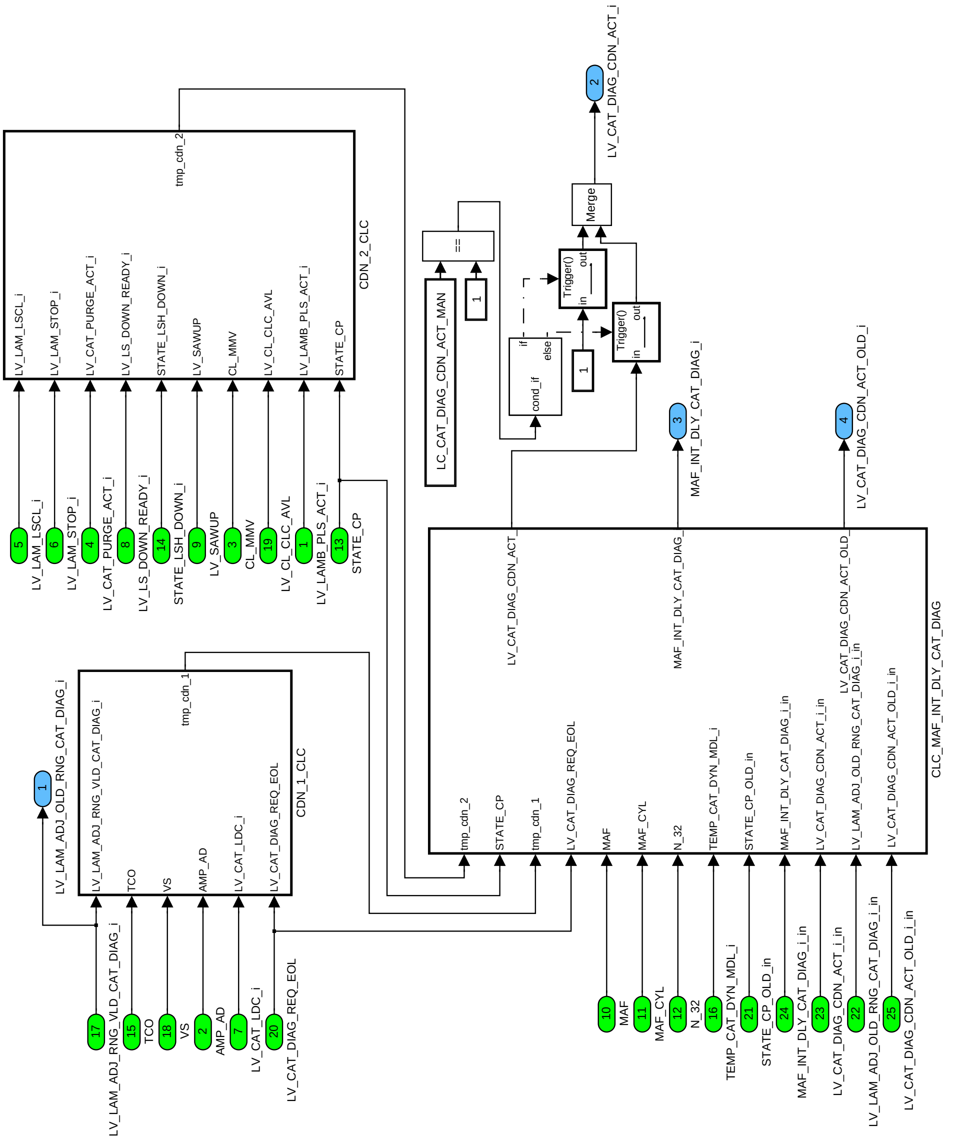

Figure B.45.5: EGTR_FCTDGCEFAC0/operate/EGTR_FCTDGCEFAC0_CBK_MNG/
EGTR_FCTDGCEFAC0_CBK_SPC

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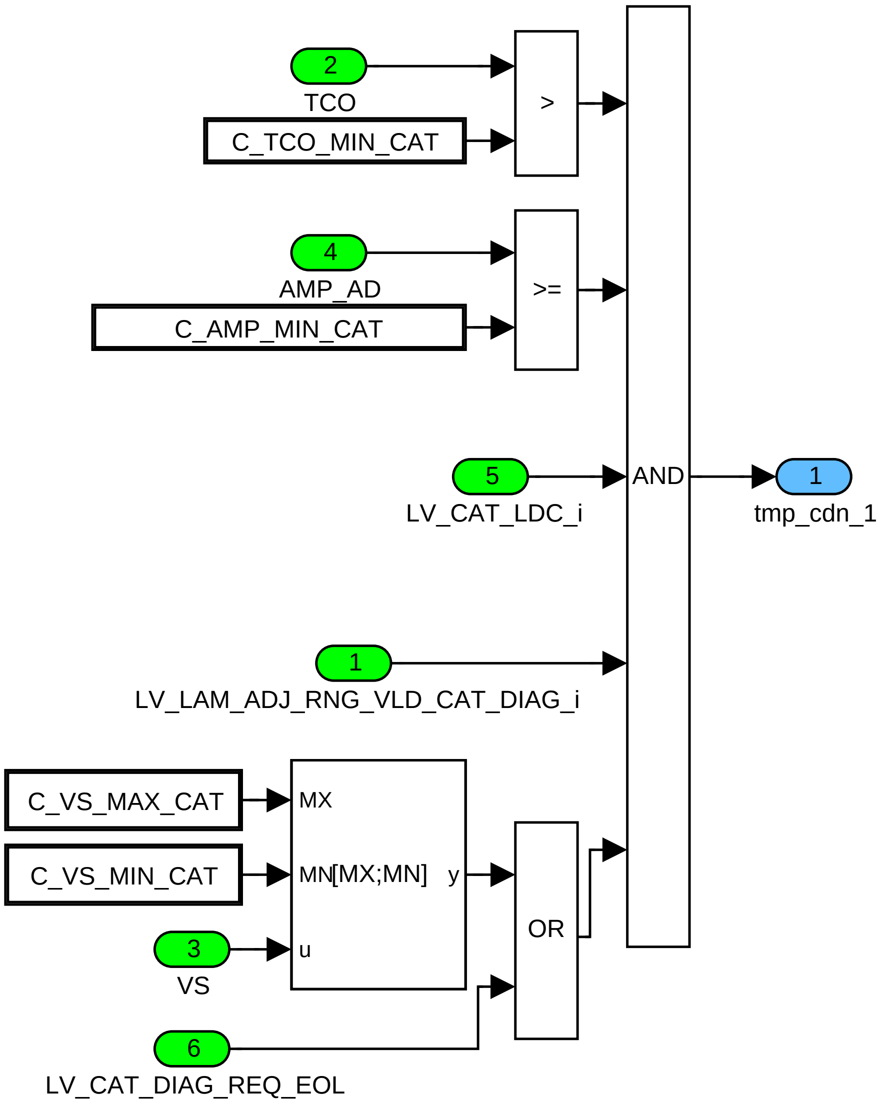

Figure B.45.6: EGTR_FCTDGCEFAC0/operate/EGTR_FCTDGCEFAC0_CBK_MNG/
EGTR_FCTDGCEFAC0_CBK_SPC/CDN_1_CLC

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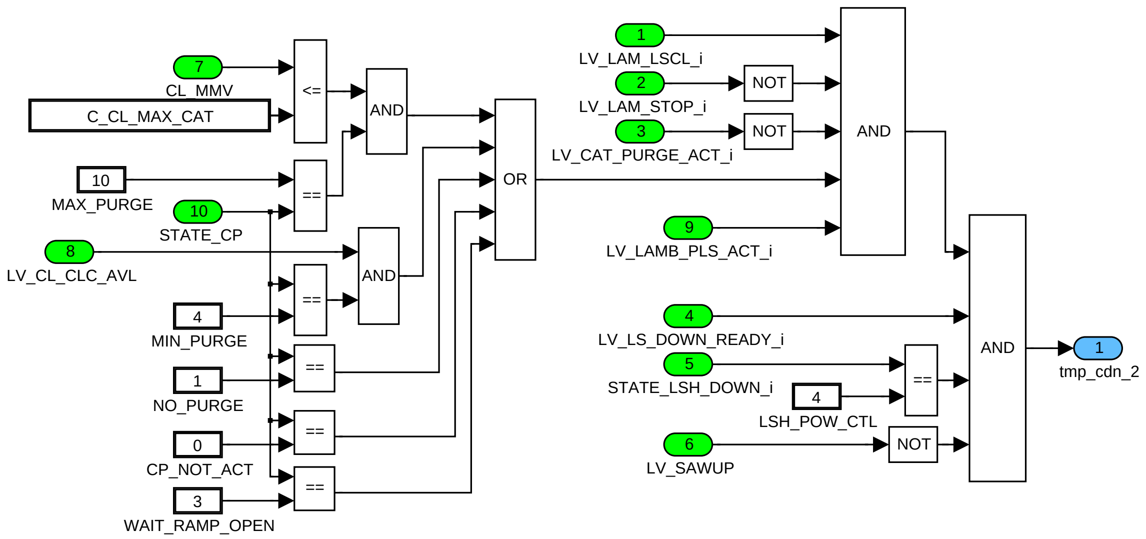

Figure B.45.7: EGTR_FCTDGCEFAC0/operate/EGTR_FCTDGCEFAC0_CBK_MNG/
EGTR_FCTDGCEFAC0_CBK_SPC/CDN_2_CLC

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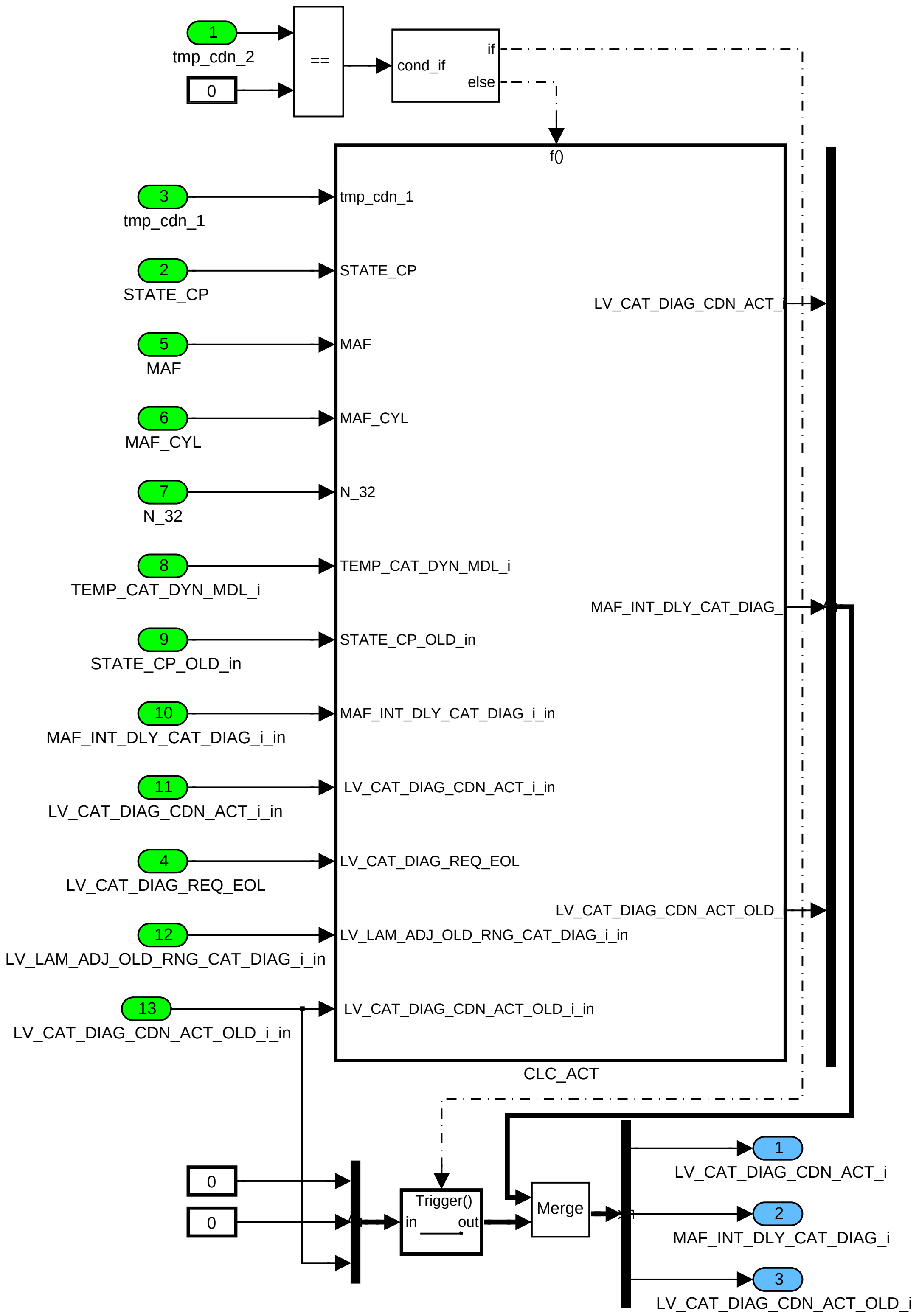

Figure B.45.8: EGTR_FCTDGCEFAC0/operate/EGTR_FCTDGCEFAC0_CBK_MNG/
EGTR_FCTDGCEFAC0_CBK_SPC/CLC_MAF_INT_DLY_CAT_DIAG

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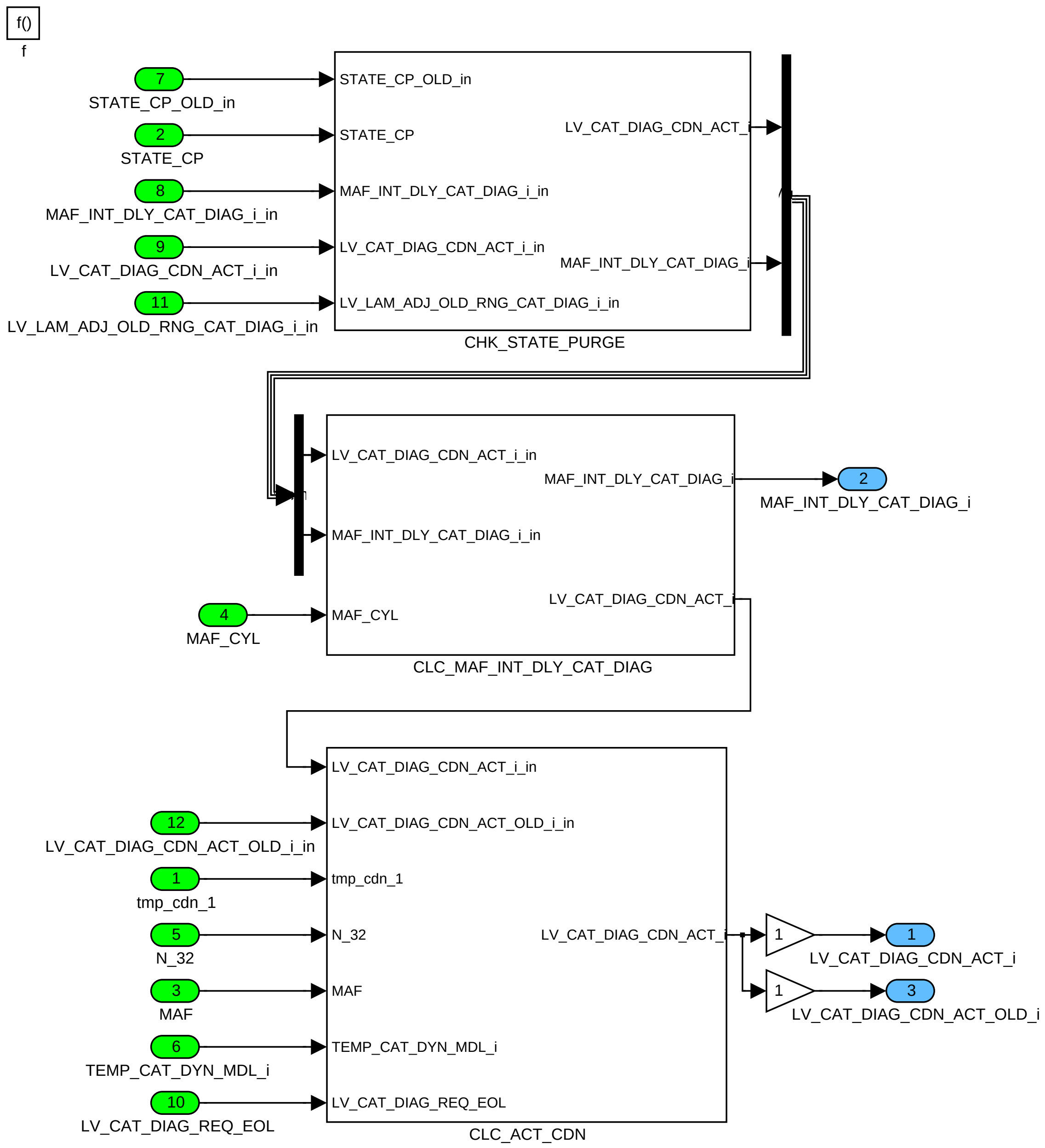

Figure B.45.9: EGTR_FCTDGCEFAC0/operate/EGTR_FCTDGCEFAC0_CBK_MNG/
EGTR_FCTDGCEFAC0_CBK_SPC/CLC_MAF_INT_DLY_CAT_DIAG/CLC_ACT

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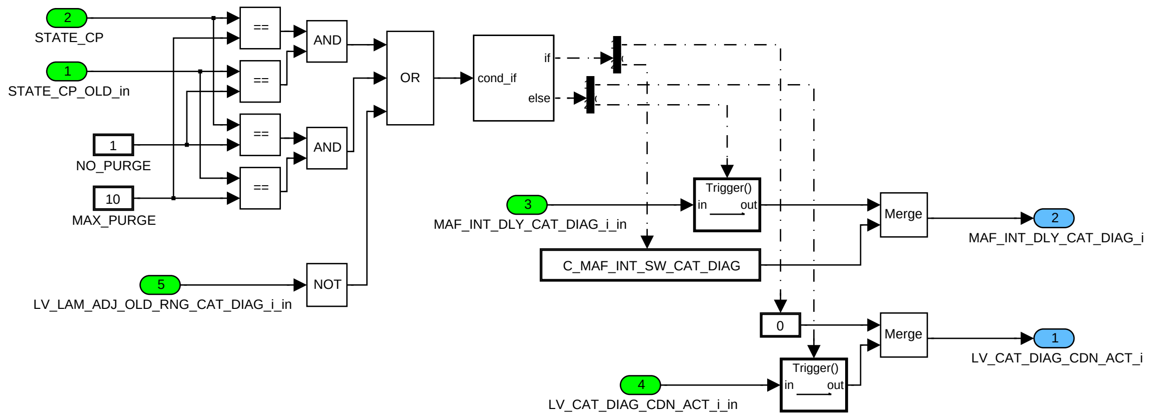

Figure B.45.10: EGTR_FCTDGCEFAC0/operate/EGTR_FCTDGCEFAC0_CBK_MNG/EGTR_FCTDGCEFAC0_CBK_SPC/CLC_MAF_INT_DLY_CAT_DIAG/CLC_ACT/CHK_STATE_PURGE

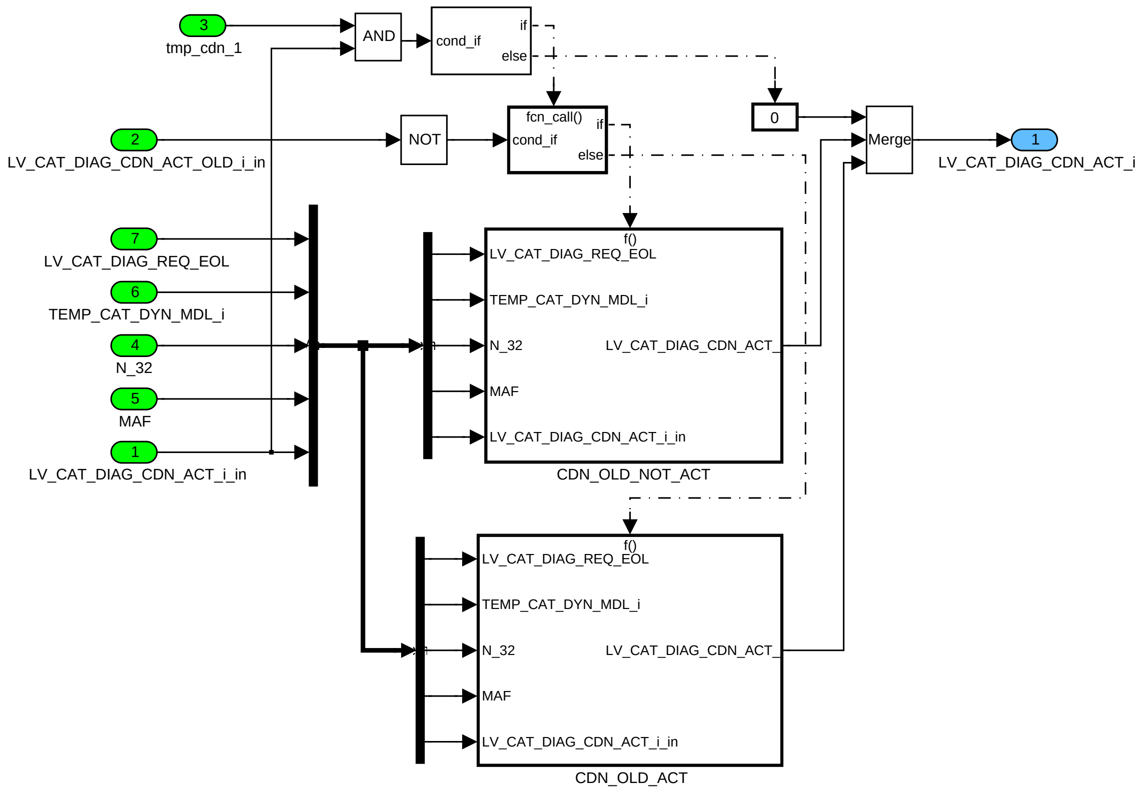

Figure B.45.11: EGTR_FCTDGCEFAC0/operate/EGTR_FCTDGCEFAC0_CBK_MNG/EGTR_FCTDGCEFAC0_CBK_SPC/CLC_MAF_INT_DLY_CAT_DIAG/CLC_ACT/CLC_ACT_CDN

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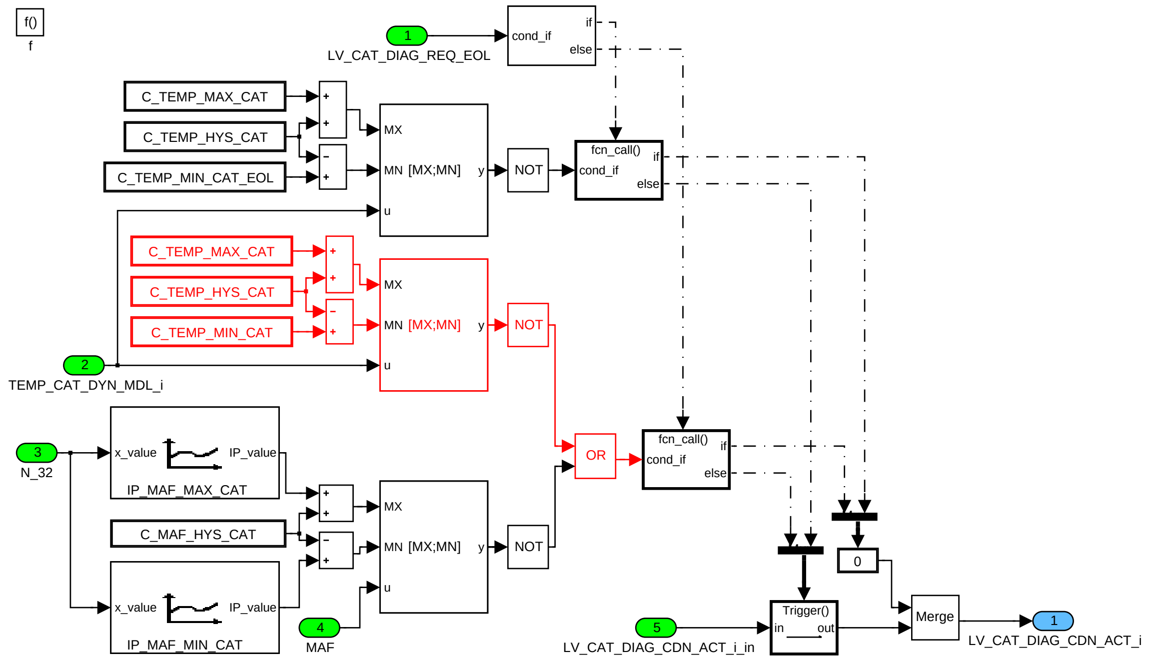

Figure B.45.12: EGTR_FCTDGCEFAC0/operate/EGTR_FCTDGCEFAC0_CBK_MNG/EGTR_FCTDGCEFAC0_CBK_SPC/CLC_MAF_INT_DLY_CAT_DIAG/CLC_ACT/CLC_ACT_CDN/CDN_OLD_ACT

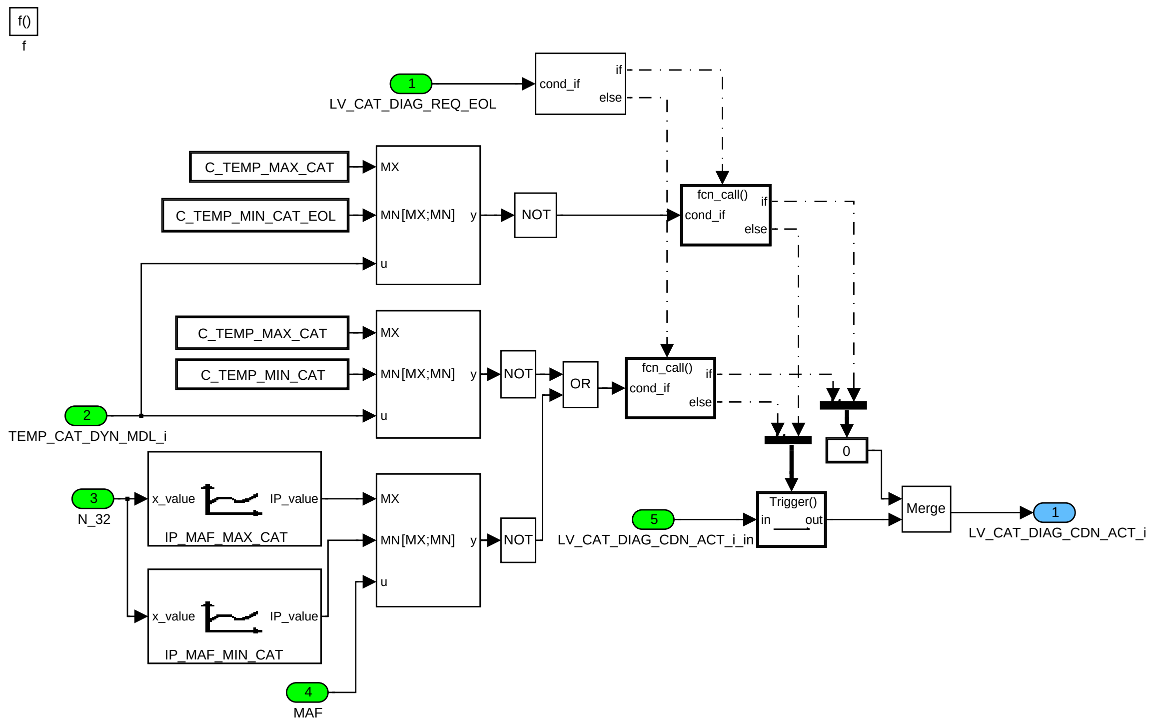

Figure B.45.13: EGTR_FCTDGCEFAC0/operate/EGTR_FCTDGCEFAC0_CBK_MNG/EGTR_FCTDGCEFAC0_CBK_SPC/CLC_MAF_INT_DLY_CAT_DIAG/CLC_ACT/CLC_ACT_CDN/CDN_OLD_NOT_ACT

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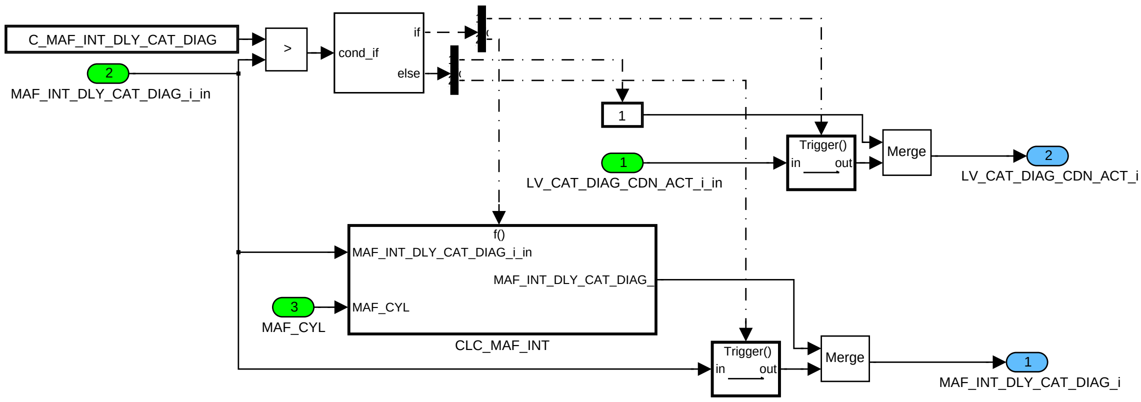

Figure B.45.14: EGTR_FCTDGCEFAC0/operate/EGTR_FCTDGCEFAC0_CBK_MNG/EGTR_FCTDGCEFAC0_CBK_SPC/CLC_MAF_INT_DLY_CAT_DIAG/CLC_ACT/CLC_MAF_INT_DLY_CAT_DIAG

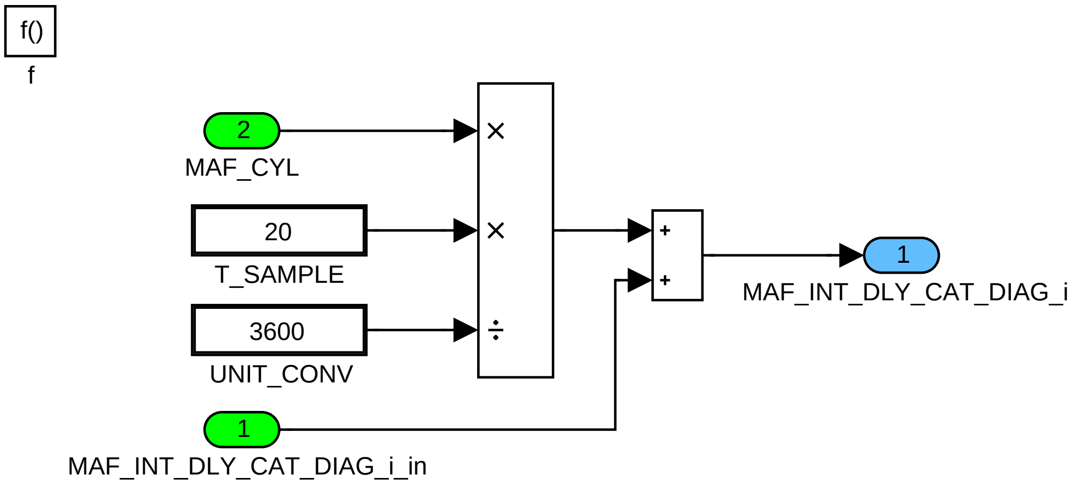

Figure B.45.15: EGTR_FCTDGCEFAC0/operate/EGTR_FCTDGCEFAC0_CBK_MNG/EGTR_FCTDGCEFAC0_CBK_SPC/CLC_MAF_INT_DLY_CAT_DIAG/CLC_ACT/CLC_MAF_INT_DLY_CAT_DIAG/CLC_MAF_INT

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B.45.1.2 SUBFUNCTION: reset

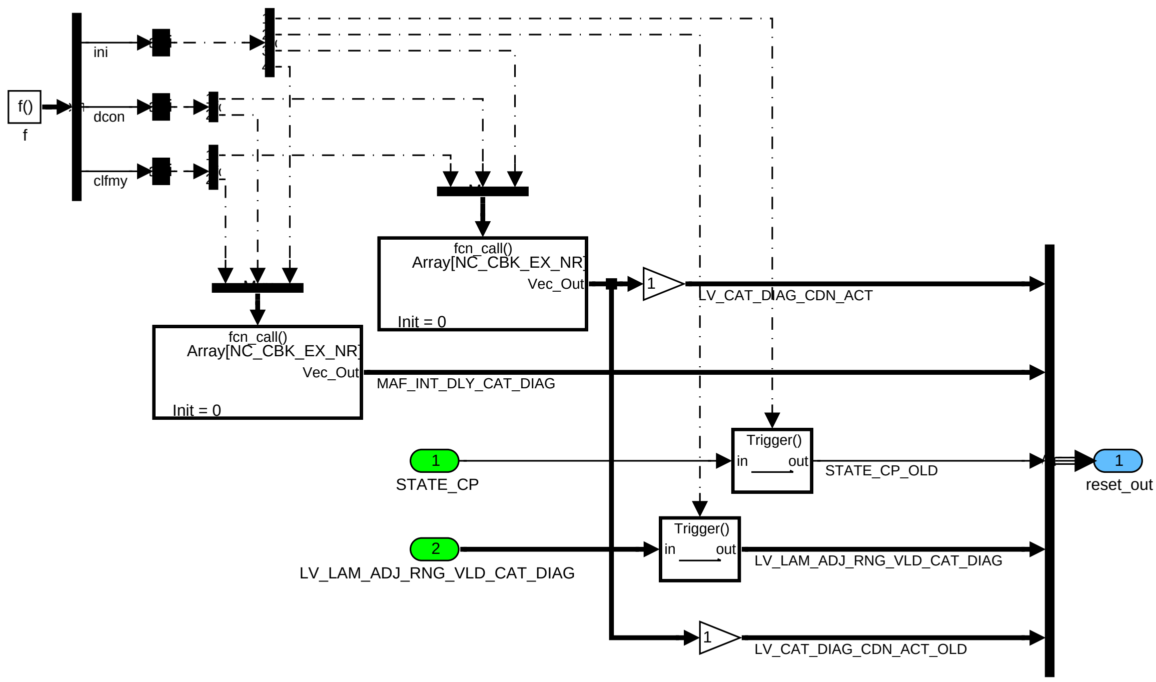

Figure B.45.16: EGTR_FCTDGCEFAC0/reset

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B.46 Catalyst efficiency diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CAT_DIAG [NC_CBK_EX_NR]	V	0... 1FFH	0... 511	1	-
monitoring cycle counter					
CTR_LAMB_CAT_DOWN_SUM [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter for the summation of LAMB_CAT_DOWN_SUM for each period					
CTR_LAMB_OUT_CAT_DIAG [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter of non valid cycle due to LAMB_CAT_DOWN_MV[i] is not in right range, for switch off Cat Diag					
CTR_TOT_CAT_DIAG [NC_CBK_EX_NR]	V/S	0... FFH	0... 255	1	-
Total sum of all completed diagnosis cycles since ECU programming					
EFF_CAT_DIAG_HOM [NC_CBK_EX_NR]	O/V/S	0... FFH	0... 1.9921875	7.8125e-3	-
Catalyst diagnosis value in OSC range (from lambda=1 cat diag)					
FLOW_O2_CAT_DIF [NC_CBK_EX_NR]	V	0... FFFFH	0... 0.00204441	31.1957e-9	g/ms
downstream O2 flow difference to mean value					
LAMB_CAT_DOWN [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Lambda downstream of catalyst; linearization of downstream LS signal					
LAMB_CAT_DOWN_MAX [NC_CBK_EX_NR]	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Maximum of LAMB_CAT_DOWN[NC_CBK_EX_NR] over diagnosis peroid					
LAMB_CAT_DOWN_MIN [NC_CBK_EX_NR]	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Minimum of LAMB_CAT_DOWN[NC_CBK_EX_NR] over diagnosis peroid					
LAMB_CAT_DOWN_MV [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	-
downstream lambda mean value for complete diagnosis period					
LAMB_CAT_DOWN_ST_CYC [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LAMB_CAT_DOWN[i] value at start of monitoring cycle					
LAMB_CAT_DOWN_SUM [NC_CBK_EX_NR]	V	0... FFFFFFFFH	0... 131071.999969	30.5176e-6	-
integral of downstream Lambda through 1diagnosis period for calculation of mean value					
LV_AFL_OLD [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Auxiliary flag for edge detection of LV_AFL[i]					
LV_CAT_CYC_WAIT_TMP [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
temporary flag for catalyst diagnosis wait state					
LV_LAM_ADJ_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to switch trim control parameters for OSC/NOX Cat. Diagnosis (only in case of NC_USE_EGTR = 0)					
LV_LAMB_PLS_REQ_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to switch forced stimulation parameters for OSC/NOX Cat. Diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MASS_O2_CAT_DIF_CYC [NC_CBK_EX_NR]	V	0... FFFFH	0... 0.0817765299	1.24783e-6	g
Mass O2 downsteam catalyst to mean value through 1 diagnosis period					
RATIO_MASS_O2_CAT_DIF [NC_CBK_EX_NR]	V	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Weighted MASS_O2_CAT_DIF_CYC[i] value related to O2-load upstream catalyst from lambda controller					
RATIO_MASS_O2_CAT_DIF_SUM [NC_CBK_EX_NR]	V	0... FFFFFFFFH	0... 131071.999969	30.5176e-6	-
Summation of MASS_O2_CAT_DIF_RATIO[i] over all valid monitoring cycles					
STATE_CAT_DIAG [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H 4H 5H	PASSIVE WAIT CYC_LEAN CYC_RICH END RAMP_UP	-	-
State of diagnosis					
STATE_CAT_DIAG_CYC_VLD [NC_CBK_EX_NR]	V	0... 3FH	0... 63	1	-
Summary validity bits, current monitoring cycle valid and involved in calculation of diagnosis value; 1H = 1CROSS; 2H = MVDEL; 4H = 2CROSS; 8H = DIFMV; 10H = RANGE; 20H = TEMP					
TEMP_CAT_DIF_DYN_STAT [NC_CBK_EX_NR]	V	0... FFH	-256 ...254	2	°C
Temperature difference between dynamic and stationary catalyst temperature (from cat. temperature model)					

Input data:

C_NR_STEP_PLS_NOM_CAT_DIAG {p. 2959}	CTR_STEP_PLS_NOM_CAT_DIAG {p. 2958}	LV_AFL [NC_CBK_EX_NR] {p. 2439}	LV_AT {p. 654}
LV_CAT_DIAG_CDN_ACT [NC_CBK_EX_NR] {p. 5459}	LV_CAT_DIAG_REQ_EOL {p. 799}	LV_DC {p. 5746}	LV_INH_DIAG_CAT_DIAG [NC_CBK_EX_NR] {p. 5506}
MAF_CYL {p. 8277}	MAF_HB {p. 805}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}
STATE_LAMB_PLS_DET_VALUE {p. 2958}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	TEMP_CAT_STAT_MDL [NC_CBK_EX_NR] {p. 8237}	VLS_DELTA_LAM_ADJ_CAT_DIAG [NC_CBK_EX_NR] {p. 2613}
VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_SP_LAM_ADJ [NC_CBK_EX_NR] {p. 2590}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_LAMB_OUT_CAT_DIAG	-	0... FFH	0... 255	1	-
Threshold to switch off Cat Diag due to to LAMB_CAT_DOWN_MV is not in the right range					
C_CTR_MIN_CAT_DIAG	-	0... 1FFH	0... 511	1	-
min. number of required monitoring cycles for catalyst diagnosis					
C_CTR_MIN_CAT_DIAG_EOL	-	0... 1FFH	0... 511	1	-
min. threshold of required monitoring cycles for catalyst diagnosis at EOL test					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_CAT_DELTA_MAX [NC_CBK_EX_NR]	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
max. deviation between LAMB_CAT_MV and setpoint for a valid monitoring cycle					
C_LAMB_CAT_DELTA_MAX_EOL [NC_CBK_EX_NR]	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
max. deviation between LAMB_CAT_MV and setpoint for a valid monitoring cycle at end-of-line test					
C_LAMB_CAT_MV_DELTA_MAX [NC_CBK_EX_NR]	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
max. allowed fluctuation between LAMB_CAT_DOWN[i] and LAMB_CAT_DOWN_MV[i] fin the same monitoring cycle					
C_LAMB_CAT_MV_DIF_MAX [NC_CBK_EX_NR]	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
max. allowed LAMB_CAT_DOWN_MV[i] fluctuation between 2 subsequent monitoring cycles					
C_N_32_CAT_DIAG_DEAC	-	0... FFH	0... 8160	32	rpm
Engine speed threshold to deactivate catalyst diagnosis to save ECU performance					
C_O2L_CAT_AFL	-	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Adjust parameter for RATIO_MASS_O2L_CAT_DIF calculation					
C_TEMP_CAT_DIF_DYN_MAX [NC_CBK_EX_NR]	-	0... 7FH	0... 254	2	°C
Max. Temperature difference for catalyst diagnosis cycle validity					
C_TEMP_CAT_DIF_DYN_ST [NC_CBK_EX_NR]	-	0... 7FH	0... 254	2	°C
Max. Temperature difference for catalyst diagnosis begin					
IP_FAC_MASS_O2_CAT_DIAG_AT	V	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
weight factor of downstream sensor signal integral for automatic transmission					
IP_FAC_MASS_O2_CAT_DIAG_MT	V	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDPM_N_32_1_EGTR	8	0... FFH	0... 8160	32	rpm
LDPM_MAF_HB_1_EGTR	8	0... FFH	0... 1389	5.4470588	mg/stk
weight factor of downstream sensor signal integral for manual transmission					
IP_FAC_TEMP_CAT_DIF_STAT	V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
LDP_TEMP_CAT_DYN_MDL_IP_FAC_CAT	8	0... FFH	-273.15 ...1766.85	8	°C
LDP_TEMP_CAT_DIF_DYN_STAT	8	0... FFH	-256 ...254	2	°C
Factor to correct cat.diag. value at catalyst temperature different to stationary temperature in this working point					
IP_LAMB_CAT	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDP_VLS_TEMP_IP_LAMB_CAT	12	0... 3FFH	0... 4.9951171875	4.88281e-3	V
lambda linearization from downstream LS signal					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

General Information

That catalyst diagnosis function is suitable for single branch (only one exhaust bank) and twin branch exhaust lines (two exhaust banks).
For a twin branch exhaust line the function has the same structure for both exhaust lines. The conversion properties of the two catalysts are monitored separately.
NC_CBK_EX_NR labels the number of exhaust banks.
For vector elements, the variable extension _i is used in the model instead of [i] as found in the textual description.

The signals from the control sensor upstream and the associated monitoring sensor downstream from the catalyst are used for catalyst diagnosis.
If a catalyst has good conversion properties, the oscillating lambda signal upstream from the catalyst generated by the lambda controller (which shall ensure defined O2-load of catalyst) downstream is smoothed by the Oxygen Storage Capacity of the catalyst.
If the conversion provided by the catalyst is low due to aging, poisoning by leaded fuel or misfire, then the oscillating lambda signal upstream of the catalyst also exists downstream of the catalyst. The lambda oscillation downstream of the catalyst is detected by an oxygen sensor (monitoring sensor).
Every monitored catalyst or combination of catalysts shall be indicated when the HC emission exceeds the applicable emission test threshold.

Description:
The diagnosis algorithm is realized with a state machine in order to improve specification understanding and coherence between specification and SW.

Monitoring cycle:(STATE_CAT_DIAG[i]: CYC_LEAN and CYC_RICH)
The first monitoring cycle is started following the rich-lean change (LV_AVL 0->1). A monitoring cycle lasts one complete lambda controller period (2 subsequent lambda richness changes). Several monitoring cycles are needed to finish the diagnosis.
At activation of Catalyst diagnosis the Forced stimulation is switched to higher Cat diag forced stimulation (soft switch in NC_NOM_CAT_DIAG_STEP cycles) and Trim control is switched to Cat diag parameters (P-share and I-share with own calibration, additionally shift of VLS setpoint depends from EFF_CAT_DIAG_HOM value). VLS_DOWN signal from monitoring Lambda sensor is converted with inverse sensor characteristic LAMB_CAT_DOWN_i.
In the wait state before the first cycle after every reactivation (rich-lean change LV_AFL) only LAMB_CAT_DOWN_MV_i is calculated. LAMB_CAT_DOWN_SUM_i is obtained by the summation of the LAMB_CAT_DOWN_i over a complete monitoring cycle. If LAMB_CAT_DOWN_MV_i agree with VLS_DOWN setpoint, catalyst diagnosis could start. WAIT state turns to RAMP_UP state and the O2load (realized by forced stimulation) ramps up from nominal value to catalyst diagnosis value. After ramp up of O2load finished, forced stimulation informs the catalyst diagnosis by forced stimulation state, really evaluated catalyst diagnosis cycles could start (CYC_LEAN/RICH).
LAMB_CAT_DOWN_MV_i is the mean value of the LAMB_CAT_DOWN_i - O2_load downstream the Catalyst calculated as inverse characteristic of binary lambda sensor from VLS_DOWN_i signal for one monitoring cycle. The calculation of MASS_O2_CAT_DIF_CYC_i is based on LAMB_CAT_DOWN_MV_i of the previous monitoring cycle. MASS_O2_CAT_DIF_CYC_i is the integrated difference between actual LAMB_CAT_DOWN_i signal and LAMB_CAT_DOWN_MV_i of the previous monitoring cycle.

Illustration monitoring cycle

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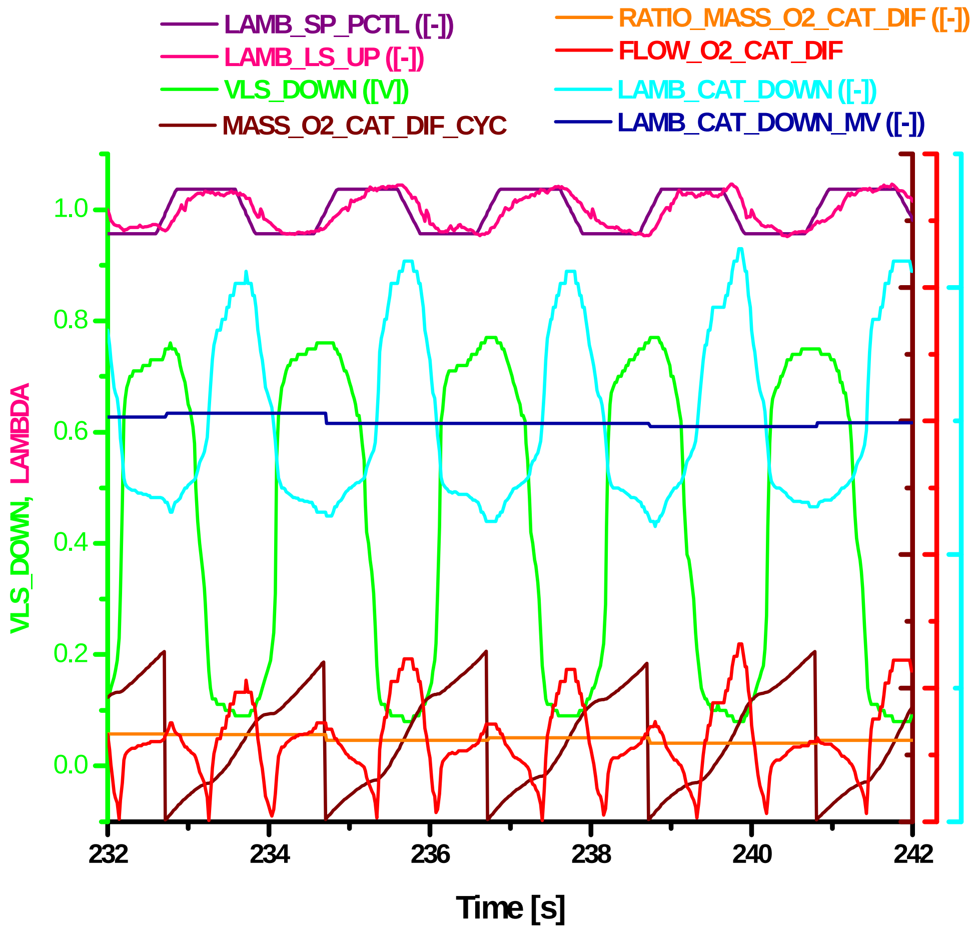

Validity check: (STATE_CAT_DIAG_i: Transition CYC_RICH -> CYC_LEAN)
The obtained MASS_O2_CAT_DIF_CYC[i] of a monitoring cycle is only used for the calculation of the diagnosis value if the validity check was passed (STATE_VLD_CAT_DIAG_i reach the minimum value for validity)

To pass the validity check it is necessary that:
LAMB_CAT_DOWN[i] must cross at least once LAMB_CAT_DOWN_MV[i] of the previous monitoring: 0.bit of STATE_VLD_CAT_DIAG_i is set (bit ’1CROSS’).
OR
The deviation between LAMB_CAT_DOWN[i] and LAMB_CAT_DOWN_MV[i] of the last monitoring cycle is smaller than C_LAMB_CAT_MV_DELTA_MAX: 1.bit of STATE_VLD_CAT_DIAG_i is set (bit ’MVDEL’).
OR
LAMB_CAT_DOWN[i] cross two times LAMB_CAT_DOWN_MV[i] of the previous monitoring (periodically braking down of VLS_DOWN occurs): 2.bit of STATE_VLD_CAT_DIAG_i is set (bit ’2CROSS’).
AND
Difference between actual and the LAMB_CAT_DOWN_MV[i] of the last monitoring cycle is not too high (if LAMB_CAT_DOWN[i] cross two times LAMB_CAT_DOWN_MV[i], higher difference allowed): 3.bit of STATE_VLD_CAT_DIAG_i is set (bit ’DIVMV’).
AND

LAMB_CAT_DOWN_MV[i] is in the right range 4.bit of STATE_VLD_CAT_DIAG_i is set (bit ’RANGE’).
AND

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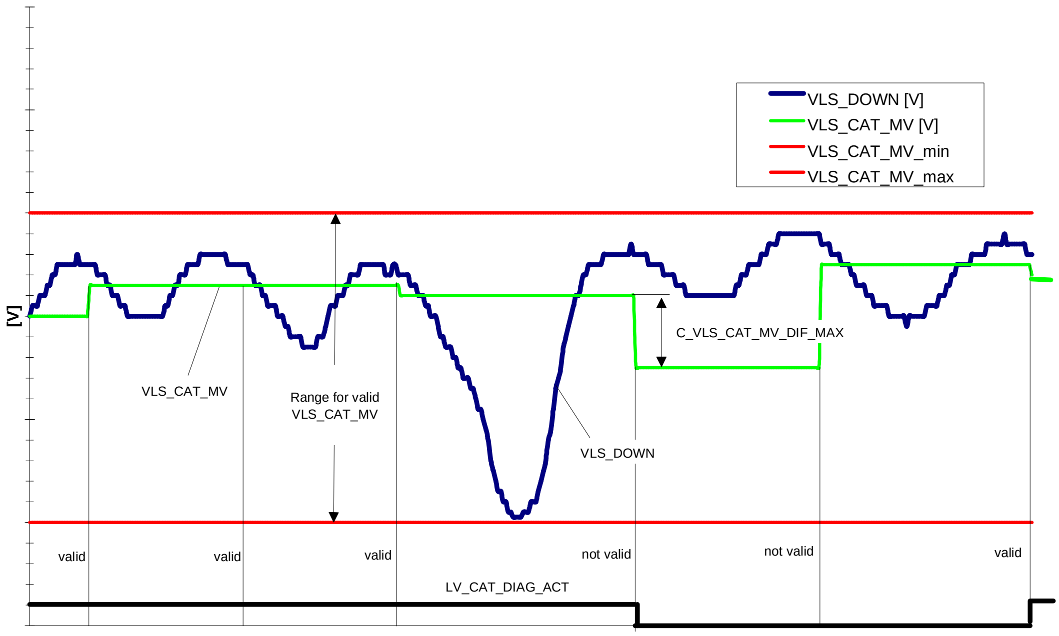
Catalyst temperature dynamic is limited: 5.bit of STATE_VLD_CAT_DIAG_i is set (bit 'TEMP').

Illustration validity check



Calculation of diagnosis value: (STATE_CAT_DIAG[i]: Transition CYC_RICH -> CYC_LEAN)
Monitoring cycle counter CTR_CAT_DIAG[i] is incremented for each valid monitoring cycle.
MASS_O2_CAT_DIF_CYC[i] is weighted by engine speed and load (IP_FAC_MASS_O2_CAT_DIAG_XX). From that calculation MASS_O2_CAT_DIF_RATIO[i] results. MASS_O2_CAT_DIF_RATIO[i] is summed up for all monitoring cycles. That summation give MASS_O2_CAT_DIF_RATIO_SUM[i]. Finally, the average of MASS_O2_CAT_DIF_RATIO_SUM[i] over all valid monitoring cycles give the diagnosis value EFF_CAT_DIAG_HOM[i]

End of diagnosis: (STATE_CAT_DIAG[i]: Transition CYC_LEAN -> END)
If the necessary number of valid monitoring cycles CTR_CAT_DIAG[i] reaches C_CTR_MIN_CAT_DIAG the diagnosis is ended for that driving cycle and the catalyst diagnosis value EFF_CAT_DIAG_HOM[i] is calculated and stored in the EEPROM.
The monitoring counter CTR_CAT_DIAG[i] is used to set the readiness code. For this reason C_CTR_MIN_CAT_DIAG must be reached in the emission test cycle.

State diagram: STATE_CAT_DIAG[i]

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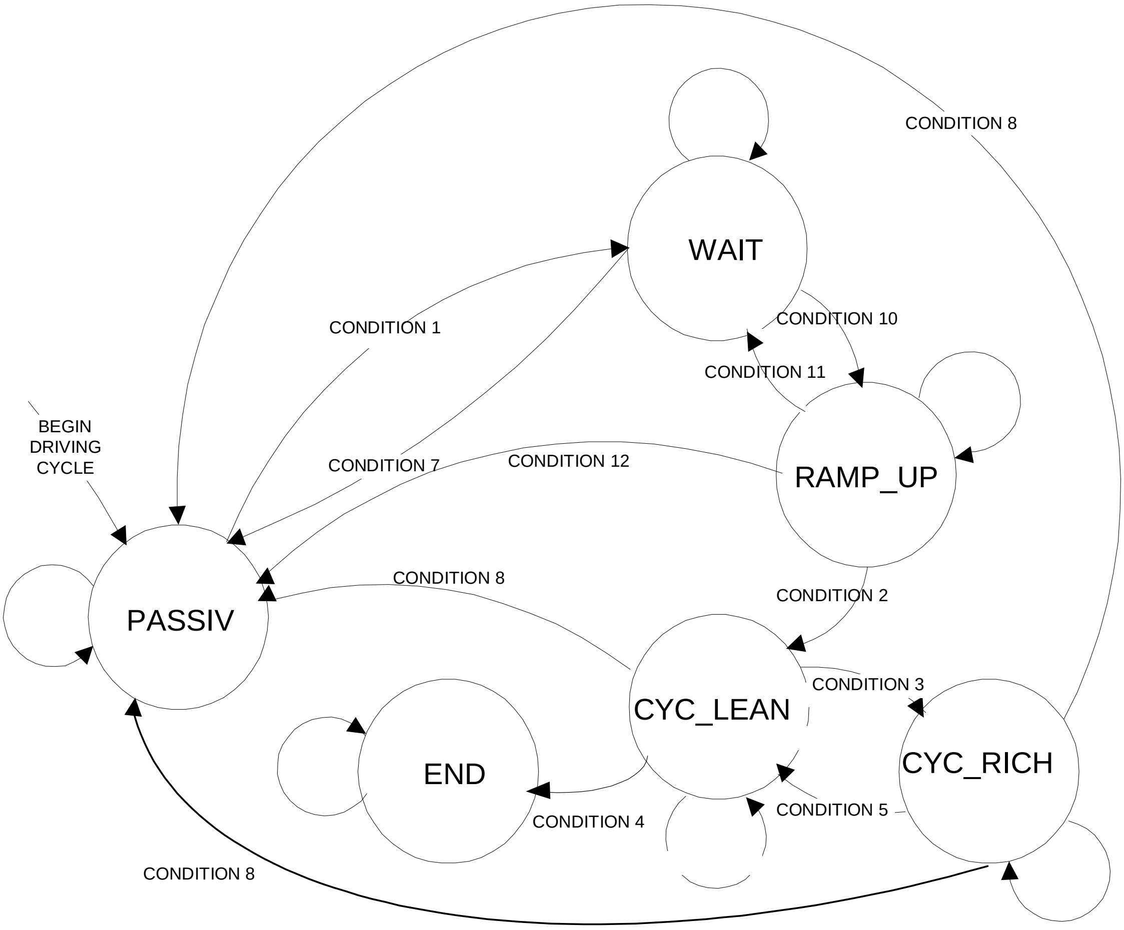

Note: The priorities of the conditions to change between states are defined by order described in the STATEFLOW diagram below. The condition 8 as transition to PASSIVE is twice available and contain the same conditions each.

The recurence time is defined by T_SAMPLE in [ms].

Application Assistance
For OBD II O2 sensor diagnosis: C_CTR_MIN_CAT_DIAG has to be applied higher then the thresholds C_SUM_CYC_MIN_DIAG and C_SUM_CYCNR_MIN_DIAG
(LV_LS_FRQ_DIAG_READY -> 1 and LV_LS_SWT_DIAG_READY -> 1).
They have to be reached before STATE_CAT_DIAG[i] is set to END.

Hint:
An active catalyst diagnosis can disable the module Downstream Fuel Trim Regulation also a additional lambda offset can be imposed on the basic lambda setpoint in the module Basic Lambda setpoint . When the catalyst diagnosis is completed the above functions return to their normal operation.

Overview: Chronological order of diagnosis algorithm:
Triggering of catalyst diagnosis calculation by LV_AFL[i] 0->1...

%setpoint of the O2-load with CAT DIAG for the lambda controller (output, not used here)
1) LAMB_CAT_DOWN[i] = IP_LAMB_CAT(VLS_DOWN[i]) %every recurrence

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2) LAMB_CAT_DOWN_SUM[i] n+1 = LAMB_CAT_DOWN_SUM[i] n+ LAMB_CAT_DOWN[i] %every recurrence
3) LAMB_CAT_DOWN_MV[i] = LAMB_CAT_DOWN_SUM[i] / CTR_LAMB_CAT_DOWN_SUM[i]
(after end of current diagnosis period)
4) FLOW_O2_CAT_DIF[i] = 0.23 * (1/3600)[g/ms] * I1/LAMB_CAT_DOWN_MV[i] - 1/LAMB_CAT_DOWN[i] I * MAF_CYL[kg/h]
5) MASS_O2_CAT_DIF_CYC[i]n+1 = MASS_O2_CAT_DIF_CYC[i] n + FLOW_O2_CAT_DIF[i]*T_SAMPLE[ms] %every recurrence
6) RATIO_MASS_O2_CAT_DIF [i] = MASS_O2_CAT_DIF_CYC[i] * IP_FAC_TEMP_CAT_DIF_STAT / (C_O2L_CAT_AFL * IP_FAC_MASS_O2_CAT_DIAG_XX) (with XX for AT or MT (after end of current diagnosis period)

7) RATIO_MASS_O2_CAT_DIF_SUM[i] n+1 = RATIO_MASS_O2_CAT_DIF_SUM[i] n + MASS_O2_CAT_DIF_RATIO[i]
(after end of current diagnosis period and passed validity check)
8) EFF_CAT_DIAG_HOM[i] = MASS_O2_CAT_DIF_RATIO_SUM[i] /CTR_CAT_DIAG[i]
(Catalyst diagnosis value after diagnosis finished)

Scheduling of formulas:
1+2: states WAIT, RAMP_UP, CYC_LEAN, CYC_RICH
3: state WAIT, transitions RAMP_UP or CYC_RICH to CYC_LEAN
4+5: states CYC_LEAN, CYC_RICH
6+7: transition CYC_RICH to CYC_LEAN
8: transition CYC_LEAN to END
Several system events will trigger a function response:

EGTR_FCTDGCEF0__RST (reset): reset
EGTR_FCTDGCEF0__20MS (regular trigger every 20 msec): operate
EGTR_FCTDGCEF0__CLFMY (clear failure memory): reset
EGTR_FCTDGCEF0__STB (standby; ECU programming or fault): reset, init_nvmy
EGTR_FCTDGCEF0__UNVMY (update non volatile memory): save_nvmy
EGTR_FCTDGCEF0__RNVMY (read non volatile memory): read_nvmy

Application Conditions

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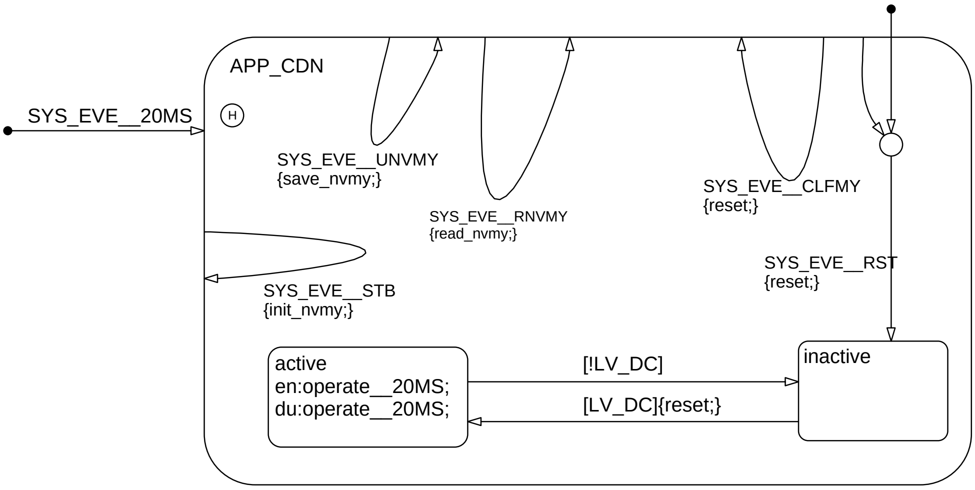

Figure B.46.1: :

Function description

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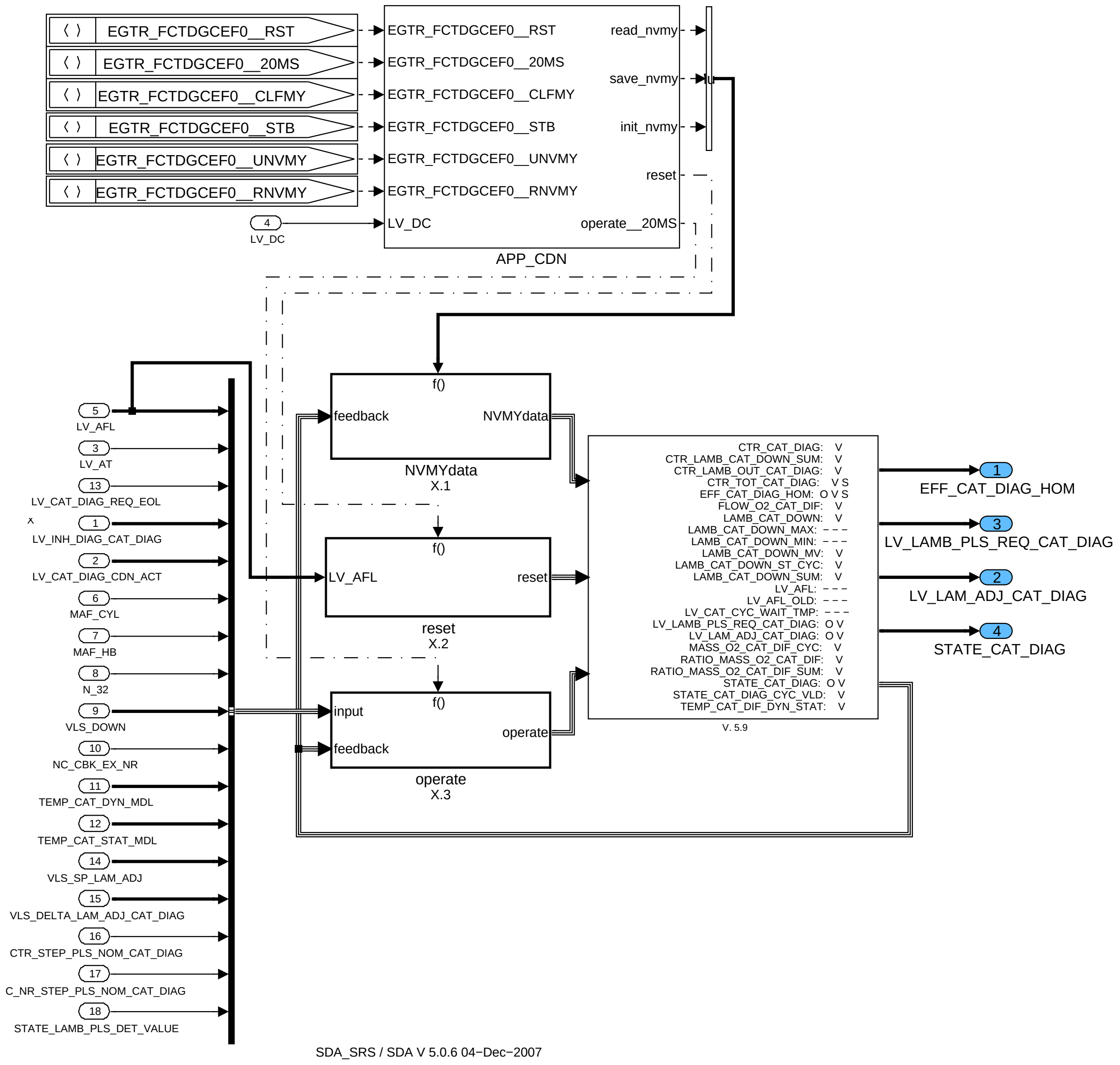

Figure B.46.2: :

B.46.1 Handling data at non volatile memory:

Triggering of one of the following actions:

RNVMY (read non volatile memory): Reading the diagnosis value of last completed diagnosis cycle and the number of totally completed diagnosis cycles since ECU programming from non volatile memory.

UNVMY (update non volatile memory): Saving the diagnosis value of last completed diagnosis cycle and the number of totally completed diagnosis cycles since ECU programming to non volatile memory.

STB (standby): Initializing the diagnosis value and the number of totally completed diagnosis cycles since ECU programming to zero and saving to non volatile memory.

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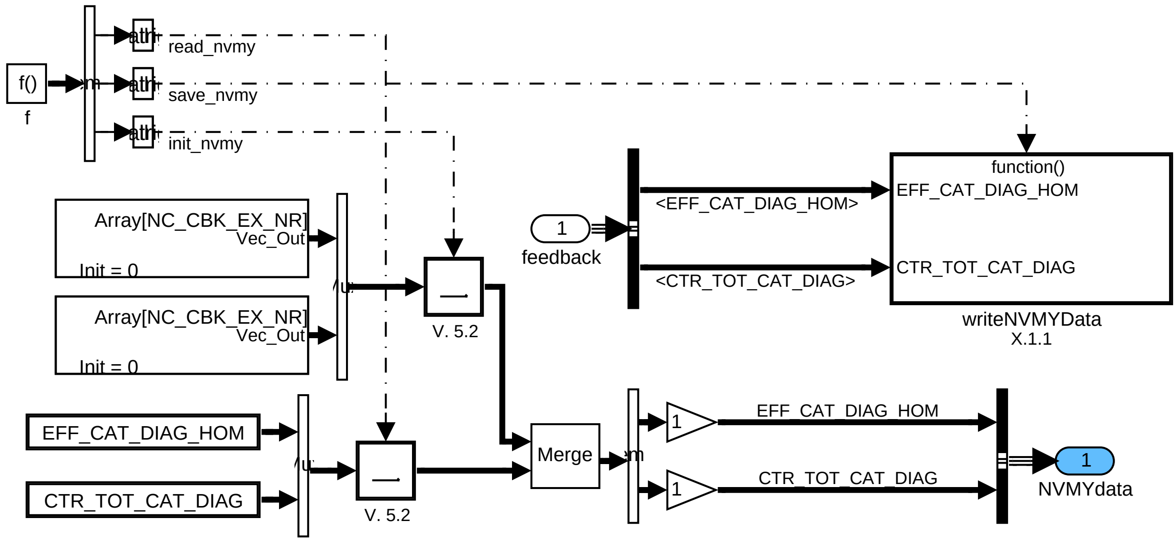

Figure B.46.3: :

B.46.1.1 Writing to non volatile memory (UNVMY):

Storing the final diagnosis value to non volatile memory and incrementing there the total number of completed diagnosis cycles since ECU programming by one.

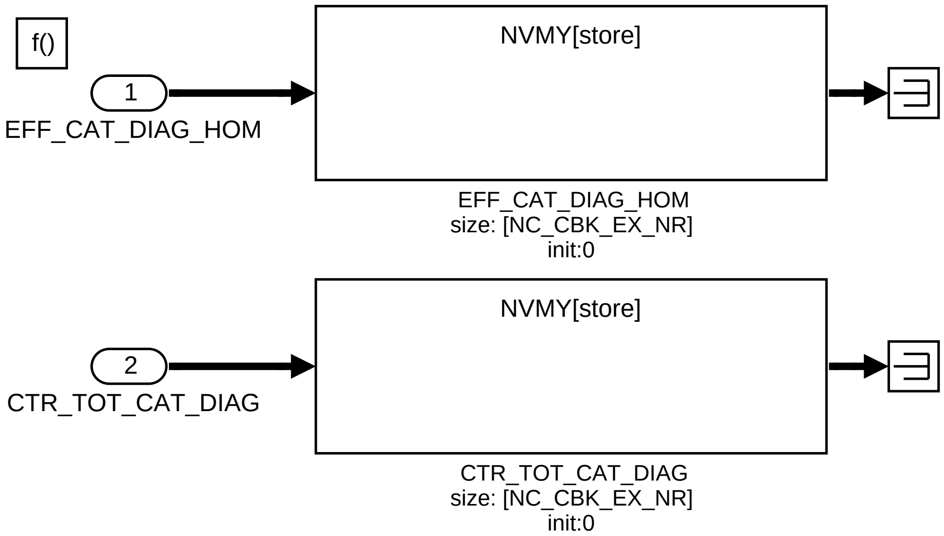

Figure B.46.4: :

B.46.2 RESET:

Initializing all listed variables to zero.

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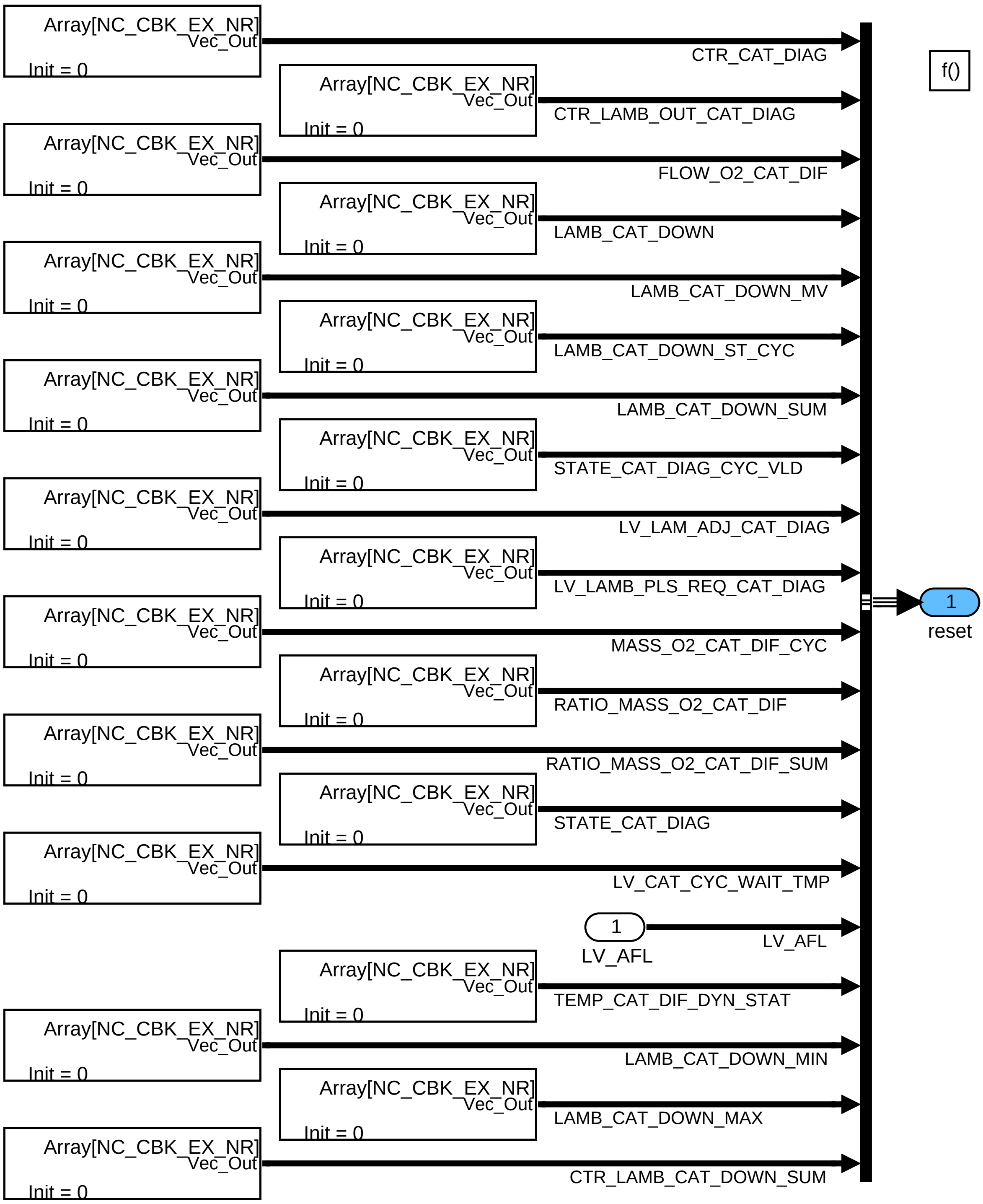

Figure B.46.5: :

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B.46.3 SUBFUNCTION: operate

B.46.3.1 EGTR_FCTDGCEF0/OPERATE/EGTR_FCTDGCEF0_CBK_MNG

B.46.3.1.1 Checking state:

Checking the transition conditions with aid of the state machine. Then, in case of changing the actual state, performing the respective transition actions and state actions for the new state.

B.46.3.1.1.1 State machine:

Checking the respective transition conditiones in dependence on current state and evaluation of the new state in compliance with exclusion thresholds, i.e. with the engine speed, the counter for the minimum required monitoring cycles to complete the catalyst diagnosis and the counter numerating subsequently following invalid monitoring cycles.

Afterwards issue of the trigger vectors for transition actions and state actions.

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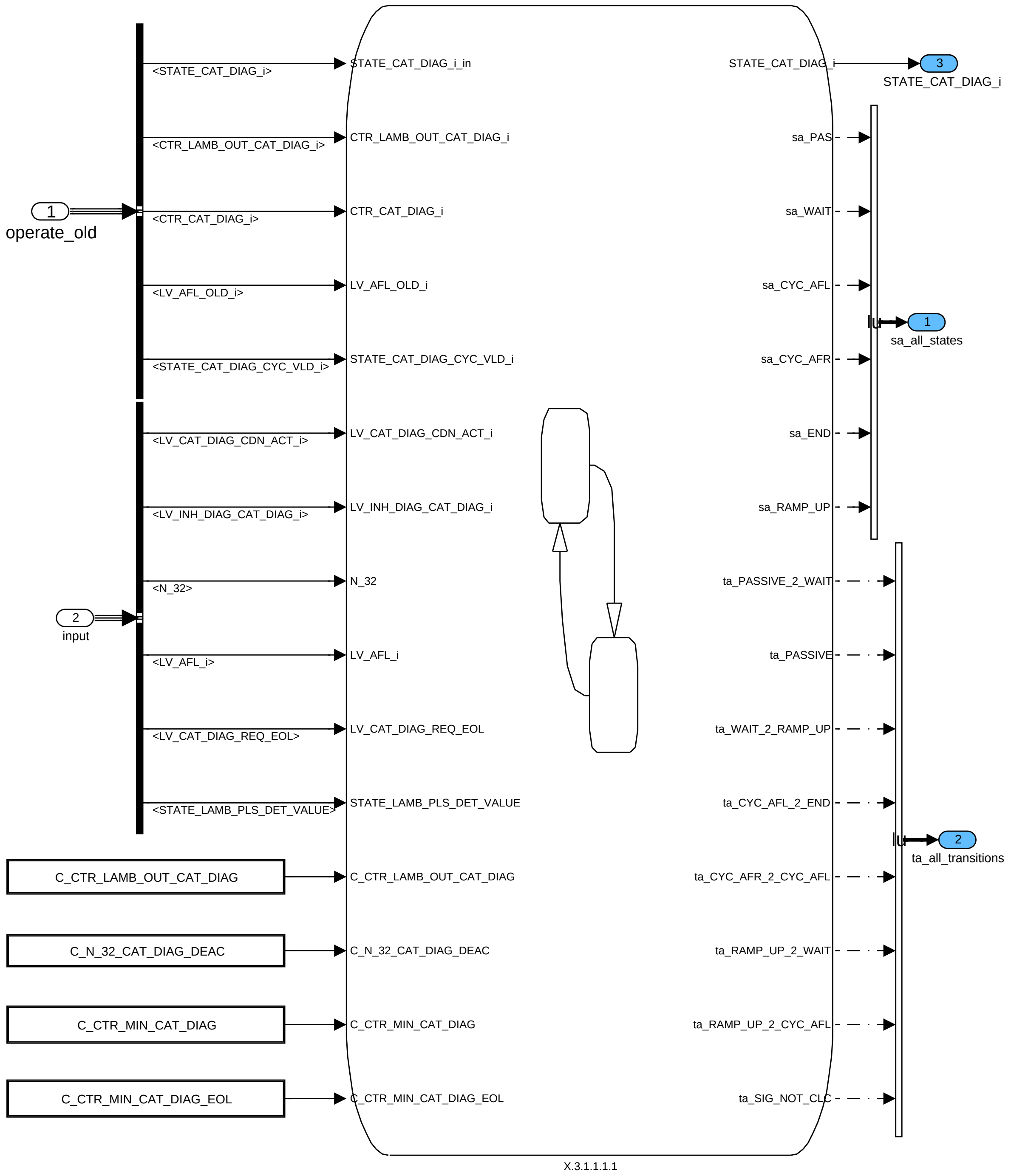

Figure B.46.6: :

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B.46.3.1.1.1.1 Chart

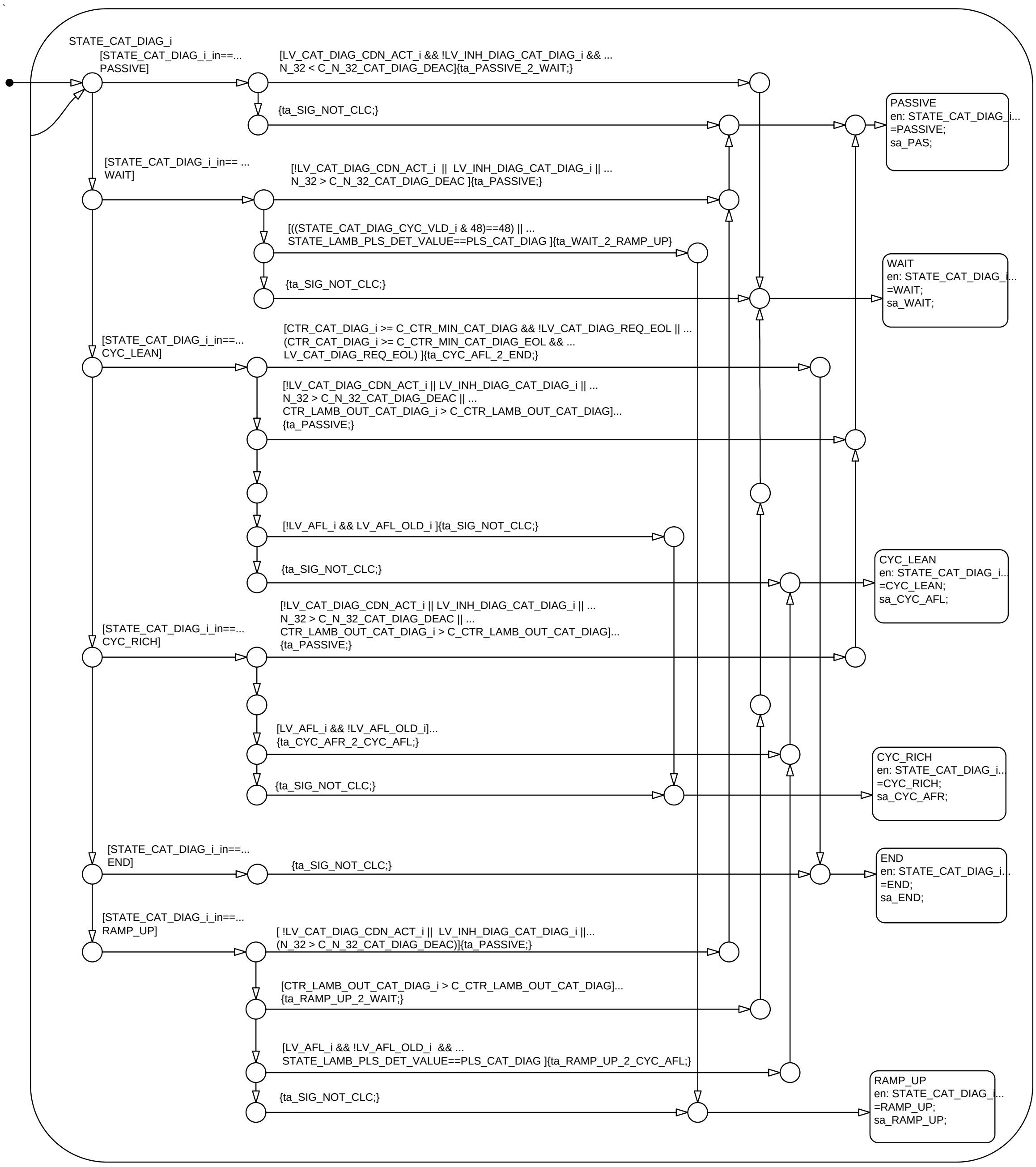

Figure B.46.7: :

B.46.3.1.1.2 Transition actions:

Performing the concerned transition action induced by the issued trigger vector.

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B.46.3.1.1.2.1 EGTR_FCTDGCEF0/OPERATE/EGTR_FCTDGCEF0_CBK_MNG/EGTR_FCTDGCEF0_CBK_SPC/TA_CAT_DIAG/TA1_PASSIVE_2_WAIT

B.46.3.1.1.2.1.1 Transition action PASSIVE to WAIT:

Setting the temporary WAIT state flag to zero to indicate the downstream lambda sum of this monitoring cycle not to be complete (no valid mean value for the next cycle).

Initializing the downstream lambda sum and its counter to zero.

Storing the old value of LV_AFL for edge detection.

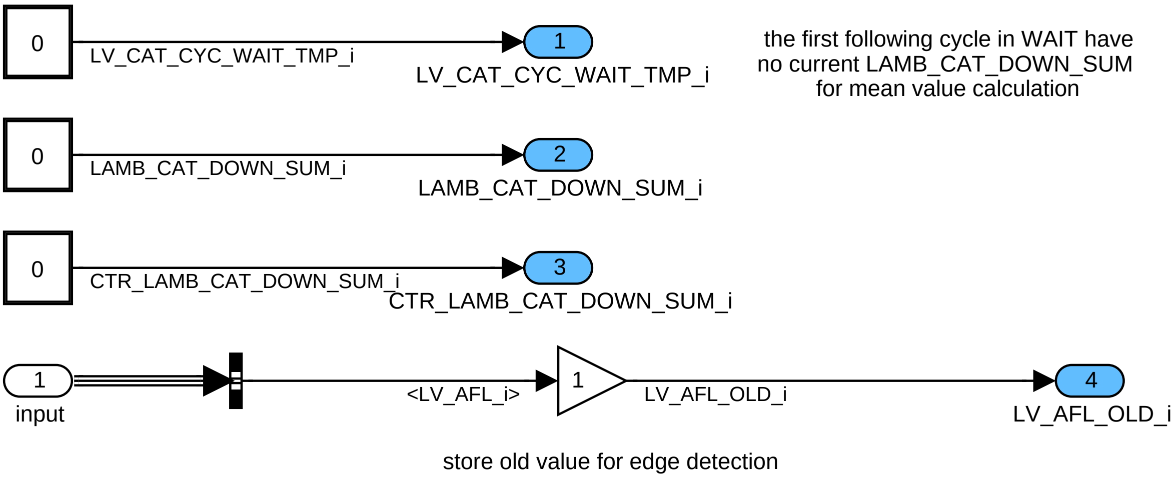

Figure B.46.8: :

B.46.3.1.1.2.2 EGTR_FCTDGCEF0/OPERATE/EGTR_FCTDGCEF0_CBK_MNG/EGTR_FCTDGCEF0_CBK_SPC/TA_CAT_DIAG/TA2_RAMPUP_2_CYC_LEAN

B.46.3.1.1.2.2.1 Transition action RAMP_UP to CYC_LEAN:

Calculation of the downstream lambda mean value of last cycle. Initializing the downstream lambda sum, its counter and the related oxygen mass to zero.

Storing the downstream lambda signal at start of the monitoring cycle and initializing the concerning min/max values to the same value.

Resetting the validity bits with regard to crossing events, setting the validity bit with regard to the permitted difference between the actual downstream lambda signal and the mean value of last cycle.

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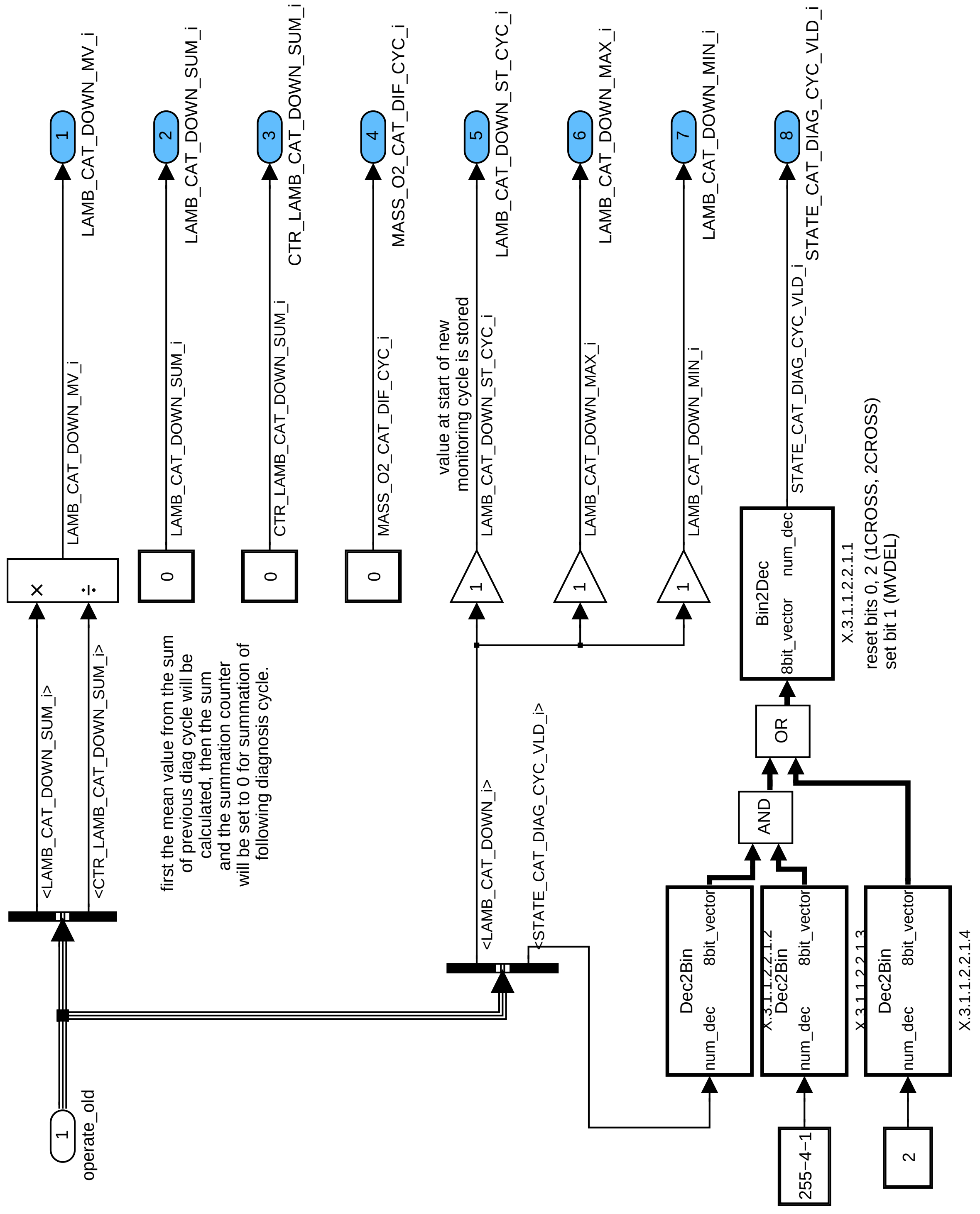

Figure B.46.9: :

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B.46.3.1.1.2.3 EGTR_FCTDGCEF0/OPERATE/EGTR_FCTDGCEF0_CBK_MNG/EGTR_FCTDGCEF0_CBK_SPC/TA_CAT_DIAG/TA4_CYC_LEAN_2_END

B.46.3.1.1.2.3.1 Transition action CYC_LEAN to END:

Calculation of the new diagnosis value and incrementing the total number of completed diagnosis cycles since ECU programming by one.

Resetting forced stimulation and trim control parameters to nominal values and all validity bits to zero.

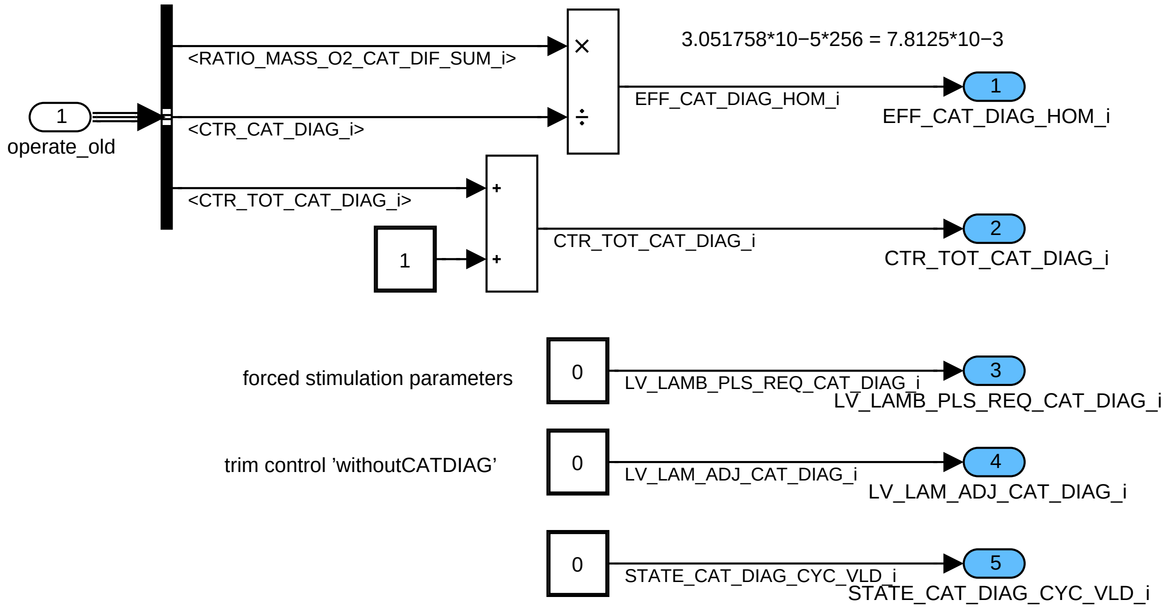

Figure B.46.10: :

B.46.3.1.1.2.4 EGTR_FCTDGCEF0/OPERATE/EGTR_FCTDGCEF0_CBK_MNG/EGTR_FCTDGCEF0_CBK_SPC/TA_CAT_DIAG/TA5_CYC_RICH_2_CYC_LEAN

B.46.3.1.1.2.4.1 Transition action CYC_RICH to CYC_LEAN:

Start of a new monitoring cycle.

Calculation of the downstream lambda mean value of last cycle.

Evaluation of the diagnosis value merely related to last monitoring cycle. Computation of the actual temperature difference between dynamic and stationary catalyst temperature.

Incrementing/resetting the number of cycles showing lambda to be out of range and setting the validity bits. In case of validity sum up the diagnosis value and increment the counter of valid cycles by one.

Initializing the single cycle bound sums and counters for next cycle.

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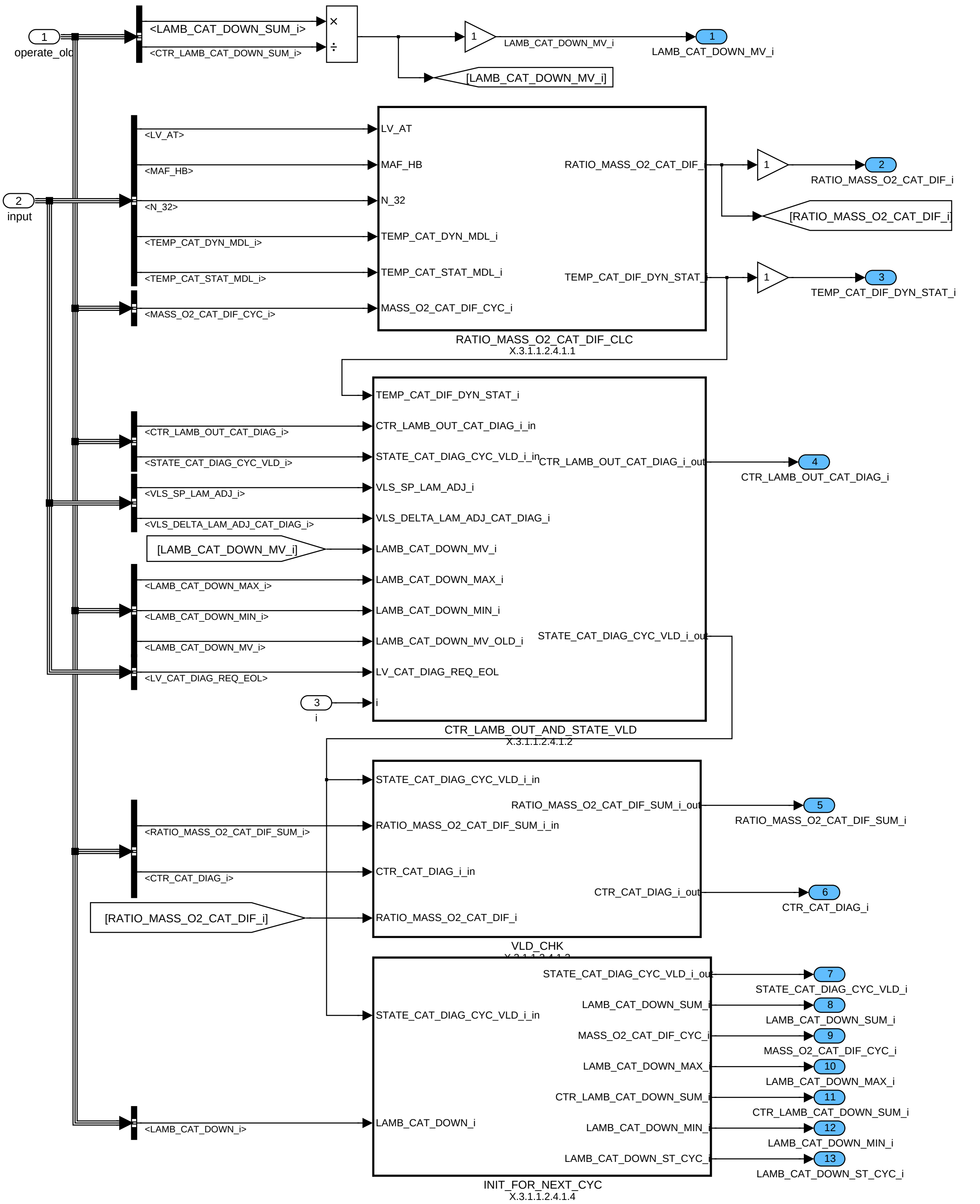

Figure B.46.11: :

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B.46.3.1.1.2.4.1.1 Weighting the diagnosis value:

Weighting the diagnosis value related to last monitoring cycle, taking into account the concerning working point and temperature dynamics.

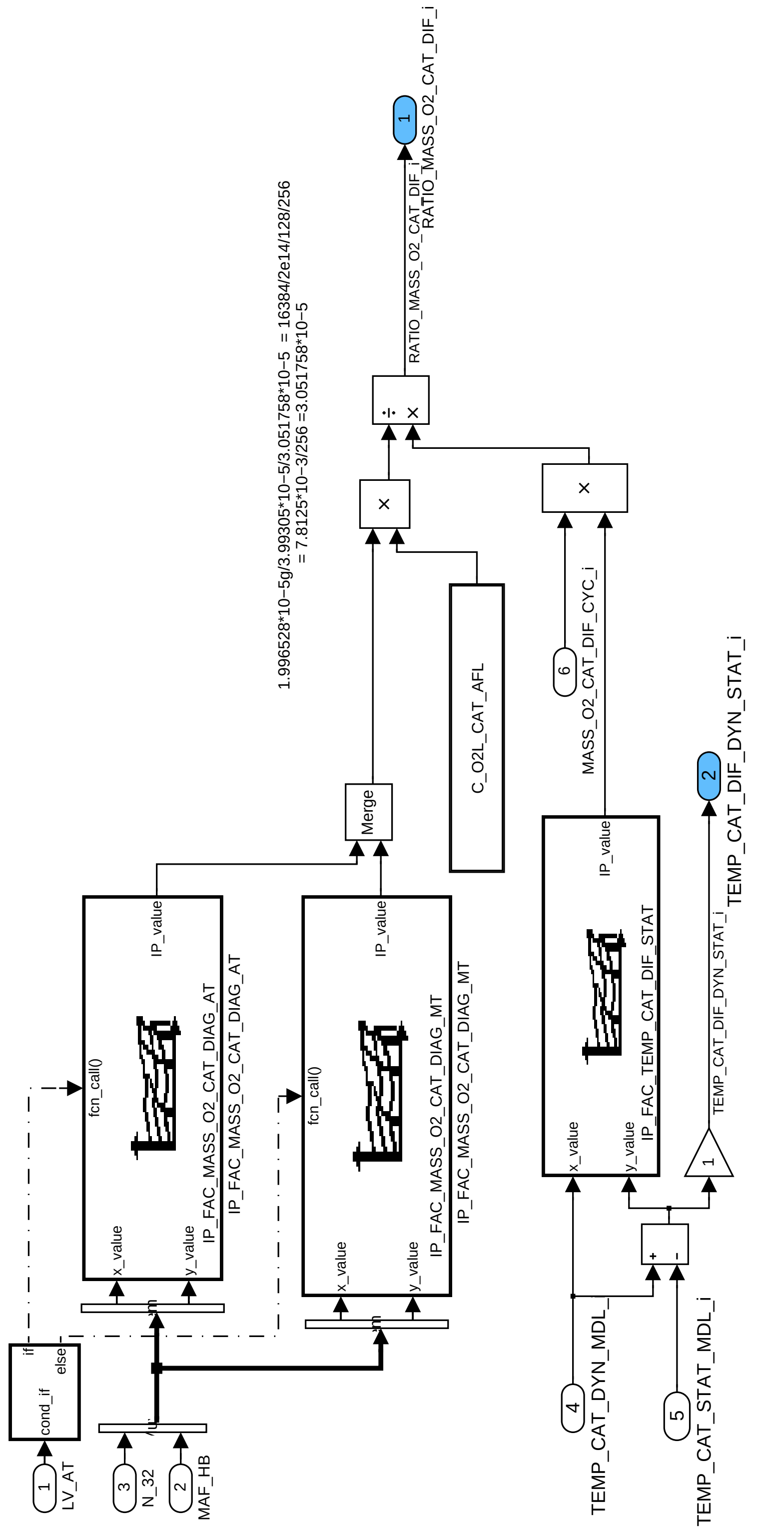

Figure B.46.12: :

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B.46.3.1.1.2.4.1.2 Monitoring cycle validity:

Computing the absolute difference between downstream lambda mean value and the corrected lambda setpoint and comparing it to the stored maximally admissible difference. Setting the RANGE bit in dependence on the result. Incrementing/resetting the counter of monitoring cycles showing lambda to be out of range.

Comparing the stat/dyn temperature difference to the stored maximally allowed value and setting the TEMPERATURE bit accordingly.

Computing the difference between downstream lambda min/max and dividing by eight. Adding this to the stored maximum allowed if the temperature range is o.k. Comparing the result to the absolute difference between actual and old mean value and setting the cycle validity bit in correspondence with.

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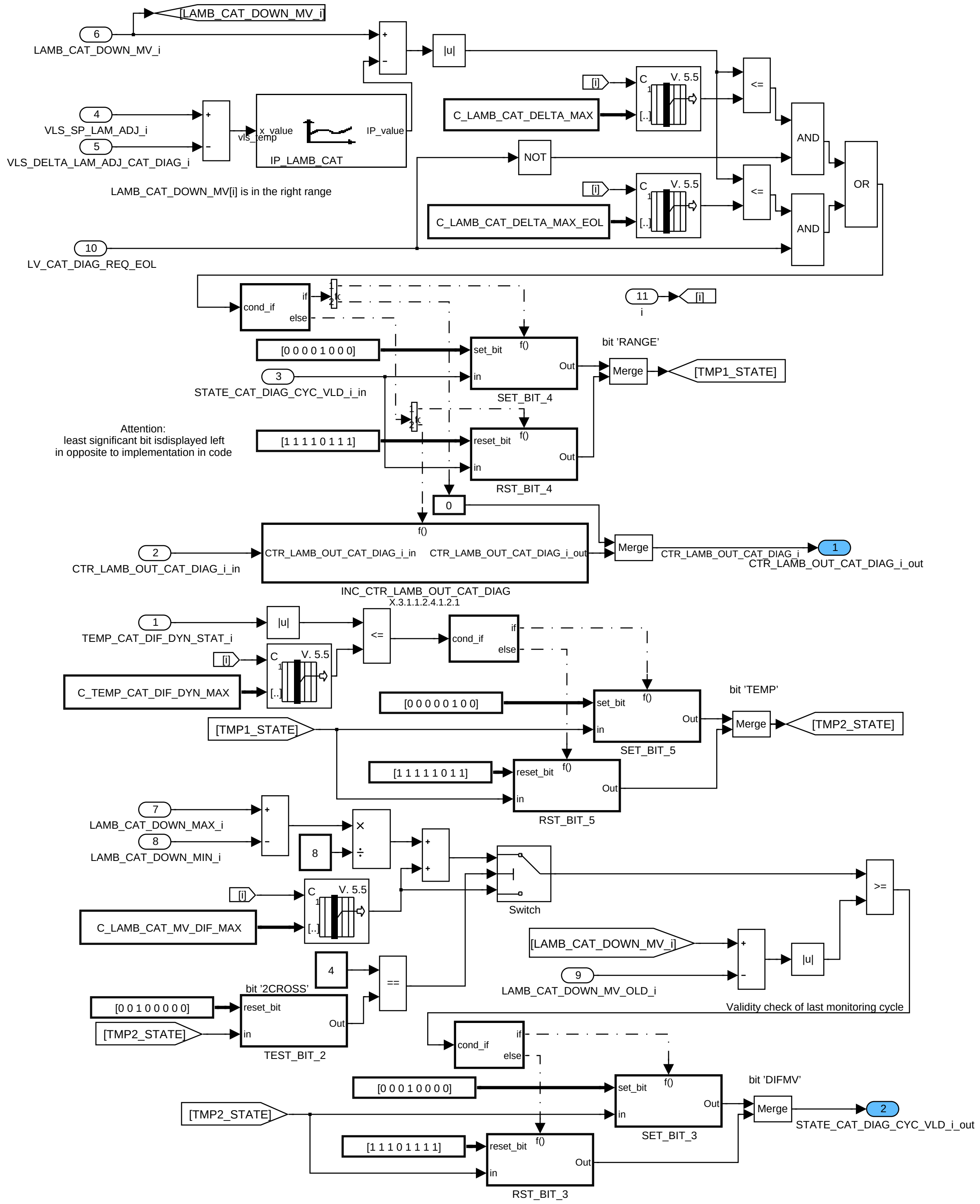

Figure B.46.13: :

B.46.3.1.1.2.4.1.2.1 Incrementing/resetting counter:

Incrementing/resetting the number of cycles showing lambda to be out of range.

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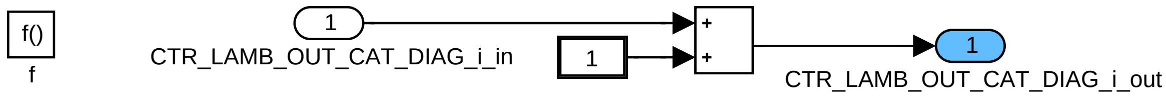

Figure B.46.14: :

B.46.3.1.1.2.4.1.3 Validity Check:

Checking last cycle for validity. If the last cycle is valid summing up the diagnosis value and adding one to the number of valid monitoring cycles.

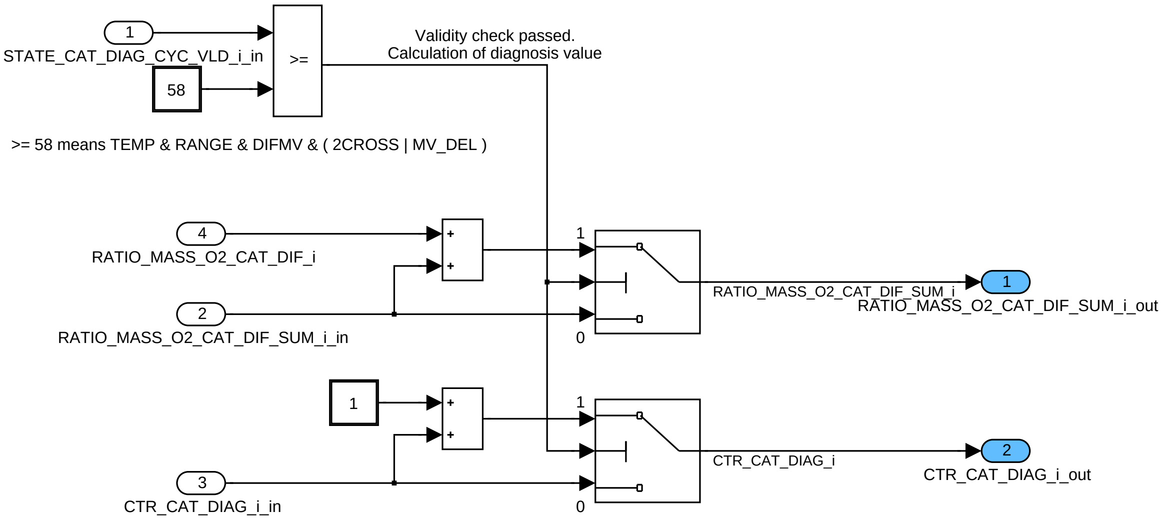

Figure B.46.15: :

B.46.3.1.1.2.4.1.4 Initialization for next cycle:

Resetting the validity bits with regard to crossing events, setting the validity bit with regard to the permitted difference between the actual downstream lambda signal and the mean value of last cycle.

Initializing the downstream lambda sum, its counter and the related oxygen mass to zero.

Storing the downstream lambda value at start of the monitoring cycle and initializing the concerning min/max values to the same value to detect crossing events.

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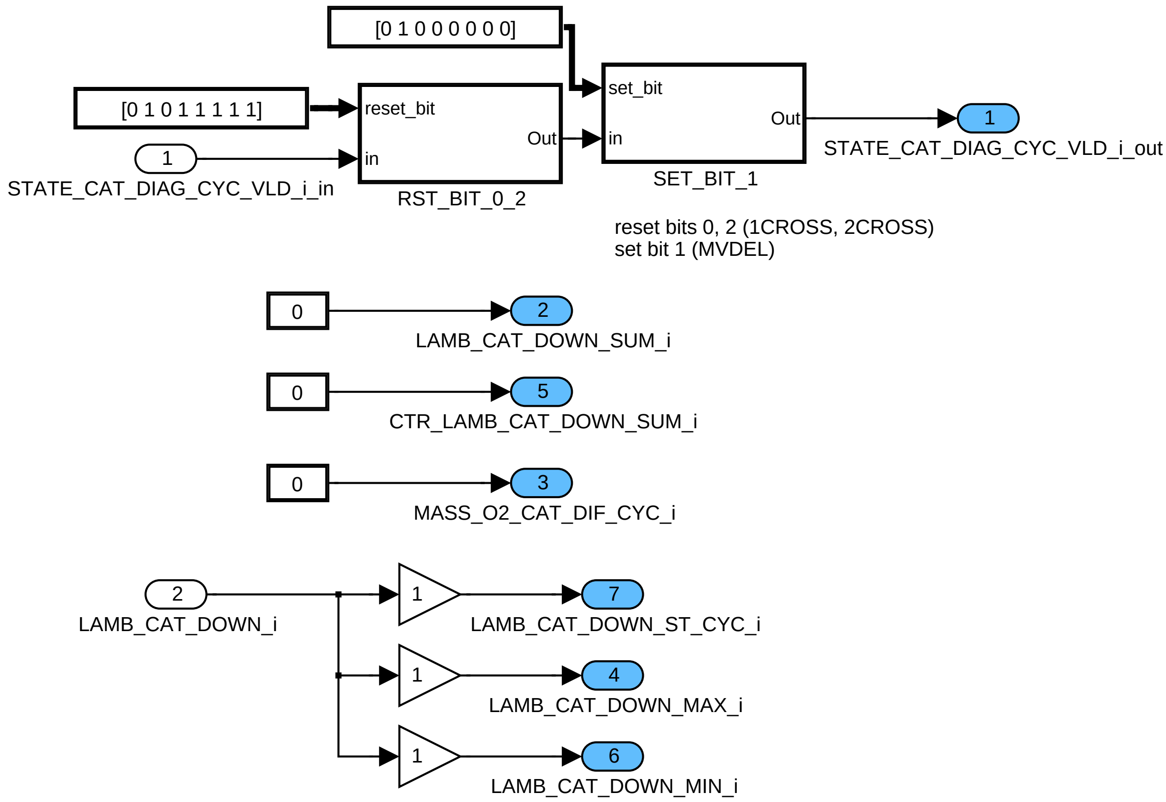

Figure B.46.16: :

B.46.3.1.1.2.5 EGTR_FCTDGCEF0/OPERATE/EGTR_FCTDGCEF0_CBK_MNG/EGTR_FCTDGCEF0_CBK_SPC/TA_CAT_DIAG/TA_PASSIVE

B.46.3.1.1.2.5.1 Transition action X to PASSIVE:

Resetting forced stimulation and trim control to nominal mode and all validity bits to zero.

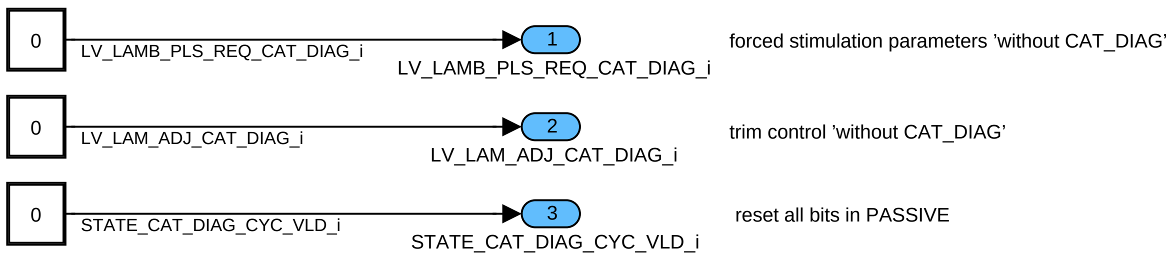

Figure B.46.17: :

B.46.3.1.1.2.6 EGTR_FCTDGCEF0/OPERATE/EGTR_FCTDGCEF0_CBK_MNG/EGTR_FCTDGCEF0_CBK_SPC/TA_CAT_DIAG/TA10_WAIT_2_RAMPUP

B.46.3.1.1.2.6.1 Transition action WAIT to RAMP_UP:

Setting forced stimulation and trim control to catalyst diagnosis mode and the number of cycles showing lambda to be out of range to zero.

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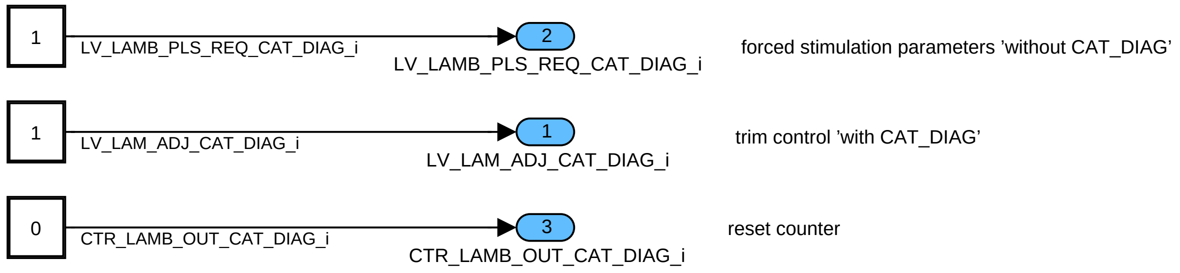

Figure B.46.18: :

B.46.3.1.1.2.7 EGTR_FCTDGCEF0/OPERATE/EGTR_FCTDGCEF0_CBK_MNG/EGTR_FCTDGCEF0_CBK_SPC/TA_CAT_DIAG/TA11_RAMPUP_2_WAIT

B.46.3.1.1.2.7.1 Transition action RAMP_UP to WAIT:

Resetting forced stimulation and trim control to nominal mode because of lambda being out of range. Resetting all validity bits to zero.

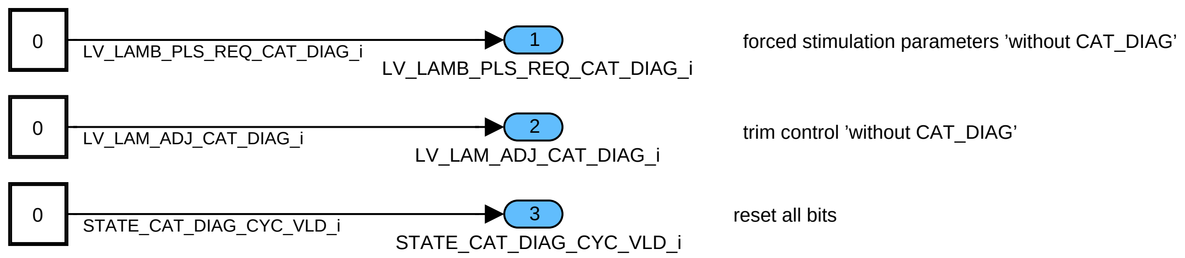

Figure B.46.19: :

B.46.3.1.1.3 State actions:

Performing the concerned state action induced by the issued trigger vector.

B.46.3.1.1.3.1 State action PASSIVE/END:

No performance of any action in states PASSIVE and END.

B.46.3.1.1.3.2 EGTR_FCTDGCEF0/OPERATE/EGTR_FCTDGCEF0_CBK_MNG/EGTR_FCTDGCEF0_CBK_SPC/SA_CAT_DIAG/WAIT

B.46.3.1.1.3.2.1 State action WAIT:

Converting the downstream sensor voltage to the related downstream lambda value.

Checking the flag for lean state and comparing with the allied old value. This action is checking for the start of a new monitoring cycle.

In case of a transition zero to one and validity of the cycle calculation of the downstream lambda mean value and resetting the downstream lambda sum and its counter afterwards. Calculating the new trim control setpoint the new trim control setpoint, the stat/dyn temperature difference and setting the validity bits.

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In case of a transition zero to one and non validity of the cycle resetting the downstream lambda sum and its counter and marking the cycle as non valid.

Summing up downstream lambda and incrementing the counter in all other cases.

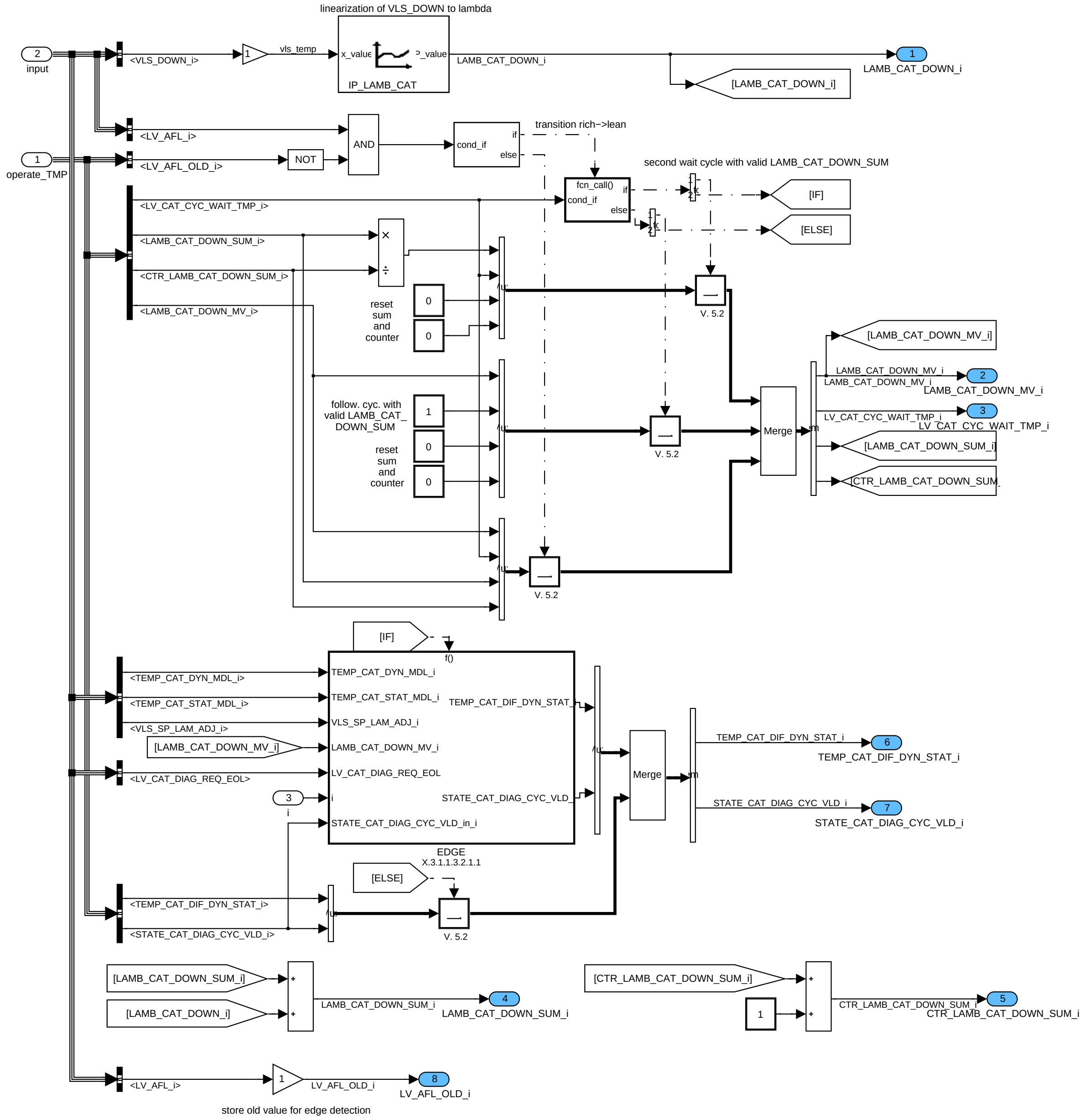

Figure B.46.20: :

B.46.3.1.1.3.2.1.1 State action WAIT/edge action:

Computing the absolute difference between downstream lambda mean value and lambda setpoint and comparing it to the stored maximally admissible difference. Setting the RANGE bit in dependence on the result.

Comparing the stat/dyn temperature difference to the stored maximally allowed value and setting the TEMPERATURE bit accordingly.

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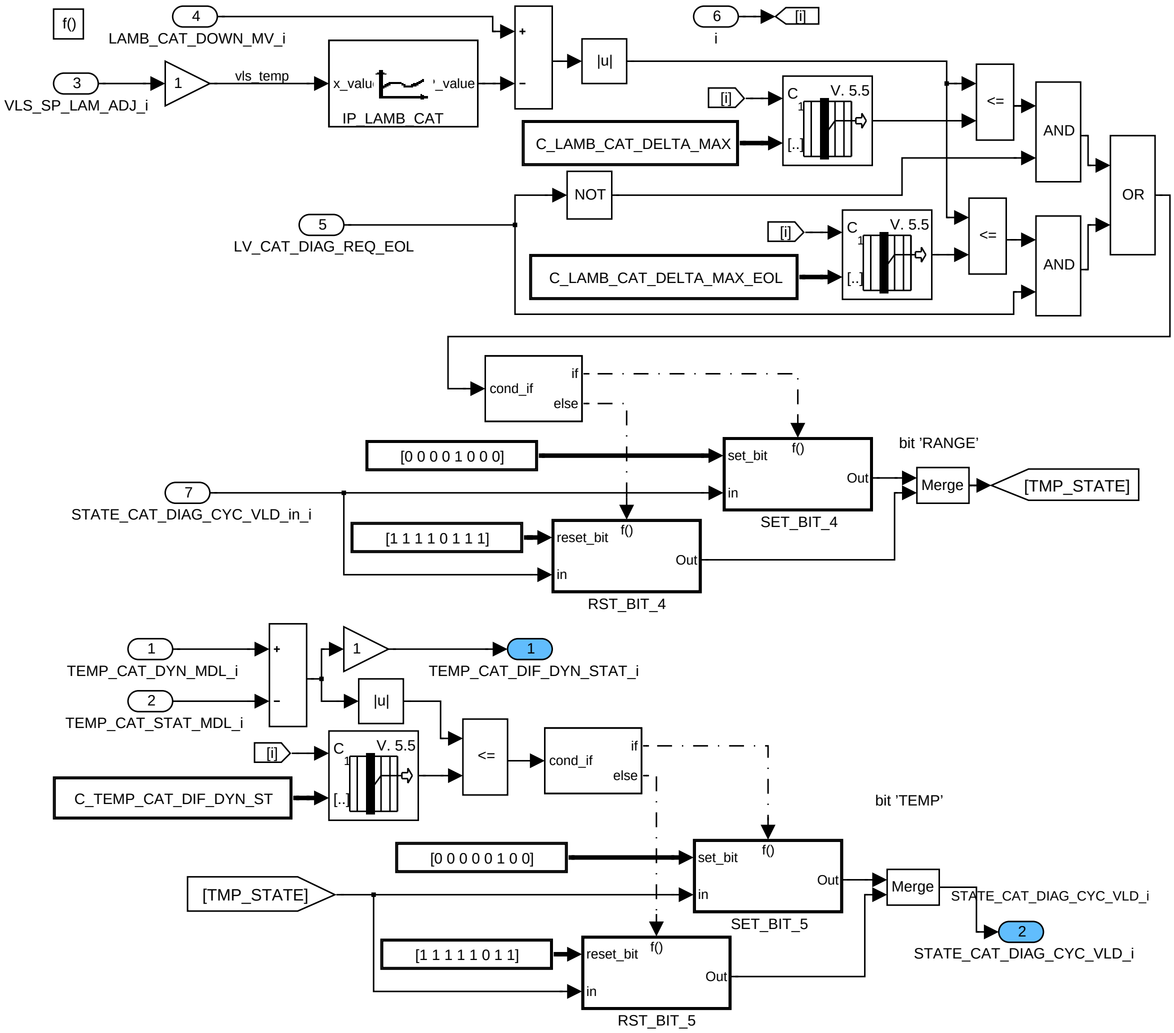

Figure B.46.21: :

B.46.3.1.1.3.3 EGTR_FCTDGCEF0/OPERATE/EGTR_FCTDGCEF0_CBK_MNG/EGTR_FCTDGCEF0_CBK_SPC/SA_CAT_DIAG/AFL_AFR

B.46.3.1.1.3.3.1 State action AFL/AFR:

Converting the downstream sensor voltage to the related downstream lambda value.

Comparing the actual downstream lambda value with stored min/max values and overwriting in case of exceeding.

Summing up the actual downstream lambda value and incrementing the counter.

Calculation of the actual downstream oxygen mass flow and integrating the passed part of the cycle.

Setting of the summary validity bits.

Storing the old lean state flag for edge detection.

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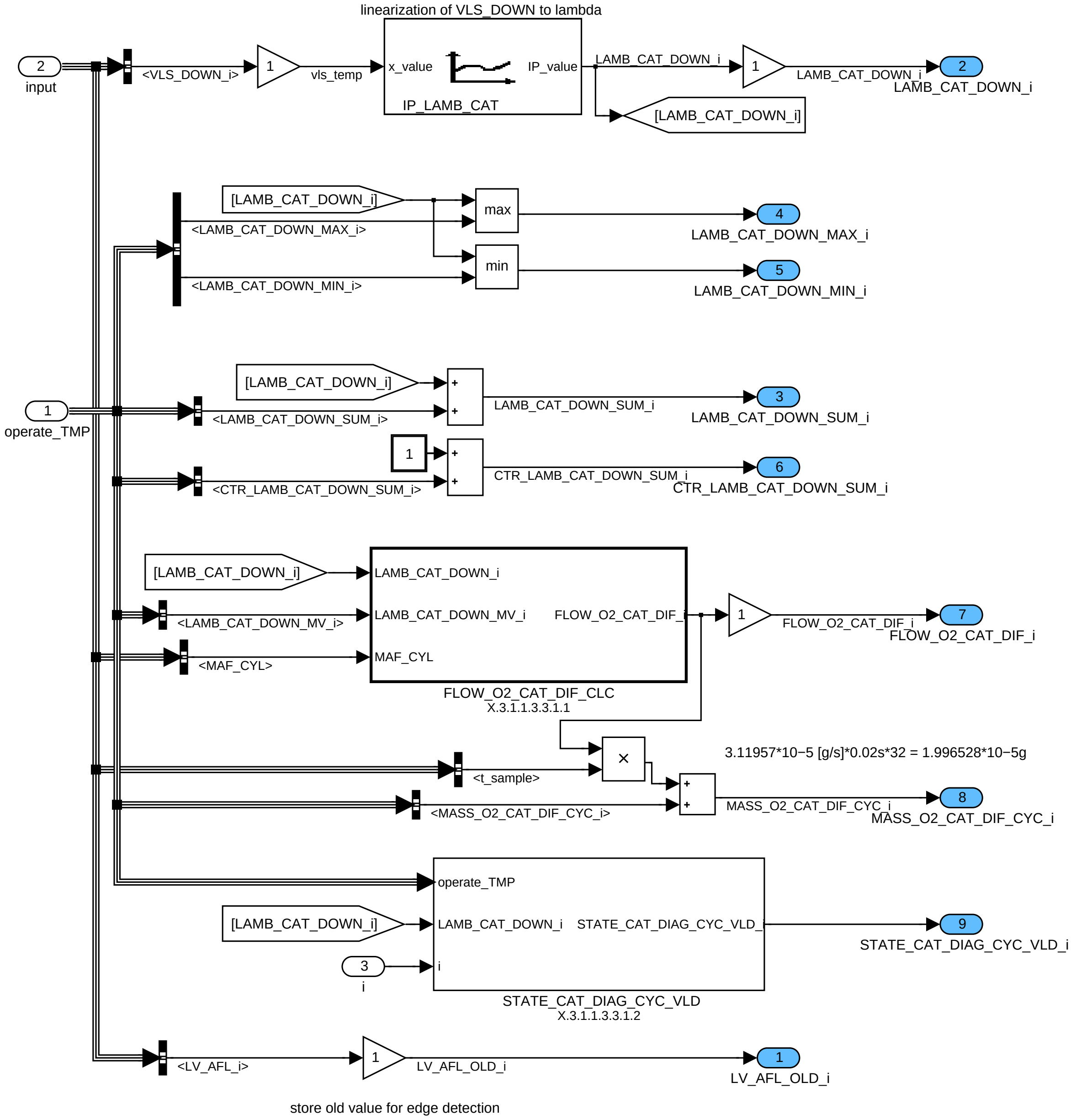

Figure B.46.22: :

B.46.3.1.1.3.3.1.1 Downstream oxygen mass flow:

Calculation of the actual downstream oxygen mass flow.

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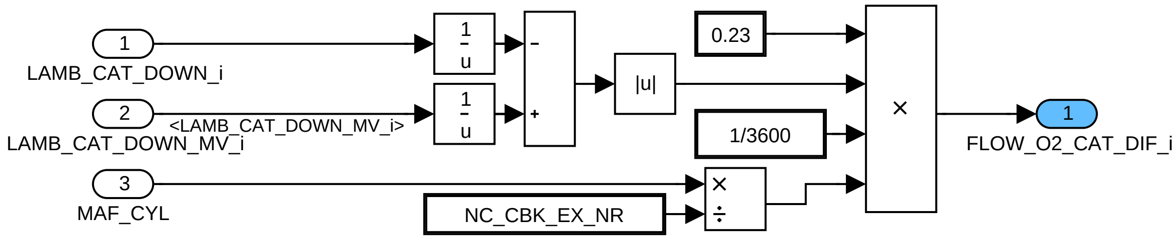

calculation 0.23*2/65536*0.03125*1000/3600*512=3.11957*10−5 [g/s]

Figure B.46.23: :

B.46.3.1.1.3.3.1.2 Check for cycle validity:

Resetting the 1CROSS bit. Checking for 1CROSS AND 2CROSS. Comparing the absolute difference between downstream lambda and lambda mean value to the related stored maximum and setting the MVDEL bit accordingly.

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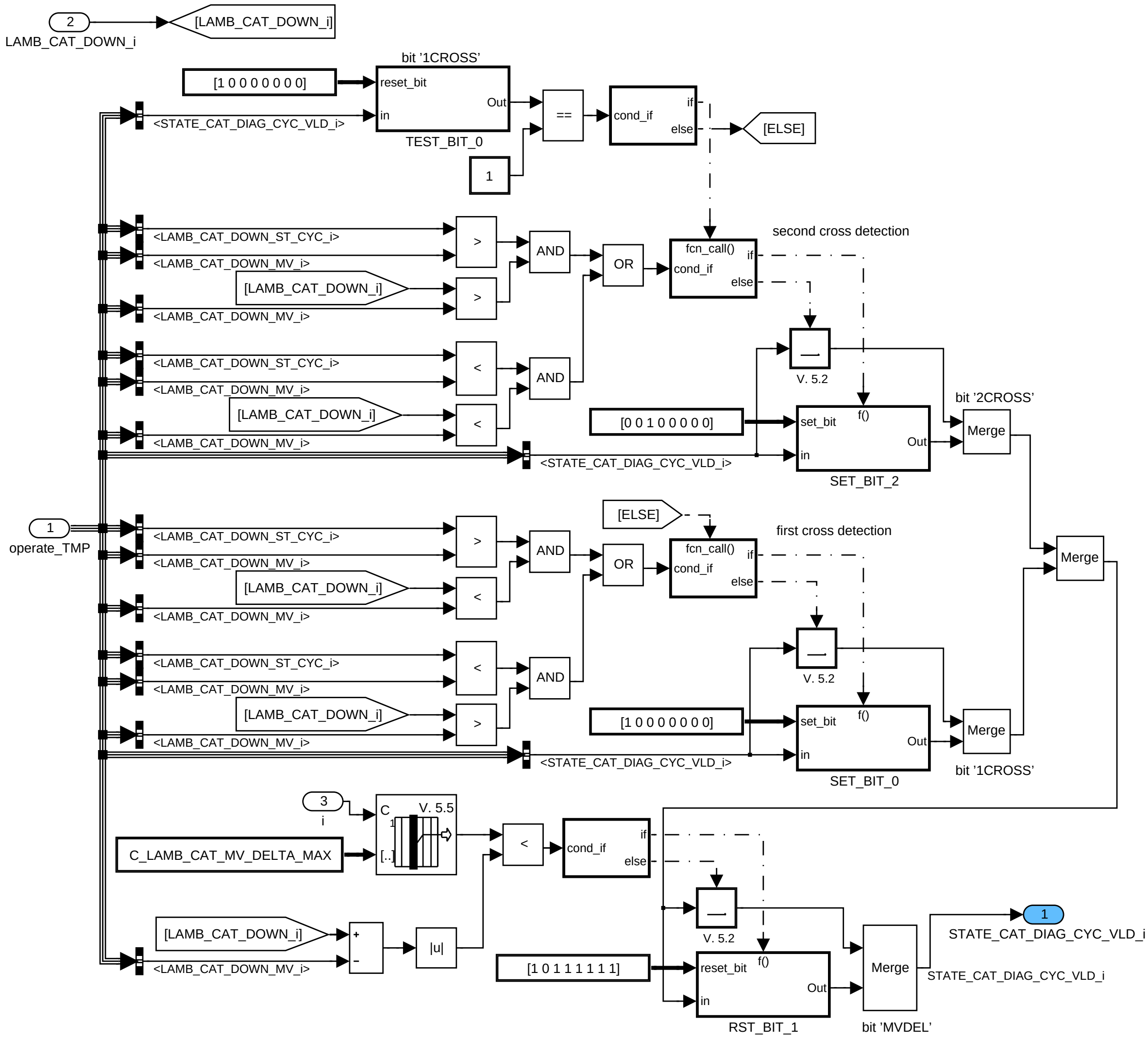

Figure B.46.24: :

B.46.3.1.1.3.4 EGTR_FCTDGCEF0/OPERATE/EGTR_FCTDGCEF0_CBK_MNG/EGTR_FCTDGCEF0_CBK_SPC/SA_CAT_DIAG/RAMP_UP

B.46.3.1.1.3.4.1 State action RAMP_UP:

Converting the downstream sensor voltage to the related downstream lambda value.

Checking the flag for lean state and comparing with the allied old value (checking for the start of a new monitoring cycle).

In case of a transition zero to one calculation of the downstream lambda mean value, incrementing the counter of monitoring cycles showing lambda out of range, setting of the summary validity bits and summing up downstream lambda and its counter.

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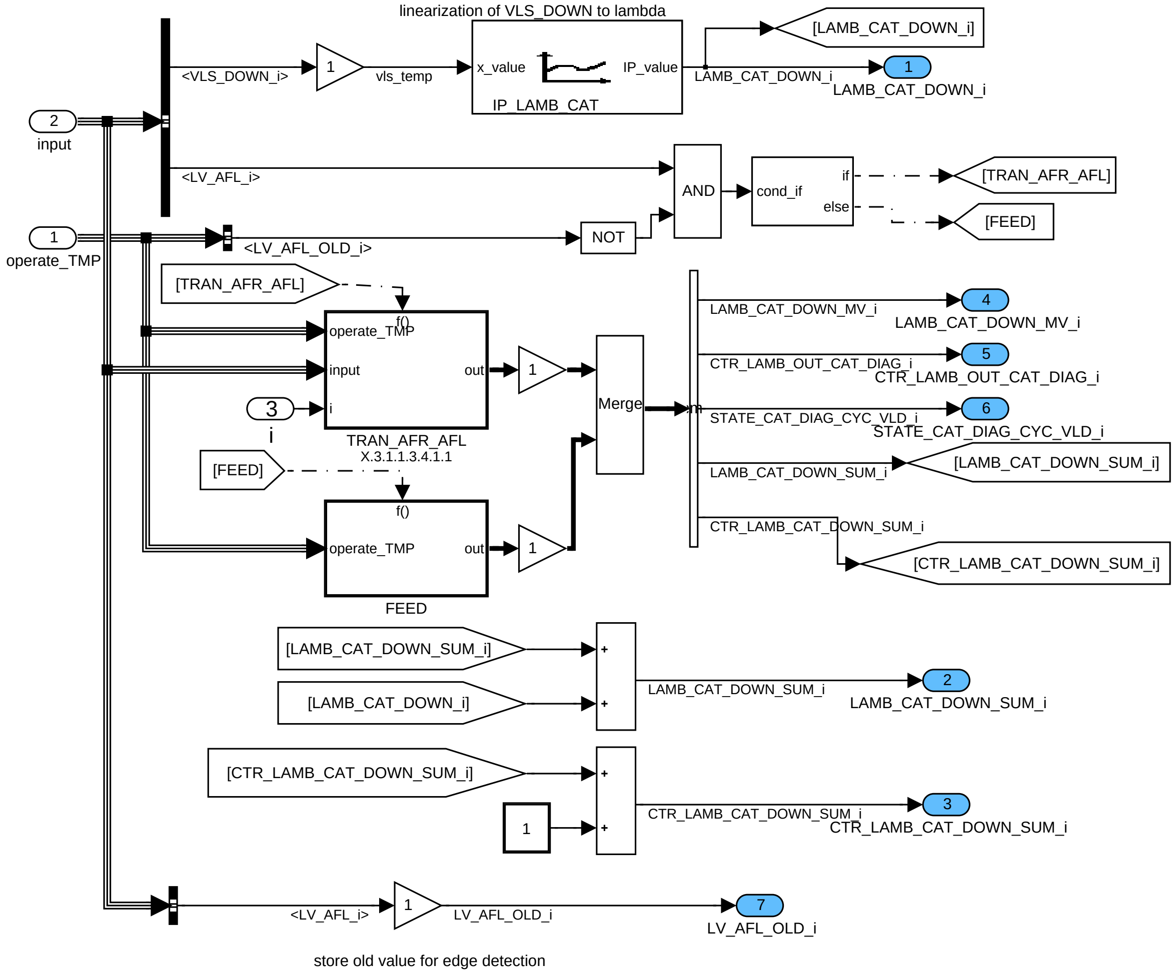

Figure B.46.25: :

B.46.3.1.1.3.4.1.1 TRAN_AFR_AFL:

Calculation of the downstream lambda mean value of last cycle and correcting the influence of asymmetric sensor characteristic.

Checking the actual sensor signal to be in the allowed range and setting the respective validity bit in accordance with as well as the counter of non valid monitoring cycles and the summary validity bits.

Resetting the downstream lambda sum and its counter to zero.

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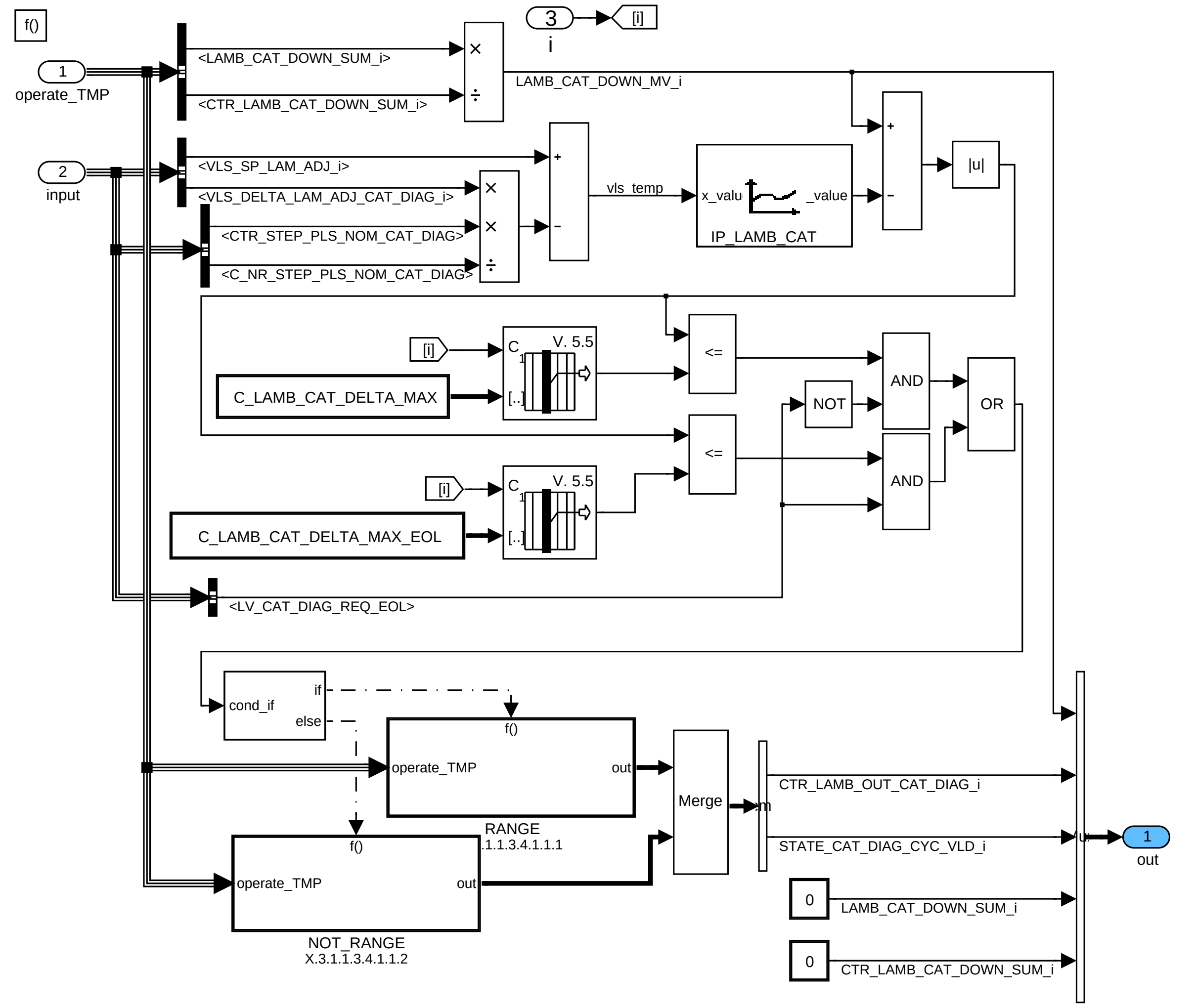

Figure B.46.26: :

B.46.3.1.1.3.4.1.1.1 TRAN_AFR_AFL/RANGE

Setting the counter of monitoring cycles showing lambda to be out of range to zero and the bit indicating that the diagnosis mean value is in the right range to one.

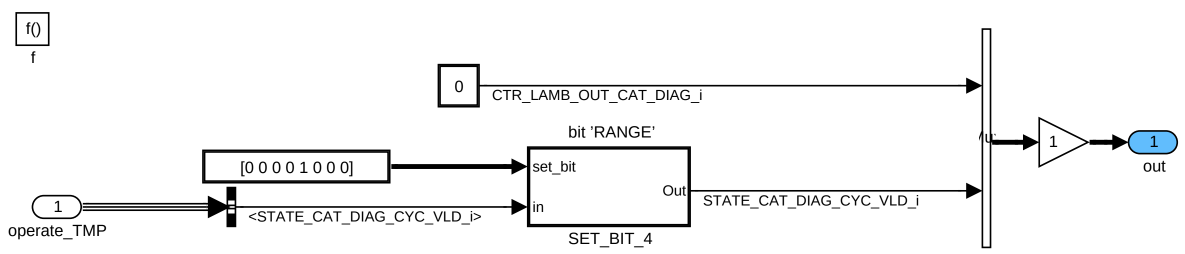

Figure B.46.27: :

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B.46.3.1.1.3.4.1.1.2 TRAN_AFR_AFL/NOT_RANGE

Adding one to the number of monitoring cycles showing lambda to be out of range and resetting the validity bit indicating that the diagnosis mean value is in the right range.

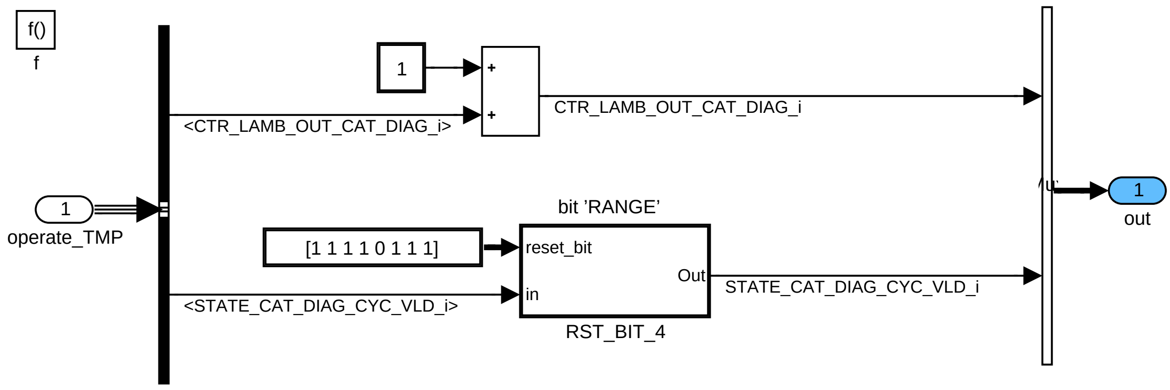

Figure B.46.28: :

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B.47 Catalyst efficiency diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LOAD_CAT_LDC	O/V	0... 3FFH	0... 99.90234375	0.09765625	%
Catalyst diagnosis specific load for limited dynamics calculation					
LV_INH_DIAG_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to inhibit catalyst diagnosis function					
LV_INH_DIAG_RBM_CAT_DIAG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag to inhibit catalyst diagnosis function if there is a OBD failure					
STATE_RBM_CAT [NC_CBK_EX_NR]	O/V	0... FH	0... 15	1	-
Interface of EFF_CAT_DIAG[i] monitor with the Rate-Based Monitoring statistics					

Input data:

CTR_ERR_DYN_NR {p. 5767}	FAC_TQ_REQ {p. 6706}	LC_DIAG_DYN_LSL_UP_CAT_SYN {p. 5355}	LC_DIAG_PUE_ACT_LS_DOWN {p. 5191}
LV_CAT_DIAG_REQ_EOL {p. 799}	LV_DC {p. 5746}	LV_END_DIAG_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}	LV_END_DIAG_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}
LV_ERR_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5282}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT] {p. 1061}
LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CHG_LS_DOWN {p. 5388}	LV_ERR_CHG_LS_UP {p. 5416}	LV_ERR_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5388}
LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}
LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5348}
LV_ERR_EL_CPS {p. 4708}	LV_ERR_EL_LSL_UP [NC_CBK_EX_NR] {p. 4293}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}
LV_ERR_FTL_MIN {p. 4762}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}
LV_ERR_LSH_DOWN [NC_CBK_EX_NR] {p. 4248}	LV_ERR_LSH_UP [NC_CBK_EX_NR] {p. 4315}	LV_ERR_LSL_UP_IF [NC_CBK_EX_NR] {p. 4285}	LV_ERR_MAF {p. 4815}

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LV_ERR_MAF_FRQ_EL [NC_MAF_NR] {p. 4815}	LV_ERR_MAF_FRQ_GRD [NC_MAF_NR] {p. 4815}	LV_ERR_MAF_FRQ_RNG [NC_MAF_NR] {p. 4815}	LV_ERR_MAP_PLAUS {p. 1062}
LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}
LV_ERR_MTC_CTL_2 {p. 4977}	LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}	LV_ERR_OBD_LSH_ DOWN [NC_CBK_EX_NR] {p. 5198}
LV_ERR_OBD_VLD_LSH_ UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_OC_LSL_UP [NC_CBK_EX_NR] {p. 4300}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_PUC_VLD_LS_ UP [NC_CBK_EX_NR] {p. 5297}	LV_ERR_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5169}	LV_ERR_REF_CRK_CAM_ EX [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_REF_CRK_CAM_ IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SHIFT_AFL_ LSL_UP [NC_CBK_EX_NR] {p. 5334}
LV_ERR_SHIFT_AFR_ LSL_UP [NC_CBK_EX_NR] {p. 5334}	LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}	LV_ERR_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5152}
LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_ IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}
LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}
LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_TTIP_MES_LSH_ UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}	LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}
LV_ERR_VS {p. 5021}	LV_ERR_VS_PLAUS {p. 5021}	LV_INH_DIAG_RBM_DYN_ VLD_LS_UP [NC_CBK_EX_NR] {p. 5377}	LV_LS_DIAG_REQ_INH_ CAT_DIAG {p. 5349}
LV_MTC_CUR_OFF {p. 6565}	NC_CBK_EX_NR {p. 1829}	NC_MAF_NR {p. 834}	NC_NR_CAM_CBK {p. 1507}
NC_NR_CBK_IVVT {p. 604}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_INH_CAT_DIAG_MAN_DEAC	V	0... 1H	0 ...1	1	-
Manual deactivation of CAT diagnosis inhibition conditions					

Import actions:

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ACTION_ERRM_CheckPendingStatus (**IN**<PRM_XX>,**OUT**<PRM_PendingStatus>)

General information

B.47.1 Inhibition of diagnosis

General information:

The inhibition of the catalyst diagnosis can be deactivated by :
LC_INH_CAT_DIAG_MAN_DEAC = 1.
For LC_INH_CAT_DIAG_MAN_DEAC = 1 the catalyst diagosis function is not inhibited by a component failure.

Description:

If one of the following components fail the catalyst efficiency diagnosis function is stopped by LV_INH_DIAG_RBM_CAT_DIAG[i] = 1. The inhibition is calculated bank-wise.

Application conditions:

Initialisation: `at reset all Variables shall be set to 0`

Activation: `LV_DC transition 0 -> 1  (start driving cycle)`

Deactivation: `LV_DC transition 1 -> 0  (driving cycle terminated)`

Recurrence: `0.02 sec`

Function description:

Formula section:

```
The calculation shall be done for all exhaust cylinder banks.
For instance, if two separate catalyst systems are concerned (NC_CBK_EX_NR
= 2), then
       i = 1, for cylinder bank 1
       i = 2, for cylinder bank 2
otherwise (NC_CBK_EX_NR = 1)
       i = 1, for single exhaust cylinder bank 1.


    If         LV_ERR_AMP = 1
    or        LV_ERR_AMP_PLAUS = 1
    or        LV_ERR_CHG_LS_DOWN = 1
    or        LV_ERR_CHG_LS_UP = 1
    or        LV_ERR_CRK_PLAUS = 1
    or        LV_ERR_CRK_SYN = 1
    or        LV_ERR_CRK_TOOTH = 1
    or        LV_ERR_CRK_TOOTH_PER = 1
    or        LV_ERR_DIAGCPS = 1
    or        LV_ERR_EL_CPS = 1
    or        LV_ERR_FTL_MIN = 1
    or        LV_ERR_FUP = 1
```

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```
or          LV_ERR_FUP_MFP_PLAUS = 1
or          LV_ERR_FUP_ORNG = 1
or          LV_ERR_FUP_ST = 1
or          LV_ERR_H_PRS_SYS = 1
or          LV_ERR_LOAD_TPS_PLAUS = 1
or          LV_ERR_MAP_PLAUS = 1
or          LV_ERR_MAP_TPS_PLAUS = 1
or          LV_ERR_MTC_CTL_2 = 1
or          LV_ERR_MTC_CTL_3 = 1
or          LV_ERR_MTC_DR = 1
or          LV_ERR_TPS_1 = 1
or          LV_ERR_TPS_2 = 1
or          LV_ERR_TPS_AD = 1
or          LV_ERR_TPS_AD_BOL = 1
or          LV_ERR_TPS_MAF_1 = 1
or          LV_ERR_TPS_MAF_2 = 1
or          LV_ERR_TPS_RATIO = 1
or          LV_ERR_TPS_ST_CHK_2 = 1
or          LV_ERR_VCV = 1
or          LV_ERR_VS = 1
or          LV_ERR_VS_PLAUS = 1
or          LV_ERR_AIR_LSL_UP [i] = 1
or          LV_ERR_CHK_LS_DOWN [i] = 1
or          LV_ERR_CTL_LSL_UP [i] = 1
or          LV_ERR_DELTA_I_LAM [i] = 1
or          LV_ERR_DYN_VLD_LS_UP [i] = 1
or          LV_ERR_EL_LSL_UP [i] = 1
or          LV_ERR_FSD [i] = 1
or          LV_ERR_FSD_LAM_LIM [i] = 1
or          LV_ERR_LSH_DOWN [i] = 1
or          LV_ERR_LSH_UP [i] = 1
or          LV_ERR_LSL_UP_IF [i] = 1
or          LV_ERR_OBD_LSH_DOWN [i] = 1
or          LV_ERR_OBD_VLD_LSH_UP [i] = 1
or          LV_ERR_OC_LS_DOWN [i] = 1
or          LV_ERR_OC_LSL_UP [i] = 1
or          LV_ERR_OFS_LSL_UP[i] = 1
or          LV_ERR_PUC_LS_DOWN [i] = 1
or          LV_ERR_PUC_VLD_LS_UP [i] = 1
or          [LV_ERR_PUE_LS_DOWN [i] = 1
             and  LC_DIAG_PUE_ACT_LS_DOWN = 1]
or          LV_ERR_SCG_LS_DOWN [i] = 1
or          LV_ERR_SCP_LS_DOWN [i] = 1
or          LV_ERR_SHIFT_AFR_LSL_UP[i] = 1
or          LV_ERR_SHIFT_AFL_LSL_UP[i] = 1
or          LV_ERR_SWT_LS_DOWN[i] = 1
or          LV_ERR_TTIP_MES_LSH_UP[i] = 1
or          LV_ERR_VLS_DOWN_DIF[i] = 1
or          LV_ERR_MAF_FRQ_EL[y]  = 1 for all y
or          LV_ERR_MAF_FRQ_GRD[y] = 1 for all y
or          LV_ERR_MAF_FRQ_RNG[y] = 1 for all y
or          LV_ERR_CAM_CST_IVVT_IN[x] = 1 for all x
or          LV_ERR_CAM_CST_IVVT_EX[x] = 1 for all x
or          LV_ERR_MEC_IVVT_IN[x] = 1 for all x
or          LV_ERR_MEC_IVVT_EX[x] = 1 for all x
or          LV_ERR_SLV_IVVT_IN[x] = 1 for all x
or          LV_ERR_SLV_IVVT_EX[x] = 1 for all x
or          LV_ERR_PER_CAM_EX[k] = 1 for all k
or          LV_ERR_PER_CAM_IN[k] = 1 for all k
or          LV_ERR_PLAUS_CAM_EX[k] = 1 for all k
or          LV_ERR_PLAUS_CAM_IN[k] = 1 for all k
```

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```
    or        LV_ERR_REF_CRK_CAM_EX[k] = 1 for all k
    or        LV_ERR_REF_CRK_CAM_IN[k] = 1 for all k
    or        LV_ERR_SYN_CAM_EX[k] = 1 for all k
    or        LV_ERR_SYN_CAM_IN[k] = 1 for all k
    or        LV_ERR_SYN_CRK_CAM_IN[k] = 1 for all k
    or        LV_ERR_TOOTH_OFF_EX[k] = 1 for all k
    or        LV_ERR_TOOTH_OFF_IN[k] = 1 for all k
    or        LV_ERR_IV[0] = 1 for i = 1 and NC_CYL_NR = 6
    or        LV_ERR_IV[2] = 1 for i = 1 and NC_CYL_NR = 6
    or        LV_ERR_IV[4] = 1 for i = 1 and NC_CYL_NR = 6
    or        LV_ERR_IV[1] = 1 for i = 2 and NC_CYL_NR = 6
    or        LV_ERR_IV[3] = 1 for i = 2 and NC_CYL_NR = 6
    or        LV_ERR_IV[5] = 1 for i = 2 and NC_CYL_NR = 6
    or        LV_ERR_MIS[0] = 1 for i = 1 and NC_CYL_NR = 6
    or        LV_ERR_MIS[2] = 1 for i = 1 and NC_CYL_NR = 6
    or        LV_ERR_MIS[4] = 1 for i = 1 and NC_CYL_NR = 6
    or        LV_ERR_MIS[1] = 1 for i = 2 and NC_CYL_NR = 6
    or        LV_ERR_MIS[3] = 1 for i = 2 and NC_CYL_NR = 6
    or        LV_ERR_MIS[5] = 1 for i = 2 and NC_CYL_NR = 6


Then          LV_INH_DIAG_RBM_CAT_DIAG[i] = 1
              (Catalyst efficiency diagnosis inhibited due to OBD error )
Else          LV_INH_DIAG_RBM_CAT_DIAG[i] = 0
              (Catalyst efficiency diagnosis not inhibited)
Endif


Inhibition due to environmental condition /  calibration:
If LV_MTC_CUR_OFF = 1
   Or (LV_INH_DIAG_RBM_CAT_DIAG[i] = 1
   and  LC_INH_CAT_DIAG_MAN_DEAC = 0)
   or (LV_LS_DIAG_REQ_INH_CAT_DIAG = 1
      and  LV_CAT_DIAG_REQ_EOL = 0
      and [(LV_END_DIAG_DYN_VLD_LS_UP[1] = 0
            and LV_INH_DIAG_RBM_DYN_VLD_LS_UP[1] = 0)
       #IF NC_CBK_EX_NR = 2
       #THEN
       or (LV_END_DIAG_DYN_VLD_LS_UP[2] = 0
             and LV_INH_DIAG_RBM_DYN_VLD_LS_UP[2] = 0)
       #ENDIF]
       and LC_DIAG_DYN_LSL_UP_CAT_SYN = 0)
Then  LV_INH_DIAG_CAT_DIAG[i] = 1 (Catalyst efficiency diagnosis inhibited)
Else LV_INH_DIAG_CAT_DIAG[i] = 0 (Catalyst efficiency diagnosis not inhibited)
Endif


Catalyst diagnosis specific load for limited dynamics calculation
LOAD_CAT_LDC = FAC_TQ_REQ
The definition of both variables are different, therefore a linear interpolation
between the physical limits (min and max) of FAC_TQ_REQ shall be applied, i.e
LOAD_CAT_LDC = 0% if FAC_TQ_REQ = 0; LOAD_CAT_LDC = 99,9023438% if FAC_TQ_
REQ = 1.999969.
```

B.47.2 Interface for Rate – Based - Monitoring

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General information:

With this module the interface between the CAT_DIAG_i monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_CAT[i] data.
Within STATE_RBM_CAT[i], three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)
  (depending on failure status: pending)
- Monitor individual RBM conditions encountered within this DC (bit 2)
  (not valid for catalyst diagnosis)

Application conditions:

Initialisation: `at LV_DC 0 ® 1 transition :`
`bit 0, bit 1 and bit 2 of STATE_RBM_CAT[i] = 0`
`on failure memory reset :`
`bit 1 of STATE_RBM_CAT[i] = 0`

Activation: `LV_DC 0 ® 1 transition` **and** `LV_DC = 1`

Deactivation: –

Recurrence: 1 s

Function description:

Formula section:

At LV_DC 0 ® 1 transition
The pending status of the following failures has to be checked only once :

Dependence	**Error**			
	LV_ERR_AMP	LV_ERR_AMP_PLAUS	LV_ERR_CHG_LS_DOWN	LV_ERR_CHG_LS_UP
		LV_ERR_CRK_PLAUS	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH
	LV_ERR_CRK_TOOTH_PER	LV_ERR_DIAGCPS	LV_ERR_EL_CPS	LV_ERR_FUP
	LV_ERR_FUP_MFP_PLAUS	LV_ERR_FUP_ORNG	LV_ERR_FUP_ST	LV_ERR_H_PRS_SYS
	LV_ERR_LOAD_TPS_PLAUS	LV_ERR_MAP_PLAUS	LV_ERR_MAP_TPS_PLAUS	LV_ERR_MTC_CTL_2
	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR		
	LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_TPS_AD	LV_ERR_TPS_AD_BOL
	LV_ERR_TPS_MAF_1	LV_ERR_TPS_MAF_2	LV_ERR_TPS_RATIO	LV_ERR_TPS_ST_CHK_2
	LV_ERR_VCV	LV_ERR_VS	LV_ERR_VS_PLAUS	

Continued on next page

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NC_CBK_EX_NR	LV_ERR_AIR_LSL_UP [i]	LV_ERR_CHK_LS_DOWN [i]	LV_ERR_CTL_LSL_UP [i]	LV_ERR_DELTA_I_LAM [i]
	LV_ERR_DYN_VLD_LS_UP [i]	LV_ERR_EL_LSL_UP [i]		LV_ERR_FSD [i]
	LV_ERR_FSD_LAM_LIM [i]	LV_ERR_LSH_DOWN [i]	LV_ERR_LSH_UP [i]	LV_ERR_LSL_UP_IF [i]
	LV_ERR_OBD_LSH_DOWN [i]	LV_ERR_OBD_VLD_LSH_UP	LV_ERR_OC_LS_DOWN [i]	LV_ERR_OC_LSL_UP
	LV_ERR_OFS_LSL_UP [i]	LV_ERR_PUC_LS_DOWN [i]	LV_ERR_PUC_VLD_LS_UP [i]	LV_ERR_PUE_LS_DOWN [i]
	LV_ERR_SCG_LS_DOWN [i]	LV_ERR_SCP_LS_DOWN [i]	LV_ERR_SHIFT_AFL_LSL_UP [i]	LV_ERR_SHIFT_AFR_LSL_UP[i]
	LV_ERR_SWT_LS_DOWN [i]	LV_ERR_TTIP_MES_LSH_UP [i]	LV_ERR_VLS_DOWN_DIF [i]	

For y = 1 to NC_MAF_NR (= for all i)

NC_MAF_NR	LV_ERR_MAF_FRQ_EL [y]	LV_ERR_MAF_FRQ_GRD [y]	LV_ERR_MAF_FRQ_RNG [y]	

For x = 1 to NC_NR_CBK_IVVT (= for all i)

NC_NR_CBK_IVVT	LV_ERR_MEC_IVVT_IN [x]	LV_ERR_MEC_IVVT_EX [x]	LV_ERR_SLV_IVVT_IN [x]	LV_ERR_SLV_IVVT_EX [x]
	LV_ERR_CAM_CST_IVVT_IN [x]	LV_ERR_CAM_CST_IVVT_EX [x]		

For k = 1 to NC_NR_CAM_CBK (= for all i)

NC_NR_CAM_CBK	LV_ERR_PER_CAM_EX [k]	LV_ERR_PER_CAM_IN [k]	LV_ERR_PLAUS_CAM_EX [k]	LV_ERR_PLAUS_CAM_IN [k]
	LV_ERR_REF_CRK_CAM_EX [k]	LV_ERR_REF_CRK_CAM_IN [k]	LV_ERR_SYN_CAM_EX [k]	LV_ERR_SYN_CAM_IN [k]
	LV_ERR_SYN_CRK_CAM_IN [k]		LV_ERR_TOOTH_OFF_EX [k]	LV_ERR_TOOTH_OFF_IN [k]

NC_CBK_EX_NR = 1

Dependence	**Error**			
NC_CYL_NR	LV_ERR_MIS[0]	LV_ERR_MIS[2]	LV_ERR_MIS[4]	LV_ERR_IV[0]

Continued on next page

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	LV_ERR_IV[2]	LV_ERR_IV[4]		

NC_CBK_EX_NR = 2

Dependence	Error			
NC_CYL_NR	LV_ERR_MIS[1]	LV_ERR_MIS[3]	LV_ERR_MIS[5]	LV_ERR_IV[1]
	LV_ERR_IV[3]	LV_ERR_IV[5]		

If(1) { CPU optimization at LV_DC 0 ® 1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn't empty }
Then(1)
While bit 1 of STATE_RBM_CAT[i] = 0 **do**
with each XX failure of the above list :
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION

If(2) XX has a pending status
Then(2)
bit 1 of STATE_RBM_CAT[i] = 1
Endif(2)
For LV_ERR_PUE_LS_DOWN[i], do the following instead:
If LC_DIAG_PUE_ACT_LS_DOWN = 1
then
ACTION_ERRM_CheckPendingStatus(IN<XX>,
OUT<PendingStatus>, SYNCHRONIZATION<CALL>)
If(3) XX has a pending status
Then(3) bit 1 of STATE_RBM_CAT[i] = 1
Endif(3)
Endif(2)
Endwhile
Else(1)
{ the dynamic failure memory is empty }
No action
Endif(1)_
Every 1 s :
If bit 0 of STATE_RBM_XX = 0
Then
If LV_END_DIAG_CAT_DIAG[i] = 1
Then bit 0 of STATE_RBM_CAT[i] = 1
Endif
Endif

If bit 1 of STATE_RBM_CAT[i] = 0
Then
If LV_INH_DIAG_RBM_CAT_DIAG[i] = 1
Then bit 1 of STATE_RBM_CAT[i] = 1
Endif
Endif

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bit 2 of STATE_RBM_XX = 1

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B.48 Catalyst efficiency diagnosis (error interface)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_CAT_DIAG_OBD [NC_CBK_EX_NR]	O/V/S	0... FFH	0... 1.9921875	7.8125e-3	-
Cat. Diag. value for OBD Scantool Mod 6 output					
EFF_CAT_DIAG_SUM	V	0... FFH	0... 1.9921875	7.8125e-3	-
Common value for catalyst conversion capability of both cylinder banks (OBD emission limit)					
EFF_CAT_DIAG_TMP [NC_CBK_EX_NR]	-	0... FFH	0... 1.9921875	7.8125e-3	-
temporary Cat. Diag. value for OBD Scantool Mod 6 output					
EFF_CAT_MAX_DIAG_OBD [NC_CBK_EX_NR]	O/V/S	0... FFH	0... 1.9921875	7.8125e-3	-
Actually threshold for Scantool Mod 6 Output					
EFF_CAT_MAX_DIAG_TMP [NC_CBK_EX_NR]	-	0... FFH	0... 1.9921875	7.8125e-3	-
temporary actually threshold for Scantool Mod 6 Output					
ERR_SYM_CAT_DIAG [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure of each symptom: failure without filtering of diagnosis value catalyst diagnose					
LV_CDN_DIAG_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag condition for catalyst diagnosis active					
LV_END_DIAG_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag catalyst diagnosis finished for that driving cycle					
LV_ERR_CAT_DIAG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Present failure catalyst efficiency					
STATE_CAT_DIAG_OLD [NC_CBK_EX_NR]	-	0H 1H 2H 3H 4H 5H	PASSIVE WAIT CYC_LEAN CYC_RICH END RAMP_UP	-	-
old value of State of diagnosis for edge detection					

Input data:

EFF_CAT_DIAG_HOM [NC_CBK_EX_NR] {p. 5473}	LV_CAT_DIAG_REQ_EOL {p. 799}	LV_DC {p. 5746}	LV_END_DIAG_LAM_ADJ [NC_CBK_EX_NR] {p. 5215}
LV_ERR_LAM_ADJ [NC_CBK_EX_NR] {p. 5216}	LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_LS_DOWN_DIAG_END [NC_CBK_EX_NR] {p. 5449}
LV_LS_UP_DIAG_END [NC_CBK_EX_NR] {p. 5449}	NC_CBK_EX_NR {p. 1829}	STATE_CAT_DIAG [NC_CBK_EX_NR] {p. 5474}	

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EFF_CAT_MAX_DIAG	-	0... FFH	0... 1.9921875	7.8125e-3	-
max. threshold for EFF_CAT_DIAG to detect a separate catalyst with OBD limit emissions					
C_EFF_CAT_MAX_DIAG_EOL	-	0... FFH	0... 1.9921875	7.8125e-3	-
max. threshold for EFF_CAT_DIAG[i] to detect a separate catalyst with OBD limit emissions at EOL Test					
C_EFF_CAT_MAX_SUM_DIAG	-	0... FFH	0... 1.9921875	7.8125e-3	-
max. threshold for EFF_CAT_DIAG to common detect of catalysts with vehicle OBD limit emissions					
IP_EFF_CAT_DIAG_SUM	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_EFF_CAT_DIAG_1_IP_EFF_CAT	6	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_EFF_CAT_DIAG_2_IP_EFF_CAT	6	0... FFH	0... 1.9921875	7.8125e-3	-
Map of common EFF_CAT_DIAG_SUM value depending from separate bank values for common OBD emiss. limit					
LC_CAT_DIAG_DIS	-	0... 1H	0 ...1	1	-
For report value to Scan tool: separate EFF_CAT_DIAG for each catalyst or common, if over OBD emiss. limit					
LC_CAT_DIAG_EOL_LS_USE	-	0... 1H	0 ...1	1	-
Boolean that considers if LS end flags are used for cat-diagnosis EOL test					
LC_CAT_DIAG_RESU	-	0... 1H	0 ...1	1	-
Switch over the failure memory setting: separate for each catalyst or common for OBD emiss. limit					

General Information

For 2 exhaust gas bank system 1 bank (catalyst) could be aged over OBD limit, but if other catalyst is O.K, emissions of whole vehicle need not be over OBD limit, so MIL needn t go on. A separate diagnosis of every cylinder bank(catalyst), or common diagnosis is switchable. A common EFF_CAT_DIAG_SUM is calculated from separate EFF_CAT_DIAG[i] values of separate banks and error memory entered if common value is over the threshold.

Configuration for diagnostic symptoms:

Diagnostic CAT_DIAG[i]	Symptom description	Symptom	Filter type
Catalyst diagnosis	´CAT_EFFIC_LOW´	SYM_0	NO

NC_CBK_EX_NR defines the number of exhaust banks.
For vector elements, the variable extension _i is used in the model instead of [i] as found in the textual description.

Application Conditions

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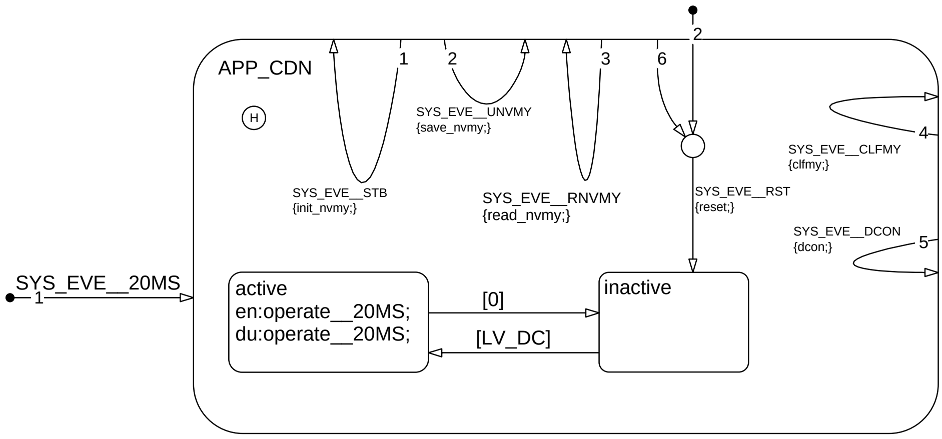

Figure B.48.1: : Path: EGTR_FCTDGCEFIF0/APP_CDN/Chart

Function description

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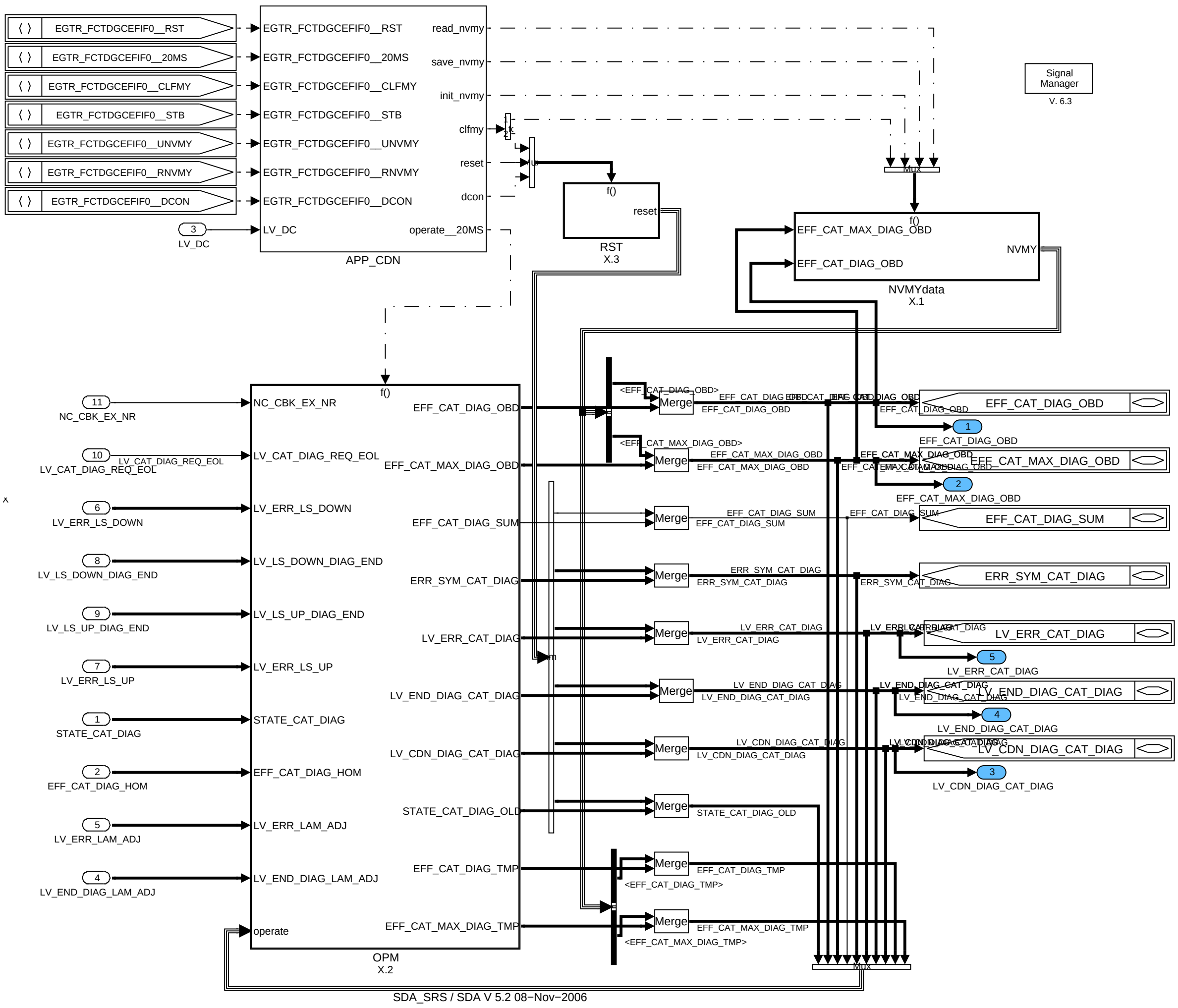

Figure B.48.2: : Path: EGTR_FCTDGCEFIF0

B.48.1 NVMY Data

Init initialization at memory fault
Read restore from memory

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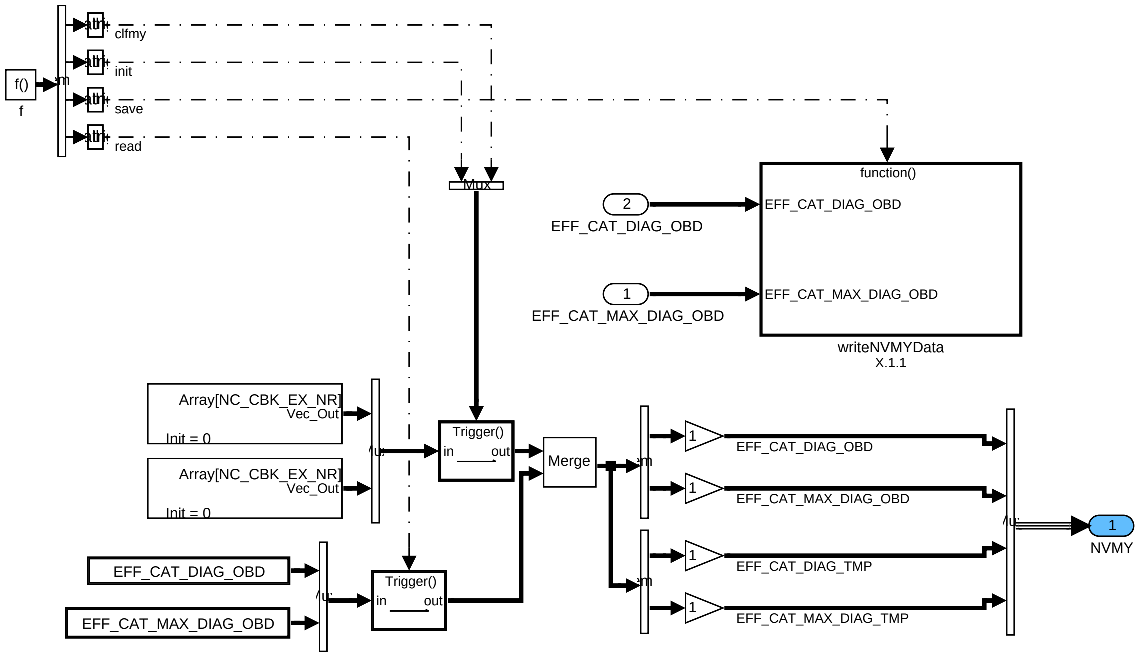

Figure B.48.3: : Path: EGTR_FCTDGCEFIF0/NVMYdata

B.48.1.1 No title given

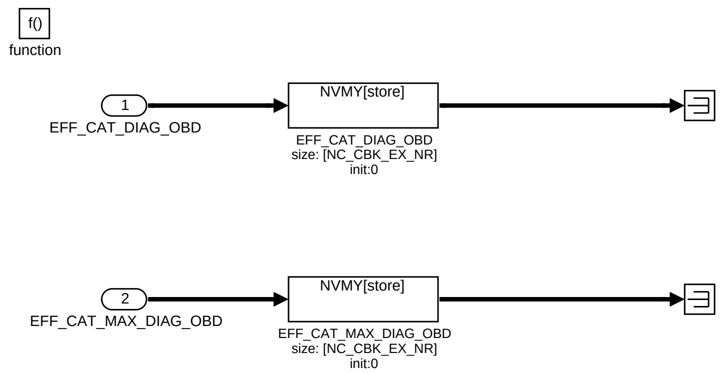

Figure B.48.4: : Path: EGTR_FCTDGCEFIF0/NVMYdata/writeNVMYData

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B.48.2 Formula Section

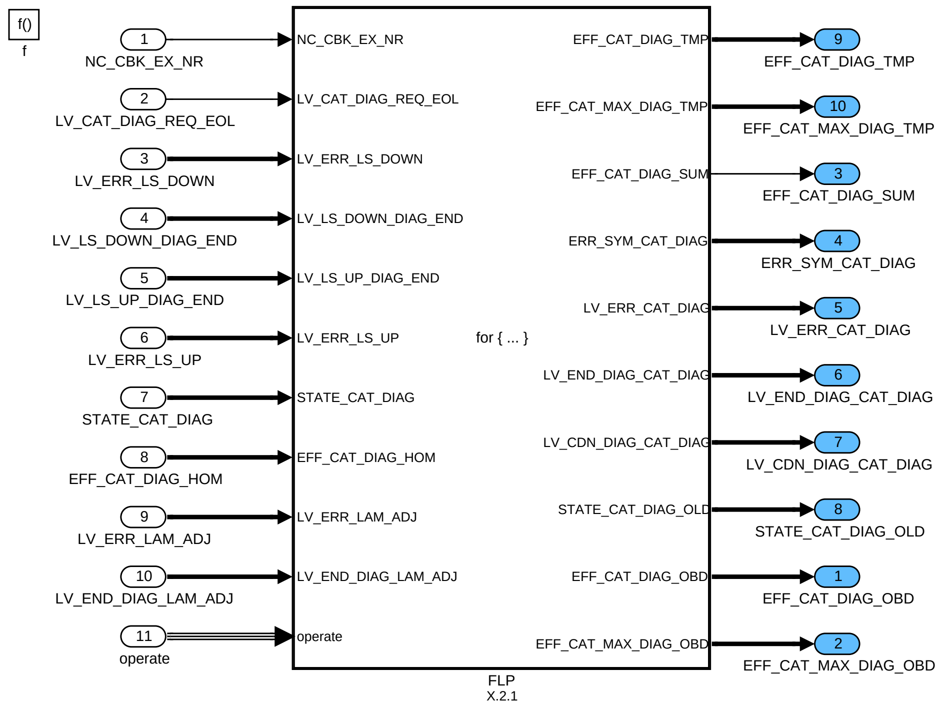

Figure B.48.5: : Path: EGTR_FCTDGCEFIF0/OPM

B.48.2.1 Introduction multiple bank system

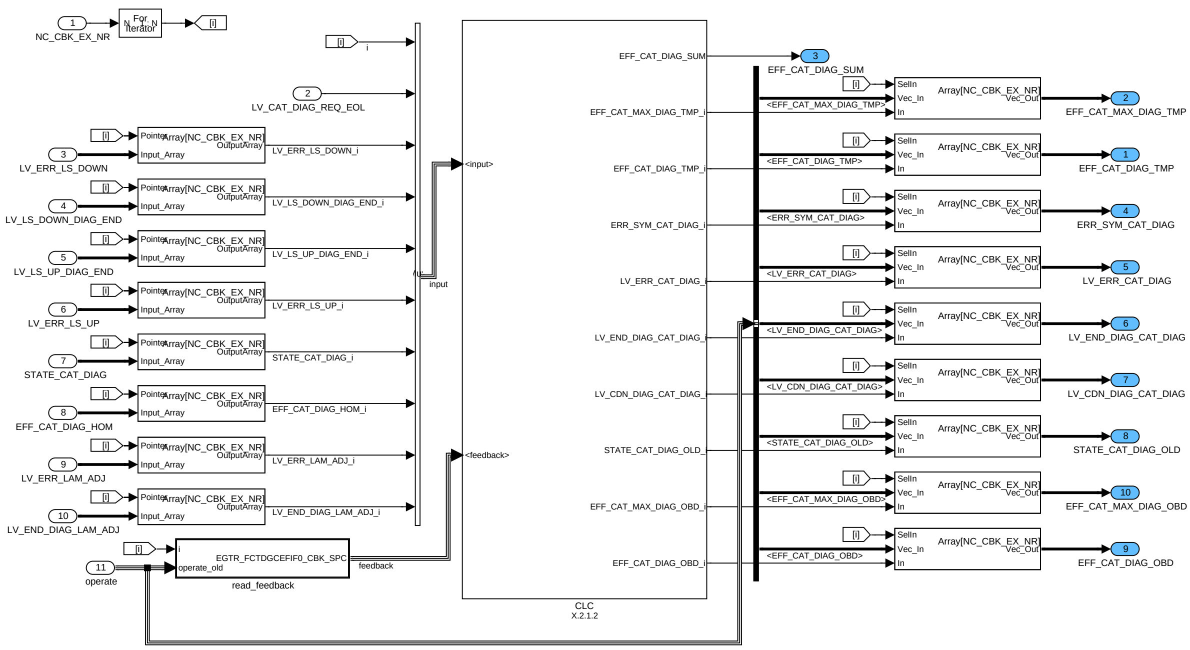

Figure B.48.6: : Path: EGTR_FCTDGCEFIF0/OPM/FLP

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B.48.2.1.1 Check general conditions

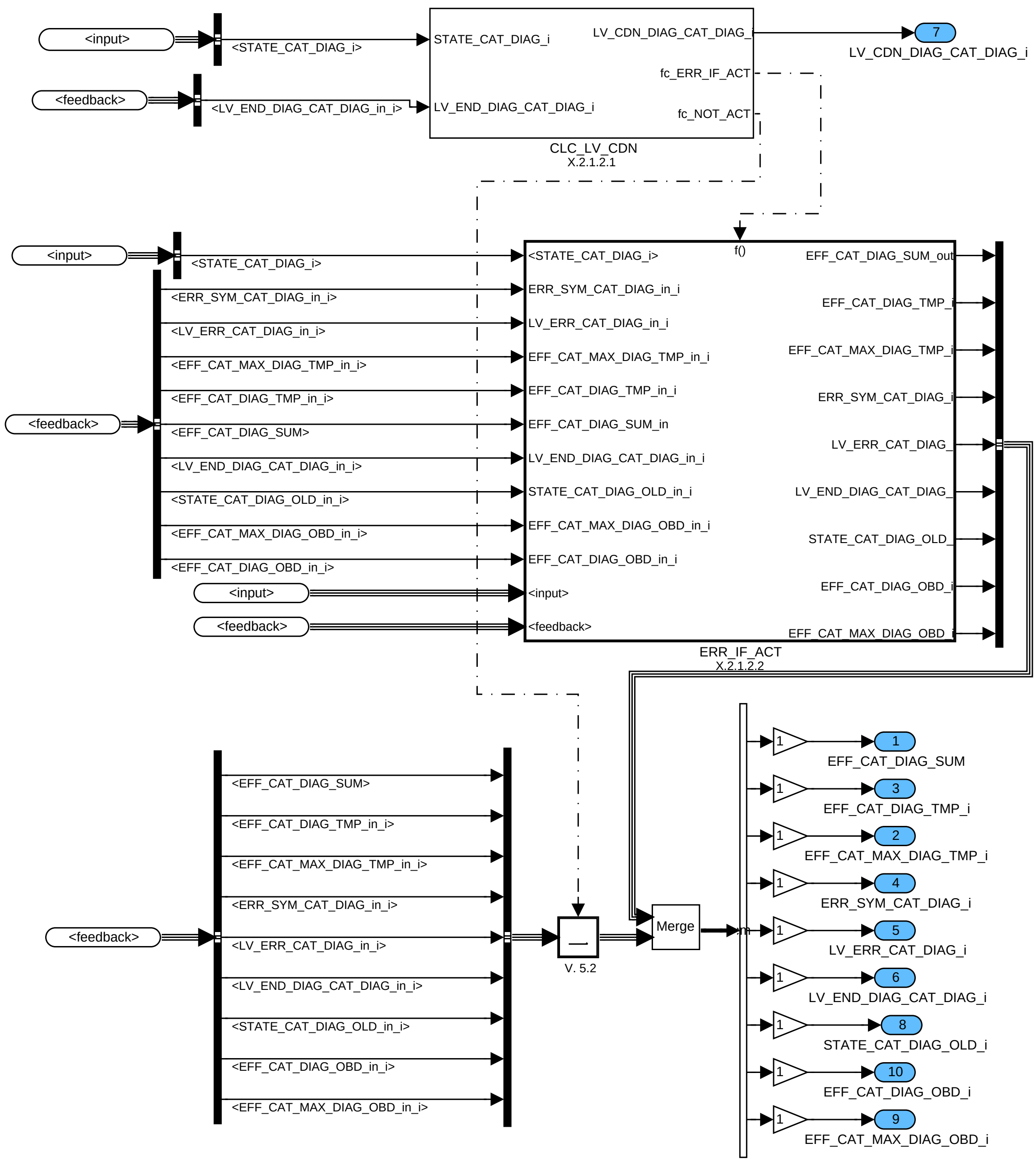

Figure B.48.7: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC

B.48.2.1.1.1 Check state of the diagnosis

ERR_IF_ACT: diagnosis not inhibited and not in passive state
NOT_ACT: no calculations are done

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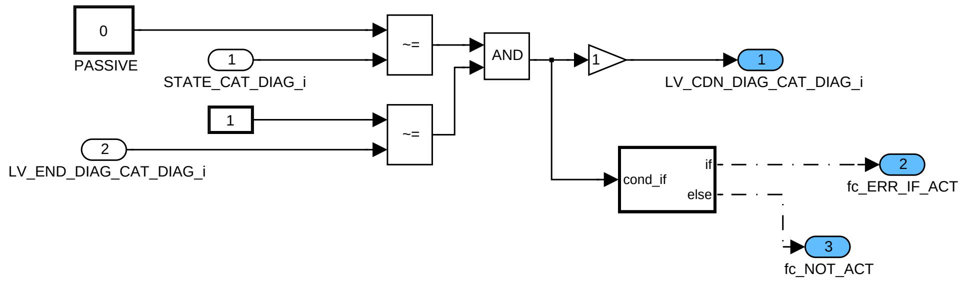

Figure B.48.8: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC/CLC_LV_CDN

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B.48.2.1.1.2 Calculations when diagnosis not inhibited and not in passive state (ERR_IF_ACT)

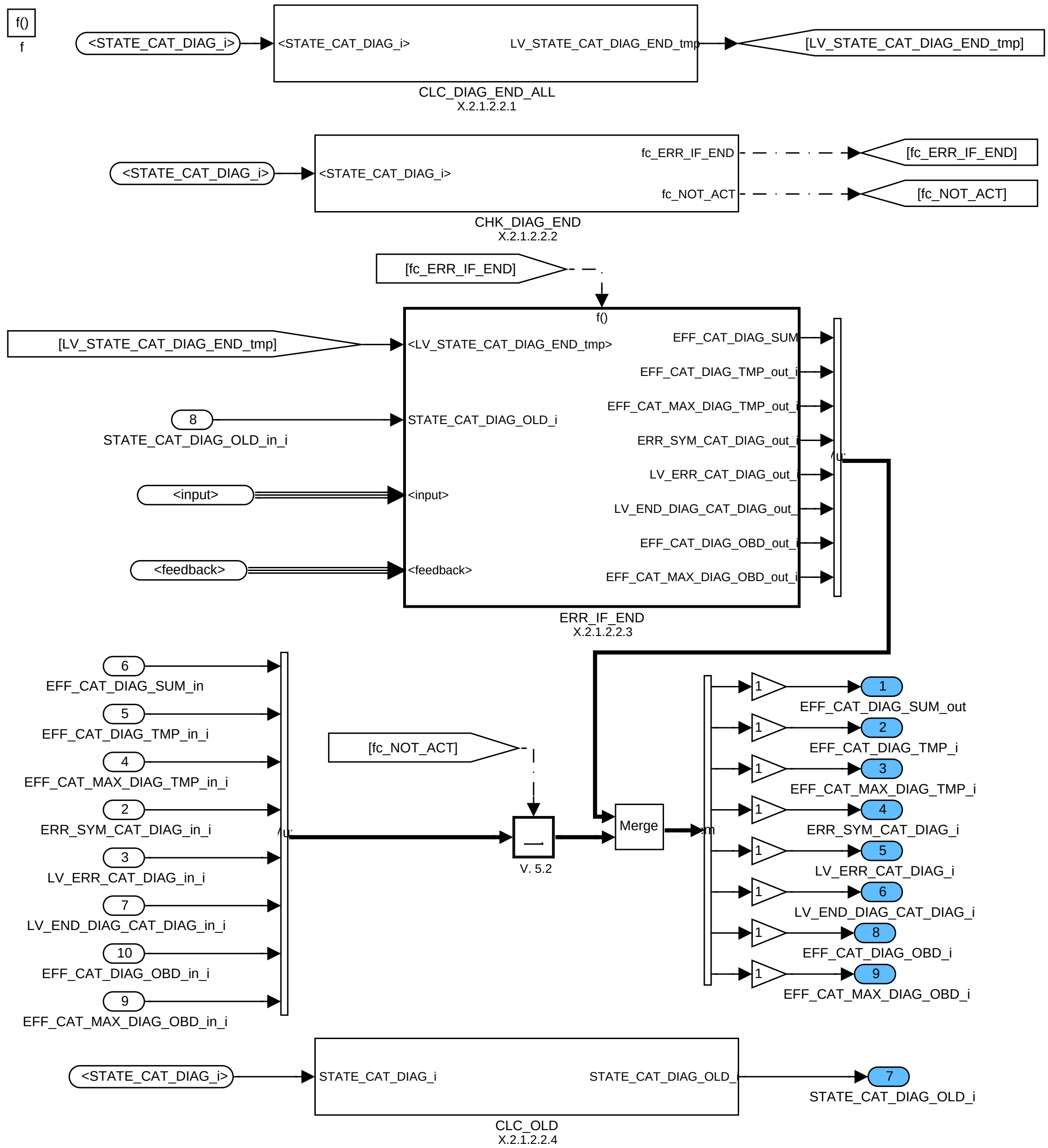

Figure B.48.9: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT

B.48.2.1.1.2.1 Check of the diagnosis state for activation of calculations

ERR_IF_END: calculation of error indicator after diagnosis is finished
NOT_ACT: no calculations are done

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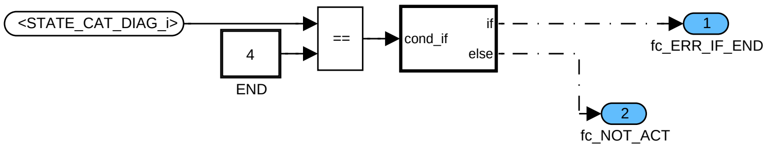

Figure B.48.10: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/CHK_DIAG_END

B.48.2.1.1.2.2 Calculation of temporary bit at diagnosis exits to end - bank crosscheck

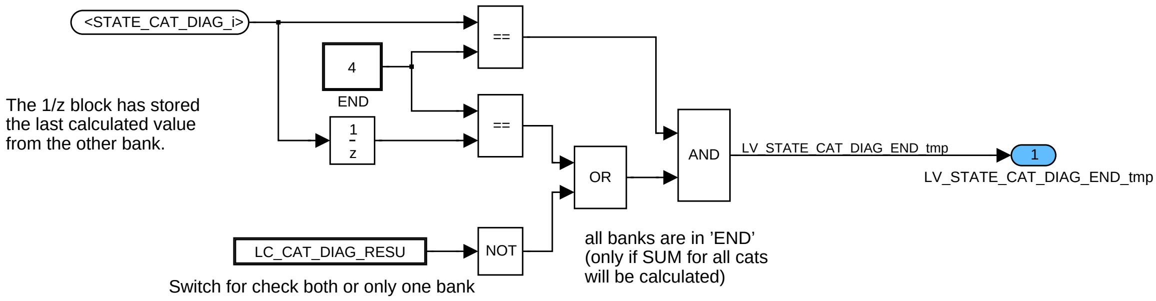

Figure B.48.11: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/CLC_DIAG_END_ALL

B.48.2.1.1.2.3 Calculation old values

Figure B.48.12: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/CLC_OLD

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B.48.2.1.1.2.4 Calculation of error indicator after diagnosis is finished (ERR_IF_END)

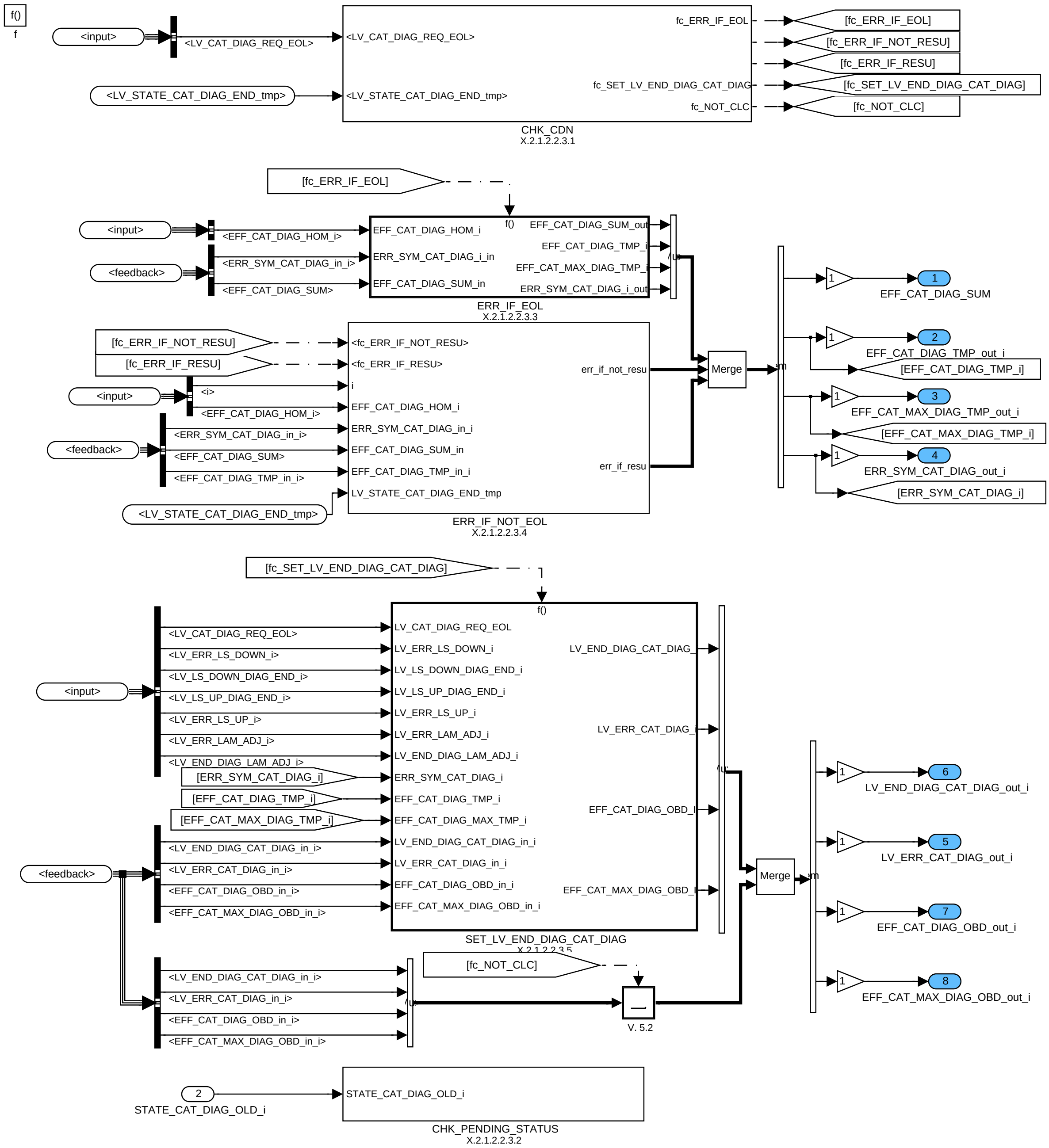

Figure B.48.13: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/ERR_IF_END

B.48.2.1.1.2.4.1 Check EOL request and temporary end bit from banks crosscheck

ERR_IF_EOL: EOL test is active
ERR_IF_NOT_RESU: check of bank sum not active
ERR_IF_RESU: check of bank sum active
SET_LV_END_DIAG_CAT_DIAG: calculation final result
NOT_CLC: no any calculation are done

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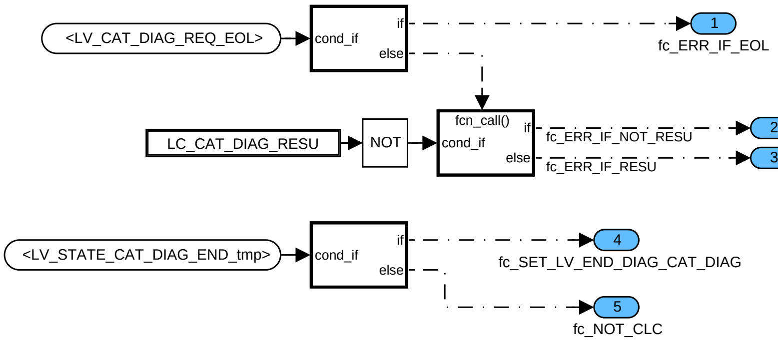

Figure B.48.14: : Path:
EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/ERR_IF_END/CHK_CDN

B.48.2.1.1.2.4.2 Check pending status

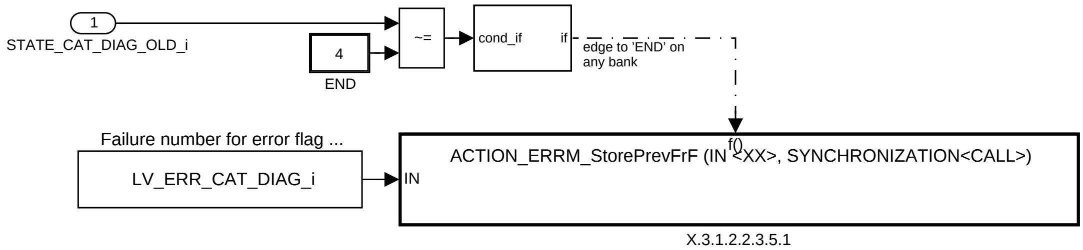

Figure B.48.15: : Path:
EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/ERR_IF_END/CHK_PENDING_STATUS

B.48.2.1.1.2.4.3 Calculations at EOL test (ERR_IF_EOL)

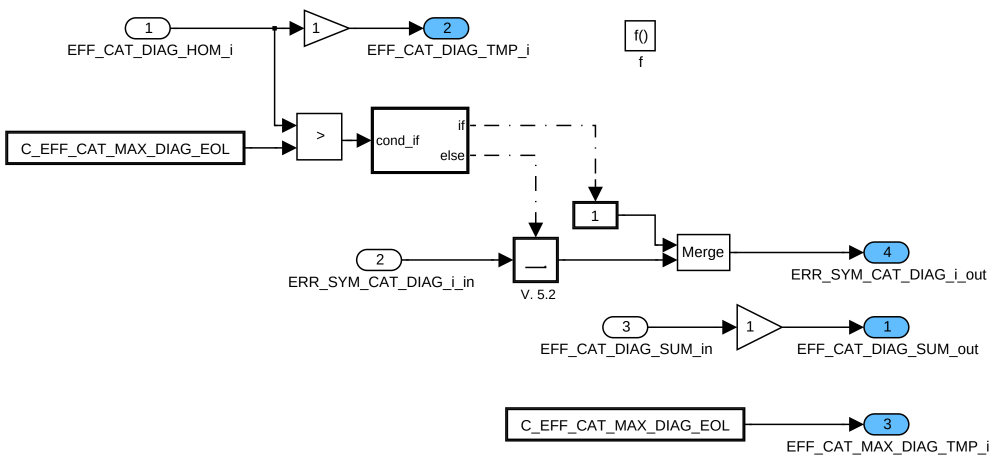

Figure B.48.16: : Path:
EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/ERR_IF_END/ERR_IF_EOL

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B.48.2.1.1.2.4.4 EOL test not active

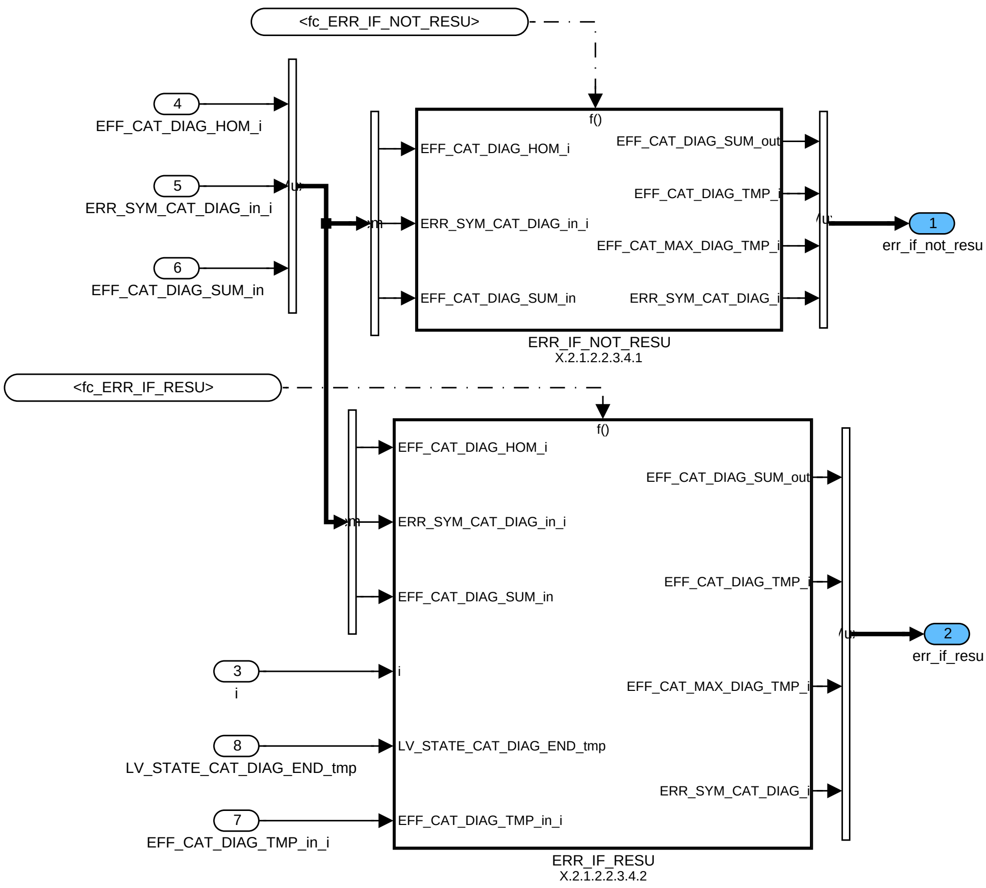

Figure B.48.17: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/ERR_IF_END/ERR_IF_NOT_EOL

B.48.2.1.1.2.4.4.1 Check of bank sum not active (ERR_IF_NOT_RESU)

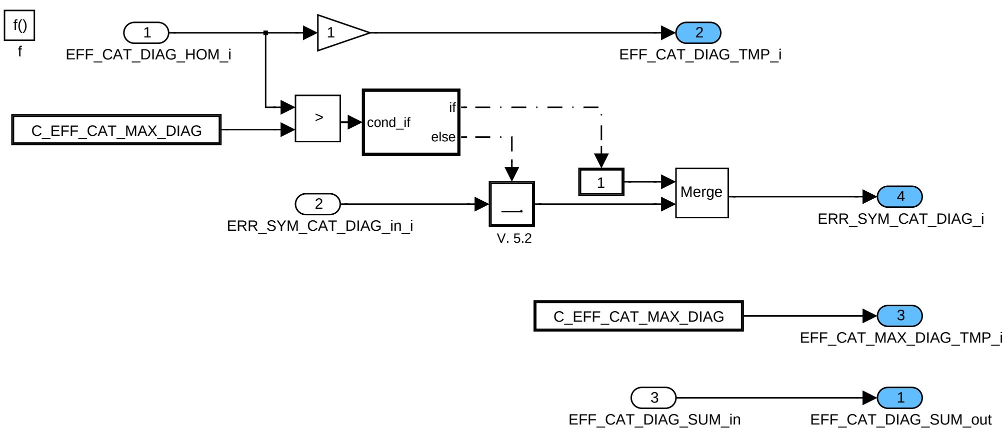

Figure B.48.18: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/ERR_IF_END/ERR_IF_NOT_EOL/ERR_IF_NOT_RESU

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B.48.2.1.1.2.4.4.2 Check of bank sum active (ERR_IF_RESU)

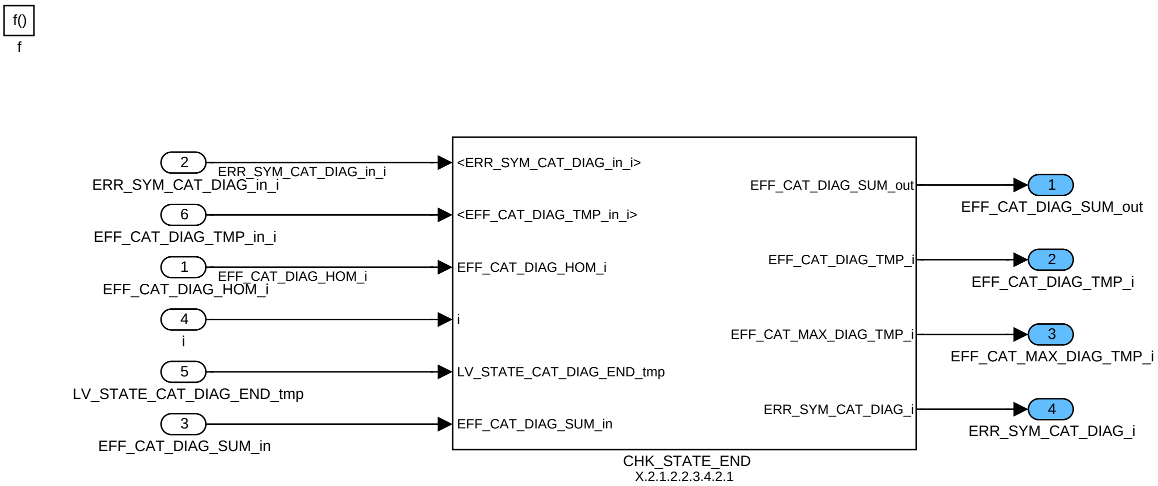

Figure B.48.19: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/ERR_IF_END/ERR_IF_NOT_EOL/ERR_IF_RESU

B.48.2.1.1.2.4.4.2.1 Check of temporary end bit from bank crosscheck

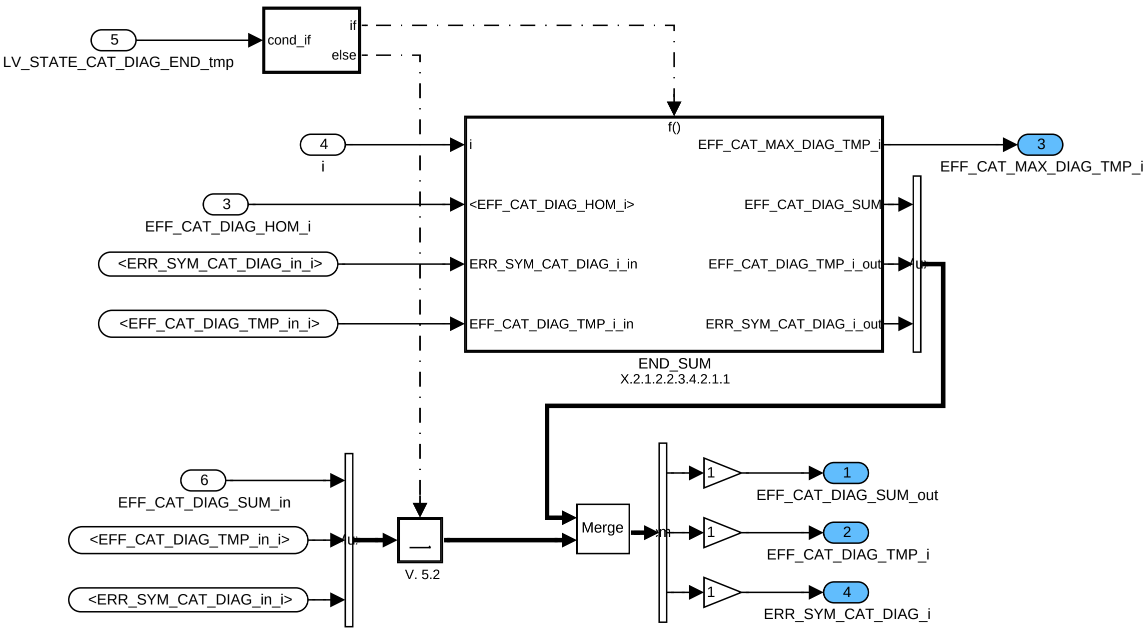

Figure B.48.20: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/ERR_IF_END/ERR_IF_NOT_EOL/ERR_IF_RESU/CHK_STATE_END

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B.48.2.1.1.2.4.4.2.1.1 Calculations active

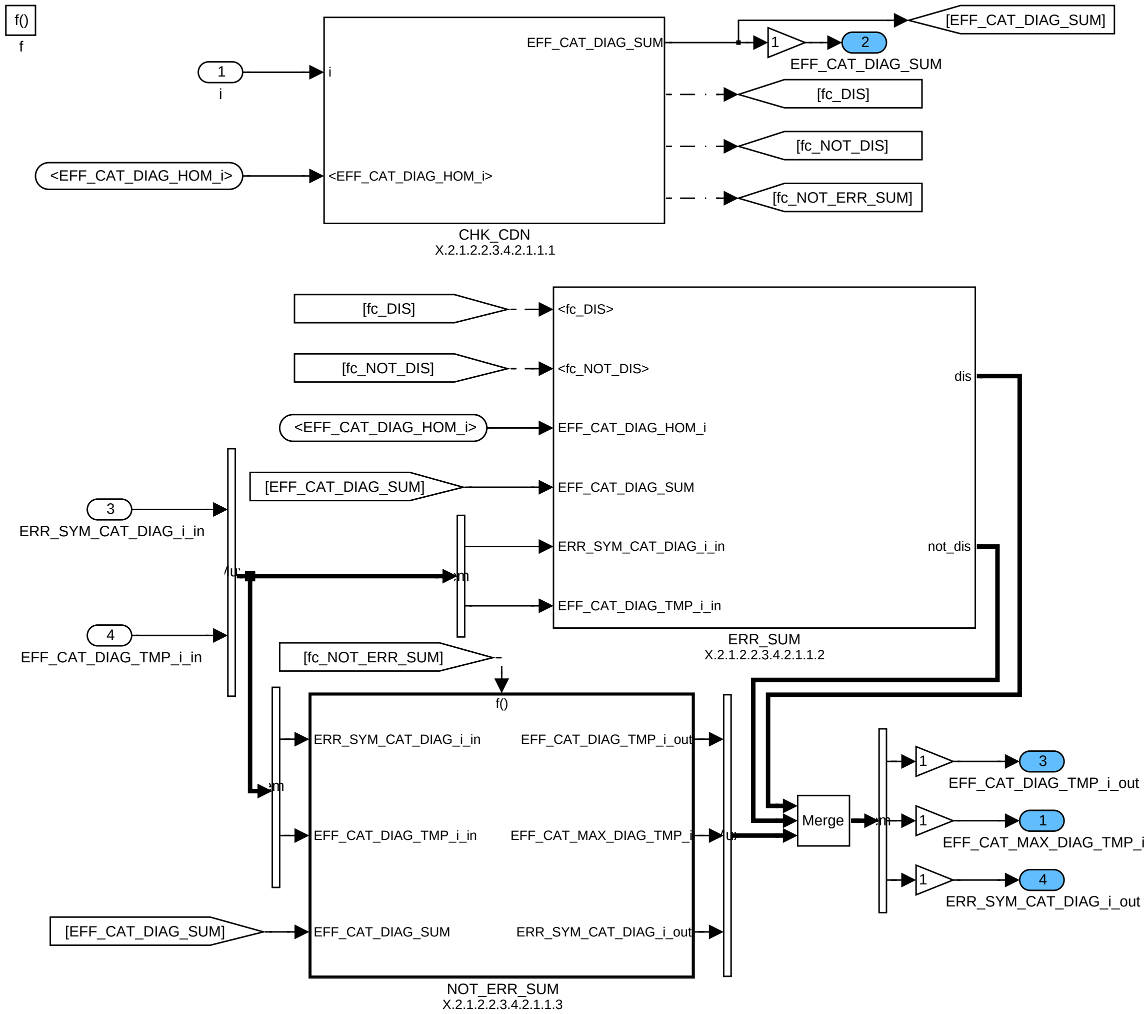

Figure B.48.21: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/ERR_IF_END/ERR_IF_NOT_EOL/ERR_IF_RESU/CHK_STATE_END/END_SUM

B.48.2.1.1.2.4.4.2.1.2 Calculations of sum diagnosis results and check the threshold

This function is switch able with LC_CAT_DIAG_RESU: separate comparison of EFF_CAT_DIAG[i] with threshold and separate failure for every cylinder bank is stored, or from separate EFF_CAT_DIAG[i] is a common EFF_CAT_DIAG_SUM calculated and failure is stored only if common threshold C_EFF_CAT_MAX_DIAG_SUM is exceeded. This module is to call immediately after module Catalyst efficiency diagnosis (OSC Method) is finished. For crossways question of symptoms i = the actually calculated bank and y = the other bank as actually calculated

DIS: check single bank active
NOT_DIS: check single bank not active
NOT_ERR_SUM: Sum diagnosis result is not bigger then threshold

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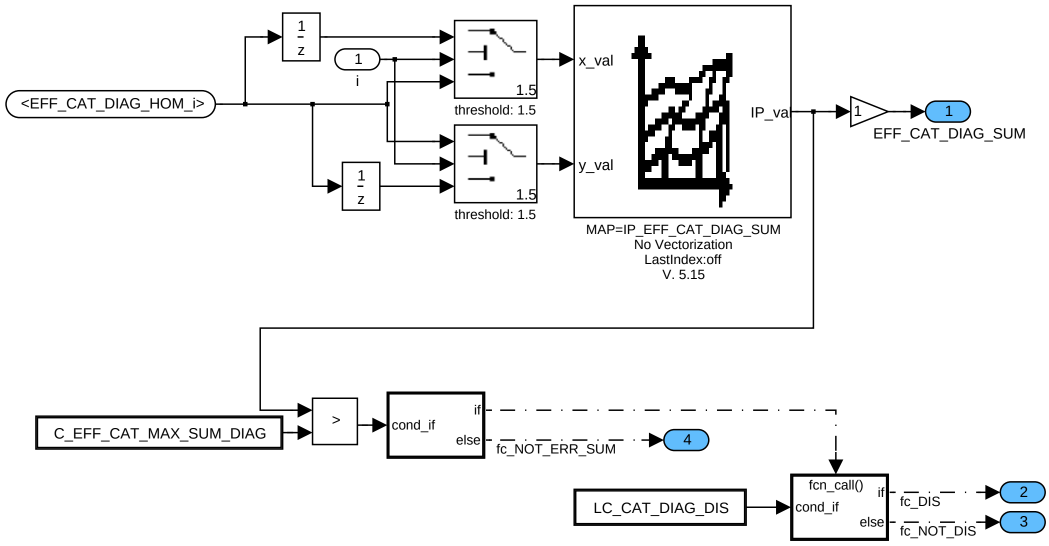

Figure B.48.22: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/ERR_IF_END/ERR_IF_NOT_EOL/ERR_IF_RESU/CHK_STATE_END/END_SUM/CHK_CDN

B.48.2.1.1.2.4.4.2.1.3 Sum diagnosis result is bigger then threshold (active are DIS and NOT_DIS)

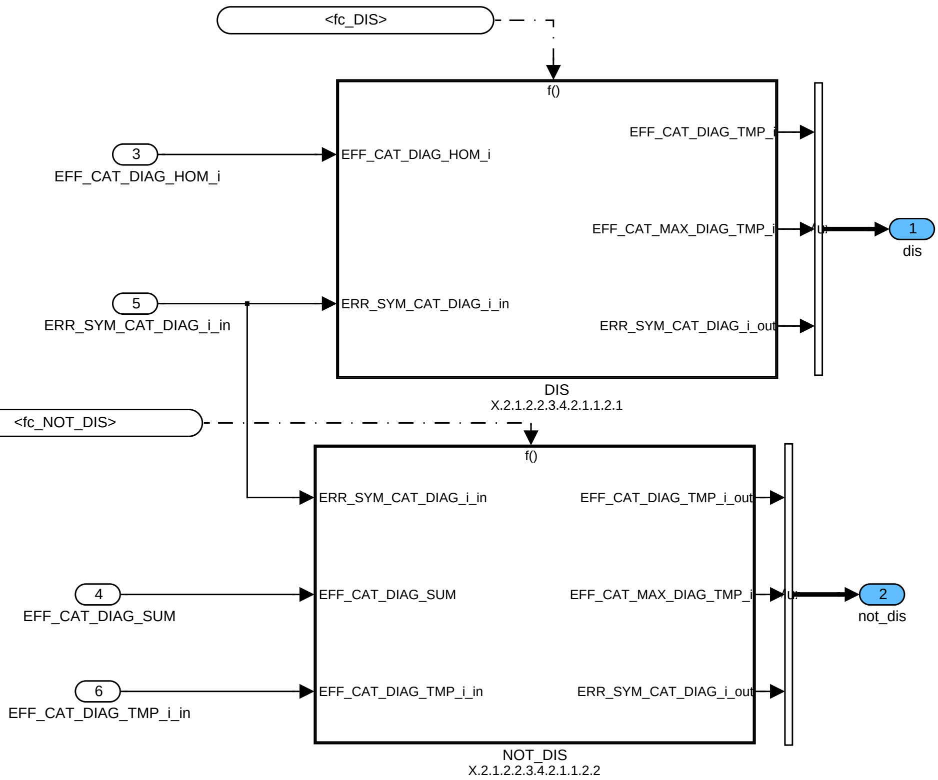

Figure B.48.23: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/ERR_IF_END/ERR_IF_NOT_EOL/ERR_IF_RESU/CHK_STATE_END/END_SUM/ERR_SUM

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B.48.2.1.1.2.4.4.2.1.4 Check single bank active (DIS)

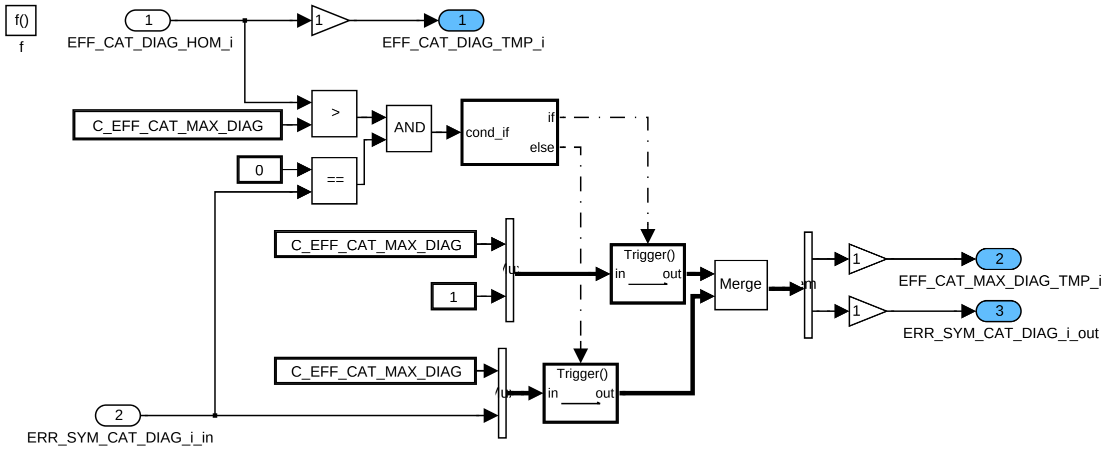

Figure B.48.24: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/ERR_IF_END/ERR_IF_NOT_EOL/ERR_IF_RESU/CHK_STATE_END/END_SUM/ERR_SUM/DIS

B.48.2.1.1.2.4.4.2.1.5 Check single bank not active (NOT_DIS)

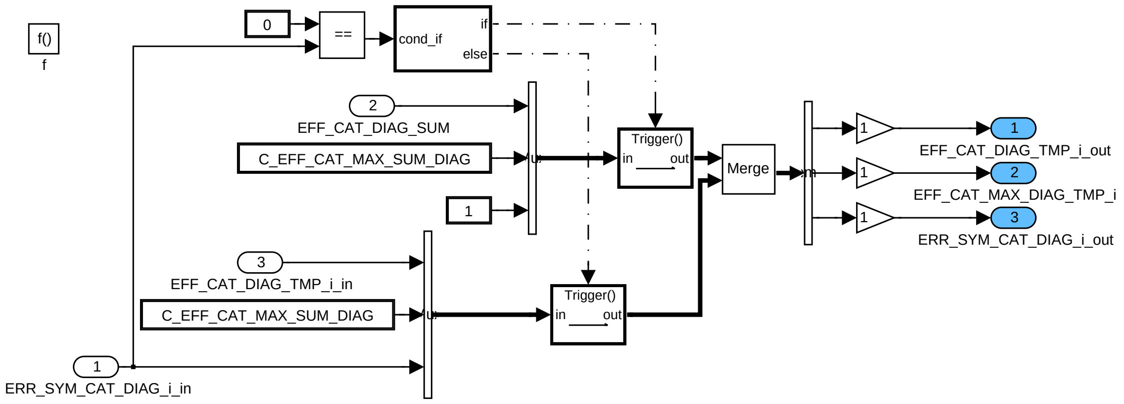

Figure B.48.25: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/ERR_IF_END/ERR_IF_NOT_EOL/ERR_IF_RESU/CHK_STATE_END/END_SUM/ERR_SUM/NOT_DIS

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B.48.2.1.1.2.4.4.2.1.6 Sum diagnosis result is not bigger then threshold (NOT_ERR_SUM)

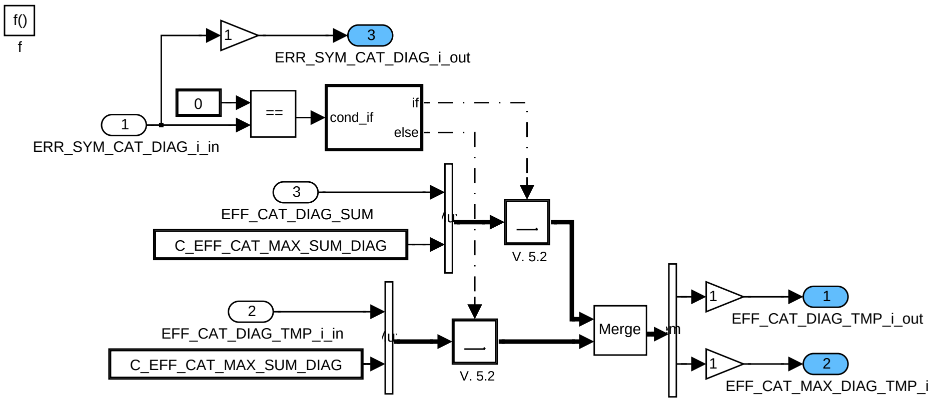

Figure B.48.26: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/ERR_IF_END/ERR_IF_NOT_EOL/ERR_IF_RESU/CHK_STATE_END/END_SUM/NOT_ERR_SUM

B.48.2.1.1.2.4.5 Calculation final result (SET_LV_END_DIAG_CAT_DIAG)

The readiness flag can be set to true only when all other diagnosis are finished and don’t deliver error. In this case the current failure status is stored in the Error Management (by means of a service of ERRM). Otherwise, the catalyst diagnosis is not finished and the old diagnosis value is used.

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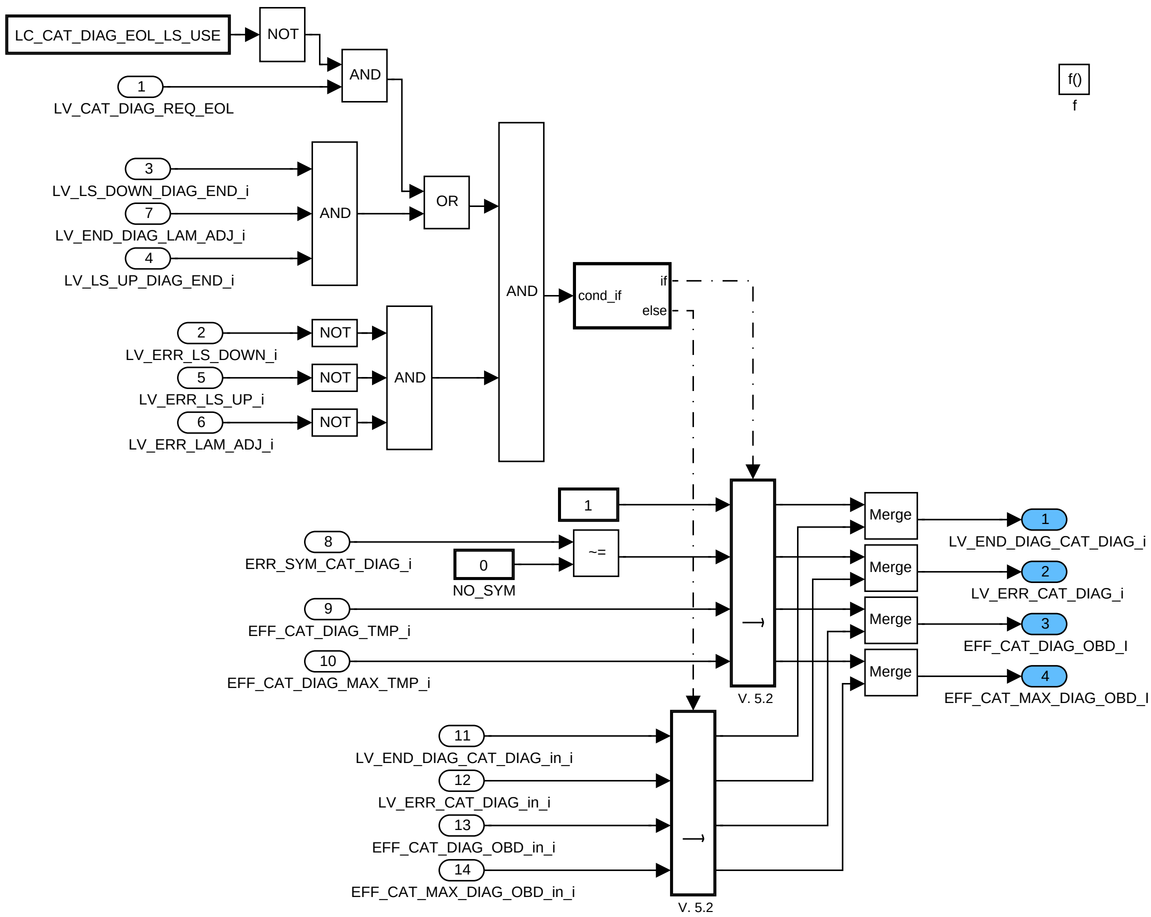

Figure B.48.27: : Path: EGTR_FCTDGCEFIF0/OPM/FLP/CLC/ERR_IF_ACT/ERR_IF_END/SET_LV_END_DIAG_CAT_DIAG

B.48.3 Initialization at RESET

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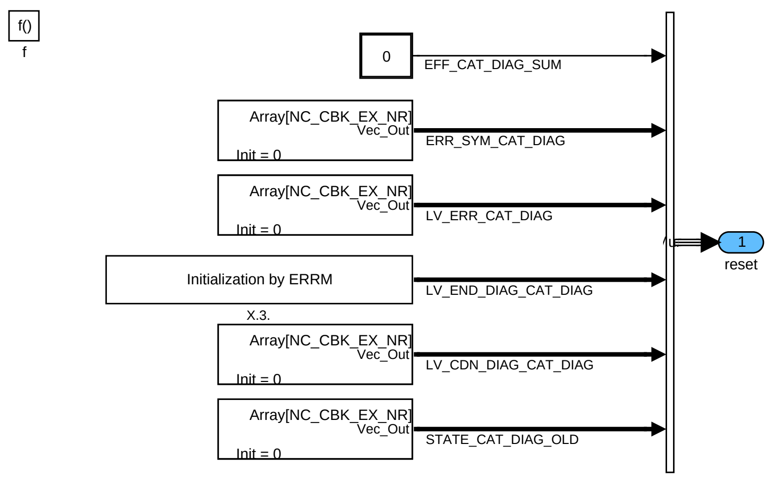

Figure B.48.28: : Path: EGTR_FCTDGCEFIF0/RST

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B.48.3.1 Initialization of ERRM relevant variables

Initialization with "0" for SDA model simulation only

Figure B.48.29: : Path: EGTR_FCTDGCEFIF0/RST/INI_ERRM

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B.49 Coordination of catalyst efficiency value

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_CAT_DIAG [NC_CBK_EX_NR]	O/V/S	0... FFH	0... 1.9921875	7.8125e-3	-
At ended diagnosis final value for catalyst conversion capability					
ERR_SYM_CAT_DIAG_SUM [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom for TWC summary of HOM and AFL diagnosis					
LV_CDN_DIAG_CAT_DIAG_SUM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (seto to one when condition is fulfilled)					
LV_END_DIAG_CAT_DIAG_SUM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
TWC summary of HOM and AFL diagnosis performed at last one time					
LV_ERR_CAT_DIAG_SUM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Present failure after filtering of the summary of HOM and AFL TWC diagnosis					

Input data:

EFF_CAT_DIAG_HOM [NC_CBK_EX_NR] {p. 5473}	ERR_SYM_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}	ERR_SYM_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5561}	LV_END_DIAG_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5561}
NC_CBK_EX_NR {p. 1829}	O2L_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5562}	STATE_CAT_DIAG [NC_CBK_EX_NR] {p. 5474}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_CAT_DIAG_SUM	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_CAT_DIAG_SUM	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
IP_EFF_CAT_DIAG_HOM	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_O2L_CAT_DIAG_AFL_IP_EFF_CAT	6	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Conversion of lean cat diag result O2L_CAT_DIAG_AFL to lambda=1 cat diag result EFF_CAT_DIAG					
LC_CAT_DIAG_AFL_ACT_SUM	-	0... 1H	0 ...1	1	-
Activation of the AFL diagnosis for error calculation					
LC_CAT_DIAG_HOM_ACT_SUM	-	0... 1H	0 ...1	1	-
Activation of the HOM diagnosis for error calculation					
LC_EFF_CAT_DIAG_HOM_ENA	-	0... 1H	0 ...1	1	-
Use EFF_CAT_DIAG_HOM from linear cat diagnosis as result EFF_CAT_DIAG					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_O2L_CAT_DIAG_AFL_ENA	-	0... 1H	0 ...1	1	-
Use O2L_CAT_DIAG_AFL from lean cat diagnosis as result EFF_CAT_DIAG					

General Information

This modul coordinates the results of both catalyst diagnosis methods
- lambda=1 catalyst diagnosis (HOM): EFF_CAT_DIAG_HOM[NC_CBK_EX_NR]
- lean catalyst diagnosis (AFL): O2L_CAT_DIAG_AFL[NC_CBK_EX_NR]

The common result is EFF_CAT_DIAG[NC_CBK_EX_NR]

Application Conditions

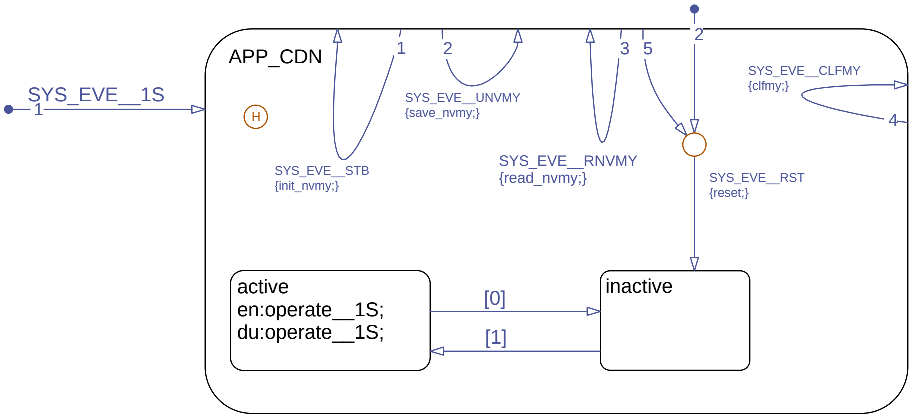

Figure B.49.1: : Path: EGTR_FCTDGCEFC0/APP_CDN/Chart

Function description

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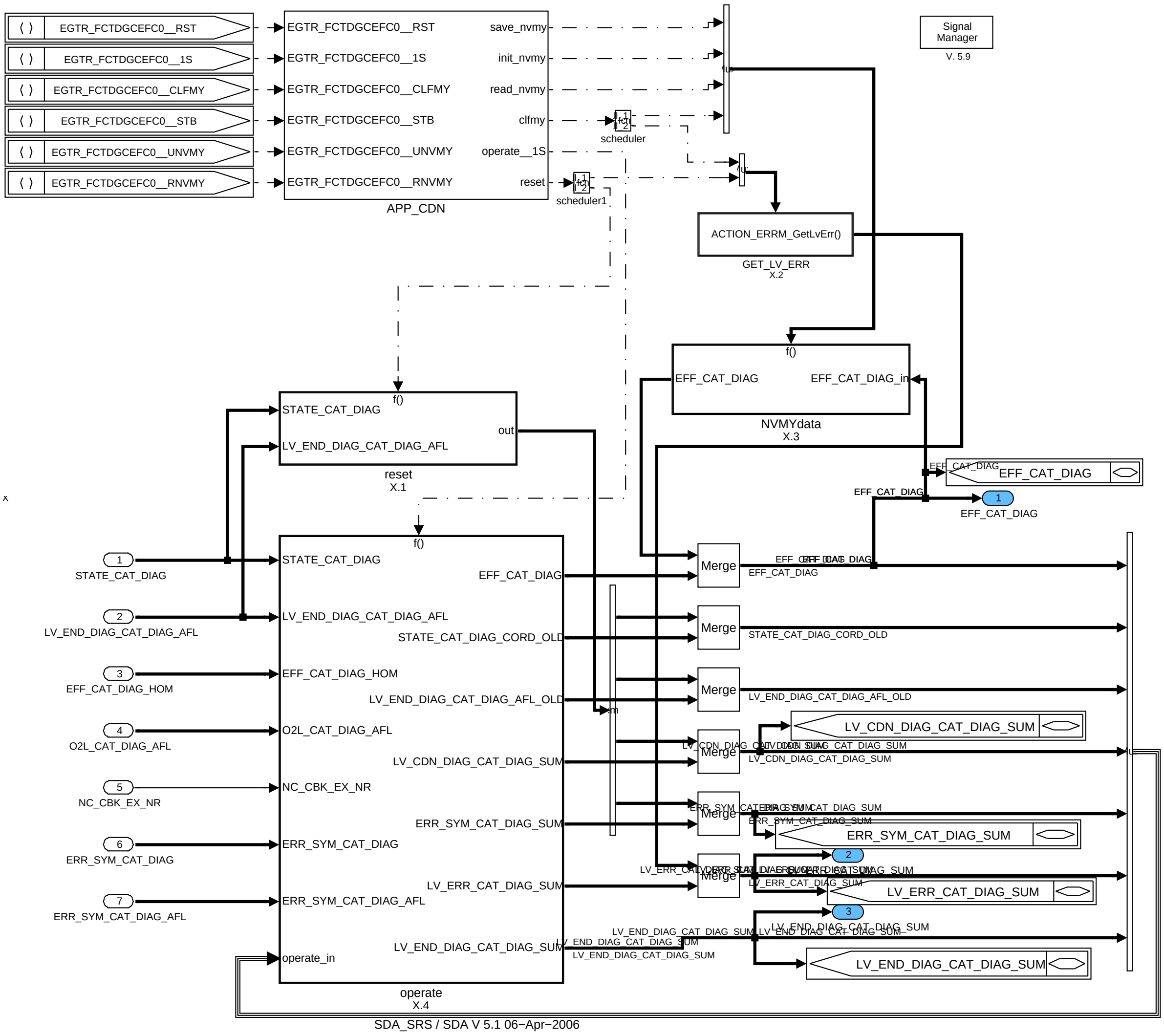

Figure B.49.2: : Path: EGTR_FCTDGCEFC0

B.49.1 Reset

The old values will be initialized with the regarding inputs, due to avoid an edge detection after reset.

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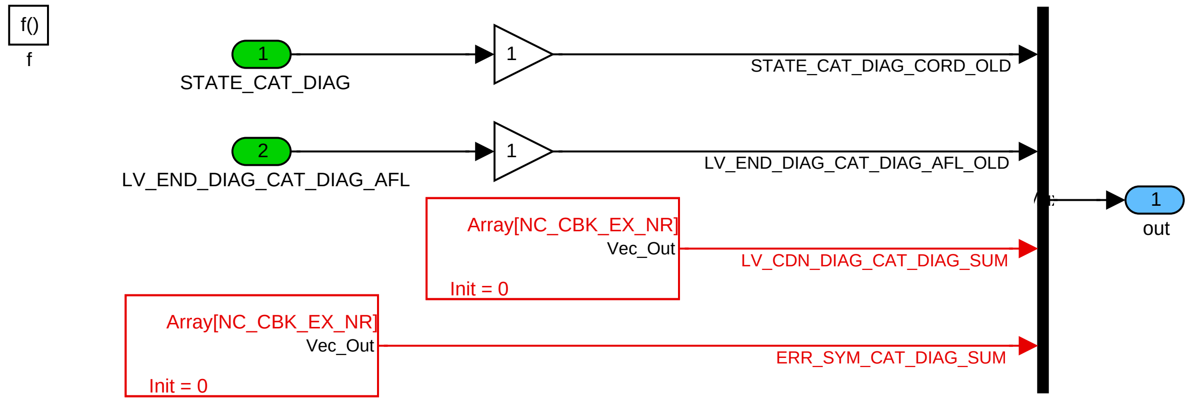

Figure B.49.3: : Path: EGTR_FCTDGCEFC0/reset

B.49.2 Synchronization of the LV_ERR_CAT_DIAG_SUM

Synchronisation between LV_ERR_CAT_DIAG_SUM and its result from ERRM is done using action ACTION_ERRM_GetLvErr() at reset and clrfmy.

B.49.3 EFF_CAT_DIAG[NC_CBK_EX_NR] will be stored in the non-volatile memory

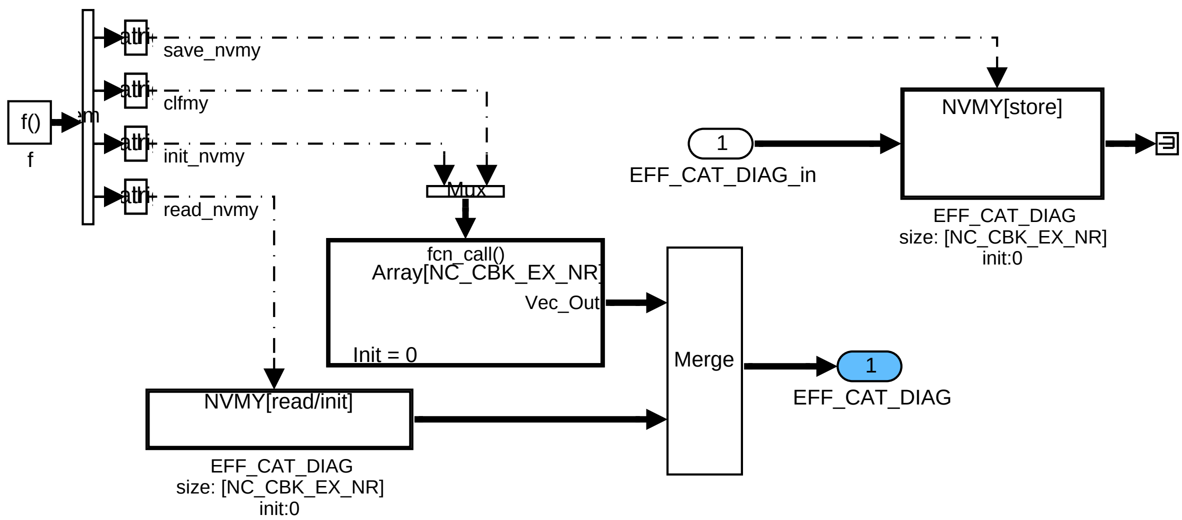

Figure B.49.4: : Path: EGTR_FCTDGCEFC0/NVMYdata

B.49.4 FORMULA SECTION

B.49.4.1 Calculation of the summary diagnosis results

B.49.4.1.1 Calculation of the summary diagnosis "end" and "error symptom" outputs

The summary diagnosis is a combination of the TWC diagnosis of homogeneous and lean combustion modes. Last finished diagnosis saves the summary diagnosis result. When the ABC counter is calibrated to e.g. 2, then both diagnoses can influence the diagnosis result depending on which one is executed.

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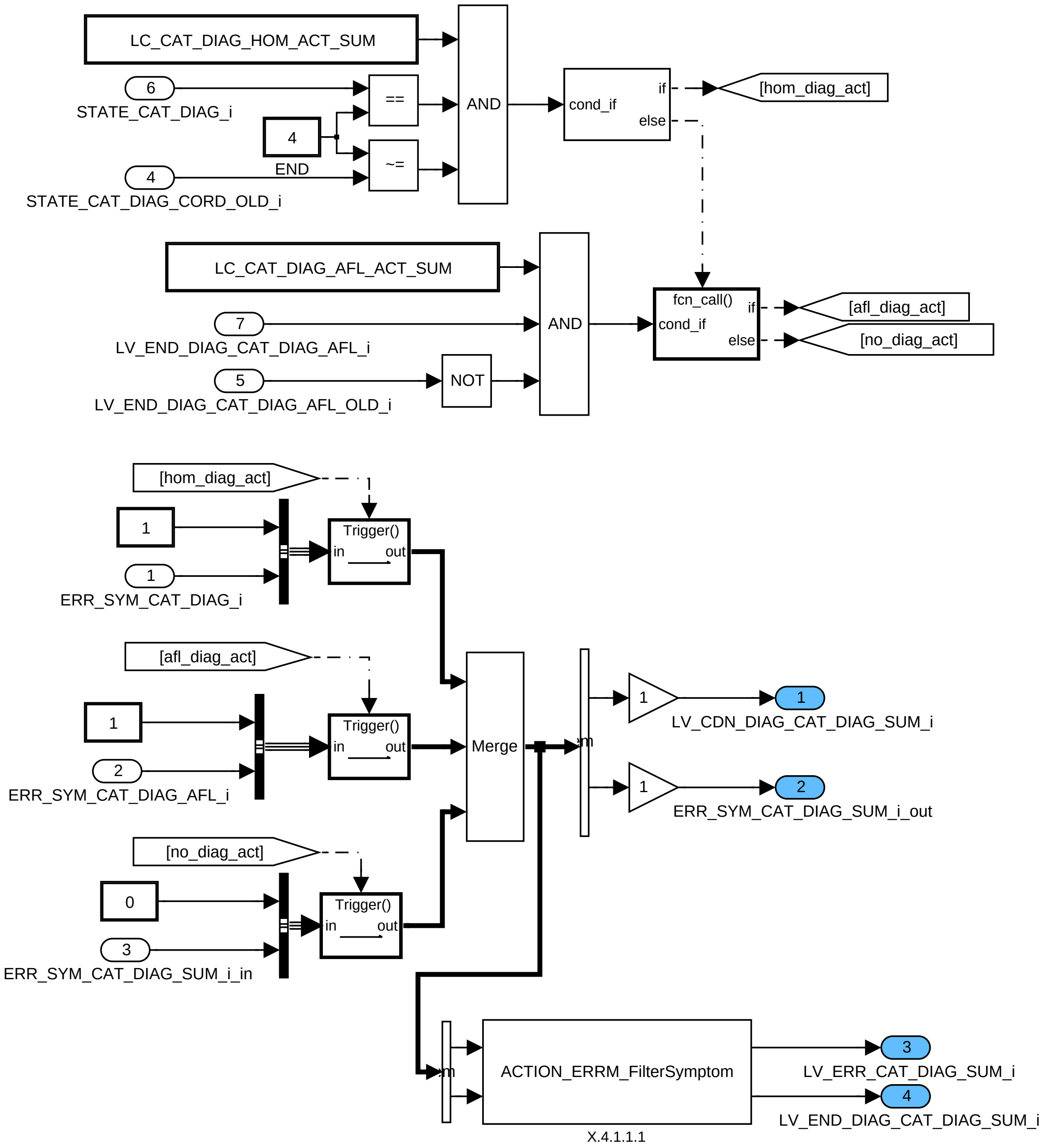

Figure B.49.5: : Path: EGTR_FCTDGCEFC0/operate/CBK_MNG/CLC0

B.49.4.1.1.1 Call of the ERRM

ACTION_ERRM_FilterSymptom(IN<XX>, IN<lv_cdn_diag_XX>, IN<err_sym_XX >, IN<C_ABC_INC_XX >, IN<C_ABC_DEC_XX >, IN<C_ABC_MAX_XX >, OUT<LV_ERR_XX>)
The action computes the elementary anti-bounce filter for one failure treatment and returns filter results

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Configuration for diagnostic symptoms:

Diagnostic CAT_DIAG_SUM[i]	Symptom description	Symptom	Filter type
Catalyst sum diagnosis	´CAT_EFFIC_LOW´	SYM_0	STD
	´CAT_DAMAGED’	SYM_1	
	Not used	SYM_2	
	Not used	SYM_3	

B.49.4.1.2 Calculation of the TWC efficiency

NC_CBK_EX_NR = 1 (one-bank system): calculation for index i = 1
NC_CBK_EX_NR = 2 (two-bank system): calculation for index i = 1 and 2

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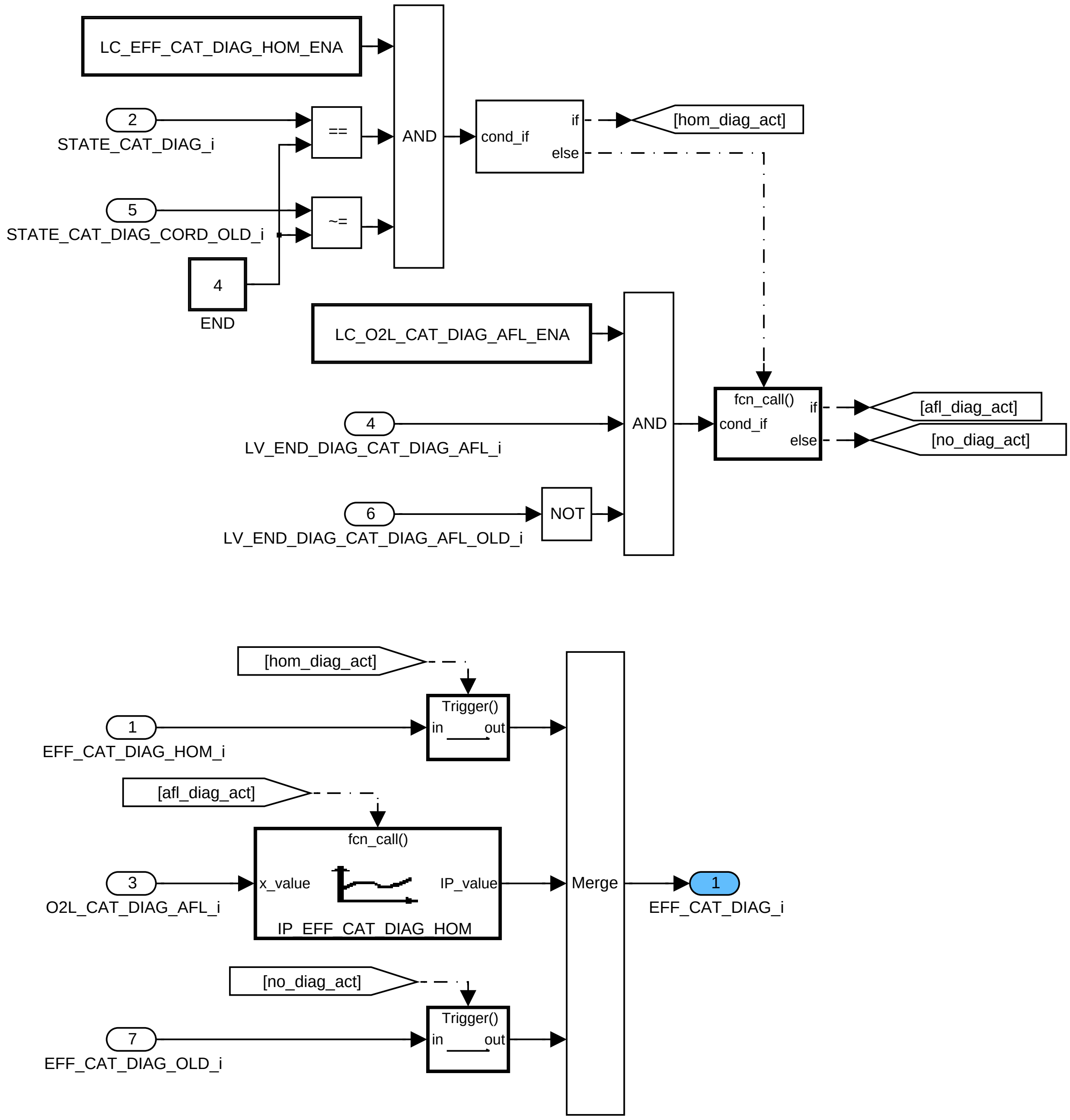

Figure B.49.6: : Path: EGTR_FCTDGCEFC0/operate/CBK_MNG/CLC1

B.49.4.1.3 Calculation of the old values

The old values of the input signals will be stored for each bank.

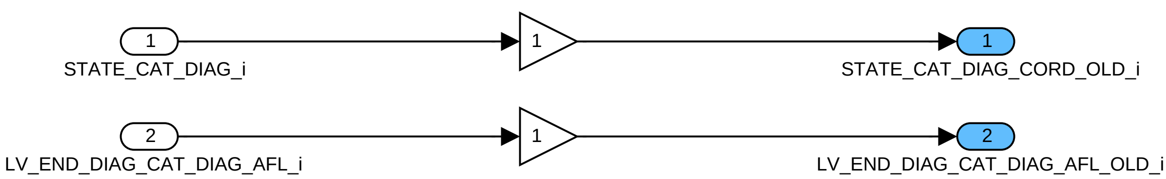

Figure B.49.7: : Path: EGTR_FCTDGCEFC0/operate/CBK_MNG/CLC2

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B.50 Limited dynamic for catalyst efficiency and oxygen sensor diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_MV_DELTA_CAT_LDC [NC_CBK_EX_NR]	V	8000... 7FFFH	0... 49.9984741	0.00152588	%
Difference between filtered and not filtered FAC_LAM_MV[i] for lambda limited dynamic					
LOAD_GRD_CAT_LDC	V	200... 1FFH	0... 1247.56	2.44140625	%/s
Load gradient for limted dynamics of catalyst diagnosis					
LOAD_GRD_SUM_CAT_LDC	V	0... FFFFH	0... 159998	2.44140625	%/s
sum value of LOAD gradient fro limited dynamics for catalyst diagnosis					
LV_CAT_LDC [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
status of limited dynamics for catalyst efficiency diagnosis					
LV_FAC_LAM_CAT_LDC [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Status limited dynamic FAC_LAM_MV[NC_CBK_EX_NR]					
LV_LOAD_GRD_CAT_LDC	V	0... 1H	0 ...1	1	-
Status limited dynamic LOAD_GRD_CAT_LDC					
LV_MAF_CAT_LDC	V	0... 1H	0 ...1	1	-
Status limited dynamic MAF					
LV_N_CAT_LDC	V	0... 1H	0 ...1	1	-
Status limited dynamic N					
MAF_INT_CAT_LDC [NC_CBK_EX_NR]	V	0... FFFFH	0 ...1	0.022222	g
integral of mass air flow since limited dynamic conditions fulfilled					
MAF_MMV_CAT_LDC	V	0... FFFFH	0... 1389	0.0211948	mg/stk
floating mean value for limited MAF					
N_MMV_CAT_LDC	V	0... 1FE0H	0... 8160	1	rpm
floating mean value for limited engine speed					

Input data:

FAC_LAM_MV {p. 1014}	FAC_LAM_MV_MMV_ LDC_DIAG [NC_CBK_EX_NR] {p. 2462}	LOAD_CAT_LDC {p. 5506}	LV_DC {p. 5746}
MAF {p. 8277}	MAF_CYL {p. 8277}	N {p. 1525}	NC_CBK_EX_NR {p. 1829}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_MAF_CAT_LDC	-	0... FFFFH	0... 0.999985	152.588e3	-
correlation constant for floating mean value calculation of air mass flow					
C_CRLC_N_CAT_LDC	-	0... FFFFH	0... 0.999985	152.588e3	-
correlation constant for floating mean value calculation of engine speed					
C_FAC_LAM_MV_DYW_CAT	-	0... FFFFH	0... 99.9984741	0.00152588	%
threshold limited dynamic lambda					
C_LOAD_GRD_DEC	-	0... 3FFH	0... 2497.56	2.44140625	%/s
decrement for calculation LOAD_CAT_LDC gradient					
C_LOAD_GRD_MIN_SUM_CAT	-	0... 1FFH	0... 1247.56	2.44140625	%/s
min. threshold for LOAD_GRD CAT_LDC summation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LOAD_GRD_SUM_MAX	-	0... FFFFH	0... 159998	2.44140625	%/s
max threshold limited dynamic LOAD_CAT_LDC gradient					
C_LOAD_GRD_SUM_MIN	-	0... FFFFH	0... 159998	2.44140625	%/s
min threshold limited dynamic LOAD_CAT_LDC gradient					
C_MAF_DYW_CAT_LDC	-	0... FFFFH	0... 1389	0.0211948	mg/stk
threshold limited dynamic engine MAF					
C_MAF_INT_MIN_CAT_LDC	-	0... FFFFH	0 ...1	0.022222	g
MAF integral after setting limited dynamic conditions LV_CAT_LDC[i] i before starting the monitoring cycle					
C_N_DYW_CAT_LDC	-	0... 1FE0H	0... 8160	1	rpm
threshold limited dynamic engine speed					
C_T_LOAD_GRD_DEC_SUM	-	0... FFH	0... 5.1	0.02	s
time periods for calculation limited dynamic LOAD_CAT_LDC gradient					
LC_FAC_LAM_RST_CAT_LDC	-	0... 1H	0 ...1	1	-
Switch for active reset of filtered FAC_LAM to not filtered after lim. Dyn. over threshold					
LC_MAF_RST_CAT_LDC	-	0... 1H	0 ...1	1	-
Switch for active reset of filtered MAF to not filtered after lim. Dyn. over threshold					
LC_N_RST_CAT_LDC	-	0... 1H	0 ...1	1	-
Switch for active reset of filtered N to not filtered after lim. Dyn. over threshold					

B.50.1 EGTR_FCTDGCEFLD0

The limited dynamic conditions LV_CAT_LDC[i] for catalyst efficiency diagnosis is set if the limited dynamic conditions for engine speed, mass air flow and lambda controller output exist and a calibration threshold for the integral of the air flow is exceeded.
Moreover the summation of the throttle position gradient LOAD_GRD_SUM_CAT_LDC[i] must not exceed a calibration threshold.

NC_CBK_EX_NR defines the number of exhaust banks.
For vector elements, the variable extension _i is used in the model instead of [i] as found in the textual description.

Function Description

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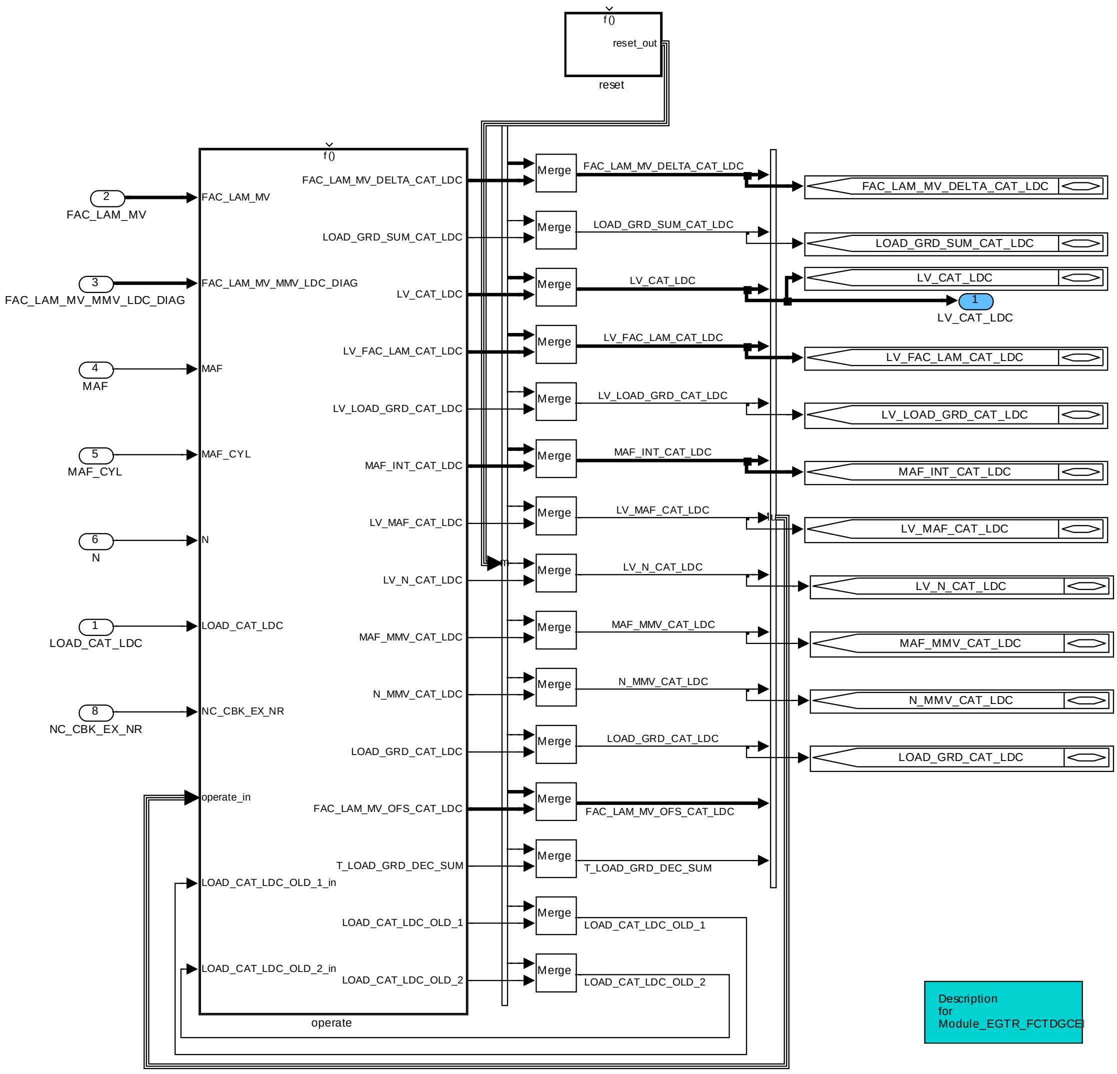

Figure B.50.1: EGTR_FCTDGCEFLD0

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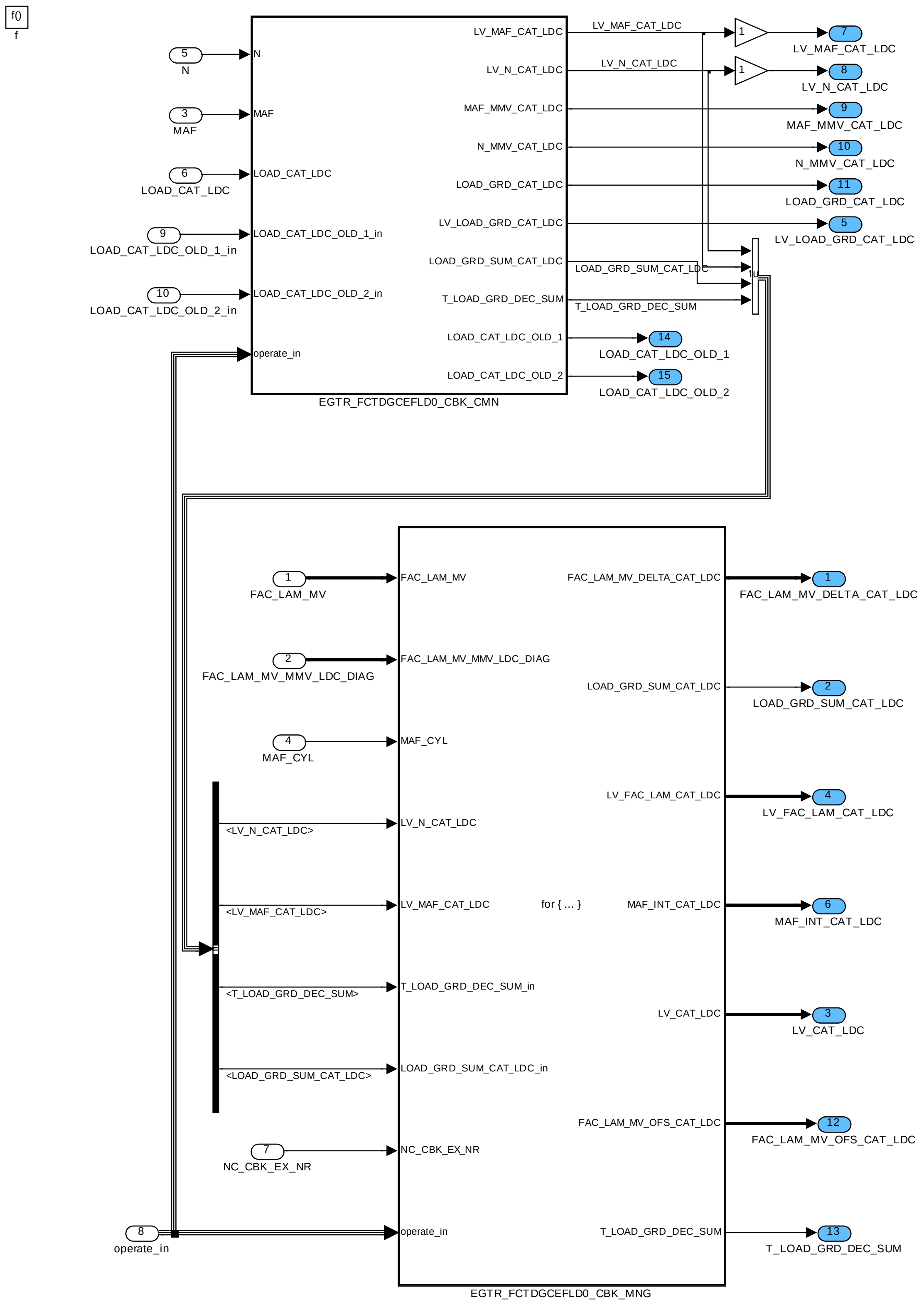

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Figure B.50.2: EGTR_FCTDGCEFLD0/operate

Cylinder bank independent calculation

Calculation of LOAD_CAT_LDC gradient:

The LOAD_CAT_LDC gradient is calculated with the reccurence T_SAMPLE in [ms].

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To this effect, the LOAD_CAT_LDC values are written into the ring buffer. Thus, the last two LOAD_CAT_LDC values are available in addition to the current LOAD_CAT_LDC value. The LOAD_CAT_LDC gradient is based on a LOAD_CAT_LDC difference of twice T_SAMPLE in [ms].
The LOAD_GRD_CAT_LDC reflects the gradient of the actual driver's demand prior to the corrections. If C_LOAD_GRD_SUM_MIN is larger than C_LOAD_GRD_SUM_MAX the LOAD_CAT_LDC gradient summation LOAD_GRD_SUM_CAT_LDC will be no condition to determine the limited dynamic bit LV_CAT_LDC[i].

Limited engine speed (N) dynamics:
The floating mean value N_MMV_CAT_LDC is computed using the filtering constant C_N_CRLC_CAT_LDC. The limited dynamics condition only exist while the engine speed N lies within the dynamics window around N_MMV_CAT_LDC.
If the above limited dynamics condition is violated, the floating mean value N_MMV_CAT_LDC is set to the current engine speed in order to reach the limited dynamics condition faster.

Limited mass air flow (MAF) dynamics:
The floating mean value MAF_MMV_CAT_LDC is computed using the averaging constant C_MAF_CRLC_CAT. The limited dynamics condition only exist while the air mass MAF stays within the dynamics window around MAF_MMV_CAT_LDC.
If the above limited dynamics condition is violated, the floating mean value MAF_MMV_CAT_LDC is set to the current airmass value in order to reach the limited dynamics condition faster.

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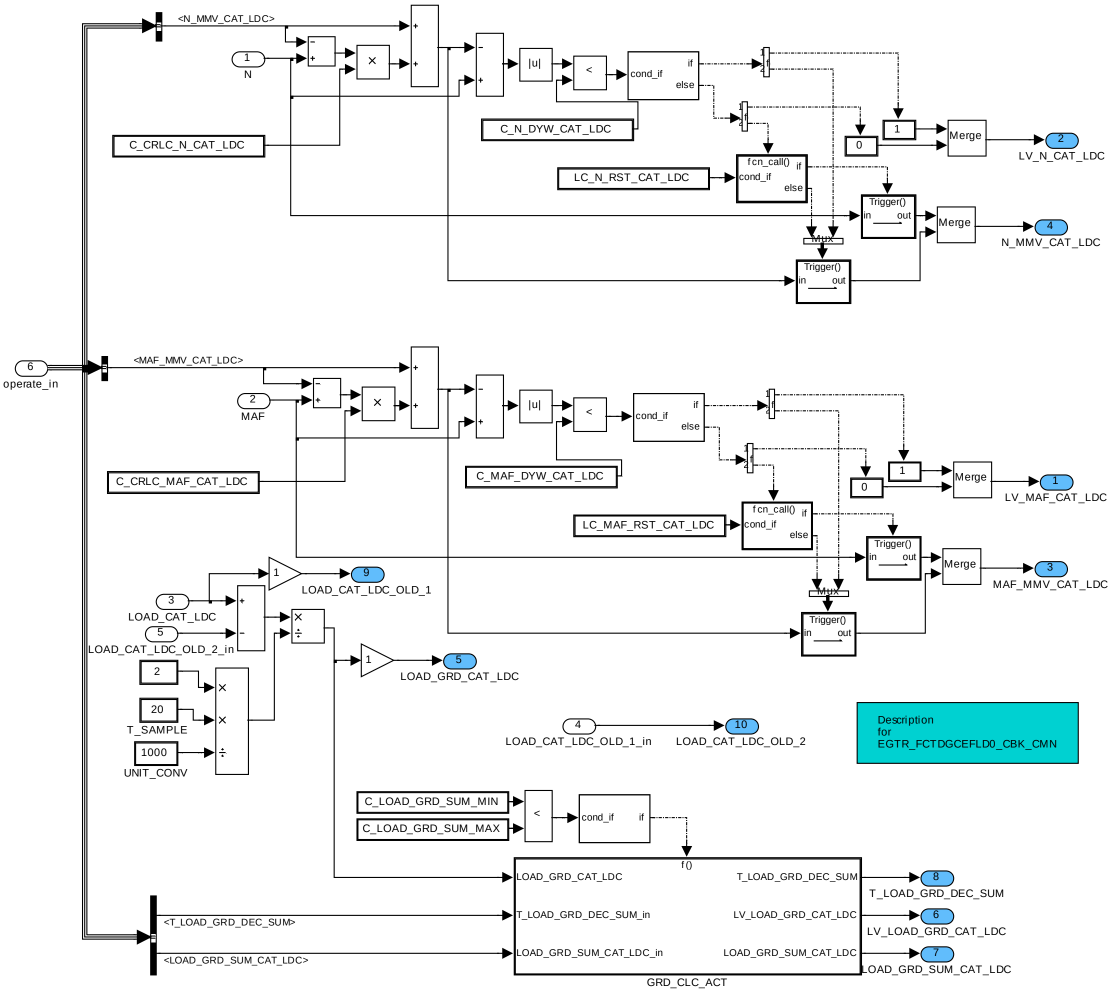

Figure B.50.3: EGTR_FCTDGCEFLD0/operate/EGTR_FCTDGCEFLD0_CBK_CMN

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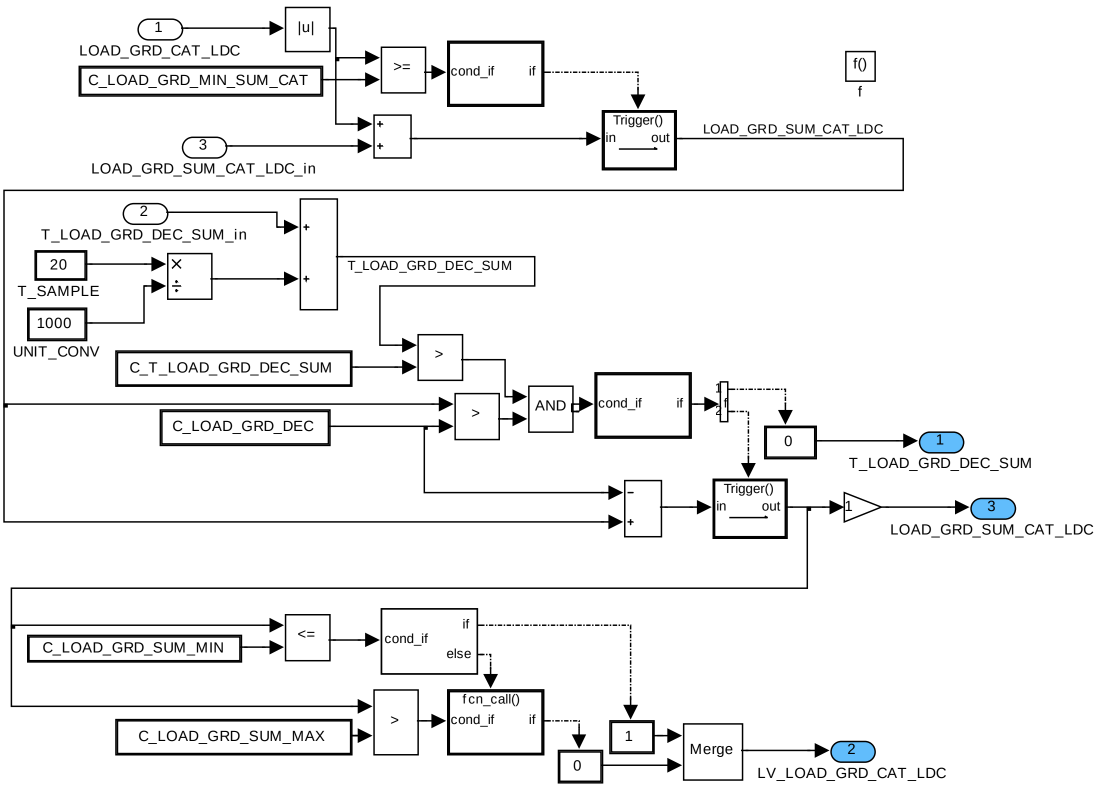

Figure B.50.4: EGTR_FCTDGCEFLD0/operate/EGTR_FCTDGCEFLD0_CBK_CMN/GRD_CLC_ACT

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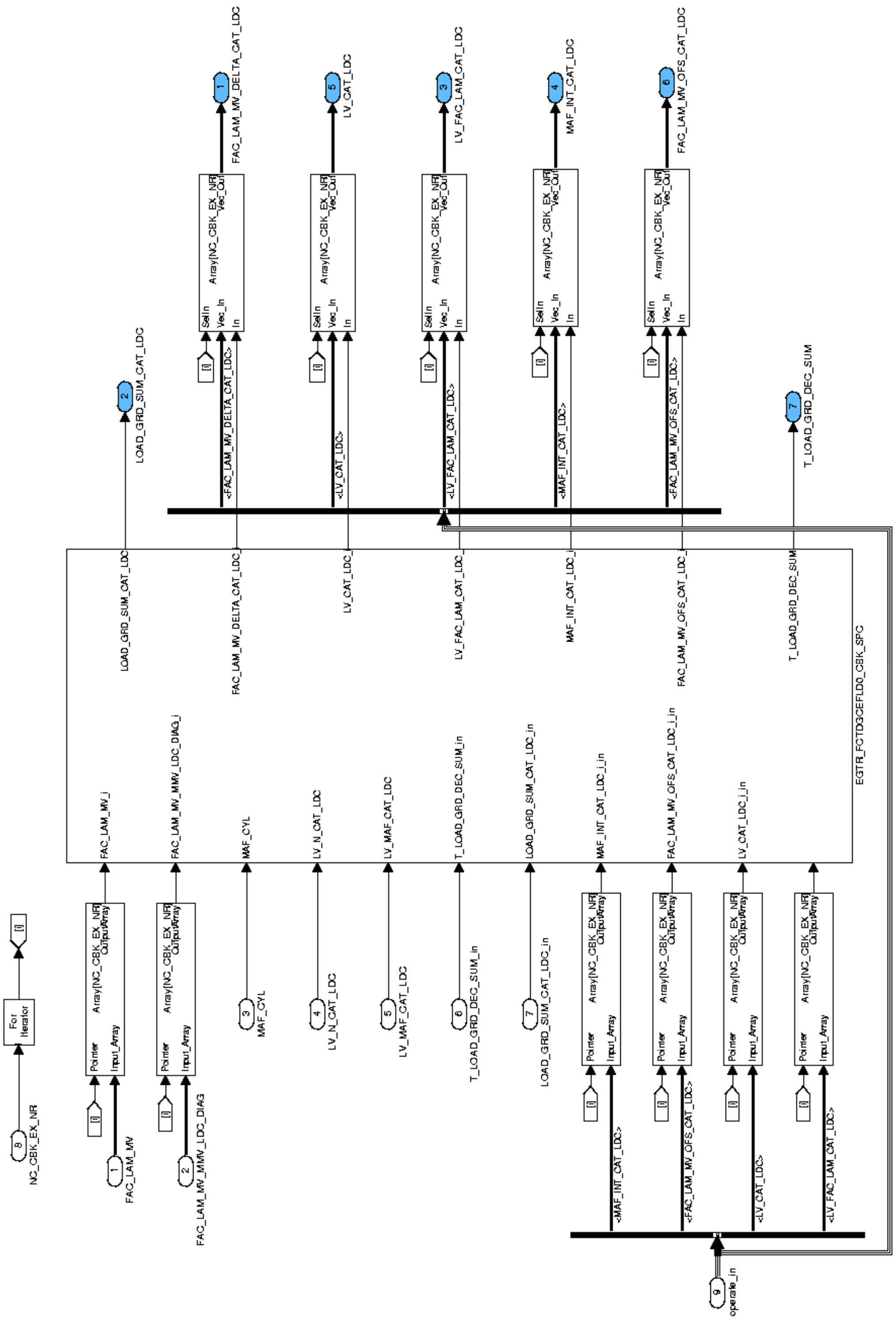

Figure B.50.5: EGTR_FCTDGCEFLD0/operate/EGTR_FCTDGCEFLD0_CBK_MNG

Cylinder bank dependent calculation

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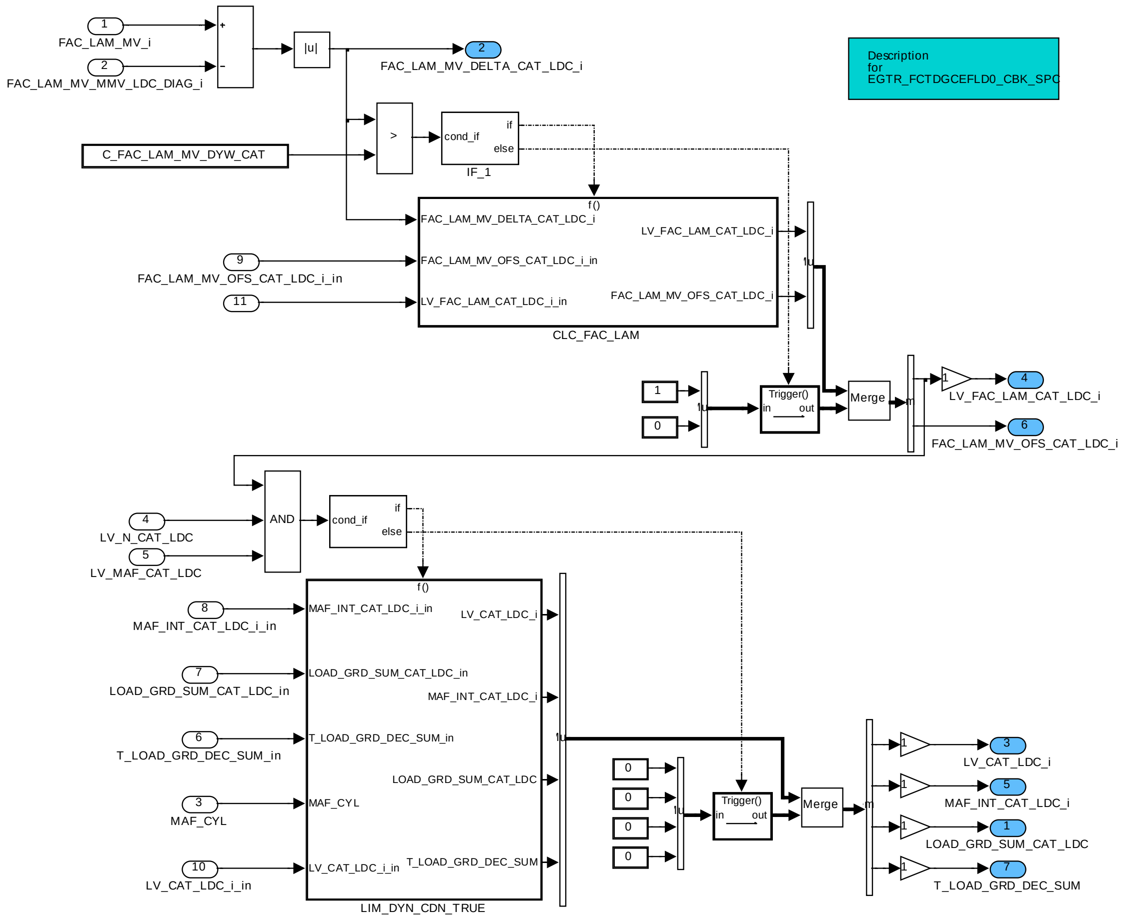

Figure B.50.6: EGTR_FCTDGCEFLD0/operate/EGTR_FCTDGCEFLD0_CBK_MNG/ EGTR_FCTDGCEFLD0_CBK_SPC

Limited mean oxygen value (FAC_LAM_MV[i]) dynamics

The floating mean value FAC_LAM_MV_MMV_CAT_LDC[i] is computed inside the AGGR LACO.

The limited dynamics condition continues to exist while the mean oxygen value FAC_LAM_MV[i] stays within the dynamics window around FAC_LAM_MV_DELTA_CAT_LDC[i].

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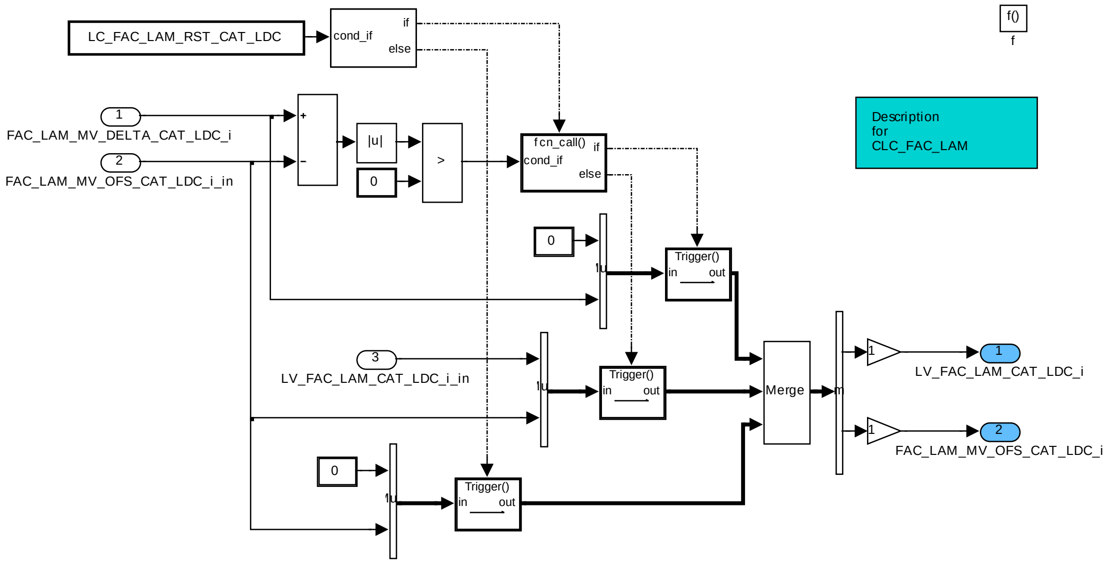

Figure B.50.7: EGTR_FCTDGCEFLD0/operate/EGTR_FCTDGCEFLD0_CBK_MNG/ EGTR_FCTDGCEFLD0_CBK_SPC/CLC_FAC_LAM

Setting of LV_CAT_LDC[i]

When the air mass flow integral exceeds a calibration limit the flag LV_CAT_LDC[i] is set to 1 indicating that the limited dynamics are fulfilled.

The reccurence time is defined by T_SAMPLE in [ms].
For the calculation of the air mass flow integral the unit conversion:
[g] = [kg/h] * [ms] * [(g*h) /(kg*ms)] /3600
has to be considered.

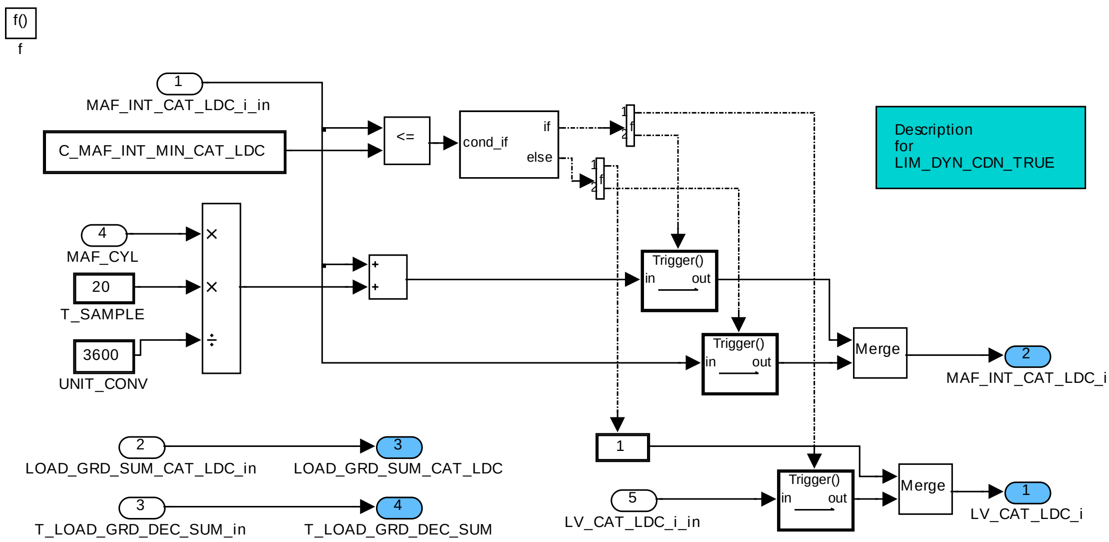

Figure B.50.8: EGTR_FCTDGCEFLD0/operate/EGTR_FCTDGCEFLD0_CBK_MNG/ EGTR_FCTDGCEFLD0_CBK_SPC/LIM_DYN_CDN_TRUE

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B.51 TWC diagnosis at lean operation - Activation conditions

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_O2L_CLC_ACT_CDN [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
General activation flag for calculation of oxygen capacity					
LV_O2L_CLC_ACT_CMB_CDN	V	0... 1H	0 ...1	1	-
Activation for diagnosis regarding combustion conditions					
LV_O2L_CLC_ACT_LDC_TEMP_TMP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Activation for diagnosis regarding TWC temperature limited dynamic					
LV_O2L_CLC_ACT_MAF_INT [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Activation for diagnosis regarding MAF integral after high load phase					
LV_O2L_CLC_ACT_OPP_TMP	V	0... 1H	0 ...1	1	-
Activation of the diagnosis regarding operating point conditions					
LV_O2L_CLC_ACT_TCO_TMP	V	0... 1H	0 ...1	1	-
Activation of the diagnosis regarding coolant temperature					
LV_O2L_CLC_ACT_TEMP_TMP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Activation for diagnosis regarding TWC temperature					
MAF_INT_CAT_DIAG_AFL [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.41666667	0.0277778	g
Maf integral after high load phase					
TEMP_LDC_CAT_DIAG_AFL [NC_CBK_EX_NR]	V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Filtered modelled catalyst dynamic temperature					
TQI_LDC_CAT_DIAG_AFL	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Filtered TQI_AV					

Input data:

EFF_CAT_DIAG [NC_CBK_EX_NR] {p. 5535}	LV_END_DIAG_AFL_TMP [NC_CBK_EX_NR] {p. 5561}	LV_END_DIAG_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5561}	LV_INH_DIAG_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5634}
LV_NT_ACT {p. 2982}	LV_ST_END {p. 1720}	MAF_CYL {p. 8277}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	NC_NT_NR {p. 644}	STATE_NOX {p. 2986}	TCO {p. 1100}
TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}	TNT_MDL_MV_SNG [NC_NT_NR] {p. 8237}	TQI_AV {p. 981}	VS {p. 1176}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_TEMP_CAT_DIAG_AFL	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation constant for calculation of filtered TWC temperature					
C_CRLC_TQI_CAT_DIAG_AFL	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation constant for calculation of filtered TQI_AV					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_INT_MAX_CAT_DIAG_AFL	-	0... FFFFH	0... 1820.41666667	0.0277778	g
MAF_CYL integral for delay of the diagnosis activation after high load phase					
C_N_32_DOWN_LIM_CAT_DIAG_AFL	-	0... FFH	0... 8160	32	rpm
Lower limit of N_32 to allow of OSC calculation					
C_N_32_UP_LIM_CAT_DIAG_AFL	-	0... FFH	0... 8160	32	rpm
Upper limit of N_32 to allow of OSC calculation					
C_TCO_DOWN_LIM_CAT_DIAG_AFL	-	0... FEH	-48... 142.5	0.75	°C
Lower limit of TCO to allow of OSC calculation					
C_TCO_UP_LIM_CAT_DIAG_AFL	-	0... FEH	-48... 142.5	0.75	°C
Upper limit of TCO to allow of OSC calculation					
C_TEMP_DYN_H_THD_CAT_DIAG_AFL	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Maximal dynamic TWC temperature for activation of the diagnosis					
C_TEMP_LDC_CAT_DIAG_AFL	-	8000... 7FFFH	-2048... 2047.9375	0.0625	°C
Threshold for deactivation of OSC calculation regarding TWC temp. limited dynamic					
C_TEMP_UP_LIM_CAT_DIAG_AFL	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Upper limit of TWC temperature to allow of OSC calculation					
C_TNT_DOWN_LIM_CAT_DIAG_AFL	-	0... FFFFH	0... 1023.984375	0.015625	°C
Lower limit of NT temperature to allow of OSC calculation					
C_TNT_UP_LIM_CAT_DIAG_AFL	-	0... FFFFH	0... 1023.984375	0.015625	°C
Upper limit of NT temperature to allow of OSC calculation					
C_TQI_LDC_CAT_DIAG_AFL	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Threshold for deactivation of OSC calculation regarding TQI_AV limited dynamic					
C_VS_DOWN_LIM_CAT_DIAG_AFL	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed for activation of the diagnosis					
C_VS_UP_LIM_CAT_DIAG_AFL	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for activation of the diagnosis					
IP_MAF_DOWN_LIM_CAT_DIAG_AFL	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDPM_N_32_IP_MAF	6	0... FFH	0... 8160	32	rpm
Lower limit of MAF for activation of the diagnosis					
IP_MAF_UP_LIM_CAT_DIAG_AFL	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
LDPM_N_32_IP_MAF	6	0... FFH	0... 8160	32	rpm
Upper limit of MAF for activation of the diagnosis					
IP_TEMP_DOWN_LIM_CAT_DIAG_AFL	-	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
LDP_EFF_CAT_DIAG_AFL_IP_TEMP	4	0... FFH	0... 1.9921875	7.8125e-3	-
Lower limit of the dynamic catalyst temperature depending on catalyst aging state					

General Information

Activation condition for calculation of OSC values in module "TWC diagnosis at lean operation - OSC calculation".
If two separate exhaust bank systems are concerned, then:
i = 1, for cylinder bank 1
i = 2, for cylinder bank 2
Otherwise:
i = 1

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Application Conditions

Initialization: RST
Recurrence: 10MS
Activation: always
Deactivation: never

Function description

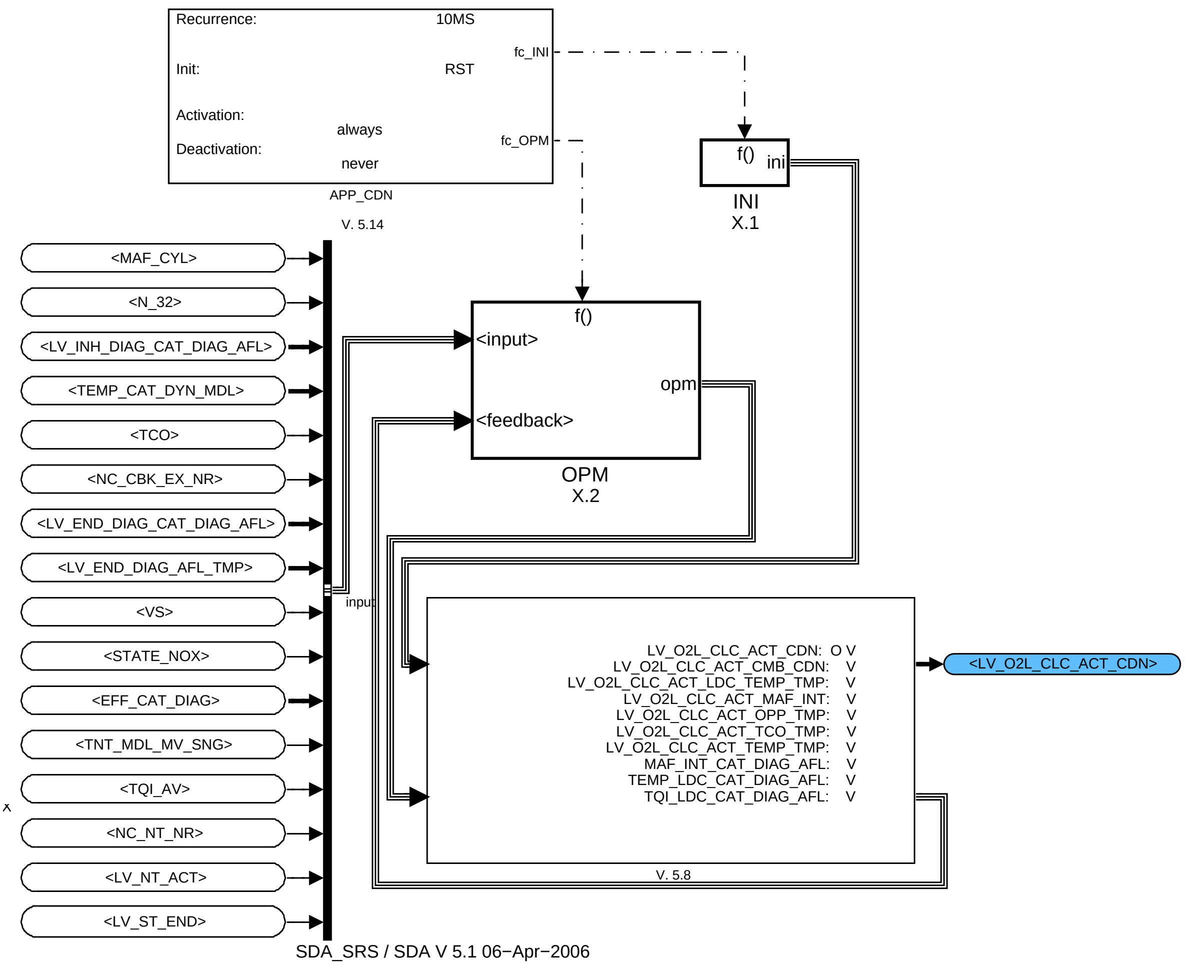

Figure B.51.1: : Overview level

B.51.1 INITIALIZATION

All variables are initialized with "0"

B.51.2 FORMULA SECTION

The bank specific and bank not specific calculations are done separate

B.51.2.1 Function active - bank not specific calculations

In this case are checked:
Operating point
Coolant temperature

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Combustion conditions

B.51.2.1.1 Check of the operating point

Deactivation of the diagnosis, when the mass air flow and rotational speed exceed defined range. Additional, dynamic of the torque request are checken

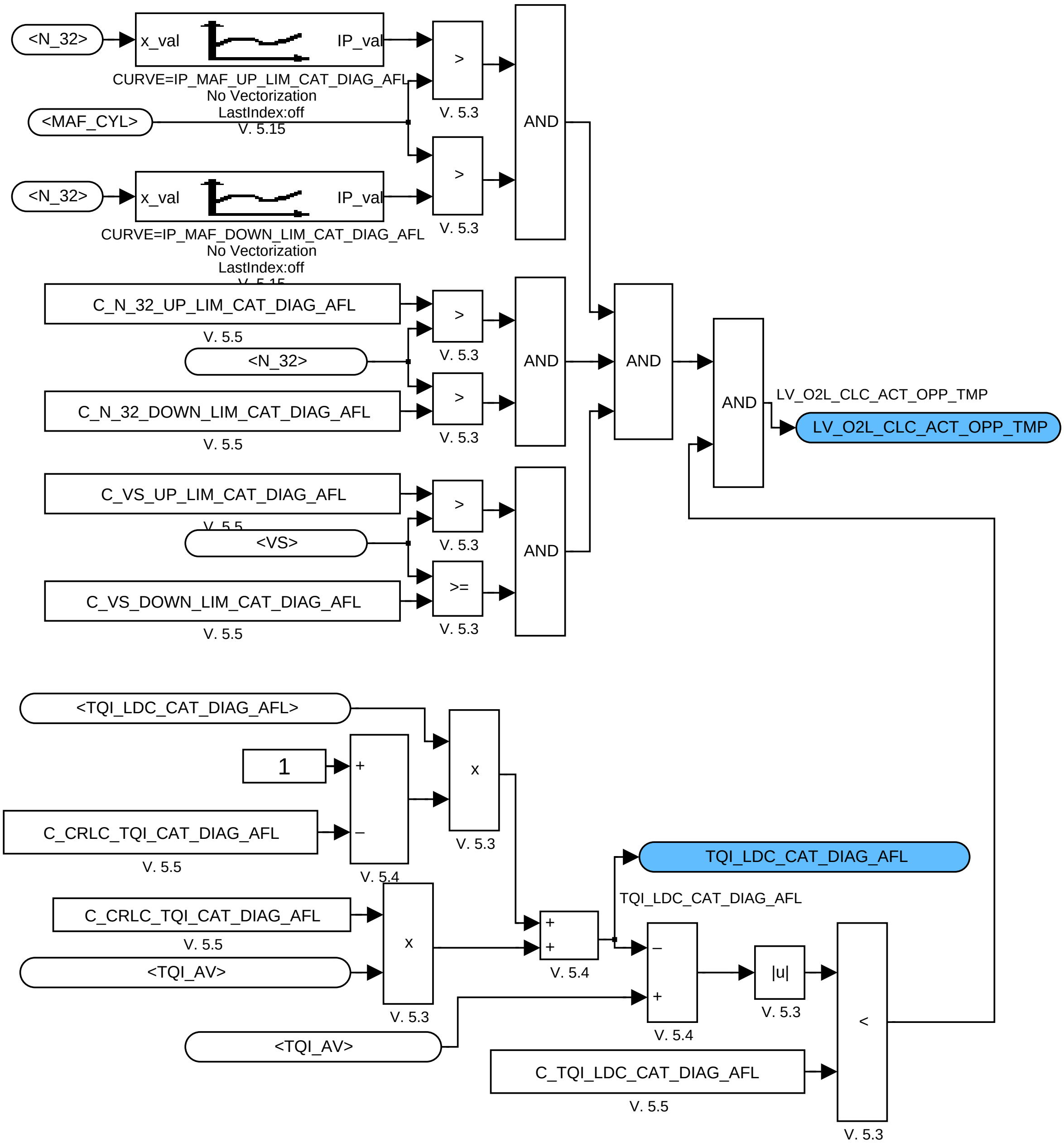

Figure B.51.2: :

B.51.2.1.2 Check of coolant temperature

Deactivation of the diagnosis, when the coolant temperature exceeds defined range

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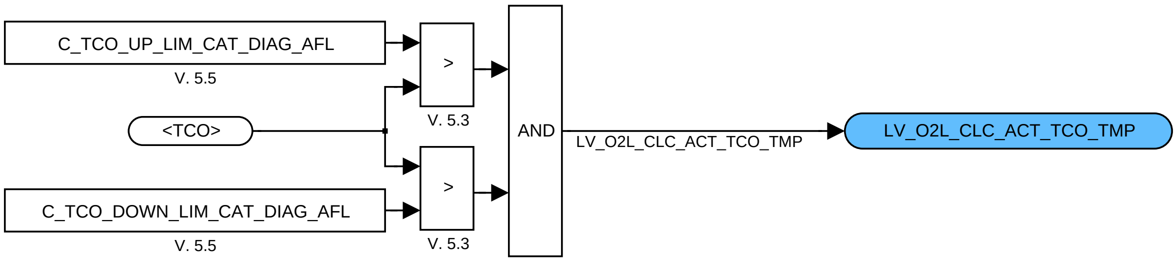

Figure B.51.3: :

B.51.2.1.3 Check of the combustion conditions

Deactivation when the NOx after treatment equipment is not active

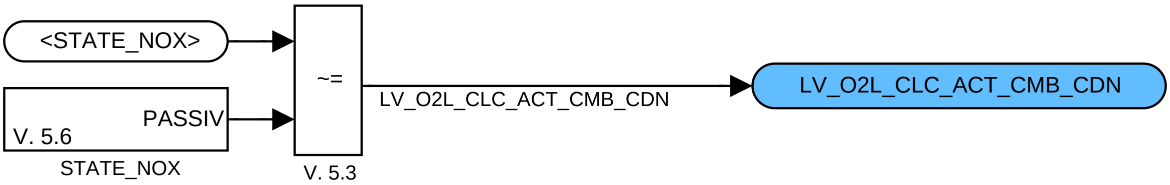

Figure B.51.4: :

B.51.2.2 Function active - bank specific calculations

B.51.2.2.1 Check of bank specific activation conditions

In this case:
The static temperature of TWC monolith is checked
The limited dynamic of TWC monolith temperature is checked
The MAF integral is calculated after high load phase
The final activation condition flag is calculated

B.51.2.2.1.1 Check of the TWC and NT monolith temperatures

Deactivation of the diagnosis, when the monolith temperatures of TWC and NT (NOx Trap) exceed defined range. For the NT, a mean value of the both monolith is used. In case of down limit of the TWC temperature, it can be different for catalysts with different aging state

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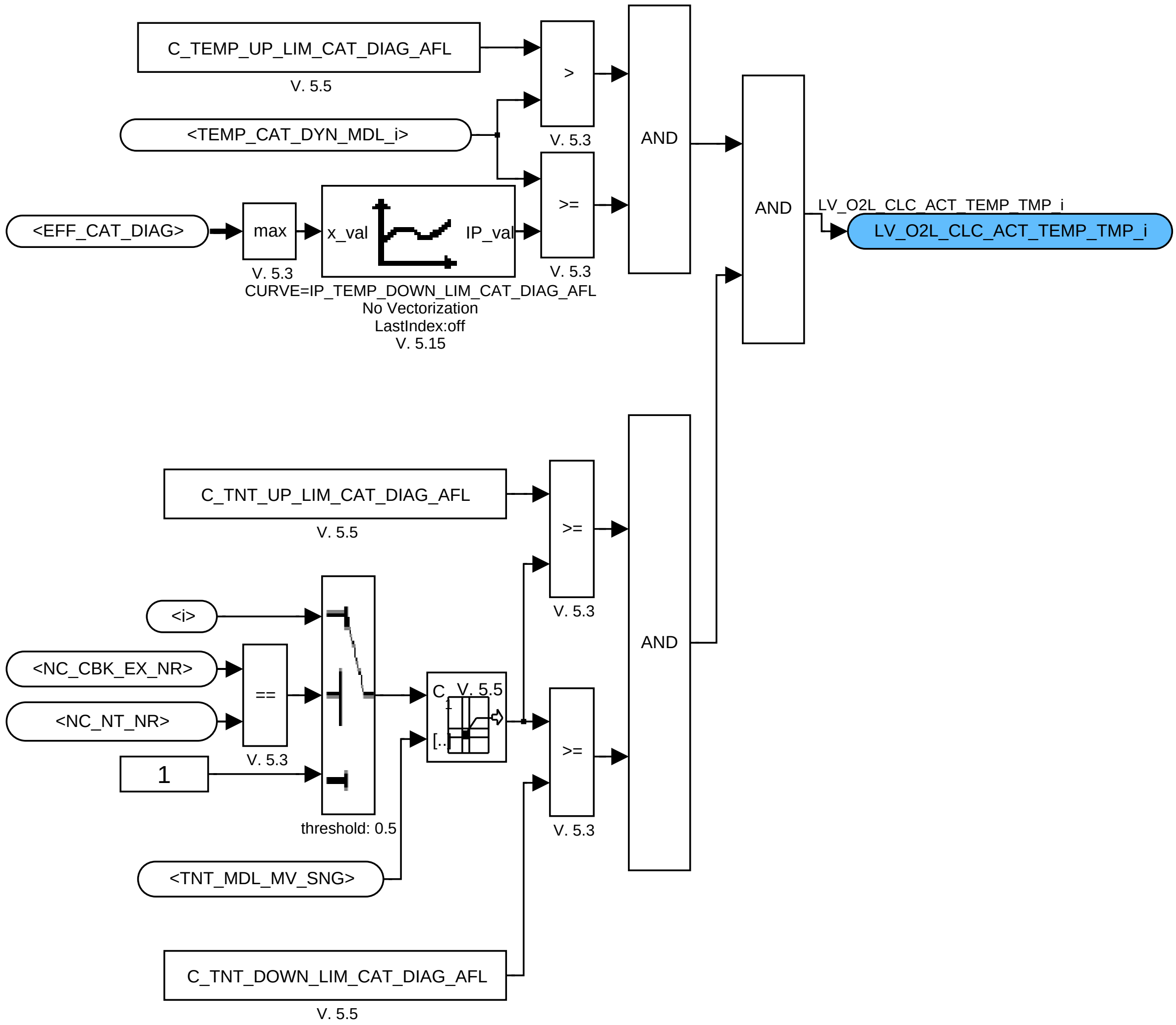

Figure B.51.5: :

B.51.2.2.1.2 Check of the limited dynamic of the TWC monolith temperature

The difference between filtered and not filtered TWC monolith temperature is shall not exceed defined threshold

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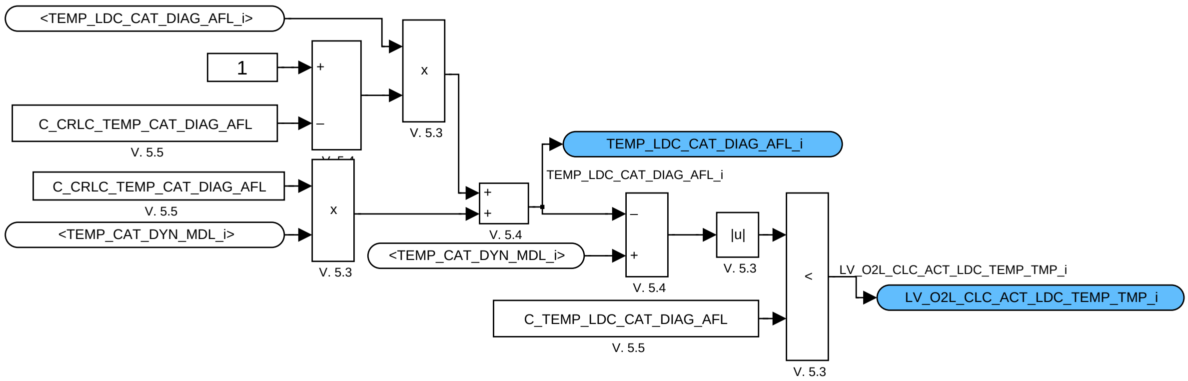

Figure B.51.6: :

B.51.2.2.1.3 Check of the MAF integral

Deactivation of the diagnosis after high load phase till defined MAF integral is not released

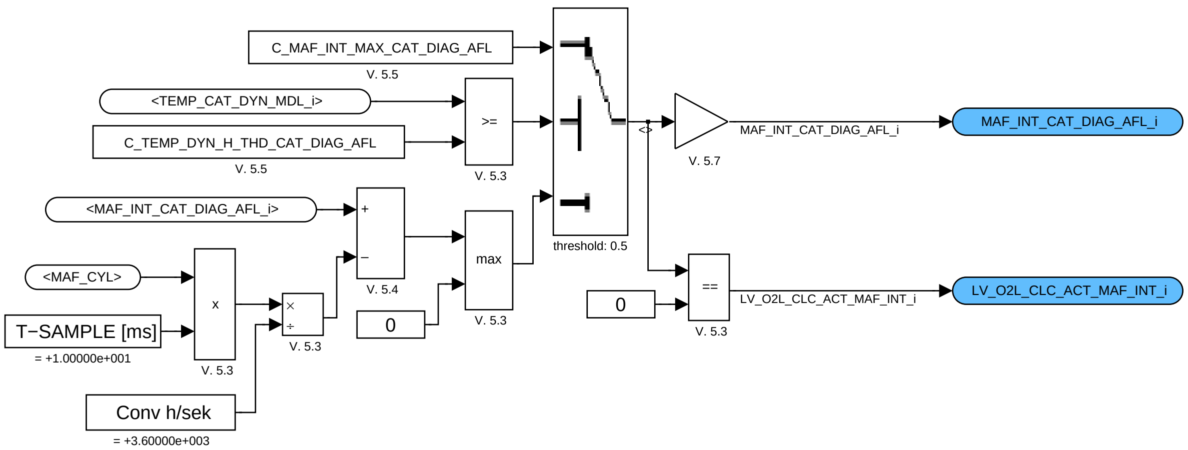

Figure B.51.7: :

B.51.2.2.1.4 Calculation of the final activation flag

The end activation flag results from the condition checked in this module, the inhibition condition and the diagnosis end condition. The diagnosis is deactivated when the calculation of it results is finished

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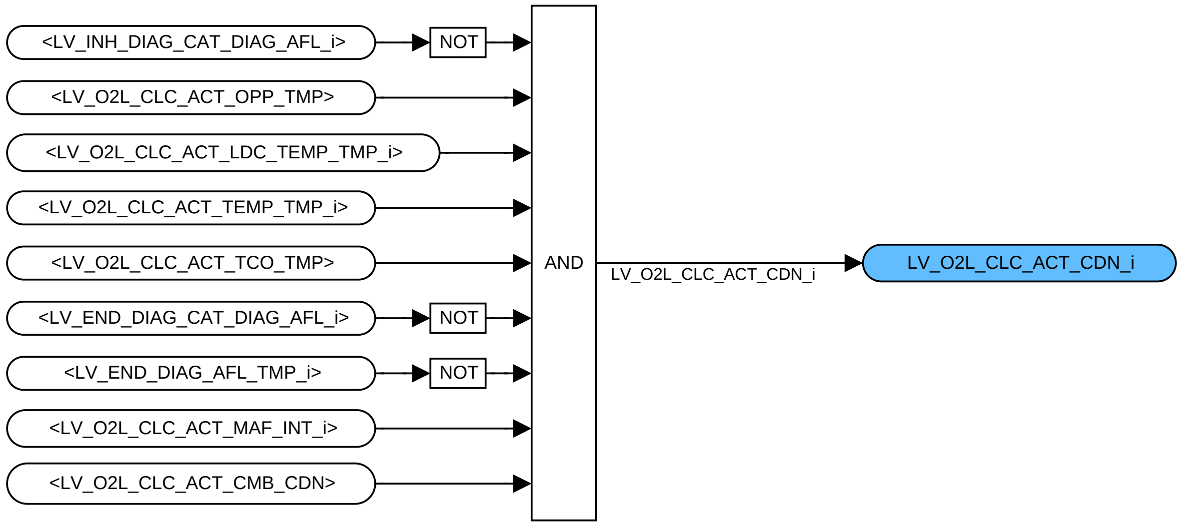

Figure B.51.8: :

B.51.2.3 Check activation conditions

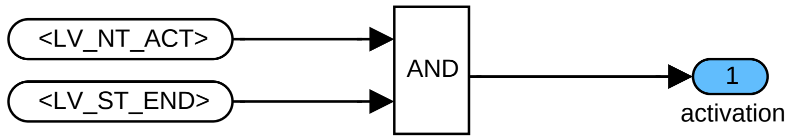

Figure B.51.9: :

B.51.2.4 Function not active

All variables are set to "0"

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B.52 TWC diagnosis at lean operation - Diagnosis value determination

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CYC_CAT_DIAG_AFL [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter of diagnosis cycles for calculation of error indicator					
CTR_O2L_SUM_H_AMPL [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for calculation of mean value of O2L calculated in high regeneration phases					
CTR_O2L_SUM_L_AMPL [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for calculation of mean value of O2L calculated in low regeneration phases					
CTR_O2L_SUM_LOAD [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for calculation of mean value of O2L calculated in load phases					
CTR_O2L_SUM_PARK [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for calculation of mean value of O2L calculated in park phases					
ERR_SYM_CAT_DIAG_AFL [NC_CBK_EX_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom for TWC lean diagnosis					
FAC_SUM_O2L_MMV_TMP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Denominator for calculation of O2L_MMV_CAT_DIAG_AFL					
LV_CDN_DIAG_CAT_DIAG_AFL [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to one when condition is fulfilled)					
LV_END_DIAG_AFL_TMP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Temporary flag for end of the Diagnostic cycle without filtering					
LV_END_DIAG_CAT_DIAG_AFL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Diagnostic performed at last one time					
LV_ERR_CAT_DIAG_AFL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Present failure after filtering of diagnostic CAT_DIAG_AFL					
LV_ERR_CAT_DIAG_AFL_TMP [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Temporary present failure of diagnostic CAT_DIAG_AFL					
LV_O2L_AFL_CDN_MAT [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Calculation of O2L_AFL_CDN_MAT was successful					
LV_O2L_CAT_DIAG_AFL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Calculation of general O2L value was successful					
LV_O2L_CAT_DIAG_AFL_SUM	V	0... 1H	0 ...1	1	-
Calculation of O2L_CAT_DIAG_AFL_SUM was successful					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_O2L_CLC_READY [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Calculation of general diagnosis value is finished					
LV_O2L_MV_CLC_END [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Calculation of mean values during diagnosis cycle has been done					
LV_RGN_NT_REQ_AFL_PREV	-	0... 1H	0 ...1	1	-
The previous value of LV_RGN_NT_REQ					
O2L_AFL_CDN_MAT [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Calculated O2L of PreCat in Lean Condition					
O2L_AFR_CDN_COR [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Corrected O2L value with mathematic method					
O2L_AFR_CDN_COR_MAT [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Corrected O2L value with empirical method					
O2L_CAT_DIAG_AFL [NC_CBK_EX_NR]	O/V/S	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Finally O2L value for calculation of Error Symptom					
O2L_CAT_DIAG_AFL_SUM	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Diagonal calculated O2L of both cylinder branches					
O2L_DELTA_AFR_CDN [NC_CBK_EX_NR]	V	0... FFFFH	-1.30844444444 ...1.3084	39.9306e-6	g
Delta between O2L values calculated during H_AMPL and L_AMPL regeneration phases					
O2L_H_AMPL_MV [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Mean value of O2L values calculated in regenerations with high amplitude phase					
O2L_H_AMPL_SUM [NC_CBK_EX_NR]	V	0... FFFFH	0... 20.93479	319.444e-6	g
Sum of O2L values calculated during regenerations with high amplitude phase					
O2L_L_AMPL_MV [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Mean value of O2L values calculated in regenerations with low amplitude phase					
O2L_L_AMPL_SUM [NC_CBK_EX_NR]	V	0... FFFFH	0... 20.93479	319.444e-6	g
Sum of O2L values calculated in regenerations with low amplitude phase					
O2L_LOAD_MV [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Mean value of O2L values calculated during load phases					
O2L_LOAD_SUM [NC_CBK_EX_NR]	V	0... FFFFH	0... 20.93479	319.444e-6	g
Sum of O2L values calculated during load phases					
O2L_MMV_CAT_DIAG_AFL [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Mean value of O2L values calculated in all phases					
O2L_NT_MAT	V	0... FFFFH	0... 20.93479	319.444e-6	g
Calculated O2L value of NOx catalyst					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
O2L_PARK_MV [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Mean value of O2L values calculated in park phases					
O2L_PARK_SUM [NC_CBK_EX_NR]	V	0... FFFFH	0... 20.93479	319.444e-6	g
Sum of O2L values calculated in park phases					
O2L_SUM_CAT_DIAG_AFL [NC_CBK_EX_NR]	V	0... FFFFH	0... 20.93479	319.444e-6	g
Sum of O2L values of all phases for calculation of O2L_MMV_CAT_DIAG_AFL					
STATE_CAT_DIAG_AFL_OLD [NC_CBK_EX_NR]	-	0H 1H 2H 3H	PASSIVE RICH_CDN LEAN_CDN WAIT	-	-
Old value for STATE_CAT_DIAG_AFL					
STATE_O2L_MV_CLC_VLD [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Collected bits due to calculation of mean values at each phase					

Input data:

C_STATE_EX_CONF {p. 5608}	C_STATE_SENS_DOWN_MISS_CBK {p. 5608}	LV_DC {p. 5746}	LV_DIAG_END_SUM_DIAG_AFL [NC_CBK_EX_NR] {p. 5634}
LV_DIAG_ERR_SUM_DIAG_AFL [NC_CBK_EX_NR] {p. 5634}	LV_O2L_CLC_ACT_CDN [NC_CBK_EX_NR] {p. 5553}	LV_RGN_NT_REQ {p. 2983}	NC_CBK_EX_NR {p. 1829}
O2L_LOAD_PHA [NC_CBK_EX_NR] {p. 5607}	O2L_PARK_PHA [NC_CBK_EX_NR] {p. 5607}	O2L_RGN_H_AMPL_PHA [NC_CBK_EX_NR] {p. 5607}	O2L_RGN_L_AMPL_PHA [NC_CBK_EX_NR] {p. 5607}
STATE_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5607}	STATE_O2L_CLC_VLD [NC_CBK_EX_NR] {p. 5608}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_CYC_CAT_DIAG_AFL	-	1... FFH	1... 255	1	-
Number of diagnosis cycles for calculation of error indicator					
C_CTR_O2L_CYC_DIAG_END_AFL [NC_CBK_EX_NR]	-	1... FFH	1... 255	1	-
Number of valid cycles of O2L calculation in lean phase for finishing of the whole one diagnosis cycle					
C_CTR_O2L_CYC_DIAG_END_AFR [NC_CBK_EX_NR]	-	1... FFH	1... 255	1	-
Number of valid cycles of O2L calculation in rich phase for finishing of the whole one diagnosis cycle					
C_CTR_O2L_MV_CLC	-	1... FFH	1... 255	1	-
Number of necessary O2L calculations for calculation of mean value of each phase					
C_FAC_AFR_CDN_MAT	-	0... FFH	0... 15.9375	0.0625	-
Factor for calculation of corrected diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_O2L_CAT_DIAG_AFL_MAX	-	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Maximal O2L value used for initialization of diagnosis value					
C_O2L_THD_ERR_CAT_DIAG_AFL [NC_CBK_EX_NR]	-	0... FFFFH	0... 2.61684895833	39.9306e-6	g
OBD threshold of diagnosis value to set the diagnosis error					
C_O2L_THD_ERR_CAT_DIAG_AFL_SUM	-	0... FFFFH	0... 2.61684895833	39.9306e-6	g
OBD threshold of diagnosis value to set of diagnosis error depending on diagonally O2L calculation					
C_O2L_THD_NOT_ERR_CAT_DIAG_AFL [NC_CBK_EX_NR]	-	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L threshold saying that the storage capacity of TWC is enough big to pre-end the diagnosis					
C_STATE_DIAG_CYC_CLC_ENA [NC_CBK_EX_NR]	-	0... FFH	0... 255	1	-
Choice of phases for finishing diagnosis cycle					
C_STATE_O2L_ERR_CLC	-	0... FH	0... 15	1	-
State for choice of O2L calculation strategy for calculation of diagnosis error					
C_STATE_O2L_MMV_CLC_ENA	-	0... FFH	0... 255	1	-
State to allow the calculation of the mean value of the O2L integrals					
IP_FAC_O2L_AFR_CDN_COR	-	0... FFH	0... 15.9375	0.0625	-
LDP_O2L_DELTA_IP_FAC_COR	8	0... FFFFH	-1.30844444444 ...1.3084	39.9306e-6	g
Correction factor for calculation of O2L value					
IP_O2L_CAT_DIAG_AFL_SUM	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
LDP_O2L_CAT_DIAG_1_IP_O2L_SUM	8	0... FFFFH	0... 2.61684895833	39.9306e-6	g
LDP_O2L_CAT_DIAG_2_IP_O2L_SUM	8	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Diagonally calculation of O2L due to both cylinder branches					
LC_O2L_CAT_DIAG_AFL_SUM	-	0... 1H	0 ...1	1	-
Manually set calculation of diagonally O2L to valid					

Action definition

ACTION_EGTR_ClcO2L_SUMandMV (**IN**<LV_O2L_MV_CLC_ACT_TMP_i>,**IN**<STATE_O2L_CLC_VLD_Bx_i>,**IN**<O2L_i>,**OUT**<LV_O2L_SUM_CLC_i>,**INOUT**<CTR_SUM_i>,**INOUT**<O2L_SUM_i>,**INOUT**<O2L_MV_i>)	Mode: O
Calculation of mean value fo O2L	

Description for Actions

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ACTION_EGTR_ClcO2L_SUMandMV(IN <LV_O2L_MV_CLC_ACT_TMP_i>, **IN** <STATE_O2L_CLC_VLD_Bx_i>, **IN** <O2L_i>, **OUT** <LV_O2L_SUM_CLC_i>, **INOUT** <CTR_SUM_i>, **INOUT** <O2L_SUM_i>, **INOUT** <O2L_MV_i>)					
Calculation of mean value fo O2L					
Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
LV_O2L_MV_CLC_ACT_TMP_i	IN	0... 1H	0... 1	1	[-]
Calculation of mean value allowed					
STATE_O2L_CLC_VLD_Bx_i	IN	0... 1H	0... 1	1	[-]
Read bit of STATE_O2L_CLC_VLD					
O2L_i	IN	0... FFFFH	0... 2.61684896	39.9306e-6	[g]
O2L value					
LV_O2L_SUM_CLC_i	OUT	0... 1H	0... 1	1	[-]
Sum calculation valid					
CTR_SUM_i	INOUT	0... FFH	0... 255	1	[-]
Counter for calculation of mean value of O2L					
O2L_SUM_i	INOUT	0... FFFFH	0... 20.93479	319.444e-6	[g]
Sum of O2L values					
O2L_MV_i	INOUT	0... FFFFH	0... 2.61684896	39.9306e-6	[g]
Mean value of O2L values					

General Information

In this module the diagnosis values are calculated and the link to the error management is implemented.

The calculation of diagnosis value is possible in several ways. Only one method is taken for calculation of finally diagnosis value. Choice of method is partly depending on exhaust gas configuration and number of regeneration cycles during diagnosis cycle. The finally bank specific diagnosis value is after that taken for calculation of diagonally diagnosis value. At the end the error indicator and the error symptom are calculated using bank specific and bank diagonally diagnosis value and the error management is called with condition "true".

Short description of all methods, numbering is equal to value in C_STATE_O2L_ERR_CLC and bit in STATE_O2L_MV_CLC_VLD:

Method 0: Mean value of O2L calculated during regeneration with high amplitude phase (excepted configuration 2b)

Method 1: Mean value of O2L calculated during regeneration with low amplitude phase (excepted configuration 2b)

Method 2: Mean value of O2L calculated during park phase (excepted configuration 2b)

Method 3: Mean value of O2L calculated during load phase (excepted configuration 2b)

Method 4: Mean value of O2L mean values calculated in all occurred phases (excepted configuration 2b)

Method 5: Corrected O2L value with empirical method to compensate of lambda sensor dynamic using phases with high and low regeneration amplitude (except configuration 2b)

Method 6: Corrected O2L value with mathematical method to compensate of lambda sensor dynamic using phases with high and low regeneration amplitude (except configuration 2b)

Method 7: O2L calculated using TWC- and NOx-Catalyst oxygen storage capacity for calculating of O2L value for bank without downstream Lambda Sensor (only configuration 2b)

Picture 1: The diagnosis is able for following exhaust gas configurations:

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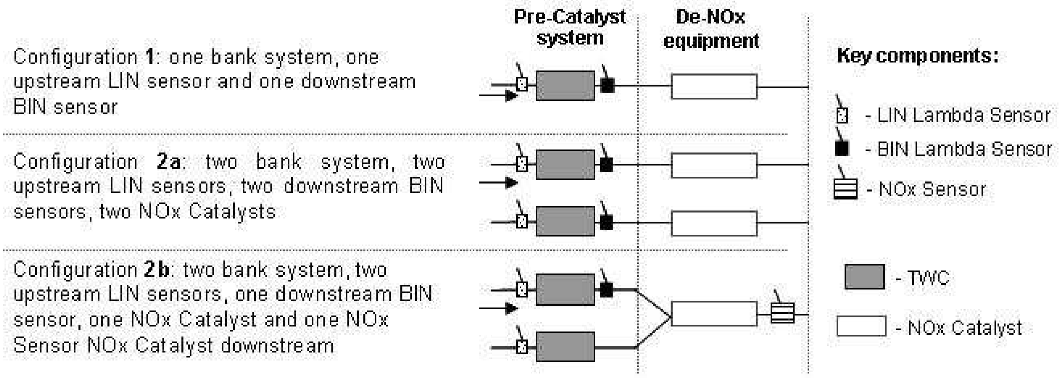
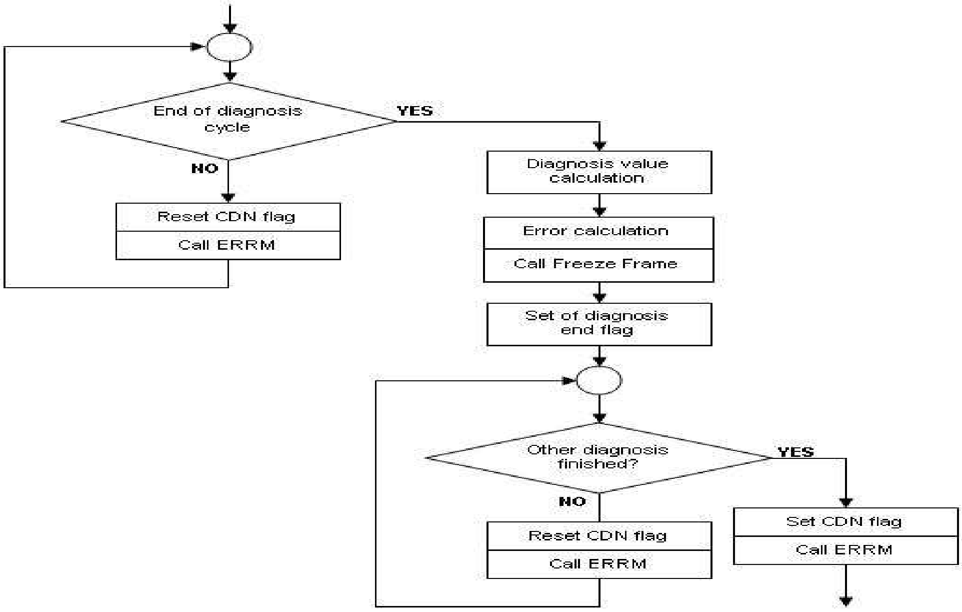


Picture 2: Signal flow for calculation of Error Indicator



If two separate exhaust bank systems are concerned, then:
i = 1, for cylinder bank 1
i = 2, for cylinder bank 2
Otherwise:
i = 1

Application Conditions

Initialization: RST, NVMINI, NVMRES, NVMSTO, CLRFMY
Recurrence: 10MS
Activation: LV_DC==1
Deactivation: LV_DC==0

Function description

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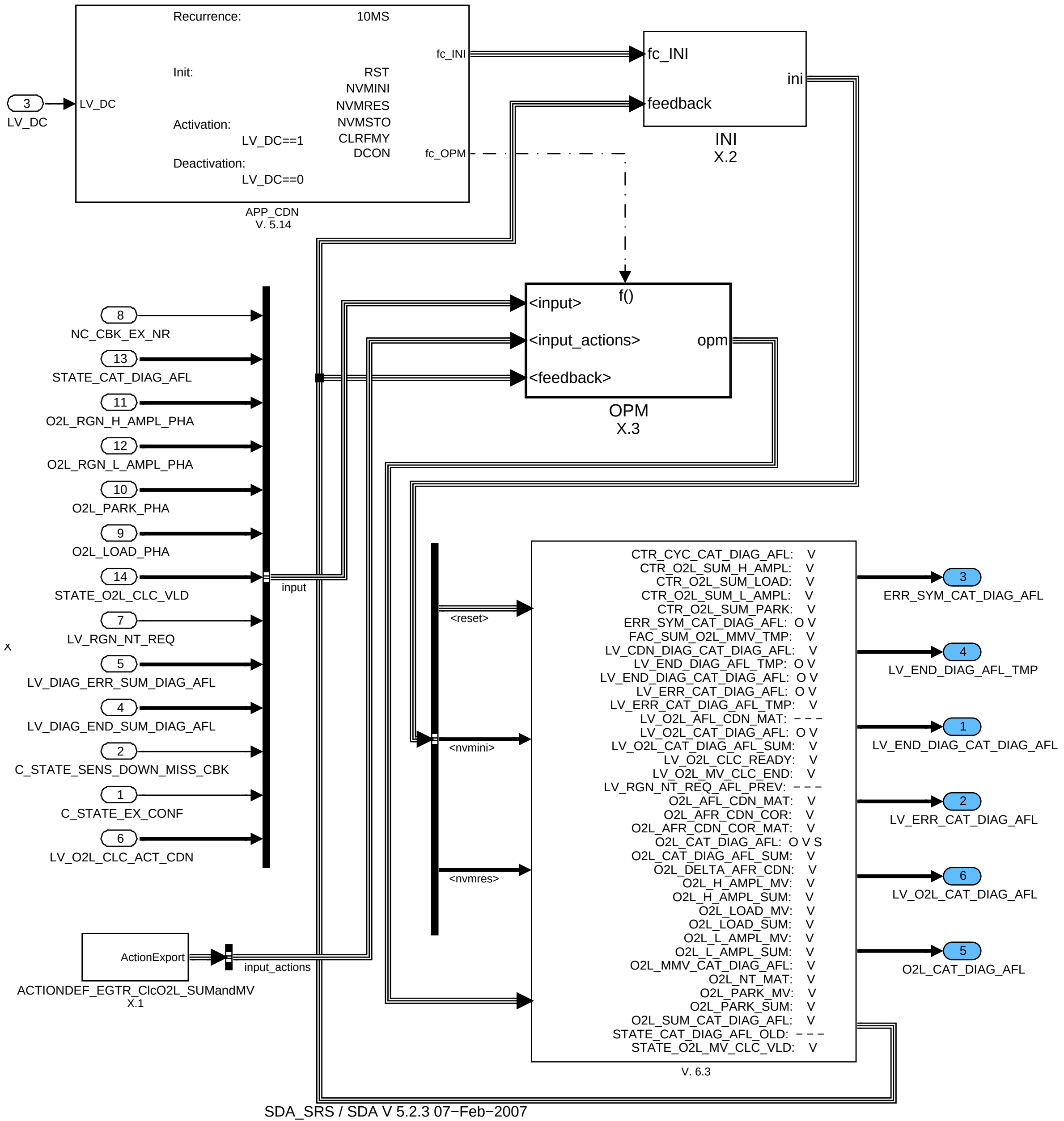

Figure B.52.1: :

B.52.1 INITIALIZATION

B.52.1.1 Initialization of NVMY data

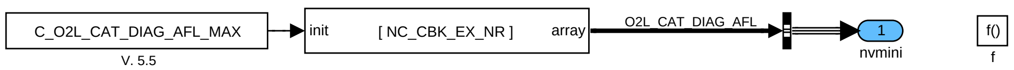

Figure B.52.2: :

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B.52.1.2 Initialization at reset and function activation (start driving cycle)

At reset and function activation (DCON) all variables except NVMY data and diagnostic result are initialized with "0".
The diagnostic result is initialized according the filtering configuration.

B.52.2 FORMULA SECTION

The formula section consists of two main sections:
Regeneration cycles counter, bank diagonally calculations inclusive calculation of method 7 and the final diagnosis result
Methods 1 to 6 and ERRM interface

B.52.2.1 Regeneration cycles counter, bank diagonally calculations inclusive method 7 and final diagnosis value

B.52.2.1.1 Counting of the regeneration cycles

B.52.2.1.1.1 Bank specific calculation of the regeneration cycles counter

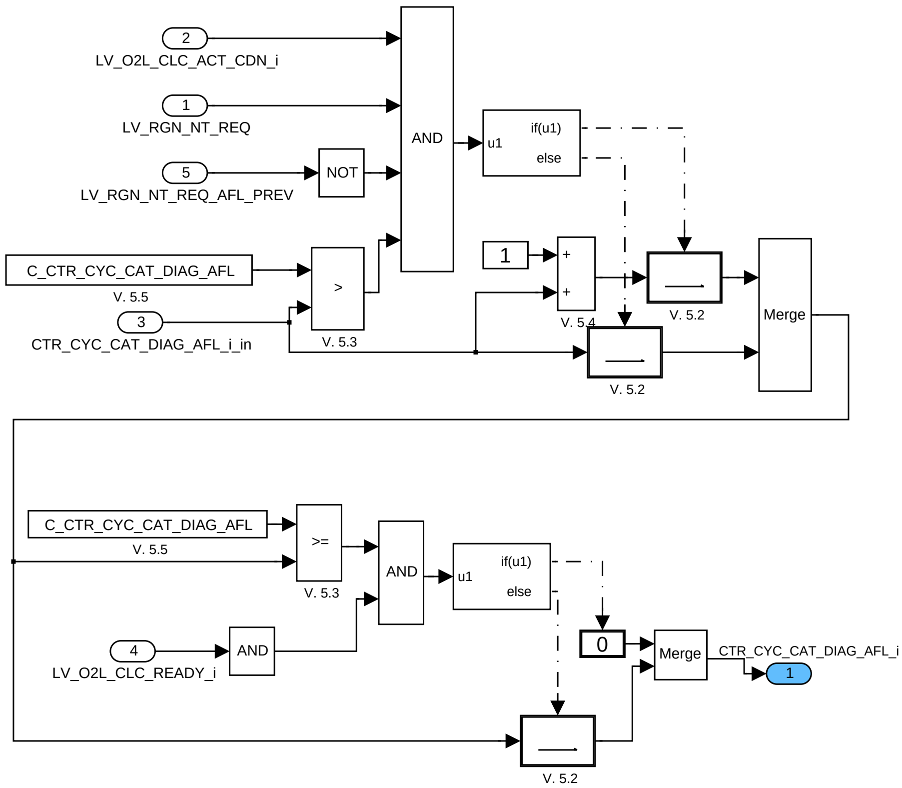

Figure B.52.3: :

B.52.2.1.2 Bank diagonally calculations inclusive method 7 and final diagnosis value

This section consists of:
Calculation of flag indicating, that diagnosis on any bank is finished
Calculation of O2L value of NOx-Catalyst in case of configuration 2b
Calculation of temporary O2L value for bank without binary downstream sensor in case of exhaust gas configuration 2b

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Calculation of finally O2L value for both banks and validation bit in case of exhaust gas configuration 2b
Choice of method for calculation of finally diagnosis value
Calculation of sum diagnosis value over all banks

B.52.2.1.2.1 Calculation of flag indicating, that diagnosis on any bank is finished

The calculation of all banks is synchronized. This flag says that the calculation of all banks is finished. Then first the diagonal calculation and after that the calculation of diagnosis results is done.
This flag is active only for one cycle.

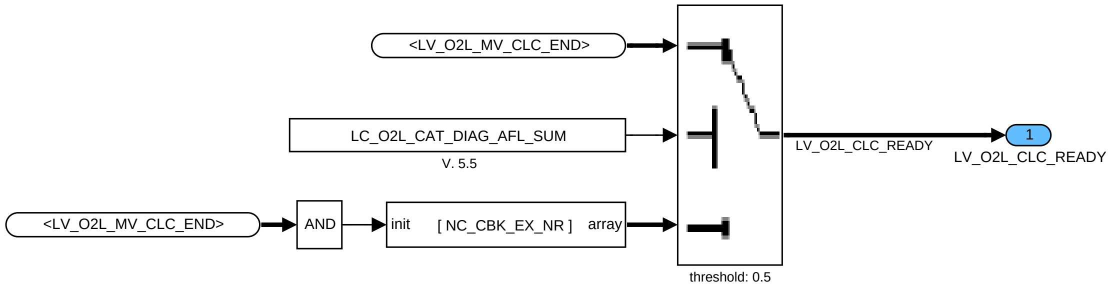

Figure B.52.4: :

B.52.2.1.2.2 Calculation of O2L value of NOx-Catalyst in case of configuration 2

The O2L value of NOx catalyst is a difference between O2L value of the whole line and O2L value of precatalyst calculated at bank with downstream binary sensor. The O2L value calculated at bank with downstream binary sensor is corrected according to the dynamic of this sensor. This is given using the IP_FAC_O2L_AFR_CDN_COR (see also Method 5)

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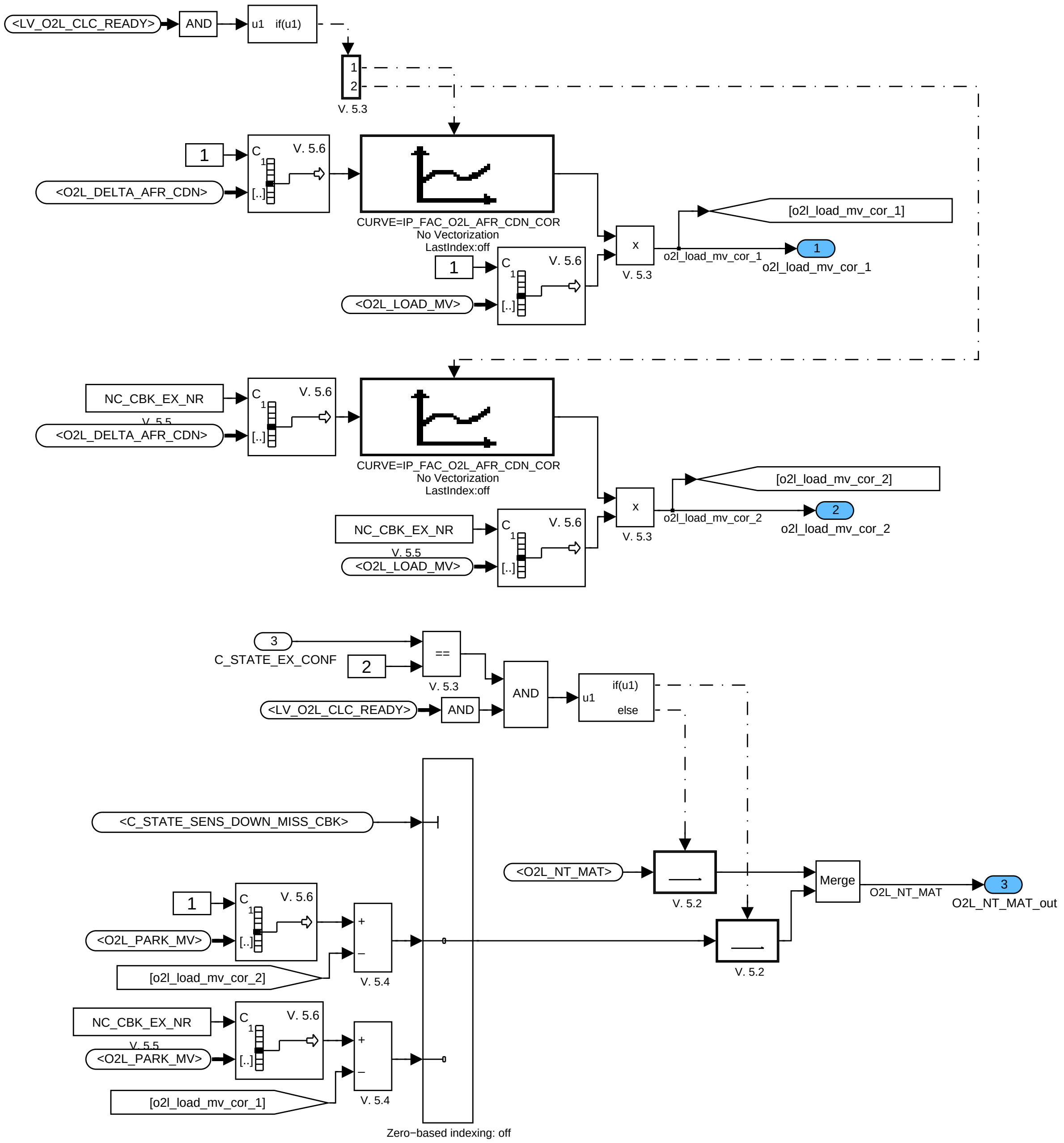

Figure B.52.5: :

B.52.2.1.2.3 Calculation of temporary O2L value for bank without binary downstream sensor in case of exhaust gas configuration 2

The O2L value of precatalyst is a difference between O2L value of the whole line and O2L value of NOx catalyst calculated at bank without downstream binary sensor

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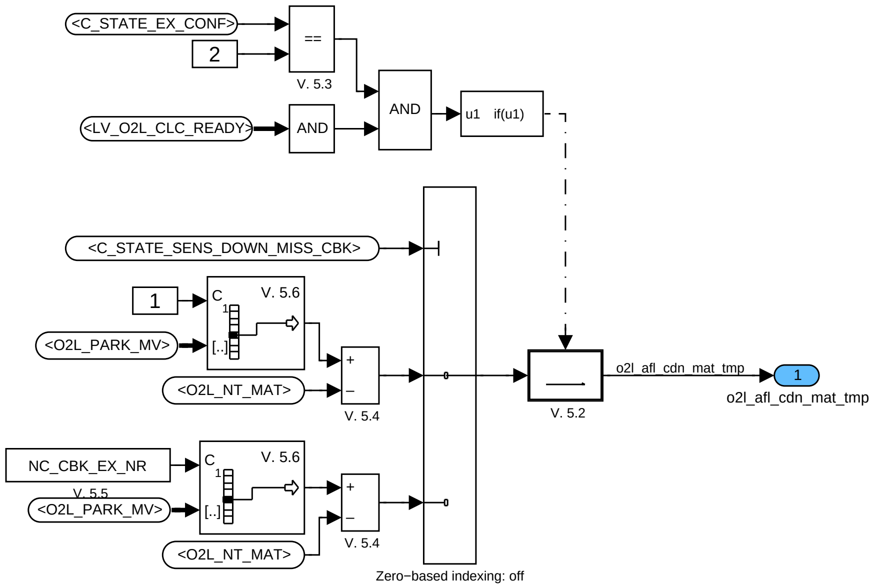

Figure B.52.6: :

B.52.2.1.2.4 Calculation of finally O2L value for both banks and validation bit in case of exhaust gas configuration 2 (Method 7)

After all diagonal calculations the result is checked, the diagnosis value of Method 7 is assigned and the valid flag is set for one recurrence.

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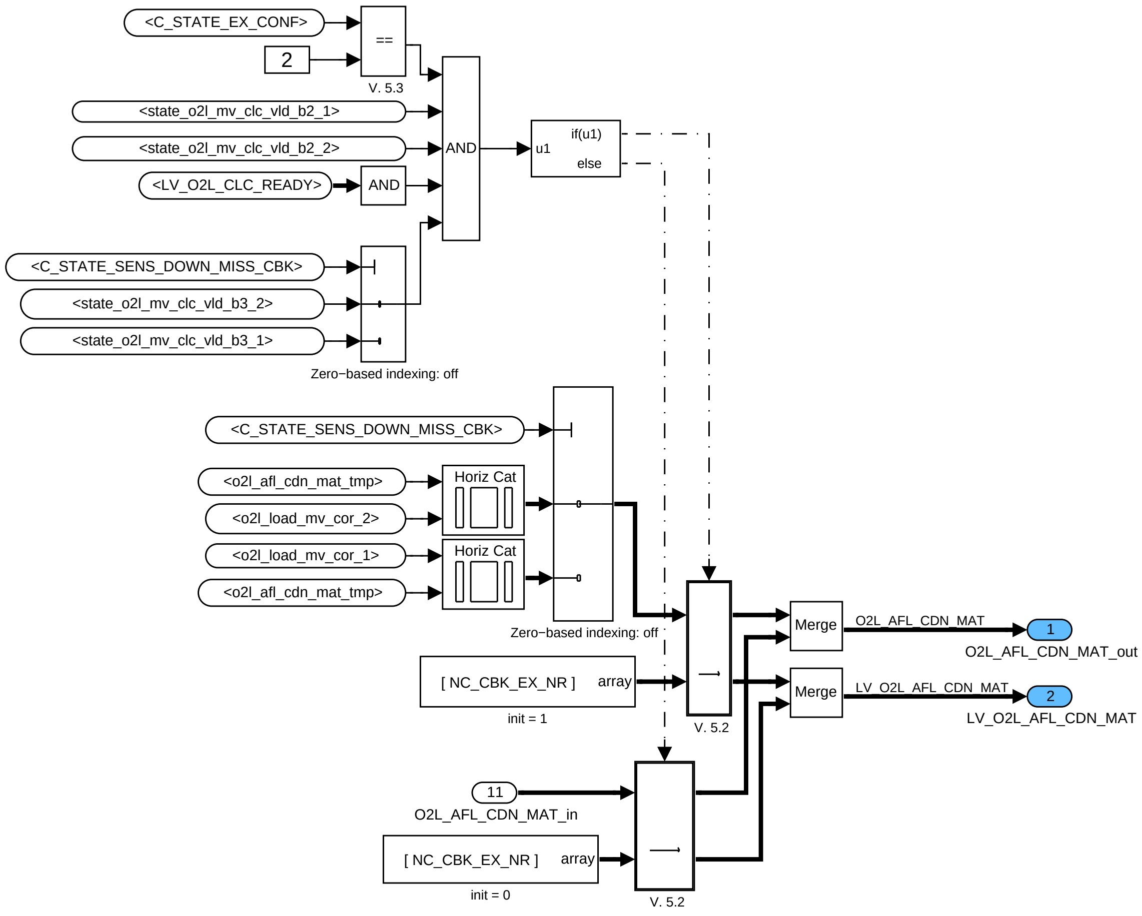

Figure B.52.7: :

B.52.2.1.2.5 Choice of method for calculation of finally diagnosis value

The O2L_CAT_DIAG_AFL used for calculation of diagnosis results is represented by O2L_xxx calculated by chosen method. The LV says that the calculation was plausible. This flag is stored in STATE_ O2L_MV_CLC_VLD (when this diagnosis was finished before others) and the STATE is reset when the diagnosis condition was true.

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B.52.2.1.2.5.1 Choice of the method and calculation temporary diagnosis value

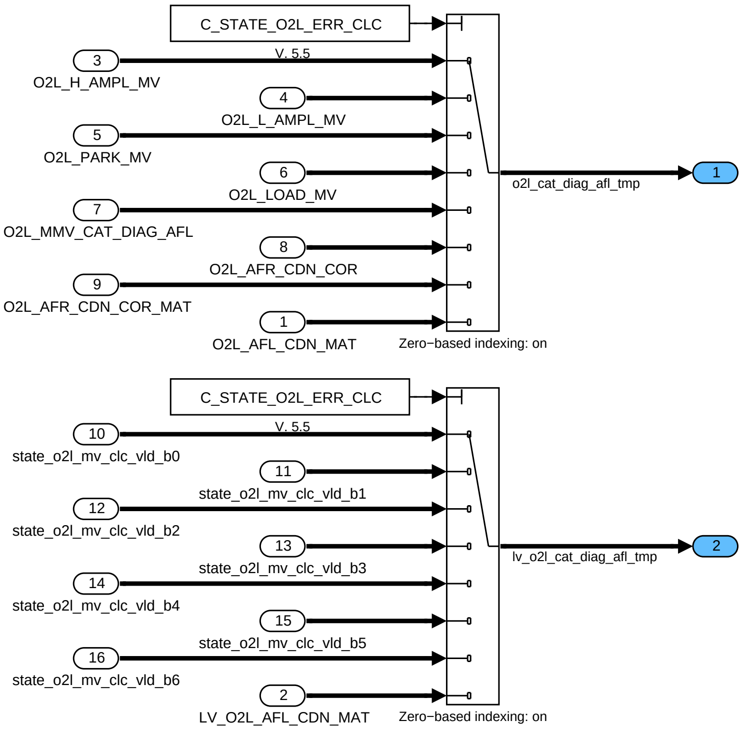

Figure B.52.8: :

B.52.2.1.2.5.2 Final diagnosis value and plausibility indicator

B.52.2.1.2.5.2.1 Calculation

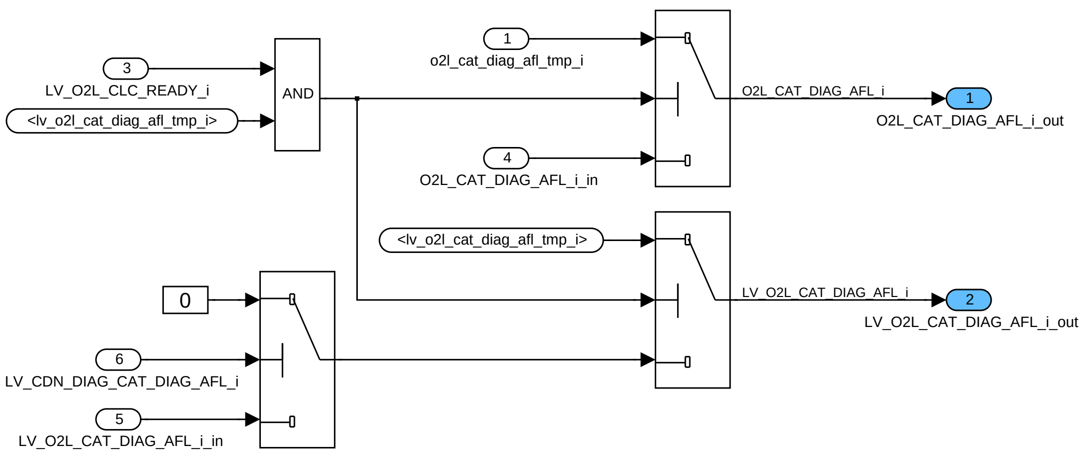

Figure B.52.9: :

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B.52.2.1.2.6 Calculation of sum diagnosis value over all banks

Indexes "1" and "2" are used regarding cylinder bank 1 and 2. Sum diagnosis value considers all banks

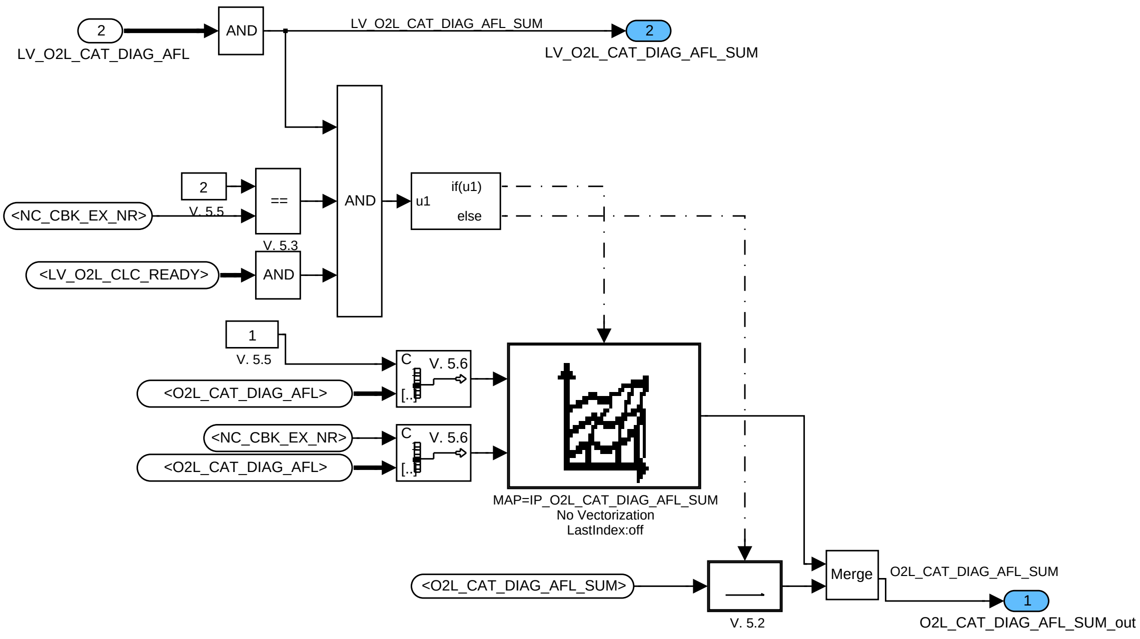

Figure B.52.10: :

B.52.2.2 Multiple bank system calculation

B.52.2.2.1 Methods 1 to 6 and ERRM interface

This section consists of three further sections:
Calculation of O2L sum and mean values
Calculation of corrected O2L values and set up of state including plausibility bits
Calculation of error symptom, condition flag and ERRM interface

B.52.2.2.1.1 Calculation of O2L sum and mean values

This section consists of:
Calculation of flag triggering calculation of mean values
Calculation of phase specific sum and mean values
Calculation of mean value of phase specific mean values (Method 4)

B.52.2.2.1.1.1 Calculation of flag triggering calculation of mean values

At the end of defined diagnosis cycles the flag triggering calculation of mean values (only one recurrence) is set for every bank separate (LV_O2L_MV_CLC_ACT_TMP). The flag LV_O2L_MV_CLC_END saves the LV_O2L_MV_CLC_ACT_TMP and is used in next cycle for calculation of summary flag of all banks (LV_O2L_CLC_READY). After that the diagonal values and diagnosis results are calculated.
The flag triggering calculation of the mean values can be set by checking counter of regeneration cycles (independent of plausibility) or counter of valid O2L calculation cycles

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B.52.2.2.1.1.1.1 Check of regeneration cycles counter

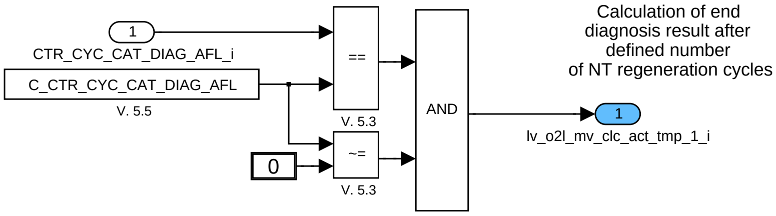

Figure B.52.11: :

B.52.2.2.1.1.1.2 Check of counter of valid O2L calculation cycles

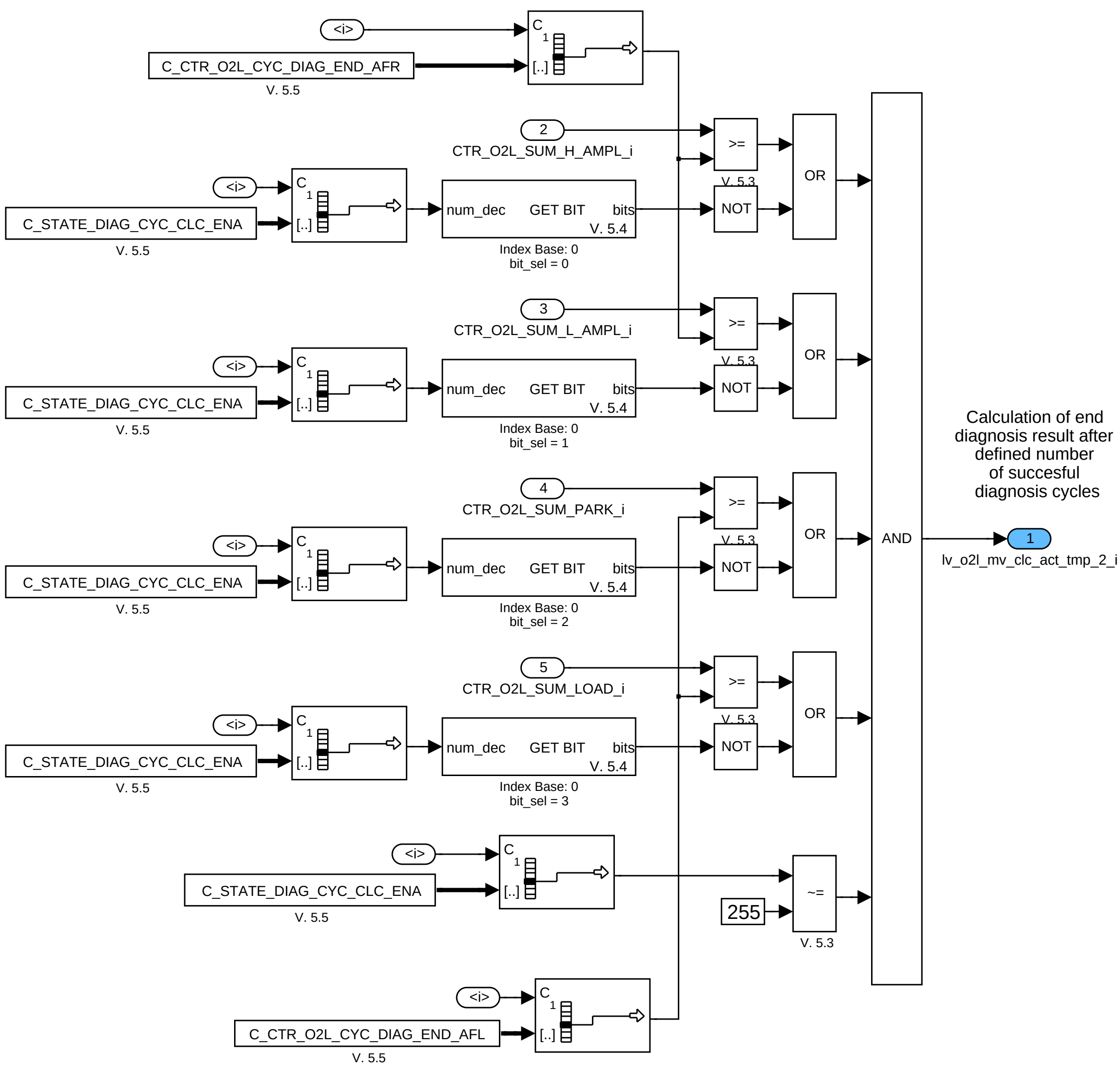

Figure B.52.12: :

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B.52.2.2.1.1.1.3 Check of storage capacity of TWC for calculation of pre-end diagnosis result (no error present)

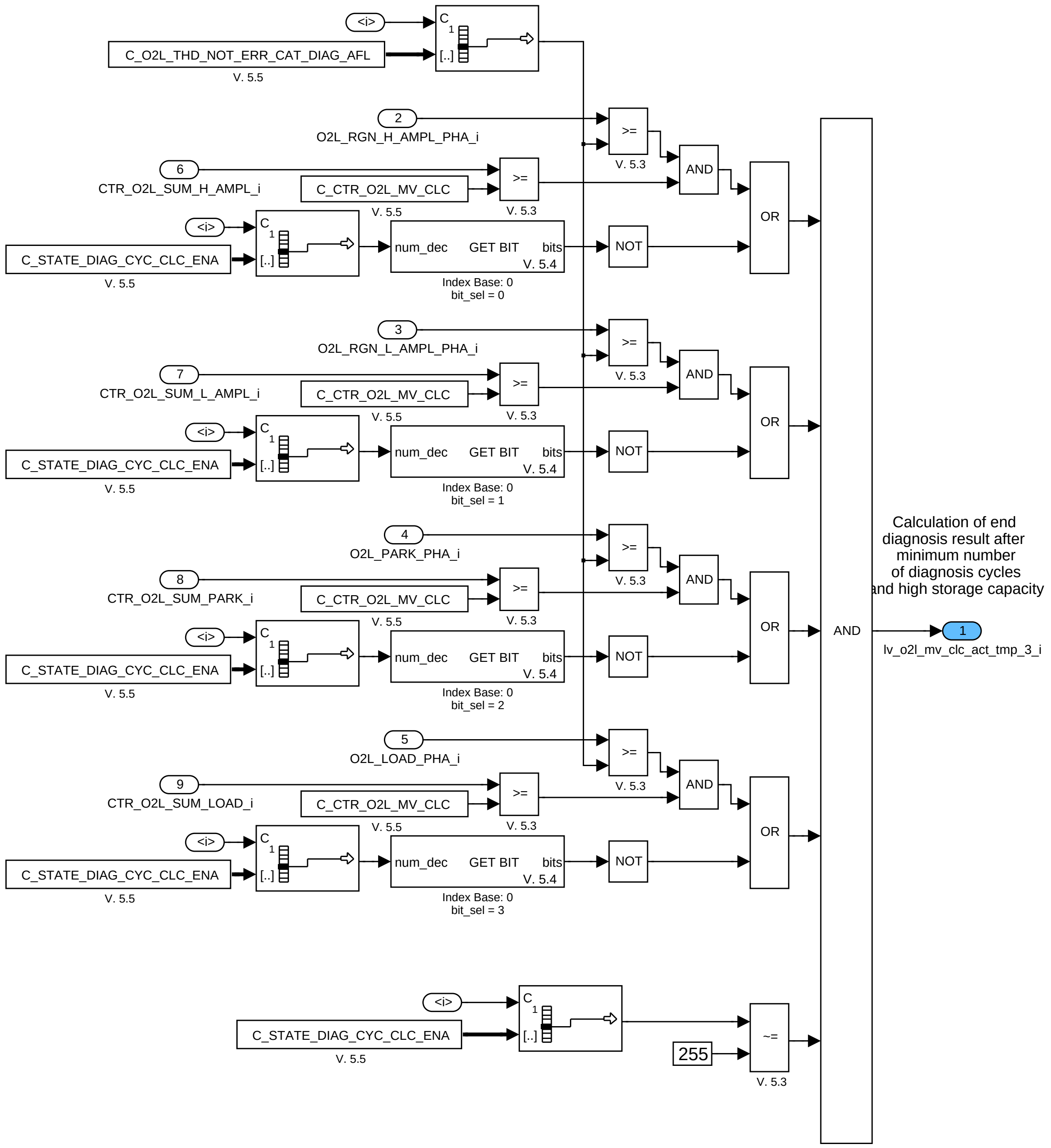

Figure B.52.13: :

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B.52.2.2.1.1.1.4 Set final triggering flag for calculation of mean values

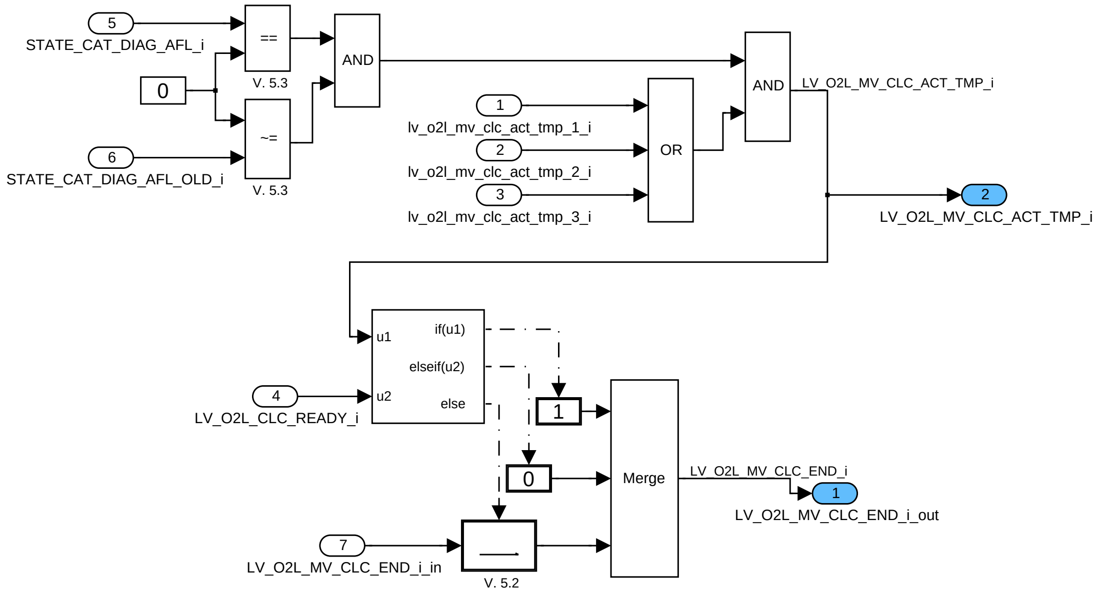

Figure B.52.14: :

B.52.2.2.1.1.2 Calculation of phase specific sum and mean values

The sum and mean values are calculated using local ACTION ClcO2L_SUMandMV

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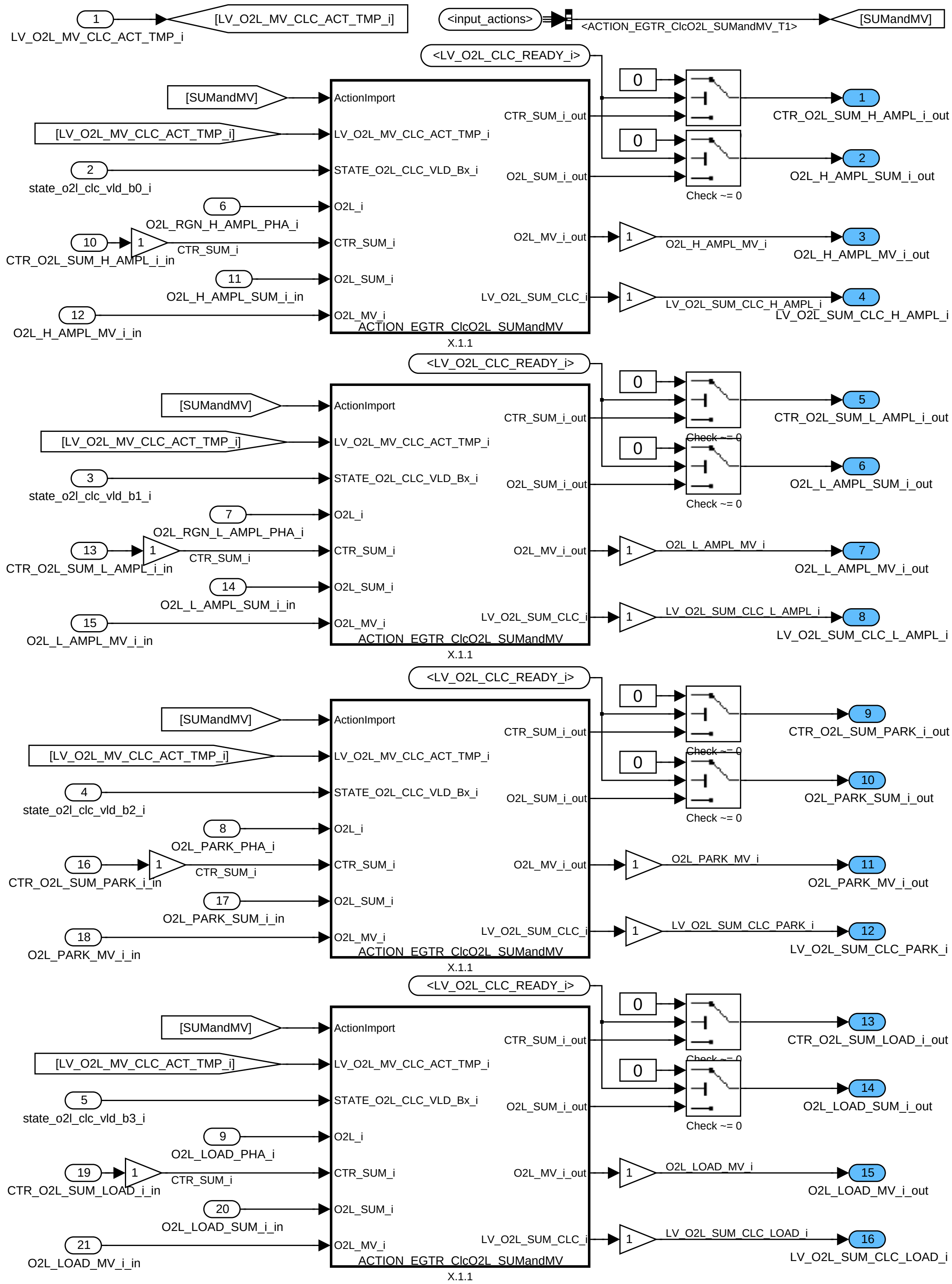

Figure B.52.15: :

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B.52.2.2.1.1.3 Mean value of phase specific mean values (Method 4)

This is calculation of the mean value of O2L values calculated in different phases (e.g. H_AMPL and L_AMPL). The phase, which is taken into the calculation, is chosen through C_STATE_O2L_MMV_CLC_ENA

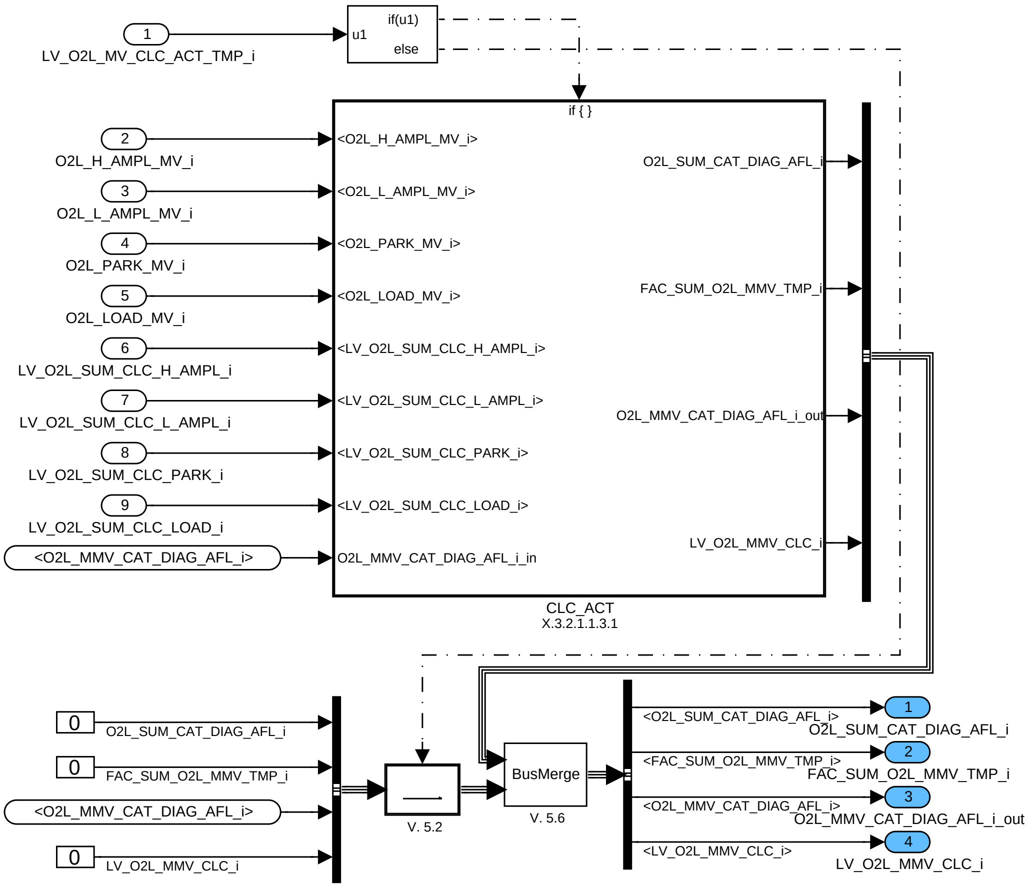

Figure B.52.16: :

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B.52.2.2.1.1.3.1 Calculations

B.52.2.2.1.1.3.1.1 Calculation of sum

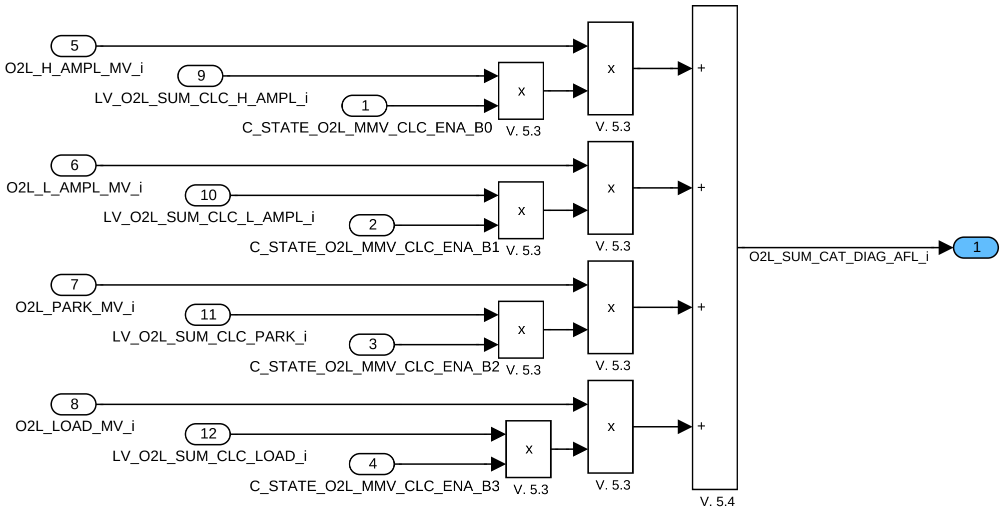

Figure B.52.17: :

B.52.2.2.1.1.3.1.2 Calculation of denominator

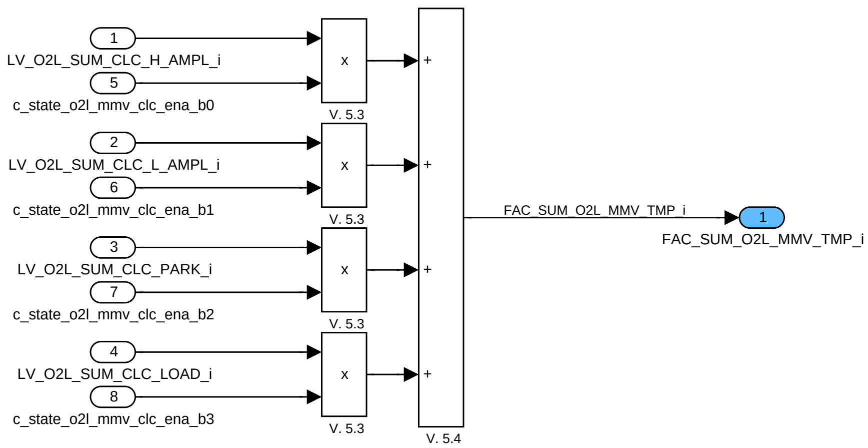

Figure B.52.18: :

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B.52.2.2.1.1.3.1.3 Check denominator for calculation of MMV

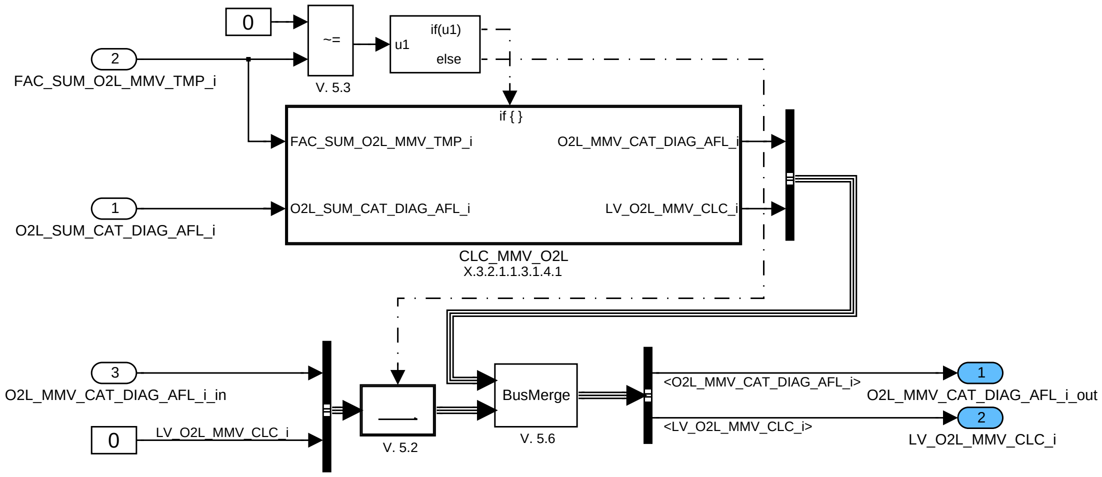

Figure B.52.19: :

B.52.2.2.1.1.3.1.3.1 Calculation of MMV

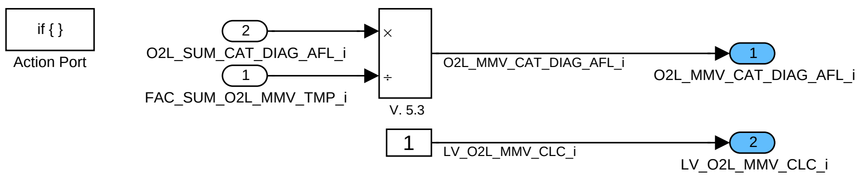

Figure B.52.20: :

B.52.2.2.1.2 Calculation of corrected O2L values and set up of state including plausibility bits

This section consists of:
Calculation of corrected O2L values
Set up of state including plausibility bits

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B.52.2.2.1.2.1 Calculation of corrected O2L values (Methods 5, 6)

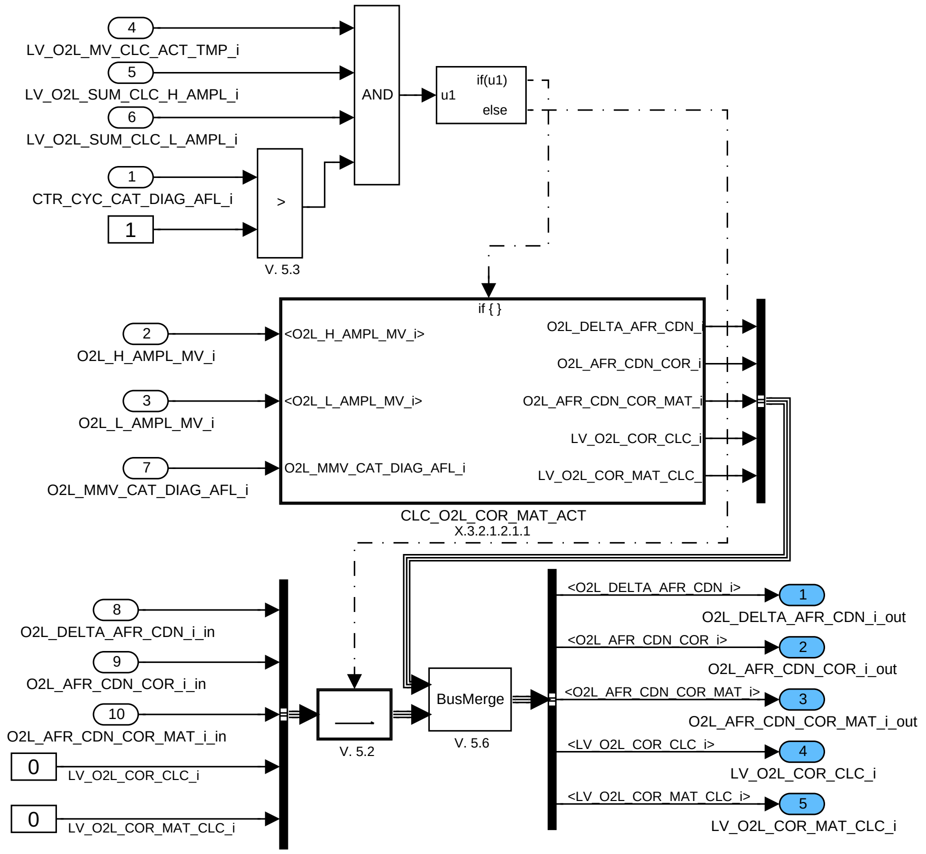

Figure B.52.21: :

B.52.2.2.1.2.1.1 Calculations

B.52.2.2.1.2.1.1.1 Calculation of delta O2L between H_AMPL and L_AMPL

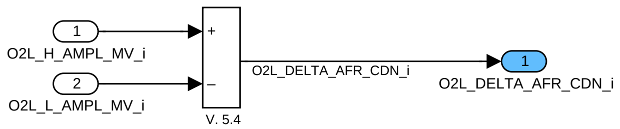

Figure B.52.22: :

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B.52.2.2.1.2.1.1.2 Calculation of corrected O2L value with method 5

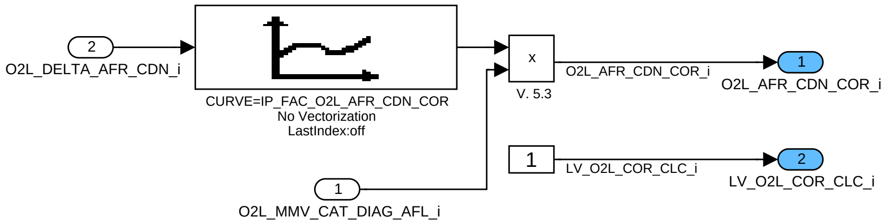

Figure B.52.23: :

B.52.2.2.1.2.1.1.3 Calculation of corrected O2L value with method 6

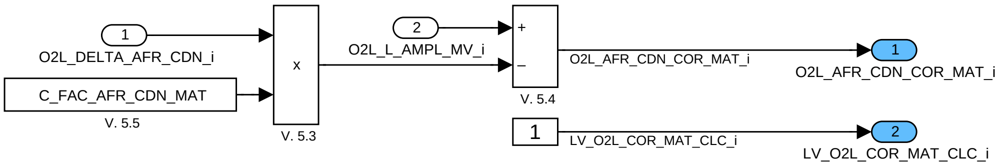

Figure B.52.24: :

B.52.2.2.1.2.2 Collecting of validation bit of all O2L calculation methods into a state

For each method for calculation of final diagnosis value exists one validation bit:
Bit 0: Using of O2L mean value from H_AMPL phase
Bit 1: Using of O2L mean value from L_AMPL phase
Bit 2: Using of O2L mean value from PARK phase
Bit 3: Using of O2L mean value from LOAD phase
Bit 4: Using of O2L mean value mean values of all phases
Bit 5: Using of O2L value corrected with empirical method
Bit 6: Using of O2L value corrected with mathematical method
Bit 7: Using of O2L calculated in lean condition in case of configuration 2b

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B.52.2.2.1.2.2.1 Set up of the state

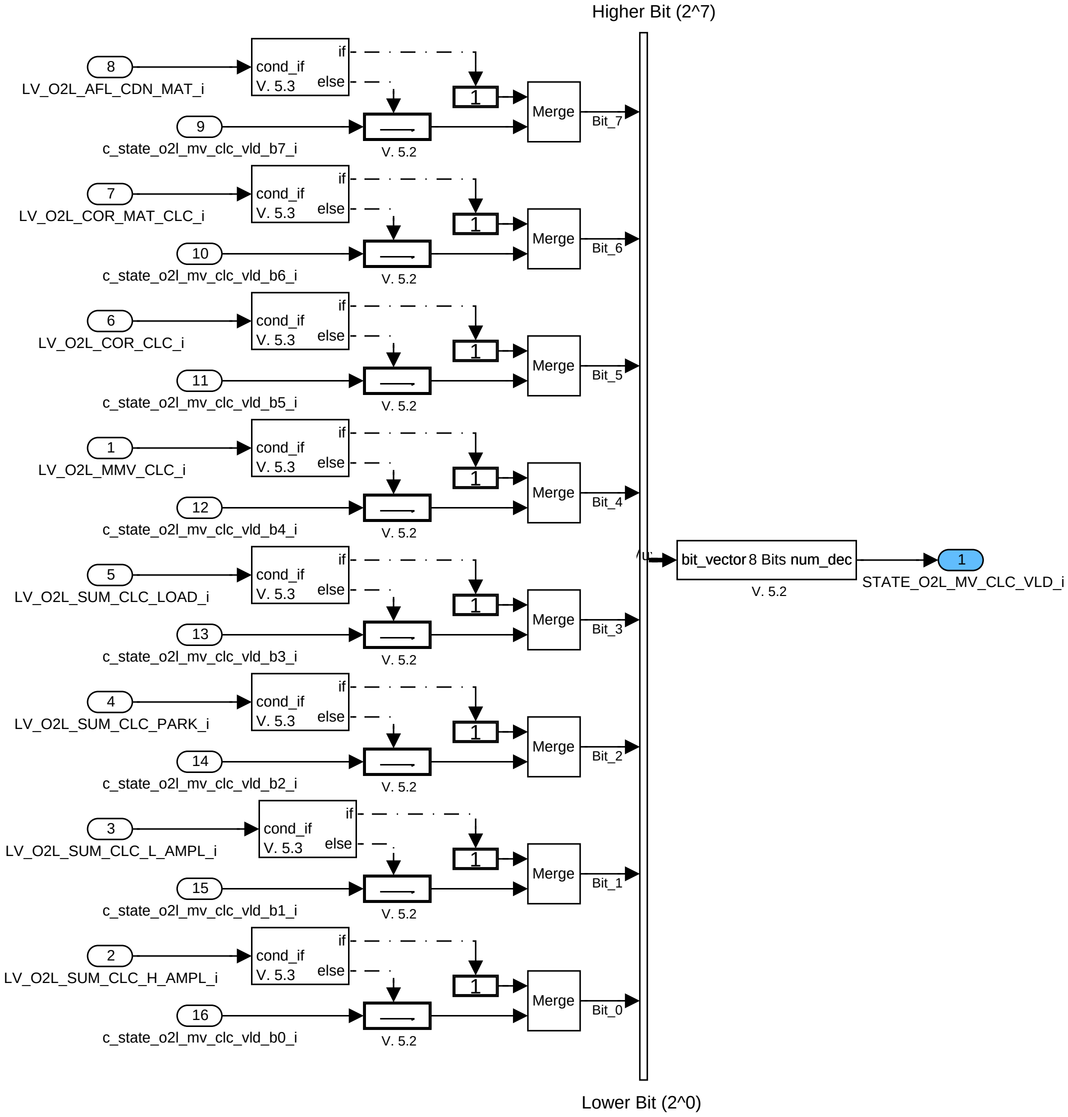

Figure B.52.25: :

B.52.2.2.1.2.2.2 Reset of the state

The STATE_O2L_MV_CLC_VLD is reset when the diagnosis condition bit was true in previous cycle

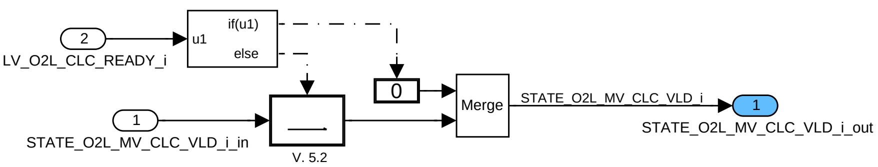

Figure B.52.26: :

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B.52.2.2.1.3 Calculation of error symptom, condition flag and ERRM interface

This section consists of:
Calculation of temporary diagnosis error after finishing of diagnosis cycle
Calculation of temporary diagnosis end bit
Calculation of condition bit for calculation of error symptom using temporary error indicator after finishing of this and other relevant diagnosis
Interface to ERRM

B.52.2.2.1.3.1 Calculation of temporary diagnosis error after finishing of diagnosis cycle

The temporary diagnosis error is calculated at the end of diagnosis cycle. At this time, pre-store of environment data is executed

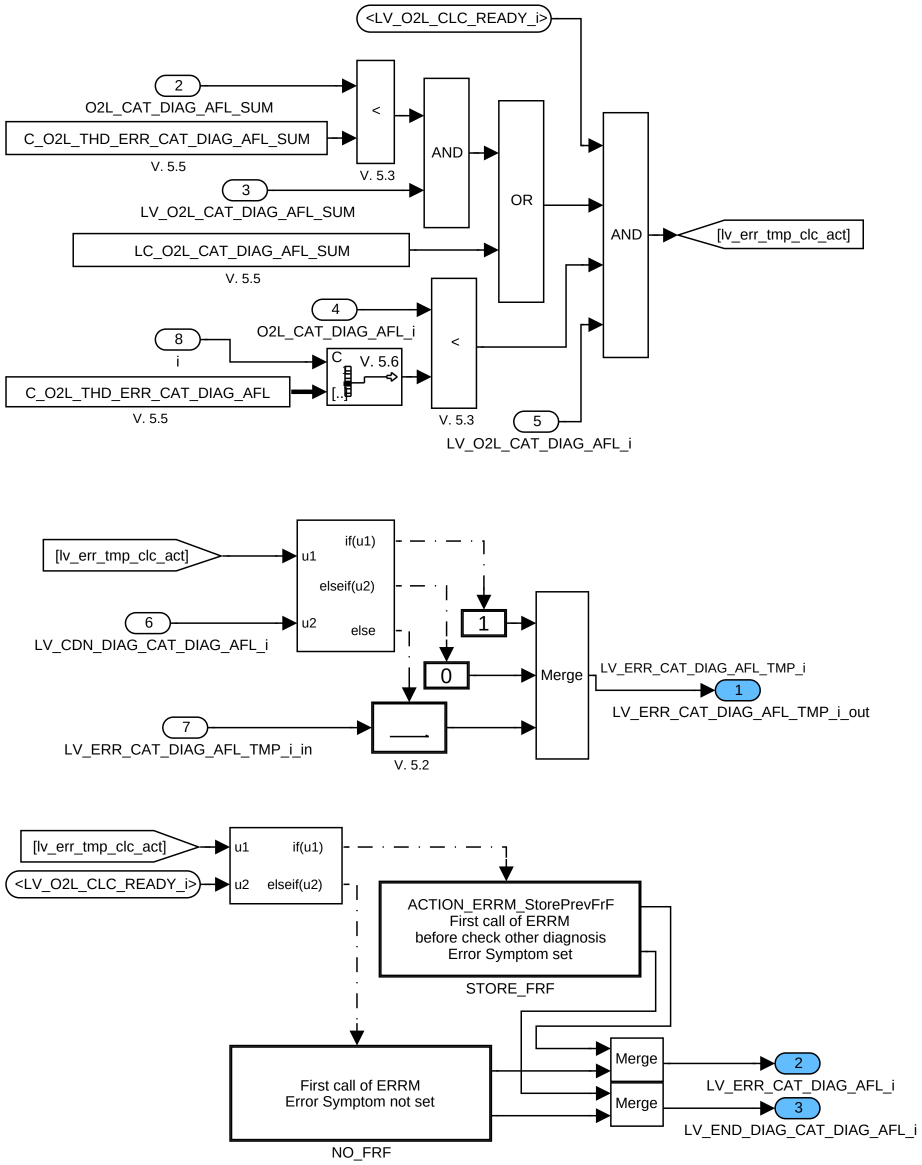

Figure B.52.27: :

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B.52.2.2.1.3.2 Calculation of temporary diagnosis end bit

The temporary "end" bit is set when diagnosis cycle is finished and calculated O2L value is plausible.

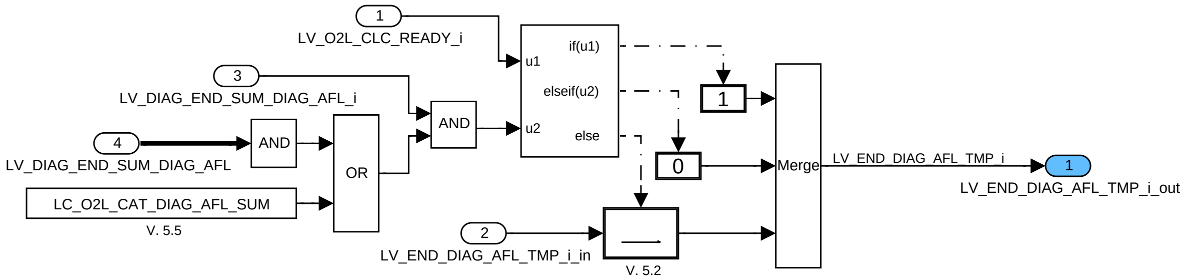

Figure B.52.28: :

B.52.2.2.1.3.3 Calculation of diagnosis condition bit and diagnosis error symptom

The diagnosis condition bit can be set when all other relevant diagnosis are finished and the result of this diagnosis is plausible. The calculation of error symptom is done after set of condition bit.
The diagnosis condition bit is set only for one recurrence.

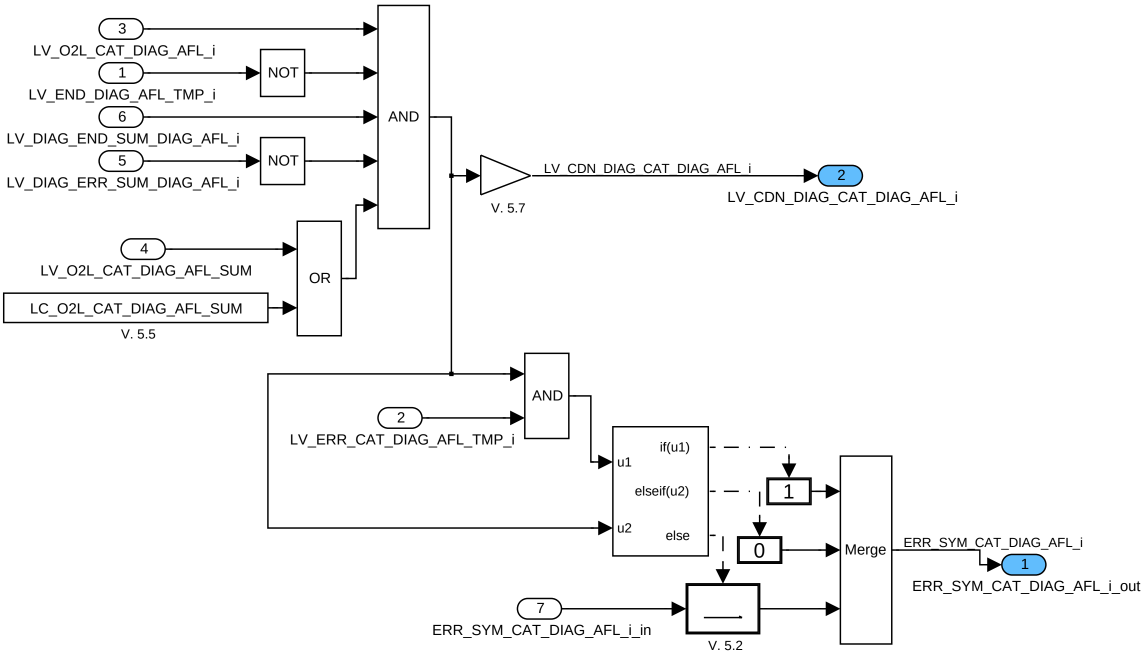

Figure B.52.29: :

B.52.2.2.1.3.4 Interface to error management

The diagnosis values are valid when the diagnosis condition flag is true. In this case the error management will take the diagnosis values into account.

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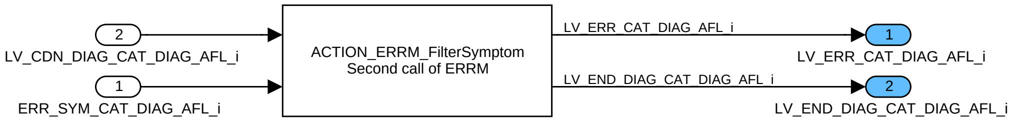

Figure B.52.30: :

B.52.3 Detailed description for Action: ACTION_EGTR_ClcO2L_SUMandMV

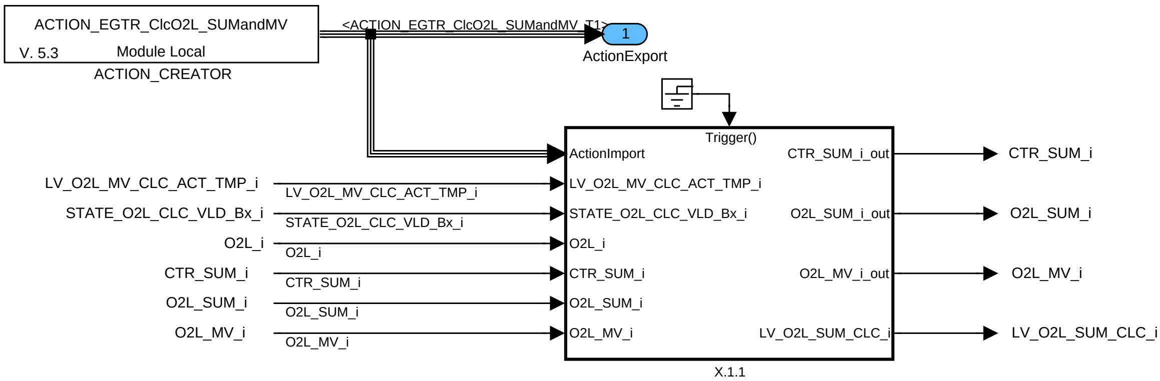

Figure B.52.31: :

B.52.3.1 Check of temporary trigger for calculation either sum, or mean o2l value

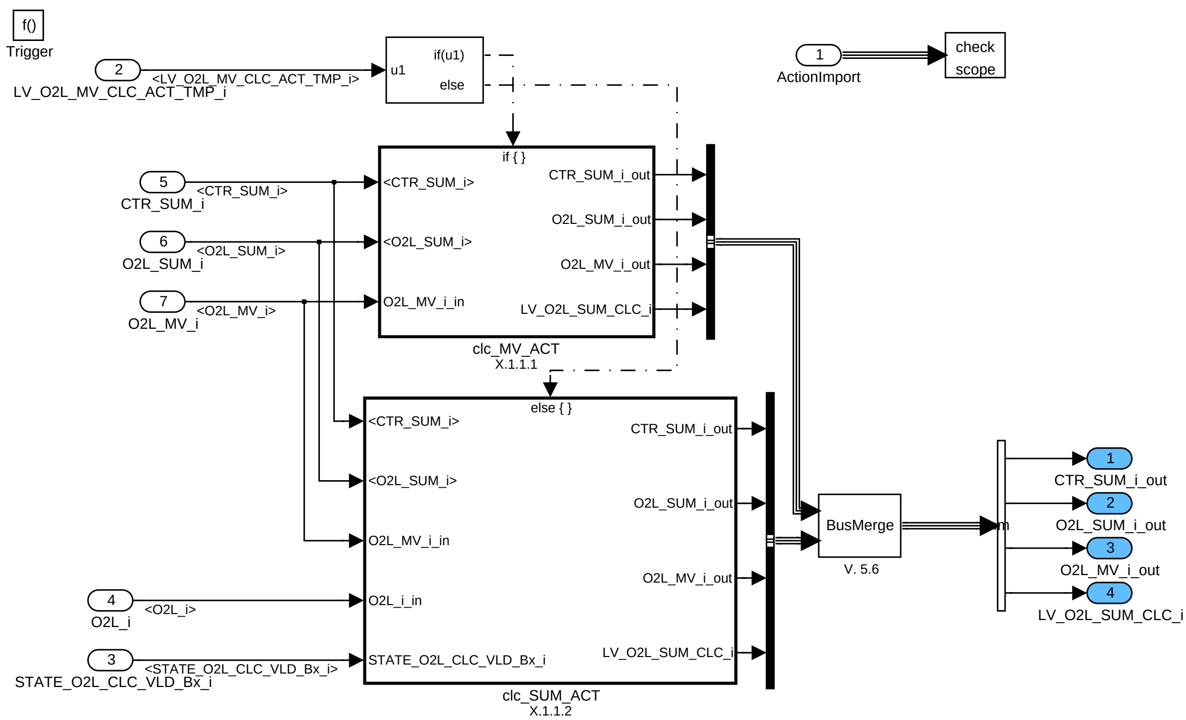

Figure B.52.32: :

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B.52.3.1.1 Check number of calculated phases for calculation of o2l mean value

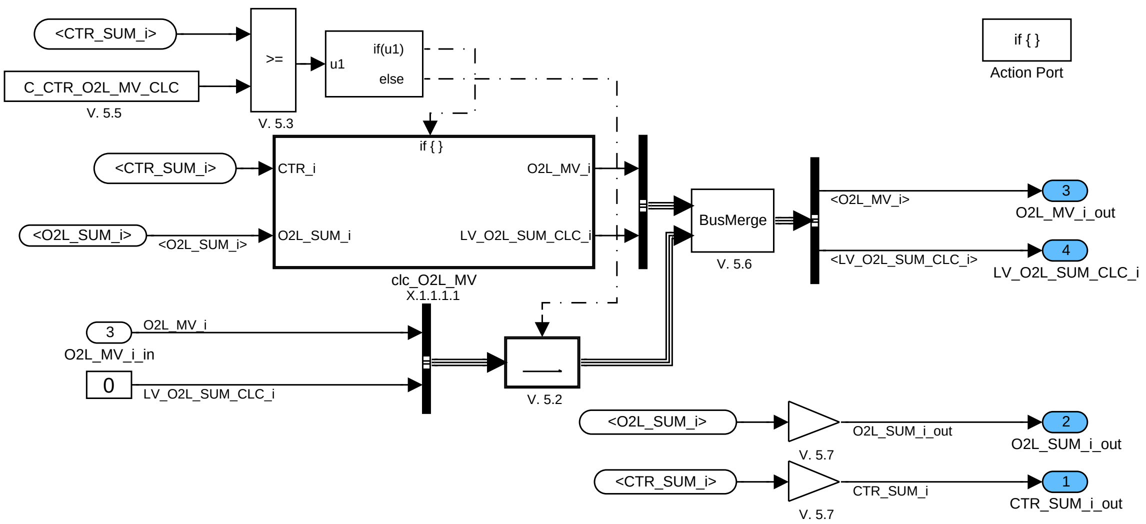

Figure B.52.33: :

B.52.3.1.1.1 Calculation of mean o2l value

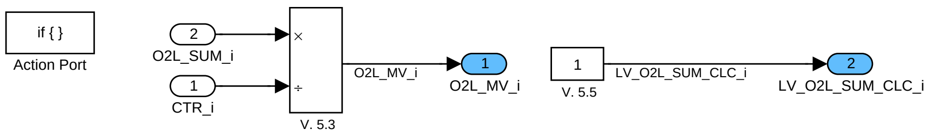

Figure B.52.34: :

B.52.3.1.2 Calculation o2l sum values

The sum value is just sum of o2l values calculated in several phases

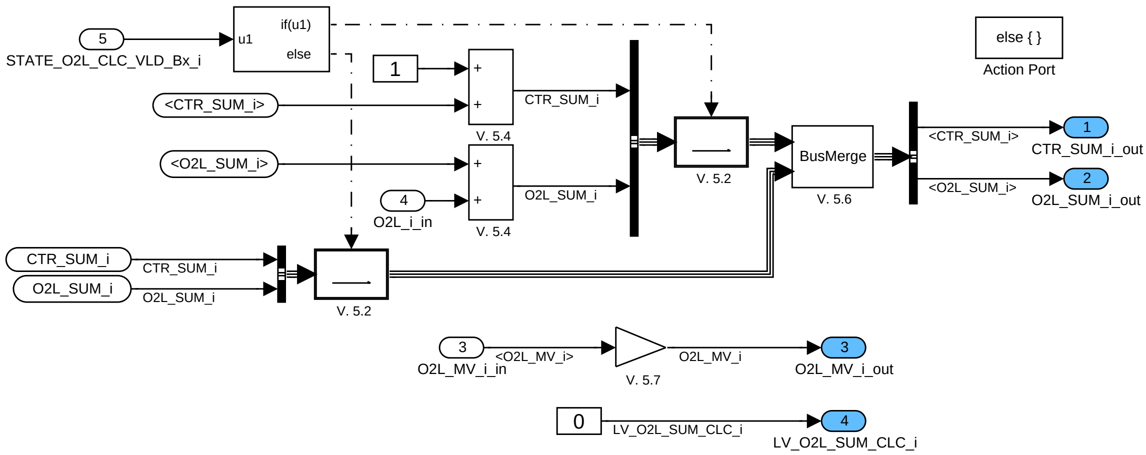

Figure B.52.35: :

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B.53 TWC diagnosis at lean operation - Lambda Setpoint

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_SP_DIAG_AFL [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda setpoint for precatalyst lean diagnosis					
LV_DIAG_AFL_REQ	O/V	0... 1H	0 ...1	1	-
Request for precatalyst lean diagnosis					
LV_LAMB_SP_DIAG_AFL_PARK [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Indicator of lambda value position at park state					
LV_MAF_INT_NT_AGI_0	-	0... 1H	0 ...1	1	-
Logical variable which is set if MAF_INT_THD_NT_AGI reached 0					
LV_NT_RGN_REQ_PREV	-	0... 1H	0 ...1	1	-
Value of LV_RGN_NT_REQ from previous calculation cycle					
MAF_INT_LAMB_SP_CAT_DIAG_AFL	V	0... FFFFH	0... 1820.42	0.0277778	g
MAF integral for keeping of rich lambda setpoint before switch to diagnosis					
MAF_INT_THD_NT_AGI	V	0... FFFFH	0... 1820.42	0.0277778	g
MAF integral threshold based on NOx trap aging factor					
STATE_RGN_CAT_DIAG_AFL [NC_CBK_EX_NR]	O/V	0... 3H	0 ...3	1	-
State for calculation of lean TWC diagnosis due state of system regeneration					

Input data:

LV_LAMB_SP_SWI {p. 2885}	LV_NT_ACT {p. 2982}	LV_O2L_CLC_ACT_CDN [NC_CBK_EX_NR] {p. 5553}	LV_RGN_NT_REQ {p. 2983}
LV_ST_END {p. 1720}	MAF {p. 8277}	MAF_CYL {p. 8277}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}	NT_AGI {p. 3073}	STATE_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5607}
STATE_RGN [NC_CBK_EX_NR] {p. 2885}	VLS_NS [NC_NOX_SENS_CONF] {p. 992}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_SP_DIAG_AFL_DIAG	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda setpoint for lean part of the lean precatalyst diagnosis					
C_LAMB_SP_DIAG_AFL_PAS	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda setpoint for passive part of the lean precatalyst diagnosis					
C_LAMB_SP_DIAG_PARK_AFR	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda setpoint for preconditioning phase before switching to diagnosis conditions					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_SP_DIAG_PARK_BAS	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Basis lambda setpoint of lean precatalyst diagnosis at park phase					
C_LAMB_SP_DIAG_PARK_SHIFT	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Lambda shift from basis lambda at park phase of the precatalyst lean diagnosis					
C_MAF_INT_LAMB_SP_AFR	-	0... FFFFH	0... 1820.42	0.0277778	g
Threshold for MAF integral for keeping of the rich lambda setpoint					
C_STATE_RGN_DIAG_AFL_ACT	-	0... 3H	0 ...3	1	-
Value of STATE_RGN_CAT_DIAG_AFL for activation of diagnosis					
C_STATE_RGN_INI_DIAG_AFL [NC_CBK_EX_NR]	-	0... 3H	0 ...3	1	-
Initialization for the lambda setpoint for precatalyst lean diagnosis at active state					
C_STATE_RGN_INI_DIAG_AFL_PAS [NC_CBK_EX_NR]	-	0... 3H	0 ...3	1	-
Initialization for the lambda setpoint for precatalyst lean diagnosis at passive state					
C_VLS_NS_THD	-	0... 578H	-200 ...1200	1	mV
Threshold voltage of binary O2 sensor signal for lambda set point calculation					
IP_LAMB_SP_DIAG_PARK_I	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDP_N_32_IP_LAMB_SP_DIAG_PARK_I	4	0... FFH	0... 8160	32	rpm
LDP_MAF_IP_LAMB_SP_DIAG_PARK_I	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Integration step for lambda setpoint for lean precatalyst diagnosis at park state					
IP_MAF_INT_THD_NT_AGI	-	0... FFFFH	0... 1820.42	0.0277778	g
LDP_NT_AGI_IP_MAF_INT_THD	4	0... FFFFH	0... 0.99998474121	15.2588e-6	-
MAF integral value based on NOx trap aging factor					
LC_DIAG_AFL_CBK_SYN	-	0... 1H	0 ...1	1	-
If true, reset of lambda setpoint flag after all banks finished, otherwise after first bank finished					
LC_MAF_INT_NT_AGI	-	0... 1H	0 ...1	1	-
Switch to enable lambda set point calculation based on NOx trap aging factor					
LC_STATE_RGN_DIAG_AFL	-	0... 1H	0 ...1	1	-
Switch between regeneration states for calculation of O2L values					

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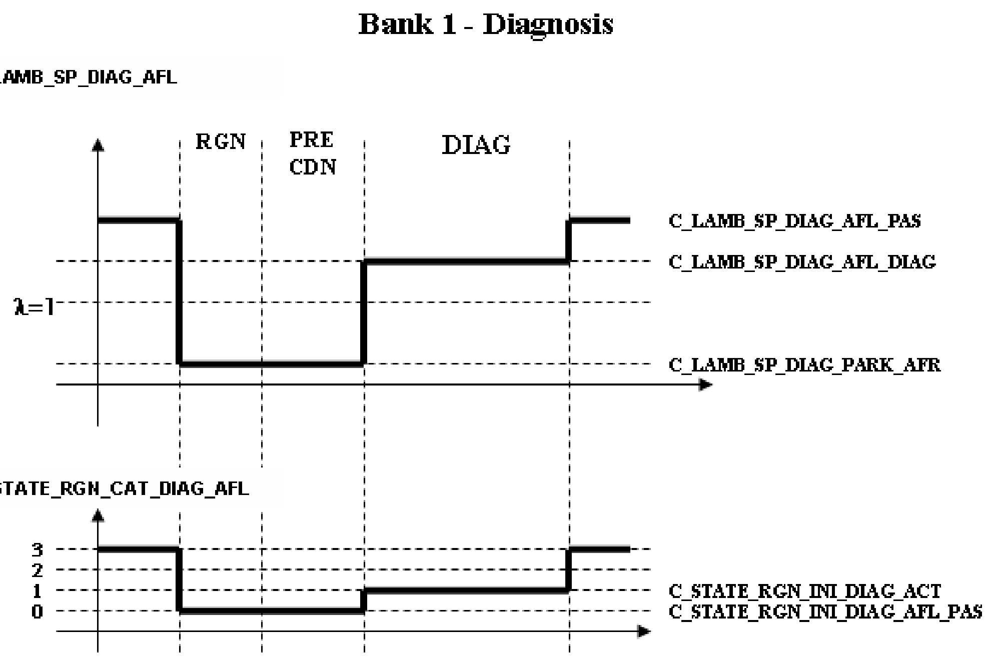
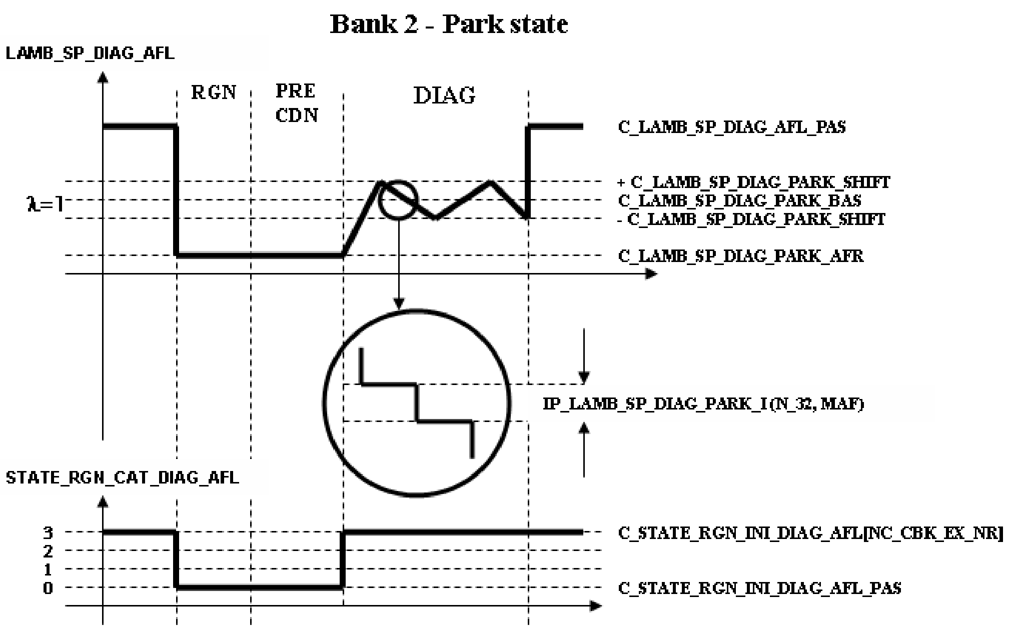
General Information

For the configuration without binary sensor after one bank, phases with rich and lean lambda value are required. When this conditions are not given by NOx Catalyst Regeneration, then a separately lambda setpoint directly after regeneration is generated. Directly before switching to the diagnosis, rich precondition of the catalysts is possible. Moreover, for each bank is used different lambda setpoint strategy. While at first bank (Picture 1, diagnosis) are the O2L values of the precatalyst and of the whole exhaust line (precatalyst + NOx Trap) calculated, the second bank (Picture 2, park state) is parked to minimize it influence to the diagnosed bank. The strategy is successively switched between both banks.

Picture 1: Lambda setpoint strategy for the diagnosed bank:



Picture 2: Lambda setpoint strategy for the parked bank:



Application Conditions

Initialization: RST
Recurrence: 10MS
Activation: LV_ST_END & & LV_NT_ACT
Deactivation: !LV_ST_END || !LV_NT_ACT

Function description

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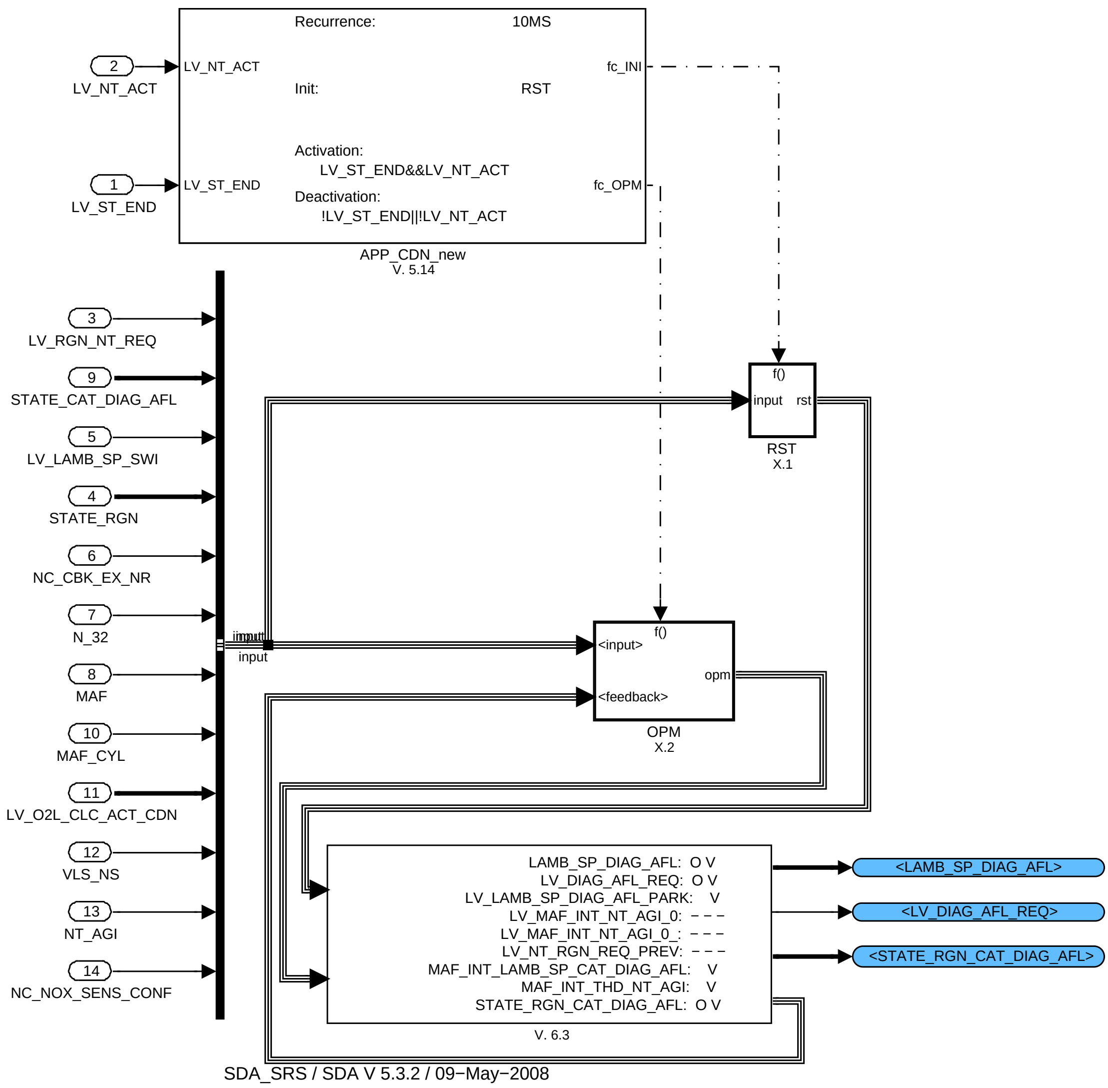

Figure B.53.1: :

B.53.1 FORMULA SECTION

The calculation of the STATE_RGN_CAT_DIAG is only active when the lambda behaviour during regeneration doesn't suit the requirements for the diagnosis. Otherwise the STATE_RGN is taken for the other modules of this diagnosis.
Then the activation flag for calculation of O2L values is checked. If any bank is not active, all variables are initialized.
The function contains of two main sections:
1.2.1: Calculation of the lambda setpoint and the regeneration state for the diagnosis (LAMB_SP_CLC)
1.2.2: Passive state (LAMB_SP_NOT_CLC)
1.2.3: Initialization when the activation conditions are not fulfilled

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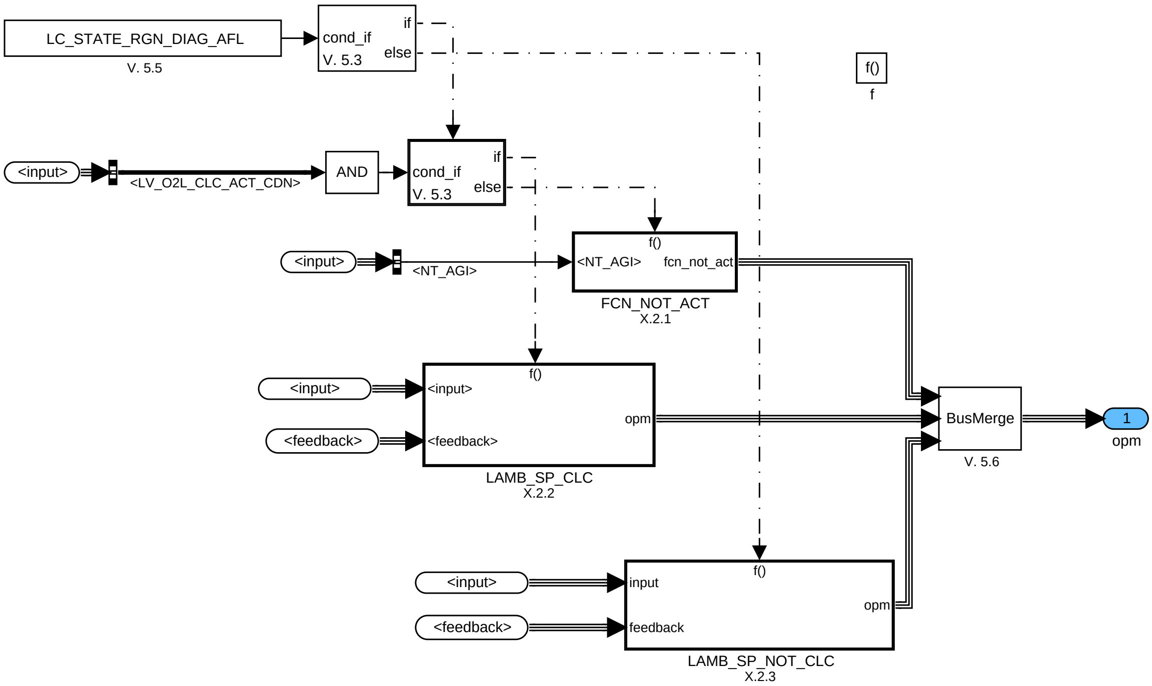

Figure B.53.2: :

B.53.1.1 Initialization when the activation flag for O2L calculation at any bank is false

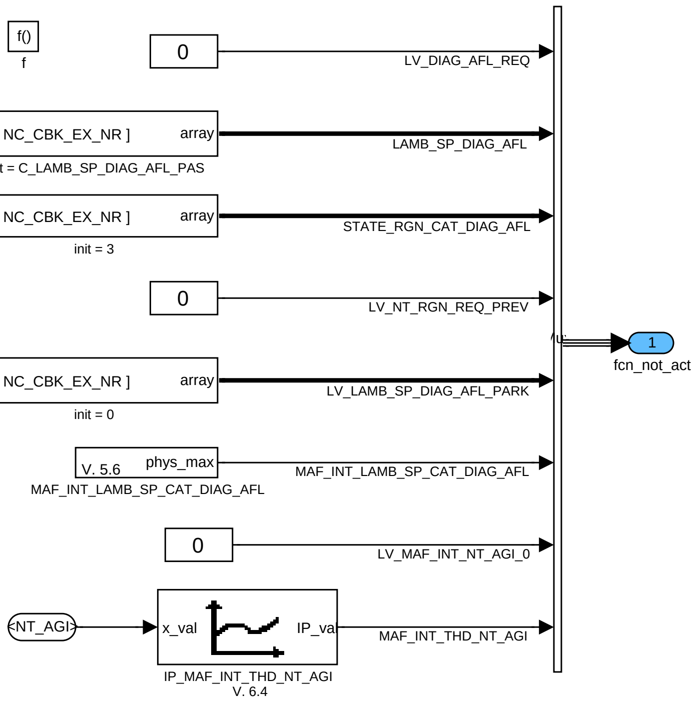

Figure B.53.3: :

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B.53.1.2 CALCULATION OF THE LAMBDA SETPOINT AND THE REGENERATION STATE FOR THE DIAGNOSIS (LAMB_SP_CLC)

The calculation is split up into following sections:
- Request for the diagnosis
- Calculation of the regeneration state for the diagnosis
- Calculation of the lambda setpoint
- Calculation of MAF-integral in dependence of the age from the NOx trap
- Calculation of the old variables

B.53.1.2.1 Request for the diagnosis

As long as the request LV_DIAG_AFL_REQ is set, the lambda set point for the system is defined by this function directly after regeneration is finished. This request is reset, when either all, or just any bank (depending on calibration) switches to STATE_CAT_DIAG_AFL=PASSIVE

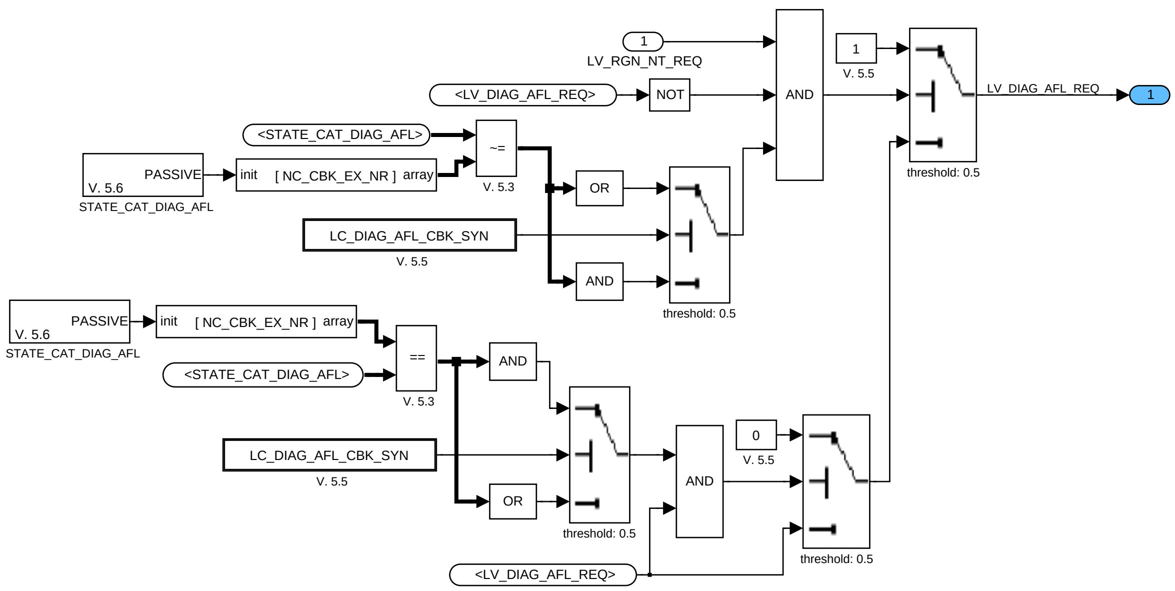

Figure B.53.4: :

B.53.1.2.2 Calculation of the regeneration state for the diagnosis

The own regeneration state for the diagnosis is initialized at the beginning of the NOx Trap regeneration. When the Nox Trap regeneration is finished, then depending on calibration a precondition phase is started. When the precondition is finished, then the own regeneration state is initialized accordingly for activation of the diagnosis at relevant bank and neutral park of the other

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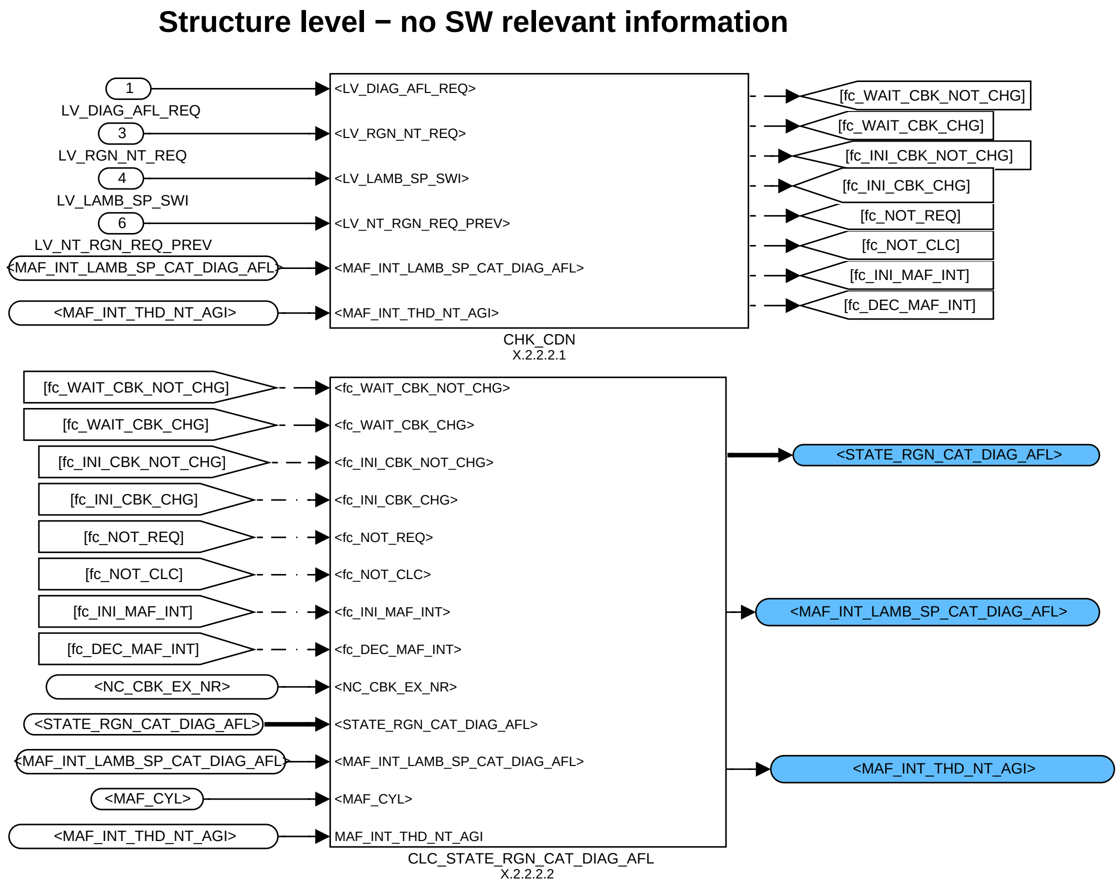

Figure B.53.5: :

B.53.1.2.2.1 Check conditions

Check of the NOx Trap regeneration state, precondition state and bank alternate bit. The calculations follow in next picture

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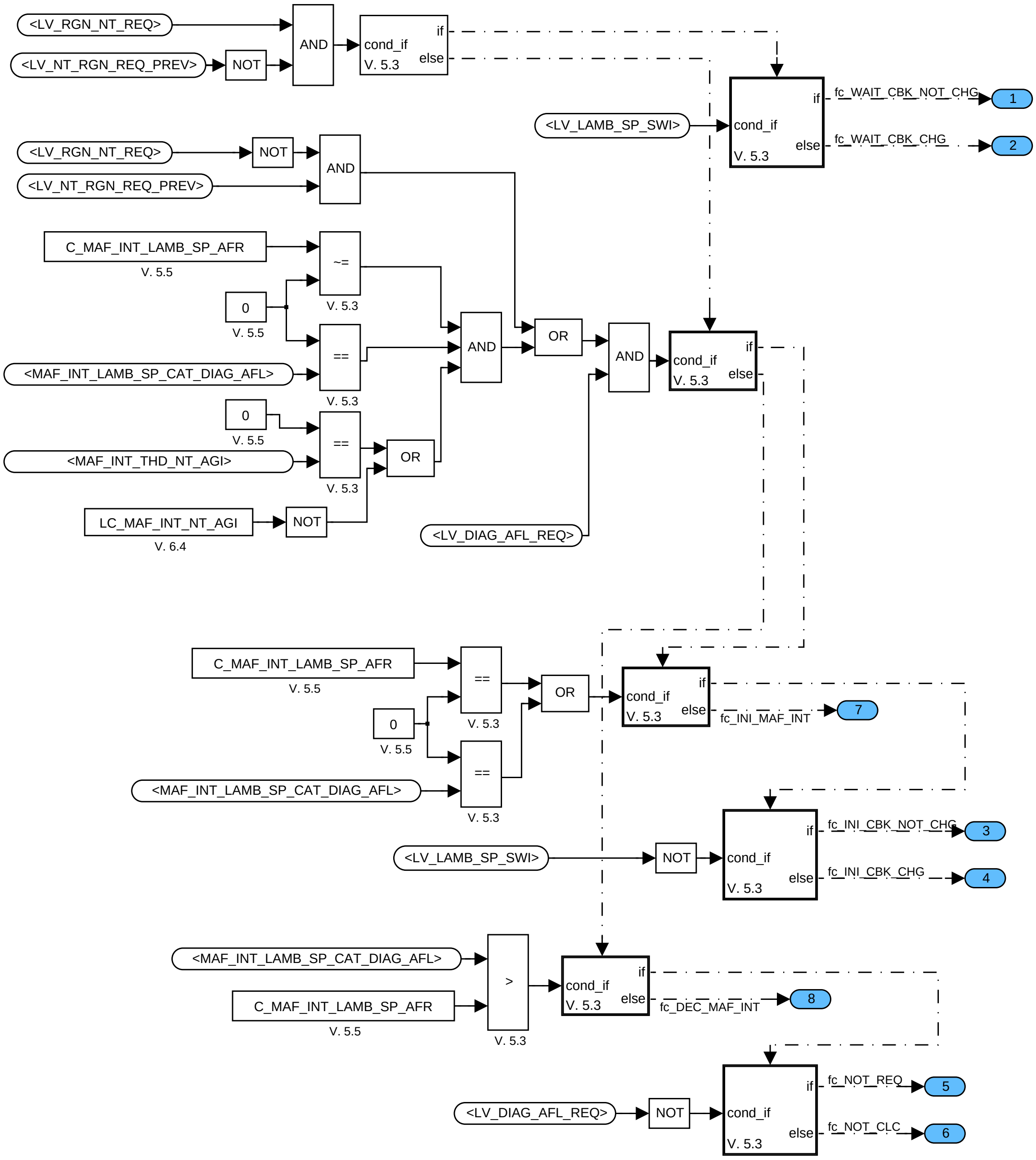

Figure B.53.6: :

B.53.1.2.2.2 Calculations

Calculation of the own regeneration state, lambda set point and MAF integral is done in following cases:

a) Waiting for the end of the Nox Trap regeneration and precondition, banks not interchanging

b) Waiting for the end of the Nox Trap regeneration and precondition, banks interchanging accordingly to C_STATE_RGN_INI_DIAG_AFL_PAS

c) Initialization for diagnosis state without interchanging of the banks

d) Initialization for diagnosis state with interchanging of the banks accordingly to C_STATE_RGN_INI_DIAG_AFL

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e) Request for the diagnosis doesn't exist
f) Request for the diagnosis exists, but initializations don't take place
g) Initialization of the MAF integral for precondition phase
h) Decrementing of the MAF integral during precondition phase

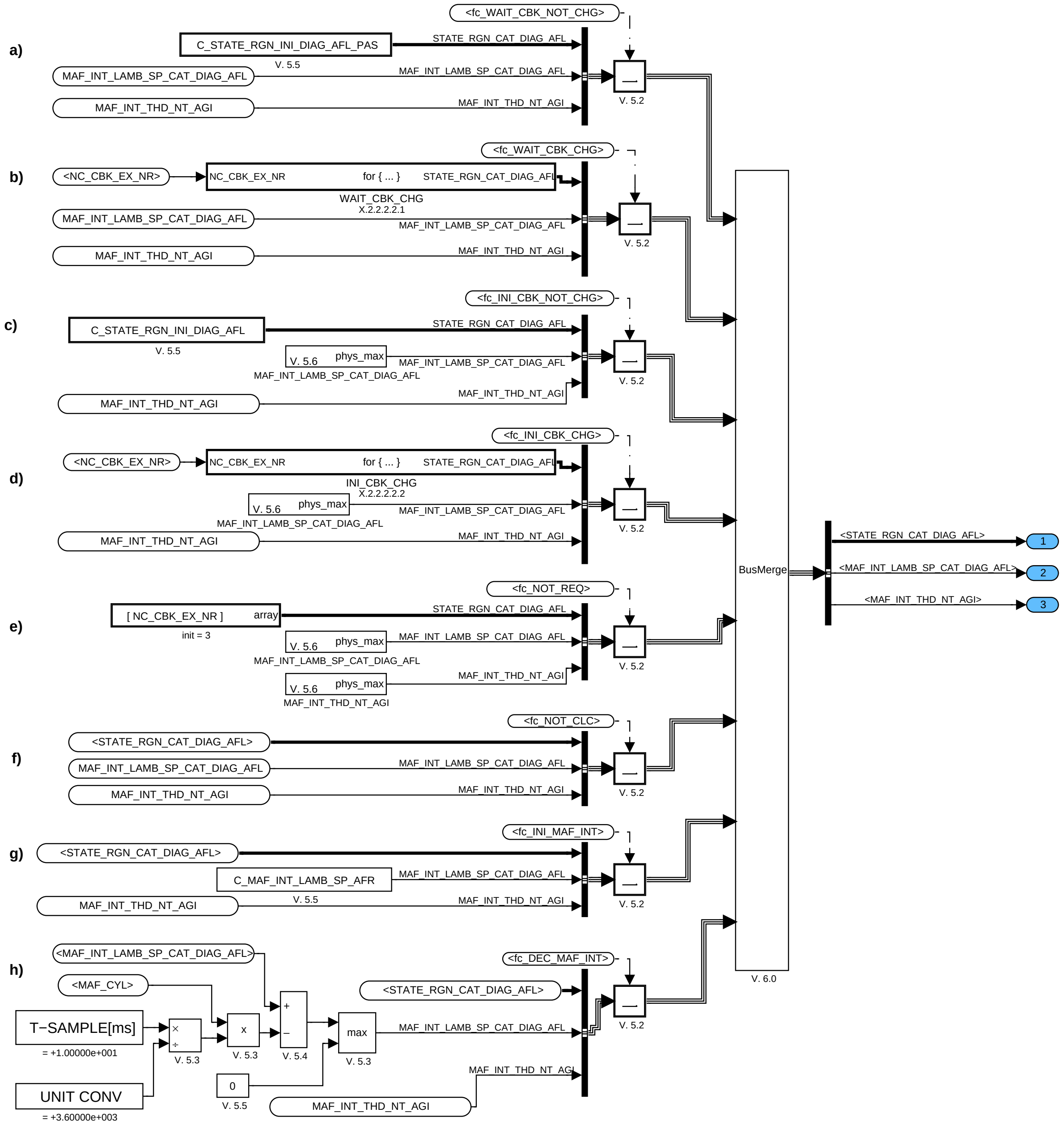

Figure B.53.7: :

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B.53.1.2.2.2.1 Interchanging of the banks accordingly to C_STATE_RGN_INI_DIAG_AFL

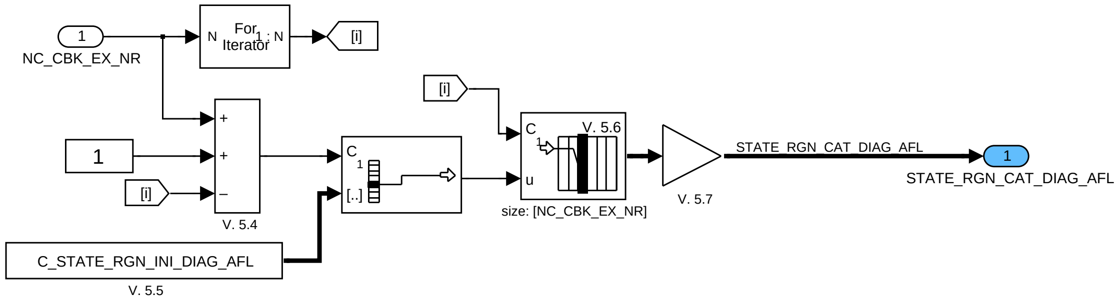

Figure B.53.8: :

B.53.1.2.2.2.2 Interchanging of the banks accordingly to C_STATE_RGN_INI_DIAG_AFL_PAS

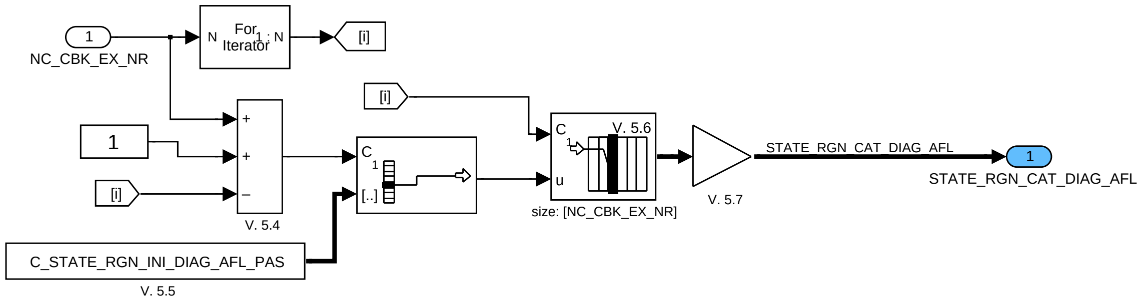

Figure B.53.9: :

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B.53.1.2.3 Multiple bank system

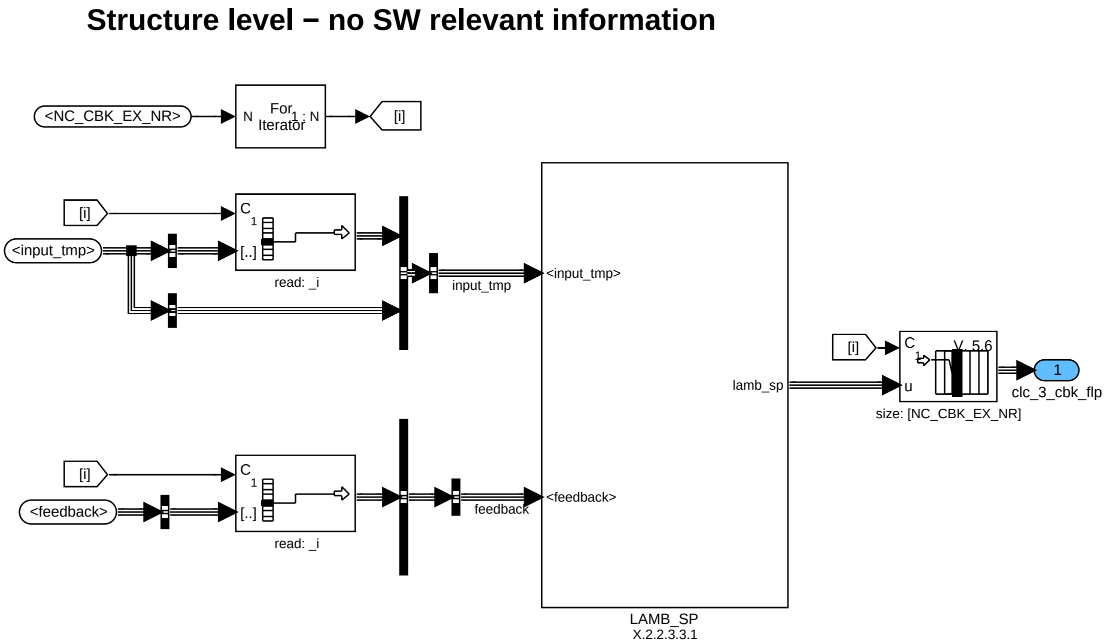

Figure B.53.10: :

B.53.1.2.3.1 Bank specific calculations - Lambda set point

The lambda set point for the precondition phase is active directly after Nox Trap regeneration. During this regeneration "WAIT" is active. After precondition the lambda set point for the diagnosed bank is calculated ("DIAG"), for the parked bank ("PARK") the calculations are done inside CLC_LAMB_PARK. When the request for the diagnosis isn’t active, PASSIVE is called

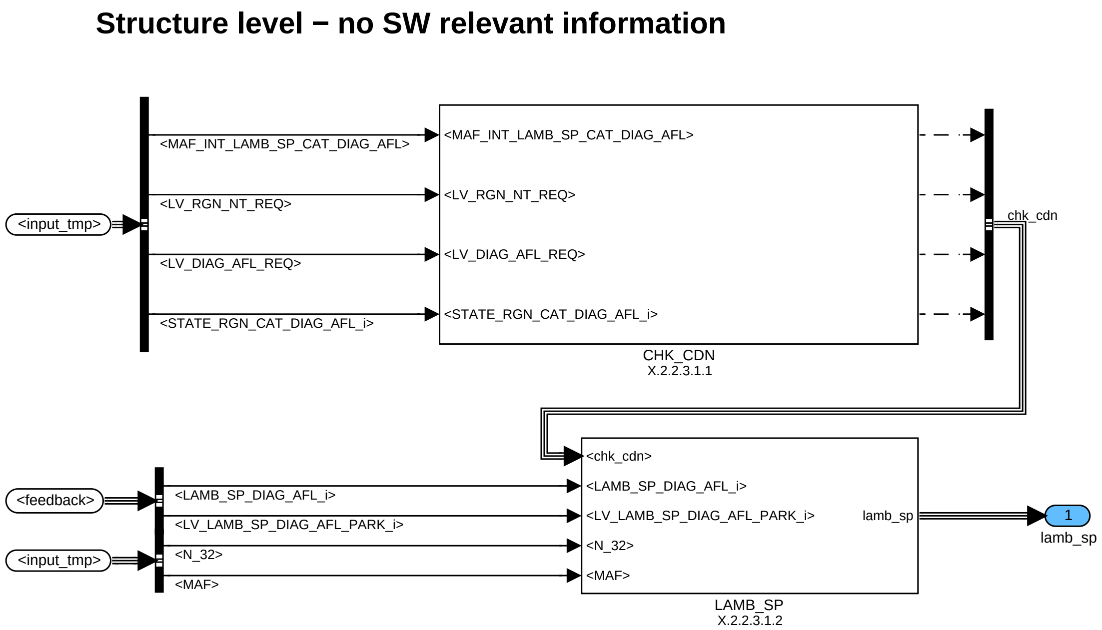

Figure B.53.11: :

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B.53.1.2.3.1.1 Check of the regeneration and diagnosis requests

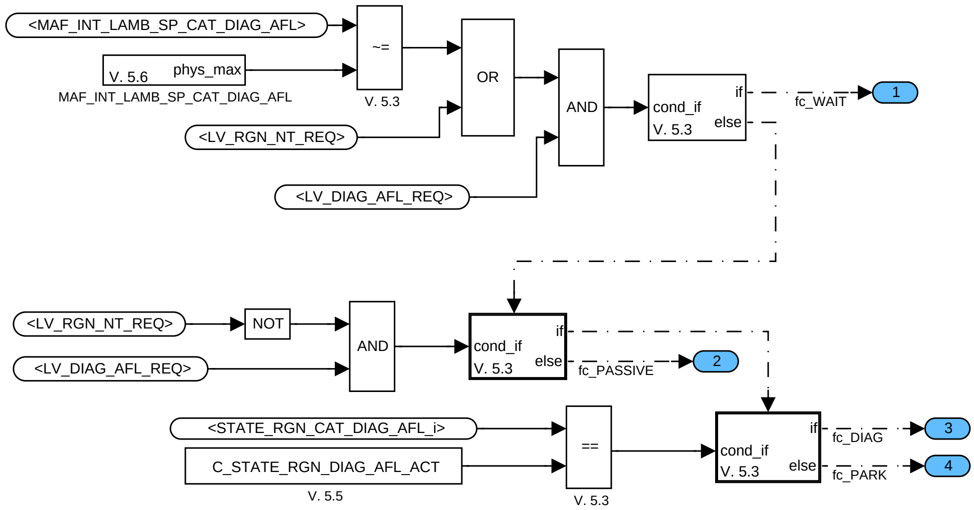

Figure B.53.12: :

B.53.1.2.3.1.2 Calculation of the lambda set point

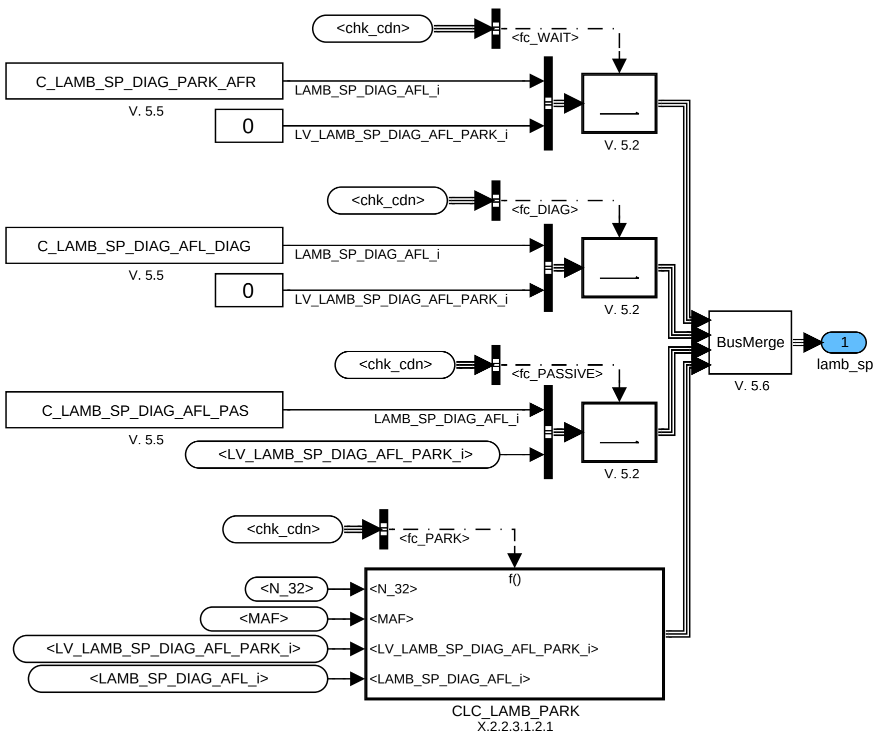

Figure B.53.13: :

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B.53.1.2.3.1.2.1 Calculation of the lambda set point for the park state (CLC_LAMB_PARK)

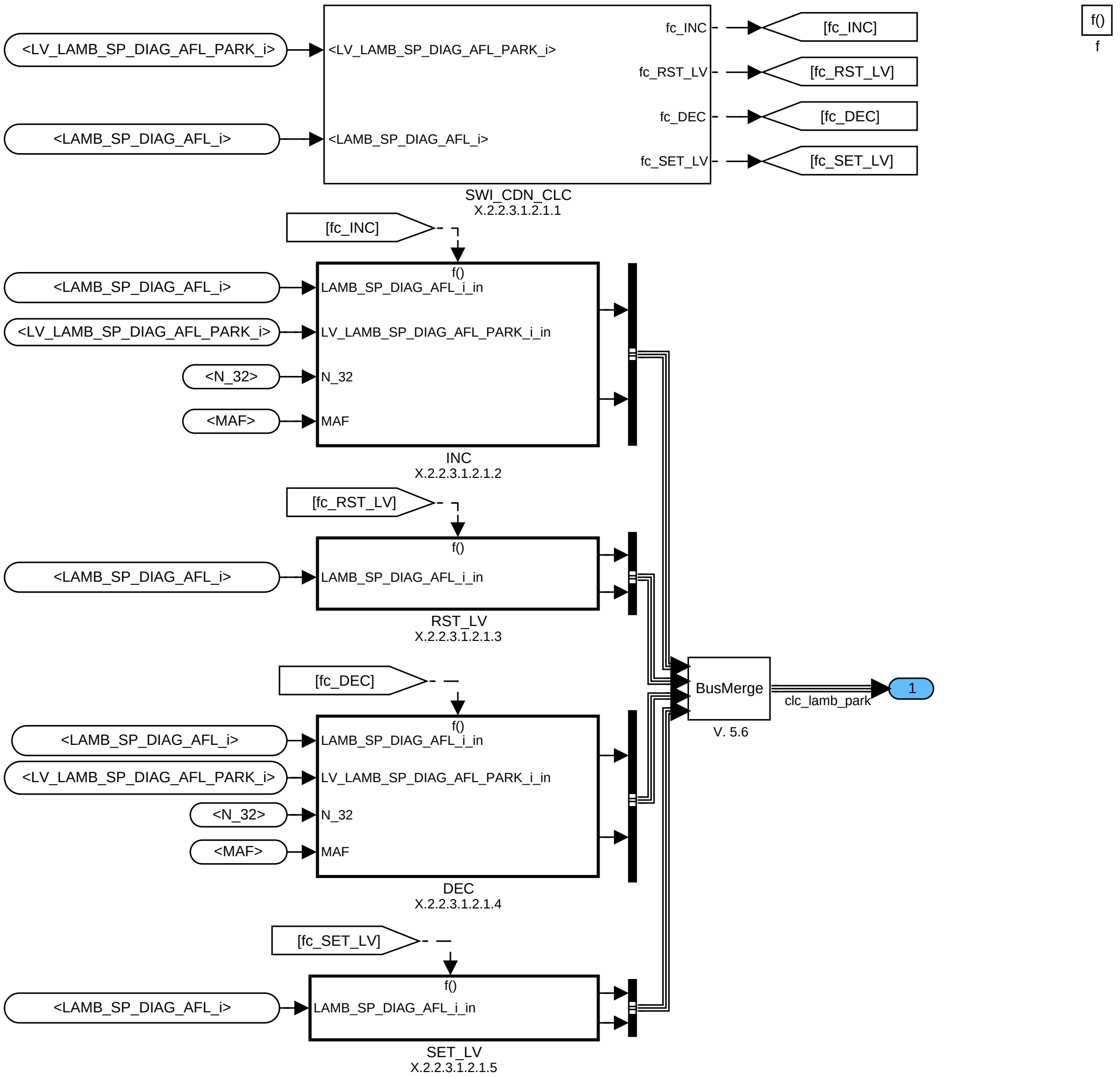

Figure B.53.14: :

B.53.1.2.3.1.2.1.1 DEC: Decrementing of the lambda set point value

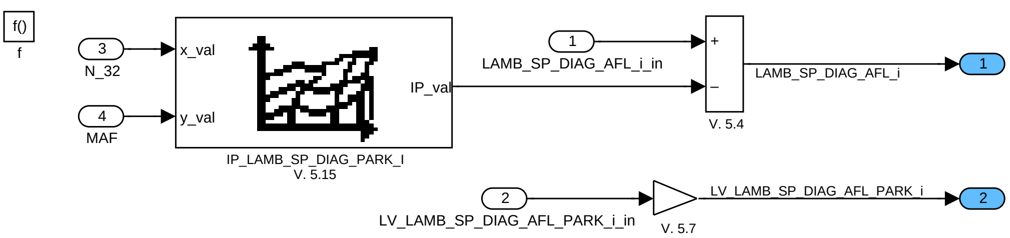

Figure B.53.15: :

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B.53.1.2.3.1.2.1.2 INC: Incrementing of the lambda set point value

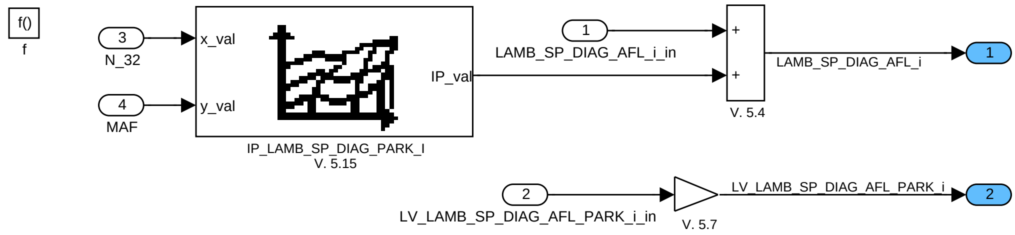

Figure B.53.16: :

B.53.1.2.3.1.2.1.3 RST_LV: Reset of the indicator flag for the lambda set point at maximum

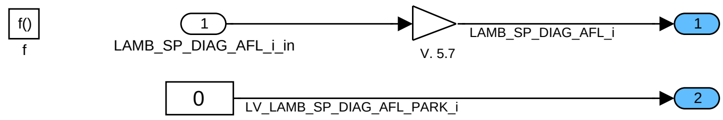

Figure B.53.17: :

B.53.1.2.3.1.2.1.4 SET_LV: Set of the indicator flag for the lambda set point at minimum

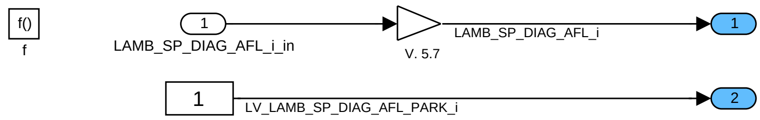

Figure B.53.18: :

B.53.1.2.3.1.2.1.5 Checking of the actual lambda value

When the lambda is bigger as the minimum then the incrementing is called, when the lambda value is smaller as the maximum then the decrementing is called

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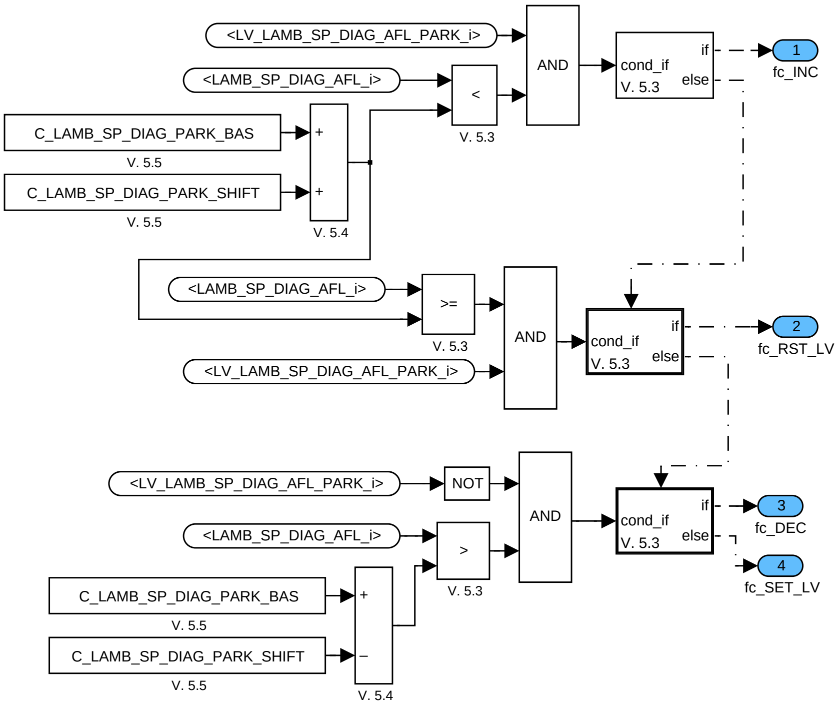

Figure B.53.19: :

B.53.1.2.4 Calculation of the old variables

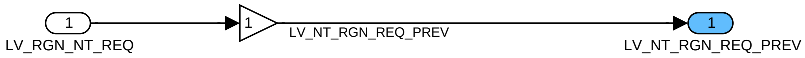

Figure B.53.20: :

B.53.1.2.5 EGTR_DEFSPTDLLD0/OPM/LAMB_SP_CLC/CLC_MAF_NT_AGI

CONTENT

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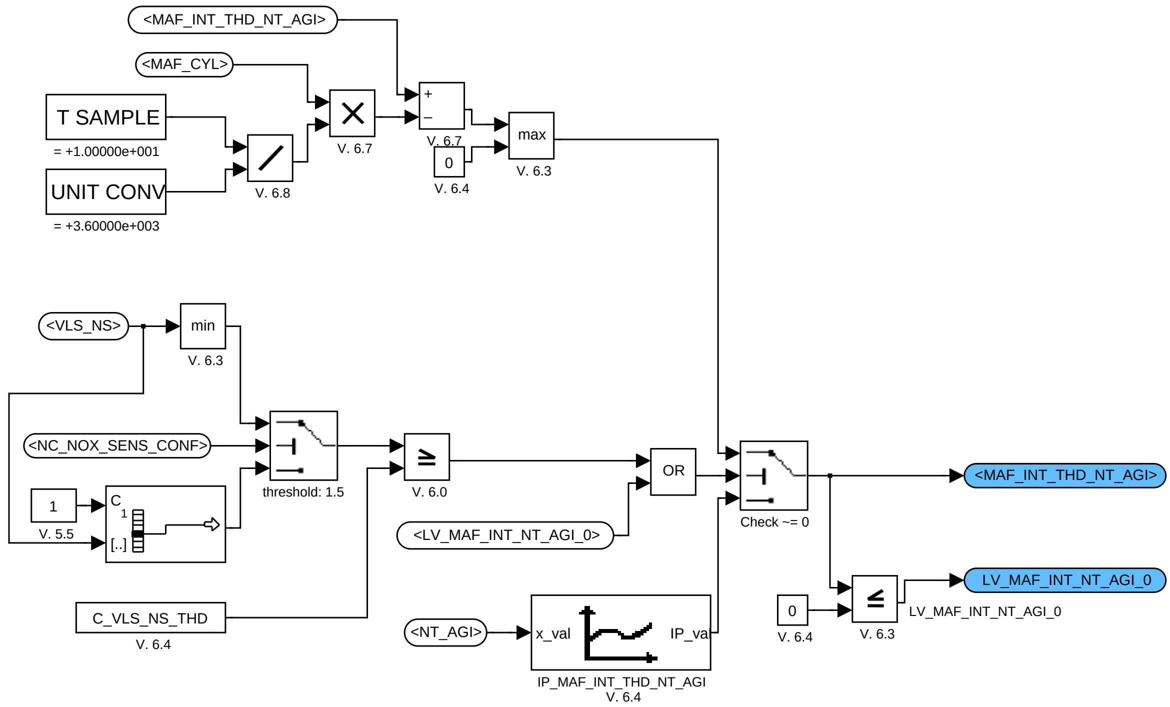

Figure B.53.21: :

B.53.1.3 PASSIVE STATE (LAMB_SP_NOT_CLC)

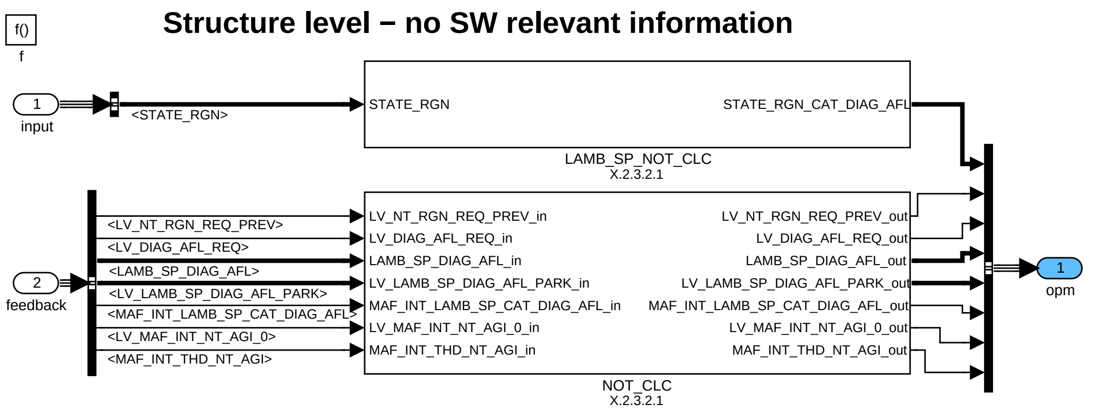

Figure B.53.22: :

B.53.1.3.1 Calculation of the regeneration state for the diagnosis

In case the extended lambda setpoint is not required for the diagnosis the regeneration state is also not calculated, but only copied from STATE_RGN

Figure B.53.23: :

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B.53.1.3.2 No title given

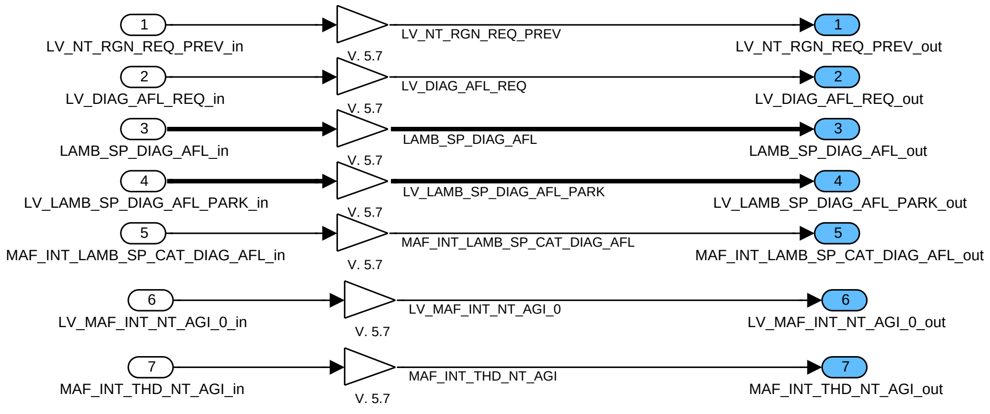

Figure B.53.24: :

B.53.2 INITIALIZATION AT RESET

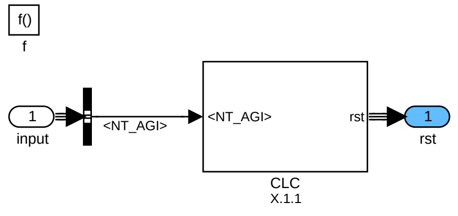

Figure B.53.25: :

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B.53.2.1 No title given

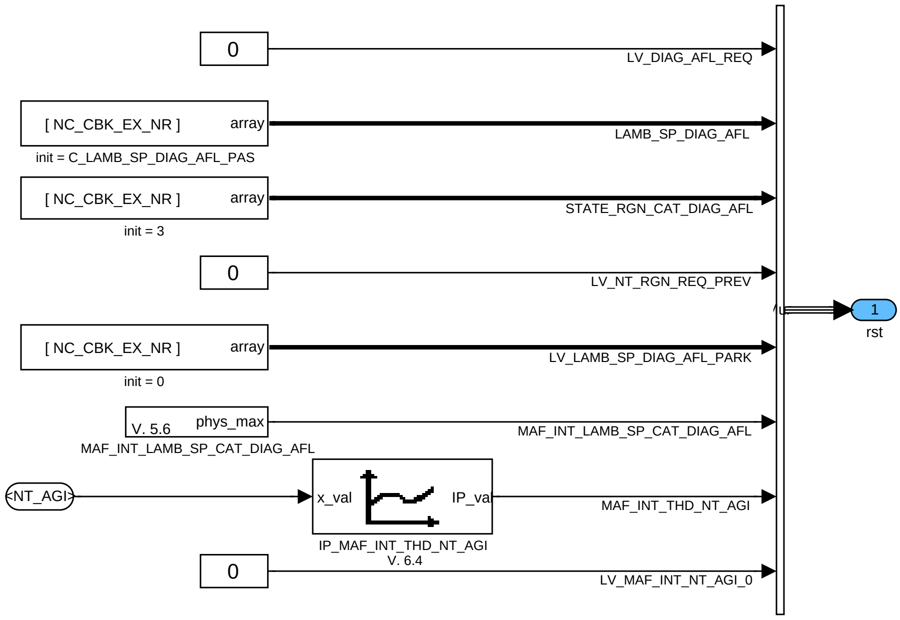

Figure B.53.26: :

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B.54 TWC diagnosis at lean operation - Oxygen storage capacity calculation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_O2L_CLC_LOAD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for calculation of O2L during load phase					
LV_O2L_CLC_PARK [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for calculation of O2L during park phase					
LV_O2L_CLC_RGN_H_AMPL [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for calculation of O2L during high regeneration phase					
LV_O2L_CLC_RGN_L_AMPL [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Flag for calculation of O2L during low regeneration phase					
O2L_INT_LOAD_PHA [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L integral in the load phase					
O2L_INT_PARK_PHA [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L integral in the park phase					
O2L_INT_RGN_H_AMPL_PHA [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L integral in the high amplitude regeneration phase					
O2L_INT_RGN_L_AMPL_PHA [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L integral in the low amplitude regeneration phase					
O2L_INT_THD_TMP_DIAG_AFL [NC_CBK_EX_NR]	V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Corrected threshold for quit of the O2L integral calculation					
O2L_LOAD_PHA [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L calculated during load phase					
O2L_PARK_PHA [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L calculated during park phase					
O2L_RGN_H_AMPL_PHA [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L calculated during high amplitude regeneration phase					
O2L_RGN_L_AMPL_PHA [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 2.61684895833	39.9306e-6	g
O2L calculated during low amplitude regeneration phase					
STATE_CAT_DIAG_AFL [NC_CBK_EX_NR]	O/V	0H 1H 2H 3H	PASSIVE RICH_CDN LEAN_CDN WAIT	-	-
OSC calculation state for TWC diagnosis at lean operation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_O2L_CLC_END [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
State for O2L calculation - calculation is finished					
STATE_O2L_CLC_VLD [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	-
Validation state for O2L integral calculation					
STATE_RGN_CAT_DIAG_AFL_OLD [NC_CBK_EX_NR]	-	0... 3H	0 ...3	1	-
Old value of state for calculation of lean TWC diagnosis due state of system regeneration					
T_AFL_CDN_OUT [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Timer for exit from state LEAN_CDN					

Input data:

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_HOM_AFL_ACT {p. 8136}	LV_NT_ACT {p. 2982}	LV_O2L_CLC_ACT_CDN [NC_CBK_EX_NR] {p. 5553}
LV_S_ACT {p. 8137}	LV_ST_END {p. 1720}	LV_T_AFL_MIN {p. 2983}	MAF_CYL {p. 8277}
MAF_FG_CYL {p. 1212}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}
NC_NT_NR {p. 644}	STATE_RGN_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5589}	T_AFL {p. 2987}	TEMP_CAT_DYN_MDL [NC_CBK_EX_NR] {p. 8237}
TEMP_CAT_STAT_MDL [NC_CBK_EX_NR] {p. 8237}	TNT_MDL_MV_SNG [NC_NT_NR] {p. 8237}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_NOX_SENS [NC_NOX_SENS_CONF] {p. 1382}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_O2L_INT_CLC	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Threshold of linear upstream lambda signal for calculation of O2L integral					
C_O2L_INT_THD_TMP_DIAG_AFL	-	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Threshold to quit of the O2L integral calculation					
C_STATE_EX_CONF	-	1... 4H	1 ...4	1	-
Exhaust gas system configuration					
C_STATE_O2L_CLC_ENA	-	0... FFH	0... 255	1	-
State to allow of calculation of O2L integrals					
C_STATE_RGN_CAT_DIAG_AFL	-	0... 8H	0 ...8	1	-
Regenerations state for calculation PARK and LOAD at STATE_EX_CONF_2					
C_STATE_RGN_CAT_DIAG_AFR	-	0... 8H	0 ...8	1	-
Additional regenerations state for calculation H_AMPL phase					
C_STATE_SENS_DOWN_MISS_CBK	-	1... 4H	1 ...4	1	-
Indicator for bank without downstream lambda sensor					
C_T_AFL_CDN_OUT	-	0... FFFFH	0... 655.35	0.01	s
Maximal time to exit from LEAN_CDN state					
C_VLS_NOX_O2L_INT_CLC	-	0... 578H	-200 ...1200	1	mV
Threshold of binary NOx-Sensor lambda signal for calculation of O2L integral					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_O2L_INT_CLC	-	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Threshold of binary downstream lambda signal for calculation of O2L integral					
IP_FAC_LAMB_DIAG_AFL	-	0... FFH	0... 3.984375	0.015625	-
LDP_LAMB_LS_UP_IP_FAC_DIAG_AFL	8	0... 7FFFH	0... 31.9990234375	976.563e-6	-
O2L correction factor depending on lambda					
IP_FAC_OPP_DIAG_AFL	V	0... FFH	0... 3.984375	0.015625	-
LDP_N_32_IP_FAC_DIAG_AFL	8	0... FFH	0... 8160	32	rpm
LDP_MAF_CYL_IP_FAC_DIAG_AFL	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
O2L correction factor depending on operating point					
IP_FAC_OPP_DIAG_AFL_SUM	V	0... FFH	0... 3.984375	0.015625	-
LDP_N_32_IP_FAC_DIAG_AFL	8	0... FFH	0... 8160	32	rpm
LDP_MAF_CYL_IP_FAC_DIAG_AFL	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correction factor of the O2L calculated in PARK phase depending on operating point conditions					
IP_FAC_T_AFL_DIAG_AFL	-	0... FFH	0... 15.9375	0.0625	-
LDP_T_AFL_IP_FAC_DIAG_AFL	8	0... FFFFH	0... 1310.7	0.02	s
Correction factor for calculation of O2L value depending on vehicle speed					
IP_FAC_TEMP_DIAG_AFL	V	0... FFH	0... 3.984375	0.015625	-
LDP_TEMP_STAT_IP_FAC_DIAG_AFL	8	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
LDP_TEMP_DIF_IP_FAC_DIAG_AFL	8	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
O2L correction factor depending on TWC temperature					
IP_FAC_TEMP_DIAG_AFL_SUM	V	0... FFH	0... 3.984375	0.015625	-
LDP_TEMP_STAT_IP_FAC_DIAG_AFL	8	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
LDP_TNT_MDL_IP_FAC_DIAG_AFL	8	0... FFFFH	0... 1023.984375	0.015625	°C
O2L correction factor depending on TWC and NT temperatures					

Action definition

ACTION_EGTR_ClcValidCheck (**IN**<LV_O2L_CLC_OK_i_tmp>,**IN**<i>,**IN**<O2L_old_i>,**IN**<LV_PHA_i>,**OUT**<O2L_i>, **OUT**<STATE_O2L_CLC_VLD_Bx_i>,**INOUT**<O2L_INT_i>)	Mode: O
Local Action: Check of plausibility of O2L integral calculation and calcualtion of O2L end value	

ACTION_EGTR_O2LIntegralCalc (**IN**<i>,**IN**<O2L_INT_old_i>,**OUT**<O2L_INT_i>)	Mode: O
Local Action: Calculation of O2L Integral	

Description for Actions

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ACTION_EGTR_ClcValidCheck(**IN** <LV_O2L_CLC_OK_i_tmp>, **IN** <i>, **IN** <O2L_old_i>, **IN** <LV_PHA_i>, **OUT** <O2L_i>, **OUT** <STATE_O2L_CLC_VLD_Bx_i>, **INOUT** <O2L_INT_i>)

Local Action: Check of plausibility of O2L integral calculation and calcualtion of O2L end value

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
LV_O2L_CLC_OK_i_tmp	IN	0... 1H	0... 1	1	[-]
Calculation of O2L integral regarding upstream and downstream lambda passed					
i	IN	1... 4H	1... 4	1	[-]
Bank specific index					
O2L_old_i	IN	0... FFFFH	0... 2.61684896	39.9306e-6	[g]
Oxygen loading old value					
LV_PHA_i	IN	0... 1H	0... 1	1	[-]
Indicator of the park phase					
O2L_i	OUT	0... FFFFH	0... 2.61684896	39.9306e-6	[g]
Calculated oxygen loading of TWC					
STATE_O2L_CLC_VLD_Bx_i	OUT	0... 1H	0... 1	1	[-]
Read bit of STATE_O2L_CLC_VLD					
O2L_INT_i	INOUT	0... FFFFH	0... 2.61684896	39.9306e-6	[g]
Integral of O2L					

ACTION_EGTR_O2LIntegralCalc(**IN** <i>, **IN** <O2L_INT_old_i>, **OUT** <O2L_INT_i>)

Local Action: Calculation of O2L Integral

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
i	IN	1... 4H	1... 4	1	[-]
Bank specific index					
O2L_INT_old_i	IN	0... FFFFH	0... 2.61684896	39.9306e-6	[g]
Integral of O2L - old value					
O2L_INT_i	OUT	0... FFFFH	0... 2.61684896	39.9306e-6	[g]
Integral of O2L					

General Information

For calculation of O2L the fresh gas per cylinder, linear lambda signal (TWC upstream), binary lambda signal (TWC downstream or NOx-Trap downstream) are used. The O2L removal is calculated when the linear lambda signal upstream shows the rich mixture (less then 1) and the binary lambda signal downstream shows the lean mixture (less then 500 [mV]). The O2L addition is calculated when the linear lambda signal upstream shows lean mixture (greater then 1) and the binary lambda signal downstream shows the rich mixture (greater then 500 [mV])

If two separate exhaust bank system are concerned, the diagnosis is relevant for two exhaust gas configurations switched with C_STATE_EX_CONF:

CONF_1: Exhaust gas configuration equipped with DeNOx technology, with two LIN-Sensors upstream TWC, two BIN-Sensors downstream TWC, two NOx Traps (NT) and one NOx-Sensor downstream NT (Picture 1, configuration 2a)

CONF_2: Exhaust gas configuration equipped with DeNOx technology, with two LIN-Sensors upstream TWC, one BIN-Sensor downstream TWC, one NOx Traps (NT) and one NOx-Sensor downstream NT (Picture 1, configuration 2b)

Picture 1: Exhaust gas configurations

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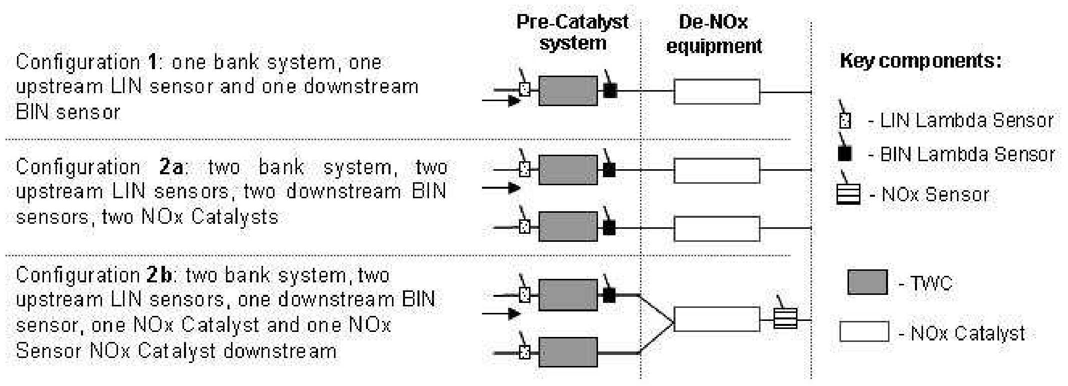
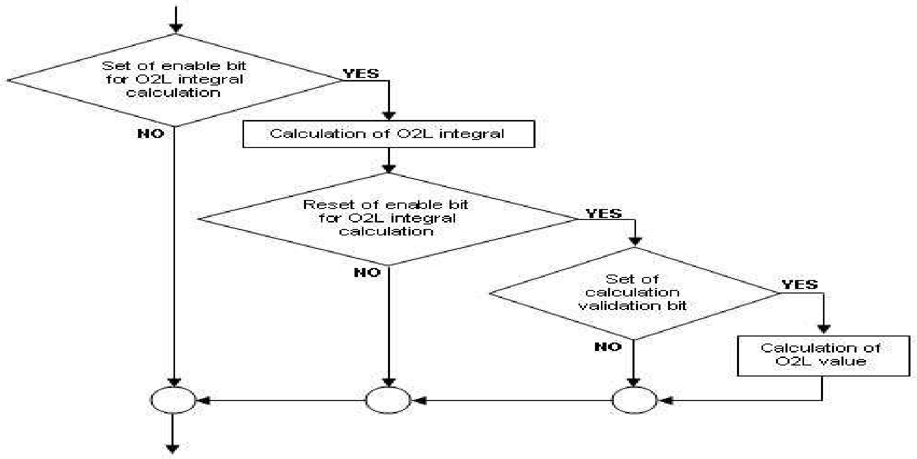


The O2L-values are calculated in four cases:
Case 1: Regeneration with high amplitude
Case 2: Regeneration with low amplitude
Case 3: Park phase (for CONF_1 calculated O2L concerns TWC, for CONF_2 calculated O2L concerns sum of TWC and NT)
Case 4: Load phase

For each case for the calculation of O2L is one validation bit in STATE_O2L_CLC_VLD[NC_CBK_EX_NR] defined:
Bit 0 (STATE_O2L_CLC_VLD_B0): Case 1
Bit 1 (STATE_O2L_CLC_VLD_B1): Case 2
Bit 2 (STATE_O2L_CLC_VLD_B2): Case 3
Bit 3 (STATE_O2L_CLC_VLD_B3): Case 4

Picture 2: Signal flow for calculation of O2L values:



If two separate exhaust bank systems are concerned, then:
i = 1, for cylinder bank 1
i = 2, for cylinder bank 2
Otherwise:
i = 1

NC_NOX_SENS_CONF is the number of NOx-Sensors. Therefore
NC_NOX_SENS_CONF = 0, for no NOx-Sensor
NC_NOX_SENS_CONF = 1 (n = 1), for one NOx-Sensor

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NC_NOX_SENS_CONF = 2 (n = i), for two NOx-Sensors

Application Conditions

Initialization: RST
Recurrence: 10MS
Activation: always
Deactivation: never

Function description

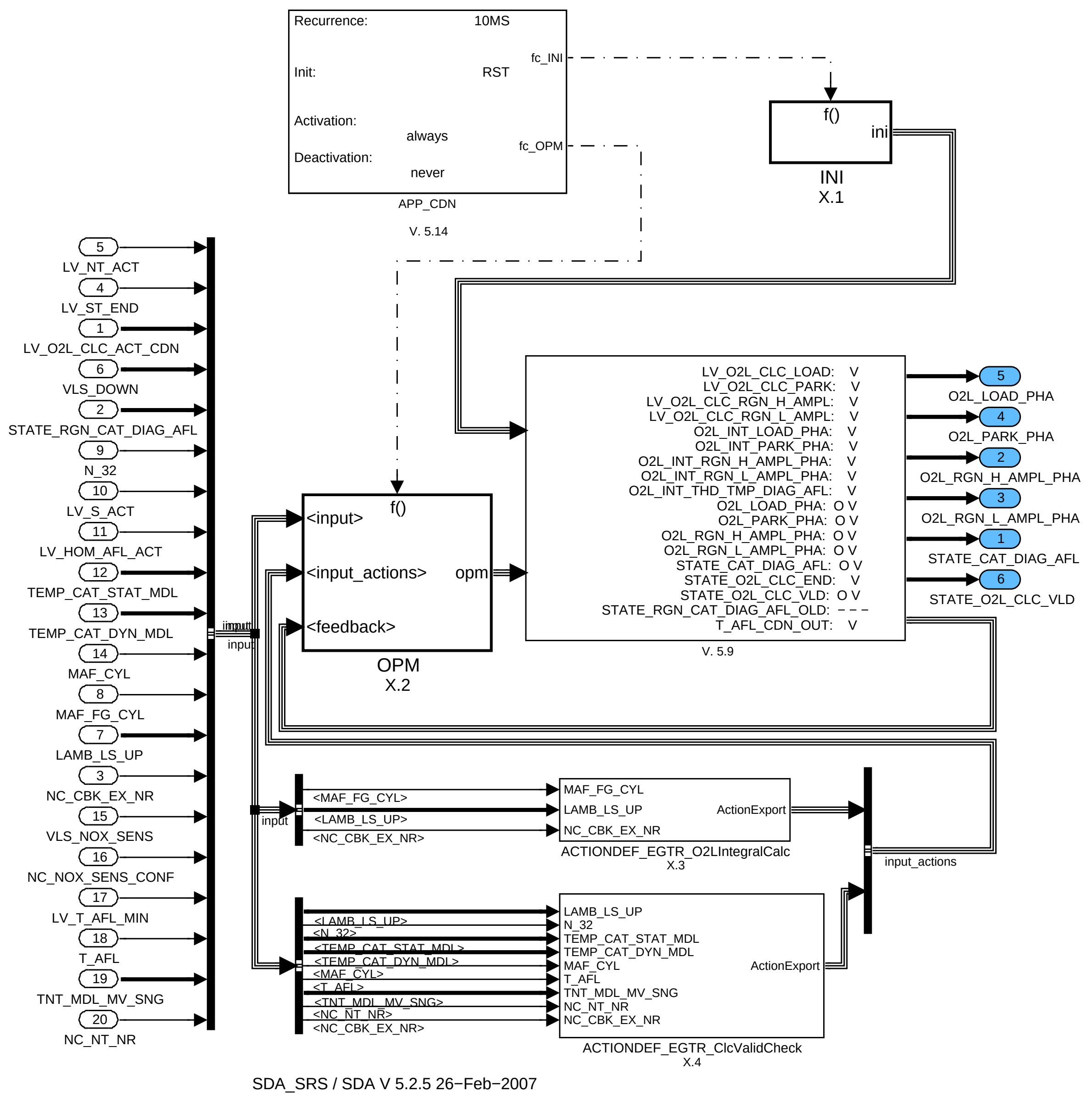

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Figure B.54.1: :

B.54.1 Initialization

O2L_INT_THD_TMP_DIAG_AFL=C_O2L_INT_THD_TMP_DIAG_AFL

All other variables are initialized with "0"

B.54.2 Formula section

All calculations are bank specific
Additional information:
"i" is an indicator for current bank within of for loop depending on NC_CBK_EX_NR.
"n" is an indicator for signals of NOx-Sensor. Therefore:
Case 1: If NC_CBK_EX_NR=1 then n=1 (in system the number of NOx-Sensors can not be greater then number of exhaust bank).
Case 2a: If NC_CBK_EX_NR=2 and NC_NOX_SENS_CONF=1 then n=1
Case 2b: If NC_CBK_EX_NR=2 and NC_NOX_SENS_CONF=2 then n=i

B.54.2.1 Check of the activation condition

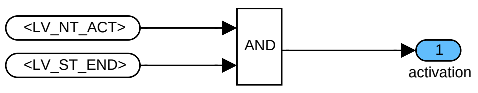

Figure B.54.2: :

B.54.2.2 Activation condition fulfilled

B.54.2.2.1 Overview of the function structure

At first, checking of transition condition and generation of function call for the active state of state machine "STATE_CAT_DIAG_AFL" are done. When the transition conditions are not fulfilled, the same state as in previous cycle is executed. In one calculation cycle only one state can be executed. The old value of STATE_RGN (for each bank separate) is also calculated after calculating of STATE_CAT_DIAG_AFL

B.54.2.2.1.1 STATE FLOW

Calculation of STATE_CAT_DIAG_AFL and generation of the function call for execution of one of it states

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B.54.2.2.1.1.1 STATE_CAT_DIAG_AFL

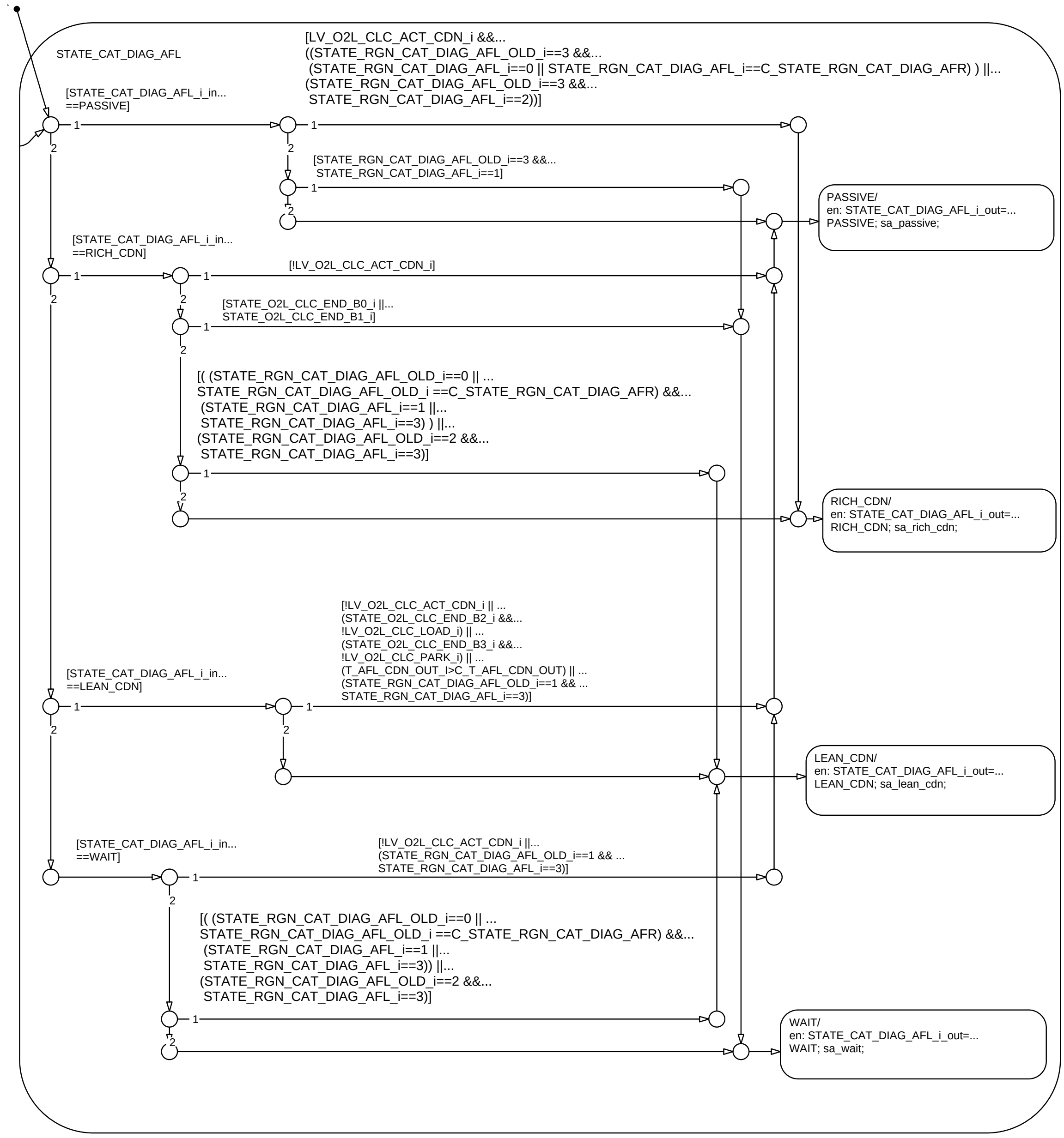

Figure B.54.3: :

B.54.2.2.1.2 EXECUTION OF THE STATES OF "STATE_CAT_DIAG_AFL"

STATE_CAT_DIAG_AFL = PASSIVE: Calculation of OSC is not active
STATE_CAT_DIAG_AFL = RICH_CDN: Calculation of OSC is done under rich operation conditions, O2L removal is calculated
STATE_CAT_DIAG_AFL = LEAN_CDN: Calculation of OSC is done under lean operation conditions, O2L addition is calculated
STATE_CAT_DIAG_AFL = WAIT: OSC calculation in RICH conditions is done, the system is waiting for change from rich to lean conditions

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B.54.2.2.1.2.1 STATE ACTION: STATE_CAT_DIAG_AFL="PASSIVE"

B.54.2.2.1.2.1.1 Calculations

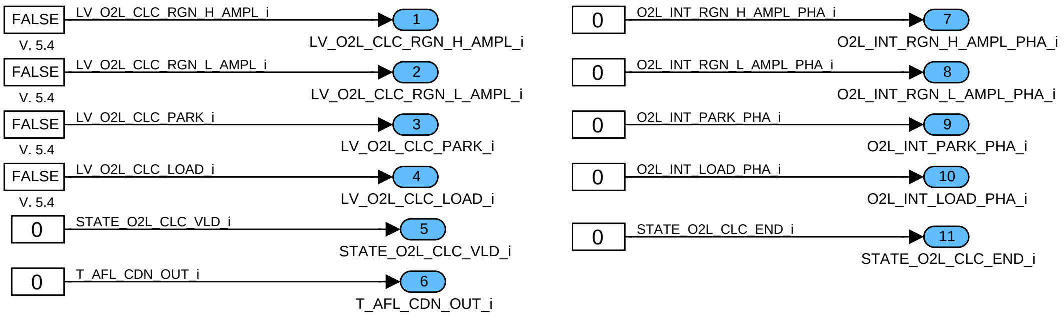

Figure B.54.4: :

B.54.2.2.1.2.2 STATE ACTION: STATE_CAT_DIAG_AFL="RICH_CDN"

In this states the O2L is calculated in one of two cases: either during high regeneration phase or during low regeneration phase.
For every of these phases are calculated separately:
a) Activation flag
b) O2L removal

For both phases:
a) Validation bits of O2L is calculated (BIT 0 for high amplitude phase and BIT 1 for low amplitude phase, BIT 2 and 3 are not calculated)
b) Counter for exit from LEAN-CDN is not changed
c) Outputs of not active state are calculated (LEAN_CDN)

B.54.2.2.1.2.2.1 OSC calculation in high amplitude regeneration - activation flag

Switching between exhaust gas configurations for calculation of the activation flag is done using C_ STATE_EX_CONF

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B.54.2.2.1.2.2.1.1 STATE_EX_CONF_1

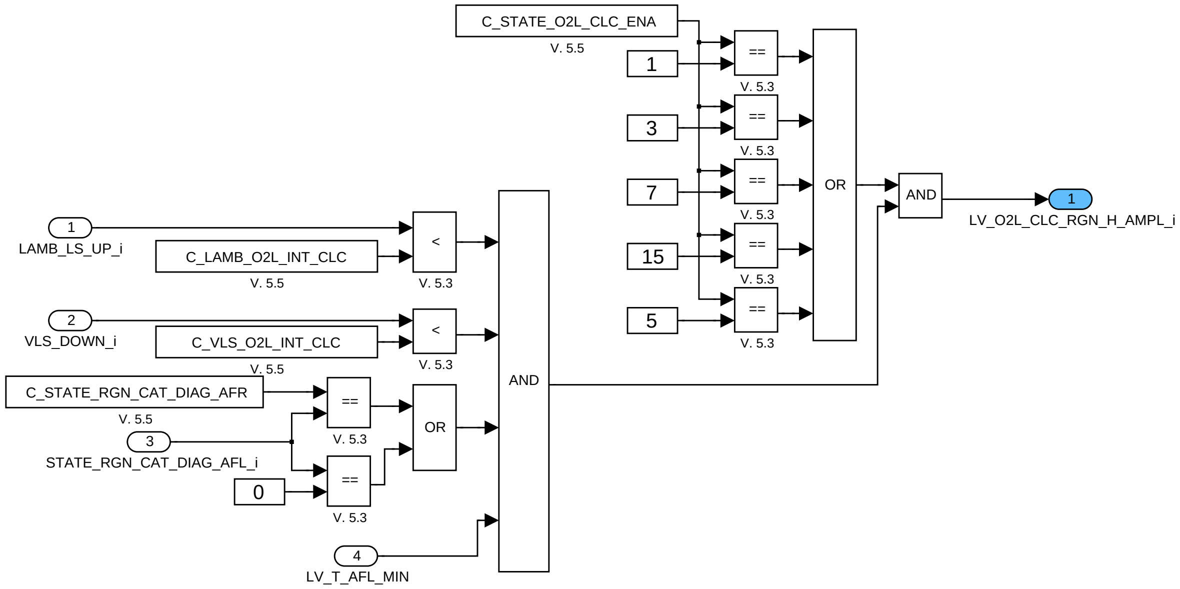

Figure B.54.5: :

B.54.2.2.1.2.2.1.2 STATE_EX_CONF_2

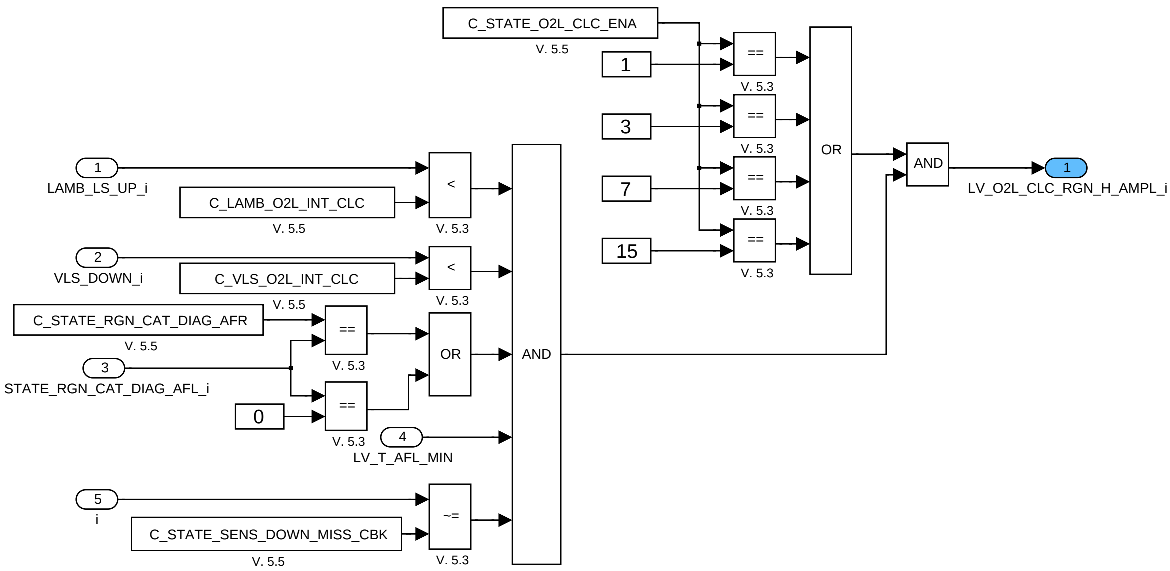

Figure B.54.6: :

B.54.2.2.1.2.2.2 OSC calculation - regeneration with high amplitude

The calculation of O2L is done in two steps:
Step 1: Calculation of O2L integral
Step 2: Calculation of O2L after calculating of O2L integral

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B.54.2.2.1.2.2.2.1 Calculation of O2L-integral at regeneration with high amplitude

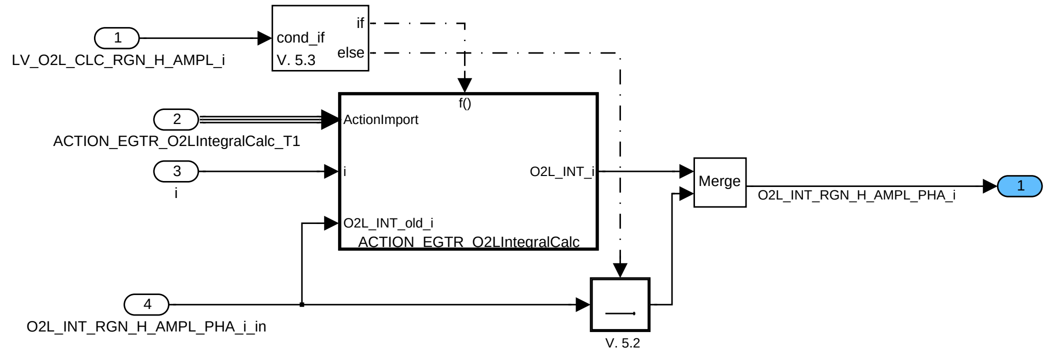

Figure B.54.7: :

B.54.2.2.1.2.2.2.2 Calculation of O2L at regeneration with high amplitude (after calculating of O2L integral)

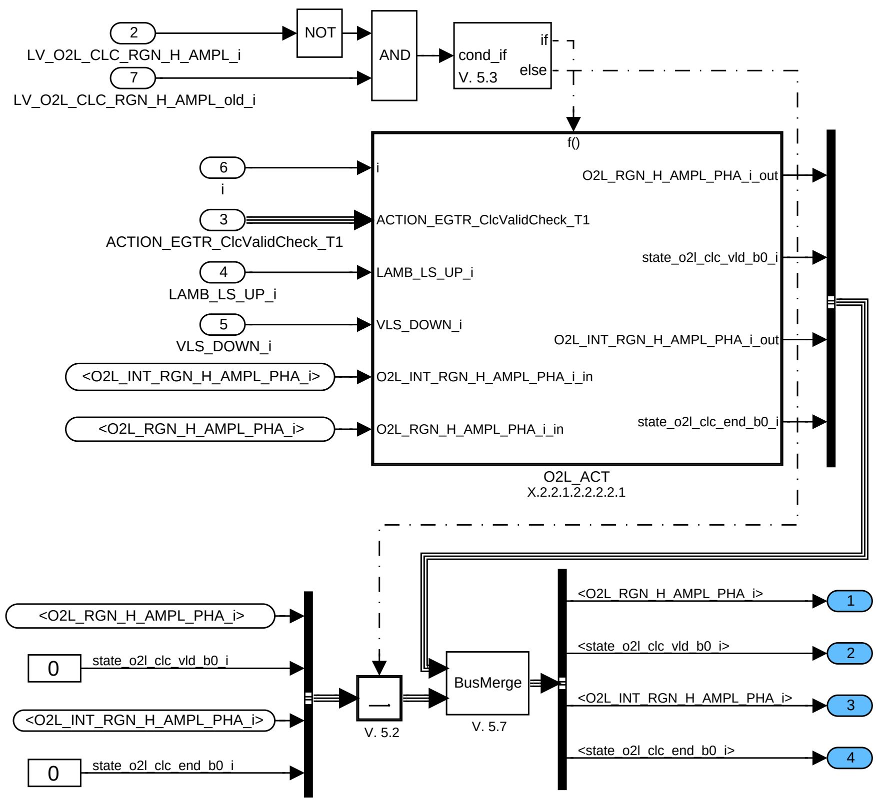

Figure B.54.8: :

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B.54.2.2.1.2.2.2.2.1 Falling edge of the activation flag of integral calculation active

B.54.2.2.1.2.2.2.2.1.1 Check of the up and down lambda signal

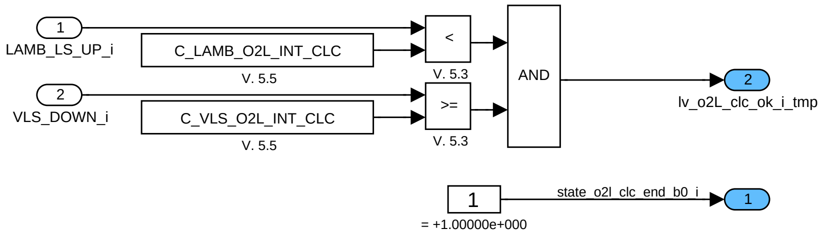

Figure B.54.9: :

B.54.2.2.1.2.2.2.2.1.2 Calculation of the O2L of the H_AMPL phase

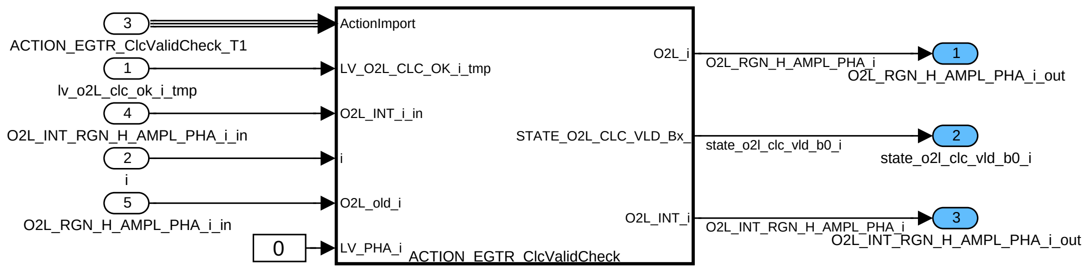

Figure B.54.10: :

B.54.2.2.1.2.2.3 OSC calculation in low amplitude regeneration - activation flag

Switching between exhaust gas configurations for calculation of the activation flag is done using C_ STATE_EX_CONF

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B.54.2.2.1.2.2.3.1 STATE_EX_CONF_1

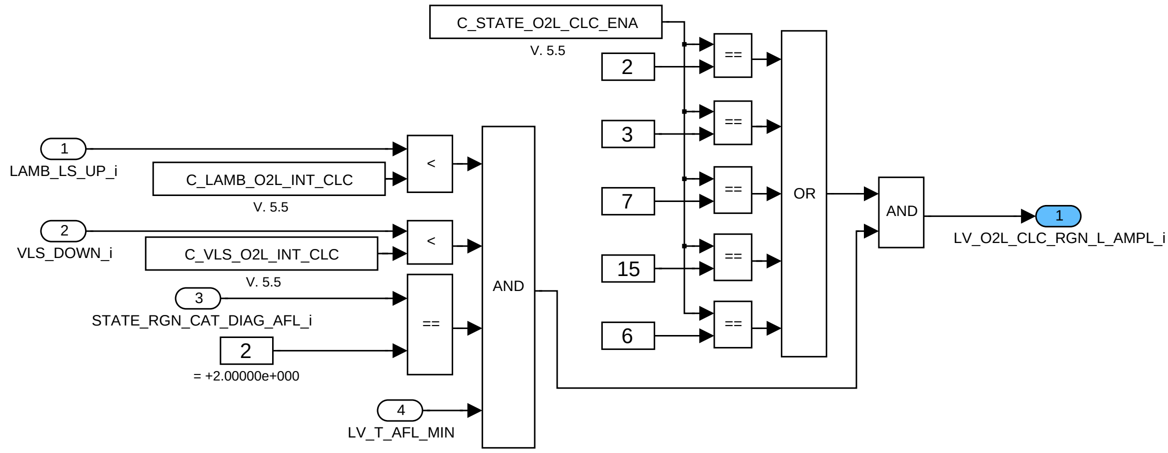

Figure B.54.11: :

B.54.2.2.1.2.2.3.2 STATE_EX_CONF_2

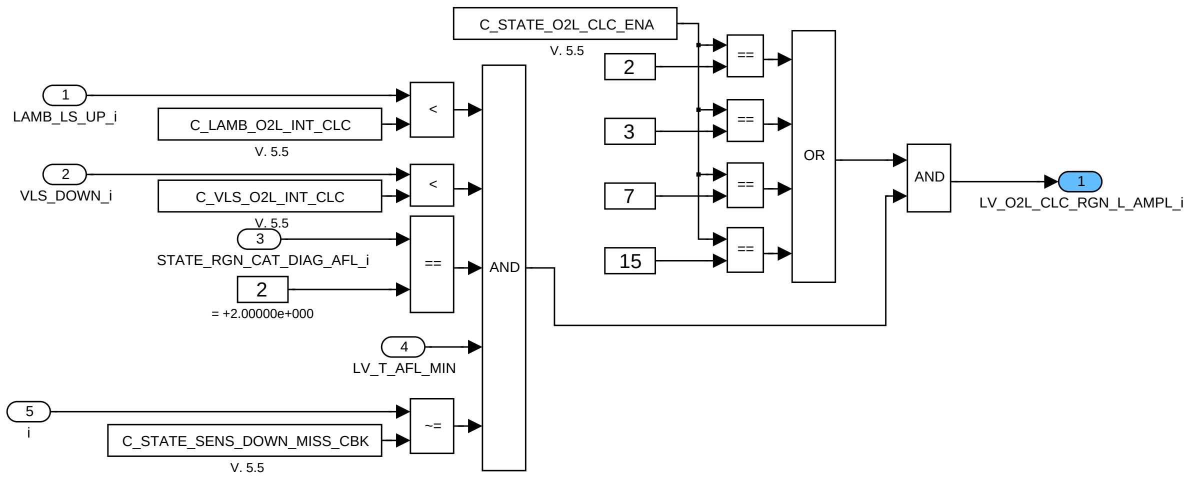

Figure B.54.12: :

B.54.2.2.1.2.2.4 OSC calculation - regeneration with low amplitude

The calculation of O2L is done in two steps:
Step 1: Calculation of O2L integral
Step 2: Calculation of O2L after calculation of O2L integral

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B.54.2.2.1.2.2.4.1 Calculation of O2L-integral at regeneration with low amplitude

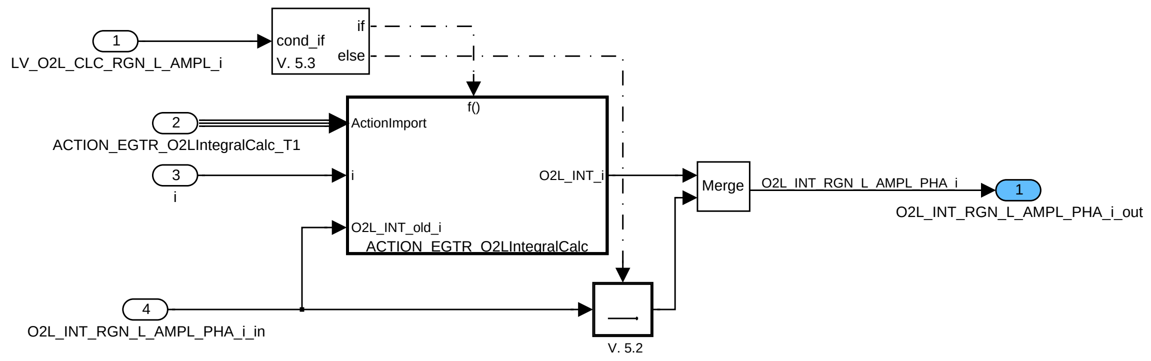

Figure B.54.13: :

B.54.2.2.1.2.2.4.2 Calculation of O2L at regeneration with low amplitude (after calculating of O2L integral)

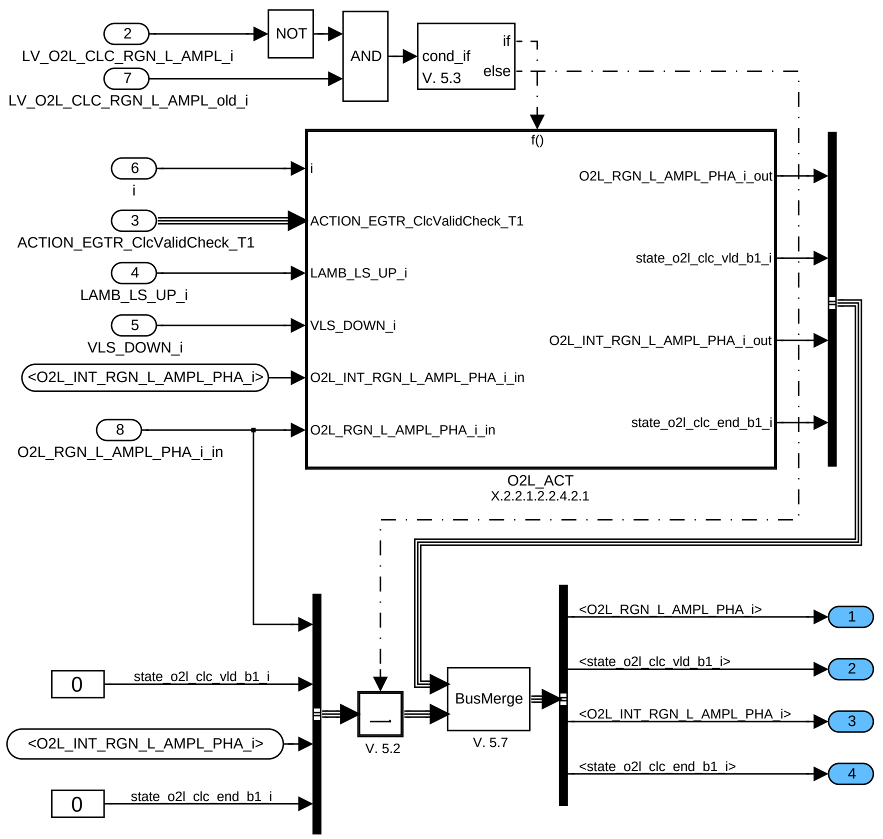

Figure B.54.14: :

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B.54.2.2.1.2.2.4.2.1 Falling edge of the activation flag of integral calculation active

B.54.2.2.1.2.2.4.2.1.1 Check of the up and down lambda signal

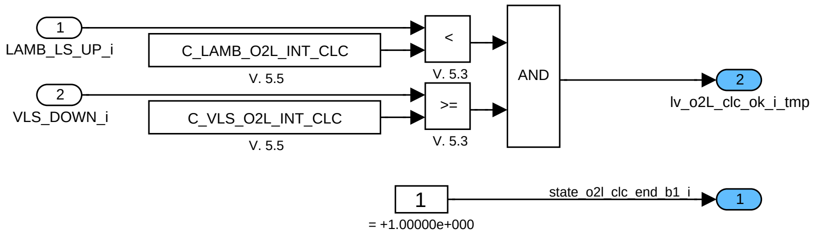

Figure B.54.15: :

B.54.2.2.1.2.2.4.2.1.2 Calculation of the O2L of the L_AMPL phase

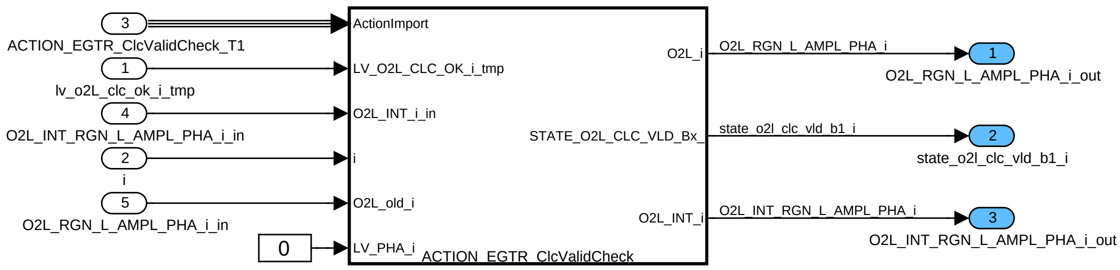

Figure B.54.16: :

B.54.2.2.1.2.2.5 Calculation of outputs of not active state

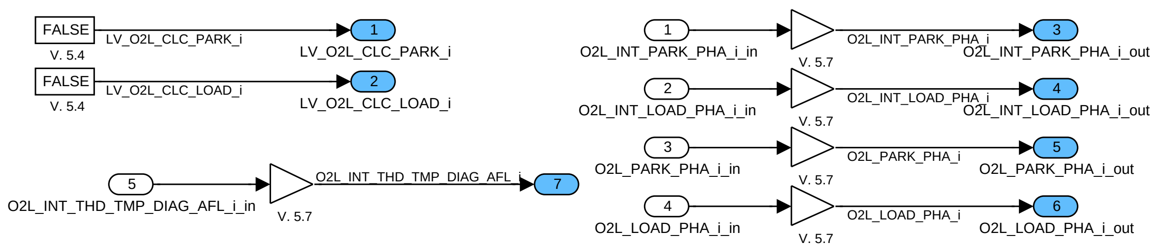

Figure B.54.17: :

B.54.2.2.1.2.3 STATE ACTION: STATE_CAT_DIAG_AFL="LEAN_CDN"

In this states the O2L is calculated in one of two cases: either during park phase or during load phase. For every of these phases are calculated separately:
a) Activation flag
b) O2L addition

For both phases:

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a) Validation bits of O2L (BIT 2 for park phase and BIT 3 for load phase, BIT 0 and BIT 1 are not calculated)
b) Counter for exit from LEAN-CDN phase
c) Outputs of not active state (RICH_CDN)

B.54.2.2.1.2.3.1 OSC calculation in park phase - activation flag

Switching between exhaust gas configurations for calculating of activation flag

B.54.2.2.1.2.3.1.1 STATE_EX_CONF_1

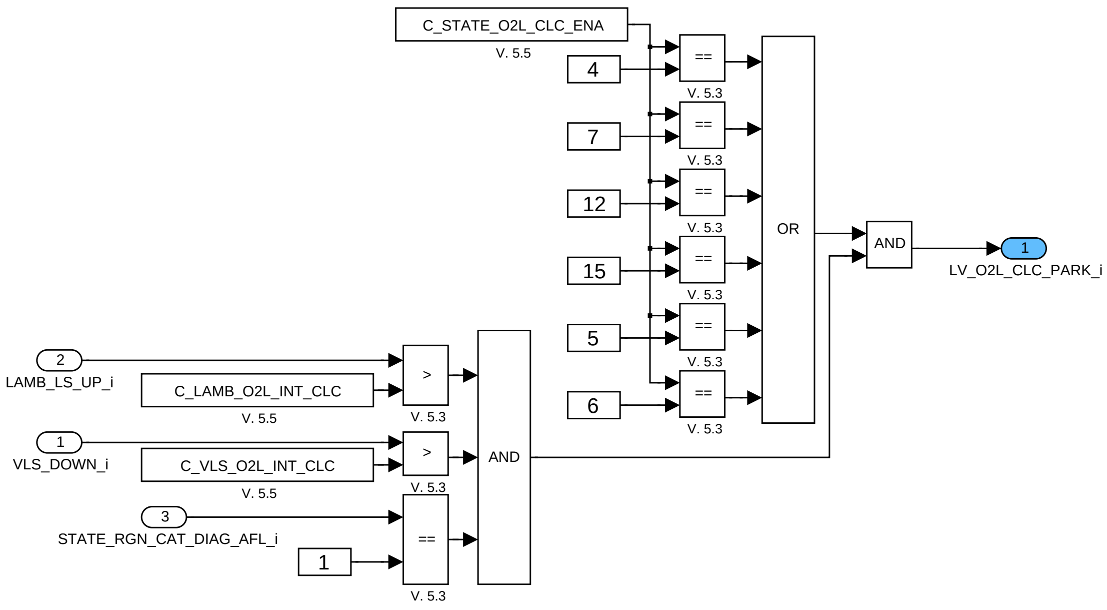

Figure B.54.18: :

B.54.2.2.1.2.3.1.2 STATE_EX_CONF_2

Apart from common conditions for calculation of the O2L integral in PARK phase, the bit 2 (saying that the calculation is finished), is checked. It shall forbid a recalculation of the O2L integral in PARK phase. Additional, to optimize the diagnosis duration, the calculation can be stopped when the O2L integral reaches defined threshold

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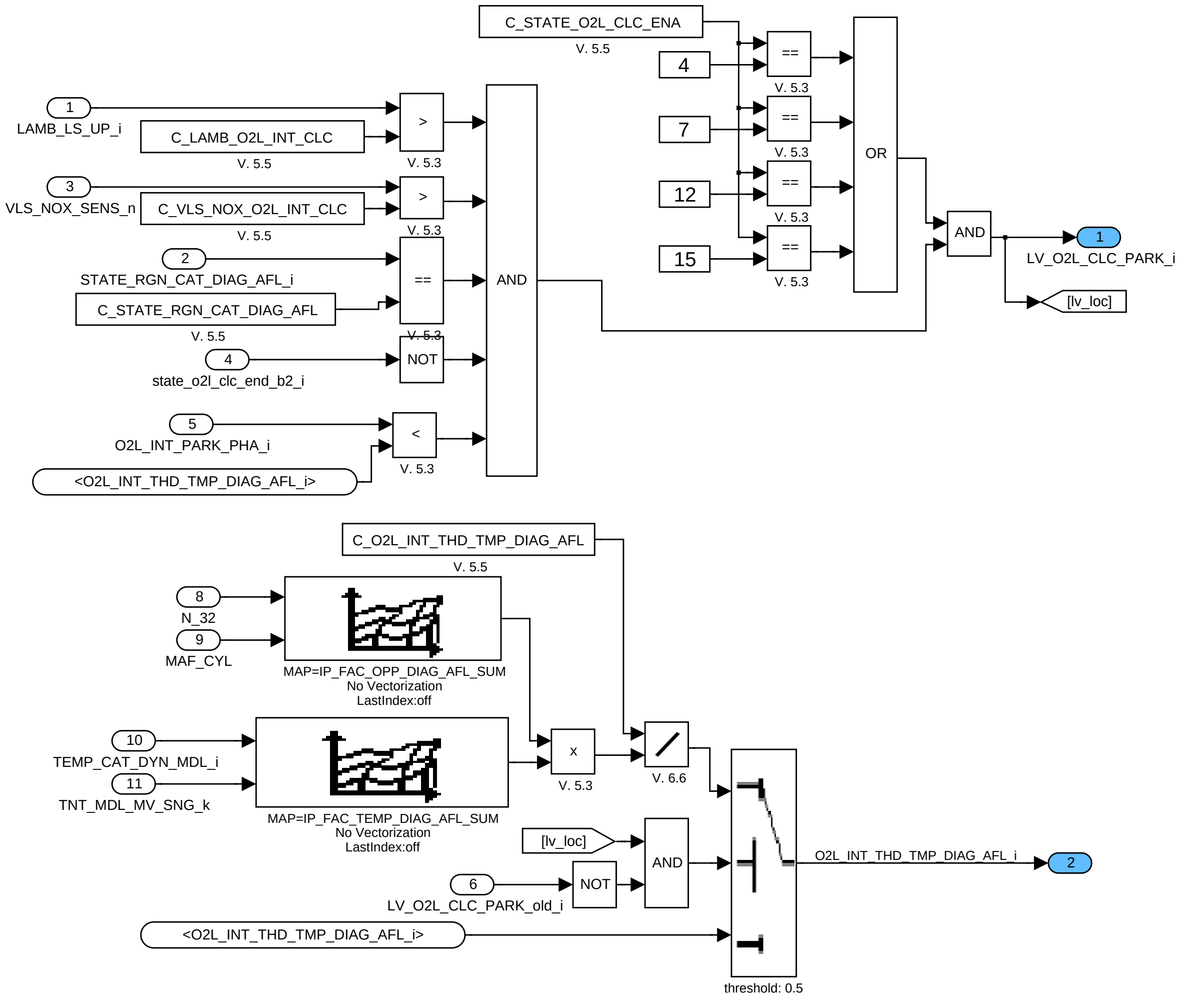

Figure B.54.19: :

B.54.2.2.1.2.3.2 OSC calculation - park phase

The calculation of O2L is done in two steps:
Step 1: Calculation of O2L integral
Step 2: Calculation of O2L after calculating of O2L integral

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B.54.2.2.1.2.3.2.1 Calculation of O2L-integral at park phase

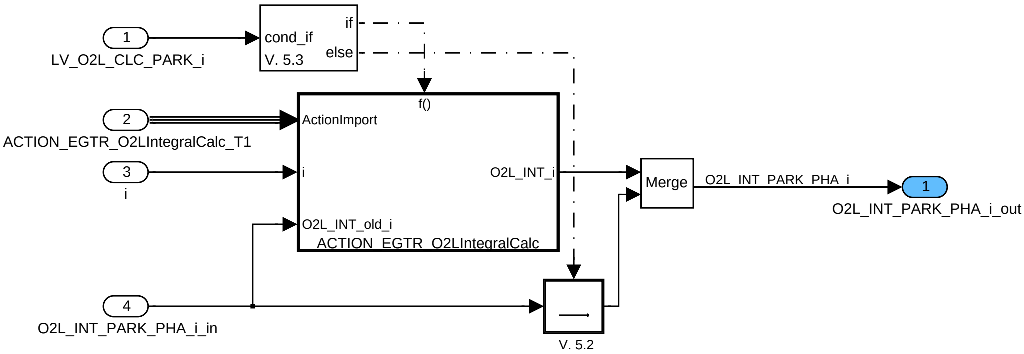

Figure B.54.20: :

B.54.2.2.1.2.3.2.2 Calculation of O2L at park phase (after calculating of O2L integral)

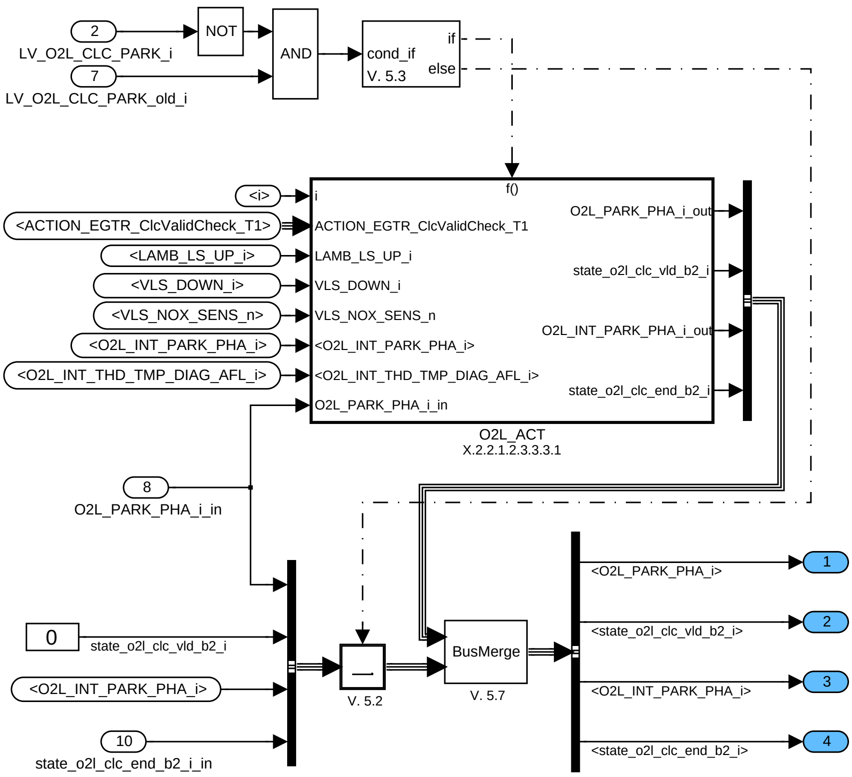

Figure B.54.21: :

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B.54.2.2.1.2.3.2.2.1 Falling edge of the activation flag of integral calculation active

B.54.2.2.1.2.3.2.2.1.1 Check of the up and down lambda signal

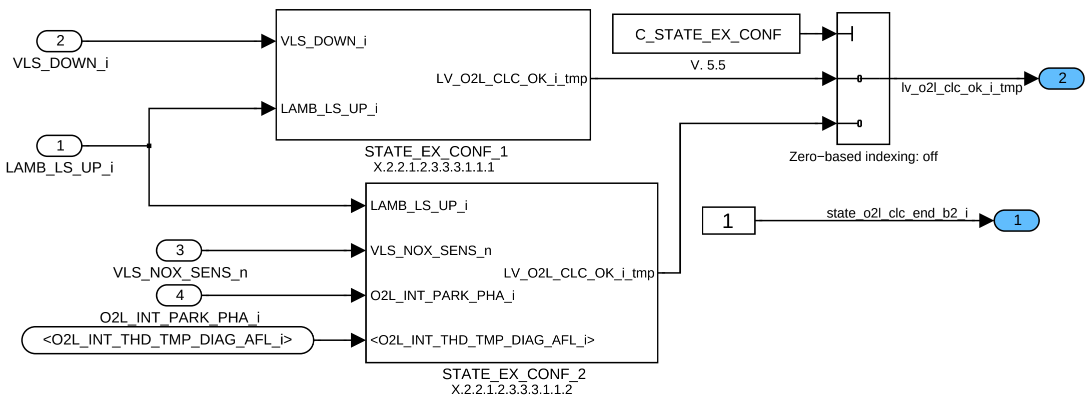

Figure B.54.22: :

B.54.2.2.1.2.3.2.2.1.2 STATE_EX_CONF_1

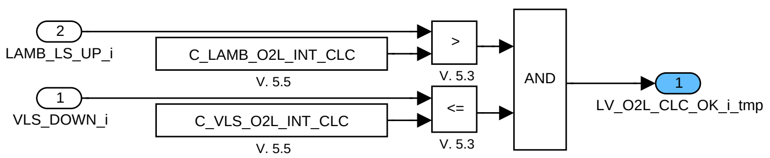

Figure B.54.23: :

B.54.2.2.1.2.3.2.2.1.3 STATE_EX_CONF_2

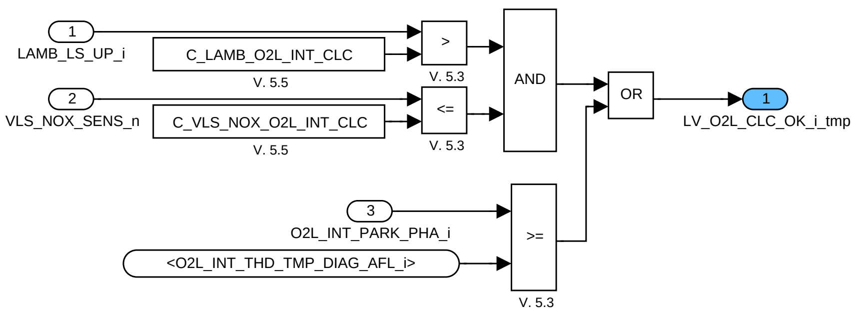

Figure B.54.24: :

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B.54.2.2.1.2.3.2.2.1.4 Calculation of the O2L of the PARK phase

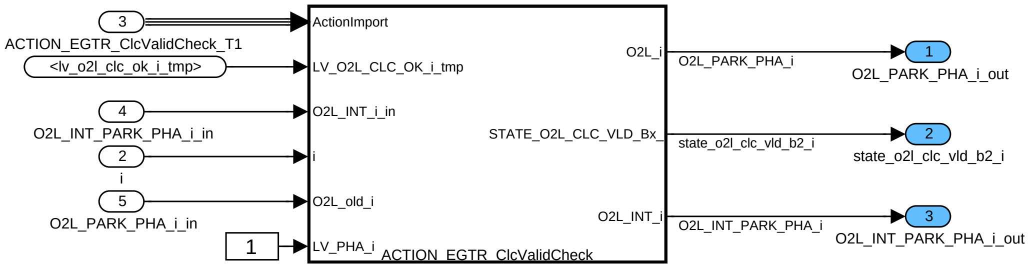

Figure B.54.25: :

B.54.2.2.1.2.3.3 OSC calculation in load phase - activation flag

Switching between exhaust gas configurations for calculation of the activation flag is done using C_ STATE_EX_CONF

B.54.2.2.1.2.3.3.1 STATE_EX_CONF_1

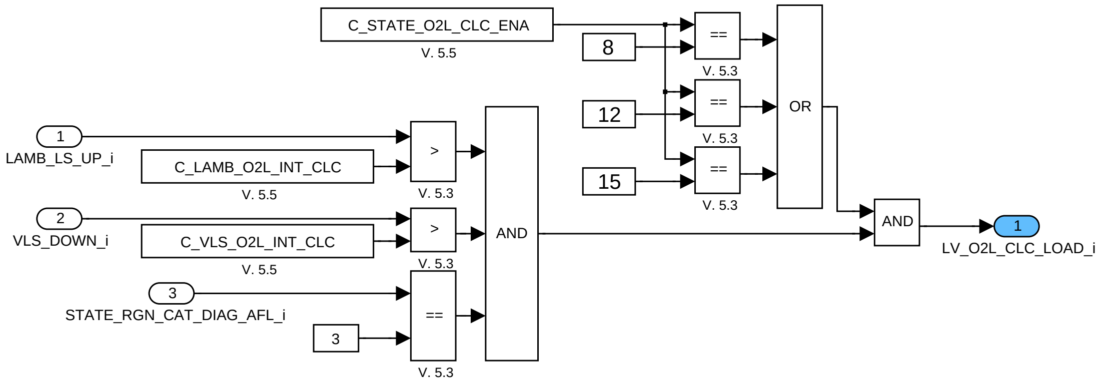

Figure B.54.26: :

B.54.2.2.1.2.3.3.2 STATE_EX_CONF_2

Apart from common conditions for calculation of the O2L integral in LOAD phase, the bit 3 (saying that the calculation is finished), is checked. It shall forbid a recalculation of the O2L integral in LOAD phase.

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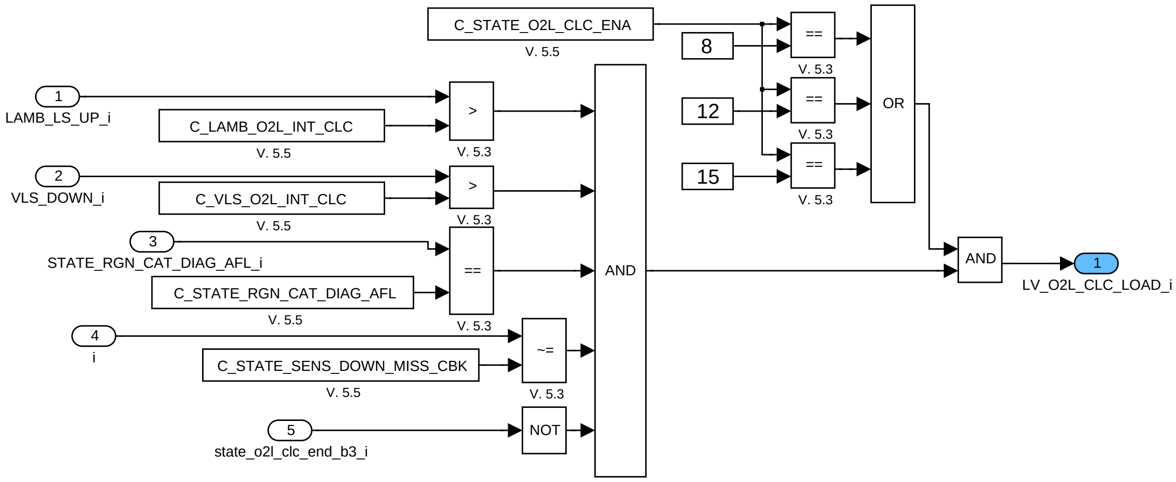

Figure B.54.27: :

B.54.2.2.1.2.3.4 OSC calculation - load phase

The calculation of O2L is done in two steps:
Step 1: Calculation of O2L integral
Step 2: Calculation of O2L after calculating of O2L integral

B.54.2.2.1.2.3.4.1 Calculation of O2L-integral at load phase

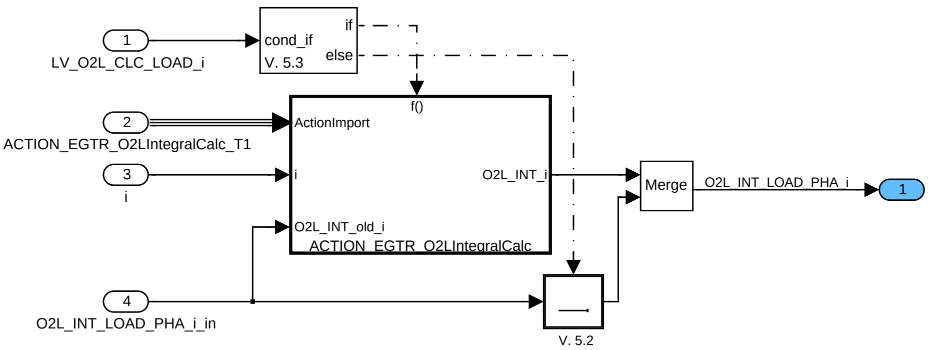

Figure B.54.28: :

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B.54.2.2.1.2.3.4.2 Calculation of O2L at load phase (after calculating of O2L integral)

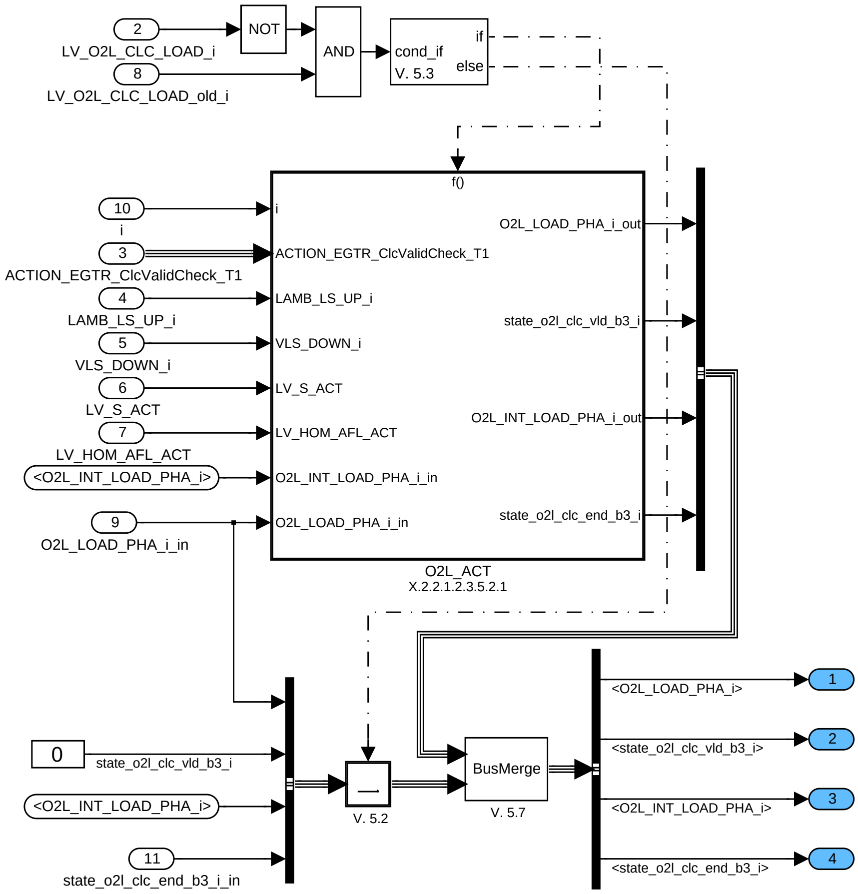

Figure B.54.29: :

B.54.2.2.1.2.3.4.2.1 Falling edge of the activation flag of integral calculation active

B.54.2.2.1.2.3.4.2.1.1 Check of the up and down lambda signal

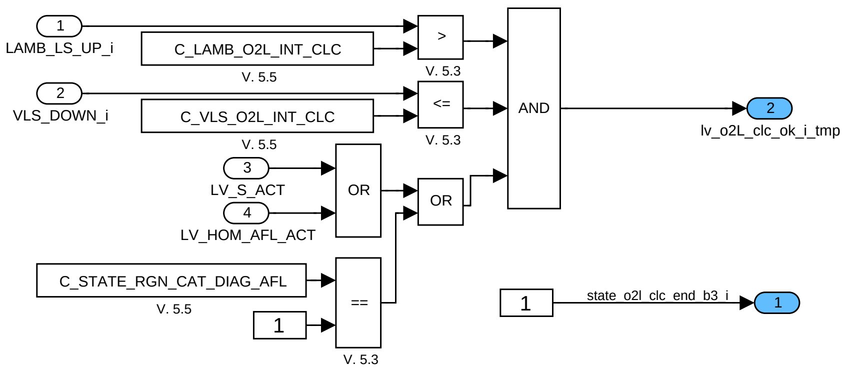

Figure B.54.30: :

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B.54.2.2.1.2.3.4.2.1.2 Calculation of the O2L of the LOAD phase

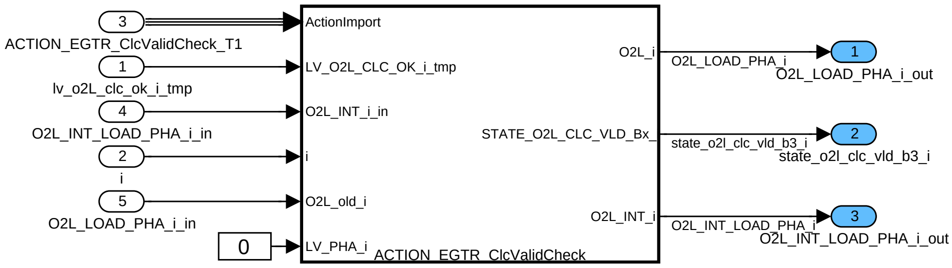

Figure B.54.31: :

B.54.2.2.1.2.3.5 Calculation of the timer to out from LEAN_CDN

The timer is calculated to make possible out from LEAN_CDN to PASSIVE if the calculation of OSC failed

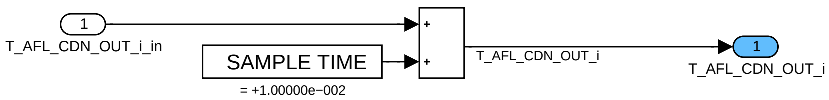

Figure B.54.32: :

B.54.2.2.1.2.3.6 Calculation of outputs of not active state

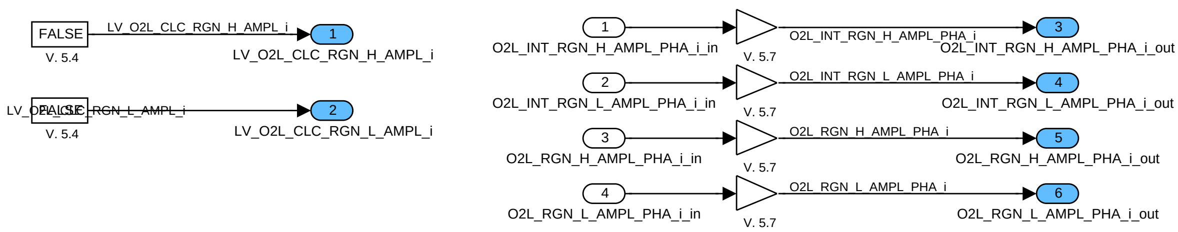

Figure B.54.33: :

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B.54.2.2.1.2.4 STATE ACTION: STATE_CAT_DIAG_AFL="WAIT"

B.54.2.2.1.2.4.1 Calculations

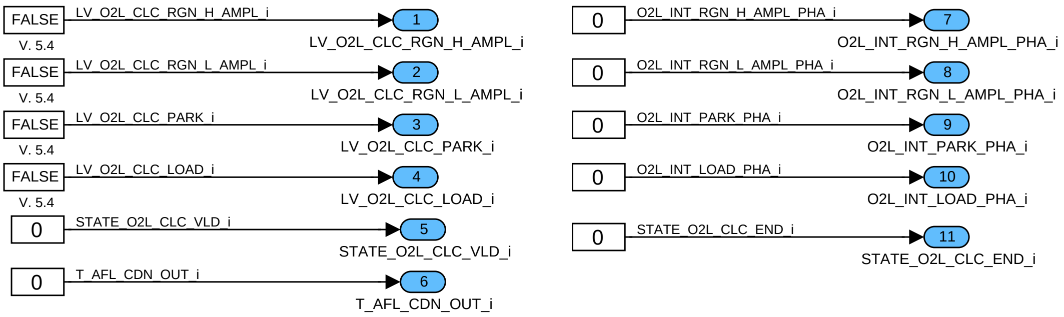

Figure B.54.34: :

B.54.2.3 Activation condition not fulfilled

O2L_INT_THD_TMP_DIAG_AFL=C_O2L_INT_THD_TMP_DIAG_AFL
All other variables are initialized with "0"

B.54.3 Detailed description for Action: ACTION_EGTR_ClcValidCheck

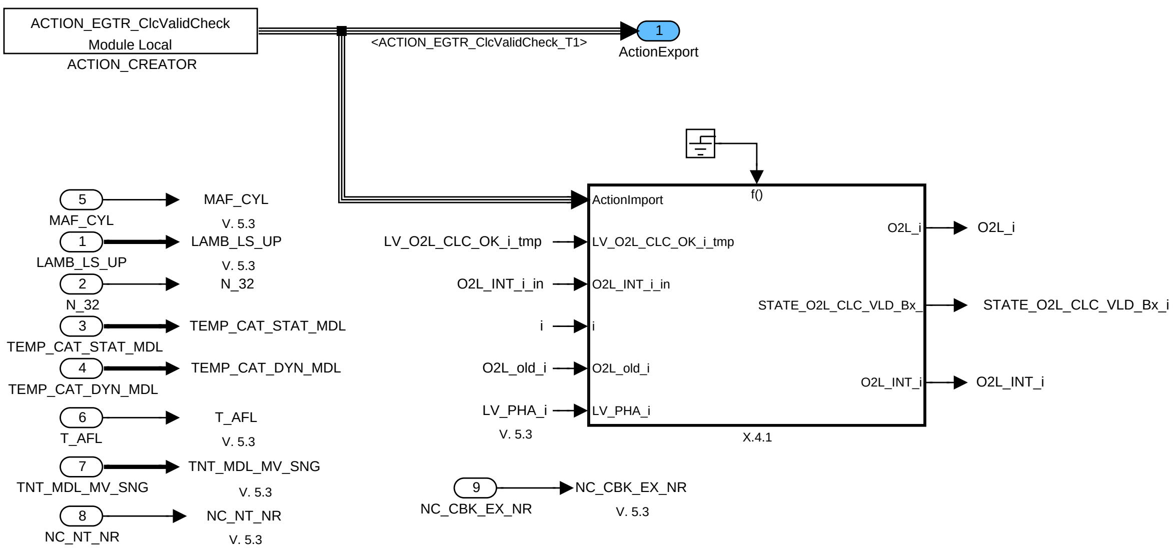

Figure B.54.35: :

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B.54.3.1 Calculation of the O2L integral finished - check of the up and down lambda signal

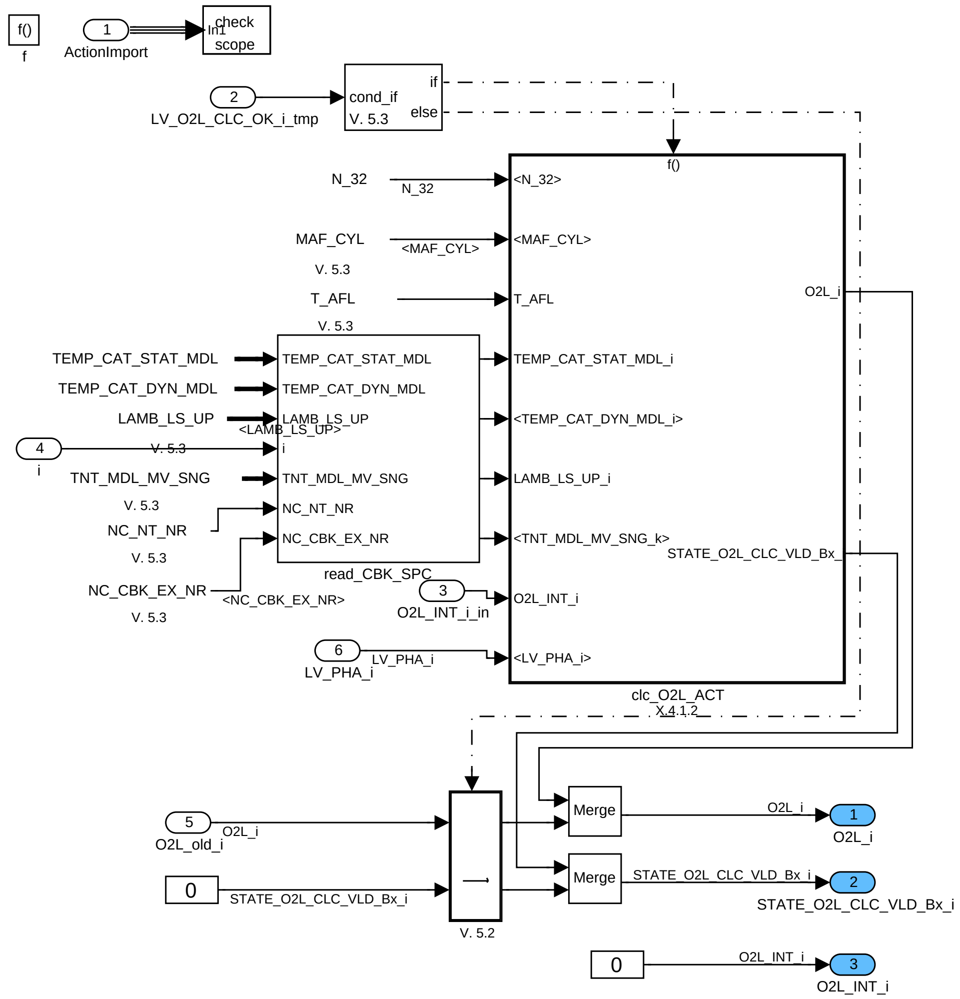

Figure B.54.36: :

B.54.3.1.1 Calculation and correction of the O2L value

Depending on the strategy for calculation of the O2L integral (configuration 1 and 2a or 2b), corresponding correction factors are used. For the configuration 2b, temperatures of TWC and NT are taken into account

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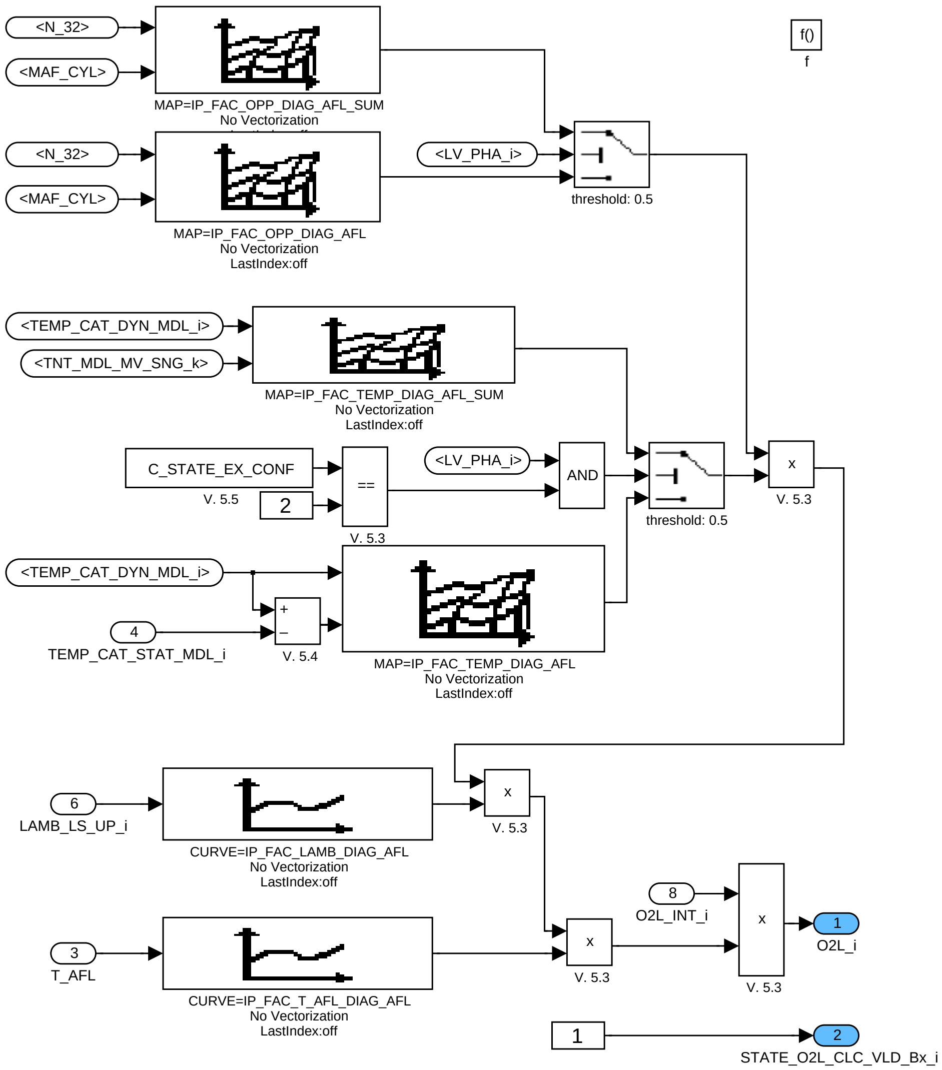

Figure B.54.37: :

B.54.4 Detailed description for Action: ACTION_EGTR_O2LIntegralCalc

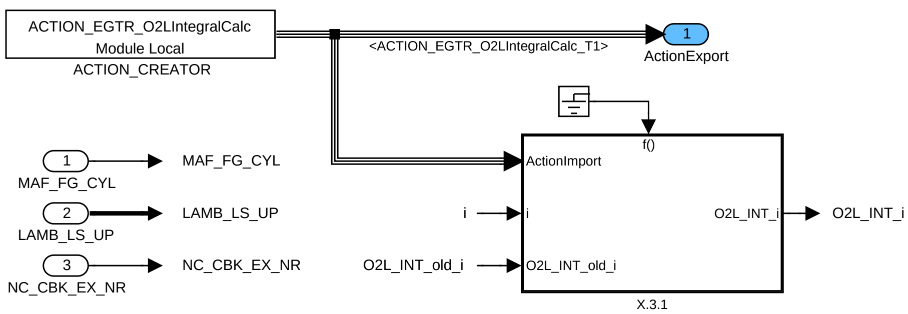

Figure B.54.38: :

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B.54.4.1 Calculation of the O2L integral

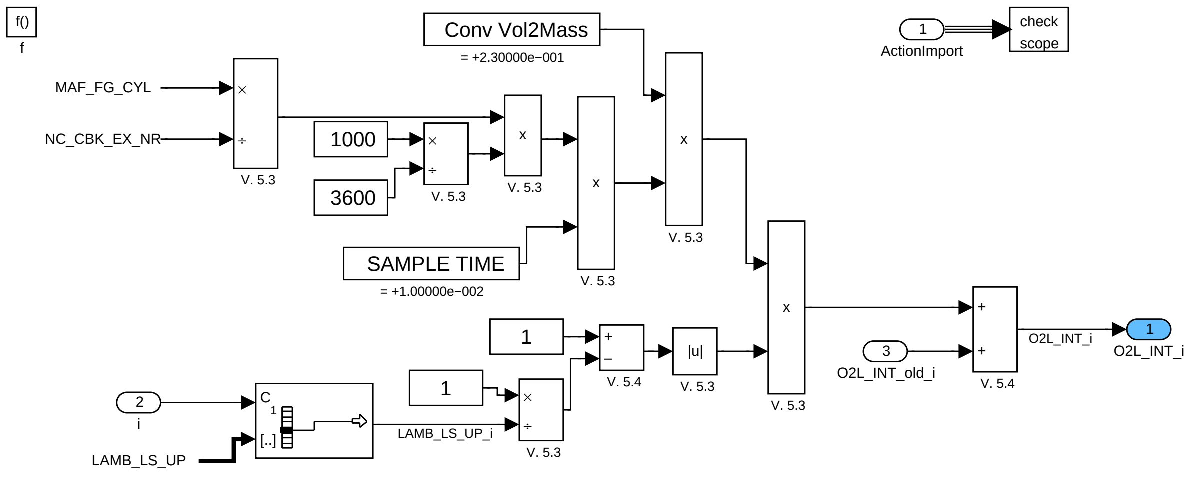

Figure B.54.39: :

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B.55 TWC diagnosis at lean operation (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_END_SUM_DIAG_AFL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Collected flag that oher relevant diagnosis are finished					
LV_DIAG_ERR_SUM_DIAG_AFL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Collected flag or errors of oher relevant diagnosis					
LV_INH_DIAG_CAT_DIAG_AFL [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition condition for the TWC lean diagnosis					

Input data:

LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}
LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}	LV_ERR_DELTA_I_LAM [NC_CBK_EX_NR] {p. 5216}	LV_ERR_DIAGCPS {p. 5926}
LV_ERR_EL_CPS {p. 4708}	LV_ERR_FL_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}
LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}
LV_ERR_MAP_TPS_PLAUS {p. 1062}	LV_ERR_MEC_IVVT_EX {p. 1062}	LV_ERR_MEC_IVVT_IN {p. 1062}	LV_ERR_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4267}
LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4275}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4267}
LV_ERR_SCP_LS_DOWN [NC_CBK_EX_NR] {p. 4267}	LV_ERR_SLV_IVVT_EX {p. 4627}	LV_ERR_SLV_IVVT_IN {p. 4627}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}
LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}	LV_ERR_TCO_PLAUS {p. 5682}
LV_ERR_TCO_STUCK {p. 5691}	LV_ERR_TCO_STUCK_RNG {p. 5675}	LV_ERR_TTIP_MES_LSH_UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}

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LV_ERR_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5216}	LV_IGK {p. 906}	LV_LS_DOWN_DIAG_END [NC_CBK_EX_NR] {p. 5449}	LV_LS_UP_DIAG_END [NC_CBK_EX_NR] {p. 5449}
LV_MIS_STATE_A {p. 6238}	LV_MIS_STATE_B {p. 6238}	LV_VLS_NS_VLD [NC_NOX_SENS_CONF] {p. 992}	NC_CBK_EX_NR {p. 1829}
NC_CYL_NR {p. 1526}	NC_NOX_SENS_CONF {p. 643}	NC_NR_CAM_CBK {p. 1507}	NC_NR_CBK_IVVT {p. 604}
STATE_END_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	STATE_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_CAT_DIAG_AFL	-	0... FFH	0... 255	1	-
Decrement value for antibounce counter					
C_ABC_INC_CAT_DIAG_AFL	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_CAT_DIAG_AFL	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_STATE_NS_OBD_2_DIAG_AFL	-	0... FFFFH	0... 65535	1	-
Choice of NS single diagnosis for calculation of summary bits					
LC_CAT_DIAG_NS_VLD	-	0... 1H	0 ...1	1	-
Switch to inhibit TWC lean diagnosis based on binary 02 signal					
LC_DIAG_CAT_DIAG_AFL_DEAC [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Deactivation flag for the TWC lean diagnosis					
LC_DIAG_SUM_DIAG_AFL	-	0... 1H	0 ...1	1	-
Manually set of end and error sum flags of other relevant diagnosis to passed					

General Information

The flag LV_INH_DIAG_CAT_DIAG_AFL permit to deactivate the corresponding diagnosis.
If two separate exhaust bank systems are concerned, then:
i = 1, for cylinder bank 1
i = 2, for cylinder bank 2
Otherwise:
i = 1

Application Conditions

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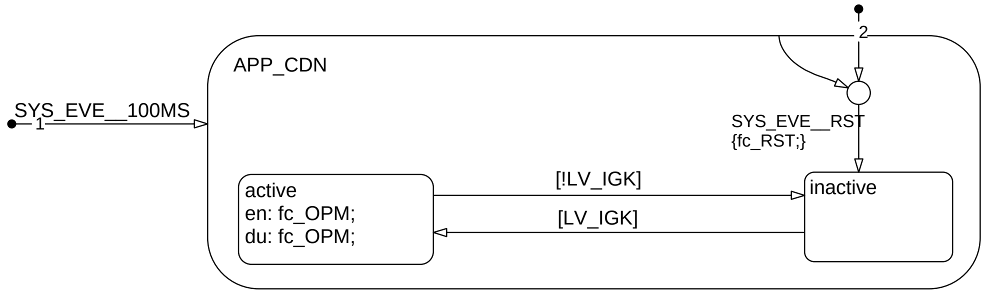

Figure B.55.1: :

Function description

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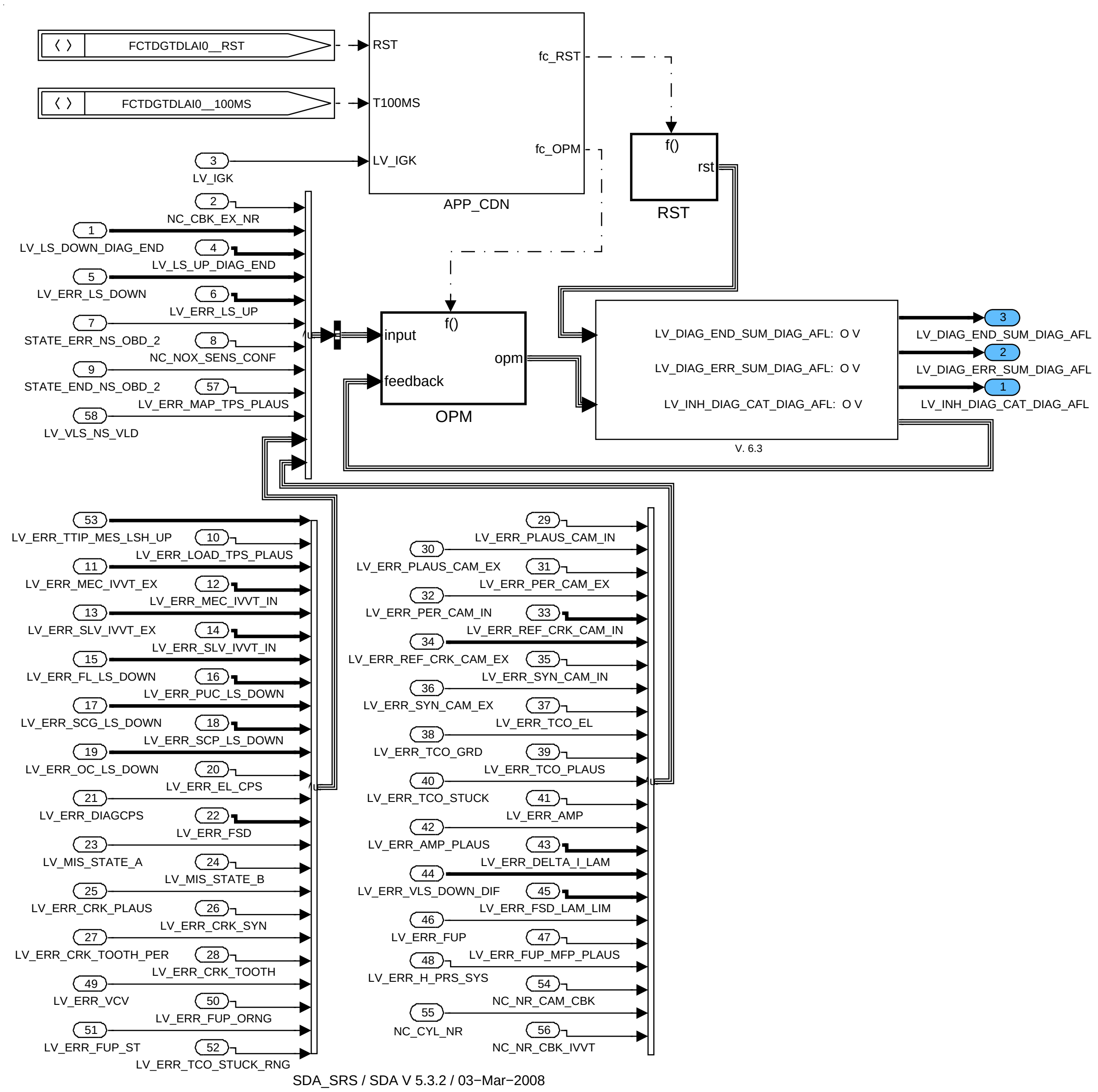

Figure B.55.2: :

B.55.1 INITIALIZATION AT RESET

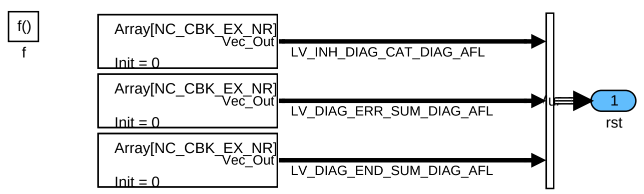

Figure B.55.3: :

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B.55.2 FORMULA SECTION

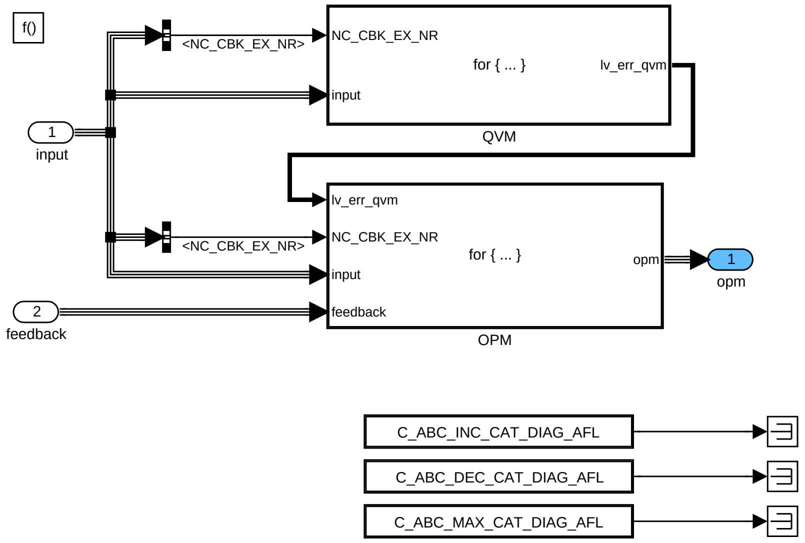

Figure B.55.4: :

B.55.2.1 EGTR_FCTDGTDLAI0/OPM/OPM

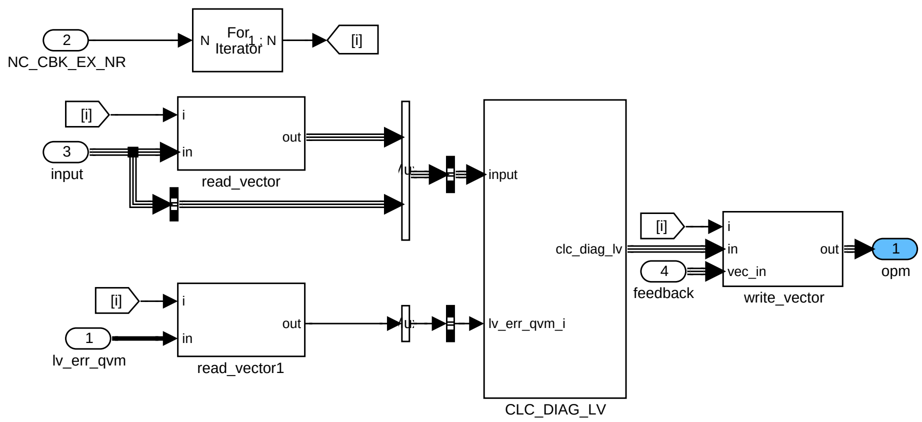

Figure B.55.5: :

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B.55.2.1.1 No title given

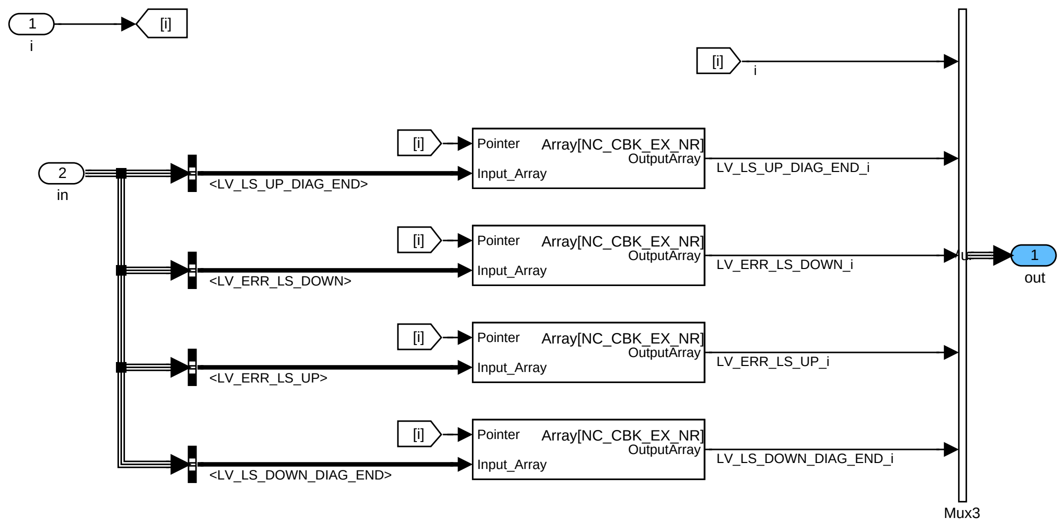

Figure B.55.6: :

B.55.2.1.2 No title given

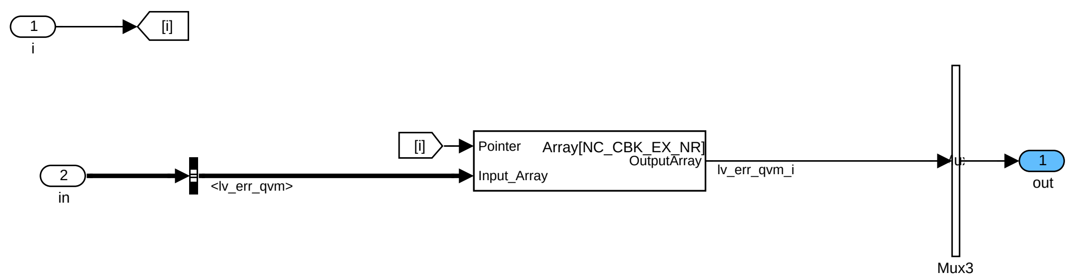

Figure B.55.7: :

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B.55.2.1.3 EGTR_FCTDGTDLAI0/OPM/OPM/CLC_DIAG_LV

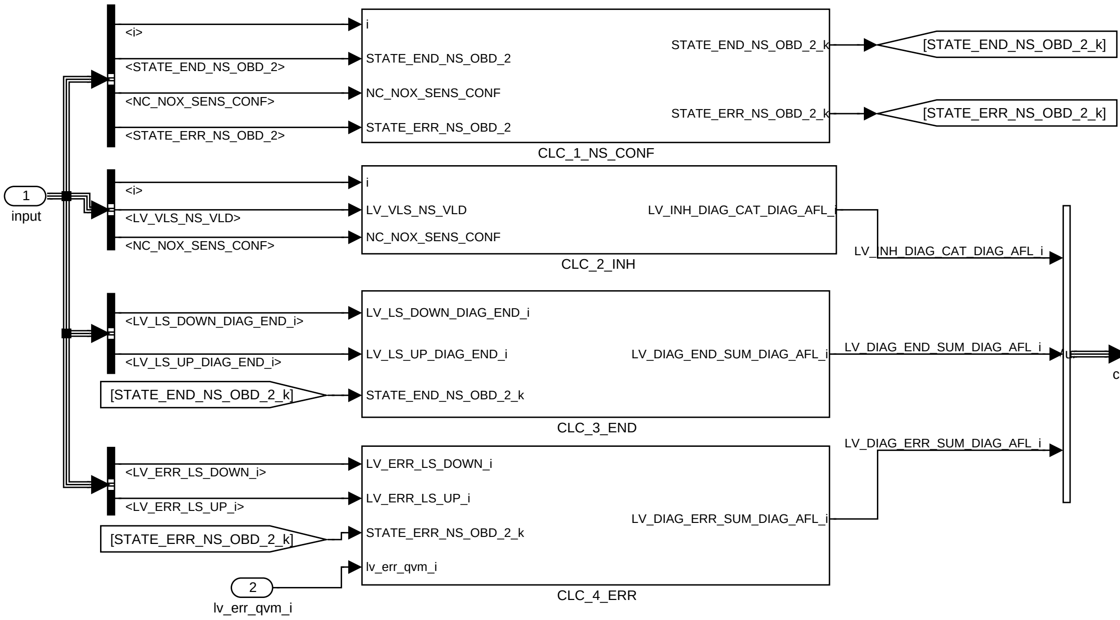

Figure B.55.8: :

B.55.2.1.3.1 Calculation of the NOx Sensor specific variables

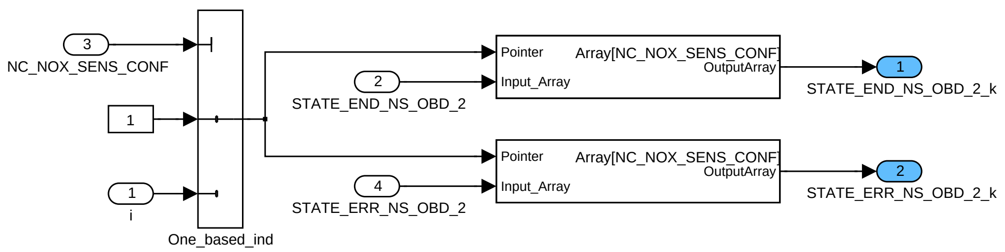

Figure B.55.9: :

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B.55.2.1.3.2 Calculation of the inhibition flag

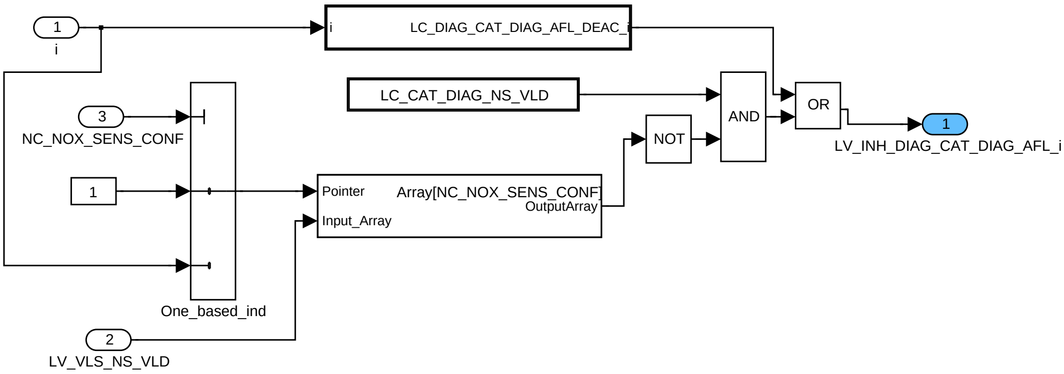

Figure B.55.10: :

B.55.2.1.3.2.1 No title given

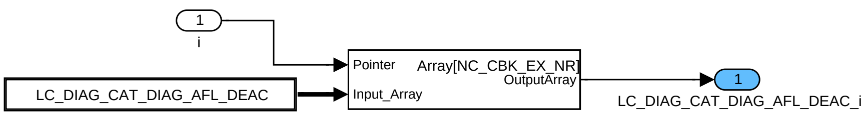

Figure B.55.11: :

B.55.2.1.3.3 Check of the end bits of other relevant diagnosis

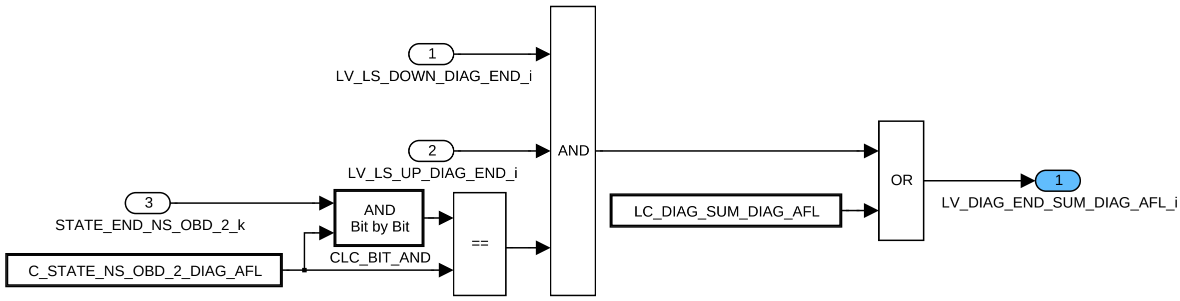

Figure B.55.12: :

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B.55.2.1.3.3.1 No title given

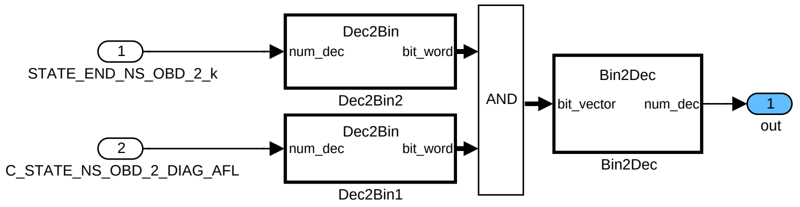

Figure B.55.13: :

B.55.2.1.3.4 Check of the error bits of other relevant diagnosis

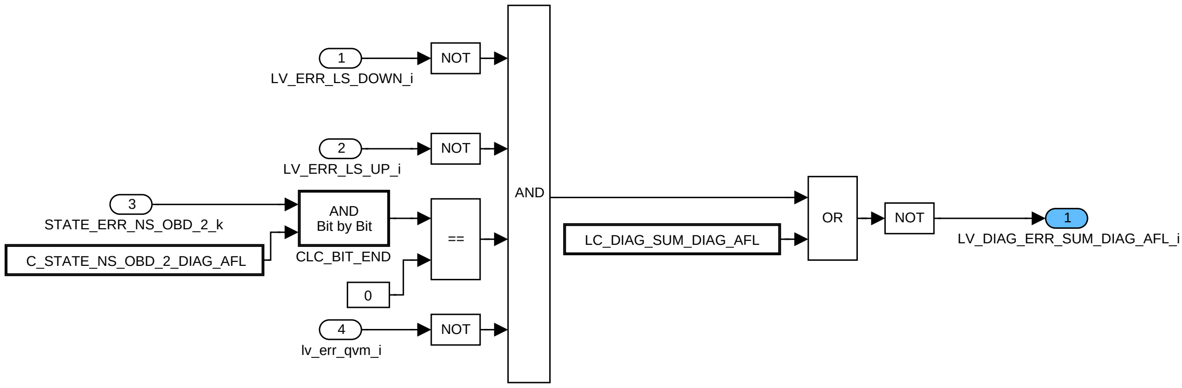

Figure B.55.14: :

B.55.2.1.3.4.1 No title given

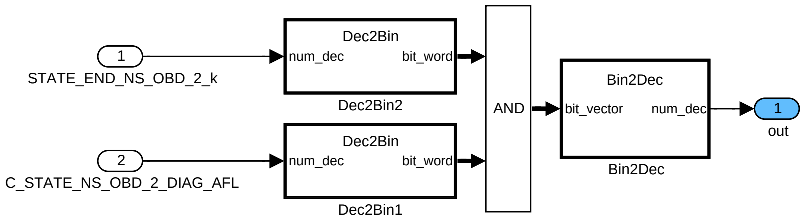

Figure B.55.15: :

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B.55.2.1.4 No title given

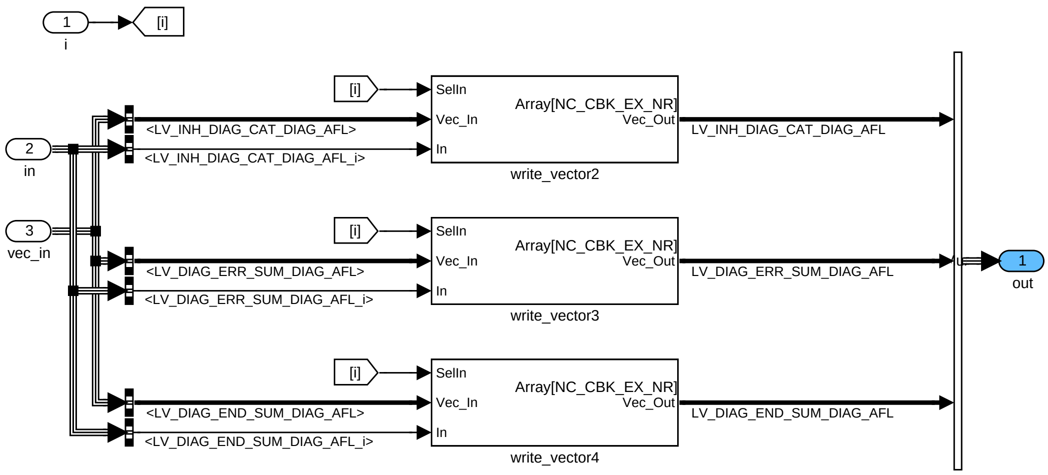

Figure B.55.16: :

B.55.2.2 EGTR_FCTDGTDLAI0/OPM/QVM

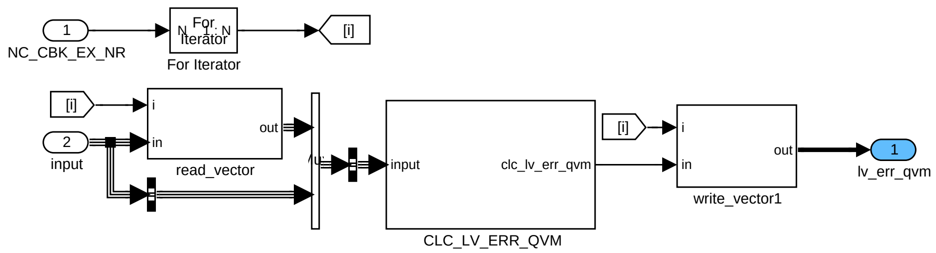

Figure B.55.17: :

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B.55.2.2.1 No title given

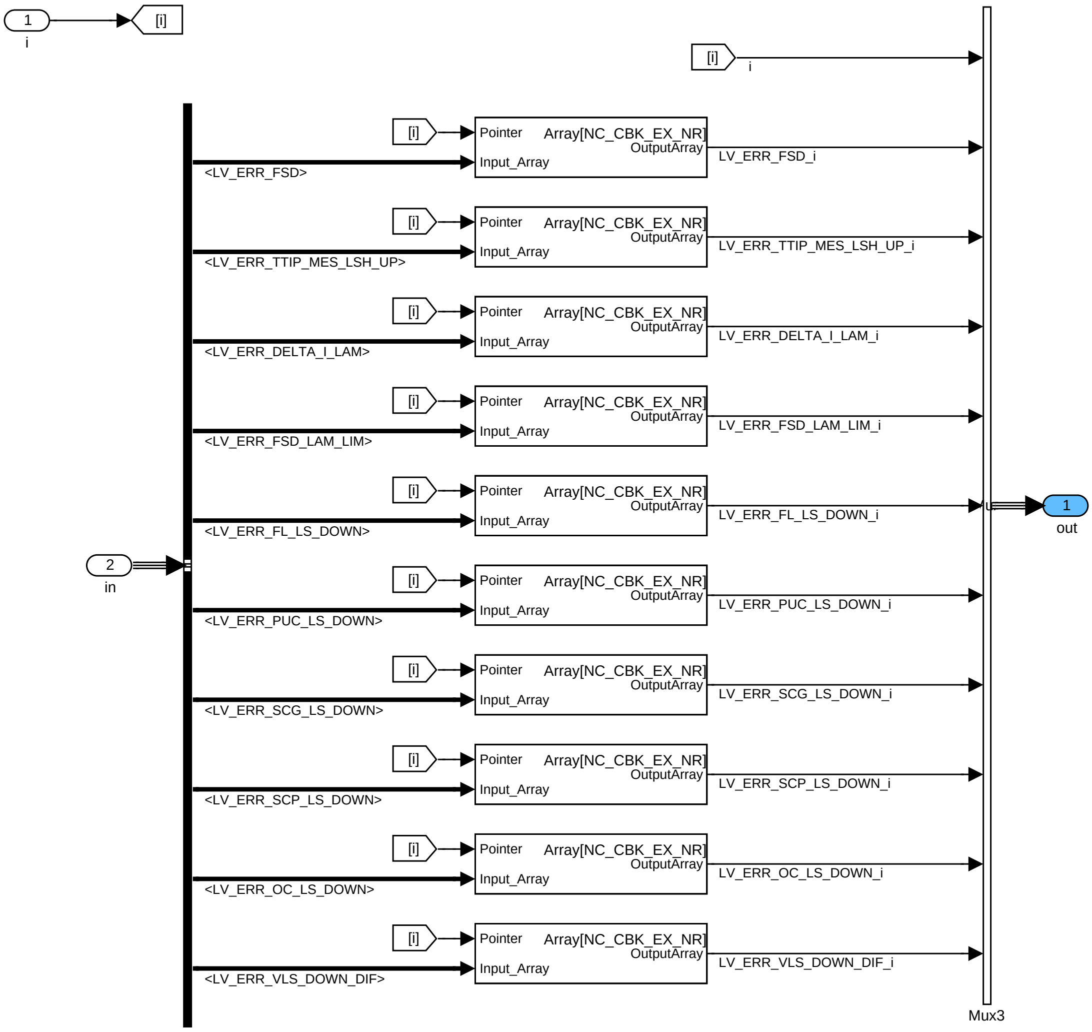

Figure B.55.18: :

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B.55.2.2.2 EGTR_FCTDGTDLAI0/OPM/QVM/CLC_LV_ERR_QVM

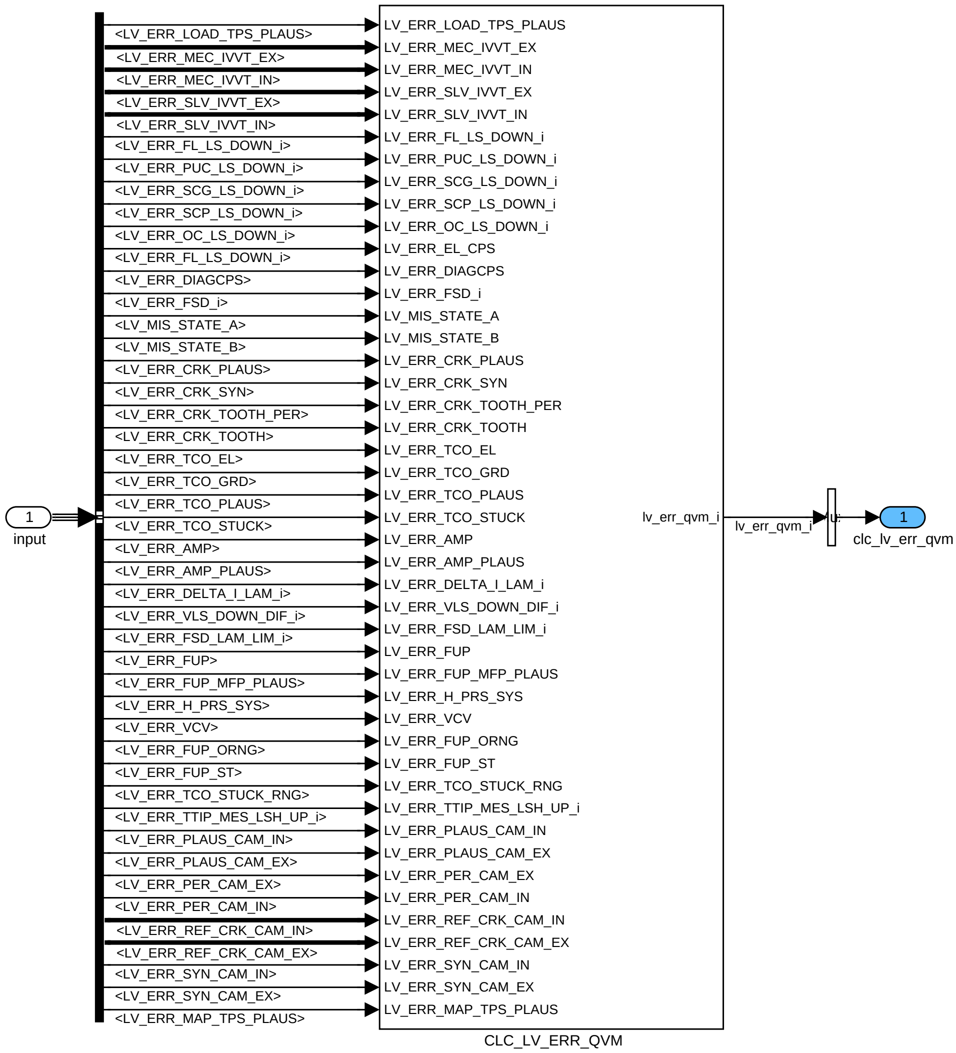

Figure B.55.19: :

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B.55.2.2.2.1 Cross Interferences Matrix

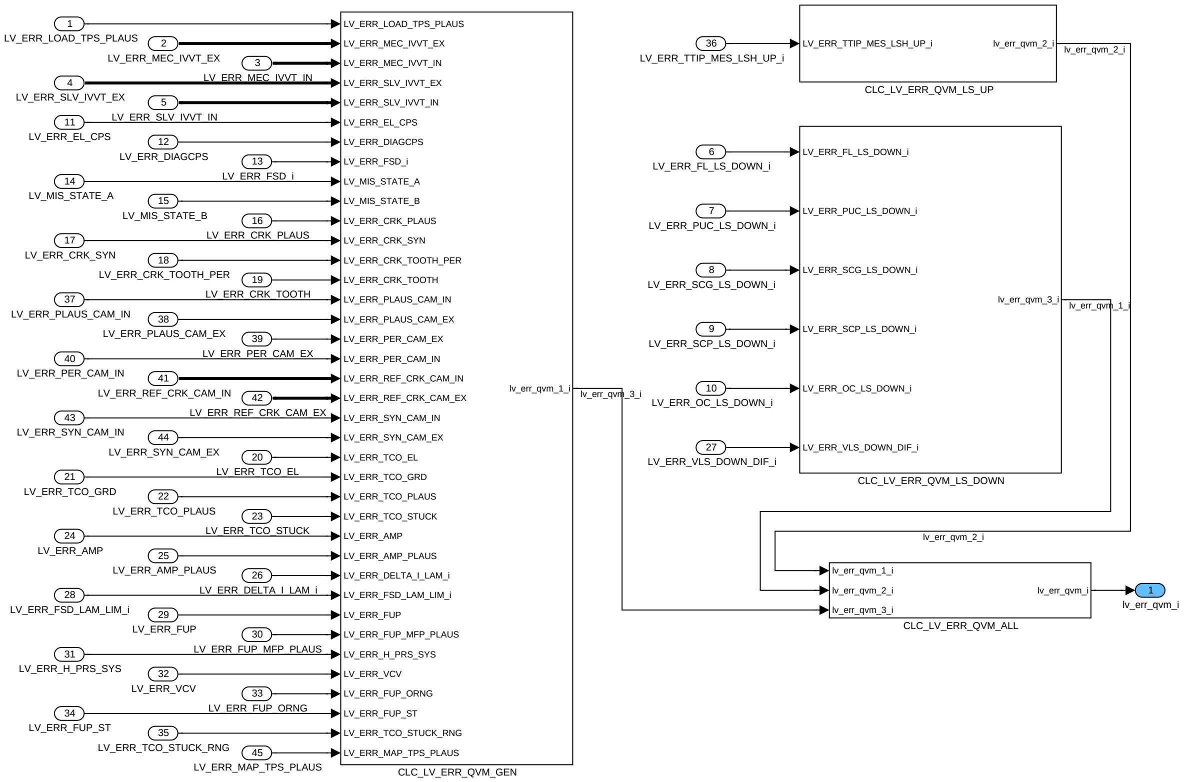

Figure B.55.20: :

B.55.2.2.2.1.1 Summary flag of Cross Interferences Matrix

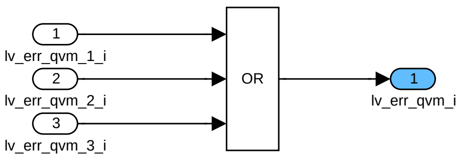

Figure B.55.21: :

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B.55.2.2.2.1.2 Cross Interferences Matrix - General Flags

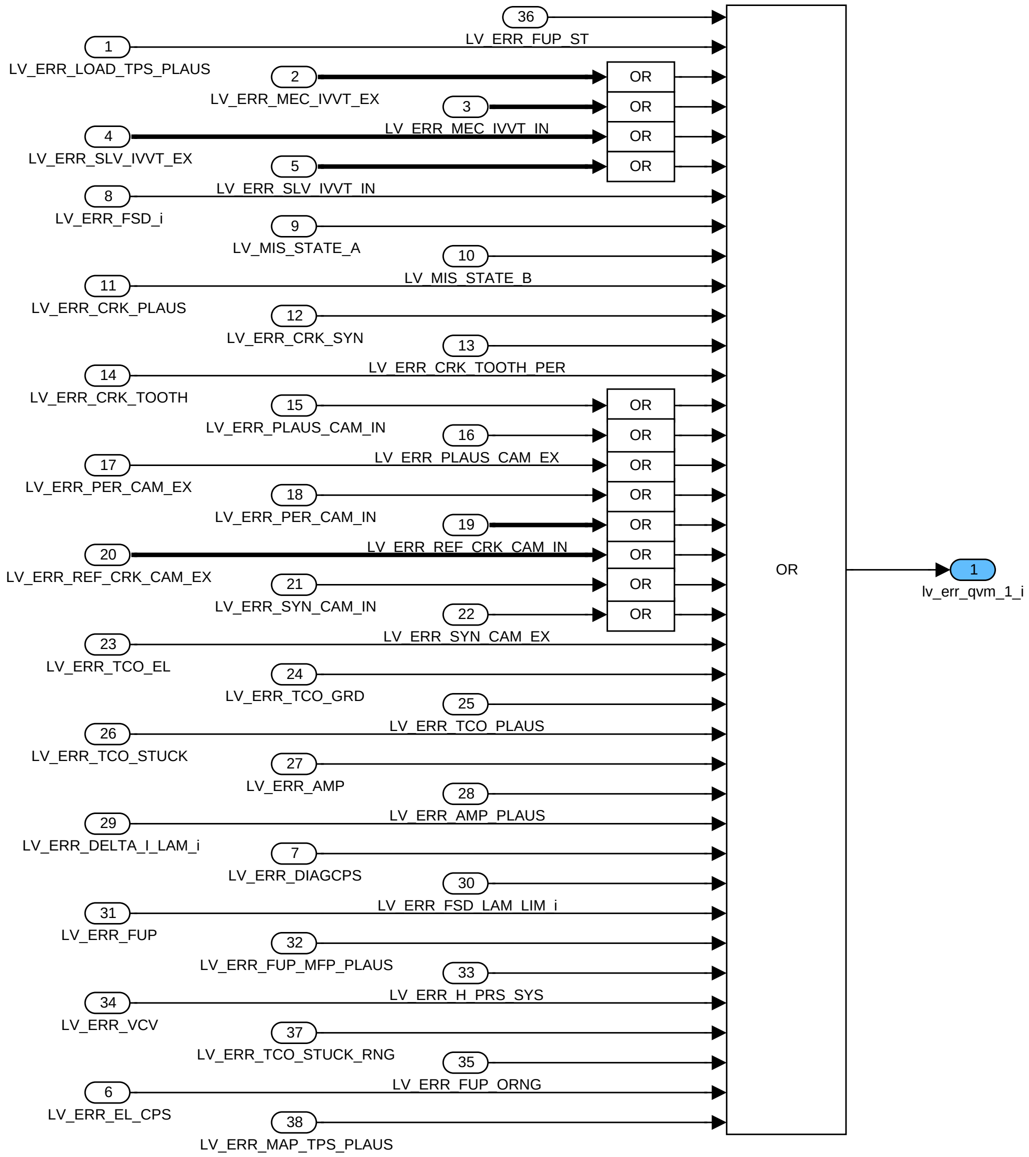

Figure B.55.22: :

B.55.2.2.2.1.2.1 No title given

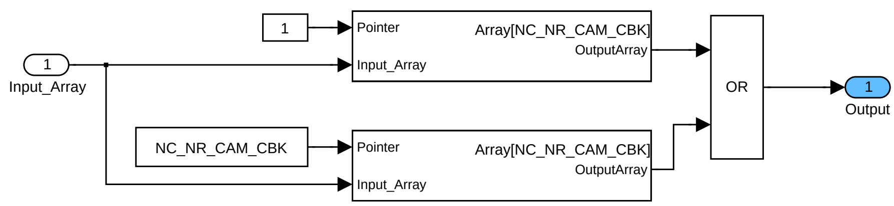

Figure B.55.23: :

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B.55.2.2.2.1.2.2 No title given

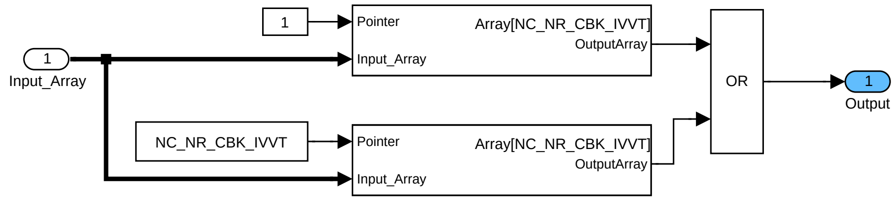

Figure B.55.24: :

B.55.2.2.2.1.2.3 No title given

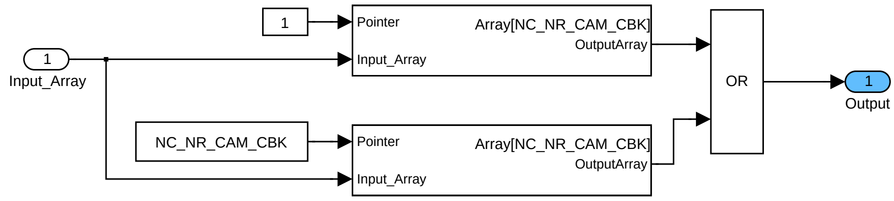

Figure B.55.25: :

B.55.2.2.2.1.2.4 No title given

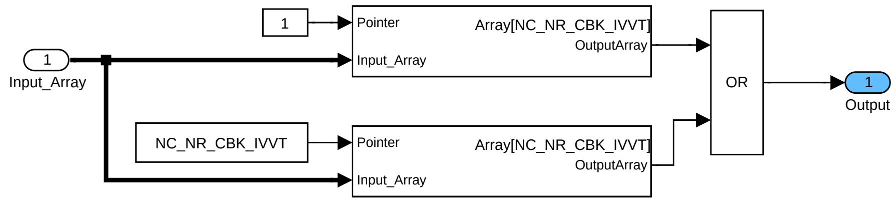

Figure B.55.26: :

B.55.2.2.2.1.2.5 No title given

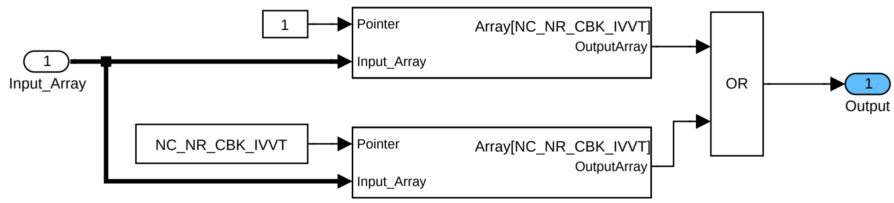

Figure B.55.27: :

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B.55.2.2.2.1.2.6 No title given

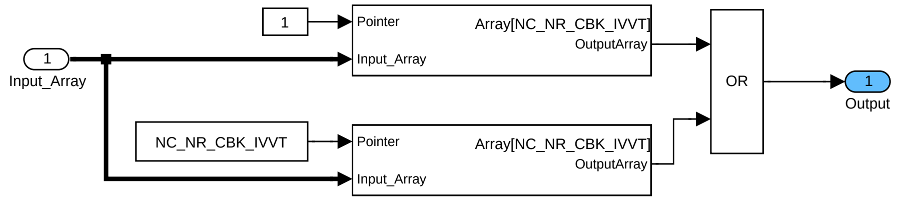

Figure B.55.28: :

B.55.2.2.2.1.2.7 No title given

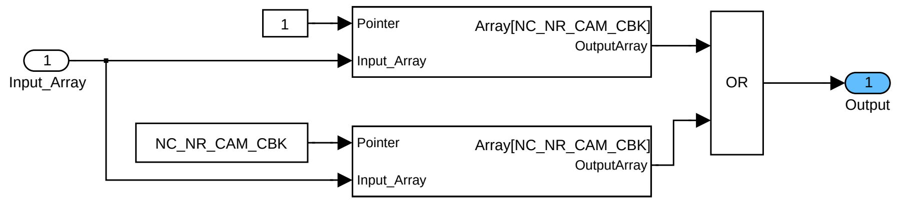

Figure B.55.29: :

B.55.2.2.2.1.2.8 No title given

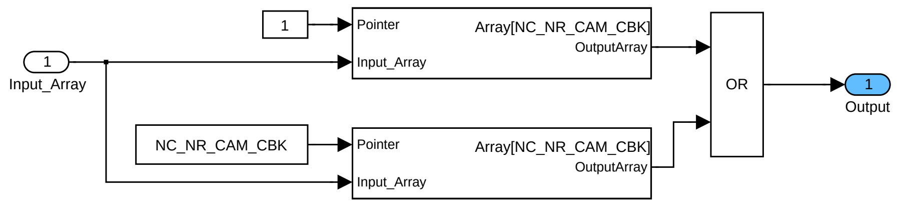

Figure B.55.30: :

B.55.2.2.2.1.2.9 No title given

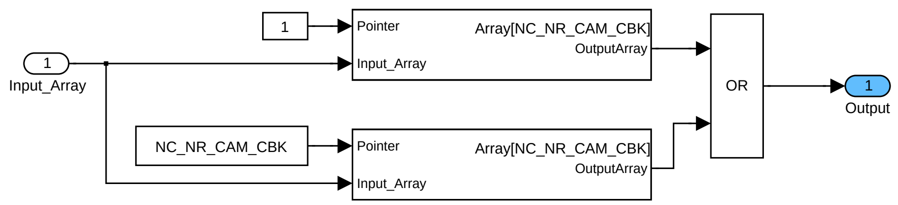

Figure B.55.31: :

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B.55.2.2.2.1.2.10 No title given

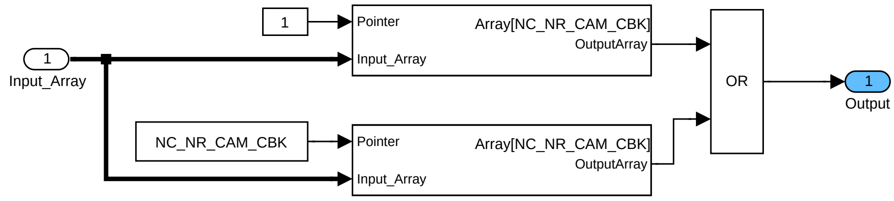

Figure B.55.32: :

B.55.2.2.2.1.2.11 No title given

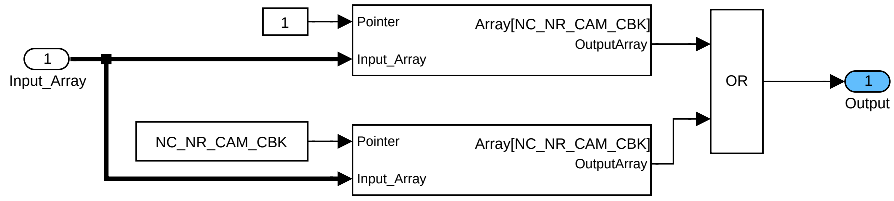

Figure B.55.33: :

B.55.2.2.2.1.2.12 No title given

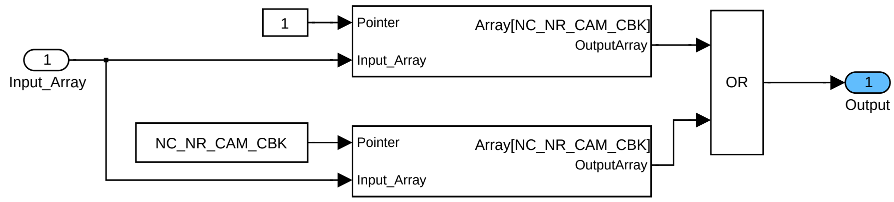

Figure B.55.34: :

B.55.2.2.2.1.3 Cross Interferences Matrix - Flags concerning downstream linear Sensor, not included in LV_ERR_LS_DOWN

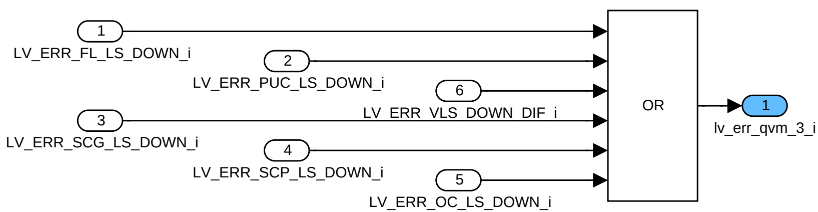

Figure B.55.35: :

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B.55.2.2.2.1.4 Cross Interferences Matrix - Flags concerning upstream linear Sensor, not included in LV_ERR_LS_UP

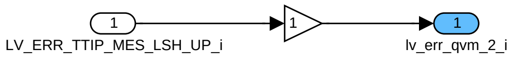

Figure B.55.36: :

B.55.2.2.3 No title given

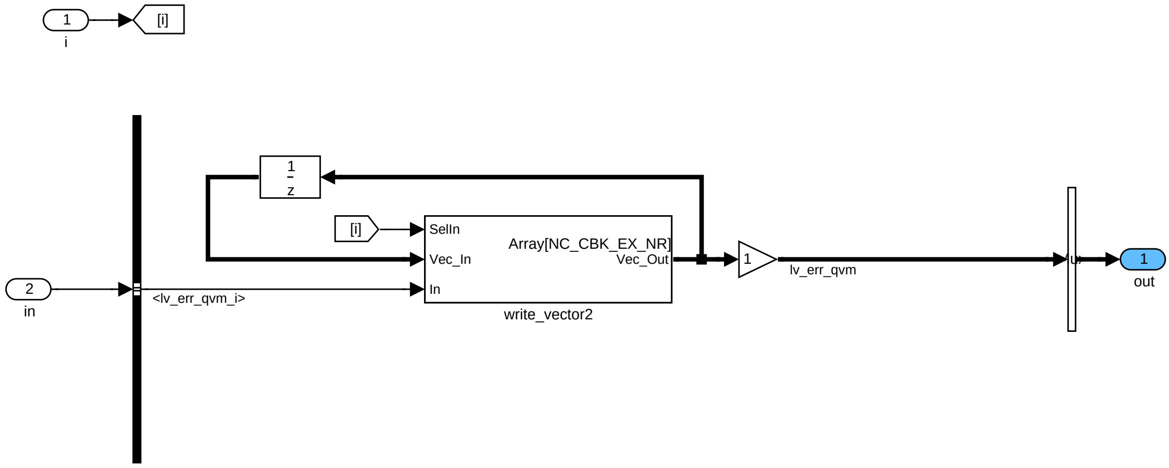

Figure B.55.37: :

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B.56 Coolant thermostat monitoring

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TH	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom for coolant thermostat error					
LV_ACT_DIAG_RBM_TH	O/V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat diagnosis activated for RBM					
LV_ACT_DIAG_TH	O/V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat diagnosis activated					
LV_CDN_DIAG_TH	O/V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat diagnosis conditions					
LV_CNL_DIAG_TH	O/V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat diagnosis cancelled					
LV_END_DIAG_RBM_TH	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant thermostat diagnosis for RBM					
LV_END_DIAG_RBM_TH_TMP	O/V	0... 1H	0 ...1	1	-
Temporary bit for end of coolant thermostat diagnosis for RBM					
LV_END_DIAG_TH	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant thermostat diagnosis					
LV_ERR_TH	O/V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat error					
LV_TCO_DE_MAX_DIAG_TH	O/V	0... 1H	0 ...1	1	-
Boolean for high coolant temperature deviation for coolant thermostat diagnosis					
T_TCO_DE_DIAG_TH	O/V	0... FFFFH	0... 65535	1	s
Timer for coolant temperature deviation for coolant thermostat diagnosis					
TCO_DE_DIAG_TH	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature deviation value for coolant thermostat diagnosis					
TCO_DE_INI_DIAG_TH	O/V	0... FEH	-48... 142.5	0.75	°C
Initialization value for coolant temperature deviation for coolant thermostat diagnosis					
TCO_DIAG_TH	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature of the performed coolant thermostat diagnosis					
TIA_DE_DIAG_TH	O/V	0... FEH	-48... 142.5	0.75	°C
Intake air temperature deviation value for coolant thermostat diagnosis					
TIA_MIN_DIAG_TH	O/V	0... FEH	-48... 142.5	0.75	°C
Minimum intake air temperature value during coolant thermostat diagnosis					

Input data:

LV_CDN_VB_OBD2 {p. 1185}	LV_INH_DIAG_TH {p. 5660}	LV_ST_END {p. 1720}	N {p. 1525}
N_REL_CWP {p. 4095}	RATIO_T_LOAD_MIN_AST {p. 4493}	RATIO_T_PUC_AST {p. 4493}	RATIO_T_VS_MAX_AST {p. 4493}
RATIO_T_VS_MIN_AST {p. 4493}	TAM {p. 1579}	TCO_MES {p. 1100}	TCO_ST {p. 1100}

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TCO_SUB {p. 1105}	TIA_THR {p. 984}	TIA_THR_ST {p. 984}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_MAX_DIAG_TH	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed for high coolant temperature deviation detection for coolant thermostat diagnosis					
C_N_REL_CWP_MAX_DIAG_TH	-	0... FFH	0... 255	1	-
Maximum cooling water pump speed for coolant thermostat diagnosis					
C_RATIO_T_VS_MAX_THD_DIAG_TH	-	0... FFH	0... 99.60937	0.390625	%
"Vehicle speed maximum" ratio threshold in per cent for coolant thermostat diagnosis					
C_T_TCO_DE_DIAG_TH	-	0... FFFFH	0... 65535	1	s
Time for high coolant temperature deviation detection for coolant thermostat diagnosis					
C_TCO_DE_MAX_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Maximum coolant temperature deviation for coolant thermostat diagnosis					
C_TCO_ST_MAX_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Maximum coolant temperature at start for coolant thermostat diagnosis					
C_TCO_ST_MIN_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature at start for coolant thermostat diagnosis					
C_TCO_WUP_MIN_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant warm up temperature for coolant thermostat diagnosis					
C_TIA_DE_MAX_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Maximum intake air temperature deviation for coolant thermostat diagnosis					
C_TIA_ST_MIN_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Minimum intake air temperature at start for coolant thermostat diagnosis					
IP_RATIO_T_LOAD_MIN_THD_DIAG_TH	-	0... FFH	0... 99.60937	0.390625	%
LDPM_TAM_IP_RATIO_DIAG_TH	4	0... FEH	-48... 142.5	0.75	°C
'Engine load minimum' ratio threshold in per cent for coolant thermostat diagnosis					
IP_RATIO_T_PUC_THD_DIAG_TH	-	0... FFH	0... 99.60937	0.390625	%
LDPM_TAM_IP_RATIO_DIAG_TH	4	0... FEH	-48... 142.5	0.75	°C
'Pull fuel cut off' ratio threshold in per cent for coolant thermostat diagnosis					
IP_RATIO_T_VS_MIN_THD_DIAG_TH	-	0... FFH	0... 99.60937	0.390625	%
LDPM_TAM_IP_RATIO_DIAG_TH	4	0... FEH	-48... 142.5	0.75	°C
'Vehicle speed minimum' ratio threshold in per cent for coolant thermostat diagnosis					
IP_TCO_TH_OPEN_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
LDPM_TAM_IP_DIAG_TH	4	0... FEH	-48... 142.5	0.75	°C
Regulation temperature for coolant thermostat opening					
IP_TCO_WUP_MIN_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
LDPM_TAM_IP_DIAG_TH	4	0... FEH	-48... 142.5	0.75	°C
Minimum coolant warm up temperature for coolant thermostat diagnosis					

FUNCTION DESCRIPTION:

General information:

Task of the coolant thermostat is to effect a quick engine warm up after start. The thermostat is closed after engine start to limit the cooling-liquid circulation until the thermostat regulating temperature is reached. The thermostat opens at this temperature and the limitation of the cooling-liquid circulation is finished. If an opened stuck thermostat occurs, the cooling-liquid circulation will not be limited after start. That means an increase of the engine warm up time and can cause emission increase as well.

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To take this behaviour into consideration, an opened stuck thermostat must be detected if either other diagnosis functions are inhibited or the coolant temperature does not reach its operating temperature within 20°F. The conditions for inhibiting the diagnosis are described in the chapter Application incidences for coolant thermostat monitoring . The coolant temperature model (TCO_SUB) must simulate the worst engine warm up temperature behaviour for a normal working thermostat (heating on. A/C on. etc.) after start until the thermostat opening temperature is reached.

Description:

The error detection is done by a comparison between the raw value of the coolant temperature sensor and the value of the coolant temperature substitute model.

Error-symptoms are defined to this diagnosis function as following:

```
□□□□
| | | └> -                          (= SYM_0)
| | └──> -                          (= SYM_1)
| └────> -                          (= SYM_2)
└──────> TH open stuck              (= SYM_3)
```

B.56.1 Activation condition for thermostat monitoring

FUNCTION DESCRIPTION:

General information:

The initialization of the function is performed as soon as EXIT_ST is detected. In this case it is regardless if the actual thermostat diagnosis status is set to enabled or canceled.
Thermostat diagnosis is performed as soon as all conditions below are fulfilled at the same time. The function is enabled at once if LV_ST_END is set to 1 . A minimum and a maximum threshold for the coolant temperature at start are limiting the diagnosis activation range as well as a minimum threshold for the intake air temperature at start.
Thermostat monitoring is finished if either the logical value for thermostat diagnosis finished or the logical value for thermostat diagnosis cancelled equals to 1 . In this case the diagnosis activation bit is set to 0 (LV_ACT_DIAG_TH = 0).

Application conditions

Initialisation at EXIT_ST:

```
LV_ERR_TH = 0
LV_CDN_DIAG_TH = 0
LV_END_DIAG_TH = 0
ERR_SYM_TH = NO_SYM
   LV_END_DIAG_RBM_TH = 0
   LV_END_DIAG_RBM_TH_TMP = 0
   LV_ACT_DIAG_RBM_TH = 0
   LV_CNL_DIAG_TH = 0
   LV_ACT_DIAG_TH = 0
TCO_DIAG_TH = -48°C
LV_TCO_DE_MAX_DIAG_TH = 0
```

Recurrence: *1000 ms*

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Activation: *LV_ST_END = 1*

Deactivation: *LV_ST_END = 0*

Formula section:

Calculation of the functionality check (RBM) enable condition:

If TCO_ST > C_TCO_ST_MIN_DIAG_TH **and**
TCO_ST < C_TCO_ST_MAX_DIAG_TH **and**
TIA_THR_ST > C_TIA_ST_MIN_DIAG_TH **and**
LV_CDN_VB_OBD2 = 1 **and**
LV_INH_DIAG_TH = 0 **and**
LV_CNL_DIAG_TH = 0
then LV_ACT_DIAG_RBM_TH = 1
else LV_ACT_DIAG_RBM_TH = 0
endif

Calculation of the functionality check enable condition:

If LV_ACT_DIAG_RBM_TH = 1 **and**
LV_END_DIAG_TH = 0
then LV_ACT_DIAG_TH = 1
else LV_ACT_DIAG_TH = 0
endif

Calculation of the intake air temperature deviation:

If (1) TCO_SUB <= IP_TCO_TH_OPEN_DIAG_TH **and**
LV_ACT_DIAG_RBM_TH = 1
then (1)
if (2) TIA_THR < TIA_MIN_DIAG_TH $_{(n-1)}$
then (2) TIA_MIN_DIAG_TH $_{(n)}$ = TIA_THR
else (2) TIA_MIN_DIAG_TH $_{(n)}$ = TIA_MIN_DIAG_TH $_{(n-1)}$
endif (2)
else (1) TIA_DE_DIAG_TH = TIA_MIN_DIAG_TH - TIA_THR_ST
endif (1)

Calculation of the coolant temperature deviation during high engine speed:

If (1) TCO_SUB <= IP_TCO_TH_OPEN_DIAG_TH **and**
LV_ACT_DIAG_RBM_TH = 1
then (1)
if (2) N >= C_N_MAX_DIAG_TH
OR N_REL_CWP > C_N_REL_CWP_MAX_DIAG_TH
then (2) (Trigger the coolant temperature deviation calculation)

1st. step: "Initialization" : No re-triggering until timer ends

TCO_DE_INI_DIAG_TH = TCO_MES
TCO_DE_DIAG_TH = TCO_MES - TCO_DE_INI_DIAG_TH
T_TCO_DE_DIAG_TH = C_T_TCO_DE_DIAG_TH
Timer T_TCO_DE_DIAG_TH starts

2nd. step: "Check for coolant temperature deviations"

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TCO_DE_DIAG_TH = TCO_MES - TCO_DE_INI_DIAG_TH

if **(3)** TCO_DE_DIAG_TH < C_TCO_DE_MAX_DIAG_TH
then (3) LV_TCO_DE_MAX_DIAG_TH = 1
endif (3)
endif (2)
endif (1)

Calculation of the diagnosis result:
If (1) LV_ACT_DIAG_TH = 1
then (1) *// Coolant thermostat functionality check enabled*
// Calculation of chapter 1.2
endif (1)

Calculation of the diagnosis condition:
If (1) LV_END_DIAG_TH = 1 **or**
LV_INH_DIAG_TH = 1 **or**
LV_CNL_DIAG_TH = 1
then (1) LV_CDN_DIAG_TH = 0
If(2) TransitionLV_END_DIAG_TH = 0 to LV_END_DIAG_TH = 1
then(2) TCO_DIAG_TH = TCO_MES
endif (2)
endif (1)

Calculation of end of diagnosis for RBM:
If (1) LV_ACT_DIAG_RBM_TH = 1 **and**
TCO_SUB > IP_TCO_TH_OPEN_DIAG_TH **and**
LV_END_DIAG_RBM_TH_TMP = 0 **and**
LV_CNL_DIAG_TH = 0
then (1)
LV_END_DIAG_RBM_TH_TMP = 1
if (2) TCO_MES >= IP_TCO_WUP_MIN_DIAG_TH
then (2)
if (3a) RATIO_T_VS_MIN_AST <=
IP_RATIO_T_VS_MIN_THD_DIAG_TH **and**
RATIO_T_LOAD_MIN_AST <=
IP_RATIO_T_LOAD_MIN_THD_DIAG_TH
then (3a) LV_END_DIAG_RBM_TH = 1
endif (3a)
else (2)
if (3b) RATIO_T_PUC_AST <=
IP_RATIO_T_PUC_THD_DIAG_TH **and**
RATIO_T_LOAD_MIN_AST <=
IP_RATIO_T_LOAD_MIN_THD_DIAG_TH **and**
RATIO_T_VS_MAX_AST <=
C_RATIO_T_VS_MAX_THD_DIAG_TH **and**
TIA_DE_DIAG_TH >= C_TIA_DE_MAX_DIAG_TH **and**
LV_TCO_DE_MAX_DIAG_TH = 0
then (3b) LV_END_DIAG_RBM_TH = 1
endif (3b)
endif (2)
endif (1)

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B.56.2 Coolant thermostat functionality check

FUNCTION DESCRIPTION:

General information:

Task of the functionality check is to detect a stuck open thermostat. Correct functionality is not guaranteed if the coolant temperature does not reach a specified warmed up temperature.
The thermostat functionality check is enabled as long as the boolean for coolant thermostat diagnosis activated is set to "1". As soon as EXIT_ST is detected, all timers and initialization values are set to neutral values.

Application conditions

Initialisation at EXIT_ST:
TIA_DE_DIAG_TH = 0°C
T_TCO_DE_DIAG_TH = 0s
TCO_DE_INI_DIAG_TH = 0°C
TCO_DE_DIAG_TH = 0°C
TIA_MIN_DIAG_TH = TIA_THR_ST

Recurrence: *1000 ms*

Activation: LV_ACT_DIAG_TH = 1
(Coolant thermostat functionality check enabled)

Deactivation: LV_ACT_DIAG_TH = 0
(Coolant thermostat functionality check disabled)

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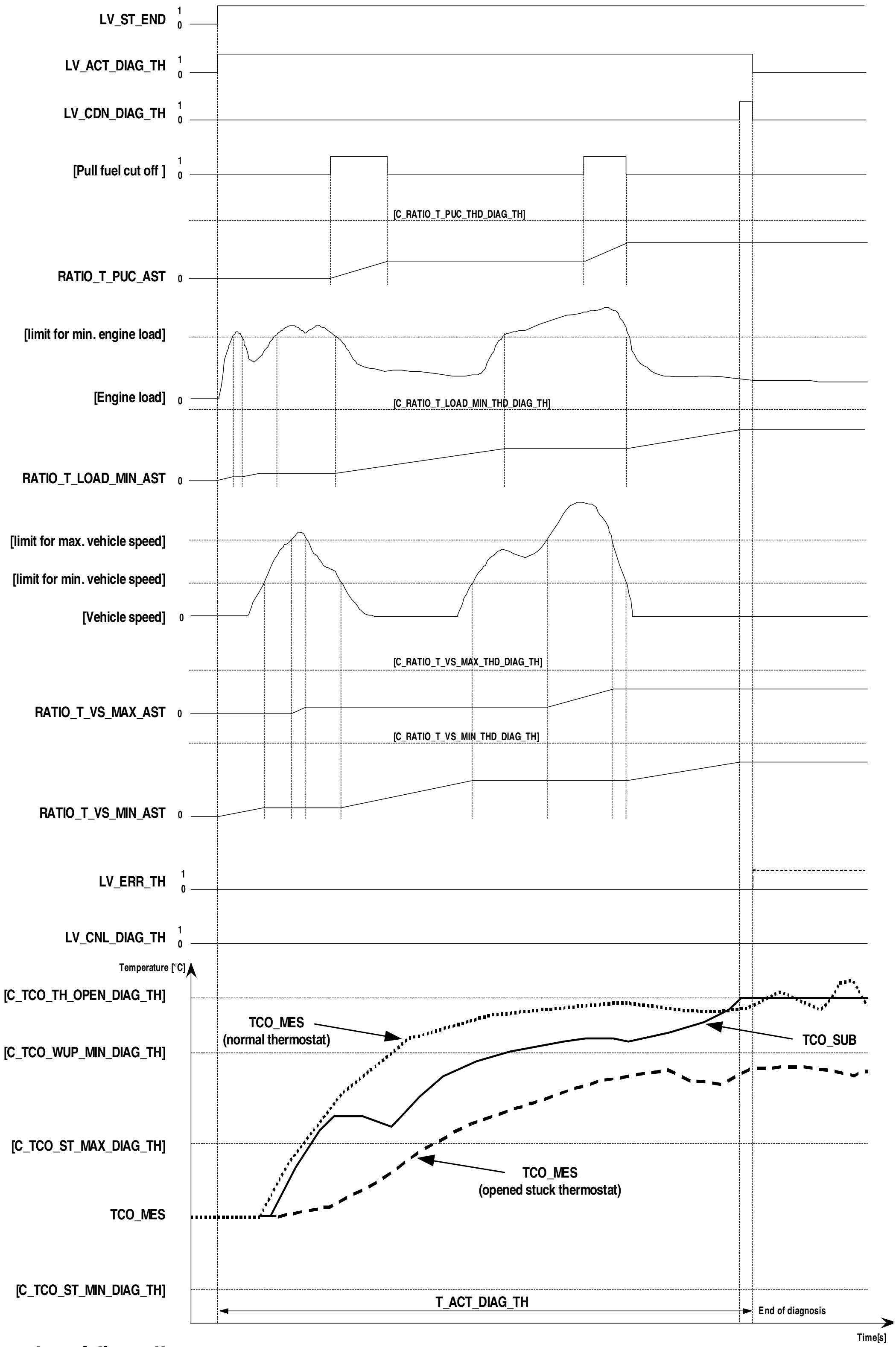

Signal flow diagram:

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Formula section:

Calculation of the diagnosis result:

If (1) TCO_MES > C_TCO_WUP_MIN_DIAG_TH

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```
then (1)
  if (2)                RATIO_T_VS_MIN_AST > IP_RATIO_T_VS_MIN_THD_DIAG_TH
             or           RATIO_T_LOAD_MIN_AST > IP_RATIO_T_LOAD_MIN_THD_DIAG_TH
        then (2)         LV_CDN_DIAG_TH = 0
                       LV_CNL_DIAG_TH = 1
        else (2)         LV_CDN_DIAG_TH = 1
                       ERR_SYM_TH =   NO_SYM
                       LV_CNL_DIAG_TH = 0
                          LV_END_DIAG_TH = 1                    (calculated in ABC)
        endif (2)
else (1)
  if (2)                TCO_SUB > IP_TCO_TH_OPEN_DIAG_TH
  then (2)
         if (3)          TCO_MES >= IP_TCO_WUP_MIN_DIAG_TH
         then (3)
              if           RATIO_T_VS_MIN_AST > IP_RATIO_T_VS_MIN_THD_DIAG_TH
             or           RATIO_T_LOAD_MIN_AST > IP_RATIO_T_LOAD_MIN_THD_DIAG_TH
              then          LV_CDN_DIAG_TH = 0
                       LV_CNL_DIAG_TH = 1
              else          LV_CDN_DIAG_TH = 1
                       ERR_SYM_TH =   NO_SYM
                          LV_END_DIAG_TH = 1                    (calculated in ABC)
                       LV_CNL_DIAG_TH = 0
              endif
         else (3)    (In case of "TCO_MES less than IP_TCO_WUP_MIN_DIAG_TH ")
           if          ( RATIO_T_PUC_AST > IP_RATIO_T_PUC_THD_DIAG_TH
             or           RATIO_T_LOAD_MIN_AST > IP_RATIO_T_LOAD_MIN_THD_DIAG_TH
             or           RATIO_T_VS_MAX_AST > C_RATIO_T_VS_MAX_THD_DIAG_TH
             or           TIA_DE_DIAG_TH < C_TIA_DE_MAX_DIAG_TH
             or           LV_TCO_DE_MAX_DIAG_TH = 1 )
         then          LV_CDN_DIAG_TH = 0
                       LV_CNL_DIAG_TH = 1
         else          LV_CDN_DIAG_TH = 1
                       ERR_SYM_TH =   SYM_3
                       LV_ERR_TH = 1                            (after debounce)
                       LV_END_DIAG_TH = 1                        (calculated in ABC)
                          LV_CNL_DIAG_TH = 0
              endif
         endif (3)
  endif (2)
endif (1)
```

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B.57 Coolant thermostat monitoring (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ECFPWM_INH_DIAG_TH	V	0... 1H	0 ...1	1	-
condition for ECFPWM exceeding threshold - for coolant thermostat diagnosis					
LV_ECTPWM_INH_DIAG_TH	V	0... 1H	0 ...1	1	-
Condition for ECTPWM exceeding threshold - for coolant thermostat diagnosis					
LV_INH_DIAG_RBM_TH	V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat diagnosis inhibit due to OBD error					
LV_INH_DIAG_TH	O/V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat diagnosis inhibit					
LV_N_REL_CWP_INH_DIAG_TH	V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat diagnosis inhibit due high cooling water pump speed					
LV_TIA_DE_INH_DIAG_TH	V	0... 1H	0 ...1	1	-
Boolean for coolant thermostat diagnosis inhibit due high intake air temperature deviation					
MASS_VOL_CWP_DIAG_TH	V	0... FFFFH	0... 65535	1	-
Cooling water pump effected coolant mass volume for coolant thermostat diagnosis					
MASS_VOL_CWP_DIAG_TH_TMP	V	0... FFFFH	0... 65535	1	-
Cooling water pump effected coolant mass volumetric-flow for coolant thermostat diagnosis					
STATE_RBM_TH	O/V	0... 7H	0 ...7	1	-
Interface of thermostat monitoring with the RBM statistics,Bit0: cond. for monitoring are met long enough to detect malfunction,Bit1: inhib. of the monitor due to system failures,Bit2: indiv. RBM cond. of the monitor were encount. within this DC					
T_ECFPWM_INH_DIAG_TH	V	0... FFH	0... 255	1	s
Max. time for ECFPWM exceeding threshold - for coolant thermostat diagnosis					
T_ECTPWM_INH_DIAG_TH	V	0... FFH	0... 255	1	s
Max. time for ECTPWM exceeding threshold - for coolant thermostat diagnosis					
T_N_REL_CWP_MAX_DIAG_TH	V	0... FFH	0... 255	1	s
Max. time for CWP speed exceeding threshold before coolant thermostat diagnosis inhibition					
TIA_DE_INH_DIAG_TH	V	0... FEH	-48... 142.5	0.75	°C
Intake air temperature deviation value for coolant thermostat diagnosis inhibition					
TIA_MIN_INH_DIAG_TH	V	0... FEH	-48... 142.5	0.75	°C
Minimum Intake air temperature value during coolant thermostat diagnosis for inhibition					

Input data:

CTR_ERR_DYN_NR {p. 5767}	ECFPWM [NC_ECF_NR] {p. 3596}	ECTPWM {p. 3858}	LV_DC {p. 5746}
LV_END_DIAG_RBM_TH {p. 5652}	LV_ERR_BN_T_ICL {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_ECT_EL {p. 4530}
LV_ERR_LOAD_TPS_PLAUS {p. 1062}	LV_ERR_MAF {p. 4815}	LV_ERR_TAM {p. 5076}	LV_ERR_TCO {p. 4496}
LV_ERR_TIA {p. 4200}	LV_ERR_VS {p. 5021}	LV_IGK {p. 906}	LV_ST_END {p. 1720}
N_REL_CWP {p. 4095}	TAM {p. 1579}	TCO_SUB {p. 1105}	TIA_THR {p. 984}
TIA_THR_ST {p. 984}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TH	-	0... FFH	0... 255	1	-
Debounce counter increment value for the coolant thermostat diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_TH	-	1... FFH	1... 255	1	-
Debounce counter maximum value for the coolant thermostat diagnosis					
C_ECFPWM_INH_DIAG_TH [NC_ECF_NR]	-	0... FFH	0... 99.60937	0.390625	%
Max. ECFPWM to deactivate coolant thermostat diagnosis					
C_ECTPWM_INH_DIAG_TH	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Max. ECTPWM to deactivate coolant thermostat diagnosis					
C_MASS_VOL_CWP_MAX	-	0... FFFFH	0... 65535	1	-
C_MASS_VOL_CWP_MAX					
C_MASS_VOL_CWP_MIN_DIAG_TH	-	0... FFFFH	0... 65535	1	-
Minimum cooling water pump effected coolant mass volume for coolant thermostat diagnosis					
C_N_REL_CWP_MIN_DIAG_TH	-	0... FFH	0... 255	1	-
Minimum cooling water pump speed for coolant thermostat diagnosis					
C_T_ECFPWM_INH_DIAG_TH	-	0... FFH	0... 255	1	s
Max. time for ECFPWM exceeding threshold - for coolant thermostat diagnosis					
C_T_ECTPWM_INH_DIAG_TH	-	0... FFH	0... 255	1	s
Max. time for ECTPWM exceeding threshold - for coolant thermostat diagnosis					
C_T_N_REL_CWP_MAX_DIAG_TH	-	0... FFH	0... 255	1	s
Max. time for CWP speed exceeding threshold before coolant thermostat diagnosis inhibition					
C_TAM_MIN_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Minimum ambient air temperature for thermostat diagnosis					
C_TIA_DE_MAX_INH_DIAG_TH	-	0... FEH	-48... 142.5	0.75	°C
Maximum intake air temperature deviation for coolant thermostat diagnosis inhibition					
ID_N_REL_CWP_MAX_DIAG_TH	-	0... FFH	0... 255	1	-
LDP_TCO_SUB_ID_N_REL_CWP_MAX	6	0... FE00H	-48... 142.5	2.9297e-3	°C
Maximum cooling water pump speed for coolant thermostat diagnosis					

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

Error treatment:

Error debounce:
Debounce counter increment: C_ABC_INC_TH
Debounce counter maximum value: C_ABC_MAX_TH

Error type:

Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Recurence	Failure class A/B
Coolant Thermostat Monitoring	*Not used*	*0*				STD_INI
	Not used	*1*				
	TH open stuck	*2*				
TH Monitoring	*Not used*	*3*				

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B.57.1 Inhibition of diagnosis

FUNCTION DESCRIPTION:

General information:

The coolant thermostat diagnosis is performed at transition from the logical value for engine stop from 1 to 0 . If the engine stalls or one of the conditions for inhibiting the diagnosis is present, it will be stopped and starts again at the next engine start.
The diagnosis is finished as soon as the boolean for end of coolant thermostat diagnosis is set to 1 . In this case the boolean for coolant thermostat error indicates either an open stuck thermostat (= 1) or a normal working thermostat (= 0).
Depending on project specific requirements, the coolant thermostat diagnosis can be inhibited by setting of LV_INH_DIAG_TH.
Interface of thermostat monitoring with the RBM statistics:
Bit 0: cond. for monitoring are met long enough to detect malfunction (bit0=1)
Bit 1: inhib. of the monitor because of system failure(s) (bit1=1)
Bit 2: individual RBM cond. of the monitor were encountered within this DC (bit2=1)

Application conditions

Initialisation:
```
at RESET or  EXIT_ST or  LV_IGK = 0->1 or  FMY clear:
   LV_INH_DIAG_TH = 0
   LV_INH_DIAG_RBM_TH = 0
   LV_TIA_DE_INH_DIAG_TH = 0
   LV_N_REL_CWP_INH_DIAG_TH = 0
   LV_ECTPWM_INH_DIAG_TH = 0
   LV_ECFPWM_INH_DIAG_TH = 0
   T_ECTPWM_INH_DIAG_TH = C_T_ECTPWM_INH_DIAG_TH
   T_ECFPWM_INH_DIAG_TH = C_T_ECFPWM_INH_DIAG_TH
   T_N_REL_CWP_MAX_DIAG_TH = C_T_N_REL_CWP_MAX_DIAG_TH
 at RESET or EXIT_ST:
   MASS_VOL_CWP_DIAG_TH_TMP = 0l
MASS_VOL_CWP_DIAG_TH = 0I
   TIA_DE_INH_DIAG_TH = 0°C
   TIA_MIN_INH_DIAG_TH = TIA_THR_ST
```

Recurrence: *1000 ms*

Activation: LV_ST_END = 1
(Coolant thermostat monitoring (Appl. Inc.) function enabled)

Deactivation: LV_ST_END = 0
(Coolant thermostat monitoring (Appl. Inc.) function disabled)

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Formula section:

Calculation of Cooling water pump effected coolant mass volumetric flow:
MASS_VOL_CWP_DIAG_TH_TMP=(N_REL_CWP /255)*C_MASS_VOL_CWP_MAX *//phs!*

Calculation of the maximum CWP speed for TH monitoring:
If N_REL_CWP $>$ ID_N_REL_CWP_MAX_DIAG_TH
Then **If** T_N_REL_CWP_MAX_DIAG_TH $>$ 0
Then T_N_REL_CWP_MAX_DIAG_TH - - *//count down*
Else LV_N_REL_CWP_INH_DIAG_TH = 1 *//set until next Ini*
Endif
Else T_N_REL_CWP_MAX_DIAG_TH = C_T_N_REL_CWP_MAX_DIAG_TH
Endif

Calculation of the maximum intake air temperature deviation:
If TIA_THR $<$ TIA_MIN_INH_DIAG_TH $_{(n-1)}$
then TIA_MIN_INH_DIAG_TH $_{(n)}$ = TIA_THR
else TIA_MIN_INH_DIAG_TH $_{(n)}$ = TIA_MIN_INH_DIAG_TH $_{(n-1)}$
endif

TIA_DE_INH_DIAG_TH = TIA_MIN_INH_DIAG_TH - TIA_THR_ST

If TIA_DE_INH_DIAG_TH $<$ C_TIA_DE_MAX_INH_DIAG_TH
then LV_TIA_DE_INH_DIAG_TH = 1 *//set until next Ini*
endif

Calculation of the minimum CWP volume for TH monitoring:
If (1) LV_N_REL_CWP_INH_DIAG_TH = 0 **and**
MASS_VOL_CWP_DIAG_TH(n) <=
C_MASS_VOL_CWP_MIN_DIAG_TH
then (1)
If (2) N_REL_CWP $>$ C_N_REL_CWP_MIN_DIAG_TH
then (2) MASS_VOL_CWP_DIAG_TH$_{(n)}$ = *//Integration*
MASS_VOL_CWP_DIAG_TH$_{(n-1)}$ + MASS_VOL_CWP_DIAG_TH_TMP$_{(n)}$
else (2) MASS_VOL_CWP_DIAG_TH$_{(n)}$ = 0
endif (2)
else (1) stop of integration, keep last value
endif (1)
Calculation of the ECTPWM condition for TH monitoring:
If ECTPWM $>$ C_ECTPWM_INH_DIAG_TH
then **if** T_ECTPWM_INH_DIAG_TH $>$ 0
then T_ECTPWM_INH_DIAG_TH - -
else LV_ECTPWM_INH_DIAG_TH = 1
endif
else T_ECTPWM_INH_DIAG_TH = C_T_ECTPWM_INH_DIAG_TH
Endif

Calculation of the ECFPWM condition for TH monitoring:
If ECFPWM $>$ C_ECFPWM_INH_DIAG_TH
then **if** T_ECFPWM_INH_DIAG_TH $>$ 0
then T_ECFPWM_INH_DIAG_TH - -
else LV_ECFPWM_INH_DIAG_TH = 1

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endif
else T_ECFPWM_INH_DIAG_TH = C_T_ECFPWM_INH_DIAG_TH
endif

Calculation of diagnosis interface parameter:

If LV_ERR_TCO = 1 **or**
LV_ERR_MAF = 1 **or**
LV_ERR_TIA = 1 **or**
LV_ERR_VS = 1 **or**
LV_ERR_TAM = 1 **or**
LV_ERR_ECT_EL = 1 **or**
LV_ERR_BN_T_ICL **or**
LV_ERR_CAN_BOFF **or**
LV_ERR_LOAD_TPS_PLAUS **or**
then LV_INH_DIAG_RBM_TH = 1
endif

If LV_INH_DIAG_RBM_TH = 1 **or**
LV_N_REL_CWP_INH_DIAG_TH = 1 **or**
LV_TIA_DE_INH_DIAG_TH = 1 **or**
TAM $<$ C_TAM_MIN_DIAG_TH **or**
MASS_VOL_CWP_DIAG_TH(n) $<$ C_MASS_VOL_CWP_MIN_DIAG_TH **or**
LV_ECTPWM_INH_DIAG_TH = 1 **or**
LV_ECFPWM_INH_DIAG_TH = 1

then LV_INH_DIAG_TH = 1
else LV_INH_DIAG_TH = 0
endif

B.57.2 Rate Base Monitoring interface for thermostat monitoring.

FUNCTION DESCRIPTION:

General information:

With this module the interface between the thermostat monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_TH data.
Within STATE_RBM_TH, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)
  (not valid for TH diagnosis)

Application conditions:

Initialisation :
at ECU reset :
bit 0, bit 1 and bit 2 of STATE_RBM_TH = 0

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at LV_DC 0   1 transition :

bit 0 and bit 1of STATE_RBM_TH = 0

bit 2 of STATE_RBM_TH = 1

on failure memory reset :

bit 1 of STATE_RBM_TH = 0

Recurrence: 1 s

Activation: LV_DC = 1

Formula section:

At LV_DC 0   1 transition

The pending status of the following failures has to be checked only once :

LV_ERR_TCO_EL	LV_ERR_TCO_GRD	LV_ERR_TCO_STUCK	LV_ERR_TCO_PLAUS
LV_ERR_TIA_EL	LV_ERR_TIA_PLAUS	LV_ERR_MAF_FRQ_RNG	LV_ERR_VS
LV_ERR_TAM_CAN	LV_ERR_TAM_PLAUS	LV_ERR_ECT_EL	LV_ERR_MAF_FRQ_GRD
LV_ERR_BN_T_ICL	LV_ERR_TIA_GRD	LV_ERR_TCO_STUCK_RNG	LV_ERR_MAF_FRQ_EL
LV_ERR_CAN_BOFF	LV_ERR_LOAD_TPS_PLAUS		

If(1) { CPU optimization at LV_DC 0   1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }
Then(1)
While bit 1 of STATE_RBM_TH = 0 **do**
with each XX failure of the above list :
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2)
bit 1 of STATE_RBM_TH = 1
Endif(2)
Endwhile
Else(1)
{ the dynamic failure memory is empty }
No action
Endif(1)

Every 1 s :

If bit 0 of STATE_RBM_TH = 0
Then
If LV_END_DIAG_RBM_TH = 1
Then bit 0 of STATE_RBM_TH = 1
Endif
Endif
If bit 1 of STATE_RBM_TH = 0
Then
If LV_INH_DIAG_RBM_TH = 1
Then bit 1 of STATE_RBM_TH = 1
Endif
Endif

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B.58 Coolant temperature sensor (radiator outlet) plausibility diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DLY_TCO_2_PLAUS	V	0... FFFFH	0... 65535	1	-
Delay counter before coolant temperature (radiator outlet) change is expected					
ERR_SYM_TCO_2_PLAUS	V	0H 1H 8H	NO_SYM SYM_0 SYM_3	-	-
Symptom for coolant temperature (radiator outlet) plausibility error					
LV_CDN_DIAG_TCO_2_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) plausibility diagnosis conditions					
LV_END_DIAG_RBM_TCO_2_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature (radiator outlet) plausibility diagnosis for RBM					
LV_END_DIAG_TCO_2_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature (radiator outlet) plausibility diagnosis					
LV_ERR_TCO_2_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) plausibility error					
LV_TCO_2_PLAUS_ENA	V	0... 1H	0 ...1	1	-
Coolant temperature (radiator outlet) plausibility (long) enabled					
T_DLY_TCO_2_PLAUS	V	0... FFFFH	0... 65535	1	s
Coolant temperature (radiator outlet) plausibility diagnosis diagnostic window time					
TCO_2_DIF_TCO_2_PLAUS	V	0... FEH	0... 190.5	0.75	(C
Maximum measured coolant temperature (radiator outlet) gap in diagnosis window					
TCO_2_PLAUS_H	V	0... FEH	-48... 142.5	0.75	(C
Maximum latched measured coolant temperature (radiator outlet) value					
TCO_2_PLAUS_L	V	0... FEH	-48... 142.5	0.75	(C
Minimum latched measured coolant temperature (radiator outlet) value					

Input data:

LV_CDN_VB_OBD2 {p. 1185}	LV_INH_DIAG_TCO_2_ PLAUS {p. 5672}	LV_PL {p. 1720}	LV_ST_END {p. 1720}
LV_TCO_2_PLAUS_ENA_ EXT {p. 5672}	N {p. 1525}	TCO {p. 1100}	TCO_2_MES {p. 1218}
TCO_2_MES_ST {p. 1218}	TCO_ST {p. 1100}	TIA_THR_ST {p. 984}	VS {p. 1176}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_DLY_INC_TCO_2_PLAUS	-	0... FFFFH	0... 65535	1	-
Increment for counter if drop out of diagnostic conditions					
C_CTR_DLY_TCO_2_PLAUS	-	0... FFFFH	0... 65535	1	-
Coolant system lag time before change in TCO_2_MES is expected					
C_N_MIN_TCO_2_PLAUS	-	0... 1FE0H	0... 8160	1	rpm
Min. engine speed needed to open thermostat relief valve					
C_T_DLY_TCO_2_PLAUS	-	0... FFFFH	0... 65535	1	s
Diagnostic window					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_2_DIF_MIN_TCO_2_PLAUS	-	0... FEH	0... 190.5	0.75	(C
Min. delta TCO_2_MES for plausibility					
C_TCO_MIN_TCO_2_PLAUS	-	0... FEH	-48... 142.5	0.75	(C
Opening temperature of coolant thermostat					
C_TCO_ST_DIF_MIN_TCO_2_PLAUS	-	0... FFH	-96... 95.5	0.75	(C
Min. difference between TCO_ST and TCO_2_MES_ST to diagnose fault at engine start					
C_TCO_ST_MAX_TCO_2_PLAUS	-	0... FEH	-48... 142.5	0.75	(C
Max. TCO_ST for TCO_2 plausibility check					
C_TCO_ST_MIN_TCO_2_PLAUS	-	0... FEH	-48... 142.5	0.75	(C
Min. TCO_ST for TCO_2 plausibility check					
C_TCO_ST_THD_TCO_2_PLAUS	-	0... FEH	-48... 142.5	0.75	(C
Max. TCO_ST for additional rationality check					
C_TIA_THR_ST_MAX_TCO_2_PLAUS	-	0... FEH	-48... 142.5	0.75	(C
Max. TIA_THR_ST for TCO_2 plausibility check					
C_TIA_THR_ST_MIN_TCO_2_PLAUS	-	0... FEH	-48... 142.5	0.75	(C
Min. TIA_THR_ST for TCO_2 plausibility check					
C_VS_MIN_TCO_2_PLAUS	-	0... FFH	0... 255	1	km/h
Min. vehicle speed needed to open thermostat relief valve					

FUNCTION DESCRIPTION:

General information:

The diagnosis is based on monitoring the alteration of TCO_2_MES (positive and negative change) at:

- During warm - up phase (long term check, no error detection)
- After opening of thermostat (long term check with error detection)
- Just after start (short test with error detection)

B.58.1 Signal flow diagram:

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TCO_2_DIF_TCO_2_PLAUS

TCO_2_MES_ST

C_N_MIN_TCO_2_PLAUS

Idle speed setpoint

DE

Initialisation at EXIT_ST:

LV_ERR_TCO_2_PLAUS = 0
LV_CDN_DIAG_TCO_2_PLAUS = 0
LV_END_DIAG_TCO_2_PLAUS = 0
ERR_SYM_TCO_2_PLAUS = NO_SYM
LV_END_DIAG_RBM_TCO_2_PLAUS = 0
LV_TCO_2_PLAUS_ENA = 0
TCO_2_DIF_TCO_2_PLAUS = 0 °C
TCO_2_PLAUS_H = -48°C
TCO_2_PLAUS_L = 142,5°C
CTR_DLY_TCO_2_PLAUS = C_CTR_DLY_TCO_2_PLAUS
T_DLY_TCO_2_PLAUS = C_T_DLY_TCO_2_PLAUS

Recurrence: 1000 ms

Activation: LV_ST_END = 1

Deactivation: LV_ST_END = 0

Description:

- During warm - up phase (long term check, no error detection)

The TCO_2 rationality diagnostic function will only run if TCO_ST and TIA_THR_ST are within a tunable range after engine start. TCO_2_PLAUS_H and TCO_2_PLAUS_L are continuously updated from engine start, after first being initialized to TCO_2_ST at power up. The difference between these two values, TCO_2_DIF_TCO_2_PLAUS, is also calculated. When this value exceeds a minimum threshold C_TCO_2_DIF_MIN_TCO_2_PLAUS then the diagnosis is finished with a positive rationality check result.

- After opening of thermostat (long term check with error detection)

The error detection is based on a change of TCO_2_MES after the opening temperature of the thermostat is reached and following the vehicle/engine is driven under certain conditions (vehicle speed, part load, engine speed, opening of thermostat) for the delay time CTR_DLY_TCO_2_PLAUS. However, should one condition drop below the threshold or the engine exit part load state during this tunable period, then the timer is reinitialized/incremented.

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Additional, at CTR_DLY_TCO_2_PLAUS = 0 a second delay timer is started (T_DLY_TCO_2_PLAUS) to wait for the change of TCO_2_MES. If the delay time is over and there s still no change in TCO_2_MES then the error is set.

- Just after start (short test with error detection)

Apart from the long term checks, an extra rationality check is carried out at engine start; if TCO_ST is smaller than a threshold and TCO_2_MES_ST - TCO_ST is greater than a threshold then a fault is also detected.

Error-symptoms are defined to this diagnosis function as following:

```
 ┌─┬─┬─┬─┐
 │ │ │ └─> TCO_2 to high after ST     (= SYM_0)
 │ │ └───> -                          (= SYM_1)
 │ └─────> -                          (= SYM_2)
 └───────> TCO_2 not plausible        (= SYM_3)
```

Formula section:

Calculation of diagnosis condition

IF LV_INH_DIAG_TCO_2_PLAUS = 0 **AND**
LV_END_DIAG_TCO_2_PLAUS = 0 **AND**
LV_CDN_VB_OBD2 = 1
THEN LV_CDN_DIAG_TCO_2_PLAUS = 1
ELSE LV_CDN_DIAG_TCO_2_PLAUS = 0
ENDIF

Calculation of Diagnosis warm-up phase:

IF(1) TCO_ST >C_TCO_ST_MIN_TCO_2_PLAUS **AND**
TCO_ST < C_TCO_ST_MAX_TCO_2_PLAUS **AND**
TIA_THR_ST > C_TIA_THR_ST_MIN_TCO_2_PLAUS **AND**
TIA_THR_ST <C_TIA_THR_ST_MAX_TCO_2_PLAUS **AND**
LV_END_DIAG_RBM_TCO_2_PLAUS = 0
THEN(1) *(calculation of formula section A, B, C and D - SYM_3 error check)*

A Calculation of min. and max. TCO_2_MES and delta TCO_2_MES

IF(2a) TCO_2_MES > TCO_2_PLAUS_H
THEN(2a) TCO_2_PLAUS_H = TCO_2_MES
ELSE(2a)
IF(3a) TCO_2_MES < TCO_2_PLAUS_L
THEN(3a) TCO_2_PLAUS_L = TCO_2_MES
ENDIF(3a)
ENDIF(2a)
TCO_2_DIF_TCO_2_PLAUS = TCO_2_PLAUS_H - TCO_2_PLAUS_L

B Calculation of TCO_2_DIF_TCO_2_PLAUS to end the diagnosis

IF(2b) LV_CDN_DIAG_TCO_2_PLAUS = 1 **AND**
TCO_2_DIF_TCO_2_PLAUS >= C_TCO_2_DIF_MIN_TCO_2_PLAUS
THEN(2b) LV_END_DIAG_TCO_2_PLAUS = 1 *// end of diagnosis*
ENDIF(2b)

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C Calculation of delay counter the reach conditions

IF(2c) [TCO > C_TCO_MIN_TCO_2_PLAUS **OR**
LV_TCO_2_PLAUS_ENA_EXT = 1] **AND**
LV_TCO_2_PLAUS_ENA = 0
THEN(2c) *//thermostat opening temperature has been reached*
IF(3c) N> C_N_MIN_TCO_2_PLAUS **AND**
LV_PL = 1 **AND**
VS>= C_VS_MIN_TCO_2_PLAUS
THEN(3c) CTR_DLY_TCO_2_PLAUS = CTR_DLY_TCO_2_PLAUS - 1
// conditions causing change in TCO_2_MES are satisfied, decrement counter
IF(4c) CTR_DLY_TCO_2_PLAUS = 0
THEN(4c) LV_TCO_2_PLAUS_ENA = 1
ELSE(4c) LV_TCO_2_PLAUS_ENA = 0
ENDIF(4c)
ELSE(3c) CTR_DLY_TCO_2_PLAUS = CTR_DLY_TCO_2_PLAUS
+ C_CTR_DLY_INC_TCO_2_PLAUS
// Conditions causing change in TCO_2_MES not fulfilled, increment counter

IF(5c) CTR_DLY_TCO_2_PLAUS >=
C_CTR_DLY_TCO_2_PLAUS
THEN(5c) CTR_DLY_TCO_2_PLAUS =
C_CTR_DLY_TCO_2_PLAUS
ENDIF(5c)
ENDIF(3c)
ELSE(2c) CTR_DLY_TCO_2_PLAUS = CTR_DLY_TCO_2_PLAUS *//freeze*
ENDIF(2c)

- -

D Start diagnostic window /Diagnostic check:

IF(2d) LV_TCO_2_PLAUS_ENA = 1
THEN(2d) T_DLY_TCO_2_PLAUS - -
//decrement timer for delay-time
// lower decrement timer value limited to 0 s, no negative values possible
IF(3d) T_DLY_TCO_2_PLAUS = 0 **AND**

LV_INH_DIAG_TCO_2_PLAUS = 0 **AND**
LV_CDN_VB_OBD2 = 1
THEN(3d)
IF(4d) LV_CDN_DIAG_TCO_2_PLAUS = 1
THEN(4d) ERR_SYM_TCO_2_PLAUS = SYM_3
LV_ERR_TCO_2_PLAUS = 1 *// without debounce*
LV_END_DIAG_TCO_2_PLAUS = 1 *// end of diagnosis*
ENDIF(4d)
LV_END_DIAG_RBM_TCO_2_PLAUS = 1 *// end of diagnosis for RBM*
ENDIF(3d)
ELSE(2d) no start condition
ENDIF(2d)

- -

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Calculation of Plausibility after start condition:

ELSEIF(1) TCO_ST < C_TCO_ST_THD_TCO_2_PLAUS **AND**
TIA_THR_ST <= C_TIA_THR_ST_MIN_TCO_2_PLAUS **AND**
LV_END_DIAG_RBM_TCO_2_PLAUS = 0
THEN(1) (*calculation of formula section E - SYM_0 error check)*

- -

E Calculation of Plausibility after start :
IF(2e) LV_CDN_DIAG_TCO_2_PLAUS = 1
THEN(2e)
IF(3e) TCO_2_MES_ST - TCO_ST > C_TCO_ST_DIF_MIN_TCO_2_PLAUS

THEN(3e) ERR_SYM_TCO_2_PLAUS = SYM_0
LV_ERR_TCO_2_PLAUS = 1 *// without debounce*
ENDIF(3e)
LV_END_DIAG_TCO_2_PLAUS = 1 *// end of diagnosis*
LV_END_DIAG_RBM_TCO_2_PLAUS = 1 *// end of diagnosis for RBM*
ENDIF(2e)

- -

ELSE(1) *(TCO_2 diagnosis finished or diagnosis conditions not met)*
ENDIF(1)

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B.59 Coolant temperature sensor (radiator outlet) plaus. Diag. (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_RBM_TCO_2_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal plausibility diagnosis inhibit due to OBD error					
LV_INH_DIAG_TCO_2_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal plausibility diagnosis inhibit					
LV_TCO_2_PLAUS_ENA_EXT	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature (radiator outlet) signal plausibility diagnosis external enable					
STATE_RBM_TCO_2_PLAUS	O/V	0... 7H	0 ...7	1	-
Interface of TCO_2 monitor with the Rate-Based Monitoring statistics					

Input data:

CTR_ERR_DYN_NR {p. 5767}	ECTPWM {p. 3858}	LV_CDN_CST_RBM {p. 5870}	LV_DC {p. 5746}
LV_END_DIAG_RBM_ TCO_2_PLAUS {p. 5666}	LV_ERR_ECT {p. 4529}	LV_ERR_TCO {p. 4496}	LV_ERR_TCO_2_EL {p. 4572}
LV_ERR_TCO_2_GRD {p. 4572}	LV_ERR_TIA {p. 4200}	LV_ERR_VS {p. 5021}	LV_IGK {p. 906}
LV_ST_END {p. 1720}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ECTPWM_MIN_TCO_2_PLAUS	-	0... FFFFH	0... 99.99847	1.5259e-3	%
Minimum ECTPWM to expect a change in TCO_2					

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

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B.59.1 Interface parameter

General information:

Depending on project specific requirements, the plausibility diagnosis of the coolant temperature sensor at radiator outlet can be inhibited by setting of the logical variable LV_INH_DIAG_TCO_2_PLAUS. As a default value LV_INH_DIAG_TCO_2_PLAUS is set as shown below.

Application conditions

Initialisation

```
at RESET or  EXIT_ST or  LV_IGK = 0 ->  1 or  FMY clear:
   LV_INH_DIAG_TCO_2_PLAUS = 0
   LV_INH_DIAG_RBM_TCO_2_PLAUS = 0
   LV_TCO_2_PLAUS_ENA_EXT = 0
```

Recurrence: *1000 ms*

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Activation: `LV_ST_END = 1`
(Calculation of the TCO_2 plausi. diagnosis interface parameter enabled)

Deactivation: `LV_ST_END = 0`
(Calculation of the TCO_2 plausi. diagnosis interface parameter disabled)

Formula section:

Calculation of diagnosis interface parameter:

If LV_ERR_TCO = 1 **or**
LV_ERR_TCO_2_EL = 1 **or**
LV_ERR_TCO_2_GRD = 1 **or**
LV_ERR_TIA = 1 **or**
LV_ERR_VS = 1 **or**
LV_ERR_ECT = 1
Then LV_INH_DIAG_RBM_TCO_2_PLAUS = 1
Endif

If LV_IGK = 0 **or**
LV_INH_DIAG_RBM_TCO_2_PLAUS = 1
Then LV_INH_DIAG_TCO_2_PLAUS = 1
Endif

If ECTPWM > C_ECTPWM_MIN_TCO_2_PLAUS
Then LV_TCO_2_PLAUS_ENA_EXT = 1
Else LV_TCO_2_PLAUS_ENA_EXT = 0
Endif

B.59.2 Interface for Rate-based-monitoring

General information:

With this module the interface between the TCO_2 plausibility monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_TCO_2_PLAUS data.
Within STATE_RBM_TCO_2_PLAUS, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

Application conditions:

Initialisation :

at ECU reset :
bit 0, bit 1 and bit 2 of STATE_RBM_TCO_2_PLAUS = 0
at LV_DC 0 1 transition :
bit 0, bit 1 and bit 2 of STATE_RBM_TCO_2_PLAUS = 0
on failure memory reset :
bit 1 of STATE_RBM_TCO_2_PLAUS = 0

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Recurrence: 1 s
Activation: LV_DC = 1

Formula section:

At LV_DC 0 1 transition
The pending status of the following failures has to be checked only once:

LV_ERR_TCO_EL	LV_ERR_TCO_PLAUS	LV_ERR_TCO_GRD	LV_ERR_TCO_STUCK
LV_ERR_TCO_2_EL	LV_ERR_TCO_2_GRD	LV_ERR_TIA_EL	LV_ERR_TIA_PLAUS
LV_ERR_VS	LV_ERR_TH	LV_ERR_ECT_EL	LV_ERR_TCO_STUCK_RNG
LV_ERR_TIA_GRD			

If(1) { CPU optimization at LV_DC 0 1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }
Then(1)
While bit 1 of STATE_RBM_TCO_2_PLAUS = 0 **do**
with each XX failure of the above list :
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2)
bit 1 of STATE_RBM_TCO_2_PLAUS = 1
Endif(2)
Endwhile
Else(1)
{ the dynamic failure memory is empty }
No action
Endif(1)

Every 1 s :
If bit 0 of STATE_RBM_TCO_2_PLAUS = 0
Then
If LV_END_DIAG_RBM_TCO_2_PLAUS = 1
Then bit 0 of STATE_RBM_TCO_2_PLAUS = 1
Endif
Endif

If bit 1 of STATE_RBM_TCO_2_PLAUS = 0
Then
If LV_INH_DIAG_RBM_TCO_2_PLAUS = 1
Then bit 1 of STATE_RBM_TCO_2_PLAUS = 1
Endif
Endif

If bit 2 of STATE_RBM_TCO_2_PLAUS = 0
Then
If LV_CDN_CST_RBM = 1
Then bit 2 of STATE_RBM_TCO_2_PLAUS = 1
Endif
Endif

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B.60 Coolant temperature sensor stuck in range diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TCO_STUCK_RNG	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom for coolant temperature signal stuck in range error					
LV_CDN_DIAG_TCO_STUCK_RNG	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature signal stuck in range diagnosis conditions					
LV_END_DIAG_TCO_STUCK_RNG	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature signal stuck in range diagnosis					
LV_ERR_TCO_STUCK_RNG	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature signal stuck in range detected					
TCO_ST_STUCK_RNG	V	0... FEH	-48... 142.5	0.75	°C
Measured coolant temperature at start					

Input data:

LV_CDN_VB_OBD2 {p. 1185}	LV_END_DIAG_TCO_EL {p. 4496}	LV_END_DIAG_TCO_GRD {p. 4496}	LV_IGK {p. 906}
LV_INH_DIAG_TCO_ STUCK_RNG {p. 5678}	LV_ST {p. 1720}	T_AST {p. 1766}	T_ES_CUS {p. 1444}
TAM_ST {p. 1214}	TCO_MES {p. 1100}	TIA_THR_ST {p. 984}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_AST_MIN_TCO_STUCK_RNG	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time after start to enable diagnosis					
C_T_ES_CUS_MAX_TCO_STUCK_RNG	-	0... FFFFH	0... 65535	1	min
Constant for maximum allowed engine off time for diagnosis					
C_T_ES_MIN_TCO_STUCK_RNG	-	0... FFFFH	0... 65535	1	min
Constant for minimum required engine off time for diagnosis					
C_TAM_ST_MIN_TCO_STUCK_RNG	-	0... FEH	-48... 142.5	0.75	°C
Constant for minimum ambient temperature at start					
C_TIA_TAM_DIF_MAX_TCO_STUCK_RNG	-	0... FEH	0... 190.5	0.75	°C
Constant for difference between intake air temperature and ambient temperature at start					
C_TIA_THR_ST_MAX_TCO_STUCK_RNG	-	0... FEH	-48... 142.5	0.75	°C
Constant for maximum intake air temperature at throttle at start					
C_TIA_THR_ST_MIN_TCO_STUCK_RNG	-	0... FEH	-48... 142.5	0.75	°C
Constant for minimum intake air temperature at throttle at start					
IP_TCO_ST_DIF_TIA_THR_ST	-	0... FEH	0... 190.5	0.75	°C
LDPM_T_ES_CUS_TCO_STUCK_RNG	4	0... FFFFH	0... 65535	1	min
Interpolation table for difference between coolant temperature and intake air temperature at start					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TCO_ST_TCO_STUCK_RNG	V	0... FEH	-48... 142.5	0.75	°C
LDPM_T_ES_CUS_TCO_STUCK_RNG	4	0... FFFFH	0... 65535	1	min
LDP_TIA_THR_ST_IP_TCO_ST	6	0... FEH	-48... 142.5	0.75	°C
Interpolation table for expected coolant temperature value depending on TIA_THR_ST and T_ES_CUS					

FUNCTION DESCRIPTION:

General information:

The purpose of the signal stuck in range diagnosis is to detect a measured coolant temperature signal, which is stuck in range above the lowest maximum enable temperature. The diagnosis function checks, if the cooling behavior of the coolant temperature is plausible in comparison to the engine off time.

The diagnosis is performed only once per engine run.The symptom of the error code is not handled by an antibounce counter.

Description:

Error-symptoms are defined to this diagnosis function as following:

```
 ┌─┬─┬─┬─┐
 │ │ │ └─> -                                              (= SYM_0)
 │ │ └───> -                                              (= SYM_1)
 │ └─────> -                                              (= SYM_2)
 └───────> Coolant temperature signal stuck in range error (= SYM_3)
```

Application conditions

Initialisation:

```
   at Exit start (EXIT_ST)
    LV_ERR_TCO_STUCK_RNG = 0
    ERR_SYM_TCO_STUCK_RNG = "NO_SYM"
    LV_CDN_DIAG_TCO_STUCK_RNG = 0
at reset:
TCO_ST_STUCK_RNG = 0
// LV_END_DIAG_TCO_STUCK_RNG is directly initialized by ERRM
```

Recurrence: *100ms*

Activation: *LV_IGK = 1*

Deactivation:

```
LV_IGK = 0                    or
   LV_END_DIAG_TCO_STUCK_RNG = 1
```

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Formula section:

If LV_ST = 1
Then TCO_ST_STUCK_RNG = TCO_MES
Endif

If T_AST > C_T_AST_MIN_TCO_STUCK_RNG *//delay-time to get a valid T_ES_CUS*
Then
If LV_CDN_VB_OBD2 = 1
and TIA_THR_ST < C_TIA_THR_ST_MAX_TCO_STUCK_RNG
and TIA_THR_ST > C_TIA_THR_ST_MIN_TCO_STUCK_RNG
and LV_INH_DIAG_TCO_STUCK_RNG = 0
and TAM_ST > C_TAM_ST_MIN_TCO_STUCK_RNG
and |TIA_THR_ST - TAM_ST| < C_TIA_TAM_DIF_MAX_TCO_STUCK_RNG
and T_ES_CUS > C_T_ES_MIN_TCO_STUCK_RNG
and T_ES_CUS < C_T_ES_CUS_MAX_TCO_STUCK_RNG
and LV_END_DIAG_TCO_EL = 1
and LV_END_DIAG_TCO_GRD = 1
Then LV_CDN_DIAG_TCO_STUCK_RNG = 1
Else LV_CDN_DIAG_TCO_STUCK_RNG = 0
Endif

If(1) LV_CDN_DIAG_TCO_STUCK_RNG = 1
then(1)
if(2) (TCO_ST_STUCK_RNG - TIA_THR_ST) > IP_TCO_ST_DIF_TIA_THR_ST
1 - comparison of intake air and coolant temperature value)
and

TCO_ST_STUCK_RNG > IP_TCO_ST_TCO_STUCK_RNG
(path 2 - comparison of engine off time to coolant temperature value)

then(2) LV_ERR_TCO_STUCK_RNG = 1
ERR_SYM_TCO_STUCK_RNG = "SYM_3"
LV_END_DIAG_TCO_STUCK_RNG = 1
else(2) LV_ERR_TCO_STUCK_RNG = 0
ERR_SYM_TCO_STUCK_RNG = "NO_SYM"
LV_END_DIAG_TCO_STUCK_RNG = 1
endif(2)
endif(1)

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B.61 Coolant temperature sensor stuck in range diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_TCO_STUCK_RNG	O/V	0... 1H	0 ...1	1	-
Boolean for inhibition of coolant temperature signal stuck in range diagnosis					
STATE_RBM_TCO_STUCK_RNG	O/V	0... FFH	0... 255	1	-
Interface of TCO_STUCK_RNG monitor with the Rate-Based Monitoring statistics					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CDN_CST_RBM {p. 5870}	LV_DC {p. 5746}	LV_END_DIAG_TCO_STUCK_RNG {p. 5675}
LV_ERR_BN_T_ICL {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_ECU_NVMY {p. 4232}	LV_ERR_T_ES {p. 4466}
LV_ERR_TAM_CAN {p. 5076}	LV_ERR_TAM_PLAUS {p. 5076}	LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}
LV_ERR_TCO_PLAUS {p. 5682}	LV_ERR_TCO_STUCK {p. 5691}	LV_ERR_TIA_EL {p. 4194}	LV_ERR_TIA_GRD {p. 4194}
LV_ERR_TIA_PLAUS {p. 5093}	LV_IGK {p. 906}	LV_ST_END {p. 1720}	

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

Error treatment:

Diagnostic TCO_STUCK_RNG	Symptom description	Symptom	Filter type
TCO sensor stuck in range diagnosis			*NO*
	TCO sensor stuck in range error	*SYM_3*	

B.61.1 Inhibition of diagnosis

FUNCTION DESCRIPTION:

FUNCTION DESCRIPTION:

General information:

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Depending on project specific requirements, the coolant temperature sensor stuck in range diagnosis can be inhibited by setting of the logical variable LV_INH_DIAG_TCO_STUCK_RNG.

Application conditions

Initialisation at RESET **or** EXIT_ST **or** LV_IGK = 0 -> 1 **or** FMY clear:
LV_INH_DIAG_TCO_STUCK_RNG = 0

Recurrence: *100 ms*

Activation: LV_IGK = 1
(Calculation of the TCO_STUCK_RNG diag. interface parameter enabled)

Deactivation: LV_IGK = 0 **or**
LV_END_DIAG_TCO_STUCK_RNG = 1
(Calculation of the TCO_STUCK_RNG diag. interface parameter disabled)

Formula section:

If LV_ERR_TCO_EL = 1 **or**
LV_ERR_TCO_GRD = 1 **or**
LV_ERR_TIA_EL = 1 **or**
LV_ERR_TIA_PLAUS = 1 **or**
LV_ERR_TAM_CAN = 1 **or**
LV_ERR_TAM_PLAUS = 1 **or**
LV_ERR_BN_T_ICL = 1 **or**
LV_ERR_TIA_GRD = 1 **or**
LV_ERR_CAN_BOFF = 1 **or**
LV_ERR_T_ES = 1 **or**
LV_ERR_ECU_NVMY = 1 **or**
((LV_ST_END = 1 **and**
(LV_ERR_TCO_PLAUS = 1 **or**
LV_ERR_TCO_STUCK = 1)) **or**
Then LV_INH_DIAG_TCO_STUCK_RNG = 1
Endif

B.61.2 Interface to rate-based monitoring

FUNCTION DESCRIPTION:

General information:

With this module the interface between the TCO_STUCK_RNG monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_TCO_STUCK_RNG data.
Within STATE_RBM_TCO_STUCK_RNG, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

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Application conditions

Initialisation:
```
at ECU reset:
bit 0, bit 1 and bit 2 of STATE_RBM_TCO_STUCK_RNG = 0
at LV_DC 0  1 transition:
bit 0, bit 1 and bit 1 of STATE_RBM_TCO_STUCK_RNG = 0
on failure memory reset:
bit 1 of STATE_RBM_TCO_STUCK_RNG = 0
```

Recurrence: *100ms*

Activation: *LV_DC 0 1 transition* ***and*** *LV_DC = 1*

Formula section:

At LV_DC 0 1 transition
The pending status of the following failures has to be checked only once:

LV_ERR_TCO_EL	LV_ERR_TCO_GRD	LV_ERR_TCO_PLAUS	LV_ERR_TIA_PLAUS
LV_ERR_TCO_STUCK	LV_ERR_TIA_EL	LV_ERR_TAM_PLAUS	LV_ERR_TAM_CAN
LV_ERR_BN_T_ICL	LV_ERR_CAN_BOFF	LV_ERR_ECU_NVMY	LV_ERR_T_ES
LV_ERR_TIA_GRD			

If(1) { CPU optimization at LV_DC 0 1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }
Then(1)
While bit 1 of STATE_RBM_TCO_STUCK_RNG = 0 **do**
with each XX failure of the above list :
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2)
bit 1 of STATE_RBM_TCO_STUCK_RNG = 1
Endif(2)
Endwhile
Else(1)
{ the dynamic failure memory is empty }
No action
Endif(1)

Every 100ms:

If bit 0 of STATE_RBM_TCO_STUCK_RNG = 0
Then
If LV_END_DIAG_TCO_STUCK_RNG = 1
Then bit 0 of STATE_RBM_TCO_STUCK_RNG = 1
Endif
Endif
If bit 1 of STATE_RBM_TCO_STUCK_RNG = 0
Then
If LV_INH_DIAG_TCO_STUCK_RNG = 1
Then bit 1 of STATE_RBM_TCO_STUCK_RNG = 1
Endif
Endif
If bit 2 of STATE_RBM_TCO_STUCK_RNG = 0
Then
If LV_CDN_CST_RBM = 1

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Then bit 2 of STATE_RBM_TCO_STUCK_RNG = 1
Endif
Endif

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B.62 Coolant temperature sensor plausibility diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TCO_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom for coolant temperature plausibility error					
LV_CDN_DIAG_TCO_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature plausibility diagnosis conditions					
LV_END_DIAG_RBM_TCO_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature plausibility diagnosis for RBM					
LV_END_DIAG_TCO_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature plausibility diagnosis					
LV_ERR_TCO_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature plausibility error					
T_AST_DIAG_TCO_PLAUS	V	0... FFFFH	0... 65535	1	s
Time after start of the performed coolant temperature plausibility diagnosis					
T_AST_MAX_DIAG_TCO_PLAUS	V	0... FFFFH	0... 65535	1	s
Maximum time after start to reach closed-loop enable temperature for coolant temperature plausibility diagnosis					
T_MIN_DIAG_TCO_PLAUS	V	0... FFFFH	0... 65535	1	s
Minimum time to activate the coolant temperature plausibility diagnosis					
TCO_DIF_DIAG_TCO_PLAUS	V	80... 7FH	-96... 95.25	0.75	°C
Difference between closed-loop enable- and coolant temperature at start for coolant plausibility diagnosis					

Input data:

LV_CDN_VB_OBD_2	LV_INH_DIAG_TCO_ PLAUS {p. 5687}	LV_PUC {p. 1720}	LV_ST_END {p. 1720}
RATIO_T_IS_AST {p. 4493}	T_DIAG_AST {p. 4493}	TCO {p. 1100}	TCO_ST {p. 1100}
TCO_SUB {p. 1105}	TIA_THR_ST {p. 984}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_T_MAX_DIAG_TCO_PLAUS	-	1... FFFFH	1... 65535	1	s
LDP_TCO_DIF_DIAG_TCO_PLAUS_ID_T	4	0... FFH	-96... 95.25	0.75	°C
Time interval to reach closed-loop enable temperature for coolant temperature plausibility diagnosis					
ID_T_MIN_DIAG_TCO_PLAUS	-	1... FFFFH	1... 65535	1	s
LDP_TIA_THR_ST_ID_T_TCO_PLAUS	6	0... FEH	-48... 142.5	0.75	°C
Minimum time for coolant temperature plausibility diagnosis activation					
ID_TCO_MIN_DIAG_TCO_PLAUS	V	0... FEH	-48... 142.5	0.75	°C
LDP_TCO_ST_ID_TCO_MIN_DIAG_TCO	6	0... FEH	-48... 142.5	0.75	°C
LDP_RATIO_T_IS_AST_ID_TCO_DIAG	6	0... FFH	0... 99.60937	0.390625	%
Minimum coolant temperature threshold for coolant temperature plausibility diagnosis					

Configuration data:

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_T_DLY_TCO_PLAUS	-	0... 1H	0 ...1	1	-
Logical calibration data to switch between delay timer based on absolute or relative temperature at start					
LC_TCO_PLAUS_TCO_SUB_DIAG_INH	-	0... 1H	0 ...1	1	-
Logical calibration data to inhibit the use of TCO_SUB condition for error detection					

FUNCTION DESCRIPTION:

General information:

To monitor the activation of the lambda control after start above a coolant temperature threshold (OBD II requirement), a plausibilization between the coolant temperature increase (TCO) and the calculated coolant temperature increase (TCO_SUB) is made.
The coolant temperature plausibility diagnosis is performed once per engine run.
If the engine stalls and the coolant temperature plausibility diagnosis has not run out, then at the next engine start the timer will be initialized new and the diagnosis starts again. When the diagnosis is finished, the Boolean for end of coolant temperature plausibility diagnosis is set.
Remark: At the time when the TCO-plausibility diagnosis is performed, it is not possible to distinguish between a TCO-plausibility error and a Thermostat error (which can only be detected later). Therefore a TCO-plausibility error is entered, even if the problem may be related to the Thermostat (in order to activate the limp home in case there is really a problem with the coolant temperature sensor).
That means, if additionally to the TCO- plausibility error a Thermostat diagnosis error is detected, the TCO-plausibility error can be ignored.

Description:

Error-symptoms are defined to this diagnosis function as following:

```
|_|_|_|_|
 | | | └─> -                                      (= SYM_0)
 | | └───> -                                      (= SYM_1)
 | └─────> -                                      (= SYM_2)
 └───────> Coolant temperature plausibility error (= SYM_3)
```

Application conditions

Initialisation at EXIT_ST:

```
LV_ERR_TCO_PLAUS = 0
LV_CDN_DIAG_TCO_PLAUS = 0
LV_END_DIAG_RBM_TCO_PLAUS = 0
ERR_SYM_TCO_PLAUS =  NO_SYM
T_MIN_DIAG_TCO_PLAUS = ID_T_MIN_DIAG_TCO_PLAUS
T_AST_DIAG_TCO_PLAUS = 0
TCO_DIF_DIAG_TCO_PLAUS =
     ID_TCO_MIN_DIAG_TCO_PLAUS - TCO_ST
T_AST_MAX_DIAG_TCO_PLAUS = ID_T_MAX_DIAG_TCO_PLAUS
```

// LV_END_DIAG_TCO_PLAUS is directly initialized by ERRM

Recurrence: 1000 ms

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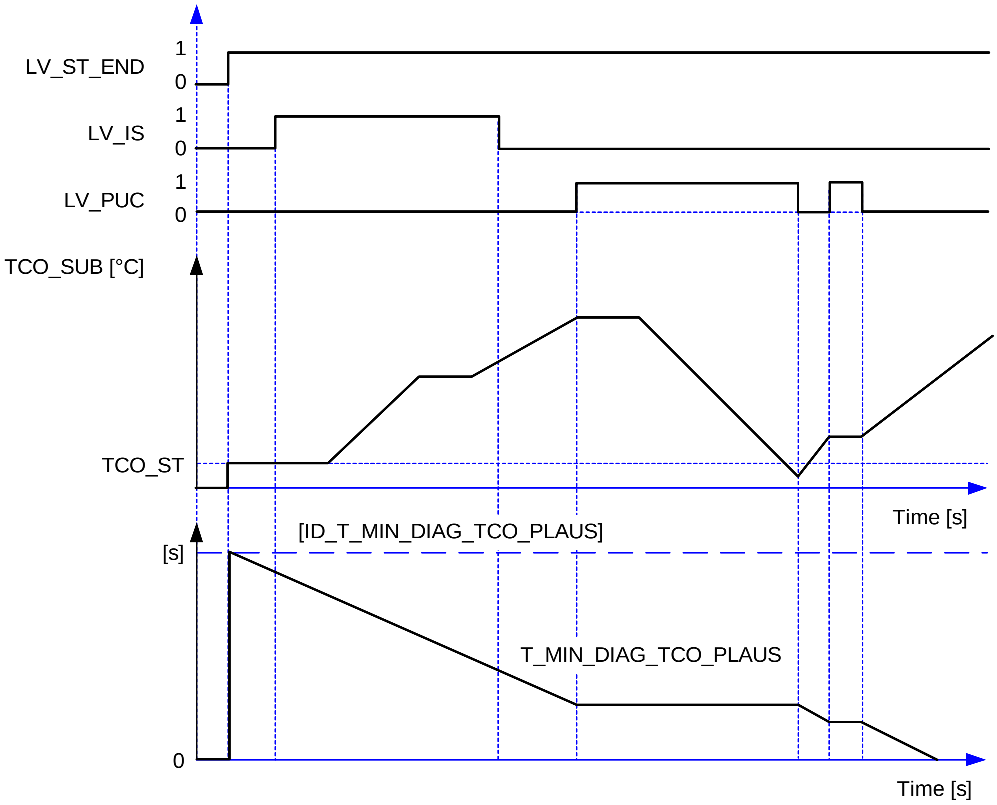
Activation: LV_ST_END = 1

Deactivation: LV_ST_END = 0

Signal flow diagram:



Formula section:

Calculation of plausibility diagnosis activation conditions:

If LV_INH_DIAG_TCO_PLAUS = 0 **and**
LV_END_DIAG_TCO_PLAUS = 0 **and**
LV_CDN_VB_OBD_2 = 1
then LV_CDN_DIAG_TCO_PLAUS = 1
else LV_CDN_DIAG_TCO_PLAUS = 0
endif

Calculation of minimum diagnosis time after engine start and end of diagnosis for RBM:

If(1) LV_END_DIAG_RBM_TCO_PLAUS = 0 **and**
LV_INH_DIAG_TCO_PLAUS = 0 **and**
LV_CDN_VB_OBD_2 = 1
then(1)
if(2a) LV_PUC = 1
then(2a) $T\_MIN\_DIAG\_TCO\_PLAUS_{(n)}$ = $T\_MIN\_DIAG\_TCO\_PLAUS_{(n-1)}$
$T\_AST\_MAX\_DIAG\_TCO\_PLAUS_{(n)}$ = $T\_AST\_MAX\_DIAG\_TCO\_PLAUS_{(n-1)}$
else(2a) $T\_MIN\_DIAG\_TCO\_PLAUS_{(n)}$ = $T\_MIN\_DIAG\_TCO\_PLAUS_{(n-1)}$ - 1 s
$T\_AST\_MAX\_DIAG\_TCO\_PLAUS_{(n)}$ = $T\_AST\_MAX\_DIAG\_TCO\_PLAUS_{(n-1)}$ - 1s

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```
                        // counter minimum value limited to zero, no overflow possible
  endif(2a)
  if(2b)                  LC_T_DLY_TCO_PLAUS = 1
  then(2b)                    // only use of delay time based on absolute temperature at start
       if(2c)                 T_MIN_DIAG_TCO_PLAUS = 0                                     and
                ( TCO_SUB      ID_TCO_MIN_DIAG_TCO_PLAUS                  or
                            LC_TCO_PLAUS_TCO_SUB_DIAG_INH = 1 )
                       // default is LC_TCO_PLAUS_TCO_SUB_DIAG_INH = 1; this must also be kept
                       for US applications, exept lambda activation by TCO is circumvented
           then(2c)             LV_END_DIAG_RBM_TCO_PLAUS = 1
                            // end of diagnosis for RBM
           endif(2c)
         else(2b)             // only use of delay time based on relative temperature at start
           if(2d)     T_AST_MAX_DIAG_TCO_PLAUS = 0                         and
                ( TCO_SUB      ID_TCO_MIN_DIAG_TCO_PLAUS                  or
                            LC_TCO_PLAUS_TCO_SUB_DIAG_INH = 1 )
                                // default is LC_TCO_PLAUS_TCO_SUB_DIAG_INH = 1; this must also
                       be kept for US applications, exept lambda activation by TCO is circumvented
           then(2d)             LV_END_DIAG_RBM_TCO_PLAUS = 1
                            // end of diagnosis for RBM
           endif(2d)
         endif(2b)
endif(1)
```

<u>Error detection:</u>

```
If(1)                          LV_CDN_DIAG_TCO_PLAUS = 1
then(1)
  If(2)                   TCO > ID_TCO_MIN_DIAG_TCO_PLAUS
  then(2)             ERR_SYM_TCO_PLAUS =   NO_SYM
                        LV_ERR_TCO_PLAUS = 0                          // without debounce
                        LV_END_DIAG_TCO_PLAUS = 1                     // end of diagnosis
                        T_AST_DIAG_TCO_PLAUS = T_DIAG_AST
  else(2)
     if(3)                LC_T_DLY_TCO_PLAUS = 1
  then(3)                  // only use of delay time based on absolute temperature at start

           if(4a)               T_MIN_DIAG_TCO_PLAUS = 0                                   and

                ( TCO_SUB      ID_TCO_MIN_DIAG_TCO_PLAUS                  or
                            LC_TCO_PLAUS_TCO_SUB_DIAG_INH = 1 )
                                // default is LC_TCO_PLAUS_TCO_SUB_DIAG_INH = 1; this must also
                       be kept for US applications, exept lambda activation by TCO is circumvented
           then(4a)     ERR_SYM_TCO_PLAUS =   SYM_3
                        LV_ERR_TCO_PLAUS = 1                          // without debounce
                        LV_END_DIAG_TCO_PLAUS = 1                     // end of diagnosis
                        T_AST_DIAG_TCO_PLAUS = T_DIAG_AST
           endif(4a)
     else(3)         // only use of delay time based on relative temperature at start
           if(4b)     T_AST_MAX_DIAG_TCO_PLAUS = 0             and
                ( TCO_SUB      ID_TCO_MIN_DIAG_TCO_PLAUS                  or
                            LC_TCO_PLAUS_TCO_SUB_DIAG_INH = 1 )
                                // default is LC_TCO_PLAUS_TCO_SUB_DIAG_INH = 1; this must also
                       be kept for US applications, exept lambda activation by TCO is circumvented
```

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```
then(4b)   ERR_SYM_TCO_PLAUS =   SYM_3
           LV_ERR_TCO_PLAUS = 1                 // without debounce
           LV_END_DIAG_TCO_PLAUS = 1            // end of diagnosis
           T_AST_DIAG_TCO_PLAUS = T_DIAG_AST
endif(4b)
endif(3)
endif(2)
endif(1)
```

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B.63 Coolant temperature sensor plausibility diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_RBM_TCO_PLAUS	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature plausibility diagnosis inhibit due to OBD error					
LV_INH_DIAG_TCO_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for coolant temperature plausibility diagnosis inhibit					
STATE_RBM_TCO_PLAUS	O/V	0... 7H	0 ...7	1	-
Interface of TCO_PLAUS monitor with the Rate-Based Monitoring statistics					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CDN_CST_RBM {p. 5870}	LV_CDN_DIAG_TCO_PLAUS {p. 5682}	LV_DC {p. 5746}
LV_END_DIAG_RBM_TCO_PLAUS {p. 5682}	LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}	LV_ERR_TCO_STUCK {p. 5691}
LV_ERR_TCO_STUCK_RNG {p. 5675}	LV_ERR_TIA_EL {p. 4194}	LV_ERR_TIA_GRD {p. 4194}	LV_ERR_TIA_PLAUS {p. 5093}
LV_ES {p. 1720}	LV_IGK {p. 906}		

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

Error treatment:

Error debounce:
no debounce

B.63.1 Diagnosis inhibition

FUNCTION DESCRIPTION:

General information:

The coolant temperature sensor plausibility diagnosis is performed at transition from the logical value for Start from 1 to 0 . If the engine stalls or one of the conditions for inhibiting the diagnosis is present, it will be stopped and starts again at the next engine start.
The diagnosis is finished as soon as the boolean for end of coolant temperature sensor plausibility diagnosis is set to 1 . In this case the boolean for coolant temperature plausibility error indicates either a not plausible (= 1) or a normal (= 0) coolant temperature sensor signal.
Depending on project specific requirements, the coolant temperature sensor plausibility diagnosis can be inhibited by setting of LV_INH_DIAG_TCO_PLAUS.

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Application conditions

Initialisation:

```
If      Reset    or  Transition:     LV_IGK = 0 -> 1
then       LV_INH_DIAG_TCO_PLAUS= 0
endif
```

Recurrence: *1000 ms*

Activation:

If LV_CDN_DIAG_TCO_PLAUS = 1
then *(Calculation of the TCO plausi. diagnosis interface parameter enabled)*
endif

Deactivation:

If LV_CDN_DIAG_TCO_PLAUS = 0
then *(Calculation of the TCO plausi. diagnosis interface parameter disabled)*
endif

Formula section:

If LV_ERR_TCO_EL = 0 **and**
LV_ERR_TCO_GRD = 0 **and**
LV_ERR_TCO_STUCK = 0 **and**
LV_ERR_TCO_STUCK_RNG = 0 **and**
LV_ERR_TIA_EL = 0 **and**
LV_ERR_TIA_PLAUS = 0 **and**
LV_ERR_TIA_GRD = 0
then LV_INH_DIAG_RBM_TCO_PLAUS = 0
else LV_INH_DIAG_RBM_TCO_PLAUS = 1
endif

If LV_ES = 0 **and**
LV_IGK = 1 **and**
LV_INH_DIAG_RBM_TCO_PLAUS = 0
then LV_INH_DIAG_TCO_PLAUS = 0
else LV_INH_DIAG_TCO_PLAUS = 1
endif

B.63.2 Interface for Rate - Based - Monitoring

FUNCTION DESCRIPTION:

General information:

With this module the interface between the TCO_PLAUS monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_TCO_PLAUS data.
Within STATE_RBM_TCO_PLAUS, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

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Application conditions:

Initialisation :
at LV_DC 0   1 transition :
bit 0, bit 1 and bit 2 of STATE_RBM_TCO_PLAUS = 0
on failure memory reset :
bit 1 of STATE_RBM_TCO_PLAUS = 0
Recurrence: 1 s
Activation: LV_DC 0   1 transition **and** LV_DC = 1

Formula section:

At LV_DC 0   1 transition
The pending status of the following failures has to be checked only once :

LV_ERR_TCO_EL	LV_ERR_TCO_STUCK	LV_ERR_TCO_GRD	LV_ERR_TIA_EL
LV_ERR_TIA_PLAUS	LV_ERR_TCO_STUCK_RNG	LV_ERR_TIA_GRD	

If(1) { CPU optimization at LV_DC 0   1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }
Then(1)
While bit 1 of STATE_RBM_TCO_PLAUS = 0 **do**
with each XX failure of the above list :
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2)
bit 1 of STATE_RBM_TCO_PLAUS = 1
Endif(2)
Endwhile
Else(1)
{ the dynamic failure memory is empty }
No action
Endif(1)
Every 1 s :
If bit 0 of STATE_RBM_TCO_PLAUS = 0
Then
If LV_END_DIAG_RBM_TCO_PLAUS = 1
Then bit 0 of STATE_RBM_TCO_PLAUS = 1
Endif
Endif

If bit 1 of STATE_RBM_TCO_PLAUS = 0
Then
If LV_INH_DIAG_RBM_TCO_PLAUS = 1
Then bit 1 of STATE_RBM_TCO_PLAUS = 1
Endif
Endif

If bit 2 of STATE_RBM_TCO_PLAUS = 0
Then
If LV_CDN_CST_RBM = 1

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Then bit 2 of STATE_RBM_TCO_PLAUS = 1
Endif
Endif

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B.64 Temperature sensor stuck low diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TCO_STUCK	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Symptom for coolant temperature stuck signal error					
LV_CDN_DIAG_TCO_STUCK	V	0... 1H	0 ...1	1	-
Boolean for coolant temperature stuck signal diagnosis conditions					
LV_END_DIAG_TCO_STUCK	O/V	0... 1H	0 ...1	1	-
Boolean for end of coolant temperature stuck signal diagnosis					
LV_ERR_TCO_STUCK	O/V	0... 1H	0 ...1	1	-
TCO Stuck signal detected					
TCO_MES_DIF_DIAG_TCO_STUCK	V	0... FEH	0... 190.5	0.75	°C
Difference of measured coolant temperature values for coolant temperature stuck signal diagnosis					
TCO_MES_MAX_DIAG_TCO_STUCK	V	0... FEH	-48... 142.5	0.75	°C
Measured coolant temperature maximum value for coolant temperature stuck signal diagnosis					
TCO_MES_MIN_DIAG_TCO_STUCK	V	0... FEH	-48... 142.5	0.75	°C
Measured coolant temperature minimum value for coolant temperature stuck signal diagnosis					
TCO_SUB_DIF_DIAG_TCO_STUCK	V	0... FEH	0... 190.5	0.75	°C
Difference of substitute coolant temperature values for coolant temperature stuck signal diagnosis					
TCO_SUB_MAX_DIAG_TCO_STUCK	V	0... FEH	-48... 142.5	0.75	°C
Substitute coolant temperature maximum value for coolant temperature stuck signal diagnosis					
TCO_SUB_MIN_DIAG_TCO_STUCK	V	0... FEH	-48... 142.5	0.75	°C
Substitute coolant temperature minimum value for coolant temperature stuck signal diagnosis					

Input data:

LV_CDN_VB_MIN_DIAG {p. 1185}	LV_INH_DIAG_TCO_ STUCK {p. 4502}	LV_ST_END {p. 1720}	TCO_MES {p. 1100}
TCO_ST {p. 1100}	TCO_SUB {p. 1105}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TCO_MES_DIF_DIAG_TCO_STUCK	-	0... FEH	0... 190.5	0.75	°C
LDPM_TCO_ST_1_ENTE	6	0... FEH	-48... 142.5	0.75	°C
Minimum increase of the TCO value for the coolant temperature stuck signal diagnosis					
IP_TCO_SUB_DIF_DIAG_TCO_STUCK	-	0... FEH	0... 190.5	0.75	°C
LDPM_TCO_ST_1_ENTE	6	0... FEH	-48... 142.5	0.75	°C
Minimum increase of the TCO_SUB value for the coolant temperature stuck signal diagnosis					

FUNCTION DESCRIPTION:

General information:

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The purpose of the signal stuck diagnosis is to detect a stuck measured coolant temperature sensor signal. The diagnosis function checks if after a variation of the calculated coolant temperature substitute value (TCO_SUB) also a variation of the measured coolant temperature value (TCO_MES) is detected.
The diagnosis is performed only once per engine run. The symptom of the error code is not handled by anti-bouncing.

Description:

Error-symptoms are defined to this diagnosis function as following:

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> -                                          (= SYM_0)
 │ │ └───> -                                          (= SYM_1)
 │ └─────> -                                          (= SYM_2)
 └───────> Coolant temperature signal stuck error     (= SYM_3)
```

Application conditions

Initialisation at Exit start (EXIT_ST): LV_ERR_TCO_STUCK = 0
LV_CDN_DIAG_TCO_STUCK = 0
LV_END_DIAG_TCO_STUCK = 0
ERR_SYM_TCO_STUCK = NO_SYM
TCO_MES_DIF_DIAG_TCO_STUCK = 0°C
TCO_SUB_DIF_DIAG_TCO_STUCK = 0°C
TCO_MES_MIN_DIAG_TCO_STUCK = 142.5°C
TCO_MES_MAX_DIAG_TCO_STUCK = -48°C
TCO_SUB_MIN_DIAG_TCO_STUCK = TCO_SUB
TCO_SUB_MAX_DIAG_TCO_STUCK = TCO_SUB

Recurrence: *1000 ms*

Activation: *LV_ST_END = 1*

Deactivation: LV_ST_END = 0

Formula section:

If LV_CDN_VB_MIN_DIAG = 1 **and**
LV_INH_DIAG_TCO_STUCK = 0 **and**
LV_END_DIAG_TCO_STUCK = 0
then LV_CDN_DIAG_TCO_STUCK = 1
else LV_CDN_DIAG_TCO_STUCK = 0
endif

IF(1) LV_CDN_DIAG_TCO_STUCK = 1
THEN(1)
Calculation of the coolant temperature-boundary values:
If(2) TCO_MES < TCO_MES_MIN_DIAG_TCO_STUCK
then(2) TCO_MES_MIN_DIAG_TCO_STUCK = TCO_MES
else(2) TCO_MES_MIN_DIAG_TCO_STUCK = TCO_MES_MIN_DIAG_TCO_STUCK
endif(2)
If(2) TCO_MES > TCO_MES_MAX_DIAG_TCO_STUCK
then(2) TCO_MES_MAX_DIAG_TCO_STUCK = TCO_MES

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else(2) TCO_MES_MAX_DIAG_TCO_STUCK = TCO_MES_MAX_DIAG_TCO_STUCK
endif(2)
If(2) TCO_SUB < TCO_SUB_MIN_DIAG_TCO_STUCK
then(2) TCO_SUB_MIN_DIAG_TCO_STUCK = TCO_SUB
else(2) TCO_SUB_MIN_DIAG_TCO_STUCK = TCO_SUB_MIN_DIAG_TCO_STUCK
endif(2)
If(2) TCO_SUB > TCO_SUB_MAX_DIAG_TCO_STUCK
then(2) TCO_SUB_MAX_DIAG_TCO_STUCK = TCO_SUB
else(2) TCO_SUB_MAX_DIAG_TCO_STUCK = TCO_SUB_MAX_DIAG_TCO_STUCK
endif(2)
Calculation of the coolant temperature-difference values:
TCO_MES_DIF_DIAG_TCO_STUCK =
| TCO_MES_MAX_DIAG_TCO_STUCK - TCO_MES_MIN_DIAG_TCO_STUCK **|**
TCO_SUB_DIF_DIAG_TCO_STUCK =
| TCO_SUB_MAX_DIAG_TCO_STUCK - TCO_SUB_MIN_DIAG_TCO_STUCK **|**

Error detection:
If (2) TCO_SUB_DIF_DIAG_TCO_STUCK > IP_TCO_SUB_DIF_DIAG_TCO_STUCK
then (2)
if (3) TCO_MES_DIF_DIAG_TCO_STUCK < IP_TCO_MES_DIF_DIAG_TCO_STUCK
then (3) LV_ERR_TCO_STUCK = 1 (without debounce)
ERR_SYM_TCO_STUCK = SYM_3
LV_END_DIAG_TCO_STUCK = 1
else (3) LV_ERR_TCO_STUCK = 0 (without debounce)
ERR_SYM_TCO_STUCK = NO_SYM
LV_END_DIAG_TCO_STUCK = 1
endif (3)
endif (2)
ENDIF(1)

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B.65 Communication interface

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_DTC [NC_NR_ERR_DYN]	-	0... FH	0... 15	1	-
Symtom calculation used by the API communication					
IDX_TMP_RBM	V	0... FFH	0... 255	1	-
Temporary current position, within the list [0 ... (NC_NR_DIAG_RBM-1)], of the monitor with the lowest ratio					
LV_MKD_MOD	O	0... 1H	0 ...1	1	-
Marked Mode					
RATIO_TMP_RBM	O	0... 200498A4H	0... 65535.0001	122e-6	-
Temporary variable used to store the lowest Numerator/Denominator ratio of the monitor located at IDX_TMP_RBM position					
SYM_CYL_DTC_MIS_A	-	0... FFFFH	0... 65535	1	-
Cylinder calculation with misfire A used by the API communication					
SYM_CYL_DTC_MIS_B1	-	0... FFFFH	0... 65535	1	-
Cylinder calculation with misfire B1 used by the API communication					
SYM_CYL_DTC_MIS_B4	-	0... FFFFH	0... 65535	1	-
Cylinder calculation with misfire B4 used by the API communication					

Input data:

C_ERR_CLAS_XX {p. 5811}	CTR_ABC_END_DIAG_XX {p. 4640}	CTR_ABC_XX {p. 4640}	CTR_CDN_OBD_RBM {p. 5858}
CTR_CDN_RBM [NC_NR_DIAG_RBM] {p. 5858}	CTR_COMP_RBM [NC_NR_DIAG_RBM] {p. 5858}	CTR_DC [NC_NR_ERR_DYN] {p. 5767}	CTR_ERR_DYN_NR {p. 5767}
CTR_FRC [NC_NR_ERR_DYN] {p. 5767}	CTR_IGK_CYC_RBM {p. 5858}	CTR_WUP_CYC [NC_NR_ERR_DYN] {p. 5767}	DC_DEC_XX
DC_INC_XX	DC_MAX_XX	ENVD_CUS_CMN [NC_NR_ENVD_CUS_CMN][NC_NR_ERR_DYN] {p. 5792}	ENVD_CUS_SET_CMN [NC_NR_ENVD_CUS_SET_CMN][NC_NR_FRF_SET][NC_NR_ERR_DYN] {p. 5792}
ENVD_CUS_SET_SPC [NC_NR_ENVD_CUS_SET_SPC][NC_NR_FRF_SET][NC_NR_ERR_DYN] {p. 5792}	ENVD_OBD [NC_NR_ENVD_OBD][NC_NR_ERR_DYN] {p. 5792}	ERR_SYM_LST [NC_NR_ERR_DYN] {p. 5756}	ERR_SYM_MEM [NC_NR_ERR_DYN] {p. 5756}
ERR_SYM_PERM [NC_NR_ERR_PERM] {p. 5842}	ERR_SYM_XX {p. 4581}	ID_ERR_DTC_MIS {p. 5756}	ID_ERR_DTC_XX {p. 5757}
LV_CDN_DIAG_XX {p. 4581}	LV_DC {p. 5746}	LV_DC_MAX [NC_NR_ERR_DYN] {p. 5767}	LV_END_DIAG_XX {p. 4581}
LV_ERR_CFM [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_DC [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_DISA [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_MEM_XX {p. 5767}

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LV_ERR_TMP [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_XX	LV_READY_XX {p. 5881}	NC_CYL_NR {p. 1526}
NC_NR_DIAG_RBM {p. 5871}	NC_NR_DTC_FMT {p. 5757}	NC_RBM_BPA {p. 5871}	NC_RBM_CAT_1 {p. 5872}
NC_RBM_CAT_2 {p. 5872}	NC_RBM_EG_1 {p. 5872}	NC_RBM_EGR_VVT {p. 5872}	NC_RBM_EGR_VVT_DSL {p. 5872}
NC_RBM_EVAP {p. 5872}	NC_RBM_LS_DOWN_1 {p. 5872}	NC_RBM_LS_DOWN_2 {p. 5872}	NC_RBM_LS_UP_1 {p. 5872}
NC_RBM_LS_UP_2 {p. 5872}	NC_RBM_NMHC {p. 5872}	NC_RBM_NT {p. 5872}	NC_RBM_PF {p. 5872}
NC_RBM_RCAT {p. 5872}	NLC_OBD_DSL {p. 5789}	NLC_OBD_RBM_ENA {p. 645}	NLC_TREAT_DIAG_MIS {p. 6265}
PRI_CONF_XX {p. 5811}	STATE_READY_OBD_1 {p. 5881}	STATE_READY_OBD_2 {p. 5881}	STATE_READY_OBD_3 {p. 5881}
SYM_CYL_LST_MIS_A {p. 5756}	SYM_CYL_LST_MIS_B1 {p. 5756}	SYM_CYL_LST_MIS_B4 {p. 5756}	SYM_CYL_MEM_MIS_A {p. 5756}
SYM_CYL_MEM_MIS_B1 {p. 5756}	SYM_CYL_MEM_MIS_B4 {p. 5756}	SYM_CYL_PERM_MIS_A {p. 5842}	SYM_CYL_PERM_MIS_B1 {p. 5842}
SYM_CYL_PERM_MIS_B4 {p. 5842}	WAL_CONF_XX {p. 5811}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_READY_CMPL_OBD_1	-	0... FFH	0... 255	1	-
Readiness MIS, FSD, CC directly set to ready					
C_STATE_READY_OBD_1	-	0... FFH	0... 255	1	-
Status configuration for readiness code (continuous tests)					
C_STATE_READY_OBD_2	-	0... FFH	0... 255	1	-
Status configuration for readiness code (non continuous tests)					
C_STATE_READY_OBD_3	-	0... FFH	0... 255	1	-
Status configuration for customer specific readiness code					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ERR_DTC_REQ_CUS	-	0... 1H	0 ...1	1	-
This bit shall be set to 0 (SYMPTOM) to read customer DTC by symptomThis bit shall be set to 1 (FAILURE) to read customer DTC by failure					
NC_ERR_DTC_REQ_OBD	-	0... 1H	0 ...1	1	-
This bit shall be set to 0 (SYMPTOM) to read OBD DTC by symptomThis bit shall be set to 1 (FAILURE) to read OBD DTC by failure					
NLC_OBD_FRF_PND	-	0... 1H	0 ...1	1	-
Defines freeze frame strategy for OBD freeze frame for Mode 02h (0: FRF on confirmed error /1: FRF on pending error)					

Action definition

ACTION_ERRM_ActivateMarkedMode (<IN>,<MarkedMode>)	Mode: O
This API shall be used to activate/deactivate the marked mode.	

ACTION_ERRM_ClearRbmStatistics (<OUT>,<PRM_RESULTCLRINFO>)	Mode: O
This action clears all the Rate-Based Monitoring statistics	

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ACTION_ERRM_ClrInfoByDtc (<IN>,<DtcIdentifier>,<IN>,<LevelOfDtc>,<OUT>,<ResultClrInfo>)	Mode: O
This action clear the failure in dynamic memory associated to a DTC number.	

ACTION_ERRM_ClrInfoByTypeOfDtc (<IN>,<TypeOfDtc>,<OUT>,<ResultClrInfo>)	Mode: O
This action clear all the failure in dynamic memory associated to DTC with a certain type.	

ACTION_ERRM_ControlDtcSettings (<IN>,<MarkedMode>)	Mode: O
This action allows to activate or deactivate the marked mode. In this mode all new failure which appears are marked and then erased when we leave this mode.	

ACTION_ERRM_ReadDtcByDtc (<IN>,<DtcIdentifier>,<IN>,<LevelOfDtc>,<OUT>,<ResultDtc>)	Mode: O
This action returns a result to learn if a DTC number of a certain level is stored in memory.	

ACTION_ERRM_ReadDtcByTypeOfDtc (<IN>,<TypeOfDtc>,<IN>,<LevelOfDtc>,<INOUT>,<ListOfDtc>,<OUT>, <ResultDtc>)	Mode: O
This action returns a list of DTC. All the DTC returns have the same type defined by the parameter TypeOfDtc	

ACTION_ERRM_ReadDtcLevelByDtcLevel (<IN>,<DtcIdentifier>,<IN>,<LevelOfDtc>,<INOUT>,<ListofDtc>, <OUT>,<ResultDtc>)	Mode: O
This action returns a Customer DTCLevel of Law DTCLevel which is stored in dynamic memory or returns a Law DTCLevel of Customer DTCLevel which is stored in dynamic memory.	

ACTION_ERRM_ReadFrfByDtc (**IN**<PRM_TYPEOFFF>,**IN**<PRM_FFIDENTIFIER>,**IN**<PRM_DTCIDENTIFIER>, **IN**<PRM_LEVELOFDTC>,**INOUT**<PRM_FRF>,**OUT**<PRM_RESULTFRF>)	Mode: O
This API returns a freeze frame or a part of freeze frame.	

Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_TYPEOFFF	in	0... FFFFH	0... 65535	1	-
Type of Freeze Frame					
PRM_FFIDENTIFIER	in	0... FFH	0... 255	1	-
Freeze frame number					
PRM_DTCIDENTIFIER	in	0... FFH	0... 255	1	-
DTC number					
PRM_LEVELOFDTC	in	01H 02H	LAW CUS	-	-
OBD or Customer DTC					
PRM_FRF	inout	0... FFH	0... 255	1	-
Pointer to buffer for Freeze frame					
PRM_RESULTFRF	out	0... FFH	0... 255	1	-
Result of Freeze frame reading					

ACTION_ERRM_ReadInfoByDtc (<IN>,<DtcIdentifier>,<IN>,<LevelOfDtc>,<IN>,<InfoIdentifier>,<INOUT>, <ListOfDtcInfo>,<OUT>,<ResultDtc>)	Mode: O
This action returns a structure of data of a DTC, which is stored in dynamic memory.	

ACTION_ERRM_ReadInfoByTypeOfDtc (<IN>,<TypeOfDtc>,<IN>,<InfoIdentifier>,<INOUT>,<ListOfDtcInfo>, <OUT>,<ResultDtc>)	Mode: O
This action returns a structure of data of DTCs. All the data returned are related to DTC, which have the same type defined by the parameter TypeOfDtc and which are stored in dynamic memory.	

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ACTION_ERRM_ReadQuantityOfDtc (**IN**<PRM_TYPEOFDTC>,**IN**<PRM_LEVELOFDTC>,**INOUT**<PRM_QUANTITY>, **OUT**<PRM_RESULTQUANTITY>)	Mode: O
This API returns the quantity of DTC with a certain type, which are stored in memory	

Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_TYPEOFDTC	in	1H 8H 10H 20H 40H 80H 100H 200H 400H	ALL PRESENT PENDING CONFIRMED DISAPPEARED MARKED NOT_MARKED OBD PERMANENT	-	-
Type of Dtc					
PRM_LEVELOFDTC	in	01H 02H	LAW CUS	-	-
Allowing to access to OBD error codes or customer error codes.					
PRM_QUANTITY	inout	0... FFH	0... 255	1	-
Software structure filled up with a quantity of DTC					
PRM_RESULTQUANTITY	out	0H 1H	NO_DTC_ PRESENT DTC_PRESENT	-	-
Result to say if the result of the API is valid					

ACTION_ERRM_ReadReadinessCodCus (<INOUT>,<ReadinessCode>,<OUT>,<ResultReadinessCode>)	Mode: O
This action allows to read the customer specific readiness code information CARB_OTHER/NO_CARB	

ACTION_ERRM_ReadReadinessCode (**INOUT**<PRM_READINESSCODE>,**OUT**<PRM_RESULTREADINESSCODE>)	Mode: O
This API returns the readiness code information required for service01h, PID01h, data B-D	

Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_READINESSCODE	inout	0... FFFFFFFFH	0... 4294967295	1	-
Software structure filled up with readiness code					
PRM_RESULTREADINESSCODE	out	0H 1H	NEGATIVE_ RESPONSE POSITIVE_ RESPONSE	-	-
Result to say if the API is done or not					

ACTION_ERRM_SelectRbmByGroup (<IN>,<PRM_GROUPNAME>,<INOUT>,<PRM_NUMERATOR>,<INOUT>, <PRM_DENOMINATOR>,<OUT>,<PRM_RESULTRBMDATABYGROUP>)	Mode: O
This action determines within one single group, the data with lowest ratios.	

ACTION_ERRM_SelectRbmData (<INOUT>,<PRM_CTR_MOD_9_RBM[36]>,<OUT>,<PRM_RES_MOD_9>)	Mode: O
This API calculates and returns the Rate-Based Monitoring data to be transmitted to the Scan-Tool, when requested by the Mode 09$ (InfoType $08).	

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Configuration data detailed description:

NC_ERR_DTC_REQ_OBD : This bit shall be set to 0 (SYMPTOM) to read OBD DTC by symptom.
This bit shall be set to 1 (FAILURE) to read OBD DTC by failure.

NC_ERR_DTC_REQ_CUS : This bit shall be set to 0 (SYMPTOM) to read Customer DTC by symptom.
This bit shall be set to 1 (FAILURE) to read Customer DTC by failure.

NLC_OBD_FRF_PND : Definition the EOBD/CARB freeze frame strategy, as follow :
0 : EOBD/CARB freeze frame data of Mode 02h will be returned after detection of a confirmed failure.
1 : EOBD/CARB freeze frame data of Mode 02h will be returned :

- after detection of a confirmed emission relevant failure if confirmed in memory
- after pending emission relevant detection if not confirmed in memory

B.65.1 Import Actions

ACTION_ERRM_EraseErr (IN <IDX>)
ACTION_ERRM_InitReadiness ( )
ACTION_ERRM_ClcPermanentByErr (IN <PRM_IDX_ERR>)
ACTION_ERRM_GetReadyClass (IN <PRM_IDX_ERR >, OUT <PRM_READY_CLAS>)
ACTION_ERRM_ClcPermanentIniErrm ( )

FUNCTION DESCRIPTION:

General information:

This chapter provides an open interface for other module which have link with error management functionality (communication module for instance). This interface is described with API (Application Programming Interface) to provide access to dynamic data flow in contrast to static data flow accessed directly through variable names.
By calling API, you can access in failure memory data related to Error Management such freeze frame and DTC stored, readiness code state and so on.
An API can have some input parameters.
Results returns by the API are defined as output parameters.
To returns functional results, a software structure (buffer) is used that allows to returns some data with not fixed size (a list of data for instance).
This structure is defined by the parameter in INOUT.
In the output parameter, a flag indicate if the software buffer is full or not.

Way of reading the failure memory :
API has to read through the failure memory to access some data related to Error Management.
In this case the failure memory is read in the order following the first failure entry, that means the oldest one. Thus the software structure is fill in first with data related to first failure entry (if need), then with data related to second failure entry (if need) and so on.

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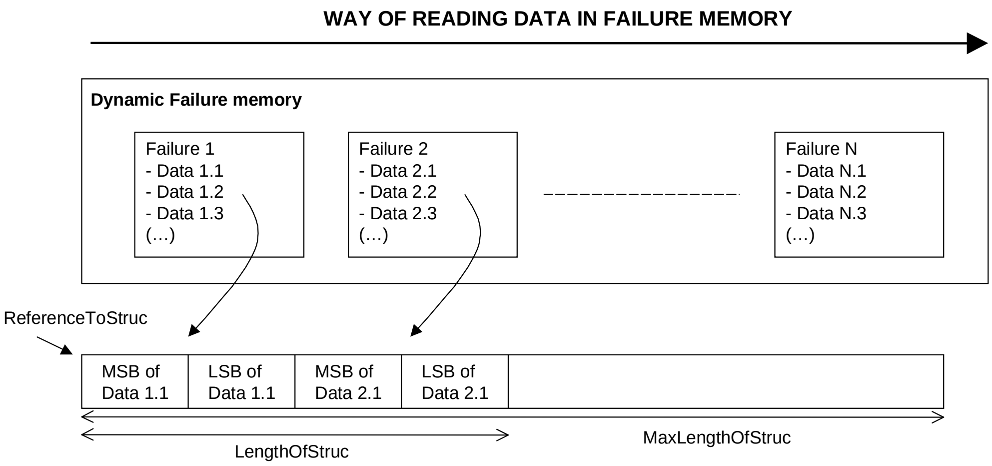

GENERAL IMPORTANT REMARK:

Please take care that the parameter PERMANENT is only linked to permanent memory (e.g. no impact on dynamic memory). For all services err_sym_dtc is still calculated with err_sym_mem and err_sym_lst (no link to err_sym_perm)

Fot the APIs :
- ACTION_ERRM_ReadDtcByDtc,
- ACTION_ERRM_ReadInfoByTypeOfDtc,
- ACTION_ERRM_ReadInfoByDtc,
- ACTION_ERRM_ReadDtcLevelByDtcLevel,
- ACTION_ERRM_ClrInfoByTypeOfDtc

It's forbidden to use the parameter PERMANENT for TypeOfDTC

For Mode 0Ah, the two APIs which must be used are
- ACTION_ERRM_ReadQuantityOfDtc with PERMANENT parameter for TypeOfDtc
- ACTION_ERRM_ReadDtcByTypeOfDtc with PERMANENT parameter for TypeOfDtc

Description of parameters IN, OUT, INOUT used by API:

The INPUT parameters used by API and their authorised value are defined below :

TypeOfDtc : Type of Dtc

Authorised values for TypeOfDtc are :

- ALL : all the DTC stored in Dynamic memory.

Failures concerned in error management : LV_ERR_MEM_XX = 1

- ALL FIRST: all the DTC stored at the first time in Dynamic memory.

Failures concerned in error management : LV_ERR_MEM_XX = 1

- ALL LAST: all the DTC stored at the last time in Dynamic memory.

Failures concerned in error management : LV_ERR_MEM_XX = 1

- PRESENT : all the DTC of present failure stored in dynamic memory.

Failures concerned in error management : LV_ERR_MEM_XX = 1
and LV_ERR_XX = 1

- PENDING : all the DTC of pending failure stored in dynamic memory.

Failures concerned in error management : LV_ERR_MEM_XX = 1

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and LV_ERR_PND[IDX] = 1

- TEMPORARY : all the DTC of temporary failure stored in dynamic memory.

Failures concerned in error management : LV_ERR_MEM_XX = 1
and LV_ERR_TMP[IDX] = 1

- CONFIRMED : all the DTC of confirmed failure stored in dynamic memory.

Failures concerned in error management : LV_ERR_MEM_XX = 1
and LV_ERR_CFM[IDX] = 1

- DISAPPEARED : all the DTC of disappeared failure stored in dynamic memory.

Failures concerned in error management : LV_ERR_MEM_XX = 1
and LV_ERR_DISA[IDX] = 1

- MARKED : all DTC of failure marked and stored in dynamic memory.

Failures concerned in error management : LV_ERR_MEM_XX = 1
and LV_ERR_MKD[IDX] = 1

- NOT MARKED : all DTC of failure not marked and stored in dynamic memory.

Failures concerned in error management : LV_ERR_MEM_XX = 1
and LV_ERR_MKD[IDX] = 0

- OBD : all DTC related to emission relevant failure.

Failures concerned in error management : LV_ERR_MEM_XX = 1
and a Carb/EOBD failure :
(emission relevant)
(definition see failure class specification)

- OBD FIRST: all the DTC stored at the first time in Dynamic memory related to emission relevant failure.

Failures concerned in error management : LV_ERR_MEM_XX = 1
and a Carb/EOBD failure :
(emission relevant)
(definition see failure class specification)

- OBD LAST: all the DTC stored at the last time in Dynamic memory.related to emission relevant failure.

Failures concerned in error management : LV_ERR_MEM_XX = 1
and a Carb/EOBD failure :
(emission relevant)
(definition see failure class specification)

- PERMANENT : all the DTC of permanent fault memory
  Failures concerned in error management : LV_ERR_PERM[IDX_PERM] = 1

- Logical AND combination between these values.

For instance : PRESENT and CONFIRMED are failure in error management with flags : LV_ERR_MEM_XX = 1 and LV_ERR_XX = 1 and LV_ERR_CFM[IDX] = 1.

Calculation of ERR_SYM_DTC[IDX] and SYM_CYL_DTC_XX following the TypeOfDtc parameter:

For all failure except the misfiring failure treated by type :

case TypeOfDtc

ALL : ERR_SYM_DTC[IDX] = ERR_SYM_LST[IDX] **or** ERR_SYM_MEM[IDX]
ALL FIRST: ERR_SYM_DTC[IDX] = ERR_SYM_MEM[IDX]
ALL LAST : ERR_SYM_DTC[IDX] = ERR_SYM_LST[IDX]
PRESENT : ERR_SYM_DTC[IDX] = ERR_SYM_LST[IDX]
PENDING : ERR_SYM_DTC[IDX] = ERR_SYM_LST[IDX]
TEMPORARY : ERR_SYM_DTC[IDX] = ERR_SYM_MEM[IDX]
CONFIRMED : ERR_SYM_DTC[IDX] = ERR_SYM_MEM[IDX]

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DISAPPEARED : ERR_SYM_DTC[IDX] = ERR_SYM_MEM[IDX]
MARKED : ERR_SYM_DTC[IDX] =
ERR_SYM_LST[IDX] **or** ERR_SYM_MEM[IDX]
NOT MARKED : ERR_SYM_DTC[IDX] =
ERR_SYM_LST[IDX] **or** ERR_SYM_MEM[IDX]
OBD : ERR_SYM_DTC[IDX] = ERR_SYM_LST[IDX] **or** ERR_SYM_MEM[IDX]
OBD FIRST : ERR_SYM_DTC[IDX] = ERR_SYM_MEM[IDX]
OBD LAST : ERR_SYM_DTC[IDX] = ERR_SYM_LST[IDX]
(!! independant of dynamic memory !!)
PERMANENT : ERR_SYM_PERM[IDX_PERM]

End case

For the misfiring failure treated by type (XX = MIS_A, MIS_B1 or MIS_B4)

IF NLC_TREAT_DIAG_MIS = 0

case TypeOfDtc

ALL : SYM_CYL_DTC_XX = SYM_CYL_LST_XX **or** SYM_CYL_MEM_XX
ALL FIRST : SYM_CYL_DTC_XX = SYM_CYL_MEM_XX
ALL LAST: SYM_CYL_DTC_XX = SYM_CYL_LST_XX
PRESENT: SYM_CYL_DTC_XX = SYM_CYL_LST_XX
PENDING : SYM_CYL_DTC_XX = SYM_CYL_LST_XX
TEMPORARY : SYM_CYL_DTC_XX = SYM_CYL_MEM_XX
CONFIRMED : SYM_CYL_DTC_XX = SYM_CYL_MEM_XX
DISAPPEARED : SYM_CYL_DTC_XX = SYM_CYL_MEM_XX
MARKED : SYM_CYL_DTC_XX = SYM_CYL_LST_XX **or** SYM_CYL_MEM_XX
NOT MARKED : SYM_CYL_DTC_XX =
SYM_CYL_LST_XX **or** SYM_CYL_MEM_XX
OBD : SYM_CYL_DTC_XX = SYM_CYL_LST_XX **or** SYM_CYL_MEM_XX
OBD FIRST: SYM_CYL_DTC_XX = SYM_CYL_MEM_XX
OBD LAST: SYM_CYL_DTC_XX = SYM_CYL_LST_XX
PERMANENT : SYM_CYL_DTC_XX = SYM_CYL_MEM_XX

End case

ENDIF { NLC_TREAT_DIAG_MIS = 0 }

For the logical AND combination between the different TypeOfDtc values, the ERR_SYM_DTC[IDX] or SYM_CYL_DTC_XX will be calculated with a binary logical AND from the associated carrier symptom.

For instance : PRESENT and CONFIRMED are failure in error management with flags : LV_ERR_MEM_XX = 1 and LV_ERR_XX = 1 and LV_ERR_CFM[IDX] = 1.

It means : ERR_SYM_DTC[IDX] = ERR_SYM_LST[IDX] **&** ERR_SYM_MEM[IDX],
SYM_CYL_DTC_XX = SYM_CYL_LST_XX **&** SYM_CYL_MEM_XX.

Calculation of ERR_SYM_DTC[IDX] and SYM_CYL_DTC_XX in case the API doesn't use the TypeOfDtc parameter :

ERR_SYM_DTC[IDX] = ERR_SYM_LST **or** ERR_SYM_MEM[IDX]
SYM_CYL_DTC_XX = SYM_CYL_LST_XX **or** SYM_CYL_MEM_XX

<u>DtcIdentifier :</u> Number of the DTC (identifier)

Authorised value for DtcIdentifier are : NO_DTC, ...<integer>

<u>TypeOfFF :</u> Type of Freeze Frame

Authorised values for TypeOfFF are :

- LAW : part of the freeze frame defined by the law (Carb)

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- CUS_CMN : part of the freeze frame defined for the customer and not in the set
- CUS_SET : part of the freeze frame defined for the customer and in the set
- All combination of these values.

LevelOfDtc : Allowing to access to OBD error codes or customer error codes.
Authorised values for LevelOfDtc are :

- LAW : the DTC corresponds to a OBD DTC (Carb)
- CUS : the DTC corresponds to a specific customer DTC

FFIdentifier : Number of FF (identifier)
Authorised values for FFIdentifier are :

- FIRST : first freeze frame is requested
- SECOND : second freeze frame is request
- ...

MarkedMode : State of the marked mode
Authorised values for MarkedMode are :

- ON : marked mode activation : all failure stored are marked.
- OFF : marked mode deactivation (normal mode)

InfoIdentifier : Identifier for the diagnosis related information which is returned by the API (only words are returned)
Authorised information for InfoIdentifier are (only one information is returned by the API):

- CTR_ABC_XX
- CTR_ABC_END_DIAG_XX
- LV_END_DIAG_XX
- LV_READY_XX
- LV_CDN_DIAG_XX
- ERR_SYM_XX
- LV_ERR_XX
- LV_ERR_MEM_XX
- CTR_FRC[IDX]
- CTR_DC[IDX]
- CTR_WUP_CYC[IDX]
- ERR_SYM_MEM[IDX]
- ERR_SYM_LST[IDX]
- ERR_SYM_DTC[IDX]
- LV_ERR_CFM[IDX]
- LV_ERR_DISA[IDX]
- LV_ERR_TMP[IDX]
- LV_ERR_PND[IDX]
- LV_ERR_PERM[IDX]
- LV_DC_MAX[IDX]
- LV_ERR_DC[IDX]
- LV_ERR_MKD[IDX]
- C_ERR_CLAS_XX
- WAL_CONF_XX
- PRI_CONF_XX
- DC_INC_XX
- DC_DEC_XX
- DC_MAX_XX
- ID_ERR_DTC_XX[0][0]
- ID_ERR_DTC_XX[0][1]
- ID_ERR_DTC_XX[0][2]
- ID_ERR_DTC_XX[0][3]
- ID_ERR_DTC_XX[0][4]

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if NC_NR_DTC_FMT = 0
(Manage 6 DTC per failure)

- ID_ERR_DTC_XX[0][5]

else
(Manage 10 DTC per failure)

- ID_ERR_DTC_XX[1][0]
- ID_ERR_DTC_XX[1][1]
- ID_ERR_DTC_XX[1][2]
- ID_ERR_DTC_XX[1][3]
- ID_ERR_DTC_XX[1][4]

endif
Please note that some application incidences can provide additional project specific informations.

The OUTPUT parameters used by API and their authorised value are defined below :

ResultDtc : Result to say if there is some DTC in memory corresponding to the API request
Authorised values for ResultDtc are :
1st bit of ResultDtc :

- (0) NO_DTC_PRESENT : there is no DTC in memory corresponding to the API request
- (1) DTC_PRESENT : there is some DTC in memory corresponding to the API request

2nd bit of ResultDtc :

- (0) NO_BUFFER_FULL : The software buffer used to return data is not full
- (1) BUFFER_FULL : The software buffer used to return data is full

ResultFrf : Result to say if there is some Freeze Frame in memory corresponding to the API request
Authorised values for ResultFrf are :
1st bit of ResultFrf :

- (0) NO_FRF_PRESENT : there is no freeze frame in memory corresponding to the API request
- (1) FRF_PRESENT : there is some freeze frame in memory corresponding to the API request

2nd bit of ResultFrf :

- (0) NO_BUFFER_FULL : The software buffer used to return data is not full
- (1) BUFFER_FULL : The software buffer used to return data is full

ResultQuantity : Result to say if the result of the API is valid.
Authorised values for ResultQuantity are :
1st bit of ResultQuantity :

- (0) NO_DTC_PRESENT : there is no DTC in memory corresponding to the API request
- (1) DTC_PRESENT : there is some DTC in memory corresponding to the API request

ResultClrInfo : Result to say if the clear DTC made by the API is done or not.
Authorised values for ResultClrInfo are :
1st bit of ResultClrInfo :

- (0) INFO_CLEARED : DTC are cleared by the call of the API
- (1) INFO_NOT_CLEARED : no DTC is cleared by the call of the API

ResultReadinessCode : Result to say if the API is done or not.
Authorised values for ResultReadinessCode are :
1st bit of ResultReadinessCode :

- (0) POSITIVE_RESPONSE : the call of the API is successful
- (1) NEGATIVE_RESPONSE : the call of the API is not successful

The INPUT/OUTPUT parameters used by API and their authorised value are defined below :

- ListOfDtc : Software structure filled up with a list of DTC

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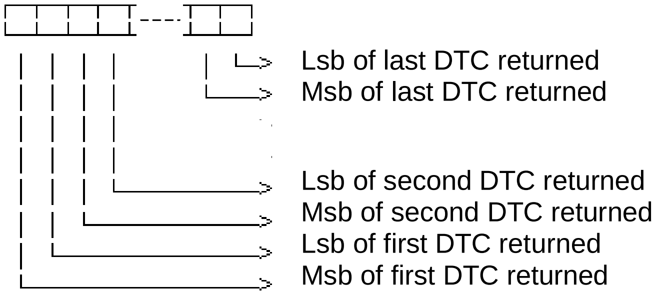
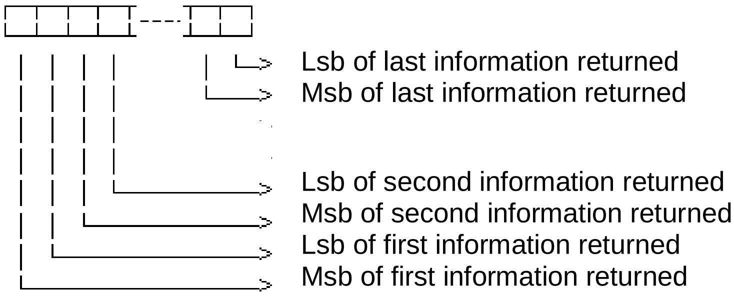
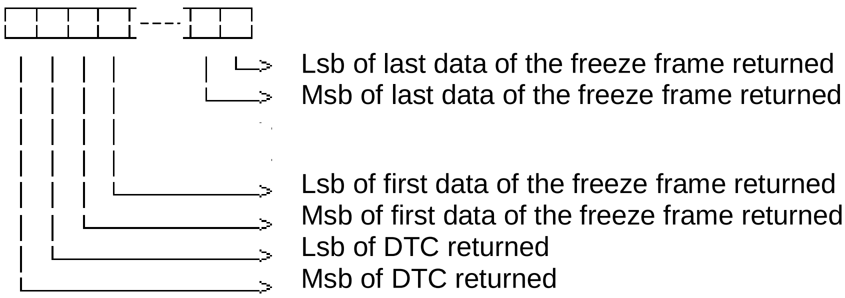


- ListOfDtcInfo : Software structure filled up with a list of DTCInfo



- Quantity : Software structure filled up with a quantity of DTC
- Frf : Software structure filled up with a freeze frame



- ReadinessCode : Software structure filled up with readiness code

B.65.2 API for reading Diagnostic Trouble Code (DTC)

B.65.2.1 Request a list of DTCs by type of DTC.

Description :

Syntax : ACTION_ERRM_ReadDtcByTypeOfDtc (
IN <TypeOfDtc>,
IN <LevelOfDtc>,
INOUT <ListOfDtc>,
OUT <ResultDtc>)

Parameter(in) :	TypeOfDtc	Type of DTC which is requested by the API.
	LevelOfDtc	OBD or customer DTC is requested by the API
Parameter(out) :	ResultDtc	Boolean to say if some DTC is in memory

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Parameter(inout) : ListOfDtc Software structure fills up with a ListOfDtc
Short Description : This API returns a list of DTCs. All the DTC returns have the same type defined by the parameter TypeOfDtc and the same level defined in LevelOfDtc.

For each failure, if NC_NR_DTC_FMT = 0 then 6 DTC are defined : one DTC for each symptom (OBD or Customer), one OBD global DTC, one customer global DTC else 10 DTC are defined : one OBD DTC for each symptom, one OBD global DTC, one customer specific DTC number for each symptom and one customer global DTC.
When LevelOfDtc = LAW : OBD Dtc is request

If NC_ERR_DTC_REQ_OBD = SYMPTOM, the DTC is build up following the detected symptom. If more than one symptom is detected, a DTC per symptom detected is returned. There is a particular case for Misfiring failure. For this failure, the DTC number is built up following the cylinder where the misfiring is detected.

If NC_ERR_DTC_REQ_OBD = FAILURE, the OBD global DTC is returned.

When LevelOfDtc = CUS : Customer Dtc is request

If NC_ERR_DTC_REQ_CUS = SYMPTOM, the DTC is build up following the detected symptom. If more than one symptom is detected, a DTC per symptom detected is returned. There is a particular case for Misfiring failure. For this failure, the DTC number is built up following the cylinder where the misfiring is detected.

If NC_ERR_DTC_REQ_CUS = FAILURE, the customer global DTC is returned.

Application conditions

Deactivation : –

Initialization: –

Recurrence : –

Formula section :

1^{st} bit of ResultDtc = NO_DTC_PRESENT
2^{nd} bit of ResultDtc = NO_BUFFER_FULL

If TypeOfDtc = PERMANENT
Then
  If CTR_ERR_PERM_NR > 0
  Then
      1^{st} bit of ResultDtc = DTC_PRESENT
  Endif
    For IDX_PERM = 0 to CTR_ERR_PERM_NR -1
      with XX = ERR_PERM[IDX_PERM]
      ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS)
      If PRM_READY_CLAS <> 00h (CARB_MIS)
      Then Condition for failure traitment is true
      Endif
      If NLC_TREAT_DIAG_MIS = 1
      Then Condition for failure traitment is true
      Endif
      If Condition for failure traitment is true
     Then If LevelOfDtc = LAW (OBD DTC is request)
        Then If NC_ERR_DTC_REQ_OBD=SYMPTOM (access by symptom)
          Then For each bit i which is set in

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```
                                    ERR_SYM_PERM[IDX_PERM]
                                    software structure fill up with
                                        ID_ERR_DTC_XX[ 0 ] [ i ]
                               Endfor
                          Else     (access by failure; NC_ERR_DTC_REQ_OBD = FAILURE)
                               software structure fill up with  ID_ERR_DTC_XX[0][4]
                          Endif
                  Else     (Customer DTC is request ; LevelOfDtc = CUS)
                       If   NC_ERR_DTC_REQ_CUS = SYMPTOM (access by symptom)
                          Then    For       each bit i which is set in
                                    ERR_SYM_PERM[IDX_PERM]
                                        software structure fill up with
                                        ID_ERR_DTC_XX[ NC_NR_DTC_FMT ] [ i ]
                            Endfor
                          Else     (access by failure; NC_ERR_DTC_REQ_CUS = FAILURE)
                               software structure fill up with
                               ID_ERR_DTC_XX
                               [NC_NR_DTC_FMT][5-NC_NR_DTC_FMT]
                          Endif
                   Endif
             Else               (particular case for misfiring failure NLC_TREAT_DIAG_MIS = 0)
                                XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
                  If        LevelOfDtc = LAW                         (OBD DTC is request)
                     Then   If         SYM_CYL_PERM_XX [12]=1             (Random)
                          Then    software structure fill up with
                               ID_ERR_DTC_MIS [ 0 ] [ NC_CYL_NR+1]
                          Endif
                          If         SYM_CYL_PERM_XX [13]=1             (Multiple cylinder)
                          Then    software structure fill up with
                               ID_ERR_DTC_MIS [ 0 ] [ NC_CYL_NR ]
                          Endif
                          For each cylinder bit i which is set in SYM_CYL_PERM_XX
                                   software structure fill up with
                                   ID_ERR_DTC_MIS[ 0 ] [ i ]
                       Endfor
                   Else    (Customer DTC is request ; LevelOfDtc = CUS)
                          If         SYM_CYL_PERM_XX [12]=1             (Random)
                          Then    software structure fill up with
                               ID_ERR_DTC_MIS [ 1 ] [ NC_CYL_NR+1]
                          Endif
                          If         SYM_CYL_PERM_XX [13]=1             (Multiple cylinder)
                          Then    software structure fill up with
                               ID_ERR_DTC_MIS [ 1 ] [ NC_CYL_NR ]
                          Endif
                          For each cylinder bit i which is set in SYM_CYL_PERM_XX
                               software structure fill up with
                               ID_ERR_DTC_MIS[ 1 ] [ i ]
                       Endfor
                  Endif
             Endif
  Endfor
Else
```

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```
For each failure IDX stored in dynamic memory,
      If          the failure belongs to failures group defined by the parameter TypeOfDtc
        Then   1st bit of ResultDtc = DTC_PRESENT
          ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS)
          If PRM_READY_CLAS <> 00h (CARB_MIS)
          Then Condition for failure traitment is true
          Endif
          If NLC_TREAT_DIAG_MIS = 1
          Then Condition for failure traitment is true
          Endif
          If Condition for failure traitment is true
         Then If      LevelOfDtc = LAW              (OBD DTC is request)
            Then  If  NC_ERR_DTC_REQ_OBD=SYMPTOM          (access by symptom)
                  Then   For each bit i which is set in ERR_SYM_DTC[IDX]
                            software structure fill up with
                               ID_ERR_DTC_XX[ 0 ] [ i ]
                       Endfor
                  Else     (access by failure; NC_ERR_DTC_REQ_OBD = FAILURE)
                       software structure fill up with  ID_ERR_DTC_XX[0][4]
                  Endif
           Else    (Customer DTC is request ; LevelOfDtc = CUS)
                If  NC_ERR_DTC_REQ_CUS = SYMPTOM (access by symptom)
                  Then   For each bit i which is set in ERR_SYM_DTC[IDX]
                               software structure fill up with
                               ID_ERR_DTC_XX[ NC_NR_DTC_FMT ] [ i ]
                    Endfor
                  Else     (access by failure; NC_ERR_DTC_REQ_CUS = FAILURE)
                       software structure fill up with
                       ID_ERR_DTC_XX
                       [NC_NR_DTC_FMT][5-NC_NR_DTC_FMT]
                  Endif
            Endif
        Else              (particular case for misfiring failure NLC_TREAT_DIAG_MIS = 0)
                          XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
           If        LevelOfDtc = LAW                         (OBD DTC is request)
             Then   If        SYM_CYL_DTC_XX [12]=1    (Random)
                  Then   software structure fill up with
                       ID_ERR_DTC_MIS [ 0 ] [ NC_CYL_NR+1]
                  Endif
                  If          SYM_CYL_DTC_XX [13]=1    (Multiple cylinder)
                  Then   software structure fill up with
                       ID_ERR_DTC_MIS [ 0 ] [ NC_CYL_NR ]
                  Endif
                  For each cylinder bit i which is set in SYM_CYL_DTC_XX
                            software structure fill up with
                            ID_ERR_DTC_MIS[ 0 ] [ i ]
                Endfor
            Else    (Customer DTC is request ; LevelOfDtc = CUS)
                  If          SYM_CYL_DTC_XX [12]=1    (Random)
                  Then   software structure fill up with
                       ID_ERR_DTC_MIS [ 1 ] [ NC_CYL_NR+1]
                  Endif
```

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If SYM_CYL_DTC_XX [13]=1 (Multiple cylinder)
Then software structure fill up with
ID_ERR_DTC_MIS [1] [NC_CYL_NR]
Endif
For each cylinder bit i which is set in SYM_CYL_DTC_XX
software structure fill up with
ID_ERR_DTC_MIS[1] [i]
Endfor
Endif
Endif
Endif
Endfor
Endif
During all the software structure filling-in, if the software buffer is full then 2^{nd} bit of ResultDtc is set to BUFFER_FULL, software process is aborted.
If there is duplicated DTC then only the oldest is returned

B.65.2.2 Request a DTC by DTC number

Description :

Syntax : ACTION_ERRM_ReadDtcByDtc (
IN <DtcIdentifier>,
IN <LevelOfDtc>,
OUT <ResultDtc>)

Parameter(in) : DtcIdentifier Number of the DTC (identifier) which is requested.
LevelOfDtc OBD or customer DTC is requested by the API
Parameter(out) : ResultDtc Boolean to say if there is the DTC in memory
Short Description : This API returns a result to learn if a DTC number of a certain level is stored in memory.

Application conditions

Deactivation : –

Initialization: –

Recurrence : –

Formula section :

1^{st} bit of ResultDtc = NO_DTC_PRESENT
2^{nd} bit of ResultDTC = NO_BUFFER_FULL

For each failure IDX stored in dynamic memory,
ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS)
If PRM_READY_CLAS <> 00h (CARB_MIS)
Then Condition for failure traitment is true
Endif
If NLC_TREAT_DIAG_MIS = 1
Then Condition for failure traitment is true
Endif

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```
    If    Condition for failure traitment is true
  Then   If         LevelOfDtc = LAW                              (OBD DTC is request)
           Then    If        NC_ERR_DTC_REQ_OBD = SYMPTOM    (access by symptom)
                         Then    For each bit i which is set in ERR_SYM_DTC[IDX]
                                        If          DtcIdentifier = ID_ERR_DTC_XX [0][i]
                                        Then    1st bit of ResultDtc = DTC_PRESENT
                                        Endif
                                 Endfor
                         Else     (access by failure ; NC_ERR_DTC_REQ_OBD = FAILURE)
                            If          DtcIdentifier = ID_ERR_DTC_XX [0][4]
                                 Then    1st bit of ResultDtc = DTC_PRESENT
                                 Endif
                         Endif
           Else     (Customer DTC is request ; LevelOfDtc = CUS)
                        If          NC_ERR_DTC_REQ_CUS = SYMPTOM     (access by symptom)
                         Then    For each bit i which is set in ERR_SYM_DTC[IDX]
                                 If          DtcIdentifier = ID_ERR_DTC_XX [NC_NR_DTC_FMT][i]
                                 Then    1st bit of ResultDtc = DTC_PRESENT
                                 Endif
                                 Endfor
                         Else     (access by failure ; NC_ERR_DTC_REQ_CUS = FAILURE)
                            If          DtcIdentifier = ID_ERR_DTC_XX
                                             [NC_NR_DTC_FMT][5-NC_NR_DTC_FMT]
                                 Then    1st bit of ResultDtc = DTC_PRESENT
                                 Endif
                         Endif
              Endif
          Else         (particular case for misfiring failure NLC_TREAT_DIAG_MIS = 0)
               XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
              If         LevelOfDtc = LAW                              (OBD DTC is request)
               Then   If          SYM_CYL_DTC_XX [12]=1                 (Random)
                         Then    If          DtcIdentifier=ID_ERR_DTC_MIS [0] [NC_CYL_NR+1]
                                 Then    1st bit of ResultDtc = DTC_PRESENT
                                 Endif
                         Endif
                         If          SYM_CYL_DTC_XX [13]=1                 (Multiple cylinder)
                         Then    If          DtcIdentifier=ID_ERR_DTC_MIS [0] [NC_CYL_NR]
                                 Then    1st bit of ResultDtc = DTC_PRESENT
                                 Endif
                         Endif
                         For each cylinder bit i which is set in            SYM_CYL_DTC_XX
                                 If          DtcIdentifier = ID_ERR_DTC_MIS[0][i]
                                 Then    1st bit of ResultDtc = DTC_PRESENT
                                 Endif
                         Endfor
              Else     (Customer DTC is request ; LevelOfDtc = CUS)
                         If          SYM_CYL_DTC_XX [12]=1                 (Random)
                         Then    If          DtcIdentifier=ID_ERR_DTC_MIS [1] [NC_CYL_NR+1]
                                 Then    1st bit of ResultDtc = DTC_PRESENT
                                 Endif
                         Else
                         If          SYM_CYL_DTC_XX [13]=1                 (Multiple cylinder)
```

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Then **If** DtcIdentifier=ID_ERR_DTC_MIS [1] [NC_CYL_NR]
Then 1^{st} bit of ResultDtc = DTC_PRESENT
Endif
Endif
For each cylinder bit i which is set in SYM_CYL_DTC_XX
If DtcIdentifier = ID_ERR_DTC_MIS[1][i]
Then 1^{st} bit of ResultDtc = DTC_PRESENT
Endif
Endfor
Endif
Endif
Endfor

B.65.3 API for reading the status of Diagnostic Trouble Code

B.65.3.1 Request a list of status of DTCs by type of DTC

Description :

Syntax : ACTION_ERRM_ReadInfoByTypeOfDtc (
IN <TypeOfDtc>,
IN <InfoIdentifier>,
INOUT <ListOfDtcInfo>,
OUT < ResultDtc>)

Parameter(in) : TypeOfDtc Type of DTC which is requested by the API.
InfoIdentifier Information which is returned by the API
Parameter(out) : ResultDtc Boolean to say if there is the DTC in memory
Parameter(inout) : ListOfDtcInfo Software structure fill up with ListOfDtcInfo
Short Description : This API returns a diagnosis information. All the information returned are related to DTC which have the same type defined by the parameter TypeOfDtc and which are stored in memory. Diagnosis information returned is defined by InfoIdentifier parameter.

Application conditions:

Deactivation : -
Initialization: -
Recurrence : -

Formula section :

1^{st} bit of ResultDtc = NO_DTC_PRESENT
2^{nd} bit of ResultDtc = NO_BUFFER_FULL
For each failure stored in dynamic memory,
If the failure belongs to group defined by the parameters TypeOfDtc
Then 1^{st} bit of ResultDtc = DTC_PRESENT
ListOfDtcInfo is fill up with data of this failure corresponding to InfoIdentifier.
Endif
EndFor

During all the software structure filling-in, if the software buffer is full then 2^{nd} bit of ResultDtc is set to BUFFER_FULL, software process is aborted.

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B.65.3.2 Request a status of a DTC by DTC number

Description :

Syntax : ACTION_ERRM_ReadInfoByDtc (
IN <DtcIdentifier>,
IN <LevelOfDtc>,
IN <InfoIdentifier>,
INOUT <ListOfDtcInfo>,
OUT <ResultDtc>)

Parameter(in) : DtcIdentifier Number of the DTC (identifier) which is requested.
LevelOfDtc OBD or customer DTC is requested by the API
InfoIdentifier Information which is returned by the API

Parameter(out) : ResultDtc Boolean to say if there is the DTC in memory

Parameter(inout) : ListOfDtcInfo Software structure fill up with ListOfDtcInfo

Short Description : This API returns a structure of diagnosis information related to a DTC which is stored in dynamic memory.
Diagnosis information returned is defined by InfoIdentifier parameter.

Application conditions:

Deactivation : -
Initialization: -
Recurrence : -

Formula section :

1^{st} bit of ResultDtc = NO_DTC_PRESENT
2^{nd} bit of ResultDtc = NO_BUFFER_FULL

```
For each failure IDX stored in dynamic memory,
    ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS)
    If          PRM_READY_CLAS <> 00h (CARB_MIS)
    Then Condition for failure traitment is true
    Endif
    If          NLC_TREAT_DIAG_MIS = 1
    Then Condition for failure traitment is true
    Endif
    If          Condition for failure traitment is true
  Then  If      LevelOfDtc = LAW                          (OBD DTC is request)
        Then  If      NC_ERR_DTC_REQ_OBD = SYMPTOM    (access by symptom)
              Then  For each bit i which is set in ERR_SYM_DTC[IDX]
                        If       DtcIdentifier = ID_ERR_DTC_XX [0][i]
                        Then  1st bit of ResultDtc = DTC_PRESENT
                              ListOfDtcInfo is fill up with data of this failure
                          corresponding to InfoIdentifier.
                        Endif
                    Endfor
              Else   (access by failure ; NC_ERR_DTC_REQ_OBD = FAILURE)
                If       DtcIdentifier = ID_ERR_DTC_XX [0][4]
                  Then  1st bit of ResultDtc = DTC_PRESENT
                        ListOfDtcInfo is fill up with data of this failure
```

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corresponding to InfoIdentifier.
Endif
Endif
Else (Customer DTC is request ; LevelOfDtc = CUS)
If NC_ERR_DTC_REQ_CUS = SYMPTOM (access by symptom)
Then **For** each bit i which is set in ERR_SYM_DTC[IDX]
If DtcIdentifier = ID_ERR_DTC_XX [NC_NR_DTC_FMT][i]
Then 1^{st} bit of ResultDtc = DTC_PRESENT
ListOfDtcInfo is fill up with data of this failure
corresponding to InfoIdentifier.
Endif
Endfor
Else (access by failure ; NC_ERR_DTC_REQ_CUS = FAILURE)
If DtcIdentifier = ID_ERR_DTC_XX
[NC_NR_DTC_FMT] [5-NC_NR_DTC_FMT]
Then 1^{st} bit of ResultDtc = DTC_PRESENT
ListOfDtcInfo is fill up with data of this failure
corresponding to InfoIdentifier.
Endif
Endif
Endif

Else (particular case for misfiring failure NLC_TREAT_DIAG_MIS = 0)
XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
If LevelOfDtc = LAW (OBD DTC is request)
Then **If** SYM_CYL_DTC_XX [13]=1 (Multiple cylinder)
Then **If** DtcIdentifier=ID_ERR_DTC_MIS [0] [NC_CYL_NR]
Then 1^{st} bit of ResultDtc = DTC_PRESENT
ListOfDtcInfo is fill up with data of this failure
corresponding to InfoIdentifier.
Endif
Endif
If SYM_CYL_DTC_XX [12]=1 (Random)
Then **If** DtcIdentifier=ID_ERR_DTC_MIS[0][NC_CYL_NR+1]
Then 1^{st} bit of ResultDtc = DTC_PRESENT
ListOfDtcInfo is fill up with data of this failure
corresponding to InfoIdentifier.
Endif
Endif
For each cylinder bit i which is set in SYM_CYL_DTC_XX
If DtcIdentifier = ID_ERR_DTC_MIS[0][i]
Then 1^{st} bit of ResultDtc = DTC_PRESENT
ListOfDtcInfo is fill up with data of this failure
corresponding to InfoIdentifier.
Endif
Endfor
Else (Customer DTC is request ; LevelOfDtc = CUS)
If SYM_CYL_DTC_XX [13]=1 (Multiple cylinder)
Then **If** DtcIdentifier=ID_ERR_DTC_MIS [1] [NC_CYL_NR]
Then 1^{st} bit of ResultDtc = DTC_PRESENT
ListOfDtcInfo is fill up with data of this failure
corresponding to InfoIdentifier.

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Endif
Endif
If SYM_CYL_DTC_XX [12]=1 (Random)
Then **If** DtcIdentifier=ID_ERR_DTC_MIS[1][NC_CYL_NR+1]
Then 1^{st} bit of ResultDtc = DTC_PRESENT
ListOfDtcInfo is fill up with data of this failure
corresponding to InfoIdentifier.
Endif
Endif
For each cylinder bit i which is set in SYM_CYL_DTC_XX
If DtcIdentifier = ID_ERR_DTC_MIS[1][i]
Then 1^{st} bit of ResultDtc = DTC_PRESENT
ListOfDtcInfo is fill up with data of this failure
corresponding to InfoIdentifier.
Endif
Endfor
Endif
Endif
Endfor

During all the software structure filling-in, if the software buffer is full then 2^{nd} bit of ResultDtc is set to BUFFER_FULL, software process is aborted.

When a failure is found in dynamic memory with the right DtcIdentifier, the treatment is stopped. That means that only the status of the first DTC found (oldest DTC) is returned.

B.65.3.3 Request a DTCLevel by an another DTCLevel

Description :

Syntax : ACTION_ERRM_ReadDtcLevelByDtcLevel (
IN <DtcIdentifier>,
IN <LevelOfDtc>,
INOUT <ListOfDtc>,
OUT <ResultDtc>)

Parameter(in) : DtcIdentifier Number of the DTC (identifier) which is requested.
LevelOfDtc OBD or customer DTC is requested by the API
Parameter(out) : ResultDtc Boolean to say if there is the DTC in memory
Parameter(inout) : ListOfDtcInfo Software structure fill up with ListOfDtcInfo
Short Description :This API returns the customer DTC from the Law DTC or the DTC Law from the DTC customer following the ‘levelofDTC’ parameter.

Application conditions:

Deactivation : -
Initialization: -
Recurrence : -

Formula section :

1^{st} bit of ResultDtc = NO_DTC_PRESENT

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```
2nd bit of ResultDtc = NO_BUFFER_FULL

For each failure IDX stored in dynamic memory,
    ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS)
    If          PRM_READY_CLAS <> 00h (CARB_MIS)
    Then Condition for failure traitment is true
    Endif
    If  NLC_TREAT_DIAG_MIS = 1
    Then Condition for failure traitment is true
    Endif
    If  Condition for failure traitment is true
  Then   If        LevelOfDtc = LAW                         (OBD DTC is request)
         Then  If        NC_ERR_DTC_REQ_OBD = SYMPTOM    (access by symptom)
                  Then  For each bit i which is set in ERR_SYM_DTC[IDX]
                            If        DtcIdentifier = ID_ERR_DTC_XX [0][i]
                            Then   1st bit of ResultDtc = DTC_PRESENT
                                   ListOfDtcInfo is fill up with
                                       If        NC_NR_DTC_FMT = 0
                                       Then   ID_ERR_DTC_XX[0][5]
                                       Else   if NC_ERR_DTC_REQ_CUS=SYMPTOM
                                                Then  ID_ERR_DTC_XX[1][i]
                                                Else   ID_ERR_DTC_XX[1][4]
                                                Endif
                                       Endif
                                       Exit
                            Endif
                     Endfor
                  Else    (access by failure ; NC_ERR_DTC_REQ_OBD = FAILURE)
                     If        DtcIdentifier = ID_ERR_DTC_XX [0][4]
                         Then  1st bit of ResultDtc = DTC_PRESENT
                               ListOfDtc is fill up with
                               If        NC_ERR_DTC_REQ_CUS = SYMPTOM
                                         (access by symptom for the customer code)
                               Then  If        only one bit is set in ERR_SYM_MEM[IDX]
                                     Then  i = bit number which is set
                                             in ERR_SYM_MEM[IDX]
                                             ID_ERR_DTC_XX[NC_NR_DTC_FMT][i]
                                  Else(many or no bit is set in ERR_SYM_MEM[IDX])
                                              ID_ERR_DTC_XX
                                              [NC_NR_DTC_FMT][5-NC_NR_DTC_FMT]
                                     Endif
                               else    (access by failure for the customer code)
                                       ID_ERR_DTC_XX
                                       [NC_NR_DTC_FMT][5-NC_NR_DTC_FMT]
                            Endif
                         Endif
                  Endif
         Else    (Customer DTC is request ; LevelOfDtc = CUS)
               If        NC_ERR_DTC_REQ_CUS = SYMPTOM    (access by symptom)
                  Then  For each bit i which is set in ERR_SYM_DTC[IDX]
                        If        DtcIdentifier = ID_ERR_DTC_XX [NC_NR_DTC_FMT][i]
                        Then   1st bit of ResultDtc = DTC_PRESENT
```

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```
                    ListOfDtcInfo is fill up with
                      If      NC_NR_DTC_FMT = 0
                      Then    ID_ERR_DTC_XX[0][4]
                      Else    if      NC_ERR_DTC_REQ_OBD = SYMPTOM
                              Then    ID_ERR_DTC_XX[0][i]
                              Else    ID_ERR_DTC_XX[0][4]
                              Endif
                    Endif
                    Exit
                Endif
                Endfor
            Else    (access by failure ; NC_ERR_DTC_REQ_CUS = FAILURE)
              If      DtcIdentifier = ID_ERR_DTC_XX
                    [NC_NR_DTC_FMT] [5-NC_NR_DTC_FMT]
                Then    1st bit of ResultDtc = DTC_PRESENT
                      ListOfDtc is fill up with
                      If      NC_ERR_DTC_REQ_OBD = SYMPTOM
                              (access by symptom for the DTC law)
                              If      only one bit is set in ERR_SYM_MEM[IDX]
                              Then    i = bit number which is set
                                      in ERR_SYM_MEM[IDX]
                                      ID_ERR_DTC_XX[0][i]
                          Else    (many or no bit is set
                                      in ERR_SYM_MEM[IDX])
                                      ID_ERR_DTC_XX[0][4]
                              Endif
                      else    (access by failure for the customer code)
                              ID_ERR_DTC_XX[0][4]
                    Endif
                Endif
            Endif
        Endif

Else            (particular case for misfiring failure)
        XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
        If      LevelOfDtc = LAW                        (OBD DTC is request)
        Then  If      SYM_CYL_DTC_XX [12]=1    (Random)
            Then  If      DtcIdentifier=ID_ERR_DTC_MIS [0] [NC_CYL_NR+1]
                Then    1st bit of ResultDtc = DTC_PRESENT
                      ListOfDtc is fill up with ID_ERR_DTC_MIS[1] [NC_CYL_NR+1]
                      Exit
                Endif
            Endif
            If      SYM_CYL_DTC_XX [13]=1    (Multiple cylinder)
            Then  If      DtcIdentifier=ID_ERR_DTC_MIS [0] [NC_CYL_NR]
                Then    1st bit of ResultDtc = DTC_PRESENT
                      ListOfDtc is fill up with ID_ERR_DTC_MIS[1] [NC_CYL_NR]
                      Exit
                Endif
            Endif
            For each cylinder bit i which is set in        SYM_CYL_DTC_XX
                If DtcIdentifier = ID_ERR_DTC_MIS[0][i]
```

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```
                    Then   1st bit of ResultDtc = DTC_PRESENT
                           ListOfDtc is fill up with ID_ERR_DTC_MIS[1][i]
                           Exit
                    Endif
               Endfor
        Else   (Customer DTC is request ; LevelOfDtc = CUS)
               If      SYM_CYL_DTC_XX [12]=1   (Random)
               Then  If       DtcIdentifier=ID_ERR_DTC_MIS [1] [NC_CYL_NR+1]
                    Then   1st bit of ResultDtc = DTC_PRESENT
                           ListOfDtc is fill up with ID_ERR_DTC_MIS[0] [NC_CYL_NR+1]
                           Exit
                    Endif
               Endif
               If      SYM_CYL_DTC_XX [13]=1   (Multiple cylinder)
               Then  If      DtcIdentifier=ID_ERR_DTC_MIS [1] [NC_CYL_NR]
                    Then   1st bit of ResultDtc = DTC_PRESENT
                           ListOfDtc is fill up with ID_ERR_DTC_MIS[0] [NC_CYL_NR]
                           Exit
                    Endif
               Endif
               For each cylinder bit i which is set in        SYM_CYL_DTC_XX
                    If DtcIdentifier = ID_ERR_DTC_MIS[1][i]
                    Then   1st bit of ResultDtc = DTC_PRESENT
                           ListOfDtc is fill up with ID_ERR_DTC_MIS[0][i]
                           Exit
                    Endif
               Endfor
      Endif
   Endif
Endfor
```

During all the software structure filling-in, if the software buffer is full then 2^{nd} bit of ResultDtc is set to BUFFER_FULL, software process is aborted.

When a failure is found in dynamic memory with the right DtcIdentifier, the treatment is stopped. That means that only the status of the first DTC found (oldest DTC) is returned.

B.65.4 API for reading the number of Diagnostic Trouble Code

B.65.4.1 Request the quantity of DTC with a certain type stored in memory

Description :

Syntax : ACTION_ERRM_ReadQuantityOfDtc (
IN <TypeOfDtc>,
IN <LevelOfDtc>,
INOUT <Quantity>,
OUT <ResultQuantity>)

Parameter(in) :	TypeOfDtc	Type of DTC which is requested by the API.
	LevelOfDtc	OBD or customer DTC is requested by the API
Parameter(out) :	ResultQuantity	Boolean to say if there is at least 1 DTC in memory
Parameter(inout) :	Quantity	Software structure fill up with quantity of Dtc

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Short Description : This API returns the quantity of DTCs with a certain type, which are stored in memory. Quantity of DTCs is the number of failures in memory. If failures have same DTC values then they are counted once.

Application conditions:

Deactivation : -
Initialization: -
Recurrence : -

Formula section :

Quantity = 0
ResultQuantity = NO_DTC_PRESENT

If PRM_TypeOfDtc = PERMANENT
Then
If CTR_ERR_PERM_NR > 0
Then
1^{st} bit of ResultDtc = DTC_PRESENT
For IDX_PERM = 0 to CTR_ERR_PERM_NR -1
with XX = ERR_PERM[IDX_PERM]
ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS)
If PRM_READY_CLAS <> 00h (CARB_MIS)
Then Condition for failure traitment is true
Endif
If NLC_TREAT_DIAG_MIS = 1
Then Condition for failure traitment is true
Endif
If Condition for failure traitment is true
Then If LevelOfDtc = LAW (OBD DTC is request)
Then If NC_ERR_DTC_REQ_OBD=SYMPTOM (access by symptom)
Then Quantity = Quantity + j
with j = number of bit set in ERR_SYM_PERM[IDX_PERM]
Else (access by failure; NC_ERR_DTC_REQ_OBD = FAILURE)
Quantity = Quantity +1
Endif
Else (Customer DTC is request ; LevelOfDtc = CUS)
If NC_ERR_DTC_REQ_CUS = SYMPTOM (access by symptom)
Then Quantity = Quantity + j
with j = number of bit set in ERR_SYM_PERM[IDX_PERM]
Else (access by failure; NC_ERR_DTC_REQ_CUS = FAILURE)
Quantity = Quantity +1
Endif
Endif
Else (particular case for misfiring failure NLC_TREAT_DIAG_MIS = 0) XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
If LevelOfDtc = LAW (OBD DTC is request) **Then**
If SYM_CYL_PERM_XX [12]=1 (Random) **Then**
Quantity = Quantity +1
Endif
If SYM_CYL_PERM_XX [13]=1 (Multiple cylinder)

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```
                        Then   Quantity = Quantity +1
                         Endif
                         If        (many cylinder bit is set in SYM_CYL_PERM_XX)
                              Quantity = Quantity + j
                              With j  = number of cylinder bit set
                                          in SYM_CYL_PERM_XX
                         Endif
                Else    (Customer DTC is request ; LevelOfDtc = CUS)
                        If        SYM_CYL_PERM_XX [12]=1          (Random)                          Then
         Quantity = Quantity +1
                        Endif
                         If        SYM_CYL_PERM_XX [13]=1          (Multiple cylinder)
                        Then   Quantity = Quantity +1
                         Endif
                         If        (many cylinder bit is set in SYM_CYL_PERM_XX)
                              Quantity = Quantity + j
                              With j  = number of cylinder bit set
                                                   in SYM_CYL_PERM_XX
                         Endif
                Endif
          Endif
        Endfor
  Endif
Else
    For each failure IDX stored in dynamic memory,
        If              the failure belongs to failures group defined by the parameter TypeOfDtc
        Then       ResultQuantity = DTC_PRESENT
                 ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS)
                 If PRM_READY_CLAS <> 00h (CARB_MIS)
                 Then Condition for failure traitment is true
                 Endif
                 If   NLC_TREAT_DIAG_MIS = 1
                 Then Condition for failure traitment is true
                 Endif
                 If Condition for failure traitment is true
                 Then     If            LevelOfDtc = LAW                   (OBD DTC is request)
                          Then     If NC_REQ_OBD = SYMPTOM          (access by symptom)
                                   Then       Quantity   = Quantity + j
                                              with j = number of bit set in ERR_SYM_DTC_IDX
                                  Else        (access by failure ; NC_REQ_OBD = FAILURE )
                                              Quantity = Quantity +1
                                  Endif
                          Else        (Customer DTC is request ; LevelOfDtc = CUS)
                                  If   NC_REQ_CUS = SYMPTOM            (access by symptom)
                                   Then       Quantity   = Quantity + j
                                              with j = number of bit set in ERR_SYM_DTC_IDX
                                  Else        (access by failure ; NC_REQ_OBD = FAILURE )
                                              Quantity = Quantity +1
                                  Endif
                          Endif

           Else     (particular case for misfiring failure)
```

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```
                XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
            If   LevelOfDtc = LAW                      (OBD DTC is request)
                Then   If      SYM_CYL_DTC_XX [12]=1    (Random)
                       Then   Quantity = Quantity +1
                       Endif
                       If      SYM_CYL_DTC_XX [13]=1    (Multiple cylinder)
                       Then   Quantity = Quantity +1
              Endif
                       If      (many cylinder bit is set in SYM_CYL_DTC_XX)
                     Quantity = Quantity + j
                     With j  = number of cylinder bit set in SYM_CYL_DTC_XX
                       Endif

            Else       (Customer DTC is request ; LevelOfDtc = CUS)
                       If      SYM_CYL_DTC_XX [12]=1    (Random)
                       Then   Quantity = Quantity +1
                       Endif
                       If      SYM_CYL_DTC_XX [13]=1    (Multiple cylinder)
                       Then   Quantity = Quantity +1
              Endif
                       If      (many cylinder bit is set in SYM_CYL_DTC_XX)
                     Quantity = Quantity + j
                     With j  = number of cylinder bit set in SYM_CYL_DTC_XX
                       Endif
          Endif
       Endif
   Endif
 EndFor
Endif
```

For each duplicated DTC, the corresponding quantity will be subtracted. Duplicated DTC will be counted once.

B.65.5 API for reading the Freeze Frame

B.65.5.1 Request a freeze frame with a certain type by DTC

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Description :

Syntax : ACTION_ERRM_ReadFrfByDtc(
IN <TypeOfFF>,
IN <FFIdentifier>,
IN <DtcIdentifier>,
IN < LevelOfDtc>
INOUT <Frf>
OUT <ResultFrf>)

Parameter(in) :	TypeOfFF	Type of freeze frame which are request by the API
	FFIdentifier	Identifier of freeze frame requested
	DtcIdentifier	Identifier of DTC of the freeze frame requested
	LevelOfDtc	OBD or customer DTC is requested by the API
Parameter(out) :	ResultFrf	Boolean to say if requested freeze frame is present
Parameter(inout) :	Frf	Software structure fill with Freeze frame

Short Description : This API returns a freeze frame or a part of freeze frame.
With the parameter TypeOfFF, some different part of a freeze frame (defined by the law or by the customer - including set or not) can be returned.
The parameter FFIdentifier is not used (reserved for future improvement).
The freeze frame can be requested :

- by DTC ; in this case the parameters DtcIdentifier and LevelOfDtc should be fulfilled.
- for the CARB/EOBD request (mode 02h) ; in this case, the parameter DtcIdentifier has to be set to NO_DTC, the parameter TypeOfFF has to be set to LAW, and the parameter FFIdentifier has to be set to FIRST.

The freeze frame associated to the oldest Carb failure among highest priority Carb failure is returned.

See definitions of freeze frame in module “Environmental data” module in “Error management” aggregate.

Application conditions:

Deactivation : -
Initialization: -
Recurrence : -

Formula section :

1^{st} bit of ResultFrf = NO_FRF_PRESENT
2^{nd} bit of ResultFrf = NO_BUFFER_FULL

If (FFIdentifier = FIRST **and** TypeOfFF = LAW **and** DtcIdentifier = NO_DTC)
Then (Law freeze frame is requested)
If NLC_OBD_FRF_PND = 0
Then
Find oldest Carb/EOBD failure (emission relevant, LC_OBD_ERR = 1) failure stored in dynamic memory and confirmed (LV_ERR_CFM[IDX] = 1). If a misfire or fuel system failure is in the memory with LV_ERR_CFM[IDX] = 1, then the oldest of these failures must be chosen.
Else
Find oldest Carb/EOBD failure (emission relevant, LC_OBD_ERR = 1) failure stored in dynamic memory and confirmed (LV_ERR_CFM[IDX] = 1). If a misfire or fuel system failure is in the memory with LV_ERR_CFM[IDX] = 1, then the oldest of these failures must be chosen.
If this failure isn’t existing, find oldest Carb/EOBD failure (emission relevant, LC_OBD_ERR = 1) failure stored in dynamic memory and pending (LV_ERR_PND[IDX] =1). If a misfire or fuel system failure is in the memory with LV_ERR_PND[IDX] = 1, then the oldest of these failures must be chosen.
Endif
ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS)
If PRM_READY_CLAS <> 00h (CARB_MIS)
Then Condition for failure traitment is true
Endif
If NLC_TREAT_DIAG_MIS = 1
Then Condition for failure traitment is true
Endif
If Condition for failure traitment is true
Then **If** NC_ERR_DTC_REQ_OBD = SYMPTOM (access by symptom)
Then **If** only one bit is set in ERR_SYM_MEM[IDX]

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```
                  Then   i = bit number which is set in ERR_SYM_MEM[IDX]
                          ReturnDtc = ID_ERR_DTC_XX [0][i]
                  Else    (many or no bit is set in ERR_SYM_MEM[IDX])
                          ReturnDtc = ID_ERR_DTC_XX [0][4]
                  Endif
              Else     (access by failure ; NC_ERR_DTC_REQ_OBD = FAILURE)
                       ReturnDtc = ID_ERR_DTC_XX [0][4]
              Endif
       Else     (particular case for misfiring failure)
              XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
              If       SYM_CYL_MEM_XX [12]=1    (Random)
              Then   ReturnDtc = ID_ERR_DTC_MIS[0][NC_CYL_NR+1]
             Else    if        SYM_CYL_MEM_XX [13]=1    (Multiple cylinder)
                          Or many cylinder bits are set in
                     Then   ReturnDtc = ID_ERR_DTC_MIS[0][NC_CYL_NR]
                    Else    (only one cylinder bit is set in SYM_CYL_MEM_XX)
                          i = bit number which is set in SYM_CYL_MEM_XX
                        ReturnDtc = ID_ERR_DTC_MIS[0][i]
                    Endif
                    Endif
        Endif
       Software structure is fill up with ReturnDtc + ENVD_OBD[u][IDX]
         1st bit of ResultFrf = FRF_PRESENT

Else            (others freeze frame is requested)
  For each failure IDX stored in dynamic memory,
       ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS)
       If   PRM_READY_CLAS <> 00h (CARB_MIS)
       Then Condition for failure traitment is true
       Endif
       If   NLC_TREAT_DIAG_MIS = 1
       Then Condition for failure traitment is true
       Endif
       If   Condition for failure traitment is true
        Then   If        LevelOfDtc = LAW                    (OBD DTC is request)
             Then   If NC_ERR_DTC_REQ_OBD=SYMPTOM  (access by symptom)
                  Then   For each bit i which is set in ERR_SYM_DTC[IDX]
                              If DtcIdentifier = ID_ERR_DTC_XX[0][i]
                                  Then    1st bit of ResultFrf = FRF_PRESENT
                                          Software structure is filled-up with DtcIdentifier plus
                                          freeze frame of failure according parameter Type-
                                          OfFF
                                  Exit
                                 Endif
                     Endfor
                  Else    (access by failure; NC_ERR_DTC_REQ_OBD = FAILURE)
                          If        DtcIdentifier = ID_ERR_DTC_XX [0][4]
                           Then   1st bit of ResultFrf = FRF_PRESENT
                                  Software structure is filled-up with DtcIdentifier   plus freeze
                                  frame of failure according parameter TypeOfFF
                           Endif
                  Endif
```

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Else (Customer DTC is request ; LevelOfDtc = CUS)
If NC_ERR_DTC_REQ_CUS=SYMPTOM (access by symptom)
Then **For** each bit i which is set in ERR_SYM_DTC[IDX]
If DtcIdentifier = ID_ERR_DTC_XX[NC_NR_DTC_FMT][i]
Then 1^{st} bit of ResultFrf = FRF_PRESENT
Software structure is filled-up with DtcIdentifier plus freeze frame of failure according parameter TypeOfFF
Exit
Endif
Endfor
Else (access by failure; NC_ERR_DTC_REQ_CUS = FAILURE)
If DtcIdentifier = ID_ERR_DTC_XX [NC_NR_DTC_FMT][5-NC_NR_DTC_FMT]
Then 1^{st} bit of ResultFrf = FRF_PRESENT
Software structure is filled-up with DtcIdentifier plus freeze frame of failure according parameter TypeOfFF
Endif
Endif
Endif
Else (particular case for misfiring failure)
XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
If LevelOfDtc = LAW (OBD DTC is request)
Then **If** SYM_CYL_DTC_XX [12]=1 (Random)
Then **If** DtcIdentifier=ID_ERR_DTC_MIS[0][NC_CYL_NR+1]
Then 1^{st} bit of ResultFrf = FRF_PRESENT
Software structure is filled-up with DtcIdentifier plus freeze frame of failure according parameter TypeOfFF
Exit
Endif
Endif
If SYM_CYL_DTC_XX [13]=1 (Multiple cylinder)
Then **If** DtcIdentifier=ID_ERR_DTC_MIS[0][NC_CYL_NR]
Then 1^{st} bit of ResultFrf = FRF_PRESENT
Software structure is filled-up with DtcIdentifier plus freeze frame of failure according parameter TypeOfFF
Exit
Endif
Endif
For each cylinder bit i which is set in SYM_CYL_DTC_XX
If DtcIdentifier = ID_ERR_DTC_MIS[0][i]
Then 1^{st} bit of ResultFrf = FRF_PRESENT
Software structure is filled-up with DtcIdentifier plus freeze frame of failure according parameter TypeOfFF
Exit
Endif
Endfor
Else (Customer DTC is request ; LevelOfDtc = CUS)
If SYM_CYL_DTC_XX [12]=1 (Random)
Then **If** DtcIdentifier=ID_ERR_DTC_MIS[1][NC_CYL_NR+1]
Then 1^{st} bit of ResultFrf = FRF_PRESENT
Software structure is filled-up with DtcIdentifier plus freeze frame of failure according parameter TypeOfFF
Exit

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```
                    Endif
                  Endif
                  If        SYM_CYL_DTC_XX [13]=1   (Multiple cylinder)
                  Then   If DtcIdentifier=ID_ERR_DTC_MIS[1][NC_CYL_NR]
                              Then   1st bit of ResultFrf = FRF_PRESENT
                                     Software structure is filled-up with DtcIdentifier  plus freeze
                                     frame of failure according parameter TypeOfFF
                                     Exit
                    Endif
                  Endif
                  For each cylinder bit i which is set in SYM_CYL_DTC_XX
                        If DtcIdentifier = ID_ERR_DTC_MIS[1][i]
                              Then   1st bit of ResultFrf = FRF_PRESENT
                                     Software structure is filled-up with DtcIdentifier  plus freeze
                                     frame of failure according parameter TypeOfFF
                                 Exit
                              Endif
                Endfor
            Endif
        Endif
    Endfor
Endif
```

"Software structure is filled-up with freeze frame of failure according parameter TypeOfFF" means :
(for failure IDX)

Software structure is filled-up with DTCIdentifier plus the softwate structure defined below :

```
If          TypeOfFF = LAW
Then        Software structure is fill up with ENVD_OBD[u][IDX]
Endif
If          TypeOfFF = CUS_CMN
Then        Software structure is fill up with ENVD_CUS_CMN[v][IDX]
Endif
If          TypeOfFF = CUS_SET
Then        Software structure is fill up with
                    ENVD_CUS_SET_CMN[w][z][IDX] + ENVD_CUS_SET_SPC[y][z][IDX]
Endif
```

Combination of parameter Type OfFF is possible. For instance if TypeOfFF is equal to LAW and CUS_CMN, both part are returned. In case of multiple part of freeze frame to returned, , the following order is respected :

- Part LAW of the freeze frame is returned first ;
- Part CUS_CMN of the freeze frame is then returned ;
- Part CUS_SET of the freeze frame is then returned .

Example : In the case of a request with TypeOfFF = LAW and CUS_CMN then the following structure is returned :

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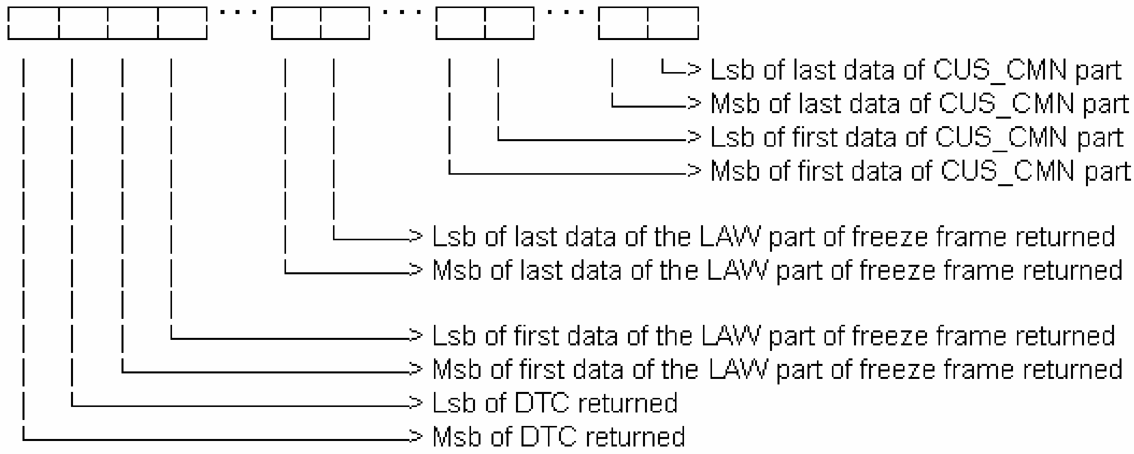

When a failure is found in dynamic memory with the right DtcIdentifier, the treatment is stopped. That means that only the freeze frame of the first DTC is found (oldest DTC) and returned by the API.
During all the software structure filling-in, if the software buffer is full then 2^{nd} bit of ResultFrf is set to BUFFER_FULL, software process is aborted.

B.65.6 API for erasing Diagnostic information

B.65.6.1 Clear the failure associated to DTC with a certain type.

Description :

Syntax : ACTION_ERRM_ClrInfoByTypeOfDtc (
IN <TypeOfDtc>,
OUT < ResultClrInfo>)

Parameter(in) : TypeOfDtc Type of DTC which is requested by the API
Parameter(out) : ResultClrInfo Indicate if some DTC are cleared or not
Short Description : This API clear all the failure in dynamic memory associated to DTC with a certain type. It permits also to reinitialised all readiness code.
Remark :
For reason of design, and time resource, it's recommended to activate this API when engine stop. (Ref. SAE Mode $04).

Application conditions:

Deactivation : -
Initialization: -
Recurrence : -

Formula section :

ResultClrInfo = INFO_NOT_CLEARED
For each failure stored in dynamic memory,
If the failure belongs to failures group defined by the parameter TypeOfDtc
Then ACTION_ERRM_EraseErr (IN<IDX>, SYNCHRONIZATION<CALL>)
All data in static memory related to failure XX (with XX = F(IDX)) is also cleared
ACTION_ERRM_ClcPermanentByErr(XX)

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ResultClrInfo = INFO_CLEARED

Endif
Endfor
In the case TypeOfDTC = All, then, the whole static memory shall be cleared (same behavior as clear failure memory using LC_ERR_FMY_CLR calibration bit)
{ Permanent calculation at ERRM clearing }
In case of TypeOfDTC = All, then call also ACTION_ERRM_ClcPermanentIniErrm( )
{ All readiness bit are reinitialised }
ACTION_ERRM_InitReadiness (SYNCHRONIZATION<CALL>)
Retransmit “failure erase service received”

B.65.6.2 Clear the failure associated to a DTC

Description :

Syntax : ACTION_ERRM_ClrInfoByDtc (
IN <DtcIdentifier>,
IN <LevelOfDtc>,
OUT < ResultClrInfo>)

Parameter(in) : DtcIdentifier Number of DTC which is requested (identifier)
LevelOfDtc OBD or customer DTC is requested by the API
Parameter(out) : ResultClrInfo to say if some DTC are cleared or not
Short Description : This API clear all the failure in dynamic memory associated to a DTC. The erasing is also applicable when there are identical DTC identifiers in the memory.

Application conditions:

Deactivation : -
Initialization: -
Recurrence : -

Formula section :

ResultClrInfo = INFO_NOT_CLEARED
{ All readiness bit are reinitialised }
ACTION_ERRM_InitReadiness (SYNCHRONIZATION<CALL>)
For each failure stored in dynamic memory **do**
ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS)
If PRM_READY_CLAS <> 00h (CARB_MIS)
Then Condition for failure traitment is true
Endif
If NLC_TREAT_DIAG_MIS = 1
Then Condition for failure traitment is true
Endif
If Condition for failure traitment is true
Then **If** LevelOfDtc = LAW (OBD DTC)
Then **If** NC_ERR_DTC_REQ_OBD = SYMPTOM (access by symptom)
Then **For** each bit i which is set in ERR_SYM_DTC[IDX]
If DtcIdentifier = ID_ERR_DTC_XX[0][i]
Then ACTION_ERRM_EraseErr (IN<IDX>,

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```
                                SYNCHRONIZATION<CALL> )
                                   All data in static memory related to failure XX (with XX =
                                   F(IDX)) is also cleared
                                    ACTION_ERRM_ClcPermanentByErr(XX)
                                    ResultClrInfo = INFO_CLEARED
                                    Exit
                              Endif
                        Endfor
                   Else   { access by failure : NC_ERR_DTC_REQ_OBD = FAILURE }
                        If       DtcIdentifier = ID_ERR_DTC_XX[ 0 ][ 4 ] )
                        Then   ACTION_ERRM_EraseErr( IN<IDX>,
                            SYNCHRONIZATION<CALL> )
                                   All data in static memory related to failure XX (with XX =
                              F(IDX)) is also cleared
                              ACTION_ERRM_ClcPermanentByErr(XX)
                                    ResultClrInfo = INFO_CLEARED
                         Endif
                   Endif
              Else   ( Customer DTC : LevelOfDtc = CUSTOMER)
                   If       NC_ERR_DTC_REQ_CUS = SYMPTOM    (access by symptom)
                   Then   For each bit i which is set in ERR_SYM_DTC[IDX]
                            If DtcIdentifier = ID_ERR_DTC_XX[NC_NR_DTC_FMT][i]
                            Then   ACTION_ERRM_EraseErr ( IN<IDX>,
                                SYNCHRONIZATION<CALL> )
                                   All data in static memory related to failure XX (with XX =
                                   F(IDX)) is also cleared
                                    ACTION_ERRM_ClcPermanentByErr(XX)
                                    ResultClrInfo = INFO_CLEARED
                                    Exit
                              Endif
                        Endfor
                   Else   (access by failure : NC_ERR_DTC_REQ_OBD = FAILURE)
                        If       DtcIdentifier = ID_ERR_DTC_XX
                                 [NC_NR_DTC_FMT][5-NC_NR_DTC_FMT]
                        Then   ACTION_ERRM_EraseErr ( IN<IDX>,
                            SYNCHRONIZATION<CALL> )
                              All data in static memory related to failure XX (with XX = F(IDX)) is
                              also cleared
                              ACTION_ERRM_ClcPermanentByErr(XX)
                              ResultClrInfo = INFO_CLEARED
                        Endif
                         Endif
              Endif
Else    (particular case for misfiring failure)
              XX = F (IDX) with XX = MIS_A, MIS_B1 or MIS_B4
         If       LevelOfDtc = LAW                       (OBD DTC)
              Then   If       SYM_CYL_DTC_XX [12]=1             (Random)
                   Then   If       DtcIdentifier=ID_ERR_DTC_MIS [0] [NC_CYL_NR+1]
                        Then   ACTION_ERRM_EraseErr ( IN<IDX>,
                            SYNCHRONIZATION<CALL> )
                              All data in static memory related to failure XX (with XX = F(IDX)) is
                              also cleared
                              ACTION_ERRM_ClcPermanentByErr(XX)
```

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```
                ResultClrInfo = INFO_CLEARED
                Exit
        Endif
Endif
If      SYM_CYL_DTC_XX [13]=1              (Multiple cylinder)
Then  If      DtcIdentifier=ID_ERR_DTC_MIS [0] [NC_CYL_NR]
        Then  ACTION_ERRM_EraseErr ( IN<IDX>,
              SYNCHRONIZATION<CALL> )
                All data in static memory related to failure XX (with XX = F(IDX)) is
                also cleared
                ACTION_ERRM_ClcPermanentByErr(XX)
                ResultClrInfo = INFO_CLEARED
                Exit
        Endif
Endif
For each cylinder bit i which is set in        SYM_CYL_DTC_XX
        If DtcIdentifier = ID_ERR_DTC_MIS[0][i]
        Then  ACTION_ERRM_EraseErr( IN<IDX>,
              SYNCHRONIZATION<CALL> )
                All data in static memory related to failure XX (with XX = F(IDX)) is
                also cleared
                ACTION_ERRM_ClcPermanentByErr(XX)
                ResultClrInfo = INFO_CLEARED
                Exit
        Endif
Endfor
```

```
Else    (Customer DTC )
        If      SYM_CYL_DTC_XX [12]=1              (Random)
        Then  If      DtcIdentifier=ID_ERR_DTC_MIS [1] [NC_CYL_NR+1]
                Then  ACTION_ERRM_EraseErr ( IN<IDX>,
                      SYNCHRONIZATION<CALL> )
                        All data in static memory related to failure XX (with XX = F(IDX)) is
                        also cleared
                        ACTION_ERRM_ClcPermanentByErr(XX)
                        ResultClrInfo = INFO_CLEARED
                        Exit
                Endif
        Endif
        If      SYM_CYL_DTC_XX [13]=1              (Multiple cylinder)
        Then  If      DtcIdentifier=ID_ERR_DTC_MIS [1] [NC_CYL_NR]
                Then  ACTION_ERRM_EraseErr ( IN<IDX>,
                      SYNCHRONIZATION<CALL> )
                        All data in static memory related to failure XX (with XX = F(IDX)) is
                        also cleared
                        ACTION_ERRM_ClcPermanentByErr(XX)
                        ResultClrInfo = INFO_CLEARED
                        Exit
                Endif
        Endif
        For each cylinder bit i which is set in        SYM_CYL_DTC_XX
                If DtcIdentifier = ID_ERR_DTC_MIS[1][i]
                Then  ACTION_ERRM_EraseErr ( IN<IDX>,
                      SYNCHRONIZATION<CALL> )
```

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All data in static memory related to failure XX (with XX = F(IDX)) is also cleared
ACTION_ERRM_ClcPermanentByErr(XX)
ResultClrInfo = INFO_CLEARED
Exit
Endif
Endfor
Endif
Endif
Endfor

When a failure is found in dynamic memory with the right DtcIdentifier, the treatment is not stopped. That means that all failure with the right DTC are erased.

B.65.7 API to manage the entry or exit of Marked Mode

B.65.7.1 Activate/deactivate the marked mode with clear failure

Description :

Syntax : ACTION_ERRM_ControlDtcSettings (IN <MarkedMode>)
Parameter(in) : MarkedMode State of marked mode
Short Description : This API permits to activate or deactivate the marked mode. In this mode all new failure which appears are marked and then erased when we leave this mode (useful in End Of Line phase). For errm inhibition, please refer to ACTION_ERRM_ActivateMarkedMode ().

Application conditions:

Deactivation : -
Initialization: -
Recurrence : -

Formula section :

If MarkedMode = ON
Then LV_MKD_MOD = 1
Else LV_MKD_MOD = 0
For each failure (IDX) stored in dynamic memory,
If LV_ERR_MKD[IDX] = 1
Then ACTION_ERRM_EraseErr (IN<IDX>)
All data in static memory related to failure XX (with XX = F(IDX)) is also cleared
ACTION_ERRM_ClcPermanentByErr(XX)
Endif
EndFor
Endif

B.65.7.2 Activate/deactivate the marked mode without clearing failures

Description :

Syntax : ACTION_ERRM_ActivateMarkedMode (IN <MarkedMode>)

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Parameter(in) : MarkedMode State of marked mode ON or OFF
Short Description : This API shall be used to activate/deactivate the marked mode. In this mode, each new occuring failure is marked.
This is useful for ERRM inhibition. This inhibition may be used during a reprogramming phase.

Application conditions:

Deactivation : -
Initialization: -
Recurrence : -

Formula section :

If MarkedMode = ON
Then LV_MKD_MOD = 1
Else LV_MKD_MOD = 0
Endif

B.65.7.3 Deactivation of marked mode (security mechanism)

Description:

Purpose of this module is to add a security mechanism regarding marked mode. Because marked mode permits to inhibit error management, a strategy shall be introduced to avoid wrong inhibition.
This strategy is to deactivate marked mode at the end of driving cycle or at the next reset.

Application conditions

Initialisation: *none*

Recurrence: *none*

Activation: *at DCOFF event* ***or*** *at RST event*

Deactivation: *none*

Formula section:

If LV_MKD_MOD = ON
Then
MarkedMode = OFF
ACTION_ERRM_ControlDtcSettings (IN<MarkedMode>)
Endif

B.65.8 API for reading readiness code

B.65.8.1 Read the readiness code information

Description :

Syntax : ACTION_ERRM_ReadReadinessCode (
INOUT <ReadinessCode>,
OUT <ResultReadinessCode>)

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Parameter(inout) : ReadinessCode Software structure fill with readiness code

Short Description : This API calculate and returns the readiness code information in the software structure.

Readiness code information are build from readiness flags.

Please see “Readiness Code” module of the “Error management” aggregate for more details.

Application conditions:

Deactivation : -
Initialization: -
Recurrence : -

Formula section :

ResultReadinessCode = NEGATIVE_RESPONSE

(Calculation of STATE_READY_OBD_1)

STATE_READY_OBD_1 :

```
|_|_|_|_|_|_|_|_|

 | | | | | | | └-> bit0 : Misfire monitoring supported
 | | | | | | └---> bit1 : Fuel system monitoring supported
 | | | | | └-----> bit2 : Comprehensive component monitoring supported
 | | | | └-------> bit3 : GS/DS vehicle (NLC_OBD_DSL = 1 for DS, 0 for GS)
 | | | └---------> bit4 : Misfire monitoring status
 | | └-----------> bit5 : Fuel system monitoring status
 | └-------------> bit6 : Comprehensive component monitoring status
 └---------------> bit7 : Reserved
```

4 less significant bit of STATE_READY_OBD_1 = 4 less significant bit of C_STATE_READY_OBD_1
4 most significant bit of STATE_READY_OBD_1 = 4 less significant bit of C_STATE_READY_OBD_1
STATE_READY_OBD_2:

```
|_|_|_|_|_|_|_|_|    GS name / DS name

 | | | | | | | └-> bit 0 : Catalyst / NMHC Catalyst monitoring
 | | | | | | └---> bit 1 : Heated catalyst / NOx Cat-Adsorber monotoring
 | | | | | └-----> bit 2 : Evaporative system / reserved monitoring
 | | | | └-------> bit 3 : Secondary air system / Boost pressure monitoring
 | | | └---------> bit 4 : reseved by ISO/SAE
 | | └-----------> bit 5 : Oxygen sensor / Exhaust Gaz sensor monitoring
 | └-------------> bit 6 : Oxygen sensor heater / PM Filter monitoring
 └---------------> bit 7 : EGR system monitoring
```

STATE_READY_OBD_2 = C_STATE_READY_OBD_2

The readiness code calculation is performed in two steps:

1. setting of readiness of a specific group CARB_YY (e.g. CARB_SA, CARB_EVAP), depending on the dynamic Error Management. If at least one failure XX is confirmed with bit 4 of WAL_CONF_XX = 1 of the group CARB_YY, then the readiness of this group can be set to ready.

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2. setting of readiness of a specific group CARB_YY, depending on the failure XX individual readiness information LV_READY_XX. E.g. in case of a failure free system only step 2 is used for the readiness code calculation.

Step 1:

```
If CTR_ERR_DYN_NR != 0          (at least one failure stored in Error Management)
Then   For  IDX = 0 to CTR_ERR_DYN_NR - 1
            If      bit 4 of WAL_CONF_XX = 1   (failure is emission relevant)
                    with XX = DIAG_INST[IDX]
            and     LV_ERR_CFM[IDX] = 1                (failure is confirmed)
            Then    ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS)
                    case PRM_READY_CLAS
                     00h (CARB_MIS) :                Bit 4 of STATE_READY_OBD_1 = 0
                     01h (CARB_FSD) :                Bit 5 of STATE_READY_OBD_1 = 0
                     02h (CARB_CC) :                 Bit 6 of STATE_READY_OBD_1 = 0
                     03h (CARB_CAT/CARB_NMHC) :  Bit 0 of STATE_READY_OBD_2 = 0
                     04h (CARB_HC/CARB_NT) :       Bit 1 of STATE_READY_OBD_2 = 0
                     05h (CARB_EVAP) :               Bit 2  of STATE_READY_OBD_2 = 0
                     06h (CARB_SA/CARB_BPA) :      Bit 3 of STATE_READY_OBD_2 = 0
                     07h             :              Bit 4 reserved by ISO/SAE always   0
                     08h (CARB_LS/CARB_EG) :              Bit 5 of STATE_READY_OBD_2 = 0
                    09h (CARB_LSH/CARB_PF) :        Bit 6 of STATE_READY_OBD_2 = 0
                    0Ah (CARB_EGR) :                Bit 7 of STATE_READY_OBD_2 = 0
            Endif
       Endfor
Endif
```

Step 2:

Distinction between GS vehicle and DS vehicle
Bit 3 of STATE_READY_OBD_1 = NLC_OBD_DSL

For each failure XX call ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS) to retrieve the readiness code group.

Misfire monitoring status bit4 :

```
    If        Bit 4 of C_STATE_READY_CMPL_OBD_1 = 0
    Then
        if    (LV_READY_XX) = 0
                         Take into account all LV_READY_XX which fulfill the following condition:
                   PRM_READY_CLAS = 00h (CARB_MIS) and
                   the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
        then       Bit 4 of STATE_READY_OBD_1 = 0
        endif
    Else
          Readiness for Misfire monitoring status is set
          Bit 4 of STATE_READY_OBD_1 = 0
    EndIf
```

Fuel system monitoring status bit5 :

```
    If        Bit 5 of C_STATE_READY_CMPL_OBD_1 = 0
    Then
```

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if (LV_READY_XX) = 0
Take into account all LV_READY_XX which fulfill the following condition:
PRM_READY_CLAS = 01h (CARB_FSD) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
then Bit 5 of STATE_READY_OBD_1 = 0
endif
Else
Readiness for Fuel system monitoring status is set
Bit 5 of STATE_READY_OBD_1 = 0
EndIf

Comprehensive component monitoring status bit6 :
If Bit 6 of C_STATE_READY_CMPL_OBD_1 = 0
Then
if (LV_READY_XX) = 0
Take into account all LV_READY_XX which fulfill the following condition:
PRM_READY_CLAS = 02h (CARB_CC) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
then Bit 6 of STATE_READY_OBD_1 = 0
endif
Else
Readiness for Comprehensive component status is set
Bit 6 of STATE_READY_OBD_1 = 0
EndIf

Bit 7 of STATE_READY_OBD_1 is unchanged

(Calculation of STATE_READY_OBD_2)

Catalyst monitoring bit 0 :
If (LV_READY_XX) = 0
Take into account all LV_READY_XX which fulfill the following condition:
PRM_READY_CLAS = 03h (CARB_CAT /CARB_NMHC) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 0 of STATE_READY_OBD_2 = 0
Endif

Heated catalyst bit 1 :
If (LV_READY_XX) = 0
Take into account all LV_READY_XX which fulfill the following condition:
PRM_READY_CLAS = 04h (CARB_HC /CARB_NT) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 1 of STATE_READY_OBD_2 = 0
Endif

Evaporative system monitoring bit2 :
If (LV_READY_XX) = 0
Take into account all LV_READY_XX which fulfill the following condition:
PRM_READY_CLAS = 05h (CARB_EVAP) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 2 of STATE_READY_OBD_2 = 0

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Endif

Secondary air system monitoring bit3 :
If (LV_READY_XX) = 0
Take into account all LV_READY_XX which fulfill the following condition:
PRM_READY_CLAS = 06h (CARB_SA /CARB_BPA) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 3 of STATE_READY_OBD_2 = 0
Endif

bit4 : Reserved by ISO/SAE

Oxygen sensor monitoring bit5 :
If (LV_READY_XX) = 0
Take into account all LV_READY_XX which fulfill the following condition:
PRM_READY_CLAS = 08h (CARB_LS /CARB_EG) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 5 of STATE_READY_OBD_2 = 0
Endif

Oxygen sensor heater monitoring bit6 :
If LV_READY_XX = 0
Take into account all LV_READY_XX which fulfill the following condition:
PRM_READY_CLAS = 09h (CARB_LSH /CARB_PF) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 6 of STATE_READY_OBD_2 = 0
Endif

EGR system monitoring bit7 :
If LV_READY_XX = 0 Take into account all LV_READY_XX which fulfill the following condition:
PRM_READY_CLAS = 0Ah (CARB_EGR) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 7 of STATE_READY_OBD_2 = 0
Endif

ReadinessCode structure is filled up with : C_STATE_READY_OBD_2, STATE_READY_OBD_1 and STATE_READY_OBD_2.
ResultReadinessCode = POSITIVE_RESPONSE

Definition of Readiness Code:
In C_STATE_READY_OBD_1, a bit set to 1 means that corresponding test is supported according to the J1979 standard.
C_STATE_READY_OBD_1 :

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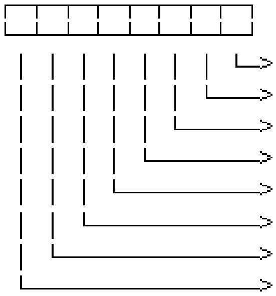
bit0 : Misfire monitoring supported
bit1 : Fuel system monitoring supported
bit2 : Comprehensive component monitoring supported
bit3 = 0 (reserved)
bit4 = 0 (reserved)
bit5 = 0 (reserved)
bit6 = 0 (reserved)
bit7 = 0 (reserved)

With C_STATE_READY_OBD_CMPL_OBD_1, it's possible to set directly Misfire, Fuel system, and comprehensive component readiness codes to "ready" status.

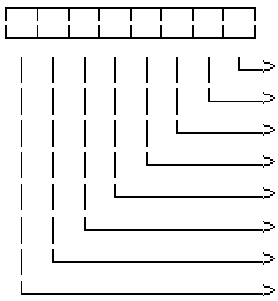
In C_STATE_READY_OBD_2, a bit set to 1 means that corresponding test is supported according to the J1979 standard.
C_STATE_READY_OBD_2:



GS name / DS name
bit 0 : Catalyst / NMHC Catalyst monitoring
bit 1 : Heated catalyst / NOx Cat-Adsorber monotoring
bit 2 : Evaporative system / reserved monitoring
bit 3 : Secondary air system / Boost pressure monitoring
bit 4 : reserved by ISO/SAE bit4 always 0
bit 5 : Oxygen sensor / Exhaust Gaz sensor monitoring
bit 6 : Oxygen sensor heater / PM Filter monitoring
bit 7 : EGR system monitoring

Calibration data detailled description for C_STATE_READY_CMPL_OBD_1 :
Readiness code calculation for CARB_MIS, CARB_FSD, CARB_CC diagnosis :
0: readiness of conserned group is calculated based on the readiness of each comprehensive component diagnostic
1: readiness of conserned group always indicates "ready"

C_STATE_READY_CMPL_OBD_1:



bit0 : 0
bit1 : 0
bit2 : 0
bit3 : 0
bit4 : set directly readiness for Misfire monitoring
bit5 : set directly readiness Fuel system monitoring
bit6 : set directly readiness Comprehensive component monitoring
bit7 : 0

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B.65.8.2 Read the readiness code information for customer specific purpose

Description :

Syntax : ACTION_ERRM_ReadReadinessCodCus(

INOUT <ReadinessCode>,
OUT <ResultReadinessCode>)

Parameter(inout): ReadinessCode Software structure filled-up with customer specific readiness code

Short Description : This API calculates and returns the readiness code information in the software structure.
Readiness code information are built thanks to readiness flags.
Please see “Readiness Code” module of the ERRM aggregate for more details.

Application conditions:

Deactivation : -
Initialization: -
Recurrence : -

Formula section :

ResultReadinessCode = NEGATIVE_RESPONSE

(Calculation of STATE_READY_OBD_3)

STATE_READY_OBD_3 :

```
|_|_|_|_|_|_|_|_|
 | | | | | | | └─> bit0 : for diagnosis classified as CARB_OTHER
 | | | | | | └───> bit1 : for diagnosis classified as NO_CARB
 | | | | | └─────> bit2 : 0
 | | | | └───────> bit3 : 0
 | | | └─────────> bit4 : 0
 | | └───────────> bit5 : 0
 | └─────────────> bit6 : 0
 └───────────────> bit7 : 0
```

STATE_READY_OBD_3 = C_STATE_READY_OBD_3

For each failure XX call ACTION_ERRM_GetReadyClass(XX, PRM_READY_CLAS) to retrieve the readiness code group.

Diagnosis classified as CARB_OTHER bit0:
If (LV_READY_XX) = 0
Take into account all LV_READY_XX which fulfill the following condition:
PRM_READY_CLAS = 0Bh (CARB_OTHER) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 0 of STATE_READY_OBD_3 = 0
Endif

Diagnosis classified as NO_CARB bit1
If (LV_READY_XX) = 0

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Take into account all LV_READY_XX which fulfill the following condition:
PRM_READY_CLAS = 0Ch (NO_ CARB) **and**
the bit 4 of WAL_CONF_XX = 0 (CARB/EOBD failure)
Then Bit 1 of STATE_READY_OBD_3 = 0
Endif

ReadinessCode structure is filled-up with : C_STATE_READY_OBD_3, STATE_READY_OBD_3.
ResultReadinessCode = POSITIVE_RESPONSE

Definition of Readiness Code:
This readiness code does not follow existing J1979 standard.
C_STATE_READY_OBD_3 :

```
|_|_|_|_|_|_|_|_|
 | | | | | | | └─> bit0 : for diagnosis classified as CARB_OTHER
 | | | | | | └───> bit1 : for diagnosis classified as NO_CARB
 | | | | | └─────> bit2 : 0
 | | | | └───────> bit3 : 0
 | | | └─────────> bit4 : 0
 | | └───────────> bit5 : 0
 | └─────────────> bit6 : 0
 └───────────────> bit7 : 0
```

B.65.9 Rate-Based Monitoring - Communication interface

FUNCTION DESCRIPTION:

Description:

The Rate-Based Monitoring statistics shall be reported to the Scan-Tool via the Mode $09.
The data to be transmitted are :

- Ignition cycle counter
- General denominator
- For each group of monitors, individual numerator and denominator of the monitor which has the lowest In-Use Performance ratios.

These statistics are required and transmitted within Mode $09 for the monitors of the following groups :

Gasoline system	*Diesel system*
Catalyst bank 1	NMHC catalyst
Catalyst bank 2	NOx reduction catalyst
Oxygen sensor upstream bank 1	NOx adsorber
Oxygen sensor upstream bank 2	Particulate matter filter
EGR system and/or VVT system	Exhaust gas sensor bank 1
Secondary air system	EGR system and/or VVT system
Evaporating system	Boost pressure control
Oxygen sensor downstream bank 1	
Oxygen sensor downstream bank 2	

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The selection of data to be displayed on Scan-Tool shall respect some rules :

- For each group of monitors, the individual numerator and denominator of monitor which has the lowest numerical In-Use Performance ratio shall be reported.
- If two or more specific monitors of the same group have identical ratios, the corresponding numerator and denominator for the specific monitor that has the highest denominator shall be reported.
- Depending on system configurations, some components might not exist (e.g. O2 Sensor for bank 2 on vehicles with 1 bank engine). In this case the numerator and denominator shall be set to 0.

B.65.9.1 API to select Rate-Based Monitoring data to be transmitted via Mode $09

The following paragraph descibes the data selection algorithm to be executed only once (for CPU load saving reason), upon external tool request via Mode $09.

Description for action:

ACTION_ERRM_*SelectRbmData* (<PRM_CTR_MOD_9_RBM[36]>, <PRM_RES_MOD_9>)					
This API calculates and returns the Rate-Based Monitoring data to be transmitted to the Scan-Tool, when requested by the Mode 09$ (InfoType $08).					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_CTR_MOD_9_RBM[36]	INOUT	0...FFFFH	0...65535	1	[-]
Table of counters to be reported to Scan Tool with Mode $09					
PRM_RES_MOD_9	OUT	0H 1H	NEGATIVE_RESPONSE POSITIVE_RESPONSE	1	[-]
Indicates if action has been executed or not					

PRM_CTR_MOD_9_RBM[36] detailled description:

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Index	***Byte n°***	***Diesel system (72 bytes)***	***Gasoline system (72 bytes)***	
0	#0 #1	00H 00H	OBD Monitoring Conditions	MSB byte LSB byte
1	#2 #3	00H 00H	Ignition Counter	MSB byte LSB byte
2	#4 #5	00H 00H	Catalyst Bank 1 - Numerator	MSB byte LSB byte
3	#6 #7	00H 00H	Catalyst Bank 1 - Denominator	MSB byte LSB byte
4	#8 #9	00H 00H	Catalyst Bank 2 - Numerator	MSB byte LSB byte
5	#10 #11	00H 00H	Catalyst Bank 2 - Denominator	MSB byte LSB byte
6	#12 #13	00H 00H	Oxygen Sensor bank 1 - Numerator	MSB byte LSB byte
7	#14 #15	00H 00H	Oxygen Sensor bank 1 - Denominator	MSB byte LSB byte
8	#16 #17	00H 00H	Oxygen Sensor bank 2 - Numerator	MSB byte LSB byte
9	#18 #19	00H 00H	Oxygen Sensor bank 2 - Denominator	MSB byte LSB byte
10	#20 #21	00H 00H	EGR/VVT System - Numeratore)	MSB byte LSB byte
11	#22 #23	00H 00H	EGR/VVT System - Denominator	MSB byte LSB byte
12	#24 #25	00H 00H	Secondary Air - Numerator	MSB byte LSB byte
13	#26 #27	00H 00H	Secondary Air - Denominator	MSB byte LSB byte
14	#28 #29	00H 00H	Evaporating System - Numerator	MSB byte LSB byte
15	#30 #31	00H 00H	Evaporating System - Denominator	MSB byte LSB byte
16	#32 #33	00H 00H	Secondary Oxygen Sensor Bank 1 - Numerator	MSB byte LSB byte
17	#34 #35	00H 00H	Secondary Oxygen Sensor Bank 1 - Denominator	MSB byte LSB byte
18	#36 #37	00H 00H	Secondary Oxygen Sensor Bank 2 - Numerator	MSB byte LSB byte
19	#38 #39	00H 00H	Secondary Oxygen Sensor Bank 2 - Denominator	MSB byte LSB byte
20	#40 #41	OBD Monitoring Conditions	00H 00H	MSB byte LSB byte
21	#42 #43	Ignition Counter	00H 00H	MSB byte LSB byte
22	#44 #45	NMHC Catalyst - Numerator	00H 00H	MSB byte LSB byte
23	#46 #47	NMHC Catalyst - Denominator	00H 00H	MSB byte LSB byte
24	#48	NOx Catalyst - Numerator	00H	MSB byte

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	#49		00H	LSB byte
25	#50 #51	NOx Catalyst - Denominator	00H 00H	MSB byte LSB byte
26	#52 #53	NOx Adsorber - Numerator	00H 00H	MSB byte LSB byte
27	#54 #55	NOx Adsorber - Denominator	00H 00H	MSB byte LSB byte
28	#56 #57	PM Filter - Numerator	00H 00H	MSB byte LSB byte
29	#58 #59	PM Filter - Denominator	00H 00H	MSB byte LSB byte
30	#60 #61	Exhaust Gas Sensor Bank 1 - Numerator	00H 00H	MSB byte LSB byte
31	#62 #63	Exhaust Gas Sensor Bank 1 - Denominator	00H 00H	MSB byte LSB byte
32	#64 #65	EGR/VVT System - Numerator	00H 00H	MSB byte LSB byte
33	#66 #67	EGR/VVT System - Denominator	00H 00H	MSB byte LSB byte
34	#68 #69	Boost Pressure Control - Numerator	00H 00H	MSB byte LSB byte
35	#70 #71	Boost Pressure Control - Denominator	00H 00H	MSB byte LSB byte

Application conditions

Initialization :

```
For i = 0 to 35 do
        PRM_CTR_MOD_9_RBM[i] = 0000H
 Endfor
 PRM_RES_MOD_9 = NEGATIVE_RESPONSE
```

Recurrence : –

Activation : *at Action call*

Deactivation : –

Formula section:

If(1) NLC_OBD_RBM_ENA = 1

If(2) NLC_OBD_DSL = 0 (Gasoline engine)

Then(2)

PRM_CTR_MOD_9_RBM[0] = CTR_CDN_OBD_RBM

PRM_CTR_MOD_9_RBM[1] = CTR_IGK_CYC_RBM

ACTION_ERRM_*SelectRbmByGroup* (NC_RBM_CAT_1, PRM_CTR_MOD_9_RBM[2], PRM_CTR_MOD_9_RBM[3], PRM_RES_MOD_9)

ACTION_ERRM_*SelectRbmByGroup* (NC_RBM_CAT_2, PRM_CTR_MOD_9_RBM[4], PRM_CTR_MOD_9_RBM[5], PRM_RES_MOD_9)

ACTION_ERRM_*SelectRbmByGroup* (NC_RBM_LS_UP_1, PRM_CTR_MOD_9_RBM[6], PRM_CTR_MOD_9_RBM[7], PRM_RES_MOD_9)

ACTION_ERRM_*SelectRbmByGroup* (NC_RBM_LS_UP_2, PRM_CTR_MOD_9_RBM[8], PRM_CTR_MOD_9_RBM[9], PRM_RES_MOD_9)

ACTION_ERRM_*SelectRbmByGroup* (NC_RBM_EGR_VVT, PRM_CTR_MOD_9_RBM[10], PRM_CTR_MOD_9_RBM[11], PRM_RES_MOD_9)

ACTION_ERRM_*SelectRbmByGroup* (NC_RBM_SA, PRM_CTR_MOD_9_RBM[12], PRM_CTR_MOD_9_RBM[13], PRM_RES_MOD_9)

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ACTION_ERRM_*SelectRbmByGroup* (NC_RBM_EVAP, PRM_CTR_MOD_9_RBM[14], CTR_MOD_9_RBM[15], PRM_RES_MOD_9)
ACTION_ERRM_*SelectRbmByGroup* (NC_RBM_LS_DOWN_1, PRM_CTR_MOD_9_RBM[16], PRM_CTR_MOD_9_RBM[17], PRM_RES_MOD_9)
ACTION_ERRM_*SelectRbmByGroup* (NC_RBM_LS_DOWN_2, PRM_CTR_MOD_9_RBM[18], PRM_CTR_MOD_9_RBM[19], PRM_RES_MOD_9)
For i = 20 to 35 **do**
PRM_CTR_MOD_9_RBM[i] = 0000H
Endfor
Else(2)
(Diesel engine)
For i = 0 to 19 **do**
PRM_CTR_MOD_9_RBM[i] = 0000H
Endfor
PRM_CTR_MOD_9_RBM[20] = CTR_CDN_OBD_RBM
PRM_CTR_MOD_9_RBM[21] = CTR_IGK_CYC_RBM
ACTION_ERRM_*SelectRbmByGroup* (NC_RBM_NMHC, PRM_CTR_MOD_9_RBM[22], PRM_CTR_MOD_9_RBM[23], PRM_RES_MOD_9)
ACTION_ERRM_*SelectRbmByGroup* (NC_RBM_RCAT, PRM_CTR_MOD_9_RBM[24], PRM_CTR_MOD_9_RBM[25], PRM_RES_MOD_9)
ACTION_ERRM_*SelectRbmByGroup* (NC_RBM_NT, PRM_CTR_MOD_9_RBM[26], PRM_CTR_MOD_9_RBM[27], PRM_RES_MOD_9)
ACTION_ERRM_*SelectRbmByGroup* (NC_RBM_PF, PRM_CTR_MOD_9_RBM[28], PRM_CTR_MOD_9_RBM[29], PRM_RES_MOD_9)
ACTION_ERRM_*SelectRbmByGroup* (NC_RBM_EG_1, PRM_CTR_MOD_9_RBM[30], PRM_CTR_MOD_9_RBM[31], PRM_RES_MOD_9)
ACTION_ERRM_*SelectRbmByGroup* (NC_RBM_EGR_VVT_DSL, PRM_CTR_MOD_9_RBM[32], PRM_CTR_MOD_9_RBM[33], PRM_RES_MOD_9)
ACTION_ERRM_*SelectRbmByGroup* (NC_RBM_BPA, PRM_CTR_MOD_9_RBM[34], PRM_CTR_MOD_9_RBM[35], PRM_RES_MOD_9)
Endif(2)
Else(1)
For i = 0 to 35 **do**
PRM_CTR_MOD_9_RBM[i] = 0000H
Endfor
Endif(1)
PRM_RES_MOD_9 = POSITIVE_RESPONSE

B.65.9.2 API to select RBM statistic with lowest in-use performance ratio within one single group

General information:

This API shall be used to determine, within one single group (see specification “Rate-Based Monitoring (Appl. Inc.)”), the counters of the monitor which has the lowest in-use performance ratio.

Description for action:

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ACTION_ERRM_*SelectRbmByGroup*(<PRM_GROUPNAME>,<PRM_NUMERATOR>,<PRM_DENOMINATOR>,<PRM_RESULTRBMDATABYGROUP>)					
This API calculates and returns the Rate-Based Monitoring data with lowest ratios, within one single group.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_GROUPNAME	IN	0...FFH	0...255	1	[-]
Group name					
PRM_NUMERATOR	INOUT	0...FFFFH	0...65535	1	[-]
Numerator of monitor with lowest ratio in the required group					
PRM_DENOMINATOR	INOUT	0...FFFFH	0...65535	1	[-]
Denominator of monitor with lowest ratio in the required group					
PRM_RESULTRBMDATA BYGROUP	OUT	0H 1H	NEGATIVE_RESPONSE POSITIVE_RESPONSE	1	[-]
Indicates if the Action has been executed or not					

Application conditions

Initialization : –

Recurrence : –

Activation : `at Action call`

Deactivation : –

Formula section:

{ For CPU optimization reasons, this implementation assumes that belonging to a same group are joined. If this requirement isn't respected, data sent to the Scan-Tool might be erroneous }

PRM_RESULTRBMDATABYGROUP = NEGATIVE_RESPONSE
m = 0
While m ≤ (NC_NR_DIAG_RBM - 1) **do**
If(1) m monitor belongs to PRM_GROUPNAME
Then(1)
If(2) CTR_CDN_RBM[m] 0 { denominator is different from 0 }
Then(2)
RATIO_TMP_RBM = CTR_COMP_RBM[m] /CTR_CDN_RBM[m]
PRM_NUMERATOR = CTR_COMP_RBM[m] and PRM_DENOMINATOR = CTR_CDN_RBM[m]
Else(2)
RATIO_TMP_RBM = 200498A4H
PRM_NUMERATOR = CTR_COMP_RBM[m] and PRM_DENOMINATOR = 0
Endif(2)
IDX_TMP_RBM = m
For j = (m+1) to (NC_NR_DIAG_RBM - 1) **do**
If(3) j monitor belongs to PRM_GROUPNAME
Then(3)
If(4) CTR_CDN_RBM[j] 0 { denominator is different from 0 }
Then(4)
{ case of one monitor with lower ratio than previous one found }
If(5) ((CTR_COMP_RBM[j] /CTR_CDN_RBM[j]) < RATIO_TMP_RBM)
Then(5)
RATIO_TMP_RBM = CTR_COMP_RBM[j] /CTR_CDN_RBM[j]
IDX_TMP_RBM = j

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```
                        PRM_NUMERATOR = CTR_COMP_RBM[j]
                        PRM_DENOMINATOR = CTR_CDN_RBM[j]
                Else(5)
                        { case of two monitors with same ratios }
                        If(6)    ( ( CTR_COMP_RBM[j] /CTR_CDN_RBM[j] ) = RATIO_
                        TMP_RBM )
                        Then(6)
                                If(7)    CTR_CDN_RBM[j] > CTR_CDN_RBM[IDX_TMP_
                                RBM]
                                Then(7)
                                        PRM_NUMERATOR = CTR_COMP_RBM[j]
                                        PRM_DENOMINATOR = CTR_CDN_RBM[j]
                                        IDX_TMP_RBM = j
                                Endif(7)
                        Endif(6)
                Endif(5)
            Else(4)
                { denominator equals 0 }
            Endif(4)
        Endif(3)
    Endfor
    Exit while loop
  Else(1)
        { m monitor doesn't belong to PRM_GROUPNAME }
        m = m +1
        PRM_NUMERATOR = 0 and PRM_DENOMINATOR = 0
  Endif(1)
Endwhile
PRM_RESULTRBMDATABYGROUP = POSITIVE_RESPONSE
```

B.65.9.3 API to clear all Rate-Based Monitoring statistics

General information:

Regulation text :
*"Each number shall be reset to zero only when a non-volatile memory reset occurs (e.g., reprogramming event, etc.) or, if the numbers are stored in keep-alive memory (KAM), when KAM is lost due to an interruption in electrical power to the control module (e.g., battery disconnect, etc.). Numbers may not be reset to zero under any other circumstances including
when a scan tool command to clear fault codes or reset KAM is received."*

The service provided in this paragraph shall be used to clear all the Rate-Based Monitoring statistics after a reprogramming session of ECU software and/or calibration data.

This service shall not be called when a Scan Tool command to clear faults (Mode 04$) is received.

Description for action:

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ACTION_ERRM_*ClearRbmStatistics* (< PRM_RESULTCLRINFO>)					
This function clears Rate-Based Monitoring statistics. Remark : For design and CPU resource reasons, this API shall be called while engine is stopped.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_RESULTCLRINFO	OUT	0H 1H	NOT_CLEARED CLEARED	1	[-]
This data informs about rate-based monitoring statistics clearing completion status					

Application conditions

Initialization : –

Recurrence : –

Activation : *at Action call*

Deactivation : –

Formula section:

PRM_RESULTCLRINFO = STATISTICS_NOT_CLEARED
CTR_IGK_CYC_RBM = 0
CTR_CDN_OBD_RBM = 0
For m = 0 to (NC_NR_DIAG_RBM -1) **do**
    CTR_CDN_RBM[m] = 0
    CTR_COMP_RBM[m] = 0
Endfor
PRM_RESULTCLRINFO = STATISTICS_CLEARED

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B.66 Communication interface (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_TYPE_BYTE [NC_NR_ERR_DYN]	O	0... FFH	0... 255	1	-
Fault-type-byte					
ERR_TYPE_EXT_BYTE [NC_NR_ERR_DYN]	O	0... FFH	0... 255	1	-
Fault-type-extension-byte					

Input data:

CTR_DC [NC_NR_ERR_DYN] {p. 5767}	CTR_WUP_CYC [NC_NR_ERR_DYN] {p. 5767}	ENVD_CUS_SET_CMN [NC_NR_ENVD_CUS_SET_CMN][NC_NR_FRF_SET][NC_NR_ERR_DYN] {p. 5792}	LV_CDN_DIAG_XX {p. 4581}
LV_DC_MAX [NC_NR_ERR_DYN] {p. 5767}	LV_END_DIAG_XX {p. 4581}	LV_ERR_CFM [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_DC [NC_NR_ERR_DYN] {p. 5767}
LV_ERR_MKD [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_TMP [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_XX	LV_READY_XX {p. 5881}
WAL_CONF_XX {p. 5811}			

B.66.1 Communication interface for BMW diagnosis tool

FUNCTION DESCRIPTION:

General information:

This communication interface is to define the data contents needed for the BMW diagnosis information. The Information in the Fault-type-byte and Fault-type-extension-byte is bit-coded and requested via KWP communication.

Application conditions

Initialisation: *managed in the specific chapters*

Recurrence: *managed in the specific chapters*

Activation: *see chapter KWP communication*

Formula section:

Definition of ERR_TYPE_BYTE[x]

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Bit No:	Description	Input
0	Specifies the error symptom: 0001-Short circuit to VBATT or signal / value above threshold (Max)	**IF** ENVD_CUS_SET_CMN[1][x] = 1H
1	Specifies the error symptom: 0010-Short circuit to ground or signal / value below threshold (Min)	**IF** ENVD_CUS_SET_CMN[1][x] = 2H
2	Specifies the error symptom: 0100-Open circuit or no signal (Sig)	**IF** ENVD_CUS_SET_CMN[1][x] = 4H
3	Specifies the error symptom: 1000-Implausible signal / condition (Plaus)	**IF** ENVD_CUS_SET_CMN[1][x] = 8H
4	BMW Readiness flag. The bit is set to 0 if the test conditions are met and the diagnostic runs to completion at least once after the fault memory has been cleared, or after power failure	**IF** LV_READY_XX = 0
5	This bit is set when the fault has been saved to the fault memory as OBD debounced.	**IF** LV_DC_MAX[x] = 1
6	This bit is set when the fault is currently present	**IF** LV_ERR_XX = 1
7	MIL calibration status, specifies wheather the MIL is to be activated	**IF** MIL_ON bit of WAL_CONF_XX =1

Definition of ERR_TYPE_EXT_BYTE[x]

Bit No:	Description	Input
0	Only for Diagnostic diagnosis; This bit is set if the diagnosis is currently running	**For diagnostic diagnosis**** LV_END_DIAG_XX = 0 **AND** LV_CDN_DIAG_XX = 1
1	Only for Diagnostic diagnosis; This bit is set if the diagnosis is interrupted for this driving cycle	**For diagnostic diagnosis**** Not defined yet
2	Cycle flag. The bit is set if the diagnosis runs to completion in this driving cycle	**IF** LV_END_DIAG_XX = 1
3	This bit is to be set if the fault is stored as a result of an action by an tester	**IF** LV_ERR_MKD[x] = 1
4	This bit is to be set if the fault is currently requesting the MIL to be illuminated.	**IF** LV_DC_MAX[x] = 1 **AND** MIL_ON bit of WAL_CONF_XX =1
5	This bit is set if MIL debouncing has been achieved, the MIL is not currently being requested for this fault and output via the Scan Tool interface has not yet occured (HLC =0 & DLC >0). (former OBDII error)	**IF** LV_ERR_CFM[x] = 1 **AND** CTR_DC[x] = 0 **AND** MIL_ON bit of WAL_CONF_XX =1 **AND** CTR_WUP_CYC[x] > 0
6	Not yet defined	
7	Not yet defined	

**Diagnostic diagnosis are all sequential diagnosis (see Table of failures - CARB status)

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B.67 Cycle manager

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DC	O/V	0... 1H	0 ...1	1	-
Driving cycle active					
LV_DC_PERM	O/V	0... 1H	0 ...1	1	-
Driving cycle including standardized vehicle operations for permanent fault code erasure after ERRM clearing					
LV_STATE_WUP	O/V	0... 1H	0 ...1	1	-
tco state for exceeding the warm-up cycle tco threshold					
LV_WUP_CYC	O/V	0... 1H	0 ...1	1	-
Warm-up cycle status flag					
STATE_DC_PERM	V	0... FFH	0... 255	1	-
Status information about all conditions necessary to set LV_DC_PERM					
T_AST_PERM	V	0... FFFFH	0... 6553.5	0.1	s
Cumulated time since engine start for permanent fault code erasing after Mode $04					
T_IS_PERM	V	0... FFFFH	0... 6553.5	0.1	s
Continuous vehicle operation in idle >= C_T_IS_RBM for permanent fault code erasing after Mode $04					
T_VS_PERM	V	0... FFFFH	0... 6553.5	0.1	s
Cumulated operation with vehicle speed >= C_T_VS_RBM for permanent fault code erasing after Mode $04					

Input data:

C_PV_IS_RBM {p. 5858}	C_T_AST_RBM {p. 5859}	C_T_IS_RBM {p. 5859}	C_T_VS_RBM {p. 5859}
C_VS_THD_IS_CDN_RBM {p. 5859}	C_VS_THD_RBM {p. 5859}	LV_ES {p. 1720}	LV_IGK {p. 906}
LV_INH_DC_PERM {p. 5753}	LV_INH_WUP_CYC {p. 5789}	LV_IS_PERM {p. 5753}	LV_PWL {p. 988}
LV_ST_END {p. 1720}	PV {p. 978}	TCO_DSL_CMN {p. 5789}	TCO_ST_DSL_CMN {p. 5789}
VS {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_ST_MAX_INH_WUP_CYC	-	0... FEH	-48... 142.5	0.75	°C
maximum engine temperature at start to detect warm up cycle (customer requirement 71,1°C)					
C_TCO_WUP_INC	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature increase from engine starting for warm-up cycle detection					
C_TCO_WUP_THD	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature to be reached for warm-up cycle detection					

Import actions:

ACTION_ERRM_ClcPermanentResetDC ()

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B.67.1 Driving cycle

FUNCTION DESCRIPTION:

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General information:

Description:

A driving cycle consists of a vehicle operation phase from engine startup to engine shutoff and includes the power-lach phase after the engine running phase (In order manage all OBD failures set only in PWL phase).
After key is on, the flag LV_DC is set when the engine exits from “engine start” state.
The flag LV_DC is reset at the end of the power-latch phase before the NVMY management. In case of a LV_IGK 0→1 transition during the powerlatch phase or at ECU reset LV_DC is also reseted.

Remark :
For simplification and global coherence, the following rule is applied:
Engine stalling is ignored (if engine restarts after stalling, without key-off/key-on transition, the cycle is considered as the same driving cycle).

Signal flow diagram:

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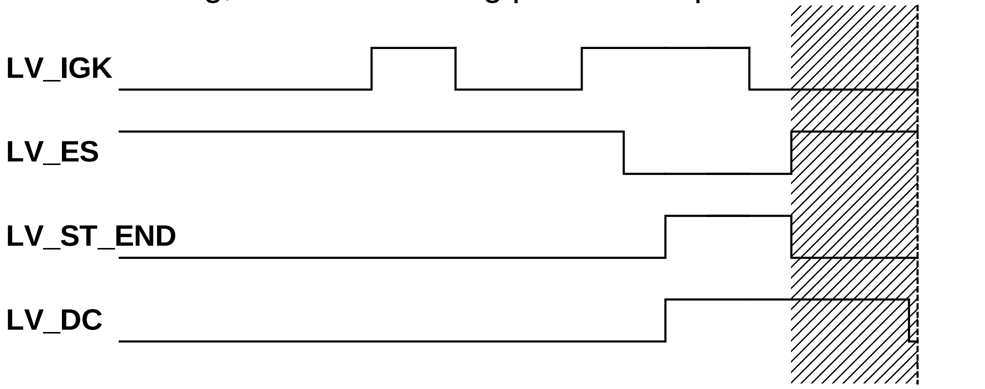
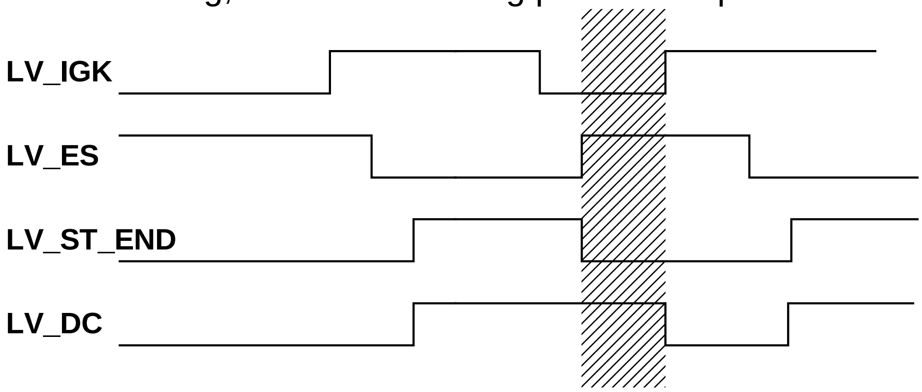
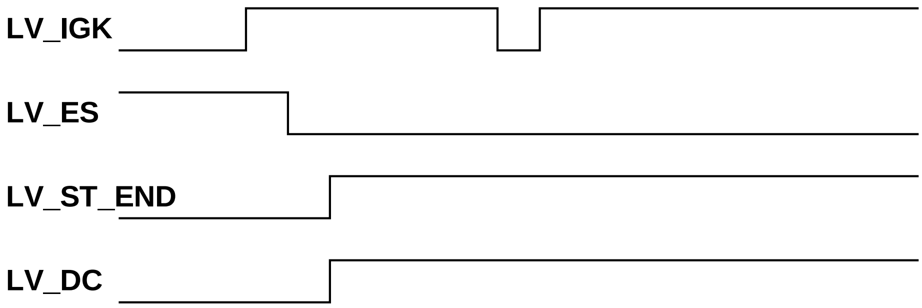
Normal cranking, no restart during powerlatch phase



Normal cranking, with restart during powerlatch phase



Short key off/on while engine is running



Application conditions

Initialisation:

```
At RST system event
     LV_DC = 0
   Before storage of data of the error management within the
NVMY
 the driving cycle is finished.
```

Recurrence: –

Activation: *see Formula section*

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Formula section:

Activation:

If LV_ST_END 0→1 transition

Then

LV_DC = 1

Endif

Deactivation:

If LV_IGK 0→1 transition

and

LV_ES =1

Then

LV_DC = 0

Before clearing static and dynamic memory (e.g. LV_END_DIAG_XX) call :

ACTION_ERRM_*ClcPermanentResetDC*()

Endif

If End of power-latch phase is reached (before NVMY storing)

Then

LV_DC = 0

Before clearing static and dynamic memory (e.g. LV_END_DIAG_XX) call :

ACTION_ERRM_*ClcPermanentResetDC*()

Endif

B.67.2 Warm-Up Cycle and Warm-Up Status

FUNCTION DESCRIPTION:

General information:

The detection of the warm-up cycle is based on the coolant temperature. The warm-up cycle is detected as soon as the coolant temperature reaches C_TCO_WUP_THD and the change with regard to the starting temperature exceeds C_TCO_WUP_INC. These values are defined by law, so a change of these values is only for development validation commodity.

The application must guarantee warm-up cycle detection when a coolant temperature sensor error exists.

Therefore if a coolant temperature sensor error has been debounced, the threshold for warm-up cycle detection are referred to the backup coolant temperature value computed by the engine control (see chapter “Diagnosis and emergency operation”).

The warm-up status is needed for similar driving conditions test.

Application conditions

Initialisation: *At RST system event* **or** *LV_DC 1→0 transition (after warm-up cycle counter management)*

LV_WUP_CYC =0
LV_STATE_WUP = 0

Recurrence: *1 s*

Activation: *LV_DC = 1*

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Formula section:

If LV_INH_WUP_CYC = 0
Then
    If TCO_DSL_CMN > C_TCO_WUP_THD
    Then
        LV_STATE_WUP = 1
        If TCO_DSL_CMN > (TCO_ST_DSL_CMN + C_TCO_WUP_INC)
        and
        TCO_ST_DSL_CMN < C_TCO_ST_MAX_INH_WUP_CYC
        Then
            LV_WUP_CYC = 1
        Endif
    Endif
Endif

Calibration hint:

C_TCO_WUP_THD = at least 72 °C for gasoline engines (OBD II requirement)
at least 70 °C for gasoline engines (EOBD requirement)
at least 60 °C for diesel engines (OBD II requirement)
C_TCO_WUP_INC = at least 23 °C for gasoline engines (OBD II requirement)
at least 22 °C for gasoline engines (EOBD requirement)

Customer specific requirement for gasoline and diesel to inhibit the warm up cycle in case of TCO at engine start > C_TCO_ST_MAX_INH_WUP_CYC

C_TCO_ST_MAX_INH_WUP_CYC = 71,1 °C (customer specific requirement)

C_TCO_ST_MAX_INH_WUP_CYC = 142.5°C (generic no inhibition)

B.67.3 Standardized vehicle operation for permanent fault code erasing after Mode $04

FUNCTION DESCRIPTION:

General information:

A special driving cycle (LV_DC_PERM) for permanent fault code clearing after Mode $04 is defined, which is set, if the following standardized vehicle operations are fulfilled:

- Cumulated trip length (time since engine start) T_AST_PERM >= C_T_AST_RBM

(CARB : 600 s)

- Cumulative vehicle operation >= C_VS_THD_RBM for minimum of C_T_VS_RBM

(CARB : >= 40 km/h (25mph) for at least 300 s)

- Continuous vehicle operation in idle equal or longer than C_T_IS_RBM (accelerator pedal released and vehicle speed less or equal than 1 mph)

(CARB : 30 s)

wathever

- altitude condition is (no criteria for ambient pressure si defined)
- ambient temperature is (no criteria on ambient temperature is defined)

Within STATE_DC_PERM the different conditions necessary to set LV_DC_PERM are visualized.
STATE_DC_PERM

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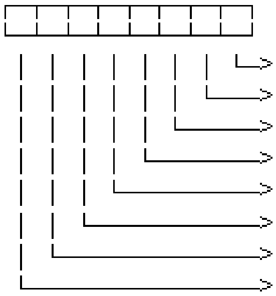

bit 0 : minimum trip length condition
bit 1 : vehicle speed condition
bit 2 : continuous idle condition
bit 3 : 0
bit 4 : 0
bit 5 : 0
bit 6 : 0
bit 7 : 0

bit value = 0 condition not yet met; bit value = 1 condition met

Application conditions

Initialisation: *at LV_DC 0 → 1 transition* **or** *RST system event*

```
LV_DC_PERM = 0
STATE_DC_PERM = 0H
T_AST_PERM = 0 s
T_VS_PERM = 0 s
T_IS_PERM = 0 s
```

Recurrence: *100 ms*

Activation: LV_DC = 1 **and** LV_DC_PERM = 0 **and** LV_INH_DC_PERM = 0 **and** LV_PWL = 0

Formula section:

Minimum trip length

If(1) bit 0 of STATE_DC_PERM = 0 (minimum trip length not reached yet)

Then(1)

T_AST_ PERM = T_AST_PERM + 100 ms

If (2) T_AST_PERM = C_T_AST_RBM

Then (2)

bit 0 of STATE_DC_PERM = 1

Endif (2)

Endif (1)

Vehicle speed

If (1) bit 1 of STATE_DC_PERM = 0 (vehicle speed condition not met yet)

and

VS >= C_VS_THD_RBM

Then (1)

T_VS_PERM = T_VS_PERM + 100 ms

If (2) T_VS_PERM = C_T_VS_RBM

Then (2)

bit 1 of STATE_DC_PERM = 1

Endif (2)

Endif (1)

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Continuous idle

If (1) bit 2 of STATE_DC_PERM = 0 (continuous idle cond. not met yet)
Then (1)
If (2) LV_IS_PERM = 1 (engine in idle mode)
and
PV <= C_PV_IS_RBM (accelerator pedal released)
and
VS <= C_VS_THD_IS_CDN_RBM (CARB: 1 mile/h)
Then (2)
T_IS_PERM = T_IS_PERM + 100 ms
If (3) T_IS_PERM = C_T_IS_RBM
Then (3)
bit 2 of STATE_DC_PERM = 1
Endif (3)
Else (2)
T_IS_PERM = 0
Endif (2)
Endif (1)

Global information about driving cycle including standardized vehicle operations
If (1) STATE_DC_PERM = 07H (all conditions are met)
Then (1) LV_DC_PERM = 1
Endif (1)

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B.68 Cycle manager (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DC_PERM	O/V	0... 1H	0 ...1	1	-
Inhibition of standardized vehicle operation for permanent fault code erasing after Mode $04					
LV_IS_PERM	O/V	0... 1H	0 ...1	1	-
Engine operating state "Idle Speed" for permanent fault code computations					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_DC {p. 5746}	LV_ERR_PVS_DOUBLE {p. 4216}	LV_ERR_VS {p. 5021}

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

General information

B.68.1 Inhibition of standardized vehicle operation operation for permanent fault code erasing after Mode $04

General information:

With the value LV_INH_DC_PERM the inhibition of the standardized vehicle operation calculation for permanent fault code erasing after Mode $04 is controlled. The OBD II system shall disable it if a malfunction of any component used to determine if the following criteria are satisfied (i.e., vehicle speed, idle operation, time of operation, ...) has been detected. Calculations shall resume as soon as the malfunction is no longer present.

Criteria required to set LV_DC_PERM (standardized vehicle operation for permanent code)

- Cumulated trip length (time since engine start) T_AST_PERM >= C_T_AST_RBM
  (CARB : 600 s)

- Cumulative vehicle operation >= C_VS_THD_RBM for minimum of C_T_VS_RBM
  (CARB : >= 40 km/h (25mph) for at least 300s)

- Continuous vehicle operation in idle equal or longer than C_T_IS_RBM
  (accelerator pedal released and vehicle speed less or equal than 1 mph)
  (CARB : 30 s)

whatever
- altitude condition is (no criteria for ambient pressure is defined)
- ambient temperature is (no criteria on ambient temperature is defined)

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Application conditions:

Initialisation:
```
at RST system event
    LV_INH_DC_PERM = 0
at LV_DC 0 → 1 transition
    LV_INH_DC_PERM = 0
```

Activation: LV_DC = 1 and LV_INH_DC_PERM = 0

Deactivation: - -

Recurrence: 1s

Function description:

Formula section:

At LV_DC 0 → 1 transition :

The pending status of the following failures has to be checked only once :

NC_IDX_DIAG_PVS_DOUBLE	NC_IDX_DIAG_VS		

```
If(1)      CTR_ERR_DYN_NR <> 0 (the dynamic failure memory isn't empty)
Then(1)
           For  each failure of the above list do
                 ACTION_ERRM_CheckPendingStatus(IN<PRM_IDX_DIAG>,
                 OUT<PRM_LV_ERR_PND>)
                 If(2)       PRM_LV_ERR_PND = 1  (XX has a pending status)
                 Then(2)
                             LV_INH_DC_PERM = 1
                             Exit   For-loop
                 Endif(2)
           Endfor
Else(1)    { the dynamic failure memory is empty }
           No action
Endif(1)
```

Every 1 s :

```
If        LV_ERR_PVS_DOUBLE = 1
          or
          LV_ERR_VS = 1
Then
          LV_INH_DC_PERM = 1
Endif
```

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B.68.2 Standardized vehicle operation adaptations

General information:

Due to new vehicles configurations encountered (Stop& Start, conventional combustio engine), CARB standardized vehicle operations (LV_DC_RBM) defined for conventional vehicles may be difficult to reach, mainly because some engine states are no more covered (idle mode).

CARB regulation:

"For hybrid vehicles, vehicles that employ alternate engine start hardware or strategies (e.g., integrated starter and generators), or alternate fuel vehicles (e.g., dedicated, bi-fuel, or dual-fuel applications), the manufacturer may request Executive Officer approval to use alternate criteria to that set forth in section (d)(4.3.2)(B) above for incrementing the denominator. In general, the Executive Officer shall not approve alternate criteria for vehicles that only employ engine shut off at or near idle/vehicle stop conditions. Executive Officer approval of the alternate criteria shall be based on the equivalence of the alternate criteria to determine the amount of vehicle operation relative to the measure of conventional vehicle operation in accordance with the criteria in section (d)(4.3.2)(B) above."

The purpose of the following formula section is to povide or re-build missing data so as to keep CARB standardized vehicle operation definition.

Application conditions:

Initialisation: at RST system event
LV_IS_PERM = 1

Activation: all ECU states

Deactivation: -

Recurrence: 100 ms

Function description:

Formula section:

```
LV_IS_PERM = 1
```

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B.69 Diagnostic trouble code management

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_DTC [NC_NR_ERR_DYN]	O/V/S	0... FFFFH	0... 65535	1	-
DTC code stored in memory for failure IDX					
ERR_SYM_LST [NC_NR_ERR_DYN]	O/V/S	0... FH	0... 15	1	-
Memorized the last detected symptom of the failure IDX (for the DTC building)					
ERR_SYM_MEM [NC_NR_ERR_DYN]	O/V/S	0... FH	0... 15	1	-
Memorized detected symptom of the failure IDX (for the DTC building)					
SYM_CYL_LST_MIS_A	O/V/S	0... FFFFH	0... 65535	1	-
Memorized the last cylinder of the misfire A failure (for the DTC building)					
SYM_CYL_LST_MIS_B1	O/V/S	0... FFFFH	0... 65535	1	-
Memorized the last cylinder of the misfire B1 failure (for the DTC building)					
SYM_CYL_LST_MIS_B4	O/V/S	0... FFFFH	0... 65535	1	-
Memorized the last cylinder of the misfire B4 failure (for the DTC building)					
SYM_CYL_MEM_MIS_A	O/V/S	0... FFFFH	0... 65535	1	-
memorized cylinder with misfire A (for the DTC building)					
SYM_CYL_MEM_MIS_B1	O/V/S	0... FFFFH	0... 65535	1	-
memorized cylinder with misfire B1 (for the DTC building)					
SYM_CYL_MEM_MIS_B4	O/V/S	0... FFFFH	0... 65535	1	-
memorized cylinder with misfire B4 (for the DTC building)					

Input data:

ERR_SYM_XX {p. 4581}	NC_CYL_NR {p. 1526}	NLC_TREAT_DIAG_MIS {p. 6265}	SYM_CYL_MIS_A {p. 6239}
SYM_CYL_MIS_B1 {p. 6239}	SYM_CYL_MIS_B4 {p. 6239}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_ERR_DTC_MIS	V	0... FFFFH	0... 65535	1	-
LDP_NR_1_ID_ERR_DTC_MIS	2	0... FFH	0... 255	1	-
LDP_NR_2_ID_ERR_DTC_MIS	NC_LDP_2_DTC_MIS_TABLE_SIZE	0... FFH	0... 255	1	-
DTC table declaration for misfiring diagnosis, J2012 shall be applied on OBD/CARB part					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_ERR_DTC_XX	V	0... FFFFH	0... 65535	1	-
LDP_NR_1_ID_ERR_DTC_XX	NC_LDP_1_DTC_TABLE_SIZE	0... FFH	0... 255	1	-
LDP_NR_2_ID_ERR_DTC_XX	NC_LDP_2_DTC_TABLE_SIZE	0... FFH	0... 255	1	-
DTC table declaration for the diagnosis instance XX, J2012 shall be applied on OBD/CARB part					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ERR_DTC_CONF	-	0... 5H	0 ...5	1	-
Type of DTCs displayed through ERR_DTC[IDX]					
NC_LDP_1_DTC_TABLE_SIZE	-	0... FH	0... 15	1	-
Table size definition for ID_ERR_DTC_XX; set to NC_NR_DTC_FMT+1					
NC_LDP_2_DTC_MIS_TABLE_SIZE	-	0... FH	0... 15	1	-
Table size definition for ID_ERR_DTC_MIS; set to NC_CYL_NR+2					
NC_LDP_2_DTC_TABLE_SIZE	-	0... FH	0... 15	1	-
Table size definition for ID_ERR_DTC_XX; set to 6-NC_NR_DTC_FMT					
NC_NR_DTC_FMT	-	0... 1H	0 ...1	1	-
Selection of 6 or 10 DTCs configurations					

Action definition

ACTION_ERRM_EraseDtc (**IN**<IDX>)	Mode: O
This action erases the memorized symptom of the failure IDX	

ACTION_ERRM_StoreDtc (**IN**<IDX>)	Mode: O
This action stores the memorized symptom of the first occurrence of the failure IDX to build the DTC	

ACTION_ERRM_StoreDtcLst (**IN**<IDX>)	Mode: O
This action stores the memorized symptom of the last occurrence of the failure IDX to build the DTC	

FUNCTION DESCRIPTION:

General information:

Purpose of this module is to catch some data (ERR_SYM_XX) when a failure occurs. Then, these data (ERR_SYM_MEM[IDX] and ERR_SYM_LST_[IDX]) are used to generate a code called DTC upon

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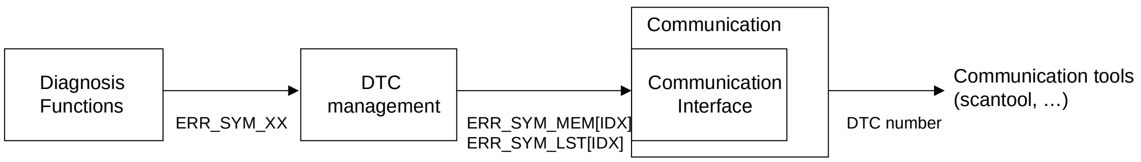
communication tool request (see Communication interface module). Additionally, for visualization (for communication tool, developpment purposes), a DTC code is stored in memory (ERR_DTC_[IDX]).
The DTC is a code used to identify the symptom of the failure or the failure (global failure). It is an interface between the diagnosis and the communication.
The customer and/or EOBD/CARB according to the standard J2012 define this DTC.
DTC encoding for regulation EOBD/CARB shall be done using J2012 definition (2 bytes interpreted [0000h to FFFFh] in hex, [P0000 to U3FFF] in J2012).
DTC encoding for customer is free. It can be in decimal, or applying J2012 definition, or any other encoding definition.

Signal flow diagram:



B.69.1 DTC Storage

B.69.1.1 DTC Storage /First occurence

Description:

When the failure IDX gets present (1^{st} occurrence), the detected of the first symptom is stored in the 2^{nd} layer memory by calling the action ACTION_ERRM_StoreDtc (IN<IDX>). Additionally, a DTC code is stored in dynamic memory for visualization :

- related to the symptom DTC if NC_ERR_DTC_CONF = 0
- related to the failure OBD DTC if NC_ERR_DTC_CONF = 1
- related to the customer specific symptom DTC if NC_ERR_DTC_CONF = 2
- related to the customer specific failure DTC if NC_ERR_DTC_CONF = 3

Syntax : ACTION_ERRM_StoreDtc (IN <IDX>)
Parameter (in) : IDX Index of failure in 2^{nd} layer memory to store the DTC
Parameter (out) : -
Short description : This action stores the memorised symptom of the first occurrence of the failure IDX to build the DTC

Application conditions

Initialization:

```
ERR_SYM_MEM[IDX] is restored from the NVMY
 SYM_CYL_MEM_MIS_A, SYM_CYL_MEM_MIS_B1 and
 SYM_CYL_MEM_MIS_B4 are restored from NVMY
    In case of damaged NVMY, ERR_SYM_MEM[IDX] = 0
         SYM_CYL_MEM_MIS_A = 0,
         SYM_CYL_MEM_MIS_B1 = 0,
         SYM_CYL_MEM_MIS_B4 = 0,
         ERR_DTC[IDX] = 0
```

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Recurrence: –

Activation: `at Action request`

Formula section:

```
If          NLC_TREAT_DIAG_MIS = 0
  (Misfire are treated by type (LV_ERR_MIS_A, MIS_B1 and MIS_B4 is defined))
Then
     For a misfiring diagnosis:
     (XX stands for MIS_A, MIS_B1, and MIS_B4) (Misfire by type NLC_TREAT_DIAG_MIS=0)
             SYM_CYL_MEM_XX = SYM_CYL_XX

           If          NC_ERR_DTC_CONF = 0 or 1 or 4                        (J2012 DTC is stored)
              Then          If          SYM_CYL_MEM_XX [12] = 1            (Random)
                            Then          ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 0 ] [ NC_CYL_NR+1 ]
                  Else          If          SYM_CYL_MEM_XX [13] = 1 (Multiple cylinder)
                                    Or many cylinder bits are set in SYM_CYL_MEM_XX
                               Then       ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 0 ] [ NC_CYL_NR ]
                         Else          (only one cylinder bit is set in SYM_CYL_MEM_XX)
                                          i = bit number which is set in SYM_CYL_MEM_XX
                                          ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 0 ] [ i ]
                         Endif
                            Endif
          Endif

              If          NC_ERR_DTC_CONF = 2 or 3 or 5           (customer encoded DTC is stored)

              Then          If          SYM_CYL_MEM_XX [12] = 1            (Random)
                            Then          ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 1 ] [ NC_CYL_NR+1 ]
                  Else          If          SYM_CYL_MEM_XX [13] = 1 (Multiple cylinder)
                                    Or many cylinder bits are set in SYM_CYL_MEM_XX
                               Then       ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 1 ] [ NC_CYL_NR ]
                         Else          (only one cylinder bit is set in SYM_CYL_MEM_XX)
                                          i = bit number which is set in SYM_CYL_MEM_XX
                                          ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 1 ] [ i ]
                         Endif
                            Endif
          Endif
Endif
  For others diagnosis :
  (also for misfire diagnosis if treated by cylinder (LV_ERR_MIS_x is defined))
              ERR_SYM_MEM[IDX] = ERR_SYM_XX
              If          NC_ERR_DTC_CONF = 0 or 4             (1st symptom J2012 DTC is stored)
               Then          If          only one bit is set in ERR_SYM_MEM[IDX]
                      Then          i = bit number which is set in ERR_SYM_MEM[IDX]
                             ERR_DTC[IDX] =   ID_ERR_DTC_XX [0] [ i ] with XX = F(IDX)
                  Else (many bit is set in ERR_SYM_MEM[IDX])
                             ERR_DTC[IDX] =   ID_ERR_DTC_XX [0] [4] with XX = F(IDX)
                      Endif
             Endif

              If          NC_ERR_DTC_CONF = 1                        (global J2012 DTC is stored)
```

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Then ERR_DTC[IDX] = ID_ERR_DTC_XX [0] [4] with XX = F(IDX)
Endif

If NC_ERR_DTC_CONF = 2 or 5 (customer encoded DTC is stored)
Then **If** only one bit is set in ERR_SYM_MEM[IDX]
Then i = bit number which is set in ERR_SYM_MEM[IDX]
ERR_DTC[IDX] =
ID_ERR_DTC_XX [NC_NR_DTC_FMT] [i] with XX = F(IDX)
Else (many bit is set in ERR_SYM_MEM[IDX])
ERR_DTC[IDX] =
ID_ERR_DTC_XX [NC_NR_DTC_FMT] [5 - NC_NR_DTC_FMT] with XX = F(IDX)
Endif
Endif

If NC_ERR_DTC_CONF = 3 (global customer encoded DTC is stored)
Then ERR_DTC[IDX] =
ID_ERR_DTC_XX [NC_NR_DTC_FMT] [5 - NC_NR_DTC_FMT] with XX = F(IDX)
Endif

B.69.1.2 DTC Storage /Last occurence

Description:

For each occurence of the failure IDX (Last occurrence), the detected of the last symptom is stored in the 2^{nd} layer memory by calling the action ACTION_ERRM_StoreDtcLst (IN<IDX>).

Syntax : ACTION_ERRM_StoreDtcLst (IN<IDX>)
Parameter (in) : IDX Index of failure in 2^{nd} layer memory to store the DTC
Parameter (out) : -
Short description : This action stores the memorised symptom of the last occurrence of the failure IDX to build the DTC

Application conditions

Initialization:
```
ERR_SYM_LST[IDX] is restored from the NVMY
 SYM_CYL_LST_MIS_A, SYM_CYL_LST_MIS_B1 and
 SYM_CYL_LST_MIS_B4 are restored from NVMY
    In case of damaged NVMY, ERR_SYM_LST[IDX] = 0
         SYM_CYL_LST_MIS_A = 0,
         SYM_CYL_LST_MIS_B1 = 0,
         SYM_CYL_LST_MIS_B4 = 0,
```

Recurrence: -

Activation: at Action request

Formula section:

ERR_SYM_LST[IDX] = ERR_SYM_XX
If NLC_TREAT_MIS_DIAG = 0
(Misfire are treated by type)
then For a misfiring diagnosis :

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```
        (XX stands for MIS_A, MIS_B1 and MIS_B4)
        SYM_CYL_LST_XX = SYM_CYL_ XX
endif

If          NLC_TREAT_DIAG_MIS = 0
  (Misfire are treated by type (LV_ERR_MIS_A, MIS_B1 and MIS_B4 is defined))
Then        For a misfiring diagnosis:

        If          NC_ERR_DTC_CONF = 4                         (J2012 DTC is stored)
          Then          If          SYM_CYL_LST_XX [12] = 1          (Random)
                    Then          ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 0 ] [ NC_CYL_NR+1 ]
              Else          If          SYM_CYL_LST_XX [13] = 1 (Multiple cylinder)
                            Or many cylinder bits are set in SYM_CYL_LST_XX
                        Then          ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 0 ] [ NC_CYL_NR ]
                  Else          (only one cylinder bit is set in SYM_CYL_LST_XX)
                                i = bit number which is set in SYM_CYL_LST_XX
                                ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 0 ] [ i ]
                  Endif
                    Endif
        Endif

          If          NC_ERR_DTC_CONF = 5                         (customer DTC is stored)
          Then          If          SYM_CYL_LST_XX [12] = 1          (Random)
                    Then          ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 1 ] [ NC_CYL_NR+1 ]
              Else          If          SYM_CYL_LST_XX [13] = 1 (Multiple cylinder)
                            Or many cylinder bits are set in SYM_CYL_LST_XX
                        Then          ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 1 ] [ NC_CYL_NR ]
                  Else          (only one cylinder bit is set in SYM_CYL_LST_XX)
                                i = bit number which is set in SYM_CYL_LST_XX
                                ERR_DTC[IDX] = ID_ERR_DTC_MIS [ 1 ] [ i ]
                  Endif
                    Endif
        Endif

  For others diagnosis :
  (also for misfire diagnosis if treated by cylinder (LV_ERR_MIS_x is defined))
          If          NC_ERR_DTC_CONF = 4                 (last symptom J2012 DTC is stored)

          Then          If          only one bit is set in ERR_SYM_LST[IDX]
                  Then          i = bit number which is set in ERR_SYM_LST[IDX]
                          ERR_DTC[IDX] =   ID_ERR_DTC_XX [0] [ i ] with XX = F(IDX)
              Else (many bit is set in ERR_SYM_LST[IDX])
                          ERR_DTC[IDX] =   ID_ERR_DTC_XX [0] [4] with XX = F(IDX)
                  Endif
          Endif


          If          NC_ERR_DTC_CONF = 5                 (customer encoded DTC is stored)

          Then          If          only one bit is set in ERR_SYM_LST[IDX]
                  Then          i = bit number which is set in ERR_SYM_LST[IDX]
                          ERR_DTC[IDX] =
```

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ID_ERR_DTC_XX [NC_NR_DTC_FMT] [i] with XX = F(IDX)
Else (many bit is set in ERR_SYM_LST[IDX])
ERR_DTC[IDX] =
ID_ERR_DTC_XX [NC_NR_DTC_FMT] [5 - NC_NR_DTC_FMT] with XX = F(IDX)
Endif
Endif

B.69.2 DTC storage for the Misfiring (with NLC_TREAT_DIAG_MIS = 0, Misfire by type)

Description:

As describe above, the cylinder in default is memorised at the first occurrence. In this part each new cylinder in default will be memorised.

Application conditions

Initialization: treated above

Recurrence: For Misfire A, B1 and B4:
Misfire segmentsynchronous

Activation: –

Formula section:

For a misfiring A diagnosis :
SYM_CYL_MEM_MIS_A is updated with the new additional bits (cylinder, multiple and random) of SYM_CYL_MIS_A
For a misfiring B1 diagnosis :
SYM_CYL_MEM_MIS_B1 is updated with the new additional bits (cylinder, multiple and random) of SYM_CYL_MIS_B1
For a misfiring B4 diagnosis :
SYM_CYL_MEM_MIS_B4 is updated with the new additional bits (cylinder, multiple and random) of SYM_CYL_MIS_B4.

B.69.3 DTC deleting

Description:

When the failure IDX is erased from 2^{nd} layer memory, the memorised detected symptom is also erased by calling the action ACTION_ERRM_EraseDtc (IN <IDX>).
Syntax : ACTION_ERRM_EraseDtc (IN <IDX>)
Parameter (in) : IDX Index of failure in 2^{nd} layer memory to store the DTC
Parameter (out) : -
Short description : This action erases the memorised symptom of the failure IDX

Application conditions

Initialization: –

Recurrence: –

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Activation: `at Action request`

Formula section:

If NLC_TREAT_DIAG_MIS = 0
(Misfire are treated by type (LV_ERR_MIS_A, MIS_B1 and MIS_B4 is defined))
Then For a misfiring A diagnosis :
SYM_CYL_MEM_MIS_A = 0
SYM_CYL_LST_MIS_A = 0
ERR_DTC[IDX] = 0
For a misfiring B1 diagnosis :
SYM_CYL_MEM_MIS_B1 = 0
SYM_CYL_LST_MIS_B1 = 0
ERR_DTC[IDX] = 0
For a misfiring B4 diagnosis :
SYM_CYL_MEM_MIS_B4 = 0
SYM_CYL_LST_MIS_B4 = 0
ERR_DTC[IDX] = 0
Endif

For other diagnoses, including misfire diagnoses if treated by cylinder (LV_ERR_MIS_x is defined) :
ERR_SYM_MEM[IDX] = 0
ERR_SYM_LST[IDX] = 0
ERR_DTC[IDX] = 0

B.69.4 Calibratable DTC number

Description:

The DTC numbers are defined by a calibration table called ID_ERR_DTC_XX.
This table defined for each failure XX :

a) with NC_NR_DTC_FMT = 0

- a DTC number for each symptom of the failure XX
- a global OBD DTC number for the failure XX
- a global customer specific DTC number

b) with NC_NR_DTC_FMT = 1

- a OBD DTC number for each symptom of the failure XX
- a global OBD DTC number for the failure XX
- a customer specific DTC number for each symptom of the failure XX
- a global customer specific DTC number

When a DTC is request by a diagnostic tool, the Communication Interface module build up the DTC number with information :

- ERR_SYM_MEM[IDX] and /or ERR_SYM_LST[IDX] stored in 2^{nd} layer memory ;
- Contents of table ID_ERR_DTC_XX .

There is a particular case for misfiring (MIS_A, MIS_B1, MIS_B4) diagnosis. The DTC numbers are defined by cylinder in a calibration table called ID_ERR_DTC_MIS.
(used if NLC_TREAT_DIAG_MIS = 0; Misfire by type)

- ID_ERR_DTC_MIS[0] [i] is the DTC for misfiring detection on the cylinder number i +1
- ID_ERR_DTC_MIS[0] [NC_CYL_NR] is the DTC for multiple misfiring
- ID_ERR_DTC_MIS[0] [NC_CYL_NR +1] is the DTC for random misfiring

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- ID_ERR_DTC_MIS[1] [i] is the customer DTC for misfiring detection on the cylinder number i+1
- ID_ERR_DTC_MIS[1] [NC_CYL_NR] is the customer DTC for multiple misfiring
- ID_ERR_DTC_MIS[1] [NC_CYL_NR +1] is the customer DTC for random misfiring

Example 1:

The failure TCO (coolant temperature) is stored in the 2nd layer memory. The calibratable table of DTC has the following value :

a) with NC_NR_DTC_FMT = 0

DTC of the 1st symptom	DTC of the 2nd symptom	DTC of the 3rd symptom	DTC of the 4th symptom	Global DTC of the failure	Specific customer code
ID_ERR_DTC_TCO [0] [0] = 0118h (P0118)	ID_ERR_DTC_TCO [0] [1] = 0117h (P0117)	ID_ERR_DTC_TCO [0] [2] = 0119h (P0119)	ID_ERR_DTC_TCO [0] [3] = 0116h (P0116)	ID_ERR_DTC_TCO [0] [4] = 0115h (P0115)	ID_ERR_DTC_TCO [0] [5] = 30

b) with NC_NR_DTC_FMT = 1

	DTC of the 1st symptom	DTC of the 2nd symptom	DTC of the 3rd symptom	DTC of the 4th symptom	Global DTC of the failure
OBD DTC	ID_ERR_DTC_TCO [0] [0] = 0118h (P0118)	ID_ERR_DTC_TCO [0] [1] = 0117h (P0117)	ID_ERR_DTC_TCO [0] [2] = 0119h (P0119)	ID_ERR_DTC_TCO [0] [3] = 0116h (P0116)	ID_ERR_DTC_TCO [0] [4] = 0115h (P0115)
Customer DTC	ID_ERR_DTC_TCO [1] [0] = 31	ID_ERR_DTC_TCO [1] [1] = 32	ID_ERR_DTC_TCO [1] [2] = 33	ID_ERR_DTC_TCO [1] [3] = 34	ID_ERR_DTC_TCO [1] [4] = 30

Upon request from the diagnosis tool, the DTC number sent to the tool will be one of the numbers defined in ID_ERR_DTC_TCO regards the symptom detected.

Example 2 :

One failure misfiring (LV_ERR_MIS_A, LV_ERR_MIS_B1 or LV_ERR_MIS_B4) is stored in the 2nd layer memory. The application is a NC_CYL_NR -cylinder engine. The calibratable table of DTC has the following value :

	Misfiring on 1st cylinder	Misfiring on 2nd cylinder	Misfiring on 3rd cylinder	Misfiring on 4th cylinder	...	Misfiring on NC_CYL_NR th cylinder	Multiple Misfiring	Random Misfiring
OBD DTC	ID_ERR_DTC_MIS [0] [0] = 0301h (P0301)	ID_ERR_DTC_MIS [0] [1] = 0302h (P0302)	ID_ERR_DTC_MIS [0] [2] = 0303h (P0303)	ID_ERR_DTC_MIS [0] [3] = 0304h (P0304)	...	ID_ERR_DTC_MIS [0] [NC_CYL_NR - 1] = 03xxh (P03xx)	ID_ERR_DTC_MIS [0] [NC_CYL_NR] = 0300h (P0300)	ID_ERR_DTC_MIS [0] [NC_CYL_NR + 1] = 0300h (P0300)
Customer DTC	ID_ERR_DTC_MIS [1] [0] = 11	ID_ERR_DTC_MIS [1] [1] = 12	ID_ERR_DTC_MIS [1] [2] = 13	ID_ERR_DTC_MIS [1] [3] = 14	...	ID_ERR_DTC_MIS [1] [NC_CYL_NR - 1] = 16	ID_ERR_DTC_MIS [1] [NC_CYL_NR] = 10	ID_ERR_DTC_MIS [1] [NC_CYL_NR + 1] = 10

Upon request from the diagnosis tool, the DTC number sent to the tool will be one of the numbers defined in ID_ERR_DTC_MIS regards the symptom detected.
With :

NC_LDP_1_DTC_TABLE_SIZE = NC_NR_DTC_FMT +1

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NC_LDP_2_DTC_TABLE_SIZE = 6 - NC_NR_DTC_FMT
NC_LDP_2_DTC_MIS_TABLE_SIZE = NC_CYL_NR +2

Configuration data detailed description:

NC_NR_DTC_FMT	= 0	6 DTCs configuration.
	= 1	10 DTCs configuration.

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B.70 Diagnostic trouble code management (Appl. Inc.)

B.70.1 Definition of additional DTC information

FUNCTION DESCRIPTION:

General information:

For several diagnosis services it is necessary to transmit an additional information for each symptom.

Description:

These additional information can be calibrated for each symptom of a failure XX with the table ID_ERR_DTC_INFO_XX.

For this project it s used to define the DTCFailureTypeByte according to ISO 14229.

Example for diagnostic instance V_TCO_RNG:

additional Info for SYM_0	additional Info for SYM_1	additional Info for SYM_2	additional Info for SYM_3
ID_ERR_DTC_INFO_V_TCO_RNG[0] = 05h	ID_ERR_DTC_INFO_V_TCO_RNG[1] = 01h	ID_ERR_DTC_INFO_V_TCO_RNG[2] = 00h	ID_ERR_DTC_INFO_V_TCO_RNG[3] = 00h

Formula section:

not used yet

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B.71 Dynamic error management core

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DC [NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Counter for driving cycle					
CTR_ERR_DYN_NR	O/V/S	0... FFH	0... 255	1	-
Number of failures stored in dynamic memory (2nd layer)					
CTR_FRC [NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Frequency counter : number of occurrences of present failure					
CTR_OCC [NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Occurences number of transitions between diagnostic executed without fault and diagnostics with fault (pass -> fail)					
CTR_WUP_CYC [NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Counter for warm-up cycle					
DIAG_INST [NC_NR_ERR_DYN]	V	0... FFFFH	0... 65535	1	-
Index of diagnosis instance XX with XX = F(IDX)					
LV_DC_MAX [NC_NR_ERR_DYN]	O/V/S	0... 1H	0 ...1	1	-
Flag for the MIL state (on or off) related to failure IDX					
LV_ERR_CFM [NC_NR_ERR_DYN]	O/V/S	0... 1H	0 ...1	1	-
Confirmed failure status flag					
LV_ERR_DC [NC_NR_ERR_DYN]	O/V	0... 1H	0 ...1	1	-
Failure present status for this driving cycle					
LV_ERR_DC_PREV [NC_NR_ERR_DYN]	O/V/S	0... 1H	0 ...1	1	-
Error failure present at end of last driving cycle					
LV_ERR_DISA [NC_NR_ERR_DYN]	O/V/S	0... 1H	0 ...1	1	-
Disappeared failure status flag					
LV_ERR_LST_CLR_XX	O/V/S	0... 1H	0 ...1	1	-
Failure set at least once since last failure memory clear					
LV_ERR_MEM_XX	O/V/S	0... 1H	0 ...1	1	-
Failure is stored in dynamic memory (2nd layer)					
LV_ERR_MKD [NC_NR_ERR_DYN]	O/V/S	0... 1H	0 ...1	1	-
Marked failure status flag					
LV_ERR_PND [NC_NR_ERR_DYN]	O/V/S	0... 1H	0 ...1	1	-
Pending failure status flag					
LV_ERR_TMP [NC_NR_ERR_DYN]	O/V/S	0... 1H	0 ...1	1	-
Temporary failure status flag					

Input data:

DC_DEC_XX	DC_INC_XX	DC_MAX_XX	LC_ENA_SCDN
LV_DC {p. 5746}	LV_END_DIAG_XX {p. 4581}	LV_ERR_XX	LV_MKD_MOD {p. 5694}
LV_WUP_CYC {p. 5746}	NLC_ENA_SCDN {p. 645}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_MAX_WUP_CYC	-	0... FFH	0... 255	1	-
Initialization value for the warm-up cycle of diagnostics					
LC_ERR_FMY_CLR	-	0... 1H	0 ...1	1	-
Boolean to clear failure memory when set to 1					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_ERR_DYN	-	1... FFH	1... 255	1	-
Maximum number of failure defined in dynamic structure (typical value : 10)					
NLC_CTR_OCC_ENA	-	0... 1H	0 ...1	1	-
Configuration to enable the CTR_OCC computation.					

Action definition

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)	Mode: O
-	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_IDX_DIAG	in	0... FFFFH	0... 65535	1	-
Diagnostic symptom instance.					
PRM_LV_ERR_PND	out	0... 1H	0 ...1	1	-
Error flag for diagnostic instance.					

ACTION_ERRM_ClcLvErrDcPrev ()	Mode: O
This action indicates if a failure was set at the end of previous DC	

ACTION_ERRM_EraseErr (**IN**<IDX>)	Mode: O

ACTION_ERRM_GetErrLastClr (<PRM_IDX_ERR>,<PRM_LV_ERR_LST_CLR>)	Mode: O
This action indicates if a failure has been set already once since the last failure memory clear.	

ACTION_ERRM_IncrementDCctrScdn (**IN**<PRM_IDX_ERR>)	Mode: O
This action is used to increment the driving cycle counter for failures using similar conditions functionality.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_IDX_ERR	in	0... FFFFH	0... 65535	1	-
Diagnostic failure instance.					

Import actions:

ACTION_ERRM_ClcPermanentIniErrm ()
ACTION_ERRM_ConfirmErrScdn (**OUT**<DCconf>,**IN**<XX>)
ACTION_ERRM_DecrementDCctrScdn (**IN**<PRM_IDX_ERR>,**OUT**<PRM_DCdec>)
ACTION_ERRM_EraseDtc (**IN**<IDX>)
ACTION_ERRM_EraseFrf (**IN**<IDX>)
ACTION_ERRM_ErasePermanentCode (**IN**<PRM_IDX_ERR>)
ACTION_ERRM_EraseScdn (**IN**<PRM_IDX_ERR>)
ACTION_ERRM_GetMilRelevant (**IN**<PRM_IDX_ERR>,**OUT**<PRM_LV_MIL_RLV>)
ACTION_ERRM_PrioRule (**OUT**<RESP>,**OUT**<IDX>)

Continued on next page

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ACTION_ERRM_StoreDtc (**IN**<IDX>)
ACTION_ERRM_StoreDtcLst (**IN**<IDX>)
ACTION_ERRM_StoreFrf (**IN**<IDX>)
ACTION_ERRM_StoreHistory (**IN**<IDX>)
ACTION_ERRM_StorePermanentCode (**IN**<PRM_IDX_ERR>)
ACTION_ERRM_TrigErrDyn (**IN**<XX>)
ACTION_ERRM_TrigFarm (**IN**<XX>)

FUNCTION DESCRIPTION:

General information:

This module is the heart of the dynamic error management function. It defines statement of principles and mechanism of dynamic error management function.
Dynamic error management receives results from diagnosis function (may be filtered by antibounce algorithm). These results are, in this module, managed as diagnosis failure following **CARB** and **EOBD** standards.
In addition, this module uses generic services defined by others modules (priority rules for example).

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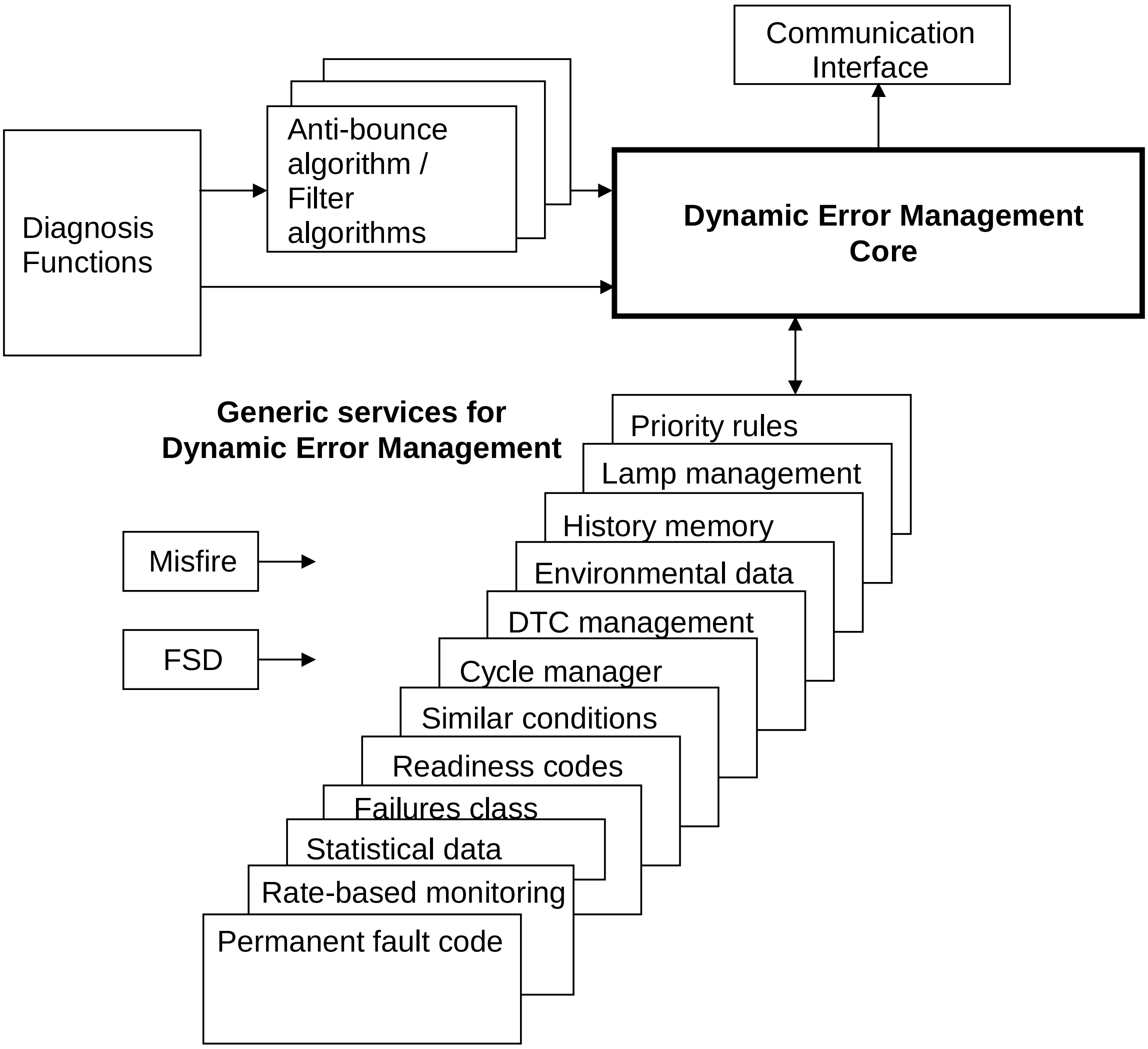

B.71.1 Diagnosis failure description

B.71.1.1 Failures definition

Description:

Dynamic error management manages failures, which have different states.

Detected failure

The detected failure is provided by a defective system (the error provided by this system is basic). It occurs when the diagnosis test and diagnosis condition of at least one symptom or more are true and disappears in other cases.

Present failure

The present failure is the detected failure after filtering. The real entry point of the error management is the present failure.

Pending failure

The pending failure is the detected failure after filtering. The failure shall stay pending until detection of a whole driving cycle without the failure present and the diagnosis done.

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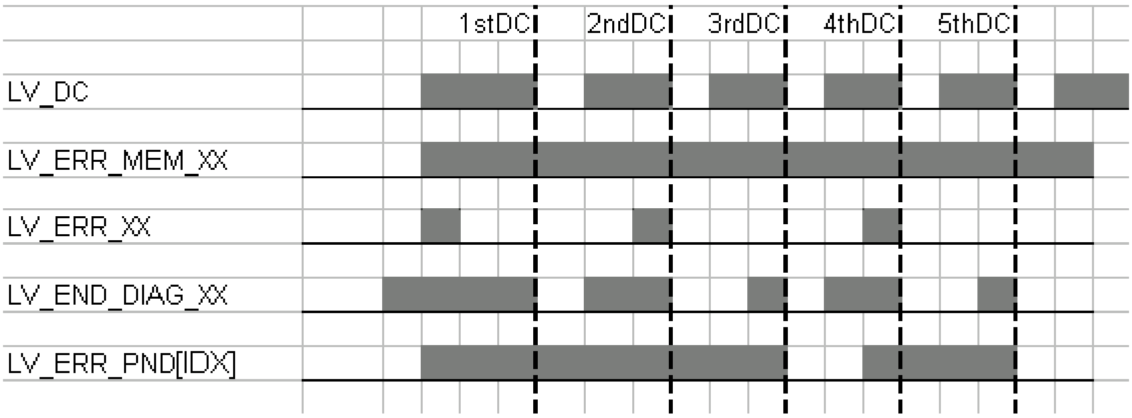


Temporary failure

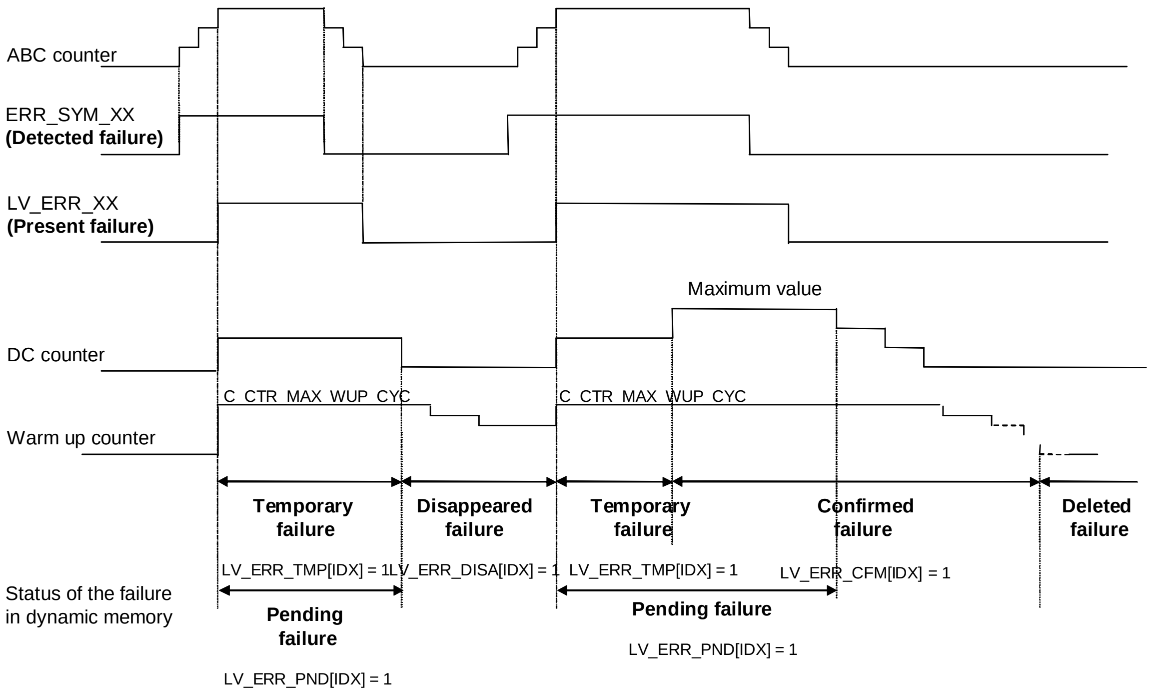
A failure is considered as temporary when this failure is present and leaves this state either when this failure is confirmed or disappeared (in this case, this failure isn't confirmed).

Disappeared failure

A failure is considered as disappeared, when no failure was detected during a complete driving cycle and the failure wasn't confirmed. It leaves this state either when the failure reoccurs or when the warm-up counter reaches 0.

Confirmed failure

A failure is considered as confirmed when the driving cycle counter reaches the maximum value and leaves this state when the warm-up counter reaches 0.



with XX = F(IDX)

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B.71.1.2 Failures information

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Description:

Each failure is constituted of informations, which are stored in the memory.
Some informations are allocated in the static memory. It means that these informations are available for each failure.
Static memory: XX represents any failure defined in the application (index of XXξ[1...65535])

- ABC counter CTR_ABC_XX
- End of diagnosis counter CTR_ABC_END_DIAG_XX
- End of diagnosis flag LV_END_DIAG_XX
- Readiness flag LV_READY_XX
- Diagnosis condition LV_CDN_DIAG_XX
- Detected symptom ERR_SYM_XX
- Present failure LV_ERR_XX
- Failure is stored in dynamic memory LV_ERR_MEM_XX
- Failure present at least one time since failure memory cleared LV_ERR_LST_CLR_XX

Some informations are allocated in the dynamic memory. It means that these informations are created in memory in case of a new dynamic failure entry (limited number of dynamic entries managed with priority rules).
Dynamic memory : IDXξ [0...NC_NR_ERR_DYN-1]

- Frequency counters CTR_FRC[IDX]
  CTR_OCC[IDX]
- Driving cycle counter CTR_DC[IDX]
- Warm up counter CTR_WUP_CYC[IDX]
- Memorized the first symptom (DTC) ERR_SYM_MEM[IDX]
- Memorized the last symptom (DTC) ERR_SYM_LST[IDX]
- Environmental data (Freeze frame) ENVD_OBD[u][m]
  ENVD_CUS_CMN[v][m]
  ENVD_CUS_SET_CMN[W][x][m]
  ENVD_CUS_SET_SPC[y][z][m]
- Confirmed failure LV_ERR_CFM[IDX]
- Disappeared failure LV_ERR_DISA[IDX]
- Memorized MIL activation flag LV_DC_MAX[IDX]
- Failure during DC LV_ERR_DC[IDX]
- Temporary failure LV_ERR_TMP[IDX]
- Pending failure LV_ERR_PND[IDX]
- Marked failure LV_ERR_MKD[IDX]
- Error present at end of last DC LV_ERR_DC_PREV[IDX]

Remark :
To keep the link between the index of the failure in dynamic memory and the index of the failure in static memory, a transfer function is defined by : XX = F (IDX)

with m=IDX_FRF[IDX]

B.71.2 Memory management

Description:

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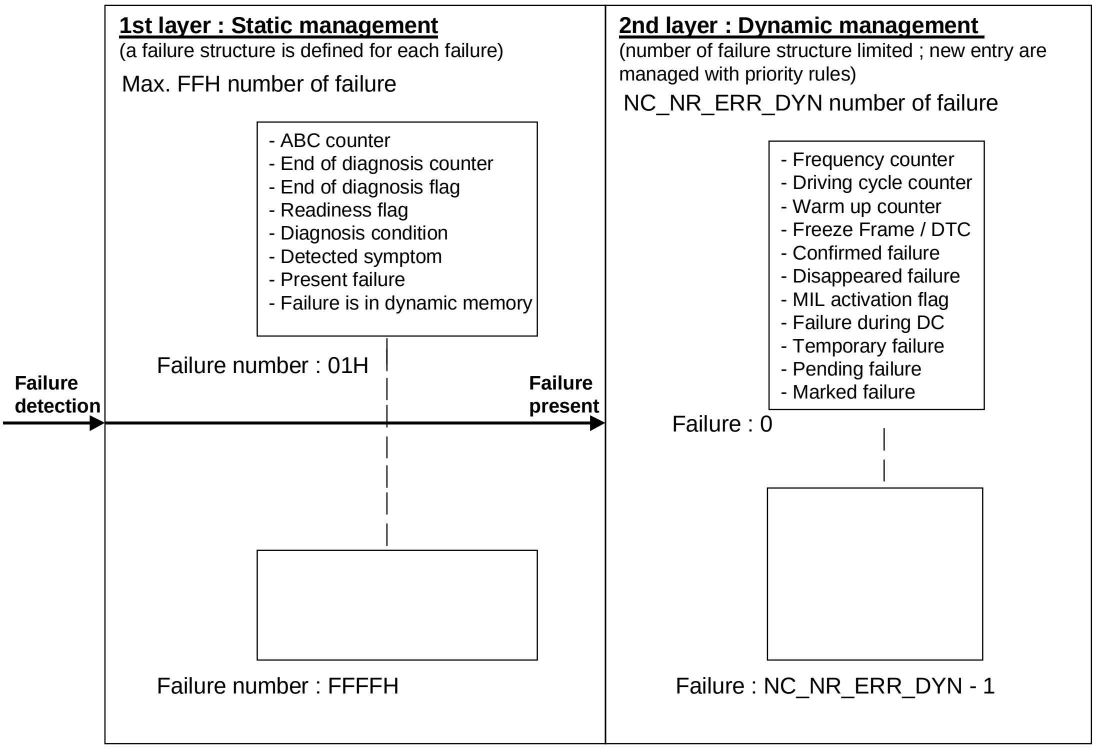
As explained above, the memory is managed as two layers.
The first layer is managed as static memory. According to failure detection, ABC counter and end of diagnosis counter are incremented or decremented. Present failure information is the output of this layer. All failures are managed in the first layer.
When a present failure appears, it may provoke a dynamic entry in the second layer (dynamic) of the memory. In this second layer, only present failures are managed. The number of failure structure is limited to a maximum value defined by NC_NR_ERR_DYN.



B.71.2.1 Failures configuration

Description:

For every diagnosis two bytes exist to configure the failure. The following items can be influenced :

- control of dashboard lamp (MIL and/or Warning lamp 1 and/or Warning lamp 2)
- the emission relevance of a failure
- failure priority, used for failure storage

The definition of these bytes is done in Failure Class module.

B.71.2.2 Store /Erase a failure in 2nd layer memory

Description:

This module manages the “Entry” (storage) and “Exit” (deleting) of failures in the 2^{nd} layer memory.
Storage :
Syntax : ACTION_ERRM_StoreErr (IN <XX>)
Parameter (in) : XX number of the failure to store in dynamic memory

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Parameter (out) : -

Short description :

If other modules call the action to store the failure XX with ACTION_ERRM_StoreErr (IN<XX>) then the failure XX (with XX = F(IDX)) is taken into the 2^{nd} layer memory and :

- frequency counter (number of occurrences of present failure) is updated ;
- the DTC is stored with ACTION_ERRM_StoreDtc (IN<IDX>) (if needed) ;
- the Freeze Frame is stored with ACTION_ERRM_StoreFrf (IN<IDX>) ;
- the index of diagnosis instance XX is stored in DIAG_INST[IDX] for visualisation

Deleting :

Syntax : ACTION_ERRM_EraseErr (IN <IDX>)

Parameter (in) : IDX index of failure in 2^{nd} layer memory to erase

Parameter (out) : -

Short description :

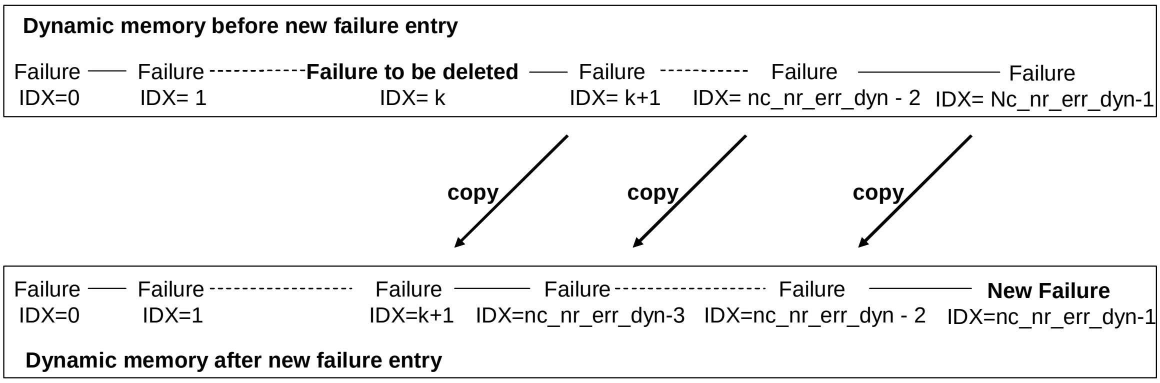
If other modules call the action to erase the failure XX with ACTION_ERRM_EraseErr (IN<IDX>) then the failure IDX is taken out of the 2^{nd} layer memory and :

- the failure is stored in history memory with ACTION_ERRM_StoreHistory (IN<IDX>) ;
- the DTC of the failure is erased with ACTION_ERRM_EraseDtc (IN<IDX>) ;
- the Freeze Frame of the failure is erased with ACTION_ERRM_EraseFrf (IN<IDX>) ;
- similar conditions of the failure are erased with ACTION_ERRM_EraseScdn (IN<XX>) if existing

2^{nd} layer memory description :

It is useful to sort the failures in the sequence in which they occurred ; first failure has index (IDX) number zero, second failure has index (IDX) number one, ... For example, when a new failure entry is accepted (memory is full), one failure is deleted, sorting algorithm is respected and the new failure entry is stored in last position.

In any case, sorting algorithm must be always respected.



Application conditions

Initialization :

```
On saved RAM lost
   CTR_ERR_DYN_NR = 0 ; LV_ERR_MEM_XX = 0
   CTR_FRC[IDX] = 0; CTR_OCC[IDX] = 0;
 LV_ERR_TMP[IDX] = 0; LV_ERR_MKD[IDX] = 0
   DIAG_INST[IDX] = 0; LV_ERR_DC_PREV[IDX] = 0;
 LV_ERR_LST_CLR_XX = 0
```

Recurrence: –

Activation: *at Action request*

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Formula section:

Store the failure in 2^{nd} layer memory :
ACTION_ERRM_StoreErr (IN <XX>) :

```
LV_ERR_LST_CLR_XX = 1
   If      LV_ERR_MEM_XX = 0
   Then    Failure XX is stored in 2nd layer memory in position IDX = CTR_ERR_DYN_NR
           LV_ERR_MEM_XX = 1
        LV_ERR_TMP[IDX] = 1
           DIAG_INST[IDX] = index of diagnosis instance XX   (with XX=F(IDX))
           ACTION_ERRM_StoreDtc (IN<IDX>)
           CTR_ERR_DYN_NR = CTR ERR_DYN_NR +1
           If       LV_MKD_MOD = 1
        Then
                    LV_ERR_MKD[IDX] = 1
           Endif
Else    ( IDX compliant with XX = F(IDX) )
Endif
CTR_FRC[IDX] = CTR_FRC[IDX] + 1
If       CTR_FRC[IDX]  > 255
Then   CTR_FRC[IDX] = 255
Endif
If       NLC_CTR_OCC_ENA = 1
Then
         If       LV_ERR_DC_PREV[IDX] = 0
         Then   CTR_OCC[IDX] = CTR_OCC[IDX] + 1
                If       CTR_OCC[IDX]  > 254 (saturation to 254 : value 255 forbidden)
                Then   CTR_OCC[IDX] = 254
                Endif
         Endif
Endif
ACTION_ERRM_StoreFrf (IN<IDX>)
(previous failure status (if disappeared) necessary for freeze frame calculation)
If       LV_ERR_DISA[IDX] = 1
Then   LV_ERR_DISA[IDX] = 0
          LV_ERR_TMP[IDX]  = 1
          ACTION_ERRM_StoreDtc (IN<IDX>)
          (Store DTC corresponding of the first occurrence of the failure)
Endif
LV_ERR_PND[IDX] = 1
ACTION_ERRM_StoreDtcLst (IN<IDX>)
(Store DTC corresponding of the last occurrence of the failure)
```

Clear the failure out of 2^{nd} layer memory

```
ACTION_ERRM_EraseErr (IN<IDX>) :
ACTION_ERRM_StoreHistory (IN<IDX>)
ACTION_ERRM_EraseDtc (IN<IDX>)
ACTION_ERRM_EraseFrf (IN<IDX>)
  If       failure is using similar conditions functionality (see Similar conditions Appli.Inc.)
           (LC_ENA_SCDN=1 and NLC_ENA_SCDN=1)
Then   ACTION_ERRM_EraseScdn (IN<XX>)
        (with XX=F(IDX))
```

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Endif
Failure XX (with XX=F(IDX)) is cleared (all data in 2^{nd} layer memory related to failure IDX are filled with 0 ; all data in static memory related to failure XX are unchanged)
LV_ERR_MEM_XX = 0 (with XX = F(IDX))
CTR_ERR_DYN_NR = CTR_ERR_DYN_NR -1

Temporary flag management :
For each failure in 2^{nd} layer memory
If LV_ERR_CFM[IDX] = 1
or
LV_ERR_DISA[IDX] = 1
Then
LV_ERR_TMP[IDX] = 0
Endif

B.71.2.3 Clear failure memory

Description:

For development conveniences, it is often useful to reinit all failure in the memory. This is possible by setting the calibration bit LC_ERR_FMY_CLR to 1.

Application conditions

Initialisation: –

Recurrence: –

Activation: *LC_ERR_FMY_CLR 0 → 1 transition*

Formula section:

Treatment performed at global clearing request (e.g. Mode$04) :
If LC_ERR_FMY_CLR = 1
Then Reset failure memory (all data in 2^{nd} layer memory and all data in static memory, e.g. LV_ERR_LST_CLR)
CTR_ERR_DYN_NR = 0
ACTION_ERRM_*ClcPermanentIniErrm*()
Endif

B.71.3 Failure management

B.71.3.1 State diagram

Description:

In the following diagram, the failure state progress is described.

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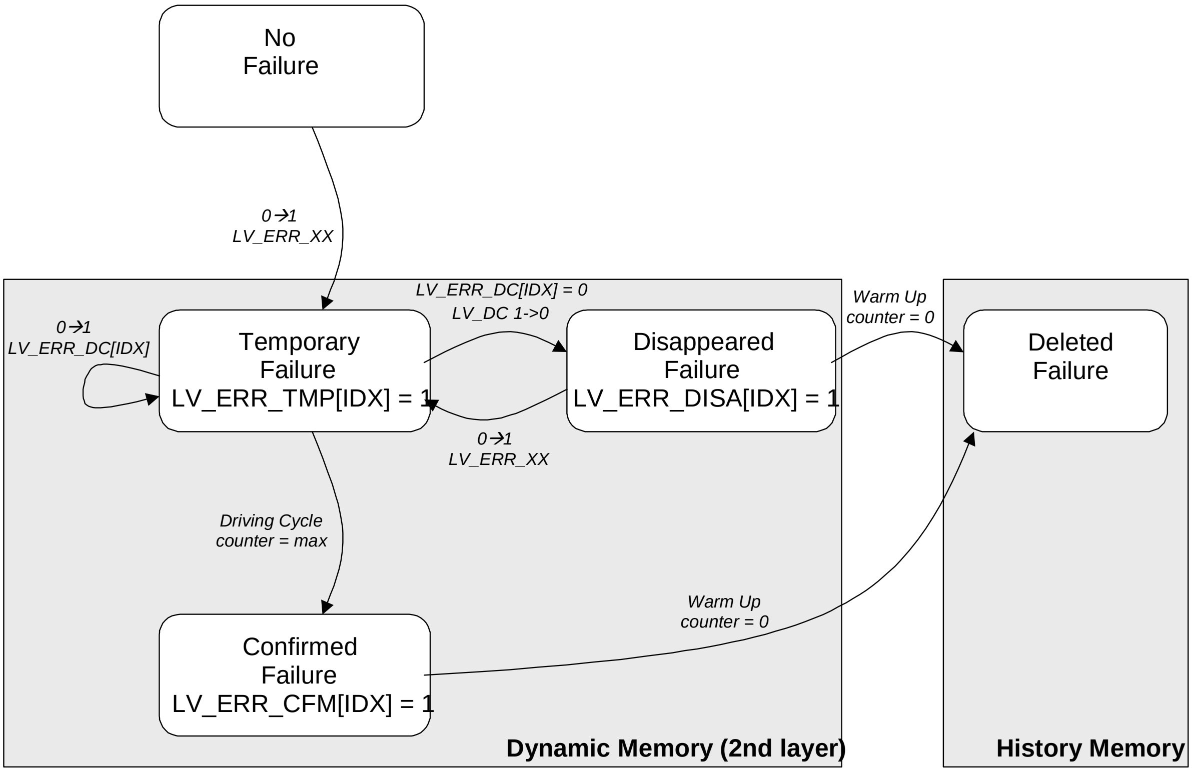

There are also additional transitions possible due to :
- Overwriting/Erasement by priority rule or Tool Request :

Temporary Failure Deleted Failure
Disappeared Failure Deleted Failure
Confirmed Failure Deleted Failure

	Driving Cycle counter value	Warm Up counter value
No Failure	0	0
Temporary Failure	[0, Max [without having reached Max	Max
Confirmed Failure	[0, Max] with having reached Max	] 0, Max]
Disappeared Failure	0	] 0, Max]
Deleted Failure	0	0

B.71.3.2 Present failure occurred

Description:

When a failure occurs (becomes present), this failure shall be stored in the 2^{nd} layer memory (if possible). If the 2^{nd} layer memory is full and marked mode is not set, a choice is made in the module “Priority rules” :

- RESP is set to OK by priority rules, if the failure can be stored in the 2^{nd} layer memory ; in this case IDX gives the index of the failure to be replaced into dynamic memory;

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- RESP is set to NOK by priority rules if the failure can't be stored in the 2^{nd} layer memory.

To monitor the failure, ACTION_ERRM_TrigErrDyn shall be called when the failure occurs (the failure is evaluated or re-evaluated) or the failure is removed.

Application conditions

Initialisation: –

Recurrence: –

Activation:
```
at LV_END_DIAG_XX 0 → 1 transition
 with  ( LV_ERR_XX = 1  and  LV_ERR_MEM_XX = 1 )
  or
at LV_ERR_XX 1 → 0 transition
(due to the physical default disappears only:  it means that
a clear failure memory or diagnosis initialization aren't  activation
condition)
```

Formula section:

ACTION_ERRM_TrigErrDyn (IN<XX>)
This action is called to indicate that a new failure has occurred, although failure is not stored.

Application conditions

Initialisation: –

Recurrence: –

Activation:
```
LV_ERR_XX 0 → 1 transition with LV_END_DIAG_XX = 1
  or
LV_END_DIAG_XX 0 → 1 transition
with  ( LV_ERR_XX = 1 and  LV_ERR_MEM_XX = 0 )
```

Formula section:

If (1) CTR_ERR_DYN_NR < NC_NR_ERR_DYN
 or LV_ERR_MEM_XX = 1
Then (1) ACTION_ERRM_StoreErr (IN<XX>)
Else (1) **If (2)** LV_MKD_MOD = 0
 Then (2) ACTION_ERRM_PrioRule (OUT<RESP>, OUT<IDX>)
  If (3) RESP = OK
  Then (3) ACTION_ERRM_EraseErr (IN<IDX>)
   ACTION_ERRM_StoreErr (IN<XX>)
  Endif (3)
 Endif (2)
Endif (1)
ACTION_ERRM_TrigErrDyn (XX)
This action is called to indicate that a new failure has occurred.

B.71.3.3 Diagnostic passed without failure

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Application conditions

Initialisation: –

Recurrence: –

Activation: `at LV_ERR_XX 1 → 0 transition (whatever LV_END_DIAG_XX value)`
or
`at LV_END_DIAG_XX 0 → 1 with LV_ERR_XX = 0`

Formula section:

If NLC_CTR_OCC_ENA = 1
Then
  If LV_ERR_MEM_XX = 1
  Then
    LV_ERR_DC_PREV[IDX] = 0
  Endif
Endif

B.71.3.4 Present failure occurred

Description:

FARM treatments are performed last

Application conditions

Initialisation: –

Recurrence: –

Activation: *at LV_END_DIAG_XX 0 → 1 transition (independant of LV_ERR value)*

Formula section:

call ACTION_ERRM_TrigFarm(XX)

B.71.3.5 Error occurred during present driving cycle

Description:

An active flag called LV_ERR_DC[IDX] indicates that an error XX (with XX = F(IDX)) has occurred during a driving cycle.
Even if the error disappears during the driving cycle, the flag remains active during the whole driving cycle.

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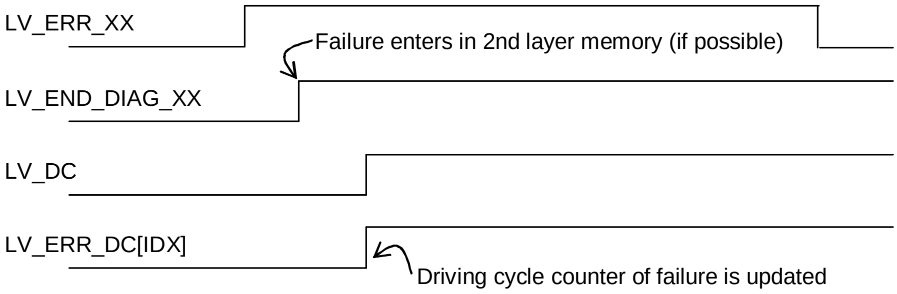
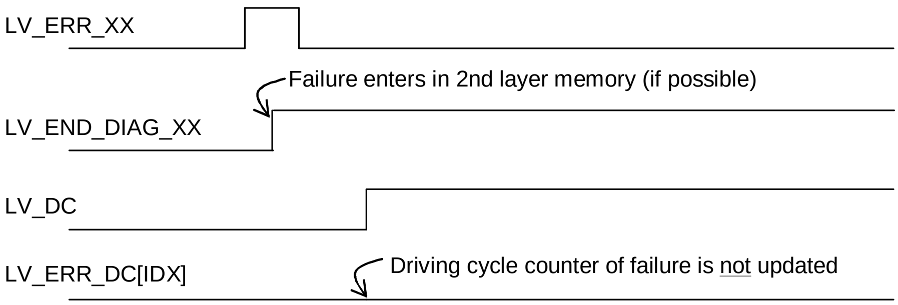
Failure present, then driving cycle is recognized, then failure not present



Failure present, then failure not present, then driving cycle is recognized



Application conditions

Initialisation: `at ECU reset` **`or`** `transition LV_DC 1->0 after treatment done at this event`
`LV_ERR_DC[IDX] = 0`

Recurrence: `same as the diagnosis routine`
`all failures are updated at transition 0->1 of LV_DC`

Activation: *`at every engine operating state`*

Formula section:

If LV_ERR_XX = 1 (failure is present)
and
LV_END_DIAG_XX =1 (current diagnosis is available)
and
LV_DC = 1 (within driving cycle)
and
LV_ERR_MEM_XX =1 (failure is stored in dynamic memory)
Then
LV_ERR_DC[IDX] = 1 (it remains 1 until the next initialization)
Endif

B.71.3.6 Driving Cycle Counter management

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Description:

The driving cycle counter CTR_DC[IDX] is associated to each failure which has a structure defined in second layer of memory.
This counter is incremented at each driving cycle in the following way:

- for all failures not using SCDN functionality (withLC_ENA_SCDN=0 or NLC_ENA_SCDN=0), when the associated failure gets present (LV_ERR_DC[IDX]).
- for failures using SCDN functionality (with LC_ENA_SCDN=1 and NLC_ENA_SCDN=1)
- when the failure gets present the first time (and stored)
- when the failure gets present again in a following driving cycle
- when the failure gets present again in another driving cycle (not previous) (driving cycle counter of this failure is != 0/max before new occurrence), if the similar conditions functionality decides, that the incrementation is possible

The driving cycle counter is decremented at the end of a driving cycle in the following cases:

- for all failures not using SCDN functionality (or LC_ENA_SCDN=0 or NLC_ENA_SCDN=0), when the associated failure was not present the complete DC (LV_ERR_DC[IDX] = 0).
- for failures using SCDN functionality (with LC_ENA_SCDN=1 and NLC_ENA_SCDN=1)
- when similar conditions are encountered without failure (for failure with present MIL illumination)
- when the similar conditions functionality decides that the decrementation is possible (for temporary failure or confirmed failure with no present MIL illumination)

The driving cycle counter is useful for MIL management and warm-up counter management (see specific chapter).

With the calibration LC_ENA_SCDN it's possible to enable/disable the similar conditions functionality. If LC_ENA_SCDN = 0 the failures using SCDN functionality (see similar conditions Appl.Inc) are treated like normal failures in the driving cycle counter management.

Application conditions

Initialization:

```
On saved RAM lost
    LV_DC_MAX[IDX] = 0
    CTR_DC[IDX] = 0
    LV_ERR_DISA[IDX] = 0
    LV_ERR_CFM[IDX] = 0
```

Recurrence: –

Activation: –

Formula section:

Treatment for all failures not using SCDN functionality (with LC_ENA_SCDN=0 or NLC_ENA_SCDN=0) stored in 2nd layer memory :

Conditions to increment the driving cycle counter :

At LV_ERR_DC[IDX] 0 → 1 transition

XX=f(IDX)
LV_ERR_DISA[IDX] = 0
If LV_DC_MAX[IDX] =1 (for confirmed failure with MIL ON)
Then
CTR_DC[IDX] = DC_MAX_XX (counter is forced to max.)
ACTION_ERRM_*GetMILRelevant*(XX,PRM_LV_MIL_RLV)
If PRM_LV_MIL_RLV= 1 (MIL illuminated and Failure OBD relevant)
Then

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```
                Permanent fault code has to be stored, if not yet done due to memory full
                ACTION_ERRM_StorePermanentCode (XX)
            Endif
Else
            CTR_DC[IDX] = CTR_DC[IDX] + DC_INC_XX
            If      CTR_DC[IDX]   DC_MAX_XX
            Then
                  CTR_DC[IDX] = DC_MAX_XX
                  LV_DC_MAX[IDX] = 1                       (failure becomes confirmed)
                  LV_ERR_CFM[IDX] = 1
                  ACTION_ERRM_GetMILRelevant(XX,PRM_LV_MIL_RLV)
                  If  PRM_LV_MIL_RLV= 1 (MIL illuminated and Failure OBD relevant)
                  Then
                      Permanent fault code has to be stored
                      ACTION_ERRM_StorePermanentCode (XX)
                   Endif
            Endif
Endif
```

Conditions to decrement the driving cycle counter :

At transition LV_DC 1 -> 0:

```
If          LV_ERR_DC[IDX] = 0
           and   LV_END_DIAG_XX   = 1
Then       LV_ERR_PND[IDX] = 0                          (Pending fault is erased)
           If        LV_ERR_CFM[IDX] = 1                    (for confirmed failure)
           Then  If LV_DC_MAX[IDX] =1
                 Then  CTR_DC[IDX] = CTR_DC[IDX] - DC_DEC_XX
                       If       CTR_DC[IDX] ≤ 0
                       Then  LV_DC_MAX[IDX] = 0
                              CTR_DC[IDX] = 0
                             ACTION_ERRM_ErasePermanentCode (XX)
                       Endif
                 Else   CTR_DC[IDX] = 0
                 Endif
           Else                                          (for temporary failure)
                  CTR_DC[IDX] = 0
                  LV_ERR_DISA[IDX] = 1                    (failure disappeared)
           Endif
Endif
```

Treatment for failures using SCDN functionality (LC_ENA_SCDN=1 and NLC_ENA_SCDN=1) (running within DC) stored in 2^{nd} layer memory.

Conditions to increment the driving cycle counter :

Done upon ACTION_ERRM_IncrementDCctrSCDN call:

(see also similar conditions specification)

Description:

Syntax : ACTION_ERRM_IncrementDCctrScdn (IN <XX>)

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Parameter (in) : XX failure in static memory with XX=F(IDX)
Parameter (out) :
Short description:
With the ACTION_ERRM_IncrementDCctrScdn (IN <XX>) the driving cycle counter for the failure XX stored in 2^{nd} layer memory at position IDX, which is using similar conditions functionality, is incremented. This action is called at the end of a diagnosis window in the following cases :

- failure occurred and similar conditions are recorded
- failure already stored in a previous driving cycle. Now failure gets present again and was also present in last driving cycle.
- failure already stored in a previous driving cycle. Now failure gets present again with SCDN recognition for detected failure.
- failure already stored in a previous driving cycle and LV_DC_MAX[IDX] = 1 (MIL is illuminated, if LC_MIL_ON =1).

For details see similar conditions specification.

Application conditions

Initialization: –

Recurrence: –

Activation: *at action request*

Formula section:

ACTION_ERRM_IncrementDCctrScdn (IN<XX>) :
XX=f(IDX)
If LV_ERR_MEM_XX = 1 (failure XX is stored in 2^{nd} layer memory)
Then LV_ERR_DISA[IDX] = 0
If LV_DC_MAX[IDX] =1 (for confirmed failure with MIL on)
Then
CTR_DC[IDX] = DC_MAX_XX (counter is forced to max.)
ACTION_ERRM_*GetMILRelevant*(XX,PRM_LV_MIL_RLV)
If PRM_LV_MIL_RLV= 1
(MIL illuminated and Failure OBD relevant)
Then
Permanent fault code has to be stored, if not yet done due to memory full
ACTION_ERRM_*StorePermanentCode* (XX)
Endif

Else ACTION_ERRM_ConfirmErrScdn (OUT<DCconf>, IN<XX>)
(allows direct failure confirmation; see similar conditions Appl.Inc.)
If DCconf = YES
Then
CTR_DC[IDX] = DC_MAX_XX (counter is forced to max.)
Else
CTR_DC[IDX] = CTR_DC[IDX] + DC_INC_XX
Endif
If CTR_DC[IDX] DC_MAX_XX
Then
CTR_DC[IDX] = DC_MAX_XX
LV_DC_MAX[IDX] = 1 (failure confirmed)
LV_ERR_CFM[IDX] = 1

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LV_ERR_TMP[IDX] = 0
ACTION_ERRM_*GetMILRelevant*(XX,PRM_LV_MIL_RLV)
If PRM_LV_MIL_RLV= 1
(MIL illuminated and Failure OBD relevant)
Then
Permanent fault code has to be stored
ACTION_ERRM_*StorePermanentCode* (XX)
Endif
Endif
Endif
Endif

Conditions to decrement the driving cycle counter :
At transition LV_DC 1 -> 0:
If LV_ERR_DC[IDX] = 0
and LV_END_DIAG_XX = 1
Then ACTION_ERRM_DecrementDCctrSCDN (OUT<DCdec>, IN<XX>)
(with XX=F(IDX))
The similar conditions functionality decides, if it's possible to decrement the driving cycle counter.
If DCdec = YES (decrementing is possible)
Then LV_ERR_PND[IDX] = 0 (Pending fault is erased)
If LV_ERR_CFM[IDX] = 1 (for confirmed failure)
Then **If** LV_DC_MAX[IDX] = 1
Then CTR_DC[IDX] = CTR_DC[IDX] - DC_DEC_XX
If CTR_DC[IDX] $\leq$ 0
Then LV_DC_MAX[IDX] = 0
CTR_DC[IDX] = 0
ACTION_ERRM_*ErasePermanentCode* (XX)
Endif
Else
CTR_DC[IDX] = 0
Endif
Else (for temporary failure)
CTR_DC[IDX] = 0
LV_ERR_DISA[IDX] = 1 (failure disappeared)
Endif
Endif
Endif

B.71.3.7 Warm-Up counter management

Description:

As soon as the failure gets present and stored in the memory, the warm-up cycle counter is initialized. With every valid warm-up cycle with no error occurrence, the warm-up cycle counter is decremented by 1. If the warm-up cycle counter reaches zero the error is deleted from the 2^{nd} layer memory.

Application conditions

Initialization: `on saved ram lost`
`CTR_WUP_CYC[IDX]= 0`

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Recurrence: –

Activation: `only at transition LV_DC 1 -> 0`

Formula section:

Treatment for all failures not using SCDN functionality (or LC_ENA_SCDN = 0) stored in 2^{nd} layer memory :

Condition to decrement the warm up counter :
The following treatment is done for all failure stored in 2^{nd} layer memory **and only at transition LV_DC 1 -> 0** (**before** treatment of driving cycle counter decrementing at end of driving cycle):

If (LV_WUP_CYC = 1 **and** C_CTR_MAX_WUP_CYC != 255)
the warm-up cycle is recognised and failure healing is possible
Then **If** (CTR_DC[IDX] = 0 **and** LV_ERR_DC[IDX] = 0)
the MIL is extinguished and no failure in this driving cycle
or
(CTR_DC[IDX] != 0 **and** LV_DC_MAX[IDX] = 0
case before the MIL may be illuminated
and LV_ERR_DC[IDX] = 0 **and** LV_END_DIAG_XX = 1)
the failure is no more pending
Then CTR_WUP_CYC[IDX] = CTR_WUP_CYC[IDX] - 1
If CTR_WUP_CYC[IDX] = 0
Then ACTION_ERRM_EraseErr (IN<IDX>)
Endif
Endif
Endif

Treatment for failures using SCDN functionality (and LC_ENA_SCDN = 1) (running within DC) stored in 2^{nd} layer memory.

Condition to decrement the warm up counter :
The following treatment is done for all failure stored in 2^{nd} layer memory **and only at transition LV_DC 1 -> 0** (**before** treatment of driving cycle counter decrementing at end of driving cycle):

If LV_WUP_CYC = 1
Then **If** CTR_DC_IDX = 0
and LV_ERR_DC_IDX = 0
Then CTR_WUP_CYC_IDX = CTR_WUP_CYC_IDX - 1
If CTR_WUP_CYC_IDX = 0
Then ACTION_ERRM_EraseErr (IDX)
Endif
Endif
Endif

Condition to reload the warm up counter :
The following treatment is done for failure XX when it is stored in 2^{nd} layer memory **when ACTION_ERRM_StoreErr (IN<XX>) is called :**
CTR_WUP_CYC[IDX] = C_CTR_MAX_WUP_CYC

B.71.3.8 Treatments at end of driving cycle

FUNCTION DESCRIPTION:

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General information:

End of driving cycle is reached when power-latch is ended, or in case on key off/on transition before the end of power-latch phase.
For CTR_OCC[IDX] computation, some treatments are executed each time a driving cycle is ended.

Application conditions

Initialisation: –

Recurrence: –

Activation: at end of power-latch phase (before NVMY storage) whatever LV_DC value
or
(LV_IGK 0→1 transition **and** LV_ES = 1 **and** LV_DC = 1)

Formula section:

ACTION_ERRM_*ClcLvErrDcPrev*( )

B.71.3.9 Calculation of LV_ERR_XX state at end of driving cycle

Description for ACTION_ERRM_ClcLvErrDcPrev

ACTION_ERRM_*ClcLvErrDCPrev* ()					
This action indicates if a failure was set at the end of previous driving cycle					
Parameter	**Type**	**Hex. Limits**	**Phys. limits**	**Resol.**	**Unit**
No Parameter					

General information:

This action indicates if a failure was set at the end of previous driving cycle.
Only when NLC_CTR_OCC_ENA = 1, this action must be called before any other treatment from ERRM.

Formula section:

For IDX = 0 to CTR_ERR_DYN_NR
with XX = f(IDX)
If LV_END_DIAG_XX = 1
THEN LV_ERR_DC_PREV[IDX] = LV_ERR_XX
ENDIF
Endfor

B.71.4 Miscellaneous services to get information

B.71.4.1 API for determination of pending status of failures

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General information:

This API shall be called to determine if any XX failure is pending or not.

Description:

Syntax: ACTION_ERRM_CheckPendingStatus (IN <PRM_IDX_DIAG>, OUT <PRM_LV_ERR_PND>)
Parameter(in): PRM_IDX_DIAG Diagnostic instance of the XX failure
Parameter(out): PRM_LV_ERR_PND State of the failure :
= 1 failure is pending (or it's impossible to determine its status)
= 0 failure is not pending

Short Description: This API shall be used to verify if a failure stored in the dynamic memory has the pending status or not. When it impossible to determine if the fault is pending or not (failure not store because the dynamic memory is full), this failure should be considered as pending anyway.

Application conditions

Initialisation: –

Recurrence: –

Activation: `at action call`

Deactivation: –

Formula section:

If (1) *{ the XX failure analysed is present in the dynamic memory }*
LV_ERR_MEM_XX = 1 (with XX = F(IDX))
Then (1)
If (2) *{ IDX is the failure index, in the dynamic memory }*
LV_ERR_PND[IDX] = 1
Then (2)
PRM_LV_ERR_PND = 1
Else (2)
PRM_LV_ERR_PND = 0
Endif (2)
Else (1)
{ failure not stored in the dynamic memory }
If (2) LV_ERR_XX = 1
Then (2)
{ the failure is stored in the static memory but it's not present in the dynamic memory : impossible to determine its status }
{ then the failure shall be considered as pending }
PRM_LV_ERR_PND = 1
Else (2)
{ the failure is neither stored in the static memory nor in the dynamic memory }
PRM_LV_ERR_PND = 0
Endif (2)
Endif (1)

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B.71.4.2 Get the "Failure set since last clear" state

Description for ACTION_ERRM_GetErrLastClr

ACTION_ERRM_*GetErrLastClr* (<PRM_IDX_ERR>, <PRM_LV_ERR_LST_CLR>)					
This action indicates if a failure has been set already once since the last failure memory clear.					
Parameter	**Type**	**Hex. Limits**	**Phys. limits**	**Resol.**	**Unit**
PRM_IDX_ERR	IN	0...FFFFH	0...65535	1	[-]
Diagnostic failure instance					
PRM_LV_ERR_LST_CLR	OUT	0...1H	0...1	1	[-]
Failure set at least once since last failure memory clear					

General information:

This API shall be called to determine if any XX failure has been set at least one time since memory clear

Formula section:

If PRM_IDX_ERR != 0
Then
with XX = PRM_IDX_ERR
PRM_LV_ERR_LST_CLR = LV_ERR_LST_CLR_XX
Else
PRM_LV_ERR_LST_CLR = 0
Endif

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B.72 Dynamic error management core (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_WUP_CYC	O/V	0... 1H	0 ...1	1	-
Warm-up cycles calculation inhibition					
TCO_DSL_CMN	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature (used only in ERRM for GS-DS diversity)					
TCO_ST_DSL_CMN	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature at start (used only in ERRM for GS-DS diversity)					

Input data:

TCO {p. 1100}	TCO_ST {p. 1100}		

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_OBD_DSL	-	0... 1H	0 ...1	1	-
Selection of engine type : gasoline (0) or diesel (1)					

Action definition

ACTION_ERRM_TrigErrDyn (**IN**<XX>)	Mode: O

ACTION_ERRM_TrigFarm (**IN**<XX>)	Mode: O

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)
ACTION_FARM_ReqInit ()
ACTION_FARM_TriggerOnEvent (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_STATE_OLD>,**OUT**<PRM_STATE_NEW>)

B.72.1 Selection of engine type : Gasoline /Diesel

NLC_OBD_DSL data is used to adapt OBD computations to engine type : gasoline (0) or diesel (1).
It is used by Statistical Data, Failure Classes, Readiness code and Rate-based monitoring modules.

B.72.2 Warm-up cycle inhibition

FUNCTION DESCRIPTION:

Description:

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The warm-up cycle is not inhibited

Application conditions

Initialisation: at ECU reset
LV_INH_WUP_CYC = 0
TCO_DSL_CMN = TCO
TCO_ST_DSL_CMN = TCO_ST

Recurrence: *100 ms*

Activation: *LV_IGK = 1*

Deactivation: –

Formula section:

LV_INH_WUP_CYC = 0
TCO_DSL_CMN = TCO
TCO_ST_DSL_CMN = TCO_ST

B.72.3 API for Trigger Event

General information:

This file defines the Action “ACTION_ERRM_TrigErrDyn” called by the error management function when a failure occurs or disappears.

Description:

Syntax: ACTION_ERRM_TrigErrDyn (IN <XX>)
Parameter (in): XX diagnostic instance of failure index of failure in static memory
Parameter (out): -
Short description: This action allows to inform the communication tools in line as soon as a failure occurs

Application conditions

Initialisation: –

Recurrence: –

Activation: *at action request*

Formula section:

ACTION_ERRM_TrigErrDyn (XX): ***not used***

B.72.4 Additional FARM interface functionality

General information:

This part defines the interfaces between ERRM and FARM in case of FARM usage inside the project. This part must be empty if FARM is not used.

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Description:

Syntax: ACTION_ERRM_TrigFarm (IN <XX>)
Parameter (in): XX diagnostic instance of failure index of failure in static memory
Parameter (out): -
Short description: This action indicates if a failure status has changed to inform FARM

Application conditions

Initialisation: at reset, after calculation of ERRM and diagnostics:
ACTION_FARM_ReqInit ()

Initialisation: at clear failure memory, after calculation of ERRM and diagnostics:
ACTION_FARM_ReqInit ()

Initialisation: at transition of LV_DC from 0 to 1, after calculation of ERRM and diagnostics:
ACTION_FARM_ReqInit ()
Reccurence: -

Activation : **none, FARM is not used**

Formula section:

PRM_STATE = 0
ACTION_ERRM_GetLvErr(IN< PRM_IDX_ERR >, OUT<PRM_LV_ERR>)
Bit 0 of PRM_STATE = PRM_LV_ERR
ACTION_ERRM_CheckPendingStatus(IN<PRM_IDX_ERR>,OUT<PRM_LV_PMD>)
Bit 3 of PRM_STATE = PRM_LV_PMD
ACTION_ERRM_GetLvEndDiag(IN<PRM_IDX_ERR>, OUT<PRM_LV_END>)
Bit 5 of PRM_STATE = PRM_LV_END
ACTION_FARM_TriggerOnEvent(XX,PRM_STATE,PRM_STATE)

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B.73 Environmental data

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ENVD_CUS_CMN [NC_NR_ENVD_CUS_CMN][NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Freeze frame FRF_CUS_CMN : environmental data common to all failure (not fixed by law)					
ENVD_CUS_SET_CMN [NC_NR_ENVD_CUS_SET_CMN][NC_NR_FRF_SET][NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Freeze frame FRF_CUS_SET_CMN : environmental data common to all failure (not fixed by law) stored in set					
ENVD_CUS_SET_SPC [NC_NR_ENVD_CUS_SET_SPC][NC_NR_FRF_SET][NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Freeze frame FRF_CUS_SET_SPC : environmental data specific to each failure (not fixed by law) stored in set					
ENVD_OBD [NC_NR_ENVD_OBD][NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Freeze frame FRF_OBD : environmental data (fixed by law)					
ENVD_PREV_CUS_CMN [NC_NR_ENVD_CUS_CMN][NC_NR_ENVD_PREV]	O/S	0... FFH	0... 255	1	-
Prestored freeze frame FRF_PREV_CUS_CMN as content for FRF_CUS_CMN;					
ENVD_PREV_CUS_SET_CMN [NC_NR_ENVD_CUS_SET_CMN][NC_NR_ENVD_PREV]	O/S	0... FFH	0... 255	1	-
Prestored Freeze frame FRF_PREV_CUS_SET_CMN as content for FRF_CUS_SET_CMN					
ENVD_PREV_CUS_SET_SPC [NC_NR_ENVD_CUS_SET_SPC][NC_NR_ENVD_PREV]	O/S	0... FFH	0... 255	1	-
Prestored freeze frame FRF_PREV_CUS_SET_SPC :as content for FRF_CUS_SET_SPC					
ENVD_PREV_OBD [NC_NR_ENVD_OBD][NC_NR_ENVD_PREV]	O/S	0... FFH	0... 255	1	-
Prestored freeze frame FRF_PREV_OBD as content for FRF_OBD;					
IDX_FRF [NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Pointer to make the link between the failure and the freeze frame					

Input data:

CTR_FRC [NC_NR_ERR_DYN] {p. 5767}	ENVD_CONF_CUS_CMN [NC_NR_ENVD_CUS_CMN] {p. 5801}	ENVD_CONF_CUS_SET_CMN [NC_NR_ENVD_CUS_SET_CMN] {p. 5801}	ENVD_CONF_OBD [NC_NR_ENVD_OBD] {p. 5801}
LV_ERR_DISA [NC_NR_ERR_DYN] {p. 5767}	NC_NR_ERR_DYN {p. 5768}		

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_ERR_ENVD_XX	V/S	0... FFFFH	0... 65535	1	-
LDP_1_ID_ERR_ENVD_XX	NC_ NR_ ENVD_ CUS_ SET_ SPC	0... FFH	0... 255	1	-
Freeze frame FRF_CUS_SET_SPC : environmental data contents for failure XX					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_ENVD_FAC [65535]	-	1... FFH	1... 255	1	-
Possible stored environmental data in FRF_CUS_SET_SPC					
NC_ENVD_CUS_CMN_UPD	-	0... 1H	0 ...1	1	-
Selection of FRF_CUS_CMN update method					
NC_ID_ENVD_FAC	-	1... FFFFH	1... 65535	1	-
Size of ID_ENVD_FAC table					
NC_NR_ENVD_CUS_CMN	-	1... FFH	1... 255	1	-
Number of different environment data (in bytes) which are common for all diagnosis instance (stored one time)					
NC_NR_ENVD_CUS_SET_CMN	-	0... FFH	0... 255	1	-
Number of different environment data (in bytes) which are common for all diagnosis instance (stored many time)					
NC_NR_ENVD_CUS_SET_SPC	-	1... FFH	1... 255	1	-
number of different environment data (in bytes) which are specific to each diagnosis instance (stored many time)typical value is 4					
NC_NR_ENVD_OBD	-	1... FFH	1... 255	1	-
Number of different environment data (in bytes) which are fixed by the law (stored one time)					
NC_NR_ENVD_PREV	-	1... FFH	1... 255	1	-
Number of different failure instances XX using prestored freeze frameIf NC_NR_ENVD_PREV = 0 , then no prestored freeze frame functionality required					
NC_NR_FRF_SET	-	1... FFH	1... 255	1	-
Number of different environment data groups (set) which can be store for one freeze frametypical value is 3 ; the value 0 is forbidden					

Action definition

ACTION_ERRM_EraseFrf (IN<IDX>)	Mode: O

ACTION_ERRM_StoreFrf (IN<IDX>)	Mode: O

ACTION_ERRM_StorePrevFrf (IN<XX>)	Mode: O
This action stores the prestored freeze frame for the diagnosis instance XX	

Note:
The link between the failure stored in the dynamic error mangement at position *IDX* is made with IDX_FRF[*IDX*]. E. g. a failure stored at the position *IDX* = 2 belongs to freeze frame

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ENVD_..._[m] with m = IDX_FRF[2]

FUNCTION DESCRIPTION:

General information:

This module describes the structure of the freeze frame and manages the storage and deleting of the freeze frame.
A freeze frame is a group of vehicle environment data catched when a failure occurs.
Freeze frame is filled up with variables, which are not limp home values : the variables are set up before going to the limp home.
A freeze frame is made of many parts :

- FRF_OBD: Environmental data, which are common to all failures and stored on time. It s only updated, if the failure has disappeared before and occurs again.

The content is defined by law. It s called usually CARB Freeze Frame and the content is according to SAE J1979.
Size of this part is defined by configuration data NC_NR_ENVD_OBD affected value is in the Environmental data (Appl. Inc.) module.
Contents of this part is fixed and defined in Environmental data (Appl. Inc.) module.

- FRF_CUS_CMN : Environmental data, which are common to all failure.

It s stored one time, if NC_ ENVD_CUS_CMN_UPD = 0.
With NC_ ENVD_CUS_CMN_UPD = 1, FRF_CUS_CMN is updated, if the failure was disappeared before and occurs again.
The content is not required by law.
Size of this part is defined by configuration data NC_NR_ENVD_CUS_CMN; affected value is in the Environmental data (Appl. Inc.) file.
Contents of this part is fixed and defined in the Environmental data (Appl. Inc.) module.

- FRF_CUS_SET_CMN : Environmental data, which are common to all failure and stored many times. The content is not required by law. For each failure occurrence several catches (called sets) can be done.

Size of this part is defined by configuration data, affected value is in the Environmental data (Appl. Inc.) module :
NC_NR_FRF_SET for number of sets per freeze frame
NC_NR_ENVD_CUS_SET_CMN for number of common data (in bytes) in each set
Contents of this part is fixed and defined in the Environmental data (Appl. Inc.) module.

- FRF_CUS_SET_SPC : Environmental data, which are specific to each failure and stored many times. The content is not required by law. For each failure occurrence several catches (called sets) can be done.

Size of this part is defined by configuration data, affected value is in Environmental data (Appl. Inc.) module :
NC_NR_FRF_SET for number of sets per freeze frame
NC_NR_ENVD_CUS_SET_SPC for number of specific data (in bytes) in each set
Contents of this part is defined by calibration, process is described in the last chapter of this module.

Signal flow diagram:

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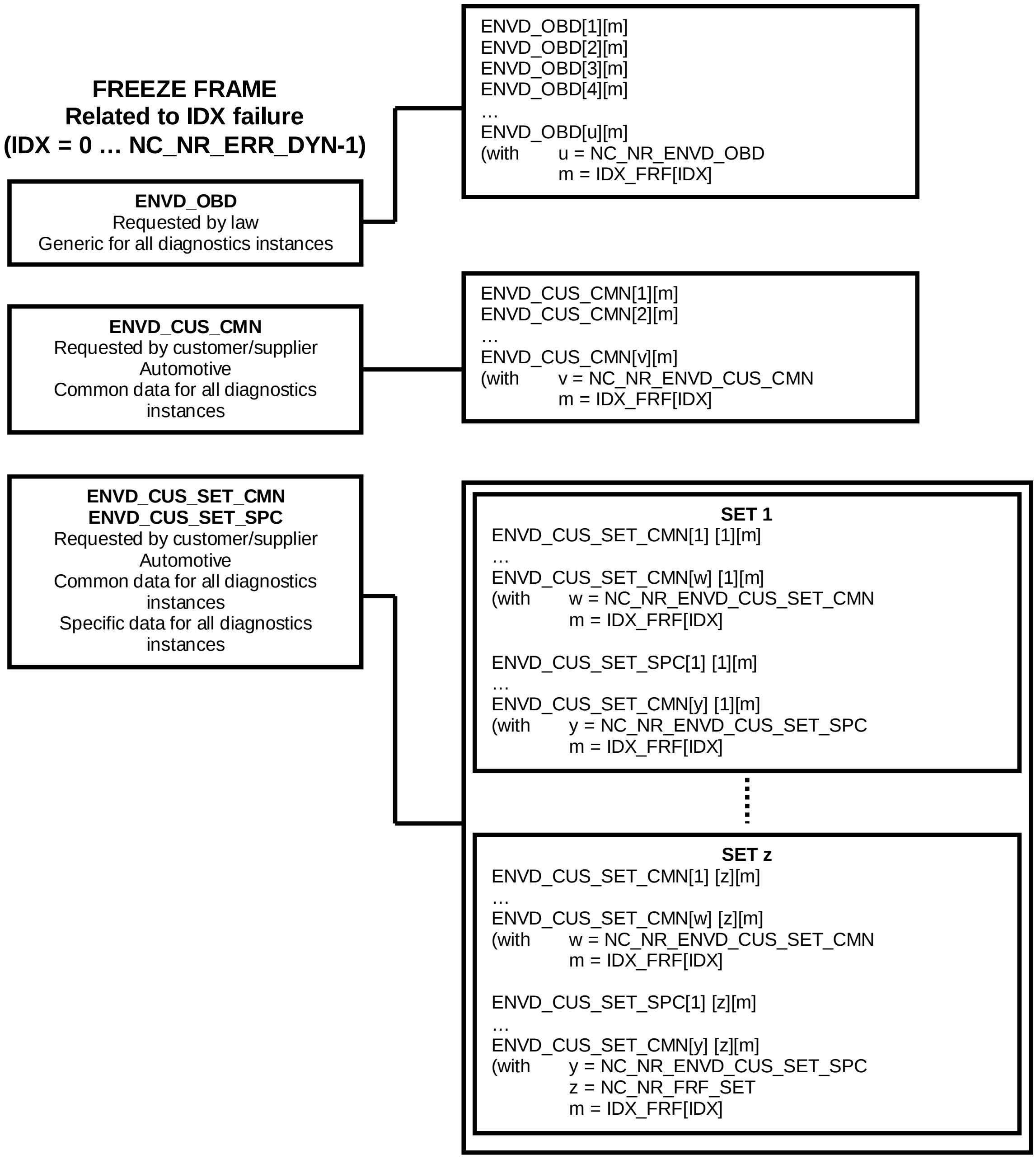

Remark: This signal flow diagram doesn t include the prestored freeze frame functionality described in chapter 1.4.

B.73.1 Freeze frame storage

Description:

Syntax : ACTION_ERRM_StoreFrf (IN <IDX>).
Parameter (in) : IDX Index of failure in 2^{nd} layer memory to store the freeze frame
Parameter (out) : -
Short description :
When the failure IDX gets present, the storage of a freeze frame is done in the 2^{nd} layer memory by calling the action ACTION_ERRM_StoreFrf (IDX).

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If several failures occur (TCO sensor, injector 1, injector 4), a freeze frame is stored for each failure. For ram memory limitation, the number of freeze frame is limited to NC_NR_ERR_DYN.
If same failure occurs several times (occurrence of the failure is defined by the frequency counter CTR_FRC[IDX]), the following rules are applied :

- 1^{st} occurrence :

Store FRF_OBD +FRF_CUS_CMN +FRF_CUS_SET_CMN + FRF_CUS_SET_SPC

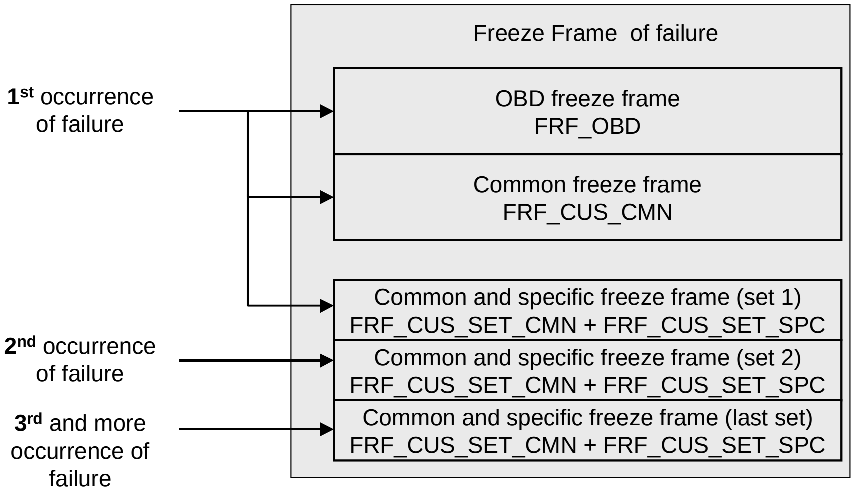
- occurrence [2 to NC_NR_FRF_SET]

Store FRF_CUS_SET_CMN + FRF_CUS_SET_SPC

- occurrence $>$ NC_NR_FRF_SET

Replace last FRF_CUS_SET_CMN + FRF_CUS_SET_SPC

Example with NC_NR_FRF_SET set to 3



Freeze frame informations are available as long as the failure is not erased in 2^{nd} layer memory.
Remark: Special behavior for FRF_OBD and FRF_CUS_CMN in case of failure status change from disappeared to temporary/confirmed.

Application conditions

Initialization: *after system initialization the freeze frame is restored from non volatile memory or in case of a damaged non volatile memory the freeze frame is with zero*

Recurrence: –

Activation: *at Action request*

Formula section:

ACTION_ERRM_StoreFrf (IDX) :
If CTR_FRC[IDX] = 1
Then (1^{st} occurrence : storage
With u = 1 ... NC_NR_ENVD_OBD
v = 1 ... NC_NR_ENVD_CUS_CMN
w = 1 ... NC_NR_ENVD_CUS_SET_CMN
y = 1 ... NC_NR_ENVD_CUS_SET_SPC)

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If (NC_NR_ENVD_PREV != 0 and
XX = diagnosis instance XX using prestored freeze frame functionality (see Environmental data (Appl. Inc.) module) with XX = F(IDX))
Then ENVD_OBD[u][m] = ENVD_PREV_OBD[u][t]
ENVD_CUS_CMN[v][m] = ENVD_PREV_CUS_CMN[v][t]
ENVD_CUS_SET_CMN[w][1][m] = ENVD_PREV_CUS_SET_CMN[w][t]
ENVD_CUS_SET_SPC[y][1][m] = ENVD_PREV_CUS_SET_SPC[y][t]
(with **m=IDX_FRF[IDX]**
with t related to failure XX, see Environmental data Appli.Inc.)

Else ENVD_OBD[u][m] = ENVD_CONF_OBD[u]
ENVD_CUS_CMN[v][m] = ENVD_CONF_CUS_CMN[v]
ENVD_CUS_SET_CMN[w][1][m] = ENVD_CONF_CUS_SET_CMN[w]
ENVD_CUS_SET_SPC[y][1][m] = ID_ERR_ENVD_XX[y]
(with XX = F(IDX))
Endif

Else (occurrence 2 to NC_NR_FRF_SET
With w = 1 .. NC_NR_ENVD_CUS_SET_CMN
y = 1 ... NC_NR_ENVD_CUS_SET_SPC
z = CTR_FRC[IDX], if CTR_FRC[IDX]   NC_NR_FRF_SET : storage
z = NC_NR_FRF_SET, if CTR_FRC[IDX] > NC_NR_FRF_SET : update
(with **m=IDX_FRF[IDX]**)
If (NC_NR_ENVD_PREV != 0 **and**
XX = diagnosis instance XX using prestored freeze frame functionality
(see Environmental data (Appl. Inc.) module) with XX = F(IDX))
Then **If** (LV_ERR_DISA[IDX] = 1)
failure was in disappeared state before this occurrence
Then ENVD_OBD[u][m] = ENVD_PREV_OBD[u][t]
FRF_OBD is updated
If (NC_ ENVD_CUS_CMN_UPD = 1)
Then ENVD_CUS_CMN[v][m] = ENVD_PREV_CUS_CMN[v][t]
FRF_CUS_CMN is updated
Endif
Endif
ENVD_CUS_SET_CMN[w][z][m] = ENVD_PREV_CUS_SET_CMN[w][t]
ENVD_CUS_SET_SPC[y][z][m] = ENVD_PREV_CUS_SET_SPC[y][t]
(with t related to failure XX, see Environmental data Appli.Inc.)
Else **If** (LV_ERR_DISA[IDX] = 1)
Failure was in disappeared state before this occurrence
Then ENVD_OBD[u][m] = ENVD_CONF_OBD[u]
Freeze frame ENVD_OBD is updated
If (NC_ ENVD_CUS_CMN_UPD = 1)
Then ENVD_CUS_CMN[v][m]= ENVD_CONF_CUS_CMN[v]
FRF_CUS_CMN is updated
Endif
Endif
ENVD_CUS_SET_CMN[w][z][m] = ENVD_CONF_CUS_SET_CMN[w]
ENVD_CUS_SET_SPC[y][z][m] = ID_ERR_ENVD_XX [y]
(with XX = F(IDX))
Endif
Endif

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B.73.2 Freeze frame deleting

Description:

Syntax : ACTION_ERRM_EraseFrf (IN <IDX>).
Parameter (in) : IDX Index of failure in 2^{nd} layer memory to store the freeze frame
Parameter (out) : -
Short description :
When the failure IDX is erased from 2^{nd} layer memory, the freeze frame of this failure is also erased by calling the action ACTION_ERRM_EraseFrf (IDX).

Application conditions

Initialization: –

Recurrence: –

Activation: `at Action request`

Formula section:

ACTION_ERRM_EraseFrf (IDX) :
(Erase OBD freeze frame, common freeze frame and all specific freeze frame
With u = 1 ... NC_NR_ENVD_OBD
v = 1 ... NC_NR_ENVD_CUS_CMN
w = 1 ... NC_NR_ENVD_CUS_SET_CMN
y = 1 ... NC_NR_ENVD_CUS_SET_SPC
z = 1 ... NC_NR_FRF_SET)
ENVD_OBD[u][m] = 0
ENVD_CUS_CMN[v][m] = 0
ENVD_CUS_SET_CMN[w][z][m] = 0
ENVD_CUS_SET_SPC[y][z][m] = 0

B.73.3 Calibratable set of environmental data

Description:

The freeze frame part called FRF_CUS_SET_SPC contains environmental data, which are :

- specific to each failure, not required by law ;
- and calibratable.

This chapter describes how to define by calibration the contents of FRF_CUS_SET_SPC .
The calibratable system of environmental data is managed via tables defined as following:
ID_ENVD_FAC : Configuration table, which describes all possible environmental data, which can be stored in a freeze frame (specific part) ;
Affected value defined in Environmental data (Appl. Inc.) module.

ID_ERR_ENVD_XX : Calibration table, which defines for each failure XX a maximum of NC_NR_ENVD_CUS_SET_SPC environmental data, which should be stored.

Example :
To store the environmental data TIA and TCO_ST in case of TCO failure ;
MAP and AMP in case of EGR failure ;

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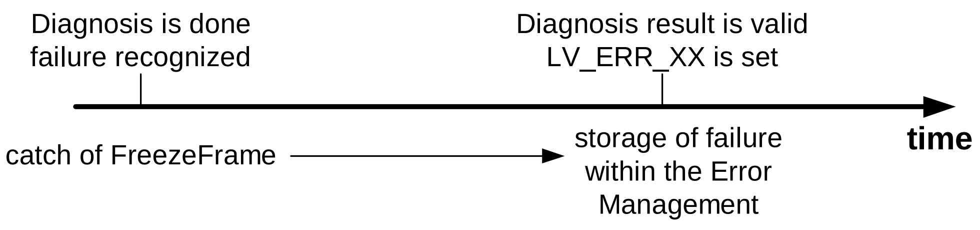
First, you should defined the possible environmental data in ID_ENVD_FAC table :
ID_ENVD_FAC[1] = & TIA
ID_ENVD_FAC[2] = & TCO_ST
ID_ENVD_FAC[3] = & MAP
ID_ENVD_FAC[4] = & AMP
Then, you should declare for each failure, the environmental data to stored :
ID_ERR_ENVD_TCO[1] = 1 ; ID_ERR_ENVD_TCO [2] = 2
ID_ERR_ENVD_EGR[1] = 3 ; ID_ERR_ENVD_EGR [2] = 4

B.73.4 Prestored freeze frame

FUNCTION DESCRIPTION:

General information:

Usually the content for the freeze frame is catched, when the failure is stored within the failure memory. In special cases, when the entry of a failure within the failure memory is delayed, it s necessary to catch the content for the freeze frame at the same time as the failure information is available.
Example:



Description:

Syntax : ACTION_ERRM_StorePrevFrf (IN <XX>).
Parameter (in) : XX diagnosis instance
Parameter (out) : -
Short description :
If ACTION_ERRM_StorePrevFrf (XX) is called by the diagnosis instance XX, a prestored freeze frame for diagnosis instance XX is stored. It s used as content for the freeze frame, if the failure is entered in the failure memory later.

Application conditions

Initialization: –

Recurrence: –

Activation: at Action request

Formula section:

ACTION_ERRM_StorePrevFrf (XX) :
with t related to failure XX, see Environmental data Appli.Inc.

ENVD_PREV_OBD[u][t] = ENVD_CONF_OBD[u]

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ENVD_PREV_CUS_CMN[v][t] = ENVD_CONF_CUS_CMN[v]
ENVD_PREV_CUS_SET_CMN[w][t] = ENVD_CONF_CUS_SET_CMN[w]
ENVD_PREV_CUS_SET_SPC[y][t] = ID_ERR_ENVD_XX[y] (with XX = F(IDX))

Configuration data detailed description:

NC_NR_ENVD_CUS_SET_SPC : Typical value is 4.

NC_NR_FRF_SET : Typical value is 3.
The value 0 is forbidden.

NC_ ENVD_CUS_CMN_UPD 0: FRF_CUS_CMN is not updated when failure status changes from "disappeared" to "temporary/confirmed".

1: FRF_CUS_CMN is updated when failure status changes from "disappeared" to "temporary/confirmed".

NC_NR_ENVD_PREV 0: No pre-stored freeze frame functionality required

Size of ID_ENVD_FAC is defined according number of data in the table ; maximum size is 65535.

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B.74 Environmental data (Appl Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DIST_KM	O/V	0... FFFFFFH	0... 16777215	1	km
Calculated KM counter (1Km resolution					
ENVD_CONF_CUS_CMN [NC_NR_ENVD_CUS_CMN]	O	0... FFH	0... 255	1	-
Freeze frame FRF_CUS_CMN : environmental common data contents					
ENVD_CONF_CUS_SET_CMN [NC_NR_ENVD_CUS_SET_CMN]	O	0... FFH	0... 255	1	-
Freeze frame FRF_CUS_SET_CMN : environmental calibrated data contents					
ENVD_CONF_OBD [NC_NR_ENVD_OBD]	O	0... FFH	0... 255	1	-
Freeze frame FRF_OBD : environmental OBD data contents					
FUP_H_SAE	O/V	0... FFFFH	0... 655350	10	kPA
PID23 Fuel rail pressure (high range for Diesel and GDI)					
LOAD_ABSV	O/V	0... FFFFH	0... 25700	0.3921569	%
Absolute load					
LOAD_CLC	O/V	0... FFH	0... 99.60937	0.390625	%
Calculated load					
OBD_EGR_DIF	O/V	0... FFH	0... 99.60937	0.390625	%
EGR actual EGR commanded					
OBD_FTL	O/V	0... FFH	0... 99.60937	0.390625	%
Fuel level input					
OBD_PV_1	O/V	0... FFH	0... 99.60937	0.390625	%
Accelerator pedal position (sensor 1)					
OBD_PV_2	O/V	0... FFH	0... 99.60937	0.390625	%
Accelerator pedal position (sensor 2)					
OBD_TPS_1	O/V	0... FFH	0... 99.60937	0.390625	%
Absolute throttle position (sensor 1)					
OBD_TPS_2	O/V	0... FFH	0... 99.60937	0.390625	%
Absolute throttle position (sensor 2)					
OBD_TPS_REL	O/V	0... FFH	0... 99.60937	0.390625	%
Relative throttle position					
OBD_TPS_SP	O/V	0... FFH	0... 99.60937	0.390625	%
Commanded throttle position					

Input data:

AMP {p. 982}	C_TPS_MAX {p. 1170}	C_TPS_SP_MAX {p. 6555}	CPPWM_CPS {p. 3749}
DIST {p. 1183}	DIST_KWP {p. 1183}	ERR_SYM_XX {p. 4581}	FAC_LAM_AD_SAE [NC_CBK_EX_NR] {p. 1014}
FAC_LAM_LIM_SAE [NC_CBK_EX_NR] {p. 1014}	FTL {p. 1564}	FUP_MES_SAE [NC_CBK_HPP_NR]	FUP_RNG_H_MES {p. 1283}
FUP_SP_SAE [NC_CBK_HPP_NR]	LAMB_DELTA_AD_LAM_ ADJ_SAE [NC_CBK_EX_NR] {p. 1014}	LAMB_SP_SAE {p. 1015}	LV_ERR_MAF {p. 4815}

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LV_ERR_MAP {p. 982}	LV_ES {p. 1720}	MAF {p. 8277}	MAF_KGH_MES_SAE [NC_MAF_NR]
MAP_SAE {p. 1198}	N_32 {p. 1525}	N_SAE_BYTE_KWP {p. 7308}	NC_CYL_NR {p. 1526}
NC_ENVD_CUS_CMN_UPD {p. 5793}	NC_ID_ENVD_FAC {p. 5793}	NC_INJ_CONF {p. 626}	NC_NR_ENVD_CUS_CMN {p. 5793}
NC_NR_ENVD_CUS_SET_CMN {p. 5793}	NC_NR_ENVD_CUS_SET_SPC {p. 5793}	NC_NR_ENVD_PREV {p. 5793}	NC_NR_FRF_SET {p. 5793}
OBD_AMP {p. 7308}	OBD_FUP	OBD_IGA_IGC {p. 7308}	OBD_MAF {p. 7308}
OBD_N {p. 7308}	OBD_TAM {p. 1569}	OBD_TCO {p. 7308}	OBD_TIA {p. 7308}
OBD_VB {p. 7309}	OPG_DIF_ACR {p. 3580}	OPG_SP_ACR {p. 3573}	STATE_LS_SAE [NC_CBK_EX_NR] {p. 2448}
STATE_OBD_SA {p. 808}	STATE_PSN_FUP_SAE {p. 819}	STATE_PSN_MAF_SAE {p. 819}	STATE_PSN_TIA_SAE {p. 819}
STATE_PSN_TPS_SAE {p. 819}	T_ABSV_COM	T_AST_SAE {p. 1766}	TIA_MES_SAE [NC_SENS_NR_TIA]
TIA_THR_MES_SAE [NC_SENS_NR_TIA_THR]	TPS_AV {p. 1169}	TPS_REL_SAE [NC_ETC_NR]	TPS_SP_MDL {p. 8377}
TPS_SP_SAE [NC_ETC_NR]	USE_SW_VER {p. 605}	V_PVS_1 {p. 831}	V_PVS_2 {p. 831}
V_TPS_1 {p. 831}	V_TPS_2 {p. 831}	VS_SAE {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FTL_REF_OBD	-	0... 7EH	0... 126	1	l
Maximum possible FTL in the vehicle					
C_MAF_REF_OBD	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Maximum air mass concerning cylinder displacement					
IP_LOAD_CLC__N_32__MAF	V	0... FFH	0... 0.99609	3.9062e-3	-
LDP_N_32_IP_LOAD_CLC	8	0... FFH	0... 8160	32	rpm
LDP_MAF_IP_LOAD_CLC	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Airflow ratio					
IP_LOAD_CLC_AMP__AMP	-	0... FFH	0... 1.99218	0.0078125	-
LDP_AMP_IP_LOAD_CLC_AMP	6	0... FFFFH	0... 5434	0.0829175	hPa
Atmospheric pressure ratio					

B.74.1 Definition of OBD freeze frame content and size

Description:

This file defines sizes and contents of Environmental data (freeze frame data) catched when a failure occurs.

Formula section:

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Freeze frame part	Caracteristics	Value
FRF_OBD	Number of data (in bytes)	**NC_NR_ENVD_OBD = 40 if NC_CYL_NR = 4 or 6** **NC_NR_ENVD_OBD = 64 if NC_CYL_NR = 8** *"= 40/64 OBD values, stored once, updated if failure was disappeared and occures again"*
	Contents	ENVD_CONF_OBD[1] = STATE_LS_SAE_1 ***(PID 03)*** *Fuel system status bank 1*
		ENVD_CONF_OBD[2] = STATE_LS_SAE_2 ***(PID 03)*** *Fuel system status bank 2*
		ENVD_CONF_OBD[3] = LOAD_CLC ***(PID 04)*** *Calculated load*
		ENVD_CONF_OBD[4] = OBD_TCO ***(PID 05)*** *Engine coolant temperature*
		ENVD_CONF_OBD[5] = FAC_LAM_LIM_SAE_1 ***(PID 06****) Short term fuel trim bank 1*
		ENVD_CONF_OBD[6] = FAC_LAM_AD_SAE_1 ***(PID 07)*** *Long term fuel trim bank 1*
		ENVD_CONF_OBD[7] = FAC_LAM_LIM_SAE_2 ***(PID 08)*** *Short term fuel trim bank 2*
		ENVD_CONF_OBD[8] = FAC_LAM_AD_SAE_2 ***(PID 09)*** *Long term fuel trim bank 2*
		ENVD_CONF_OBD[9] = OBD_FUP ***(PID 0A)*** *Fuel pressure*
		ENVD_CONF_OBD[10] = MAP_SAE ***(PID 0B)*** *Intake manifold absolute pressure*
		ENVD_CONF_OBD[11] = OBD_N ***(PID 0C)*** *Engine RPM (high byte)*
		ENVD_CONF_OBD[12] = OBD_N ***(PID 0C)*** *Engine RPM (low byte)*
		ENVD_CONF_OBD[13] = VS_SAE ***(PID 0D)*** *Vehicle speed*
		ENVD_CONF_OBD[14] = OBD_IGA_IGC ***(PID 0E)*** *Ignition timing advance cylinder 1*
		ENVD_CONF_OBD[15] = OBD_TIA ***(PID 0F)*** *Temperature intake air*
		ENVD_CONF_OBD[16] = OBD_MAF ***(PID 10)*** *Air flow rate mass air flow sensor (high byte)*
		ENVD_CONF_OBD[17] = OBD_MAF ***(PID 10)*** *Air flow rate mass air flow sensor (low byte)*

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		ENVD_CONF_OBD[18] = OBD_TPS_1 ***(PID 11)*** *Absolute Throttle position (signal 1)*
		ENVD_CONF_OBD[19] = STATE_OBD_SA ***(PID 12)*** *Commanded secondary air status*
		ENVD_CONF_OBD[20] = T_AST_SAE ***(PID 1F)*** *Time since engine start (high byte)*
		ENVD_CONF_OBD[21] = T_AST_SAE *(**PID 1F**) Time since engine start (low byte)*
		ENVD_CONF_OBD[22] = FUP_H_SAE ***(PID 23)*** *Fuel Pressure High (high byte)*
		ENVD_CONF_OBD[23] = FUP_H_SAE ***(PID 23)*** *Fuel Pressure High (low byte)*
		ENVD_CONF_OBD[24] = CPPWM_CPS ***(PID 2E)*** *Commanded Evaporative Purge*
		ENVD_CONF_OBD[25] = OBD_FTL ***(PID 2F)*** *Fuel level input*
		ENVD_CONF_OBD[26] = OBD_AMP ***(PID 33)*** *Barometric pressure*
		ENVD_CONF_OBD[27] = OBD_VB ***(PID 42)*** *Control module voltage (high byte)*
		ENVD_CONF_OBD[28] = OBD_VB ***(PID 42)*** *Control module voltage (low byte)*
		ENVD_CONF_OBD[29] = LOAD_ABSV ***(PID 43)*** *Absolute load value (high byte)*
		ENVD_CONF_OBD[30] = LOAD_ABSV ***(PID 43)*** *Absolute load value (low byte)*
		ENVD_CONF_OBD[31] = LAMB_SP_SAE ***(PID 44)*** *Commanded equivalence ratio (high byte)*
		ENVD_CONF_OBD[32] = LAMB_SP_SAE ***(PID 44)*** *Commanded equivalence ratio (low byte)*
		ENVD_CONF_OBD[33] = OBD_TPS_REL ***(PID 45)*** *Relative Throttle position*
		ENVD_CONF_OBD[34] = OBD_TAM ***(PID 46)*** *Ambient air temperature*
		ENVD_CONF_OBD[35] = OBD_TPS_2 ***(PID 47)*** *Absolute throttle position (sensor 2)*
		ENVD_CONF_OBD[36] = OBD_PV_1 ***(PID 49)*** *Acceleration pedal position (sensor 1)*
		ENVD_CONF_OBD[37] = OBD_PV_2 ***(PID 4A)*** *Acceleration pedal position (sensor 2)*

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		ENVD_CONF_OBD[38] = OBD_TPS_SP ***(PID 4C)*** *Commanded throttle position*
		ENVD_CONF_OBD[39] = LAMB_DELTA_AD_LAM_ADJ_SAE[1] ***(PID 56)*** *Long term fuel trim - bank 1*
		ENVD_CONF_OBD[40] = LAMB_DELTA_AD_LAM_ADJ_SAE[2] ***(PID 58)*** *Long term fuel trim - bank 2*
		ENVD_CONF_OBD[41] = STATE_PSN_MAF_SAE ***(PID 66)*** *Mass air flow sensor - Support status*
		ENVD_CONF_OBD[42] = MAF_KGH_MES_SAE[1] ***(PID 66)*** *Mass air flow - sensor 1 (high-byte)*
		ENVD_CONF_OBD[43] = MAF_KGH_MES_SAE[1] ***(PID 66)*** *Mass air flow - sensor 1 (low-byte)*
		ENVD_CONF_OBD[44] = MAF_KGH_MES_SAE[2] ***(PID 66)*** *Mass air flow - sensor 2 (high-byte)*
		ENVD_CONF_OBD[45] = MAF_KGH_MES_SAE[2] ***(PID 66)*** *Mass air flow - sensor 2 (low-byte)*
		ENVD_CONF_OBD[46] = STATE_PSN_TIA_SAE ***(PID 68)*** *Intake air temperature - Support status*
		ENVD_CONF_OBD[47] = TIA_MES_SAE[1] ***(PID 68)*** *Intake air temperature - B1S1*
		ENVD_CONF_OBD[48] = TIA_THR_MES_SAE[1] ***(PID 68)*** *Intake air temperature - B1S2*
		ENVD_CONF_OBD[49] = TIA_MES_SAE[2] ***(PID 68)*** *Intake air temperature - B2S1*
		ENVD_CONF_OBD[50] = TIA_THR_MES_SAE[1] ***(PID 68)*** *Intake air temperature - B2S2*
		ENVD_CONF_OBD[51] = STATE_PSN_TPS_SAE ***(PID 6C)*** *Throttle - Support status*

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		ENVD_CONF_OBD[52] = TPS_SP_SAE[1] ***(PID 6C)*** *Throttle - Commanded THR 1*
		ENVD_CONF_OBD[53] = TPS_REL_SAE[1] ***(PID 6C)*** *Throttle - Rel. Position THR 1*
		ENVD_CONF_OBD[54] = TPS_SP_SAE[2] ***(PID 6C)*** *Throttle - Commanded THR 2*
		ENVD_CONF_OBD[55] = TPS_REL_SAE[2] ***(PID 6C)*** *Throttle - Rel. Position THR 2*
		ENVD_CONF_OBD[56] = STATE_PSN_FUP_SAE ***(PID 6D)*** *Fuel pressure - Support status*
		ENVD_CONF_OBD[57] = FUP_SP_SAE[1] ***(PID 6D)*** *Fuel pressure - Commanded B1 (high byte)*
		ENVD_CONF_OBD[58] = FUP_SP_SAE[1] ***(PID 6D)*** *Fuel pressure - Commanded B1 (low byte)*
		ENVD_CONF_OBD[59] = FUP_MES_SAE[1] ***(PID 6D)*** *Fuel pressure - Measured B1 (high byte)*
		ENVD_CONF_OBD[60] = FUP_MES_SAE[1] ***(PID 6D)*** *Fuel pressure - Measured B1 (low byte)*
		ENVD_CONF_OBD[61] = FUP_SP_SAE[2] ***(PID 6D)*** *Fuel pressure - Commanded B2 (high byte)*
		ENVD_CONF_OBD[62] = FUP_SP_SAE[2] ***(PID 6D)*** *Fuel pressure - Commanded B2 (low byte)*
		ENVD_CONF_OBD[63] = FUP_MES_SAE[2] ***(PID 6D)*** *Fuel pressure - Measured B2 (high byte)*
		ENVD_CONF_OBD[64] = FUP_MES_SAE[2] ***(PID 6D)*** *Fuel pressure - Measured B2 (low byte)*

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Freeze frame part	Caracteristics	Value
FRF_CUS_CMN	Number of data (in bytes)	**NC_NR_ENVD_CUS_CMN = 1** *"= One common value for each diagnosis, stored at same event like FRF_OBD"*
	Contents	ENVD_CONF_CUS_CMN[1] = N_SAE_BYTE_KWP *Engine Speed (SAE resolution)*
"Set of Freeze Frame"	Number of set	**NC_NR_FRF_SET = 3** *"= First, second, last occurrence"*
FRF_CUS_SET _CMN	Number of common data per set (in bytes)	**NC_NR_ENVD_CUS_SET_CMN = 10** *"= ten common values for all diagnosis, stored at every occurrence"*
	Contents	ENVD_CONF_CUS_SET_CMN[1] = ERR_SYM_XX *Detected symptom*
		ENVD_CONF_CUS_SET_CMN[2] = DIST_KWP *Calculated Km counter [8km] (high-byte)*
		ENVD_CONF_CUS_SET_CMN[3] = DIST_KWP *Calculated Km counter [8km] (low-byte)*
		ENVD_CONF_CUS_SET_CMN[4] = T_ABSV_COM *Absolute lifetime of vehicle [1s] (byte 1 - MSB)* *//only L6*
		ENVD_CONF_CUS_SET_CMN[5] = T_ABSV_COM *Absolute lifetime of vehicle [1s] (byte 2)* *//only L6*
		ENVD_CONF_CUS_SET_CMN[6] = T_ABSV_COM *Absolute lifetime of vehicle [1s] (byte 3)* *//only L6*
		ENVD_CONF_CUS_SET_CMN[7] = T_ABSV_COM *Absolute lifetime of vehicle [1s] (byte 4 - LSB)* *//only L6*
		ENVD_CONF_CUS_SET_CMN[8] = DIST_KM *Kilometer counter [1km resolution] (byte 1 -MSB)* *//only L6*

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		ENVD_CONF_CUS_SET_CMN[9] = DIST_KM *Kilometer counter [1km resolution] (byte 2)* *//only L6*
		ENVD_CONF_CUS_SET_CMN[10] = DIST_KM *Kilometer counter [1km resolution] (byte 3)* *//only L6*
FRF_CUS_SET_SPC	Number of specific data per set (in bytes)	**NC_NR_ENVD_CUS_SET_SPC = 4** *" = 4 calibratable environmental data per failure"*
	Contents	Define by calibration ID_ERR_ENVD_XX (see Environmental data module) Possible stored environmental data : NC_ID_ENVD_FAC [1] = see DDLI list NC_ID_ENVD_FAC [2] = see DDLI list ... NC_ID_ENVD_FAC [255] = see DDLI list

B.74.2 Configuration of update of FRF_CUS_CMN

FUNCTION DESCRIPTION:

Description:

This file defines the update of the FRF_CUS_CMN in case of failure status change from disappeared to temporary/confirmed.

Update of FRF_CUS_CMN in case of failure status change from disappeared to temporary/confirmed.	**NC _ENVD_CUS_CMN_UPD = 1** 0: no update **1: update**

B.74.3 Configuration for prestored freeze frame

FUNCTION DESCRIPTION:

Description:

This file defines the usage of the prestored freeze frame functionality.

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Number of diagnosis instances XX using prestored freeze frame	**NC_NR_ENVD_PREV = 7 or 8 or 10**, see below
Diagnosis instance XX	**prestored freeze frame number (t)**
ROUGH_LEAK	1
CAT_DIAG[1]	2 (If NC_INJ_CONF = 1) *//only for MSD*
CAT_DIAG[2]	3 (If NC_INJ_CONF = 1) *//only for MSD*
EFF_IGA_CST_IS	4
EFF_IGA_CST_PL	5
SMALL_LEAK	6
DMTL_PLAUS	7
DMTL_SIG	8 (If USE_SW_VER <> NC_4DC) *//**not** for MSD 81.0*
DMTL_MIN	9 (If USE_SW_VER <> NC_4DC) *//**not** for MSD 81.0*
DMTL_MAX	10 (If USE_SW_VER <> NC_4DC) *//**not** for MSD 81.0*

Remark: The usage of the prestored freeze frame functionality must be limited for special diagnosis functions, because of memory consumption.
NC_NR_ENVD_PREV = 7 for MSD81.0, NC_NR_ENVD_PREV = 8 for MSVxx

B.74.4 Definition of OBD - Systemvariables for MODE 1 /2

General information:

The variables are used for OBD powertrain diagnostic data (MODE1) and OBD Freeze-frame calculation (MODE 2).

Application conditions

Initialisation: `0 at reset`

Recurrence: `100ms`

Activation: `at every engine operating state`

Formula section:

All calculation done in physical way

IF LV_ES = 1 **OR**
LV_ERR_MAF= 1 **OR**
LV_ERR_MAP = 1
THEN LOAD_CLC = 0
LOAD_ABSV = 0
ELSE LOAD_CLC = IP_LOAD_CLC__N_32__MAF*IP_LOAD_CLC_AMP__AMP*100%
LOAD_ABSV = (MAF /C_MAF_REF_OBD) * 100%
ENDIF

OBD_TPS_SP = (TPS_SP_MDL /C_TPS_SP_MAX) * 100%

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OBD_TPS_1 = (V_TPS_1 /5V) * 100%
OBD_TPS_2 = ((5V - V_TPS_2) /5V) * 100%
OBD_TPS_REL = (TPS_AV /C_TPS_MAX) 100%
OBD_FTL = (FTL /C_FTL_REF_OBD) * 100%
OBD_PV_1 = (V_PVS_1 /5V) * 100%
OBD_PV_2 = (V_PVS_2 /2,5V) * 100%
OBD_EGR_DIF = I OPG_DIF_ACR /OPG_SP_ACR I * 100%
FUP_H_SAE = FUP_RNG_H_MES

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B.75 Failure classes

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DC_DEC_XX	O	0... FFH	0... 255	1	-
Decrement of the driving cycle counter for failure XX					
CTR_DC_INC_XX	O	0... FFH	0... 255	1	-
Increment of the driving cycle counter for failure XX					
CTR_DC_MAX_XX	O	0... FFH	0... 255	1	-
Maximum value of the driving cycle counter for failure XX					
PRI_CONF_XX	O	0... 7H	0 ...7	1	-
Priority configuration for failure XX					
WAL_CONF_XX	O	0... FFH	0... 255	1	-
Lamp configuration for failure XX					

Input data:

NLC_OBD_DSL {p. 5789}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ERR_CLAS_2_XX	-	0... FFH	0... 255	1	-
Second Failure class number for failure XX					
C_ERR_CLAS_XX	-	0... FFH	0... 255	1	-
Failure class number for failure XX					
ID_ERR_CLAS_A_FMT	-	0... FFH	0... 255	1	-
LDPM_CLAS_A_ID_CLAS_FMY	16	0... FFFFH	0... 65535	1	-
Sub Class A definition					
ID_ERR_CLAS_B_FMT	V	0... FFH	0... 255	1	-
LDP_CLAS_B_ID_CLAS_FMY	4	0... FFFFH	0... 65535	1	-
LDPM_CLAS_A_ID_CLAS_FMY	16	0... FFFFH	0... 65535	1	-
Sub Class B definition					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ERR_PRI_H	-	0... 7H	0 ...7	1	-
Failures with priority greater or equal than NC_ERR_PRI_H are considered as high priority failures					

Action definition

ACTION_ERRM_GetMILRelevant (**IN**<PRM_IDX_ERR>,**OUT**<PRM_LV_MIL_RLV>)	Mode: O
This action is used to know if the failure is MIL relevant or not	

ACTION_ERRM_GetOBDRelevant (**IN**<PRM_IDX_ERR>,**OUT**<PRM_LV_OBD_RLV>)	Mode: O
This action is used to know if the failure is OBD relevant or not (visible via scantools or not)	

ACTION_ERRM_GetReadyClass (**IN**<PRM_IDX_ERR>,**OUT**<PRM_READY_CLAS>)	Mode: O
This action returns the readiness code group	

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FUNCTION DESCRIPTION:

General information:

Because the diagnosis system becomes more and more complex, to avoid multiplication of calibrations and to help the tuning team for simplifying the calibration process, each failure is defined via classes of failure.
Each class defines the type of this failure as emission relevant or not, as MIL handling or not, as using driving cycle for MIL illumination, and so on. It allows too to affect a readiness code group for each failure.
The configuration of a failure is defined by WAL_CONF_XX, PRI_CONF_XX, CTR_DC_INC_XX, CTR_DC_DEC_XX and CTR_DC_MAX_XX.

Format of WAL_CONF_XX		
Bit	Logical value	Description
0	LC_WAL_1_ON	Enable WAL_1 (0 : Off / 1 : On) See details in “Lamp management” module.
1	LC_WAL_2_ON	Enable WAL_2 (0 : Off / 1 : On) See details in “Lamp management” module.
2	LC_MIL_ON	Enable MIL (0 : Off / 1 : On) See details in “Lamp management” module.
3	LC_MIL_FLL	Enable flash mode for MIL (0 : Off / 1 : On) See details in “Lamp management” module.
4	LC_OBD_ERR	Defines failure as a “CARB/EOBD failure” (emission relevant). (failure visible via scantool) 0 : failure is not considered as a “CARB/EOBD failure” 1 : failure is considered as a “CARB/EOBD failure”

Figure B.75.1: Format of PRI_CONF_XX

Format of PRI_CONF_XX		
Bit	Logical value	Description
0	LC_ERR_PRI_1	This option defines the priority of the XX diagnosis.
1	LC_ERR_PRI_2	It is used for storage of failure and freeze frame.
2	LC_ERR_PRI_3	000: lowest priority for errors which are not significant for emission 011: highest priority for errors, which are not significant for emission 100: lowest priority for errors, which are significant for emission 111: highest priority which are significant for emission See details in “Priority rules” module. For emission relevant (EOBD, CARB) failure : LC_ERR_PRI_3 = 1 For non emission relevant failure : LC_ERR_PRI_3 = 0

B.75.1 Failure assignation

For each failure XX, a failure class is allocated. The failure class number makes this affectation, which are the calibrations named C_ERR_CLAS_XX and C_ERR_CLAS_2_XX.
(The calibration C_ERR_CLAS_2_XX is present inside the SW but "hard coded" and not visible in INCA)

This table is defined in the General Diagnosis Information .

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Diagnosis instance	Failure Class number Class A / Class B / Class C
Failure XX	C_ERR_CLAS_XX / C_ERR_CLAS_2_XX
Failure YY	C_ERR_CLAS_YY / C_ERR_CLAS_2_YY
...	...

The failure class number is a byte divided in two subclasses named class B (defined by the most significant quartet) and class A (defined by the less significant quartet).
Failure class number for failure XX

C_ERR_CLAS_XX =

(Class B) (Class A)

C_ERR_CLAS_2_XX =

Reserved				Class C			

B.75.2 Failure class definition

A failure class defines for a failure, which belongs to this failure class :

Part sub-class A :

- if the failure have impact on MIL illumination or not ;
- if the failure have impact on MIL blinking or not ;
- if the failure have impact on Warning Lamp 1 or not ;
- if the failure have impact on Warning lamp 2 or not ;
- if the failure is considered as a CARB/EOBD failure (emission relevant)

(failure visible with scantool, failure can set OBD freeze frame for mode 2h)

Part sub-class B :

- the increment value for driving cycle counter management ;
- the maximum value of driving cycle counter ;
- the decrement value for driving cycle counter management ;
- the priority of the failure.

Part sub-class C :

- Readiness code group.

Each subclass of a failure class is composed of 4 bits, so 16 different values are possible for each subclass. For each subclass, some values are predefined and some values are reserved for improvement/validation and are managed by calibration.

Sub Class A definition : ID_ERR_CLAS_A_FMT (1 byte x 16)

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Subclass A Value (i) in hex / Name	Description	ID_ERR_CLAS_A_FMT [i]
0 / NO_LAMP	*- Predefined value -* Failure without impact on any lamp	%0000 0000 (in binary)
1 / WAL_1_ON	*- Predefined value -* Failure with impact on WAL1 lamp	%0000 0001 (in binary)
2 / WAL_2_ON	*- Predefined value -* Failure with impact on WAL2 lamp	%0000 0010 (in binary)
3 / MIL_ON	*- Predefined value -* Failure with impact on Mil (on)	%0001 0100 (in binary)
4 / MIL_ON_FLL	*- Predefined value -* Failure with impact on Mil (on & blinking)	%0001 1100 (in binary)
5 / LAMP_CUS_1	*Free for customer definition*	*Free for customer definition*
6 / LAMP_CUS_2	*Free for customer definition*	*Free for customer definition*
7 / LAMP_CUS_3	*Free for customer definition*	*Free for customer definition*
8 / LAMP_CUS_4	*Free for customer definition*	*Free for customer definition*
9 / LAMP_CUS_5	*Free for customer definition*	*Free for customer definition*
A / LAMP_CUS_6	*Free for customer definition*	*Free for customer definition*
B / LAMP_CUS_7	*Free for customer definition*	*Free for customer definition*
C / LAMP_CUS_8	*Free for customer definition*	*Free for customer definition*
D / LAMP_CUS_9	*Free for customer definition*	*Free for customer definition*
E / LAMP_CUS_10	*Free for customer definition*	*Free for customer definition*
F / LAMP_CUS_11	*Free for customer definition*	*Free for customer definition*

Formula section:

For each failure XX allocated to the failure class number C_ERR_CLAS_XX :
WAL_CONF_XX = ID_ERR_CLAS_A_FMT [4 Less Significant Bit of C_ERR_CLAS_XX]

Sub Class B definition : ID_ERR_CLAS_B_FMT (4 bytes x 16)

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Subclass B Value (i) in hex/ Name	Description	ID_ERR_CLAS_B_FMT [i] [0] DC inc	[i] [1] DC max	[i] [2] DC dec	[i] [3] Priority
0 / NO_LAW_L	*- Predefined value -* Non Carb/EOBD failure with low priority	1	1	1	0
1 / NO_LAW_M	*- Predefined value -* Non Carb/EOBD failure with medium priority	1	1	1	1
2 / NO_LAW_H	*- Predefined value -* Non Carb/EOBD failure with high priority	1	1	1	2
3 / LAW_CC_L	*- Predefined value -* Carb/EOBD failure with low priority Comprehensive component	3	3	1	4
4 / LAW_L	*- Predefined value -* Carb/EOBD failure with low priority	3 / 2 *)	6	2	4
5 / LAW_M	*- Predefined value -* Carb/EOBD failure with medium priority	3 / 2 *)	6	2	5
6 / LAW_H	*- Predefined value -* Carb/EOBD failure with high priority	3 / 2 *)	6	2	6
7 / VALID	For validation	1	1	1	4
8 / NO_ERASE	*- Predefined value -* failure with high priority, not erasable by warm-up cycles.	3	3	0	6
9 / DC_CUS_1	*Free for customer definition*	-	-	-	-
A / DC_CUS_2	*Free for customer definition*	-	-	-	-
B / DC_CUS_3	*Free for customer definition*	-	-	-	-
C / DC_CUS_4	*Free for customer definition*	-	-	-	-
D / DC_CUS_5	*Free for customer definition*	-	-	-	-
E / DC_CUS_6	*Free for customer definition*	-	-	-	-
F / DC_CUS_7	*Free for customer definition*	-	-	-	-

Formula section:

For each failure XX allocated to the failure class number C_ERR_CLAS_XX :
CTR_DC_INC_XX = ID_ERR_CLAS_B_FMT[4 Most Significant Bit of C_ERR_CLAS_XX][0]
CTR_DC_MAX_XX = ID_ERR_CLAS_B_FMT[4 Most Significant Bit of C_ERR_CLAS_XX][1]
CTR_DC_DEC_XX = ID_ERR_CLAS_B_FMT[4 Most Significant Bit of C_ERR_CLAS_XX][2]
Bit 0,1,2 of PRI_CONF_XX = ID_ERR_CLAS_B_FMT [4 Most Significant Bit of C_ERR_CLAS_XX][3]

Remark: The increment of the DC counter (*) for the failures defined by the failure classes LAW_L, LAW_M and LAW_H depends on the required regulation (Carb/EOBD).

Sub Class C definition :

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Valu e in hex	**Name for GS** (NLC_OBD_DSL = 0 for gazoline)	**Name for DS** (NLC_OBD_DSL = 1 for diesel)	**Readiness code group description for GS**	**Readiness code group description for DS**
0	CARB_MIS	CARB_MIS	Misfire	Misfire
1	CARB_FSD	CARB_FSD	Fuel system	Fuel system
2	CARB_CC	CARB_CC	Comprehensive component	Comprehensive component
3	CARB_CAT	CARB_NMHC	Catalyst	NMHC Catalyst
4	CARB_HC	CARB_NT	Heated catalyst	NOx Catalyst / Adsorber
5	CARB_EVAP	Reserved	Evaporative	Reserved
6	CARB_SA	CARB_BPA	Secondary air	Boost Pressure
7	-	-	(reserved by ISO)	(reserved by ISO)
8	CARB_LS	CARB_EG	Oxygen sensor	Exhaust gaz sensor
9	CARB_LSH	CARB_PF	Oxygen sensor heater	PM filter
A	CARB_EGR	CARB_EGR	EGR system	EGR system
B	CARB_OTHER	CARB_OTHER	Customer specific readiness	Customer specific readiness
C	NO	NO	No readiness computation	No readiness computation
D	-	-	*Reserved*	*Reserved*
E	-	-	*Reserved*	*Reserved*
F	-	-	*Reserved*	*Reserved*

B.75.3 Example

To define the failure MIS_A (Misfiring A) as :

- a failure with high priority
- with only impact on MIL (On and Blinking)
- with CARB_MIS readiness class

Set the failure MIS_A in class number 64 (in hex) with C_ERR_CLAS_MIS_A = 64H and C_ERR_CLAS_2_MIS_A = 00H

That means :

- The value of sub class A is 4H => Failure with impact on MIL (On and blinking) (failure visible via scantool):

  WAL_CONF_MIS_A = %0001 1100 (in binary)

- The value of sub class B is 6H => "Carb/EOBD failure with high priority":

  DC_INC_MIS_A = 3
  DC_MAX_MIS_A = 6
  DC_DEC_MIS_A = 2
  PRI_CONF_MIS_A = %0000 0110 (in binary)

- The value of sub class C is 0H => The value of sub class C is 0 ;

The readiness code group of the failure is "MIS" group (Misfire monitoring system)

B.75.4 MIL relevant

Description for actions:

ACTION_ERRM_*GetMILRelevant* (<PRM_IDX_ERR >, <PRM_LV_MIL_RLV>)					
- This actions returns: 0 if the failure is not MIL relevant 1 if the failure is MIL relevant					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_IDX_ERR	IN	0...FFFFH	0...65535	1	[-]
Diagnostic failure instance					
PRM_LV_MIL_RLV	OUT	0...1H	0...1	1	[-]
Mil relevant failure					

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Formula section:

PRM_LV_MIL_RLV = 0
If PRM_IDX_ERR ! = 0
Then
MIL relevant means enable MIL or enable flash mode for MIL and CARB/EOBD failure (visible via scantool)
If (bit 2 **or** bit 3 of WAL_CONF_XX = 1) **and** bit 4 of WAL_CONF_XX = 1
Then PRM_LV_MIL_RLV = 1
Endif
Endif

B.75.5 OBD relevant

Description for actions:

ACTION_ERRM_*GetOBDRelevant* (<PRM_IDX_ERR >, <PRM_LV_OBD_RLV>)					
- This actions returns: 0 if the failure is not OBD relevant (failure not visible via scantool) 1 if the failure is OBD relevant (failure visible via scantool)					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_IDX_ERR	IN	0...FFFFH	0...65535	1	[-]
Diagnostic failure instance					
PRM_LV_OBD_RLV	OUT	0...1H	0...1	1	[-]
OBD relevant failure (failure visible via scantool)					

Formula section:

PRM_LV_OBD_RLV = 0
If PRM_IDX_ERR ! = 0
Then
OBD relevant means CARB/EOBD failure (failure visible via scantool)
If bit 4 of WAL_CONF_XX = 1
Then PRM_LV_OBD_RLV = 1
Endif
Endif

B.75.6 Readiness code class

Description for actions:

ACTION_ERRM_*GetReadyClass* (<PRM_IDX_ERR >, <PRM_READY_CLAS>)					
- This actions returns: The readiness code group					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_IDX_ERR	IN	0...FFFFH	0...65535	1	[-]
Diagnostic failure instance					
PRM_READY_CLAS	OUT	0...FH	0...15	1	[-]
Readiness code group					

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Formula section:

If PRM_IDX_ERR ! = 0
Then
Readiness code group for the failure IDX_ERR
PRM_READY_CLAS = Bit 0,1,2,3 of C_ERR_CLAS_2_XX
Else
PRM_READY_CLAS = 0Fh
Endif

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B.76 Failure classes (Appl. Inc.)

B.76.1 Readiness class affectation

General information:

In this section, the calibrations C_ERR_CLAS_2_XX are "hard coded" inside the SW for this project. The list below describes how CARB class to affect for each failure.

Description:

For generation of the readiness-status of the OBD system in MODE 01h (only done if the diagnosis instance is calibrated as emission relevant /visible for SCAN - tool => LC_OBD_ERR = 1 /C_ERR_CLAS_xx , see Failure classes) all diagnosis must be clasified as:

- CARB_CC - Comprehensive component, continuous test
- CARB_MIS - Misfire monitoring, continuous test
- CARB_FSD - Fuel system monitoring, continuous test
- CARB_CAT - Catalyst monitoring, sequential test
- CARB_EVAP - Evaporative system monitoring, sequential test
- CARB_SA - Secondary air monitoring
- CARB_LS - Oxygen sensor monitoring
- CARB_LSH - Oxygen sensor heater monitoring
- CARB_EGR - EGR /IVVT system monitoring, sequential test

Formula section:

All diagnosis instances are configured as **CARB_CC**,
ecxept the list below

Diagnostic Instance Name(xx)	CARB clasification for Readiness
MIS_0	CARB_MIS
MIS_1	
MIS_2	
MIS_3	
MIS_4	
MIS_5	
MIS_FTL_L	
MIS_MPL	
DELTA_I_LAM_1	CARB_FSD
DELTA_I_LAM_2	
FSD_1	
FSD_2	
FSD_LAM_LIM_1	
FSD_LAM_LIM_2	

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CAT_DIAG_1	CARB_CAT
CAT_DIAG_2	
CAT_DIAG_AFL_1	
CAT_DIAG_AFL_2	
CAT_DIAG_SUM_1	
CAT_DIAG_SUM_2	
DIAGCPS	CARB_EVAP
DMTL_PUMP	
DMTLH	
DMTLS	
ROUGH_LEAK	
SMALL_LEAK	
DMTL_PLAUS	
DMTL_SIG	
DMTL_MIN	
DMTL_MAX	
	CARB_SA
not supported	
AIR_LSL_UP_1	CARB_LS
AIR_LSL_UP_2	
CHK_LS_DOWN_1	
CHK_LS_DOWN_2	
DYN_VLD_LS_UP_1	
DYN_VLD_LS_UP_2	
PUC_VLD_LS_UP_1	
PUC_VLD_LS_UP_2	
PUC_LS_DOWN_1	
PUC_LS_DOWN_2	
PUE_LS_DOWN_1	
PUE_LS_DOWN_2	
SHIFT_AFL_LSL_UP_1	
SHIFT_AFL_LSL_UP_2	
SHIFT_AFR_LSL_UP_1	
SHIFT_AFR_LSL_UP_2	
SWT_LS_DOWN_1	
SWT_LS_DOWN_2	
VLS_DOWN_DIF_1	
VLS_DOWN_DIF_2	
CHG_LS_DOWN	
OBD_LSH_DOWN_1	CARB_LSH
OBD_LSH_DOWN_2	
OBD_VLD_LSH_UP_1	
OBD_VLD_LSH_UP_2	
MEC_IVVT_IN	CARB_EGR
MEC_IVVT_EX	
TOOTH_OFF_IN_1	
TOOTH_OFF_EX_1	
REF_CRK_CAM_IN_1	
REF_CRK_CAM_EX_1	

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B.77 History memory

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ERR_HIS_NR	O/V/S	0... FFH	0... 255	1	-
Number of failures stored in the history memory					
ERR_HIS [NC_NR_ERR_HIS] [NC_NR_HIS]	O/V/S	0... FFH	0... 255	1	-
Array for data to be stored in history memory					
ERR_HIS_DTC [NC_NR_ERR_HIS]	O/V/S	0... FFFFH	0... 65535	1	-
DTC of failure in history memory					

Input data:

ERR_DTC [NC_NR_ERR_DYN] {p. 5756}	ERR_HIS_CONF [NC_NR_HIS] {p. 5825}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_ERR_FMY_HIS_CLR	V	0... 1H	0 ...1	1	-
Calibration to clear the history memory (when set to 1)					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_ERR_HIS	-	0... FFH	0... 255	1	-
Max number of failure in the historic memory					
NC_NR_HIS	-	0... FFH	0... 255	1	-
Max number of data (in bytes) to stored for a failure in the historic memory					

General information

Export actions:

ACTION_ERRM_StoreHistory (IN <IDX>)
This action stores the failure IDX in the history memory

Output data detailed description:

ERR_HIS_DTC[NC_NR_ERR_HIS] array counts NC_NR_ERR_HIS elements (1... NC_NR_ERR_HIS).

ERR_HIS[NC_NR_ERR_HIS][NC_NR_HIS] array counts NC_NR_ERR_HIS x NC_NR_HIS elements (1... NC_NR_ERR_HIS, 1... NC_NR_HIS).

B.77.1 History memory

General information:

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This module is called by the dynamic error management module just before erasing a failure in the 2^{nd} layer memory (dynamic memory).

The principle is to copy some data related to this failure in a separate memory, called history memory. So the failure become historic failure.

The number of historic failure is limited to a maximum of NC_NR_ERR_HIS. When this maximum number is reach, new historic failure entry deletes the oldest historic failure in memory ("first in first out" principle).

History memory is defined by :

- ERR_HIS_DTC[x] with : x = index of failure in history memory

  A DTC number related to the failure.

- ERR_HIS[x][y] with : x = index of failure in history memory
  y = index of data stored for failure x in history memory

  Some others data.

  Contents of history memory is the same for each failure and defined in History memory (Appl. Inc.) module.

The history memory can be read and erased separately by dedicated diagnosis tool service.

The history memory can be deleted by setting the calibration LC_ERR_FMY_HIS_CLR to 1.

Application conditions:

Initialisation: –

Activation: –

Deactivation: –

Recurrence: –

Function description:

Formula section:

B.77.2 Store a failure in history memory

General information:

Description:

Syntax : ACTION_ERRM_StoreHistory (IN <IDX>)

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Parameter (in) : IDX Index of failure to store in history memory

Parameter(out) : -

Short description : This action stores a failure in history memory

Application conditions:

Initialisation: after system initialization the history memory is restored from non-volatile memory or in case of a damaged non volatile memory the history memory is initialized with zero

Activation: at action request

Deactivation: –

Recurrence: –

Function description:

Formula section:

```
If    CTR_ERR_HIS_NR < NC_NR_ERR_HIS
Then   CTR_ERR_HIS_NR = CTR_ERR_HIS_NR + 1
Else  ERR_HIS_DTC[x] = ERR_HIS_DTC[x+1]  ("first in first out" principle)
      ERR_HIS[x][y] = ERR_HIS[x+1][y]    (with x = 1...CTR_ERR_HIS_NR-1, y
                                          = 1..NC_NR_HIS)
Endif
ERR_HIS_DTC[x] = ERR_DTC[IDX]
ERR_HIS[x][y] = ERR_HIS_CONF[y]
(with x = 1..  NC_NR_HIS, y = CTR_ERR_HIS_NR)
```

B.77.3 Clear the History Memory

General information:

The history memory can be erased by setting the calibration bit LC_ERR_FMY_HIS_CLR at 1

Application conditions:

Initialisation: after system initialization the history memory is restored from non-volatile memory or in case of a damaged non volatile memory the history memory is initialized with zero

Activation: at LC_ERR_FMY_HIS_CLR 0→1 transition

Deactivation: –

Recurrence: –

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Function description:

Formula section:

```
ERR_HIS_DTC[x]  = 0
ERR_HIS[x][y]   = 0
               (with  x = 1 ...  NC_NR_ERR_HIS
                      y = 1 ...  NC_NR_HIS)
CTR_ERR_HIS_NR = 0
```

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B.78 History memory (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_HIS_CONF [NC_NR_HIS]	O	0... FFH	0... 255	1	-
Contents of history memory					

Input data:

C_ERR_CLAS_XX {p. 5811}	CTR_FRC_IDX	ENVD_CUS_SET_CMN [NC_NR_ENVD_CUS_SET_CMN][NC_NR_FRF_SET][NC_NR_ERR_DYN] {p. 5792}	ERR_TYPE_BYTE_IDX
NC_NR_ERR_HIS {p. 5821}	NC_NR_HIS {p. 5821}		

FUNCTION DESCRIPTION:

General information:

This file defines size and contents of the History memory.

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History memory	Caracteristics	Value
	Max number of failure	NC_NR_ERR_HIS = 10
	Number of data to store for a failure (in bytes)	NC_NR_HIS = 9
	Contents	ERR_HIS_CONF[1] = ERR_TYPE_BYTE_IDX *BMW error type byte*
		ERR_HIS_CONF[2] = CTR_FRC_IDX *Frequency counter of error IDX*
		ERR_HIS_CONF[3] = ENVD_CUS_SET_CMN_2_1_IDX *Freeze frame data km-counter (high byte) 1st. occur.*
		ERR_HIS_CONF[4] = ENVD_CUS_SET_CMN_3_1_IDX *Freeze frame data km-counter (low byte) 1st. occur.*
		ERR_HIS_CONF[5] = ENVD_CUS_SET_CMN_2_2_IDX *Freeze frame data km-counter (high byte) 2st. occur.*
		ERR_HIS_CONF[6] = ENVD_CUS_SET_CMN_3_2_IDX *Freeze frame data km-counter (low byte) 2st. occur.*
		ERR_HIS_CONF[7] = ENVD_CUS_SET_CMN_2_3_IDX *Freeze frame data km-counter (high byte) last occur.*
		ERR_HIS_CONF[8] = ENVD_CUS_SET_CMN_3_3_IDX *Freeze frame data km-counter (low byte) last occur.*
		ERR_HIS_CONF[9] = C_ERR_CLAS_XX *Error class*

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B.79 Lamp management

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DLY_MIL_READY	V	0... FFFFH	0... 32767.5	0.5	s
Delay time to unable MIL blinking during pre-drive check mode					
LV_MIL	O/V	0... 1H	0 ...1	1	-
Boolean indicating MIL physical output (0 : off /1 : on)					
LV_MIL_FLL_READY	O/V	0... 1H	0 ...1	1	-
Boolean indicating MIL shall blink during pre-drive check mode phase 2 (0 : not blink /1 : blink)					
LV_WAL_1	O/V	0... 1H	0 ...1	1	-
Boolean indicating WAL_1 physical output (0 : off /1 : on)					
LV_WAL_2	O/V	0... 1H	0 ...1	1	-
Boolean indicating WAL_2 physical output (0 : off /1 : on)					
LV_WAL_ST	O/V	0... 1H	0 ...1	1	-
Boolean indicating Pre-drive Check mode (0 : off /1 : on)					
STATE_MIL	O/V/S	0... 2H	0 ...2	1	-
State of MIL illumination commanded by error management (ON (1), OFF (0), MIL_FLL (2))					
STATE_WAL_1	O/V/S	0... 1H	0 ...1	1	-
State of WAL_1 illumination commanded by error management (ON (1), OFF (0))					
STATE_WAL_2	O/V/S	0... 1H	0 ...1	1	-
State of WAL_2 illumination commanded by error management (ON (1), OFF (0))					
T_WAL_ST	V	0... FFH	0... 127.5	0.5	s
Timer for pre-drive check duration					

Input data:

C_CONF_MIL {p. 5827}	INH_IV_MIS {p. 6237}	LV_DC_MAX [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_XX
LV_ES {p. 1720}	LV_IGK {p. 906}	LV_MIL_ACT_REQ {p. 5840}	LV_MIS_STATE_A {p. 6238}
LV_STST_STOP_CYC {p. 805}	LV_WAL_1_ACT_REQ {p. 5840}	LV_WAL_2_ACT_REQ {p. 5840}	NLC_MIL_ACT_REQ {p. 5899}
STATE_READY_OBD_1 {p. 5881}	STATE_READY_OBD_2 {p. 5881}	SYM_CYL_MIS_A {p. 6239}	WAL_CONF_XX {p. 5811}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CONF_MIL	-	0... FFH	0... 255	1	-
Configuration of MIL					
C_CONF_WAL_1	-	0... FFH	0... 255	1	-
Configuration of warning lamp 1 (WAL_1)					
C_CONF_WAL_2	-	0... FFH	0... 255	1	-
Configuration of warning lamp 2 (WAL_2)					
C_DLY_INH_IV_MIS	-	0... FFH	0... 127.5	0.5	s
Delay for MIL blinking in case of misfiring present failure with cylinder cut off					
C_DLY_MIL_READY_1	-	0... FFH	0... 127.5	0.5	s
Delay to start MIL blinking for readiness display during pre-drive checkShall be in between 15 and 20 sec. Typical value 20sec					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DLY_MIL_READY_2	-	0... FFH	0... 127.5	0.5	s
MIL blinking duration for readiness display during pre-drive checkShall be in between 5 and 10 sec. Typical value 10sec					
C_T_MIN_WAL_ST	-	0... FFH	0... 127.5	0.5	s
Minimum time of pre-drive check duration					
LC_T_MAX_WAL_ST_ENA	-	0... 1H	0 ...1	1	-
Activation of maximum time of pre-drive check					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_MIL_CHK_TYP	-	0... 3H	0 ...3	1	-
Bit 0 = 0 : disable pre-drive check between "stalling event/engine start"Bit 0 = 1 : enable pre-drive check between "stalling event/engine start"Bit 1 = 0 : disable readiness status display during pre-drive check (MIL blinking)Bit 1 = 1 : enable readiness					

Import actions:

ACTION_ERRM_ MilOffToOnTrans (???<No Name available>)

FUNCTION DESCRIPTION:

General information:

It is possible to manage up to three different lamps. They are called:

- MIL: Malfunction Indicator Lamp; this lamp is used to inform the vehicle driver in case of failures which can affect emissions.
- WAL_1: Warning Lamp 1 and WAL_2: Warning Lamp 2; these lamps are used to inform the vehicle driver in case of others failures.

For each lamp, a task evaluated the state of MIL, WAL_1 and WAL_2. These states STATE_MIL, STATE_WAL_1 and STATE_WAL_2 are respectively what error management commanded to the lamps regard to failure status.
Then, the real physical state of each lamp (LV_MIL for MIL, LV_WAL_1 for WAL_1 and LV_WAL_2 for WAL_2) is build related to the mode in which they are. Lamps behavior is based on two modes:

- A predrive check mode between transition LV_IGK 0->1 and engine start; this mode is used to check the correct lamps working.
- A normal mode for the rest of the time.

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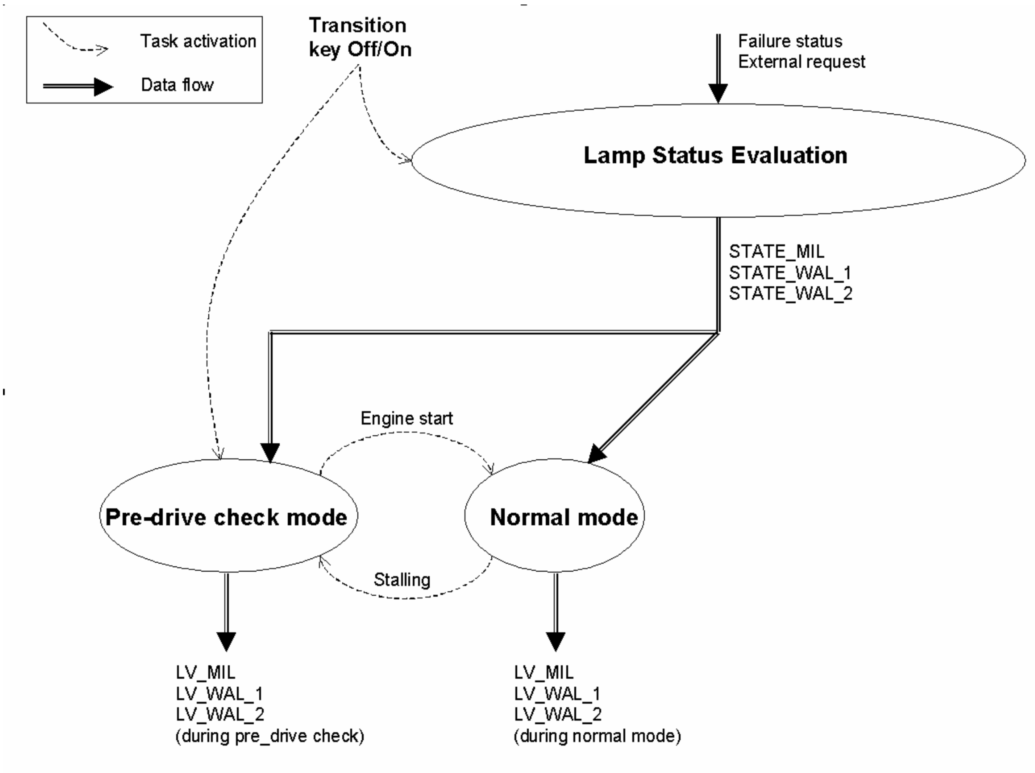

A configuration byte is defined for each lamp: C_CONF_XXX (with XXX = MIL C_CONF_MIL, WAL_1 or WAL_2, C_CONF_WAL_1 C_CONF_WAL_2).
It is then possible to inhibit a lamp illumination, to allow or not external request for lamp illumination and to link lamp illumination each other's.

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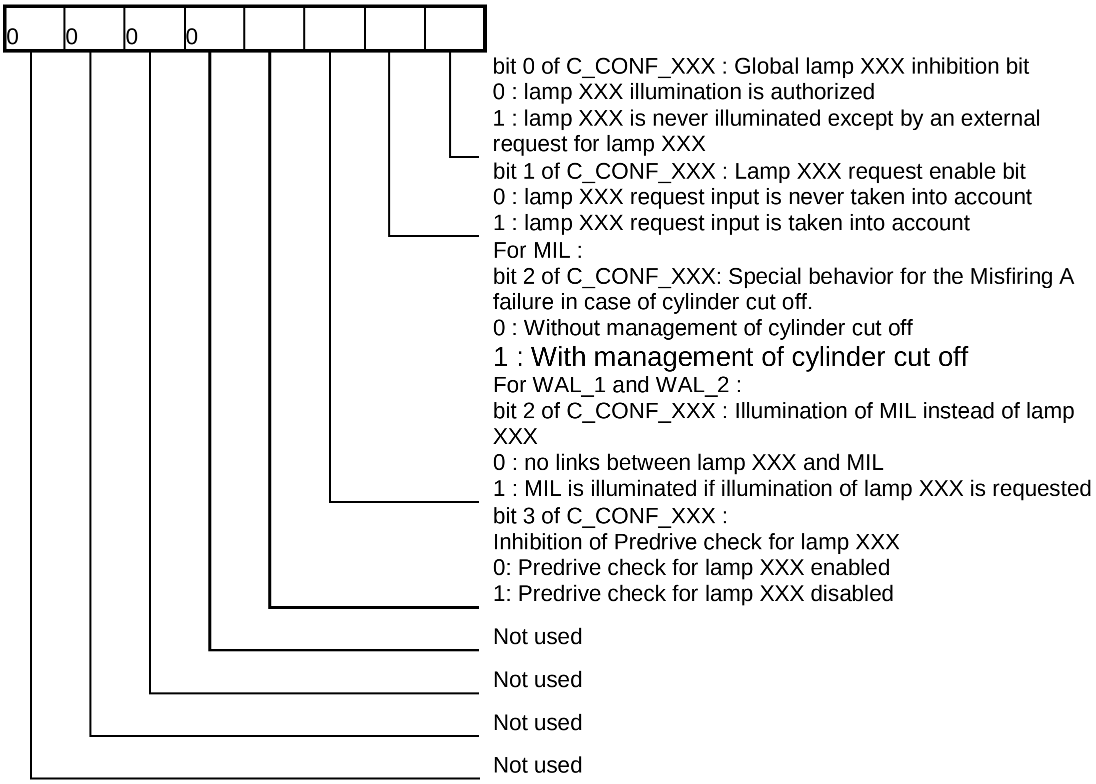

Impact of each failure on lamp is defined in WAL_CONF_XX byte:

- bit 0 : if set, the present failure may caused a WAL_1 illumination ;
- bit 1 : if set, the present failure may caused a WAL_2 illumination ;
- bit 2 : if set, the failure may caused a MIL illumination when driving cycle counter reaches maximum ;
- bit 3: if set, the present failure may cause a MIL blinking.

B.79.1 Lamp Status Evaluation

Description:

Management of WAL_1 and WAL_2

Behavior of WAL_1 and WAL_2 are identical. WAL_1 and WAL_2 may be illuminated (state is ON) or not (state is OFF). When the global lamp inhibition bit is not set, the lamp is requested to illuminate:

- if at least one failure is present (LV_ERR_XX) with the corresponding bit of WAL_CONF_XX (bit 0 for WAL_1, bit 1 for WAL_2) in enable position and this failure is stored in 2^{nd} layer memory ;
- or in case of allowed lamp request.

Management of MIL

MIL internal management is based on 3 states:

- STATE_MIL = OFF (MIL is requested continuously off)
- STATE_MIL = ON (MIL is requested continuously on)
- STATE_MIL = MIL_FLL (MIL is requested blinking at 1 Hz)

When the global MIL inhibition bit is not set, the MIL is requested to illuminate (ON):

- if at least one failure has reached its driving cycle maximum value and is unequal to zero (LV_DC_MAX[IDX]) with the corresponding bit of WAL_CONF_XX (bit 2) in enable position and this failure is stored in 2^{nd} layer memory ;
- or in case of allowed lamp request ;

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- or WAL_1 is requested to be illuminated and WAL_1 is link with MIL ;
- or WAL_2 is requested to be illuminated and WAL_2 is link with MIL ;

When the global MIL inhibition bit is not set, the MIL is requested to be blinking at 1hz (MIL_FLL):

- if at least one failure is present (LV_ERR_XX) with the corresponding bit of WAL_CONF_XX (bit 3) in enable position and this failure is stored in 2^{nd} layer memory ;

A special calculation can be enabled for Misfire A failure with the management of cylinder shut off (bit 2 of C_CONF_MIL):

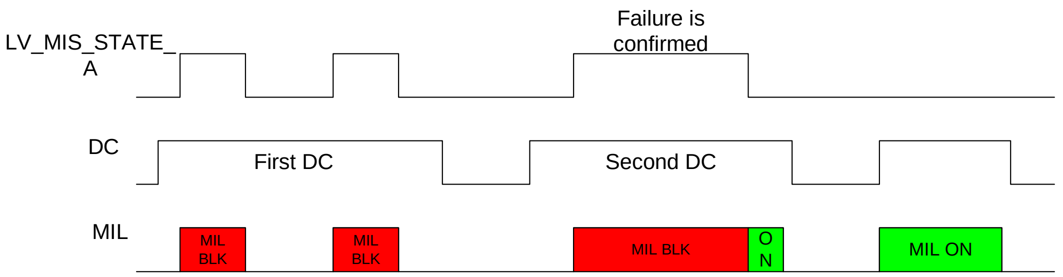
- bit 2 of C_CONF_MIL = 0: When a misfire A failure (LV_MIS_STATE_A) is present, the MIL is blinking.
- bit 2 of C_CONF_MIL = 1: If Misfire A failure (LV_MIS_STATE_A) is present with cylinder cut off, the MIL is blinking only for a calibratable time (C_DLY_INH_IV_MIS). After this time, the MIL is ON again.

Beware: The “blinking mode” is priority mode compared to “continuous on mode”.

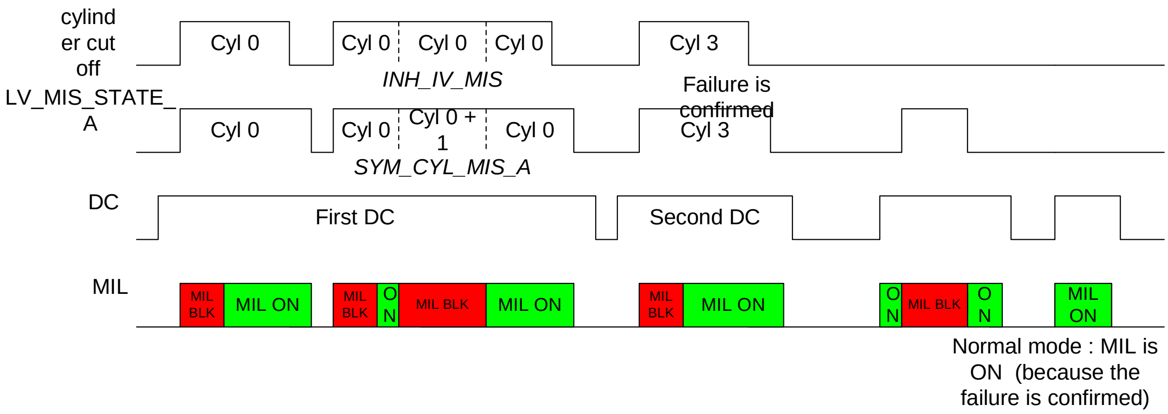
Signal flow diagram:

Special behavior for Misfire A failure with bit LC_MIL_INH_IV_MIS of C_CONF_MIL:

Behavior of Misfiring failure MIS_A without management of cylinder cut off (LC_MIL_INH_IV_MIS = 0)



Behavior of Misfiring A failure with management of cylinder cut off (LC_MIL_INH_IV_MIS = 1) :



Application conditions

Initialization: –

Recurrence: 500 ms

Activation: –

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Formula section:

```
If      bit 0 of C_CONF_WAL_1 = 1        (lamp WAL_1 illumination not authorized)
Then    STATE_WAL_1 = OFF        (lamp WAL_1 is off)
Else    If      at least one failure in 2nd layer memory has:
                        (LV_ERR_XX and bit 0 of WAL_CONF_XX) = 1
                            (lamp WAL_1 illumination by a failure)
        Then    STATE_WAL_1 = ON         (lamp WAL_1 is on)
        Else    STATE_WAL_1 = OFF        (lamp WAL_1 is off)
        Endif
Endif

If      bit 0 of C_CONF_WAL_2 = 1        (lamp WAL_2 illumination not authorized)
Then    STATE_WAL_2 = OFF        (lamp WAL_2 is off)
Else    If      at least one failure in 2nd layer memory has:
                        (LV_ERR_XX and bit 1 of WAL_CONF_XX) = 1
                            (lamp WAL_2 illumination by a failure)
      Then    STATE_WAL_2 = ON         (lamp WAL_2 is on)
        Else    STATE_WAL_2 = OFF        (lamp WAL_2 is off)
        Endif
Endif


If      bit 0 of C_CONF_MIL = 1      (MIL illumination not authorized)
Then    STATE_MIL = OFF     (MIL is requested continuously off)
Else    If      at least one failure in 2nd layer memory has:
                (LV_DC_MAX[IDX]   and bit 2 of WAL_CONF_XX ) = 1
                (at least one failure request to illuminate the MIL)
                or (STATE_WAL_1 = ON   and    bit 2 of C_CONF_WAL_1 = 1)
                (a failure illuminates WAL_1 and WAL1 is linked with MIL)
                or (STATE_WAL_2 = ON   and    bit 2 of C_CONF_WAL_2 = 1)
                (a failure illuminates WAL_2 and WAL_2 is linked with MIL)
        Then   STATE_MIL = ON      (MIL is requested continuously on)
      Else   STATE_MIL = OFF     (MIL is requested continuously off)
        Endif
        If      LV_MIS_STATE_A = 1
                (CARB A misfire failure criterion)
        then    if      bit 2 of C_CONF_MIL = 0
                        (Without management of cylinder shut off for the misfiring A)
                then    STATE_MIL = MIL_FLL
                     (MIL is requested blinking at 1Hz)
                else    (Management of cylinder shut off for the misfiring A)
                        If      (any cylinder bit within SYM_CYL_MIS_A 0 -> 1
                        and     corresponding bit within INH_IV_MIS is set to 1)
                        Then    STATE_MIL = MIL_FLL only during C_DLY_INH_IV_MIS
                                After C_DLY_INH_IV_MIS, STATE_MIL = ON
                                mode = 'blink mode during a delay + continuous ON'
                        Endif
                        if      any cylinder bit within SYM_CYL_MIS_A 0 -> 1
                                and corresponding bit within INH_IV_MIS is set to 0
                        then    mode = 'blink mode'
                        Endif
```

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If mode = 'blink mode'
Then **if** any cylinder bit SYM_CYL_MIS_A is set
And
corresponding bit within INH_IV_MIS remains to 0
(no transition 1-> 0 of the corresponding bit during the failure)
Then mode = 'blink mode'
Else mode ='blink mode during a delay + continuous ON'
Endif
Endif
If mode = 'blink mode'
Then STATE_MIL = MIL_FLL
(MIL is requested blinking at 1Hz)
else **if** C_DLY_INH_IV_MIS isn't achieved
Then STATE_MIL = MIL_FLL
(MIL is requested blinking at 1Hz)
Else STATE_MIL = ON
(MIL is requested continuously on)
Endif
Endif
Endif
Endif
If at least one failure in 2nd layer memory has :
(LV_ERR_XX and bit 3 of WAL_CONF_XX) = 1
(at least one failure request to blink the MIL)
Then STATE_MIL = MIL_FLL
(MIL is requested blinking at 1Hz)
Endif
Endif

Remark:
For the misfiring A failure (treated as a particular case), the Bit 3 of WAL_CONF_XX mustn't be set to 1 by calibration (only bit 2 for continuous MIL illumination).

B.79.1.1 MIL transition from Off to On

Formula section:

IF ((STATE_MIL transition OFF -> MIL_FLL or OFF -> ON) **AND**
LV_MIL_ACT_REQ = 0)
or (NLC_MIL_ACT_REQ = 1
and LV_MIL_ACT_REQ transition 0 -> 1 **AND** STATE_MIL = OFF
and bit 1 of C_CONF_MIL = 1**)**
(Hint: LV_MIL_ACT_REQ is stored in NVMY (defined in the Lamp managenment Appl. Inc.)). To check the transition LV_MIL_ACT_REQ 0->1 the old value of this flag (*LV_MIL_ACT_REQ_OLD*) has to be initialised with the value from NVMY at reset !!!)
THEN
ACTION_ERRM_MilOffToOnTrans()
ENDIF

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B.79.2 Lamp mode

B.79.2.1 Predrive Check mode

Description:

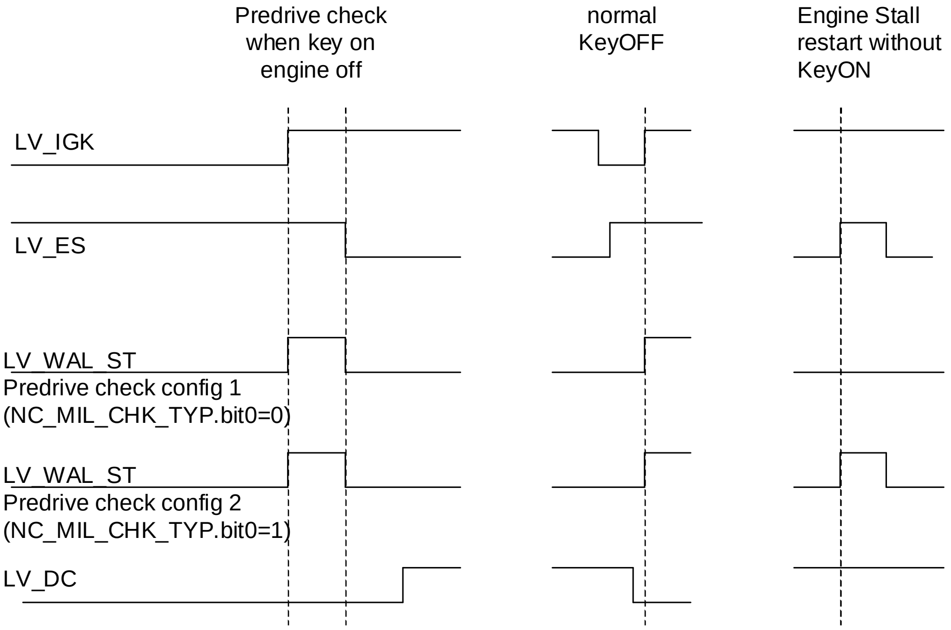
Predrive check mode is used to enable a visual check of the correct lamp working. Additionally it can be used to display readiness status as an option (MIL blinking).

Nevertheless a failure may also illuminate a lamp. Illumination of lamp during pre-drive check mode is performed only when :

- the global lamp inhibition bit is not set (bit 0 of C_CONF_XXX = 1) and the lamp individual predrive check inhibition is not set (bit 3 of C_CONF_XXX = 1)
- or error management commands a lamp
- or no inhibition because of active StartStop cycle LV_STST_STOP_CYC = 1
- Configuration of predrive check behaviour in case of stalling event:

  with NC_MIL_CHK_TYP (bit 0)

Predrive check mode phase can be defined in 2 ways:
- between key on transition LV_IGK 0->1 and engine start (bit 0 of NC_MIL_CHK_TYP=0)
- or between key on transition LV_IGK 0->1 and engine start, plus between an engine stall event and engine start (bit 0 of NC_MIL_CHK_TYP=1)



1. Configuration of MIL blinking readiness status functionality:

   with NC_MIL_CHK_TYP (bit 1)

During predrive check mode, you can display the status of readiness codes through the MIL warning lamp : the MIL is blinking if readiness not complete.
This strategy is part of predrive check and does not affect the MIL status (STATE_MIL).

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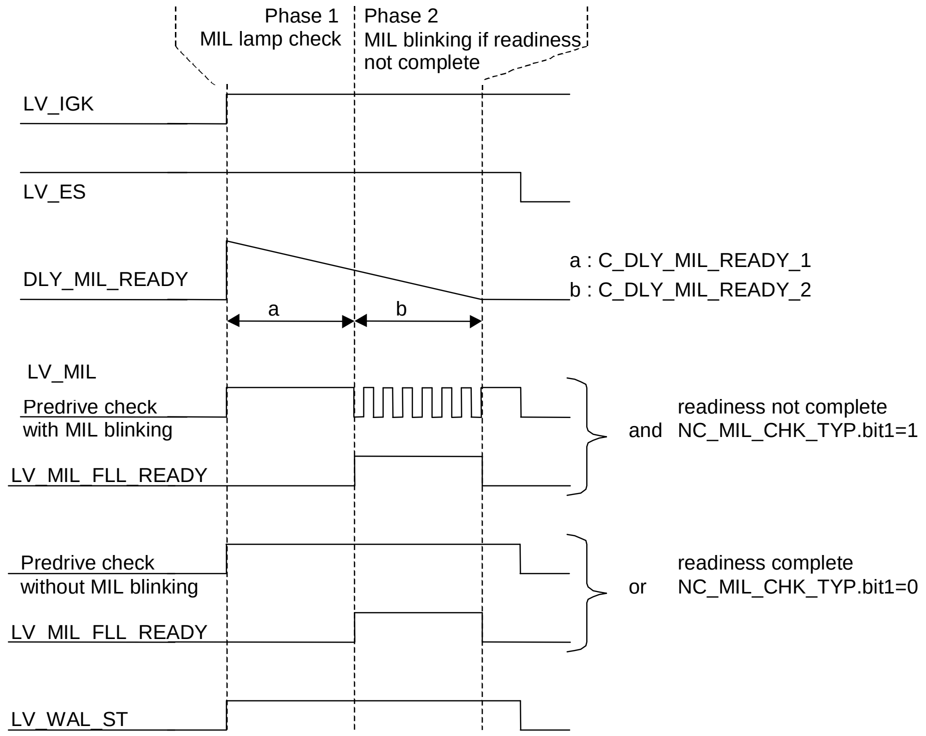
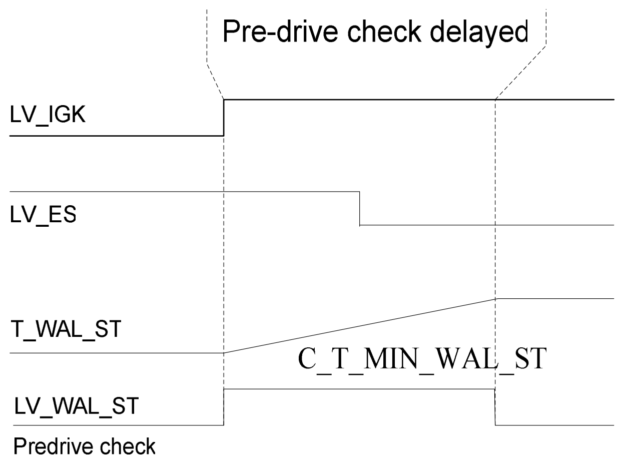


1. Management of minimum time of predrive check duration

-> only relevant after engine cranking (LV_ES 1->0)

Wih the calibration C_T_MIN_WAL_ST it's possible to set a minimum time for the predrive check duration independant of engine cranking (LV_ES 1->0). This gives the possibility to illuminate the Mil for predrive check (e.g. in case of a quick start).



1. Management of maximum time of predrive check duration

-> only relevant before engine cranking (LV_ES = 0)

With the calibration LC_T_MAX_WAL_ST_ENA, it's possible to activated the maximum time of predrive check functionality. If this functionality is activated (LC_T_MAX_WAL_ST_ENA = 1) the maximum predrive check duration before engine cranking is C_DLY_MIL_READY_1 + C_DLY_MIL_READY_2. This gives the possibility to finish the predrive check before engine cranking e.g. in case of a long key on engine stop phase.

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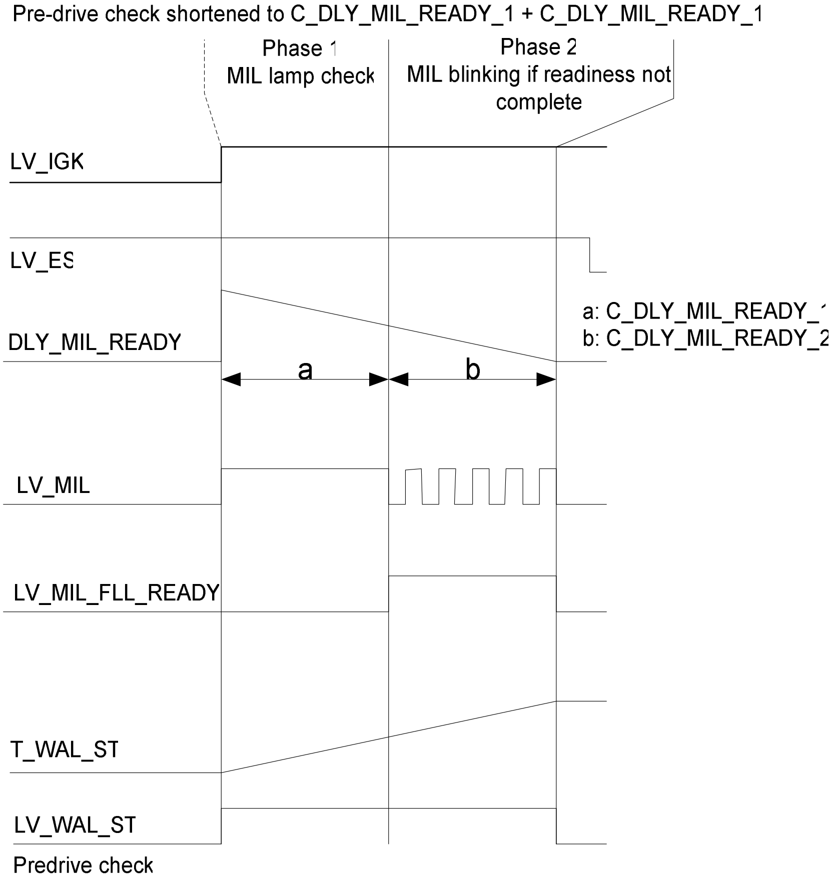

Application conditions

Initialization:

At LV_IGK transition 0 to 1
T_WAL_ST = 0 **and** LV_MIL_FLL_READY=0
At LV_ES transition 0 to 1
T_WAL_ST = 0
At LV_IGK transition 1 to 0 or if reset
LV_WAL_ST = 0 (Pre-drive check mode deactivated)

Recurrence: 500 ms and at LV_IGK 0 -> 1 transition

Activation:

(pre-drive check enable between “stalling event/ engine start”)
bit 0 of NC_MIL_CHK_TYP=1
and LV_IGK = 1 **and** LV_ES = 1
and LV_STST_STOP_CYC = 0
and (T_WAL_ST < C_DLY_READY_1 + C_DLY_READY_2
or LC_T_MAX_WAL_ST_ENA = 0)
and (bit 0 of C_CONF_WAL_1 = 0
or bit 0 of C_CONF_WAL_2 = 0
or bit 0 of C_CONF_MIL = 0)
or
(pre-drive check disable between “stalling event/ engine start”)
bit 0 of NC_MIL_CHK_TYP=0
and transition LV_IGK 0 ->1 **and** LV_ES = 1
and (T_WAL_ST < C_DLY_READY_1 + C_DLY_READY_2

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```
                  or LC_T_MAX_WAL_ST_ENA = 0)
            and   (bit 0 of C_CONF_WAL_1 = 0
                  or bit 0 of C_CONF_WAL_2 = 0
                   or bit 0 of C_CONF_MIL = 0)
```

Deactivation:

```
(LV_ES = 0                     (engine not stopped)
       and    T_WAL_ST >= C_T_ MIN_WAL_ST)
                  (minimum time of predrive check reached)
 or
((LV_ES = 1               (engine stopped)
      and    T_WAL_ST >= C_DLY_READY_1 + C_DLY_READY_2
       and    LC_T_MAX_WAL_ST_ENA = 1)
                  (maximum time of predrive check reached)
 or   LV_IGK=0                   (or key off)
```

Formula section:

LV_WAL_ST=1 during activation of this formula section.
LV_WAL_ST=0 and LV_MIL_FLL_READY=0 during deactivation of this formula section (end of predrive check).

T_WAL_ST = T_WAL_ST + 0.5 s

If bit 1 of NC_MIL_CHK_TYP = 1 (**if readiness display enable**)
Then

If transition of LV_WAL_ST from 0 to 1 (on beginning of predrive check)
Then (initialize time delay)
Initialize Delay time DLY_MIL_READY with C_DLY_MIL_READY_1+C_DLY_MIL_READY_2
Endif
DLY_MIL_READY = DLY_MIL_READY - 0.5 s

(check if delay is within the timing window)

If DLY_MIL_READY < C_DLY_MIL_READY_2
And DLY_MIL_READY > 0
Then
(check if some supported readiness status are "complete")

If (bit 4 to 7 of STATE_READY_OBD_1=0)
And (STATE_READY_OBD_2=0)

Then
LV_MIL_FLL_READY=0 (if "complete" then MIL does not blink)
Else
LV_MIL_FLL_READY=1 (if "not complete" then MIL lamp shall blink)
Endif

Else
LV_MIL_FLL_READY = 0 (the readiness status phase is finished)
Endif

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Endif

If bit 0 of C_CONF_MIL = 0 (MIL not inhibit)
and bit 3 of C_CONF_MIL = 0 (predrive check for MIL enable)
and LV_MIL_FLL_READY = 1 (readiness not complete)
Then
LV_MIL shall blink at 1Hz
Endif

(“**predrive check**”**: switch on warning lamps**)

If bit 0 of C_CONF_WAL_1 = 0 (WAL_1 not inhibit)
and bit 3 of C_CONF_WAL_1 = 0 (predrive check for WAL_1 enabled)
Then LV_WAL_1 = 1
Endif
If bit 0 of C_CONF_WAL_2 = 0 (WAL_2 not inhibit)
and bit 3 of C_CONF_WAL_2 = 0 (predrive check for WAL_2 enabled)
Then LV_WAL_2 = 1
Endif
If bit 0 of C_CONF_MIL = 0 (MIL not inhibit)
and bit 3 of C_CONF_MIL = 0 (predrive check for MIL enabled)
and LV_MIL_FLL_READY = 0 (MIL not blinking readiness status)
Then LV_MIL = 1
Endif

B.79.2.2 Normal mode

The normal mode is defined as “not to be in pre-drive check mode”.

B.79.2.3 All modes

Description:

The following treatment is done in pre-drive check mode and in normal mode.

Application conditions

Initialization: at transition LV_IGK 1->0 or if reset
LV_MIL = 0 (MIL is off)
LV_WAL_1 = 0 (WAL_1 is off)
LV_WAL_2 = 0 (WAL_2 is off)

Recurrence: *500 ms and at LV_IGK 0 -> 1 transition*

Activation: LV_IGK=1

Formula section:

If STATE_MIL = MIL_FLL
Then LV_MIL blink at 1Hz
Else If (STATE_MIL = ON **or** (LV_MIL_ACT_REQ = 1 **and** bit 1 of C_CONF_MIL = 1))
(allowed MIL request)
AND (LV_MIL_FLL_READY=0 **or** bit 3 of C_CONF_MIL = 1)
(case MIL blinking during the pre-drive check: readiness not completed)

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Then LV_MIL = 1
Else **If** we are in normal mode **or** bit 3 of C_CONF_MIL = 1
(predrive check not authorized for MIL)
Then LV_MIL = 0
Endif
Endif
Endif

If STATE_WAL_1 = ON **or** (LV_WAL_1_ACT_REQ = 1 **and** bit 1 of C_CONF_WAL_1 = 1)
(allowed lamp WAL_1 request)
Then LV_WAL_1 = 1
Else **If** we are in normal mode **or** bit 3 of C_CONF_WAL_1 = 1
(pre drivecheck not authorized for WAL_1)
Then LV_WAL_1 = 0
Endif
Endif

If STATE_WAL_2 = ON **or** (LV_WAL_2_ACT_REQ = 1 **and** bit 1 of C_CONF_WAL_2 = 1)
(allowed lamp WAL_2 request)
Then LV_WAL_2 = 1
Else **If** we are in normal mode **or** bit 3 of C_CONF_WAL_2 = 1
(pre drivecheck not authorized for WAL_2)

Then LV_WAL_2 = 0
Endif
Endif

Configuration data detailed description:

Bit 0 = 0 : disable pre-drive check between “stalling event/engine start”
Bit 0 = 1 : enable pre-drive check between “stalling event/engine start”
Bit 1 = 0 : disable readiness status display during pre-drive check (MIL blinking)
Bit 1 = 1 : enable readiness
Typical value bit 0 = 0, bit 1 = 0

Calibration data detailed description:

C_DLY_MIL_READY_1: Delay to start MIL blinking for readiness display during pre-drive check. Shall be tuned between 15 s and 20 s. Typical value 20 s.

C_DLY_MIL_READY_2: MIL blinking duration for readiness display during pre-drive check. Shall be tuned between 5 s and 10 s. Typical value 10 s.

LC_T_MAX_WAL_ST_ENA: = 1: maximum time of predrive check with LV_ES = 1 is C_DLY_MIL_READY_1 + C_DLY_MIL_READY_2

= 0: maximum time of predrive check with LV_ES = 1 is unlimited

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B.80 Lamp management (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MIL_ACT_REQ	O/V	0... 1H	0 ...1	1	-
Request of MIL activation by others					
LV_MIL_ACT_REQ_DC	O	0... 1H	0 ...1	1	-
Request of MIL activation by others this DC					
LV_WAL_1_ACT_REQ	O/V	0... 1H	0 ...1	1	-
Request of WAL 1 activation by others					
LV_WAL_2_ACT_REQ	O/V	0... 1H	0 ...1	1	-
Request of WAL 2 activation by others					

Input data:

LV_IGK {p. 906}	LV_MIL_REQ_ETCU {p. 1566}	LV_MIS_STATE_A {p. 6238}	LV_MIS_STATE_B1 {p. 6238}
LV_MIS_STATE_B4 {p. 6238}	STATE_ETCU_OBD {p. 1574}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_WAL_CONF_MIS	V	0... 7H	0 ...7	1	-
Constant for WAL_1 illumination by MISF					
LC_MIL_ACT_REQ_ETCU	V	0... 1H	0 ...1	1	-
logical constant for MIL illumination by ETCU					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_LAMP	-	0... 3H	0 ...3	1	-
Quantity of warning lamps					

General information

The external request management of all lamps is done directly on the CAN output-signal, thus this function is now only used by the EGS - ECU.

Application conditions:

Initialisation:
```
At ECU reset:
LV_MIL_ACT_REQ = 0
LV_WAL_1_ACT_REQ = 0
LV_WAL_2_ACT_REQ = 0
LV_MIL_ACT_REQ_DC = 0
```

Activation: `LV_IGK = 1`

Deactivation: `LV_IGK = 0 then set all outputs equal to 0`

Recurrence: `100 ms`

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Function description:

Formula section:

MIL activation at Gear Request

```
If     LV_MIL_REQ_ETCU = 1           or
       [ LC_MIL_ACT_REQ_ETCU = 1     and
       (STATE_ETCU_OBD = 0100 b      or
       STATE_ETCU_OBD = 0110 b) ]
Then      LV_MIL_ACT_REQ = 1
Else      LV_MIL_ACT_REQ = 0
Endif

LV_MIL_ACT_REQ_DC = 0                      // not used
```

WAL_1 (EML) activation at active Misfire

```
If    (bit 0 of C_WAL_CONF_MIS =1 and  LV_MIS_STATE_A =1)  or
      (bit 1 of C_WAL_CONF_MIS =1 and  LV_MIS_STATE_B1 =1) or
      (bit 2 of C_WAL_CONF_MIS =1 and  LV_MIS_STATE_B4 =1)
Then      LV_WAL_1_ACT_REQ = 1
Else      LV_WAL_1_ACT_REQ = 0
Endif
```

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B.81 Permanent fault code

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ERR_PERM_NR	O/V/S	0... FFH	0... 255	1	-
Number of permanent fault codes stored					
ERR_PERM [NC_NR_ERR_PERM]	O/V/S	0... FFFFH	0... 65535	1	-
Permanent fault index					
ERR_SYM_PERM [NC_NR_ERR_PERM]	O/V/S	0... FH	0... 15	1	-
Permanent fault symptom					
LV_DC_PERM_MEM	V/S	0... 1H	0 ...1	1	-
Memorization of LV_DC_PERM until next ERRM clearing (Mode $04,...)					
LV_ERR_CLR [NC_NR_ERR_PERM]	V/S	0... 1H	0 ...1	1	-
Failure is only permanent due ERRM data clearing					
LV_ERR_PERM [NC_NR_ERR_PERM]	O/V/S	0... 1H	0 ...1	1	-
Permanent fault code					
LV_ERR_PERM_CLR_OLD	-	0... 1H	0 ...1	1	-
Previous state of LC_ERR_PERM_CLR					
SYM_CYL_PERM_MIS_A	O/V/S	0... FFFFH	0... 65535	1	-
Permanent memorized cylinder with misfire A (for the DTC building)					
SYM_CYL_PERM_MIS_B1	O/V/S	0... FFFFH	0... 65535	1	-
Permanent memorized cylinder with misfire B1 (for the DTC building)					
SYM_CYL_PERM_MIS_B4	O/V/S	0... FFFFH	0... 65535	1	-
Permanent memorized cylinder with misfire B4 (for the DTC building)					

Input data:

ERR_SYM_MEM [NC_NR_ERR_DYN] {p. 5756}	LV_DC_PERM {p. 5746}	LV_READY_XX {p. 5881}	NLC_TREAT_DIAG_MIS {p. 6265}
SYM_CYL_MEM_MIS_A {p. 5756}	SYM_CYL_MEM_MIS_B1 {p. 5756}	SYM_CYL_MEM_MIS_B4 {p. 5756}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_ERR_PERM_CLR	-	0... 1H	0 ...1	1	-
Calibration to clear permanent failure memory (at 0->1 transition)					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_ERR_PERM	-	1... FFH	1... 255	1	-
Maximum number of failure defined in permanent failure memory structure (CARB required minimum value : 4)					

Action definition

ACTION_ERRM_ClcPermanentByErr (**IN**<PRM_IDX_ERR>)	Mode: O
ACTION_ERRM_GetReadyClass (IN <PRM_IDX_ERR >, OUT <PRM_READY_CLAS>)	

ACTION_ERRM_ClcPermanentIniErrm ()	Mode: O

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ACTION_ERRM_ClcPermanentResetDC ()	Mode: O

ACTION_ERRM_ErasePermanentCode (**IN**<PRM_IDX_ERR>)	Mode: O

ACTION_ERRM_GetErrPerm (**OUT**<PRM_LV_ERR_PERM>,**IN**<PRM_IDX_ERR>)	Mode: O
This action is called to know if a given failure has a permanent code stored or not.	

Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_LV_ERR_PERM	out	0... 1H	0 ...1	1	-
Permanent status.					
PRM_IDX_ERR	in	0... FFFFH	0... 65535	1	-
Failure Index					

ACTION_ERRM_StorePermanentCode (**IN**<PRM_IDX_ERR>)	Mode: O

Import actions:

ACTION_ERRM_GetErrLastClr (<PRM_IDX_ERR>,<PRM_LV_ERR_LST_CLR>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetReadyClass (**IN**<PRM_IDX_ERR>,**OUT**<PRM_READY_CLAS>)

FUNCTION DESCRIPTION:

General information:

Any DTC that is commanding MIL on must be logged as a permanent fault code in non-volatile memory. A Permanent DTC can only be erased by the vehicle's OBD II system.
Vehicle owners and technicians would not be able to clear or erase permanent fault codes by any generic or manufacturer specific scan tool command (or by disconnecting the battery). Instead, these fault codes would only be allowed to be self-cleared by the OBD II system itself (ERRM), once the monitor responsible for setting that fault code has run enough times to confirm that the fault was no longer present.

The permanent fault code is set as soon as the failure gets the confirmed status (MIL is switched on).
The permanent fault code is erased after self-healing of the failure, when the MIL goes off.

Subsequent to a clearing of the failure memory (e.g. Mode $04), the permanent fault code is erased if the diagnostic that caused the permanent fault code to be stored has been fully executed and determined the malfunction is no longer present and special vehicle operation has been encountered (defined by LV_DC_PERM) such as :

- Cumulated trip length (time since engine start) T_AST_PERM >= 600 s
- Cumulative vehicle operation >= 40 km/h (25mph) for at least 300 s
- Continuous vehicle operation in idle >= 30 s (accelerator pedal released and vehicle speed less or equal than 1 mph)

wathever

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- Altitude condition is (no criteria for ambient pressure si defined)
- Ambient temperature is (no criteria on ambient temperature is defined)

A minimum of four permanent fault codes shall be retained by by the OBD II system (ERRM). But the permanent failure memory may be adjusted over the four elements size thanks to NC_NR_ERR_PERM configuration data.
Permanent fault codes may not be erased when ECU is reprogrammed unless the readiness status for all monitored components is set to “not complete” in conjunction with the reprogramming event.

The permanent failure memory structure is defined as follow:
Index: IDX_PERM ξ [1...NC_NR_ERR_PERM]

- Permanent fault index	ERR_PERM[IDX_PERM]
- Permanent fault code	LV_ERR_PERM[IDX_PERM]
- Failure is only permanent due ERRM data clearing	LV_ERR_CLR[IDX_PERM]
- Permanent Fault symptom	ERR_SYM_PERM[IDX_PERM]
- Permanent memorized cylinder with misfire A, B1, B4	SYM_CYL_PERM_XX

B.81.1 Permanent failure memory

FUNCTION DESCRIPTION:

General information:

The permanent failure memory is a data structure containing NC_NR_ERR_PERM elements.
Permanent faults codes are stored there, with a chronological order, but the clearing is done randomly, because it is based on the natural failure healing. When the data structure is full, no additional permanent fault code can be entered, until an empty space is freed within the structure.
The permanent failure memory must retain at least four permanent faults codes.

Application conditions

Initialisation:

```
at NVMINI system event
 CTR_ERR_PERM_NR = 0
 LV_DC_PERM_MEM = 0
   For  IDX_PERM = 1 to NC_NR_ERR_PERM
     ERR_PERM[IDX_PERM] = 0
     LV_ERR_CLR[IDX_PERM] = 0
        LV_ERR_PERM[IDX_PERM] = 0
     ERR_SYM_PERM[IDX_PERM] = 0 (NO_SYM)
     #IF    NLC_TREAT_DIAG_MIS = 0
 SYM_CYL_PERM_MIS_A = 0,
 SYM_CYL_PERM_MIS_B1 = 0,
 SYM_CYL_PERM_MIS_B4 = 0
        #ENDIF
   Endfor
```

Recurrence: –

Activation: –

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Formula section:

No action specified.

B.81.2 Storage of permanent fault code

Description for actions:

ACTION_ERRM_*StorePermanentCode* (< PRM_IDX_ERR >)					
This action shall be called in order to store a permanent fault code. When permanent memory is full, the permament code storage is postponed until a free space within memory is released. Permanent codes are stored according the chronological appearance order.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_IDX_ERR	IN	0...FFFFH	0...65535	1	[-]
Failure index					

Formula section:

For IDX_PERM = 1 to NC_NR_ERR_PERM
If(1) ERR_PERM[IDX_PERM] = PRM_IDX_ERR
Then(1)
(Permanent failure related to PRM_IDX_ERR is already stored)
(If failure was only permanent due to a previous ERRM data clearing, this information is cleared to avoid permanent clearing at end of driving cycle)
LV_ERR_CLR[IDX_PERM] = 0
LV_ERR_PERM[IDX_PERM] = 1
Exit
Else(1)
If(2) CTR_ERR_PERM_NR <> NC_NR_ERR_PERM
Then(2)
(Permanent failure memory is not full)
If(3) LV_ERR_PERM[IDX_PERM] = 0
Then(3)
(Empty area detected)
ERR_PERM[IDX_PERM] = PRM_IDX_ERR
LV_ERR_CLR[IDX_PERM] = 0
LV_ERR_PERM[IDX_PERM] = 1
If NLC_TREAT_DIAG_MIS = 1
Then
"Conditions for treatment are true"
Endif
ACTION_ERRM_GetReadyClass(PRM_IDX_ERR, PRM_READY_CLAS)

If PRM_READY_CLAS <> CARB_MIS
Then
"Conditions for treatment are true"
Endif
If "Conditions for treatment are true"
Then
with IDX_DYN = f (PRM_IDX_ERR)
ERR_SYM_PERM[IDX_PERM] = ERR_SYM_MEM[IDX_DYN]
Else

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If PRM_IDX_ERR = MIS_A
Then
SYM_CYL_PERM_MIS_A = SYM_CYL_MEM_MIS_A
Else If PRM_IDX_ERR = MIS_B1
Then
SYM_CYL_PERM_MIS_B1 = SYM_CYL_MEM_MIS_B1
Else If PRM_IDX_ERR = MIS_B4
Then
SYM_CYL_PERM_MIS_B4 = SYM_CYL_MEM_MIS_B4
Endif
EndIf
If(4) CTR_ERR_PERM_NR < NC_NR_ERR_PERM
Then(4)
CTR_ERR_PERM_NR = CTR_ERR_PERM_NR + 1
Else(4)
CTR_ERR_PERM_NR = NC_NR_ERR_PERM
Endif(4)
Exit
Else(3)
(A permanent failure is already logged at this position)
Endif(3)
Else(2)
(Permanent failure memory is full)
(PRM_IDX_ERR failure can not be stored as permanent until a free space is released)
Endif(2)
Endif(1)
Endfor

B.81.3 Erasing permanent fault code (self-clearing)

Description for actions:

ACTION_ERRM_*ErasePermanentCode* (< PRM_IDX_ERR >)					
This action shall be called to erase a permanent fault code from memory. A permanent fault code is always self cleared. None external action can affect or delete this code.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_IDX_ERR	IN	0...FFFFH	0...65535	1	[-]
Failure index					

Formula section:

(Erasing permanent fault code)
For IDX_PERM = 1 to NC_NR_ERR_PERM
If(1) ERR_PERM[IDX_PERM] = PRM_IDX_ERR
Then(1)
(PRM_IDX_ERR error to be cleared has been found)
ERR_PERM[IDX_PERM] = 0
LV_ERR_CLR[IDX_PERM] = 0
LV_ERR_PERM[IDX_PERM] = 0
If NLC_TREAT_DIAG_MIS = 1
Then

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```
                "Conditions for treatment are true"
        Endif
        ACTION_ERRM_GetReadyClass(PRM_IDX_ERR, PRM_READY_CLAS)
        If    PRM_READY_CLAS <> CARB_MIS
        Then
                "Conditions for treatment are true"
            Endif
        If    "Conditions for treatment are true"
        Then
                ERR_SYM_PERM[IDX_PERM] = 0 (NO_SYM)
            Else
                If        PRM_IDX_ERR = MIS_A
                Then
                        SYM_CYL_PERM_MIS_A = 0
                    Else    If        PRM_IDX_ERR = MIS_B1
                            Then
                                    SYM_CYL_PERM_MIS_B1 = 0
                  Else    If        PRM_IDX_ERR = MIS_B4
                            Then
                                    SYM_CYL_PERM_MIS_B4 = 0
                          Endif
            Endif
        If(2)      CTR_ERR_PERM_NR > 0
        Then(2)
                CTR_ERR_PERM_NR = CTR_ERR_PERM_NR - 1
        Else(2)
                CTR_ERR_PERM_NR = 0
        Endif(2)
        (newly created empty place has IDX_PERM index value)
         Exit
   Endif(1)
Endfor

(Permanent failure memory sorting to remove empty space generated above)
If(1)          IDX_PERM <> NC_NR_ERR_PERM
Then(1)
  For k = IDX_PERM to (NC_NR_ERR_PERM-1)
  ERR_PERM[k] = ERR_PERM[k+1]
  LV_ERR_CLR[k] = ERR_PERM[k+1]
     LV_ERR_PERM[k] = ERR_PERM[k+1]
  ERR_SYM_PERM[k] = ERR_SYM_PERM[k+1]
  Endfor
ERR_PERM[NC_NR_ERR_PERM] = 0
LV_ERR_CLR[NC_NR_ERR_PERM] = 0
LV_ERR_PERM[NC_NR_ERR_PERM] = 0
ERR_SYM_PERM[NC_NR_ERR_PERM] = 0 (NO_SYM)
Endif(1)
```

B.81.4 Impact of error management data clearing inside permanent memory

Description for actions:

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ACTION_ERRM_*ClcPermanentIniErrm* ( )					
This action is called when all error management data is cleared (e.g. Mode $04 executed by scan tool). After an overall data clearing of error management data, permanent errors are marked in order to allow a self clearing at the end of next driving cycle, if the following conditiong are gathered: - diagnosis has run long enough to detect a possible malfunction - malfunction not present					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
No parameter					

Formula section:

LV_DC_PERM_MEM = 0

For IDX_PERM = 1 to NC_NR_ERR_PERM
If(1) LV_ERR_PERM[IDX_PERM] = 1
Then(1)
(A permanent fault code is stored at IDX_PERM position)
LV_ERR_CLR[IDX_PERM] = 1
Else(1)
(No permanent fault code stored as from position IDX_PERM until end)
Exit
Endif(1)
Endfor

B.81.5 Impact of failure clearing (with diagnostic tool) inside permanent memory

Description for actions:

ACTION_ERRM_*ClcPermanentByErr* (< PRM_IDX_ERR >)					
This action is called when one unique failure is cleared by a diagnostic tool. After clearing of any individual failure, the related permanent code is marked to allow a self clearing at the end of next driving cycle, if the following conditiong are gathered: - diagnosis has run long enough to detect a possible malfunction - malfunction not present					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_IDX_ERR	IN	0...FFFFH	0...65535	1	[-]
Failure index					

Formula section:

LV_DC_PERM_MEM = 0

For IDX_PERM = 1 to NC_NR_ERR_PERM
If(1) ERR_PERM[IDX_PERM] = PRM_IDX_ERR
Then(1)
LV_ERR_CLR[IDX_PERM] = 1
Exit
Endif(1)
Endfor

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B.81.6 End of driving cycle computations

Description for actions:

ACTION_ERRM_*ClcPermanentResetDC* ( )					
This action is called by dynamic error management core module to execute computations linked to the end of driving cycle.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
No parameter					

Formula section:

(Has LV_DC_PERM already been set since last ERRM clearing (Mode $04...) ?)
If(1) LV_DC_PERM_MEM = 0
Then(1)
LV_DC_PERM_MEM = LV_DC_PERM
Endif(1)
(Clearing of permanent failure for which diagnostic has passed)
For IDX_PERM = 1 to NC_NR_ERR_PERM
If(1) (LV_ERR_PERM[IDX_PERM] = 1 **and** LV_ERR_CLR[IDX_PERM] = 1)
Then(1)
ACTION_ERRM_*GetErrLastClr*(ERR_PERM[IDX_PERM], PRM_LV_ERR_LST_CLR)
With XX = ERR_PERM[IDX_PERM]
If(2) PRM_LV_ERR_LST_CLR = 0
Then(2)
If(3) (LV_DC_PERM_MEM = 1 **and** LV_READY_XX = 0)
If(4) NLC_TREAT_DIAG_MIS = 1
Then(4)
"Conditions for treatment are true"
Endif(4)
ACTION_ERRM_*GetReadyClass*(ERR_PERM[IDX_PERM], PRM_READY_CLAS)
If(4) PRM_READY_CLAS <> CARB_MIS
Then(4)
"Conditions for treatment are true"
Endif(4)
If(4) "Conditions for treatment are true"
Then(4)
ERR_SYM_PERM[IDX_PERM] = 0 (NO_SYM)
Else(4)
If(5) PRM_IDX_ERR = MIS_A
Then(5)
SYM_CYL_PERM_MIS_A = 0
Else **If(5)** PRM_IDX_ERR = MIS_B1
Then(5)
SYM_CYL_PERM_MIS_B1 = 0
Else **If(5)** PRM_IDX_ERR = MIS_B4
Then(5)
SYM_CYL_PERM_MIS_B4 = 0
Endif(5)
Endif(4)

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```
                    (Permanent failure may be cleared)
                     ERR_PERM[IDX_PERM] = 0
                    LV_ERR_CLR[IDX_PERM] = 0
                     LV_ERR_PERM[IDX_PERM] = 0
                (Permanent failure counter is decreased)
                    If(4)      CTR_ERR_PERM_NR > 0
                    Then(4)
                               CTR_ERR_PERM_NR = CTR_ERR_PERM_NR - 1
                    Else(4)
                             CTR_ERR_PERM_NR = 0
                    Endif(4)
            Endif(3)
        Else(2)
            (Failure has been encountered at least once since last ERRM clear)
            (Permanent code must be locked until next ERRM clearing (Mode $04,...))
            LV_ERR_CLR[IDX_PERM] = 0
        Endif(2)
  Endif(1)
Endfor

(Permanent failure memory sorting to remove empty spaces - "heapsorting")
For IDX_PERM = 1 to (NC_NR_ERR_PERM-1)
      If(1)      ERR_PERM[IDX_PERM] = 0
  Then(1)
            For k = (IDX_PERM + 1) to NC_NR_ERR_PERM
                  If(2)      ERR_PERM[k] <> 0
                  Then(2)
                        (Swapping)
                         ERR_PERM[IDX_PERM] = ERR_PERM[k]
                         LV_ERR_CLR[IDX_PERM] = LV_ERR_CLR[k]
                        LV_ERR_PERM[IDX_PERM] = LV_ERR_PERM[k]
                         ERR_SYM_PERM[IDX_PERM] = ERR_SYM_PERM[k]
                         (Clearing of swapped data)
                         ERR_PERM[k] = 0
                         LV_ERR_CLR[k] = 0
                        LV_ERR_PERM[k] = 0
                         ERR_SYM_PERM[k] = 0 (NO_SYM)
                        Exit
                  Endif(2)
            Endfor
      Endif(1)
Endfor
```

B.81.7 Get failure permanent status

Description for actions:

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ACTION_ERRM_*GetErrPerm* (<PRM_IDX_ERR>, <PRM_LV_ERR_PERM>)					
This action is called to know if a given failure has a permanent code stored or not.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_IDX_ERR	IN	0...FFFFH	0...65535	1	[-]
Failure index					
PRM_LV_ERR_PERM	OUT	0...1H	0...1	1	[-]
Permanent status					

Formula section:

For IDX_PERM = 1 to NC_NR_ERR_PERM
If(1) ERR_PERM[IDX_PERM] = PRM_IDX_ERR
Then(1)
PRM_LV_ERR_PERM = 1
Exit
Else(2)
PRM_LV_ERR_PERM = 0
Endif(1)
Endfor

B.81.8 Clearing of permanent failure memory, in development

FUNCTION DESCRIPTION:

Description:

For development conveniences, it is often useful to reinitialise the permanent failure memory. This is possible by setting the calibration bit LC_ERR_PERM_CLR to 1.

Application conditions

Initialisation: *at RST system event*
LV_ERR_PERM_CLR_OLD = LC_ERR_PERM_CLR
at IGKON system event
LV_ERR_PERM_CLR_OLD = LC_ERR_PERM_CLR

Recurrence: *1 s*

Activation: *Always*

Formula section:

(Detection of LC_ERR_PERM_CLR 0 → 1 transition)
If (LV_ERR_PERM_CLR_OLD = 0
and
LC_ERR_PERM_CLR = 1)
Then
For IDX_PERM = 1 to NC_NR_ERR_PERM
ERR_PERM[IDX_PERM] = 0
LV_ERR_CLR[IDX_PERM] = 0
LV_ERR_PERM[IDX_PERM] = 0

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```
            ERR_SYM_PERM[IDX_PERM] = 0 (NO_SYM)
    Endfor
    If NLC_TREAT_DIAG_MIS = 0
    Then
            (XX stands for MIS_A, MIS_B1, and MIS_B4)
            SYM_CYL_PERM_XX = 0
    Endif
  CTR_ERR_PERM_NR = 0
    LV_DC_PERM_MEM = 0
Endif
LV_ERR_PERM_CLR_OLD = LC_ERR_PERM_CLR
```

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B.82 Priority rules

Input data:

LV_DC_MAX [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_CFM [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_DISA [NC_NR_ERR_DYN] {p. 5767}	NC_ERR_PRI_H {p. 5811}
PRI_CONF_XX {p. 5811}	WAL_CONF_XX {p. 5811}		

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_INC_ERR_PRI	-	0... 1H	0 ...1	1	-
Enable(1)/disable(0) increased failure priority strategy					
NLC_OBD_ENA_PRI_PERM	-	0... 1H	0 ...1	1	-
Activation/deactivation of special priority rule treatment for failures which are permanent (0: permanent failures are not protected, 1: permanent failures are protected)					
NLC_OLD_ERR_PRI	-	0... 1H	0 ...1	1	-
Set this bit to 1 to give priority to old failure regards to new failureSet this bit to 0 to give priority to new failure regards to old failure					

Import actions:

ACTION_ERRM_GetErrPerm (**OUT**<PRM_LV_ERR_PERM>,**IN**<PRM_IDX_ERR>)

General information

Export actions:

ACTION_ERRM_PrioRule (OUT <RESP>, OUT <IDX>)
This action performs priority rules, when failure memory is full, to say if the new failure is accepted or not.

B.82.1 Priority rules

General information:

The dynamic error management module calls this module in case of present failure occurrence when the 2^{nd} layer memory is full.

It defines criteria to store or not this failure in the 2^{nd} layer memory (dynamic memory). Only one failure occurrence is stored.

Results of this module is either:

- "storage of new failure not possible"
- or ("storage of new failure possible" ; index of failure to delete in 2^{nd} layer memory)

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In case of new failure entry whereas the dynamic memory is full (number of stored failure = NC_NR_ERR_DYN), different criteria are applied to prioritize the failure:

- A new failure is more important than a disappeared failure

- Failure priority as defined in PRI_CONF_XX ;
  - Chronological failure order

    If NLC_OLD_ERR_PRI = 1: old failure has priority regards of new failure;
    (Failure i older than failure j means failure i has entered 2^{nd} layer memory before failure j)

    If NLC_OLD_ERR_PRI = 0: new failure has priority regards of old failure;
    (Failure i newer than failure j means failure i has entered 2^{nd} layer memory after failure j)

- NLC_OBD_ENA_PRI_PERM

  - Set this bit to 1 in order to protect permanent failures within priority rules algorithm: permanent faults cannot be deleted by priority rules

  - NLC_OBD_ENA_PRI_PERM = 1 : Permanent faults are protected.
    Must be used with US applications

  - Set this bit to 0 to apply always priority rules even if failure to be removed is permanent.

  - NLC_OBD_ENA_PRI_PERM = 0 : Permanent faults not protected.

  - When the ERRM memory is full, this action manages failure entry based on priority rules.
    Then, based on action result, failure entry is authorized or rejected.

.

Additional features of this functionality:

- MIL can never be switched off

- Failure setting the OBD freeze frame (e.g. used for diagnostic communication with scantool /mode 2h) cannot be erased.

- The “increased priority” can be enabled with the configuration NLC_INC_ERR_PRI. This priority is a final rule, which is used, if it’s not possible to enter a failure with any of the other possibilities. Then it’s possible (only for failure with priority $>=$ 4) to store the failure, if a confirmed failure not of the highest priority (priority $<$ NC_ERR_PRI_H), which is not illumination the MIL anymore, can erased instead.If the new failure entry is not accepted because of the priority, this failure will not be stored in the 2^{nd} layer memory but limp home is activated, thus the freeze frame is not memorized and also no lamp management for this failure is possible.

Application conditions:

Initialisation: –

Activation: –

Deactivation: –

Recurrence: –

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Function description:

Formula section:

B.82.2 Detailed description for Action: ACTION_ERRM_ClcPriorityRules

General information:

Syntax : ACTION_ERRM_PrioRule (OUT <RESP>, OUT <IDX>)
Parameter (in) : -
Parameter (out) : RESP OK if storage is possible; NOK if storage is not possible
IDX Index of failure in 2^{nd} layer memory to delete
Short description : This action performs priority rules, when failure memory is full, to say if the new failure
is accepted or not.

Application conditions:

Initialisation: –

Activation: –

Deactivation: at action request

Recurrence: –

Function description:

Formula section:

ACTION_ERRM_PrioRule (RESP, IDX) :

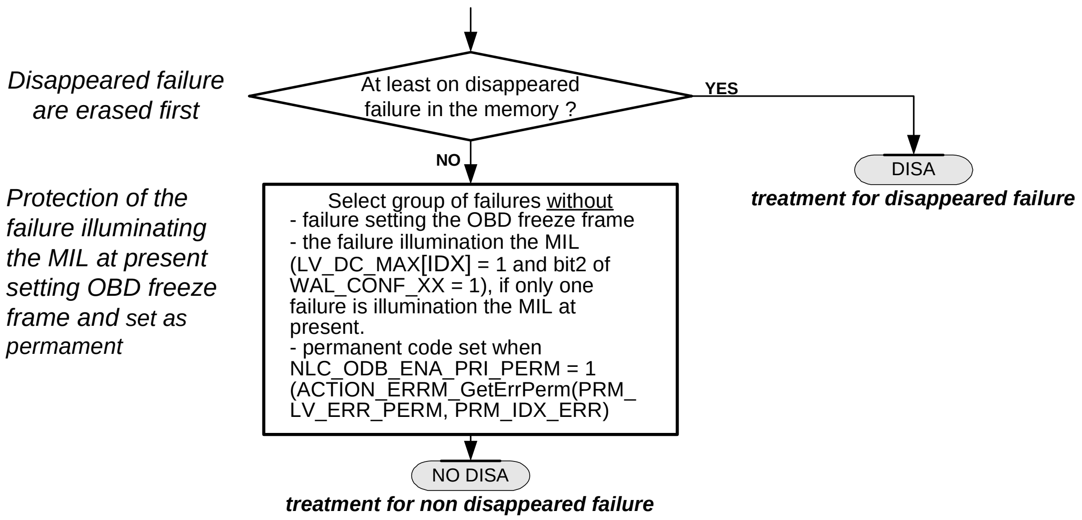

Figure B.82.1:

Treatment for non disappeared failure:

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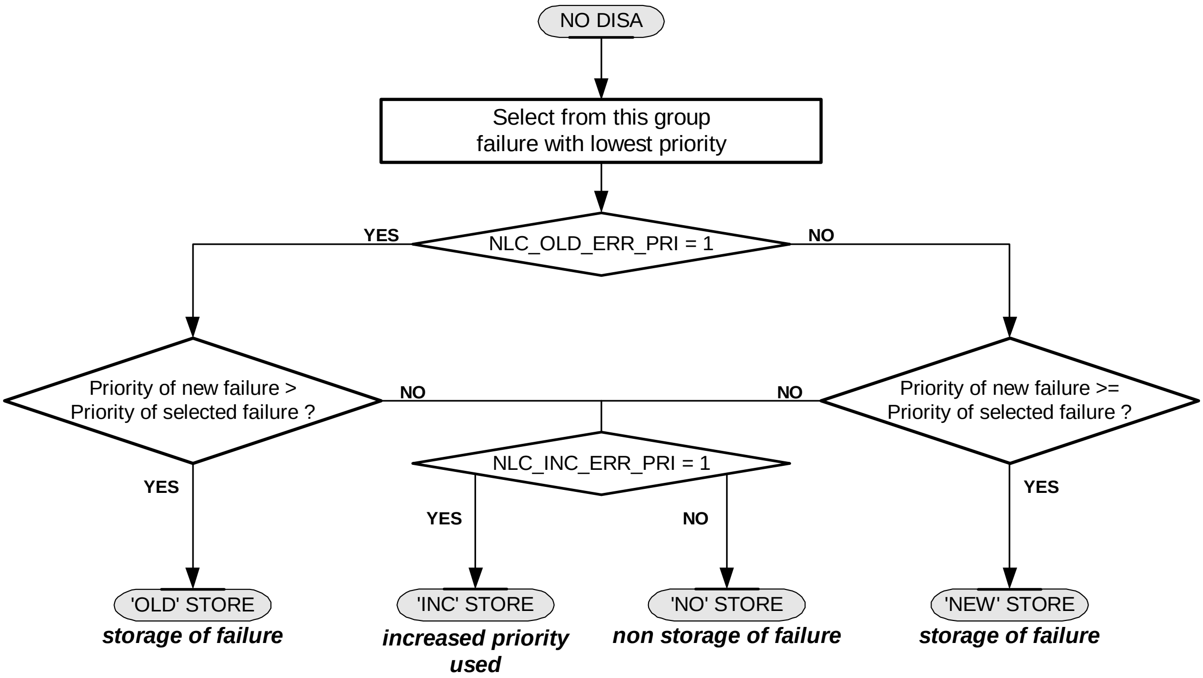

Figure B.82.2:

Treatment for disappeared failure:

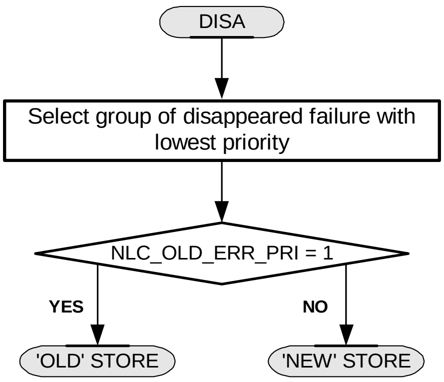

Figure B.82.3:

Storage /non storage of failure:

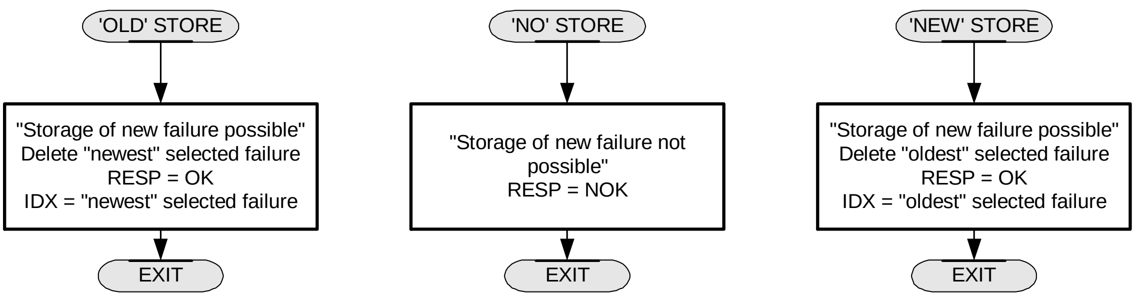

Figure B.82.4:

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Increased priority (with NLC_INC_ERR_PRI = 1):

New failure with priority >= 4 gets specific chance to enter the error memory.

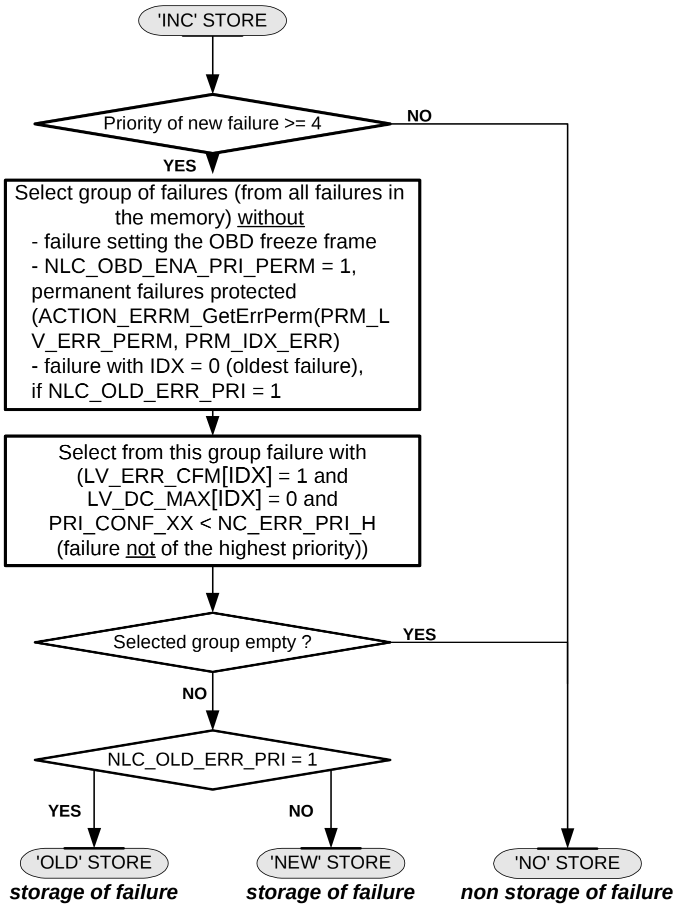

Figure B.82.5:

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B.83 Rate based monitoring

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CDN_OBD_RBM	O/V/S	0... FFFFH	0... 65535	1	-
General denominator: Number of DC with valid standardized vehicle operations since first ECU power up					
CTR_CDN_RBM [NC_NR_DIAG_RBM]	O/V/S	0... FFFFH	0... 65535	1	-
Monitor individual denominator: Number of DC with convenient vehicle operation for monitor since first power up					
CTR_COMP_RBM [NC_NR_DIAG_RBM]	O/V/S	0... FFFFH	0... 65535	1	-
Monitor individual numerator: Number of DC with monitor done since first power up					
CTR_IGK_CYC_RBM	O/V/S	0... FFFFH	0... 65535	1	-
Ignition cycle counter: Number of DC since first ECU power up					
LV_DC_CDN_CST_RBM	O/V	0... 1H	0 ...1	1	-
Cold start conditions for individual denominator calculation					
LV_DC_RBM	O/V	0... 1H	0 ...1	1	-
DC including standardized vehicle operations for Rate-Based Monitoring					
LV_IGK_CYC_RBM	V	0... 1H	0 ...1	1	-
Boolean to indicate, that incrementation of CTR_IGK_CYC_RBM done this DC					
STATE_CTR_RBM [NC_NR_DIAG_RBM]	V	0... 3H	0 ...3	1	-
Information data for CTR_COMP_RBM					
STATE_DC_RBM	V	0... FFH	0... 255	1	-
Status information about all conditions necessary to set LV_DC_RBM					
T_AST_CST_RBM	V	0... FFFFH	0... 6553.5	0.1	s
Cumulative time since engine start (based on ambient temperature conditions)					
T_AST_RBM	V	0... FFFFH	0... 6553.5	0.1	s
Cumulated time since engine start with Rate-Based Monitoring conditions					
T_IS_RBM	V	0... FFFFH	0... 6553.5	0.1	s
Continuous vehicle operation in idle >= C_T_IS_RBM with Rate-Based Monitoring conditions					
T_VS_RBM	V	0... FFFFH	0... 6553.5	0.1	s
Cumulated vehicle operation with vehicle speed >= C_T_VS_RBM with Rate-Based Monitoring conditions					
TAM_ST_DSL_CMN	V	0... FEH	-48... 142.5	0	°C
Ambient temperature at engine start (used within ERRM only to handle GS/DS data types diversity)					

Input data:

AMP {p. 982}	LV_DC {p. 5746}	LV_INH_DC_RBM {p. 5870}	LV_IS_RBM {p. 5870}
LV_PWL {p. 988}	NC_NR_DIAG_RBM {p. 5871}	PV {p. 978}	STATE_RBM [NC_NR_DIAG_RBM] {p. 5870}
TAM_DSL_CMN {p. 5870}	TCO_ST_DSL_CMN {p. 5789}	VS {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_MIN_RBM	-	0... FFFFH	0... 5434	0.0829175	hPa
Minimum ambient pressure for Rate-Based Monitoring (relation to altitude)					
C_DLY_AST_RBM	-	0... FFFFH	0... 6553.5	0.1	s
Time after start, necessary to increment the ignition cycle counter					
C_PV_IS_RBM	-	0... 3FFH	0... 99.90234	0.0976562	%
Minimum threshold to detect accelerator pedal released					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_AST_CST_RBM	-	0... FFFFH	0... 6553.5	0	s
Minimum comulative time since engine start for cold start condition detection					
C_T_AST_RBM	-	0... FFFFH	0... 6553.5	0.1	s
Minimum trip length for Rate-Based Monitoring					
C_T_IS_RBM	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time of continuous idle operation for Rate-Based Monitoring					
C_T_VS_RBM	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time with VS_H_RES greater or equal than C_VS_THD_RBM for Rate-Based Monitoring					
C_TAM_MAX_CST_RBM	-	0... FEH	-48... 142.5	0	°C
Maximum ambient temperature threshold for for RBM cold start condition					
C_TAM_MIN_CST_RBM	-	0... FEH	-48... 142.5	0	°C
Minimum ambient temperature threshold for RBM cold start condition					
C_TAM_MIN_RBM	-	0... FEH	-48... 142.5	0.75	°C
Minimum ambient temperature for Rate-Based Monitoring					
C_TAM_ST_HYS_CST_RBM	-	0... FEH	-48... 142.5	0	°C
Ambient temperature hysteresis for RBM cold start condition					
C_TCO_ST_MAX_CST_RBM	-	0... FEH	-48... 142.5	0	°C
Maximum engine start temperature threshold for RBM cold start condition					
C_TCO_ST_MIN_CST_RBM	-	0... FEH	-48... 142.5	0	°C
Minimum engine start temperature threshold for RBM cold start condition					
C_VS_THD_IS_CDN_RBM	-	0... FFH	0... 25.5	0.1	km/h
Vehicle speed threshold for continuous idle speed operation, for Rate-Based Monitoring					
C_VS_THD_RBM	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed threshold to start timer T_VS_RBM					

Output data detailed description:

STATE_CTR_RBM[NC_NR_DIAG_RBM] : Information data for CTR_COMP_RBM[NC_NR_DIAG_RBM] and CTR_CDN_RBM[NC_NR_DIAG_RBM] calculations.

bit 0: incrementation of monitor individual numerator done in this DC

bit 1: incrementation of monitor individual denominator done in this DC

FUNCTION DESCRIPTION:

General information:

To gain more information about the monitoring performance under real world conditions, CARB required to implement software algorithms to track and report in-use performance for the following monitors in a standardized format: Catalyst, Oxygen sensor, Evaporating system, EGR system, VVT system and Secondary air system.

For this kind of statistic different counters are necessary:

- Ignition cycle counter

Counter that indicates the number of ignition cycles a vehicle has experienced

- General denominator

Measures the number of times a vehicle is operated under standardized conditions

- Monitor individual numerator

Measures the number of driving cycles in which the monitor was done

- Monitor individual denominator

Counter that indicates the number of times a vehicle is operated under monitor indiividual conditions.

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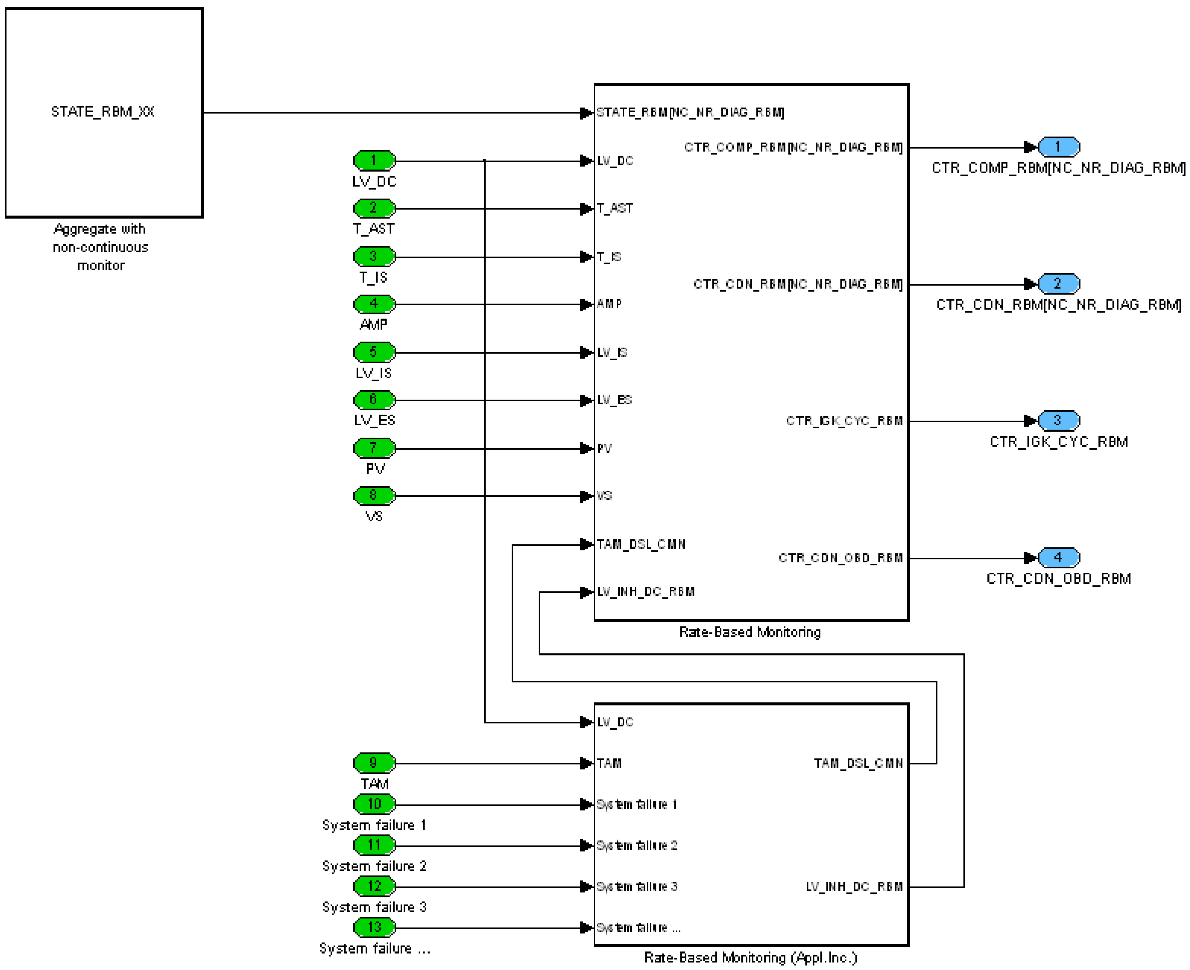
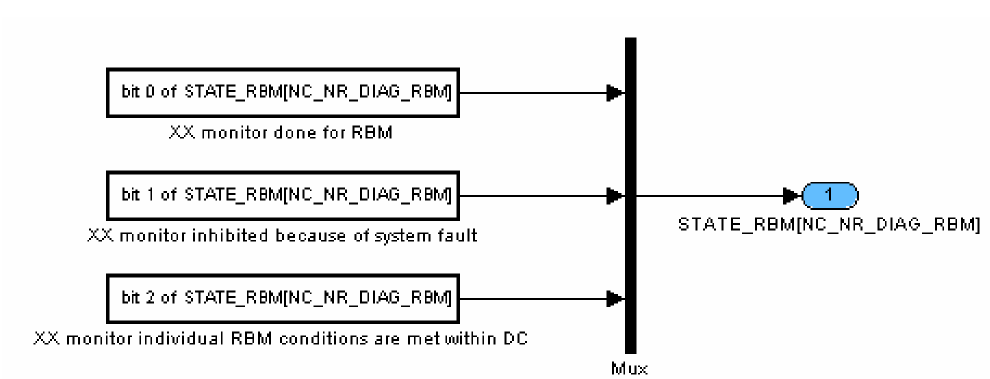
All these counters are set to zero only when a non-volatile memory reset occurs (e.g. reprogramming). They will not be initialized with zero on any other circumstances including when a scan-tool command to clear fault codes is received.

Signal flow diagram:

Overview :



STATE_RBM[NC_NR_DIAG_RBM] definition :



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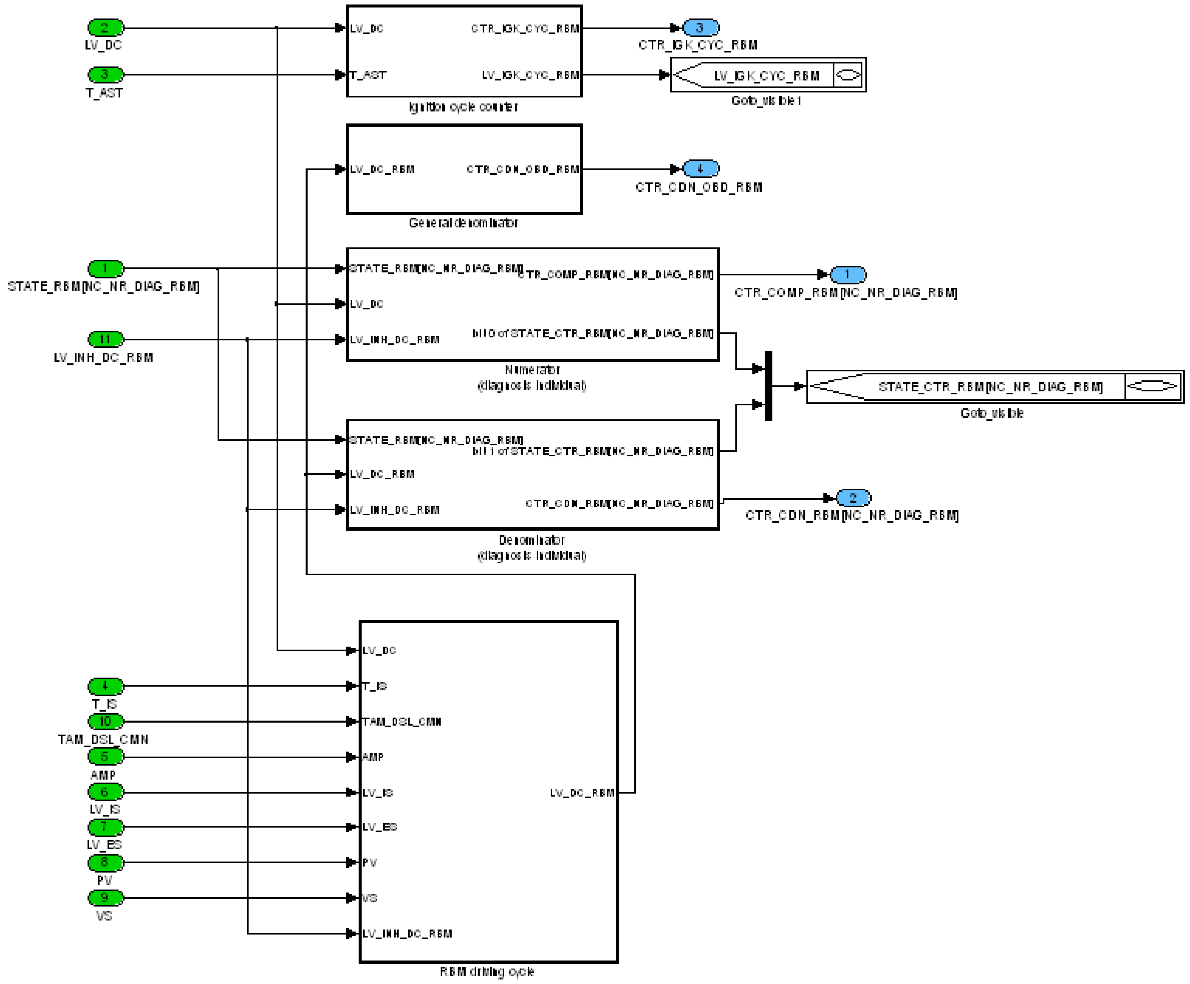
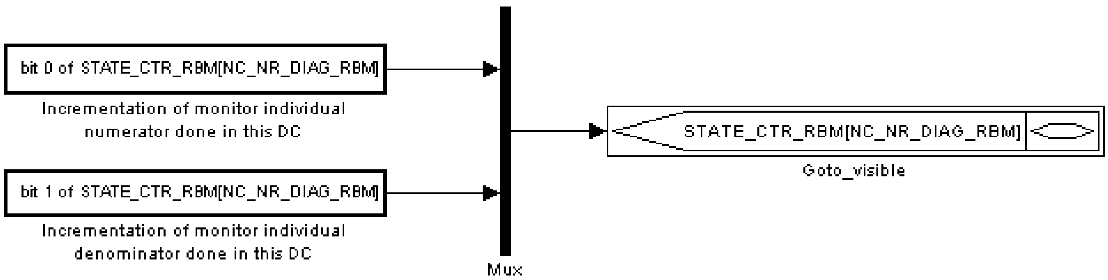
Modules of Rate-Based Monitoring :



STATE_CTR_RBM[NC_NR_DIAG_RBM] definition:



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B.83.1 Ignition cycle counter

Description:

The number of ignition cycles since the first ECU power up are counted within CTR_IGK_CYC_RBM. The counter is incremented each time a driving cycle with engine running for at least 2 seconds ($\pm$1s)

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(C_DLY_AST_RBM) is detected. This value is only initialized with 0 on saved RAM lost (or reprogramming). If CTR_IGK_CYC_RBM is incremented LV_IGK_CYC_RBM is set to 1 to indicate that counter is already incremented within this driving cycle.
If the counter reaches its maximum value, the value is set to 0 on the next calculation.

Application conditions

Initialisation: at first ECU power up / on saved RAM lost (or reprogramming)
CTR_IGK_CYC_RBM = 0
at reset
CTR_IGK_CYC_RBM = restored from NVMY
at LV_DC 0 → 1 transition and ECU reset
LV_IGK_CYC_RBM = 0

Recurrence: *1 s*

Activation: *LV_DC = 1* ***and*** *LV_IGK_CYC_RBM = 0*

Formula section:

Quantity of driving cycles calculation:
If T_AST >= C_DLY_AST_RBM (time after start at least C_DLY_AST_RBM)
Then
If CTR_IGK_CYC_RBM = 65535 (maximum value of CTR_IGK_CYC_RBM)
Then
CTR_IGK_CYC_RBM = 0
Else
CTR_IGK_CYC_RBM = CTR_IGK_CYC_RBM + 1
Endif
LV_IGK_CYC_RBM = 1 (CTR_IGK_CYC_RBM incremented this DC)
Endif

B.83.2 General denominator calculation

Description:

The counter for the general denominator CTR_CDN_OBD_RBM is incremented each time a valid DC with standardized vehicle operation (LV_DC_RBM = 1) is recognized. The numbers of driving cycles are counted since the first ECU power up. This value is only initialized with 0 on saved RAM lost (or reprogramming).
If the counter reaches its maximum value, the value is set to 0 on the next calculation.

Application conditions

Initialisation: at first ECU power up / on saved RAM lost (or reprogramming)
CTR_CDN_OBD_RBM = 0
at reset
CTR_CDN_OBD_RBM = restored from NVMY

Recurrence: –

Activation: *LV_DC_RBM 0→1 transition*

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Formula section:

If CTR_CDN_OBD_RBM = 65535 (maximum value of CTR_CDN_OBD_RBM)
Then
CTR_CDN_OBD_RBM = 0
Else
General denominator calculation:
CTR_CDN_OBD_RBM = CTR_CDN_OBD_RBM + 1
Endif

B.83.3 Monitor individual numerator calculation

Description:

For all monitors requiring Rate-Based Monitoring (m = 0 to (NC_NR_DIAG_RBM - 1)) a numerator must be calculated. This numerator CTR_COMP_RBM[m] is incremented, if the conditions for the monitor were present for a sufficient time (bit 0 of STATE_RBM[m] = 1), but only one time within the driving cycle. This value is only initialized with 0 on saved RAM lost (or reprogramming)
If the counter CTR_CDN_RBM[m] is halved, because of maximum value limitation, the value CTR_COMP_RBM[m] is also divided by 2 (positive rounded).

Application conditions

Initialisation:
```
at first ECU power up /  on saved RAM lost (or reprogramming)
   CTR_COMP_RBM[m]  = 0
  at reset
   CTR_COMP_RBM[m]  = restored from NVMY
 at LV_DC 0 →1 transition or ECU reset
   STATE_CTR_RBM[m]  = 0
  with m = 0 to (NC_NR_DIAG_RBM – 1)
```
Recurrence: `10 s` **or** `LV_DC 1 → 0 transition`

Activation: `LV_INH_DC_RBM = 0` **and** `LV_DC = 1`

Formula section:

For m = 0 to (NC_NR_DIAG_RBM - 1)
all monitor requiring Rate-Based Monitoring
{ see specification "Rate-Based Monitoring (Appl. Inc.)" }
If bit 0 of STATE_CTR_RBM[m] = 0
(Incrementation of CTR_COMP_RBM[m] not yet done in this DC)
Then **If** bit 0 of STATE_RBM[m] = 1
(monitor is done for RBM)
and bit 1 of STATE_RBM[m] = 0
(monitor isn't inhibited because of a system fault)
Then CTR_COMP_RBM[m] = CTR_COMP_RBM[m] + 1
bit 0 of STATE_CTR_RBM[m] = 1
(Incrementation of CTR_COMP_RBM[m] done in DC)
Endif
Endif
Endfor

B.83.4 Monitor individual denominator calculation

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Description:

In comparison to the counter CTR_IGK_CYC_RBM, counting the numbers of driving cycles (longer C_DLY_AST_RBM) since the first ECU power-up, the monitor individual denominator is counting the number of DC in which special vehicle/driving and ambient conditions are met individually for each monitor.
The counter CTR_CDN_RBM[m] is managed individually for each monitor (m = 0 to (NC_NR_DIAG_RBM - 1)), for which the monitoring of the real in-use performance is made. To increment the monitor denominator, some common conditions must be fulfilled (LV_DC_RBM = 1) but also monitor individual conditions. These monitor individual conditions are managed within the monitor function (bit 2 of STATE_RBM[m]). The value is only initialized with 0 on saved RAM lost (or reprogramming).
If the counter CTR_COMP_RBM[m] is halved, because of maximum value limitation, the value CTR_CDN_RBM[m] is also divided by 2 (positive rounded).

Application conditions

Initialisation:

```
at first ECU power up /  on saved RAM lost (or reprogramming)
      CTR_CDN_RBM[m]   = 0
   at reset
      CTR_CDN_RBM[m]   = restored from NVMY
   with m = 0 to (NC_NR_DIAG_RBM - 1)
```

Recurrence: *10 s **or** LV_DC 1 → 0 transition (before LV_DC_RBM initialisation performed at LV_DC 1 → 0)*

Activation: *LV_INH_DC_RBM = 0 **and** LV_DC_RBM = 1*

Formula section:

For m = 0 to (NC_NR_DIAG_RBM - 1)
all monitor requiring Rate-Based Monitoring
{ see specification "Rate-Based Monitoring (Appl. Inc.)" }
If bit 1 of STATE_CTR_RBM[m] = 0
(incrementation is not done yet)
Then **If** bit 1 of STATE_RBM[m] = 0
(monitor is not inhibit, because of a system fault)
and bit 2 of STATE_RBM[m] = 1
(monitor individual RBM conditions are met within this DC)
Then CTR_CDN_RBM[m] = CTR_CDN_RBM[m] +1
bit 1 of STATE_CTR_RBM[m] = 1
(incrementation is done within DC)
Endif
Endif
Endfor

B.83.5 Counter overflow treatment for monitor individual numerator and denominator

Description:

If either the numerator or denominator for a specific component reaches the maximum value (65535), both numbers shall be divided by two before either is incremented again to avoid overflow problems.

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Application conditions

Initialisation: –

Recurrence: –

Activation: `LV_DC 0 → 1 transition`

Formula section:

For m = 0 to (NC_NR_DIAG_RBM - 1)
  all monitor requiring Rate-Based Monitoring
  { see specification “Rate-Based Monitoring (Appl. Inc.)” }
  If CTR_CDN_RBM[m] = 65535 (maximum value of CTR_CDN_RBM[m])
  or
  CTR_COMP_RBM[m] = 65535 (maximum value of CTR_COMP_RBM[m])
  Then CTR_CDN_RBM[m] = CTR_CDN_RBM[m] /2
  CTR_COMP_RBM[m] = CTR_COMP_RBM[m] /2
  Endif
Endfor

B.83.6 Standardized vehicle operation for Rate-Based Monitoring

FUNCTION DESCRIPTION:

General information:

For the calculation of the denominators for Rate-Based Monitoring, CARB standardized vehicle operations, which must be met to increment the denominator counter.

Description:

A special driving cycle (LV_DC_RBM) for Rate-Based Monitoring is defined, which is set, if the following standardized vehicle operations are fulfilled:

- Cumulated trip length (time since engine start) T_AST_RBM >= C_T_AST_RBM

(CARB : 600 s)

- Cumulative vehicle operation >= C_VS_THD_RBM for minimum of C_T_VS_RBM

(CARB : >= 40 km/h (25mph) for at least 300 s)

- Continuous vehicle operation in idle equal or longer than C_T_IS_RBM (accelerator pedal released and vehicle speed less or equal than 1 mph)

(CARB : 30 s)

with

- altitude such as ambient pressure AMP > C_AMP_MIN_RBM

(CARB : 8000 feet)

- ambient temperature (TAM_DSL_CMN) >= C_TAM_MIN_RBM

  (CARB : 20 °F)

Remark: to manage data type diversity between GS and DS divisions, TAM_DSL_CMN variable is updated with ambient temperature information every 100 ms.

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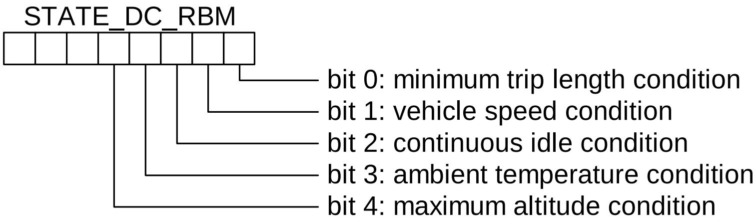
Within STATE_DC_RBM the different conditions necessary to set LV_DC_RBM are visualized.



bit value = 0: condition not met yet; bit value = 1: condition met

Application conditions

Initialisation:

```
at LV_DC 0 → 1 transition or  reset
      LV_DC_RBM = 0
      STATE_DC_RBM = 0H
     T_AST_RBM = 0 s
     T_VS_RBM = 0 s
     T_IS_RBM = 0 s
 at LV_DC 1 → 0 transition
    after individual numerator/ denominator computations:
      LV_DC_RBM = 0
             STATE_DC_RBM = 0H
```

Recurrence: *100 ms*

Activation:

```
LV_DC = 1 and LV_PWL = 0
and
LV_DC_RBM = 0
and
LV_INH_DC_RBM = 0
```

Formula section:

Ambient temperature

If (1) TAM_DSL_CMN >= C_TAM_MIN_RBM (ambient temperature condition)
Then (1) bit 3 of STATE_DC_RBM = 1 (ambient temperature condition reached)
Else (1) bit 3 of STATE_DC_RBM = 0 (ambient temperature condition not reached)
Endif (1)

Maximum altitude

If (1) AMP > C_AMP_MIN_RBM (maximum altitude condition)
Then (1) bit 4 of STATE_DC_RBM = 1 (maximum altitude condition reached)
Else (1) bit 4 of STATE_DC_RBM = 0 (maximum altitude condition not reached)
Endif (1)

If (1) bit 3 and bit 4 of STATE_DC_RBM = 1
Then (1)

Minimum trip length

If (2) bit 0 of STATE_DC_RBM = 0 (minimum trip length not reached yet)
Then (2)

T_AST_RBM = T_AST_RBM + 100 ms
If (3) T_AST_RBM = C_T_AST_RBM

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Then (3)
bit 0 of STATE_DC_RBM = 1
Endif (3)
Endif (2)
Vehicle speed
If (2) bit 1 of STATE_DC_RBM = 0 (vehicle speed condition not met yet)
and
VS >= C_VS_THD_RBM
Then (2)
T_VS_RBM = T_VS_RBM + 100 ms
If (3) T_VS_RBM = C_T_VS_RBM
Then (3)
bit 1 of STATE_DC_RBM = 1
Endif (3)
Endif (2)

Continuous idle
If (2) bit 2 of STATE_DC_RBM = 0 (continuous idle cond. not met yet)
Then (2)
If (3) LV_IS_RBM = 1 (engine is considered as being in idle)
and
PV <= C_PV_IS_RBM (accelerator pedal released)
and
VS <= C_VS_THD_IS_CDN_RBM (CARB: 1 mile/h)
Then (3)
T_IS_RBM = T_IS_RBM + 100 ms
If (4) T_IS_RBM = C_T_IS_RBM
Then (4)
bit 2 of STATE_DC_RBM = 1
Endif (4)

Else (3)
T_IS_RBM = 0
Endif (3)
Endif (2)
Else (1)
T_IS_RBM = 0 (ambient temperature and maximum altitude conditions not met during the whole continuous idle speed condition)
Endif (1)

Global information about DC including standardized vehicle operations
If (1) STATE_DC_RBM = 1FH (all conditions are met)
Then (1) LV_DC_RBM = 1
Endif (1)

B.83.7 Cold start conditions detection

FUNCTION DESCRIPTION:

General information:

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The individual monitor condition established for evaporative system denominator calculation (see §1968.2 - 4.3.2, section D) can be applied for other diagnoses (bit 2 calculation of STATE_RBM_xx) that require extended monitoring evaluation (e.g. coolant or intake air rationality).

Description:

Cold start conditions are set within the driving cycle when: (see §1968.2 - 4.3.2, section D)

- Cumulative time since engine start is greater than or equal to 600 seconds while at an ambient temperature of greater than or equal to 40 degrees Fahrenheit but less than or equal to 95 degrees Fahrenheit
- Engine cold start occurs with engine coolant temperature at engine start greater than or equal to 40 degrees Fahrenheit but less than or equal to 95 degrees Fahrenheit and less than or equal to 12 degrees Fahrenheit higher than ambient temperature at engine start.

Application conditions

Initialisation: at RST system event **or** at LV_DC 0 → 1 transition
LV_DC_CDN_CST_RBM = 0
T_AST_CST_RBM = 0 s
TAM_ST_DSL_CMN = TAM_DSL_CMN

Recurrence: *100ms*

Activation: LV_DC = 1
and
LV_DC_CDN_CST_RBM = 0
and
LV_INH_DC_RBM = 0
Dectivation: LV_DC = 0
or
LV_DC_CDN_CST_RBM = 1
or
LV_INH_DC_RBM = 1

Formula section:

If(1) C_TAM_MIN_CST_RBM <= TAM_DSL_CMN <= C_TAM_MAX_CST_RBM
(ambient temperature greater than or equal to 40 degrees Fahrenheit but less than or equal to 95 degrees Fahrenheit)
Then(1)
If(2) T_AST_CST_RBM >= C_T_AST_CST_RBM
(time since start is greater than or equal to 600 seconds)
Then(2)
T_AST_CST_RBM is frozen
If(3) C_TCO_ST_MIN_CST_RBM <= TCO_ST_DSL_CMN <= C_TCO_ST_MAX_CST_RBM
(engine coolant temperature at engine start is greater than or equal to 40 degrees but less than or equal to 95 degrees Fahrenheit)
and
TCO_ST_DSL_CMN <= (TAM_ST_DSL_CMN + C_TAM_ST_HYS_CST_RBM)
(less than or equal to 12 degrees Fahrenheit higher than ambient temperature at engine start)
Then(3)
LV_DC_CDN_CST_RBM = 1
Endif(3)

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Else(2)

T_AST_CST_RBM = T_AST_CST_RBM + 100ms

Endif(2)

Else(1)

T_AST_CST_RBM is frozen

Endif(1)

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B.84 Rate based monitoring (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_CST_RBM	O/V	0... 1H	0 ...1	1	-
Cold start conditions for individual denominator calculation					
LV_INH_DC_RBM	O/V	0... 1H	0 ...1	1	-
Inhibition of standardized vehicle operation calculation, due to a system failure that influences the conditions necessary to set LV_DC_RBM					
LV_IS_RBM	O/V	0... 1H	0 ...1	1	-
Adaptation for STST Hybrid Idle detection					
LV_OBD_IS_RBM_CUS_ADJ	O/V	0... 1H	0 ...1	1	-
Adaptation for costumer specific idle detection used inside rbm cycle					
STATE_RBM [NC_NR_DIAG_RBM]	O	0... FH	0... 15	1	-
Monitor interface for the Rate-Based Monitoring statistics					
TAM_DSL_CMN	O/V	0... FEH	-48... 142.5	0.75	°C
Ambient temperature (used within ERRM only to support GS/DS data types diversity)					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_DC {p. 5746}	LV_DC_CDN_CST_RBM {p. 5858}	LV_DC_RBM {p. 5858}
LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_TAM_CAN {p. 5076}	LV_ERR_TAM_PLAUS {p. 5076}	LV_ERR_VS {p. 5021}
NC_CYL_NR {p. 1526}	NC_IDX_DIAG_XX	NC_INJ_CONF {p. 626}	STATE_RBM_AIR_LSL_UP [NC_CBK_EX_NR] {p. 5285}
STATE_RBM_AMP_PLAUS {p. 6130}	STATE_RBM_ANG_CHK_MAX_VVL	STATE_RBM_ANG_INST_AD_VVL	STATE_RBM_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT] {p. 1063}
STATE_RBM_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT] {p. 1063}	STATE_RBM_CAT_DIAG [NC_CBK_EX_NR]	STATE_RBM_CHK_LS_DOWN [NC_CBK_EX_NR] {p. 5407}	STATE_RBM_CS {p. 5018}
STATE_RBM_CSERS_INJ {p. 6117}	STATE_RBM_CYL_BAL_LAM [NC_CYL_NR]	STATE_RBM_DIAGCPS {p. 5954}	STATE_RBM_DMTLM {p. 6037}
STATE_RBM_DYN_VLD_LS_UP [NC_CBK_EX_NR] {p. 5378}	STATE_RBM_EAC	STATE_RBM_EFF_IGA_CST_IS {p. 6508}	STATE_RBM_EFF_IGA_CST_PL {p. 6508}
STATE_RBM_ER_BAL_HOM [NC_NR_CBK_BAL_HOM]	STATE_RBM_FTL_OBD {p. 4757}	STATE_RBM_FUP_CH [NC_CBK_HPP_NR] {p. 6102}	STATE_RBM_ISC {p. 4392}
STATE_RBM_ISC_CST {p. 4392}	STATE_RBM_LOAD_TPS_PLAUS {p. 1063}	STATE_RBM_MAF {p. 4820}	STATE_RBM_MAP_DIP_PLAUS {p. 1063}

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STATE_RBM_MAP_TPS_PLAUS [NC_MAP_SENS_NR]	STATE_RBM_MEC_IVVT_EX {p. 1063}	STATE_RBM_MEC_IVVT_IN {p. 1064}	STATE_RBM_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5210}
STATE_RBM_OBD_VLD_LSH_UP [NC_CBK_EX_NR] {p. 5433}	STATE_RBM_OC_LS_DOWN [NC_CBK_EX_NR] {p. 4252}	STATE_RBM_OC_LSL_UP [NC_CBK_EX_NR] {p. 4309}	STATE_RBM_PUC_LS_DOWN [NC_CBK_EX_NR] {p. 4252}
STATE_RBM_PUC_VLD_LS_UP [NC_CBK_EX_NR] {p. 5291}	STATE_RBM_PUE_LS_DOWN [NC_CBK_EX_NR] {p. 5190}	STATE_RBM_ROUGH_LEAK {p. 6037}	STATE_RBM_SA_SAFM
STATE_RBM_SA_SAP	STATE_RBM_SA_SAV	STATE_RBM_SA_SAV_LSL	STATE_RBM_SA_SYS
STATE_RBM_SCG_LS_DOWN [NC_CBK_EX_NR] {p. 4252}	STATE_RBM_SHIFT_AFL_LSL_UP [NC_CBK_EX_NR] {p. 5340}	STATE_RBM_SHIFT_AFR_LSL_UP [NC_CBK_EX_NR] {p. 5340}	STATE_RBM_SMALL_LEAK {p. 6037}
STATE_RBM_SWT_LS_DOWN [NC_CBK_EX_NR] {p. 5160}	STATE_RBM_T_ES {p. 4477}	STATE_RBM_T_ES_TCO_FAST {p. 4477}	STATE_RBM_T_ES_TCO_SLOW {p. 4477}
STATE_RBM_TAM_PLAUS {p. 5083}	STATE_RBM_TCO_2_PLAUS {p. 5672}	STATE_RBM_TCO_PLAUS {p. 5687}	STATE_RBM_TCO_STUCK {p. 4502}
STATE_RBM_TCO_STUCK_RNG {p. 5678}	STATE_RBM_TH {p. 5660}	STATE_RBM_TIA_MES_PLAUS [NC_SENS_NR_TIA]	STATE_RBM_TIA_PLAUS {p. 5103}
STATE_RBM_TIA_THR_MES_PLAUS [NC_SENS_NR_TIA_THR]	STATE_RBM_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4415}	STATE_RBM_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4415}	STATE_RBM_TPS {p. 5007}
STATE_RBM_TQ_CST {p. 1064}	STATE_RBM_VLS_DOWN_DIF [NC_CBK_EX_NR] {p. 5229}	TAM {p. 1579}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_RBM_CLR	-	0... 1H	0 ...1	1	-
reinit the rate base monitoring statistics at LC_RBM_CLR 0->1					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_TBL_DIAG_RBM [NC_NR_DIAG_RBM]	-	0... FFH	0... 255	1	-
Table of monitors connected to Rate-Based Monitoring function					
NC_NR_DIAG_RBM	-	1... FFH	1... 255	1	-
Instance number of monitor using RBM statistics					
NC_NR_DIST_RBM	-	1... FFH	1... 255	1	-
Number of diesel monitors with mileage criteria to increment denominator (Typical value : 1)					
NC_RBM_BPA	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for boost pressure control (diesel only)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_RBM_CAT_1	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for catalyst bank 1					
NC_RBM_CAT_2	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for catalyst bank 2					
NC_RBM_CUS	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for specific customer group (not displayed on Scan Tool)					
NC_RBM_EG_1	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for exhaust gas sensor bank 1 (diesel only)					
NC_RBM_EGR_VVT	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for EGR and VVT systems					
NC_RBM_EGR_VVT_DSL	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for EGR and VVT systems (diesel only)					
NC_RBM_EVAP	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for evaporative system					
NC_RBM_LS_DOWN_1	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for secondary oxygen sensor bank 1 (gasoline only)					
NC_RBM_LS_DOWN_2	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for secondary oxygen sensor bank 2 (gasoline only)					
NC_RBM_LS_UP_1	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for oxygen sensor bank 1					
NC_RBM_LS_UP_2	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for oxygen sensor bank 2					
NC_RBM_NMHC	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for NMHC catalyst (diesel only)					
NC_RBM_NT	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for NOx adsorber (NOx trap) (diesel only)					
NC_RBM_PF	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for PM particulate filter (diesel only)					
NC_RBM_RCAT	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for NOx reduction catalyst (diesel only)					
NC_RBM_SA	-	0... FFH	0... 255	1	-
Rate-based monitoring group name for secondary air system					

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)
ACTION_ERRM_ClearRbmStatistics (<OUT>,<PRM_RESULTCLRINFO>)

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B.84.1 Definition of diagnosis using RBM

FUNCTION DESCRIPTION:

Description:

Depending on the system configuration and the customer requirements, the diagnosis individual counters for Rate-Based Monitoring, the numerator and denominator, must be calculated for specific monitors.

Within this module the monitors using RBM statistics are defined.

Application conditions

Initialisation : at ECU reset and LV_DC 0 1 transition :

```
    For  i = 0 to NC_NR_DIAG_RBM do
    STATE_RBM[i] = 0
        Endfor
```

Recurrence: 10 s { always executed prior to Rate-Based Monitoring main module }

Activation: every engine operating state

Formula section:

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	Interface byte	Group Name
1	STATE_RBM_CAT_DIAG_1	NC_RBM_CAT_1
2	STATE_RBM_CAT_DIAG_2	NC_RBM_CAT_2
3	STATE_RBM_DYN_VLD_LS_UP_1	NC_RBM_LS_UP_1
4	STATE_RBM_SHIFT_AFL_LSL_UP_1	NC_RBM_LS_UP_1
5	STATE_RBM_SHIFT_AFR_LSL_UP_1	NC_RBM_LS_UP_1
6	STATE_RBM_AIR_LSL_UP_1	NC_RBM_LS_UP_1
7	STATE_RBM_DYN_VLD_LS_UP_2	NC_RBM_LS_UP_2
8	STATE_RBM_SHIFT_AFL_LSL_UP_2	NC_RBM_LS_UP_2
9	STATE_RBM_SHIFT_AFR_LSL_UP_2	NC_RBM_LS_UP_2
10	STATE_RBM_AIR_LSL_UP_2	NC_RBM_LS_UP_2
11	STATE_RBM_SMALL_LEAK	NC_RBM_EVAP
12	STATE_RBM_MEC_IVVT_IN	NC_RBM_EGR_VVT (If NC_CYL_NR = 4 or 6)
13	STATE_RBM_MEC_IVVT_EX	NC_RBM_EGR_VVT (If NC_CYL_NR = 4 or 6)
14	STATE_RBM_MEC_IVVT_IN_1	NC_RBM_EGR_VVT (If NC_CYL_NR = 8)
15	STATE_RBM_MEC_IVVT_EX_1	NC_RBM_EGR_VVT (If NC_CYL_NR = 8)
16	STATE_RBM_MEC_IVVT_IN_2	NC_RBM_EGR_VVT (If NC_CYL_NR = 8)
17	STATE_RBM_MEC_IVVT_EX_2	NC_RBM_EGR_VVT (If NC_CYL_NR = 8)
18	STATE_RBM_TOOTH_OFF_IN_1	NC_RBM_EGR_VVT
19	STATE_RBM_TOOTH_OFF_EX_1	NC_RBM_EGR_VVT
20	STATE_RBM_TOOTH_OFF_IN_2	NC_RBM_EGR_VVT (If NC_CYL_NR = 8)
21	STATE_RBM_TOOTH_OFF_EX_2	NC_RBM_EGR_VVT (If NC_CYL_NR = 8)
22	STATE_RBM_SA_SYS	NC_RBM_SA (If NC_INJ_CONF = 0; //MSV80,90)
23	STATE_RBM_SA_SAFM	NC_RBM_SA (If NC_INJ_CONF = 0; //MSV80,90)
24	STATE_RBM_SA_SAV	NC_RBM_SA

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		(If NC_INJ_CONF = 0; //MSV80,90)
25	STATE_RBM_SA_SAP	NC_RBM_SA (If NC_INJ_CONF = 0; //MSV80,90)
26	STATE_RBM_SA_SAV_LSL	NC_RBM_SA (If NC_INJ_CONF = 0; //MSV80,90)
27	STATE_RBM_CHK_LS_DOWN_1	NC_RBM_LS_DOWN_1
28	STATE_RBM_SWT_LS_DOWN_1	NC_RBM_LS_DOWN_1
29	STATE_RBM_PUC_LS_DOWN_1	NC_RBM_LS_DOWN_1
30	STATE_RBM_PUE_LS_DOWN_1	NC_RBM_LS_DOWN_1
31	STATE_RBM_CHK_LS_DOWN_2	NC_RBM_LS_DOWN_2
32	STATE_RBM_SWT_LS_DOWN_2	NC_RBM_LS_DOWN_2
33	STATE_RBM_PUC_LS_DOWN_2	NC_RBM_LS_DOWN_2
34	STATE_RBM_PUE_LS_DOWN_2	NC_RBM_LS_DOWN_2
35	STATE_RBM_DIAGCPS	NC_RBM_CUS
36	STATE_RBM_ROUGH_LEAK	NC_RBM_CUS
37	STATE_RBM_DMTLM	NC_RBM_CUS
38	STATE_RBM_TH	NC_RBM_CUS
39	STATE_RBM_TCO_PLAUS	NC_RBM_CUS
40	STATE_RBM_TCO_STUCK	NC_RBM_CUS
41	STATE_RBM_TCO_2_PLAUS	NC_RBM_CUS
42	STATE_RBM_TAM_PLAUS	NC_RBM_CUS
43	STATE_RBM_VS_PLAUS	NC_RBM_CUS
44	STATE_RBM_FTL_OBD	NC_RBM_CUS
45	STATE_RBM_OBD_LSH_DOWN_1	NC_RBM_CUS
46	STATE_RBM_OBD_LSH_DOWN_2	NC_RBM_CUS
47	STATE_RBM_OBD_VLD_LSH_UP_1	NC_RBM_CUS
48	STATE_RBM_OBD_VLD_LSH_UP_2	NC_RBM_CUS
49	STATE_RBM_CS	NC_RBM_CUS
50	STATE_RBM_ISC	NC_RBM_CUS
51	STATE_RBM_MAF	NC_RBM_CUS
52	STATE_RBM_TIA_PLAUS	NC_RBM_CUS (If NC_CYL_NR = 4 or 6)
53	STATE_RBM_AMP_PLAUS	NC_RBM_CUS
54	STATE_RBM_LOAD_TPS_PLAUS	NC_RBM_CUS

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		(If NC_CYL_NR = 4 or 6)
55	STATE_RBM_LOAD_TPS_PLAUS_0	NC_RBM_CUS (If NC_CYL_NR = 8)
56	STATE_RBM_LOAD_TPS_PLAUS_1	NC_RBM_CUS (If NC_CYL_NR = 8)
57	STATE_RBM_MAP_DIP_PLAUS	NC_RBM_CUS (If NC_CYL_NR = 4 or 6)
58	STATE_RBM_MAP_TPS_PLAUS_0	NC_RBM_CUS (If NC_CYL_NR = 8)
59	STATE_RBM_MAP_TPS_PLAUS_1	NC_RBM_CUS (If NC_CYL_NR = 8)
60	STATE_RBM_VLS_DOWN_DIF_1	NC_RBM_CUS
61	STATE_RBM_VLS_DOWN_DIF_2	NC_RBM_CUS
62	STATE_RBM_T_ES	NC_RBM_CUS
63	STATE_RBM_TPS	NC_RBM_CUS (If NC_CYL_NR = 4 or 6)
64	STATE_RBM_TPS_0	NC_RBM_CUS (If NC_CYL_NR = 8)
65	STATE_RBM_TPS_1	NC_RBM_CUS (If NC_CYL_NR = 8)
66	STATE_RBM_ISC_CST	NC_RBM_CUS
67	STATE_RBM_TQ_CST	NC_RBM_CUS
68	STATE_RBM_TCO_STUCK_RNG	NC_RBM_CUS
69	STATE_RBM_ANG_INST_AD_VVL	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
70	STATE_RBM_ANG_CHK_MAX_VVL	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
71	STATE_RBM_EAC	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
72	STATE_RBM_TIA_MES_PLAUS_0	NC_RBM_CUS (If NC_CYL_NR = 8)
73	STATE_RBM_TIA_MES_PLAUS_1	NC_RBM_CUS (If NC_CYL_NR = 8)
74	STATE_RBM_TIA_THR_MES_PLAUS_0	NC_RBM_CUS (If NC_CYL_NR = 8)
75	STATE_RBM_TIA_THR_MES_PLAUS_1	NC_RBM_CUS (If NC_CYL_NR = 8)
76	STATE_RBM_T_ES_TCO_FAST	NC_RBM_CUS
77	STATE_RBM_T_ES_TCO_SLOW	NC_RBM_CUS
78	STATE_RBM_FUP_CH_1	NC_RBM_CUS (If NC_INJ_CONF = 1)
79	STATE_RBM_FUP_CH_2	NC_RBM_CUS (If NC_CYL_NR = 8)

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80	STATE_RBM_EFF_IGA_CST_IS	NC_RBM_CUS
81	STATE_RBM_EFF_IGA_CST_PL	NC_RBM_CUS
82	STATE_RBM_CAM_CST_IVVT_IN_1	NC_RBM_CUS
83	STATE_RBM_CAM_CST_IVVT_IN_2	NC_RBM_CUS (If NC_CYL_NR = 8)
84	STATE_RBM_CAM_CST_IVVT_EX_1	NC_RBM_CUS
85	STATE_RBM_CAM_CST_IVVT_EX_2	NC_RBM_CUS (If NC_CYL_NR = 8)
86	STATE_RBM_ER_BAL_HOM_0	NC_RBM_CUS (If NC_CYL_NR = 8)
87	STATE_RBM_ER_BAL_HOM_1	NC_RBM_CUS (If NC_CYL_NR = 8)
88	STATE_RBM_CYL_BAL_LAM[0]	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
89	STATE_RBM_CYL_BAL_LAM[1]	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
90	STATE_RBM_CYL_BAL_LAM[2]	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
91	STATE_RBM_CYL_BAL_LAM[3]	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
92	STATE_RBM_CYL_BAL_LAM[4]	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
93	STATE_RBM_CYL_BAL_LAM[5]	NC_RBM_CUS (If NC_INJ_CONF = 0; //MSV80,90)
94	STATE_RBM_PUC_VLD_LS_UP_1	NC_RBM_CUS (If NC_CYL_NR > 4)
95	STATE_RBM_PUC_VLD_LS_UP_2	NC_RBM_CUS (If NC_CYL_NR > 4)
96	STATE_RBM_ OC_LS_DOWN_1	NC_RBM_CUS (If NC_CYL_NR > 4)
97	STATE_RBM_ OC_LS_DOWN_2	NC_RBM_CUS (If NC_CYL_NR > 4)
98	STATE_RBM_ SCG_LS_DOWN_1	NC_RBM_CUS (If NC_CYL_NR > 4)
99	STATE_RBM_ SCG_LS_DOWN_2	NC_RBM_CUS (If NC_CYL_NR > 4)
100	STATE_RBM_ OC_LSL_UP_1	NC_RBM_CUS (If NC_CYL_NR > 4)
101	STATE_RBM_ OC_LSL_UP_2	NC_RBM_CUS (If NC_CYL_NR > 4)
102	STATE_RBM_ CSERS_INJ	NC_RBM_CUS (If NC_INJ_CONF = 1;//all MSD)
4-cyl (MSD)	**59**	NC_NR_DIAG_RBM
6-cyl (MSD)	**67**	NC_NR_DIAG_RBM
6-cyl (MSV)	**79**	NC_NR_DIAG_RBM

8-cyl (MSD)	**82**	NC_NR_DIAG_RBM

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B.84.2 Clear rate base monitoring statistics

Description:

For development conveniences, it is often useful to reinit the rate base monitoring statistics. This is possible by setting the calibration bit LC_RBM_CLR to 1.

Application conditions

Initialisation: –

Recurrence: –

Activation: `0 1 transition of LC_RBM_CLR`

Formula section:

If LC_RBM_CLR = 1
Then ACTION_ERRM_ClearRbmStatistics (OUT < ResultClrInfo>)
Endif

B.84.3 Inhibition of standardized vehicle operation calculation

FUNCTION DESCRIPTION:

General information:

The calculation of the standardized vehicle operation LV_DC_RBM, necessary for the calculation of the denominators for the Rate-Based Monitoring functionality, depends on different engine and ambient conditions.

Description:

With the value LV_INH_DC_RBM the inhibition of the standardized vehicle operation calculation is controlled. An inhibition is possible due to a system failure that influences the conditions necessary to set LV_DC_RBM.

Application conditions

Initialisation: `at ECU reset or LV_DC 0 1 transition : LV_INH_DC_RBM = 0`

Recurrence: `1 s`

Activation: `LV_DC = 1`
and `LV_INH_DC_RBM = 0`

Formula section:

At LV_DC 0 1 transition :

The pending status of the following failures has to be checked only once :

- LV_ERR_AMP
- LV_ERR_AMP_PLAUS

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- LV_ERR_VS
- LV_ERR_TAM_PLAUS
- LV_ERR_TAM_CAN

If(1) { CPU optimization at LV_DC 0 1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }
Then(1)
While LV_INH_DC_RBM = 0 **do**
with each XX failure of the above list : ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<CALL>)
If(2) XX has a pending status
Then(2)
LV_INH_DC_RBM = 1
Endif(2)
Endwhile
Else(1)
{ the dynamic failure memory is empty }
No action
Endif(1)

Every 1 s :

If LV_ERR_AMP = 1
or LV_ERR_AMP_PLAUS = 1
or LV_ERR_VS = 1
or LV_ERR_TAM_PLAUS = 1
or LV_ERR_TAM_CAN = 1
Then LV_INH_DC_RBM = 1
Endif

B.84.4 Calculation of cold start denominator

FUNCTION DESCRIPTION:

General information:

Calculation is done in generic part. LV_CDN_CST_RBM is still defined due to interface reasons.

Application conditions

Initialisation: *at LV_DC 0->1 transition or ECU reset set LV_CDN_CST_RBM = 0*

Recurrence: *1s*

Activation: *LV_DC = 1 and LV_CDN_CST_RBM = 0*

Formula section:

LV_CDN_CST_RBM = LV_DC_CDN_CST_RBM

B.84.5 Ambient air temperature adaptation to handle GS/DS data types differences

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FUNCTION DESCRIPTION:

Description:

Some temperatures values can be delivered from Diesel or Gasoline system:
Ambient temperature TAM
As data types may be different, the following fomula section shall be used to allow adaptation to each environment.

Application conditions

Initialisation: `at ECU reset set TAM_DSL_CMN = TAM`

Recurrence: *100 ms*

Activation: *always*

Formula section:

TAM_DSL_CMN = TAM

B.84.6 Standardized vehicle operation adaptations

FUNCTION DESCRIPTION:

General information:

Due to new vehicles configurations encountered (Stop& Start, conventional combustio engine), CARB standardized vehicle operations (LV_DC_RBM) defined for conventional vehicles may be difficult to reach, mainly because some engine states are no more covered (idle mode).
CARB regulation:
"For hybrid vehicles, vehicles that employ alternate engine start hardware or strategies (e.g., integrated starter and generators), or alternate fuel vehicles (e.g., dedicated, bi-fuel, or dual-fuel applications), the manufacturer may request Executive Officer approval to use alternate criteria to that set forth in section (d)(4.3.2)(B) above for incrementing the denominator. In general, the Executive Officer shall not approve alternate criteria for vehicles that only employ engine shut off at or near idle/vehicle stop conditions. Executive Officer approval of the alternate criteria shall be based on the equivalence of the alternate criteria to determine the amount of vehicle operation relative to the measure of conventional vehicle operation in accordance with the criteria in section (d)(4.3.2)(B) above."

The purpose of the following formula section is to povide or re-build missing data so as to keep CARB standardized vehicle operation definition.

Application conditions

Initialisation: *at RST system event*

```
LV_IS_RBM = 1
LV_OBD_IS_RBM_CUS_ADJ = 1 (bit always to one)
```

Recurrence: *100 ms*

Activation: *all ECU states*

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B.85 Readiness codes

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_READY_XX	O/V/S	0... 1H	0 ...1	1	-
Readiness flag related to diagnosis XX					
STATE_READY_OBD_1	O/V/S	0... FFH	0... 255	1	-
Readiness code completion status 1					
STATE_READY_OBD_2	O/V/S	0... FFH	0... 255	1	-
Readiness code completion status 2					
STATE_READY_OBD_3	O/V/S	0... FFH	0... 255	1	-
Readiness code completion status 3					

Input data:

LV_DC {p. 5746}	LV_DC_MAX [NC_NR_ERR_DYN] {p. 5767}	LV_END_DIAG_XX {p. 4581}	LV_EOL_OBD_DC {p. 1061}
LV_ERR_DC [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_MEM_XX {p. 5767}	LV_ERR_XX	

Action definition

ACTION_ERRM_InitReadiness ()	Mode: O

Import actions:

ACTION_ERRM_ReadReadinessCodCus (<INOUT>,<ReadinessCode>,<OUT>,<ResultReadinessCode>)
ACTION_ERRM_ReadReadinessCode (**INOUT**<PRM_READINESSCODE>,**OUT**<PRM_RESULTREADINESSCODE>)

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FUNCTION DESCRIPTION:

General information:

Readiness flag allows to know if a full diagnostic check (not in EOL phase) has been done or not (minimum number of checks necessary for MIL illumination if failure is present).

A readiness flag is defined for each diagnosis (LV_READY_XX). Based on these flags, readiness code status (2 bytes STATE_READY_OBD_1 and STATE_READY_OBD_2) are generated in the Communication Interface (API) file for Carb mode.
Readiness flags are mainly used by after market service and inspections maintenance. When after market achieves a repair, the system should be controlled before to give back the car to its owner.
Because some failure need a long time (and may be 2 DC) to be diagnosed, the repair operator need an as quick as possible information meaning the repairs is OK.
The readiness flag indicates when it is set to 0 that :

- the diagnosis related to failure XX is done since the last clear DTC service received.

- and if a failure XX is present, MIL would be illuminated.

For after market time optimisation, in case of no failure at all, the readiness flag is set to 0.
The readiness flag indicates when it is set to 1 that :

- the diagnosis related to failure XX is not done since the last clear DTC service received.
- or if a failure XX is present, MIL is not still illuminated (may takes many driving cycle).

After failure erase, all bits associated to supported functions are set to 1.
When the system has executed enough driving cycles for determining if MIL should be switch On or not, all the readiness flags are in 0 state. At this occurrence, failures which may have switch on the MIL could be considered as repaired if MIL is Off.

B.85.1 Readiness flag set to 0

Description:

The readiness flag LV_READY_XX is set to 0 when enough driving cycle has been done without failure XX.

Application conditions

Initialization: On saved ram lost
LV_READY_XX = 1

Recurrence: at the recurrence of activation condition

Activation: *at transition LV_DC 0->1*
or *at transition LV_END_DIAG_XX 0->1*

Formula section:

```
If      LV_READY_XX = 1                          (diag XX not still ready)
        and LV_DC = 1                            (driving cycle valid)
          and LV_END_DIAG_XX = 1                 (diag done)
          and LV_EOL_OBD_DC = 0                  (not in EOL tests)
Then      If     LV_ERR_MEM_XX = 1               (failure in 2nd layer memory)
  Then      If LV_ERR_DC[IDX] = 0 (no failure present this DC)
              Then      LV_READY_XX = 0          (diag XX is ready)
                Else      If      LV_DC_MAX[IDX] = 1
                          Then    LV_READY_XX = 0     (diag XX is ready)
                Endif
          Endif
            Else      If      LV_ERR_XX = 0
                   Then       LV_READY_XX = 0          (diag XX is ready)
                   Endif
            Endif
Endif
```

B.85.2 Readiness flag reinitialisation (set to 1)

Description:

Syntax : ACTION_ERRM_InitReadiness ( )
Parameter(in) : No parameter
Parameter(out) : No parameter

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Short description :
The readiness flag LV_READY_XX is reinitialized (set to 1) upon communication tool request via the action ACTION_ERRM_InitReadiness ( ).
This reinitilisation is always done when all failure are erased from failure memory.

Application conditions

Initialization: –

Recurrence: –

Activation: *at action request*

Formula section:

For every failure : LV_READY_XX = 1

B.85.3 Readiness code information update

Description:

Purpose of this paragraph is to update readiness code completion status. This update shall be done :

- at end of driving cycle, for readiness status display,
- on action call, for customer tool and Scan Tool coherency with STATE_READY_OBD_X.

Important remark: each time ACTION_ERRM_ReadReadinessCode is called Readiness codes completion status (STATE_READY_OBD_1 and STATE_READY_OBD_2) are calculated.

Application conditions

Activation: at LV_DC 1 0 transition

Initialization: on non-volatil memory reset/ lost **or** on failure erase service received
STATE_READY_OBD_1 = FFh,
STATE_READY_OBD_2 = FFh
{FFh value indicates that readiness code is not yet computed}

Recurrence: none, executed single time on activation.

Formula section:

{ Action call to update STATE_READY_OBD_1 and STATE_READY_OBD_2 }

Call ACTION_ERRM_ReadReadinessCode(INOUT<STATE_READY_OBD_1, STATE_READY_OBD_2>, OUT<ResultReadinessCode>)

Application conditions

Activation : at LV_DC 1 0 transition

Initialization: on non-volatil memory reset/ lost
or
on failure erase service received
STATE_READY_OBD_3 = FFh

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```
{ FFh value permits to indicate that readiness is not yet computed
}
```

Recurrence : none, executed single time on activation.

Formula section:

{ Action call to update STATE_READY_OBD_3 }

Call ACTION_ERRM_ReadReadinessCodCus(INOUT<STATE_READY_OBD_3>, OUT<ResultReadinessCode>
)

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B.86 Similar conditions

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_SCDN_EQU [NC_NR_WIN_SCDN]	V	0... FFFFH	0... 65535	1	-
Number of times N/LOAD is within SCDN window					
CTR_SCDN_EQU_DC [NC_NR_WIN_SCDN]	V/S	0... FFH	0... 255	1	-
Counter of non occurrence of similar condition					
CTR_SCDN_SUM [NC_NR_WIN_SCDN]	V	0... FFFFH	0... 65535	1	-
Number of times the diagnosis condition are set					
LOAD_MAX_SCDN_EQU [NC_NR_WIN_SCDN]	V/S	0... FFH	0... 99.609375	0.390625	%
maximal load of similar conditions window					
LOAD_MIN_SCDN_EQU [NC_NR_WIN_SCDN]	V/S	0... FFH	0... 99.609375	0.390625	%
minimal load of similar conditions window					
LV_WUP_SCDN_EQU [NC_NR_WIN_SCDN]	V/S	0... 1H	0 ...1	1	-
Warm-up status for similar conditions for OBDII continuous error					
N_MAX_SCDN_EQU [NC_NR_WIN_SCDN]	V/S	0... 1FE0H	0... 8160	1	rpm
maximal engine speed of similar conditions window					
N_MIN_SCDN_EQU [NC_NR_WIN_SCDN]	V/S	0... 1FE0H	0... 8160	1	rpm
minimal engine speed of similar conditions window					
STATE_SCDN [NC_NR_WIN_SCDN]	V/S	0... 3FH	0... 63	1	-
Similar condition status					

Input data:

CTR_DC [NC_NR_ERR_DYN] {p. 5767}	LC_ENA_SCDN	LOAD_SCDN {p. 5895}	LV_CDN_DIAG_XX {p. 4581}
LV_DC {p. 5746}	LV_ERR_DC [NC_NR_ERR_DYN] {p. 5767}	LV_STATE_WUP {p. 5746}	N {p. 1525}
NLC_ENA_SCDN {p. 645}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_SCDN_EQU_DC_MAX	V	0... FFH	0... 255	1	-
maximum value of the driving cycle counter for similar conditions erase					
C_CTR_SCDN_NOT_ERR_THD [NC_NR_WIN_SCDN]	V	0... FFH	0... 99.609375	0.390625	%
threshold for ratio CTR_SCDN_EQU[NC_NR_WIN_SCDN] /CTR_SCDN_SUM[NC_NR_WIN_SCDN] to recognize SCDN without failure					
C_LOAD_SCDN_EQU	V	0... FFH	0... 99.609375	0.390625	%
LOAD value for similar conditions detection (typical 20%)					
C_N_SCDN_EQU	V	0... 1FE0H	0... 8160	1	rpm
engine speed threshold for similar conditions detection (375 rpm)					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_WIN_SCDN	-	1... FFH	1... 255	1	-
Number of instances used for similar conditions calculation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Action definition

ACTION_ERRM_CdnDiagScdn (**IN**<PRM_IDX_DIAG>)					Mode: O
This action is used to calculate a ratio to recognize the similar condition without failure					
Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_IDX_DIAG	in	0... FFFFH	0... 65535	1	-
Diagnostic symptom instance.					

ACTION_ERRM_DecrementDCctrScdn (**IN**<PRM_IDX_ERR>,**OUT**<PRM_DCdec>)					Mode: O
This action calculates the possibility to decrement the driving cycle counter related to failure IDX_ERR					
Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_IDX_ERR	in	0... FFFFH	0... 65535	1	-
Failure Index					
PRM_DCdec	out	0H 1H	NO YES	-	-
Control of Driving cycle counter decrementation					

ACTION_ERRM_EndWinScdn (**IN**<PRM_IDX_ERR>,**IN**<PRM_EXC>)					Mode: O
This is used to store similar conditions and recognize similar condition with or without failure					
Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_IDX_ERR	in	0... FFFFH	0... 65535	1	-
Failure Index					
PRM_EXC	in	0... 1H	0 ...1	1	-
Exceedance reported from diagnostic function					

ACTION_ERRM_EraseScdn (**IN**<PRM_IDX_ERR>)					Mode: O
This action erase the similar conditions related to failure IDX_ERR					
Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_IDX_ERR	in	0... FFFFH	0... 65535	1	-
Failure Index					

Import actions:

ACTION_ERRM_IncrementDCctrScdn (**IN**<PRM_IDX_ERR>)

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General information

STATE_SCDN[k] : Similar conditions status for diagnostic instance k

bit 0: 0: SCDN will be recorded (updated) at next failure occurrence
1: SCDN are recorded
bit 1: Recognition of similar conditions with failure detection this DC
bit 2: Recognition of similar condition without failure/exceedance detection this DC

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It’s also set after C_CTR_SCDN_EQU_DC_MAX driving cycles without similar conditions without error

bit 3: Failure XX was present last DC

bit 4: Request to increment driving cycle counter of failure XX

bit 5: " exceedance" of specific limit was reported for failure XX

Similar Conditions

General Information:

The different states of a failure are managed regards their driving cycle and warm up cycle counters values (see Dynamic error management core for details).

For Misfire and Fuel system failures, some additional conditions should be fulfilled to increment and decrement their driving cycle counter. These additional conditions are related to engine conditions and are called similar conditions.

When similar conditions without failure are fulfilled for the failure XX already stored in the dynamic memory in a previous driving cycle, bit 2 of STATE_SCDN[k] is set to 1. That means, that the driving cycle counter of failure XX could be decremented at the end of the driving cycle if the failure XX will not get present till this treatment. If an exceedance is reported by the diagnostic function (bit 5 of STATE_SCDN[k] is set to 1), the driving cycle counter is not decremented at the end of the DC. Exception: Driving cycle counter decrementation linked with C_CTR_SCDN_EQU_DC_MAX DCs, see description below.

Also the incrementation of the driving cycle counter of a failure stored in dynamic memory is controlled by the similar conditions functionality. The incrementation done in the error management core is triggered by the ACTION_ERRM_IncrementDCctrScdn (XX) in the following cases:

- Similar conditions are recorded
  (bit 0 of STATE_SCDN[k] 0->1).

- A failure already stored in memory occurs again in the following driving cycle
  (bit 2 of STATE_SCDN[k] = 1).

- A temporary failure or a confirmed failure with MIL off (LV_DC_MAX[IDX] = 0) occurs again not in the following driving cycle but with similar conditions with failure
  (bit 1 of STATE_SCDN[k] = 1).

- A confirmed failure with MIL on (LV_DC_MAX[IDX] = 1) occurs again.

In all of these cases, the driving cycle counter is incremented (bit 4 of STATE_SCDN[k] 0→1).

For a temporary failure or confirmed failure with MIL off (LV_DC_MAX[IDX] = 0), even if similar conditions are not recognized during a C_CTR_CDN_EQU_DC_MAX number of driving cycles, the driving cycle counter of the failure can be decremented after C_CTR_CDN_EQU_DC_MAX driving cycles.

Similar conditions functionality is inhibited when LC_ENA_SCDN=0 or NLC_ENA_SCDN=0.

Remark:

To keep the link between the index of the failure using the similar condition and the index of the failure in static memory, a transfer function is defined: k = Scdn (XX). The link between the diagnosis instance and the similar conditions instance k is described in the application incidence of similar condition.

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B.86.1 Ratio calculation to recognize the similar condition without failure

General information:

For the recognition of similar conditions the current engine speed /load conditions are compared with the recorded similar conditions window.
Based on two counters calculated with this algorithm the SCDN recognition at end of the diagnostic window is done. (see next chapter)

- CTR_SCDN_EQU[k]

  counting the number of times engine speed /load conditions are within the recorded similar conditions window (with LV_CDN_DIAG_XX = 1)
- CTR_SCDN_SUM[k]
  counting the number of times the diagnosis conditions are set (LV_CDN_DIAG_XX = 1)

The calculation of the counters is stopped, if an exceedance is reported from diagnostic function.

Syntax :	ACTION_ERRM_CdnDiagScdn (IN <XX>)	
Parameter (in) :	XX	failure XX using similar condition instance XX
Parameter (out) :	-	

Short description:

This action is called at each diagnosis condition. It is used to calculate a ratio to recognize the similar condition with or without failure.

Application conditions:

Initialisation:
```
at transition LV_DC 0 -> 1 or reset
bit 0, bit 3 of STATE_SCDN[k]            = restored from NVMY
bit 1, bit 2, bit 4, bit 5  of STATE_SCDN[k]     = 0

CTR_SCDN_EQU[k]                                  = 0
CTR_SCDN_SUM[k]                                  = 0
```

Activation:
```
At action request  and LV_DC = 1
and  LC_ENA_SCDN = 1 and NLC_ENA_SCDN = 1
(similar conditions enable)
```

Deactivation: –

Recurrence: –

Function description:

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Formula section:

```
k = Scdn (XX)
If   bit 0 of STATE_SCDN[k]    = 1   (similar conditions are
                                          recorded for failure XX)
and  bit 5 of STATE_SCDN[k]    = 0   (no exceedance reported from
                                          diagnostic function)
Then        If    LV_CDN_DIAG_XX = 1
            Then  CTR_SCDN_SUM[k] ++
                  (check if current N, LOAD_SCDN point is within SCDN window)
                  If       N <=  N_SCDN_MAX_EQU[k]
                  and      N >=  N_SCDN_MIN_EQU[k]
                  and      LOAD_SCDN <=  LOAD_SCDN_MAX_EQU[k]
                  and      LOAD_SCDN >=  LOAD_SCDN_MIN_EQU[k]
                  Then       CTR_SCDN_EQU[k] ++
                  Endif
Endif
```

B.86.2 Record and recognition of similar conditions at end of diagnosis window

General information:

The similar conditions are stored for a failure XX (or updated) in the following cases:

- The similar conditions are frozen within the window N/LOAD_MAX/MIN_SCDN_EQU[k], if the corresponding failure is stored in the memory (failure gets present the first time)

- The similar conditions are stored again (updated) within the window N/LOAD_MAX/MIN_SCDN_EQU[k], if the corresponding failure occurs again and the driving cycle counter of this failure was 0 before.

In both cases bit 0 of STATE_SCDN[k] is 0 before the storage.

The recognition of similar conditions for detected failure is done by comparing, if the actual N/LOAD point is within the stored SCDN window. If also the same warmup status is reached at this time, similar conditions with failure are recognized. This calculation is done at the action call depending of the monitoring function, only in the following case:

- Similar conditions are stored in a previous driving cycle (bit 0 of STATE_SCDN[k] = 1)

- and the same failure XX was not present the last driving cycle. In case of same failure present last driving cycle, the driving cycle counter is incremented without asking for similar conditions.

- and failure is not illuminating the MIL. In case failure is illuminating the MIL at present the driving cycle counter is set to the maximum without asking for similar conditions.

- and driving cycle counter not already incremented in this driving cycle

If no error is present at the end of the diagnosis window, the ratio (CTR_SCDN_EQU[k] /CTR_SCDN_SUM[k]) is compared with the threshold C_CTR_SCDN_NOT_ERR_THD[k]. If the threshold and the same warmup status are reached at this time, similar conditions without failure are recognized.

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This calculation is done at the end of a diagnosis window, only if no failure XX is present in the following cases:

- Similar conditions are already recorded for failure XX (bit 0 of STATE_SCDN[k] = 1) in a previous driving cycle

- Similar conditions were not already encountered within this driving cycle with no failure

- no exceedance reported from diagnostic function (bit 5 of STATE_SCDN[k] = 0)

- Driving cycle counter was not incremented this driving cycle yet.

Syntax : ACTION_ERRM_EndWinScdn (IN <XX>, <EXC>)

Parameter (in) : XX failure XX using similar condition instance XX
EXC Exceedance reported from Diagnostic function

Parameter (out) : -

Short description:

This action is called at each end of diagnosis windows if there's no failure or when the failure gets present or when an exceedance is recognized by the diagnostic function. This usage of this function depends on the diagnostic function. It is used for recognition of similar condition with or without failure

Application conditions:

Initialisation: –

Activation: At action request **and** LV_DC = 1
and LC_ENA_SCDN = 1 **and** NLC_ENA_SCDN = 1
(similar conditions enable)

Deactivation: –

Recurrence: –

Function description:

Formula section:

```
k = Scdn(XX)
If    EXC = 1       (Exceedance reported from Diagnostic function)
Then  bit 5 of STATE_SCDN[k] = 1
Endif
If    bit 4 of STATE_SCDN[k] = 0         (request to increment driving cycle
                                          counter of failure XX not made)
and   LV_ERR_XX = 1                      (failure present)
Then  If    bit 0 of STATE_SCDN[k] = 1   (similar conditions recorded
                                          for failure XX)
      Then  If   bit 3 of STATE_SCDN[k] = 1
                     (failure present the last driving cycle)

            or       LV_DC_MAX[IDX] = 1
```

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```
                 (failure is confirmed with MIL on)

          Then   ACTION_ERRM_IncrementDCctrScdn (XX)
                 (request to increment driving cycle counter
                  for  failure XX)

                 bit 4 of STATE_SCDN[k] = 1
                 (request to increment driving cycle counter of
                  was made)

          Else   (recognition of similar conditions with failure)

                 (check if ratio to recognize SCDN is reached)
                 If     N <=  N_MAX_SCDN_EQU[k]
                 and    N >=  N_MIN_SCDN_EQU[k]
                 and    LOAD_SCDN <=  LOAD_MAX_SCDN_EQU[k]
                 and    LOAD_SCDN >=  LOAD_MIN_SCDN_EQU[k]
                 and    LV_WUP_SCDN_EQU[k] = LV_STATE_WUP
                 Then   bit 1 of STATE_SCDN[k] = 1
                        (similar conditions encountered with failure
                        window)
                        bit 2 of STATE_SCDN[k] = 0
                        (similar conditions not encountered with no
                        failure)
                        ACTION_ERRM_IncrementDCctrScdn (XX)
                        (request to increment driving cycle counter for
                        failure XX)
                        bit 4 of STATE_SCDN[k] = 1
                        (request to increment driving cycle counter
                        of was made)
                 Endif
          Endif

      Else  (SCDN engine speed/ load point frozen)
          N_SCDN_MAX_EQU[k] = N + C_N_SCDN_EQU
          N_SCDN_MIN_EQU[k] = N - C_N_SCDN_EQU
          LOAD_SCDN_MAX_EQU[k] = LOAD_SCDN + C_LOAD_SCDN_EQU
          LOAD_SCDN_MIN_EQU[k] = LOAD_SCDN - C_LOAD_SCDN_EQU
          LV_WUP_SCDN_EQU[k] = LV_STATE_WUP     (warm-up status stored)
          CTR_SCDN_EQU_DC[k] = C_CTR_SCDN_EQU_DC_MAX
           bit0 of STATE_SCDN[k] = 1       (similar conditions recorded
                                          for failure XX)
          ACTION_ERRM_IncrementDCctrScdn (XX)
          (request to increment driving cycle counter
           for failure XX)
          bit 4 of STATE_SCDN[k] = 1
          (request to increment driving cycle counter
           was made)
      Endif
Else (recognition of similar conditions without failure)
     If    bit 0 of STATE_SCDN[k]      = 1 (similar conditions recorded
                                           for failure XX)

     and   bit 4 of STATE_SCDN[k]  = 0    (request to increment driving
                                           cycle counter of failure XX
                                           was  not made)
     and   bit 2 of STATE_SCDN[k]  = 0    (similar conditions not
                                           encountered with no failure)
     and   LV_ERR_XX               = 0    (no failure present)
     and   bit 5 of STATE_SCDN[k]  = 0    (no exceedance reported from
                                          Diagnostic function)
```

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```
     Then  If            CTR_SCDN_EQU[k]     /         CTR_SCDN_SUM[k]>=
           C_CTR_SCDN_NOT_ERR_THD[k]
           and      LV_STATE_WUP = LV_WUP_SCDN_EQU[k] (warm-up status)
           Then    bit 2 of STATE_SCDN[k] = 1 (similar conditions
                                            encountered with no failure)
           Endif
     Endif
Endif

If   bit 0 of STATE_SCDN[k] = 1  (similar conditions recorded for failure XX)
Then         CTR_SCDN_EQU[k] = 0
             CTR_SCDN_SUM[k] = 0
Endif
```

B.86.3 SCDN storage and recognition for detected failure performed last DC

General information:

According regulation the information, if a failure XX (using SCDN functionality) was present the last driving cycle, must be respected to increment the DC counter. In case of a new failure occurrence, if the same failure was present the last driving cycle, the driving cycle counter must be incremented (if not already incremented this driving cycle) independently of similar conditions.

Application conditions:

Initialisation: –

Activation: At LV_DC transition 1 -> 0 **and** LC_ENA_SCDN = 1 **and** NLC_ENA_SCDN = 1 (similar conditions enable)

Deactivation: –

Recurrence: –

Function description:

Formula section:

```
For k = 0 to NC_NR_WIN_SCDN - 1
    k = Scdn(XX); XX = F(IDX)
      If  LV_ERR_DC[IDX]    = 1       (failure present in this DC)
      Then     bit 3 of STATE_SCDN[k] = 1
          (failure present the last driving cycle)

          CTR_SCDN_EQU_DC[k] = C_CTR_SCDN_EQU_DC_MAX
          re-initialization of similar conditions counters)

      Else     bit 3 of STATE_SCDN[k] = 0
          (failure not present the last driving cycle)
      Endif
EndFor
```

B.86.4 SCDN usage to decrement driving cycle counter

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General information:

Syntax : ACTION_ERRM_DecrementDCctrScdn (OUT <DCdec>, IN <XX>)

Parameter (in) : XX number of failure to store in dynamic memory
Parameter (out) : DCdec YES if decrementation of DC counter is possible

NO if decrementation of DC counter is not possible

Short description:

At the end of a driving cycle (LV_DC 1->0) the driving cycle counter for the failure XX can be decremented if similar conditions without failure are recognized and no exceedance reported from diagnostic function (bit 5 of STATE_SCDN[k] = 0) (used for misfire monitoring). For temporary failure or confirmed failure with MIL off, even if similar conditions are not recognized during a C_CTR_CDN_EQU_DC_MAX number of driving cycle, the driving cycle counter of the failure can be decremented after C_CTR_CDN_EQU_DC_MAX driving cycles.

Application conditions:

Initialisation: –
Activation: at action request
Deactivation: –
Recurrence: –

Function description:

Formula section:

```
k = Scdn(XX)
DCdec = NO     (decrementation of DC counter is not possible)
If   bit 2 of STATE_SCDN[k] = 1     (similar conditions encountered
                                              with no failure)
and  bit 5 of STATE_SCDN[k] = 0     (no exceedance reported)
Then      DCdec = YES               (decrementation of DC counter is possible)
Else      If   LV_DC_MAX[IDX] = 0  (failure is temporary or confirmed
                                     with MIL off)
          Then CTR_SCDN_EQU_DC[k] = CTR_SCDN_EQU_DC[k] - 1
               If   CTR_SCDN_EQU_DC[k] = 0
                    bit 2 of STATE_SCDN[k] = 1
                    DCdec = YES     (decrementation of DC counter is possible)
               Endif
          Endif
Endif

If      DCdec = YES
and     (LV_DC_MAX[IDX] = 0    (failure is temporary or confirmed with
                                MIL off and DC counter of failure will
                                be 0 after decrementation)

        or (LV_DC_MAX[IDX] = 1 and  CTR_DC[IDX] <= DC_DEC_XX))

                                     (failure is confirmed with MIL on and
                                     MIL will be switched off after
                                     decrementation)

Then    bit 0 of STATE_SCDN[k] = 0  (The SCDN window of failure XX will be
                                     updated  With new engine conditions (N /
                                     LOAD (min/ max))at next failure
                                     occurrence)
Endif
```

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B.86.5 Similar conditions erase

General information:

Syntax : ACTION_ERRM_EraseScdn (IN <XX>)

Parameter (in) : XX number of failure to store in dynamic memory

Parameter (out) : -

Short description:

The similar conditions are erased by calling the action ACTION_ERRM_EraseScdn :
- when saved ram lost (at initialization)
- when corresponding failure is erased (see dynamic error management core module)

Application conditions:

Initialisation: –

Activation: at action request

Deactivation: –

Recurrence: –

Function description:

Formula section:

```
k = Scdn (XX)
STATE_SCDN[k]           = 0
N_MAX_SCDN_ EQU [k]     = 0 [rpm]
N_MIN_SCDN_EQU[k]       = 8160 [rpm]
LOAD_MAX_SCDN_EQU[k]    = 0 [%]
LOAD_MIN_SCDN_EQU[k]    = 99.60937 [%]
CTR_SCDN_EQU_DC[k]      = 0
LV_WUP_SCDN_EQU[k]      = 0
CTR_SCDN_EQU[k]   = 0
CTR_SCDN_SUM[k]   = 0
```

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B.87 Similar conditions (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LOAD_SCDN	O/V	0... FFH	0... 99.60937	0.390625	%
Engine load for SCDN calculation					

Input data:

LOAD_CLC {p. 5801}	LV_CDN_DIAG_FSD [NC_CBK_EX_NR] {p. 6140}	LV_CDN_DIAG_FSD_ LAM_LIM [NC_CBK_EX_NR] {p. 6140}	LV_END_DIAG_WIN_FSD [NC_CBK_EX_NR] {p. 6140}
LV_END_DIAG_WIN_FSD_ LAM_LIM [NC_CBK_EX_NR] {p. 6140}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_INJ_CONF {p. 626}
NC_NR_WIN_SCDN {p. 5885}			

Action definition

ACTION_ERRM_ConfirmErrScdn (**OUT**<DCconf>,**IN**<XX>)	Mode: O

Import actions:

ACTION_ERRM_CdnDiagScdn (**IN**<PRM_IDX_DIAG>)
ACTION_ERRM_EndWinScdn (**IN**<PRM_IDX_ERR>,**IN**<PRM_EXC>)

FUNCTION DESCRIPTION:

General information:

This file defines the usage of the similar conditions functionality.

B.87.1 Similar conditions window definition

B.87.1.1 Similar condition data definition

Description:

There is only some failure using the similar condition so this table allows to do the link between the index of the failure in static memory and the index of the failure using the similar condition:

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Diagnosis instances XX using similar conditions functionality	NC_NR_WIN_SCDN = **8 (4 cyl or MSV)** NC_NR_WIN_SCDN = **10 (6 cyl)** NC_NR_WIN_SCDN = **12 (8 cyl)**

Diagnosis instance XX	**similar conditions instance (k)**
FSD_1	0
FSD_2	1
FSD_LAM_LIM_1	2 If NC_INJ_CONF = ! 0
FSD_LAM_LIM_2	3 If NC_INJ_CONF = ! 0
MIS_0	4
MIS_1	5
MIS_2	6
MIS_3	7
MIS_4	8 If NC_CYL_NR = 6 or 8
MIS_5	9 If NC_CYL_NR = 6 or 8
MIS_6	10 If NC_CYL_NR = 8
MIS_7	11 If NC_CYL_NR = 8
	(NC_NR_WIN_SCDN - 1)

One function is defined to do the link between the index of the failure in static memory and the index of the failure using the similar condition: k = Scdn(XX)

B.87.1.2 Load calculation for similar condition

Description:

The calculated load SAE1979 (LOAD_CLC) is used for similar condition.

Application conditions

Initialisation: `At reset: LOAD_SCDN = LOAD_CLC`

Recurrence: `100 ms`

Activation: –

Formula section:

LOAD_SCDN = LOAD_CLC

B.87.1.3 Treatment activated by the fuel system diagnosis for the similar condition

Description:

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This treatement allows to call the two generic ACTION_ERRM_CdnDiagScdn (IN <XX>), ACTION_ERRM_EndWinScdn (IN <XX>, IN <EXC>) actions using for the similar condition.

Application conditions

Initialisation: –
Recurrence: *fuel system diagnosis recurrency*
Activation: –

Formula section:

For i = 0 to NC_CBK_EX_NR - 1
Adaptation to calculate a ratio used to recognize the similar condition with or without failure:
If LV_CDN_DIAG_FSD[i] = 1
Then ACTION_ERRM_CdnDiagScdn (FSD[i])
Endif
If LV_CDN_DIAG_FSD_LAM_LIM[i] = 1
Then ACTION_ERRM_CdnDiagScdn (FSD_LAM_LIM[i])
Endif

Adaptation for the record and recognition of similar conditions:
If LV_END_DIAG_WIN_FSD[i] 0 ->1
Then
Record and recognition of similar conditions at the end of diagnosis or when the failure is present:
ACTION_ERRM_EndWinScdn (FSD[i], 0)
Endif
If LV_END_DIAG_WIN_FSD_LAM_LIM[i] 0 ->1
Then
Record and recognition of similar conditions at the end of diagnosis or when the failure is present:
ACTION_ERRM_EndWinScdn (FSD_LAM_LIM[i], 0)
Endif
EndFor

B.87.2 SCDN usage for direct failure confirmation

Description:

Syntax : ACTION_ERRM_ConfirmErrScdn (OUT <DCconf>, IN <XX>)
Parameter (in) : XX number of failure to store in dynamic memory
Parameter (out) : DCconf 1 if failure must be confirmed directly
0 if failure should not be confirmed directly

Short description:
With the ACTION_ERRM_ConfirmErrScdn (OUT <DCconf>, IN <XX>) the value DCconf is transmitted to the driving cycle counter management to give the possibility to confirm a failure directly by incrementing the driving cycle counter for the failure XX to the maximum. This treatment must be done in the following situation:
A temporary failure XX caused by misfire B is in the memory and a failure XX caused by misfire A occures (not stored before). Then the misfire B depending failure can be erased and the misfire A failure can be confirmed directly.

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Application conditions

Initialization: –

Recurrence: –

Activation: *at action request*

Formula section:

DCconf = 0 (direct confirmation of failure XX is not possible)

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B.88 Statistical data

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ACT_MIL	S	0... FFH	0... 255	1	-
Counter for warm up cycle with MIL Off					
CTR_WUP_DTC_CLR	O/V/S	0... FFH	0... 255	1	-
Number of warm-ups since diagnostic trouble codes cleared					
DIST_ACT_MIL	O/V/S	0... FFFFH	0... 65535	1	km
Global distance traveled while the MIL is illuminated					
DIST_DTC_CLR	O/V/S	0... FFFFH	0... 65535	1	km
Distance since diagnostic trouble codes cleared					
DIST_REL_ACT_MIL	S	0... FFFFFFFFH	0... 4294967295	1	km
Relative distance to calculate distance traveled while the MIL is illuminated					
DIST_REL_DTC_CLR	V/S	0... FFFFFFFFH	0... 4294967295	1	km
Distance at following event : diagnostic trouble codes cleared					
STATE_CMPL_OBD	O/V	0... FFFFH	0... 65535	1	-
Monitor completion status for the current driving cycle					
STATE_ENA_OBD	O/V	0... FFFFH	0... 65535	1	-
Monitor enable status for the current driving cycle					
T_ACT_MIL	O/V/S	0... FFFFH	0... 65535	1	min
Minutes run by the engine while MIL activated					
T_ACT_MIL_60	V/S	0... 3CH	0... 60	1	s
Seconds run by the engine while MIL activated for T_ACT_MIL calculation (0 ... 59)					
T_DTC_CLR	O/V/S	0... FFFFH	0... 65535	1	min
Time since diagnostic trouble codes cleared					

Input data:

C_CTR_MAX_WUP_CYC {p. 5767}	C_STATE_READY_OBD_1 {p. 5695}	C_STATE_READY_OBD_2 {p. 5695}	DIST {p. 1183}
LV_DC {p. 5746}	LV_END_DIAG_XX {p. 4581}	LV_ES {p. 1720}	LV_MIL_ACT_REQ {p. 5840}
LV_MIL_ACT_REQ_DC {p. 5840}	LV_PWL {p. 988}	LV_STALL {p. 1766}	LV_WUP_CYC {p. 5746}
NLC_OBD_DSL {p. 5789}	STATE_MIL {p. 5827}	WAL_CONF_XX {p. 5811}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_SET_CMPL_OBD	-	0... FFH	0... 255	1	-
Monitoring status MIS, FSD, CC directly set to ready					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_MIL_ACT_REQ	-	0... 1H	0 ...1	1	-
External MIL request is taken or not into account for DIST_ACT_MIL and T_ACT_MIL calculation (0 : not taken and 1 : taken)					

Action definition

ACTION_ERRM_MilOffToOnTrans ()	Mode: O
This action describes the initialisation at MIL transition from OFF to FLL; OFF to ON.	

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Import actions:

ACTION_ERRM_GetReadyClass (**IN**<PRM_IDX_ERR>,**OUT**<PRM_READY_CLAS>)	
ACTION_ERRM_MonitorEnableStatus (**INOUT**<PRM_MONITORENABLESTATUS>)	

FUNCTION DESCRIPTION:

General information:

EOBD/CARB official requirements include a list of statistical data related to Error Management. These statistical data are counters and timers related to Error Management events. You can find below, in the following chapters, a description of all these requirements.

B.88.1 Time since diagnostic trouble codes cleared

Description:

Purpose of this strategy is to compute the time accumulated by the vehicle since diagnostic trouble codes cleared (referenced in ISO15031 as Modes 01h & 02h PID4Eh). It is simply an indication for I/M (Inspection/Maintenance), of the last time an external test equipment was used to clear DTCs.

Application conditions

Initialization: on non-volatil memory reset or lost
or on failure erase service received
T_DTC_CLR = 0

Recurrence : 1 minute ±1 second, after event : on "failure erase" service received

Activation : –

Deactivation: –

Formula section :

{ T_DTC_CLR is updated at required recurrence }
{ T_DTC_CLR shall saturate to its maximal value 65535 }

If T_DTC_CLR < 65535
Then
T_DTC_CLR = T_DTC_CLR + 1
Endif

B.88.2 Distance counters since MIL activation and Minutes run by the engine with MIL activated

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Description:

According to ISO/DIS 15031-5.8 (Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 5: Emissions-related diagnostic services), ECU must be able to indicate :

- the distance travelled while the MIL is activated
- the number of minutes run by the engine while MIL is activated

Distance Travelled While MIL is Activated

The purpose is to compute the covered distance while the MIL is illuminated (MIL blinking is considered as a MIL illumination). This mileage (DIST_ACT_MIL) is a global distance :

- which is not linked with any failure and is independent from the Pre-drive check
- which is dependent from the global inhibition MIL boolean
- which is dependent of the MIL request
- which is readable with Scan-Tool with kilometer as unit

Conditions for “Distance travelled” counter :

- reset to 0 when MIL state changes from deactivated to activated by this ECU
- accumulate counts in km if MIL is activated (ON)
- do not change value while MIL is not activated (OFF)
- reset to 0 if diagnostic information is cleared either by service 04h or 40 warm-up cycles without MIL activated
- do not wrap to 0 if value is FFFFh

Minutes run by the engine while MIL activated

The purpose is to compute the time accumulated while MIL is activated (Modes 01h & 02h PID4Dh). This duration shall be cleared when failure memory is erased and after 40 warm-up cycles.

Conditions for “Minutes run by the engine while MIL activated” counter :

- reset to 0 when MIL state changes from deactivated to activated by this ECU
- accumulate counts in minutes if MIL is activated (ON)
- do not change value while MIL is not activated (OFF)
- reset to 0 if diagnostic information is cleared either by service 04h or 40 warm-up cycles without MIL activated
- do not wrap to 0000h if value is FFFFh

B.88.2.1 Initialisatation at Transtion MIL OFF to ON or FLL (external MIL request)

Description for actions:

ACTION_ERRM_*MilOffToOnTrans* ()
This action describes the initialisation at MIL transition from OFF to FLL; OFF to ON

FUNCTION DESCRIPTION:

This action is called from generic Lamp Management at MIL-transition from OFF2FFL and OFF2ON.

Formula section:

DIST_REL_ACT_MIL = DIST
DIST_ACT_MIL = 0
CTR_ACT_MIL = C_CTR_MAX_WUP_CYC
T_ACT_MIL = 0

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T_ACT_MIL_60 = 0

B.88.2.2 Calculation of DIST_ACT_MIL and T_ACT_MIL

Application conditions

Initialization:
```
On saved ram lost
  or      failure erase service received
        DIST_REL_ACT_MIL = DIST
        DIST_ACT_MIL = 0
        CTR_ACT_MIL = C_CTR_MAX_WUP_CYC
        T_ACT_MIL = 0
      T_ACT_MIL_60 = 0
```

Recurrence: *upon LV_DC 1→0 transition and 1 s*

Activation: LV_DC = 1 **and** LV_PWL = 0 **and** (LV_STALL = 0 **or** LV_ES = 0)

Formula section:

Each 1s:

If(1) STATE_MIL = MIL_FLL **or** STATE_MIL = ON **or**
(NLC_MIL_ACT_REQ = 1 **and** LV_MIL_ACT_REQ = 1
and bit 1 of C_CONF_MIL = 1**)**
Then(1)
  If(2) (DIST - DIST_REL_ACT_MIL) < 65535
  Then(2)
    DIST_ACT_MIL = DIST - DIST_REL_ACT_MIL
  Else(2)
    DIST_ACT_MIL = 65535
  Endif(2)
  T_ACT_MIL_60 = T_ACT_MIL_60 + 1 s
  If(2) (T_ACT_MIL_60 = 60)
  Then(2)
    T_ACT_MIL_60 = 0
    If(3) T_ACT_MIL < 65535
    Then(3)
      T_ACT_MIL = T_ACT_MIL + 1 min
    Else(3)
      T_ACT_MIL = 65535
    Endif(3)
  Endif(2)
Endif(1)

At LV_DC 1→0 transition :

If(1) LV_WUP_CYC = 1
and
STATE_MIL was OFF during all the warm-up cycle
and
(LV_MIL_ACT_REQ_DC = 0 during driving cycle
or bit 1 of C_CONF_MIL = 0 **or** NLC_MIL_ACT_REQ = 0**)**

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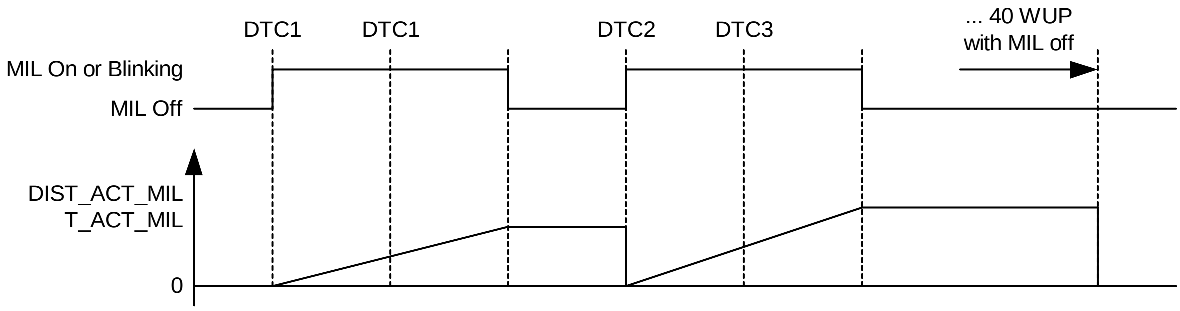
and
CTR_ACT_MIL > 0
Then(1)
CTR_ACT_MIL = CTR_ACT_MIL -1
If(2) CTR_ACT_MIL = 0
Then(2)
DIST_REL_ACT_MIL = DIST
DIST_ACT_MIL = 0
T_ACT_MIL = 0
T_ACT_MIL_60 = 0
Endif(2)
Endif(1)



B.88.3 Distance since diagnostic trouble codes cleared

Description :

Purpose of this strategy is to compute the distance accumulated by the vehicle since diagnostic trouble codes cleared (referenced in ISO15031 as mode01h& 02hPID31h). It is simply an indication for Inspection/Maintenance, of the last time an external test equipment was used to clear DTCs.

Application conditions

Initialization: `on non-volatil memory reset or lost`
`or`
`on failure erase service received`
`DIST_DTC_CLR = 0`
`DIST_REL_DTC_CLR = DIST`

Recurrence : `1 second`

Activation : –

Deactivation: –

Formula section :

{ DIST_DTC_CLR is updated regularly regarding DIST }
{ DIST_DTC_CLR shall saturate to its maximal value 65535 km}

If DIST - DIST_REL_DTC_CLR < 65535
Then
DIST_DTC_CLR = DIST - DIST_REL_DTC_CLR

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Else

DIST_DTC_CLR = 65535

Endif

B.88.4 Number of warm-ups since diagnostic trouble codes cleared

Description:

Purpose of this strategy is to compute number of warm-ups since diagnostic trouble codes cleared (referenced in ISO15031 as Modes 01h & 02h PID30h). It's just an indication for Inspection/Maintenance, to determine the last time an external test equipment was used to clear DTCs.

Application conditions

Activation : `On LV_WUP_CYC 0 → 1 transition`

Initialization: `On non-volatil memory reset or lost`
or `on failure erase service received`
`CTR_WUP_DTC_CLR=0`

Recurrence : `none, executed single time on activation.`

Formula section:

{ on detection of a warm-up cycle CTR_WUP_DTC_CLR is incremented }
{ CTR_WUP_DTC_CLR shall saturate to its maximal value 255 }

If CTR_WUP_DTC_CLR < 255
Then

CTR_WUP_DTC_CLR = CTR_WUP_DTC_CLR + 1

Endif

B.88.5 Monitor enable/completion status for the current driving cycle

General information:

Purpose of this strategy is to get the follwoing informations :

- if a diagnosis (a monitor) is disabled for rest of this monitoring cycle or not (referenced in ISO15031 as Modes 01h & 02h PID41h).
- if a diagnosis (a monitor) is completed for the current monitoring cycle or not (referenced in ISO15031 as Modes 01h & 02h PID41h).

Each concerned diagnosis is part of a generic list : Misfire, Fuel system, Comprehensive component, Catalyst, Heated catalyst, Evaporative system, Secondary air system, A/C system refrigerant, Oxygen sensor, Oxygen sensor heater, EGR system monitoring.

MonitorEnableStatus :
Each bit of STATE_ENA_OBD variable contains status for each predefined diagnosis as defined below :

Enable status of a diagnosis this monitoring cycle:

- NO (STATE_ENA_OBD[n]=0) means disabled for rest of this monitoring cycle

or not supported in C_STATE_READY_OBD_1 & C_STATE_READY_OBD_2

- YES (STATE_ENA_OBD[n]=1) means enabled for this monitoring cycle.

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MonitorCompletionStatus :

Each bit of STATE_CMPL_OBD variable contains status for each predefined diagnosis as defined below :

Completion status of a diagnosis this monitoring cycle:

- YES (STATE_CMPL_OBD[n]=0) means monitor complete this monitoring cycle, or not supported in C_STATE_READY_OBD_1 & C_STATE_READY_OBD_2
- NO (STATE_CMPL_OBD[n]=1) means monitor not complete this monitoring cycle.

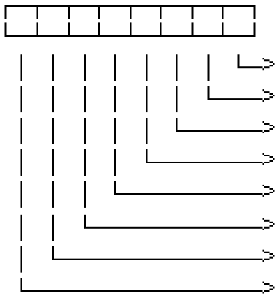
Calibration data detailled description for C_STATE_SET_CMPL_OBD :

Completion status calculation for CARB_MIS, CARB_FSD, CARB_CC diagnosis :

0: Completion status of conserned group is calculated based on the end of diagnosis of each group of diagnostic

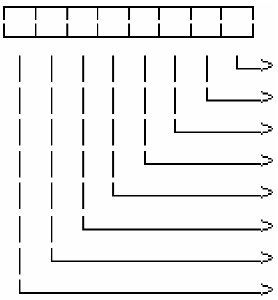
1: Completion status of conserned group always indicates "completed"

C_STATE_SET_CMPL_OBD:



bit0 : set directly ready Misfire monitoring status
bit1 : set directly ready Fuel system monitoring status
bit2 : set directly ready Comprehensive component monitoring status
bit3 : 0
bit4 : 0
bit5 : 0
bit6 : 0
bit7 : 0

Bit 0 to 7 of STATE_ENA_OBD[0..7] :



bit0: Misfire monitoring
bit1: Fuel system monitoring
bit2: Comprehensive component monitoring
bit3: GS/DS vehicle (NLC_OBD_DSL = 1 for DS: 0 for GS)
bit4: reserved
bit5: reserved
bit6: reserved
bit7: reserved

Bit 8 to 15 of STATE_ENA_OBD[8..15] :

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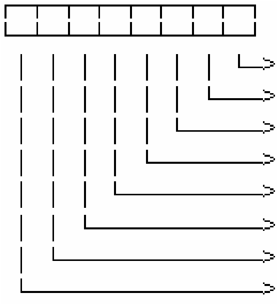
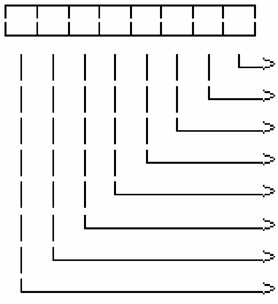
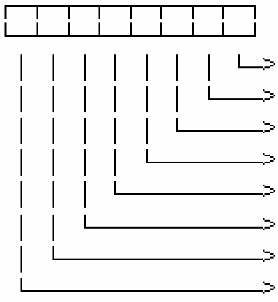


GS name / DS Name





bit8:   Catalyst /NMHC Catalyst monitoring
bit9:   Heated catalyst /NOx Cat-Adsorber monitoring
bit10: Evaporative system /reserved monitoring
bit11: Secondary air system /Boost pressure monitoring
bit12: reserved
bit13: Oxygen sensor /Exhaust Gaz sensor monitoring
bit14: Oxygen sensor heater /PM Filter monitoring
bit15: EGR system monitoring monitoring

Bit 0 to 7 of STATE_CMPL_OBD[0..7] :

bit0: Misfire monitoring
bit1: Fuel system monitoring
bit2: Comprehensive component monitoring
bit3: reserved
bit4: reserved
bit5: reserved
bit6: reserved

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bit7: reserved

Bit 8 to 15 of STATE_CMPL_OBD[8..15] :
GS name /DS Name

bit8: Catalyst /NMHC Catalyst monitoring
bit9: Heated catalyst /NOx Cat-Adsorber monitoring
bit10: Evaporative system /reserved monitoring
bit11: Secondary air system /Boost pressure monitoring
bit12: reserved
bit13: Oxygen sensor /Exhaust Gaz sensor monitoring
bit14: Oxygen sensor heater /PM Filter monitoring
bit15: EGR system monitoring monitoring

Application conditions

Initialization: `on LV_DC 1 → 0 transition`
`STATE_ENA_OBD = 0`
`STATE_CMPL_OBD = 0`

Recurrence : `10 seconds`

Activation : –

Deactivation: –

Formula section :

{

{ *Action call definition shall define strategy related to each supported diagnosis* }
{ *each bit of STATE_ENA_OBD shall be computed according diagnosis strategy* }

{ *STATE_ENA_OBD computation* }
{ *STATE_ENA_OBD is the result returned by ACTION_ERRM_MonitorEnableStatus action* }
{ Please refer to ACTION_ERRM_MonitorEnableStatus definition in }
{ the Application Incidence file }

ACTION_ERRM_MonitorEnableStatus(INOUT<STATE_ENA_OBD>,
SYNCHRONIZATION<CALL>)

{ *STATE_CMPL_OBD computation* }
{ *Each bit of STATE_CMPL_OBD shall be computed according end diagnosis flags* }

STATE_CMPL_OBD[0..7] = C_STATE_READY_OBD_1
STATE_CMPL_OBD[8..15] = C_STATE_READY_OBD_2

Distinction between GS vehicle and DS vehicle
Bit 3 of STATE_ENA_OBD = NLC_OBD_DSL
Bit 3 of STATE_CMPL_OBD = 0

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Misfire monitoring status bit :
If bit 0 of C_STATE_SET_CMPL_OBD = 0
Then
If LV_END_DIAG_XX=1 for all diagnosis XX defined below
Take into account all LV_END_DIAG_XX which fulfill the following condition:
ACTION_ERRM_GetReadyClass(XX,PRM_READY_CLAS)
PRM_READY_CLAS = 00h (CARB_MIS) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 0 of STATE_CMPL_OBD = 0
Endif
Else
Readiness for Misfire monitoring status is always set
Bit 0 of STATE_CMPL_OBD = 0
Endif

Fuel system monitoring status bit :
If bit 1 of C_STATE_SET_CMPL_OBD = 0
Then
If LV_END_DIAG_XX=1 for all diagnosis XX defined below
Take into account all LV_END_DIAG_XX which fulfill the following condition:
ACTION_ERRM_GetReadyClass(XX,PRM_READY_CLAS)
PRM_READY_CLAS = 01h (CARB_FSD) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 1 of STATE_CMPL_OBD = 0
Endif
Else
Readiness for Misfire monitoring status is always set
Bit 1 of STATE_CMPL_OBD = 0
Endif

Comprehensive component monitoring status bit :
If bit 2 of C_STATE_SET_CMPL_OBD = 0
Then
If LV_END_DIAG_XX = 1 for all diagnosis XX defined below
Take into account all LV_END_DIAG_XX which fulfill the following condition:
ACTION_ERRM_GetReadyClass(XX,PRM_READY_CLAS)
PRM_READY_CLAS = 02h (CARB_CC) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 2 of STATE_CMPL_OBD = 0
Endif
Else
Readiness for Misfire monitoring status is always set
Bit 2 of STATE_CMPL_OBD = 0
Endif

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Catalyst monitoring bit :
If LV_END_DIAG_XX = 1 for all diagnosis XX defined below

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Take into account all LV_END_DIAG_XX which fulfill the following condition:
ACTION_ERRM_GetReadyClass(XX,PRM_READY_CLAS)
PRM_READY_CLAS = 03h (CARB_CAT /CARB_NMHC) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 8 of STATE_CMPL_OBD = 0
Endif

Heated catalyst bit :
If LV_END_DIAG_XX = 1 for all diagnosis XX defined below
Take into account all LV_END_DIAG_XX which fulfill the following condition:
ACTION_ERRM_GetReadyClass(XX,PRM_READY_CLAS)
PRM_READY_CLAS = 04h (CARB_HC /CARB_NT) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 9 of STATE_CMPL_OBD = 0
Endif

Evaporative system monitoring bit :
If LV_END_DIAG_XX = 1 for all diagnosis XX defined below
Take into account all LV_END_DIAG_XX which fulfill the following condition:
ACTION_ERRM_GetReadyClass(XX,PRM_READY_CLAS)
PRM_READY_CLAS = 05h (CARB_EVAP) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 10 of STATE_CMPL_OBD = 0
Endif

Secondary air system monitoring bit :
If LV_END_DIAG_XX = 1 for all diagnosis XX defined below
Take into account all LV_END_DIAG_XX which fulfill the following condition:
ACTION_ERRM_GetReadyClass(XX,PRM_READY_CLAS)
PRM_READY_CLAS = 06h (CARB_SA /CARB_BPA) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 11 of STATE_CMPL_OBD = 0
Endif

Bit 12 of STATE_CMPL_OBD is reserved

Oxygen sensor monitoring bit :
If LV_END_DIAG_XX = 1 for all diagnosis XX defined below
Take into account all LV_END_DIAG_XX which fulfill the following condition:
ACTION_ERRM_GetReadyClass(XX,PRM_READY_CLAS)
PRM_READY_CLAS = 08h (CARB_LS /CARB_EG) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)
Then Bit 13 of STATE_CMPL_OBD = 0
Endif

Oxygen sensor heater monitoring bit :
If LV_END_DIAG_XX = 1 for all diagnosis XX defined below
Take into account all LV_END_DIAG_XX which fulfill the following condition:
ACTION_ERRM_GetReadyClass(XX,PRM_READY_CLAS)
PRM_READY_CLAS = 09h (CARB_LSH /CARB_PF) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)

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Then Bit 14 of STATE_CMPL_OBD = 0
Endif

EGR system monitoring bit :
If LV_END_DIAG_XX = 1 for all diagnosis XX defined below
Take into account all LV_END_DIAG_XX which fulfill the following condition:
ACTION_ERRM_GetReadyClass(XX,PRM_READY_CLAS)
PRM_READY_CLAS = 0Ah (CARB_EGR) **and**
the bit 4 of WAL_CONF_XX = 1 (CARB/EOBD failure)

Then Bit 15 of STATE_CMPL_OBD = 0
Endif

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B.89 Statistical data (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DC_ERR_DET [NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Number of driving cycles since DTC detection					
CTR_DC_ERR_DET_DIAG_CDN [NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Number of DC since DTC detection with diag started					
CTR_DC_ERR_DET_DIAG_CMPL [NC_NR_ERR_DYN]	O/V/S	0... FFH	0... 255	1	-
Number of DC since DTC detection with diag completed					
LV_CDN_DIAG_DC [NC_NR_ERR_DYN]	O/V/S	0... 1H	0 ...1	1	-
Flag to detect that diag conditions have been met during DC					

Input data:

AMP {p. 982}	C_AMP_MIN_CAT {p. 5459}	C_AMP_MIN_FSD {p. 6133}	C_AMP_MIN_MIS {p. 6226}
C_STATE_READY_OBD_1 {p. 5695}	C_STATE_READY_OBD_2 {p. 5695}	C_TAM_MIN_FSD {p. 6133}	LV_END_DIAG_XX {p. 4581}
LV_ERR_DC [NC_NR_ERR_DYN] {p. 5767}	LV_ERR_MEM_XX {p. 5767}	LV_INH_DIAG_SA {p. 803}	TAM {p. 1579}

Action definition

ACTION_ERRM_MonitorEnableStatus (**INOUT**<PRM_MONITORENABLESTATUS>)	Mode: O
This action allows to read the MonitorEnableStatus information	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_MONITORENABLESTATUS	inout	0... FFFFH	0... 65535	1	-
Monitor Enable Status					

General information

B.89.1 Diagnostic conditions have been met during the driving cycle

General information:

.

Figure B.89.1:

.

Figure B.89.2:

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Figure B.89.3:

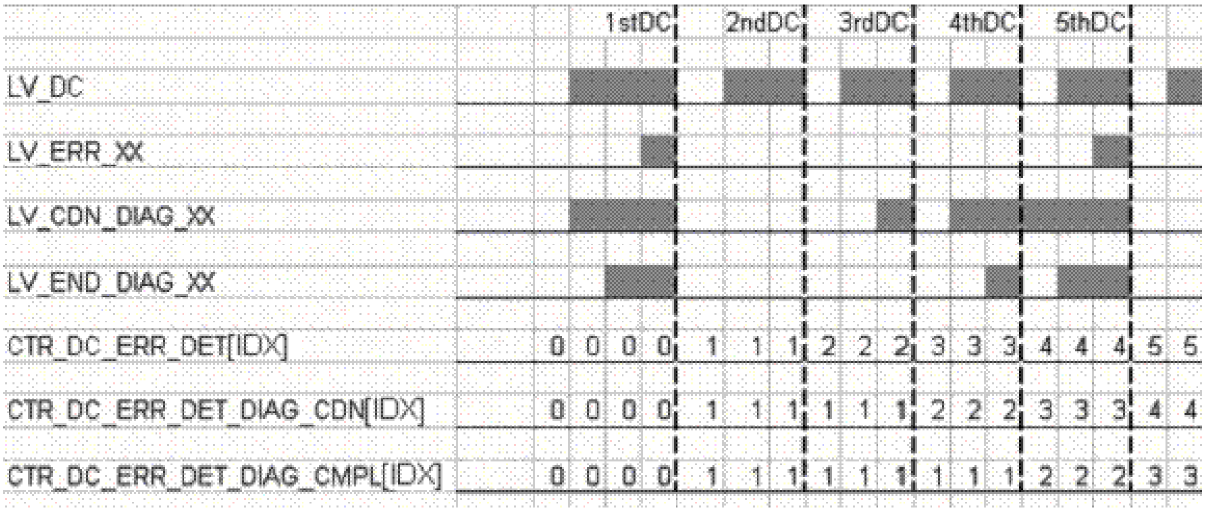

Figure B.89.4:

Purpose of this formula section is to detect that diag. conditions have been met during driving cycle.

Application conditions:

Initialisation: `at LV_DC 1 -> 0 transition`
`    LV_CDN_DIAG_DC[IDX]=0`

Activation: `at LV_CDN_DIAG_XX 0 -> 1 transition`
`and`
`LV_ERR_MEM_XX = 1`

Deactivation: `-`

Recurrence: `none, executed only once on activation`

Function description:

Formula section:

```
#at detection of diagnosis conditions: LV_CDN_DIAG_DC[IDX] is updated
LV_CDN_DIAG_DC[IDX] = 1
```

B.89.2 Driving cycles counters since DTC present

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General information:

.

Figure B.89.5:

.

Figure B.89.6:

.

Figure B.89.7:

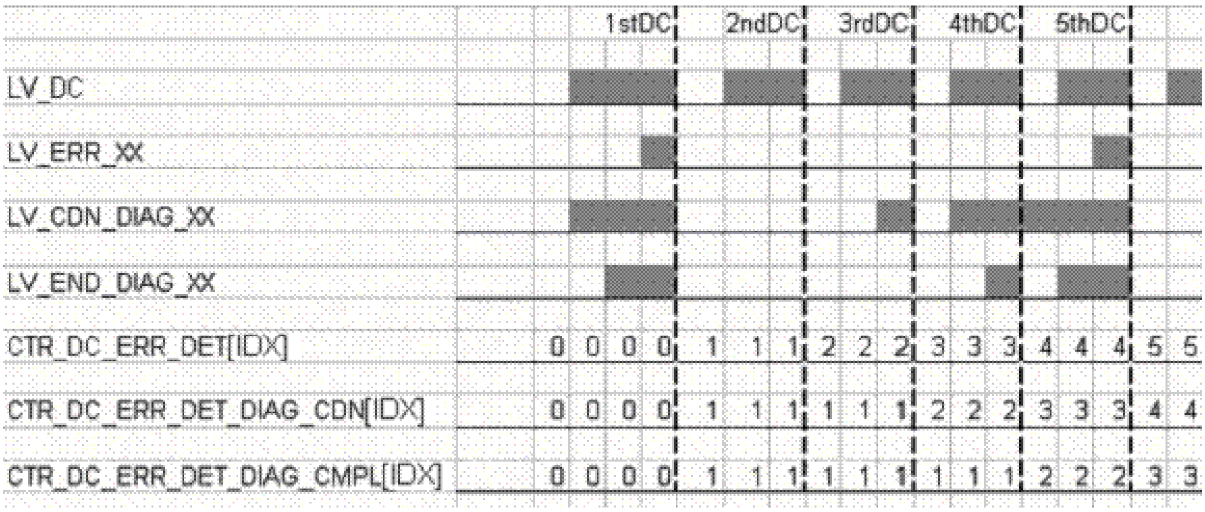

Figure B.89.8:

Purpose of this section is to compute the number of driving cycles regarding the following events :

- detection of diagnostic trouble codes (action call)
- detection of an error in last driving cycle (LV_ERR_DC[IDX])
- detection of diag. conditions have been met during last driving cycle (LV_CDN_DIAG_DC[IDX])
- detection of diag. completion have been met during last driving cycle (LV_END_DIAG_XX)

Application conditions:

Initialisation:

```
at NVMINI
or
on failure erase service received
or
on dynamic failure memory erase
     CTR_DC_ERR_DET[IDX] = 0
     CTR_DC_ERR_DET_DIAG_CDN[IDX] = 0
     CTR_DC_ERR_DET_DIAG_CMPL[IDX] = 0
```

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Activation: at LV_DC 1 -> 0 transition

Deactivation: -

Recurrence: none, executed only once on activation

Function description:

Formula section:

```
#Detection of an error in last driving cycle shall start counters

#On detection of an error in driving cycle counters are updated
#Saturation value of counters is 255

If(0)   LV_ERR_DC[IDX] = 1    #error detection within driving cycle
Then(0)
    If(1a)   CTR_DC_ERR_DET[IDX] < MAX(CTR_DC_ERR_DET[IDX])
    Then(1a)
            CTR_DC_ERR_DET[IDX] = CTR_DC_ERR_DET[IDX] + 1
    Endif(1a)

    If(1b)  CTR_DC_ERR_DET_DIAG_CDN[IDX] < MAX(CTR_DC_ERR_DET_DIAG_CDN[IDX])
    Then(1b)
            CTR_DC_ERR_DET_DIAG_CDN[IDX] = CTR_DC_ERR_DET_DIAG_CDN[IDX] + 1
    Endif(1b)

    If(1c)  CTR_DC_ERR_DET_DIAG_CMPL[IDX] < MAX(CTR_DC_ERR_DET_DIAG_CMPL[IDX])
    Then(1c)
            CTR_DC_ERR_DET_DIAG_CMPL[IDX] = CTR_DC_ERR_DET_DIAG_CMPL[IDX] + 1
    Endif(1c)

Else(0)         #no error detection within driving cycle

    #CTR_DC_ERR_DET[IDX] update
    #after error detection CTR_DC_ERR_DET[IDX] is updated every driving cycle
    #CTR_DC_ERR_DET[IDX] shall saturate to its maximal value 255

    If(1a)  CTR_DC_ERR_DET[IDX] > 0
            and
            CTR_DC_ERR_DET[IDX] < MAX(CTR_DC_ERR_DET[IDX])
    Then(1a)
            CTR_DC_ERR_DET[IDX] = CTR_DC_ERR_DET[IDX] + 1
    Endif(1a)
    #CTR_DC_ERR_DET_DIAG_CDN[IDX] update
    #on detection of diag.  conditions in driving cycle after error detection
    #CTR_DC_ERR_DET_DIAG_CDN[IDX] is updated
    #CTR_DC_ERR_DET_DIAG_CDN[IDX] shall saturate to its maximal value 255

    If(1b)  CTR_DC_ERR_DET_DIAG_CDN[IDX] > 0
            and
            LV_CDN_DIAG_DC[IDX] = 1
            and
            CTR_DC_ERR_DET_DIAG_CDN[IDX] < MAX(CTR_DC_ERR_DET_DIAG_CDN[IDX])
    Then(1b)
        CTR_DC_ERR_DET_DIAG_CDN[IDX] = CTR_DC_ERR_DET_DIAG_CDN[IDX] + 1
    Endif(1b)

    #CTR_DC_ERR_DET_DIAG_CMPL[IDX] update
```

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```
    #on detection of diag.  conditions in driving cycle after error detection
    #CTR_DC_ERR_DET_DIAG_CMPL[IDX] is updated
    #CTR_DC_ERR_DET_DIAG_CMPL[IDX] shall saturate to its maximal value 255

    If(1c)   CTR_DC_ERR_DET_DIAG_CMPL[IDX] > 0
             and
             LV_END_DIAG_XX = 1
             and
             CTR_DC_ERR_DET_DIAG_CMPL[IDX] < MAX(CTR_DC_ERR_DET_DIAG_CMPL[IDX])
    Then(1c)
        CTR_DC_ERR_DET_DIAG_CMPL[IDX] = CTR_DC_ERR_DET_DIAG_CMPL[IDX] + 1
    Endif(1c)

Endif(0)
```

B.89.3 Monitor enable status for the current driving cycle (PID41)

General information:

Purpose of this strategy is to get the follwoing informations :

- if a diagnosis (a monitor) is disabled for rest of this monitoring cycle or not (referenced as Mode01h& 02hPID41h ISO15031).

Each concerned diagnosis is part of a generic list : Misfire, Fuel system, Comprehensive component, Catalyst, Heated catalyst, Evaporative system, Secondary air system, A/C system refrigerant, Oxygen sensor, Oxygen sensor heater, EGR /VVT system monitoring.

MonitorEnableStatus :

Each bit of MonitorEnableStatus variable contains status for each predefined diagnosis as defined below :

Enable status of a diagnosis this monitoring cycle: NO (MonitorEnableStatus[n]=0) means disabled for rest of this monitoring cycle, YES (MonitorEnableStatus[n]=1) means enabled for this monitoring cycle.

Bit 0 to 7 of MonitorEnableStatus[0..7] :

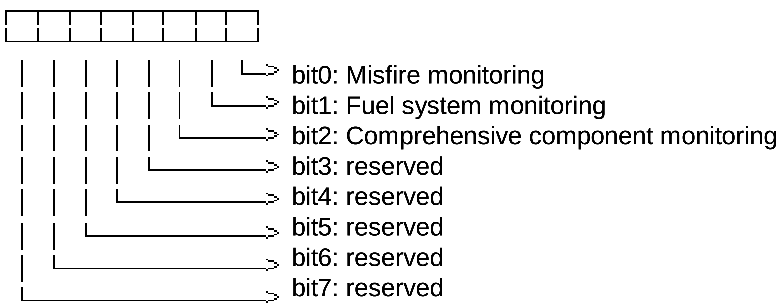

Figure B.89.9:

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Bit 8 to 15 of MonitorEnableStatus[8..15] :

bit8: Catalyst monitoring
bit9: Heated catalyst monitoring
bit10: Evaporative system monitoring
bit11: Secondary air system monitoring
bit12: A/C system refrigerant monitoring
bit13: Oxygen sensor monitoring
bit14: Oxygen sensor heater monitoring
bit15: EGR / VVT system monitoring monitoring

Figure B.89.10:

Description :

Syntax: ACTION_ERRM_MonitorEnableStatus (OUT < MonitorEnableStatus >)
Parameter (in): No parameter
Parameter (out): MonitorEnableStatus with the same format as MonitorEnableStatus
Short Description: This API calculates and returns the monitor enable status result information in the software structure.

Application conditions:

Initialisation: `all bits 0`

Activation: `at ACTION request`

Deactivation: `- -`

Recurrence: `- -`

Function description:

Formula section:

Misfire monitoring status bit :
```
if      AMP > C_AMP_MIN_MIS
then    Bit 0 of MonitorEnableStatus = 1
else    Bit 0 of MonitorEnableStatus = 0
endif
```

Fuel system monitoring status bit :
```
if      AMP > C_AMP_MIN_FSD                 and
        TAM > C_TAM_MIN_FSD
then    Bit 1 of MonitorEnableStatus = 1
else    Bit 1 of MonitorEnableStatus = 0
endif
```

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Comprehensive component monitoring status:

```
        Bit 2 of MonitorEnableStatus = 1
```

Catalyst monitoring bit :

```
if       AMP > C_AMP_MIN_CAT
then    Bit 8 of MonitorEnableStatus = 1
else    Bit 8 of MonitorEnableStatus = 0
endif
```

Heated catalyst monitoring status bit6 :

```
        Bit 9 of MonitorEnableStatus = 0
```

Evaporative system monitoring bit :

```
        Bit 10 of MonitorEnableStatus = 1
```

Secondary air system monitoring bit :

```
if       LV_INH_DIAG_SA = 0
then    Bit 11 of MonitorEnableStatus = 1
else    Bit 11 of MonitorEnableStatus = 0
endif
```

A/C system refrigerant monitoring bit :

```
        Bit 12 of MonitorEnableStatus = 0
```

Oxygen sensor monitoring bit :

```
        Bit 13 of MonitorEnableStatus = 1
```

Oxygen sensor heater monitoring bit :

```
        Bit 14 of MonitorEnableStatus = 1
```

EGR system monitoring bit :

```
        Bit 15 of MonitorEnableStatus = 1
```

```
MonitorEnableStatus [0..7] = MonitorEnableStatus [0..7] and C_STATE_READY_OBD_
1
MonitorEnableStatus [8..15] = MonitorEnableStatus 8..15] and C_STATE_READY_OBD_
2
```

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B.90 Evaporative system monitoring

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AMP_CHK_FUC	O/V	0... FFFFH	0... 5434	0.0829175	hPa
ambient pressure difference during check fuc					
CTR_CHK_FUC_OPEN	O/V/S	0... FFH	0... 255	1	-
Number of tests cfc with result filler cap open					
CTR_DC_ENA_CHK_FUC	O/V/S	0... FFH	0... 255	1	-
Number of DC since CFC request					
ERR_SYM_CHK_FUC	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom					
LV_CDN_DIAG_CHK_FUC	V	0... 1H	0 ...1	1	-
Diagnosis condition					
LV_CHK_FUC_CLOSE	V	0... 1H	0 ...1	1	-
Filler cap close					
LV_CHK_FUC_END	V	0... 1H	0 ...1	1	-
Test filler cap ended					
LV_CHK_FUC_OPEN	O/V/S	0... 1H	0 ...1	1	-
Filler cap open					
LV_CHK_FUC_OPEN_ACT	O/V/S	0... 1H	0 ...1	1	-
Check filler cap lamp was already set					
LV_CHK_FUC_OPEN_CAN	O/V	0... 1H	0 ...1	1	-
Set check filler cap lamp in the ICL					
LV_CTR_DC_CHK_FUC	O/V/S	0... 1H	0 ...1	1	-
Indicator of driving cycle counter enabled					
LV_ENA_CHK_FUC_REFU	O/V/S	0... 1H	0 ...1	1	-
Valid refilling recognized					
LV_ENA_CHK_FUC_ROUGH_LEAK_MES	O/V	0... 1H	0 ...1	1	-
Rough leak request enabled due to check filler cap					
LV_END_DIAG_CHK_FUC	V	0... 1H	0 ...1	1	-
End of diagnosis					
LV_ERR_CHK_FUC	V	0... 1H	0 ...1	1	-
Error flag check filler cap (open filler cap)					
LV_REP_CHK_FUC	O/V/S	0... 1H	0 ...1	1	-
Healing test enabled					
LV_ROUGH_LEAK_SUSP_CHK_FUC	O/V/S	0... 1H	0 ...1	1	-
Evap emission system suspects rough leak					
LV_T_VS_CHK_FUC_OPEN_CAN	V	0... 1H	0 ...1	1	-
Min. vehicle speed for control cfc lamp reached					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_T_VS_CHK_FUC_OPEN_MAX	V	0... 1H	0 ...1	1	-
Recognized vehicle stops					

Input data:

AMP_MES {p. 1163}	FTL {p. 1564}	LC_CONF_DMTL	LV_CONF_DMTL {p. 654}
LV_CYC_ROUGH_LEAK_ SUSP {p. 5963}	LV_ENA_CHK_FUC_ ROUGH_LEAK {p. 5964}	LV_ERR_FTL {p. 5965}	LV_ERR_FTL_PLAUS {p. 5965}
LV_ERR_VS {p. 5021}	LV_REFU {p. 5966}	LV_REFU_VAL {p. 5967}	LV_ROUGH_LEAK_SUSP {p. 5967}
STATE_DMTL {p. 5969}	T_AST {p. 1766}	VS {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_CHK_FUC_MAX	-	0... FFFFH	0... 5434	0.0829175	hPa
maximum deviation of the ambient pressure during check fuc					
C_CTR_CHK_FUC_OPEN_MAX	-	0... FFH	0... 255	1	-
Threshold for number of tests cfc with result filler cap open					
C_CTR_DC_ENA_CHK_FUC_MAX	-	0... FFH	0... 255	1	-
Threshold for number of DC since CFC request					
C_FTL_DELTA_CHK_FUC_MAX	-	0... 7EH	0... 126	1	l
Max. difference between two consecutive FTL					
C_T_AST_DC_CHK_FUC	-	0... FFFFH	0... 6553.5	0.1	s
Threshold for AST to detect a DC					
C_T_CHK_FUC_OPEN_CAN	-	0... FFFFH	0... 6553.5	0.1	s
Duration of setting the cfc lamp					
C_T_VS_CHK_FUC_OPEN_CAN_MIN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for vehicle speed higher than threshold					
C_T_VS_CHK_FUC_OPEN_MIN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for vehicle speed lower than threshold					
C_VS_CHK_FUC_OPEN_CAN_MIN	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed for setting cfc lamp					
C_VS_CHK_FUC_OPEN_MAX	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for setting the healing					
C_VS_DELTA_CHK_FUC_MAX	-	0... FFH	0... 255	1	km/h
Max. difference between two consecutive VS					
C_VS_ENA_CHK_FUC_OPEN_MAX	-	0... FFH	0... 255	1	km/h
Max. vehicle speed to enable cfc test					
C_VS_ENA_CHK_FUC_OPEN_MIN	-	0... FFH	0... 255	1	km/h
Min. vehicle speed to enable cfc test					
LC_COD_CHK_FUC	-	0... FFH	0... 255	1	-
Calibration codebyte for check filler cap test					

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General information:

The function check filler cap during DC is part of the tank leakage detection package.
The function controls the conditions, which are responsible , to enable a check of open filler cap. Is such a condition available, a request LV_ENA_CHK_FUC_ROUGH_LEAK_MES can be set and a rough leak measurement shall be enabled.

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The trigger for the check of open filler cap can be either a valid refueling or a given rough leak suspicion. Are the conditions available, which enable a check, that means low acceleration and low oscillation of the fuel tank level, then a check will be done, if a minimum speed of the vehicle is reached.
A test request is still present for a calibratable number of driving cycles. In case of a detected open filler cap, a calibratable number of tests can be done, after a indication lamp in the instrument cluster was set.

B.90.1 Rough leak request due to check filler cap during DC

General information:

Conditions to set the test request LV_ENA_CHK_FUC_ROUGH_LEAK_MES:

- A valid refueling is given. Setting of the nv-bit LV_ENA_CHK_FUC_REFU. The resetting of this logical value is done, if a CFC-test has finished.
- Availability of a suspected rough leak from the tank leakage detection function. The request is stored until a CFC-test has finished.
- Setting of the test request, if the vehicle speed is greater or equal than a threshold.

Conditions to reset the test request LV_ENA_CHK_FUC_ROUGH_LEAK_MES:

- Vehicle speed is lower than a threshold
- Powerful acceleration of the vehicle
- high ambient pressure deviation

FUNCTION DESCRIPTION:

Application conditions

Initialisation:
```
in case of reset or LV_IGK = 0  1:
    AMP_CHK_FUC = AMP_MES, all other variables to 0
    Restore out of the NV-memory:
 LV_ENA_CHK_FUC_REFU,      LV_ROUGH_LEAK_SUSP_CHK_FUC
       LV_CTR_DC_CHK_FUC
  In case of clear FMY:
    All variables to 0
    AMP_CHK_FUC = AMP_MES
```

Recurrence: *100 ms*

Activation: *LC_CONF_DMTL = 1, during all ECU states*

Formula section:

If LV_ROUGH_LEAK_SUSP = 1 **AND** // suspected rough leak
LC_COD_CHK_FUC = 1. Bit
Then LV_ROUGH_LEAK_SUSP_CHK_FUC = 1
Endif

If LC_COD_CHK_FUC = 0. Bit **AND**
LV_REFU = 1 **AND** // valid refueling
LV_REFU_VAL = 1
Then LV_ENA_CHK_FUC_REFU = 1
Endif

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If LV_CHK_FUC_END = 1
Then LV_ROUGH_LEAK_SUSP_CHK_FUC = 0
LV_ENA_CHK_FUC_REFU = 0
Endif

If [LV_ROUGH_LEAK_SUSP_CHK_FUC = 1 **OR**
(LC_COD_CHK_FUC = ! 0. Bit **AND**
LC_COD_CHK_FUC = ! 1. Bit) **OR**
LV_ENA_CHK_FUC_REFU = 1] **AND**
VS C_VS_ENA_CHK_FUC_OPEN_MIN
Then LV_ENA_CHK_FUC_ROUGH_LEAK_MES = 1 // test request due to cfc
LV_CTR_DC_CHK_FUC = 1 // enabling DC-counter
If STATE_DMTL = REF_LEAK_MES ? ROUGH_LEAK_MES
Then AMP_CHK_FUC = AMP
Endif
Endif

If VS $<$ C_VS_ENA_CHK_FUC_OPEN_MAX **OR**
|VS$_{(n)}$ - VS$_{(n-1)}$| $>$ C_VS_DELTA_CHK_FUC_MAX **OR**
((LV_ERR_FTL = 0 **AND**
LV_ERR_FTL_PLAUS = 0 **AND**
LC_COD_CHK_FUC = 2. Bit) **AND**
|FTL$_{(n)}$ - FTL$_{(n-1)}$| $>$ C_FTL_DELTA_CHK_FUC_MAX) **OR**
LV_CHK_FUC_END = 1 **OR**
(LV_CHK_FUC_OPEN = 1 **AND**
LV_REP_CHK_FUC = 0) **OR**
|AMP_MES - AMP_CHK_FUC| $>$ C_AMP_CHK_FUC_MAX
Then LV_ENA_CHK_FUC_ROUGH_LEAK_MES = 0 // reset of the test request
AMP_CHK_FUC = AMP_MES
End

If LV_CHK_FUC_END = 1 **OR**
LV_CHK_FUC_OPEN = 0 1
Then LV_CTR_DC_CHK_FUC = 0
Endif

B.90.2 Decision of check filler cap open or closed

General information:

Conditions to set LV_CHK_FUC_END:

- Number of the maximum DC are reached. This condition is reached, if the engine stops C_CTR_DC_ENA_CHK_FUC_MAX times, indicated by T_AST. The number of the counted cycles is reseted, if the filler cap test has ended or in case of the error open filler cap .
- Cfc test successfully ended, to be recognized by the cycleflag of the rough leak test in common with no suspected rough leak
- End of the test with C_CTR_CHK_FUC_OPEN_MAX times open filler cap.

Conditions to reset LV_CHK_FUC_END:

- By initialisation of the ECU
- With recognition of a new valid refueling

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Conditions to set LV_CHK_FUC_OPEN

- Cycle flag of the rough leak measurement
- Suspected rough leak

Condition to reset LV_CHK_FUC_OPEN

- End of check filler cap test

FUNCTION DESCRIPTION:

Application conditions

Initialisation:

```
in case of reset or LV_IGK = 0  1:
    Restore out of the NV-memory:
 CTR_DC_ENA_CHK_FUC,      CTR_CHK_FUC_OPEN
       LV_CHK_FUC_OPEN
  All other variables with 0
  In case of clear FMY:
    All variables to 0
```

Recurrence: *100 ms*

Activation: *LC_CONF_DMTL = 1, during all ECU states*

Formula section:

If LV_CTR_DC_CHK_FUC = 1 **AND**
LV_CTR_DC_ENA_CHK_FUC = 0
Then CTR_DC_ENA_CHK_FUC ++ // driving cycle counter
LV_CTR_DC_ENA_CHK_FUC = 1
Endif

If LV_ROUGH_LEAK_SUSP = 0 **AND**
LV_CYC_ROUGH_LEAK_SUSP = 0 1 **AND**
LV_ENA_CHK_FUC_ROUGH_LEAK = 1
Then LV_CHK_FUC_CLOSE = 1 // filler cap closed
Else LV_CHK_FUC_CLOSE = 0
Endif

If LV_ROUGH_LEAK_SUSP = 1 **AND**
LV_CYC_ROUGH_LEAK_SUSP = 0 1 **AND**
LV_ENA_CHK_FUC_ROUGH_LEAK = 1
Then LV_CHK_FUC_OPEN = 1 // filler cap opened
CTR_CHK_FUC_OPEN ++
Endif

If CTR_DC_ENA_CHK_FUC = C_CTR_DC_ENA_CHK_FUC_MAX **OR**
LV_ERR_VS = 1 **OR**
LV_CHK_FUC_CLOSE = 1 **OR**
CTR_CHK_FUC_OPEN = C_CTR_CHK_FUC_OPEN_MAX
Then LV_ CHK_FUC_END = 1 // filler cap test ended
Endif

If LC_COD_CHK_FUC = 0. Bit **AND**

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LV_ENA_CHK_FUC_REFU = 0 1 // valid refueling recognized
Then LV_CHK_FUC_END = 0
Endif

If LV_CHK_FUC_END = 1
Then LV_CHK_FUC_OPEN = 0
Endif

If LV_CHK_FUC_END = 1 **OR**
LV_CHK_FUC_OPEN = 0 1
Then CTR_DC_ENA_CHK_FUC = 0
CTR_CHK_FUC_OPEN = 0
Endif

B.90.3 Control of the check filler cap lamp in the instrument cluster

General information:

Forming of the lamp control by LV_CHK_FUC_OPEN and the stored value LV_CHK_FUC_OPEN_ACT. If an opened filler cap is recognized and the vehicle speed is higher than a threshold for a calibratable time, the indication lamp will be set for a calibratable time. To prevent a setting of the lamp after the lamp has burned once, this information is stored in LV_CHK_FUC_OPEN_ACT. This bit shall be reseted after the end of the check filler cap test.

FUNCTION DESCRIPTION:

Application conditions

Initialisation:
```
in case of reset or LV_IGK = 0  1:
    Restore out of the NV-memory:
 LV_CHK_FUC_OPEN_ACT,      LV_REP_CHK_FUC
  All other variables with 0
  In case of clear FMY:
    All variables to 0
```

Recurrence: *100 ms*

Activation: *LC_CONF_DMTL = 1, during all ECU states*

Formula section:

If VS C_VS_CHK_FUC_OPEN_CAN_MIN
Then T_VS_CHK_FUC_OPEN_CAN_MIN ++
Else T_VS_CHK_FUC_OPEN_CAN_MIN = 0
Endif

If T_VS_CHK_FUC_OPEN_CAN_MIN C_T_VS_CHK_FUC_OPEN_CAN_MIN
Then LV_T_VS_CHK_FUC_OPEN_CAN = 1
Else LV_T_VS_CHK_FUC_OPEN_CAN = 0
Endif

If VS C_VS_CHK_FUC_OPEN_MAX
Then T_VS_CHK_FUC_OPEN_MAX ++

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```
        Else        T_VS_CHK_FUC_OPEN_MAX = 0
Endif

If        T_VS_CHK_FUC_OPEN_MAX   C_T_VS_CHK_FUC_OPEN_MIN
        Then        LV_T_VS_CHK_FUC_OPEN_MAX = 1
        Else        LV_T_VS_CHK_FUC_OPEN_MAX = 0
Endif

If        LV_CHK_FUC_OPEN = 1                        AND
        LV_T_VS_CHK_FUC_OPEN_CAN = 1            AND
        LV_CHK_FUC_OPEN_ACT = 0
        Then        LV_CHK_FUC_OPEN_CAN = 1
            LV_CHK_FUC_OPEN_ACT = 1
                T_CHK_FUC_OPEN_CAN = C_T_CHK_FUC_OPEN_CAN
        Else        T_CHK_FUC_OPEN_CAN - -
                If        T_CHK_FUC_OPEN_CAN = 0
                        Then        LV_CHK_FUC_OPEN_CAN = 0
                Endif
Endif

If        LV_CHK_FUC_OPEN_ACT = 1                    AND
        LV_T_VS_CHK_FUC_OPEN_MAX = 1
        Then        LV_REP_CHK_FUC = 1
Endif

If        LV_CHK_FUC_END = 1
        Then        LV_REP_CHK_FUC = 0
Endif
If        LV_CHK_FUC_END = 1                    OR
        LV_CYC_ROUGH_LEAK_SUSP = 0   1                    // sequencing ???
        Then        LV_CHK_FUC_OPEN_ACT = 0
Endif
```

B.90.4 Forming the error flag

FUNCTION DESCRIPTION:

Application conditions

Initialisation: `in case of reset or LV_IGK = 0   1:`

```
  All other variables with 0
  In case of clear FMY:
    All variables to 0
```

Recurrence: *100 ms*

Activation: *LC_CONF_DMTL = 1, during all ECU states*

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Formula section:

If LV_ENA_CHK_FUC_ROUGH_LEAK = 1
Then LV_CDN_DIAG_CHK_FUC = 1
Else LV_CDN_DIAG_CHK_FUC = 0
Endif

If LV_CHK_FUC_OPEN = 0 1 **OR**
LV_CHK_FUC_CLOSE = 0 1
Then LV_END_DIAG_CHK_FUC = 1
Endif

If LV_CHK_FUC_OPEN = 0 1 **AND**
LV_CHK_FUC_CLOSE = 0
Then ERR_SYM_CHK_FUC = MAX
LV_ERR_CHK_FUC = 0
LV_ERR_CHK_FUC = 1
Endif

If LV_CHK_FUC_OPEN = 0 **AND**
LV_CHK_FUC_CLOSE = 0 1
Then ERR_SYM_CHK_FUC = NO_SYM
LV_ERR_CHK_FUC = 0
Endif

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B.91 Functional check canister purge solenoid

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CL_MMV_DIAGCPS_MAX_SAE	O/V/S	0... FFFFH	0... 1.99996	30.5e-6	-
Canister load max-value for Output mode06h					
CL_MMV_DIAGCPS_MIN_SAE	O/V/S	0... FFFFH	0... 1.99996	30.5e-6	-
Canister load min-value for Output mode06h					
CL_MMV_SAE	O/V/S	0... FFFFH	0... 1.99996	30.5e-6	-
Output mode06h - Step 1					
CL_MMV_TMP_SAE	V	0... FFFFH	0... 1.99996	0.0000305	-
Canister load mean value: Temporary auxiliar variable for STEP_1 not passed					
ERR_SYM_DIAGCPS	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure - functional check CPS					
FLOW_SP_CP_DIAGCPS	O/V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow setpoint through the CPS during functional check CPS					
FLOW_SP_CPS_OLD	V	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Last EVAP-calculated flow setpoint through the CPS before start of FC CPS					
LV_ACT_DIAGCPS	O/V	0... 1H	0 ...1	1	-
Indication for functional check cps (step 2 or 3) being activated					
LV_CDN_DIAG_DIAGCPS	O/V	0... 1H	0 ...1	1	-
Condition of diagnosis - functional check CPS					
LV_DI_SUM_DIAGCPS	-	0... 1H	0 ...1	1	-
Auxiliary bit for step 2 - functional check CPS					
LV_DIAGCPS_MIN_MOD	O/V	0... 1H	0 ...1	1	-
Indication EVAC sent into MIN_PURGE by FC CPS					
LV_END_DIAG_DIAGCPS	O/V	0... 1H	0 ...1	1	-
End of diagnosis - functional check CPS					
LV_END_RBM_DIAGCPS	O/V	0... 1H	0 ...1	1	-
Indication for RBM that all three steps have been executed - functional check CPS					
LV_EOL_CPS_ERR	O/V	0... 1H	0 ...1	1	-
LV indicating error of functional check CPS (step 2) after EOL-test					
LV_EOL_CPS_INI	V	0... 1H	0 ...1	1	-
LV indicating EOL-requested functional check CPS					
LV_ERR_DIAGCPS	O/V	0... 1H	0 ...1	1	-
Indication for faulty functions - functional check CPS					
LV_INH_MAP_CTL_DIAGCPS	O/V	0... 1H	0 ...1	1	-
inhibition of MAP-control during step 2 - functional check CPS					
LV_LAM_DIAGCPS	V	0... 1H	0 ...1	1	-
Auxiliary bit for step 2 functional check CPS					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAM_SUM_DIAGCPS	V	0... 1H	0 ...1	1	-
Auxiliary bit for step 2 functional check CPS					
LV_MAF_DIAGCPS_0	V	0... 1H	0 ...1	1	-
Auxiliary bit for step 3 - functional check CPS					
LV_MAF_DIAGCPS_1	V	0... 1H	0 ...1	1	-
Auxiliary bit for step 3 - functional check CPS					
LV_MAF_SP_TQI_DYW_DIAGCPS	O/V	0... 1H	0 ...1	1	-
Indication for limited dynamic condition - functional check CPS					
LV_MAP_DIF_DIAGCPS	V	0... 1H	0 ...1	1	-
Auxiliary bit for step 2 - functional check CPS					
LV_MAP_DIF_DIAGCPS_1	-	0... 1H	0 ...1	1	-
Auxiliary bit for step 2 - functional check CPS					
LV_N_DIF_DIAGCPS	V	0... 1H	0 ...1	1	-
Auxiliary bit for step 2 - functional check CPS					
LV_N_DIF_DIAGCPS_1	-	0... 1H	0 ...1	1	-
Auxiliary bit for step 2 - functional check CPS					
LV_OPM_AV_CNG_DIAGCPS	V	0... 1H	0 ...1	1	-
LV indicating change of operation mode					
LV_OPM_AV_DIAGCPS_P_THR	V	0... 1H	0 ...1	1	-
LV indicating change of operation mode within OPM_AV = 1 (Teildrosselung in UGD)					
LV_SUPP_ACCIN_DIAGCPS	O/V	0... 1H	0 ...1	1	-
Bit to suppress the air conditioning compressor request signal - functional check CPS					
LV_T_DIAGCPS_RBM	V	0... 1H	0 ...1	1	-
Auxiliary bit timer for RBM - functional check CPS					
MAF_DIAGCPS	V	0... FFFFH	0... 1389	0.0211948	mg/stk
MAF value on start of step 3 - functional check CPS					
MAF_DIAGCPS_SAE	O/V/S	0... FFFFH	0... 1389	0.0211948	mg/stk
Output mode06h - Step 3					
MAF_DIAGCPS_THD_SAE	O/V/S	0... FFFFH	0... 1389	0.0211948	mg/stk
Output mode06h - Step 3					
MAF_SP_TQI_MMV_DIAGCPS	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Moving mean value of MAF_SP_TQI (RAM cell) - functional check CPS					
MAP_DIAGCPS	V	0... FFFFH	0... 5434	0.0829175	hPa
MAP value on starting the time C_T_DIAGCPS_N_MAP_2					
N_DIAGCPS	V	0... 1FE0H	0... 8160	1	rpm
N value on starting the time C_T_DIAGCPS_N_2					
PRS_IM_CTL_I_DIAGCPS	V	8000... 7FFFH	-2... 1.99993	61e-6	-
Pressure controller I-part value on starting the time C_T_DIAGCPS_N_MAP_2					
STATE_DIAGCPS	O/V	0H 1H 2H 3H 4H 5H	STEP_INIT STEP_1 STEP_2 STEP_3 CPS_RAMP LOCK_STEP	-	-
State - functional check CPS					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_DIAGCPS_RBM	V	0H 1H 2H 3H 4H 5H	STEP_INIT STEP_1 STEP_2 STEP_3 CPS_RAMP LOCK_STEP	-	-
State - functional check CPS					
SUM_DIAG_DIAGCPS	V	0... FFH	0... 255	1	cyc
Number of diagnoses - functional check CPS					
SUM_DIAG_DIAGCPS_EOL	O/V	0... FFH	0... 255	1	cyc
Number of diagnoses if EOL-Test is active - functional check CPS					
SUM_DIAG_DIAGCPS_SAE	O/V/S	0... FFH	0... 255	1	cyc
Output mode06h - Step 2					
SUM_DIAGCPS_MAX_SAE	O/V/S	0... FFH	0... 255	1	cyc
Output mode06h - Step 2					
SUM_FLOW_SP_DIAGCPS	V	0... FFH	0... 255	1	cyc
Number of step 2 loops which have been passed - functional check CPS					
SUM_FLOW_SP_DIAGCPS_EOL	O/V	0... FFH	0... 255	1	cyc
Number of step 2 loops which have been passed if EOL-Test is active - fuctional check CPS					
SUM_MAF_DIAG_DIAGCPS_OFS	V	0... FFH	0... 255	1	cyc
Number of diagnoses results MAF within 1 offset - functional check CPS					
SUM_MAP_DIAG_DIAGCPS	V	0... FFH	0... 255	1	cyc
Number of diagnoses results MAP - functional check CPS					
SUM_MAP_DIAG_DIAGCPS_OFS	V	0... FFH	0... 255	1	cyc
Number of diagnoses results MAP within 1 offset - functional check CPS					
SUM_N_DIAG_DIAGCPS	V	0... FFH	0... 255	1	cyc
Number of diagnoses results N - functional check CPS					
SUM_N_DIAG_DIAGCPS_OFS	V	0... FFH	0... 255	1	cyc
Number of diagnoses results N within 1 offset - functional check CPS					
T_CL_MMV_DIAGCPS	O/V	0... FFH	0... 25.5	0.1	s
Timer to count how long the CL_MMV has been above the threshold in Step 1 (UGD)					
T_CL_MMV_DIAGCPS_2	O/V	0... FFH	0... 25.5	0.1	s
Timer to count how long the CL_MMV has been above the threshold in Step 1 (VVTNOTL1)					
T_DIAGCPS_DLY	V	1... FFH	0.1... 25.5	0.1	s
Delay time - functional check CPS					
T_DIAGCPS_DLY_1_RBM	V	1... FFH	0.1... 25.5	0.1	s
Delay time step 2 (RBM) - functional check CPS					
T_DIAGCPS_DLY_2_RBM	V	1... FFH	0.1... 25.5	0.1	s
Delay time step 3 (RBM) - functional check CPS					
T_DIAGCPS_LAM_1	V	1... FFH	0.1... 25.5	0.1	s
1st time interval for LAM-Diagnosis - functional check CPS					
T_DIAGCPS_MAF	V	1... FFH	0.1... 25.5	0.1	s
Time for active FLOW_SP offset - functional check CPS					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_DIAGCPS_MAF_RBM	V	1... FFH	0.1... 25.5	0.1	s
Time for active FLOW_SP offset step 3 (RBM) - functional check CPS					
T_DIAGCPS_N_MAP_1	V	1... FFH	0.1... 25.5	0.1	s
1st time interval for N-DIF-Diagnosis - functional check CPS					
T_DIAGCPS_N_MAP_1_RBM	V	1... FFFFH	0.1... 6553.5	0.1	s
time interval for N-DIF-Diagnosis step 2 (RBM) - functional check CPS					
T_DIAGCPS_N_MAP_2	V	1... FFH	0.1... 25.5	0.1	s
2nd time interval for N-DIF-Diagnosis - functional check CPS					
T_DIAGCPS_N_MAP_3	V	1... FFH	0.1... 25.5	0.1	s
3rd time interval for N-DIF-Diagnosis - functional check CPS					
TI_LAM_DIAGCPS_DIF [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
TI_LAM_COR_i - difference while CPS-opening during STEP_2 - functional check CPS					
TI_LAM_DIAGCPS_MAX [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
TI_LAM_COR_i - max-value while CPS-opening during STEP_2 - functional check CPS					
TI_LAM_DIAGCPS_MIN [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
TI_LAM_COR_i - min-value while CPS-opening during STEP_2 - functional check CPS					

Input data:

CL_MMV {p. 3698}	FLOW_SP_CPS {p. 3635}	LV_CH {p. 8232}	LV_CL_MDL_ACT {p. 3728}
LV_CL_MMV_CAL_ACT {p. 3699}	LV_CP_CLL {p. 3636}	LV_DC {p. 5746}	LV_DI_DIAGCPS {p. 5954}
LV_EOL_CPS {p. 7763}	LV_HOM_ACT {p. 8136}	LV_IGK {p. 906}	LV_INH_DIAGCPS {p. 5954}
LV_IS {p. 1720}	LV_TQ_ISC_I_TQ_PSTE {p. 3440}	MAF {p. 8277}	MAF_MES {p. 1192}
MAF_SP_TQI {p. 8390}	MAP_DIP_MES_BAS {p. 1198}	MAP_DIP_SP_MMV {p. 805}	N {p. 1525}
N_DIF {p. 1122}	PRS_IM_CTL_I {p. 8278}	STATE_OPM_ENG_CP {p. 3680}	T_DLY_PURGE_DIAGCPS {p. 1002}
TCO {p. 1100}	TI_LAM_COR [NC_CBK_EX_NR] {p. 1017}	VS {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MMV_DIAGCPS	-	0... FFFFH	0... 1.99996	30.5e-6	-
Moving mean value of canister load for functional check CPS					
C_CL_MMV_DIAGCPS_VLD	-	0... FFFFH	0... 1.99996	30.5e-6	-
Threshold on CL_MMV to avoid going into Step 2 or Step 3 if the AKF is too full					
C_CRLC_MAF_SP_TQI_DIAGCPS	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for calculation of MAF_SP_TQI_MMV_DIAGCPS					
C_FLOW_SP_DIAGCPS_MAF	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow setpoint offset in step 3 - functional check CPS					
C_FLOW_SP_DIAGCPS_N	-	0... FFFFH	0... 7.99987	122.1e-6	kg/h
Flow setpoint offset in step 2 - functional check CPS					
C_LGRD_FLOW_SP_NEG_DIAGCPS	-	1... FFFFH	0... 7.99987	122.1e-6	kg/h
Limitation gradient for closing the CPS- funtional check CPS					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LGRD_FLOW_SP_POS_DIAGCPS	-	1... FFFFH	0... 7.99987	122.1e-6	kg/h
Limitation gradient for opening the CPS - functional check CPS					
C_MAF_DIAGCPS_2	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Delta MAF for MAF decrease - functional check CPS, gedrosselt					
C_MAF_MAX_DIAGCPS	-	0... FFFFH	0... 1389	0.0211948	mg/stk
MAF condition - functional check CPS					
C_MAP_DIAGCPS_1	-	0... FFFFH	0... 5434	0.0829175	hPa
Threshold for map difference in step 2 - functional check CPS, ungedrosselt					
C_MAP_DIAGCPS_2	-	0... FFFFH	0... 5434	0.0829175	hPa
Threshold for map difference in step 2 - functional check CPS, gedrosselt					
C_MAP_DIP_SP_MMV_DIAGCPS	-	8000... 7FFFH	-1280... 1279.96093	0.0390625	hPa
Threshold for map difference in step 2 - functional check CPS, gedrosselt					
C_N_DIAGCPS_2	-	0... 1FE0H	0... 8160	1	rpm
Threshold for engine speed increase in step 2 - functional check CPS, gedrosselt					
C_N_DIF_DIAGCPS	-	0... 1FE0H	0... 8160	1	rpm
Condition for IS engine speed difference - functional check CPS					
C_PRS_IM_CTL_I_DIAGCPS	-	0... FFFFH	0... 3.99993	61e-6	-
Threshold for Pressure controller I-part difference in step 2 - functional check CPS					
C_SUM_DIAGCPS_EOL	-	0... FFH	0... 255	1	cyc
EOL-test: Counter limit of SUM_DIAGCPS_EOL - funtional check CPS					
C_SUM_DIAGCPS_MAX	-	0... FFH	0... 255	1	cyc
Counter limit of C_SUM_DIAGCPS - funtional check CPS					
C_SUM_FLOW_SP_DIAGCPS_MAX	-	0... FFH	0... 255	1	cyc
Max. number of step 2 loops which have been passed - functional check CPS					
C_SUM_MAF_DIAG_DIAGCPS_OFS	-	0... FFH	0... 255	1	cyc
Counter for MAF-events per offset during STEP_2 - functional check CPS					
C_SUM_MAP_DIAG_DIAGCPS_OFS	-	0... FFH	0... 255	1	cyc
Counter for MAP-events per offset during STEP_2 - functional check CPS					
C_SUM_N_DIAG_DIAGCPS_OFS	-	0... FFH	0... 255	1	cyc
Counter for n-events per offset during STEP_2 - functional check CPS					
C_T_CL_MMV_DIAGCPS	-	0... FFH	0... 25.5	0.1	s
Timer to count how long the CL_MMV has been above the threshold in Step 1 (UGD)					
C_T_CL_MMV_DIAGCPS_2	-	0... FFH	0... 25.5	0.1	s
Timer to count how long the CL_MMV has been above the threshold in Step 1 (VVTNOTL1)					
C_T_DIAGCPS_DLY	-	1... FFH	0.1... 25.5	0.1	s
Delay time - functional check CPS					
C_T_DIAGCPS_MAF	-	1... FFH	0.1... 25.5	0.1	s
Time for active FLOW_SP offset C_FLOW_SP_DIAGCPS_MAF - functional check CPS					
C_T_DIAGCPS_N_MAP_1	-	1... FFH	0.1... 25.5	0.1	s
Time interval after expiry of which the cycle of step 2 is repeated - functional check CPS					
C_T_DIAGCPS_N_MAP_2	-	1... FFH	0.1... 25.5	0.1	s
Time for evaluaiton of N, MAP reaction - functional check CPS					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DIAGCPS_N_MAP_3	-	1... FFH	0.1... 25.5	0.1	s
Time for increasing FLOW_SP - functional check CPS					
C_T_DIAGCPS_N_MAP_4	-	1... FFH	0.1... 25.5	0.1	s
Time for evaluation of N, MAP reaction - functional check CPS					
C_T_INH_MAP_CTL_DIAGCPS	-	1... FFH	0.1... 25.5	0.1	s
time threshold for inhibition of MAP-control - functional check CPS					
C_TCO_MIN_DIAGCPS	-	0... FEH	-48... 142.5	0.75	°C
Min. temperature for functional check CPS					
C_TI_LAM_DIAGCPS_DIF	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Min. TI_LAM_COR_i - difference while CPS-opening during STEP_2 - funcitonal check CPS					
LC_DIAGCPS_MAP_ACT_OPM_2	-	0... 1H	0 ...1	1	-
MAP monitoring activated during STEP_2 - throttled mode					

FUNCTION DESCRIPTION:

General Information:

The diagnosis is used for the functional test of the CP solenoid. Therefore the CPS is diagnosed via its effects on the engine.
The functional check of the CPS consists of 3 steps:

- Step 1: based on the ACF load degree
- Step 2: based on
  - the engine speed change at IS,
  - the deviation of lambda-controller   and
  - the measured MAP before and during CPS-opening
- Step 3: based on the difference between the measured air mass flow before and during a CPS opening

If the CPS has been detected to be OK within a step or as not OK after step 3 then the function is exited irreversibly until the next engine start.
The steps 1, 2 and 3 are processed successively, i.e. the next step may only be performed if the preceeding one has not been detected as OK. The only exception is step 1. Step 1 may also be performed parallel to step 2 and 3, which means:
After step 1 has been processed once and CPS has not been detected as OK then (if enable conditions are fulfilled) it is proceeded with step 2 and at the same time calculation of step 1 is started again. Calculation of step 1 is done until CPS is detected as OK within one of the steps (1, 2 or 3) or until CPS is dectected as definitely not OK by the end of step 3.
If the CPS is detected to be not OK after all 3 steps have been passed (end of step 3), then the error is set.
The complete diagnosis “functional check CPS” is performed only once per driving cycle.
Exception:
Activation of functional check CPS via EOL-test (LV_EOL_CPS 0 - ->1):
Through the EOL-test the functional check CPS can be triggered several times per engine operation.
The diagnosis is addressed via the serial interface. Only STEP_2 will be performed.
For general enable conditions of the diagnosis see chapter "Appl. Inc. Functional Check CPS".

Error-symptoms are defined to this diagnosis function as following :

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```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │  │  │  └─> -                                  (= SYM_0)
 │  │  └───> -                                   (= SYM_1)
 │  └─────> CPS - EOL-error                      (= SYM_2)
 └───────> CPS - plausibility-error              (= SYM_3)
```

Application conditions:

Initialisation: 1) on transition LV_IGK OFF→ ON or reset:
All variables from output-data-section have to be initialized with zero:
except: STATE_DIAGCPS_OLD = STEP_1
STATE_DIAGCPS = STEP_INIT
T_DIAGCPS_DLY = C_T_DIAGCPS_DLY
T_CL_MMV_DIAGCPS = C_T_CL_MMV_DIAGCPS
T_CL_MMV_DIAGCPS_2 = C_T_CL_MMV_DIAGCPS_2
CL_MMV_SAE = CL_MMV_SAE
CL_MMV_DIAGCPS_MIN_SAE = CL_MMV_DIAGCPS_MIN_SAE
CL_MMV_DIAGCPS_MAX_SAE = CL_MMV_DIAGCPS_MAX_SAE
SUM_DIAG_DIAGCPS_SAE = SUM_DIAG_DIAGCPS_SAE
SUM_DIAGCPS_MAX_SAE = SUM_DIAGCPS_MAX_SAE
MAF_DIAGCPS_SAE = MAF_DIAGCPS_SAE
MAF_DIAGCPS_THD_SAE = MAF_DIAGCPS_THD_SAE

2) on clearing failure memory
All variables from output-data-section have to be initialized with zero:
except: STATE_DIAGCPS_OLD = STEP_1
STATE_DIAGCPS = STEP_INIT
T_DIAGCPS_DLY = C_T_DIAGCPS_DLY
T_CL_MMV_DIAGCPS = C_T_CL_MMV_DIAGCPS
T_CL_MMV_DIAGCPS_2 = C_T_CL_MMV_DIAGCPS_2

Recurrence: 100 ms
Activation: LV_DC = 1
Deactivation: LV_DC = 0

Conditions for End-of-line (EOL) - Test:

Description:

This is to secure that any time the functional check CPS is activated via EOL-Test :

- the functional check starts right from the beginning again
- only those steps of the functional check CPS are performed regarding the EOL-Test
- the diagnosis results of the functional check (issued via serial interface) are the results from the EOL-Test only

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Formula section:

Detection of EOL-Request:
IF (LV_EOL_CPS(k-1) = 0 **AND** LV_EOL_CPS(k) = 1)

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```
THEN        LV_EOL_CPS_INI = 1
            STATE_DIAGCPS = STEP_INIT
ELSE        LV_EOL_CPS_INI = 0
ENDIF
```

Detection of OPM-Change: *// OPM = operation mode*

```
IF      MAP_DIP_SP_MMV > C_MAP_DIP_SP_MMV_DIAGCPS
THEN  LV_OPM_AV_DIAGCPS_P_THR = 1     //GD, T-GD (gedrosselt); direct injection vehicles
ELSE  LV_OPM_AV_DIAGCPS_P_THR = 0     //UGD (ungedrosselt); VVT vehicles
    ENDIF

  IF      STATE_DIAGCPS = STEP_2         or
          STATE_DIAGCPS = STEP_3
  THEN
  IF    (LV_OPM_AV_DIAGCPS_P_THR k != // UGD ⇓ T- GD or GD
              LV_OPM_AV_DIAGCPS_P_THR k-1)
     THEN        LV_OPM_AV_CNG_DIAGCPS = 1
                 STATE_DIAGCPS = STEP_INIT
       ELSE        LV_OPM_AV_CNG_DIAGCPS = 0
       ENDIF
  ENDIF
```

The functionality in Step 1 which consists in counting the time during which the CL_MMV is above the threshold C_CL_MMV_DIAGCPS, needs to be reset in the following cases:

- transition between UGD/GD happens
- the system is in open loop (CL_MMV frozen)
- the canister load model is active (CL_MMV not reliable)

```
IF        (LV_OPM_AV_DIAGCPS_P_THR k ! =
          LV_OPM_AV_DIAGCPS_P_THR k-1)         OR
             LV_CP_CLL = 0                          OR
             LV_CL_MDL_ACT = 1                      OR
             LV_CL_MMV_CAL_ACT = 0
             THEN  T_CL_MMV_DIAGCPS = C_T_CL_MMV_DIAGCPS
                   T_CL_MMV_DIAGCPS_2 = C_T_CL_MMV_DIAGCPS_2
  ENDIF
```

STEP_INIT:

LV_ACT_DIAGCPS = 0
LV_DIAGCPS_MIN_MOD = 0
LV_INH_MAP_CTL_DIAGCPS = 0
LV_MAF_DIAGCPS_i = 0
LV_EOL_CPS_ERR = 0
LV_N_DIF_DIAGCPS = 0
LV_N_DIF_DIAGCPS_1 = 0
LV_DI_SUM_DIAGCPS = 0
LV_MAP_DIF_DIAGCPS = 0
LV_MAP_DIF_DIAGCPS_1 = 0
SUM_MAP_DIAG_DIAGCPS_OFS = 0
SUM_N_DIAG_DIAGCPS_OFS = 0

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SUM_MAF_DIAG_DIAGCPS_OFS = 0
LV_SUPP_ACCIN_DIAGCPS = 0
LV_LAM_DIAGCPS = 0
MAF_DIAGCPS = 0
N_DIAGCPS = 0
MAP_DIAGCPS = 0
PRS_IM_CTL_I_DIAGCPS = 0
SUM_DIAG_DIAGCPS_EOL = 0
SUM_FLOW_SP_DIAGCPS_EOL = 0
T_DIAGCPS_N_MAP_1 = 0
T_DIAGCPS_N_MAP_2 = 0
T_DIAGCPS_N_MAP_3 = 0
T_DIAGCPS_LAM_1 = 0
T_DIAGCPS_MAF = 0
TI_LAM_DIAGCPS_DIF_i = 0
TI_LAM_DIAGCPS_MIN_i = 7FFFH
TI_LAM_DIAGCPS_MAX_i = 8000H
T_DIAGCPS_DLY = C_T_DIAGCPS_DLY
T_DIAGCPS_DLY_1_RBM = 0
T_DIAGCPS_DLY_2_RBM = 0
T_DIAGCPS_N_MAP_1_RBM = 0
T_DIAGCPS_MAF_RBM = 0
LV_T_DIAGCPS_RBM = 0
T_CL_MMV_DIAGCPS = C_T_CL_MMV_DIAGCPS
T_CL_MMV_DIAGCPS_2 = C_T_CL_MMV_DIAGCPS_2

IF(1) LV_INH_DIAGCPS = 1 **OR** // Functional check CPS is exited irreversibly
LV_EOL_CPS_INI = 1 **OR** // EOL-Test active
LV_OPM_AV_CNG_DIAGCPS = 1 // change of OPM_AV detected
THEN(1) LV_EOL_CPS_INI = 0
LV_OPM_AV_CNG_DIAGCPS = 0
FLOW_SP_CP_DIAGCPS = 0
FLOW_SP_CPS_OLD = 0
SUM_DIAG_DIAGCPS = 0
SUM_FLOW_SP_DIAGCPS = 0
SUM_N_DIAG_DIAGCPS = 0
SUM_MAP_DIAG_DIAGCPS = 0
LV_LAM_SUM_DIAGCPS = 0
except: STATE_DIAGCPS_OLD = STEP_1
LV_ERR_DIAGCPS **and** ERR_SYM_DIAGCPS
must not be changed
ELSE(1) FLOW_SP_CP_DIAGCPS = FLOW_SP_CPS_OLD
IF(2) LV_DI_DIAGCPS = 0
THEN(2) STATE_DIAGCPS = STEP_1
ENDIF(2)
ENDIF(1)

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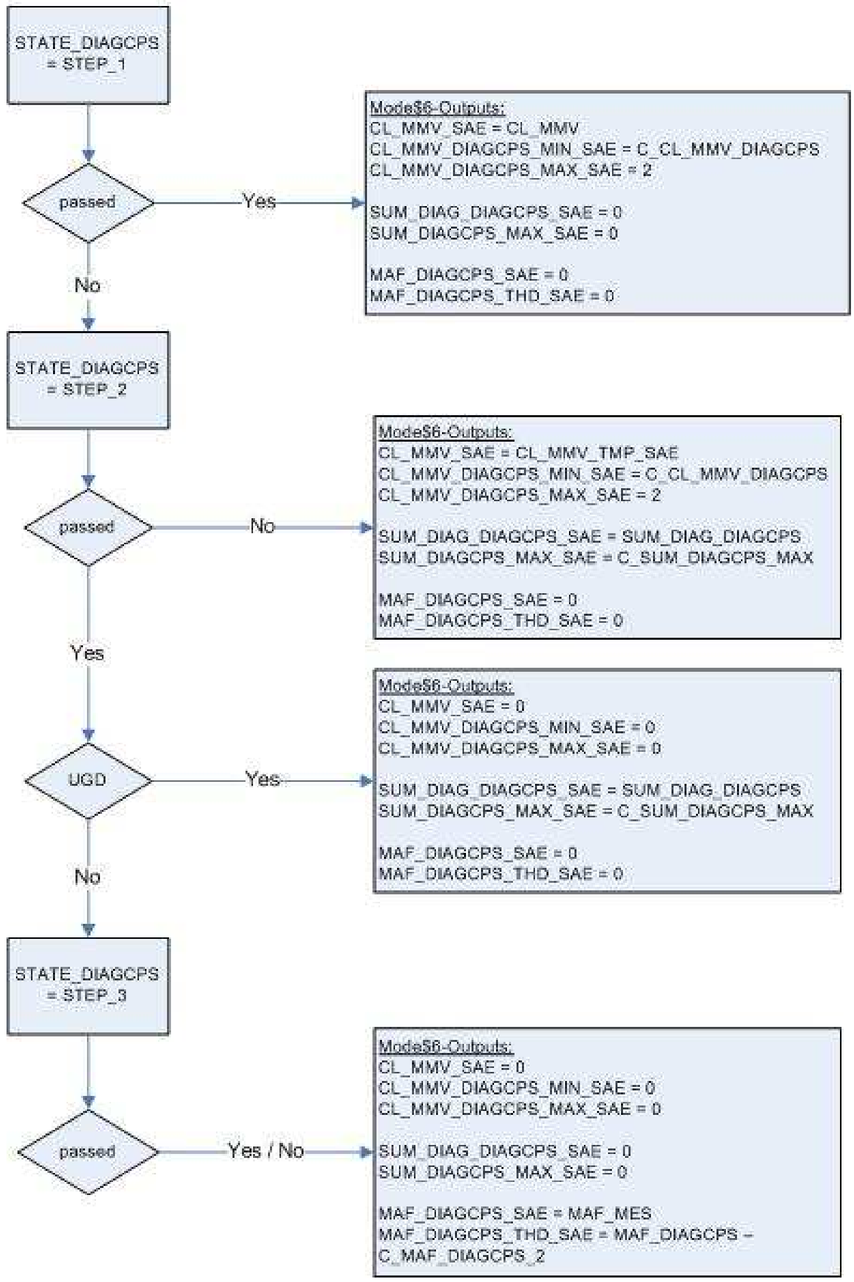
Mode$6-Output for TEV-Check: Helping hand



Canister load diagnosis

Description:

Functional check of the CPS based on the ACF- load degree. The “Canister Load diagnosis” is calculated permanently until the functional check CPS is finished (LV_END_DIAGCPS = 1).

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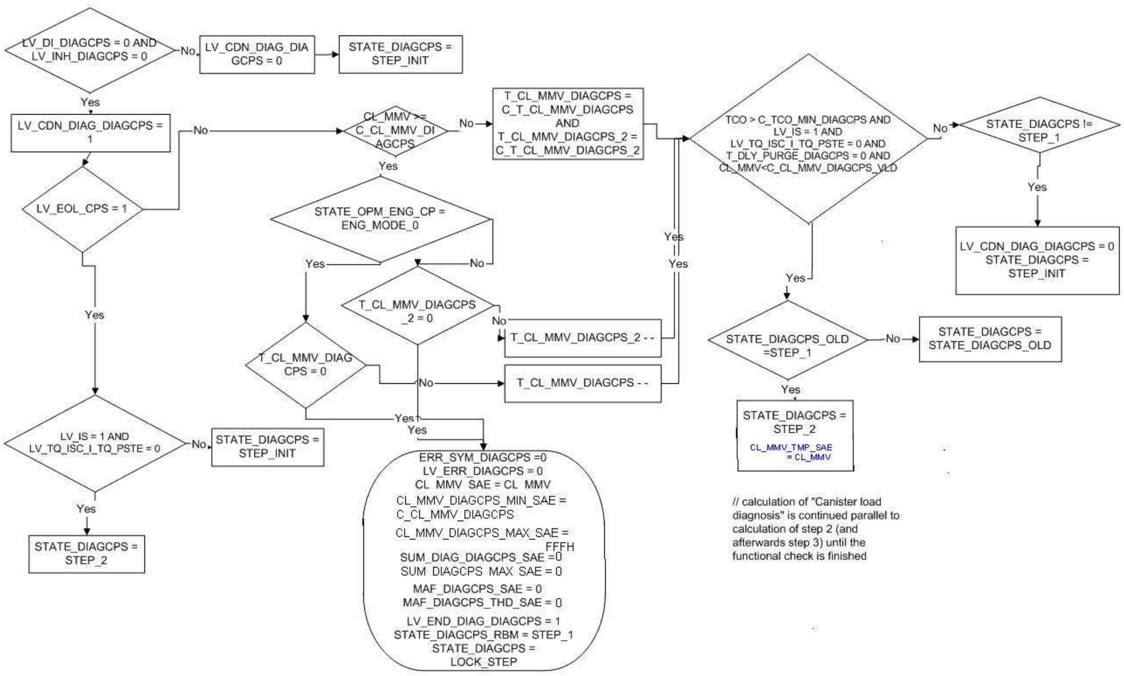
Overview:



Formula section:

IF$_{(1)}$ LV_DI_DIAGCPS = 0 **AND**
LV_INH_DIAGCPS = 0
THEN$_{(1)}$ LV_CDN_DIAG_DIAGCPS = 1
IF$_{(2)}$ LV_EOL_CPS = 1
THEN$_{(2)}$**IF**$_{(3a)}$ LV_IS = 1 **AND**
LV_TQ_ISC_I_TQ_PSTE = 0
THEN$_{(3a)}$ STATE_DIAGCPS = STEP_2
ELSE(3a) STATE_DIAGCPS = STEP_INIT
ENDIF(3a)
ELSE(2)IF(3b) CL_MMV >= C_CL_MMV_DIAGCPS //AKF load sufficiently high
THEN(3b) IF(3c) STATE_OPM_ENG_CP = ENG_MODE_0
THEN(3c)
IF(3d) T_CL_MMV_DIAGCPS=0
THEN(3d)
// STEP_1 passed ERR_SYM_DIAGCPS = NO_SYM
LV_ERR_DIAGCPS = 0
LV_END_DIAG_DIAGCPS = 1
CL_MMV_SAE = CL_MMV
CL_MMV_DIAGCPS_MIN_SAE = C_CL_MMV_DIAGCPS CL_
MMV_DIAGCPS_MAX_SAE = FFFFh
SUM_DIAG_DIAGCPS_SAE = 0
SUM_DIAGCPS_MAX_SAE = 0
MAF_DIAGCPS_SAE = MAF_DIAGCPS_THD_SAE = 0
STATE_DIAGCPS_RBM = STEP_1
STATE_DIAGCPS = LOCK_STEP

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ELSE(3d)
T_CL_MMV_DIAGCPS - -
IF(3e) TCO > C_TCO_MIN_DIAGCPS **AND**
LV_IS = 1 **AND**
LV_TQ_ISC_I_TQ_PSTE = 0 **AND**
T_DLY_PURGE_DIAGCPS = 0 **AND**
CL_MMV < C_CL_MMV_DIAGCPS_VLD
//STEP_1 not passed goto STEP_2 **THEN(3e)**
IF(3f) STATE_DIAGCPS_OLD = STEP_1
THEN(3f) CL_MMV_TMP_SAE = CL_MMV
STATE_DIAGCPS = STEP_2
ELSE(3f) STATE_DIAGCPS =
STATE_DIAGCPS_OLD

ENDIF(3f)
ELSE(3e) IF(3g) STATE_DIAGCPS != STEP_1
THEN(3g) LV_CDN_DIAG_DIAGCPS = 0
STATE_DIAGCPS = STEP_INIT
ENDIF(3g)
ENDIF(3e)
ENDIF(3d)
ELSE(3c)
IF(3h) T_CL_MMV_DIAGCPS_2 = 0
THEN(3h)
// STEP_1 passed ERR_SYM_DIAGCPS = NO_SYM
LV_ERR_DIAGCPS = 0
LV_END_DIAG_DIAGCPS = 1
CL_MMV_SAE = CL_MMV
CL_MMV_DIAGCPS_MIN_SAE = C_CL_MMV_DIAGCPS CL_
MMV_DIAGCPS_MAX_SAE = FFFFH
SUM_DIAG_DIAGCPS_SAE = 0
SUM_DIAGCPS_MAX_SAE = 0
MAF_DIAGCPS_SAE = MAF_DIAGCPS_THD_SAE = 0
STATE_DIAGCPS_RBM = STEP_1
STATE_DIAGCPS = LOCK_STEP
ELSE(3h)
T_CL_MMV_DIAGCPS_2 - -
IF(3i) TCO > C_TCO_MIN_DIAGCPS **AND**
LV_IS = 1 **AND**
LV_TQ_ISC_I_TQ_PSTE = 0 **AND**
T_DLY_PURGE_DIAGCPS = 0 **AND**
CL_MMV < C_CL_MMV_DIAGCPS_VLD
//STEP_1 not passed goto STEP_2 **THEN(3i)**
IF(3j) STATE_DIAGCPS_OLD = STEP_1
THEN(3j) CL_MMV_TMP_SAE = CL_MMV
STATE_DIAGCPS = STEP_2
ELSE(3j) STATE_DIAGCPS =

STATE_DIAGCPS_OLD
ENDIF(3j)
ELSE(3i) IF(3k) STATE_DIAGCPS !=STEP_1
THEN(3k) LV_CDN_DIAG_DIAGCPS = 0
STATE_DIAGCPS = STEP_INIT

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```
                              ENDIF(3k)
                          ENDIF(3i)
                      ENDIF(3h)
                  ENDIF(3c)
            ELSE(3b)    T_CL_MMV_DIAGCPS = C_T_CL_MMV_DIAGCPS
                        T_CL_MMV_DIAGCPS_2 = C_T_CL_MMV_DIAGCPS_2
                  IF(4a)  TCO > C_TCO_MIN_DIAGCPS       AND
                        LV_IS = 1                       AND
                        LV_TQ_ISC_I_TQ_PSTE = 0         AND
                        T_DLY_PURGE_DIAGCPS = 0         AND
                        CL_MMV < C_CL_MMV_DIAGCPS_VLD
                  THEN(4a)                              //STEP_1 not passed goto
                  STEP_2
                        IF(5a)        STATE_DIAGCPS_OLD = STEP_1
                        THEN(5a)      CL_MMV_TMP_SAE = CL_MMV
                                      STATE_DIAGCPS = STEP_2
                        ELSE(5a)      STATE_DIAGCPS = STATE_DIAGCPS_OLD
                        ENDIF(5a)
                  ELSE(4a)
                        IF(5b)        STATE_DIAGCPS != STEP_1
                        THEN(5b)      LV_CDN_DIAG_DIAGCPS = 0
                                      STATE_DIAGCPS = STEP_INIT
                        ENDIF(5b)
                  ENDIF(4a)
            ENDIF(3b)
  ENDIF(2)
ELSE(1)     LV_CDN_DIAG_DIAGCPS = 0
            STATE_DIAGCPS = STEP_INIT
ENDIF(1)
```

STEP 2: N-DIF-/LAM-/MAP-Diagnosis

Description:

In step 2, the CPS is evaluated based on the engine speed change (throttled mode), MAP change (unthrottled mode) and Lambda deviation at IS. To this effect, the CPS is opened for a short time and the engine speed monitored for a certain period.
After step 2 has been enabled for the first time, it is requested during each IS phase. This is repeated as long as a result has been reached in step 2. The function is not bound to one IS phase, but can be distributed to several IS phases.

Overview:

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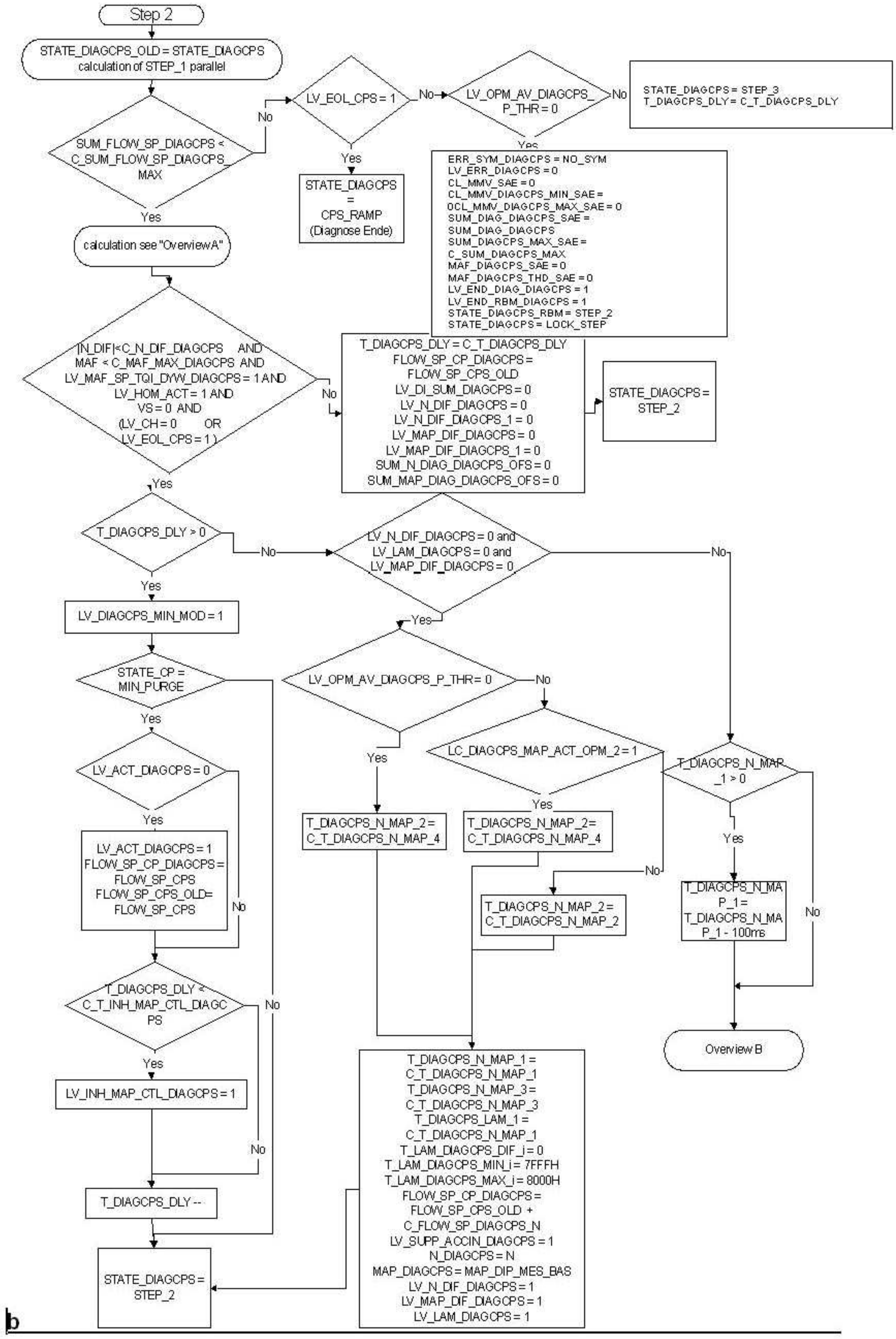

Formula section:

STATE_DIAGCPS_OLD = STATE_DIAGCPS
calculate STEP_1 parallelly

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IF(1) SUM_FLOW_SP_DIAGCPS < C_SUM_FLOW_SP_DIAGCPS_MAX
THEN(1)IF(2a) LV_LAM_SUM_DIAGCPS = 0 and LV_LAM_DIAGCPS = 1
THEN(2a)
IF(3a) T_DIAGCPS_LAM_1 > 0
THEN(3a)T_DIAGCPS_LAM_1 -
// Lamb-Monitoring:
TI_LAM_DIAGCPS_MAX_1 =
MAX (TI_LAM_DIAGCPS_MAX_1 $_{N-1}$;TI_LAM_COR_1 $_{N}$)
TI_LAM_DIAGCPS_MAX_2 =
MAX (TI_LAM_DIAGCPS_MAX_2 $_{N-1}$; TI_LAM_COR_2 $_{N}$)
TI_LAM_DIAGCPS_MIN_1 =
MIN (TI_LAM_DIAGCPS_MIN_1 $_{N-1}$; TI_LAM_COR_1 $_{N}$)
TI_LAM_DIAGCPS_MIN_2 =
MIN (TI_LAM_DIAGCPS_MIN_2 $_{N-1}$; TI_LAM_COR_2 $_{N}$)
ELSE(3a)LV_LAM_DIAGCPS = 0
TI_LAM_DIAGCPS_DIF_1 = TI_LAM_DIAGCPS_MAX_1-
TI_LAM_DIAGCPS_MIN_1
TI_LAM_DIAGCPS_DIF_2 = TI_LAM_DIAGCPS_MAX_2-
TI_LAM_DIAGCPS_MIN_2
IF(4a) TI_LAM_DIAGCPS_DIF_1 > C_TI_LAM_DIAGCPS_DIF **OR**
LAM_DIAGCPS_DIF_2 > C_TI_LAM_DIAGCPS_DIF
THEN(4a) LV_LAM_SUM_DIAGCPS = 1
Jump to STEP_2B
ENDIF(4a)
ENDIF(3a)
ENDIF(2a)
IF(2b) | N_DIF < C_N_DIF_DIAGCPS **AND**
MAF < C_MAF_MAX_DIAGCPS **AND**
LV_MAF_SP_TQI_DYW_DIAGCPS = 1 **AND**
LV_HOM_ACT = 1 **AND**
VS = 0 **AND**
(LV_CH = 0 **OR**
LV_EOL_CPS = 1)
THEN(2b)
IF(3b) T_DIAGCPS_DLY > 0
THEN(3b)LV_DIAGCPS_MIN_MOD = 1
IF(4b) STATE_CP = MIN_PURGE
THEN(4b)
IF(5a) LV_ACT_DIAGCPS = 0
THEN(5a)LV_ACT_DIAGCPS = 1
FLOW_SP_CP_DIAGCPS = FLOW_SP_CPS
FLOW_SP_CPS_OLD = FLOW_SP_CPS
ENDIF(5a)
IF(5b) T_DIAGCPS_DLY < C_T_INH_MAP_CTL_DIAGCPS
THEN(5b) LV_INH_MAP_CTL_DIAGCPS = 1
ENDIF(5b)
T_DIAGCPS_DLY = T_DIAGCPS_DLY -
ENDIF(4b)
ELSE(3b)
IF(4c) LV_N_DIF_DIAGCPS = 0 **AND**
LV_LAM_DIAGCPS = 0 **AND**
LV_MAP_DIF_DIAGCPS = 0

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THEN(4c)
IF(5c) LV_OPM_AV_DIAGCPS_P_THR = 0
Then(5c) T_DIAGCPS_N_MAP_2 = C_T_DIAGCPS_N_MAP_4
Else(5c)

If(6a) LC_DIAGCPS_MAP_ACT_OPM_2 = 1

Then(6a) T_DIAGCPS_N_MAP_2= C_T_DIAGCPS_N_MAP_4

Else(6a) T_DIAGCPS_N_MAP_2 = C_T_DIAGCPS_N_MAP_2
Endif(6a)
Endif(5c)
T_DIAGCPS_N_MAP_1 = C_T_DIAGCPS_N_MAP_1
T_DIAGCPS_N_MAP_3 = C_T_DIAGCPS_N_MAP_3
T_DIAGCPS_LAM_1 = C_T_DIAGCPS_N_MAP_1
TI_LAM_DIAGCPS_MIN_i = 7FFFH
TI_LAM_DIAGCPS_MAX_i = 8000H
FLOW_SP_CP_DIAGCPS = FLOW_SP_CPS_OLD +
C_FLOW_SP_DI-
AGCPS_N
LV_SUPP_ACCIN_DIAGCPS = 1
N_DIAGCPS = N
MAP_DIAGCPS = MAP_DIP_MES_BAS
PRS_IM_CTL_I_DIAGCPS = PRS_IM_CTL_I
LV_N_DIF_DIAGCPS = 1
LV_MAP_DIF_DIAGCPS = 1
LV_LAM_DIAGCPS = 1
ELSE(4c)
IF(5d) T_DIAGCPS_N_MAP_1 > 0
THEN(5d)T_DIAGCPS_N_MAP_1 = T_DIAGCPS_N_MAP_1 - -
ENDIF(5d)
IF(5e) T_DIAGCPS_N_MAP_2 > 0
THEN(5e) T_DIAGCPS_N_MAP_2 = T_DIAGCPS_N_MAP_2 - -

IF(6b) T_DIAGCPS_N_MAP_3 > 0

THEN(6b)T_DIAGCPS_N_MAP_3= T_DIAGCPS_N_MAP_3 - -
ELSE(6b)
IF(7a) FLOW_SP_CP_DIAGCPS > FLOW_SP_CPS_OLD

THEN(7a) FLOW_SP_CP_DIAGCPS =

FLOW_SP_CPS_OLD

ENDIF(7a)

ENDIF(6b)
IF(6c) LV_OPM_AV_DIAGCPS_P_THR = 0
THEN(6c)

IF(7b) MAP_DIP_MES_BAS - MAP_DIAGCPS >
//to use for MAF-System
C_MAP_DIAGCPS_1 **OR**

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PRS_IM_CTL_I_DIAGCPS - PRS_IM_CTL_I >
//to use for MAP-System C_PRS_IM_CTL_I_DIAGCPS
THEN(7b) SUM_MAP_DIAG_DIAGCPS_OFS ++
IF(8a)SUM_MAP_DIAG_DIAGCPS_OFS >
C_SUM_MAP_DIAG_DIAGCPS_OFS
Then(8a) LV_MAP_DIF_DIAGCPS_1 = 1
Endif(8a)
ENDIF(7b)
ELSE(6c)
If(7c) LC_DIAGCPS_MAP_ACT_OPM_2 = 1
Then(7c)
IF(8b) MAP_DIP_MES_BAS - MAP_DIAGCPS > C_
MAP_DIAGCPS_2 **OR**
PRS_IM_CTL_I_DIAGCPS - PRS_IM_CTL_
I > C_PRS_IM_CTL_I_DIAGCPS
THEN(8b) SUM_MAP_DIAG_DIAGCPS_OFS ++

IF(9a) SUM_MAP_DIAG_DIAGCPS_OFS > C_SUM_MAP_DIAG_DIAGCPS_OFS

Then(9a) LV_MAP_DIF_DIAGCPS_1 = 1

Endif(9a)
ENDIF(8b)
Else(7c)
IF(8c) N_DIAGCPS - N > C_N_DIAGCPS_2
THEN(8c) SUM_N_DIAG_DIAGCPS_OFS ++
IF(9b) SUM_N_DIAG_DIAGCPS_OFS >
C_SUM_N_DIAG_DIAGCPS_OFS
Then(9b) LV_N_DIF_DIAGCPS_1 = 1
Endif(9b)
ENDIF(8c)
Endif(7c)
ENDIF(6c)
ELSE(5e)
IF(6d) LV_DI_SUM_DIAGCPS = 0
THEN(6d)
IF(7d) LV_N_DIF_DIAGCPS_1 = 1
THEN(7d) SUM_N_DIAG_DIAGCPS ++
ENDIF(7d)
IF(7e) LV_MAP_DIF_DIAGCPS_1 = 1
THEN(7e) SUM_MAP_DIAG_DIAGCPS ++
ENDIF(7e)
SUM_FLOW_SP_DIAGCPS ++
LV_DI_SUM_DIAGCPS = 1
ENDIF(6d)
IF(6e) T_DIAGCPS_N_MAP_1 = 0
THEN(6e) LV_DI_SUM_DIAGCPS = 0
LV_N_DIF_DIAGCPS = 0
LV_N_DIF_DIAGCPS_1 = 0
LV_MAP_DIF_DIAGCPS = 0
LV_MAP_DIF_DIAGCPS_1 = 0
SUM_MAP_DIAG_DIAGCPS_OFS = 0
SUM_N_DIAG_DIAGCPS_OFS = 0

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```
                              ENDIF(6e)
                                ENDIF(5e)
                                Jump to "STEP_2B"
                          ENDIF(4c)
                  ENDIF(3b)
          ELSE(2b)       T_DIAGCPS_DLY = C_T_DIAGCPS_DLY
                          FLOW_SP_CP_DIAGCPS = FLOW_SP_CPS_OLD
                          LV_DI_SUM_DIAGCPS = 0
                          LV_N_DIF_DIAGCPS = 0
                          LV_N_DIF_DIAGCPS_1 = 0
                          LV_MAP_DIF_DIAGCPS = 0
                          LV_MAP_DIF_DIAGCPS_1 = 0
                           SUM_MAP_DIAG_DIAGCPS_OFS = 0
                           SUM_N_DIAG_DIAGCPS_OFS = 0
   ENDIF(2b)
ELSE(1)IF(2c)      LV_EOL_CPS = 1
                 THEN(2c)          STATE_DIAGCPS = CPS_RAMP    (Diagnose Ende)
                 ELSE(2c)
                 IF(3c)  LV_OPM_AV_DIAGCPS_P_THR = 0
                 THEN(3c)
                          ERR_SYM_DIAGCPS = NO_SYM                 //STEP2 passed
                           LV_ERR_DIAGCPS = 0
                           CL_MMV_SAE = 0
                              CL_MMV_DIAGCPS_MIN_SAE = CL_MMV_DIAGCPS_MAX_SAE = 0
                           SUM_DIAG_DIAGCPS_SAE = SUM_DIAG_DIAGCPS
                              SUM_DIAGCPS_MAX_SAE = C_SUM_DIAGCPS_MAX
                           MAF_DIAGCPS_SAE = MAF_DIAGCPS_THD_SAE = 0
                           LV_END_DIAG_DIAGCPS = 1
                           LV_END_RBM_DIAGCPS = 1
                          STATE_DIAGCPS_RBM = STEP_2
                           STATE_DIAGCPS = LOCK_STEP
                 ELSE(3c)                                  //STEP2 not passed goto STEP3
                          STATE_DIAGCPS = STEP_3
                           T_DIAGCPS_DLY = C_T_DIAGCPS_DLY
                 ENDIF(3c)
                ENDIF(2c)
ENDIF(1)
```

Overview A:

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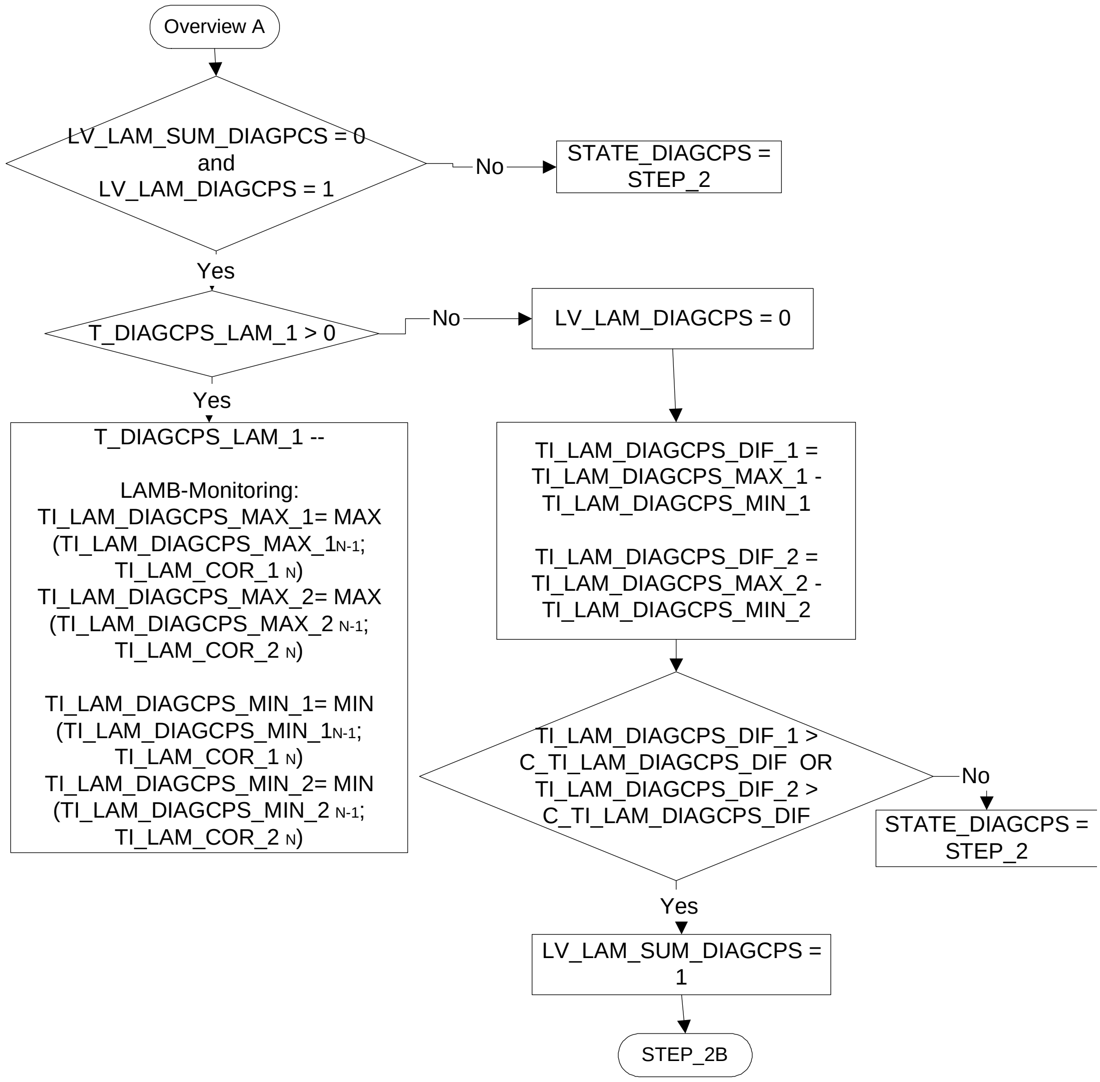

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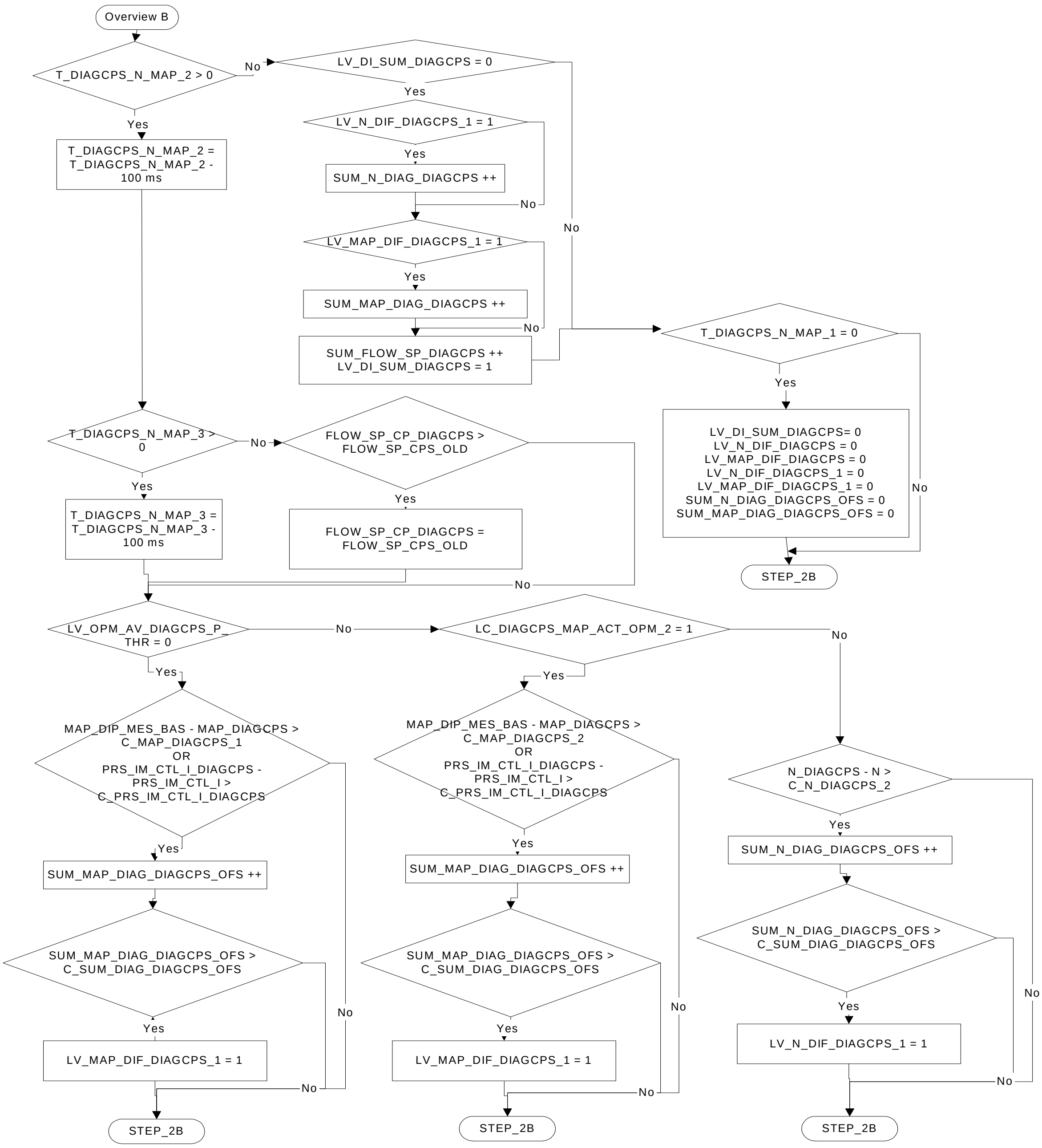

STEP_2B:

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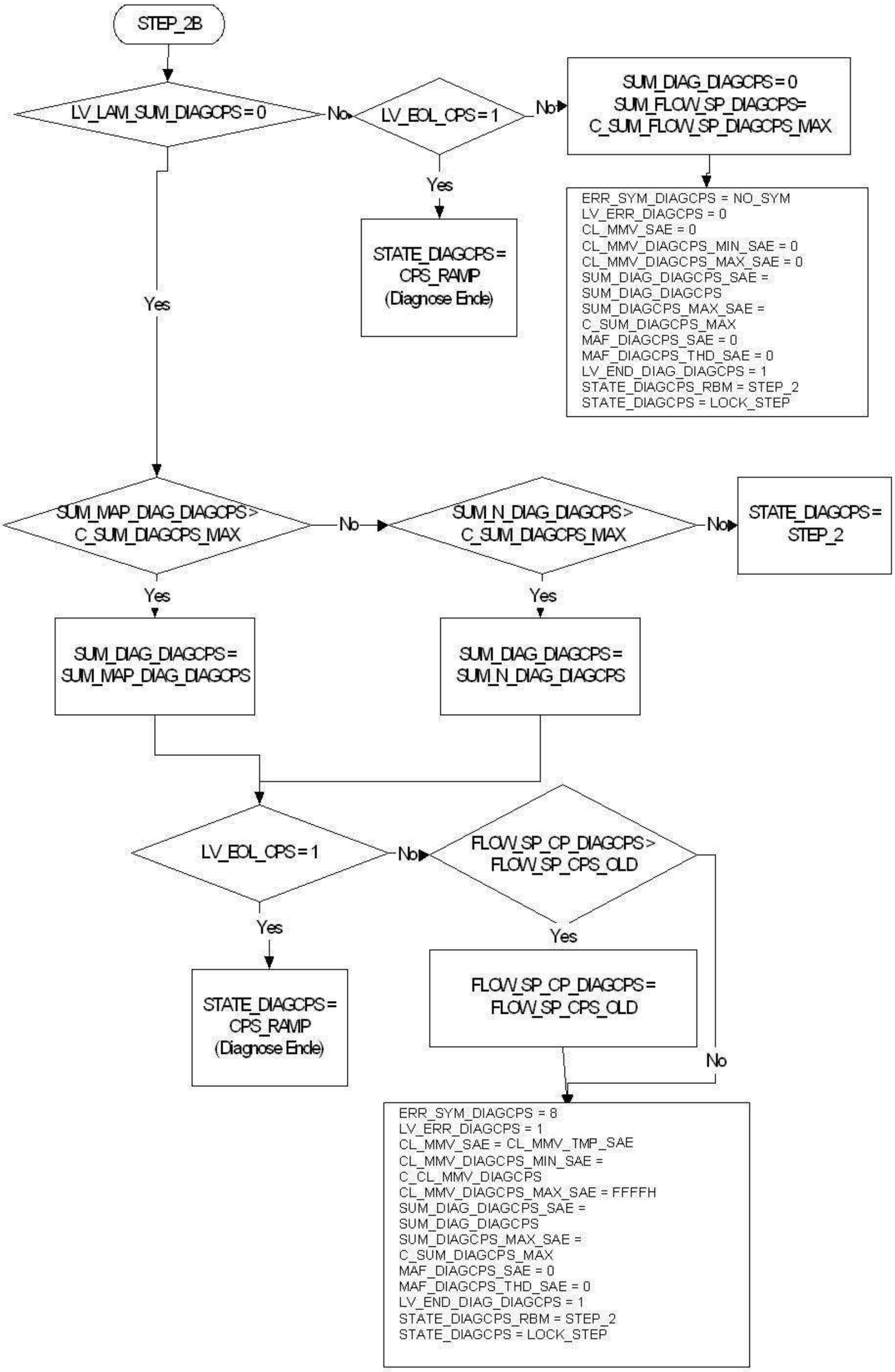

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STEP_2B:

IF(1) LV_LAM_SUM_DIAGCPS = 0
THEN(1)IF(2a) SUM_MAP_DIAG_DIAGCPS > C_SUM_DIAGCPS_MAX

```
   THEN(2a)      SUM_DIAG_DIAGCPS = SUM_MAP_DIAG_DIAGCPS
      ELSE(2a)      IF(3a)          SUM_N_DIAG_DIAGCPS > C_SUM_DIAGCPS_MAX
                   THEN(3a)       SUM_DIAG_DIAGCPS = SUM_N_DIAG_DIAGCPS
                   ELSE(3a)       STATE_DIAGCPS = STEP_2
                   ENDIF(3a)
   ENDIF(2a)
      IF(2b)            SUM_DIAG_DIAGCPS > C_SUM_DIAGCPS_MAX
      THEN(2b)      IF(3b)  LV_EOL_CPS = 1
                      THEN(3b)      STATE_DIAGCPS = CPS_RAMP
                                    (Diagnose Ende)
                      ELSE(3b)      IF(4a)  FLOW_SP_CP_DIAGCPS > FLOW_SP_CPS_OLD
                                    THEN(4a)      FLOW_SP_CP_DIAGCPS =
                                                        FLOW_SP_CPS_OLD
                                    ENDIF(4a)                   // STEP2 failed; irreversible diagnose
end
                                    ERR_SYM_DIAGCPS = SYM_3 (cps_plaus error)
                                        LV_ERR_DIAGCPS = 1
                                    SUM_DIAG_DIAGCPS_SAE = SUM_DIAG_DIAGCPS
                                       SUM_DIAGCPS_MAX_SAE = C_SUM_DIAGCPS_MAX
                                      CL_MMV_SAE = CL_MMV_TMP_SAE CL_MMV_DIAGCPS_MIN_
                                      SAE = C_CL_MMV_DIAGCPS
                                      CL_MMV_DIAGCPS_MAX_SAE = FFFFH
                                    MAF_DIAGCPS_SAE = MAF_DIAGCPS_THD_SAE = 0
                                    LV_END_DIAG_DIAGCPS = 1
                                       STATE_DIAGCPS_RBM = STEP_2
                                       STATE_DIAGCPS = LOCK_STEP
                      ENDIF(3b)
      ELSE(2b)      jump to beginning of STEP_2
      ENDIF(2b)
ELSE(1)IF(2c)         LV_EOL_CPS = 1
      THEN(2c)      STATE_DIAGCPS = CPS_RAMP
                      (Diagnose Ende)
         ELSE(2c)      SUM_DIAG_DIAGCPS = 0                   // STEP_2 passed
                      SUM_FLOW_SP_DIAGCPS = C_SUM_FLOW_SP_DIAGCPS_MAX
                      ERR_SYM_DIAGCPS = 0
                      LV_ERR_DIAGCPS = 0
                    CL_MMV_SAE = 0
                    CL_MMV_DIAGCPS_MIN_SAE = CL_MMV_DIAGCPS_MAX_SAE = 0
                      SUM_DIAG_DIAGCPS_SAE = SUM_DIAG_DIAGCPS
                         SUM_DIAGCPS_MAX_SAE = C_SUM_DIAGCPS_MAX
                      MAF_DIAGCPS_SAE = MAF_DIAGCPS_THD_SAE = 0
                      LV_END_DIAG_DIAGCPS = 1
                      STATE_DIAGCPS_RBM = STEP_2
                      STATE_DIAGCPS = LOCK_STEP

      ENDIF(2c)
ENDIF(1)
```

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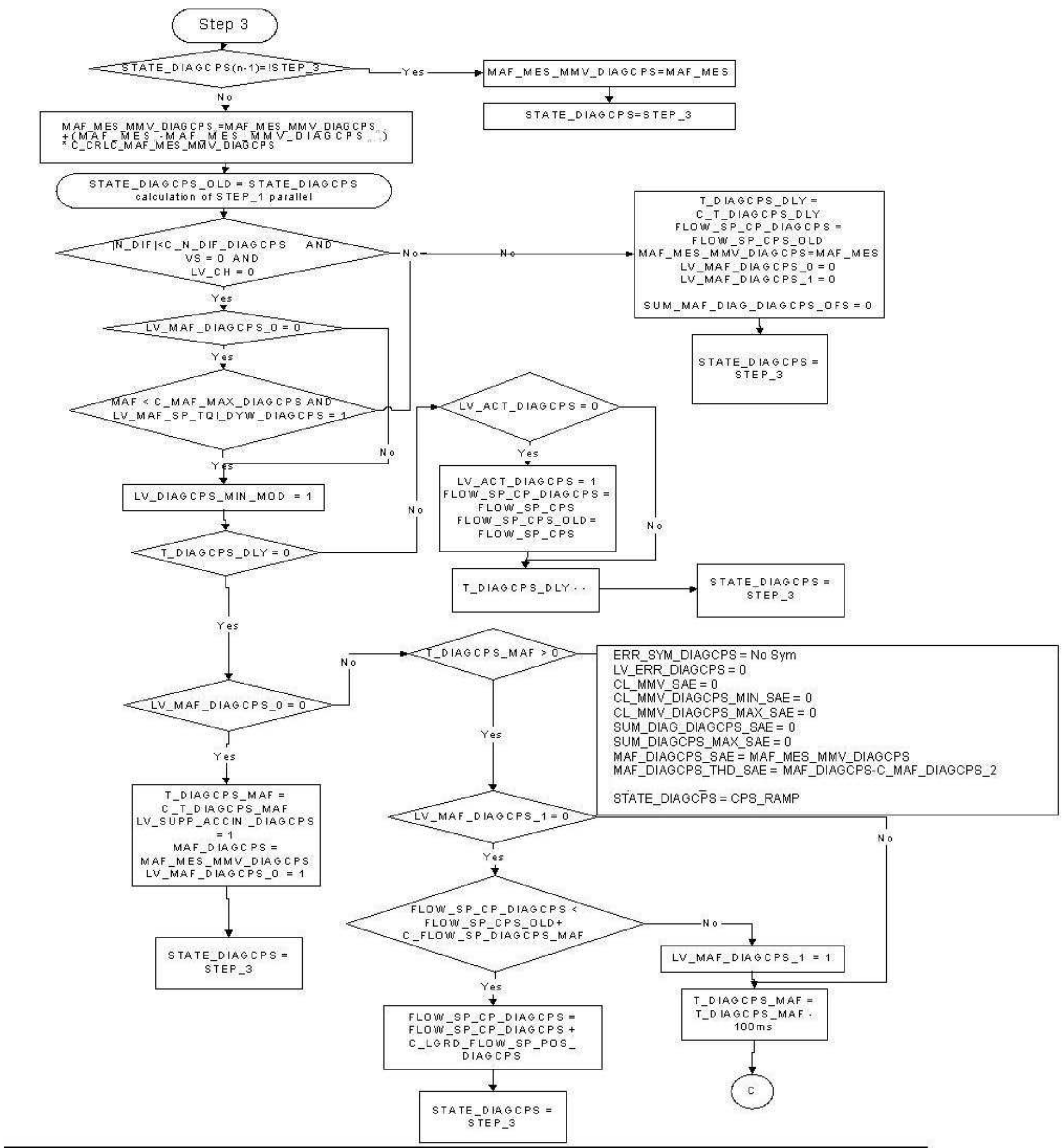
STEP 3: MAF-DIF_Diagnosis

Description:

If the functional check is not recognized as OK via step 1 and via step 2, but as not OK via both steps, then step 3 is requested.
In step 3 the CPS is considered on the basis of the measured mass air flow before and during a CPS opening phase.

Overview:



Formula Section:

STATE_DIAGCPS_OLD = STATE_DIAGCPS
calculate STEP_1 parallely
IF(0) | N_DIF < C_N_DIF_DIAGCPS **AND**
VS = 0 **AND**

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LV_CH = 0 **AND**
[(LV_MAF_DIAGCPS_0 = 0 **AND**
MAF < C_MAF_MAX_DIAGCPS **AND**
LV_MAF_SP_TQI_DYW_DIAGCPS = 1) **OR**
LV_MAF_DIAGCPS_0 = 1]
THEN(0) LV_DIAGCPS_MIN_MOD=1
IF(1) T_DIAGCPS_DLY = 0
THEN(1) IF(2a) LV_MAF_DIAGCPS_0 = 0
THEN(2a) T_DIAGCPS_MAF = C_T_DIAGCPS_MAF
LV_SUPP_ACCIN_DIAGCPS = 1
MAF_DIAGCPS = MAF_MES
LV_MAF_DIAGCPS_0 = 1
ELSE(2a) IF(3a) T_DIAGCPS_MAF > 0
THEN(3a)IF(4a) LV_MAF_DIAGCPS_1 = 0 **AND**
FLOW_SP_CP_DIAGCPS <
FLOW_SP_CPS_OLD
+

C_FLOW_SP_DIAGCPS_MAF
THEN(4a) FLOW_SP_CP_DIAGCPS=

FLOW_SP_CP_DIAGCPS +
C_LGRD_FLOW_SP_POS_
DIAGCPS
ELSE(4a) LV_MAF_DIAGCPS_1 = 1
T_DIAGCPS_MAF = T_DIAGCPS_MAF - -
Jump to **C**
ENDIF(4a)
// STEP_3 passed **ELSE(3a)** ERR_SYM_DIAGCPS = NO_SYM
LV_ERR_DIAGCPS = 0
MAF_DIAGCPS_SAE = MAF_MES
MAF_DIAGCPS_THD_SAE =
MAF_DIAGCPS-C_MAF_DIAGCPS_2
CL_MMV_SAE = 0
MMV_DIAGCPS_MIN_SAE = 0

CL_MMV_DIAGCPS_MAX_SAE = 0
SUM_DIAG_DIAGCPS_SAE = 0
SUM_DIAGCPS_MAX_SAE = 0
STATE_DIAGCPS = CPS_RAMP
ENDIF(3a)
ENDIF(2a)
ELSE(1)IF(2b) LV_ACT_DIAGCPS = 0
THEN(2b) LV_ACT_DIAGCPS = 1
FLOW_SP_CP_DIAGCPS = FLOW_SP_CPS
FLOW_SP_CPS_OLD = FLOW_SP_CPS
ENDIF(2b) T_DIAGCPS_DLY = T_DIAGCPS_DLY - 100ms
ENDIF(1)
Else(0) T_DIAGCPS_DLY = C_T_DIAGCPS_DLY
FLOW_SP_CP_DIAGCPS = FLOW_SP_CPS_OLD
LV_MAF_DIAGCPS_0 = 0
LV_MAF_DIAGCPS_1 = 0
SUM_MAF_DIAG_DIAGCPS_OFS = 0

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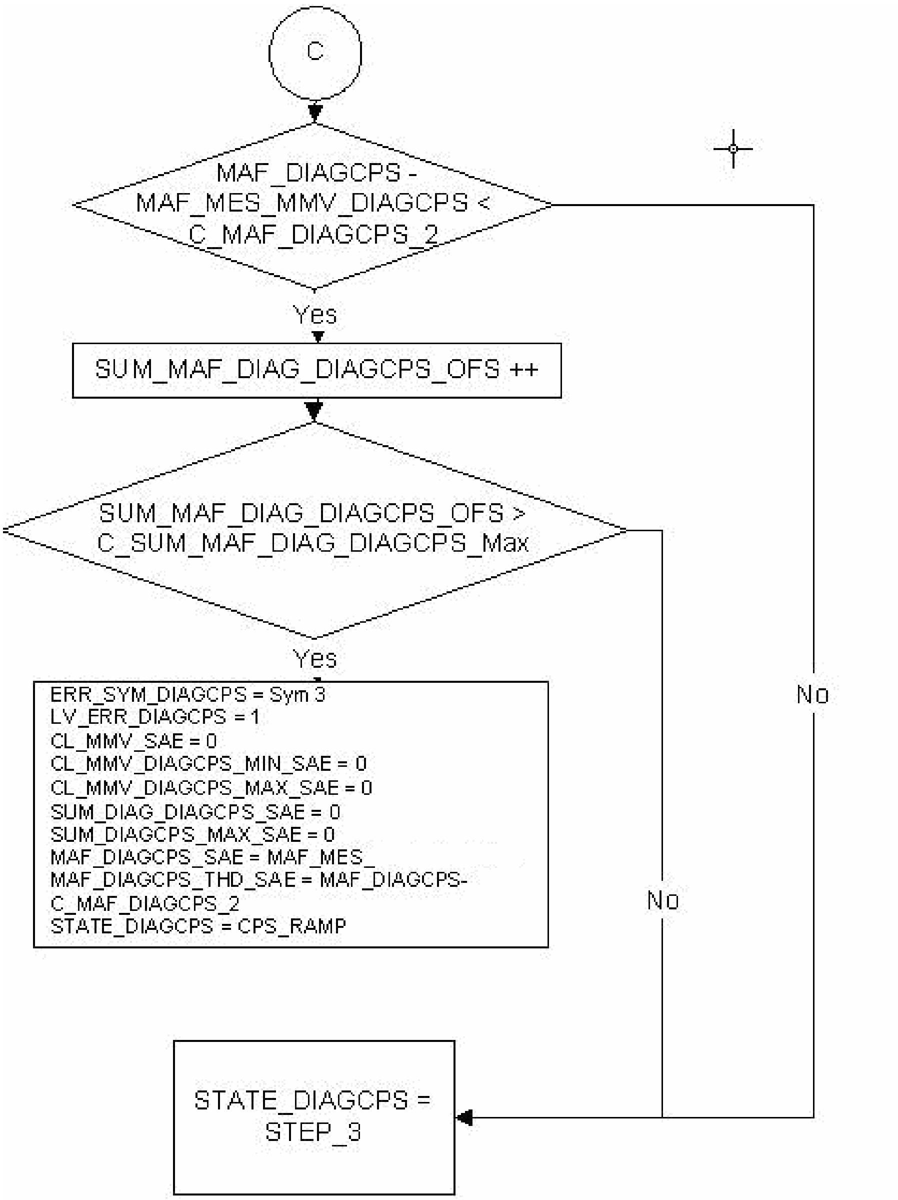
STATE_DIAGCPS = STEP_3

Endif(0)

Overview C :



C:

IF(1) MAF_DIAGCPS - MAF_MES < C_MAF_DIAGCPS_2

THEN(1) SUM_MAF_DIAG_DIAGCPS_OFS ++

IF(2) SUM_MAF_DIAG_DIAGCPS_OFS > C_SUM_MAF_DIAG_DIAGCPS_OFS

THEN(2) ERR_SYM_DIAGCPS = SYM_3 *// STEP_3 failed*

LV_ERR_DIAGCPS = 1

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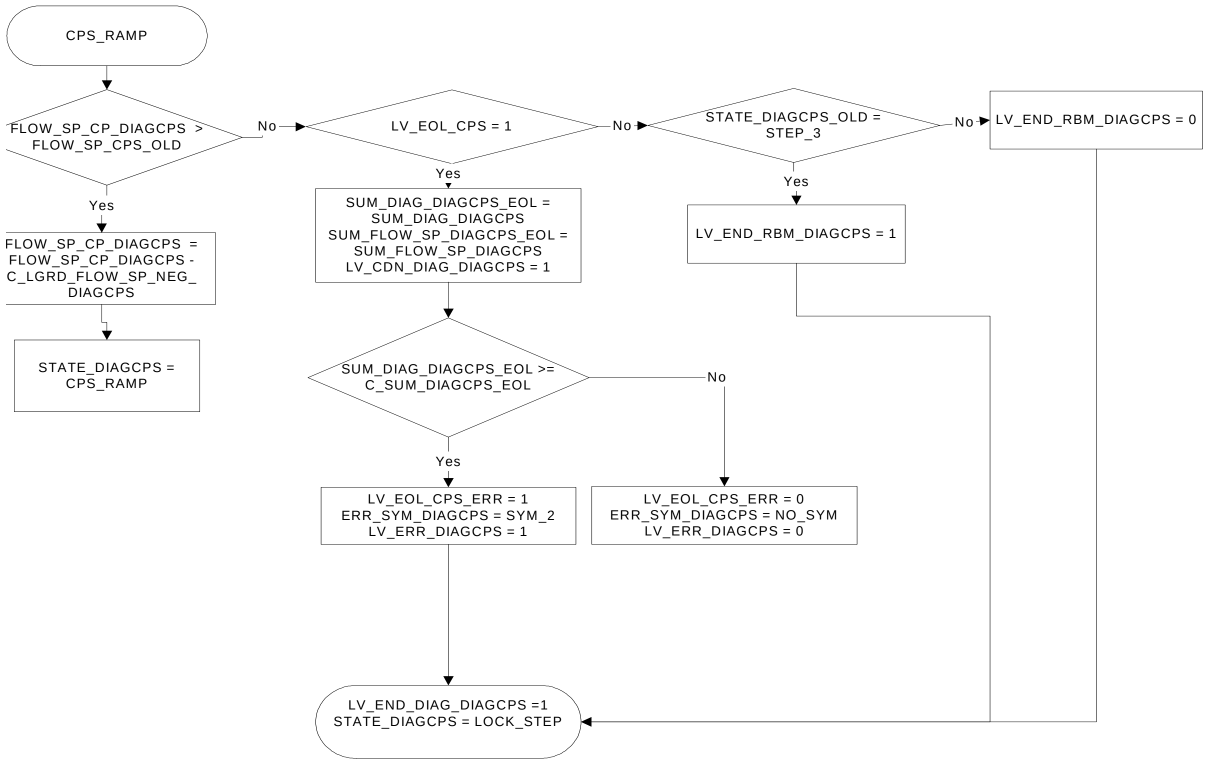
MAF_DIAGCPS_SAE = MAF_MES
MAF_DIAGCPS_THD_SAE = MAF_DIAGCPS - C_MAF_DIAGCPS_2
CL_MMV_SAE = 0
CL_MMV_DIAGCPS_MIN_SAE = CL_MMV_DIAGCPS_MAX_SAE = 0
SUM_DIAGCPS_MAX_SAE = SUM_DIAG_DIAGCPS_SAE = 0

STATE_DIAGCPS = CPS_RAMP
ELSE(2) STATE_DIAGCPS = STEP_3
ENDIF(2)
ELSE(1) STATE_DIAGCPS = STEP_3
ENDIF(1)

Overview:



CPS-Ramp:

IF(1) FLOW_SP_CP_DIAGCPS > FLOW_SP_CPS_OLD
THEN(1) FLOW_SP_CP_DIAGCPS = FLOW_SP_CP_DIAGCPS - C_LGRD_FLOW_SP_NEG_DIAGCPS
ELSE(1) **IF(2)** LV_EOL_CPS = 1
THEN(2) SUM_DIAG_DIAGCPS_EOL = SUM_DIAG_DIAGCPS
SUM_FLOW_SP_DIAGCPS_EOL = SUM_FLOW_SP_DIAGCPS
LV_CDN_DIAG_DIAGCPS = 1
IF(3a) SUM_DIAG_DIAGCPS_EOL >= C_SUM_DIAGCPS_EOL
THEN(3a) LV_EOL_CPS_ERR = 1
ERR_SYM_DIAGCPS = SYM_2

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```
                    LV_ERR_DIAGCPS = 1
          ELSE(3a)    LV_EOL_CPS_ERR = 0
                    ERR_SYM_DIAGCPS = NO_SYM
                    LV_ERR_DIAGCPS = 0
          ENDIF(3a)
     ELSE(2)      IF(3b)  STATE_DIAGCPS_OLD = STEP_3
                  THEN(3b)     LV_END_RBM_DIAGCPS = 1
                  ELSE(3b)     LV_END_RBM_DIAGCPS = 0
                  ENDIF(3b)
     ENDIF(2)
     LV_END_DIAG_DIAGCPS = 1
     STATE_DIAGCPS = LOCK_STEP
ENDIF(1)
```

Reset EOL-request-bit

LOCK_STEP:

Description:

FLOW_SP_CP_DIAGCPS = FLOW_SP_CPS_OLD
LV_ACT_DIAGCPS = 0
LV_DIAGCPS_MIN_MOD = 0
LV_INH_MAP_CTL_DIAGCPS = 0
LV_SUPP_ACCIN_DIAGCPS = 0

// RBM in case of TEV-check ended with o.k. before all 3 STEPs have been completed

```
IF          LV_T_DIAGCPS_RBM = 0
THEN       T_DIAGCPS_DLY_1_RBM = C_ T_DIAGCPS_DLY
            T_DIAGCPS_DLY_2_RBM = C_ T_DIAGCPS_DLY
            T_DIAGCPS_N_MAP_1_RBM = C_SUM_DIAGCPS_MAX
                                        * C_ T_DIAGCPS_N_MAP_1
            T_DIAGCPS_MAF_RBM = C_T_DIAGCPS_MAF
            LV_T_DIAGCPS_RBM = 1
ENDIF

IF(1)       TCO > C_TCO_MIN_DIAGCPS        and
            LV_IS = 1                      and
            VS = 0                         and
            LV_CH = 0                      and
            LV_END_RBM_DIAGCPS = 0         and
            T_DLY_PURGE_DIAGCPS = 0
THEN(1)    IF(2)          STATE_DIAGCPS_RBM = STEP_1
            THEN(2)IF(3a)        T_DIAGCPS_DLY_1_RBM > 0
                  THEN(3a)      T_DIAGCPS_DLY_1_RBM - -
                  ELSE(3a)IF(4a)      T_DIAGCPS_N_MAP_1_RBM > 0
                         THEN(4a)     T_DIAGCPS_N_MAP_1_RBM - -
                         ELSE(4a)
                              IF (5a)        LV_OPM_AV_DIAGCPS_P_THR = 0
                              THEN(5a)     LV_END_RBM_DIAGCPS = 1
```

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ELSE(5a) **IF(6a)** T_DIAGCPS_DLY_2_RBM > 0
THEN(6a)T_DIAGCPS_DLY_2_RBM - -
ELSE(6a)
IF(7a) T_DIAGCPS_MAF_RBM > 0
THEN(7a)T_DIAGCPS_MAF_RBM - -
ELSE(7a)LV_END_RBM_DIAGCPS = 1
ENDIF(7a)
ENDIF(6a)
ENDIF(5a)
ENDIF(4a)
ENDIF(3a)
ELSE(2)IF(3b) STATE_DIAGCPS_RBM = STEP_2
THEN(3b)IF(4b) T_DIAGCPS_DLY_2_RBM > 0
THEN(4b) T_DIAGCPS_DLY_2_RBM - -
ELSE(4b)IF(5b) T_DIAGCPS_MAF_RBM > 0
THEN(5b) T_DIAGCPS_MAF_RBM - -
ELSE(5b) LV_END_RBM_DIAGCPS = 1
ENDIF(5b)
ENDIF(4b)
ENDIF(3b)
ENDIF (2)
ENDIF(1)

B.91.1 Limited dynamic condition LV_MAF_SP_TQI_DYW_DIAGCPS

FUNCTION DESCRIPTION:

Application conditions

Initialisation: at reset or at transition LV_IGK OFF → ON
LV_MAF_SP_TQI_DYW_DIAGCPS = 0
MAF_SP_TQI_MMV_DIAGCPS = 0

Recurrence: *100 ms*

Activation: *LV_DC = 1*

Deactivation: LV_DC = 0

Formula section:

Calculation of MAF_SP_TQI_MMV_DIAGCPS:
MAF_SP_TQI_MMV_DIAGCPS = MAF_SP_TQI_MMV_DIAGCPS* (1-C_CRLC_MAF_SP_TQI_DIAGCPS) + C_CRLC_MAF_SP_TQI_DIAGCPS * MAF_SP_TQI

IF MAF_SP_TQI - MAF_SP_TQI_MMV_DIAGCPS
< C_MAF_SP_TQI _DYW_DIAGCPS

THEN LV_MAF_SP_TQI_DYW_DIAGCPS= 1
ELSE LV_MAF_SP_TQI_DYW_DIAGCPS= 0
MAF_SP_TQI_MMV_DIAGCPS = MAF_SP_TQI
ENDIF

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B.92 Functional check canister purge solenoid (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DI_DIAGCPS	O/V	0... 1H	0 ...1	1	-
activation condition for functional check CPS, reversible					
LV_INH_DIAG_RBM_DIAGCPS	V	0... 1H	0 ...1	1	-
Flag to inhibit catalyst diagnosis function if there is a OBD failure					
LV_INH_DIAGCPS	O/V	0... 1H	0 ...1	1	-
activation condition for functional check CPS, irreversible					
OPM_AV_DIAGCPS	O/V	0... 2H	0 ...2	1	-
Operation mode DIAGCPS					
STATE_RBM_DIAGCPS	O/V	0... FFH	0... 255	1	-
Interface of DIAGCPS monitor with the Rate-Based Monitoring statistics					

Input data:

C_TCO_MIN_DIAGCPS {p. 5931}	CTR_ERR_DYN_NR {p. 5767}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LV_CL_MMV {p. 1001}
LV_CP_ENA {p. 3737}	LV_DC {p. 5746}	LV_END_RBM_DIAGCPS {p. 5926}	LV_EOL_CPS {p. 7763}
LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_AMP_PLAUS_CUS {p. 1061}	LV_ERR_CHK_FUC {p. 5918}
LV_ERR_DMTL_MIN {p. 5965}	LV_ERR_DMTL_PLAUS {p. 5965}	LV_ERR_DMTL_PUMP {p. 4626}	LV_ERR_DMTLH {p. 4626}
LV_ERR_DMTLS {p. 4627}	LV_ERR_ECU_RAM {p. 4232}	LV_ERR_EL_CPS {p. 4708}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}
LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_FUP_ST {p. 6062}	LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_ISC {p. 4377}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}
LV_ERR_MAF {p. 4815}	LV_ERR_MAP_DIP_PLAUS {p. 1062}	LV_ERR_MAP_DIP_SENS {p. 4824}	LV_ERR_MAP_DIP_SHIFT {p. 4824}
LV_ERR_MAP_PLAUS {p. 1062}	LV_ERR_MAP_TPS_PLAUS {p. 1062}	LV_ERR_MIS [NC_CYL_NR] {p. 6264}	LV_ERR_MIS_MPL {p. 6264}
LV_ERR_PVS_DOUBLE {p. 4216}	LV_ERR_ROUGH_LEAK {p. 5965}	LV_ERR_SMALL_LEAK {p. 5965}	LV_ERR_SPI_MPS {p. 4245}
LV_ERR_TCO {p. 4496}	LV_ERR_TPS {p. 4982}	LV_ERR_TPS_AD {p. 4951}	LV_ERR_TPS_AD_BOL {p. 4951}
LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_VCV {p. 4729}	LV_ERR_VS {p. 5021}	LV_IGK {p. 906}

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LV_MTC_CUR_OFF {p. 6565}	LV_VAR_BN {p. 655}	OPM_AV {p. 8137}	STATE_CP {p. 3637}
TCO {p. 1100}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_SP_MAX_DIAGCPS	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Max. lambda setpoint for FC CPS/Step1 (CL diagnosis)					
C_LAMB_SP_MIN_DIAGCPS	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Min. lambda setpoint for FC CPS/Step1 (CL diagnosis)					
C_TCO_MIN_DIAGCPS_1	-	0... FEH	-48... 142.5	0.75	°C
Min. temperature for FC CPS/Step1 (CL diagnosis)					
ID_OPM_AV_DIAGCPS	-	0... 2H	0 ...2	1	-
LDPM_OPM_AV	8	0... 8H	0 ...8	1	-
Operation mode for which DIAGCPS is enabled (0H = never, 1H = UGD, 2H = GD)					

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

B.92.1 Diagnosis inhibition

FUNCTION DESCRIPTION:

General information:

The functional check is used for the functional test of the CP solenoid which means that the CPS is diagnosed via its effects on the engine.
There are many errors which make it necessary to stop the functional check CPS when they occure. Therefore a diagnosis has to be made whether the functional check can be enabled or not.
If LV_INH_DIAGCPS = 0 and LV_DI_DIAGCPS = 0 then the functional check is enabled.
If the bit LV_INH_DIAGCPS = 1 is set through one of the errors listed below, then the functional check is exited irreversibly until the next engine start.
If the bit LV_INH_DIAGCPS=0 and LV_DI_DIAGCPS=1 then the functional check is exited reversibly until LV_DI_DIAGCPS = 0 (recurrence 100 ms).
If one of the OBD errors ocurs as mentioned in the formula section the RBM of the functional check CPS diagnosis is inhibited by LV_INH_DIAG_RBM_DIAGCPS = 1.

Application conditions

Initialisation: *at every LV_IGK = 0→1 and reset all variables are initialized with 0*

Recurrence: *100 ms*

Activation: *LV_DC = 1*

Deactivation: LV_DC = 0

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Formula section:

Inhibition due to OBDI error

If LV_ERR_TPS = 1 **or**
LV_ERR_MAF = 1 **or**
LV_ERR_LOAD_TPS_PLAUS = 1 **or**
LV_ERR_EL_CPS = 1 **or**
LV_ERR_ROUGH_LEAK = 1 **or**
LV_ERR_SMALL_LEAK = 1 **or**
LV_ERR_DMTLH = 1 **or**
LV_ERR_DMTL_PLAUS = 1 **or**
LV_ERR_DMTL_MIN = 1 **or**
LV_ERR_DMTL_PUMP = 1 **or**
LV_ERR_DMTLS = 1 **or**
LV_ERR_AMP = 1 **or**
LV_ERR_VS = 1 **or**
LV_ERR_TCO = 1 **or**
LV_ERR_ISC = 1 **or**
LV_ERR_FSD[NC_CBK_EX_NR] = 1 **or**
LV_ERR_MAP_DIP_SENS = 1 **or**
LV_ERR_MAP_DIP_PLAUS = 1 **or**
LV_ERR_MAP_DIP_SHIFT = 1 **or**
LV_ERR_PVS_DOUBLE = 1 **or**
LV_ERR_FUP = 1 **or**
LV_ERR_FUP_MFP_PLAUS = 1 **or**
LV_ERR_H_PRS_SYS = 1 **or**
LV_ERR_VCV = 1 **or**
LV_ERR_FUP_ORNG = 1 **or**
LV_ERR_FUP_ST = 1 **or**
LV_ERR_MAP_TPS_PLAUS = 1 **or**
LV_ERR_AMP_PLAUS_CUS = 1 **or**
LV_ERR_AMP_PLAUS = 1 **or**
LV_ERR_MAP_PLAUS = 1 **or**
LV_ERR_CHK_FUC = 1 **or**
LV_ERR_FSD_LAM_LIM[NC_CBK_EX_NR] = 1 **or**
LV_ERR_MIS[NC_CYL_NR] = 1 **or**
LV_ERR_MIS_MPL = 1 **or**
LV_ERR_TPS_AD = 1 **or**
LV_ERR_TPS_AD_BOL = 1 **or**
LV_ERR_TPS_ST_CHK_2 = 1 **or**
LV_ERR_SPI_MPS = 1
Then LV_INH_DIAG_RBM_DIAGCPS = 1
Else LV_INH_DIAG_RBM_DIAGCPS = 0
Endif

Inhibition due to environmental condition /calibration:

If LV_INH_DIAG_RBM_DIAGCPS = 1 **or**
LV_MTC_CUR_OFF = 1
Then LV_INH_DIAGCPS = 1
Else LV_INH_DIAGCPS = 0
Endif
OPM_AV_DIAGCPS = ID_OPM_AV_DIAGCPS

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If LV_INH_DIAGCPS = 0 **and**
(OPM_AV_DIAGCPS =1H **or** OPM_AV_DIAGCPS = 2H) **and**
[(TCO > C_TCO_MIN_DIAGCPS_1 **and**
C_LAMB_SP_MIN_DIAGCPS < LAMB_SP[i] < C_LAMB_SP_MAX_DIAGCPS
and
STATE_CP > 1H **and**
LV_CP_ENA = 1 **and**
LV_CL_MMV = 1) **or**
LV_EOL_CPS = 1 **]**
Then LV_DI_DIAGCPS = 0
Else LV_DI_DIAGCPS = 1
Endif

B.92.2 Interface for Rate - Based - Monitoring

FUNCTION DESCRIPTION:

General information:

With this module the interface between the DIAGCPS monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_DIAGCPS data.
Within STATE_RBM_DIAGCPS, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)
  (not valid for DIAGCPS diagnosis)

Application conditions

Initialisation : at LV_DC 0 → 1 transition :
bit 0, bit 1 and bit 2 of STATE_RBM_DIAGCPS = 0
on failure memory reset :
bit 1 of STATE_RBM_DIAGCPS = 0

Recurrence: 1 s

Activation: LV_DC 0 → 1 transition **and** LV_DC = 1

Formula section:

At LV_DC 0 → 1 transition
The pending status of the following failures has to be checked only once :

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LV_ERR_MAP_TPS_PLAUS	LV_ERR_TPS_RATIO	LV_ERR_AMP	LV_ERR_MAP_DIP_SHIFT
LV_ERR_TPS_1	LV_ERR_TPS_2	LV_ERR_LOAD_TPS_PLAUS	LV_ERR_FUP_ST
LV_ERR_TPS_MAF_2	LV_ERR_VS	LV_ERR_FUP	LV_ERR_DMTL_MIN
LV_ERR_ISC	LV_ERR_DMTL_PUMP	LV_ERR_DMTLH	LV_ERR_DMTLS
LV_ERR_TPS_MAF_1	LV_ERR_TCO_EL	LV_ERR_TCO_STUCK	LV_ERR_TCO_GRD
LV_ERR_TCO_PLAUS	LV_ERR_ROUGH_LEAK	LV_ERR_SMALL_LEAK	LV_ERR_TCO_STUCK_RNG
LV_ERR_FUP_MFP_PLAUS	LV_ERR_H_PRS_SYS	LV_ERR_VCV	LV_ERR_PVS_DOUBLE
LV_ERR_MAP_DIP_SENS	LV_ERR_MAP_DIP_PLA_US	LV_ERR_FUP_ORNG	LV_ERR_FSD[NC_CBK_EX_NR]
LV_ERR_TPS_ST_CHK_2	LV_ERR_AMP_PLAUS_CUS	LV_ERR_MAP_PLAUS	LV_ERR_CHK_FUC
LV_ERR_MIS_MPL	LV_ERR_ECU_RAM	LV_ERR_MIS[NC_CYL_NR]	LV_ERR_TPS_AD_BOL
LV_ERR_AMP_PLAUS	LV_ERR_MAF_FRQ_EL_0	LV_ERR_MAF_FRQ_RNG_0	LV_ERR_FSD_LAM_LIM[i]
LV_ERR_TPS_AD	LV_ERR_MTC_CTL_2	LV_ERR_MTC_CTL_3	LV_ERR_MTC_DR
LV_ERR_ECU_CKS	LV_ERR_MAF_FRQ_GRD_0	LV_ERR_EL_CPS	LV_ERR_SPI_MPS
LV_ERR_DMTL_PLAUS			

If(1) { CPU optimization at LV_DC 0 $\rightarrow$ 1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn't empty }
Then(1)
While bit 1 of STATE_RBM_DIAGCPS = 0 **do**
with each XX failure of the above list :
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2) bit 1 of STATE_RBM_DIAGCPS = 1
Endif(2)
Endwhile
Else(1) { the dynamic failure memory is empty }
No action
Endif(1)

Every 1 s :
If bit 0 of STATE_RBM_DIAGCPS = 0
Then
If LV_END_RBM_DIAGCPS = 1 **and**
Then bit 0 of STATE_RBM_DIAGCPS = 1
Endif
Endif

If bit 1 of STATE_RBM_DIAGCPS = 0
Then
If LV_INH_DIAG_RBM_DIAGCPS = 1
Then bit 1 of STATE_RBM_DIAGCPS = 1
Endif
Endif
bit 2 of STATE_RBM_DIAGCPS = 1

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B.93 Leakage detection pump function diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CNL_ROUGH_LEAK_MES_FUC	O/V/S	0... FFH	0... 255	1	-
Number of aborted check filler cap checks					
CTR_CNL_SMALL_LEAK_MES	O/V/S	0... FFH	0... 255	1	-
Number of aborted miniature leak measurements due to current fluctuations					
CTR_CUR_DMTL_REF_DIF_MAX	O/V/S	0... FFFFH	0... 65535	1	-
Number of aborted measurements due to current fluctuation					
CTR_DIAG_CFM_DMTL_MAX	O/V/S	0... FFH	0... 255	1	-
Remaining number of to be confirmed DMTL_MAX errors (after MIL-On due to DMTL_MAX) for deactivation of DMTL diagnosis					
CTR_DIAG_CFM_DMTL_MIN	O/V/S	0... FFH	0... 255	1	-
Remaining number of to be confirmed DMTL_MIN errors (after MIL-On due to DMTL_MIN) for deactivation of DMTL diagnosis					
CTR_DIAG_CFM_DMTL_PLAUS	O/V/S	0... FFH	0... 255	1	-
Remaining number of to be confirmed DMTL_PLAUS errors (after MIL-On due to DMTL_PLAUS) for deactivation of DMTL diagnosis					
CTR_DIAG_CFM_DMTL_SIG	O/V/S	0... FFH	0... 255	1	-
Remaining number of to be confirmed DMTL_SIG errors (after MIL-On due to DMTL_SIG) for deactivation of DMTL diagnosis					
CTR_DIAG_CFM_ROUGH_LEAK	O/V/S	0... FFH	0... 255	1	-
Remaining number of to be confirmed ROUGH_LEAK errors (after MIL-On due to ROUGH_LEAK) for deactivation of DMTL diagnosis					
CTR_DIAG_CFM_SMALL_LEAK	O/V/S	0... FFH	0... 255	1	-
Remaining number of to be confirmed SMALL_LEAK errors (after MIL-On due to SMALL_LEAK) for deactivation of DMTL diagnosis					
CTR_ENA_DMTL_CHK_FUC	V	0... FFH	0... 255	1	-
Number of enabled check filler cap checks					
CTR_ERR_DET_DMTL_MAX	O/V/S	0... FFH	0... 255	1	-
Number of consecutive DMTL_MAX errors					
CTR_ERR_DET_DMTL_MIN	O/V/S	0... FFH	0... 255	1	-
Number of consecutive DMTL_MIN errors					
CTR_ERR_DET_DMTL_PLAUS	O/V/S	0... FFH	0... 255	1	-
Number of consecutive DMTL_PLAUS errors					
CTR_ERR_DET_DMTL_SIG	O/V/S	0... FFH	0... 255	1	-
Number of consecutive DMTL_SIG errors					
CTR_ERR_DET_ROUGH_LEAK	O/V/S	0... FFH	0... 255	1	-
Number of consecutive ROUGH_LEAK errors					
CTR_ERR_DET_SMALL_LEAK	O/V/S	0... FFH	0... 255	1	-
Number of consecutive SMALL_LEAK errors					
CTR_REP_ROUGH_LEAK_MES_FUC	O/V/S	0... FFH	0... 255	1	-
Number of repeated check filler cap checks					
CTR_TCO_ST_DMTL	O/V/S	0... FFH	0... 255	1	-
Counter of recognized cold starts for DMTL small leak test					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CUR_DMTL	O/V	0... FFFFH	0... 399.99389	6.1035e-3	mA
Pump current tank leakage diagnosis					
CUR_DMTL_COMP_ROUGH_LEAK	O/V	0... FFFFH	0... 399.99389	6.1035e-3	mA
Pump current comparision in case of rough leak measurement					
CUR_DMTL_COMP_SMALL_LEAK_LEN	O/V	0... FFFFH	0... 399.99389	6.1035e-3	mA
Pump current comparision in case of 2. miniature leak measurement					
CUR_DMTL_COR	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Corrected pump current					
CUR_DMTL_COR_FIL	O/V	0... FFFFFFFFH	0... 399.99999	93.1e-9	mA
Corrected and filtered pump current					
CUR_DMTL_COR_FIL_EOL	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Corrected and filtered pump current for tester tool					
CUR_DMTL_COR_FIL_MAX	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Maximum pump current during reference leka measurement					
CUR_DMTL_COR_FIL_MIN	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Minimum pump current during reference leak measurement					
CUR_DMTL_COR_FIL_REFU_HPF	O/V	7FFFH FFFF8000... H	199.98779 -200...	-	mA
Corrected, high-pass filtered pump current					
CUR_DMTL_DIF	O/V	0... FFFFH	0... 399.99389	6.1035e-3	mA
Differential pump current					
CUR_DMTL_DIF_REF_ROUGH_LEAK	O/V	0... FFFFH	0... 399.99389	6.1035e-3	mA
Difference, pump current between reference and min. in case of rough leak check					
CUR_DMTL_DMTLS_TEST	O/V	0... FFFFH	0... 399.99389	6.1035e-3	mA
Pump current during pump test					
CUR_DMTL_REF_DIF_MAX	V	0... FFFFH	0... 399.99389	6.1e-3	mA
Delta pump current during reference measurement					
CUR_DMTL_REF_LEAK	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Pump current reference leakage					
CUR_DMTL_REF_LEAK_EOL	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Pump current reference leakage for tester tool					
CUR_DMTL_ROUGH_LEAK_END	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Pump current at the end of the rough leak measurement					
CUR_DMTL_ROUGH_LEAK_LEN_END	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Pump current at the end of the rough leak measurement extension					
CUR_DMTL_ROUGH_LEAK_MIN	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Min. pump current in case of rough leak measurement					
CUR_DMTL_ROUGH_LEAK_MIN_EOL	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Min. pump current in case of rough leak measurement for tester tool					
CUR_DMTL_SMALL_LEAK_END	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Pump current at the end of the miniature leak measurement					
CUR_DMTL_THD_DMTLS_TEST	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Pump current threshold in case of DMTL valve check					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CUR_DMTL_THD_ROUGH_LEAK	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Pump current threshold in case of rough leak measurement					
CUR_DMTL_THD_ROUGH_LEAK_LEN	O/V	0... FFFFH	0... 399.99389	6.1e-3	mA
Pump current threshold in case of rough leak measurement extension					
DIF_FCO_FTL	-	80... 7FH	-128 ...127	1	l
Fuel difference to determinate upper and lower threshold of the consumption diagnosis					
DIF_FTL_AST	-	80... 7FH	-128 ...127	1	l
Fuel tank level difference after start					
DIF_FTL_VST	-	80... 7FH	-128 ...127	1	l
Fuel tank level difference at vehicle stopped and under possible refuelling conditions at IGK on and FTL reading					
DIST_DMTL	O/V/S	0... FFFFFFFFH	0... 65535	15.3e-6	m
Distance covered for DMTL function					
ERR_SYM_DMTL_MAX	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure of each symptom for max-dmtl failure					
ERR_SYM_DMTL_MIN	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure of each symptom for min-dmtl failure					
ERR_SYM_DMTL_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure of each symptom for plaus-dmtl failure					
ERR_SYM_DMTL_SIG	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure of each symptom for sig-dmtl failure					
ERR_SYM_ROUGH_LEAK	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure of each symptom for rough leak failure					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_SMALL_LEAK	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure of each symptom for small leak failure					
FCO_AV_DMTL	O/V/S	0... FFFFH	0... 4294.9	65.5e-3	l
Currently consumed fuel					
FTL_AV	-	0... 7FH	0... 127	1	l
Fuel tank level actual value					
FTL_INI	O/V/S	0... 7FH	0... 127	1	l
Ini value level for diagnostic cycle					
FTL_OLD	O/V/S	0... 7EH	0... 126	1	l
FTL for plausibility check					
FTL_ST	-	0... 7FH	0... 127	1	l
Fuel tank level at start					
FTL_VST_IN	-	0... 7FH	0... 127	1	l
Fuel tank level at vehicle stopped and under possible refuelling conditions at IGK on and FTL reading					
LV_CDN_DIAG_DMTL_MAX	V	0... 1H	0 ...1	1	-
Diagnosis condition for dmtl max diagnosis					
LV_CDN_DIAG_DMTL_MIN	V	0... 1H	0 ...1	1	-
Diagnosis condition for dmtl min diagnosis					
LV_CDN_DIAG_DMTL_PLAUS	V	0... 1H	0 ...1	1	-
Diagnosis condition for dmtl plausibility diagnosis					
LV_CDN_DIAG_DMTL_SIG	V	0... 1H	0 ...1	1	-
Diagnosis condition for dmtl signal diagnosis					
LV_CDN_DIAG_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
Diagnosis condition for rough leak diagnosis					
LV_CDN_DIAG_SMALL_LEAK	O/V	0... 1H	0 ...1	1	-
Diagnosis condition for small leak diagnosis					
LV_CHK_DMTL_CUR_DMTL_VLD	O/V	0... 1H	0 ...1	1	-
Check of components on pump current thresholds valid					
LV_CHK_DMTL_CUR_DMTL_VLD_CFM	O/V	0... 1H	0 ...1	1	-
Confirmation bit (after check of refueling) for check of components on pump current thresholds valid					
LV_CHK_DMTL_VLD	O/V	0... 1H	0 ...1	1	-
Check of components on current fluctuations valid					
LV_CHK_DMTL_VLD_CFM	O/V	0... 1H	0 ...1	1	-
Confirmation bit (after check of refueling) for check of components on current fluctuations valid					
LV_CLR_FTL	-	0... 1H	0 ...1	1	-
set variable to reinitialize the FTL_Plaus diagnosis after clr FMY or consumption higher than tank volume					
LV_CTR_CNL_SMALL_LEAK_MES	O/V/S	0... 1H	0 ...1	1	-
Threshold of aborted miniature leak measurements due to current fluctuations exceeded					
LV_CTR_CNL_SMALL_LEAK_MES_CFM	O/V	0... 1H	0 ...1	1	-
Confirmation bit (after refueling check) for threshold of aborted miniature leak measurements due to current fluctuations exceeded					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CUR_DMTL_DMTLS_TEST	O/V	0... 1H	0 ...1	1	-
Pump current threshold reached in case of DMTL-valve check					
LV_CUR_DMTL_REF_DIF_MAX	O/V/S	0... 1H	0 ...1	1	-
Condition "delta reference current" exceeded					
LV_CUR_DMTL_REF_MES_MAX	O/V	0... 1H	0 ...1	1	-
Upper pump current threshold reached during reference measurement					
LV_CUR_DMTL_REF_MES_MIN	O/V	0... 1H	0 ...1	1	-
Lower pump current threshold reached during reference measurement					
LV_CUR_DMTL_THD_DIF_MES	O/V/S	0... 1H	0 ...1	1	-
Decreasing pump current during measurement					
LV_CYC_ROUGH_LEAK_MODE6	O/V	0... 1H	0 ...1	1	-
Cycle flag, rough leak error					
LV_CYC_ROUGH_LEAK_SUSP	O/V	0... 1H	0 ...1	1	-
Cycle flag, rough leak suspected					
LV_CYC_SMALL_LEAK_MODE6	O/V	0... 1H	0 ...1	1	-
Cycle flag, miniature leak					
LV_CYC_SMALL_LEAK_MODE6_CFM	O/V	0... 1H	0 ...1	1	-
Cycle flag, miniature leak confirmed (after check of refueling)					
LV_DET_FUC_OPEN	O/V/S	0... 1H	0 ...1	1	-
Detection of fuel cap open					
LV_DET_REFU	O/V/S	0... 1H	0 ...1	1	-
Detection of refueling					
LV_DIST_DET_ROUGH_LEAK	O/V/S	0... 1H	0 ...1	1	-
Distance covered since rough leak detection					
LV_DIST_DMTL	O/V	0... 1H	0 ...1	1	-
Minimum distance after suspected rough leak or refueling					
LV_DMTL_ACT	O/V	0... 1H	0 ...1	1	-
DMTL state machine running					
LV_DMTL_ASA	O/V	0... 1H	0 ...1	1	-
Factory test active					
LV_DMTL_EOL	O/V	0... 1H	0 ...1	1	-
End of line test active					
LV_DMTL_PUMP	O/V	0... 1H	0 ...1	1	-
controlbit of the DMTL pump powerstage					
LV_DMTL_PUMP_ON	O/V	0... 1H	0 ...1	1	-
DMTL pump motor on					
LV_DMTL_RST_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
Inhibit small leak diagnosis					
LV_DMTL_STOP	O/V/S	0... 1H	0 ...1	1	-
Abnormal termination of DMTL function					
LV_DMTLS	O/V	0... 1H	0 ...1	1	-
controlbit of the DMTL solenoid powerstage					
LV_DMTLS_ON	O/V	0... 1H	0 ...1	1	-
DMTL valve on					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DR_DMTL	O/V	0... 1H	0 ...1	1	-
Enabling the output stages of the DMTL module					
LV_DR_DMTL_PUMP	O/V	0... 1H	0 ...1	1	-
DMTL pump activation					
LV_DR_DMTLS	O/V	0... 1H	0 ...1	1	-
DMTL solenoid valve activation					
LV_ENA_CHK_FUC_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
Enable rough leak measurement due to Check Filler Cap					
LV_ENA_FCO_DIAG	O/V	0... 1H	0 ...1	1	-
Consumption diagnosis enable					
LV_ENA_FTL_DIAG	O/V	0... 1H	0 ...1	1	-
Fuel level diagnosis enable					
LV_ENA_FUC	O/V/S	0... 1H	0 ...1	1	-
Request check filler cap					
LV_ENA_FUC_ROUGH_LEAK_MES	O/V	0... 1H	0 ...1	1	-
Enable rough leak measurement due to Check Filler Cap					
LV_ENA_LEAK_DMTL	O/V	0... 1H	0 ...1	1	-
Enabling function request, coarse /miniature leakage measurement					
LV_ENA_MAIN_DMTL	O/V	0... 1H	0 ...1	1	-
DMTL main enabling					
LV_ENA_MAIN_DMTL_FUC	O/V	0... 1H	0 ...1	1	-
Main enabling DMTL Check Filler Cap					
LV_ENA_ROUGH_LEAK_1	O/V	0... 1H	0 ...1	1	-
Auxiliary bit enable condition for rough leak check is present					
LV_ENA_ROUGH_LEAK_2	O/V	0... 1H	0 ...1	1	-
Auxiliary bit enabling rough leak check through manual activation					
LV_ENA_ROUGH_LEAK_3	O/V	0... 1H	0 ...1	1	-
Auxiliary bit interruption of rough leak check					
LV_ENA_ROUGH_LEAK_MES	O/V	0... 1H	0 ...1	1	-
Enabling rough leak measurement					
LV_ENA_ROUGH_LEAK_MES_ONLY	O/V	0... 1H	0 ...1	1	-
Enable only rough leak measurement					
LV_ENA_SMALL_LEAK_1	O/V	0... 1H	0 ...1	1	-
Enable for miniature leak check via test unit intervention					
LV_ENA_SMALL_LEAK_MES	O/V/S	0... 1H	0 ...1	1	-
Enable miniature leak measurement					
LV_ENA_SMALL_LEAK_MES_END	O/V	0... 1H	0 ...1	1	-
End of enable miniature leak measurement					
LV_END_DIAG_DMTL_MAX	V	0... 1H	0 ...1	1	-
End of dmtl max diagnosis					
LV_END_DIAG_DMTL_MIN	V	0... 1H	0 ...1	1	-
End of dmtl min diagnosis					
LV_END_DIAG_DMTL_PLAUS	V	0... 1H	0 ...1	1	-
End of dmtl plaus diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_DMTL_SIG	V	0... 1H	0 ...1	1	-
End of dmtl sig diagnosis					
LV_END_DIAG_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
End of rough leak diagnosis					
LV_END_DIAG_SMALL_LEAK	O/V	0... 1H	0 ...1	1	-
End of small leak diagnosis					
LV_ERR_DET_DMTL_MAX	O/V/S	0... 1H	0 ...1	1	-
Error maximum value DMTL					
LV_ERR_DET_DMTL_MIN	O/V/S	0... 1H	0 ...1	1	-
Error minimum value DMTL					
LV_ERR_DET_ROUGH_LEAK_MIN	O/V/S	0... 1H	0 ...1	1	-
Rough leak error					
LV_ERR_DET_SMALL_LEAK_MIN	O/V/S	0... 1H	0 ...1	1	-
Error, minimum value detected, miniature leakage					
LV_ERR_DET_SMALL_LEAK_MIN_CFM	O/V	0... 1H	0 ...1	1	-
Confirmation bit (after check of refueling) for small leak detected in tank					
LV_ERR_DMTL_MAX	O/V	0... 1H	0 ...1	1	-
Error Dmtl max					
LV_ERR_DMTL_MIN	O/V	0... 1H	0 ...1	1	-
Error Dmtl min					
LV_ERR_DMTL_PLAUS	O/V	0... 1H	0 ...1	1	-
Error Dmtl plaus					
LV_ERR_DMTL_SET	O/V/S	0... 1H	0 ...1	1	-
Indication bit for DMTLM diagnosis has run through w/wo error					
LV_ERR_DMTL_SIG	O/V	0... 1H	0 ...1	1	-
Error Dmtl sig					
LV_ERR_DMTLM	O/V/S	0... 1H	0 ...1	1	-
Error DMTL module					
LV_ERR_FTL	O/V/S	0... 1H	0 ...1	1	-
Tank level error					
LV_ERR_FTL_PLAUS	O/V/S	0... 1H	0 ...1	1	-
Tank level plausibility error					
LV_ERR_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
Error rough leak					
LV_ERR_SIG_DMTL	O/V/S	0... 1H	0 ...1	1	-
Error signal DMTL					
LV_ERR_SMALL_LEAK	O/V	0... 1H	0 ...1	1	-
Error miniature leak					
LV_FCO_DIAG_MAX	O/V	0... 1H	0 ...1	1	-
Upper consumption diagnosis threshold					
LV_FCO_DIAG_MIN	O/V	0... 1H	0 ...1	1	-
Lower consumption diagnosis threshold					
LV_FCO_H_FTL	O/V	0... 1H	0 ...1	1	-
Consumed fuel greater than tank level					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_FTL_DEC	O/V	0... 1H	0 ...1	1	-
Tank volume has decreased					
LV_FTL_DEC_IGK_ON	O/V	0... 1H	0 ...1	1	-
Tank filling volume has decreased in case of ignition key ON					
LV_FTL_DIAG	O/V/S	0... 1H	0 ...1	1	-
Level sensor diagnosis					
LV_FTL_DMTL_MAX	O/V	0... 1H	0 ...1	1	-
Max. tank level for DMTL function					
LV_FTL_DMTL_MIN	O/V	0... 1H	0 ...1	1	-
Min. tank level for DMTL function					
LV_FTL_DMTL_VAL	O/V	0... 1H	0 ...1	1	-
Validated tank level for DMTL function					
LV_FTL_DYN	O/V	0... 1H	0 ...1	1	-
Level dynamics due to refueling					
LV_FTL_INC	O/V	0... 1H	0 ...1	1	-
Tank volume has increased					
LV_FTL_INC_IGK_ON	O/V	0... 1H	0 ...1	1	-
Tank filling volume has increased in case of ignition key ON					
LV_FUC_CAN	O/V	0... 1H	0 ...1	1	-
Tank cap open - display					
LV_FUC_OPEN	O/V/S	0... 1H	0 ...1	1	-
Filler cap open					
LV_HDMTL_ON	O/V	0... 1H	0 ...1	1	-
Heater DMTL					
LV_NO_PURGE_DMTL	O/V	0... 1H	0 ...1	1	-
Request for no_purge of the evap.-system					
LV_NO_PURGE_DMTL_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
request bit for no_purge					
LV_NO_PURGE_DMTL_SMALL_LEAK	O/V	0... 1H	0 ...1	1	-
Request for no_purge					
LV_NO_PURGE_DR_DMTL	O/V	0... 1H	0 ...1	1	-
Pulse width modulation of canister-purge					
LV_RD_FTL	O/V	0... 1H	0 ...1	1	-
Level diagnosis active					
LV_REF_LEAK_ROUGH_LEAK_SUSP	O/V	0... 1H	0 ...1	1	-
Condition, second reference measurement due to "rough leak suspected"					
LV_REFU	O/V	0... 1H	0 ...1	1	-
Refueling					
LV_REFU_1	O/V	0... 1H	0 ...1	1	-
Refueling process, internal					
LV_REFU_DMTL	O/V/S	0... 1H	0 ...1	1	-
Condition refueling					
LV_REFU_DMTL_SMALL_LEAK	O/V/S	0... 1H	0 ...1	1	-
Refueling detection auxiliary bit for evaluation of small leak diagnostic result					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_REFU_DMTLM	O/V/S	0... 1H	0 ...1	1	-
Refueling detection auxiliary bit for evaluation of DMTL module diagnostic result					
LV_REFU_END	O/V	0... 1H	0 ...1	1	-
Refueling finished					
LV_REFU_RLS_DIAG	O/V	0... 1H	0 ...1	1	-
Refueling diagnosis possible					
LV_REFU_VAL	O/V	0... 1H	0 ...1	1	-
Refueling bit valid					
LV_REFU_VAL_1	O/V	0... 1H	0 ...1	1	-
Refueling bit valid, internal					
LV_REQ_ENA_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
Request rough leak measurement					
LV_REQ_PWL_DMTL	O/V	0... 1H	0 ...1	1	-
Request of STG off delay, tank leakage diagnosis					
LV_REQ_PWL_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
Request of STG off delay, rough leak diagnosis					
LV_REQ_PWL_SMALL_LEAK	O/V	0... 1H	0 ...1	1	-
Request of STG off delay, miniature leak test					
LV_REQ_ROUGH_LEAK	O/V	0... 1H	0 ...1	1	-
Request rough leak measurement (low volatile fuel)					
LV_ROUGH_LEAK_MES_LEN	O/V	0... 1H	0 ...1	1	-
Condition, extension rough leak measurement					
LV_ROUGH_LEAK_SUSP	O/V	0... 1H	0 ...1	1	-
Rough leak suspected					
LV_ROUGH_LEAK_SUSP_SET	O/V/S	0... 1H	0 ...1	1	-
Rough leak suspicion with cycle bit rough leak suspicion present					
LV_SDR_DMTL	O/V/S	0... 1H	0 ...1	1	-
Error plausibility DMTL					
LV_SMALL_LEAK_MES_LEN	O/V	0... 1H	0 ...1	1	-
Condition, extension miniature leak measurement					
LV_T_DLY_DMTL_PWL	O/V	0... 1H	0 ...1	1	-
Waiting time DMTL start finished					
LV_T_DMTL_MAX	O/V/S	0... 1H	0 ...1	1	-
Max. time for DMTL					
LV_TCO_ST_DMTL	O/V	0... 1H	0 ...1	1	-
Coldstart condition for DMTL fulfilled					
LV_VB_DIF_MAX	O/V/S	0... 1H	0 ...1	1	-
High battery voltage deviation					
LV_VB_RANGE_DMTL	O/V	0... 1H	0 ...1	1	-
DMTL does not start because battery is out of band width					
M6_CTR_CNL_SMALL_LEAK_MES	O/V/S	0... FFH	0... 255	1	-
mode06 - Module-diagnosis, Signal failure					
M6_CTR_CNL_SMALL_LEAK_MES_SAVE	O/V/S	0... FFH	0... 255	1	-
Store value mode06 - Module-diagnosis, Signal failure					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
M6_CUR_DMTL_COR_FIL_CID18	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - module diagnosis minimum failure					
M6_CUR_DMTL_COR_FIL_CID18_SAVE	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Store value Mode06 - module diagnosis minimum failure					
M6_CUR_DMTL_COR_FIL_CID19	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - module diagnosis maximum failure					
M6_CUR_DMTL_COR_FIL_CID19_SAVE	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Store value Mode06 - module diagnosis maximum failure					
M6_CUR_DMTL_DMTLS_TEST	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - module diagnosis plausibility failure					
M6_CUR_DMTL_DMTLS_TEST_SAVE	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Store value Mode06 - module diagnosis plausibility failure					
M6_CUR_DMTL_REF_LEAK	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - DMTL, Small leak thd					
M6_CUR_DMTL_REF_LEAK_SAVE	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Store value Mode06 - DMTL, Small leak thd					
M6_CUR_DMTL_ROUGH_LEAK_END	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - DMTL, Rough-leak short cycle					
M6_CUR_DMTL_ROUGH_LEAK_LEN_END	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - DMTL, Rough leak long cycle					
M6_CUR_DMTL_SMALL_LEAK_END	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - DMTL, Small leak					
M6_CUR_DMTL_SMALL_LEAK_END_SAVE	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Store value for Mode06 - DMTL, Small leak					
M6_CUR_DMTL_THD_DMTLS_TEST	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - module diagnosis plausibility diagnosis thd					
M6_CUR_DMTL_THD_DMTLS_TEST_SAVE	O/V/S	0... FFFFH	0... 399.99389	6.1035e-3	mA
Store value Mode06 - module diagnosis plausibility diagnosis thd					
M6_CUR_DMTL_THD_ROUGH_LEAK	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - DMTL, Rough-leak short cycle thd					
M6_CUR_DMTL_THD_ROUGH_LEAK_LEN	O/V/S	0... FFFFH	0... 399.99389	6.1e-3	mA
Mode06 - DMTL, Rough leak long cycle thd					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_DMTL	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H AH BH CH undef3581d21630-5486473d75H undef3581d21630-5486473d77H undef3581d21630-5486473d80H undef3581d21630-5486473d82H	START REF_LEAK_MES ROUGH_LEAK_MES ROUGH_LEAK_MES_LEN ROUGH_LEAK_MES_END SMALL_LEAK_MES SMALL_LEAK_MES_LEN REF_LEAK_MES_2 TANK_PROOFED SMALL_LEAK ROUGH_LEAK MODULE_ERROR END undef undef undef undef	-	-
DMTL state					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_DMTL_EOL	O/V/S	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H AH BH CH 11H 12H 21H 22H 23H 24H 25H 26H undef:1H undef3581d21630-5486473d101H undef3581d21630-5486473d114H undef3581d21630-5486473d94H undef3581d21630-5486473d96H undef3581d21630-5486473d99H	START REF_LEAK_MES ROUGH_LEAK_MES ROUGH_LEAK_MES_LEN ROUGH_LEAK_MES_END SMALL_LEAK_MES SMALL_LEAK_MES_LEN REF_LEAK_MES_2 TANK_PROOFED SMALL_LEAK ROUGH_LEAK MODULE_ERROR END VB_OUT_OF_RANGE ELECTRICAL_ERR REFUELLING TANK_CAP_OPEN VB_GITTER T_DMTL_MAX CUR_REF_DIF_MAX THD_CUR_DMTL_DIF_MES undef undef undef undef undef	-	-

Status of DMTL EOL diagnosis

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_ACT_CUR_DMTL_STAT	O/V	0... FFFFH	0... 6553.5	0.1	s
Current time, pump current stable					
T_ACT_LEAK_MES	O/V/S	0... FFFFH	0... 6553.5	0.1	s
Current time, leakage measurement					
T_ACT_REF_LEAK_MES	O/V	0... FFFFH	0... 6553.5	0.1	s
Current time, reference leakage measurement					
T_DMTL_EOL	V	0... FFFFH	0... 6553.5	0.1	s
Time used for end of line diagnosis after test unit initiation					
VB_DMTL_FIL	O/V	0... FFFFH	0... 25.9996	397e-6	V
Filtered battery voltage					
VB_DMTL_REF	O/V	0... FFFFH	0... 25.9996	397e-6	V
Filtered battery voltage on transition to refeence leak measurement					

Input data:

AMP_MES {p. 1163}	CL_MMV_NORM_PURGE_END {p. 1001}	ECU_STATE {p. 1091}	FCO_DMTL {p. 3846}
FTL {p. 1564}	LV_ACT_DMTL_PUMP_EXT_ADJ {p. 7432}	LV_ACT_DMTLH_EXT_ADJ {p. 7432}	LV_ACT_DMTLS_EXT_ADJ {p. 7432}
LV_CLOSE_ACT_CP {p. 1000}	LV_CONF_DMTL {p. 654}	LV_DMTL_PUMP_EXT_ADJ {p. 7433}	LV_DMTLH_EXT_ADJ {p. 7433}
LV_DMTLS_EXT_ADJ {p. 7433}	LV_ENA_CHK_FUC_ROUGH_LEAK_MES {p. 5918}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}
LV_ERR_BN_KM_ICL {p. 4870}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DMTL_PUMP {p. 4626}	LV_ERR_DMTLS {p. 4627}
LV_ERR_EL_CPS {p. 4708}	LV_ERR_SPI_MPS {p. 4245}	LV_ERR_TAM {p. 5076}	LV_ERR_TCO {p. 4496}
LV_ERR_TOUT_ICL_2 {p. 802}	LV_ERR_VS {p. 5021}	LV_ES {p. 1720}	LV_FTL_CAN_ERR {p. 1565}
LV_IGK {p. 906}	LV_IS {p. 1720}	LV_PL {p. 1720}	LV_PU {p. 1720}
LV_PUC {p. 1720}	LV_ST_END {p. 1720}	LV_T_ES_NOT_PLAUS {p. 4467}	LV_T_REL_CAN_REG {p. 1567}
STATE_EFP_CRASH_CAN {p. 1573}	T_AST {p. 1766}	TAM {p. 1579}	TAM_ST {p. 1214}
TCO_ST {p. 1100}	TRT {p. 1504}	V_DMTL	VB {p. 1185}
VS {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_DMTL_MAX	-	0... FFFFH	0... 5434	0.0829175	hPa
Lower altitude threshold for DMTL function /upper ambient pressure for DMTL function					
C_CL_DMTL_MAX	-	0... FFFFH	0... 1.99996	30.5e-6	-
Maximum loading degree for the DMTL function					
C_COD_2_DMTL	-	0... FFH	0... 255	1	-
2nd application code word of DMTL function					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_COD_DMTL	-	0... FFH	0... 255	1	-
Calibrationconstant					
C_CRLC_CUR_DMTL_FIL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Time constant of pump current filtering					
C_CRLC_CUR_DMTL_FIL_LIM	-	0... FFFFH	0... 0.99998	15.3e-6	-
Time constant at the beginning of pump current filtering					
C_CRLC_CUR_DMTL_FIL_LIM	-	0... FFFFH	0... 0.99998	15.3e-6	-
Time constant at the beginning of pump current filtering					
C_CRLC_CUR_DMTL_FIL_REFU	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation constant for pump current filtering in case of refueling detection					
C_CRLC_VB_DMTL_FIL	-	0... FFFFH	0... 0.99998	15.3e-6	-
Time constant of VB filtering					
C_CRLC_VB_DMTL_FIL_LIM	-	0... FFFFH	0... 0.99998	15.3e-6	-
Time constant at the beginning of VB filtering					
C_CTR_DIAG_CFM_DMTLM_LEAK	-	0... FFH	0... 255	1	-
Calibratable number of to be confirmed DMTL_MIN/MAX/PLAUS/SIG and ROUGH/SMALL_LEAK error diagnositcs (after MIL-On due to DMTL_MIN/MAX/PLAUS/SIG or ROUGH/SMALL_LEAK) for deactivation of DMTL diagnosis					
C_CTR_ENA_DMTL_CHK_FUC	-	0... FFH	0... 255	1	-
maximum number of enabled check filler cap checks					
C_CTR_ERR_DET_DMTLM_LEAK	-	0... FFH	0... 255	1	-
Calibratable threshold for number of consecutive errors (of dmlt_max/min/sig/plaus or rough/small_leak) from which activation of error-confirmation diagnostic loop is enabled					
C_CTR_TCO_ST_DMTL_MIN	-	0... FFH	0... 255	1	-
Threshold of recognized cold start for DMTL small leak test					
C_CUR_DMTL_COR_FIL_OFS_AMP	-	... 7FFFH FFFF8000H	Error State - 200...199.98779	-	mA
Pump current offset in case of ambient pressure					
C_CUR_DMTL_DIF_CUR_DMTL_STAT	-	0... FFFFH	0... 399.99389	6.1035e-3	mA
Delta pump current for pump current					
C_CUR_DMTL_DIF_THD_FUC	-	8000... 7FFFH	-200... 199.99389	6.1035e-3	mA
Threshold pump current change for fuel cap detection					
C_CUR_DMTL_DIF_THD_MES	-	0... FFFFH	0... 399.99389	6.1035e-3	mA
Current decrease threshold during measurement					
C_CUR_DMTL_DIF_THD_REFU	-	8000... 7FFFH	-200... 199.99389	6.1035e-3	mA
Threshold pump current change for refueling detection					
C_CUR_DMTL_REF_DIF_MAX	-	0... FFFFH	0... 399.99389	6.1035e-3	mA
Upper threshold of the Delta pump current					
C_CUR_DMTL_REF_LEAK_MAX	-	0... FFFFH	0... 399.99389	6.1035e-3	mA
Upper threshold of pump current for reference measurement					
C_CUR_DMTL_REF_LEAK_MIN	-	0... FFFFH	0... 399.99389	6.1035e-3	mA
Lower threshold of pump current for reference measurement					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CUR_DMTL_REF_OFS	-	0... FFFFH	0... 399.99389	6.1035e-3	mA
Reference pump current offset					
C_DIST_REFU_ROUGH_LEAK_MIN	-	0... FFFFH	0... 65535	1	m
Lower threshold of distance covered between refueling and rough leak suspicion					
C_ENA_FCO_DIAG	-	0... FFFFH	0... 4294.9	0.0655365	l
Threshold consumed fuel for diagnosis enable					
C_FAC_T_CUR_DMTL_STAT_LEN	-	0... FFFFH	0... 0.99998	15.3e-6	-
Factor for 2. stabilization					
C_FCO_DIAG_MAX	-	80... 7FH	-128 ...127	1	l
Upper tolerance variable for level sensor diagnosis					
C_FCO_DIAG_MIN	-	80... 7FH	-128 ...127	1	l
Lower tolerance variable for level sensor diagnosis					
C_FTL_DEC_FTL_DIAG_MIN	-	80... 7FH	-128 ...127	1	l
Minimum level decrease for refueling detection					
C_FTL_DIAG_MAX	-	0... 783H	0... 126	0.0655226	l
maximum tank level					
C_FTL_DIAG_MIN	-	80... 7FH	-128 ...127	1	l
Minimum fuel tank volume for refueling detection					
C_FTL_DMTL_MAX	-	0... 7EH	0... 126	1	l
Max. tank level for DMTL function					
C_FTL_DMTL_MIN	-	0... 7EH	0... 126	1	l
Min. tank level for DMTL function					
C_HYS_FTL_DMTL	-	0... 7EH	0... 126	1	l
Hysteresis for tank level bit for DMTL function					
C_R_DMTL	-	0... FFH	0... 50	0.1953125	Ohm
Resistance of pump current measurement					
C_SUM_CNL_LEAK_MES_FUC_MAX	-	0... FFH	0... 255	1	-
Maximum number of aborted check filler cap checks					
C_SUM_CNL_SMALL_LEAK_MES_MAX	-	0... FFH	0... 255	1	-
Max. number of aborted miniature leak checks due to current fluctuations					
C_SUM_REP_LEAK_MES_FUC_MAX	-	0... FFH	0... 255	1	-
Maximum number of repeated check filler cap checks					
C_T_ACT_ROUGH_LEAK	-	0... FFFFH	0... 6553.5	0.1	s
Time for rough leak measurement					
C_T_ACT_ROUGH_LEAK_CHK_FUC	-	0... FFFFH	0... 6553.5	0.1	s
Time for rough leak measurement in case of check filler cap					
C_T_ACT_SMALL_LEAK	-	0... FFFFH	0... 6553.5	0.1	s
Time for miniature leak measurement					
C_T_AST_DMTL_CHK_FUC	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time after start for enabling check filler cap check					
C_T_AST_DMTL_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Min. post-starting period for canister purge diagnosis					
C_T_CUR_DMTL_ROUGH_LEAK_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Max. time pump current check in rough leak phase					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_CUR_DMTL_ROUGH_LEAK_MIN	-	0... FFFFH	0... 6553.5	0.1	s
Min. time pump current check in rough leak phase					
C_T_CUR_DMTL_STAT	-	0... FFFFH	0... 6553.5	0.1	s
Time for pump current stable					
C_T_DLY_CUR_DMTL_DIF_MES	-	0... FFFFH	0... 6553.5	0.1	s
Current decrease detection delay during measurement					
C_T_DLY_DET_REFU	-	0... FFFFH	0... 6553.5	0.1	s
Wait period of refueling detection					
C_T_DLY_DMTLS	-	0... FFH	0... 25.5	0.1	s
Waiting time after change-over of solenoid valve					
C_T_DLY_ES_PWL	-	0... FFH	0... 25.5	0.1	s
Post-operating wait period until start of DMTL function					
C_T_DLY_FUC_CAN_OFF	-	0... FFFFH	0... 6553.5	0.1	s
Delay time with which Check filler Cap - light is switched off					
C_T_DLY_FUC_CAN_ON	-	0... FFFFH	0... 6553.5	0.1	s
Delay time with which Check filler Cap - light is switched on					
C_T_DLY_IGK_FTL	-	0... FFH	0... 25.5	0.1	s
Minimum time for which LV_IGK must be = 1 to issue a validated level					
C_T_DLY_REQ_PWL_DMTL	-	0... FFH	0... 25.5	0.1	s
Post-operating time after no request for extending the post-operating phase is present any longer					
C_T_DLY_STOP_REFU	-	0... FFFFH	0... 65535	1	s
Delay time stop before refueling					
C_T_DMTL_EOL_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Max. time for end of line diagnosis after test unit initiation					
C_T_DMTL_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time for DMTL diagnosis					
C_T_ENA_DMTL_CHK_FUC	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time between two chk filler cap checks					
C_T_ENA_DR_DMTL_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Max. time for function request DMTL output stages					
C_T_REF_LEAK_MES_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Time for reference leakage measurement					
C_T_REF_LEAK_MES_REP_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Time for repeat reference leakage measurement					
C_T_REF_TEST_ROUGH_LEAK	-	0... FFFFH	0... 6553.5	0.1	s
Time for reference test in case of rough leak check					
C_T_VB_DLY_DMTL	-	0... FFFFH	0... 6553.5	0.1	s
Time delay for Vbat monitoring					
C_TAM_DMTL_CHK_FUC_MIN	-	0... FEH	-48... 142.5	0.75	°C
Minimum ambient temperature for enabling check filler cap check					
C_TAM_DMTL_MAX	-	0... FEH	-48... 142.5	0.75	°C
Upper temperature threshold for the DMTL function					
C_TAM_DMTL_MIN	-	0... FEH	-48... 142.5	0.75	°C
Lower temperature threshold for the DMTL function					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_ST_DMTL_COLD	-	80... 7FH	-96... 95.25	0.75	°C
TCO_ST offset of TAM to enable a DMTL diagnosis					
C_TCO_ST_DMTL_MIN	-	0... FEH	-48... 142.5	0.75	°C
Min. TCO_ST for DMTL enable					
C_TRT_DMTL_EOL_MAX	-	0... FFFFFFFFH	0... 119304.64708	27.7999e-6	h
max. TRT time to run the end of line diagnosis					
C_VB_DMTL_ASA_MAX	-	0... FFH	0... 25.89843	0.1015625	V
Maximum battery threshold at end of line for DMTL					
C_VB_DMTL_ASA_MIN	-	0... FFH	0... 25.89843	0.1015625	V
Minimum battery threshold at end of line for DMTL					
C_VB_DMTL_CHK_FUC_MAX	-	0... FFH	0... 25.89843	0.1015625	V
Maximum battery voltage for enabling check filler cap check					
C_VB_DMTL_CHK_FUC_MIN	-	0... FFH	0... 25.89843	0.1015625	V
Minimum battery voltage for enabling check filler cap check					
C_VB_DMTL_DIF	-	0... FFFFH	0... 25.9996	396.7e-6	V
Delta VB threshold for DMTL					
C_VB_DMTL_DIF_CHK_FUC	-	0... FFFFH	0... 25.9996	396.7e-6	V
Delta VB threshold for DMTL in case of check filler cap					
C_VB_DMTL_MAX	-	0... FFH	0... 25.89843	0.1015625	V
Maximum battery threshold for the DMTL function					
C_VB_DMTL_MIN	-	0... FFH	0... 25.89843	0.1015625	V
Minimum battery threshold for the DMTL function					
C_VS_DMTL_MAX	-	0... FFH	0... 255	1	km/h
Max. vehicle speed					
C_VS_FTL_DIAG_MAX	-	0... FFH	0... 255	1	km/h
Max. VS threshold for FTL DIAG					
C_VS_FUC_CAN_MIN	-	0... FFH	0... 255	1	km/h
Minimum speed for activation Check filler cap					
IP_FAC_CUR_DMTL	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_VB_DMTL_FIL__FAC_CUR_DMTL	6	0... FFFFH	0... 25.9996	396.7e-6	V
Battery-voltage dependent correction factor for the pump current					
IP_FAC_CUR_DMTL_CHK_FUC_ROUGH	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_CUR_DMTLDIFREFROUGHLEAK_1	8	0... FFFFH	0... 399.99389	6.1035e-3	mA
Factor delta pump current for rouh leak detection concerning reference in case of check filler cap test					
IP_FAC_CUR_DMTL_REF	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_CUR_DMTLDIFREFROUGHLEAK_1	8	0... FFFFH	0... 399.99389	6.1035e-3	mA
Factor delta pump current for rough leak detection concerning reference					
IP_FAC_CUR_DMTL_ROUGH	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_CUR_DMTLDIFREFROUGHLEAK_1	8	0... FFFFH	0... 399.99389	6.1035e-3	mA
Factor delta pump current for rough leak detection					
IP_T_ACT_ROUGH_LEAK	-	0... FFFFH	0... 6553.5	0.1	s
LDP_FTL__T_ROUGH_LEAK_TEST	6	0... 7EH	0... 126	1	l
Time for rough leak measurement					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_T_ACT_ROUGH_LEAK_CHK_FUC	-	0... FFFFH	0... 6553.5	0.1	s
LDP_FTL__T_ROUGH_LEAK_TEST	6	0... 7EH	0... 126	1	I
Time for rough leak measurement in case of check filler cap and error FTL					
IP_T_ACT_SMALL_LEAK__FTL	-	0... FFFFH	0... 6553.5	0.1	s
LDP_FTL__T_SMALL_LEAK_TEST	6	0... 7EH	0... 126	1	I
Time for miniature leak measurement					
IP_T_CUR_DMTL_STAT	V	0... FFFFH	0... 6553.5	0.1	s
LDP_FTL__T_CUR_DMTL_STAT	8	0... 7EH	0... 126	1	I
LDPM_CUR_DMTLDIFREFROUGHLEAK_1	8	0... FFFFH	0... 399.99389	6.1035e-3	mA
Time for pump current stable					

Import actions:

ACTION_ERRM_StorePrevFrf (IN<XX>)

Error treatment:

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	**Name (XX)**	**Description**	**Nr**		
Diagnositic Mode for DMTL module, MAX	DMTL_MAX	MAX (SYM_0)	0	NO	EVAP
Diagnositic Mode for DMTL module, MIN	DMTL_MIN	MAX (SYM_1)	1	NO	EVAP
Diagnositic Mode for DMTL module, SIG	DMTL_SIG	MAX (SYM_2)	2	NO	EVAP
Diagnositic Mode for DMTL module, PLAUS	DMTL_PLAUS	MAX (SYM_3)	3	NO	EVAP
Tank leak error	SMALL_LEAK	-	0	NO	EVAP
		MIN	1		
		-	2		
		-	3		
Tank leak error	ROUGH_LEAK	MAX	0	NO	EVAP
		-	1		
		-	2		
		-	3		

Fields information (For more information refers to Error Management file Table of Failure) :

- ABC Type : STD_INI, STD, MEM, MEM_INI, DEC_CAL, STC, NO, MPL_STD_INI
- CARB Class : MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO.

How maximum error DMTL is built up

General information:

In the scope of the legal requirements for On-Board Diagnosis (OBD II) it must be possible to detect a rough leak with a diameter of > 1.0 mm as well as a miniature leak with a diameter of > 0.5 mm within the tank system.

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The leakage diagnostic unit DMTL is installed to the fresh air connector of the CP. To measure a leakage within the tank system, an excess pressure is built up in the tank system after closing the canister purge valve and changing over a valve in the diagnostic module. An excess pressure of approx. 25 hPa is built up by means of the electrical pump in the diagnostic module. The pump's power consumption is used as a measure for the tank tightness. The power consumption in a defined reference leakage serves as a reference for stating the size of a leakage.

Function description

The function is basically enabled via the variant bit LV_CONF_DMTL which is set to 1 via the data record if the DMTL module is installed.
The diagnostic sequence is controlled via the state machine of the central sequencing control system. It receives from the function enabling module the enable LV_ENA_SMALL_LEAK_MES for measuring the miniature leak, and the enable LV_ENA_ROUGH_LEAK_MES for measuring the rough leak. Subsequently, the state machine starts a reference leakage measurement. After the time C_T_REF_LEAK_MES_MAX has elapsed, a transition to the rough leak diagnosis is performed, except in case the current monitoring detects a module error or the diagnosis is interrupted due to a detected diagnosis.
The system detects a rough leak suspect if the pump current does not exceed the threshold CUR_DMTL_THD_ROUGH_LEAK within the time T_DMTL_ROUGH_LEAK and if the pump current does not reach the threshold CUR_DMTL_THD_ROUGH_LEAK_LEN after the extension time T_DMTL_ROUGH_LEAK. In case of a rough leak suspect a second reference measurement is performed on the basis of which the final decision on a rough leck suspect is made. Subsequently, a transition to the miniature leak diagnosis is performed. The tank system is detected to be tight if the pump current exceeds the reference current CUR_DMTL_REF_LEAK.
If the pump current is detected to have reached steady state twice after the time T_DMTL_SMALL_LEAK, a second reference measurement is performed. If a current increase is detected, a miniature leakage is diagnosed. In case of a current reduction, the tank system is detected to be tight .
At the end of the diagnosis, the pump motor is switched off and the change-over valve is reset to its regeneration position.
The errors are indicated with the logic variable LV_ERR_DMTLM for a DMTL module error, LV_ERR_ROUGH_LEAK in case a rough leak is present, or LV_ERR_SMALL_LEAK if a miniature leak has been detected.

A current diagnosis is indicated with the bit LV_DMTL_ACT; interruption of diagnosis is requested via the bit LV_DMTL_STOP. The diagnosis is interrupted if tank cover open has been detected, at the beginning of refueling, in case of an excessive battery voltage fluctuation during diagnosis, in case of decreasing pump current during the measuring phase or if a short-circuit of the pump output stage has been detected.
During the reference stage the function is finished without results if humidity has been detected.
The pump current CUR_DMTL is filtered after conversion to a standard voltage of 12 V in the function block of the pump current filtering. At the beginning of the reference measurement and at the beginning of the rough leak measurement, a smaller time constant is used to enable short transient period of the filter.
Moreover, the filtered battery voltage is sampled at the end of the reference measurement, and the change is monitored in the following rough/miniature leak measurement for the threshold C_VB_DMTL_DIF. The result LV_VB_DIF_MAX = 1 results in interruption of the diagnosis.
During the reference leakage measurement it is taken care of current fluctuations which can lead to an interruption of the diagnosis.
The function block "Fuel cap and refueling check" differentiates the corrected pump current and checks for exceeding a positive threshold C_THD_CUR_DMTL_DIF_REFU, i.e. for increasing pump current to detect "refueling", as the tank pressure and the pump current rise on refueling. When the tank cap is opened, the tank pressure collapses; thus the pump current is reduced. When the negative threshold C_THD_CUR_DMTL_DIF_FUC is no longer reached, the logic variable LV_DET_FUC_OPEN is set to indicate that the fuel cap is open.

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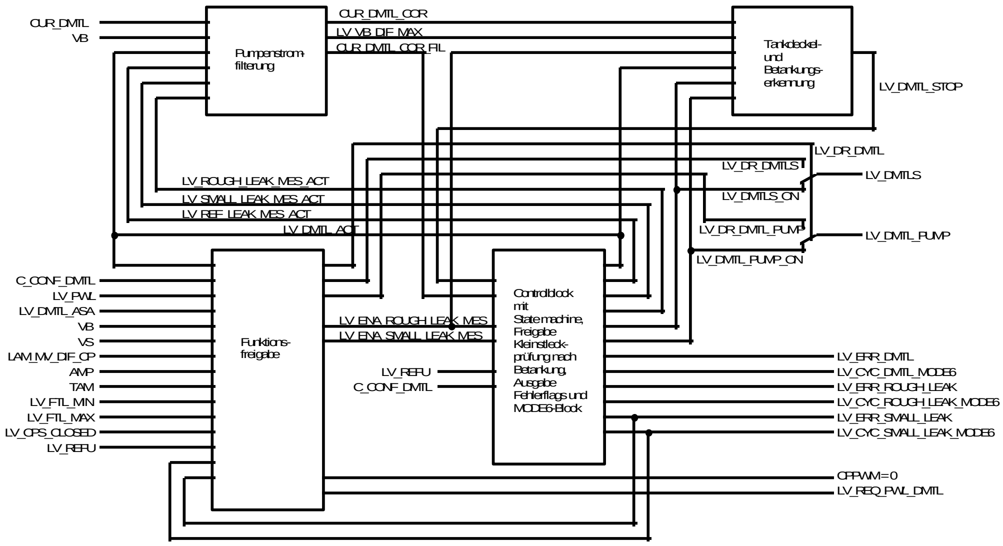
A slow decrease of C_THD_CUR_DMTL_DIF_MES of the pump current leads to an interruption of the diagnosis.
The error and cycle flags are generated in the error block.
Enabling of the minimum leakage diagnosis is essentially initiated while the control unit is closed during off delay, below a certain level, while the vehicle does not run, if the CP is not excessively loaded, at ambient temperatures within a certain band width, the battery voltage within a certain band width and while the CPS is closed.
Moreover, the system checks whether a minimum time since engine start C_T_AST_DMTL_MIN has elapsed, a cold start was given and whether the engine is running.
When the bit LV_REQ_PWL_DMTL is set, the extension of the post-operating phase is enforced up to the end of diagnosis. The diagnosis is started with the delay C_T_DLY_ES_PWL after engine start.
In the function block Demand rough leak check due to Check Filler Cap a rough leak check is activated after refuelling has been detected. With this check a tank cover check is performed. The error entry can be prevented while this check. If a rough leak has been detected a info in the instrument board will be activated in the combi instrument.

Application conditions

Recurrence: 100 ms

Activation: LV_CONF_DMTL = 1

Signal flow diagram:



Formula section:

If LV_DR_DMTL = 1
Then LV_DMTLS = LV_DR_DMTLS
LV_DMTL_PUMP = LV_DR_DMTL_PUMP
Else LV_DMTLS = LV_DMTLS_ON
LV_DMTL_PUMP = LV_DMTL_PUMP_ON
Endif

B.93.1 Central sequencing control

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General information:

The sequence of measurements of the individual currents and coordination of the various output stages pertaining to the DMTL module is ensured by the central sequencing control.

Application conditions

Initialisations: *on clear fmy*
```
T_ACT_LEAK_MES = 0
CUR_DMTL_REF_LEAK = 0
CUR_DMTL_ROUGH_LEAK_MIN = 0
```

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

Signal flow diagram:

Formula section:

Diagnosis times for rough and small leak measurement:

```
If      LV_ERR_FTL = 0                         AND
        LV_ERR_FTL_PLAUS = 0
Then        If      LV_ENA_CHK_FUC_ROUGH_LEAK = 0
            Then    T_ACT_ROUGH_LEAK    = IP_T_ACT_ROUGH_LEAK
            Else    T_ACT_ROUGH_LEAK    = IP_T_ACT_ROUGH_LEAK_CHK_FUC
            Endif
                T_ACT_SMALL_LEAK        = IP_T_ACT_SMALL_LEAK
                T_CUR_DMTL_STAT         = IP_T_CUR_DMTL_STAT
Else        If      LV_ENA_CHK_FUC_ROUGH_LEAK = 0
            Then    T_ACT_ROUGH_LEAK    = C_T_ACT_ROUGH_LEAK
            Else    T_ACT_ROUGH_LEAK    = C_T_ACT_ROUGH_LEAK_CHK_FUC
            Endif
                T_ACT_SMALL_LEAK        = C_T_ACT_SMALL_LEAK
                T_CUR_DMTL_STAT         = C_T_CUR_DMTL_STAT
Endif
```

STATE Machine:

state diagram - start **STATE_DMTL = 0:**

Reset condition: LV_DMTL_STOP = 1 **OR**
LV_ENA_ROUGH_LEAK_MES = 0
(is approached from all states, if fulfilled)

LV_DMTL_ACT	= 0	Diagnosis inactive
LV_DMTL_PUMP_ON	= 0	Pump OFF
LV_DMTLS_ON	= 0	Valve OFF

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LV_CHK_DMTL_CUR_DMTL_VLD = 0 Diagnostic module not finished
LV_CYC_ROUGH_LEAK_SUSP = 0 Rough leak diagn. not finished
LV_CYC_SMALL_LEAK_MODE6 = 0 Miniature leak diag. not finished
LV_REF_LEAK_ROUGH_LEAK_SUSP = 0
If LV_ERR_SIG_DMTL = 1
Then
LV_CUR_DMTL_REF_MES_MAX = 0
LV_CUR_DMTL_REF_MES_MIN = 0
LV_CUR_DMTL_DMTLS_TEST = 0
Endif

If LV_CONF_DMTL = 0 (no DMTL - module installed)
Then
LV_CUR_DMTL_REF_MES_MAX = 0
LV_CUR_DMTL_REF_MES_MIN = 0
LV_CUR_DMTL_DMTLS_TEST = 0
LV_CHK_DMTL_CUR_DMTL_VLD = 0
LV_ERR_DET_SMALL_LEAK_MIN = 0
LV_CYC_SMALL_LEAK_MODE6 = 0 Miniature leakage diagn. not finished
LV_ROUGH_LEAK_SUSP = 0
LV_CYC_ROUGH_LEAK_SUSP = 0 Rough leakage diagn. not finished
Endif

If LV_ENA_ROUGH_LEAK_MES = 1
Then Transition to state diagram
reference leak measurement /STATE_DMTL = 1H
LV_DMTL_ACT = 1 Diagnosis active
CUR_DMTL_REF_LEAK = 0
CUR_DMTL_ROUGH_LEAK_MIN = 0
T_ACT_LEAK_MES = 0
LV_ERR_DET_SMALL_LEAK_MIN_CFM = 0
LV_CYC_SMALL_LEAK_MODE6_CFM = 0
LV_CTR_CNL_SMALL_LEAK_MES_CFM = 0
LV_CHK_DMTL_CUR_DMTL_VLD_CFM = 0
LV_CHK_DMTL_VLD_CFM = 0
Else Remaining in state diagramm Start /STATE_DMTL = 0H
Endif

State diagram - reference leak measurement STATE_DMTL = 1H:

Initialization: LV_DMTL_PUMP_ON = 1 Pump ON
T_ACT_REF_LEAK_MES = 0
CUR_DMTL_REF_LEAK = 0
LV_ROUGH_LEAK_MES_LEN = 0
Calculations and conditions for setting:
T_ACT_REF_LEAK_MES = T_ACT_REF_LEAK_MES + T (= 100ms)
CUR_DMTL_REF_LEAK = CUR_DMTL_REF_LEAK_EOL =
CUR_DMTL_COR_FIL + C_CUR_DMTL_REF_OFS

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If T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_MAX max. time for reference leakage measurement elapsed

Then M6_CUR_DMTL_COR_FIL_CID18_SAVE = CUR_DMTL_COR_FIL
M6_CUR_DMTL_COR_FIL_CID19_SAVE = CUR_DMTL_COR_FIL
If CUR_DMTL_REF_LEAK > C_CUR_DMTL_REF_LEAK_MAX
Then LV_CUR_DMTL_REF_MES_MAX = 1 max. error detected
LV_CUR_DMTL_REF_MES_MIN = 0
LV_CUR_DMTL_DMTLS_TEST = 0 no plausibility error
LV_CHK_DMTL_CUR_DMTL_VLD = 1
Elseif CUR_DMTL_REF_LEAK C_CUR_DMTL_REF_LEAK_MIN:
Then LV_CUR_DMTL_REF_MES_MAX = 0
LV_CUR_DMTL_REF_MES_MIN = 1 min. error detected
LV_CUR_DMTL_DMTLS_TEST = 0 no plausibility error
LV_CHK_DMTL_CUR_DMTL_VLD = 1
Endif
Endif
Endif

If LV_CUR_DMTL_REF_MES_MAX = 1 **OR**
LV_CUR_DMTL_REF_MES_MIN = 1
Then transition to the state diagram module error DMTL_ERR /STATE_DMTL = BH
Else transition to state diagram rough leak measurement /STATE_DMTL = 2H
Endif

State diagram - rough leak diagnosis STATE_DMTL = 2H:

Initialization: LV_DMTLS_ON = 1 Solenoid valve ON
T_ACT_LEAK_MES = 0
CUR_DMTL_ROUGH_LEAK_MIN = CUR_DMTL_ROUGH_LEAK_MIN_EOL = CUR_DMTL_COR_FIL minimum current
CUR_DMTL_DIF_REF_ROUGH_LEAK = CUR_DMTL_REF_LEAK - CUR_DMTL_ROUGH_LEAK_MIN
CUR_DMTL_ROUGH_LEAK_END = CUR_DMTL_COR_FIL
If LV_ENA_CHK_FUC_ROUGH_LEAK = 0
Then CUR_DMTL_THD_ROUGH_LEAK = CUR_DMTL_ROUGH_LEAK_MIN + IP_FAC_CUR_DMTL_ROUGH * CUR_DMTL_DIF_REF_ROUGH_LEAK
Else CUR_DMTL_THD_ROUGH_LEAK = CUR_DMTL_ROUGH_LEAK_MIN + IP_FAC_CUR_DMTL_CHK_FUC_ROUGH * CUR_DMTL_DIF_REF_ROUGH_LEAK
Endif
CUR_DMTL_THD_DMTLS_TEST = CUR_DMTL_REF_LEAK + C_CUR_DMTL_COR_FIL_OFS_AMP
CUR_DMTL_DMTLS_TEST = CUR_DMTL_ROUGH_LEAK_MIN

Calculations and conditions for setting:
T_ACT_LEAK_MES = T_ACT_LEAK_MES + T
CUR_DMTL_ROUGH_LEAK_END = CUR_DMTL_COR_FIL Rough leak current

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If CUR_DMTL_COR_FIL < CUR_DMTL_ROUGH_LEAK_MIN
Then CUR_DMTL_ROUGH_LEAK_MIN =
CUR_DMTL_ROUGH_LEAK_MIN_EOL = CUR_DMTL_COR_FIL
CUR_DMTL_DIF_REF_ROUGH_LEAK = CUR_DMTL_REF_LEAK -
CUR_DMTL_ROUGH_LEAK_MIN

If LV_ENA_CHK_FUC_ROUGH_LEAK = 0
Then CUR_DMTL_THD_ROUGH_LEAK = CUR_DMTL_ROUGH_LEAK_MIN + IP_FAC_CUR_DMTL_ROUGH *
CUR_DMTL_DIF_REF_ROUGH_LEAK
Else CUR_DMTL_THD_ROUGH_LEAK = CUR_DMTL_ROUGH_LEAK_MIN + IP_FAC_CUR_DMTL_CHK_FUC_ROUGH *
CUR_DMTL_DIF_REF_ROUGH_LEAK
Endif
CUR_DMTL_DMTLS_TEST = CUR_DMTL_ROUGH_LEAK_MIN
Endif

Checks:
If T_ACT_LEAK_MES > C_T_CUR_DMTL_ROUGH_LEAK_MIN **AND**
T_ACT_LEAK_MES < C_T_CUR_DMTL_ROUGH_LEAK_MAX **AND**
Then
M6_CUR_DMTL_DMTLS_TEST_SAVE = CUR_DMTL_DMTLS_TEST
M6_CUR_DMTL_THD_DMTLS_TEST_SAVE = CUR_DMTL_THD_DMTLS_TEST
Endif

If T_ACT_LEAK_MES > C_T_CUR_DMTL_ROUGH_LEAK_MIN **AND**
T_ACT_LEAK_MES < C_T_CUR_DMTL_ROUGH_LEAK_MAX **AND**
CUR_DMTL_DMTLS_TEST >= CUR_DMTL_THD_DMTLS_TEST
Then
LV_CUR_DMTL_REF_MES_MAX = 0 no maximum error, DMTL module
LV_CUR_DMTL_REF_MES_MIN = 0 no minimum error, DMTL module
LV_CUR_DMTL_DMTLS_TEST = 1 Plausibility error, DMTL
LV_CHK_DMTL_CUR_DMTL_VLD = 1 Module diagn. concluded
Transition to the state diagram
module error DMTL_ERR /STATE_DMTL = BH
Endif

If LV_ENA_CHK_FUC_ROUGH_LEAK = 0
Then **If** T_ACT_LEAK_MES > T_ACT_ROUGH_LEAK **AND**
CUR_DMTL_ROUGH_LEAK_END < CUR_DMTL_THD_ROUGH_LEAK
Then Transition to state diagram
rough leak diagnosis extension /STATE_DMTL = 3H
Endif
Else **If** T_ACT_LEAK_MES > T_ACT_ROUGH_LEAK **AND**
CUR_DMTL_ROUGH_LEAK_END < CUR_DMTL_THD_ROUGH_LEAK
Then Transition to state diagram
rough leak detected /STATE_DMTL = AH
Endif
Endif

If T_ACT_LEAK_MES > C_T_REF_TEST_ROUGH_LEAK **AND**

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CUR_DMTL_ROUGH_LEAK_END >= CUR_DMTL_THD_ROUGH_LEAK
Then Transition to state diagram
end of rough leak diagnosis /STATE_DMTL = 4H
Endif

State diagram - rough leak diagnosis extension STATE_DMTL = 3H:

Initialization: LV_ROUGH_LEAK_MES_LEN = 1
LV_DMTLS_ON = 1
CUR_DMTL_THD_ROUGH_LEAK_LEN = CUR_DMTL_REF_LEAK -
CUR_DMTL_DIF_REF_ROUGH_LEAK
*
IP_FAC_CUR_DMTL_REF
CUR_DMTL_ROUGH_LEAK_LEN_END = CUR_DMTL_COR_FIL
Calculations and conditions for setting:
T_ACT_LEAK_MES = T_ACT_LEAK_MES + T
CUR_DMTL_ROUGH_LEAK_LEN_END = CUR_DMTL_COR_FIL
If CUR_DMTL_COR_FIL < CUR_DMTL_ROUGH_LEAK_MIN
Then CUR_DMTL_ROUGH_LEAK_MIN =
CUR_DMTL_ROUGH_LEAK_MIN_EOL = CUR_DMTL_COR_FIL
CUR_DMTL_DIF_REF_ROUGH_LEAK = CUR_DMTL_REF_LEAK -
CUR_DMTL_ROUGH_LEAK_MIN

CUR_DMTL_THD_ROUGH_LEAK_LEN = CUR_DMTL_REF_LEAK -
IP_FAC_CUR_DMTL_REF *
CUR_DMTL_DIF_REF_ROUGH_LEAK
Endif

Checks:
If CUR_DMTL_ROUGH_LEAK_LEN_END >= CUR_DMTL_THD_ROUGH_LEAK_LEN
Then Transition to state diagram
end of rough leak diagnosis /STATE_DMTL = 4H
Else if T_ACT_LEAK_MES > T_ACT_SMALL_LEAK
Then LV_REF_LEAK_ROUGH_LEAK_SUSP = 1
Transition to state diagram
2. reference leak diagnosis /STATE_DMTL = 7H
Endif
Endif

State diagram - rough leak diagnosis end STATE_DMTL = 4H:

Initialization: LV_ROUGH_LEAK_SUSP = 0
LV_CYC_ROUGH_LEAK_SUSP = 1
If LV_ENA_SMALL_LEAK_MES = 0 no miniature leak check
Then LV_CUR_DMTL_DMTLS_TEST = 0 no plausibility error DMTL
LV_CUR_DMTL_REF_MES_MIN = 0 no minimum error, DMTL module
LV_CUR_DMTL_REF_MES_MAX = 0 no maximum error, DMTL module
LV_CHK_DMTL_CUR_DMTL_VLD = 1 Module diagn. concluded
Transition to state diagram end /STATE_DMTL = CH

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Else LV_ROUGH_LEAK_MES_LEN = 0
Transition to state diagram
miniature leak diagnosis /STATE_DMTL = 5H
Endif

State diagram - miniature leak diagnosis STATE_DMTL = 5H:

Initialization: T_ACT_CUR_DMTL_STAT = 0
CUR_DMTL_DIF = 0
CUR_DMTL_COMP_ROUGH_LEAK = CUR_DMTL_COR_FIL
LV_CYC_ROUGH_LEAK_SUSP = 0
LV_DMTLS_ON = 1
Calculations and conditions for setting:
T_ACT_CUR_DMTL_STAT = T_ACT_CUR_DMTL_STAT + T
CUR_DMTL_DIF = | CUR_DMTL_COR_FIL -
CUR_DMTL_COMP_ROUGH_LEAK |
T_ACT_LEAK_MES = T_ACT_LEAK_MES + T
Checks:
If CUR_CMTL_COR_FIL > CUR_DMTL_REF_LEAK
Then CUR_DMTL_SMALL_LEAK_END = CUR_DMTL_COR_FIL
LV_CUR_DMTL_DMTLS_TEST = 0 no plausibility error, DMTL
LV_CUR_DMTL_REF_MES_MIN = 0 no minimum error, DMTL module
LV_CUR_DMTL_REF_MES_MAX = 0 no maximum error DMTL module
LV_CHK_DMTL_CUR_DMTL_VLD = 1 module diagn. concluded
Transition to state diagram tank is tight /STATE_DMTL = 8H
Endif

If CUR_DMTL_DIF >= C_CUR_DMTL_DIF_CUR_DMTL_STAT
Then Transition to state diagram
miniature leak diagnosis /STATE_DMTL = 5H
Endif

If T_ACT_CUR_DMTL_STAT > T_CUR_DMTL_STAT **AND**
T_ACT_LEAK_MES > T_ACT_SMALL_LEAK
Then CUR_DMTL_COMP_ROUGH_LEAK = CUR_DMTL_COR_FIL
Transition to state diagram
miniature leak diagnosis extension /STATE_DMTL = 6H
Endif

State diagram - miniature leak diagnosis extension STATE_DMTL = 6H:

Initialization: CUR_DMTL_DIF = 0
T_ACT_CUR_DMTL_STAT = 0
CUR_DMTL_COMP_SMALL_LEAK_LEN = CUR_DMTL_COR_FIL
LV_SMALL_LEAK_MES_LEN = 1
Calculations and conditions for setting:
T_ACT_CUR_DMTL_STAT = T_ACT_CUR_DMTL_STAT + T
T_ACT_LEAK_MES = T_ACT_LEAK_MES + T
CUR_DMTL_DIF = |CUR_DMTL_COR_FIL -
CUR_DMTL_COMP_SMALL_LEAK_LEN|

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Checks:

If CUR_DMTL_DIF > C_CUR_DMTL_DIF_CUR_DMTL_STAT
Then LV_SMALL_LEAK_MES_LEN = 0
Transition to state diagram
miniature leak diagnosis /STATE_DMTL = 5H
Endif

If T_ACT_CUR_DMTL_STAT > T_CUR_DMTL_STAT * C_FAC_T_CUR_DMTL_STAT_LEN
Then LV_SMALL_LEAK_MES_LEN = 0
CUR_DMTL_ROUGH_LEAK_END = CUR_DMTL_COR_FIL
Transition to state diagram
2. reference leak measurement /STATE_DMTL = 7H
Endif

State diagram - 2. reference leak measurement STATE_DMTL = 7H:

Initialtization: T_ACT_REF_LEAK_MES = 0
CUR_DMTL_REF_LEAK = 0
LV_DMTLS_ON = 0
LV_CHK_DMTL_CUR_DMTL_VLD = 0

Calculations and conditions for setting:
T_ACT_REF_LEAK_MES = T_ACT_REF_LEAK_MES + T
CUR_DMTL_REF_LEAK = CUR_DMTL_REF_LEAK_EOL = DMTL_COR_FIL + C_CUR_DMTL_REF_OFS
CUR_DMTL_ROUGH_LEAK_MIN = CUR_DMTL_REF_LEAK - DMTL_DIF_REF_ROUGH_LEAK

CUR_DMTL_THD_ROUGH_LEAK = CUR_DMTL_ROUGH_LEAK_MIN + CUR_DMTL_DIF_REF_ROUGH_LEAK * IP_FAC_CUR_DMTL_ROUGH

CUR_DMTL_THD_ROUGH_LEAK_LEN = CUR_DMTL_REF_LEAK - CUR_DMTL_DIF_REF_ROUGH_LEAK * IP_FAC_CUR_DMTL_REF

Checks:

If T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_MAX max. time for reference leakage measurement elapsed

Then
M6_CUR_DMTL_COR_FIL_CID18_SAVE = CUR_DMTL_COR_FIL
M6_CUR_DMTL_COR_FIL_CID19_SAVE = CUR_DMTL_COR_FIL
Endif

If T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_REP_MAX **AND**
CUR_DMTL_REF_LEAK > C_CUR_DMTL_REF_LEAK_MAX
Then LV_CUR_DMTL_DMTLS_TEST = 0 no plausibility error, DMTL

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LV_CUR_DMTL_REF_MES_MIN = 0 no minimum error, DMTL module
LV_CUR_DMTL_REF_MES_MAX = 1 maximum error, DMTL module
LV_CHK_DMTL_CUR_DMTL_VLD = 1 module diagn. concluded
Transition to the state diagram
module error DMTL_ERR /STATE_DMTL = BH

Endif

If T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_REP_MAX **AND**
CUR_DMTL_REF_LEAK < C_CUR_DMTL_REF_LEAK_MIN
Then LV_CUR_DMTL_DMTLS_TEST = 0 no plausibility error, DMTL
LV_CUR_DMTL_REF_MES_MIN = 1 minimum error, DMTL module
LV_CUR_DMTL_REF_MES_MAX = 0 no maximum error, DMTL module
LV_CHK_DMTL_CUR_DMTL_VLD = 1 module diagn. concluded
Transition to the state diagram
module error DMTL_ERR /STATE_DMTL = BH

Endif

If [T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_REP_MAX **AND**
CUR_DMTL_ROUGH_LEAK_LEN_END <
CUR_DMTL_THD_ROUGH_LEAK_LEN **AND**
LV_ROUGH_LEAK_MES_LEN = 1]
OR
[T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_REP_MAX **AND**
CUR_DMTL_ROUGH_LEAK_END < CUR_DMTL_THD_ROUGH_LEAK **AND**
LV_ROUGH_LEAK_MES_LEN = 0]
Then LV_CUR_DMTL_DMTLS_TEST = 0 no plausibility error, DMTL
LV_CUR_DMTL_REF_MES_MIN = 0 no minimum error, DMTL module
LV_CUR_DMTL_REF_MES_MAX = 0 no maximum error, DMTL module
LV_CHK_DMTL_CUR_DMTL_VLD = 1 module diagn. concluded
Transition to state diagram rough leak detected /STATE_DMTL = AH

Endif

If T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_REP_MAX **AND**
CUR_DMTL_ROUGH_LEAK_END >= CUR_DMTL_THD_ROUGH_LEAK **AND**
LV_REF_LEAK_ROUGH_LEAK_SUSP = 1
Then LV_REF_LEAK_ROUGH_LEAK_SUSP = 0
T_ACT_LEAK_MES = 0
Transition to state diagram
end of rough leak diagnosis /STATE_DMTL = 4H

Endif

If T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_REP_MAX **AND**
CUR_DMTL_COMP_ROUGH_LEAK <= CUR_DMTL_REF_LEAK **AND**
LV_REF_LEAK_ROUGH_LEAK_SUSP = 0
Then CUR_DMTL_SMALL_LEAK_END = CUR_DMTL_COMP_ROUGH_LEAK
LV_CUR_DMTL_DMTLS_TEST = 0 no plausibility error, DMTL

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LV_CUR_DMTL_REF_MES_MIN = 0 no minimum error, DMTL module
LV_CUR_DMTL_REF_MES_MAX = 0 no maximum error, DMTL module
LV_CHK_DMTL_CUR_DMTL_VLD = 1 module diagn. concluded
Transition to state diagram miniature leak detected /STATE_DMTL = 9H

Endif

If T_ACT_REF_LEAK_MES > C_T_REF_LEAK_MES_REP_MAX **AND**
CUR_DMTL_COMP_ROUGH_LEAK > CUR_DMTL_REF_LEAK **AND**
LV_REF_LEAK_ROUGH_LEAK_SUSP = 0

Then CUR_DMTL_SMALL_LEAK_END = CUR_DMTL_COMP_ROUGH_LEAK
LV_CUR_DMTL_DMTLS_TEST = 0 no plausibility error, DMTL
LV_CUR_DMTL_REF_MES_MIN = 0 no minimum error, DMTL module
LV_CUR_DMTL_REF_MES_MAX = 0 no maximum error, DMTL module
LV_CHK_DMTL_CUR_DMTL_VLD = 1 module diagn. concluded
Transition to state diagram tank is tight /STATE_DMTL = 8H

Endif

State diagram - tank is tight STATE_DMTL = 8H:

LV_ERR_DET_SMALL_LEAK_MIN = 0 no miniature leak detected
LV_CYC_SMALL_LEAK_MODE6 = 1 miniature leak diagnisis finished
Transition to state diagram end /STATE_DMTL = CH

State diagram - miniature leak detected STATE_DMTL = 9H:

LV_ERR_DET_SMALL_LEAK_MIN = 1 miniature leak detected
LV_CYC_SMALL_LEAK_MODE6 = 1
ERR_SYM_SMALL_LEAK = MIN
Transition to state diagram end /STATE_DMTL = CH

State diagram - rough leak detected STATE_DMTL = AH:

LV_ROUGH_LEAK_SUSP = 1 Rough leak suspected
LV_CYC_ROUGH_LEAK_SUSP = 1 Rough leak diagnosis finished
Transition to state diagram end /STATE_DMTL = CH

State diagram - module error DMTL_ERR STATE_DMTL = BH:

Transition to state diagram end /STATE_DMTL = CH

State diagram - end STATE_DMTL = CH:

LV_DMTL_PUMP_ON = 0 Pump OFF
LV_DMTLS_ON = 0 valve OFF

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LV_DMTL_ACT	= 0	Diagnosis finished

B.93.2 Pump current of DMTL module

General information:
The most important analog input of the "tank leakage diagnostic function" represents the pump current of the DMTL module. The current to be evaluated is recorded and calculated by voltage measurement at the corresponding shunts. Subsequently, the calculated current is corrected and filtered before it is included in calculation of the function as an input variable.

B.93.2.1 Pump current DMTL

General information:

The current of the pump motor by means of which an excess pressure is built up in the tank system serves as measure for the detection of a leakage in the tank system.
To detect the equivalent current from the measured voltage V_DMTL which is generated in the control unit using the measurement shunt, this requirement is taken into consideration via the calibratable constant C_R_DMTL.
The module is calculated with a time base of 10 ms.

Application conditions

Initialisation: *CUR_DMTL = 0*

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

Formula section:

CUR_DMTL = V_DMTL /C_R_DMTL

B.93.2.2 Filtering of pump current

General information:

The pump current is filtered after conversion to the referenced battery voltage. At the beginning and at the end of the reference measurement, a greater time constant is used to ensure a short filter settling time.
A correction factor for the pump current is taken as a function of the calculated value VB_DMTL_FIL via a characteristic IP_FAC_CUR_DMTL. Thus, the pump current CUR_DMTL is corrected depending on the battery voltage, and results in relation to CUR_DMTL_COR.

Application conditions

Initialisation: *CUR_DMTL_COR = 0*
CUR_DMTL_COR_FIL = 0

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

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Formula section:

CUR_DMTL_COR = CUR_DMTL * IP_FAC_CUR_DMTL

If STATE_DMTL = 0H 1H **OR**
STATE_DMTL = 1H 2H **OR**
STATE_DMTL = 3H 7H **OR**
STATE_DMTL = 6H 7H **OR**
STATE_DMTL = 7H 4H
Then T_DLY_DMTLS = C_T_DLY_DMTLS
Endif

If T_DLY_DMTLS $>$ 0
Then CUR_DMTL_COR_FIL$_{(n)}$ = CUR_DMTL_COR_FIL$_{(n-1)}$ +
(CUR_DMTL_COR$_{(n)}$ - CUR_DMTL_COR_FIL$_{(n-1)}$) *
C_CRLC_CUR_DMTL_FIL_LIM
T_DLY_DMTLS = T_DLY_DMTLS - -
Else CUR_DMTL_COR_FIL$_{(n)}$ = CUR_DMTL_COR_FIL$_{(n-1)}$ +
(CUR_DMTL_COR$_{(n)}$ - CUR_DMTL_COR_FIL$_{(n-1)}$) *
C_CRLC_CUR_DMTL_FIL
Endif

CUR_DMTL_COR_FIL_EOL = CUR_DMTL_COR_FIL #only in case of tester diag

B.93.2.3 VB depending pump current correction

General information:

At the end of the reference measurement, the filtered battery voltage VB_DMTL_REF is measured and monitored for a higher deviation in the following rough or miniature leak measurement. If a high battery voltage deviation is detected, LV_VB_DIF_MAX is set and the diagnosis is aborted.

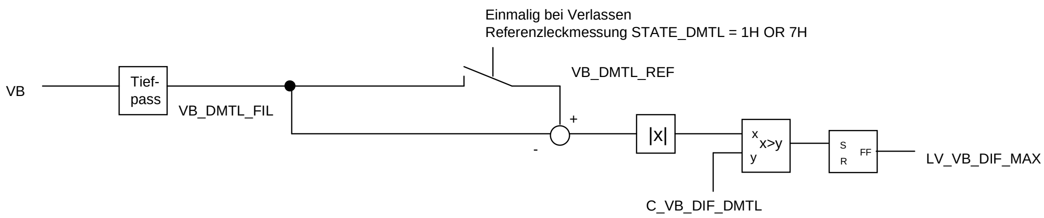
Application conditions

Initialisation: *LV_VB_DIF_MAX is restored from the NVMY*
VB_DMTL_REF = VB_DMTL_FIL = 12V

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

Signal flow diagram:



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Formula section:

If LV_DMTL_ACT = 0   1
  Then T_DLY_VB_DMTL_FIL = C_T_DLY_DMTLS
Endif
If LV_DMTL_ACT = 1 AND T_DLY_VB_DMTL $>$ 0
  Then VB_DMTL_FIL$_{(n)}$ = VB_DMTL_FIL$_{(n-1)}$ +
  (VB$_{(n)}$ - VB_DMTL_FIL$_{(n-1)}$) * C_CRLC_VB_DMTL_FIL_LIM
  T_DLY_VB_DMTL = T_DLY_VB_DMTL - 100 ms
Endif

If LV_DMTL_ACT = 1 AND T_DLY_VB_DMTL = 0
  Then VB_DMTL_FIL$_{(n)}$ = VB_DMTL_FIL$_{(n-1)}$ +
  (VB$_{(n)}$ - VB_DMTL_FIL$_{(n-1)}$) * C_CRLC_VB_DMTL_FIL
Endif

If STATE_DMTL = 1H   2H **OR**
  STATE_DMTL = 7H   4H
  Then VB_DMTL_REF = VB_DMTL_FIL
  Else VB_DMTL_REF = VB_DMTL_REF
Endif

If [STATE_DMTL = 2H **OR**
  STATE_DMTL = 3H **OR**
  STATE_DMTL = 5H **OR**
  STATE_DMTL = 6H] **AND**
  [**If** LV_ENA_CHK_FUC_ROUGH_LEAK = 0
  Then |VB_DMTL_REF - VB_DMTL_FIL| $>$ C_VB_DMTL_DIF
  Else |VB_DMTL_REF - VB_DMTL_FIL| $>$ C_VB_DMTL_DIF_CHK_FUC
  Endif]
  Then LV_VB_DIF_MAX = 1
  Else LV_VB_DIF_MAX = 0
Endif

If LV_DMTL_ACT = 0   1
  Then LV_VB_DIF_MAX = 0
Endif

B.93.3 Interruption of function due to current fluctuations

General information:

The function block monitors the filtered and corrected pump current for excessively high current fluctuations during the reference leakage measurement. If this case is detected, the tank leakage diagnosis is aborted. The interruption is cumulated in a counter.

Application conditions

Initialisation: *LV_CUR_DMTL_REF_DIF_MAX is restored out of NVMY*
CTR_CUR_DMTL_REF_DIF_MAX is restored out of NVMY

Recurrence: *100 ms*

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Activation: *LV_DMTL_ACT = 1*

Formula section:

If STATE_DMTL = 0H   1H **OR**
STATE_DMTL = 3H   7H **OR**
STATE_DMTL = 6H   7H
Then T_DLY_CUR_DMTL_REF_DIF = C_T_DLY_DMTLS
Endif

If [STATE_DMTL = 1H **OR**
STATE_DMTL = 7H] **AND**
T_DLY_CUR_DMTL_REF_DIF > 0
Then CUR_DMTL_COR_FIL_MAX = CUR_DMTL_COR_FIL
CUR_DMTL_COR_FIL_MIN = CUR_DMTL_COR_FIL
T_DLY_CUR_DMTL_REF_DIF = T_DLY_CUR_DMTL_REF_DIF - 100 ms
Endif

If [STATE_DMTL = 1H **OR**
STATE_DMTL = 7H] **AND**
T_DLY_CUR_DMTL_REF_DIF = 0
Then CUR_DMTL_REF_DIF_MAX =
MAX(CUR_DMTL_COR_FIL. CUR_DMTL_COR_FIL_MAX) -
MIN(CUR_DMTL_COR_FIL. CUR_DMTL_COR_FIL_MIN)
Endif

If CUR_DMTL_REF_DIF_MAX > C_CUR_DMTL_REF_DIF_MAX
Then LV_CUR_DMTL_REF_DIF_MAX = 1
Else LV_CUR_DMTL_REF_DIF_MAX = 0
Endif

If LV_DMTL_ACT = 0   1
Then LV_CUR_DMTL_REF_DIF_MAX = 0
Endif

If LV_CUR_DMTL_REF_DIF_MAX = 0   1 **OR**
LV_CUR_DMTL_THD_DIF_MES = 0   1
Then CTR_CUR_DMTL_REF_DIF_MAX = CTR_CUR_DMTL_REF_DIF_MAX + 1
Else CTR_CUR_DMTL_REF_DIF_MAX = CTR_CUR_DMTL_REF_DIF_MAX
Endif

B.93.4 Function enabling

Application conditions

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

General information:

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The enabling of the tank leakage diagnostic function is to be represented here in terms of an overview. The individual bits comprised are explained subsequently in the following chapters. Some remarkable points are to be mentioned in this context.

Formula section:

If ECU_STATE != PWL ECU_STATE = PWL
Then T_DLY_ES_PWL = C_T_DLY_ES_PWL
Endif

If ECU_STATE = PWL **AND**
T_DLY_ES_PWL > 0
Then T_DLY_ES_PWL = T_DLY_ES_PWL - 100 ms
LV_T_DLY_DMTL_PWL = 0
Else LV_T_DLY_DMTL_PWL = 1
Endif

If LV_REQ_PWL_ROUGH_LEAK = 1 **OR**
LV_REQ_PWL_SMALL_LEAK = 1
Then LV_REQ_PWL_DMTL = 1
T_DLY_REQ_PWL_DMTL = 0
Endif

If LV_REQ_PWL_DMTL = 1 **AND**
LV_REQ_PWL_ROUGH_LEAK = 0 **AND**
LV_REQ_PWL_SMALL_LEAK = 0
Then T_DLY_REQ_PWL_DMTL = T_DLY_REQ_PWL_DMTL + 100 ms
Else T_DLY_REQ_PWL_DMTL = 0
Endif

If T_DLY_REQ_PWL_DMTL > C_T_DLY_REQ_PWL_DMTL
Then LV_REQ_PWL_DMTL = 0
Endif

If LV_ENA_SMALL_LEAK_MES = 1 **OR**
LV_ENA_ROUGH_LEAK_MES_ONLY = 1
Then LV_ENA_ROUGH_LEAK_MES = 1
Else LV_ENA_ROUGH_LEAK_MES = 0
Endif

If LV_NO_PURGE_DMTL_ROUGH_LEAK = 1 **OR**
LV_NO_PURGE_DMTL_SMALL_LEAK = 1 **OR**
LV_NO_PURGE_DR_DMTL = 1
Then LV_NO_PURGE_DMTL = 1
Else LV_NO_PURGE_DMTL = 0
Endif

Signal flow diagram:

B.93.5 Main switch-on conditions

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Application conditions

Initialisation: *LV_ENA_MAIN_DMTL = 0*
LV_ENA_LEAK_DMTL = 0
LV_ENA_MAIN_DMTL_FUC = 0

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

Formula section:

If CTR_DIAG_CFM_SMALL_LEAK = 0 **OR**
CTR_DIAG_CFM_ROUGH_LEAK = 0 **OR**
CTR_DIAG_CFM_DMTL_MAX = 0 **OR**
CTR_DIAG_CFM_DMTL_MIN = 0 **OR**
CTR_DIAG_CFM_DMTL_SIG = 0 **OR**
CTR_DIAG_CFM_DMTL_PLAUS = 0
Then LV_ENA_LEAK_DMTL = 0
Else **If** LV_ERR_EL_CPS = 0 **AND**
LV_ERR_DIAGCPS = 0 **AND**
LV_ERR_DMTLS = 0 **AND**
LV_ERR_DMTL_PUMP = 0 **AND**
LV_ERR_DMTLH = 0 **AND**
LV_ERR_SPI_MPS = 0
Then LV_ENA_LEAK_DMTL = 1
Else LV_ENA_LEAK_DMTL = 0
Endif
Endif

If ECU_STATE = PWL **AND**
[AMP_MES > C_AMP_DMTL_MAX **AND**
ERR_AMP = 0 **AND**
LV_ERR_AMP_PLAUS = 0] **AND**
[LV_ERR_TAM = 0 **AND**
C_TAM_DMTL_MIN < TAM <= C_TAM_DMTL_MAX] **AND**
[TCO_ST >= C_TCO_ST_DMTL_MIN **OR**
LV_TCO_ST_LIH = 1 in case of determination TCO_ST] **AND**
CL_MMV_NORM_PURGE_END < C_CL_DMTL_MAX **AND**
[[LV_FTL_DMTL_MIN = 0 **AND**
LV_FTL_DMTL_VAL = 1] **OR**
LV_ERR_FTL = 1 **OR**
LV_ERR_FTL_PLAUS = 1] **AND**
LV_DMTL_ASA = 0 **AND**
[VS < C_VS_DMTL_MAX **OR**
LV_ERR_VS = 1] **AND**
STATE_EFP_CRASH_CAN   2 **AND**
[C_VB_DMTL_MIN < VB <= C_VB_DMTL_MAX **OR**
C_VB_DMTL_MIN >= VB > C_VB_DMTL_MAX for maximum
C_T_VB_DLY_DMTL] **AND**
LV_ENA_LEAK_DMTL = 1
Then LV_ENA_MAIN_DMTL_FUC = 1
Else LV_ENA_MAIN_DMTL_FUC = 0
Endif

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If [[LV_FTL_DMTL_MAX = 0 **AND**
LV_FTL_DMTL_VAL = 1] **OR**
LV_ERR_FTL = 1 **OR**
LV_ERR_FTL_PLAUS = 1] **AND**
T_AST >= C_T_AST_DMTL_MAX **AND**
LV_ENA_MAIN_DMTL_FUC = 1
Then LV_ENA_MAIN_DMTL = 1
Else LV_ENA_MAIN_DMTL = 0
Endif

B.93.6 Tank level sensor

General information:

The function enabling of the tank leakage diagnostic function depends, amongst other things, on the tank being filled to between 15 % and 85 % of its capacity. The tank level information is transferred to the control unit via CAN in the INSTR2 message. If a level error is transmitted by CAN or if the CAN message is not issued, then the bit is set for a validated tank level LV_FTL_DMTL_VAL = 0.

Application conditions

Initialisation: *LV_FTL_DMTL_VAL = 0*
LV_FTL_DMTL_MAX = 0
LV_FTL_DMTL_MIN = 0

Recurrence: *1 s*

Activation: *LV_IGK = 1*

Formula section:

If LV_IGK = 0 1
Then T_DLY_IGK_FTL = C_T_DLY_IGK_FTL
LV_FTL_DMTL_VAL = 0
Endif

If LV_IGK = 1 **AND**
T_DLY_IGK_FTL > 0
Then T_DLY_IGK_FTL = T_DLY_IGK_FTL - 1 s
Endif

If LV_ERR_FTL = 0 **AND**
T_DLY_IGK_FTL = 0
Then LV_FTL_DMTL_VAL = 1
Else LV_FTL_DMTL_VAL = 0
Endif

If LV_ERR_FTL = 0
Then LV_FTL_DMTL_MAX = LV_FTL_DMTL_MAX
LV_FTL_DMTL_MIN = LV_FTL_DMTL_MIN
Else LV_FTL_DMTL_MAX = 0
LV_FTL_DMTL_MIN = 0

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Endif

If FTL > C_FTL_DMTL_MAX + C_HYS_FTL_DMTL
Then LV_FTL_DMTL_MAX = 1
Endif

If FTL < C_FTL_DMTL_MAX - C_HYS_FTL_DMTL
Then LV_FTL_DMTL_MAX = 0
Endif

If FTL < C_FTL_DMTL_MIN + C_HYS_FTL_DMTL
Then LV_FTL_DMTL_MIN = 1
Endif

If FTL > C_FTL_DMTL_MIN - C_HYS_FTL_DMTL
Then LV_FTL_DMTL_MIN = 0
Endif

B.93.7 Tank level plausibility check

For the tank diagnostic function, it is necessary to detect a refueling process, to obtain certain tank level bits and to perform a plausibility check of the tank level signal.

B.93.7.1 Initialization of diagnostic quantities

Application conditions

Initialisation: *FCO_AV_DMTL is restored out of NVMY*
FCO_DMTL_INI = 0 - FCO_AV_DMTL

Recurrence: *1 s*

Activation: *LV_IGK = 1*

Deactivation: LV_IGK = 1 (0

General information:

To perform a plausibility check of the level signal, a fuel consumption resulting from the difference between two fuel level values is compared with the fuel consumption resulting from the injection calculation.

Signal flow diagram:

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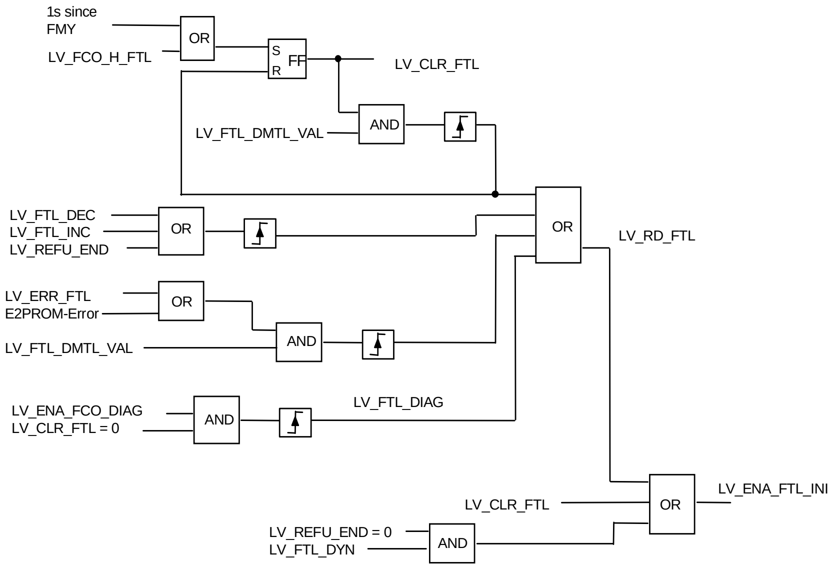

In case of the initial initialization or an EEPROM error, FCO_AV_DMTL = FCO_DMTL_INI = FTL_INI = 0 is set.
In case the failure memory is deleted, FTL_INI = 0.

Formula section:

If FCO_AV_DMTL $>$ C_FTL_DIAG_MAX
Then LV_FCO_H_FTL = 1
Endif

If FMY is cleared **OR**
LV_FCO_H_FTL = 1
Then LV_CLR_FTL = 1
Endif

If LV_CLR_FTL = 1$_{(n-1)}$ **AND**
LV_FTL_DMTL_VAL = 1
Then LV_RD_FTL _1 = 1
LV_CLR_FTL = 0$_{(n)}$
Endif
If LV_FTL_DEC = 1 **OR**
LV_FTL_INC = 1 **OR**
LV_REFU_END = 1
Then LV_RD_FTL _2 = 1
Endif
If LV_ERR_FTL = 1 **AND**
LV_FTL_DMTL_VAL = 1
Then LV_RD_FTL _3 = 1
Endif
If LV_ENA_FCO_DIAG = 1 **AND**
LV_CLR_FTL = 0
Then LV_RD_FTL _4 = 1
LV_FTL_DIAG = 1

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Endif

If LV_RD_FTL_1 = 0 1 **OR**
LV_RD_FTL_2 = 0 1 **OR**
LV_RD_FTL_3 = 0 1 **OR**
LV_RD_FTL_4 = 0 $1_{(n-1)}$ **OR**
LV_CLR_FTL = 1 **OR**
[LV_REFU_END = 0 **AND**
LV_FTL_DYN = 1]
Then LV_ENA_FTL_INI = 1
Endif

If LV_ENA_FTL_INI = 1
Then FTL_INI = FTL
FCO_AV_DMTL = 0
FCO_DMTL_INI = FCO_DMTL
Else FTL_INI = FTL_INI
FCO_AV_DMTL = FCO_DMTL - FCO_DMTL_INI
Endif

B.93.7.2 Refueling detection case of ignition key ON and level reading

Application conditions

Recurrence: *1 s*

Activation: *LV_IGK = 1*

Initialization: DIF_FTL_VST = 0 in case of LV_IGK off to on
on ERU to PWL:
LV_REFU_RLS_DIAG = 0 (and falling edge as well)

Formula section:

If VS < C_VS_FTL_DIAG_MAX UND LV_FTL_DMTL_VAL = 1
for a period longer than C_T_DLY_STOP_REFU
Then LV_REFU_RLS_DIAG = 1
Endif

If LV_FTL_DMTL_VAL = 0 **OR**
LV_ERR_VS = 1 **OR**
VS >= C_VS_FTL_DIAG_MAX
Then LV_REFU_RLS_DIAG = 0
Endif

If LV_REFU_RLS_DIAG = 0 **AND** LV_FTL_DYN = 1
Then LV_REFU_END = 1
Else LV_REFU_END = 0
Endif

If LV_ERR_VS = 1 **OR**
LV_ENA_FTL_DIAG = 0
Then FTL_AV = FTL_VST_IN = DIF_FTL_VST = 0

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Endif

If LV_REFU_RLS_DIAG = 0 1
Then FTL_VST_IN = FTL
FCO_VST = FCO_DMTL
Endif

If LV_REFU_RLS_DIAG = 1
Then FTL_AV = FTL
DIF_FTL_VST = FTL_AV - (FTL_VST_IN - (FCO_DMTL - FCO_VST))
Endif
Subsequently the following interrogations are processed:

If LV_ERR_VS = 0 **AND**
LV_ENA_FTL_DIAG = 1 **AND**
DIF_FTL_VST > C_FTL_DIAG_MIN
Then LV_FTL_INC_IGK_ON = 1
Else LV_FTL_INC_IGK_ON = 0
Endif

If LV_ERR_VS = 0 **AND**
LV_ENA_FTL_DIAG = 1 **AND**
DIF_FTL_VST < C_FTL_DEC_FTL_DIAG_MIN
Then LV_FTL_DEC_IGK_ON = 1
Else LV_FTL_DEC_IGK_ON = 0
Endif

If LV_FTL_INC_IGK_ON = 1 **OR** LV_FTL_DEC_IGK_ON = 1
Then LV_FTL_DYN = 1
Else LV_FTL_DYN = 0
Endif

In case of "delete failure memory", the following occurs:
LV_REFU_END = LV_FTL_DYN = FTL_VST_IN = FTL_AV = DIF_FTL_VST = LV_FTL_DEC_IGK_ON = LV_FTL_INC_IGK_ON = LV_REFU_RLS_DIAG = 0

B.93.7.3 Refueling detection after restart

Application conditions

Recurrence: *1 s*

Activation: *LV_IGK = 1*

Function description:

In the case of an EEPROM error or on initial initialization, this refueling detection must not be performed.

Signal flow diagram:

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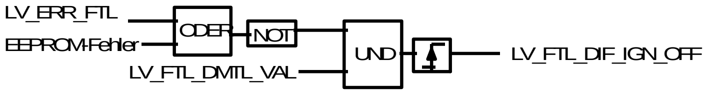

Formula section:

If [LV_FTL_DMTL_VAL = 1 *for minimum one second* **AND**
LV_ST_END = 1] **OR**
[LV_CLR_FTL = 1 **AND**
LV_FTL_DIF_IGN_OFF = 1]
Then FTL_OLD = FTL
Endif

If LV_FTL_DIF_IGN_OFF = 1
Then FTL_ST = FTL
DIF_FTL_AST = FTL_ST - FTL_OLD
Endif

If LV_FTL_DIF_IGN_OFF = 1
then **If** LV_ENA_FTL_DIAG = 1 **AND**
DIF_FTL_AST > C_FTL_DIAG_MIN
Then LV_FTL_INC = 1
Else LV_FTL_INC = 0
Endif
If LV_ENA_FTL_DIAG = 1 **AND**
DIF_FTL_AST < C_FTL_DEC_FTL_DIAG_MIN
Then LV_FTL_DEC = 1
Else LV_FTL_DEC = 0
Endif
Endif

If LV_REFU_RLS_DIAG = 0 → 1
Then LV_FTL_DEC = 0
LV_FTL_INC = 0
DIF_FTL_AST = 0
Endif

In case of the initial initialization or an EEPROM error, FTL_OLD = 0 is initialized.

In case of "delete failure memory", the following occurs:

LV_FTL_IN = FTL_OLD = LV_FTL_DEC = LV_FTL_INC = FTL_ST = DIF_FTL_AST = 0

B.93.7.4 Refueling flag output

Application conditions

Recurrence: *1 s*

Activation: *LV_IGK = 1*

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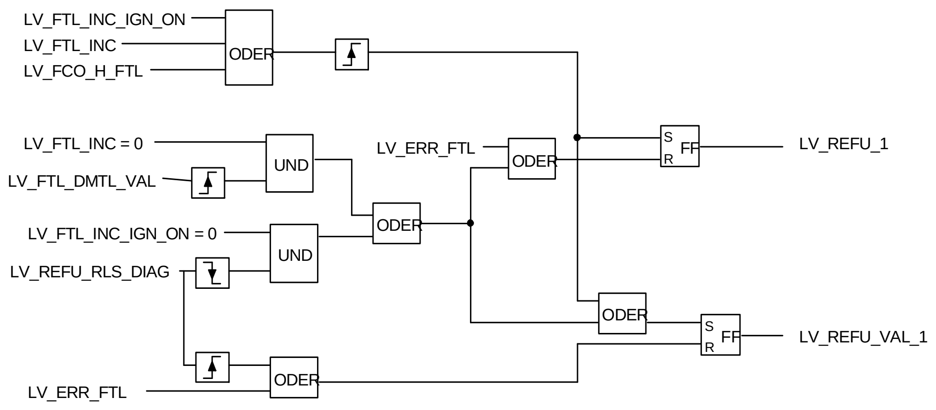
Signal flow diagram:



The output of the refueling bits LV_REFU and LV_REFU_VAL depends on the level diagnosis enable state.

The following logic is derived therefrom:

If LV_ENA_FTL_DIAG = 1 **AND** LV_REFU_1 = 1
Then LV_REFU = 1
Else LV_REFU = 0
Endif

If LV_ENA_FTL_DIAG = 1 **AND** LV_REFU_VAL_1 = 1
Then LV_REFU_VAL = 1
Else LV_REFU_VAL = 0
Endif

If no diagnosis has been enabled LV_ENA_FTL_DIAG = 0, then the refueling bits LV_REFU = 0 and LV_REFU_VAL = 0 are issued.

In case of "delete failure memory", the following occurs:
LV_REFU_1 = LV_REFU_VAL_1 = 0

In case of ERU to PWL:
LV_REFU_VAL_1 = 0

In case of igkOff2on:
LV_REFU_VAL = 0

B.93.7.5 Fuel level diagnosis

Application conditions

Recurrence: *1 s*

Activation: *LV_IGK = 1*

Formula section:

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Consumption diagnosis enable:

```
If      LV_FTL_DMTL_VAL = 1                         AND
        [LV_FTL_DYN = 0                OR
        LV_REFU_END = 1]                            AND
        FCO_AV_DMTL > C_ENA_FCO_DIAG                AND
        LV_ENA_FTL_DIAG =1
  Then  LV_ENA_FCO_DIAG = 1
  Else  LV_ENA_FCO_DIAG = 0
Endif
```

Upper and lower threshold of the consumption diagnosis:

```
If      LV_FTL_DIAG = 1              AND      LV_ENA_FTL_DIAG = 1
  Then  If    DIF_FCO_FTL = FCO_AV_DMTL - (FTL_INI - FTL) > C_FCO_DIAG_MAX
              Then    LV_FCO_DIAG_MAX = 1
              Else    LV_FCO_DIAG_MAX = 0
        Endif
        If    DIF_FCO_FTL = FCO_AV_DMTL - (FTL_INI - FTL) < C_FCO_DIAG_MIN
              Then    LV_FCO_DIAG_MIN = 1
              Else    LV_FCO_DIAG_MIN = 0
  Else  LV_FCO_DIAG_MAX = 0       AND       LV_FCO_DIAG_MIN = 0
Endif
```

In case of "delete failure memory", the following occurs:

LV_FCO_DIAG_MAX = LV_FCO_DIAG_MIN = LV_ENA_FCO_DIAG = DIF_FCO_FTL = 0

B.93.7.6 Fuel level diagnosis enable

Application conditions

Recurrence: *1 s*

Activation: *LV_IGK = 1*

Formula section:

```
If      LV_CONF_DMTL = 1
    Then    LV_ENA_FTL_DIAG = 1
    Else    LV_ENA_FTL_DIAG = 0
Endif
```

B.93.7.7 Tank level error

Application conditions

Initialisation: *restored out of FMY*

Recurrence: *1 s*

Activation: *LV_IGK = 1*

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Formula section:

If LV_FTL_CAN_ERR = 1 **OR**
LV_ERR_TOUT_ICL_2 = 1 **OR**
LV_ERR_BN_KM_ICL = 1
Then LV_ERR_FTL = 1
Else LV_ERR_FTL = 0
Endif

If LV_FTL_DIAG = 1
Then **If** [LV_FCO_DIAG_MAX = 1 **OR**
LV_FCO_DIAG_MIN = 1] **AND**
LV_ERR_TOUT_ICL_2 = 0 **AND**
LV_ERR_BN_KM_ICL = 0
Then LV_ERR_FTL_PLAUS = 1
Else LV_ERR_FTL_PLAUS = 0
Endif
Endif

B.93.8 Enabling the rough leak check

Application conditions

Initialisation: *at ERU to PWL:*
LV_REQ_PWL_ROUGH_LEAK = 0
LV_INH_ROUGH_LEAK_MES = 0

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

Signal flow diagram:

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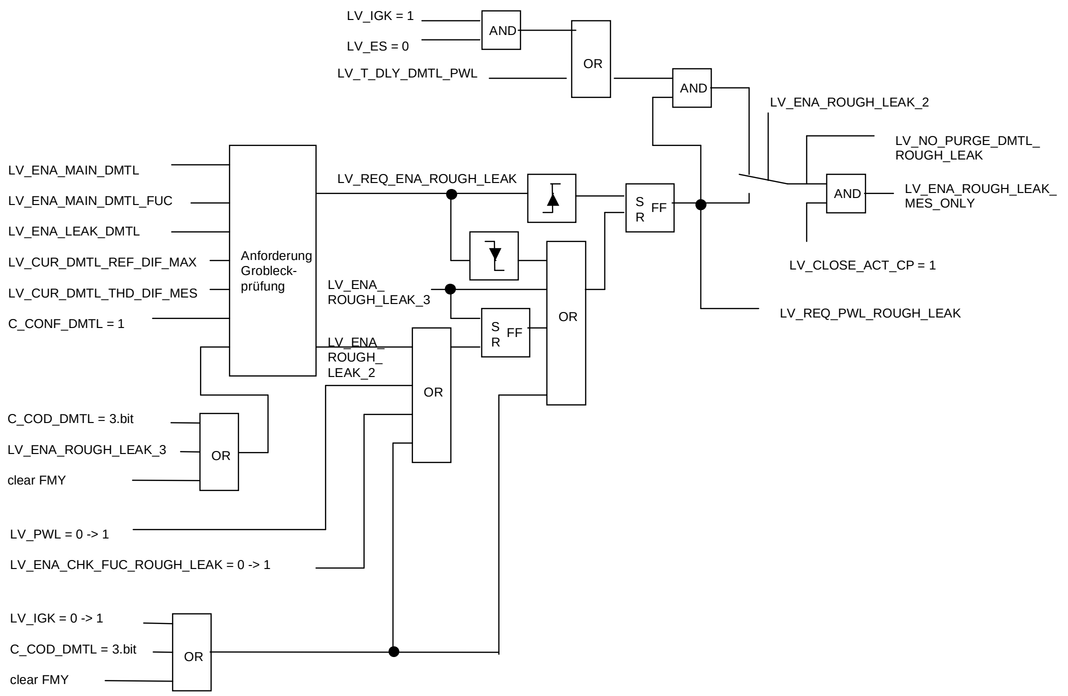

Formula section:

If LV_REQ_ENA_ROUGH_LEAK = 0   1
  Then LV_REQ_PWL_ROUGH_LEAK = 1
Endif

If LV_REQ_ENA_ROUGH_LEAK = 1   0 **OR**
LV_ENA_ROUGH_LEAK_3 = 1 **OR**
LV_INH_ROUGH_LEAK_MES = 1 **OR**
LV_IGK = 0   1 **OR**
C_COD_DMTL = 3.bit **OR**
clear FMY
  Then LV_REQ_PWL_ROUGH_LEAK = 0
Endif

If LV_ENA_ROUGH_LEAK_3 = 1
  Then LV_INH_ROUGH_LEAK_MES= 1
Endif

If LV_ENA_ROUGH_LEAK_2 = 1 **OR**
LV_IGK = 0   1 **OR**
C_COD_DMTL = 3.bit **OR**
clear FMY **OR**
ECU_STATE != PWL   ECU_STATE = PWL **OR**
LV_ENA_CHK_FUC_ROUGH_LEAK = 0   1
  Then LV_INH_ROUGH_LEAK_MES= 0
Endif

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If [LV_REQ_PWL_ROUGH_LEAK = 1 **AND**
LV_ENA_ROUGH_LEAK_2 = 1] **OR**
[LV_REQ_PWL_ROUGH_LEAK = 1 **AND**
[LV_T_DLY_DMTL_PWL = 1 **OR**
[LV_IGK = 1 **AND**
LV_ES = 0]] **AND**
LV_ENA_ROUGH_LEAK_2 = 0]
Then LV_NO_PURGE_DMTL_ROUGH_LEAK = 1
Endif

If LV_CLOSE_ACT_CP = 1 **AND**
LV_NO_PURGE_DMTL_ROUGH_LEAK = 1
Then LV_ENA_ROUGH_LEAK_MES_ONLY = 1
Else LV_ENA_ROUGH_LEAK_MES_ONLY = 0
Endif

If LV_DMTL_ACT = 1 0
Then LV_ENA_ROUGH_LEAK_3 = 1
Else LV_ENA_ROUGH_LEAK_3 = 0
Endif

B.93.9 Request rough leak check

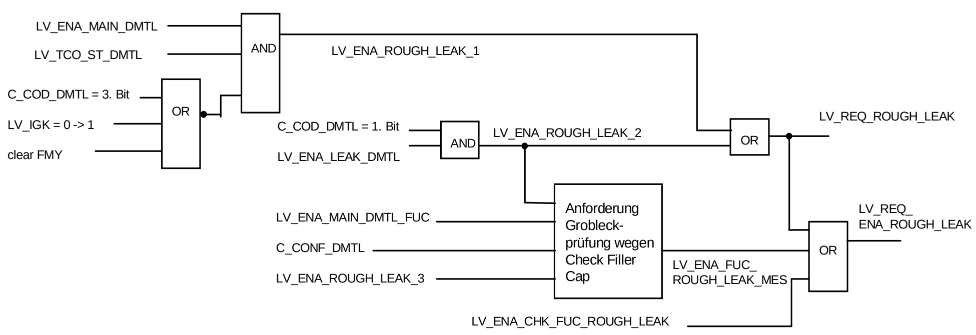
Application conditions

Initialisation: *LV_ENA_ROUGH_LEAK_1 = 0*
LV_TCO_ST_DMTL = 0 in case of reset and LV_IGK = 0 1

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

Signal flow diagram:



Formula section:

If TCO_ST TAM_ST + C_TCO_ST_DMTL_COLD
Then LV_TCO_ST_DMTL = 1
Else LV_TCO_ST_DMTL = 0
Endif

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If LV_ENA_MAIN_DMTL = 1 **AND**
LV_TCO_ST_DMTL = 1 **AND**
NOT(C_COD_DMTL = 3. bit **OR**
LV_IGK = 0 →1 **OR**
no clear FMY)
Then LV_ENA_ROUGH_LEAK_1 = 1
Else LV_ENA_ROUGH_LEAK_1 = 0
Endif

If LV_ENA_LEAK_DMTL = 1 **AND**
C_COD_DMTL = 1. bit
Then LV_ENA_ROUGH_LEAK_2 = 1
Else LV_ENA_ROUGH_LEAK_2 = 0
Endif

LV_ENA_ROUGH_LEAK_1 = 1 **OR**
LV_ENA_ROUGH_LEAK_2 = 1
Then LV_REQ_ROUGH_LEAK = 1
Else LV_REQ_ROUGH_LEAK = 0
Endif

If LV_REQ_ROUGH_LEAK = 1 **OR**
LV_ENA_FUC_ROUGH_LEAK_MES = 1 **OR**
LV_ENA_CHK_FUC_ROUGH_LEAK = 1
Then LV_REQ_ENA_ROUGH_LEAK = 1
Else LV_REQ_ENA_ROUGH_LEAK = 0
Endif

B.93.10 Rough leak check request due to Check Filler Cap

Application conditions

Initialisation: *CTR_CNL_ROUGH_LEAK_MES_FUC is restored out of the NVMY*
CTR_REP_ROUGH_LEAK_MES_FUC is restored out of the NVMY
LV_ENA_FUC is restored out of the NVMY

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

Signalflußdiagramm :

Formula section:

If [LV_REFU = 1 **AND**
LV_REFU_VAL = 1] **OR**
[LV_ERR_DET_ROUGH_LEAK_MIN = 1 **AND**
LV_CYC_ROUGH_LEAK_MODE6 = 1]
Then LV_ENA_FUC_1 = 1
Else LV_ENA_FUC_1 = 0
Endif

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```
If          LV_ENA_FUC_1 = 0   1                 AND
            C_COD_2_DMTL = 6.bit
    Then        LV_ENA_FUC = 1
Endif

If          LV_ENA_FUC = 1                       AND
            LV_ENA_MAIN_DMTL_FUC = 1             AND
            LV_REQ_ROUGH_LEAK = 0                AND
            LV_ENA_SMALL_LEAK_MES = 0            AND
            no clear FMY
    Then        LV_ENA_FUC_ROUGH_LEAK_MES = 1
    Else        LV_ENA_FUC_ROUGH_LEAK_MES = 0
Endif

If          LV_ENA_ROUGH_LEAK_MES_ONLY = 1                 AND
            LV_REQ_ROUGH_LEAK = 0
  Then      LV_CTR_CNL_ROUGH_LEAK_MES_FUC = 1
  Else      LV_CTR_CNL_ROUGH_LEAK_MES_FUC = 0
Endif

If          LV_CTR_CNL_ROUGH_LEAK_MES_FUC = 0   1
   Then   CTR_CNL_ROUGH_LEAK_MES_FUC =
          CTR_CNL_ROUGH_LEAK_MES_FUC +1
  Else      CTR_CNL_ROUGH_LEAK_MES_FUC = CTR_CNL_ROUGH_LEAK_MES_FUC
Endif

If          LV_CYC_ROUGH_LEAK_SUSP = 1   0                OR
            LV_ENA_FUC_1 = 0   1                          OR
            clear FMY
    Then        CTR_CNL_ROUGH_LEAK_MES_FUC = 0
Endif

If          LV_ROUGH_LEAK_SUSP = 1                 AND
            LV_CYC_ROUGH_LEAK_SUSP = 1             AND
            LV_REQ_ROUGH_LEAK = 0                  AND
            LV_ENA_SMALL_LEAK_MES = 0              AND
            no clear FMY
  Then      LV_CTR_REP_ROUGH_LEAK_MES_FUC = 1
  Else      LV_CTR_REP_ROUGH_LEAK_MES_FUC = 0
Endif

If          LV_CTR_REP_ROUGH_LEAK_MES_FUC = 0   1
   Then   CTR_REP_ROUGH_LEAK_MES_FUC =
          CTR_REP_ROUGH_LEAK_MES_FUC +1
  Else      CTR_REP_ROUGH_LEAK_MES_FUC = CTR_REP_ROUGH_LEAK_MES_FUC
Endif

If          LV_ENA_FUC_1 = 0   1                          OR
            clear FMY
    Then        CTR_REP_ROUGH_LEAK_MES_FUC = 0
Endif
```

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If [[CTR_CNL_ROUGH_LEAK_MES_FUC >
C_SUM_CNL_LEAK_MES_FUC_MAX **OR**
CTR_REP_ROUGH_LEAK_MES_FUC >
C_SUM_REP_LEAK_MES_FUC_MAX] **AND**
LV_ENA_ROUGH_LEAK_3 = 1] **OR**
[[LV_ROUGH_LEAK_SUSP = 0 **AND**
LV_CYC_ROUGH_LEAK_SUSP = 1 0] **OR**
clear FMY]
Then LV_ENA_FUC = 0
Endif

B.93.11 Rough leak check request due to Check Filler Cap during trip

Application conditions

Initialisation:
CTR_ENA_DMTL_CHK_FUC = 0 at LV_IGK = 0 1 and clr fmy
LV_ENA_CHK_FUC_ROUGH_LEAK = 0 at LV_IGK = 0 1 and clr fmy

LV_T_ENA_DMTL_CHK_FUC = 0 at LV_IGK = 0 1 and clr fmy
LV_CTR_ENA_DMTL_CHK_FUC = 0 at LV_IGK = 0 1 and clr fmy

T_ENA_DMTL_CHK_FUC = 0 at LV_IGK = 0 1 and clr fmy
LV_T_ENA_DMTL_CHK_FUC = 0 at LV_IGK = 0 1 and clr fmy
LV_T_ENA_AST_DMTL_CHK_FUC = 0 at LV_IGK = 0 1 and clr fmy

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

Formula section:

If LV_ES = 0 **and**
[LV_ERR_TAM = 1 **or**
TAM > C_TAM_DMTL_CHK_FUC_MIN] **and**
STATE_EFP_CRASH_CAN 2 **and**
C_COD_2_DMTL = 0. bit **and**
C_VB_DMTL_CHK_FUC_MIN VB C_VB_DMTL_CHK_FUC_MAX **and**
CTR_ENA_DMTL_CHK_FUC < C_CTR_ENA_DMTL_CHK_FUC **and**
LV_ENA_LEAK_DMTL = 1 **and**
LV_DMTL_ASA = 0 **and**
LV_ENA_CHK_FUC_ROUGH_LEAK_MES = 1 **and**
LV_T_ENA_DMTL_CHK_FUC = 1
Then LV_ENA_CHK_FUC_ROUGH_LEAK = 1
Else LV_ENA_CHK_FUC_ROUGH_LEAK = 0
Endif

If LV_DMTL_ACT = 1 **and**
LV_ENA_CHK_FUC_ROUGH_LEAK = 1
Then LV_CTR_ENA_DMTL_CHK_FUC = 1
Else LV_CTR_ENA_DMTL_CHK_FUC = 0
Endif

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If LV_CTR_ENA_DMTL_CHK_FUC = 0   1
Then CTR_ENA_DMTL_CHK_FUC ++
Endif

If LV_DMTL_ACT = 1   0 **or**
ECU_STATE = PWL
Then T_ENA_DMTL_CHK_FUC = 0
LV_T_ENA_AST_DMTL_CHK_FUC = 0
LV_ENA_CHK_FUC_ROUGH_LEAK = 0
Endif

If LV_ENA_CHK_FUC_ROUGH_LEAK = 0 **and**
LV_IGK = 1 **and**
LV_ES = 0
Then T_ENA_DMTL_CHK_FUC ++
Endif

If T_AST = C_T_AST_DMTL_CHK_FUC
Then LV_T_ENA_AST_DMTL_CHK_FUC = 1
Endif

If T_ENA_DMTL_CHK_FUC   C_T_ENA_DMTL_CHK_FUC **or**
LV_T_ENA_AST_DMTL_CHK_FUC = 1
Then LV_T_ENA_DMTL_CHK_FUC = 1
Else LV_T_ENA_DMTL_CHK_FUC = 0
Endif

B.93.12 Enable of miniature leak check

Application conditions

Initialisation: `LV_ENA_SMALL_LEAK_MES is restored out of the NVMY`
`CTR_TCO_ST_DMTL is restored out of the NVMY`

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

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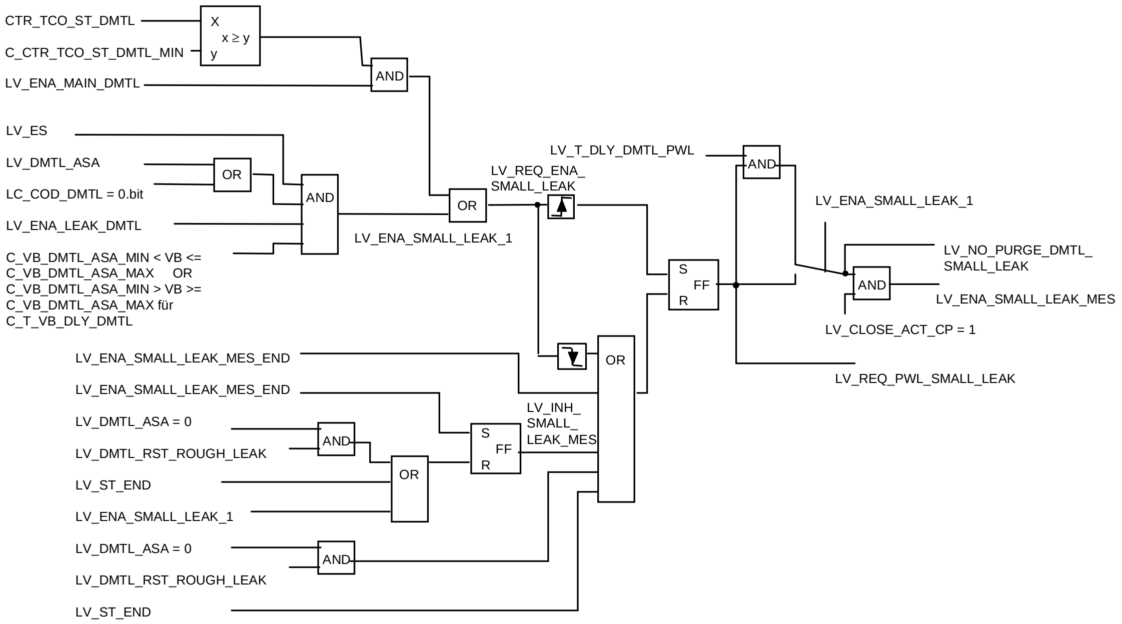
Signal flow diagram:



Formula section:

If LV_TCO_ST_DMTL = 0 1
Then CTR_TCO_ST_DMTL ++
Endif
If LV_CYC_SMALL_LEAK_MODE6 = 1 **OR**
LV_DMTL_RST_ROUGH_LEAK = 1
Then CTR_TCO_ST_DMTL = 0
Endif

If [CTR_TCO_ST_DMTL C_CTR_TCO_ST_DMTL_MIN **AND**
LV_ENA_MAIN_DMTL] **OR**
LV_ENA_SMALL_LEAK_1 = 1
Then LV_REQ_ENA_SMALL_LEAK = 1
Else LV_REQ_ENA_SMALL_LEAK = 0
Endif

If LV_ES = 1 **AND**
[LV_DMTL_ASA = 1 **OR**
C_COD_DMTL = 0.bit] **AND**
LV_ENA_LEAK_DMTL **AND**
[C_VB_DMTL_ASA_MIN < VB C_VB_DMTL_ASA_MAX **OR**
C_VB_DMTL_ASA_MIN > VB >= C_VB_DMTL_ASA_MAX for maximum
C_T_VB_DLY_DMTL]
Then LV_ENA_SMALL_LEAK_1 = 1
Else LV_ENA_SMALL_LEAK_1 = 0
Endif

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If [LV_DMTL_ASA = 0 **AND**
LV_DMTL_RST_ROUGH_LEAK = 1] **OR**
LV_ST_END = 1 **OR**
LV_ENA_SMALL_LEAK_1
Then LV_INH_SMALL_LEAK_MES = 0
Endif

If LV_DMTL_ACT = 0 **AND**
LV_ENA_SMALL_LEAK_MES$_{(n-1)}$ = 1
Then LV_ENA_SMALL_LEAK_MES_END = 1
LV_INH_SMALL_LEAK_MES = 1
Endif

If C_COD_DMTL = 2.bit **OR**
clear FMY
Then LV_DMTL_RST_ROUGH_LEAK = 1
Else LV_DMTL_RST_ROUGH_LEAK = 0
Endif

If LV_REQ_ENA_SMALL_LEAK = 0 1
Then LV_REQ_PWL_SMALL_LEAK = 1
Endif

If LV_REQ_ENA_SMALL_LEAK = 1 0 **OR**
LV_ENA_SMALL_LEAK_MES_END = 1 **OR**
LV_INH_SMALL_LEAK_MES = 1 **OR**
LV_ST_END = 0 1 **OR**
[LV_DMTL_ASA = 0 **AND**
LV_DMTL_RST_ROUGH_LEAK = 1]
Then LV_REQ_PWL_SMALL_LEAK = 0
Endif

If [LV_REQ_PWL_SMALL_LEAK = 1 **AND**
LV_ENA_SMALL_LEAK_1 = 1] **OR**
[LV_REQ_PWL_SMALL_LEAK = 1 **AND**
LV_T_DLY_DMTL_PWL = 1 **AND**
LV_ENA_SMALL_LEAK_1 = 0]
Then LV_NO_PURGE_DMTL_SMALL_LEAK = 1
Endif

If LV_CLOSE_ACT_CP = 1 **AND**
LV_NO_PURGE_DMTL_SMALL_LEAK = 1
Then LV_ENA_SMALL_LEAK_MES = 1
Else LV_ENA_SMALL_LEAK_MES = 0
Endif

If C_VB_DMTL_ASA_MIN $>$ VB $>$ C_VB_DMTL_ASA_MAX **OR**
C_VB_DMTL_ASA_MIN $<$ VB $<$ C_VB_DMTL_ASA_MAX for maximum
C_T_VB_DLY_DMTL
Then LV_VB_RANGE_DMTL = 1
Else LV_VB_RANGE_DMTL = 0

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Endif

B.93.13 Miniature leak check request due to abnormal termination through current fluctuations

Application conditions

Initialisation: *LV_CTR_CNL_SMALL_LEAK_MES is restored out of the NVMY*
CTR_CNL_SMALL_LEAK_MES is restored out of the NVMY

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

Signal flow diagram:

Formula section:

If [LV_CUR_DMTL_THD_DIF_MES = 0 1 **OR**
LV_CUR_DMTL_REF_DIF_MAX = 0 1] **AND**
LV_ENA_CHK_FUC_ROUGH_LEAK = 0
Then CTR_CNL_SMALL_LEAK_MES = CTR_CNL_SMALL_LEAK_MES + 1
Else CTR_CNL_SMALL_LEAK_MES = CTR_CNL_SMALL_LEAK_MES
Endif

If [LV_CUR_DMTL_THD_DIF_MES = 0 **AND**
LV_CUR_DMTL_REF_DIF_MAX = 0 **AND**
LV_ENA_ROUGH_LEAK_3 = 1] **OR**
clear FMY **OR**
LV_CTR_CNL_SMALL_LEAK_MES = $1_{(n-1)}$
Then CTR_CNL_SMALL_LEAK_MES = 0
Else CTR_CNL_SMALL_LEAK_MES = CTR_CNL_SMALL_LEAK_MES
Endif

If CTR_CNL_SMALL_LEAK_MES $>$ C_SUM_CNL_SMALL_LEAK_MES_MAX
Then LV_CTR_CNL_SMALL_LEAK_MES = 1
Endif

If [LV_CUR_DMTL_THD_DIF_MES = 0 **AND**
LV_CUR_DMTL_REF_DIF_MAX = 0 **AND**
LV_ENA_ROUGH_LEAK_3 = 1] **OR**
clear FMY **OR**
LV_CTR_CNL_SMALL_LEAK_MES = $1_{(n-1)}$ **OR**
[[LV_ERR_DET_DMTL_MIN = 1 **OR**
LV_ERR_DET_DMTL_MAX = 1 **OR**
LV_SDR_DMTL = 1] **AND**
LV_CTR_CNL_SMALL_LEAK_MES = $0_{(n)}$]
Then LV_CTR_CNL_SMALL_LEAK_MES = 0
Endif

If LV_ENA_CHK_FUC_ROUGH_LEAK = 1 **OR**
LV_ENA_FUC_ROUGH_LEAK_MES = 1 **OR**

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LV_DMTL_STOP = 1
Then LV_INH_CHK_DMTL_VLD = 1
Endif
If LV_ENA_ROUGH_LEAK_3 = 1 → 0 **OR**
ECU_STATE != PWL → ECU_STATE = PWL **OR**
LV_IGK = 0 → 1
Then LV_INH_CHK_DMTL_VLD = 0
Endif
If (LV_INH_CHK_DMTL_VLD = 0 AND
LV_ENA_ROUGH_LEAK_3 = 1) OR
LV_CTR_CNL_SMALL_LEAK_MES = 1
Then LV_CHK_DMTL_VLD = 1
Else LV_CHK_DMTL_VLD = 0
Endif

B.93.14 Function request "output stage test"

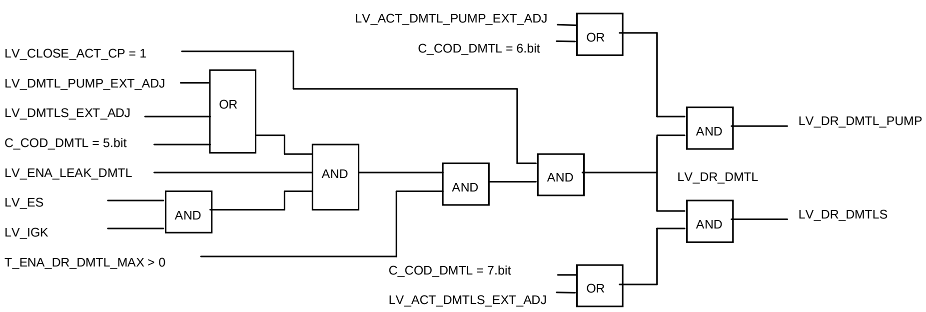
Application conditions

Initialisation: *LV_DR_DMTL_PUMP = 0*
LV_DR_DMTLS = 0

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

Signal flow diagram:



Formula section:

If [LV_DMTL_PUMP_EXT_ADJ = 1 **OR**
LV_DMTLS_EXT_ADJ = 1 **OR**
C_COD_DMTL = 5.bit] **AND**
LV_ENA_LEAK_DMTL = 1 **AND**
[LV_ES = 1 **AND**
LV_IGK = 1]
Then T_ENA_DR_DMTL_MAX = T_ENA_DR_DMTL_MAX + 100 ms
LV_NO_PURGE_DR_DMTL = 1
Endif

If [LV_DMTL_PUMP_EXT_ADJ = 1 **OR**
LV_DMTLS_EXT_ADJ = 1 **OR**

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C_COD_DMTL = 5.bit] **AND**
LV_ENA_LEAK_DMTL = 1 **AND**
[LV_ES = 1 **AND**
LV_IGK = 1] **AND**
T_ENA_DR_DMTL_MAX < C_T_ENA_DR_DMTL_MAX **AND**
LV_CLOSE_ACT_CP = 1
Then LV_DR_DMTL = 1
Else LV_DR_DMTL = 0
Endif

If LV_DR_DMTL = 1 **AND**
[LV_ACT_DMTL_PUMP_EXT_ADJ = 1 **OR**
C_COD_DMTL = 6.bit]
Then LV_DR_DMTL_PUMP = 1
Else LV_DR_DMTL_PUMP = 0
Endif

If LV_DR_DMTL = 1 **AND**
[LV_ACT_DMTLS_EXT_ADJ = 1 **OR**
C_COD_DMTL = 7.bit]
Then LV_DR_DMTLS = 1
Else LV_DR_DMTLS = 0
Endif

B.93.15 Fuel cap and refueling detection

Application conditions

Initialisation: *LV_DMTL_STOP is restored out of the NVMY*
LV_DET_FUC_OPEN is restored out of the NVMY
LV_DET_REFU is restored out of the NVMY
LV_CUR_DMTL_THD_DIF_MES is restored out of the NVMY
LV_T_DMTL_MAX is restored out of the NVMY

Initialisation at clear FMY: LV_DMTL_STOP = 1

Recurrence: 100 ms for calculation of the currents
100 ms for the use of the currents

Activation: LV_CONF_DMTL = 1

Signal flow diagram:

Formula section:

If LV_DMTL_PUMP_ON = 1 **AND**
LV_DMTLS_ON = 1
Then T_DLY_DET_REFU = T_DLY_DET_REFU + 100 ms
Else T_DLY_DET_REFU = 0
Endif

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If LV_DMTL_ACT = 1
Then CUR_DMTL_COR_FIL_REFU$_{(n)}$ = CUR_DMTL_COR_FIL_REFU$_{(n-1)}$ +
(CUR_DMTL_COR$_{(n)}$ - CUR_DMTL_COR_FIL_REFU$_{(n-1)}$) *
C_CRLC_CUR_DMTL_FIL_LIM
Endif

If LV_DMTL_PUMP_ON = 1 **AND**
LV_DMTLS_ON = 1 **AND**
T_DLY_DET_REFU $<$ C_T_DLY_DET_REFU
Then CUR_DMTL_COR_FIL_REFU_FIL$_{(n)}$ =
CUR_DMTL_COR_FIL_REFU_FIL$_{(n-1)}$ +
(CUR_DMTL_COR_FIL_REFU$_{(n)}$ - CUR_DMTL_COR_FIL_REFU_FIL$_{(n-1)}$) *
C_CRLC_CUR_DMTL_FIL_LIM
T_DLY_VB_DMTL = T_DLY_VB_DMTL - 100 ms
Endif

If LV_DMTL_PUMP_ON = 1 **AND**
LV_DMTLS_ON = 1 **AND**
T_DLY_DET_REFU   C_T_DLY_DET_REFU
Then CUR_DMTL_COR_FIL_REFU_FIL$_{(n)}$ =
CUR_DMTL_COR_FIL_REFU_FIL$_{(n-1)}$ +
(CUR_DMTL_COR_FIL_REFU$_{(n)}$ - CUR_DMTL_COR_FIL_REFU_FIL$_{(n-1)}$) *
C_CRLC_CUR_DMTL_FIL_REFU
Endif

CUR_DMTL_COR_FIL_REFU_HPF = CUR_DMTL_COR_FIL_REFU -
CUR_DMTL_COR_FIL_REFU_FIL

If CUR_DMTL_COR_FIL_REFU_HPF $>$
C_CUR_DMTL_DIF_THD_REFU **AND**
T_DLY_DET_REFU   C_T_DLY_DET_REFU
Then LV_DET_REFU = 1
Endif

If LV_DMTL_ACT = 0   1
Then LV_DET_REFU = 0
LV_DET_FUC_OPEN = 0
LV_CUR_DMTL_THD_DIF_MES = 0
T_DLY_CUR_DMTL_DIF_MES = 0
LV_T_DMTL_MAX= 0
Endif

If CUR_DMTL_COR_FIL_REFU_HPF $<$
C_CUR_DMTL_DIF_THD_FUC **AND**
T_DLY_DET_REFU   C_T_DLY_DET_REFU **AND**
LV_DMTL_ASA = 0
Then LV_DET_FUC_OPEN = 1
Endif

If T_DLY_DET_REFU   C_T_DLY_DET_REFU

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Then CUR_DMTL_COR_FIL_MES_MAX =
MAX (CUR_DMTL_COR_FIL$_{(n)}$, CUR_DMTL_COR_FIL$_{(n-1)}$) -
CUR_DMTL_COR_FIL$_{(n)}$
Endif
If CUR_DMTL_COR_FIL_MES_MAX >
C_CUR_DMTL_DIF_THD_MES **AND**
T_DLY_DET_REFU C_T_DLY_DET_REFU **AND**
LV_DMTL_ASA = 0
Then T_DLY_CUR_DMTL_DIF_MES = T_DLY_CUR_DMTL_DIF_MES + 100 ms
Else T_DLY_CUR_DMTL_DIF_MES = 0
Endif

If T_DLY_CUR_DMTL_DIF_MES > C_T_DLY_CUR_DMTL_DIF_MES
Then LV_CUR_DMTL_THD_DIF_MES = 1
Endif

If LV_DMTL_ACT = 1
Then T_DMTL_MAX = T_DMTL_MAX + 100 ms
Else T_DMTL_MAX = 0
Endif

If T_DMTL_MAX > C_T_DMTL_MAX
Then LV_T_DMTL_MAX = 1
Endif

If [LV_DET_REFU = 1 **OR**
LV_DET_FUC_OPEN = 1 **OR**
LV_VB_DIF_MAX = 1 **OR**
LV_CUR_DMTL_REF_DIF_MAX = 1 **OR**
LV_CUR_DMTL_THD_DIF_MES = 1 **OR**
LV_T_DMTL_MAX= 1] **AND**
LV_DMTL_ACT = 1
Then LV_DMTL_STOP = 1
Endif

If LV_ENA_ROUGH_LEAK_MES = 0 1
Then LV_DMTL_STOP = 0
Endif

B.93.16 Generating rough leak error from suspected rough leak error

Application conditions

Initialisation:

```
LV_ERR_DET_ROUGH_LEAK_MIN is restored out of the NVMY
        LV_REFU_DMTL is restored out of the NVMY
        LV_DIST_DET_ROUGH_LEAK is restored out of the NVMY

        LV_ROUGH_LEAK_SUSP_SET is restored out of the NVMY

        DIST_DMTL is restored out of the NVMY
  LV_REFU_DMTL_SMALL_LEAK restored from NVMY
  LV_REFU_DMTLM restored from NVMY
  at clr fmy:
```

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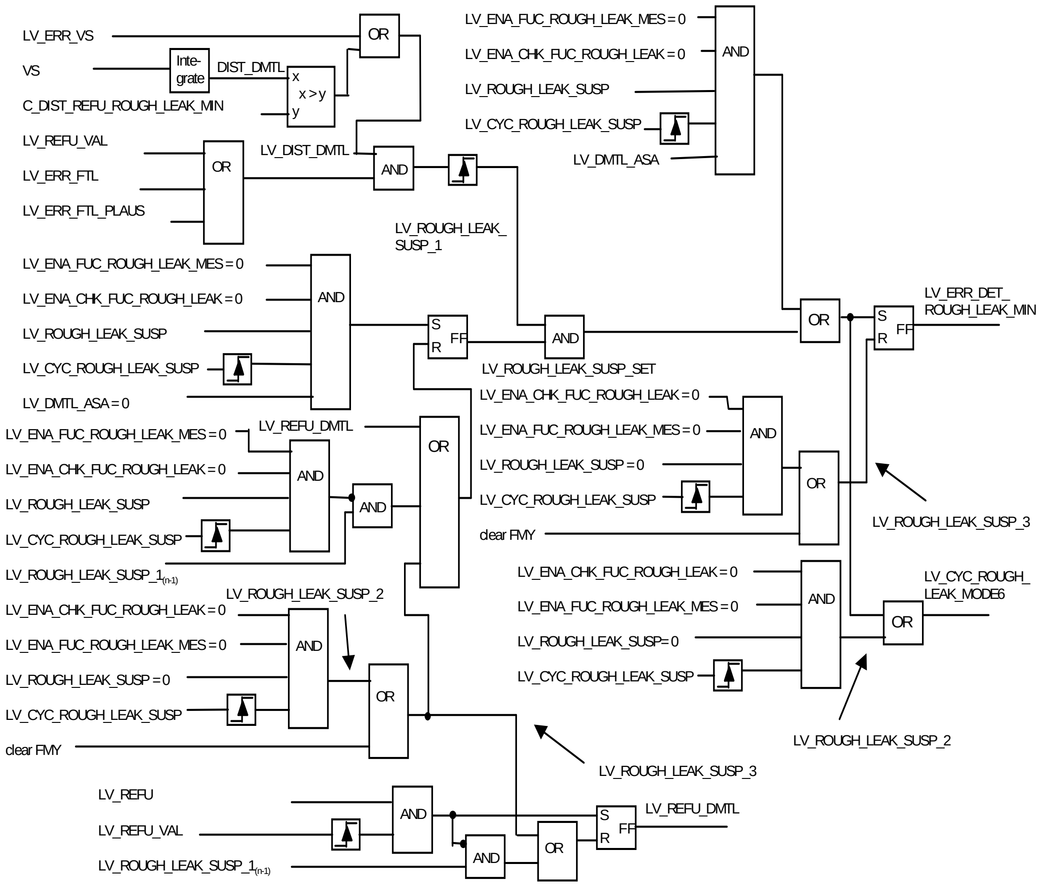
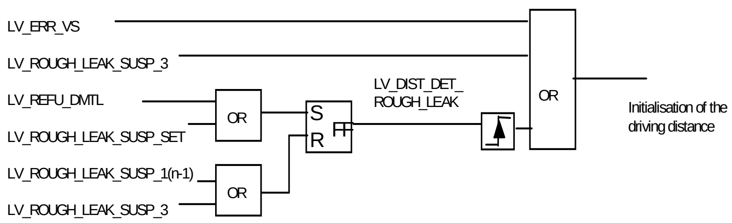
```
LV_REFU_DMTL_SMALL_LEAK = 0
LV_REFU_DMTLM = 0
```

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

Signal flow diagram:





Formula section:

If LV_VS_RUN = 1

Then $DIST\_DMTL_{(n)} = DIST\_DMTL_{(n-1)} + VS/36$

Else $DIST\_DMTL_{(n)} = DIST\_DMTL_{(n-1)}$

Endif

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If DIST_DMTL > C_DIST_REFU_ROUGH_LEAK_MIN **OR**
LV_ERR_VS = 1
Then LV_DIST_DMTL = 1
Else LV_DIST_DMTL = 0
Endif
If [LV_DIST_DMTL = 1 **AND**
[LV_REFU_VAL = 1 **OR**
LV_ERR_FTL = 1 **OR**
LV_ERR_FTL_PLAUS = 1]] once **AND**
LV_ROUGH_LEAK_SUSP_1(n-1) = 0
Then LV_ROUGH_LEAK_SUSP_1 = 1
Else LV_ROUGH_LEAK_SUSP_1 = 0
Endif

If LV_ENA_FUC_ROUGH_LEAK_MES = 0 **AND**
LV_ENA_CHK_FUC_ROUGH_LEAK = 0 **AND**
LV_ROUGH_LEAK_SUSP = 1 **AND**
LV_CYC_ROUGH_LEAK_SUSP = 0 1 **AND**
LV_DMTL_ASA = 0
Then LV_ROUGH_LEAK_SUSP_SET = 1
LV_CDN_DIAG_ROUGH_LEAK = 1
ERR_SYM_ROUGH_LEAK = MAX
ACTION_ERRM_StorePrevFrf (ROUGH_LEAK)
This action stores the prestored freeze frame for the diagnosis instance ROUGH_LEAK, see chapter Environmental data, OBDII functions
LV_CDN_DIAG_ROUGH_LEAK = 0
Endif

If LV_REFU_DMTL = 1 **OR**
[Not [LV_ENA_FUC_ROUGH_LEAK_MES = 0 **AND**
LV_ENA_CHK_FUC_ROUGH_LEAK = 0 **AND**
LV_ROUGH_LEAK_SUSP = 1 **AND**
LV_CYC_ROUGH_LEAK_SUSP = 0 1] **AND**
LV_ROUGH_LEAK_SUSP_1$_{(n-1)}$] **OR**
LV_ROUGH_LEAK_SUSP_3]
Then LV_ROUGH_LEAK_SUSP_SET = 0
Endif

If [LV_ROUGH_LEAK_SUSP_1 = 1 **AND**
LV_ROUGH_LEAK_SUSP_SET = 1] **OR**
[LV_ENA_FUC_ROUGH_LEAK_MES = 0 **AND**
LV_ENA_CHK_FUC_ROUGH_LEAK = 0 **AND**
LV_ROUGH_LEAK_SUSP = 1 **AND**
LV_CYC_ROUGH_LEAK_SUSP = 0 1 **AND**
LV_DMTL_ASA = 1]
Then LV_ERR_DET_ROUGH_LEAK_MIN = 1
Endif

If LV_ROUGH_LEAK_SUSP_3 = 1
Then LV_ERR_DET_ROUGH_LEAK_MIN = 0
Endif

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If [LV_ROUGH_LEAK_SUSP_1 = 1 **AND**
LV_ROUGH_LEAK_SUSP_SET = 1] **OR**
[LV_ENA_FUC_ROUGH_LEAK_MES = 0 **AND**
LV_ENA_CHK_FUC_ROUGH_LEAK = 0 **AND**
LV_ROUGH_LEAK_SUSP = 1 **AND**
LV_CYC_ROUGH_LEAK_SUSP = 0 1 **AND**
LV_DMTL_ASA = 1] **OR**
LV_ROUGH_LEAK_SUSP_2
Then LV_CYC_ROUGH_LEAK_MODE6 = 1
Else LV_CYC_ROUGH_LEAK_MODE6 = 0
Endif

If LV_ENA_FUC_ROUGH_LEAK_MES = 0 **AND**
LV_ENA_CHK_FUC_ROUGH_LEAK = 0 **AND**
LV_ROUGH_LEAK_SUSP = 0 **AND**
LV_CYC_ROUGH_LEAK_SUSP = 0 1
Then LV_ROUGH_LEAK_SUSP_2 = 1
Else LV_ROUGH_LEAK_SUSP_2 = 0
Endif

If LV_ROUGH_LEAK_SUSP_2 = 1 **OR**
clear FMY
Then LV_ROUGH_LEAK_SUSP_3 = 1
Else LV_ROUGH_LEAK_SUSP_3 = 0
Endif

If LV_REFU = 1 **AND**
LV_REFU_VAL = 0 1
Then LV_REFU_SET = 1
LV_REFU_DMTL = 1
If LV_ERR_DET_SMALL_LEAK_MIN = 1
Then LV_REFU_DMTL_SMALL_LEAK = 1
Endif
If LV_ERR_DMTL_SET = 1
Then LV_REFU_DMTLM = 1
Endif
Else LV_REFU_SET = 0
Endif

If [LV_REFU_SET = 0 **AND**
LV_ROUGH_LEAK_SUSP_1$_{(n-1)}$ = 1] **OR**
LV_ROUGH_LEAK_SUSP_3 = 1
Then LV_REFU_DMTL = 0
Endif

If LV_REFU_DMTL = 1 **OR**
LV_ROUGH_LEAK_SUSP_SET = 1
Then LV_DIST_DET_ROUGH_LEAK = 1
Endif

If LV_ROUGH_LEAK_SUSP_1$_{(n-1)}$ = 1 **OR**
LV_ROUGH_LEAK_SUSP_3 = 1

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Then LV_DIST_DET_ROUGH_LEAK = 0
Endif

If LV_ERR_VS = 1 **OR**
LV_ROUGH_LEAK_SUSP_3 = 1 **OR**
LV_DIST_DET_ROUGH_LEAK = 0 1 **OR**
STATE_DMTL = MODULE_ERROR **OR**
STATE_DMTL = SMALL_LEAK_DETECTED **OR**
STATE_DMTL = ROUGH_LEAK_DETECTED **OR**
LV_ERR_SIG_DMTL = 0 1
Then DIST_DMTL = 0
Endif

B.93.17 Combi-display activate Check Filler Cap

Application conditions

Initialisation: *LV_FUC_OPEN is restored out of the NVMY*

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

FUNCTION DESCRIPTION:

If a rough leak suspect is detected the module has to indicate, via the CAN-signal of the combi instrument, to the driver that possibly the tank cap has not been adjusted properly.

Formula section:

```
If      LV_FUC_CAN = 0
then      if      LV_FUC_INT = 0
            then      T_DLY_FUC_CAN = C_T_DLY_FUC_CAN_ON
            else      T_DLY_FUC_CAN = T_DLY_FUC_CAN -
                  If      T_DLY_FUC_CAN = 0
                  then      LV_FUC_CAN = 1
                        T_DLY_FUC_CAN = C_T_DLY_FUC_CAN_OFF
                  endif
            endif
else      T_DLY_FUC_CAN = T_DLY_FUC_CAN -
            if      T_DLY_FUC_CAN = 0                        OR
                  (LV_ROUGH_LEAK_SUSP = 0      AND
                  LV_CYC_ROUGH_LEAK_SUSP = 0 → 1)
            then      LV_FUC_CAN = 0
                  T_DLY_FUC_CAN = C_T_DLY_FUC_CAN_ON
            endif
endif

If      LV_FUC_CAN = 1 → 0          OR
      clr FMY
then      LV_FUC_OPEN = 0
else      if      LV_CYC_ROUGH_LEAK_MODE6 = 0 → 1
            then      if      LV_ERR_ROUGH_LEAK = 0
```

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```
                    then        LV_FUC_OPEN = 0
                    else        LV_FUC_OPEN = 1
                    endif
            endif
endif
If              LV_FUC_OPEN = 1                     AND
                VS > C_VS_FUC_CAN_MIN                AND
                LV_IGK = 1
Then          LV_FUC_INT = 1
Else         LV_FUC_INT = 0
Endif
```

B.93.18 Output of the errorflags

Application conditions

Initialisation:

```
If          LV_CONF_DMTL = 1
Then
LV_ERR_DMTLM is restored out of the NVMY
LV_ERR_DET_DMTL_MAX is restored out of the NVMY
LV_ERR_DET_DMTL_MIN is restored out of the NVMY
LV_SDR_DMTL is restored out of the NVMY
LV_ERR_SIG_DMTL is restored out of the NVMY
LV_ERR_DET_SMALL_LEAK_MIN is restored from NVMY
LV_ERR_DMTL_SET is restored from NVMY
 M6_CTR_CNL_SMALL_LEAK_MES is restored from NVMY
 M6_CTR_CNL_SMALL_LEAK_MES_SAVE is restored from NVMY
 M6_CUR_DMTL_COR_FIL_CID18 is restored from NVMY
 M6_CUR_DMTL_COR_FIL_CID18_SAVE is restored from NVMY
 M6_CUR_DMTL_COR_FIL_CID19 is restored from NVMY
 M6_CUR_DMTL_COR_FIL_CID19_SAVE is restored from NVMY
 M6_CUR_DMTL_DMTLS_TEST is restored from NVMY
 M6_CUR_DMTL_DMTLS_TEST_SAVE is restored from NVMY
 M6_CUR_DMTL_THD_DMTLS_TEST is restored from NVMY
 M6_CUR_DMTL_THD_DMTLS_TEST_SAVE is restored from NVMY
 M6_CUR_DMTL_SMALL_LEAK_END_SAVE is restored from NVMY
 M6_CUR_DMTL_REF_LEAK_SAVE is restored from NVMY
 M6_CUR_DMTL_SMALL_LEAK_END is restored from NVMY
 M6_CUR_DMTL_REF_LEAK is restored from NVMY
 CTR_ERR_DET_DMTL_MAX/ MIN/ PLAUS/ SIG are restored from NVMY
 CTR_ERR_DET_ROUGH/ SMALL_LEAK are restored from NVMY
 CTR_DIAG_CFM_DMTL_MAX/ MIN/ PLAUS/ SIG are restored from NVMY
 CTR_DIAG_CFM_ROUGH/ SMALL_LEAK are restored from NVMY
 Endif
At clr fmy:
 LV_ERR_DMTLM = 0
 LV_ERR_DET_DMTL_MAX = 0
 LV_ERR_DET_DMTL_MIN = 0
 LV_SDR_DMTL = 0
 LV_ERR_SIG_DMTL = 0
 LV_ERR_DMTLM = 0
 LV_ERR_DMTL_MAX/ MIN/ PLAUS/ SIG = 0
 LV_ERR_ROUGH/ SMALL_LEAK = 0
    LV_CTR_CNL_SMALL_LEAK_MES_CFM = 0
  LV_CHK_DMTL_CUR_DMTL_VLD_CFM = 0
  LV_CHK_DMTL_VLD_CFM = 0
  LV_ERR_DMTL_SET = 0
```

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```
  M6_CTR_CNL_SMALL_LEAK_MES = 0
  M6_CTR_CNL_SMALL_LEAK_MES_SAVE = 0
  M6_CUR_DMTL_COR_FIL_CID18 = 0
  M6_CUR_DMTL_COR_FIL_CID18_SAVE = 0
 M6_CUR_DMTL_COR_FIL_CID19 = 0
 M6_CUR_DMTL_COR_FIL_CID19_SAVE = 0
M6_CUR_DMTL_DMTLS_TEST = 0
  M6_CUR_DMTL_DMTLS_TEST_SAVE = 0
  M6_CUR_DMTL_THD_DMTLS_TEST = 0
  M6_CUR_DMTL_THD_DMTLS_TEST_SAVE = 0
  M6_CUR_DMTL_SMALL_LEAK_END_SAVE = 0
  M6_CUR_DMTL_REF_LEAK_SAVE = 0
  M6_CUR_DMTL_SMALL_LEAK_END = 0
  M6_CUR_DMTL_REF_LEAK = 0
  LV_ERR_DET_SMALL_LEAK_MIN = 0
 LV_ERR_DET_SMALL_LEAK_MIN_CFM = 0
 LV_CYC_SMALL_LEAK_MODE6_CFM = 0
 LV_CYC_SMALL_LEAK_MODE6 = 0
  CTR_ERR_DET_DMTL_MAX/ MIN/ PLAUS/ SIG = 0
  CTR_ERR_DET_ROUGH/ SMALL_LEAK = 0
  CTR_DIAG_CFM_DMTL_MAX/ MIN/ PLAUS/ SIG = 0
  CTR_DIAG_CFM_ROUGH/ SMALL_LEAK = 0
 In case of  LV_IGK = 0 -> 1:
 clear ERR_SYM, LV_CDN_DIAG of
     - ROUGH_LEAK
     - SMALL_LEAK
     - DMTL_MAX/ MIN/ PLAUS/ SIG
 LV_ERR_DET_SMALL_LEAK_MIN_CFM = 0
 LV_CYC_SMALL_LEAK_MODE6_CFM = 0
 LV_CTR_CNL_SMALL_LEAK_MES_CFM = 0
 LV_CHK_DMTL_CUR_DMTL_VLD_CFM = 0
 LV_CHK_DMTL_VLD_CFM = 0
```

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

Signal flow diagram:

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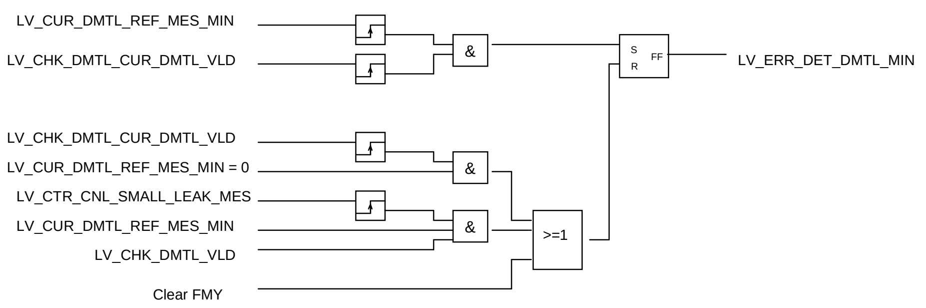
Formula section:

If LV_CUR_DMTL_REF_MES_MAX = 0 1 **AND**
LV_CHK_DMTL_CUR_DMTL_VLD = 0 1
Then LV_ERR_DET_DMTL_MAX = 1
ERR_SYM_DMTL_MAX = "MAX"
LV_CDN_DIAG_DMTL_MAX = 1
ACTION_ERRM_StorePrevFrf (DMTL_MAX)
**** action is only called if specified in ERRM of project. For example, in MSD81-6 it is not processed ****
LV_CDN_DIAG_DMTL_MAX = 0
Endif

If [LV_CHK_DMTL_CUR_DMTL_VLD = 0 1 **AND**
LV_CUR_DMTL_REF_MES_MAX = 0] **OR**
[LV_CTR_CNL_SMALL_LEAK_MES = 0 1 **AND**
LV_CUR_DMTL_REF_MES_MAX = 1 **AND**
LV_CHK_DMTL_VLD = 1] **OR**
clear FMY
Then LV_ERR_DET_DMTL_MAX = 0
Endif

How minimum error DMTL is built up

Signal flow diagram:



Formula section:

If LV_CUR_DMTL_REF_MES_MIN = 0 1 **AND**
LV_CHK_DMTL_CUR_DMTL_VLD = 0 1
Then LV_ERR_DET_DMTL_MIN = 1
ERR_SYM_DMTL_MIN = "MIN"
LV_CDN_DIAG_DMTL_MIN = 1
ACTION_ERRM_StorePrevFrf (DMTL_MIN)
**** action is only called if specified in ERRM of project. For example, in MSD81-6 it is not processed ****
LV_CDN_DIAG_DMTL_MIN = 0
Endif
If [LV_CHK_DMTL_CUR_DMTL_VLD = 0 1 **AND**
LV_CUR_DMTL_REF_MES_MIN = 0] **OR**
[LV_CTR_CNL_SMALL_LEAK_MES = 0 1 **AND**

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LV_CUR_DMTL_REF_MES_MIN = 1 **AND**
LV_CHK_DMTL_VLD = 1] **OR**
clear FMY
Then LV_ERR_DET_DMTL_MIN = 0
Endif

How plausibility error DMTL is built up

Signal flow diagram:

Formula section:

If LV_CUR_DMTL_DMTLS_TEST = 0 1 **AND**
LV_CHK_DMTL_CUR_DMTL_VLD = 0 1
Then LV_SDR_DMTL = 1
ERR_SYM_DMTL_PLAUS = "PLAUS"
LV_CDN_DIAG_DMTL_PLAUS = 1
ACTION_ERRM_StorePrevFrf (DMTL_PLAUS)
LV_CDN_DIAG_DMTL_PLAUS = 0
Endif
If [LV_CHK_DMTL_CUR_DMTL_VLD = 0 1 **AND**
LV_CUR_DMTL_DMTLS_TEST = 0] **OR**
[LV_CTR_CNL_SMALL_LEAK_MES = 0 1 **AND**
LV_CUR_DMTL_DMTLS_TEST = 1 **AND**
LV_CHK_DMTL_VLD = 1] **OR**
clear FMY
Then LV_SDR_DMTL = 0
Endif

How signal error DMTL is built up

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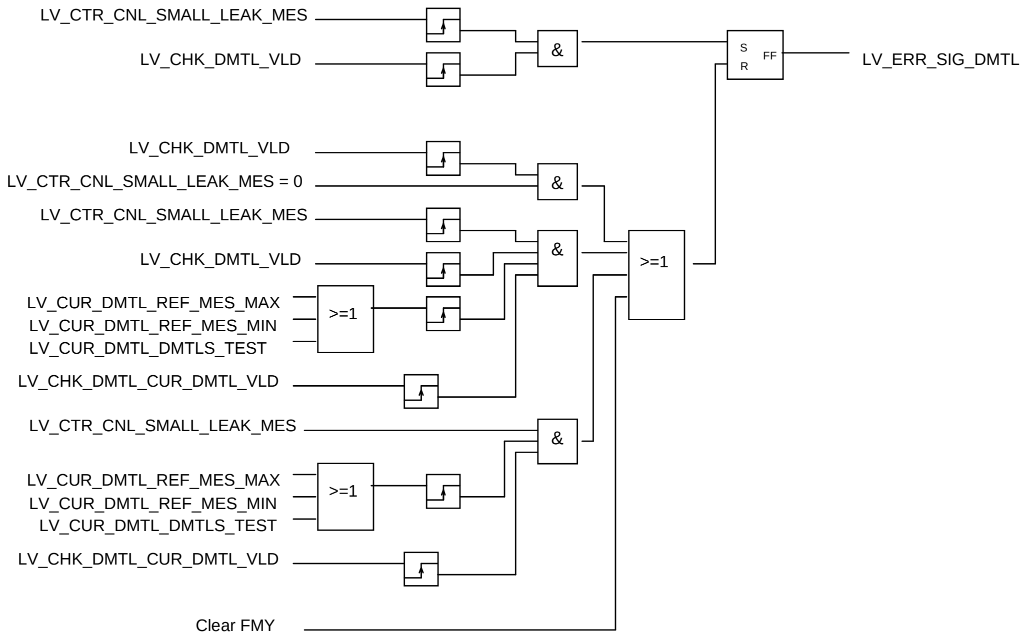
Signal flow diagram:



Formula section:

If LV_CTR_CNL_SMALL_LEAK_MES = 0 1 **AND**
LV_CHK_DMTL_VLD = 0 1
Then LV_ERR_SIG_DMTL = 1
ERR_SYM_DMTL_SIG = "SIG"
LV_CDN_DIAG_DMTL_SIG = 1
ACTION_ERRM_StorePrevFrf (DMTL_SIG)
**** action is only called if specified in ERRM of project. For example, in MSD81-6 it is not processed ****
LV_CDN_DIAG_DMTL_SIG = 0
Endif
.
If [LV_CHK_DMTL_VLD = 0 1 **AND**
LV_CTR_CNL_SMALL_LEAK_MES = 0] **OR**
[LV_CTR_CNL_SMALL_LEAK_MES = 0 1 **AND**
LV_CHK_DMTL_VLD = 0 1 **AND**
[LV_CUR_DMTL_REF_MES_MIN = 0 1 **OR**
LV_CUR_DMTL_REF_MES_MAX = 0 1 **OR**
LV_CUR_DMTL_DMTLS_TEST = 0 1] **AND**
LV_CHK_DMTL_CUR_DMTL_VLD = 0 1] **OR**
[LV_CTR_CNL_SMALL_LEAK_MES = 1 **AND**
[LV_CUR_DMTL_REF_MES_MIN = 0 1 **OR**
LV_CUR_DMTL_REF_MES_MAX = 0 1 **OR**
LV_CUR_DMTL_DMTLS_TEST = 0 1] **AND**
LV_CHK_DMTL_CUR_DMTL_VLD = 0 1] **OR**
clear FMY
Then LV_ERR_SIG_DMTL = 0

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Endif

How the error DMTL module is built up

Signal flow diagram:

Formula section:

If LV_SDR_DMTL = 1 **OR**
LV_ERR_DET_DMTL_MIN = 1 **OR**
LV_ERR_DET_DMTL_MAX = 1
Then LV_ERR_DET_DMTL_1 = 1
Else LV_ERR_DET_DMTL_1 = 0
Endif

If [LV_ERR_DET_DMTL_1 = 0 1 **AND**
LV_CTR_CNL_SMALL_LEAK_MES = 1] **OR**
[LV_ERR_SIG_DMTL = 0 **AND**
LV_CHK_DMTL_CUR_DMTL_VLD = 1] **OR**
[LV_ERR_SIG_DMTL = 1 **AND**
LV_CHK_DMTL_VLD = 1] **OR**
[LV_ERR_SIG_DMTL = 1 0 **AND**
LV_CHK_DMTL_VLD = 0 1]
Then LV_ERR_DET_DMTL_2 = 1
M6_CTR_CNL_SMALL_LEAK_MES_SAVE = CTR_CNL_SMALL_LEAK_MES
Else LV_ERR_DET_DMTL_2 = 0
Endif

IF LV_ERR_DET_DMTL_2 =0- ->1 **AND**
LV_ENA_CHK_FUC_ROUGH_LEAK = 0
THEN
LV_ERR_DMTL_SET = 1
ENDIF

LV_CHK_DMTL_VLD_CFM = 0

IF$_{(1a)}$LV_ERR_DMTL_SET = 1
THEN$_{(1a)}$
IF$_{(2a)}$ (LV_ERR_DET_DMTL_MAX = 1 **OR**
LV_ERR_DET_DMTL_MIN = 1 **OR**
LV_SDR_DMTL = 1 **OR**
LV_ERR_SIG_DMTL = 1)
THEN$_{(2a)}$
IF$_{(3a)}$ **[** LV_DIST_DMTL = 1 **AND**
LV_ES = 0 **AND**
((LV_REFU_VAL = 1 **AND**
LV_REFU_VAL(n-1) = 1 **AND**
LV_FTL_DMTL_VAL = 1) **OR**
LV_ERR_FTL = 1 **OR**
LV_ERR_FTL_PLAUS **)]** **OR**

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```
        LV_DMTL_EOL = 1
    THEN(3a)
        IF(4)     LV_REFU_DMTLM = 0    OR
            LV_DMTL_EOL = 1
                THEN(4)
                    IF(5)          LV_ERR_DET_DMTL_MAX = 1
                    THEN(5)
                        IF(6a)   LV_ERR_DMTL_MAX = 1
                        THEN(6a)
                            LV_CDN_DIAG_DMTL_MAX = 1
                            LV_ERR_DMTL_MAX = 0
                            ERR_SYM_DMTL_MAX =   MAX
                            LV_END_DIAG_DMTL_MAX = 1
                        ENDIF(6a)

                        LV_CDN_DIAG_DMTL_MAX = 1
                        LV_ERR_DMTL_MAX = 1
                        ERR_SYM_DMTL_MAX =   MAX
                        LV_END_DIAG_DMTL_MAX = 1

                        LV_ERR_DMTLM = 1

                        LV_ERR_DET_DMTL_MAX = 0
                        LV_CHK_DMTL_CUR_DMTL_VLD_CFM = 1
                        CTR_ERR_DET_DMTL_MAX =
                                    CTR_ERR_DET_DMTL_MAX + 1
                    ELSE(5)
                        IF(6b)   LV_ERR_DET_DMTL_MIN = 1
                        THEN(6b)
                            IF(7a)   LV_ERR_DMTL_MIN = 1
                            THEN(7a)
                                LV_CDN_DIAG_DMTL_MIN = 1
                                LV_ERR_DMTL_MIN = 0
                                ERR_SYM_DMTL_MIN =   MIN
                                LV_END_DIAG_DMTL_MIN = 1
                            ENDIF(7a)

                            LV_CDN_DIAG_DMTL_MIN = 1
                            ERR_SYM_DMTL_MIN =   MIN"
                            LV_ERR_DMTL_MIN = 1
                            LV_END_DIAG_DMTL_MIN = 1

                            LV_ERR_DMTLM = 1

                            LV_ERR_DET_DMTL_MIN = 0
                            LV_CHK_DMTL_CUR_DMTL_VLD_CFM = 1
                            CTR_ERR_DET_DMTL_MIN =
                                        CTR_ERR_DET_DMTL_MIN + 1
                        ELSE(6b)
                            IF(7b)LV_SDR_DMTL = 1
                            THEN(7b)
                                IF(8a)   LV_ERR_DMTL_PLAUS = 1
```

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```
THEN(8a)
        LV_CDN_DIAG_DMTL_PLAUS = 1
        LV_ERR_DMTL_PLAUS = 0
ERR_SYM_DMTL_PLAUS =   PLAUS
        LV_END_DIAG_DMTL_PLAUS = 1
ENDIF(8a)

LV_CDN_DIAG_DMTL_PLAUS = 1
ERR_SYM_DMTL_PLAUS =   PLAUS
LV_ERR_DMTL_PLAUS= 1
LV_END_DIAG_DMTL_PLAUS = 1

LV_ERR_DMTLM = 1

LV_SDR_DMTL = 0
LV_CHK_DMTL_CUR_DMTL_VLD_CFM = 1
CTR_ERR_DET_DMTL_PLAUS =
        CTR_ERR_DET_DMTL_PLAUS + 1
ELSE(7b)
    IF(8b) LV_ERR_SIG_DMTL = 1
    THEN(8b)
        IF(9)   LV_ERR_DMTL_SIG = 1
        THEN(9)
            LV_CDN_DIAG_DMTL_SIG = 1
            LV_ERR_DMTL_SIG = 0
            ERR_SYM_DMTL_SIG =   SIG
            LV_END_DIAG_DMTL_SIG = 1
        ENDIF(9)

        ERR_SYM_DMTL_SIG =   SIG
        LV_ERR_DMTL_SIG = 1
        LV_CDN_DIAG_DMTL_SIG = 1
        LV_END_DIAG_DMTL_SIG = 1

        LV_ERR_DMTLM = 1

        LV_ERR_SIG_DMTL = 0
LV_CTR_CNL_SMALL_LEAK_MES_CFM = 1
        CTR_ERR_DET_DMTL_SIG =
ERR_DET_DMTL_SIG + 1
    ENDIF(8b)
ENDIF(7b)
ENDIF(6b)
ENDIF(5)
LV_CDN_DIAG_DMTL_MAX/MIN/PLAUS/SIG = 0

M6_CTR_CNL_SMALL_LEAK_MES =
        M6_CTR_CNL_SMALL_LEAK_MES_SAVE
M6_CUR_DMTL_COR_FIL_CID18 =
        M6_CUR_DMTL_COR_FIL_CID18_SAVE
M6_CUR_DMTL_COR_FIL_CID19 =
        M6_CUR_DMTL_COR_FIL_CID19_SAVE
```

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```
                    M6_CUR_DMTL_DMTLS_TEST =
                                    M6_CUR_DMTL_DMTLS_TEST_SAVE
                    M6_CUR_DMTL_THD_DMTLS_TEST =
                              M6_CUR_DMTL_THD_DMTLS_TEST_SAVE

                    LV_ERR_DMTL_SET = 0
                    LV_CHK_DMTL_VLD_CFM = 1
                    LV_REFU_DMTLM = 0
               ELSE(4)
                    LV_ERR_DET_DMTL_MAX = 0
                    LV_ERR_DET_DMTL_MIN = 0
                    LV_SDR_DMTL = 0
                    LV_ERR_SIG_DMTL = 0
                    LV_ERR_DMTL_SET = 0
                    LV_REFU_DMTLM = 0
               ENDIF(4)
          ENDIF(3a)
     ELSE(2a)
          LV_CDN_DIAG_DMTL_MAX/MIN/PLAUS/SIG = 1
          ERR_SYM_DMTL_MAX/MIN/PLAUS/SIG = "NO_SYM"
          LV_ERR_DMTL_MAX/MIN/PLAUS/SIG = 0
          LV_END_DIAG_DMTL_MAX/MIN/PLAUS/SIG = 1
          LV_CDN_DIAG_DMTL_MAX/MIN/PLAUS/SIG = 0

          LV_ERR_DMTLM = 0

          CTR_ERR_DET_DMTL_MAX = CTR_ERR_DET_DMTL_MAX - 1
          CTR_ERR_DET_DMTL_MIN = CTR_ERR_DET_DMTL_MIN - 1
          CTR_ERR_DET_DMTL_SIG = CTR_ERR_DET_DMTL_SIG - 1
          CTR_ERR_DET_DMTL_PLAUS = CTR_ERR_DET_DMTL_PLAUS - 1

          LV_ERR_DMTL_SET = 0
          LV_REFU_DMTLM = 0
          LV_CHK_DMTL_CUR_DMTL_VLD_CFM = 1
          LV_CHK_DMTL_VLD_CFM = 1

          M6_CTR_CNL_SMALL_LEAK_MES =
                                    M6_CTR_CNL_SMALL_LEAK_MES_SAVE
          M6_CUR_DMTL_COR_FIL_CID18 = M6_CUR_DMTL_COR_FIL_CID18_SAVE
          M6_CUR_DMTL_COR_FIL_CID19 = M6_CUR_DMTL_COR_FIL_CID18_SAVE
          M6_CUR_DMTL_DMTLS_TEST = M6_CUR_DMTL_DMTLS_TEST_SAVE
          M6_CUR_DMTL_THD_DMTLS_TEST =
                              M6_CUR_DMTL_THD_DMTLS_TEST_SAVE
     ENDIF(2a)
ENDIF(1a)

IF(1b)         CTR_ERR_DET_DMTL_MAX > C_CTR_ERR_DET_DMTLM_LEAK
THEN(1b)
     IF(2b)         LV_END_DIAG_DMTL_MAX = 0 - -> 1
     THEN(2b)
          IF(3b)    LV_ERR_DMTL_MAX = 1
          THEN(3b)CTR_DIAG_CFM_DMTL_MAX = CTR_DIAG_CFM_DMTL_MAX - 1
```

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ELSE$_{(3b)}$CTR_DIAG_CFM_DMTL_MAX = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF$_{(3b)}$
ENDIF$_{(2b)}$
ELSE$_{(1b)}$ CTR_DIAG_CFM_DMTL_MAX = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF$_{(1b)}$

IF$_{(1c)}$ CTR_ERR_DET_DMTL_MIN $>$ C_CTR_ERR_DET_DMTLM_LEAK
THEN$_{(1c)}$
IF$_{(2c)}$ LV_END_DIAG_DMTL_MIN = 0 - -$>$ 1
THEN$_{(2c)}$
IF$_{(3c)}$ LV_ERR_DMTL_MIN = 1
THEN$_{(3c)}$CTR_DIAG_CFM_DMTL_MIN = CTR_DIAG_CFM_DMTL_MIN- 1
ELSE$_{(3c)}$CTR_DIAG_CFM_DMTL_MIN = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF$_{(3c)}$
ENDIF$_{(2c)}$
ELSE$_{(1c)}$CTR_DIAG_CFM_DMTL_MIN = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF$_{(1c)}$

IF$_{(1d)}$ CTR_ERR_DET_DMTL_PLAUS$>$ C_CTR_ERR_DET_DMTLM_LEAK
THEN$_{(1d)}$
IF$_{(2c)}$ LV_END_DIAG_DMTL_PLAUS = 0 - -$>$ 1
THEN$_{(2c)}$
IF$_{(3d)}$ LV_ERR_DMTL_PLAUS = 1
THEN$_{(3d)}$CTR_DIAG_CFM_DMTL_PLAUS=CTR_DIAG_CFM_DMTL_PLAUS - 1
ELSE$_{(3d)}$CTR_DIAG_CFM_DMTL_PLAUS= C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF$_{(3d)}$
ENDIF$_{(2c)}$
ELSE$_{(1d)}$ CTR_DIAG_CFM_DMTL_PLAUS = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF$_{(1d)}$

IF$_{(1e)}$ CTR_ERR_DET_DMTL_SIG $>$ C_CTR_ERR_DET_DMTLM_LEAK
THEN$_{(1e)}$
IF$_{(2d)}$ LV_END_DIAG_DMTL_SIG = 0 - -$>$ 1
THEN$_{(2d)}$
IF$_{(3e)}$ LV_ERR_DMTL_SIG = 1
THEN$_{(3e)}$ CTR_DIAG_CFM_DMTL_SIG = CTR_DIAG_CFM_DMTL_SIG - 1
ELSE$_{(3e)}$ CTR_DIAG_CFM_DMTL_SIG = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF$_{(3e)}$
ENDIF$_{(2d)}$
ELSE$_{(1e)}$CTR_DIAG_CFM_DMTL_SIG = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF$_{(1e)}$

How rough leak error is built

Signal flow diagram:

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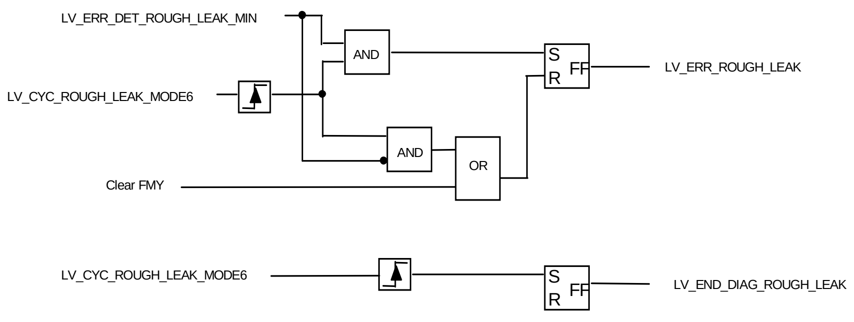

Formula section:

If$_{(1a)}$ LV_ERR_DET_ROUGH_LEAK_MIN = 1 **AND**
LV_CYC_ROUGH_LEAK_MODE6 = 1
Then$_{(1a)}$
IF$_{(2a)}$ LV_ERR_ROUGH_LEAK = 1
THEN$_{(2a)}$
LV_CDN_DIAG_ROUGH_LEAK = 1
LV_ERR_ROUGH_LEAK = 0
ERR_SYM_ROUGH_LEAK = MAX
LV_END_DIAG_ROUGH_LEAK = 1
ENDIF$_{(2a)}$
LV_CDN_DIAG_ROUGH_LEAK = 1
LV_ERR_ROUGH_LEAK = 1
ERR_SYM_ROUGH_LEAK = MAX
LV_END_DIAG_ROUGH_LEAK = 1
LV_CDN_DIAG_ROUGH_LEAK = 0
CTR_ERR_DET_ROUGH_LEAK = CTR_ERR_DET_ROUGH_LEAK + 1
Endif$_{(1a)}$

If$_{(1b)}$ [LV_ERR_DET_ROUGH_LEAK_MIN = 0 **AND**
LV_CYC_ROUGH_LEAK_MODE6 = 1]
Then$_{(1b)}$ LV_CDN_DIAG_ROUGH_LEAK = 1
LV_ERR_ROUGH_LEAK = 0
ERR_SYM_ROUGH_LEAK = NO_SYM
LV_END_DIAG_ROUGH_LEAK = 1
LV_CDN_DIAG_ROUGH_LEAK = 0
CTR_ERR_DET_ROUGH_LEAK = CTR_ERR_DET_ROUGH_LEAK - 1
Endif$_{(1b)}$

IF$_{(1c)}$CTR_ERR_DET_ROUGH_LEAK $>$ C_CTR_ERR_DET_DMTLM_LEAK
THEN
IF$_{(2b)}$ LV_END_DIAG_ROUGH_LEAK = 0 - -$>$ 1
THEN$_{(2b)}$
IF$_{(3)}$ LV_ERR_ROUGH_LEAK = 1
THEN$_{(3)}$CTR_DIAG_CFM_ROUGH_LEAK =
CTR_DIAG_CFM_ROUGH_LEAK - 1
ELSE$_{(3)}$CTR_DIAG_CFM_ROUGH_LEAK =

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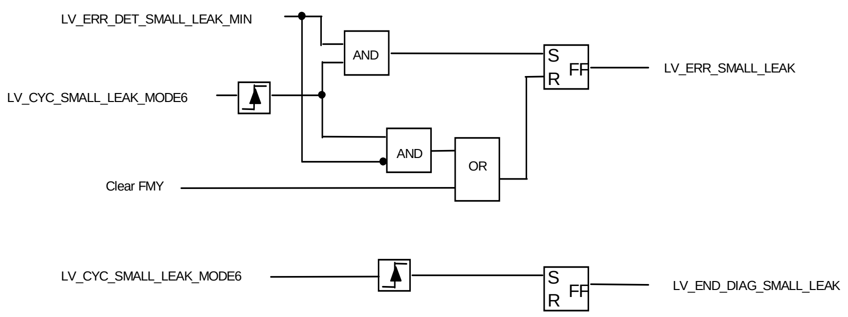
C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF$_{(3)}$
ENDIF$_{(2b)}$
ELSE$_{(1c)}$ CTR_DIAG_CFM_ROUGH_LEAK = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF$_{(1c)}$

How small leak error is built

Signal flow diagram:



Formula section:

If$_{(1a)}$ LV_ERR_DET_SMALL_LEAK_MIN = 1 **AND**
LV_CYC_SMALL_LEAK_MODE6 = 1
Then$_{(1a)}$ ERR_SYM_SMALL_LEAK = SMALL_LEAK
LV_CDN_DIAG_SMALL_LEAK = 1
ACTION_ERRM_StorePrevFrf(SMALL_LEAK)
LV_CDN_DIAG_SMALL_LEAK = 0
M6_CUR_DMTL_SMALL_LEAK_END_SAVE = CUR_DMTL_SMALL_LEAK_END
M6_CUR_DMTL_REF_LEAK_SAVE = CUR_DMTL_REF_LEAK
Endif$_{(1a)}$

LV_CYC_SMALL_LEAK_MODE6_CFM = 0

If$_{(1b)}$ [LV_ERR_DET_SMALL_LEAK_MIN = 0 **AND**
LV_CYC_SMALL_LEAK_MODE6 = 1]
Then$_{(1b)}$ LV_CDN_DIAG_SMALL_LEAK = 1
LV_ERR_SMALL_LEAK = 0
ERR_SYM_SMALL_LEAK = NO_SYM
LV_END_DIAG_SMALL_LEAK = 1
LV_CDN_DIAG_SMALL_LEAK = 0

LV_ERR_DET_SMALL_LEAK_MIN_CFM = 0
LV_CYC_SMALL_LEAK_MODE6_CFM = 1
LV_REFU_DMTL_SMALL_LEAK = 0
CTR_ERR_DET_SMALL_LEAK = CTR_ERR_DET_SMALL_LEAK -.1

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M6_CUR_DMTL_SMALL_LEAK_END_SAVE = CUR_DMTL_SMALL_LEAK_END
M6_CUR_DMTL_REF_LEAK_SAVE = CUR_DMTL_REF_LEAK
M6_CUR_DMTL_SMALL_LEAK_END =
M6_CUR_DMTL_SMALL_LEAK_END_SAVE
M6_CUR_DMTL_REF_LEAK = M6_CUR_DMTL_REF_LEAK_SAVE

Endif$_{(1b)}$

IF$_{(1c)}$ LV_ERR_DET_SMALL_LEAK_MIN = 1 **AND**
LV_ES = 0
THEN$_{(1c)}$
IF$_{(2a)}$ **[** LV_DIST_DMTL = 1 **AND**
((LV_REFU_VAL = 1 **AND**
LV_REFU_VAL(n-1) = 1 **AND**
LV_FTL_DMTL_VAL = 1**)** **OR**
LV_ERR_FTL = 1 **OR**
LV_ERR_FTL_PLAUS **)]** **OR**
LV_DMTL_EOL = 1
THEN$_{(2a)}$
IF$_{(3a)}$ LV_REFU_DMTL_SMALL_LEAK = 0 **OR**
LV_DMTL_EOL = 1
THEN$_{(3a)}$
IF$_{(4)}$ LV_ERR_SMALL_LEAK = 1
THEN$_{(4)}$
LV_CDN_DIAG_SMALL_LEAK = 1
LV_ERR_SMALL_LEAK = 0
ERR_SYM_SMALL_LEAK = MIN
LV_END_DIAG_SMALL_LEAK = 1
ENDIF$_{(4)}$

LV_CDN_DIAG_SMALL_LEAK = 1
LV_ERR_SMALL_LEAK = 1
ERR_SYM_SMALL_LEAK = MIN
LV_END_DIAG_SMALL_LEAK = 1
LV_CDN_DIAG_SMALL_LEAK = 0

LV_ERR_DET_SMALL_LEAK_MIN = 0
LV_ERR_DET_SMALL_LEAK_MIN_CFM = 1
LV_CYC_SMALL_LEAK_MODE6_CFM = 1
LV_REFU_DMTL_SMALL_LEAK = 0
CTR_ERR_DET_SMALL_LEAK =
CTR_ERR_DET_SMALL_LEAK + 1
M6_CUR_DMTL_SMALL_LEAK_END =
M6_CUR_DMTL_SMALL_LEAK_END_SAVE
M6_CUR_DMTL_REF_LEAK =
M6_CUR_DMTL_REF_LEAK_SAVE
ELSE$_{(3a)}$
LV_ERR_DET_SMALL_LEAK_MIN = 0
LV_REFU_DMTL_SMALL_LEAK = 0
ENDIF$_{(3a)}$
ENDIF$_{(2a)}$
ENDIF$_{(1c)}$

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IF$_{(1d)}$ CTR_ERR_DET_SMALL_LEAK $>$ C_CTR_ERR_DET_DMTLM_LEAK
THEN$_{(1d)}$
IF$_{(2b)}$ LV_END_DIAG_SMALL_LEAK = 0 - -> 1
THEN$_{(2b)}$
IF$_{(3b)}$ LV_ERR_SMALL_LEAK = 1
THEN$_{(3b)}$CTR_DIAG_CFM_SMALL_LEAK = CTR_DIAG_CFM_SMALL_LEAK- 1
ELSE$_{(3b)}$CTR_DIAG_CFM_SMALL_LEAK = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF$_{(3b)}$
ENDIF$_{(2b)}$
ELSE$_{(1d)}$ CTR_DIAG_CFM_SMALL_LEAK = C_CTR_DIAG_CFM_DMTLM_LEAK
ENDIF$_{(1d)}$

B.93.19 End of line test and factory test of DMTL function

Application conditions

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

Initialisation: LV_DMTL_ASA = 0

FUNCTION DESCRIPTION:

The end of line test and the factory test must permit execution of the tank leak diagnostic function via test unit.
The fundamental difference is the fact that at the end of line, the timeout monitoring of the test unit signal is deleted and that a change-over of "ignition key" into both directions does not interrupt the function. Another particularity of the end of line function is the fact that the function is started anew without any further test unit intervention if it has been aborted due to "engine speed detected, but START not exited", provided that all enable conditions are present.
On the other hand, activation in the factory is only admissible with the test unit connected and ignition key ON.

Formula section:

If (STATE_EOL_KWP_DMTL = 0 (Start Command from Tester received))
Then LV_DMTL_ASA = 1
Else if (STATE_EOL_KWP_DMTL = 7 (Stop Command from Tester received))
Then LV_DMTL_ASA = 0
Endif
Endif

If LV_DMTL_ASA = 1 **AND**

TRT $<$ C_TRT_DMTL_EOL_MAX
Then LV_DMTL_EOL = 1
Endif

If LV_PUC = 1 **OR** LV_PU = 1 **OR** LV_PL = 1 **OR** LV_IS = 1 **OR**
LV_DMTL_ACT = 1 0 **OR**

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```
                 LV_DMTL_STOP = 1                                       OR
                 (STATE_EOL_KWP_DMTL        = 7 (Stop Command from Tester received) )   OR
                 T_DMTL_EOL > C_T_DMTL_EOL_MAX
  Then           LV_DMTL_EOL = 0
Endif
If                LV_DMTL_EOL = 1
        Then         T_DMTL_EOL = T_DMTL_EOL + 100 ms
        Else         T_DMTL_EOL = 0
Endif

If LV_DMTL_EOL
     Then
    /*DIAGNOSIS CURRENTLY RUNNING,
     OUTPUT OF STATE VARIABLE */
    STATE_DMTL_EOL = STATE_DMTL
     Else /* DIAGNOSIS CANCELLED OR FINISHED */
     If !LV_VB_RANGE_DMTL
            Then
            /* VB IS OUT OF RANGE FOR EOLT */
            STATE_DMTL_EOL = VB_OUT_OF_RANGE;

            Else
            If !LV_ENA_LEAK_DMTL
                    Then
                    /* ELECTRICAL ERROR */
                    STATE_DMTL_EOL = ELECTRICAL_ERR;

                    Else
                    If T_DMTL_EOL >= C_T_DMTL_EOL_MAX
                            Then
                            /* MAX. DURATION OF DIAGNOSIS REACHED */
                            STATE_DMTL_EOL = T_DMTL_MAX;

                            Else
                            If LV_DET_REFU
                                    Then
                                    /* REFUELLMENT */
                                    STATE_DMTL_EOL = REFUELLING;

                                    Else
                                    If LV_VB_DIF_MAX
                                            Then
                                            /* GITTER VB TOO LARGE */
                                            STATE_DMTL_EOL = VB_GITTER;

                                            Else
                                            If LV_CUR_DMTL_REF_DIF_MAX
                                                    Then
                                                    /* GITTER REFERENCE CURRENT TOO
                                                    LARGE */
                                                    STATE_DMTL_EOL = CUR_REF_DIF_MAX;
```

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Else
If (LV_CUR_DMTL_THD_DIF_MES)
Then
/* FALLING CURRENT DURING MEASUREMENT */
STATE_DMTL_EOL = THD_CUR_DMTL_DIF_MES;
Endif
Endif
Endif
Endif
Endif
Endif
Endif
Endif

B.93.20 Heater DMTL module

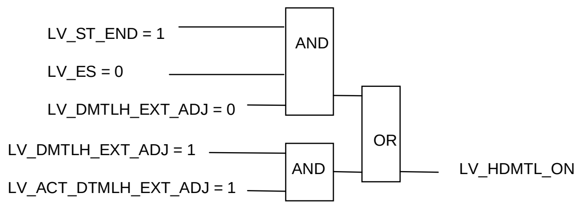
Application conditions

Recurrence: *100 ms*

Activation: *LV_CONF_DMTL = 1*

Initialisation: LV_HDMTL_ON = 0

Signal flow diagram:



Formula section:

If [$_{(1)}$LV_DMTLH_EXT_ADJ = 1 **AND**
LV_ACT_DMTLH_EXT_ADJ = 1]$_{(1)}$ **OR**
[$_{(6)}$LV_DMTLH_EXT_ADJ = 0 **AND**
LV_ST_END = 1 **AND**
LV_ES = 0 **AND**
Then LV_HDMTL_ON = 1
Else LV_HDMTL_ON = 0
Endif

B.93.21 Mode06 DMTL

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General information:

Testvalues and Tresholds has to be prepared for output via obdII-communication mode06.
All M6_XX has to be set to 0 in case of clearing failure memory.

Formula section:

Module-Diagnosis, minimum failure: (see *"State machine"* chapter *"How the error DMTL module is built up")*
M6_CUR_DMTL_COR_FIL_CID18

Module-Diagnosis, maximum failure: (see *"State machine"* chapter *"How the error DMTL module is built up")*
M6_CUR_DMTL_COR_FIL_CID19

Module-Diagnosis, plausibility failure: (see *"State machine"* chapter *"How the error DMTL module is built up")*

M6_CUR_DMTL_DMTLS_TEST
M6_CUR_DMTL_THD_DMTLS_TEST

Module-Diagnosis, plausibility failure: (see chapter *"How the error DMTL module is built up")*
M6_CTR_CNL_SMALL_LEAK_MES

DMTL, Rough-leak, short cycle:
IF LV_CYC_ROUGH_LEAK_MODE6 = 1 **AND** LV_ROUGH_LEAK_MES_LEN = 0
THEN
M6_CUR_DMTL_ROUGH_LEAK_END = CUR_DMTL_ROUGH_LEAK_END
M6_CUR_DMTL_THD_ROUGH_LEAK = CUR_DMTL_THD_ROUGH_LEAK
ELSE
m6_cur_dmtl_rough_leak_end = m6_cur_dmtl_rough_leak_end
m6_cur_dmtl_thd_rough_leak = M6_cur_dmtl_thd_rough_leak
ENDIF

DMTL, Small-leak: (see chapter *"How small leak error is built up")*

M6_CUR_DMTL_SMALL_LEAK_END
M6_CUR_DMTL_REF_LEAK

DMTL, Rough-leak, long cycle:
IF LV_CYC_ROUGH_LEAK_MODE6 = 1 **AND** LV_ROUGH_LEAK_MES_LEN = 1
THEN
M6_CUR_DMTL_ROUGH_LEAK_LEN_END = CUR_DMTL_ROUGH_LEAK_LEN_END
M6_CUR_DMTL_THD_ROUGH_LEAK_LEN = CUR_DMTL_THD_ROUGH_LEAK_LEN
ELSE
M6_CUR_DMTL_ROUGH_LEAK_LEN_END = M6_CUR_DMTL_ROUGH_LEAK_LEN_END

M6_CUR_DMTL_THD_ROUGH_LEAK_LEN=M6_CUR_DMTL_THD_ROUGH_LEAK_LEN
ENDIF

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B.94 Leakage detection pump function diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CNL_SMALL_LEAK_MES_VIRT	O/V/S	0... FFH	0... 255	1	-
Virtuel number of aborted miniature leak measurements dur to current fluctuations					
LV_CHK_DMTL_CUR_DMTL_VLD_VIRT	O/V/S	0... 1H	0 ...1	1	-
Virtuel check of component concerning valid pump current					
LV_CTR_CNL_SMALL_LEAK_VIRT	O/V/S	0... 1H	0 ...1	1	-
Virtuel aborted miniature leak measurements due to current fluctuations exceeded					
LV_DET_NO_ROUGH_LEAK	O/V/S	0... 1H	0 ...1	1	-
Condition leak check done and no rough leak detected					
LV_DET_NO_SMALL_LEAK	O/V/S	0... 1H	0 ...1	1	-
Stored bit, that in the last DC no small leak was recognized					
LV_DET_SMALL_LEAK	O/V/S	0... 1H	0 ...1	1	-
Stored bit, that in the last DC small leak was recognized					
LV_INH_DIAG_RBM_DMTL	O/V	0... 1H	0 ...1	1	-
Flag to inhibit DMTL diagnosis function if there is a OBD failure					
STATE_RBM_DMTLM	O/V	0... 7H	0 ...7	1	-
Interface of DMTLM monitor with the Rate-Based Monitoring statistics					
STATE_RBM_ROUGH_LEAK	O/V	0... 7H	0 ...7	1	-
Interface of ROUGH_LEAK monitor with the Rate-Based Monitoring					
STATE_RBM_SMALL_LEAK	O/V	0... 7H	0 ...7	1	-
Interface of SMALL_LEAK monitor with the Rate-Based Monitoring statistics					
T_AST_DMTL_RBM	V	0... FFFFH	0... 6553.5	0.1	s
comulative time since engine start for incrementation of the evaporative system monitor denominator					

Input data:

C_DIST_REFU_ROUGH_LEAK_MIN {p. 5973}	C_SUM_CNL_SMALL_LEAK_MES_MAX {p. 5973}	CTR_ERR_DYN_NR {p. 5767}	LV_CHK_DMTL_CUR_DMTL_VLD_CFM {p. 5962}
LV_CHK_DMTL_VLD_CFM {p. 5962}	LV_CTR_CNL_SMALL_LEAK_MES_CFM {p. 5962}	LV_CYC_ROUGH_LEAK_MODE6 {p. 5963}	LV_CYC_SMALL_LEAK_MODE6_CFM {p. 5963}
LV_DC {p. 5746}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_DET_ROUGH_LEAK_MIN {p. 5965}
LV_ERR_DET_SMALL_LEAK_MIN_CFM {p. 5965}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_DMTL_PUMP {p. 4626}	LV_ERR_DMTLH {p. 4626}
LV_ERR_DMTLM {p. 5965}	LV_ERR_DMTLS {p. 4627}	LV_ERR_EL_CPS {p. 4708}	LV_ERR_SPI_MPS {p. 4245}
LV_ERR_TAM_CAN {p. 5076}	LV_ERR_TAM_PLAUS {p. 5076}	LV_ERR_TCO {p. 4496}	LV_ERR_TCO_STUCK_RNG {p. 5675}
LV_ERR_VS {p. 5021}	LV_FTL_DMTL_VAL {p. 5966}	LV_IGK {p. 906}	LV_REFU {p. 5966}

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LV_REFU_VAL {p. 5967}	T_ES_CUS {p. 1444}	TAM {p. 1579}	TAM_ST {p. 1214}
TCO_ST {p. 1100}	VS {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_COD_DMTL_RBM	-	0... FFH	0... 255	1	-
configuration byte for DMTL RBM					
C_T_AST_DMTL_RBM	-	0... FFFFH	0... 6553.5	0.1	s
Minimum comulative time since engine start for incrementation of the evaporative system monitor denominator					
C_T_DLY_FTL_DMTL_VAL	-	0... FFFFH	0... 6553.5	0.1	s
Delay time for a valid FTL for DMTL_RBM					
C_T_ES_DMTL_DIAG_MAX	-	0... FFFFH	0... 65535	1	min
Maximum time for a DMTL diagnosis					
C_TAM_MAX_DMTL_RBM	-	0... FEH	-48... 142.5	0.75	°C
Maximum ambient temperature threshold for DMTL_RBM					
C_TAM_MIN_DMTL_RBM	-	0... FEH	-48... 142.5	0.75	°C
Minimum ambient temperature threshold for DMTL_RBM					
C_TAM_ST_HYS_DMTL_RBM	-	80... 7FH	-96... 95.25	0.75	°C
Ambient temperature hysteresis for DMTL_RBM					
C_TCO_ST_MAX_DMTL_RBM	-	0... FEH	-48... 142.5	0.75	°C
Maximum engine start temperature threshold for DMTL_RBM					
C_TCO_ST_MIN_DMTL_RBM	-	0... FEH	-48... 142.5	0.75	°C
Minimum engine start temperature threshold for DMTL_RBM					

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

B.94.1 Inhibition of diagnosis

FUNCTION DESCRIPTION:

Description:

If one of the following components fail the DMTL diagnosis function is stopped by LV_INH_DIAG_RBM_DMTL = 1.

Application conditions

Initialization: `0 at reset`

Recurrence: `0.1 sec`

Activation: `LV_DC transition 0 -> 1 (start driving cycle)`

Deactivation: `LV_DC transition 1 -> 0 (driving cycle terminated)`

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Formula section:

Inhibition due to OBDI error

If LV_ERR_EL_CPS = 1
or LV_ERR_DIAGCPS = 1
or LV_ERR_DMTLS = 1
or LV_ERR_DMTL_PUMP = 1
or LV_ERR_TCO = 1
or LV_ERR_VS = 1
or LV_ERR_SPI_MPS = 1
or LV_ERR_TAM = 1
or LV_ERR_AMP = 1
or LV_ERR_AMP_PLAUS = 1
or LV_ERR_DMTLH = 1
Then LV_INH_DIAG_RBM_DMTL = 1
(DMTL diagnosis inhibited due to OBD error)
Else LV_INH_DIAG_RBM_DMTL = 0
(DMTL diagnosis not inhibited)
Endif

B.94.2 Interface for Rate - Based - Monitoring

FUNCTION DESCRIPTION:

General information:

With this module the interface between the tank leakage detection monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_DMTLM, STATE_RBM_ROUGH_LEAK and STATE_RBM_SMALL_LEAK data.
Within STATE_RBM_xxx, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)
  (not valid for DMTL function)

Application conditions:

Initialisation :

at LV_DC 0 1 transition :
bit 0, bit 1 and bit 2 of STATE_RBM_DMTLM = 0
bit 0, bit 1 and bit 2 of STATE_RBM_ROUGH_LEAK = 0
bit 0, bit 1 and bit 2 of STATE_RBM_SMALL_LEAK = 0
T_AST_DMTL_RBM = 0
LV_REFU_VAL_DC = 0
LV_DET_ROUGH_LEAK_VIRT = 0
LV_DET_SMALL_LEAK_VIRT = 0
DIST_DET_ROUGH_LEAK_VIRT = 0
T_DLY_FTL_DMTL_VAL = C_T_DLY_FTL_DMTL_VAL

on failure memory reset :

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bit 1 of STATE_RBM_DMTLM = 0
bit 1 of STATE_RBM_ROUGH_LEAK = 0
bit 1 of STATE_RBM_SMALL_LEAK = 0
CTR_CNL_SMALL_LEAK_MES_VIRT = 0
LV_CTR_CNL_SMALL_LEAK_VIRT = 0
LV_CHK_DMTL_CUR_DMTL_VLD_VIRT = 0
LV_DET_SMALL_LEAK = 0
LV_DET_NO_SMALL_LEAK = 0
LV_DET_NO_ROUGH_LEAK = 0
LV_DET_ROUGH_LEAK = 0
DIST_DET_ROUGH_LEAK_VIRT = 0

at reset:

CTR_CNL_SMALL_LEAK_MES_VIRT out of NVMY
LV_CTR_CNL_SMALL_LEAK_VIRT out of NVMY
LV_CHK_DMTL_CUR_DMTL_VLD_VIRT out of NVMY
LV_DET_SMALL_LEAK out of NVMY
LV_DET_NO_SMALL_LEAK out of NVMY
LV_DET_NO_ROUGH_LEAK out of NVMY
T_DLY_FTL_DMTL_VAL = C_T_DLY_FTL_DMTL_VAL

Recurrence: 100ms
Activation: LV_DC 0 1 transition **and** LV_DC = 1

Formula section:

At LV_DC 0 1 transition

The pending status of the following failures has to be checked only once :

LV_ERR_DIAGCPS	LV_ERR_EL_CPS	LV_ERR_TCO_EL	LV_ERR_TCO_GRD
LV_ERR_TCO_STUCK	LV_ERR_TCO_PLAUS	LV_ERR_VS	LV_ERR_DMTLS
LV_ERR_DMTL_PUMP	LV_ERR_SPI_MPS	LV_ERR_DMTLH	LV_ERR_TCO_STUCK_RNG
LV_ERR_TAM_CAN	LV_ERR_TAM_PLAUS	LV_ERR_AMP	LV_ERR_AMP_PLAUS

If(1) { CPU optimization at LV_DC 0 1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }

Then(1)

While bit 1 of STATE_RBM_DMTLM = 0 **do**
with each XX failure of the above list :
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2)
bit 1 of STATE_RBM_DMTLM = 1
Endif(2)

Endwhile

Else(1)
{ the dynamic failure memory is empty }
No action

Endif(1)

If(1) { CPU optimization at LV_DC 0 1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }

Then(1)

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While bit 1 of STATE_RBM_ROUGH_LEAK = 0 **do**
with each XX failure of the above list :
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2)
bit 1 of STATE_RBM_ROUGH_LEAK = 1
Endif(2)
Endwhile
Else(1)
{ the dynamic failure memory is empty }
No action
Endif(1)

If(1) { CPU optimization at LV_DC 0 1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }
Then(1)
While bit 1 of STATE_RBM_SMALL_LEAK = 0 **do**
with each XX failure of the above list :
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2)
bit 1 of STATE_RBM_SMALL_LEAK = 1
Endif(2)
Endwhile
Else(1)
{ the dynamic failure memory is empty }
No action
Endif(1)

numerator calculation DMTL module error
Every 100 ms
If LV_CHK_DMTL_VLD_CFM = 0 → 1
Then CTR_CNL_SMALL_LEAK_MES_VIRT ++
Endif

If CTR_CNL_SMALL_LEAK_MES_VIRT >
C_SUM_CNL_SMALL_LEAK_MES_MAX
Then LV_CTR_CNL_SMALL_LEAK_VIRT = 1
CTR_CNL_SMALL_LEAK_MES_VIRT = 0
Endif

If (LV_CHK_DMTL_VLD_CFM = 1 **AND**
LV_CTR_CNL_SMALL_LEAK_MES_CFM = 1)
Then CTR_CNL_SMALL_LEAK_MES_VIRT = 0
Endif

If LV_CHK_DMTL_CUR_DMTL_VLD_CFM = 0 → 1 **OR**
LV_CTR_CNL_SMALL_LEAK_MES_CFM = 0→ 1
Then LV_CHK_DMTL_CUR_DMTL_VLD_VIRT = 1
Endif

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```
If        bit 0 of STATE_RBM_DMTLM = 0
Then
     If        [LV_CTR_CNL_SMALL_LEAK_VIRT = 1                  OR
          [LV_ERR_DMTLM = 1          AND
          LV_CHK_DMTL_CUR_DMTL_VLD_VIRT = 1]]                  AND
          LV_IGK = 1
        Then          bit 0 of STATE_RBM_DMTLM = 1
           LV_CTR_CNL_SMALL_LEAK_VIRT = 0
           LV_CHK_DMTL_CUR_DMTL_VLD_VIRT = 0
        Endif
Endif
```

numerator calculation DMTL rough leak error

Every 100 ms:

```
If        LV_FTL_DMTL_VAL = 0
   Then          T_DLY_FTL_DMTL_VAL -
        If        T_DLY_FTL_DMTL_VAL > 0
        Then          LV_FTL_DMTL_VAL_VIRT = 0
        Else          LV_FTL_DMTL_VAL_VIRT = 1
        Endif
   Else        T_DLY_FTL_DMTL_VAL = C_T_DLY_FTL_DMTL_VAL
        LV_FTL_DMTL_VAL_VIRT = 0
   Endif

   If         ((LV_REFU_VAL_DC = 0                    AND
        LV_REFU = 0                          AND
        LV_REFU_VAL = 1)                         OR
        (LV_FTL_DMTL_VAL_VIRT = 1        AND
        C_COD_DMTL_RBM = 0. bit))                      AND
        T_ES_CUS > C_T_ES_DMTL_DIAG_MAX
   Then          LV_T_ES_NO_REFU = 1
   Else         LV_T_ES_NO_REFU = 0
   Endif

   If         LV_ERR_DET_ROUGH_LEAK_MIN = 0           AND
        LV_CYC_ROUGH_LEAK_MODE6 = 1
   Then          LV_DET_NO_ROUGH_LEAK = 1
   Endif

If        LV_DET_NO_ROUGH_LEAK = 1
   Then          If          LV_REFU_VAL = 0   1           AND
           LV_REFU = 1
        Then          DIST_DET_ROUGH_LEAK_VIRT = 0
        Endif

        If         [LV_FTL_DMTL_VAL = 1            AND
          LV_ERR_VS = 0                      AND
          LV_IGK = 1                          AND
          LV_VS_RUN = 1]
        Then          DIST_DET_ROUGH_LEAK_VIRT(n) =
```

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DIST_DET_ROUGH_LEAK_VIRT$_{(n-1)}$ + (VS /36)
Endif

If LV_ERR_VS = 1 **OR**
LV_FTL_DMTL_VAL_VIRT = 1 **OR**
DIST_DET_ROUGH_LEAK_VIRT
C_DIST_REFU_ROUGH_LEAK_MIN
Then LV_DIST_DMTL_VIRT = 1
Else LV_DIST_DMTL_VIRT = 0
Endif
Endif

If LV_ERR_DET_ROUGH_LEAK_MIN = 1 **AND**
LV_CYC_ROUGH_LEAK_MODE6 = 1
Then LV_DET_ROUGH_LEAK = 1
LV_DET_NO_ROUGH_LEAK = 0
Endif
If LV_DET_NO_ROUGH_LEAK = 1 **AND**
LV_T_ES_NO_REFU =1
Then LV_DET_ROUGH_LEAK_VIRT = 1
Endif

If bit 0 of STATE_RBM_ROUGH_LEAK = 0
Then
If [[LV_DIST_DMTL_VIRT = 1 **AND**
LV_DET_ROUGH_LEAK_VIRT = 1] **OR**
LV_DET_ROUGH_LEAK = 1] **AND**
LV_IGK = 1
Then bit 0 of STATE_RBM_ROUGH_LEAK = 1
LV_DET_NO_ROUGH_LEAK = 0
LV_DET_ROUGH_LEAK = 0
Endif
Endif
If **[**T_ES_CUS $\leq$ C_T_ES_DMTL_DIAG_MAX **OR**
(LV_REFU_VAL_DC = 0 **AND**
LV_REFU = 1 **AND**
LV_REFU_VAL = 1)**]** **AND**
LV_IGK = 1
Then LV_T_ES_REFU = 1
LV_DET_NO_ROUGH_LEAK = 0
Else LV_T_ES_REFU = 0
Endif

numerator calculation DMTL small leak error

Every 100 ms

If LV_ERR_DET_SMALL_LEAK_MIN_CFM = 1 **AND**
LV_CYC_SMALL_LEAK_MODE6_CFM = 1
Then LV_DET_SMALL_LEAK = 1
LV_DET_NO_SMALL_LEAK = 0
Endif
If LV_ERR_DET_SMALL_LEAK_MIN_CFM = 0 **AND**

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```
                LV_CYC_SMALL_LEAK_MODE6_CFM = 1
        Then        LV_DET_NO_SMALL_LEAK = 1
        Endif
            If      LV_DET_NO_SMALL_LEAK = 1                AND
                  LV_T_ES_NO_REFU = 1
            Then        LV_DET_SMALL_LEAK_VIRT = 1
            Endif

        If        bit 0 of STATE_RBM_SMALL_LEAK = 0
        Then        If        [LV_DET_SMALL_LEAK = 1              OR
                        LV_DET_SMALL_LEAK_VIRT = 1]             AND
                        LV_IGK = 1
                  Then        bit 0 of STATE_RBM_SMALL_LEAK = 1
                        LV_DET_SMALL_LEAK = 0
                        LV_DET_NO_SMALL_LEAK = 0
                  Endif
        Endif

            If      LV_T_ES_REFU = 1
            Then        LV_DET_NO_SMALL_LEAK = 0
        Endif
            If      LV_REFU_VAL = 1
            Then        LV_REFU_VAL_DC = 1
            Endif


If        bit 1 of STATE_RBM_DMTLM = 0
Then
        If        LV_INH_DIAG_RBM_DMTL = 1
        Then    bit 1 of STATE_RBM_DMTLM = 1
        Endif
Endif
If        bit 1 of STATE_RBM_ROUGH_LEAK = 0
Then
        If        LV_INH_DIAG_RBM_DMTL = 1
        Then    bit 1 of STATE_RBM_ROUGH_LEAK = 1
        Endif
Endif
If        bit 1 of STATE_RBM_SMALL_LEAK = 0
Then
        If        LV_INH_DIAG_RBM_DMTL = 1
        Then    bit 1 of STATE_RBM_SMALL_LEAK = 1
        Endif
Endif
```

denominator definition

```
If        C_TAM_MIN_DMTL_RBM ≤ TAM ≤          C_TAM_MAX_DMTL_RBM              AND
        LV_ST_END = 1
Then        if        T_AST_DMTL_RBM < C_T_AST_DMTL_RBM
                    T_AST_DMTL_RBM ++
```

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Endif
Endif

If bit 2 of STATE_RBM_DMTLM = 0
Then If TCO_ST < TAM_ST + C_TAM_ST_HYS_DMTL_RBM **AND**
C_TCO_ST_MIN_DMTL_RBM ≤ TCO_ST ≤ C_TCO_ST_MAX_DMTL_RBM **AND**
T_AST_DMTL_RBM ≥ C_T_AST_DMTL_RBM
Then bit 2 of STATE_RBM_DMTLM = 1
Endif
Endif

If bit 2 of STATE_RBM_ROUGH_LEAK = 0
Then If TCO_ST < TAM_ST + C_TAM_ST_HYS_DMTL_RBM **AND**
C_TCO_ST_MIN_DMTL_RBM ≤ TCO_ST ≤ C_TCO_ST_MAX_DMTL_RBM **AND**
T_AST_DMTL_RBM ≥ C_T_AST_DMTL_RBM
Then bit 2 of STATE_RBM_ROUGH_LEAK = 1
Endif
Endif

If bit 2 of STATE_RBM_SMALL_LEAK = 0
Then If TCO_ST < TAM_ST + C_TAM_ST_HYS_DMTL_RBM **AND**
C_TCO_ST_MIN_DMTL_RBM ≤ TCO_ST ≤ C_TCO_ST_MAX_DMTL_RBM **AND**
T_AST_DMTL_RBM ≥ C_T_AST_DMTL_RBM
Then bit 2 of STATE_RBM_SMALL_LEAK = 1
Endif
Endif

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B.95 Fuel system pressure diagnosis for low pressure (Appl. Inc.)

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_EFPPWM_PLAUS	V	0... FFH	0... 255	1	-
Increment of the plausibility check of EFPPWM anti-bounce counter					
C_ABC_INC_FUP_EFP_NOT_PLAUS	V	0... FFH	0... 255	1	-
Increment of the loose contact check of FUP EFP anti-bounce counter					
C_ABC_INC_L_PRS_SYS	V	0... FFH	0... 255	1	-
Increment of low pressure system monitoring anti-bounce counter					
C_ABC_MAX_EFPPWM_PLAUS	V	1... FFH	1... 255	1	-
Threshold to be reached, before plausibility check error of EFPPWM					
C_ABC_MAX_FUP_EFP_NOT_PLAUS	V	1... FFH	1... 255	1	-
Threshold to be reached, before FUP_EFP loose contact					
C_ABC_MAX_L_PRS_SYS	V	1... FFH	1... 255	1	-
Threshold to be reached, before permanently activating low pressure system monitoring error					

General Information

The low pressure system diagnosis is not inhibited.

Error treatment:
Error debounce:
Debounce counter increment: C_ABC_INC_L_PRS_SYS
Debounce counter maximum value: C_ABC_MAX_L_PRS_SYS

Debounce counter increment: C_ABC_INC_EFPPWM_PLAUS
Debounce counter maximum value: C_ABC_MAX_EFPPWM_PLAUS

- Debounce counter increment: C_ABC_INC_FUP_EFP_NOT_PLAUS
- Debounce counter maximum value: C_ABC_MAX_FUP_EFP_NOT_PLAUS

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Configuration for diagnostic symptoms:

Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Failure class A/B
EFPPWM plausibility check	integral part of EFPPWM out of range	0		P0002	0/NO_LAM P/10h
	adaptive integral part of EFPPWM out of range	1		P0002	
	adaptive minimum EFPPWM out of range	2		P0002	
EFPPWM_PLAUS					

Diagnosis	Symptom	Nr	P-Code/ Failure	P-Code/ Symptom	Failure class A/B
Low pressure system monitoring	FUP_EFP top limit 1 reached	*0*		P0088	0/NO_LAM P/10h
	FUP_EFP top limit 2 reached	*1*		P0215	
	FUP_EFP bottom limit 1 reached	*2*		P0087	
L_PRS_SYS					

Diagnosis	Symptom	Nr	P-Code / Failure	P-Code/ Symptom	Failure class A/B
FUP EFP loose contact	Low pressure sensor loose contact	0		P0000	STD_INI
FUP_EFP_NOT_PLAUS					

Application Conditions

Initialization: all outputs to zero at RST
Recurrence: 20MS
Activation: 1
Deactivation: 0

Function description

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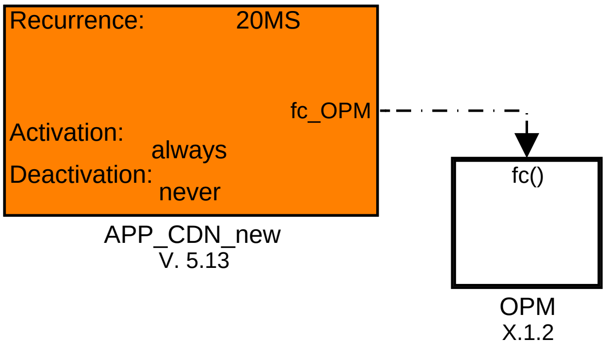

SDA_SRS / SDÂ V 5.0.4 24−Mar−2006

Figure B.95.1: : Path: FUSL_MB073

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B.95.1 CALCULATION

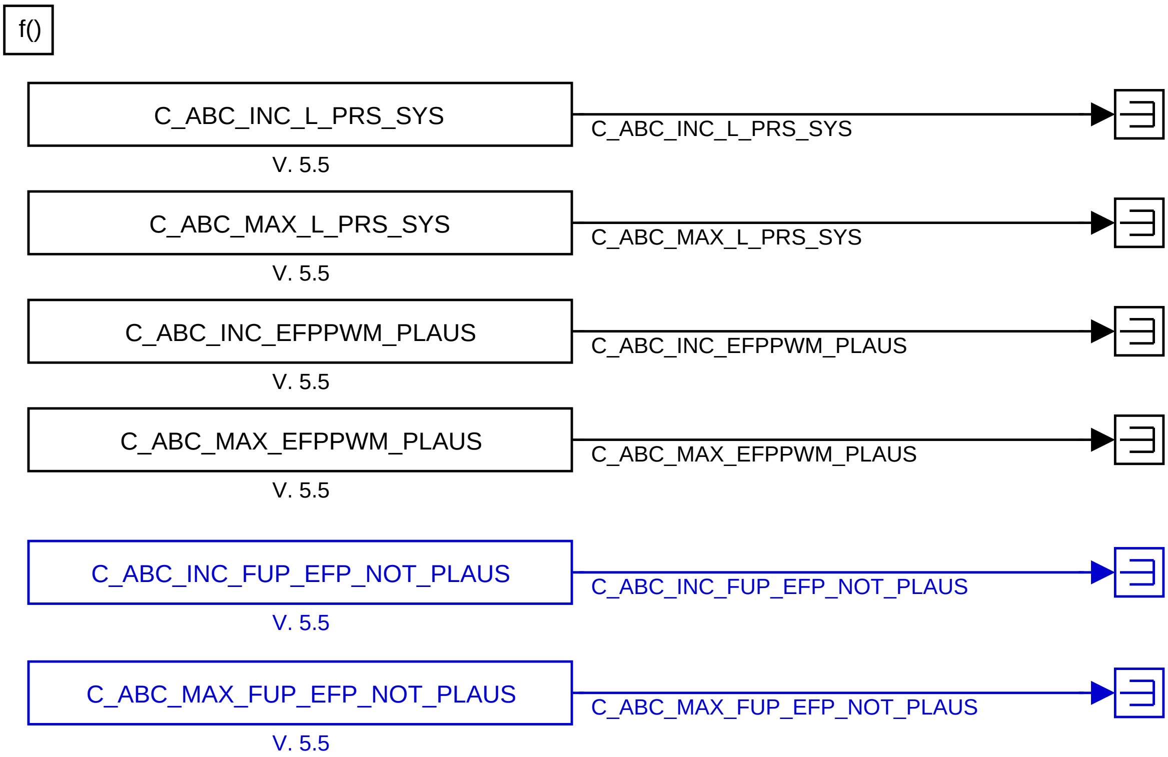

Figure B.95.2: : Path: FUSL_MB073/OPM

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B.96 Fuel system pressure diagnosis for low pressure

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_EFPPWM_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom EFPPWM plausibility check					
ERR_SYM_FUP_EFP_NOT_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom for FUP_EFP_NOT_PLAUS diagnosis					
ERR_SYM_L_PRS_SYS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom for low pressure system monitoring					
FUP_EFP_NOT_PLAUS	V	0... FFFFH	0... 173888	2.65336079	hPa
Filtered FUP_EFP for FUP_EFP_NOT_PLAUS diagnosis					
LV_CDN_DIAG_EFPPWM_PLAUS	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for EFPPWM plausibility check					
LV_CDN_DIAG_FUP_EFP_NOT_PLAUS	V	0... 1H	0 ...1	1	-
Condition flag for FUP_EFP_NOT_PLAUS diagnosis					
LV_CDN_DIAG_L_PRS_SYS	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for low pressure system monitoring					
LV_END_DIAG_EFPPWM_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis flag for EFPPWM plausibility check					
LV_END_DIAG_FUP_EFP_NOT_PLAUS	V	0... 1H	0 ...1	1	-
End diag flag for FUP_EFP_NOT_PLAUS diagnosis					
LV_END_DIAG_L_PRS_SYS	V	0... 1H	0 ...1	1	-
End of diagnosis flag for low pressure system monitoring					
LV_ERR_EFPPWM_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean that indicates inconsistencies of the EFPPWM signal					
LV_ERR_FUP_EFP_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
Error flag for FUP_EFP_NOT_PLAUS diagnosis					
LV_ERR_L_PRS_SYS	O/V	0... 1H	0 ...1	1	-
Boolean that indicates abnormal fuel pressure value in low pressure fuel system					
T_EFPPWM_PLAUS_0	V	0... FFH	0... 5.1	0.02	s
Delaytime for EFPPWM_PLAUS SYM 0					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_FUP_EFP_NOT_PLAUS_PWM_SWI	V	0... FFFFH	0... 1310.7	0.02	s
Timer for delay after STATE_PWM_SWI to allow FUP_EFP_NOT_PLAUS diagnosis					
T_PUC_END	V	0... FFH	0... 5.1	0.02	s
Timer EFPPWM plausibility check inhibition after PUC					

Input data:

EFPPWM_I {p. 3796}	EFPPWM_I_AD {p. 3796}	EFPPWM_MIN_AD {p. 3796}	FTL {p. 1564}
FUP_EFP {p. 1290}	FUP_EFP_MES {p. 1290}	FUP_EFP_SP {p. 3792}	LV_ECU_LOCK
LV_ECU_SLA {p. 800}	LV_EFPPWM_I_AD_VLD {p. 3796}	LV_EFPPWM_MIN_VLD {p. 3797}	LV_ERR_CAN_BOFF {p. 4846}
LV_ERR_COM_2_BOFF {p. 801}	LV_ERR_COM_2_EFP {p. 801}	LV_ERR_COM_3_BOFF {p. 801}	LV_ERR_COM_3_EFP {p. 801}
LV_ERR_EFP {p. 4721}	LV_ERR_FUP_EFP {p. 4733}	LV_FUP_LIH_HOM_VCV_OPEN_REQ {p. 4001}	LV_FUP_LIH_L_PRS_CTL_REQ {p. 4001}
LV_IGK {p. 906}	LV_PUC {p. 1720}	LV_VAR_EFP_COM_2 {p. 805}	LV_VAR_EFP_COM_3 {p. 805}
MFF_SP_FUP_CTL {p. 2151}	N_32 {p. 1525}	NC_STATE_ECU_MST_SLA {p. 806}	STATE_EFP {p. 3797}
STATE_PWM_VCV {p. 3955}	T_AST {p. 1766}	TCO {p. 1100}	VFF_MFF_SP_FUP_CTL {p. 3881}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_FUP_EFP_NOT_PLAUS	V	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant for FUP_EFP_NOT_PLAUS calculation					
C_EFPPWM_I_AD_DIAG_MAX	V	8000... 7FFFH	-50... 49.998474121093	0.00152587	%
Maximum threshold for adaptive I-part of the EFPPWM					
C_EFPPWM_I_AD_DIAG_MIN	V	8000... 7FFFH	-50... 49.998474121093	0.00152587	%
Minimum threshold for adaptive I-part of the EFPPWM					
C_EFPPWM_I_DIAG_MAX	V	8000... 7FFFH	-50... 49.998474121093	0.00152587	%
Maximum threshold for I-part of the EFPPWM					
C_EFPPWM_I_DIAG_MIN	V	8000... 7FFFH	-50... 49.998474121093	0.00152587	%
Minimum threshold for I-part of the EFPPWM					
C_EFPPWM_MIN_AD_DIAG_MAX	V	0... FFFFH	0... 99.998474121093	0.00152587	%
Maximum threshold for adaptive minimum EFPPWM					
C_EFPPWM_MIN_AD_DIAG_MIN	V	0... FFFFH	0... 99.998474121093	0.00152587	%
Minimum threshold for adaptive minimum EFPPWM					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FTL_MIN_EFPPWM_PLAUS_DIAG	V	0... 7FH	0... 127	1	l
Minimum fuel tank level for the EFPPWM plausibility diagnosis					
C_FTL_MIN_L_PRS_SYS_DIAG	V	0... 7FH	0... 127	1	l
Minimum fuel tank level for the low pressure system diagnosis					
C_FUP_EFP_BOL_1	V	0... FFFFH	0... 173888	2.65336079	hPa
Bottom fuel pressure threshold 1					
C_FUP_EFP_NOT_PLAUS_DEV_MAX	V	0... FFFFH	0... 173888	2.65336079	hPa
Maximum FUP EFP deviation for FUP_EFP_NOT_PLAUS error					
C_FUP_EFP_SP_DIF_DIAG_FUP_EFP	V	0... FFFFH	0... 173888	2.65336079	hPa
Condition for stable FUP EFP for NOT_PLAUS error					
C_FUP_EFP_SP_MAX_EFPPWM_PLAUS	V	0... FFFFH	0... 173888	2.65336079	hPa
Maximum fuel pressure setpoint of electrical fuel pump for the plausibility check					
C_FUP_EFP_SP_MIN_EFPPWM_PLAUS	V	0... FFFFH	0... 173888	2.65336079	hPa
Minimum fuel pressure setpoint of electrical fuel pump for the plausibility check					
C_FUP_EFP_TOL_1	V	0... FFFFH	0... 173888	2.65336079	hPa
Top fuel pressure threshold 1					
C_FUP_EFP_TOL_2	V	0... FFFFH	0... 173888	2.65336079	hPa
Top fuel pressure threshold 2					
C_MFF_SP_MAX_EFPPWM_PLAUS	V	0... FFFFH	0... 1389	0.02119478	mg/stk
Maximum mass fuel flow setpoint of fuel pressure control used for the plausibility check					
C_MFF_SP_MAX_FUP_EFP_NOT_PLAUS	V	0... FFFFH	0... 1389	0.02119478	mg/stk
Maximum injected fuel mass for the FUP_EFP_NOT_PLAUS diagnosis					
C_MFF_SP_MIN_EFPPWM_PLAUS	V	0... FFFFH	0... 1389	0.02119478	mg/stk
Minimum mass fuel flow setpoint of fuel pressure control used for the plausibility check					
C_MFF_SP_MIN_FUP_EFP_NOT_PLAUS	V	0... FFFFH	0... 1389	0.02119478	mg/stk
Minimum injected fuel mass for the FUP_EFP_NOT_PLAUS diagnosis					
C_N_32_FUP_EFP_DIAG	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for EFPWPM plausibility check (Default value 800)					
C_N_32_MAX_EFPPWM_PLAUS	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for the plausibility check					
C_N_32_MAX_FUP_EFP_NOT_PLAUS	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for the FUP_EFP_NOT_PLAUS diagnosis					
C_N_32_MAX_L_PRS_SYS	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for the plausibility check					
C_N_32_MIN_EFPPWM_PLAUS	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for the plausibility check					
C_N_32_MIN_FUP_EFP_NOT_PLAUS	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for the FUP_EFP_NOT_PLAUS diagnosis					
C_N_32_MIN_L_PRS_SYS	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for the plausibility check					
C_T_AST_FUP_EFP_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
Time for inhibit diagnosis for the low pressure system					
C_T_AST_FUP_EFP_NOT_PLAUS	V	0... FFFFH	0... 6553.5	0.1	s
Time after start to allow FUP_EFP_NOT_PLAUS diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_EFPPWM_PLAUS_0	V	0... FFH	0... 5.1	0.02	s
INI value of delaytime for EFPPWM_PLAUS SYM 0					
C_T_FUP_EFP_NOT_PLAUS_PWM_SWI	V	0... FFFFH	0... 1310.7	0.02	s
Time after STATE_PWM_SWI to allow FUP_EFP_NOT_PLAUS diagnosis					
C_T_PUC_END_EFPPWM_PLAUS	V	0... FFH	0... 5.1	0.02	s
Time of EFPPWM plausibility check inhibition after PUC					
C_TCO_MAX_EFPPWM_PLAUS	V	0... FEH	-48... 142.5	0.75	°C
Maximum temperature for the plausibilty check					
C_TCO_MIN_EFPPWM_PLAUS	V	0... FEH	-48... 142.5	0.75	°C
Minimum temperature for the plausibility check					
C_VFF_SP_MAX_EFPPWM_PLAUS	V	0... FFFFH	0... 255	0.00389105	l/h
Maximum volume fuel flow through the injectors for the plausibility check					
C_VFF_SP_MIN_EFPPWM_PLAUS	V	0... FFFFH	0... 255	0.00389105	l/h
Minimum volume fuel flow through the injectors for the plausibility check					
LC_EFPPWM_I_AD_ENA	V	0... 1H	0 ...1	1	-
Logical constant for enabling of the I-Part adaptive					
LC_EFPPWM_MIN_ENA	V	0... 1H	0 ...1	1	-
Logical constant for enabling of the minimum EFPPWM					

General information

The purpose of this module is to diagnose mechanical errors in the low pressure system.

Specific diagnostic information for the project is defined in chapters ‘Diagnosis information’ (freeze frame, DTC, error code number, symptom number, data for MIL management, ...).

After debounce, the correponding error bit LV_ERR... is set to 1, and the corresponding symptom is active.
Only if the driving cycle is finished, the error bit LV_ERR... and the debounced counter are set to 0, and the corresponding symptom is not active.

B.96.1 Fuel system pressure diagnosis for low pressure

General information:

If the software works in a master/slave ECU environment, the compiler switch NC_STATE_ECU_MST_SLA has a value $>$ 0.
In this case, the module will not be activated on the slave ECU, and all outputs will remain 0.

Application conditions:

Initialisation:

```
All values are initialized at ECU Reset, according Filter-type
STD_INI

T_PUC_END   =  C_T_PUC_END_EFPPWM_PLAUS
```

Activation:

```
If ( NC_STATE_ECU_MST_SLA = 0 // no master/ slave system
   or LV_ECU_SLA = 0 )         // master ECU
   and ( LV_IGK = 1 and N_32 > C_N_32_FUP_EFP_DIAG )
```

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Deactivation: *activation condition not fullfilled*

```
at deactivation: LV_CDN_DIAG_EFPPWM_PLAUS = 0
                 LV_CDN_DIAG_L_PRS_SYS = 0
                 LV_CDN_DIAG_FUP_EFP_NOT_PLAUS = 0
                 T_EFPPWM_PLAUS_0 = 0
```

Recurrence: 20ms

Function description:

Formula section:

B.96.2 Plausibility check EFPPWM

General information:

The plausibility check for the EFPPWM consists out of three parts:
1) A check of the I-part of the controller is done, which indicates mainly rapid changes in the performance of the pump or other low pressure system related topics.
2) The adaptive integral part can be used as an indicator for life time topics of the fuel pump.
3) The adaptive minimum EFPPWM gives the functionality of the fuel pump at ‘zero delivery’ to the high pressure system.

Application conditions:

Initialisation: –

Activation: –

Deactivation: –

Recurrence: –

Function description:

Formula section:

The calculation of the plausibility check is only done, if the function is activated, otherwise the plausibiltiy check is stopped and all values are stored until reactivation.

```
timeout after trailing throttle fuel cut-off
If(1)    LV_PUC = 0
then(1)  T_PUC_END - - //decrement timer until 0s
else(1)  T_PUC_END = C_T_PUC_END_EFPPWM_PLAUS
endif(1)

condition for plausibility check EFPPWM
If(1)    LV_ERR_EFPPWM_PLAUS = 0                        and
         LV_ERR_FUP_EFP = 0                             and
         LV_ERR_CAN_BOFF = 0                            and
         LV_FUP_LIH_HOM_VCV_OPEN_REQ = 0                and
         LV_FUP_LIH_L_PRS_CTL_REQ = 0                   and
```

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```
            C_N_32_MAX_EFPPWM_PLAUS >= N_32 >= C_N_32_MIN_EFPPWM_PLAUS and
            C_TCO_MAX_EFPPWM_PLAUS >= TCO >= C_TCO_MIN_EFPPWM_PLAUS    and
            FUP_EFP_SP          >= C_FUP_EFP_SP_MIN_EFPPWM_PLAUS       and
            FUP_EFP_SP          <= C_FUP_EFP_SP_MAX_EFPPWM_PLAUS       and
            MFF_SP_FUP_CTL      >= C_MFF_SP_MIN_EFPPWM_PLAUS           and
            MFF_SP_FUP_CTL      <= C_MFF_SP_MAX_EFPPWM_PLAUS           and
            VFF_MFF_SP_FUP_CTL >= C_VFF_SP_MIN_EFPPWM_PLAUS            and
            VFF_MFF_SP_FUP_CTL <= C_VFF_SP_MAX_EFPPWM_PLAUS            and
            LV_PUC = 0 and T_PUC_END = 0                               and
            STATE_EFP = EFP_ON (2H)                                    and
            T_AST > C_T_AST_FUP_EFP_DIAG                               and
            FTL > C_FTL_MIN_EFPPWM_PLAUS_DIAG                          and
            ( ( LC_EFPPWM_MIN_ENA = 0 and  LV_EFPPWM_MIN_VLD = 1 )
            or  LC_EFPPWM_MIN_ENA = 1 )                                and
            ( ( LC_EFPPWM_I_AD_ENA = 0 and  LV_EFPPWM_I_AD_VLD = 1 )
            or  LC_EFPPWM_I_AD_ENA = 1 )                               and
            (
               ( LV_VAR_EFP_COM_2 = 1 and  LV_ERR_COM_2_BOFF = 0 and
                 LV_ERR_COM_2_EFP = 0 )
              or
               ( LV_VAR_EFP_COM_3 = 1 and  LV_ERR_COM_3_BOFF = 0 and
                 LV_ERR_COM_3_EFP = 0 )
            )
then(1)     LV_CDN_DIAG_EFPPWM_PLAUS  =  1
else(1)     LV_CDN_DIAG_EFPPWM_PLAUS  =  0
endif(1)

failure detection for plausibility check EFPPWM
If(1)       LV_CDN_DIAG_EFPPWM_PLAUS = 1
then(1)     If(2)      EFPPWM_I < C_EFPPWM_I_DIAG_MIN or
                       EFPPWM_I > C_EFPPWM_I_DIAG_MAX

            then(2)    check of integral part of EFPPWM
            If(3)      T_EFPPWM_PLAUS_0 < C_T_EFPPWM_PLAUS_0
            then(3)    T_EFPPWM_PLAUS_0 ++
                       //increment timer until C_T_EFPPWM_PLAUS_0
            else(3)    symptom "integral part of EFPPWM out of range" active
                       ERR_SYM_EFPPWM_PLAUS = SYM_0
                       increment anti-bounce counter
                       apply filter on current symptom
            If(4)      filtering result available (after debounce)
            then(4)    LV_ERR_EFPPWM_PLAUS = filtering result
                       LV_END_DIAG_EFPPWM_PLAUS = 1
                       deliver diagnostic result to error management
            endif(4)
            endif(3)

            else(2)    check of adaptive integral part of EFPPWM
                       T_EFPPWM_PLAUS_0 = 0
            If(3)      EFPPWM_I_AD < C_EFPPWM_I_AD_DIAG_MIN or
                       EFPPWM_I_AD > C_EFPPWM_I_AD_DIAG_MAX
            then(3)    symptom "adaptive integral part of EFPPWM out of range"
                       active
                       ERR_SYM_EFPPWM_PLAUS = SYM_1
                       increment anti-bounce counter
                       apply filter on current symptom
            If(4)      filtering result available (after debounce)
            then(4)    LV_ERR_EFPPWM_PLAUS = filtering result
                       LV_END_DIAG_EFPPWM_PLAUS = 1
                       deliver diagnostic result to error management
            endif(4)
```

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```
          else(3)  check of adaptive minimum of EFPPWM
          If(4)    EFPPWM_MIN_AD < C_EFPPWM_MIN_AD_DIAG_MIN or
                   EFPPWM_MIN_AD > C_EFPPWM_MIN_AD_DIAG_MAX
          then(4)  symptom "adaptive minimum EFPPWM out of range" active
                   ERR_SYM_EFPPWM_PLAUS = SYM_2
                   increment anti-bounce counter
                   apply filter on current symptom
          If(5)    filtering result available (after debounce)
          then(5)  LV_ERR_EFPPWM_PLAUS = filtering result
                   LV_END_DIAG_EFPPWM_PLAUS = 1
                   deliver diagnostic result to error management
          endif(5)

          else(4)  no symptom active
                   ERR_SYM_EFPPWM_PLAUS = NO_SYM
                   decrement anti-bounce counter
          endif(4)
          endif(3)
          endif(2)
else(1)   T_EFPPWM_PLAUS_0 = 0
endif(1)
```

B.96.3 LP system monitoring

General information:

Certain pressure thresholds are monitored, in order to detect mechanical faults of the components of the fuel circuit.
There are two pressure limits to detect overpressure, and there is one to detect that pressure is too low:
1) FUP_EFP > Tol2 : Indicates an overpressure with an error in the LP pump pressure relief valve. The pressure is higher than the pressure at which the relief valve should open.
2) Tol1 < FUP_EFP < Tol2 : Indicates a pressure which is below the critical value of the LP pump pressure relief valve. This could happen when there is a mechanical fault, but the overpressure relief valve is still ok.
3) FUP < Bol1 : Indicates an excessive loss of pressure. Mechanical failure in the pump or regulator, or fuel leakage, can be detected this way.

Application conditions:

Initialisation: –

Activation: –

Deactivation: –

Recurrence: –

Function description:

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Formula section:

```
condition for LP system monitoring
If(1)    LV_ERR_L_PRS_SYS = 0                                        and
         LV_ERR_FUP_EFP = 0                                          and
         LV_FUP_LIH_HOM_VCV_OPEN_REQ = 0                             and
         C_N_32_MAX_L_PRS_SYS >= N_32 >= C_N_32_MIN_L_PRS_SYS        and
         STATE_EFP = EFP_ON (2H)                                     and
         T_AST > C_T_AST_FUP_EFP_DIAG                                and
         FTL > C_FTL_MIN_L_PRS_SYS_DIAG                              and
         (( NC_STATE_ECU_MST_SLA = 0 or LV_ECU_LOCK = 0 ) or

         // no master/ slave system or current bank is enabled
then(1)  LV_CDN_DIAG_L_PRS_SYS  =  1
else(1)  LV_CDN_DIAG_L_PRS_SYS  =  0
endif(1)

failure detection for LP system monitoring
If(1)    LV_CDN_DIAG_L_PRS_SYS = 1
then(1)  check of top limit 2 error
         If(2)     (FUP_EFP > C_FUP_EFP_TOL_2)
         then(2)  symptom "FUP_EFP top limit 2 reached" active
                  ERR_SYM_L_PRS_SYS = SYM_1
                  increment anti-bounce counter
                  apply filter on current symptom
         If(3)    filtering result available (after debounce)
         then(3)  LV_ERR_L_PRS_SYS = filtering result
                  LV_END_DIAG_L_PRS_SYS = 1
                  deliver diagnostic result to error management
         endif(3)

         else(2)  check of top limit 1 error
         If(3)    (FUP_EFP > C_FUP_EFP_TOL_1)
         then(3)  symptom "FUP_EFP top limit 1 reached" active
                  ERR_SYM_L_PRS_SYS = SYM_0
                  increment anti-bounce counter
                  apply filter on current symptom
         If(4)    filtering result available (after debounce)
         then(4)  LV_ERR_L_PRS_SYS = filtering result
                  LV_END_DIAG_L_PRS_SYS = 1
                  deliver diagnostic result to error management
         endif(4)

         else(3)  check bottom limit 1 error
         If(4)    (FUP_EFP < C_FUP_EFP_BOL_1)
         then(4)  symptom "FUP_EFP bottom limit 1 reached" active
                  ERR_SYM_L_PRS_SYS = SYM_2
                  increment anti-bounce counter
                  apply filter on current symptom
         If(5)    filtering result available (after debounce)
         then(5)  LV_ERR_L_PRS_SYS = filtering result
                  LV_END_DIAG_L_PRS_SYS = 1
                  deliver diagnostic result to error management
         endif(5)

         else(4)  no symptom active
                  ERR_SYM_L_PRS_SYS = NO_SYM
                  decrement anti-bounce counter
         endif(4)
         endif(3)
         endif(2)
endif(1)
```

B.96.4 FUP_EFP_NOT_PLAUS monitoring

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General information:

Diagnosis to detect wire break at low fuel pressure sensor.

Application conditions:

Initialisation: –

Activation: –

Deactivation: –

Recurrence: –

Function description:

Formula section:

```
condition for FUP_EFP_NOT_PLAUS monitoring
If(1)     STATE_PWM_VCV_n   = STATE_PWM_VCV_n-1
then(1)   T_FUP_EFP_NOT_PLAUS_PWM_SWI - - //decrement timer until 0s
else(1)   T_FUP_EFP_NOT_PLAUS_PWM_SWI = C_T_FUP_EFP_NOT_PLAUS_PWM_SWI
endif(1)

If(1)     LV_ERR_EFP = 0                    and
          LV_ERR_FUP_EFP = 0                and
          C_N_32_MAX_FUP_EFP_NOT_PLAUS
          >= N_32 >=
          C_N_32_MIN_FUP_EFP_NOT_PLAUS      and
          C_MFF_SP_MAX_FUP_EFP_NOT_PLAUS
          >= MFF_SP_FUP_CTL >=
          C_MFF_SP_MIN_FUP_EFP_NOT_PLAUS    and
          T_AST > C_T_AST_FUP_EFP_NOT_PLAUS and
          T_FUP_EFP_NOT_PLAUS_PWM_SWI = 0
then(1)   LV_CDN_DIAG_FUP_EFP_NOT_PLAUS = 1
else(1)   LV_CDN_DIAG_FUP_EFP_NOT_PLAUS = 0
endif(1)

failure detection for FUP_EFP_NOT_PLAUS monitoring
If(1)     LV_CDN_DIAG_FUP_EFP_NOT_PLAUS = 1
then(1)   If(2)     LV_CDN_DIAG_FUP_EFP_NOT_PLAUS_n-1  = 0
          then(2)   FUP_EFP_NOT_PLAUS = FUP_EFP_MES
          else(2)   FUP_EFP_NOT_PLAUS = FUP_EFP_NOT_PLAUS_n-1
                    + C_CRLC_FUP_EFP_NOT_PLAUS
                    * ( FUP_EFP_MES - FUP_EFP_NOT_PLAUS_n-1)
          endif(2)

          If(2)     check of "FUP_EFP_NOT_PLAUS top limit 1 reached" error
                    Abs( FUP_EFP_SP_n  - FUP_EFP_SP_n-1)
                    < C_FUP_EFP_SP_DIF_DIAG_FUP_EFP          and
                    Abs( FUP_EFP_MES - FUP_EFP_NOT_PLAUS )
                    > C_FUP_EFP_NOT_PLAUS_DEV_MAX
          then(2)   symptom "FUP_EFP_NOT_PLAUS top limit 1 reached" active
                    ERR_SYM_FUP_EFP_NOT_PLAUS = SYM_0
                    increment anti-bounce counter
                    apply filter on current symptoms
          If(3)     filtering result available (after debounce)
          then(3)   LV_ERR_FUP_EFP_NOT_PLAUS = filtering result
                    LV_END_DIAG_ FUP_EFP_NOT_PLAUS = 1
```

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```
                deliver diagnostic result to error management
        endif(3)

        else(2)  no symptom active
                 ERR_SYM_FUP_EFP_NOT_PLAUS = NO_SYM
                 decrement anti-bounce counter
        endif(2)
endif(1)
```

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B.97 Fuel system pressure diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_FUP_MFP_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom FUP/MFP plausibility check					
ERR_SYM_FUP_ORNG	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom FUP_ORNG check					
ERR_SYM_FUP_ST_DLY	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom delayed FUP start					
ERR_SYM_FUP_ST_H_PRS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom of FUP start diagnosis - fuel pressure at high pressure start is too low					
ERR_SYM_FUP_ST_NO_RISE	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom FUP_ST_NO_RISE					
ERR_SYM_FUP_STOP	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom FUP check after engine stop					
ERR_SYM_H_PRS_SYS_PRE	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom for high pressure system monitoring					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_VCV_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom for adaptation plausibility check					
FAC_LAM_DIF_MFP_PLAUS	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Deviation of fuel mass controller for MFP_PLAUS					
LV_CDN_DIAG_FUP_MFP_PLAUS	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for FUP/MFP plausibility check					
LV_CDN_DIAG_FUP_MFP_PLAUS_1	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for FUP/MFP plausibility check SYM 1					
LV_CDN_DIAG_FUP_ORNG	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for FUP_ORNG check					
LV_CDN_DIAG_FUP_ST_DLY	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for delayed FUP start					
LV_CDN_DIAG_FUP_ST_H_PRS	V	0... 1H	0 ...1	1	-
Conditions fulfilled for detection of fault or fault-free state of FUP start diagnosis - fuel pressure at high pressure start is too low					
LV_CDN_DIAG_FUP_ST_NO_RISE	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for FUP_ST_NO_RISE					
LV_CDN_DIAG_FUP_STOP	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for FUP check after engine stop					
LV_CDN_DIAG_H_PRS_SYS_PRE	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for high pressure system monitoring					
LV_CDN_DIAG_H_PRS_SYS_PRE_2	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for high pressure system monitoring SYM 2					
LV_CDN_DIAG_VCV_PLAUS	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for VCV adaption plausibility check					
LV_END_DIAG_FUP_MFP_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis flag for FUP/MFP plausibility check					
LV_END_DIAG_FUP_ORNG	V	0... 1H	0 ...1	1	-
End of diagnosis flag for FUP sensor ORNG check					
LV_END_DIAG_FUP_ST_DLY	V	0... 1H	0 ...1	1	-
End of diagnosis flag for delayed FUP too low at engine start					
LV_END_DIAG_FUP_ST_H_PRS	V	0... 1H	0 ...1	1	-
End of diagnosis flag FUP start diagnosis - fuel pressure at high pressure start is too low					
LV_END_DIAG_FUP_ST_NO_RISE	V	0... 1H	0 ...1	1	-
End of diagnosis flag for FUP_ST_NO_RISE					
LV_END_DIAG_FUP_STOP	V	0... 1H	0 ...1	1	-
End of diagnosis flag for FUP check after engine stop					
LV_END_DIAG_H_PRS_SYS_PRE	V	0... 1H	0 ...1	1	-
End of diagnosis flag for high pressure system monitoring					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_VCV_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis flag for dadption plausibility check					
LV_ERR_FUP_MFP_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean that indicates inconsistencies between fuel pressure and mass fuel pump					
LV_ERR_FUP_ORNG	O/V	0... 1H	0 ...1	1	-
Boolean that indicates fuel pressure out of range					
LV_ERR_FUP_ST	O/V	0... 1H	0 ...1	1	-
Error flag for fuel pressure at start too low					
LV_ERR_FUP_ST_DLY	O/V	0... 1H	0 ...1	1	-
Error flag for delayed fuel pressureat start too low					
LV_ERR_FUP_ST_H_PRS	O/V	0... 1H	0 ...1	1	-
Error flag for FUP start diagnosis - fuel pressure at high pressure start is too low					
LV_ERR_FUP_ST_NO_RISE	O/V	0... 1H	0 ...1	1	-
Error flag for no rising fuel pressure at start					
LV_ERR_FUP_STOP	O/V	0... 1H	0 ...1	1	-
Boolean that indicates to high fuel pressure after engine stop					
LV_ERR_H_PRS_SYS	O/V	0... 1H	0 ...1	1	-
Boolean that indicates abnormal fuel pressure value in fuel system					
LV_ERR_H_PRS_SYS_PRE	O/V	0... 1H	0 ...1	1	-
Boolean that indicates abnormal fuel pressure value in fuel system					
LV_ERR_VCV_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean that indicates abnormal value of the VCV adaptation					
T_DLY_ERR_SYM_FUP_ST_DLY	V	0... FFH	0... 2550	10	ms
Delay timer for setting delayed fuel pressure at start too low symptom					
T_FUP_STOP	V	0... FFFFH	0... 1310.7	0.02	s
Time for detection of to high fuel pressure in the power latch					
VFF_VCV_DIAG_CLC	V	0... FFFFH	0... 255	3.89105e-3	l/h
Calculated VCV flow for diagnosis					

Input data:

CUR_VCV_BAS {p. 3953}	CUR_VCV_BAS_AD_VAR_2_ADD {p. 3953}	CUR_VCV_DIF_REL {p. 3953}	CUR_VCV_MIN_AD {p. 3953}
ERR_SYM_FSD [NC_CBK_EX_NR] {p. 6140}	ERR_SYM_FSD_H_RNG [NC_CBK_EX_NR] {p. 6140}	ERR_SYM_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6140}	FAC_CUR_VCV_BAS_AD_VAR_2 {p. 3953}
FAC_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2461}	FAC_LAM_LIM [NC_CBK_EX_NR] {p. 2461}	FAC_MFF_ADD_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2641}	FUEL_MASS_REQ_CTL {p. 3908}
FUP {p. 1283}	FUP_DIF {p. 3909}	LV_CAT_PURGE_ACT [NC_CBK_EX_NR] {p. 2927}	LV_CH {p. 8232}
LV_DC {p. 5746}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_H_RNG [NC_CBK_EX_NR] {p. 6141}	LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR] {p. 6141}
LV_ERR_FUP_CH {p. 6102}	LV_IGK {p. 906}	LV_INH_FUP_MFP_PLAUS {p. 6095}	LV_INH_FUP_ORNG {p. 6095}

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LV_INH_FUP_ST_BOL {p. 6095}	LV_INH_FUP_STOP {p. 6095}	LV_INH_H_PRS_SYS_PRE {p. 6095}	LV_INH_VCV_PLAUS {p. 6095}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	LV_PWL {p. 988}	LV_ST_END {p. 1720}	LV_ST_H_PRS {p. 8242}
LV_ST_INJ_AUTH {p. 8242}	LV_SYM_FUP_ST_NO_RISE {p. 8262}	LV_TI_1_HOM_MIN {p. 2000}	LV_TI_2_HOM_MIN {p. 2000}
MFF_SP_FUP_CTL {p. 2151}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_IDX_DIAG_FUP_MFP_PLAUS
NC_IDX_DIAG_FUP_ORNG	NC_IDX_DIAG_FUP_ST_DLY	NC_IDX_DIAG_FUP_ST_H_PRS	NC_IDX_DIAG_FUP_ST_NO_RISE
NC_IDX_DIAG_FUP_STOP	NC_IDX_DIAG_H_PRS_SYS_PRE	NC_IDX_DIAG_VCV_PLAUS	STATE_FUP_CTL {p. 3881}
STATE_PWM_VCV {p. 3955}	T_AST {p. 1766}	TCO_ST {p. 1100}	TFU {p. 1232}
VFF_MFF_SP_FUP_CTL {p. 3881}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_FUP_MFP_PLAUS	V	0... FFH	0... 255	1	-
Increment of the plausibility check of FUP/MFP anti-bounce counter					
C_ABC_INC_FUP_ORNG	V	0... FFH	0... 255	1	-
Increment of the FUP ORNG anti-bounce counter					
C_ABC_INC_FUP_ST_DLY	V	0... FFH	0... 255	1	-
Increment of delayed FUP at start monitoring anti-bounce counter					
C_ABC_INC_FUP_ST_H_PRS	V	0... 7FH	0... 127	1	-
Debounce counter increment of FUP start diagnosis - fuel pressure at high pressure start is too low					
C_ABC_INC_FUP_ST_NO_RISE	V	0... FFH	0... 255	1	-
Increment for no rising fuel pressure at start monitoring anti-bounce counter					
C_ABC_INC_FUP_STOP	V	0... FFH	0... 255	1	-
Increment of the FUP_STOP check anti-bounce counter					
C_ABC_INC_H_PRS_SYS_PRE	V	0... FFH	0... 255	1	-
Increment of high pressure system monitoring anti-bounce counter					
C_ABC_INC_VCV_PLAUS	V	0... FFH	0... 255	1	-
Increment of the VCV adaption check anti-bounce counter					
C_ABC_MAX_FUP_MFP_PLAUS	V	1... FFH	1... 255	1	-
Threshold to be reached, before plausibility check error of FUP/MFP					
C_ABC_MAX_FUP_ORNG	V	1... FFH	1... 255	1	-
Threshold to be reached, before FUP ORNG error					
C_ABC_MAX_FUP_ST_DLY	V	1... FFH	1... 255	1	-
Threshold to be reached, before permanently activating delayed FUP too low at start monitoring error					
C_ABC_MAX_FUP_ST_H_PRS	V	1... 7FH	1... 127	1	-
Debounce counter maximum of FUP start diagnosis - fuel pressure at high pressure start is too low					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_FUP_ST_NO_RISE	V	1... FFH	1... 255	1	-
Threshold to be reached, before permanently activating no rising fuel pressure at start monitoring error					
C_ABC_MAX_FUP_STOP	V	1... FFH	1... 255	1	-
Threshold to be reached, before FUP_STOP check error					
C_ABC_MAX_H_PRS_SYS_PRE	V	1... FFH	1... 255	1	-
Threshold to be reached, before permanently activating high pressure system monitoring error					
C_ABC_MAX_VCV_PLAUS	V	1... FFH	1... 255	1	-
Threshold to be reached, before VCV adaption check error					
C_CUR_VCV_AD_MFP_DIAG_MAX	V	8000... 7FFFH	-32.768 ...32.767	0.001	A
Maximum adapted additive curent value					
C_CUR_VCV_AD_MFP_DIAG_MAX_1	V	8000... 7FFFH	-32.768 ...32.767	0.001	A
Maximum adapted additive curent value SYM 1					
C_CUR_VCV_AD_MFP_DIAG_MAX_2	V	8000... 7FFFH	-32.768 ...32.767	0.001	A
Maximum adapted additive curent value SYM 2					
C_CUR_VCV_AD_MFP_DIAG_MIN	V	8000... 7FFFH	-32.768 ...32.767	0.001	A
Minimum adapted additive curent value					
C_CUR_VCV_BAS_AD_VCV_PLAUS_MAX	V	8000... 7FFFH	-32.768 ...32.767	0.001	A
Maximum adapted additive curent value					
C_CUR_VCV_BAS_AD_VCV_PLAUS_MIN	V	8000... 7FFFH	-32.768 ...32.767	0.001	A
Minimum adapted additive curent value					
C_CUR_VCV_DIF_REL_DIAG_MAX	V	8000... 7FFFH	-2... 1.9999389648437	61.0351e-6	-
Maximum relative current deviation to enable FUP_MFP_PLAUS and H_PRS_SYS diagnosis					
C_CUR_VCV_MIN_AD_VCV_PLAUS_MAX	V	8000... 7FFFH	-32.768 ...32.767	0.001	A
Maximum adapted minimum curent value					
C_CUR_VCV_MIN_AD_VCV_PLAUS_MIN	V	8000... 7FFFH	-32.768 ...32.767	0.001	A
Minimum adapted minimum curent value					
C_DLY_ERR_SYM_FUP_ST_DLY	V	0... FFH	0... 2550	10	ms
Delay time for setting delayed fuel pressure at start too low symptom					
C_FAC_CUR_VCV_AD_MFP_DIAG_MAX	V	8000... 7FFFH	-2... 1.9999389648437	61.0351e-6	-
Maximum adapted factor value					
C_FAC_CUR_VCV_AD_MFP_DIAG_MAX_1	V	8000... 7FFFH	-2... 1.9999389648437	61.0351e-6	-
Maximum adapted factor value SYM 1					
C_FAC_CUR_VCV_AD_MFP_DIAG_MAX_2	V	8000... 7FFFH	-2... 1.9999389648437	61.0351e-6	-
Maximum adapted factor value SYM 2					
C_FAC_CUR_VCV_AD_MFP_DIAG_MIN	V	8000... 7FFFH	-2... 1.9999389648437	61.0351e-6	-
Minimum adapted factor value					
C_FAC_CUR_VCV_PLAUS_MAX	V	8000... 7FFFH	-2... 1.9999389648437	61.0351e-6	-
Maximum adapted factor value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_CUR_VCV_PLAUS_MIN	V	8000... 7FFFH	-2... 1.9999389648437	61.0351e-6	-
Minimum adapted factor value					
C_FAC_LAM_AD_MFP_PLAUS_0	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Limit of FAC Lambda contr. range for MFP_PLAUS SYM_0					
C_FAC_LAM_AD_MFP_PLAUS_1	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Limit of FAC Lambda contr. range for MFP_PLAUS SYM_1					
C_FAC_LAM_H_PRS_SYS_PRE_MAX_0	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Limit of Lambda contr. range for H_PRS_SYS_PRE SYM_0					
C_FAC_LAM_H_PRS_SYS_PRE_MAX_1	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Limit of Lambda contr. range for H_PRS_SYS_PRE SYM_1					
C_FAC_LAM_H_PRS_SYS_PRE_MAX_2	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Limit of Lambda contr. range for H_PRS_SYS_PRE SYM_2					
C_FAC_LAM_H_PRS_SYS_PRE_MIN_0	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Limit of Lambda contr. range for H_PRS_SYS_PRE SYM_0					
C_FAC_LAM_H_PRS_SYS_PRE_MIN_1	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Limit of Lambda contr. range for H_PRS_SYS_PRE SYM_1					
C_FAC_LAM_H_PRS_SYS_PRE_MIN_2	V	8000... 7FFFH	-50... 49.998474121093	1.52587e-3	%
Limit of Lambda contr. range for H_PRS_SYS_PRE SYM_2					
C_FUEL_REQ_CTL_MFP_DIAG_MAX	V	8000... 7FFFH	- 694.5105973907 ...694.48940260929	21.1947e-3	mg
Maximum threshold for highpressure controller					
C_FUEL_REQ_CTL_MFP_DIAG_MAX_1	V	8000... 7FFFH	- 694.5105973907 ...694.48940260929	21.1947e-3	mg
Maximum threshold for highpressure controller SYM1					
C_FUEL_REQ_CTL_MFP_DIAG_MAX_2	V	8000... 7FFFH	- 694.5105973907 ...694.48940260929	21.1947e-3	mg
Maximum threshold for highpressure controller SYM 2					
C_FUEL_REQ_CTL_MFP_DIAG_MIN	V	8000... 7FFFH	- 694.5105973907 ...694.48940260929	21.1947e-3	mg
Minimum threshold for highpressure controller					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUEL_REQ_CTL_MFP_DIAG_MIN_0	V	8000... 7FFFH	-694.5105973907 ...694.48940260929	21.1947e-3	mg
Minimum threshold for highpressure controller SYM0					
C_FUP_BOL_1	V	0... FFFFH	0... 347776	5.30672159	hPa
Bottom fuel pressure threshold 1					
C_FUP_DIF_BOL	V	8000... 7FFFH	-173890 ...173884	5.30669108	hPa
Min FUP difference for H_PRS_SYS SYM 0					
C_FUP_DIF_TOL	V	8000... 7FFFH	-173890 ...173884	5.30669108	hPa
Top limit of FUP difference					
C_FUP_STOP	V	0... FFFFH	0... 347776	5.30672159	hPa
Constant for the limit of fuel pressure after engine stop					
C_FUP_TOL_1	V	0... FFFFH	0... 347776	5.30672159	hPa
Top fuel pressure threshold 1					
C_FUP_TOL_2	V	0... FFFFH	0... 347776	5.30672159	hPa
Top fuel pressure threshold 2					
C_MFF_SP_FUP_MFP_PLAUS_MAX	V	0... FFFFH	0... 1389	21.1947e-3	mg/stk
Maximum Mass fuel flow for FUP_MFP_PLAUS diagnosis					
C_MFF_SP_FUP_MFP_PLAUS_MAX_1	V	0... FFFFH	0... 1389	21.1947e-3	mg/stk
Maximum Mass fuel flow for FUP_MFP_PLAUS diagnosis SYM_1					
C_MFF_SP_FUP_MFP_PLAUS_MIN	V	0... FFFFH	0... 1389	21.1947e-3	mg/stk
Minnimum Mass fuel flow for FUP_MFP_PLAUS diagnosis					
C_MFF_SP_FUP_MFP_PLAUS_MIN_1	V	0... FFFFH	0... 1389	21.1947e-3	mg/stk
Minnimum Mass fuel flow for FUP_MFP_PLAUS diagnosis SYM_1					
C_MFF_SP_H_PRS_SYS_PRE_BOL_0	V	0... FFFFH	0... 1389	21.1947e-3	mg/stk
Bottom limit of MFF for detection of stucked VCV					
C_MFF_SP_H_PRS_SYS_PRE_BOL_2	V	0... FFFFH	0... 1389	21.1947e-3	mg/stk
Bottom limit of MFF for detection of stucked VCV					
C_MFF_SP_H_PRS_SYS_PRE_MAX_2	V	0... FFFFH	0... 1389	21.1947e-3	mg/stk
Maximum Mass fuel flow for FUP_MFP_PLAUS diagnosis SYM_2					
C_MFF_SP_H_PRS_SYS_PRE_MIN_2	V	0... FFFFH	0... 1389	21.1947e-3	mg/stk
Minimum Mass fuel flow for FUP_MFP_PLAUS diagnosis SYM_2					
C_N_32_FUP_DIAG	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for FUP/FPAPWM plausibility check (Default value 800)					
C_N_32_FUP_MFP_PLAUS_MAX	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for the plausibility check					
C_N_32_FUP_MFP_PLAUS_MAX_1	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for the plausibility check SYM_1					
C_N_32_FUP_MFP_PLAUS_MIN	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for the plausibility check					
C_N_32_FUP_MFP_PLAUS_MIN_1	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for the plausibility check SYM_1					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_32_H_PRS_SYS_PRE_MAX_2	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for the plausibility check SYM_2					
C_N_32_H_PRS_SYS_PRE_MIN_2	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for the plausibility check SYM_2					
C_N_32_VCV_PLAUS_MAX	V	0... FFH	0... 8160	32	rpm
Maximum engine speed for the VCV adaption plausibility check					
C_N_32_VCV_PLAUS_MIN	V	0... FFH	0... 8160	32	rpm
Minimum engine speed for VCV adapation plausibility check					
C_N_MIN_ERR_SYM_FUP_ST_DLY	V	0... FFH	0... 8160	32	rpm
Minimum engine speed threshold for setting FUP_ST_DLY error immediately					
C_T_AST_FUP_DIAG_ENA	V	0... FFFFH	0... 6553.5	0.1	s
Threshold for deactivating high pressure start diagnostics after start					
C_T_FUP_STOP	V	0... FFFFH	0... 1310.7	0.02	s
Time constant for detection of the fuel low pressure in the power latch					
C_T_MAX_H_PRS_SYS_PRE_0	V	1... FFFFH	0... 655.35	0.01	s
Maximum delay time to debounce H_PRS_SYS_PRE SYM_0					
C_T_MAX_H_PRS_SYS_PRE_1	V	1... FFFFH	0... 655.35	0.01	s
Maximum delay time to debounce H_PRS_SYS_PRE SYM_1					
C_T_MAX_H_PRS_SYS_PRE_2	V	1... FFFFH	0... 655.35	0.01	s
Maximum delay time to debounce H_PRS_SYS_PRE SYM_2					
C_TFU_VCV_PLAUS_MAX	V	0... FEH	-48... 142.5	0.75	°C
Maximum threshold for the VCV adapation plausibility check					
C_TFU_VCV_PLAUS_MIN	V	0... FEH	-48... 142.5	0.75	°C
Minimum threshold for the VCV adaptatin plausibility check					
C_VFF_VCV_DIF_DIAG_0	V	0... FFFFH	-127.5 ...127.5	3.89105e-3	l/h
Threshold of VCV flow deviation to detect SYM 0					
C_VFF_VCV_DIF_DIAG_1	V	0... FFFFH	-127.5 ...127.5	3.89105e-3	l/h
Threshold of VCV flow deviation to detect SYM 1					
C_VFF_VCV_DIF_DIAG_2	V	0... FFFFH	-127.5 ...127.5	3.89105e-3	l/h
Threshold of VCV flow deviation to detect SYM 2					
C_VFF_VCV_DIF_DIAG_MAX	V	0... FFFFH	-127.5 ...127.5	3.89105e-3	l/h
Threshold of VCV flow deviation to detect FUP_MFP_PLAUS_SYM_1					
C_VFF_VCV_DIF_DIAG_MIN	V	0... FFFFH	-127.5 ...127.5	3.89105e-3	l/h
Threshold of VCV flow deviation to detect FUP_MFP_PLAUS_SYM_0					
IP_FLOW_CUR_BAS_VCV	V	0... FFFFH	0... 255	3.89105e-3	l/h
LDP_CUR_VCV_IP_FLOW_CUR_BAS	16	0... FFFFH	0... 65.535	0.001	A
Map to convert CUR_VCV_BAS into VFF_VCV_DIAG_CLC					
IP_FUP_ST_BOL	V	0... FFFFH	0... 347776	5.30672159	hPa
LDP_TCO_ST_IP_FUP_ST_BOL	6	0... FEH	-48... 142.5	0.75	°C
Threshold to detect FUP at start to low					
LC_ERR_SYM_FUP_ST_DLY	V	0... 1H	0 ...1	1	-
Manual switch for enabling delayed fuel pressure at start too low diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_FUP_MFP_PLAUS_VAR_2_ACT	V	0... 1H	0 ...1	1	-
Switch to enable the second variant of MFP_PLAUS and H_PRS_SYS diagnosis					
LC_INH_FUP_DIAG_ON_CH	V	0... 1H	0 ...1	1	-
High pressure system diagnoses (FUP_MFP_PLAUS and H_PRS_SYS) are inhibited during catalyst heating, if set to 1					
LC_MOD_ERR_H_PRS_SYS	V	0... 1H	0 ...1	1	-
Defines behaviour of LV_ERR_H_PRS_SYS (0 = H_PRS_SYS_PRE, 1 = H_PRS_SYS_PRE or FUP_CH)					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

General information:

The purpose is to diagnose mechanical errors.
Specific diagnosis information to the project are defined in chapters Diagnosis information (Freeze frame, DTC, error code number, symptom number, data for MIL management ...).
General information:
After debounce the corresponding error bit LV_ERR... is set to 1 and the corresponding symptom is active. Only if the driving cycle is finished the error bit LV_ERR... and the debounced counter are set to 0 and the corresponding symptom is not active.
The fuel system pressure diagnosis will be executed in dependency on the status of the fuel pressure sensor.
If the diagnosis is not prohibited the MFP plausibility check, the FUP sensor plausibility check and the HP system monitoring can be executed. The MFP plausibility check will be calculated only in state MFP_CTL.

The high-pressure system check indicates mainly an abnormal fuel pressure value in fuel system.

If a plausibility check error or the high-pressure system check error is detected a request for Lambda=1 mode is set to identify the origin of the non-plausibility.

The flags LV_CDN_DIAG_XXX exept the flag for FUP_STOP are ==0 if the function is not active. LV_CDN_DIAG_FUP_STOP == 1 if the function is not active.

Application conditions:

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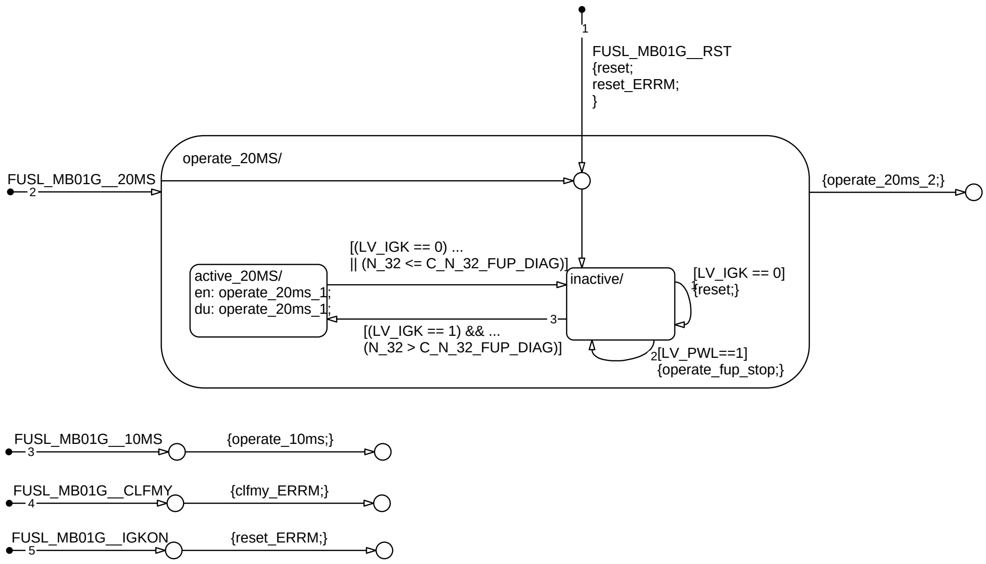

Figure B.97.1: :

Function description:

Formula section:

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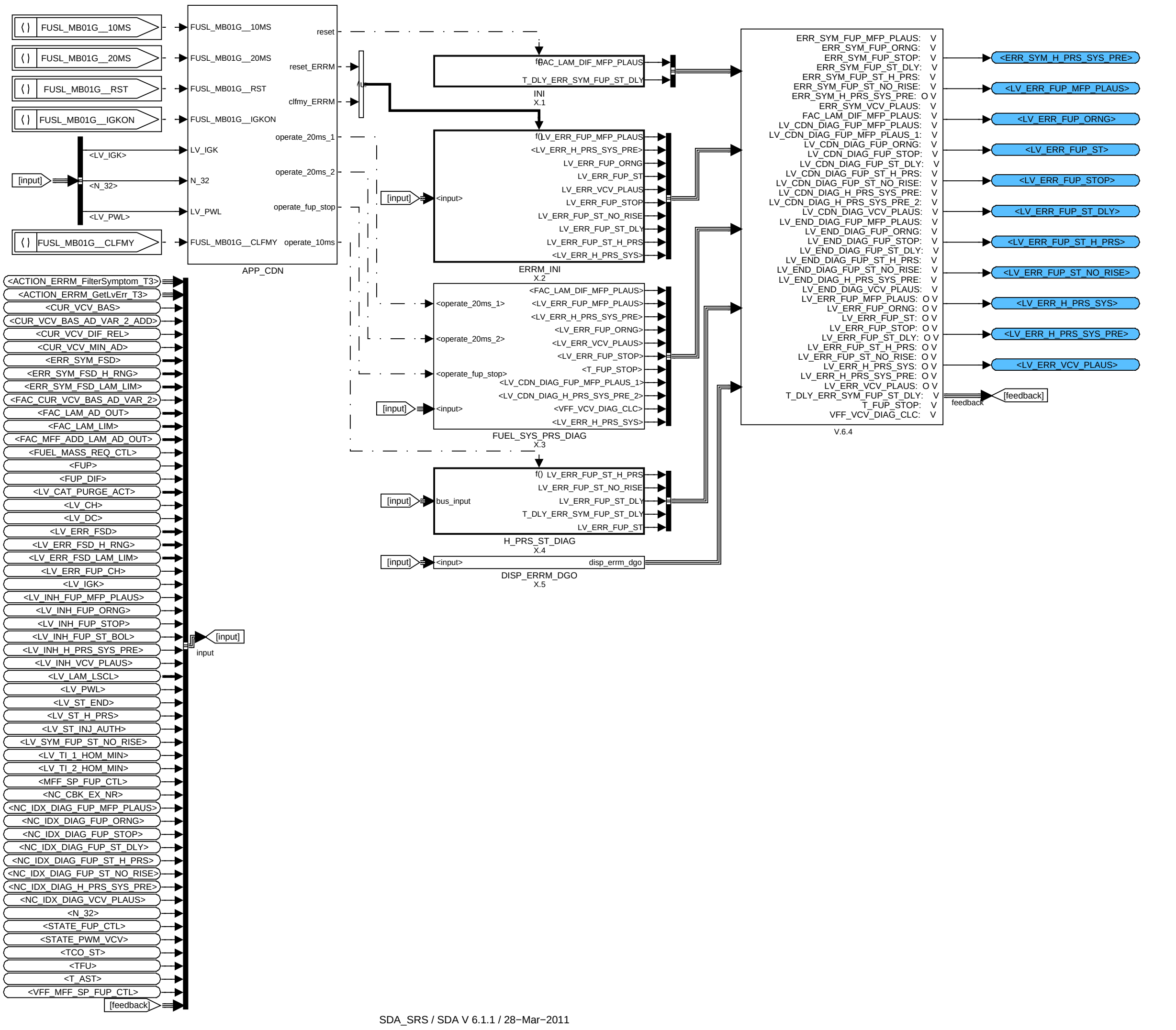

Figure B.97.2: :

B.97.1 Initialization

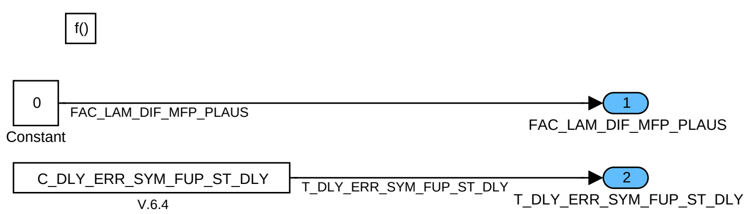

Figure B.97.3: :

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B.97.2 SUBFUNCTION: ERRM_INI

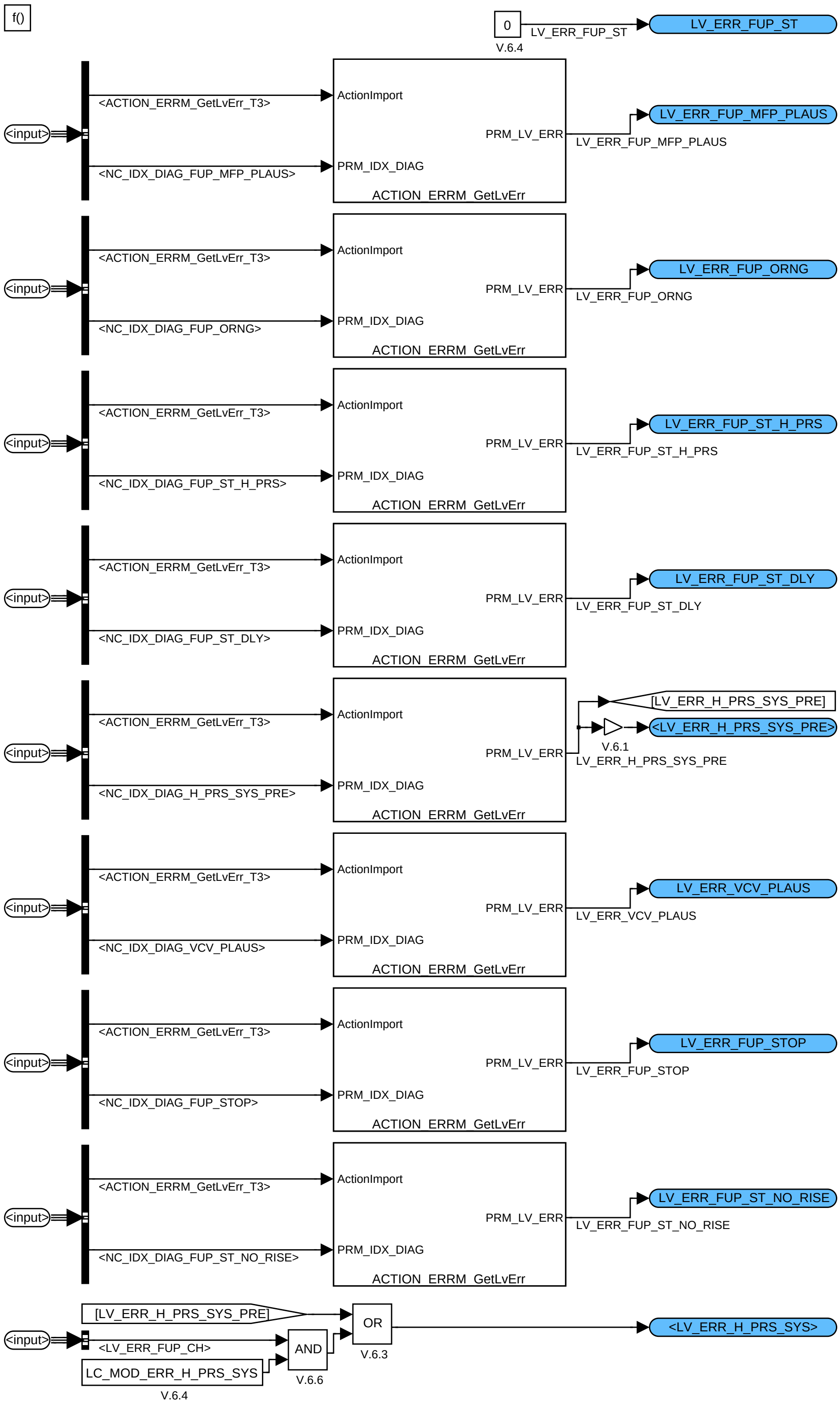

Figure B.97.4: :

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B.97.3 FUSL_MB01G/FUEL_SYS_PRS_DIAG

General overview of the parts of the diagnosis function.

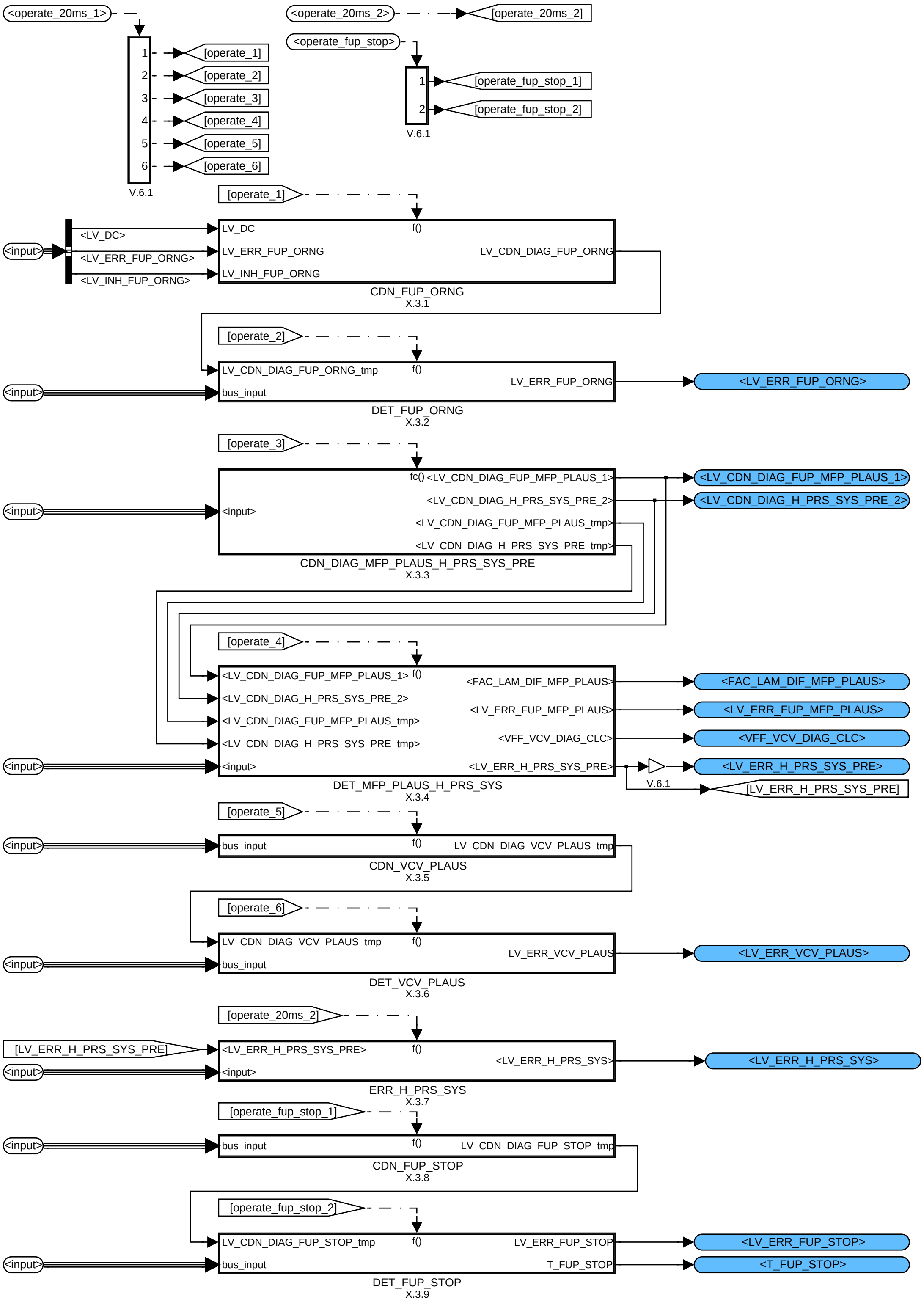

Figure B.97.5: :

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B.97.3.1 FUSL_MB01G/FUEL_SYS_PRS_DIAG/CDN_FUP_ORNG

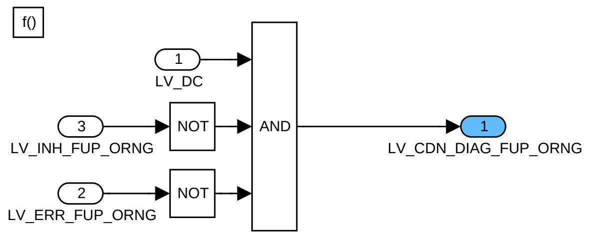

Figure B.97.6: :

B.97.3.2 FUSL_MB01G/FUEL_SYS_PRS_DIAG/DET_FUP_ORNG

Detection of fuel pressure out of range.

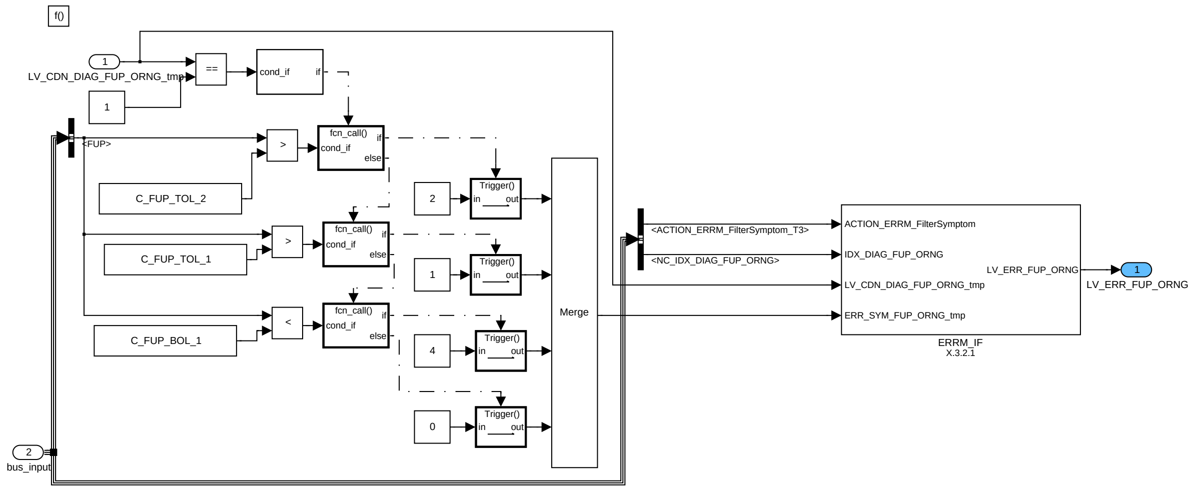

Figure B.97.7: :

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B.97.3.2.1 FUSL_MB01G/FUEL_SYS_PRS_DIAG/DET_FUP_ORNG/ERRM_IF

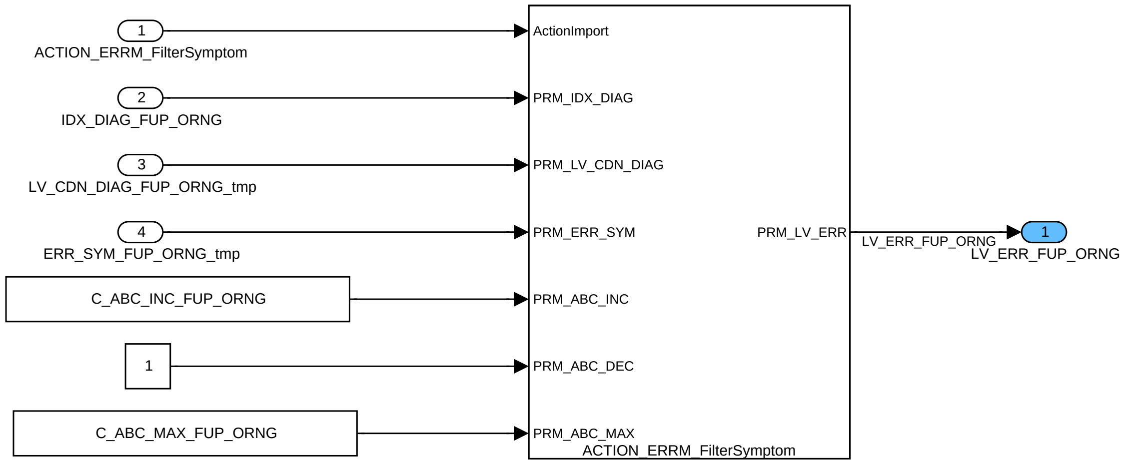

Figure B.97.8: :

B.97.3.3 FUSL_MB01G/FUEL_SYS_PRS_DIAG/CDN_DIAG_MFP_PLAUS_H_PRS_SYS

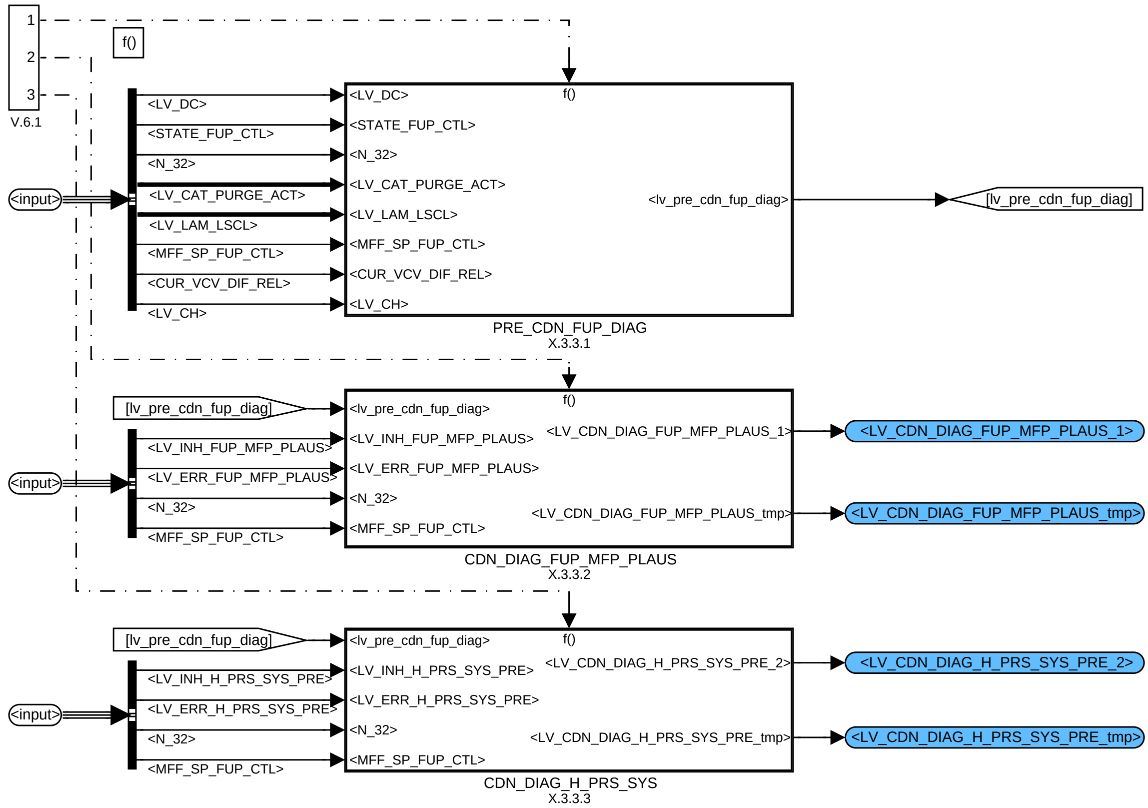

Figure B.97.9: :

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B.97.3.3.1 FUSL_MB01G/FUEL_SYS_PRS_DIAG/CDN_DIAG_MFP_PLAUS_H_PRS_SYS/PRE_CDN_FUP_DIAG

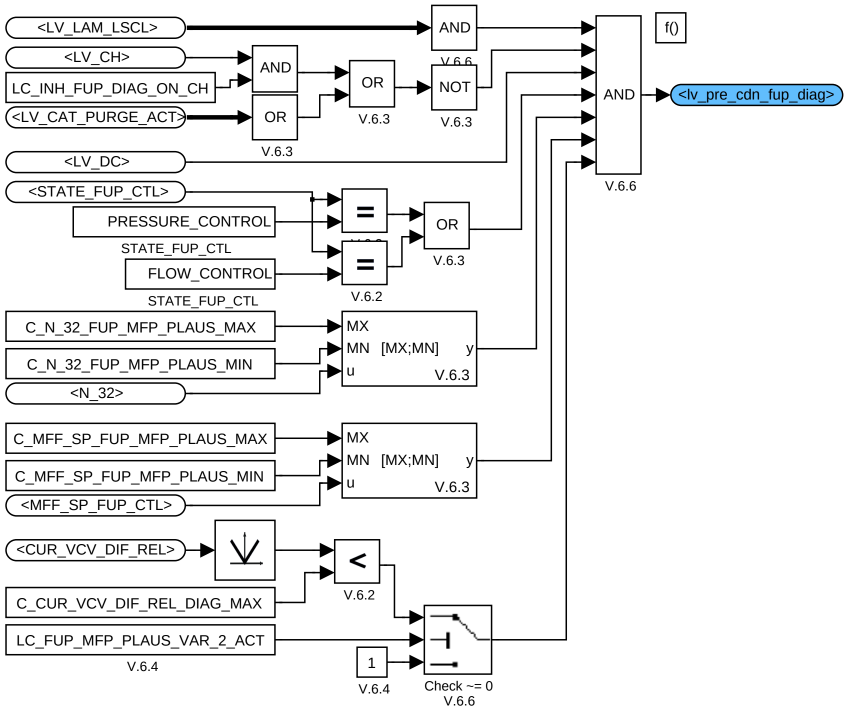

Figure B.97.10: :

B.97.3.3.2 FUSL_MB01G/FUEL_SYS_PRS_DIAG/CDN_DIAG_MFP_PLAUS_H_PRS_SYS/CDN_DIAG_FUP_MFP_PLAUS

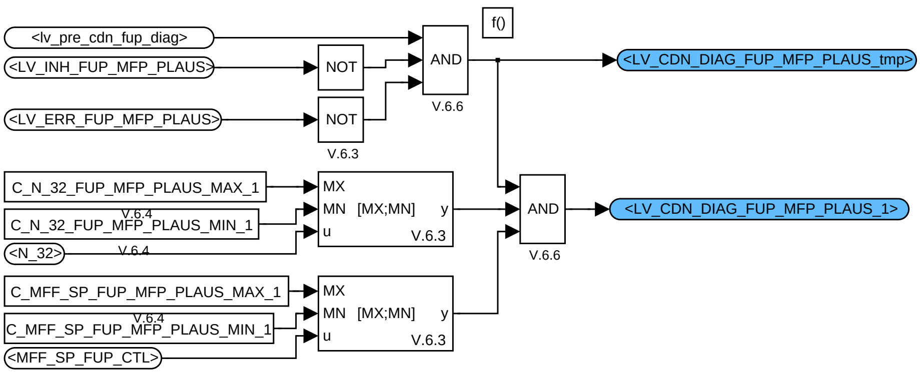

Figure B.97.11: :

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B.97.3.3.3 FUSL_MB01G/FUEL_SYS_PRS_DIAG/CDN_DIAG_MFP_PLAUS_H_PRS_SYS/CDN_DIAG_H_PRS_SYS

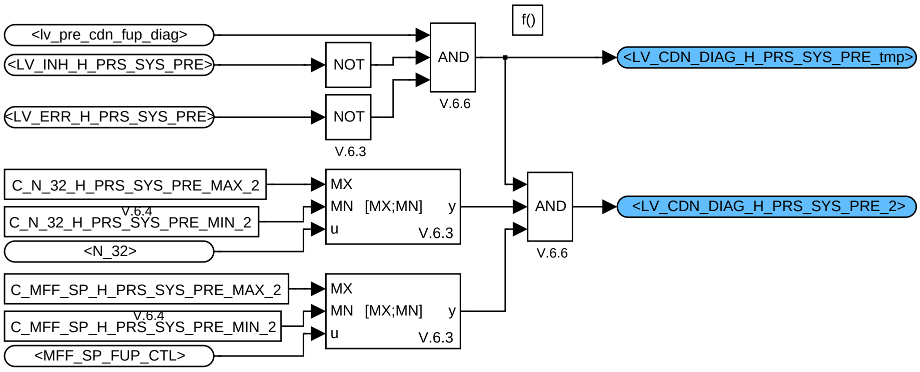

Figure B.97.12: :

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B.97.3.4 FUSL_MB01G/FUEL_SYS_PRS_DIAG/DET_MFP_PLAUS_H_PRS_SYS

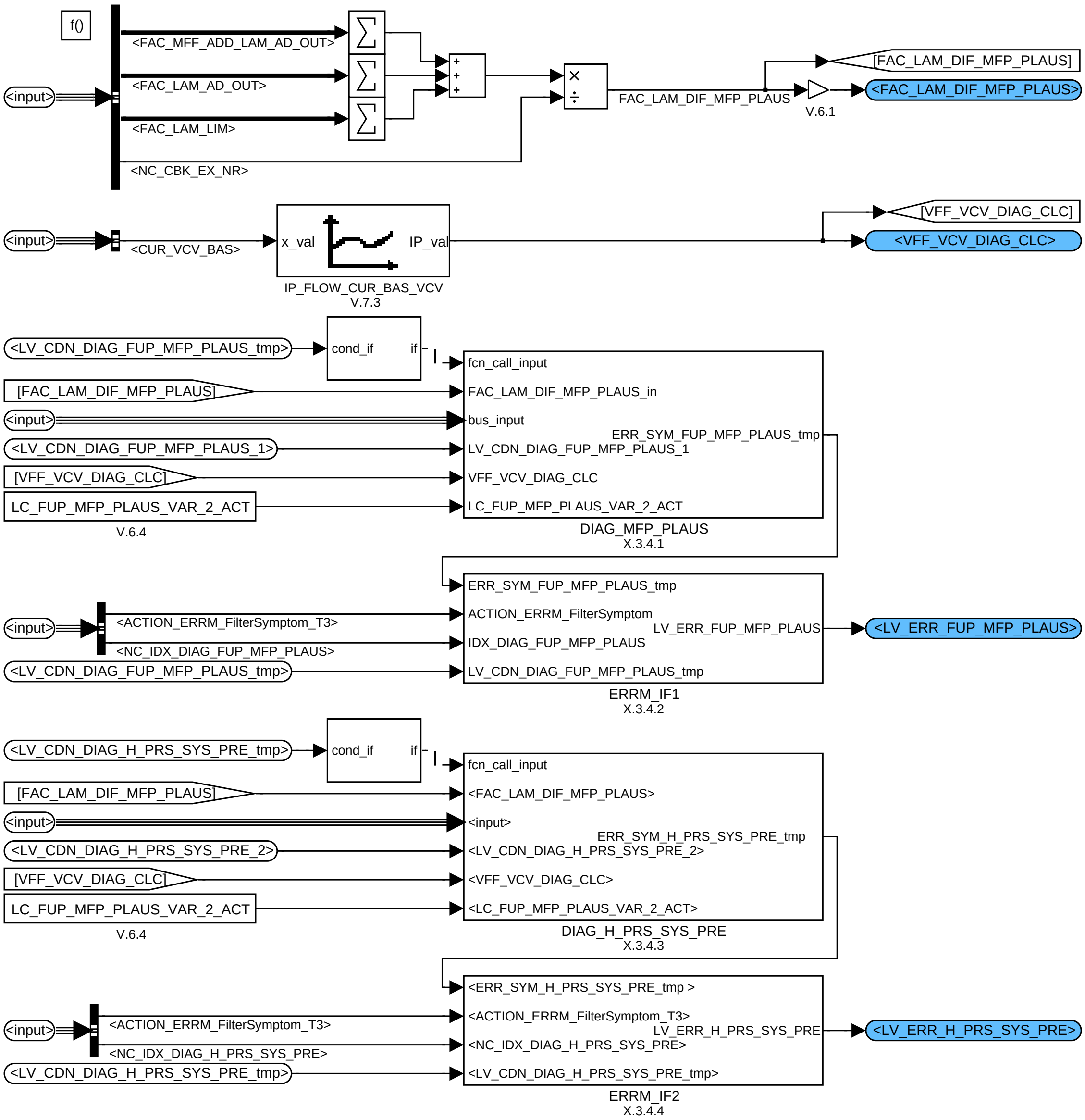

Figure B.97.13: :

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B.97.3.4.1 FUSL_MB01G/FUEL_SYS_PRS_DIAG/DET_MFP_PLAUS_H_PRS_SYS/DIAG_MFP_PLAUS

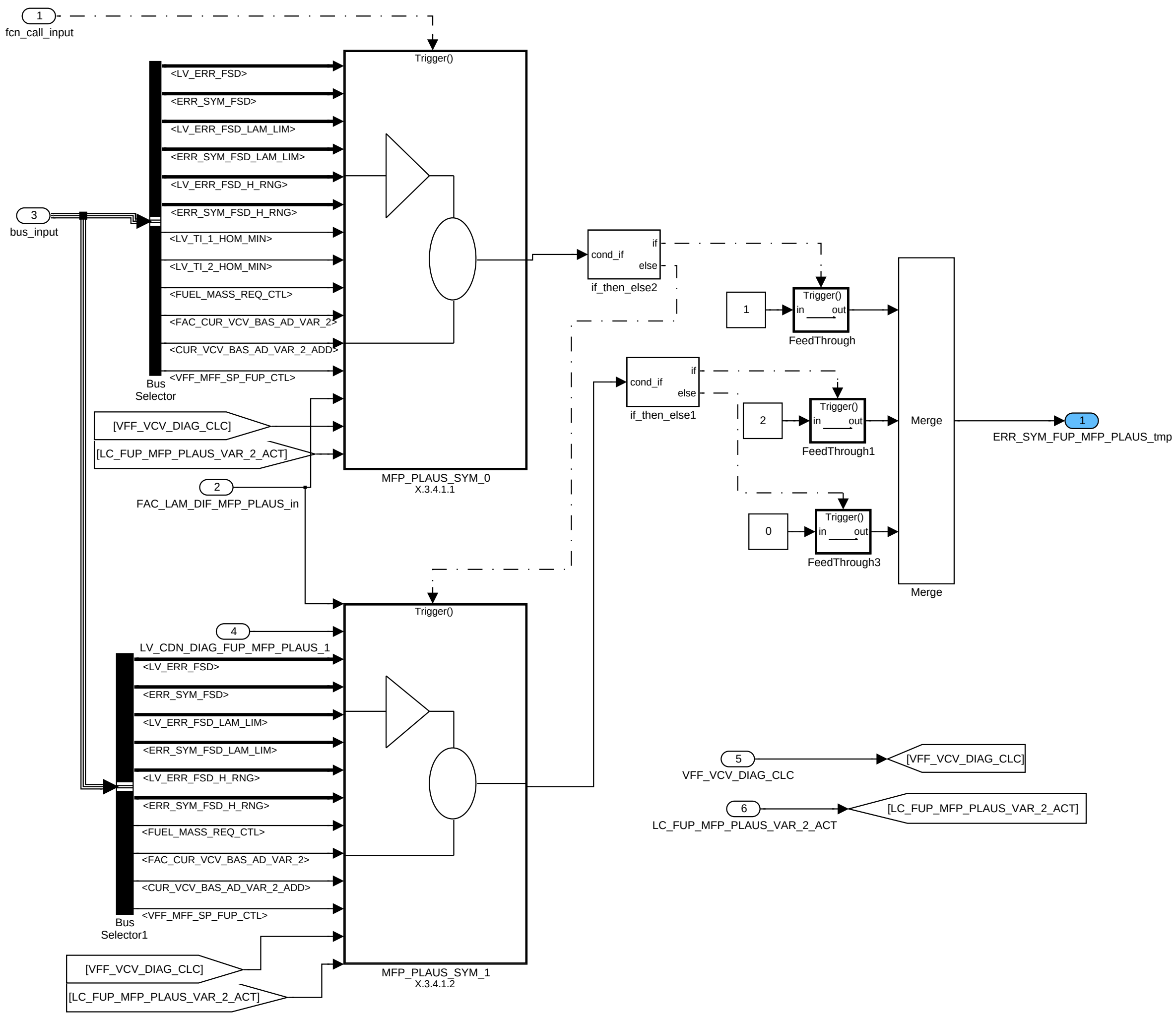

Figure B.97.14: :

B.97.3.4.1.1 FUSL_MB01G/FUEL_SYS_PRS_DIAG/DET_MFP_PLAUS_H_PRS_SYS/DIAG_MFP_PLAUS/MFP_PLAUS_SYM_0

Detection of FUP_MFP_PLAUS SYM_0, FUP sensor shows a too high value.

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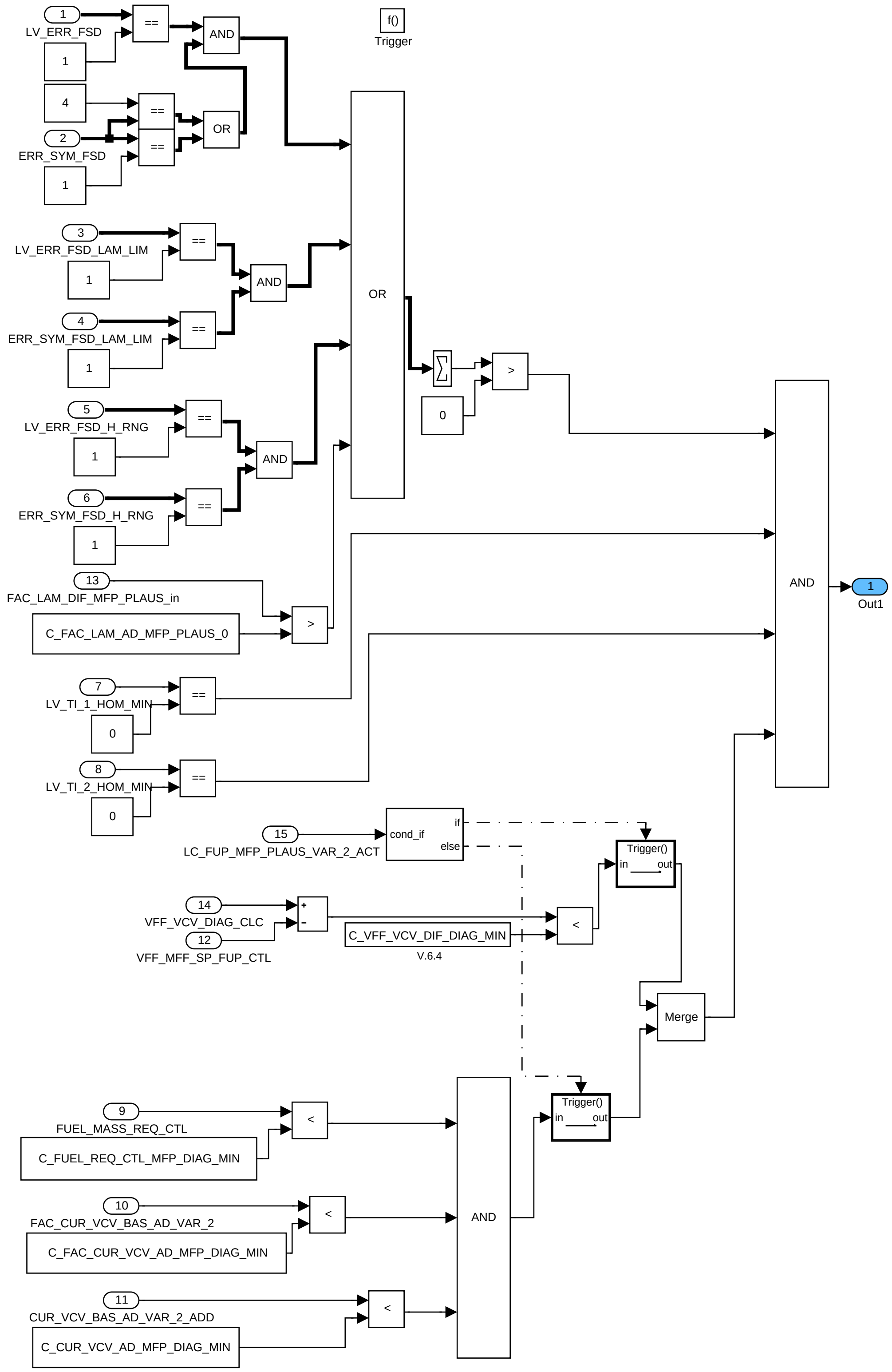

Figure B.97.15: :

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B.97.3.4.1.2 FUSL_MB01G/FUEL_SYS_PRS_DIAG/DET_MFP_PLAUS_H_PRS_SYS/DIAG_MFP_PLAUS/MFP_PLAUS_SYM_1

Detection of FUP_MFP_PLAUS SYM_1, FUP sensor shows a too low value.

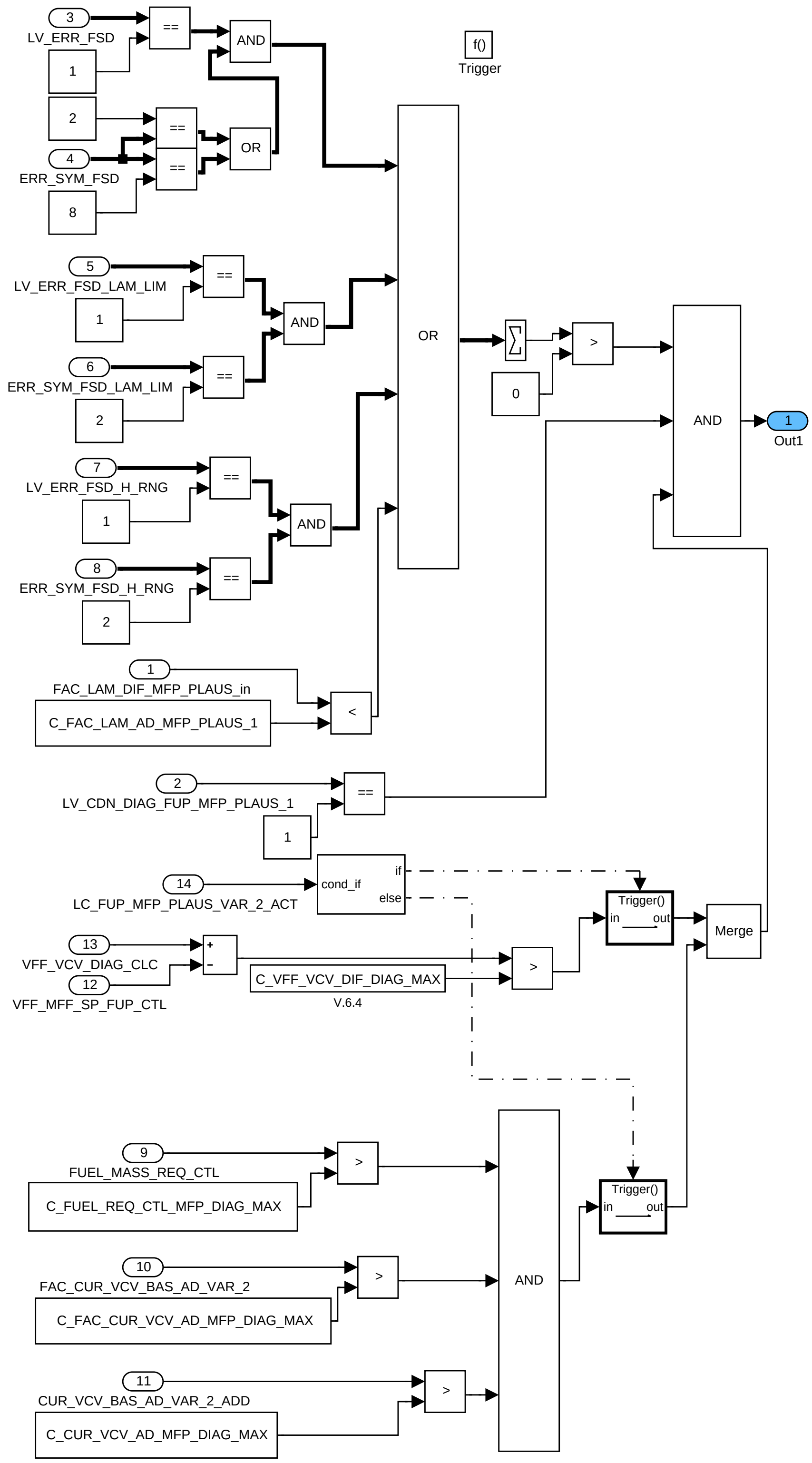

Figure B.97.16: :

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B.97.3.4.2 FUSL_MB01G/FUEL_SYS_PRS_DIAG/DET_MFP_PLAUS_H_PRS_SYS/ERRM_IF1

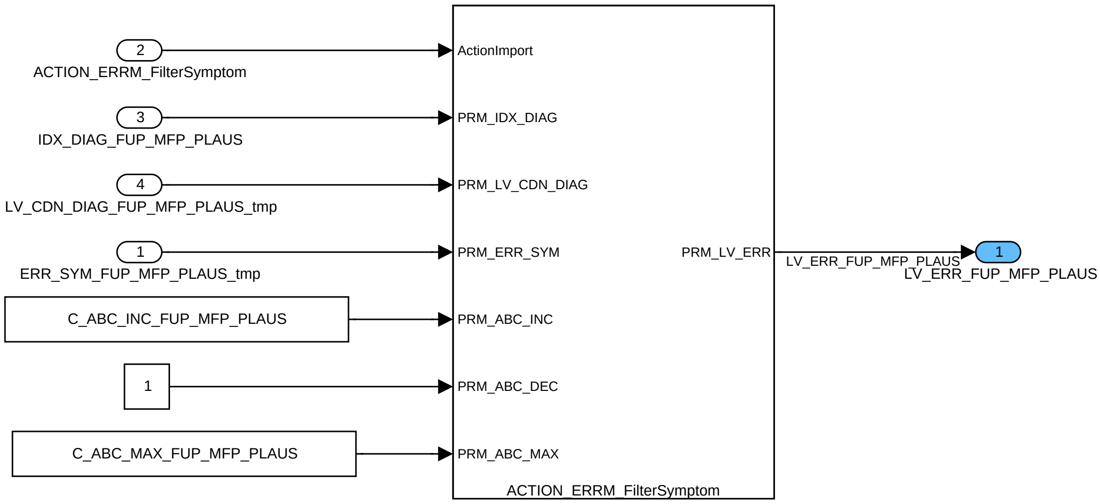

Figure B.97.17: :

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B.97.3.4.3 FUSL_MB01G/FUEL_SYS_PRS_DIAG/DET_MFP_PLAUS_H_PRS_SYS/DIAG_H_PRS_SYS

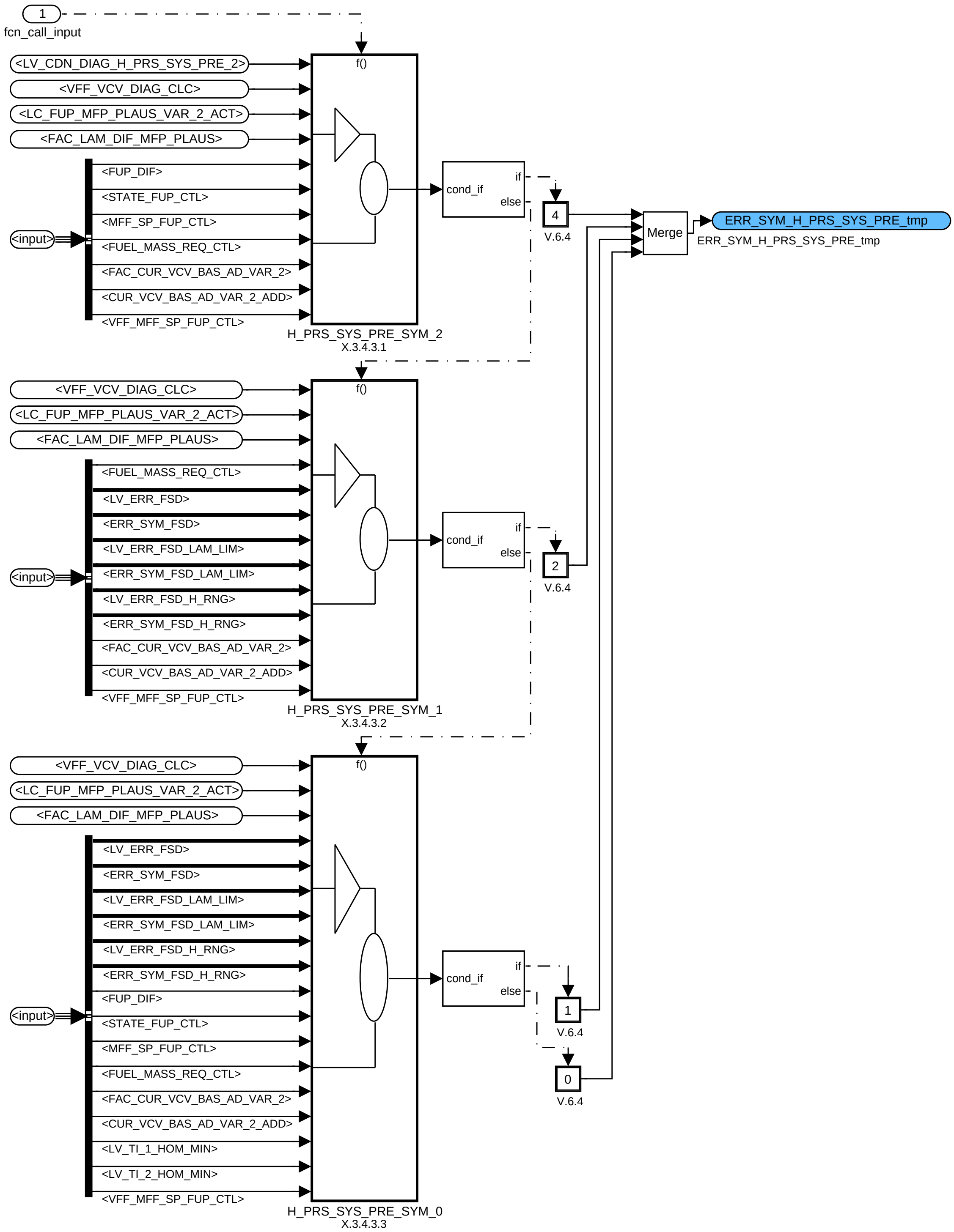

Figure B.97.18: :

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B.97.3.4.3.1 FUSL_MB01G/FUEL_SYS_PRS_DIAG/DET_MFP_PLAUS_H_PRS_SYS/DIAG_H_PRS_SYS/H_PRS_SYS_SYM_2

Detection of H_PRS_SYS SYM_2, delivery of pump is too low, or OPV is open, or VCV stuck at low delivery.

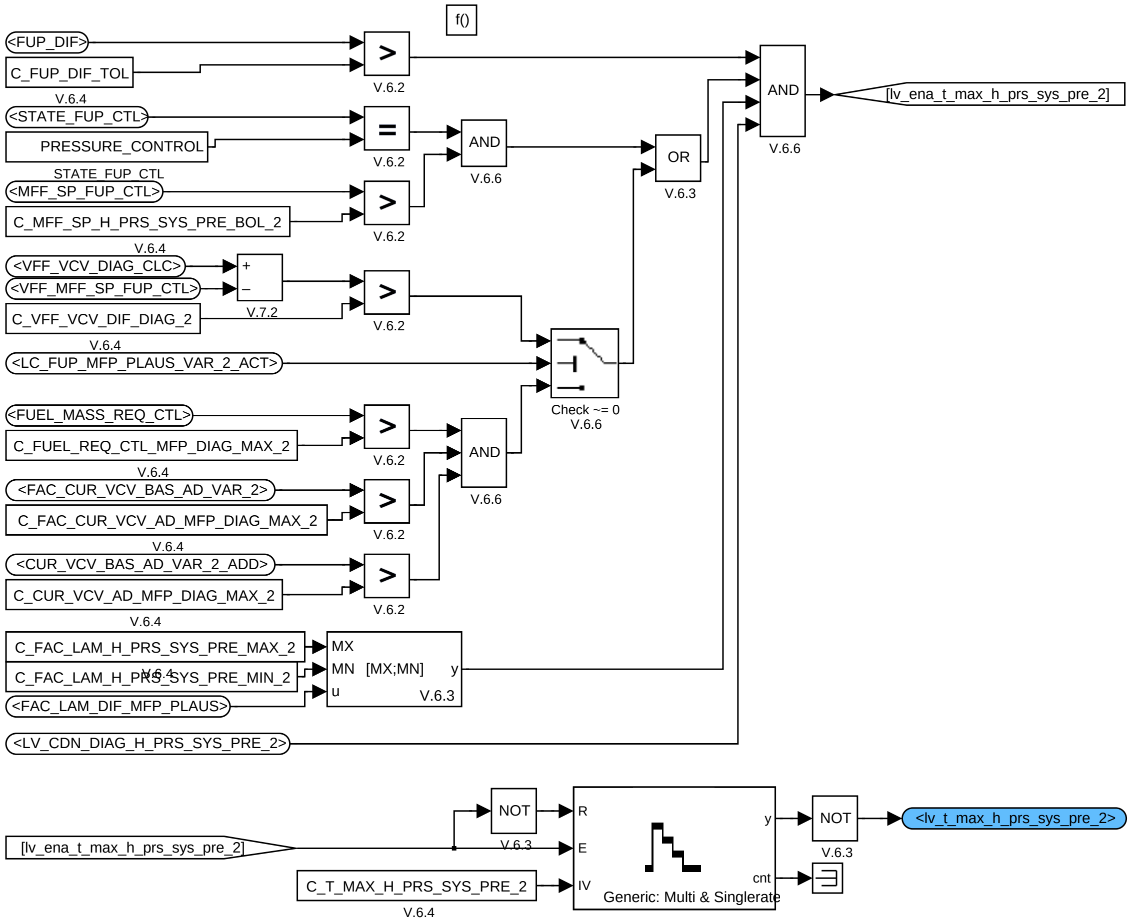

Figure B.97.19: :

B.97.3.4.3.2 FUSL_MB01G/FUEL_SYS_PRS_DIAG/DET_MFP_PLAUS_H_PRS_SYS/DIAG_H_PRS_SYS/H_PRS_SYS_SYM_1

Detection of H_PRS_SYS SYM_1, delivery of pump is too low.

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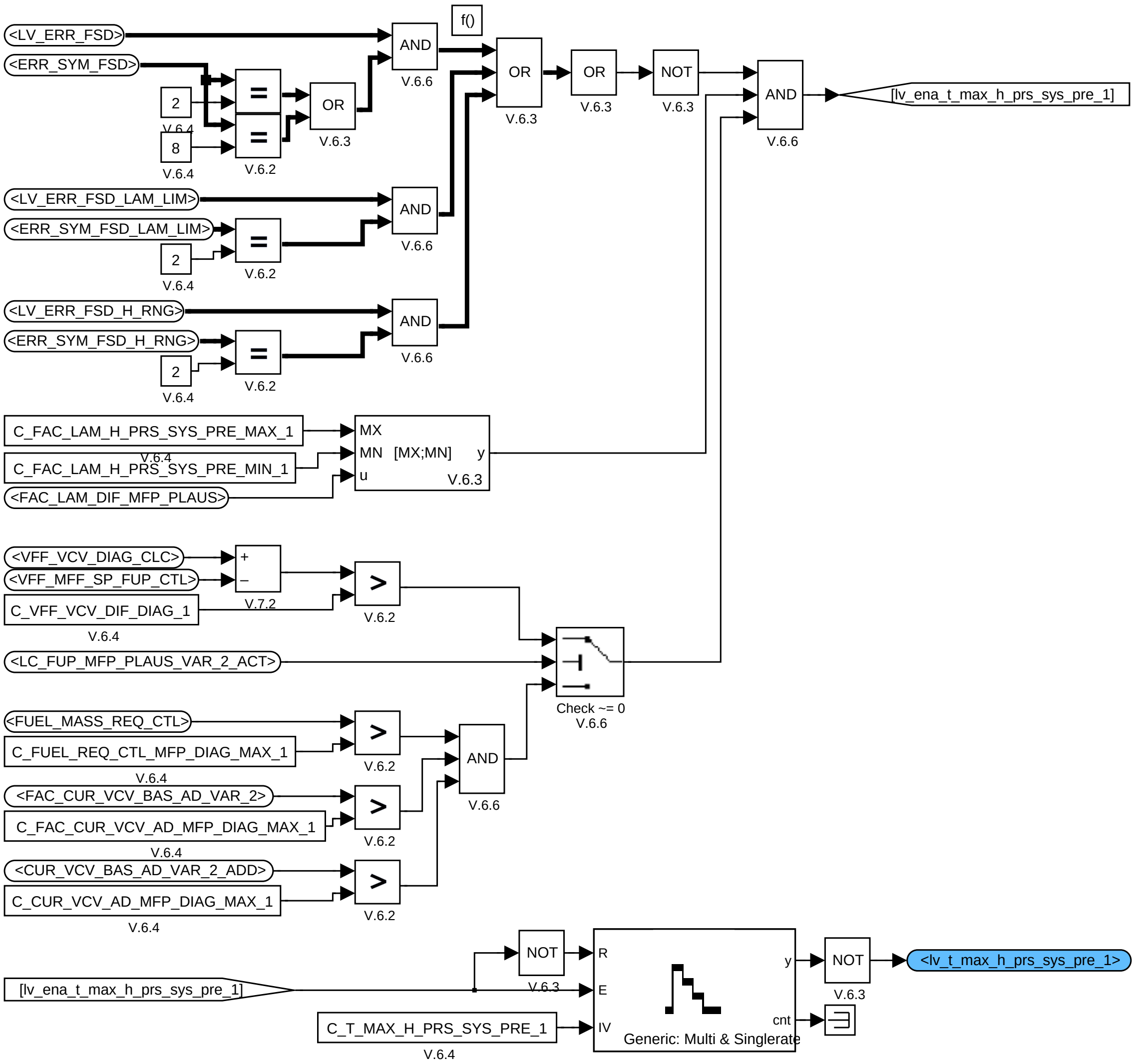

Figure B.97.20: :

B.97.3.4.3.3 FUSL_MB01G/FUEL_SYS_PRS_DIAG/DET_MFP_PLAUS_H_PRS_SYS/DIAG_H_PRS_SYS/H_PRS_SYS_SYM_0

Detection of H_PRS_SYS SYM_0, delivery of pump is too high.

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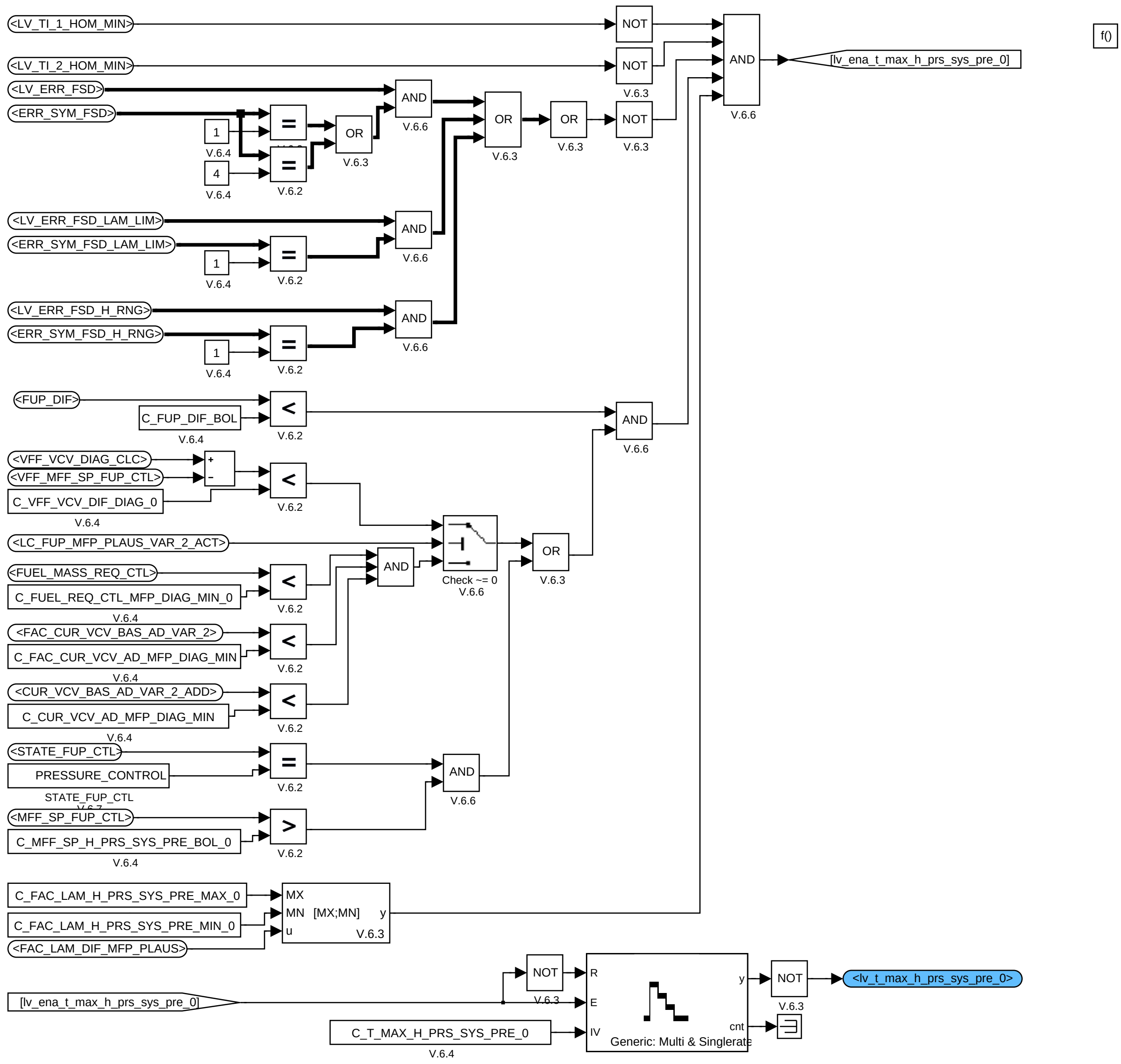

Figure B.97.21: :

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B.97.3.4.4 FUSL_MB01G/FUEL_SYS_PRS_DIAG/DET_MFP_PLAUS_H_PRS_SYS/ERRM_IF2

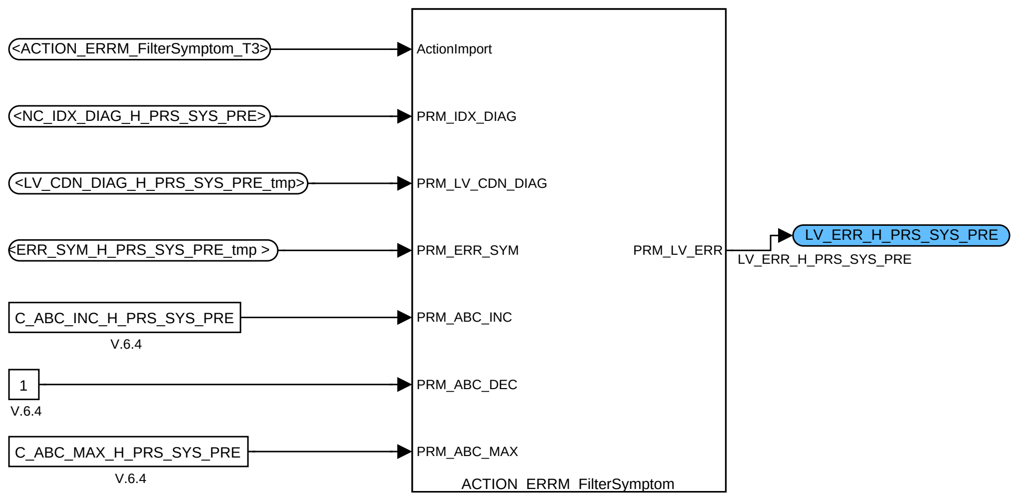

Figure B.97.22: :

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B.97.3.5 FUSL_MB01G/FUEL_SYS_PRS_DIAG/CDN_VCV_PLAUS

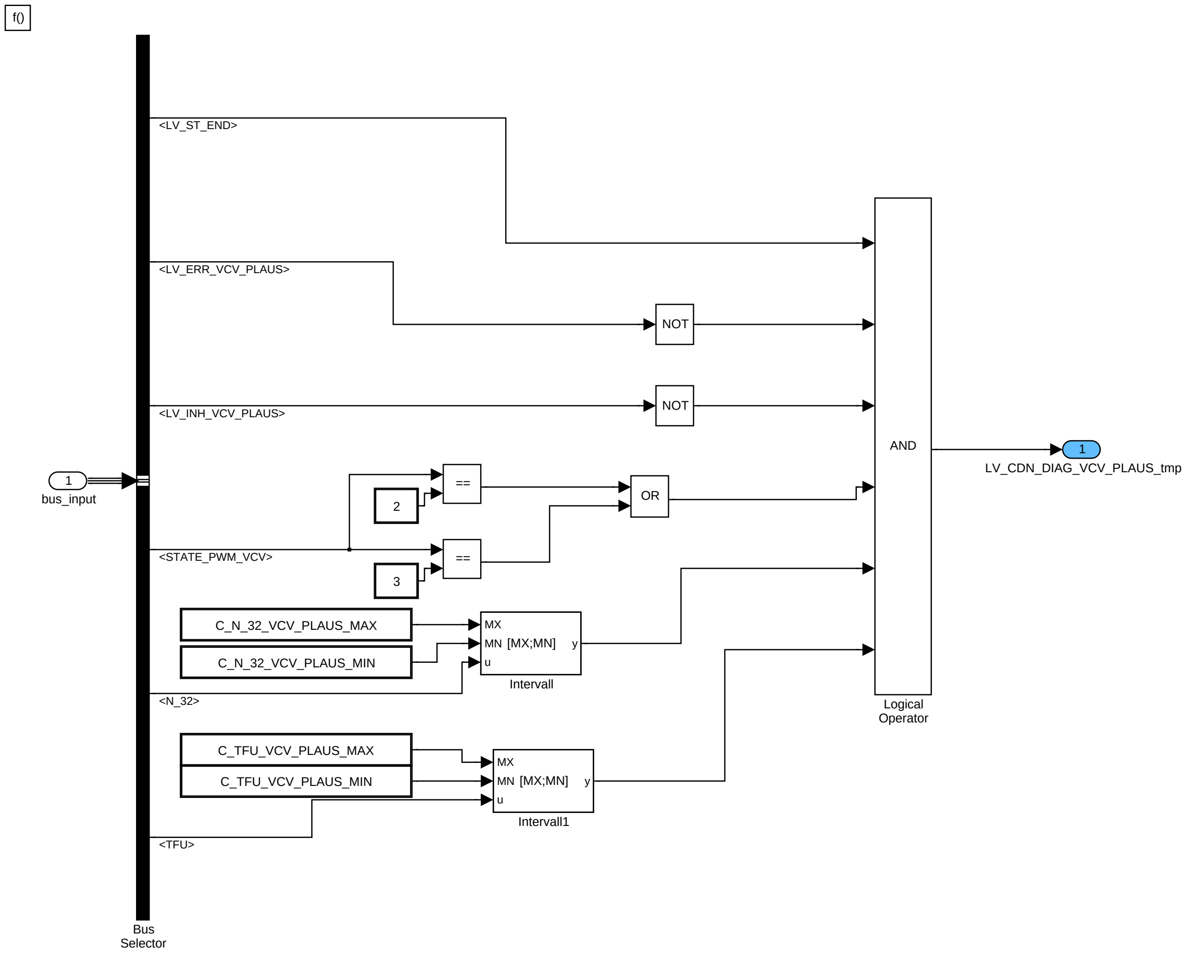

Figure B.97.23: :

B.97.3.6 FUSL_MB01G/FUEL_SYS_PRS_DIAG/DET_VCV_PLAUS

Plausibility check of VCV adaptation values.

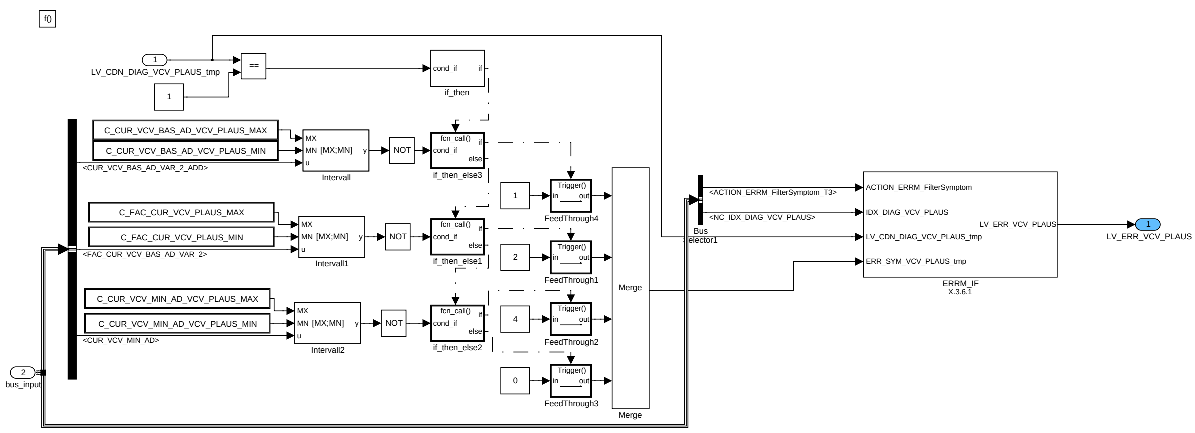

Figure B.97.24: :

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B.97.3.6.1 FUSL_MB01G/FUEL_SYS_PRS_DIAG/DET_VCV_PLAUS/ERRM_IF

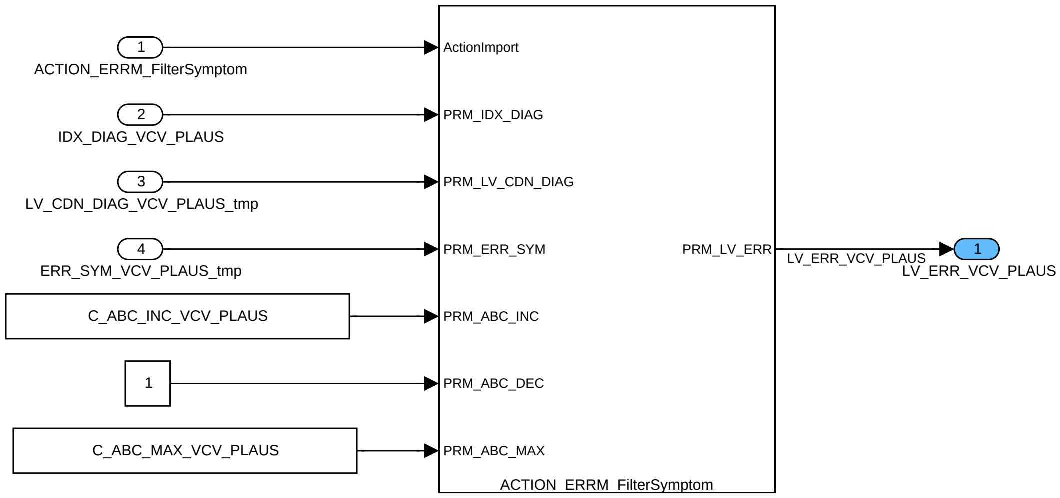

Figure B.97.25: :

B.97.3.7 Calculation of LV_ERR_H_PRS_SYS

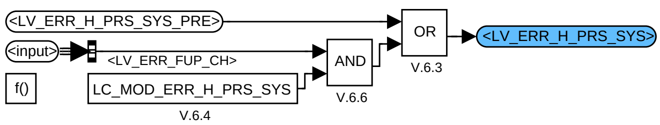

Figure B.97.26: :

B.97.3.8 FUSL_MB01G/FUEL_SYS_PRS_DIAG/CDN_FUP_STOP

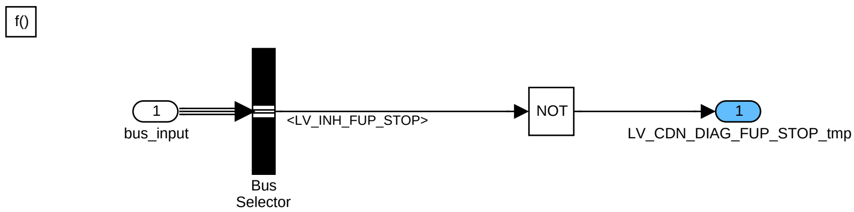

Figure B.97.27: :

B.97.3.9 FUSL_MB01G/FUEL_SYS_PRS_DIAG/DET_FUP_STOP

Detection of fuel pressure at engine stop to high.

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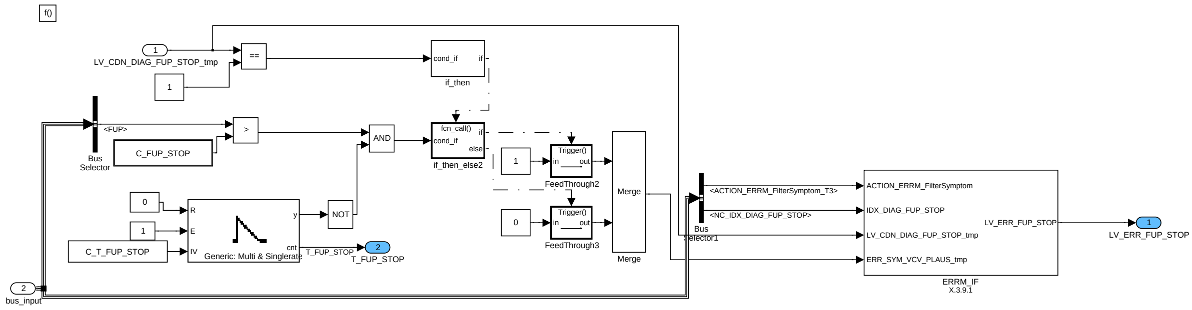

Figure B.97.28: :

B.97.3.9.1 FUSL_MB01G/FUEL_SYS_PRS_DIAG/DET_FUP_STOP/ERRM_IF

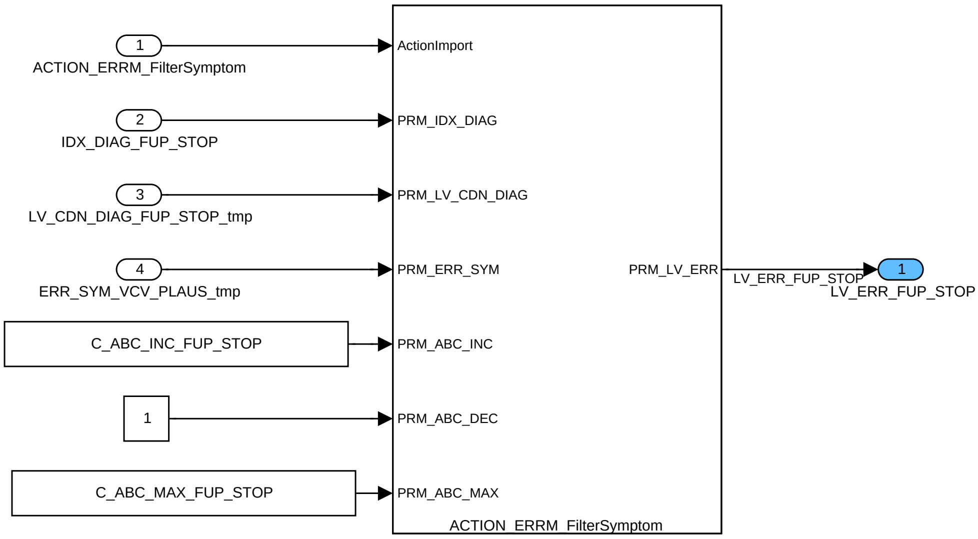

Figure B.97.29: :

B.97.4 FUSL_MB01G/H_PRS_ST_DIAG

Detection of fuel pressure at start of injection is to low.
The calibration C_DLY_ERR_SYM_FUP_ST_DLY
has to be calibrated smaller than C_T_AST_FUP_DIAG_ENA

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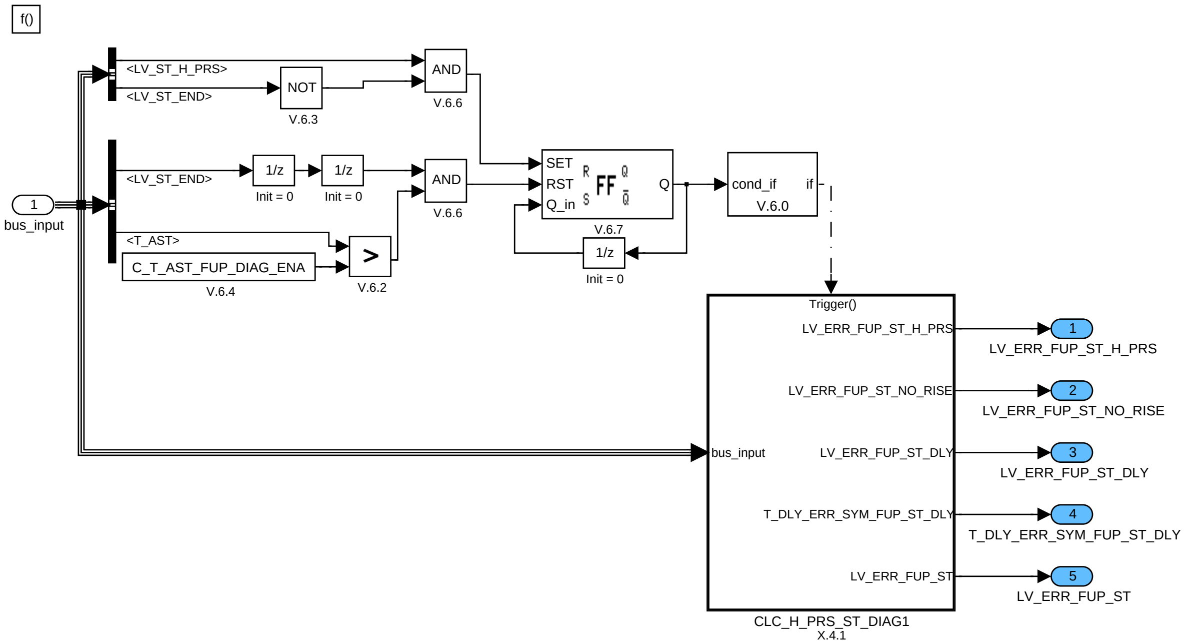

Figure B.97.30: : Function sequencing for fuel pressure diagnostics at start

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B.97.4.1 Fuel pressure diagnostics at start

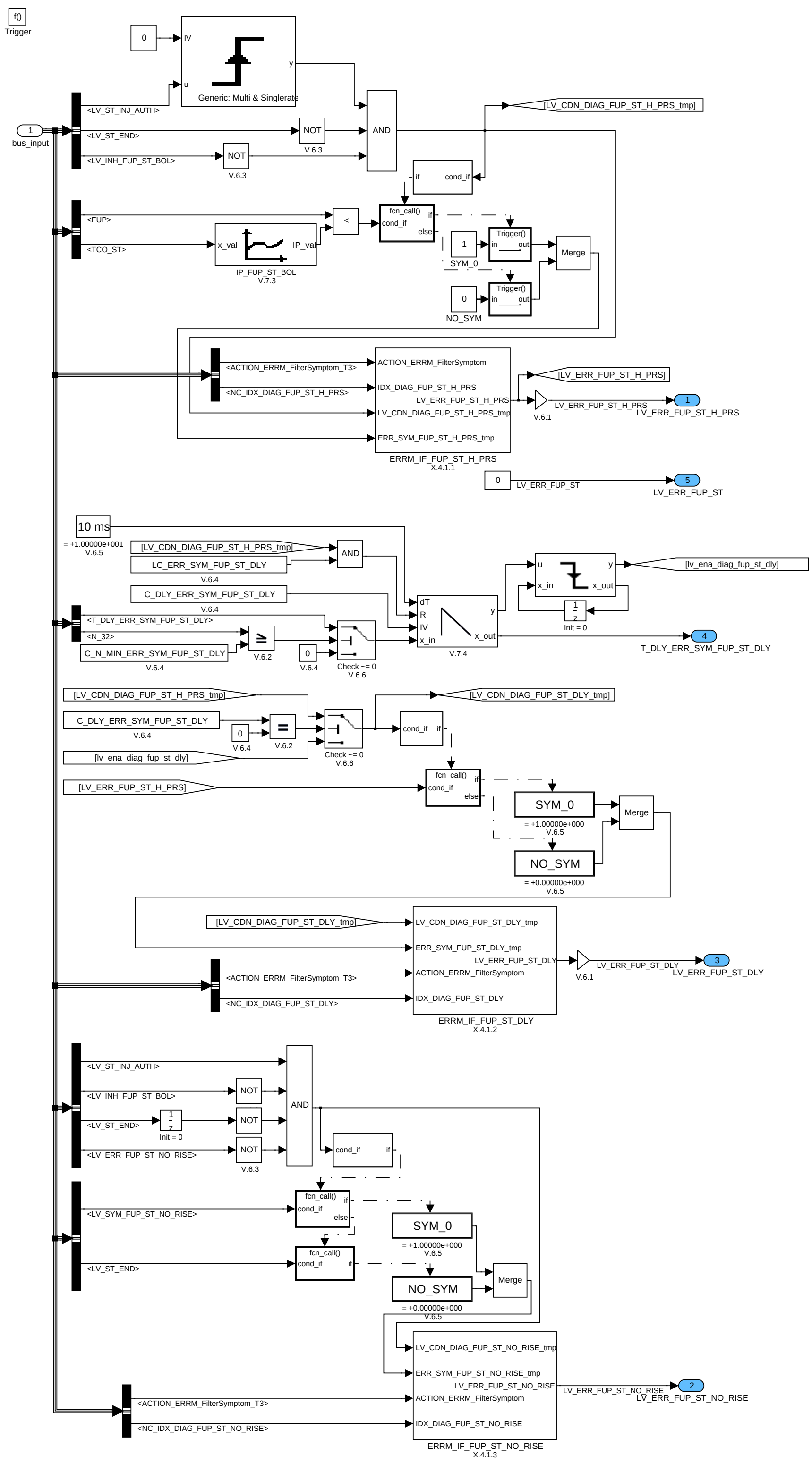

Figure B.97.31: :

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B.97.4.1.1 FUSL_MB01G/H_PRS_ST_DIAG/ERRM_IF_FUP_ST_H_PRS

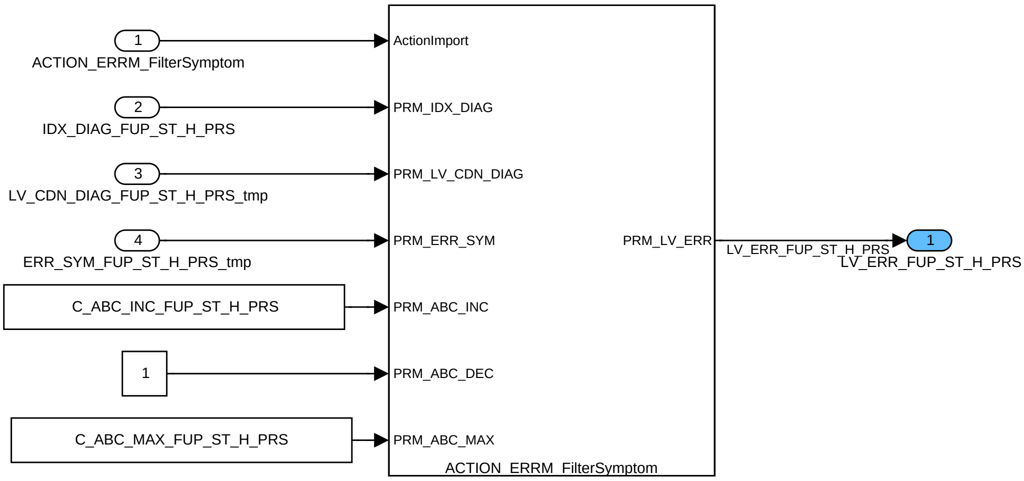

Figure B.97.32: :

B.97.4.1.2 FUSL_MB01G/H_PRS_ST_DIAG/ERRM_IF_FUP_ST_DLY

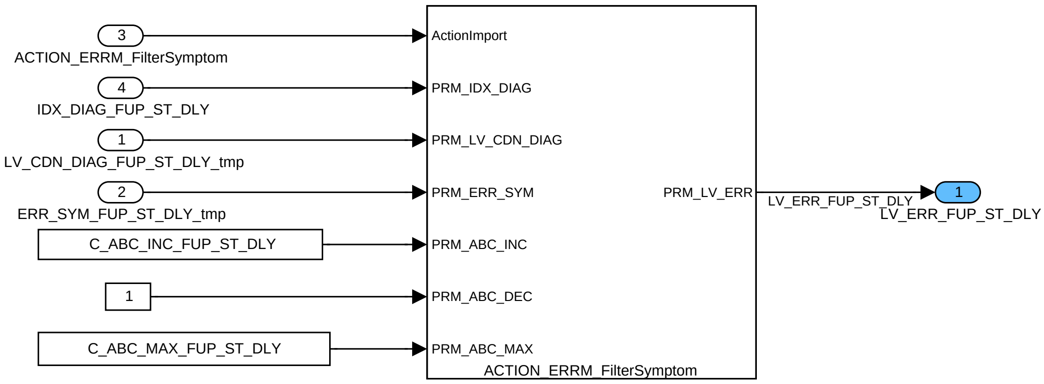

Figure B.97.33: :

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B.97.4.1.3 FUSL_MB01G/H_PRS_ST_DIAG/ERRM_IF_FUP_ST_NO_RISE

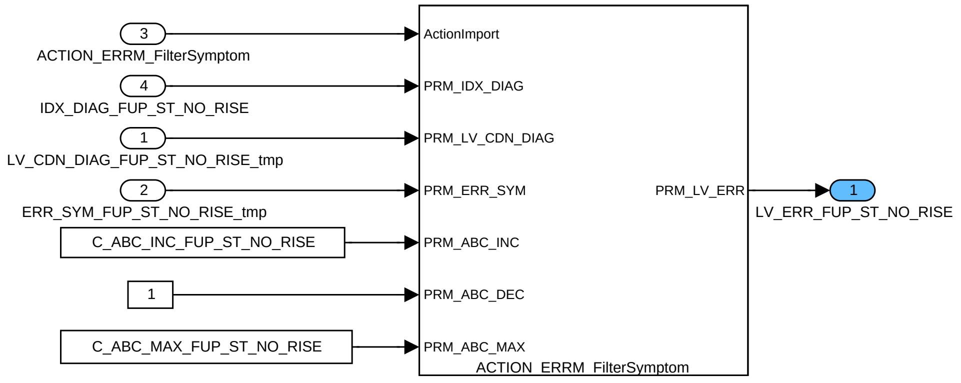

Figure B.97.34: :

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B.97.5 SUBFUNCTION: DISP_ERRM_DGO

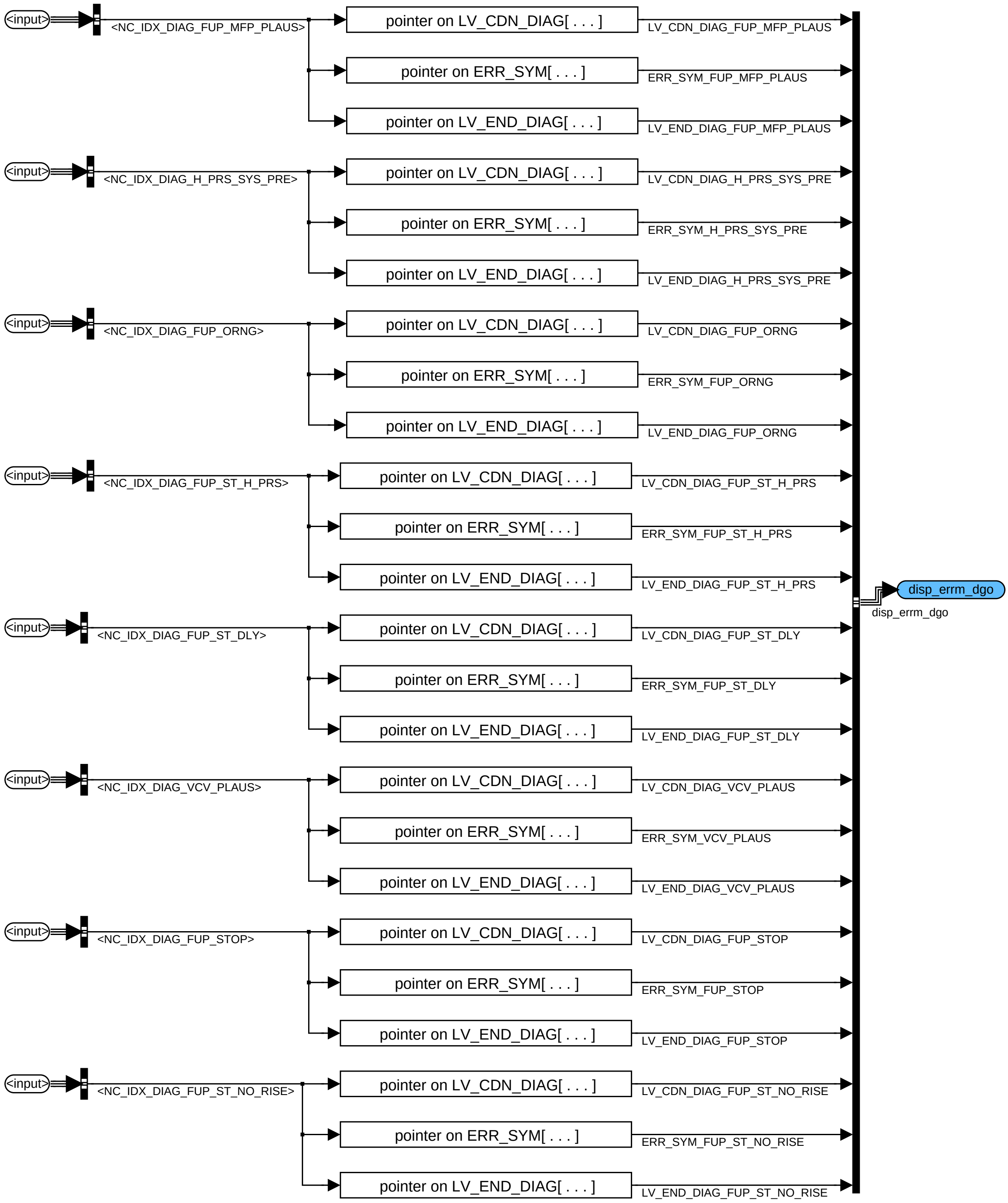

Figure B.97.35: :

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B.98 Fuel system pressure diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_FUP_MFP_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean flag to stop the plausibility check of FUP/MFP					
LV_INH_FUP_ORNG	O/V	0... 1H	0 ...1	1	-
Boolean flag to stop the FUP ORNG check					
LV_INH_FUP_SENS_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean flag to stop the FUP sensor plausibility check					
LV_INH_FUP_ST_BOL	O/V	0... 1H	0 ...1	1	-
Boolean flag to stop the diagnosis of FUP at start of injection					
LV_INH_FUP_STOP	O/V	0... 1H	0 ...1	1	-
Boolean flag to stop the FUP_STOP check					
LV_INH_H_PRS_SYS_PRE	O/V	0... 1H	0 ...1	1	-
Boolean flag to stop the high pressure system monitoring					
LV_INH_VCV_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean flag to stop the VCV_PLAUS check					

Input data:

CL_MMV {p. 3698}	FUP_SP {p. 3868}	LV_ACT_DIAGCPS {p. 5926}	LV_ERR_CAT_DIAG [NC_CBK_EX_NR] {p. 5515}
LV_ERR_EL_CPS {p. 4708}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_MEC_OPEN_ CPS {p. 1001}	LV_ERR_RLY_VCV {p. 988}
LV_ERR_VCV {p. 4729}	LV_IGK {p. 906}	LV_VCV_RLY {p. 988}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	STATE_CP {p. 3637}	STATE_ERR_IV {p. 4803}	T_AST {p. 1766}
VFF_MFF_SP_FUP_CTL {p. 3881}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MAX_DIAG_MFP_PLAUS	-	0... FFFFH	0... 7.9998779296875	122.07e-6	-
Maximum canister load to detect a fault in highpressure system					
C_FUP_SP_DIAG_MAX	-	0... FFFFH	0... 347776	5.30672159	hPa
Maximum FUP_SP to enable high pressure dianosis					
C_FUP_SP_DIAG_MIN	-	0... FFFFH	0... 347776	5.30672159	hPa
Minimum FUP_SP to enable high pressure dianosis					
C_T_AST_H_PRS_DIAG_INH	-	0... FFFFH	0... 6553.5	0.1	s
Inhibit time for deactivation of the high pressure system diagnosis					
C_T_FUP_ORNG_DIAG_INH	-	0... FFFFH	0... 1310.7	0.02	s
Inhibit time for deactivation of the FUP ORNG diagnosis					
C_T_H_PRS_DIAG_INH	-	0... FFFFH	0... 1310.7	0.01	s
Inhibit time for deactivation of the high pressure system diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_VFF_MAX_FUP_DIAG	-	0... FFFFH	0... 255	3.89105e-3	l/h
LDP_N_32_IP_VFF_MAX_FUP_DIAG	4	0... FFH	0... 8160	32	rpm
Maximun fuel flow to enable high pressure diagnosis					

Error treatment:

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Diagnostic Identifier / Diagnostic Description	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
FUP_MFP_PLAUS	High pressure sensor inappropriately high	0			STD_INI	CC
Fuel pressure/mass fuel pump plausibility check	High pressure sensor inappropriately low	1				
		2				
		3				
Diagnostic Identifier / Diagnostic Description	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
FUP_ORNG	FUP top limit 1 reached	0			STD_INI	CC
Fuel pressure out of range	FUP top limit 2 reached	1				
	FUP bottom limit 1 reached	2				
		3				
Diagnostic Identifier / Diagnostic Description	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
FUP_ST_DLY	FUP at start too low	0			STD_INI	CC
FUP_ST_H_PRS follow-up failure entry		1				
		2				
		3				
Diagnostic Identifier / Diagnostic Description	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
FUP_ST_H_PRS	FUP at high pressure start too low	0			STD_INI	CC
Fuel pressure at high pressure start		1				
		2				
		3				
Diagnostic Identifier / Diagnostic Description	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
FUP_ST_NO_RISE	No fuel pressure increase at start detected, high pressure start abortion active	0			STD_INI	CC
High pressure start abortion		1				
		2				
		3				
Diagnostic Identifier / Diagnostic Description	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
FUP_STOP	FUP at engine stop too high	0			STD_INI	CC
Fuel pressure stop		1				
		2				
		3				
Diagnostic Identifier / Diagnostic Description	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
H_PRS_SYS_PRE	VCV stuck open	0			STD_INI	CC

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High pressure system monitoring	VCV stuck closed	1				
	VCV stuck closed or OPV defect	2				
		3				
Diagnostic Identifier Diagnostic Description	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
VCV_PLAUS	ADD adaptation out of range	0			STD_INI	CC
VCV plausibility check	FAC adaptation out of range	1				
	Pressure curve adaptation out of range	2				
		3				

General information:

To inhibit the fuel system pressure diagnosis, several Diagnostic errors examined.

Application conditions:

Initialisation: RST
Recurrence: 10MS
Activation: LV_IGK==1
Deactivation: LV_IGK==0

Function description:

Formula section:

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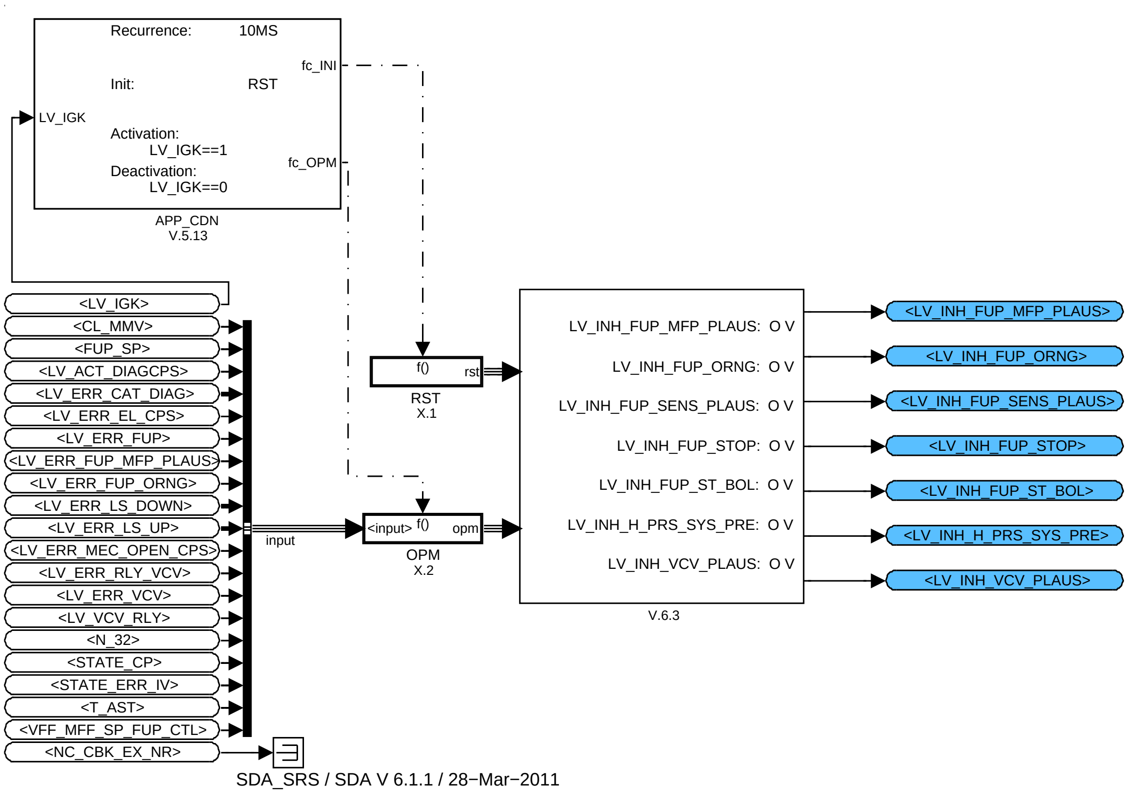

Figure B.98.1: :

B.98.1 Initialisation:

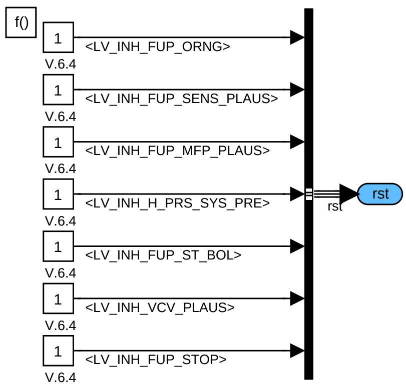

Figure B.98.2: :

Function Description:

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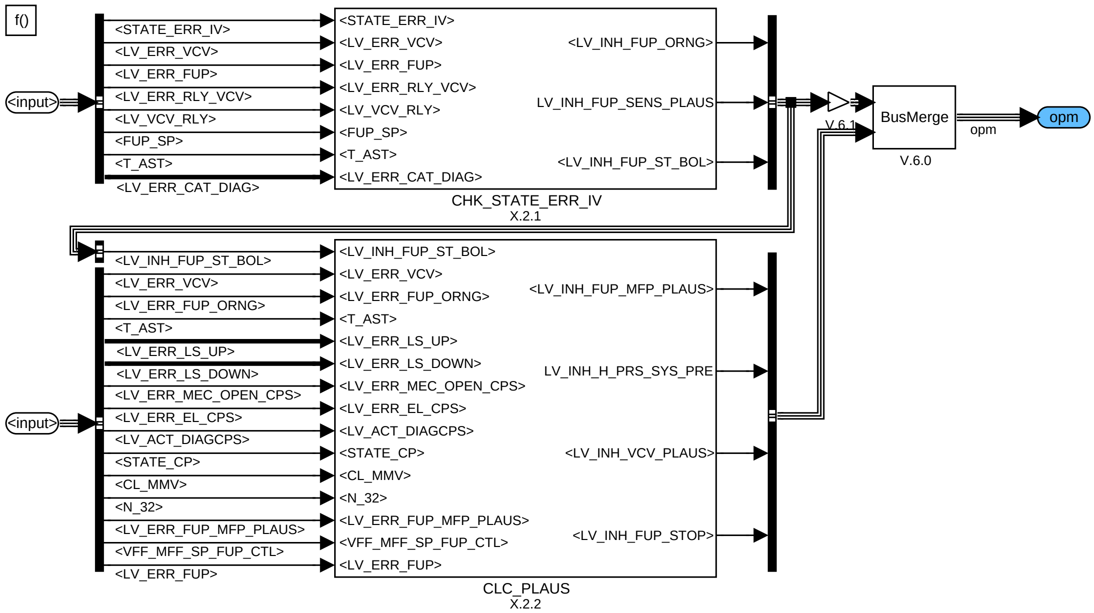

Figure B.98.3: :

B.98.2 Calculation of inhibition fuel pressure:

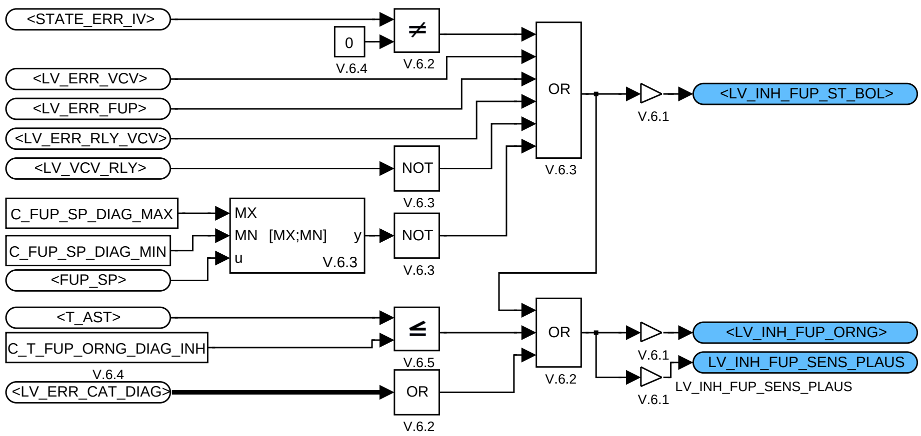

Figure B.98.4: :

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B.98.3 Calculation for mass fuel pump:

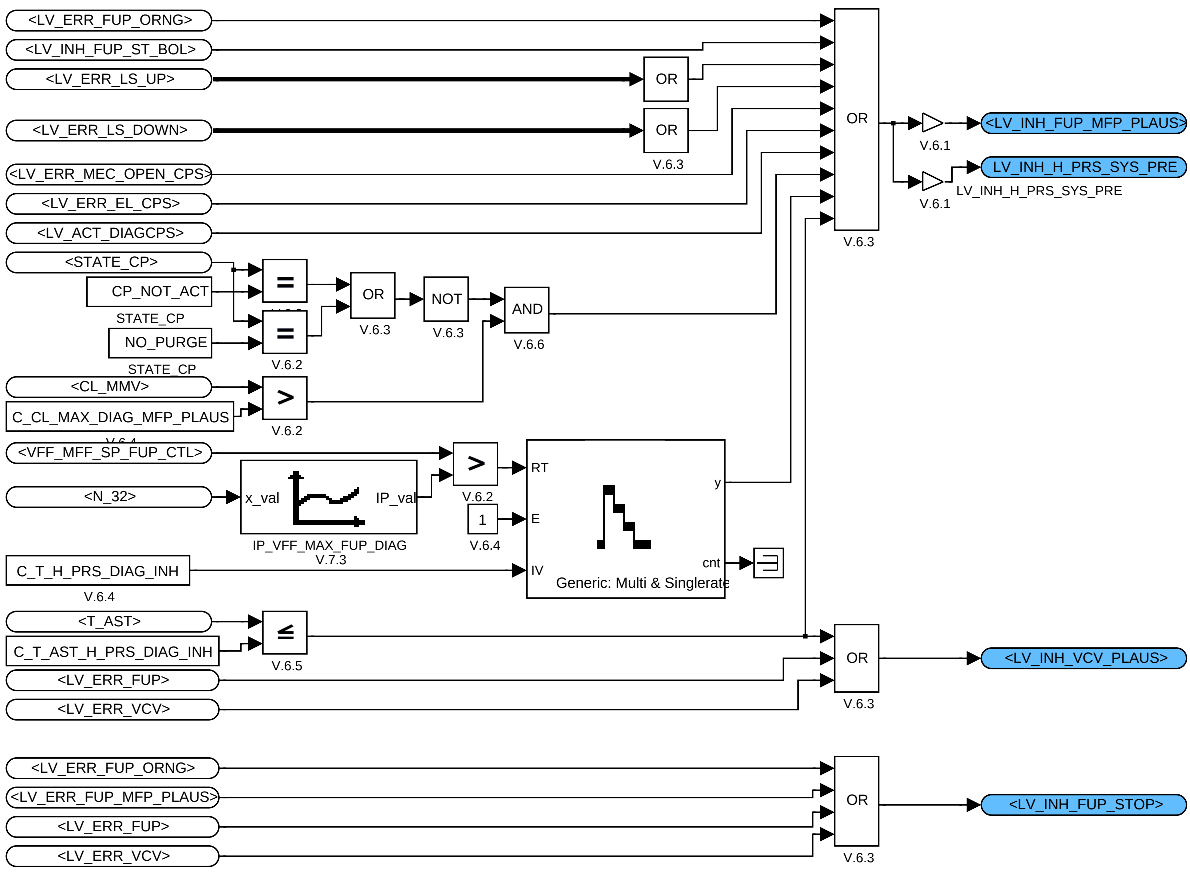

Figure B.98.5: :

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B.99 FUSL rate based monitoring interface

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_FUP_CH	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom FUP_CH					
LV_CDN_DIAG_FUP_CH	V	0... 1H	0 ...1	1	-
Status of diagnosis for FUP monitoring during CH					
LV_END_DIAG_FUP_CH	V	0... 1H	0 ...1	1	-
End of diagnosis flag for FUP check during CH					
LV_END_DIAG_RBM_FUP_CH	V	0... 1H	0 ...1	1	-
End of diagnosis flag for FUP check during CH for RBM					
LV_ERR_FUP_CH	O/V	0... 1H	0 ...1	1	-
Boolean that indicates a deviation in fuel pressure during CH					
LV_INH_DIAG_RBM_FUP_CH	O/V	0... 1H	0 ...1	1	-
FUP_CH plausibility diagnosis inhibition condition for RBM interface definition					
STATE_RBM_FUP_CH [NC_CBK_HPP_NR]	O/V	0... FFH	0... 255	1	-
Interface of 'fuel pressure during CH' monitor with the Rate-Based Monitoring statistics.					
T_END_DIAG_RBM_FUP_CH	V	0... FFFFH	0... 6553.5	0.1	s
Timer for setting the RBM diagnosis end flag for FUP_CH					
T_FUP_CH_DIAG_MAX	V	0... FFFFH	0... 1310.7	0.02	s
Timer indicating time with too high fuel pressure					
T_FUP_CH_DIAG_MIN	V	0... FFFFH	0... 1310.7	0.02	s
Timer indicating time with too low fuel pressure					

Input data:

C_N_32_FUP_DIAG {p. 6066}	CTR_ERR_DYN_NR {p. 5767}	FUP_DIF {p. 3909}	LV_CH {p. 8232}
LV_DC {p. 5746}	LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}
LV_ERR_H_PRS_SYS_PRE {p. 6062}	LV_ERR_VCV {p. 4729}	LV_IGK {p. 906}	N_32 {p. 1525}
NC_CBK_HPP_NR [1] {p. 812}	T_AST {p. 1766}	TCO {p. 1100}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_FUP_CH	-	0... FFH	0... 255	1	-
Increment of the FUP_CH anti-bounce counter					
C_ABC_MAX_FUP_CH	-	1... FFH	1... 255	1	-
Threshold to be reached, before FUP_CH error					
C_FUP_DIF_DIAG_MAX	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Maximum threshold for FUP_DIF					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_DIF_DIAG_MIN	-	8000... 7FFFH	-173890 ...173884	5.3066911	hPa
Minimum threshold for FUP_DIF					
C_T_AST_MIN_FUP_CH	-	0... FFFFH	0... 6553.5	0.1	s
Min T_AST treshold for fuel pressure diagnosis during CH					
C_T_AST_RBM_FUP_CH	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time to increment the RBM denominator for FUP_CH diagnosis					
C_T_END_DIAG_RBM_FUP_CH	-	0... FFFFH	0... 6553.5	0.1	s
Timer for setting the RBM diagnosis end flag for FUP_CH					
C_T_FUP_CH_DIAG_MAX	-	0... FFFFH	0... 1310.7	0.02	s
Timer threshold for pre-debouncing of FUP_CH diagnosis					
C_T_FUP_CH_DIAG_MIN	-	0... FFFFH	0... 1310.7	0.02	s
Timer threshold for pre-debouncing of FUP_CH diagnosis					
C_TCO_MIN_FUP_CH	-	0... FEH	-48... 142.5	0.75	°C
Min TCO threshold for fuel pressure diagnosis during CH					

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)
ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

Error treatment:

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	Name (XX)	Description	Nr		
Fuel pressure monitoring during catalyst heating	FUP_CH	Fuel pressure too high	0	STD_INI	CC
		Fuel pressure too low	1		

Fields information (For more information refers to Error Management file “Table of Failure”) :

- ABC Type : STD_INI, STD, MEM, MEM_INI, DEC_CAL, STC, NO, MPL_STD_INI
- CARB Class : MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO.

B.99.1 Rate Based Monitoring interface for FUP_CH diagnosis

STATE_RBM_xx definition

Bit 0: conditions for monitoring are met long enough to detect malfunction (’bit 0’ = 1)

Bit 1: inhibition of the monitor because of system failure(s) (’bit 1’ = 1)

Bit 2: individual RBM conditions of the monitor were encountered within this DC (’bit 2’ = 1)

B.99.1.1 Calculation of LV_END_DIAG_RBM_XX and LV_INH_DIAG_RBM_XX

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FUNCTION DESCRIPTION:

General information:

To inhibit the monitoring of fuel system pressure diagnosis, several
Diagnostic errors examined.

Application conditions

Initialisation: on transition LV_IGK OFF → ON **OR** reset **OR** Failure memory cleared
All output variables initialized to 0h excepted:
ACTION_ERRM_GetLvErr(NC_IDX_DIAG_FUP_CH, LV_ERR_FUP_CH)
T_END_DIAG_RBM_FUP_CH initialised with C_T_END_DIAG_RBM_FUP_CH

Recurrence: *100 ms*

Activation: LV_DC = 1

Deactivation: LV_DC = 0

Formula section:

IF LV_CDN_DIAG_FUP_CH= 1 **AND** LV_END_DIAG_RBM_FUP_CH= 0
THEN decrement the timer T_END_DIAG_RBM_FUP_CH
ENDIF
IF LV_CDN_DIAG_FUP_CH= 0 **AND** LV_END_DIAG_RBM_FUP_CH= 0
THEN T_END_DIAG_RBM_FUP_CH= C_T_END_DIAG_RBM_FUP_CH
ENDIF
IF T_END_DIAG_RBM_FUP_CH = 0
THEN LV_END_DIAG_RBM_FUP_CH = 1
ENDIF

if LV_ERR_FUP = 1 **or**
LV_ERR_H_PRS_SYS_PRE = 1 **or**
LV_ERR_FUP_MFP_PLAUS = 1 **or**
LV_ERR_FUP_ORNG = 1 **or**
LV_ERR_VCV = 1
then LV_INH_DIAG_RBM_FUP_CH = 1
else LV_INH_DIAG_RBM_FUP_CH = 0
endif

B.99.1.2 Calculation of STATE_RBM_XX

FUNCTION DESCRIPTION:

General information:

With this module the interface between the monitor XX and the Rate-Based Monitoring statistics is defined with STATE_RBM_XX data.
Within STATE_RBM_XX three different information are defined:

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Information about bit 0 of STATE_RBM_XX:
Conditions for monitoring are met long enough to detect malfunction (no intrusive operation, no short trip)

Information about bit 1 of STATE_RBM_XX:
Monitor disabled because of system malfunction (depending on failure status: pending)

Information about bit 2 of STATE_RBM_XX:
Monitor individual RBM conditions encountered within this DC

Only calculation of STATE_RBM_FUP_CH[0] supported. If NC_CBK_HPP_NR=2, than STATE_RBM_FUP_CH[1] =0.

Application conditions

Initialisation:

```
 at ECU reset :
bit 0, bit 1 and bit 2 of  STATE_RBM_FUP_CH[0] = 0

at LV_DC 0 -> 1 transition :

bit 0, bit 1, bit 2 of  STATE_RBM_FUP_CH[0] = 0
 On failure memory reset :

bit 1 of  STATE_RBM_FUP_CH[0] = 0

 if      NC_CBK_HPP_NR >1
then   STATE_RBM_FUP_CH[1]=0
endif
```

Recurrence: *1 s (excepted parts where the recurrence is given explicitly)*

Activation: *LV_DC = 1*

Deactivation: LV_DC = 0

Formula section:

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FUP_CH

At LV_DC 0 → 1 transition

The pending status of the following failures has to be checked only once:

LV_ERR_H_PRS_SYS_PRE	LV_ERR_FUP	LV_ERR_VCV	LV_ERR_FUP_ORNG
LV_ERR_FUP_MFP_PLAUS			

If(1) { CPU optimization at LV_DC 0 → 1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn't empty }

Then(1)

While bit 1 of STATE_RBM_FUP_CH[0] = 0 **do**

with each failure of the above list :

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ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2)
bit 1 of STATE_RBM_FUP_CH[0] = 1
Endif(2)
Endwhile
Else(1)
{ the dynamic failure memory is empty }
No action
Endif(1)

Every 1 s :
If bit 0 of STATE_RBM_FUP_CH[0] = 0
Then
If LV_END_DIAG_RBM_FUP_CH = 1
Then bit 0 of STATE_RBM_FUP_CH[0] = 1
Endif
Endif
If bit 1 of STATE_RBM_FUP_CH[0] = 0
Then
If LV_INH_DIAG_RBM_FUP_CH = 1
Then bit 1 of STATE_RBM_FUP_CH[0] = 1
Endif
Endif

Every 100 ms:
If bit 2 of STATE_RBM_ FUP_CH[0] = 0
Then
If LV_CH = 1 **And**
T_AST > C_T_AST_RBM_FUP_CH
Then bit 2 of STATE_RBM_FUP_CH[0] = 1
Endif
Endif

B.99.2 FUP diagnosis during catalyst heating (LV_ERR_FUP_CH)

General information:

During catalyst heating a deviation in FUP_SP to FUP (FUP_DIF) is observed. If the deviation is smaller or greater than a threshold for a defined time the corresponding symptom and error will be set after debounce.

Application conditions:

Initialisation: STD_INI, all other at reset with 0
Recurrence: 20ms
Activation: (LV_IGK = 1) **and** (N_32 > C_N_32_FUP_DIAG)
Deactivation: **If** (LV_IGK = 0) **or** (N_32 <= C_N_32_FUP_DIAG)
Then LV_CDN_DIAG_FUP_CH = 0
T_FUP_CH_DIAG_MIN = 0 ms
T_FUP_CH_DIAG_MAX = 0 ms

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```
            Endif
```

Formula section:

```
If          LV_INH_DIAG_RBM_FUP_CH = 0     and
            LV_ERR_FUP_CH = 0              and
            LV_CH = 1                      and
            TCO > C_TCO_MIN_FUP_CH         and
            T_AST > C_T_AST_MIN_FUP_CH

Then        // check if FUP is too low:
            If      FUP_DIF > C_FUP_DIF_DIAG_MAX
             Then   T_FUP_CH_DIAG_MIN ++      (until max reached)
             Else   T_FUP_CH_DIAG_MIN = 0 ms
             Endif
             // check if FUP is too high:
            If      FUP_DIF < C_FUP_DIF_DIAG_MIN
             Then   T_FUP_CH_DIAG_MAX ++      (until max reached)
             Else   T_FUP_CH_DIAG_MAX = 0 ms
             Endif

             // setting of error symptom:
             If      T_FUP_CH_DIAG_MAX > C_T_FUP_CH_DIAG_MAX
             Then    symptom FUP is too high is detected:
                      LV_CDN_DIAG_FUP_CH = 1
                     ERR_SYM_FUP_CH = SYM_0
             Else    If      T_FUP_CH_DIAG_MIN > C_T_FUP_CH_DIAG_MIN
                      Then   symptom FUP is too low is detected:
                             LV_CDN_DIAG_FUP_CH = 1
                              ERR_SYM_FUP_CH = SYM_1
                      Else   no symptom detected:
                              If     (T_FUP_CH_DIAG_MIN == 0 AND
  T_FUP_CH_DIAG_MAX == 0)
                              Then
                                     LV_CDN_DIAG_FUP_CH = 1
      ERR_SYM_FUP_CH = NO_SYM
                                Else
                                     LV_CDN_DIAG_FUP_CH = 0
                              Endif
                      Endif
                Endif
Else
                LV_CDN_DIAG_FUP_CH = 0

             reset of timers:
             T_FUP_CH_DIAG_MIN = 0 ms
            T_FUP_CH_DIAG_MAX = 0 ms
Endif
```

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LV_ERR_XXX[i] and LV_END_XXX[i] be set by ERRM after debounce. For failure and error management treatment the anti-bounce mechanism is called (ABC_DEC=1):
ACTION_ERRM_FilterSymptom(IN<NC_IDX_DIAG >, IN<LV_CDN_DIAG_FUP_CH>, IN<ERR_SYM_FUP_CH>, IN<ABC_INC>, IN<ABC_DEC>, IN<ABC_MAX>, OUT<LV_ERR_FUP_CH>)

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B.100 Cold start emission reduction strategy diagnosis for injection

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ANG_INJ_CSERS_MAX [NC_NR_IV_PLS] [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
Maximum possible angle setpoint for a CSERS angle evaluation cycle					
ANG_INJ_CSERS_MIN [NC_NR_IV_PLS] [NC_CYL_NR]	V	0... 780H	0... 720	0.375	°CRK
Minimum possible angle setpoint for a CSERS angle evaluation cycle					
ANG_MEM [NC_NR_IV_PLS]	V	0... 780H	0... 720	0.375	°CRK
Memorized angle set point used for two consecutive evaluation cycles.					
CTR_CSERS_INJ_ERR	V	0... FFFFH	0... 65535	1	-
Error counter, increments one time per segment if error of CSERS multiple injection in phasing or timing or pulse number occurs					
CTR_SEG_CH	V	0... FFFFH	0... 65535	1	-
Segment counter, increments if catalyst heating segment with valid CSERS multiple injection diagnosis occurs					
LV_SYM_CSERS_INJ_DIAG	O/V	0... 1H	0 ...1	1	-
Symptom of CSERS multiple injection diagnosis					
LV_T_CH_ACT	O/V	0... 1H	0 ...1	1	-
CSERS multiple injection diagnosis was long enough valid. CSERS multiple injection diagnosis returns valid symptom					
RATIO_CSERS_INJ_ERR	V	0... FFFFH	0 ...1	15.259e-6	-
Error ratio of detected errors to evaluated catalyst heating segments					
TI_4_CSERS_MAX [NC_NR_IV_PLS] [NC_CYL_NR]	V	0... FFFFH	0... 262.14	0.004	ms
Maximum possible timing setpoint for a CSERS timing evaluation cycle					
TI_4_CSERS_MIN [NC_NR_IV_PLS] [NC_CYL_NR]	V	0... FFFFH	0... 262.14	0.004	ms
Minimum possible timing setpoint for a CSERS timing evaluation cycle					
TI_4_MEM [NC_NR_IV_PLS]	V	0... FFFFH	0... 262.14	0.004	ms
Memorized timing set point used for two consecutive evaluation cycles.					

Input data:

ANG_INJ [NC_NR_INJ_CMB] [NC_NR_IV_PLS] [NC_CYL_NR] {p. 6117}	EOI_MES_CSERS [NC_NR_IV_PLS] [NC_CYL_NR] {p. 6117}	LF_INJ_PLS_ENA_SP_CYL [NC_NR_INJ_CMB] [NC_CYL_NR] {p. 6117}	LV_CDN_PRE_CSERS_INJ_DIAG {p. 6117}
NC_CYL_NR {p. 1526}	NC_NR_INJ_CMB {p. 627}	NC_NR_IV_PLS {p. 627}	NLC_INJ_MPI_AUX {p. 629}
SEG_NR {p. 1525}	SOI_MES_CSERS [NC_NR_IV_PLS] [NC_CYL_NR] {p. 6117}	STATE_PLS_TYP_SP_CYL [NC_NR_INJ_CMB] [NC_NR_IV_PLS] [NC_CYL_NR] {p. 6117}	TI_4 [NC_NR_INJ_CMB] [NC_NR_IV_PLS] [NC_CYL_NR] {p. 6118}
TI_MES_4 [NC_NR_IV_PLS] [NC_CYL_NR] {p. 6118}			

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ANG_INJ_CSERS_DELTA_THD	V	0... 780H	0... 720	0.375	°CRK
Error in phasing is detected for CSEERS multiple injection if measured angle of pulse exceeds threshold					
C_CTR_CH_ACT_THD	V	0... FFFFH	0... 65535	1	-
Threshold indicating that CSERS multiple injection diagnosis was long enough valid. CSERS multiple injection diagnosis returns valid symptom if threshold is exceeded.					
C_RATIO_CSERS_INJ_ERR_THD	V	0... FFFFH	0 ...1	15.259e-6	-
An error symptom is set for CSERS multiple injection diagnosis if threshold is excceded					
C_SEG_DELTA_INJ_BAS	V	0... FH	0... 15	1	-
Calibrated constant assigning the packege of set points which will be used for CSERS multiple injection diagnosis					
C_T_INJ_PLS_NOT_RUN	V	0... FFFFH	0... 262.14	0.004	ms
TI_MES equates to TI = 0ms if threshold is not exceeded					
C_TI_4_CSERS_DELTA_THD	V	0... FFFFH	0... 262.14	0.004	ms
Error in timing is detected for CSEERS multiple injection if measured duration of pulse exceeds threshold					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_MAX_SEG_CSERS_INJ	-	0... FFH	0... 255	1	-
Number of segments which have to be waited until first CSERS multiple injection diagnosis run can be made					

Action definition

ACTION_INJR_ChkInjSp (IN<PRM_CYL>)	Mode: -
Diagnosis action comparing ASW set points to BSW measurement values, returning error symptom if CSERS conditions for INJR are not met	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_CYL	in	0... FFH	0... 255	1	-
This action relates to cylinder Cyl.					

ACTION_INJR_IniInjSpMem (IN<PRM_CYL>)	Mode: -
Action stores last possible set points in cycle to be used as first possible set points in following cycle for CSERS diagnosis.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_CYL	in	0... FFH	0... 255	1	-
This action relates to cylinder Cyl.					

ACTION_INJR_SetIniInjSP (IN<PRM_CYL>)	Mode: -
Copy memorised injection set points to min/max calculation of new cycle.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_CYL	in	0... FFH	0... 255	1	-
This action relates to cylinder Cyl.					

ACTION_INJR_UpInjSpMinMax (IN<PRM_CYL>)	Mode: -
Update of min and max set points	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_CYL	in	0... FFH	0... 255	1	-
This action relates to cylinder Cyl.					

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General information

For a comparison of set point values to the actual value, the set point values have to be prepared. Reason for this is that the set point values are calculated for each segment, but used only once each motor cycle. It is not known in ASW which set point value is taken in BSW. Therefore, all calculated set points have to be taken into account.
This is done by storing min and max values of each possible used set point for each single motor cycle. The acquisition separates set points for cylinders and pulses.

Application conditions:

Initialisation: `at reset, clear FMY, IGK on to off:`
```
CTR_SEG_CH = 0
CTR_CSERS_INJ_ERR = 0
RATIO_CSERS_INJ_ERR = 0
LV_SYM_CSERS_INJ_DIAG = 0
LV_T_CH_ACT = 0
```

Activation: `always`

Deactivation: `never`

Recurrence: `segment`

Function description:

Signal flow diagram:

For a robust diagnosis, we have to take account segment jitter, jitter of injbas-event (interrupt or task at 180° after TDC of each cylinder where BSW passes measured values of last injection cycle to ASW), wide ranges of phasing set points and injection times.
Furthermore, regarding set point variation, different update behaviour is configured for different injection modes. So, the actually executed injection times and phasing of the different pulses usually not match the respective set points calculated at a certain segment, but depend on the set point variation over several segments of an injection.

For example:
1) Supposed is SOI = 500°CEK and TI = 3ms and BSW has started the pulse. During execution of the pulse we get a new set point SOI = 480°CRK, TI = 4ms.
BSW maybe configured in such a way that 4ms are applied but SOI = 500°CRK since the pulses had already started. So we have a mixture of two set points. If the pulse is configured as an EOI-pulse, than the EOI would not correspond to any of the two set points.
2) Supposed is an update between two pulses. The first pulse might be executed according to the first set point, the second pulse according to the second set point. In update mode "update" the TI difference of the first pulse might be applied to the second pulse. So the second pulse might not correspond to any set point.
3) Supposed is an EOI_TI pulse with EOI = 400°CRK and TI = 5ms. Further, an angular frequency of 10°CRK/1ms (N=1667/min) is supposed. As result, the set point SOI = 450°CRK. At 430° another set point is requested with EOI = 420° and TI = 7ms.
BSW will prolong the actually performed pulse to 7ms, so the performed pulse is SOI = 450°CRK, EOI = 380°CRK. This is 20° less than the minimum of both EOI set points and will lead with high probability to an increment of the error counter.
4) There are lots of cases in terms of pulse collisions, collisions with SOI_LIM, EOI_LIM, maximum injection range violations in current or past cycles, application of TI_T or T_TI pulses, special update mode configurations where a wrong failure symptom may be detected. So an adequate calibration of the error ratio threshold C_RATIO_CSERS_INJ_ERR_THD has to be considered

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So, the following algorithm is applied for the diagnosis:
LV_CDN_PRE_CSERS_INJ_DIAG must be 1 for at least NC_CYL_NR + 1 segments (no inhibits, same mode for all cylinders, no electrical defects, . . . , see Appl. Inc.). Set points for injection angles and times are sampled over NC_NR_CL + 1 segments and the respective minimum and maximum values are calculated for each cylinder. For the error evaluation it is checked if the measured values of injection angles and times are in between [min - threshold; max + threshold]. If this is not the case, an error counter is incremented.

The figure below shows where the sampled set points take place referring to the segment where the evaluation is done (typical scenario for a 4-cylinder engine).

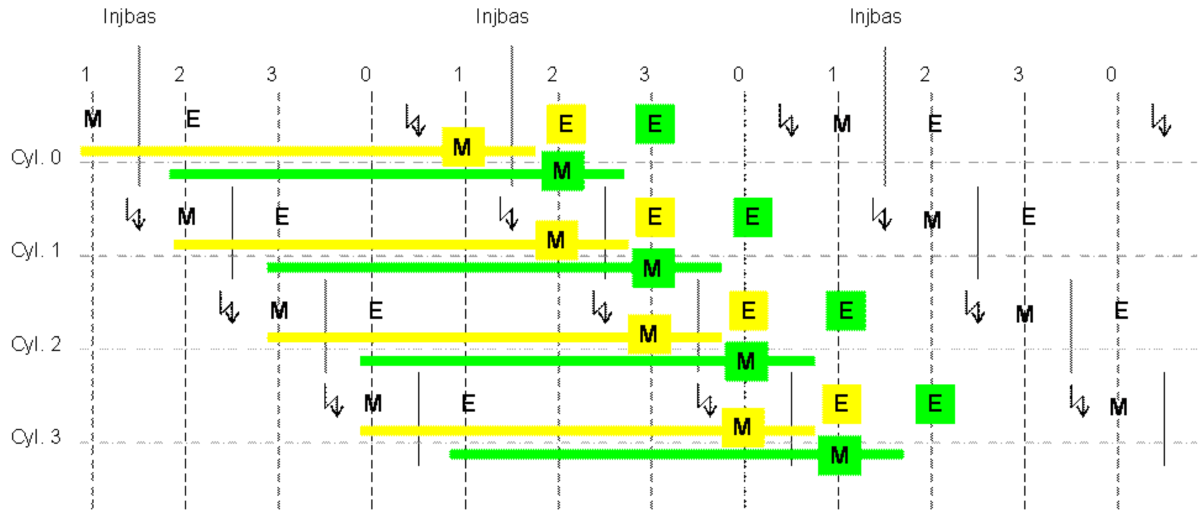

Figure B.100.1:

The injbas-event of a certain cylinder is 180°CRK after TDC. Here, the BSW passes the measured values of the last injection cycle to the ASW.
For cylinder 0: SEG_NR = s is the first segment after injbas_0 (figure above: s = 2).
a) If s is more than 30°CRKafter injbas_0, evaluation is done at segment s = 2 (calibratable via C_SEG_DELTA_INJ_BAS = 2, yellow line in figure above) and set point sampling is done every segment, from 1 up to NC_CYL_NR + 1 segments before.
b) If s is less than 30°CRK after injbas_0, evaluation is done at segment s + 1 (= 3 in figure above, calibratable via C_SEG_DELTA_INJ_BAS = 3, green line). Set point sampling is done from 1 up to NC_CYL_NR + 1 segments before.
So it is guaranteed that the measured values are up-to-date for evaluation (E in figure) and that all relevant set points have been sampled.
As NC_CYL_NR + 1 samples of set points are necessary for the diagnosis evaluation, the injection parameter of the last segment have to be memorized and used for the next consecutive evaluation cycle again (marked with M in figure above).

Calibration hint for C_SEG_DELTA_INJ_BAS:
For low engine speed, measure CRK_PSN_INJ_BAS_0 and SEG_NR (update rate every segment) in the application system. If the biggest value of CRK_PSN_INJ_BAS_0 is smaller than 690°CRK (note that 0°CRK is considered as 720°CRK), than set C_SEG_DELTA_INJ_BAS to the respective SEG_NR of the biggest value (= 2 in the example above).
Otherwise set C_SEG_DELTA_INJ_BAS to the next SEG_NR (= 3 in the example above).

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Formula section:

```
#IF    NLC_INJ_MPI_AUX == 0        /* no MPI */
#THEN    NC_MAX_SEG_CSERS_INJ = NC_CYL_NR
#ELSE    NC_MAX_SEG_CSERS_INJ = 2 * NC_CYL_NR           /* SDI together with MPI */
#ENDIF


IF(1)    LV_CDN_PRE_CSERS_INJ_DIAG                          /* diagnosis pre condition */
THEN(1)

   FOR    i = 0 to NC_CYL_NR -1
   IF(2)    i = 0
    THEN(2)    x = NC_CYL_NR + SEG_NR - C_SEG_DELTA_INJ_BAS    /* actual evaluated cylinder
*/
                                                       /* x E [1, 2*NC_CYL_NR - 1] */
      IF(3)    x >= NC_CYL_NR
      THEN(3)    x = x - NC_CYL_NR
      ENDIF(3)

      IF(4)    ctr_cdn > NC_MAX_SEG_CSERS_INJ       /* wait some time after valid pre condition*/
      THEN(4)    Call ACTION_INJR_ChkInjSp(IN<x>, OUT<LV_SYM_CSERS_INJ_DIAG>)
                                             /* Evaluation of CSERS diagnosis for INJR */
      ENDIF(4)

               Call ACTION_INJR_SetIniInjSp(IN<x>)    /* Copy last set point of last cycle to new cycle
*/

   ELSE(2)    x= x+ 1                                  /* not evaluated cylinders */
      IF(5)    x >= NC_CYL_NR
      THEN(5)    x = 0
      ENDIF(5)

      IF(6)    i = 1
       THEN(6)    Call ACTION_INJR_IniInjSpMem(IN<x>)     /* memorize set point (M)*/
      ENDIF(6)
   ENDIF(2)

        Call ACTION_INJR_UpdInjSpMinMax(IN<x>)            /*calculation of min and max set points
of
                                                 one engine cycle */
   ENDFOR

   IF(7)    ctr_cdn <= NC_MAX_SEG_CSERS_INJ
   THEN(7)    ctr_cdn ++
   ENDIF(7)

ELSE(1)    ctr_cdn = 0
```

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ENDIF(1)

B.100.1 ACTION_INJR_IniInjSpMem

Formula section:

FOR pls = 0 to NC_NR_IV_PLS - 1
ANG_MEM[pls] = ANG_INJ[0][pls][x]
TI_4_MEM[pls] = TI_4[0][pls][x]
ENDFOR

B.100.2 ACTION_INJR_SetIniInjSP

Formula section:

FOR pls = 0 to NC_NR_IV_PLS - 1
ANG_INJ_CSERS_MIN[pls][x] = ANG_MEM[pls]
ANG_INJ_CSERS_MAX[pls][x] = ANG_MEM[pls]

TI_4_CSERS_MIN[pls][x] = TI_4_MEM[pls]
TI_4_CSERS_MAX[pls][x] = TI_4_MEM[pls]
ENDFOR

B.100.3 ACTION_INJR_UpInjSpMinMax

Formula section:

FOR pls = 0 to NC_NR_IV_PLS - 1
ANG_INJ_CSERS_MIN[pls][x] =
MIN(ANG_INJ_CSERS_MIN[pls][x], ANG_INJ[0][pls][x])
ANG_INJ_CSERS_MAX[pls][x] =
MAX(ANG_INJ_CSERS_MAX[pls][x], ANG_INJ[0][pls][x])

TI_4_CSERS_MIN[pls][x] = **MIN**(TI_4_CSERS_MIN[pls][x], TI_4[0][pls][x])
TI_4_CSERS_MAX[pls][x] = **MAX**(TI_4_CSERS_MAX[pls][x], TI_4[0][pls][x])
ENDFOR

B.100.4 ACTION_INJR_ChkInjSp

An error counter should be incremented exactly one time, if at least one of the following parameters is wrong:
- injection angle
- injection timing

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- number of pulses

Wrong injection angle is detected, if the minimum difference between min and max injection phase set point and BSW injection phase measurement value for an engine cycle exceeds a calibratable threshold.
Wrong injection timing is detected, if the minimum difference between min and max injection time set point and BSW injection time measurement value for an engine cycle exceeds a calibratable threshold.
Wrong number of pulses is detected via previous checks if an enabled pulse is not executed and via a check that BSW injection time measurement does not exceed a threshold for a disabled pulse.

For error evaluation, the error counter is compared relative to the number of combustions which were driven since the diagnosis started. If the error ratio exceeds a calibratable threshold, the error symptom for CSERS for multiple injection is set.
The error symptom must not be set before catalyst heating was active for a minimum time.

Formula section:

```
CTR_SEG_CH ++                 /* SW: limit counter to max value */
tmp_err_flag = 0

FOR     pls = 0 to NC_NR_IV_PLS - 1
  IF(1)     LF_INJ_PLS_ENA_SP_CYL[0][x][bit pls] = 1
  THEN(1)   /* pulse enabled */
    IF(2)      STATE_PLS_TYP_SP_CYL[0][pls][x] = "SOI_TI" OR "TI_T"
    THEN(2)  tmp_ang = SOI_MES_CSERS[pls][x]
    ELSE(2)  tmp_ang = EOI_MES_CSERS[pls][x]
    ENDIF(2)

    IF(3)   tmp_ang > (ANG_INJ_CSERS_MAX[pls][x] + C_ANG_INJ_CSERS_DELTA_THD)  OR
                                                 /* phasing error - pulse to early */
            tmp_ang < (ANG_INJ_CSERS_MIN[pls][x] - C_ANG_INJ_CSERS_DELTA_THD)  OR
                                                 /* phasing error - pulse to late*/

           TI_MES_4[pls][x] > (TI_4_CSERS_MAX[pls][x] + C_TI_4_CSERS_DELTA_THD)  OR
                                                 /* timing error - pulse too long*/
            TI_MES_4[pls][x] < (TI_4_CSERS_MIN[pls][x] - C_TI_4_CSERS_DELTA_THD)
                                                 /* timing error - pulse too short*/
    THEN(3)   tmp_err_flag = 1
    ENDIF(3)

  ELSE(1)   /* pulse disabled */
    IF(4)    TI_MES_4[pls][x] > C_T_INJ_PLS_NOT_RUN  /* measured pulse is higher (0ms + noise)
*/
    THEN(4)   tmp_err_flag = 1                   /* wrong number of pulses */
    ENDIF(4)
  ENDIF(1)
ENDFOR

IF(1)   tmp_err_flag == 1
THEN(2)   CTR_CSERS_INJ_ERR ++                 /* SW: limit counter to max value */
ENDIF(2)
```

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```
RATIO_CSERS_INJ_ERR = CTR_CSERS_INJ_ERR /CTR_SEG_CH
IF(3)    CTR_SEG_CH > C_CTR_CH_ACT_THD
THEN(3)    LV_T_CH_ACT = 1
   IF(4)    RATIO_CSERS_INJ_ERR > C_RATIO_CSERS_INJ_ERR_THD
   THEN(4)    LV_SYM_CSERS_INJ_DIAG = 1
   ELSE(4)    LV_SYM_CSERS_INJ_DIAG = 0
   ENDIF(4)
ENDIF(3)
```

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B.101 Cold start emission reduction strategy diagnosis for INJ (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ANG_INJ [NC_NR_INJ_CMB] [NC_NR_IV_PLS] [NC_CYL_NR]	O/V	0... 780H	0... 720	0.375	°CRK
Injection angle (SOI or EOI).					
EOI_MES_CSERS [NC_NR_IV_PLS] [NC_CYL_NR]	O	0... 780H	0... 720	0.375	°CRK
Actual performed EOI, estimated; for CSERS_INJ diagnosis					
ERR_SYM_CSERS_INJ	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom of CSERS multiple injection diagnosis filtered with LV_CDN_DIAG_CSERS_INJ					
LF_INJ_PLS_ENA_SP_CYL [NC_NR_INJ_CMB] [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Field to indicate if respective injection puls is active (=1) or inactive (=0).					
LV_CDN_DIAG_CSERS_INJ	V	0... 1H	0 ...1	1	-
Condition of CSERS multiple injection diagnosis					
LV_CDN_PRE_CSERS_INJ_DIAG	O/V	0... 1H	0 ...1	1	-
Pre condition indicating if CSERS multiple injection diagnosis is allowed					
LV_CH_FIRST_DEAC	V	0... 1H	0 ...1	1	-
Flag indicating that catalyst heating was active at least one time					
LV_CSERS_INJ_PLS_TEST_MOD_ENA	O/V	0... 1H	0 ...1	1	-
Flag indicating that injection demo test mode for CSERS multiple injection diagnosis is enabled					
LV_END_DIAG_CSERS_INJ	V	0... 1H	0 ...1	1	-
End of CSERS multiple injection diagnosis					
LV_ERR_CSERS_INJ	O/V	0... 1H	0 ...1	1	-
Error flag of CSERS multiple injection diagnosis					
SOI_MES_CSERS [NC_NR_IV_PLS] [NC_CYL_NR]	O	0... 780H	0... 720	0.375	°CRK
Actual performed SOI, estimated, for CSERS_INJ diagnosis					
STATE_PLS_TYP_SP_CYL [NC_NR_INJ_CMB] [NC_NR_IV_PLS] [NC_CYL_NR]	O/V	0H 1H 2H 3H	EOI_TI SOI_TI T_TI TI_T	-	-
Pulse type of injection pulses cylinder individual					
STATE_RBM_CSERS_INJ	O/V	0... FFH	0... 255	1	-
Interface of CSERS_INJ monitor with the Rate-Based Monitoring statistics					
T_STATE_CSERS_INJ_RBM	V	0... FFH	0... 255	1	s
Timer indicating running time of RBM for CSERS multiple injection diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TI_4 [NC_NR_INJ_CMB] [NC_NR_IV_PLS] [NC_CYL_NR]	O/V	0... FFFFH	0... 262.14	0.004	ms
Injection time for respective mode, pulse and cylinder.					
TI_MES_4 [NC_NR_IV_PLS] [NC_CYL_NR]	O/V	0... FFFFH	0... 262.14	0.004	ms
Performed cylinder individual injection time					

Input data:

CTR_CYL_NR_ST_CLC {p. 1754}	CTR_CYL_NR_STOP_CLC {p. 1754}	CTR_ERR_DYN_NR {p. 5767}	EOI_1_HOM {p. 2122}
EOI_1_MES [NC_CYL_NR] {p. 2036}	EOI_2_HOM [NC_CYL_NR] {p. 2130}	EOI_2_MES [NC_CYL_NR] {p. 2036}	EOI_3_HOM [NC_CYL_NR] {p. 2133}
EOI_POST_MES [NC_CYL_NR] {p. 2037}	INH_INJ {p. 2295}	INJ_MOD_SP [NC_CYL_NR] {p. 3328}	LV_CH {p. 8232}
LV_DC {p. 5746}	LV_ERR_IV [NC_CYL_NR] {p. 4802}	LV_ERR_PBK_IV [NC_PBK_IV_NR] {p. 4797}	LV_ES {p. 1720}
LV_IGK {p. 906}	LV_ST_END {p. 1720}	LV_SYM_CSERS_INJ_DIAG {p. 6109}	LV_T_CH_ACT {p. 6109}
NC_CYL_NR {p. 1526}	NC_IDX_DIAG_IV [NC_CYL_NR]	NC_IDX_DIAG_PBK_IV [NC_PBK_IV_NR]	NC_INJ_MOD_MASK_2 {p. 2045}
NC_INJ_MOD_SINGLE {p. 2045}	NC_NR_INJ_CMB {p. 627}	NC_NR_IV_PLS {p. 627}	NC_PBK_IV_NR {p. 628}
SOI_1_HOM [NC_CYL_NR] {p. 2122}	SOI_1_MES [NC_CYL_NR] {p. 2039}	SOI_2_MES [NC_CYL_NR] {p. 2039}	SOI_POST_MES [NC_CYL_NR] {p. 2039}
STATE_DIAG_IV {p. 4803}	STATE_DIAG_PBK_IV {p. 4797}	STATE_ERR_IV {p. 4803}	STATE_ERR_PBK_IV {p. 4797}
TI_1_HOM [NC_CYL_NR] {p. 2002}	TI_1_MES [NC_CYL_NR] {p. 2040}	TI_2_HOM [NC_CYL_NR] {p. 2003}	TI_2_MES [NC_CYL_NR] {p. 2040}
TI_3_HOM [NC_CYL_NR] {p. 2003}	TI_POST_MES [NC_CYL_NR] {p. 2041}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_STATE_CSERS_INJ_RBM	V	0... FFH	0... 255	1	s
Calibratable limit for CSERS multiple injection diagnosis RBM timer to allow increment of denominator					
LC_CH_CSERS_INJ_TEST_ENA	V	0... 1H	0 ...1	1	-
Switch to enable catalyst heating independent test of CSERS multiple injection diagnosis					
LC_CSERS_INJ_DIAG_ENA	V	0... 1H	0 ...1	1	-
Enable switch to allow CSERS multiple injection diagnosis					
LC_CSERS_INJ_PLS_TEST_MOD_ENA	V	0... 1H	0 ...1	1	-
Switch to enable injection demo test mode for CSERS multiple injection diagnosis					

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

ACTION_ERRM_NoFilterReset (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR>)

Continued on next page

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ACTION_ERRM_NoFilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_LV_ERR_SET>,**IN**<PRM_LV_ERR_RST>,**IN**<PRM_LV_END_DIAG>,**OUT**<PRM_LV_ERR>)

Error treatment

Diagnostic Identifier	Symptom Description	Nr	OBD Sym DTC	OBD Global DTC	Filter Type	CARB class
Diagnostic Description						
CSERS_INJ	CSERS thresholds for INJR are exceeded	0			NO_FIL	CC
CSERS diagnosis for multiple injection		1				
		2				
		3				

General information

In this specification following functions are handled:

- calculation of project specific diagnosis condition
- mapping of project specific set points and measurement variables to generic CSERS diagnosis variables
- project specific error handling

B.101.1 Variable mapping

General information:

Variable mapping has to be done for "old" INJR pulse concept. In this function, the names of the old set point variables are mapped to the names which are also used in the CSERS for multiple injection diagnosis core specification.

Application conditions:

Initialisation: `-`

Activation: `always`

Deactivation: `never`

Recurrence: `every segment;`
`before calculation of CSERS core spec and after calculation of iftrans0`

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Function description:

Formula section:

```
IF(1)   (LV_CH OR LC_CH_CSERS_INJ_TEST_ENA) == 1        /* catalyst heating or test mode active */
THEN(1)
  FOR   pls = 0 to NC_NR_IV_PLS - 1
    FOR   x = 0 to NC_CYL_NR - 1

        IF(2)   pls == 0  /* project specific cases if pulses are SOI or EOI based, for 4D9 catalyst heating
                   is only driven in homogenous mode, so 1st pulse is SOI, all further pulses EOI based */

      THEN(2)   STATE_PLS_TYP_SP_CYL[0][pls][x] = "SOI_TI"
        IF(3)   pls == 0
        THEN(3)   ANG_INJ[0][pls][x] = SOI_1_HOM[x]
        ELSE(3)
          IF(4)   pls == 1
          THEN(4)   ANG_INJ[0][pls][x] = 0°CRK              /* SOI_2_HOM[x] not available */
          ELSE(4)   ANG_INJ[0][pls][x] = 0°CRK              /* SOI_3_HOM[x] not available */
          ENDIF(4)
        ENDIF(3)

      ELSE(2)   STATE_PLS_TYP_SP_CYL[0][pls][x] = "EOI_TI"
        IF(5)   pls == 0
        THEN(5)   ANG_INJ[0][pls][x] = EOI_1_HOM[x]
        ELSE(5)
          IF(6)   pls == 1
          THEN(6)   ANG_INJ[0][pls][x] = EOI_2_HOM[x]
          ELSE(6)   ANG_INJ[0][pls][x] = EOI_3_HOM[x]
          ENDIF(6)
        ENDIF(5)
      ENDIF(2)

      IF(7)   pls == 0
        THEN(7)   TI_4[0][pls][x] = TI_1_HOM[x]   /* note for SW: different resolutions have to be mapped
                  TI_MES_4[pls][x] = TI_1_MES[x]   /* note for SW: different resolutions have to be
                                                      mapped */
                  SOI_MES_CSERS[pls][x] = SOI_1_MES[x]
                  EOI_MES_CSERS[pls][x] = EOI_1_MES[x]
      ELSE(7)
        IF(8)   pls == 1
        THEN(8)   TI_4[0][pls][x] = TI_2_HOM[x]   /* note for SW: different resolutions
                    TI_MES_4[pls][x] = TI_2_MES[x] /* note for SW: different resolutions have to be
                                                      mapped */
                    SOI_MES_CSERS[pls][x] = SOI_2_MES[x]
                    EOI_MES_CSERS[pls][x] = EOI_2_MES[x]

        ELSE(8)   TI_4[0][pls][x] = TI_3_HOM[x]   /* note for SW: different resolutions
```

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```
                TI_MES_4[pls][x] = TI_POST_MES[x]  /* note for SW: different resolutions have to
                                                   be mapped */
                 SOI_MES_CSERS[pls][x] = SOI_POST_MES[x]
                 EOI_MES_CSERS[pls][x] = EOI_POST_MES[x]
            ENDIF(8)
         ENDIF(7)
      ENDFOR
   ENDFOR

   FOR    x = 0 to NC_CYL_NR - 1
          tmp_nr = INJ_MOD_SP[x] bitwise_AND NC_INJ_MOD_MASK_2
      IF(9)    tmp_nr == 1
      THEN(9)    LF_INJ_PLS_ENA_SP_CYL[0][x] = 1
      ELSE(9)
         IF(10)    tmp_nr == 2
         THEN(10)   LF_INJ_PLS_ENA_SP_CYL[0][x] = 3
         ELSE(10)   LF_INJ_PLS_ENA_SP_CYL[0][x] = 7
         ENDIF(10)
      ENDIF(9)
   ENDFOR

ENDIF(1)
```

B.101.2 Condition calculation of CSERS diagnosis for INJR

General information:

Condition for CSERS multiple injection diagnosis is given if:
- start ended . . . AND
- engine state is catalyst heating or if test mode is activated . . . AND
- no injection inhibition is active . . . AND
- more than one injection pulses are active . . . AND
- injection modes are equal for all cylinders . . . AND
- catalyst heating was not deactivated yet in driving cycle . . . AND
- no injection valve failure symptom or debounced error is present . . . AND
- no injection power stage bank failure symptom or debounced error is present

Due to hardware constraints on some power stages (e.g. ATIC21) STATE_DIAG_IV != 0 or STATE_DIAG_PBK_IV != 0 would cause false failure recognition. Accordingly the diagnosis is faded out then.

Application conditions:

Initialisation: `at reset, clear FMY, IGK off to on:`
`LV_CDN_PRE_CSERS_INJ_DIAG = 0`
`LV_CH_FIRST_DEAC = 0`

Activation: `always`

Deactivation: `never`

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Recurrence: every segment;
before calculation of CSERS core spec and after calculation

of iftrans0

Function description:

Formula section:

LV_CDN_PRE_CSERS_INJ_DIAG = 1 /* *initialize pre cdn with 1 and reset if cdn is not given* */

```
IF(1)   !LV_ST_END                                                        OR
        !(LV_CH OR LC_CH_CSERS_INJ_TEST_ENA)                              OR
        INH_INJ != 0                                                      OR
        CTR_CYL_NR_ST_CLC != 0 OR CTR_CYL_NR_STOP_CLC != NC_CYL_NR -1     OR
        (state_inj_mod_csers bitwise_AND NC_INJ_MOD_MASK_2) <= 1          OR
        ! ( !LV_CH_FIRST_DEAC OR LC_CH_CSERS_INJ_TEST_ENA)                OR
        STATE_DIAG_IV != 0 OR STATE_ERR_IV != 0                           OR
        STATE_DIAG_PBK_IV != 0 OR STATE_ERR_PBK_IV != 0

THEN(1)   LV_CDN_PRE_CSERS_INJ_DIAG = 0      /* non-cylinder individual condition is not given
*/
ELSE(1)                                      /* check cylinder individual conditions */
   FOR   x = 0 to NC_CYL_NR -1
      IF(2)   INJ_MOD_SP[x] != state_inj_mod_csers                        OR
              LF_INJ_PLS_ENA_SP_CYL[0][x] != lf_inj_pls_ena_csers
      THEN(2)   LV_CDN_PRE_CSERS_INJ_DIAG = 0    /* cylinder individual condition is not given
*/
      ENDIF(2)
   ENDFOR
ENDIF(1)

state_inj_mod_csers = INJ_MOD_SP[0]
lf_inj_pls_ena_csers = LF_INJ_PLS_ENA_SP_CYL[0][0]
```

B.101.3 CSERS_INJ demo test mode activation

General information:

Here, the condition for enabling the CSERS multiple injection diagnosis demo test mode is calculated.

Condition for enabling the CSERS multiple injection diagnosis demo test mode is:
- multiple injection is active
- catalyst heating is active
- demo test mode is activated by calibration

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Application conditions:

Initialisation: –

Activation: always

Deactivation: never

Recurrence: every segment
before calculating "Transfer to basic software"

Function description:

Formula section:

IF(1) (LV_CH **AND** LC_CSERS_INJ_PLS_TEST_MOD_ENA) == 1
THEN(1) LV_CSERS_INJ_PLS_TEST_MOD_ENA = 1
FOR x = 0 to (NC_CYL_NR - 1)
IF(2) (INJ_MOD_SP[x] **BitwiseAND** NC_INJ_MOD_MASK_2) != NC_INJ_MOD_SINGLE
THEN(2) Do nothing
ELSE(2) LV_CSERS_INJ_PLS_TEST_MOD_ENA = 0
ENDIF(2)
ENDFOR
ELSE(1) LV_CSERS_INJ_PLS_TEST_MOD_ENA = 0
ENDIF(1)

B.101.4 Error handling

General information:

Error-symptoms are defined to this diagnostic function as following :

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │││└─> CSERS thresholds for INJR are exceeded                 (= SYM_0)
 ││└───> (not used or give here the symptom 1 description)      (= SYM_1)
 │└─────> (not used or give here the symptom 2 description)      (= SYM_2)
 └───────> (not used or give here the symptom 3 description)      (= SYM_3)
```

Application conditions:

Initialisation: at reset, clear FMY, IGK off to on:
LV_CDN_DIAG_CSERS_INJ = 0
LV_ERR_CSERS_INJ = ACTION_ERRM_NoFilterReset(IN<NC_IDX_DIAG_CSERS_INJ>, OUT <LV_ERR_CSERS_INJ>)

Activation: always

Deactivation: never

Recurrence: every segment; after calculation of CSERS core spec

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Function description:

Formula section:

Condition calculation:

IF(1) LV_T_CH_ACT = 1 *\/* catalyst heating was active for a minimum time */*

THEN(1) LV_CDN_DIAG_CSERS_INJ = 1
ELSE(1) LV_CDN_DIAG_CSERS_INJ = 0
ENDIF(1)

Error symptom calculation:

IF(2) LV_SYM_CSERS_INJ_DIAG = 1

THEN(2) ERR_SYM_CSERS_INJ = SYM_0
ELSE(2) ERR_SYM_CSERS_INJ = NO_SYM
ENDIF(2)

/ Error function call at end of catalyst heating, if CSERS_INJ diagnosis is enabled */*
IF(3) LV_CH 1 **->** 0 transition **AND** LC_CSERS_INJ_DIAG_ENA == 1 **AND**
LV_CH_FIRST_DEAC == 0 **AND** LV_ST_END ==1
THEN(3) LV_ERR_CSERS_INJ =
ACTION_ERRM_NoFilterSymptom(IN<CSERS_INJ>, IN<LV_CDN_DIAG_CSERS_INJ>,
IN <ERR_SYM_CSERS_INJ>,
IN<set = LV_SYM_CSERS_INJ_DIAG **AND** LV_CDN_DIAG_CSERS_INJ>,
IN<reset = **NOT**(LV_SYM_CSERS_INJ_DIAG) **AND** LV_CDN_DIAG_CSERS_INJ>,
IN<end = LV_T_CH_ACT>,
OUT<LV_ERR_CSERS_INJ>)

LV_CH_FIRST_DEAC = 1
/ LV_END_DIAG_CSERS_INJ = LV_T_CH_ACT Note: is produced in ERRM by action call */*
ENDIF(3)

IF(4) LC_CSERS_INJ_DIAG_ENA == 0
THEN(4) LV_ERR_CSERS_INJ =
ACTION_ERRM_NoFilterSymptom(IN<CSERS_INJ>, IN<cdn = 1>,
IN <sym = 0>, IN<set = 0>, IN<reset = 1>, IN<end = 1>, OUT<LV_ERR_CSERS_INJ>)

/ LV_END_DIAG_CSERS_INJ = 1 Note: is produced in ERRM by action call */*
ENDIF(4)

B.101.5 Rate based monitoring

General information:

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With this module the interface between the XX monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_XX data.
Within STATE_RBM_XX, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)
  (depending on failure status: pending)
- Monitor individual RBM conditions encountered within this DC (bit 2)

Application conditions:

Initialisation:
```
reset:  bit 0, bit 1 and bit 2 of STATE_RBM_CSERS_INJ = 0
LV_DC 0 -> 1 transition:  bit 0, bit 1 and bit 2 of STATE_
RBM_CSERS_INJ = 0
CLR_FMY: bit 1 of STATE_RBM_CSERS_INJ = 0

reset, LV_DC 0 ->1, CLR_FMY: T_STATE_CSERS_INJ_RBM = 0
```

Activation: `LV_DC 0 ->  1 transition and LV_DC = 1`

Deactivation: `never`

Recurrence: `1s`

Function description:

Formula section:

Monitor disablement because of system malfunction

At LV_DC 0 -> 1 transition
The pending status of the following failures has to be checked only once:

NC_IDX_DIAG_IV[NC_CYL_NR]	NC_IDX_DIAG_PBK_IV[NC_PBK_IV_NR]		

If(1) CTR_ERR_DYN_NR <> 0 */* the dynamic failure memory isn't empty */*
Then(1)
For each failure of the above list **do**
ACTION_ERRM_CheckPendingStatus(IN<PRM_IDX_DIAG>, OUT<PRM_LV_ERR_PND>)
If(2) PRM_LV_ERR_PND = 1 /* pending fault */
Then(2) bit 1 of STATE_RBM_CSERS_INJ = 1
Exit For-loop
Endif(2)
Endfor
Endif(1)

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Conditions for monitoring are met long enough to detect malfunction

Every 1s

```
If(3)    bit 0 of STATE_RBM_CSERS_INJ == 0
Then(3)
  If(4)      LV_END_DIAG_CSERS_INJ == 1      /* SW: use ACTION_ERRM_GetLvEndDiag
                                                (IN<IDX_DIAG_CSERS_INJ>,
                                                OUT< LV_END_DIAG_CSERS_INJ >) */
  Then(4)  bit 0 of STATE_RBM_CSERS_INJ = 1
  Endif(4)
Ednif(3)

If(5)    bit 1 of STATE_RBM_CSERS_INJ == 0
Then(5)
  For   x = 0 to NC_CYL_NR - 1
    For   p = 0 to NC_PBK_IV_NR - 1
      If(6)      LV_ERR_IV[x] OR LV_ERR_PBK_IV[p]
      Then(6)  bit 1 of STATE_RBM_CSERS_INJ = 1
      Endif(6)
    Endfor
  Endfor
Ednif(5)
```

Additional requirements

```
If(7)       bit 2 of STATE_RBM_CSERS_INJ == 0
Then(7)
    If(8)     T_STATE_CSERS_INJ_RBM >= C_T_STATE_CSERS_INJ_RBM
              /* CSERS_INJ active time more then 10 seconds */
    Then(8)
                bit 2 of STATE_RBM_CSERS_INJ = 1
    Endif(8)  ´
Endif(7)


IF(9)     LV_CH == 1 AND LV_CH_FIRST_DEAC == 0 AND LC_CSERS_INJ_DIAG_ENA == 1 AND
            LV_ES == 0
THEN(9)
  tmp_cdn = 1

  FOR   x = 0 to NC_CYL_NR - 1
   IF(10)   (INJ_MOD_SP[x] bitwise_AND NC_INJ_MOD_MASK_2) <= 1
   THEN(10)  tmp_cdn = 0
   ENDIF(10)
  ENDFOR

  IF(11)  tmp_cdn == 1
  THEN(11)  T_STATE_CSERS_INJ_RBM = T_STATE_CSERS_INJ_RBM + 1s
  ENDIF(11)
ENDIF(9)
```

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B.102 Ambient and manifold pressure plausibility diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AMP_MMV_PLAUS	V	0... FFFFH	0... 5434	0.0829175	hPa
Mean moving value of AMP_MES					
ERR_SYM_AMP_PLAUS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected symptom Ambient pressure plausibility					
LV_CDN_DIAG_AMP_PLAUS	V	0... 1H	0 ...1	1	-
Status of diagnosis flag for Ambient pressure plausibility					
LV_END_DIAG_AMP_PLAUS	V	0... 1H	0 ...1	1	-
End of diagnosis flag for Ambient pressure plausibility diagnosis					
LV_ERR_AMP_PLAUS	O/V	0... 1H	0 ...1	1	-
Boolean for detected error Ambient pressure plausibility diagnosis					

Input data:

AMP_MES {p. 1163}	LV_IGK {p. 906}	LV_INH_DIAG_AMP_PLAUS {p. 6130}	VS {p. 1176}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_AMP_PLAUS	-	0... FFH	0... 255	1	-
Anti bounce increment AMP_PLAUS					
C_ABC_MAX_AMP_PLAUS	-	1... FFH	1... 255	1	-
Anti bounce maximum AMP_PLAUS					
C_AMP_PLAUS_DIF_ERR	-	0... FFFFH	0... 5434	0.0829175	hPa
Maximum allowed offset to detect a unplausible AMP_MES					
IP_CLRC_AMP_PLAUS	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_VS_IP_CLRC_AMP_PLAUS	4	0... FFH	0... 255	1	km/h
Filter constant for mean moving calculation of AMP_MES					

FUNCTION DESCRIPTION:

General information:

Due to CARB requirements the diagnosis detects unplausible ambient pressures which cannot be detected by electrical diagnosis.

The diagnosis is based gradient monitoring of AMP_MES.

Description:

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AMP_MMV_PLAUS is the mean-moving value of AMP_MES and represents the maximum possible change of AMP if the car is driving uphill or downhill.

If AMP_MES is below or upper AMP_MMV_PLAUS -/+ calibratable offset C_AMP_PLAUS_DIF_ERR the sensor is detected as not plausible and ERR_SYM_AMP_PLAUS is set.

Application conditions

Initialisation: according ABC - type **"MEM"** *(all 0 at LV_IGK 0->1, error is set irreversible)*
AMP_MMV_PLAUS = AMP_MES at LV_IGK 0->1 **or** Reset

Recurrence: 1s

Activation: *LV_IGK = 1* ***and*** *LV_INH_DIAG_AMP_PLAUS = 0*

Deactivation: LV_IGK = 0 **or** LV_INH_DIAG_AMP_PLAUS = 1
(set LV_CDN_DIAG_AMP_PLAUS = 0 at deactivation)

Formula section:

Continuous gradient monitoring:
LV_CDN_DIAG_AMP_PLAUS = 1
AMP_MMV_PLAUS(n) = AMP_MMV_PLAUS(n-1)
+ IP_CLRC_AMP_PLAUS * (AMP_MES - AMP_MMV_PLAUS(n-1))
If AMP_MES > AMP_MMV_PLAUS + C_AMP_PLAUS_DIF_ERR
Then ERR_SYM_AMP_PLAUS = SYM_0
Elseif AMP_MES < AMP_MMV_PLAUS - C_AMP_PLAUS_DIF_ERR
Then ERR_SYM_AMP_PLAUS = SYM_1
Else ERR_SYM_AMP_PLAUS = NO_SYM
Endif

LV_ERR_AMP_PLAUS, LV_END_DIAG_AMP_PLAUS is calculated by error management.

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B.103 Ambient and manifold pressure plausibility diagnosis (Appl.Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_AMP_PLAUS	O/V	0... 1H	0 ...1	1	-
Inhibition of AMP_PLAUS diagnosis					
STATE_RBM_AMP_PLAUS	O/V	0... 7H	0 ...7	1	-
Interface of AMP_PLAUS monitor with the Rate-Based Monitoring statistics					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_DC {p. 5746}	LV_END_DIAG_AMP_PLAUS {p. 6128}	LV_ERR_AMP {p. 4822}
LV_ERR_VS {p. 5021}	LV_IGK {p. 906}	LV_INH_DIAG_AMP_PLAUS {p. 6130}	

Import actions:

ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

B.103.1 Inhibition of diagnosis

Description:

LV_INH_DIAG_AMP_PLAUS is set to 1 if AMP_PLAUS diagnosis is inhibited due to a present OBD1 error.

Application conditions

Initialisation: `0 at reset`

Recurrence: `1s`

Activation: `LV_IGK = 1`

Deactivation: `LV_IGK = 0`

Formula section:

If LV_ERR_VS = 1 **or**
LV_ERR_AMP = 1
Then LV_INH_DIAG_AMP_PLAUS = 1
Else LV_INH_DIAG_AMP_PLAUS = 0
Endif

B.103.2 Interface for Rate-based-monitoring

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General information:

With this module the interface between the AMP_PLAUS plausibility monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_AMP_PLAUS data.
Within STATE_RBM_AMP_PLAUS, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)
  (not valid for AMP_PLAUS diagnosis)

Application conditions:

Initialisation :
at ECU reset :
bit 0, bit 1 and bit 2 of STATE_RBM_AMP_PLAUS = 0
at LV_DC 0 1 transition :
bit 0 and bit 1of STATE_RBM_AMP_PLAUS = 0
bit 2 of STATE_RBM_AMP_PLAUS = 1
on failure memory reset :
bit 1 of STATE_RBM_AMP_PLAUS = 0
Recurrence: 1 s
Activation: LV_DC = 1

Formula section:

At LV_DC 0 1 transition
The pending status of the following failures has to be checked only once :

LV_ERR_AMP	LV_ERR_VS		

If(1) { CPU optimization at LV_DC 0 1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }
Then(1)
While bit 1 of STATE_RBM_AMP_PLAUS = 0 **do**
with each XX failure of the above list :
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2)
bit 1 of STATE_RBM_AMP_PLAUS = 1
Endif(2)
Endwhile
Else(1)
{ the dynamic failure memory is empty }
No action
Endif(1)

Every 1 s :
If bit 0 of STATE_RBM_AMP_PLAUS = 0
Then

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```
            If          LV_END_DIAG_AMP_PLAUS = 1
                Then        bit 0 of STATE_RBM_AMP_PLAUS = 1
                Endif
Endif

If          bit 1 of STATE_RBM_AMP_PLAUS = 0
Then
            If          LV_INH_DIAG_AMP_PLAUS = 1
            Then        bit 1 of STATE_RBM_AMP_PLAUS = 1
            Endif
Endif
```

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B.104 Activation of fuel system monitoring

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_STOP_FSD	O/V/S	0... FFH	0... 255	1	-
Counter value as a measure of the oil dilution under cold start conditions					
DLY_DEC_FSD_STOP_OIL	V	0... FFH	0... 255	1	s
Time delay for decreasing the debounce counter for oil dilution detection in fuel system diagnosis					
LV_FSD_ACT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Global activation flag for fuel system diagnosis					
LV_FSD_STOP_OIL_ES_OLD	-	0... 1H	0 ...1	1	-
Value of last recurrence of LV_ES					
LV_INH_FSD_STOP_OIL	O/V	0... 1H	0 ...1	1	-
Inhibition flag for fuel system diagnosis due to oil dilution under cold start conditions					
T_DEC_FSD_STOP_OIL	V	0... FFH	0... 255	1	s
Timer for decreasing the debounce counter for oil dilution detection in fuel system diagnosis					

Input data:

AMP {p. 982}	LV_ES {p. 1720}	LV_INH_DIAG_FSD [NC_CBK_EX_NR] {p. 6199}	LV_INH_DIAG_FSD_CP [NC_CBK_EX_NR] {p. 6199}
LV_LAM_LSCL [NC_CBK_EX_NR] {p. 2463}	MAF_HB {p. 805}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}
TAM {p. 1579}	TCO {p. 1100}	TCO_ST {p. 1100}	TIA_IM {p. 984}
TOIL {p. 8204}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_MIN_FSD	-	0... FFFFH	0... 5434	0.08291752	hPa
Minimum ambient pressure threshold for fuel system diagnosis					
C_CTR_MAX_FSD_STOP_OIL	-	0... FFH	0... 255	1	-
Maximum value for the debounce counter for oil dilution detection in fuel system diagnosis					
C_MAF_MIN_FSD	-	0... FFH	0... 1389	5.44705882	mg/stk
Mass air flow threshold for fuel system diagnosis					
C_N_MIN_FSD	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for fuel system diagnosis					
C_TAM_MIN_FSD	-	0... FEH	0... 142.5	0.75	°C
Minimum ambient temperature threshold for fuel system diagnosis					
C_TCO_MIN_FSD	-	0... FEH	0... 142.5	0.75	°C
Minimum threshold of TCO for fuel system diagnosis					
C_TIA_MIN_FSD	-	0... FEH	0... 142.5	0.75	°C
Minimum intake air temperature threshold for fuel system diagnosis					
C_TOIL_MIN_DEC_FSD_STOP_OIL	-	0... C8H	0... 160	1	°C
Minimum oil temperature threshold to activate timer to debounce oil dilution detection in fuel system diagnosis					
ID_CTR_INC_FSD_STOP_OIL	-	0... FFH	0... 255	1	-
LDP_TCO_ST_ID_CTR_INC_FSD_STOP	4	0... FEH	0... 142.5	0.75	°C
Increasing value for the debounce counter for oil dilution detection in fuel system diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_DLY_DEC_FSD_STOP_OIL	-	0... FFH	0... 255	1	s
LDP_TOIL_ID_DLY_DEC_FSD_OIL	4	0... C8H	0... 160	1	°C
Time delay for decreasing the debounce counter for oil dilution detection in fuel system diagnosis					

General information

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

NC_CBK_EX_NR defines the number of exhaust banks.
For vector elements the variable extension _i is used in the model instead of [i] as found in the textual description.

Application Condition

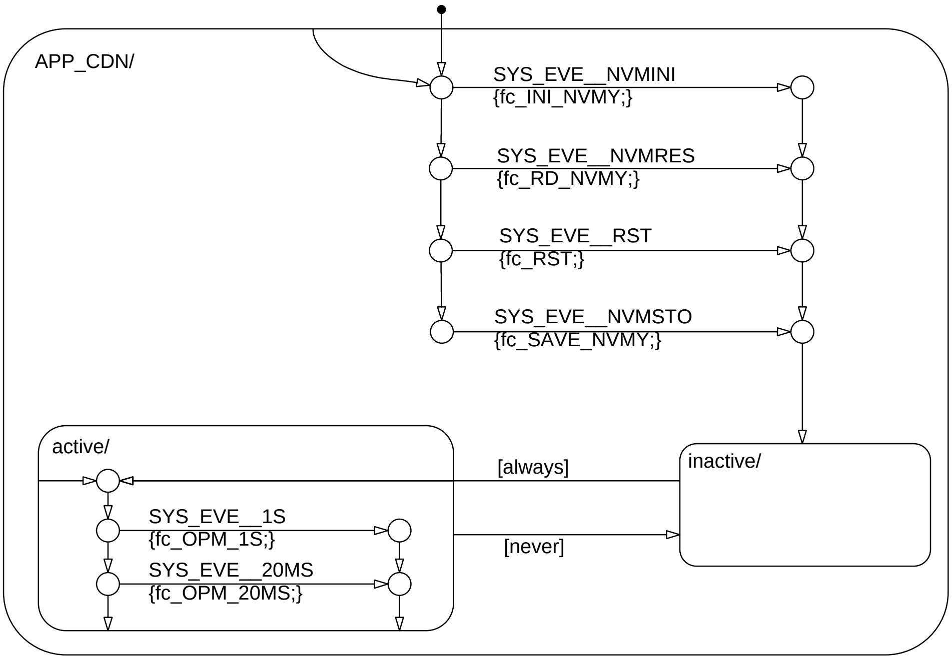

Figure B.104.1: LACO_FCTDGFSDA0/APP_CDN/Chart

Function Description

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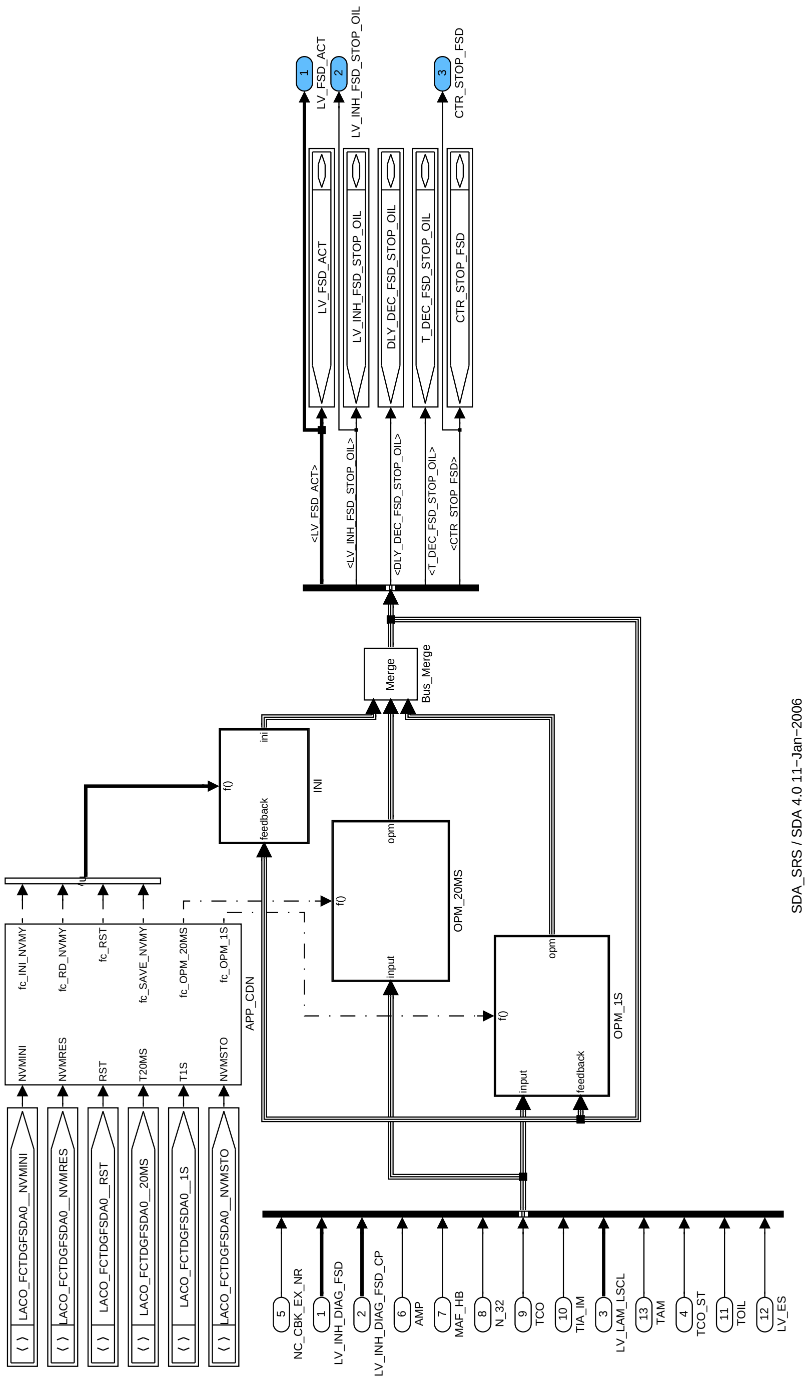

Figure B.104.2: LACO_FCTDGFSDA0

B.104.1 Initialization

Initialization at ECU reset

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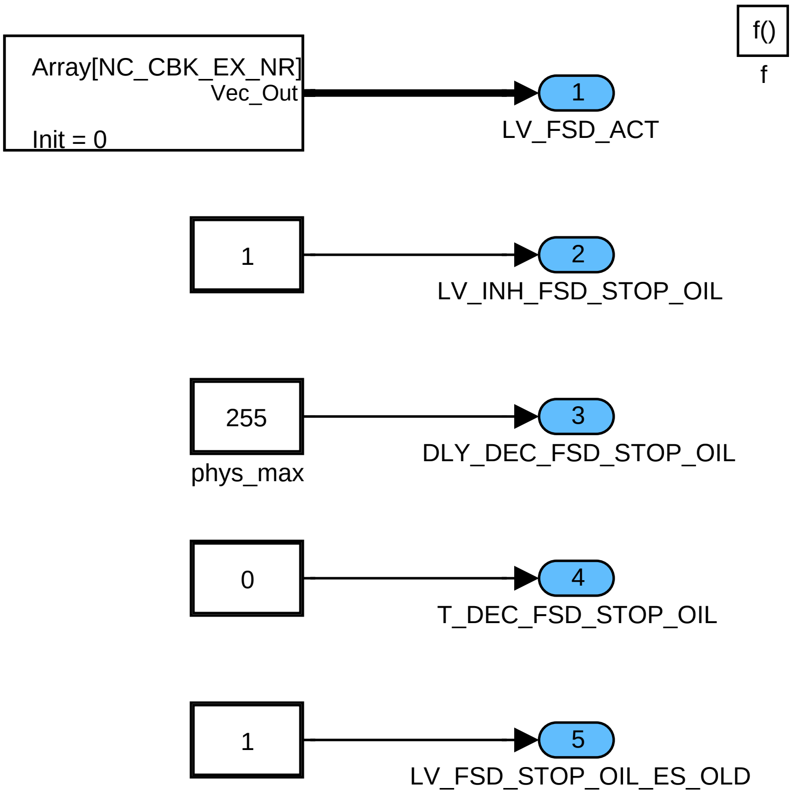

Figure B.104.3: LACO_FCTDGFSDA0/INI/RST

Initialize NVMY data

CTR_STOP_FSD is set to 0 in case of failure in the nonvolatile memory data storage.

Read NVMY data

CTR_STOP_FSD is restored from the nonvolatile memory data storage after reset.

Store NVMY data

CTR_STOP_FSD is saved in the nonvolatile memory data storage during PWL phase.

B.104.2 Formula section for 20ms task

Exhaust bank specific functionality

Activation of fuel system diagnosis

Calculation of LV_FSD_ACT[i]

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In order to activate fuel system diagnosis no inhibition must be present, lambda controller must be active and ambient pressure, air mass flow, engine speed, coolant temperature and intake air temperature must be above their thresholds.

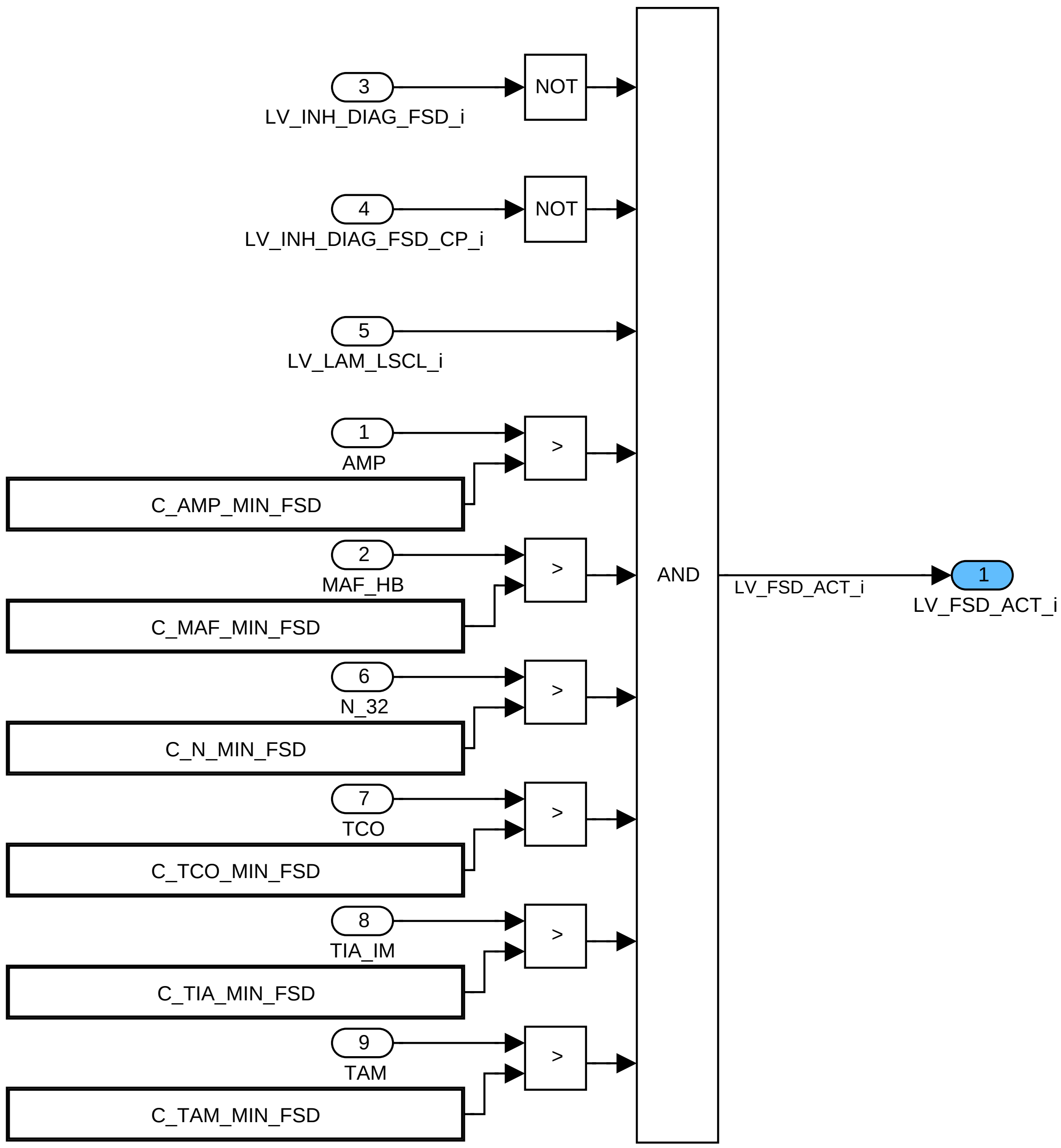

Figure B.104.4: LACO_FCTDGFSDA0/OPM_20MS/OPM/FSD_ACT/FSD_ACT

B.104.3 Formula section for 1s task

For high rate of evaporated fuel (diluted in the engine oil) during rich warmup phase under cold start conditions lambda controller and adaptation may reach the negative limits relevant for FSD (MIN limits). In order to prevent an error detection in that case the flag LV_INH_FSD_STOP_OIL used by FSD is set. The counter CTR_STOP_FSD is a measure for the amount of diluted fuel in the engine oil.

Increment of CTR_STOP_FSD

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At each transition from engine stop to engine run (LV_ES switches from 1 to 0) the counter CTR_CTOP_FSD is incremented by the TCO_ST depending map value ID_CTR_INC_FSD_STOP_OIL.

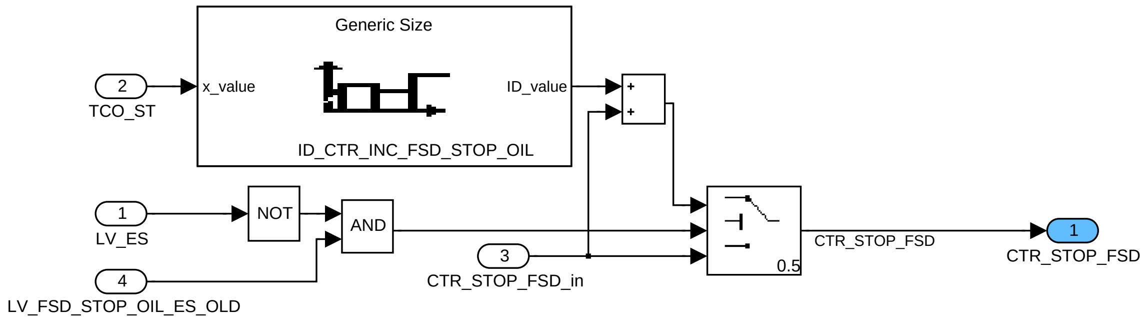

Figure B.104.5: LACO_FCTDGFSDA0/OPM_1S/INC_CTR

Decrement CTR_STOP_FSD

ID_DLY_DEC_FSD_STOP_OIL defines the time to elapse at a certain TOIL range for decrementing CTR_STOP_FSD by 1. The TOIL range is defined by 2 adjacent map break points. At engine stop and as long as the oil temperature is below a threshold this timer is set to 0 in order to not run the increment functionality. The timer is reset to 0 as soon the threshold is reached.

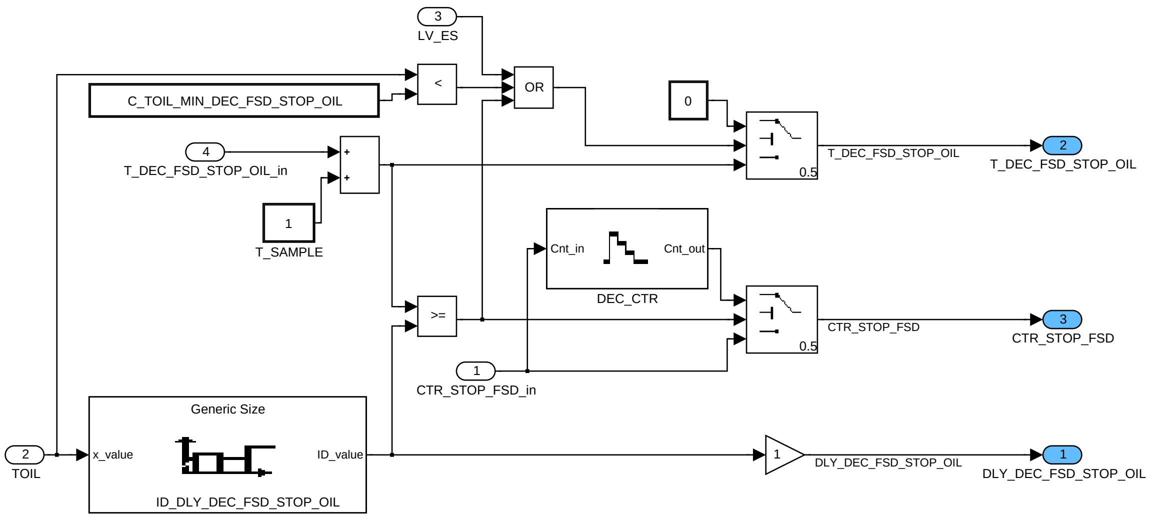

Figure B.104.6: LACO_FCTDGFSDA0/OPM_1S/DEC_CTR

Inhibition of fuel system diagnosis

The flag LV_INH_FSD_STOP_OIL is set if the counter CTR_STOP_FSD reaches a calibration threshold.

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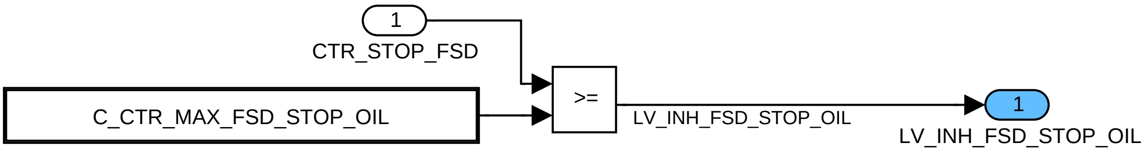

Figure B.104.7: LACO_FCTDGFSDA0/OPM_1S/INH_FSD

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B.105 Fuel system monitoring

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_LAM_LIM_LAM_AD_REQ [NC_CBK_EX_NR]	V	0... FFFFH	0... 65535	1	-
Counter for activation of forced lambda adaptation					
ERR_SYM_FSD [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure of each symptom in case for lambda adaptation monitoring relevant to MIL					
ERR_SYM_FSD_H_RNG [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure of each symptom in upper multiplicative adaptation learning area					
ERR_SYM_FSD_LAM_LIM [NC_CBK_EX_NR]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected failure of each symptom in case of lambda control in dead stop relevant to MIL					
LV_CDN_DIAG_FSD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Diagnosis conditions for lambda adaptation monitoring					
LV_CDN_DIAG_FSD_H_RNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Diagnosis conditions in upper multiplicative adaptation learning area					
LV_CDN_DIAG_FSD_LAM_LIM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Diagnosis conditions in the area where the lambda control output concerned relevant to MIL					
LV_END_DIAG_FSD [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
End of first diagnosis cycle in case of lambda adaptation monitoring					
LV_END_DIAG_FSD_H_RNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
End of first diagnosis cycle in upper multiplicative adaptation learning area					
LV_END_DIAG_FSD_LAM_LIM [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
End of first diagnosis cycle in the area where the lambda control output concerned					
LV_END_DIAG_WIN_FSD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of diagnosis cycle for similar conditions window in additive adaptation learning area					
LV_END_DIAG_WIN_FSD_LAM_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of diagnosis cycle for similar conditions window in case of lambda control in dead stop					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_FSD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Failure of lambda adaptation monitoring relevant to malfunction indication light					
LV_ERR_FSD_H_RNG [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Failure in upper multiplicative adaptation learning area					
LV_ERR_FSD_LAM_LIM [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Failure for lambda controller in dead stop relevant to malfunction indication light					
LV_LAM_LIM_LAM_AD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Request for forced lambda adaptation					
LV_LAM_ORNG_LAM_AD_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that request timer for forced lambda adaptation expired (lambda controller out of range for defined time)					
T_LAM_AD_ACT_FSD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer indicating the forced lambda adaptation is running					
T_SUM_END_DIAG_WIN_FSD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Counter for the diagnosis window relevant to MIL					
T_SUM_END_DIAG_WIN_FSD_ADD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Counter for the diagnosis window additive adaptation learning area					
T_SUM_END_DIAG_WIN_FSD_FAC_L [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Counter for the diagnosis window lower multiplicative adaptation learning area					
T_SUM_END_DIAG_WIN_FSD_H_RNG [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Counter for the diagnosis window upper multiplicative adaptation learning area					
T_SUM_END_DIAG_WIN_FSD_LAM [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Counter for the diagnosis window lambda control in dead stop					
T_SUM_MAX_FSD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Total duration of LV_MFF_ADD_LIM_MAX_LAM_AD[i] = 1 or LV_FAC_L_RNG_LIM_MAX_LAM_AD[i] = 1					
T_SUM_MAX_FSD_H_RNG [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Total duration of LV_FAC_H_RNG_LIM_MAX_LAM_AD[i] = 1					
T_SUM_MAX_FSD_LAM_LIM [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Total duration of LV_FAC_LAM_LIM_MAX[i] = 1					
T_SUM_MIN_FSD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Total duration of LV_MFF_ADD_LIM_MIN_LAM_AD[i] = 1 or LV_FAC_L_RNG_LIM_MIN_LAM_AD[i] = 1					
T_SUM_MIN_FSD_H_RNG [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Total duration of LV_FAC_H_RNG_LIM_MIN_LAM_AD[i] = 1					
T_SUM_MIN_FSD_LAM_LIM [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Total duration of LV_FAC_LAM_LIM_MIN[i] = 1					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_SUM_RST_FSD [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer to reset the counter of total duration in MIL area					
T_SUM_RST_FSD_H_RNG [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer to reset the counter of total duration in H_RNG area					
T_SUM_RST_FSD_LAM_LIM [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer to reset the counter of total duration for lambda control in dead stop					

Input data:

FAC_LAM_MV_MMV [NC_CBK_EX_NR] {p. 2462}	LV_FAC_H_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	LV_FAC_H_RNG_LIM_MAX_LAM_AD [NC_CBK_EX_NR] {p. 2641}	LV_FAC_H_RNG_LIM_MIN_LAM_AD [NC_CBK_EX_NR] {p. 2641}
LV_FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	LV_FAC_L_RNG_LIM_MAX_FSD [NC_CBK_EX_NR] {p. 6199}	LV_FAC_L_RNG_LIM_MIN_FSD [NC_CBK_EX_NR] {p. 6199}	LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR] {p. 2463}
LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR] {p. 2463}	LV_FSD_ACT [NC_CBK_EX_NR] {p. 6133}	LV_INH_FSD_STOP_OIL {p. 6133}	LV_MFF_ADD_LIM_MAX_FSD [NC_CBK_EX_NR] {p. 6199}
LV_MFF_ADD_LIM_MIN_FSD [NC_CBK_EX_NR] {p. 6199}	LV_MFF_ADD_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2642}	LV_STALL {p. 1766}	NC_CBK_EX_NR {p. 1829}
NC_IDX_DIAG_FSD [NC_CBK_EX_NR] {p. 6200}	NC_IDX_DIAG_FSD_H_RNG [NC_CBK_EX_NR]	NC_IDX_DIAG_FSD_LAM_LIM [NC_CBK_EX_NR]	STATE_LAM_AD [NC_CBK_EX_NR] {p. 2643}
TCO {p. 1100}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_T_SUM_WIN_FSD_RST	-	0... FFH	0... 0.99609375	0.00390625	-
Minimal fraction of counter threshold that must be spent in ADD as well as L_RNG for error healing					
C_CTR_DEC_LAM_LIM_LAM_AD_REQ	-	0... FFFFH	0... 65535	1	-
Counter decrement for activation of forced lambda adaptation					
C_CTR_INC_LAM_LIM_LAM_AD_REQ	-	0... FFFFH	0... 65535	1	-
Counter increment for activation of forced lambda adaptation					
C_CTR_MAX_LAM_LIM_LAM_AD_REQ	-	0... FFFFH	0... 65535	1	-
Counter threshold for activation of forced lambda adaptation					
C_T_LAM_AD_ACT_MIN_FSD	-	1... FFFFH	0.02... 1310.7	0.02	s
Minimum threshold of active forced lambda adaptation to reset the request flag					
C_T_SUM_MAX_THD_FSD	-	1... FFFFH	0.02... 1310.7	0.02	s
Maximum value of counter for ADD , FAC_L and FAC_H adaptation area (upper limit)					
C_T_SUM_MAX_THD_FSD_LAM_LIM	-	1... FFFFH	0.02... 1310.7	0.02	s
Maximum value of counter in case of lambda control dead stop (upper limit)					
C_T_SUM_MIN_THD_FSD	-	1... FFFFH	0.02... 1310.7	0.02	s
Maximum value of counter for ADD , FAC_L and FAC_H adaptation area (lower limit)					

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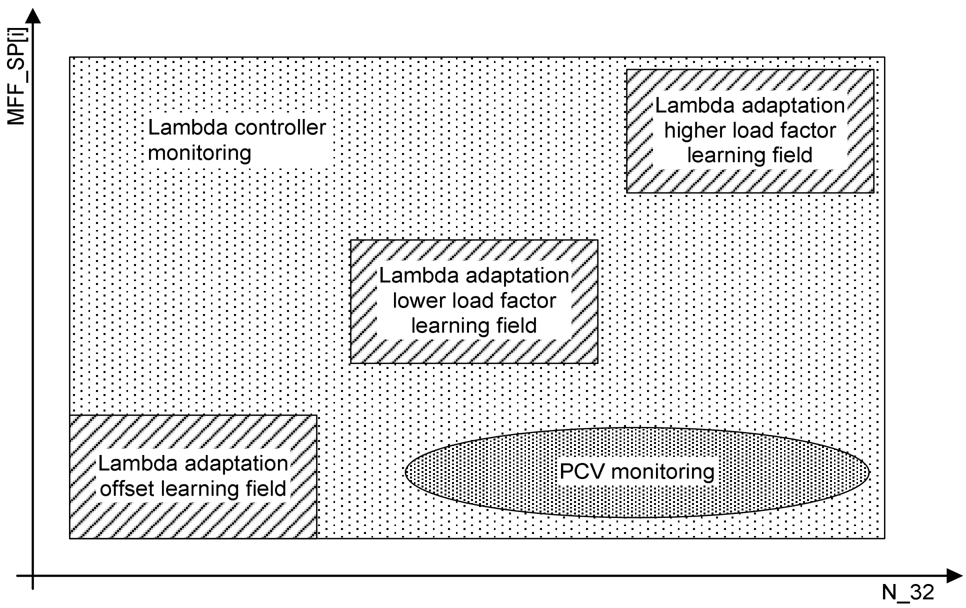
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_SUM_MIN_THD_FSD_LAM_LIM	-	1... FFFFH	0.02... 1310.7	0.02	s
Maximum value of counter in case of lambda control dead stop (lower limit)					
C_T_SUM_RST_FSD	-	1... FFFFH	0.02... 1310.7	0.02	s
Calibration threshold to reset anti bounce timers					
IP_FAC_LAM_OUT_MAX_FSD	-	0... FFFFH	0... 49.9984741	0.00152588	%
LDPM_TCO_4_LACO	6	0... FEH	0... 142.5	0.75	°C
The upper limit of lambda controller output to request forced lambda adaptation					
IP_FAC_LAM_OUT_MIN_FSD	-	0... FFFFH	0... 49.9984741	0.00152588	%
LDPM_TCO_4_LACO	6	0... FEH	0... 142.5	0.75	°C
The lower limit of lambda controller output to request forced lambda adaptation					

Import actions:

ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)
ACTION_ERRM_NoFilterReset (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_NoFilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_LV_ERR_SET>,**IN**<PRM_LV_ERR_RST>,**IN**<PRM_LV_END_DIAG>,**OUT**<PRM_LV_ERR>)

General information

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



Monitoring area of fuel system diagnosis

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Breaking the adaptation and lambda controller limits for a long time, which may have been caused by failures in the fuel or intake system will involve emission rise and therefore shall be diagnosed by fuel system diagnosis.
FSD errors are located in three failure memories with two and four symptoms each:

ERR_SYM_FSD[i]:
NO_SYM: no symptom
SYM_0: maximum limit of additive adaptation value reached
SYM_1: minimum limit of additive adaptation value reached
SYM_2: maximum limit of multiplicative adaptation value (lower area) reached
SYM_3: minimum limit of multiplicative adaptation value (lower area) reached

ERR_SYM_FSD_H_RNG[i]:
NO_SYM: no symptom
SYM_0: maximum limit of multiplicative adaptation value (upper area) reached
SYM_1: minimum limit of multiplicative adaptation value (upper area) reached

ERR_SYM_FSD_LAM_LIM[i]:
NO_SYM: no symptom
SYM_0: lambda control in dead stop (upper limit)
SYM_1: lambda control in dead stop (lower limit)

NC_CBK_EX_NR defines the number of exhaust banks.
For vector elements the variable extension _i is used in the model instead of [i] as found in the textual description.

Application Condition

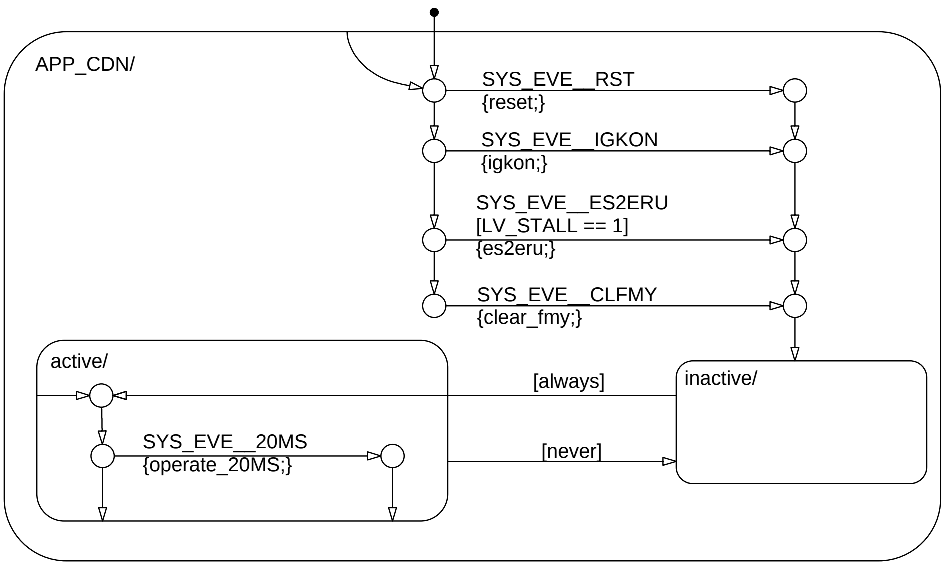

Figure B.105.1: LACO_FCTDGFSD0/APP_CDN/Chart

Function Description

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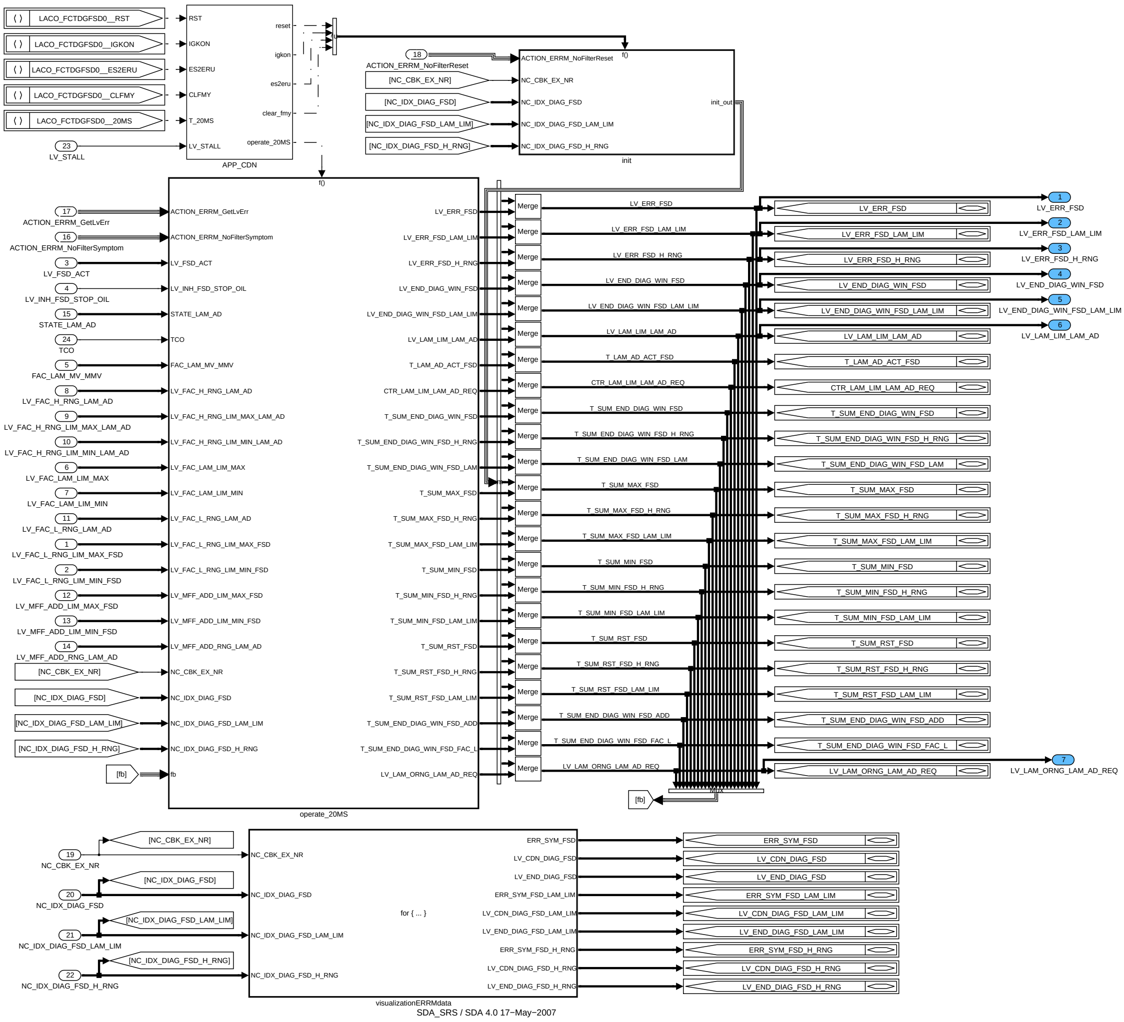

Figure B.105.2: LACO_FCTDGFSD0

B.105.1 Initialization

At ECU reset, IGKON, ES2ERU while LV_STALL is set (in order to cover engine stalling) and at clearance of failure memory all variables are initialized with 0.

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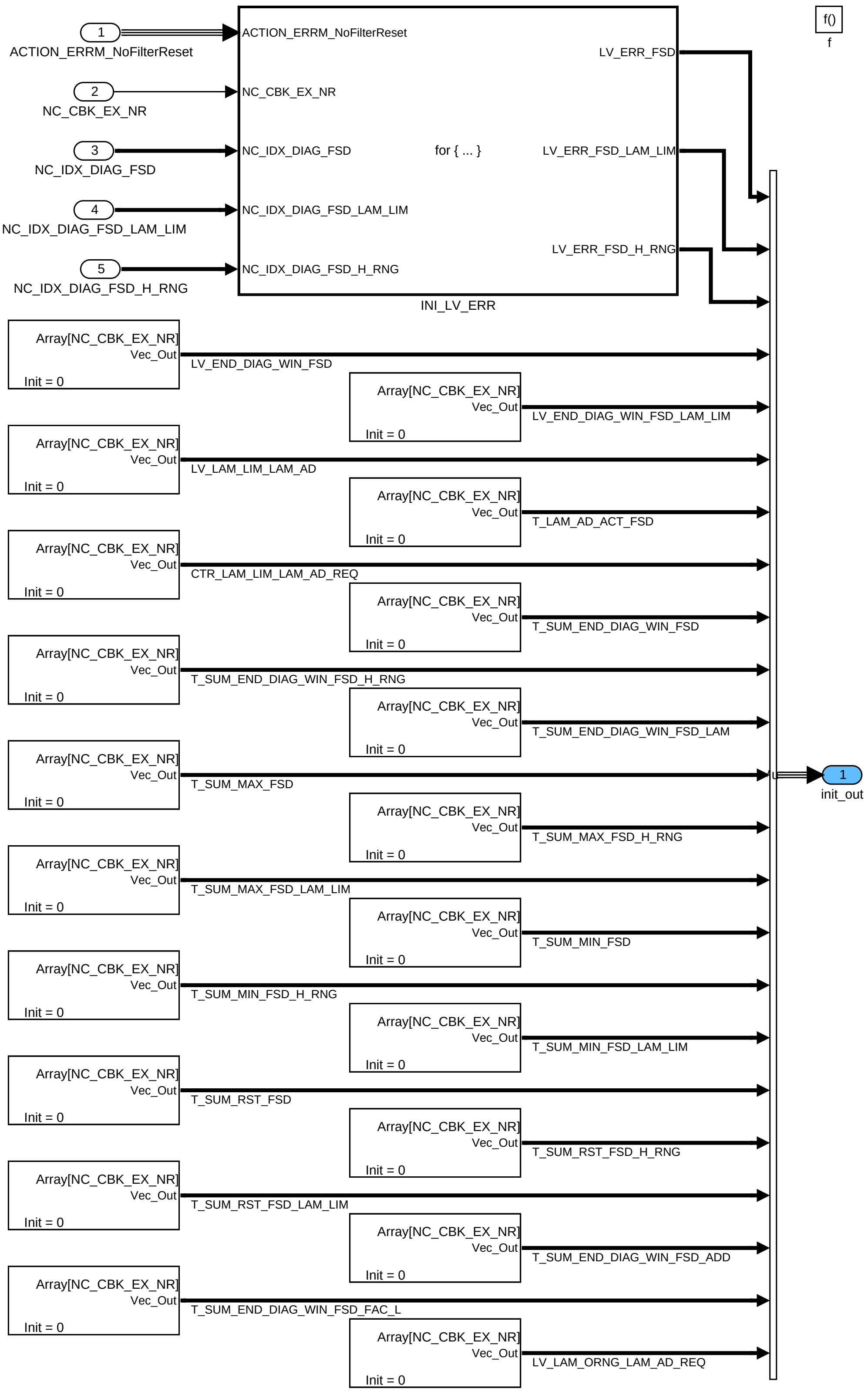

Figure B.105.3: LACO_FCTDGFSD0/init

Initialization of error flags

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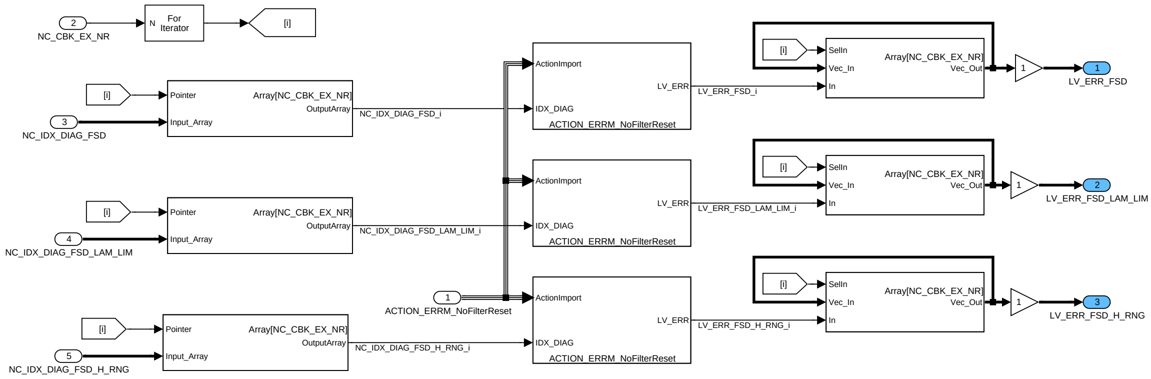

Figure B.105.4: LACO_FCTDGFSD0/init/INI_LV_ERR

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B.105.2 Formula section

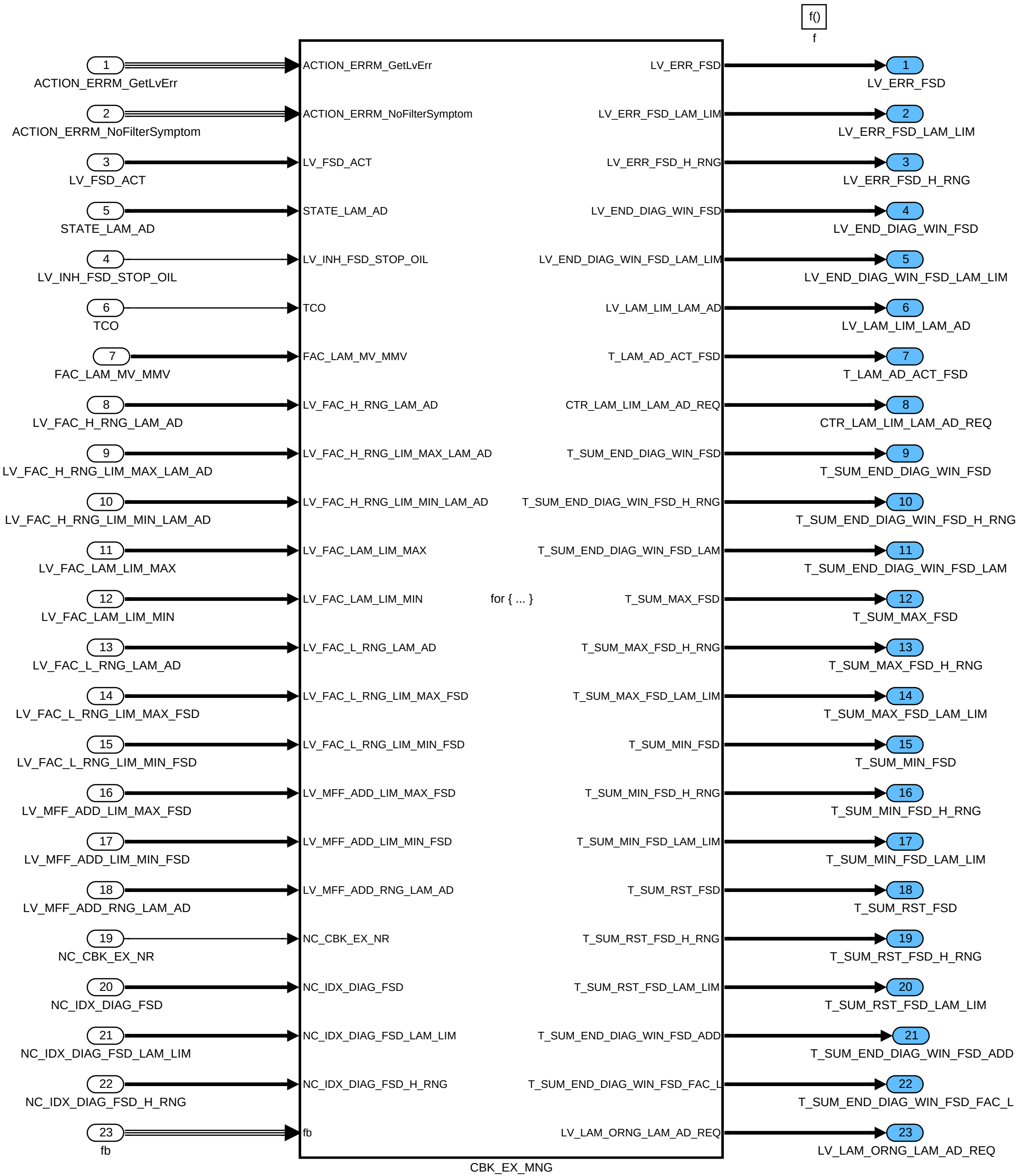

Figure B.105.5: LACO_FCTDGFSD0/operate_20MS

Exhaust bank specific functionality

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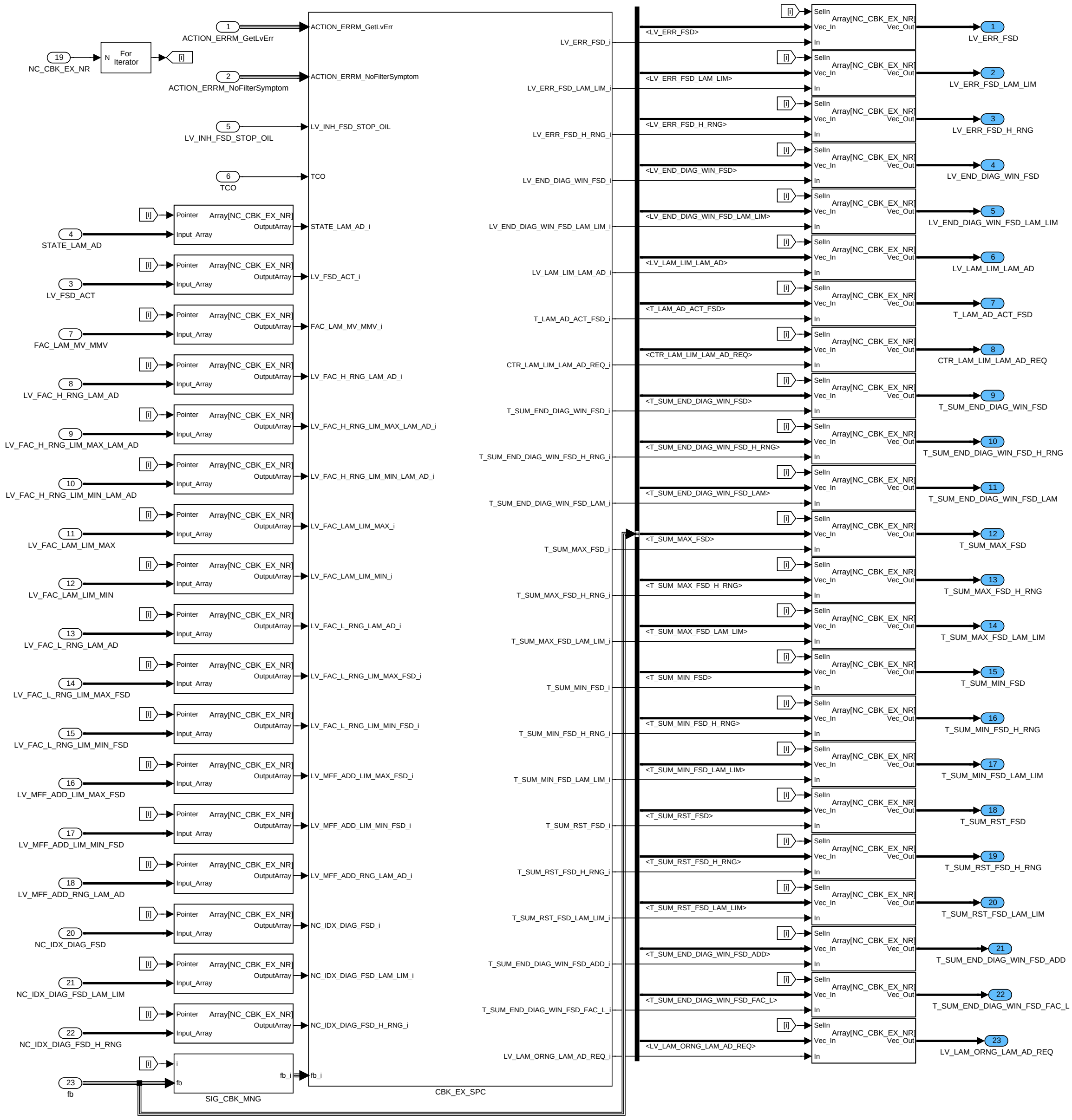

Figure B.105.6: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG

Overview about the diagnostics

The diagnosis function is split into 4 blocks.
1. By means of an interface functionality to the lambda adaptation the forced lambda adaptation can be requested by the FSD. This functionality runs independent of the rest.
2. The diagnosis conditions for all failure location are evaluated separately from each other.
3. The main block is the evaluation of the error symptom and the management of the end of diagnosis information. The decision about present errors is also part of this block.
4. The interface to the error management ERRM is handled in this block. My means of ACTION calls the relevant information is transmitted to the ERRM.

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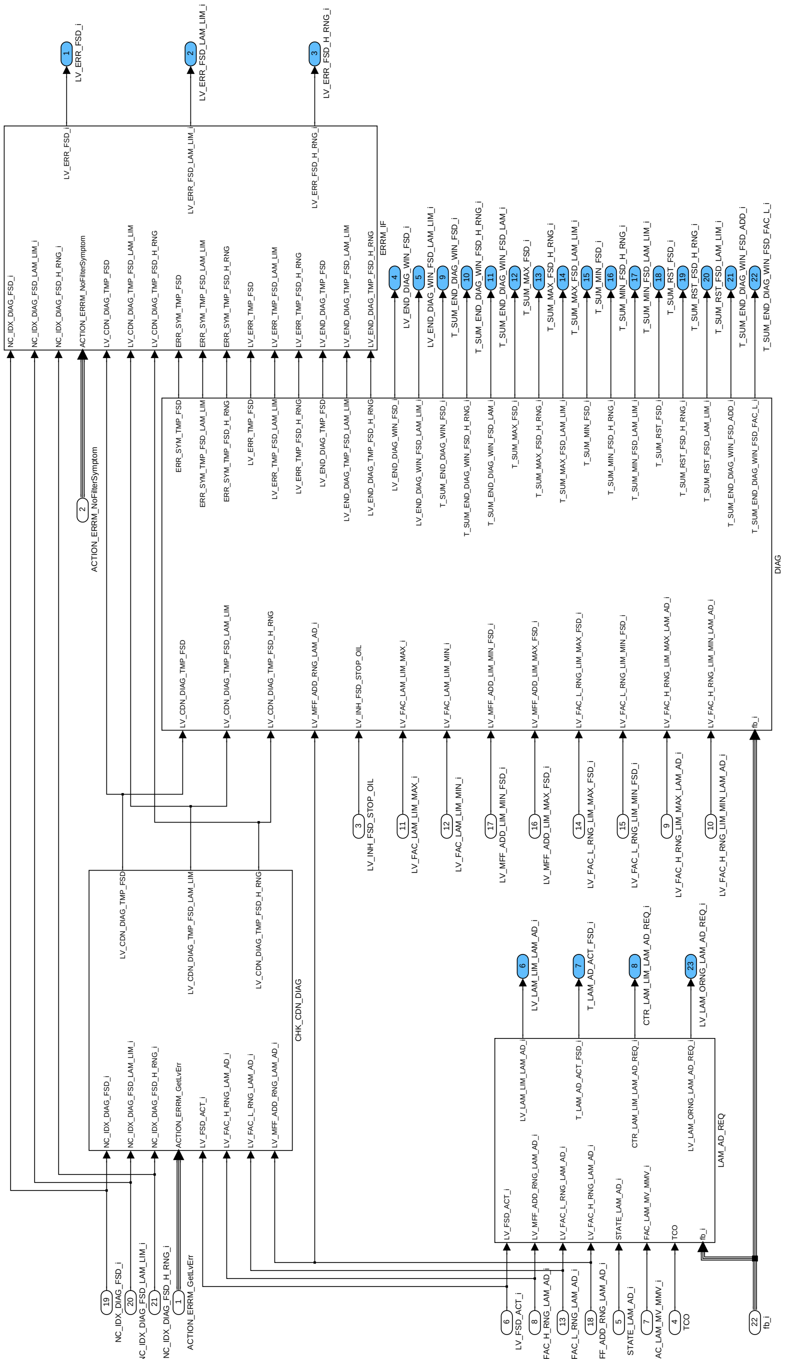

Figure B.105.7: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC

Interface to lambda adaptation

When the lowpass filtered lambda controller output exceeds a minimum or maximum calibration threshold the lambda adaptation shall be forced by the FSD to get active and adapt the lambda controller deviation in order to confirm to lambda excursion. The request for this forced lambda adaptation is controlled by an antibounce mechanism.

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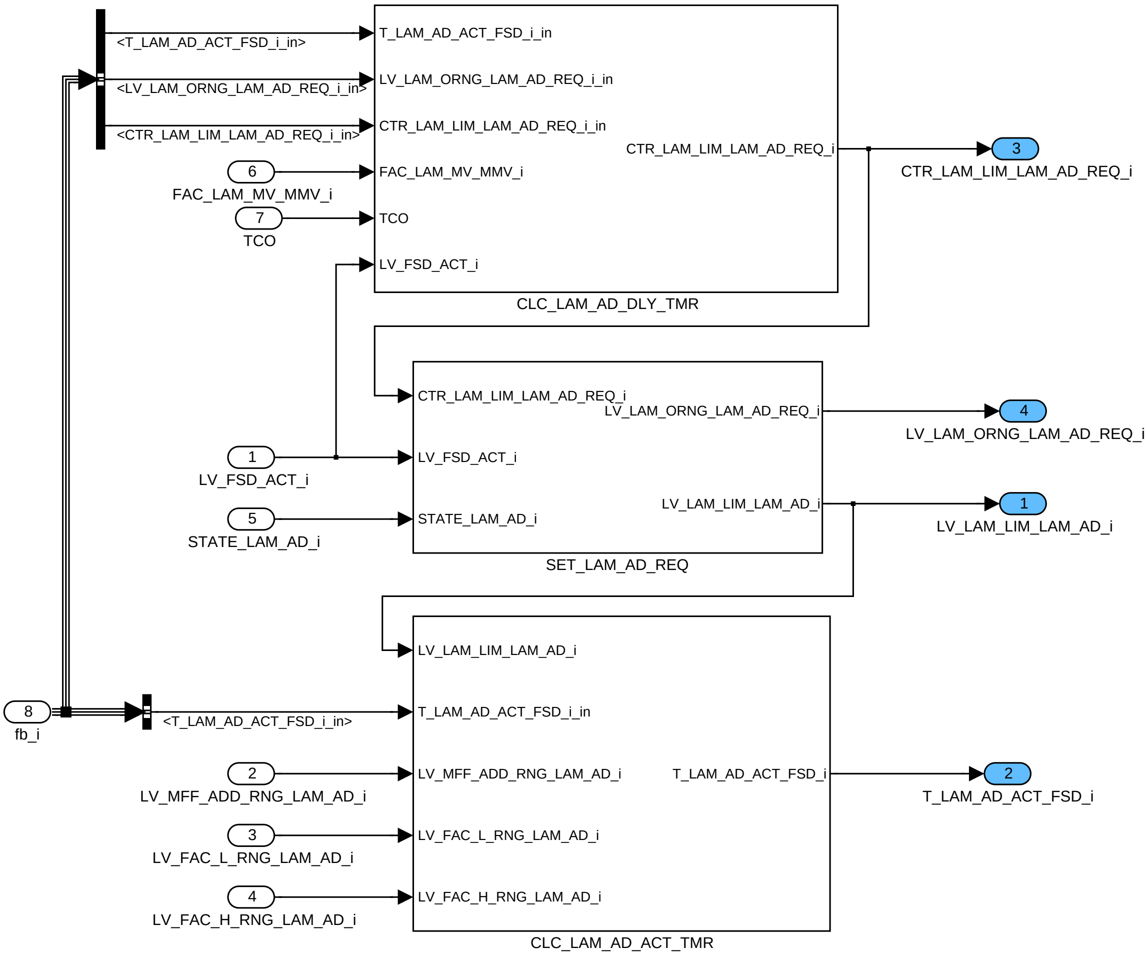

Figure B.105.8: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/LAM_AD_REQ

Request counter

The request counter CTR_LAM_LIM_LAM_AD_REQ[i] is reset to 0 as soon as the activation timer T_ LAM_AD_ACT_FSD[i] expires.

As long as
the request counter is not yet expired
(indicated by the flag LV_LAM_ORNG_LAM_AD_REQ[i]),
fuel system diagnosis is active (LV_FSD_ACT[i] = 1) and
lambda controller output is not zero
the counter is either incremented or decremented depending on whether lambda controller output is inside or outside the permitted range. The incrementation /decrementation speed is tunable.

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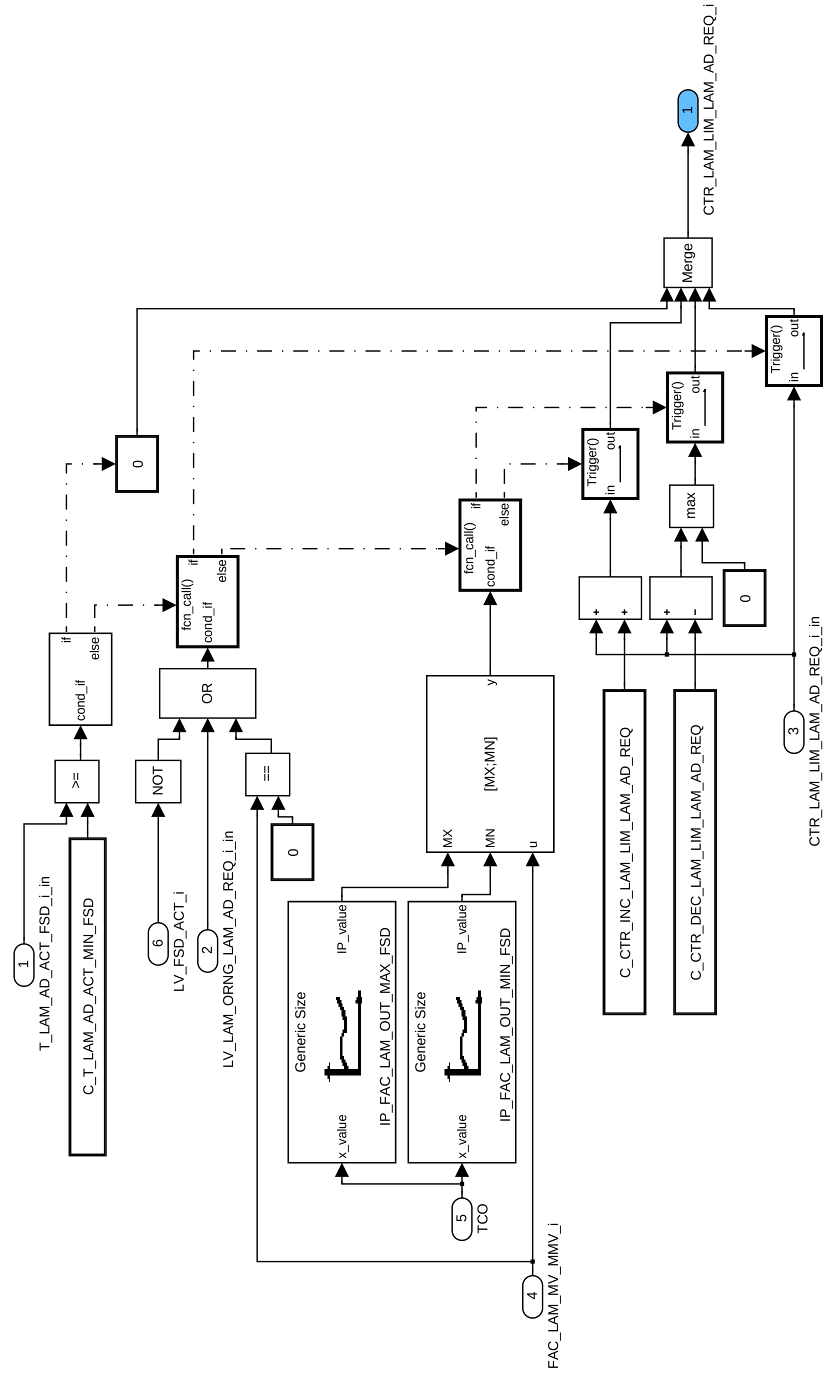

Figure B.105.9: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/LAM_AD_REQ/
CLC_LAM_AD_DLY_TMR

Request flag /Lamda controller out of range flag

If the request counter is expired, fuel system diagnosis is active and the lambda adaptation is inside one of its learning fields (either state CDN_FAC_L, CDN_FAC_H, CDN_ADD, ADAPT_FAC_L, ADAPT_FAC_H or ADAPT_ADD indicated by STATE_LAM_AD[i] >= CDN_FAC_L), the flag LV_LAM_LIM_LAM_AD[i] that requests the forced lambda adaptation is set to 1.

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As soon as request counter reaches the calibration threshold the flag LV_LAM_ORNG_LAM_AD_REQ[i] indicating that the request timer expired is set.

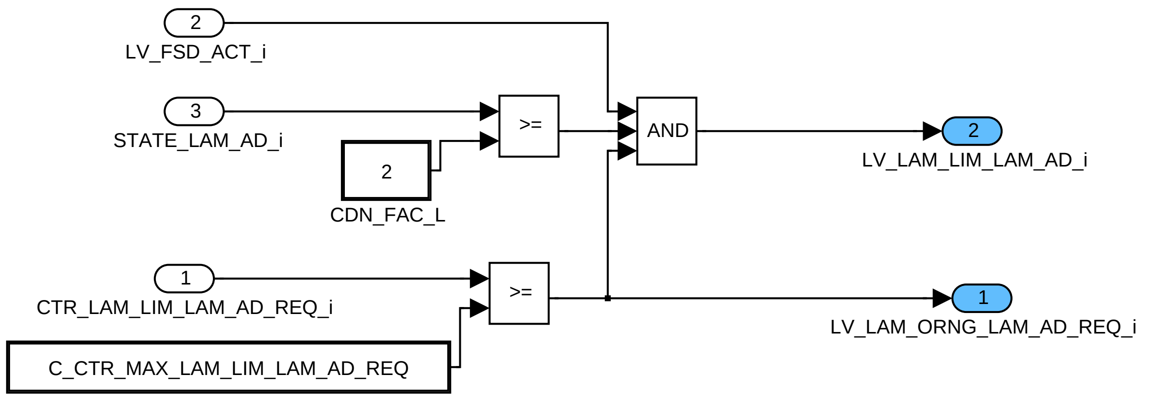

Figure B.105.10: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/LAM_AD_REQ/SET_LAM_AD_REQ

Activation timer

The activation timer T_LAM_AD_ACT_FSD[i] is incremented as long as the request flag for forced lambda adaptation is set and lambda adaptation is active. As soon as the activation timer expires it is reset to 0.

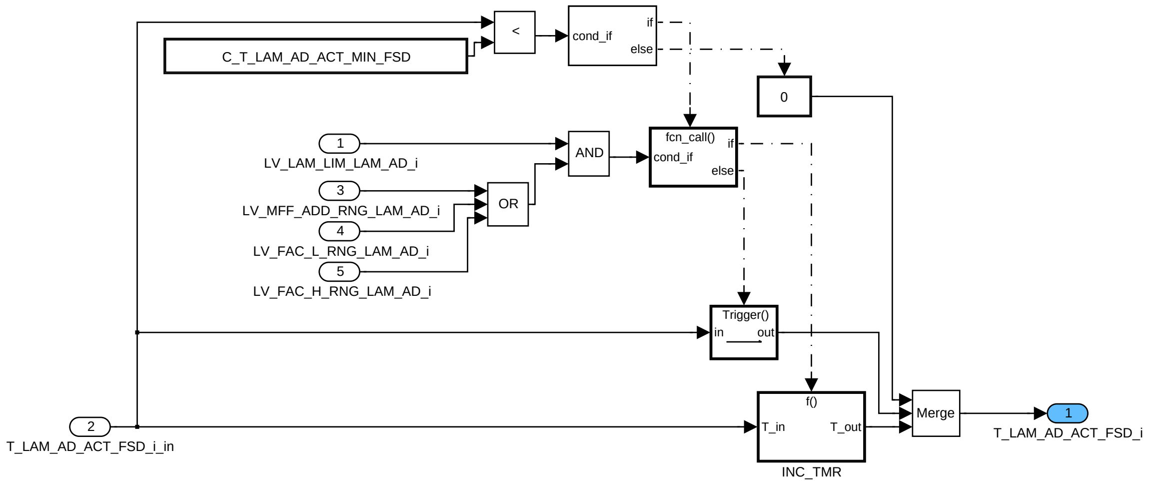

Figure B.105.11: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/LAM_AD_REQ/CLC_LAM_AD_ACT_TMR

Increment timer

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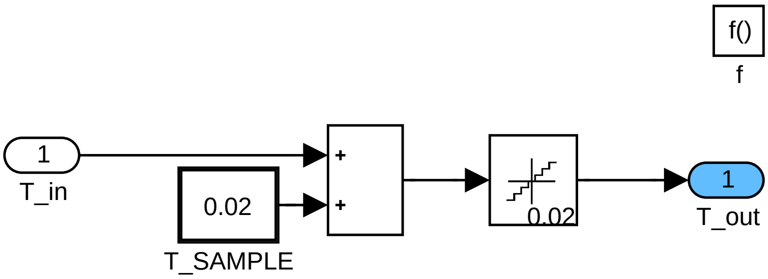

Figure B.105.12: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/LAM_AD_REQ/CLC_LAM_AD_ACT_TMR/INC_TMR

Check diagnostic conditions

For each failure location the diagnostic condition is evaluated separately.

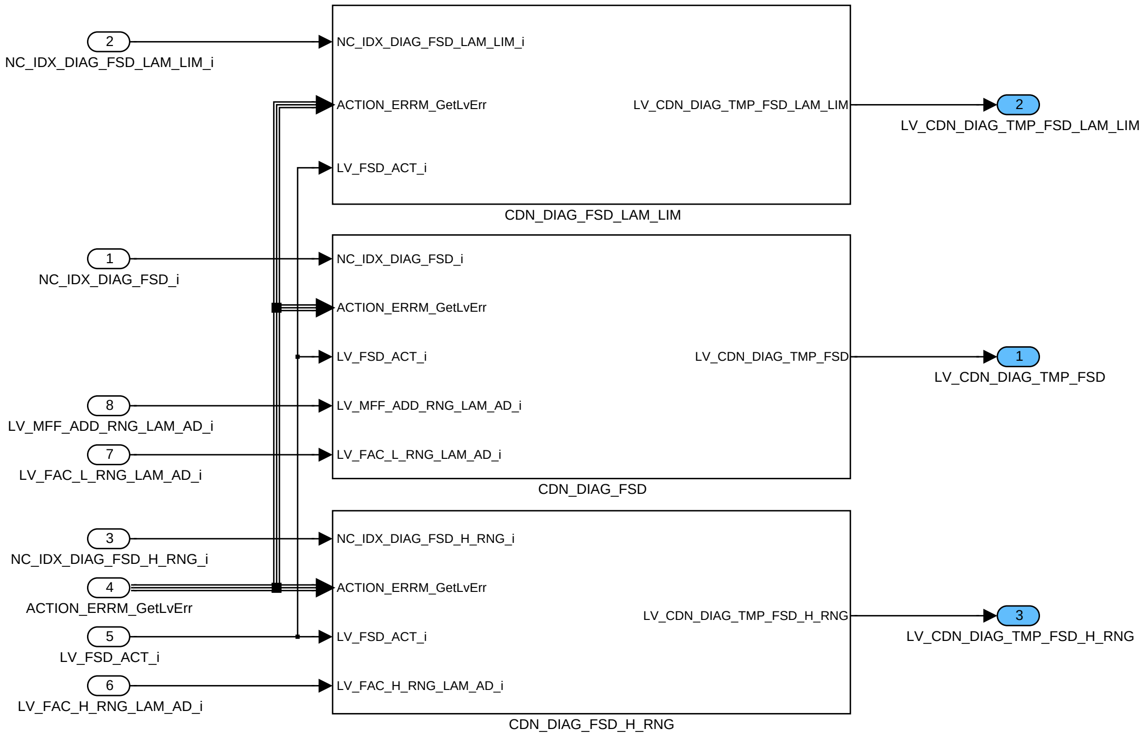

Figure B.105.13: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/CHK_CDN_DIAG

Check conditions for lambda adaptation monitoring

Conditions are fulfilled when no error is present, the global activation conditions are fulfilled and the lambda adaptation is either in the offset or lower load factor learning field.

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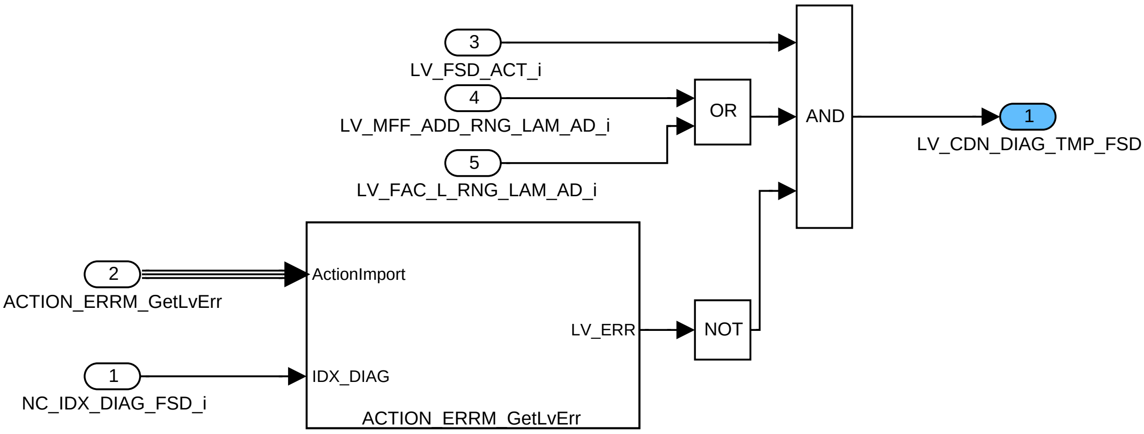

Figure B.105.14: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/
CHK_CDN_DIAG/CDN_DIAG_FSD

Check conditions for lambda controller monitoring

Conditions are fulfilled when no error is present and the global activation conditions are fulfilled. The lambda controller monitoring is executed in the whole operating range.

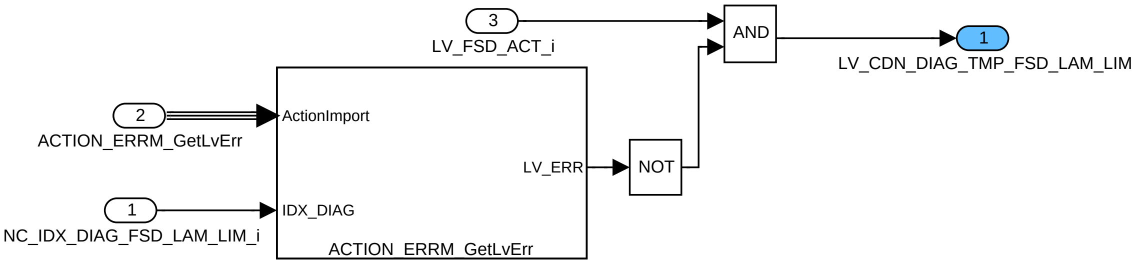

Figure B.105.15: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/
CHK_CDN_DIAG/CDN_DIAG_FSD_LAM_LIM

Check conditions for lambda adaptation high load monitoring

Conditions are fulfilled when no error is present, the global activation conditions are fulfilled and the lambda adaptation is in the higher load factor learning field.

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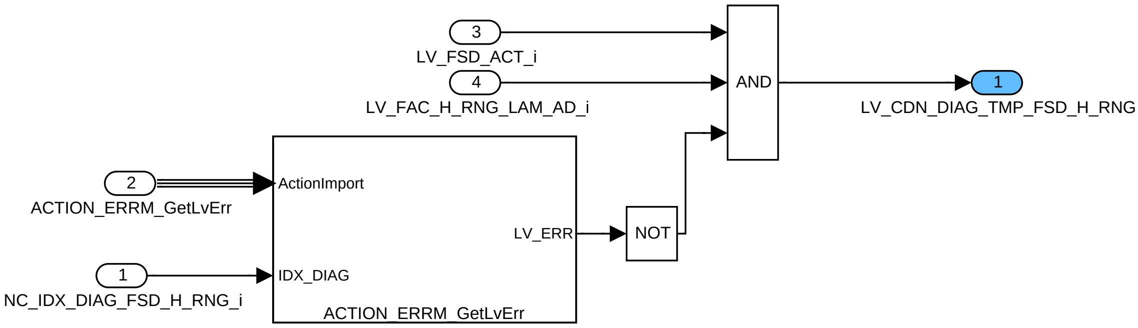

Figure B.105.16: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/CHK_CDN_DIAG/CDN_DIAG_FSD_H_RNG

Error detection and end of diagnosis management

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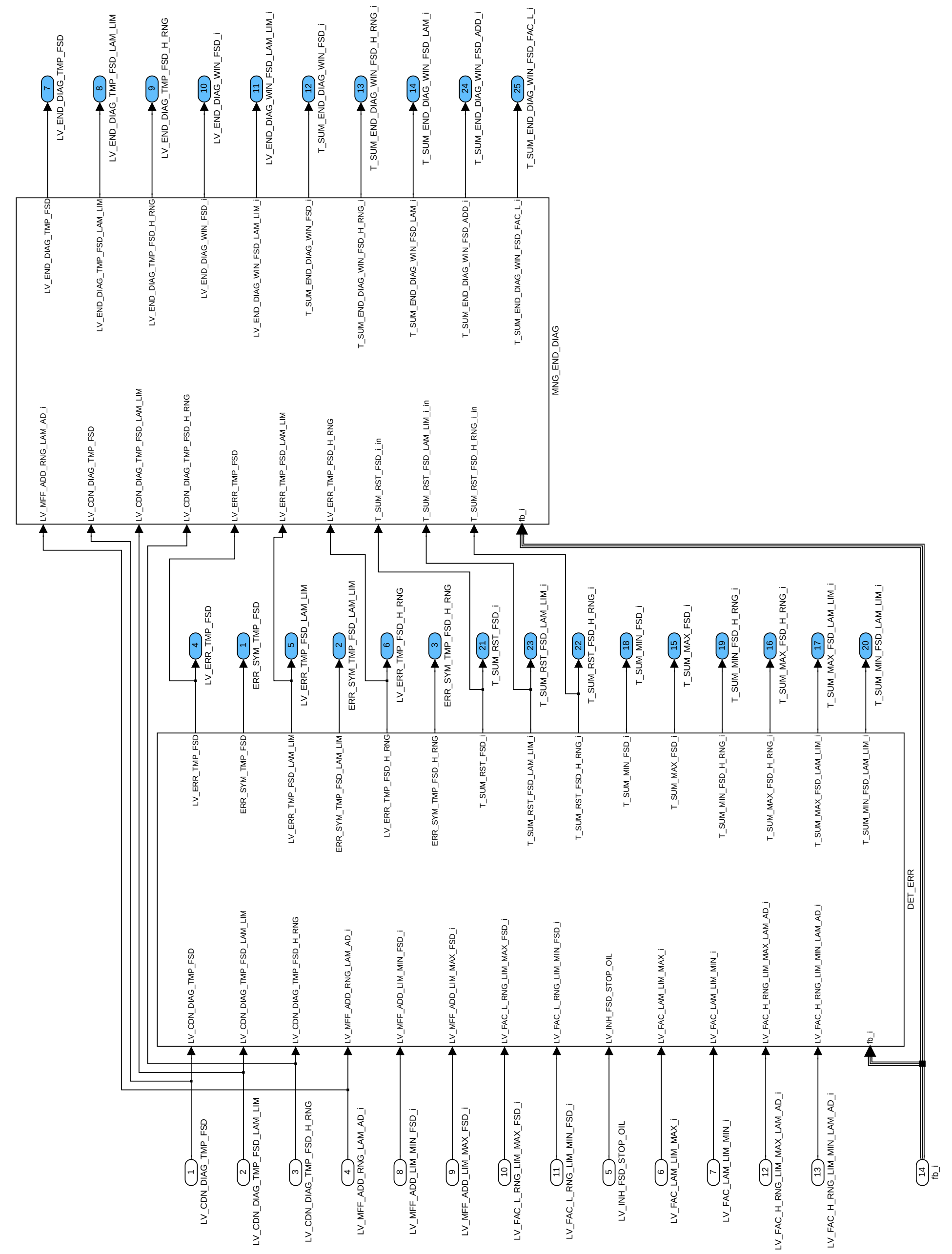

Figure B.105.17: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG

Error symptom detection

For each failure location the symptom detection is executed separately.

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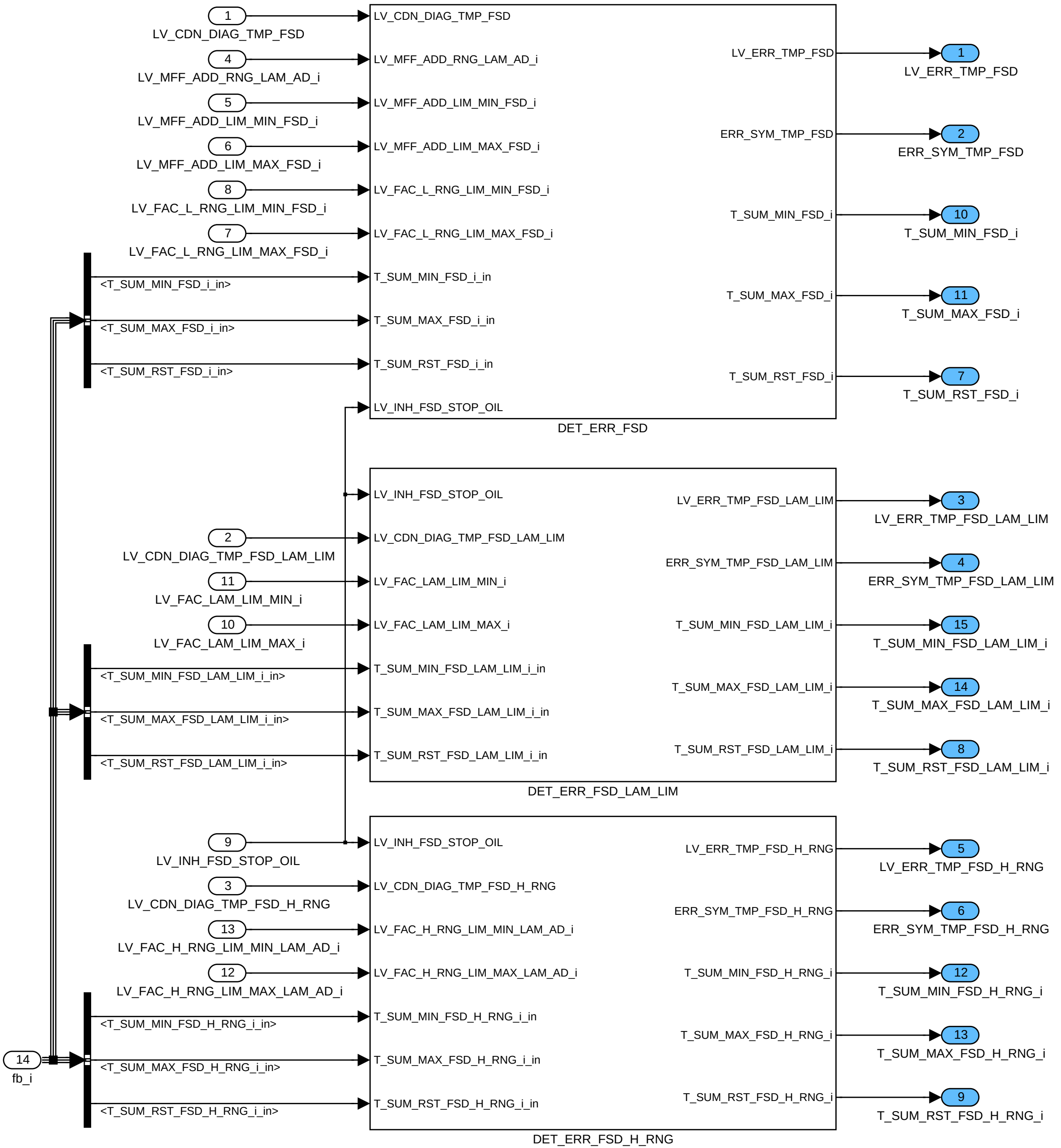

Figure B.105.18: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR

Error symptom detection for lambda adaptation monitoring

In case the conditions are not fulfilled all timers remain unchanged and the temporary error flag and symptom have no relevance.
Depending on whether lambda adaptation is in the offset or lower load factor learning field different but similar functionalities are executed.

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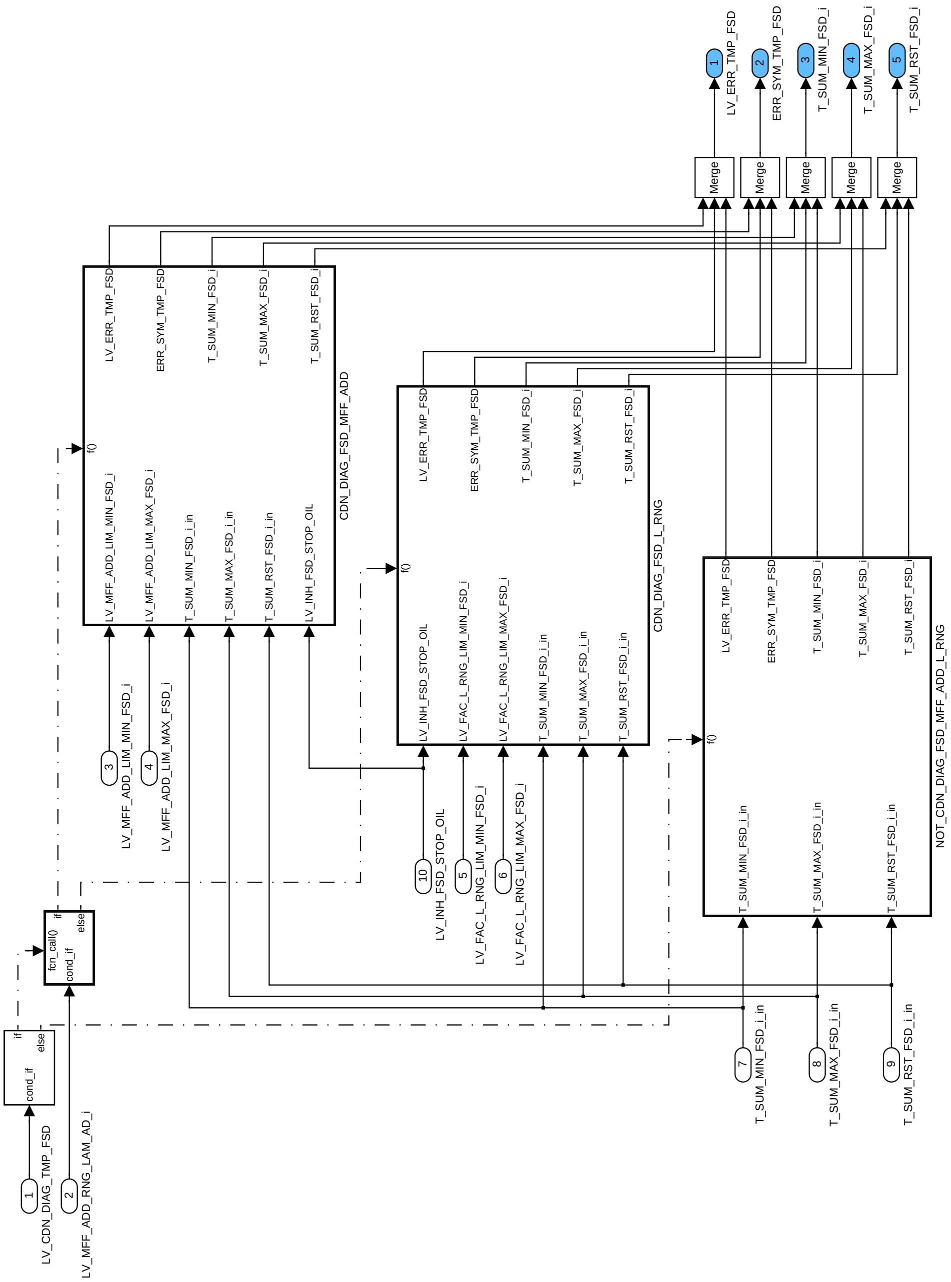

Figure B.105.19:
LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD

Conditions for lambda adaptation offset monitoring fulfilled

Between 3 different cases must be distinguished:

1. Lambda adaptation factor for lower load is at its minimum threshold (indicated by the flag LV_ MFF_ ADD _LIM_MIN_LAM_AD[i]) and no inhibition due to oil dilution under cold start conditions.
2. Lambda adaptation factor for lower load is at its maximum threshold (indicated by the flag LV_MFF_ ADD_LIM_MAX_LAM_AD[i]).
3. No limitation of the lambda adaptation factor for lower load.

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Independent of these cases the antibounce timers used to finally set the error are evaluated afterwards.

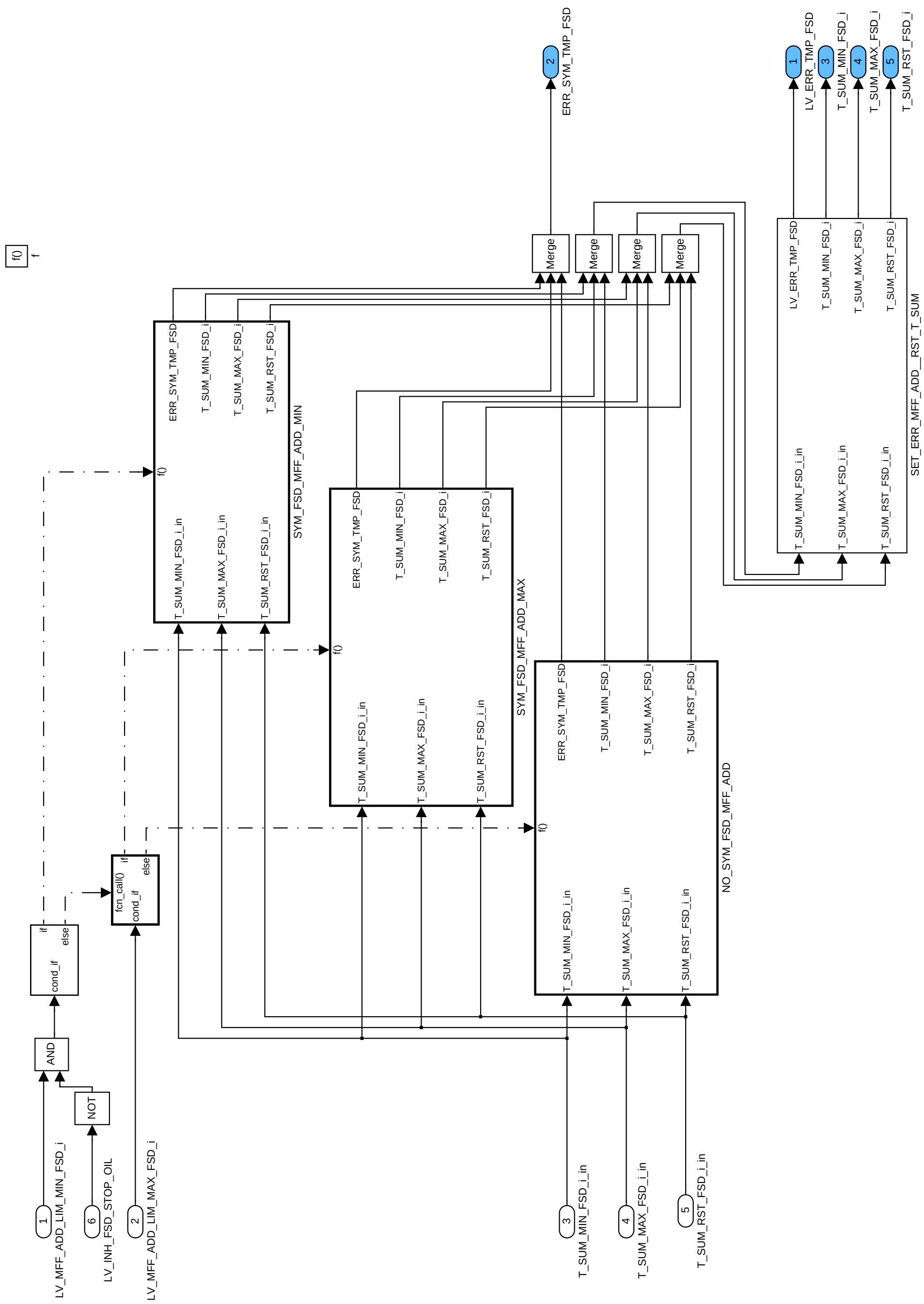

Figure B.105.20: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/
DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_MFF_ADD

Set error symptom for lambda adaptation offset at the minimum

The error symptom is set to the respective value (SYM_1). The timer indicating that the minimum threshold is reached and the reset timer are both increased.

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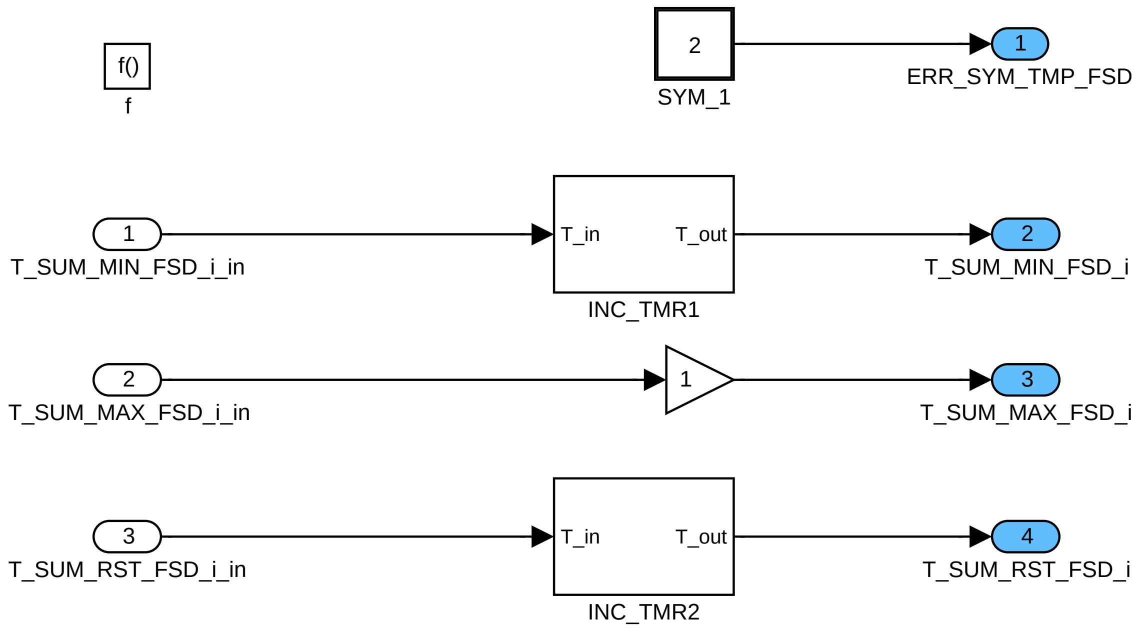

Figure B.105.21: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/
DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_MFF_ADD/SYM_FSD_MFF_ADD_MIN

Increment timer

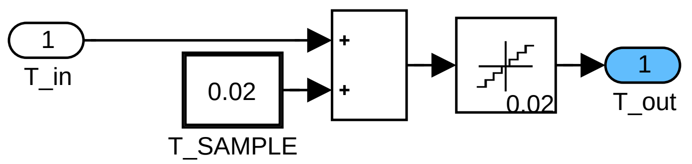

Figure B.105.22: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/
DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_MFF_ADD/SYM_FSD_MFF_ADD_MIN/INC_TMR1

Increment timer

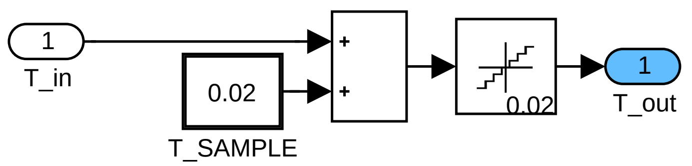

Figure B.105.23: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/
DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_MFF_ADD/SYM_FSD_MFF_ADD_MIN/INC_TMR2

Set error symptom for lambda adaptation offset at the maximum

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The error symptom is set to the respective value (SYM_0). The timer indicating that the maximum threshold is reached and the reset timer are both increased.

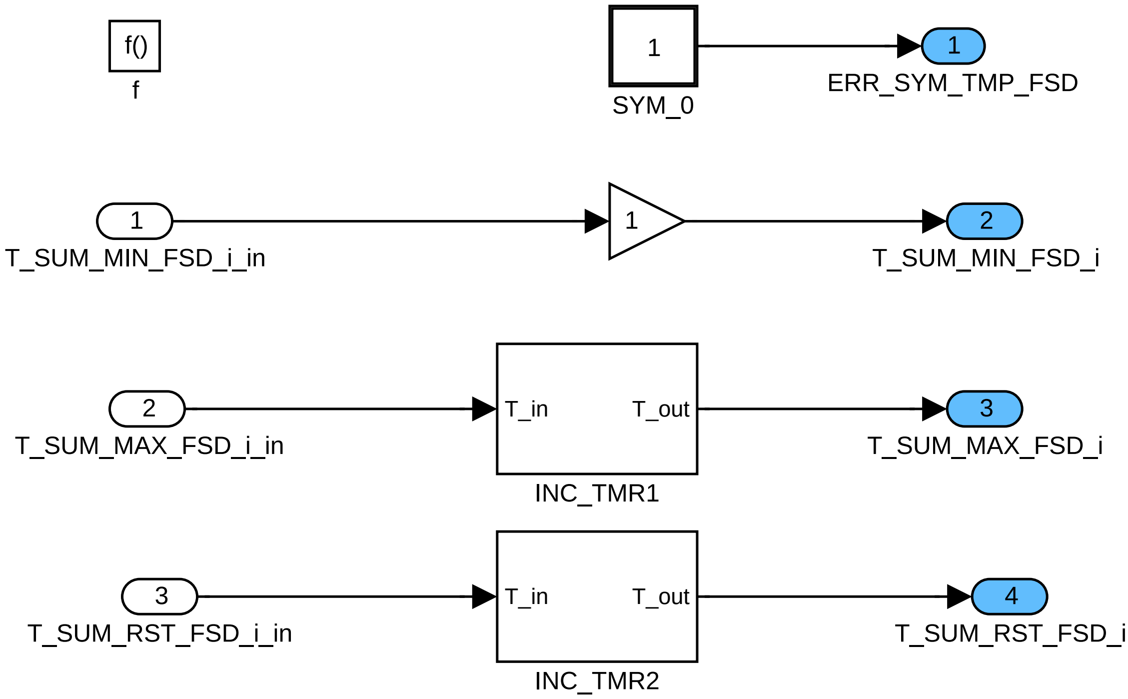

Figure B.105.24: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_MFF_ADD/SYM_FSD_MFF_ADD_MAX

Increment timer

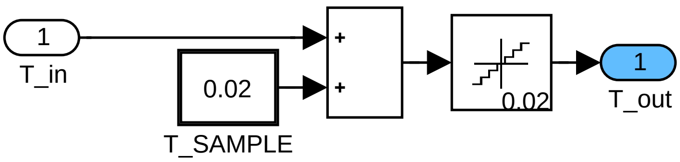

Figure B.105.25: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_MFF_ADD/SYM_FSD_MFF_ADD_MAX/INC_TMR1

Increment timer

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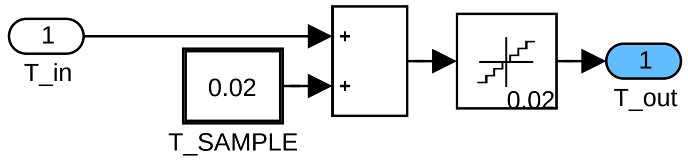

Figure B.105.26: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/
DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_MFF_ADD/SYM_FSD_MFF_ADD_MAX/INC_TMR2

No error symptom for lambda adaptation offset

The error symptom is set to NO_SYM and the reset timer is increased in case it is already different from 0. In that case the error symptom was at least one time different from NO_SYM.

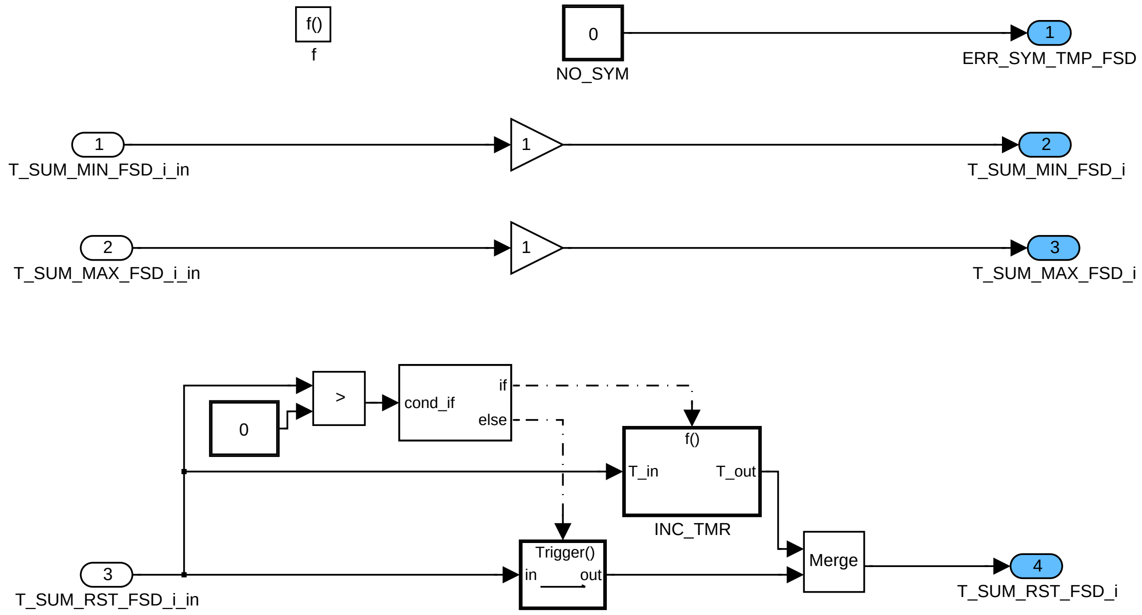

Figure B.105.27: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/
DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_MFF_ADD/NO_SYM_FSD_MFF_ADD

Increment timer

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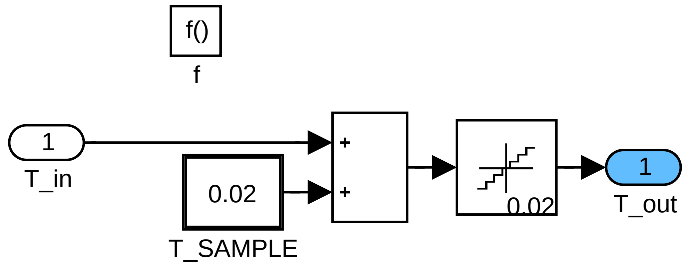

Figure B.105.28: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_MFF_ADD/NO_SYM_FSD_MFF_ADD/INC_TMR

Set error flag for lambda adaptation offset monitoring

The temporary error flag is set if the lambda adaptation factor was either to long at its maximum or at its minimum.
When the reset timer reaches the threshold C_T_SUM_RST_FSD all timers are reset to 0.

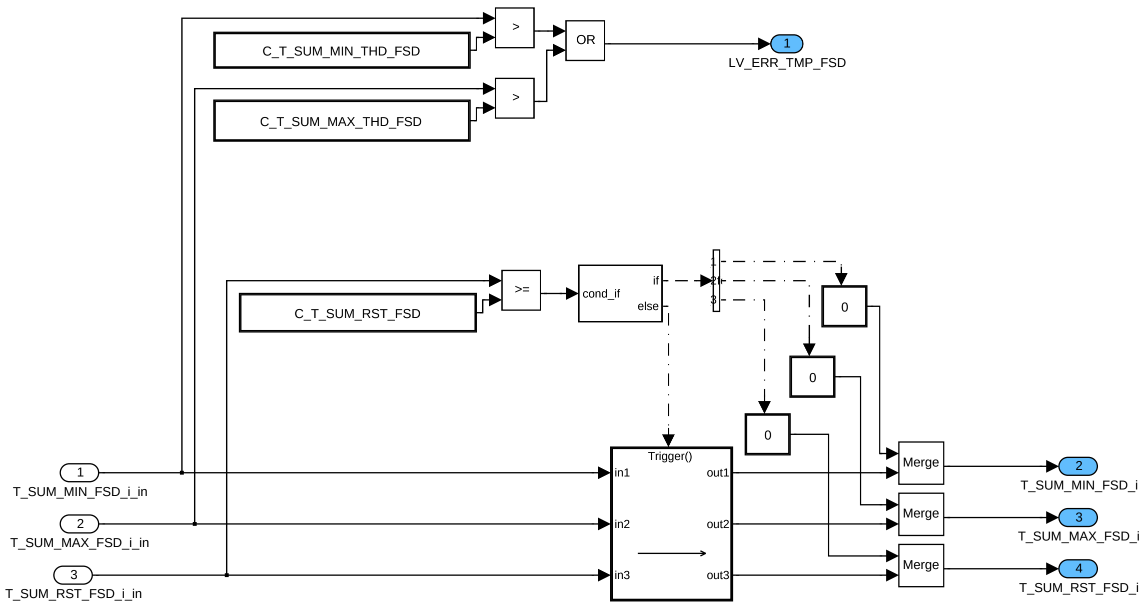

Figure B.105.29: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_MFF_ADD/SET_ERR_MFF_ADD__RST_T_SUM

Conditions for lambda adaptation low range monitoring fulfilled

Between 3 different cases must be distinguished:
1. Lambda adaptation factor for lower load is at its minimum threshold (indicated by the flag LV_FAC_L_RNG_LIM_MIN_FSD[i] which is assigned in the application incidences) and no inhibition due to oil dilution under cold start conditions.
2. Lambda adaptation factor for lower load is at its maximum threshold (indicated by the flag LV_FAC_L_RNG_LIM_MAX_FSD[i] which is assigned in the application incidences).
3. No limitation of the lambda adaptation factor for lower load.

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Independent of these cases the antibounce timers used to finally set the error are evaluated afterwards.

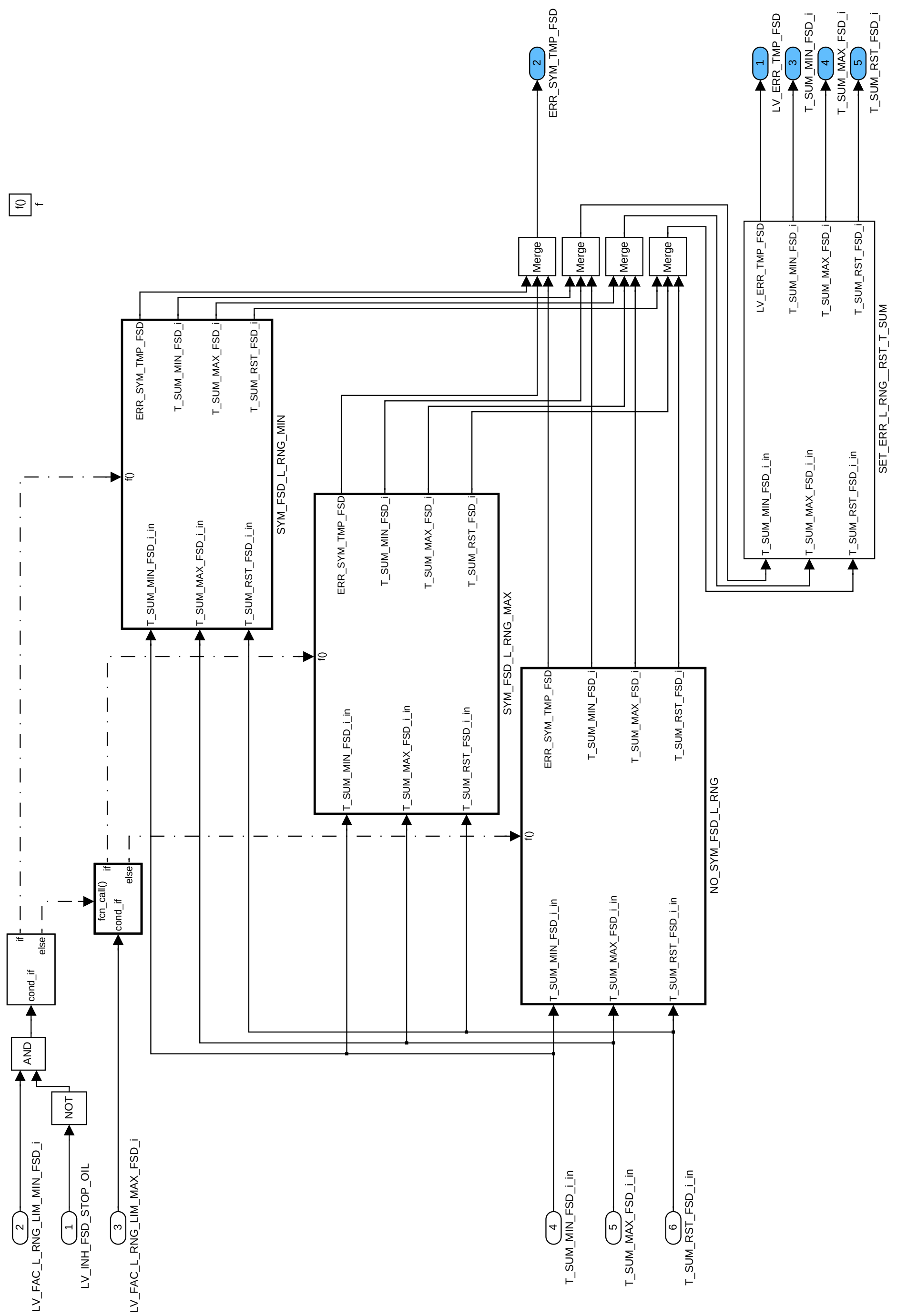

Figure B.105.30: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_L_RNG

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Set error symptom for lambda adaptation low range at the minimum

The error symptom is set to the respective value (SYM_3). The timer indicating that the minimum threshold is reached and the reset timer are both increased.

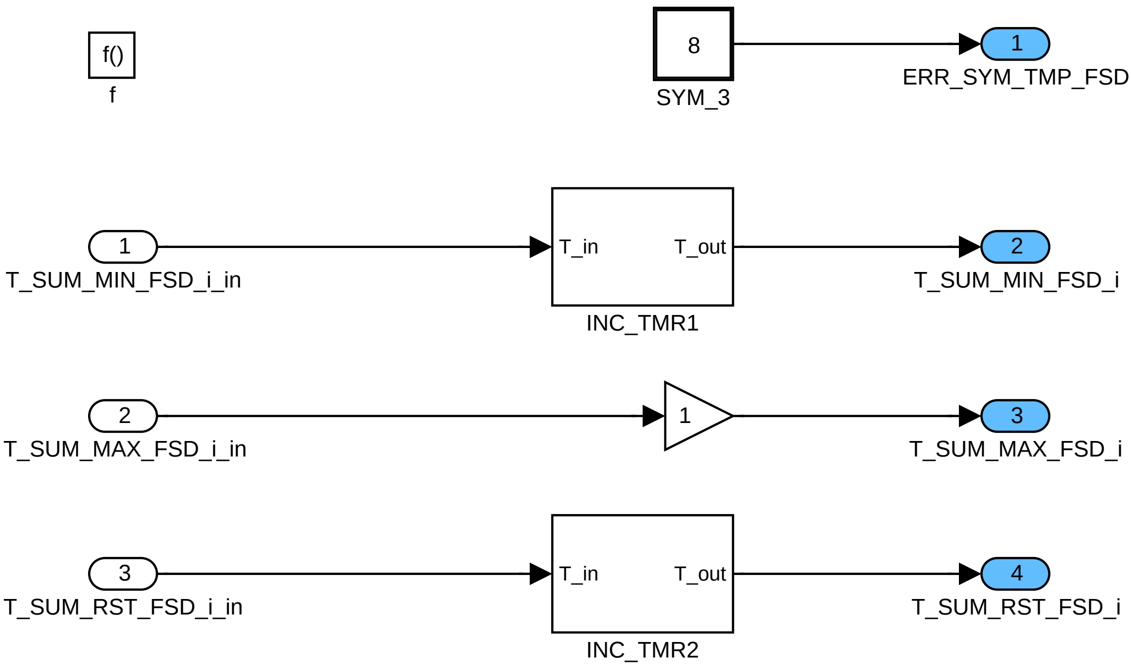

Figure B.105.31: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_L_RNG/SYM_FSD_L_RNG_MIN

Increment timer

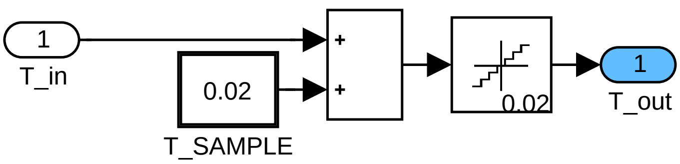

Figure B.105.32: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_L_RNG/SYM_FSD_L_RNG_MIN/INC_TMR1

Increment timer

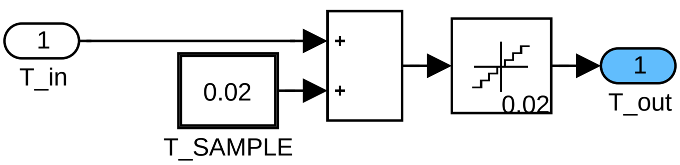

Figure B.105.33: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_L_RNG/SYM_FSD_L_RNG_MIN/INC_TMR2

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Set error symptom for lambda adaptation low range at the maximum

The error symptom is set to the respective value (SYM_2). The timer indicating that the maximum threshold is reached and the reset timer are both increased.

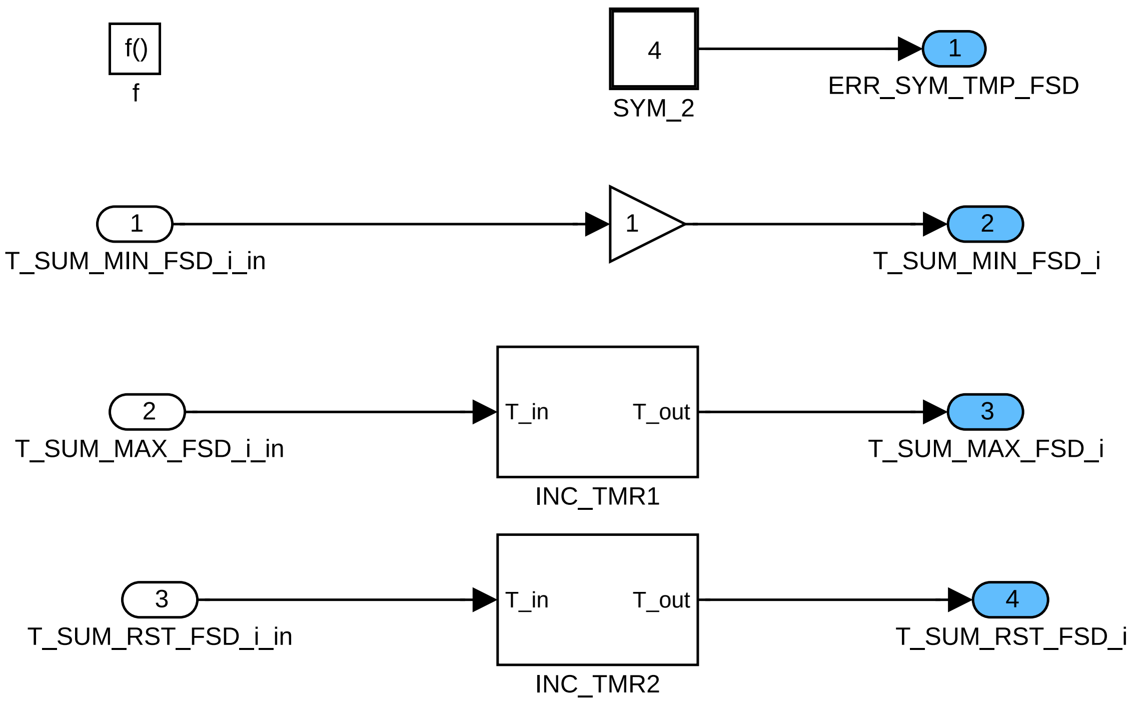

Figure B.105.34: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_L_RNG/SYM_FSD_L_RNG_MAX

Increment timer

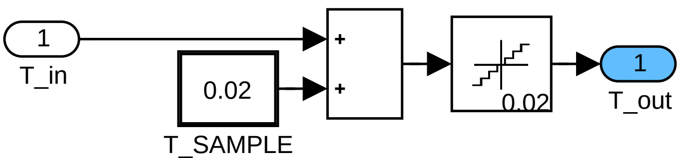

Figure B.105.35: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_L_RNG/SYM_FSD_L_RNG_MAX/INC_TMR1

Increment timer

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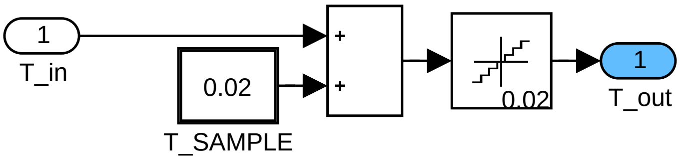

Figure B.105.36: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_L_RNG/SYM_FSD_L_RNG_MAX/INC_TMR2

No error symptom for lambda adaptation low range

The error symptom is set to NO_SYM and the reset timer is increased in case it is already different from 0. In that case the error symptom was at least one time different from NO_SYM.

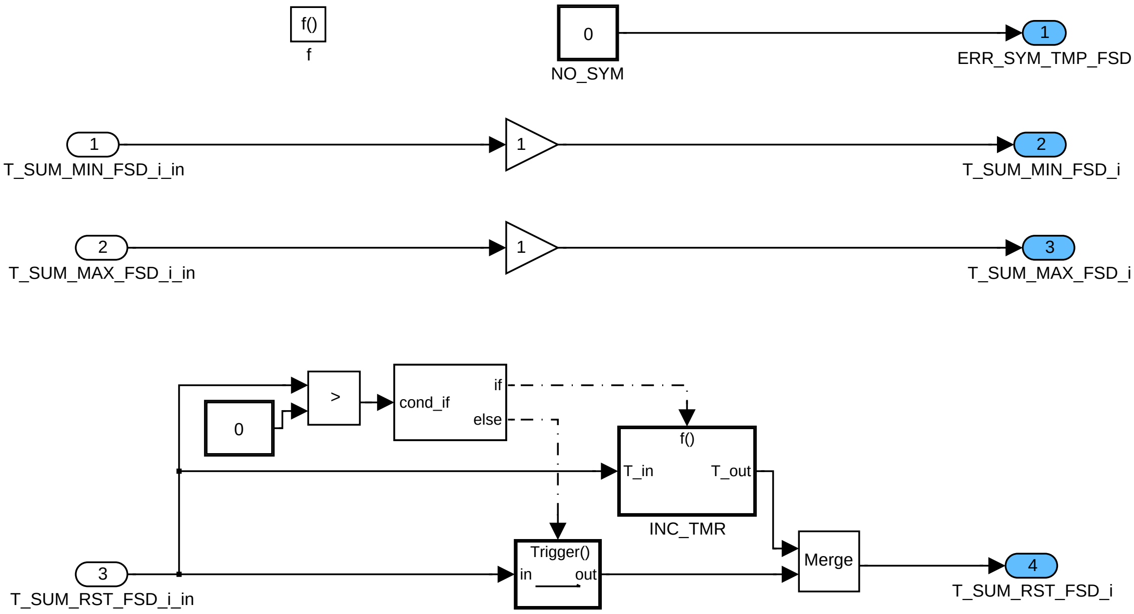

Figure B.105.37: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_L_RNG/NO_SYM_FSD_L_RNG

Increment timer

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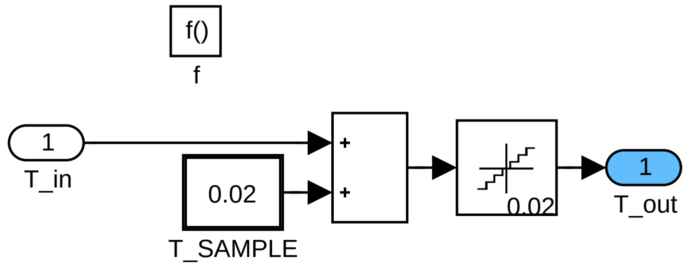

Figure B.105.38: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_L_RNG/NO_SYM_FSD_L_RNG/INC_TMR

Set error flag for lambda adaptation low range monitoring

The temporary error flag is set if the lambda adaptation factor was either to long at its maximum or at its minimum.
When the reset timer reaches the threshold C_T_SUM_RST_FSD all timers are reset to 0.

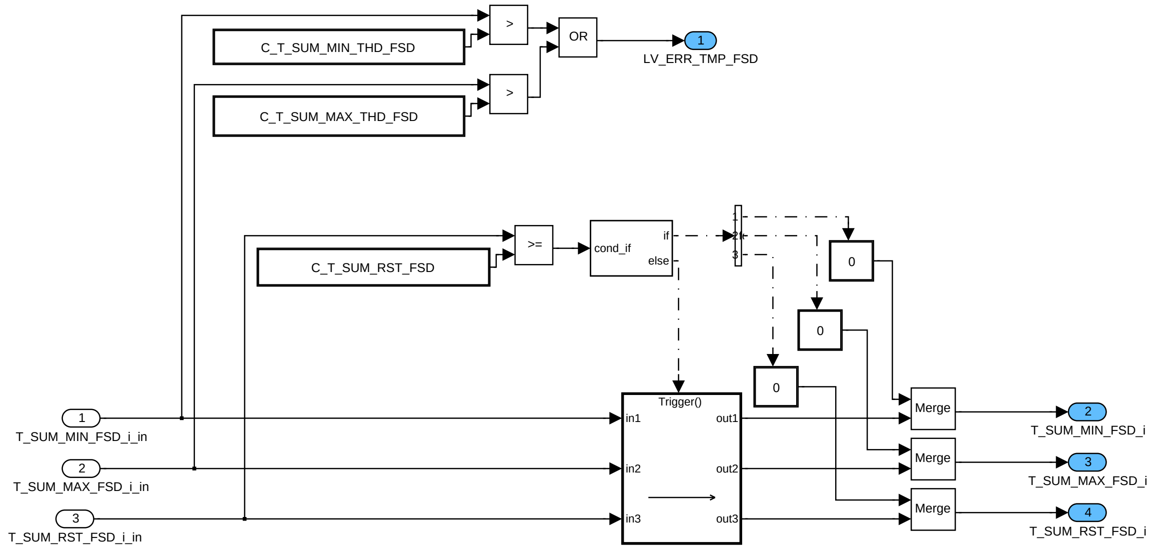

Figure B.105.39: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD/CDN_DIAG_FSD_L_RNG/SET_ERR_L_RNG__RST_T_SUM

Conditions for lambda adaptation monitoring not fulfilled

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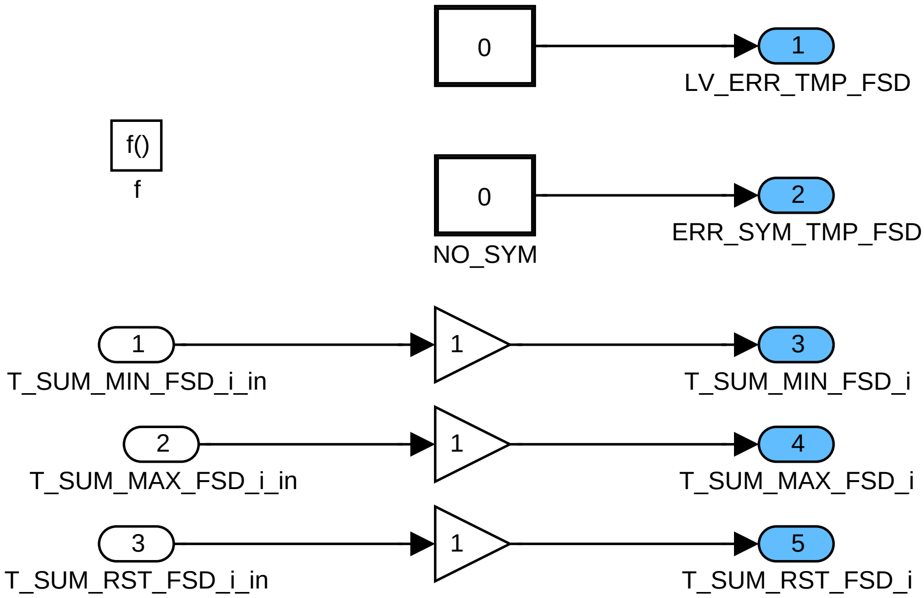

Figure B.105.40: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD/NOT_CDN_DIAG_FSD_MFF_ADD_L_RNG

Error symptom detection for lambda controller monitoring

In case the conditions are not fulfilled all timers remain unchanged and the temporary error flag and symptom have no relevance.

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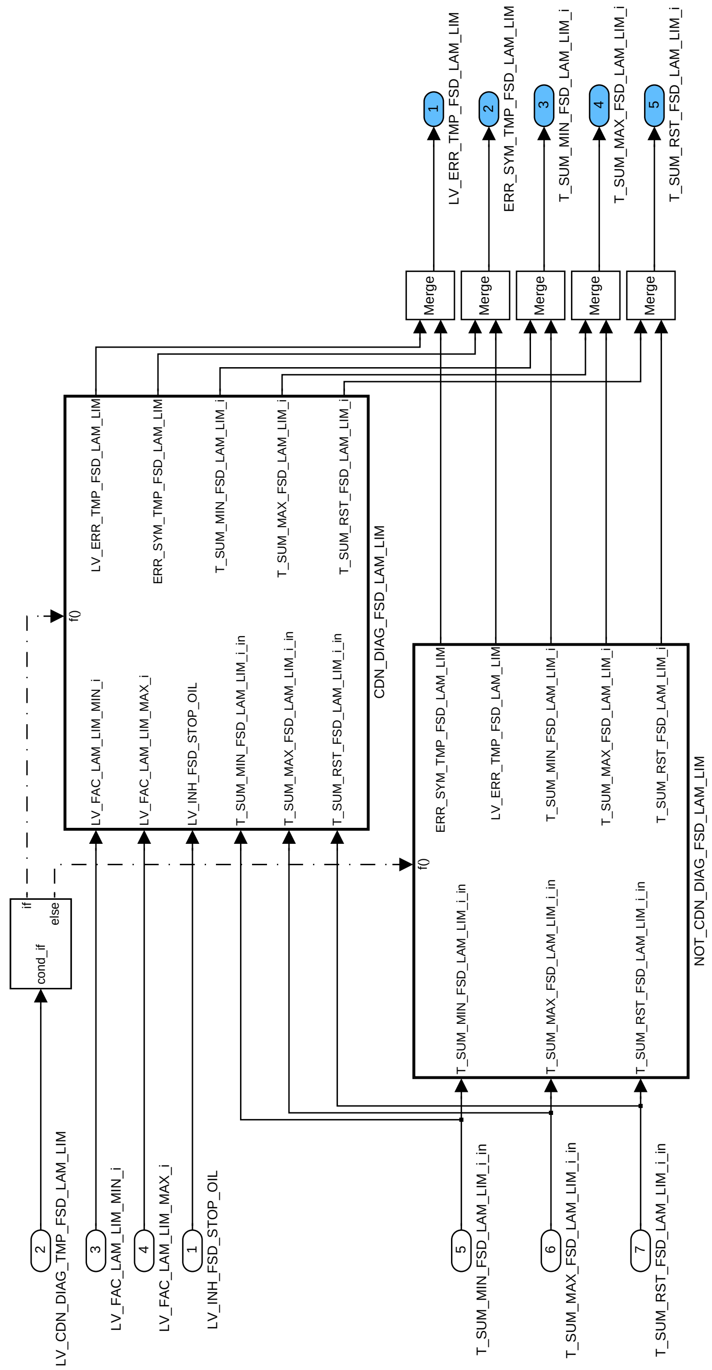

Figure B.105.41: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD_LAM_LIM

Conditions for lambda controller monitoring fulfilled

Between 3 different cases must be distinguished:

1. Lambda controller is at its minimum threshold (indicated by the flag LV_FAC_LAM_LIM_MIN[i]) and no inhibition due to oil dilution under cold start conditions.
2. Lambda controller is at its maximum threshold (indicated by the flag LV_FAC_LAM_LIM_MAX[i]).

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3. No limitation of the lambda controller.

Independent of these cases the antibounce timers used to finally set the error are evaluated afterwards.

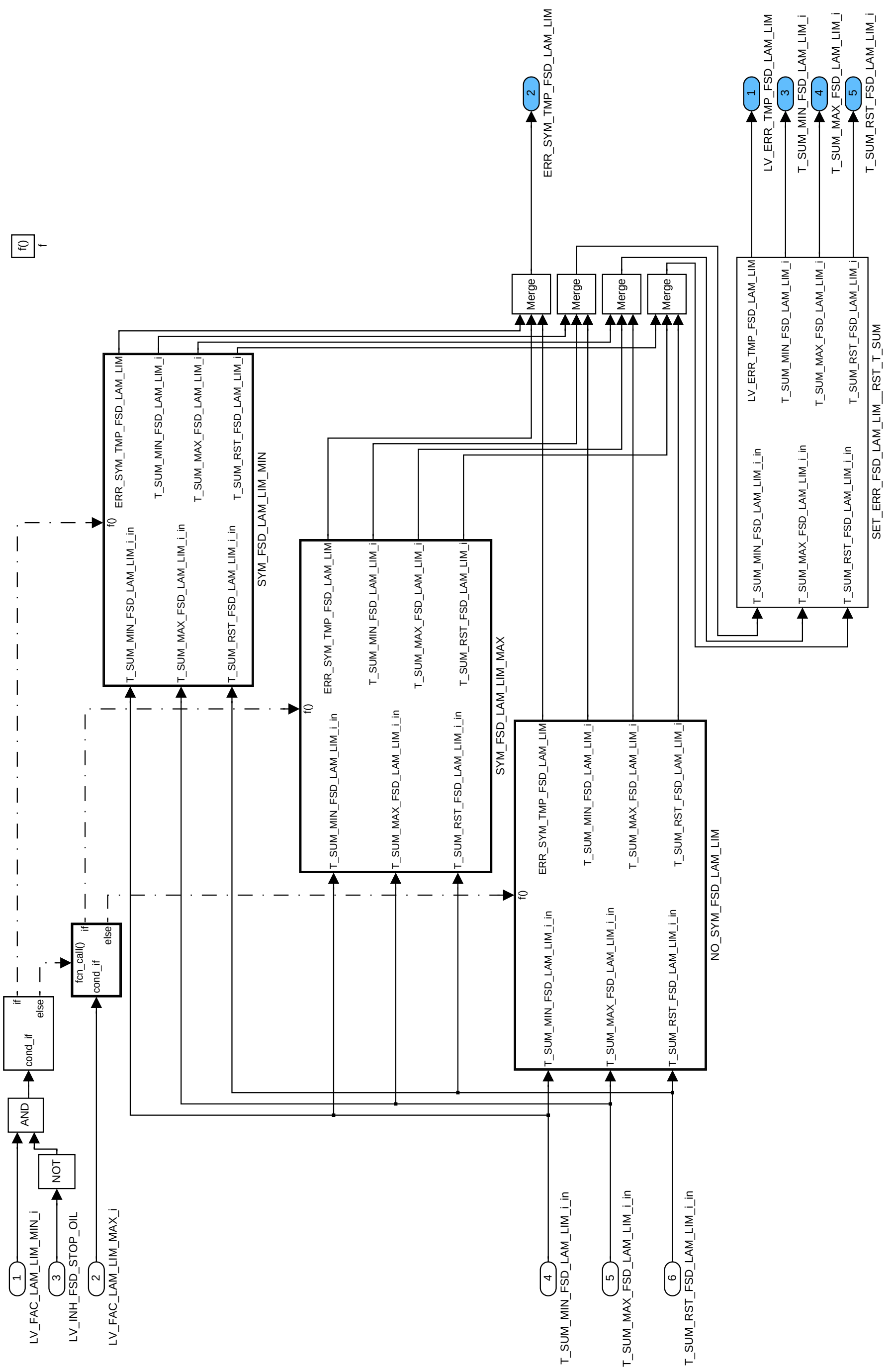

Figure B.105.42: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD_LAM_LIM/CDN_DIAG_FSD_LAM_LIM

Set error symptom for lambda controller at the minimum

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The error symptom is set to the respective value (SYM_1). The timer indicating that the minimum threshold is reached and the reset timer are both increased.

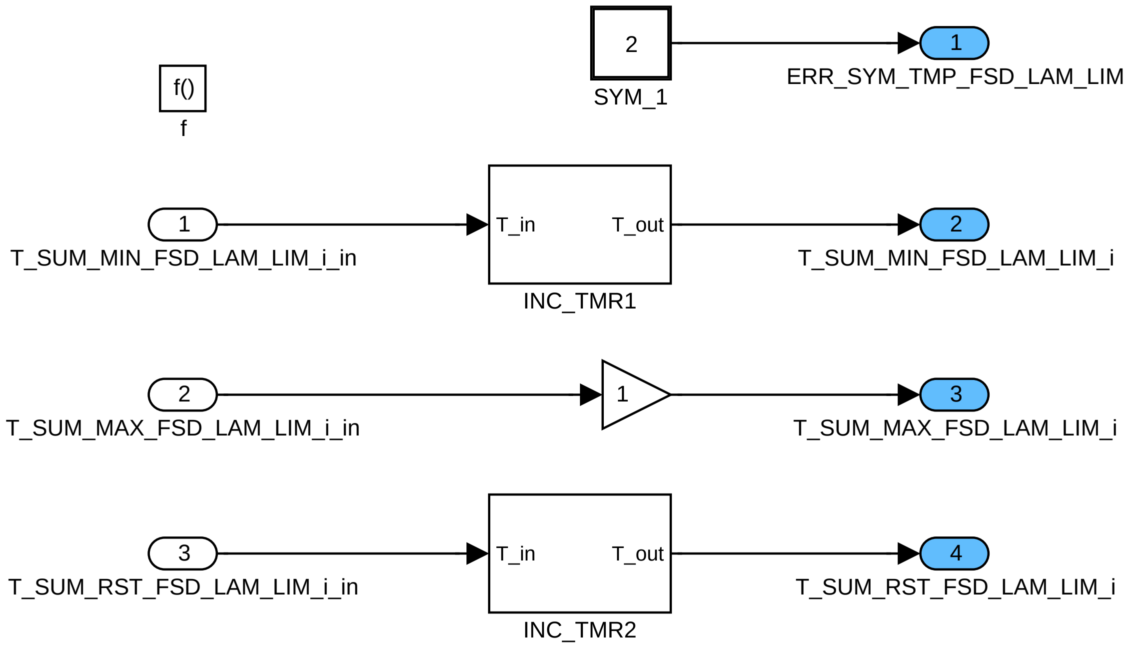

Figure B.105.43: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/ DET_ERR/DET_ERR_FSD_LAM_LIM/CDN_DIAG_FSD_LAM_LIM/SYM_FSD_LAM_LIM_MIN

Increment timer

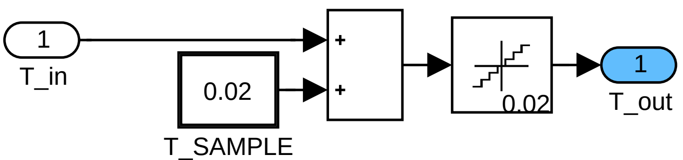

Figure B.105.44: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/ DET_ERR_FSD_LAM_LIM/CDN_DIAG_FSD_LAM_LIM/SYM_FSD_LAM_LIM_MIN/INC_TMR1

Increment timer

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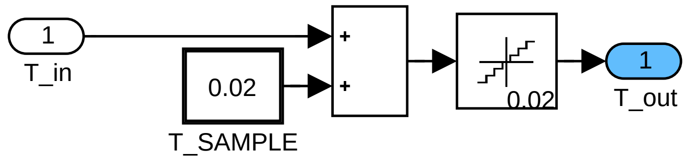

Figure B.105.45: -
LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/
DET_ERR_FSD_LAM_LIM/CDN_DIAG_FSD_LAM_LIM/SYM_FSD_LAM_LIM_MIN/INC_TMR2

Set error symptom for lambda controller at the maximum

The error symptom is set to the respective value (SYM_0). The timer indicating that the maximum threshold is reached and the reset timer are both increased.

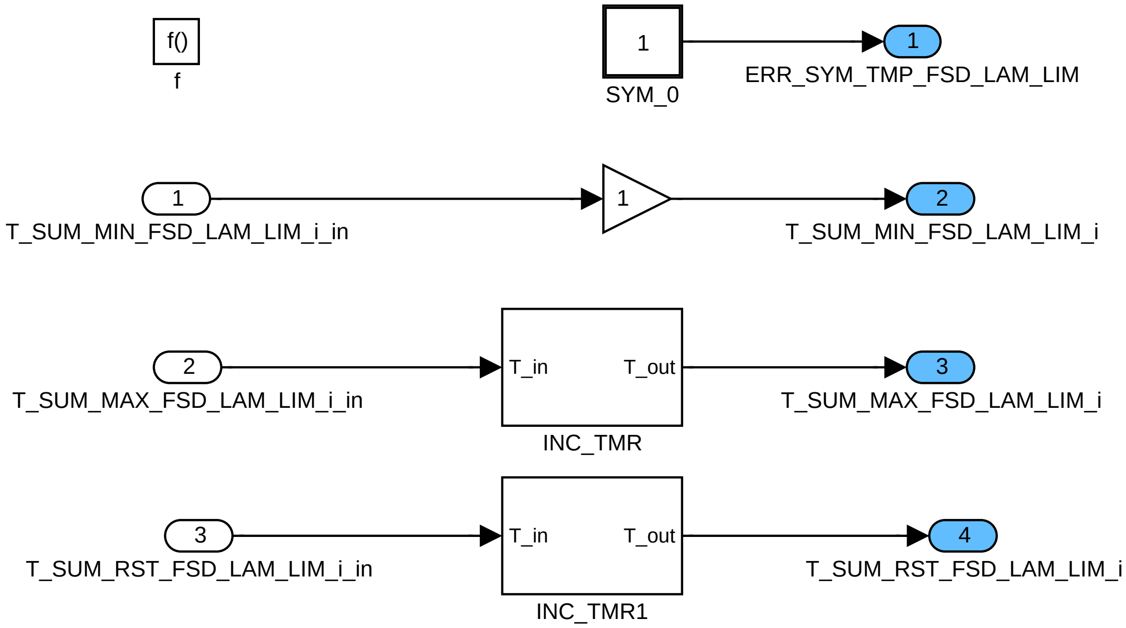

Figure B.105.46: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/
DET_ERR/DET_ERR_FSD_LAM_LIM/CDN_DIAG_FSD_LAM_LIM/SYM_FSD_LAM_LIM_MAX

Increment timer

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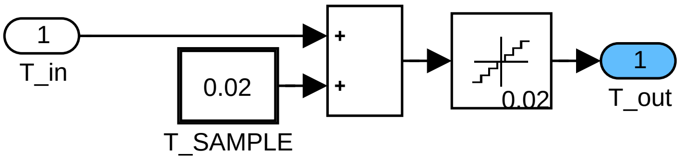

Figure B.105.47:
LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/
DET_ERR_FSD_LAM_LIM/CDN_DIAG_FSD_LAM_LIM/SYM_FSD_LAM_LIM_MAX/INC_TMR

Increment timer

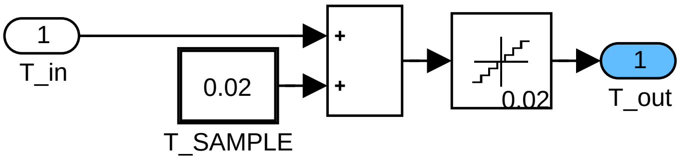

Figure B.105.48:
LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/
DET_ERR_FSD_LAM_LIM/CDN_DIAG_FSD_LAM_LIM/SYM_FSD_LAM_LIM_MAX/INC_TMR1

No error symptom for lambda controller monitoring

The error symptom is set to NO_SYM and the reset timer is increased in case it is already different from 0. In that case the error symptom was at least one time different from NO_SYM.

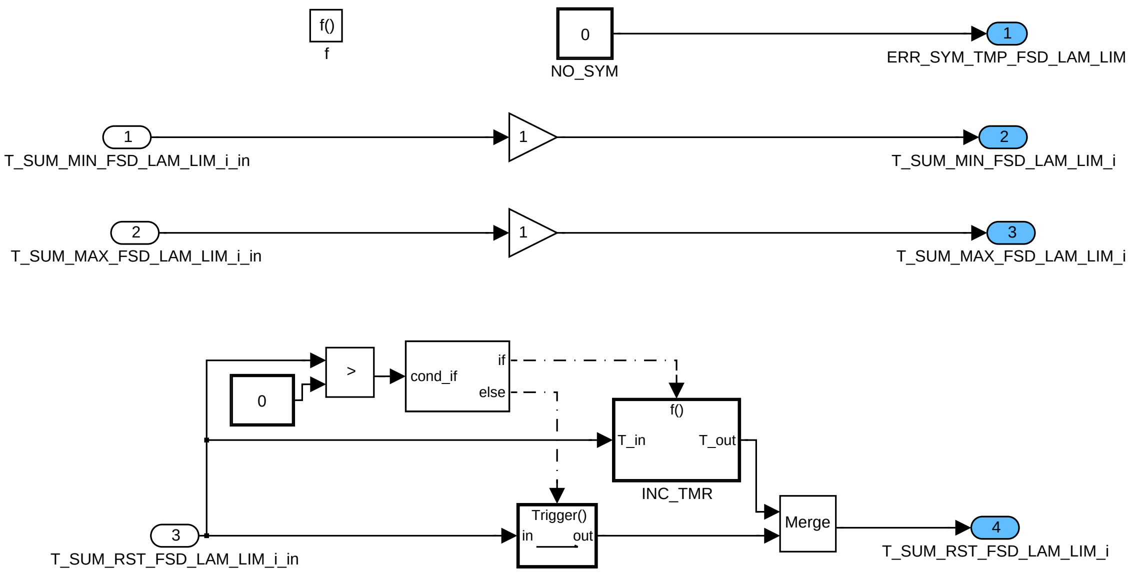

Figure B.105.49: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/
DET_ERR/DET_ERR_FSD_LAM_LIM/CDN_DIAG_FSD_LAM_LIM/NO_SYM_FSD_LAM_LIM

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Increment timer

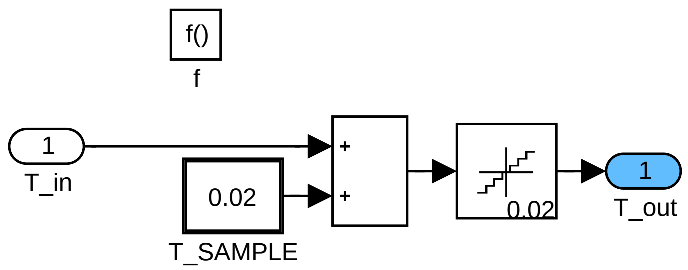

Figure B.105.50:
LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/
DET_ERR_FSD_LAM_LIM/CDN_DIAG_FSD_LAM_LIM/NO_SYM_FSD_LAM_LIM/INC_TMR

Set error flag for lambda controller monitoring

The temporary error flag is set if the lambda controller was either to long at its maximum or at its minimum.
When the reset timer reaches the threshold C_T_SUM_RST_FSD all timers are reset to 0.

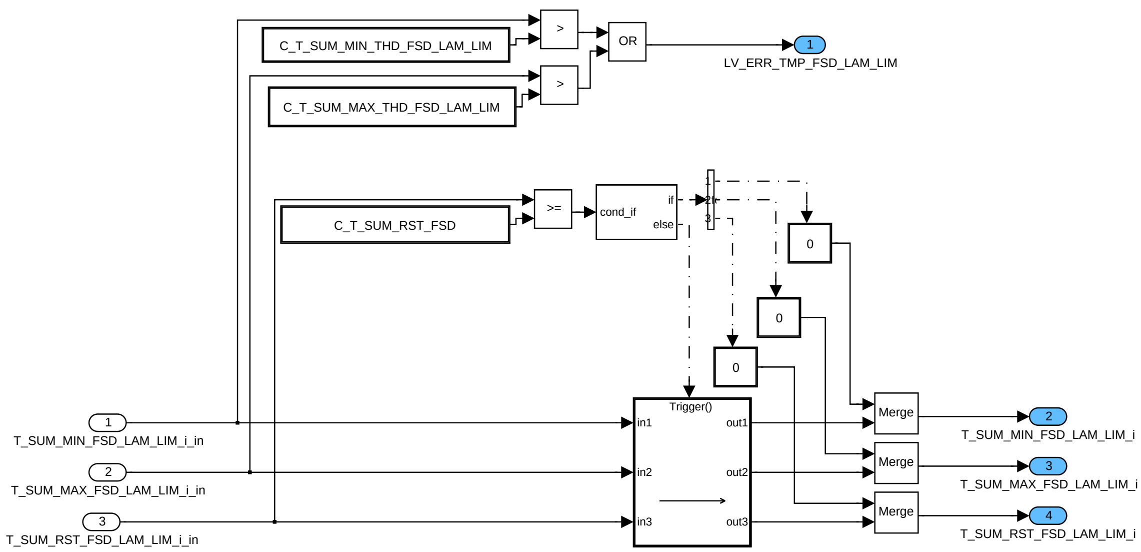

Figure B.105.51:
LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/
DET_ERR_FSD_LAM_LIM/CDN_DIAG_FSD_LAM_LIM/SET_ERR_FSD_LAM_LIM__RST_T_SUM

Conditions for lambda controller monitoring not fulfilled

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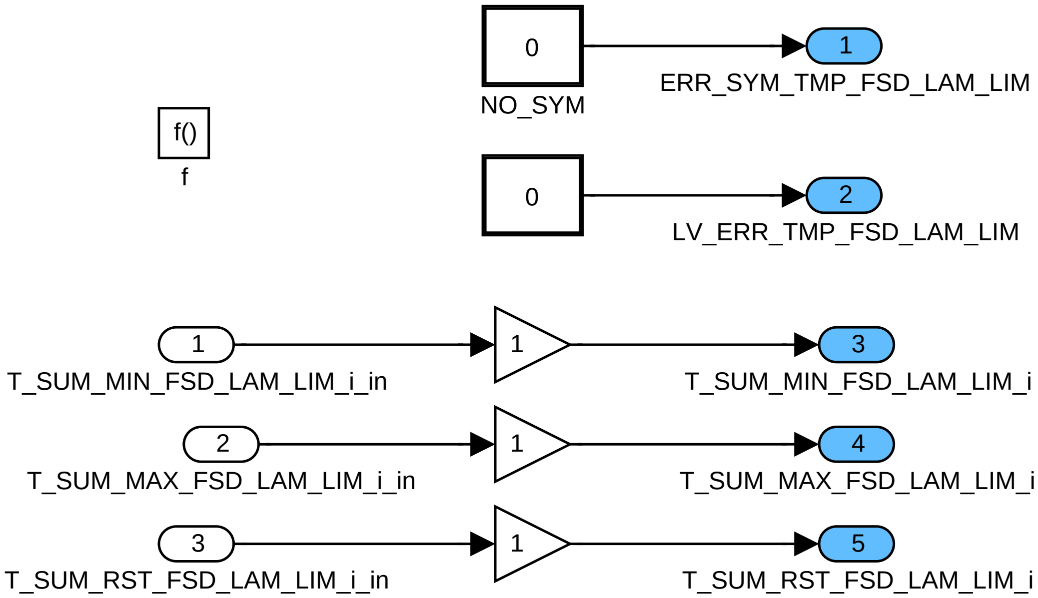

Figure B.105.52: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD_LAM_LIM/NOT_CDN_DIAG_FSD_LAM_LIM

Error symptom detection for lambda adaptation high range monitoring

In case the conditions are not fulfilled all timers remain unchanged and the temporary error flag and symptom have no relevance.

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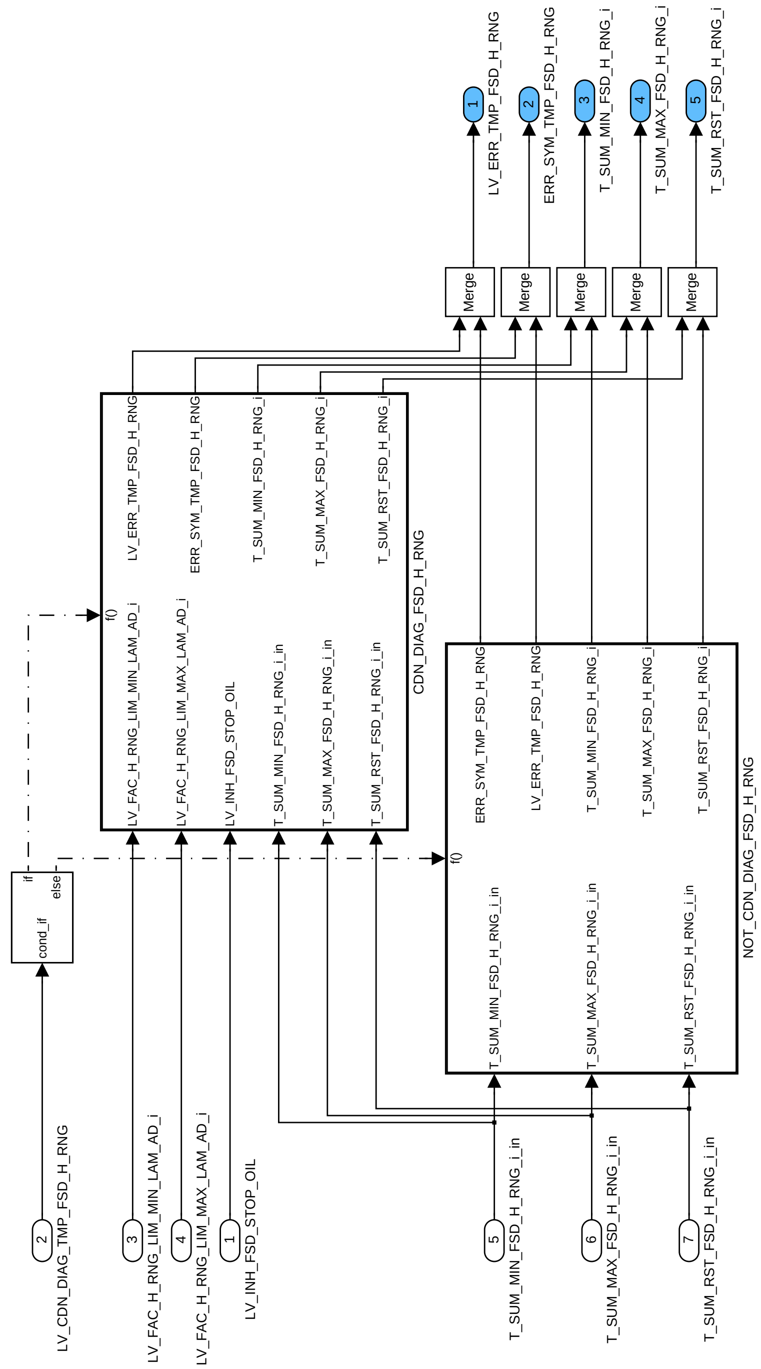

Figure B.105.53: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD_H_RNG

Conditions for lambda adaptation high range monitoring fulfilled

Between 3 different cases must be distinguished:

1. Lambda adaptation factor for higher load is at its minimum threshold (indicated by the flag LV_FAC_H_RNG_LIM_MIN_LAM_AD[i]) and no inhibition due to oil dilution under cold start conditions.

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2. Lambda adaptation factor for higher load is at its maximum threshold (indicated by the flag LV_FAC_H_RNG_LIM_MAX_LAM_AD[i]).
3. No limitation of the lambda adaptation factor for higher load.

Independent of these cases the antibounce timers used to finally set the error are evaluated afterwards.

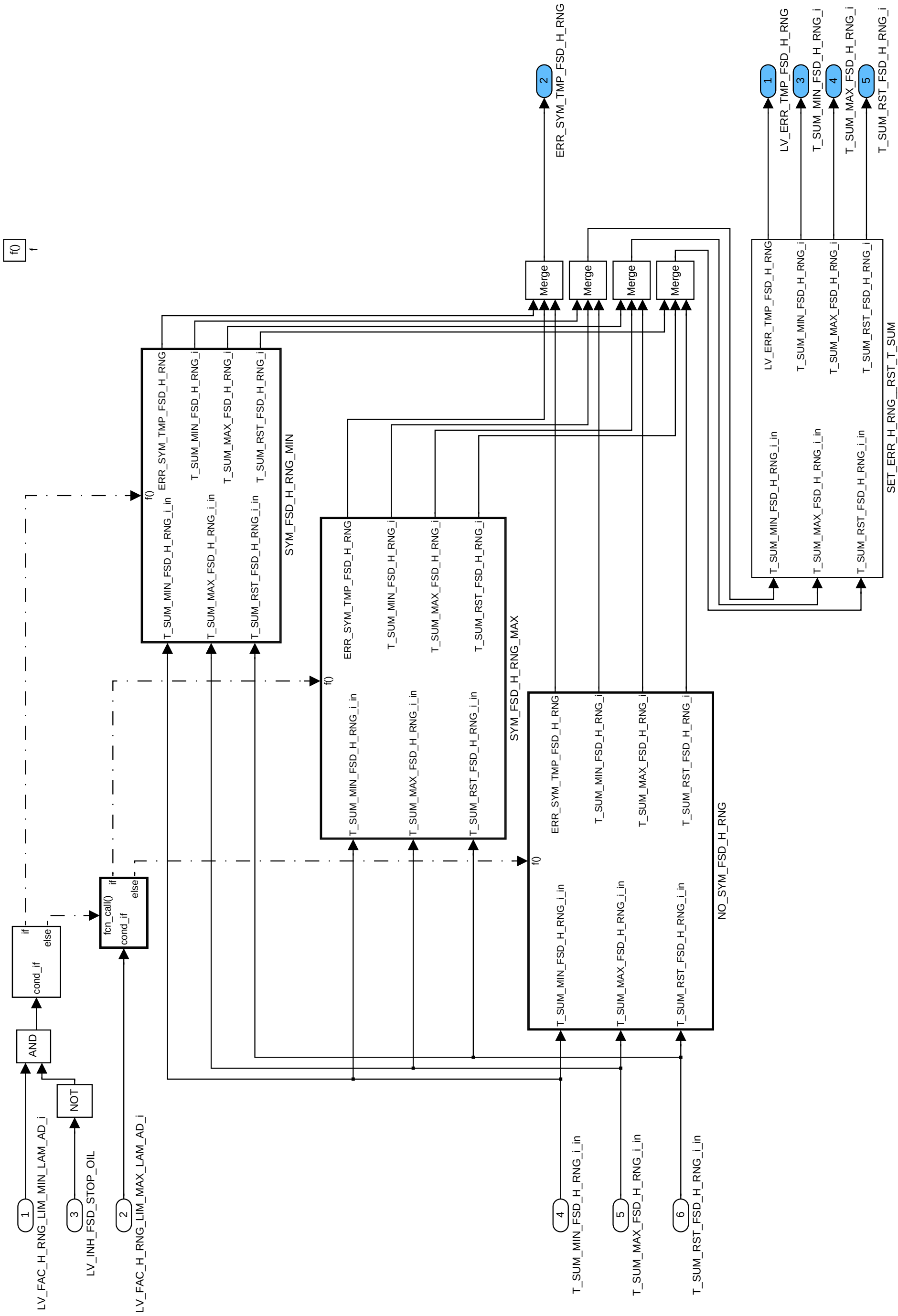

Figure B.105.54: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD_H_RNG/CDN_DIAG_FSD_H_RNG

Set error symptom for lambda adaptation high range at the minimum

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The error symptom is set to the respective value (SYM_1). The timer indicating that the minimum threshold is reached and the reset timer are both increased.

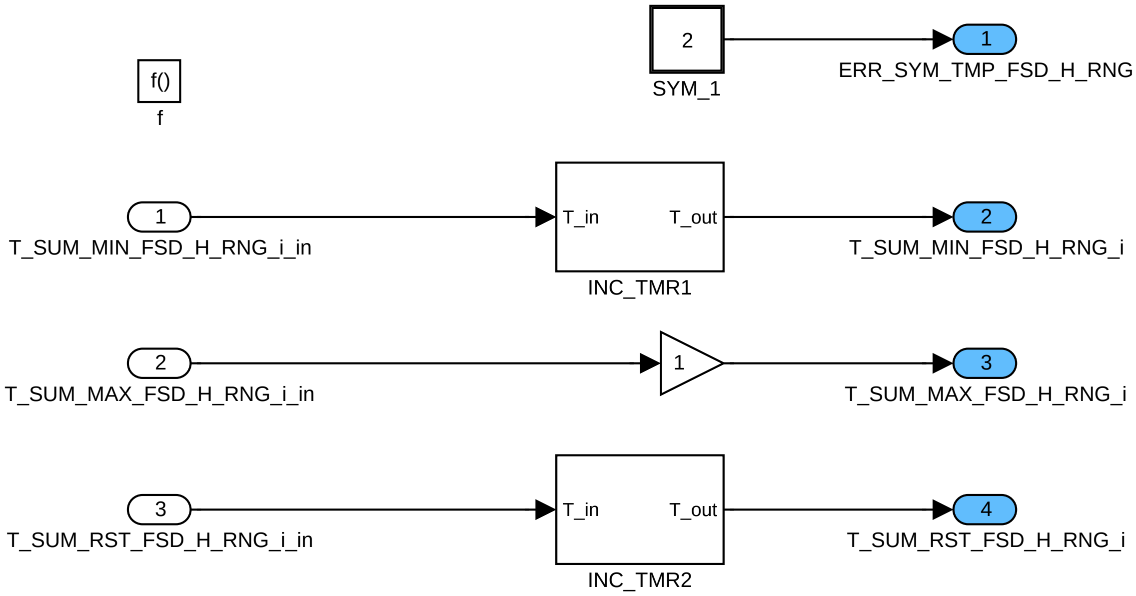

Figure B.105.55: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD_H_RNG/CDN_DIAG_FSD_H_RNG/SYM_FSD_H_RNG_MIN

Increment timer

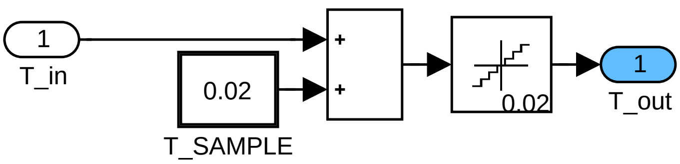

Figure B.105.56: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD_H_RNG/CDN_DIAG_FSD_H_RNG/SYM_FSD_H_RNG_MIN/INC_TMR1

Increment timer

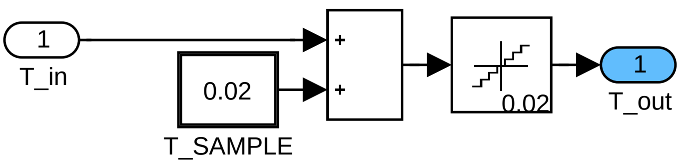

Figure B.105.57: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD_H_RNG/CDN_DIAG_FSD_H_RNG/SYM_FSD_H_RNG_MIN/INC_TMR2

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Set error symptom for lambda adaptation high range at the maximum

The error symptom is set to the respective value (SYM_0). The timer indicating that the maximum threshold is reached and the reset timer are both increased.

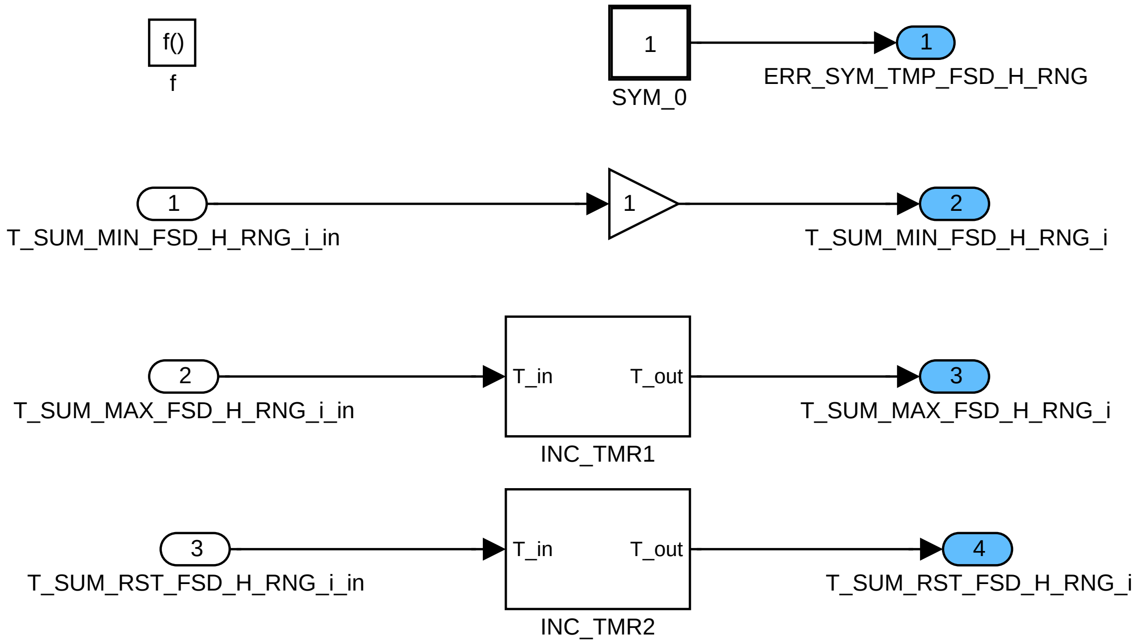

Figure B.105.58: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD_H_RNG/CDN_DIAG_FSD_H_RNG/SYM_FSD_H_RNG_MAX

Increment timer

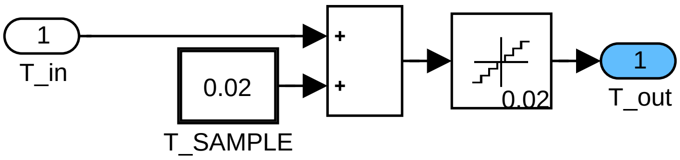

Figure B.105.59: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD_H_RNG/CDN_DIAG_FSD_H_RNG/SYM_FSD_H_RNG_MAX/INC_TMR1

Increment timer

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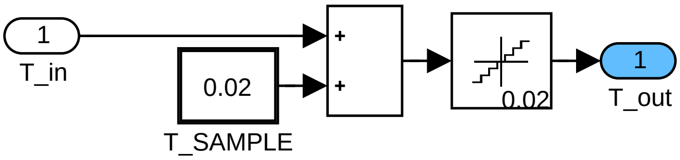

Figure B.105.60: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD_H_RNG/CDN_DIAG_FSD_H_RNG/SYM_FSD_H_RNG_MAX/INC_TMR2

No error symptom for lambda adaptation high range

The error symptom is set to NO_SYM and the reset timer is increased in case it is already different from 0. In that case the error symptom was at least one time different from NO_SYM.

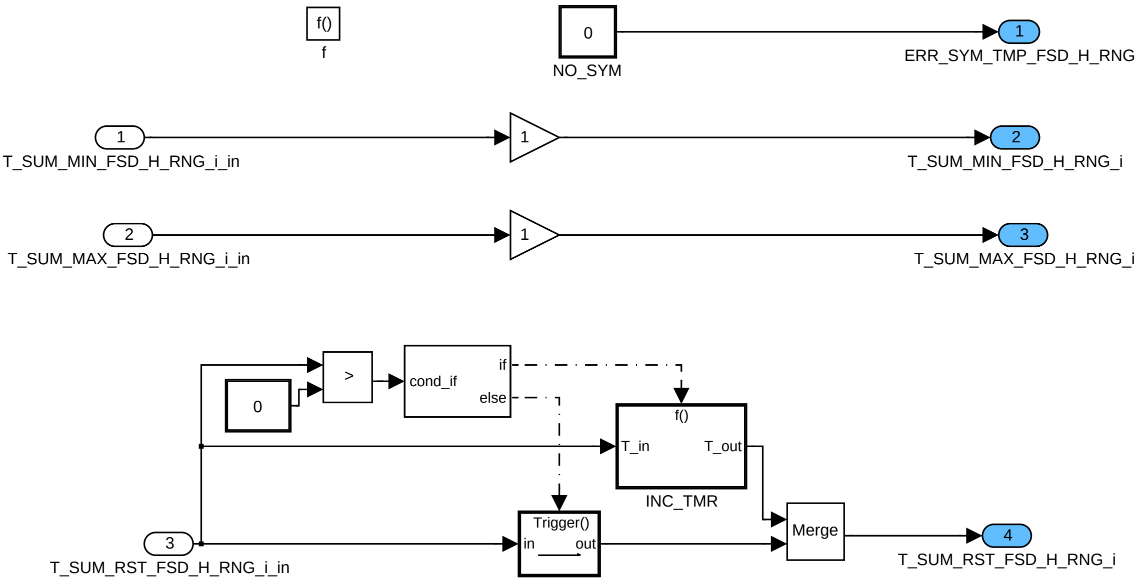

Figure B.105.61: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD_H_RNG/CDN_DIAG_FSD_H_RNG/NO_SYM_FSD_H_RNG

Increment timer

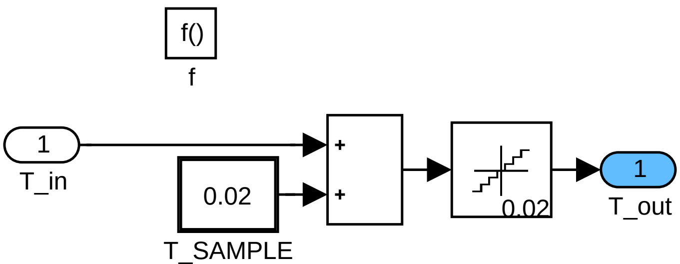

Figure B.105.62: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD_H_RNG/CDN_DIAG_FSD_H_RNG/NO_SYM_FSD_H_RNG/INC_TMR

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Set error flag for lambda adaptation high range monitoring

The temporary error flag is set if the lambda adaptation factor was either to long at its maximum or at its minimum.
When the reset timer reaches the threshold C_T_SUM_RST_FSD all timers are reset to 0.

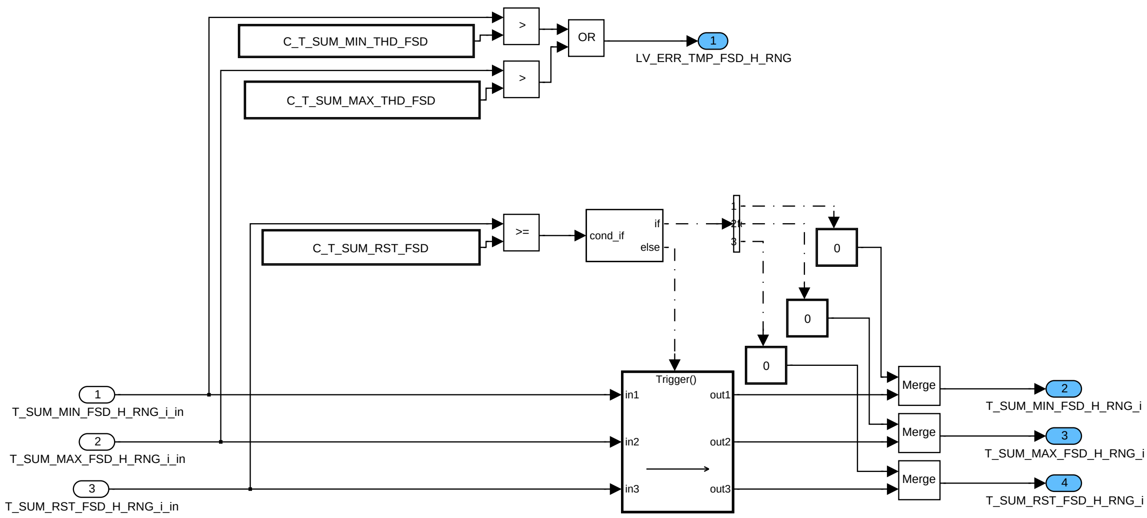

Figure B.105.63: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD_H_RNG/CDN_DIAG_FSD_H_RNG/SET_ERR_H_RNG__RST_T_SUM

Conditions for lambda adaptation high range monitoring not fulfilled

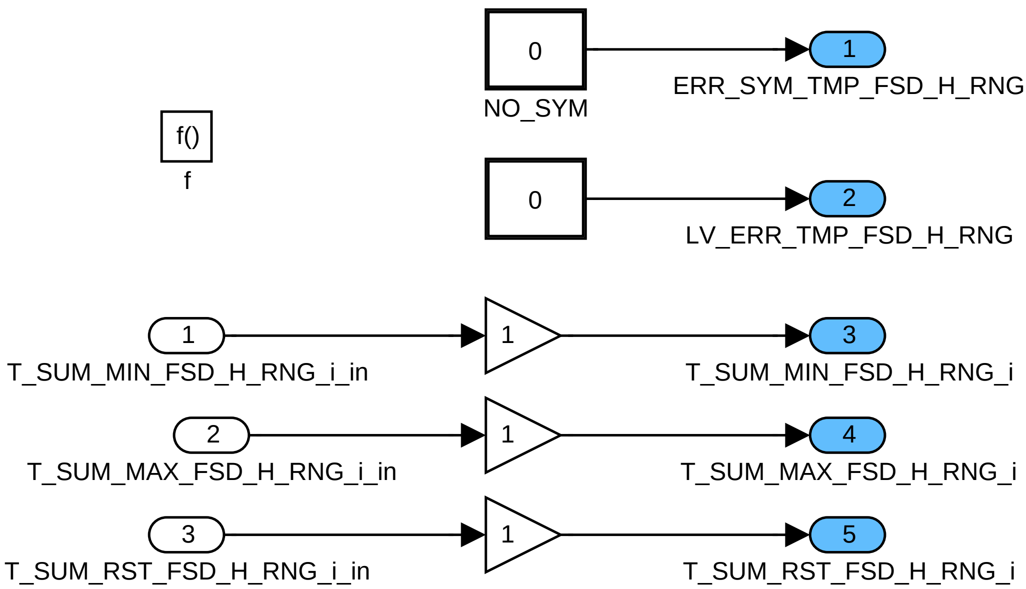

Figure B.105.64: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/DET_ERR/DET_ERR_FSD_H_RNG/NOT_CDN_DIAG_FSD_H_RNG

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Management of end of diagnosis flags

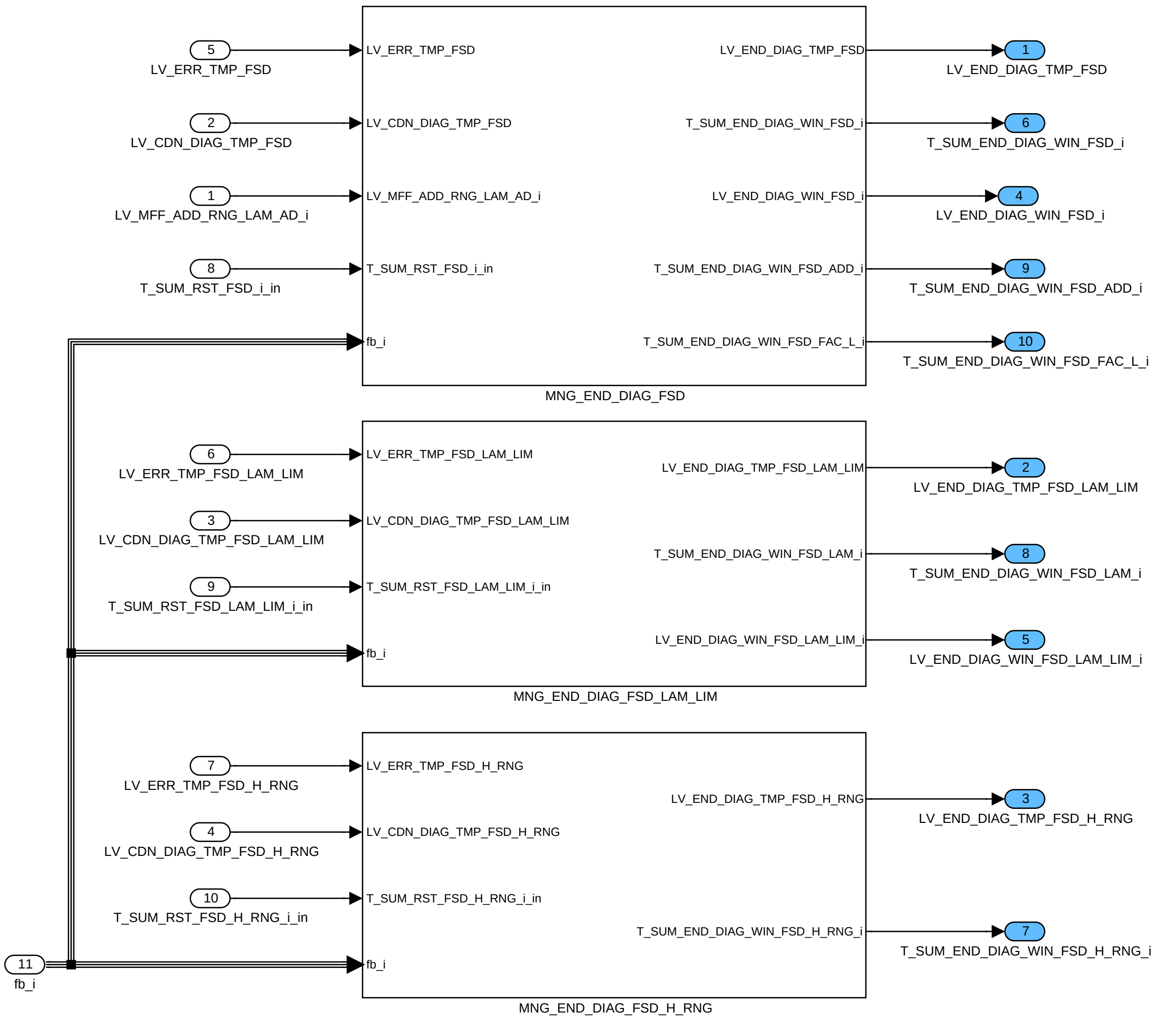

Figure B.105.65:
LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/MNG_END_DIAG

Manage end flags for lambda adaptation monitoring

First the end flag timers are calculated and then the conditions to set the end flags are evaluated.

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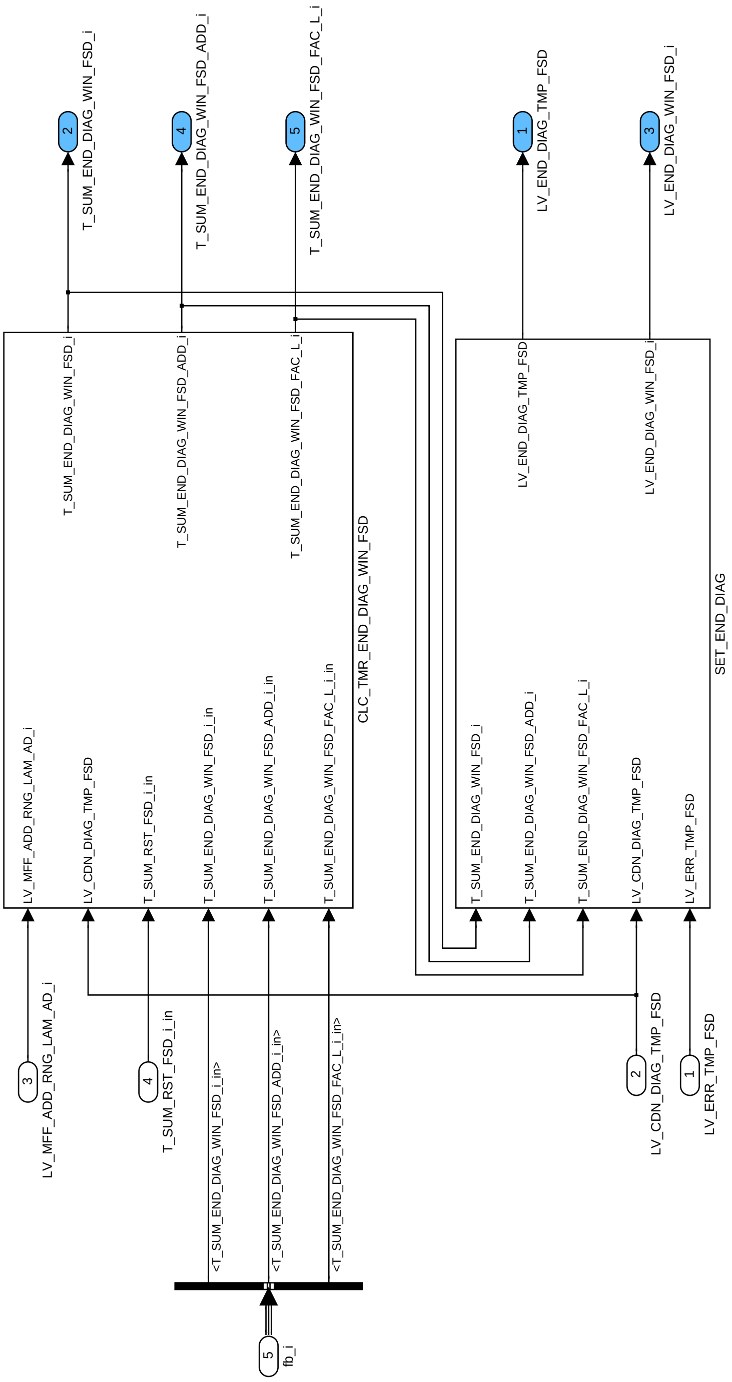

Figure B.105.66: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/MNG_END_DIAG/MNG_END_DIAG_FSD

Calculate end of diagnosis timers for lambda adaptation monitoring

If the conditions are not fulfilled all timers T_SUM_END_DIAG_WIN_FSD[i], T_SUM_END_DIAG_WIN_FSD_ADD[i] and T_SUM_END_DIAG_WIN_FSD_FAC_L[i] remain unchanged.
The end timers are reset (to one sample step) either if the calibration threshold is reached by T_SUM_END_DIAG_WIN_FSD[i] and both timers T_SUM_END_DIAG_WIN_FSD_ADD[i] and T_SUM_

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END_DIAG_WIN_FAC_L[i] were above the threshold defined by C_T_SUM_RST_FSD and C_CRLC_T_SUM_WIN_FSD_RST or when the reset timer was started to be incremented.
In all other cases the timers are incremented as described in the corresponding subsystem.

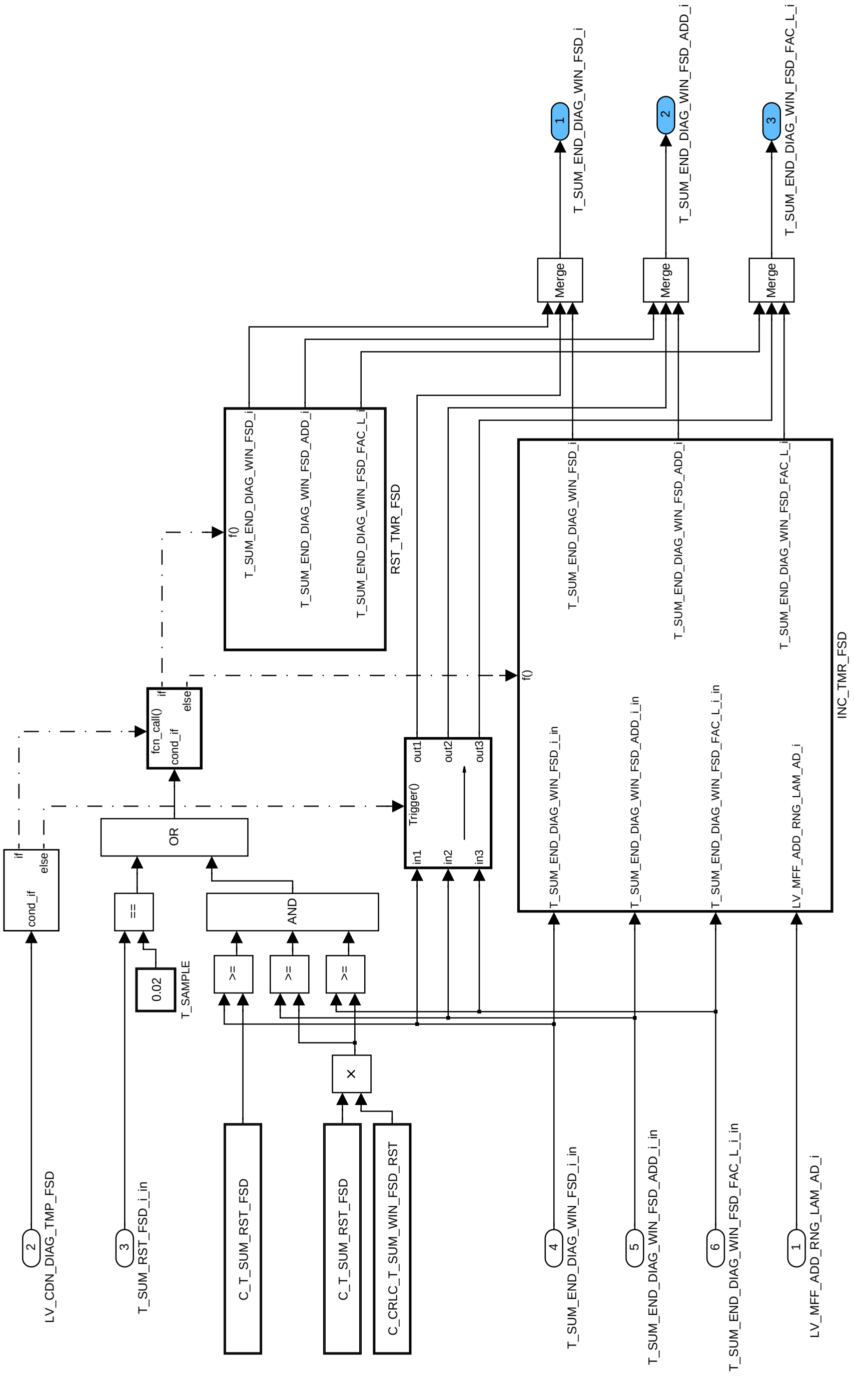

Figure B.105.67: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/MNG_END_DIAG/MNG_END_DIAG_FSD/CLC_TMR_END_DIAG_WIN_FSD

Reset end of diagnosis timers for lambda adaptation monitoring

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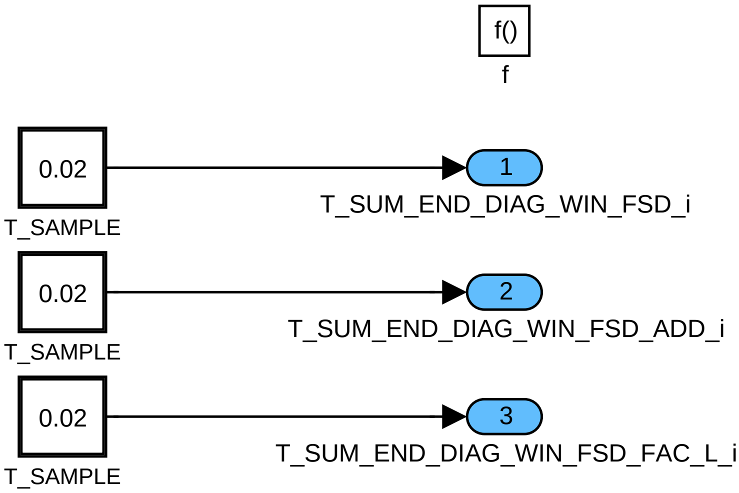

Figure B.105.68: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/MNG_END_DIAG/MNG_END_DIAG_FSD/CLC_TMR_END_DIAG_WIN_FSD/RST_TMR_FSD

Increment end of diagnosis timers for lambda adaptation monitoring

T_SUM_END_DIAG_WIN_FSD[i] is incremented without restrictions.
T_SUM_END_DIAG_WIN_FSD_ADD[i] is incremented when the lambda adaptation is in the offset learning field.
T_SUM_END_DIAG_WIN_FSD_FAC_L[i] is incremented when the lambda adaptation is in the lower load factor learning field.

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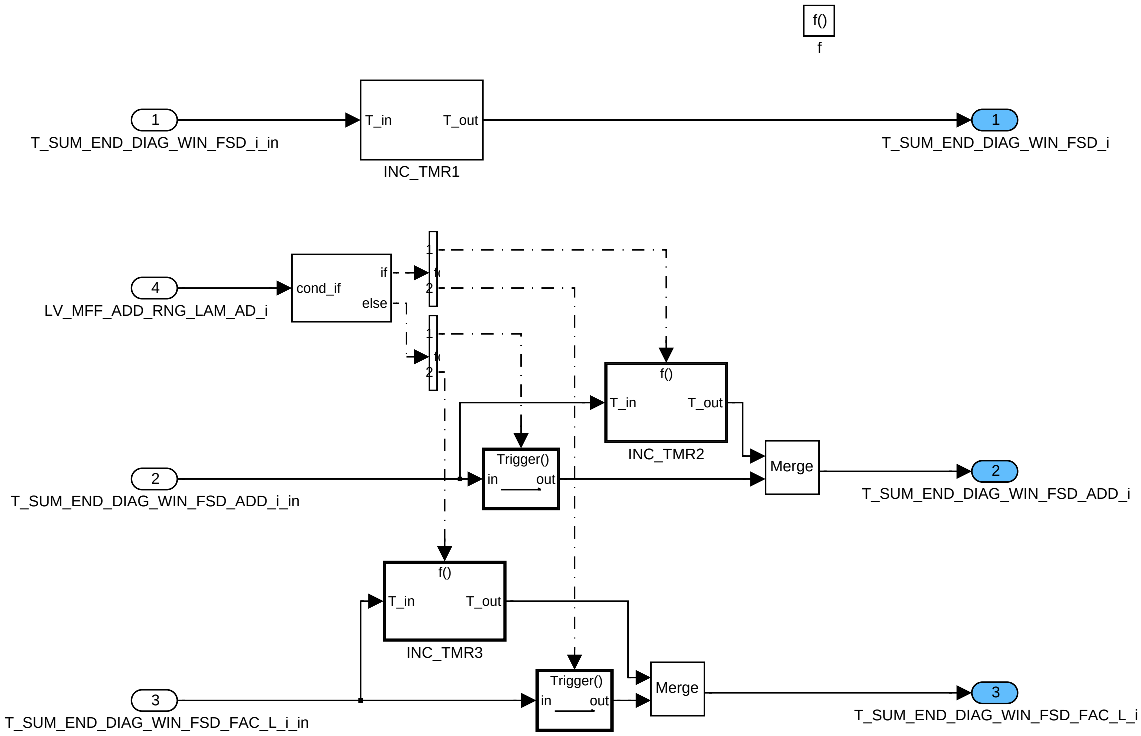

Figure B.105.69: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/MNG_END_DIAG/MNG_END_DIAG_FSD/CLC_TMR_END_DIAG_WIN_FSD/INC_TMR_FSD

Increment timer

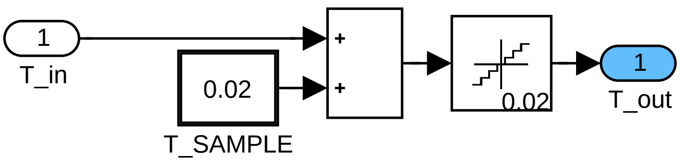

Figure B.105.70: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/MNG_END_DIAG/MNG_END_DIAG_FSD/CLC_TMR_END_DIAG_WIN_FSD/INC_TMR_FSD/INC_TMR1

Increment timer

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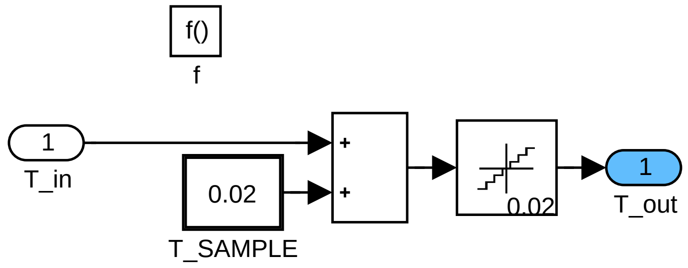

Figure B.105.71:
LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/MNG_END_DIAG/
MNG_END_DIAG_FSD/CLC_TMR_END_DIAG_WIN_FSD/INC_TMR_FSD/INC_TMR2

Increment timer

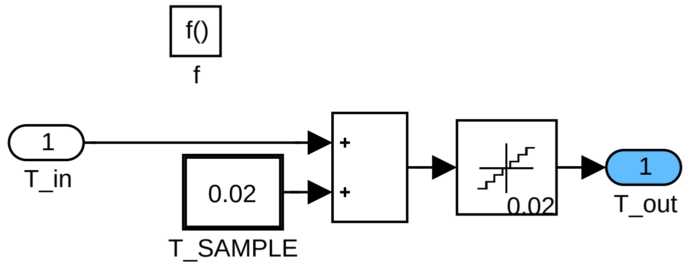

Figure B.105.72:
LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/MNG_END_DIAG/
MNG_END_DIAG_FSD/CLC_TMR_END_DIAG_WIN_FSD/INC_TMR_FSD/INC_TMR3

Set end of diagnosis for lambda adaptation monitoring

The condition to set the temporary end flag LV_END_DIAG_TMP_FSD are: Diagnostic condition must be fulfilled and either an error was detected (temporary end flag LV_ERR_TMP_FSD is 1) or the timer T_SUM_END_DIAG_WIN_FSD[i] has reached the calibration threshold.
If LV_END_DIAG_TMP_FSD is set once, the corresponding error flag of the error management remain set for the rest of the driving cycle.
In order to set the end flag for similar conditions LV_END_DIAG_WIN_FSD[i] the diagnostic conditions must be fulfilled too and either the temporary error flag was set or the timer T_SUM_END_DIAG_WIN_FSD[i] has reached the calibration threshold and both timers T_SUM_END_DIAG_WIN_FSD_ADD[i] and T_SUM_END_DIAG_WIN_FAC_L[i] were above the threshold defined by C_T_SUM_RST_FSD and C_CRLC_T_SUM_WIN_FSD_RST.

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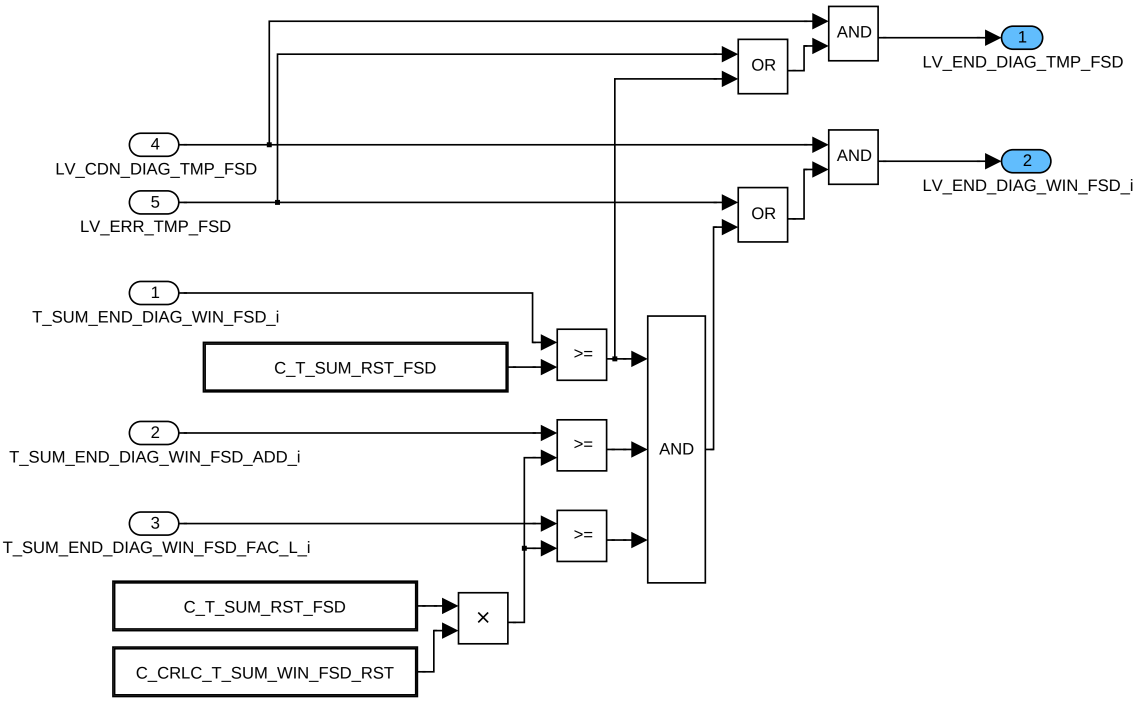

Figure B.105.73: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/MNG_END_DIAG/MNG_END_DIAG_FSD/SET_END_DIAG

Manage end flags for lambda controller monitoring

First the end flag timers are calculated and then the conditions to set the end flags are evaluated.

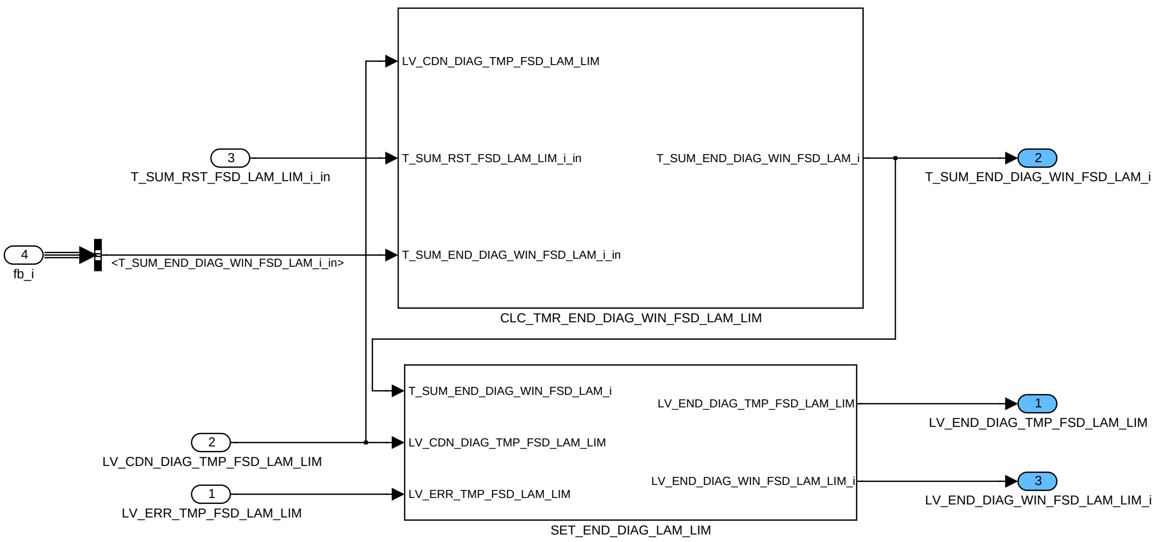

Figure B.105.74: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/MNG_END_DIAG/MNG_END_DIAG_FSD_LAM_LIM

Calculate end of diagnosis timers for lambda controller monitoring

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If the conditions are not fulfilled the timer T_SUM_END_DIAG_WIN_FSD_LAM_LIM[i] remains unchanged.
The end timer is reset (to one sample step) either if the calibration threshold is reached or when the reset timer was started to be incremented.
In all other cases the timer is incremented.

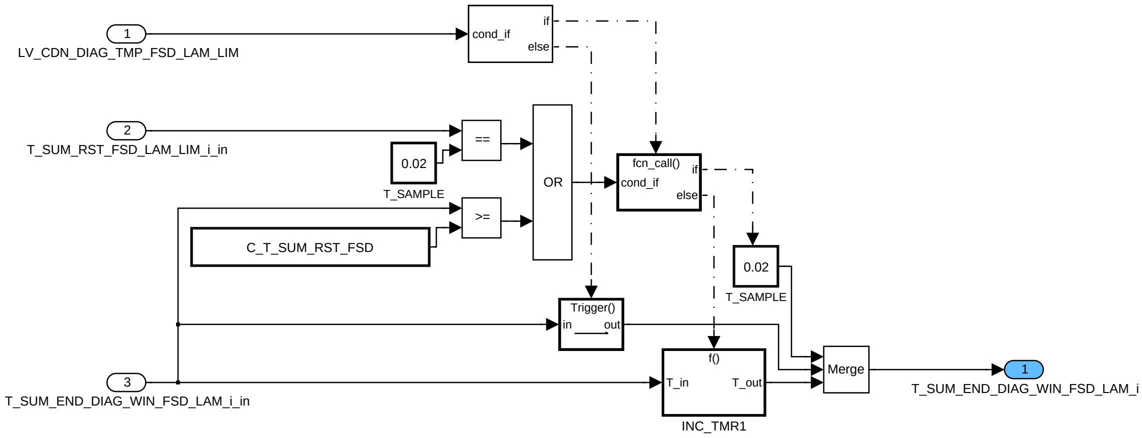

Figure B.105.75: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/MNG_END_DIAG/MNG_END_DIAG_FSD_LAM_LIM/CLC_TMR_END_DIAG_WIN_FSD_LAM_LIM

Increment timer

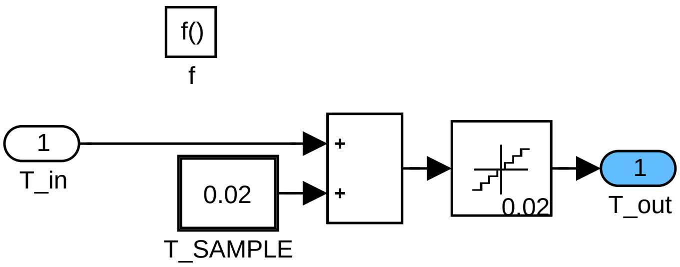

Figure B.105.76:
LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/MNG_END_DIAG/MNG_END_DIAG_FSD_LAM_LIM/CLC_TMR_END_DIAG_WIN_FSD_LAM_LIM/INC_TMR1

Set end of diagnosis for lambda controller monitoring

The temporary end flag LV_END_DIAG_TMP_FSD_LAM_LIM and the end flag for similar conditions LV_END_DIAG_WIN_FSD_LAM_LIM[i] are set when the same conditions are fulfilled. If LV_END_DIAG_TMP_FSD_LAM_LIM is set once, the corresponding error flag of the error management remain set for the rest of the driving cycle. LV_END_DIAG_WIN_FSD_LAM_LIM[i] is only set for one recurrence.
The condition to set the end flags are: Diagnostic condition must be fulfilled and either an error was detected (temporary end flag LV_ERR_TMP_FSD_LAM_LIM is 1) or the timer T_SUM_END_DIAG_WIN_FSD_LAM_LIM[i] has reached the calibration threshold.

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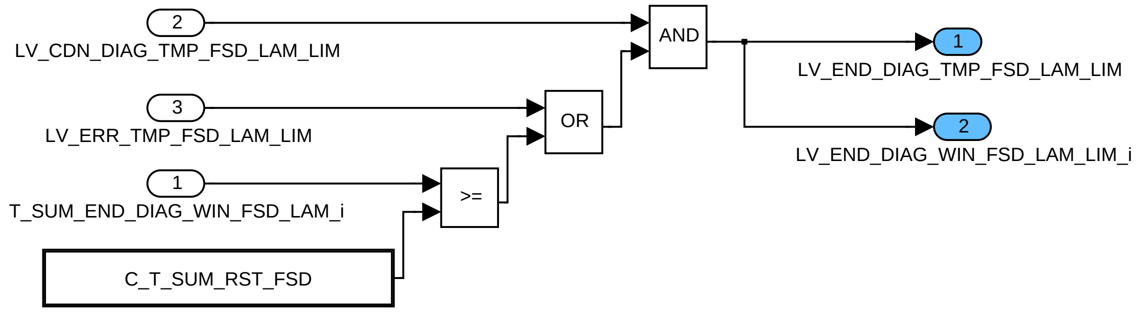

Figure B.105.77: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/MNG_END_DIAG/MNG_END_DIAG_FSD_LAM_LIM/SET_END_DIAG_LAM_LIM

Manage end flags for lambda adaptation high range monitoring

First the end flag timers are calculated and then the conditions to set the end flags are evaluated.

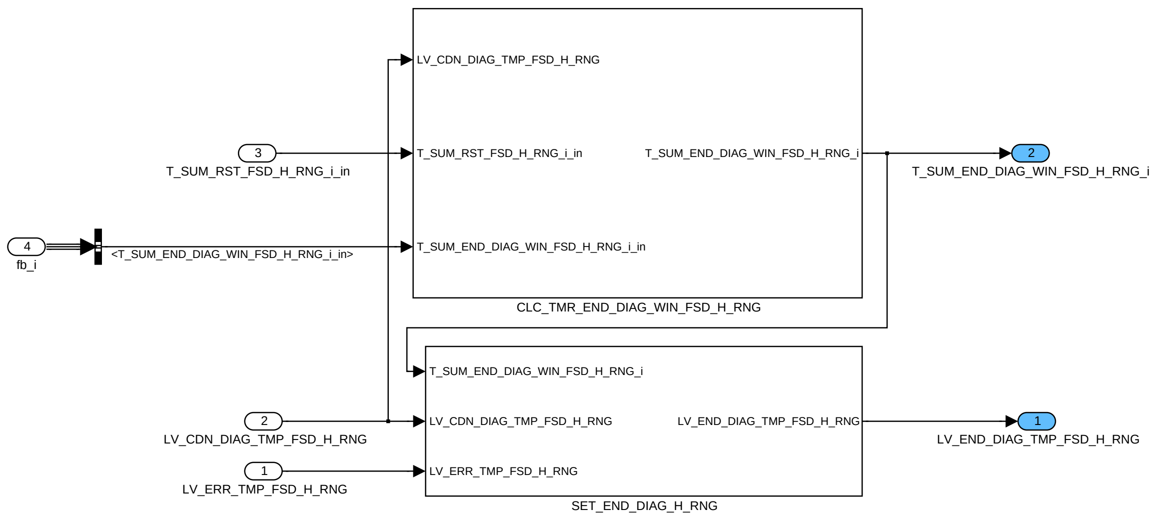

Figure B.105.78: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/MNG_END_DIAG/MNG_END_DIAG_FSD_H_RNG

Calculate end of diagnosis timers for lambda adaptation high range monitoring

If the conditions are not fulfilled the timer T_SUM_END_DIAG_WIN_FSD_H_RNG[i] remains unchanged. The end timer is reset (to one sample step) either if the calibration threshold is reached or when the reset timer was started to be incremented.
In all other cases the timer is incremented.

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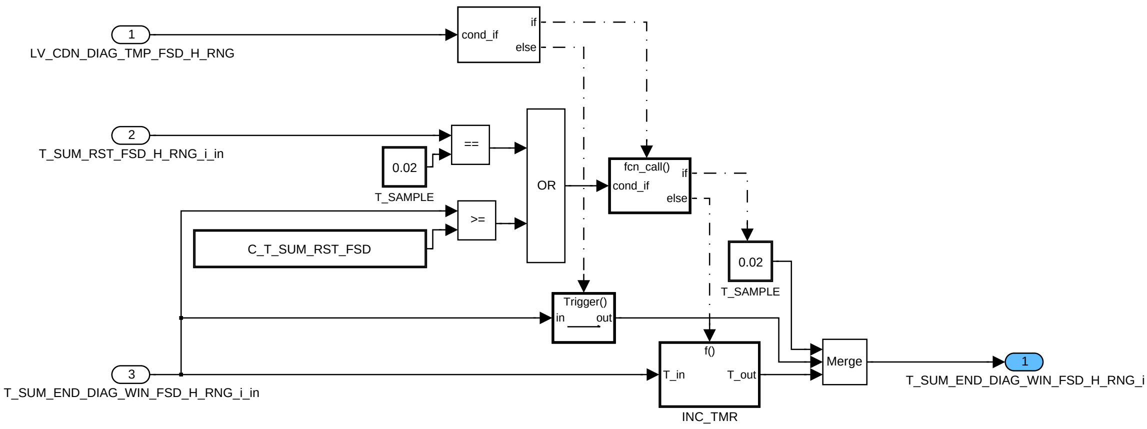

Figure B.105.79: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/ MNG_END_DIAG/MNG_END_DIAG_FSD_H_RNG/CLC_TMR_END_DIAG_WIN_FSD_H_RNG

Increment timer

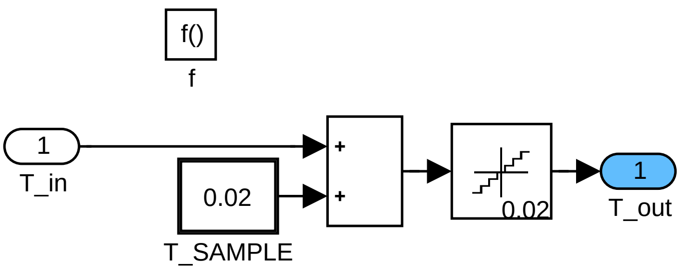

Figure B.105.80:
LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/MNG_END_DIAG/ MNG_END_DIAG_FSD_H_RNG/CLC_TMR_END_DIAG_WIN_FSD_H_RNG/INC_TMR

Set end of diagnosis for lambda adaptation high range monitoring

The condition to set the temporary end flag LV_END_DIAG_TMP_FSD_H_RNG are: Diagnostic condition must be fulfilled and either an error was detected (temporary end flag LV_ERR_TMP_FSD_H_RNG is 1) or the timer T_SUM_END_DIAG_WIN_FSD_H_RNG[i] has reached the calibration threshold.
If LV_END_DIAG_TMP_FSD_LAM_LIM is set once, the corresponding error flag of the error management remain set for the rest of the driving cycle.

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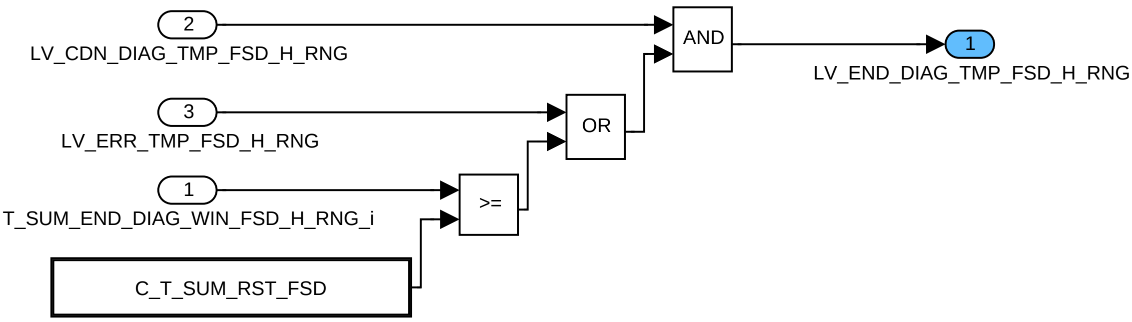

Figure B.105.81: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/DIAG/MNG_END_DIAG/MNG_END_DIAG_FSD_H_RNG/SET_END_DIAG_H_RNG

Interface to error management

For each failure location a separate ACTION is called. By means of the temporary condition and error flags and the temporary error symptom all relevant information is transmitted to the error management. The output of each ACTION is the error information for each failure location.

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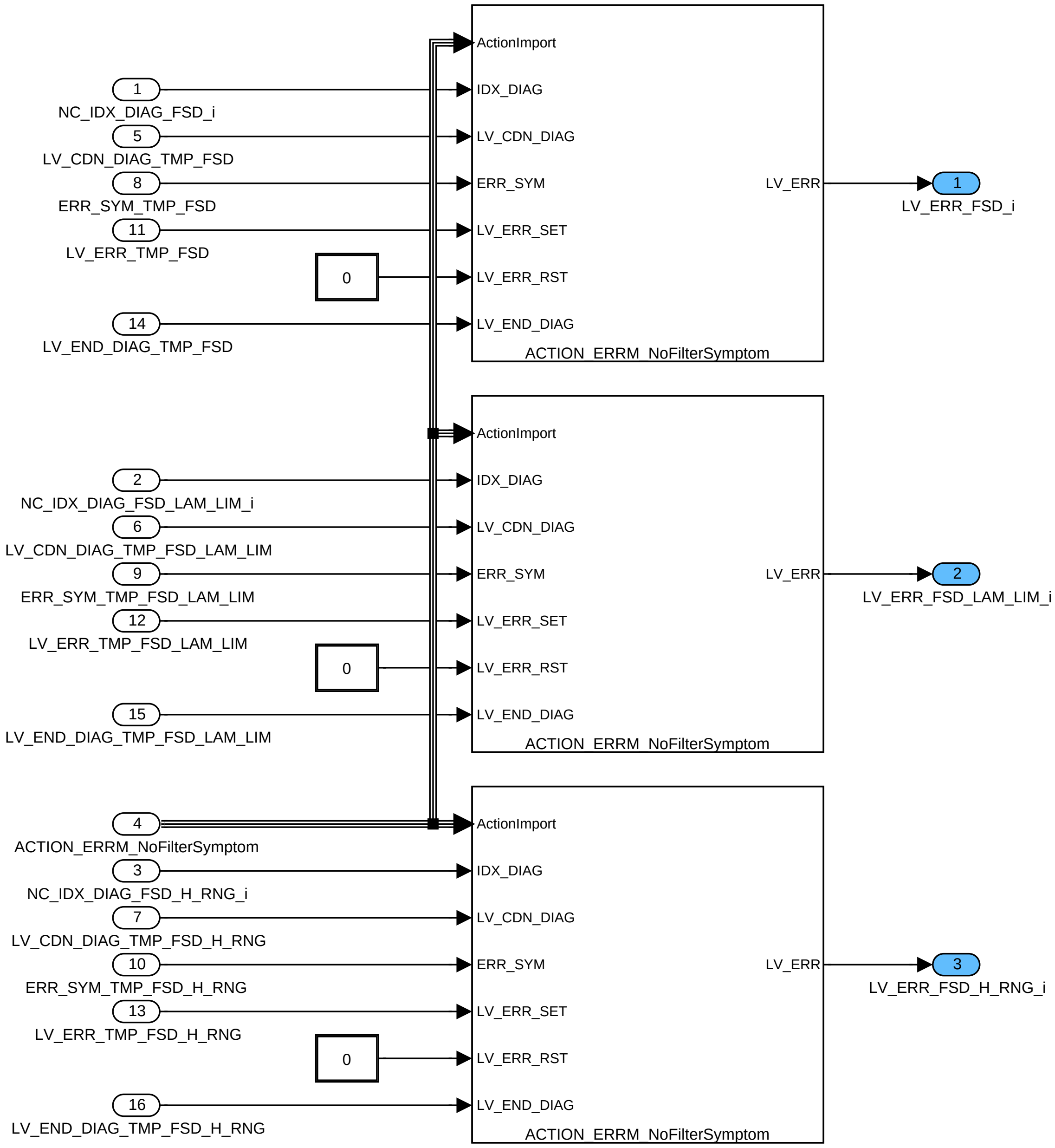

Figure B.105.82: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/CBK_EX_SPC/ERRM_IF

Read bank specific output values of last recurrence

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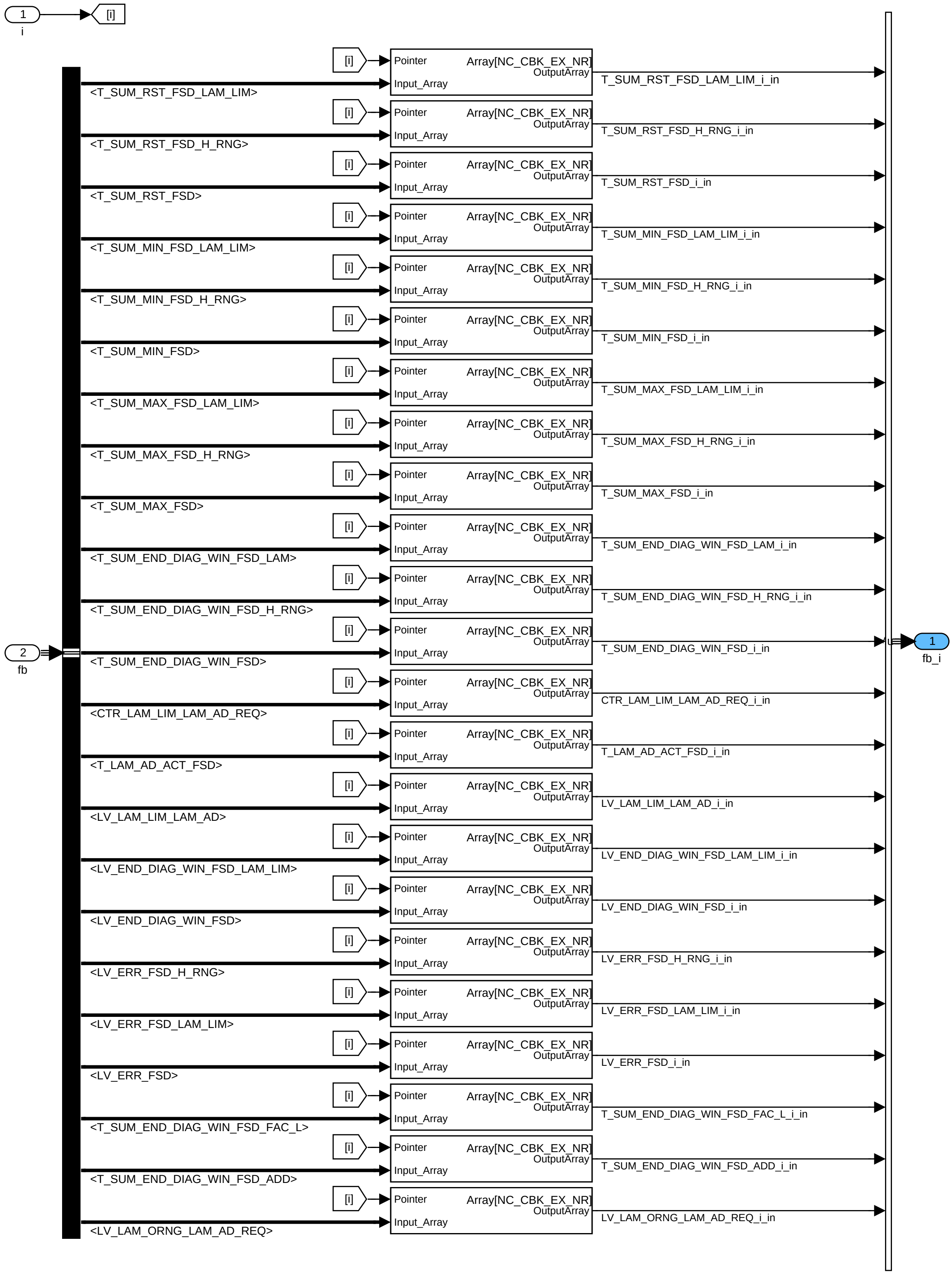

Figure B.105.83: LACO_FCTDGFSD0/operate_20MS/CBK_EX_MNG/SIG_CBK_MNG

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B.105.3 Visualization of ERRM data

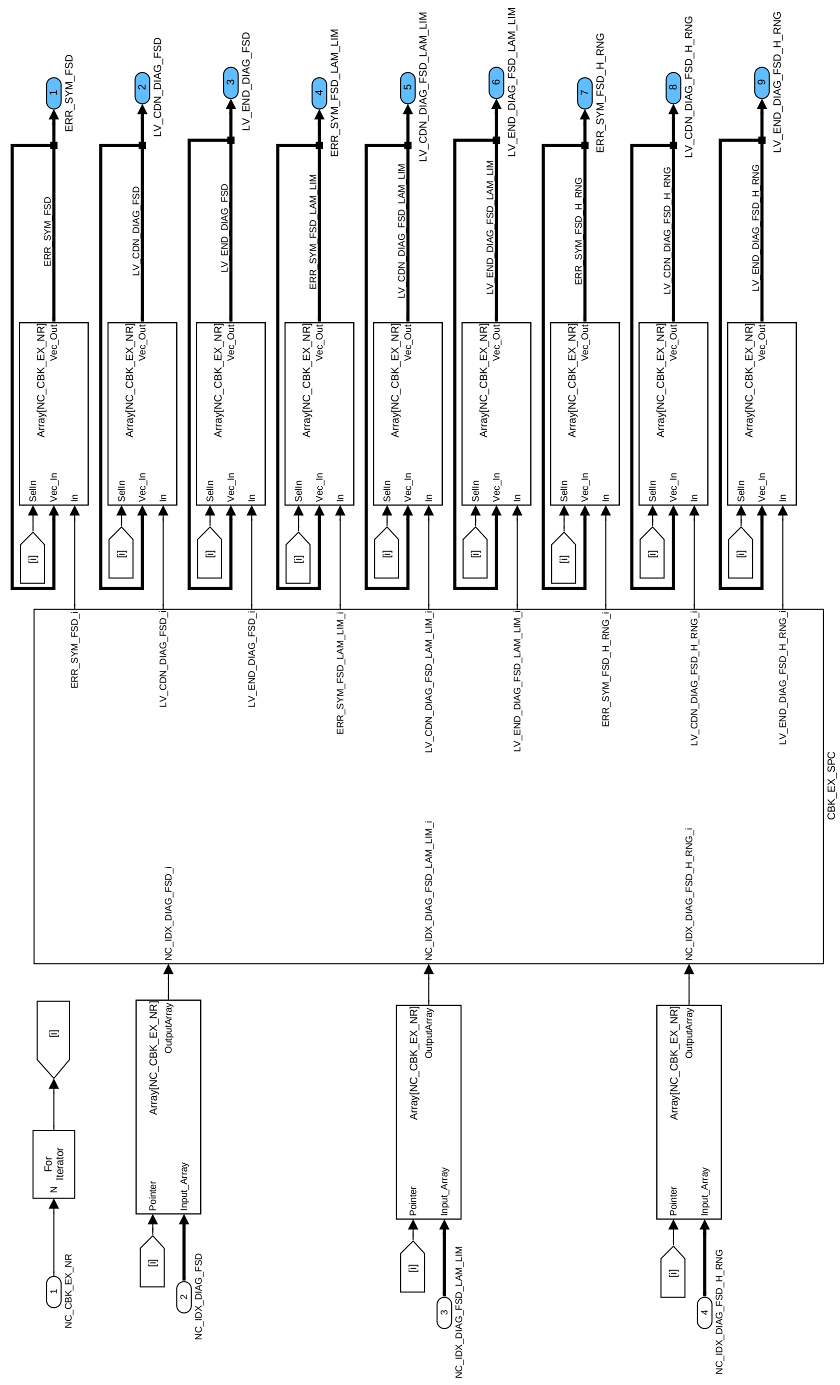

Figure B.105.84: LACO_FCTDGFSD0/visualizationERRMdata

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Pointer on ERRM data

The error management variables, that are only visible (no output), are visualized by means of a pointer on the respective entry in the ERRM array structure.

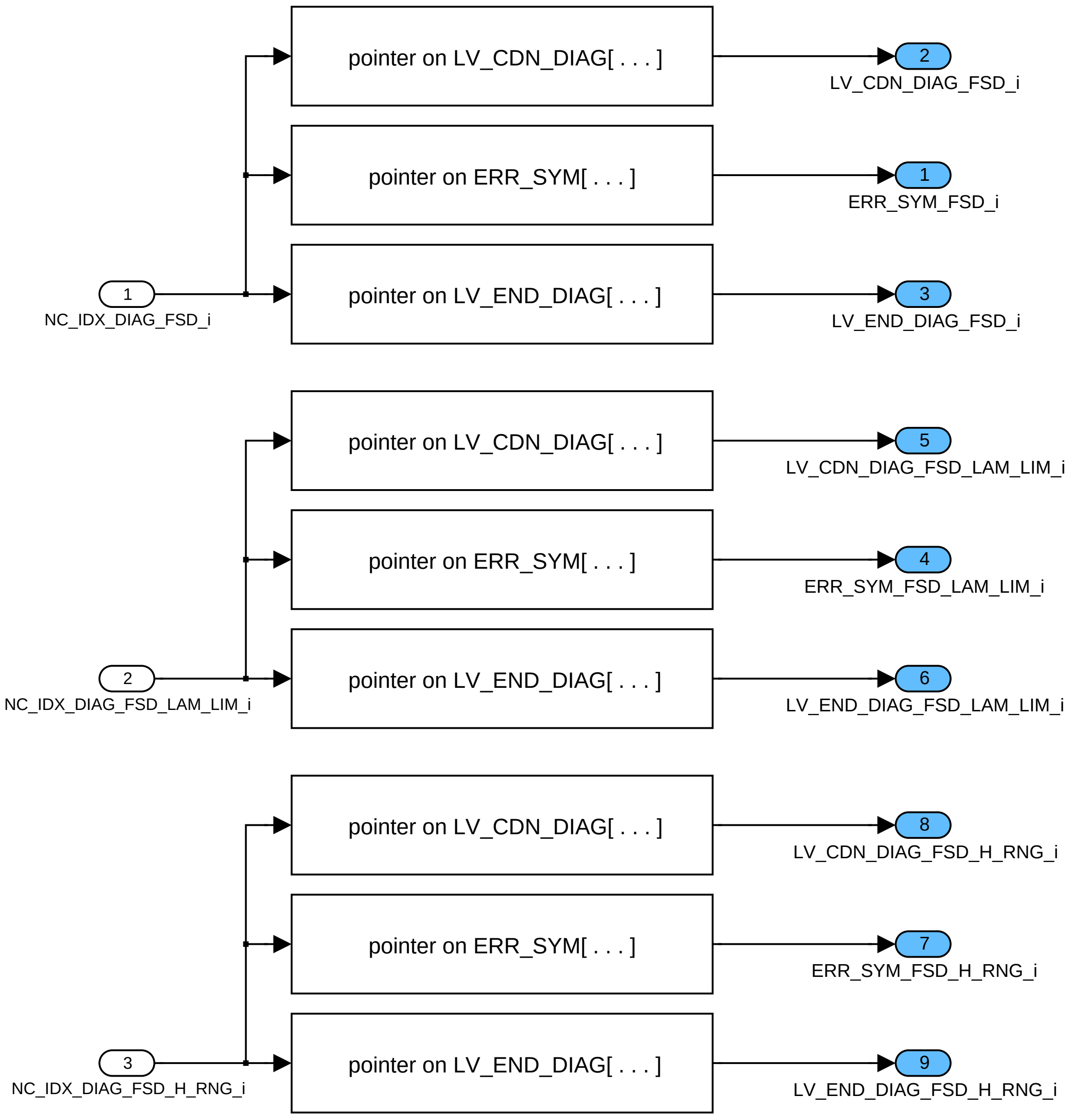

Figure B.105.85: LACO_FCTDGFSD0/visualizationERRMdata/CBK_EX_SPC

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B.106 Fuel system monitoring (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_FAC_L_RNG_LIM_MAX_FSD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating maximum limitation of lambda adaptation used by fuel system diagnosis					
LV_FAC_L_RNG_LIM_MIN_FSD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating minimum limitation of lambda adaptation used by fuel system diagnosis					
LV_INH_DIAG_FSD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition flag for fuel system diagnosis					
LV_INH_DIAG_FSD_CP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Inhibition flag for fuel system diagnosis due to internal states of canister purge function					
LV_MFF_ADD_LIM_MAX_FSD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating top limitation of lambda adaptation for FSD module					
LV_MFF_ADD_LIM_MIN_FSD [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
flag indicating bottom limitation of lambda adaptation for FSD module					
T_FSD_SET_END_DIAG [NC_CBK_EX_NR]	V	0... FFFFH	0... 1310.7	0.02	s
Timer to force end of diagnostic for FSD					

Input data:

CL_MMV {p. 3698}	ERR_INH_FSD [NC_CBK_EX_NR] {p. 1014}	LV_ACT_SA_EOL {p. 7763}	LV_CP_CLOSE_ACT {p. 3749}
LV_FAC_L_RNG_LIM_ MAX_EXT_LAM_AD [NC_CBK_EX_NR] {p. 1016}	LV_FAC_L_RNG_LIM_ MAX_LAM_AD [NC_CBK_EX_NR] {p. 2642}	LV_FAC_L_RNG_LIM_ MIN_EXT_LAM_AD [NC_CBK_EX_NR] {p. 1016}	LV_FAC_L_RNG_LIM_ MIN_LAM_AD [NC_CBK_EX_NR] {p. 2642}
LV_FAC_LAM_LIM_MAX [NC_CBK_EX_NR] {p. 2463}	LV_FAC_LAM_LIM_MIN [NC_CBK_EX_NR] {p. 2463}	LV_FSD_ACT [NC_CBK_EX_NR] {p. 6133}	LV_LAM_AD_EXT {p. 1016}
LV_MFF_ADD_LIM_MAX_ LAM_AD [NC_CBK_EX_NR] {p. 2642}	LV_MFF_ADD_LIM_MIN_ LAM_AD [NC_CBK_EX_NR] {p. 2642}	NC_CBK_EX_NR {p. 1829}	STATE_CP {p. 3637}
STATE_LAM_AD [NC_CBK_EX_NR] {p. 2643}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CL_MMV_MAX_FSD	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Maximum value for CL_MMV to permit FSD					
C_T_MAX_FSD_SET_END_DIAG	-	0... FFFFH	0... 1310.7	0.02	s
Timer threshold to force end of diagnostic for FSD					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_FSD_SET_END_DIAG_ENA	-	0... 1H	0 ...1	1	-
Calibration flag to enable forced setting of end of diagnostic for FSD					
LC_INH_FSD_MAN_DEAC	-	0... 1H	0 ...1	1	-
Manual deactivation of fuel system diagnosis inhibition					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_FSD [NC_CBK_EX_NR]	-	0... FFFFH	0... 65535	1	-
ERRM diagnosis identifier of fuel system diagnosis					

Import actions:

ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_NoFilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_LV_ERR_SET>,**IN**<PRM_LV_ERR_RST>,**IN**<PRM_LV_END_DIAG>,**OUT**<PRM_LV_ERR>)

General information:

This function manages the inhibition of the fuel system diagnosis (FSD) due to system errors and canister purge states.

NC_CBK_EX_NR defines the number of exhaust banks.
For vector elements the variable extension _i is used in the model instead of [i] as found in the textual description.
Configuration for diagnostic symptoms:

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Diagnostic **FSD[i]**	**Symptom description**	**Symptom**	**Filter type**
Fuel System Diagnosis for lambda adaptation monitoring - relevant to malfunction indication light	*maximum limit of additive adaptation value reached*	*SYM_0*	*NO*
	minimum limit of additive adaptation value reached	*SYM_1*	
	maximum limit of multiplicative adaptation value (lower area) reached	*SYM_2*	
	minimum limit of multiplicative adaptation value (lower area) reached	*SYM_3*	
Diagnostic **FSD_LAM_LIM[i]**	**Symptom description**	**Symptom**	**Filter type**
Fuel System Diagnosis in area where lambda controller output is concerned - relevant to malfunction indication light	*lambda control in dead stop (upper limit)*	*SYM_0*	*NO*
	lambda control in dead stop (lower limit)	*SYM_1*	
Diagnostic **FSD_H_RNG[i]**	**Symptom description**	**Symptom**	**Filter type**
Fuel System Diagnosis in upper multiplicative adaptation learning area	*maximum limit of multiplicative adaptation value (upper area) reached*	*SYM_0*	*NO*
	minimum limit of multiplicative adaptation value (upper area) reached	*SYM_1*	

Application conditions:

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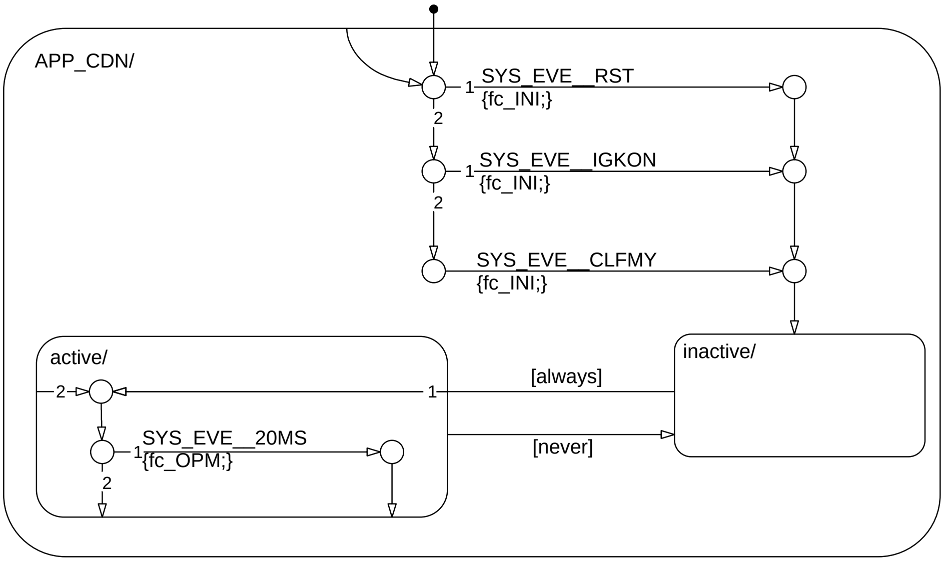

Figure B.106.1: :

Function description:

Formula section:

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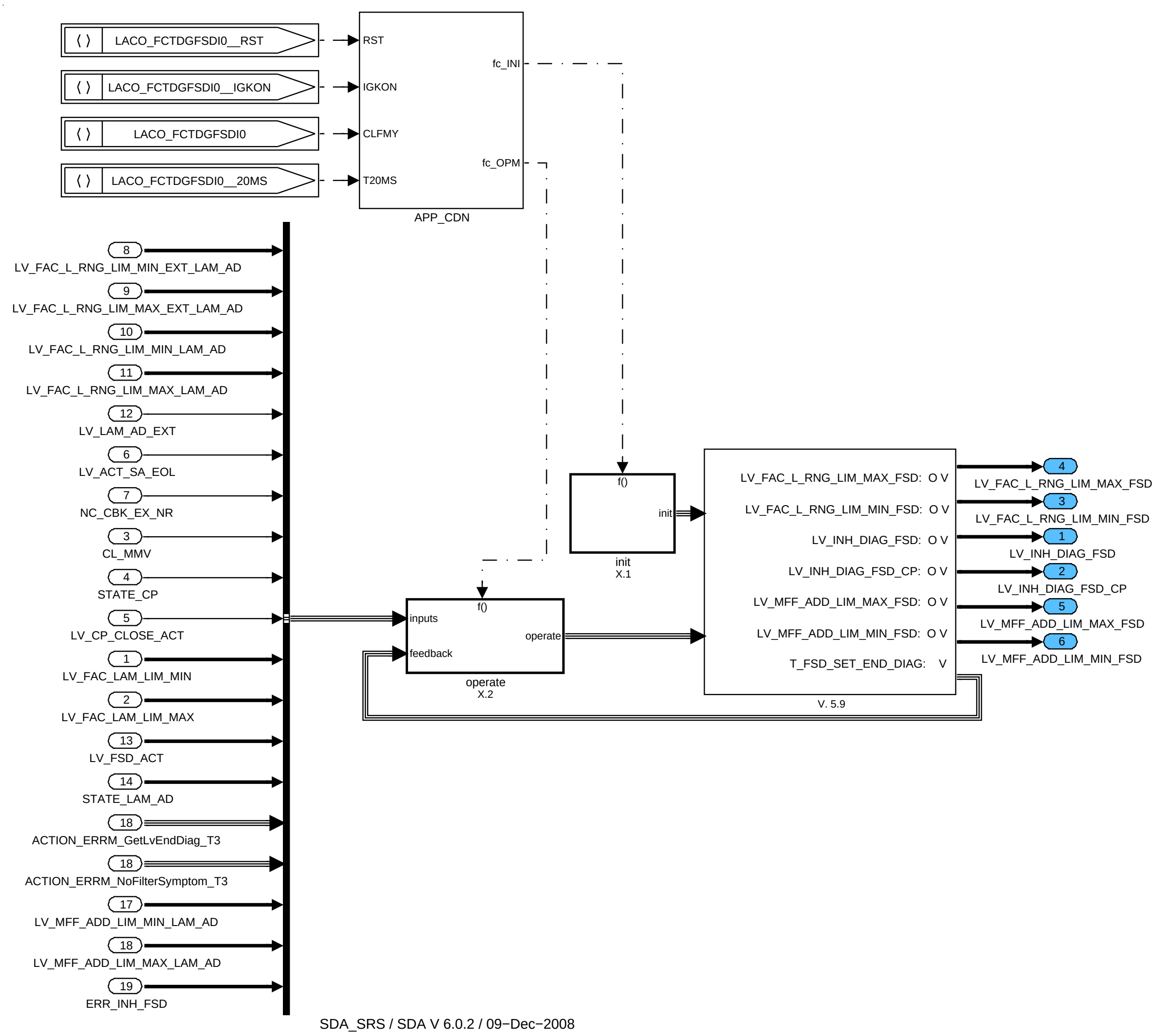

Figure B.106.2: :

B.106.1 Initialization

The inhibition flags LV_INH_DIAG_FSD[i] and LV_INH_DIAG_FSD_CP[i] are both set to 1. All other variables are initialzed with 0.

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B.106.1.1 Calculation of initialization

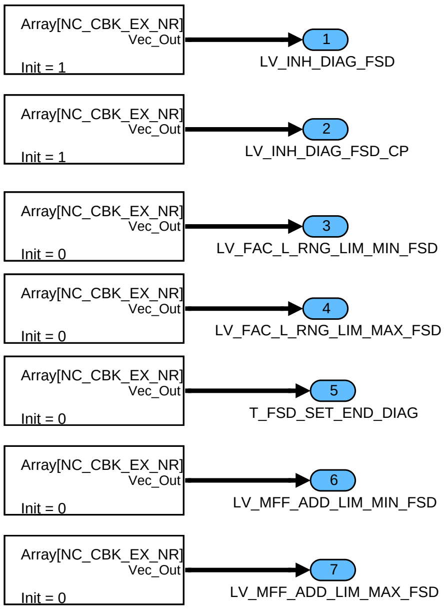

Figure B.106.3: :

B.106.2 Formula section

B.106.2.1 Inhibition of fuel system diagnosis

LV_INH_DIAG_FSD[i] represents the influence of errors deactivating the fuel system diagnosis.
All exhaust bank independent errors are summarized in the temporary and not visible variable LV_INH_DIAG_FSD_NOT_CBK_SPC.
The temporary and not visible inhibition flagaffects the relevant exhaust bank for FSD.
If LC_INH_FSD_MAN_DEAC is set to 1 fuel system diagnosis is not inhibited by a present error.

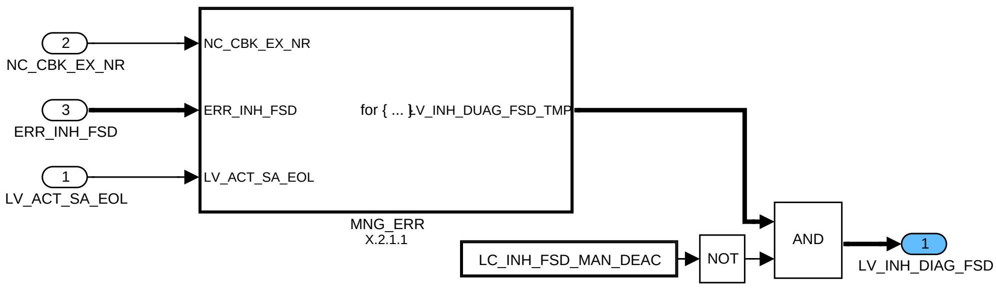

Figure B.106.4: :

B.106.2.1.1 Exhaust bank specific inhibition

The temporary and not visible inhibition flags.

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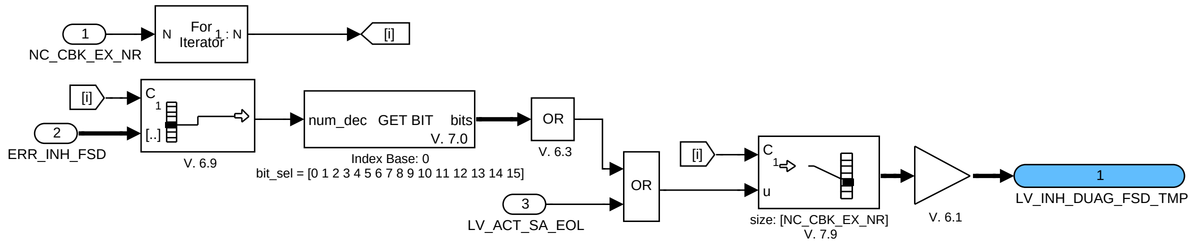

Figure B.106.5: :

B.106.2.2 Inhibition of fuel system diagnosis due to canister purge

B.106.2.2.1 Exhaust bank specific functionality

LV_INH_DIAG_FSD_CP[i] respects the influence of canister purge on FSD. The inhibition flag is not set when the canister purge valve is closed, in MAX PURGE at low charcoal canister load and in MIN_ PURGE when the lambda controller is at one of its limits.

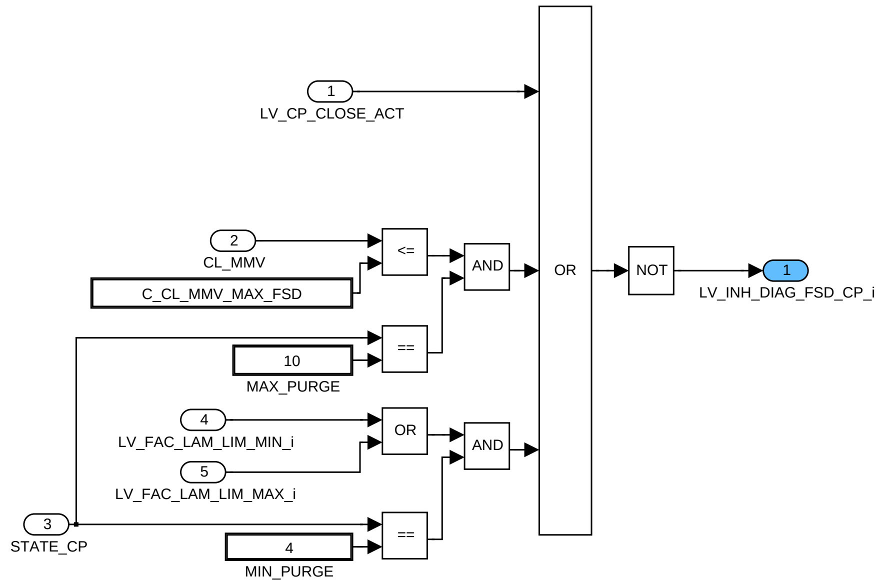

Figure B.106.6: :

B.106.2.3 Determination of limitation flags for lambda adaption (in- /outside LACO)

Determination if indicator flag for minimum and maximum limitation of lambda adaptation used by fuel system diagnosis is calculated inside of outside of LACO, according to LV_LAM_AD_EXT.

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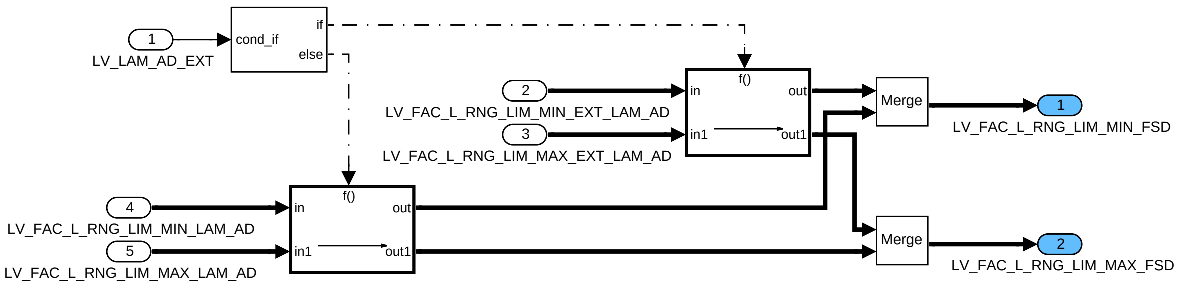

Figure B.106.7: :

B.106.2.4 Force FSD end diag flag to 1

B.106.2.4.1 Exhaust bank specific functionality

B.106.2.4.1.1 Increment timer

The timer T_SET_END_DIAG_FSD[i] that forces FSD end of diagnostic flag to 1 is incremented if general FSD activation conditions are fulfilled and engine is running in one of the lambda adaptation fields independent whether adaptation is active or not.

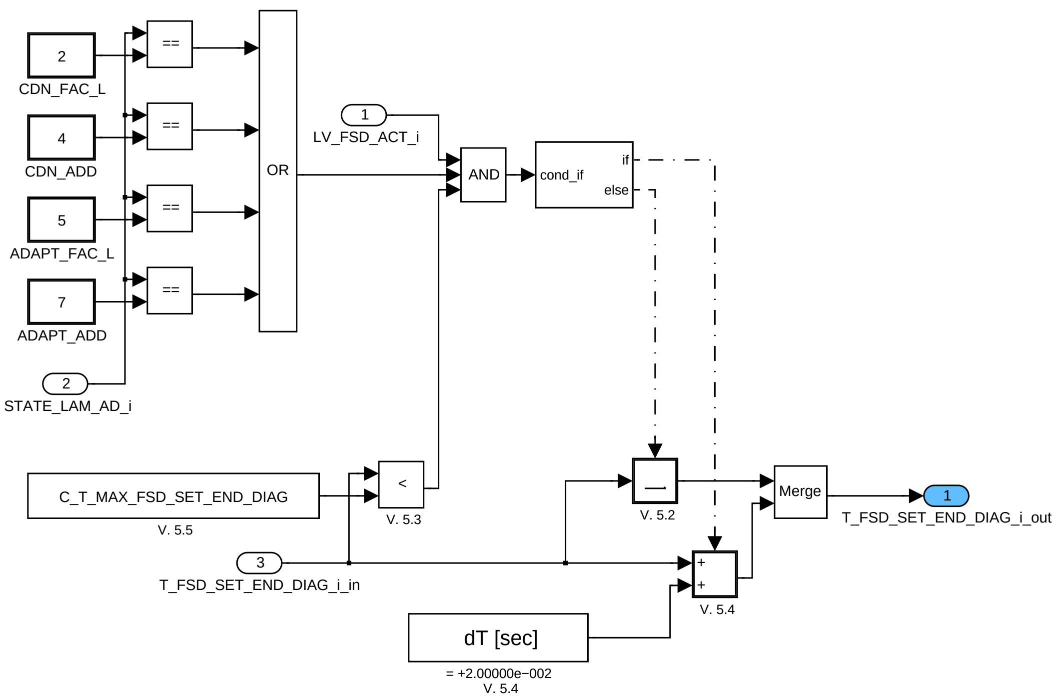

Figure B.106.8: :

B.106.2.4.1.2 Timer elapsed

As soon as the timer T_SET_END_DIAG_FSD[i] reaches a calibration threshold the error management is called to set the end of diagnosis information (if not yet set).
This feature can be disabled by the calibration flag LC_FSD_SET_END_DIAG_ENA.

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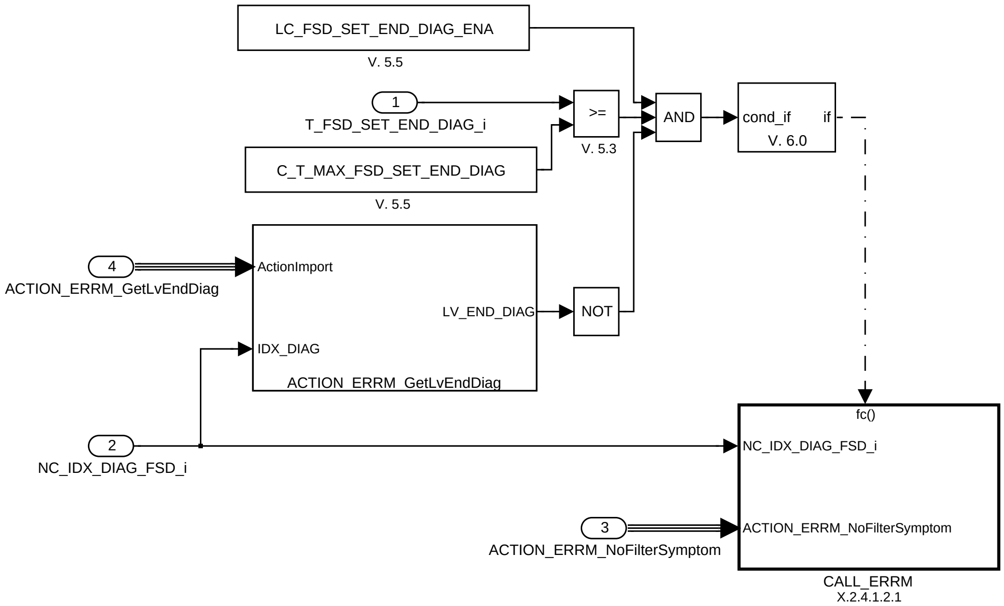

Figure B.106.9: :

B.106.2.4.1.2.1 Call Error Management

Error management is called with action NoFilterSymptom in order to set end of FSD diagnostic information.

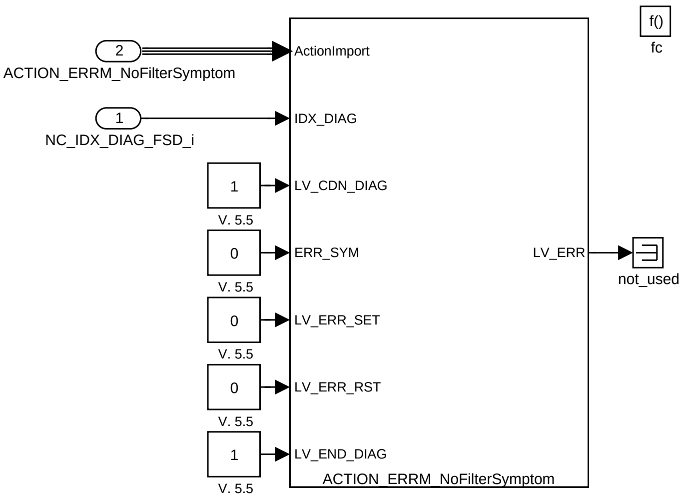

Figure B.106.10: :

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B.106.2.5 Calculation of LV_MFF_ADD_LIM_MIN_FSD and LV_MFF_ADD_LIM_MAX_FSD

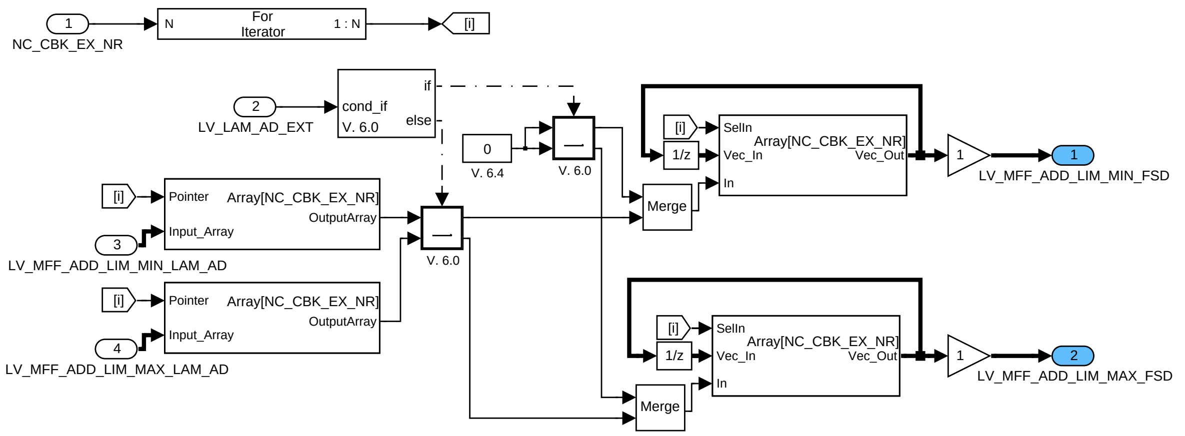

Figure B.106.11: :

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B.107 Crankshaft oscillation detection

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_TDC_CRK_OSC_ACT	V	0... FFH	0... 255	1	-
TDC counter to enable crankshaft oscillation detection after misfiring detection					
DRV0_ER_SUM_OSC	V	0... FFFFH	0... 65535	1	µs
Integrated DRV0_ER value for amplitude criterion reseted every sign change or DRV0					
DRV0_ER_SUM_THD_OSC	V	0... FFFFH	0... 65535	1	µs
Threshold for DRV0_ER_SUM_OSC to fulfill amplitude criteria					
LV_AMPL_CRIT_CRK_OSC	V	0... FFH	0... 255	1	-
Critical crankshaft oscillaction amplitude detected					
LV_CRK_OSC_DET_ACT	V	0... 1H	0 ...1	1	-
Crankshaft oscillation detection active					
LV_FRQ_CRIT_CRK_OSC	V	0... FFH	0... 255	1	-
Critical crankshaft oscillaction frequency detected					
LV_STATE_CRK_OSC	O/V	0... 1H	0 ...1	1	-
Status of crankshaft oscillation condition					
RATIO_VS_N_CRK_OSC	V	0... FFH	0... 0.05	196e-6	(km/h)/ rpm
Ratio VS /N for gear area determination					
SEG_SUM_FRQ_CRK_OSC	V	0... FFH	0... 255	1	-
Segment counter for frequency criterion reseted every sign change or DRV0					

Input data:

DRV0_ER {p. 1454}	LC_MIS_INH {p. 6277}	LOAD_MIS {p. 6213}	LV_DET_CFM_MIS {p. 6237}
LV_ENA_ER {p. 1454}	LV_INH_CRK_OSC_DET {p. 6283}	N {p. 1525}	N_32 {p. 1525}
VS {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DLY_TDC_CRK_OSC	-	0... FFH	0... 255	1	-
Active TDC s of crankshaft oscillation status after detection triggering					
C_N_MAX_CRK_OSC	-	0... FFH	0... 8160	32	rpm
Maximum speed for crankshaft oscillation calculation					
C_NR_TDC_MAX_CRK_OSC	-	0... FFH	0... 255	1	-
Maximum TDC after detected misfire to activate crankshaft oscillation detection process					
C_RATIO_VS_N_MIN_CRK_OSC	-	0... FFH	0... 0.05	196e-6	(km/h)/ rpm
Minimum VS /N ratio to activate crankshaft oscillation detection					
IP_DRV0_ER_THD_OSC	V	0... FFFFH	0... 65535	1	µs
LDP_N_32_IP_DRV0_ER_THD_OSC	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_MIS_IP_DRV0_ER_THD_OSC	6	0... 7FFFH	0... 99.99694	3.05e-3	%
DRV0 amplitude threshold to detect critical crankshaft oscillation amplitude					
IP_SEG_MIN_FRQ_CRK_OSC	-	0... FFH	0... 255	1	-
LDP_N_32_IP_SEG_MIN_FRQ_CRK_OSC	4	0... FFH	0... 8160	32	rpm
Minimum number of segment after turn of speed direction for detecting critical high frequency					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_USE_CRK_OSC_MIS	-	0... 1H	0 ...1	1	-
Crankshaft oscillation detection module used (=1) or stub version (=0)					

General information

The misfire detection based on engine roughness index (ER) may be disturbed by crankshaft oscillations when single misfire (random) occurs, especially for front drive vehicles crankshaft in the low engine speed /high engine load area (in combination with a 3rd, 4th or 5th gear ratio). A single misfire acts as a drivetrain /crankshaft oscillations trigger, in this case the ER index is distrubed by these oscillations, in some conditions it is practically not possible to distinguish on ER index, real misfire towards speed drop caused through crankshaft speed oscillations.
The trigger for such oscillations can be a single misfire, an obstacle, a big torque change or others instantaneous conditions.
The principle of this crankshaft /drivetrain oscillation detection is to detect such an oscillation and then to fade-out the misfire detection for a short period to avoid over-detection.
Initialisation: *on ECU reset, on LC_MIS_INH 0 to 1 transition*
SEG_SUM_FRQ_CRK_OSC = 0
DRV0_ER_SUM_OSC = 0
LV_STATE_CRK_OSC = 0

Application conditions:

Activation/Deactivation:
RATIO_VS_N_CRK_OSC = VS/N
If LV_DET_CFM_MIS = 1
Then CTR_TDC_CRK_OSC_ACT = C_NR_TDC_MAX_CRK_OSC
ElseIf CTR_TDC_CRK_OSC_ACT 0
Then CTR_TDC_CRK_OSC_ACT = CTR_TDC_CRK_OSC_ACT - 1
EndIf
If LV_ENA_ER = 1
And LC_MIS_INH = 0
And LV_INH_CRK_OSC_DET = 0
And N_32 < C_N_MAX_CRK_OSC
And RATIO_VS_N_CRK_OSC > C_RATIO_VS_N_MIN_CRK_OSC
And CTR_TDC_CRK_OSC_ACT 0
Then LV_CRK_OSC_DET_ACT = 1 *// Crankshaft oscillation detection active*
Else LV_CRK_OSC_DET_ACT = 0 *// Crankshaft oscillation detection inactive*
SEG_SUM_FRQ_CRK_OSC = 0
DRV0_ER_SUM_OSC = 0
EndIf
Update rate: Segment

B.107.1 Detection description

The final decision about crankshaft oscillation consists of two parts:

- The detection of a critical engine roughness oscillation frequency.
- The detection of a critical engine roughness oscillation amplitude.

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If both parts fulfilled at the same time their own detection criterion, a crankshaft oscillation is detected. The reason therefore is, that even at constant speed due to normal little speed variations a high frequency or at a normal acceleration phase a big amplitude is possible.

B.107.1.1 Determination of a critical engine roughness frequency

Application conditions

Activation: *LV_CRK_OSC_DET_ACT = 1*

Deactivation: *LV_CRK_OSC_DET_ACT = 0*

Formula section:

If Bit sign between DRV0_ER$_{(n-1)}$and DRV0_ER$_{(n)}$changes
Then SEG_SUM_FRQ_CRK_OSC = IP_SEG_MIN_FRQ_CRK_OSC(N_32)
ElseIf SEG_SUM_FRQ_CRK_OSC 0
Then SEG_SUM_FRQ_CRK_OSC = SEG_SUM_FRQ_CRK_OSC - 1
EndIf
If SEG_SUM_FRQ_CRK_OSC 0
Then LV_FRQ_CRIT_CRK_OSC = 1 *// Critical crankshaft frequency status is active*
Else LV_FRQ_CRIT_CRK_OSC = 0
EndIf

B.107.1.2 Determination of a critical engine roughness oscillation amplitude

Application conditions

Activation: *LV_CRK_OSC_DET_ACT = 1*

Deactivation: *LV_CRK_OSC_DET_ACT = 0*

Formula section:

If Bit sign between DRV0_ER$_{(n-1)}$and DRV0_ER$_{(n)}$changes
Then DRV0_ER_SUM_OSC$_{(n)}$ = DRV0_ER$_{(n)}$
Else DRV0_ER_SUM_OSC$_{(n)}$ = DRV0_ER_SUM_OSC$_{(n-1)}$ + DRV0_ER$_{(n)}$
// with saturation
EndIf
DRV0_ER_SUM_THD_OSC = IP_DRV0_ER_THD_OSC(N_32, LOAD_MIS)
If DRV0_ER_SUM_OSC DRV0_ER_SUM_THD_OSC
Then LV_AMPL_CRIT_CRK_OSC = 1 *// Critical crankshaft amplitude status is active*
Else LV_AMPL_CRIT_CRK_OSC = 0
EndIf

B.107.1.3 Determination of crankshaft oscillation final status

Application conditions

Activation: *LV_CRK_OSC_DET_ACT = 1*

Deactivation: *LV_CRK_OSC_DET_ACT = 0*

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Formula section:

If in the same time, both conditions are active, a crankshaft oscillation status is triggered :

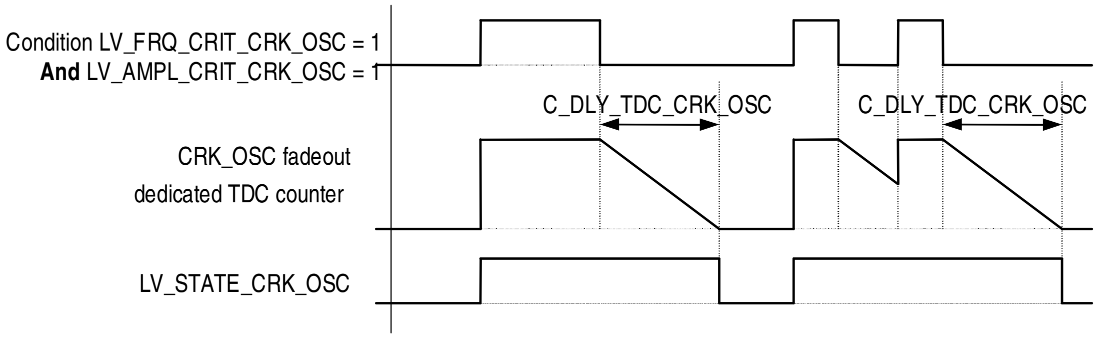
If LV_FRQ_CRIT_CRK_OSC = 1

And LV_AMPL_CRIT_CRK_OSC = 1

Then After condition rising edge triggering, LV_STATE_CRK_OSC flag is set to 1 as long as condition is true.

After condition falling edge triggering, LV_STATE_CRK_OSC flag is hold to 1 for a period of C_DLY_TDC_CRK_OSC tdc's, even if LV_CRK_OSC_DET_ACT is then set to 0.

EndIf



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B.108 Generic misfire parameters and fade-out conditions

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IGA_BAS_DIF_MIS	V	0... FFH	-35.625 ...60	0.375	°CRK
Ignition angle difference between IGA_BAS_COR_MV and IGA_AV, segment sample					
IGA_DIF_MIS	V	0... FFH	0... 95.625	0.375	°CRK
Absolute Ignition angle difference between 2 misfire segment tasks					
IGA_MIS	V	0... FFH	-35.625 ...60	0.375	°CRK
Ignition angle at current misfire segment					
IGA_MIS_1	-	0... FFH	-35.625 ...60	0.375	°CRK
Ignition angle 1 misfire segment before					
IGA_MIS_2	-	0... FFH	-35.625 ...60	0.375	°CRK
Ignition angle 2 misfire segment before					
LOAD_GRD_MIS	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Normalised engine load gradient for misfire detection					
LOAD_MIS	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Normalised engine load for misfire detection - sampled at current misfire segment					
LOAD_MIS_1	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
Normalised engine load for misfire detection - 1 misfire segment before					
LOAD_MIS_2	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
Normalised engine load for misfire detection - 2 misfire segment before					
LOAD_MIS_3	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Normalised engine load for misfire detection - 3 misfire segment before					
LV_INH_ACC_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to Air Conditionner transient condition					
LV_INH_IGA_DIF_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to IGA_DIF condition					
LV_INH_LOAD_GRD_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to LOAD_GRD_MIS condition					
LV_INH_MAP_DIF_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to MAP_DIF condition					
LV_INH_TPS_GRD_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to TPS gradient condition					
LV_REQ_APP_INH_MIS	O/V	0... 1H	0 ...1	1	-
Misfire detection APP INC fade out request flag					
MAP_DIF_MIS	V	0... FFFFH	0... 5434	0.0829175	hPa
Manifold air pressure difference between 2 misfire segment tasks					
MIS_DET_CDN_APP_INH	V	0... FFFFH	0... 65535	1	-
Misfiring APP INC detection fade out requests carrier word (before masking)					
MIS_DET_CDN_APP_INH_NR	V	0... FFH	0... 255	1	-
Misfiring APP INC detection fade out requests number (after masking)					

Input data:

AMP {p. 982}	CTR_T_ZDLY_MIS {p. 6225}	FAC_GAIN_LOAD_MIS {p. 6283}	IGA_AV [NC_CYL_NR] {p. 1005}
IGA_BAS_COR_MV {p. 6283}	LC_MIS_INH {p. 6277}	LV_ACCOUT_RLY {p. 3589}	LV_ENA_ER {p. 1454}

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LV_ENA_SEG_T_MES {p. 1447}	LV_IGA_GRD_ACT {p. 1828}	LV_INH_APP_DET_MIS {p. 6283}	LV_INH_CMB_TRA_MIS {p. 6283}
LV_INH_FTL_L_DET_MIS {p. 6283}	LV_INH_OBD_DET_MIS {p. 6283}	LV_IS {p. 1720}	LV_S_ACT {p. 8137}
LV_STATE_CRK_OSC {p. 6209}	LV_STATE_RR {p. 6301}	MAF {p. 8277}	MAP {p. 8278}
N {p. 1525}	N_32 {p. 1525}	NC_CMB_CONF {p. 812}	SEG_NR {p. 1525}
TCO {p. 1100}	TPS_AV {p. 1169}	TPS_GRD {p. 1169}	TQI_AV {p. 981}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CONF_LOAD_MIS	-	0... 2H	0 ...2	1	-
LOAD_MIS switch configuration versus engine combustion mode: (=0) LOAD_MIS always relative to TQI_AV (=1) LOAD_MIS relative to MAF in homog. & rel. to TQI_AV in stratif. mode, (=2) LOAD_MIS relative to MAP in homog. & rel. to TQI_AV in stratif. mode					
C_MAP_MAX_MIS	-	0... FFFFH	0... 5434	0.0829175	hPa
Maximum manifold air pressure value to determine engine load ratio scale for misfire detection					
C_MASK_APP_INH_DET_MIS	-	0... FFFFH	0... 65535	1	-
MIS_DET_CDN_APP_INH carrier structure fade out configuration mask (detection in nominal phase out of IS)					
C_MASK_APP_INH_DET_MIS_IS	-	0... FFFFH	0... 65535	1	-
MIS_DET_CDN_APP_INH carrier structure fade out configuration mask (detection in nominal phase & in IS)					
C_MASK_APP_INH_DET_ZDLY_MIS	-	0... FFFFH	0... 65535	1	-
MIS_DET_CDN_APP_INH carrier structure fade out configuration mask (misfire detection in zero delay phase)					
C_N_32_MAX_IGA_IS_MIS	-	0... FFH	0... 8160	32	rpm
Maximum engine speed to apply iga_dif_mis in idle speed					
C_NR_TDC_IGA_BAS_DIF_MIS	-	0... FFH	0... 255	1	-
Fade out duration when absolute IGA criterion has been detected					
C_NR_TDC_IGA_DIF_IS_MIS	-	0... FFH	0... 255	1	-
Fade out duration when relative IGA criterion in idle speed has been detected					
C_NR_TDC_IGA_DIF_MIS	-	0... FFH	0... 255	1	-
Fade out duration when IGA difference per TDC has been detected.					
C_T_ACCOUT_DLY_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when air - conditioning compressor has been switched on.					
C_T_LOAD_GRD_HOM_DLY_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when maximum LOAD_GRD_MIS has been detected in homogeneous combustion modes					
C_T_LOAD_GRD_S_DLY_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when maximum LOAD_GRD_MIS has been detected in stratified combustion mode					
C_T_MAP_DIF_DLY_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when manifold air pressure gradient has been detected.					
C_T_TPS_GRD_DLY_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when maximum throttle gradient has been detected.					
C_T_TPS_GRD_DLY_ZDLY_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when maximum throttle gradient has been detected during zero delay starting phase					
IP_DELTA_IGA_BAS_MIS	V	0... FFH	-35.625 ...60	0.375	°CRK
LDP_N_32_IP_DELTA_IGA_BAS_MIS	8	0... FFH	0... 8160	32	rpm
LDP_LOAD_IP_DELTA_IGA_BAS_MIS	8	0... 7FFFH	0... 99.99694	3.0518e-3	%
Absolute spark advance angle difference for misfire inhibition					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_DELTA_IGA_IS_MIS	V	0... FFH	0... 95.625	0.375	°CRK
LDP_TCO_IP_DELTA_IGA_IS_MIS	4	0... FEH	-48... 142.5	0.75	°C
LDP_LOAD_IP_DELTA_IGA_IS_MIS	4	0... 7FFFH	0... 99.99694	3.0518e-3	%
Spark advance angle difference in idle speed for misfire inhibition					
IP_DELTA_IGA_MIS	V	0... FFH	0... 95.625	0.375	°CRK
LDP_N_32_IP_DELTA_IGA_MIS	8	0... FFH	0... 8160	32	rpm
LDP_LOAD_MIS_IP_DELTA_IGA_MIS	8	0... 7FFFH	0... 99.99694	3.0518e-3	%
Spark advance angle difference at part load for misfire inhibition					
IP_LOAD_GRD_MIS	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_LOAD_MIS_IP_LOAD_GRD_MIS	12	0... 7FFFH	0... 99.99694	3.0518e-3	%
Maximum LOAD_MIS gradient for fade out condition in homogeneous combustion modes					
IP_LOAD_GRD_S_MIS	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_LOAD_MIS_IP_LOAD_GRD_S_MIS	12	0... 7FFFH	0... 99.99694	3.0518e-3	%
Maximum LOAD_MIS gradient for fade out condition in stratified combustion mode					
IP_MAF_MAX_MIS	-	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_32_IP_MAF_MAX_MIS	6	0... FFH	0... 8160	32	rpm
Maximum air mass value to determine engine load ratio scale for misfire detection					
IP_MAP_DIF_MAX_MIS	-	0... FFFFH	0... 5434	0.0829175	hPa
LDP_MAP_IP_MAP_DIF_MAX_MIS	12	0... FFFFH	0... 5434	0.0829175	hPa
Maximum MAP gradient for fade out condition.					
IP_TPS_GRD_MAX_MIS	-	0... FFH	0... 2987.5	11.715686	°TPS/s
LDP_TPS_AV_IP_TPS_GRD_MAX_MIS	10	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Maximum throttle gradient threshold for fade out condition.					
IP_TPS_GRD_ZDLY_MIS	-	0... FFH	0... 2987.5	11.715686	°TPS/s
LDP_TPS_AV_IP_TPS_GRD_ZDLY_MIS	6	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Maximum throttle gradient threshold for fade out condition during zero delay misfire monitoring activation					
IP_TQI_AV_MAX_MIS	-	0... 7FFFH	0... 1023.97	0.03125	Nm
LDP_N_32_IP_TQI_AV_MAX_MIS	8	0... FFH	0... 8160	32	rpm
Maximum torque value to determine engine load ratio scale for misfire detection					

B.108.1 Misfire detection engine parameters

FUNCTION DESCRIPTION:

In order to cover all the combustion states of an engine (Hom. AFS, AFL & Strat.) in torque based engine control, a general variable LOAD_MIS that represents the ratio of engine load - whatever should be the load definition depending on engine combustion state (*eg. MAF in Hom. and TQI_AV in Strat.*) - is defined for the purpose of the Misfire function and the calculation of the ER-misfire detection thresholds.
Depending on the project choice configuration (*with C_CONF_LOAD_MIS*), in Homogenous combustion mode this Misfire load variable should be either MAF, MAP or TQI_AV. In the other hand this Misfire load variable is always TQI_AV in Stratified combustion mode.
Legally, the presence of engine misfire in the engine operating region is bounded by the positive torque line (i.e. engine load with the transmission in neutral) and an engine speed value.
The zero load line is a function of the engine speed and depends on the engine combustion mode (for GDI application), coolant temperature and atmospheric pressure.

Application conditions

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Initialisation: All variables are initialised to 0 at reset, at engine stop **Or** at LC_MIS_INH 0 to 1 transition
LOAD_GRD_MIS is first time calculated when LOAD_MIS stack have been fill in (4 segments).

Recurrence: *every segment task*

Activation: LV_ENA_SEG_T_MES = 1
And LC_MIS_INH = 0

Deactivation: LV_ENA_SEG_T_MES = 0
Or LC_MIS_INH = 1

Formula section:

Normalised engine load dedicated to misfire detection
For each misfire segment, the following stack is serviced:
LOAD_MIS_3 =LOAD_MIS_2
LOAD_MIS_2 =LOAD_MIS_1
LOAD_MIS_1 = LOAD_MIS
If C_CONF_LOAD_MIS = 0
Or LV_S_ACT = 1
Then *LOAD_MIS_Temp* = TQI_AV /IP_TQI_AV_MAX_MIS(N_32) *// TQI_AV based*
ElseIf C_CONF_LOAD_MIS = 1
Then *LOAD_MIS_Temp* = MAF /IP_MAF_MAX_MIS(N32) *// MAF based*
Else *LOAD_MIS_Temp* = MAP /C_MAP_MAX_MIS *// MAP based*
EndIf
LOAD_MIS = FAC_GAIN_LOAD_MIS * *LOAD_Temp* *// Application incidence correction*
LOAD_GRD_MIS = | LOAD_MIS - LOAD_MIS_3 |
Note : LOAD_MIS calculation steps are checked against division by zero
LOAD_MIS_Temp is a non visible, temporary value

B.108.2 Generic fade out conditions for misfire detection

General information:

Generic fade out (LV_REQ_APP_INH_MIS) is based on all conditions who could create unreliable conditions for misfire detection :

- Engine gradients (engine load, throttle, combustion mode & ignition angle transients).
- Crankshaft jolt effects who can distrub detection process (rough road, drivetrain oscillations, air conditionner & accessoiries activation/deactivation).
- OBDI errors on one of the sensors used by the misfire monitoring process.

All these different conditions are merge into a carrier (MIS_DET_CDN_APP_INH).

Application conditions

Initialisation: at ECU reset, at Engine Stop **Or** at LC_MIS_INH 0 to 1 transition
LV_REQ_APP_INH_MIS = 1
MIS_DET_CDN_APP_INH = 2047
MIS_DET_CDN_APP_INH_NR = 11
MAP_DIF_MIS = 0
IGA_DIF_MIS = 0
IGA_BAS_DIF_MIS = 0
IGA_MIS_2 = 0
IGA_MIS_1 = 0
IGA_MIS = 0

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Recurrence: segment task for data process
10 ms for free running timers

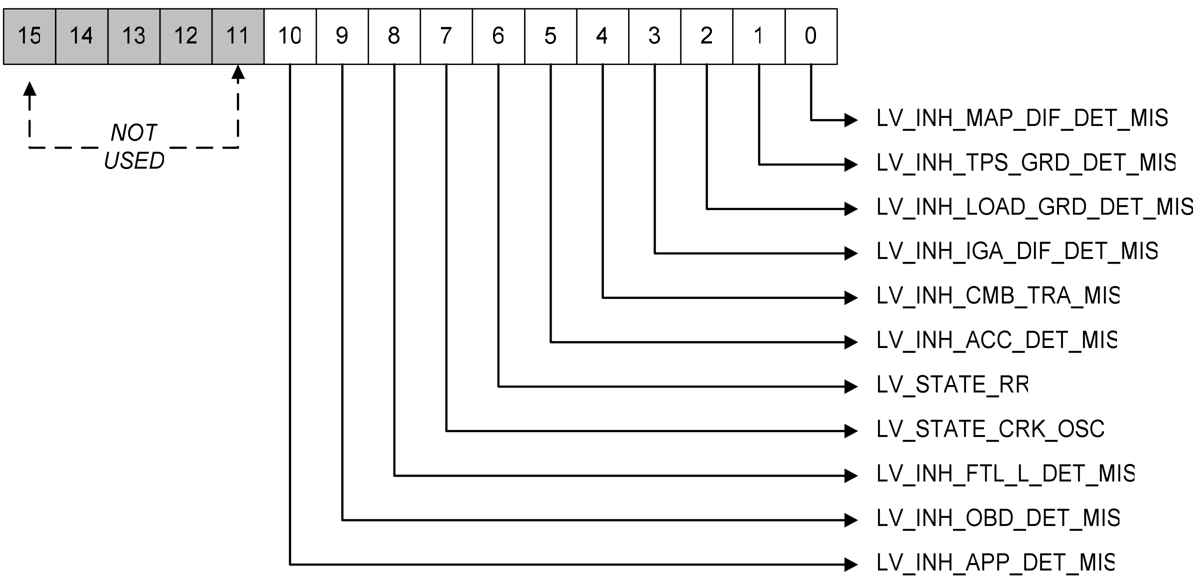
Activation: LV_ENA_ER = 1
And LC_MIS_INH = 0

Deactivation: LV_ENA_ER = 0
Or LC_MIS_INH = 1

Remark : Timers used for delay are 10 ms free running decounters, they are not linked to activation/ deactivation conditions described above.

B.108.2.1 Generic fade out condition carrier definition

MIS_DET_CDN_APP_INH



remark : MIS_DET_CDN_APP_INH is updated at current misfire task

B.108.2.2 Configurable generic fade-out management

Generic fade out management during zero delay phase, nominal phase & idle speed engine state can be configurated via 3 bitfield masks that allow to take in account or not some conditions in a phase and not in the other.
If the corresponding bit in the MIS_DET_CDN_APP_INH carrier structure is set to 0 in C_MASK_APP_INH_DET_ZDLY_MIS, C_MASK_APP_INH_DET_MIS or C_MASK_APP_INH_DET_MIS_IS calibration, then the corresponding condition will not fade-out misfire detection.
For the definition of C_MASK_APP_INH_DET_ZDLY_MIS, C_MASK_APP_INH_DET_MIS & C_MASK_APP_INH_DET_MIS_IS masks please refer to the legal requirements & customer recommendations.

Overview:

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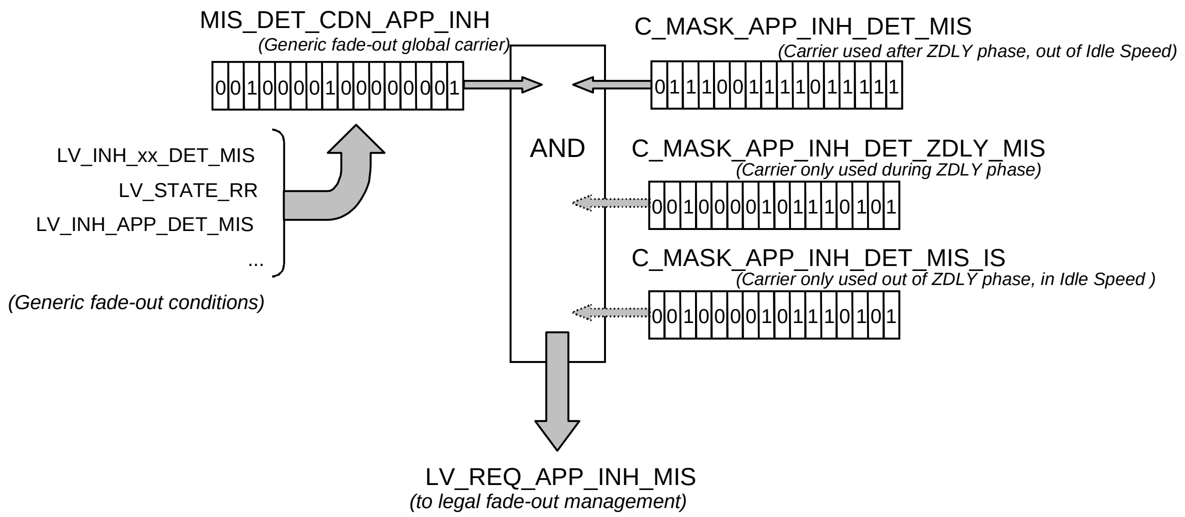

Formula section:

If(1) CTR_T_ZDLY_MIS != 0
Then(1) *// ZDLY phase*
MIS_DET_CDN_APP_INH_NR =
sum(MIS_DET_CDN_APP_INH & C_MASK_APP_INH_DET_ZDLY_MIS)
(bitfield operations)
Else(1)
If(2) LV_IS = 1
Then(2) *// Idle Speed engine state*
MIS_DET_CDN_APP_INH_NR =
sum(MIS_DET_CDN_APP_INH & C_MASK_APP_INH_DET_MIS_IS)
(bitfield operations)
Else(2) *// Out of idle speed engine state*
MIS_DET_CDN_APP_INH_NR =
sum(MIS_DET_CDN_APP_INH & C_MASK_APP_INH_DET_MIS)
(bitfield operations)
EndIf(2)
EndIf(1)

If MIS_DET_CDN_APP_INH_NR != 0
Then LV_REQ_APP_INH_MIS = 1
Else LV_REQ_APP_INH_MIS = 0
EndIf

B.108.2.3 Maximum manifold air-pressure gradient

Due to trailing throttle /acceleration transition problems, it could be necessary to disable misfire detection for a short period when the manifold air-pressure gradient exceeds an applicable value.

Application conditions:

In all homogeneous combustion mode, Misfire detection is disabled when the amount of the MAP gradient exceeds IP_MAP_DIF_MAX_MIS(MAP)

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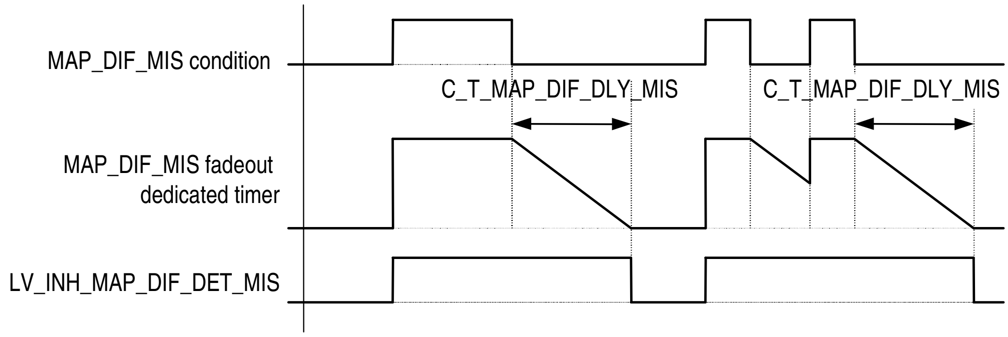
Initialisation: *at ECU reset, at Engine Stop* ***Or*** *at LC_MIS_INH 0 to 1 transition*
LV_INH_MAP_DIF_DET_MIS = 1

Formula section:

MAP_DIF_MIS = | MAP$_{(n)}$ - MAP$_{(n-2)}$ |
If LV_S_ACT = 0
And MAP_DIF_MIS $>$ IP_MAP_DIF_MAX_MIS(MAP)
Then
After condition rising edge triggering, LV_INH_MAP_DIF_DET_MIS flag is set to 1 as long as condition is true.
After condition falling edge triggering, LV_INH_MAP_DIF_DET_MIS flag is hold to 1 for a period of C_T_MAP_DIF_DLY_MIS.
EndIf

Fade out behaviour summary:



B.108.2.4 Maximum throttle gradient

Due to trailing throttle /acceleration transient problems at low load, it is necessary to disable misfire detection for a short period when the throttle gradient exceeds an applicable value.

Application conditions:

Misfire detection can be disabled when the amount of the throttle gradient exceeds the applicable value hereunder mentioned. But during the 0-delay activation of the misfire monitoring, driver-induced fade-out is allowed:

Initialisation: *at ECU reset, at Engine Stop* ***Or*** *at LC_MIS_INH 0 to 1 transition*
LV_INH_TPS_GRD_DET_MIS = 1

Formula section:

If(1) CTR_T_ZDLY_MIS = 0
Then(1)
If(2) TPS_GRD $>$ IP_TPS_GRD_MAX_MIS(TPS_AV)
Then(2)
After condition rising edge triggering, LV_INH_TPS_GRD_DET_MIS flag is set to 1 as long as condition is true.
After condition falling edge triggering, LV_INH_TPS_GRD_DET_MIS flag is hold to 1 for a period of C_T_TPS_GRD_DLY_MIS.

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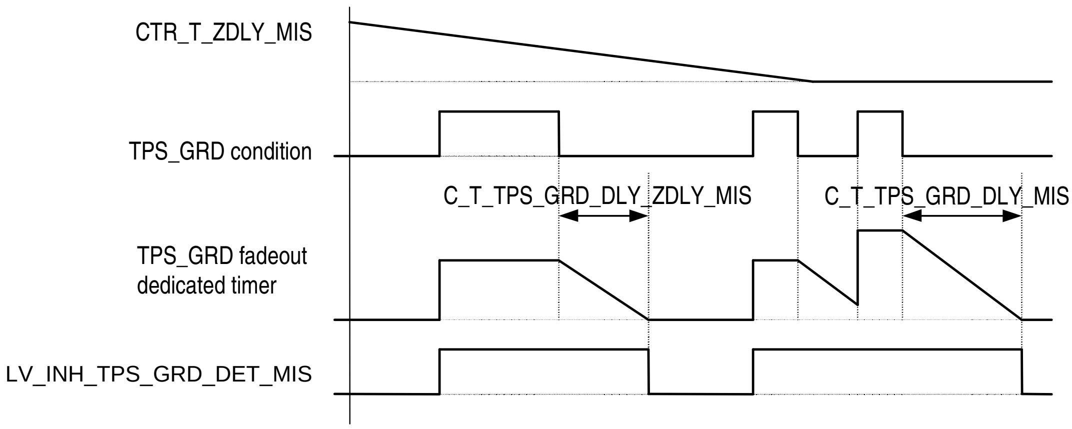
EndIf(2)
Else(1)
If(2) TPS_GRD > IP_TPS_GRD_ZDLY_MIS(TPS_AV)
Then(2)
After condition rising edge triggering, LV_INH_TPS_GRD_DET_MIS flag is set to 1 as long as condition is true.
After condition falling edge triggering, LV_INH_TPS_GRD_DET_MIS flag is hold to 1 for a period of C_T_TPS_GRD_DLY_ZDLY_MIS.
EndIf(2)
EndIf(1)

Fade out behaviour summary:



B.108.2.5 Maximum engine load gradient

Due to trailing throttle /acceleration transient problems at low load, it could be necessary to disable misfire detection for a short period when the engine load exceeds an applicable value.

Application conditions:

Misfire detection can be disabled when the amount of engine load gradient exceeds a calibration value, this value is switched according combustion mode. Fade out delay is also specific to combustion mode.

Initialisation: *at ECU reset, at Engine Stop **Or** at LC_MIS_INH 0 to 1 transition*
LV_INH_LOAD_GRD_DET_MIS = 1

Formula section:

If(1) LV_S_ACT = 0
Then(1)
If(2) LOAD_GRD_MIS > IP_LOAD_GRD_MIS(LOAD_MIS)
Then(2)
After condition rising edge triggering, LV_INH_LOAD_GRD_DET_MIS flag is set to 1 as long as condition is true.
After condition falling edge triggering, LV_INH_LOAD_GRD_DET_MIS flag is hold to 1 for a period of C_T_LOAD_GRD_HOM_DLY_MIS.
EndIf(2)

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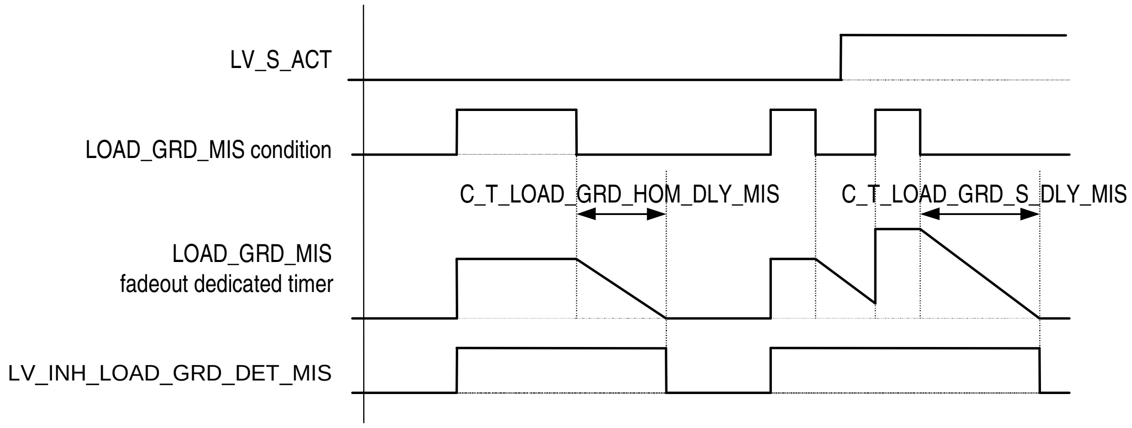
EndIf(1)
#If NC_CMB_CONF = AFS_S Or AFS_AFL_S
If(1) LV_S_ACT = 1
Then(1)
If(2) LOAD_GRD_MIS > IP_LOAD_GRD_S_MIS(LOAD_MIS)
Then(2)
After condition rising edge triggering, LV_INH_LOAD_GRD_DET_MIS flag is set to 1 as long as condition is true.
After condition falling edge triggering, LV_INH_LOAD_GRD_DET_MIS flag is hold to 1 for a period of C_T_LOAD_GRD_S_DLY_MIS.
EndIf(2)
EndIf(1)
#EndIf

Fade out behaviour summary:



B.108.2.6 Ignition retardation without change limitation

Various functions or CAN requests (e.g.. gear-shift signal. torque reduction. etc...) cause an ignition - timing retardation, without change limitation. Misfire detection can be disabled when the amount of the ignition timing retardation is too important.
Several criterion are available to disable the misfire monitoring according the ignition angle behaviour. Two relative criterions dedicated to focus on IGA transients, one in idle speed and one in part load, plus one absolute criterion dedicated to focus on too important IGA values compared to the
Initialisation: *at ECU reset, at Engine Stop* ***Or*** *at LC_MIS_INH 0 to 1 transition*
LV_INH_IGA_DIF_DET_MIS = 1

Formula section:

For each TDC, the following stacks are serviced after having calculated IGA_AV_x.
IGA_DIF_MIS = | IGA_MIS_2 - IGA_MIS |
IGA_BAS_DIF_MIS = IGA_BAS_COR_MV - IGA_MIS
IGA_MIS_2 = IGA_MIS_1
IGA_MIS_1 = IGA_MIS
IGA_MIS = IGA_AV[SEG_NR]

If(1) LV_S_ACT = 0
Then(1)

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If(2) LV_IS = 1
And N_32 < C_N_32_MAX_IGA_IS_MIS
Then(2)
If(3) IGA_DIF_MIS > IP_DELTA_IGA_IS_MIS(TCO, LOAD_MIS_2)
Then(3) After condition rising edge triggering, LV_INH_IGA_DIF_DET_MIS flag is set to 1 as long as condition is true.
Else(3) After condition falling edge triggering, LV_INH_IGA_DIF_DET_MIS flag is hold to 1 for a period of C_NR_TDC_IGA_DIF_IS_MIS.
When this period is exceeded without retriggering, LV_INH_IGA_DIF_DET_MIS releases to 0.
EndIf(3)
Else(2) *// out of idle speed conditions*
If(3) IGA_DIF_MIS > IP_DELTA_IGA_MIS(N_32, LOAD_MIS)
Then(3) After condition rising edge triggering, LV_INH_IGA_DIF_DET_MIS flag is set to 1 as long as condition is true.
Else(3) After condition falling edge triggering, LV_INH_IGA_DIF_DET_MIS flag is hold to 1 for a period of C_NR_TDC_IGA_DIF_MIS.
When this period is exceeded without retriggering, LV_INH_IGA_DIF_DET_MIS releases to 0.
EndIf(3)
EndIf(2)
If(2) LV_IGA_GRD_ACT = 0 *// out of IGA engine start calculation phase*
And IGA_BAS_DIF_MIS > IP_DELTA_IGA_BAS_MIS(N_MIS,LOAD_MIS)
Then(2) After condition rising edge triggering, LV_INH_IGA_DIF_DET_MIS flag is set to 1 as long as condition is true.
Else(2) After condition falling edge triggering, LV_INH_IGA_DIF_DET_MIS flag is hold to 1 for a period of C_NR_TDC_IGA_BAS_DIF_MIS.
When this period is exceeded without retriggering, LV_INH_IGA_DIF_DET_MIS releases to 0.
EndIf (2)
EndIf(1)

// note: the TDC decounter is retriggered only if the considered preload calibration is greater than the decounter actual value.

Fade out behaviour summary:

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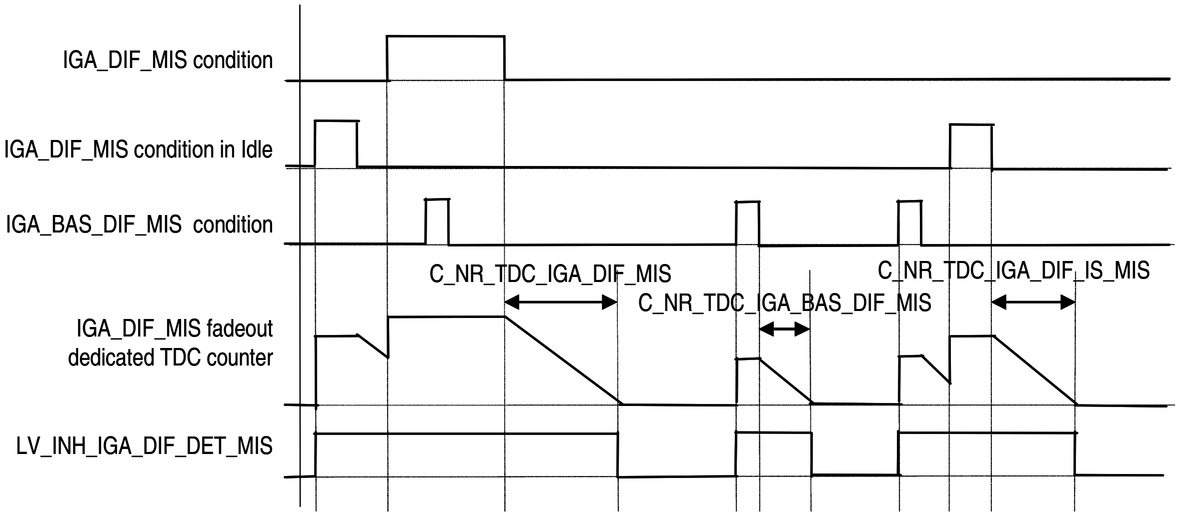

B.108.2.7 Combustion mode transients

Application conditions:

While the combustion manager is in transient state, the misfire detection can be disabled to have a proper base for evaluation of the ER-misfire detection thresholds, which are defined for the stationary modes (AFS, AFL & S). See definiton in Application Incidences file. (LV_INH_CMB_TRA_MIS = 1).

B.108.2.8 Air - conditioning compressor activation

When the air - conditioning compressor is switched on, an additional load is briefly applied to the engine.
This load jump can cause a segment period jump and crankshaft vibration, depending on the engine operating state and load request.

Application conditions:

Misfire detection can be suppressed for the applicable constant period C_T_ACCOUT_DLY_MIS, starting if the air - conditioning compressor is switched on or off (LV_ACCOUT_RLY changes from 0 to 1 or from 1 to 0), during this period LV_INH_ACC_DET_MIS is set to 1.

Initialisation: *at ECU reset, at Engine Stop* ***Or*** *at LC_MIS_INH 0 to 1 transition*
LV_INH_ACC_DET_MIS = 1

Formula section:

If LV_ACCOUT_RLY = 0 -> 1
Or LV_ACCOUT_RLY = 1 -> 0
Then LV_INH_ACC_DET_MIS is set to 1 during C_T_ACCOUT_DLY_MIS
EndIf

B.108.2.9 Rough road detection

Application conditions:

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Misfire detection can be suppressed when the status of the *rough road detection* is active (LV_STATE_RR = 1).

B.108.2.10 Crankshaft oscillation detection

Application conditions:

Misfire detection can be suppressed when the status of the *crankshaft oscillation detection* is active (LV_STATE_CRK_OSC = 1).

B.108.2.11 Low fuel level

Application conditions:

Misfire detection can be suppressed when the low fuel level is detected (LV_INH_FTL_L_DET_MIS=1).

B.108.2.12 OBDI diagnosis fade-out

Application conditions:

LV_INH_OBD_DET_MIS combines all OBD project specific error bits to generate an input for the generic misfire detection fade-out conditions. *See definition in Misfire detection - Application Incidences file.* Misfiring detection can be suppressed if LV_INH_OBD_DET_MIS = 1

B.108.2.13 Application incidences fade-out

Application conditions:

LV_INH_APP_DET_MIS combines all project specific special conditions to generate an input for the generic misfire detection fade-out conditions. *See definition in Misfire detection - Application Incidences file*. Misfiring detection can be suppressed if LV_INH_APP_DET_MIS = 1

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B.109 Legal misfire detection fade-out conditions

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_T_ZDLY_MIS	O/V	0... FFFFH	0... 655.35	0.01	s
10 ms decounter for diagnostic fade out (general purpose)					
CTR_TDC_ZDLY_MIS	V	0... FFFFH	0... 65535	1	-
TDC decounter for disabled diagnostic					
LV_DIAG_MIS	O/V	0... 1H	0 ...1	1	-
Nominal Misfire Monitoring Phase					
LV_INH_AMP_MIN_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flagdue to minimum atmospheric pressure condition					
LV_INH_IV_OFF_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to cylinder shut-off condition					
LV_INH_LOAD_MIN_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to zero load line condition					
LV_INH_N_MAX_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to maximum engine speed condition					
LV_INH_N_MIN_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to minimum engine speed condition					
LV_INH_ST_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to engine start condition					
LV_INH_TCO_MIN_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out request flagdue to minimum temperature condition					
LV_IV_OFF_DET_MIS	V	0... 1H	0 ...1	1	-
Misfire detection fade out flag due to cylinder shut-off, phased with misfire detection index					
LV_PUC_DET_MIS	V	0... 1H	0 ...1	1	-
Fuel Cut-Off dedicated to misfire detection, including a delay time for fuel reactivation					
LV_REQ_INH_MIS	O/V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag					
LV_ZDLY_DIAG_MIS	O/V	0... 1H	0 ...1	1	-
Zero Delay Misfire Monitoring Phase					
MIS_DET_CDN_INH	V	0... 3FH	0... 63	1	-
Misfiring detection fade out requests carrier byte (before masking)					
MIS_DET_CDN_INH_NR	V	0... FFH	0... 255	1	-
Misfiring detection fade out requests number (after masking)					
STATE_DIAG_MIS	V	0H 1H 2H 3H 4H	INI_PHA PREP_0_DLY 0_DLY_MON PREP_MON NOM_MON	-	-
Misfire Detection Phase State Machine					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Input data:

AMP {p. 982}	LC_MIS_INH {p. 6277}	LOAD_MIN_MIS {p. 6283}	LOAD_MIS {p. 6213}
LV_AT {p. 654}	LV_DC {p. 5746}	LV_ES {p. 1720}	LV_INJ_CUT {p. 2295}
LV_REQ_APP_INH_MIS {p. 6213}	LV_RUN_ENG {p. 1505}	LV_ST {p. 1720}	N {p. 1525}
NC_CYL_NR {p. 1526}	PREV_STATE_IV {p. 2039}	SEG_NR {p. 1525}	SUM_INH_INJ {p. 2295}
TCO {p. 1100}	TCO_ST {p. 1100}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_MIN_MIS	-	0... FFFFH	0... 5434	82.8999e-3	hPa
Minimum atmospheric pressure for misfire detection					
C_MASK_INH_DET_MIS	-	0... FFH	0... 255	1	-
MIS_DET_CDN_INH carrier structure fade out configuration mask (misfire detection nominal phase)					
C_MASK_INH_DET_ZDLY_MIS	-	0... FFH	0... 255	1	-
MIS_DET_CDN_INH carrier structure fade out configuration mask (misfire detection zero delay phase)					
C_N_MAX_MIS_AT	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed for misfire detection /automatic transmission.					
C_N_MAX_MIS_MT	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed for misfire detection /manual transmission.					
C_N_MIN_MIS	-	0... 1FE0H	0... 8160	1	rpm
Minimum engine speed for misfire detection.					
C_N_MIN_ZDLY_MIS	-	0... 1FE0H	0... 8160	1	rpm
Minimum monitoring engine speed for engine start monitoring phase					
C_NR_TDC_INH_MIS	-	0... FFH	0... 255	1	-
Fade out duration in TDC when engine speed rise up to C_N_MIN_ZDLY_MIS					
C_NR_TDC_IV_OFF_DET_MIS	-	0... 7H	0 ...7	1	-
TDC delay to synchronise cylinder shut-off information with the misfire detection index					
C_NR_TDC_ZDLY_MIS	-	0... FFH	0... 255	1	-
Standard TDC count disablement tdc number before monitoring (engine start phase)					
C_SEG_NR_OFS_PREV_STATE_IV	-	0... BH	0... 11	1	-
Offset to correct index of PREV_STATE_IV with reference to segement number					
C_SUM_INH_IV_MAX_MIS	-	0... 8H	0 ...8	1	-
Maximum number of cylinders in shut-off to fade-out					
C_T_DLY_IV_OFF_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration after injection is back on.					
C_T_DLY_ST_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when engine operating state start LV_ST has been exited.					
C_T_ZDLY_MIS	-	0... FFFFH	0... 655.35	0.01	s
Duration for engine start specific misfire monitoring (5s according CARB)					
C_TCO_MIN_MIS	-	0... FEH	-48... 142.5	0.75	°C
Minimum coolant temperature for misfire detection					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_WUP_MIN_MIS	-	0... FEH	-48... 142.5	0.75	°C
Minimum warm up coolant temperature for misfire detection					
LC_REQ_ZDLY_MIS	-	0... 1H	0 ...1	1	-
Activation of CARB-required 0-delay monitoring					

General information

This chapter is relative to misfire detection fade out management as defined by legal texts linked to functionnal OBD diagnosis (OBDII, EOBD...).
Continuous misfire monitoring from engine starting instant:

- ***Engine start instant*** *: the point when the engine reaches a speed 150 rpm below the normal, warmed-up idle speed (as determined in the drive position for vehicles equipped with an automatic transmission) (CARB definition).*
- *One engine cycle (2 crankshaft revolutions) is allowed to initialise misfire detection process (see CTR_TDC_ZDLY_MIS using).*

Fade out conditions may disable misfire monitoring with the following conditions:

- **Minimum engine speed** : N_IS_SP - 150 rpm *(US)*
- **Maximum engine speed** : Redline engine speed *(US)* or -00 rpm *(EC)*
- **Minimum engine load** :

Zero load line (engine positive torque line)

A line joining the point (3000 rpm, zero load) and a point (6000 rpm, 135 hPa *(or 4 inches Hg)* above the zero load line)

- **Minimum coolant or ambiant temperature**

Below 20°F (US) or -7°C (EC) *(equivalent),*

Or If Engine start coolant temperature is below 20°F, until current temperature reaches warm up engine temperature 70°F.

- **Minimum atmospheric pressure**

Elevations above 8000 feet above sea level (US) or 2 500 meters (EC)

- **Time after start**

A 5s time after start fade-out can be allowed for EC market

Such kind of fade out is prohibited for US market (see CARB requirement for zero delay misfire monitoring activation)

- **Cylinder shut-off**

During fuel cut-off phase, on a specific cylinder shut-off or the number of cylinder in shut-off is too important, misfire diagnosis may be fade out *(no injection/combustion occurs)*

B.109.1 Misfire detection fade out management

FUNCTION DESCRIPTION:

CARB requests an activation of the misfire monitoring and diagnosis as off engine start. Particular fade-out conditions are required during the first 5 seconds since engine running. In this section the flag representing the request is defined, and is used in several other modules that are concerned with this requirement *(LC_REQ_ZDLY_MIS = 1).*
For non-CARB applications, this special monitoring is not required and has to be de-activated *(LC_ REQ_ZDLY_MIS = 0).*
A state-based approach is taken for the activation of the misfire detection algorithms, distinguishing the separate monitoring during the first 5 seconds and the ’nominal’ monitoring afterwards, and preparatory phases. During the monitoring phases, the normal fade-out mechanisms are used, corrected for some fade-outs that are not allowed during the first 5 seconds.

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Application conditions:

Activation:
Engine Start LV_RUN_ENG = 1
Deactivation:
Engine Stop LV_RUN_ENG = 0 **Or** ECU reset
Remark: At deactivation, ALL internal and external variables related to the legal fade out misfire detection conditions must be reset to 0.

In nominal mode (after engine start and zero delay period), the state machine executes no operations.

Formula section:

At engine start-up (LV_RUN_ENG switches from 0 to 1) the system starts in STATE_DIAG_MIS = 0 (initialisation phase).
In the case of a CARB-application, special monitoring takes placed during C_T_ZDLY_MIS seconds. The timer is started at detection of engine running:

If LC_REQ_ZDLY_MIS = 1
And STATE_DIAG_MIS = 0
Then CTR_T_ZDLY_MIS = C_T_ZDLY_MIS
EndIf

Transition initialisation state to preparation states for 0-delay OR to nominal monitoring

If LC_REQ_ZDLY_MIS = 1
And STATE_DIAG_MIS = 0
And N > C_N_MIN_ZDLY_MIS
Then ***Zero-Delay Activation of Misfire Detection***
STATE_DIAG_MIS = 1
CTR_TDC_ZDLY_MIS = C_NR_TDC_ZDLY_MIS
ElseIf LC_REQ_ZDLY_MIS = 0
And STATE_DIAG_MIS = 0
And N > C_N_MIN_ZDLY_MIS
Then ***Standard Activation of Misfire Detection***
STATE_DIAG_MIS = 3
CTR_TDC_ZDLY_MIS = C_NR_TDC_ZDLY_MIS
Else ***Initialisation Phase***
LV_DIAG_MIS = 0
LV_ZDLY_DIAG_MIS = 0
EndIf

Transition back to the initialisation phase

If LV_ES = 1
And STATE_DIAG_MIS <> 0
Then ***In case of engine stop, return to initialisation phase***
STATE_DIAG_MIS = 0
EndIf

Transition preparation state 0-delay monitoring to 0-delay monitoring state

If LC_REQ_ZDLY_MIS = 1 CARB application
And STATE_DIAG_MIS = 1 0-delay preparation state
And N > C_N_MIN_ZDLY_MIS engine speed over threshold
And CTR_TDC_ZDLY_MIS = 0 1 engine cycle passed
Then STATE_DIAG_MIS = 2
LV_ZDLY_DIAG_MIS = 1
EndIf

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Transition preparation nominal state to nominal monitoring state

If LC_REQ_ZDLY_MIS = 0 standard application
And STATE_DIAG_MIS = 3 preparation monitoring state
And N > C_N_MIN_ZDLY_MIS engine speed over threshold
And CTR_TDC_ZDLY_MIS = 0 1 engine cycle passed
Then STATE_DIAG_MIS = 4
LV_DIAG_MIS = 1
EndIf

Transition 0-delay monitoring state to nominal monitoring state

If LC_REQ_ZDLY_MIS = 1 *CARB application*
And STATE_DIAG_MIS = 2 *0-delay monitoring state*
And N > C_N_MIN_ZDLY_MIS *engine speed over threshold*
And CTR_TDC_ZDLY_MIS = 0 *1 engine cycle passed*
And CTR_T_ZDLY_MIS = 0 *timer finished (typically 5 seconds)*
Then STATE_DIAG_MIS = 4
LV_DIAG_MIS = 1
LV_ZDLY_DIAG_MIS = 0
EndIf

The counter CTR_T_ZDLY_MIS is decremented at every time instance of 10 ms when STATE_DIAG_MIS != 0.
The counter CTR_TDC_ZDLY_MIS is decremented with 1 at every TDC.
(both counters are saturated to 0)
Rermark: During the 0-delay misfire detection, no fade-outs are allowed for crankshaft oscillation, rough road detection and zero-load line conditions (see appropriate sections). However, it is allowed to have so-called driver-induced fade-outs (e.g. gradient on pedal value). This latter section has been added.

At hot resets, the system starts again in the initialisation phase.

B.109.2 Misfire detection legal fade out conditions

FUNCTION DESCRIPTION:

General information:

Legal fade out (LV_REQ_INH_MIS) is based on all fade out conditions allowed by the legal texts for continuous misfire monitoring.
All these different fade-out conditions are merge into a global carrier (MIS_DET_CDN_INH).
Timers used for fade-out conditions delays are free running timers who are not deactivated according following conditions.

Application conditions: *(global to Misfire detection legal fade out conditions chapter)*
Initialisation: at Reset, Engine Stop, **Or** on Deactivation event
LV_PUC_DET_MIS = 0
LV_IV_OFF_DET_MIS = 1
LV_REQ_INH_MIS = 1
MIS_DET_CDN_INH = 127
MIS_DET_CDN_INH_NR = 7
Recurrence: every segment task
Activation: *LC_MIS_INH = 0*
Deactivation: *LC_MIS_INH = 1*

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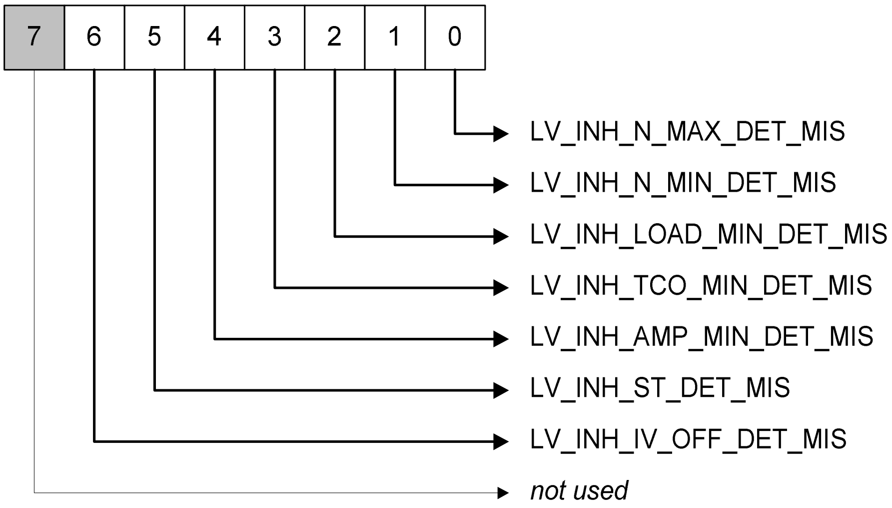
B.109.2.1 Fade out carrier definition

Misfire fade out conditions carrier:

MIS_DET_CDN_INH

Carrier used for fade-out conditions merge
(legal fade-out overview)



B.109.2.2 Configurable Fade-out Management

Application conditions:

Fade out management during zero delay phase & nominal phase can be configurated via 2 bitfield masks that allow to take in account or not some conditions in a phase and not in the other.
If the corresponding bit in the MIS_DET_CDN_INH carrier structure is set to 0 in C_MASK_INH_DET_ZDLY_MIS or C_MASK_INH_DET_MIS calibration, then the corresponding condition will not fade-out misfire detection.
For the definition of C_MASK_INH_DET_ZDLY_MIS & C_MASK_INH_DET_MIS masks please refer to the legal requirements & customer recommendations.

Formula section:

If CTR_T_ZDLY_MIS ? 0
Then
MIS_DET_CDN_INH_NR = sum(MIS_DET_CDN_INH & C_MASK_INH_DET_ZDLY_MIS)
(bitfield operations)
Else
MIS_DET_CDN_INH_NR = sum(MIS_DET_CDN_INH & C_MASK_INH_DET_MIS)
(bitfield operations)
EndIf
If MIS_DET_CDN_INH_NR 0

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Or LV_REQ_APP_INH_MIS = 1 *// Fade out request linked to misfire detection method*
Then LV_REQ_INH_MIS = 1 *// General fade out request*
Else LV_REQ_INH_MIS = 0
EndIf

B.109.2.3 Maximum engine speed fade-out

Application conditions:

The misfire monitoring can be inhibated when the engine speed reachs the maximum engine speed imposed by the market target : Redline engine speed for US applications or -00 rpm for EC applications. Moreover this information is use to stop misfire monitoring process for high speed if not required (limitation of cpu load especially for european application).

Formula section:

If (LV_AT = 1 **And** N > C_N_MAX_MIS_AT)
Or (LV_AT = 0 **And** N > C_N_MAX_MIS_MT)
Then LV_INH_N_MAX_DET_MIS = 1
Else LV_INH_N_MAX_DET_MIS = 0
EndIf

B.109.2.4 Minimum engine speed fade-out

The irregular engine operation test is performed as soon as the above-mentioned condition is disabled.

Important:

- C_N_MIN_MIS is defined by the current configuration of the index used for misfire detection in the current application. C_N_MIN_MIS should be lower than C_N_MIN_ZDLY_MIS.
- C_N_MIN_ZDLY_MIS is defined as the engine speed set-point for a warm engine minus 150 rpm. After passing below the C_N_MIN_ZDLY_MIS threshold, one is allowed one engine cycle (meaning for example for a 4-cylinder engine 4 tdc's) before reactivating the output of the misfire detection algorithm. Misfire detection is suppressed for a period of C_NR_TDC_INH_MIS tdc's.
- It should be checked in each application that within the allowed number of TDC's proper misfire detection index values have been re-obtained. Typically, it should be possible to restart misfire detection earlier.

Application conditions:

N < C_N_MIN_ZDLY_MIS

Engine speed below CARB requirements *(used for US applications)*.

Typically, once N < C_N_MIN_ZDLY_MIS, the output of the misfire detection is inhibited, allthough the calculation is still valid. C_NR_TDC_ZDLY_MIS tdc's decounter is started at passing engine speed C_N_MIN_ZDLY_MIS again. Once the decounter is at 0, misfire detection index output is allowed.

N < C_N_MIN_MIS

Engine speed below misfire detection index resolution *(used for CE applications)*. If the engine speed falls below C_N_MIN_MIS.

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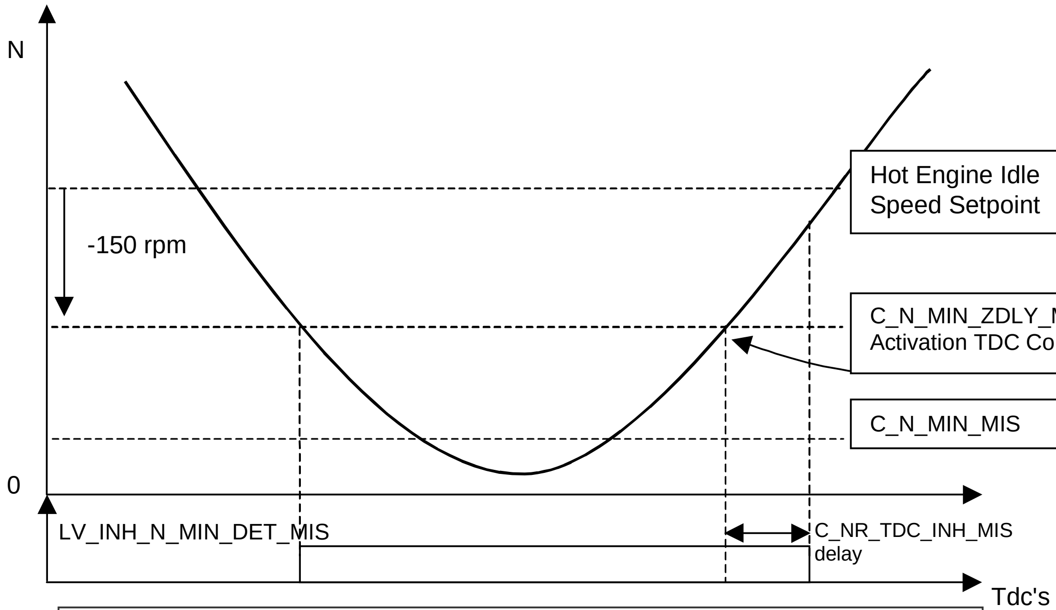

Explanation on the mechanism to re-activate the misfire detection after an engine speed drop

As the misfiring test is not mandatory and risky over a certain engine speed threshold, a fade out condition is tested on engine rpm (not allowed for US market).
Activation: *LV_INH_N_MAX_DET_MIS = 0*
Deactivation: *LV_INH_N_MAX_DET_MIS = 1*
Action on deactivation event: *LV_INH_N_MIN_DET_MIS = 1*

Formula section:

If N < C_N_MIN_ZDLY_MIS
Or N < C_N_MIN_MIS
Then LV_INH_N_MIN_DET_MIS = 1
Else LV_INH_N_MIN_DET_MIS = 0
caution : see specific reactivation conditions above when N > C_N_MIN_ZDLY_MIS, C_NR_TDC_INH_MIS delay used
EndIf

B.109.2.5 Minimum engine load

Application conditions:

Below a specific load (zero load), fluctuations in engine speed cannot be detected, even in the event of misfire. In this case, the misfire detection is disabled.
Activation: *LV_INH_N_MAX_DET_MIS = 0*
Deactivation: *LV_INH_N_MAX_DET_MIS = 1*
Action on deactivation event: *LV_INH_LOAD_MIN_DET_MIS = 1*

Formula section:

If LOAD_MIS < LOAD_MIN_MIS
Then LV_INH_LOAD_MIN_DET_MIS = 1
Else LV_INH_LOAD_MIN_DET_MIS = 0

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EndIf

B.109.2.6 Minimum coolant temperature

Application conditions:

Misfire detection can be disabled when the coolant temperature is below a threshold (20°F /-7°C). Additionally when the coolant temperature at engine start is below this threshold, the misfire monitoring can be disable on that driving cycle until the current engine temperature reaches a warm up temperature threshold (70°F /21°C):
Activation: *LV_INH_N_MAX_DET_MIS = 0*
Deactivation: *LV_INH_N_MAX_DET_MIS = 1*
Action on deactivation event: *LV_INH_TCO_MIN_DET_MIS = 1*

Formula section:

LV_TEMP : temporary bit used to check only one occurence per engine start
Initialisation : *LV_TEMP = 0 at ECU reset* ***Or*** *LV_DC 0 -> 1*
If TCO < C_TCO_MIN_MIS
Or (TCO_ST < C_TCO_MIN_MIS
And TCO < C_TCO_WUP_MIN_MIS
And *LV_TEMP = 0*)
Then LV_INH_TCO_MIN_DET_MIS = 1
Else LV_INH_TCO_MIN_DET_MIS = 0
LV_TEMP = 1
EndIf

B.109.2.7 Minimum atmospheric pressure

Application conditions:

Misfire detection can be disabled when the atmospheric pressure is below a threshold:
Activation: *LV_INH_N_MAX_DET_MIS = 0*
Deactivation: *LV_INH_N_MAX_DET_MIS = 1*
Action on deactivation event: *LV_INH_AMP_MIN_DET_MIS = 1*

Formula section:

If AMP < C_AMP_MIN_MIS
Then LV_INH_AMP_MIN_DET_MIS = 1
Else LV_INH_AMP_MIN_DET_MIS = 0
EndIf

B.109.2.8 After start

Application conditions

Activation: `LV_INH_N_MAX_DET_MIS = 0`

Deactivation: `LV_INH_N_MAX_DET_MIS = 1`

Action on deactivation event: `LV_INH_ST_DET_MIS = 1`

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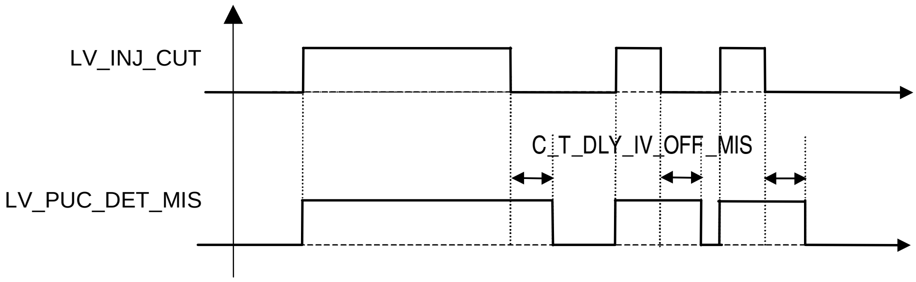
Misfire detection can be suppressed (see legal requirements - forbidden for CARB zero delay requirements) for a C_T_DLY_ST_MIS duration after the engine exits the operating state start (LV_ST), during this period LV_INH_ST_DET_MIS is set to 1, even if C_T_DLY_ST_MIS = 0.

B.109.2.9 Injection shut-off

Application conditions:

Misfire detection can be suppressed for the cylinder(s), for which injection has been shut-off.
General fuel shut-off:
LV_INJ_CUT indicates a general fuel shut-off. LV_PUC_DET_MIS bit includes a calibration delay time (C_T_DLY_IV_OFF_MIS) triggered at fuel cut-off condition falling edge, in a way to start the misfire detection only after crankshaft oscillations due to fuel reactivation.



Cylinder specific shut-off:
If the current cylinder checked by misfire detection is shut-off by any EMS function even MISF limp home functionnality), a fade-out can be apply for the misfire detection of this cylinder.
Due to the delay between the misfire index and the injection current informations, a calibration delay (C_NR_TDC_IV_OFF_DET_MIS) has been introduced on LV_IV_OFF_DET_MIS.
This delay synchronises MISF & INJR informations in a way to apply correctly the fade-out on the proper cylinder during individual cylinder shut-off operations, and to be able the perform the misfire monitoring on the other cylinders who are not in shut-off mode.

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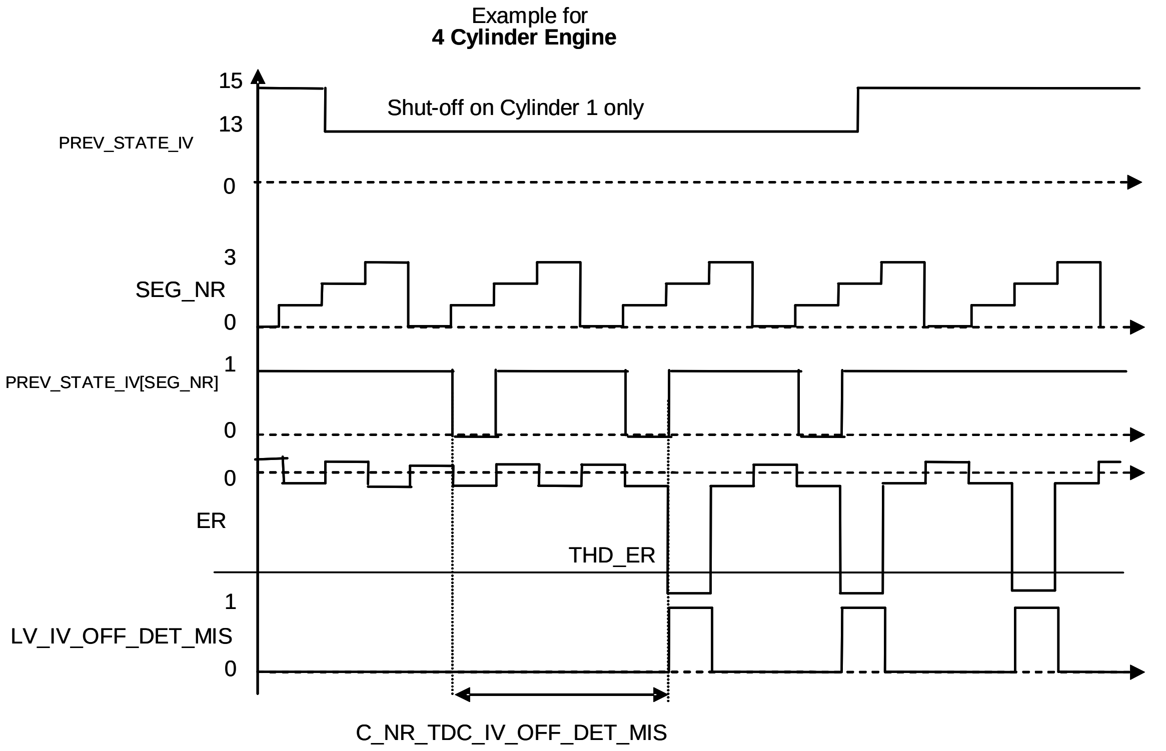

Limit number of cylinders shut-off:

If the number of shut-off cylinders reaches a calibration data (C_SUM_INH_IV_MAX_DET_MIS), reliable misfire detection is impossible. In such case is preferable to inhibate misfire detection.

Formula section:

General fuel shut-off:

If LV_INJ_CUT = 1 *// All cylinders are shut off*
Then LV_PUC_DET_MIS = 1
Else LV_PUC_DET_MIS = 0 after C_T_DLY_IV_OFF_MIS delay time
EndIf

Cylinder fuel shut-off:

If PREV_STATE_IV[(SEG_NR+C_SEG_NR_OFS_PREV_STATE_IV)%NC_CYL_NR] = 0 *// indexed by cylinder bit position*
Then LV_IV_OFF_DET_MIS = 1 after a C_NR_TDC_IV_OFF_DET_MIS delay
Else LV_IV_OFF_DET_MIS = 0 after a C_NR_TDC_IV_OFF_DET_MIS delay
EndIf

Activation: *LV_INH_N_MAX_DET_MIS = 0*
Deactivation: *LV_INH_N_MAX_DET_MIS = 1*
Action on deactivation event: *LV_INH_IV_OFF_DET_MIS = 1*

Formula section:

General definition:

If LV_PUC_DET_MIS = 1
Or LV_IV_OFF_DET_MIS = 1
Or SUM_INH_INJ >= C_SUM_INH_IV_MAX_MIS

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Then LV_INH_IV_OFF_DET_MIS = 1
Else LV_INH_IV_OFF_DET_MIS = 0
EndIf

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B.110 Misfire rate determination and error management

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CHK_MIS_A	V	0... FFH	0... 255	1	-
CARB A windows occurrence counter					
CTR_CHK_MIS_B4	V	0... FFH	0... 255	1	-
CARB B4 window occurrence counter					
CTR_DET_MIS_A	V	0... FFH	0... 255	1	-
CARB A misfire criterion detected counter					
CTR_DET_MIS_B4	V	0... FFH	0... 255	1	-
CARB B4 misfire criterion detected counter					
CTR_FTP_CDN_MIS_A	V	0... FFFFH	0... 65535	1	-
TDC counter for FTP condition detection					
CTR_MIS_A_LIH_CYL [NC_CYL_NR]	V	0... FFH	0... 255	1	-
Cylinder dedicated counters for CARB A Limp-home phases on current DC					
CTR_MIS_DC_CYL [NC_CYL_NR]	O/V/S	0... FFFFH	0... 65535	1	-
Former /current driving cycle misfire detection cylinder counters (ISO15031 Data $0C)					
CTR_MIS_DC_MMV_CYL [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Exponential weighted moving average (EWMA) misfire counters (ISO15031 Data $0B)					
CTR_MIS_DC_MMV_CYL_IT [NC_CYL_NR]	V/S	0... 63FF9CH	0... 65535	0.01	-
Exponential internal weighted moving average (EWMA) misfire counters (ISO15031 Data $0B)					
CTR_MIS_TOT_DC	O/V/S	0... FFFFH	0... 65535	1	-
Former /current driving cycle overall misfire detection counter					
CTR_MIS_TOT_NVMY	V/S	0... FFFFFFFFH	0... 4294967295	1	-
Overall misfire detection counter					
FAC_IGC_DIAG_MIS	V	0... FFH	0... 1.99218	0.0078125	-
Reliability weighting factor for ignition diagnosis (ignition failure detected)					
FAC_IV_DIAG_MIS	V	0... FFH	0... 1.99218	0.0078125	-
Reliability weighting factor for injection valve (injection valve failure detected)					
INH_IV_MIS	O/V	0... FFH	0... 255	1	-
Identification of cylinders shut off by misfire CARB A					
LV_DET_CFM_MIS	O/V	0... 1H	0 ...1	1	-
Flag for individual confirmed misfire detection after crossed diagnosis					
LV_DET_MIS_A	V	0... 1H	0 ...1	1	-
CARB A misfire criterion detected in actual 200 rev. window (not debounced)					
LV_DET_MIS_B4	V	0... 1H	0 ...1	1	-
CARB B4 misfire criterion detected in actual 1000 rev. window, (not debounced)					
LV_END_MIS_A	O/V	0... 1H	0 ...1	1	-
CARB A misfire criterion determination end					
LV_END_MIS_B1	O/V	0... 1H	0 ...1	1	-
CARB B1misfire criterion determination end					
LV_END_MIS_B4	O/V	0... 1H	0 ...1	1	-
CARB B4 misfire criterion determination end					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_WIN_MIS_A	O/V	0... 1H	0 ...1	1	-
End of CARB A window for similar condition					
LV_END_WIN_MIS_B1	O/V	0... 1H	0 ...1	1	-
End of CARB B1 window for similar condition					
LV_END_WIN_MIS_B4	O/V	0... 1H	0 ...1	1	-
End of CARB B4 window for similar condition					
LV_ERR_IN_WIN_MIS_A	O/V	0... 1H	0 ...1	1	-
End during CARB A window for similar condition					
LV_ERR_IN_WIN_MIS_B1	V	0... 1H	0 ...1	1	-
Error during CARB B1 window for similar condition					
LV_ERR_IN_WIN_MIS_B4	V	0... 1H	0 ...1	1	-
Error during CARB B4 window for similar condition					
LV_ERR_MIS_A_IN_WIN_B	O/V	0... 1H	0 ...1	1	-
Error MIS_A during CARB B1/B4 window for similar condition					
LV_FTP_MIS_A	V	0... 1H	0 ...1	1	-
Boolean for FTP emission cycle condition status at the end of CARB A window					
LV_INH_IV_MIS_A	O/V	0... 1H	0 ...1	1	-
At least one cylinder is shut-off by a CARB A misfire criterion confirmed					
LV_MIS_STATE_A	O/V	0... 1H	0 ...1	1	-
CARB A misfire criterion confirmed (debounced)					
LV_MIS_STATE_B	O/V	0... 1H	0 ...1	1	-
CARB B (B1 or B4) misfire criterion confirmed (debounced)					
LV_MIS_STATE_B1	O/V	0... 1H	0 ...1	1	-
CARB B1 misfire criterion confirmed					
LV_MIS_STATE_B4	O/V	0... 1H	0 ...1	1	-
CARB B4 misfire criterion confirmed (debounced)					
MIS_A_FAC	V	0... 64H	0... 100	1	-
Catalyst damage weighting factor to increment cylinder specific counters when misfire is detected					
MIS_A_FAC_BUF [NC_SIZE_THD_ER_BUF]	V	0... 64H	0... 100	1	-
Catalyst damage weighting factor buffer					
MIS_CTR_A [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Misfire sums (cylinder individual) after combination and weighting in CARB A window.					
MIS_CTR_B [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Misfire sums (cylinder individual) after combination in CARB B window					
MIS_NR_TDC_A	V	0... FFFFH	0... 65535	1	-
TDC counter CARB A window (200 crankshaft revolutions).					
MIS_NR_TDC_B	V	0... FFFFH	0... 65535	1	-
TDC counter CARB B window (1000 crankshaft revolutions)					
MIS_SUM_A	O/V	0... FFFFH	0... 65535	1	-
CARB A misfire weighted sum (global)					
MIS_SUM_A_CBK [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
CARB A misfire weighted sum (dedicated to Exhaut cylinder bank)					
MIS_SUM_B	O/V	0... FFFFH	0... 65535	1	-
CARB B misfire sum (global)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MIS_SUM_B_CBK [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
CARB B misfire sum (exhaut cylinder bank dedicated)					
SEG_NR_CBK_ER	V	0... FFH	0... 255	1	-
Exhaust cylinder bank reference for misfire monitoring					
SUM_FAC_DIAG_MIS	V	0... 2FDH	0... 5.97656	0.0078125	-
Sum of the weighting factor from diagnosis combinations for final misfire decision.					
SYM_CYL_MIS_A	O/V	0... FFFFH	0... 65535	1	-
CARB A misfire criterion symptoms					
SYM_CYL_MIS_B1	O/V	0... FFFFH	0... 65535	1	-
CARB B1 misfire criterion symptoms					
SYM_CYL_MIS_B4	O/V	0... FFFFH	0... 65535	1	-
CARB B4 misfire criterion symptoms					

Input data:

FAC_ER_DIAG_MIS {p. 6263}	FAC_MIS_A_APP {p. 6263}	FAC_MIS_A_THD_IND_APP {p. 6263}	FAC_MIS_SUM_A_THD_APP {p. 6263}
FAC_MIS_SUM_B1_THD_APP {p. 6263}	FAC_MIS_SUM_B4_THD_APP {p. 6263}	IGC_DIAG_MIS {p. 4772}	INH_INJ {p. 2295}
LC_MIS_INH {p. 6277}	LOAD_MIS {p. 6213}	LV_AT {p. 654}	LV_CDN_MIS_A {p. 6264}
LV_CDN_MIS_B1 {p. 6264}	LV_CDN_MIS_B4 {p. 6264}	LV_DC {p. 5746}	LV_DET_MIS {p. 6276}
LV_ENA_ER {p. 1454}	LV_ES {p. 1720}	LV_INH_IGC_DIAG_MIS {p. 6264}	LV_INH_IV_DIAG_MIS {p. 6264}
LV_MIS_B_DIAG_REQ_APP {p. 6264}	LV_PUC {p. 1720}	LV_REQ_APP_CTR_MIS_A {p. 6264}	LV_SYN_ENG {p. 1506}
N {p. 1525}	N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
NLC_ENA_SCDN_NEW {p. 645}	SEG_NR_ER {p. 1454}	STATE_DIAG_IV {p. 4803}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LOAD_MIS_FTP	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
FTP cycle engine load threshold					
C_MIS_A_IND_THD_AT	-	0... FFFFH	0... 65535	1	-
Cylinder individual threshold used for cylinder shut-off during CARB A criterion window with AT					
C_MIS_A_IND_THD_MT	-	0... FFFFH	0... 65535	1	-
Cylinder individual threshold used for cylinder shut-off during CARB A criterion window with MT					
C_MIS_A_MIN_NR	-	0... FFH	0... 99.60937	0.390625	%
Cylinder identification ratio for CARB A criterion detection					
C_MIS_B1_MIN_NR	-	0... FFH	0... 99.60937	0.390625	%
Cylinder identification ratio for CARB B1 criterion detection					
C_MIS_B4_MIN_NR	-	0... FFH	0... 99.60937	0.390625	%
Cylinder identification ratio for CARB B4 criterion detection					
C_MIS_MAX_NR_OFF_IV	-	0... 4H	0 ...4	1	-
Maximum number of allowed cylinder to be shut-off after detection of the misfire status CARB A.					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MIS_MIN_NR_PUC	-	1... FFH	1... 255	1	-
Minimum number of trailing throttle fuel cut-off phases LV_PUC before cancelling cylinder(s) shut-off.					
C_MIS_NR_OFF_IV_IGCFB	-	0... 8H	0 ...8	1	-
Threshold for number of cylinders shut off due to misfire					
C_MIS_SUM_A_CBK_THD_AT	-	0... FFFFH	0... 65535	1	-
Exhaust cylinder bank threshold for misfire status CARB A detection with AT					
C_MIS_SUM_A_CBK_THD_MT	-	0... FFFFH	0... 65535	1	-
Exhaust cylinder bank threshold for misfire status CARB A detection with MT					
C_MIS_SUM_A_THD_AT	-	0... FFFFH	0... 65535	1	-
Cylinder global threshold for misfire status CARB A detection with AT					
C_MIS_SUM_A_THD_MT	-	0... FFFFH	0... 65535	1	-
Cylinder global threshold for misfire status CARB A detection with MT					
C_MIS_SUM_B1_CBK_THD	-	0... FFFFH	0... 65535	1	-
Exhaut cylinder bank threshold for CARB B1 misfire criterion detection					
C_MIS_SUM_B1_THD_AT	-	0... FFFFH	0... 65535	1	-
Global threshold for CARB B1 misfire criterion detection, LV_AT = 1					
C_MIS_SUM_B1_THD_MT	-	0... FFFFH	0... 65535	1	-
Global threshold for CARB B1 misfire criterion detection, LV_AT = 0					
C_MIS_SUM_B4_CBK_THD	-	0... FFFFH	0... 65535	1	-
Exhaut cylinder bank threshold for CARB B4 misfire criterion detection					
C_MIS_SUM_B4_THD_AT	-	0... FFFFH	0... 65535	1	-
Global threshold for CARB B4 misfire criterion detection, LV_AT = 1					
C_MIS_SUM_B4_THD_MT	-	0... FFFFH	0... 65535	1	-
Global threshold for CARB B4 misfire criterion detection, LV_AT = 0					
C_N_MIS_FTP	-	0... 1FE0H	0... 8160	1	rpm
FTP cycle engine speed threshold					
C_NR_CYL_MPL_MIS_A	-	0... FFH	0... 255	1	-
Number of cylinder in MIS_A to set the multiple misfire CARB A status (typical: 2)					
C_NR_CYL_MPL_MIS_B	-	0... FFH	0... 255	1	-
Number of cylinder in MIS_Bx to set the multiple misfire CARB Bx status (typical: 2)					
C_NR_DET_MAX_MIS_A	-	0... FFH	0... 255	1	-
Maximum value to confirm misfire CARB A status detection (typical: 3) for long term protection					
C_NR_DET_MAX_MIS_B4	-	0... FFH	0... 255	1	-
Maximum value of CTR_DET_MIS_B4 for misfire CARB B4 status detection (typical: 4)					
C_NR_MAX_MIS_A_LIH_CYL	-	0... FFH	0... 255	1	-
Maximum number of MIS_A cylinder limp-home cycle to disable fuel reactivation during current DC					
C_RATIO_FTP_CDN_IND_MIS_AT	-	0... FFH	0... 99.60937	0.390625	%
Covering ratio to detect FTP conditions for short term protection with AT vehicle					
C_RATIO_FTP_CDN_IND_MIS_MT	-	0... FFH	0... 99.60937	0.390625	%
Covering ratio to detect FTP conditions for short term protection with MT vehicle					
C_RATIO_FTP_CDN_MIS_AT	-	0... FFH	0... 99.60937	0.390625	%
Covering ratio to detect FTP conditions for long term protection with AT vehicle					
C_RATIO_FTP_CDN_MIS_MT	-	0... FFH	0... 99.60937	0.390625	%
Covering ratio to detect FTP conditions for long term protection with MT vehicle					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MIS_MIN_PUC	-	1... 3E8H	0.1 ...100	0.1	s
Minimum duration of trailing throttle fuel cut-off phase to be validated like this.					
ID_NR_DET_ENA_MIS_A_LIH_AT	-	0... FFH	0... 255	1	-
LDPM_N_32_1_MISF	8	0... FFH	0... 8160	32	rpm
Number of CARB-A detections to enable MIS_A cylinder switch-off limp-home for AT					
ID_NR_DET_ENA_MIS_A_LIH_MT	-	0... FFH	0... 255	1	-
LDPM_N_32_1_MISF	8	0... FFH	0... 8160	32	rpm
Number of CARB-A detections to enable MIS_A cylinder switch-off limp-home for MT					
IP_FAC_IGC_DIAG_MIS	V	0... FFH	0... 1.99218	0.0078125	-
LDP_N_32_IP_FAC_IGC_DIAG_MIS	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_IP_FAC_IGC_DIAG_MIS	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for ignition diagnosis (ignition failure detected).					
IP_FAC_IV_DIAG_MIS	V	0... FFH	0... 1.99218	0.0078125	-
LDP_N_32_IP_FAC_IV_DIAG_MIS	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_MIS_IP_FAC_IV_DIAG_MIS	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for injection valve diagnosis (injection valve failure detected).					
LC_CONF_INH_IV_MIS	-	0... 1H	0 ...1	1	-
Cylinder switch back on configuration mode : switch back on at the end of driving cycle (=0) or after a defined number of fuel cut-off phases (=1)					
LC_CONF_MIS_A_LIH	-	0... 1H	0 ...1	1	-
Configuration to select MIL mode in case of cylinder shut-off (=0, LV_MIS_STATE_A=0, MIL is not set by cylinder shut-off function), (=1, LV_MIS_STATE_A=1, MIL is ON until end of cylinder shut-off, see mode chosen with LC_CONF_INH_IV_MIS)					
LC_CONF_MIS_STATE_B	-	0... 1H	0 ...1	1	-
Configuration for LV_MIS_STATE_B setting (=0, setting by MIS_B1 only when end of MIS_B4 isn't reached, then only set by MIS_B4) (=1, setting by MIS_B1 or MIS_B4 in any case)					
LC_CONF_MPL_DET_MIS_A	-	0... 1H	0 ...1	1	-
Configuration for multiple cylinder status set in SYM_CYL_MIS_A (multiple misfire pattern Pcode saved) (=1)					
LC_CONF_MPL_DET_MIS_B	-	0... 1H	0 ...1	1	-
Configuration for multiple cylinder status set in SYM_CYL_MIS_Bx (multiple misfire pattern Pcode saved) (=1)					
LC_CONF_RND_DET_MIS_A	-	0... 1H	0 ...1	1	-
Configuration for random cylinder detection when no specific cylinder identified, (=0) Cyl. with the highest value is identified in SYM_CYL_MIS_A or (=1) No identification is realised and RDN bit is set to 1 in SYM_CYL_MIS_A					
LC_CONF_RND_DET_MIS_B	-	0... 1H	0 ...1	1	-
Configuration for random cylinder detection when no specific cylinder identified,: (=0) Cyl. with the highest value is identified in SYM_CYL_MIS_B1 or SYM_CYL_MIS_B4 or (=1) No identification is realised and RDN bit is set to 1 in SYM_CYL_MIS_B1/B4					
LC_ENA_MIS_A_IND_LIH	-	0... 1H	0 ...1	1	-
Enable the misfire cylinder limp home process during the CARB A window (short term catalyst protection) (=1, active)					
LC_ENA_MIS_A_LIH	-	0... 1H	0 ...1	1	-
Enable the misfire cylinder limp home process at the end of the CARB A window (long term catalyst protection) (=1, active)					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CBK_EX_NR_MISF [NC_CYL_NR]	-	0... FFH	0... 255	1	-
Exhaust cylinder bank allocation according misfire segment phasing					

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General information:

The misfire rate determination and misfire specific error management are applied to the following CARB misfire legal definitions:

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- **CARB A misfire failure criterion** *(LV_MIS_STATE_A)*:

Risk of catalyst damage, monitoring interval over 200 crankshaft revolutions (= 200 * NC_CYL_NR /2 TDCs) during the driving cycle.

- **CARB B1 misfire failure criterion** *(LV_MIS_STATE_B1):*

Emission increase, monitoring interval over the first 1000 crankshaft revolutions (= 1000 * NC_CYL_NR /2 TDCs) of the driving cycle.

- **CARB B4 misfire failure criterion** *(LV_MIS_STATE_B4):*

Emission increase, monitoring interval over 1000 crankshaft revolutions (= 1000 * NC_CYL_NR /2 TDCs). For criterion confirmation, misfire must be take place for 4 monitoring intervals (consecutive or not).

MIS_A, MIS_B1 & MIS_B4 Handling Flowchart diagram:

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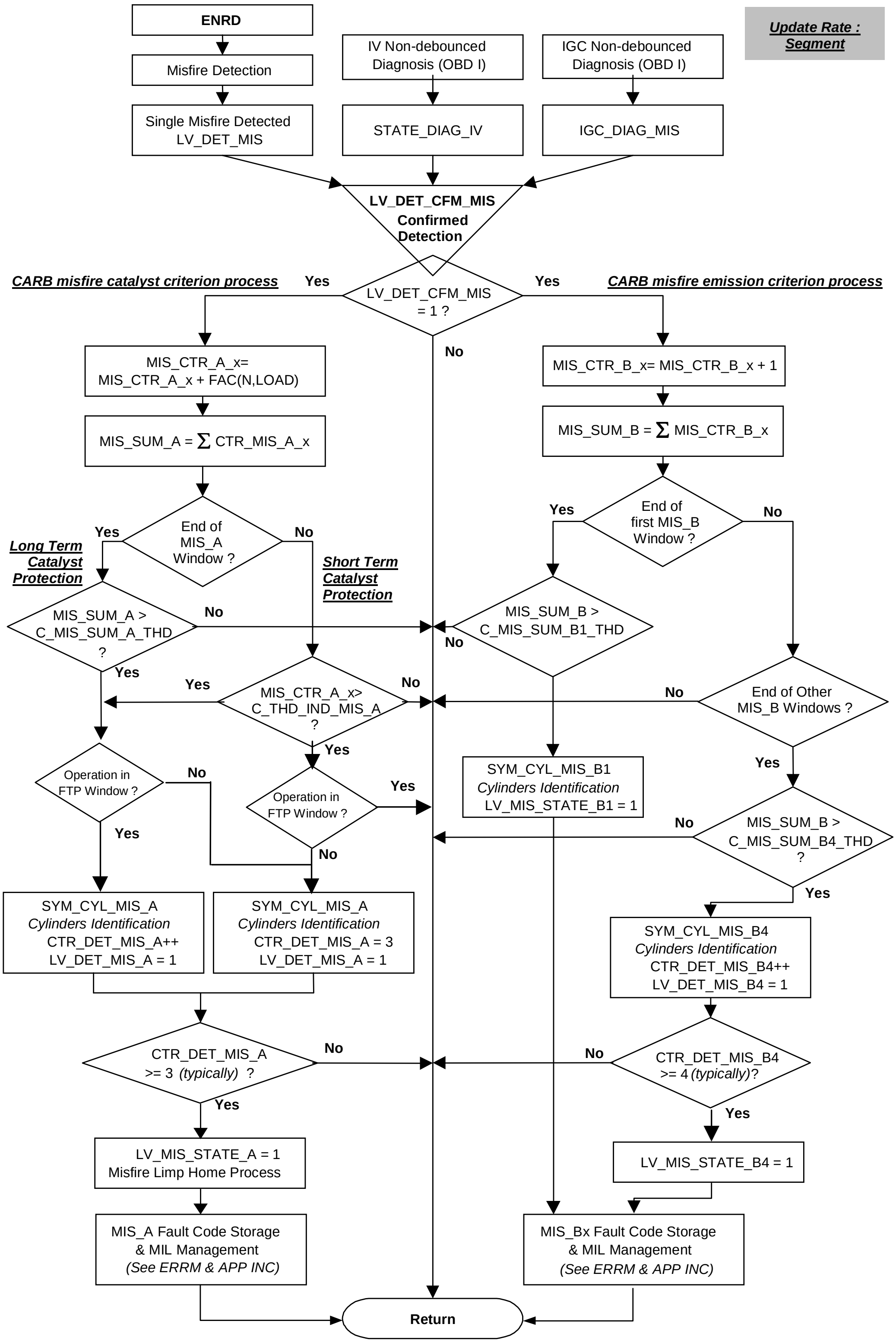

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B.110.1 Combination of different diagnosis reliability levels (misfire detection, ignition, injection)

FUNCTION DESCRIPTION:

General information:

Due to their physical principle, the individual diagnostic functions have a different diagnostic relevance depending on the operating point.
To achieve the best possible detection of misfires, the individual diagnostic methods are combined. Here with an assumed misfire of a part function, an operating point dependent weighting factor, which reflects the reliability of this part function in the current operating point, is taken from a map. If the sum of these three values now exceeds a threshold for one combustion, then misfire is detected.
The value which is not debounced is used as input value of the IV and IGCFB diagnoses. The injection for a cylinder is cut off exclusively by the CARB error mechanism and not by the IV and IGCFB diagnostic functions.

Application conditions:

Misfire segment after detection, before CARB diagnosis

Application conditions

Update rate: `every segment`

Activation:
LC_MIS_INH = 0
Deactivation:
LC_MIS_INH = 1
Initialisation on ECU reset, on LV_DC 0 to 1 transition and on LC_MIS_INH 0 to 1 transition:
SUM_FAC_DIAG_MIS = 0
FAC_IGC_DIAG_MIS = 0
FAC_IV_DIAG_MIS = 0
LV_DET_CFM_MIS = 0

Formula section:

The output from the misfire detection, injection and ignition diagnosis functions is influenced by weighting interpolated table, giving the reliability of the individual functions.
- A weighting value of **0** means that detection is not possible for this engine operating point.
- A value equal to or greater than **1** indicates reliable detection.
- The values in between represent the corresponding levels of reliability.

- Irregular engine operation weighting (LV_DET_MIS = 1):
If misfiring is suspected by the irregular engine operation test, a weighting factor for the corresponding engine operating point is applied. This factor is derived from tables according combustion mode and determine in application incidence. The corresponding result is in FAC_ER_DIAG_MIS data.

- Ignition diagnosis weighting (IGC_DIAG_MIS):
IGC_DIAG_MIS is the not debounced carrier from Ignition diagnosis, which has to be delayed due to misfire detection *(according segment reference SEG_NR_ER-1, cylinder x compression phase)*. If misfiring is suspected by the ignition diagnosis function, a weighting factor for the corresponding engine operating point is applied.
This factor is derived from IP_FAC_IGC_DIAG_MIS table.
For the time the number of cylinders shut off due to misfire detection limp home reaches or exceeds the applicable number of C_MIS_NR_OFF_IV_IGCFB, FAC_IGC_DIAG factor is forced to 1 *(test based on INH_IV_MIS carrier)*.

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If(1) IGC_DIAG_MIS[SEG_NR_ER] = 1
And LV_INH_IGC_DIAG_MIS = 0
Then(1)
If(2) number of bits set to "1" in INH_IV_MIS carrier structure >= C_MIS_NR_OFF_IV_IGCFB

Then(2) FAC_IGC_DIAG_MIS = 1
Else(2) FAC_IGC_DIAG_MIS = IP_FAC_IGC_DIAG_MIS(N_32, LOAD_MIS)
EndIf(2)
Else(1) FAC_IGC_DIAG_MIS = 0
EndIf(1)

- Injection diagnosis weighting (STATE_DIAG_IV) :

STATE_DIAG_IV is a not debounced carrier from Injection valves diagnosis.
Injection valve in default is identifed according segment reference SEG_NR_ER within the bitfield structure STATE_DIAG_IV.
If misfiring is suspected by the injection valve diagnosis function, a weighting factor for the corresponding engine combustion mode is applied.

If STATE_DIAG_IV[SEG_NR_ER] = 1
And LV_INH_IV_DIAG_MIS = 0
Then FAC_IV_DIAG_MIS = IP_FAC_IV_DIAG_MIS(N_32, LOAD_MIS)
Else FAC_IV_DIAG_MIS = 0
EndIf

- Formation of a cylinder - specific diagnosis weighting sum :

The sum of the three weighting values SUM_FAC_DIAG_MIS is performed for the individual cylinder. as soon as one of the three diagnosis function suspects misfiring.

SUM_FAC_DIAG_MIS = FAC_ER_DIAG_MIS
+ FAC_IGC_DIAG_MIS
+ FAC_IV_DIAG_FAC

If SUM_FAC_DIAG_MIS >= 1
Then LV_DET_CFM_MIS = 1 *misfire status is confirmed*
Else LV_DET_CFM_MIS = 0 *no misfire*
EndIf

B.110.2 Misfire detection counters (ISO 15031 Data)

FUNCTION DESCRIPTION:

General information:

These counters are incremented at each misfire detection based on misfire index evaluation *(after crossed diagnosis with IGC & IV OBDI diags evaluation)*. Thus, it s possible to determine the total number of misfire detected during engine lifetime and during current driving cycle.
Moreover, cylinder misfire counters have been introduced for Mode 6 communication service, as described in last ISO specification available (ISO/DIS 15031-5.8).
The calculation of CTR_MIS_DC_MMV_CYL (resolution=1) is rounded to 1 and that leads to a loss of information, since only when CTR_MIS_DC_CYL reaches 10 the MMV value will count up one time.
To avoid this, the calculation must be done, like the described in the CARB requirement, with a intermediate variable with higher resolution to keep the information.
Note: CTR_MIS_TOT_DC & CTR_MIS_DC_CYL[NC_CYL_NR] are initialised only at engine running to keep the information after engine stop.

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B.110.2.1 NVMY Data Formating

On non volatile memory formatting or on NV memory corruption detection:
CTR_MIS_TOT_NVMY = 0
CTR_MIS_TOT_DC = 0
For(1) x = 0 : NC_CYL_NR-1
CTR_MIS_DC_CYL[x] = 0
CTR_MIS_DC_MMV_CYL_IT[x] = 0
CTR_MIS_DC_MMV_CYL[x] = CTR_MIS_DC_MMV_CYL_IT[x]
EndFor(1)

B.110.2.2 Initialisation of former /current driving cycle counters

Initialisations:

- NVMY data loading loading at NVMY_READ event
  Read all the counters from NVMY
  Write NVMY high resolution counter to non-NVMY low resolution counter
  For(1) x = 0 : NC_CYL_NR-1
  // round-off to nearest integer (ceil or floor the value to integer value)
  CTR_MIS_DC_MMV_CYL[x] = CTR_MIS_DC_MMV_CYL_IT[x]
  EndFor(1)
- NVMY data store at NVMY_STO event
  Store all the counters to NVMY
- at LV_DC 0 -> 1 transition event
  CTR_MIS_TOT_DC = 0
  For(1) x = 0 : NC_CYL_NR-1
  CTR_MIS_DC_CYL[x] = 0
  EndFor(1)

B.110.2.3 Increment of misfire counters during current driving cycle

Application conditions

Activation: *LV_ENA_ER = 1*
And *LC_MIS_INH = 0*

Deactivation: *LV_ENA_ER = 0*
Or *LC_MIS_INH = 1*

Update rate: Segment task

Formula section:

If LV_DET_CFM_MIS = 1
Then CTR_MIS_TOT_DC = CTR_MIS_TOT_DC + 1 *// with saturation*
CTR_MIS_TOT_NVMY = CTR_MIS_TOT_NVMY + 1 *// with saturation*
CTR_MIS_DC_CYL[SEG_NR_ER] = CTR_MIS_DC_CYL[SEG_NR_ER] + 1
// with saturation
EndIf

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B.110.2.4 Update of the EWMA misfire counters

Exponential weighted moving average (EWMA) misfire counters are updated at the beginning of the driving cycle based on former driving cycle values.

Update rate: at LV_DC 0 -> 1 transition event*before CTR_MIS_DC_CYL[x] reset (section "Initializations" above)*

For x = 0 : NC_CYL_NR-1
CTR_MIS_DC_MMV_CYL_IT[x] =
0.9 * CTR_MIS_DC_MMV_CYL_IT[x]+ 0.1 * CTR_MIS_DC_CYL[x]
//Write high resolution counter to low resolution counter
// round-off to nearest integer (ceil or floor the value to integer value)
CTR_MIS_DC_MMV_CYL[x] = CTR_MIS_DC_MMV_CYL_IT[x]
EndFor

B.110.3 Exhaust cylinder bank reference for misfire detection

FUNCTION DESCRIPTION:

For catalyst damage and/or emission criterion, misfire diagnosis functions can be set via calibration data in a way to be able to detect criterions according exhaust cylinder bank phasing instead of a global criterion detection.
Exhaust cylinder bank reference for misfire detection allows to increase these criterions on the dedicated cylinder bank weighting factor if the misfire detected has effect on the impacted cylinder bank and not on the other (if multiple exhaust cylinder bank design).

Description:

The exhaust cylinder bank reference SEG_NR_CBK_ER is determinate according the segment reference SEG_NR_ER. It already includes the delay introduced by the misfire index chosen.

Application conditions

Update rate: *Segment task*

Activation: LV_SYN_ENG = 1

Deactivation: LV_SYN_ENG = 0

Initialisation on Deactivation condition:
SEG_NR_CBK_ER = 0
Initialisation: at ECU reset, at DCON, at LC_MIS_INH 0->1, clearing failure memory
SEG_NR_CBK_ER = 0

Formula section:

SEG_NR_CBK_ER = NC_CBK_EX_NR_MISF[SEG_NR_ER]

B.110.4 Determination of CARB A misfire criterion, causing catalyst damage

Description:

With a CARB A misfire rate criterion, the emissions are increased and there is a risk of catalyst damage if the cylinder causing the failure criterion can not be shut off.
Detection:

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The check for misfire rate violation **CARB A** comprises 200 crankshaft revolutions *(100 * NC_CYL_NR tdc's)* for statistic misfiring and cyclewise monitoring for best possible catalyst protection.
If a confirmed misfiring is detected on ER current TDC (LV_DET_CFM_MIS=1), a weighting factor (MIS_A_FAC) is added to the cylinder-specific counter MIS_CTR_A[SEG_NR_ER], extracted from an interpolated table *(see APP. INC.)* who depends on engine combustion mode and current operating point. The increment represents the severity of catalyst damage.
Statistic:
The monitoring for Misfire **CARB A** is performed continuously in intervals of 200 crankshaft revolutions.
Monitoring during CARB A window:
Toguaranteebest possible catalyst protection, the cylinder-specific counters are monitored each cycle. For that purpose, MIS_CTR_A[SEG_NR_ER] is compared to the applicable value C_MIS_A_IND_THD representing the critical threshold for single cylinder misfiring.
If the threshold is reached outside of the FTP cycle, the concerning cylinder is shut off immediately. CARB A misfire criterion is confirmed, else the criterion will be evaluated at the end of the 200 crankshaft revolution window.
Monitoring at the end of 200 crankshaft revolutions:
At the end of each monitoring interval the cylinder-specific sums MIS_CTR_A[NC_CYL_NR] and the global sum (MIS_SUM_A) are available.
If the sum MIS_SUM_A is greater than the threshold C_MIS_SUM_A_THD, the cylinder with the highest misfire rate is determined (by comparing the different MIS_CTR_A[NC_CYL_NR] values).
Then operation inside/outside of the FTP-area is checked by comparison of the counter CTR_FTP_CDN_MIS_A /MIS_NR_TDC_A with the threshold C_RATIO_FTP_CDN_MIS_A. If the FTP tdc's ratio is lower than the threshold, not enough operating points have been inside the FTP-window and therefore operation outside FTP-area is detected (LV_FTP_MIS_A=0). This is done in order to fulfil the CARB-regulations, which require MIL-illumination at first threshold exceeding outside the FTP-area and at third exceeding inside the FTP-area.
Therefore the counter CTR_DET_MIS_A is incremented inside the FTP-area at each threshold exceeding. That means it reaches the maximum of C_NR_DET_MAX_MIS_A = 3 only if the threshold is exceeded in 3 succeeding monitoring intervals.
Outside the FTP-area the failure CARB A is validated immediately. The counter is reset only after an ECU-reset.
Even if we are inside the FTP-area, a specific application request (according catalyst temperature or else) LV_REQ_APP_CTR_MIS_A can force to validate immediately the failure CARB A *(see legal requirements & customer wishes).* This request is defined in associated Application Incidences file.
Note: cylinder and Exhaut cylinder bank specific counters are respectively indexed with SEG_NR_ER and SEG_NR_CBK_ER phase reference counters to take in account ERND delay in misfire monitoring process

Application conditions

Initialisation: *at ECU reset, at LV_DC 0 - > 1 transition, at LC_MIS_INH 0 to 1 transition & at MIS_A or MIS_[NC_CYL_NR] errors clearing*

```
SYM_CYL_MIS_A    = 0
INH_IV_MIS     = 0
MIS_NR_TDC_A    = 0
MIS_SUM_A     = 0
CTR_FTP_CDN_MIS_A  = 0
CTR_DET_MIS_A    = 0
CTR_CHK_MIS_A    = 0
LV_END_WIN_MIS_A = 0
 LV_END_MIS_A    = 0
 LV_FTP_MIS_A    = 0
LV_MIS_STATE_A    = 0
LV_INH_IV_MIS_A   = 0
 LV_DET_MIS_A   = 0
```

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```
 LV_ERR_IN_WIN_MIS_A     = 0
For x = 0 :  NC_CYL_NR-1
 MIS_CTR_A[x] = 0   // All cylinder specific counters
 CTR_MIS_A_LIH_CYL[x] = 0 // All cylinder specific counters
EndFor
For i = 0 :  NC_CBK_EX_NR-1
 MIS_SUM_A_CBK[i] = 0 // All Exhaut cylinder bank specific
counters
EndFor
```

Update rate: *segment task*

Activation:
LV_DC = 1
And LC_MIS_INH = 0
Deactivation:
LV_DC = 0
Or LC_MIS_INH = 1

B.110.4.1 Determination of catalyst damage weighting factor

Catalyst damage weighting factor is determinated according engine combustion mode & buffered to take in account admission phase (SEG_NR_ER - 2).
MIS_A_FAC_BUF is managed as a rotary buffer, MIS_A_FAC_BUF[0] is the weighting factor for the actual segment value.
At each ER segment recurrence:
FAC_MIS_A_APP depends on the combustion mode and determine in application incidence (must be calculated first)
MIS_A_FAC_BUF is managed as a rotary buffer

MIS_A_FAC_BUF[current_position] = FAC_MIS_A_APP
MIS_A_FAC = MIS_A_FAC_BUF [oldest_position] *// points on the oldest value of the buffer*

B.110.4.2 CARB A window management (main process)

If(1) LV_CDN_MIS_A = 1 *// MIS_A monitoring active (see App Inc file)*
Then(1)
 If(2) LV_DET_CFM_MIS = 1 *// Individual misfire detected*
 Then(2) Call **'CARB A Misfire counters increment process'** *(see description below)*
 Else(2) MIS_A Misfire counters unchanged
 EndIf(2)
 If(2) MIS_NR_TDC_A < 100 * NC_CYL_NR
 Then(2) MIS_NR_TDC_A = MIS_NR_TDC_A + 1
  LV_END_WIN_MIS_A = 0 *// End of window not reached*
  If(3) LOAD_MIS < C_LOAD_MIS_FTP
  And N < C_N_MIS_FTP *// FTP window conditions*
  Then(3) CTR_FTP_CDN_MIS_A = CTR_FTP_CDN_MIS_A + 1
  EndIf(3)
  call **'Monitoring process during CARB A window'***(see description below)*
 Else(2) call **'Monitoring process at CARB A window end'***(see description below)*
  call **'CARB A criterion end detection process'***(see description below)*
  call **'CARB A window reset process'***(see description below)*
 EndIf(2)
Else(1) *no process* *// Counters & flags unchanged*
EndIf(1)

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B.110.4.3 CARB A Misfire counters increment process

MIS_SUM_A = MIS_SUM_A + MIS_A_FAC
MIS_SUM_A_CBK[SEG_NR_CBK_ER] =
MIS_SUM_A_CBK[SEG_NR_CBK_ER] + MIS_A_FAC
// Assign only ER current specific Exhaut cylinder bank counter
MIS_CTR_A[SEG_NR_ER] = MIS_CTR_A[SEG_NR_ER] + MIS_A_FAC
// Assign only ER current specific cylinder counter

B.110.4.4 Monitoring process during CARB A window (short term catalyst protection & limp home)

If(1) **{ [** LV_MIS_A_DIAG_REQ_APP = 0
And((LV_AT = 0 **And** MIS_CTR_A[SEG_NR_ER]   C_MIS_A_IND_THD_MT)
Or
(LV_AT = 1 **And** MIS_CTR_A[SEG_NR_ER]   C_MIS_A_IND_THD_AT) **)]**
// Test based only on ER current specific cylinder counter

Or [LV_MIS_A_DIAG_REQ_APP = 1
And((LV_AT = 0 **And** MIS_CTR_A[SEG_NR_ER]
FAC_MIS_A_THD_IND_APP * C_MIS_A_IND_THD_MT)
Or (LV_AT = 1 **And** MIS_CTR_A[SEG_NR_ER]
FAC_MIS_A_THD_IND_APP * C_MIS_A_IND_THD_AT) **)] }**
Then(1)
<u>*Short term FTP conditions check*</u>
If(2) **[** LV_AT = 1 **And**
CTR_FTP_CDN_MIS_A/MIS_NR_TDC_A < C_RATIO_FTP_CDN_IND_MIS_AT **]**
Or [LV_AT = 0 **And**
CTR_FTP_CDN_MIS_A/MIS_NR_TDC_A < C_RATIO_FTP_CDN_IND_MIS_MT **]**
// Out of FTP cycle inside CARB A window
Then(2) Set concerned cylinder bit in structure SYM_CYL_MIS_A to 1
LV_DET_MIS_A = 1 *// Misfire CARB A criterion detected*
LV_MIS_STATE_A = 1 *// Misfire CARB A criterion confirmed*
LV_ERR_IN_WIN_MIS_A = 1
CTR_DET_MIS_A = max(CTR_DET_MIS_A+1, C_NR_DET_MAX_MIS_A)
LV_END_MIS_A = 1
// Substract Current cylinder MIS_A & MIS_SUM_A_CBK counters on global & cylinder bank MIS_A sums to avoid wrong global MIS_A detection at end of current Long term diagnosis
MIS_SUM_A = MIS_SUM_A - MIS_CTR_A[SEG_NR_ER]
MIS_SUM_A_CBK[SEG_NR_CBK_ER] =
MIS_SUM_A_CBK[SEG_NR_CBK_ER] - MIS_CTR_A[SEG_NR_ER]
MIS_CTR_A[SEG_NR_ER] = 0
// Avoid to retrigger criterion until end of the current window
If(3) LC_ENA_MIS_A_IND_LIH = 1
Then(3)
Shut off cylinder indexed by SEG_NR_ER via INH_IV_MIS carrier
Evaluate <u>**'Misfire Cylinder Limp Home process'**</u>
(see description afterwards)
EndIf(3)
Else(2) no operation *// MIS_A criterion evaluated at the end of MIS_A window or*
// at the next cylinder evaluation

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EndIf(2)
Else(1) *flags & data unchanged*
EndIf(1)

#If(1) NLC_ENA_SCDN_NEW = 1
In this case, we do exactly the same operations that those done in "**'Monitoring process at CARB A window end'.**

#EndIf(1)

B.110.4.5 Monitoring process at CARB A window end (long term catalyst protection & limp home)

Global CARB A FTP conditions check
If **[** LV_AT = 1 **And**
CTR_FTP_CDN_MIS_A /MIS_NR_TDC_A C_RATIO_FTP_CDN_MIS_AT **]**
Or **[** LV_AT = 0 **And**
CTR_FTP_CDN_MIS_A /MIS_NR_TDC_A C_RATIO_FTP_CDN_MIS_MT **]**
Then LV_FTP_MIS_A = 1
Else LV_FTP_MIS_A = 0
EndIf
Criterion detection process
// Be carefull, the counter of window A (CTR_CHK_MIS_A) is incremented only at the end of the window and not during.
CTR_CHK_MIS_A = CTR_CHK_MIS_A + 1
If(1) **{** LV_MIS_A_DIAG_REQ_APP = 0
And **[** **(** LV_AT = 0 **And**
(MIS_SUM_A C_MIS_SUM_A_THD_MT
Or MIS_SUM_A_CBK[0...NC_CBK_EX_NR-1]
C_MIS_SUM_A_CBK_THD_MT) *// Check for each exhaust CBK*
)
Or (LV_AT = 1 **And**
(MIS_SUM_A C_MIS_SUM_A_THD_AT
Or MIS_SUM_A_CBK[0...NC_CBK_EX_NR-1]
C_MIS_SUM_A_CBK_THD_AT) *// Check for each exhaust CBK* **)**
] }
Or **{** LV_MIS_A_DIAG_REQ_APP = 1
And **[** **(** LV_AT = 0 **And**
(MIS_SUM_A FAC_MIS_SUM_A_THD_APP * C_MIS_SUM_A_THD_MT
Or MIS_SUM_A_CBK[0...NC_CBK_EX_NR-1]
FAC_MIS_SUM_A_THD_APP * C_MIS_SUM_A_CBK_THD_MT) *// Check for each exhaust CBK* **)**
Or **(** LV_AT = 1 **And**
(MIS_SUM_A FAC_MIS_SUM_A_THD_APP * C_MIS_SUM_A_THD_AT**)**
Or MIS_SUM_A_CBK[0...NC_CBK_EX_NR-1]
FAC_MIS_SUM_A_THD_APP * C_MIS_SUM_A_CBK_THD_AT
) *// Check for each exhaust CBK* **)] }**
Then(1)
If(2) LV_ERR_IN_WIN_MIS_A = 0
Then(2)

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LV_DET_MIS_A = 1
LV_ERR_IN_WIN_MIS_A = 1
As soon as the misfire criterion detected counter reached his threshold, we directly set the error. To avoid to stored it in the same window a second time, we used *lv_err_in_win_mis_a flag.*

If(3) LV_FTP_MIS_A = 0 *// Outside of FTP cycle*
Or LV_REQ_APP_CTR_MIS_A = 1 *// Application specific request*
Then(3) CTR_DET_MIS_A=max(CTR_DET_MIS_A+1, C_NR_DET_MAX_MIS_A)
Else(3) CTR_DET_MIS_A = CTR_DET_MIS_A + 1
EndIf(3)
If(3) CTR_DET_MIS_A C_NR_DET_MAX_MIS_A
Then(3) ***// Global MIS_A default***
LV_MIS_STATE_A = 1
// MIS_A cylinder identification
For(4)x = 0 to NC_CYL_NR - 1 *// Check for each cylinder x*
If(5) MIS_CTR_A[x] > C_MIS_A_MIN_NR * MIS_SUM_A
Then(5) Set in SYM_CYL_MIS_A the cylinder x concerned bit to 1
If(6) LC_ENA_MIS_A_LIH = 1 **And**
[LV_AT = 0 **And**
CTR_DET_MIS_A ID_NR_DET_ENA_MIS_A_LIH_MT(N_32)
]
Or[LV_AT = 1 **And**
CTR_DET_MIS_A ID_NR_DET_ENA_MIS_A_LIH_AT(N_32) **]**
Then(6) Shut off cylinder x via INH_IV_MIS carrier
Evaluate **'<u>Misfire Cylinder Limp Home process</u>'**
(see description afterwards)
Else(6) *No operation*
EndIf(6)
EndIf(5)
EndFor(4)
// MIS_A random cylinder pattern
If(4) No specific cylinder counters comply with C_MIS_A_MIN_NR * MIS_SUM_A criterion
Then(4)
If(5) LC_CONF_RND_DET_MIS_A = 0
Then(5) EvaluateCylinder with the highest MIS_CTR_A[x] value
Set concerned cylinder bit to 1 in SYM_CYL_MIS_A carrier
Set RDN bit *(random)* to 0 in SYM_CYL_MIS_A carrier
Else(5) Set RDN bit *(random)* to 1 in SYM_CYL_MIS_A carrier
Endif(5)
Else(4) Set RDN bit *(random)* to 0 in SYM_CYL_MIS_A carrier
EndIf(4)
EndIf(3)
EndIf(2)
Else(1)
// Be carefull, the 3 following datas are reseted only at the end of the window and not during.
SYM_CYL_MIS_A = 0
LV_DET_MIS_A = 0
LV_MIS_STATE_A = 0
EndIf(1)
// MIS_A default management in case of cylinder shut-off
If INH_IV_MIS 0 **And** LC_CONF_MIS_A_LIH = 1
Then LV_DET_MIS_A = 1
LV_MIS_STATE_A = 1

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Set in SYM_CYL_MIS_A the cylinder bit(s) who are set in INH_IV_MIS *(OR mask)*
Else no action
EndIf
// MIS_A multiple cylinder identification
If LC_CONF_MPL_DET_MIS_A = 1
And Number of cylinder(s) set to 1 in SYM_CYL_MIS_A is equal or over C_NR_CYL_MPL_MIS_A
Then Set MPL bit *(multiple)* to 1 in SYM_CYL_MIS_A carrier
Else Set MPL bit *(multiple)* to 0 in SYM_CYL_MIS_A carrier
End

B.110.4.6 CARB A end detection process

If LV_FTP_MIS_A = 0
Or CTR_DET_MIS_A C_NR_DET_MAX_MIS_A
Or CTR_CHK_MIS_A C_NR_DET_MAX_MIS_A
Then LV_END_MIS_A = 1
EndIf
LV_END_WIN_MIS_A = 1 *// Set for one segment*

B.110.4.7 CARB A window reset process

MIS_NR_TDC_A = 0
MIS_SUM_A = 0
CTR_FTP_CDN_MIS_A = 0
LV_ERR_IN_WIN_MIS_A = 0
For x = 0 : NC_CYL_NR-1
MIS_CTR_A[x] = 0 *// All cylinder specific counters*
EndFor
For i = 0 : NC_CBK_EX_NR-1
MIS_SUM_A_CBK[i] = 0 *// All exhaust cylinder bank specific counters*
EndFor
Reset of Misfire Status:
The Misfire Status CARB A is resetted at the end of the driving cycle see formula section

B.110.4.8 Misfire Cylinder Identification SYM_CYL_MIS_A

The location of detected cylinders with misfire status CARB A is coded in a carrier word:

SYM_CYL_MIS_A

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```
┌┬┬┬┬┬┬┬┬┬┬┬┬┬┬┐
││││││││││││││││
│││││││││││││││└──> Cylinder 0
││││││││││││││└───> Cylinder 1
│││││││││││││└────> Cylinder 2
││││││││││││└─────> Cylinder 3
│││││││││││└──────> Cylinder 4
││││││││││└───────> Cylinder 5
│││││││││└────────> Cylinder 6
││││││││└─────────> Cylinder 7
│││││││└──────────> Cylinder 8
││││││└───────────> Cylinder 9
│││││└────────────> Cylinder 10
││││└─────────────> Cylinder 11
│││└──────────────> RDN
││└───────────────> MPL
│└────────────────> -
└─────────────────> -
```

B.110.4.9 Misfire Cylinder Limp Home process:

Cylinder shut off is limited by a C_MIS_MAX_NR_OFF_IV maximum number of cylinders that can be shut-off simultaneously
Each time, the misfire cylinder limp home process on one (or more) cylinder(s) is triggered, the corresponding cylinder counter(s) CTR_MIS_A_LIH_CYL[NC_CYL_NR] is(are) unitary incremented.
The location of switched off Cylinder(s) x is set to 1 in INH_IV_MIS, other cylinder bits are set to 0.
On the same driving cycle, if after a cylinder shut-off cancellation, a new cylinder MIS_A criterion occurs during CARB A window, the sytem must shut-off this cylinder once more.

Carrier structure :

INH_IV_MIS

```
┌┬┬┬┬┬┬┬┐
││││││││
│││││││└──> Cylinder 0
││││││└───> Cylinder 1
│││││└────> Cylinder 2
││││└─────> Cylinder 3
│││└──────> Cylinder 4
││└───────> Cylinder 5
│└────────> Cylinder 6
└─────────> Cylinder 7
```

B.110.4.10 Conditions for Cylinder switch back on

Update rate: *every 100ms, independently of MIS_A window process & conditions*
Cylinder(s) x can be switched on according two different methods:

1. Cylinder(s) x can be switched back on at the end of the driving cycle

   LC_CONF_INH_IV_MIS = 0

1. Cylinder(s) x can be switched back on after a defined number of fuel cut-off phases **and** at the end of the driving cycle

   LC_CONF_INH_IV_MIS = 1

   For this purpose, the system performs a test for the applicable number C_MIS_MIN_NR_PUC of trailing throttle fuel cut-off LV_PUC cycles, since the last cylinder(s) shutoff.

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Therefore, the trailing throttle fuel cut-off LV_PUC flag must have been active for the applicable minimum period C_T_MIS_MIN_PUC.

If the condition concerning the minimum number of trailing throttle fuel cut-off events is met. Cylinder shut-off is cancelled at the end of the last trailing throttle fuel cut-off phase only for cylinders who answer to the conditions CTR_MIS_A_LIH_CYL[x] < C_NR_MAX_MIS_A_LIH_CYL *(check for all cylinders),* all other cylinders stay in fuel cut-off up to end of the driving cycle.

Cylinder shut-off is also cancelled after engine stopped LV_ES.

B.110.4.11 Process on cylinder shut-off cancellation

Update rate: every TDC, independently of MIS_A window process & conditions

If Any 1 -> 0 cylinder bit(s) transition within INH_IV_MIS
And LC_CONF_MIS_A_LIH = 1
Then Corresponding bit(s) within SYM_CYL_MIS_A is set to 0
If LC_CONF_MPL_DET_MIS_A = 1
And Number of remaining cylinder bit(s) set to 1 in SYM_CYL_MIS_A is less than C_NR_CYL_MPL_MIS_A cylinders
Then Set MPL bit *(multiple)* to 0 in SYM_CYL_MIS_A carrier
EndIf
If No more cylinder bit(s) or RNDbit are set to 1 whitin SYM_CYL_MIS_A structure
Then LV_DET_MIS_A = 0
LV_MIS_STATE_A = 0
EndIf
Else *No action*
EndIf
If Any cylinder bit(s) within INH_IV_MIS is set to 1
And Corresponding bit(s) within INH_INJ is (are) also set to 1
Then LV_INH_IV_MIS_A = 1
Else LV_INH_IV_MIS_A = 0
EndIf

B.110.5 Determination of CARB B1 & B4 misfire criterions, causing increased emissions

Description:

The purpose is to detect a misfire rate causing an emission increase. The failure criterion entry is performed by direct statistical evaluation.

Detection:

The check for misfire rate violation CARB comprises 1.000 crankshaft revolutions (500*NC_CYL_NR tdc's).

Each combustion during these 1.000 crankshaft revolutions is monitored for misfiring.

If a confirmed misfiring is detected on ER current TDC (LV_DET_CFM_MIS=1), the cylinder-specific misfire counter MIS_CTR_B[SEG_NR_ER] is incremented by one.

In every driving cycle a distinction is made between misfires detected during the first 1000 crankshaft revs after engine start (**CARB B1**) and misfires detected in later observing intervals. In the second case, a misfire rate violation must take place during four monitoring intervals to recognise misfire (**CARB B4**).

Statistic:

At the end of the first 1.000 crankshaft revolutions, the added cylinder-specific sums are evaluated. If the sum exceeds the applicable value C_THD_MIS_B1_AT/MT, **CARB B1** misfire criterion is detected.

At the end of each following 1.000 crankshaft revolutions interval, the added cylinder-specific sums are evaluated. If the sum exceeds the applicable value C_THD_MIS_B1_AT/MT the anti-bounce counter

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CTR_DET_MIS_B4 will be incremented till its maximum C_NR_DET_MAX_MIS_B4 (typical = 3) is reached. If the sum does not exceed C_THD_MIS_B1_AT/MT, CTR_DET_MIS_B4 remains unchanged.
To filter out those cylinders with low misfire rates, the cylinder-specific counters MIS_CTR_B[NC_CYL_NR] shall be compared to the applicable value C_THD_MIS_B_MIN before storage takes place.
If none of the cylinder-specific counters is higher than C_THD_MIS_B_MIN, a maximum choice is done and the cylinder with the highest misfire rate is entered into failure memory.

Application conditions

Initialisation: *at ECU reset, at LV_DC 0 -> 1 transition, at LC_MIS_INH 0 to 1 transition & at MIS_B1/ B4 or MIS_[NC_CYL_NR] errors clearing*

```
LV_MIS_STATE_B1    = 0
LV_DET_MIS_B4    = 0
LV_MIS_STATE_B4    = 0
LV_MIS_STATE_B    = 0
SYM_CYL_MIS_B1    = 0
SYM_CYL_MIS_B4    = 0
MIS_NR_TDC_B    = 0
MIS_SUM_B    = 0
CTR_DET_MIS_B4    = 0
CTR_CHK_MIS_B4    = 0
 LV_END_MIS_B1    = 0
 LV_END_MIS_B4    = 0
 LV_END_WIN_MIS_B1   = 0
 LV_END_WIN_MIS_B4   = 0
 LV_ERR_IN_WIN_MIS_B1 = 0
 LV_ERR_IN_WIN_MIS_B4 = 0
 LV_ERR_MIS_A_IN_WIN_B = 0
For x = 0 :  NC_CYL_NR-1
 MIS_CTR_B[x] = 0  // All cylinder specific counters
EndFor
For i  = 0 :  NC_CBK_EX_NR-1
 MIS_SUM_B_CBK[i] = 0 // All Exhaut cylinder bank specific counters
EndFor
```

Update rate: *every segment*

Activation:

LV_DC = 1
And LC_MIS_INH = 0

Deactivation:

LV_DC = 0
Or LC_MIS_INH = 1

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Formula section:

B.110.5.1 CARB B1/B4 windows management (main process)

If(1) LV_CDN_MIS_B1 = 1 *// CARB B1 monitoring active (see App Inc file)*
Or LV_CDN_MIS_B4 = 1 *// CARB B4 monitoring active (see App Inc file)*
Then(1)
If(2) LV_DET_CFM_MIS = 1 *// Misfire detected*
Then(2) call**'CARB B1/B4 Misfire counters increment process'**
(see description below)
Else(2) *MIS_B1/B4 counters unchanged*
EndIf(2)
If(2) LV_ERR_IN_WIN_MIS_A = 1
Then(2) LV_ERR_MIS_A_IN_WIN_B = 1
EndIf(2)
If(2) MIS_NR_TDC_B < 500 * NC_CYL_NR
Then(2) MIS_NR_TDC_B= MIS_NR_TDC_B + 1
LV_END_WIN_MIS_B1 = 0
LV_END_WIN_MIS_B4 = 0
If(3)NLC_ENA_SCDN_NEW = 1

'Monitoring process during CARB B1/B4 window'

EndIf(3)

(End of windows not reached)
Else(2) call **'Monitoring process at CARB B1/B4 window end'**
(see description below)
call **'CARB B1/B4 ends detection process'**
(see description below)
call **'CARB B1/B4 window reset process'***(see description below)*
EndIf(2)
If(1) **[** LV_MIS_STATE_B1 = 1
And (LV_END_MIS_B4 = 0 **Or** LC_CONF_MIS_STATE_B = 1) **]**
Or LV_MIS_STATE_B4 = 1
Then(1) LV_MIS_STATE_B = 1
Else(1) LV_MIS_STATE_B = 0
EndIf(1)
Else(1) *no process (Counters & flags unchanged)*
EndIf(1)

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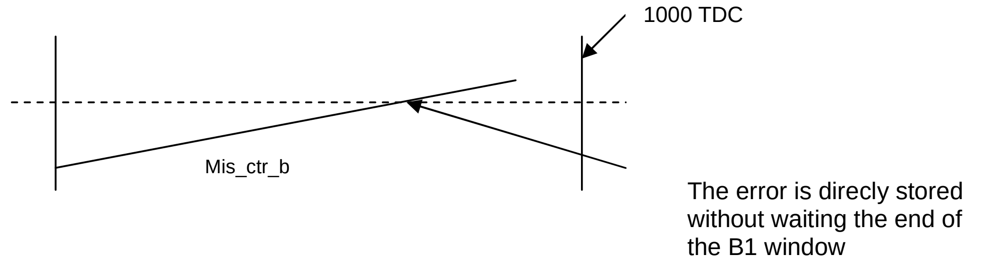
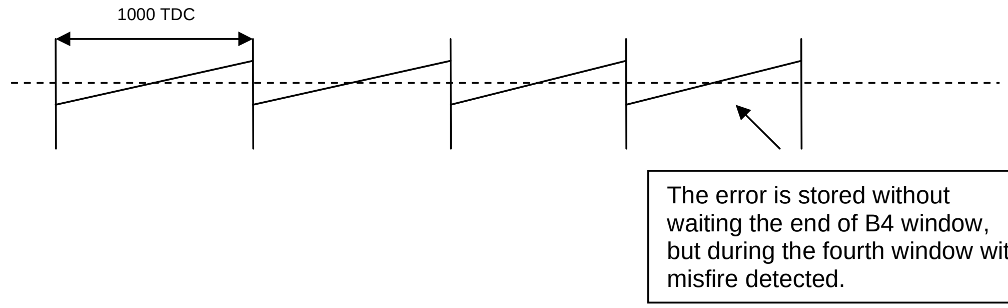
MIS_B1 Management



MIS_B4 Management



B.110.5.2 CARB B1/B4 Misfire counters increment process

MIS_SUM_B = MIS_SUM_B + 1
MIS_SUM_B_CBK[SEG_NR_CBK_ER] = MIS_SUM_B_CBK[SEG_NR_CBK_ER] + 1
// Assign only ER current specific exhaut cylinder bank counter
MIS_CTR_B[SEG_NR_ER] = MIS_CTR_B[SEG_NR_ER] + 1
// Assign only ER current specific cylinder counter

B.110.5.3 Monitoring process at CARB B1/B4 window end

If(1) LV_END_MIS_B1 = 0 *// End of CARB B1 window*
Then(1)
If(2) **{** LV_MIS_B_DIAG_REQ_APP = 0 **And**
[(MIS_SUM_B   C_MIS_SUM_B1_THD_MT **And** LV_AT = 0 **)**
Or **(** MIS_SUM_B   C_MIS_SUM_B1_THD_AT **And** LV_AT = 1 **)**
Or MIS_SUM_B_CBK[0...NC_CBK_EX_NR-1]
C_MIS_SUM_B1_CBK_THD **] }**
// Check for each exhaust cylinder banks
Or
{ LV_MIS_B_DIAG_REQ_APP = 1 **And**
[(MIS_SUM_B
(FAC_MIS_SUM_B1_THD_APP * C_MIS_SUM_B1_THD_MT)
And LV_AT = 0 **)**
Or **(** MIS_SUM_B
(FAC_MIS_SUM_B1_THD_APP * C_MIS_SUM_B1_THD_AT)
And LV_AT = 1 **)**
Or MIS_SUM_B_CBK[0...NC_CBK_EX_NR-1]
FAC_MIS_SUM_B1_THD_APP * C_MIS_SUM_B1_CBK_THD**]}**

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// Check for each exhaust cylinder banks

Then(2) call **'CARB B1 criterion determination process'** *(see description below)*
Else(2) *no criterion detection*
LV_MIS_STATE_B1 = 0
EndIf(2)
Else(1)
// Be carefull, the counter of window B4 (CTR_CHK_MIS_B4) is incremented only at the end of the window and not during.
CTR_CHK_MIS_B4 = CTR_CHK_MIS_B4 + 1 *// at the End of CARB B4 window*
If(2) **{** LV_MIS_B_DIAG_REQ_APP = 0 **And**
[(MIS_SUM_B C_MIS_SUM_B4_THD_MT **And** LV_AT = 0 **)**
Or **(** MIS_SUM_B C_MIS_SUM_B4_THD_AT **And** LV_AT = 1 **)**
Or MIS_SUM_B_CBK[0...NC_CBK_EX_NR-1]
C_MIS_SUM_B4_CBK_THD **] }**
// Check for each exhaust cylinder banks
Or
{ LV_MIS_B_DIAG_REQ_APP = 1 **And**
[(MIS_SUM_B
(FAC_MIS_SUM_B4_THD_APP * C_MIS_SUM_B4_THD_MT)
And LV_AT = 0 **)**
Or (MIS_SUM_B
(FAC_MIS_SUM_B4_THD_APP * C_MIS_SUM_B4_THD_AT)
And LV_AT = 1 **)**
Or MIS_SUM_B_CBK[0...NC_CBK_EX_NR-1]
FAC_MIS_SUM_B4_THD_APP * C_MIS_SUM_B4_CBK_THD**]}**
// Check for each exhaust cylinder banks

Then(2) call **'CARB B4 criterion determination process'** *(see description below)*
Else(2) *no criterion detection*
// Be carefull, the 3 following datas are reseted only at the end of the window and not during.
LV_DET_MIS_B4 = 0
LV_MIS_STATE_B4 = 0
SYM_CYL_MIS_B4 = 0
EndIf(2)
EndIf(1)

B.110.5.4 Monitoring process during CARB B1/B4 window

This part is realized during CARB B1/B4 window when NLC_ENA_SCDN_NEW=1.
In this case, we do exactly the same operations that those done in "**'Monitoring process at CARB B1/B4 window end'.**

B.110.5.5 CARB B1 criterion determination process:

// Global CARB B1 default

As soon as an error occurs during B1 window, we set the error.
But if the error enters again, we do not want to store it again. This is realized by lv_err_in_win_mis_b1 flag.

if(1) (LV_ERR_IN_WIN_MIS_B1 = 0)
Then(1)

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LV_MIS_STATE_B1 = 1
LV_ERR_IN_WIN_MIS_B1 = 1
// CARB B1 cylinder identification
For x = 0 to NC_CYL_NR - 1 *// Check for each cylinder x*
If(2) MIS_CTR_B[x] > C_MIS_B1_MIN_NR * MIS_SUM_B
Then(2) Set in SYM_CYL_MIS_B1 the cylinder x concerned bit to 1
EndIf(2)
EndFor
// CARB B1 random cylinder pattern
If No specific cylinder counters comply with C_MIS_B1_MIN_NR * MIS_SUM_B criterion
Then
If(3) LC_CONF_RND_DET_MIS_B = 0
Then(3) EvaluateCylinder with the highest MIS_CTR_B[x] value
Set concerned cylinder bit to 1 in SYM_CYL_MIS_B1 carrier
Set RDN bit *(random)* to 0 in SYM_CYL_MIS_B1 carrier
Else(3) Set RDN bit *(random)* to 1 in SYM_CYL_MIS_B1 carrier
Endif(3)
Else Set RDN bit *(random)* to 0 in SYM_CYL_MIS_B1 carrier
EndIf
// CARB B1 multiple cylinder identification
If LC_CONF_MPL_DET_MIS_B = 1
And number of cylinder(s) set to 1 in SYM_CYL_MIS_B1 is equal or over C_NR_CYL_MPL_MIS_B
Then Set MPL bit *(multiple)* to 1 in SYM_CYL_MIS_B1 carrier
Else Set MPL bit *(multiple)* to 0 in SYM_CYL_MIS_B1 carrier
End
Endif(1)

B.110.5.6 CARB B4 criterion determination process

If(1) (LV_ERR_IN_WIN_MIS_B4 = 0)
Then(1)
CTR_DET_MIS_B4 = CTR_DET_MIS_B4 + 1
LV_DET_MIS_B4 = 1
LV_ERR_IN_WIN_MIS_B4 = 1

As soon as the misfire criterion detected counter reached his threshold, we directly set the error. To avoid to stored it in the same window a second time, we used *lv_err_in_win_mis_b4 flag.*

If(2) (CTR_DET_MIS_B4 C_NR_DET_MAX_MIS_B4)
Then(2)
// Global CARB B4 default
LV_MIS_STATE_B4 = 1
// CARB B4 cylinder identification
For(3) x = 0 to NC_CYL_NR-1 *// Check for each cylinder x*
If(4) MIS_CTR_B[x] > C_MIS_B4_MIN_NR * MIS_SUM_B
Then(4) Set in SYM_CYL_MIS_B4 the cylinder x concerned bit to 1
EndIf(4)
EndFor(3)
// CARB B4 random cylinder pattern
If(3) No specific cylinder counters comply with C_MIS_B4_MIN_NR * MIS_SUM_B criterion
Then (3)
If(4) LC_CONF_RND_DET_MIS_B = 0
Then(4) EvaluateCylinder with the highest MIS_CTR_B[x] value

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Set concerned cylinder bit to 1 in SYM_CYL_MIS_B4 carrier
Set RDN bit *(random)* to 0 in SYM_CYL_MIS_B4 carrier
Else(4) Set RDN bit *(random)* to 1 in SYM_CYL_MIS_B4 carrier
Endif(4)
Else(3) Set RDN bit *(random)* to 0 in SYM_CYL_MIS_B4 carrier
EndIf(3)
// CARB B4 multiple cylinder identification
If(3) LC_CONF_MPL_DET_MIS_B = 1
And number of cylinder(s) set to 1 in SYM_CYL_MIS_B4 is equal or over C_NR_CYL_MPL_MIS_B
Then(3) Set MPL bit *(multiple)* to 1 in SYM_CYL_MIS_B4 carrier
Else(3) Set MPL bit *(multiple)* to 0 in SYM_CYL_MIS_B4 carrier
End(3)
Else(2)
SYM_CYL_MIS_B4 = 0
LV_MIS_STATE_B4 = 0
EndIf(2)
EndIf(1)

B.110.5.7 CARB B1/B4 ends detection process

If(1) LV_END_MIS_B1 = 0
Then(1) LV_END_MIS_B1 = 1
LV_END_WIN_MIS_B1 = 1 *(set for one segment)*
Else(1)
LV_END_WIN_MIS_B4 = 1 *(set for one segment)*
If(2) CTR_DET_MIS_B4 C_NR_DET_MAX_MIS_B4
Or CTR_CHK_MIS_B4 C_NR_DET_MAX_MIS_B4
Then(2) LV_END_MIS_B4 = 1
EndIf(2)
EndIf(1)

B.110.5.8 CARB B1/B4 window reset process

MIS_NR_TDC_B = 0
MIS_SUM_B = 0
LV_ERR_IN_WIN_MIS_B1 = 0
LV_ERR_IN_WIN_MIS_B4 = 0
LV_ERR_MIS_A_IN_WIN_B = 0
For x = 0 : NC_CYL_NR-1
MIS_CTR_B[x] = 0 *// All cylinder specific counters*
EndFor
For i = 0 : NC_CBK_EX_NR-1
MIS_SUM_B_CBK[i] = 0 *// All exhaust cylinder bank specific counters*
EndFor

B.110.5.9 SYM_CYL_MIS_B1 and SYM_CYL_MIS_B4 carriers definition

The location of detected cylinders with misfire status CARB B is coded in two carrier bytes:

SYM_CYL_MIS_B1, SYM_CYL_MIS_B4

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```
┌─┬─┬─┬─┬─┬─┬─┬─┬─┬─┬─┬─┬─┬─┬─┬─┐
│ │ │ │ │ │ │ │ │ │ │ │ │ │ │ │ │
└─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┴─┘
 │ │ │ │ │ │ │ │ │ │ │ │ │ │ │ └───> Cylinder 0
 │ │ │ │ │ │ │ │ │ │ │ │ │ │ └─────> Cylinder 1
 │ │ │ │ │ │ │ │ │ │ │ │ │ └───────> Cylinder 2
 │ │ │ │ │ │ │ │ │ │ │ │ └─────────> Cylinder 3
 │ │ │ │ │ │ │ │ │ │ │ └───────────> Cylinder 4
 │ │ │ │ │ │ │ │ │ │ └─────────────> Cylinder 5
 │ │ │ │ │ │ │ │ │ └───────────────> Cylinder 6
 │ │ │ │ │ │ │ │ └─────────────────> Cylinder 7
 │ │ │ │ │ │ │ └───────────────────> Cylinder 8
 │ │ │ │ │ │ └─────────────────────> Cylinder 9
 │ │ │ │ │ └───────────────────────> Cylinder 10
 │ │ │ │ └─────────────────────────> Cylinder 11
 │ │ │ └───────────────────────────> RDN
 │ │ └─────────────────────────────> MPL
 │ └───────────────────────────────> -
 └─────────────────────────────────> -
```

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B.111 Misfire rate determination and error management (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_MIS_DET	O/V/S	0... FFFFH	0... 65535	1	-
Number of misfire events of all cylinders in one DC					
CTR_MIS_DET_CYL [NC_CYL_NR]	O/V/S	0... FFFFH	0... 65535	1	-
Number of lifetime misfire events per cylinder					
CTR_SEG_MIS_ACT	O/V/S	0... FFFFFFFFH	0... 4294967295	1	-
Number of segments with active misfire detection					
ERR_SYM_MIS [NC_CYL_NR]	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom specific cylinder misfire					
ERR_SYM_MIS_FTL_L	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom misfire with low fuel					
ERR_SYM_MIS_MPL	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom multiple cylinder misfire					
FAC_ER_DIAG_MIS	O/V	0... FFH	0... 1.99218	0.0078125	-
Reliability weighting factor for detection based on misfire detection index (ER)					
FAC_MIS_A_APP	O/V	0... 64H	0... 100	1	-
Catalyst damage weighting factor used to increment counters for MIS_A criterion pending application specific conditions					
FAC_MIS_A_THD_IND_APP	O/V	0... 1FFH	0... 1.99609	3.9063e-3	-
Cylinder individual threshold used for cylinder shut-off during CARB A criterion window pending application specific conditions					
FAC_MIS_SUM_A_THD_APP	O/V	0... 1FFH	0... 1.99609	3.9063e-3	-
Global threshold used for CARB A criterion pending application specific conditions					
FAC_MIS_SUM_B1_THD_APP	O/V	0... 1FFH	0... 1.99609	3.9063e-3	-
Global threshold used for CARB B1 criterion pending application specific conditions					
FAC_MIS_SUM_B4_THD_APP	O/V	0... 1FFH	0... 1.99609	3.9063e-3	-
Global threshold used for CARB B4 criterion pending application specific conditions					
LV_CDN_DIAG_MIS [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Diagnosis condition specific cylinder misfire					
LV_CDN_DIAG_MIS_FTL_L	O/V	0... 1H	0 ...1	1	-
Diagnosis condition misfire with low fuel					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_MIS_MPL	O/V	0... 1H	0 ...1	1	-
Diagnosis condition multiple cylinder misfire					
LV_CDN_MIS_A	O/V	0... 1H	0 ...1	1	-
CARB A misfire criterion monitoring condition					
LV_CDN_MIS_B1	O/V	0... 1H	0 ...1	1	-
CARB B1 misfire criterion monitoring condition					
LV_CDN_MIS_B4	O/V	0... 1H	0 ...1	1	-
CARB B4 misfire criterion monitoring condition					
LV_END_DIAG_MIS [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
End of diagnosis flag					
LV_END_DIAG_MIS_FTL_L	O/V	0... 1H	0 ...1	1	-
End of diagnosis flag					
LV_END_DIAG_MIS_MPL	O/V	0... 1H	0 ...1	1	-
End of diagnosis flag					
LV_ERR_MIS [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
Present error flag specific cylinder misfire					
LV_ERR_MIS_FTL_L	O/V	0... 1H	0 ...1	1	-
Present error flag misfire with low fuel					
LV_ERR_MIS_MPL	O/V	0... 1H	0 ...1	1	-
Present error flag multiple cylinder misfire					
LV_INH_IGC_DIAG_MIS	O/V	0... 1H	0 ...1	1	-
Inhibition of misfire crossed diagnosis with IGC OBD I errors					
LV_INH_IV_DIAG_MIS	O/V	0... 1H	0 ...1	1	-
Inhibition of misfire crossed diagnosis with IV OBD I errors					
LV_MIS_A_DIAG_REQ_APP	O/V	0... 1H	0 ...1	1	-
Specific request to evaluate CARB A criterion with project specific calibration set according external conditions (bad fuel quality...)					
LV_MIS_B_DIAG_REQ_APP	O/V	0... 1H	0 ...1	1	-
Specific request to evaluate CARB B1 & B4 criterions with project specific calibration set according external conditions (bad fuel quality...)					
LV_REQ_APP_CTR_MIS_A	O/V	0... 1H	0 ...1	1	-
Specific request to allow out of FTP counting mode even if we are within FTP area					

Input data:

LC_CONF_MPL_DET_MIS_A {p. 6241}	LC_CONF_MPL_DET_MIS_B {p. 6241}	LC_MIS_INH {p. 6277}	LOAD_MIS {p. 6213}
LV_DC {p. 5746}	LV_DET_MIS {p. 6276}	LV_END_MIS_B1 {p. 6237}	LV_END_MIS_B4 {p. 6237}
LV_END_WIN_MIS_B1 {p. 6238}	LV_END_WIN_MIS_B4 {p. 6238}	LV_ERR_IN_WIN_MIS_A {p. 6238}	LV_ERR_IN_WIN_MIS_B4 {p. 6238}
LV_ERR_MIS_A_IN_WIN_B {p. 6238}	LV_FTL_L_DIAG_MIS {p. 6283}	LV_INH_DET_MIS {p. 6276}	LV_MIS_STATE_A {p. 6238}
LV_MIS_STATE_B1 {p. 6238}	LV_MIS_STATE_B4 {p. 6238}	LV_REQ_INH_MIS {p. 6225}	LV_RUN_ENG {p. 1505}
N {p. 1525}	N_32 {p. 1525}	NC_CMB_CONF {p. 812}	NLC_ENA_SCDN_NEW {p. 645}

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OPM_AV {p. 8137}	SEG_NR_ER {p. 1454}	SYM_CYL_MIS_A {p. 6239}	SYM_CYL_MIS_B1 {p. 6239}
SYM_CYL_MIS_B4 {p. 6239}	TEG_CAT_UP_MDL_MAX {p. 1939}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TEG_CAT_UP_MIS_A_MAX	-	0... 7FF0H	0... 2047	0.0625	°C
TEG Threshold for Misfire A counter management					
IP_FAC_ER_AFS_DIAG_MIS	V	0... FFH	0... 1.99218	0.0078125	-
LDP_N_32_IP_FAC_ER_AFS_DIAG_MIS	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_IP_FAC_ER_AFS_DIAG_MIS	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for irregular engine operation (engine speed analysis) in AFS combustion mode					
IP_FAC_ER_HOM_S_DIAG_MIS	V	0... FFH	0... 1.99218	0.0078125	-
LDP_N_32_IP_FAC_ER_HOM_S_MIS	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_IP_FAC_ER_HOM_S_MIS	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for irregular engine operation (engine speed analysis) in HOM_S combustion mode					
IP_FAC_ER_S_DIAG_MIS	V	0... FFH	0... 1.99218	0.0078125	-
LDP_N_32_IP_FAC_ER_S_DIAG_MIS	6	0... FFH	0... 8160	32	rpm
LDP_LOAD_IP_FAC_ER_S_DIAG_MIS	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Weighting factor for irregular engine operation (engine speed analysis) in S combustion mode					
IP_MIS_A_FAC_AFS	V	0... 64H	0... 100	1	-
LDP_N__MIS_A_FAC_AFS	6	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS__MIS_A_FAC_AFS	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Catalyst damage weighting factor used for MIS_A counters increment (AFS combustion mode)					
IP_MIS_A_FAC_HOM_S	V	0... 64H	0... 100	1	-
LDP_N__MIS_A_FAC_HOM_S	6	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS__MIS_A_FAC_HOM_S	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Catalyst damage weighting factor used for MIS_A counters increment (HOM_S combustion mode)					
IP_MIS_A_FAC_S	V	0... 64H	0... 100	1	-
LDP_N__MIS_A_FAC_S	6	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS__MIS_A_FAC_S	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
Catalyst damage weighting factor used for MIS_A counters increment (Stratified combustion mode)					
LC_CTR_CONF_DIAG_MIS	-	0... 1H	0 ...1	1	-
Diagnosis TDC counting mode : counting all TDCs (=0) or only diagnosed TDC's (=1)					
LC_CTR_CONF_OSC_MIS	-	0... 1H	0 ...1	1	-
Diagnosis TDC counting mode when crankshaft oscillations occurs: stop counting TDC's (=0) or counting allowed TDC's (=1)					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_TREAT_DIAG_MIS	-	0... 1H	0 ...1	1	-
Misfire default failures generated per symptoms CARB_A, CARB_B1 & CARB_B4 (NLC_TREAT_DIAG_MIS = 0) or per specific cylinder misfire errors (NLC_TREAT_DIAG_MIS = 1)					

Import actions:

ACTION_ERRM_CdnDiagScdn (**IN**<PRM_IDX_DIAG>)
Continued on next page

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ACTION_ERRM_EndWinScdn (**IN**<PRM_IDX_ERR>,**IN**<PRM_EXC>)

B.111.1 Application Incidences data for diagnosis

Description:

LV_REQ_APP_CTR_MIS_A is used for Misfire A calculation considering the load for the catalyst due to exhaust temperature.

Application conditions

Initialisation: *0 at reset*

Recurrence: ENRD segment synchronous,
After misfire detection, Before misfire diagnosis

Activation: *LC_MIS_INH = 0* ***and*** *LV_DC = 1*

Deactivation: *LC_MIS_INH = 1* ***or*** *LV_DC = 0*

Formula section:

LV_INH_IV_DIAG_MIS = LV_INH_DET_MIS
LV_INH_IGC_DIAG_MIS = LV_INH_DET_MIS
Calculation of LV_REQ_APP_CTR_MIS_A
If TEG_CAT_UP_MDL_MAX > C_TEG_CAT_UP_MIS_A_MAX
Then LV_REQ_APP_CTR_MIS_A = 1
Else LV_REQ_APP_CTR_MIS_A = 0
EndIf
Request to evaluate CARB A criterion with project specific calibration set
LV_MIS_A_DIAG_REQ_APP = 0
FAC_MIS_A_THD_IND_APP = 0
FAC_MIS_SUM_A_THD_APP = 0

Request to evaluate CARB B1 & B4 criterions with project specific calibration set
LV_MIS_B_DIAG_REQ_APP = 0
FAC_MIS_SUM_B1_THD_APP = 0
FAC_MIS_SUM_B4_THD_APP = 0

B.111.2 Combustion mode influence on the catalyst damage weigthing factor

At each ER segment recurrence:
FAC_MIS_A_APP must be calculated before "Determination of catalyst damage weighting factor" in the generic specification named **Misfire rate and error management**

Convention for combustion mode determination:
#If **NC_CMB_CONF = AFS_AFL Or AFS_AFL_S**
If OPM_AV = 3 (homogeneous-stratified)
Then xx = "HOM_S"
EndIf
#EndIf

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#If **NC_CMB_CONF = AFS_S Or AFS_AFL_S**
If OPM_AV = 1 (stratified)
Then xx = "S"
EndIf
#EndIf
If OPM_AV <> 1 and OPM_AV <> 3 (homogeneous)
Then xx = "AFS"
EndIf

FAC_MIS_A_APP= IP_MIS_A_FAC_xx(N, LOAD_MIS)

B.111.3 Combustion mode gestion for combination of different diagnosis reliability level

FUNCTION DESCRIPTION:

General information:

FAC_ER_DIAG_MIS must be calculated before the determination of SUM_FAC_DIAG_MIS (in the generic specification named Misfire rate determination and error mamagement)

Application conditions:

Misfire segment after detection, before CARB diagnosis
Update rate: every segment
Activation:
LC_MIS_INH = 0
Deactivation:
LC_MIS_INH = 1

Formula section:

Initialisation on ECU reset, on LV_DC 0 to 1 transition and on LC_MIS_INH 0 to 1 transition:
FAC_ER_DIAG_MIS = 0
Irregular engine operation weighting (LV_DET_MIS = 1):
If misfiring is suspected by the irregular engine operation test, a weighting factor for the corresponding engine operating point is applied. This factor is derived from tables according combustion mode.

Convention for combustion mode determination:
#If **NC_CMB_CONF = AFS_AFL Or AFS_AFL_S**
If OPM_AV = 3 (homogeneous-stratified)
Then xx = "HOM_S"
EndIf
#EndIf
#If **NC_CMB_CONF = AFS_S Or AFS_AFL_S**
If OPM_AV = 1 (stratified)
Then xx = "S"
EndIf
#EndIf
If OPM_AV <> 1 and OPM_AV <> 3 (homogeneous)
Then xx = "AFS"

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EndIf

If LV_DET_MIS = 1
Then FAC_ER_DIAG_MIS = IP_FAC_ER_xx_DIAG_MIS(N_32, LOAD_MIS)
Else FAC_ER_DIAG_MIS = 0
EndIf

B.111.4 Determination of CARB misfire criterion monitoring conditions (ER algorithm integration, NC_MISF_VERS = 1)

Description:

Depending on customers & legal requirements reached, two Tdc's counting modes are available :

- counting each Tdc's even if some aren't diagnosed *(LC_CTR_CONF_DIAG_MIS* = *0)*
- counting only diagnosed Tdc's *(LC_CTR_CONF_DIAG_MIS* = *1)*

LV_DC	LC_CTR_CONF_DIAG_MIS	LV_INH_DET_MIS	LC_CTR_CONF_OSC_MIS	LV_STATE_CRK_OSC	LV_CDN_MIS_A LV_CDN_MIS_B1 LV_CDN_MIS_B4	MIS_A, MIS_B1 & MIS_B4 Monitoring Modes
0	x	x	x	x	0	Out of Driving Cycle
1	0	x	x	x	1	All TDC's Counting Mode
1	1	1	x	x	0	Diagnosed TDC's Counting Mode / Classical Fade Out
1	1	0	0	0	1	Diagnosed TDC's Counting Mode / No Fade Out
1	1	0	0	1	0	Classical Fade Out **with** CRK_OSC / Diagnosed TDC's Counting Mode
1	1	0	1	0	1	Diagnosed TDC's Counting Mode / No Fade Out
1	1	0	1	1	1	Classical Fade Out **without** CRK_OSC / Diagnosed TDC's Counting Mode

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Application conditions

Initialization: *0 at LV_DC 0->1* ***or*** *reset* ***or*** *LC_MIS_INH 0 to 1 transition*

Recurrence: ENRD segment synchronous,
After misfire detection, Before misfire diagnosis

Activation: *LC_MIS_INH = 0* ***and*** *LV_DC = 1*

Deactivation: *LC_MIS_INH = 1* ***or*** *LV_DC = 0*

Formula section:

If **NC_MISF_VERS = 1**
Module Integrated
Else
Module Not Integrated

EndIf

If(1) LC_CTR_CONF_DIAG_MIS = 0 *// Counting each TDC s*
Or
{ (LC_CTR_CONF_DIAG_MIS = 1 **And** LV_INH_DET_MIS = 0)
And
[LC_CTR_CONF_OSC_MIS = 1
Or (LC_CTR_CONF_OSC_MIS = 0 **And** LV_STATE_CRK_OSC = 0)] **}**
// if Crankshaft oscillation detection module integrated, to be deleted if not
Then(1)
LV_CDN_MIS_A = 1 *// Carb A diagnosis active*
If(2) LV_END_MIS_B1 = 0
Then(2)
LV_CDN_MIS_B1 = 1 *// Carb B1 diagnosis active*
LV_CDN_MIS_B4 = 0 *// Carb B4 diagnosis inactive*
Else(2)
LV_CDN_MIS_B1 = 0 *// Carb B1 diagnosis inactive*
LV_CDN_MIS_B4 = 1 *// Carb B4 diagnosis active*
EndIf(2)
Else(1)
LV_CDN_MIS_A = 0 *// Carb A diagnosis inactive*
LV_CDN_MIS_B1 = 0 *// Carb B1 diagnosis inactive*
LV_CDN_MIS_B4 = 0 *// Carb B4 diagnosis inactive*
EndIf(1)

B.111.5 Specific cylinder misfire errors

FUNCTION DESCRIPTION:

General information:

There is one LV_ERR_MIS[x] for each cyllinder (x = 0, 1, 2, 3, 4, 5), thus a seperate calibration of P-codes for each symptom is possible.

Description:

If Misfire criterion is detected on one cylinder with at least one of the CARB_A, CARB_B1 or CARB4 default criterions, the corresponding cylinder error is set (error is set directly without debounce). The symptom is always corresponding to the last error occurence, and the error is reseted only when all misfire criterions on this cylinder have disappeared.
Error-symptoms are defined to this diagnosis function as following :

```
[ | | | ]
 | | | └> - Cylinder in misfire, Criterion default : MIS_A     (= SYM_0)
 | | └───> - Cylinder in misfire, Criterion default : MIS_B1    (= SYM_1)
 | └─────> - Cylinder in misfire, Criterion default : MIS_B4    (= SYM_2)
 └───────> -                                                   (= SYM_3)
```

Formula section:

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Initialisation: at ECU reset **or** LV_DC 0 -> 1 **or** LC_MIS_INH 0 -> 1 for all cylinders

LV_CDN_DIAG_MIS[x] = 0
LV_END_DIAG_MIS[x] = 0
LV_ERR_MIS[x] = 0
ERR_SYM_MIS[x] = 0

Recurrence: The application recurrence is **ENRD segment**
After misfire detection, after misfire diagnosis !

Activation:

If(1) LV_DC = 1
And LC_MIS_INH = 0
And **(** LV_CDN_MIS_A = 1
Or LV_CDN_MIS_B4 = 1
Or LV_CDN_MIS_B1 = 1 **)**
Then(1) **For**(2)x = 0 ... NC_CYL_NR-1
LV_CDN_DIAG_MIS[x] = 1 *// Diagnosis is active for all cylinders*
If(3)NLC_ENA_SCDN_NEW = 1
Then(3) ACTION_ERRM_CdnDiagScdn (MIS[x])
EndIf(3)
EndFor(2)
Else(1) **For**(2)x = 0 ... NC_CYL_NR-1
LV_CDN_DIAG_MIS[x] = 0 *// Diagnosis is passive for all cylinders*
EndFor(2)
EndIf(1)

Formula section:

Remark:

Note : CARRIER*[x]* = 1, stands for bit dedicated to cylinder x inside CARRIER structure is set to 1
ERR_SYM[x]*[0]* = 1, stands for symptom 0 inside ERR_SYM[x] structure is set to 1
[x] *(italic)* stands for bit assignement within a data, [x] stands for data assignement within an array

Individual cylinder errors set in case of MIS_A failure

If(1) LV_MIS_STATE_A = 1 *// MIS_A failure criterion*
For(2) x = 0 to NC_CYL_NR - 1 *// Check for each cylinder x*
If(3) SYM_CYL_MIS_A*[x]* = 1
Then(3) LV_ERR_MIS[x] = 1 *// MIS failure on Cyl x*
ERR_SYM_MIS[x]*[0]* = 1 *// MIS_A symptom on Cyl x*
Delivery the result to Error Management
If(4) **(**NLC_ENA_SCDN_NEW=1 and LV_ERR_MIS[x]=0 ->1**)**
Then(4) ACTION_ERRM_EndWinScdn(MIS[x],1)

End If(4)
Else(3) **If**(4) SYM_CYL_MIS_B1*[x]* = 0
And SYM_CYL_MIS_B4*[x]* = 0
Then(4) LV_ERR_MIS[x] = 0
ERR_SYM_MIS[x] = 0H
Delivery the result to Error Management

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```
                    Else(4)                      ERR_SYM_MIS[x][0] = 0                    // MIS_
A symptom on Cyl x
                                Delivery the result to Error Management
                      EndIf(4)

                    EndIf(3)
              EndFor(2)
       Else(1)        // No MIS_A failure criterion
          For(2)          x = 0 to NC_CYL_NR - 1                            // Check for each cylinder x
              If(3)          SYM_CYL_MIS_B1[x] = 0
                  And SYM_CYL_MIS_B4[x] = 0
              Then(3) LV_ERR_MIS[x] = 0
                       ERR_SYM_MIS[x] = 0H
                     Delivery the result to Error Management
              Else(3) ERR_SYM_MIS[x][0] = 0         // Symptom MIS_A erased
                     Delivery the result to Error Management
              EndIf(3)
       EndFor(2)
       EndIf(1)
```

Individual cylinder errors set in case of MIS_B1 failure

```
If(1)          (LV_END_MIS_B1 = 0 or LV_END_WIN_MIS_B1 = 1)     // Diagnosis during window MIS_
B1
Then(1)
  If(2)          LV_MIS_STATE_B1 = 1                              // MIS_B1 failure criterion
          For(3)          x = 0 to NC_CYL_NR - 1                   // Check for each cylinder x
                    If(4)              SYM_CYL_MIS_B1[x] = 1
              Then(4) LV_ERR_MIS[x] = 1          // MIS failure on Cyl x
                       ERR_SYM_MIS[x][1] = 1          // MIS_B1 symptom on Cyl x
                     Delivery the result to Error Management
                    EndIf(4)
              EndFor(3)
       Else(2)
              // No MIS_B1 failure criterion, MIS_B1 symptom on Cyl x evaluated once per driving
cycle
              No operation
       EndIf(2)
         If(5)NLC_ENA_SCDN_NEW = 1
  Then(5)
              For(6)          x = 0 to NC_CYL_NR - 1
                                   If(7) (LV_ERR_MIS[x]=0→1 or LV_END_WIN_MIS_B1 = 1)
             ACTION_ERRM_EndWinScdn(MIS[x],LV_ERR_MIS[x]+
                    LV_ERR_MIS_A_IN_WIN_Bold) // Check for each cylinder
                    EndIf(7)
                EndFor(6)
         EndIf(5)
EndIf(1)
```

Individual cylinder errors set in case of MIS_B4 failure

```
If(1)          LV_MIS_STATE_B4 = 1                              // MIS_B4 failure criterion
  For(2)          x = 0 to NC_CYL_NR - 1                        // Check for each cylinder x
              If(3)              SYM_CYL_MIS_B4[x] = 1
       Then(3) LV_ERR_MIS[x] = 1          // MIS failure on Cyl x
                    ERR_SYM_MIS[x][2] = 1          // MIS_B4 symptom on Cyl x
```

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Delivery the result to Error Management

Else(3) **If**(4) SYM_CYL_MIS_A*[x]* = 0
And SYM_CYL_MIS_B1*[x]* = 0
Then(4) LV_ERR_MIS[x] = 0
ERR_SYM_MIS[x] = 0H
Delivery the result to Error Management

Else(4) ERR_SYM_MIS[x]*[2]* = 0 *// MIS_B4 symptom on Cyl x*
Delivery the result to Error Management
EndIf(4)
EndIf(3)
EndFor(2)
Else(1) *// No MIS_B4 failure criterion*
For(2) x = 0 to NC_CYL_NR - 1 *// Check for each cylinder x*
If(3) SYM_CYL_MIS_A*[x]* = 0
And SYM_CYL_MIS_B1*[x]* = 0
Then(3) LV_ERR_MIS[x] = 0
ERR_SYM_MIS[x] = 0H
Delivery the result to Error Management
Else(3) ERR_SYM_MIS[x]*[2]* = 0 *// Symptom MIS_B4 erased*
Delivery the result to Error Management
EndIf(3)
EndFor(2)
EndIf(1)
If(1) **(**NLC_ENA_SCDN_NEW = 1**)**
Then(1)
For(2) x = 0 to NC_CYL_NR - 1
If(3) **(**LV_ERR_MIS[x]=0 & LV_END_WIN_MIS_B4=1 **)**
Then(3) ACTION_ERRM_EndWinScdn (MIS[x], LV_ERR_IN_WIN_MIS_B4old + LV_ERR_MIS_A_IN_WIN_Bold)
// previous values of lv_err_mis_a_in_win_b and lv_err_in_win_mis_b4.
Else If(4) **(**LV_ERR_MIS[x]=1 & LV_ERR_IN_WIN_MIS_B4=0->1 **)**
ACTION_ERRM_EndWinScdn (MIS[x], LV_ERR_IN_WIN_MIS_B4)
End If(4)
End If(3)
EndFor(2)
End If(1)

<u>End of Diagnosis:</u>

If LV_ERR_MIS[x] = 1
Then LV_END_DIAG_MIS[x] = 1 *// for all cylinders*
Else LV_END_DIAG_MIS[x] = LV_END_MIS_B4 *// for all cylinders*
EndIf

B.111.6 Multiple cylinder misfire

<u>Description:</u>

If at the end of the concerned checking range (LV_END_WIN_MIS_A), misfire is detected on two or more cylinders, then the Multiple cylinder misfire is detected.

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Depending if only MIS_A, MIS_B1, MIS_B4 or a combination is active, the concerned bits are set. The error is set directly without debounce.

Error-symptoms are defined to this diagnosis function as following :

```
 ┌─┬─┬─┬─┐
 └─┴─┴─┴─┘
  │ │ │ └─> Multiple cylinder MIS_A detected      (= SYM_0)
  │ │ └───> Multiple cylinder MIS_B1 detected     (= SYM_1)
  │ └─────> Multiple cylinder MIS_B4 detected     (= SYM_2)
  └───────> Multiple cylinder misfire detected    (= SYM_3)
```

Application conditions

Initialisation: *all outputs with 0 at LV_DC 0->1* ***or*** *reset*

Recurrence: The application recurrence is **ENRD segment,** After misfire detection, After misfire diagnosis

Activation:

```
If     LV_DC = 1
 And    LV_CDN_MIS_A = 1
 And    LC_MIS_INH = 0
 And    ( LC_CONF_MPL_DET_MIS_A = 1        or
  LC_CONF_MPL_DET_MIS_B = 1 )
 And        LV_END_WIN_MIS_A = 1
Then        LV_CDN_DIAG_MIS_MPL = 1      // diagnosis is active
Else        LV_CDN_DIAG_MIS_MPL = 0      // diagnosis is passive
 Endif
```

Formula section:

Error detection Muliple misfire without symptom detection

If LV_CDN_DIAG_MIS_MPL = 1
Then **If** at least two Multiple Misfire Bits are active (Bits MPL are set in SYM_CYL_MIS_A, SYM_CYL_MIS_B1, SYM_CYL_MIS_B4)
Then ERR_SYM_MIS_MPL = SYM_3
LV_ERR_MIS_MPL = 1

Error detection Muliple misfire MIS_A
Else If onlyMPL Misfire MIS_A is active (Bit MPL is set in SYM_CYL_MIS_A)
Then ERR_SYM_MIS_MPL = SYM_0
LV_ERR_MIS_MPL = 1

Error detection Muliple misfire MIS_B1
Else If only MPL Misfire MIS_B1 is active (Bit MPL is set in SYM_CYL_MIS_B1)
Then ERR_SYM_MIS_MPL = SYM_1
LV_ERR_MIS_MPL = 1

Error detection Muliple misfire MIS_B4
Else If only MPL Misfire MIS_B4 is active (Bit MPL is set in SYM_CYL_MIS_B4)
Then ERR_SYM_MIS_MPL = SYM_2
LV_ERR_MIS_MPL = 1

No Muliple misfire
Else If no BIT Multiple Misfire is active (all Bits MPL are 0)
Then ERR_SYM_MIS_MPL = NO_SYM
LV_ERR_MIS_MPL = 0

Endif

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Else waiting for diagnosis condition (end of diagnosis window MIS_A)
Endif

End of Diagnosis

If LV_ERR_MIS_MPL = 1 **or**
LV_END_MIS_B4 = 1
Then LV_END_DIAG_MIS_MPL = 1
Endif

B.111.7 Misfire with low fuel signal active

Description:

If Misfire is detected (CARB_A /CARB_B1/4) with low fuel signal active then a error bit is set in order to supply a own P-code requested by CARB (error is set directly without debounce)

Error-symptoms are defined to this diagnosis function as following :

```
┌─┬─┬─┬─┐
│ │ │ │ │
└─┴─┴─┴─┘
 │  │  │  └─> -                                    (= SYM_0)
 │  │  └────> Misfire with active fuel-tank reserve (= SYM_1)
 │  └───────> -                                    (= SYM_2)
 └──────────> -                                    (= SYM_3)
```

Application conditions

Initialisation: *all outputs with 0 at LV_DC 0->1* ***or*** *reset*

Recurrence: The application recurrence is ***ENRD segment,*** After misfire detection, After misfire diagnosis

Activation:
```
If      LV_DC = 1
 And    LV_CDN_MIS_A = 1
 And    LC_MIS_INH = 0
 Then   LV_CDN_DIAG_MIS_FTL_L = 1        (diagnosis is active)
Else    LV_CDN_DIAG_MIS_FTL_L = 0   (diagnosis is passive)
Endif
```

Formula section:

Error detection

If (LV_MIS_STATE_A = 1 **or**
LV_MIS_STATE_B1 = 1 **or**
LV_MIS_STATE_B4 = 1)
and
LV_FTL_L_DIAG_MIS = 1 *fuel reseve active and calibrated*

Then ERR_SYM_MIS_FTL_L = SYM_1
LV_ERR_MIS_FTL_L = 1 *set directly*
Else ERR_SYM_MIS_FTL_L = NO_SYM
LV_ERR_MIS_FTL_L = 0 *reset*
Endif

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End of Diagnosis

If LV_ERR_MIS_FTL_L = 1 **or**
LV_END_MIS_B4 = 1
Then LV_END_DIAG_MIS_FTL_L = 1
Endif

B.111.8 Misfire event counters

Description:

The counters should be used for reading out diagnosis data in the workshop. All Data are stored in NVMY. The DC - related counters (CTR_SEG_MIS_ACT and CTR_MIS_DET) are initialized if engine is started or if NVMY is cleared.

Application conditions

Initialisation:	CTR_SEG_MIS_ACT and CTR_MIS_DET are initialized from MVMY and set to 0 at LV_RUN_ENG 0->1 **or** at clearing misfire NVMY variables. CTR_MIS_DET_CYL[i] are initialized from MVMY and only set to 0 at clearing misfire NVMY variables	
Recurrence:	*ER segment task, after ER determination process & Misfire detection*	
Activation:	*LV_REQ_INH_MIS = 0*	*increment counters*
Deactivation:	*LV_REQ_INH_MIS = 1*	*counters are unchanged*

Formula section:

Calculation of CTR_SEG_MIS_ACT
CTR_SEG_MIS_ACT n = CTR_SEG_MIS_ACT n-1 +1
//counting every segment if MSF detetion is active

Calculation of CTR_MIS_DET
If LV_DET_MIS = 1
Then CTR_MIS_DET n = CTR_MIS_DET n-1 +1
CTR_MIS_DET_CYL[SEG_NR_ER] n =
CTR_MIS_DET_CYL[SEG_NR_ER] n-1 +1

Endif
Remark for all counters:
If the counters reaches the end of Hex-limit, then the inrementing process is stopped and value remain on max value.

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B.112 Misfire detection

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_THD_ER	V	0... 400H	0 ...4	3.91e-3	?????
Global gain multiplicative correction applied to basic misfire detection thresholds					
LV_DET_MIS	O/V	0... 1H	0 ...1	1	-
Single misfire detected and confirmed (after fade out test)					
LV_DET_THD_MIS	V	0... 1H	0 ...1	1	-
Single misfire detected based only on threshold criterion (before fade out test)					
LV_INH_DET_MIS	O/V	0... 1H	0 ...1	1	-
General misfire detection fade out					
MIS_DET_CYL_INH	V	0... FFH	0... 255	1	-
Cylinder misfiring detection inhibition carrier byte when a fade out condition occurred (after masking & delay)					
MIS_STATE_ER	V	0... FFH	0... 255	1	-
Status carrier byte of actual detected misfire through engine roughness index - 1 bit /cylinder					
THD_ER	O/V	8000... 7FFFH	-32768 ...32767	1	-
Misfire detection threshold for current ER value					
THD_ER_BUF [NC_SIZE_THD_ER_BUF]	V	8000... 7FFFH	-32768 ...32767	1	-
Misfire detection threshold stack for ER evaluation					
THD_ER_CYL [NC_CYL_NR]	V	8000... 7FFFH	-32768 ...32767	1	-
Cylinder Misfire detection threshold for current ER value					

Input data:

ER {p. 1454}	ER_STND {p. 1454}	FAC_THD_APP_ER {p. 6283}	INH_INJ {p. 2295}
LC_MIS_INH {p. 6277}	LOAD_MIS {p. 6213}	LV_AT {p. 654}	LV_CVT
LV_DIAG_MIS {p. 6225}	LV_DRI {p. 1302}	LV_ENA_ER {p. 1454}	LV_ENA_SEG_T_MES {p. 1447}
LV_ER_CLC_MIS_DET_CUS_SPC {p. 8360}	LV_HOM_AFL_ACT {p. 8136}	LV_IS {p. 1720}	LV_REQ_INH_MIS {p. 6225}
LV_S_ACT {p. 8137}	LV_VAR_4WD {p. 655}	LV_ZDLY_DIAG_MIS {p. 6225}	MIS_STATE_CUS_SPC {p. 8360}
N {p. 1525}	N_32 {p. 1525}	NC_CMB_CONF {p. 812}	NC_CYL_NR {p. 1526}
SEG_NR_ER {p. 1454}	TCO {p. 1100}	THD_ER {p. 6276}	THD_ER_CLC {p. 6283}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_THD_IV_ER	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_N_32_IP_FAC_THD_IV_ER	6	0... FFH	0... 8160	32	rpm
Factor for adaptation of the threshold in case of active cylinder cut-off					
IP_FAC_THD_IV_S_ER	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDP_N_32_IP_FAC_THD_IV_S_ER	6	0... FFH	0... 8160	32	rpm
Factor for adaptation of the threshold in case of active cylinder cut-off in stratified combustion mode					
IP_FAC_THD_TCO_ER	-	0... 1FFH	0... 1.99609	3.9063e-3	-
LDP_TCO_IP_FAC_THD_TCO_ER	8	0... FEH	-48... 142.5	0.75	°C
Temperature-dependent threshold reduction					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_MIS_INH	-	0... 1H	0 ...1	1	-
Global switch to disable all misfire monitoring related modules (Inhibition with = 1)					
LC_MIS_INH_CUS_SPC	-	0... 1H	0 ...1	1	-
Global switch to disable customer specific misfire monitoring (Inhibition with = 1)					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_SIZE_THD_ER_BUF	-	0... 8H	0 ...8	1	-
Misfire detection threshold buffer size					
NLC_USE_ER_STND_MIS	-	0... 1H	0 ...1	1	-
Misfire detection integration mode (based on ER index = 0, based on ER_STND index = 1)					

B.112.1 Global fade out switch for misfire detection and monitoring

Description:

There is one global switch which can be used for inhibiting all the MISF aggregate modules:

- Generic misfire parameters & fade-out conditions : Aggr MISF, chapter OBDII
- Legal misfire detection fade-out conditions : Aggr MISF, chapter OBDII
- Rough road detection : Aggr MISF, chapter OBDII
- Crankshaft oscillation detection : Aggr MISF, chapter OBDII
- Misfire detection : Aggr MISF, chapter OBDII
- Appl. Inc. for misfire detection : Aggr MISF, chapter OBDII
- Misfire rate and criterions determination : Aggr MISF, chapter OBDII
- Appl. Inc. for Misfire rate and criterions determination : Aggr MISF, chapter OBDII

B.112.2 Misfire detection thresholds determination for engine roughness index

Function description:

ER strategy misfire detection is based on a comparison between a cylinder specific ER value (nominal or normalised) and a threshold who is relative to the engine parameters when this same cylinder was in intake phase (threshold relative to combustion conditions image).
The engine roughness value ER depends strongly on the current operating point, both in its spread during undisturbed engine operation, and in the signal amplitude in case of an actual misfire.
ER misfire detection thresholds are defined according basic threshold maps and threshold corrections:

- *A basic threshold map:*

This map is function of engine load and speed which are calibrated for engine at operating temperature as well as for adapted transmitter gear. One map is assigned through the vehicle transmission type, idle speed condition & the combustion mode.

- *A threshold temperature correction:*

A temperature correction is applied to compensate larger signal amplitudes arise of ER values at lower engine temperatures. This correction is relative to TCO value.

- *A threshold correction during active injection valve cut-off:*

If one or several injection valves are cut off selectively by the engine management system (IV diagnoses ...), then the cylinder or cylinders are excluded from the misfire check. Due to the system, the signal amplitude of the ER value is reduced with a misfire at another cylinder. To improve the detection for this period, the absolute amount of the threshold can be reduced multiplicatively with the factor IP_

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FAC_THD_IV_ER(N_32) or IP_FAC_THD_IV_S_ER(N_32) *(in stratifed mode)*. *FAC_THD_IV_ER is a temporary data.*

- *A threshold correction defined in application incidences:*

FAC_THD_APP_ER is a threshold multiplicative correction who is defined in the misfire detection application incidences file.

B.112.2.1 Multiplicative correction for misfire thresholds

Application conditions

Initialisation: FAC_THD_IV_ER = 1

Recurrence: *every ENRD segment task*

Activation: *LV_ENA_SEG_T_MES = 1*
And *LC_MIS_INH = 0*

Deactivation: *LV_ENA_SEG_T_MES = 0*
Or *LC_MIS_INH = 1*

Formula section:

#IF NC_CMB_CONF = AFS_S Or AFS_AFL_S
If INH_INJ = 0
Then FAC_THD_IV_ER = 1
ElseIf LV_S_ACT = 1
Then FAC_THD_IV_ER = IP_FAC_THD_IV_S_ER(N_32)
Else FAC_THD_IV_ER = IP_FAC_THD_IV_ER(N_32)
EndIf
#ELSE
If INH_INJ = 0
Then FAC_THD_IV_ER = 1
Else FAC_THD_IV_ER = IP_FAC_THD_IV_ER(N_32)
EndIf
#ENDIF
FAC_THD_ER = IP_FAC_THD_TCO_ER(TCO) * FAC_THD_IV_ER * FAC_THD_APP_ER

B.112.2.2 Misfire detection threshold buffers management

To manage the delay between cylinder intake phase and cylinder ER values, buffers are used to store threshold values before using for detection.
THD_ER_BUF[NC_SIZE_THD_ER_BUF] buffer is managed as a FIFO stack.
THD_ER_BUF[0] threshold value is the one obtained at current segment.
THD_ER is threshold value delayed and who will be used for detection with current segment ER value. This delay between ER value and cylinder corresponding threshold depends on engine cylinder number (NC_CYL_NR).

B.112.2.3 Misfire detection threshold based on engine roughness value (THD_ER)

By using the ER value for misfire detection, the engine speed has the greatest influence on basic thresholds definition. On the other hand, by using the ER_STND values for misfire detection, the engine load has the greatest influence on basic thresholds definition.
The influence of the engine load on the detection thresholds can change rapidly during instationary operation, it is urgently necessary to determine and to temporarily store the threshold values already at the time of the actual combustion before the calculatory check.

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note: at each ER segment occurence, THD_ER_BUF is shifted with one memory unit (FIFO management) before determination process.

Application conditions

Initialisation:

```
at ECU reset Or  engine stop
 THD_ER = -32768
//  ER Threshold buffer init on ER buffer reinitialisation
For  k = 0 :  NC_SIZE_THD_ER_BUF-1
THD_ER_BUF[k] = -32768 // For all buffer cells
 EndFor
For  x = 0 :  NC_CYL_NR-1
 THD_ER_CYL[x] = -32768 // For all cylinders
 EndFor
```

Recurrence: *every ENRD segment task*

Activation: *LV_ENA_SEG_T_MES = 1*
And *LC_MIS_INH = 0*

Deactivation: *LV_ENA_SEG_T_MES = 0*
Or *LC_MIS_INH = 1*

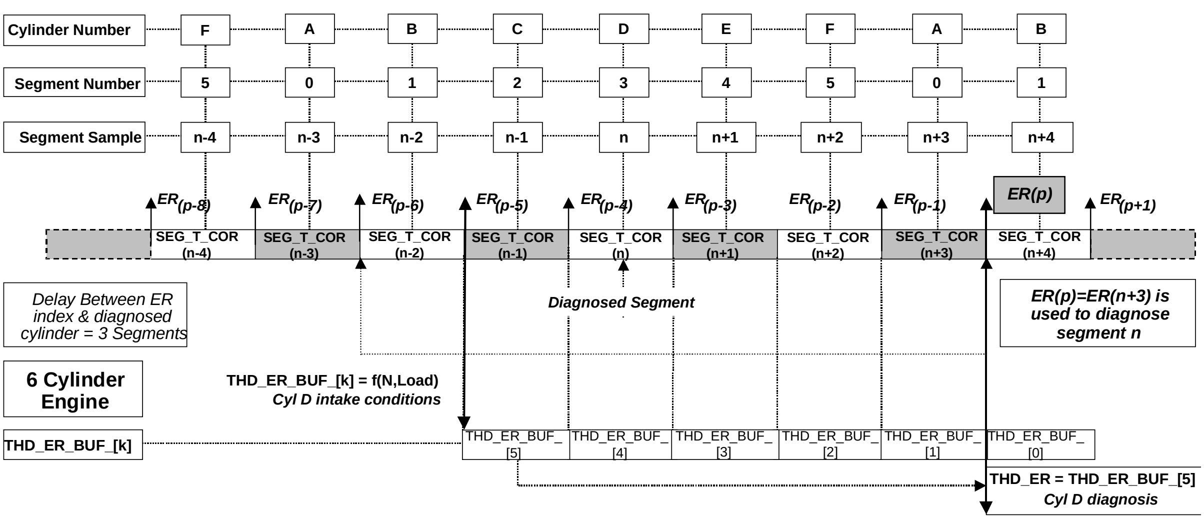
Actions on Deactivation event:

THD_ER = -32768
// ER Threshold buffer init on ER buffer reinitialisation
For k = 0 : NC_SIZE_THD_ER_BUF-1
THD_ER_BUF[k] = -32768 *// For all buffer cells*
EndFor
For x = 0 : NC_CYL_NR-1
THD_ER_CYL[x] = -32768 *// For all cylinders*
EndFor

Formula section:

THD_ER_BUF[0] = THD_ER_CLC * FAC_THD_ER
THD_ER = THD_ER_BUF[NC_SIZE_THD_ER_BUF-1] *// Last cell of THD_ER buffer*
THD_ER_CYL[SEG_NR_ER] = THD_ER

6 cylinder engine example



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B.112.3 Misfire detection based on engine roughness evaluation

General information:

The system identifies misfiring by monitoring engine roughness index. Misfiring causes the angular velocity of the crankshaft to drop in an angular range specific to the cylinder in question.
Misfire detection is based on nominal engine roughness (ER) by using THD_ER detection threshold.
The identification of the cylinder(s) detected in misfire is realised according SEG_NR_ER segment reference (see definition and scheme in ENRD aggregate) *(Chapter system variables)*.
THD_ER is already phased according ER delay *(see detection thresholds management)*.

Application conditions

Initialisation: *at ECU reset, at Engine Stop* ***Or*** *at Deactivation Event*
LV_DET_MIS = 0
LV_DET_THD_MIS = 0
LV_INH_DET_MIS = 1
MIS_STATE_ER = 0
MIS_DET_CYL_INH = $2^{NC\_CYL\_NR} - 1$

Recurrence: *every segment task*

Activation: *LV_ENA_ER = 1*
And *LC_MIS_INH = 0*

Deactivation: *LV_ENA_ER = 0*
Or *LC_MIS_INH = 1*

Update rate:

ENRD segment task

Forumla section:

Misfire detection criterion

#IF NLC_USE_ER_STND_MIS = 0 ***// ER based detection***
If (ER < THD_ER)
OR
{
LC_MIS_INH_CUS_SPC = 0 **AND**
LV_ER_CLC_MIS_DET_CUS_SPC =1 **AND**
(Bit (SEG_NR_ER) **of** MIS_STATE_CUS_SPC = 1 **)**
}
// Read bit position of MIS_STATE_CUS_SPC
Then LV_DET_THD_MIS = 1 *// basic detection before fade-out*
Else LV_DET_THD_MIS = 0
EndIf
#ELSE ***// ER_STND based detection***
If (ER_STND < THD_ER)
OR
{
LC_MIS_INH_CUS_SPC = 0 **AND**
LV_ER_CLC_MIS_DET_CUS_SPC =1 **AND**
(Bit (SEG_NR_ER) **of** MIS_STATE_CUS_SPC = 1 **)**
}

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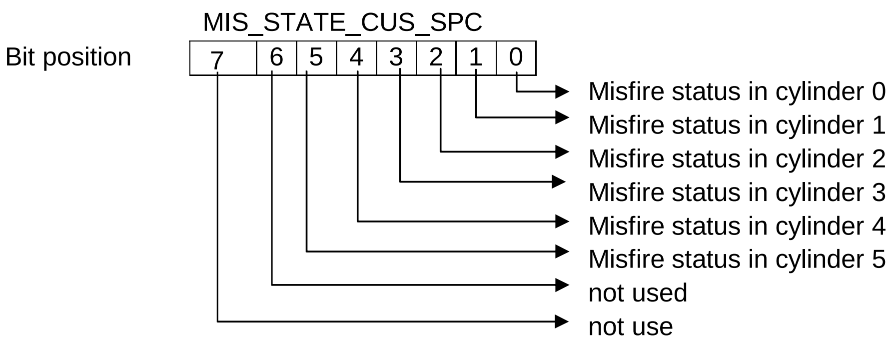
// Read bit position of MIS_STATE_CUS_SPC

Then LV_DET_THD_MIS = 1 *// basic detection before fade-out*
Else LV_DET_THD_MIS = 0
EndIf
#ENDIF

// Customer specific misfire detection algorithm, has been introduced in this release, If there is catalyst heating and all related conditions are met, then LV_ER_CLC_MIS_DET_CUS_SPC is set to 1. This enables customer specific algorithm. MIS_STATE_CUS_SPC is a status byte, and the information from the misfiring cylinder are stored in it.



Value in Bit position = 0, No misfire detected.
Value in Bit position = 1, Misfire detected on respective cylinder.

General fade-out management

If LV_REQ_INH_MIS = 0 *// no fade-out request on going (legal and generic)*
And **(** LV_ZDLY_DIAG_MIS = 1 **Or** LV_DIAG_MIS = 1 **)** *// diagnosis phase started*
Then LV_INH_DET_MIS = 0
MIS_DET_CYL_INH[SEG_NR_ER] = 0
(corresponding cylinder bit in MIS_DET_CYL_INH structure is set to 0,
misfire detection will be enabled on this cylinder
Else LV_INH_DET_MIS = 1
MIS_DET_CYL_INH[SEG_NR_ER] = 1
(corresponding cylinder bit in MIS_DET_CYL_INH structure is set to 1,
misfire detection will be disabled on this cylinder
EndIf

Misfire detection & cylinder identification

If LV_DET_THD_MIS = 1
And LV_INH_DET_MIS = 0 *// no fade out on monitored cylinder*
Then LV_DET_MIS = 1 *// an instantaneous misfiring is detected*
MIS_STATE_ER[SEG_NR_ER] = 1
Cylinder specific bit in MIS_STATE_ER carrier structure is set to 1 according SEG_NR_ER segment reference.
Else LV_DET_MIS = 0
MIS_STATE_ER[SEG_NR_ER] = 0

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Cylinder specific bit in MIS_STATE_ER carrier structure is set to 0 according SEG_NR_ER segment reference.

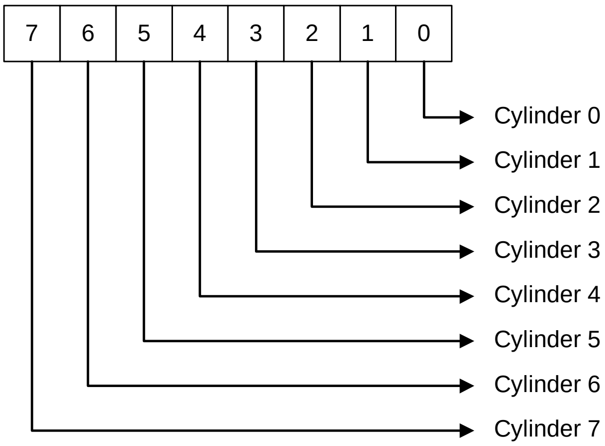
EndIf

Misfire cylinder fade out carrier definition:

MIS_DET_CYL_INH : Carrier used for cylinder fade-out reference
Shows the cylinders that will be in fade-out during the detection phase

MIS_STATE_ER *:* Carrier used for identification of the cylinder detected in misfire
Shows the cylinders that will be detected in misfire

Carrier stucture valid for
MIS_STATE_ER
and
MIS_DET_CYL_INH



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B.113 Misfire detection (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_TOT_MIS	V/S	0... FFFFFFFFH	0... 4294967295	1	-
Overall misfire detection counter					
FAC_GAIN_LOAD_MIS	O/V	0... 1FFH	0... 1.99609	3.9063e-3	-
Correction gain of the normalised engine load for misfire, specific to application					
FAC_THD_APP_ER	O/V	0... 1FFH	0... 1.99609	3.9063e-3	-
Misfire detection threshold correction gain specific to application					
IGA_BAS_COR_MV	O/V	0... FFH	-35.625 ...60	0.375	°CRK
Mean value of the corrected basic ignition angles					
LOAD_MIN_MIS	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Normalised engine "zero" load for misfire detection					
LV_ER_CLC_PREV_INI	-	0... 1H	0 ...1	1	-
Boolean for initialisation of THD_ER_CLC_PREV at start of gradient limitation					
LV_FTL_L_DIAG_MIS	O/V	0... 1H	0 ...1	1	-
Request to allow error management of misfire occurence with low fuel tank level					
LV_INH_APP_DET_MIS	O/V	0... 1H	0 ...1	1	-
Misfire detection process inhibition flag (application specific).					
LV_INH_APP_RR	O/V	0... 1H	0 ...1	1	-
Rough road detection appl. Inc. fade out					
LV_INH_CMB_TRA_MIS	O/V	0... 1H	0 ...1	1	-
Misfire detection fade out request flag due to combustion mode transients					
LV_INH_CRK_OSC_DET	O/V	0... 1H	0 ...1	1	-
Crankshaft oscillation detection fade out					
LV_INH_FTL_L_DET_MIS	O/V	0... 1H	0 ...1	1	-
Misfire detection inhibition flag in case of low fuel tank level					
LV_INH_OBD_DET_MIS	O/V	0... 1H	0 ...1	1	-
OBD I misfire detection process inhibition flag					
LV_MIS_INH_CS	V	0... 1H	0 ...1	1	-
Misfire detection process inhibition during clutch transition.					
LV_MIS_INH_IV_KNK	V	0... 1H	0 ...1	1	-
Misfire detection process inhibition due to injection shut of from knock control					
THD_ER_CLC	O/V	8000... 7FFFH	-32768 ...32767	1	-
Value of the table used for Misfire detection threshold at current segment					
THD_ER_CLC_PREV	V	8000... 7FFFH	-32768 ...32767	1	-
Previous value of the table used for misfire detection threshold at current segment					

Input data:

AMP {p. 982}	IGA_BAS_COR {p. 8266}	INH_IV_KNK {p. 1960}	LC_MIS_INH {p. 6277}
LOAD_MIS {p. 6213}	LV_AT {p. 654}	LV_CS_CUS {p. 1419}	LV_DET_MIS {p. 6276}
LV_ENA_ER {p. 1454}	LV_ENA_SEG_T_MES {p. 1447}	LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}
LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}	LV_ERR_IVVT {p. 1062}	LV_ERR_MTC_CTL_2 {p. 4977}

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LV_ERR_MTC_CTL_3 {p. 4977}	LV_ERR_MTC_DR {p. 5002}	LV_ERR_SEG_AD_ER {p. 4367}	LV_ERR_T_SEG_ER {p. 4367}
LV_ERR_TPS {p. 4982}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}	LV_ERR_TPS_AD {p. 4951}
LV_ERR_TPS_AD_BOL {p. 4951}	LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_MON_1 {p. 6859}
LV_ERR_TPS_RATIO {p. 4990}	LV_ERR_TPS_ST_CHK_2 {p. 4951}	LV_ERR_VS {p. 5021}	LV_FTL_OBD_INH_L {p. 1565}
LV_GS {p. 1565}	LV_IS {p. 1720}	LV_S_ACT {p. 8137}	LV_VAR_TCT {p. 656}
N {p. 1525}	N_32 {p. 1525}	NC_CMB_CONF {p. 812}	OPM_AV {p. 8137}
STATE_CC {p. 1571}	TCO {p. 1100}	TQ_ADD_CH {p. 6582}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_32_MAX_IS_MIS	-	0... FFH	0... 8160	32	rpm
Maximum engine speed to apply specific ER detection threshold in idle speed					
C_N_THD_MIS_INH	-	0... FFH	0... 8160	32	rpm
Global condition for inhibiting (deactivation) of all misfire modules					
C_NR_TDC_CMB_TRA_AFL_MIS	-	0... FFH	0... 255	1	-
Fade out TDC’s duration when engine combustion manager enter or leave air/fuel lean combustion mode					
C_NR_TDC_CMB_TRA_HOM_MIS	-	0... FFH	0... 255	1	-
Fade out TDC s duration when engine combustion manager enter in homogen combustion mode					
C_NR_TDC_CMB_TRA_S_MIS	-	0... FFH	0... 255	1	-
Fade out TDC’s duration when engine combustion manager enter or leave stratified combustion mode					
C_NR_TDC_IV_OFF_DET_MIS_KNK	-	0... FFH	0... 255	1	-
TDC delay to synchronise cylinder shut-off (from Knock control) information with the misfire detection index					
C_T_AMT_GS_DLY_MIS	-	0... FFFFH	0... 655.35	0.01	s
Fade out duration when gearshift of AMT has been detected					
C_T_CS_DLY_MIS	-	0... FFH	0... 255	1	-
No. of TDC,s for which misfire is deactivated during clutch transition.					
C_THD_ER_CLC_GRD	-	0... 7FFFH	0... 32767	1	µs
Gradient to limit the misfire detection threshold THD_ER_CLC in positive direction					
IP_FAC_THD_ER_CH	-	0... 1FFH	0... 1.99609	3.9063e-3	-
LDP_TQ_ADD_CH_IP_FAC_THD_ER_CH	4	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Threshold correction depending on TQ_ADD_CH for catalyst heating					
IP_LOAD_MIN_MIS_AFS_AT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_IP_LOAD_MIN_MIS_AFS_AT	8	0... 1FE0H	0... 8160	1	rpm
LDP_TCO_IP_LOAD_MIN_MIS_AFS_AT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed and coolant temperature in AFS combustion mode, with AT vehicle					
IP_LOAD_MIN_MIS_AFS_MT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_IP_LOAD_MIN_MIS_AFS_MT	8	0... 1FE0H	0... 8160	1	rpm
LDP_TCO_IP_LOAD_MIN_MIS_AFS_MT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed and coolant temperature in AFS combustion mode, with MT vehicle					
IP_LOAD_MIN_MIS_AFS_TCT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_IP_LOAD_MIN_MIS_AFS_TCT	8	0... 1FE0H	0... 8160	1	rpm
LDP_TCO_IP_LOAD_MIN_MIS_AFS_TCT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed and coolant temperature in AFS combustion mode, with TCT vehicle					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_LOAD_MIN_MIS_HOM_S_AT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_32_IP_LOAD_MIN_HOM_S_AT	6	0... FFH	0... 8160	32	rpm
LDP_TCO_IP_LOAD_MIN_HOM_S_AT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed and coolant temperature in HOM_S combustion mode, with AT vehicle					
IP_LOAD_MIN_MIS_HOM_S_MT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_32_IP_LOAD_MIN_HOM_S_MT	6	0... FFH	0... 8160	32	rpm
LDP_TCO_IP_LOAD_MIN_HOM_S_MT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed and coolant temperature in HOM_S combustion mode, with MT vehicle					
IP_LOAD_MIN_MIS_HOM_S_TCT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_32_IP_LOAD_MIN_HOM_S_TCT	6	0... FFH	0... 8160	32	rpm
LDP_TCO_IP_LOAD_MIN_HOM_S_TCT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed and coolant temperature in HOM_S combustion mode, with TCT vehicle					
IP_LOAD_MIN_MIS_S_AT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_32_IP_LOAD_MIN_MIS_S_AT	6	0... FFH	0... 8160	32	rpm
LDP_TCO_IP_LOAD_MIN_MIS_S_AT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed anc coolant temperature in S combustion mode, with AT vehicle					
IP_LOAD_MIN_MIS_S_MT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_32_IP_LOAD_MIN_MIS_S_MT	6	0... FFH	0... 8160	32	rpm
LDP_TCO_IP_LOAD_MIN_MIS_S_MT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed anc coolant temperature in S combustion mode, with MT vehicle					
IP_LOAD_MIN_MIS_S_TCT	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
LDP_N_32_IP_LOAD_MIN_MIS_S_TCT	6	0... FFH	0... 8160	32	rpm
LDP_TCO_IP_LOAD_MIN_MIS_S_TCT	6	0... FEH	-48... 142.5	0.75	°C
Zero load curve vs engine speed anc coolant temperature in S combustion mode, with TCT vehicle					
IP_THD_AFS_ER_AT_CC_CLOSE	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_AT_CLOSE	12	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_AFS_ER_AT_CLOSE	8	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS mode, AT vehicle transmission type and converter clutch in state closed					
IP_THD_AFS_ER_AT_CC_CTL	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_AT_CTL	12	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_AFS_ER_AT_CTL	8	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS mode, AT vehicle transmission type and converter clutch in state controlled					
IP_THD_AFS_ER_AT_CC_OPEN	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_AT_OPEN	12	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_AFS_ER_AT_OPEN	8	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS mode, AT vehicle transmission type and converter clutch in state open					
IP_THD_AFS_ER_IS_AT_CC_CLOSE	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_IS_AT_CLOSE	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_AFS_ER_IS_AT_CLOSE	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS combustion mode & in idle speed, AT vehicle and converter clutch state close.					
IP_THD_AFS_ER_IS_AT_CC_CTL	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_IS_AT_CTL	4	0... 1FE0H	0... 8160	1	rpm

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_LOAD_IP_AFS_ER_IS_AT_CTL	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS combustion mode & in idle speed, AT vehicle and converter clutch state controlled.					
IP_THD_AFS_ER_IS_AT_CC_OPEN	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_IS_AT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_AFS_ER_IS_AT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS combustion mode & in idle speed, AT vehicle and converter clutch open state.					
IP_THD_AFS_ER_IS_MT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_IS_MT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_AFS_ER_IS_MT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS combustion mode & in idle speed, MT vehicle					
IP_THD_AFS_ER_IS_TCT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_IS_TCT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_AFS_ER_IS_TCT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS combustion mode & in idle speed, TCT vehicle					
IP_THD_AFS_ER_MT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_MT	12	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_IP_THD_AFS_ER_MT	8	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS mode, MT vehicle transmission type					
IP_THD_AFS_ER_TCT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_AFS_ER_TCT	12	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_IP_THD_AFS_ER_TCT	8	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in AFS mode, TCT vehicle transmission type					
IP_THD_HOM_S_ER_AT_CC_CLOSE	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_HOM_S_ER_AT_CLOSE	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_HOM_S_ER_AT_CLOSE	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S mode, AT vehicle transmission type and converter clutch state closed.					
IP_THD_HOM_S_ER_AT_CC_CTL	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_HOM_S_ER_AT_CTL	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_HOM_S_ER_AT_CTL	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S mode, AT vehicle transmission type and converter clutch state controlled.					
IP_THD_HOM_S_ER_AT_CC_OPEN	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_HOM_S_ER_AT_OPEN	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_HOM_S_ER_AT_OPEN	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S mode, AT vehicle transmission type and converter clutch state open.					
IP_THD_HOM_S_ER_IS_AT_CC_CLOSE	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_HOM_S_ER_IS_AT_CLOSE	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_HOM_S_ER_IS_CLOSE	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S combustion mode & in idle speed, AT vehicle transmission type and converter clutch state closed					
IP_THD_HOM_S_ER_IS_AT_CC_CTL	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_HOM_S_ER_IS_AT_CTL	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_HOM_S_ER_IS_AT_CTL	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S combustion mode & in idle speed, AT vehicle transmission type and converter clutch state controlled					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_THD_HOM_S_ER_IS_AT_CC_OPEN	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_HOM_S_ER_IS_AT_OPEN	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_HOM_S_ER_IS_AT_OPEN	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S combustion mode & in idle speed, AT vehicle transmission type and converter clutch state open					
IP_THD_HOM_S_ER_IS_MT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_HOM_S_ER_IS_MT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_HOM_S_ER_IS_MT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S combustion mode & in idle speed, MT vehicle transmission type					
IP_THD_HOM_S_ER_IS_TCT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_HOM_S_ER_IS_TCT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_HOM_S_ER_IS_TCT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S combustion mode & in idle speed, TCT vehicle transmission type					
IP_THD_HOM_S_ER_MT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_HOM_S_ER_MT	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_IP_THD_HOM_S_ER_MT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S mode, MT vehicle transmission type					
IP_THD_HOM_S_ER_TCT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_HOM_S_ER_TCT	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_HOM_S_ER_TCT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in HOM_S mode, TCT vehicle transmission type					
IP_THD_S_ER_AT_CC_CLOSE	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_AT_CLOSE	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_S_ER_AT_CLOSE	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S mode, AT vehicle transmission type and converter clutch state closed					
IP_THD_S_ER_AT_CC_CTL	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_AT_CTL	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_IP_THD_S_ER_AT_CTL	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S mode, AT vehicle transmission type and converter clutch state controlled					
IP_THD_S_ER_AT_CC_OPEN	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_AT_OPEN	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_S_ER_AT_OPEN	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S mode, AT vehicle transmission type and converter clutch state open					
IP_THD_S_ER_IS_AT_CC_CLOSE	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_IS_AT_CLOSE	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_S_ER_IS_AT_CLOSE	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S combustion mode & in idle speed, AT vehicle transmission type and converter clutch state closed					
IP_THD_S_ER_IS_AT_CC_CTL	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_IS_AT_CTL	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_S_ER_IS_AT_CTL	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S combustion mode & in idle speed, AT vehicle transmission type and converter clutch state controlled					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_THD_S_ER_IS_AT_CC_OPEN	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_IS_AT_OPEN	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_IP_THD_S_ER_IS_AT_OPEN	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S combustion mode & in idle speed, AT vehicle transmission type and converter clutch state open					
IP_THD_S_ER_IS_MT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_IS_MT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_IP_THD_S_ER_IS_MT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S combustion mode & in idle speed, MT vehicle transmission type					
IP_THD_S_ER_IS_TCT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_IS_TCT	4	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_IP_THD_S_ER_IS_TCT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S combustion mode & in idle speed, TCT vehicle transmission type					
IP_THD_S_ER_MT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_MT	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_IP_THD_S_ER_MT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S mode, MT vehicle transmission type					
IP_THD_S_ER_TCT	V	8000... 7FFFH	-32768 ...32767	1	-
LDP_N_IP_THD_S_ER_TCT	9	0... 1FE0H	0... 8160	1	rpm
LDP_LOAD_MIS_IP_THD_S_ER_TCT	6	0... 7FFFH	0... 99.99694	3.0518e-3	%
ER threshold for misfire detection in S mode, TCT vehicle transmission type					
LC_FTL_L_DET_MIS	-	0... 1H	0 ...1	1	-
Inhibition of misfire detection in case of low fuel tank level					
LC_FTL_L_DIAG_MIS	-	0... 1H	0 ...1	1	-
Enable error management of misfire with low fuel tank level					
LC_MIS_INH_CS	-	0... 1H	0 ...1	1	-
Switch to enable misfire deactivation during Clutch transition					
LC_MIS_INH_GS	-	0... 1H	0 ...1	1	-
Switch to enable misfire deactivation during gear shift.					
LC_MIS_INH_IV_KNK	-	0... 1H	0 ...1	1	-
Switch to enable misfire deactivation due to injection switch off from knock control					
LC_USE_IVVT_INH_MIS	-	0... 1H	0 ...1	1	-
Enable IVVT diagnosis for Inhibition of misfire detection					

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B.113.1 Global fade out condition (N_32 threshold)

FUNCTION DESCRIPTION:

General information:

There is one global condition N_32 > C_N_THD_MIS_INH which can be used for inhibition (deactivation) of the following modules:

- Appl. Inc. for engine roughness calc. : chapter System variables
- Engine roughness calculation : chapter System variables
- Appl. Inc. for misfire detection : chapter OBDII
- Misfire detection : chapter OBDII
- Misfire rate detection and error handling : chapter OBDII

Formula section:

If N_32 > C_N_THD_MIS_INH
Then Engine roughness/Misfire detection is inhibited
Else no inhibition due to this condition
Endif

B.113.2 Misfire detection threshold correction gain specific to application

Description:

To ensure misfire detection during active catalyst heating in IS (in homogenous mode only), the threshold is multiplied with a factor depending on the torque reserve at catalyst heating TQ_ADD_CH.

Application conditions

Initialization: all 1 at reset and at each activation and deactivation
Recurrency: segment

Activation: *LV_ENA_SEG_T_MES = 1* ***and*** *LC_MIS_INH = 0*

Deactivation: *LV_ENA_SEG_T_MES = 0* ***or*** *LC_MIS_INH = 1*

Formula section:

If LV_IS = 1 **and**
LV_S_ACT = 0
Then FAC_THD_APP_ER = IP_FAC_THD_ER_CH(TQ_ADD_CH)
Else FAC_THD_APP_ER = 1
EndIf

B.113.3 Misfire detection inhibition related to OBDI diagnosis

Description:

Misfire detection process is inhibited when one of the following OBD I errors occurs.
Depending on calibration, IVVT diagnosis is considered for inhibition or not.

Application conditions

Initialization: all 0 at reset and at each activation and deactivation
Recurrency: updated every segment before misfire detection function

Activation: *LV_ENA_ER = 1* ***and*** *LC_MIS_INH = 0*

Deactivation: *LV_ENA_ER = 0* ***or*** *LC_MIS_ INH = 1*

Formula section:

If LV_ERR_TPS = 1 *// throttle error*
OR **[** LV_ERR_IVVT = 1 **and** LC_USE_IVVT_INH_MIS = 1**]** *// VANOS error*
OR LV_ERR_SEG_AD_ER = 1 *// Segment adaptation error*
OR LV_ERR_CRK_PLAUS = 1

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OR LV_ERR_CRK_SYN = 1
OR LV_ERR_CRK_TOOTH = 1
OR LV_ERR_CRK_TOOTH_PER = 1
OR LV_ERR_TPS_1 = 1
OR LV_ERR_TPS_2 =1
OR LV_ERR_TPS_AD = 1
OR LV_ERR_TPS_MAF_1 = 1
OR LV_ERR_TPS_MAF_2 = 1
OR LV_ERR_TPS_MON_1 = 1
OR LV_ERR_TPS_RATIO = 1
OR LV_ERR_TPS_ST_CHK_2 = 1
OR LV_ERR_T_SEG_ER = 1
OR LV_ERR_MTC_CTL_2 = 1
OR LV_ERR_MTC_CTL_3 = 1
OR LV_ERR_MTC_DR = 1
OR LV_ERR_TPS_AD_BOL = 1
Then LV_INH_OBD_DET_MIS = 1
Else LV_INH_OBD_DET_MIS = 0
EndIf

B.113.4 Misfire detection inhibition related to AMT gearshift intervention

FUNCTION DESCRIPTION:

General information:

LV_INH_APP_DET_MIS is used for project-specific inhibition of Misfire detection, e.g.:

- AMT gearshift intervention

Description:

When AMT gearshift intervention is detected (LV_GS = 1) misfire detection can be suppresed because this load jump can cause a segment period jump and crankshaft vibration, depending on the engine operating state and load request.

If AMT gearshift intervention has been detected (LV_GS changes from 1 to 0 or 0 to 1), Misfire detection can be suppressed for the applicable constant period C_T_AMT_GS_DLY_MIS starting at transition LV_GS 1->0.

Application conditions

Initialization:	all 0 at reset and at each activation and deactivation
Recurrence:	*updated every segment before misfire detection function*
Activation:	*LV_ENA_ER = 1* **and** *LC_MIS_INH = 0*
Deactivation:	*LV_ENA_ER = 0* **or** *LC_MIS_ INH = 1*

Formula section:

Cylinder fuel shut-off:

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// if any one cylinder is switched off from Knock control fuinction, then misfire is deactivated. This can be activated using the switch LC_MIS_INH_IV_KNK.

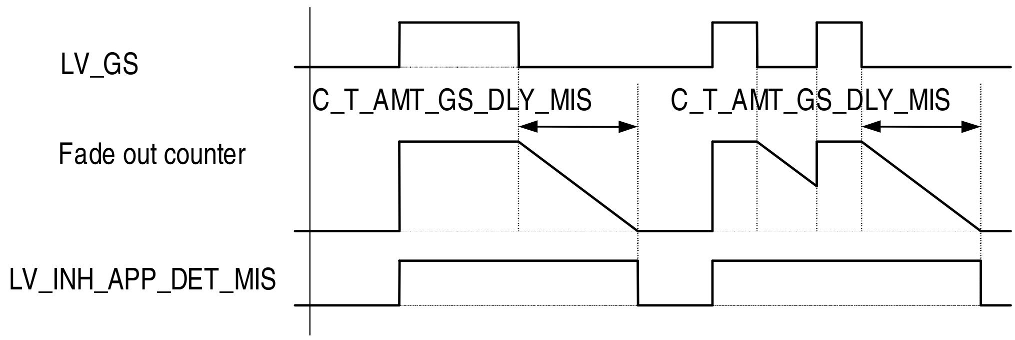
NOTE: The Activation by LC_MIS_INH_IV_KNK has to be checked with CARB

If(1) INH_IV_KNK > 0 *// indexed by cylinder bit position*
Then(1) LV_MIS_INH_IV_KNK = 1 after a delay of C_NR_TDC_IV_OFF_DET_MIS_KNK TDC,s
Else(1) LV_ MIS_INH_IV_KNK = 0 after a delay of C_NR_TDC_IV_OFF_DET_MIS_KNK TDC,s
EndIf(1)

If(2) ((LV_CS_CUS 1->0 or LV_CS_CUS 0->1) AND LC_MIS_INH_CS=1)
Then(2) LV_MIS_INH_CS = 1 for C_T_CS_DLY_MIS TDC,s
Else(2) LV_MIS_INH_CS = 0
Endif(2)
// inhibition of misfire function during gear change, is not allowed for CARB applications.

If(3) **(** LV_GS = 1 and LC_MIS_INH_GS=1 and LV_VAR_TCT=1)
Or **((** LV_GS 1->0 **and** Time C_T_AMT_GS_DLY_MIS is active**)** and LC_MIS_INH_GS=1 and LV_VAR_TCT=1)
Or LV_MIS_INH_IV_KNK =1 AND LC_MIS_INH_IV_KNK = 1
Or LV_MIS_INH_CS = 1
Then(3) LV_INH_APP_DET_MIS = 1
Else(3) LV_INH_APP_DET_MIS = 0
EndIf(3)

<u>Fade out behaviour summary for AMT gear shift :</u>



<u>Fade out behaviour summary for MT - Change in clutch signal</u>

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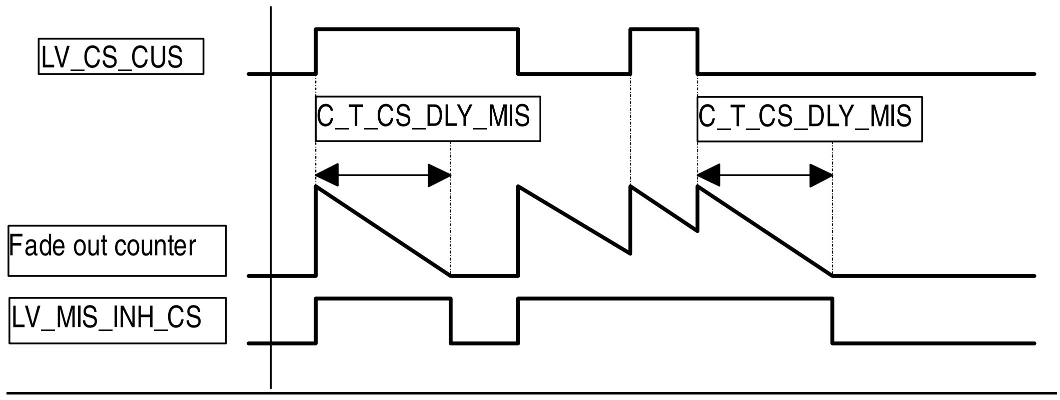
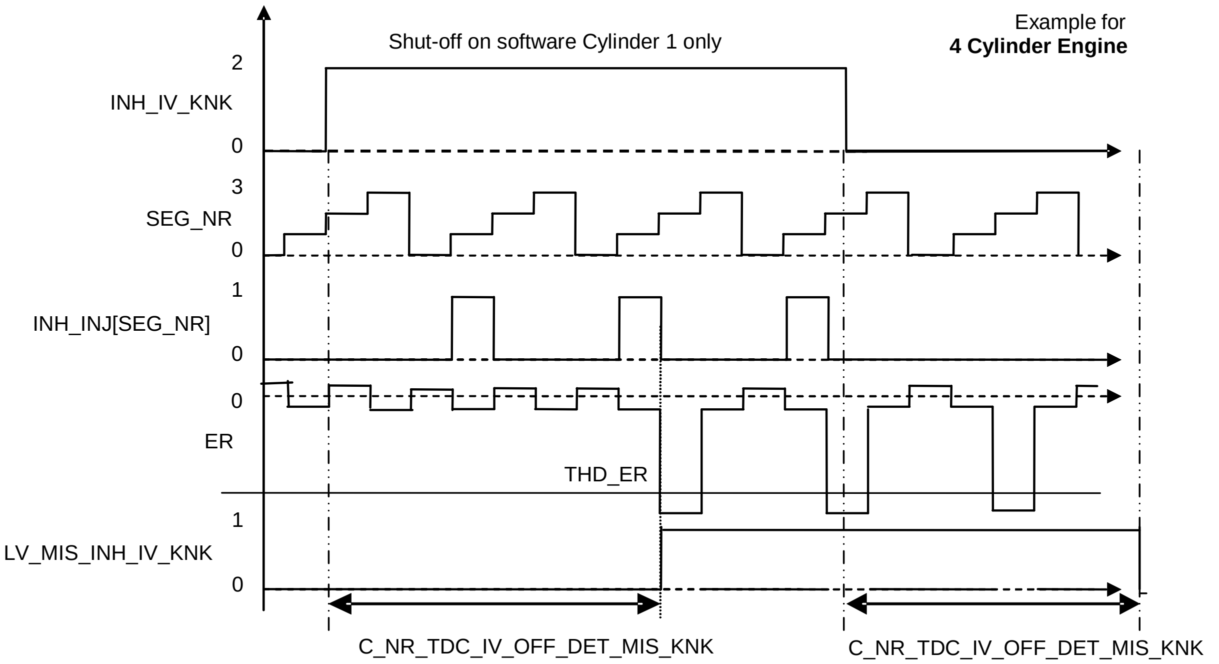


// Initial appliation value for C_NR_TDC_IV_OFF_DET_MIS_KNK, should be taken from C_NR_TDC_IV_OFF_DET_MIS + *NC_CYL_NR-2*
There is a delay of 2 segments for calculation of INH_IV_KNK, hence delay of NC_CYL_NR-2 segments to shut off the injector. Injection switch off only in the next segment calculation.
Further there is a delay of C_NR_TDC_IV_OFF_DET_MIS TDC,s for ER calculation. Hence total delay is C_NR_TDC_IV_OFF_DET_MIS + *NC_CYL_NR-2*



B.113.5 Rough road detection fade out condition

Description:

Rough road detection is inhibited if no VS signal is available (LV_ERR_VS = 1).

Application conditions

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Initialisation: *all 0 at reset and at each activation and deactivation*

Recurrence: *same as rough road detection update rate*

Activation: *LC_MIS_INH = 0*

Deactivation: *LC_MIS_ INH = 1*

Formula section:

If LV_ERR_VS = 1
Then LV_INH_APP_RR = 1
Else LV_INH_APP_RR = 0
Endif

B.113.6 Misfire low fuel tank level informations

Description:

- Misfire detection can be supressed if low fuel is detected (LV_INH_FTL_L_DET_MIS).
- Low fuel signal can be used to calculate P-Code Misfire with low fuel P313.

Application conditions

Initialisation: *all 0 at reset and at each activation and deactivation*

Recurrence: *200ms //same as fuel tank level information*

Activation: *LC_MIS_INH = 0*

Deactivation: *LC_MIS_INH = 1*

Formula section:

Low fuel tank level information for misfire detection inhibition
If LV_FTL_OBD_INH_L = 1
And LC_FTL_L_DET_MIS = 1
Then LV_INH_FTL_L_DET_MIS = 1
Else LV_INH_FTL_L_DET_MIS = 0
EndIf

Low fuel tank level information for error management of symptom "misfire with low fuel tank level".
If LV_FTL_OBD_INH_L = 1
And LC_FTL_L_DIAG_MIS = 1
Then LV_FTL_L_DIAG_MIS = 1
Else LV_FTL_L_DIAG_MIS = 0
EndIf

B.113.7 Total counter misfire detection

FUNCTION DESCRIPTION:

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General information:

This counter is incremented at each misfire detection based on misfire index evaluation *(before crossed diagnosis with IGC & IV OBDI diags evaluation)*. Thus, it s possible to determine the total number of misfire detected during engine lifetime.

Application conditions

Initialisation: *restored from NVMY*

Recurrence: *updated every segment after LV_DET_MIS calculation*

Activation: *LC_MIS_INH = 0*

Deactivation: *LC_MIS_INH = 1*

Formula section:

On NV memory formatting or on NV memory corruption detection :
CTR_TOT_MIS = 0

Processing :
at each transition LV_DET_MIS 0 -> 1
CTR_TOT_MIS = CTR_TOT_MIS + 1

B.113.8 Crankshaft oscillation detection fade-out

FUNCTION DESCRIPTION:

Crankshaft oscillation detection process can be inhibited when one function and/or error requires an inhibition.
Note : This bit is necessary only if the crankshaft oscillation detection module is used in the project (NLC_USE_CRK_OSC_MIS = 1)

Application conditions

Initialisation: *all 0 at reset and at each activation and deactivation*

Recurrence: *Segment, before Crankshaft oscillation detection*

Activation: *LC_MIS_INH = 0*

Deactivation: *LC_MIS_ INH = 1*

Formula section:

If LV_ERR_VS = 1
Then LV_INH_CRK_OSC_DET = 1
Else LV_INH_CRK_OSC_DET = 0
EndIf

B.113.9 Mean value of the corrected basic ignition angles

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Application conditions

Initialisation: *IGA_BAS_COR_MV = 0 at reset*

Recurrence: *10 ms*

Activation: *LV_IGK = 1*

Formula section:

IGA_BAS_COR_MV = IGA_BAS_COR

B.113.10 Correction gain for engine load specific to application

Description:

Here can be defined a gain who can change the normalised engine load dedicated to misfire monitoring according specific load corrections.

This correction can be applied during torque reduction sequences specific to project.

Application conditions

Activation: *LV_ENA_SEG_T_MES = 1*
And *LC_MIS_INH = 0*

Deactivation: *LV_ENA_SEG_T_MES= 0*
Or *LC_MIS_INH = 1*

Initialisation: FAC_GAIN_LOAD_MIS = 1
Recurrency: –

B.113.11 Current Misfire Detection Threshold

General information:

THD_ER_CLC represents the current value used for determination of the misfire detection threshold. This data must be calculated before THD_ER calculation and after LOAD_MIS calculation.

Description:

Keyword configuration table:

NC_CMB_CONF	OPM_AV	xx
AFS	2	AFS
AFS_AFL	2	AFS
AFS_AFL	3	HOM_S
AFS_S	1	S
AFS_S	2	AFS
AFS_AFL_S	1	S
AFS_AFL_S	2	AFS
AFS_AFL_S	3	HOM_S

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Application conditions

Initialisation: at ECU reset **Or** engine stop
THD_ER_CLC = -32768
THD_ER_CLC_PREV = -32768
LV_ER_CLC_PREV_INI = 1

Recurrence: *every ENRD segment task*

Activation: *LV_ENA_SEG_T_MES = 1*
And *LC_MIS_INH = 0*

Deactivation: *LV_ENA_SEG_T_MES = 0*
Or *LC_MIS_INH = 1*

Actions on Deactivation event:
THD_ER_CLC = -32768
LV_ER_CLC_PREV_INI = 1

Formula section:

Convention for combustion mode determination:
#If **NC_CMB_CONF = AFS_AFL Or AFS_AFL_S**
If OPM_AV = 3 (homogeneous-stratified)
Then xx = "HOM_S"
EndIf
#EndIf
#If **NC_CMB_CONF = AFS_S Or AFS_AFL_S**
If OPM_AV = 1 (stratified)
Then xx = "S"
EndIf
#EndIf
If OPM_AV <> 1 **and** OPM_AV <> 3 (homogeneous)
Then xx = "AFS"
EndIf
Convention for transmission type determination:

If(1) LV_AT = 1
Then(1)

// Based on the state of converter clutch in AT vehicle, an appropriate map is selected.//

STATE_CC	yy
0H (converter clutch open)	AT_CC_OPEN
1H (converter clutch controlled)	AT_CC_CTL
2H (converter clutch closed)	AT_CC_CLOSE
3H (not defined or Signal not valid or Error)	AT_CC_OPEN

ElseIf(2) LV_VAR_TCT = 1
Then(2)
yy= TCT
Else(2)
yy= MT

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Endif(2)
Endif(1)

Calculation of THD_ER_CLC:
If LV_IS = 1
Then THD_ER_CLC = IP_THD_xx_ER_IS_yy(N,LOAD_MIS)
Else THD_ER_CLC = IP_THD_xx_ER_yy(N,LOAD_MIS)
End
Initialisation of THD_ER_CLC_PREV:
If LV_ER_CLC_PREV_INI = 1
then THD_ER_CLC_PREV = THD_ER_CLC
LV_ER_CLC_PREV_INI = 0
endif
Positive gradient limitation of THD_ER_CLC:
If THD_ER_CLC - THD_ER_CLC_PREV > C_THD_ER_CLC_GRD
then THD_ER_CLC = THD_ER_CLC_PREV + C_THD_ER_CLC_GRD
else **if** THD_ER_CLC > THD_ER_CLC_PREV + C_THD_ER_CLC_GRD
then THD_ER_CLC = THD_ER_CLC_PREV + C_THD_ER_CLC_GRD
else THD_ER_CLC = THD_ER_CLC // no change!
endif
endif
Store previous value of THD_ER_CLC:
THD_ER_CLC_PREV = THD_ER_CLC

B.113.12 Zero Load Line for Misfire detection

FUNCTION DESCRIPTION:

The zero load line is a function of the engine speed and depends on the engine combustion mode (for GDI application), coolant temperature and atmospheric pressure.

Application conditions

Initialisation: Variable is initialised to 0 at reset, at engine stop **Or** at LC_MIS_INH 0 to 1 transition

Recurrence: every segment task

Activation: LV_ENA_SEG_T_MES = 1
And LC_MIS_INH = 0

Deactivation: LV_ENA_SEG_T_MES = 0
Or LC_MIS_INH = 1

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Formula section:

Minimum engine load and zero load lines
Convention for combustion mode determination:
#If **NC_CMB_CONF = AFS_AFL Or AFS_AFL_S**
If OPM_AV = 3 (homogeneous-stratified)
Then xx = "HOM_S"
EndIf

#EndIf
#If NC_CMB_CONF = AFS_S Or AFS_AFL_S
If OPM_AV = 1 (stratified)
Then xx = "S"
EndIf
#EndIf

If OPM_AV <> 1 and OPM_AV <> 3 (homogeneous)
Then xx = "AFS"
EndIf

Convention for transmission type determination:

If(1) LV_AT = 1
Then(1)
yy= AT
ElseIf(2) LV_VAR_TCT = 1
Then(2)
yy= TCT
Else(2)
yy= MT
Endif(2)
Endif(1)

LOAD_MIN_MIS = IP_LOAD_MIN_MIS_xx_yy(N, TCO)

B.113.13 Misfire Combustion mode transients informations

Application conditions:

While the combustion manager is in transient state, the misfire detection can be disabled to have a proper base for evaluation of the ER-misfire detection thresholds, which are defined for the stationary modes (AFS, AFL & S).
This function must be called before the generic specification named "Generic fade out conditions for misfire detection"

Initialisation: *at ECU reset, at Engine Stop* ***Or*** *at LC_MIS_INH 0 to 1 transition*
LV_INH_CMB_TRA_MIS = 1

Formula section:

#If NC_CMB_CONF = AFS_S Or AFS_AFL_S
If OPM_AV = x -> 1 (x is different of 1)
Then LV_INH_CMB_TRA_MIS is set to 1 during C_NR_TDC_CMB_TRA_S_MIS tdc's
EndIf
#EndIf

#If NC_CMB_CONF = AFS_AFL Or AFS_AFL_S
If OPM_AV = x -> 3 (x is different of 3)
Then LV_INH_CMB_TRA_MIS is set to 1 during C_NR_TDC_CMB_TRA_AFL_MIS tdc's
EndIf
#EndIf

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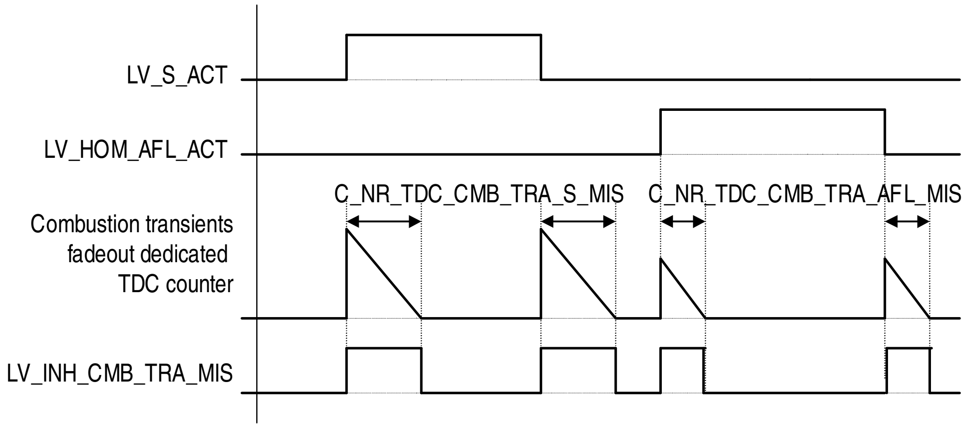
If OPM_AV = x -> 2 (x is different of 2)
Then LV_INH_CMB_TRA_MIS is set to 1 during C_NR_TDC_CMB_TRA_HOM_MIS tdc's
EndIf



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B.114 Rough road detection

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
DLY_ER_RR	V	0... FFFFH	0... 655.35	0.01	s
Fade out time for engine roughness after rough road detection					
ERR_SYM_WHEEL_GRD_FR_LE	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
error symptoms of diagnostic instance WHEEL_GRD_FR_LE					
ERR_SYM_WHEEL_GRD_FR_RI	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
error symptoms of diagnostic instance WHEEL_GRD_FR_RI					
ERR_SYM_WHEEL_GRD_RE_LE	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
error symptoms of diagnostic instance WHEEL_GRD_RE_LE					
ERR_SYM_WHEEL_GRD_RE_RI	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
error symptoms of diagnostic instance WHEEL_GRD_RE_RI					
LV_CDN_DIAG_WHEEL_GRD_FR_LE	V	0... 1H	0 ...1	1	-
Boolean for wheel gradient signal diagnosis front left					
LV_CDN_DIAG_WHEEL_GRD_FR_RI	V	0... 1H	0 ...1	1	-
Boolean for wheel gradient signal diagnosis front right					
LV_CDN_DIAG_WHEEL_GRD_RE_LE	V	0... 1H	0 ...1	1	-
Boolean for wheel gradient signal diagnosis rear left					
LV_CDN_DIAG_WHEEL_GRD_RE_RI	V	0... 1H	0 ...1	1	-
Boolean for wheel gradient signal diagnosis rear right					
LV_END_DIAG_WHEEL_GRD_FR_LE	V	0... 1H	0 ...1	1	-
Boolean for wheel gradient signal diagnosis front left					
LV_END_DIAG_WHEEL_GRD_FR_RI	V	0... 1H	0 ...1	1	-
Boolean for wheel gradient signal diagnosis front right					
LV_END_DIAG_WHEEL_GRD_RE_LE	V	0... 1H	0 ...1	1	-
Boolean for wheel gradient signal diagnosis rear left					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_WHEEL_GRD_RE_RI	V	0... 1H	0 ...1	1	-
Boolean for wheel gradient signal diagnosis rear right					
LV_ERR_WHEEL_GRD_FR_LE	O/V	0... 1H	0 ...1	1	-
error on wheel gradient signal front left					
LV_ERR_WHEEL_GRD_FR_RI	O/V	0... 1H	0 ...1	1	-
error on wheel gradient signal front right					
LV_ERR_WHEEL_GRD_RE_LE	O/V	0... 1H	0 ...1	1	-
error on wheel gradient signal rear left					
LV_ERR_WHEEL_GRD_RE_RI	O/V	0... 1H	0 ...1	1	-
error on wheel gradient signal rear right					
LV_RR_PREV_INI	V	0... 1H	0 ...1	1	-
Boolean for initialisation of VS_RR_EDGE_T/CTR_AV(n-1) at activation of function					
LV_STATE_RR	O/V	0... 1H	0 ...1	1	-
Boolean for state of rough road detection (No : Yes).					
N_WHEEL_GRD_FN_LE	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
calculated gradient from N_WHEEL_FN_LE					
N_WHEEL_GRD_FN_RI	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
calculated gradient from N_WHEEL_FN_RI					
N_WHEEL_GRD_RE_LE	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
calculated gradient from N_WHEEL_RE_LE					
N_WHEEL_GRD_RE_RI	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
calculated gradient from N_WHEEL_RE_RI					
RATIO_FR_LE	V	0... FFH	0 ...1	3.9216e-3	-
calculated ratio wheel front left					
RATIO_FR_RI	V	0... FFH	0 ...1	3.9216e-3	-
calculated ratio wheel front right					
RATIO_RE_LE	V	0... FFH	0 ...1	3.9216e-3	-
calculated ratio wheel rear left					
RATIO_RE_RI	V	0... FFH	0 ...1	3.9216e-3	-
calculated ratio wheel rear right					
SEG_T_MES_0_RR	V	0... 1FFFFFFFH	0... 4294967288	8	µs
Actual segment time measurement from the wheel speed signal.					
SEG_T_MES_1_RR	V	0... 1FFFFFFFH	0... 4294967288	8	µs
Previous segment time measurement from the wheel speed signal.					
SUM_RR	V	0... FFH	0... 255	1	-
Counter of rough road detection events.					
T_WHEEL_GRD_FR_LE_ERR_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
timer to detect the wheel gradient error					
T_WHEEL_GRD_FR_RI_ERR_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
timer to detect the wheel gradient error					
T_WHEEL_GRD_RE_LE_ERR_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
timer to detect the wheel gradient error					
T_WHEEL_GRD_RE_RI_ERR_DIAG	V	0... FFFFH	0... 6553.5	0.1	s
timer to detect the wheel gradient error					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VS_RR_EDGE_CTR_AV	V	0... FFFFH	0... 65535	1	-
actual value of vehicle speed tooth counter on rough road (free running counter)					
VS_RR_EDGE_T_AV	V	0... FFFFFFFFH	0... 34359738.36	0.008	ms
actual timestamp of last tooth on rough road(free running timer)					
VS_RR_EDGE_T_AV_MAX	V	0... FFFFFFFFH	0... 34359738.36	0.008	ms
actual maximum timestamp of last tooth on rough road(free running timer)					
WHEEL_GRD	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
Wheel speed gradient maximum					
WHEEL_GRD_MMV	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
Rough road value					
WHEEL_GRD_MMV_FR_LE	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
Rough road moving mean value front left					
WHEEL_GRD_MMV_FR_RI	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
Rough road moving mean value front right					
WHEEL_GRD_MMV_RE_LE	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
Rough road moving mean value rear left					
WHEEL_GRD_MMV_RE_RI	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
Rough road moving mean value rear right					
WHEEL_GRD_MMV_THD	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
Rough road value threshold					
WHEEL_GRD_MMV_THD_DIAG	V	0... 3FFFH	0... 999.93896	0.0610352	°/oo
Rough road diagnosis value threshold					

Input data:

LV_AT {p. 654}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_VS_PLAUS {p. 5021}	LV_ST_END {p. 1720}
VS {p. 1176}	WHEEL_CAN_FN_LE {p. 1583}	WHEEL_CAN_FN_RI {p. 1583}	WHEEL_CAN_RE_LE {p. 1583}
WHEEL_CAN_RE_RI {p. 1583}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_WHEEL_GRD_FR_LE	-	0... FFH	0... 255	1	-
anti bounce counter increment for diagnosis instance WHEEL_GRD_FR_LE					
C_ABC_INC_WHEEL_GRD_FR_RI	-	0... FFH	0... 255	1	-
anti bounce counter increment for diagnosis instance WHEEL_GRD_FR_RI					
C_ABC_INC_WHEEL_GRD_RE_LE	-	0... FFH	0... 255	1	-
anti bounce counter increment for diagnosis instance WHEEL_GRD_RE_LE					
C_ABC_INC_WHEEL_GRD_RE_RI	-	0... FFH	0... 255	1	-
anti bounce counter increment for diagnosis instance WHEEL_GRD_RE_RI					
C_ABC_MAX_WHEEL_GRD_FR_LE	-	1... FFH	1... 255	1	-
anti bounce counter maximum for diagnosis instance WHEEL_GRD_FR_LE					
C_ABC_MAX_WHEEL_GRD_FR_RI	-	1... FFH	1... 255	1	-
anti bounce counter maximum for diagnosis instance WHEEL_GRD_FR_RI					
C_ABC_MAX_WHEEL_GRD_RE_LE	-	1... FFH	1... 255	1	-
anti bounce counter maximum for diagnosis instance WHEEL_GRD_RE_LE					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_WHEEL_GRD_RE_RI	-	1... FFH	1... 255	1	-
anti bounce counter maximum for diagnosis instance WHEEL_GRD_RE_RI					
C_DLY_ER_RR	-	0... FFFFH	0... 655.35	0.01	s
Fade out time for engine roughness after rough road detection					
C_MIN_WHEEL_GRD	-	0... FFH	0 ...1	3.9216e-3	-
treshold for ratio to detect gradient failure					
C_T_WHEEL_GRD_ERR_DIAG	-	0... FFFFH	0... 6553.5	0.1	s
timer treshold for wheel gradient error					
C_VS_MAX_RR	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for rough road detection.					
C_VS_MIN_RR	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed for rough road detection.					
C_WHEEL_GRD_CLC_DIAG	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation factor for floating averaging of the monitored rough road mmv values					
C_WHEEL_GRD_CLC_RR	-	0... FFFFH	0... 0.99998	15.3e-6	-
Correlation factor for floating averaging of the rough road raw values					
IP_WHEEL_GRD_MMV_THD_AT__VS	-	0... 3FFFH	0... 999.93896	0.0610352	°/oo
LDPM_VS_WHEEL_GRD_MMV_THD	9	0... FFH	0... 255	1	km/h
Threshold versus vehicle speed for rough road detection, automatic transm.					
IP_WHEEL_GRD_MMV_THD_DIAG_AT_VS	-	0... 3FFFH	0... 999.93896	0.0610352	°/oo
LDPM_VS_WHEEL_GRD_MMV_THD	9	0... FFH	0... 255	1	km/h
Threshold versus vehicle speed for rough road failure detection, automatic transm.					
IP_WHEEL_GRD_MMV_THD_DIAG_MT_VS	-	0... 3FFFH	0... 999.93896	0.0610352	°/oo
LDPM_VS_WHEEL_GRD_MMV_THD	9	0... FFH	0... 255	1	km/h
Threshold versus vehicle speed for rough road failure detection, manual transm.					
IP_WHEEL_GRD_MMV_THD_MT__VS	-	0... 3FFFH	0... 999.93896	0.0610352	°/oo
LDPM_VS_WHEEL_GRD_MMV_THD	9	0... FFH	0... 255	1	km/h
Threshold versus vehicle speed for rough road detection, manual transm.					
LC_ENA_WHEEL_GRD_DIAG	-	0... 1H	0 ...1	1	-
global switch to activate WHEEL_GRD_DIAG (activation with = 1)					
LC_SWI_RR_CAN	-	0... 1H	0 ...1	1	-
global switch for wheel gradient calculation					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_SEG_TOOTH_RR	-	1... FFH	1... 255	1	-
Number of wheel speed signal teeth to build one segment, typical value = 4					

Import actions:

ACTION_INFR_GetVsRrPulsStamp (**OUT**<vs_rr_edge_ctr_av>,**OUT**<vs_rr_edge_t_av>,**OUT**<vs_rr_edge_t_av_max>)

Error treatment:

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Diagnostic Instance		Symptoms		ABC type	CARB class
Description	**Name (XX)**	**Description**	**Nr**		
wheel gradient monitoring	WHEEL_GRD_FR_RI	wheel gradient not plausible	0	MEM	CC
			1		
			2		
			3		

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	**Name (XX)**	**Description**	**Nr**		
wheel gradient monitoring	WHEEL_GRD_FR_LE	wheel gradient not plausible	0	MEM	CC
			1		
			2		
			3		

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	**Name (XX)**	**Description**	**Nr**		
wheel gradient monitoring	WHEEL_GRD_RE_RI	wheel gradient not plausible	0	MEM	CC
			1		
			2		
			3		

Diagnostic Instance		Symptoms		ABC type	CARB class
Description	**Name (XX)**	**Description**	**Nr**		
wheel gradient monitoring	WHEEL_GRD_RE_LE	wheel gradient not plausible	0	MEM	CC
			1		
			2		
			3		

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Fields information (For more information refers to Error Management file “Table of Failure”) :

- ABC Type : STD_INI, STD, MEM, MEM_INI, DEC_CAL, STC, NO, MPL_STD_INI
- CARB Class : MIS, FSD, CC, CAT, HC, EVAP, SA, AC, LS, LSH, EGR, OTHER, NO.

The above imported action is defined in the VHMD - IRS (Infrastructure Requirement Specification)

FUNCTION DESCRIPTION:

General information:

Rough road conditions must be detected to prevent erroneous misfire detection because of the influence jolty tracks have on the crankshaft as a result of transmission via the drive train. The speed disturbance of one wheel can be used to calculate the road conditions. Therefore, the control unit uses the signal from the driven wheel on the right side (ABS sensor or an additive sensor for the version without ABS) because the probability of the presence of a jolty track is greater than left.
However, transmission from the left to the right side has also been observed depending on the chassis and other circumstances, so that a limited detection of unilateral rough-road conditions on the left side is also possible.
The minimum number of integrated teeth for one segment depends on the number of teeth per revolution of the wheel speed. An angle of about 30 ° is preferable (e.g. an integration of 4 teeth is used for a wheel with 48 teeth). This number is determined by the non calibrateable constant NC_SEG_TOOTH_RR.
At higher speed ranges the number of integrated teeth for one segment is determined by the recurrence time of 10 ms.

B.114.1 Rough road detection

Application conditions

Initialisation:
SUM_RR = 0 at ECU-reset
LV_RR_PREV_INI = 1 at ECU-reset and at function deactivation
all other outputs = 0 at ECU-reset and at function deactivation

Recurrence: *10 ms*

Activation:
LV_ERR_VS_PLAUS = 0 **and**
VS C_VS_MIN_RR **and**
VS $\leq$ C_VS_MAX_RR **and**
LV_ST_END = 1

Deactivation:
LV_ERR_VS_PLAUS = 1 **or**
VS $<$ C_VS_MIN_RR **or**
VS $>$ C_VS_MAX_RR **or**
LV_ST_END = 0

Remark: to avoid unnecessary burden of the micro controler it is recommended to calibrate C_VS_MAX_RR according the needs. At vehicle speeds above approximately 100 km/h there is no more feed back from wheels to crankshaft.

Formula section:

IF(1) LC_SWI_RR_CAN = 0
THEN(1)

ACTION_INFR_GetVsRrPulsStamp(VS_RR_EDGE_CTR_AV, VS_RR_EDGE_T_AV, VS_RR_EDGE_T_AV_MAX)

Initialisation of VS_RR_EDGE_T_AV/CTR(n-1) and new_rr_clc:
If LV_RR_PREV_INI = 1
then VS_RR_EDGE_T_AV(n-1) = VS_RR_EDGE_T_AV(n)
VS_RR_EDGE_CTR_AV(n-1) = VS_RR_EDGE_CTR_AV(n)
new_rr_clc = 2
LV_RR_PREV_INI = 0
endif

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a) Segment period acquisition

The function uses consecutive segment times for calculation of a wheel speed gradient. The segments are built with a minimum number of NC_SEG_TOOTH_RR edges and afterwards normalized to a length of 8 teeth.

If VS_RR_EDGE_CTR_AV$_n$ - VS_RR_EDGE_CTR_AV$_{n-1}$ >= NC_SEG_TOOTH_RR

then

$$SEG\_T\_MES\_0\_RR = \left| \frac{(VS\_RR\_EDGE\_T\_AV_n - VS\_RR\_EDGE\_T\_AV_{n-1}) * 8}{VS\_RR\_EDGE\_CTR\_AV_n - VS\_RR\_EDGE\_CTR\_AV_{n-1}} \right|$$

SEG_T_MES_1_RR is the segment period preceding SEG_T_MES_0_RR.

endif

b) Calculation of rough road value

$$WHEEL\_GRD = \left| \frac{SEG\_T\_MES\_1\_RR - SEG\_T\_MES\_0\_RR}{SEG\_T\_MES\_1\_RR} \right| * 1000[‰]$$

The raw values WHEEL_GRD are used in a floating averaging, to restrict suppression to actual rough road conditions.

ELSE(1) *//calculation of rough road values with CAN signals in 20ms*
because WHEEL_CAN_XX_XX signals will be updated every 20ms
(that's the reason for the internal CTR_CALC)

CTR_CALC**++**

If CTR_CALC = 2

Then

If LV_ERR_WHEEL_GRD_RE_RI = 0 **and**

WHEEL_CAN_RE_RI$_{(n)}$ ≠ 0 **and** *//only values different from zero (physical)*
WHEEL_CAN_RE_RI$_{(n-1)}$ ≠ 0 *are allowed to abort division by zero!*

Then

$$N\_WHEEL\_GRD\_RE\_RI = \left| \frac{WHEEL\_CAN\_RE\_RI(n-1) - WHEEL\_CAN\_RE\_RI(n)}{WHEEL\_CAN\_RE\_RI(n-1)} \right| * 1000[‰]$$

Else N_WHEEL_GRD_RE_RI = 0

If LV_ERR_WHEEL_GRD_RE_LE = 0 **and**

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$WHEEL\_CAN\_RE\_LE_{(n)} \neq 0$ **and** *//only values different from zero (physical)*
$WHEEL\_CAN\_RE\_LE_{(n-1)} \neq 0$ *are allowed to abort division by zero!*

Then

$$N\_WHEEL\_GRD\_RE\_LE = \left| \frac{WHEEL\_CAN\_RE\_LE(n-1) - WHEEL\_CAN\_RE\_LE(n)}{WHEEL\_CAN\_RE\_LE(n-1)} \right| * 1000[‰]$$

Else N_WHEEL_GRD_RE_LE = 0

If LV_ERR_WHEEL_GRD_FR_RI = 0 **and**

$WHEEL\_CAN\_FN\_RI_{(n)} \neq 0$ **and** *//only values different from zero (physical)*
$WHEEL\_CAN\_FN\_RI_{(n-1)} \neq 0$ *are allowed to abort division by zero!*

Then

$$N\_WHEEL\_GRD\_FN\_RI = \left| \frac{WHEEL\_CAN\_FN\_RI(n-1) - WHEEL\_CAN\_FN\_RI(n)}{WHEEL\_CAN\_FN\_RI(n-1)} \right| * 1000[‰]$$

Else N_WHEEL_GRD_FN_RI = 0

If LV_ERR_WHEEL_GRD_FR_LE = 0 **and**

$WHEEL\_CAN\_FN\_LE_{(n)} \neq 0$ **and** *//only values different from zero (physical)*
$WHEEL\_CAN\_FN\_LE_{(n-1)} \neq 0$ *are allowed to abort division by zero!*

Then

$$N\_WHEEL\_GRD\_FN\_LE = \left| \frac{WHEEL\_CAN\_FN\_LE(n-1) - WHEEL\_CAN\_FN\_LE(n)}{WHEEL\_CAN\_FN\_LE(n-1)} \right| * 1000[‰]$$

Else N_WHEEL_GRD_FN_LE = 0

WHEEL_GRD = MAX(N_WHEEL_GRD_RE_RI; N_WHEEL_GRD_RE_LE;
N_WHEEL_GRD_FN_RI; N_WHEEL_GRD_FN_LE)

calculation of the values used in Diagnosis function:

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WHEEL_GRD_MMV_RE_RI$_{n}$ = WHEEL_GRD_MMV_RE_RI$_{n-1}$
+ C_WHEEL_GRD_CLC_DIAG * (N_WHEEL_GRD_RE_RI$_{n}$ - WHEEL_GRD_MMV_RE_RI$_{n-1}$)

WHEEL_GRD_MMV_RE_LE$_{n}$ = WHEEL_GRD_MMV_RE_LE$_{n-1}$
+ C_WHEEL_GRD_CLC_DIAG * (N_WHEEL_GRD_RE_LE$_{n}$ - WHEEL_GRD_MMV_RE_LE$_{n-1}$)

WHEEL_GRD_MMV_FR_RI$_{n}$ = WHEEL_GRD_MMV_FR_RI$_{n-1}$
+ C_WHEEL_GRD_CLC_DIAG * (N_WHEEL_GRD_FN_RI$_{n}$ - WHEEL_GRD_MMV_FR_RI$_{n-1}$)

WHEEL_GRD_MMV_FR_LE$_{n}$ = WHEEL_GRD_MMV_FR_LE$_{n-1}$
+ C_WHEEL_GRD_CLC_DIAG * (N_WHEEL_GRD_FN_LE$_{n}$ - WHEEL_GRD_MMV_FR_LE$_{n-1}$)

CTR_CALC = 0

//When the calculation is stopped due to the vehicle speed condition (see above), the calculation of WHEEL_GRD and WHEEL_GRD_MMV_XX_XX is stopped.

Else
no calculation

c) Calculation of moving mean value

WHEEL_GRD_MMV$_{n}$ = WHEEL_GRD_MMV$_{n-1}$
+ C_WHEEL_GRD_CRLC_RR * (WHEEL_GRD$_{n}$ - WHEEL_GRD_MMV$_{n-1}$)

The following information is regarding the calc. in THEN(1) path with HW signals:
When the calculation of the wheel speed segment duration is stopped due to the vehicle speed condition (see above), the calculation of WHEEL_GRD and WHEEL_GRD_MMV is stopped as well until again 2 consecutive segment durations could be determined (realised by the internal SW counter new_rr_clc).

Set of VS_RR_EDGE_T_AV/CTR(n-1) after each calculation of WHEEL_GRD(_MMV):
VS_RR_EDGE_T_AV(n-1) = VS_RR_EDGE_T_AV(n)
VS_RR_EDGE_CTR_AV(n-1) = VS_RR_EDGE_CTR_AV(n)

d) Detection of rough road status//calc. complete formula section in 10ms
WHEEL_GRD_MMV_THD = IP_WHEEL_GRD_MMV_THD_XX__VS
(XX = AT for automatic transmission, LV_AT = 1 ; XX = MT for manual transmission, LV_AT = 0)

If WHEEL_GRD_MMV WHEEL_GRD_MMV_THD
then LV_STATE_RR = 1 **and** timer DLY_ER_RR becomes started **and** increment SUM_RR by one
elseif timer DLY_ER_RR $>$ 0
then LV_STATE_RR = 1 **and** decrement timer DLY_ER_RR
else LV_STATE_RR = 0
endif
endif

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The start value of the timer DLY_ER_RR is C_DLY_ER_RR.
//LV_STATE_RR is calc. in 10ms so DLY_ER_RR must also calc. in 10ms

B.114.2 Wheel Gradient diagnosis for rough road detection

General information:

Wheel Gradient monitoring for rough road detection:
With the rough road detection function it is possible to calculate a wheel gradient which indicates rough road. If this gradient exceeds a THD, then rough road is detected and MISF monitoring is disabled. To confirm CARB requirements it is necessary to monitor the calculated wheel gradient value to avoid wrong MISF inhibition.

Application conditions:

Initialisation:	`all = 0, except RATIO_XX_XX = 1`
	`at RESET`
	`at LV_IGK = 0 -> 1`
	`at` *`CLRFMY`*
	`at function deactivation`	

Recurrence:	`100 ms`	
Activation:	`LV_IGK == 1`	**and**
	`LV_ERR_CAN_BOFF == 0`	**and**
	`LC_ENA_WHEEL_GRD_DIAG == 1`	
Deactivation:	`if activation condition not true`	

Function description:

Formula section:

max_1 = MAX(WHEEL_GRD_MMV_RE_RI; WHEEL_GRD_MMV_RE_LE;
WHEEL_GRD_MMV_FR_RI; WHEEL_GRD_MMV_FR_LE)

WHEEL_GRD_MMV_THD_DIAG = IP_WHEEL_GRD_MMV_THD_DIAG_XX_VS
(XX = AT for automatic transmission, LV_AT = 1 ; XX = MT for manual transmission, LV_AT = 0)

remark: calc. for all wheels in one subfunction
If LV_ERR_WHEEL_GRD_RE_RI = 0 **and**
LV_ERR_VS_PLAUS = 0 **and**
VS $\geq$ C_VS_MIN_RR **and**
VS $\leq$ C_VS_MAX_RR
and
LV_ST_END = 1
Then LV_CDN_DIAG_WHEEL_GRD_RE_RI = 1
Else LV_CDN_DIAG_WHEEL_GRD_RE_RI = 0
Endif
If(1) max_1 = WHEEL_GRD_MMV_RE_RI **and**
WHEEL_GRD_MMV_RE_RI $>$ WHEEL_GRD_MMV_THD_DIAG

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```
    Then(1)  max_2 = MAX( WHEEL_GRD_MMV_FR_LE; WHEEL_GRD_MMV_FR_RI;
                         WHEEL_GRD_MMV_RE_LE)
                     RATIO_RE_RI = (max_2/max_1)
      If(2)      (RATIO_RE_RI < C_MIN_WHEEL_GRD              and
                  LV_ERR_WHEEL_GRD_RE_LE = 0                 and
                  LV_ERR_WHEEL_GRD_FR_LE = 0                 and
                  LV_ERR_WHEEL_GRD_FR_RI = 0)
      Then(2)  T_WHEEL_GRD_RE_RI_ERR_DIAG++
        Else(2)   T_WHEEL_GRD_RE_RI_ERR_DIAG reset
                  ERR_SYM_WHEEL_GRD_RE_RI = no_sym
                  RATIO_RE_RI = 1
        Endif(2)
      Else(1)   T_WHEEL_GRD_RE_RI_ERR_DIAG reset
                ERR_SYM_WHEEL_GRD_RE_RI = no_sym
                RATIO_RE_RI = 1
    Endif(1)
    If        T_WHEEL_GRD_RE_RI_ERR_DIAG > C_T_WHEEL_GRD_ERR_DIAG
    Then      ERR_SYM_WHEEL_GRD_RE_RI = sym_0
    Endif
ACTION_ERRM_FilterSymptom( IN< IDX_DIAG >, IN< LV_CDN_DIAG_WHEEL_GRD_RE_RI >,
IN< ERR_SYM_WHEEL_GRD_RE_RI >, IN< C_ABC_INC_WHEEL_GRD_RE_RI >, IN< 1 >,
IN< C_ABC_MAX_WHEEL_GRD_RE_RI >, OUT< LV_ERR_WHEEL_GRD_RE_RI > )

   If       LV_ERR_WHEEL_GRD_RE_LE = 0                     and
            LV_ERR_VS_PLAUS = 0                                        and
             VS ≥  C_VS_MIN_RR                                   and
            VS ≤  C_VS_MAX_RR
and
             LV_ST_END = 1
  Then      LV_CDN_DIAG_WHEEL_GRD_RE_LE = 1
  Else      LV_CDN_DIAG_WHEEL_GRD_RE_LE = 0
   Endif
    If(1)      max_1 = WHEEL_GRD_MMV_RE_LE                    and
               WHEEL_GRD_MMV_RE_LE > WHEEL_GRD_MMV_THD_DIAG
    Then(1)  max_2 = MAX( WHEEL_GRD_MMV_FR_RI; WHEEL_GRD_MMV_FR_LE;
                          WHEEL_GRD_MMV_RE_RI)
                      RATIO_RE_LE = (max_2/max_1)
      If(2)      (RATIO_RE_LE < C_MIN_WHEEL_GRD              and
                  LV_ERR_WHEEL_GRD_FR_RI = 0                 and
                  LV_ERR_WHEEL_GRD_FR_LE = 0                 and
                  LV_ERR_WHEEL_GRD_RE_RI = 0)
      Then(2)  T_WHEEL_GRD_RE_LE_ERR_DIAG++
      Else(2)  T_WHEEL_GRD_RE_LE_ERR_DIAG reset
                  ERR_SYM_WHEEL_GRD_RE_LE = no_sym
                  RATIO_RE_LE = 1
      Endif(2)
    Else(1)   T_WHEEL_GRD_RE_LE_ERR_DIAG reset
                ERR_SYM_WHEEL_GRD_RE_LE = no_sym
                RATIO_RE_LE = 1
    Endif(1)
    If        T_WHEEL_GRD_RE_LE_ERR_DIAG > C_T_WHEEL_GRD_ERR_DIAG
    Then      ERR_SYM_WHEEL_GRD_MON_RE_LE = sym_0
```

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Endif
ACTION_ERRM_FilterSymptom(IN< IDX_DIAG >, IN< LV_CDN_DIAG_WHEEL_GRD_RE_LE >, IN< ERR_SYM_WHEEL_GRD_RE_LE >, IN< C_ABC_INC_WHEEL_GRD_RE_LE >, IN< 1 >, IN< C_ABC_MAX_WHEEL_GRD_RE_LE >, OUT< LV_ERR_WHEEL_GRD_RE_LE >)

```
If        LV_ERR_WHEEL_GRD_FR_RI = 0                  and
          LV_ERR_VS_PLAUS = 0                          and
          VS ≥ C_VS_MIN_RR                             and
          VS ≤ C_VS_MAX_RR
and
          LV_ST_END = 1
Then      LV_CDN_DIAG_WHEEL_GRD_FR_RI = 1
Else      LV_CDN_DIAG_WHEEL_GRD_FR_RI = 0
Endif
If(1)     max_1 = WHEEL_GRD_MMV_FR_RI                  and
          WHEEL_GRD_MMV_FR_RI > WHEEL_GRD_MMV_THD_DIAG
Then(1)   max_2 = MAX( WHEEL_GRD_MMV_FR_LE; WHEEL_GRD_MMV_RE_RI;
                    WHEEL_GRD_MMV_RE_LE)
                RATIO_FR_RI = (max_2/max_1)
 If(2)    (RATIO_FR_RI < C_MIN_WHEEL_GRD               and
          LV_ERR_WHEEL_GRD_FR_LE = 0                   and
          LV_ERR_WHEEL_GRD_RE_LE = 0                   and
          LV_ERR_WHEEL_GRD_RE_RI = 0)
 Then(2)  T_WHEEL_GRD_FR_RI_ERR_DIAG++
 Else(2)  T_WHEEL_GRD_FR_RI_ERR_DIAG reset
          ERR_SYM_WHEEL_GRD_FR_RI = no_sym
          RATIO_FR_RI = 1
 Endif(2)
Else(1)   T_WHEEL_GRD_FR_RI_ERR_DIAG reset
          ERR_SYM_WHEEL_GRD_FR_RI = no_sym
          RATIO_FR_RI = 1
Endif(1)
If        T_WHEEL_GRD_FR_RI_ERR_DIAG > C_T_WHEEL_GRD_ERR_DIAG
Then      ERR_SYM_WHEEL_GRD_FR_RI = sym_0
Endif
```

ACTION_ERRM_FilterSymptom(IN< IDX_DIAG >, IN< LV_CDN_DIAG_WHEEL_GRD_FR_RI >, IN< ERR_SYM_WHEEL_GRD_FR_RI >, IN< C_ABC_INC_WHEEL_GRD_FR_RI >, IN< 1 >, IN< C_ABC_MAX_WHEEL_GRD_FR_RI >, OUT< LV_ERR_WHEEL_GRD_FR_RI >)

```
If        LV_ERR_WHEEL_GRD_FR_LE = 0                  and
          LV_ERR_VS_PLAUS = 0                          and
          VS ≥ C_VS_MIN_RR                             and
          VS ≤ C_VS_MAX_RR
and
          LV_ST_END = 1
Then      LV_CDN_DIAG_WHEEL_GRD_FR_LE = 1
Else      LV_CDN_DIAG_WHEEL_GRD_FR_LE = 0
Endif
If(1)     max_1 = WHEEL_GRD_MMV_FR_LE                  and
          WHEEL_GRD_MMV_FR_LE > WHEEL_GRD_MMV_THD_DIAG
Then(1)   max_2 = MAX( WHEEL_GRD_MMV_FR_RI; WHEEL_GRD_MMV_RE_RI;
                    WHEEL_GRD_MMV_RE_LE)
```

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RATIO_FR_LE = (max_2/max_1)
If(2) (RATIO_FR_LE < C_MIN_WHEEL_GRD **and**
LV_ERR_WHEEL_GRD_FR_RI = 0 **and**
LV_ERR_WHEEL_GRD_RE_LE = 0 **and**
LV_ERR_WHEEL_GRD_RE_RI = 0)
Then(2) T_WHEEL_GRD_FR_LE_ERR_DIAG++
Else(2) T_WHEEL_GRD_FR_LE_ERR_DIAG reset
ERR_SYM_WHEEL_GRD_FR_LE = no_sym
RATIO_FR_LE = 1
Endif(2)
Else(1) T_WHEEL_GRD_FR_LE_ERR_DIAG reset
ERR_SYM_WHEEL_GRD_FR_LE = no_sym
RATIO_FR_LE = 1
Endif(1)
If T_WHEEL_GRD_FR_LE_ERR_DIAG > C_T_WHEEL_GRD_ERR_DIAG
Then ERR_SYM_WHEEL_GRD_FR_LE = sym_0
Endif

ACTION_ERRM_FilterSymptom(IN< IDX_DIAG >, IN< LV_CDN_DIAG_WHEEL_GRD_FR_LE >, IN< ERR_SYM_WHEEL_GRD_FR_LE >, IN< C_ABC_INC_WHEEL_GRD_FR_LE >, IN< 1 >, IN< C_ABC_MAX_WHEEL_GRD_FR_LE >, OUT< LV_ERR_WHEEL_GRD_FR_LE >)

// remark: LV_ERR_XX and LV_END_DIAG_XX are calculated by ERRM after debouncing

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B.115 NOx sensor OBDII diagnosis - Sensor version check

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NS_VERS [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom for NOx sensor version check diagnosis					
LV_CDN_DIAG_NS_VERS [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (seto to one when condition is fulfilled)					
LV_END_DIAG_NS_VERS [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor version check diagnosis was performed at last one time					
LV_ERR_NS_VERS [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Present failure after filtering of NOx sensor. NOx-Sensor version check					
NOX_CAN_SW_VERS_DIAG_BOL_SAE [NC_NOX_SENS_CONF]	O/V/S	0... FFH	0... 255	1	-
Mode 06 - minimum value of test limit for NOx sensor version check diagnosis					
NOX_CAN_SW_VERS_DIAG_SAE [NC_NOX_SENS_CONF]	O/V/S	0... FFH	0... 255	1	-
Mode 06 - test value of NOx sensor version check diagnosis					
STATE_NS_VERS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
State for NOx Sensor version check diagnosis					

Input data:

C_STATE_NS_MASK_ MODE_3_A {p. 1400}	C_STATE_NS_MASK_ MODE_3_B {p. 1400}	CAN_STATE_NS_TMP [NC_NOX_SENS_CONF] {p. 1398}	CAN_SW_NS [NC_NOX_SENS_CONF] {p. 1398}
LV_DC {p. 5746}	LV_INH_DIAG_NS_OBD_ 2_VERS [NC_NOX_SENS_CONF] {p. 6468}	NC_NOX_SENS_CONF {p. 643}	T_AST_SAE {p. 1766}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_NS_VERS	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_NS_VERS	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_NOX_NS_DIAG_VERS_SW_THD	-	0... FFH	0... 255	1	-
Theshold for NOx sensor version check diagnosis value					
C_T_AST_MIN_NS_VERS_DIAG	-	0... FFFFH	0... 65535	1	s
Minimum value of PID1F Cumulated time					
LC_NS_VERS_CHK_REP	-	0... 1H	0 ...1	1	-
switch for request of NOx Sensor version check diagnosis value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

General Information

This is evaluation of NOx sensor software version. In case of too less version, an error shall be generated.

Meaning of states:

PAS passive state, no actions are executed
REQ request for NOx sensor software version
CHK check of the NOx sensor software version and calculation of diagnosis values
END diagnosis finished

Application Conditions

Initialization: RST, CLRFMY, NVMINI, NVMRES, NVMSTO
Recurrence: 100MS
Activation: LV_DC==1
Deactivation: LV_DC==0

Function description

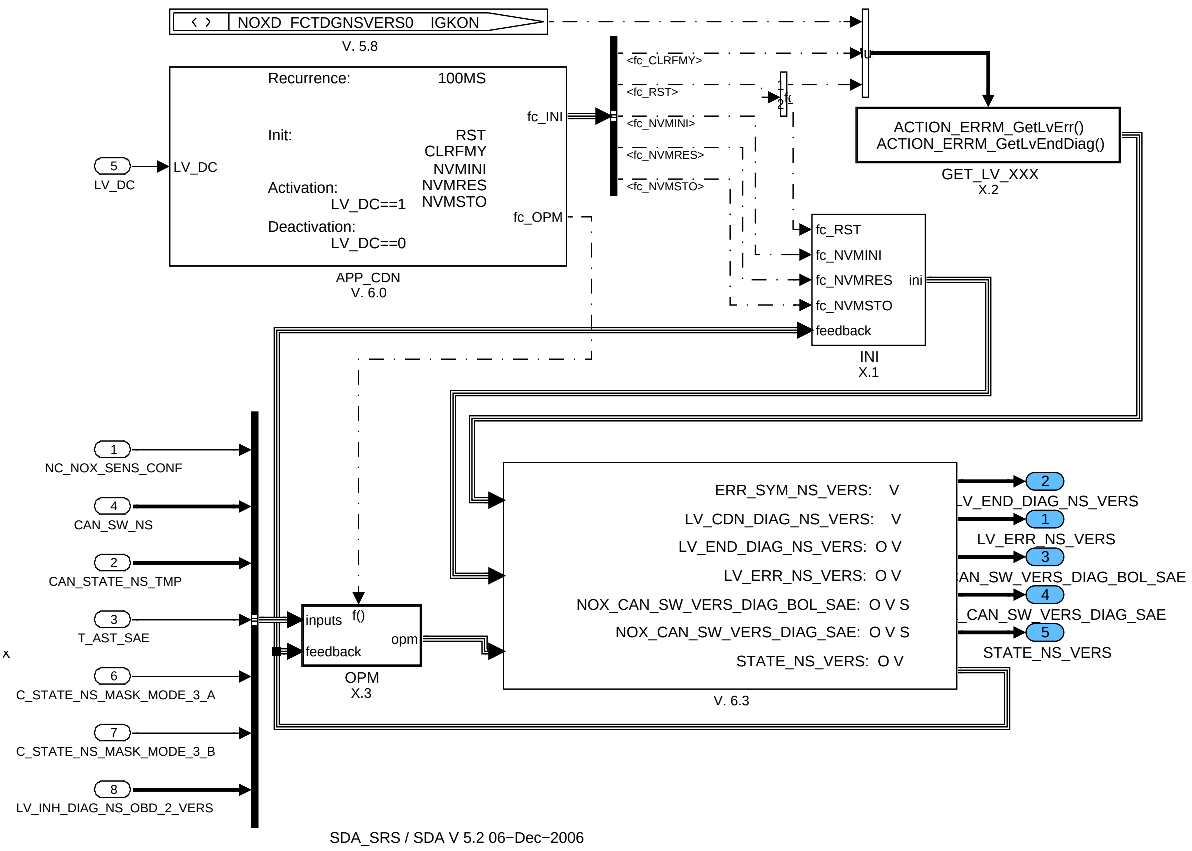

Figure B.115.1: :

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B.115.1 Initialization and Management of nonvolatile memory

B.115.1.1 Initialization at Reset

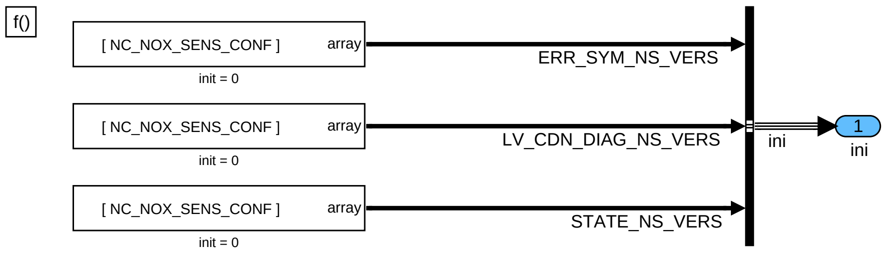

Figure B.115.2: :

B.115.1.2 Initialization of NVMY data

All Mode 6 values will be stored in the nonvolatile memory. The values will be reset to zero, if failure memory will be cleared.

B.115.2 Synchronization of the LV_ERR_NS_VERS and LV_END_DIAG_NS_VERS

Synchronisation between LV_ERR_NS_VERS and its result from ERRM is done using action ACTION_ERRM_GetLvErr() similarly synchronisation between LV_END_DIAG_NS_ VERS and its result from ERRM is done using action ACTION_ERRM_GetLvEndDiag()at RESET ,IGKON and CLRFMY events.

B.115.3 Operation at 100ms

B.115.3.1 Introduction of multiple sensor system

B.115.3.1.1 Calculation of the diagnosis results

B.115.3.1.1.1 Determination of diagnostic condition

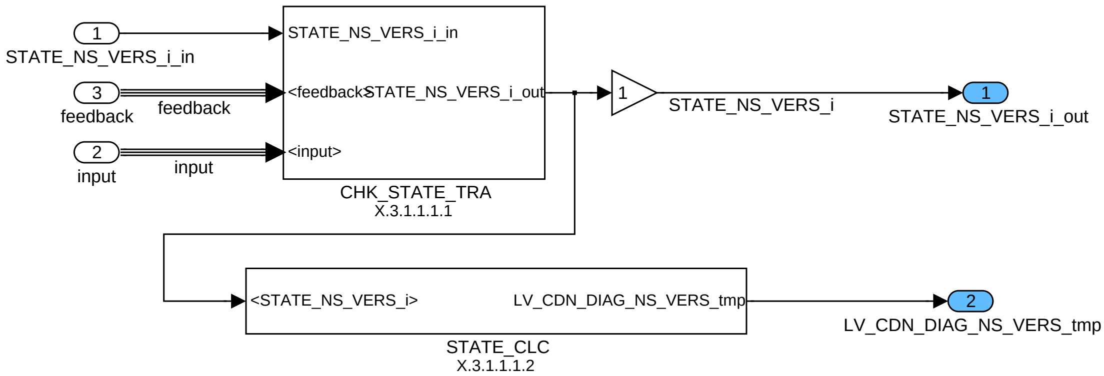

Figure B.115.3: :

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B.115.3.1.1.1.1 Check transition conditions of STATE_NS_VERS

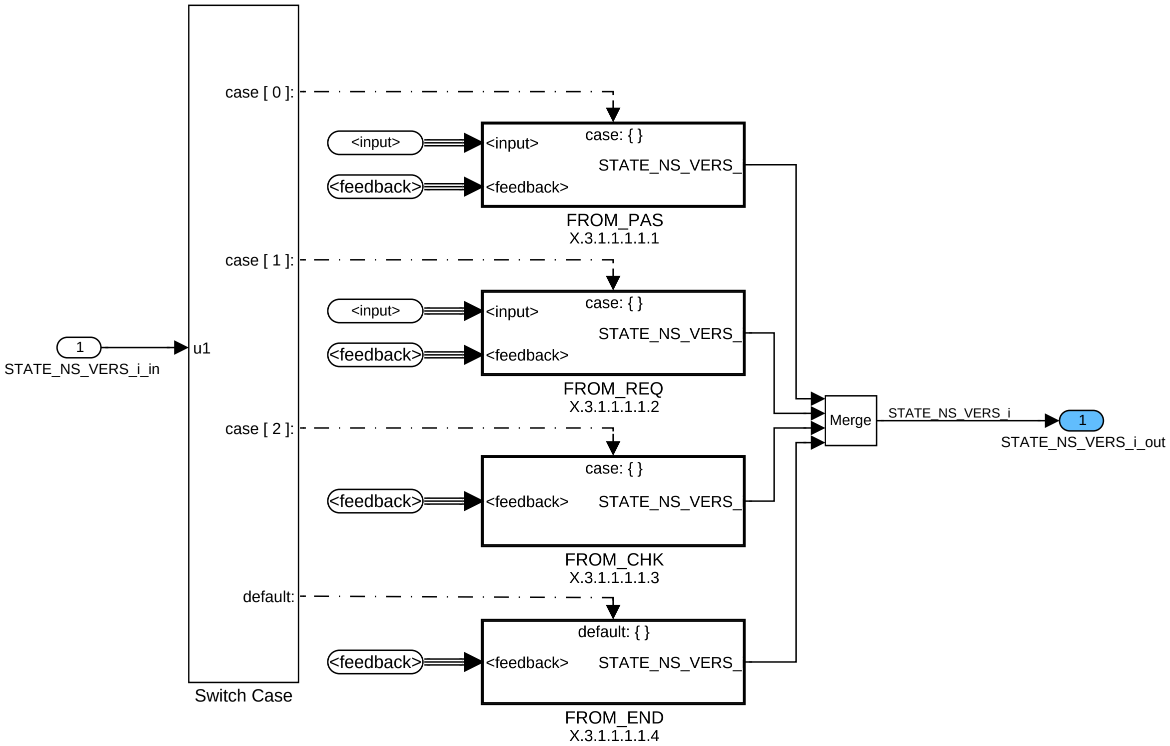

Figure B.115.4: :

B.115.3.1.1.1.1.1 From PASSIVE

B.115.3.1.1.1.1.1.1 Check transition conditions from PASSIVE and Transition PASSIVE to REQUEST actions

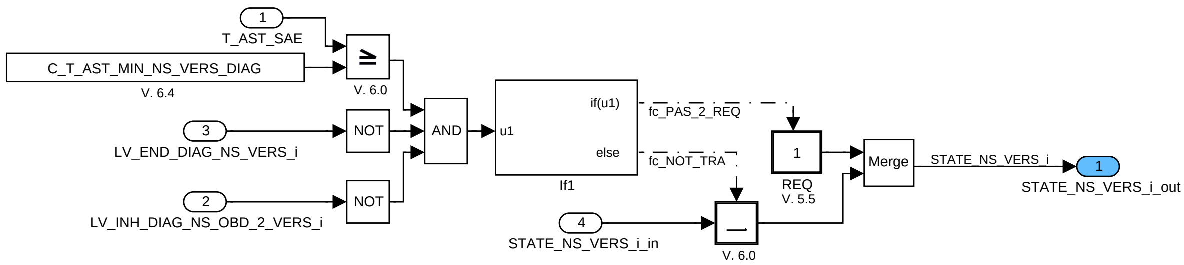

Figure B.115.5: :

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B.115.3.1.1.1.1.2 From REQUEST

B.115.3.1.1.1.1.2.1 Check transition conditions from REQUEST and Transition REQUEST to CHECK actions

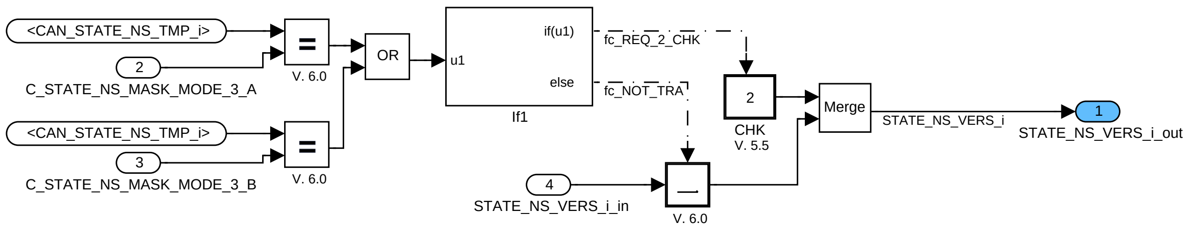

Figure B.115.6: :

B.115.3.1.1.1.1.3 From CHECK

B.115.3.1.1.1.1.3.1 Check transition conditions from CHECK and Transition CHECK to END actions

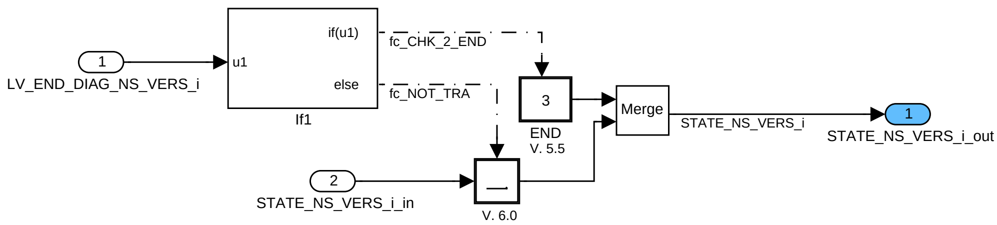

Figure B.115.7: :

B.115.3.1.1.1.1.4 From END

B.115.3.1.1.1.1.4.1 Check transition conditions from END and Transition END to PASSIVE actions

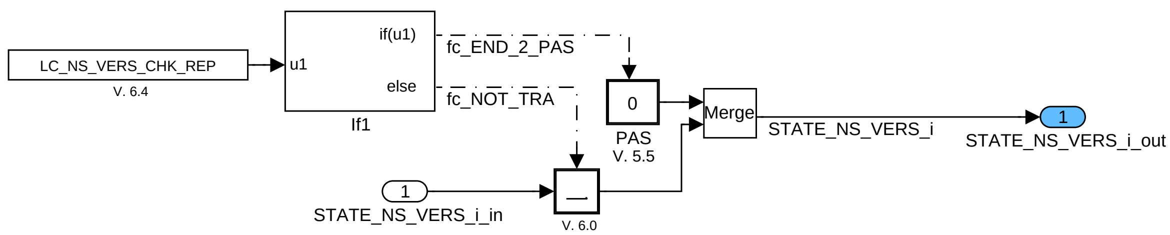

Figure B.115.8: :

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B.115.3.1.1.1.2 Actions calculation of STATE_NS_VERS

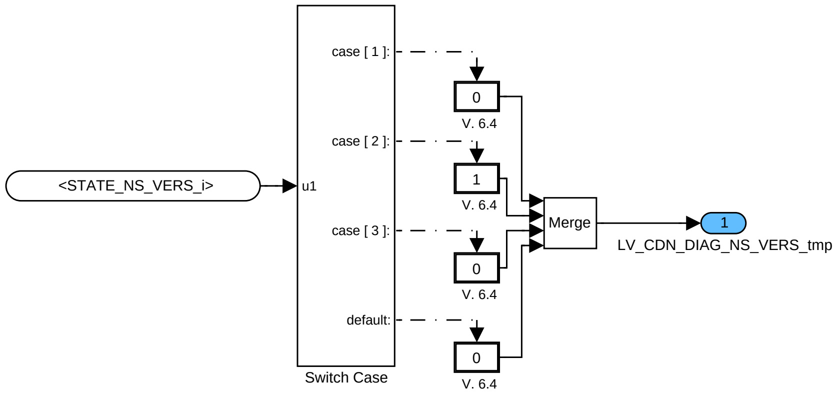

Figure B.115.9: :

B.115.3.1.1.2 Determination of error symptom

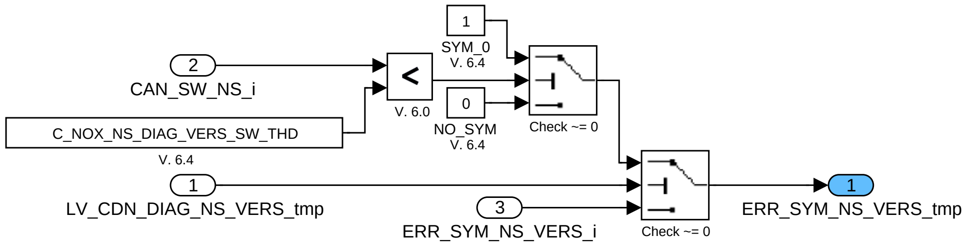

Figure B.115.10: :

B.115.3.1.1.3 Call for ERRM

ACTION_ERRM_FilterSymptom(IN<XX>, IN<lv_cdn_diag_XX>, IN<err_sym_XX >, IN<C_ABC_INC_XX >, IN<C_ABC_DEC_XX >, IN<C_ABC_MAX_XX >, OUT<LV_ERR_XX>)
The action computes the elementary anti-bounce filter for one failure treatment and returns filter results

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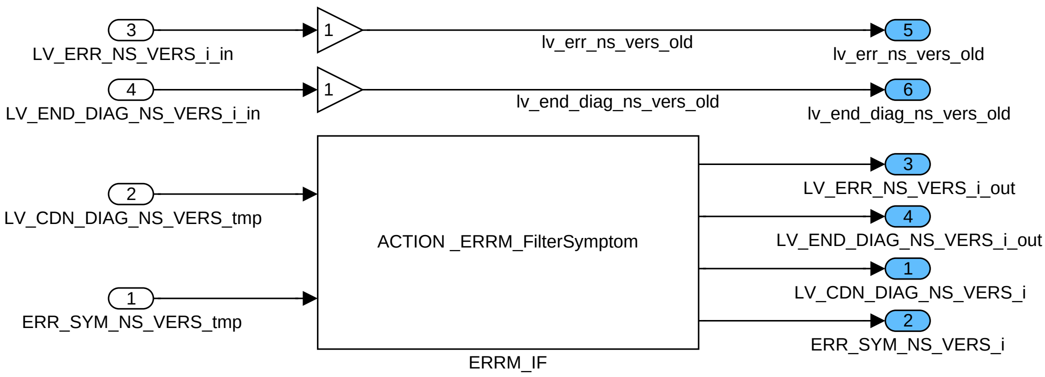

Figure B.115.11: :

B.115.3.1.1.4 Diagnosis Mode 6 handling

Mode 6 values will be stored, if error management is finishing the diagnosis or is setting an error.

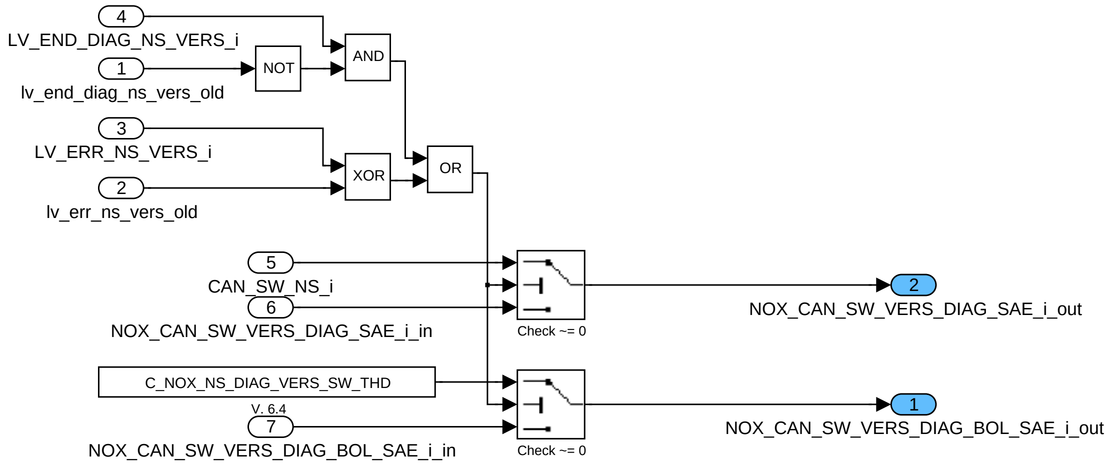

Figure B.115.12: :

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B.116 NOx sensor OBDII diagnosis - General

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_NS_OBD_2_ERR [NC_NOX_SENS_CONF]	O/V/S	0... FFH	0... 255	1	-
Number of consecutive driving cycles at which a NOx sensor failure was detected					
LAMB_LS_UP_MMV_NS [NC_CBK_EX_NR]	V	0... 7FFFH	0... 31.9990234	976.563e-6	-
Moving mean value of upstream lambda					
LV_ERR_NS_OBD_2 [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Result of NOx sensor OBD II diagnosis					
LV_LAMB_LS_UP_LDC	V	0... 1H	0 ...1	1	-
Limited dynamic of signal LAMB_LS_UP (one condition for all exhaust banks)					
LV_LAMB_LS_UP_LDC_SNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Limited dynamic of signal LAMB_LS_UP (one condition for each exhaust bank)					
LV_NS_LDC [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Limited dynamics for NOx sensor state evaluation					
MAF_INT_LDC_DLY_NS [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 1820.42	0.02777778	g
Integral of air mass flow since limited dynamic conditions are fulfilled					
MAF_MMV_NS	V	0... FFFFH	0... 1389	0.02119478	mg/stk
Moving mean value of mass air flow					
N_MMV_NS	V	0... 1FE0H	0... 8160	1	rpm
Moving mean value of engine speed					
STATE_END_NS_OBD_2 [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 65535	1	-
Collection of all diagnosis end bits of OBDII diagnosis					
STATE_ERR_NS_OBD_2 [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 65535	1	-
Collection of all error bits of OBDII diagnosis					

Input data:

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_END_DIAG_NS_ACT [NC_NOX_SENS_CONF] {p. 6358}	LV_END_DIAG_NS_AFR [NC_NOX_SENS_CONF] {p. 6389}	LV_END_DIAG_NS_AVL [NC_NOX_SENS_CONF] {p. 6368}
LV_END_DIAG_NS_GAIN [NC_NOX_SENS_CONF] {p. 6377}	LV_END_DIAG_NS_HTP [NC_NOX_SENS_CONF] {p. 6330}	LV_END_DIAG_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF] {p. 6396}	LV_END_DIAG_NS_OFS [NC_NOX_SENS_CONF] {p. 6378}
LV_END_DIAG_NS_PUC [NC_NOX_SENS_CONF] {p. 6405}	LV_END_DIAG_NS_RAW [NC_NOX_SENS_CONF]	LV_END_DIAG_NS_SHIFT [NC_NOX_SENS_CONF] {p. 6412}	LV_END_DIAG_NS_STOP [NC_NOX_SENS_CONF] {p. 6347}
LV_END_DIAG_NS_VERS [NC_NOX_SENS_CONF] {p. 6313}	LV_END_DIAG_NS_VLS_DYN [NC_NOX_SENS_CONF] {p. 6338}	LV_ERR_NS_ACT [NC_NOX_SENS_CONF] {p. 6358}	LV_ERR_NS_AFR [NC_NOX_SENS_CONF] {p. 6389}

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LV_ERR_NS_AVL [NC_NOX_SENS_CONF] {p. 6368}	LV_ERR_NS_GAIN [NC_NOX_SENS_CONF] {p. 6377}	LV_ERR_NS_HTP [NC_NOX_SENS_CONF] {p. 6330}	LV_ERR_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF] {p. 6396}
LV_ERR_NS_OFS [NC_NOX_SENS_CONF] {p. 6378}	LV_ERR_NS_PUC [NC_NOX_SENS_CONF] {p. 6405}	LV_ERR_NS_RAW [NC_NOX_SENS_CONF]	LV_ERR_NS_SHIFT [NC_NOX_SENS_CONF] {p. 6412}
LV_ERR_NS_STOP [NC_NOX_SENS_CONF] {p. 6347}	LV_ERR_NS_VERS [NC_NOX_SENS_CONF] {p. 6313}	LV_ERR_NS_VLS_DYN [NC_NOX_SENS_CONF] {p. 6338}	LV_INH_DIAG_NS_OBD_2_PLAUS [NC_NOX_SENS_CONF] {p. 6468}
LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_ST_END {p. 1720}	MAF {p. 8277}	MAF_KGH {p. 1195}
N {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_LAMB_LS_UP_MMV_NS	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Filter constant for calculation of moving mean value of upstream lambda					
C_CRLC_MAF_MMV_NS	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
filter constant for calculation of moving mean value of mass air flow					
C_CRLC_N_MMV_NS	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
filter constant for calculation of moving mean value of engine speed					
C_CTR_NS_OBD_2_ERR_MAX	-	0... FFH	0... 255	1	-
Maximum number of consecutive driving cycles at which a NOx sensor failure was detected					
C_ERR_END_NS_OBD_2_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of end of diagnosis signal that will be evaluated before decrement counter					
C_ERR_RST_NS_OBD_2	-	0... 2H	0 ...2	1	-
Selection of reset strategy of global NOx sensor OBD2 error					
C_MAF_DYW_NS	-	0... FFFFH	0... 1389	0.02119478	mg/stk
Limited dynamic threshold of MAF					
C_MAF_INT_LDC_DLY_NS	-	0... FFFFH	0... 1820.42	0.02777778	g
MAF integral threshold after reaching limited dynamic conditions, before LV_NS_LDC is set					
C_N_DYW_NS	-	0... 1FE0H	0... 8160	1	rpm
Limited dynamic threshold of engine speed					
C_STATE_ERR_NS_OBD_2_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of STATE_ERR_NS_OBD_2 error bits					
IP_LAMB_LS_UP_DYW_NS	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
LDP_LAMB_LS_UP_IP_LAMB_DYW_NS	4	0... 7FFFH	0... 31.9990234	976.563e-6	-
Lambda signal value of the WRAF sensor					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_FAC_MAF_INT_LDC	-	0... FFFFH	0... 1.02398437	15.625e-6	s
normalization factor for calculation of integral of MAF_KGH					

General information

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This module consists a limited dynamics evaluation for the NOx sensor and the global NOx sensor OBD II error flag.

The reset strategy of this error bit LV_ERR_NS_OBD_2_i can be selected by C_ERR_RST_NS_OBD_2_i. It can be chosen between following possibilities for error bit reset:
- reset only at clear of error memory
- reset at every start of new driving cycle
- manual reset, permanent reset.

Application Condition

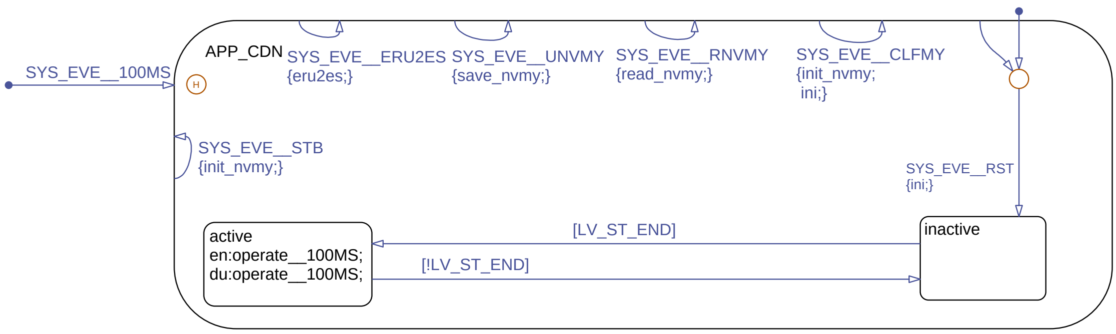

Figure B.116.1: NOXD_MODULB07G/APP_CDN/Chart

Function Description

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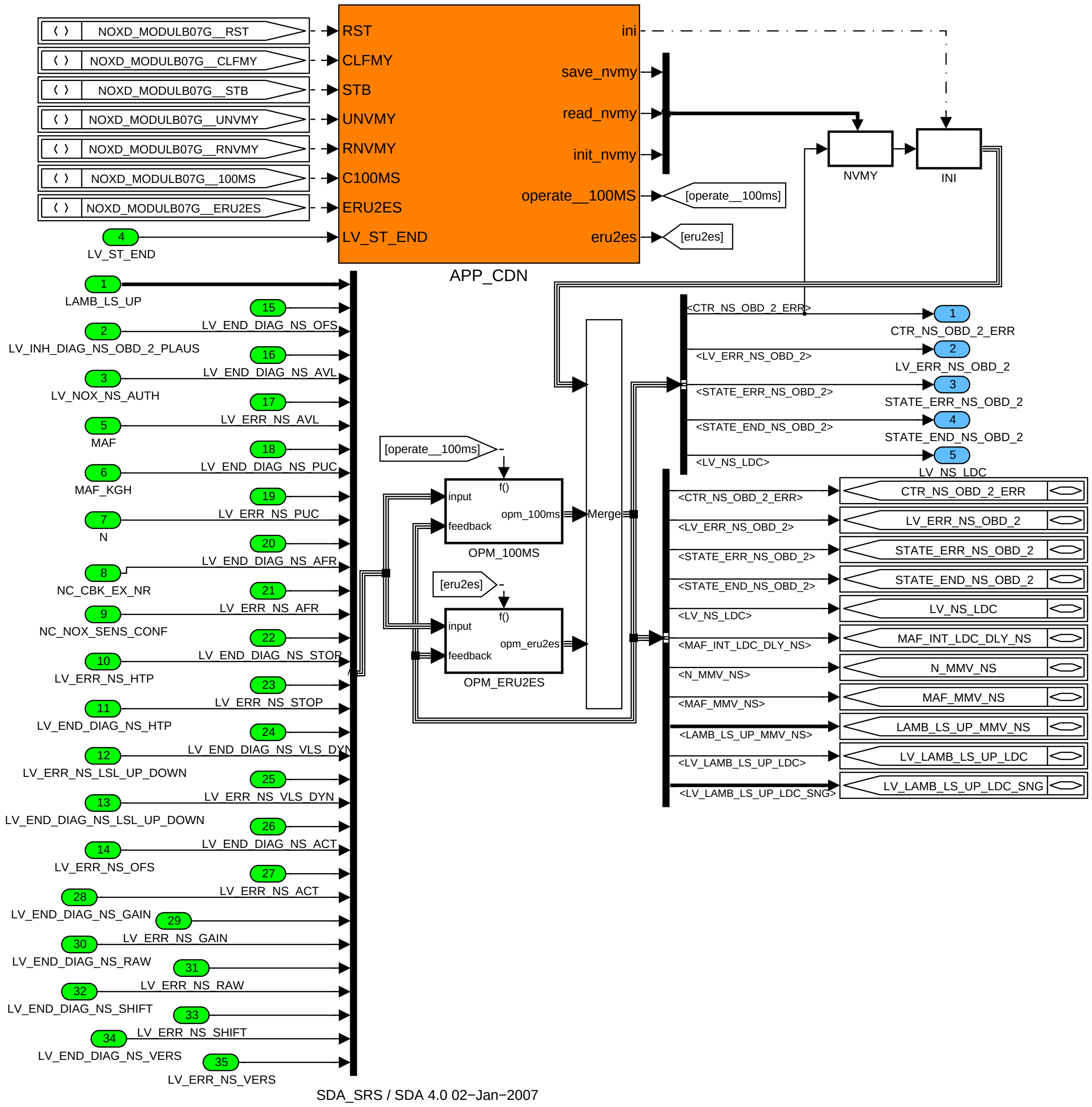

Figure B.116.2: NOXD_MODULB07G

B.116.1 Initialization at reset or at clear failure memory

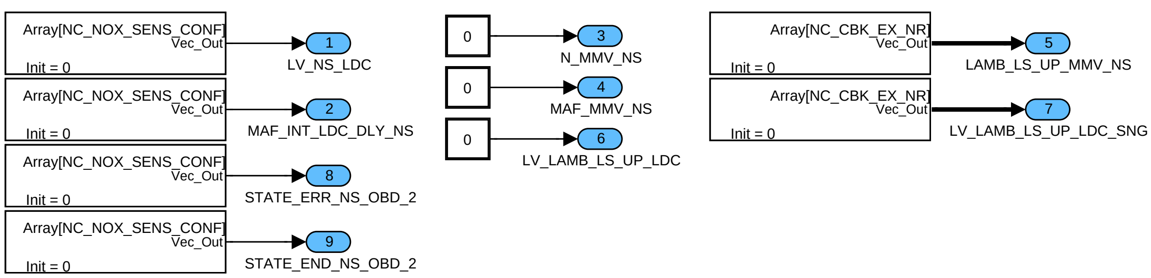

Figure B.116.3: NOXD_MODULB07G/INI/CLC1

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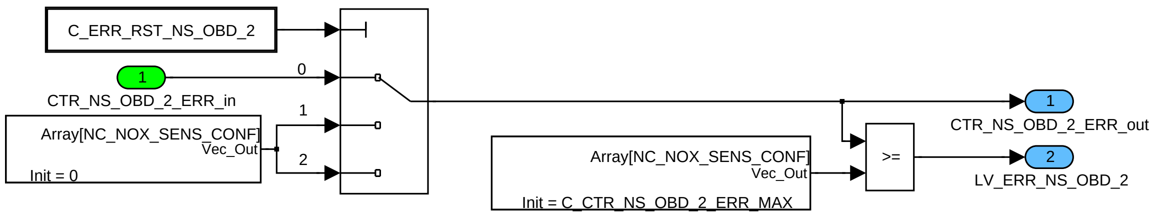

Figure B.116.4: NOXD_MODULB07G/INI/CLC2

B.116.2 Management of non-volatile memory

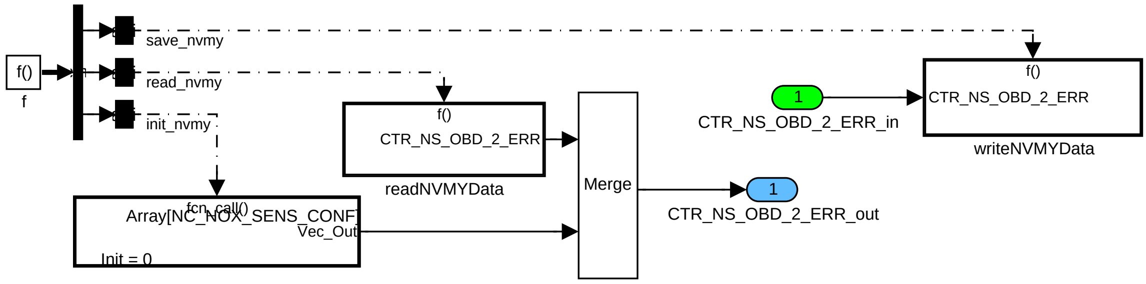

Figure B.116.5: NOXD_MODULB07G/NVMY

B.116.3 Loop control 100 ms

The calculation inside FOR_LOOP_LS have to be done for each upstream lambda sensor, controlled by configuration data NC_CBK_EX_NR.
If NC_CBK_EX_NR = 1, then calculation for i = 1.
If NC_CBK_EX_NR = 2, then calculation for i = 1 and 2.

The calculation inside NO_LOOP have to be done only once.

The calculation inside FOR_LOOP_NS have to be done for each NOx sensor, controlled by configuration data NC_NOX_SENS_CONF.
If NC_NOX_SENS_CONF = 1, then calculation for i = 1.
If NC_NOX_SENS_CONF = 2, then calculation for i = 1 and 2.

NC_NOX_SENS_CONF cannot be greater than NC_CBK_EX_NR.

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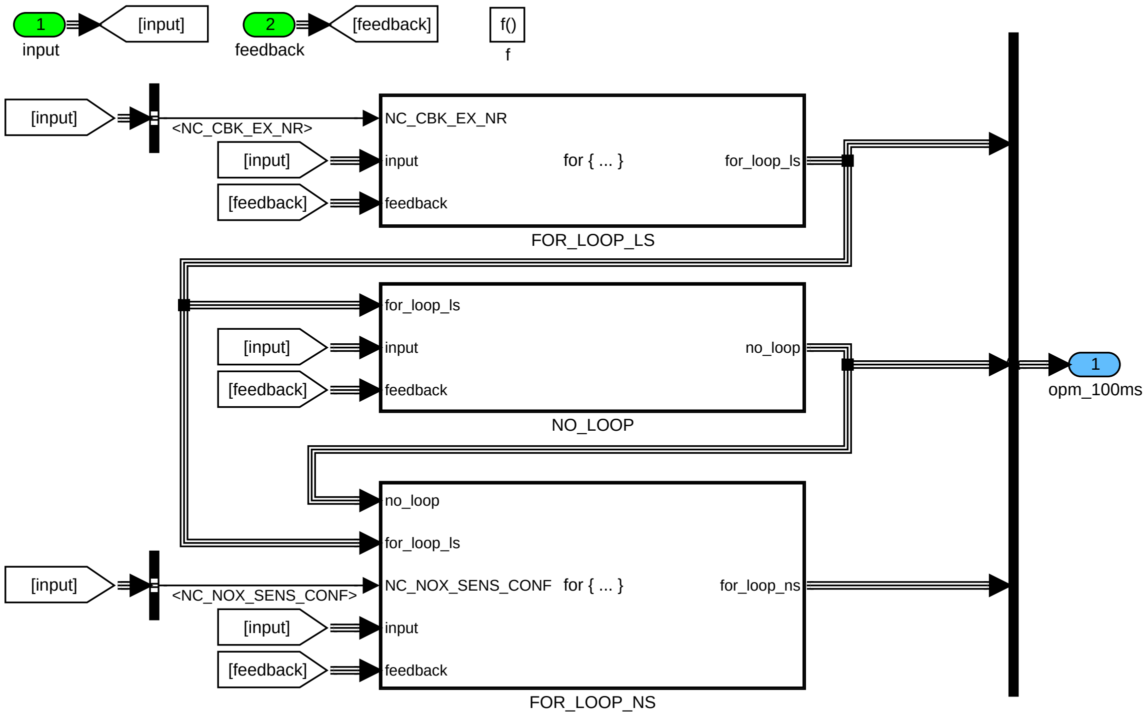

Figure B.116.6: NOXD_MODULB07G/OPM_100MS

Calculation for each upstream lambda sensor

Filter for upstream lambda

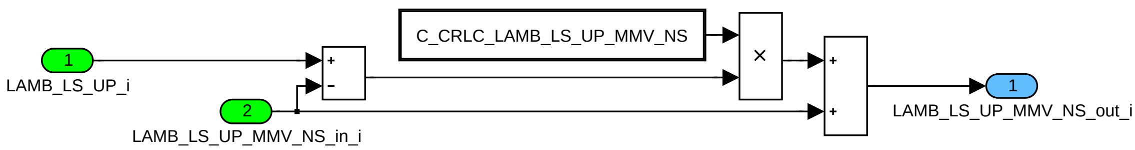

Figure B.116.7: NOXD_MODULB07G/OPM_100MS/FOR_LOOP_LS/CLC1

Check of deviation of upstream lambda from its mean value

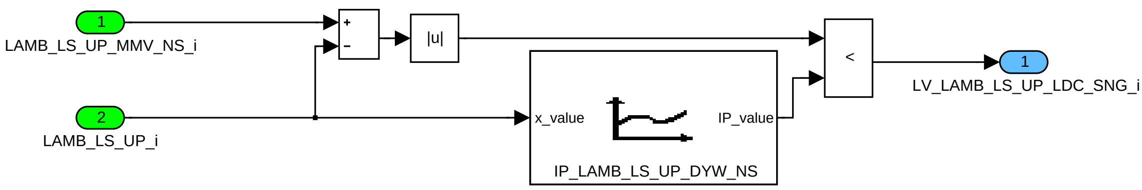

Figure B.116.8: NOXD_MODULB07G/OPM_100MS/FOR_LOOP_LS/CLC2

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Bank independent calculation

Filter of motor speed

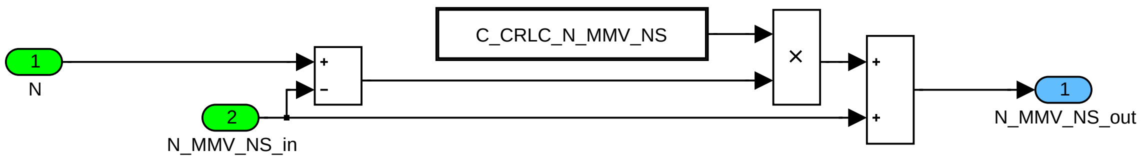

Figure B.116.9: NOXD_MODULB07G/OPM_100MS/NO_LOOP/CLC1

Filter of mass air flow

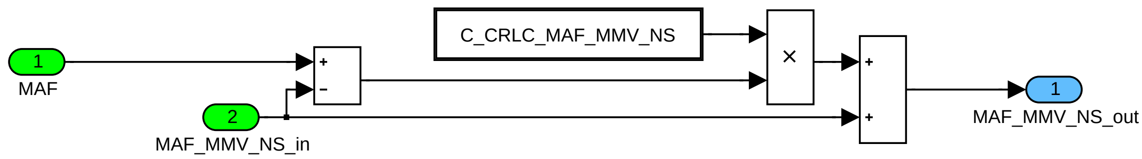

Figure B.116.10: NOXD_MODULB07G/OPM_100MS/NO_LOOP/CLC2

Lambda deviation signal for all banks

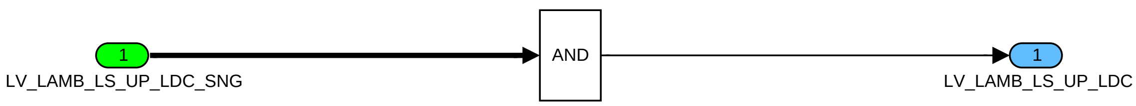

Figure B.116.11: NOXD_MODULB07G/OPM_100MS/NO_LOOP/CLC3

Calculation for each NOx sensor

Evaluation of limited dynamics

The dynamic is limited if several conditions are valid for a longer time, controlled by the MAF integral.

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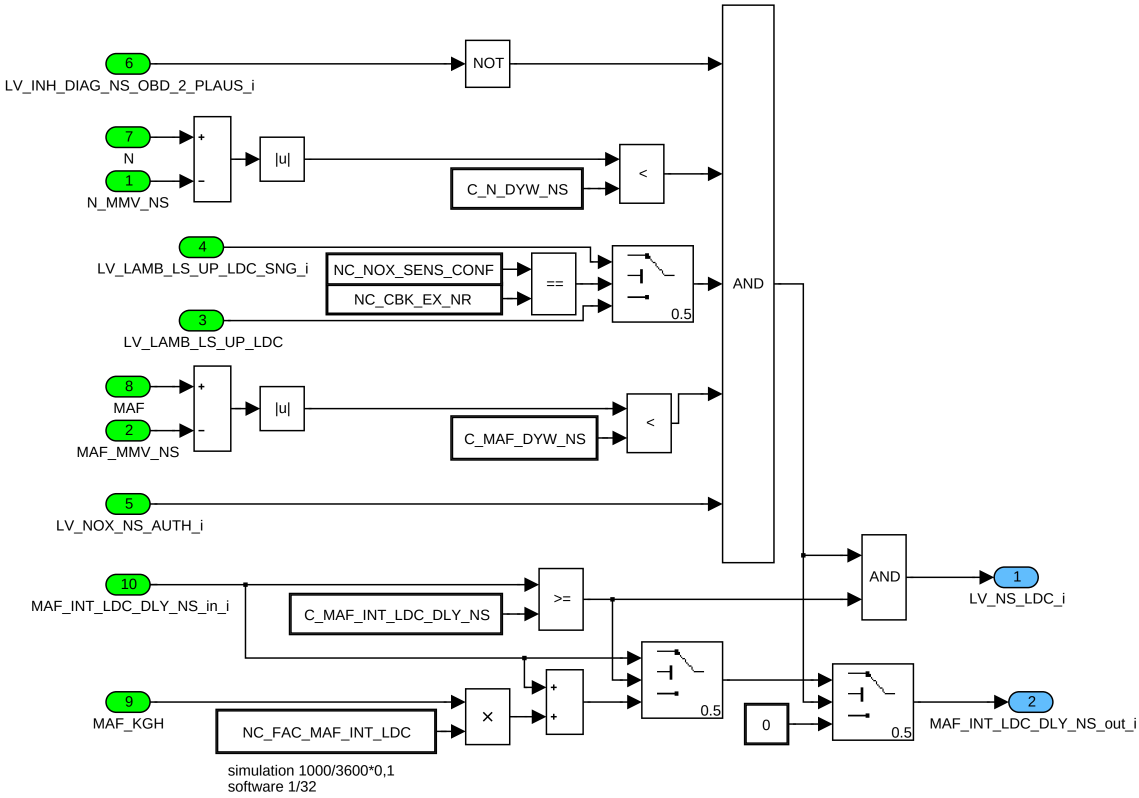

Figure B.116.12: NOXD_MODULB07G/OPM_100MS/FOR_LOOP_NS/CLC1

Collection of error information of all OBD II diagnosis types

The results of all diagnosis types will be collected in two status variables.

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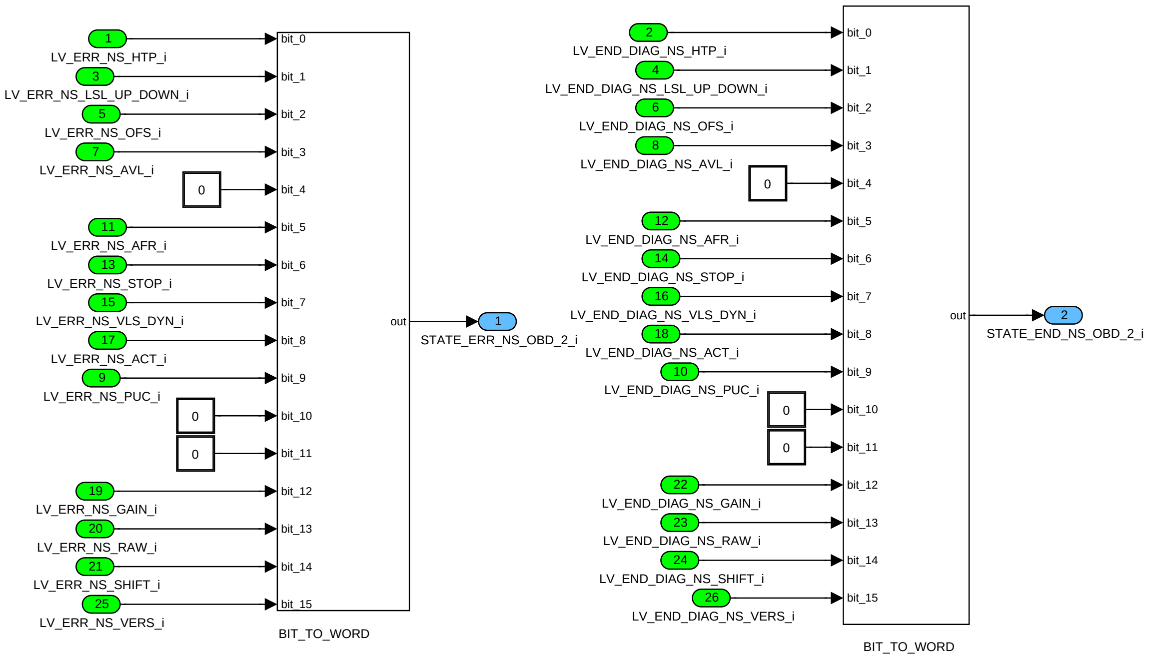

Figure B.116.13: NOXD_MODULB07G/OPM_100MS/FOR_LOOP_NS/CLC2

Global OBD II error bit

If any diagnosis detects an error, then the global error bit will be set.

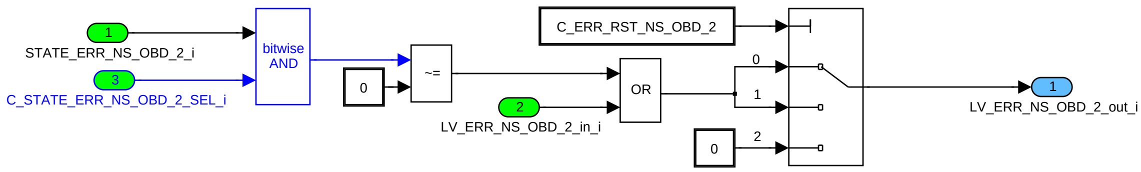

Figure B.116.14: NOXD_MODULB07G/OPM_100MS/FOR_LOOP_NS/CLC3

B.116.4 Loop control at engine run to engine stop

The calculation inside FOR_LOOP_NS have to be done for each NOx sensor, controlled by configuration data NC_NOX_SENS_CONF.
If NC_NOX_SENS_CONF = 1, then calculation for i = 1.
If NC_NOX_SENS_CONF = 2, then calculation for i = 1 and 2.

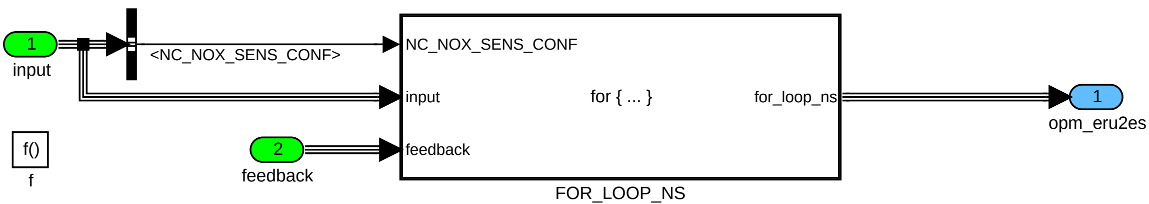

Figure B.116.15: NOXD_MODULB07G/OPM_ERU2ES

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Error counter

For each NOx sensor a counter will be incremented if any OBD II error was detected or decremented if all selected end of OBD II diagnosis signals are valid. This is only done once at the end of the driving cycle. This selection will be done with the bit mask C_ERR_NS_OBD_2_BIT_SEL_i.

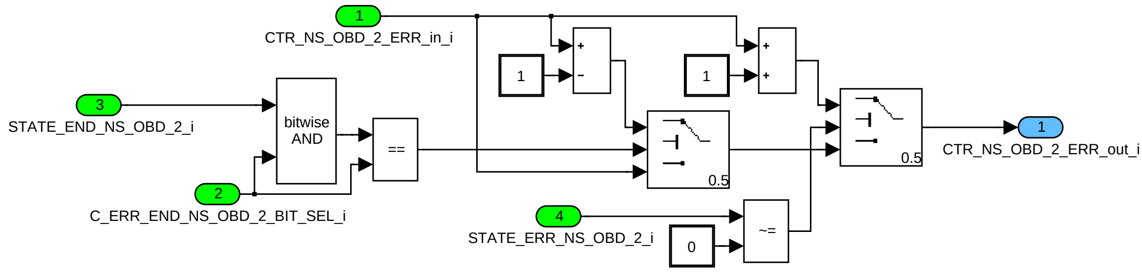

Figure B.116.16: NOXD_MODULB07G/OPM_ERU2ES/FOR_LOOP_NS/CLC1

Error flag for next driving cycle

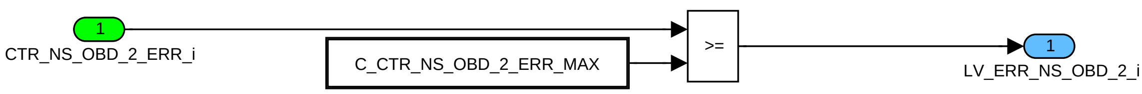

Figure B.116.17: NOXD_MODULB07G/OPM_ERU2ES/FOR_LOOP_NS/CLC2

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B.117 NOx sensor OBDII diagnosis - Heater diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NS_HTP [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx sensor heater diagnosis					
LV_CDN_DIAG_NS_HTP [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx sensor heater diagnosis					
LV_END_DIAG_NS_HTP [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor heater diagnosis					
LV_ERR_NS_HTP [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of NOx sensor heater diagnosis					
STATE_NS_HTP_DIAG [NC_NOX_SENS_CONF]	V	0H 1H 2H 3H 4H	OFF START PASSIVE ACTIVE POWER	-	-
State of heater performance diagnosis at normal operation					
T_NS_HTP_DIAG [NC_NOX_SENS_CONF]	V	0... FFH	0... 255	1	s
Timer for NOx sensor heater diagnosis					

Input data:

LV_INH_DIAG_NS_OBD_2_HTP [NC_NOX_SENS_CONF] {p. 6468}	LV_PUC {p. 1720}	LV_ST_END {p. 1720}	LV_TEMP_NS_OK [NC_NOX_SENS_CONF] {p. 991}
LV_TNT_MIN_THD_2 {p. 3181}	LV_VB_NS_OK [NC_NOX_SENS_CONF] {p. 991}	MAF_INT_PUC_ACT {p. 2942}	NC_IDX_DIAG_NS_HTP [NC_NOX_SENS_CONF]
NC_NOX_SENS_CONF {p. 643}	TNT_MDL_L {p. 8237}	VB {p. 1185}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_HTP	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor heater diagnosis					
C_ABC_INC_NS_HTP	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor heater diagnosis					
C_ABC_MAX_NS_HTP	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx sensor heater diagnosis					
C_MAF_INT_PUC_HTP_MAX	-	0... FFFFH	0... 2912.67	0.04444444	g
MAF threshold for break off a heater performance diagnosis					

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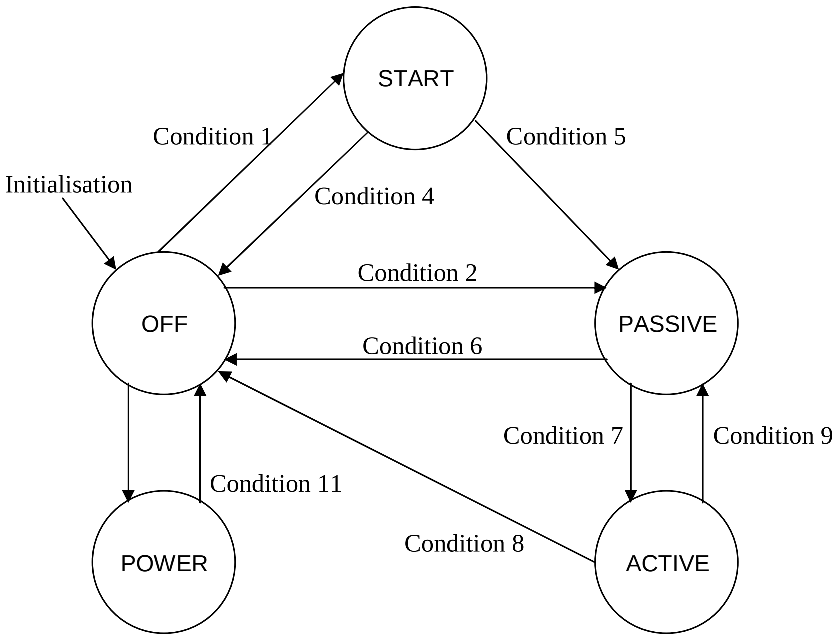
Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_NS_HTP_MAX	-	0... FFH	0... 255	1	s
Maximum time of invalid sensor temperature at normal operation					
C_T_NS_HTP_ST_MAX	-	0... FFH	0... 255	1	s
Maximum heating up time of NOx sensor					
C_TNT_MDL_HTP_MIN	-	0... FFFFH	0... 1023.98	0.015625	°C
Minimum temperature of NOx catalyst, at which a NOx sensor heater test can be started					
C_VB_MAX_NS	-	0... FFH	0... 25.8984375	0.1015625	V
Maximum battery voltage for correct NOx sensor operation					
C_VB_MIN_NS	-	0... FFH	0... 25.8984375	0.1015625	V
Minimum battery voltage for correct NOx sensor operation					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

General information

If the sensor is OK, then the diagnosis state machine is in the state PASSIVE, see next picture. If the temperature of the sensor is not OK, then a diagnosis will be made inside state ACTIVE. If the power supply is not OK, then a diagnosis will be made inside state POWER.
Additionally, at start-up a diagnosis of the sensor temperature behaviour will be made inside state START.
Signal flow diagram:



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Application Condition

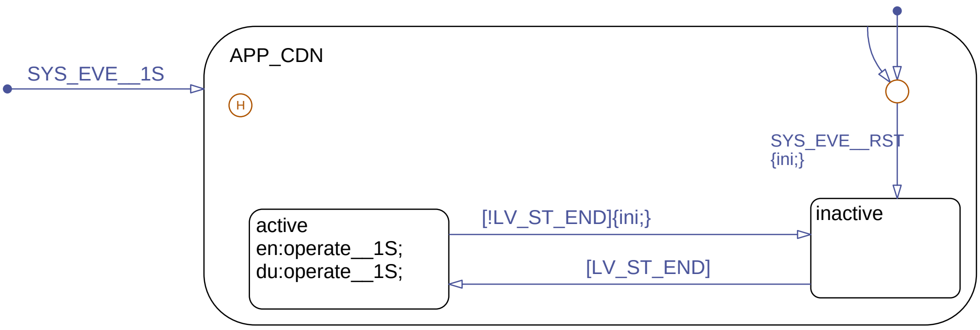

Figure B.117.1: NOXD_MODULB07A/APP_CDN/Chart

Function Description

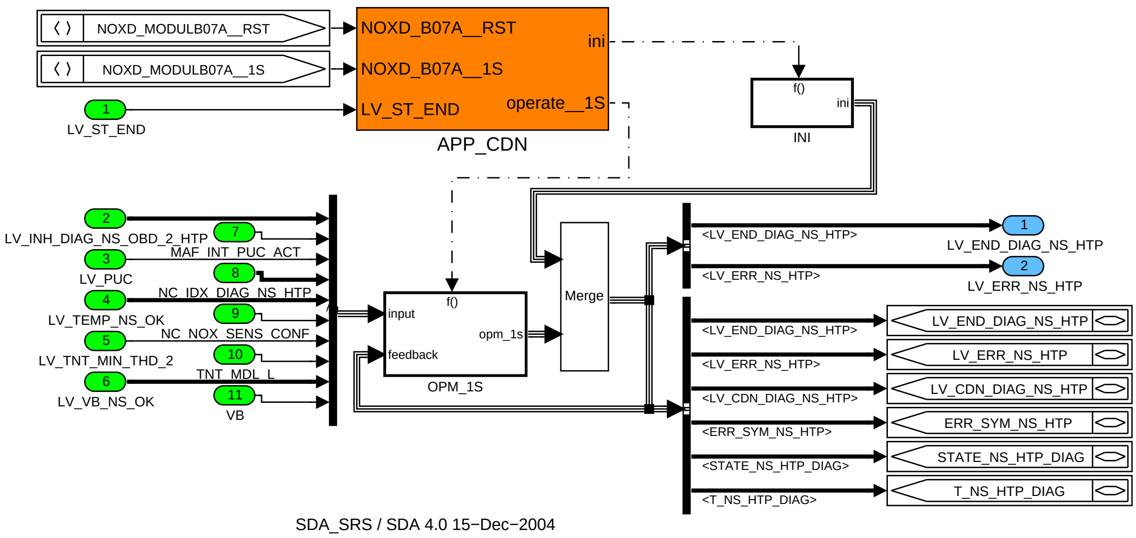

Figure B.117.2: NOXD_MODULB07A

B.117.1 Initialization at reset and deactivation

These actions initialized the diagnostic data according filtering configuration :
ACTION_ERRM_GetLvErr(IN<NC_IDX_DIAG_XX>, OUT< LV_ERR_XX >)
ACTION_ERRM_GetLvEndDiag(IN<NC_IDX_DIAG_XX>, OUT< LV_END_DIAG_XX >)

Figure B.117.3: NOXD_MODULB07A/INI/CLC

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B.117.2 Calculation for each NOx sensor

The calculation have to be done for each NOx sensor, controlled by configuration data NC_NOX_SENS_CONF.
If NC_NOX_SENS_CONF = 1, then calculation for i = 1.
If NC_NOX_SENS_CONF = 2, then calculation for i = 1 and 2.

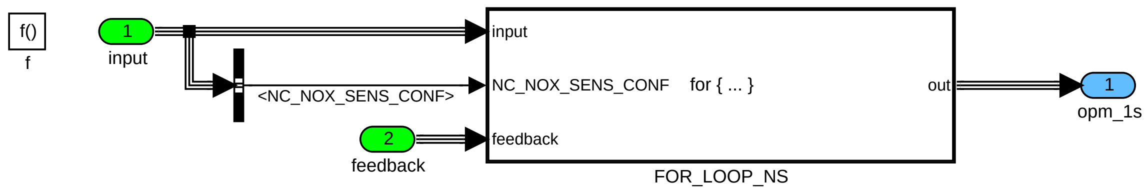

Figure B.117.4: NOXD_MODULB07A/OPM_1S

Main calculation

If the diagnosis is inhibited, then all values will be set to zero, else the diagnosis will be calculated. LV_ERR_NS_HTP will be get by ACTION_ERRM_GetLvErr and LV_END_DIAG_NS_HTP will be get by ACTION_ERRM_GetLvEndDiag.

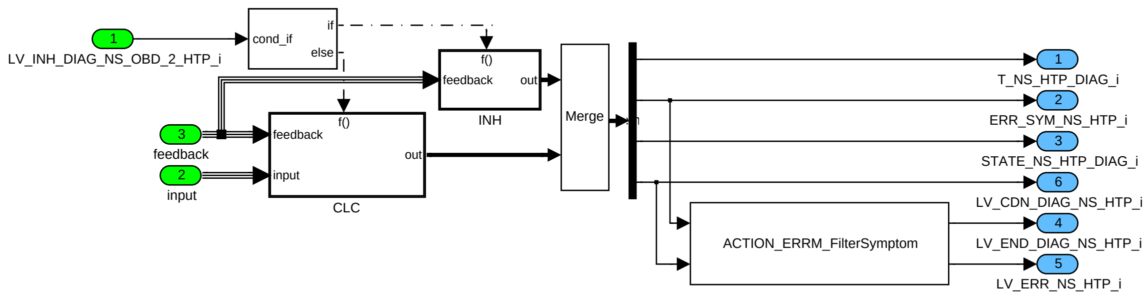

Figure B.117.5: NOXD_MODULB07A/OPM_1S/FOR_LOOP_NS/MAIN

Diagnosis inhibited

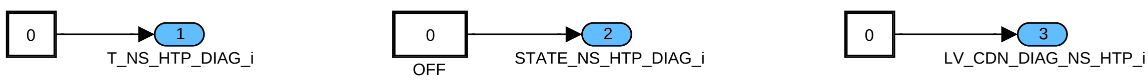

Figure B.117.6: NOXD_MODULB07A/OPM_1S/FOR_LOOP_NS/MAIN/INH/CLC

State machine

The default case is case 0 (OFF).

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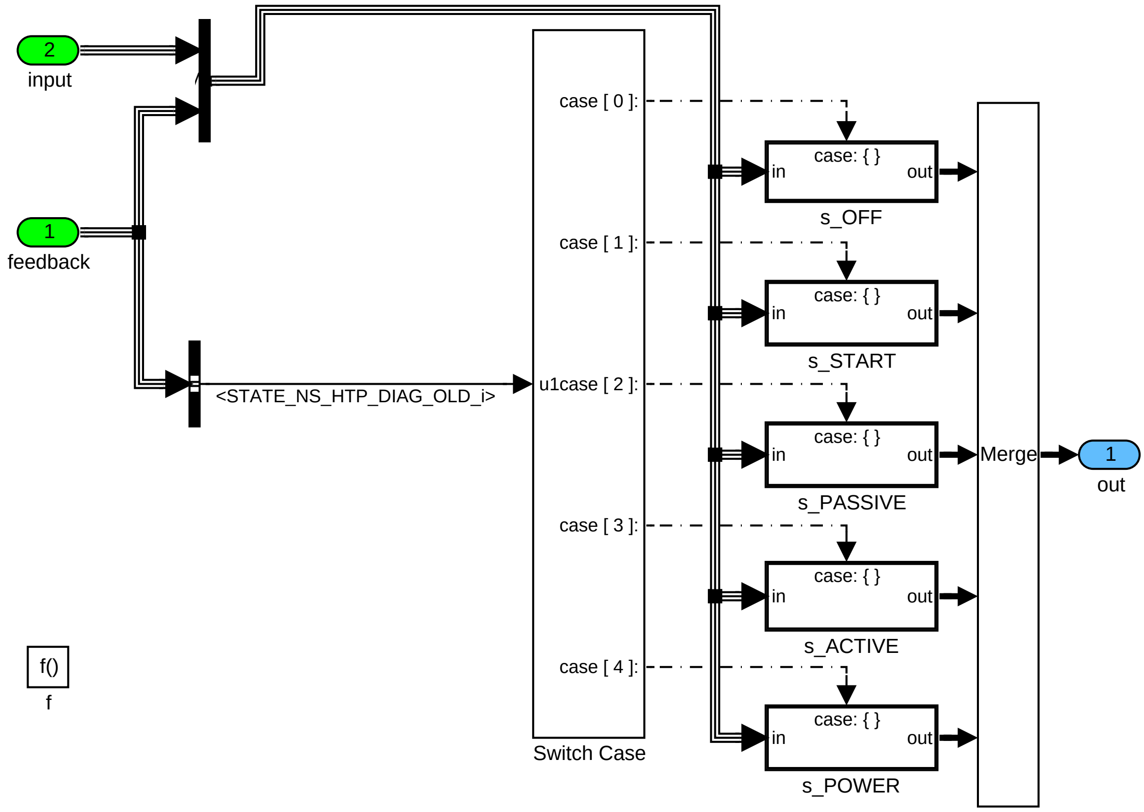

Figure B.117.7: NOXD_MODULB07A/OPM_1S/FOR_LOOP_NS/MAIN/CLC

STATE_NS_HTP_DIAG_i = 0 (OFF)

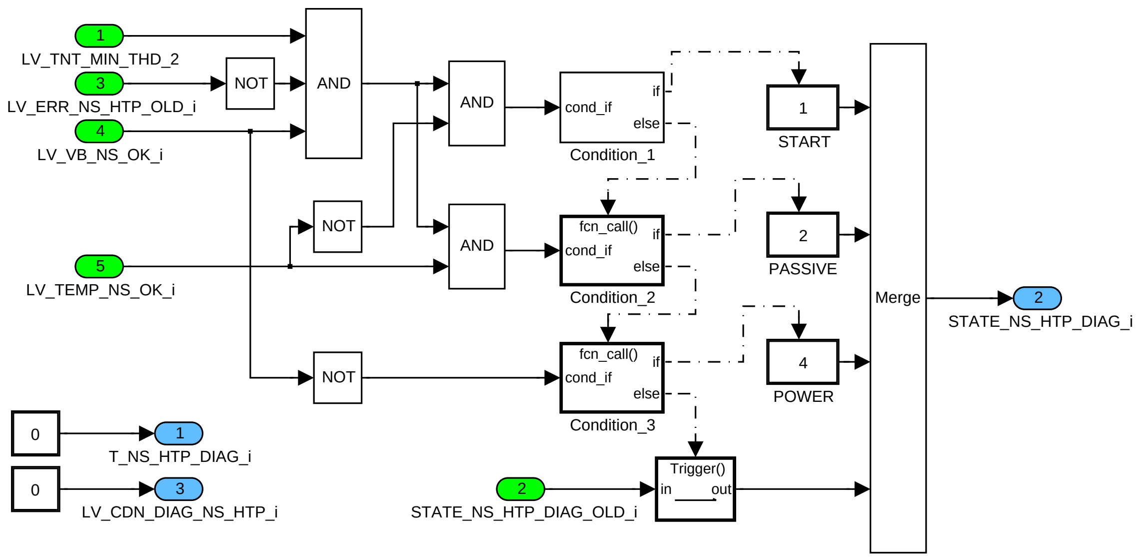

Figure B.117.8: NOXD_MODULB07A/OPM_1S/FOR_LOOP_NS/MAIN/CLC/s_OFF/CLC

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STATE_NS_HTP_DIAG_i = 1 (START)

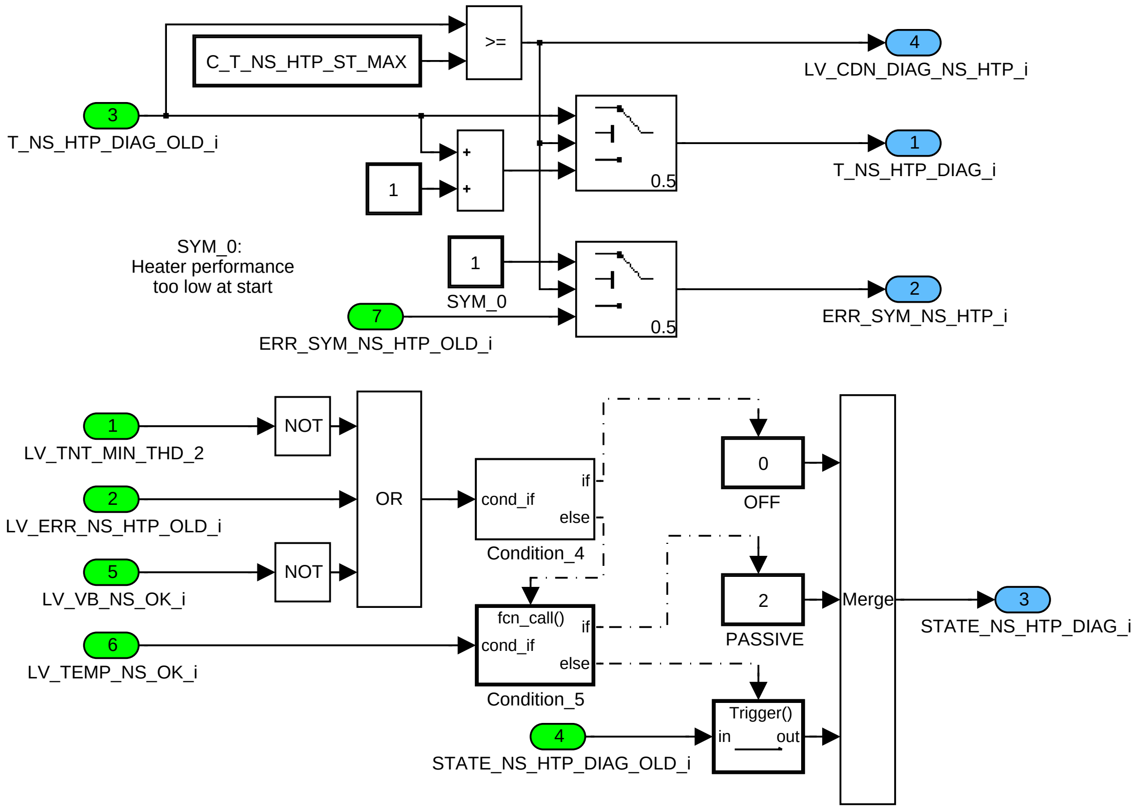

Figure B.117.9: NOXD_MODULB07A/OPM_1S/FOR_LOOP_NS/MAIN/CLC/s_START/CLC

STATE_NS_HTP_DIAG_i = 2 (PASSIVE)

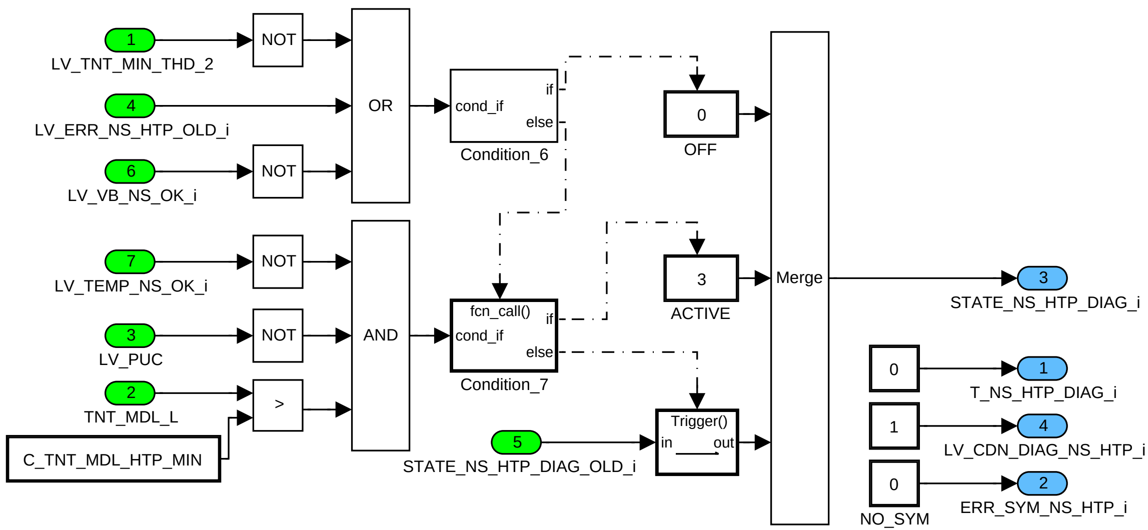

Figure B.117.10: NOXD_MODULB07A/OPM_1S/FOR_LOOP_NS/MAIN/CLC/s_PASSIVE/CLC

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STATE_NS_HTP_DIAG_i = 3 (ACTIVE)

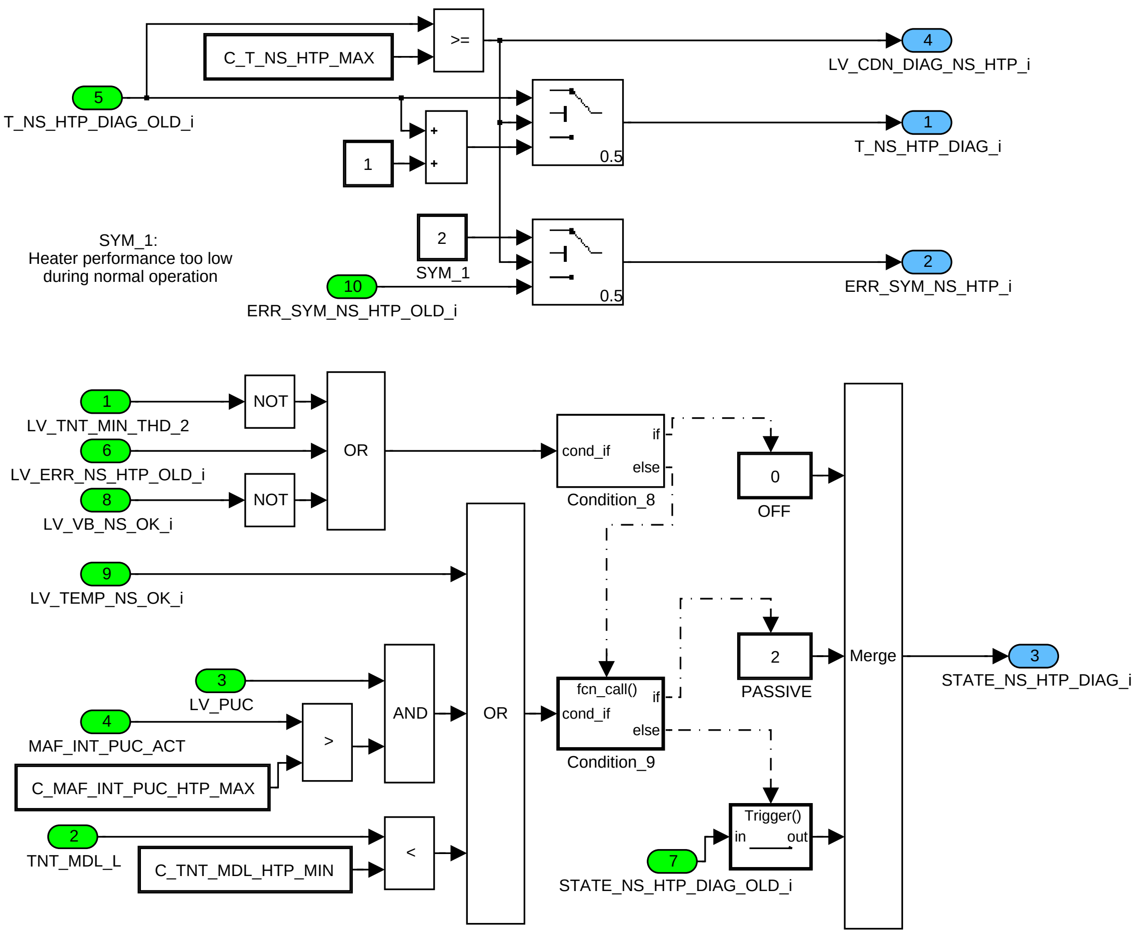

Figure B.117.11: NOXD_MODULB07A/OPM_1S/FOR_LOOP_NS/MAIN/CLC/s_ACTIVE/CLC

STATE_NS_HTP_DIAG_i = 4 (POWER)

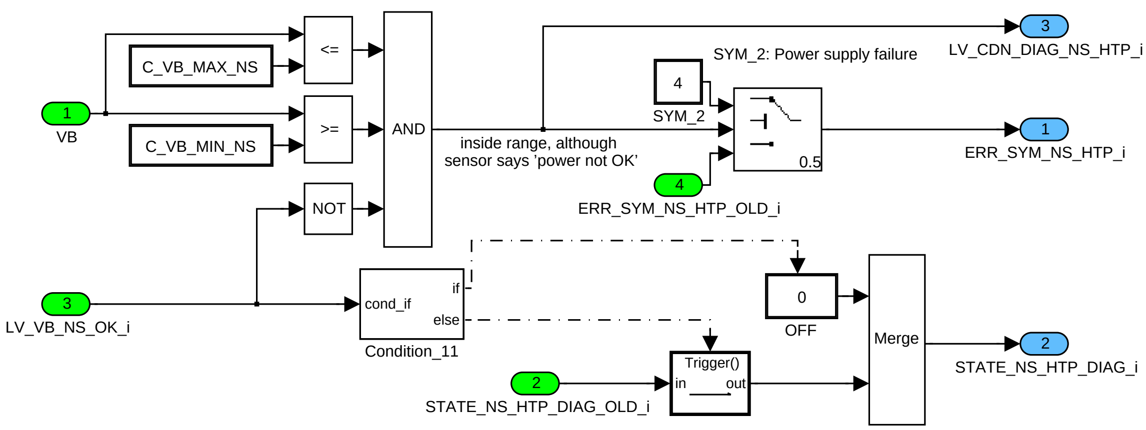

Figure B.117.12: NOXD_MODULB07A/OPM_1S/FOR_LOOP_NS/MAIN/CLC/s_POWER/CLC

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B.118 NOx sensor OBDII diagnosis - Lambda signal dynamic

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NS_VLS_DYN [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx sensor dynamic diagnosis of binary signal					
LV_CDN_DIAG_NS_VLS_DYN [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx sensor dynamic diagnosis of binary signal					
LV_END_DIAG_NS_VLS_DYN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor dynamic diagnosis of binary signal					
LV_ERR_NS_VLS_DYN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of NOx sensor dynamic diagnosis of binary signal					
LV_NT_RGN_REQ_OLD	-	0... 1H	0 ...1	1	-
Old value of LV_NT_RGN_REQ for edge detection					
STATE_VLS_RGN_NT_DIAG [NC_NOX_SENS_CONF]	V	0H 1H 2H	WAIT INIT DIAG	-	-
State of dynamic diagnosis for binary signal					
T_VLS_NS_SWI [NC_NOX_SENS_CONF]	V	0... FFH	0... 5.1	0.02	s
Timer for signal switch time measurement					
T_WAIT_VLS_DYN [NC_NOX_SENS_CONF]	V	0... FFH	0... 5.1	0.02	s
Timer for waiting of stratified mode activation					
VLS_NS_RGN_NT_END [NC_NOX_SENS_CONF]	V	0... 578H	-200 ...1200	1	mV
NOx sensor binary O2 signal voltage at the time of leaving NOx catalyst regeneration phase					

Input data:

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_INH_DIAG_NS_OBD_2_DYN [NC_NOX_SENS_CONF] {p. 6468}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_NT_RGN_REQ {p. 996}
LV_NT_RGN_REQ_AD {p. 996}	LV_S_ACT {p. 8137}	LV_ST_END {p. 1720}	LV_VLS_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}
MAF_KGH {p. 1195}	NC_CBK_EX_NR {p. 1829}	NC_IDX_DIAG_NS_VLS_DYN [NC_NOX_SENS_CONF]	NC_NOX_SENS_CONF {p. 643}
STATE_NOX {p. 2986}	T_VLS_NS_HLD [NC_NOX_SENS_CONF] {p. 992}	VLS_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}	

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_VLS_DYN	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor dynamic diagnosis of binary signal					
C_ABC_INC_NS_VLS_DYN	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor dynamic diagnosis of binary signal					
C_ABC_MAX_NS_VLS_DYN	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx sensor dynamic diagnosis of binary signal					
C_LAMB_VLS_NS_DYN_MIN	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Minimum upstream WRAF signal value during the dynamic diagnosis					
C_T_VLS_NS_HLD_DYN_DIAG	-	0... 7FFFH	0... 327.67	0.01	s
Time with binary O2 signal state = "invalid", after which a diagnosis is started					
C_T_WAIT_VLS_DYN_MAX	-	0... FFH	0... 5.1	0.02	s
Maximum time for waiting of stratified mode activation					
C_VLS_NS_DIAG_SWI_END	-	0... 578H	-200 ...1200	1	mV
Binary O2 signal threshold for stop of switch time diagnosis					
C_VLS_NS_DIAG_SWI_ST	-	0... 578H	-200 ...1200	1	mV
Binary O2 signal threshold for start of switch time diagnosis					
C_VLS_NS_RGN_NT_END_MIN	-	0... 578H	-200 ...1200	1	mV
Minimum binary O2 signal voltage after a NOx catalyst regeneration for start a switch time diagnosis					
IP_T_VLS_NS_SWI_MAX	-	0... FFH	0... 5.1	0.02	s
LDP_MAF_KGH_IP_T_VLS_NS_SWI_MAX	6	0... FFFFH	0... 2047.97	0.03125	kg/h
Diagnosis threshold for binary O2 signal switch time diagnosis					
LC_VLS_NS_DYN_VLD_ON	-	0... 1H	0 ...1	1	-
Valid binary O2 signal of NOx-Sensor necessary for this diagnosis					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

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B.118.1 General description

This diagnosis observes the dynamic of the binary O2 signal of NOx sensor after a NOx catalyst regeneration.

Signal flow:

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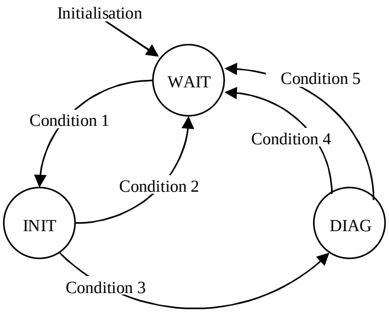
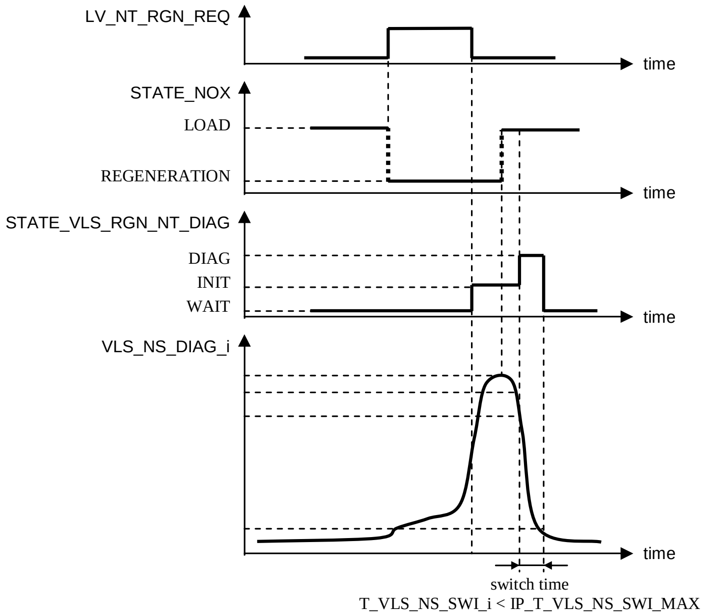


Characteristic signals:



Application Condition

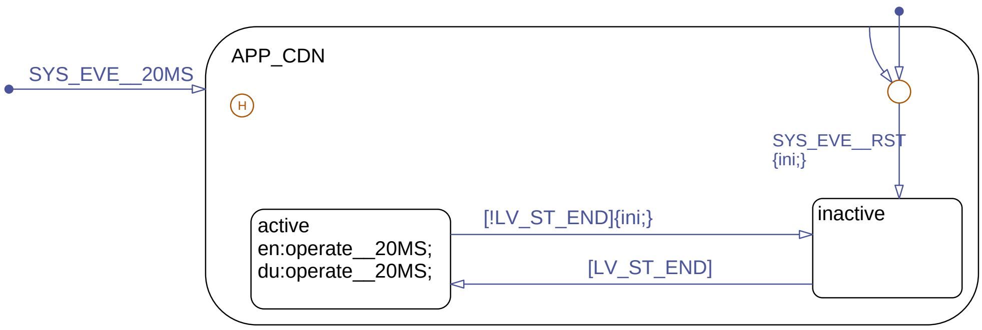


Figure B.118.1: NOXD_MODULB07E/APP_CDN/Chart

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Function Description

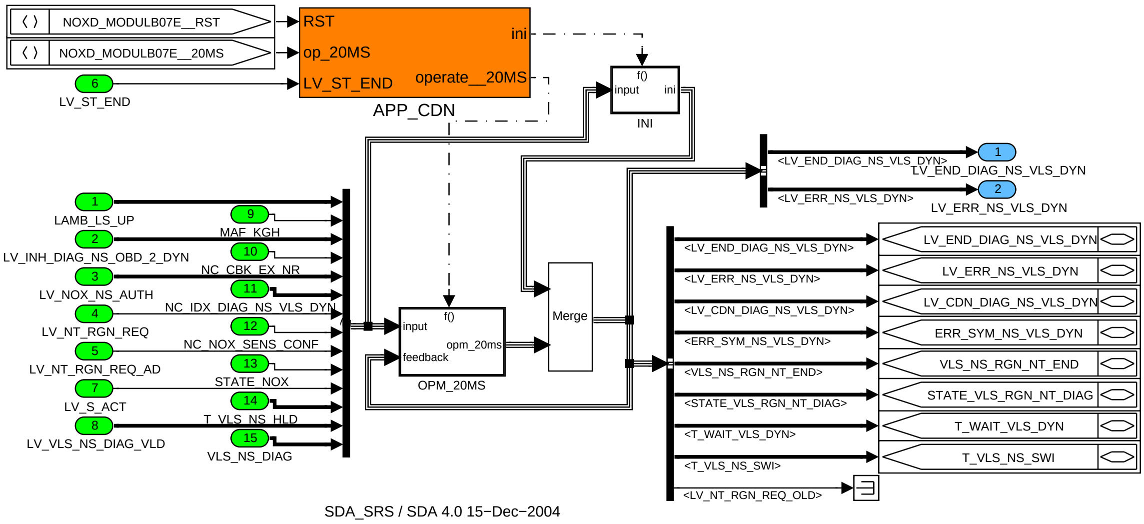

Figure B.118.2: NOXD_MODULB07E

B.118.1.1 Initialization at reset and deactivation

These actions initialized the diagnostic data according filtering configuration :
ACTION_ERRM_GetLvErr(IN<NC_IDX_DIAG_XX>, OUT< LV_ERR_XX >)
ACTION_ERRM_GetLvEndDiag(IN<NC_IDX_DIAG_XX>, OUT< LV_END_DIAG_XX >)

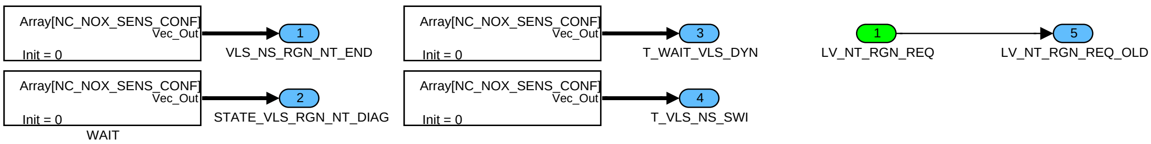

Figure B.118.3: NOXD_MODULB07E/INI/CLC

B.118.1.2 Loop control

The calculation inside both NO_LOOP subsystems have to be done only once.

The calculation inside FOR_LOOP_NS have to be done for each NOx sensor, controlled by configuration data NC_NOX_SENS_CONF.
If NC_NOX_SENS_CONF = 1, then calculation for i = 1.
If NC_NOX_SENS_CONF = 2, then calculation for i = 1 and 2.

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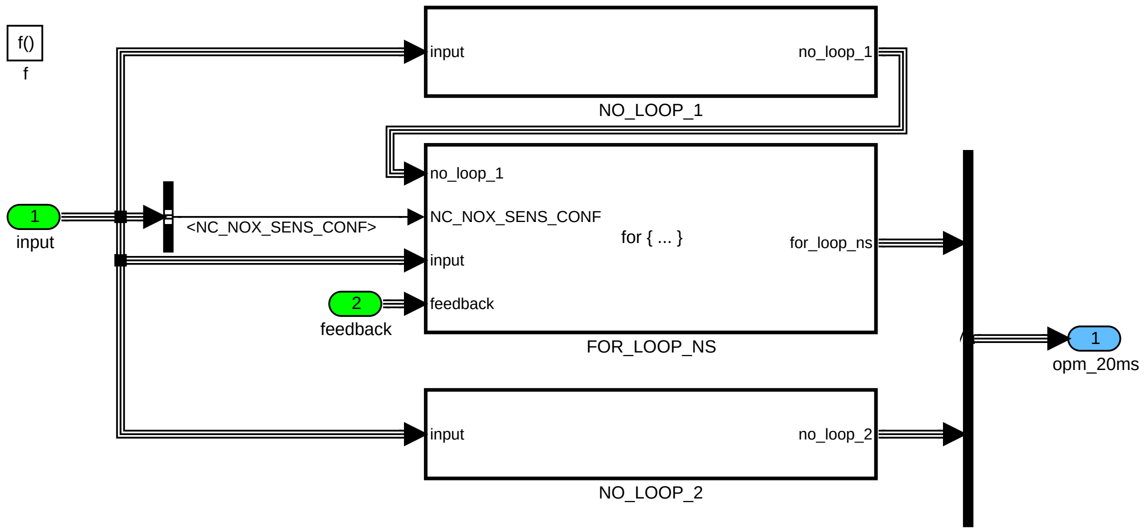

Figure B.118.4: NOXD_MODULB07E/OPM_20MS

Bank independent calculation (part 1)

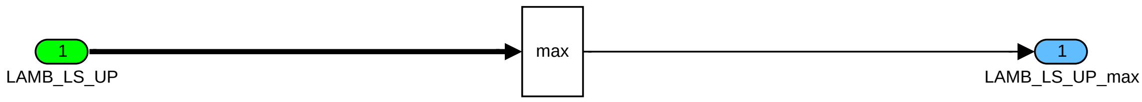

Figure B.118.5: NOXD_MODULB07E/OPM_20MS/NO_LOOP_1/CLC

Calculation for each NOx sensor

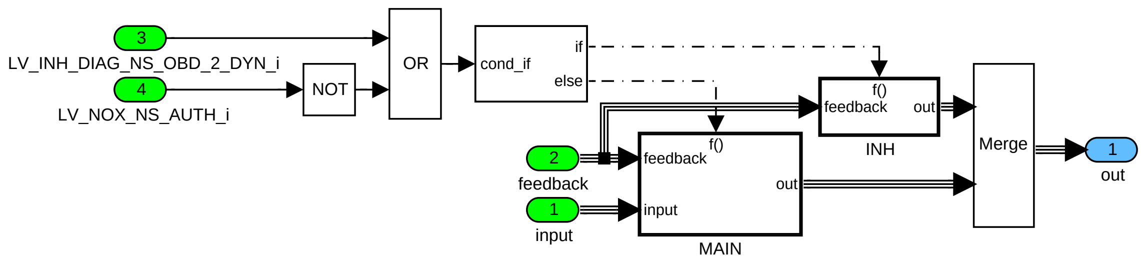

Figure B.118.6: NOXD_MODULB07E/OPM_20MS/FOR_LOOP_NS/CLC

Inhibition of diagnosis for one sensor

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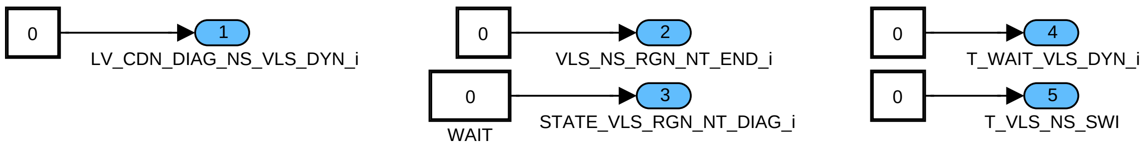

Figure B.118.7: NOXD_MODULB07E/OPM_20MS/FOR_LOOP_NS/CLC/INH/CLC

State machine

This diagnosis is divided into 3 states:
- WAIT: waiting for the end of a regeneration phase of NOx catalyst
- INIT: regeneration phase left, initial conditions for diagnosis present
- DIAG: Diagnosis runs

The default case is is case 0 (WAIT).

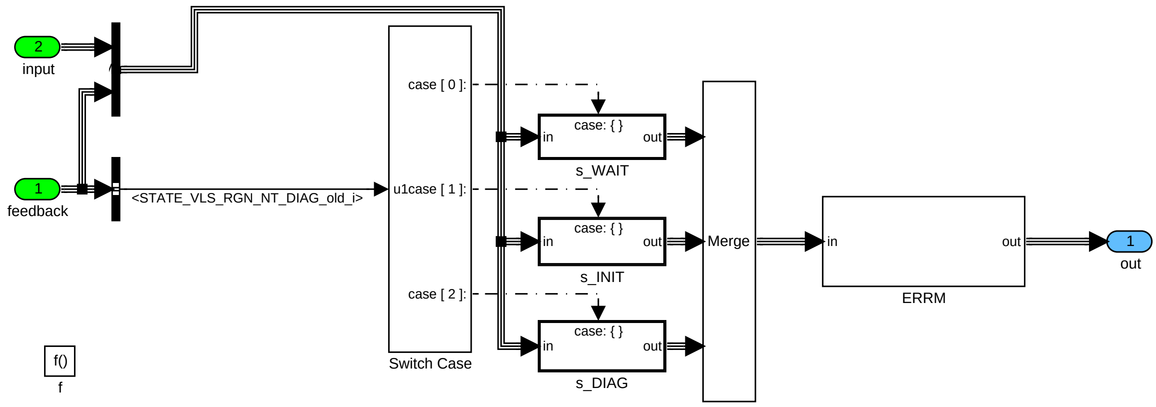

Figure B.118.8: NOXD_MODULB07E/OPM_20MS/FOR_LOOP_NS/CLC/MAIN

STATE_VLS_RGN_NT_DIAG_i = 0 (WAIT)

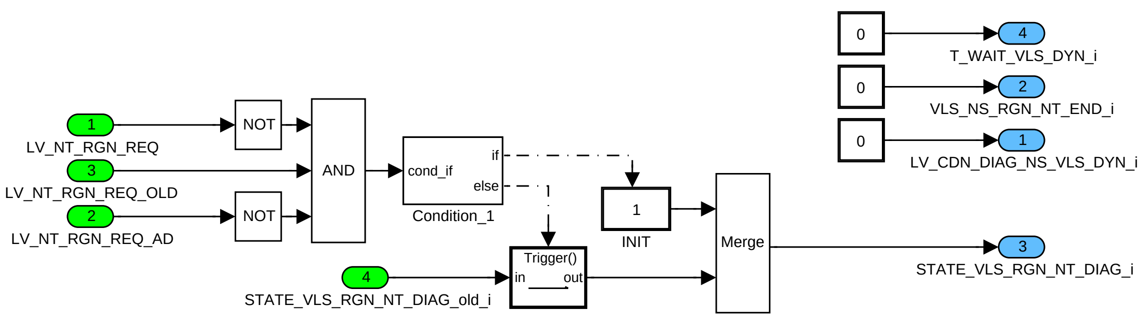

Figure B.118.9: NOXD_MODULB07E/OPM_20MS/FOR_LOOP_NS/CLC/MAIN/s_WAIT/CLC

STATE_VLS_RGN_NT_DIAG_i = 1 (INIT)

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This timer limits the phase INIT. If no diagnosis will be started in this time, then the state machine switches back to WAIT.

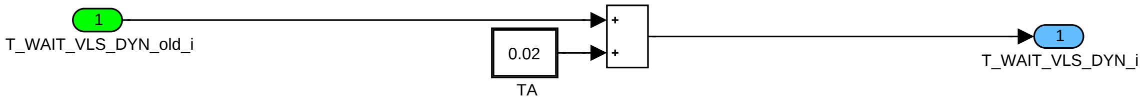

Figure B.118.10: NOXD_MODULB07E/OPM_20MS/FOR_LOOP_NS/CLC/MAIN/s_INIT/CLC1

During the waiting the binary O2 signal voltage is checked on their validity. If the signal is valid or if a special condition is fulfilled then the last binary O2 signal value is stored.

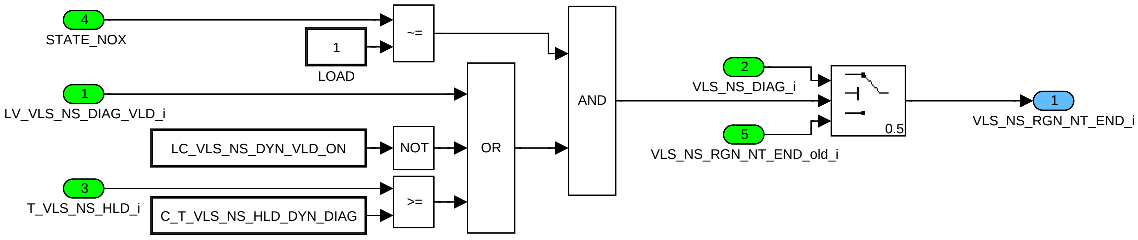

Figure B.118.11: NOXD_MODULB07E/OPM_20MS/FOR_LOOP_NS/CLC/MAIN/s_INIT/CLC2

The diagnosis will be started if the binary signal has a suitable behaviour. The threshould C_VLS_NS_DIAG_SWI_ST defines the start of the gradient check.

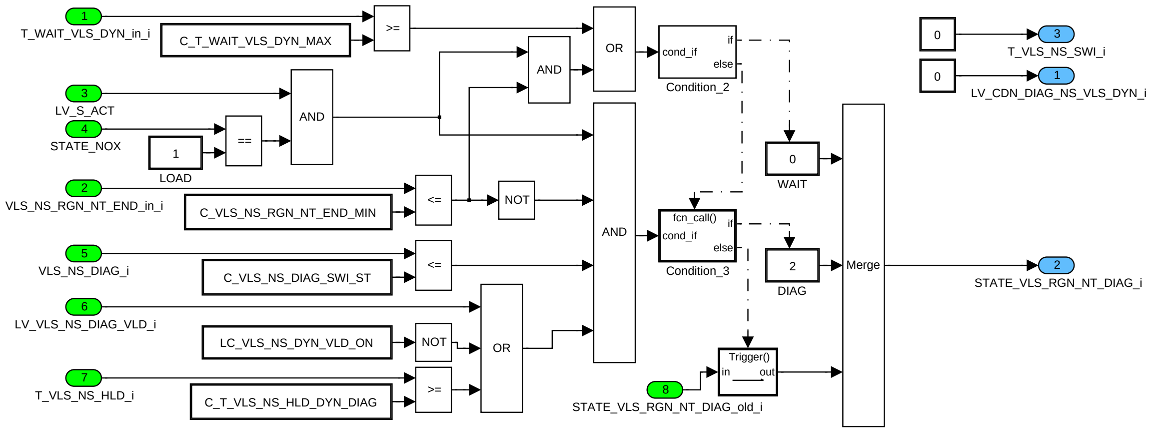

Figure B.118.12: NOXD_MODULB07E/OPM_20MS/FOR_LOOP_NS/CLC/MAIN/s_INIT/CLC3

STATE_VLS_RGN_NT_DIAG_i = 2 (DIAG)

The time of the gradient of the binary signal will be measured.

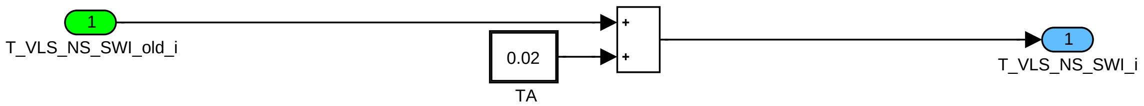

Figure B.118.13: NOXD_MODULB07E/OPM_20MS/FOR_LOOP_NS/CLC/MAIN/s_DIAG/CLC1

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The threshould C_VLS_NS_DIAG_SWI_END defines the end of the gradient check. The elapsed time for the gradient will be evaluated to decide whether the sensor dynamic is OK or not.

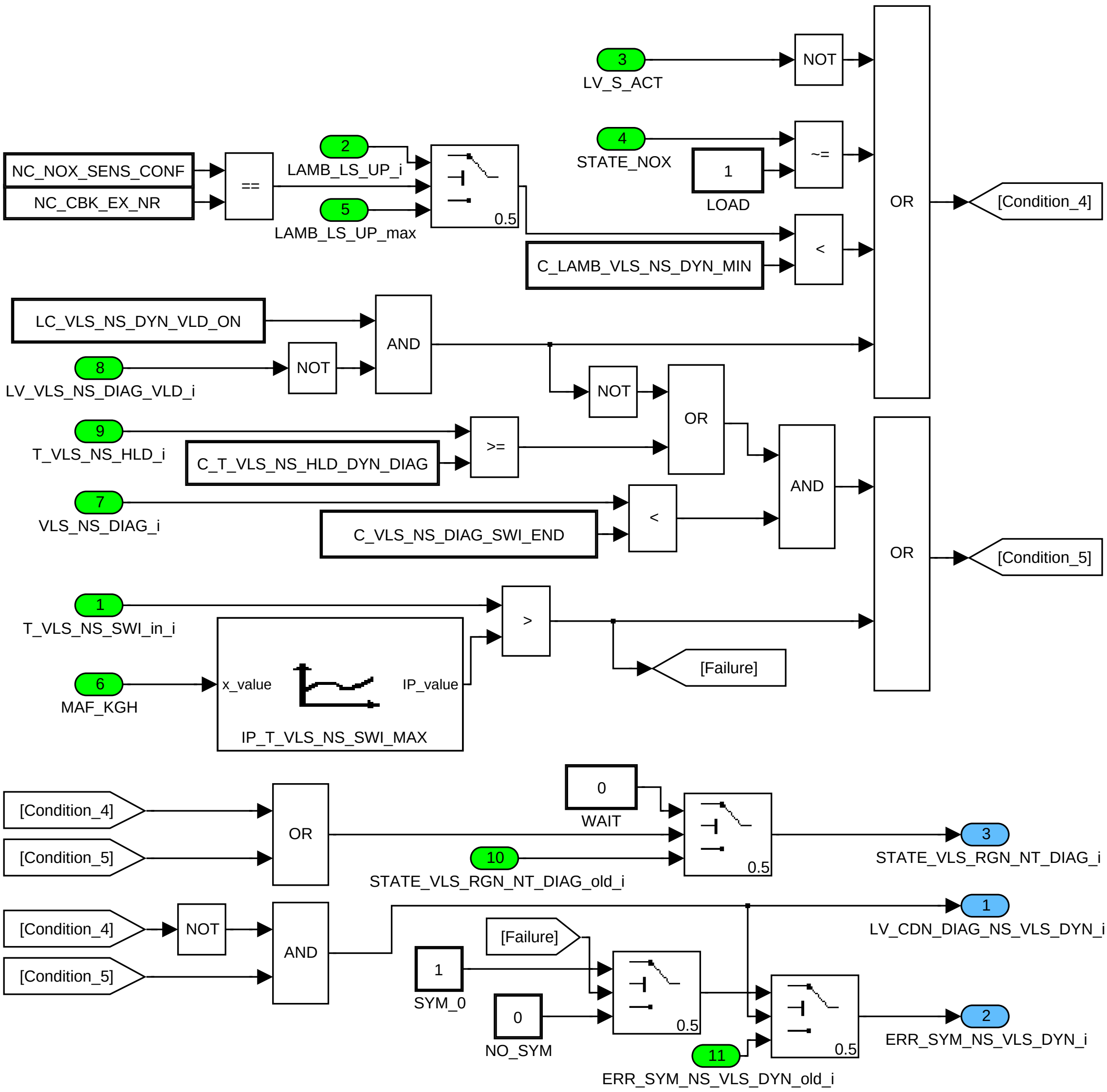

Figure B.118.14: NOXD_MODULB07E/OPM_20MS/FOR_LOOP_NS/CLC/MAIN/s_DIAG/CLC2

Error management

LV_ERR_NS_VLS_DYN will be get by ACTION_ERRM_GetLvErr and LV_END_DIAG_NS_VLS_DYN will be get by ACTION_ERRM_GetLvEndDiag.

Figure B.118.15: NOXD_MODULB07E/OPM_20MS/FOR_LOOP_NS/CLC/MAIN/ERRM/CLC

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Bank independent calculation (part 2)

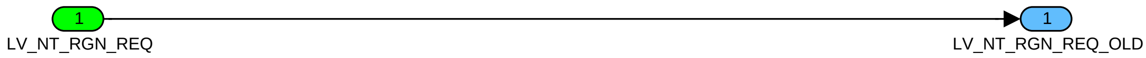

Figure B.118.16: NOXD_MODULB07E/OPM_20MS/NO_LOOP_2/CLC

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B.119 NOx sensor OBDII diagnosis - Regeneration stop observation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_RGN_STOP_MDL [NC_NOX_SENS_CONF]	V	0... FFH	0... 255	1	-
Number of successive regenerations, which are stopped by model					
ERR_SYM_NS_STOP [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx sensor plausibility diagnosis at regeneration stop					
LV_CDN_DIAG_NS_STOP [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx sensor plausibility diagnosis at regeneration stop					
LV_END_DIAG_NS_STOP [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor plausibility diagnosis at regeneration stop					
LV_ERR_NS_STOP [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of NOx sensor diagnosis at regeneration stop					
LV_INH_NT_RGN_STOP_MDL_DIAG [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Request to NOx catalyst management to inhibit the model based NOx regeneration stop					
LV_INH_NTL_DEC_INT_DIAG [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Inhibition of signal diagnosis by regeneration agent integral because od high NOx catalyst temperature difference					
LV_NS_STOP_DIAG_RUN [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Indicator that regeneration stop observation is running					
NTL_DEC_INT_THD [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 10485.6	0.16	mg
Integral of the lack of oxygen during regeneration phase					
T_MAF_KGH_RGN_MIN [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 655.35	0.01	s
Timer which measures the regeneration duration at which th mass air flow is higher than a threshold					

Input data:

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_NS [NC_NOX_SENS_CONF] {p. 991}	LV_HOM_AFS_ACT {p. 8136}	LV_INH_DIAG_NS_OBD_2_PLAUS [NC_NOX_SENS_CONF] {p. 6468}
LV_LAMB_NS_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_NT_MDL_AFR {p. 996}	LV_NT_RGN_REQ {p. 996}
LV_NT_RGN_STOP_SENS {p. 996}	LV_NT_SENS_AFR [NC_NT_NR] {p. 996}	LV_NT_TOUT_AFR {p. 996}	LV_ST_END {p. 1720}

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LV_VLS_NS_VLD [NC_NOX_SENS_CONF] {p. 992}	MAF_KGH {p. 1195}	NC_IDX_DIAG_NS_STOP [NC_NOX_SENS_CONF]	NC_NOX_SENS_CONF {p. 643}
NC_NT_NR {p. 644}	NTL_DEC_INT [NC_NT_NR] {p. 2985}	NTL_RGN_ST {p. 2986}	T_RGN {p. 2885}
TNT_MDL_1 [NC_NT_NR] {p. 8237}	TNT_MDL_2 [NC_NT_NR] {p. 8237}	TNT_MDL_H {p. 8237}	TNT_MDL_L {p. 8237}
TNT_MDL_MV {p. 8237}	TNT_MDL_MV_SNG [NC_NT_NR] {p. 8237}	VLS_NS [NC_NOX_SENS_CONF] {p. 992}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_STOP	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor diagnosis at regeneration stop					
C_ABC_INC_NS_STOP	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor diagnosis at regeneration stop					
C_ABC_MAX_NS_STOP	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx sensor diagnosis at regeneration stop					
C_CTR_RGN_STOP_MDL_MAX	-	0... FFH	0... 255	1	-
maximum number of successive regenerations, which are stopped by model					
C_LAMB_LS_UP_NS_STOP_DIAG	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Lambda signal threshold for counting time of rich exhaust gas with not too low flow					
C_LAMB_NS_RGN_STOP_DIAG	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Diagnosis threshold for detection of WRAF signal capability to stop a regeneration					
C_MAF_KGH_RGN_MIN	-	0... FFFFH	0... 2047.97	0.03125	kg/h
Minimum mass air flow for set free of failure count					
C_NTL_DEC_INT_DFT_THD	-	0... FFFFH	0... 10485.6	0.16	mg
Default diagnosis threshold					
C_NTL_RGN_ST_MIN	-	0... FFFFH	0... 10485.6	0.16	mg
Threshold for switch between default and calculated diagnosis threshold					
C_STATE_SENS_AFR_NS_DIAG [NC_NOX_SENS_CONF]	-	0H 1H 2H 3H 4H	VLS_DOWN VLS_NOX_SENS LAMB_NOX_SENS LS_NT_DOWN NONE	-	-
bench-selective mode to determine rich exhaust gas downstream NOx trap					
C_T_MAF_KGH_RGN_MIN	-	0... FFFFH	0... 655.35	0.01	s
Time threshold for set free of failure count					
C_T_RGN_NS_RGN_STOP_DIAG	-	0... FFFFH	0... 655.35	0.01	s
Minimum regeneration duration for activation of regeneration stop observation					
C_TNT_MDL_DIF_MAX	-	0... FFFFH	0... 1023.98	0.015625	°C
Temperature threshold for set free of signal diagnosis by regeneration agent integral					
C_TNT_NS_DIAG_STOP_MAX	-	0... FFFFH	0... 1023.98	0.015625	°C
Threshold for disabling NOx sensor regeneration stop diagnosis at high NOx trap temperature					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_NS_RGN_STOP_DIAG	-	0... 578H	-200 ...1200	1	mV
Diagnosis threshold for detection of binary Lambda signal capability to stop a regeneration					
IP_FAC_NTL_RGN_ST	-	0... FFFFH	0... 255	0.00389105	-
LDP_TNT_MDL_MV_IP_FAC_NTL_RGN	6	0... FFFFH	0... 1023.98	0.015625	°C
Temperature dependent factor for calculation of diagnosis threshold					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

B.119.1 General description

This diagnosis observes the Lambda signal of NOx sensor, which was selected to stop a NOx catalyst regeneration. The signal is checked on its capability to stop a NOx catalyst regeneration. It is possible that the signal can not exceed the NOx catalyst regeneration stop threshold because of sensor aging or a defect. In this case the regeneration is stopped by a time limit. If this problem is present then it is not possible to fulfil the emission regulations. Then it is necessary to inhibit the engine lean burn operation mode and to mark the NOx sensor as defect .

Application Condition

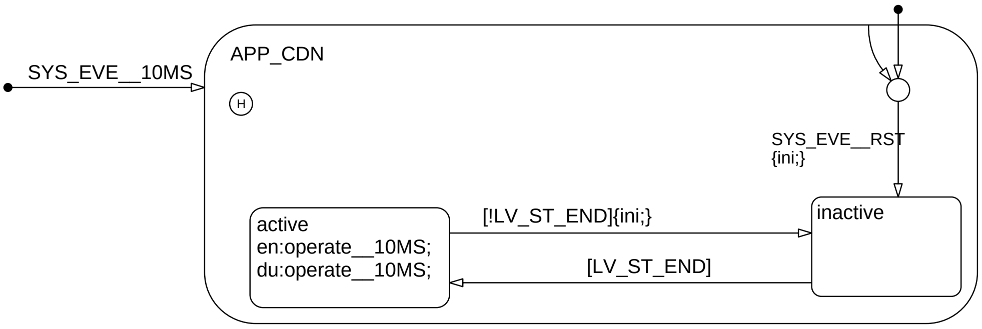

Figure B.119.1: NOXD_MODULB080/APP_CDN/Chart

Function Description

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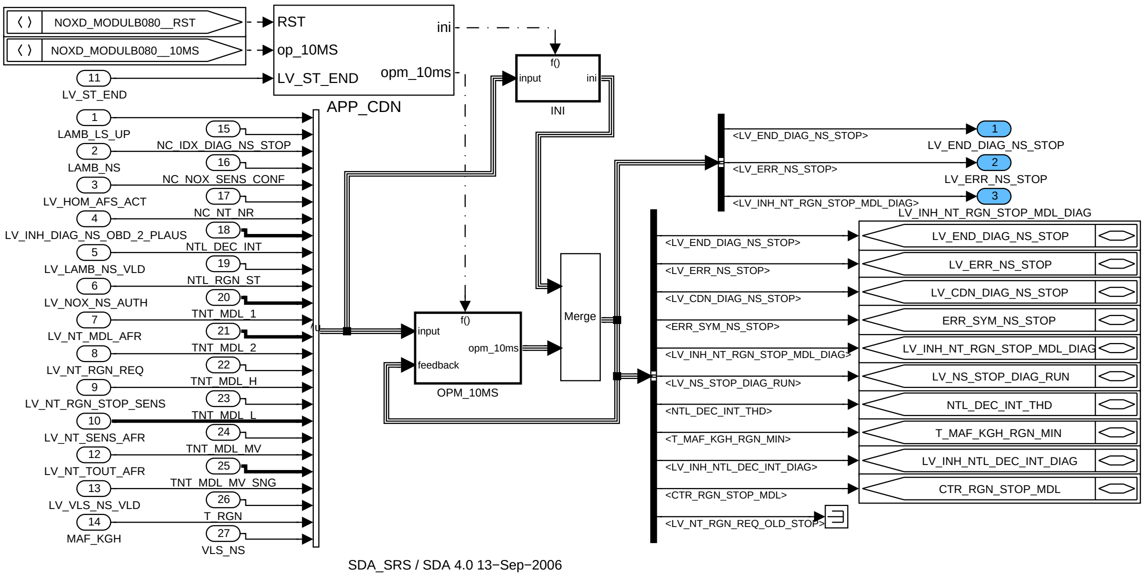

Figure B.119.2: NOXD_MODULB080

B.119.1.1 Initialization at reset and deactivation

These actions initialized the diagnostic data according filtering configuration :
ACTION_ERRM_GetLvErr(IN<NC_IDX_DIAG_XX>, OUT< LV_ERR_XX >)
ACTION_ERRM_GetLvEndDiag(IN<NC_IDX_DIAG_XX>, OUT< LV_END_DIAG_XX >)

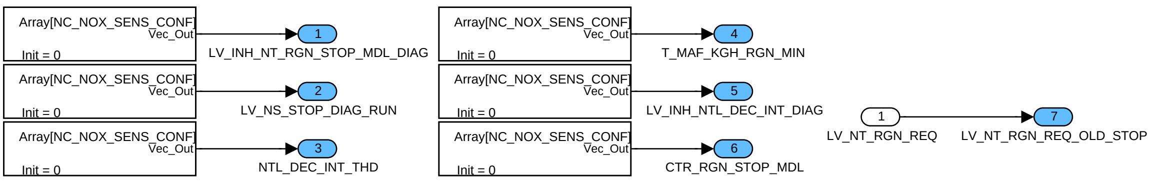

Figure B.119.3: NOXD_MODULB080/INI/CLC

B.119.1.2 Loop control

The calculation inside both NO_LOOP subsystems have to be done only once.

The calculation inside FOR_LOOP_NS have to be done for each NOx sensor, controlled by configuration data NC_NOX_SENS_CONF.
If NC_NOX_SENS_CONF = 1, then calculation for i = 1.
If NC_NOX_SENS_CONF = 2, then calculation for i = 1 and 2.

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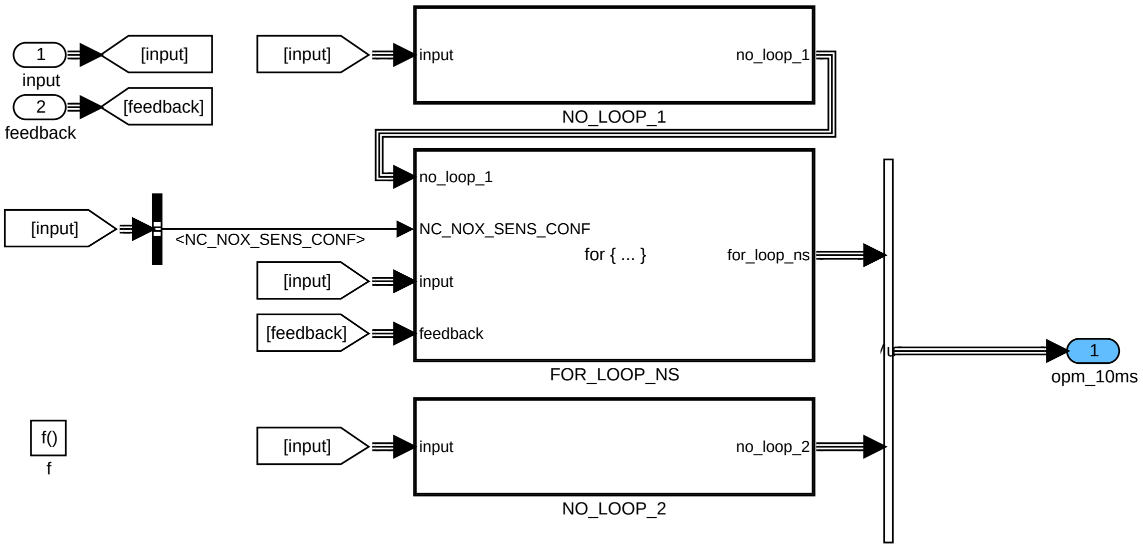

Figure B.119.4: NOXD_MODULB080/OPM_10MS

Bank independent calculation (part 1)

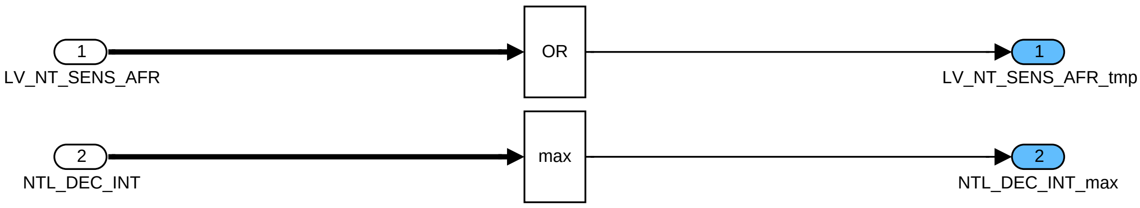

Figure B.119.5: NOXD_MODULB080/OPM_10MS/NO_LOOP_1/CLC

Calculation for each NOx sensor

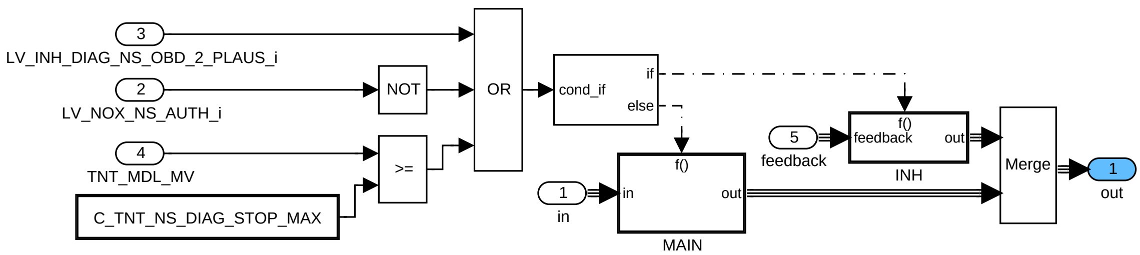

Figure B.119.6: NOXD_MODULB080/OPM_10MS/FOR_LOOP_NS/CLC

Inhibition of diagnosis for one sensor

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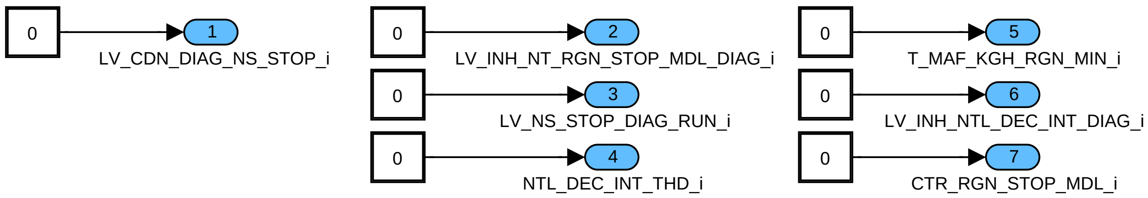

Figure B.119.7: NOXD_MODULB080/OPM_10MS/FOR_LOOP_NS/CLC/INH/CLC

Main part of diagnosis

Start of regeneration stop observation

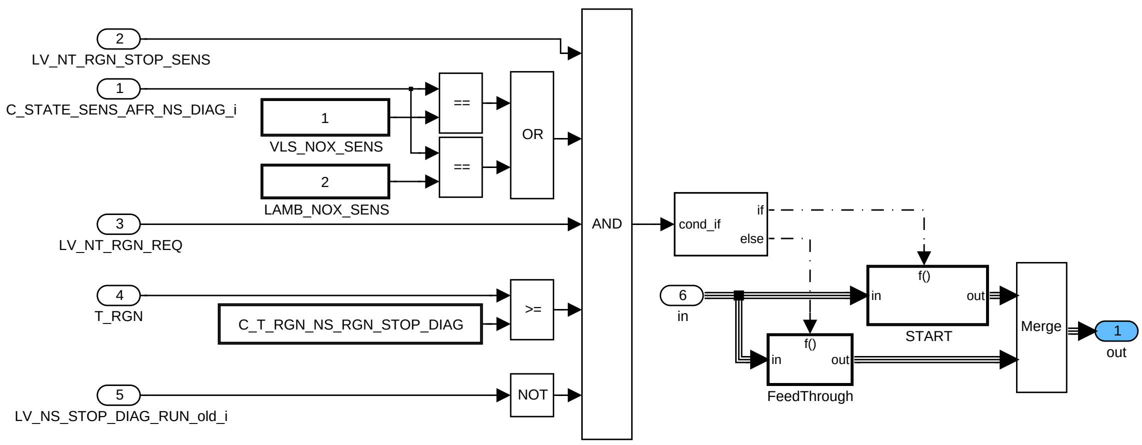

Figure B.119.8: NOXD_MODULB080/OPM_10MS/FOR_LOOP_NS/CLC/MAIN/CLC1

The diagnosis threshold (maximum necessary amount of regeneration agent) NTL_DEC_INT_THD_i is calculated by the absolute NOx and O2 loading of NOx catalyst at start of regeneration NTL_RGN_ST and a safety factor. The safety factor depends on the mean NOx catalyst monolith temperature in order to consider the NOx storage capability of catalyst.
Additionally the temperature difference between first and second NOx catalyst monolith is determined at the start of regeneration. If this temperature threshold is higher than the threshold C_TNT_MDL_DIF_MAX then regeneration agent diagnosis is inhibited because the NOx catalyst regeneration behaviour is not exactly predictable.
At the first regeneration (after warm up of catalyst) NTL_RGN_ST is about 0. Then the default diagnosis threshold C_NTL_DEC_INT_DFT_THD is used.

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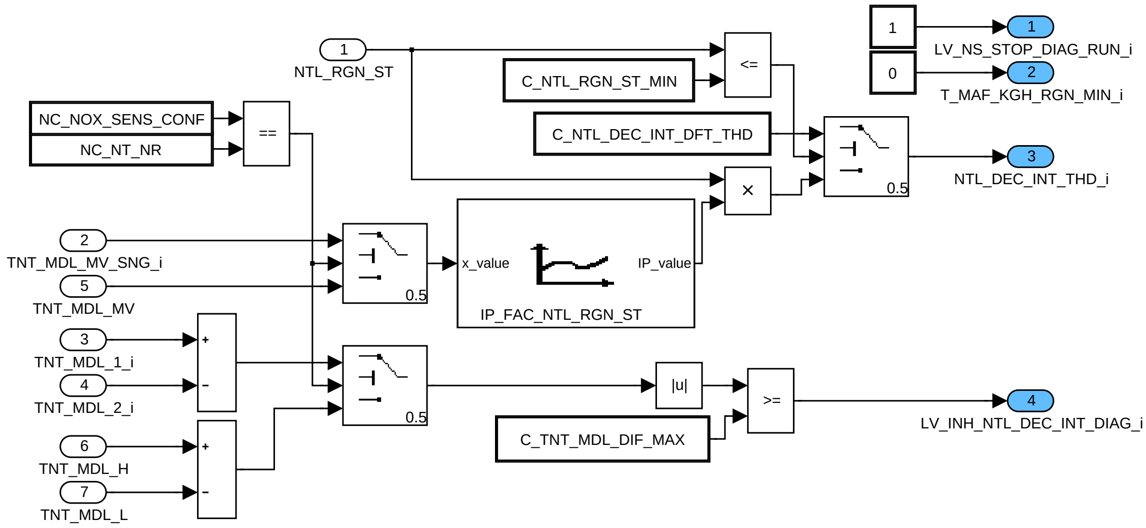

Figure B.119.9: NOXD_MODULB080/OPM_10MS/FOR_LOOP_NS/CLC/MAIN/CLC1/START/CLC

Observation of regeneration agent integral during regeneration

The system knows the absolute loading of NOx catalyst with NOx and O2. On this base it is possible to determine the necessary amount of regeneration agent. When this amount of regeneration agent was transferred to the NOx catalyst then the NOx catalyst shall be cleared from NOx and O2. Now the sensor signal must stop the NOx regeneration by exceeding of regeneration stop threshold. Otherwise the sensor signal is wrong.

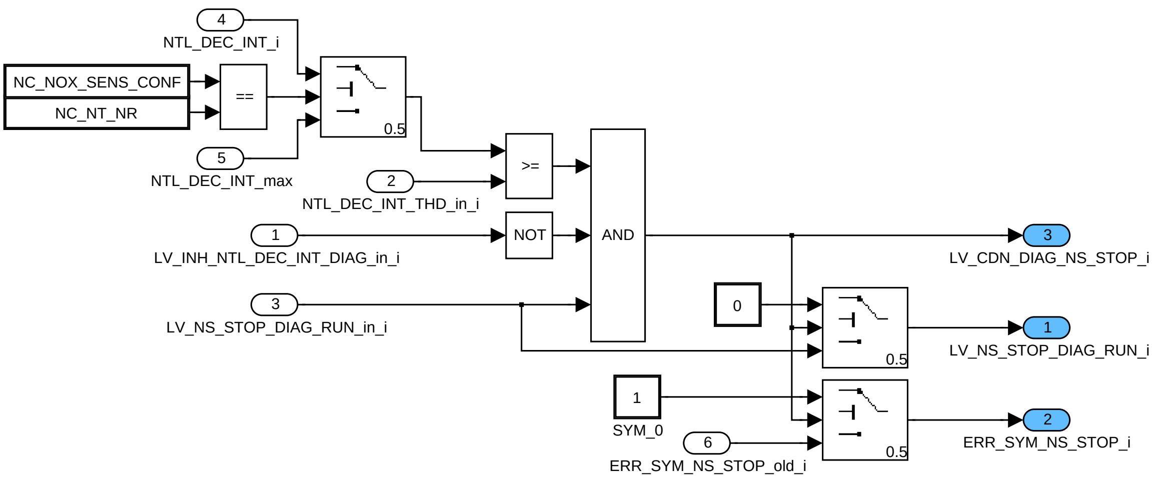

Figure B.119.10: NOXD_MODULB080/OPM_10MS/FOR_LOOP_NS/CLC/MAIN/CLC2

Observation of air flow and lambda during regeneration

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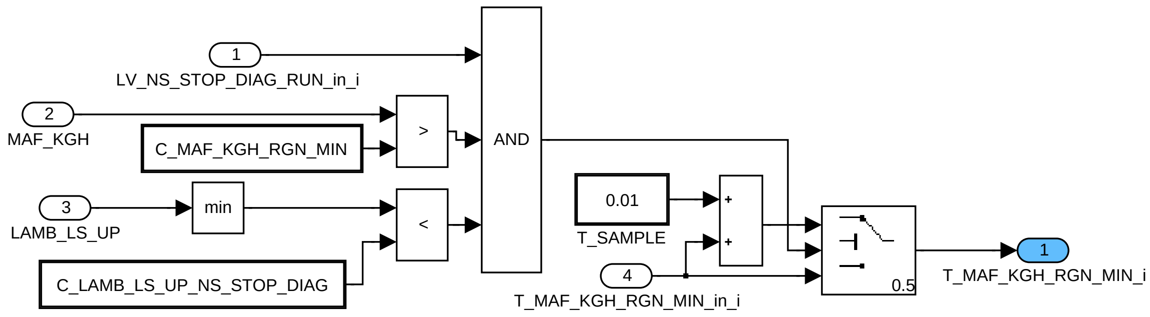

Figure B.119.11: NOXD_MODULB080/OPM_10MS/FOR_LOOP_NS/CLC/MAIN/CLC3

Detection of regeneration stop

The NOx catalyst regeneration stop can be caused by
- rich exhaust gas, which is detected by a sensor based lambda signal
- NOx catalyst model
- maximum regeneration duration (time out).

The NOx catalyst management indicates the regeneration stop method by the bits LV_SENS_AFR_i (sensor stop), LV_NT_MDL_AFR (catalyst model) and LV_T_OUT_AFR (time out). This bits are used to observe the lambda signals of NOx sensor on its capability to stop a NOx catalyst regeneration.

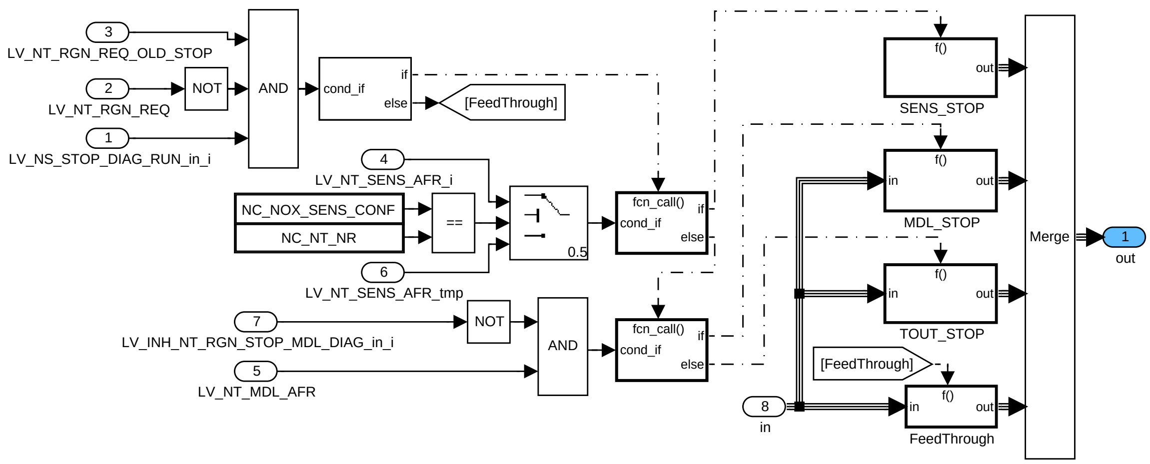

Figure B.119.12: NOXD_MODULB080/OPM_10MS/FOR_LOOP_NS/CLC/MAIN/CLC4

Regeneration stop by sensor

Normally the NOx catalyst regeneration is stopped by a sensor signal. Then the sensor is classified as OK.

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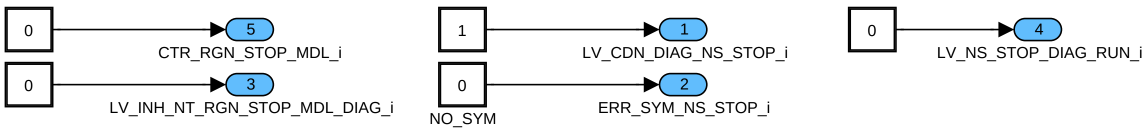

Figure B.119.13:
NOXD_MODULB080/OPM_10MS/FOR_LOOP_NS/CLC/MAIN/CLC4/SENS_STOP/CLC

Regeneration stop by model

If the regeneration was stopped by the NOx catalyst model, then it is not possible to classify the sensor as OK or defect. Hence the number of successive regenerations, which are stopped by model, is determined by CTR_RGN_STOP_MDL_i. If CTR_RGN_STOP_MDL_i exceeds a threshold then the regeneration stop by model is inhibited by set of LV_INH_NT_RGN_STOP_MDL_DIAG_i. Now the next regeneration can be stopped only by sensor (LV_SENS_AFR_i) or by time out (LV_T_OUT_AFR). If the next regeneration is stopped by sensor then the sensor is OK. Remark: In this case the calibration values and/or adaptation values of model should be checked.

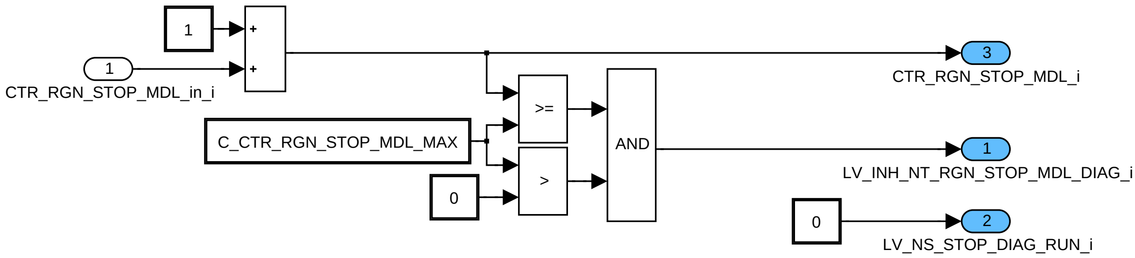

Figure B.119.14:
NOXD_MODULB080/OPM_10MS/FOR_LOOP_NS/CLC/MAIN/CLC4/MDL_STOP/CLC

Regeneration stop by time out

If the regeneration is stopped by time out then the sensor is not able to stop the regeneration (sensor is defect) or the calibration of maximum regeneration duration is to short. Especially regenerations with a low air flow (idle speed) are critical. Hence the mass air flow is observed during the regenerations. The observation measures the time at which the mass air flow is higher than the threshold C_MAF_KGH_RGN_MIN. If a regeneration time out is reached now then it is checked the duration at which the mass air flow was higher than the threshold C_MAF_KGH_RGN_MIN. When the regeneration duration with a sufficient mass air flow is lower than C_T_MAF_KGH_MIN then this signal diagnosis is inhibited, the failure counter is not incremented. When the regeneration duration with a sufficient mass air flow is higher than C_T_MAF_KGH_MIN then the sensor is classified as defect and the failure counter is incremented.

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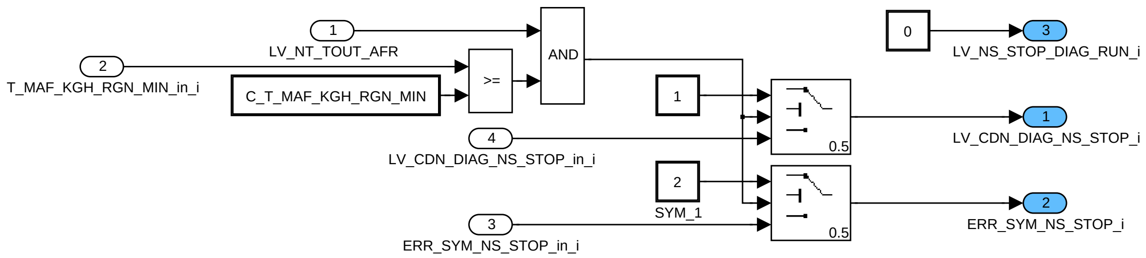

Figure B.119.15:
NOXD_MODULB080/OPM_10MS/FOR_LOOP_NS/CLC/MAIN/CLC4/TOUT_STOP/CLC

Lambda 1 operation

It is possible that the Lambda signals of NOx-Sensor exceeds the regeneration stop threshold at homogeneous Lambda = 1.0 engine operation. This fact is used to classify the sensor as OK.

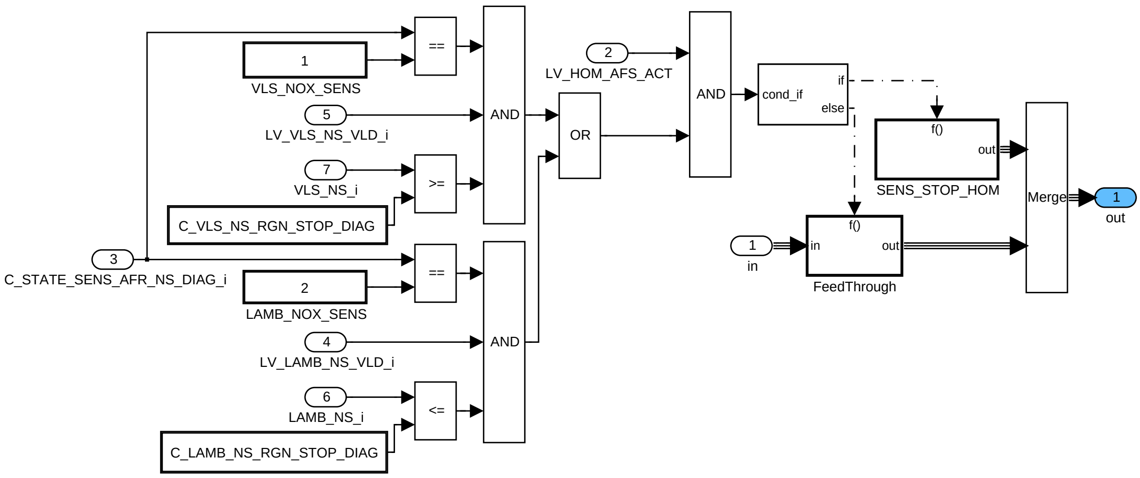

Figure B.119.16: NOXD_MODULB080/OPM_10MS/FOR_LOOP_NS/CLC/MAIN/CLC5

Figure B.119.17:
NOXD_MODULB080/OPM_10MS/FOR_LOOP_NS/CLC/MAIN/CLC5/SENS_STOP_HOM/CLC

Error management

LV_ERR_NS_STOP will be get by ACTION_ERRM_GetLvErr and LV_END_DIAG_NS_STOP will be get by ACTION_ERRM_GetLvEndDiag.

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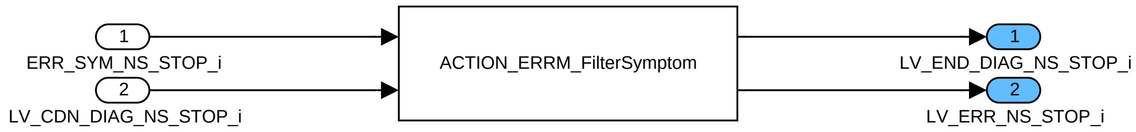

Figure B.119.18: NOXD_MODULB080/OPM_10MS/FOR_LOOP_NS/CLC/MAIN/CLC6

Bank independent calculation (part 2)

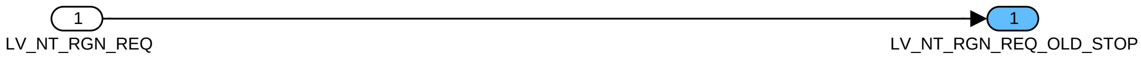

Figure B.119.19: NOXD_MODULB080/OPM_10MS/NO_LOOP_2/CLC

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B.120 NOx sensor OBDII diagnosis - Signal activity

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_NOX_RGN_DIAG_ACT [NC_NOX_SENS_CONF]	V	0... FFH	0... 255	1	-
Number of suitable regenerations during activity diagnosis					
ERR_SYM_NS_ACT [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx sensor activity diagnosis					
LV_CDN_DIAG_NS_ACT [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx sensor activity diagnosis					
LV_END_DIAG_NS_ACT [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor activity diagnosis					
LV_ERR_NS_ACT [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of NOx sensor activity diagnosis					
LV_NOX_NS_ACT [NC_NOX_SENS_CONF]	O/V/S	0... 1H	0 ...1	1	-
NOx signal activity detected					
LV_NOX_NS_ACT_NVMY [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Value LV_NOX_NS_ACT from last driving cycle stored in non-volatile memory					
LV_NT_RGN_REQ_ACT_OLD	V	0... 1H	0 ...1	1	-
Old value of LV_NT_RGN_REQ for edge detection, used for activity diagnosis					
NOX_NS_DIAG_ACT_GRD_MAX [NC_NOX_SENS_CONF]	V	0... 5DCH	0... 1500	1	ppm
Maximum NOx signal gradient during activity diagnosis					
NOX_NS_DIAG_ACT_MAX [NC_NOX_SENS_CONF]	V	0... 5DCH	0... 1500	1	ppm
Maximum NOx signal value during activity diagnosis					
NOX_NS_DIAG_ACT_MMV [NC_NOX_SENS_CONF]	V	0... 5DCH	0... 1500	1	ppm
Filtered value of NOx concentration measured by NOx sensor for diagnosis functions					
NOX_NS_DIAG_ACT_OLD [NC_NOX_SENS_CONF]	V	FF9C... 5DCH	-100 ...1500	1	ppm
Old value of NOx concentration value for diagnosis, used for activity diagnosis					
T_NS_DIAG_ACT [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for NOx sensor activity diagnosis					
T_RGN_ACT_OLD	V	0... FFFFH	0... 655.35	0.01	s
Old value of time counter for regeneration active					

Input data:

LV_INH_DIAG_NS_OBD_2_ACT [NC_NOX_SENS_CONF] {p. 6468}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_NT_RGN_REQ {p. 996}	LV_PL {p. 1720}

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LV_SENS_AFR [NC_NT_NR] {p. 2983}	LV_ST_END {p. 1720}	NC_IDX_DIAG_NS_ACT [NC_NOX_SENS_CONF]	NC_NOX_SENS_CONF {p. 643}
NC_NT_NR {p. 644}	NOX_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}	T_RGN {p. 2885}	TNT_MDL_H {p. 8237}
TNT_MDL_L {p. 8237}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_ACT	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor activity diagnosis					
C_ABC_INC_NS_ACT	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor activity diagnosis					
C_ABC_MAX_NS_ACT	-	1... FFH	1... 255	1	s
Anti bounce counter maximum for the NOx sensor activity diagnosis					
C_CRLC_NOX_NS_DIAG_ACT	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Filter constant for calculation of moving mean value of NOx value for diagnosis					
C_CTR_NOX_RGN_DIAG_ACT_MAX	-	0... FFH	0... 255	1	-
Maximum number of regenerations for NOx signal activity diagnosis					
C_NOX_NS_DIAG_ACT_GRD_MIN	-	0... 5DCH	0... 1500	1	ppm
Minimum NOx signal gradient for registration of maximum NOx signal value					
C_NOX_NS_DIAG_ACT_MIN	-	0... 5DCH	0... 1500	1	ppm
Minimum NOx signal value as diagnosis threshould					
C_NOX_NS_DIAG_GRD_MIN	-	0... 5DCH	0... 1500	1	ppm
Minimum NOx signal gradient as diagnosis threshould					
C_T_NS_DIAG_ACT_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Time threshold to enable the lean operation possibility without successful NOx signal activity diagnosis					
C_T_RGN_DIAG_ACT_MIN	-	0... FFFFH	0... 655.35	0.01	s
Minimum regeneration duration for counting the regeneration within the NOx signal activity diagnosis					
C_TNT_DIAG_ACT_MAX	-	0... FFFFH	0... 1023.98	0.015625	°C
Maximum NOx trap temperature for NOx sensor activity diagnosis					
C_TNT_DIAG_ACT_MIN	-	0... FFFFH	0... 1023.98	0.015625	°C
Minimum NOx trap temperature for NOx sensor activity diagnosis					
LC_NOX_NS_ACT_INI	-	0... 1H	0 ...1	1	-
Init value for LV_NOX_NS_ACT at initialization of non-volatile memory					
LC_NOX_NS_ACT_RST	-	0... 1H	0 ...1	1	-
Selection of reset strategy for LV_NOX_NS_ACT					
LC_SENS_AFR_DIAG_ACT_OFF	-	0... 1H	0 ...1	1	-
Switch if LV_SENS_AFR will be used for counting of regenerations					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

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General information

This diagnosis observes the NOx signal and the NOx signal gradient in order to check that the NOx signal is able to generate a NOx catalyst regeneration request.

Application Condition

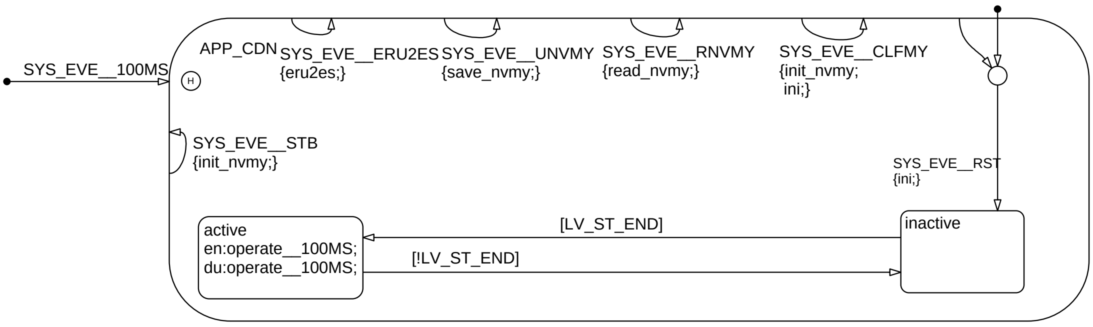

Figure B.120.1: NOXD_MODULB07F/APP_CDN/Chart

Function Description

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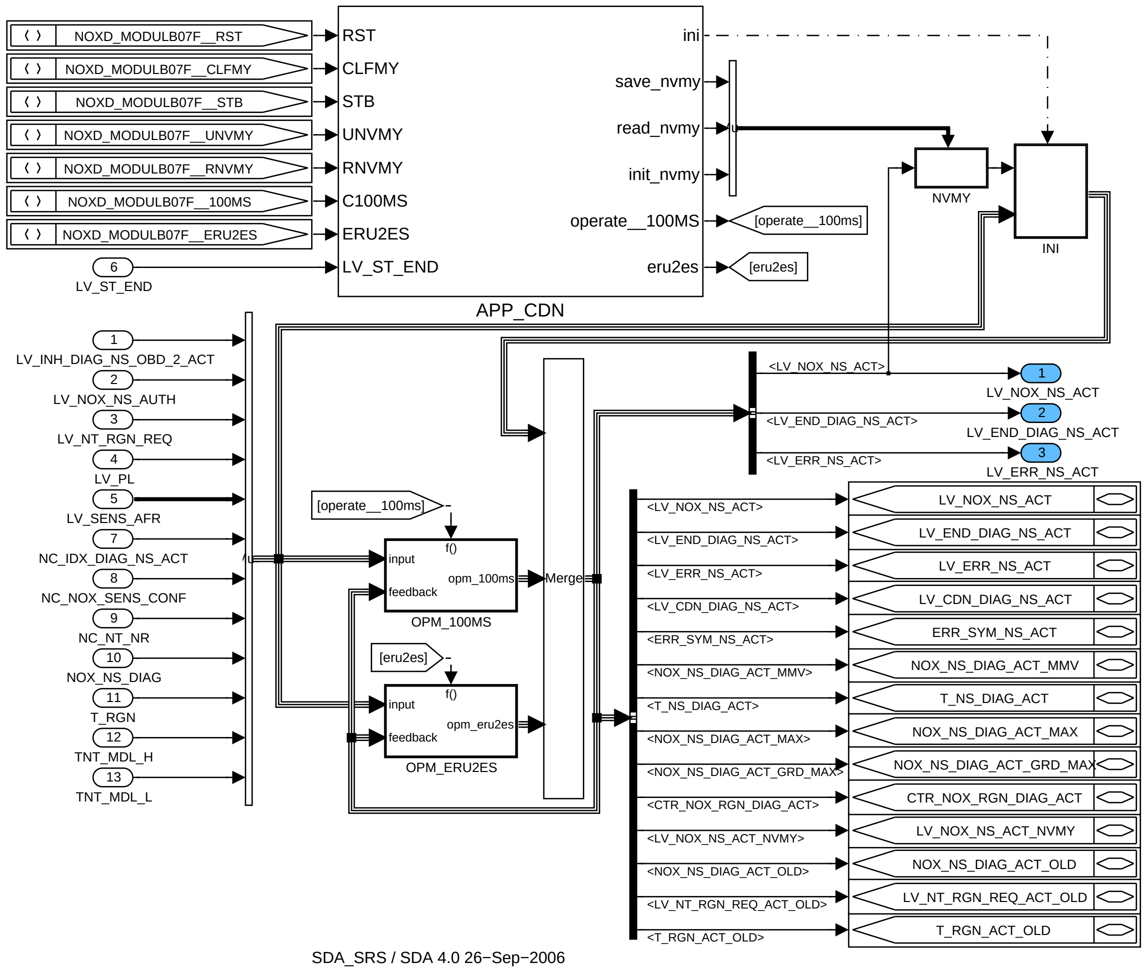

Figure B.120.2: NOXD_MODULB07F

B.120.1 Management of non-volatile memory

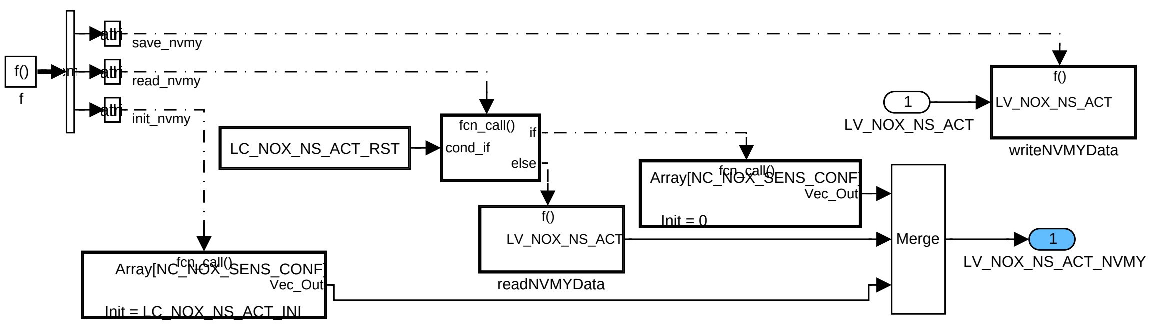

Figure B.120.3: NOXD_MODULB07F/NVMY

B.120.2 Initialization at activation

These actions initialized the diagnostic data according filtering configuration :
ACTION_ERRM_GetLvErr(IN<NC_IDX_DIAG_XX>, OUT< LV_ERR_XX >)

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ACTION_ERRM_GetLvEndDiag(IN<NC_IDX_DIAG_XX>, OUT< LV_END_DIAG_XX >) with XX=NS_ACT

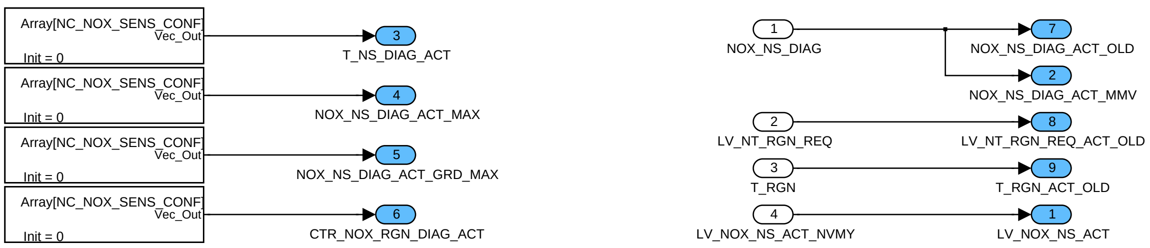

Figure B.120.4: NOXD_MODULB07F/INI/CLC

B.120.3 Loop control 100 ms

The calculation inside FLP_NS have to be done for each NOx sensor, controlled by configuration data NC_NOX_SENS_CONF.
If NC_NOX_SENS_CONF = 1, then calculation for i = 1.
If NC_NOX_SENS_CONF = 2, then calculation for i = 1 and 2.
The calculation inside NOT_FLP have to be done only once.

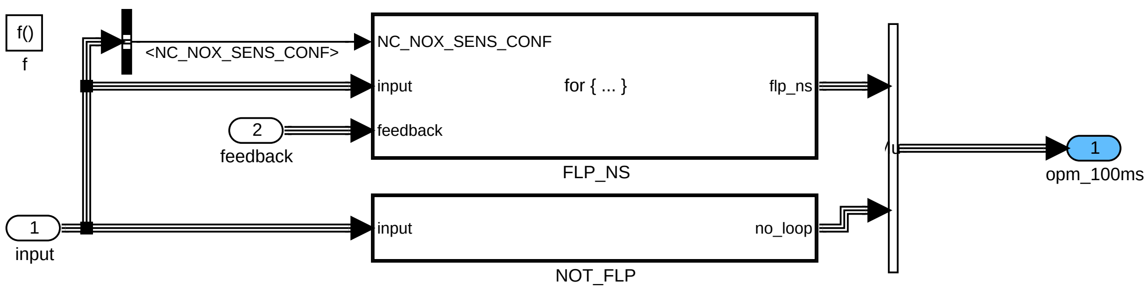

Figure B.120.5: NOXD_MODULB07F/OPM_100MS

Calculation for each NOx sensor

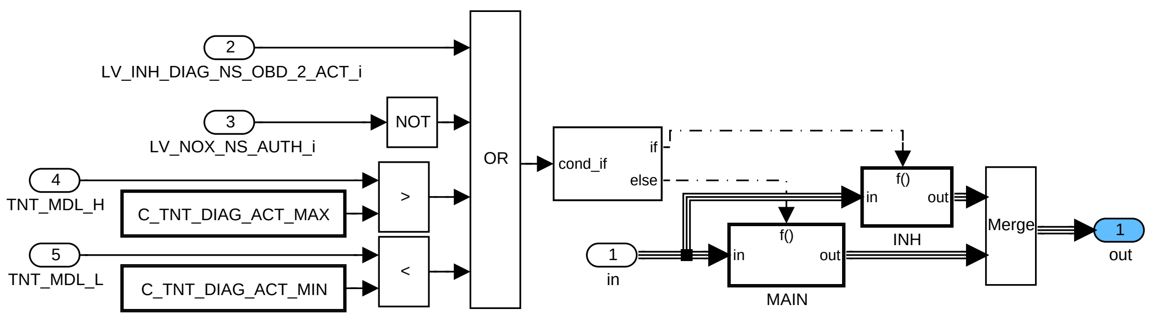

Figure B.120.6: NOXD_MODULB07F/OPM_100MS/FLP_NS/CLC

Diagnosis inhibited for one sensor

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Figure B.120.7: NOXD_MODULB07F/OPM_100MS/FLP_NS/CLC/INH/CLC

Main calculation

Filter of NOx signal for diagnosis

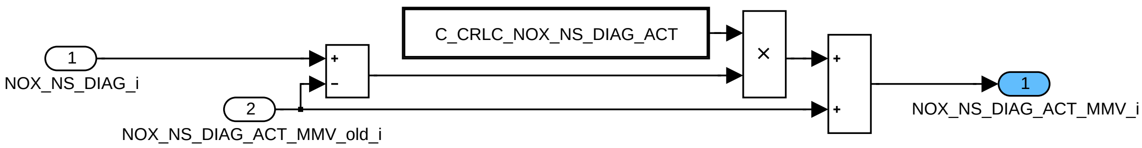

Figure B.120.8: NOXD_MODULB07F/OPM_100MS/FLP_NS/CLC/MAIN/CLC1

Maximum of NOx signal gradient

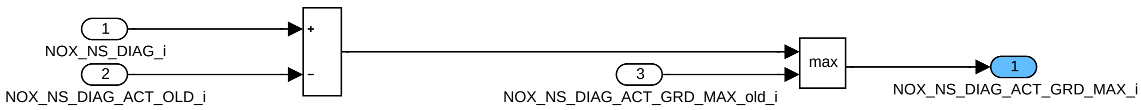

Figure B.120.9: NOXD_MODULB07F/OPM_100MS/FLP_NS/CLC/MAIN/CLC2

Maximum of NOx signal

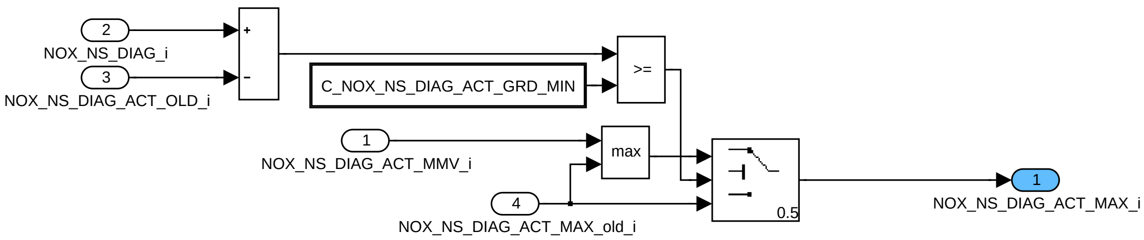

Figure B.120.10: NOXD_MODULB07F/OPM_100MS/FLP_NS/CLC/MAIN/CLC3

Diagnosis thresholds

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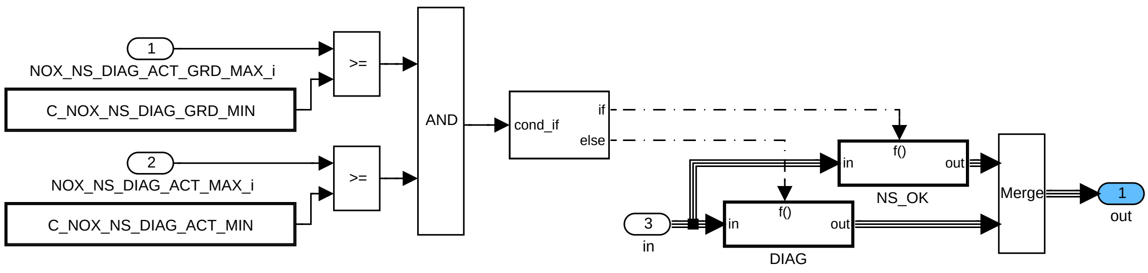

Figure B.120.11: NOXD_MODULB07F/OPM_100MS/FLP_NS/CLC/MAIN/CLC4

NOx sensor is OK

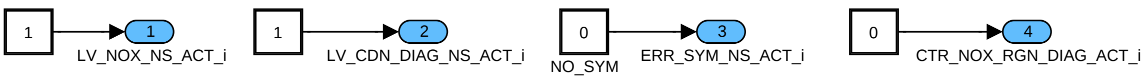

Figure B.120.12: NOXD_MODULB07F/OPM_100MS/FLP_NS/CLC/MAIN/CLC4/NS_OK/CLC

NOx sensor diagnosis is running

The maximum detection will be divided into two periods. The first period is a calibrated time of part load. The second period is a calibrated number of suitable regenerations. A NOx sensor activity error will be set if during both periods the maxima have not reached the diagnosis threshoulds.

Time of part load is measured

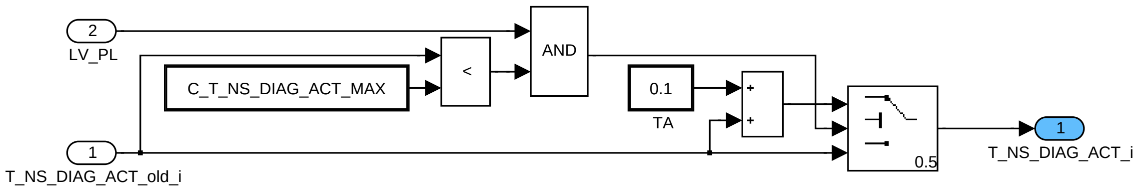

Figure B.120.13: NOXD_MODULB07F/OPM_100MS/FLP_NS/CLC/MAIN/CLC4/DIAG/CLC1

NOx sensor error decision

After the calibrated number of regenerations the error will be set.

Figure B.120.14: NOXD_MODULB07F/OPM_100MS/FLP_NS/CLC/MAIN/CLC4/DIAG/CLC2

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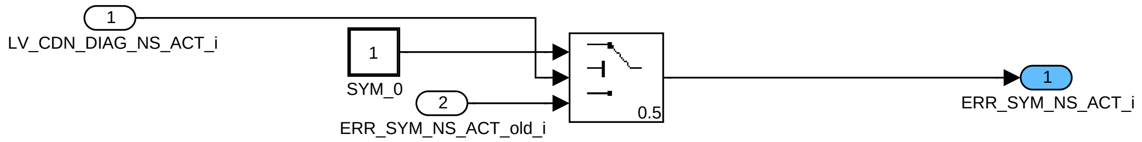

Figure B.120.15: NOXD_MODULB07F/OPM_100MS/FLP_NS/CLC/MAIN/CLC4/DIAG/CLC3

Control of stratified mode

If an error after the second period will be detected, then the stratified mode will be inhibited. Otherwise, if the first period is over, then the stratified mode will be allowed, although no activity was detected during the first period. In this period activity of the NOx signal should be monitored due to the stimulation by regeneration.

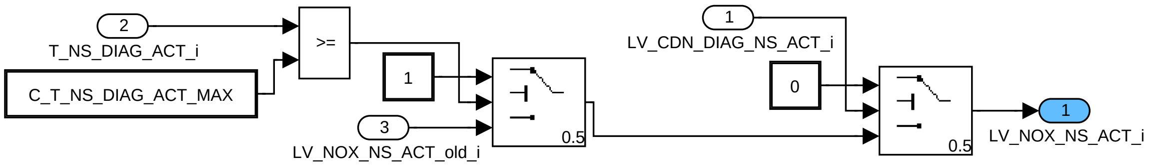

Figure B.120.16: NOXD_MODULB07F/OPM_100MS/FLP_NS/CLC/MAIN/CLC4/DIAG/CLC4

Regeneration counter

During the second period the number of suitable regenerations will be counted.

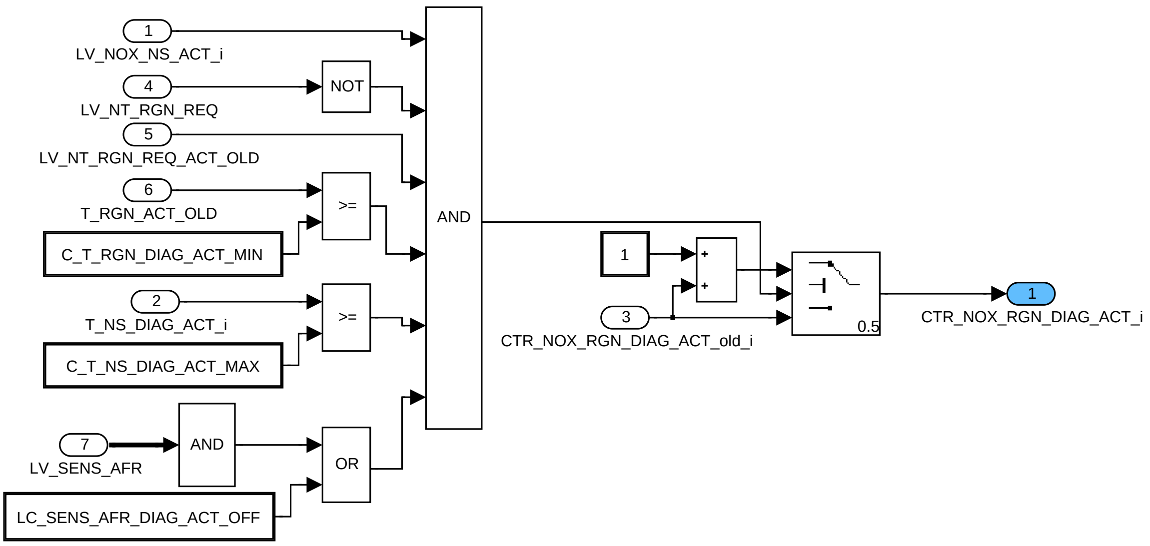

Figure B.120.17: NOXD_MODULB07F/OPM_100MS/FLP_NS/CLC/MAIN/CLC4/DIAG/CLC5

Error management

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LV_ERR_NS_ACT will be get by ACTION_ERRM_GetLvErr and LV_END_DIAG_NS_ACT will be get by ACTION_ERRM_GetLvEndDiag.

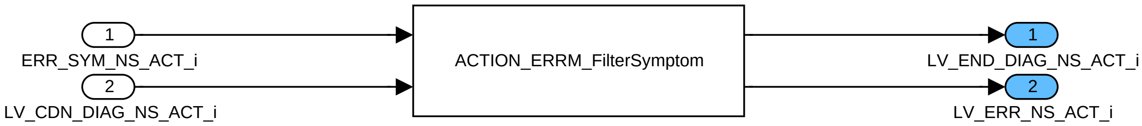

Figure B.120.18: NOXD_MODULB07F/OPM_100MS/FLP_NS/CLC/MAIN/CLC5

Old value for gradient calculation

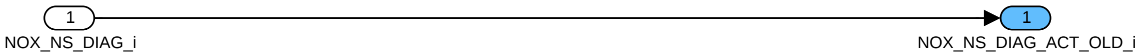

Figure B.120.19: NOXD_MODULB07F/OPM_100MS/FLP_NS/CLC/MAIN/CLC6

Bank independent calculation

The old values of the inputs will be stored for edge detection and because the regeneration time before the edge is needed.

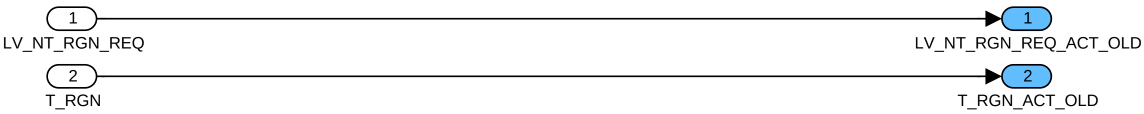

Figure B.120.20: NOXD_MODULB07F/OPM_100MS/NOT_FLP/CLC

B.120.4 Loop control at engine run to engine stop

The calculation inside FLP_NS have to be done for each NOx sensor, controlled by configuration data NC_NOX_SENS_CONF.
If NC_NOX_SENS_CONF = 1, then calculation for i = 1.
If NC_NOX_SENS_CONF = 2, then calculation for i = 1 and 2.

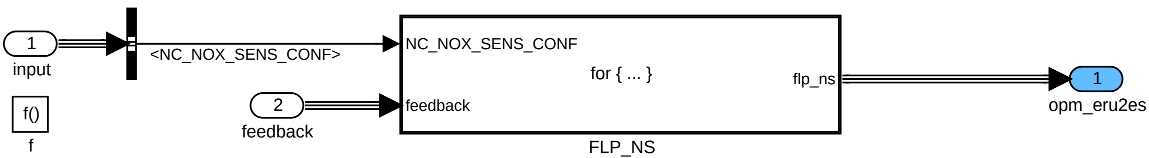

Figure B.120.21: NOXD_MODULB07F/OPM_ERU2ES

Decision about storage of diagnosis result

The new activity result will be stored in the non-volatile memory if the diagnosis was finished. Otherwise the stored value from the last driving cycle will be kept.

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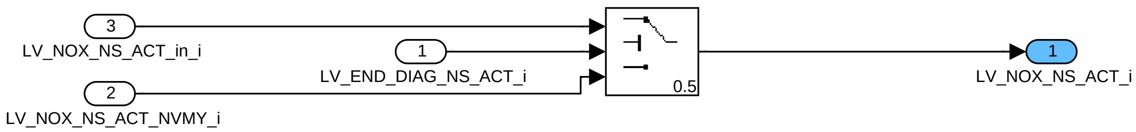

Figure B.120.22: NOXD_MODULB07F/OPM_ERU2ES/FLP_NS/CLC

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B.121 NOx sensor OBDII diagnosis - Signal availability

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NS_AVL [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx sensor availability diagnosis					
FRC_NS_AVL [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 65535	1	-
Frequency counter for NOx signal available					
LV_CDN_DIAG_NS_AVL [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx sensor availability diagnosis					
LV_END_DIAG_NS_AVL [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor availability diagnosis					
LV_ERR_NS_AVL [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of NOx sensor availability diagnosis					
STATE_NS_DIAG_AVL [NC_NOX_SENS_CONF]	V	0H 1H 2H 3H	INIT PASSIVE START ACTIVE	-	-
State of NOx sensor availability diagnosis					
TCC_NS_AVL [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 65535	1	-
Maximum test cycle counter value; used for detection of end of diagnosis					

Input data:

LV_HOM_AFS_ACT {p. 8136}	LV_HOM_AFS_REQ {p. 8136}	LV_INH_DIAG_NS_OBD_2_AVL [NC_NOX_SENS_CONF] {p. 6468}	LV_INH_NT_RGN_REQ {p. 996}
LV_MIS_STATE_A {p. 6238}	LV_MIS_STATE_B1 {p. 6238}	LV_MIS_STATE_B4 {p. 6238}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}
LV_NOX_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_PU {p. 1720}	LV_S_REQ_EGR {p. 804}	LV_SCC [NC_CBK_EX_NR] {p. 2295}
LV_ST_END {p. 1720}	LV_T_NS_VLD_TMP [NC_NOX_SENS_CONF] {p. 3193}	LV_TEMP_MIN_THD_CAN [NC_NOX_SENS_CONF] {p. 991}	LV_TEMP_NS_OK [NC_NOX_SENS_CONF] {p. 991}
LV_VB_NS_OK [NC_NOX_SENS_CONF] {p. 991}	NC_CBK_EX_NR {p. 1829}	NC_IDX_DIAG_NS_AVL [NC_NOX_SENS_CONF]	NC_NOX_SENS_CONF {p. 643}
STATE_NOX {p. 2986}	T_NOX_NS_HLD [NC_NOX_SENS_CONF] {p. 992}		

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_AVL	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor availability diagnosis					
C_ABC_INC_NS_AVL	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor availability diagnosis					
C_ABC_MAX_NS_AVL	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx sensor availability diagnosis					
C_FRC_NS_AVL_MAX	-	0... FFFFH	0... 65535	1	-
Maximum number of cycles with an invalid NOx signal during a NOx signal availability evaluation					
C_T_NOX_NS_ST_DIAG_AVL	-	0... FFFFH	0... 655.35	0.01	s
Minimum time of full NOx-Sensor readiness to stop the NOx-Sensor start up diagnosis					
C_TCC_NS_AVL_MAX	-	0... FFFFH	0... 65535	1	-
Number of test cycles for a NOx signal availability evaluation					
C_TCC_NS_AVL_ST_MAX	-	0... FFFFH	0... 65535	1	-
Maximum number of test cycles after start after which the NOx signal must be available					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

General information

This diagnosis observes the availability of NOx signal after the start and during the LOAD phases of NOx catalyst. This function shall detect when the NOx sensor is not able to transmit valid signals because of controller problems such as oscillations.

In normal operation mode the diagnosis is in state ACTIVE if suitable lean conditions are reached, otherwise the state PASSIVE is set. Inside ACTIVE the signal LV_NOX_NS_DIAG_VLD_i will be observed by a statistical method.

At the start-up the diagnosis observes the time which the sensor needs in order to reach the full readiness. This is necessary in order to detect NOx sensors with instable control loops. It will be done inside the state START.

Signal flow diagram:

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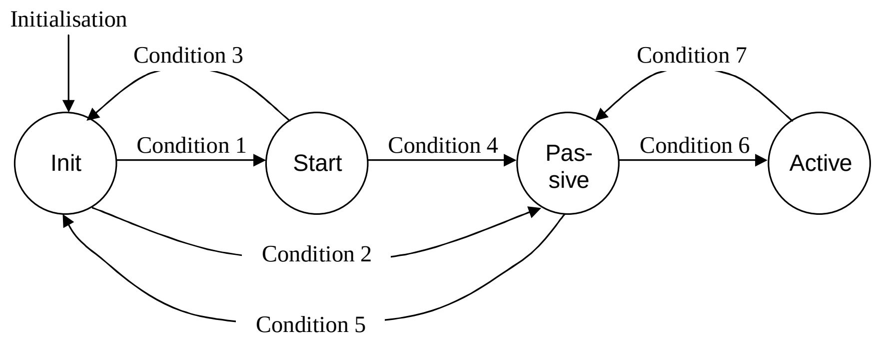

Application Condition

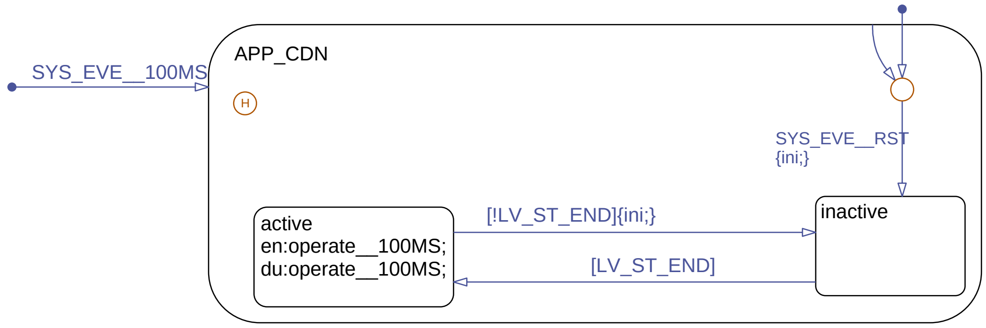

Figure B.121.1: NOXD_MODULB07B/APP_CDN/Chart

Function Description

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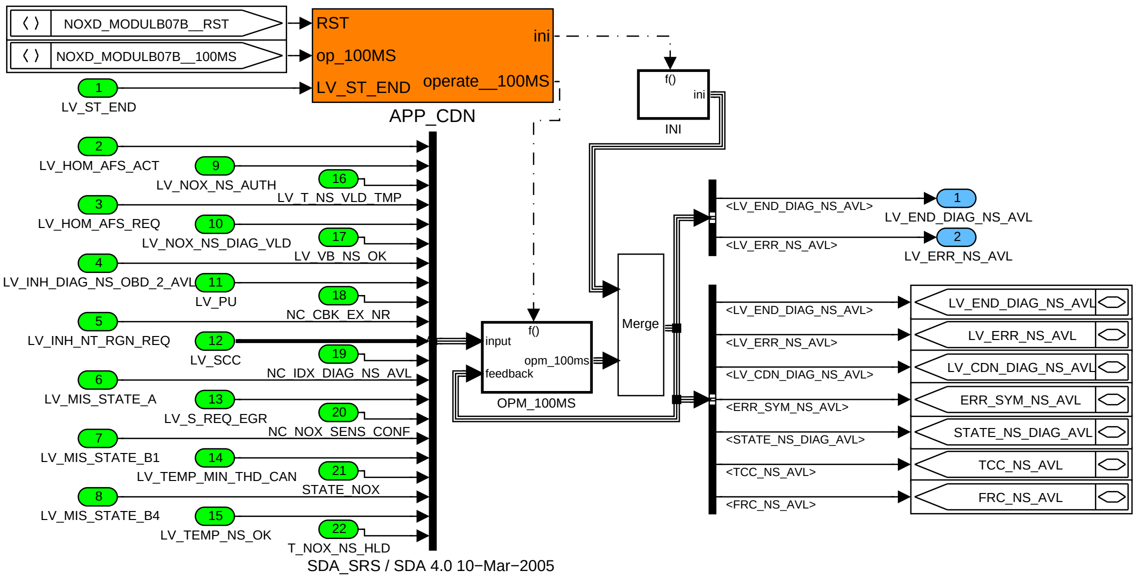

Figure B.121.2: NOXD_MODULB07B

B.121.1 Initialization at reset and deactivation

These actions initialized the diagnostic data according filtering configuration :
ACTION_ERRM_GetLvErr(IN<NC_IDX_DIAG_XX>, OUT< LV_ERR_XX >)
ACTION_ERRM_GetLvEndDiag(IN<NC_IDX_DIAG_XX>, OUT< LV_END_DIAG_XX >)

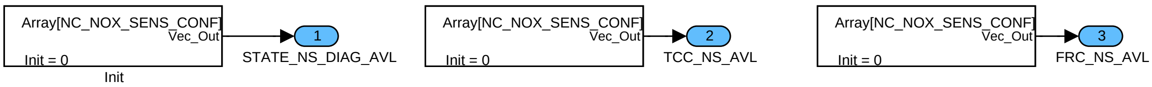

Figure B.121.3: NOXD_MODULB07B/INI/CLC

B.121.2 Loop control

The calculation inside FOR_LOOP_NS have to be done for each NOx sensor, controlled by configuration data NC_NOX_SENS_CONF.
If NC_NOX_SENS_CONF = 1, then calculation for i = 1.
If NC_NOX_SENS_CONF = 2, then calculation for i = 1 and 2.
The calculation inside NO_LOOP have to be done only once.

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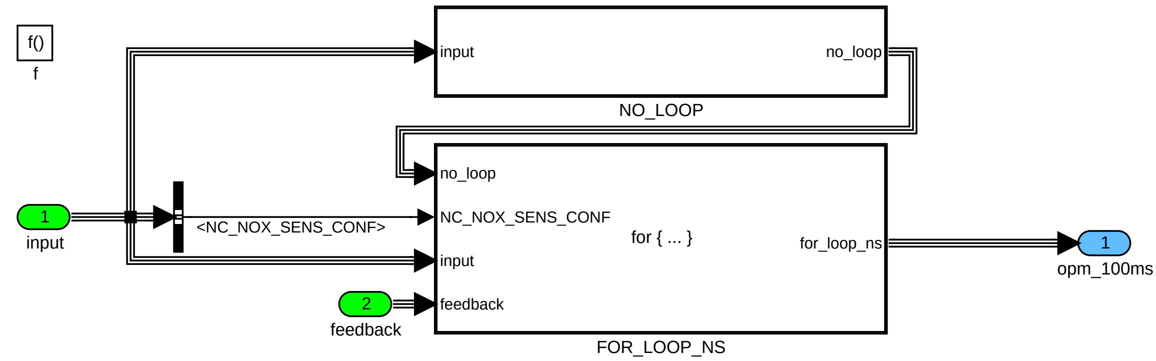

Figure B.121.4: NOXD_MODULB07B/OPM_100MS

Bank independent calculation

This condition forces the state machine for each NOx sensor to INIT or PASSIVE and prevent the transition to state START or ACTIVE.

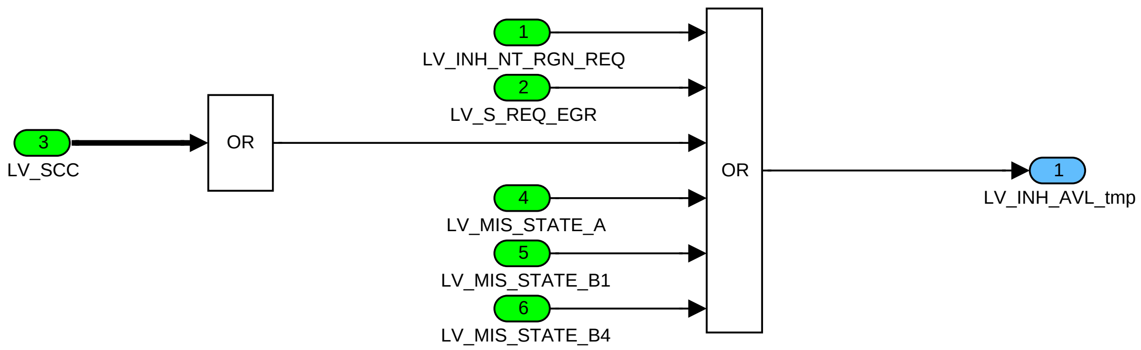

Figure B.121.5: NOXD_MODULB07B/OPM_100MS/NO_LOOP/CLC

Calculation for each NOx sensor

If the diagnosis for a bank is inhibited, then all values will be set to zero, else the diagnosis will be calculated.

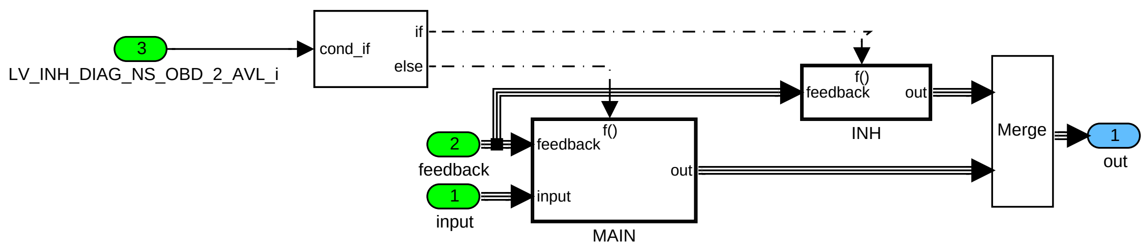

Figure B.121.6: NOXD_MODULB07B/OPM_100MS/FOR_LOOP_NS/CLC

Diagnosis inhibited

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Figure B.121.7: NOXD_MODULB07B/OPM_100MS/FOR_LOOP_NS/CLC/INH/CLC

State machine

The default case is is case 0 (INIT).

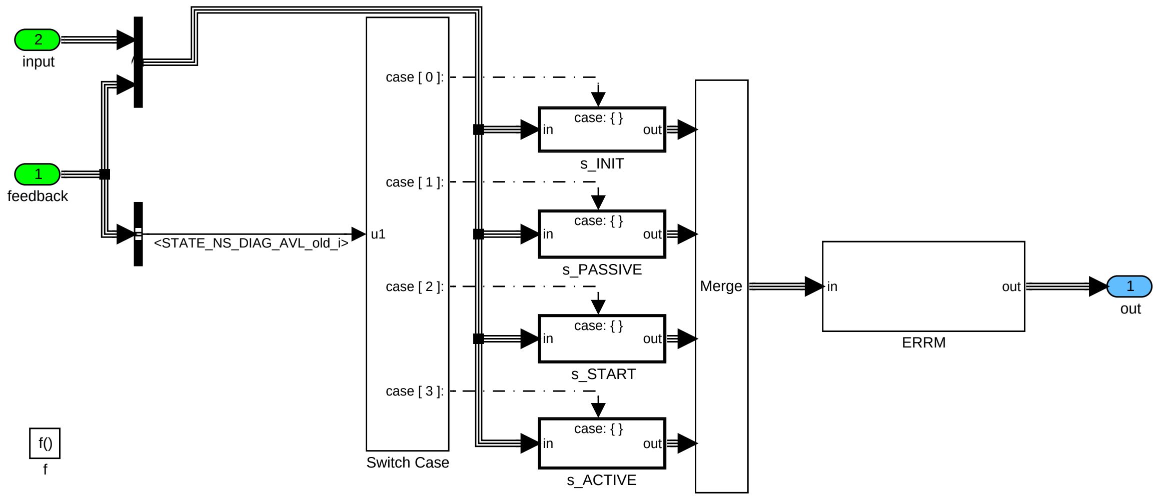

Figure B.121.8: NOXD_MODULB07B/OPM_100MS/FOR_LOOP_NS/CLC/MAIN

STATE_NS_DIAG_AVL_i = 0 (INIT)

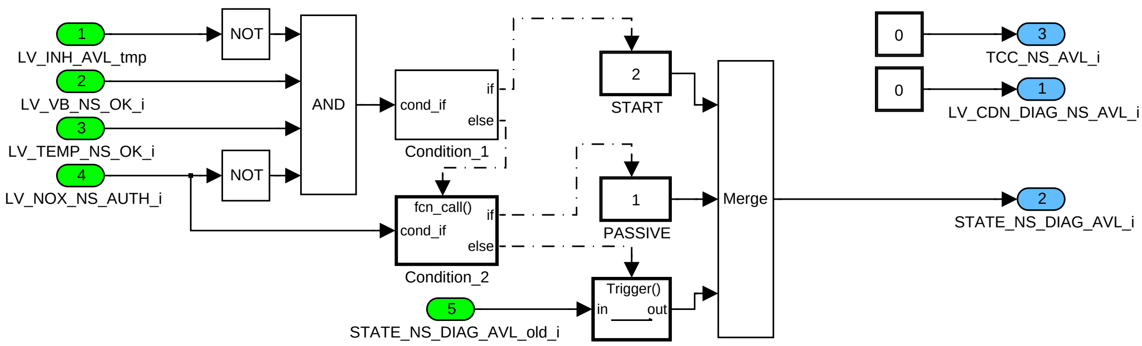

Figure B.121.9: NOXD_MODULB07B/OPM_100MS/FOR_LOOP_NS/CLC/MAIN/s_INIT/CLC

STATE_NS_DIAG_AVL_i = 1 (PASSIVE)

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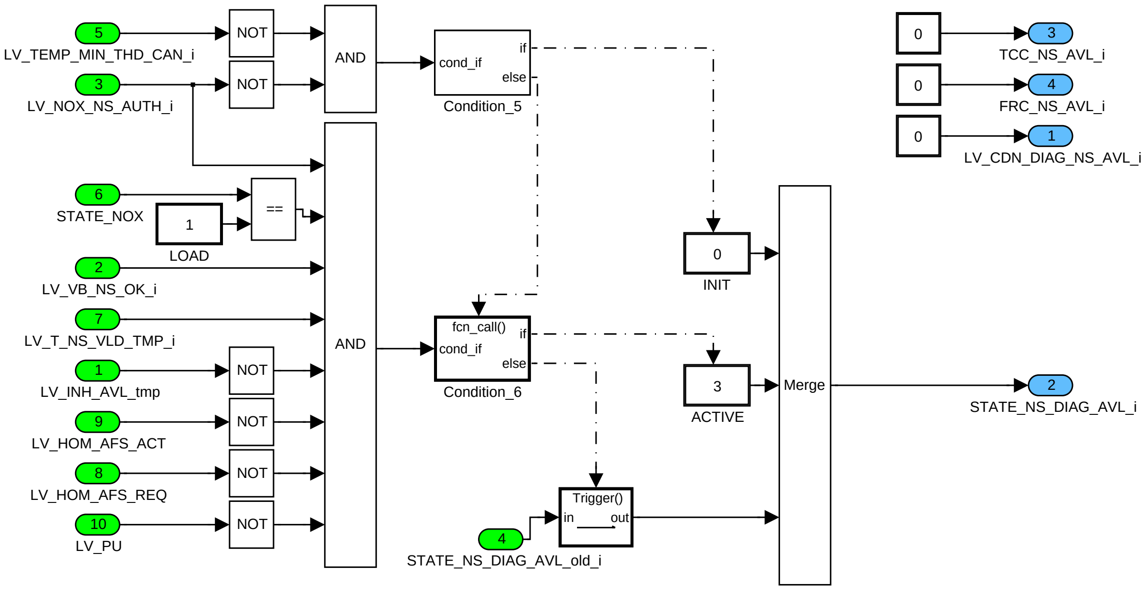

Figure B.121.10: NOXD_MODULB07B/OPM_100MS/FOR_LOOP_NS/CLC/MAIN/s_PASSIVE/CLC

STATE_NS_DIAG_AVL_i = 2 (START)

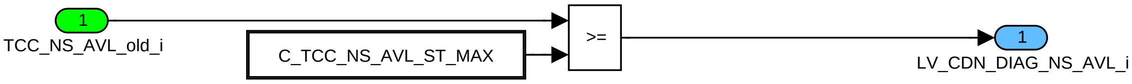

Figure B.121.11: NOXD_MODULB07B/OPM_100MS/FOR_LOOP_NS/CLC/MAIN/s_START/CLC1

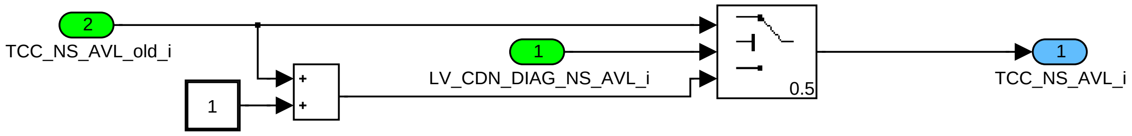

Figure B.121.12: NOXD_MODULB07B/OPM_100MS/FOR_LOOP_NS/CLC/MAIN/s_START/CLC2

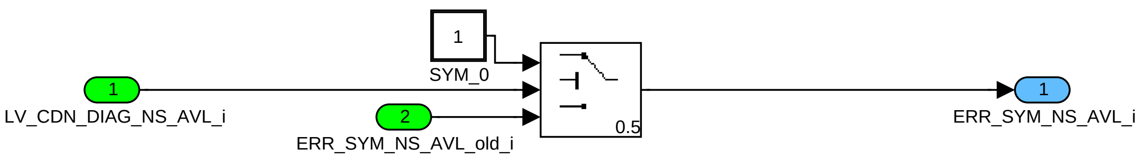

Figure B.121.13: NOXD_MODULB07B/OPM_100MS/FOR_LOOP_NS/CLC/MAIN/s_START/CLC3

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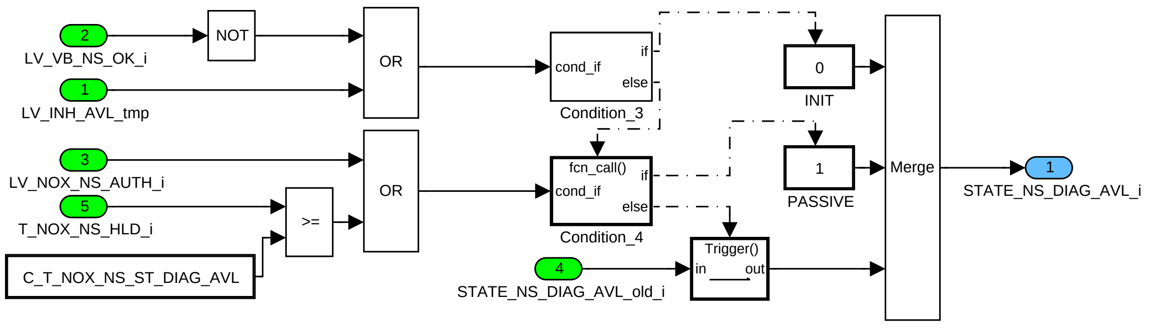

Figure B.121.14: NOXD_MODULB07B/OPM_100MS/FOR_LOOP_NS/CLC/MAIN/s_START/CLC4

STATE_NS_DIAG_AVL_i = 3 (ACTIVE)

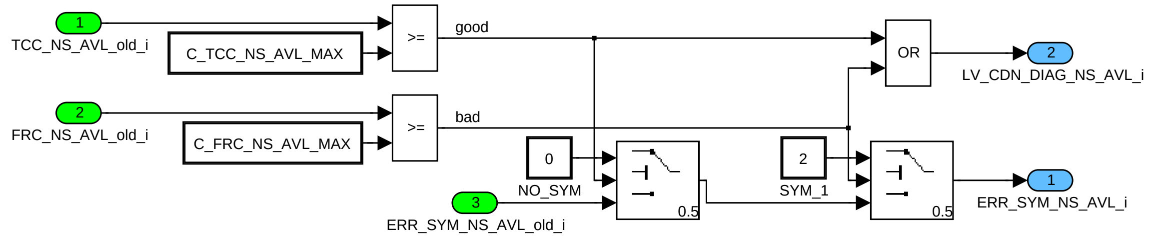

Figure B.121.15: NOXD_MODULB07B/OPM_100MS/FOR_LOOP_NS/CLC/MAIN/s_ACTIVE/CLC1

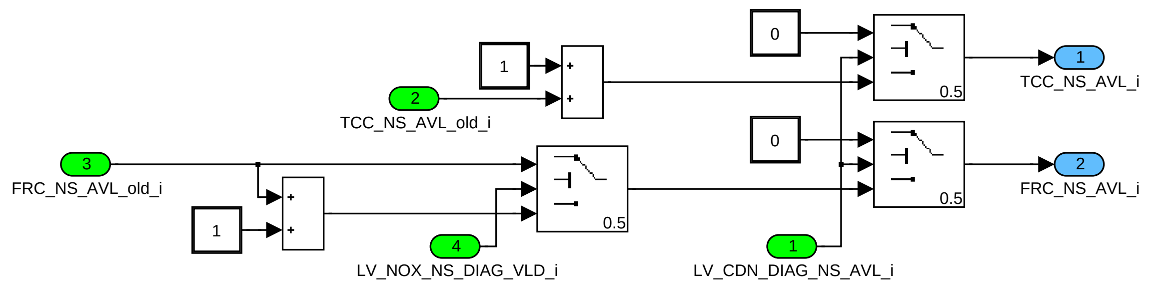

Figure B.121.16: NOXD_MODULB07B/OPM_100MS/FOR_LOOP_NS/CLC/MAIN/s_ACTIVE/CLC2

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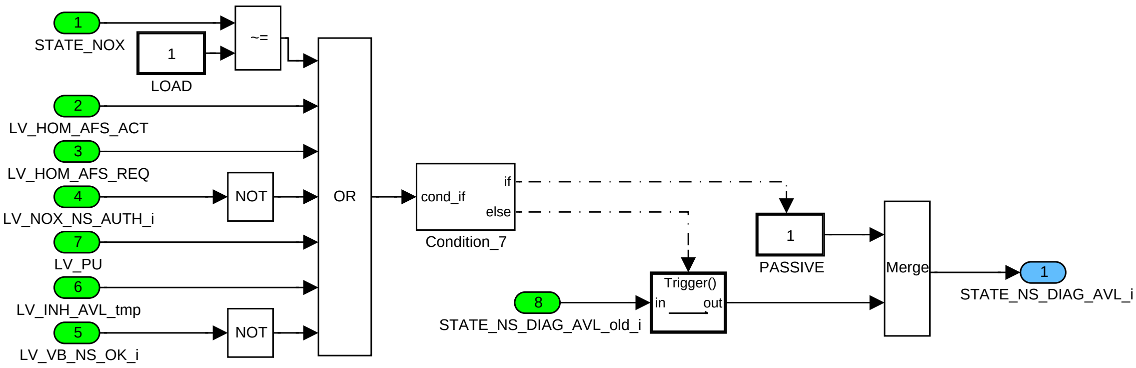

Figure B.121.17: NOXD_MODULB07B/OPM_100MS/FOR_LOOP_NS/CLC/MAIN/s_ACTIVE/CLC3

Error management

LV_ERR_NS_AVL will be get by ACTION_ERRM_GetLvErr and LV_END_DIAG_NS_AVL will be get by ACTION_ERRM_GetLvEndDiag.

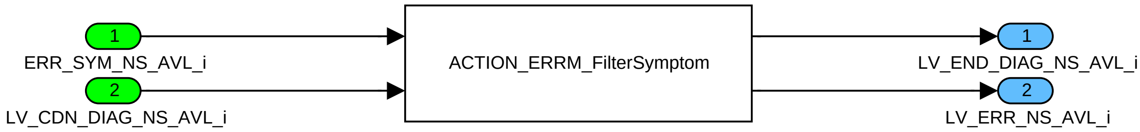

Figure B.121.18: NOXD_MODULB07B/OPM_100MS/FOR_LOOP_NS/CLC/MAIN/ERRM/CLC

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B.122 NOx sensor OBDII diagnosis - Signal gain

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_END_DIAG_NS_GAIN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Diagnostic performed at last one time for NOx signal gain adaptation					
LV_ERR_NS_GAIN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Present failure after filtering of the NOx signal gain adaptation diagnosis					

Input data:

NC_NOX_SENS_CONF {p. 643}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_NOX_NS_AD_AFS_MAX	-	0... FFFFH	0... 127.99804	1.9531e-3	-
NOx signal adaptation factor - maximum value - for requesting Lambda=1.0 operation					
C_FAC_NOX_NS_AD_AFS_MIN	-	0... FFFFH	0... 127.99804	1.9531e-3	-
NOx signal adaptation factor - minimum value - for requesting Lambda=1.0 operation					

FUNCTION DESCRIPTION:

General information:

Stub module for recource optimization

Application conditions

Initialisation:

```
at reset:
  LV_END_DIAG_NS_GAIN[i] = 0
  LV_ERR_NS_GAIN[i] = 0
```

Recurrence:

Activation:

Deactivation:

Formula section:

- –

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B.123 NOx sensor OBDII diagnosis - Signal offset

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_RGN_INH_OFS_DIAG	O/V/S	0... FFH	0... 255	1	-
Counter for regenerations after a too long lean phase before NOx sensor offset diagnosis will be enabled					
ERR_SYM_NS_OFS [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx sensor offset diagnosis					
LV_CDN_DIAG_NS_OFS [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx sensor offset diagnosis					
LV_DIAG_NS_OFS_VLD	V	0... 1H	0 ...1	1	-
Offset diagnosis result is valid if the NOx raw emissions are low enough to store them in the NOx catalyst					
LV_END_DIAG_NS_OFS [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor offset diagnosis					
LV_ERR_NS_OFS [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of NOx sensor offset diagnosis					
LV_SENS_AFR_INH_OFS_DIAG	V	0... 1H	0 ...1	1	-
downstream sensor measures rich exhaust gas on all branches to detect successful regeneration					
NOX_OFS_LOAD_DIAG [NC_NOX_SENS_CONF]	V	FF9C... 5DCH	-100 ...1500	1	ppm
NOx signal minimum for offset diagnosis					
T_AFL_INH_OFS_DIAG	V	0... FFFFH	0... 655.35	0.01	s
elapsed lean time since last successful regeneration					
T_NOX_OFS_DIAG_MIN [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 655.35	0.01	s
Time for active minimum observation for NOx signal offset diagnosis					
TCC_NS_OFS [NC_NOX_SENS_CONF]	O/V	0... FFH	0... 255	1	-
Maximum test cycle counter value; used for detection of end of diagnosis					

Input data:

CTR_NT_AGI_AD_CMPL_SUM {p. 3072}	LV_INH_DIAG_NS_OBD_2_OFS [NC_NOX_SENS_CONF] {p. 6468}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}
LV_NT_HOM_INI {p. 2982}	LV_SENS_AFR [NC_NT_NR] {p. 2983}	NC_IDX_DIAG_NS_OFS [NC_NOX_SENS_CONF]	NC_NOX_SENS_CONF {p. 643}
NC_NT_NR {p. 644}	NOX_COR_RED {p. 2984}	NOX_NS [NC_NOX_SENS_CONF] {p. 992}	NOX_NS_AD [NC_NOX_SENS_CONF] {p. 3193}
NOX_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}	NT_AGI {p. 3073}	NT_AGI_SUL {p. 3073}	NT_AGI_SUL_SNG [NC_NT_NR] {p. 3073}

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NT_SUL {p. 3113}	NT_SUL_32 [NC_NT_NR] {p. 3113}	NTLD {p. 2986}	STATE_NOX {p. 2986}
T_AFL {p. 2987}	T_NOX_NS_MDL [NC_NOX_SENS_CONF] {p. 992}	T_NOX_NS_OSC [NC_NOX_SENS_CONF] {p. 1381}	TNT_MDL_H {p. 8237}
TNT_MDL_L {p. 8237}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_OFS	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor offset diagnosis					
C_ABC_INC_NS_OFS	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor offset diagnosis					
C_ABC_MAX_NS_OFS	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx sensor offset diagnosis					
C_CTR_NT_AGI_AD_CMPL_SUM_MIN	-	0... FFFFH	0... 65535	1	-
Minimum completed sulphur adaptations for set free of NOx signal offset diagnosis					
C_CTR_RGN_INH_OFS_DIAG	-	0... FFH	0... 255	1	-
Number of regenerations after a too long lean phase before NOx sensor offset diagnosis will be enabled					
C_NOX_MAX_NS_DIAG_OFS	-	0... FFFFH	0... 1023.98	0.015625	mg/s
NOx raw emission limit to allow NOx sensor offset diagnosis					
C_NOX_NS_OFS_MAX_THD	-	FF9C... 5DCH	-100 ...1500	1	ppm
NOx signal offset threshold for positive NOx signal values					
C_NOX_NS_OFS_MIN_THD	-	FF9C... 5DCH	-100 ...1500	1	ppm
NOx signal offset threshold for negative NOx signal values					
C_NOX_OFS_DIAG_SEL	-	0H 1H 2H	NOX_NS_AD NOX_NS NOX_NS_DIAG	-	-
Selection of diagnosis signal					
C_NOX_OFS_LOAD_OK_MAX	-	FF9C... 5DCH	-100 ...1500	1	ppm
Positive NOx signal offset threshold for counting the diagnosis result as "ok"					
C_NOX_OFS_LOAD_OK_MIN	-	FF9C... 5DCH	-100 ...1500	1	ppm
Negative NOx signal offset threshold for counting the diagnosis result as "ok"					
C_NT_AGI_NOX_OFS_DIAG_MIN	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Threshold for NOx trap aging factor					
C_NT_AGI_SUL_NOX_OFS_MIN	-	0... FFFFFFFFH	0 ...1	232.83e-12	-
Minimum NOx catalyst aging factor due to sulphur for set free of NOx signal offset diagnosis					
C_NT_SUL_NOX_OFS_MAX	-	0... FFFFH	0... 10485.6	0.16	mg
Maximum NOx catalyst sulphur load for set free of NOx signal offset diagnosis					
C_NTLD_INH_OFS_DIAG	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Maximum NOx trap loading degree to detect too long lean phase					
C_SYM_NS_OFS	-	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx sensor offset diagnosis (see NOx sensor OBDII diag - Appl. Inc.)					

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<table>
<tr><th>Name</th><th>Mode</th><th>Hex. limits</th><th>Phys. limits</th><th>Resol.</th><th>Unit</th></tr>
<tr><td>C_T_AFL_INH_OFS_DIAG</td><td>-</td><td>0... FFFFH</td><td>0... 655.35</td><td>0.01</td><td>s</td></tr>
<tr><td colspan="6">Maximum elapsed lean time since last successful regeneration to detect too long lean phase</td></tr>
<tr><td>C_T_AFL_NOX_OFS_DIAG_MIN</td><td>-</td><td>0... FFFFH</td><td>0... 1310.7</td><td>0.02</td><td>s</td></tr>
<tr><td colspan="6">Threshold for lean mixture cycle time</td></tr>
<tr><td>C_T_AFL_NOX_OFS_NEG_MIN</td><td>-</td><td>0... FFFFH</td><td>0... 1310.7</td><td>0.02</td><td>s</td></tr>
<tr><td colspan="6">Minimum lean engine operation time for evaluation of negative NOx signal offset threshold</td></tr>
<tr><td>C_T_AFL_NOX_OFS_OK_MIN</td><td>-</td><td>0... FFFFH</td><td>0... 1310.7</td><td>0.02</td><td>s</td></tr>
<tr><td colspan="6">Minimum lean engine operation time for counting the diagnosis result as "ok"</td></tr>
<tr><td>C_T_NOX_NS_DIAG_OFS</td><td>-</td><td>0... FFFFH</td><td>0... 655.35</td><td>0.01</td><td>s</td></tr>
<tr><td colspan="6">Threshold for timer T_NOX_NS_MDL to activate minimum aquisition</td></tr>
<tr><td>C_T_NOX_NS_OSC_OFS_DIAG</td><td>-</td><td>0... FFFFH</td><td>0... 655.35</td><td>0.01</td><td>s</td></tr>
<tr><td colspan="6">Waiting time after last detection of an oscillation of NOx signal for offset diagnosis</td></tr>
<tr><td>C_T_NOX_OFS_DIAG_MIN</td><td>-</td><td>0... FFFFH</td><td>0... 655.35</td><td>0.01</td><td>s</td></tr>
<tr><td colspan="6">Minimum time for active minimum observation for NOx signal offset diagnosis</td></tr>
<tr><td>C_TCC_NS_OFS_MAX</td><td>-</td><td>0... FFH</td><td>0... 255</td><td>1</td><td>-</td></tr>
<tr><td colspan="6">Maximum test cycle counter value; used for detection of end of diagnosis</td></tr>
<tr><td>C_TNT_MDL_NOX_OFS_DIAG_MAX</td><td>-</td><td>0... FFFFH</td><td>0... 1023.98</td><td>0.015625</td><td>°C</td></tr>
<tr><td colspan="6">Maximum threshold for modelled NOx catalyst monolith temperatures</td></tr>
<tr><td>C_TNT_MDL_NOX_OFS_DIAG_MIN</td><td>-</td><td>0... FFFFH</td><td>0... 1023.98</td><td>0.015625</td><td>°C</td></tr>
<tr><td colspan="6">Minimum threshold for modelled NOx catalyst monolith temperatures</td></tr>
<tr><td>LC_CTR_RGN_INH_OFS_DIAG_RST</td><td>-</td><td>0... 1H</td><td>0 ...1</td><td>1</td><td>-</td></tr>
<tr><td colspan="6">counter of valid regenerations will be reset at initialization</td></tr>
<tr><td>LC_NT_HOM_INI_DIAG_SEL</td><td>-</td><td>0... 1H</td><td>0 ...1</td><td>1</td><td>-</td></tr>
<tr><td colspan="6">manual flag: NOx trap initialised due to sufficient hom. stoic. operation (accumulation effects eliminated)</td></tr>
</table>

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

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General information

This diagnosis checks the NOx signal behaviour after the start of a NOx catalyst LOAD phase. The use of NOx signal for generation of a NOx catalyst regeneration request is blocked for a limited time after the start of a NOx catalyst LOAD phase. This is necessary because of NH3 cross sensitivity of sensor. This cross sensitivity pushes up the NOx signal up to the upper limit at the end of a NOx catalyst regeneration. Hence the sensor needs a recovery time after the start of next NOx catalyst LOAD phase. During this recovery time the NOx signal must go to a level which is lower than the threshold for start of a new regeneration. Otherwise it is a sensor failure present.

Application Condition

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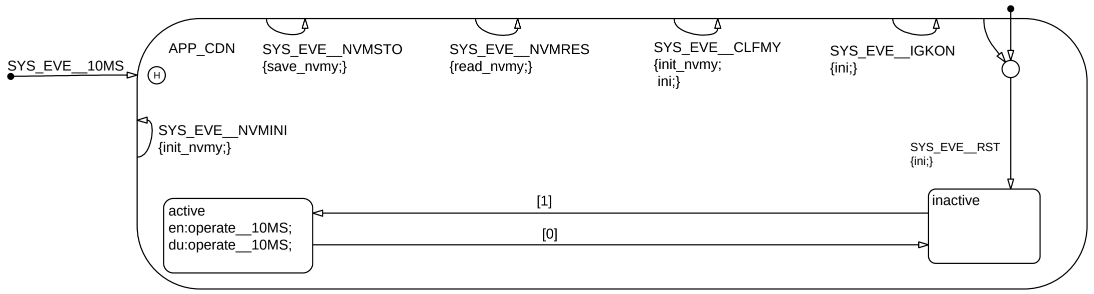

Figure B.123.1: NOXD_MODULB07D/APP_CDN/Chart

Function Description

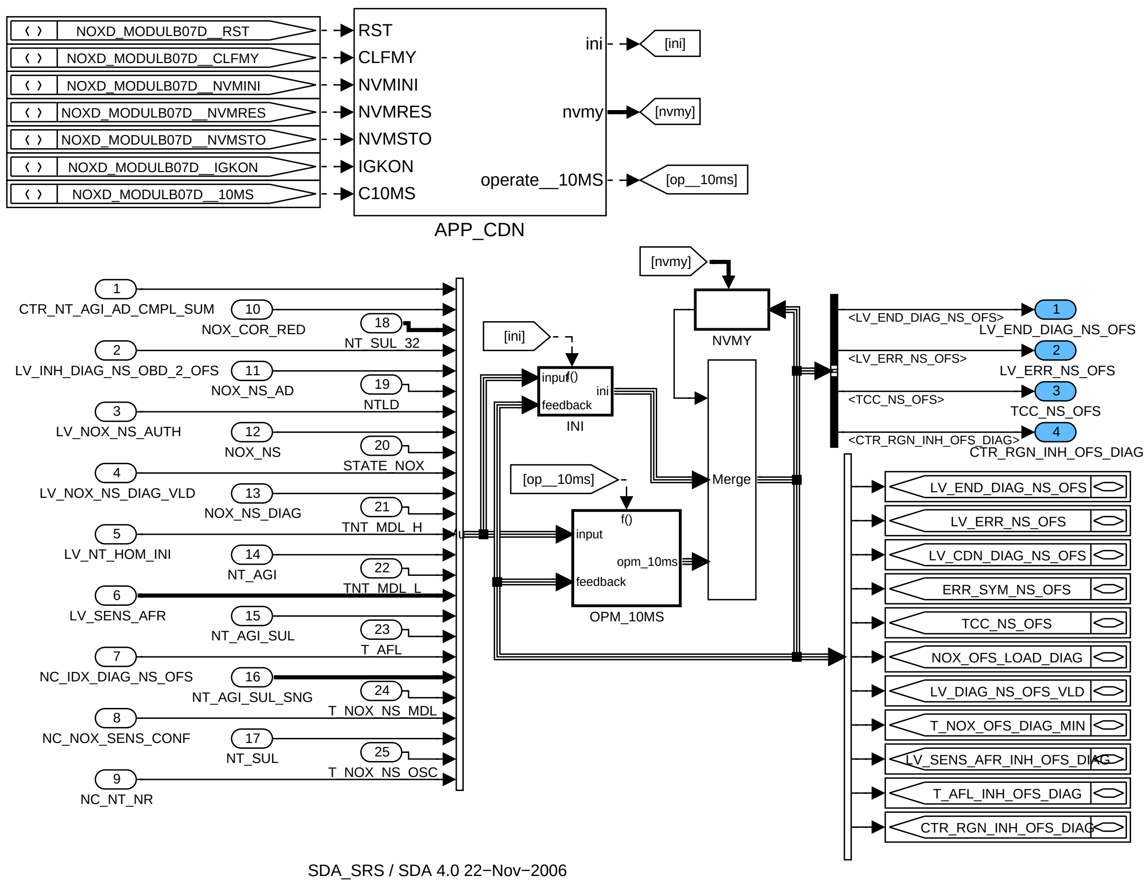

Figure B.123.2: NOXD_MODULB07D

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B.123.1 Management of non-volatile memory

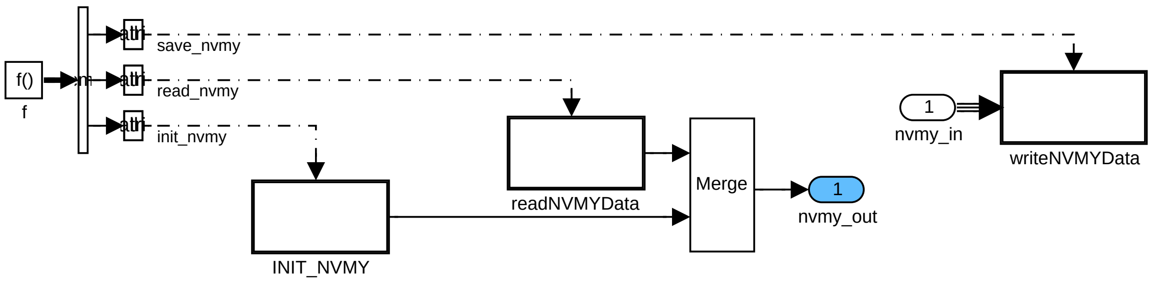

Figure B.123.3: NOXD_MODULB07D/NVMY

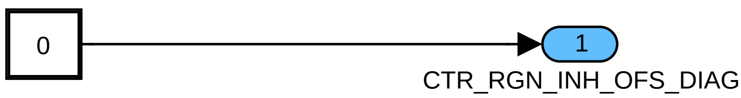

Figure B.123.4: NOXD_MODULB07D/NVMY/INIT_NVMY/CLC

B.123.2 Initialization

These actions initialized the diagnostic data according filtering configuration :
ACTION_ERRM_GetLvErr(IN<NC_IDX_DIAG_XX>, OUT< LV_ERR_XX >)
ACTION_ERRM_GetLvEndDiag(IN<NC_IDX_DIAG_XX>, OUT< LV_END_DIAG_XX >)

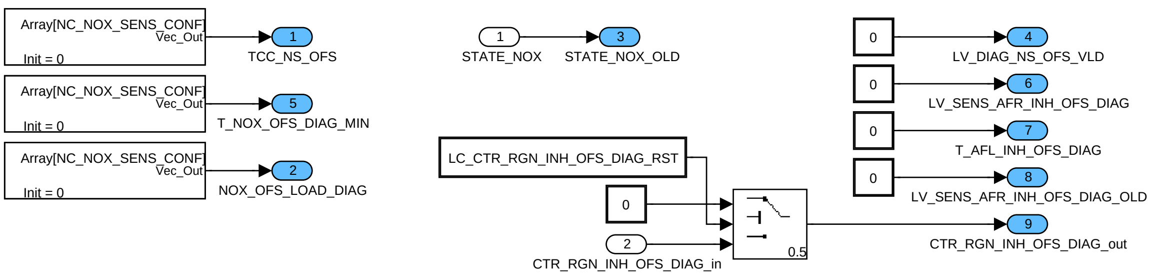

Figure B.123.5: NOXD_MODULB07D/INI/CLC

B.123.3 Loop control

The calculation inside FOR_LOOP_NS have to be done for each NOx sensor, controlled by configuration data NC_NOX_SENS_CONF.
If NC_NOX_SENS_CONF = 1, then calculation for i = 1.
If NC_NOX_SENS_CONF = 2, then calculation for i = 1 and 2.
The calculation inside NO_LOOP have to be done only once.

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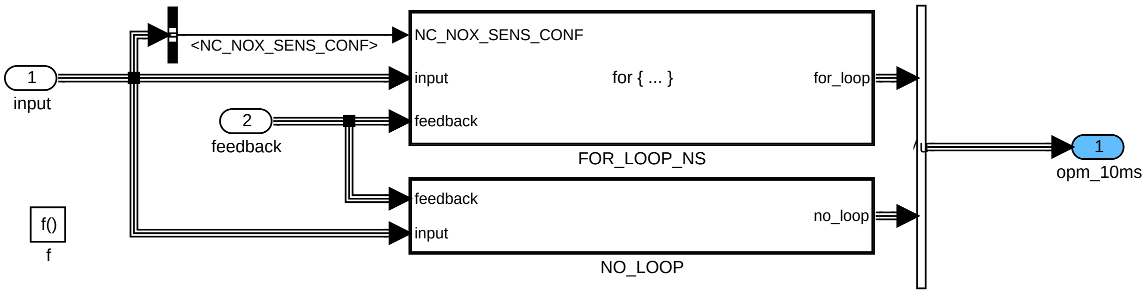

Figure B.123.6: NOXD_MODULB07D/OPM_10MS

Calculation for each NOx sensor

Minimum search

The minimum of the selected NOx signal during the load phase will be calculated.

NOX_NS_AD:
The signal NOX_NS_AD_i is a 'strong' filtered and offset adapted NOx signal. The lower limit of NOX_NS_AD_i value range is 0 ppm. Hence this selection does not allow to diagnose a negative NOx signal offset.

NOX_NS:
The signal NOX_NS_i is a 'strong' filtered NOx signal. This selection allows to diagnose a negative NOx signal offset.

NOX_NS_DIAG:
The signal NOX_NS_DIAG_i is a 'light' filtered NOx signal. This selection allows to diagnose a negative NOx signal offset.

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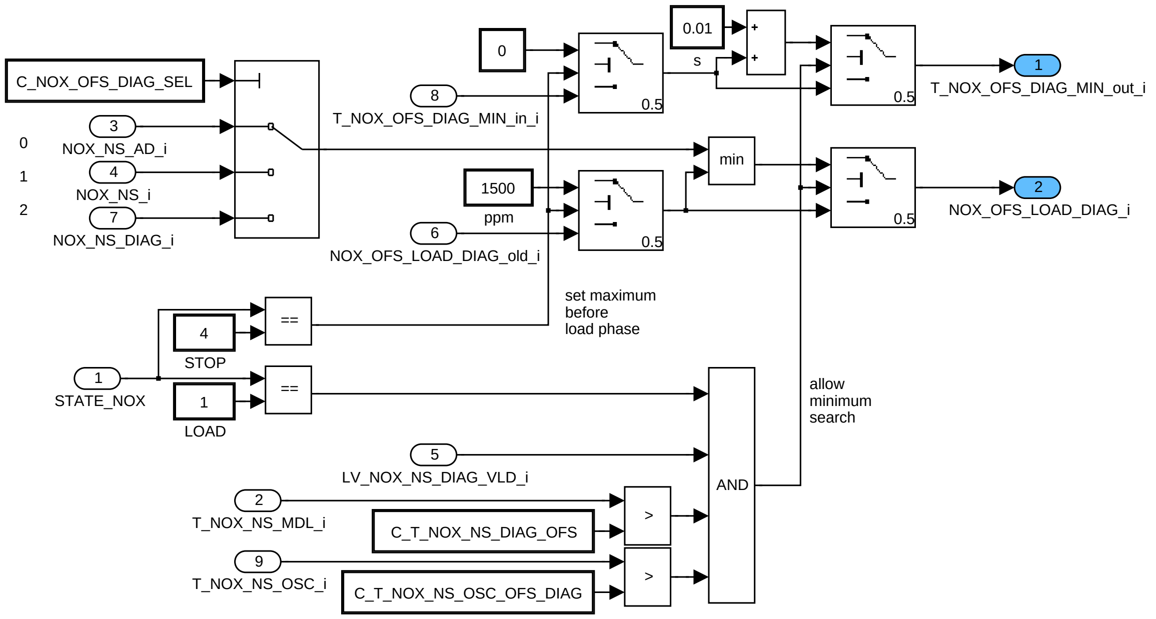

Figure B.123.7: NOXD_MODULB07D/OPM_10MS/FOR_LOOP_NS/CLC1

Condition for evaluation of the diagnosis result

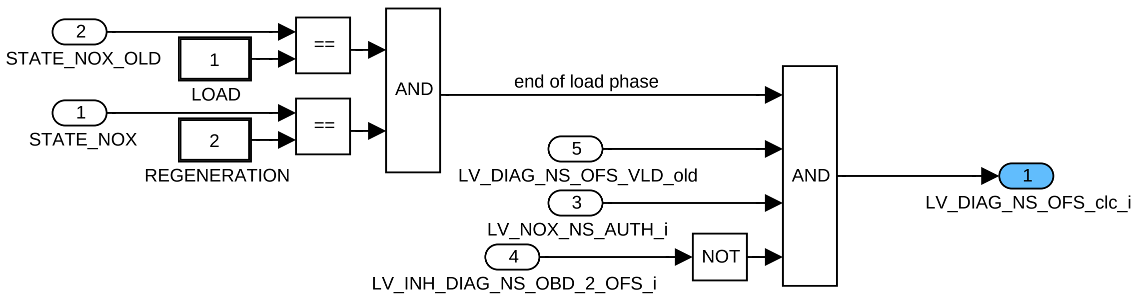

Figure B.123.8: NOXD_MODULB07D/OPM_10MS/FOR_LOOP_NS/CLC2

Minimum validation

At the end of the load phase the minimum of the NOx signal will be evaluated to get the result if the sensor is OK.

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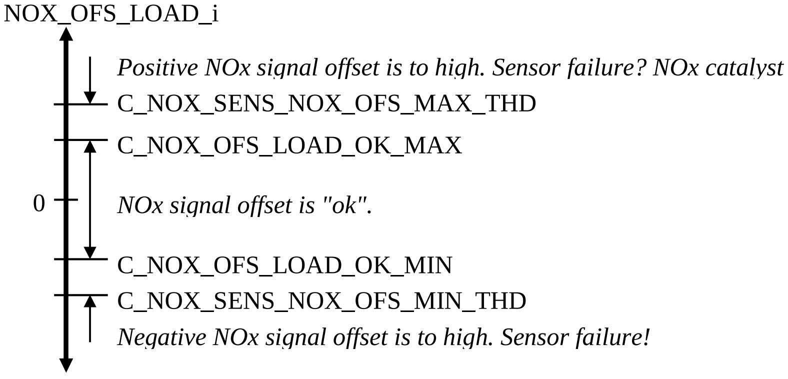

Application hint: The constant C_NOX_NS_OFS_MIN_THD shall be set to a negative value. So it is possible to detect a high negative NOx signal offset.

Application hint: The constant C_SYM_NS_OFS has to be set to the symptom as described in NOx sensor OBDII (Appl. Inc.).

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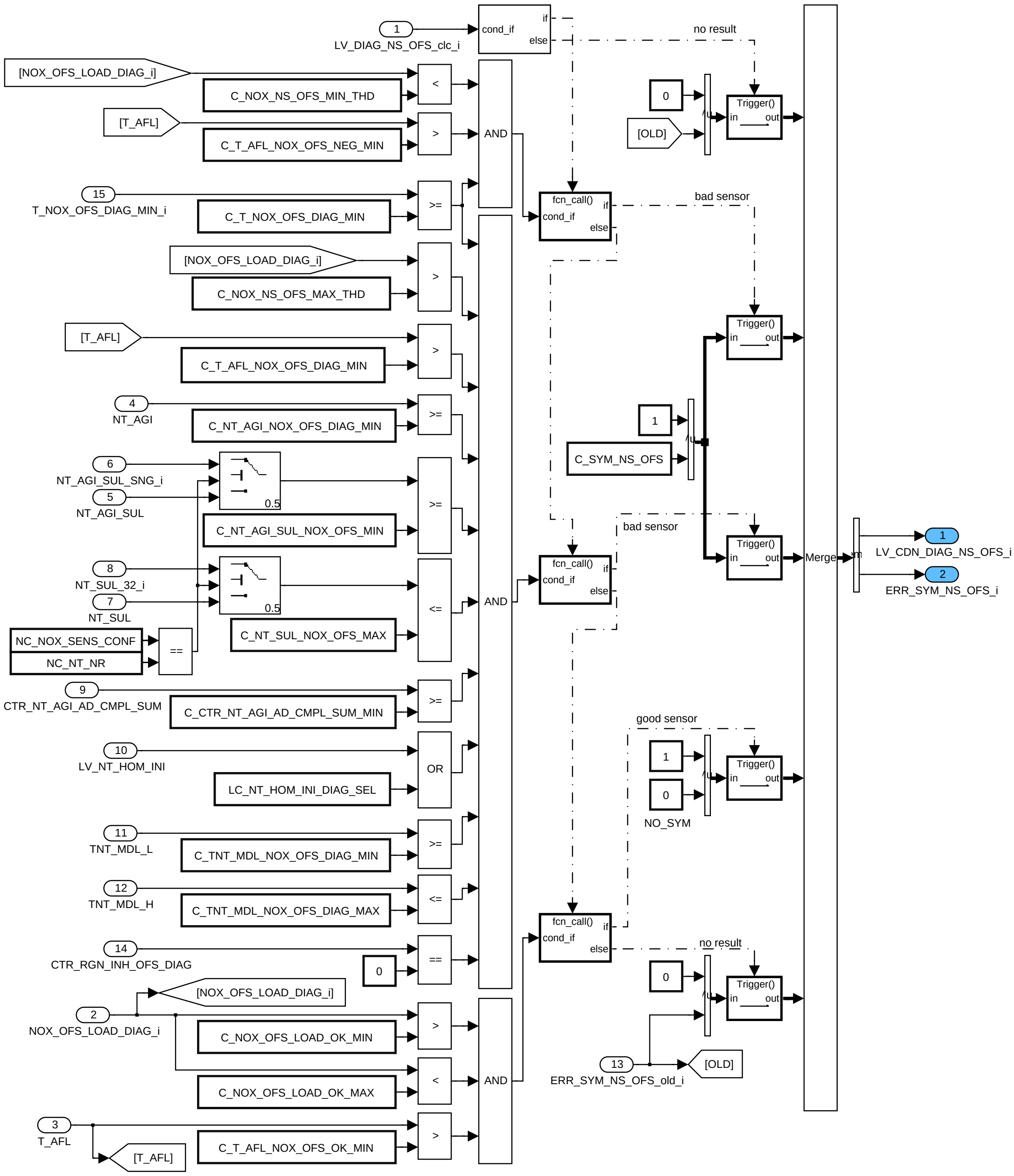

Figure B.123.9: NOXD_MODULB07D/OPM_10MS/FOR_LOOP_NS/CLC3

Test cycle counter

The test cycle counter TCC_NS_OFS_i counts the number of completed offset diagnoses. This information is needed for detection of diagnosis readiness and decrementation of counter for consecutive driving cycles with or without a NOx sensor failure.

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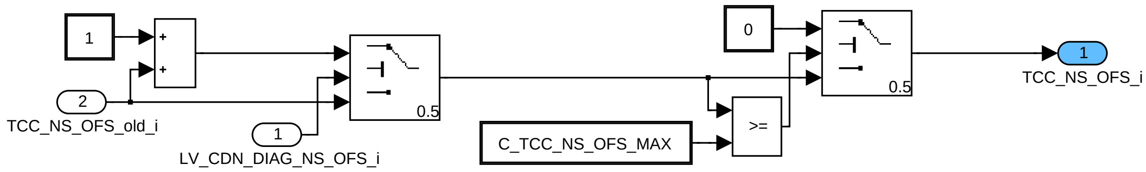

Figure B.123.10: NOXD_MODULB07D/OPM_10MS/FOR_LOOP_NS/CLC4

Error management

LV_ERR_NS_OFS will be get by ACTION_ERRM_GetLvErr and LV_END_DIAG_NS_OFS will be get by ACTION_ERRM_GetLvEndDiag.

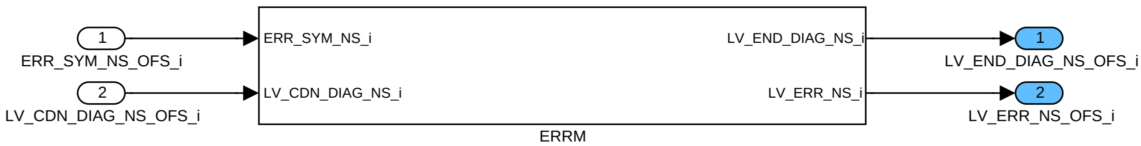

Figure B.123.11: NOXD_MODULB07D/OPM_10MS/FOR_LOOP_NS/CLC5

Bank independent calculation

Observation of valid LOAD-REGERNERATION cycle

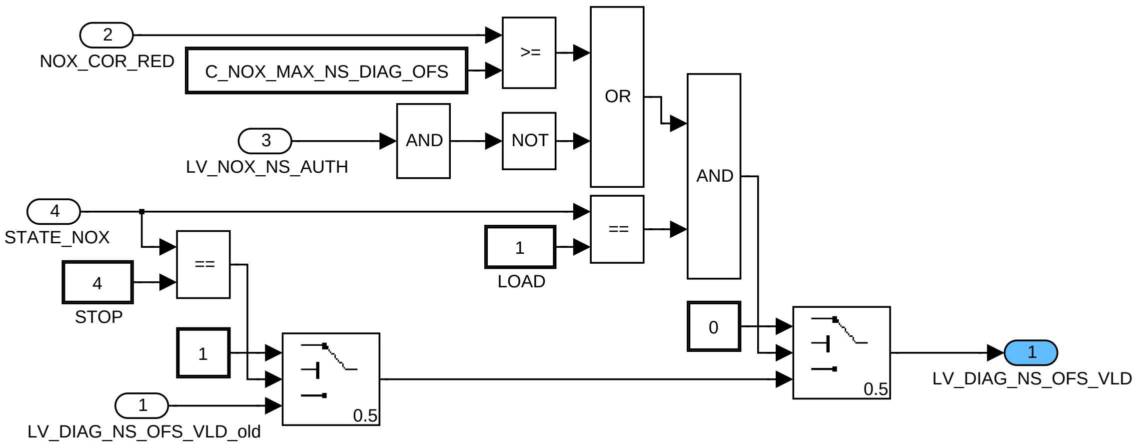

Figure B.123.12: NOXD_MODULB07D/OPM_10MS/NO_LOOP/CLC1

Detection of valid regeneration of all NOx traps

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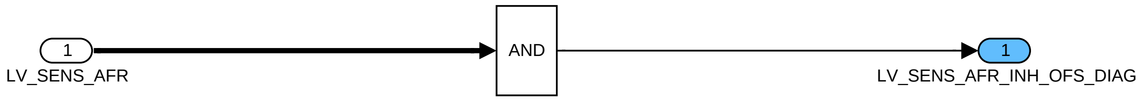

Figure B.123.13: NOXD_MODULB07D/OPM_10MS/NO_LOOP/CLC2

Lean time between two valid regenerations

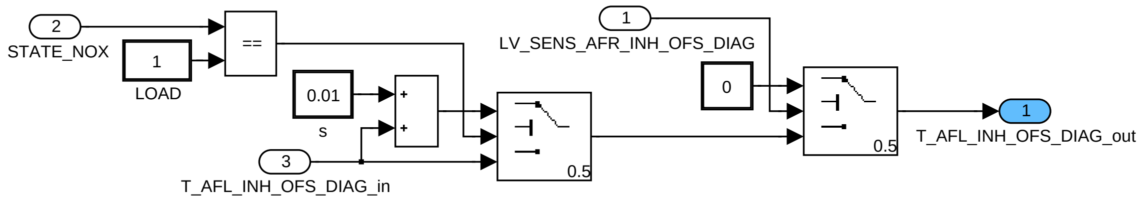

Figure B.123.14: NOXD_MODULB07D/OPM_10MS/NO_LOOP/CLC3

Counter of valid regenerations after a too long lean phase

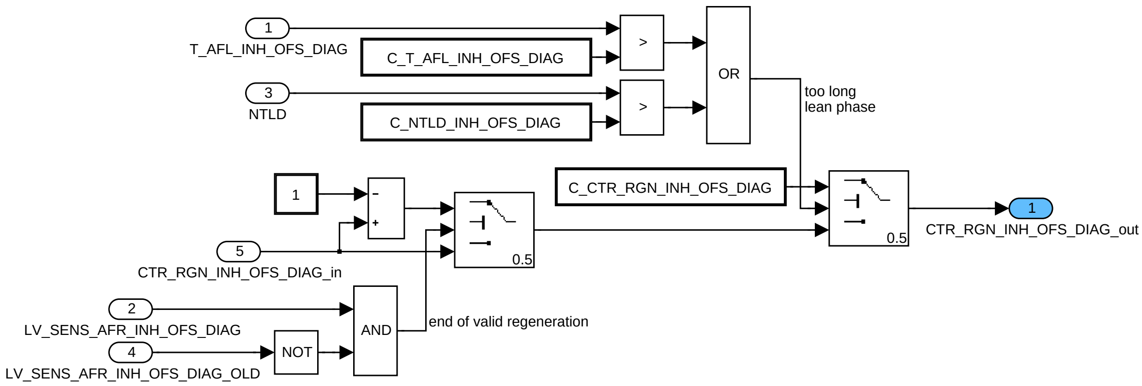

Figure B.123.15: NOXD_MODULB07D/OPM_10MS/NO_LOOP/CLC4

Old values for edge detection

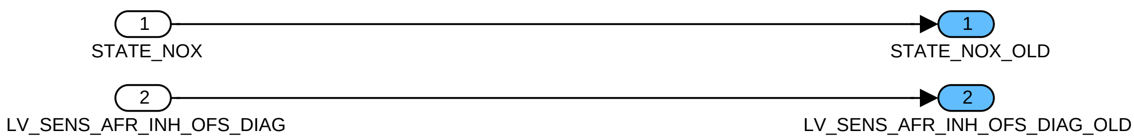

Figure B.123.16: NOXD_MODULB07D/OPM_10MS/NO_LOOP/CLC5

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B.124 NOx sensor OBDII diagnosis - Signal plausibility at rich conditions

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NS_AFR [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx sensor plausibility diagnosis at rich condition					
LV_CDN_DIAG_NS_AFR [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx sensor plausibility diagnosis at rich condition					
LV_END_DIAG_NS_AFR [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor plausibility diagnosis at rich condition					
LV_ERR_NS_AFR [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of NOx sensor rich diagnosis					
LV_FAC_RANGE_AFR_SNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Signal FAC_LSL_GAIN_AD is inside the desired range for diagnosis at rich condtion					
LV_LAMB_VLD_AFR_SNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Lambda signal is valid for diagnosis at rich condition (bench selective)					
LV_MAF_AFR_DIAG_VLD	V	0... 1H	0 ...1	1	-
Mass air flow higher than threshold to allow diagnosis					
MAF_INT_AFR_DIAG [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 7281.67	0.11111111	g
Sucked air mass after leaving rich condition					
TCC_NS_AFR_DIAG [NC_NOX_SENS_CONF]	V	0... FFH	0... 255	1	-
Test cycle counter for plausibility checks at actual rich phase					

Input data:

FAC_LSL_GAIN_AD [NC_CBK_EX_NR] {p. 2371}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_NS_DIAG [NC_NOX_SENS_CONF] {p. 991}	LV_INH_DIAG_NS_OBD_2_PLAUS [NC_NOX_SENS_CONF] {p. 6468}
LV_LAMB_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_VLS_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}
MAF_KGH {p. 1195}	NC_CBK_EX_NR {p. 1829}	NC_IDX_DIAG_NS_AFR [NC_NOX_SENS_CONF]	NC_NOX_SENS_CONF {p. 643}
NOX_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}	T_LAMB_NS_HLD [NC_NOX_SENS_CONF] {p. 992}	T_NOX_NS_HLD [NC_NOX_SENS_CONF] {p. 992}	T_VLS_NS_HLD [NC_NOX_SENS_CONF] {p. 992}

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VLS_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_AFR	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor plausibility diagnosis at rich condition					
C_ABC_INC_NS_AFR	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor plausibility diagnosis at rich condition					
C_ABC_MAX_NS_AFR	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx sensor plausibility diagnosis at rich condition					
C_FAC_LSL_GAIN_AD_AFR_MAX	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
Maximum WRAF sensor gain adaptation factor for activation of plausibility check at rich condition					
C_FAC_LSL_GAIN_AD_AFR_MIN	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
Minimum WRAF sensor gain adaptation factor for activation of plausibility check at rich condition					
C_LAMB_AFR_PLAUS_MAX	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Maximum upstream Lambda value to start the NOx sensor rich check					
C_LAMB_NS_DIAG_AFR_MAX	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Maximum lambda value of NOx sensor at rich condition					
C_MAF_INT_AFR_DIAG_MIN	-	0... FFFFH	0... 7281.67	0.11111111	g
MAF threshold for starting the rich diagnosis					
C_MAF_KGH_AFR_DIAG_MIN	-	0... FFFFH	0... 2047.97	0.03125	kg/h
Threshold of mass air flow to allow NOx sensor diagnosis at rich conditions					
C_NOX_NS_DIAG_AFR_MIN	-	FF9C... 5DCH	-100 ...1500	1	ppm
Minimum NOx concentration signal value of NOx sensor at rich condition					
C_T_LAMB_NS_HLD_DIAG_AFR	-	0... 7FFFH	0... 327.67	0.01	s
Time with lambda signal state = invalid, after which a plausibility diagnosis at rich condition is started					
C_T_NOX_NS_HLD_DIAG_AFR	-	0... 7FFFH	0... 327.67	0.01	s
Time with NOx signal state = invalid, after which a plausibility diagnosis at rich condition is started					
C_T_VLS_NS_HLD_DIAG_AFR	-	0... 7FFFH	0... 327.67	0.01	s
Time with binary O2 signal state = invalid, after which a plausibility diagnosis at rich condition is started					
C_TCC_NS_AFR_DIAG_MAX	-	0... FFH	0... 255	1	-
Maximum number of test cycles per rich phase					
C_VLS_NS_DIAG_AFR_MIN	-	0... 578H	-200 ...1200	1	mV
Minimum binary O2 signal voltage of NOx sensor at rich condition					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_FAC_MAF_INT_AFR	-	0... FFFFH	0... 1.02398437	15.625e-6	s
normalization factor for calculation of integral of MAF_KGH					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

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General information

This plausibility test checks the sensor signals at rich exhaust gas. With this check shall be detected a sensor poisoning.

Application Condition

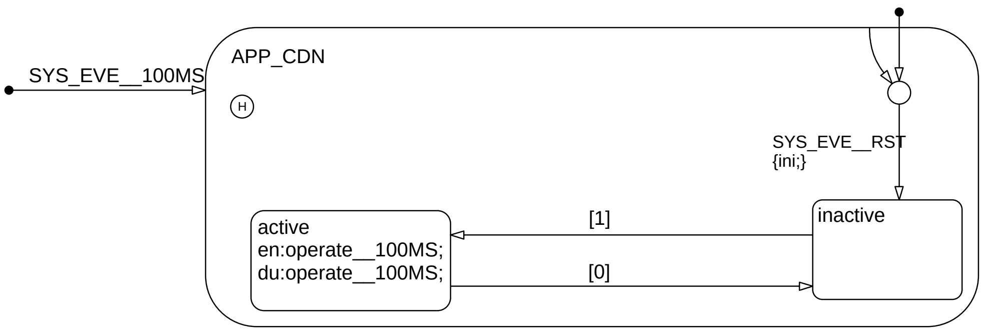

Figure B.124.1: NOXD_MODULB07Z/APP_CDN/Chart

Function Description

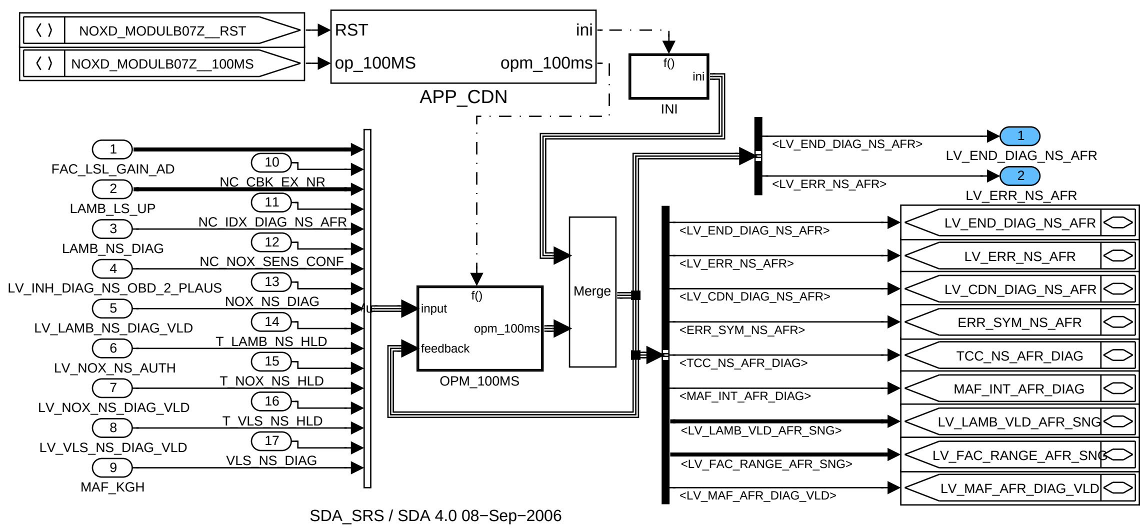

Figure B.124.2: NOXD_MODULB07Z

B.124.1 Initialization at reset and deactivation

These actions initialized the diagnostic data according filtering configuration :
ACTION_ERRM_GetLvErr(IN<NC_IDX_DIAG_XX>, OUT< LV_ERR_XX >)
ACTION_ERRM_GetLvEndDiag(IN<NC_IDX_DIAG_XX>, OUT< LV_END_DIAG_XX >)

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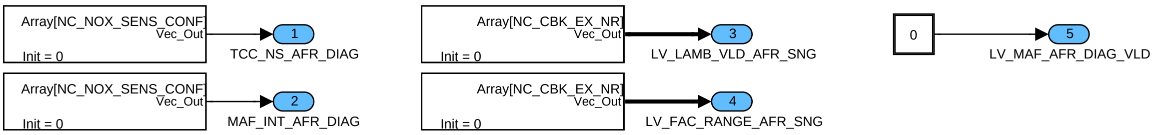

Figure B.124.3: NOXD_MODULB07Z/INI/CLC

B.124.2 Loop control

The calculation inside FOR_LOOP_LS have to be done for each upstream lambda sensor, controlled by configuration data NC_CBK_EX_NR.
If NC_CBK_EX_NR = 1, then calculation for i = 1.
If NC_CBK_EX_NR = 2, then calculation for i = 1 and 2.

The calculation inside both NO_LOOP subsystems have to be done only once.

The calculation inside FOR_LOOP_NS have to be done for each NOx sensor, controlled by configuration data NC_NOX_SENS_CONF.
If NC_NOX_SENS_CONF = 1, then calculation for i = 1.
If NC_NOX_SENS_CONF = 2, then calculation for i = 1 and 2.

NC_NOX_SENS_CONF cannot be greater than NC_CBK_EX_NR.

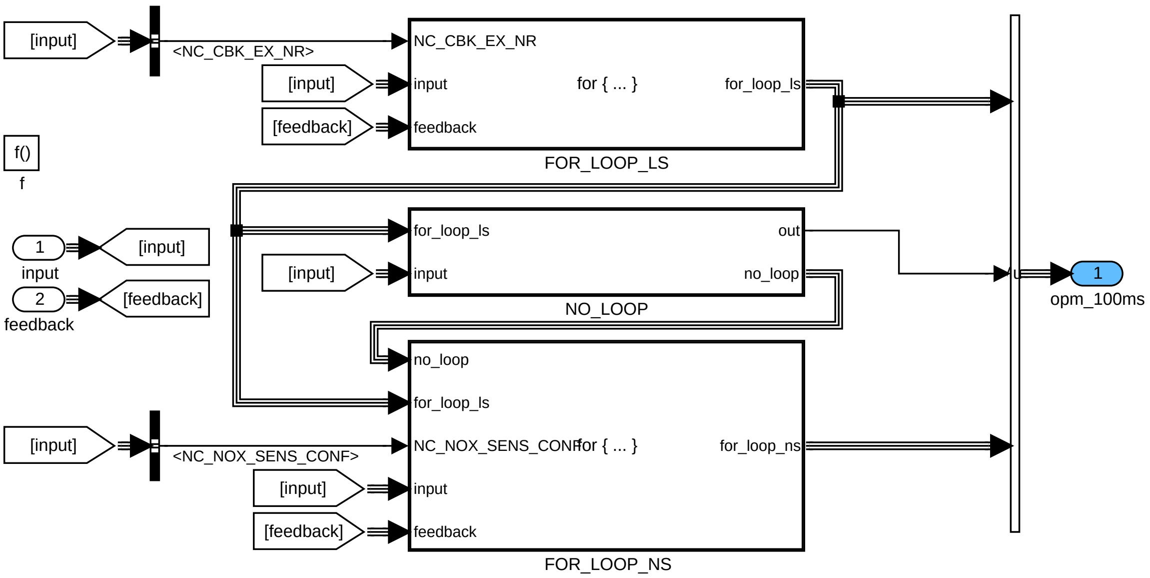

Figure B.124.4: NOXD_MODULB07Z/OPM_100MS

Calculation for each upstream lambda sensor

Lambda sensor rich check

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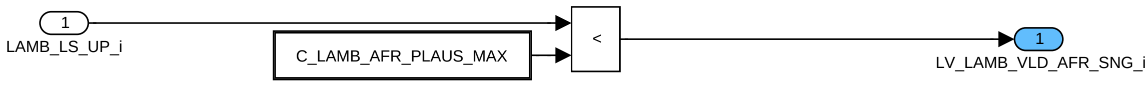

Figure B.124.5: NOXD_MODULB07Z/OPM_100MS/FOR_LOOP_LS/CLC1

Lambda controller gain adaptation

The lambda controller gain adaptation have to be in a desired range to avoid a wrong diagnosis result for the NOx sensor.

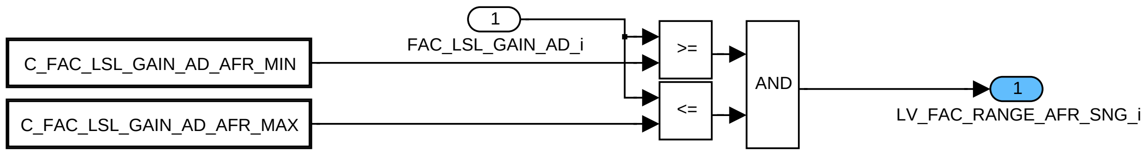

Figure B.124.6: NOXD_MODULB07Z/OPM_100MS/FOR_LOOP_LS/CLC2

Bank independent calculation

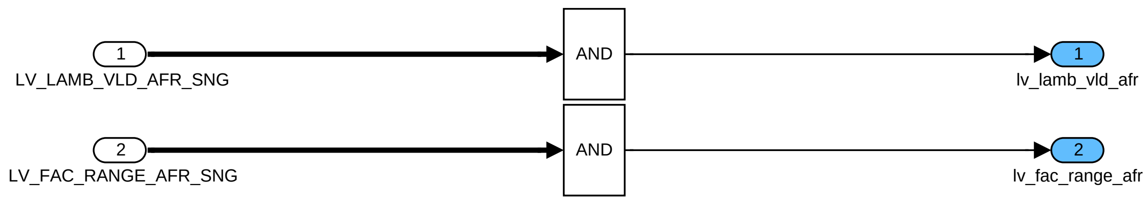

Figure B.124.7: NOXD_MODULB07Z/OPM_100MS/NO_LOOP/CLC1

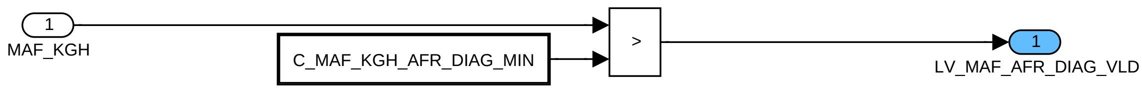

Figure B.124.8: NOXD_MODULB07Z/OPM_100MS/NO_LOOP/CLC2

Calculation for each NOx sensor

MAF integral and plausibility check counter

At every rich phase the number of plausibility checks will be counted with this counter and limited with C_MAF_INT_AFR_DIAG_MIN.
The MAF integral will start if the upstream lambda becomes higher than the rich threshould due to identify, when the rich exhaust gas should be arrived at the NOx sensor.

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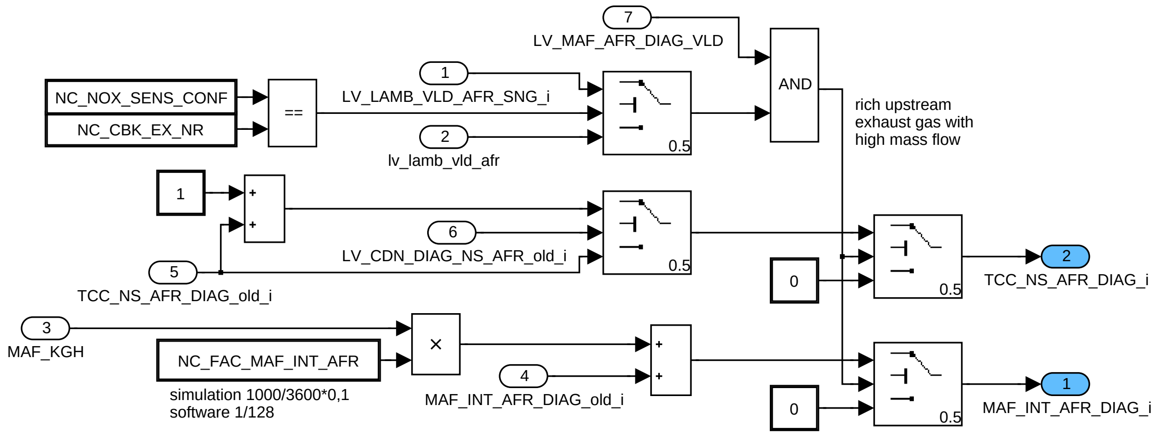

Figure B.124.9: NOXD_MODULB07Z/OPM_100MS/FOR_LOOP_NS/CLC1

Diagnosis evaluation

The NOx sensor may only be identified as defect if the lambda control adaptation is inside the desired range. Outside this range the sensor may only be identified as OK.

The check of the NOx threshould C_NOX_NS_DIAG_AFR_MIN uses the NOx sensor cross sensitivity on NH3, which is originate in the catalyst at rich exhaust gas conditions.

Application hint: The constant C_MAF_INT_AFR_DIAG_MIN shall be calibrated so that this diagnosis is not activated during a NOx catalyst regeneration.

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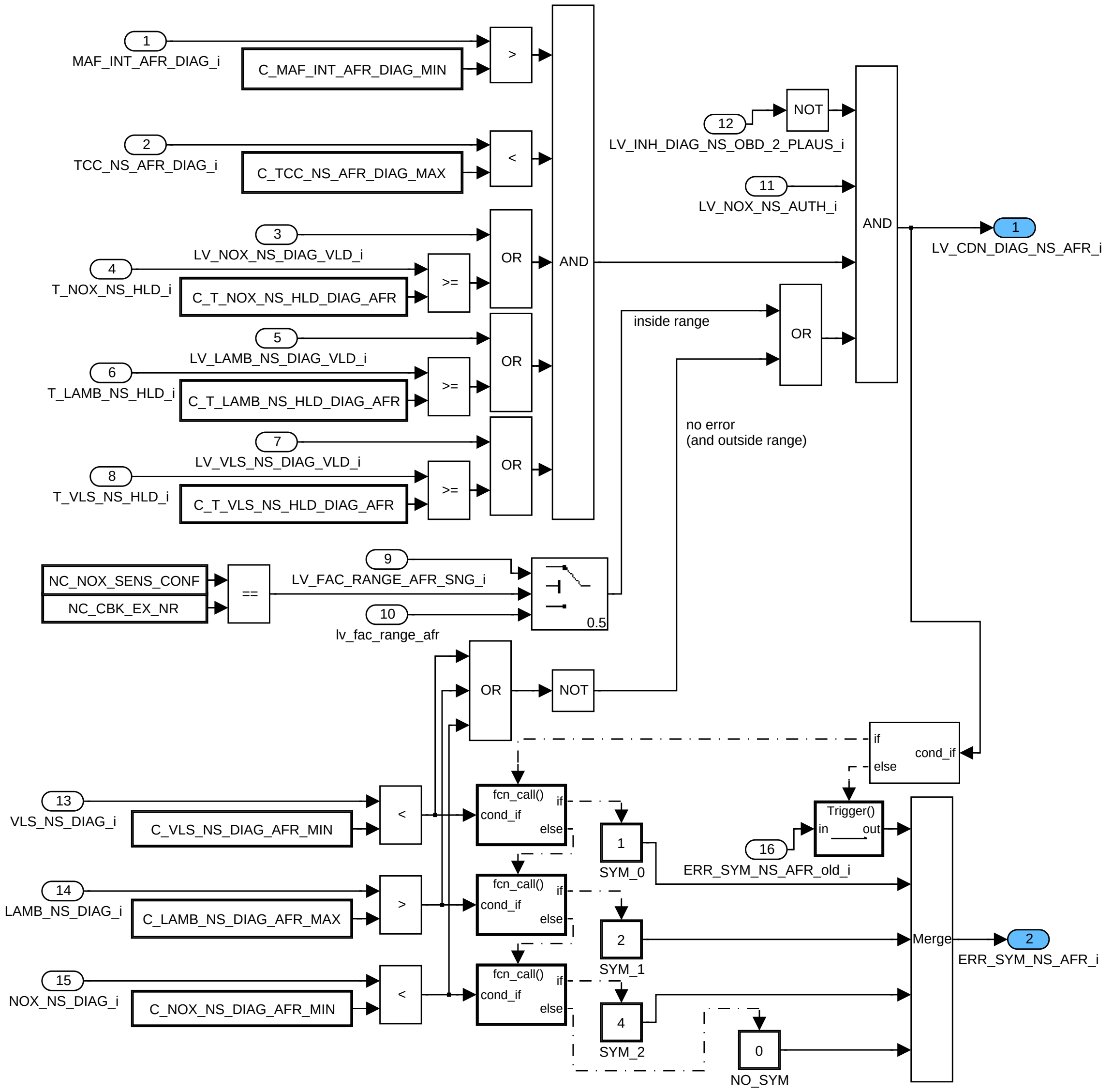

Figure B.124.10: NOXD_MODULB07Z/OPM_100MS/FOR_LOOP_NS/CLC2

Error management

LV_ERR_NS_AFR will be get by ACTION_ERRM_GetLvErr and LV_END_DIAG_NS_AFR will be get by ACTION_ERRM_GetLvEndDiag.

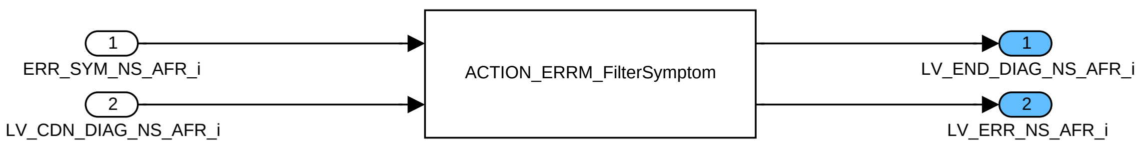

Figure B.124.11: NOXD_MODULB07Z/OPM_100MS/FOR_LOOP_NS/CLC3

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B.125 NOx sensor OBDII diagnosis - Signal plausibility up/down

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the plausibility diagnosis between upstream and downstream WRAF signal					
LV_CDN_DIAG_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of plausibility diagnosis between upstream and downstream WRAF signal					
LV_END_DIAG_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor plausibility diagnosis between upstream and downstream WRAF signal					
LV_ERR_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of plausibility diagnosis between upstream and downstream WRAF signal					
LV_FAC_RANGE_SNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Signal FAC_LSL_GAIN_AD is inside the desired range for diagnosis					
LV_LAMB_NOT_PLAUS_SNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Lambda signals are not plausible					
LV_LAMB_RANGE_SNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Lambda signals are inside the desired range for diagnosis					
LV_LAMB_VLD_TMP	V	0... 1H	0 ...1	1	-
Bank independent values are valid for diagnosis					
MAF_INT_LAMB_LS_UP [NC_CBK_EX_NR]	V	0... FFFFH	0... 1820.42	0.02777778	g
Integral of air mass flow for plausibility diagnosis between upstream and downstream WRAF signal					
TCC_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF]	V	0... FFH	0... 255	1	-
Test cycle counter for plausibility check of WRAF signals					

Input data:

FAC_LSL_GAIN_AD [NC_CBK_EX_NR] {p. 2371}	LAMB_DELTA_I_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_NS_DIAG [NC_NOX_SENS_CONF] {p. 991}
LV_INH_DIAG_NS_OBD_2_PLAUS [NC_NOX_SENS_CONF] {p. 6468}	LV_LAMB_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_NS_LDC [NC_NOX_SENS_CONF] {p. 6320}
LV_PU {p. 1720}	LV_ST_END {p. 1720}	MAF {p. 8277}	MAF_KGH {p. 1195}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_IDX_DIAG_NS_LSL_UP_DOWN [NC_NOX_SENS_CONF]	NC_NOX_SENS_CONF {p. 643}

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STATE_CMB_CTL {p. 8137}	T_LAMB_NS_HLD [NC_NOX_SENS_CONF] {p. 992}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_LSL_UP_DOWN	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor plausibility diagnosis between WRAF signals					
C_ABC_INC_NS_LSL_UP_DOWN	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor plausibility diagnosis between WRAF signals					
C_ABC_MAX_NS_LSL_UP_DOWN	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx sensor plausibility diagnosis between WRAF signals					
C_FAC_LSL_GAIN_AD_MAX	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
Maximum WRAF sensor gain adaptation factor for activation of plausibility check					
C_FAC_LSL_GAIN_AD_MIN	-	0... FFFFH	0... 1.99996948	30.5175e-6	-
Minimum WRAF sensor gain adaptation factor for activation of plausibility check					
C_LAMB_DIF_MAX_LSL_UP_DOWN	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Activation threshould for lambda difference between both banks					
C_LAMB_PLAUS_LSL_UP_DOWN_MAX	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Maximum lambda threshold for deactivation of plausibility check					
C_LAMB_PLAUS_LSL_UP_DOWN_MIN	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Minimum lambda threshold for deactivation of plausibility check					
C_MAF_INT_LAMB_PLAUS	-	0... FFFFH	0... 1820.42	0.02777778	g
MAF threshold for starting the Lambda plausibility diagnosis of NOx-Sensor					
C_T_LAMB_NS_HLD_DIAG_PLAUS	-	0... 7FFFH	0... 327.67	0.01	s
Time with lambda signal state = invalid, after which a plausability diagnosis is started					
C_TCC_NS_LSL_UP_DOWN_MAX	-	0... FFH	0... 255	1	-
Maximum number of test cycles per steady state phase					
IP_LAMB_LS_UP_PLAUS_GRD_MAX	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
LDP_LAMB_LS_UP_IP_LAMB_GRD	4	0... 7FFFH	0... 31.9990234	976.563e-6	-
Maximum allowed gradient of LAMB_LS_UP to calculate the MAF integral					
IP_LAMB_PLAUS_LSL_UP_DOWN	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
LDP_LAMB_LS_UP_IP_LAMB_UP_DOWN	4	0... 7FFFH	0... 31.9990234	976.563e-6	-
Signal tolerance between upstream and downstream WRAF signal					
IP_MAF_MIN_LAMB_LS_UP_PLAUS	-	0... FFFFH	0... 1389	0.02119478	mg/stk
LDP_N_32_IP_MAF_MIN_LAMB_PLAUS	6	0... FFH	0... 8160	32	rpm
Minimum MAF threshold for activation of upstream and downstream WRAF signal plausibility check					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_FAC_MAF_INT_PLAUS	-	0... FFFFH	0... 1.02398437	15.625e-6	s
normalization factor for calculation of integral of MAF_KGH					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
Continued on next page

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ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

General information

This signal plausibility check compares the upstream oxygen signal (WRAF sensor) with the WRAF signal of NOx-Sensor, which is downstream of NOx catalyst. The result of this check can indicate a strong discrepancy between the two sensors, which can be caused by reference air contamination.

Application Condition

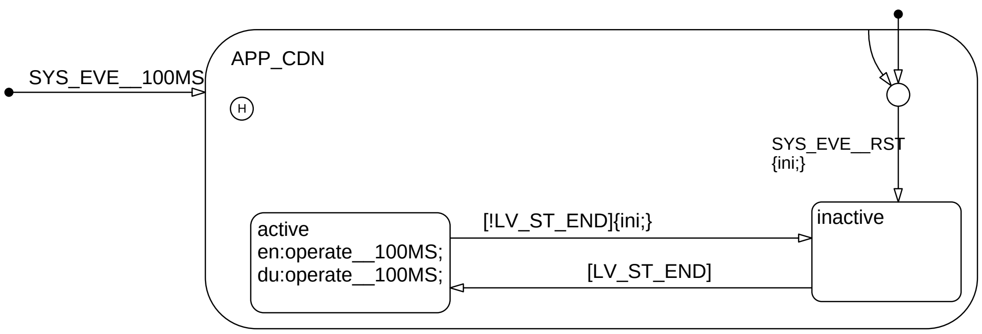

Figure B.125.1: NOXD_MODULB07X/APP_CDN/Chart

Function Description

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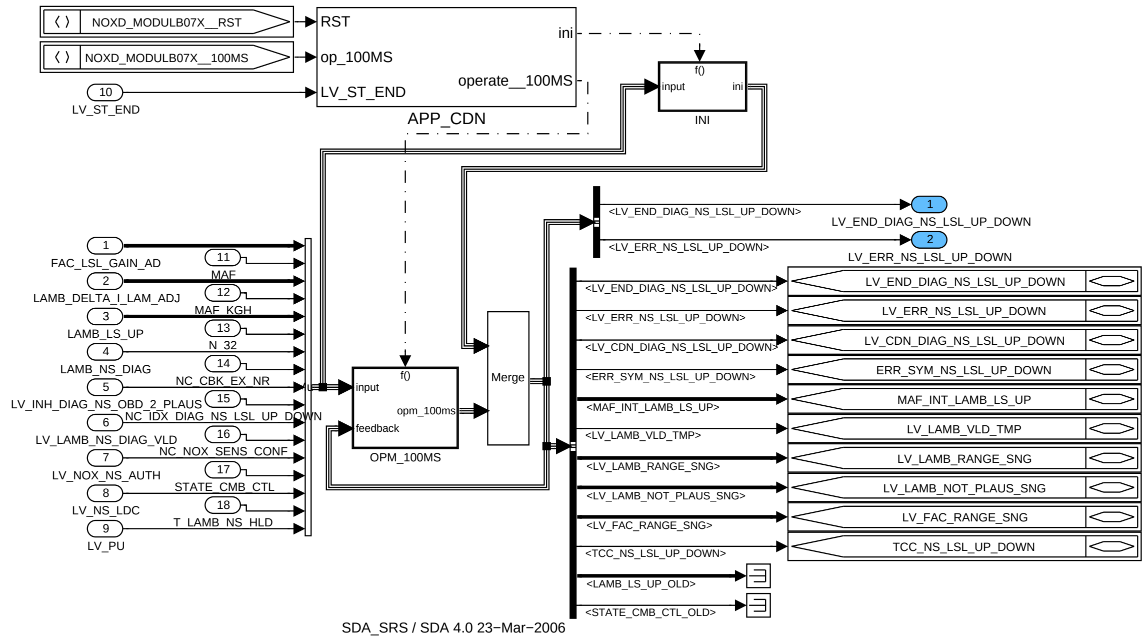

Figure B.125.2: NOXD_MODULB07X

B.125.1 Initialization at reset and deactivation

These actions initialized the diagnostic data according filtering configuration :
ACTION_ERRM_GetLvErr(IN<NC_IDX_DIAG_XX>, OUT< LV_ERR_XX >)
ACTION_ERRM_GetLvEndDiag(IN<NC_IDX_DIAG_XX>, OUT< LV_END_DIAG_XX >)

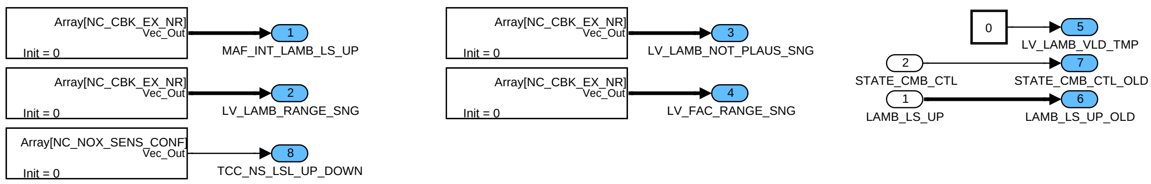

Figure B.125.3: NOXD_MODULB07X/INI/CLC

B.125.2 Loop control

The calculation inside FOR_LOOP_LS have to be done for each upstream lambda sensor, controlled by configuration data NC_CBK_EX_NR.
If NC_CBK_EX_NR = 1, then calculation for i = 1.
If NC_CBK_EX_NR = 2, then calculation for i = 1 and 2.

The calculation inside both NO_LOOP subsystems have to be done only once.

The calculation inside FOR_LOOP_NS have to be done for each NOx sensor, controlled by configuration data NC_NOX_SENS_CONF.
If NC_NOX_SENS_CONF = 1, then calculation for i = 1.
If NC_NOX_SENS_CONF = 2, then calculation for i = 1 and 2.

NC_NOX_SENS_CONF cannot be greater than NC_CBK_EX_NR.

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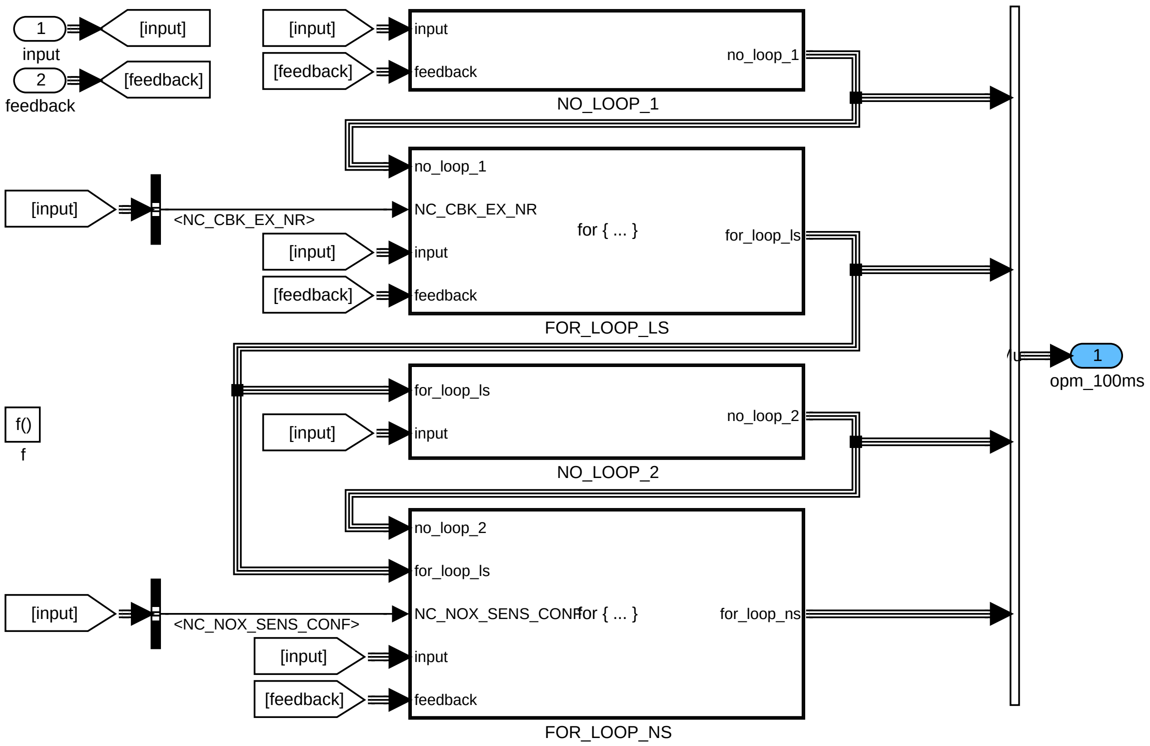

Figure B.125.4: NOXD_MODULB07X/OPM_100MS

Bank independent calculation (part 1)

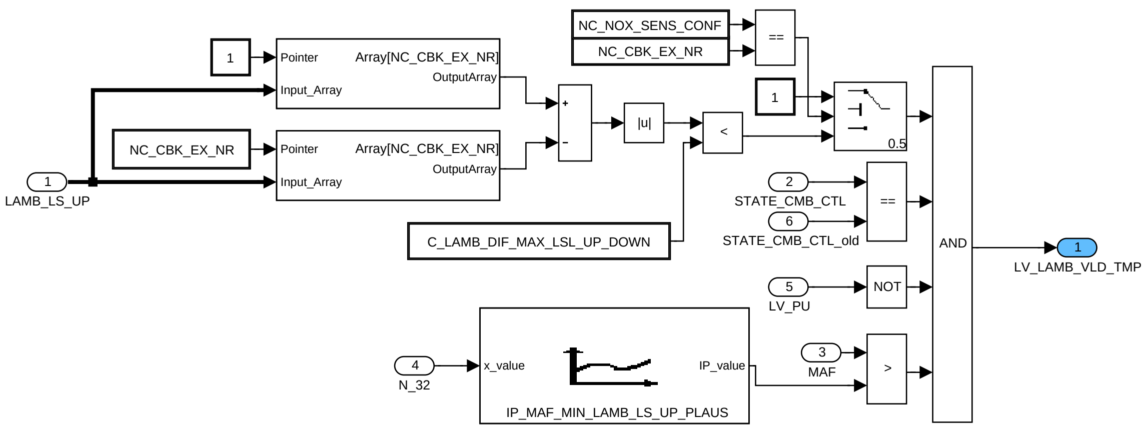

Figure B.125.5: NOXD_MODULB07X/OPM_100MS/NO_LOOP_1/CLC

Calculation for each upstream lambda sensor

Integral of air mass flow

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The MAF integral will be calculated if the operating condition are nearly stationary, otherwise the integral will be reset.

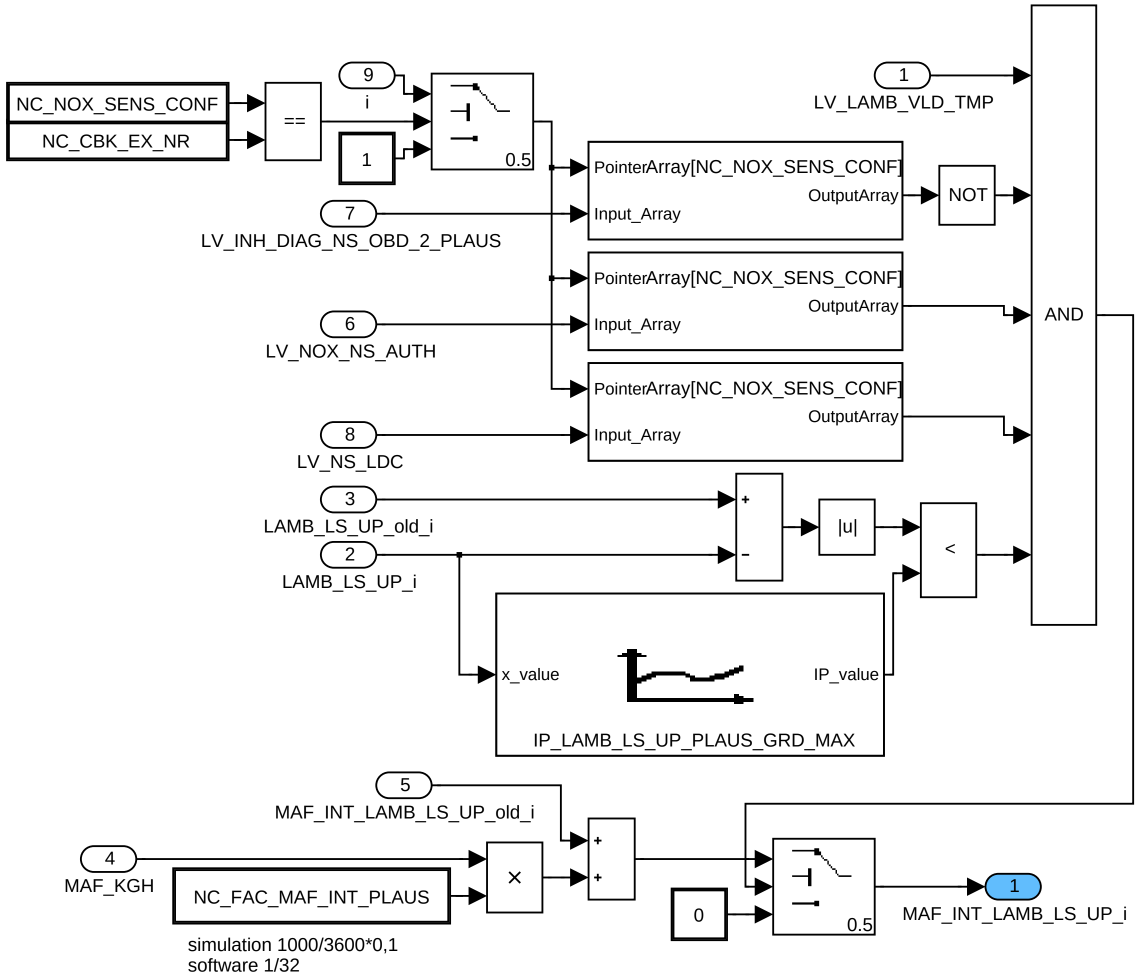

Figure B.125.6: NOXD_MODULB07X/OPM_100MS/FOR_LOOP_LS/CLC1

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Lambda range

The diagnosis will be activated if the upstream lambda is in a desired range and the MAF integral shows that also behind the NOx trap should be the same lambda.

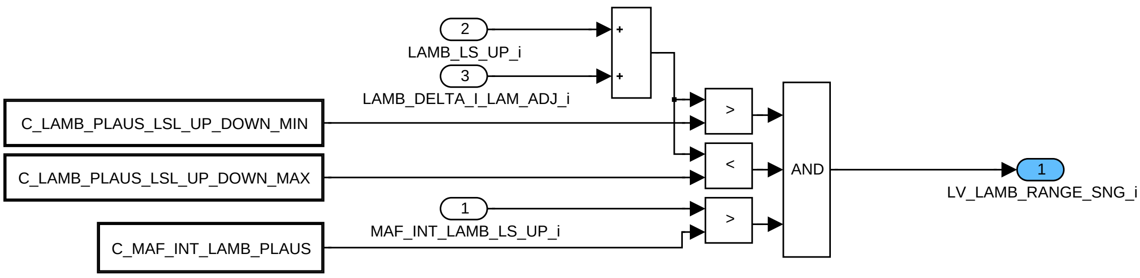

Figure B.125.7: NOXD_MODULB07X/OPM_100MS/FOR_LOOP_LS/CLC2

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Lambda comparison

The linear lambda of the NOx sensor will be compared with the upstream lambda to get the diagnosis result.

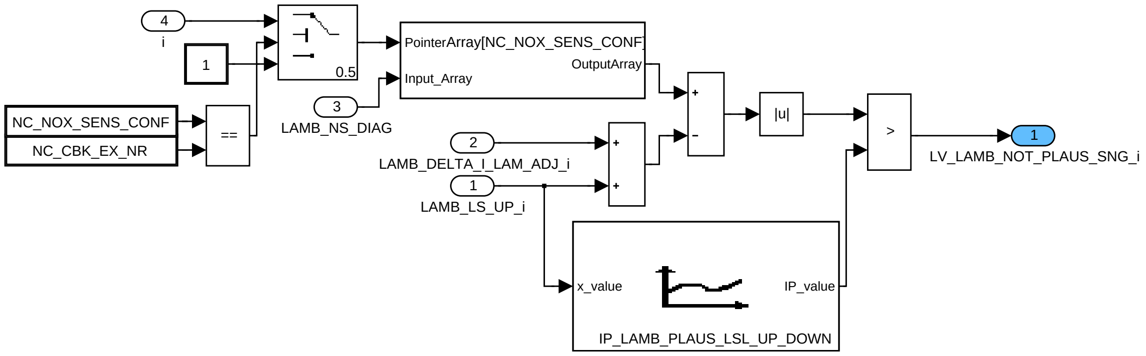

Figure B.125.8: NOXD_MODULB07X/OPM_100MS/FOR_LOOP_LS/CLC3

Lambda controller gain adaptation

The lambda controller gain adaptation have to be in a desired range to avoid a wrong diagnosis result for the NOx sensor during the comparison with the upstream lambda sensor.

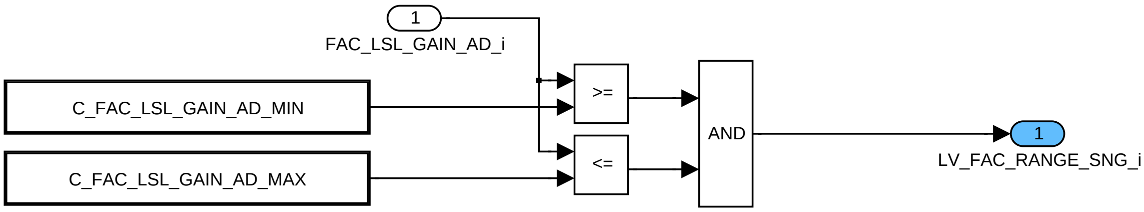

Figure B.125.9: NOXD_MODULB07X/OPM_100MS/FOR_LOOP_LS/CLC4

Bank independend calculation (part 2)

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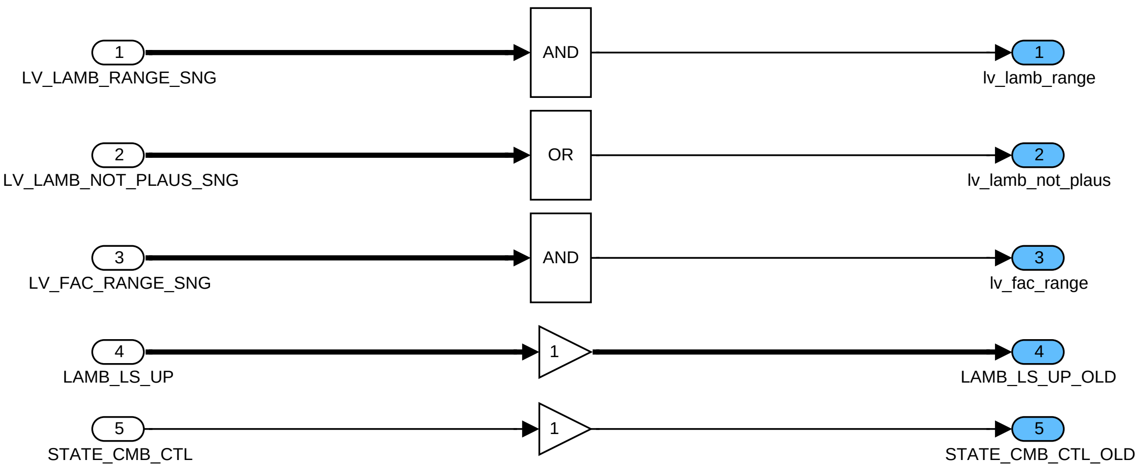

Figure B.125.10: NOXD_MODULB07X/OPM_100MS/NO_LOOP_2/CLC

Calculation for each NOx sensor

Diagnosis evaluation

For each NOx sensor diagnosis result have to be used either the signals of the same bank or resulting signals if a NOX sensor sees the exhaust gas from more than one bank.

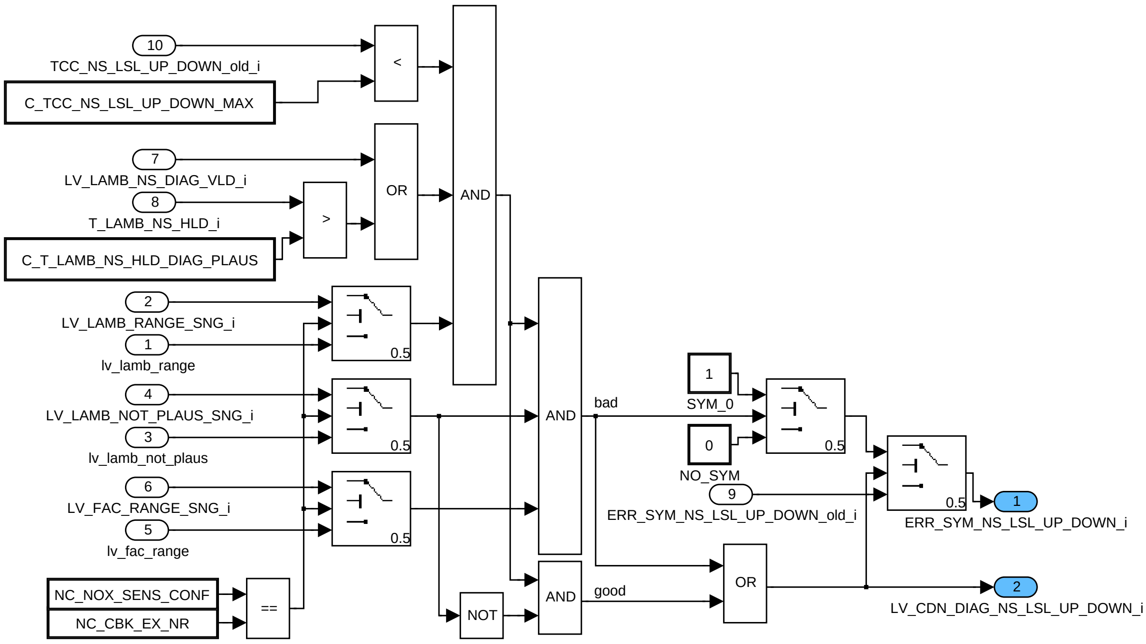

Figure B.125.11: NOXD_MODULB07X/OPM_100MS/FOR_LOOP_NS/CLC1

Test cycle counter

The number of test cycles per steady state phase may be calibrated.

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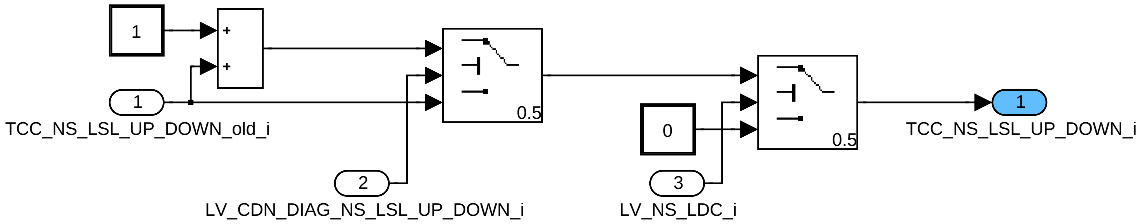

Figure B.125.12: NOXD_MODULB07X/OPM_100MS/FOR_LOOP_NS/CLC2

Error management

LV_ERR_NS_LSL_UP_DOWN will be get by ACTION_ERRM_GetLvErr and LV_END_DIAG_NS_LSL_UP_DOWN will be get by ACTION_ERRM_GetLvEndDiag.

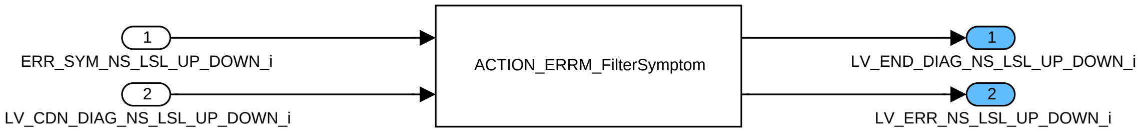

Figure B.125.13: NOXD_MODULB07X/OPM_100MS/FOR_LOOP_NS/CLC3

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B.126 NOx sensor OBDII diagnosis - Signal plausibility at pull fuel cutoff

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NS_PUC [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx sensor plausibility diagnosis at PUC					
LV_CDN_DIAG_NS_PUC [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx sensor plausibility diagnosis at PUC					
LV_END_DIAG_NS_PUC [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
End of NOx sensor plausibility diagnosis at PUC					
LV_ERR_NS_PUC [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Error flag of NOx sensor plausibility diagnosis at PUC					
LV_LAMB_VLD_PUC	V	0... 1H	0 ...1	1	-
All lambda signals are valid for diagnosis at PUC					
LV_LAMB_VLD_PUC_SNG [NC_CBK_EX_NR]	V	0... 1H	0 ...1	1	-
Lambda signal is valid for diagnosis at PUC (bench selective)					
TCC_NS_PUC_DIAG [NC_NOX_SENS_CONF]	V	0... FFH	0... 255	1	-
Test cycle counter for plausibility checks at actual PUC phase					

Input data:

CTR_NT_AGI_AD_CMPL_SUM {p. 3072}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_NS_DIAG [NC_NOX_SENS_CONF] {p. 991}	LV_INH_DIAG_NS_OBD_2_PLAUS [NC_NOX_SENS_CONF] {p. 6468}
LV_LAMB_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_NS_AUTH [NC_NOX_SENS_CONF] {p. 991}	LV_NOX_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	LV_NT_HOM_INI {p. 2982}
LV_PUC {p. 1720}	LV_VLS_NS_DIAG_VLD [NC_NOX_SENS_CONF] {p. 991}	MAF_INT_PUC_ACT {p. 2942}	NC_CBK_EX_NR {p. 1829}
NC_IDX_DIAG_NS_PUC [NC_NOX_SENS_CONF]	NC_NOX_SENS_CONF {p. 643}	NOX_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}	NTLD {p. 2986}
T_LAMB_NS_HLD [NC_NOX_SENS_CONF] {p. 992}	T_NOX_NS_HLD [NC_NOX_SENS_CONF] {p. 992}	T_VLS_NS_HLD [NC_NOX_SENS_CONF] {p. 992}	TNT_MDL_MV {p. 8237}
VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}		

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NS_PUC	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx sensor plausibility diagnosis at PUC					
C_ABC_INC_NS_PUC	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx sensor plausibility diagnosis at PUC					
C_ABC_MAX_NS_PUC	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx sensor plausibility diagnosis at PUC					
C_CTR_NT_AGI_AD_CMPL_SUM_NS_PUC	-	0... FFFFH	0... 65535	1	-
Minimum threshold of completed aging adaptations for NOx sensor PUC diagnosis					
C_LAMB_NS_DIAG_PUC_MIN	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Minimum Lambda value of NOx-Sensor at PUC					
C_LAMB_PUC_PLAUS_MIN	-	0... 7FFFH	0... 31.9990234	976.563e-6	-
Minimum upstream Lambda value to start the NOx-Sensor PUC check					
C_MAF_INT_PUC_PLAUS_MIN	-	0... FFFFH	0... 1820.42	0.02777778	g
MAF threshold for starting the PUC diagnosis					
C_NOX_NS_DIAG_PUC_MAX	-	FF9C... 5DCH	-100 ...1500	1	ppm
Maximum NOx concentration signal value of NOx-Sensor at PUC					
C_NOX_NS_DIAG_PUC_MIN	-	FF9C... 5DCH	-100 ...1500	1	ppm
Minimum NOx concentration signal value of NOx-Sensor at PUC					
C_NTLD_NS_PLAUS_PUC	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
Maximum NOx loading of NOx catalyst for detecting a NOx signal failure					
C_T_LAMB_NS_HLD_DIAG_PUC	-	0... 7FFFH	0... 327.67	0.01	s
Time with lambda signal state = invalid, after which a PUC diagnosis is started					
C_T_NOX_NS_HLD_DIAG_PUC	-	0... 7FFFH	0... 327.67	0.01	s
Time with NOx signal state = invalid, after which a PUC diagnosis is started					
C_T_VLS_NS_HLD_DIAG_PUC	-	0... 7FFFH	0... 327.67	0.01	s
Time with binary O2 signal state = invalid, after which a PUC diagnosis is started					
C_TCC_NS_PUC_DIAG	-	0... FFH	0... 255	1	-
Number of test cycles at a PUC phase					
C_TNT_MDL_MV_NS_PUC_MAX	-	0... FFFFH	0... 1023.98	0.015625	°C
Maximum threshold of NOx trap temperature for NOx sensor PUC diagnosis					
C_VLS_DOWN_PUC_PLAUS_MAX [NC_CBK_EX_NR]	-	0... 3FFH	0... 4.99511719	0.00488281	V
Maximum VLS_DOWN signal value to start the NOx-Sensor PUC check					
C_VLS_NS_DIAG_PUC_MAX	-	0... 578H	-200 ...1200	1	mV
Maximum binary O2 signal voltage of NOx-Sensor at PUC					
LC_NT_HOM_INI_PUC_PLAUS	-	0... 1H	0 ...1	1	-
NOx signal plausibility diagnosis at PUC runs only after a complete NOx catalyst regeneration					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

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General information

This signal check tests all NOx sensor measurement signals on theirs plausibility at the special engine operating state pull fuel cut-off (PUC). With this check shall be detected a sensor poisoning or signal offset problems.

Application Condition

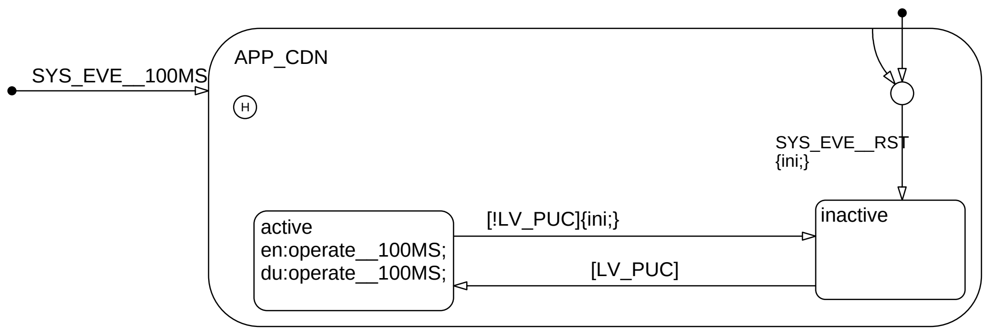

Figure B.126.1: NOXD_MODULB07Y/APP_CDN/Chart

Function Description

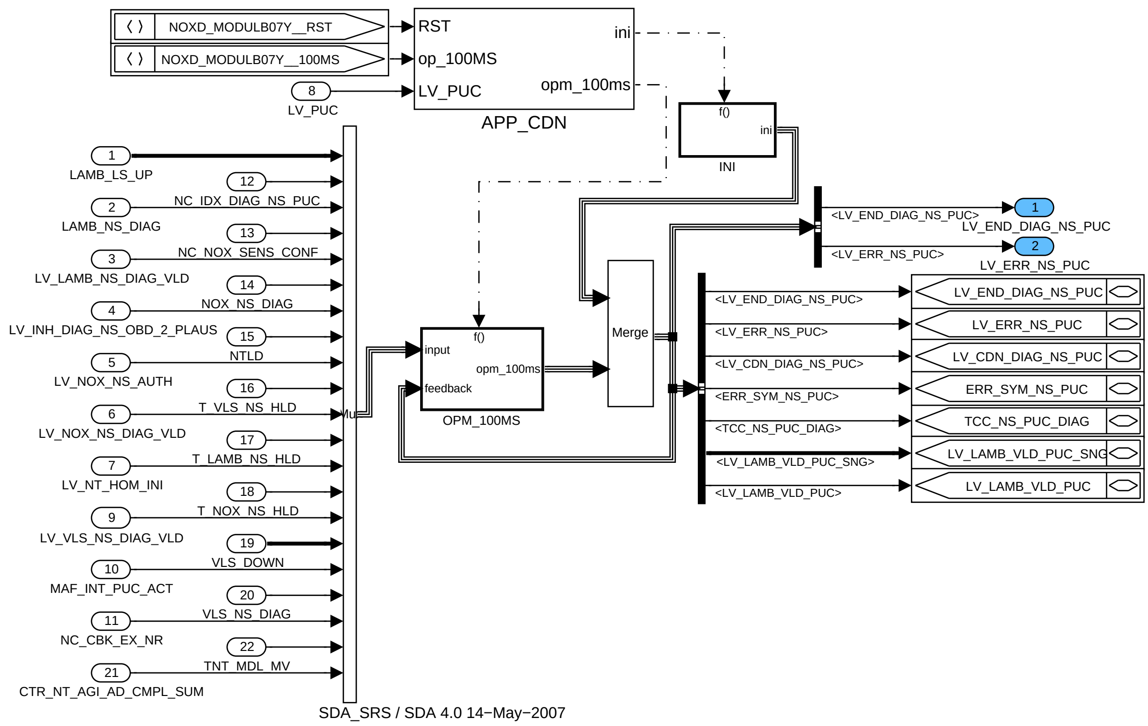

Figure B.126.2: NOXD_MODULB07Y

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B.126.1 Initialization at reset and deactivation

These actions initialized the diagnostic data according filtering configuration :
ACTION_ERRM_GetLvErr(IN<NC_IDX_DIAG_XX>, OUT< LV_ERR_XX >)
ACTION_ERRM_GetLvEndDiag(IN<NC_IDX_DIAG_XX>, OUT< LV_END_DIAG_XX >)

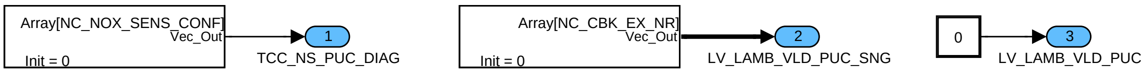

Figure B.126.3: NOXD_MODULB07Y/INI/CLC

B.126.2 Loop control

The calculation inside FOR_LOOP_LS have to be done for each upstream lambda sensor, controlled by configuration data NC_CBK_EX_NR.
If NC_CBK_EX_NR = 1, then calculation for i = 1.
If NC_CBK_EX_NR = 2, then calculation for i = 1 and 2.

The calculation inside both NO_LOOP subsystems have to be done only once.

The calculation inside FOR_LOOP_NS have to be done for each NOx sensor, controlled by configuration data NC_NOX_SENS_CONF.
If NC_NOX_SENS_CONF = 1, then calculation for i = 1.
If NC_NOX_SENS_CONF = 2, then calculation for i = 1 and 2.

NC_NOX_SENS_CONF cannot be greater than NC_CBK_EX_NR.

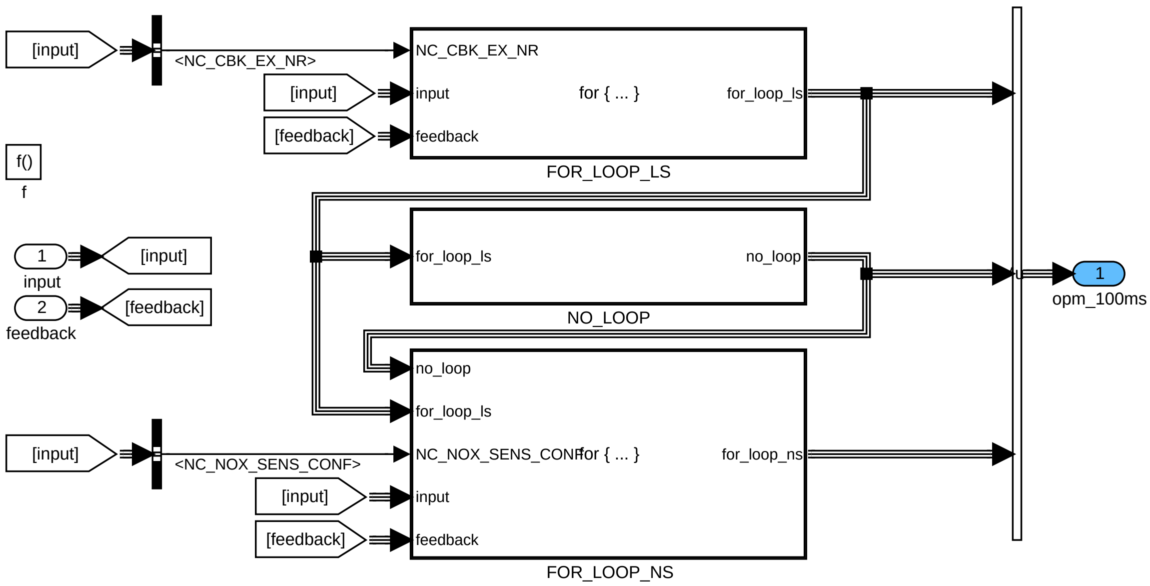

Figure B.126.4: NOXD_MODULB07Y/OPM_100MS

Calculation for each upstream lambda sensor

Lambda sensor lean check

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Linear as well as binary lambda sensors of a bank will be checked if PUC is active.

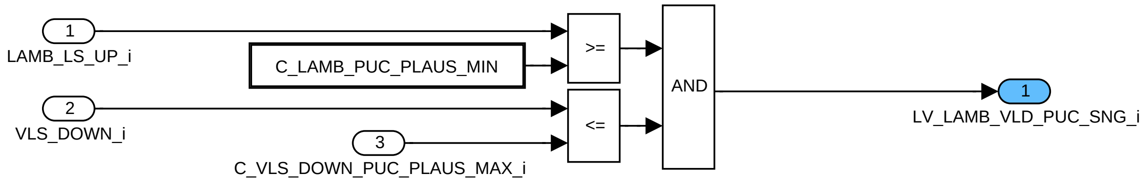

Figure B.126.5: NOXD_MODULB07Y/OPM_100MS/FOR_LOOP_LS/CLC

Bank independent calculation

The signal shows that all lambda sensors of all banks measures lean exhaust gas due to PUC.

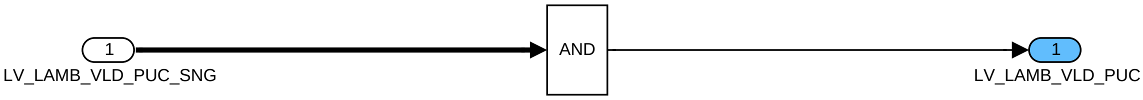

Figure B.126.6: NOXD_MODULB07Y/OPM_100MS/NO_LOOP/CLC

Calculation for each NOx sensor

Activation of diagnosis

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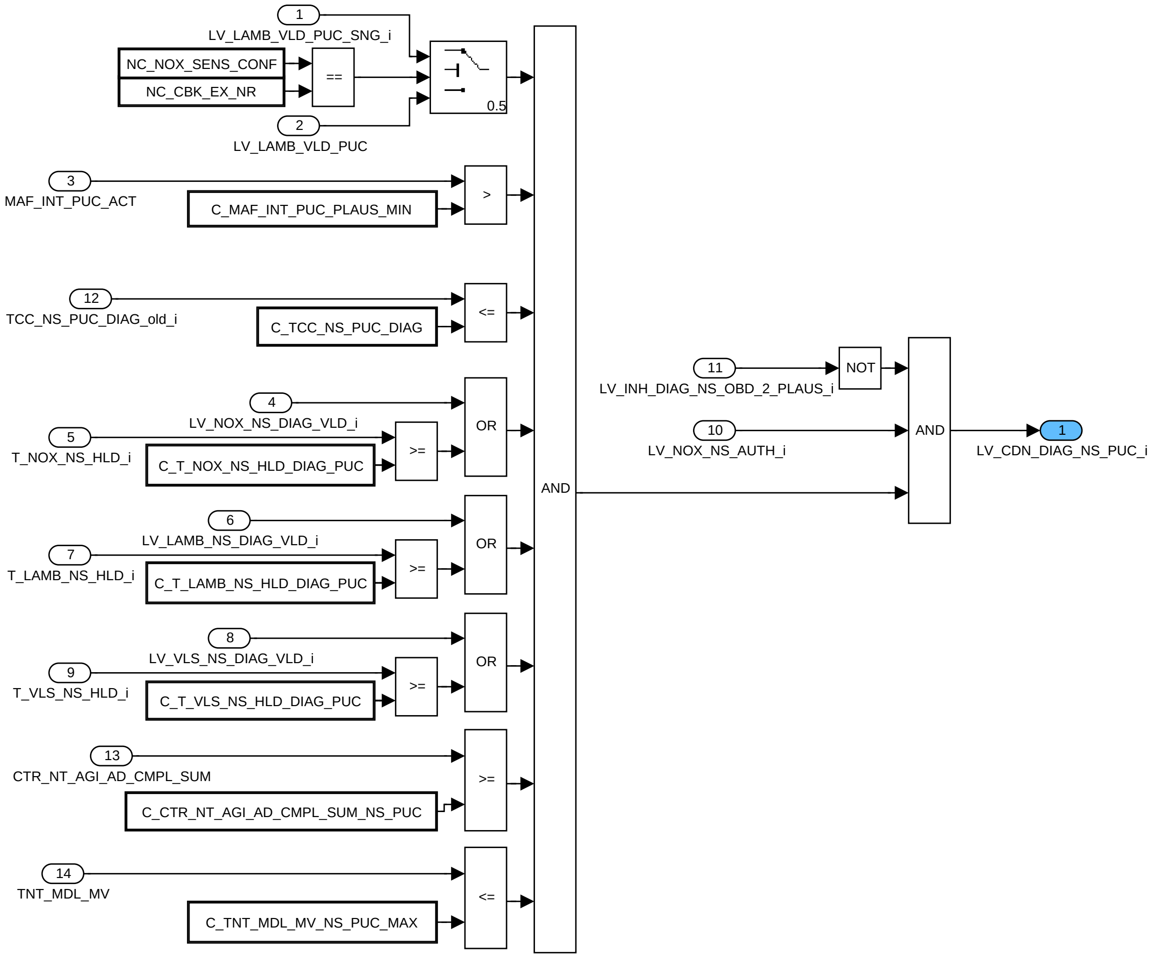

Figure B.126.7: NOXD_MODULB07Y/OPM_100MS/FOR_LOOP_NS/CLC1

Plausibility check counter

At every PUC phase the number of plausibility checks is counted with this counter and limited with C_TCC_NS_PUC_DIAG.

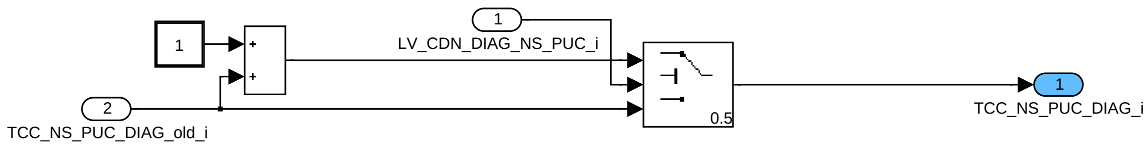

Figure B.126.8: NOXD_MODULB07Y/OPM_100MS/FOR_LOOP_NS/CLC2

Signal diagnosis

Both lambda signals of the NOx sensor will be compared with a threshould.
The NOx signal will be checked with a range.
If the signal is higher than the top limit, then a special check have to be done. The reason is a NOx loading of NOx storage catalyst at start of ’pull fuel cut-off’ phase and the fact that the NOx catalyst

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loses a part of its stored NOx at 'pull fuel cut-off'. Hence a NOx signal, which is higher than the diagnosis threshold at 'pull fuel cut-off' diagnosis time, shall be interpreted as sensor failure only if the NOx loading of NOx catalyst is low at start of 'pull fuel cut-off' diagnosis time.

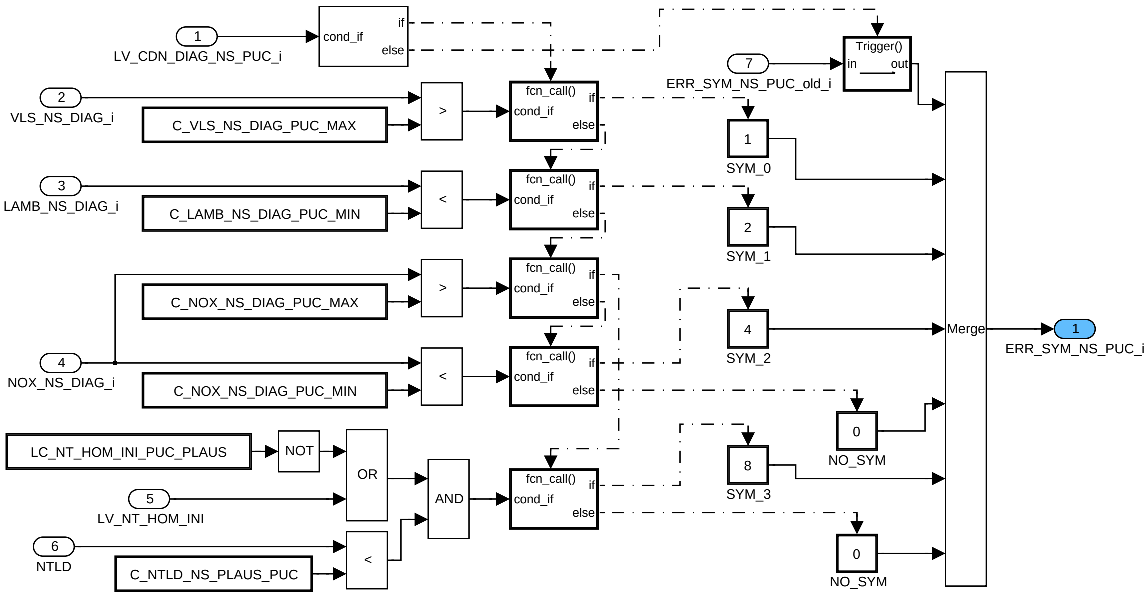

Figure B.126.9: NOXD_MODULB07Y/OPM_100MS/FOR_LOOP_NS/CLC3

Error management

LV_ERR_NS_PUC will be get by ACTION_ERRM_GetLvErr and LV_END_DIAG_NS_PUC will be get by ACTION_ERRM_GetLvEndDiag.

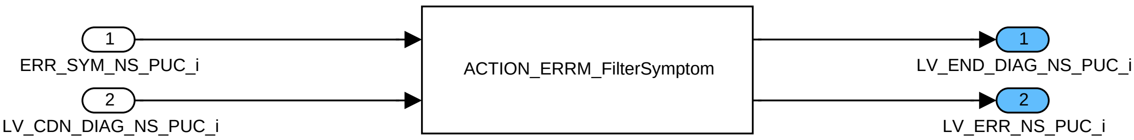

Figure B.126.10: NOXD_MODULB07Y/OPM_100MS/FOR_LOOP_NS/CLC4

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B.127 NOx sensor OBDII diagnosis - Setpoint shift

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CRLC_RATIO_MMV_NS_SHIFT_DIAG [NC_NOX_SENS_CONF]	O/V	0... FFH	0 ...1	3.92157e-3	-
Correlation constant of NOx signal shift diagnosis mean value					
CTR_RATIO_MMV_DIAG_NS_SHIFT [NC_NOX_SENS_CONF]	O/V/S	0... FFH	0... 255	1	-
Counter of single diagnosis cycles for calculation of mean value					
ERR_SYM_NS_SHIFT [NC_NOX_SENS_CONF]	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error symptom for NOx signal internal setpoint shift diagnosis					
LV_CDN_DIAG_NS_SHIFT [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (seto to one when condition is fulfilled)					
LV_END_DIAG_NS_SHIFT [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
NOx sensor internal setpoint shift diagnosis was performed at last one time					
LV_ERR_NS_SHIFT [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Present failure after filtering of the NOx sensor internal setpoint shift diagnosis					
LV_NS_SHIFT_DIAG_MMV_EXT_ADJ [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
External values of MMV values for the NOx signal shift diagnosis available					
LV_NS_SHIFT_DIAG_MMV_INI [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Initialization of MMV values for the NOx signal shift diagnosis					
LV_RATIO_SUM_CLC_ACT [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Calculation of RATIO active					
RATIO_MMV_NS_SHIFT_DIAG [NC_NOX_SENS_CONF]	O/V/S	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
NOx signal shift diagnosis mean value					
RATIO_NS_SHIFT_DIAG [NC_NOX_SENS_CONF]	O/V	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
NOx signal shift diagnosis value					
RATIO_NS_SHIFT_DIAG_BOL_SAE [NC_NOX_SENS_CONF]	O/V/S	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
Mode 06 - minimum value of test limit					
RATIO_NS_SHIFT_DIAG_SAE [NC_NOX_SENS_CONF]	O/V/S	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
Mode 06 - test value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
RATIO_NS_SHIFT_DIAG_TOL_SAE [NC_NOX_SENS_CONF]	O/V/S	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
Mode 06 - maximum value of test limit					
RATIO_SUM_NS_SHIFT_DIAG [NC_NOX_SENS_CONF]	O/V/S	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	-
Numerator for calculation of diagnosis mean value					
STATE_NS_SHIFT_DIAG_OLD [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Old value of STATE_NS_SHIFT_DIAG					

Input data:

CAN_NOX_DIAG_NS [NC_NOX_SENS_CONF] {p. 1398}	CAN_NOX_REF_NS [NC_NOX_SENS_CONF] {p. 1398}	LV_INH_DIAG_NS_OBD_2_SHIFT [NC_NOX_SENS_CONF] {p. 6468}	LV_NS_SHIFT_DIAG_ACT_EXT_ADJ [NC_NOX_SENS_CONF] {p. 6426}
LV_NS_SHIFT_DIAG_ERR [NC_NOX_SENS_CONF] {p. 1381}	MAF_CYL {p. 8277}	NC_NOX_SENS_CONF {p. 643}	RATIO_MMV_NS_SHIFT_DIAG_EXT_ADJ [NC_NOX_SENS_CONF] {p. 7683}
STATE_NS_SHIFT_DIAG [NC_NOX_SENS_CONF] {p. 6427}	TNT_MDL_MV {p. 8237}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_NS_SHIFT	-	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_NS_SHIFT	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_ABC_MAX_NS_SHIFT_EXT_ACT	-	1... FFH	1... 255	1	-
Maximum value for antibounce counter - for external manual activation					
C_CRLC_RATIO_NS_SHIFT_DIAG_MIN	-	0... FFH	0 ...1	3.92157e-3	-
Minimum Correlation constant for NOx signal shift diagnosis mean value					
C_CTR_RATIO_MMV_DIAG_NS_SHIFT	-	1... FFH	1... 255	1	-
Maximum of single diagnosis cycles for calculation of mean value					
C_CTR_RATIO_MMV_SHIFT_EXT_ACT	-	1... FFH	1... 255	1	-
Maximum of single diagnosis cycles for calculation of mean value - external activation					
C_RATIO_NS_SHIFT_DIAG_AFS_MAX	-	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
Maximal threshold for NOx signal shift diagnosis for requesting Lambda=1.0 operation					
C_RATIO_NS_SHIFT_DIAG_AFS_MIN	-	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
Minimal threshold for NOx signal shift diagnosis for requesting Lambda=1.0 operation					
C_RATIO_NS_SHIFT_DIAG_THD_MAX	-	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
Maximal threshold for NOx signal shift diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_RATIO_NS_SHIFT_DIAG_THD_MIN	-	8000... 7FFFH	-1... 0.99996948242	30.5176e-6	-
Minimal threshold for NOx signal shift diagnosis					
IP_CRLC_RATIO_MMV_NS_SHIFT_DIAG	V	0... FFH	0 ...1	3.92157e-3	-
LDP_RATIO_DIF_IP_CRLC_RATIO_MMV	6	0... FFFFH	-1... 0.99996948	30.5176e-6	-
LDP_RATIO_IP_CRLC_RATIO_MMV	4	0... FFFFH	-1... 0.99996948	30.5176e-6	-
Filter constant for NOx signal shift diagnosis mean value					
IP_FAC_MAF_NS_SHIFT	-	0... FFH	0... 3.984375	0.015625	-
LDP_MAF_IP_FAC_NS_SHIFT	8	0... FFFFH	0... 2047.96875	0.03125	kg/h
Correction factor of NOx signal depending on MAF_CYL					
IP_FAC_TNT_MDL_MV_NS_SHIFT	-	0... FFH	0... 3.984375	0.015625	-
LDP_TNT_MDL_MV_IP_NS_SHIFT	8	0... FFFFH	0... 1023.984375	0.015625	°C
Correction factor of NOx signal depending on TNT_MDL_MV					
LC_NS_SHIFT_DIAG_ERR_ACT	-	0... 1H	0 ...1	1	-
Switch to result of diagnosis comming from NOx sensor software					

Action definition

ACTION_NOXD_CleanMMVNSAdapt ()	Mode: O
Initialization of NOx signal shift MMV diagnosis values	

ACTION_NOXD_WriteMMVNSExtAdj ()	Mode: O
Write external adjustment values to NOx signal shift MMV diagnosis values	

Description for Actions

ACTION_NOXD_CleanMMVNSAdapt()
Initialization of NOx signal shift MMV diagnosis values

ACTION_NOXD_WriteMMVNSExtAdj()
Write external adjustment values to NOx signal shift MMV diagnosis values

General Information

Application Conditions

Initialization: RST, CLRFMY, NVMINI, NVMRES, NVMSTO
Recurrence: 100MS
Activation: always
Deactivation: never

Function description

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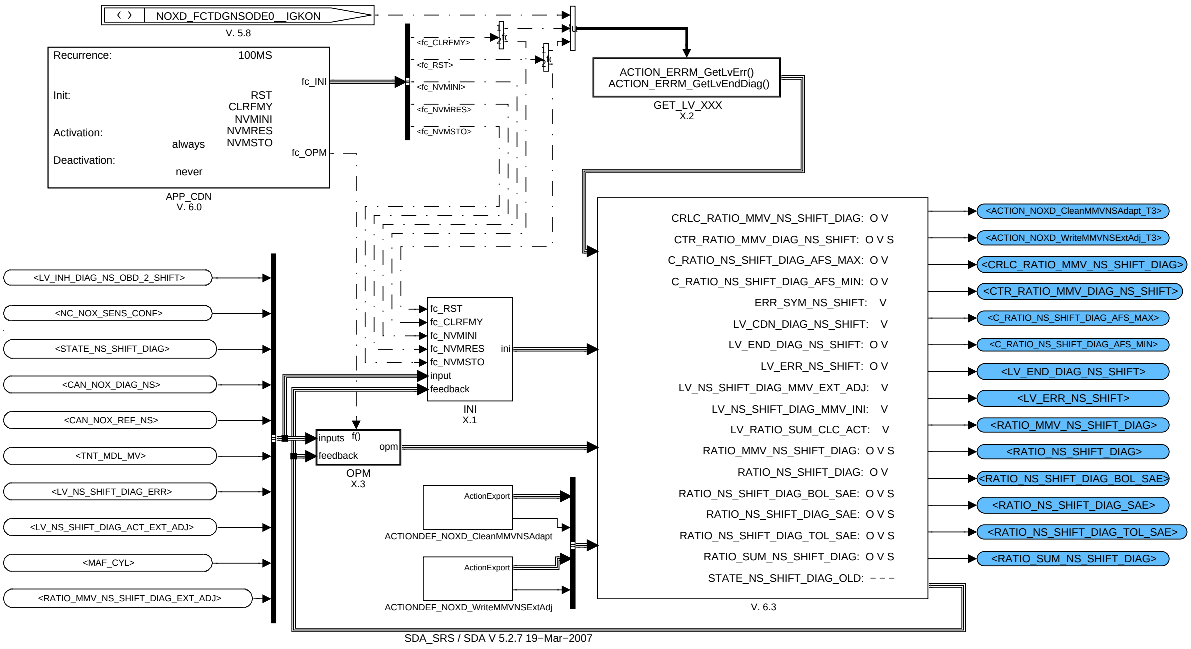

Figure B.127.1: :

B.127.1 Initialization and Management of nonvolatile memory

B.127.1.1 Initialization at Reset

The old values will be initialized with the regarding inputs, due to avoid an edge detection after reset.

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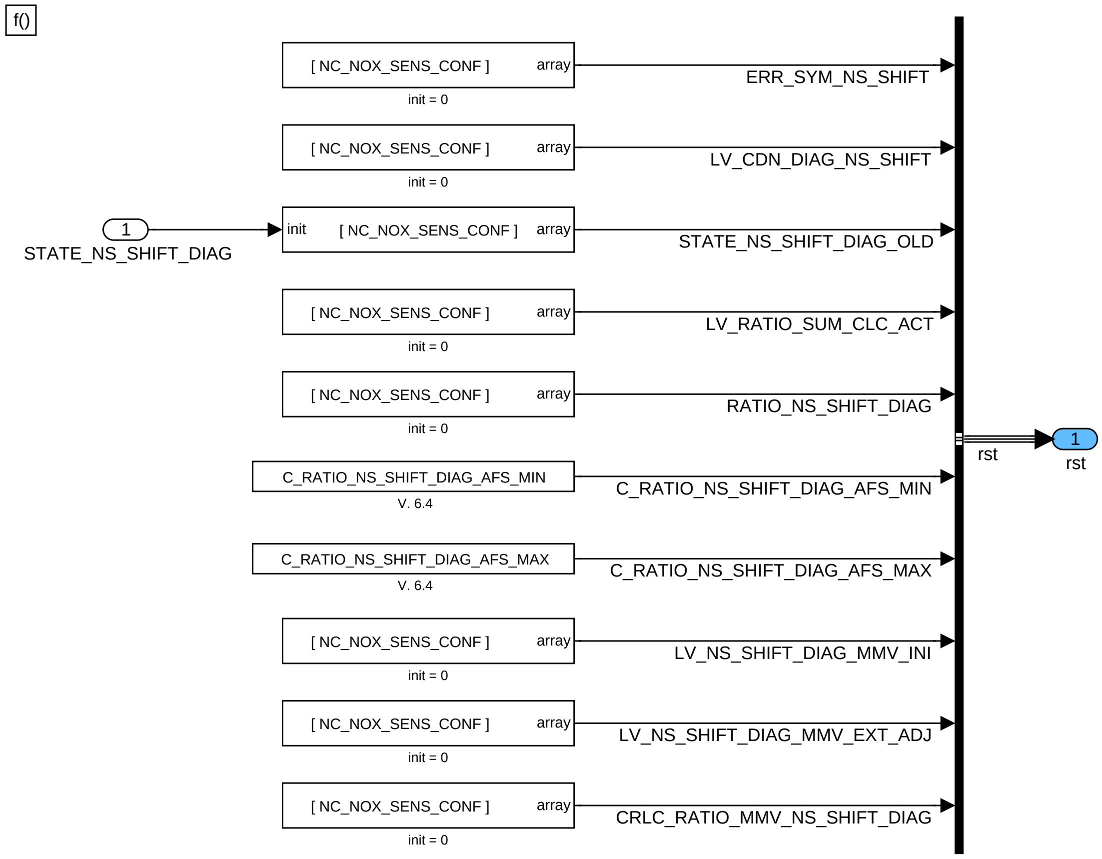

Figure B.127.2: :

B.127.1.2 Initialization of NVMY variables

All Mode 6 values will be stored in the nonvolatile memory. The values will be reset to zero, if failure memory will be cleared.

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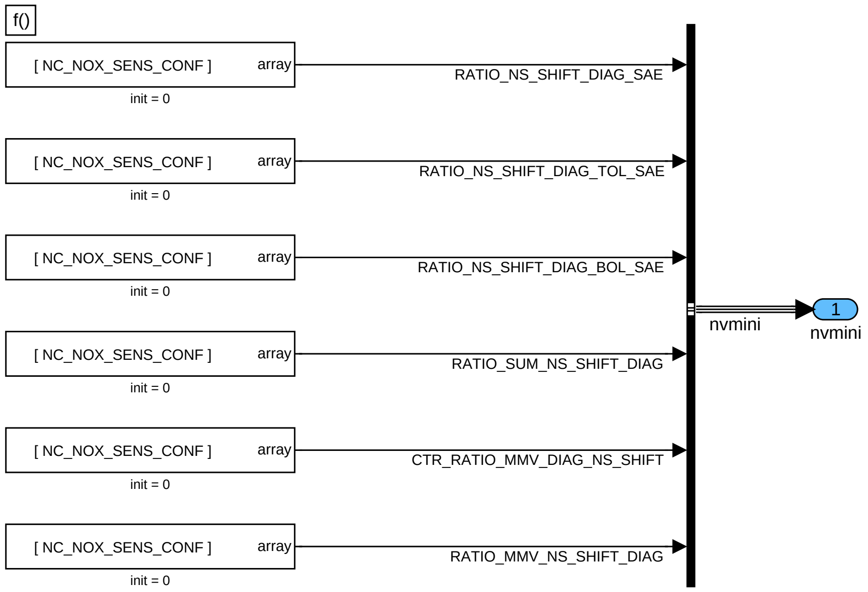

Figure B.127.3: :

B.127.1.3 Actions at clear fault memory

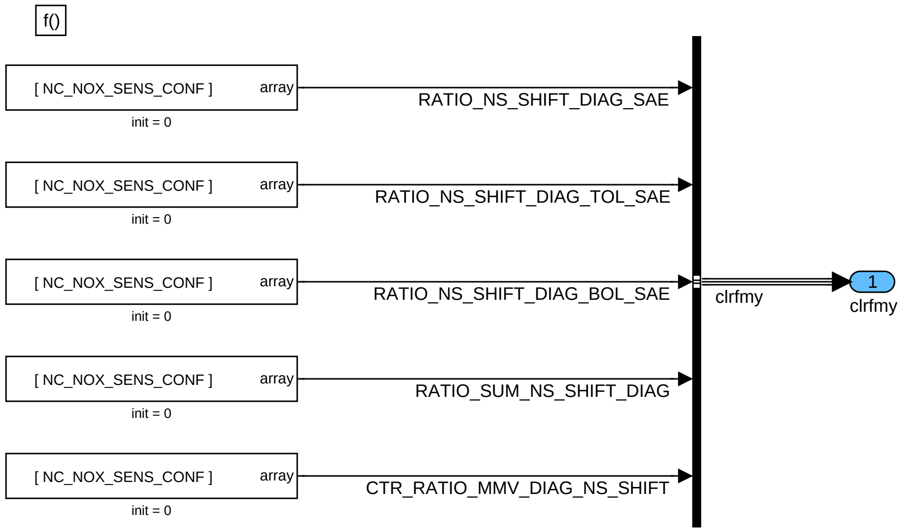

Figure B.127.4: :

B.127.2 Synchronization of the LV_ERR_NS_SHIFT and LV_END_DIAG_NS_SHIFT

Synchronisation between LV_ERR_NS_SHIFT and its result from ERRM is done using action ACTION_ERRM_GetLvErr() similarly synchronisation between LV_END_DIAG_NS_SHIFT and its result from ERRM is done using action ACTION_ERRM_GetLvEndDiag()at RESET ,IGKON and CLRFMY events.

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B.127.3 Operation at 100MS

B.127.3.1 Introduction of multiple sensor system

B.127.3.1.1 Calculation of the diagnosis results

B.127.3.1.1.1 Determination of diagnostic condition and calculation of counter

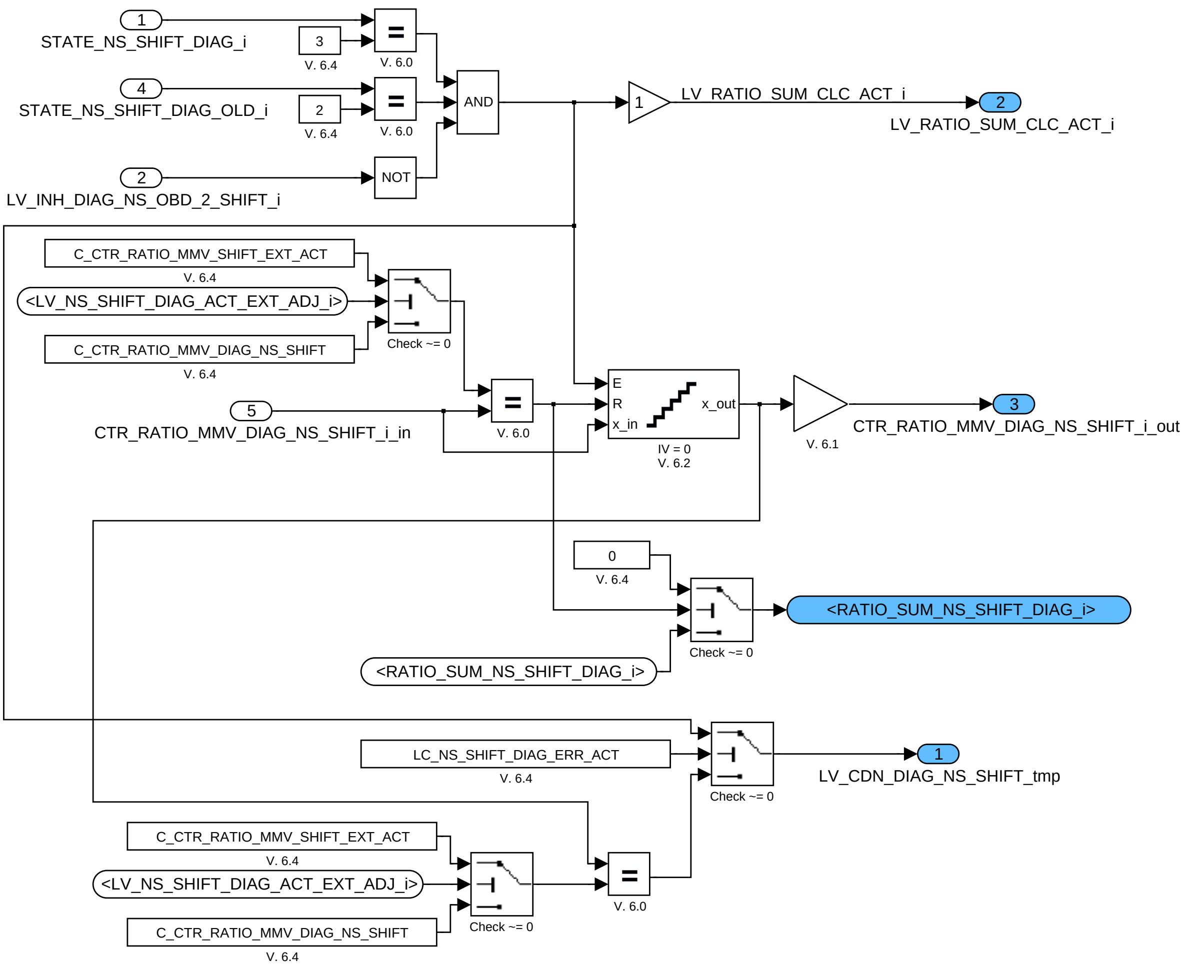

Figure B.127.5: :

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B.127.3.1.1.2 Calculation of single diagnosis value

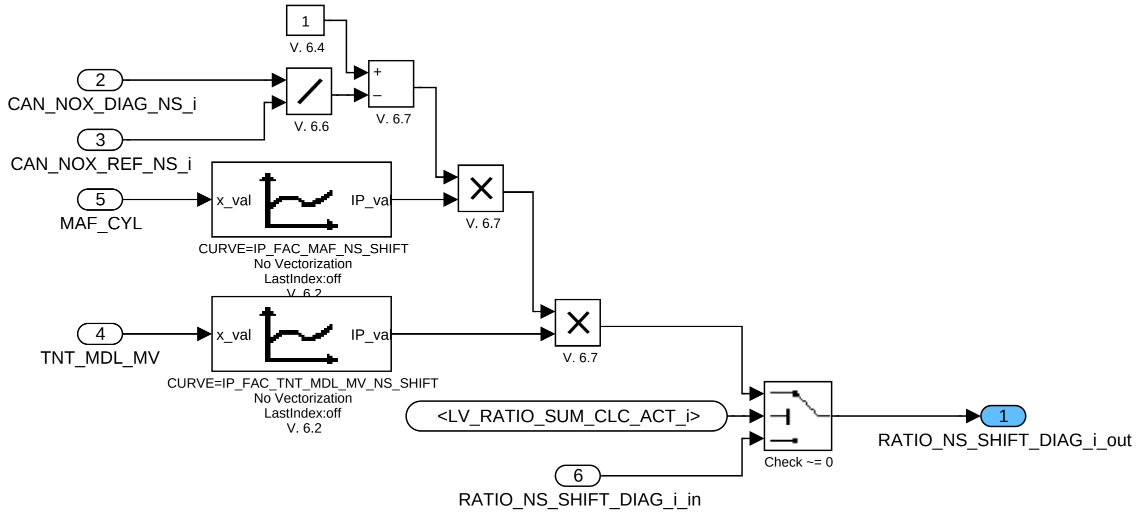

Figure B.127.6: :

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B.127.3.1.1.3 Calculation of mean value over defined number of single diagnosis values

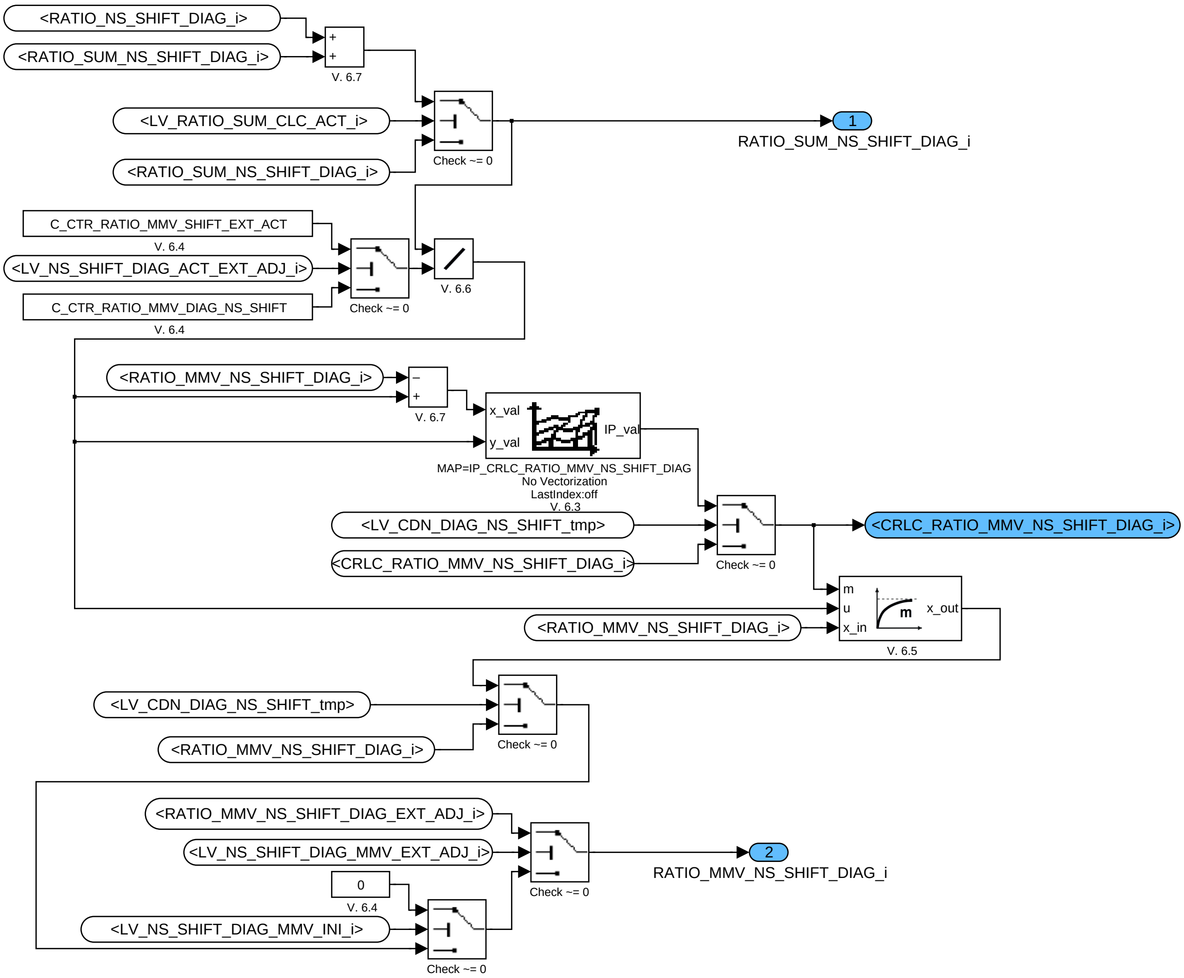

Figure B.127.7: :

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B.127.3.1.1.4 Determination of error symptom

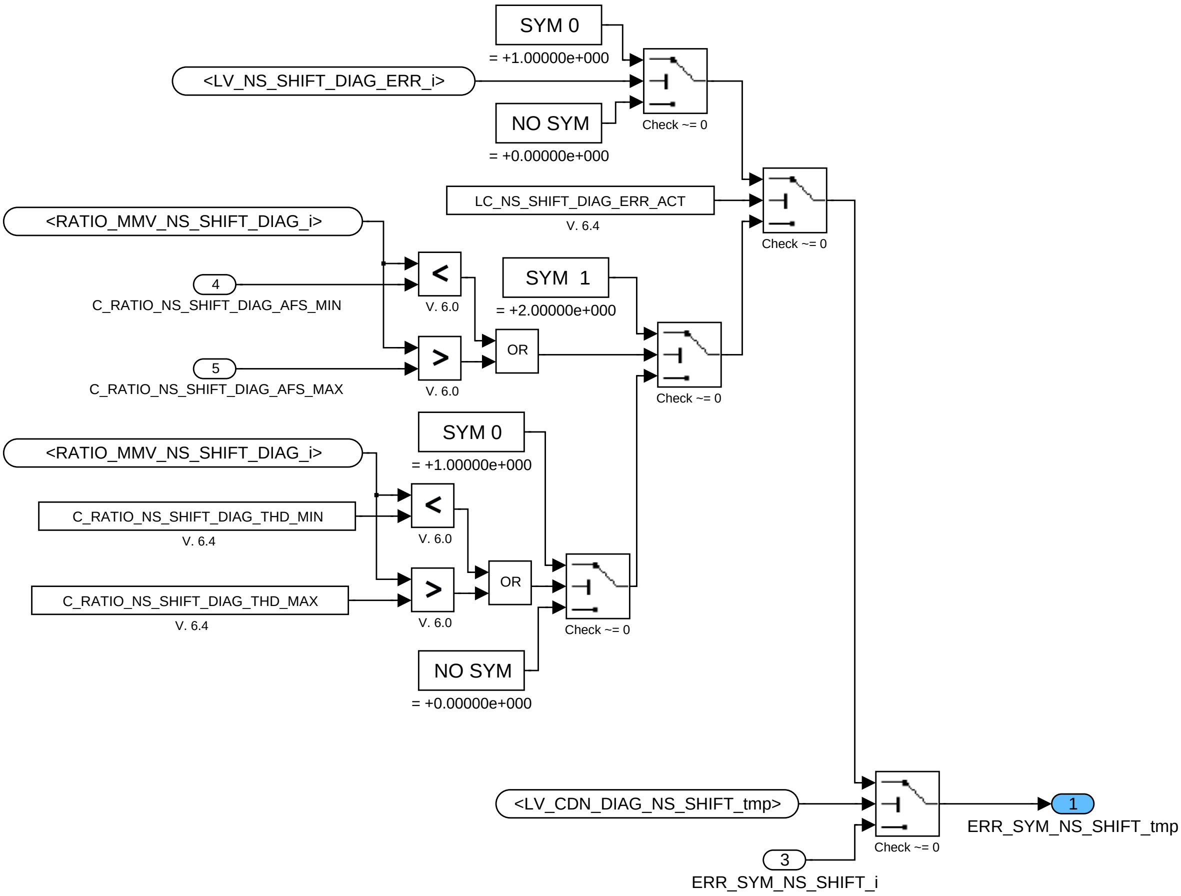

Figure B.127.8: :

B.127.3.1.1.5 Call for ERRM

ACTION_ERRM_FilterSymptom(IN<XX>, IN<lv_cdn_diag_XX>, IN<err_sym_XX >, IN<C_ABC_INC_XX >, IN<C_ABC_DEC_XX >, IN<C_ABC_MAX_XX >, OUT<LV_ERR_XX>)
The action computes the elementary anti-bounce filter for one failure treatment and returns filter results

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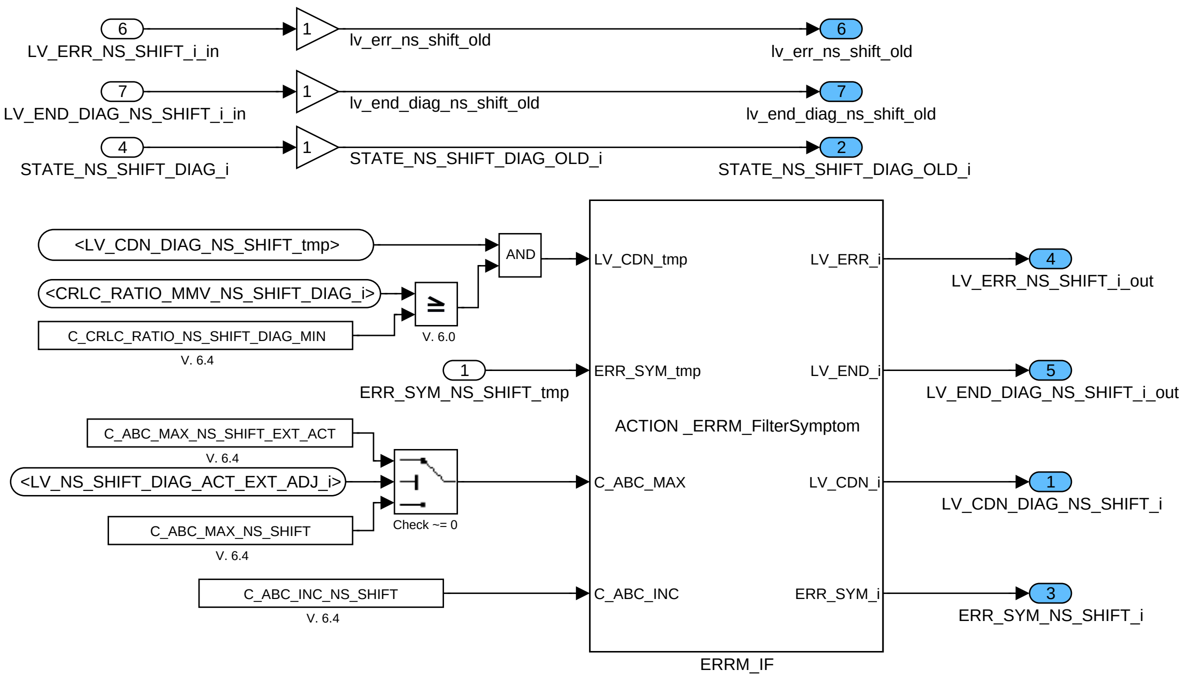

Figure B.127.9: :

B.127.3.1.1.6 Diagnosis Mode 6 handling

Mode 6 values will be stored, if error management is finishing the diagnosis or is setting an error.

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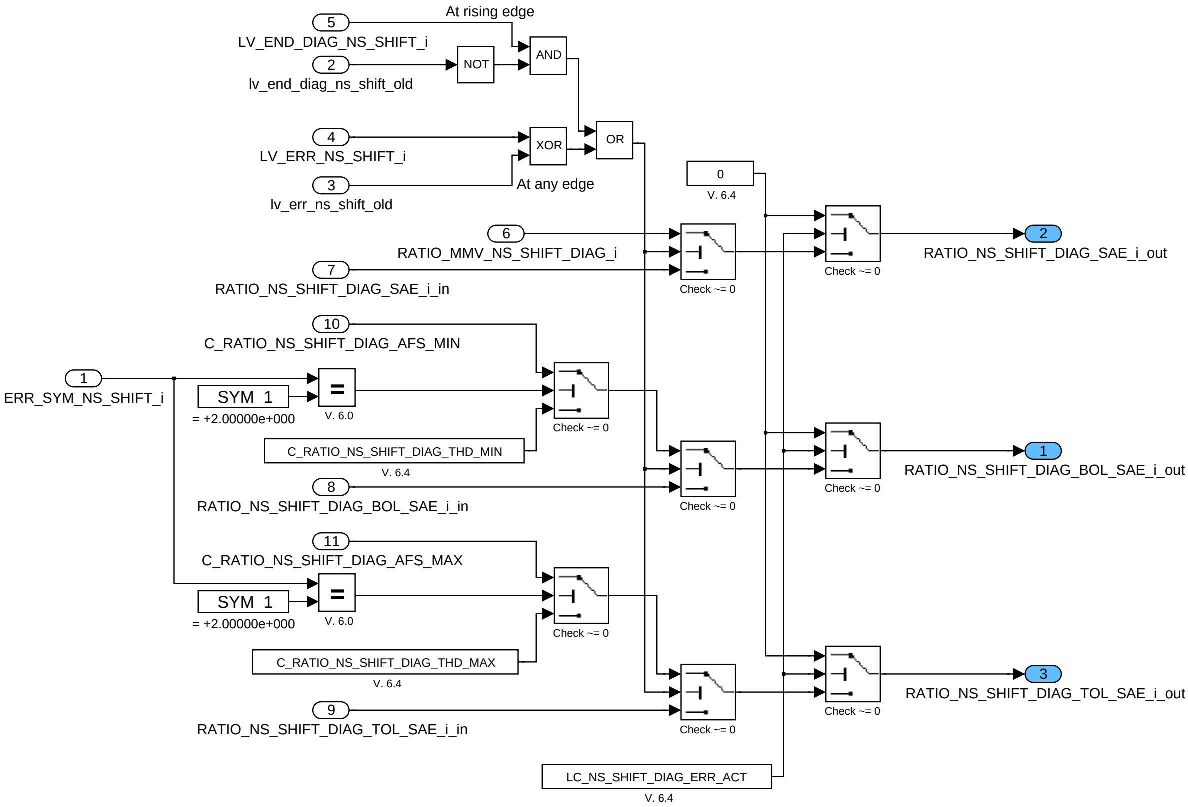

Figure B.127.10: :

B.127.3.1.1.7 Reset bits for writing external values or initialization of MMV values

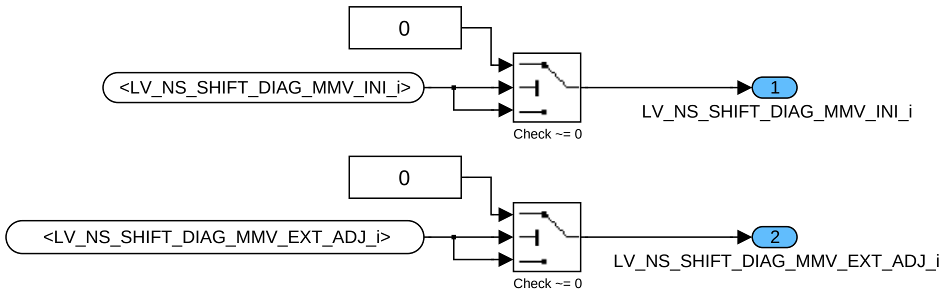

Figure B.127.11: :

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B.127.4 Detailed description for Action: ACTION_NOXD_CleanMMVNSAdapt

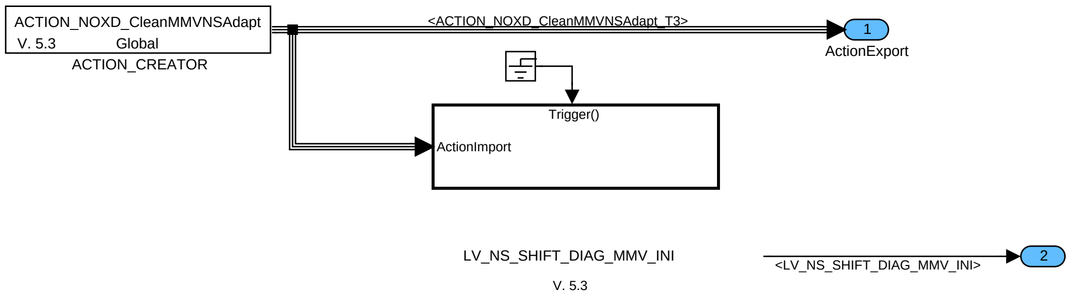

Figure B.127.12: :

B.127.4.1 No title given

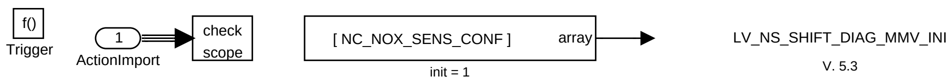

Figure B.127.13: :

B.127.5 Detailed description for Action: ACTION_NOXD_WriteMMVNSExtAdj

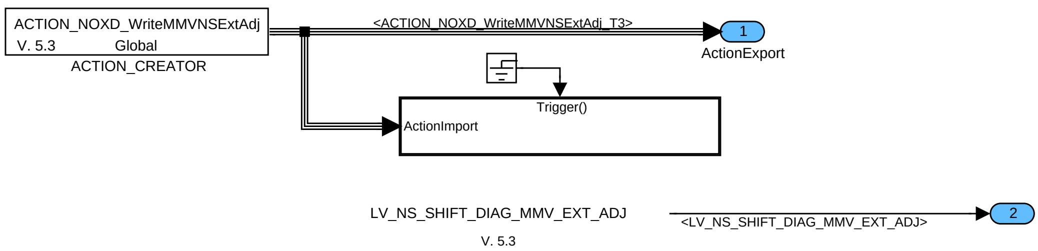

Figure B.127.14: :

B.127.5.1 No title given

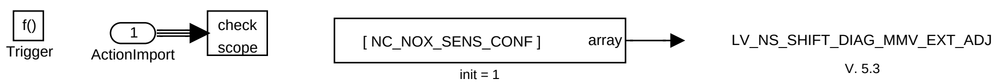

Figure B.127.15: :

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B.128 NOx sensor setpoint shift diagnosis manager

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_NS_SHIFT_CYC [NC_NOX_SENS_CONF]	O/V/S	0... FFFFH	0... 65535	1	-
Counter of finished NOx signal shift diagnosis					
CTR_NS_SHIFT_CYC_NOT_VLD [NC_NOX_SENS_CONF]	V	0... FFH	0... 255	1	-
Counter for not valid diagnosis cycles					
CTR_NS_SHIFT_CYC_VLD [NC_NOX_SENS_CONF]	V	0... FFH	0... 255	1	-
Counter of valid diagnosis cycles					
CTR_NS_SHIFT_DIAG_INH	V	0... FFH	0... 255	1	-
Counter of successful regenerations					
DIST_NT_NS_SHIFT [NC_NOX_SENS_CONF]	O/V/S	0... FFFFH	0... 524280	8	km
Distance between two active NOx signal diagnosis					
FCO_DELTA_NS_SHIFT [NC_NOX_SENS_CONF]	O/V	0... FFFFFFFFH	0... 4294970000	1	µl
Additional fuel consumption for NOx signal shift diagnosis					
LAMB_NS_MMV_NS_SHIFT [NC_NOX_SENS_CONF]	V	0... 7FFFFFFFH	0... 31.9999999851	14.9012e-9	-
Filtered LAMB_NS signal					
LAMB_NS_MMV_NS_SHIFT_DIF_ABSV [NC_NOX_SENS_CONF]	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Absolut value of difference between filtered and origin LAMB_NS signals					
LV_DIAG_ACT_CDN_DYN_NS_TMP [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Dynamic activation conditions for the shift diagnosis due to NOx Sensor check					
LV_DIAG_ACT_CDN_DYN_TMP	V	0... 1H	0 ...1	1	-
Dynamic activation conditions for the shift diagnosis					
LV_DIAG_ACT_CDN_STAT_NS_TMP [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Static activation conditions for the shift diagnosis due to NOx Sensor check					
LV_DIAG_ACT_CDN_STAT_TMP	V	0... 1H	0 ...1	1	-
Static activation conditions for the shift diagnosis					
LV_DIAG_ACT_CDN_SUM [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Summary activation conditions for the shift diagnosis					
LV_DIAG_ACT_CDN_VLS_DOWN_TMP	V	0... 1H	0 ...1	1	-
Dynamic activation conditions for the shift diagnosis					
LV_DIAG_NS_SHIFT_END [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
The diagnosis was executed last time					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_REQ_NS_SHIFT [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Request for NOx sensor for active signal shift diagnosis					
LV_END_DIAG_NS_SHIFT_MNG_OLD [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Old value of LV_END_DIAG_NS_SHIFT					
LV_ERR_NS_SHIFT_MNG_OLD [NC_NOX_SENS_CONF]	-	0... 1H	0 ...1	1	-
Old value of LV_ERR_NS_SHIFT					
LV_LAMB_REQ_DEAC_NS [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Deactivation combustion request due to NOx sensor binary signal					
LV_NS_SHIFT_CMB_INT_REQ	O/V	0... 1H	0 ...1	1	-
Request for combustion managment					
LV_NS_SHIFT_CMB_INT_REQ_SNG [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Request for combustion managment, NOx sensor specific					
LV_NS_SHIFT_DIAG_ACT_EXT_ADJ [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Activation of the diagnosis by service tool					
LV_NS_SHIFT_DIAG_DEAC_EXT_ADJ [NC_NOX_SENS_CONF]	V	0... 1H	0 ...1	1	-
Manual deactivation of the diagnosis by service tool					
LV_NS_SHIFT_DIAG_EXT_ADJ [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
External adjustment values for NOx signal shift diagnosis available					
LV_NS_SHIFT_DIAG_INI [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Initialization of NOx signal shift diagnosis variables					
MAF_CYL_INT_NS_SHIFT	V	0... FFFFH	0... 1820.41666667	0.0277778	g
MAF integral for inhibition of the diagnosis after PUC phase					
MAF_CYL_INT_NS_SHIFT_DYN [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 1820.41666667	0.0277778	g
MAF integal during limited dynamics are fulfilled					
MAF_MMV_NS_SHIFT	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Filtered MAF signal					
MAF_MMV_NS_SHIFT_DIF_ABSV	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Absoult value of limited dynamic value of MAF					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_EOL_KWP_NS_SHIFT_DIAG [NC_NOX_SENS_CONF]	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H	NOT_START ST_INH PAR_NOT_ PLAUS WAIT_REL UNDEF ACT END_WOUT_ RESULT ABORTED END_WOUT_ ERR END_WITH_ ERR	-	-
State of NOx-SensorShiftDiagnosis					
STATE_NS_SHIFT_CMB_REQ	O/V	0... FFFFH	0... 65535	1	-
Requested mode for combustion manager					
STATE_NS_SHIFT_DIAG [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 65535	1	-
NOx signal shift diagnosis state					
T_AFL_NS_SHIFT_DIAG_INH	V	0... FFFFH	0... 6553.5	0.1	s
Time since last successful regeneration					
T_NS_SHIFT_CMB_INT_REQ	V	0... FFFFH	0... 6553.5	0.1	s
Time for calculation of combustion request					
T_NS_SHIFT_CMB_INT_REQ_SUM	V	0... FFFFH	0... 6553.5	0.1	s
Timer of active request in one DC					
T_NS_SHIFT_DEAC_SO2P	V	0... FFFFH	0... 6553.5	0.1	s
Timer after desulphurization					
T_NS_SHIFT_DEAC_TEMP [NC_NOX_SENS_CONF]	V	0... 9F6H	0... 255	0.1	s
Timer for activation of the NOx signal shift diagnosis after set of the dew point					
T_NS_SHIFT_READY_WAIT [NC_NOX_SENS_CONF]	V	0... FFH	0... 25.5	0.1	s
Timer for waiting for sensor readiness					
T_NS_SHIFT_WAIT_REP [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for repetition of NOx signal shift diagnosis					
T_NS_SHIFT_WAIT_REP_REQ [NC_NOX_SENS_CONF]	V	0... FFFFH	0... 6553.5	0.1	s
Timer for repetition of NOx signal shift diagnosis combustion request					
TQI_MMV_NS_SHIFT	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Filtered TQI_AV_signal					
TQI_MMV_NS_SHIFT_DIF_ABSV	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Absoult value of limited dynamic value of TQI					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VLS_DOWN_MMV_NS_SHIFT [NC_CBK_EX_NR]	V	0... FFFFH	0... 4.99992371	76.2939e-6	V
Filtered VLS_DOWN signal					
VLS_NS_MMV_NS_SHIFT [NC_NOX_SENS_CONF]	V	80000000... 7FFFFFFFH	-1200... 1199.99999944	558.794e-9	mV
Filtered VLS_NS_REF_MMV_NS_SHIFT signal					
VLS_NS_MMV_NS_SHIFT_DIF_ABSV [NC_NOX_SENS_CONF]	V	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Absoult value of difference between first and second filtered VLS_NS signal					
VLS_NS_REF_CHK_DIAG_VLD [NC_NOX_SENS_CONF]	V	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Reference VLS_NS signal for check of the diagnosis validity					
VLS_NS_REF_MMV_NS_SHIFT [NC_NOX_SENS_CONF]	V	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Filtered VLS_NS signal					
VLS_NS_REF_MMV_NS_SHIFT_MAX [NC_NOX_SENS_CONF]	V	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Maximum reference value for check validation of the NOx sensor binary signal					
VLS_NS_REF_MMV_NS_SHIFT_MIN [NC_NOX_SENS_CONF]	V	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Minimum reference value for check validation of the NOx sensor binary signal					

Input data:

AMP {p. 982}	CTR_NS_SHIFT_CYC_EXT_ADJ [NC_NOX_SENS_CONF] {p. 7679}	DIST_NS_NEW {p. 3193}	DIST_NT {p. 3180}
DIST_NT_NS_SHIFT_EXT_ADJ [NC_NOX_SENS_CONF] {p. 7679}	EFF_CAT_DIAG_HOM [NC_CBK_EX_NR] {p. 5473}	FCO {p. 3846}	FCO_AV_1 {p. 3846}
FCO_AV_2 {p. 3846}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_NS [NC_NOX_SENS_CONF] {p. 991}	LV_END_DIAG_NS_SHIFT [NC_NOX_SENS_CONF] {p. 6412}
LV_ERR_NS_SHIFT [NC_NOX_SENS_CONF] {p. 6412}	LV_INH_DIAG_NS_OBD_2_SHIFT [NC_NOX_SENS_CONF] {p. 6468}	LV_LAM_ADJ_ACT [NC_CBK_EX_NR] {p. 2589}	LV_NS_AD_REQ {p. 3189}
LV_PUC {p. 1720}	LV_RGN_NT_REQ {p. 2983}	LV_SENS_AFR [NC_NT_NR] {p. 2983}	LV_SO2P_REQ {p. 3129}
LV_TEMP_NS_OK [NC_NOX_SENS_CONF] {p. 991}	MAF {p. 8277}	MAF_CYL {p. 8277}	N_32 {p. 1525}
NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_NOX_SENS_CONF {p. 643}	NOX_NS_AD [NC_NOX_SENS_CONF] {p. 3193}

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NOX_NS_DIAG [NC_NOX_SENS_CONF] {p. 992}	NT_AGI_THERMO {p. 3073}	NTLD {p. 2986}	O2L_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5562}
OPM_AV {p. 8137}	OPM_REQ_CUS {p. 8137}	STATE_NOX {p. 2986}	STATE_NS [NC_NOX_SENS_CONF] {p. 1381}
T_AST_SAE {p. 1766}	TCO_ST {p. 1100}	TCO_ST_DC {p. 1100}	TIA {p. 1226}
TNT_MDL_MV {p. 8237}	TQI_AV {p. 981}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_NS [NC_NOX_SENS_CONF] {p. 992}
VS {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_MIN_NS_SHIFT_DIAG_ACT	-	0... FFFFH	0... 5434	0.0829175	hPa
Minimum ambient presure for activation of the diagnosis					
C_CRLC_LAMB_NS_MMV_NS_SHIFT	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for LAMB_NS filtering					
C_CRLC_MAF_MMV_NS_SHIFT	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for MAF filtering					
C_CRLC_TQI_MMV_NS_SHIFT	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for TQI filtering					
C_CRLC_VLS_DOWN_MMV_NS_SHIFT	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for VLS_DOWN filtering					
C_CRLC_VLS_NS_MMV_NS_SHIFT	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for VLS_NS second filtering					
C_CRLC_VLS_NS_REF_MMV_NS_SHIFT	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Correlation factor for VLS_NS first filtering					
C_CTR_NS_SHIFT_CYC_NOT_VLD_EXT	-	0... FFH	0... 255	1	-
Maximal number of additional not valid diagnosis cycles - valid at activation by service tool					
C_CTR_NS_SHIFT_CYC_NOT_VLD_MAX	-	0... FFH	0... 255	1	-
Maximal number of additional not valid diagnosis cycles					
C_CTR_NS_SHIFT_CYC_VLD_EXT	-	0... FFH	0... 255	1	-
Maximal number of additional valid diagnosis cycles - valid at activation by service tool					
C_CTR_NS_SHIFT_CYC_VLD_MAX	-	0... FFH	0... 255	1	-
Maximal number of additional valid diagnosis cycles					
C_CTR_THD_NS_SHIFT_DIAG_INH	-	0... FFH	0... 255	1	-
Minimum number of successful regenerations for activation of the NOx signal shift diagnosis					
C_DIST_NT_NS_SHIFT_MIN	-	0... FFFFH	0... 524280	8	km
Minimum distance between two active NOx signal diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DIST_NT_NS_SHIFT_MIN_NEW	-	0... FFFFH	0... 524280	8	km
Minimum distance for activation first active NOx signal diagnosis					
C_EFF_CAT_MAX_DIAG_HOM_NS_SHIFT [NC_CBK_EX_NR]	-	0... FFH	0... 1.9921875	7.8125e-3	-
Maximum homogeneous catalyst diagnosis value for activation of the diagnosis					
C_FAC_AGI_MIN_THERMO_NS_SHIFT	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Minimum thermal aging factor of NT for activation of the diagnosis					
C_LAMB_MAX_NS_SHIFT_DIAG_ACT	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Maximum lambda threshold for activation of the NOx signal shift diagnosis					
C_LAMB_MIN_NS_SHIFT_DIAG_ACT	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Minimum lambda threshold for activation of the NOx signal shift diagnosis					
C_LAMB_NS_MMV_THD_LDC_ABSV	-	0... FFFFH	0... 31.9995117188	488.281e-6	-
Limited dynamic threshold for LAMB_NS signal					
C_LAMB_NS_THD_NS_SHIFT_MAX	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Maximum NOx sensor lambda signal for activation of the diagnosis					
C_LAMB_NS_THD_NS_SHIFT_MIN	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Minimum NOx sensor lambda signal for activation of the diagnosis					
C_MAF_CYL_INT_NS_SHIFT_INI	-	0... FFFFH	0... 1820.41666667	0.0277778	g
Initialization value of MAF integral after PUC phase					
C_MAF_MMV_THD_NS_SHIFT	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Threshold for limited dynamic of MAF					
C_MAF_THD_MAX_NS_SHIFT	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Upper MAF threshold for activation of the diagnosis					
C_MAF_THD_MIN_NS_SHIFT	-	0... FFFFH	0... 2047.96875	0.03125	kg/h
Lower MAF threshold for activation of the diagnosis					
C_N_32_MAX_NS_SHIFT_DIAG_ACT	-	0... FFH	0... 8160	32	rpm
Maximum N_32 value for activation of the diagnosis					
C_N_32_MIN_NS_SHIFT_DIAG_ACT	-	0... FFH	0... 8160	32	rpm
Minimum N_32 value for activation of the diagnosis					
C_NOX_MAX_NS_SHIFT_DIAG_ACT	-	FF9C... 5DCH	-100 ...1500	1	ppm
Maximum value of NOX signal for activation of the diagnosis					
C_NTLD_THD_MAX_NS_SHIFT	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Allowed NOx trap loading grad for activation of the NOx signal shift diagnosis					
C_NTLD_THD_MAX_NS_SHIFT_ACT_REQ	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Allowed NOx trap loading degree for active NOx signal shift diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_NTLD_THD_MIN_NS_SHIFT_ACT_REQ	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Minimum allowed NOx trap loading degree for active NOx signal shift diagnosis					
C_NTLD_THD_NS_SHIFT_DIAG_INH	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
Minimum NTLD value for recognition of long lean phase					
C_O2L_CAT_MIN_DIAG_AFL_NS_SHIFT [NC_CBK_EX_NR]	-	0... FFFFH	0... 2.61684895833	39.9306e-6	g
Minimum lean catalyst diagnosis value for activation of the diagnosis					
C_STATE_NS_REP_INI_NS_SHIFT	-	0... FFH	0... 255	1	-
Initialization of repetition timer in state DIAG					
C_STATE_NS_SHIFT_CMB_REQ	-	0... FFFFH	0... 65535	1	-
Combustion mode request for NOx signal internal shift diagnosis					
C_T_AFL_THD_NS_SHIFT_DIAG_INH	-	0... FFFFH	0... 6553.5	0.1	s
Minimum lean time since last successful regeneration for inhibition of the NOx signal shift diagnosis					
C_T_MIN_NS_SHIFT_DEAC_SO2P	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for inhibition of the diagnosis after desulphurization					
C_T_NS_SHIFT_CMB_INT_REQ_MAX	-	0... FFFFH	0... 6553.5	0.1	s
Maximum time for set of combustion request for NOx signal shift diagnosis					
C_T_NS_SHIFT_CMB_MAX_NS_CHK	-	0... FFFFH	0... 6553.5	0.1	s
Waiting time for valid binary NOx sensor signal					
C_T_NS_SHIFT_DEAC_TEMP_MIN	-	0... 9F6H	0... 255	0.1	s
Minimum time for activation of the NOx signal shift diagnosis after set of dew point					
C_T_NS_SHIFT_READY_WAIT_MAX	-	0... FFH	0... 25.5	0.1	s
Maximum time for waiting for NOx sensor readiness for diagnosis					
C_T_NS_SHIFT_WAIT_REP_MIN	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for repetition of the NOx sensor shift diagnosis					
C_T_NS_SHIFT_WAIT_REP_MIN_REQ	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time for repetition of the HOM request for NOx sensor shift diagnosis					
C_TIA_MAX_NS_SHIFT_DIAG_ACT	-	0... FEH	-48... 142.5	0.75	°C
Maximum TIA value for activation of the diagnosis					
C_TIA_MIN_NS_SHIFT_DIAG_ACT	-	0... FEH	-48... 142.5	0.75	°C
MinimumTIA value for activation of the diagnosis					
C_TNT_THD_MAX_NS_SHIFT	-	0... FFFFH	0... 1023.984375	0.015625	°C
Upper TNT threshold for activation of the diagnosis					
C_TNT_THD_MIN_NS_SHIFT	-	0... FFFFH	0... 1023.984375	0.015625	°C
Lower TNT threshold for activation of the diagnosis					
C_TQI_MMV_THD_HOM_REQ_NS_SHIFT	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limited dynamic threshold of TQI for set of the HOM request					
C_TQI_MMV_THD_NS_SHIFT	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Threshold for limited dynamic of TQI_AV					
C_VLS_DOWN_MAX_NS_SHIFT [NC_CBK_EX_NR]	-	0... FFFFH	0... 4.99992371	76.2939e-6	V
Maximum threshold for VLS_DOWN for activation of the function					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_DOWN_MIN_NS_SHIFT [NC_CBK_EX_NR]	-	0... FFFFH	0... 4.99992371	76.2939e-6	V
Maximum threshold for VLS_DOWN for activation of the function					
C_VLS_NS_MMV_THD_LDC_ABSV	-	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Limited dynamic threshold for LAMB_NS signal					
C_VLS_NS_THD_CMB_REQ_NS_SHIFT	-	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Threshold of binary NOx sensor signal for re-activation of the combustion request					
C_VLS_NS_THD_NS_SHIFT_EXT	-	0... 578H	-200 ...1200	1	mV
Maximum threshold for VLS_NS for activation of the diagnosis, for external manual activation					
C_VLS_NS_THD_NS_SHIFT_MAX	-	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Maximum threshold for VLS_NS for activation of the diagnosis					
C_VLS_NS_THD_NS_SHIFT_MIN	-	8000... 7FFFH	-1200... 1199.96337891	0.0366211	mV
Minimum threshold for VLS_NS for activation of the diagnosis					
C_VS_MAX_NS_SHIFT_DIAG_ACT	-	0... FFH	0... 255	1	km/h
Maximum VS value for activation of the diagnosis					
C_VS_MIN_NS_SHIFT_DIAG_ACT	-	0... FFH	0... 255	1	km/h
Minimum VS value for activation of the diagnosis					
IP_FCO_DELTA_NS_SHIFT_MAX	-	0... FFFFFFFFH	0... 4294970000	1	µl
LDP_FCO_IP_FCO_DELTA_NS_SHIFT	6	0... FFFFFFFFH	0... 4294970000	1	µl
Maximal allowed additional fuel consumption for NOx signal shift diagnosis					
IP_MAF_CYL_INT_NS_SHIFT_INI_DYN	-	0... FFFFH	0... 1820.42	0.0277778	g
LDP_N_32_IP_MAF_CYL_INT_SHIFT	4	0... FFH	0... 8160	32	rpm
Initalization value of MAF integral for diagnosis activation due to limited dynamics					
IP_T_AST_MIN_NS_SHIFT	-	0... FFFFH	0... 65535	1	s
LDP_TCO_ST_IP_T_AST_MIN_SHIFT	6	0... FEH	-48... 142.5	0.75	°C
Minimum time after engine start for function activation					
IP_T_NS_SHIFT_CMB_INT_REQ_SUM	-	0... FFFFH	0... 6553.5	0.1	s
LDP_T_AST_SAE_IP_T_NS_SHIFT	6	0... FFFFH	0... 65535	1	s
Inhibition of combustion request due to total request time					
IP_VLS_NS_THD_DELTA_MAX_MMV	-	0... FFFFH	-1200... 1199.96337891	0.0366211	mV
LDPM_VLS_NS_IP_VLS_NS_VLD	4	0... FFFFH	-1200... 1199.96337891	0.0366211	mV
Threshold to check difference between maximum and actual value of binary NOx sensor signal					
IP_VLS_NS_THD_DELTA_MAX_REF	-	0... FFFFH	-1200... 1199.96337891	0.0366211	mV
LDPM_VLS_NS_IP_VLS_NS_VLD	4	0... FFFFH	-1200... 1199.96337891	0.0366211	mV
Threshold to check difference between maximum and reference of binary NOx sensor signal					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_VLS_NS_THD_DELTA_MIN_REF	-	0... FFFFH	-1200... 1199.96337891	0.0366211	mV
LDPM_VLS_NS_IP_VLS_NS_VLD	4	0... FFFFH	-1200... 1199.96337891	0.0366211	mV
Threshold to check difference between reference and minimum of binary NOx sensor signal					
LC_DIST_NT_SHIFT_DIAG_ACT	-	0... 1H	0 ...1	1	-
Activation of saving of distance value between diagnosis at writing of SAE values					
LC_LAM_ADJ_ACT_NS_SHIFT [NC_CBK_EX_NR]	-	0... 1H	0 ...1	1	-
Manual deactivation of check of trim controller					
LC_NOX_SIG_SWI	-	0... 1H	0 ...1	1	-
Manual choice of NOX signal for activation					
LC_NS_AD_REQ_MAN_DEAC	-	0... 1H	0 ...1	1	-
Manual deactivation of inhibition during NOx signal gain adaptation					
LC_NS_SHIFT_SET_HOM_REQ	-	0... 1H	0 ...1	1	-
Activation of keeping of the HOM request independently on it set conditions					
LC_SWI_REP_ENA_DIAG_END	-	0... 1H	0 ...1	1	-
Manual deactivation of check of readiness flag of the NOx signal shift OBDII diagnosis					
LC_SWI_REP_ENA_NS_SHIFT	-	0... 1H	0 ...1	1	-
Manual reinitialization of the finished diagnosis					
LC_TCO_SWI_NS_SHIFT	-	0... 1H	0 ...1	1	-
Switch between TCO_ST and TCO_ST_DC					

Action definition

ACTION_NOXD_CleanNSShiftAdapt ()	Mode: O
Initialization of NOx signal shift diagnosis values	

ACTION_NOXD_EndNNShiftDiag ()	Mode: O
Manual end of the NOx signal Shift Diagnosis	

ACTION_NOXD_StartNNShiftDiag ()	Mode: O
Manual initialization of the NOx signal Shift Diagnosis	

ACTION_NOXD_WriteNSShiftDiagExtAdj ()	Mode: O
Write external adjust values for NOx Sensor shift diagnosis	

Description for Actions

ACTION_NOXD_CleanNSShiftAdapt()
Initialization of NOx signal shift diagnosis values

ACTION_NOXD_EndNNShiftDiag()
Manual end of the NOx signal Shift Diagnosis

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ACTION_NOXD_StartNNShiftDiag()
Manual initialization of the NOx signal Shift Diagnosis

ACTION_NOXD_WriteNSShiftDiagExtAdj()
Write external adjust values for NOx Sensor shift diagnosis

General Information

Introduction of NOx signal internal setpoint shift diagnosis.
When activation conditions are fulfilled, then a request for the NOx signal shift is generated. In this case, via modification of NOx sensor internal signals the diagnosis is executed. After the NOx sensor delivered it status, the diagnosis is either finished or paused, depending on allowed length.

Description of the STATE_NS_SHIFT_DIAG actions:
PASSIVE: check of activation condition, especially combustion state
CDN: if the combustion conditions are fulfilled, switch to DIAG state is done after minimum time between two diagnoses. In case of executed maximum of valid or not valid diagnoses, switch to END state is done.
DIAG: if the combustion conditions are fulfilled, request for the diagnosis is sent to the NOx sensor. If the sensor doesn't confirm it readiness, transition to the CDN is performed and counter for not valid cycle calculated. In case of valid diagnosis cycle, transition to the END state is done
END: if maximum number of not valid or valid diagnoses is not exceeded, transition to the CDN state is done. In all other cases (except manual switch), no any transition is done and the diagnosis is finally finished

Short overview of states:

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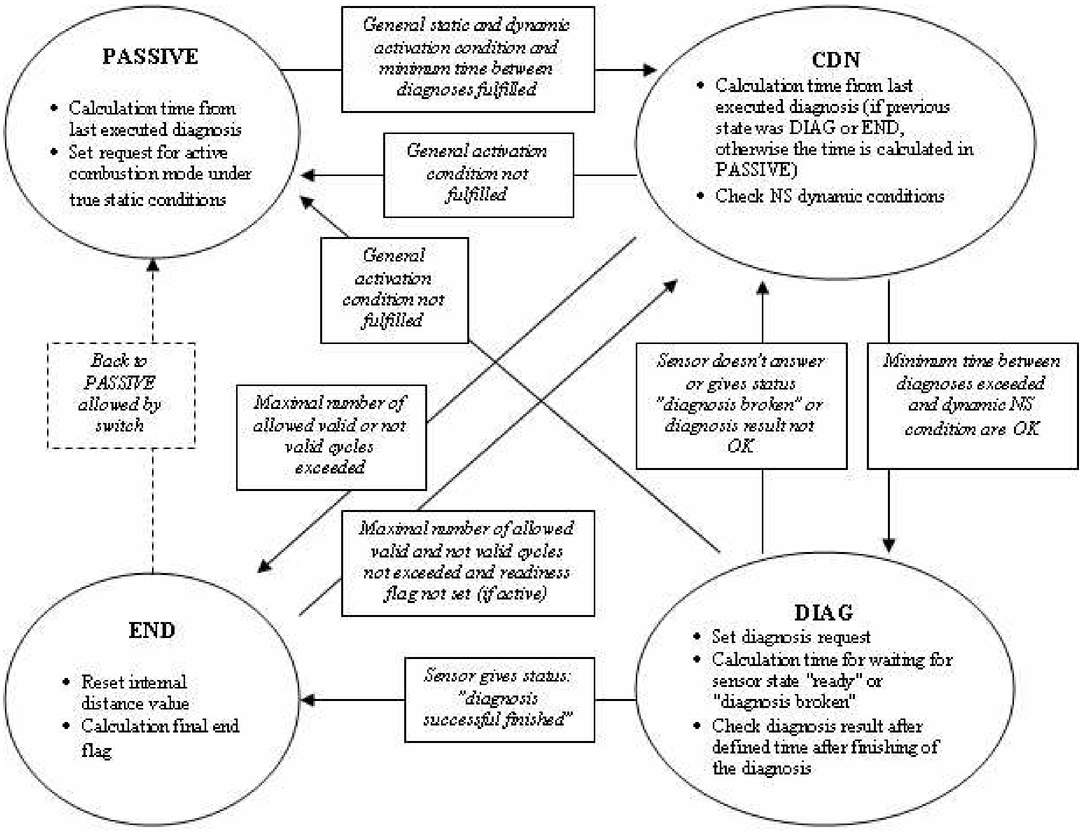
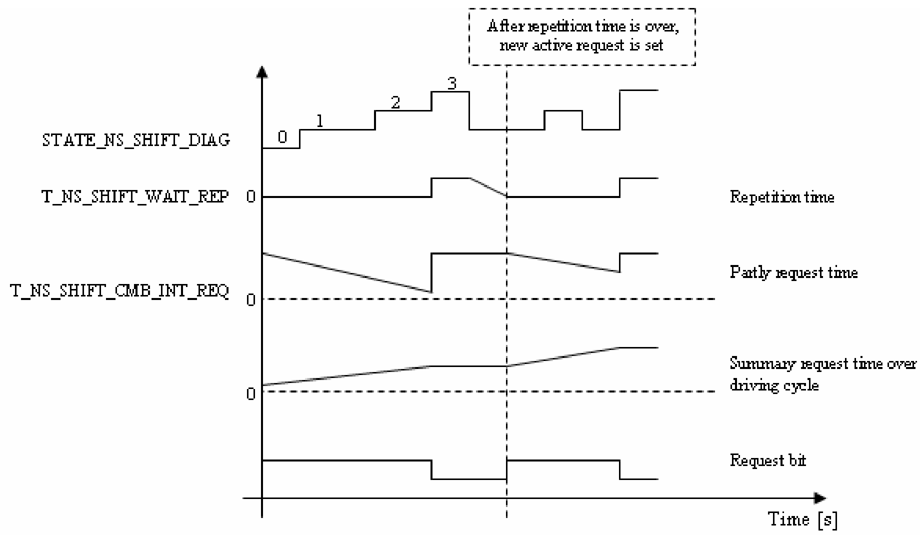


Short overview of valid and not valid counters:



Short overview of timers:

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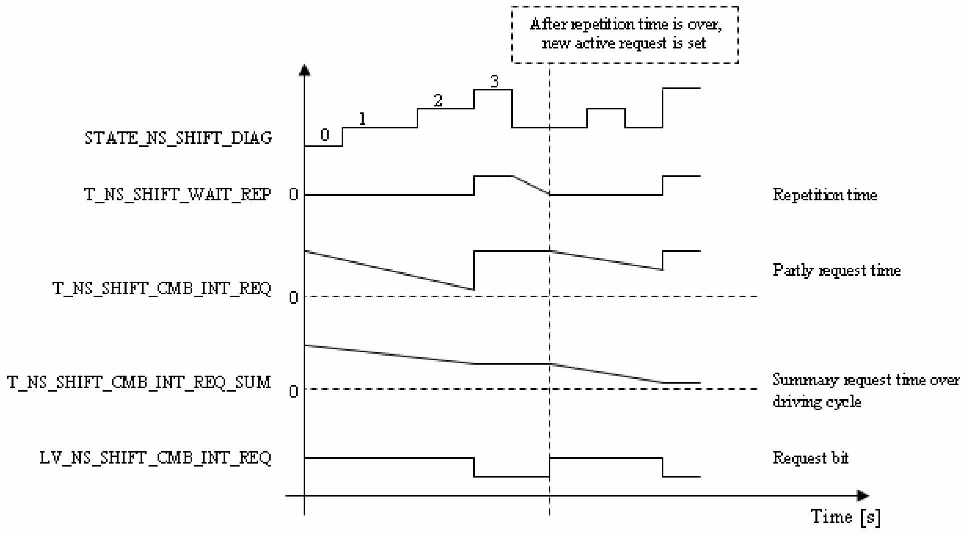

Application Conditions

Initialization: RST, NVMINI, NVMRES, NVMSTO
Recurrence: 100MS
Activation: always
Deactivation: never

Function description

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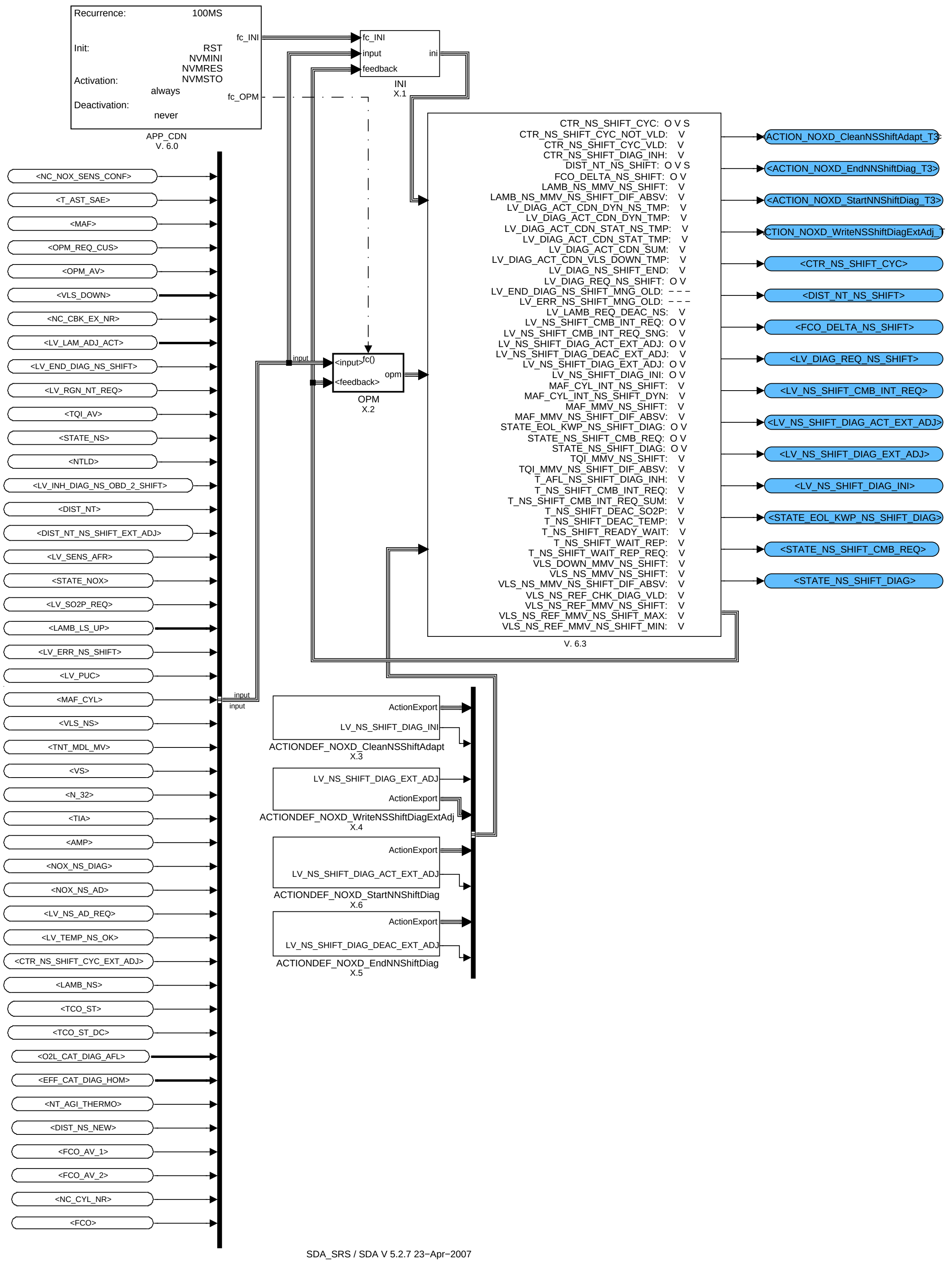

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Figure B.128.1: :

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B.128.1 INITIALIZATION

B.128.1.1 Initialization at RESET

All variables except listed below are initialized by "0"

B.128.1.1.1 List of variables which are not initialized by "0"

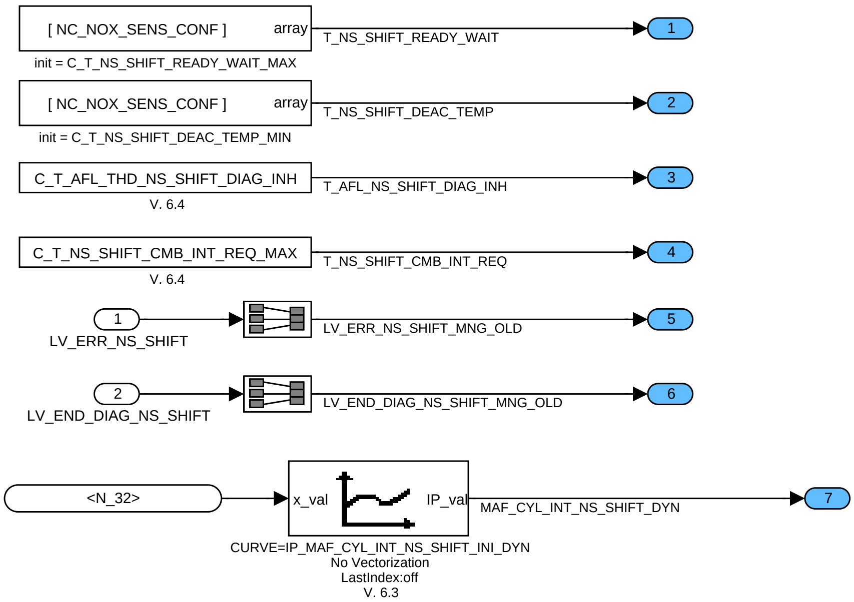

Figure B.128.2: :

B.128.1.2 Initialization of NVMY data at memory fault

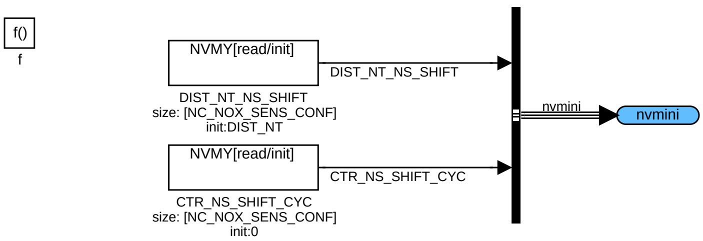

Figure B.128.3: :

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B.128.2 Formula section

B.128.2.1 General activation condition

B.128.2.1.1 Check of loading degree of the NOx storage catalyst after long lean phase

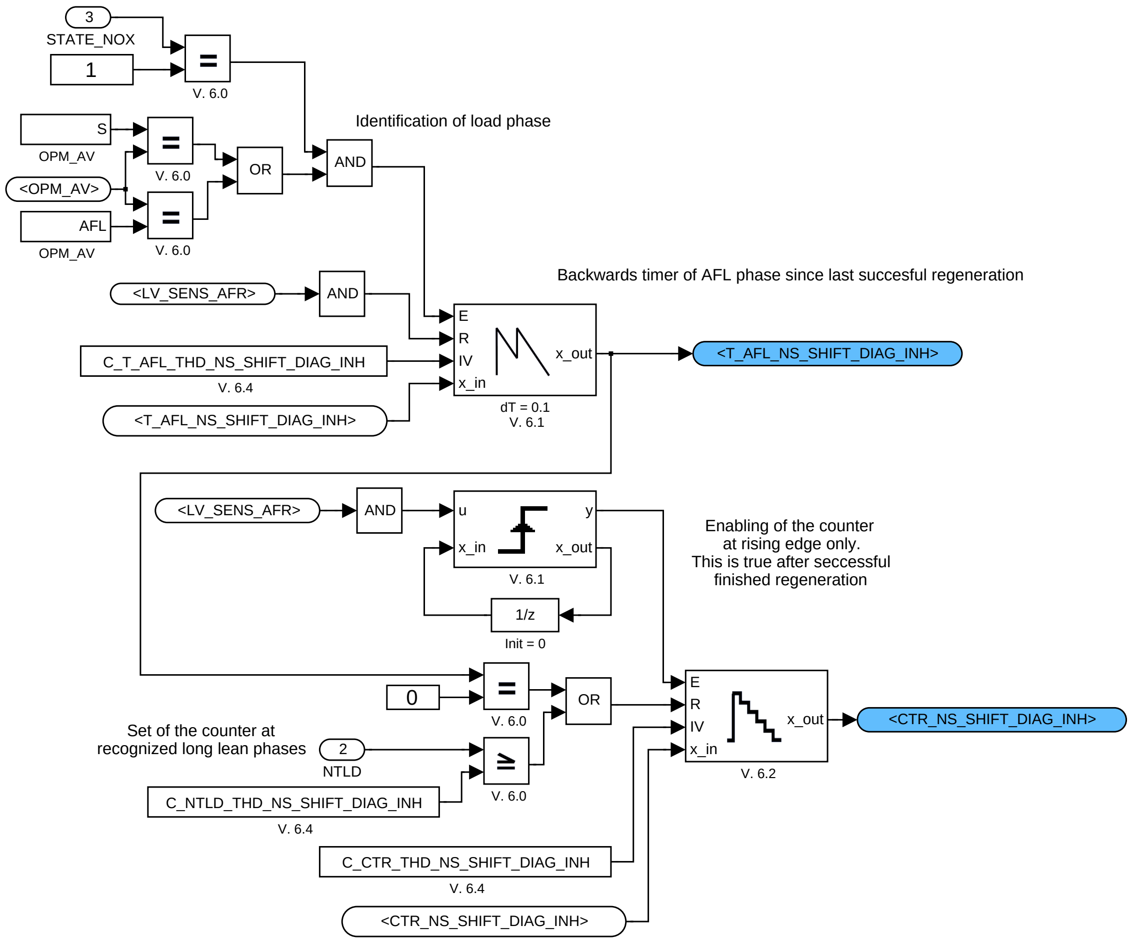

Figure B.128.4: :

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B.128.2.1.2 Calculation of limited dynamics

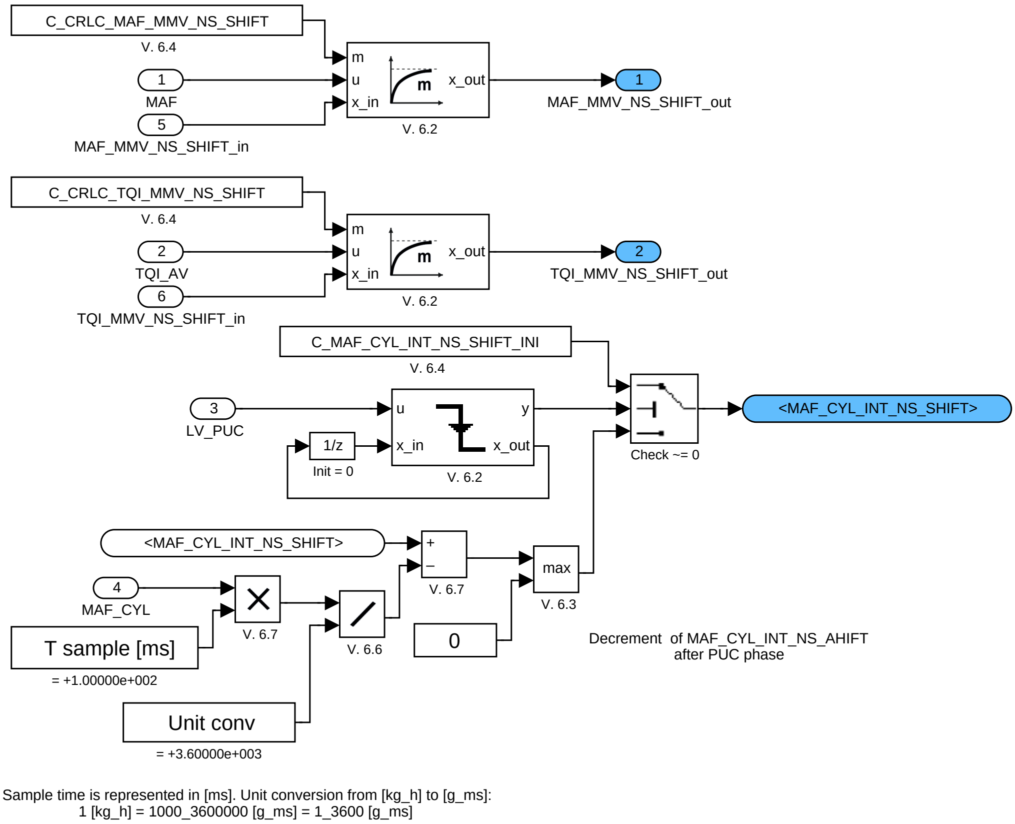

Figure B.128.5: :

B.128.2.1.3 Calculation of timer after desulphurization

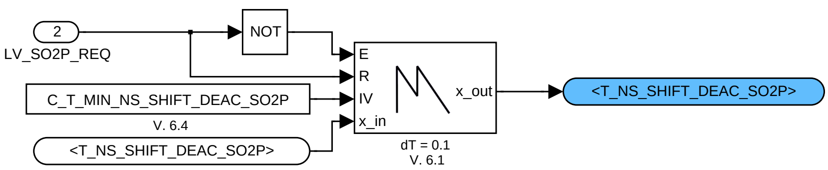

Figure B.128.6: :

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B.128.2.1.4 Check static conditions

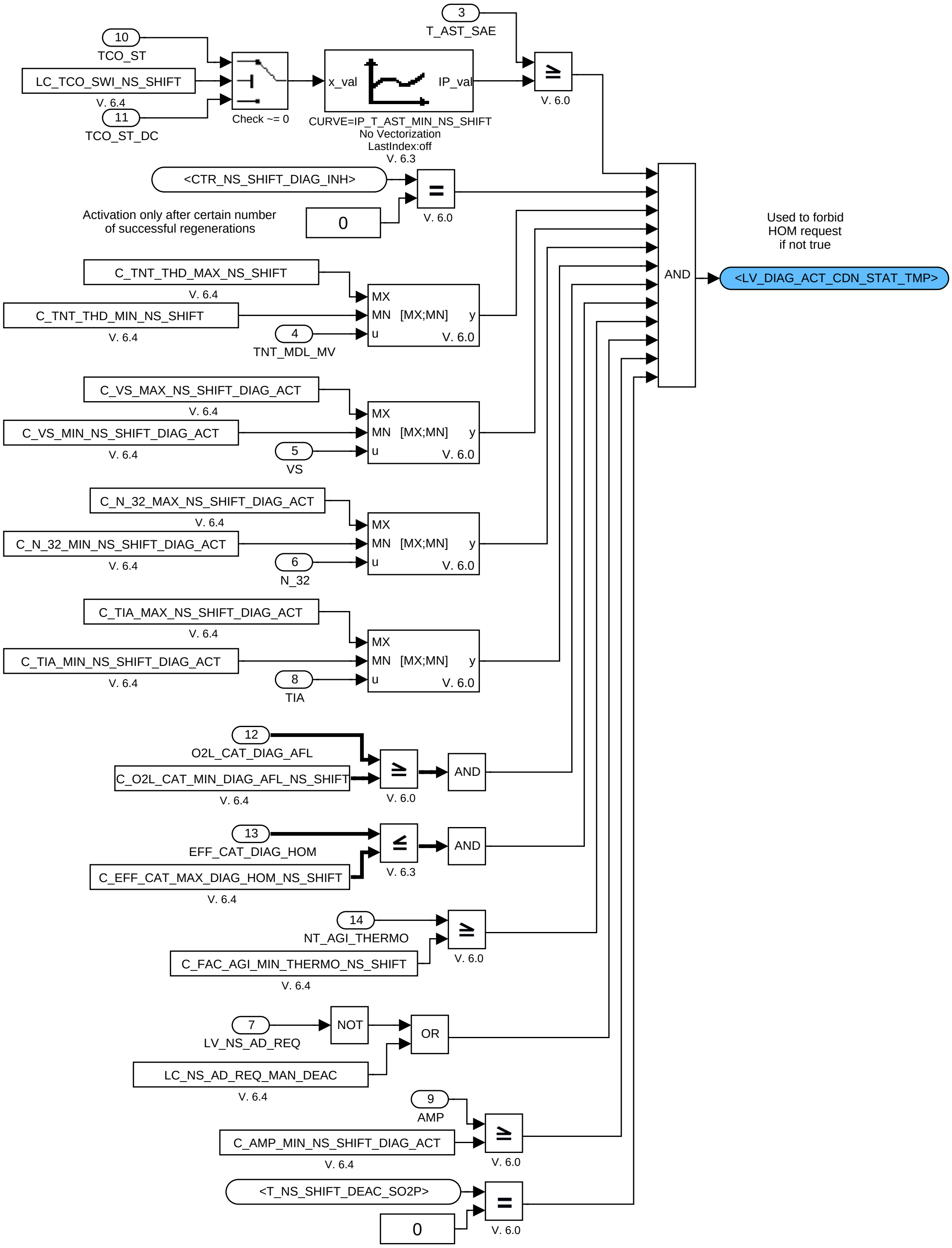

Figure B.128.7: :

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B.128.2.1.5 Dynamic conditions

B.128.2.1.5.1 Calculation dynamic conditions

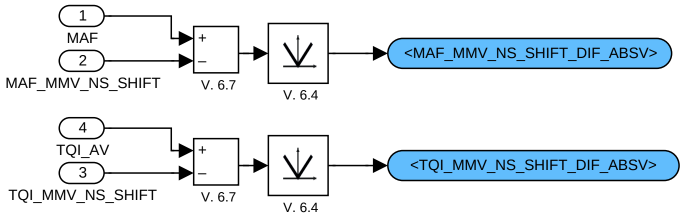

Figure B.128.8: :

B.128.2.1.5.2 Check dynamic conditions

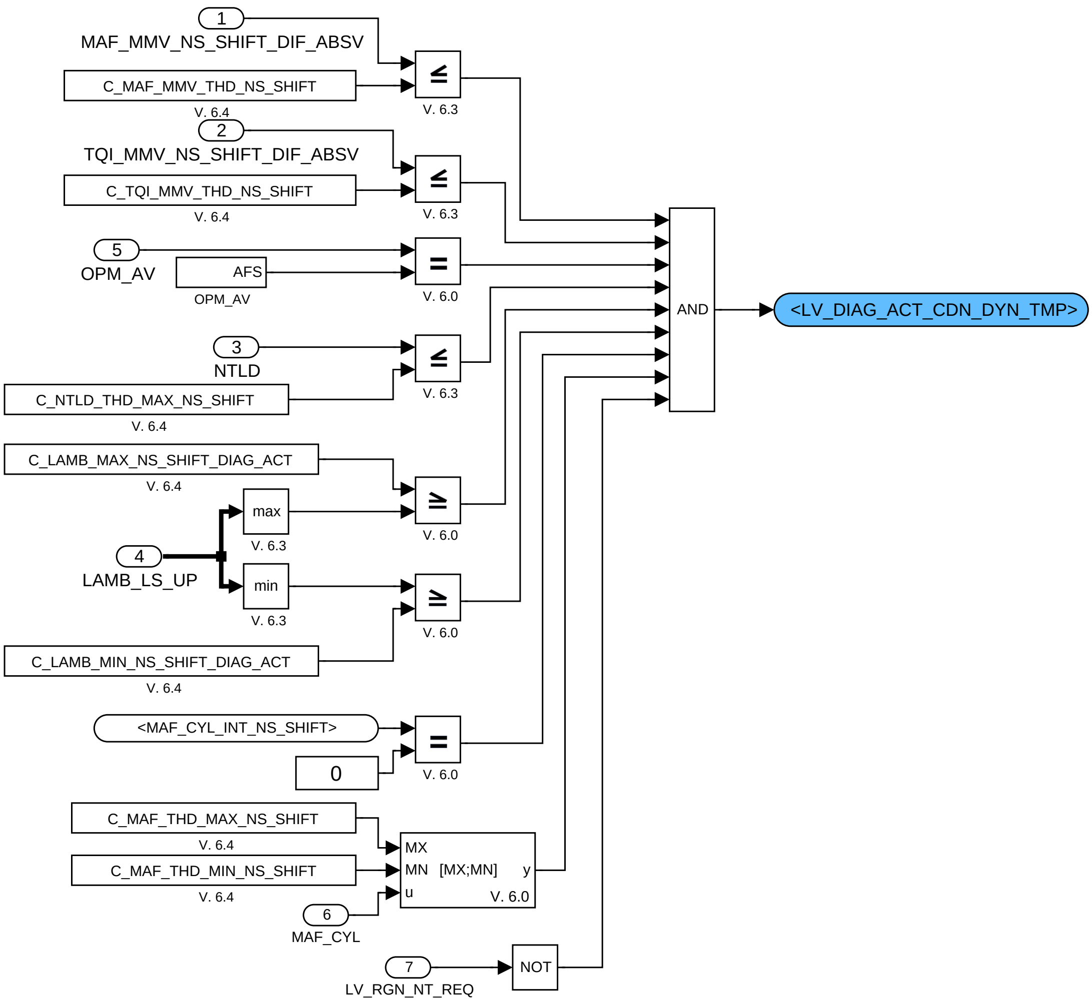

Figure B.128.9: :

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B.128.2.1.6 Introduction multiple bank system for check binary lambda signal

B.128.2.1.6.1 Check binary lambda signal after pre-catalyst

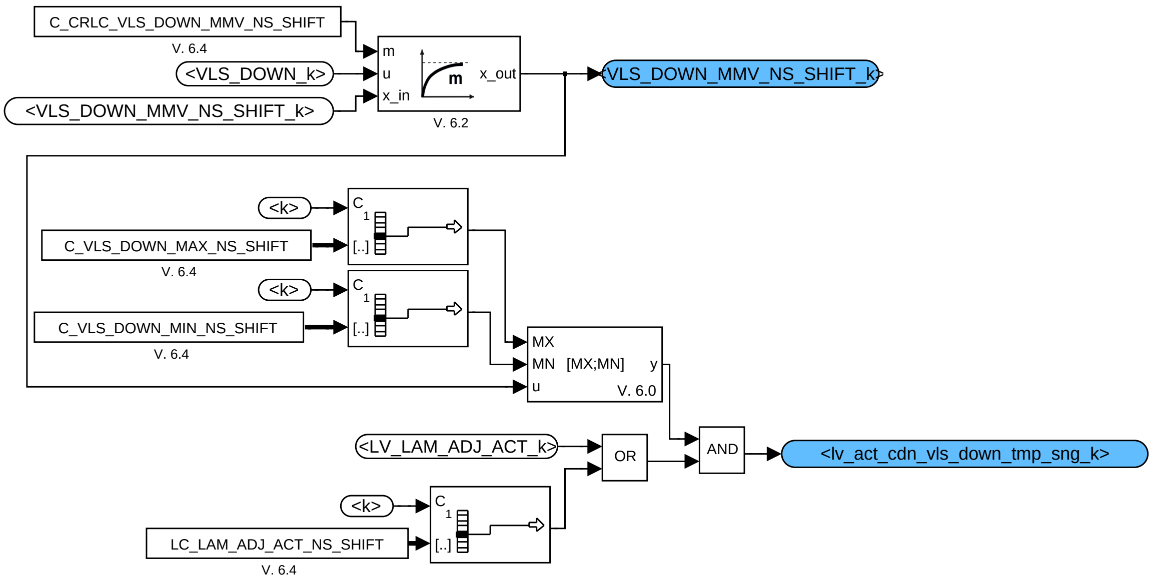

Figure B.128.10: :

B.128.2.1.7 Check activation due VLS_DOWN signal over all exhaust banks

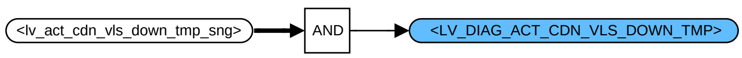

Figure B.128.11: :

B.128.2.2 Introduction multiple sensor system

B.128.2.2.1 Summary activation flag

B.128.2.2.1.1 Check static and dynamic conditions of NOx sensor signal

B.128.2.2.1.1.1 Static conditions

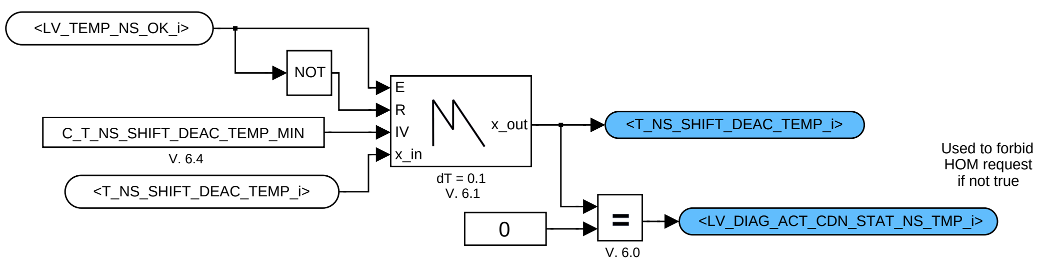

Figure B.128.12: :

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B.128.2.2.1.1.2 Filtering of the VLS_NS signal

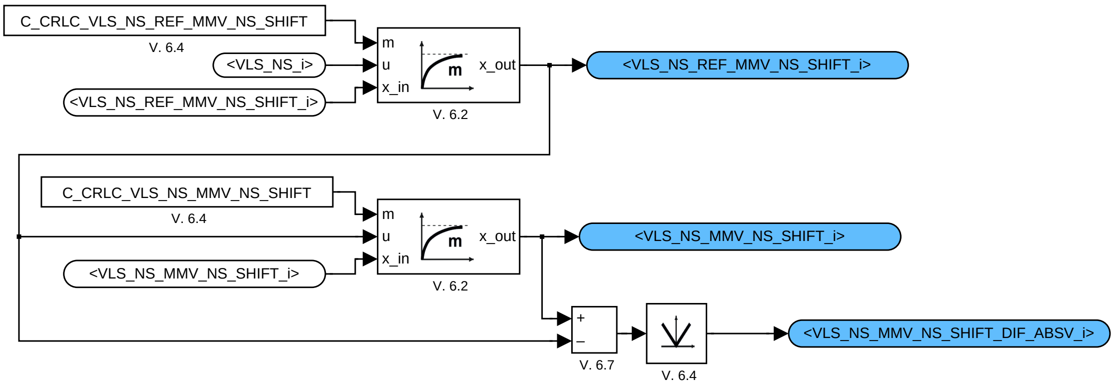

Figure B.128.13: :

B.128.2.2.1.1.3 Dynamic of NOx sensor lambda signal

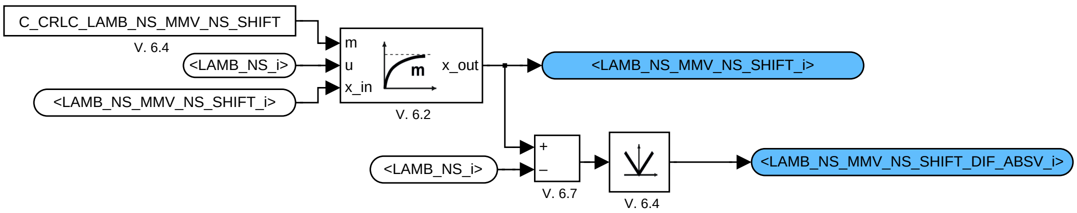

Figure B.128.14: :

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B.128.2.2.1.1.4 Calculation MAF integral at fulfilled dynamic conditions

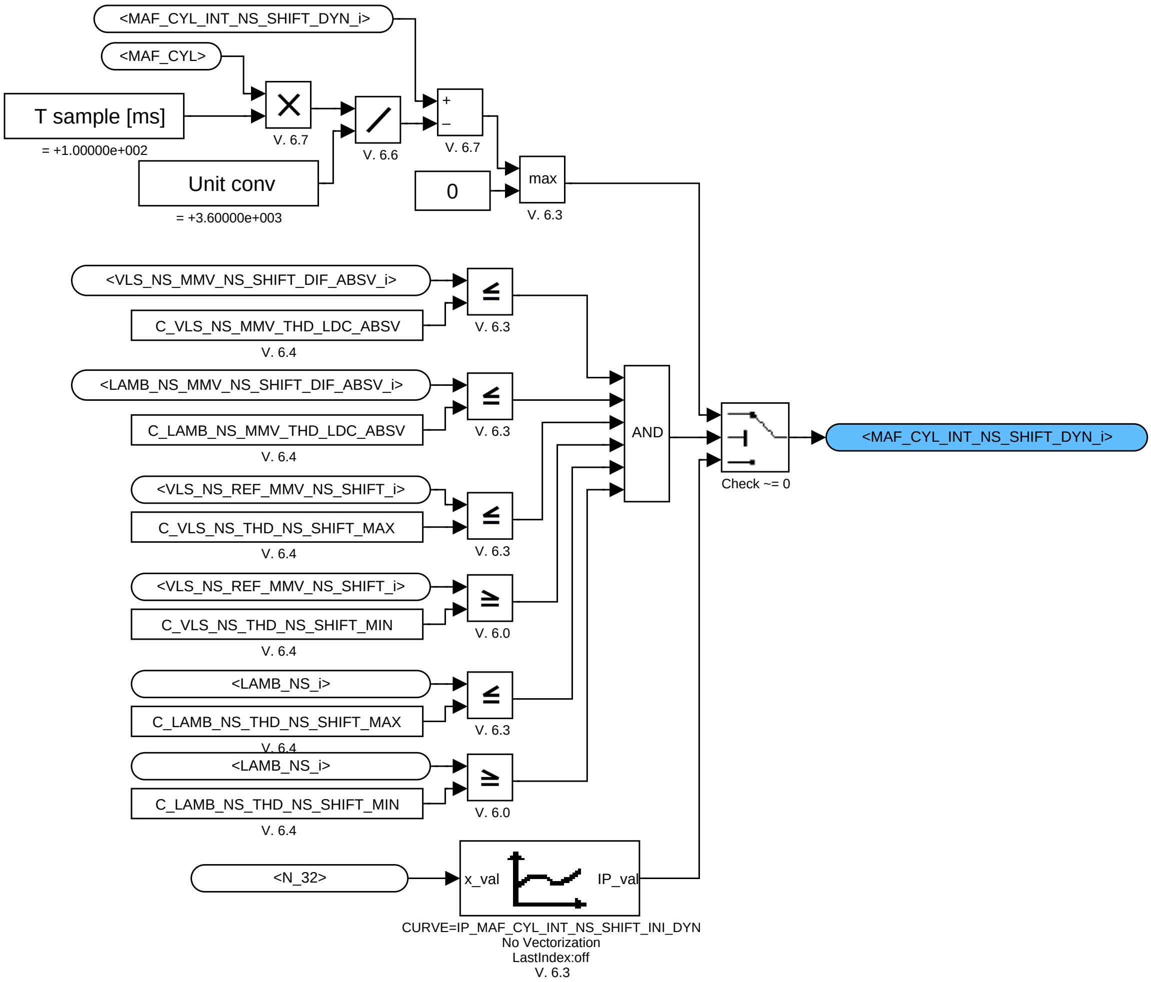

Figure B.128.15: :

B.128.2.2.1.1.5 Calculation of the repetition timer

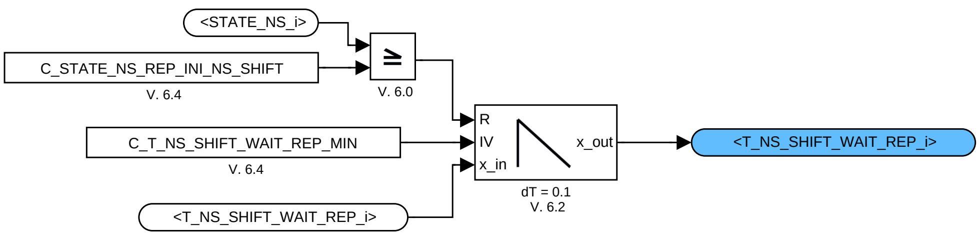

Figure B.128.16: :

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B.128.2.2.1.1.6 Final dynamic conditions

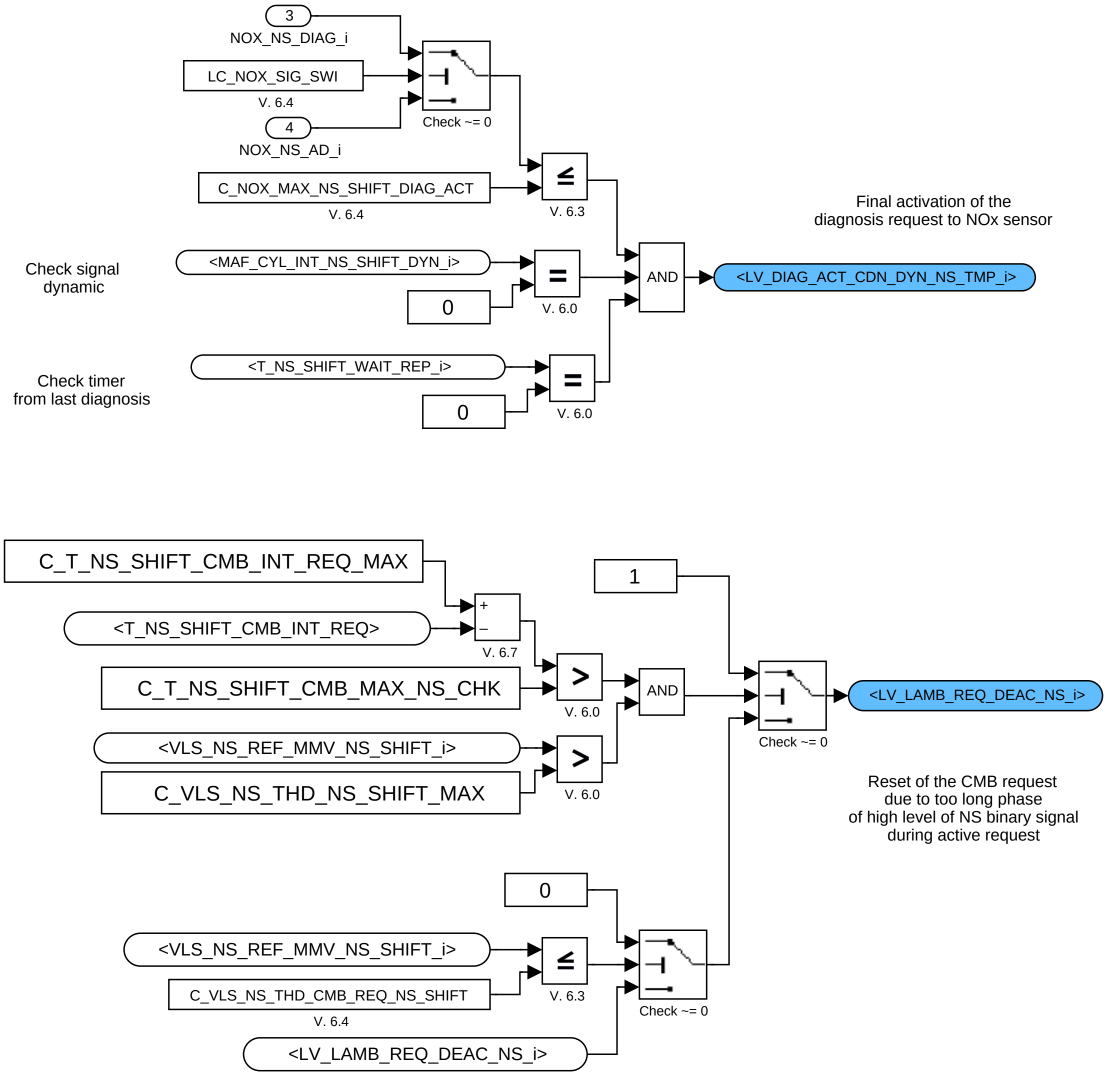

Figure B.128.17: :

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B.128.2.2.1.1.7 Calculation of additional fuel consumption for activation of combustion request

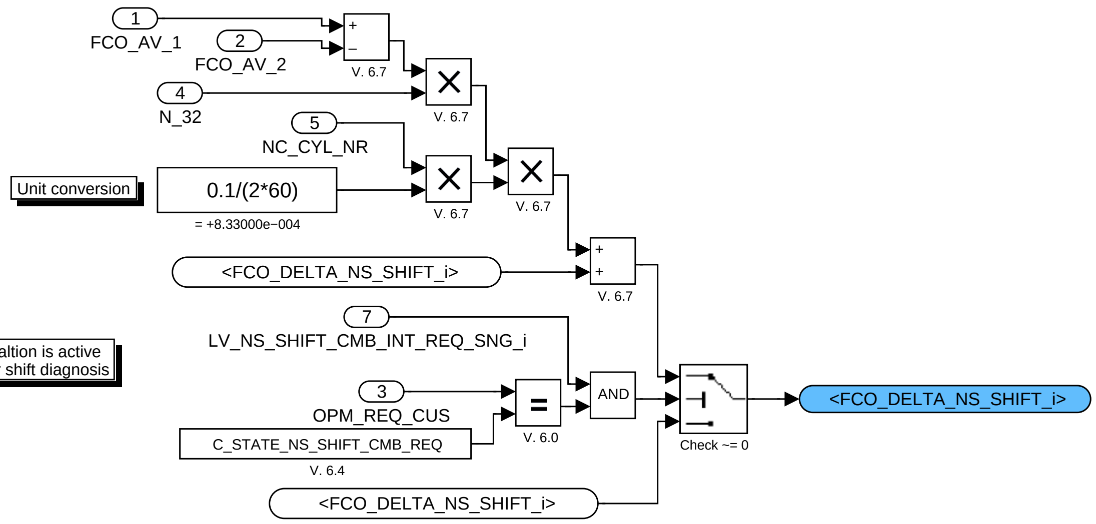

Figure B.128.18: :

B.128.2.2.1.2 Check summary activation conditions

Parallel to the common activation condition, the diagnosis can be activated by service tool

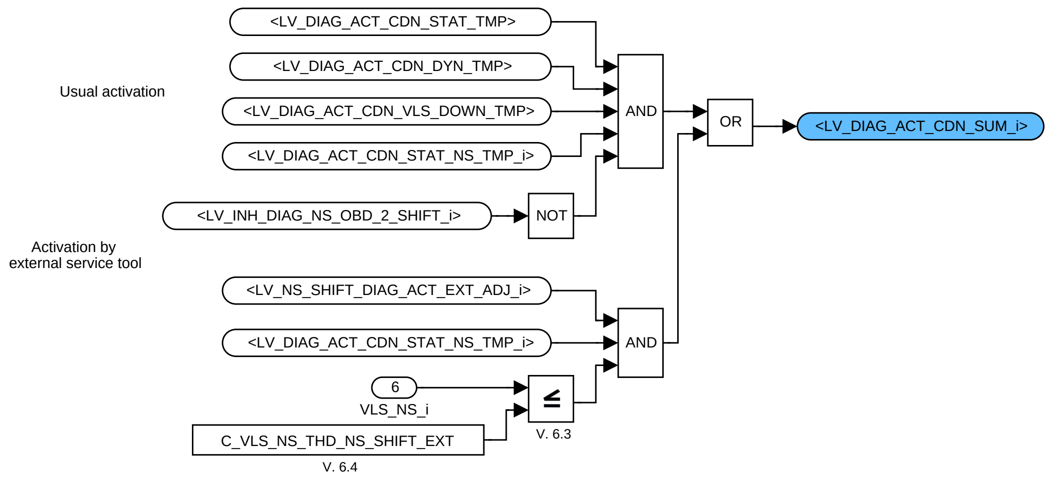

Figure B.128.19: :

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B.128.2.2.2 Check transition conditions of STATE_NS_SHIFT_DIAG

B.128.2.2.2.1 From PASSIVE

B.128.2.2.2.1.1 Check transition conditions from PASSIVE

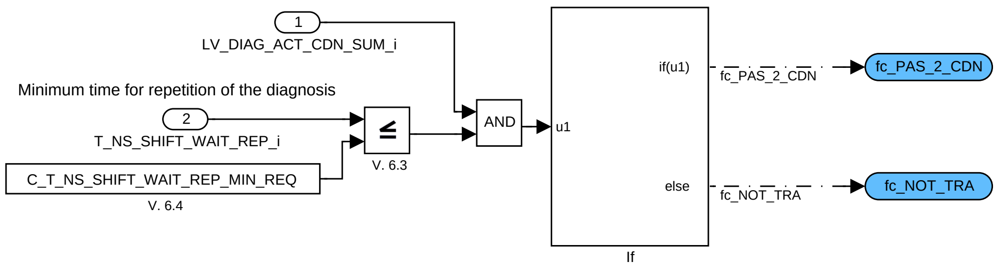

Figure B.128.20: :

B.128.2.2.2.1.2 Transition PASSIVE to CDN - actions

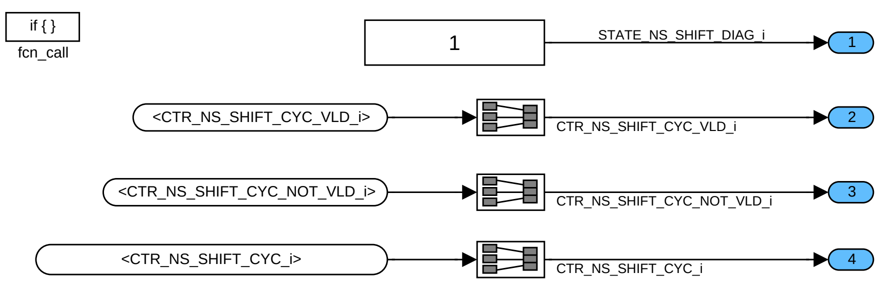

Figure B.128.21: :

B.128.2.2.2.1.3 Actions at no transition from PASSIVE

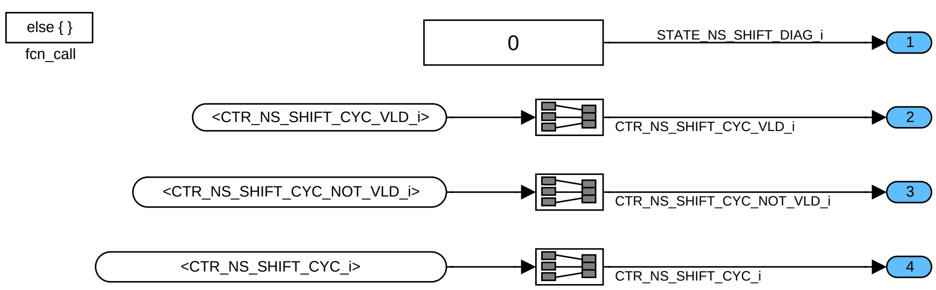

Figure B.128.22: :

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B.128.2.2.2.2 From CDN

B.128.2.2.2.2.1 Check transition conditions from CDN

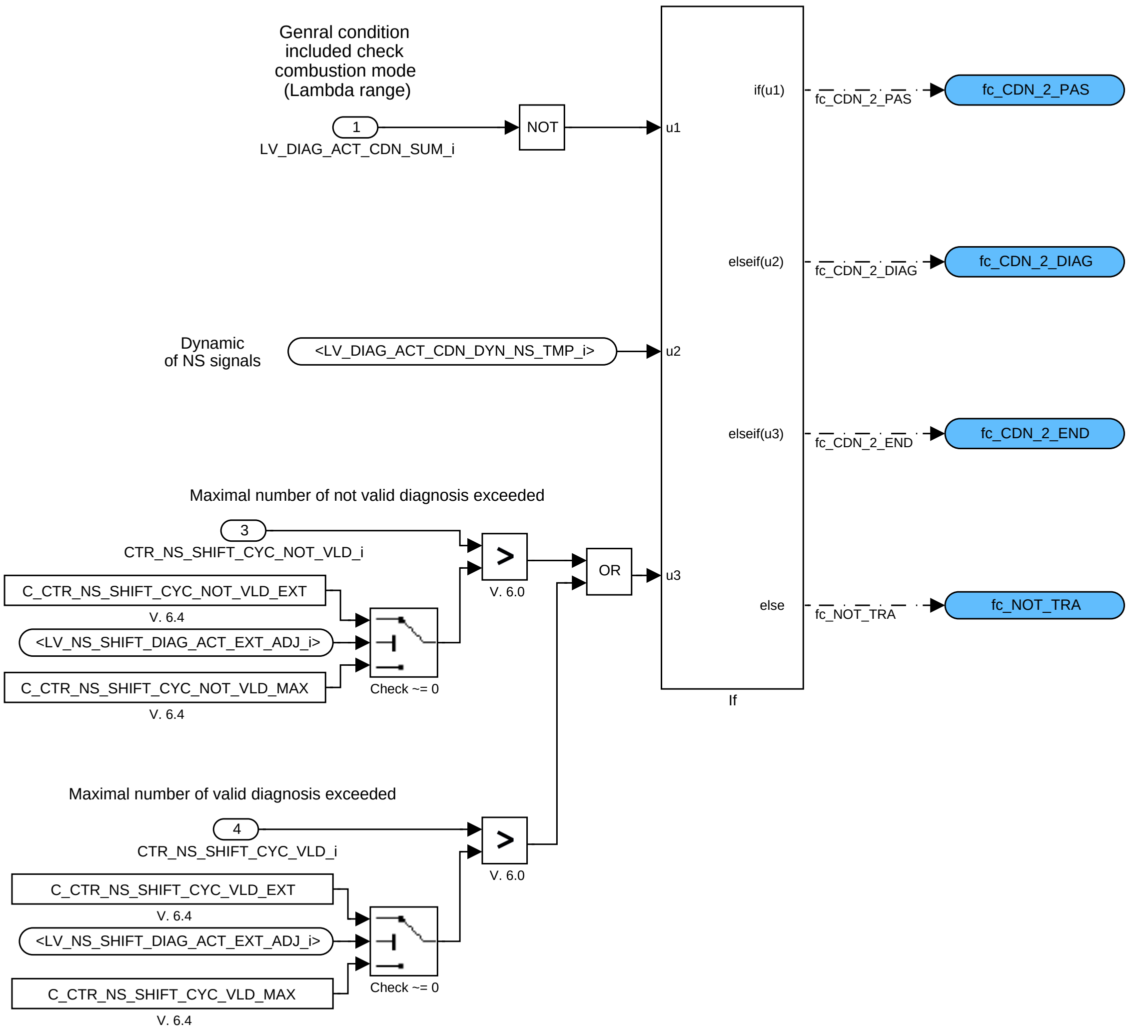

Figure B.128.23: :

B.128.2.2.2.2.2 Transition CDN to PASSIVE - actions

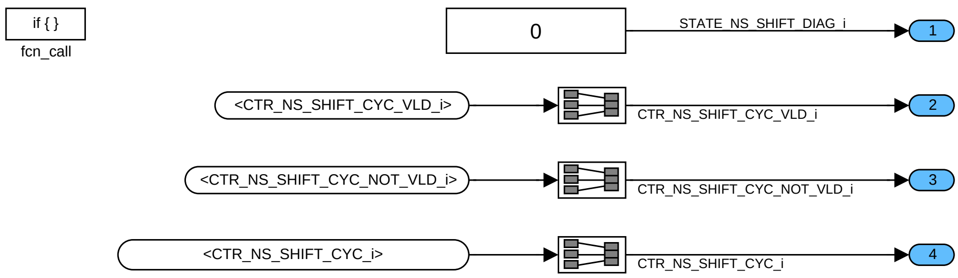

Figure B.128.24: :

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B.128.2.2.2.2.3 Transition CDN to DIAG - actions

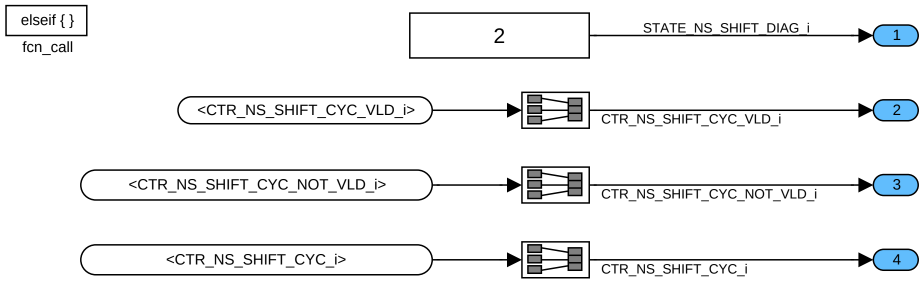

Figure B.128.25: :

B.128.2.2.2.2.4 Transition CDN to END - actions

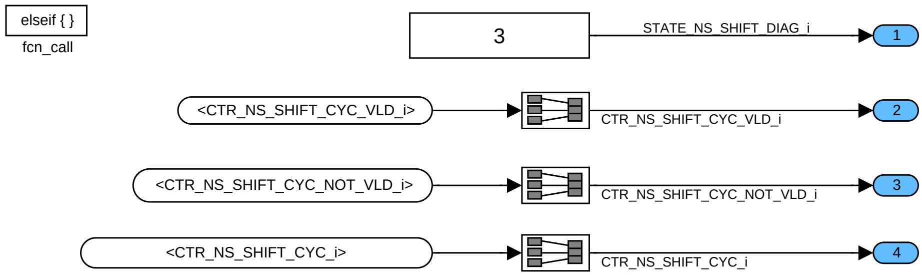

Figure B.128.26: :

B.128.2.2.2.2.5 Actions at no transition from CDN

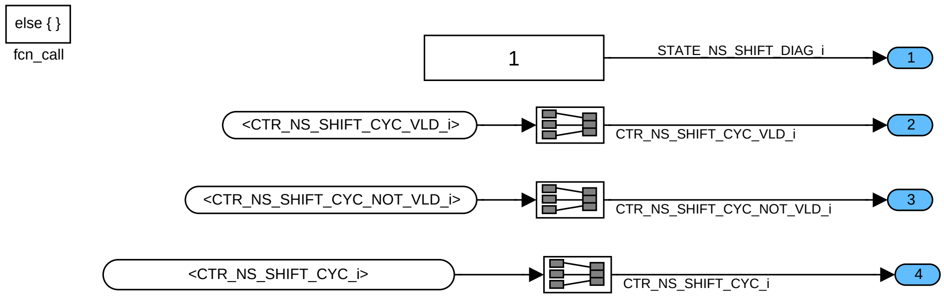

Figure B.128.27: :

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B.128.2.2.2.3 From DIAG

B.128.2.2.2.3.1 Check transition conditions from DIAG

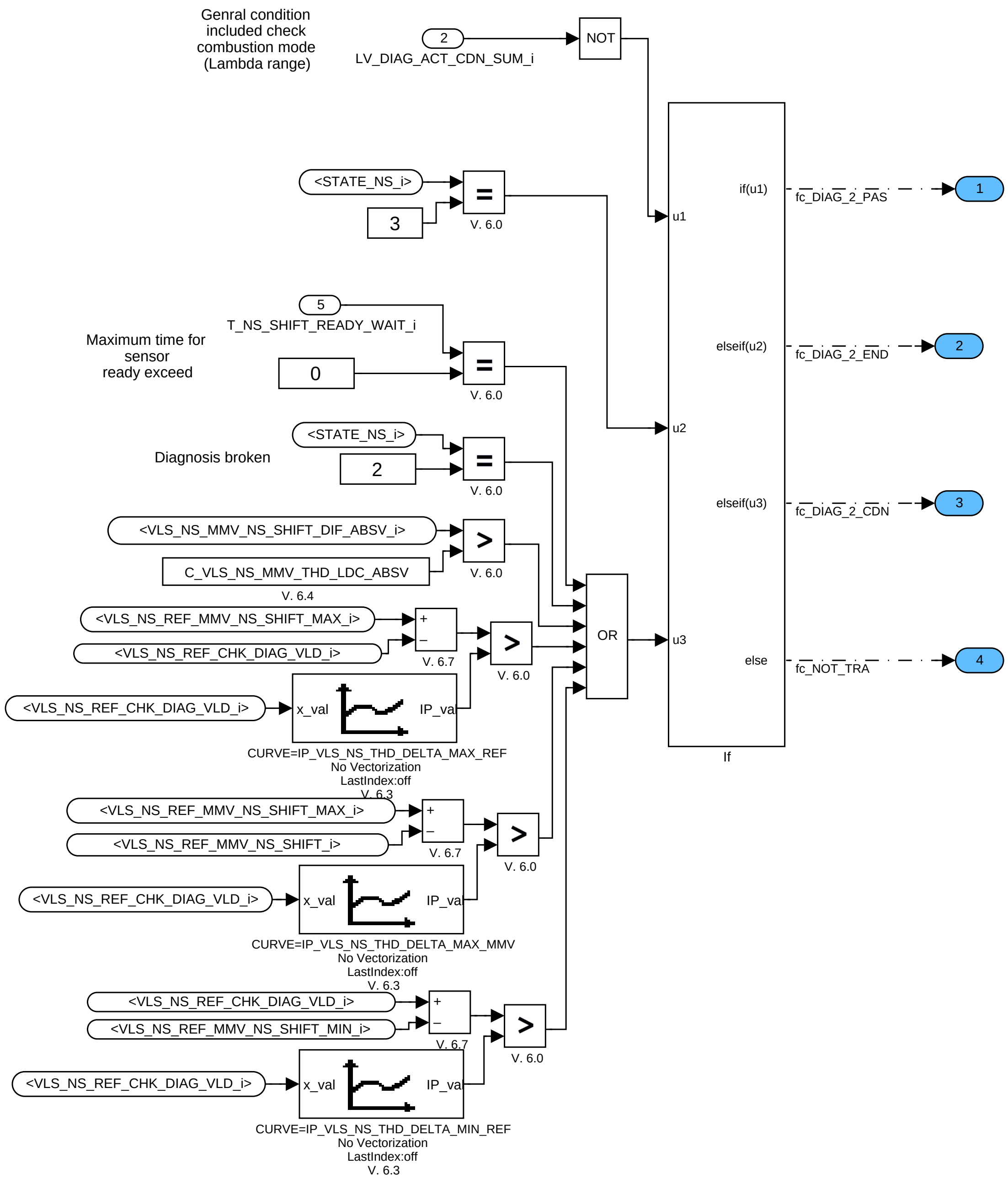

Figure B.128.28: :

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B.128.2.2.2.3.2 Transition DIAG to PASSIVE - actions

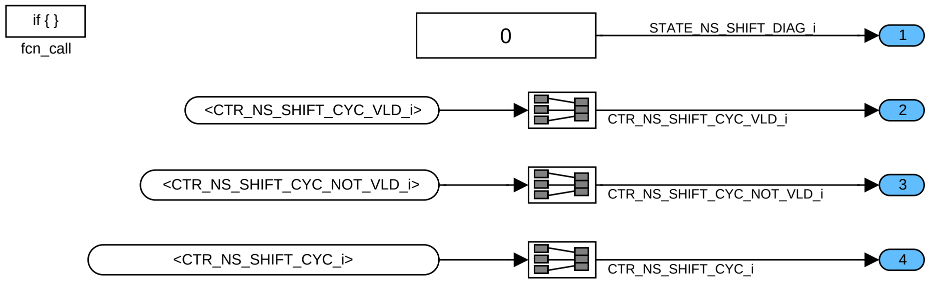

Figure B.128.29: :

B.128.2.2.2.3.3 Transition DIAG to CDN - actions

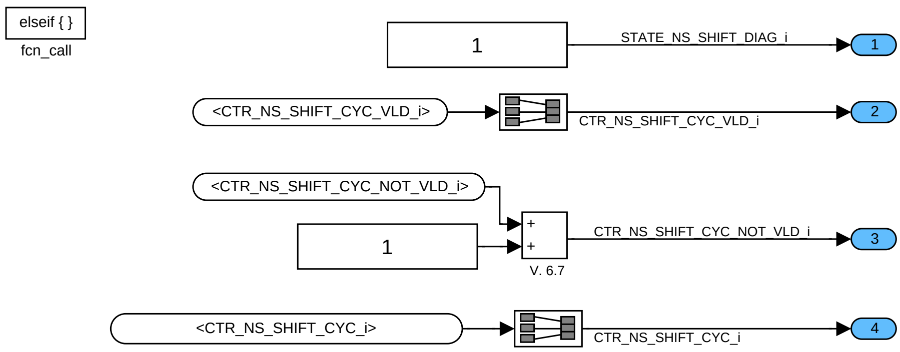

Figure B.128.30: :

B.128.2.2.2.3.4 Transition DIAG to END - actions

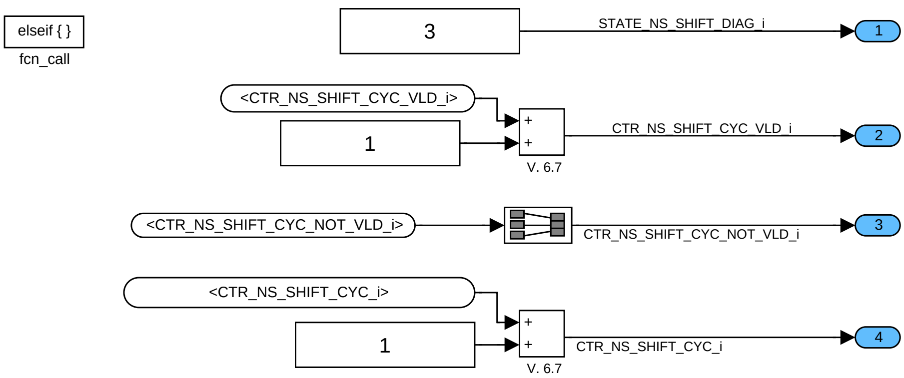

Figure B.128.31: :

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B.128.2.2.2.3.5 Actions at no transition from DIAG

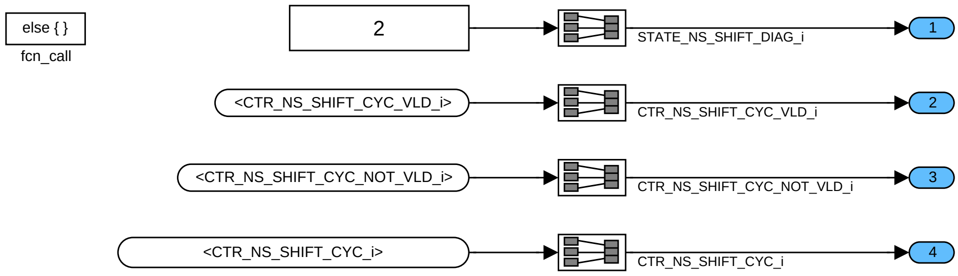

Figure B.128.32: :

B.128.2.2.2.4 From END

B.128.2.2.2.4.1 Check transition conditions from END

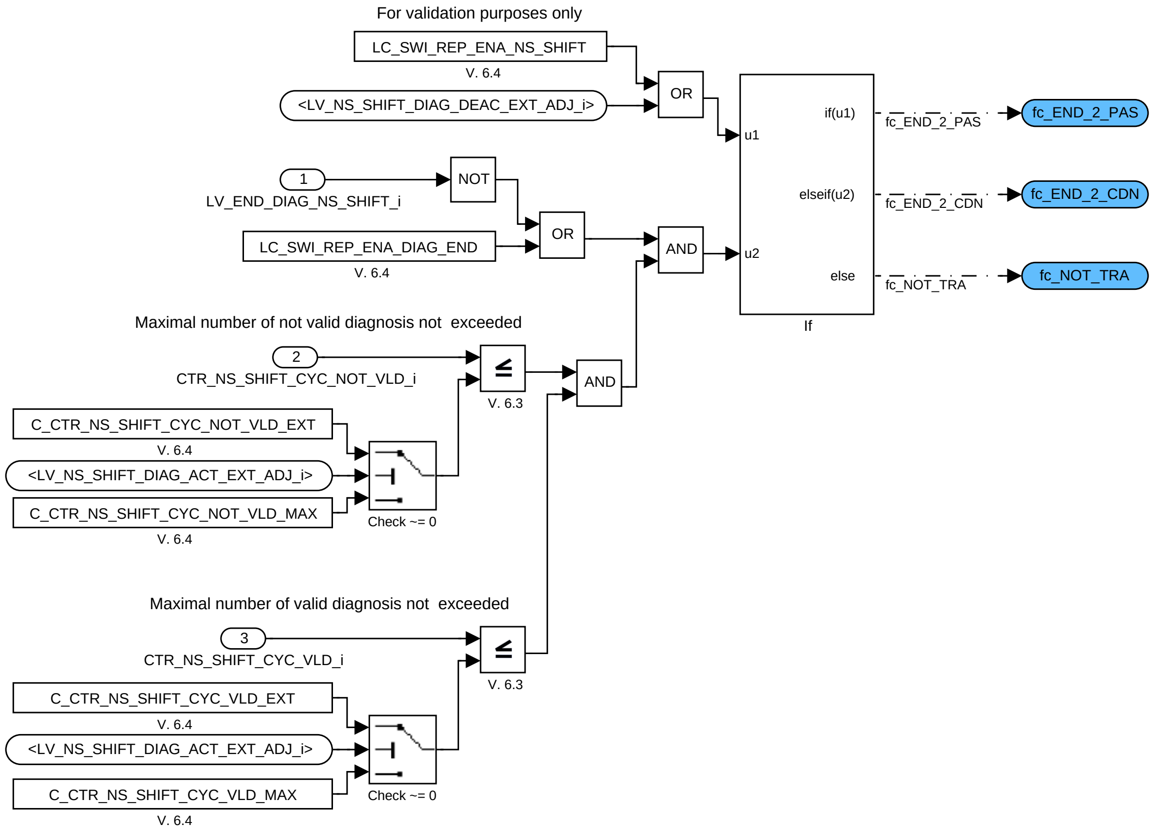

Figure B.128.33: :

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B.128.2.2.2.4.2 Transition END to PASSIVE - actions

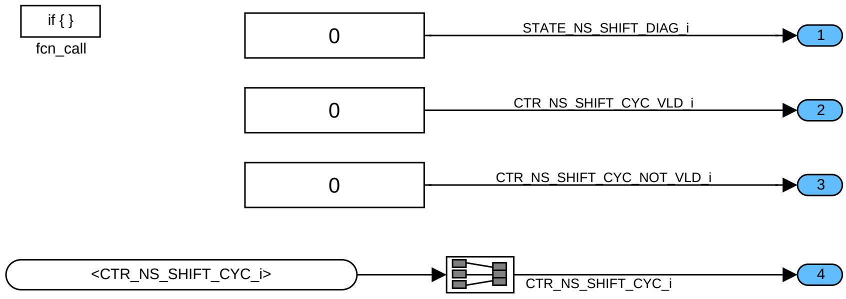

Figure B.128.34: :

B.128.2.2.2.4.3 Transition END to CDN - actions

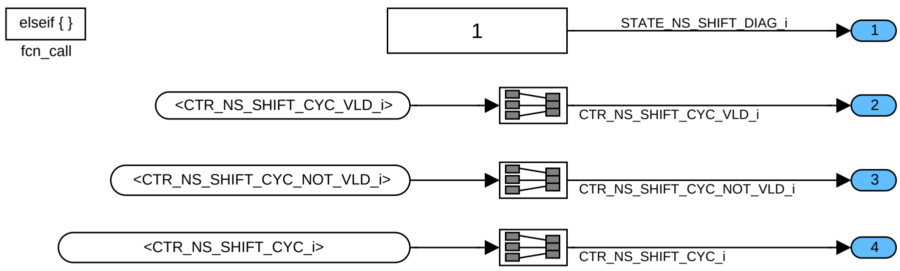

Figure B.128.35: :

B.128.2.2.2.4.4 Actions at no transition from END

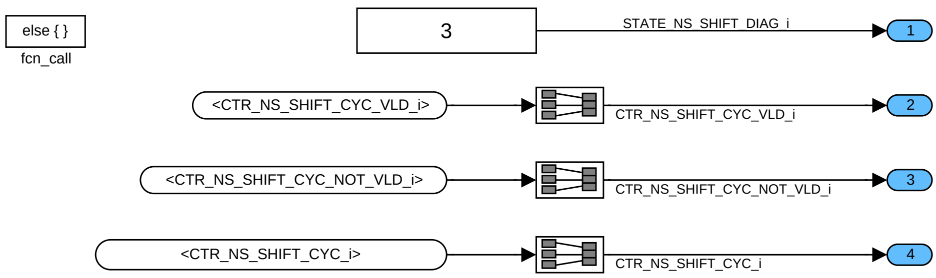

Figure B.128.36: :

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B.128.2.2.3 Actions calculation of STATE_NS_SHIFT_DIAG

B.128.2.2.3.1 State PASSIVE

B.128.2.2.3.1.1 Calculation request of homogeneous mode

B.128.2.2.3.1.1.1 Combustion request repetition timer

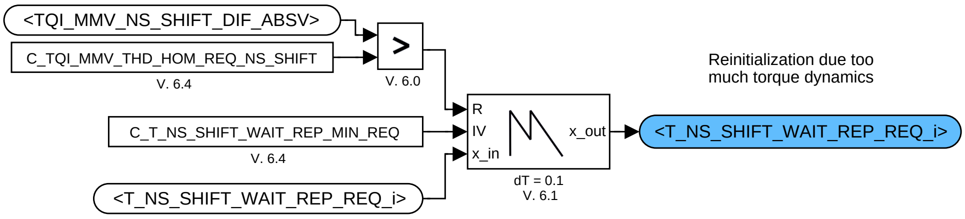

Figure B.128.37: :

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B.128.2.2.3.1.1.2 Check condition for combustion request

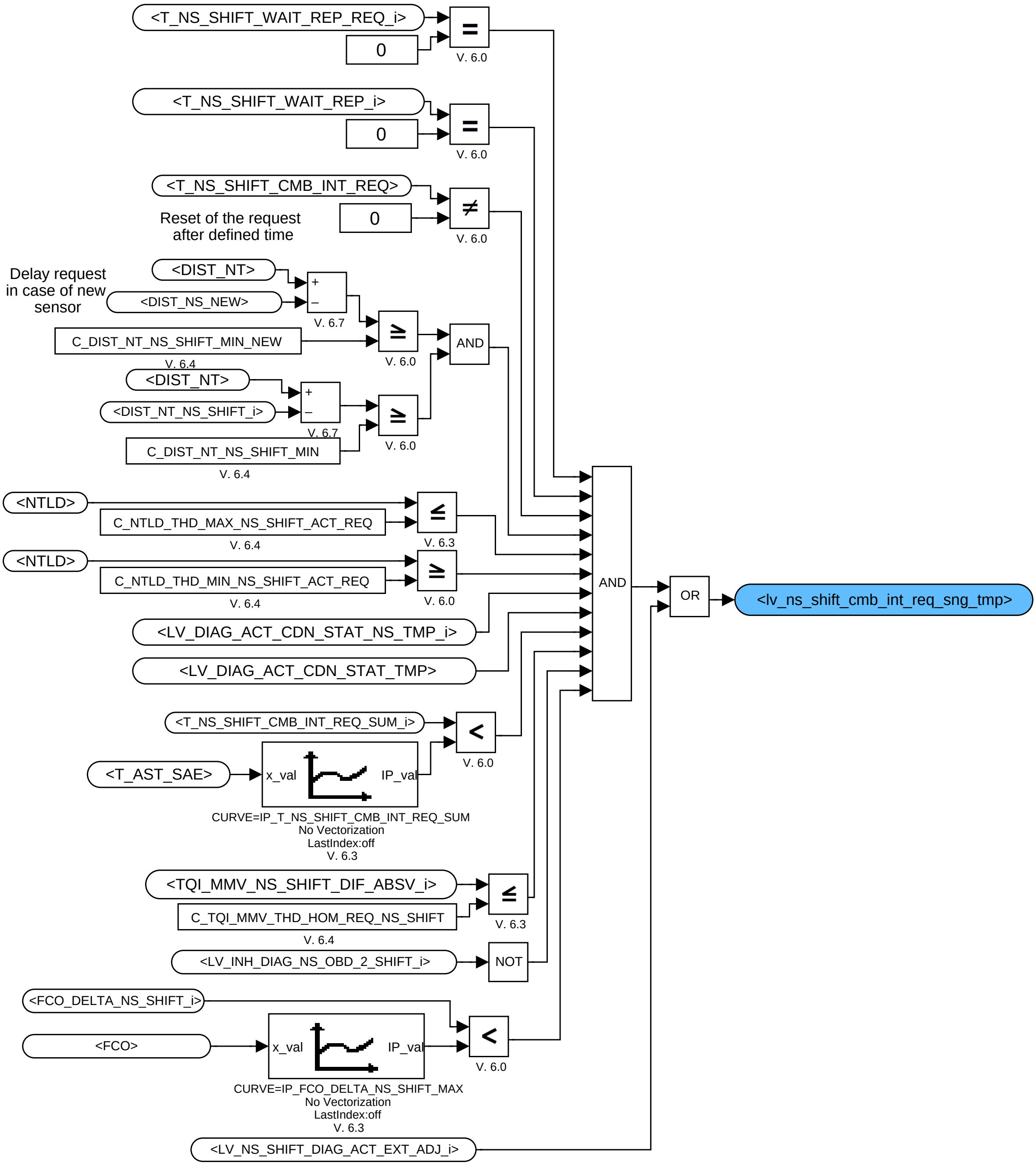

Figure B.128.38: :

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B.128.2.2.3.1.1.3 Set/Reset of the combustion request

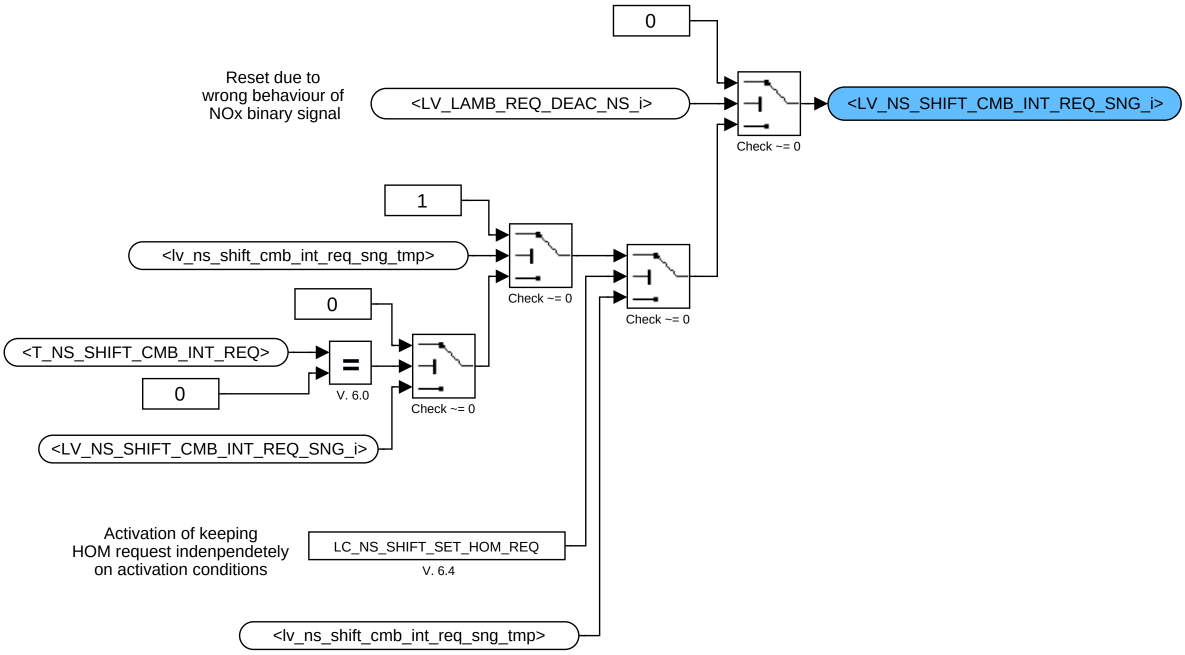

Figure B.128.39: :

B.128.2.2.3.1.2 Calculation of timers and initialization other variables

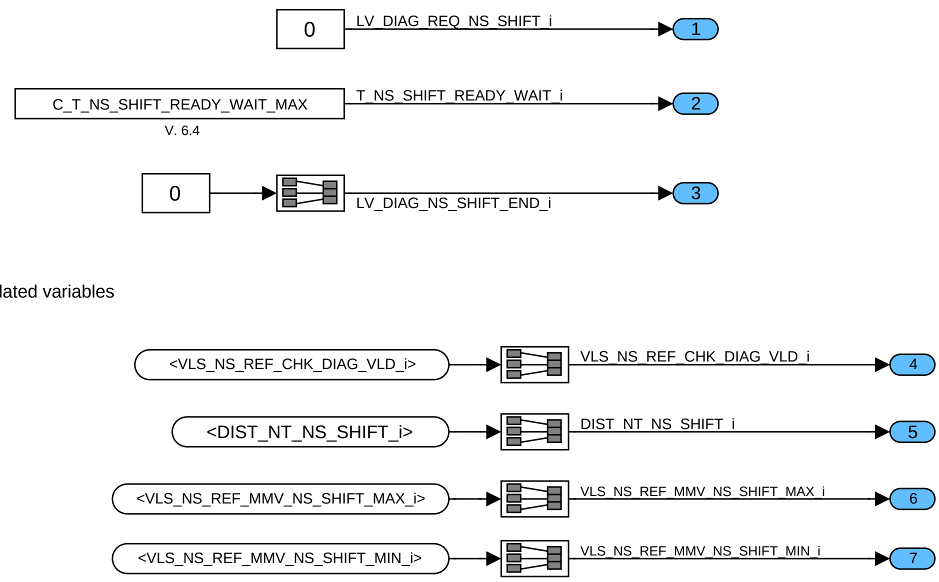

Figure B.128.40: :

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B.128.2.2.3.2 State CDN

B.128.2.2.3.2.1 Calculations

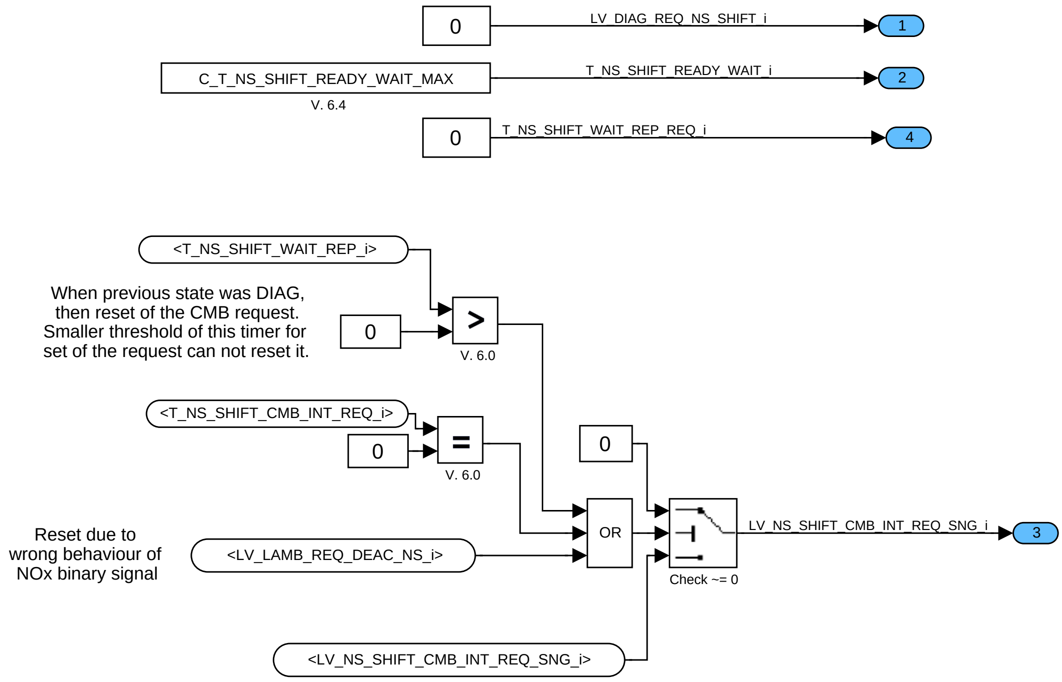

Figure B.128.41: :

B.128.2.2.3.2.2 Not calculated variables

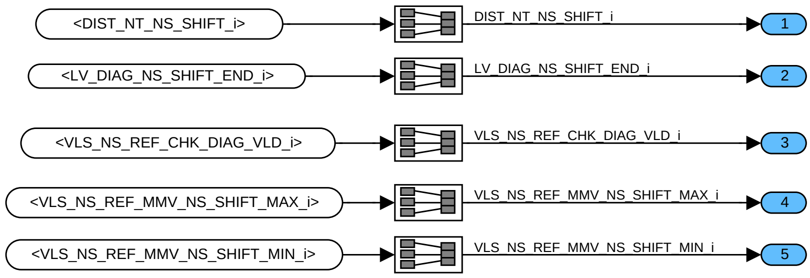

Figure B.128.42: :

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B.128.2.2.3.3 State DIAG

B.128.2.2.3.3.1 Calculation timers for waiting and repetition

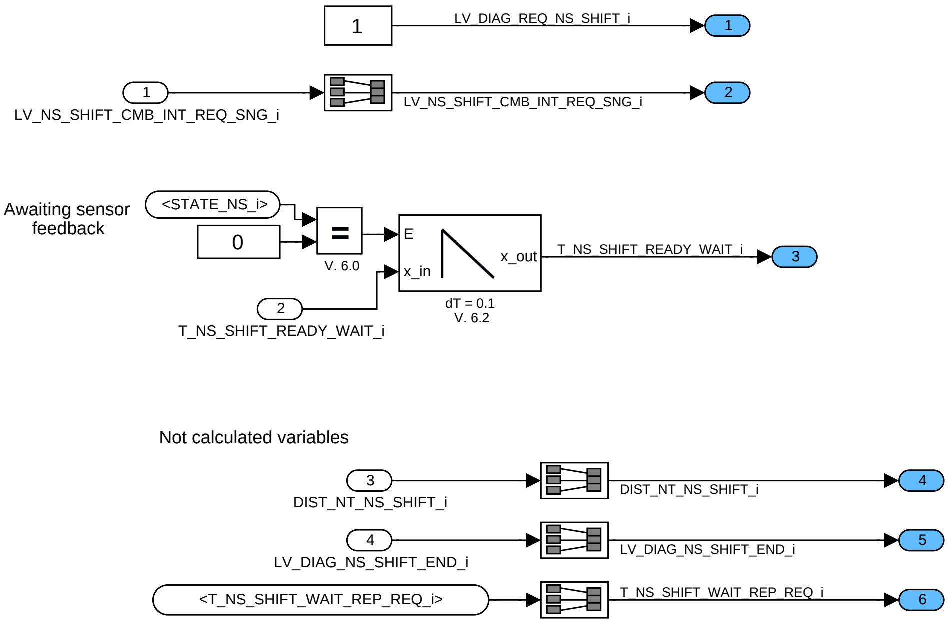

Figure B.128.43: :

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B.128.2.2.3.3.2 Check validation of diagnosis result

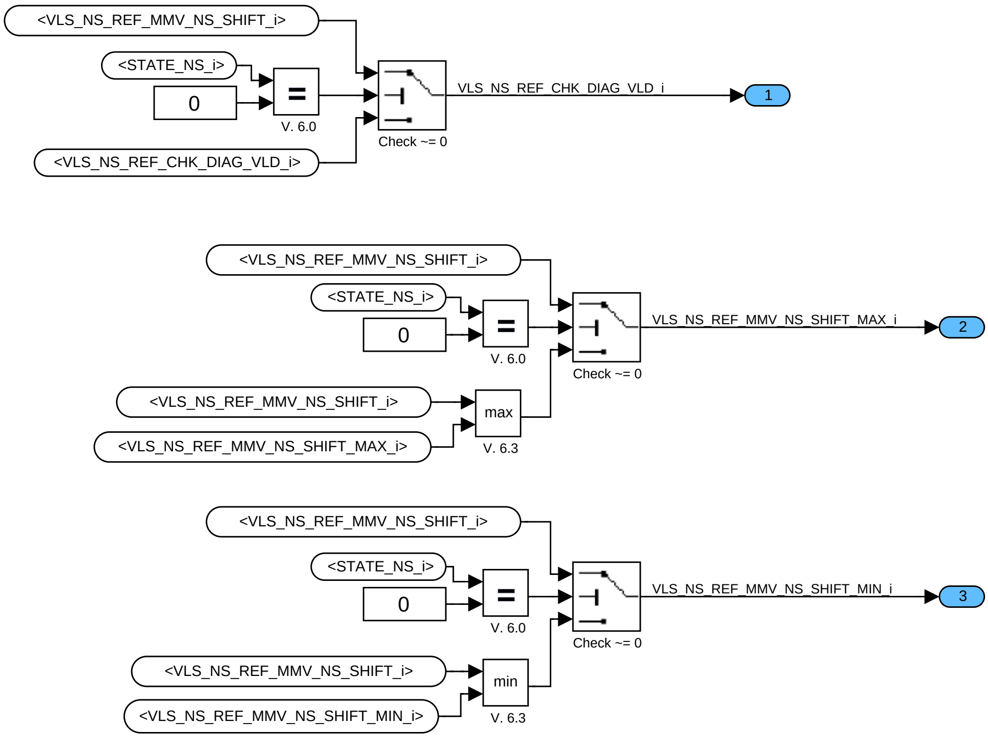

Figure B.128.44: :

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B.128.2.2.3.4 State END

B.128.2.2.3.4.1 Calculations

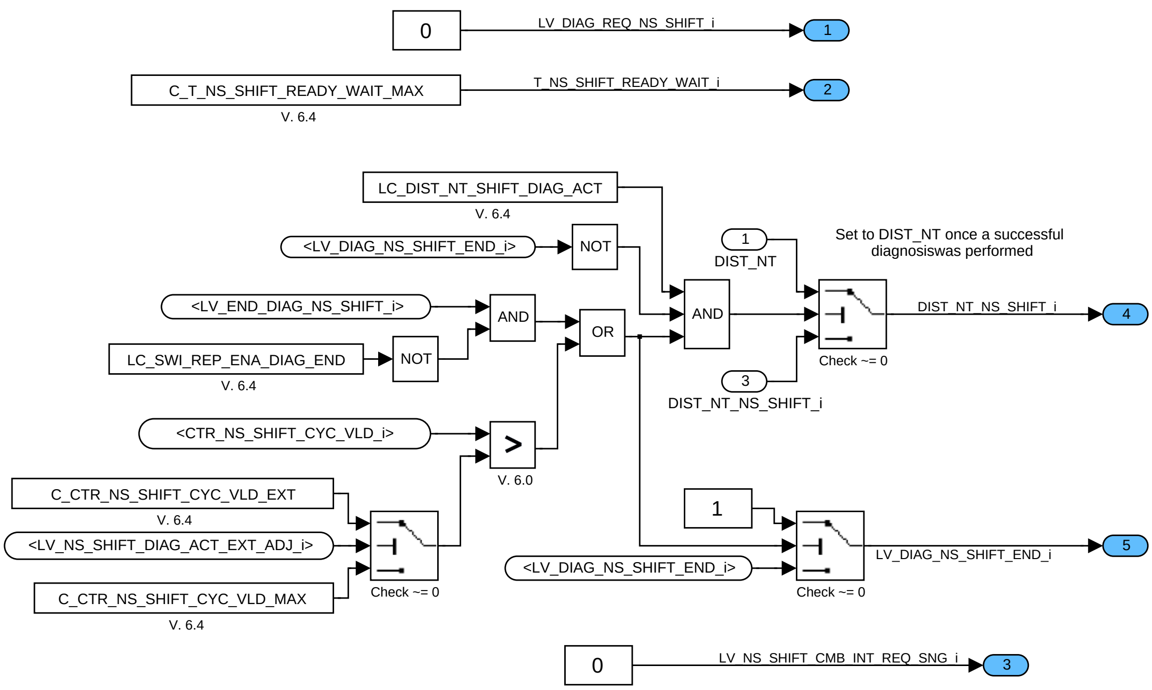

Figure B.128.45: - :

B.128.2.2.3.4.2 Not calculated variables

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B.128.2.2.4 Calculations at availability of external values

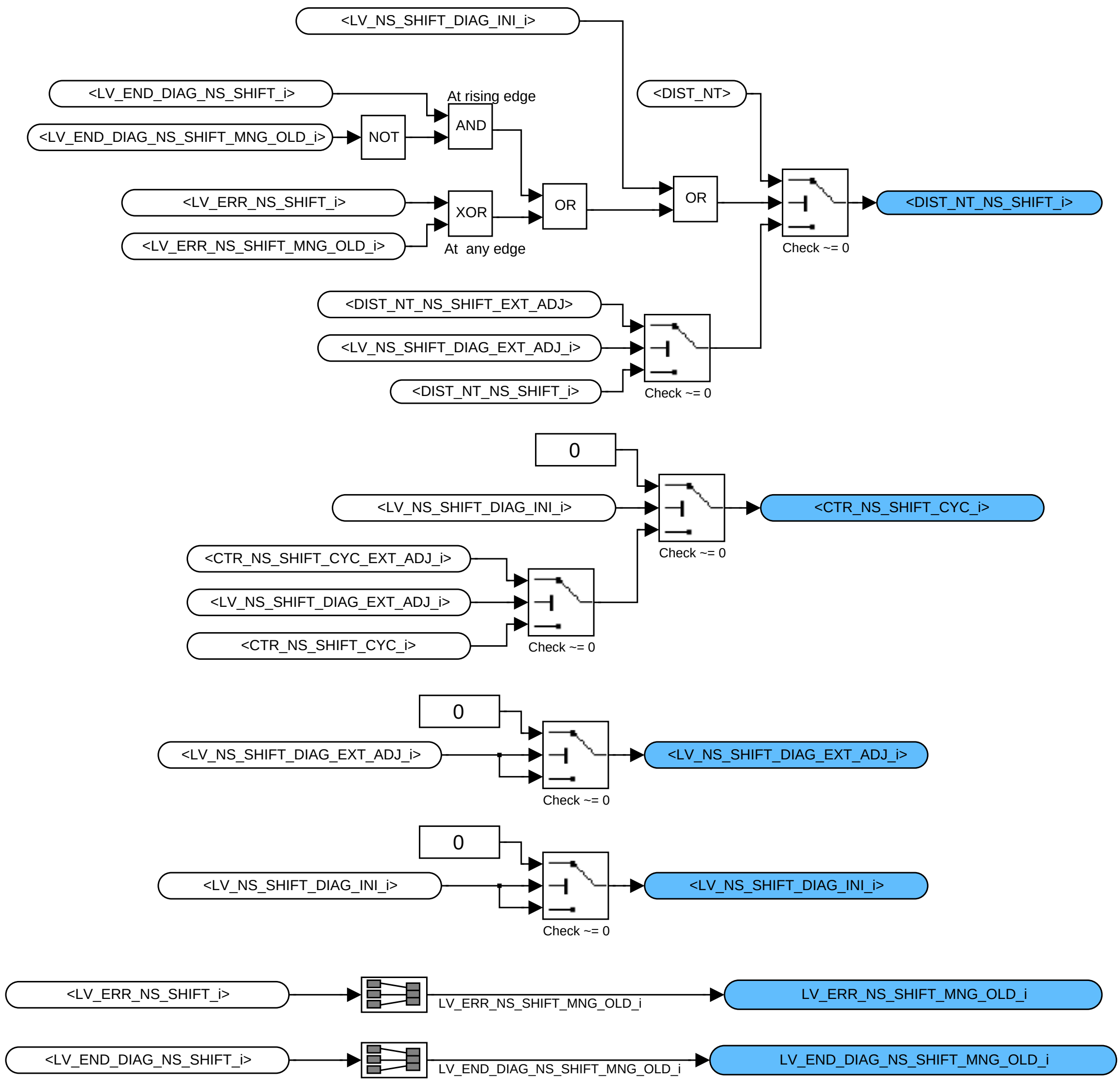

Figure B.128.46: :

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B.128.2.2.5 Calculation of diagnosis status for external service tool

B.128.2.2.5.1 Managing of the START and STOP switches

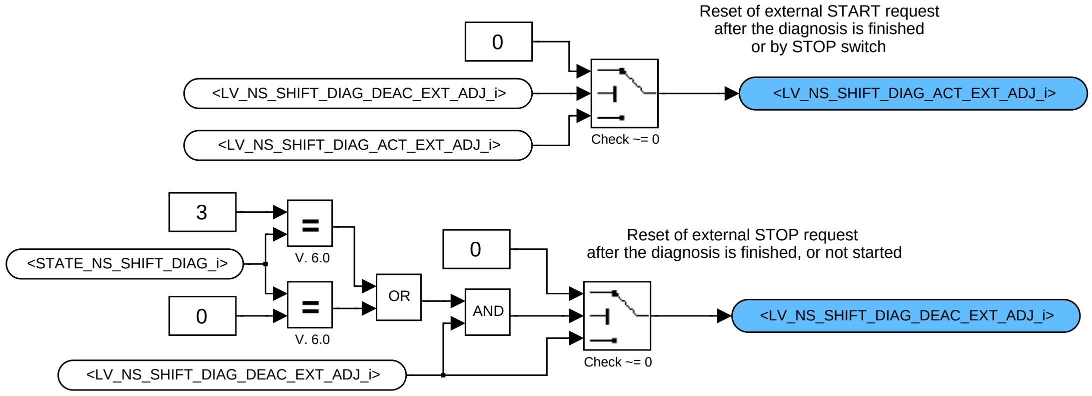

Figure B.128.47: :

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B.128.2.2.5.2 KWP value calculation

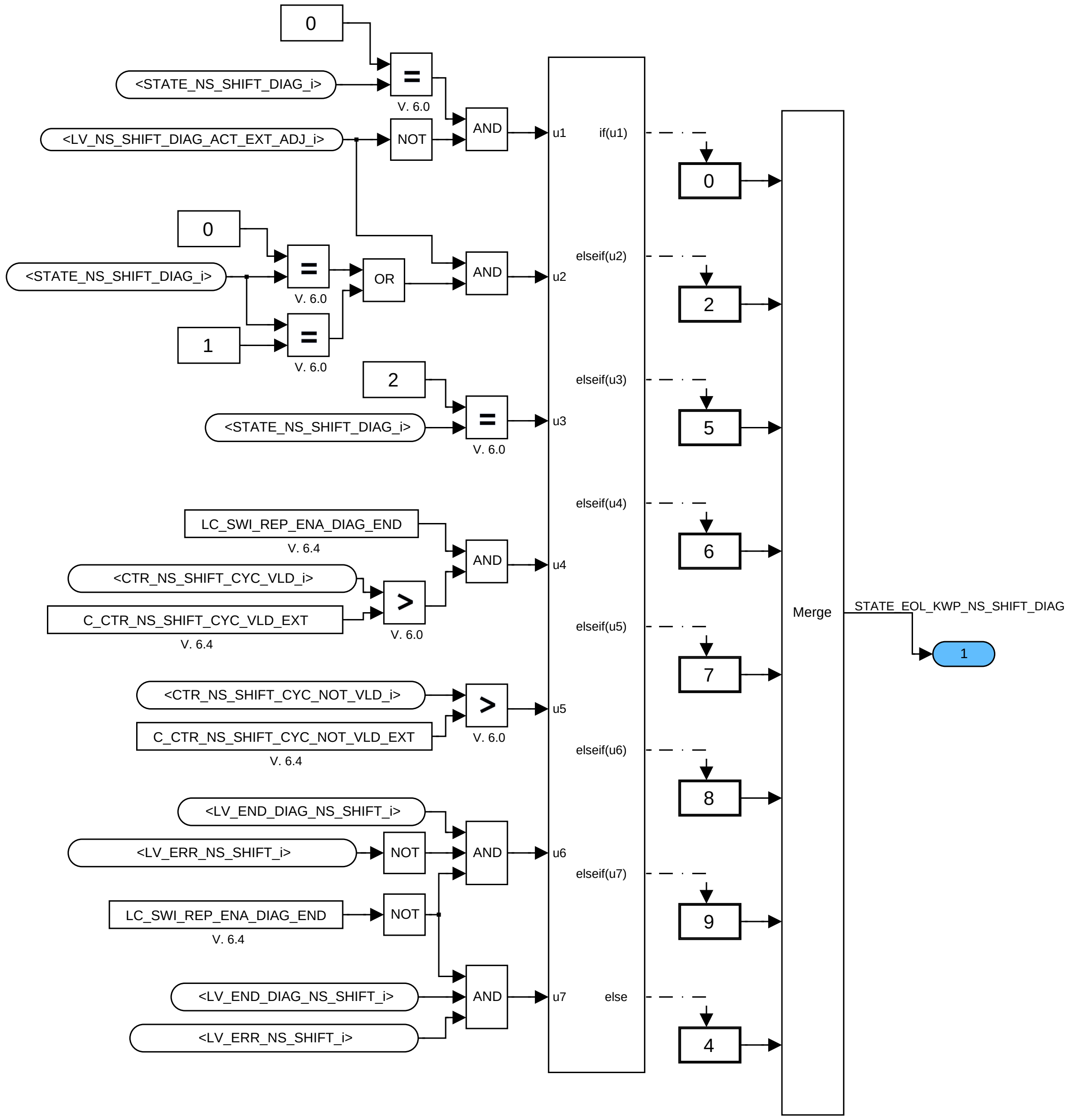

Figure B.128.48: :

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B.128.2.3 Synchronization of all sensors and generation summary request for combustion manager

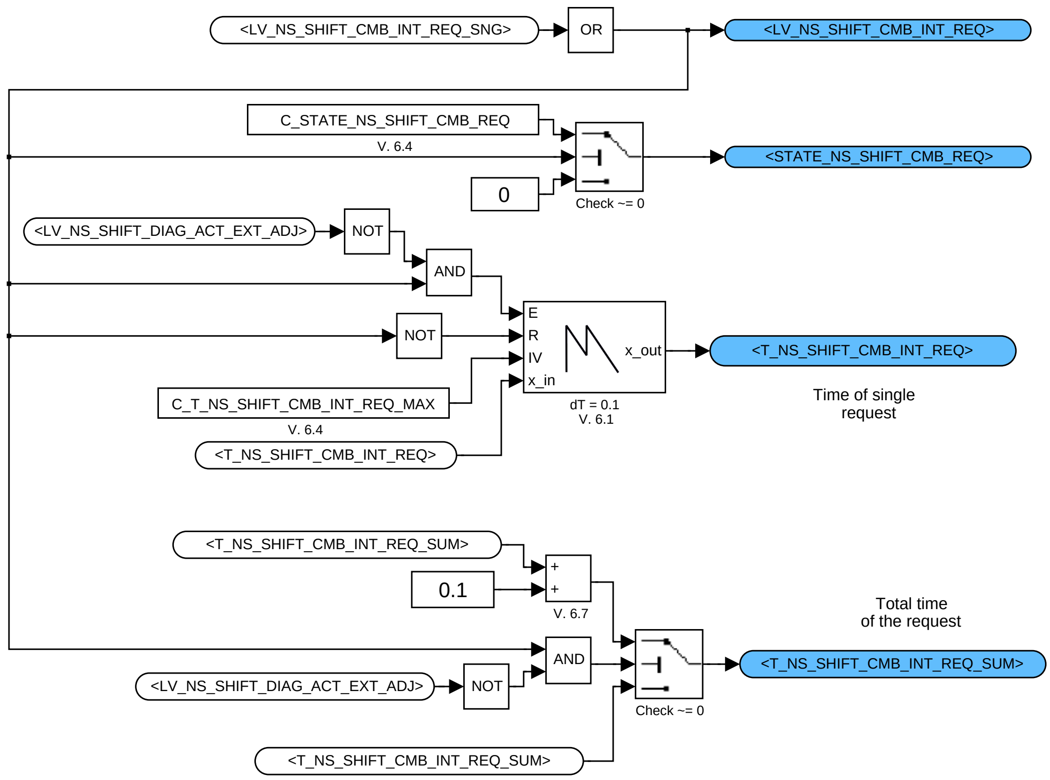

Figure B.128.49: :

B.128.3 Detailed description for Action: ACTION_NOXD_CleanNSShiftAdapt

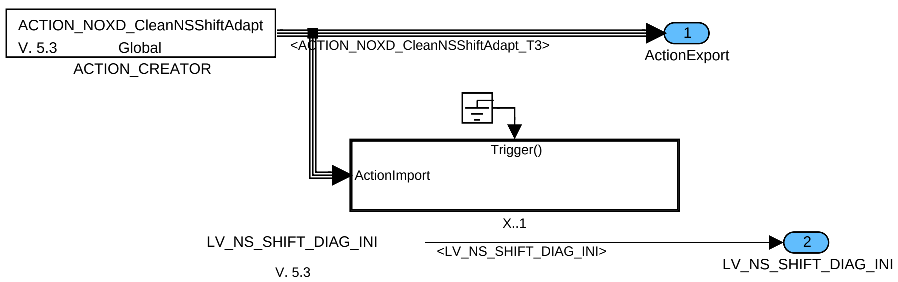

Figure B.128.50: :

B.128.3.1 Calculations in ACTION_NOXD_CLEANNSSHIFTADAPT

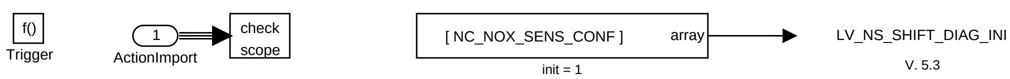

Figure B.128.51: :

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B.128.4 Detailed description for Action: ACTION_NOXD_EndNNShiftDiag

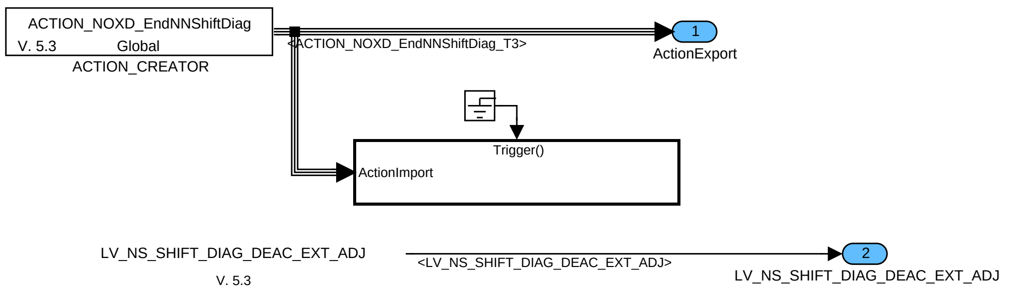

Figure B.128.52: :

B.128.4.1 Calculation in ACTION_NOXD_ENDNNSHIFTDIAG

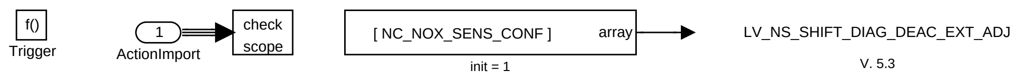

Figure B.128.53: :

B.128.5 Detailed description for Action: ACTION_NOXD_StartNNShiftDiag

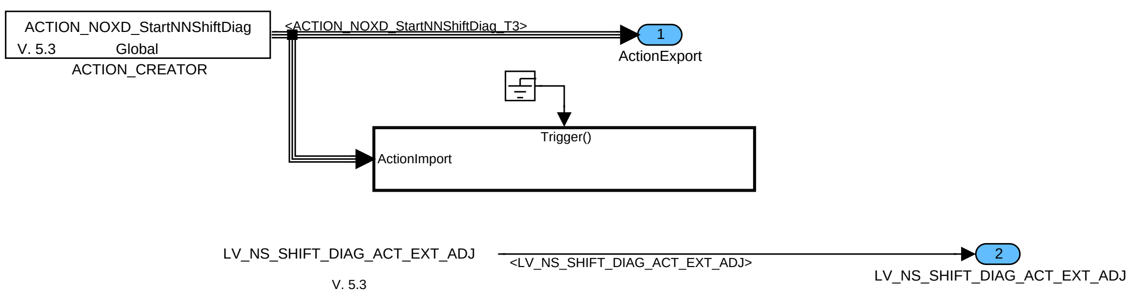

Figure B.128.54: :

B.128.5.1 Calculation in ACTION_NOXD_STARTNNSHIFTDIAG

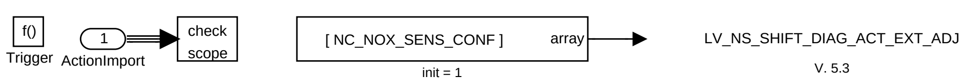

Figure B.128.55: :

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B.128.6 Detailed description for Action: ACTION_NOXD_WriteNSShiftDiagExtAdj

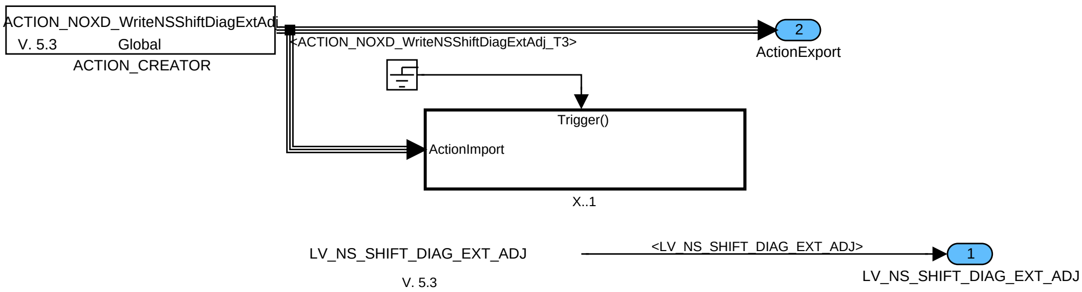

Figure B.128.56: :

B.128.6.1 Calculation in ACTION_NOXD_WRITENSSHIFTDIAGEXTADJ

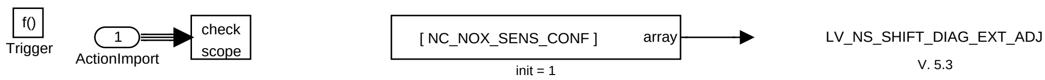

Figure B.128.57: :

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B.129 NOx sensor OBDII diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_PV_GRD_ABSV_INT	V	0... FFFFH	0... 65535	1	-
Integral of absolute value of pedal gradient for detection of vandalism					
LV_ERR_FUEL_TMP	V	0... 1H	0 ...1	1	-
Error on any fuel component detected					
LV_ERR_LAMB_TMP	V	0... 1H	0 ...1	1	-
Error on any lambda sensor detected					
LV_INH_DIAG_NS_OBD_2_ACT [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor activity diagnosis					
LV_INH_DIAG_NS_OBD_2_AVL [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor availability diagnosis					
LV_INH_DIAG_NS_OBD_2_DYN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor dynamic diagnosis					
LV_INH_DIAG_NS_OBD_2_GAIN [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor - NOx signal gain diagnosis					
LV_INH_DIAG_NS_OBD_2_HTP [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor heater performance diagnosis					
LV_INH_DIAG_NS_OBD_2_OFS [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor offset diagnosis					
LV_INH_DIAG_NS_OBD_2_PLAUS [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx-Sensor plausibility diagnosis					
LV_INH_DIAG_NS_OBD_2_RAW [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor - NOx raw emission diagnosis					
LV_INH_DIAG_NS_OBD_2_SHIFT [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor internal setpoint shift diagnosis					
LV_INH_DIAG_NS_OBD_2_VERS [NC_NOX_SENS_CONF]	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx sensor version diagnosis					
LV_PV_GRD_NS_DIAG	V	0... 1H	0 ...1	1	-
Pedal gradient disables diagnosis					
PV_AV_OLD_AVL	-	0... FFH	0... 99.60937	0.390625	%
Old value of global degree of activation of the accelerator pedal (low resolution)					
T_LAMB_LS_UP_NOT_VLD [NC_CBK_EX_NR]	V	0... FFFFH	0... 655.35	0.01	s
Time since LAMB_VLS_UP is not valid					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_WOUT_NS_AD	V	0... FFFFH	0... 65535	1	s
Time after last NOx sensor gain adaptation					

Input data:

LV_ERR_CAT_DIAG_AFL [NC_CBK_EX_NR] {p. 5561}	LV_ERR_CTL_LSL_UP [NC_CBK_EX_NR] {p. 5248}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_EL_CPS {p. 4708}
LV_ERR_FUP {p. 4717}	LV_ERR_FUP_MFP_ PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}	LV_ERR_FUP_ST {p. 6062}
LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_LS_DOWN [NC_CBK_EX_NR] {p. 5449}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_MAF {p. 4815}
LV_ERR_MAP {p. 982}	LV_ERR_MAP_TPS_ PLAUS {p. 1062}	LV_ERR_NS_CAN_BOFF {p. 991}	LV_ERR_NS_CAN_MSG_ LOST [NC_NOX_SENS_CONF] {p. 991}
LV_ERR_NS_OBD_1 [NC_NOX_SENS_CONF] {p. 4915}	LV_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	LV_ERR_NT_AGI {p. 6485}	LV_ERR_OFS_LSL_UP [NC_CBK_EX_NR] {p. 5248}
LV_ERR_TEG_PCAT_ DOWN {p. 4713}	LV_ERR_TTIP_MES_LSH_ UP [NC_CBK_EX_NR] {p. 5438}	LV_ERR_VCV {p. 4729}	LV_LAM_ADJ_CAT_DIAG [NC_CBK_EX_NR] {p. 5473}
LV_LAMB_LS_UP_VLD [NC_CBK_EX_NR] {p. 2352}	LV_NS_AD_REQ {p. 3189}	LV_SO2P_REQ {p. 3129}	LV_ST_END {p. 1720}
NC_CBK_EX_NR {p. 1829}	NC_NOX_SENS_CONF {p. 643}	NTLD {p. 2986}	PV_AV {p. 1269}
STATE_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	STATE_INH_NS_OBD_2_ EXT_ADJ [NC_NOX_SENS_CONF]	STATE_NS [NC_NOX_SENS_CONF] {p. 1381}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ERR_NS_ACT_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit activity diagnosis					
C_ERR_NS_AVL_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit availability diagnosis					
C_ERR_NS_DYN_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit dynamic diagnosis					
C_ERR_NS_GAIN_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit NOx signal gain diagnosis					
C_ERR_NS_HTP_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit heater diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ERR_NS_OFS_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit offset diagnosis					
C_ERR_NS_PLAUS_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit plausibility diagnosis					
C_ERR_NS_RAW_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit NOx raw emission diagnosis					
C_ERR_NS_SHIFT_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit NOx sensor internal setpoint shift diagnosis					
C_ERR_NS_VERS_BIT_SEL [NC_NOX_SENS_CONF]	-	0... FFFFH	0... 65535	1	-
Selection of NOx sensor diagnosis errors to inhibit NOx sensor version diagnosis					
C_FAC_PV_GRD_ABSV_INT_DEC	-	0... FFFFH	0... 65535	1	-
Decrement value for integral of absolute value of pedal gradient for detection of vandalism					
C_FAC_PV_GRD_ABSV_INT_MAX	-	0... FFFFH	0... 65535	1	-
Maximum threshold for integral of absolute value of pedal gradient for detection of vandalism					
C_FAC_PV_GRD_ABSV_INT_MIN	-	0... FFFFH	0... 65535	1	-
Minimum threshold for integral of absolute value of pedal gradient for detection of vandalism					
C_NTLD_T_WOUT_NS_AD	-	0... FFFFH	0... 0.99998	15.3e-6	-
NOx trap loading degree for detection of active gain adaptation for calculation of time after gain adaptation					
C_STATE_INH_NS_ACT [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor activity diagnosis					
C_STATE_INH_NS_AVL [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor availability diagnosis					
C_STATE_INH_NS_DYN [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor dynamic diagnosis					
C_STATE_INH_NS_GAIN [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor - NOx signal gain diagnosis					
C_STATE_INH_NS_HTP [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor heater diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_INH_NS_OFS [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor offset diagnosis					
C_STATE_INH_NS_PLAUS [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor plausibility diagnosis					
C_STATE_INH_NS_RAW [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor - NOx raw emission diagnosis					
C_STATE_INH_NS_SHIFT [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor internal setpoint shift diagnosis					
C_STATE_INH_NS_VERS [NC_NOX_SENS_CONF]	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx sensor version diagnosis					
C_T_LAMB_LS_UP_NOT_VLD_MAX	-	0... FFFFH	0... 655.35	0.01	s
Time since LAMB_VLS_UP is not valid					
C_T_WOUT_NS_AD_INH_NS_DIAG	-	0... FFFFH	0... 65535	1	s
Time after last NOx sensor gain adaptation					
LC_NS_DIAG_EXT_ADJ_ENA	-	0... 1H	0 ...1	1	-
Enable inhibition of NOx sensor diags by external adjustment					
LC_NS_SHIFT_INH_CAT_DIAG	-	0... 1H	0 ...1	1	-
Shift diagnosis will be inhibited if cat diagnosis is active					
LC_T_WOUT_NS_AD	-	0... 1H	0 ...1	1	-
Enable signal LV_NS_AD_REQ for detection of active gain adaptation for calculation of time after gain calculation					

Error treatment:

Heater diag (B07A)

Diagnostic NS_HTP	Symptom description	Symptom	Filter type
NOx sensor heater diagnosis	Heater performance too low at start	SYM_0	STD_INI
	Heater performance too low during normal operation	*SYM_1*	
	Power supply failure	*SYM_2*	
		SYM_3	

Figure B.129.1: Diagnostic

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Diagnostic **NS_HTP**	**Symptoms**	**Ref.**	**DTC Symptom CARB**	**DTC Symptom Customer**	**DTC Global CARB**	**DTC Global Customer**	**Failure class A/B**	**Readiness code**
NOx sensor heater diagnosis	Heater performance too low at start	*SYM_0*						
	Heater performance too low during normal operation	*SYM_1*						
	Power supply failure	*SYM_2*						
		SYM_3						

Signal availability (B07B)

Diagnostic **NS_AVL**	**Symptom description**	**Symptom**	**Filter type**
NOx sensor availability diagnosis	Signal not available at start	SYM_0	STD_INI
	Signal not available during normal operation	*SYM_1*	
		SYM_2	
		SYM_3	

Figure B.129.2: Diagnostic

Diagnostic **NS_AVL**	**Symptoms**	**Ref.**	**DTC Symptom CARB**	**DTC Symptom Customer**	**DTC Global CARB**	**DTC Global Customer**	**Failure class A/B**	**Readiness code**
NOx sensor availability diagnosis	Signal not available at start	*SYM_0*						
	Signal not available during normal operation	*SYM_1*						
		SYM_2						
		SYM_3						

Signal offset (B07D)

Diagnostic **NS_OFS**	**Symptom description**	**Symptom**	**Filter type**
NOx sensor offset diagnosis	NOx signal offset failure	SYM_0	STD_INI
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.3: Diagnostic

Diagnostic **NS_OFS**	**Symptoms**	**Ref.**	**DTC Symptom CARB**	**DTC Symptom Customer**	**DTC Global CARB**	**DTC Global Customer**	**Failure class A/B**	**Readiness code**
NOx sensor offset diagnosis	NOx signal offset failure	*SYM_0*						
		SYM_1						
		SYM_2						
		SYM_3						

Binary lambda signal dynamic (B07E)

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Diagnostic NS_VLS_DYN	Symptom description	Symptom	Filter type
NOx sensor binary dynamic diagnosis	Binary dynamic too low	SYM_0	STD_INI
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.4: Diagnostic

Diagnostic NS_VLS_DYN	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NOx sensor binary dynamic diagnosis	Binary dynamic too low	*SYM_0*						
		SYM_1						
		SYM_2						
		SYM_3						

Signal activity (B07F)

Diagnostic NS_ACT	Symptom description	Symptom	Filter type
NOx sensor activity diagnosis	NOx signal activity too low	SYM_0	STD_INI
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.5: Diagnostic

Diagnostic NS_ACT	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NOx sensor activity diagnosis	NOx signal activity too low	*SYM_0*						
		SYM_1						
		SYM_2						
		SYM_3						

Signal plausibility up/down (B07X)

Diagnostic NS_LSL_UP_DOWN	Symptom description	Symptom	Filter type
NOx sensor plausibility up/down diagnosis	Lambda signal up/downstream not plausible	SYM_0	STD_INI
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.6: Diagnostic

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Diagnostic NS_LSL_UP_DOWN	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NOx sensor plausibility up/down diagnosis	Lambda signal up/downstream not plausible	*SYM_0*						
		SYM_1						
		SYM_2						
		SYM_3						

Signal plausibility at PUC (B07Y)

Diagnostic NS_PUC	Symptom description	Symptom	Filter type
NOx sensor plausibility diagnosis at PUC	Binary lambda signal too rich	SYM_0	STD_INI
	Linear lambda too rich	*SYM_1*	
	NOx signal too low	*SYM_2*	
	NOx signal too high	*SYM_3*	

Figure B.129.7: Diagnostic

Diagnostic NS_PUC	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NOx sensor plausibility diagnosis at PUC	Binary lambda signal too rich	*SYM_0*						
	Linear lambda too rich	*SYM_1*						
	NOx signal too low	*SYM_2*						
	NOx signal too high	*SYM_3*						

Signal plausibility at rich conditions (B07Z)

Diagnostic NS_AFR	Symptom description	Symptom	Filter type
NOx sensor plausibility diagnosis at rich conditions	Binary lambda signal too lean	SYM_0	STD_INI
	Linear lambda too lean	*SYM_1*	
	NOx signal too low	*SYM_2*	
		SYM_3	

Figure B.129.8: Diagnostic

Diagnostic NS_AFR	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NOx sensor plausibility diagnosis at rich conditions	Binary lambda signal too lean	*SYM_0*						
	Linear lambda too lean	*SYM_1*						
	NOx signal too low	*SYM_2*						
		SYM_3						

Regeneration stop observation (B080)

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Diagnostic NS_STOP	Symptom description	Symptom	Filter type
NOx sensor diagnosis at regeneration stop	Regeneration agent failure	SYM_0	STD_INI
	Time out	*SYM_1*	
		SYM_2	
		SYM_3	

Figure B.129.9: Diagnostic

Diagnostic NS_STOP	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NOx sensor diagnosis at regeneration stop	Regeneration agent failure	*SYM_0*						
	Time out	*SYM_1*						
		SYM_2						
		SYM_3						

NOx signal gain (B0A0)

Diagnostic NS_GAIN	Symptom description	Symptom	Filter type
NOx signal gain diagnosis	NOx signal gain failure	SYM_0	STD_INI
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.10: Diagnostic

Diagnostic NS_GAIN	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NOx signal gain diagnosis	NOx signal gain failure	*SYM_0*						
		SYM_1						
		SYM_2						
		SYM_3						

NOx raw emission (B0A1)

Diagnostic NS_RAW	Symptom description	Symptom	Filter type
NOx raw emission	NOx raw emission plausibility failure	SYM_0	STD_INI
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.11: Diagnostic

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Diagnostic NS_GAIN	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NOx raw emission	NOx raw emission plausibility failure	*SYM_0*						
		SYM_1						
		SYM_2						
		SYM_3						

NOx sensor setpoint shift (B0A3)

Diagnostic NS_SHIFT	Symptom description	Symptom	Filter type
NOx sensor setpoint shift	Setpoint shift failure	SYM_0	STD_INI
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.12: Diagnostic

Diagnostic NS_SHIFT	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NOx sensor setpoint shift	Setpoint shift failure	*SYM_0*						
		SYM_1						
		SYM_2						
		SYM_3						

NOx sensor version (B0A4)

Diagnostic NS_VERS	Symptom description	Symptom	Filter type
NOx sensor version	Wrong version	SYM_0	STD_INI
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.129.13: Diagnostic

Diagnostic NS_VERS	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NOx sensor version	Wrong version	*SYM_0*						
		SYM_1						
		SYM_2						
		SYM_3						

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General information:

Each type of OBDII diagnosis will be inhibited, if any used input signal is not valid. Additionally, each diagnosis may be enabled or disabled without any cross dependencies.

The calculation have to be done for each NOx sensor, controlled by configuration data NC_NOX_SENS_CONF.

If NC_NOX_SENS_CONF = 1, then calculation for i = 1.
If NC_NOX_SENS_CONF = 2, then calculation for i = 1 and 2.

Application conditions

Initialisation:
```
at reset:
    FAC_PV_GRD_ABSV_INT = 0
    PV_AV_OLD_AVL = 0
    T_LAMB_LS_UP_NOT_VLD[k] = 0            k = 1...NC_CBK_EX_NR
```

Recurrence: *10 ms*

Activation:

Deactivation:

Formula section:

FAC_PV_GRD_ABSV_INT = FAC_PV_GRD_ABSV_INT
+ 16 * ABS(PV_AV - PV_AV_OLD_AVL)
- C_FAC_PV_GRD_ABSV_INT_DEC

PV_AV_OLD_AVL = PV_AV

The values PV_AV and PV_AV_OLD_AVL should be normalized to the resolution, which results in an easy addition of the hex values.

For each lambda sensor: k **= 1...NC_CBK_EX_NR**

If LV_LAMB_LS_UP_VLD[k]
Then T_LAMB_LS_UP_NOT_VLD[k] = 0
Else increment T_LAMB_LS_UP_NOT_VLD[k] *10ms*
Endif

Application conditions

Initialisation:
```
at reset and at deactivation:
    LV_INH_DIAG_NS_OBD_2_HTP[i] = 1
    LV_INH_DIAG_NS_OBD_2_AVL[i] = 1
    LV_INH_DIAG_NS_OBD_2_OFS[i] = 1
    LV_INH_DIAG_NS_OBD_2_DYN[i] = 1
    LV_INH_DIAG_NS_OBD_2_ACT[i] = 1
    LV_INH_DIAG_NS_OBD_2_PLAUS[i] = 1
    LV_INH_DIAG_NS_OBD_2_GAIN[i] = 1
    LV_INH_DIAG_NS_OBD_2_RAW[i] = 1
    LV_INH_DIAG_NS_OBD_2_SHIFT[i] = 1
 LV_PV_GRD_NS_DIAG = 0
    T_WOUT_NS_AD = 65535s
```

Recurrence: *1 s*

Activation: *LV_ST_END = 1*

Deactivation: *LV_ST_END = 0*

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Formula section:

Temporary flag (shows an error on any lambda sensor)

#if NC_CBK_EX_NR = 1

LV_ERR_LAMB_TMP = LV_ERR_LS_UP[1] **OR**
LV_ERR_LS_DOWN[1] **OR**
LV_ERR_TTIP_MES_LSH_UP[1] **OR**
LV_ERR_CTL_LSL_UP[1] **OR**
LV_ERR_OFS_LSL_UP[1] **OR**
T_LAMB_LS_UP_NOT_VLD[1] > C_T_LAMB_LS_UP_NOT_VLD_MAX

#endif

#if NC_CBK_EX_NR = 2

LV_ERR_LAMB_TMP = (LV_ERR_LS_UP[1] **OR** LV_ERR_LS_UP[2]) **OR**
(LV_ERR_LS_DOWN[1] **OR** LV_ERR_LS_DOWN[2]) **OR**
(LV_ERR_TTIP_MES_LSH_UP[1] **OR**
LV_ERR_TTIP_MES_LSH_UP[2]) **OR**
LV_ERR_CTL_LSL_UP[1] **OR**
LV_ERR_CTL_LSL_UP[2] **OR**
LV_ERR_OFS_LSL_UP[1] **OR**
LV_ERR_OFS_LSL_UP[2] **OR**
T_LAMB_LS_UP_NOT_VLD[1] > C_T_LAMB_LS_UP_NOT_VLD_MAX
OR
T_LAMB_LS_UP_NOT_VLD[2] > C_T_LAMB_LS_UP_NOT_VLD_MAX

#endif

Temporary flag for fuel depending errors

LV_ERR_FUEL_TMP = LV_ERR_EL_CPS **OR**
LV_ERR_DIAGCPS **OR**
LV_ERR_FUP **OR**
LV_ERR_FUP_MFP_PLAUS **OR**
LV_ERR_H_PRS_SYS **OR**
LV_ERR_FUP_ORNG **OR**
LV_ERR_FUP_ST **OR**
LV_ERR_VCV

Time after last NOx sensor gain adaptation

If (LV_NS_AD_REQ = 1 **AND** LC_T_WOUT_NS_AD = 1) **OR**
NTLD > C_NTLD_T_WOUT_NS_AD
Then T_WOUT_NS_AD = 0
Else T_WOUT_NS_AD = T_WOUT_NS_AD + 1s
Endif

Inhibition mode of Heater diagnosis

case selection on C_STATE_INH_NS_HTP[i]

C_STATE_INH_NS_HTP[i] = 0 ('AUTO'):

if LV_ERR_NS_OBD_1[i] = 1 **OR**

LV_ERR_NS_CAN_MSG_LOST[i] = 1 **OR**

LV_ERR_NS_CAN_BOFF = 1 **OR**

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LV_ERR_MAF = 1 **OR**
LV_ERR_MAP = 1 **OR**
LV_ERR_MAP_TPS_PLAUS = 1 **OR**

(Bit 0 (STATE_INH_NS_OBD_2_EXT_ADJ[i]**)** = 1 **AND** LC_NS_DIAG_EXT_ADJ_ENA = 1**)** **OR**
(STATE_ERR_NS_OBD_2[i] **bitwise AND** C_ERR_NS_HTP_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_HTP[i] = 1
else LV_INH_DIAG_NS_OBD_2_HTP[i] = 0
endif

C_STATE_INH_NS_HTP[i] = 1 ('DISABLE'):
LV_INH_DIAG_NS_OBD_2_HTP[i] = 1

C_STATE_INH_NS_HTP[i] = 2 ('ENABLE'):
LV_INH_DIAG_NS_OBD_2_HTP[i] = 0
end case selection

Inhibition mode of signal availability diagnosis
case selection on C_STATE_INH_NS_AVL[i]
C_STATE_INH_NS_AVL[i] = 0 ('AUTO'):
If FAC_PV_GRD_ABSV_INT < C_FAC_PV_GRD_ABSV_INT_MIN
Then LV_PV_GRD_NS_DIAG = 0
Else **If** FAC_PV_GRD_ABSV_INT > C_FAC_PV_GRD_ABSV_INT_MAX
Then LV_PV_GRD_NS_DIAG = 1
Endif
Endif

if LV_ERR_NS_OBD_1[i] = 1 **OR**

LV_ERR_NS_CAN_MSG_LOST[i] = 1 **OR**

LV_ERR_NS_CAN_BOFF = 1 **OR**

LV_PV_GRD_NS_DIAG = 1 **OR**

(Bit 3 (STATE_INH_NS_OBD_2_EXT_ADJ[i]**)** = 1 **AND** LC_NS_DIAG_EXT_ADJ_ENA = 1**)** **OR**
(STATE_ERR_NS_OBD_2[i] **bitwise AND** C_ERR_NS_AVL_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_AVL[i] = 1
else LV_INH_DIAG_NS_OBD_2_AVL[i] = 0
endif

C_STATE_INH_NS_AVL[i] = 1 ('DISABLE'):
LV_INH_DIAG_NS_OBD_2_AVL[i] = 1

C_STATE_INH_NS_AVL[i] = 2 ('ENABLE'):
LV_INH_DIAG_NS_OBD_2_AVL[i] = 0
end case selection

Inhibition mode of signal offset diagnosis
case selection on C_STATE_INH_NS_OFS[i]
C_STATE_INH_NS_OFS[i] = 0 ('AUTO'):

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if LV_ERR_NS_OBD_1[i] = 1 **OR**
LV_ERR_NS_CAN_MSG_LOST[i] = 1 **OR**
LV_ERR_NS_CAN_BOFF = 1 **OR**
(Bit 2 (STATE_INH_NS_OBD_2_EXT_ADJ[i]**)** = 1 **AND** LC_NS_DIAG_EXT_ADJ_ENA = 1**)** **OR**
(STATE_ERR_NS_OBD_2[i] **bitwise AND** C_ERR_NS_OFS_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_OFS[i] = 1
else LV_INH_DIAG_NS_OBD_2_OFS[i] = 0
endif

C_STATE_INH_NS_OFS[i] = 1 ('DISABLE'):
LV_INH_DIAG_NS_OBD_2_OFS[i] = 1

C_STATE_INH_NS_OFS[i] = 2 ('ENABLE'):
LV_INH_DIAG_NS_OBD_2_OFS[i] = 0
end case selection

Inhibition mode of signal dynamic diagnosis
case selection on C_STATE_INH_NS_DYN[i]
C_STATE_INH_NS_DYN[i] = 0 ('AUTO'):
if LV_ERR_NS_OBD_1[i] = 1 **OR**
LV_ERR_NS_CAN_MSG_LOST[i] = 1 **OR**
LV_ERR_NS_CAN_BOFF = 1 **OR**
LV_ERR_LAMB_TMP = 1 **OR**
LV_ERR_FUEL_TMP = 1 **OR**LV_ERR_MAF = 1 **OR**
LV_ERR_MAP = 1 **OR**
LV_ERR_MAP_TPS_PLAUS = 1 **OR**
(Bit 7 (STATE_INH_NS_OBD_2_EXT_ADJ[i]**)** = 1 **AND** LC_NS_DIAG_EXT_ADJ_ENA = 1**)** **OR**
(STATE_ERR_NS_OBD_2[i] **bitwise AND** C_ERR_NS_DYN_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_DYN[i] = 1
else LV_INH_DIAG_NS_OBD_2_DYN[i] = 0
endif

C_STATE_INH_NS_DYN[i] = 1 ('DISABLE'):
LV_INH_DIAG_NS_OBD_2_DYN[i] = 1

C_STATE_INH_NS_DYN[i] = 2 ('ENABLE'):
LV_INH_DIAG_NS_OBD_2_DYN[i] = 0
end case selection

Inhibition mode of signal activity diagnosis
case selection on C_STATE_INH_NS_ACT[i]
C_STATE_INH_NS_ACT[i] = 0 ('AUTO'):
if LV_ERR_NS_OBD_1[i] = 1 **OR**
LV_ERR_NS_CAN_MSG_LOST[i] = 1 **OR**

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LV_ERR_NS_CAN_BOFF = 1 **OR**

(Bit 8 (STATE_INH_NS_OBD_2_EXT_ADJ[i]**)** = 1 **AND** LC_NS_DIAG_EXT_ADJ_ENA = 1**)** **OR**
(STATE_ERR_NS_OBD_2[i] **bitwise AND** C_ERR_NS_ACT_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_ACT[i] = 1
else LV_INH_DIAG_NS_OBD_2_ACT[i] = 0
endif

C_STATE_INH_NS_ACT[i] = 1 ('DISABLE'):
LV_INH_DIAG_NS_OBD_2_ACT[i] = 1

C_STATE_INH_NS_ACT[i] = 2 ('ENABLE'):
LV_INH_DIAG_NS_OBD_2_ACT[i] = 0
end case selection

Inhibition mode of signal plausibility diagnosis (LSL_UP_DOWN, PUC, AFR, STOP)
case selection on C_STATE_INH_NS_PLAUS[i]
C_STATE_INH_NS_PLAUS[i] = 0 ('AUTO'):
if LV_ERR_NS_OBD_1[i] = 1 **OR**

LV_ERR_NS_CAN_MSG_LOST[i] = 1 **OR**

LV_ERR_NS_CAN_BOFF = 1 **OR**

LV_ERR_LAMB_TMP = 1 **OR**
LV_ERR_FUEL_TMP = 1 **OR**LV_
ERR_MAF = 1 **OR**
LV_ERR_MAP = 1 **OR**
LV_ERR_MAP_TPS_PLAUS = 1 **OR**

(Bit 1 (STATE_INH_NS_OBD_2_EXT_ADJ[i]**)** = 1 **AND** LC_NS_DIAG_EXT_ADJ_ENA = 1**)** **OR**
T_WOUT_NS_AD < C_T_WOUT_NS_AD_INH_NS_DIAG

STATE_NS[i] != 0 **OR**
(STATE_ERR_NS_OBD_2[i] **bitwise AND** C_ERR_NS_PLAUS_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_PLAUS[i] = 1
else LV_INH_DIAG_NS_OBD_2_PLAUS[i] = 0
endif

C_STATE_INH_NS_PLAUS[i] = 1 ('DISABLE'):
LV_INH_DIAG_NS_OBD_2_PLAUS[i] = 1

C_STATE_INH_NS_PLAUS[i] = 2 ('ENABLE'):
LV_INH_DIAG_NS_OBD_2_PLAUS[i] = 0
end case selection

Inhibition mode of NOx signal gain diagnosis
case selection on C_STATE_INH_NS_GAIN[i]
C_STATE_INH_NS_GAIN[i] = 0 ('AUTO'):
if LV_ERR_NS_OBD_1[i] = 1 **OR**

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LV_ERR_NS_CAN_MSG_LOST[i] = 1 **OR**

LV_ERR_NS_CAN_BOFF = 1 **OR**

LV_ERR_LAMB_TMP = 1 **OR**
LV_ERR_FUEL_TMP = 1 **OR**LV_
ERR_MAF = 1 **OR**
LV_ERR_MAP = 1 **OR**
LV_ERR_MAP_TPS_PLAUS = 1 **OR**

LV_ERR_NT_AGI = 1 **OR**
LV_ERR_NS_OBD_2[i] = 1 **OR**
LV_ERR_CAT_DIAG_AFL[1] = 1 **OR**

(NC_CBK_EX_NR = 2 **AND** LV_ERR_CAT_DIAG_AFL[2] = 1**)**

LV_ERR_TEG_PCAT_DOWN = 1 **OR**

LV_SO2P_REQ = 1 **OR**
(Bit 12 (STATE_INH_NS_OBD_2_EXT_ADJ[i]**)** = 1 **AND** LC_NS_DIAG_EXT_ADJ_ENA = 1**)** **OR**
(STATE_ERR_NS_OBD_2[i] **bitwise AND** C_ERR_NS_GAIN_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_GAIN[i] = 1
else LV_INH_DIAG_NS_OBD_2_GAIN[i] = 0
endif

C_STATE_INH_NS_GAIN[i] = 1 ('DISABLE'):
LV_INH_DIAG_NS_OBD_2_GAIN[i] = 1

C_STATE_INH_NS_GAIN[i] = 2 ('ENABLE'):
LV_INH_DIAG_NS_OBD_2_GAIN[i] = 0
end case selection

Inhibition mode of NOx raw emission diagnosis
case selection on C_STATE_INH_NS_RAW[i]
C_STATE_INH_NS_RAW[i] = 0 ('AUTO'):
if LV_ERR_NS_OBD_1[i] = 1 **OR**

LV_ERR_NS_CAN_MSG_LOST[i] = 1 **OR**

LV_ERR_NS_CAN_BOFF = 1 **OR**

LV_ERR_LAMB_TMP = 1 **OR**
LV_ERR_FUEL_TMP = 1 **OR**LV_
ERR_MAF = 1 **OR**
LV_ERR_MAP = 1 **OR**
LV_ERR_MAP_TPS_PLAUS = 1 **OR**

(Bit 13 (STATE_INH_NS_OBD_2_EXT_ADJ[i]**)** = 1 **AND** LC_NS_DIAG_EXT_ADJ_ENA = 1**)** **OR**
(STATE_ERR_NS_OBD_2[i] **bitwise AND** C_ERR_NS_RAW_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_RAW[i] = 1
else LV_INH_DIAG_NS_OBD_2_RAW[i] = 0
endif

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C_STATE_INH_NS_RAW[i] = 1 ('DISABLE'):
LV_INH_DIAG_NS_OBD_2_RAW[i] = 1

C_STATE_INH_NS_RAW[i] = 2 ('ENABLE'):
LV_INH_DIAG_NS_OBD_2_RAW[i] = 0
end case selection

Inhibition mode of NOx sensor internal setpoint shift diagnosis
case selection on C_STATE_INH_NS_SHIFT[i]
C_STATE_INH_NS_SHIFT[i] = 0 ('AUTO'):
if LV_ERR_NS_OBD_1[i] = 1 **OR**

LV_ERR_NS_CAN_MSG_LOST[i] = 1 **OR**

LV_ERR_NS_CAN_BOFF = 1 **OR**

LV_ERR_LAMB_TMP = 1 **OR**

LV_ERR_FUEL_TMP = 1 **OR**LV_
ERR_MAF = 1 **OR**
LV_ERR_MAP = 1 **OR**
LV_ERR_MAP_TPS_PLAUS = 1 **OR**

(LC_NS_SHIFT_INH_CAT_DIAG **AND**
(LV_LAM_ADJ_CAT_DIAG[1] = 1 **OR**
(NC_CBK_EX_NR = 2 **AND** LV_LAM_ADJ_CAT_DIAG[2] = 1**)))**
14 (STATE_INH_NS_OBD_2_EXT_ADJ[i]**)** = 1 **AND** LC_NS_DIAG_EXT_ADJ_ENA = 1**)**

(STATE_ERR_NS_OBD_2[i] **bitwise AND** C_ERR_NS_SHIFT_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_SHIFT[i] = 1
else LV_INH_DIAG_NS_OBD_2_SHIFT[i] = 0
endif

C_STATE_INH_NS_SHIFT[i] = 1 ('DISABLE'):
LV_INH_DIAG_NS_OBD_2_SHIFT[i] = 1

C_STATE_INH_NS_SHIFT[i] = 2 ('ENABLE'):
LV_INH_DIAG_NS_OBD_2_SHIFT[i] = 0
end case selection

Inhibition mode of NOx sensor version diagnosis
case selection on C_STATE_INH_NS_VERS[i]
C_STATE_INH_NS_VERS[i] = 0 ('AUTO'):
if LV_ERR_NS_CAN_MSG_LOST[i] =
1 **OR**
LV_ERR_NS_CAN_BOFF = 1 **OR**

(Bit 15 (STATE_INH_NS_OBD_2_EXT_ADJ[i]**)** = 1 **AND** LC_NS_DIAG_EXT_ADJ_ENA
= 1**)** **OR**
(STATE_ERR_NS_OBD_2[i] **bitwise AND** C_ERR_NS_VERS_BIT_SEL[i]) != 0
then LV_INH_DIAG_NS_OBD_2_VERS[i] = 1
else LV_INH_DIAG_NS_OBD_2_VERS[i] = 0
endif

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C_STATE_INH_NS_VERS[i] = 1 ('DISABLE'):
LV_INH_DIAG_NS_OBD_2_VERS[i] = 1

C_STATE_INH_NS_VERS[i] = 2 ('ENABLE'):
LV_INH_DIAG_NS_OBD_2_VERS[i] = 0

end case selection

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B.130 NOx storage catalyst diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_NT_AGI	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx catalyst aging diagnosis					
ERR_SYM_NT_SO2P	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for the NOx catalyst missing desulfation diagnosis					
LV_CDN_DIAG_NT_AGI	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx catalyst aging diagnosis					
LV_CDN_DIAG_NT_SO2P	V	0... 1H	0 ...1	1	-
Diagnosis condition of NOx catalyst missing desulfation diagnosis					
LV_END_DIAG_NT_AGI	O/V	0... 1H	0 ...1	1	-
End of NOx catalyst aging diagnosis					
LV_END_DIAG_NT_SO2P	O/V	0... 1H	0 ...1	1	-
End of NOx catalyst missing desulfation diagnosis					
LV_ERR_NT_AGI	O/V	0... 1H	0 ...1	1	-
Error flag of NOx catalyst aging diagnosis					
LV_ERR_NT_SO2P	O/V	0... 1H	0 ...1	1	-
Error flag of NOx catalyst missing desulfation diagnosis					

Input data:

LV_INH_DIAG_NT_AGI {p. 6490}	LV_INH_DIAG_NT_SO2P {p. 6490}	LV_NT_AFS_REQ_AGI_ TMP_3 {p. 3072}	LV_ST_END {p. 1720}
NC_IDX_DIAG_NT_AGI	NC_IDX_DIAG_NT_SO2P	NT_AGI_SUL {p. 3073}	NT_AGI_THERMO {p. 3073}
NT_SUL {p. 3113}	NT_SUL_H {p. 3113}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_NT_AGI	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx catalyst aging diagnosis					
C_ABC_DEC_NT_SO2P	-	0... FFH	0... 255	1	-
Anti bounce counter decrement for the NOx catalyst missing desulfation diagnosis					
C_ABC_INC_NT_AGI	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx catalyst aging diagnosis					
C_ABC_INC_NT_SO2P	-	0... FFH	0... 255	1	-
Anti bounce counter increment for the NOx catalyst missing desulfation diagnosis					
C_ABC_MAX_NT_AGI	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx catalyst aging diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_NT_SO2P	-	1... FFH	1... 255	1	-
Anti bounce counter maximum for the NOx catalyst missing desulfation diagnosis					
C_FAC_NT_AGI_ERR_SO2P	-	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx trap aging factor threshold for the missing desulfation error					
IP_SUL_H_NT_MIN_ERR_SO2P	-	0... FFFFH	0... 10485.6	0.16	mg
LDPM_NT_AGI_THERMO_IP_SUL_ERR	6	0... FFFFH	0... 0.99998474	15.2587e-6	-
NOx Trap sulphur loading threshold (for high sulphured fuel) for missing desulfation error					
IP_SUL_NT_MAX_ERR_SO2P	-	0... FFFFH	0... 10485.6	0.16	mg
LDPM_NT_AGI_THERMO_IP_SUL_ERR	6	0... FFFFH	0... 0.99998474	15.2587e-6	-
Sulphur model threshold for missing desulfation error					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

General information

If the stratified combustion mode is irreversible forbidden due to NOx catalyst aging, a failure mode entry is done.
If the NOx trap is aged reversible by sulfur, a failure mode entry is done.

Application Condition

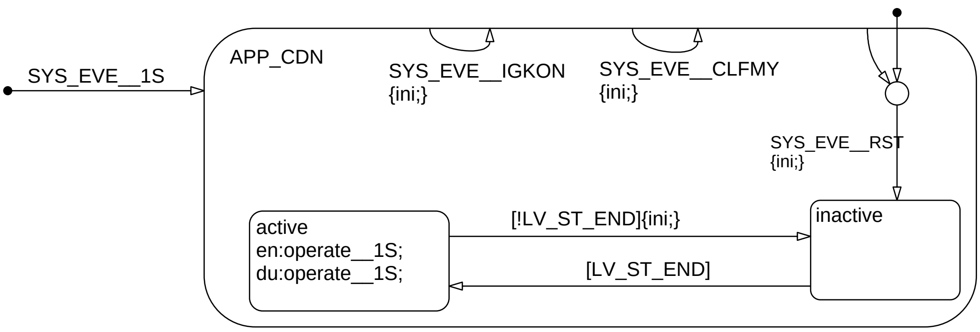

Figure B.130.1: NOXM_MODULB01Z/APP_CDN/Chart

Function Description

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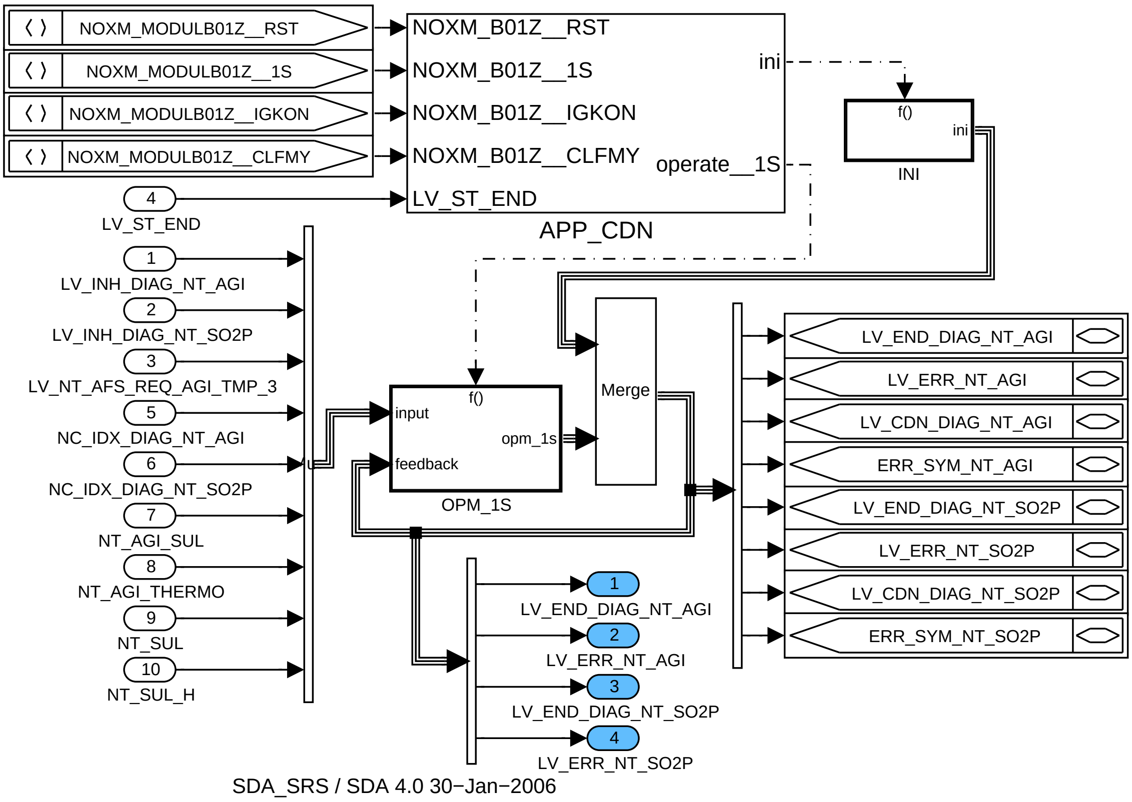

Figure B.130.2: NOXM_MODULB01Z

B.130.1 Initialization at reset and deactivation

These actions initialized the diagnostic data according filtering configuration :
ACTION_ERRM_GetLvErr(IN<NC_IDX_DIAG_XX>, OUT<LV_ERR_XX>)
ACTION_ERRM_GetLvEndDiag(IN<NC_IDX_DIAG_XX>, OUT<LV_END_DIAG_XX>)

B.130.2 Calculation at 1 s

1.1.2.1 Enabling of aging diagnosis

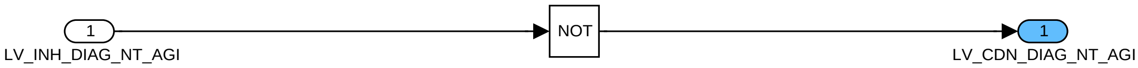

Figure B.130.3: NOXM_MODULB01Z/OPM_1S/CLC1

1.1.2.2 Error symptom for aging diagnosis

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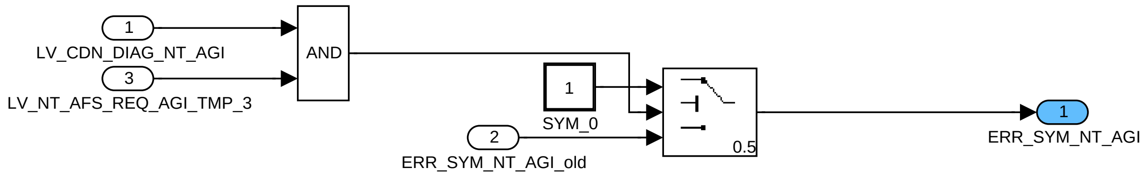

Figure B.130.4: NOXM_MODULB01Z/OPM_1S/CLC2

1.1.2.3 Error management for aging diagnosis

LV_ERR_NT_AGI will be get by ACTION_ERRM_GetLvErr and LV_END_DIAG_NT_AGI will be get by ACTION_ERRM_GetLvEndDiag.

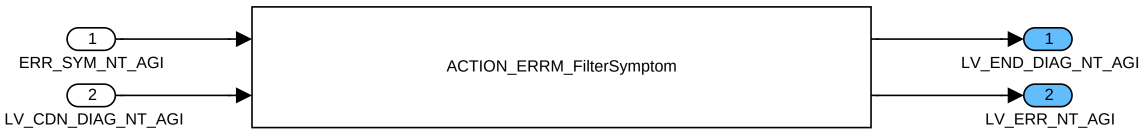

Figure B.130.5: NOXM_MODULB01Z/OPM_1S/CLC3

1.1.2.4 Enabling of missing desulfation diagnosis

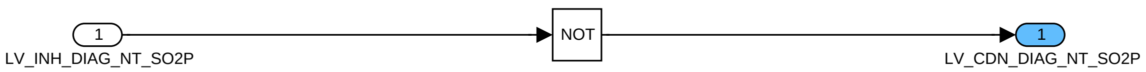

Figure B.130.6: NOXM_MODULB01Z/OPM_1S/CLC4

1.1.2.5 Error symptom for missing desulfation diagnosis

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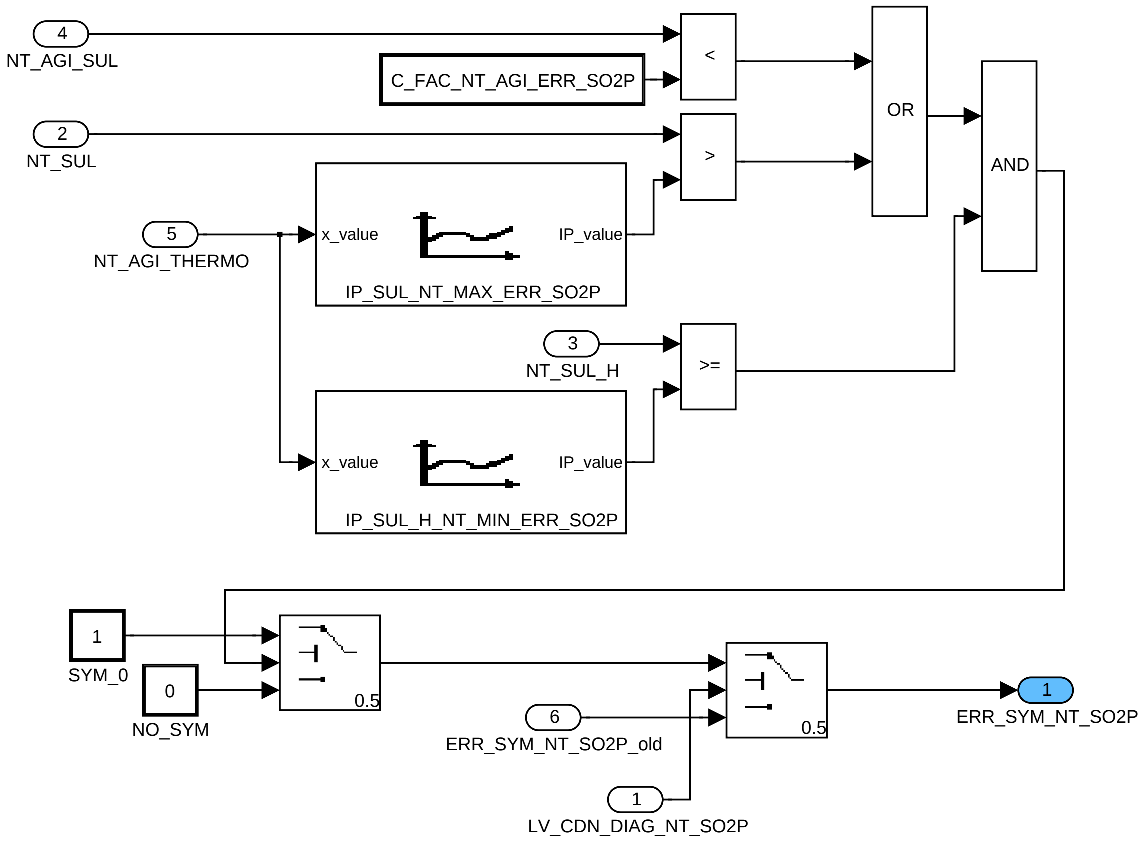

Figure B.130.7: NOXM_MODULB01Z/OPM_1S/CLC5

1.1.2.6 Error management for missing desulfation diagnosis

LV_ERR_NT_AGI will be get by ACTION_ERRM_GetLvErr and LV_END_DIAG_NT_AGI will be get by ACTION_ERRM_GetLvEndDiag.

Figure B.130.8: NOXM_MODULB01Z/OPM_1S/CLC6

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B.131 NOx storage catalyst diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_DIAG_NT_AGI	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx catalyst aging diagnosis					
LV_INH_DIAG_NT_SO2P	O/V	0... 1H	0 ...1	1	-
Inhibition of NOx catalyst diagnosis for missing desulfation					

Input data:

LV_ST_END {p. 1720}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_STATE_INH_NT_AGI	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx catalyst aging diagnosis					
C_STATE_INH_NT_SO2P	-	0H 1H 2H	AUTO DISABLE ENABLE	-	-
Switch for selection of inhibition mode of NOx catalyst diagnosis for missing desulfation					

Error treatment:

Diagnostic NT_AGI	Symptom description	Symptom	Filter type
NOx storage catalyst diagnosis	NOx storage capacity too low	SYM_0	STD
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.131.1: Diagnostic

Diagnostic NT_AGI	Symptoms	Ref.	DTC Symptom CARB	DTC Symptom Customer	DTC Global CARB	DTC Global Customer	Failure class A/B	Readiness code
NOx storage catalyst diagnosis	NOx storage capacity too low	*SYM_0*						
		SYM_1						
		SYM_2						
		SYM_3						

Figure B.131.2: Diagnostic

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Diagnostic **NT_SO2P**	**Symptom description**	**Symptom**	**Filter type**
NOx storage catalyst diagnosis	NOx trap sulfur load too high	SYM_0	STD
		SYM_1	
		SYM_2	
		SYM_3	

Figure B.131.3: Diagnostic

Diagnostic **NT_SO2P**	**Symptoms**	**Ref.**	**DTC Symptom CARB**	**DTC Symptom Customer**	**DTC Global CARB**	**DTC Global Customer**	**Failure class A/B**	**Readiness code**
NOx storage catalyst diagnosis	NOx trap sulfur load too high	*SYM_0*						
		SYM_1						
		SYM_2						
		SYM_3						

General information:

Both diagnoses will be inhibited, if any used input signal is not valid. Additionally, the diagnosis may be enabled or disabled without any cross dependencies.

Application conditions

Initialisation:
```
at reset and at deactivation:
    LV_INH_DIAG_NT_AGI     = 1
    LV_INH_DIAG_NT_SO2P     = 1
```

Recurrence: *1 s*

Activation: *LV_ST_END = 1*

Deactivation: *LV_ST_END = 0*

Formula section:

case selection on C_STATE_INH_NT_AGI
C_STATE_INH_NT_AGI = 0 ('AUTO'):
LV_INH_DIAG_NT_AGI = 0 *(no cross dependencies)*

C_STATE_INH_NT_AGI = 1 ('DISABLE'):
LV_INH_DIAG_NT_AGI = 1

C_STATE_INH_NT_AGI = 2 ('ENABLE'):
LV_INH_DIAG_NT_AGI = 0
end case selection

case selection on C_STATE_INH_NT_SO2P
C_STATE_INH_NT_SO2P = 0 ('AUTO'):
LV_INH_DIAG_NT_SO2P = 0 *(no cross dependencies)*

C_STATE_INH_NT_SO2P = 1 ('DISABLE'):

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LV_INH_DIAG_NT_SO2P = 1

C_STATE_INH_NT_SO2P = 2 ('ENABLE'):
LV_INH_DIAG_NT_SO2P = 0

end case selection

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B.132 Ignition angle efficiency diagnosis

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_SUM_EFF_IGA_CST_IS	V	80000000... 7FFFFFFFH	-65536... 65535.9999695	30.5176e-6	-
Integral of EFF_IGA_DIF at idle speed					
CTR_SUM_EFF_IGA_CST_PL	V	80000000... 7FFFFFFFH	-65536... 65535.9999695	30.5176e-6	-
Integral of EFF_IGA_DIF at part load					
CTR_SUM_TQ_DIF_P_D_FAST	V	0... FFFFH	0... 65535	1	-
Accumulated sum of the signal TQ_DIF_P_D_FAST_IS					
CTR_T_EFF_IGA_CST_IS	V	0... FFFFH	0... 6553.5	0.1	s
Cumulated counted step ammount at idle speed with active catalyst heating for EFF_IGA_CST diagnosis					
CTR_T_EFF_IGA_CST_PL	V	0... FFFFH	0... 6553.5	0.1	s
Cumulated counted step ammount at part load with active catalyst heating for EFF_IGA_CST diagnosis					
EFF_IGA_CST_QUO_IS	O/V	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Quotient of Ignition angle efficiency integral and time at idle speed					
EFF_IGA_CST_QUO_IS_MAX	O/V/S	0... FFH	0... 255	1	%
Maximum quotient of ignition angle efficiency integral and time at idle speed (relative to the maximum threshold in percent)					
EFF_IGA_CST_QUO_PL	O/V	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Quotient of Ignition angle efficiency integral and time in part load					
EFF_IGA_CST_QUO_PL_MAX	O/V/S	0... FFH	0... 255	1	%
Maximum quotient of ignition angle efficiency integral and time in part load (relative to the maximum threshold in percent)					
EFF_IGA_DIF	V	8000... 7FFFH	-2... 1.99993896484	61.0352e-6	-
Difference of EFF_IGA_AV and EFF_IGA_SP_CH					
EFF_IGA_SP_CH	O/V	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Setpoint of ignition angle efficiency due to catalyst heating request					
LF_STATE_DGO_EFF_IGA_CST_IS	O/V	0... FFFFH	0... 65535	1	-
State of ignition angle efficiency monitoring at cold start - idle speed					
LF_STATE_DGO_EFF_IGA_CST_PL	O/V	0... FFFFH	0... 65535	1	-
State of ignition angle efficiency monitoring at cold start - part load					
LV_CTR_HLD_EFF_IGA_CST	V	0... 1H	0 ...1	1	-
Resulting hold set by engine speed or load dynamic detection for stopping the ignition angle diagnosis in idle and part load					
LV_MAF_CTR_HLD_EFF_IGA_CST	V	0... 1H	0 ...1	1	-
Hold set by load dynamic detection for stopping the ignition angle diagnosis in idle and part load					
LV_N_CTR_HLD_EFF_IGA_CST	V	0... 1H	0 ...1	1	-
Hold set by engine speed dynamic detection for stopping the ignition angle diagnosis in idle and part load					
LV_T_MIN_CH_CST	O/V	0... 1H	0 ...1	1	-
Boolean indicating minimum time in catalyst heating reached					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_T_MIN_EFF_IGA_CST_IS	V	0... 1H	0 ...1	1	-
Logical flag indicating minimum time reached for ignition angle efficiency diagnosis for catalyst heating in part load					
LV_T_MIN_EFF_IGA_CST_PL	V	0... 1H	0 ...1	1	-
Logical flag indicating minimum time reached for ignition angle efficiency diagnosis for catalyst heating in part load					
MAF_SP_FIL_CST	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Filtered value of the air mass setpoint for load dynamic detection					
N_FIL_CST	V	0... 1FE0H	0... 8160	1	rpm
Filtered value of engine speed for engine speed dynamic detection					
T_CH_CST	V	0... FFFFH	0... 6553.5	0.1	s
Time since the activation of cold start catalyst heating					
TQ_DIF_SUM_P_D_FAST	V	0... FFFFFFH	0... 52428.796875	3.125e-3	Nm*s
High resolution accumulated sum of the signal TQ_DIF_P_D_FAST_IS					

Input data:

AMP {p. 982}	EFF_IGA_AV {p. 1845}	EFF_IGA_MIN {p. 1845}	LV_IGK {p. 906}
LV_INH_DIAG_EFF_IGA_CST {p. 6508}	LV_IS {p. 1720}	LV_PL {p. 1720}	LV_PU {p. 1720}
LV_ST_END {p. 1720}	LV_STATE_STST_ENG_STOP {p. 804}	MAF_SP {p. 8278}	N {p. 1525}
PQ {p. 8278}	STATE_CH {p. 1777}	TCO_ST {p. 1100}	TQ_ADD_CH_DIAG {p. 6582}
TQ_DIF_P_D_FAST_IS {p. 3441}	TQ_LOSS {p. 8385}	TQI_REQ_TRA {p. 8192}	VS {p. 1176}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AMP_MIN_EFF_IGA_CST	-	0... FFFFH	0... 5434	0.0829175	hPa
Minimum value for ambient pressure for the diagnosis to run					
C_CRLC_MAF_SP_FIL_CST	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for detection of the load dynamic via difference with the not filtered air mass setpoint					
C_CRLC_N_FIL_CST	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation constant for detection of the engine speed dynamic via difference with the not filtered engine speed					
C_CTR_T_EFF_IGA_CST_IS	-	0... FFFFH	0... 6553.5	0.1	s
Minimum counted step ammount at idle speed with active catalyst heating for EFF_IGA_CST diagnosis					
C_CTR_T_EFF_IGA_CST_PL	-	0... FFFFH	0... 6553.5	0.1	s
Minimum counted step ammount at part load with active catalyst heating for EFF_IGA_CST diagnosis					
C_EFF_IGA_SP_CH_THD_IS	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Ignition angle efficiency upper bound for the cold start diagnosis at idle speed					
C_EFF_IGA_SP_CH_THD_PL	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Ignition angle efficiency upper bound for the cold start diagnosis in part load mode					
C_MAF_SP_GRD_THD_CST	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass-air-flow setpoint gradient threshold for dynamic behaviour detection					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_GRD_THD_CST	-	0... 1FE0H	0... 8160	1	rpm
Engine speed gradient threshold for dynamic behaviour detection					
C_T_MAF_CTR_HLD_EFF_IGA_CST	-	0... FFFFH	0... 6553.5	0.1	s
Calibratible value for the hold time caused by a preliminary detection of load dynamic					
C_T_N_CTR_HLD_EFF_IGA_CST	-	0... FFFFH	0... 6553.5	0.1	s
Calibratible value for the hold time caused by a preliminary detection of engine speed dynamic					
C_T_RBM_EFF_IGA_CST	-	0... FFFFH	0... 6553.5	0.1	s
RBM Diagnose threshold for the time since state catalyst heating active					
C_VS_EFF_IGA_CST_THD_PL	-	0... FFH	0... 255	1	km/h
Minimum vehicle speed threshold for running the integral and cumulated counted step ammount at part load					
IP_FAC_EFF_IGA_DIF	-	0... FFH	0... 0.99609375	3.90625e-3	-
LDP_SUM_TQ_DIF_P_D_IS	3	0... FFFFH	0... 65535	1	-
Weighting factor used to reduce the cold start diagnosis error due to slipping clutch					
IP_FAC_PQ_EFF_IGA_CST_THD_IS	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
LDP_TQ_LOSS_IP_FAC_PQ_EFF_IGA	6	0... 8000H	-1024 ...0	0.03125	Nm
Maximum relative filling threshold, torque loss dependant for running the integral and cumulated counted step ammount at idle					
IP_INT_EFF_IGA_SP_CH_QUO_IS_MAX	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDPM_TCO_ST_1	8	0... FEH	-48... 142.5	0.75	°C
Maximum threshold map for quotient of EFF_IGA integral and cumulated time at idle speed of ignition angle diagnosis for catalyst heating					
IP_INT_EFF_IGA_SP_CH_QUO_PL_MAX	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDPM_TCO_ST_1	8	0... FEH	-48... 142.5	0.75	°C
Maximum threshold map for quotient of EFF_IGA integral and cumulated time in part load of ignition angle diagnosis for catalyst heating					
LC_INH_SYM_EFF_IGA_CST	-	0... 1H	0 ...1	1	-
Inhibition bit for suppressing ERRM-interaction of eff_iga_cst diagnosis					

Action definition:

ACTION_TQDR_ResetMainEffIgaCst(IN <PRM_STATE_INI>)					Mode: O
Action to initialize main function of ignition angle efficiency monitoring					
Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_STATE_INI	IN	0... FFH	0... 255	1	-
Type of initialization (Clear: CLR; restart: REST)					

General information:

Legal requirement according to California code regulation 1968.2 (e) (11):
Cold start emission reduction strategy monitoring.
If a vehicle incorporates a specific engine control strategy to reduce cold start emissions, the OBD II system shall monitor the commanded elements for proper function (e.g., increased engine idle speed, commanded ignition timing retard, etc.), other than secondary air, while the control strategy is active to ensure proper operation of the control strategy.

This module describes the technical solution of the ignition angle efficiency monitoring to fulfill the legal requirement.

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Application conditions:

Initialisation:	`RST, NVMINI, NVMRES, NVMSTO`
Recurrence:	`100MS`
Activation:	`always`
Deactivation:	`if activation not true`

Function description:

Formula section:

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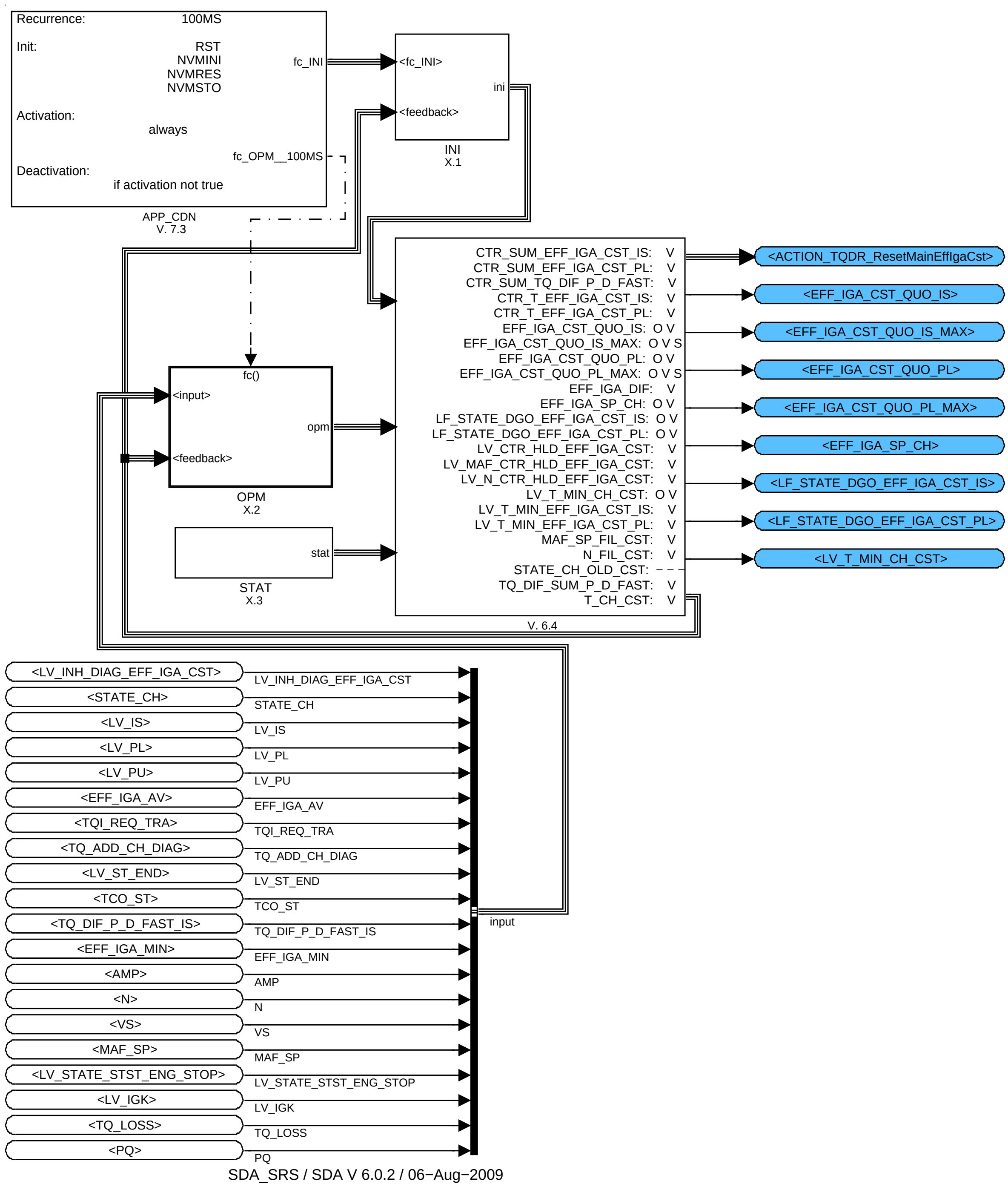

Figure B.132.1: :

B.132.1 Initialization

B.132.1.1 At ECU reset

Variables which are initialized only once at ECU reset are listed here. All other variables are initialized by means of an action call (TQDR_ResetMainEffIgaCst) from ERRM interface (the action itself is defined in this module).

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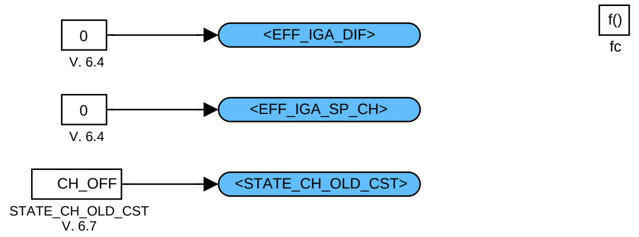

Figure B.132.2: :

B.132.1.2 Initialization of NVMY data in case of EEPROM error

Default values in case of check-sum error are 0.

B.132.1.3 Restore NVMY data

At ECU reset EFF_IGA_CST_QUO_ IS/PL_MAX are restored from NVMY memory.

B.132.1.4 Store NVMY data

At end of power-latch phase EFF_IGA_CST_QUO_ IS/PL_MAX are stored into NVMY.

B.132.2 Formula section

B.132.2.1 Calculation of ignition angle efficiency due to catalyst heating request

The torque reserve for catalyst heating TQ_ADD_CH_DIAG is transformed into a set point for the ignition angle efficiency EFF_IGA_SP_CH used to realize this reserve.

B.132.2.1.1 Set point calculation

EFF_IGA_SP_CH is calculated based on TQ_ADD_CH_DIAG from EXTC. The set point is limited to maximum value of 1.

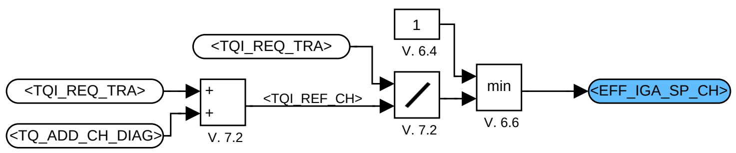

Figure B.132.3: :

B.132.2.1.2 Calculation of minimum time during catalyst heating

During catalyst heating the timer T_CH_CST is increased when EFF_IGA_SP_CH is below 1. The timer starts to run when LV_ST_END switches to 1.
When the timer reaches the threshold C_T_RBM_EFF_IGA_CST the flag LV_T_MIN_CH_CST is set. This flag is evaluated for RBM indicating that minimum time during catalyst heating was reached.

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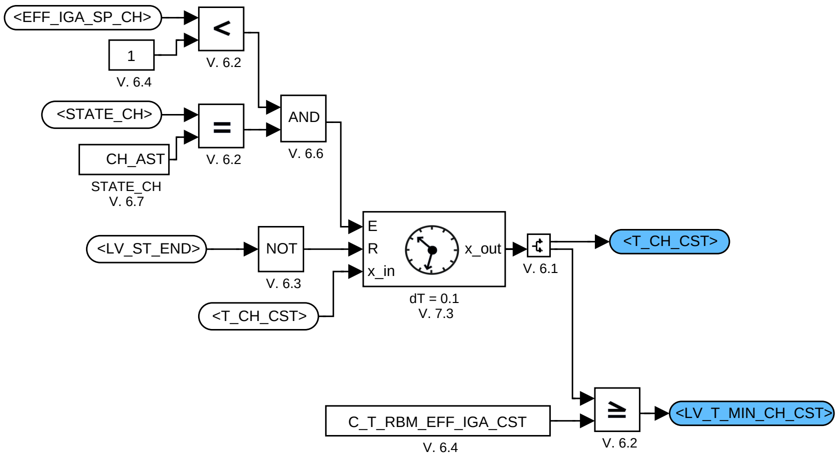

Figure B.132.4: :

B.132.2.2 Diagnostic function

The difference between the actual ignition angle efficiency and set point, limited by the minimum ignition angle efficiency, is integrated for the engine phases "idle speed" and "part load" separately. The integrated values are normalized by division with the accumulated time spent in the respective engine phases. The symptoms LV_SYM_EFF_IGA_CST_IS/PL are set accordingly if the normalized integration values exceed the respective maximum thresholds. The maximum drag indicators are stored in the nonvolatile memory. The drag indicators can be cleared by calibration or customer test interface.

Three cases are distinguished:
1. Catalyst heating active
2. End of catalyst heating (1 recurrence after Catalyst heating active)
3. Diagnostic not active

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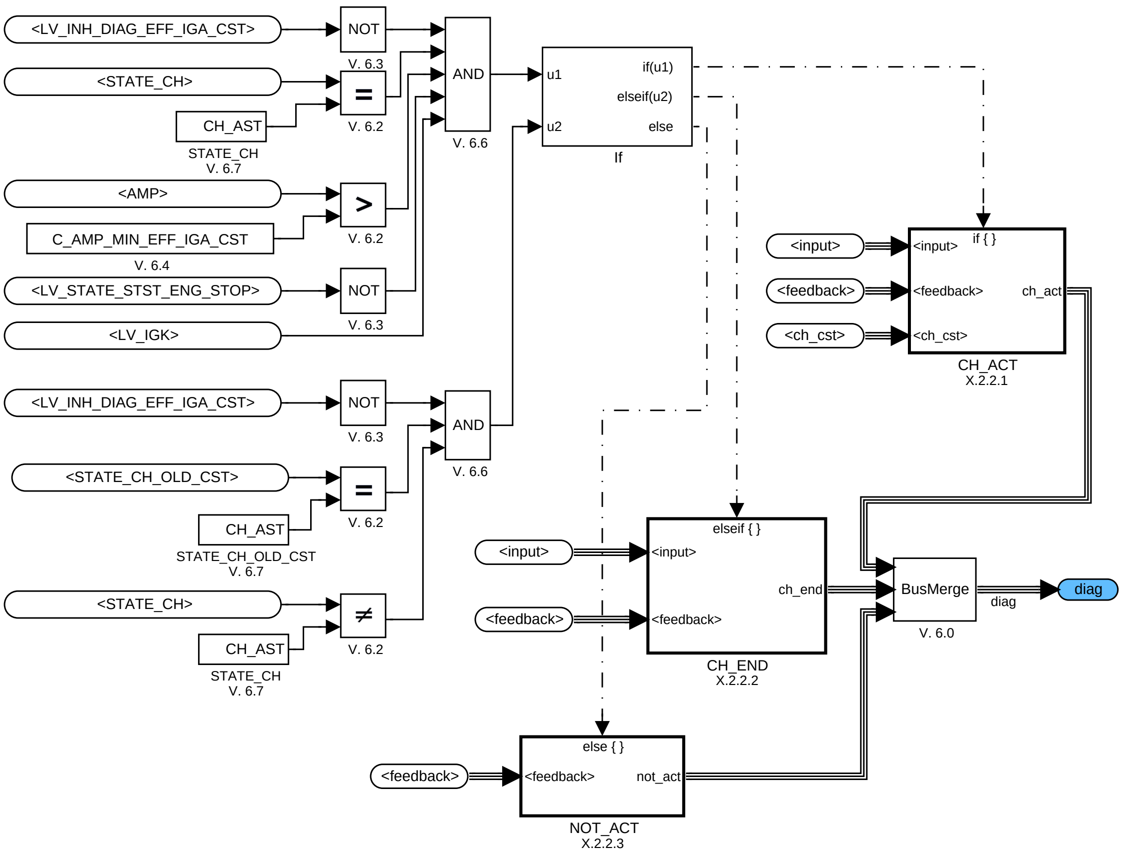

Figure B.132.5: :

B.132.2.2.1 Catalyst heating active

Following functionality is executed when catalyst heating is active and no inhibition of the diagnostic is present.

B.132.2.2.1.1 Calculation of ignition angle efficiency difference

The difference between ignition angle actual value and catalyst heating set point is calculated. This difference is weighted with a factor depending on the accumulated PD-part for fast-path of torque coordination. This accumulated PD-part is normalized to unit [-] in the variable CTR_SUM_TQ_DIF_P_D_FAST.

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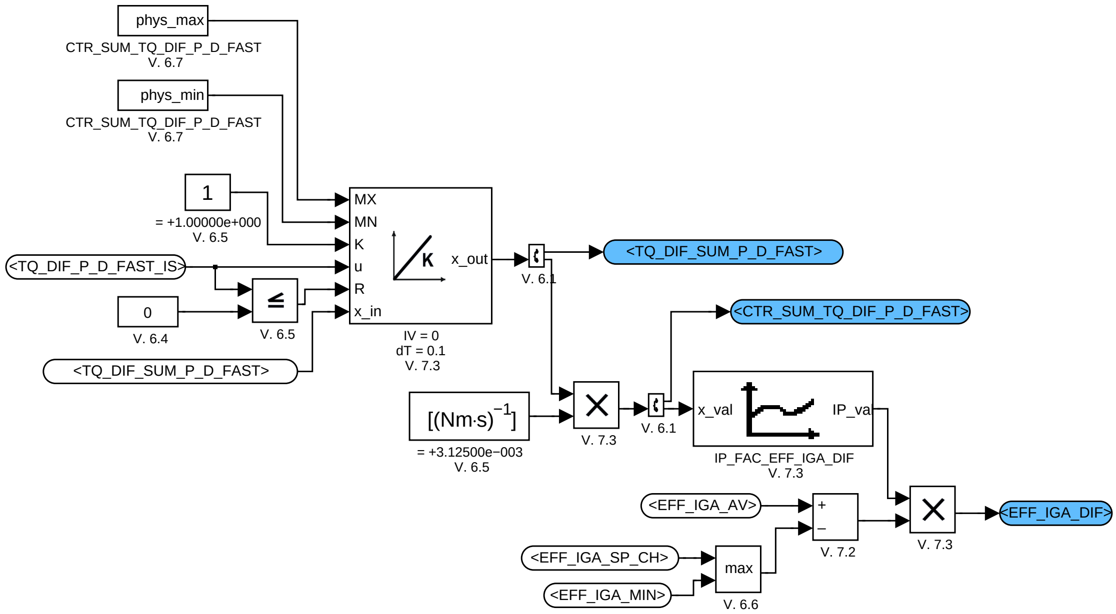

Figure B.132.6: :

B.132.2.2.1.2 Ignition angle efficiency quotient in idle speed

Ignition angle efficiency difference is integrated and normalized with the variable CTR_SUM_EFF_IGA_CST_IS. Enabling condition for the integrator is that the ignition angle efficiency set point is below the maximum C_EFF_IGA_SP_CH_THD_IS and engine state is IS or PU. When these conditions are fulfilled a timer is running in order to calculate the quotient of integrated ignition angle efficiency CTR_SUM_EFF_IGA_CST_IS and to set a flag when minimum time during catalyst heating for the diagnostic is reached.
Furthermore bit 0 of LF_STATE_DGO_EFF_IGA_CST_IS is set the enabling conditions in order to indicate that diagnostic conditions are fulfilled and bit 2 is set to 1 in order to indicate that the diagnostic result is not yet de-bounced.

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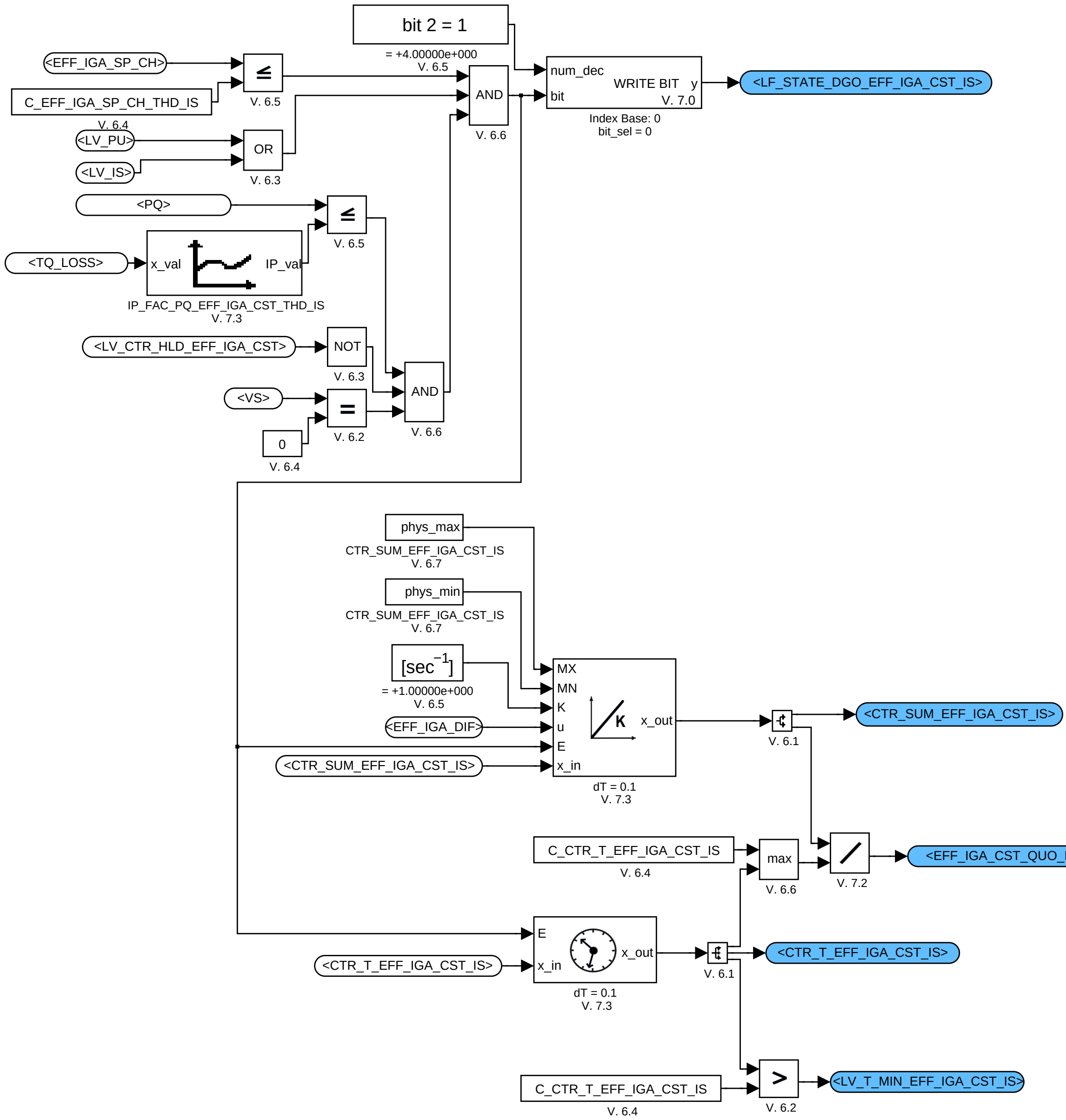

Figure B.132.7: :

B.132.2.2.1.3 Ignition angle efficiency quotient in part load

Ignition angle efficiency difference is integrated and normalized with the variable CTR_SUM_EFF_IGA_CST_PL. Enabling condition for the integrator is that the ignition angle efficiency set point is below the maximum C_EFF_IGA_SP_CH_THD_PL and engine state is part load. When these conditions are fulfilled a timer is running in order to calculate the quotient of integrated ignition angle efficiency CTR_SUM_EFF_IGA_CST_PL and to set a flag when minimum time during catalyst heating for the diagnostic is reached.

Furthermore bit 0 of LF_STATE_DGO_EFF_IGA_CST_PL is set the enabling conditions in order to indicate that diagnostic conditions are fulfilled and bit 2 is set to 1 in order to indicate that the diagnostic result is not yet de-bounced.

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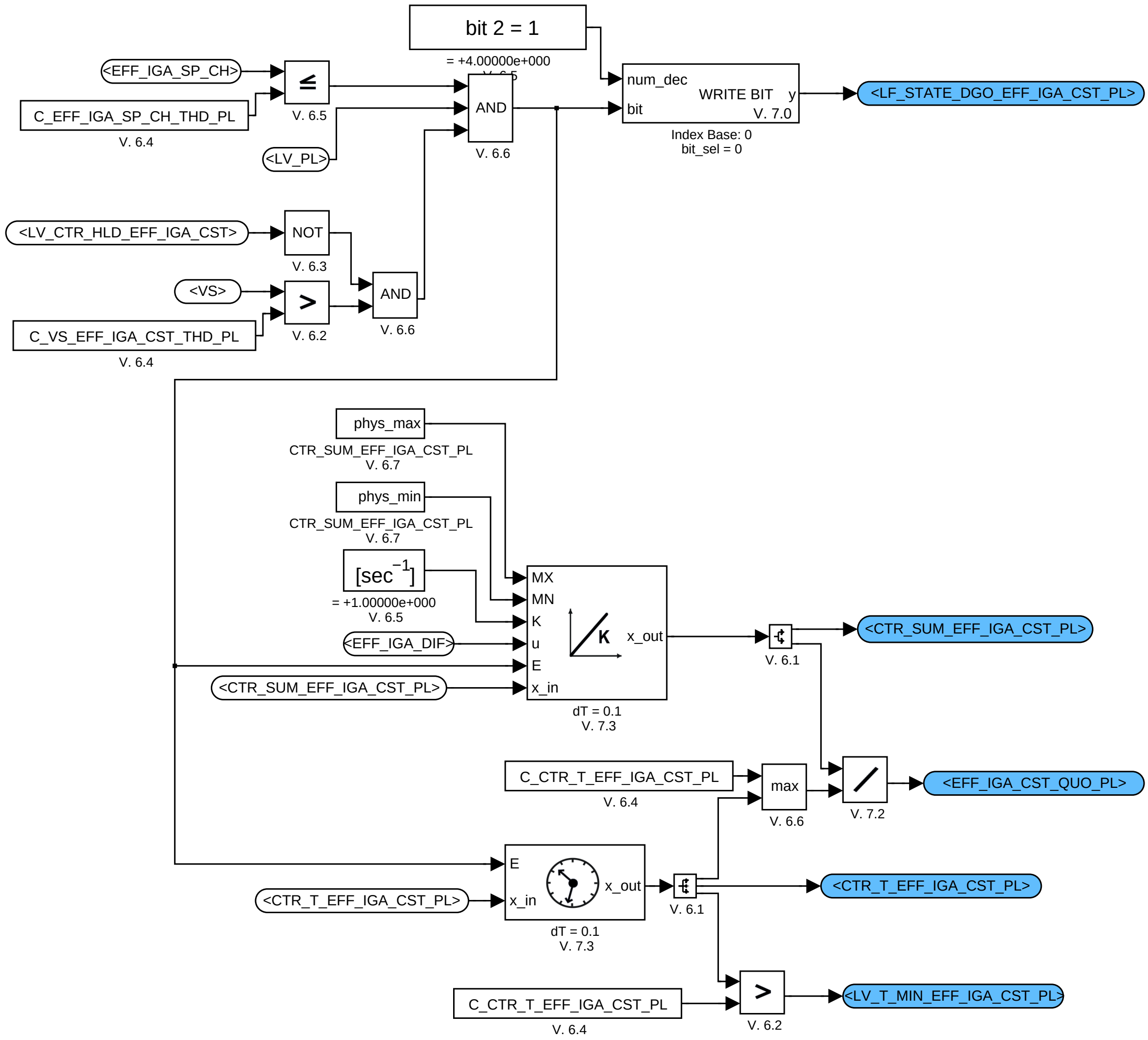

Figure B.132.8: :

B.132.2.2.1.4 Hold flag calculation

The hold flag is set by engine speed or load dynamic detection for stopping the ignition angle diagnosis in idle and part load.

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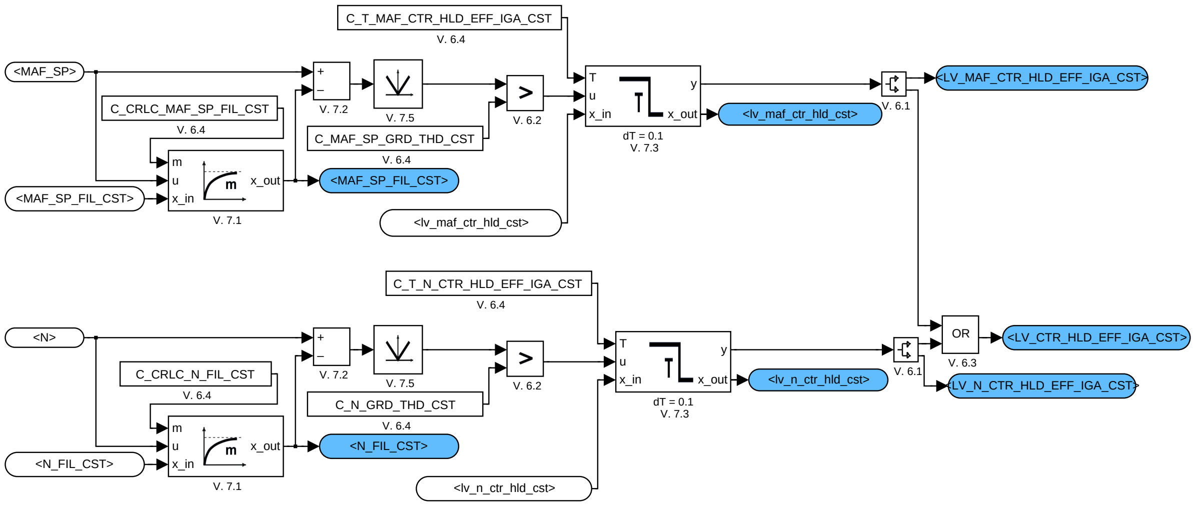

Figure B.132.9: :

B.132.2.2.2 Symptom evaluation at end of catalyst heating

The symptom detection and calculation of the drag indicators is done at the end of every catalyst heating phase once (if diagnosis was not inhibited). For error-free field trial of the catalyst heating quality the symptom delivery to ERRM can be suppressed by calibration.

B.132.2.2.2.1 Symptom evaluation for idle speed

If the quotient of ignition angle efficiency integral is above the threshold defined by IP_INT_EFF_IGA_SP_CH_QUO_IS_MAX the symptom is present. It can be suppressed by mean of the calibration switch LC_INH_SYM_EFF_IGA_CST.
The maximum quotient is stored to the variable EFF_IGA_CST_QUO_IS_MAX (in [%]) as trailing indicator.
The symptom information is stored in bit 1 of LF_STATE_DGO_EFF_IGA_CST_IS and the information that the symptom was de-bounced (LV_T_MIN_EFF_IGA_CST_IS=1; means time during catalyst heating long enough) is stored in bit 2 (set to 0 if LV_T_MIN_EFF_IGA_CST_IS=1).

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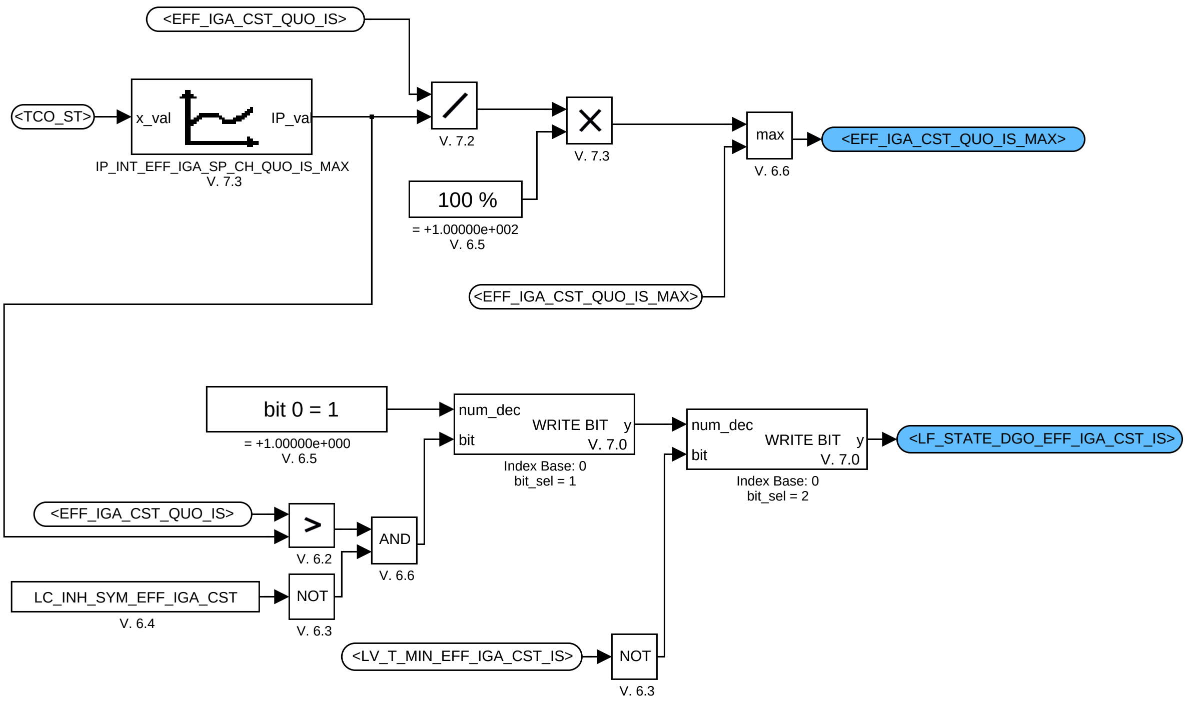

Figure B.132.10: :

B.132.2.2.2.2 Symptom evaluation for part load

If the quotient of ignition angle efficiency integral is above the threshold defined by IP_INT_EFF_IGA_SP_CH_QUO_PL_MAX the symptom is present. It can be suppressed by mean of the calibration switch LC_INH_SYM_EFF_IGA_CST.
The maximum quotient is stored to the variable EFF_IGA_CST_QUO_PL_MAX (in [%]) as trailing indicator.
The symptom information is stored in bit 1 of LF_STATE_DGO_EFF_IGA_CST_PL and the information that the symptom was de-bounced (LV_T_MIN_EFF_IGA_CST_PL=1; means time during catalyst heating long enough) is stored in bit 2 (set to 0 if LV_T_MIN_EFF_IGA_CST_PL=1).

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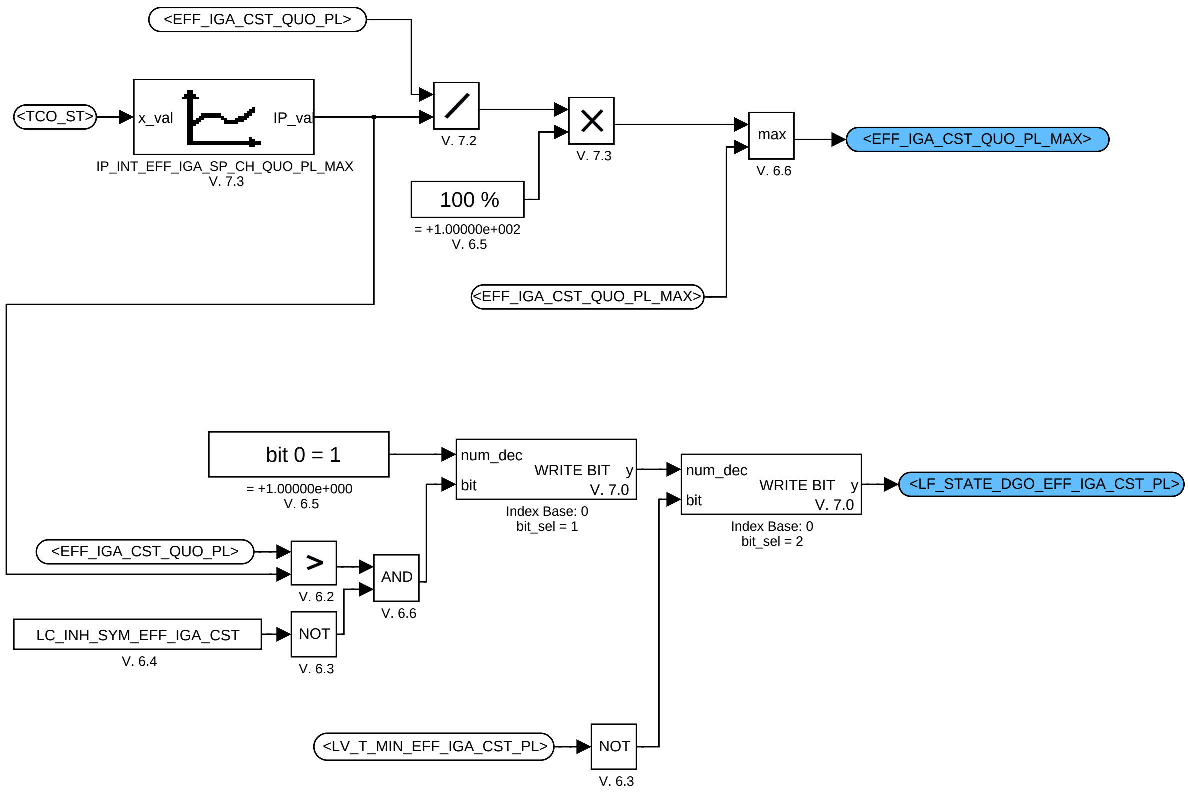

Figure B.132.11: :

B.132.2.2.3 Diagnostic not active

B.132.2.2.3.1 Reset LF_STATE_DGO_...

If the diagnosis is not running interface variables LF_STATE_DGO_EFF_IGA_CST_IS/PL are set to passive values (=0; no delivery to ERRM).

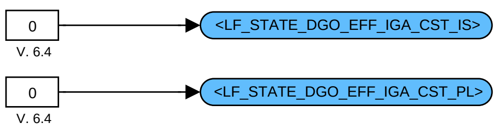

Figure B.132.12: :

B.132.3 Action definition

B.132.3.1 Detailed description for Action: ACTION_TQDR_ResetMainEffIgaCst

B.132.3.1.1 Formula section for action

B.132.3.1.1.1 Initialization of all module variables

In order to allow initialization of the module from other functions this action is provided.

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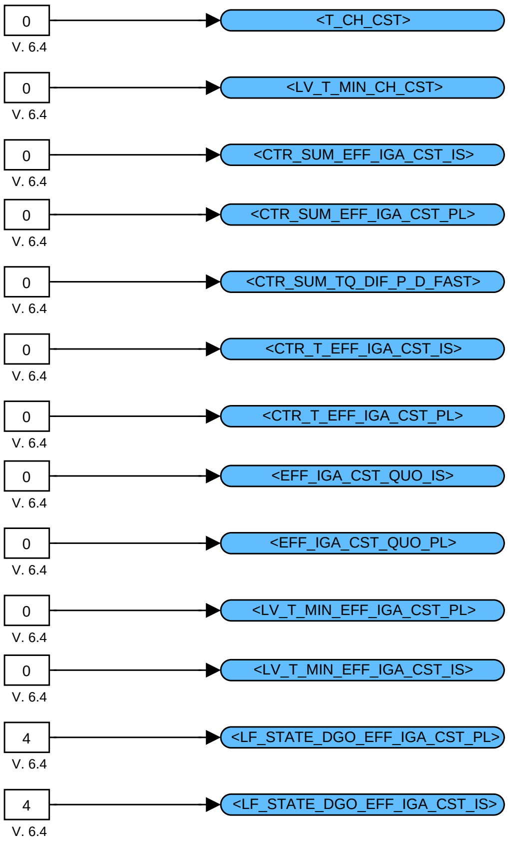

Figure B.132.13: :

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B.133 Ignition angle efficiency diagnosis (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DIAG_CST_ACT	O/V	0... 1H	0 ...1	1	-
Condition for cold start diagnosis active					
LV_INH_DIAG_EFF_IGA_CST	O/V	0... 1H	0 ...1	1	-
Flag for inhibitation of the Ignition angle efficiency Diagnosis					
LV_INH_DIAG_RBM_EFF_IGA_CST	V	0... 1H	0 ...1	1	-
Deactivation of RBM of EFF_IGA_CST-Montior by cross dependency					
STATE_EOL_DGNC_CH_DIAG	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H undef:1H	NOT_START ST_INH PAR_NOT_ PLAUS WAIT_REL UNDEF ACT END_WOUT_ RESULT ABORTED END_WOUT_ ERR END_WITH_ ERR	-	-
State of catalyst heating diagnosis					
STATE_RBM_EFF_IGA_CST_IS	O/V	0... FFH	0... 255	1	-
Rate-Based Monitoring statistics for idle speed mode: monitoring conditions met long enough (bit 0 = 1) monitoring inhibition because of system failure(s) (bit 1 = 1) individual RBM monitoring conditions encountered within this DC (bit 2 = 1)					
STATE_RBM_EFF_IGA_CST_PL	O/V	0... FFH	0... 255	1	-
Rate-Based Monitoring statistics for part load mode: monitoring conditions met long enough (bit 0 = 1) monitoring inhibition because of system failure(s) (bit 1 = 1) individual RBM monitoring conditions encountered within this DC (bit 2 = 1)					

Input data:

CTR_ERR_DYN_NR {p. 5767}	LV_CH_DIAG_EXT_ACT {p. 6597}	LV_CH_DIAG_EXT_REQ {p. 7482}	LV_DC {p. 5746}
LV_END_DIAG_EFF_IGA_CST_IS {p. 6517}	LV_END_DIAG_EFF_IGA_CST_PL {p. 6517}	LV_ERR_CAM_CST_IVVT_EX [NC_NR_CBK_IVVT] {p. 1061}	LV_ERR_CAM_CST_IVVT_IN [NC_NR_CBK_IVVT] {p. 1061}
LV_ERR_CRK_PLAUS {p. 4446}	LV_ERR_CRK_SYN {p. 4431}	LV_ERR_CRK_TOOTH {p. 4432}	LV_ERR_CRK_TOOTH_PER {p. 4432}
LV_ERR_EFF_IGA_CST_IS {p. 6517}	LV_ERR_EFF_IGA_CST_PL {p. 6517}	LV_ERR_FUP_MFP_PLAUS {p. 6062}	LV_ERR_FUP_ORNG {p. 6062}

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LV_ERR_H_PRS_SYS {p. 6062}	LV_ERR_ISC {p. 4377}	LV_ERR_ISC_CST {p. 4377}	LV_ERR_LOAD_TPS_PLAUS {p. 1062}
LV_ERR_MAF_FRQ_EL [NC_MAF_NR] {p. 4815}	LV_ERR_MAF_FRQ_GRD [NC_MAF_NR] {p. 4815}	LV_ERR_MAF_FRQ_RNG [NC_MAF_NR] {p. 4815}	LV_ERR_MAP_DIP_PLAUS {p. 1062}
LV_ERR_MAP_DIP_SENS {p. 4824}	LV_ERR_MAP_DIP_SHIFT {p. 4824}	LV_ERR_MAP_TPS_PLAUS {p. 1062}	LV_ERR_MEC_IVVT_EX {p. 1062}
LV_ERR_MEC_IVVT_IN {p. 1062}	LV_ERR_PER_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PER_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_PLAUS_CAM_EX [NC_NR_CAM_CBK] {p. 4446}
LV_ERR_PLAUS_CAM_IN [NC_NR_CAM_CBK] {p. 4446}	LV_ERR_PUT_EL {p. 4828}	LV_ERR_PUT_PLAUS {p. 1062}	LV_ERR_PVS_1 {p. 4216}
LV_ERR_PVS_2 {p. 4216}	LV_ERR_REF_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_REF_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_SLV_IVVT_EX {p. 4627}
LV_ERR_SLV_IVVT_IN {p. 4627}	LV_ERR_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 4426}	LV_ERR_SYN_CRK_CAM_EX [NC_NR_CAM_CBK] {p. 4447}
LV_ERR_SYN_CRK_CAM_IN [NC_NR_CAM_CBK] {p. 4447}	LV_ERR_TCO_EL {p. 4496}	LV_ERR_TCO_GRD {p. 4496}	LV_ERR_TCO_STUCK {p. 5691}
LV_ERR_TCO_STUCK_RNG {p. 5675}	LV_ERR_TOOTH_OFF_EX [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TOOTH_OFF_IN [NC_NR_CAM_CBK] {p. 4421}	LV_ERR_TPS_1 {p. 4990}
LV_ERR_TPS_2 {p. 4990}	LV_T_MIN_CH_CST {p. 6493}	STATE_CH {p. 1777}	T_AST {p. 1766}
TCO_ST {p. 1100}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_AST_MIN_EFF_IGA_CST	-	0... FFFFH	0... 6553.5	0.1	s
Minimum time after start for active ignition angle efficiency diagnosis for catalyst heating					
C_TCO_ST_MAX_DIAG_CST	-	0... FEH	-48... 142.5	0.75	°C
Maximum temperature threshold for ignition angle efficiency diagnosis					
C_TCO_ST_MIN_DIAG_CST	-	0... FEH	-48... 142.5	0.75	°C
Minimum temperature threshold for ignition angle efficiency diagnosis					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_EFF_IGA_CST_IS	-	1... FFFFH	1... 65535	1	-
Diagnostic EFF_IGA_CST at idle speed					
NC_IDX_DIAG_EFF_IGA_CST_PL	-	1... FFFFH	1... 65535	1	-
Diagnostic EFF_IGA_CST in part load					

Import actions:

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ACTION_ERRM_CheckPendingStatus (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR_PND>)

FUNCTION DESCRIPTION:

General information:

The ignition angle efficiency diagnosis for catalyst heating at coldstart CSERS

Application conditions

Initialisation:
At RST or with IGKON event

LV_DIAG_CST_ACT = 0
LV_INH_DIAG_EFF_IGA_CST = 1

Recurrence:
100MS

Activation:
always

Deactivation:

never

Formula section:

Calculation of diagnosis interface parameter:

```
IF          STATE_CH=1 and
            TCO_ST >=C_TCO_ST_MIN_DIAG_CST
            and TCO_ST<=C_TCO_ST_MAX_DIAG_CST

THEN

        LV_DIAG_CST_ACT = 1

ELSE

        LV_DIAG_CST_ACT = 0

ENDIF

IF          LV_DIAG_CST_ACT = 0 or LV_INH_DIAG_RBM_EFF_IGA_CST = 1 or
        T_AST <= C_T_AST_MIN_EFF_IGA_CST
THEN     LV_INH_DIAG_EFF_IGA_CST = 1
ELSE     LV_INH_DIAG_EFF_IGA_CST = 0
```

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ENDIF

B.133.1 Rate Base Monitoring interface for Ignition angle efficiency monitoring

FUNCTION DESCRIPTION:

General information:

With this module the interface between the EFF_IGA_CST monitor and the Rate-Based Monitoring statistics is defined with STATE_RBM_EFF_IGA_CST_IS/PL data.
Within STATE_RBM_EFF_IGA_CST_IS/PL, three different information are defined:

- Conditions for monitoring are met long enough to detect malfunction (bit 0)
  (no intrusive operation, no short trip)
- Monitor disabled because of system malfunction (bit 1)

(depending on failure status: pending)

- Monitor individual RBM conditions encountered within this DC (bit 2)

Application conditions:

Initialisation :
at ECU reset :
bit 0, bit 1 and bit 2 of STATE_RBM_EFF_IGA_CST_IS = 0
bit 0, bit 1 and bit 2 of STATE_RBM_EFF_IGA_CST_PL = 0
at LV_DC 0   1 transition:
bit 0, bit 1 and bit 2 ofSTATE_RBM_ EFF_IGA_CST_IS = 0
bit 0, bit 1 and bit 2 ofSTATE_RBM_ EFF_IGA_CST_PL = 0
LV_INH_DIAG_RBM_EFF_IGA_CST = 0
on failure memory reset :
bit 1 of STATE_RBM_ EFF_IGA_CST_IS = 0
bit 1 of STATE_RBM_ EFF_IGA_CST_PL = 0
LV_INH_DIAG_RBM_EFF_IGA_CST = 0

Recurrence: 1 S
Activation: LV_DC = 1
Deactivation: LV_DC = 0

Formula section:

At LV_DC 0   1 transition
The pending status of the following failures has to be checked only once:

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LV_ERR_PUT_EL	LV_ERR_PVS_1	LV_ERR_PVS_2	LV_ERR_ISC
LV_ERR_ISC_CST	LV_ERR_CRK_PLAUS	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH
LV_ERR_CRK_TOOTH_PER	LV_ERR_PER_CAM_EX[1...NC_NR_CAM_CBK]	LV_ERR_PER_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_PLAUS_CAM_EX[1...NC_NR_CAM_CBK]
LV_ERR_PLAUS_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_REF_CRK_CAM_EX[1...NC_NR_CAM_CBK]	LV_ERR_REF_CRK_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_SYN_CAM_EX[1...NC_NR_CAM_CBK]
LV_ERR_SYN_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_SYN_CRK_CAM_EX[1...NC_NR_CAM_CBK]	LV_ERR_SYN_CRK_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_TOOTH_OFF_EX[1...NC_NR_CAM_CBK]
LV_ERR_TOOTH_OFF_IN[1...NC_NR_CAM_CBK]	LV_ERR_TCO_EL	LV_ERR_TCO_GRD	LV_ERR_MAF_FRQ_GRD
LV_ERR_TCO_STUCK	LV_ERR_TCO_STUCK_RNG	LV_ERR_LOAD_TPS_PLAUS[1...NC_MAF_NR]	LV_ERR_MAP_DIP_PLAUS
LV_ERR_MAP_TPS_PLAUS	LV_ERR_MEC_IVVT_EX[1...NC_NR_CBK_IVVT]	LV_ERR_MEC_IVVT_IN[1...NC_NR_CBK_IVVT]	LV_ERR_SLV_IVVT_EX[1...NC_NR_CBK_IVVT]
LV_ERR_SLV_IVVT_IN[1...NC_NR_CBK_IVVT]	LV_ERR_PUT_PLAUS[1...NC_ETC_NR]	LV_ERR_FUP_MFP_PLAUS[0...NC_CBK_HPP_NR-1]	LV_ERR_FUP_ORNG[0...NC_CBK_HPP_NR-1]
LV_ERR_H_PRS_SYS[0...NC_CBK_HPP_NR-1]	LV_ERR_MAF_FRQ_EL[1...NC_MAF_NR]	LV_ERR_MAF_FRQ_RNG[1...NC_MAF_NR]	LV_ERR_MAP_DIP_SENS
LV_ERR_TPS_1[1...NC_ETC_NR]	LV_ERR_TPS_2[1...NC_ETC_NR]	LV_ERR_MAP_DIP_SHIFT	LV_ERR_CAM_CST_IVVT_IN[1...NC_NR_CBK_IVVT]
LV_ERR_CAM_CST_IVVT_EX[1...NC_NR_CBK_IVVT]			

If(1) { CPU optimization at LV_DC 0 1 transition }
CTR_ERR_DYN_NR <> 0 { the dynamic failure memory isn t empty }
Then(1)
While bit 1 of STATE_RBM_EFF_IGA_CST_IS = 0 **do**
with each XX failure of the above list :
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2)
bit 1 of STATE_ RBM_EFF_IGA _CST_IS = 1
Endif(2)
Endwhile
While bit 1 of STATE_RBM_EFF_IGA_CST_PL = 0 **do**
with each XX failure of the above list :
ACTION_ERRM_CheckPendingStatus(IN<XX>, OUT<PendingStatus>, SYNCHRONIZATION<C

If(2) XX has a pending status
Then(2)
bit 1 of STATE_ RBM_EFF_IGA _CST_PL = 1
Endif(2)
Endwhile
Else(1)
{ the dynamic failure memory is empty }
No action
Endif(1)

Every 1S :

If at least one of the following LV_ERR_xx-Bits is set to 1

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LV_ERR_PUT_EL	LV_ERR_PVS_1	LV_ERR_PVS_2	LV_ERR_ISC
LV_ERR_ISC_CST	LV_ERR_CRK_PLAUS	LV_ERR_CRK_SYN	LV_ERR_CRK_TOOTH
LV_ERR_CRK_TOOTH_PER	LV_ERR_PER_CAM_EX[1...NC_NR_CAM_CBK]	LV_ERR_PER_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_PLAUS_CAM_EX[1...NC_NR_CAM_CBK]
LV_ERR_PLAUS_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_REF_CRK_CAM_EX[1...NC_NR_CAM_CBK]	LV_ERR_REF_CRK_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_SYN_CAM_EX[1...NC_NR_CAM_CBK]
LV_ERR_SYN_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_SYN_CRK_CAM_EX[1...NC_NR_CAM_CBK]	LV_ERR_SYN_CRK_CAM_IN[1...NC_NR_CAM_CBK]	LV_ERR_TOOTH_OFF_EX[1...NC_NR_CAM_CBK]
LV_ERR_TOOTH_OFF_IN[1...NC_NR_CAM_CBK]	LV_ERR_TCO_EL	LV_ERR_TCO_GRD	LV_ERR_MAF_FRQ_GRD
LV_ERR_TCO_STUCK	LV_ERR_TCO_STUCK_RNG	LV_ERR_LOAD_TPS_PLAUS[1...NC_MAF_NR]	LV_ERR_MAP_DIP_PLAUS
LV_ERR_MAP_TPS_PLAUS	LV_ERR_MEC_IVVT_EX[1...NC_NR_CBK_IVVT]	LV_ERR_MEC_IVVT_IN[1...NC_NR_CBK_IVVT]	LV_ERR_SLV_IVVT_EX[1...NC_NR_CBK_IVVT]
LV_ERR_SLV_IVVT_IN[1...NC_NR_CBK_IVVT]	LV_ERR_PUT_PLAUS[1...NC_ETC_NR]	LV_ERR_FUP_MFP_PLAUS[0...NC_CBK_HPP_NR-1]	LV_ERR_FUP_ORNG[0...NC_CBK_HPP_NR-1]
LV_ERR_H_PRS_SYS[0...NC_CBK_HPP_NR-1]	LV_ERR_MAF_FRQ_EL[1...NC_MAF_NR]	LV_ERR_MAF_FRQ_RNG[1...NC_MAF_NR]	LV_ERR_MAP_DIP_SENS
LV_ERR_TPS_1[1...NC_ETC_NR]	LV_ERR_TPS_2[1...NC_ETC_NR]	LV_ERR_MAP_DIP_SHIFT	LV_ERR_CAM_CST_IVVT_IN[1...NC_NR_CBK_IVVT]
LV_ERR_CAM_CST_IVVT_EX[1...NC_NR_CBK_IVVT]			

Then LV_INH_DIAG_RBM_EFF_IGA_CST = 1
Else LV_INH_DIAG_RBM_EFF_IGA_CST = 0
Endif

If bit 0 of STATE_RBM_EFF_IGA_CST_IS = 0 { numerator }
Then
  If LV_END_DIAG_EFF_IGA_CST_IS = 1
    Then bit 0 of STATE_RBM_EFF_IGA_CST_IS = 1
    Endif
Endif

If bit 0 of STATE_RBM_EFF_IGA_CST_PL = 0 {numerator}
Then
  If LV_END_DIAG_EFF_IGA_CST_PL = 1
    Then bit 0 of STATE_RBM_EFF_IGA_CST_PL = 1
    Endif
Endif

If bit 1 of STATE_RBM_EFF_IGA_CST_IS = 0 {monitoring inhibit}
Then
  If LV_INH_DIAG_RBM_EFF_IGA_CST = 1
  Then bit 1 of STATE_RBM_EFF_IGA_CST_IS = 1
  Endif
Endif

If bit 1 of STATE_RBM_EFF_IGA_CST_PL = 0 {monitoring inhibit}
Then
  If LV_INH_DIAG_RBM_EFF_IGA_CST = 1
  Then bit 1 of STATE_RBM_EFF_IGA_CST_PL = 1
  Endif
Endif

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If bit 2 of STATE_RBM_ EFF_IGA _CST_IS = 0 {individual RBM conditions or CSERS-specific denominator}
Then
  If LV_T_MIN_CH_CST=1
  Then bit 2 of STATE_RBM_ EFF_IGA _CST_IS = 1
  Endif
Endif

If bit 2 of STATE_RBM_ EFF_IGA _CST_PL = 0 {individual RBM conditions or CSERS-specific denominator}
Then
  If LV_T_MIN_CH_CST=1
  Then bit 2 of STATE_RBM_ EFF_IGA _CST_PL = 1
  Endif
Endif

B.133.2 Service Response Calculation for Ignition angle efficiency monitoring

FUNCTION DESCRIPTION:

General information:

With this state machine the feedback STATE_EOL_DGNC_CH_DIAG for the tester service CSERS will be calculated. The communication part with the tester will be done at the diagnosis specification.

Application conditions

Initialisation:
At RESET or with IGKON event

STATE_EOL_DGNC_CH_DIAG = "*NOT_START*"

Recurrence:
1s

Activation:
LV_CH_DIAG_EXT_REQ$_{n-1}$ == 0 **AND** LV_CH_DIAG_EXT_REQ$_n$ == 1

Deactivation:
STATE_EOL_DGNC_CH_DIAG == "*ABORTED*" **OR**
STATE_EOL_DGNC_CH_DIAG == "*END_WOUT_RESULT*" **OR**
STATE_EOL_DGNC_CH_DIAG == "*END_WOUT_ERR*" **OR**
STATE_EOL_DGNC_CH_DIAG == "*END_WITH_ERR*"

Formula section:

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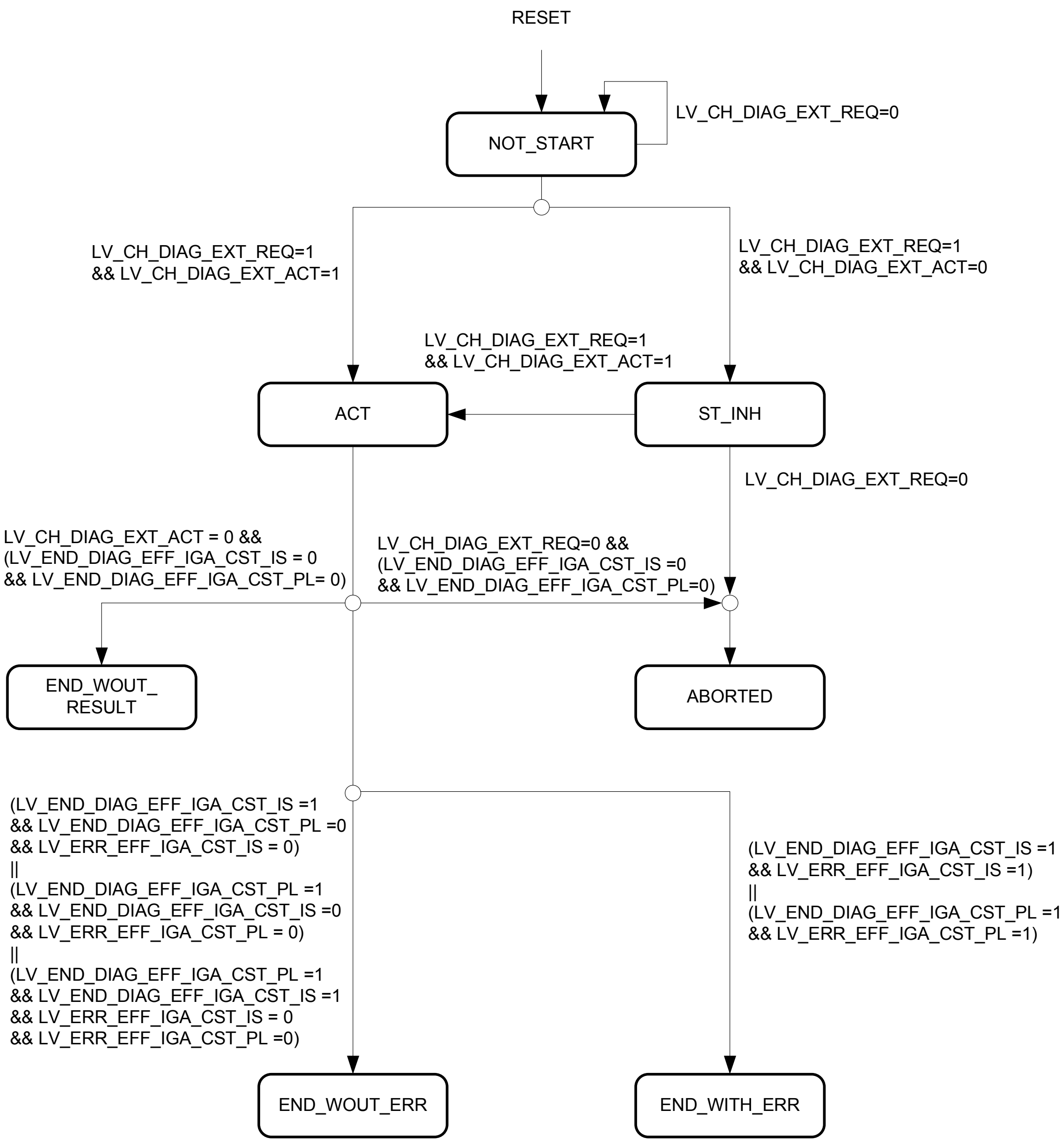

The variable STATE_EOL_DGNC_CH_DIAG can contain following states:

STATE "*NOT START*":
CSERS Service is not started

STATE "*ACT*":
CSERS Service is activated and running

STATE "*ST_INH*":
Start of the CSERS Service is inhibited

STATE "*ABORTED":*
CSERS Service was aborted (not completely finished)

STATE "*END_WOUT_RESULT":*
Catalyst heating was finished without the minimum required time to complete the CSERS Service.

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STATE "*END_WOUT_ERR*":

CSERS Service was finished (no errors detected)

For "*END_WOUT_ERR*" state, no error is allowed at the end of the test. This means, that three cases have to be checked.

Good cases are: _IS test finished with no error, _PL test finished with no error, _IS and _PL finished with no errors

STATE "*END_WITH_ERR*":

CSERS Service was finished (errors were detected)

For the "END_WITH_ERR" state it is enough, if one of the two tests has finished with an error.

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B.134 Ignition angle efficiency diagnosis (error management interface)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_EFF_IGA_CST_IS	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error sympton ignition angle efficiency diagnosis after coldstart in idle speed mode					
ERR_SYM_EFF_IGA_CST_PL	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Detected error sympton ignition angle efficiency diagnosis after coldstart in part load mode					
LV_CDN_DIAG_EFF_IGA_CST_IS	O/V	0... 1H	0 ...1	1	-
Diagnosis conditions fulfilled Ignition angle efficiency at coldstart - idle speed					
LV_CDN_DIAG_EFF_IGA_CST_PL	O/V	0... 1H	0 ...1	1	-
Diagnosis conditions fulfilled Ignition angle efficiency at coldstart - part load					
LV_END_DIAG_EFF_IGA_CST_IS	O/V	0... 1H	0 ...1	1	-
Coldstart diagnosis in idle speed mode done completely at least one time					
LV_END_DIAG_EFF_IGA_CST_PL	O/V	0... 1H	0 ...1	1	-
Coldstart diagnosis in part load mode done completely at least one time					
LV_ERR_EFF_IGA_CST_IS	O/V	0... 1H	0 ...1	1	-
Boolean variable indicating that ignition angle efficiency is too high during the cold start diagnosis in idle speed mode					
LV_ERR_EFF_IGA_CST_PL	O/V	0... 1H	0 ...1	1	-
Boolean variable indicating that ignition angle efficiency is too high during the cold start diagnosis in part load mode					
LV_STATE_INH_CALL_IS	V	0... 1H	0 ...1	1	-
Inhibit the triggering of the Pre-Freeze Frame in 100MS raster after first time shooting of the Pre-Freeze Frame in idle					
LV_STATE_INH_CALL_PL	V	0... 1H	0 ...1	1	-
Inhibit the triggering of the Pre-Freeze Frame in 100MS raster after first time shooting of the Pre-Freeze Frame in part load					

Input data:

EFF_IGA_CST_QUO_IS {p. 6493}	EFF_IGA_CST_QUO_PL {p. 6493}	IP_INT_EFF_IGA_SP_CH_QUO_IS_MAX {p. 6495}	IP_INT_EFF_IGA_SP_CH_QUO_PL_MAX {p. 6495}
LC_INH_SYM_EFF_IGA_CST {p. 6495}	LF_STATE_DGO_EFF_IGA_CST_IS {p. 6493}	LF_STATE_DGO_EFF_IGA_CST_PL {p. 6493}	NC_IDX_DIAG_EFF_IGA_CST_IS {p. 6509}
NC_IDX_DIAG_EFF_IGA_CST_PL {p. 6509}	TCO_ST {p. 1100}		

Import actions:

ACTION_ERRM_GetLvCdnDiag (**IN**<IDX_DIAG>,**OUT**<LV_CDN_DIAG>)
Continued on next page

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ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_NoFilterReset (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_NoFilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_LV_ERR_SET>,**IN**<PRM_LV_ERR_RST>,**IN**<PRM_LV_END_DIAG>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_StorePrevfrf (**IN**<PRM_IDX_ERR>)
ACTION_TQDR_ResetMainEffIgaCst (**IN**<PRM_STATE_INI>)

General information:

This module defines the interface functionality between main module for Ignition angle efficiency monitoring and error management (ERRM). This variant covers for ERRM 4.x.

Main interface variable is LF_STATE_DGO_EFF_IGA_CST_IS and LF_STATE_DGO_EFF_IGA_CST_PL.

These bit coded variables have following meaning:

Bit 0: Condition fulfilled if set to 1
Bit 1: Failure symptom present if set to 1
Bit 2: Failure not yet de-bounced if set to 1; only used if filter service from ERRM not used.

Examples:
LF_STATE_DGO_EFF_IGA_CST_IS/PL set to ...

0: no diagnostic condition
1: condition and no symptom, diagnostic passed.
3: condition and symptom present; diagnostic failed
5: condition and no symptom, not yet de-bounced
7: condition and symptom present, not yet de-bounced

Application conditions:

Initialisation:	`RST, IGKON, CLRFMY`
Recurrence:	`100MS, 1S`
Activation:	`always`
Deactivation:	`never`

Function description:

Formula section:

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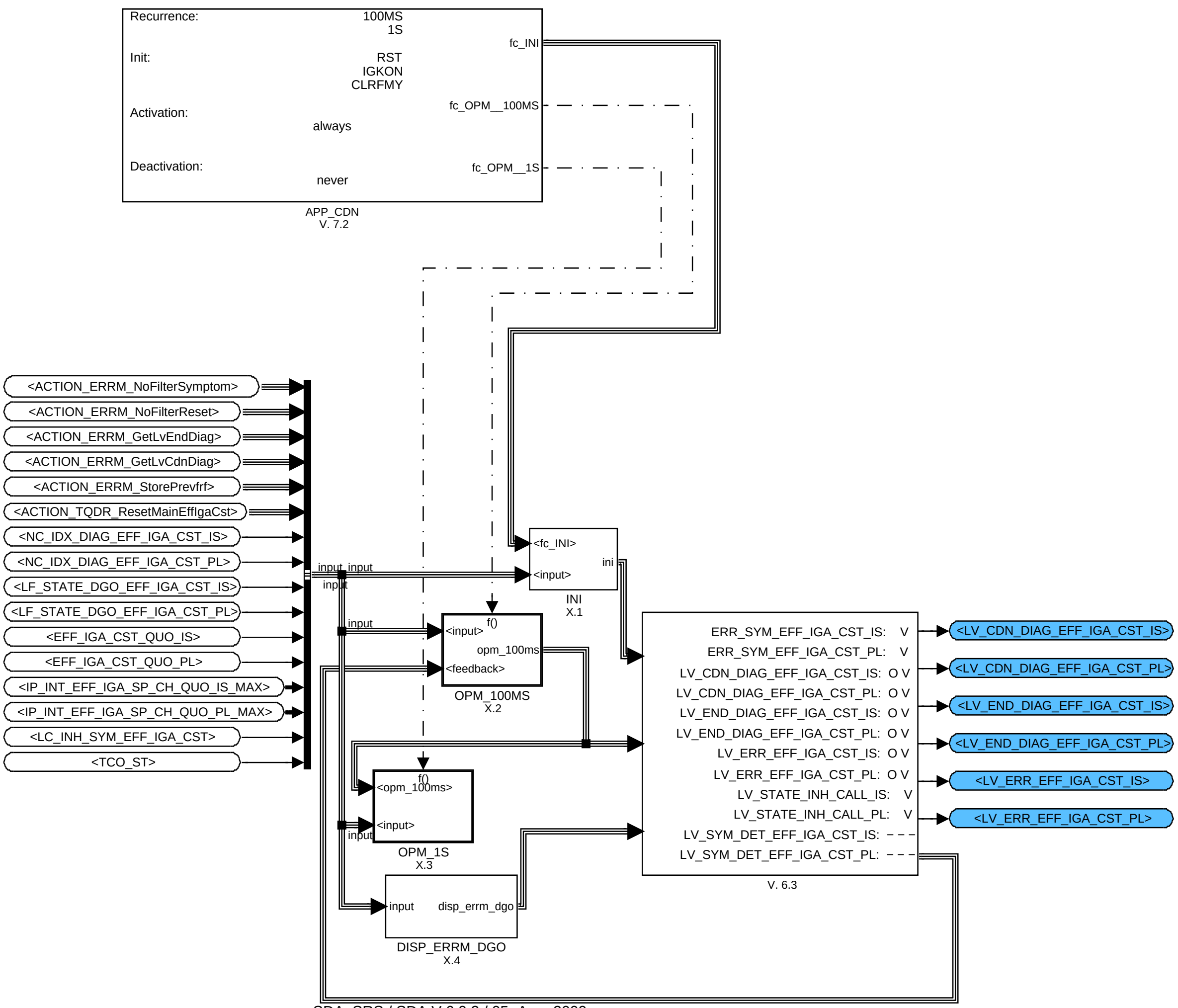

Figure B.134.1: :

B.134.1 Initialization

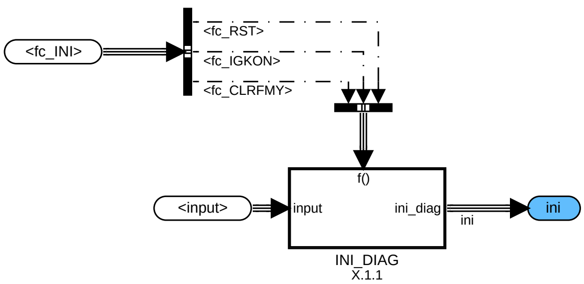

Figure B.134.2: :

B.134.1.1 Initialization of diagnosis

Get the old value of LV_ERR, LV_END_DIAG and ERR_SYM.

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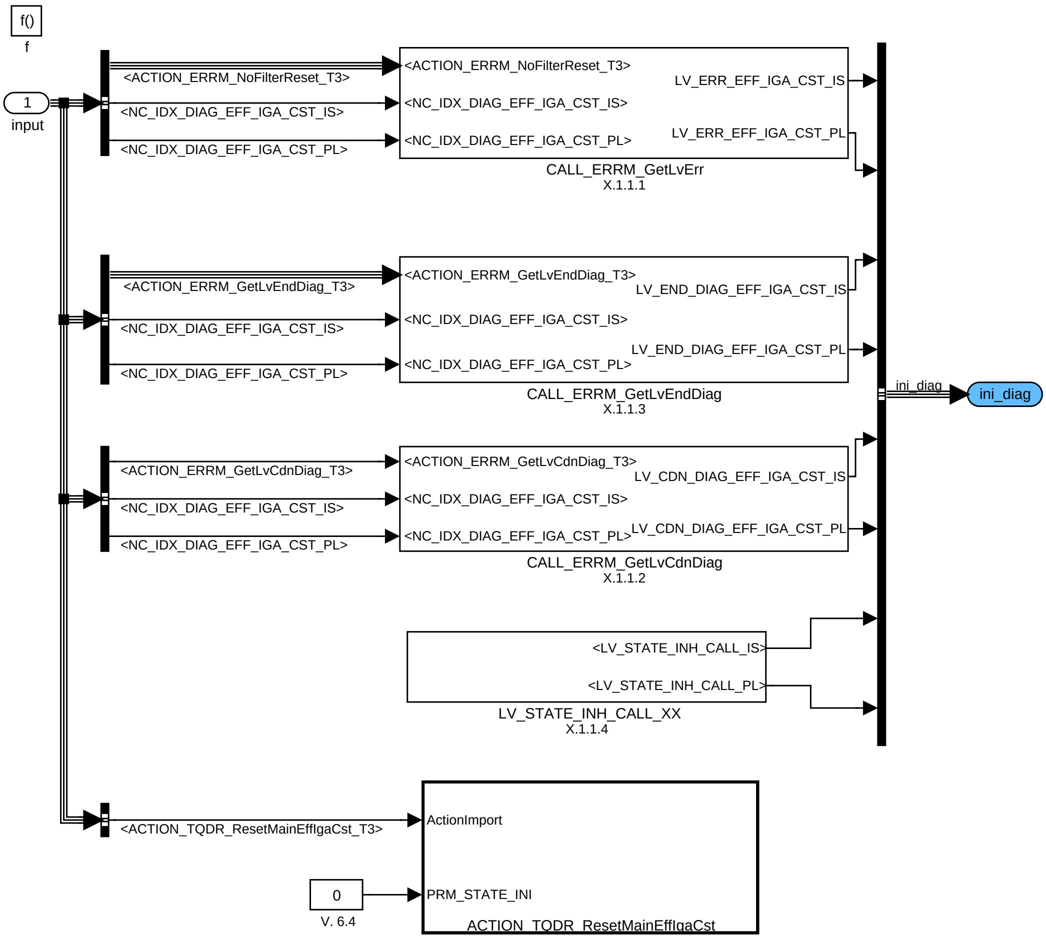

Figure B.134.3: :

B.134.1.1.1 Call Action GetLvErr

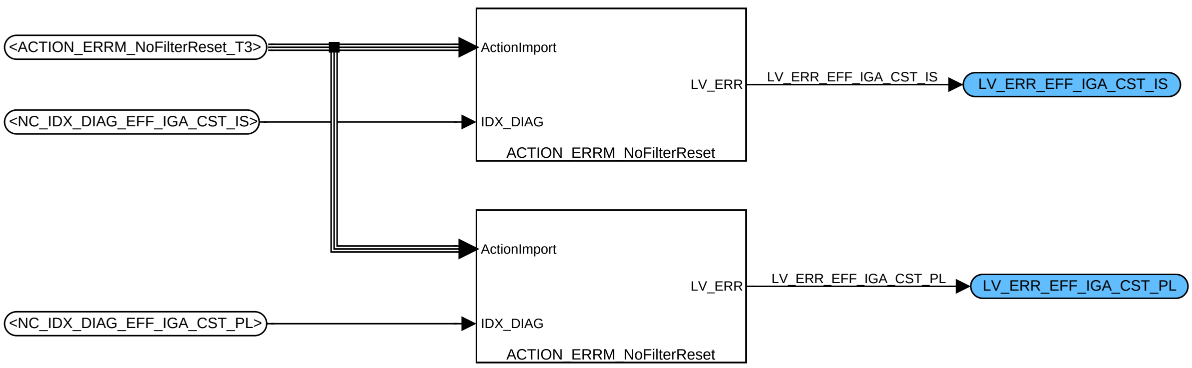

Figure B.134.4: :

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B.134.1.1.2 Call Action GetLvCdnDiag

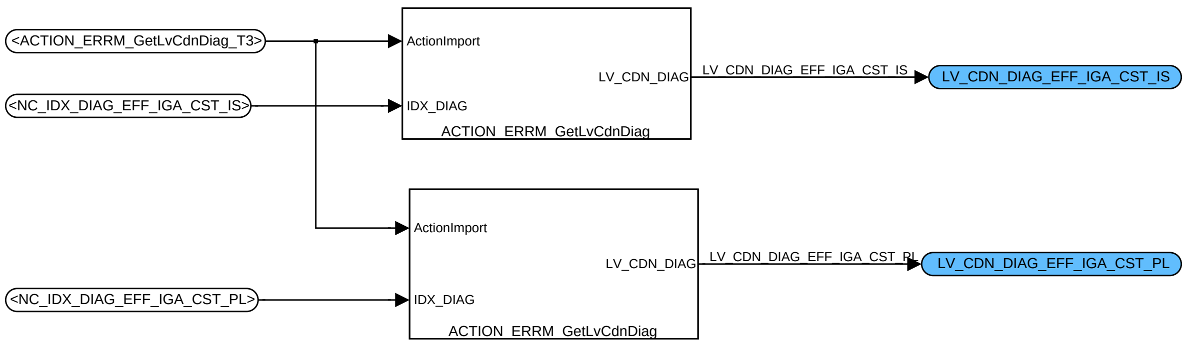

Figure B.134.5: :

B.134.1.1.3 Call Action GetLvEndDiag

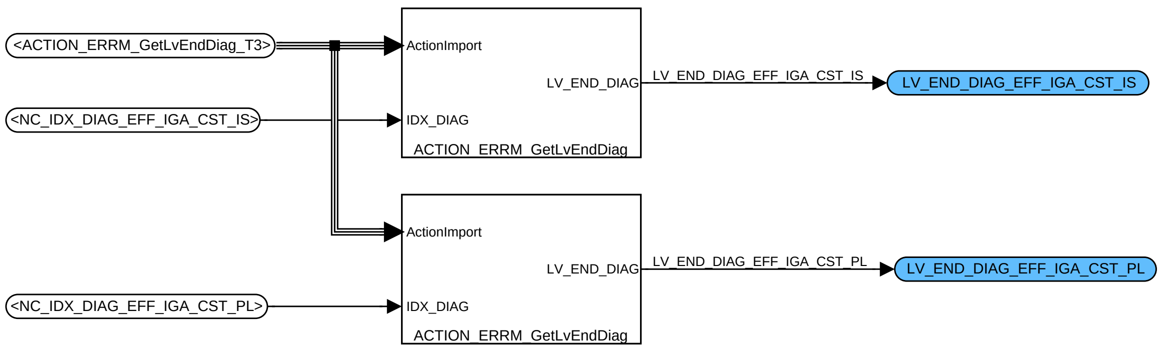

Figure B.134.6: :

B.134.1.1.4 INI of LV_STATE_INH_CALL_XX

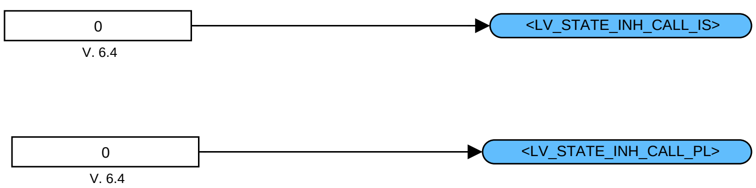

Figure B.134.7: :

B.134.2 Operating mode 100MS

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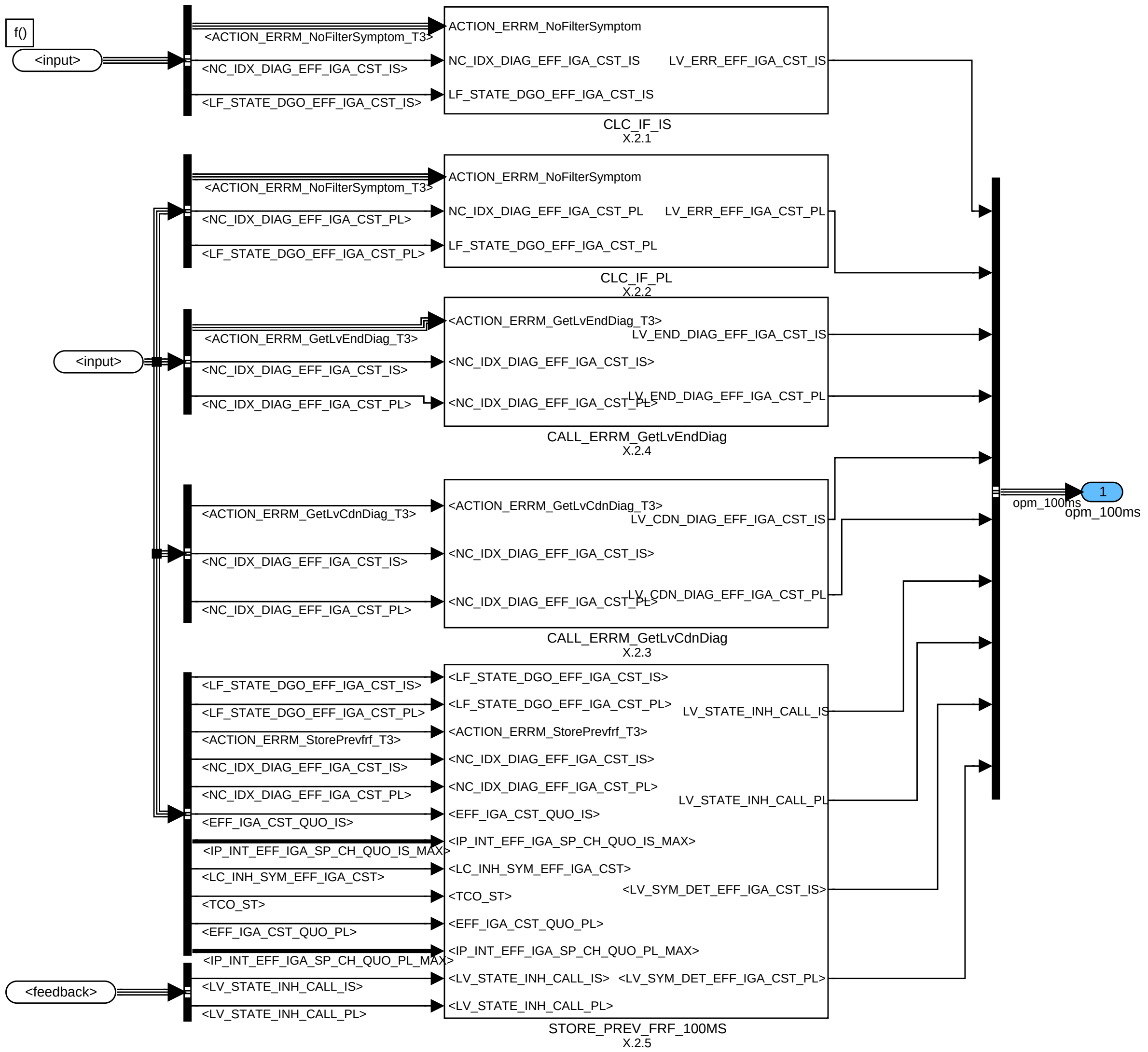

Figure B.134.8: :

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B.134.2.1 Write Error Indication for Diagnosis in Idle Speed Mode

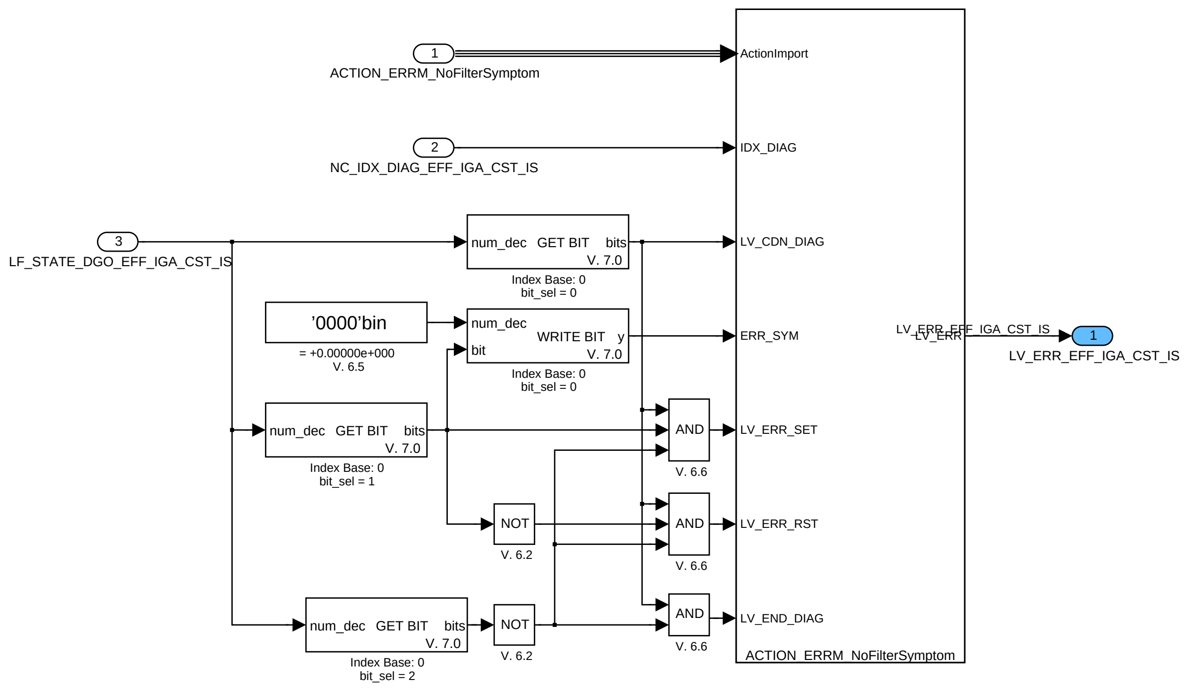

Figure B.134.9: :

B.134.2.2 Write Error Indication for Diagnosis in Part Load Mode

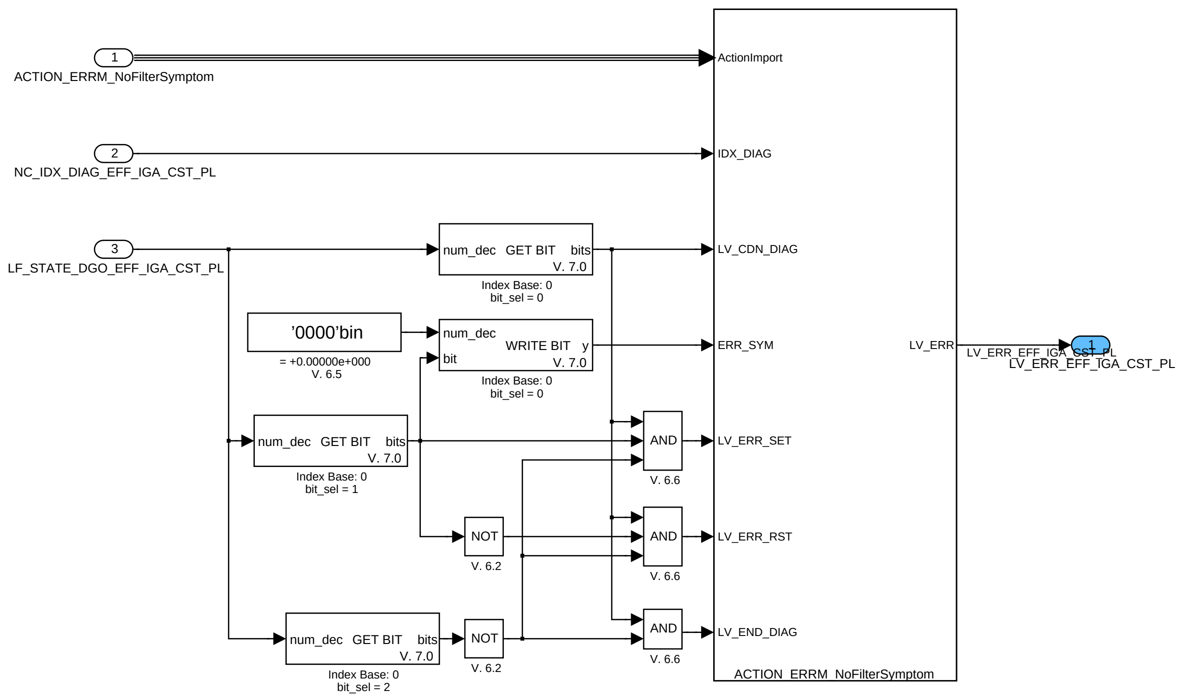

Figure B.134.10: :

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B.134.2.3 Call Action GetLvCdnDiag

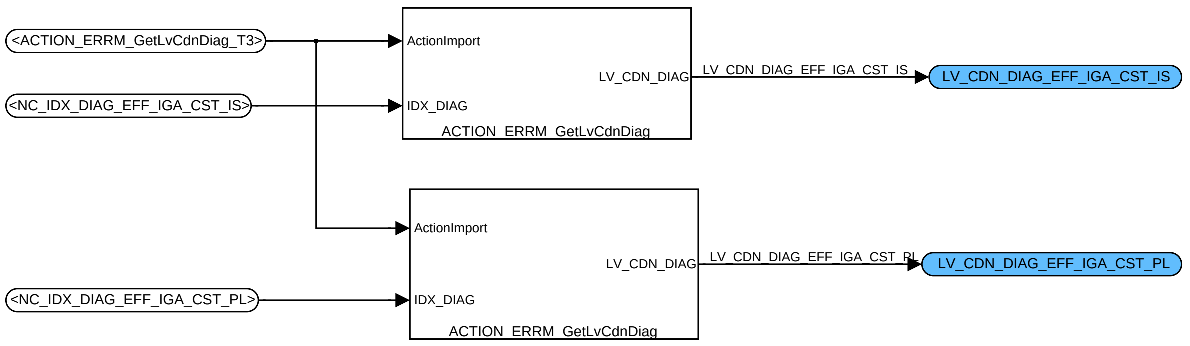

Figure B.134.11: :

B.134.2.4 Call Action GetLvEndDiag

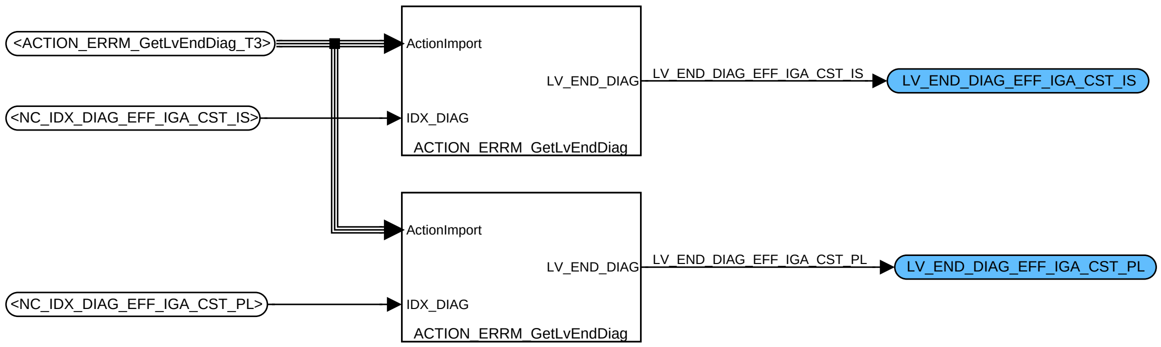

Figure B.134.12: :

B.134.2.5 Freeze Frame Triggering in 100MS Raster

For catching the environmental data by first overriding the diagnostic threshold in the actual driving area a Pre-Freeze Frame must be shot. By the first time shooting of the Pre-Freeze Frame an inhibition flag will be set which deactivates the triggering of the Pre-Freeze Frame action call in 100MS raster. The action will still be continuously triggered in 1s raster by meeting the diagnosis conditions for a certain area and by diagnostic threshold overridden.

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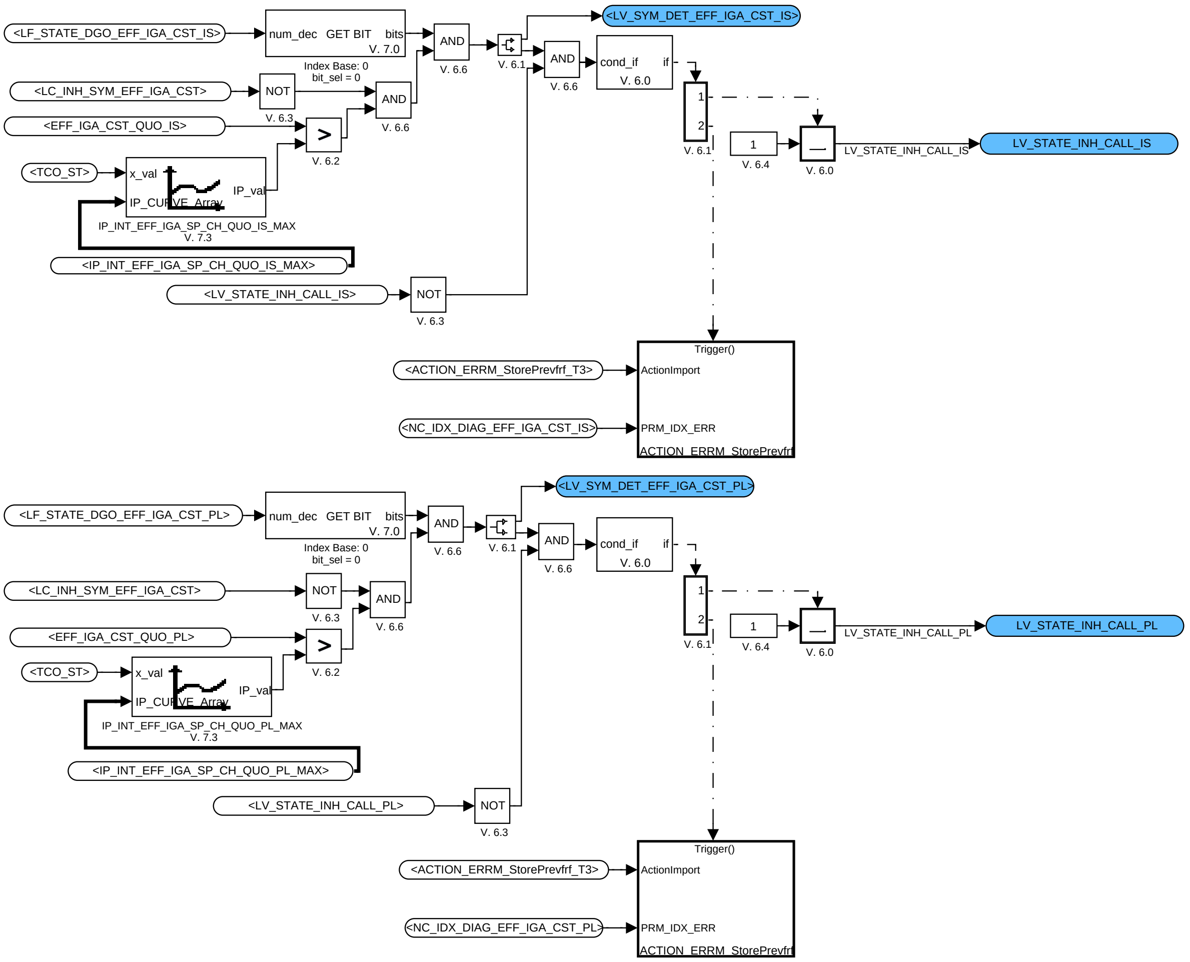

Figure B.134.13: :

B.134.3 Operating mode 1S

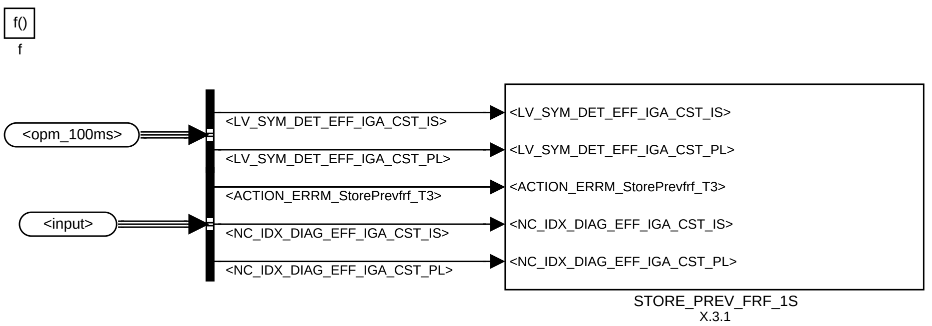

Figure B.134.14: :

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B.134.3.1 Freeze Frame Triggering in 1s Raster

The diagnostic evaluation is done for both areas (idle and part-load) at the end of catalyst heating. For catching the environmental data by overriding the diagnostic threshold a Pre-Freeze Frame must be shot continuously in both areas.

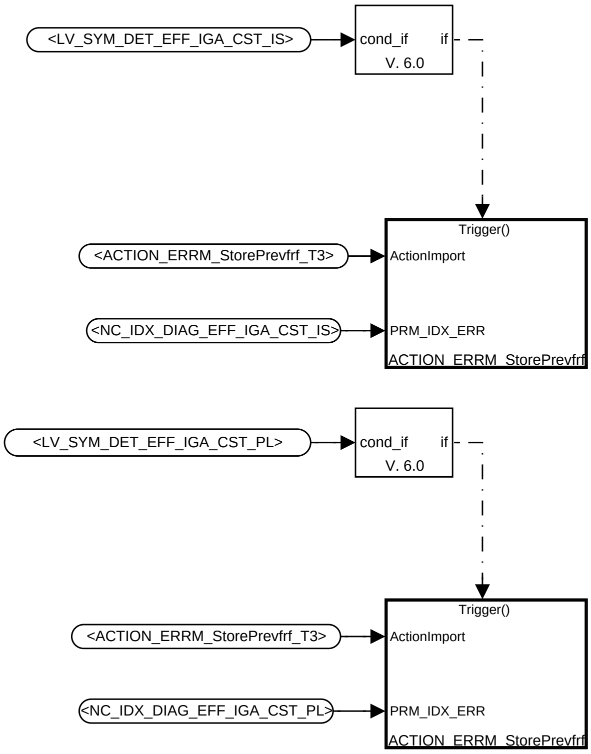

Figure B.134.15: :

B.134.4 Visualization of ERRM data

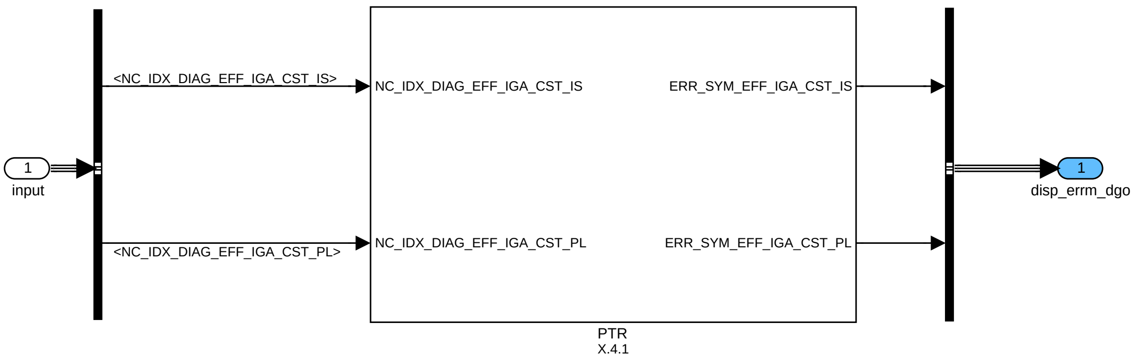

Figure B.134.16: :

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B.134.4.1 Pointer

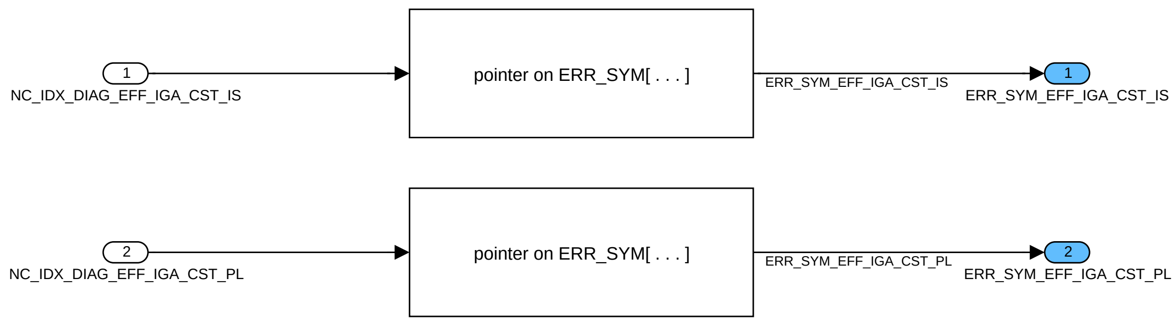

Figure B.134.17: :

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C - ETC Electronic throttle control

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C.1 Mass air flow correction for catalyst heating in stratified mode

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MAF_DIF_S_CH	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass air flow difference for cat. heating in stratified mode (possibly with post injection)					

Input data:

NC_CYL_NR {p. 1526}	STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_DIF_ADD_MFF_POST_CH_L	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass of post injection depending correction for MAF_DIF					
C_MAF_DIF_S_CH_L_BAS	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Basic difference of mass of air flow for low load stratified catalyst heating					
C_MAF_DIF_S_CH_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Manual setting of MAF-difference for stratified catalyst heating					
LC_MAF_DIF_S_CH_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of MAF-difference for stratified catalyst heating					

General Information

During catalyst heating in stratified mode (possibly with post injection) it is necessary to reduce the mass of air flow and so the cooling effect. In this module the difference of MAF is generated.

Application Conditions

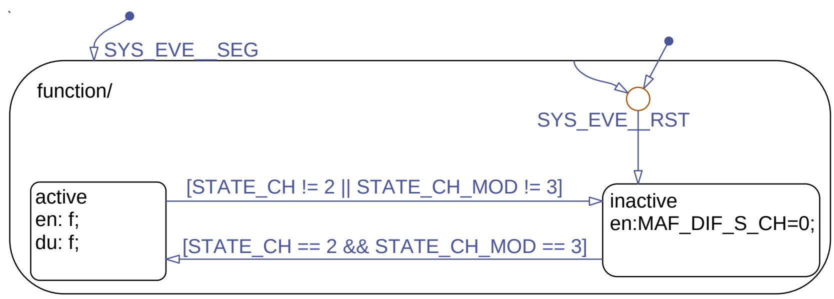

Figure C.1.1: : Path: EXTC_REQGNsmaf0/APP_CDN/Chart

Function description

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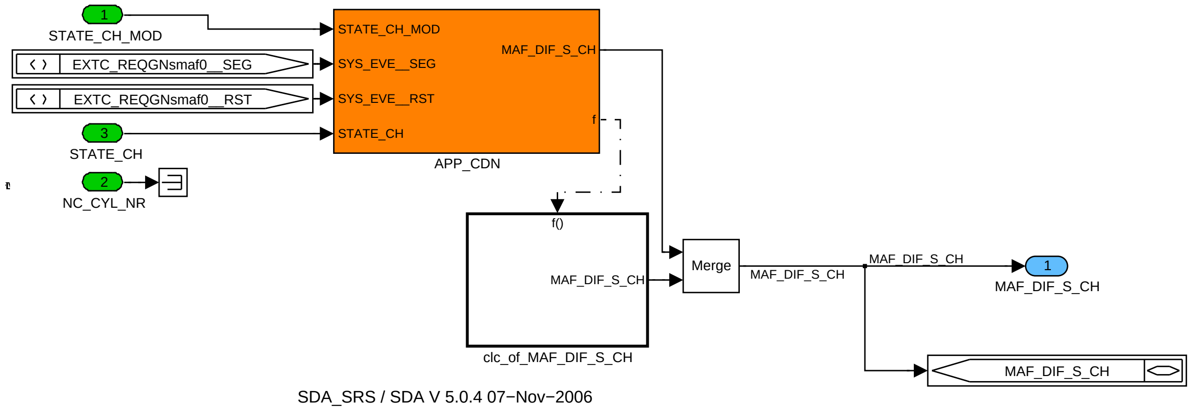

Figure C.1.2: : Path: EXTC_REQGNsmaf0

C.1.1 Calculation of MAF_DIF_S_CH in low load catalyst heating

There is a load/engine speed depending map, an external correction that is not used up to now and a 2nd correction depending on the actual mass of post injection. The read_vector block picks out one element (here the 1st) of the cylinder individuell MFF_POSTvector.

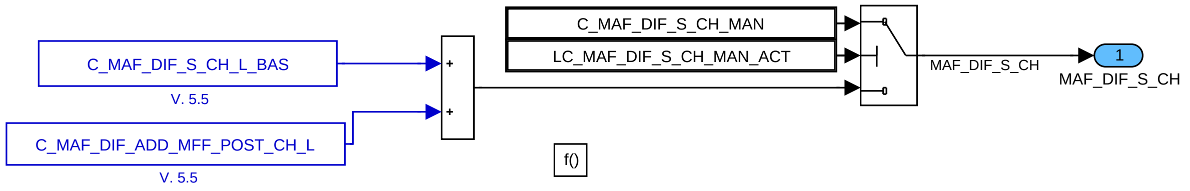

Figure C.1.3: : Path: EXTC_REQGNsmaf0/clc_of_MAF_DIF_S_CH

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C.2 Electronic throttle control jam detection

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_MTC_HEAT_ACT	V	0... FH	0... 15	1	-
Counter active cycle throttle housing heater					
CTR_RLY_MTC_HEAT	V	0... FFFFH	0... 6553.5	0.1	s
Counter throttle housing heater relay active					
CTR_TPS_JAM_DET_ACT	O/V/S	0... FFFFH	0... 65535	1	-
The variable indicates the number of activations and is saved in the non-volatile memory					
CTR_TPS_JAM_INH	V	0... FFH	0... 255	1	-
Inhibition counter locks the ice-breaking functionality for a defined time					
CTR_TPS_JAM_PER	V	0... FFH	0... 255	1	-
Counter variable indicates the current number of rectangle pulses					
CTR_TPS_JAM_PER_MAX	V	0... FFH	0... 255	1	-
The counter variable includes the half period of the rectangle pulse					
CTR_TPS_JAM_PLS	V	0... FFH	0... 255	1	-
The counter variable is used for the calculation of the rectangle pulses					
ERR_SYM_TPS_JAM_DET	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
For each symptom : status of failure (set to 1 when failure symptom is detected)					
LV_CDN_DIAG_TPS_JAM_DET	V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled)					
LV_END_DIAG_TPS_JAM_DET	V	0... 1H	0 ...1	1	-
Diagnostic done completely at least one time					
LV_ERR_TPS_JAM_DET	O/V	0... 1H	0 ...1	1	-
Present safety critical failure without filtering of ETC jam diagnostic					
LV_MTC_HEAT_READY	O/V	0... 1H	0 ...1	1	-
Throttle housing heater cycle finished (1:engine start enabled, 0: engine start disabled)					
LV_N_LIM_TPS_JAM_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable requests engine speed limitation from the module ETC limp-home management					
LV_RLY_MTC_HEAT	O/V	0... 1H	0 ...1	1	-
Throttle housing heater relay (1:activated, 0:deactivated)					
LV_TPS_JAM_DET_DEAC	V	0... 1H	0 ...1	1	-
Deactivation condition of the ETC jam detection					
LV_TPS_JAM_OPEN_DIR	O/V	0... 1H	0 ...1	1	-
Logical variable indicates a disturbance of the throttle flap in opening direction					
LV_TPS_SP_JAM	O/V	0... 1H	0 ...1	1	-
Logical variable indicates a throttle position setpoint request for ETC jam detection					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_MTC_HEAT	O/V	0H 1H 2H 3H 4H	HEAT_OFF HEAT_OFF_ DLY HEAT_ON_DLY HEAT_ON HEAT_EXT_ ADJ	-	-
STATE throttle housing heater relay					
STATE_TPS_JAM_DET	O/V	0H 1H 2H	INIT ICE_BREAK SP_LIMIT	-	-
State variable indicates the current state of the ETC jam detection					
TPS_JAM_ACT	V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Throttle position indicates the location of the jammed position					
TPS_JAM_PLS	V	C001... 3FFFH	-119.5 ...119.5	7.2941e-3	°TPS
Height of the rectangle pulse during active ice-breaking					
TPS_SP_JAM	O/V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Throttle position setpoint request in case of a jammed ETC actuator					
TPS_SP_JAM_TMP	-	C001... 3FFFH	-119.5 ...119.5	7.2941e-3	°TPS
Throttle position setpoint request in case of a jammed ETC actuator					

Input data:

ECU_STATE {p. 1091}	LV_ACT_RLY_MTC_HEAT_EXT_ADJ {p. 7432}	LV_AST_END {p. 2100}	LV_CTR_TPS_JAM_DET_ACT_EXT_ADJ {p. 7482}
LV_ERR_RLY_MTC_HEAT {p. 5004}	LV_IGK {p. 906}	LV_KEY_VLD {p. 1566}	LV_RLY_MTC_HEAT_EXT_ADJ {p. 7434}
LV_ST {p. 1720}	LV_TPS_JAM_DET_ACT {p. 6543}	LV_TPS_JAM_DET_DI {p. 6543}	T_MTCPWM_PI_DIAG {p. 4977}
TCO {p. 1100}	TIA {p. 1226}	TPS_AV {p. 1169}	TPS_DIF {p. 6546}
TPS_SP_MDL {p. 8377}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_MTC_HEAT_ACT	-	0... FH	0... 15	1	-
Number of MTC heater cycle					
C_CTR_REAC_MTC_HEAT	-	0... FFFFH	0... 6553.5	0.1	s
Reactivation time limit for MTC heater					
C_CTR_TPS_JAM_INH	-	0... FFH	0... 255	1	-
Inhibition counter for the locking of active ice-breaking					
C_CTR_TPS_JAM_PER_CLOSE	-	1... FFH	1... 255	1	-
Half period of the rectangle pulse in throttle flap closing direction					
C_CTR_TPS_JAM_PER_OPEN	-	1... FFH	1... 255	1	-
Half period of the rectangle pulse in throttle flap opening direction					
C_CTR_TPS_JAM_PLS_MAX	-	0... FFH	0... 255	1	-
Maximum number of possible rectangle pulse					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DLY_RLY_MTC_HEAT	-	0... FFH	0... 255	1	-
Number of recurrences until activation conditions MTC Heater are met (default = 2)					
C_TCO_MAX_MTC_HEAT	-	0... FEH	-48... 142.5	0.75	°C
Maximal cooling water temperature for MTC heater					
C_TIA_MAX_MTC_HEAT	-	0... FEH	-48... 142.5	0.75	°C
Maximal intake air temperature for MTC heater					
C_TIA_REAC_MTC_HEAT	-	0... FEH	-48... 142.5	0.75	°C
Reactivation intake air temperature for MTC heater					
C_TPS_JAM_HYS	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Throttle position hysteresis for the deactivation of the ice-function					
C_TPS_JAM_OFS	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Throttle position offset for the new throttle position setpoint definition					
C_TPS_JAM_PLS_CLOSE	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Rectangle pulse height in throttle flap closing direction					
C_TPS_JAM_PLS_OPEN	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Rectangle pulse height in throttle flap opening direction					
LC_CTR_TPS_JAM_DET_ACT_CLR	-	0... 1H	0 ...1	1	-
Logical constant for initializing the activation counter for jam detection					
LC_MTC_HEAT_ST_INH	-	0... 1H	0 ...1	1	-
Logical switch MTC heater at start active (=0 heater active)					

General information:

The described module is used for the detection or the removing of ice between throttle flap and body.

C.2.1 Import Actions

ACTION_INFR_SetMTCHEAT(IN <lv_rly_mtc_heat>**)**
This action sets the output pin for the "MTC_HEAT Switch"

Note: The imported actions are defined in the THRO - IRS (infrastructure requirement specification).

ACTION_ERRM_NoFilterSymptom(**IN**< *XX* >, **IN**< lv_cdn_diag_XX >, **IN**< err_sym_XX >, **IN**< lv_err_set_XX >, **IN**< lv_err_reset_XX >, **IN**< lv_end_diag_XX >, **OUT**< LV_ERR_XX >)

C.2.2 Throttle housing heater relay control

General information:

Under very cold conditions it is possible that the throttle valve ices due to the humidity in the blow by gas. Additionally after engine stop a accumulation of water is possible between flap and housing. When the dew point drops the water freezes and the detection of the ETC bottom limit is disturbed. The described module is used for the removing of ice between throttle flap and body.
To ensure the function of the ETC the housing is heated before engine start. The ECU controls a relay through the Pin A_S_BBH. This is done immediately after unlocking the vehicle and the wake up of the ECU. If the ECU is locked after powerlatch no control is done.
The heater relay is deactivated.
In order to take care of the battery capacity the heater is only activated in defined time intervals. An often re-activation shall be avoid.

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Hint: The output of the air temperature sensor VP_TIA and cooling water sensor VP_TCO are calculated by using the action infrastructure ACTION_INFR_GetVpTia (VP_TIA) and ACTION_INFR_GetVpTco (VP_TCO). To ensure the availability of TIA and TCO in ECU_STATE ***WAKE_UP*** the action calls are active after ECU reset.

Application conditions

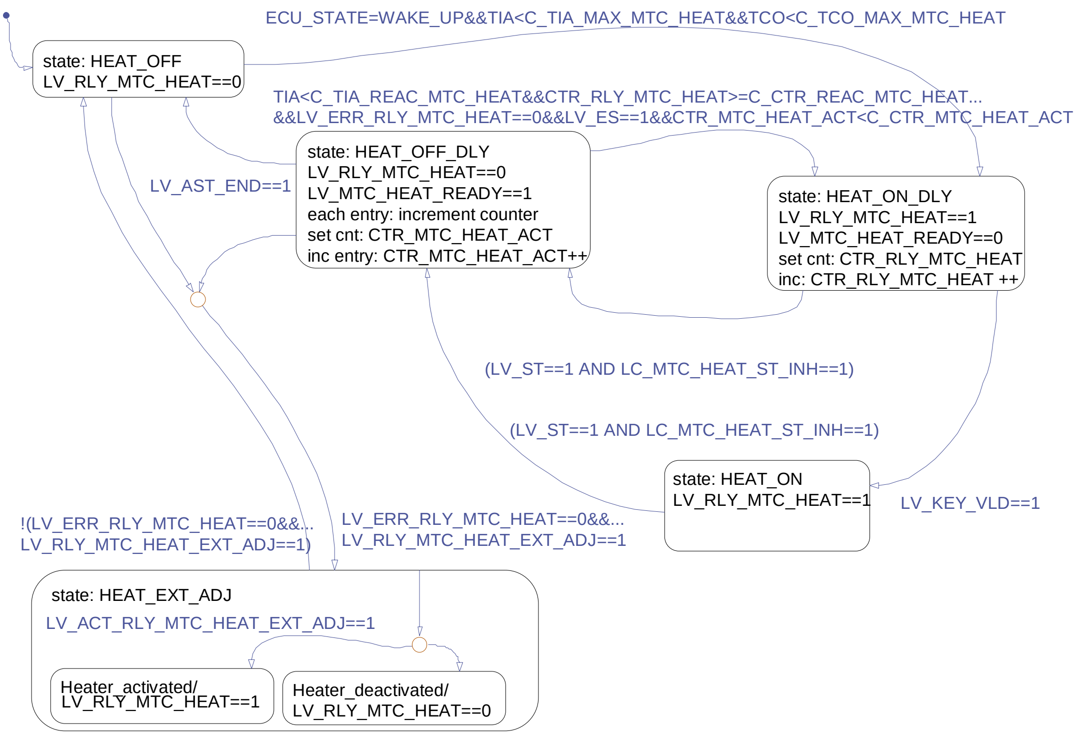
Initialization: at reset, all variables are initialized with 0, but LV_MTC_HEAT_READY = 1
set delay counter for C_DLY_RLY_MTC_HEAT

Recurrence: 100 ms

Activation: after reset, every engine operating state
Activation conditions are met for the C_DLY_RLY_MTC_HEAT recurrence

Deactivation:

Signal flow diagram:



Formula section:

see also signal flow diagram

Heater deactivated

STATE_MTC_HEAT = HEAT_OFF

LV_RLY_MTC_HEAT = 0

ACTION_INFR_SetMTCHEAT(IN < LV_RLY_MTC_HEAT >**)**

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Exit to **HEAT_ON_DLY**:
(STATE_ECU = WAKE_UP **AND**
TCO < C_TCO_MAX_MTC_HEAT **AND**
TIA < C_TIA_MAX_MTC_HEAT)

Exit to **HEAT_EXT_ADJ**:
(LV_ERR_RLY_MTC_HEAT = 0 **AND**
LV_RLY_MTC_HEAT_EXT_ADJ = 1)

Heater previous activated
STATE_MTC_HEAT = HEAT_ON_DLY
LV_RLY_MTC_HEAT = 1
LV_MTC_HEAT_READY = 0
ACTION_INFR_SetMTCHEAT(IN < LV_RLY_MTC_HEAT >**)**
set timer: CTR_RLY_MTC_HEAT = 0
increment timer continuously: CTR_RLY_MTC_HEAT + 1
Hint: Timer is active as long as STATE_HEAT_OFF is reached

Exit to **HEAT_OFF_DLY**:
(LV_ST = 1 AND LC_MTC_HEAT_ST_INH = 1)

Exit to **HEAT_ON**:
LV_KEY_VLD = 1

Heater activated
STATE_MTC_HEAT = HEAT_ON
LV_RLY_MTC_HEAT = 1
ACTION_INFR_SetMTCHEAT(IN < LV_RLY_MTC_HEAT >**)**

Exit to **HEAT_OFF_DLY**:
(LV_ST = 1 AND LC_MTC_HEAT_ST_INH = 1)

Heater previous deactivated
STATE_MTC_HEAT = HEAT_OFF_DLY
LV_RLY_MTC_HEAT = 0
LV_MTC_HEAT_READY = 1
set counter: CTR_MTC_HEAT_ACT = 0
increment only each entry: CTR_MTC_HEAT_ACT + 1
ACTION_INFR_SetMTCHEAT(IN < LV_RLY_MTC_HEAT >**)**

Exit to **HEAT_OFF**:
LV_AST_END = 1

Exit to **HEAT_ON_DLY**:
(TIA < C_TIA_REAC_MTC_HEAT **AND**
CTR_RLY_MTC_HEAT > C_CTR_REAC_MTC_HEAT **AND**
LV_ERR_RLY_MTC_HEAT = 0 **AND**
LV_ES = 1 **AND**
CTR_MTC_HEAT_ACT < C_CTR_MTC_HEAT_ACT)

Exit to **HEAT_EXT_ADJ**:

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(LV_ERR_RLY_MTC_HEAT = 0 **AND**
LV_RLY_MTC_HEAT_EXT_ADJ = 1)

External adjustment
STATE_MTC_HEAT = HEAT_EXT_ADJ
If LV_ACT_RLY_MTC_HEAT_EXT_ADJ = 1
Then LV_RLY_MTC_HEAT = 1
Else LV_RLY_MTC_HEAT = 0
Endif
ACTION_INFR_SetMTCHEAT(IN < LV_RLY_MTC_HEAT >**)**

Exit to **HEAT_OFF**:
(LV_ERR_RLY_MTC_HEAT = 1 **OR**
LV_RLY_MTC_HEAT_EXT_ADJ = 0)

C.2.3 ETC ice breaking

FUNCTION DESCRIPTION:

General information:

In case of very low temperatures it is possible that the throttle actuator is jammed by ice. The described module is used for the detection and the removing of ice between throttle flap and body. The functionality is able to detect the location of the throttle flap disturbance. We can distinguish ice in closing and opening throttle flap direction.
The ice shall be removed with a variation of the setpoint for the digital position controller.
CTR_TPS_JAM_DET_ACT is used to count these events. It needs to be saved reset resistant AND in NVMY !

Signal flow diagram:

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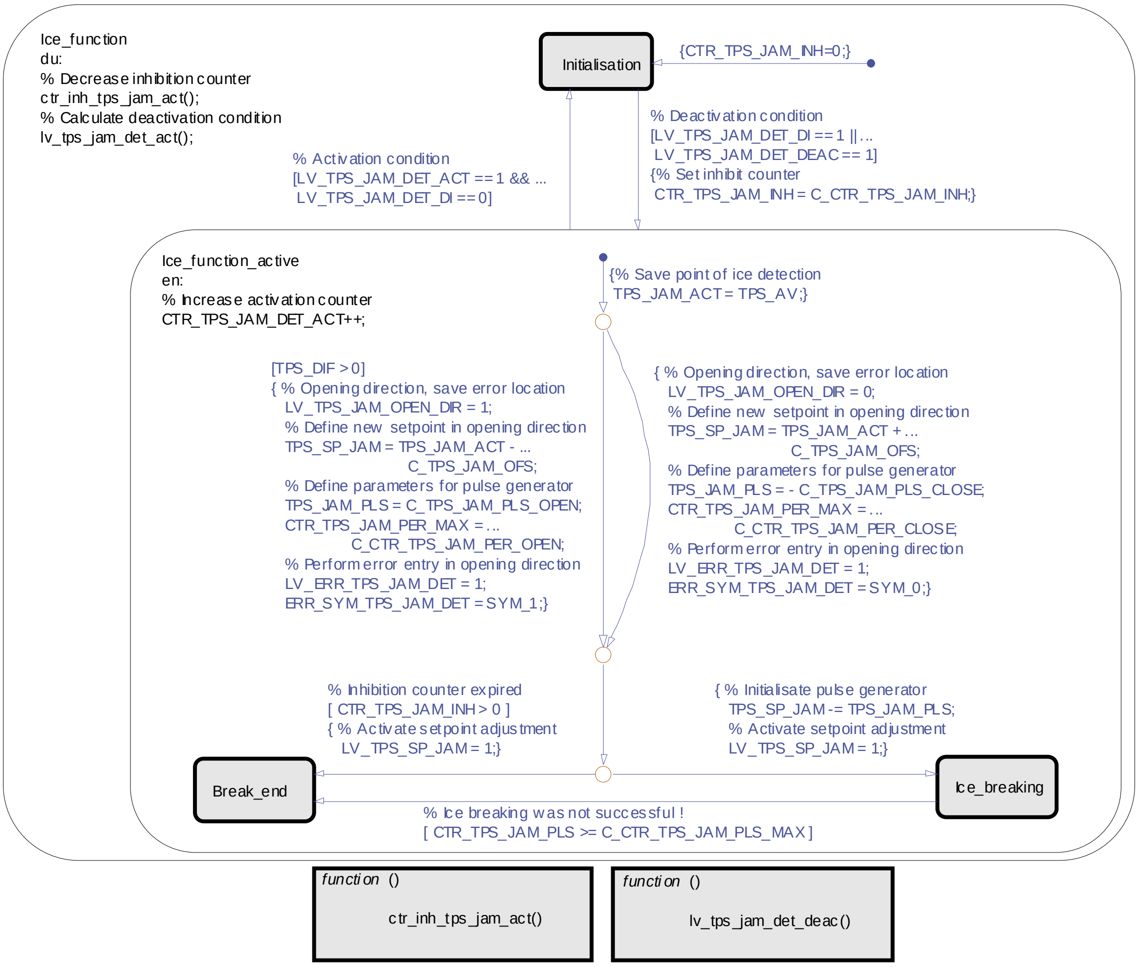

C.2.4 Diagnosis conditions and error symptom definition

Description:

The diagnostic conditions of the ETC jam detection are true as long as the general disable condition isn't set. The error symptoms are defined for this diagnosis as:

ERR_SYM_TPS_JAM_DET

```
 |_|_|_|_|
  |  |  |  └─> TPS jammed in closing direction        (= SYM_0)
  |  |  └────> TPS jammed in opening direction        (= SYM_1)
  |  └───────> -                                      (= SYM_2)
  └──────────> -                                      (= SYM_3)
```

Application conditions

Initialisation: *at IGKON or RST set all error variables ...TPS_JAM_DET to zero (done by the error - management function)*

Recurrence: *20 ms*

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Activation: *LV_IGK == 1*

Deactivation: *When the activation condition isn't fulfilled !*

Formula section:

if LV_TPS_JAM_DET_DI == 0
then *{ Set condition and end of diagnosis information }*
LV_CDN_DIAG_TPS_JAM_DET = 1
lv_end_diag_tps_jam_det = 1
ERR_SYM_TPS_JAM_DET(k) = ERR_SYM_TPS_JAM_DET(k-1)
else *{ remove condition diagnosis information }*
LV_CDN_DIAG_TPS_JAM_DET = 0
endif

C.2.5 Control condition for ETC jam detection

Description:

The following section describes the deactivation condition and the continuously part of the ETC jam detection. The aim is to control the state machine and the ice-breaking function.

Application conditions

Initialisation: *at IGKON or RST set all to zero*

Recurrence: *20 ms*

Activation: *LV_IGK == 1*

Deactivation: *When the activation condition isn't fulfilled !*

Formula section:

{ Calculate blocking time for active ice-breaking }
if CTR_TPS_JAM_INH > 0
then CTR_TPS_JAM_INH - = 1H *{ counter is decremented }*
endif
{ Calculate deactivation condition for ETC jam detection }
if LV_TPS_JAM_OPEN_DIR == 1
then *{ Deactivation in opening direction }*
LV_TPS_JAM_DET_DEAC = **(** ...
TPS_SP_MDL < TPS_JAM_ACT - C_TPS_JAM_HYS **or**
TPS_AV > TPS_JAM_ACT + C_TPS_JAM_HYS **)**
else *{ Deactivation in closing direction }*
LV_TPS_JAM_DET_DEAC = **(** ...
TPS_SP_MDL > TPS_JAM_ACT + C_TPS_JAM_HYS **or**
TPS_AV < TPS_JAM_ACT - C_TPS_JAM_HYS **)**
endif

C.2.6 State machine for ETC jam detection

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Description:

This section describes the state machine of the ETC jam detection functionality. The state machine is used for the coordination of the different requirements during the detection of jammed ETC throttle actuator. Additionally the function manages all kind of requests to the remaining software system, that are engine speed limitation, throttle position setpoint adjustment and the inhibition of selected functions. The state machine distinguishes the following states:

STATE_TPS_JAM_DET	Note
INIT	The initialisation state initialises all important variables and checks the transition conditions to the other states.
ICE_BREAK	The ice-breaking state is used for an active breaking of ice in the throttle actuator. For this case the throttle position setpoint is varied by a rectangle function. If the ice-breaking is not successful after a defined number of rectangle pulses the function changes into the state throttle position setpoint limitation. During the active ice-breaking engine speed limitation is requested !
BREAK_END	The ice-breaking was not successful or the inhibition counter for ice-breaking isn't yet expired.

Application conditions

Initialisation: at IGKON or RST set all to zero with exception of CTR_TPS_JAM_DET_ACT and STATE_TPS_JAM_DET = INIT

Recurrence: *20 ms*

Activation: *LV_IGK == 1*

Deactivation: *When the activation condition isn't fulfilled !*

Formula section:

{ Reset of the activation counter in service }
if LC_CTR_TPS_JAM_DET_ACT_CLR == 1 **or**
LV_CTR_TPS_JAM_DET_ACT_EXT_ADJ == 1
Then *{ The throttle has been changed in service ! The activation counter is reset ! }*
CTR_TPS_JAM_DET_ACT = 0
EndIf

switch(STATE_TPS_JAM_DET **)** *{ State machine of ETC jam detection ! }*
case INIT: *{ ETC jam detection is in the initialisation state }*
{ Remove engine speed limitation request }
LV_N_LIM_TPS_JAM_REQ = 0
{ Remove throttle position setpoint request }
LV_TPS_SP_JAM = 0
{ Remove error entry }
lv_err_tps_jam_det = 0
ERR_SYM_TPS_JAM_DET = NO_SYM
{ Initialisation of the counter variables }
CTR_TPS_JAM_PLS = 0
CTR_TPS_JAM_PER = 0
{ Calculate transitions to the setpoint limitation and ice-breaking function }

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```
if      LV_TPS_JAM_DET_ACT == 1        and
        LV_TPS_JAM_DET_DI == 0
then    { A jammed ETC actuator has been detected ! At first the throttle position of the
         ice detection is saved for the further function ! }
        TPS_JAM_ACT = TPS_AV
        if      TPS_DIF > 0
        then    { The throttle actuator is jammed in opening direction }
                LV_TPS_JAM_OPEN_DIR = 1
                { Define new setpoint in opening direction }
                TPS_SP_JAM_TMP = TPS_JAM_ACT - C_TPS_JAM_OFS
                { Define parameters for throttle position setpoint pulse generator }
                TPS_JAM_PLS            = C_TPS_JAM_PLS_OPEN
                CTR_TPS_JAM_PER_MAX  = C_CTR_TPS_JAM_PER_OPEN
                { Perform error entry in opening direction }
                lv_err_tps_jam_det          = 1
                ERR_SYM_TPS_JAM_DET  = SYM_1
        else    { The throttle actuator is jammed in closing direction }
                LV_TPS_JAM_OPEN_DIR = 0
                { Define new setpoint in closing direction }
                TPS_SP_JAM_TMP = TPS_JAM_ACT + C_TPS_JAM_OFS
                { Define parameters for throttle position setpoint pulse generator }
                TPS_JAM_PLS            = - C_TPS_JAM_PLS_CLOSE
                CTR_TPS_JAM_PER_MAX  = C_CTR_TPS_JAM_PER_CLOSE
                { Perform error entry in closing direction }
                lv_err_tps_jam_det                  = 1
                ERR_SYM_TPS_JAM_DET  = SYM_0
        endif
        { Increase activation counter }
        CTR_TPS_JAM_DET_ACT + = 1H
        { Selection between setpoint limitation and active ice-breaking depend on the
          function inhibition counter ! }
        if      CTR_TPS_JAM_INH > 0
        then    { End of Ice breaking ! }
                STATE_TPS_JAM_DET = BREAK_END
        else    { Initialise pulse generator }
                TPS_SP_JAM_TMP - = TPS_JAM_PLS
                { Ice-breaking function will be started ! }
                STATE_TPS_JAM_DET = ICE_BREAK
        endif
        { Activate throttle position setpoint request }
        LV_TPS_SP_JAM = 1


endif
 break
case    ICE_BREAK:  { ETC jam detection requests ice-breaking ! }
        { Engine speed limitation is requested only in closing direction ! }
        if      LV_TPS_JAM_OPEN_DIR == 0
        then    LV_N_LIM_TPS_JAM_REQ = 1
        endif
```

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```
            { Increase period counter of the rectangle pulse sequence }
            CTR_TPS_JAM_PER + = 1H;
            { Generate throttle position setpoint pulse sequence for the active ice-breaking ! }
            if      CTR_TPS_JAM_PER == CTR_TPS_JAM_PER_MAX
            then    { Half period of the rectangle pulse is finished, change throttle position setpoint
            }
                    TPS_SP_JAM_TMP + = 2 * TPS_JAM_PLS
            endif
            if      CTR_TPS_JAM_PER >= 2 * CTR_TPS_JAM_PER_MAX
            then    { Increase pulse counter }
                    CTR_TPS_JAM_PLS + = 1H;
                    { Calculate transition to the setpoint limitation function }
                    if      CTR_TPS_JAM_PLS >= C_CTR_TPS_JAM_PLS_MAX
                    then    { The maximum pulse number has been performed, the function has to
                    go in End of Ice breaking, ice-breaking was not successful ! }
                            STATE_TPS_JAM_DET = BREAK_END
                            { Set final throttle position setpoint }
                            TPS_SP_JAM_TMP - = TPS_JAM_PLS
                    else    { Full period of the rectangle pulse is finished, change throttle position
                              setpoint }
                            TPS_SP_JAM_TMP - = 2 * TPS_JAM_PLS
                            { Reset period counter of the rectangle pulse sequence }
                            CTR_TPS_JAM_PER = 0H;
                    endif
            endif
            { Calculate transition to the initialisation state }
            if      LV_TPS_JAM_DET_DI       == 1      or
                    LV_TPS_JAM_DET_DEAC     == 1
            then    { The ETC jam detection is deactivated !  }
                    STATE_TPS_JAM_DET = INIT
                    { Initialise inhibition counter for the next activation }
                    CTR_TPS_JAM_INH = C_CTR_TPS_JAM_INH
            endif
             break
            case    BREAK_END: { End of Ice breaking }
            { ETC jam detection is not requested ! }
            LV_TPS_SP_JAM = 0
            { Engine speed limitation is not requested ! }
            LV_N_LIM_TPS_JAM_REQ = 0
            { Calculate transition to the initialisation state }
            if      LV_TPS_JAM_DET_DI       == 1      or
                    LV_TPS_JAM_DET_DEAC     == 1
            then    { The ETC jam detection is deactivated !  }
                    STATE_TPS_JAM_DET = INIT
                    { Initialise inhibition counter for the next activation }
                    CTR_TPS_JAM_INH = C_CTR_TPS_JAM_INH
            endif
             break
   default
end switch
{ Finally copy throttle position setpoint ! }
TPS_SP_JAM = TPS_SP_JAM_TMP
```

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For error management treatment the following action is called:
ACTION_ERRM_NoFilterSymptom(...
TPS_JAM_DET, LV_CDN_DIAG_TPS_JAM_DET, ERR_SYM_TPS_JAM_DET, **lv_err_tps_jam_det**, ~**lv_err_tps_jam_det**, **lv_end_diag_tps_jam_det**, LV_ERR_TPS_JAM_DET)
This algorithm sets
LV_ERR_TPS_JAM_DET and LV_END_DIAG_TPS_JAM_DET
according the diagnostic result and delivers the result to Error Management.

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C.3 Electronic throttle control jam detection (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_DLY_TPS_JAM	V	0... FFH	0... 255	1	-
Time delay for the detection of abnormal engine operating state					
LV_TPS_JAM_DET_ACT	O/V	0... 1H	0 ...1	1	-
Activation condition of the ETC jam detection					
LV_TPS_JAM_DET_DI	O/V	0... 1H	0 ...1	1	-
Disable condition of the ETC jam detection					
LV_TPS_SP_JAM_OFF	V	0... 1H	0 ...1	1	-
Irreversible lock condition after detection of abnormal engine operating state					

Input data:

CTR_TPS_JAM_DET_ACT {p. 6531}	GEAR {p. 1302}	LV_ERR_MAF {p. 4815}	LV_ERR_MAP {p. 982}
LV_ERR_TIA_THR {p. 984}	LV_IGK {p. 906}	LV_IS {p. 1720}	LV_MTC_CUR_OFF {p. 6565}
MTCPWM {p. 6546}	N {p. 1525}	T_MTCPWM_PI_DIAG {p. 4977}	TCO {p. 1100}
TIA_THR {p. 984}	VS {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_MAX_GEAR_TPS_JAM	-	0... FFH	0... 255	1	-
Counter maximum for TPS jam detection being active with gear engaged and engine speed too high					
C_CTR_MAX_NEUT_TPS_JAM	-	0... FFH	0... 255	1	-
Counter maximum for TPS jam detection being active with gear not engaged and engine speed too high					
C_CTR_TPS_JAM_DET_ACT_MAX	-	0... FFFFH	0... 65535	1	-
Counter maximum for TPS jam detection being active to prevent ETC damage					
C_N_MAX_GEAR_TPS_JAM	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed for TPS jam detection being active with gear engaged					
C_N_MAX_NEUT_TPS_JAM	-	0... 1FE0H	0... 8160	1	rpm
Maximum engine speed for TPS jam detection being active with gear not engaged					
C_PWM_ETC_TPS_JAM	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
PWM_ETC activation threshold for ETC jam detection function					
C_T_MIN_DIAG_TPS_JAM	-	0... FFH	0... 2.55	0.01	s
Debounce timer activation threshold for TPS jam detection function					
C_VS_MAX_TPS_JAM	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for TPS jam detection being active					
IP_TIA_MAX_TPS_JAM	-	0... FEH	-48... 142.5	0.75	°C
LDP_TCO_IP_TIA_MAX_TPS_JAM	4	0... FEH	-48... 142.5	0.75	°C
TIA activation threshold for ETC jam detection dependent on TCO					

Error treatment:

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```
LV_MTC_CUR_OFF        == 1        )
```

Configuration for diagnostic symptoms:

Diagnostic TPS_JAM_DET	Symptom description	Symptom	Filter type
ETC jam detection	*TPS jammed in closing direction*	*SYM_0*	*NO*
	TPS jammed in opening direction	*SYM_1*	
	-	*SYM_2*	
	-	*SYM_3*	

FUNCTION DESCRIPTION:

General information:

The following module described the application incidence of the ETC jam detection and should be used for the control of the ice-breaking algorithm.

C.3.1 Engine Speed Monitoring for TPS Jam Function being active

General information:

The following functionality is used for the detection of abnormal engine operating state, in this case the ETC jam detection functionality will be locked and the ETC actuator diagnosis must indicate an ETC actuator error.

Application conditions

Initialisation: *at RST set all to zero*

Recurrence: *20 ms*

Activation: *All engine operating states*

Deactivation: *No deactivation*

Formula section:

```
if      LV_IGK == 1
then    if    LV_IS == 1      and
          VS < C_VS_MAX_TPS_JAM        and
          ( N > C_N_MAX_NEUT_TPS_JAM         and     GEAR == 0     or
            N > C_N_MAX_GEAR_TPS_JAM         and     GEAR ~= 0     )
        then         CTR_DLY_TPS_JAM += 1H
        else         CTR_DLY_TPS_JAM = 0
        endif
        if      GEAR == 0
        then    if      CTR_DLY_TPS_JAM   C_CTR_MAX_NEUT_TPS_JAM
                then    LV_TPS_SP_JAM_OFF = 1        { set for the driving cycle }
                endif
        else    if      CTR_DLY_TPS_JAM   C_CTR_MAX_GEAR_TPS_JAM
                then    LV_TPS_SP_JAM_OFF = 1        { set for the driving cycle }
```

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endif
endif
else *{ Re-initialize function variables }*
LV_TPS_SP_JAM_OFF = 0; CTR_DLY_TPS_JAM = 0
endif

C.3.2 Control condition for ETC jam detection

Description:

The following section describes the control conditions of the ETC jam detection. The aim is to gather all activation and inhibition conditions for an efficient control of the algorithm.

Application conditions

Initialisation: *at RST set all to zero*

Recurrence: *20 ms*

Activation: *All engine operating states*

Deactivation: *No deactivation*

Formula section:

{ Calculate activation condition for ETC jam detection }
LV_TPS_JAM_DET_ACT = **(** ...
TIA_THR < IP_TIA_MAX_TPS_JAM **and**
| MTCPWM | > C_PWM_ETC_TPS_JAM **and**
T_MTCPWM_PI_DIAG > C_T_MIN_DIAG_TPS_JAM **and**
CTR_TPS_JAM_DET_ACT< C_CTR_TPS_JAM_DET_ACT_MAX**)**

{ Calculate disable condition for ETC jam detection }
LV_TPS_JAM_DET_DI = **(** LV_IGK == 0 **or**
LV_ERR_TIA_THR == 1 **or**
LV_ERR_MAF == 1 **or**
LV_ERR_MAP == 1 **or**
LV_TPS_SP_JAM_OFF == 1 **or**
LV_MTC_CUR_OFF == 1 **)**

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C.4 Electronic throttle control position controller

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MTCPWM_CLOSE_ACT	O/V	0... 1H	0 ...1	1	-
logical variable (is set, if closing duty cycle is active)					
LV_TPS_CHG_POS	V	0... 1H	0 ...1	1	-
detection of changed direction from LV_TPS_SP_POS					
LV_TPS_SP_POS	V	0... 1H	0 ...1	1	-
position detection of TPS-setpoint (0: below LIH; 1: above LIH)					
MTCPWM	O/V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
duty cycle MTC					
MTCPWM_ADD	V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
Tastverhältnis der Feed-Forward-Steuerung					
MTCPWM_CTL	V	E0000... 1FFFFH	-400 ...400	0.00305	%
duty cycle of PID-control					
MTCPWM_D	V	8000... 7FFFH	-400... 399.98779	0.012207	%
duty cycle of D-share					
MTCPWM_I	V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
duty cycle of I-share					
MTCPWM_I_ADD	V	0... 7FFFH	0... 99.99694	3.0518e-3	%
additive friction compensation of I-share					
MTCPWM_P	V	8000... 7FFFH	-400... 399.98779	0.012207	%
duty cycle of P-share					
MTCPWM_VB_FAC	V	0... FFH	0... 1.99218	0.0078125	-
battery voltage correction					
T_MTCPWM_CLOSE_ACT	V	0... 3FEH	0... 5110	5	ms
time counter for closing condition					
TPS_AV_LIH_DIF	V	0... 7FFEH	-119.5 ...119.5	7.2941e-3	°TPS
difference between TPS_AV and TPS_LIH					
TPS_DIF	O/V	0... 7FFEH	-119.5 ...119.5	7.2941e-3	°TPS
controller deviation					
TPS_DIF_GRD	V	0... 7FFEH	-119.5 ...119.5	7.2941e-3	°TPS
gradient of controller deviation					
TPS_SP_CTL	V	C001... 3FFFH	-119.5 ...119.5	7.2941e-3	°TPS
throttle position setpoint (+ or -)					
TPS_SP_LIH_DIF	V	0... 7FFEH	-119.5 ...119.5	7.2941e-3	°TPS
difference between TPS_SP and TPS_LIH					

Input data:

C_TPS_SP_LGRD_STOP {p. 6555}	LV_IGK {p. 906}	LV_MTC_CUR_OFF {p. 6565}	TPS_AV {p. 1169}
TPS_AV_CTL {p. 1169}	TPS_LIH {p. 1169}	TPS_SP {p. 6555}	VB {p. 1185}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MTCPWM_ADD_FIL	-	0... FFH	0... 0.99609	3.9063e-3	-
PT1-filtering constant					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MTCPWM_CLOSE	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
closing duty cycle					
C_MTCPWM_CLOSE_MAX	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
duty cycle limitation at bottom mechanical limit					
C_MTCPWM_HYS	-	0... 7FFFH	0... 99.99694	3.0518e-3	%
hysteresis to prevent MTCPWM-switching according to VB-changes					
C_MTCPWM_I_ADD	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
friction compensation of I-share					
C_MTCPWM_I_INI	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
initialization of MTCPWM_I					
C_MTCPWM_I_MAX_NEG	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
limitation of I-share downwards					
C_MTCPWM_I_MAX_POS	-	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
limitation of I-share upwards					
C_T_MTCPWM_CLOSE_ACT_MAX	-	0... 3E8H	0 ...5	0.005	s
timer-threshold for switching to closing duty cycle					
C_TPS_SP_CTL_MAX	-	FFFFC001... 0H	-119.5 ...0	0.0073	°TPS
limitation of TPS_SP_CTL					
C_TPS_SP_LIH_DIF_HYS	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
hysteresis at LIH-position for I-share initialization					
C_TPS_SP_STOP_HYS	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
setpoint hysteresis for closing throttle					
C_TPS_SP_STOP_MAX	-	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
threshold for testing duty cycle on value					
IP_MTCPWM_ADD__TPS_SP_LIH_DIF	-	0... FFFFH	-100... 99.99694	3.0518e-3	%
LDPM_TPS_SP_LIH_DIF__MTCPWM_ADD	8	0... 7FFEH	-119.5 ...119.5	7.2941e-3	°TPS
feed-forward-control at positive movving direction					
IP_MTCPWM_D__TPS_DIF_GRD	-	0... FFFFH	-400... 399.98779	0.012207	%
LDP_TPS_DIF_GRD__MTCPWM_D	8	0... 7FFEH	-119.5 ...119.5	7.2941e-3	°TPS
position controller D-share					
IP_MTCPWM_I__TPS_DIF	-	0... FFFFH	-100... 99.99694	3.0518e-3	%
LDP_TPS_DIF__MTCPWM_I	8	0... 7FFEH	-119.5 ...119.5	7.2941e-3	°TPS
position controller I-share					
IP_MTCPWM_I_FAC__TPS_AV_LIH_DIF	-	0... FFH	0... 7.97	0.03125	-
LDP_TPS_AV_LIH_DIF__MTCPWM_I	8	0... 7FFEH	-119.5 ...119.5	0.0073	°TPS
LIH-correction of I-share					
IP_MTCPWM_P__TPS_DIF	-	0... FFFFH	-400... 399.98779	0.012207	%
LDP_TPS_DIF__MTCPWM_P	8	0... 7FFEH	-119.5 ...119.5	7.2941e-3	°TPS
position controller P-share					
IP_MTCPWM_VB_FAC__VB	-	0... FFH	0... 1.99218	0.0078125	-
LDP_VB__MTCPWM_VB_FAC	8	0... FFH	0... 25.89843	0.1015625	V
battery voltage correction					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

FUNCTION DESCRIPTION:

General information:

The position controller is an adaptive PID-controller with a feed forward control.

Application conditions

Initialisation: *at deactiavtion* ***or*** *LV_IGK 0->1* ***or*** *ECU reset*

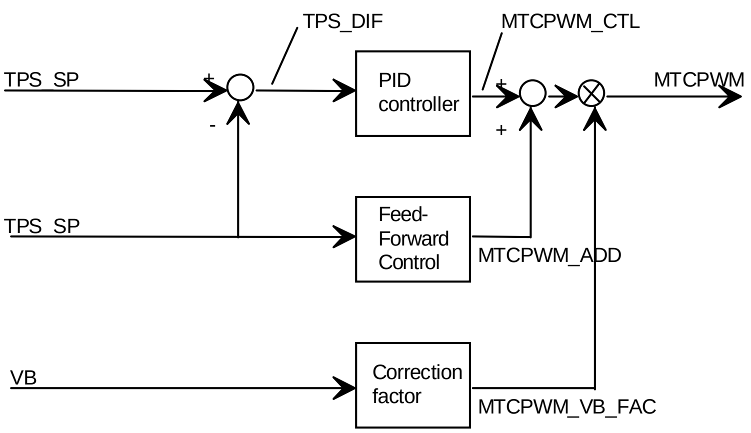
Recurrence: *5 ms*

Activation: ***If*** *LV_MTC_CUR_OFF = 0*

Deactivation:

```
If          LV_MTC_CUR_OFF = 1
 Then     Initialization of variables:
        [ MTCPWM, MTCPWM_P, MTCPWM_I, MTCPWM_I_ADD
    MTCPWM_D, MTCPWM_ADD, MTCPWM_CTL ] with 0
    TPS_SP_CTL = (S16) C_TPS_SP_STOP_HYS
    T_MTCPWM_CLOSE_ACT = 0
    LV_MTCPWM_CLOSE_ACT = 0
    TPS_DIF = 0x3FFF
    TPS_DIF_GRD = 0x3FFF
```

Signal flow diagram:



C.4.1 PID-Controller

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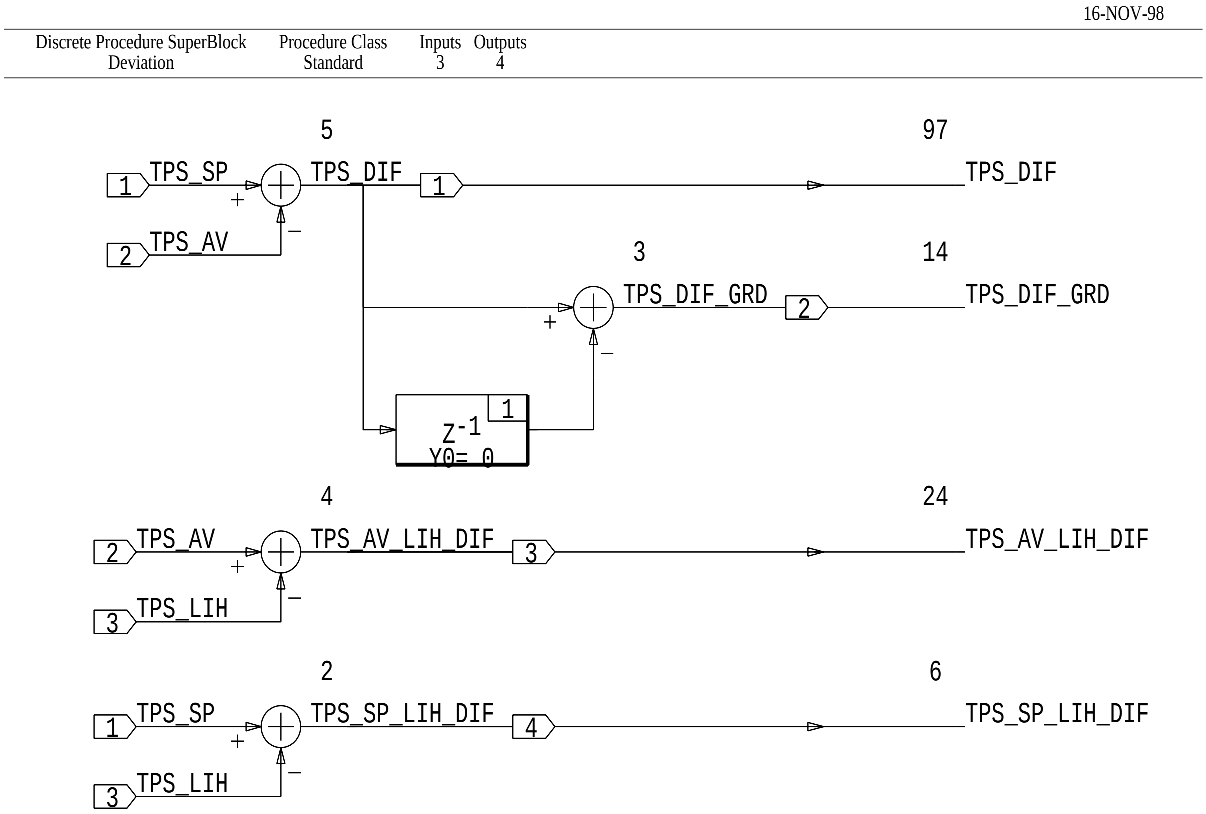
Description:

The PID-controller is nonlinear. It consists of three parts: P-part, I-part and D-part P- and I-part depend on deviation. The D-part depends on deviation gradient.
Near the mechanical bottom limit the controller deviation is calculated with an offset on the actual throttle position that is equal to the setpoint gradient limitation, even if setpoint value is at its lower limit. So the throttle is moving to the stop with a defined velocity. To calculate the controller deviation a value of the throttle position that can also be negativ is formed.
The time where duty cycle is above the closing value is measured. If meanwhile the setpoint leaves the lower bottom limit, the time counter is set back to zero.

C.4.1.1 Calculation of Deviation

Signal flow diagram:



Formula section:

controller deviation:

If TPS_SP > C_TPS_SP_STOP_HYS
then TPS_DIF = TPS_SP - TPS_AV
TPS_SP_CTL = C_TPS_SP_STOP_HYS
else TPS_SP_CTL = TPS_SP_CTL - C_TPS_SP_LGRD_STOP
TPS_DIF = MAX(TPS_SP_CTL;C_TPS_SP_CTL_MAX) - TPS_AV_CTL
endif

Remark: C_TPS_SP_STOP_HYS should be calibrated nearly to 0.

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gradient of the controller deviation:
TPS_DIF_GRD = TPS_DIFn - TPS_DIFn-1
difference between the actual value and the limp home position:
TPS_AV_LIH_DIF = TPS_AV - TPS_LIH
TPS_SP_LIH_DIF = TPS_SP - TPS_LIH

C.4.1.2 Duty Cycle Supervision /Set Timer

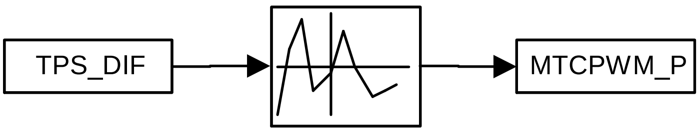
Description:

Below the threshold C_TPS_SP_STOP_MAX is supervised if the throttle is at bottom mechanical limit, i.e. if he duty cycle has exceeded the threshold C_MTCPWM_CLOSE * MTCPWM_VB_FAC. In that case a time counter is started.

Formula section:

If (1) TPS_SP C_TPS_SP_STOP_MAX
then (1)
if (2) MTCPWM <= C_MTCPWM_CLOSE * MTCPWM_VB_FAC + C_MTCPWM_HYS
then (2) T_MTCPWM_CLOSE_ACT = T_MTCPWM_CLOSE_ACT + 5ms
else (2) T_MTCPWM_CLOSE_ACT = 0
endif (2)
else (1) T_MTCPWM_CLOSE_ACT = 0
endif (1)
Remark: It s not allowed to calibrate C_TPS_SP_STOP_MAX smaller than C_TPS_SP_STOP_HYS!

C.4.1.3 P-share:



IP_MTCPWM_P__TPS_DIF

Signal flow diagram:

Formula section:

MTCPWM_P = IP_MTCPWM_P__TPS_DIF

C.4.1.4 I- share:

Formula section:

detection of the TPS_SP direction :
if (1) TPS_SP_LIH_DIF < - C_TPS_SP_LIH_DIF_HYS

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then (1) LV_TPS_SP_POS = 0
else (1)
if (2) TPS_SP_LIH_DIF $>$ C_TPS_SP_LIH_DIF_HYS
then (2) LV_TPS_SP_POS = 1
endif (2)
endif (1)

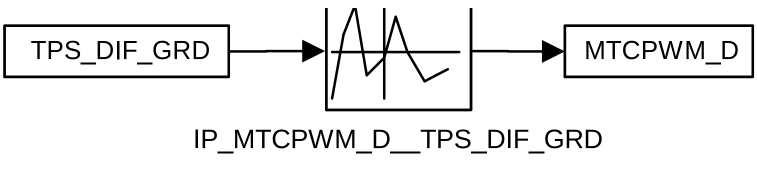
if (1) LV_TPS_SP_POS$_n$ LV_TPS_SP_POS$_{n-1}$
then (1) LV_TPS_CHG_POS = 1
if (2) LV_TPS_SP_POS$_n$ $<$ LV_TPS_SP_POS$_{n-1}$
and MTCPWM_I -C_MTCPWM_I_ADD
then (2) MTCPWM_I_ADD = -C_MTCPWM_I_ADD
else (2)
if (3) LV_TPS_SP_POS$_n$ $>$ LV_TPS_SP_POS$_{n-1}$
and MTCPWM_I C_MTCPWM_I_ADD
then (3) MTCPWM_I_ADD = C_MTCPWM_I_ADD
endif (3)
endif (2)
else (1) MTCPWM_I_ADD$_n$ = MTCPWM_I$_{n-1}$
LV_TPS_CHG_POS = 0
endif (1)
MTCPWM_I = MTCPWM_I_ADD + IP_MTCPWM_I__TPS_DIF
IP_MTCPWM_I_FAC__TPS_AV_LIH_DIF

Limitation of I-share:
I-share is limited to a range C_MTCPWM_I_MAX_NEG, C_MTCPWM_I_MAX_POS.

if (1) MTCPWM_I $>$ C_MTCPWM_I_MAX_POS
then (1) MTCPWM_I = C_MTCPWM_I_MAX_POS
else (1)
if(2) MTCPWM_I $<$ C_MTCPWM_I_MAX_NEG
then (2) MTCPWM_I = C_MTCPWM_I_MAX_NEG
else (2) MTCPWM_I = MTCPWM_I
endif (2)
endif (1)

C.4.1.5 D-share:

Signal flow diagram:



Formula section:

MTCPWM_D = IP_MTCPWM_D__TPS_DIF_GRD

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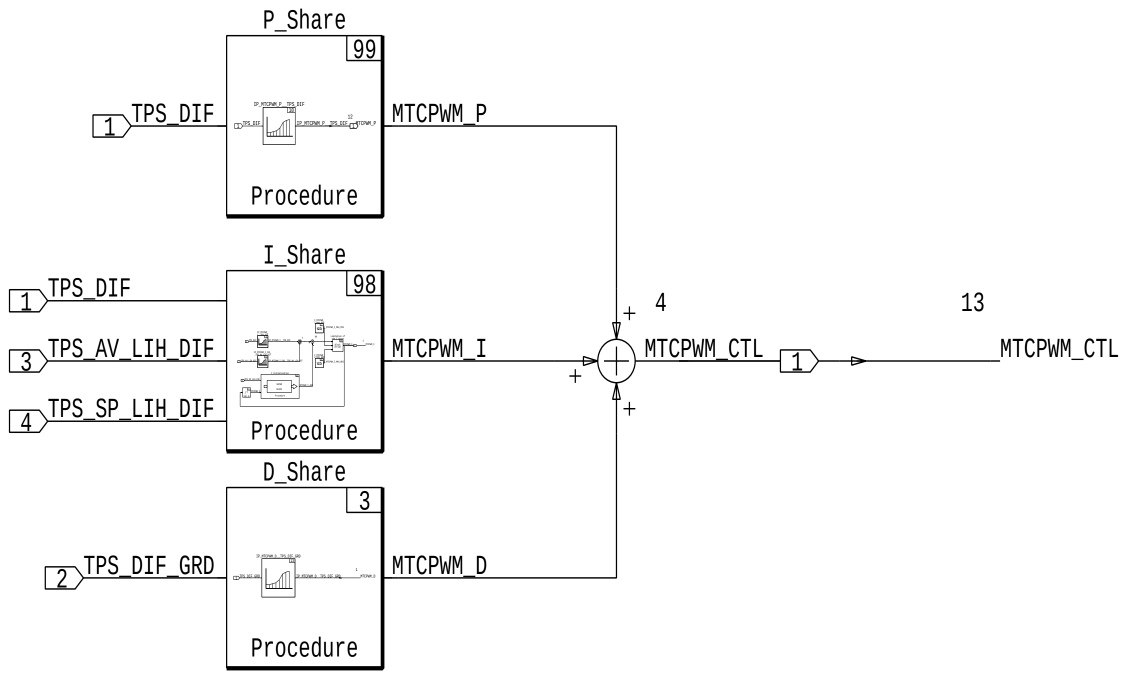
C.4.1.6 Calculation of Controller Value:

Signal flow diagram:

16-NOV-98

Discrete Procedure SuperBlock	Procedure Class	Inputs	Outputs
PID_controller	Standard	4	1



Formula section:

MTCPWM_CTL = MTCPWM_P + MTCPWM_I + MTCPWM_D

C.4.1.7 Initialization of Position Controller after mechanical limitation stop respectively closing mode

If the throttle is opening beginning at bottom mechanical limit and exceeds the calibratable threshold C_ TPS_SP_STOP_HYS the I-share is initialized with C_MTCPWM_I_INI, TPS_DIF_GRD is set to actual TPS_DIF and T_MTCPWM_CLOSE_ACT is set to zero.

if TPS_SP > C_TPS_SP_STOP_HYS
and T_MTCPWM_CLOSE_ACT > 0
then MTCPWM_I = C_MTCPWM_I_INI
TPS_DIF_GRD = TPS_DIF
T_MTCPWM_CLOSE_ACT = 0
endif

C.4.2 Feed - Forward Control of the MTC

Description:

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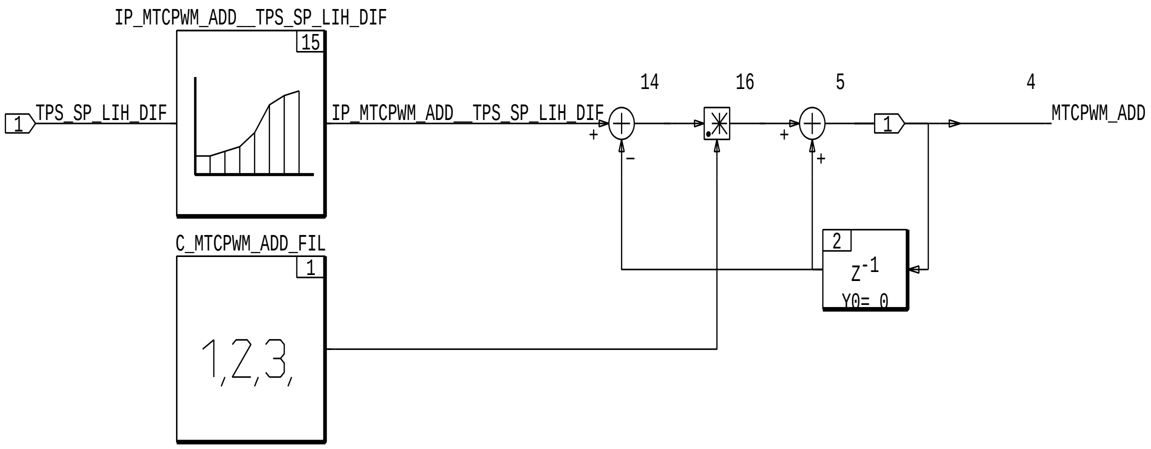
The friction torque of the bearing and of the spring set a very strong non-linearization of the control course. To compensate this and to avoid instability a feed-forward-control is used dependent on the throttle setpoint deviation to LIH-position (TPS_SP_LIH_DIF). For to take into consideration the dynamic behavior a PT1-filter with the time constant C_MTCPWM_ADD_FIL is used.

Signal flow diagram:

16-NOV-98

Discrete Procedure SuperBlock	Procedure Class	Inputs	Outputs
Feed_Forward_Controller	Standard	1	1



Formula section:

$$MTCPWM\_ADD_n = MTCPWM\_ADD_{n-1} + (IP\_MTCPWM\_ADD\_\_TPS\_SP\_LIH\_DIF_n - MTCPWM\_ADD_{n-1}) * C\_MTCPWM\_ADD\_FIL$$

C.4.3 Battery Voltage Correction

Description:

The control duty cycle will be corrected through the battery voltage VB.

Signal flow diagram:

Formula section:

MTCPWM_VB_FAC = IP_MTCPWM_VB_FAC__VB

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C.4.4 Calculation of MTCPWM

Description:

The duty cycle that controls the main throttle is the sum of a feed-forward-controller value and the PID-controller value. This sum is corrected by a factor depending on battery voltage.
Is the throttle position for sure at the lower mechanical stop, the duty cycle is limited to the allowed value. A rise of the duty cycle over the maximum value marks that the throttle position has reached the mechanical stop. The maximum duty cycle is allowed only for a defined time. Then the duty cycle is switched back to the closing level.

Formula section:

```
MTCPWM    =    (MTCPWM_CTL+ MTCPWM_ADD) * MTCPWM_VB_FAC
LV_MTCPWM_CLOSE_ACT = 0
        if (1)              T_MTCPWM_CLOSE_ACT > 0
        then (1)        MTCPWM =        MAX{(C_MTCPWM_CLOSE_MAX * MTCPWM_VB_FAC);
                                        MTCPWM}
                if(2)       T_MTCPWM_CLOSE_ACT > C_ T_MTCPWM_CLOSE_ACT_MAX
                then(2)         MTCPWM = C_MTCPWM_CLOSE * MTCPWM_VB_FAC
                                LV_MTCPWM_CLOSE_ACT = 1
                endif(2)
        endif (1)
```

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C.5 Electronic throttle control setpoint selection

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TPS_SP	O/V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Throttle position setpoint for MTC position controller					
TPS_SP_LIM	V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Limited throttle position setpoint					
TPS_SP_LIM_1	V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Throttle position setpoint after absolute value limitation					
TPS_SP_LIM_2	V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Throttle position setpoint after gradient limitation over whole operating range					
TPS_SP_SEL	O/V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Selected throttle position setpoint before limitation					

Input data:

LV_ES {p. 1720}	LV_TPS_AD_ACT {p. 4951}	LV_TPS_AD_REQ {p. 4951}	LV_TPS_PWL {p. 6565}
LV_TPS_SP_EXT {p. 6565}	LV_TPS_SP_JAM {p. 6531}	LV_TPS_SP_LIH {p. 6565}	TPS_AV {p. 1169}
TPS_LIH {p. 1169}	TPS_SP_AD {p. 4952}	TPS_SP_ES {p. 6565}	TPS_SP_EXT {p. 6565}
TPS_SP_JAM {p. 6532}	TPS_SP_MDL {p. 8377}	TPS_SP_PWL {p. 6565}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TPS_AV_BOL	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Lower limit (actual value) of the closing speed limitation of the throttle setpoint					
C_TPS_AV_TOL	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Upper limit (actual value) of the opening speed limitation of the throttle setpoint					
C_TPS_SP_BOL	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Lower limit of opening velocity limitation of throttle position setpoint					
C_TPS_SP_BOL_TPS_AD_REQ	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Lower limit of opening velocity limitation of throttle position setpoint without throttle adaptation					
C_TPS_SP_LGRD_STOP	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS/ 10ms
max. admissible gradient of throttle position setpoint for range of top and bottom stop					
C_TPS_SP_LGRD_TOT	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS/ 10ms
max. admissible gradient of throttle position setpoint for whole operating range					
C_TPS_SP_MAX	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Upper limit of throttle position setpoint					
C_TPS_SP_MAX_TPS_AD_REQ	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Upper limit of throttle position setpoint without throttle adaptation					
C_TPS_SP_MIN	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Lower limit of throttle position setpoint					
C_TPS_SP_MIN_TPS_AD_REQ	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Lower limit of throttle position setpoint without throttle adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TPS_SP_TOL	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Upper limit of opening velocity limitation of throttle position setpoint					
C_TPS_SP_TOL_TPS_AD_REQ	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Upper limit of opening velocity limitation of throttle position setpoint without throttle adaptation					

FUNCTION DESCRIPTION:

General information:

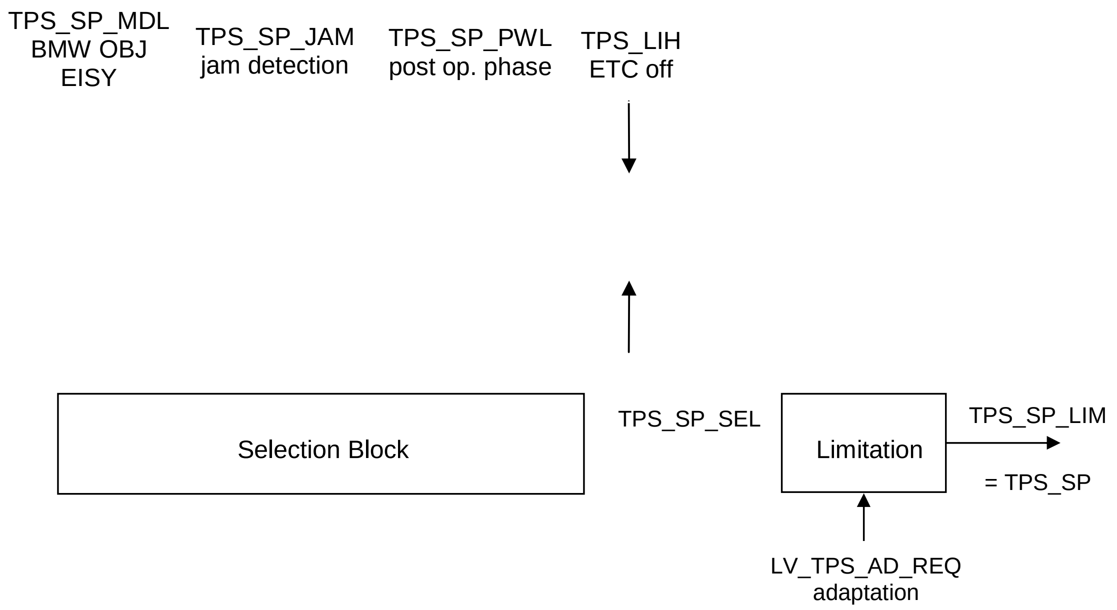
This module is describing the generation of the throttle position setpoint TPS_SP which is used as an input variable in the module ETC Position Controller.
The module consists of two blocks (see figure 1): In a first step the setpoint is selected depending on the engine state, in a second step the selected value is limited. This limitation acts as protection so that the throttle blade does not hit the mechanical stops with too high energy. Otherwise the throttle could be damaged.
The setpoint before limitation TPS_SP_SEL is selected from the following variables:

1. Basic throttle position setpoint: TPS_SP_MDL (output of BMW OBJ EISY)
2. Throttle position setpoint for engine stopped: TPS_SP_ES
3. Throttle position setpoint for jam detection: TPS_SP_JAM
4. Throttle position setpoint during adaptation: TPS_SP_AD
5. Throttle position setpoint in case of external activation: TPS_SP_EXT
6. Throttle position setpoint during the post operating phase: TPS_SP_PWL
7. Throttle position setpoint when the position controller is switched off: TPS_LIH

From TPS_SP_SEL the final setpoint TPS_SP is generated by means of a limitation function which is including a limitation by absolute values and by gradients.

The setpoint is determined every 10 ms, except during adaptation (5ms).

Signal flow diagram:



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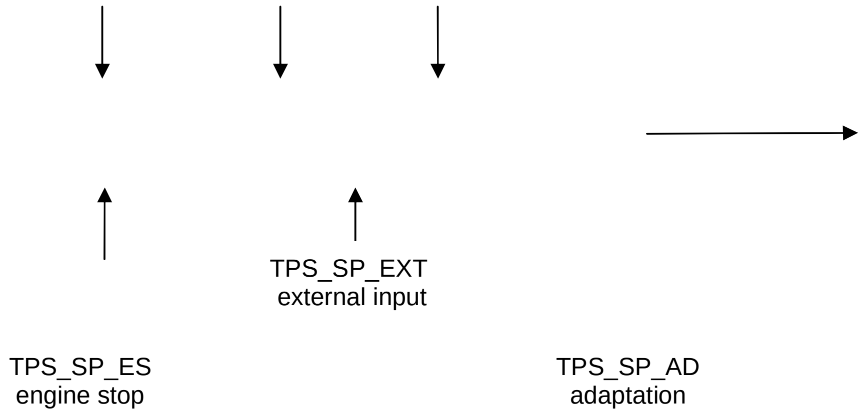

Figure C.5.1: : Throttle position setpoint selection and limitation.

Application conditions

Activation: *at every engine state*

Deactivation: –

Initialisation: –

Update rate: 10 ms (5ms during adaptation)

C.5.1 Throttle position setpoint selection

For the selection logic see figure 2.

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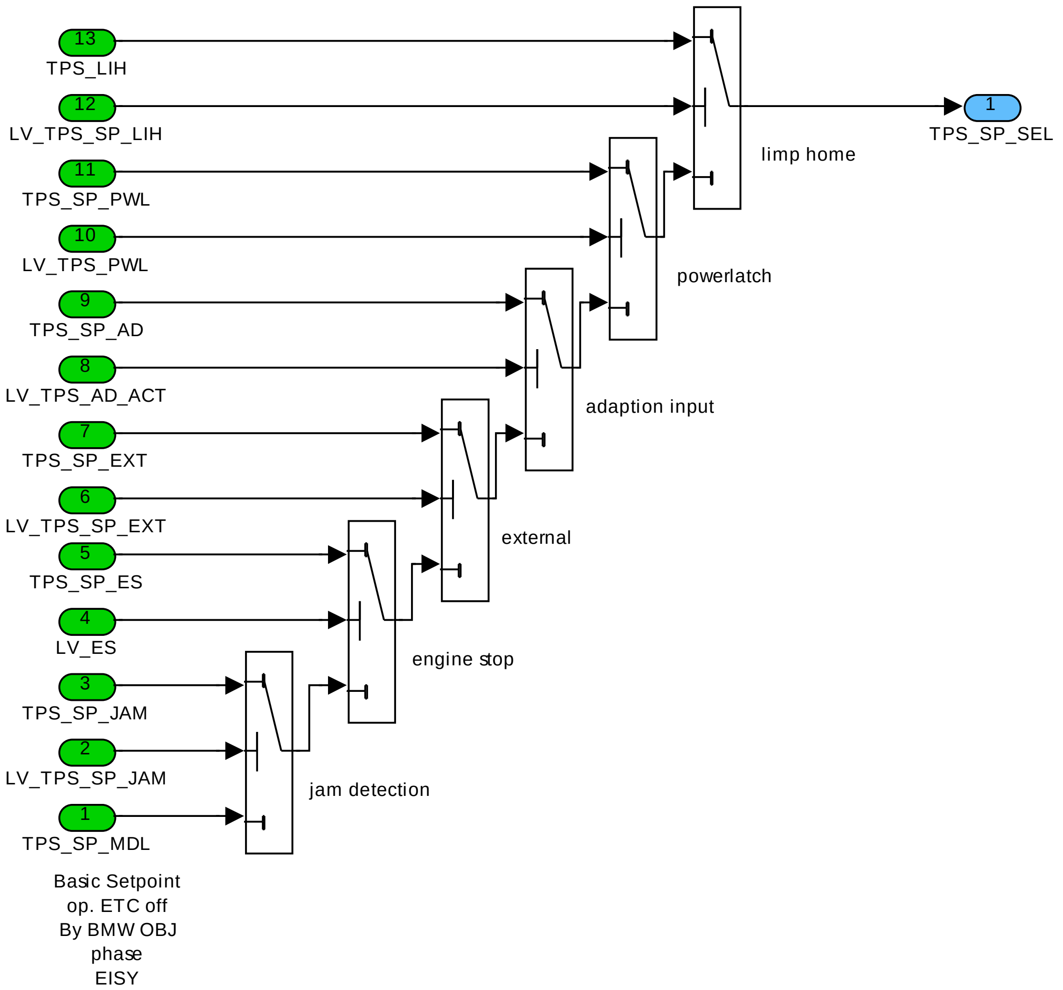

Figure C.5.2: : Throttle position setpoint selection block.

C.5.1.1 Throttle position setpoint for jam detection

During jam detection the throttle position setpoint is set from the jam detection module.

Formula section:

if (LV_TPS_SP_JAM = 1 **and**
LV_ES = 0 **and**
LV_TPS_SP_EXT = 0 **and**
LV_TPS_AD_ACT= 0 **and**
LV_TPS_PWL = 0 **and**
LV_TPS_SP_LIH = 0)

then TPS_SP_SEL = TPS_SP_JAM

else TPS_SP_SEL = TPS_SP_MDL

endif

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C.5.1.2 Throttle position setpoint for engine stopped

During the engine state “Engine stopped” (LV_ES = 1) the throttle position setpoint is determined by the special variable TPS_SP_ES.

Formula section:

```
if      (LV_ES = 1                 and
         LV_TPS_SP_EXT = 0           and
         LV_TPS_AD_ACT= 0                and
         LV_TPS_PWL = 0             and
         LV_TPS_SP_LIH = 0 )

then    TPS_SP_SEL = TPS_SP_ES

endif
```

C.5.1.3 Throttle position setpoint by external device

In case of request by an external device the throttle position setpoint is set by the value TPS_SP_EXT.

Formula section:

```
if      ( LV_TPS_SP_EXT = 1          and
         LV_TPS_AD_ACT= 0                and
         LV_TPS_PWL = 0             and
         LV_TPS_SP_LIH = 0)

then    TPS_SP_SEL = TPS_SP_EXT

endif
```

C.5.1.4 Throttle position setpoint during adaptation

During TPS adaptation the throttle position setpoint is set from the adaptation module.

Formula section:

```
if      (LV_TPS_AD_ACT= 1            and
         LV_TPS_PWL = 0             and
         LV_TPS_SP_LIH = 0 )

then    TPS_SP_SEL = TPS_SP_AD

endif
```

C.5.1.5 Throttle position setpoint during post operating phase

To avoid that for ‘Pin 15 Off’ the throttle blade is currentless and set to limp home position, a throttle position setpoint during the post operating phase is available.

Formula section:

```
if      ( LV_TPS_PWL = 1             and
```

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LV_TPS_SP_LIH = 0)

then TPS_SP_SEL = TPS_SP_PWL

endif

C.5.1.6 Throttle position setpoint for ETC controller switched off

In case of the ETC controller switched off the TPS setpoint is set to the limp home position TPS_LIH.

Formula section:

if LV_TPS_SP_LIH = 1

then TPS_SP_SEL = TPS_LIH

endif

C.5.2 Throttle position setpoint limitation

The task of this function is a protection mechanism for the throttle blade. Therefore, it must be evaluated after the TPS setpoint selection.

For adjusting the setpoint to the physics of the throttle the variable TPS_SP_SEL is limited by

1. absolute values, for the non adapted throttle (LV_TPS_AD_REQ =1 remains set after adaptation) the values indicated by "(_TPS_AD_REQ)" are used,
2. a gradient valid for the whole operating range,
3. a gradient valid for the range of upper and lower stop.

The intermediate results of the limitation actions mentioned above are stored in the following way:
a) b) c)
TPS_SP_SEL - -> TPS_SP_LIM_1 - -> TPS_SP_LIM_2 - -> TPS_SP_LIM = TPS_SP

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For illustration see figure 3.

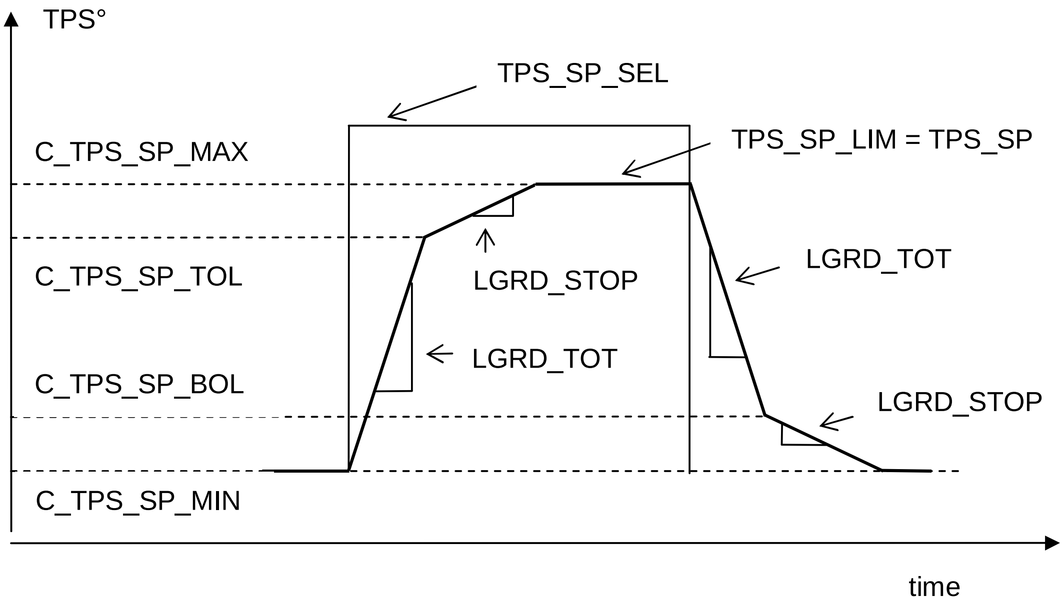

Figure C.5.3: : Throttle position setpoint limitation.

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C.5.2.1 Limitation using absolute values

The throttle position setpoint may not fall below the value C_TPS_SP_MIN(_TPS_AD_REQ) or exceed C_TPS_SP_MAX(_TPS_AD_REQ).

Formula section:

if (TPS_SP_SEL $>$ C_TPS_SP_MAX(_TPS_AD_REQ))

then TPS_SP_LIM_1 = C_TPS_SP_MAX(_TPS_AD_REQ)

else **if** TPS_SP_SEL $<$ C_TPS_SP_MIN(_TPS_AD_REQ)

then TPS_SP_LIM_1 = C_TPS_SP_MIN(_TPS_AD_REQ)

else TPS_SP_LIM_1 = TPS_SP_SEL

endif

endif

C.5.2.2 Gradient limitation over whole operating range

The gradient of the throttle position setpoint is limited throughout the whole operating range. A maximum change of C_TPS_SP_LGRD_TOT is permitted.

Formula section:

if TPS_SP_LIM_1 $>$ TPS_SP_LIM$_{i-1}$

then TPS_SP_LIM_2 =
MIN(TPS_SP_LIM_1, TPS_SP_LIM$_{i-1}$ + C_TPS_SP_LGRD_TOT)

else TPS_SP_LIM_2 =
MAX(TPS_SP_LIM_1, TPS_SP_LIM$_{i-1}$ - C_TPS_SP_LGRD_TOT)

endif

C.5.2.3 Gradient limitation near upper and lower position

The throttle position gradient is additionally limited as soon as the throttle position is near the upper or lower stop position: If TPS_SP_LIM_2 is close to the stop positions, for one step the setpoint TPS_SP_LIM is set to the value C_TPS_SP_TOL(_TPS_AD_REQ) or C_TPS_SP_BOL(_TPS_AD_REQ), respectively. When TPS_SP_LIM_2 is further moving towards the stops a gradient C_TPS_SP_LGRD_STOP $<$ C_TPS_SP_LGRD_TOT is permitted. Thus a mechanical collision of blade and stops should be avoided (at least when TPS_AV is close toTPS_SP).

An additional protection mechanism near the mechanical stops is taking into account also the actual position TPS_AV of the throttle blade. If the difference between the desired TPS_SP and the actual TPS_AV is too high, the ETC controller will react aggressively. This reaction could lead to banging the throttle against the mechanical stops. To avoid such a behaviour the following algorithm is implemented: If TPS_AV is too far away from TPS_SP_LIM_2 (near the lower stop: TPS_AV $>$ C_TPS_AV_BOL $>$ C_TPS_SP_BOL whereas TPS_SP_LIM_2 $\approx$ C_TPS_SP_BOL; near the upper stop: TPS_AV $<$ C_TPS_AV_TOL $<$ C_TPS_SP_TOL whereas TPS_SP_LIM_2 $\approx$ C_TPS_SP_TOL), then TPS_SP_LIM is kept on the value C_TPS_SP_BOL (or C_TPS_SP_TOL, respectively) until TPS_AV

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is arriving below C_TPS_AV_BOL (or above C_TPS_AV_TOL) such that the difference between desired and actual position is small enough to have no strong ETC controller reactions. For illustration of the algorithm see figure 4.

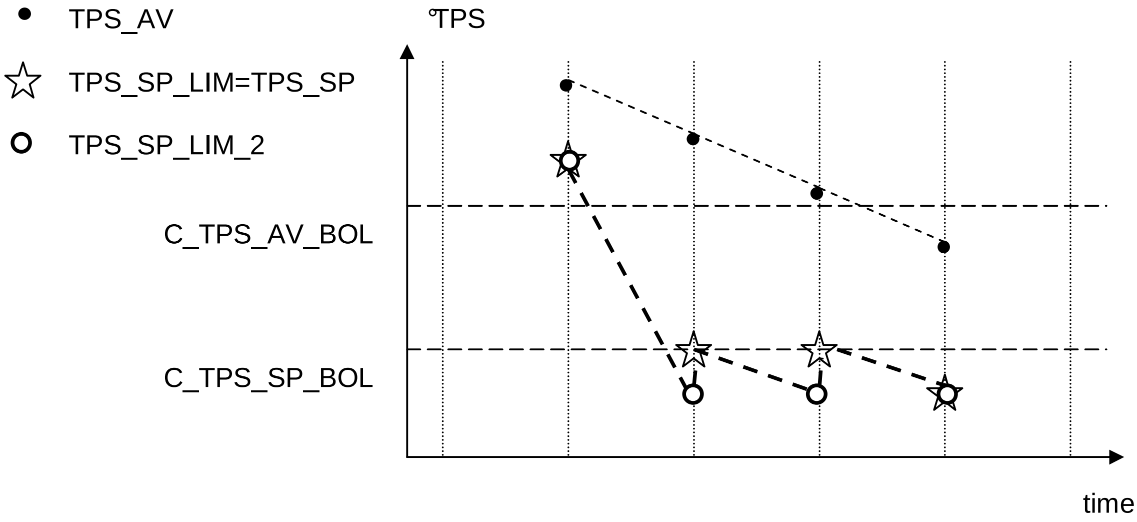

Figure 4: TPS_SP limitation mechanism at lower mechanical stop depending on TPS_AV.

Formula section:

if TPS_SP_LIM_2 $>$ C_TPS_SP_TOL(_TPS_AD_REQ) {above top limit}

then **if** (TPS_SP_LIM_{i-1} $<$ C_TPS_SP_TOL(_TPS_AD_REQ) **or**
TPS_AV $<$ C_TPS_AV_TOL)

then TPS_SP_LIM = C_TPS_SP_TOL(_TPS_AD_REQ)

else TPS_SP_LIM = MIN(TPS_SP_LIM_2,
TPS_SP_LIM_{i-1}+C_TPS_SP_LGRD_STOP)

endif

else **if** TPS_SP_LIM_2 $<$ C_TPS_SP_BOL(_TPS_AD_REQ) {below bottom limit}

then **if** (TPS_SP_LIM_{i-1} $>$C_TPS_SP_BOL(_TPS_AD_REQ) **or**
TPS_AV $>$ C_TPS_AV_BOL)

then TPS_SP_LIM = C_TPS_SP_BOL(_TPS_AD_REQ)

else TPS_SP_LIM = MAX(TPS_SP_LIM_2,
TPS_SP_LIM_{i-1} -C_TPS_SP_LGRD_STOP)

endif

else TPS_SP_LIM = TPS_SP_LIM_2

endif

endif

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Remark: For correct working of the algorithm the following settings **must** be chosen:

- C_TPS_SP_BOL(_TPS_AD_REQ) $<$ C_TPS_AV_BOL $<$ TPS_LIH
- C_TPS_SP_TOL(_TPS_AD_REQ) $>$ C_TPS_AV_TOL

C.5.2.4 Output of limited setpoint

Formula section:

TPS_SP = TPS_SP_LIM

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C.6 Electronic throttle control setpoint selection (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_T_TPS_PWL	O	0... FFH	0... 255	1	s
Timer after engine stop					
LV_MTC_CUR_OFF	O/V	0... 1H	0 ...1	1	-
The logical variable indicate the state of the ETC power stage					
LV_TPS_PWL	O/V	0... 1H	0 ...1	1	-
Bit for throttle position setpoint in post operating phase active					
LV_TPS_SP_EXT	O/V	0... 1H	0 ...1	1	-
Bit active for external input of throttle position setpoint					
LV_TPS_SP_LIH	O/V	0... 1H	0 ...1	1	-
Bit collecting the requests of all 3 monitoring levels to switch off MTC					
TPS_SP_ES	O/V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Throttle position setpoint for engine stopped					
TPS_SP_EXT	O/V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Throttle position setpoint of external device					
TPS_SP_PWL	O/V	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Throttle position setpoint during post operating phase					

Input data:

C_TPS_SP_MAX {p. 6555}	LV_ERR_ECU_CKS {p. 4232}	LV_ERR_ECU_RAM {p. 4232}	LV_ERR_MU_MC {p. 7072}
LV_ERR_TMP_MU_MC {p. 7072}	LV_ES {p. 1720}	LV_IGK {p. 906}	LV_MC_SOPC_INH_DI {p. 7186}
LV_MTC_CUR_OFF {p. 6565}	LV_MTC_CUR_OFF_REQ {p. 4982}	LV_OFF_MTC_MON {p. 6877}	LV_TPS_AD_ACT {p. 4951}
LV_TPS_AD_CUR_OFF {p. 4951}	LV_TPS_PWL {p. 6565}	LV_TPS_SP_EXT {p. 6565}	LV_TPS_SP_EXT_ADJ {p. 7435}
N_32 {p. 1525}	PV_AV {p. 1269}	TCO {p. 1100}	TPS_SP_EXT_ADJ {p. 7438}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_PV_AV_EXT_ADJ_MIN	-	0... FFH	0... 99.60937	0.390625	%
Min. threshold for external ajustment about PV_AV					
C_T_MTC_ISA_OFF	-	0... FFH	0... 255	1	s
Active time period for throttle position setpoint during post operating phase					
C_TPS_SP_AS_MAN	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Manual throttle setpoint					
C_TPS_SP_EXT_ADJ_ENA	-	0... 3H	0 ...3	1	-
Variable enabled for throttle position setpoint manual or about PV_AV					
C_TPS_SP_PWL_LGRD	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS/ 10ms
Gradient limitation TPS					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TPS_SP_PWL_UP	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
Threshold opening throttele after power latch					
IP_TPS_SP_ES	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
LDPM_TCO_1_THRO	8	0... FEH	-48... 142.5	0.75	°C
Throttle position setpoint for engine stopped					
IP_TPS_SP_EXT_ADJ	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
LDP_PV_AV__TPS_SP_EXT	6	0... FFH	0... 99.60937	0.390625	%
External adjustment setpoint					
IP_TPS_SP_PWL	-	0... 3FFFH	0... 119.5	7.29e-3	°TPS
LDP_N_32_TPS_SP_PWL	4	0... FFH	0... 8160	32	rpm
Throttle position setpoint during post operating phase					

C.6.1 Throttle position setpoint for engine stopped

FUNCTION DESCRIPTION:

General information:

For engine stopped TPS_SP_ES is generated from a TCO dependent map. The TPS_SP_ES value must be chosen with respect to the expected TPS_SP_ST. A sensible choice diminishes the transient time when the TPS_AV is approaching TPS_SP_ST.

Application conditions

Initialisation: –

Recurrence: *10 ms*

Activation: *in every engine state*

Formula section:

If LV_ES = 1

then TPS_SP_ES = IP_TPS_SP_ES

endif

C.6.2 Throttle position setpoint by external device

Description:

For different tasks during calibration phase and for service procedures at the workshops, it is necessary to implement an external adjustment at throttle position.

Throttle position can be influenced via serial tester (KWP) or manual in the following way:

C_TPS_SP_EXT_ADJ_ENA = 0 : no manual adjustment
C_TPS_SP_EXT_ADJ_ENA = 1 : manual setpoint via application system

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C_TPS_SP_EXT_ADJ_ENA = 2 : manual setpoint via PV_AV
C_TPS_SP_EXT_ADJ_ENA = 3 : manual setpoint via PV_AV and application system

Application conditions

Initialisation: *0*

Recurrence: *10ms*

Activation: *LV_IGK = 1*

Formula section:

```
If(1)          LV_TPS_SP_EXT_ADJ = 1
Then(1)   LV_TPS_SP_EXT = 1
            TPS_SP_EXT = (TPS_SP_EXT_ADJ /100%) * C_TPS_SP_MAX
                                                 //to convert from % into °TPS
Else(1)   If(2)   C_TPS_SP_EXT_ADJ_ENA = 1     and
                    LV_ES = 1
           Then(2)     TPS_SP_EXT = C_TPS_SP_AS_MAN
                        LV_TPS_SP_EXT = 1
           Else(2)     If(3)   C_TPS_SP_EXT_ADJ_ENA = 2          and
                                PV_AV > C_PV_AV_EXT_ADJ_MIN  and
                                LV_ES = 1
                       then(3) TPS_SP_EXT = IP_TPS_SP_EXT_ADJ
                                  LV_TPS_SP_EXT = 1
                       else(3)        If(4)   C_TPS_SP_EXT_ADJ_ENA = 3      and
                                      PV_AV > C_PV_AV_EXT_ADJ_MIN
                             then(4) TPS_SP_EXT = C_TPS_SP_AS_MAN +
                                                              IP_TPS_SP_EXT_ADJ
                                      LV_TPS_SP_EXT = 1
                             else(4) LV_TPS_SP_EXT = 0
                                      TPS_SP_EXT = 0
                             endif(4)
                       endif(3)
           endif(2)
endif(1)
```

C.6.3 Throttle position setpoint during post operating phase

General information:

To avoid that for ‚Power Down‘ the currentless throttle is set to the limp home position, for a tuneable time period a throttle position setpoint during the post operating phase is available.
A time counter is started on detection of ignition key OFF and N $<$ 32 rpm (engine stopped). If the counter reaches its maximum C_T_MTC_ISA_OFF, the throttle is actuated to the setpoint C_TPS_SP_PWL_UP by the current TPS_SP and then de-energized. Thus, it is ensured that the throttle are closed until a defined time after ignition key OFF and engine stopped.
If the throttle is already deenergized when ignition key OFF is detected, it is not re-energized.

Formula section:

If (1) LV_IGK = 0 **and**

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LV_MTC_CUR_OFF = 0; at LV_IGK = 1 to 0
Then(1) LV_TPS_PWL =1
If(2) LV_ES = 0
Then(2) TPS_SP_PWL = IP_TPS_SP_PWL
Else (2) Timer started (LV_ES = 1 to 0)
if (3) (CTR_T_TPS_PWL $<$ C_T_MTC_ISA_OFF)
Then(3) TPS_SP_PWL = IP_TPS_SP_PWL
Else (3)
Begin TPS_SP_PWL_n = TPS_SP_PWL_{n-1} + C_TPS_SP_PWL_LGRD
Until TPS_SP_PWL $\geq$ C_TPS_SP_PWL_UP
Then LV_TPS_PWL =0
Else(1) LV_TPS_PWL =0
Endif

C.6.4 Throttle position setpoint and conditions for ETC switched off

Application conditions

Initialisation: *1*

Recurrence: *5 ms*

Activation: *in every engine state*

Formula section:

If(1) LV_ES = 1 **and** *//Engine stopped*
LV_IGK = 1 **and** *//Key ON*
LV_TPS_AD_ACT = 0 **and** *//No TPS adaptation active*
LV_TPS_SP_EXT = 0 **or** *//No external adjustment TPS active*
LV_TPS_AD_CUR_OFF = 1 **or** *//Adaption-step with MTC off active*
LV_MTC_CUR_OFF_REQ = 1 **or** *//Request from TPS/MTC diagnosis*
(LV_IGK = 0 **and** LV_TPS_PWL = 0) **or** *//No activation in PWL*
LV_OFF_MTC_MON = 1 **or** *//bit set by monitoring level 2*
LV_ERR_ECU_RAM = 1 **or** *//ECU RAM error*
LV_ERR_ECU_CKS = 1 **or** *//ECU CKS error*
LV_ERR_TMP_MU_MC =1 **or** *//bits set by monitoring level 3*
LV_ERR_MU_MC= 1

then(1) LV_MTC_CUR_OFF = 1
else(1) LV_MTC_CUR_OFF = 0
endif(1)

LV_TPS_SP_LIH = LV_MTC_CUR_OFF

If(2) LV_MC_SOPC_INH_DI = 1
then(2) switch MTC HBR on, because MTC is disabled by MU
else(2) switch MTC HBR according LV_MTC_CUR_OFF
endif(2)

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D.1 Pedal value interpretation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_REQ_DRIV	O/V	0... FFFFH	0... 1.999969	305.176e3	-
scaling factor for requested torque at clutch from driver					
LV_RNG_L_REQ	O/V	0... 1H	0 ...1	1	-
Activation condition for low range mode					

Input data:

LV_RNG_L {p. 1302}	LV_RNG_L_AT {p. 1302}	LV_SOF_SWI_REQ {p. 3851}	N {p. 1525}
PV_AV_GRD {p. 1269}	PV_CUS {p. 1269}	STATE_GEAR_REV_AT_AMT {p. 1302}	STATE_GEAR_REV_CAN {p. 1574}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_REQ_DRIV_SOF_MAX	-	0... FFFFH	0... 1.999969	305.176e3	-
scaling factor treshold for activation IP_FAC_TQ_REQ_DRIV_RNG_L					
C_PV_AV_GRD_SOF_MAX	-	0... FFH	0... 1240.23	9.765625	%/s
Pedal value gradient threshold for recognition of LV_RNG_L					
C_PV_CUS_SOF_MIN	-	0... FFFFH	0... 99.9984741	0.00152588	%
PV_CUS threshold for activation IP_FAC_TQ_REQ_DRIV_RNG_L					
C_T_PV_AV_GRD_SOF_MAX	-	0... FFFFH	0... 655.35	0.01	s
Minimum time for pedal value gradient for recognition of LV_RNG_L					
IP_FAC_TQ_REQ_DRIV	-	0... FFFFH	0... 1.999969	305.176e3	-
LDPM_N_FAC_TQ_REQ_DRIV	12	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_CUS_FAC_TQ_REQ_DRIV	12	0... FFFFH	0... 99.9984741	0.00152588	%
Scaling factor for requested torque at clutch from driver					
IP_FAC_TQ_REQ_DRIV_RNG_L	-	0... FFFFH	0... 1.999969	305.176e3	-
LDPM_N_FAC_TQ_REQ_DRIV	12	0... 1FE0H	0... 8160	1	rpm
LDPM_PV_CUS_FAC_TQ_REQ_DRIV	12	0... FFFFH	0... 99.9984741	0.00152588	%
Scaling factor for requested torque at clutch from driver in low range mode					
LC_RNG_L_MAN_AS	-	0... 1H	0 ...1	1	-
Calibration constant for to activate IP_FAC_TQ_REQ_DRIV_RNG_L (low range mode) in case if LV_RNG_L = 0 (default value = 0)					

FUNCTION DESCRIPTION:

General information:
The scaling factor FAC_TQ_REQ_DRIV is the interpretation of the driver torque demand depending on engine speed and pedal value. Depending on gear mode LV_RNG_L (LV_RNG_L =1 if low range is engaged) two maps can be calibrated with different pedal value interpretation for normal and low range mode.

Application Condition

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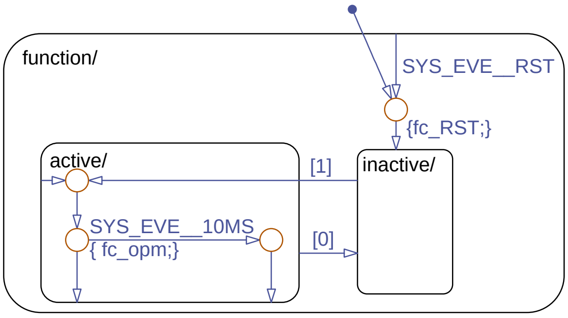

Figure D.1.1: DRRQ_MD00P/APP_CDN/Chart

Function Description

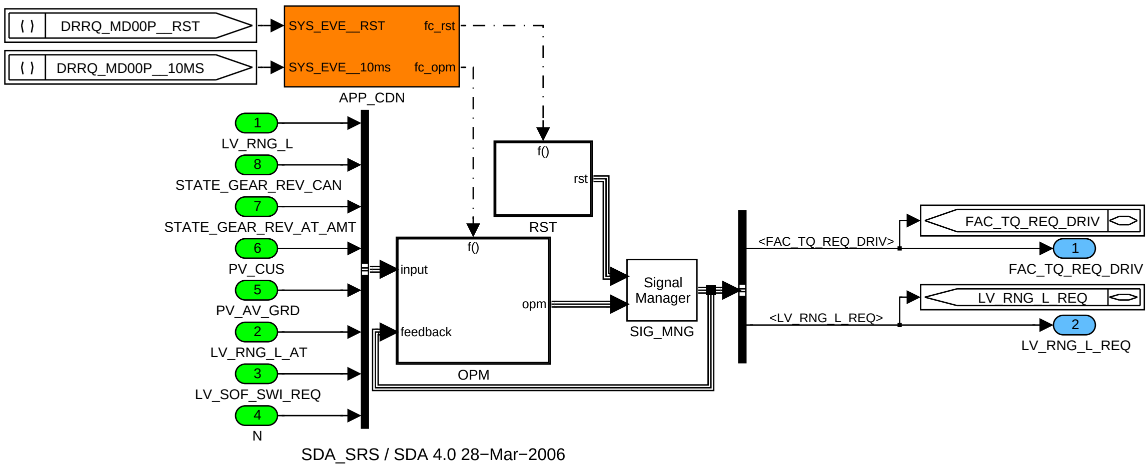

Figure D.1.2: DRRQ_MD00P

D.1.1 Initialisation

Scaling factor FAC_TQ_REQ_DRIV is initialised to 0 at reset

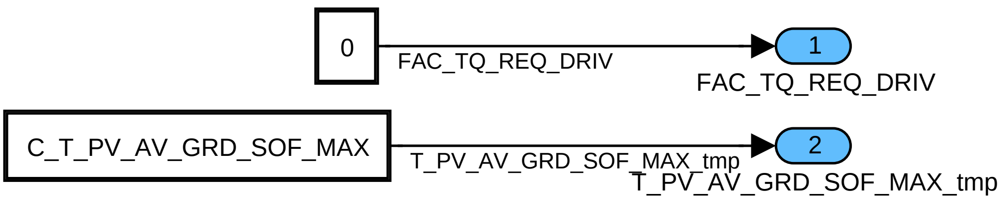

Figure D.1.3: DRRQ_MD00P/RST/INI

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D.1.2 Formula section

Gear mode detection

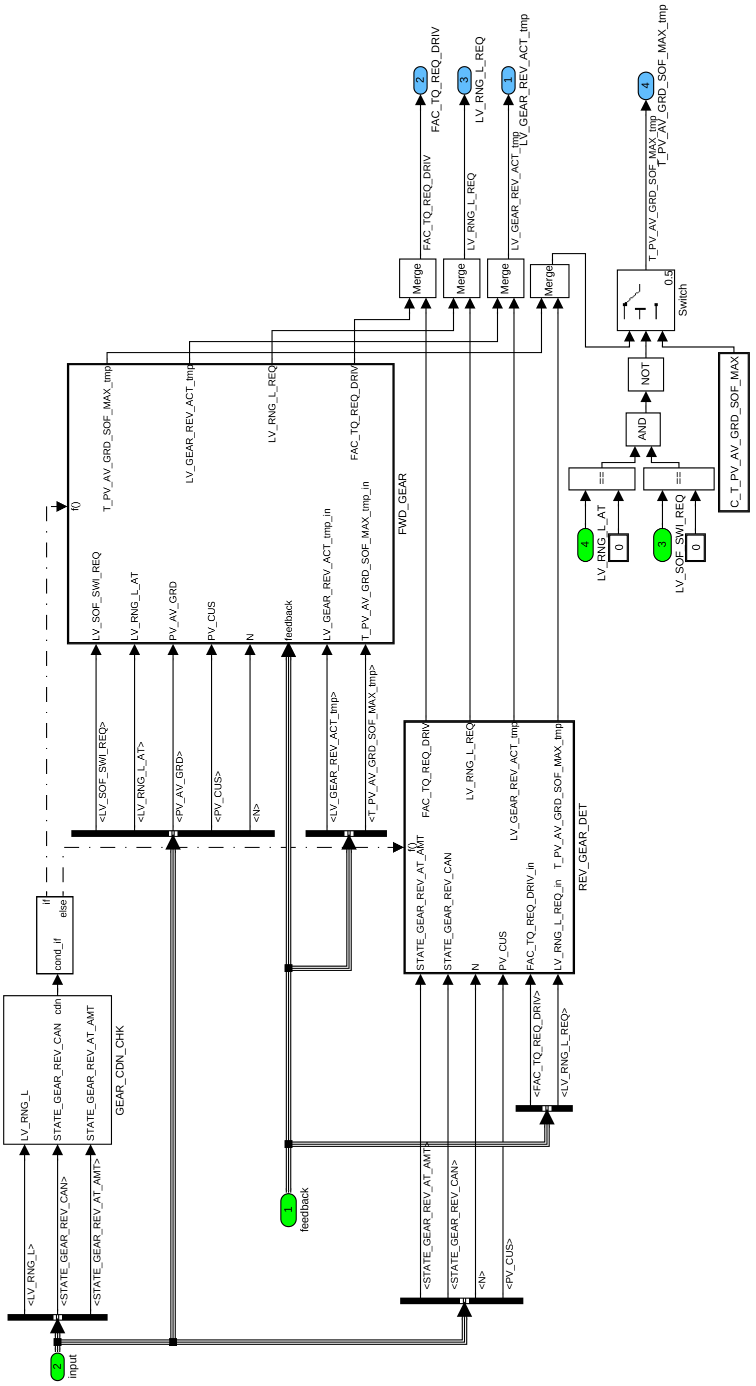

Figure D.1.4: DRRQ_MD00P/OPM/OPM_10MS

Detection of gear condition

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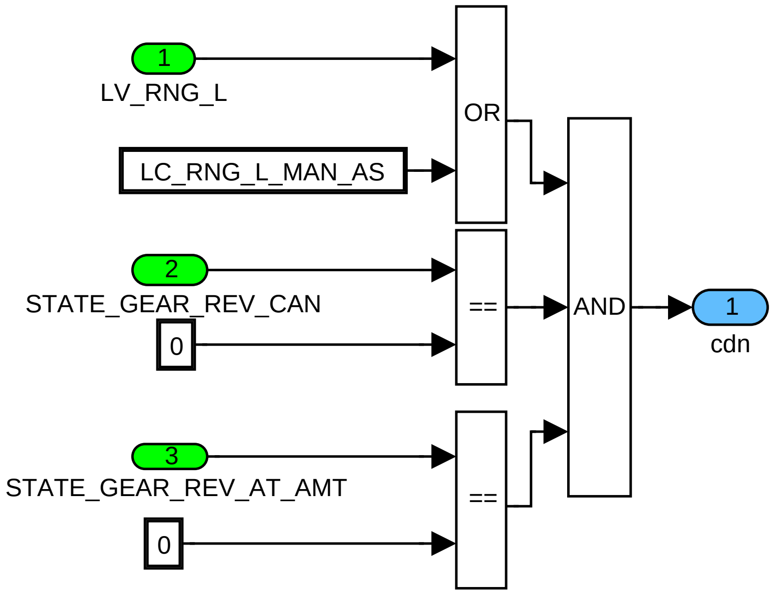

Figure D.1.5: DRRQ_MD00P/OPM/OPM_10MS/GEAR_CDN_CHK

Forward gear detection

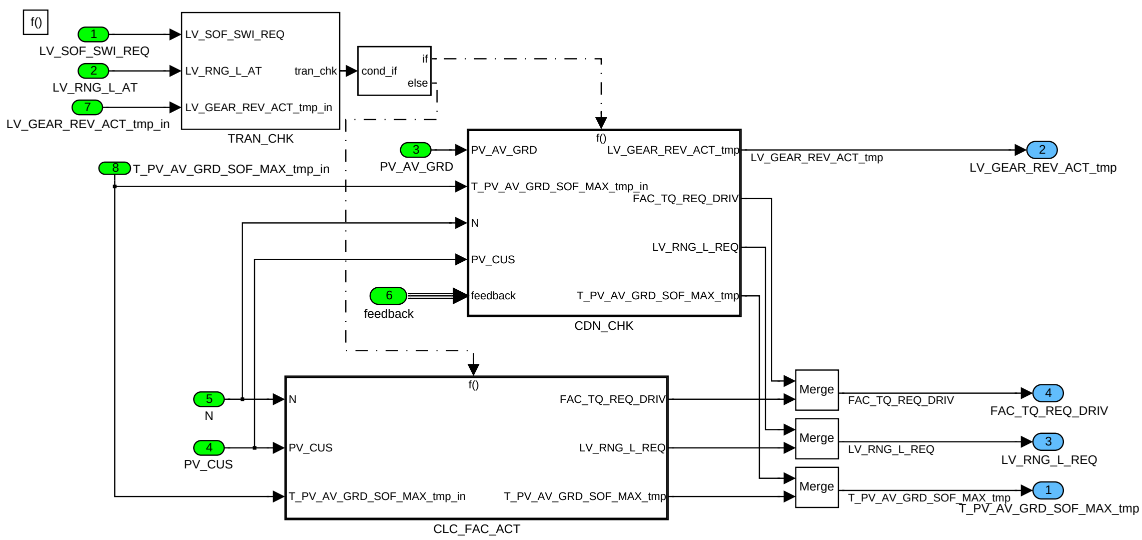

Figure D.1.6: DRRQ_MD00P/OPM/OPM_10MS/FWD_GEAR

Transition check

Transition of LV_SOF_SWI_REQ, LV_RNG_L_AT & Reverse gear to forward gear are checked.

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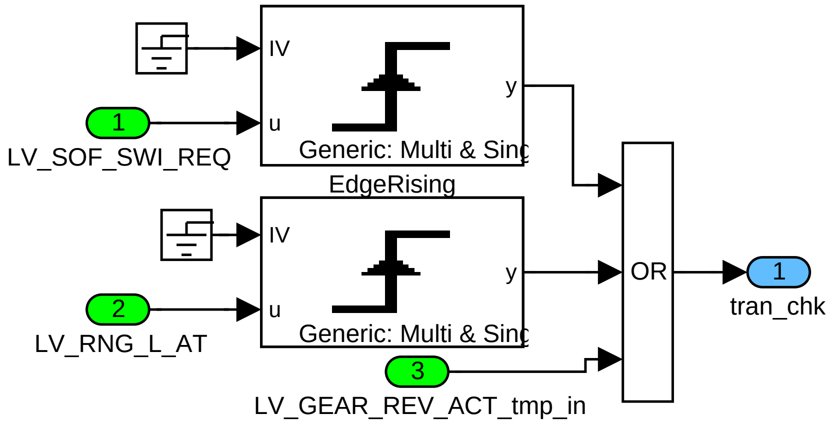

Figure D.1.7: DRRQ_MD00P/OPM/OPM_10MS/FWD_GEAR/TRAN_CHK

Formula section

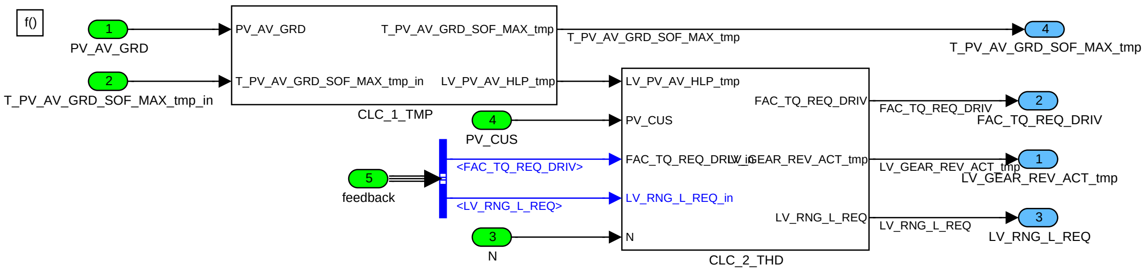

Figure D.1.8: DRRQ_MD00P/OPM/OPM_10MS/FWD_GEAR/CDN_CHK

Timer calculation

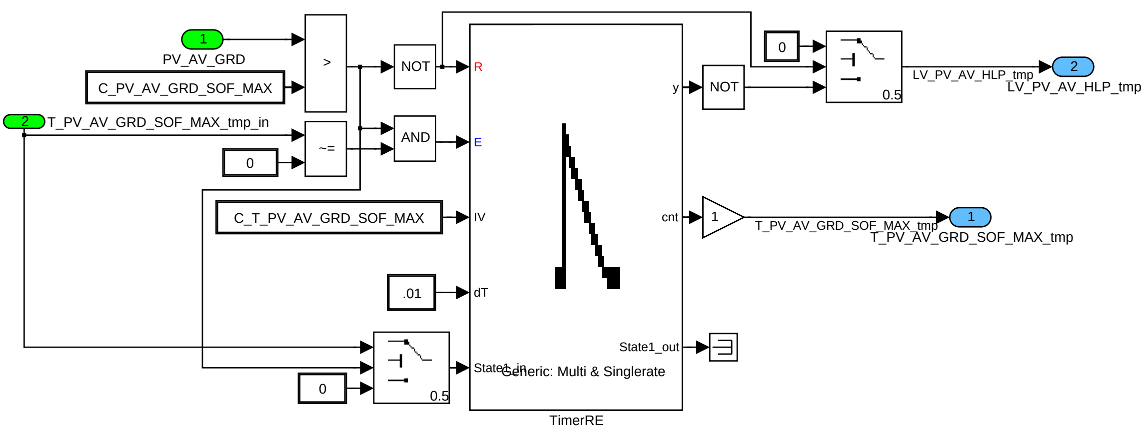

Figure D.1.9: DRRQ_MD00P/OPM/OPM_10MS/FWD_GEAR/CDN_CHK/CLC_1_TMP

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PV_CUS threshold calculation

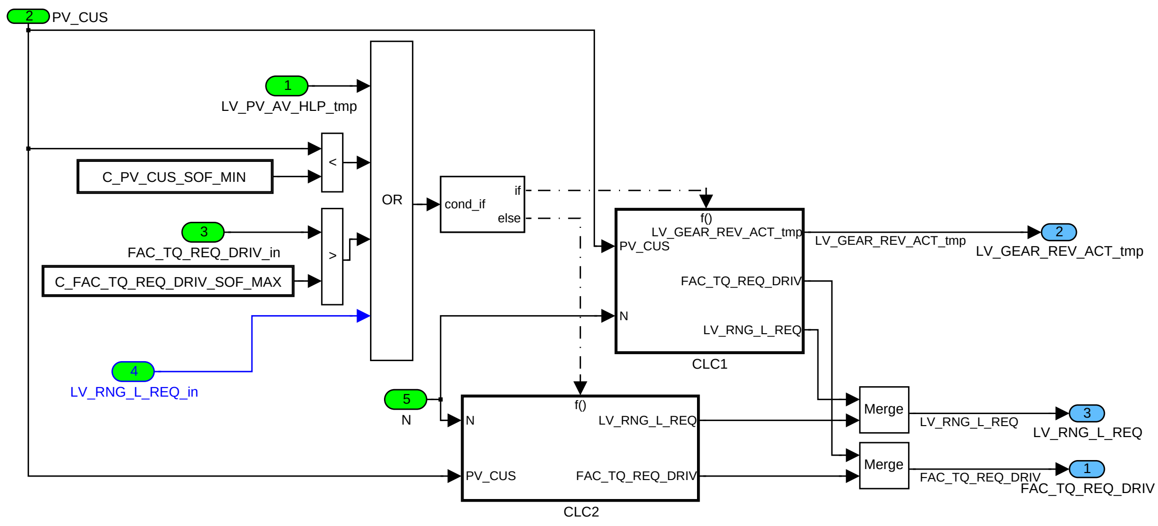

Figure D.1.10: DRRQ_MD00P/OPM/OPM_10MS/FWD_GEAR/CDN_CHK/CLC_2_THD

Calculation of scaling factor and activation condition

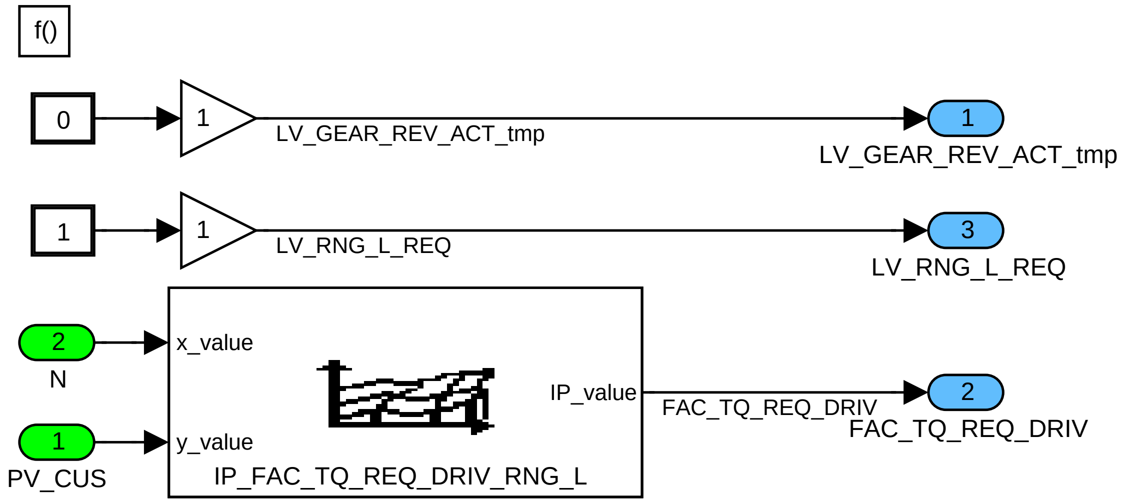

Figure D.1.11: DRRQ_MD00P/OPM/OPM_10MS/FWD_GEAR/CDN_CHK/CLC_2_THD/CLC1

Calculation of scaling factor and activation condition

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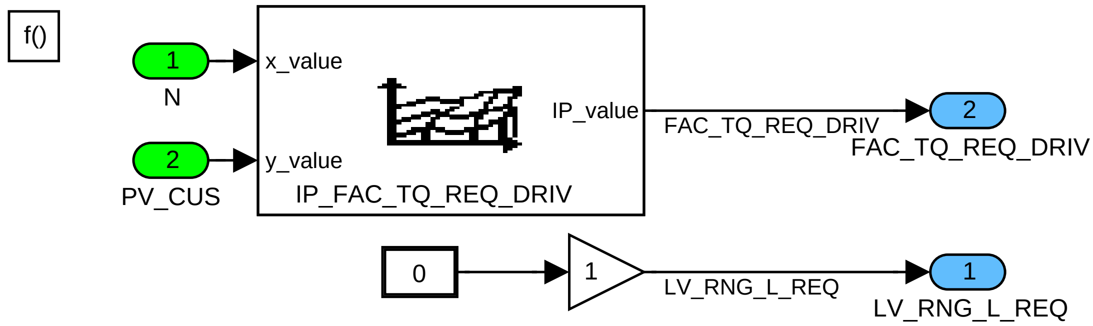

Figure D.1.12: DRRQ_MD00P/OPM/OPM_10MS/FWD_GEAR/CDN_CHK/CLC_2_THD/CLC2

Calculation of scaling factor & activation condition

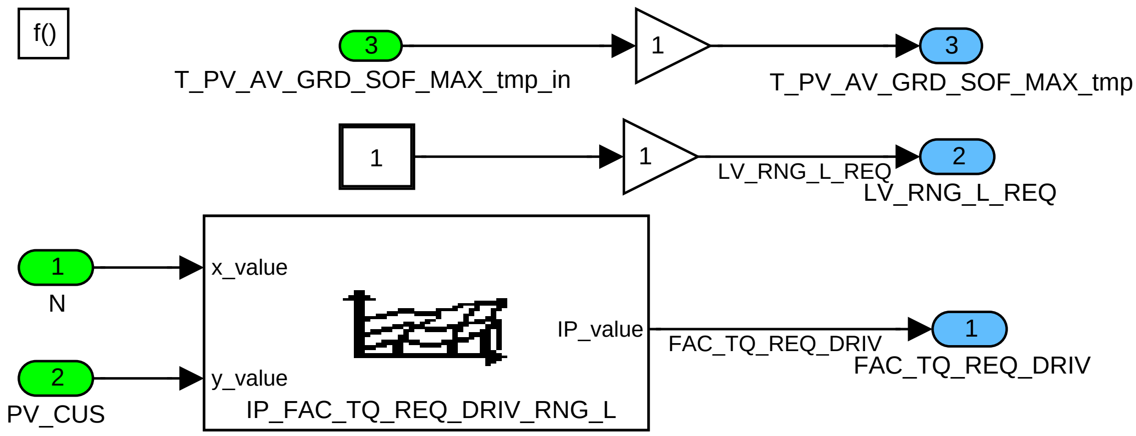

Figure D.1.13: DRRQ_MD00P/OPM/OPM_10MS/FWD_GEAR/CLC_FAC_ACT

Reverse gear detection

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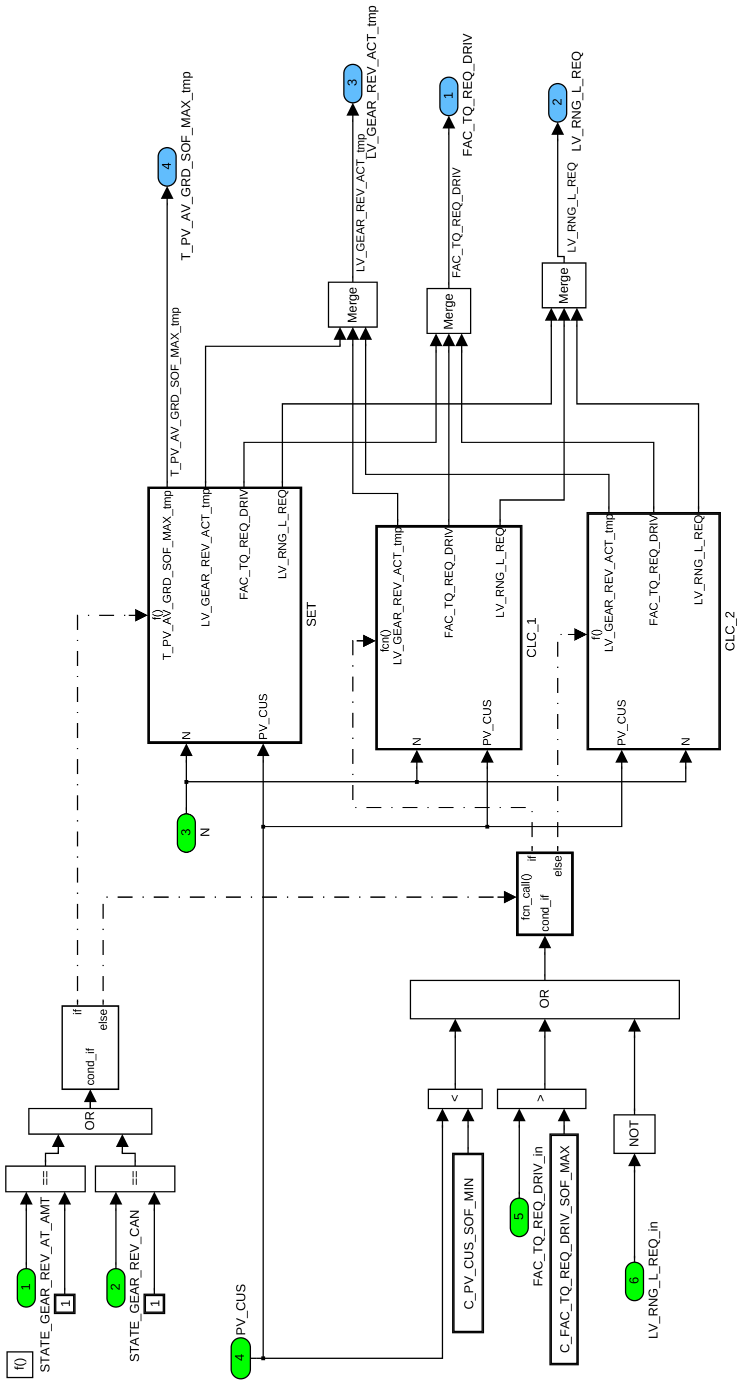

Figure D.1.14: DRRQ_MD00P/OPM/OPM_10MS/REV_GEAR_DET

Calculation of LV_GEAR_REV_ACT_tmp & T_PV_AV_GRD_SOF_MAX_tmp

Both these variables are temporary variables & used only in this module

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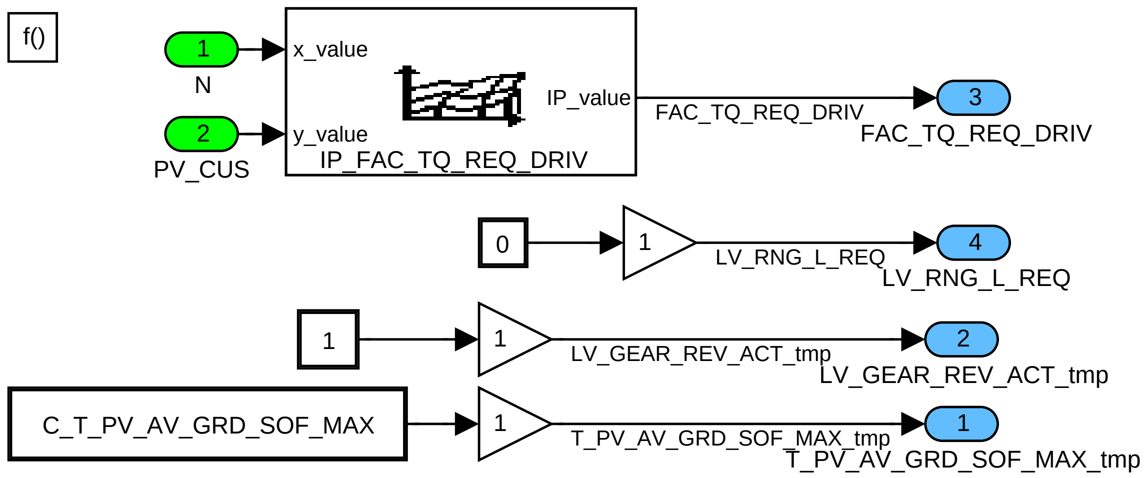

Figure D.1.15: DRRQ_MD00P/OPM/OPM_10MS/REV_GEAR_DET/SET

Calculation of scaling factor and activation condition

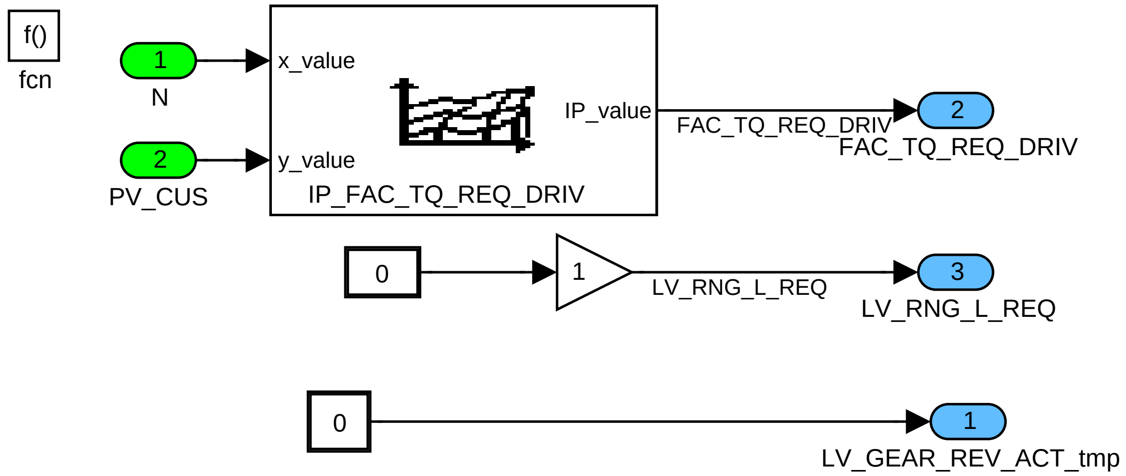

Figure D.1.16: DRRQ_MD00P/OPM/OPM_10MS/REV_GEAR_DET/CLC_1

Calculation of scaling factor and activation condition

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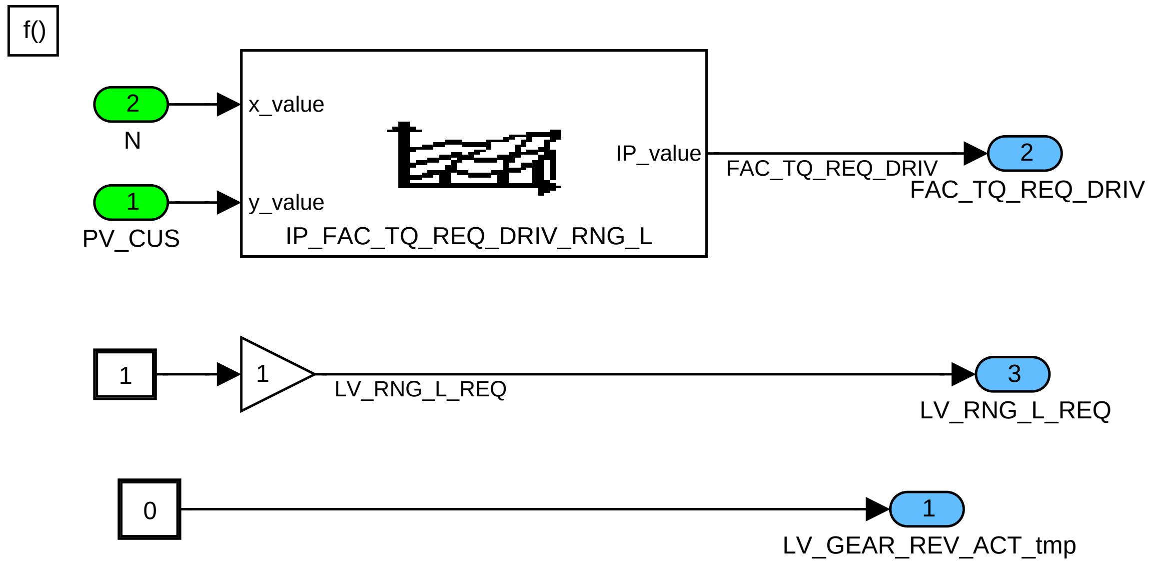

Figure D.1.17: DRRQ_MD00P/OPM/OPM_10MS/REV_GEAR_DET/CLC_2

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D.2 Torque loss electric cooling fan

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_LOSS_ECF	O/V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Torque loss of the electronic controlled cooling fan(s)					

Input data:

ECFPWM [NC_ECF_NR] {p. 3596}	LV_ES {p. 1720}	LV_IGK {p. 906}	LV_POW_CORD_INH
N {p. 1525}	NC_ECF_NR {p. 576}	STATE_ALTER {p. 8368}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LGRD_TQ_LOSS_ECF	-	0... 7FFF H	0... 1023.97	0.03125	Nm/ 100ms
ECF torque loss limitation gradient					
IP_POW_LOSS_ECF	-	0... FF H	0... -5100	20	W
LDP_ECFPWM [1]__POW_LOSS_EC]	8	0... FF H	0... 99.6	0.39	%
ECF power consumption					

FUNCTION DESCRIPTION:

General information:

TQ_LOSS_ECF represents the engine torque loss due to power consumption by the electric cooling fan (ECF).

Application conditions

Activation: *LV_IGK = 1 and LV_ES = 0*

Deactivation: -

Initialisation: TQ_LOSS_ECF = 0 Nm at reset

Recurrence: 100 ms

(see: ENTE scheduler *)*

Formula section:

Annotation:
At the MSV70 project only one electronic controlled cooling fan is available. The number of cooling fans is configured with 1 therefore. In this case the following condition is permitted:
ECFPWM[NC_ECF_NR] = ECFPWM[1] = ECFPWM_1

Calculation of the torque loss:
If **(** LV_POW_CORD_INH = 0 **and** STATE_ALTER = 0 **)** **or**
N = 0
then TQ_LOSS_ECF = 0 Nm
else TQ_LOSS_ECF = (IP_POW_LOSS_ ECF * 60) /(2 * 3.141828 * N)

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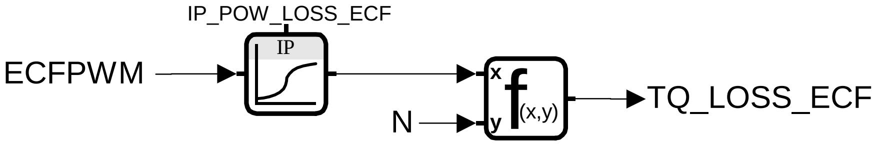
endif

The change of TQ_LOSS_ECF is limited by limitation gradient C_LGRD_TQ_LOSS_ECF

Signal flow diagram:



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D.3 Torque based catalyst heating

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_ADD_CH	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for catalyst heating					
TQ_ADD_CH_DIAG	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for catalyst heating for ignition angle efficiency monitoring					
TQ_ADD_SO2P	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve requested for desulfatisation catalyst heating					
TQ_ADD_SO2P_I	V	8000... 7FFFH	-128... 127.9961	3.90625e-3	Nm
I-share of torque reserve for desulfation catalyst heating					
TQ_ADD_SO2P_MAX	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum limit of torque reserve for desulfatisation catalyst heating					
TQ_ADD_SO2P_P	V	8000... 7FFFH	-128... 127.9961	3.90625e-3	Nm
P-share of torque reserve for desulfation catalyst heating					
TQ_ADD_SO2P_PCTL	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Precontrolled torque reserve for desulfation catalyst heating					
TQ_ADD_SO2P_RAW	V	3FFFF... C0000H	-1024 ...1024	3.90624e-3	Nm
Torque reserve for desulfation catalyst heating - in high resolution					

Input data:

AMP {p. 982}	CTR_KM_CAN {p. 1563}	FAC_CH_DIAG_EXT_ADJ_IS {p. 7482}	FAC_CH_DIAG_EXT_ADJ_PL {p. 7482}
FAC_TQ_ADD_SO2P_EXT {p. 8232}	LAMB_SP_CH [NC_CBK_EX_NR] {p. 2169}	LC_CH_DIAG_EXT_MAN {p. 6598}	LV_AT {p. 654}
LV_CH_AST_REQ_TCHA_DIAG {p. 8232}	LV_CH_DIAG_EXT_ACT {p. 6597}	LV_DRI {p. 1302}	LV_IS {p. 1720}
LV_LAMB_COP [NC_CBK_EX_NR] {p. 8233}	LV_NT_SO2P_EXT_ADJ_ACT {p. 3144}	LV_PU {p. 1720}	LV_PUC {p. 1720}
N_32 {p. 1525}	NC_CBK_EX_NR {p. 1829}	STATE_CH {p. 1777}	STATE_CH_MOD {p. 1796}
STATE_CH_MOD_REQ {p. 1796}	T_AST_COR_CH {p. 1801}	TCO_ST {p. 1100}	TEMP_CAT_DIF_CH_L {p. 1777}
TNT_DIF_CH_L {p. 1777}	TNT_DIF_CH_SO2P {p. 1813}	TQ_ADD_CH_TCHA_DIAG {p. 8233}	TQ_ADD_MAX {p. 8390}
TQI_REQ_TRA {p. 8192}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_CH_DIAG_EXT_MAN_IS	-	0... FFH	0... 1.9921875	7.8125e-3	-
Manual manipulation factor of CH torque reserve for ignition angle efficiency monitoring in IS					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_CH_DIAG_EXT_MAN_PL	-	0... FFH	0... 1.9921875	7.8125e-3	-
Manual manipulation factor of CH torque reserve for ignition angle efficiency monitoring in PL					
C_FAC_TQ_ADD_CH_L	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Difference between cat. temperatures and target temp. depending correction for TQ_ADD_CH_L					
C_FAC_TQ_ADD_SO2P_PCTL_MPLH	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
Factor to weigh the precontrolled torque reserve in case of homogen split - mode					
C_TQ_ADD_CH_HOM_MAN	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Manual setting of torque reserve for catalyst heating in homogeneous mode					
C_TQ_ADD_CH_L_HOM	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Basic torque reserve for homogenous low load catalyst heating					
C_TQ_ADD_CH_L_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for torque reserve in low load cat. heating					
C_TQ_ADD_CH_LGRD_OFF	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Gradient for decreasing TQ_ADD_CH in after start catalyst heating					
C_TQ_ADD_CH_LGRD_ON	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Gradient for increasing TQ_ADD_CH in after start catalyst heating					
C_TQ_ADD_CH_MPLH_MAN	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Manual setting of torque reserve for catalyst heating in homogeneous mode with split injection					
C_TQ_ADD_SO2P_I	-	0... FFFFH	0 ...1	15.259e-6	Nm/K
Correlation constant for the I-share of the controller					
C_TQ_ADD_SO2P_I_MAX	-	0... 7FFFH	0... 127.9961	3.90625e-3	Nm
Maximium of the I-share of the controller					
C_TQ_ADD_SO2P_MAX_EXT_ADJ	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum torque reserve for desulfation catalyst heating in case of external adjustment					
C_TQ_ADD_SO2P_P	-	0... FFFFH	0 ...2	30.518e-6	Nm/K
Correlation constant for the P-share of the controller					
C_TQ_ADD_SO2P_P_MAX	-	0... 7FFFH	0... 127.9961	3.90625e-3	Nm
Maximium of the P-share of the controller					
C_TQ_ADD_SO2P_PCTL_EXT_ADJ	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Precontrolled torque reserve for desulfation catalyst heating in case of external adjustment					
C_TQ_ADD_SO2P_RAMP_DEC	-	0... FFFFH	0... 255.99609	3.90625e-3	Nm/ 100ms
Ramp gradient for gradual decrease of the torque reserve					
C_TQ_ADD_SO2P_RAMP_INC	-	0... FFFFH	0... 255.99609	3.90625e-3	Nm/ 100ms
Ramp gradient for gradual increase of the torque reserve					
IP_FAC_TQ_ADD_CH_AMP	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDP_TCO_ST_IP_FAC_TQ_ADD_CH_AMP	8	0... FEH	-48... 142.5	0.75	°C
LDP_AMP_IP_FAC_TQ_ADD_CH_AMP	6	0... FFFFH	0... 5434	0.0829175	hPa
Reduction of torque reserve due to ambient pressure					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_TQ_ADD_CH_CTR_KM	-	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_CTR_KM_CAN_1_EXTC	4	0... FFFFH	0... 655350	10	km
Reduction of torque reserve depending on catalyst age					
IP_FAC_TQ_ADD_CH_HOM	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_T_AST_COR_CH_1_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_4_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Coolant temperature and time after start depending correction TQ_ADD_CH					
IP_FAC_TQ_ADD_CH_HOM_AT	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_T_AST_COR_CH_1_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_4_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Coolant temperature and time after start depending correction TQ_ADD_CH, for AT					
IP_FAC_TQ_ADD_CH_HOM_DRI	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_N_32_3_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_TRA_1_EXTC	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Factor on torque reserve for homogeneous catalyst heating at engaged drivetrain (only for AT relevant)					
IP_FAC_TQ_ADD_CH_L_RGN	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
LDP_LAMB_DIF_IP_TQ_ADD_CH_L	4	0... 7FFFH	-16... 15.9990234375	976.563e-6	-
Factor on TQ_ADD_CH_L depending on the split up of lambda setpoints for catalyst heating					
IP_FAC_TQ_ADD_CH_MPLH	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_T_AST_COR_CH_1_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_4_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Coolant temperature and time after start depending correction TQ_ADD_CH_HSP					
IP_FAC_TQ_ADD_CH_MPLH_AT	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_T_AST_COR_CH_1_EXTC	8	0... FFFFH	0... 6553.5	0.1	s
LDPM_TCO_ST_4_EXTC	6	0... FEH	-48... 142.5	0.75	°C
Coolant temperature and time after start depending correction TQ_ADD_CH, for AT					
IP_FAC_TQ_ADD_CH_MPLH_DRI	V	0... FFH	0... 0.99609375	3.90625e-3	-
LDPM_N_32_3_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_TRA_1_EXTC	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Factor on torque increase for catalyst heating at homogeneous split injection at engaged drivetrain (only for AT relevant)					
IP_TQ_ADD_CH_HOM	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32_3_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_TRA_1_EXTC	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Basic torque reserve for homogeneous catalyst heating					
IP_TQ_ADD_CH_HOM_AT	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32_3_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_TRA_1_EXTC	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Basic torque reserve for homogeneous catalyst heating with automatic transmission					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TQ_ADD_CH_HOM_IS	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32_5_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_TRA_2_EXTC	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Basic torque reserve for homogeneous catalyst heating in idle speed					
IP_TQ_ADD_CH_L_HOM_IS	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_TQ_ADD_CH_L_IS	6	0... FFH	0... 8160	32	rpm
LDP_TQI_REQ_IP_TQ_ADD_CH_L_IS	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque reserve for low load catalyst heating in idle speed					
IP_TQ_ADD_CH_MPLH	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32_3_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_TRA_1_EXTC	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Basic torque increase for catalyst heating at homogeneous split injection					
IP_TQ_ADD_CH_MPLH_AT	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32_3_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_TRA_1_EXTC	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Basic torque increase for catalyst heating at homogeneous split injection with automatic transmission					
IP_TQ_ADD_CH_MPLH_IS	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32_5_EXTC	6	0... FFH	0... 8160	32	rpm
LDPM_TQI_REQ_TRA_2_EXTC	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Basic torque increase for catalyst heating for homogeneous split					
IP_TQ_ADD_SO2P_MAX	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_TQ_SO2P_MAX	6	0... FFH	0... 8160	32	rpm
LDP_TQI_REQ_TRA_IP_TQ_SO2P_MAX	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum torque reserve for desulfation catalyst heating					
IP_TQ_ADD_SO2P_PCTL	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_TQ_SO2P_PCTL	6	0... FFH	0... 8160	32	rpm
LDP_TQI_REQ_TRA_IP_TQ_SO2P_PCTL	6	0... 7FFFH	0... 1023.96875	0.03125	Nm
Precontrolled torque reserve for desulfation catalyst heating					
LC_TQ_ADD_CH_HOM_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of torque reserve for catalyst heating in homogeneous mode					
LC_TQ_ADD_CH_MPLH_MAN_ACT	-	0... 1H	0 ...1	1	-
Activation of manual setting of torque reserve for catalyst heating in homogeneous mode, split injection					

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General information:

This module concerns the calculation of a torque reserve which causes an ignition angle retardation and so exhaust gas temperature increase.

There are three functional parts: Cat. heating after (cold-) start, low load and for desulfation.

Signal flow diagram:

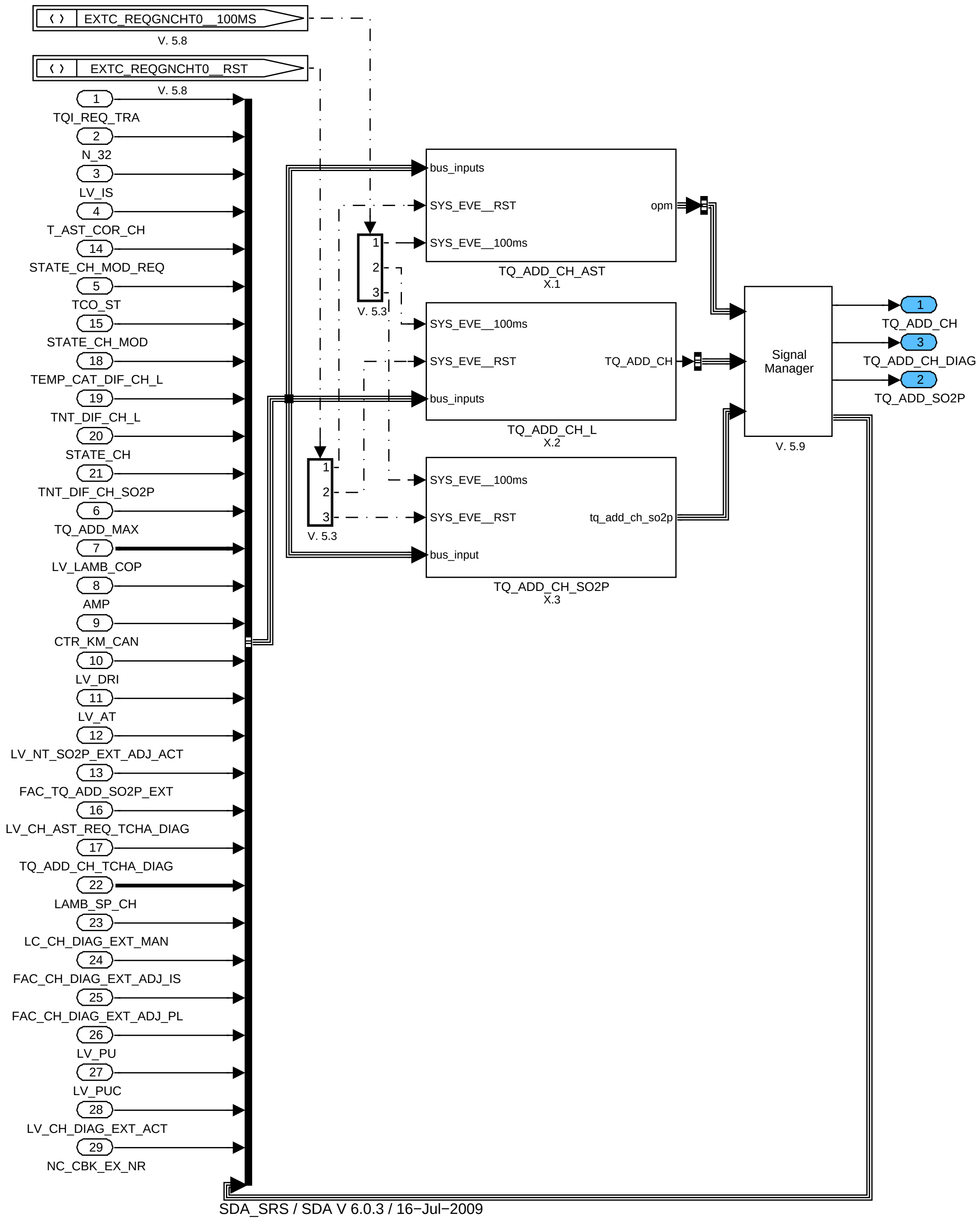

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Figure D.3.1: :

D.3.1 Catalyst heating after start

General information:

There are several setpoints for single and multiple injection. The output is ramped via a difference limiter.

Application conditions:

Initialisation:	`RST`
Recurrence:	`100MS`
Activation:	`STATE_CH == 1`
Deactivation:	`(STATE_CH==0 && TQ_ADD_CH==0) || STATE_CH>1`

Function description:

Formula section:

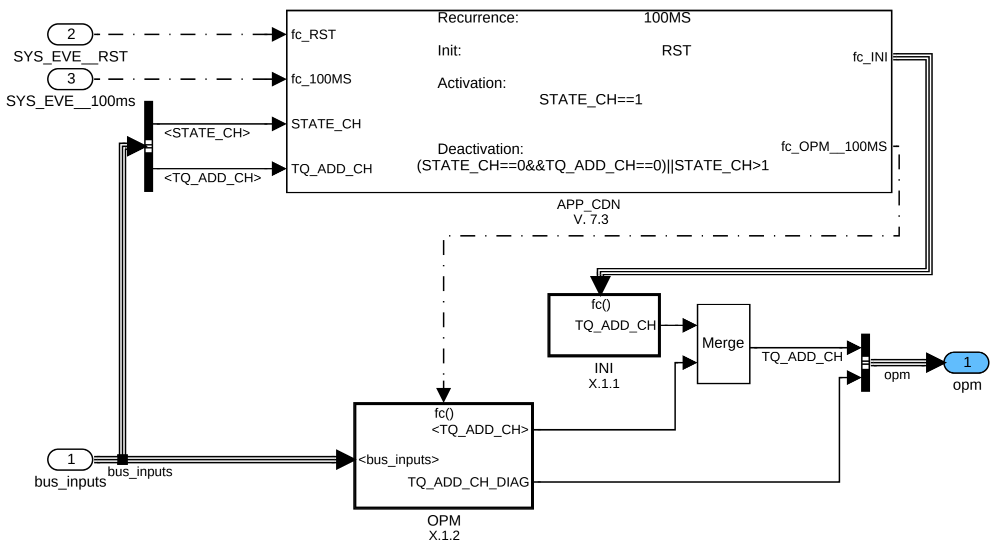

Figure D.3.2: :

D.3.1.1 Initialisation

The output variable TQ_ADD_CH is set to 0.

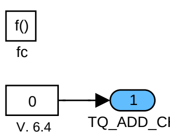

Figure D.3.3: :

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D.3.1.2 Subsystem of OPM for Torque catalyst heating

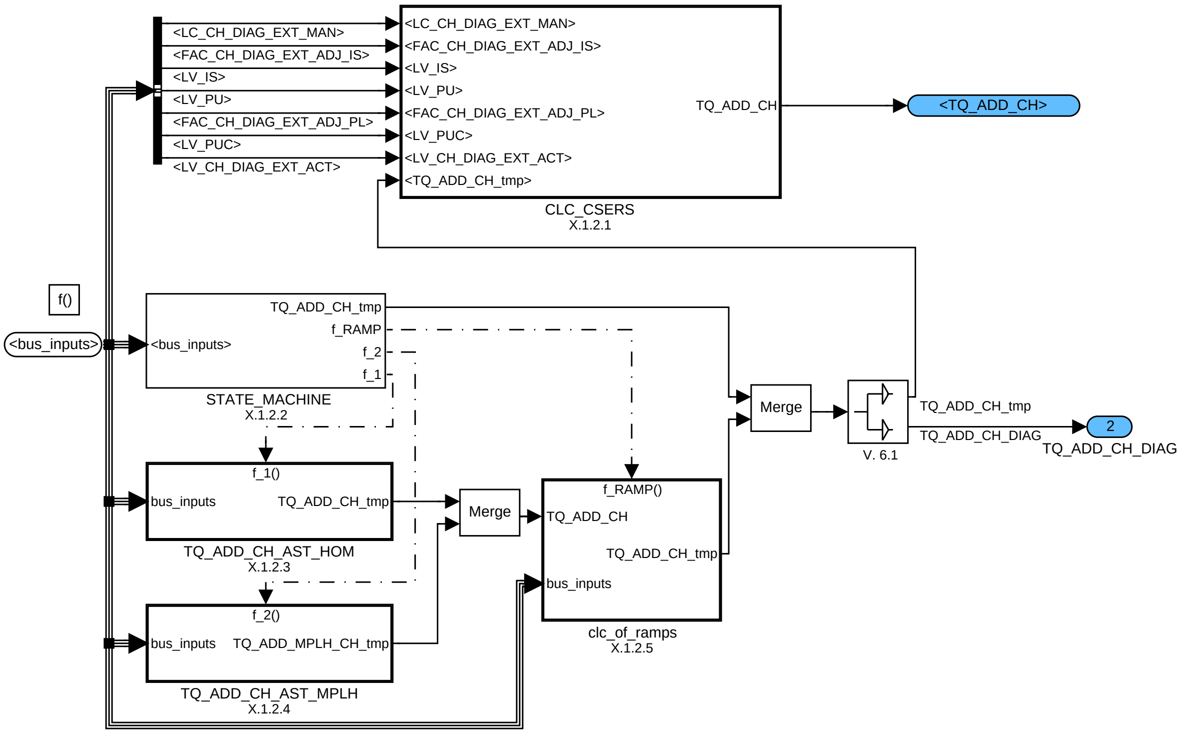

Figure D.3.4: :

D.3.1.2.1 CSERS implementation

Legal requirement concerning OBD-II system LH3.1.

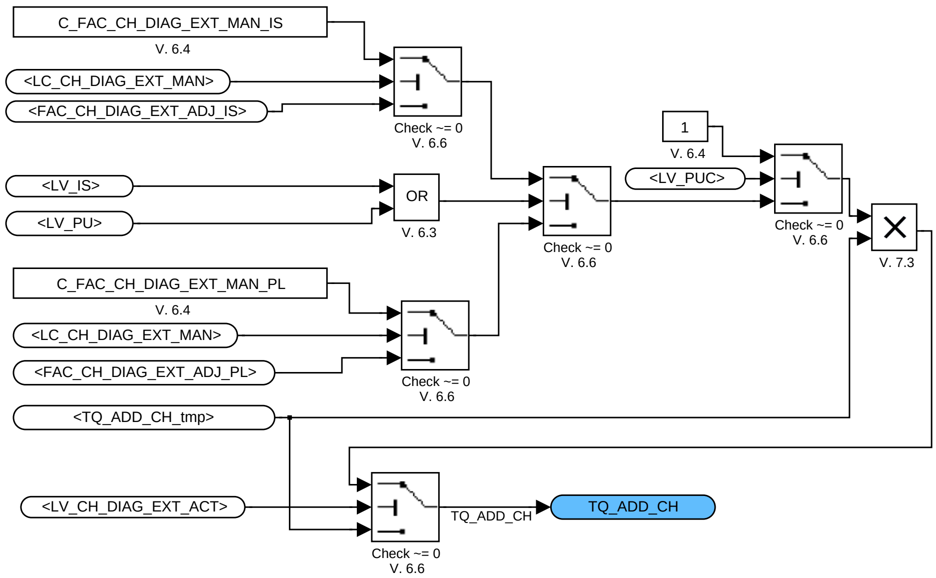

Figure D.3.5: :

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D.3.1.2.2 Subsystem STATE_MACHINE

D.3.1.2.2.1 STATE_MACHINE_CHART

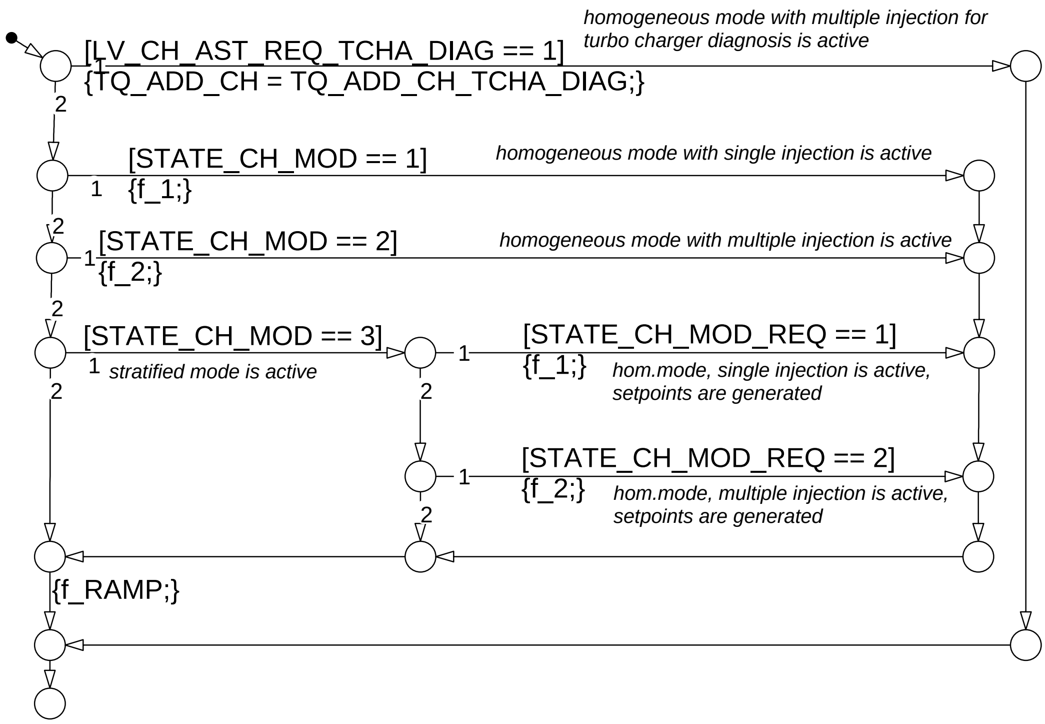

Figure D.3.6: :

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D.3.1.2.3 Homogenous mode, single injection

D.3.1.2.3.1 Homogenous mode, single injection - Subsystem

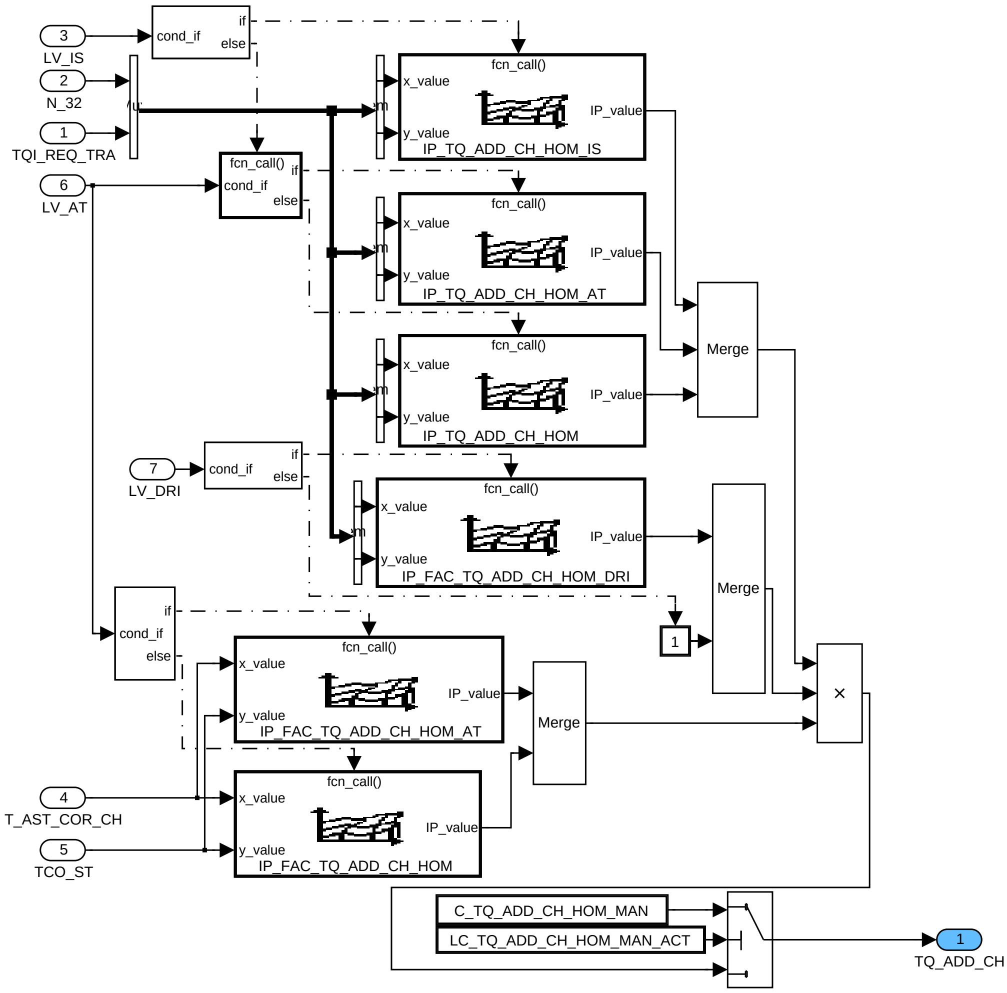

Figure D.3.7: :

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D.3.1.2.4 Homogenous mode, multiple injection

D.3.1.2.4.1 Homogenous mode, multiple injection - Subsystem

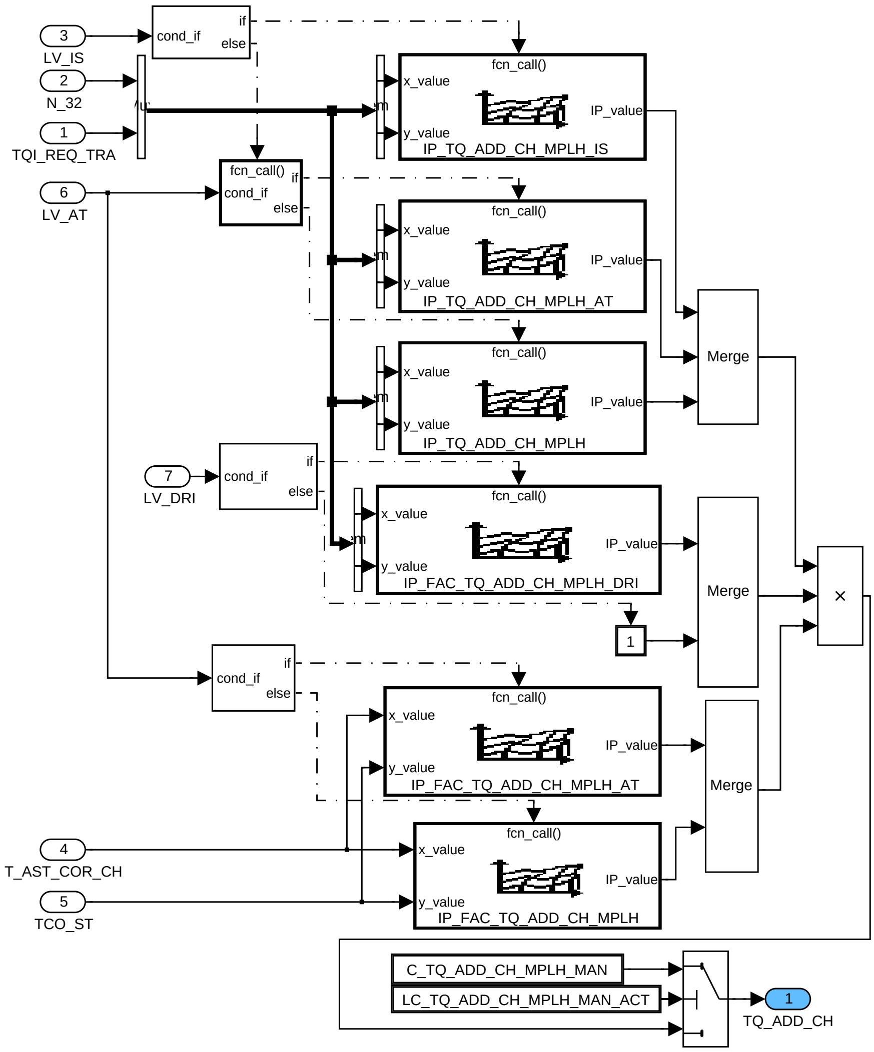

Figure D.3.8: :

D.3.1.2.5 Ramp-function

D.3.1.2.5.1 Ramp-function - Subsystem

With IP_FAC_TQ_ADD_CH_AMP the torque reserve can be reduced with decreasing ambient pressure and so increasing elevation. The resulting torque reserve is filtered by a difference limiter.

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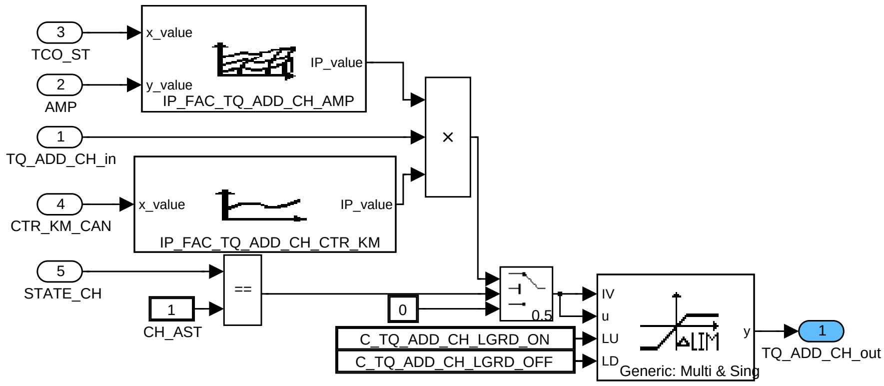

Figure D.3.9: :

D.3.2 Catalyst heating in low load

General information:

In low load catalyst heating there is no homogeneous mode with split injection.

Application conditions:

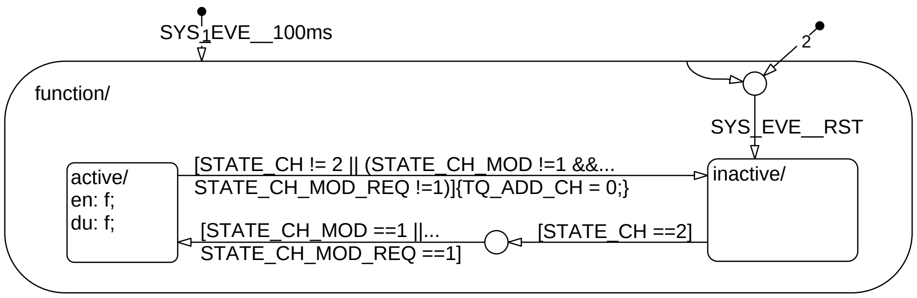

Figure D.3.10: :

Function description:

Formula section:

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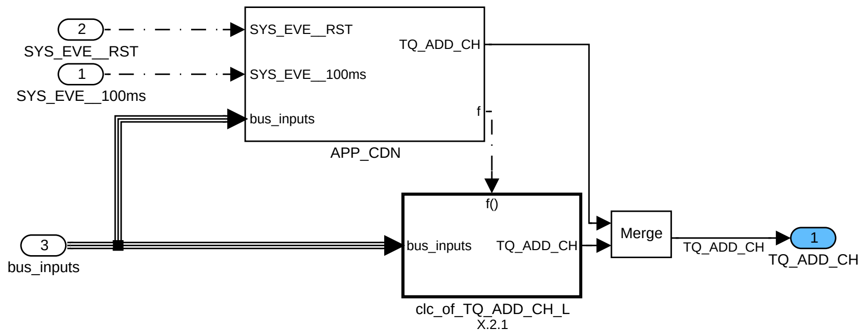

Figure D.3.11: :

D.3.2.1 Torque reserve at low load catalyst heating

D.3.2.1.1 Torque reserve at low load catalyst heating - Subsystem

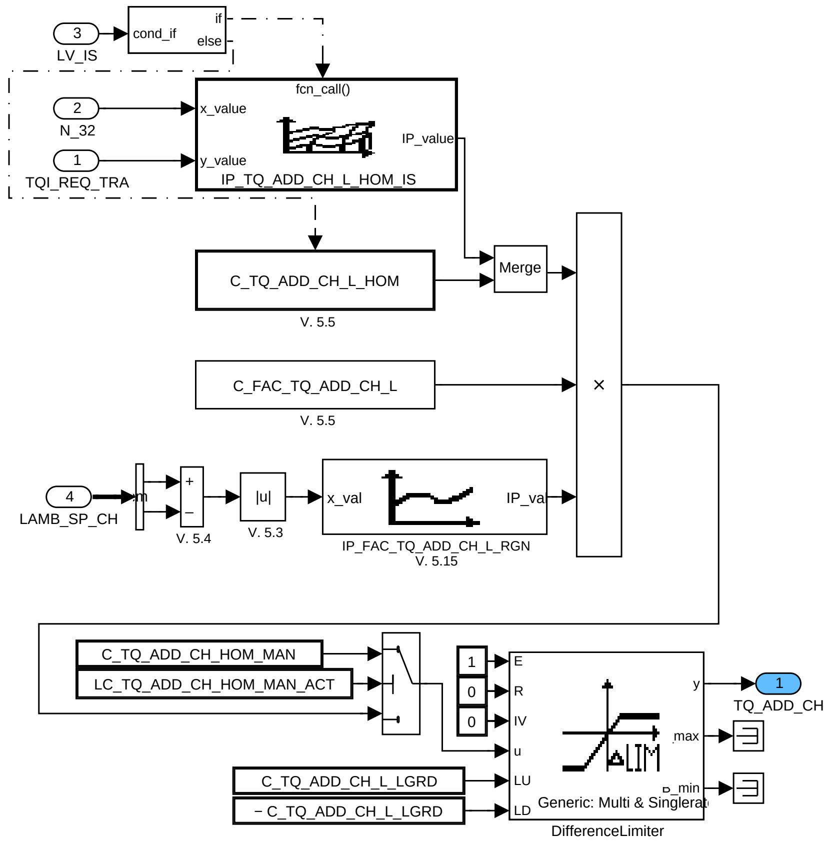

Figure D.3.12: :

D.3.3 Catalyst heating for desulfation

General information:

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TQ_ADD_CH is set by a controller, which controls the lowest NOx-trap temperature. Therefore TNT_DIF_CH_SO2P is the difference between the temperature setpoint for desulfation and the actual temperature (set in "Catalyst heating for desulfation strategy"). It is negative if temperature is too low.

Application conditions:

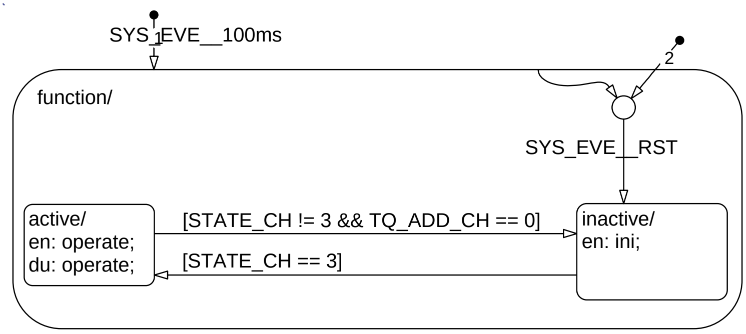

Figure D.3.13: :

Function description:

Formula section:

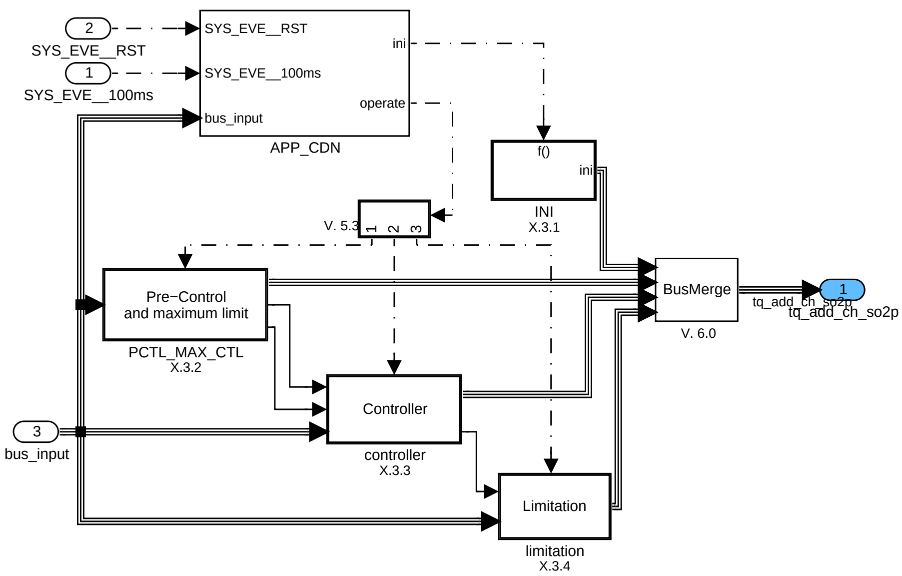

Figure D.3.14: :

D.3.3.1 Initialisation

The values are set to 0 at reset and once at function deactivation.

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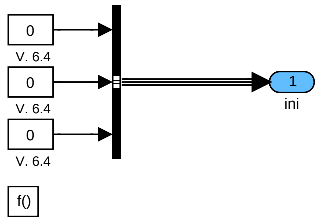

Figure D.3.15: :

D.3.3.2 Precontrol and maximum limit

D.3.3.2.1 Precontrol and maximum limit - Subsystem

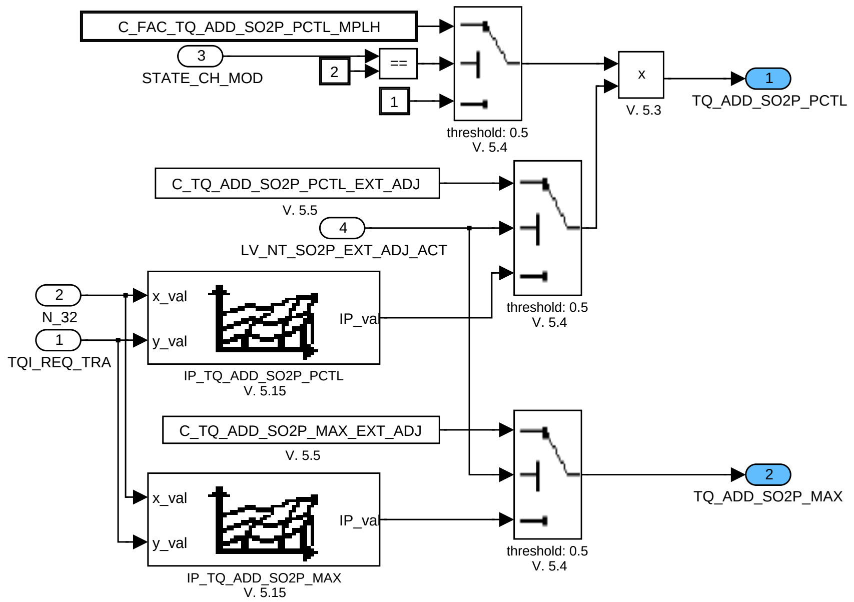

Figure D.3.16: :

D.3.3.3 Controller of NOx-trap temperature

D.3.3.3.1 Controller of NOx-trap temperature - Subsystem

The controller consists of an integral and a proportional part (PI-controller). The I-part is frozen if the overall controller output exceeds the maximum available torque reserve TQ_ADD_MAX or the map-value.

The pre-controlled value for TQ_ADD_SO2P is added to the PI-controller output.

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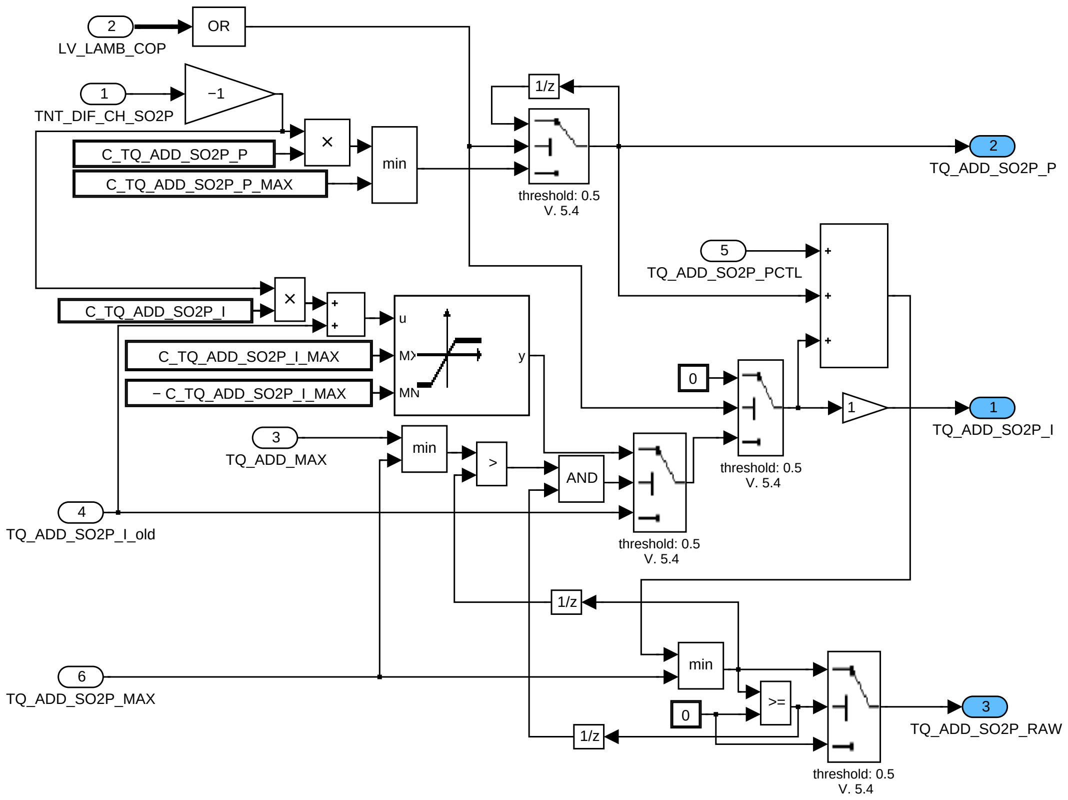

Figure D.3.17: :

D.3.3.4 Limitation

D.3.3.4.1 Limitation - Subsystem

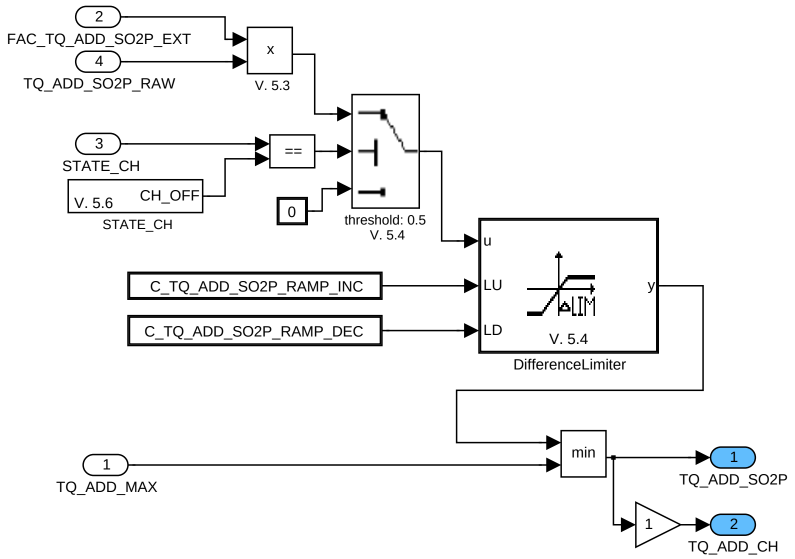

Figure D.3.18: :

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D.4 Torque based catalyst heating (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_IGA_CST_LIM	V	0... FFFFH	0... 1.99996	30.5e-6	-
Limited ignition angle efficiency for torque limitation during catalyst heating					
LV_CH_DIAG_EXT_ACT	O/V	0... 1H	0 ...1	1	-
Status bit for ignition angle efficiency monitoring - demo-mode active					
TQ_ADD_MIN_CH	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Minimum torque reserve for catalyst heating					

Input data:

EFF_IGA_CST_LIM_EXT_ADJ {p. 7482}	EFF_IGA_CST_QUO_IS {p. 6493}	EFF_IGA_CST_QUO_PL {p. 6493}	EFF_IGA_SP_CH {p. 6493}
EFF_TOT_WOUT_IGA {p. 981}	IP_INT_EFF_IGA_SP_CH_QUO_IS_MAX {p. 6495}	IP_INT_EFF_IGA_SP_CH_QUO_PL_MAX {p. 6495}	LV_CDN_DIAG_EFF_IGA_CST_IS {p. 6517}
LV_CDN_DIAG_EFF_IGA_CST_PL {p. 6517}	LV_CH_DIAG_EXT_REQ {p. 7482}	LV_IS {p. 1720}	LV_PU {p. 1720}
LV_PUC {p. 1720}	STATE_CH {p. 1777}	TCO_ST {p. 1100}	TQ_ADD_CH {p. 6582}
TQI_BAS {p. 6661}	TQI_REF {p. 8380}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EFF_IGA_CST_LIM_EXT_MAN	-	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Manual adjusted efficiency limitation during demo-mode					
C_FAC_TQ_ADD_MIN_CH	-	0... FFH	0... 0.99609375	3.90625e-3	-
Factor on TQ_ADD_CH for limitation					
C_TQ_ADD_MIN_CH_CST_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for TQ_ADD_MIN_CH for cold start monitoring					
C_TQ_ADD_MIN_CH_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for TQ_ADD_MIN_CH					
IP_INT_QUO_EFF_IGA_CST_IS	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
LDPM_EFF_IP_INT_QUO_EFF_IGA_CST	6	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Cold start diagnosis efficiency limitation in idle speed					
IP_INT_QUO_EFF_IGA_CST_PL	-	0... FFFFH	0... 0.99998474121	15.2588e-6	-
LDPM_EFF_IP_INT_QUO_EFF_IGA_CST	6	0... FFFFH	0... 1.99996948242	30.5176e-6	-
Cold start diagnosis efficiency limitation in part load					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_CH_DIAG_EXT_ENA	-	0... 1H	0 ...1	1	-
Enable efficiency limitation and CH torque reserve manipulation by external device					
LC_CH_DIAG_EXT_MAN	-	0... 1H	0 ...1	1	-
Manual switch to start ignition angle efficiency monitoring - demo-mode					
LC_EFF_IGA_CST_LIM_ENA	-	0... 1H	0 ...1	1	-
Global enable bit of ignition angle efficiency limitation during coldstart					

General information:

This module provides project specific functions related to the torque request for catalyst heating.

Application conditions:

Initialisation: `RST, Deactivation`
Recurrence: `100MS`
Activation: `STATE_CH==1`
Deactivation: `STATE_CH==0`

Function description:

Formula section:

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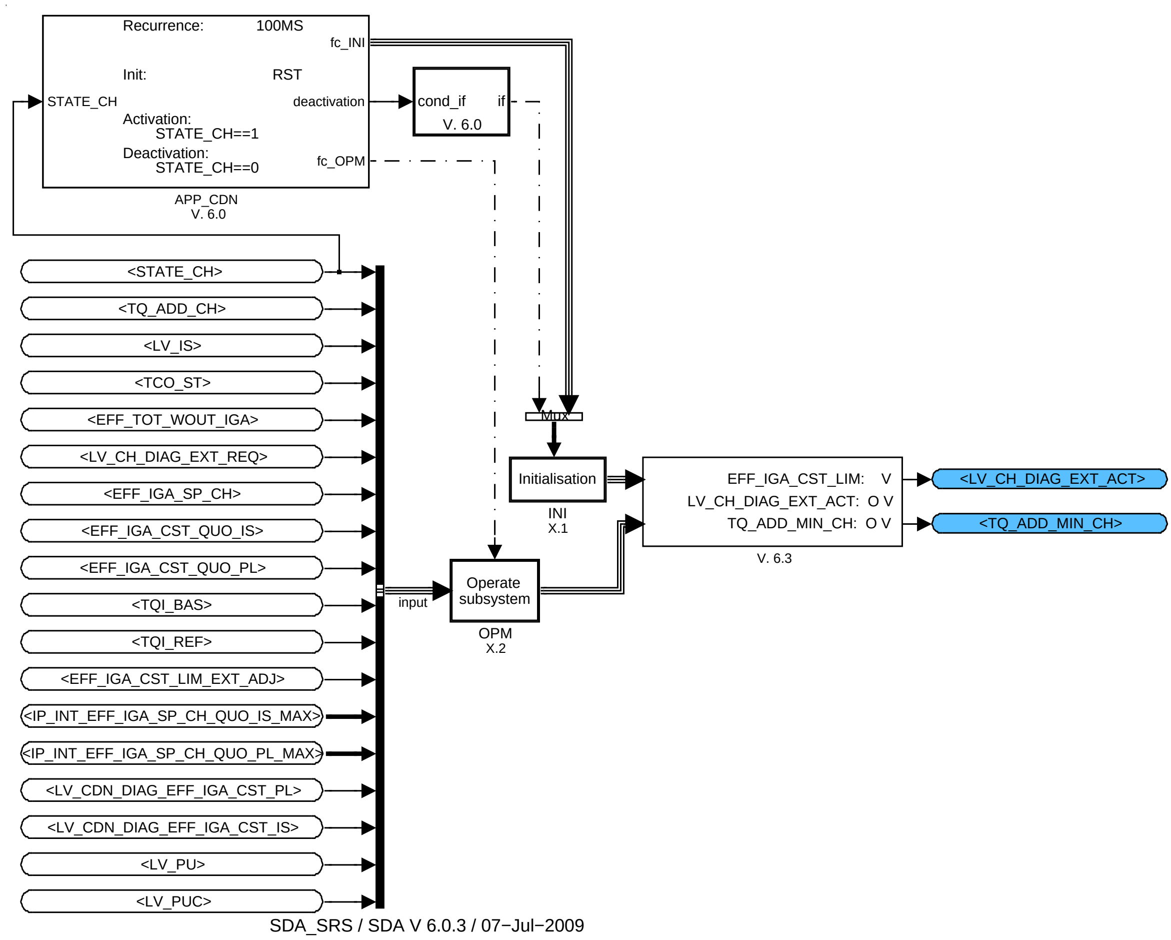

Figure D.4.1: :

D.4.1 INI

D.4.1.1 INI

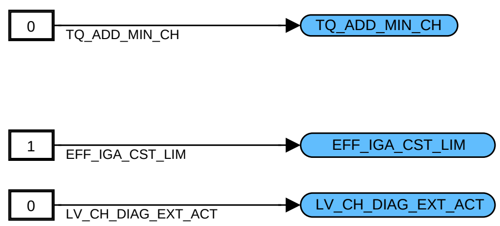

Figure D.4.2: :

D.4.2 OPM

D.4.2.1 Ignition angle efficiency limitation for CSERS

Due to requirements of the Cold Start Emission Reduction Strategy (CSERS), the applied torque request on ignition path (TQI_SP) is limited via the interface TQ_ADD_MIN_CH to ensure the requested torque reserve for catalyst heating under all circumstances. Therefore a limited ignition angle efficiency is

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calculated in this module based on the diagnosed deviation integral delivered from the "Ignition angle efficiency monitoring" diagnosis.

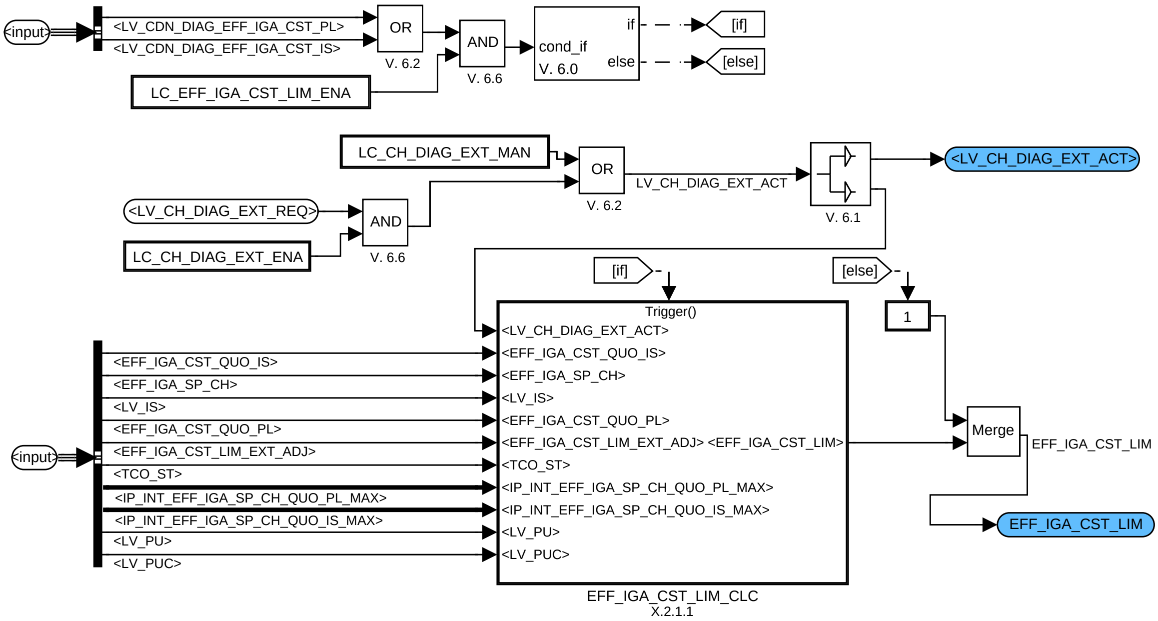

Figure D.4.3: :

D.4.2.1.1 Calculation of EFF_IGA_CST_LIM

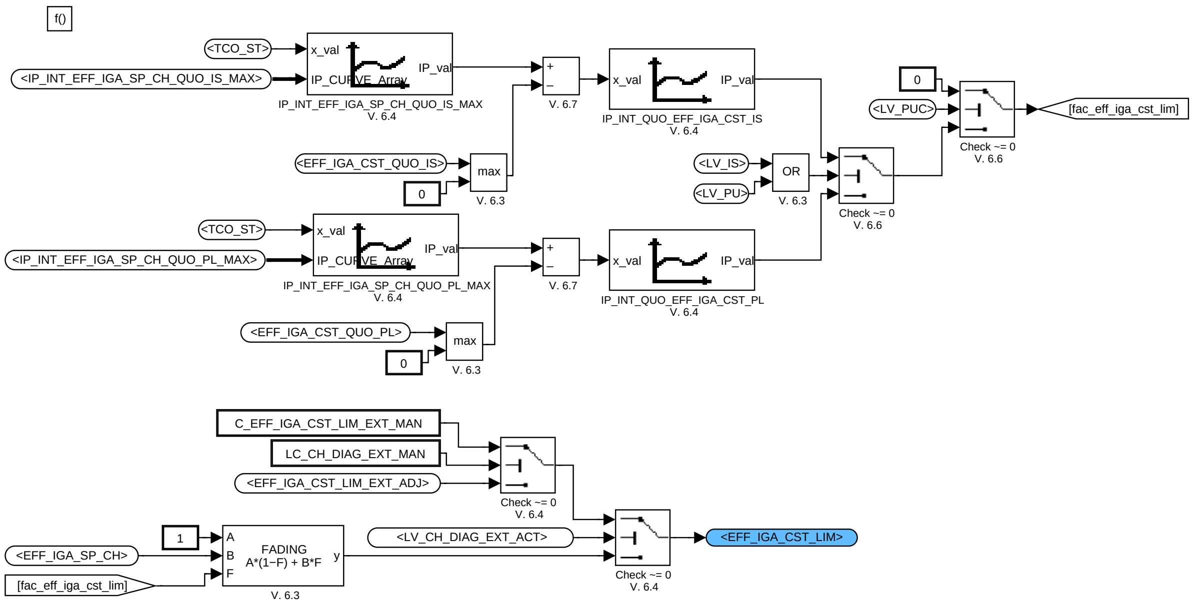

Figure D.4.4: :

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D.4.2.2 Calculation of minimum torque reserve for catalyst heating

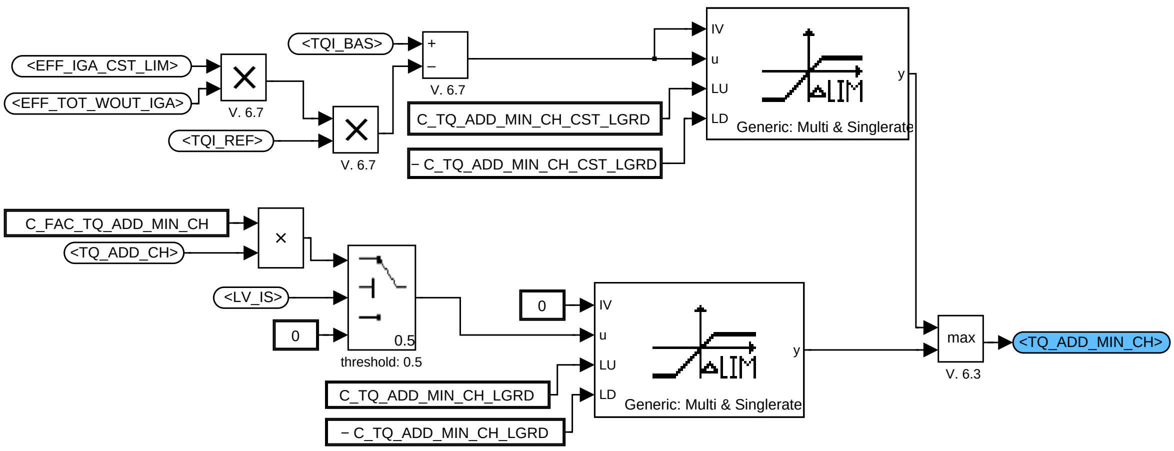

Figure D.4.5: :

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D.5 Torque loss and reserve for air conditioning compressor

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_SP_N_PSTE	O/V	0... FFH	0... 1.9921875	7.8125e-3	-
Factor of engine speed relative to setpoint					
LV_REQ_HEAT_ACC_ENA	O/V	0... 1H	0 ...1	1	-
LV indicating that the conditions for additional heating are fulfilled					
LV_TOUT_REQ_HEAT_ACC	O/V	0... 1H	0 ...1	1	-
logical variable to start deactivation of torque reserve TQ_ADD_HEAT_ACC					
T_REQ_HEAT_ACC	O/V	0... FFFFFFFFH	0... 42949672.95	0.01	s
Timer for duration of torque reserve TQ_ADD_HEAT_ACC calculation					
TQ_ADD_ACC	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for switching on air conditioning compressor					
TQ_ADD_HEAT_ACC	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for switching on additional heating by ACC					
TQ_LOSS_ACC	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque losses air conditioning compressor					
TQ_LOSS_ACC_INP	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
ACC torque loss due to engine-speed and ACC torque demand					

Input data:

LV_ACCOUT_RLY {p. 3589}	LV_ACCOUT_RLY_ENA {p. 3589}	LV_REQ_HEAT {p. 1567}	LV_TOUT_ACC {p. 3589}
N {p. 1525}	N_32 {p. 1525}	N_SP_IS {p. 1122}	T_ACC {p. 3589}
TAM {p. 1579}	TCO {p. 1100}	TQ_ACCIN_CAN {p. 1580}	TQ_DIF_IS_AD_ACC {p. 3518}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_TQ_LOSS_ACC_INP	-	0... FFH	0... 0.99609375	3.90625e-3	-
Correlation Factor for tQ_ACCIN_CAN calculation					
C_N_SP_IS_PSTE	-	0... FFH	0... 8160	32	rpm
Idle speed setpoint power steering, only for FAC_SP_N_PSTE calculation					
C_T_REQ_HEAT_ACC	-	0... FFFFFFFFH	0... 42949672.95	0.01	s
time for duration of torque reserve TQ_ADD_HEAT_ACC calculation					
C_TAM_MIN_REQ_HEAT_ACC	-	0... FEH	-48... 142.5	0.75	°C
TAM threshold for enabling additional heat request					
C_TCO_MIN_REQ_HEAT_ACC	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold for enabling additional heat request					
C_TQ_ADD_ACC_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for TQ_ADD_ACC decrease after deactivation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQ_ADD_ACC_LGRD_ON	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for TQ_ADD_ACC increase at activation					
C_TQ_ADD_HEAT_ACC_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for TQ_ADD_HEAT_ACC decrease after deactivation					
C_TQ_LOSS_MAX_ACC	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum TQ_LOSS_ACC					
IP_FAC_TQ_LOSS_ACC_OFF	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDPM_T_ACC__FAC_TQ_LOSS_ACC	8	0... FFFFH	0... 655.35	0.01	s
TQ_LOSS_ACC weighting factor at ACC deactivation					
IP_FAC_TQ_LOSS_ACC_ON	V	0... FFH	0... 1.9921875	7.8125e-3	-
LDPM_T_ACC__FAC_TQ_LOSS_ACC_ON	8	0... FFFFH	0... 655.35	0.01	s
LDP_FAC_SP_N_PSTE_IP_FAC_TQ	8	0... FFH	0... 1.9921875	7.8125e-3	-
TQ_LOSS_ACC weighting factor for A/C compressor clutch time behavior at activation					
IP_TQ_ADD_ACC	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32__TQ_ADD_ACC	6	0... FFH	0... 8160	32	rpm
LDP_TQ_LOSS_ACC_INP__TQ_ADD_ACC	6	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for switching on air conditioning compressor depending on expected A/C torque loss					
IP_TQ_ADD_HEAT_ACC	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32__TQ_ADD_HEAT_ACC	6	0... FFH	0... 8160	32	rpm
Torque reserve for switching on additional heating					
IP_TQ_LOSS_ACC_INP	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32__TQ_LOSS_ACC	6	0... FFH	0... 8160	32	rpm
LDP_TQ_ACCIN_CAN__TQ_LOSS_ACC	6	0... FFH	0... 127.5	0.5	Nm
ACC torque loss due to engine-speed and ACC torque demand					
LC_FAC_SP_N_PSTE_SWI	-	0... 1H	0 ...1	1	-
LC to switch between use of N_SP_IS or C_N_SP_IS_PSTE(1:N_SP_IS)					

General Information

Application Conditions

Initialization: RST
Recurrence: 10MS
Activation: always
Deactivation: never

Function description

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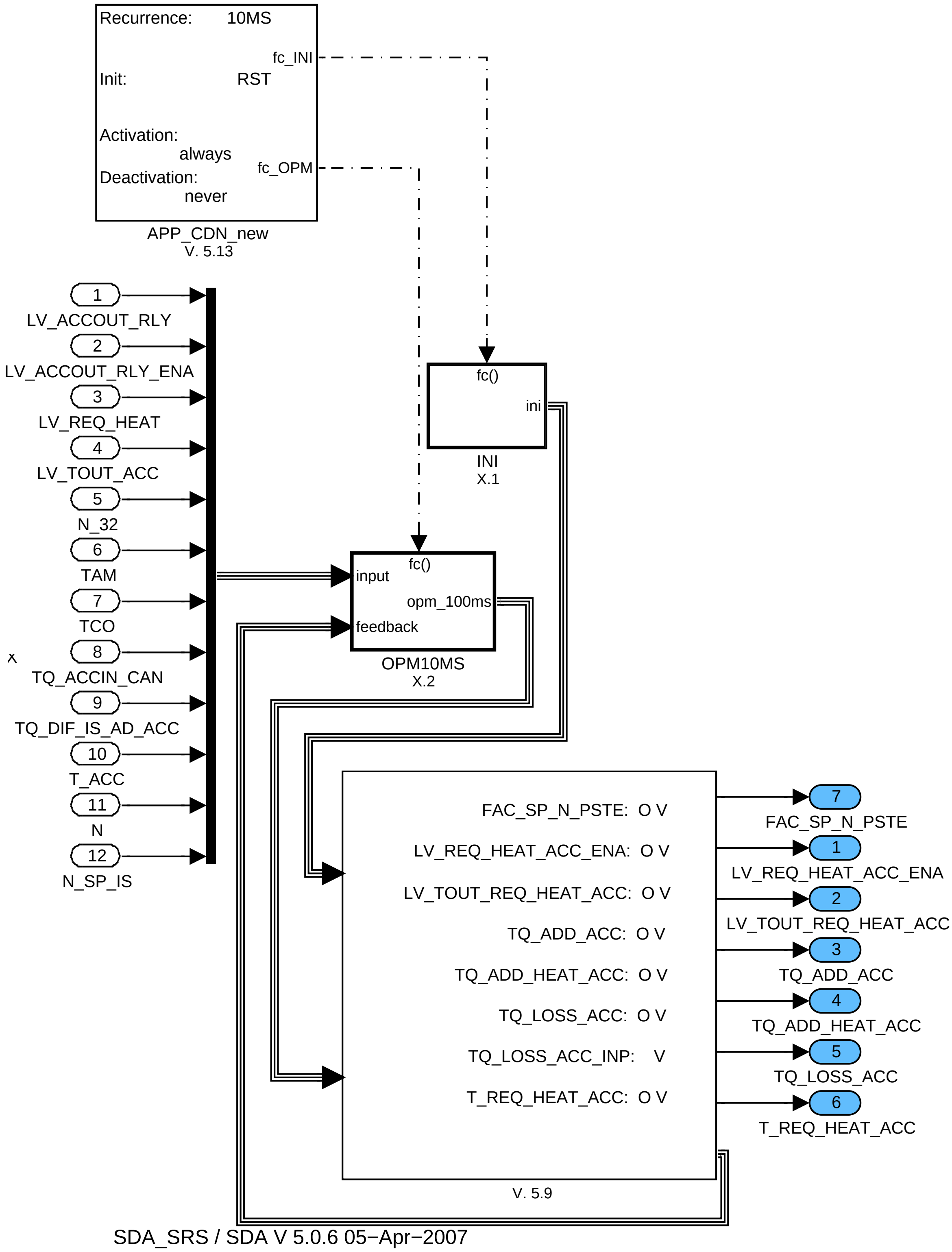

Figure D.5.1: :

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D.5.1 Initialisation

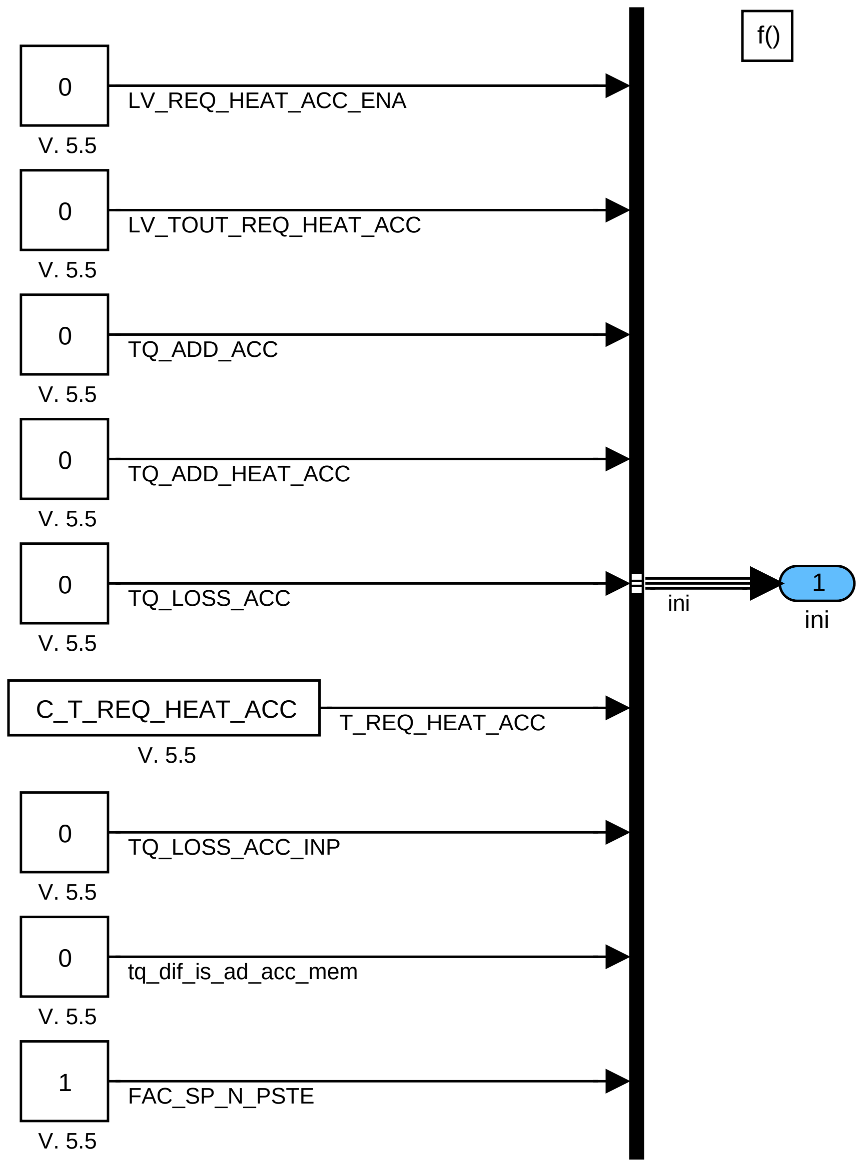

Figure D.5.2: :

D.5.2 Calculation of torque loss and reserve for Air conditioning compressor:

1.Determination of torque loss ACC
2.Determination of torque reserve for ACC
2.1 Determination of torque reserve ACC
2.2 Detemination of REQ_HEAT by ACC

D.5.2.1 Determination of Torque Loss ACC

FUNCTION DESCRIPTION:
The calculation of TQ_LOSS_ACC starts already at transition LV_ACCOUT_RLY_ENA =

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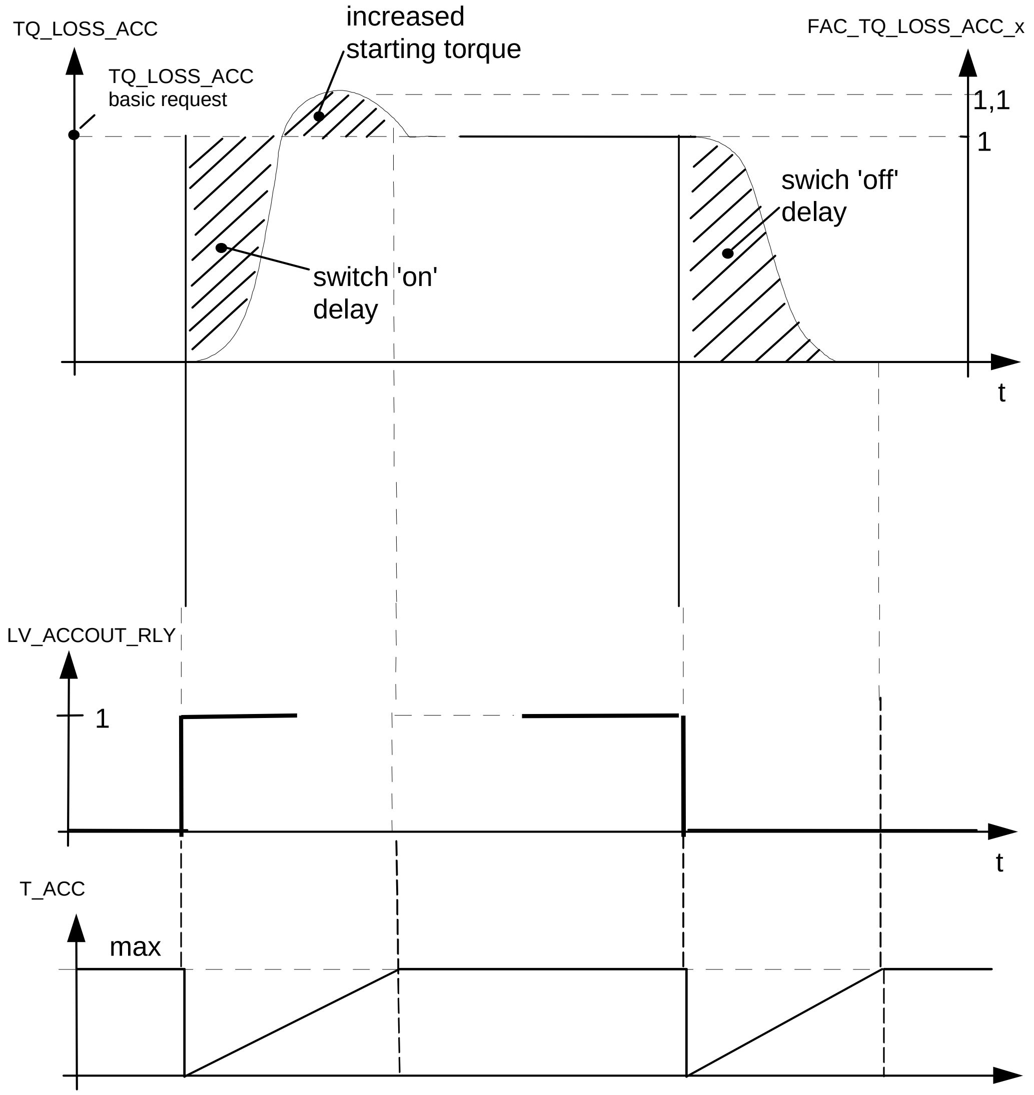
0 - -> 1. The adaptation value TQ_DIF_IS_AD_ACC, determined in the module "idle speed adaptation", is added to the A/C compressor torque TQ_LOSS_ACC_INP which depends on ACC-torque from CAN and on engine speed (N_32).
The A/C-compressor is switched ON and OFF using an electro-magnetic clutch. If the clutch is closing the starting torque overshoots the torque calculated for steady state conditions (basic request) due to the inertia of compressor, which has to be accelerated. This overshoot is taken into account by the weighting factor IP_FAC_TQ_LOSS_ACC_ON depending on time T_ACC and by relative engine speed due to dynamic torque loss depending on target compressor speed (engine speed). The transient correction for clutch switching ON is always active as long as LV_ACCOUT_RLY_ENA = 1. So IP_FAC_TQ_LOSS_ACC_ON has to be 1 at steady state conditions are reached, at latest at T_ACC = 2.55s. At opening clutch the time delay until A/C compressor torque loss has reached 0 Nm is pre-controlled by IP_FAC_TQ_LOSS_ACC_OFF depending on T_ACC. The transient correction for clutch switching OFF is always active as long as LV_ACCOUT_RLY_ENA = 0. So IP_FAC_TQ_LOSS_ACC_OFF has to be 0 at latest at T_ACC = 2.55s.
Signal flow diagram:



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D.5.2.1.1 Calculation of ACC torque loss due to engine speed and ACC torque demand

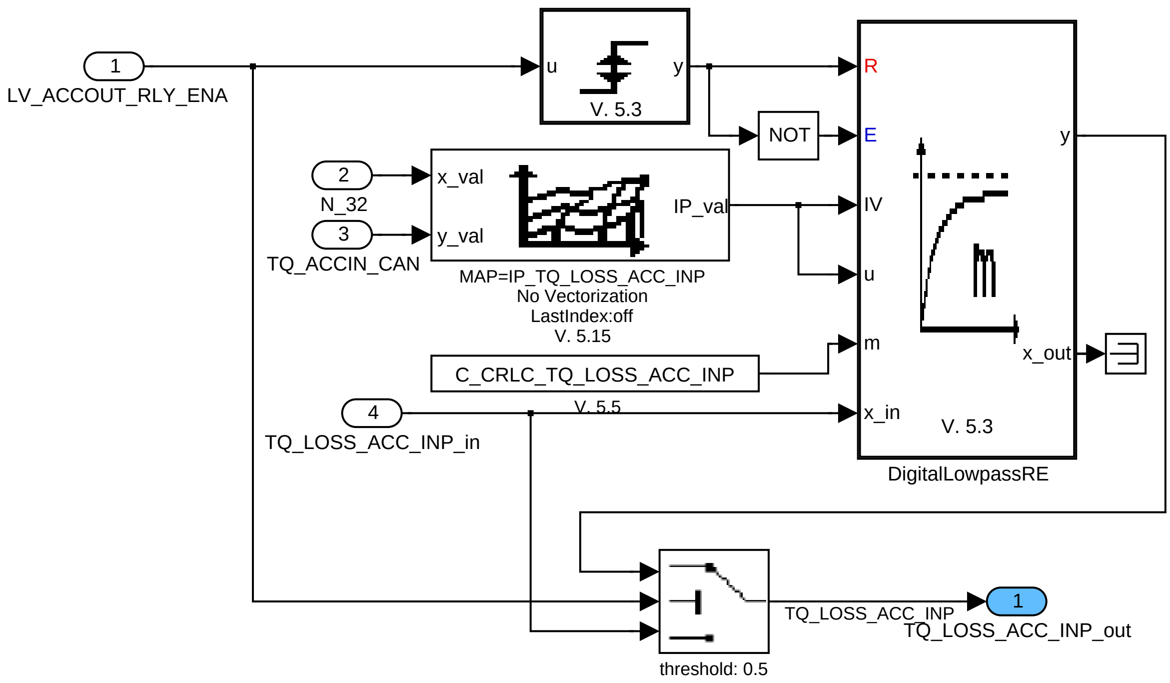

Figure D.5.3: :

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D.5.2.1.2 Calculation of torque loss of air conditioning compressor

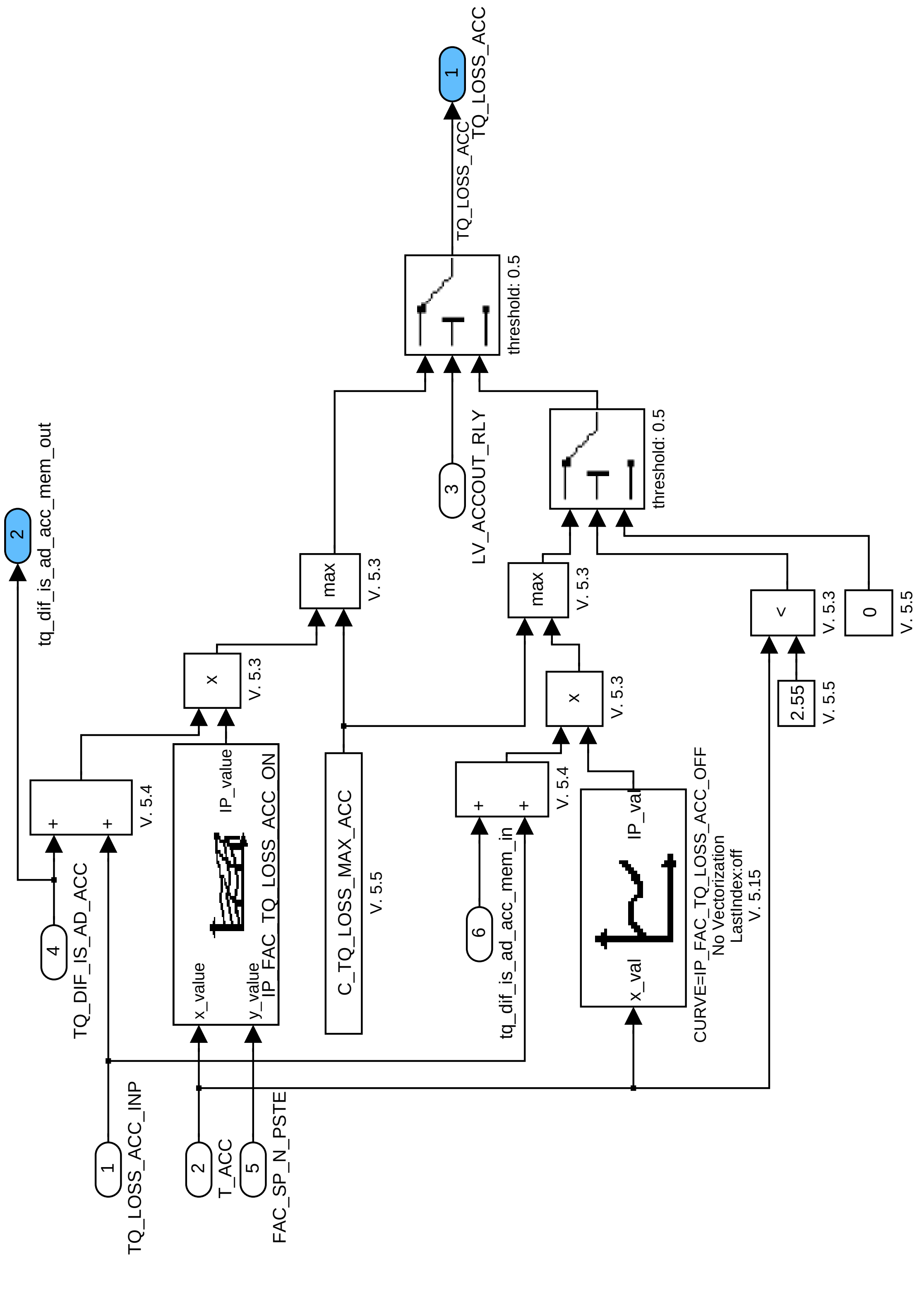

Figure D.5.4: :

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D.5.2.1.3 Calculation of factor of engine speed relative to setpoint

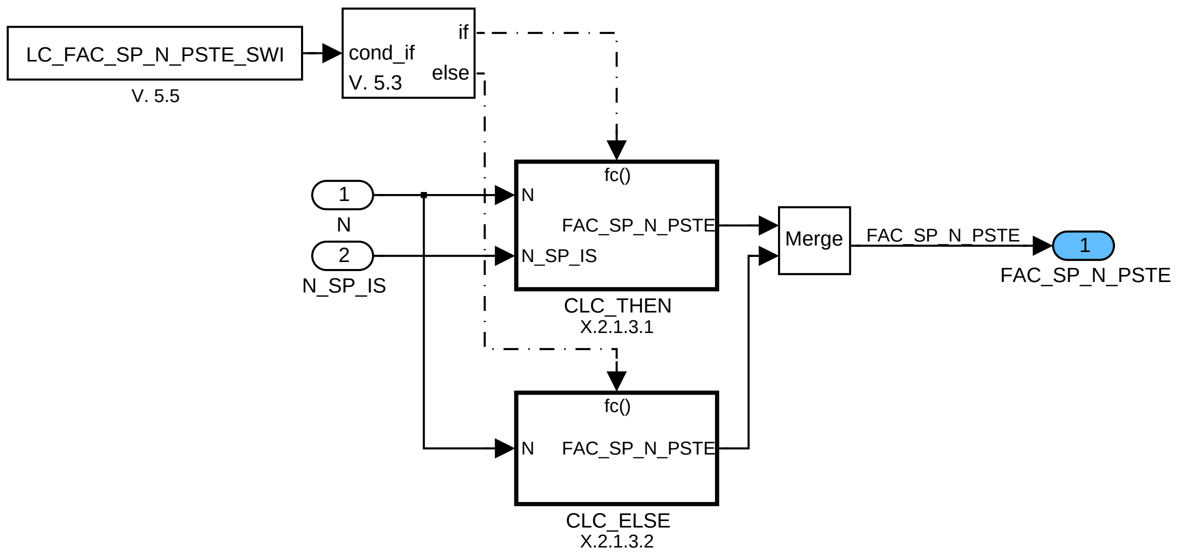

Figure D.5.5: :

D.5.2.1.3.1 Calculate FAC_N_SP_PSTE based on idle speed setpoint

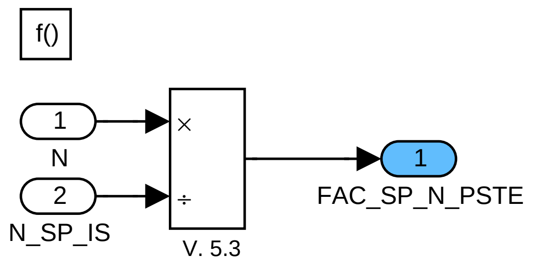

Figure D.5.6: :

D.5.2.1.3.2 Calculate FAC_N_SP_PSTE based on constant for idle speed setpoint

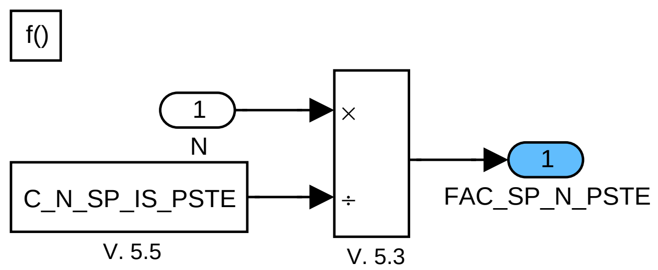

Figure D.5.7: :

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D.5.2.2 Determination of Torque reserve for ACC

Torque reserve ACC
FUNCTION DESCRIPTION:
General information:
To guarantee idle quality during A/C compressor clutch switching ON a positive torque reserve can be requested. To avoid fast spark advance/retard rampsare used for activation/deactivation of TQ_ADD_ACC.

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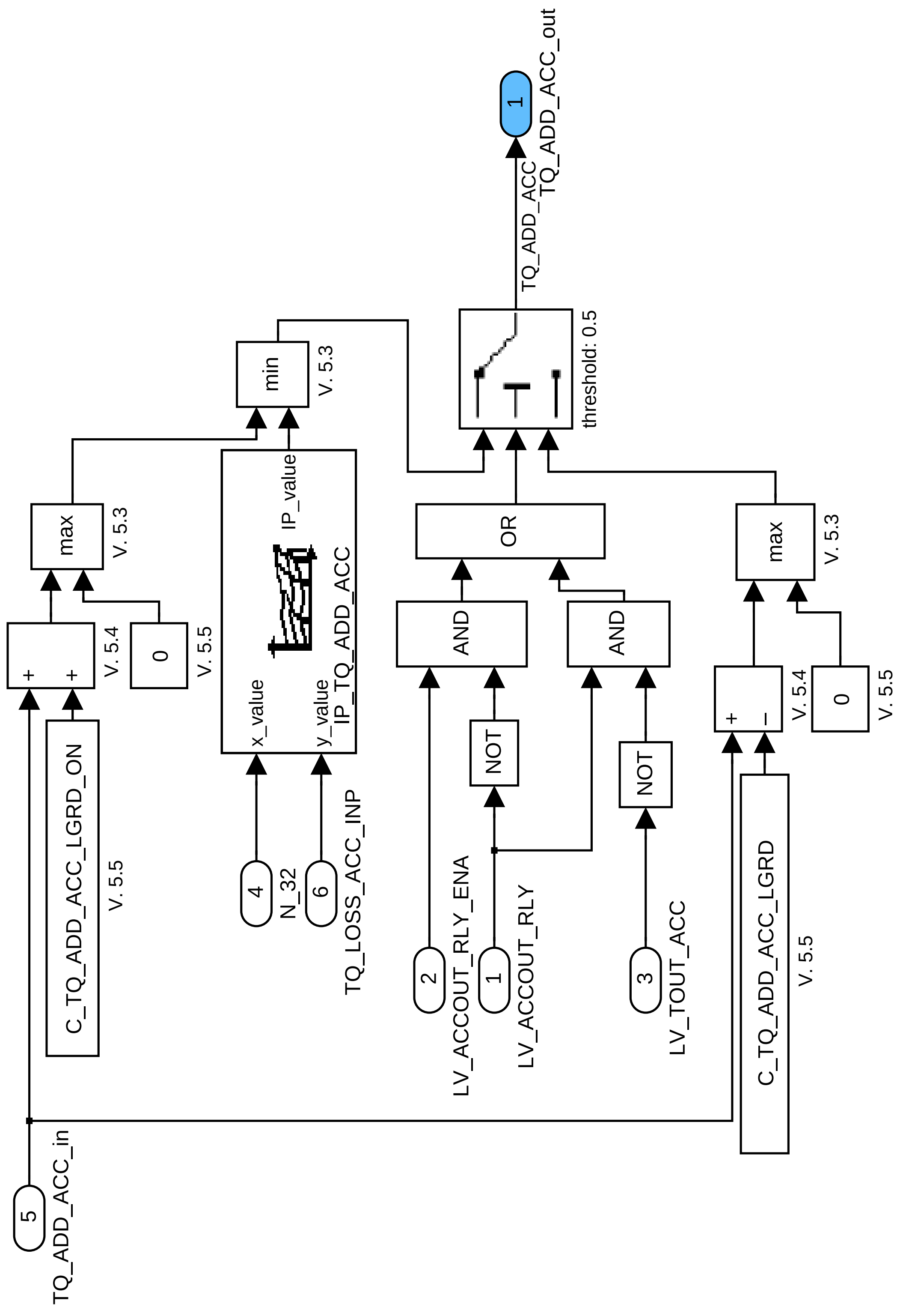

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Figure D.5.8: :

D.5.2.3 Determination of Torque reserve REQ_HEAT by ACC

Torque reserve REQ_HEAT by ACC
FUNCTION DESCRIPTION:

General information:
To guarantee idle quality during additional heating being present (required by INSTR3-message/CAN11H or IHKA/BN2000) a positive torque reserve can be requested.

At transition LV_REQ_HEAT_ACC_ENA = 0 - -> 1 the timer T_REQ_HEAT_ACC is set to zero and starts to count until its maximum value is reached. The timer s maximum value is hold until transition LV_REQ_HEAT_ACC_ENA = 1 - -> 0. Then the timer is set to zero and and starts again until its maximum value.

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D.5.2.3.1 Calculation of LV_REQ_HEAT_ACC_ENA

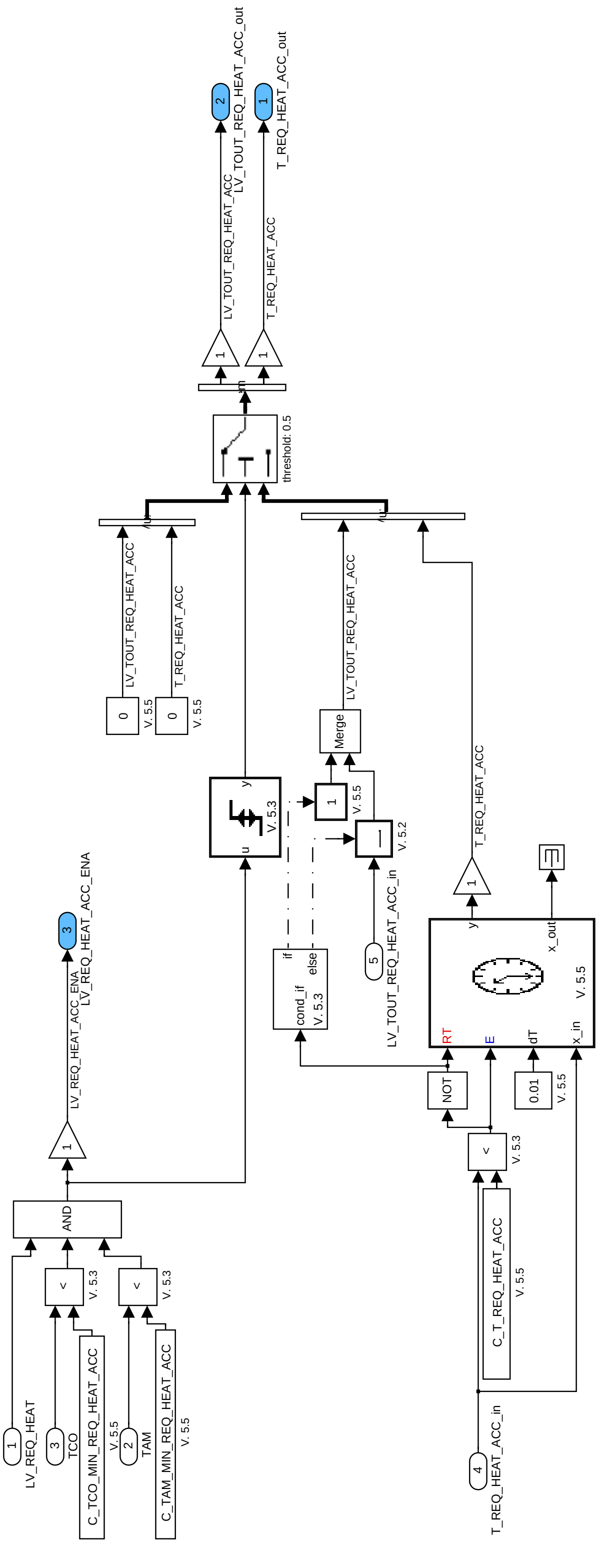

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Figure D.5.9: :

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D.5.2.3.2 Calculation of toeque reserve for switching on additional heating by ACC

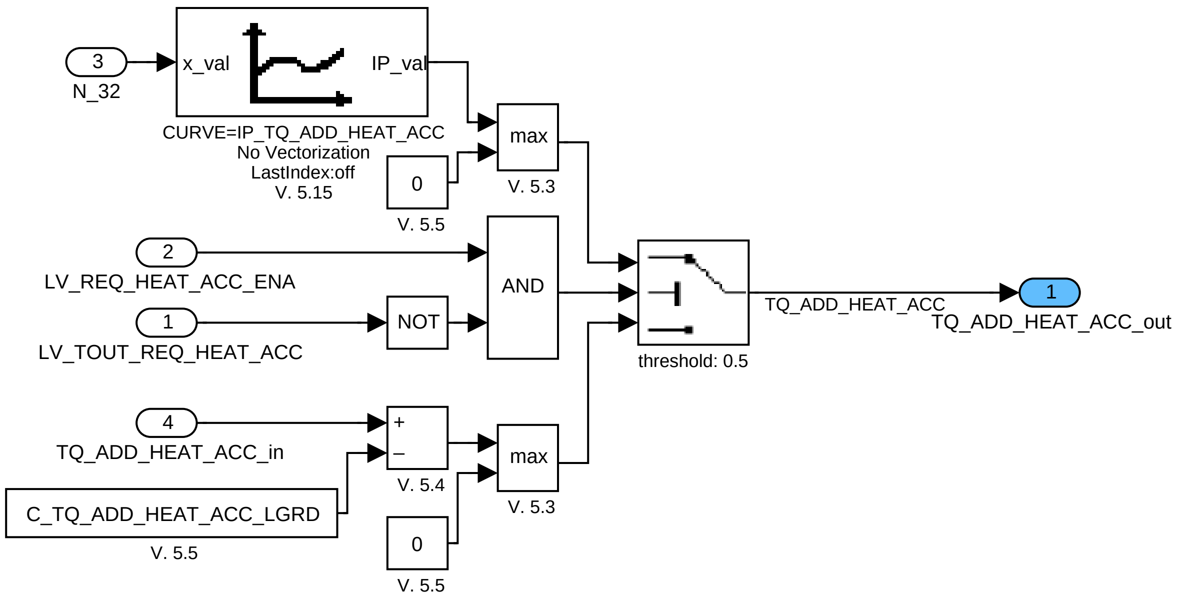

Figure D.5.10: :

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D.6 Torque request from IPM

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LDM_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable for torque interventiondue to LDM					
LV_LDM_DISABLE_CAN	O/V	0... 1H	0 ...1	1	-
Logical variable for disabling LDM intervention due to CAN error					
LV_LDM_ENA	O/V	0... 1H	0 ...1	1	-
Logical variable for increased torque intervention due to LDM					
LV_LDM_LIH	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention LIH due to LDM					
LV_LDM_PUC_INH	O/V	0... 1H	0 ...1	1	-
Logical variable for PUC-inhibit due to LDM					
STATE_TQ_LDM_PLAUS	O/V	0... FFH	0... 255	1	-
Bitwise coded State for LDM intervention state					
T_LDM_LIH_CTR	V	0... FFH	0... 2.55	0.01	s
Time counter delay time					
TQ_SP_WHEEL	O/V	8000... 7FFFH	-32768 ...32767	1	Nm
wheel torque setpoint					
TQ_WHEEL_LDM_REQ	V	8000... 7FFFH	-32768 ...32767	1	Nm
Torque increase for torque intervention during LDM					

Input data:

LV_CDN_VB_CAN_TQ_DIAG {p. 1185}	LV_ERR_BN_LDM {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_LDM_INH_MON {p. 6983}
LV_IGK {p. 906}	LV_LDM_BRAKE_PLAUS_ERR {p. 5054}	LV_LDM_ENA_PLAUS_ERR {p. 5054}	LV_LDM_LIH_CAN {p. 1566}
LV_LDM_OFF_ECU {p. 5054}	LV_TQ_WHEEL_LDM_BN_ERR {p. 1568}	LV_TQ_WHEEL_LDM_REQ {p. 1568}	LV_VAR_BN_LDM {p. 655}
STATE_DI_PUC {p. 1572}	STATE_ENGG_POS {p. 8289}	TQ_WHEEL_LDM_BN {p. 1582}	TQ_WHEEL_LDM_INC_DEC_BN {p. 1711}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LGRD_LIH_LDM	-	0... 7FFFH	0... 1023.96875	0.03125	Nm/10ms
Limiting gradient for LDM emergency ramp function (default 0.6 Nm/10ms)					
C_STATE_DI_PUC_ACT	-	0... 3H	0 ...3	1	-
State disable IS/PU/PUC engine states					
C_T_DLY_LIH_LDM	-	0... FFH	0... 2.55	0.01	s
Delay time for activation of LDM emergency ramp function (default 0s)					
LC_LDM_OFF_CLU	-	0... 1H	0 ...1	1	-
Switch for using LDM clutch info to deactivate LDM torque intervention					

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General information:

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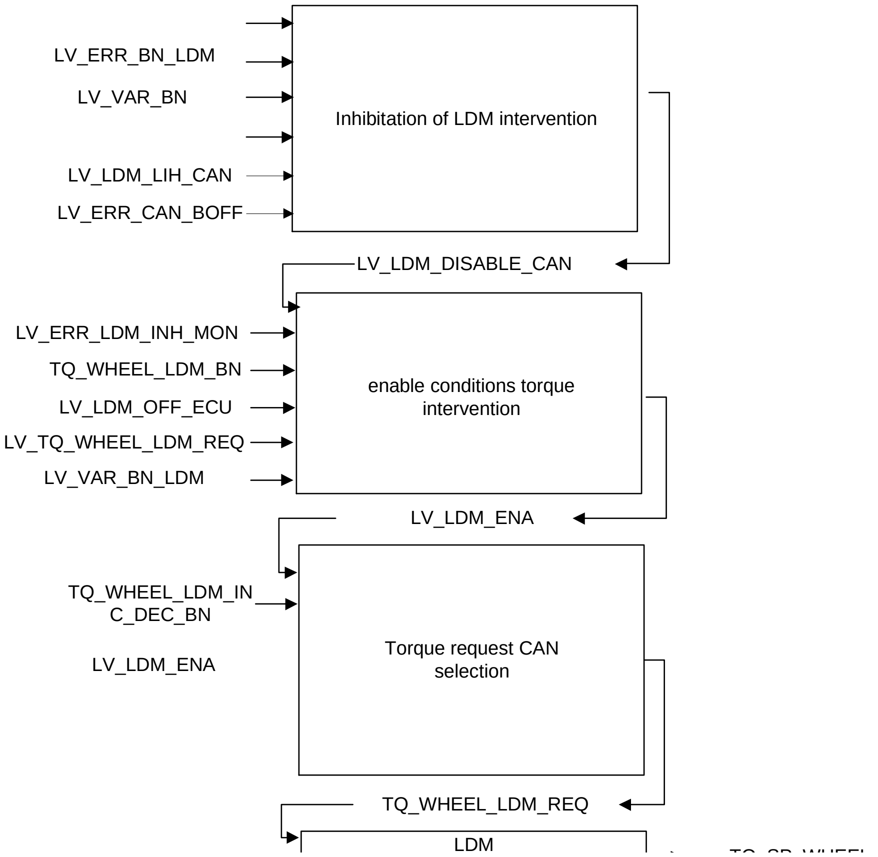
The LDM unit delivers a torque request via BN. This module serves the enable conditions and the torque request which will be used in the torque request selection.



Signal flow diagram:

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D.6.1 Enable conditions

D.6.1.1 Inhibitation LDM intervention

FUNCTION DESCRIPTION:

If the EMS detects an error on the CAN messages, the logical variable LV_LDM_DISABLE_CAN is set to 1.

Application conditions

Initialisation: *LV_LDM_DISABLE_CAN = 0* ***at reset***

Recurrence: *10 ms*

Activation: *LV_IGK = 1 and LV_VAR_BN_LDM = 1*

Deactivation: –

Formula section:

CAN enviroment LDM inhibition:

```
if      LV_ERR_BN_LDM              = 1    or
        LV_ERR_CAN_BOFF            = 1    or
        LV_LDM_LIH_CAN             = 1    or
        LV_CDN_VB_CAN_TQ_DIAG = 0

then        LV_LDM_DISABLE_CAN    = 1
else        LV_LDM_DISABLE_CAN    = 0
endif
```

D.6.1.2 enable conditions torque intervention

FUNCTION DESCRIPTION:

Depending on the configuration and plausible torque interfaces an increaced torque intervention is possible.

Application conditions

Initialisation: *LV_LDM_ENA = 0* ***at reset***

Recurrence: *10 ms*

Activation: *LV_IGK = 1 and LV_VAR_BN_LDM =1*

Formula section:

Torque increase intervention:

```
if      LV_LDM_OFF_ECU = 0              and
        LV_TQ_WHEEL_LDM_REQ = 1         and
        LV_LDM_DISABLE_CAN =   0        and
        LV_TQ_WHEEL_LDM_BN_ERR = 0      and
        LV_ERR_LDM_INH_MON = 0          and
```

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(STATE_ENGG_POS != 2H **or** LC_LDM_OFF_CLU = 0)
then LV_LDM_ENA = 1
else LV_LDM_ENA = 0
endif

STATE_TQ_LDM_PLAUS

if LV_LDM_BRAKE_PLAUS_ERR = 1 BIT [00] set
If LV_LDM_ENA_PLAUS_ERR = 1 BIT [01] set
if LV_LDM_OFF_ECU = 1 BIT [03] set
if LV_TQ_WHEEL_LDM_REQ = 1 **and**
LV_TQ_WHEEL_LDM_BN_ERR = 1 BIT [05] set
else BIT [04] set
endif

D.6.2 Torque request CAN selection

FUNCTION DESCRIPTION:

If the LDM intervention is enabled (LV_LDM_ENA = 1), the torque request is received from CAN and copied into TQ_SP_WHEEL.
After LV_LDM_ACT changes back to 0, TQ_SP_WHEEL becomes its minimum value again.

Application conditions

Initialisation: at reset and LV_IGK off - -> on
TQ_WHEEL_LDM_REQ = -32000 Nm

Recurrence: *10 ms*

Activation: *at LV_IGK = 1 and LV_VAR_BN_LDM = 1*

Deactivation: –

Formula section:

IF LV_LDM_ENA = 1
Then TQ_WHEEL_LDM_REQ = TQ_WHEEL_LDM_INC_DEC_BN
Else TQ_WHEEL_LDM_REQ = -32000 Nm
Endif

D.6.2.1 LDM increased intervention and emergency operation

FUNCTION DESCRIPTION:

If during an active LDM intervention an LDM or an EMS error occurs, the current torque offset is continued for the time C_T_DLY_LIH_LDM and then subsequently decreased to TQ_SP_WHEEL = -32000 Nm using C_LGRD_LIH_LDM. The LDM unit itself controls the torque leading during active LV_TQ_WHEEL_LDM_REQ therefore you won't have a plausible Torque request without LV_LDM_ENA.

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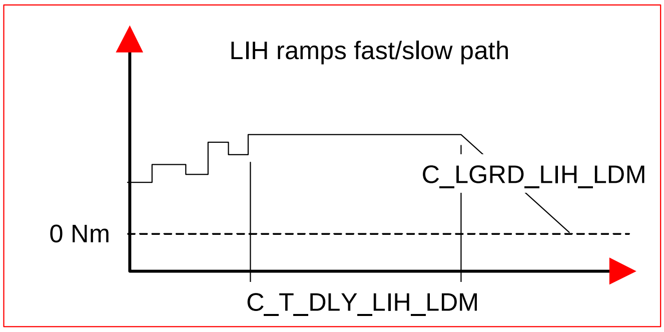
Signal flow diagram:



Application conditions

Initialisation: `at reset or at transition LV_IGK off -> on`
`LV_LDM_LIH = 0`
`LV_LDM_ACT = 0`
`TQ_SP_WHEEL = -32000 Nm`
`T_LDM_LIH_CTR = C_T_DLY_LIH_LDM`

Recurrence: *10 ms*

Activation: `LV_IGK = 1` **and** `LV_VAR_BN_LDM = 1`

Formula section:

LDM_INC intervention and detection of LDM_INC limp home operation :

If(1) LV_LDM_OFF_ECU = 1
then(1)
if(2) TQ_SP_WHEEL > -32000 Nm
then(2) LV_LDM_LIH = 1
if(3) T_LDM_LIH_CTR = 0 (*time delay*)
then(3) $TQ\_SP\_WHEEL_{N}$ = $TQ\_SP\_WHEEL_{N-1}$ - C_LGRD_LIH_LDM
(till TQ_SP_WHEEL = -32000Nm)
else(3) $TQ\_SP\_WHEEL_{N}$ = $TQ\_SP\_WHEEL_{N-1}$ (*last valid value*)
$T\_LDM\_LIH\_CTR_{N}$ = $T\_LDM\_LIH\_CTR_{N-1}$ - 10 ms

(till T_LDM_LIH_CTR = C_T_DLY_LIH_LDM)
endif(3)
else(2) LV_LDM_LIH = 0
T_LDM_LIH_CTR = C_T_DLY_LIH_LDM
endif(2)
else(1) LV_LDM_LIH = 0
T_LDM_LIH_CTR = C_T_DLY_LIH_LDM
TQ_SP_WHEEL = TQ_WHEEL_LDM_REQ
endif(1)

LDM intervention active (LV_LDM_ACT) :

if TQ_SP_WHEEL > -32000Nm
then LV_LDM_ACT = 1

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```
else      LV_LDM_ACT        = 0
endif
```

LDM inhibitation of PUC active (LV_LDM_PUC_INH) :

```
if         (LV_LDM_ACT = 1    and
          STATE_DI_PUC = C_STATE_DI_PUC_ACT )
then      LV_LDM_PUC_INH    = 1
else      LV_LDM_PUC_INH    = 0
endif
```

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D.7 Torque loss power steering

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_PSTE_2_DISABLE	O/V	0... 1H	0 ...1	1	-
LV for disabling PSTE intervention due to EMS error					
LV_PSTE_2_DISABLE_CAN	O/V	0... 1H	0 ...1	1	-
LV for disabling PSTE intervention due to CAN error					
LV_PSTE_2_ENA	O/V	0... 1H	0 ...1	1	-
LV for enabling PSTE intervention					
LV_PSTE_3_DISABLE	O/V	0... 1H	0 ...1	1	-
LV for disabling PSTE intervention due to EMS error					
LV_PSTE_3_DISABLE_CAN	O/V	0... 1H	0 ...1	1	-
LV for disabling PSTE 3 intervention due to CAN error					
LV_PSTE_3_ENA	O/V	0... 1H	0 ...1	1	-
LV for enabling PSTE intervention					
LV_PSTE_DISABLE	O/V	0... 1H	0 ...1	1	-
LV for disabling PSTE intervention due to EMS error					
LV_PSTE_DISABLE_CAN	O/V	0... 1H	0 ...1	1	-
LV for disabling PSTE intervention due to CAN error					
LV_PSTE_ENA	O/V	0... 1H	0 ...1	1	-
LV for enabling PSTE intervention					
LV_TQ_ADD_PSTE_IS_AD_INH	O/V	0... 1H	0 ...1	1	-
Flag for inhibition of IS-control adaptations due to torque reserve PSTE					
LV_TQ_LOSS_PSTE_IS_AD_INH	O/V	0... 1H	0 ...1	1	-
Flag for inhibition of IS-control adaptations due to torque losses PSTE					
STATE_TQ_PSTE_2_PLAUS	O/V	0... FFH	0... 255	1	-
Bitwise coded State for PSTE_2 intervention state					
STATE_TQ_PSTE_3_PLAUS	O/V	0... FFH	0... 255	1	-
Bitwise coded State for PSTE_3 intervention state					
T_PSTE_2	O/V	0... FFH	0... 2.55	0.01	s
SP AV Timer PSTE_2					
T_PSTE_3	O/V	0... FFH	0... 2.55	0.01	s
SP AV Timer PSTE_3					
TQ_ADD_PSTE	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque reserve for power steering					
TQ_ADD_PSTE_1	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque reserve for power steering					
TQ_ADD_PSTE_2	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm/10ms
Engine torque reserve active front steering					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_ADD_PSTE_3	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque reserve for eletric power steering (EHB3)					
TQ_LOSS_PSTE	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Summary Engine torque losses power steering					
TQ_LOSS_PSTE_1	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses power steering					
TQ_LOSS_PSTE_2	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses active front steering					
TQ_LOSS_PSTE_2_AV	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses active front steering active value					
TQ_LOSS_PSTE_2_DIF	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses active front steering difference					
TQ_LOSS_PSTE_2_GRD	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm/10ms
Engine torque losses active front steering gradient					
TQ_LOSS_PSTE_2_RAW	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm/10ms
Engine torque losses active front steering					
TQ_LOSS_PSTE_2_SP	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses active front steering set point					
TQ_LOSS_PSTE_2_TMP	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Intermidiate LABEL used as input 2nd axis of IP_TQ_ADD_PSTE_2_TMP					
TQ_LOSS_PSTE_3	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses for electric power steering (EHB3)					
TQ_LOSS_PSTE_3_AV	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses actual value for electric power steering (EHB3)					
TQ_LOSS_PSTE_3_DIF	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses difference for electric power steering (EHB3)					
TQ_LOSS_PSTE_3_GRD	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses gradient for electric power steering (EHB3)					
TQ_LOSS_PSTE_3_RAW	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses for electric power steering (EHB3)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_LOSS_PSTE_3_SP	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Engine torque losses electric power steering setpoint					

Input data:

ANG_PSTE_STND {p. 1420}	FAC_SP_N_PSTE {p. 6602}	LV_CDN_VB_CAN_TQ_ DIAG {p. 1185}	LV_DI_TQ_REQ_CAN_ MPI_GDI {p. 800}
LV_ERR_ANG_PSTE_CAN {p. 1565}	LV_ERR_BN_ANG_PSTE {p. 4869}	LV_ERR_BN_TQ_PSTE_2 {p. 4871}	LV_ERR_BN_TQ_PSTE_3 {p. 4871}
LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_TOUT_PSTE_1 {p. 802}	LV_ES {p. 1720}	LV_IGK {p. 906}
LV_PSTE_2_ERR {p. 1567}	LV_ST {p. 1720}	LV_TCS_DISABLE_CAN {p. 6741}	LV_TQ_PSTE_3_CAN_DI {p. 1568}
LV_TQ_PSTE_3_CAN_LIH {p. 1568}	LV_TQI_REQ_CAN_INH {p. 6687}	LV_VAR_BN {p. 655}	LV_VAR_PSTE {p. 656}
LV_VAR_PSTE_2 {p. 656}	LV_VAR_PSTE_3 {p. 656}	N {p. 1525}	N_32 {p. 1525}
STATE_PSTE_2_INTV {p. 1575}	STATE_PSTE_3_INTV {p. 1576}	STATE_PSTE_3_SRC {p. 1576}	STATE_SENS_ANG_PSTE {p. 1576}
TQ_LOSS_PSTE_2_AV_ CAN {p. 1581}	TQ_LOSS_PSTE_2_SP_ CAN {p. 1581}	TQ_LOSS_PSTE_3_AV_ CAN {p. 1581}	TQ_LOSS_PSTE_3_SP_ CAN {p. 1581}
VEL_ANG_PSTE_COR {p. 1420}	VS {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_LOSS_PSTE_2_DIF	-	0... FFH	-2... 1.984375	0.015625	-
Correction value differences					
C_FAC_TQ_LOSS_PSTE_2_GRD	-	0... FFH	-2... 1.984375	0.015625	-
Correction value gradient					
C_FAC_TQ_LOSS_PSTE_3_DIF	-	0... FFH	-2... 1.984375	0.015625	-
Correction value differences					
C_FAC_TQ_LOSS_PSTE_3_GRD	-	0... FFH	-2... 1.984375	0.015625	-
Correction value gradient					
C_T_PSTE_DLY_AD	-	0... FFH	0... 2.55	0.01	s
Threshold torque losses PSTE for inhibition of IS-control adaptations					
C_TQ_ADD_PSTE_1_LIH	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limp home value torque reserve					
C_TQ_ADD_PSTE_AD	-	0... 7FFFH	0... 1023.97	0.03125	Nm
threshold torque reserve PSTE for inhibition of IS-control adaptations					
C_TQ_LOSS_PSTE_1_LIH	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Limp home value torque losses					
C_TQ_LOSS_PSTE_2_LIH	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Limp home value torque losses					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQ_LOSS_PSTE_2_SP_MIN	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min torque threshold for timer reset					
C_TQ_LOSS_PSTE_3_LIH	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Limp home value torque losses					
C_TQ_LOSS_PSTE_3_SP_MIN	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min torque threshold for timer reset					
C_TQ_LOSS_PSTE_AD	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
threshold torque losses PSTE for inhibition of IS-control adaptations					
IP_FAC_TQ_ADD_PSTE_2_VS	-	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_2	6	0... FFH	0... 255	1	km/h
Active power steering torque loss correction					
IP_FAC_TQ_ADD_PSTE_3_VS_PSTE	-	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
electric power steering torque loss correction					
IP_FAC_TQ_ADD_PSTE_3_VS_PSTE_2	-	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
electric power steering torque loss correction					
IP_FAC_TQ_LOSS_PSTE	-	0... FFH	0... 3.984375	0.015625	-
LDP_N__FAC_TQ_LOSS_PSTE	8	0... 1FE0H	0... 8160	1	rpm
factor for weighting the torque request in dependance of speed (P=M*()					
IP_FAC_TQ_LOSS_PSTE_2	V	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_2	6	0... FFH	0... 255	1	km/h
LDPM_N_32__PSTE_2	8	0... FFH	0... 8160	32	rpm
Factor active power steering torque loss correction vs					
IP_FAC_TQ_LOSS_PSTE_2_ANG	V	0... FFH	0... 3.984375	0.015625	-
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDPM_VEL_ANG_PSTE_TQLO	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
factor active power steering torque loss correction °STW					
IP_FAC_TQ_LOSS_PSTE_2_AV	V	0... FFH	-2... 1.984375	0.015625	-
LDPM_N_32__PSTE_2_1	4	0... FFH	0... 8160	32	rpm
LDPM_T_PSTE_2__PSTE_2	4	0... FFH	0... 2.55	0.01	s
Active power steering torque loss correction AV					
IP_FAC_TQ_LOSS_PSTE_2_SP	V	0... FFH	-2... 1.984375	0.015625	-
LDPM_N_32__PSTE_2_1	4	0... FFH	0... 8160	32	rpm
LDPM_T_PSTE_2__PSTE_2	4	0... FFH	0... 2.55	0.01	s
Active power steering torque loss correction SP					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_TQ_LOSS_PSTE_2_VS	V	0... FFH	0... 3.984375	0.015625	-
LDPM_VS_TQ_LOSS_PSTE_2	6	0... FFH	0... 255	1	km/h
LDPM_N_32__PSTE_2	8	0... FFH	0... 8160	32	rpm
Factor active power steering torque loss correction vs					
IP_FAC_TQ_LOSS_PSTE_3_AV	V	0... FFH	-2... 1.984375	0.015625	-
LDPM_N_32__PSTE_3_1	4	0... FFH	0... 8160	32	rpm
LDPM_T_PSTE_3__PSTE_3	4	0... FFH	0... 2.55	0.01	s
Electric power steering torque loss correction AV					
IP_FAC_TQ_LOSS_PSTE_3_COR_PSTE	V	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
LDPM_FAC_SP_N_PSTE_1_STSY	8	0... FFH	0... 1.9921875	7.8125e-3	-
Factor electric power steering (EHB 3) torque loss correction vs					
IP_FAC_TQ_LOSS_PSTE_3_COR_PSTE2	V	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
LDPM_FAC_SP_N_PSTE_1_STSY	8	0... FFH	0... 1.9921875	7.8125e-3	-
Factor electric power steering (EHB 3) torque loss correction vs					
IP_FAC_TQ_LOSS_PSTE_3_MDL_PSTE	V	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
LDPM_FAC_SP_N_PSTE_1_STSY	8	0... FFH	0... 1.9921875	7.8125e-3	-
Factor electric power steering (EHB 3) torque loss correction vs					
IP_FAC_TQ_LOSS_PSTE_3_MDL_PSTE2	V	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
LDPM_FAC_SP_N_PSTE_1_STSY	8	0... FFH	0... 1.9921875	7.8125e-3	-
Factor electric power steering (EHB 3) torque loss correction vs					
IP_FAC_TQ_LOSS_PSTE_3_PSTE	V	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
LDPM_FAC_SP_N_PSTE_1_STSY	8	0... FFH	0... 1.9921875	7.8125e-3	-
Factor electric power steering (EHB 3) torque loss correction vs					
IP_FAC_TQ_LOSS_PSTE_3_PSTE_2	V	0... FFH	0... 3.984375	0.015625	-
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
LDPM_FAC_SP_N_PSTE_1_STSY	8	0... FFH	0... 1.9921875	7.8125e-3	-
Factor electric power steering (EHB 3) torque loss correction vs					
IP_FAC_TQ_LOSS_PSTE_3_SP	V	0... FFH	-2... 1.984375	0.015625	-
LDPM_N_32__PSTE_3_1	4	0... FFH	0... 8160	32	rpm
LDPM_T_PSTE_3__PSTE_3	4	0... FFH	0... 2.55	0.01	s
Electric power steering torque loss correction SP					
IP_TQ_ADD_PSTE	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDPM_ANG_PSTE_STND_TQLO_1	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
Power steering torque reserve depending on engine-speed					
IP_TQ_ADD_PSTE_2	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDP_TQ_LOSS_PSTE_2_SP_CAN	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Active power steering torque reserve					
IP_TQ_ADD_PSTE_2_LIH	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_VS_TQ_LOSS_PSTE_2	6	0... FFH	0... 255	1	km/h
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
Factor active power steering torque loss correction vs					
IP_TQ_ADD_PSTE_2_TMP	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDP_TQ_LOSS_PSTE_2_TMP	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Active power steering torque reserve using different 2nd axis					
IP_TQ_ADD_PSTE_3_LIH	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_VS_TQ_LOSS_PSTE_3	6	0... FFH	0... 255	1	km/h
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
Factor eletric power steering (EHB 3) torque loss correction vs					
IP_TQ_ADD_PSTE_3_PSTE	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDP_TQ_LOSS_PSTE_3_SP_CAN	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
electric power steering torque reserve					
IP_TQ_ADD_PSTE_3_PSTE_2	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDP_TQ_LOSS_PSTE_3_SP_CAN	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
electric power steering torque reserve					
IP_TQ_LOSS_PSTE	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_ANG_PSTE_STND_TQLO_1	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDP_VEL_ANG_PSTE_TQLO_1	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
power steering torque loss versus engine-speed					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TQ_LOSS_PSTE_2	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDPM_VEL_ANG_PSTE_TQLO	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
Active power steering torque loss correction					
IP_TQ_LOSS_PSTE_3_ANG_PSTE	V	0... FFH	0... 3.984375	0.015625	-
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDPM_VEL_ANG_PSTE_TQLO	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
electric power steering torque loss correction					
IP_TQ_LOSS_PSTE_3_ANG_PSTE_2	V	0... FFH	0... 3.984375	0.015625	-
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDPM_VEL_ANG_PSTE_TQLO	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
electric power steering torque loss correction					
IP_TQ_LOSS_PSTE_3_COR_PSTE	V	0... FFH	0... 3.984375	0.015625	-
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDPM_VEL_ANG_PSTE_TQLO	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
electric power steering torque loss correction					
IP_TQ_LOSS_PSTE_3_COR_PSTE_2	V	0... FFH	0... 3.984375	0.015625	-
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDPM_VEL_ANG_PSTE_TQLO	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
electric power steering torque loss correction					
IP_TQ_LOSS_PSTE_3_MDL_PSTE	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDPM_VEL_ANG_PSTE_TQLO	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
electric power steering torque loss correction					
IP_TQ_LOSS_PSTE_3_MDL_PSTE_2	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_ANG_PSTE_STND_TQLO	8	0... FFFFH	-100... 99.9969482422	3.05176e-3	%
LDPM_VEL_ANG_PSTE_TQLO	8	0... FFFFH	-1439.98976 ...1439.9	0.0439-	°STW/s
electric power steering torque loss correction					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_PSTE_2_ENA	-	0... 1H	0 ...1	1	-
Logical variable for inhibitation of active power steering					
LC_PSTE_2_MAN_ACT	-	0... 1H	0 ...1	1	-
Logical variable for manual activation of PSTE_2 conditions independent of PSTE_2 messages					
LC_PSTE_3_ENA	-	0... 1H	0 ...1	1	-
Logical variable for inhibitation of eletric power steering EHB 3					
LC_PSTE_ENA	-	0... 1H	0 ...1	1	-
Logical variable for enabling of power steering					
LC_TQ_ADD_PSTE_2_SWI	-	0... 1H	0 ...1	1	-
Switch to change 2nd axis of IP_TQ_ADD_PSTE_2					
LC_TQ_LOSS_PSTE_2_SWI	-	0... 1H	0 ...1	1	-
Configuration AFS switch					
LC_TQ_LOSS_PSTE_3_SWI	-	0... 1H	0 ...1	1	-
Configuration EHB3 switch					

Overview

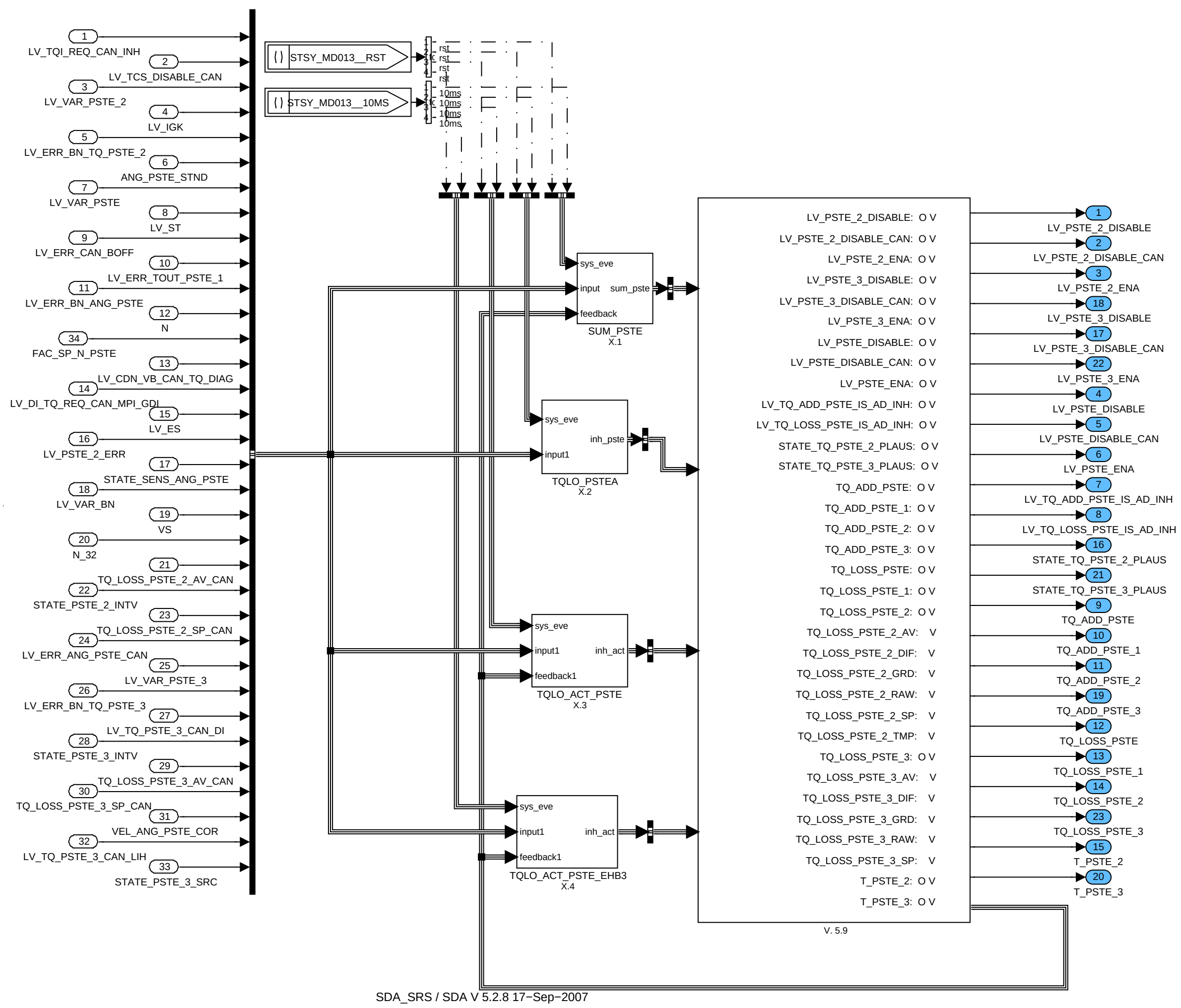

Figure D.7.1: :

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General Information

D.7.1 Summary of power steering losses

FUNCTION DESCRIPTION:

Application Conditions

Initialization: RST
Recurrence: 10MS
Activation: LV_IGK & & (LV_VAR_PSTE_2 || LV_VAR_PSTE || LV_VAR_PSTE_3)
Deactivation: never

Function description

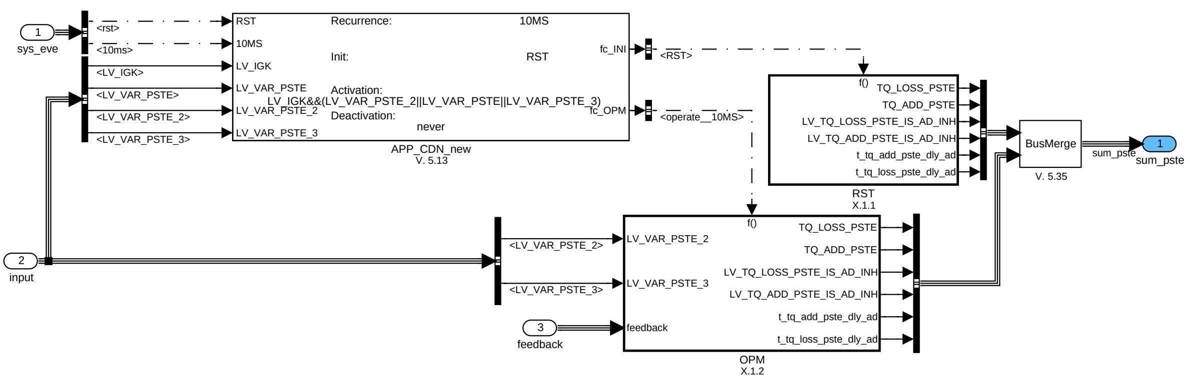

Figure D.7.2: :

D.7.1.1 Reset of variables is done here.

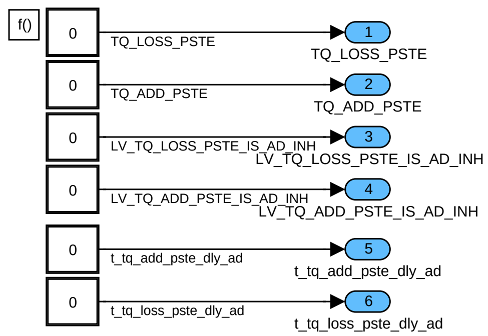

Figure D.7.3: :

D.7.1.2 Formula section:

"TQ_LOSS_PSTE_1, TQ_LOSS_PSTE_2 and TQ_LOSS_PSTE_3 have to be calculate before TQ_ LOSS_PSTE (using current values)."

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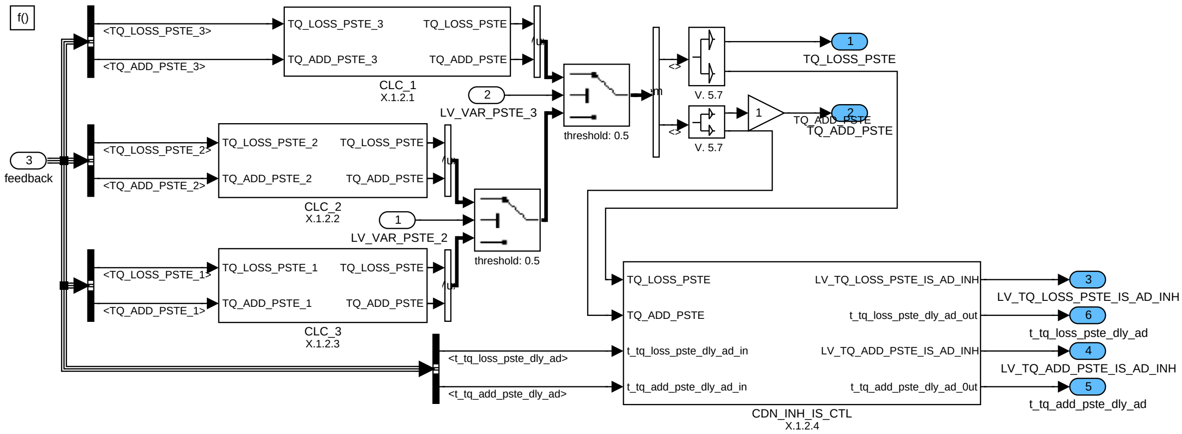

Figure D.7.4: :

D.7.1.2.1 Calculation of TQ_LOSS_PSTE and TQ_ADD_PSTE when LV_VAR_PSTE_3 is set

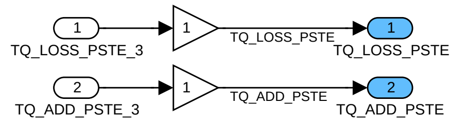

Figure D.7.5: :

D.7.1.2.2 Calculation of TQ_LOSS_PSTE and TQ_ADD_PSTE when LV_VAR_PSTE_2 is set

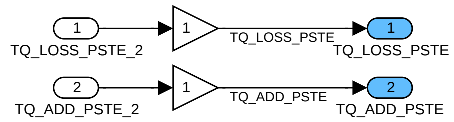

Figure D.7.6: :

D.7.1.2.3 Calculation of TQ_LOSS_PSTE and TQ_ADD_PSTE when LV_VAR_PSTE_2 is reset

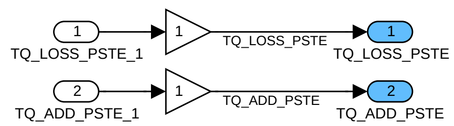

Figure D.7.7: :

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D.7.1.2.4 Condition for inhibition of IS-control adaptations:

D.7.1.2.4.1 Calculation of LV_TQ_LOSS_PSTE_IS_AD_INH and TIMER

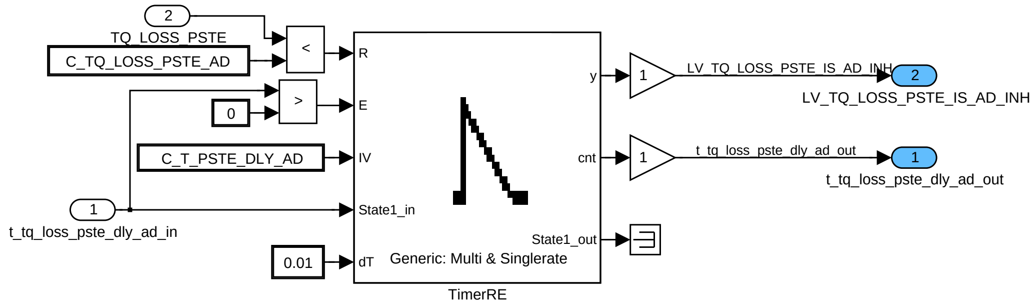

Figure D.7.8: :

D.7.1.2.4.2 Calculation of LV_TQ_ADD_PSTE_IS_AD_INH and TIMER

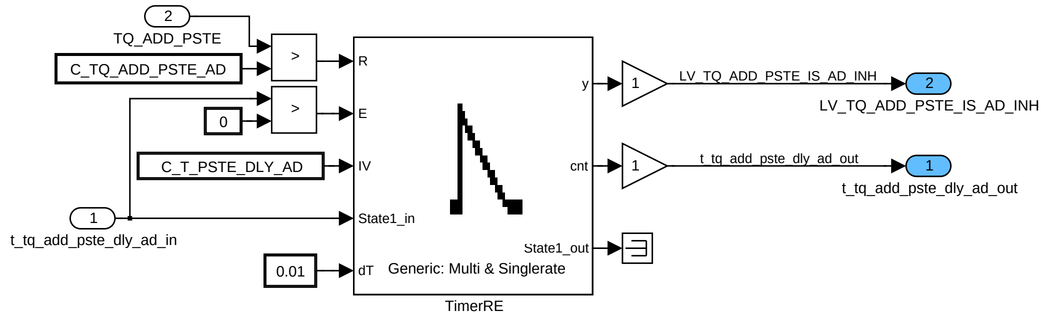

Figure D.7.9: :

D.7.2 Torque losses power steering assistance

Application Conditions

Initialization: RST
Recurrence: 10MS
Activation: LV_IGK & & LV_VAR_PSTE
Deactivation: never

Function description

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D.7.2.1 Reset of variables

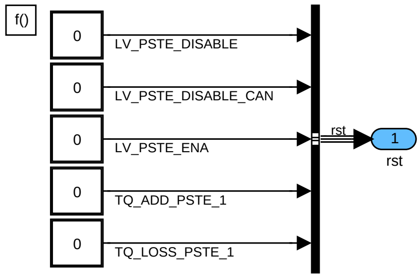

Figure D.7.10: :

Function description.

D.7.2.2 Inhibition of power steering

General information:
TQ_LOSS_PSTE_1 describes the needed torque during activation of power steering. ANG_PSTE is the angle of power steering and VEL_ANG_PSTE the velocity of ANG_PSTE.

D.7.2.2.1 CAN environment error PSTE inhibition:

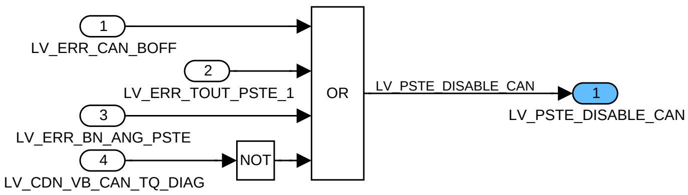

Figure D.7.11: :

D.7.2.2.2 General PSTE inhibition:

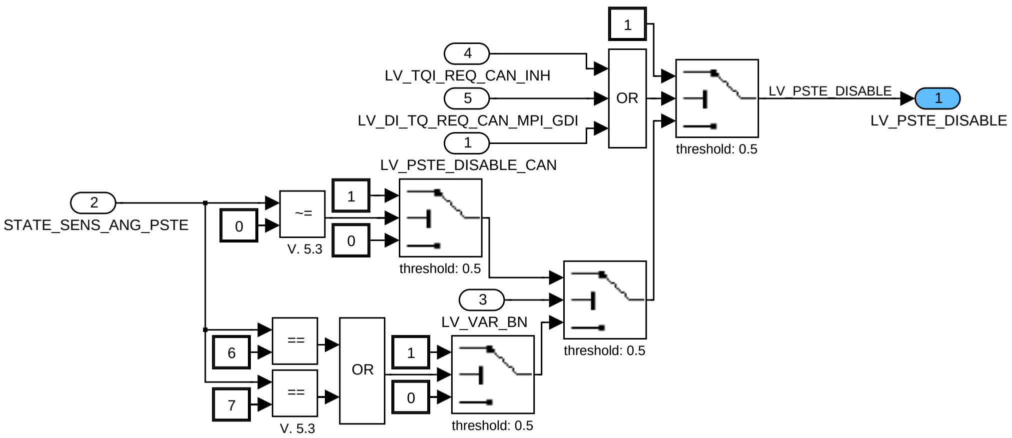

Figure D.7.12: :

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D.7.2.3 Enable conditions PSTE intervention

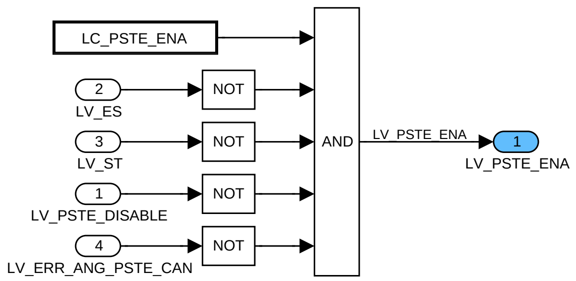

Figure D.7.13: :

D.7.2.4 Torque loss & reserve for power steering assistance

Calculation of TQ_LOSS_PSTE_1 and TQ_ADD_PSTE_1.

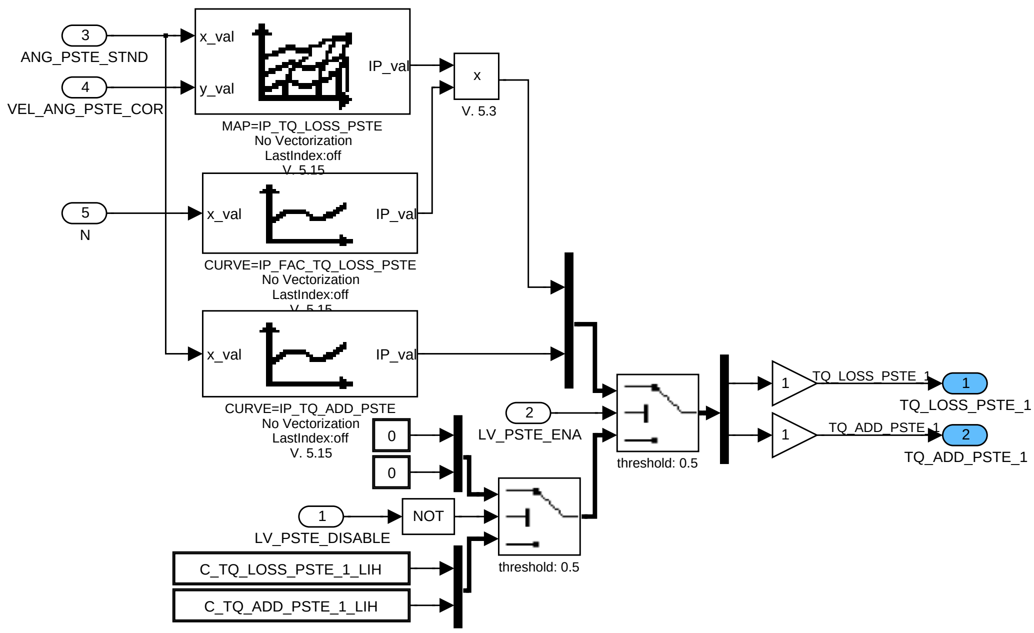

Figure D.7.14: :

D.7.3 Torque Loss for active power steering (BN 2000)

General information:
TQ_LOSS_PSTE_2 describes the torque demand and losses of active power steering. There are two informations the predicted and the Active Torque losses.

Application Conditions

Initialization: RST
Recurrence: 10MS
Activation: LV_IGK & & LV_VAR_BN & & LV_VAR_PSTE_2

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Deactivation: never

Function description

D.7.3.1 Reset of variables.

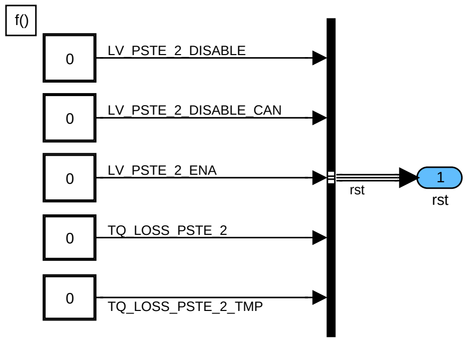

Figure D.7.15: :

Function description

D.7.3.2 Inhibition of active power steering

D.7.3.2.1 CAN environment error PSTE_2 inhibition:

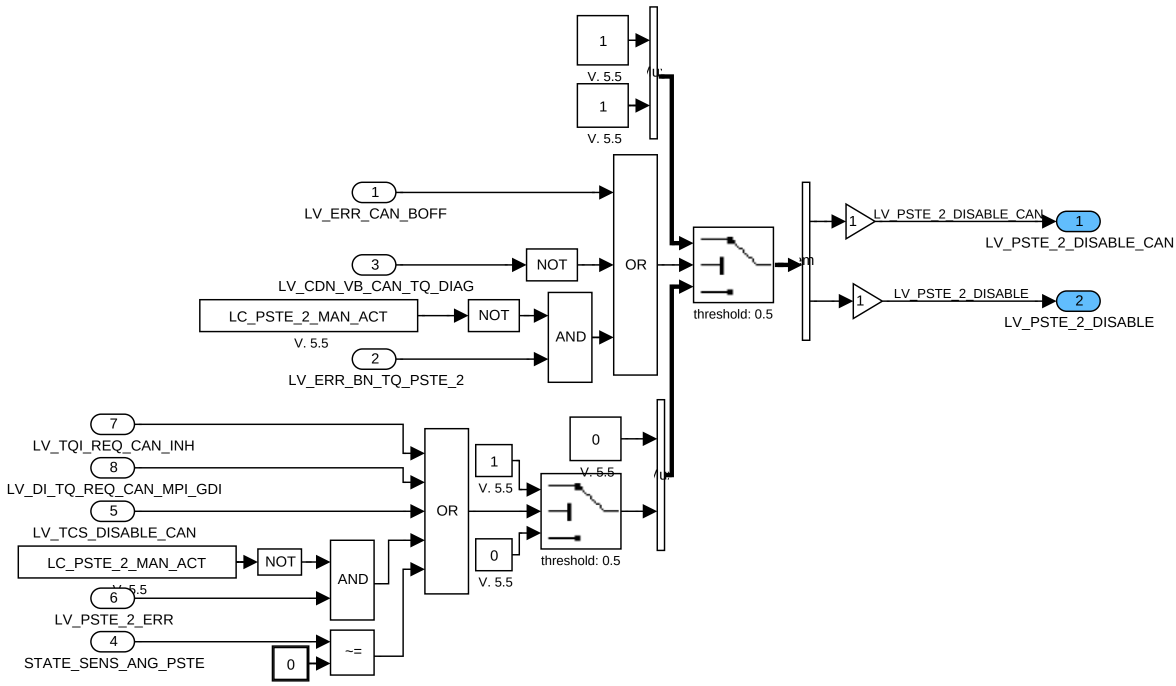

Figure D.7.16: :

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D.7.3.3 Enable conditions PSTE intervention

FUNCTION DESCRIPTION:
The State STATE_TQ_PSTE_2_PLAUS indicates the interrupted condition which is responsible for enable Bit = 0. The [x] Value shows the HEX adress inside the Bitwise coded State.

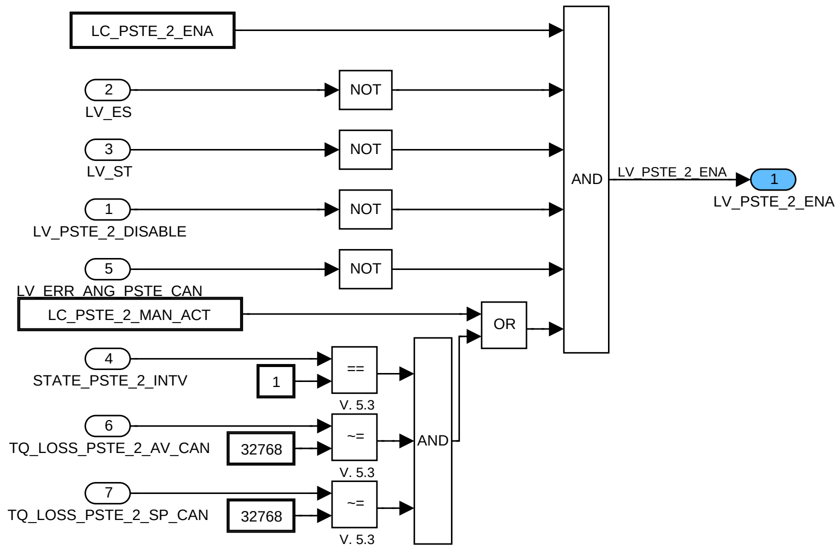

Figure D.7.17: :

D.7.3.4 Torque loss active PSTE_2

D.7.3.4.1 Calculation depending on LV_PSTE_2_ENA

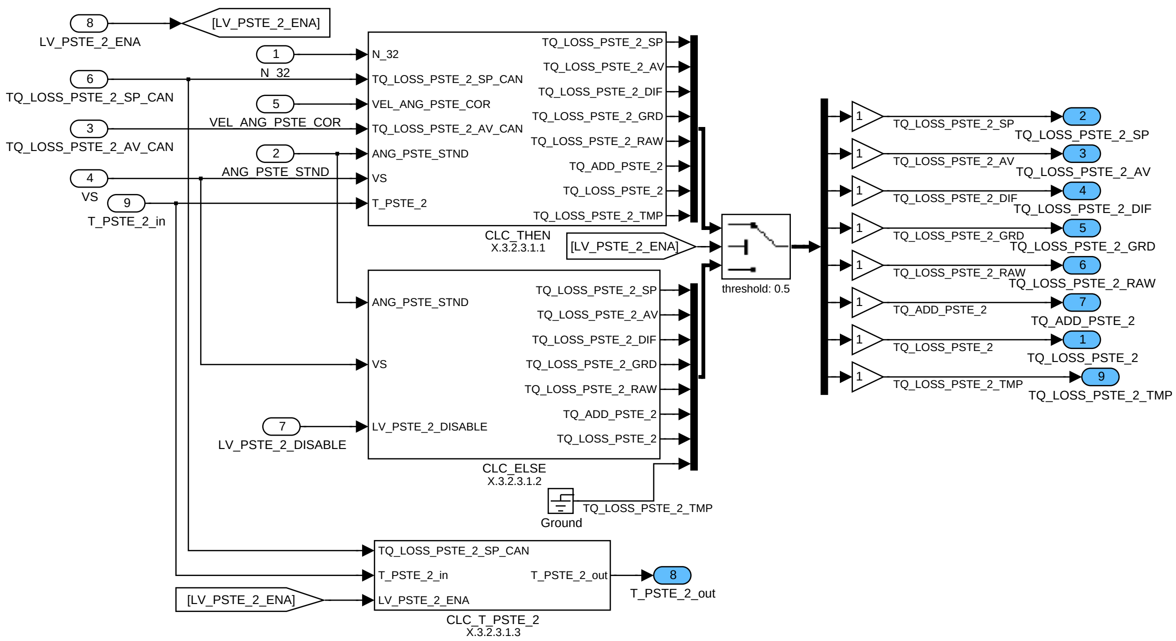

Figure D.7.18: :

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D.7.3.4.1.1 Calculation when LV_PSTE_2_ENA is true.

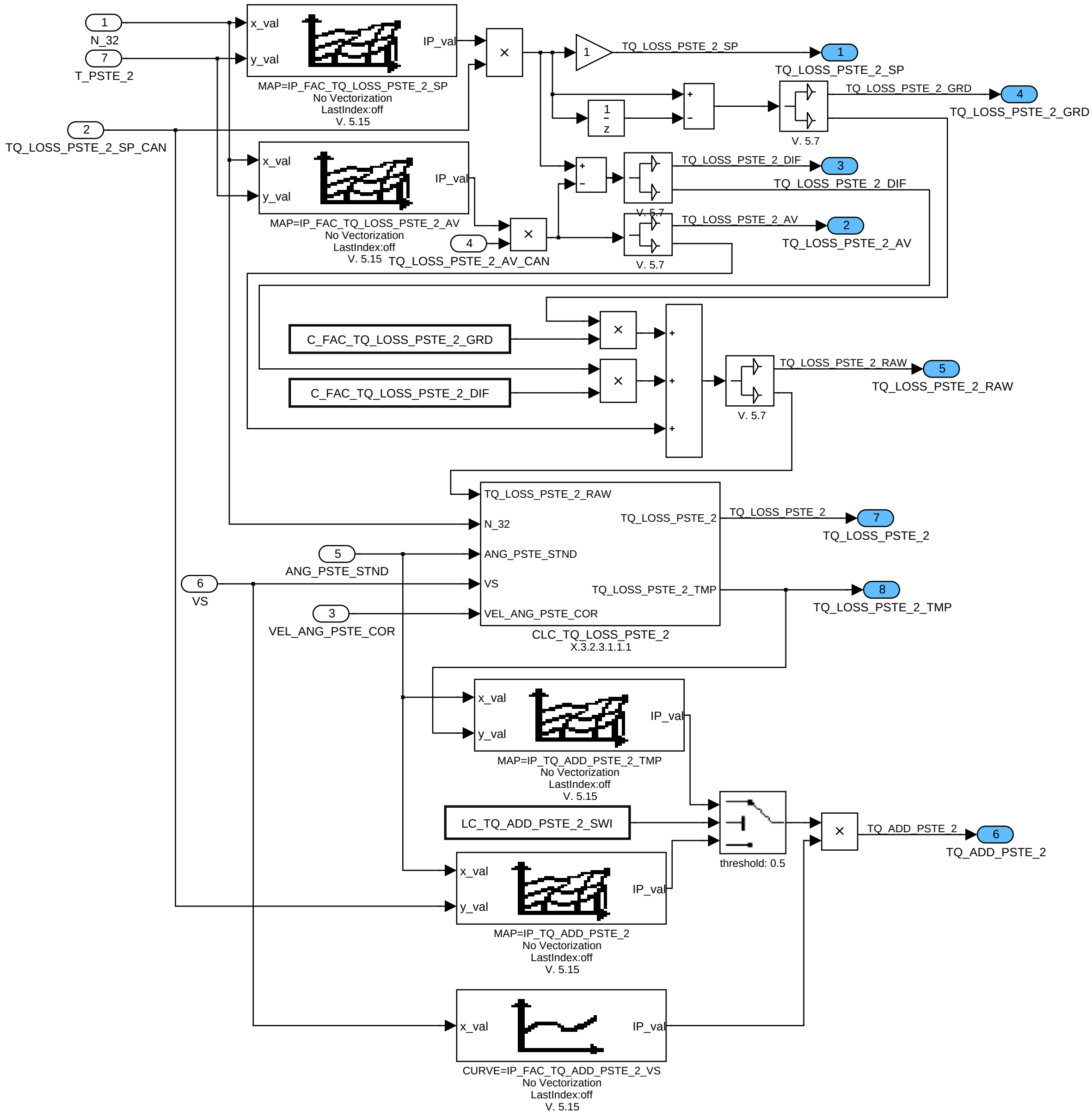

Figure D.7.19: :

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D.7.3.4.1.1.1 Calculation of TQ_LOSS_PSTE_2

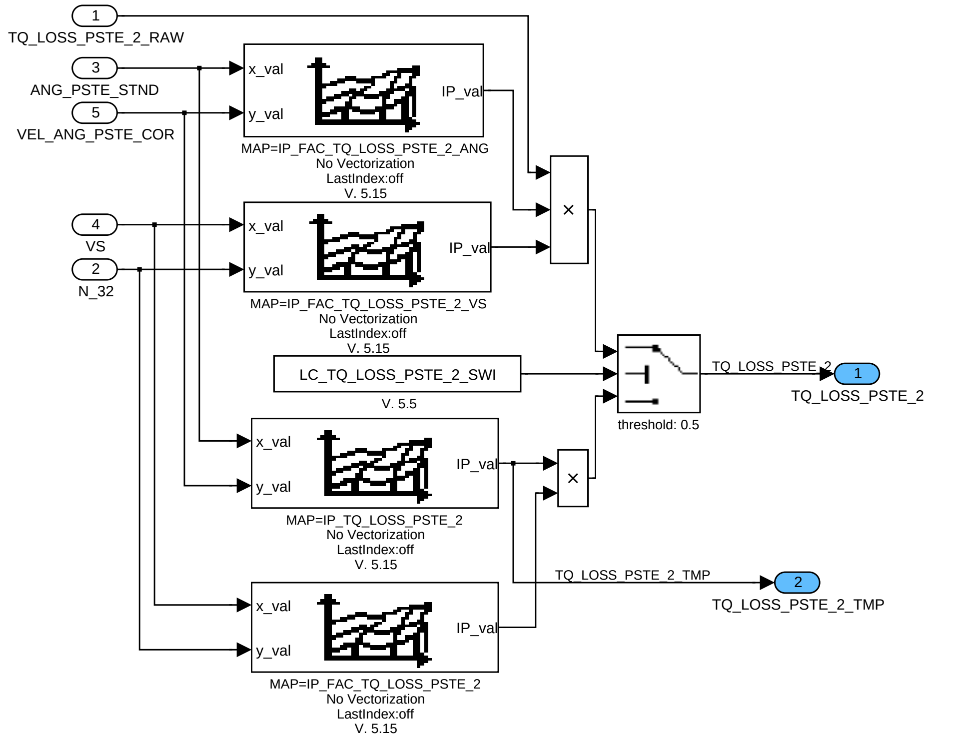

Figure D.7.20: :

D.7.3.4.1.2 Calculation when LV_PSTE_2_ENA is false.

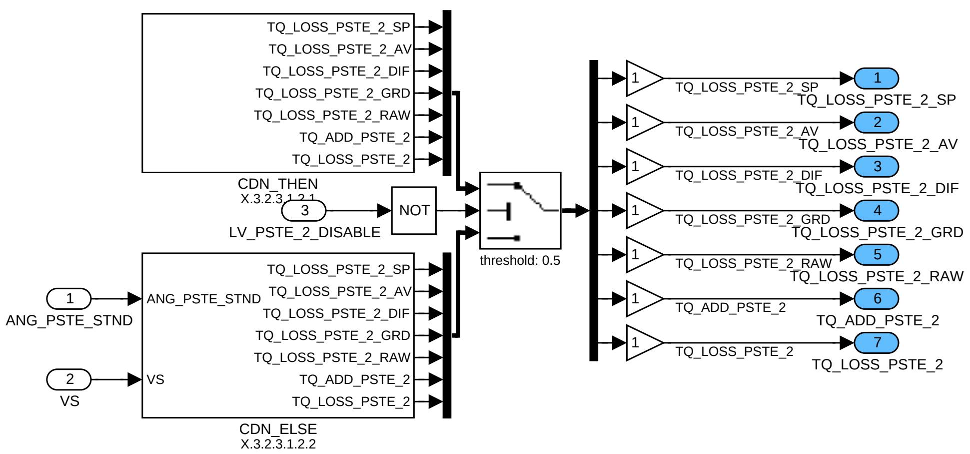

Figure D.7.21: :

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D.7.3.4.1.2.1 Calculation when LV_PSTE_2_DISABLE is true.

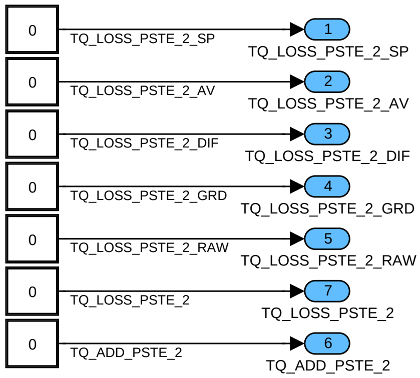

Figure D.7.22: :

D.7.3.4.1.2.2 Calculation depending on LV_PSTE_2_DISABLE.

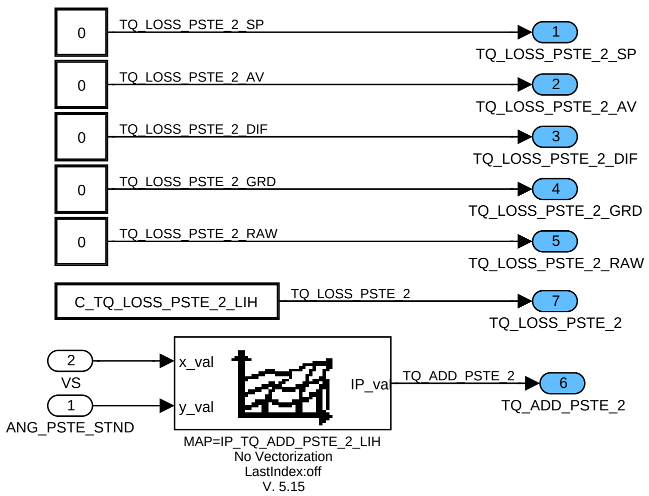

Figure D.7.23: :

D.7.3.4.1.3 Timer calculation.

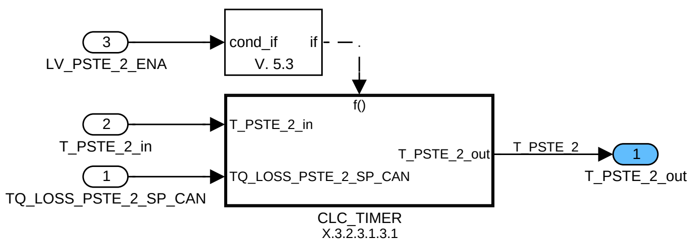

Figure D.7.24: :

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D.7.3.4.1.3.1 Calculation of timer T_PSTE_2.

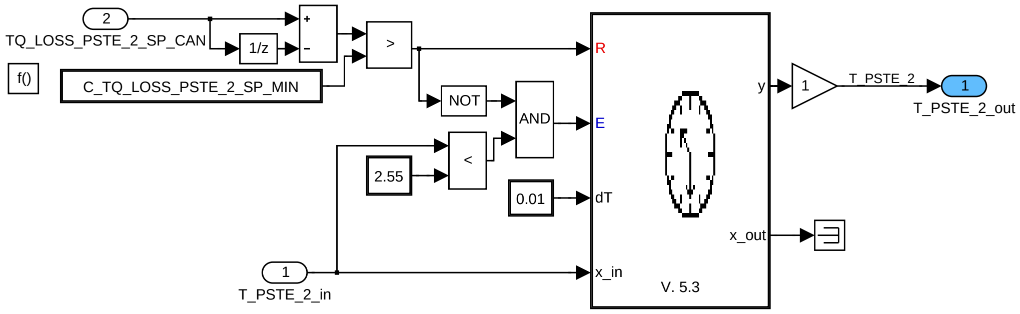

Figure D.7.25: :

D.7.3.5 STATE_TQ_PSTE_2_PLAUS

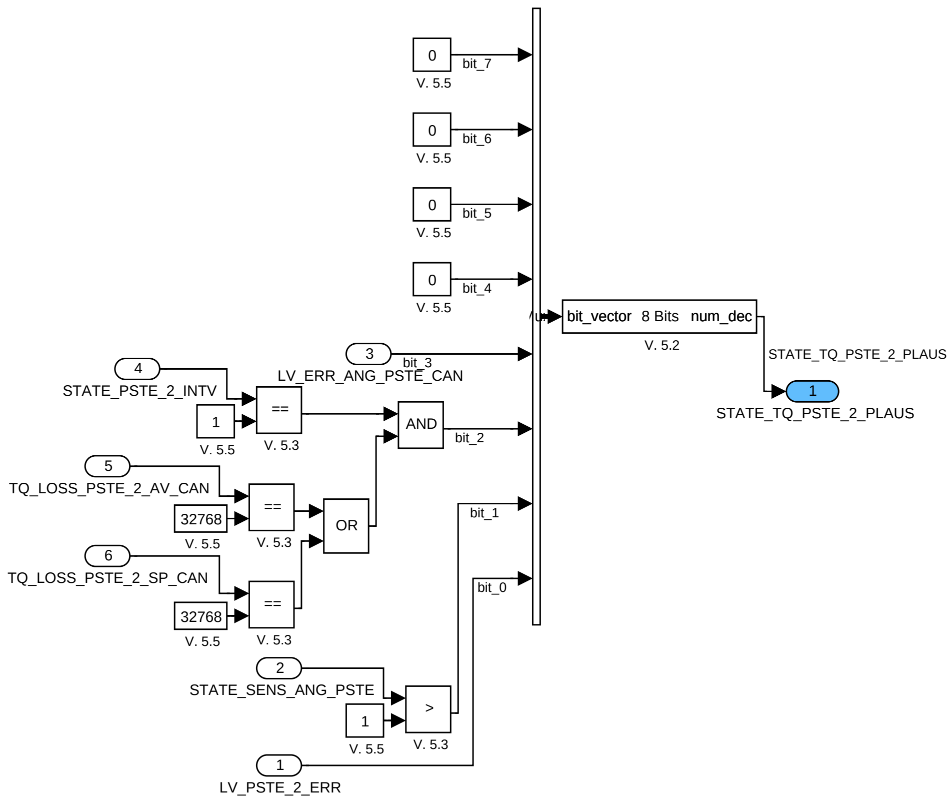

Figure D.7.26: :

D.7.4 Torque Loss for active power steering via EHB3 Control Unit (BN 2000)

General information:

TQ_LOSS_PSTE_3 describes the torque demand and losses of active power steering. Torque loss and reserve are calculated via torque request from EHB3-CPU.

Application Conditions

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Initialization: RST
Recurrence: 10MS
Activation: LV_IGK & & LV_VAR_PSTE_3
Deactivation: never

Function description

D.7.4.1 Reset of variables.

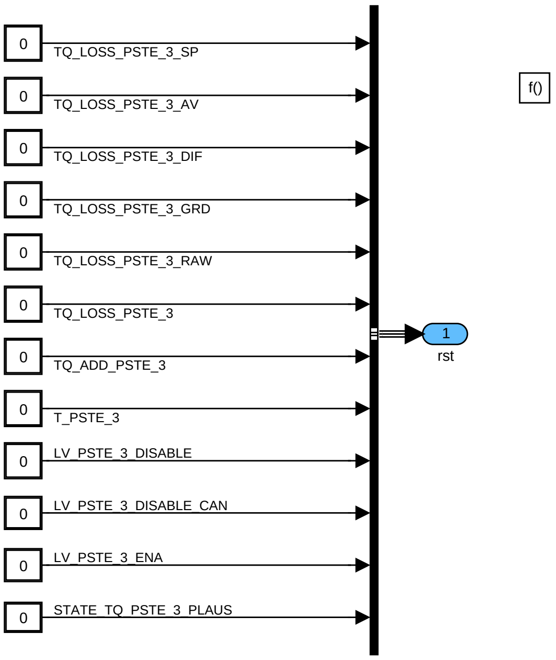

Figure D.7.27: :

Function description.

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D.7.4.2 Inhibition of active power steering

D.7.4.2.1 CAN environment error PSTE_3 inhibition:

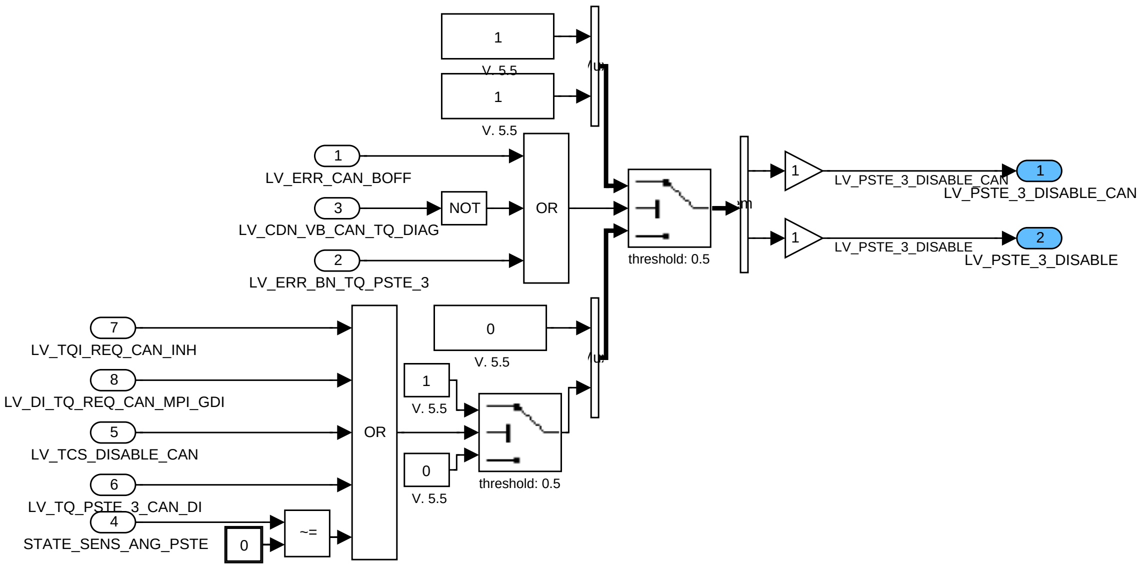

Figure D.7.28: :

D.7.4.3 Enable conditions PSTE_3 intervention

FUNCTION DESCRIPTION:
The State STATE_TQ_PSTE_3_PLAUS indicates the interrupted condition which is responsible for enable Bit = 0. The [x] Value shows the HEX adress inside the Bitwise coded State.

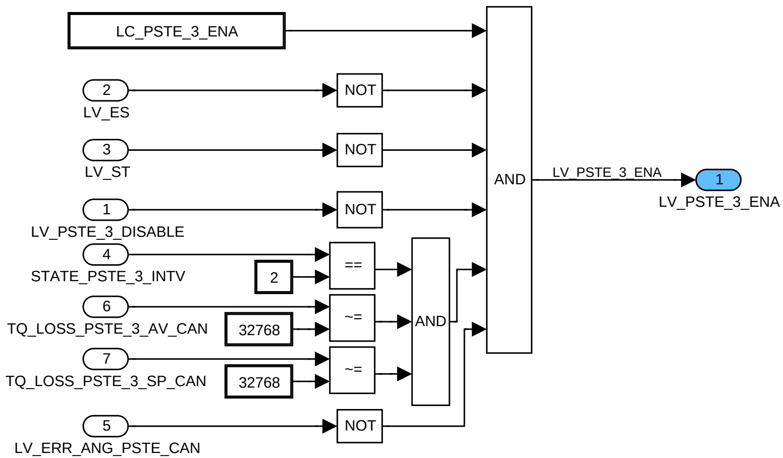

Figure D.7.29: :

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D.7.4.4 Torque loss active PSTE_3 (EHB3)

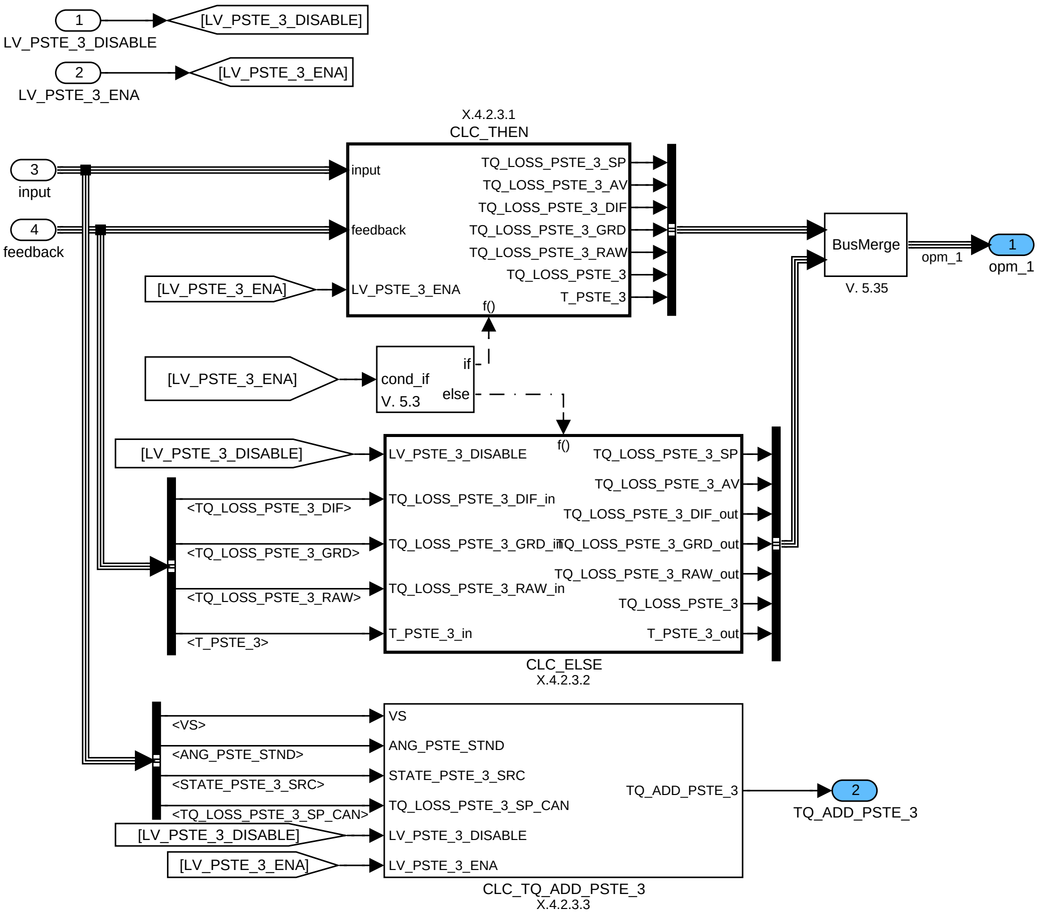

Figure D.7.30: :

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D.7.4.4.1 Calculation when LV_PSTE_3_ENA is set.

D.7.4.4.1.1 Calculation part.

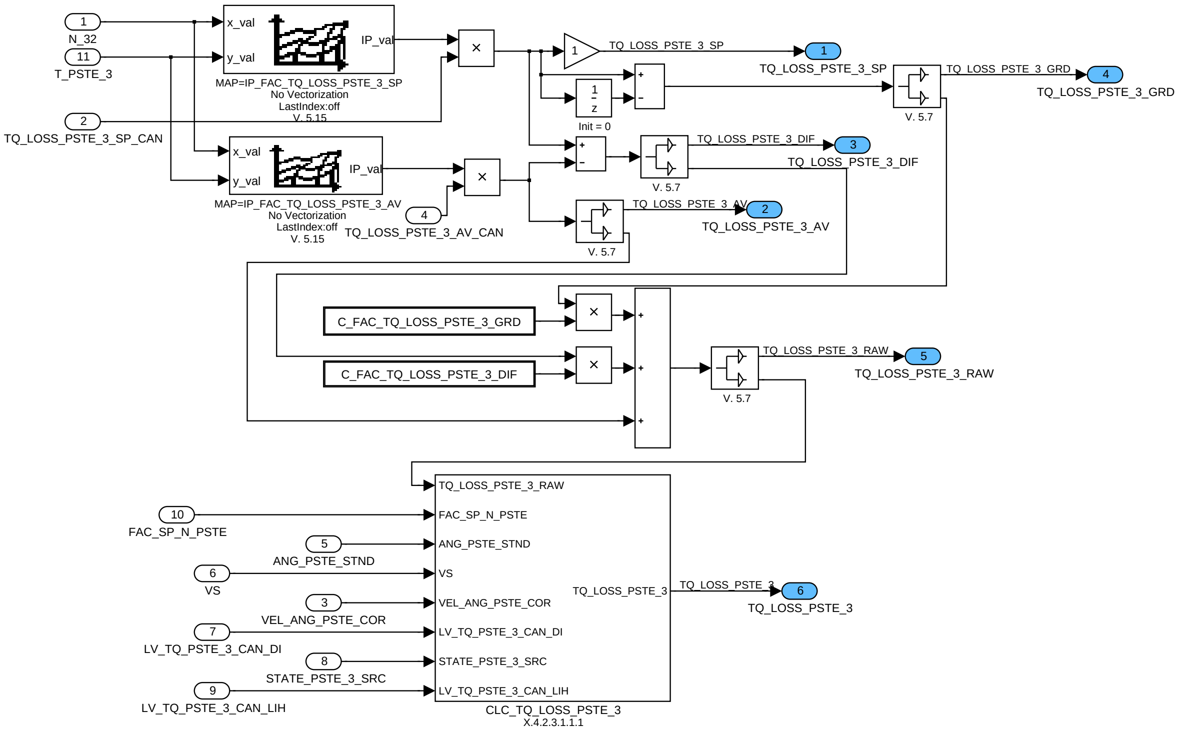

Figure D.7.31: :

D.7.4.4.1.1.1 Calculation of TQ_LOSS_PSTE_3

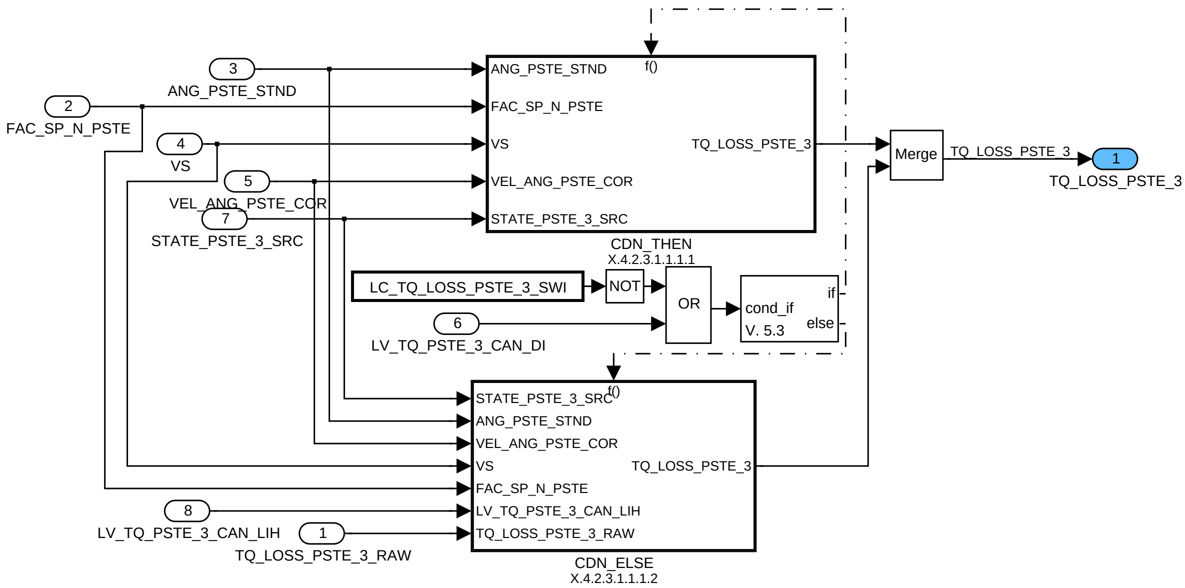

Figure D.7.32: :

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D.7.4.4.1.1.1.1 Calculation of TQ_LOSS_PSTE_3 depending on the state variable.

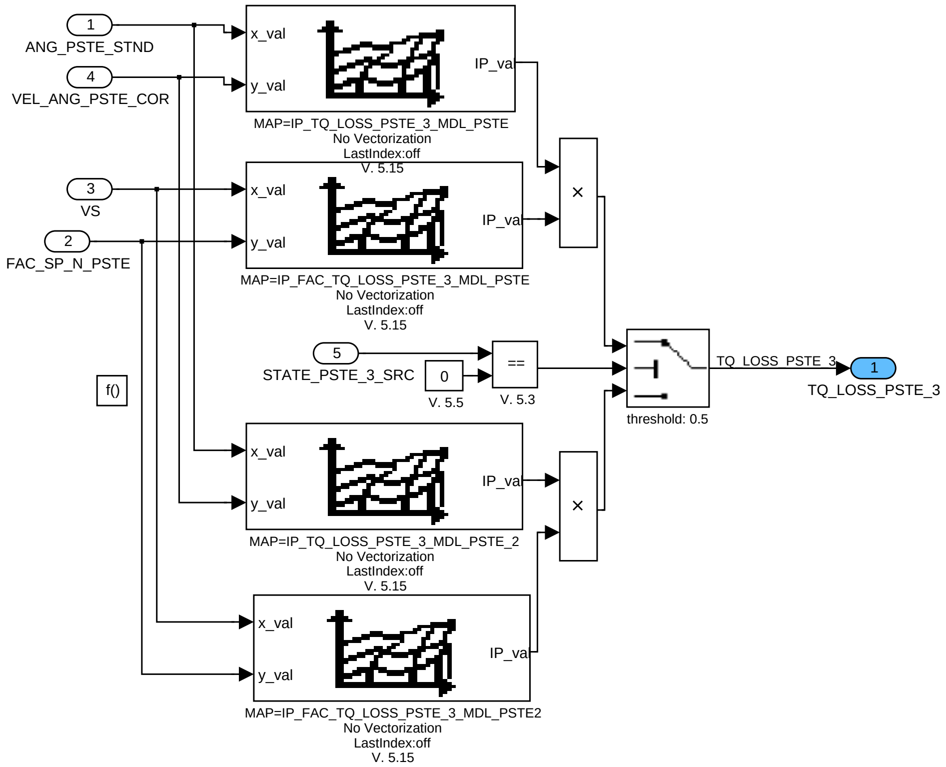

Figure D.7.33: :

D.7.4.4.1.1.1.2 Calculation of TQ_LOSS_PSTE_3 depending on LV_TQ_PSTE_3_CAN_LIH.

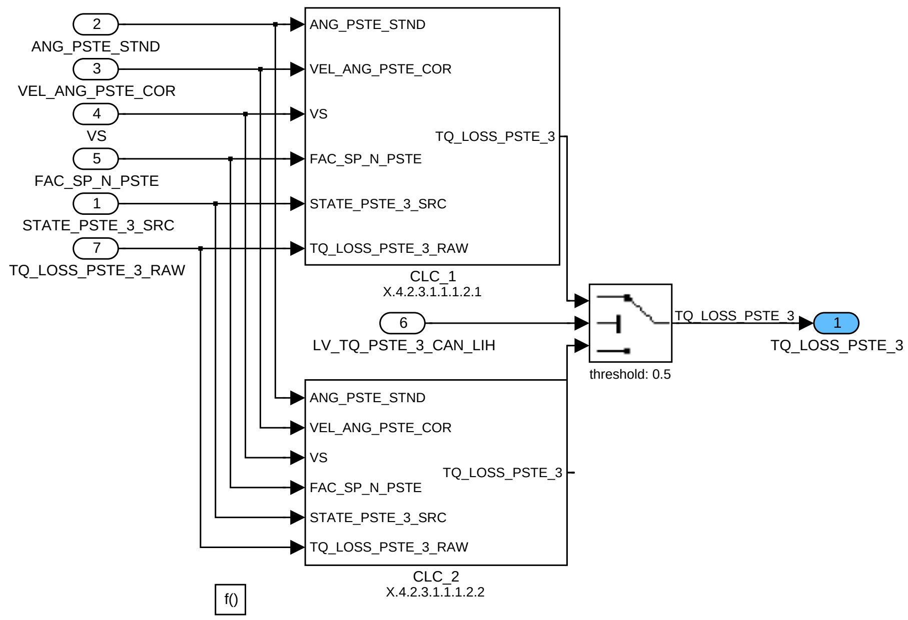

Figure D.7.34: :

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D.7.4.4.1.1.1.2.1 Calculation of TQ_LOSS_PSTE_3 depending on the state variable.

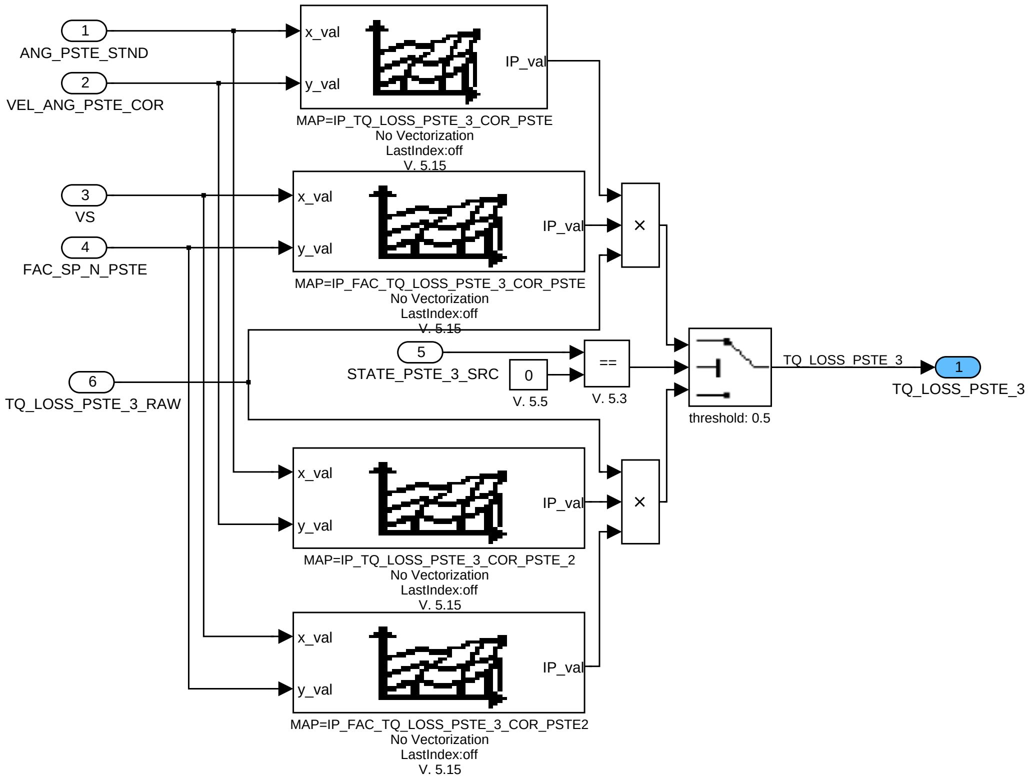

Figure D.7.35: :

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D.7.4.4.1.1.1.2.2 Calculation of TQ_LOSS_PSTE_3 depending on the state variable.

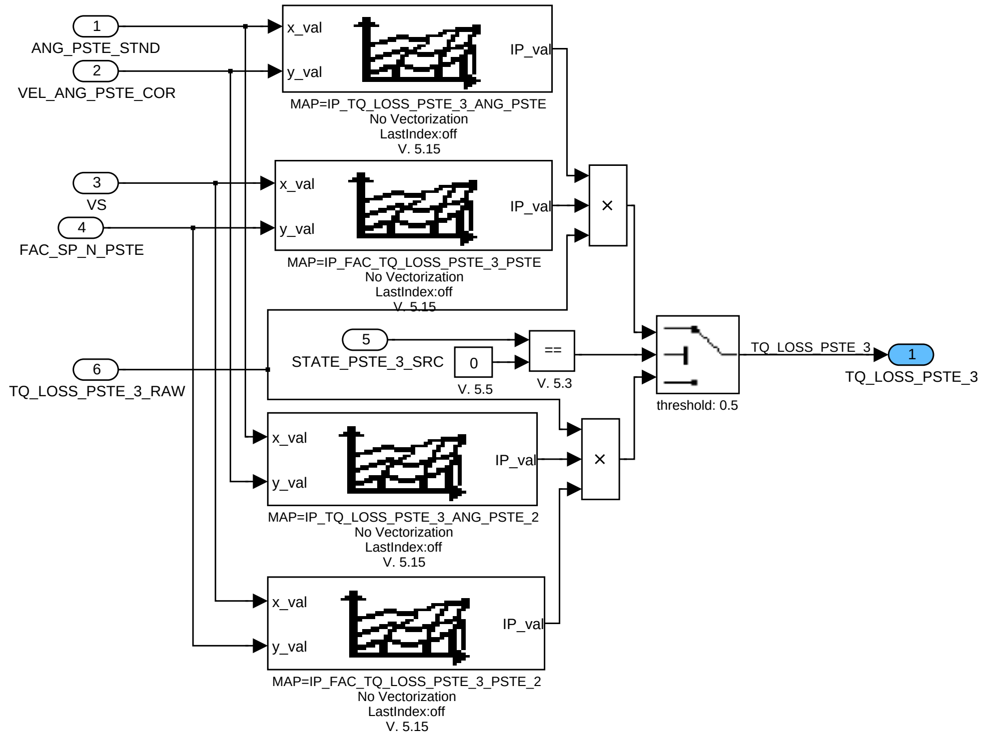

Figure D.7.36: :

D.7.4.4.1.2 Calculation of timer.

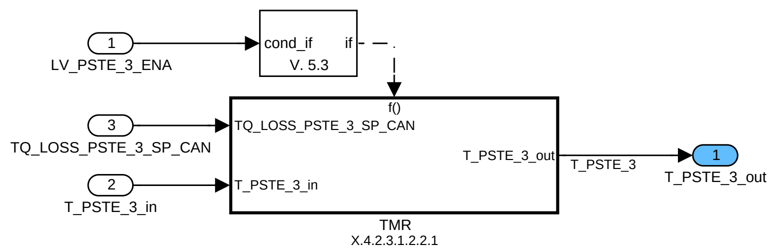

Figure D.7.37: :

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D.7.4.4.1.2.1 Calculation of timer T_PSTE_3.

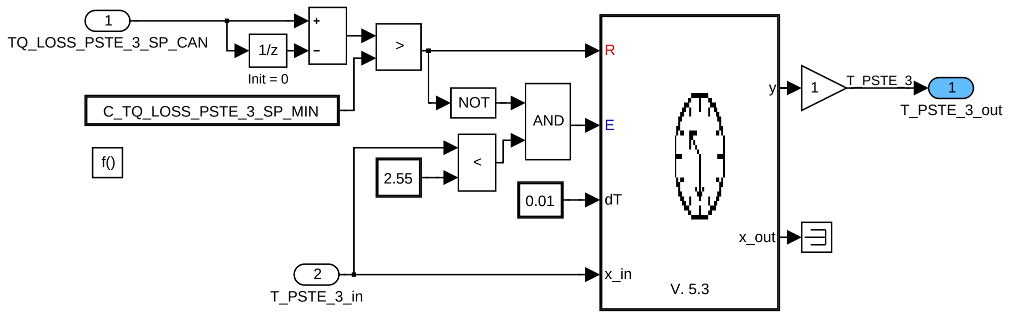

Figure D.7.38: :

D.7.4.4.2 Calculation depending on LV_PSTE_3_ENA.

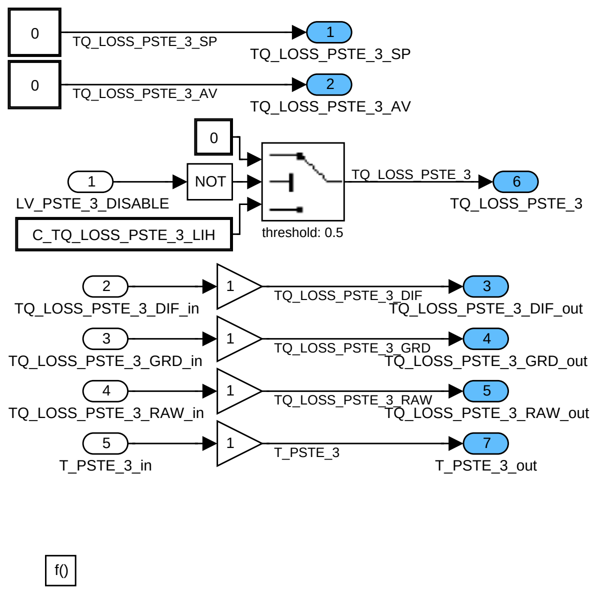

Figure D.7.39: :

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D.7.4.4.3 Calculation of TQ_ADD_PSTE_3

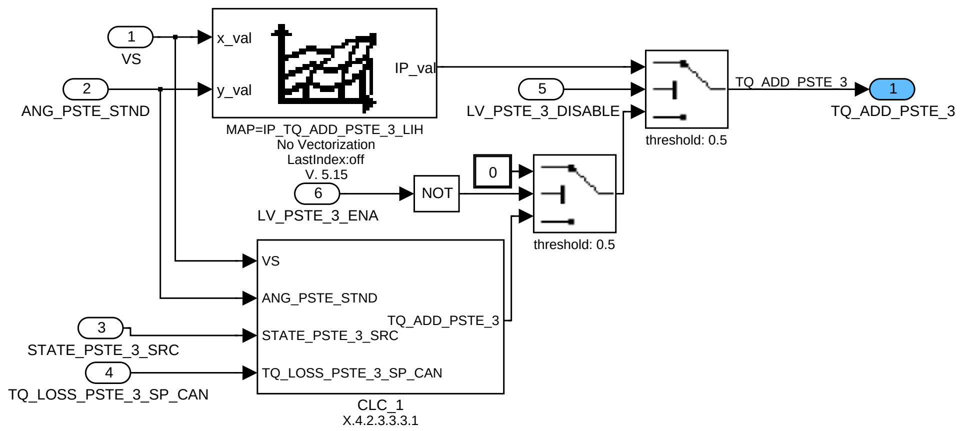

Figure D.7.40: :

D.7.4.4.3.1 Calculation of TQ_ADD_PSTE_3 depending on the state variable.

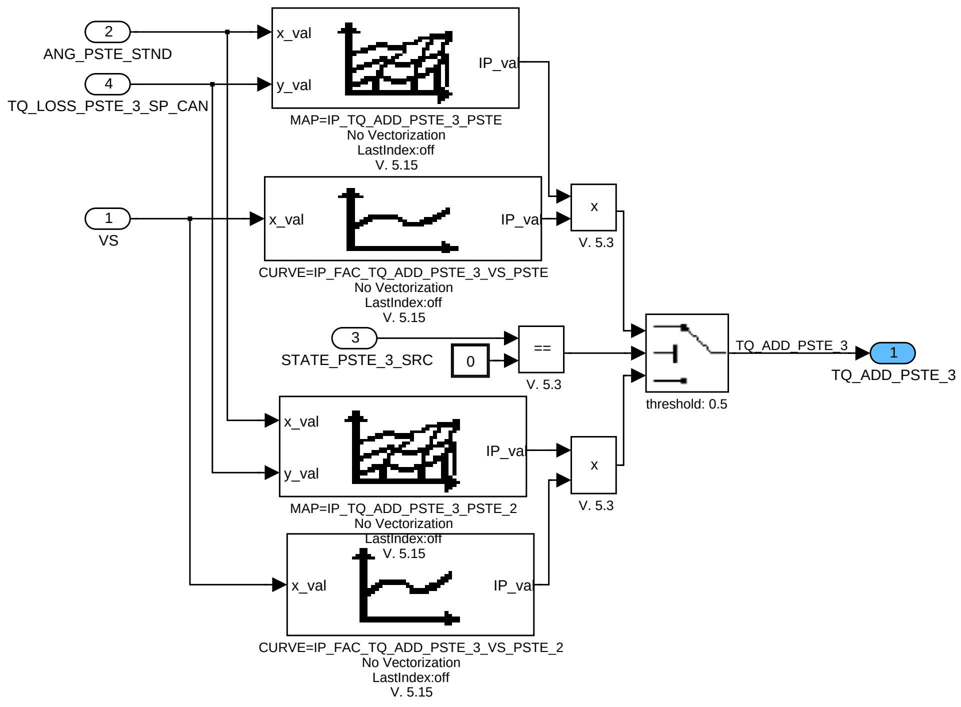

Figure D.7.41: :

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D.7.4.5 STATE_TQ_PSTE_3_PLAUS

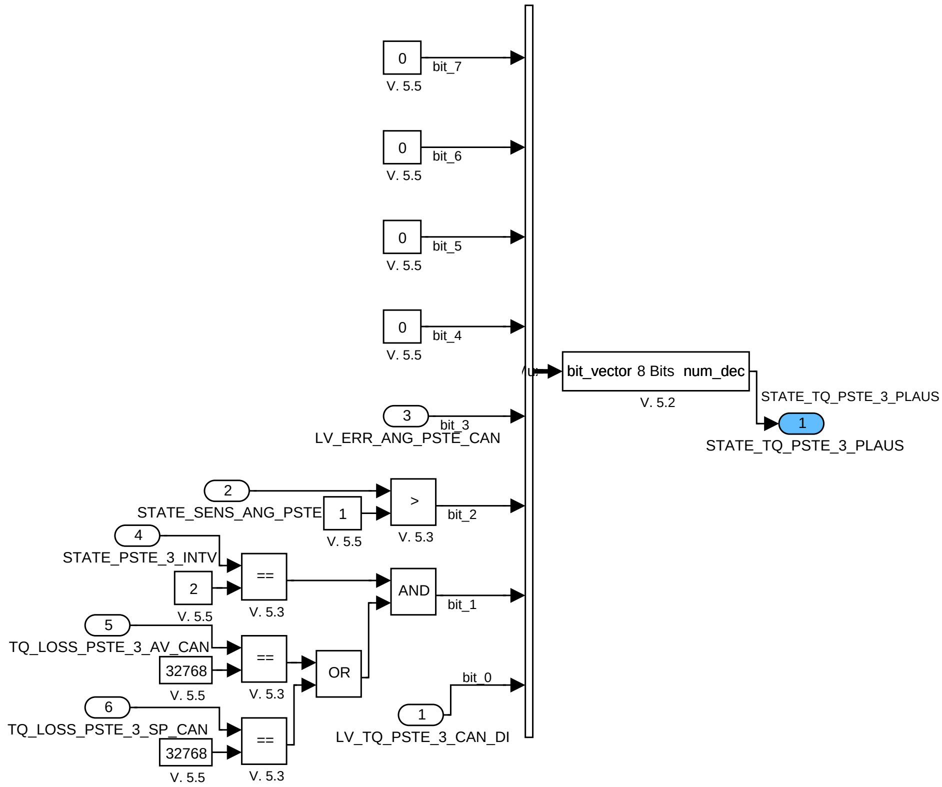

Figure D.7.42: :

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D.8 Torque loss - Anti roll stabilisation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ARS_DISABLE	O/V	0... 1H	0 ...1	1	-
logical variable for disabling ARS intervention due to EMS error					
LV_ARS_DISABLE_CAN	O/V	0... 1H	0 ...1	1	-
logical variable for disabling ARS intervention due to CAN error					
LV_ARS_ENA	O/V	0... 1H	0 ...1	1	-
logical variable for ARS intervention enabling					
LV_TQ_LOSS_ARS_IS_AD_INH	O/V	0... 1H	0 ...1	1	-
flag for inhibition of IS-control adaptations due to torque losses ARS					
LV_TQ_MAX_ARS	O/V	0... 1H	0 ...1	1	-
logical variable indicating maximum torque request - ARS					
STATE_TQ_ARS_PLAUS	O/V	0... FFH	0... 255	1	-
Bitwise coded State for ARS intervention state					
T_DLY_TQ_MAX_ARS	O/V	0... FFFFH	0... 655.35	0.01	s
Delay time for activation of LV_TQ_MAX_ARS					
TQ_LOSS_ARS	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque loss by ARS-intervention					
TQ_LOSS_ARS_AV_MAX	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
ARS actual value of torque loss - maximum (considering offset)					
TQ_LOSS_ARS_AV_MAX_1	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
ARS actual value of torque loss - maximum					
TQ_LOSS_ARS_DIF	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Difference torque loss TQ_LOSS_ARS_SP_CAN - TQ_LOSS_ARS_AV_CAN					
TQ_LOSS_ARS_GRD	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque loss gradient - ARS					
TQ_LOSS_ARS_SP_CAN_MAX	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
torque loss SP via CAN by ARS-intervention					
TQ_LOSS_ARS_SP_MAX	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
ARS target torque loss - maximum (considering offset)					
TQ_LOSS_ARS_SP_MAX_1	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
ARS target torque loss - maximum					

Input data:

AC_VEH_TRV_TCS {p. 1561}	LV_CDN_VB_CAN_TQ_ DIAG {p. 1185}	LV_DI_TQ_REQ_CAN_ MPI_GDI {p. 800}	LV_ERR_BN_ARS {p. 4869}
LV_ERR_BN_VS_TCS {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_TQ_LOSS_ARS_ AV_CAN {p. 1565}	LV_ERR_TQ_LOSS_ARS_ SP_CAN {p. 1565}

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LV_ES {p. 1720}	LV_IGK {p. 906}	LV_ST {p. 1720}	LV_TCS_DISABLE_CAN {p. 6741}
LV_TQI_REQ_CAN_INH {p. 6687}	LV_VAR_ARS {p. 655}	LV_VAR_BN {p. 655}	N_32 {p. 1525}
STATE_ARS_CAN {p. 1570}	TQ_LOSS_ARS_AV_CAN {p. 1581}	TQ_LOSS_ARS_SP_CAN {p. 1581}	VS_FIL {p. 1176}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_LOSS_ARS_DIF	-	0... FFFFH	0... 0.99998	15.3e-6	-
ARS torque loss actual value - correction factor					
C_FAC_TQ_LOSS_ARS_GRD	-	0... FFFFH	0... 0.99998	15.3e-6	-
ARS torque loss gradient - correction factor					
C_N_MAX_ARS_DIAG	-	0... FFH	0... 8160	32	rpm
engine speed limit threshold for diagnosis					
C_T_ARS_DLY_AD	-	0... FFH	0... 2.55	0.01	s
threshold torque losses PSTE for inhibition of IS-control adaptations					
C_T_DLY_TQ_MAX_ARS	-	0... FFFFH	0... 655.35	0.01	s
Time delay for activating LV_TQ_MAX_ARS					
C_TQ_LOSS_ARS_AD	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
threshold torque losses PSTE for inhibition of IS-control adaptations					
C_TQ_LOSS_ARS_AV_OFS	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Offset for TQ_LOSS_ARS_AV					
C_TQ_LOSS_ARS_SP_OFS	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Offset for TQ_LOSS_ARS_SP					
C_V_MAX_ARS_DIAG	-	0... FFFFH	0... 511.99218	0.0078125	km/h
filtered vehicle speed threshold for diagnosis					
IP_TQ_LOSS_ARS_AV_CAN_MAX	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_TQ_LOSS_ARS_AV_CAN_MAX	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_N_32__TQ_LOSS_ARS	4	0... FFH	0... 8160	32	rpm
ARS torque loss depending on torque loss (AV) via CAN and engine speed					
IP_TQ_LOSS_ARS_AV_MAX	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_AC_VEH_TRV_TCS	8	10... FFF0H	-51.175 ...51.175	0.0015625	m/s**2
LDP_VS_FIL	8	0... FFFFH	0... 511.99218	0.0078125	km/h
ARS Actual value of torque loss - maximum					
IP_TQ_LOSS_ARS_SP_CAN_MAX	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_TQ_LOSS_ARS_SP_CAN	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_N_32__TQ_LOSS_ARS	4	0... FFH	0... 8160	32	rpm
ARS torque loss depending on torque loss (SP) via CAN and engine speed					
IP_TQ_LOSS_ARS_SP_MAX	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDPM_AC_VEH_TRV_TCS	8	10... FFF0H	-51.175 ...51.175	0.0015625	m/s**2
LDP_VS_FIL	8	0... FFFFH	0... 511.99218	0.0078125	km/h
ARS target torque loss - maximum					

FUNCTION DESCRIPTION:

General information:

TQ_LOSS_ARS represents the engine torque loss due to power consumption by the ARS control unit during anti-roll-stabilisation intervention.

D.8.1 Enable conditions

D.8.1.1 Inhibitation ARS intervention

FUNCTION DESCRIPTION:

Application conditions

Initialisation: LV_ARS_DISABLE =0 , LV_ARS_DISABLE_CAN = 0 **at reset**

Update Rate: 10 ms

Activation: *LV_VAR_BN = 1* ***and*** *LV_IGK = 1*

Deactivation: –

Formula section:

CAN environment error ARS inhibition:

If LV_ERR_CAN_BOFF = 1 **or**
LV_ERR_BN_ARS = 1 **or**
LV_CDN_VB_CAN_TQ_DIAG = 0
Then LV_ARS_DISABLE_CAN = 1
Else LV_ARS_DISABLE_CAN = 0
Endif

General ARS inhibition:

If LV_TQI_REQ_CAN_INH = 1 **or**
LV_DI_TQ_REQ_CAN_MPI_GDI = 1 **or**
LV_ARS_DISABLE_CAN = 1 **or**
LV_TCS_DISABLE_CAN = 1 **or**
LV_ERR_TQ_LOSS_ARS_SP_CAN = 1 **or**
LV_ERR_TQ_LOSS_ARS_AV_CAN = 1
Then LV_ARS_DISABLE = 1
Else LV_ARS_DISABLE = 0

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Endif

D.8.1.2 Enable conditions ARS intervention

FUNCTION DESCRIPTION:

The State STATE_TQ_ARS_PLAUS indicates the interrupted condition which is responsible for enable Bit = 0. The [x] Value shows the HEX adress inside the Bitwise coded State.

Application conditions

Initialisation:	`LV_ARS_ENA = 0` **at reset**
Update Rate:	`10 ms`
Activation:	*LV_VAR_ARS* **and** *LV_IGK = 1*
Deactivation:	-

Formula section:

Enable conditions for ARS intervention:

If LV_ES = 0 **and**
LV_ST = 0 **and**
LV_ARS_DISABLE = 0 **and**
LV_TQ_MAX_ARS = 0 **and**
STATE_ARS_CAN = 01H
Then LV_ARS_ENA = 1
Else LV_ARS_ENA = 0

STATE_TQ_ARS_PLAUS:

If LV_ERR_TQ_LOSS_ARS_SP_CAN = 1 **or** BIT [00] set
LV_ERR_TQ_LOSS_ARS_AV_CAN = 1 BIT [01] set
If LV_TQ_MAX_ARS = 1 BIT [02] set
Then If STATE_ARS_CAN = 01H BIT [03] set

D.8.2 Maximum Torque Request

FUNCTION DESCRIPTION:

If either:

- the target torque loss via CAN is bigger than the minimum selection of maximum target torque loss (depending on VS_FIL, AC_VEH_TRV_TCS) and 100 Nm

or:

- the actual value of torque loss via CAN is bigger than the minimum selection of the actual value (maximum) of torque loss (depending on VS_FIL, AC_VEH_TRV_TCS) and 100 Nm

then after a time delay (C_T_DLY_TQ_MAX_ARS) LV_MAX_ARS is set to 1.
LV_MAX_ARS is indicating whether maximum torque request is present or not. The logical variable is used for validating the status of ARS.

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Application conditions

Initialisation: `LV_TQ_MAX_ARS = 0`
`TQ_LOSS_ ARS_SP_MAX = 0 Nm`
`TQ_LOSS_ARS_SP_MAX_1 = 0 Nm`
`TQ_LOSS_ARS_AV_MAX = 0 Nm`
`TQ_LOSS_ARS_AV_MAX_1 = 0 Nm`
`T_DLY_TQ_MAX_ARS = C_T_DLY_TQ_MAX_ARS` **at reset**

Update Rate: `10 ms`

Activation: *LV_VAR_ARS = 1* **and** *LV_IGK = 1*

Deactivation: –

Formula section:

If VS_FIL ≤ C_V_MAX_ARS_DIAG **and**
N_32 < C_N_MAX_ARS_DIAG
Then TQ_LOSS_ARS_SP_MAX = TQ_LOSS_ARS_SP_MAX_1 + C_TQ_LOSS_ARS_SP_OFS
TQ_LOSS_ARS_AV_MAX = TQ_LOSS_ARS_AV_MAX_1 + C_TQ_LOSS_ARS_AV_OFS
Else TQ_LOSS_ARS_SP_MAX = TQ_LOSS_ARS_SP_MAX_1
TQ_LOSS_ARS_AV_MAX = TQ_LOSS_ARS_AV_MAX_1
Endif

TQ_LOSS_ARS_SP_MAX_1 = IP_TQ_LOSS_ARS_SP_MAX
TQ_LOSS_ARS_AV_MAX_1 = IP_TQ_LOSS_ARS_AV_MAX

If TQ_LOSS_ARS_SP_CAN > MIN (TQ_LOSS_ARS_SP_MAX, 100 Nm) **or**
TQ_LOSS_ARS_AV_CAN > MIN (TQ_LOSS_ARS_AV_MAX, 100 Nm)
Then T_DLY_TQ_MAX_ARS = T_DLY_TQ_MAX_ARS - 10ms
If T_DLY_TQ_MAX_ARS ≤ 0
Then LV_TQ_MAX_ARS = 1
Else LV_TQ_MAX_ARS = 0
Endif
Else T_DLY_TQ_MAX_ARS = C_T_DLY_TQ_MAX_ARS
LV_TQ_MAX_ARS = 0
Endif

D.8.3 Torque Loss ARS

FUNCTION DESCRIPTION:

General information:

TQ_LOSS_ARS represents the engine torque loss due to power consumption by the ARS control unit during anti-roll-stabilisation intervention.

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Application conditions

Activation: *LV_VAR_ARS = 1* **and** *LV_IGK = 1*

Deactivation: –

Initialisation: TQ_LOSS_ARS = 0 Nm **at reset**

Update Rate: 10 ms

Formula section:

Calculation of TQ_LOSS_ARS:

If LV_ARS_ENA = 1
Then TQ_LOSS_ARS_SP_CAN_MAX = IP_TQ_LOSS_ARS_SP_CAN_MAX
TQ_LOSS_ARS_GRD = TQ_LOSS_ARS_SP_CAN_MAX$_N$ -
TQ_LOSS_ARS_SP_CAN_MAX $_{N-1}$
TQ_LOSS_ARS_DIF = IP_TQ_LOSS_ARS_SP_CAN_MAX -
IP_TQ_LOSS_ARS_AV_CAN_MAX
TQ_LOSS_ARS = TQ_LOSS_ARS_DIF * C_FAC_TQ_LOSS_ARS_DIF +
IP_TQ_LOSS_ARS_AV_CAN_MAX + TQ_LOSS_ARS_GRD *
C_FAC_TQ_LOSS_ARS_GRD
Else TQ_LOSS_ARS_GRD = 0 Nm
TQ_LOSS_ARS_DIF = 0 Nm
TQ_LOSS_ARS = 0 Nm
Endif

Condition for inhibition of IS-control adaptations:

If TQ_LOSS_ARS $<$ C_TQ_LOSS_ARS_AD
Then T_TQ_LOSS_ARS_DLY_AD = C_T_ARS_DLY_AD
LV_TQ_LOSS_ARS_IS_AD_INH = 1
Else **If** T_TQ_LOSS_ARS_DLY_AD $>$ 0
Then decrement timer to zero
Else LV_TQ_LOSS_ARS_IS_AD_INH = 0
Endif
Endif

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D.9 Actual engine torque

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_TOT_AV	V	0... FFFF H	0... 1.999969	30.518e-6	-
Total actual efficiency (in homogeneous mode)					
TQ_AV	O/V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Actual engine torque static at clutch					
TQE	O/V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Effective engine torque at clutch					
TQE_DIF	V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Difference effective engine torque at clutch					

Input data:

EFF_IGA_AV {p. 1845}	EFF_LAMB_AV {p. 8379}	EFF_SCC_AV {p. 6665}	LV_HOM_RUN {p. 8136}
LV_S_ACT {p. 8137}	N_GRD {p. 1525}	TQ_LOSS {p. 8385}	TQI_AV {p. 981}
TQI_AV_HOM {p. 8380}	TQI_AV_S {p. 8380}	TQI_REF {p. 8380}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQE	-	0... FF H	0... 0.249	976.47e-6	kg*m^2/s
Effective engine torque at clutch					

FUNCTION DESCRIPTION:

General information:

TQI_AV is the actual indicated engine torque produces either in homogeneous or stratified combustion mode. The combustion mode is indicated by the logical variable LV_S_ACT (1 ... stratified combustion; 0 ... homogeneous combustion). TQ_AV is the actual static effective torque at clutch. TQE is the actual effective torque at clutch inclusive inertia.
These values are used for external units (e.g. traction control and gear box) as a feedback signal.

Application conditions

Activation: *at every engine state*

Deactivation: -

Initialization at reset
TQ_AV = TQE = TQE_DIF = 0 Nm

Update rate: 10 ms

Formula section:

EFF_TOT_AV = EFF_IGA_AV * EFF_SCC_AV * EFF_LAMB_AV
TQ_AV = TQI_AV + TQ_LOSS
TQE_DIF = C_FAC_TQE * N_GRD
TQE = TQ_AV - TQE_DIF

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The dynamic torque is derived as follows:

TQE_DIF = J (kg*m^2) * d/dt (1/s^2)

TQE_DIF = J (kg*m^2) * /30*N_GRD (1/min/s)

TQE_DIF = C_FAC_TQE (kg*m^2*min) * N_GRD (1/min/s)

C_FAC_TQE = J (kg*m^2) * /30

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D.10 Initialization module

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ACP	O/V	0... FFH	0... 127.5	0.5	bar
AC-fluid presssure					
ACP_MMV	O/V	0... FFH	0... 127.5	0.5	bar
AC-fluid presssure					
EFF_EGR_S	O/V	0... FFFFH	0... 1.999969	30.517e-6	-
No description given					
EFF_PHA_S	O/V	0... FFFFH	0... 1.999969	30.517e-6	-
No description given					
LAMB_BAS_COR_MAX	O/V	0... 7FFFH	0... 31.9990234	0,00098	-
Maximum value basic lambda value					
LV_ACP_ORNG	O/V	0... 1H	0 ...1	1	-
No description given					
LV_AMT_ACT	O/V	0... 1H	0 ...1	1	-
AMT intervention active					
LV_CAN_GS_ACK	O/V	0... 1H	0 ...1	1	-
No description given					
LV_ERR_ACP	O/V	0... 1H	0 ...1	1	-
No description given					
LV_GS_ACT	O/V	0... 1H	0 ...1	1	-
Gs intervention active					
LV_IGA_CH_SO2P_STB	O/V	0... 1H	0 ...1	1	-
No description given					
LV_TQ_GS_IGA	O/V	0... 1H	0 ...1	1	-
Torque intervention due gear shift about IGA					
LV_TQ_GS_SCC	O/V	0... 1H	0 ...1	1	-
Torque intervention due gear shift about SCC					
LV_TQ_SCC_INH	O/V	0... 1H	0 ...1	1	-
No description given					
LV_TQ_SCC_REQ	O/V	0... 1H	0 ...1	1	-
No description given					
TACE	O/V	0... FEH	-48... 142.5	0,75	°C
ACC LOW pressure side temperature					
TQ_AD_ADD_S_SWI	O/V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
Adaptive engine torque value for switch between hom. and strat.					
TQ_ADD_REQ_ACT_FIL_CH	O/V	8000... 7FFFH	-1024... 1023.97	0.03125	Nm
No description given					
TQ_LOSS_CWP_EL	O/V	8000... 0H	-1024 ...0	0.03125	Nm
Engine torque losses electric water pump					
TQ_LOSS_SCHA	O/V	8000... 0H	-1024 ...0	0.03125	Nm
Torque losses super-charger					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_LOSS_THERMO	O/V	8000... 0H	-1024 ...0	0.03125	Nm
Engine torque losses thermostat					
TQ_LOSS_WIN_HEAT	O/V	8000... 0H	-1024 ...0	0.03125	Nm
Engine torque losses rear window heater					
TQI_CAT_PROT	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
No description given					
TQI_VS_MAX	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
No description given					

Input data:

LV_AMT_DEC_ACT {p. 799}	LV_AMT_INC_ACT {p. 799}	LV_GS_DEC_ACT {p. 6718}	LV_S_RUN {p. 8137}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQ_AD_ADD_S_SWI	-	8000... 7FFFH	-1024... 1023.97	0,03125	Nm
Adaptive engine torque value for switch between hom. and strat.					

FUNCTION DESCRIPTION:

General information:

The initialization module is a temporary software module which is gradually reduced in that amount how functionallity of the MS-CP software is growing.
It generates output data (torque values, state bits and other values) as substitute input values for existing SW modules. The source modules will be realized in future.

Application conditions

Recurrence:
Activation: *at every engine operating state*

Initialisation:

```
at reset
ACP   = ACP_MMV   =  0     bar
TACE          =     142,5 °C
EFF_EGR_S     =     1
EFF_PHA_S     =     1
LAMB_BAS_COR_MAX   =  2
LV_ACP_ORNG     =     1
LV_CAN_GS_ACK   =  0
LV_TQ_FAST_ENA   =  1
LV_TQ_IGA_ENA     =     1
LV_TQ_SCC_INH     =     0
LV_TQ_SCC_ENA   =  0
LV_ERR_ACP     =     0
TQ_AD_ADD_S_SWI   =  C_TQ_AD_ADD_S_SWI
TQ_LOSS_SCHA     =     0     Nm
TQ_LOSS_THERMO    =  0     Nm
TQ_LOSS_WIN_HEAT    =  0     Nm
TQ_LOSS_CWP_EL    =  0     Nm
TQI_CAT_PROT     =     1024     Nm
```

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```
TQI_VS_MAX    =     1024     Nm
LV_TQ_GS_IGA = LV_TQ_GS_SCC =  LV_GS_ACT
LV_GS_ACT          =  LV_GS_DEC_ACT
LV_AMT_ACT  =  LV_AMT_INC_ACT or LV_AMT_DEC_ACT
LV_IGA_CH_SO2P_STB  =0
```

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D.11 Reference and basic torque

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_TOT_BAS	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Total basic efficiency					
EFF_TOT_BAS_SLOW	O/V	0... FFFFH	0... 1.99996948	305.176e3	-
Total basic efficiency for feedback to slow torque path					
TQI_BAS	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Basic indicated engine torque					
TQI_REF_IGA	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Indicated engine torque corrected by EFF_IGA_BAS_COR					
TQI_REF_IGA_LAMB	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Indicated engine torque corrected by EFF_IGA_BAS_COR and EFF_LAMB_BAS					
TQI_REF_IGA_MIN_LAMB	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Indicated engine torque corrected by EFF_IGA_MIN and EFF_LAMB_BAS					
TQI_REF_IGA_SCC	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Indicated engine torque corrected by EFF_IGA_BAS_COR and EFF_SCC_BAS					
TQI_REF_LAMB	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Indicated engine torque corrected by EFF_LAMB_BAS					
TQI_REF_LAMB_SCC	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Indicated engine torque corrected by EFF_LAMB_BAS and EFF_SCC_BAS					
TQI_REF_SCC	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Indicated engine torque corrected by EFF_SCC_BAS					

Input data:

EFF_IGA_BAS_COR {p. 1845}	EFF_IGA_BAS_COR_ KNK_FIL {p. 1845}	EFF_IGA_MIN {p. 1845}	EFF_LAMB_AV {p. 8379}
EFF_LAMB_BAS_COR {p. 8379}	EFF_LAMB_SP_BAS {p. 8379}	EFF_SCC_AV {p. 6665}	EFF_SCC_BAS {p. 6665}
LV_HOM_RUN {p. 8136}	TQI_REF {p. 8380}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_MOD_EFF_AV	-	0... 1H	0 ...1	1	-
Logical constant to switch to EFF_LAMB_AV and EFF_SCC_AV calculation mode for TQI_BAS					

D.11.1 TQDR_MD001

General information:
This module delivers the basic indicated engine torque TQI_BAS and other basic torque values for the torque model in homogeneous combustion mode.

Application Condition

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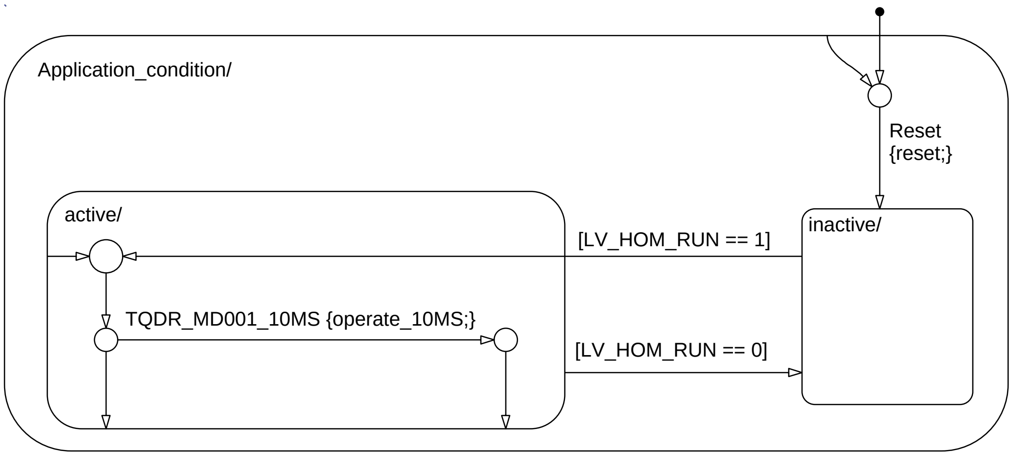

Figure D.11.1: TQDR_MD001/APP_CDN/APPCND

Function Description

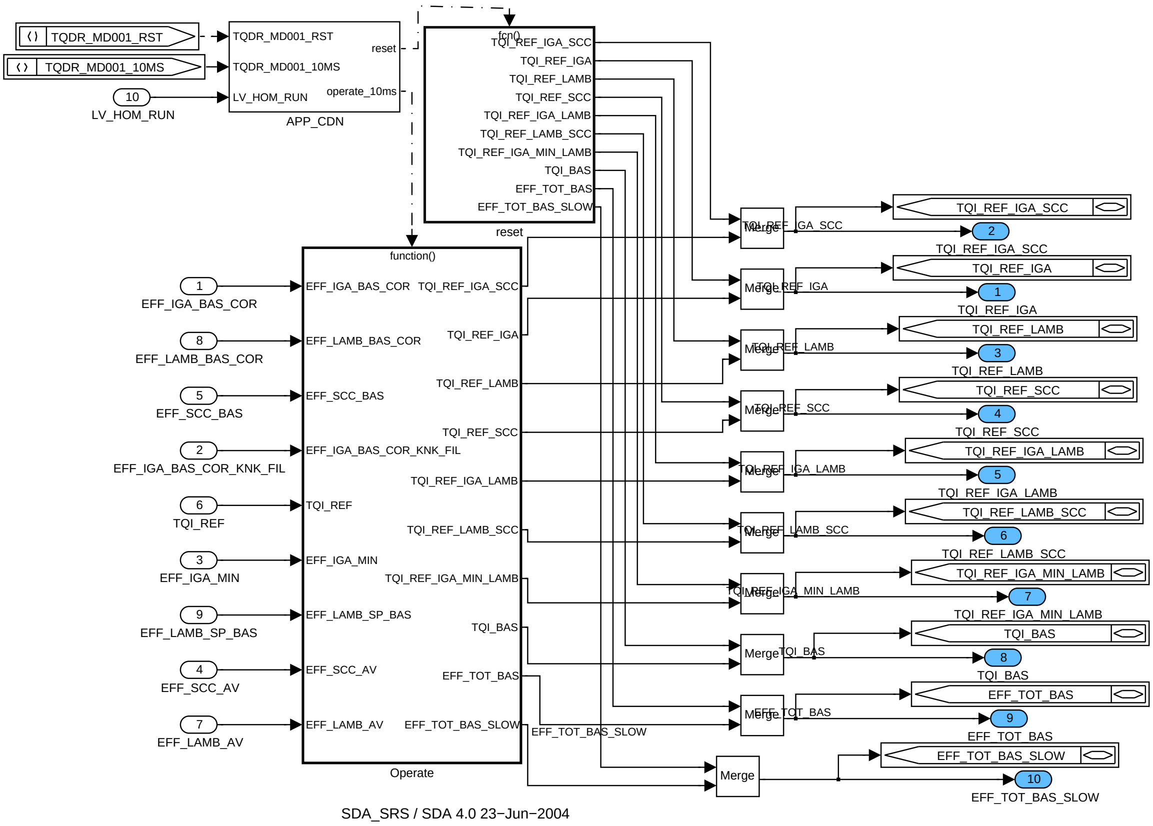

Figure D.11.2: TQDR_MD001

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D.11.1.1 SUBFUNCTION: Operate

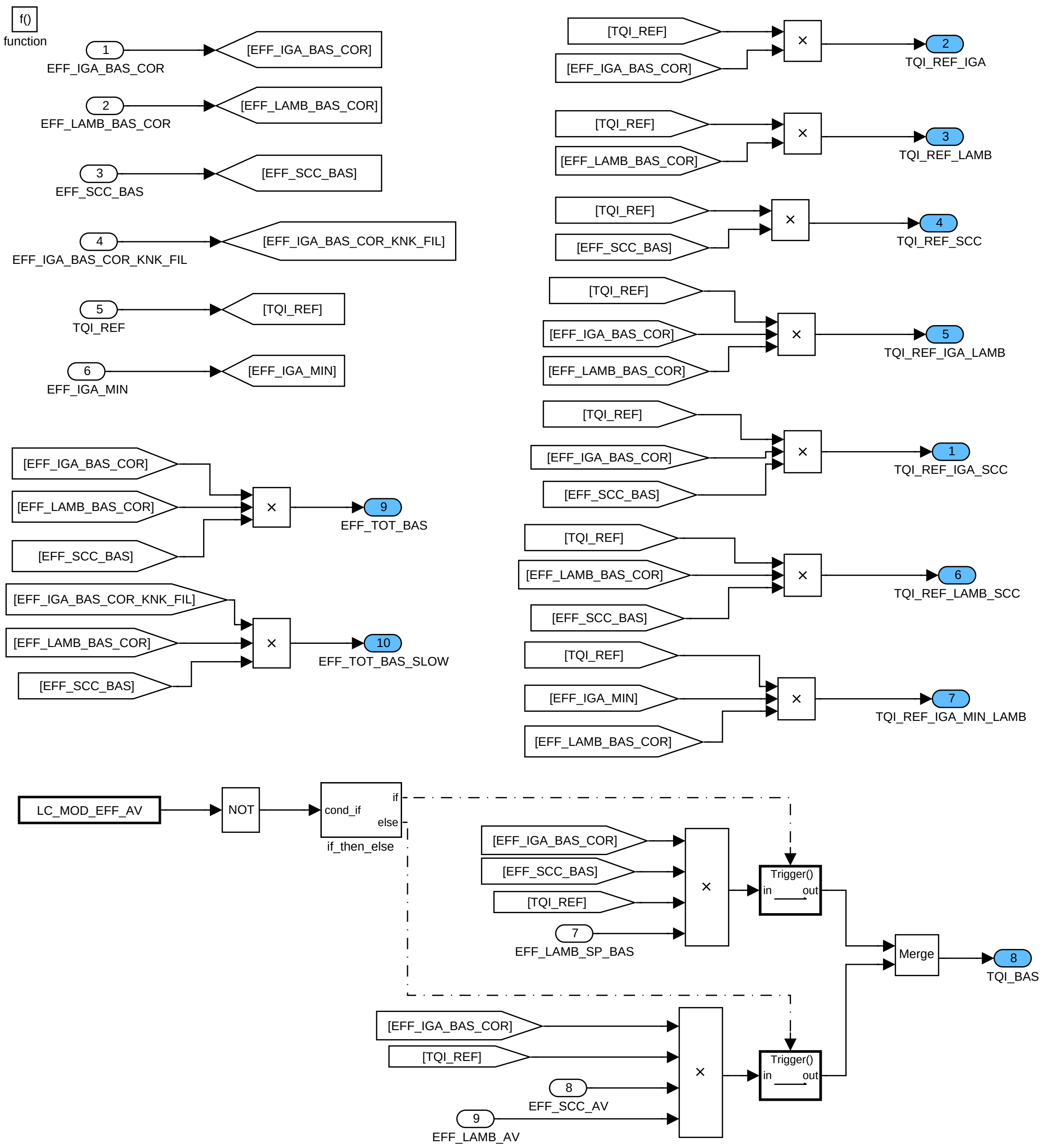

Figure D.11.3: TQDR_MD001/Operate

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D.11.1.2 SUBFUNCTION: reset

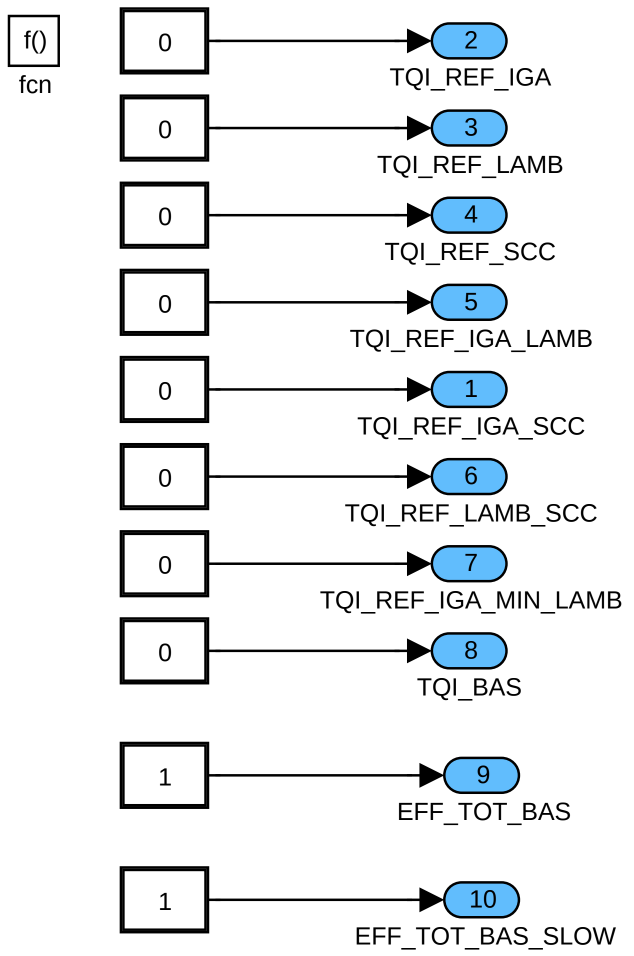

Figure D.11.4: TQDR_MD001/reset

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D.12 Torque based pattern calculation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_SCC_AV	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Actual efficiency fuel cut-off					
EFF_SCC_AV_CAN	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Actual efficiency fuel cut-off					
EFF_SCC_BAS	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
basic efficiency fuel cut-off					
EFF_SCC_SP	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Setpoint efficiency fuel cut-off pattern					
EFF_SCC_SP_HYS	V	0... FFFFH	0... 1.99996	30.5e-6	-
Setpoint efficiency fuel cut-off pattern with hysteresis					
FAC_IGA_MIN_TEG_IGA_BAS	V	0... FFFFH	0... 1.99996	30.5e-6	-
scaling factor for efficiency calculation with EFF_IGA_MIN_TEG and EFF_IGA_BAS_COR					
INH_IV_TOT	V	0... FFFFH	0... 65535	1	-
Overall shut off pattern (static and dynamic)					
LV_AUTH_TQ_PAT	V	0... 1H	0 ...1	1	-
logical variable for authorizing fuel cut-off pattern					
NR_PAT_SCC	O/V	0... FFH	0... 255	1	-
Selected index of fuel cut-off pattern					
SUM_INH_IV_BAS	V	0... 8H	0 ...8	1	-
Sum of cylinders which are shut off due to malfunctions					
SUM_INH_IV_TOT	V	0... 8H	0 ...8	1	-
Sum of cylinders which are shut off either by means of static or dynamic fuel cut-off pattern					

Input data:

EFF_IGA_BAS_COR {p. 1845}	EFF_IGA_MIN_TEG {p. 1845}	EFF_LAMB_BAS_COR {p. 8379}	EFF_SCC_BAS {p. 6665}
INH_IV {p. 2295}	INH_IV_DIAG_ERR {p. 4810}	INH_IV_IGC {p. 4780}	INH_IV_MIS {p. 6237}
INH_SWI_IV {p. 2295}	LV_AMT_ACT {p. 6658}	LV_ASR_ACT {p. 6741}	LV_DCC_INC_ACT {p. 6731}
LV_DCC_PUC_INH {p. 1565}	LV_FCUT_FAST {p. 6675}	LV_GS {p. 1565}	LV_GS_ACT {p. 6658}
LV_HOM_ACT {p. 8136}	LV_INH_FCUT_AMT {p. 803}	LV_INH_FCUT_GS {p. 6718}	LV_LDM_ACT {p. 6615}
LV_LDM_PUC_INH {p. 6615}	LV_N_MAX {p. 3779}	LV_TQ_GS_IGA {p. 6658}	LV_TQ_GS_SCC {p. 6658}
LV_TQ_LIM_INTV {p. 6692}	LV_TQ_SCC_INH {p. 6658}	LV_TQ_SCC_REQ {p. 6658}	LV_VAR_TCT {p. 656}
NC_CYL_NR {p. 1526}	TQI_MIN_S {p. 8380}	TQI_REF {p. 8380}	TQI_REQ_FAST {p. 8391}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EFF_SCC_BAS_MAN	-	0... FFFFH	0... 1.99996	30.5e-6	-
manually adjusted basic efficiency fuel cut-off					
C_EFF_SCC_SP_HYS	-	0... FFFFH	0... 1.99996	30.5e-6	-
hysteresis applied on EFF_SCC_SP for NR_PAT_SCC calculation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EFF_SCC_SP_MAN	-	0... FFFFH	0... 1.99996	30.5e-6	-
setpoint for efficiency of fuel cut-off set by application intervention					
C_FAC_IGA_MIN_TEG_IGA_BAS	-	0... 8000H	0 ...1	30.5e-6	-
Manually adjusted scaling factor for efficiency calculation with EFF_IGA_MIN_TEG and EFF_IGA_BAS_COR					
C_HYS_EFF_IGA_MIN_TEG	-	0... FFFFH	0... 1.99996	30.5e-6	-
hysteresis in falling direction for IGA_MIN_TEG correction					
C_MIN_DEC_EFF_IGA_MIN_TEG_1	-	0... FFFFH	0... 1.99996	30.5e-6	-
minimum decrement for first decrease phase					
C_MIN_DEC_EFF_IGA_MIN_TEG_2	-	0... FFFFH	0... 1.99996	30.5e-6	-
minimum decrement for second decrease phase					
ID_NR_PAT_SCC	-	0... FFH	0... 255	1	-
LDP_EFF_SCC_SP__NR_PAT_SCC	13	0... FFFFH	0... 1.99996	30.5e-6	-
SCC pattern depending on SCC efficiency					
LC_EFF_SCC_BAS_SWI_CLC	-	0... 1H	0 ...1	1	-
logical variable for deactivation of basic efficiency fuel cut-off calculation through missfire pattern					
LC_EFF_SCC_SP_MAN	-	0... 1H	0 ...1	1	-
flag for setting EFF_SCC_SP by application system					
LC_ENA_EFF_SCC_BAS_MAN	-	0... 1H	0 ...1	1	-
logical variable for manually adjusting basic efficiency fuel cut-off					
LC_ENA_FCUT_TOT_AMT	-	0... 1H	0 ...1	1	-
logical variable for setting scaling factor due to AMT					
LC_ENA_FCUT_TOT_ASR	-	0... 1H	0 ...1	1	-
logical variable for setting scaling factor due to ASR					
LC_ENA_FCUT_TOT_DCC	-	0... 1H	0 ...1	1	-
logical variable for setting scaling factor due to DCC					
LC_ENA_FCUT_TOT_FAST	-	0... 1H	0 ...1	1	-
logical variable for setting scaling factor due to fast fuel cut-off					
LC_ENA_FCUT_TOT_GS	-	0... 1H	0 ...1	1	-
logical variable for setting scaling factor due to gear shift intervention					
LC_ENA_FCUT_TOT_LDM	-	0... 1H	0 ...1	1	-
logical variable for setting scaling factor due to LDM					
LC_ENA_FCUT_TOT_N_MAX	-	0... 1H	0 ...1	1	-
logical variable for setting scaling factor due to engine speed limitation					
LC_INH_FCUT_AMT	-	0... 1H	0 ...1	1	-
inhibition flag for fuel cut-off due to AMT intervention					
LC_INH_FCUT_ASR	-	0... 1H	0 ...1	1	-
inhibition flag for fuel cut-off due to ASR					
LC_INH_FCUT_DCC	-	0... 1H	0 ...1	1	-
inhibition flag for fuel cut-off due to DCC intervention					
LC_INH_FCUT_FAST	-	0... 1H	0 ...1	1	-
inhibition flag for fuel cut-off due fast fuel cut-off					
LC_INH_FCUT_GS	-	0... 1H	0 ...1	1	-
inhibition flag for fuel cut-off due to gear shift intervention					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_INH_FCUT_GS_IGA	-	0... 1H	0 ...1	1	-
inhibition flag for fuel cut-off due to gear shift intervention with spark retarding					
LC_INH_FCUT_LDM	-	0... 1H	0 ...1	1	-
inhibition flag for fuel cut-off due to LDM intervention					
LC_INH_FCUT_N_MAX	-	0... 1H	0 ...1	1	-
inhibition flag for fuel cut-off due to speed limitation					
LC_INH_FCUT_TCT	-	0... 1H	0 ...1	1	-
Inhibition flag for fuel cut-off due to TCT intervention					
LC_TQ_SCC_ENA_MAN	-	0... 1H	0 ...1	1	-
flag for enabling SCC by application system					
LC_TQ_SCC_INH_MAN	-	0... 1H	0 ...1	1	-
inhibition flag for fuel cut-off due to torque management					

D.12.1 Pattern calculation

FUNCTION DESCRIPTION:

General information:

The objective of this module is to generate a torque intervention by fuel cut-off pattern.
This torque intervention could be caused by several conditions which are summarized in the label LV_AUTH_TQ_PAT (see chapter 1.1.1 "Authorization for single cylinder cut-off"). The label LV_FCUT_FAST can be used for project specific fast fuel cut-off conditions (see module "Torque based pattern calculation (Appl. Inc.)").
Based on the TQI_REQ_FAST and the TQI_REF corrected with the basic a/f ratio efficiency and the ignition angle efficiency an efficiency setpoint for the single cylinder cut-off EFF_SCC_SP is calculated, which leads to the pattern index NR_PAT_SCC (see chapter 1.1.3 "Setpoint efficiency fuel cut-off").
In general, a torque reduction could be realized by spark retarding or single cylinder cut-off. With the scaling factor FAC_IGA_MIN_TEG_IGA_BAS a scaling between earliest cylinder cut-off (no spark retarding) and latest cylinder cut-off (full spark retarding up to IGA_MIN) can be realized (see chapter 1.1.2 "Determination of scaling factor").

Application conditions

Activation: *at every engine state*

Deactivation: -

Initialization:
```
EFF_SCC_SP = 1 at reset
EFF_SCC_SP_HYS = 1 at reset
NR_PAT_SCC = 0 at reset
```

Update rate: `10 ms`

D.12.1.1 Authorization for single cylinder cut-off

General information:

The authorization flag is set depending on:

- a manual enabling => LV_TQ_SCC_ENA_MAN
- a request from traction control (ASR) => LV_ASR_ACT

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- a request from gear shift intervention (GS), if gear shift intervention is not explicitly inhibited because gear shift intervention should only work via spark retarding => LV_GS_ACT and LV_TQ_GS_IGA (see module "Torque request for gear shift intervention")
- a request from engine speed limitation (N_MAX) => LV_N_MAX
- other project specific requests for fast fuel cut-off => LV_FCUT_FAST (see module "Torque based pattern calculation (Appl. Inc.)")
- a request from torque management => LV_TQ_SCC_REQ and LV_TQ_SCC_INH
- a request from safety concept => LV_TQ_LIM_INTV (see module "Torque request for safety")

Due to logical calibration constants nearly all of these request can be inhibited, except of the requests from torque management and safety concept.

Formula section:

IF LC_TQ_SCC_ENA_MAN == 1
OR LV_TQ_LIM_INTV == 1
OR (LV_TQ_SCC_INH == 0
AND LC_TQ_SCC_INH_MAN == 0
AND LV_TQ_SCC_REQ == 1)
OR (LV_ASR_ACT == 1 **AND** LC_INH_FCUT_ASR == 0)
OR (LV_N_MAX == 1 **AND** LC_INH_FCUT_N_MAX == 0)
OR [LV_AMT_ACT == 1
AND (LV_INH_FCUT_AMT = 0 **OR** LC_INH_FCUT_AMT == 0)]
OR [LV_VAR_TCT == 1 **AND**
LV_GS = 1 **AND**
(LV_INH_FCUT_GS = 0 **OR** LC_INH_FCUT_TCT == 0)]
OR (LV_DCC_INC_ACT == 1**and** LV_DCC_PUC_INH = 0
AND LC_INH_FCUT_DCC == 0)
OR (LV_LDM_ACT == 1**and** LV_LDM_PUC_INH = 0
AND LC_INH_FCUT_LDM == 0)
OR (LV_FCUT_FAST == 1 **AND** LC_INH_FCUT_FAST == 0)
OR (LV_GS_ACT == 1 **AND** LV_VAR_TCT == 0
AND LC_INH_FCUT_GS == 0
AND NOT(LV_TQ_GS_IGA == 1 **AND** LC_INH_FCUT_GS_IGA == 0))
THEN LV_AUTH_TQ_PAT = 1
ELSE LV_AUTH_TQ_PAT = 0
ENDIF

D.12.1.2 Determination of scaling factor

General information:

The factor FAC_IGA_MIN_TEG_IGA_BAS is used to scale between the efficiencies EFF_IGA_MIN_TEG (corrected basic minimum ignition angle including spark retard limitation due to exhaust gas temperature) and EFF_IGA_BAS_COR (corrected basic minimum ignition angle without spark retard limitation due to exhaust gas temperature). For a torque intervention due to gear shift, traction control, engine speed limitation and fast fuel cut-off the possibility of deactivating this scaling factor must be realized. So the scaling factor can be set equal to "1", if one of that interventions is active and if this method will be allowed (LC_ENA_FCUT_TOT_... = 1). It is also set equal to "1", if the basic efficiency for fuel cut-off is smaller than "1".

Formula section:

IF EFF_SCC_BAS < 1.0

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OR (LV_GS_ACT == 1
AND LC_ENA_FCUT_TOT_GS == 1
AND LV_TQ_GS_SCC == 1)
OR (LV_ASR_ACT == 1 **AND** LC_ENA_FCUT_TOT_ASR == 1)
OR (LV_N_MAX == 1 **AND** LC_ENA_FCUT_TOT_N_MAX == 1)
OR (LV_AMT_ACT== 1 **AND** LC_ENA_FCUT_TOT_AMT == 1)
OR (LV_DCC_INC_ACT== 1 **and** LV_DCC_PUC_INH ==0
AND LC_ENA_FCUT_TOT_DCC == 1)
OR (LV_LDM_ACT== 1 **and** LV_LDM_PUC_INH ==0
AND LC_ENA_FCUT_TOT_LDM == 1)
OR (LV_FCUT_FAST == 1 **AND** LC_ENA_FCUT_TOT_FAST == 1)
THEN FAC_IGA_MIN_TEG_IGA_BAS = 1
ELSE FAC_IGA_MIN_TEG_IGA_BAS = C_FAC_IGA_MIN_TEG_IGA_BAS
ENDIF

D.12.1.3 Setpoint efficiency fuel cut-off

Overview

Description:

Depending on the authorization flag LV_AUTH_TQ_PAT the efficiency EFF_SCC_SP is set to the calculated value EFF_SCC_SP_1 or is set equal to "1". Additionally, two application labels allow to manipulate the efficiency setpoint (LC_EFF_SCC_SP_MAN and C_EFF_SCC_SP_MAN). Depending on the efficiency setpoint a pattern is calculated. To avoid uncomfortable jumps of pattern, if the setpoint EFF_SCC_SP jitters, the calculation of the pattern index NR_PAT_SCC is done by applying a hysteresis C_EFF_SCC_SP_HYS on EFF_SCC_SP (see figure 1).

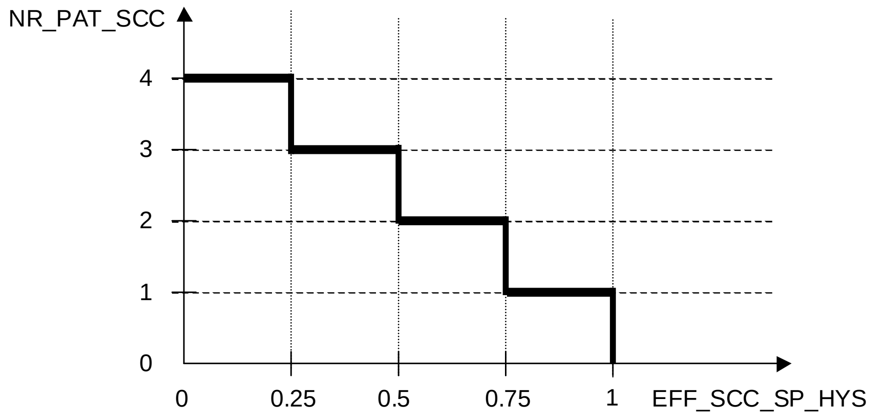

Figure D.12.1: : Example for a four cylinder engine

Formula section:

IF LV_AUTH_TQ_PAT == 1
THEN EFF_SCC_SP_2 = EFF_SCC_SP_1
ELSE EFF_SCC_SP_2 = 1.0
ENDIF

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```
IF        LC_EFF_SCC_SP_MAN == 1
THEN      EFF_SCC_SP = C_EFF_SCC_SP_MAN
ELSE      EFF_SCC_SP = EFF_SCC_SP_2
ENDIF
```

```
IF        (EFF_SCC_SP - EFF_SCC_SP_HYS   >   C_ EFF_SCC_SP_HYS)
          OR   (EFF_SCC_SP        1 - C_ EFF_SCC_SP_HYS)
          OR   (EFF_SCC_SP   <   EFF_SCC_SP_HYS)
THEN      EFF_SCC_SP_HYS   =   EFF_SCC_SP
ELSE      EFF_SCC_SP_HYS   =   EFF_SCC_SP_HYS
ENDIF
```

```
NR_PAT_SCC   =   ID_NR_PAT_SCC(EFF_SCC_SP_HYS)
```

D.12.1.3.1 Calculation of efficiency for single cylinder cut-off

Description:

The efficiency for single cylinder cut-off depends on the ratio between TQI_REQ_FAST and TQI_REF corrected with the basic efficiencies for a/f ratio and ignition angle. Generally, a scaling between EFF_IGA_MIN_TEG and EFF_IGA_BAS_COR is possible. The philosophy of this function is to give the customer the possibility to work with minimum ignition angle before fuel cut-off or to work with the basic ignition angle.

Formula section:

```
IF        LV_HOM_ACT = 1
THEN      EFF_SCC_SP_1 =   TQI_REQ_FAST /
                             (TQI_REF
                             * EFF_LAMB_BAS_COR
                             * (FAC_IGA_MIN_TEG_IGA_BAS
                             * EFF_IGA_BAS_COR
                             + (1.0 - FAC_IGA_MIN_TEG_IGA_BAS)
                             * EFF_IGA_MIN_TEG_LGRD))
ELSE      EFF_SCC_SP_1 =   TQI_REQ_FAST /
                             TQI_MIN_S
ENDIF
```

```
IF        EFF_SCC_SP_1 > 1.0
THEN      EFF_SCC_SP_1 = 1.0
ELSEIF    EFF_SCC_SP_1 < 0.0
THEN      EFF_SCC_SP_1 = 0.0
ENDIF
```

D.12.1.3.2 Rate limitations for negative gradients

Description:

Changes of the efficiency EFF_IGA_MIN_TEG has to be limited in falling direction to avoid high frequent jumps between pattern and spark retarding. Therefore a calibratable rate limit function is added. The principle application parameters for these rate limitations are C_MIN_DEC_EFF_IG_MIN_TEG_1, C_

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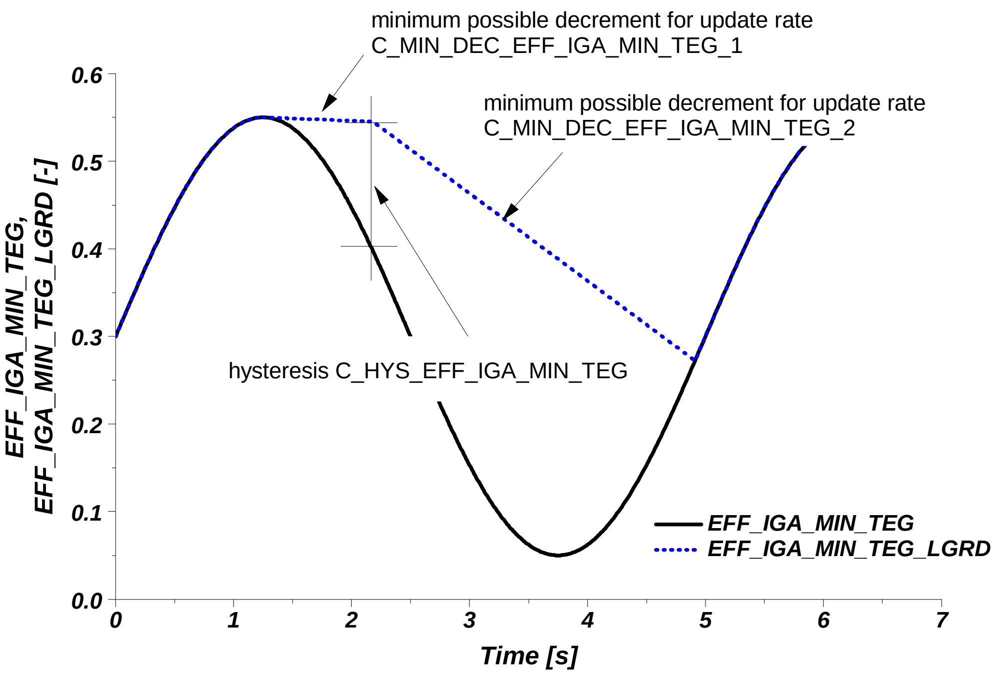
MIN_DEC_EFF_IG_MIN_TEG_2 and C_LGRD_EFF_IGA_MIN_TEG. The background is illustrated in figure 2.

Figure 2: Rate limitations for EFF_IGA_MIN_TEG



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Formula section:

IF (EFF_IGA_MIN_TEG_LGRD_1$_{k-1}$ $>$ EFF_IGA_MIN_TEG$_k$)
THEN **IF** ((EFF_IGA_MIN_TEG_LGRD_1$_{k-1}$ - EFF_IGA_MIN_TEG$_k$)
$>$ C_MIN_DEC_EFF_IGA_MIN_TEG_1)
THEN EFF_IGA_MIN_TEG_LGRD_1$_k$ = EFF_IGA_MIN_TEG_LGRD_1$_{k-1}$
- C_MIN_DEC_EFF_IGA_MIN_TEG_1
ELSE EFF_IGA_MIN_TEG_LGRD_1$_k$ = EFF_IGA_MIN_TEG$_k$
ENDIF
ELSE EFF_IGA_MIN_TEG_LGRD_1$_k$ = EFF_IGA_MIN_TEG$_k$
ENDIF

IF ((EFF_IGA_MIN_TEG$_{k-1}$ $<$ EFF_IGA_MIN_TEG$_k$)
OR
(C_HYS_EFF_IGA_MIN_TEG
$<=$ (EFF_IGA_MIN_TEG_LGRD_1 - EFF_IGA_MIN_TEG)))
THEN EFF_IGA_MIN_TEG_LGRD_2 = EFF_IGA_MIN_TEG
ELSE EFF_IGA_MIN_TEG_LGRD_2 = EFF_IGA_MIN_TEG_LGRD_1
ENDIF

IF (EFF_IGA_MIN_TEG_LGRD$_{k-1}$ $>$ EFF_IGA_MIN_LGRD_2$_k$)
THEN **IF** ((EFF_IGA_MIN_TEG_LGRD$_{k-1}$ - EFF_IGA_MIN_LGRD_2$_k$)
$>$ C_MIN_DEC_EFF_IGA_MIN_TEG_2)
THEN EFF_IGA_MIN_TEG_LGRD$_k$ = EFF_IGA_MIN_TEG_LGRD$_{k-1}$
- C_MIN_DEC_EFF_IGA_MIN_TEG_2
ELSE EFF_IGA_MIN_TEG_LGRD$_k$ = EFF_IGA_MIN_LGRD_2$_k$
ENDIF
ELSE EFF_IGA_MIN_TEG_LGRD$_k$ = EFF_IGA_MIN_LGRD_2$_k$
ENDIF

D.12.2 Basic efficiency fuel cut-off

General information:

EFF_SCC_BAS is the basic efficiency for single cylinder fuel cut-off. It is calculated by count of opened injectors divided by the number of cylinders (NC_CYL_NR), whereas only injectors which are shut off due to failures (e.g. failure on injector /ignition output stage) are considered.
Activation: at every engine state
Deactivation: -
Initialization: EFF_SCC_BAS = 1.0 at reset and LV_IGK = 0 -> 1
Update rate: 10 ms

Formula section:

SUM_INH_IV_BAS = bitwise summation (Bits 0 to (NC_CYL_NR-1)) of:
INH_IV_MIS **or** INH_IV_DIAG_ERR **or** INH_IV_IGC
Maximal possible value: NC_CYL_NR

If LC_EFF_SCC_BAS_SWI_CLC = 1
Then **If** LC_ENA_EFF_SCC_BAS_MAN = 1
Then EFF_SCC_BAS = C_EFF_SCC_BAS_MAN
Else EFF_SCC_BAS = 1.0

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Endif
Else EFF_SCC_BAS = 1- (SUM_INH_IV_BAS /NC_CYL_NR)
Endif

D.12.3 Actual efficiency fuel cut-off

FUNCTION DESCRIPTION:

General information:
EFF_SCC_AV is the actual efficiency from fuel cut-off interventions. The value is calculated by count of opened injectors divided by the number of cylinders (NC_CYL_NR). The input value INH_IV defines the status of each injector during the next injection cycle due to static fuel cut-off. The input value INH_SWI_IV defines the status of all injectors during the next injection cycle due to dynamic fuel cut-off.
Further information see in chapter “Basic SW inputs and Outputs” in subchapter “Injection information”.
Every static fuel cut-off request intervention deriving from pattern (engine speed limitation, ASR and GS), trailing throttle fuel cut-off, misfire, engine stop, etc. is considered by means of INH_IV.

Every dynamic fuel cut-off request intervention deriving from "torque based pattern"- and/or "sequential fuel cut off and restart fuel feed"-interventions is considered by means of INH_SWI_IV.

The pattern INH_IV_TOT is the bitwise OR of all pattern (static and dynamic) and SUM_INH_IV_TOT is the corresponding sum of cylinders which are shut off.

The EFF_SCC_AV_CAN is calculated like EFF_SCC_AV only at external intervention the efficiency is not regarded.

Activation: at every engine state except engine stopped
Deactivation: at engine stopped
Initialization: at reset or at engine stop
Update rate: 10 ms

Formula section:

If INH_IV = 1 (bitwise) **or**
INH_SWI_IV = 1 (bitwise)
Then INH_IV_TOT = 1 (bitwise)
Else INH_IV_TOT = 0 (bitwise)
Endif

SUM_INH_IV_TOT = bitwise summation of INH_IV_TOT (Bits 0 to (NC_CYL_NR-1))
Maximal possible value: NC_CYL_NR

EFF_SCC_AV = 1- (SUM_INH_IV_TOT /NC_CYL_NR)

Calculation of EFF_SCC_AV_CAN for CAN Torque:

If LV_GS_ACT = 1 **or**
LV_AMT_ACT = 1 **or**
LV_ASR_ACT = 1 **or**
(LV_DCC_INC_ACT = 1 **and**
LV_DCC_PUC_INH = 0**)** **or**
(LV_LDM_ACT = 1 **and**

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LV_LDM_PUC_INH = 0**)**
Then EFF_SCC_AV_CAN = 1
Else EFF_SCC_AV _CAN = EFF_SCC_AV
Endif

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D.13 Torque based pattern calculation (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CS_CHG	V	0... 1H	0 ...1	1	-
Logical variable for detection of clutch switch state change					
LV_CT_CHG	V	0... 1H	0 ...1	1	-
Logical variable for detection of accelerator pedal released state change					
LV_FCUT_FAST	O/V	0... 1H	0 ...1	1	-
Logical variable for authorizing fuel cut-off pattern					
T_MAX_FCUT_FAST	V	0... FFH	0... 2.55	0.01	s
Time counter for clutch switch observation fast fuel cut-off					
T_MAX_FCUT_FAST_TCHA	V	0... FFH	0... 2.55	0.01	s
Time counter for gear shift observation fast fuel cut-off turbo charger					

Input data:

LV_CS {p. 8394}	LV_CT {p. 1442}	LV_GS_ACT_FL {p. 8379}	LV_PL {p. 1720}
LV_PU {p. 1720}	LV_VAR_AMT {p. 655}	LV_VAR_TCHA {p. 656}	LV_VAR_TCT {p. 656}
MAF {p. 8277}	MAF_MES {p. 1192}	MAF_MMV {p. 1195}	N {p. 1525}
TCO {p. 1100}	VS {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MAF_DIF_MIN_FCUT_FAST	-	0... FFFFH	0... 1389	0.0211948	mg/stk
min. load decrease fast fuel cut-off					
C_T_MAX_FCUT_FAST	-	0... FFH	0... 2.55	0.01	s
max. time clutch switch observation fast fuel cut-off					
C_T_MAX_FCUT_FAST_TCHA	-	0... FFH	0... 2.55	0.01	s
max. time gear shift observation fast fuel cut-off turbo charger					
C_TCO_MIN_FCUT_FAST	-	0... FEH	-48... 142.5	0.75	°C
min. coolant temperature fast fuel cut-off					
C_VS_MIN_FCUT_FAST	-	0... FFH	0... 255	1	km/h
min veh. speed fuel cut-off					
C_VS_MIN_FCUT_FAST_TCHA	-	0... FFH	0... 255	1	km/h
min veh. speed fuel cut-off turbo charger					
ID_MAF_N_MIN_FCUT_FAST	V	0... 1H	0 ...1	1	-
LDP_MAF__MIN_FCUT_FAST	4	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N__MIN_FCUT_FAST	4	0... 1FE0H	0... 8160	1	rpm
engine speed -load threshold for fast fuel cut-off					

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General Information

General information:

The objective of this module is to define the application incidences for the module "Torque based pattern calculation" including determination of Fast fuel cut off -condition .

Application Conditions

Initialization: RST

Recurrence: 10MS
Activation: always
Deactivation: never

Function description

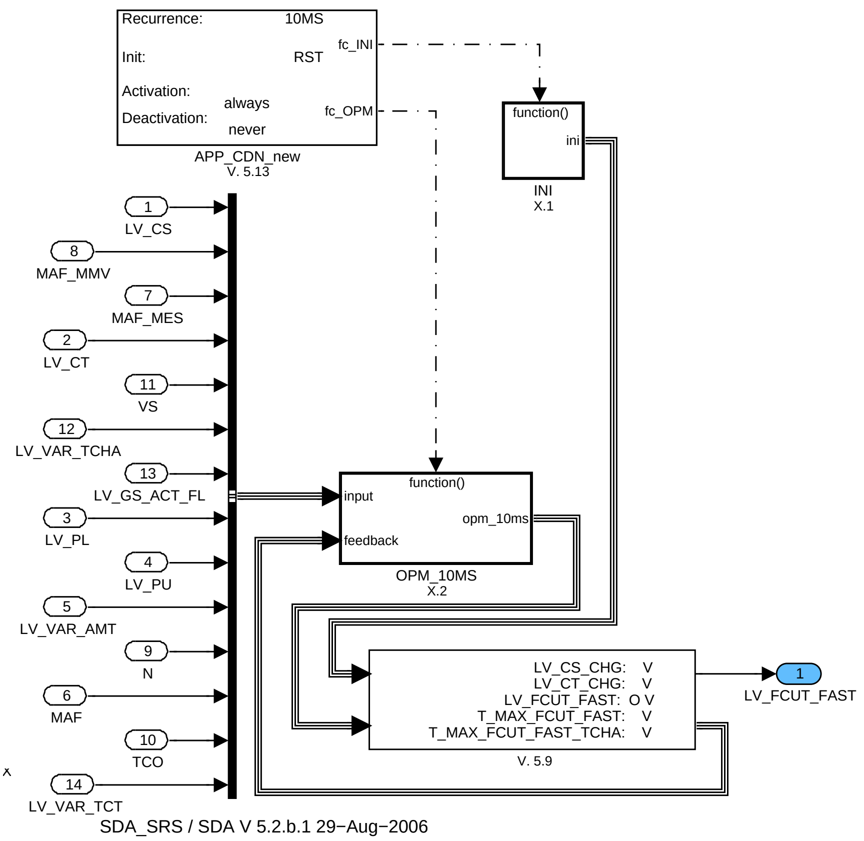

Figure D.13.1: :

D.13.1 Initialisation at reset

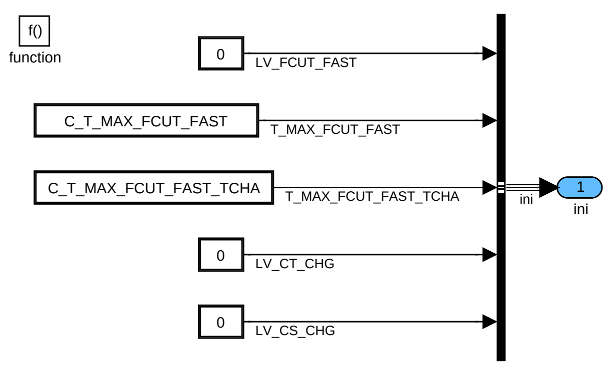

Figure D.13.2: :

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D.13.2 Recurrence 10 ms

Determination of fast fuel cut-off conditions
General information:

The objective of this module is to define the condition for fast fuel cut-off. This function shall prevent engine speed overshooting during gear shift with manual transmission vehicles. If fast fuel cut-off is enabled, cylinder deactivation will be managed by the torque management.

Description:

The fast fuel cut-off will be enabled for the following situation:
the coolant temperature must exceed a calibratable threshold (see activation condidtions) and the load must decrease
the accelerator pedal must be released and the clutch has to be opened; these conditions have to be happen within a maximum time frame
if the clutch pedal has been pushed during this observation time and if it is still pushed the fast fuel cut-off is possible
the variant turbo regards the flag LV_GS_ACT_FL in order to set fast fuel cut-off

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D.13.2.1 Activation conditions for calculation

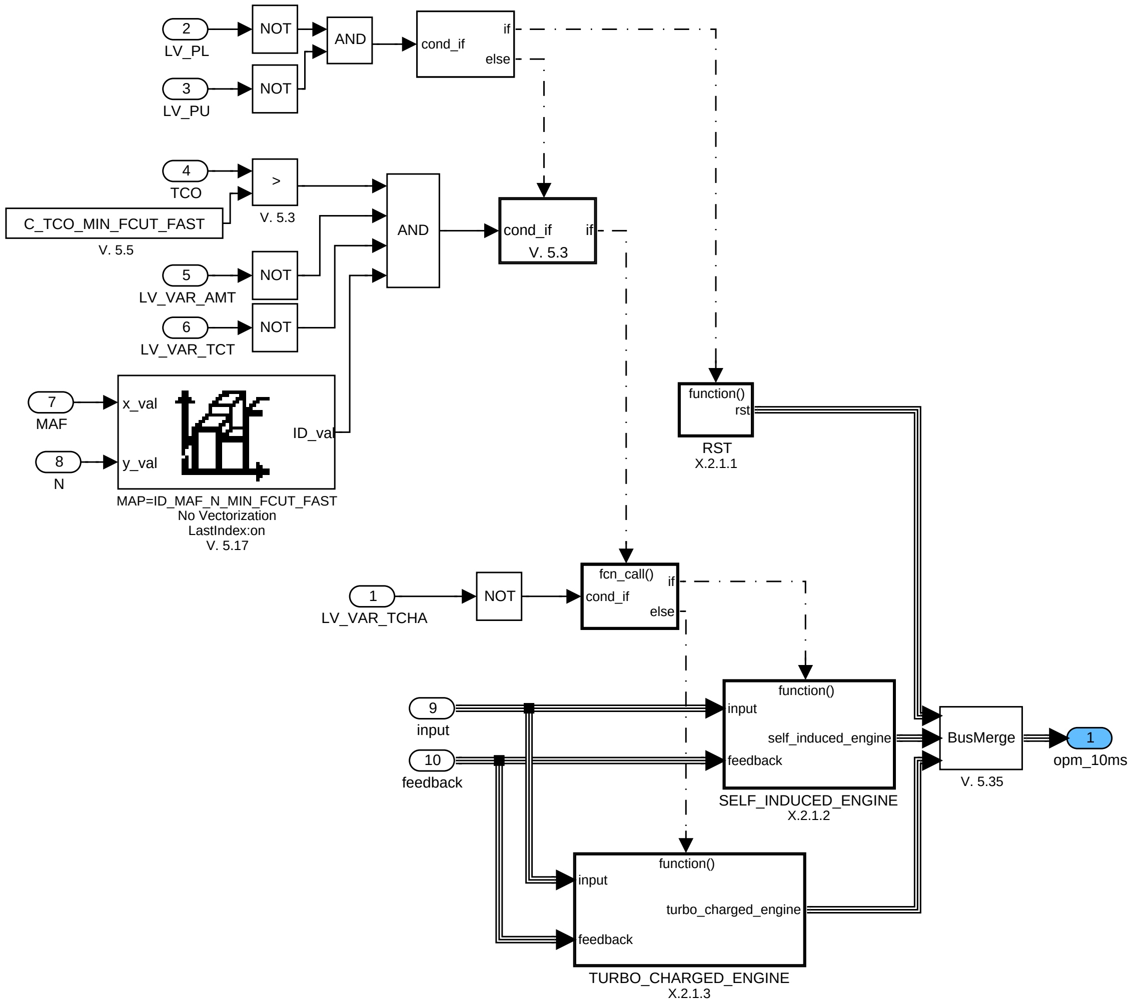

Figure D.13.3: :

D.13.2.1.1 Reset at LV_PL = 0 and LV_PU = 0

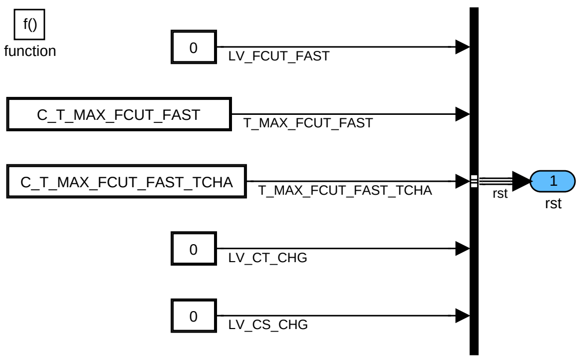

Figure D.13.4: :

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D.13.2.1.2 Self induced engine

D.13.2.1.2.1 Calculation of self induced engine

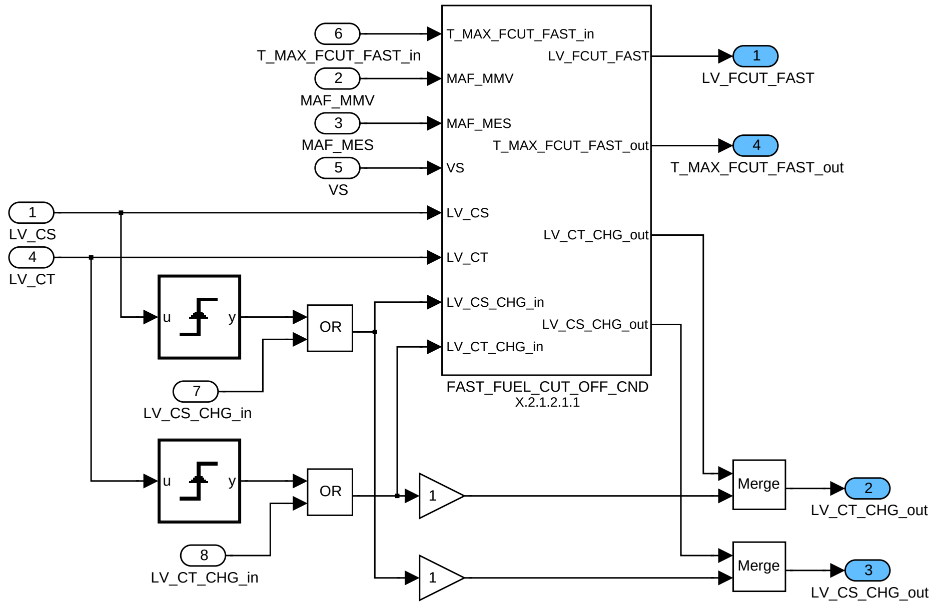

Figure D.13.5: :

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D.13.2.1.2.1.1 Determination of fast fuel cut off conditions

D.13.2.1.2.1.1.1 Determination_of_fast_fuel_cut_off_conditions

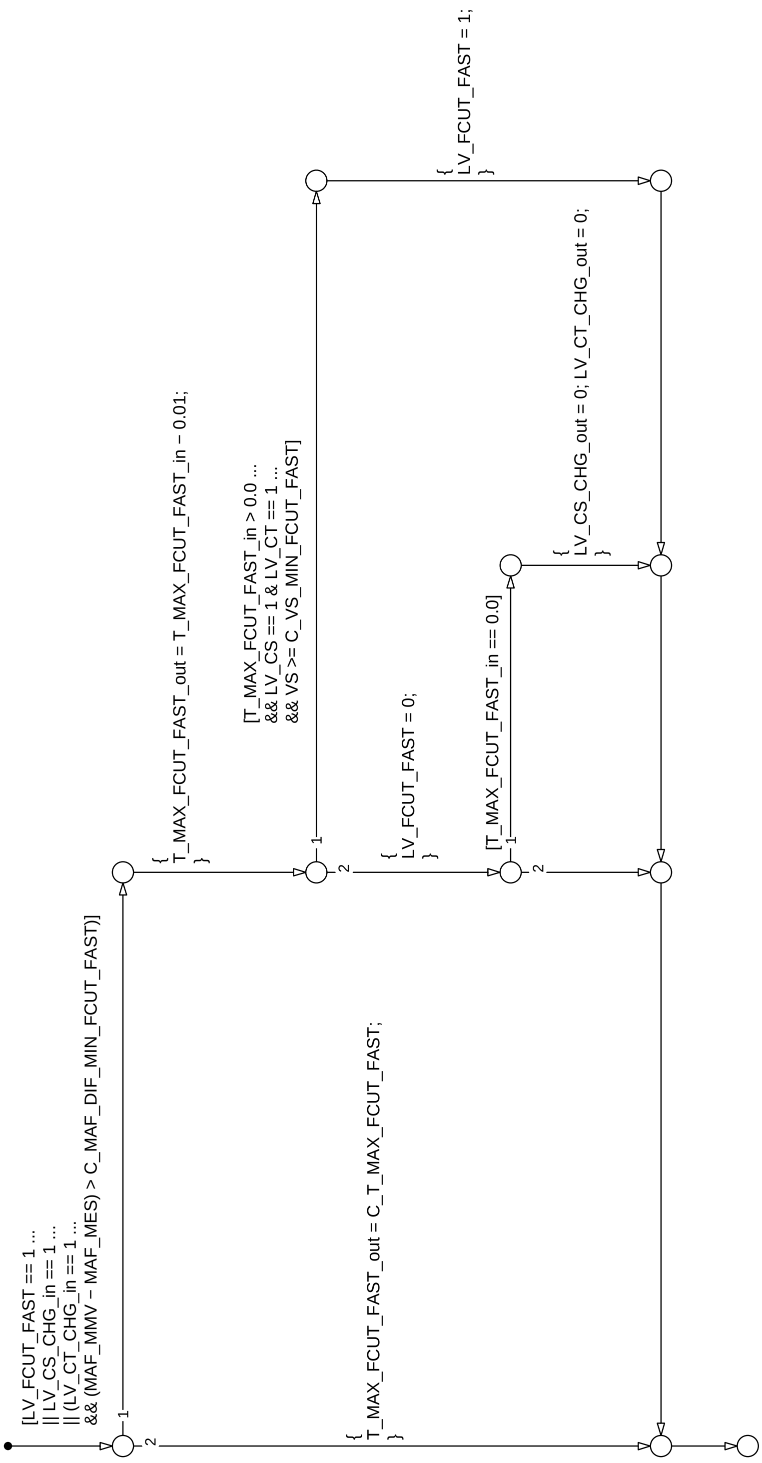

Figure D.13.6: :

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D.13.2.1.3 Turbo charged engine

D.13.2.1.3.1 Calculation of turbo charged engine

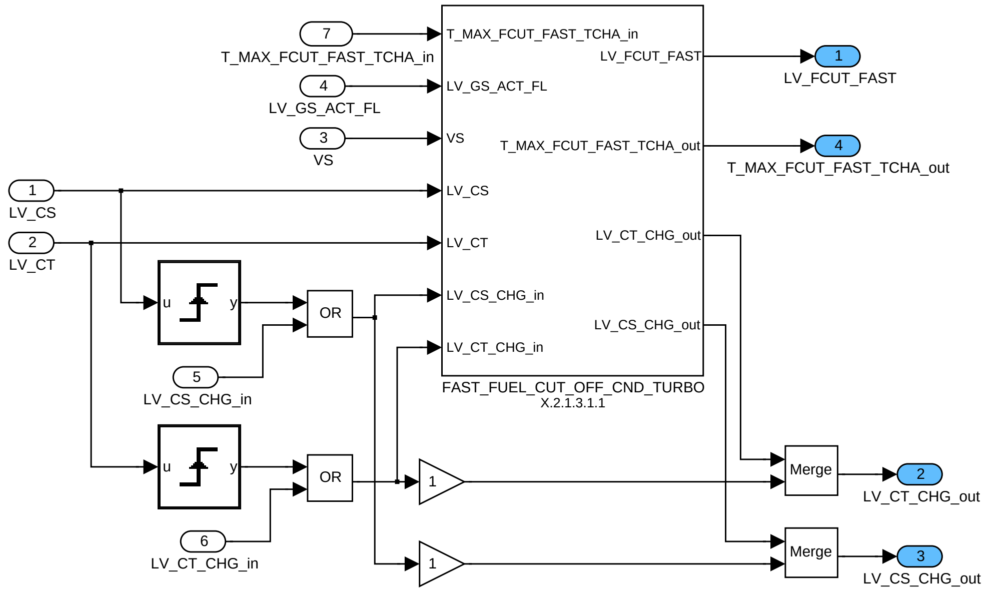

Figure D.13.7: :

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D.13.2.1.3.1.1 Fast fuel cut off conditions turbo

D.13.2.1.3.1.1.1 fast_fuel_cut_off_conditions_turbo

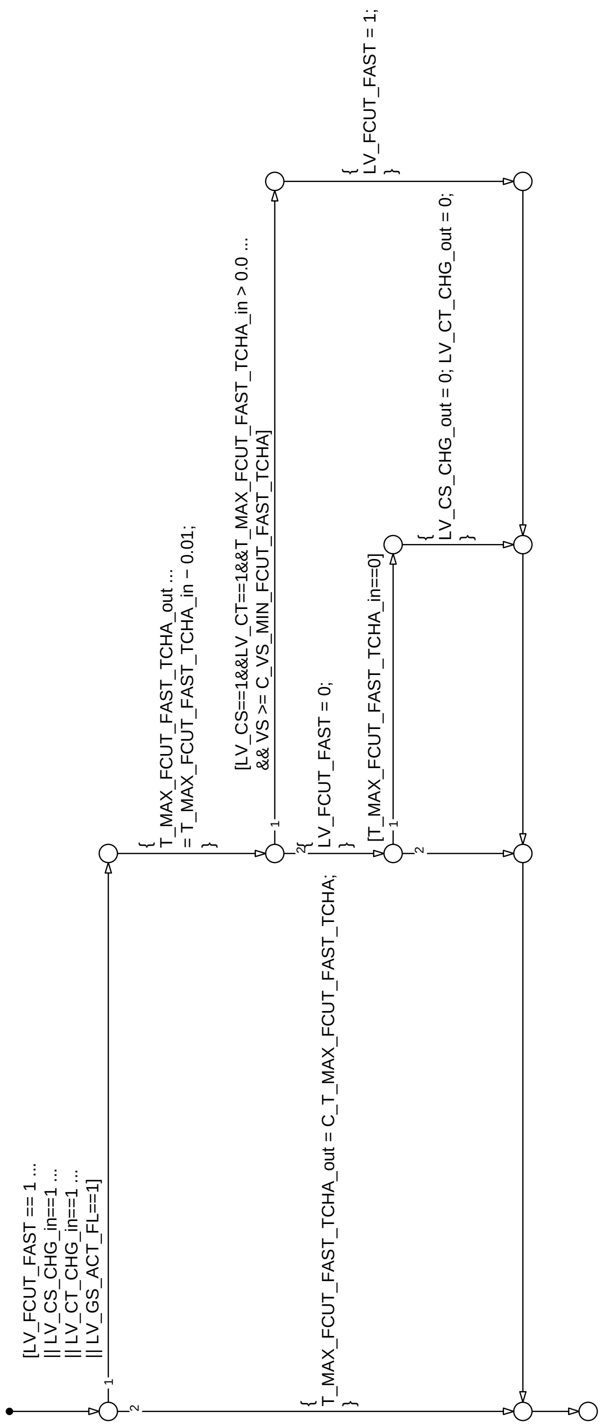

Figure D.13.8: :

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D.14 Torque control at start

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
OPM_AV_SEL_TQ_ST	V	1... 8H	1 ...8	1	-
Operation mode (selektiert)					
TQ_ST	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Engine Start Torque					
TQ_ST_1	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Engine Start Torque raw value					

Input data:

LV_AT {p. 654}	LV_ST {p. 1720}	LV_TQ_MIN_CLU {p. 8379}	N_DIF {p. 1122}
OPM_AV {p. 8137}	TCO {p. 1100}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_TQ_ST	-	0... FFH	0... 0.99609375	0.00390625	-
Correlation constant for negative PT1 filtering					
ID_OPM_AV_TQ_ST	-	1... 8H	1 ...8	1	-
LDPM_OPM_AV	8	0... 8H	0 ...8	1	-
Operation mode matrix (actual)					
IP_TQ_ST_AT_OPM_1	-	0... FFFFH	0... 1023.97	0.03125	Nm
LDPM_N_DIF_IP_TQ_ST	8	0... FFFFH	0... 32767	1	rpm
LDPM_TCO_IP_TQ_ST	8	0... FEH	0... 142.5	0.75	°C
Engine torque at start for automatic transmission in engine operation mode 1					
IP_TQ_ST_AT_OPM_2	-	0... FFFFH	0... 1023.97	0.03125	Nm
LDPM_N_DIF_IP_TQ_ST	8	0... FFFFH	0... 32767	1	rpm
LDPM_TCO_IP_TQ_ST	8	0... FEH	0... 142.5	0.75	°C
Engine torque at start for automatic transmission in engine operation mode 2					
IP_TQ_ST_MT_OPM_1	-	0... FFFFH	0... 1023.97	0.03125	Nm
LDPM_N_DIF_IP_TQ_ST	8	0... FFFFH	0... 32767	1	rpm
LDPM_TCO_IP_TQ_ST	8	0... FEH	0... 142.5	0.75	°C
Engine torque at start for manual transmission in engine operation mode 1					
IP_TQ_ST_MT_OPM_2	-	0... FFFFH	0... 1023.97	0.03125	Nm
LDPM_N_DIF_IP_TQ_ST	8	0... FFFFH	0... 32767	1	rpm
LDPM_TCO_IP_TQ_ST	8	0... FEH	0... 142.5	0.75	°C
Engine torque at start for manual transmission in engine operation mode 2					

D.14.1 TQSP_MD00S

General information:

The engine start torque TQ_ST influences the torque at clutch during start phase as a result it determines the engine speed transient response. It is calculated from a one dimensional map versus engine speed difference N_DIF.
TQ_ST is imported into module Minimum Torque at Clutch in order to increase engine speed during start phase. To bring the engine speed to its setpoint at idle the engine speed overshoot can be limitted supported by the tuning data IP_TQ_ST_MT(AT)_XY which depend on engine operation mode OPM_AV_SEL_TQ_ST.

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Application conditions:

Activation: LV_TQ_MIN_CLU = 0
Deactivation: LV_TQ_MIN_CLU = 1
Initialization: TQ_ST = 0 Nm at transition LV_ST = 0 to 1
Update rate: 10 ms

Application Condition

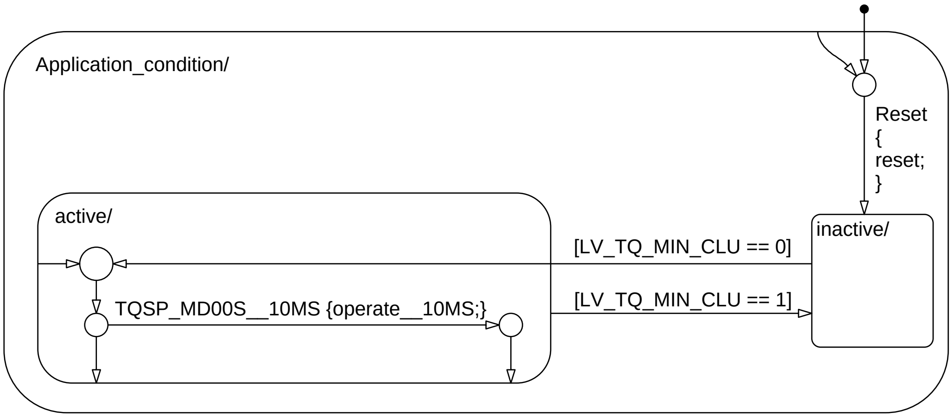

Figure D.14.1: TQSP_MD00S/APP_CDN/APPCND

Function Description

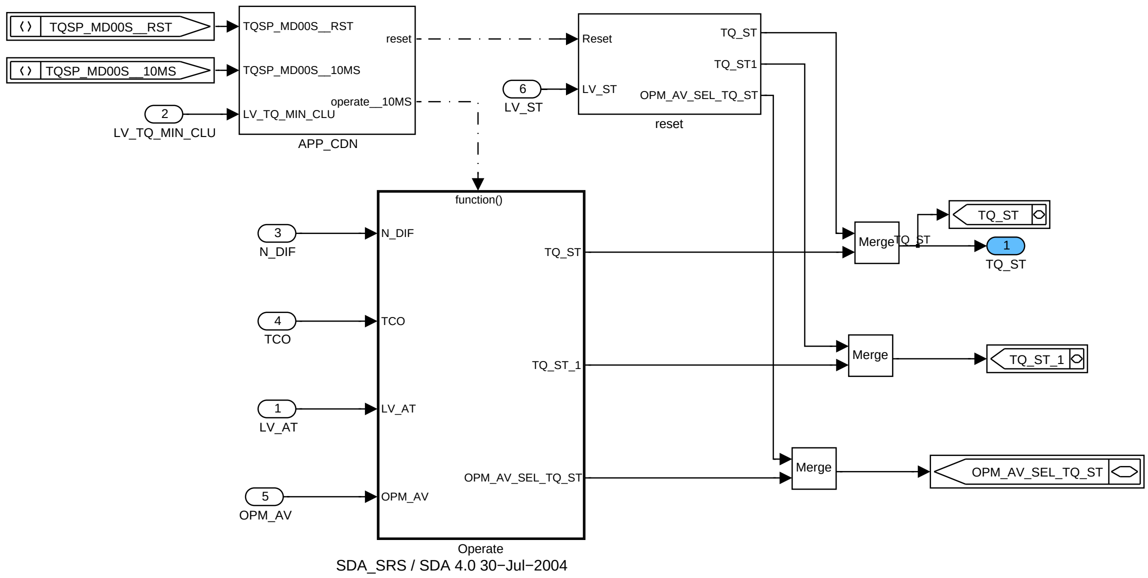

Figure D.14.2: TQSP_MD00S

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D.14.1.1 SUBFUNCTION: Operate

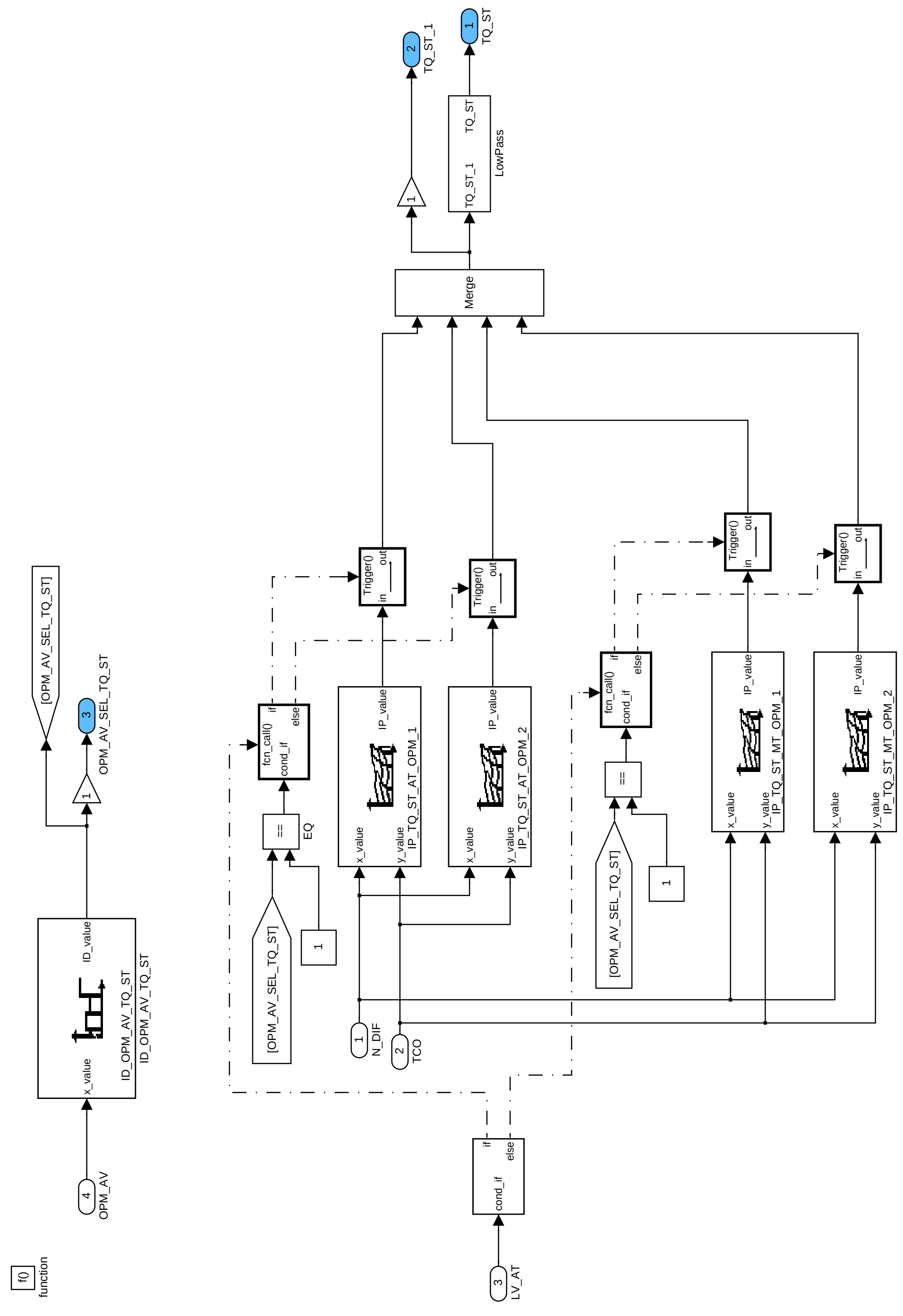

Figure D.14.3: TQSP_MD00S/Operate

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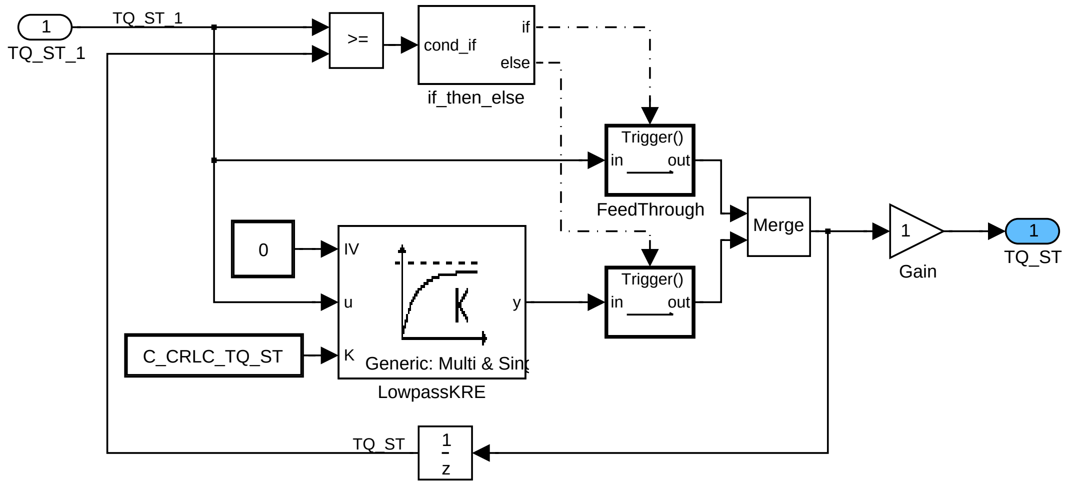

Figure D.14.4: TQSP_MD00S/Operate/LowPass

D.14.1.2 SUBFUNCTION: reset

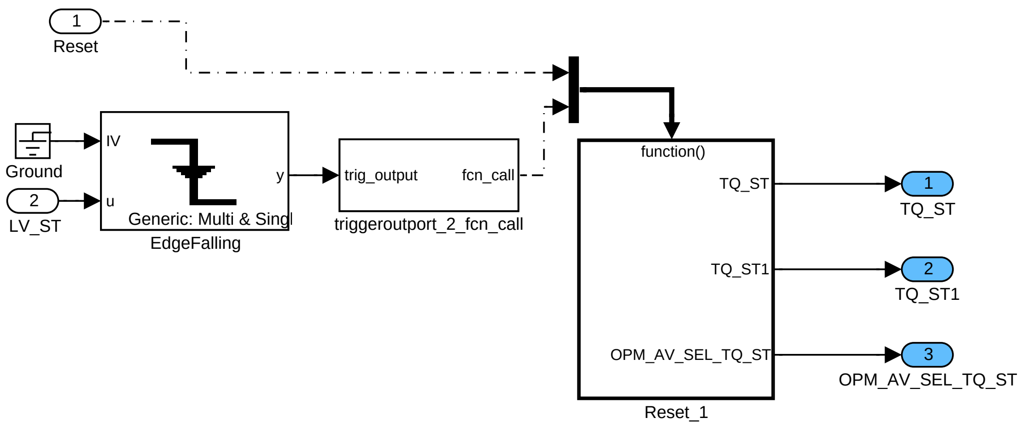

Figure D.14.5: TQSP_MD00S/reset

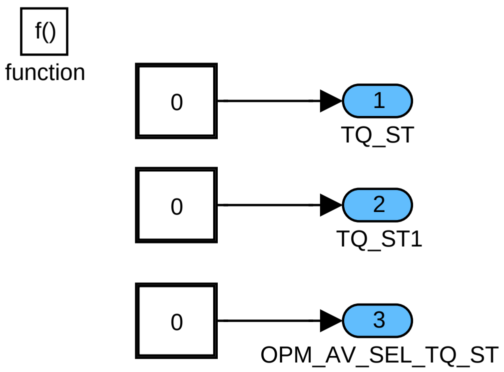

Figure D.14.6: TQSP_MD00S/reset/Reset_1

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D.15 Torque coordination

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_TQI_REQ_CAN_INH	O/V	0... 1H	0 ...1	1	-
general flag for inhibition of external torque requests					

Input data:

LV_ERR_MTC_CTL_1 {p. 4977}	SF_TQD {p. 6741}		

FUNCTION DESCRIPTION:

General information:

LV_TQI_REQ_CAN_INH collects all states or flags within engine management which shall lead to ignoring external torque requests.

Application conditions

Initialisation: *LV_TQI_REQ_CAN_INH = 0 for LV_IGK 0 - -> 1 or at reset*

Recurrence: *10ms*

Activation: *at every engine state*

Deactivation: *otherwise*

Formula section:

If SF_TQD = 3 **or** *// - -> see remark **
LV_ERR_MTC_CTL_1 = 1

then LV_TQI_REQ_CAN_INH = 1

else LV_TQI_REQ_CAN_INH = 0

Endif

Remark:
For detailed calculation of SF_TQD see chapter "Torque request for traction control"
SF_TQD = 3 H is set if
STATE_ETC_LIH = ETC_LIH_1 ***or***
STATE_ETC_LIH = ETC_LIH_2_REV ***or***
STATE_ETC_LIH = ETC_LIH_2 ***or***
LV_OFF_MTC_MON = 1 ***or***
LV_SF_TQD_MON = 1

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(see Chapter: "Applc. Inc of process monitoring" and "Fault reaction of Process monitoring")

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D.16 Torque coordination general

General information:

The torque structure introduces the engine torque as a fundamental quantity . Either torque at clutch or indicated engine torque is used depending on the needs for the coordination structure.
Every external or internal torque requests are coordinated in the torque coordination modules where several criteria such as emissions, fuel consumption, engine protection and driveabillity are considered. Then torque request is distributed to the different regulated quantities load, ignition, mixture and fuel cut-off.
In this way the complexity can be reduced by the modular approach of the torque structure.
Every subfunction is linked by a torque interface to the torque structure (e.g. idle speed control, anti jerk function, engine speed limitation or catalyst heating, etc.). So the mutual interference of the subfunctions disapear because there is no direct link anymore to the different regulated quantities which decrease the tuning effort.
For the following overview of the torque structure only the most important modules and interface variables are mentionend to show the main track through the structure.

Pedal value interpretation

The Driver requests his driving wish by manipulation of the drivng pedal. As a result a certain pedal value PV_AV is observed which is transformed by different functions into a scaling factor FAC_TQ_REQ_DRIV (0...1).

Coordination of scaling factors for requested torque

This module coordinates different "driver" whises comming from the manual driver, cruise control or variable vehicle speed limitation.
The result is a coordinated scaling factor FAC_TQ_REQ.

Torque request at clutch general

The structure "Torque request at clutch general" consits of the modules "Maximum torque at clutch" and "Minimum torque at clutch". By the scaling factor FAC_TQ_REQ the requested torque at clutch TQ_REQ_CLU is calculated.

Torque Transient

The driver torque request TQ_REQ_CLU is filtered to protect the powertrain from jerking. The step response of the torque transient function are linear ramps. The slope of the ramps are a function of gear ratio, engine speed, torque range and torque increase and decrease state.
The outputs are TQ_REQ_CLU_TRA and TQI_REQ_TRA (TQ_REQ_CLU_TRA - TQ_LOSS) which is the indicated torque representation.
Parallel a torque reserve can be activated by "Torque reserve for torque transient" withe the output variable TQ_ADD_TRA. This torque reserve minimizes the difference between torque setpoint TQI_REQ_TRA and the actual engine torque TQI_AV which leads to a better response behavior of the engine at positive torque jump requests.

Torque reserve coordination

The torque reserve builds up an additionbal load which can be used when a fast torque increase is necessary (e.g. idle speed control) or if the ignition efficiency has to be reduced like for catalyst heating.

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The torque reserve quantities TQ_ADD_XXX are added to the requested torque value inside the slow torque path. Automatically parallel to the load increase a spark retard is done which will compensate the torque. To build up a torque reserve is a torque neutral process.

Minimum /Maximum torque request selection

This module collects all torque requests to generate the torque setpoint for the slow path TQI_REQ_SLOW and TQI_REQ_FAST for the fast path.

External torque requests:
- driver torque request TQI_REQ_TRA , TQI_ADD_ACT
- traction control (torque reduction/increase) TQI_ASR/MSR_FAST/SLOW
- automatic transmission (gear support) TQI_GS_FAST/SLOW_INC/DEC

Internal torque requests:
- engine speed limitation TQI_N_MAX
- vehicle speed limitation TQI_VS_MAX
- cruise control (optional)
- engine power limitation TQI_P_MAX
- catalyst protection TQI_CAT_PROT
- torque plausibility check in level 1 TQI_REQ_LIM_SLOW/FAST

Minimum indicated engine torque at trailing throttle

This module will provide a minimum indicated engine torque TQI_MIN_PU to limit the throttle opening to a minimum value to ensure a safe combustion and to limit the intake manifold pressure.
For the engine operation states the status bit LV_TQI_BOL_SET is delivered to prepare the trailing throttle fuel cut-off. It indicates that the torque setpoint TQI_SP is below the minimum torque TQI_BOL at minimum ignition efficiency.

Torque coordination

The coordinated torque values TQI_REQ_SLOW and TQI_REQ_FAST are entered into the slow and fast torque path where they are confronted with
- torque limitations TQI_MIN_PU, TQI_BAS
- idle speed control TQ_DIF_P_D_SLOW_IS, TQ_DIF_P_D_FAST_IS
- standardization to efficiency 1.00 by EFF_TOT_BAS_SLOW (for the air path torque TQI_REQ_SLOW)
- anti jerk correction TQ_DIF_AJ

The output from the slow path is MAF_SP_TQI which is an input into the inverse air path to determine the throttle opening.

TQI_SP the final target torque is the output from the fast torque path to be obtained in homogeneous mode. It serves as an input for the fast torque path like ignition angle, lambda adjustment (where it is necessary) and fuel cut-off pattern calculations.

Overview torque structure:

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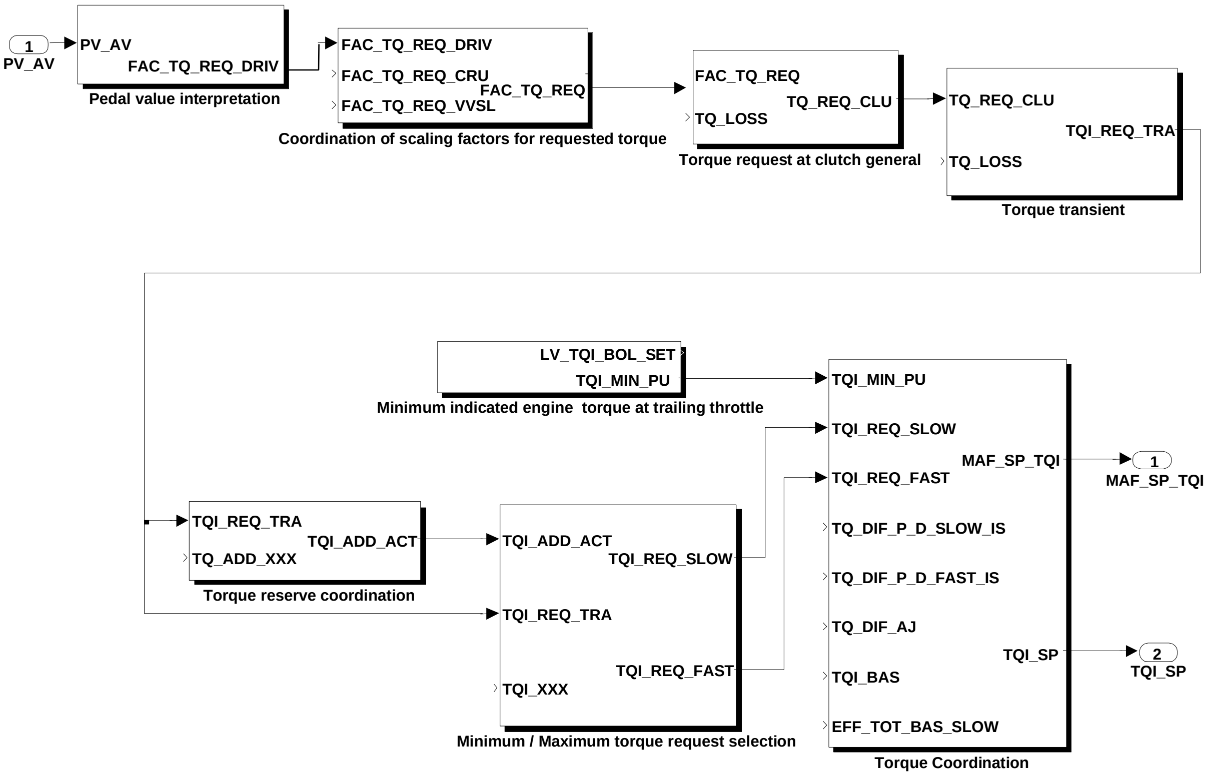

TQ_COORD_General_001.mdl

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D.17 Torque request for safety

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_TQ_LIM_INTV	O/V		-	-	-
Bit for torque intervention for safety active					
LV_TQ_LIM_INTV_1	V		-	-	-
Result for TQI_AV > TQI_SP_MON					
LV_TQ_LIM_INTV_2	V		-	-	-
ON-Delayed (40ms) result for TQI_AV > TQI_SP_MON					
SUM_TQI_REQ_LIM	O/V/S	0... FFFF H	0... 65535	1	-
Event counter of active torque limitations (stored in non volatile memory)					
T_TQ_LIM_INTV	V	0... FFFFH	0... 2621.4	0.04	s
Decremented time counter after transition LV_TQ_LIM_INTV_2 1 - -> 0 to set LV_TQ_LIM_INTV = 0					
T_TQI_REQ_LIM	V	0... FFFFH	0... 2621.4	0.04	s
Incremented time counter after transition LV_TQ_LIM_INTV_2 0 - ->1 to set LV_TQ_LIM_INTV = 0					
T_TQI_REQ_LIM_MAX	O/V/S	0... FFFFH	0... 2621.4	0.04	s
max time counter after transition LV_TQ_LIM_INTV_2 0 - ->1 to set LV_TQ_LIM_INTV = 0					
TQI_DIF_LIM	V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Torque offset for recognition torque intervention active					
TQI_REQ_LIM_1	V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Intermediate value 1 for requested torque for safety					
TQI_REQ_LIM_2	V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Intermediate value 2 for requested torque for safety					
TQI_REQ_LIM_3	V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Intermediate value 3 for requested torque for safety					
TQI_REQ_LIM_4	V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Intermediate value 4 for requested torque for safety					
TQI_REQ_LIM_DIF	V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
difference of torque request for safety					
TQI_REQ_LIM_DIF_MAX	O/V/S	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Max difference of torque request for safety					
TQI_REQ_LIM_DIF_OFS	-	0... 1FE0 H	0... 255	0.03125	Nm
Permitted deviation offset					
TQI_REQ_LIM_FAST	O/V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Requested torque for safety for fast path					
TQI_REQ_LIM_SLOW	O/V	8000... 7FFF H	-1024... 1023.97	0.03125	Nm
Requested torque for safety for slow path					

Input data:

LC_AD_CLR_TQ	LV_ES {p. 1720}	LV_IGK {p. 906}	LV_MTC_CUR_OFF {p. 6565}
LV_TQ_LIM_EXT_ADJ	N_32 {p. 1525}	TQI_AV {p. 981}	TQI_SP_MON {p. 6851}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DEC_TQI_LIM_DIF_MAX	-	20... 1FE0H	1... 255	0,03125	Nm
decrement after start condition					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_TQ_LIM_INTV	-	0... FFFFH	0... 2621.4	0.04	s
Time after active torque intervention to reset LV_TQ_LIM_INTV					
C_TQ_LIM_DEC	-	0... 7FFF H	0... 1023.97	0.03125	Nm
Maximum negative gradient of the requested torque TQI_REQ_LIM_SLOW					
C_TQ_LIM_INC	-	0... 7FFF H	0... 1023.97	0.03125	Nm
Maximum positve gradient of the requested torque TQI_REQ_LIM					
C_TQI_DIF_LIM_MAX_OFS	-	0... 1FE0H	0... 255	0.03125	Nm
Offset after start condition					
C_TQI_REQ_LIM_PAS	-	0... 7FFF H	0... 1023.97	0.03125	Nm
Passive torque request for no torque intervention					
IP_TQI_DIF_LIM	V	0... FFFF H	-1024... 1023.97	0.03125	Nm
LDP_N_32__TQI_DIF_TQI_LIM	4	0... FF H	0... 8160	32	rpm
LDP_TQI_SP_MON__TQI_DIF_TQI_LIM	4	0... FF H	0... 510	2	Nm
Torque threshold depending on TQI_SP_MON					
LC_TQ_LIM_INH	-	0... 1 H	0 ...1	1	-
Logical constant inhibition torque intervention for safety in general					
LC_TQ_LIM_INH_FAST	-	0... 1 H	0 ...1	1	-
Logical constant inhibition torque intervention for safety for fast path					
LC_TQ_LIM_INH_SLOW	-	0... 1 H	0 ...1	1	-
Logical constant inhibition torque intervention for safety for slow path					

FUNCTION DESCRIPTION:

General information:
The ETC safety concept monitors the torque generation of the engine by comparing the actual indicated engine torque TQI_AV to the desired indicated engine torque TQI_SP_MON. In order to avoid a false diagnosis decision caused by tolerances and disturbances this torque intervention function is introduced.
The module *Torque Request for Safety* delivers two torque request values TQI_REQ_LIM_FAST for the fast torque path (ignition and fuel cut-off) and TQI_REQ_LIM_SLOW for the slow torque path (air path) which leads to a torque intervention if the actual reference torque TQI_AV exceeds the setpoint TQI_SP_MON by more than a specified threshold.
This state is indicated by the bit LV_TQ_LIM_INTV_1. It is set if TQI_AV is bigger than the setpoint TQI_SP_MON plus the offset TQI_DIF_LIM.
The bit LV_TQ_LIM_INTV is set to 1 if LV_TQ_LIM_INTV_2 = 1 and set to 0 C_T_TQ_LIM_INTV seconds after an transition of LV_TQ_LIM_INTV_2 to 0 to prevent LV_TQ_LIM_INTV from to fast jittering if the torque limitation goes on off on ... and is used for diagnosis. LV_TQ_LIM_INTV_2 is used to activate ignition or fuel cut of intervention.
TQI_AV is calculated from the reference torque value TQI_REF which includes the actual engine speed N_32 and MAF and actual efficencies of lambda ignition and cylinder shut off.
TQI_DIF_LIM is the safety offset which is the sum of TQI_SP_MON and IP_TQI_DIF_LIM which depends on N_32 and TQI_SP_MON itself.
If the actual torque TQI_AV is inside the permitted range (LV_TQ_LIM_INTV_1 = 0) then TQI_REQ_LIM_2 is set to the calibratible value C_TQI_REQ_LIM_PAS (e.g. max. engine torque + 10%).
The torque increase of TQI_REQ_LIM_3 is realized by a change limitation (C_TQ_LIM_INC) to avoid positive torque jumps if the limitation condition disappears.
TQI_REQ_LIM_SLOW is also limited by a rate limiter to avoid negative jumps of the throttle.
By the tuneable logical constants LC_TQ_LIM_INH_FAST and LC_TQ_LIM_INH_SLOW either the fast torque output or the slow torque output or both can be inhibited (set to passive values) for further investigations.
ON-Delay:

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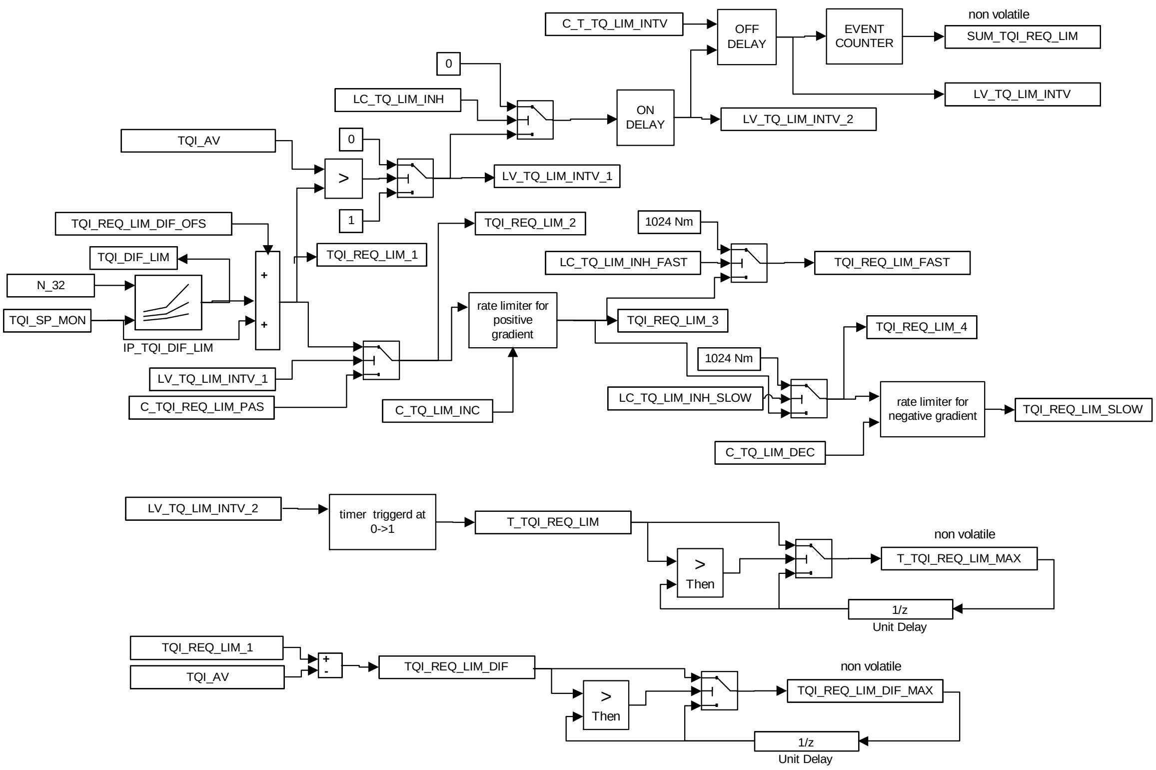
The ON-Delay is necessary because of this module is not synchronized to the module Desired indicated engine torque of level 2. This could cause inaccurate torque limitation in case of a high positive torque gradient in level 1 while TQI_SP_MON is not updated yet.

Drag Pointer functions:

Within the tuning phase is reliable a statistical evaluation of interventions. Therefore some drag pointers information are available.

Signal flow diagram:



Application conditions:

Activation: LV_IGK = 1 **and** LV_ES = 0 **and** LV_MTC_CUR_OFF = 0

Deactivation: otherwise

Initialization: at reset **or** LV_IGK = 0 **or** LV_ES = 1 **or** LV_MTC_CUR_OFF = 1

then LV_TQ_LIM_INTV = 0
LV_TQ_LIM_INTV_1 = 0
LV_TQ_LIM_INTV_2 = 0
TQI_REQ_LIM_FAST = C_TQI_REQ_LIM_PAS
TQI_REQ_LIM_SLOW = C_TQI_REQ_LIM_PAS
TQI_REQ_LIM_3 = C_TQI_REQ_LIM_PAS
T_TQ_LIM_INTV = 0 s
T_TQI_REQ_LIM = 0 s
TQI_REQ_LIM_DIF = 0 Nm
TQI_REQ_LIM_DIF_OFS = C_TQI_DIF_LIM_MAX_OFS

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Update-Rate: *40 ms*

Formula section:

$TQI\_REQ\_LIM\_DIF\_OFS_n$ =
MAX ($TQI\_REQ\_LIM\_DIF\_OFS_{(n-1)}$ - C_DEC_TQI_LIM_DIF_MAX; 0Nm)

Request-Calculation (I):
TQI_REQ_LIM_1 = TQI_SP_MON + IP_TQI_DIF_LIM (N_32 ; TQI_SP_MON) +
TQI_REQ_LIM_DIF_OFS
TQI_REQ_LIM_DIF = TQI_REQ_LIM_1 - TQI_AV

IF LC_TQ_LIM_INH == 1
THEN $LV\_TQ\_LIM\_INTV\_1_k$ = 0
ELSE **IF** TQI_AV $>$ TQI_REQ_LIM_1
THEN $LV\_TQ\_LIM\_INTV\_1_k$ = 1
ELSE $LV\_TQ\_LIM\_INTV\_1_k$ = 0
ENDIF
ENDIF

ON-Delay:
IF [($LV\_TQ\_LIM\_INTV\_1_{k-2}$ == 1) **AND** ($LV\_TQ\_LIM\_INTV\_1_{k-1}$ == 1) **AND** ($LV\_TQ\_LIM\_INTV\_1_k$ == 1)]
{delay by 2 recurrencies of the module}
THEN $LV\_TQ\_LIM\_INTV\_2_k$ = 1
ELSE $LV\_TQ\_LIM\_INTV\_2_k$ = 0
ENDIF

Off-Delay:
IF $LV\_TQ\_LIM\_INTV\_2_k$ == 1
THEN (LV_TQ_LIM_INTV = 1
T_TQ_LIM_INTV = C_T_TQ_LIM_INTV)
ELSE (T_TQ_LIM_INTV = T_TQ_LIM_INTV - [update rate] {limited to 0}
IF T_TQ_LIM_INTV == 0
THEN LV_TQ_LIM_INTV = 0
ENDIF)
ENDIF

Request-Calculation (II):
IF $LV\_TQ\_LIM\_INTV\_2_k$ == 1
THEN TQI_REQ_LIM_2 = TQI_REQ_LIM_1
ELSE TQI_REQ_LIM_2 = C_TQI_REQ_LIM_PAS
ENDIF

Rate limiter for positive gradient:
IF (TQI_REQ_LIM_2 $>$ ($TQI\_REQ\_LIM\_3_{k-1}$ + C_TQ_LIM_INC))
THEN $TQI\_REQ\_LIM\_3_k$ = $TQI\_REQ\_LIM\_3_{k-1}$ + C_TQ_LIM_INC
ELSE $TQI\_REQ\_LIM\_3_k$ = TQI_REQ_LIM_2
ENDIF

TQI_REQ_LIM_FAST calculation:
IF LC_TQ_LIM_INH_FAST == 1 {fast torque request path disabled}
THEN TQI_REQ_LIM_FAST = 1023.97 {upper limit}
ELSE TQI_REQ_LIM_FAST = $TQI\_REQ\_LIM\_3_k$
ENDIF

TQI_REQ_LIM_4 calculation:

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IF LC_TQ_LIM_INH_SLOW == 1 {slow torque request path disabled}
THEN TQI_REQ_LIM_4 = 1023.97 {upper limit}
ELSE TQI_REQ_LIM_4 = TQI_REQ_LIM_3$_k$
ENDIF
Rate limiter for negative gradient:
IF (TQI_REQ_LIM_4 < (TQI_REQ_LIM_ SLOW$_{k-1}$ - C_TQ_LIM_DEC))
THEN TQI_REQ_LIM_SLOW$_k$ = TQI_REQ_LIM_SLOW$_{k-1}$ - C_TQ_LIM_DEC
ELSE TQI_REQ_LIM_SLOW$_k$ = TQI_REQ_LIM_4
ENDIF
Event counter active torque limitation: SUM_TQI_REQ_LIM
At transition LV_TQ_LIM_INTV = 0 -> 1
THEN **increment** SUM_TQI_REQ_LIM **by** 1
ELSE SUM_TQI_REQ_LIM unchanged
ENDIF
The counter SUM_TQI_REQ_LIM is stored in non volatile memory till error memory is erased or is reseted at external adjustment or LC_AD_CLR_TQ

Drag pointer of torque intervention:
IF LV_TQ_LIM_INTV_2 = 1 **and** TQI_REQ_LIM_DIF < TQI_REQ_LIM_DIF_MAX
Then TQI_REQ_LIM_DIF_MAX = TQI_REQ_LIM_DIF
else TQI_REQ_LIM_DIF_MAX unchanged
endif

IF(1) LV_TQ_LIM_INTV_2$_n$ = 1 **and** LV_TQ_LIM_INTV_2$_{n-1}$ = 0
Then(1) T_TQI_REQ_LIM = 0s ("reset at activation")
Else(1) IF(2) LV_TQ_LIM_INTV_2$_n$ = 1
Then (2) T_TQI_REQ_LIM = T_TQI_REQ_LIM + Update rate
IF(3) T_TQI_REQ_LIM > T_TQI_REQ_LIM_MAX
Then(3) T_TQI_REQ_LIM_MAX = T_TQI_REQ_LIM
Else(3) T_TQI_REQ_LIM_MAX unchanged
Else(2) T_TQI_REQ_LIM unchanged
Endif
The drag pointers TQI_REQ_LIM_DIF_MAX and T_TQI_REQ_LIM_MAX are stored in non volatile memory till error memory is erased or a reset is done at external adjustment or LC_AD_CLR_TQ .

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D.18 Torque based engine power limitation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACT_TQI_PBR_MAX	V	0... 1H	0 ...1	1	-
Bit indicating conditions for torque limitation due to PBR fulfilled					
STATE_MOD_GB_WLC	O/V	0H 1H 2H 3H 7H	SSC_SBC_OFF SSC_ON SBC_ON SSC_SBC_ON INVALID_SIGNAL	-	-
State mode gearbox for torque limitation due to WLC error (AT)					
TQ_LIM_AT	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum allowed torque at clutch in case of TCU limp home (autarkic transmission protection for AT)					
TQ_LIM_TCT	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum allowed torque at clutch in case of TCU limp home (autarkic transmission protection for TCT)					
TQ_LIM_WLC	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum allowed torque at clutch in case of wandler launch control (WLC) error for AT					
TQI_P_MAX	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
maximum allowed indicated torque due to torque limitation					
TQI_PBR_MAX	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
maximum allowed indicated torque due to PBR					

Input data:

AC_WHEEL_PBR {p. 1561}	C_CTR_KM_CAN_EGY_2_MAX {p. 1149}	CTR_KM_CAN {p. 1563}	ERR_SYM_BN_ETCU {p. 4861}
ERR_SYM_BN_TQ_ETCU {p. 4864}	ERR_SYM_BN_TQ_TCS {p. 4865}	ERR_SYM_BN_VS_TCS {p. 4865}	GEAR {p. 1302}
LV_AT {p. 654}	LV_CFT_MOD_PBR {p. 1564}	LV_CS {p. 8394}	LV_CS_2 {p. 1565}
LV_DRI {p. 1302}	LV_ETCU_DISABLE_CAN {p. 6718}	LV_TCS_DISABLE_CAN {p. 6741}	LV_VAR_TCT {p. 656}
N_32 {p. 1525}	STATE_EGY_MIN_KWP {p. 7483}	STATE_HLD_PBR {p. 1574}	STATE_MOD_GB {p. 1575}
STATE_PBR {p. 1575}	STATE_PBR_ACT {p. 1575}	STATE_PBR_ACT_QLY {p. 1575}	STATE_ST_TQ_LIM_GS {p. 1577}
STATE_TQ_WHEEL_PBR_QLY {p. 1578}	TQ_LOSS {p. 8385}	VS {p. 1176}	VS_FIL {p. 1176}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_TQ_LIM_TOUT_AT	-	0... FFFFH	0... 655.35	0.01	s
Delay time for TCU limp - home (AT)					
C_T_TQ_LIM_TOUT_TCT	-	0... FFFFH	0... 655.35	0.01	s
Delay time for TCU limp - home (TCT)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_TQ_LIM_WLC	-	0... FFFFH	0... 655.35	0.01	s
Delay time for torque limitation due to WLC error (AT)					
C_TQ_LIM_AT_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitating gradient at end of AT torque limitation					
C_TQ_LIM_TCT_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitating gradient at end of TCT torque limitation					
C_TQ_LIM_TOUT_AT_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for TCU limp - home (AT)					
C_TQ_LIM_TOUT_TCT_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for TCU limp - home (TCT)					
C_TQ_LIM_WLC_LGRD	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Limitation gradient for WLC error (AT)					
C_TQI_PBR_MAX	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
maximum allowed TQI_ PBR_MAX					
C_VS_MAX_TQ_LIM_PBR	-	0... FFH	0... 255	1	km/h
Threshold of vehicle speed limitation for PBR					
C_VS_MIN_TQI_LIM_PBR	-	0... FFH	0... 255	1	km/h
Minimum threshold of vehicle speed limitation for PBR					
ID_TQ_P_MAX_AT	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDPM_GEAR__TQ_P_MAX	13	0... CH	0... 12	1	-
maximum allowed torque at clutch due to torque limitation depending on gear ratio by AT					
ID_TQ_P_MAX_MT	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDPM_GEAR__TQ_P_MAX	13	0... CH	0... 12	1	-
maximum allowed torque at clutch due to torque limitation depending on gear ratio by MT					
IP_TQ_LIM_AT	V	0... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_VS_FIL_IP_TQ_LIM_AT	8	0... FFFFH	0... 511.9921875	7.8125e-3	km/h
LDPM_N_32_IP_TQ_LIM_AT	8	0... FFH	0... 8160	32	rpm
Maximum allowed torque at clutch in case of TCU limp - home (autarkic transmission protection for AT)					
IP_TQ_LIM_TCT	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDPM_VS_FIL_IP_TQ_LIM_TCT	8	0... FFFFH	0... 511.9921875	7.8125e-3	km/h
LDPM_N_32_IP_TQ_LIM_TCT	8	0... FFH	0... 8160	32	rpm
Maximum allowed torque at clutch in case of TCU limp - home (autarkic transmission protection for TCT)					
IP_TQ_LIM_TOUT_AT	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDPM_VS_FIL_IP_TQ_LIM_AT	8	0... FFFFH	0... 511.9921875	7.8125e-3	km/h
LDPM_N_32_IP_TQ_LIM_AT	8	0... FFH	0... 8160	32	rpm
Maximum allowed torque at clutch before TCU limp - home (AT)					
IP_TQ_LIM_TOUT_TCT	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDPM_VS_FIL_IP_TQ_LIM_TCT	8	0... FFFFH	0... 511.9921875	7.8125e-3	km/h
LDPM_N_32_IP_TQ_LIM_TCT	8	0... FFH	0... 8160	32	rpm
Maximum allowed torque at clutch before TCU limp - home (TCT)					
IP_TQ_LIM_WLC	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDP_N_32_IP_TQ_LIM_WLC	8	0... FFH	0... 8160	32	rpm
Maximum allowed torque at clutch in case of wandler launch control (WLC) error (AT)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TQ_P_MAX_EGY_2	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDP_N_32_IP_TQ_P_MAX_EGY_2	8	0... FFH	0... 8160	32	rpm
Maximum allowed torque due to energy spare mode 2					
LC_TQI_P_MAX_INH_AS	-	0... 1H	0 ...1	1	-
switch for torque limitation ON/OFF (0 = ON)					

General information:

Due to customer- or hardware- (gear box) request the maximum torque at clutch depending on gear ratio and transmission type can be limited.

Application conditions:

Initialisation: `RST, IGKON`
Recurrence: `10MS`
Activation: `always`
Deactivation: `never`

Function description:

Formula section:

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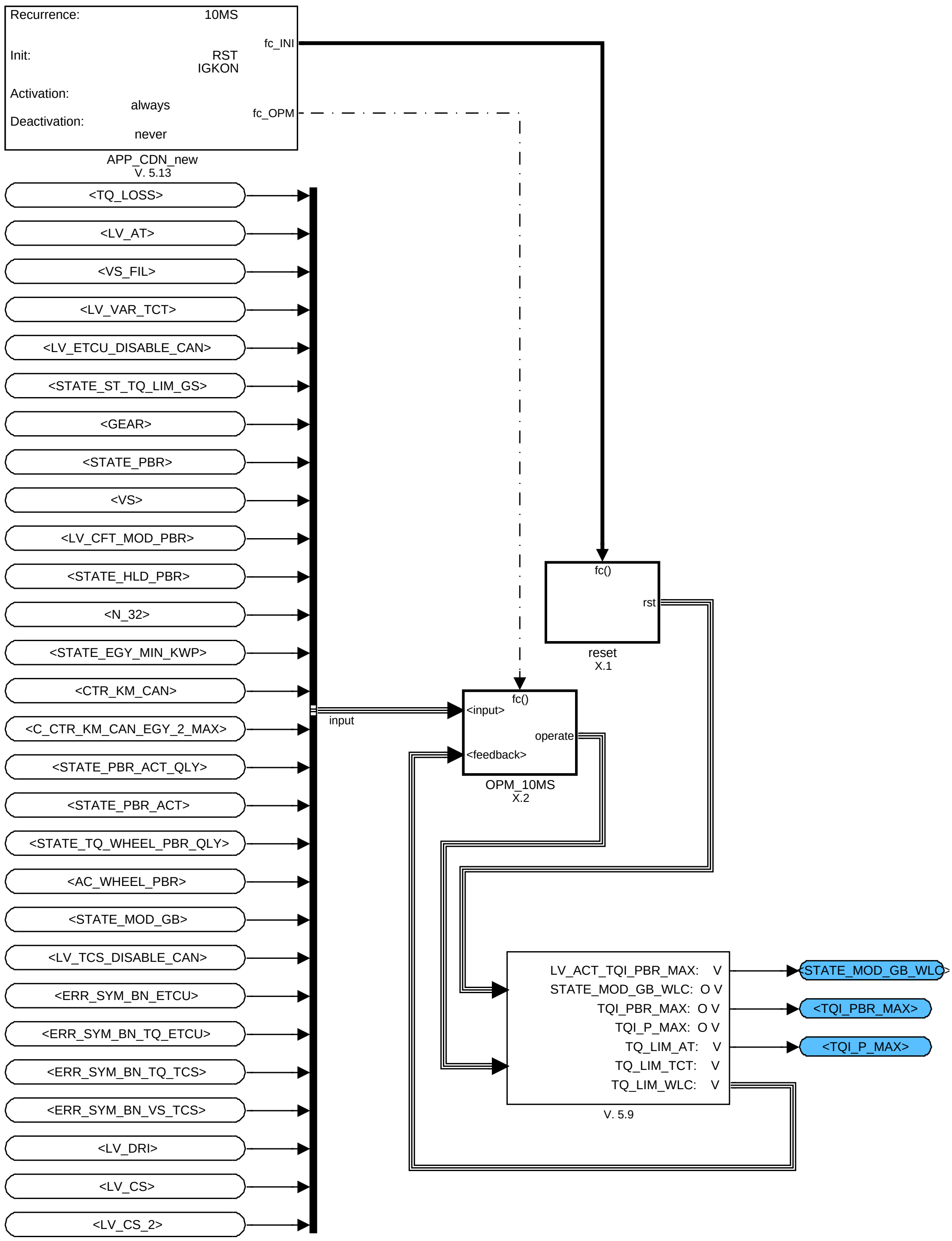

SDA_SRS / SDA V 6.0.3 / 20−Jul−2009

Figure D.18.1: :

D.18.1 Initialisation at reset or LV_IGK = 0 to 1

TQI_P_MAX = 1023,97 Nm
TQ_PBR_MAX = 1023,97 Nm
TQ_LIM_AT = 1023,97 Nm

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TQ_LIM_TCT = 1023,97 Nm
LV_ACT_TQI_PBR_MAX = 0

D.18.2 Recurrence:10 ms

D.18.2.1 Calculation of TQ_LIM_WLC

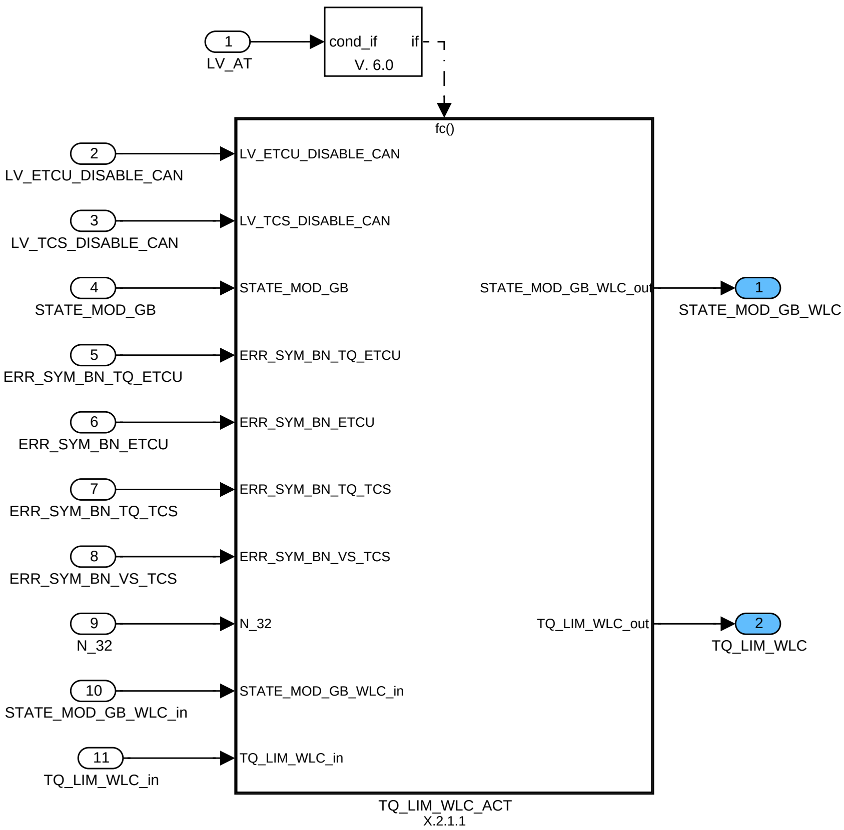

Figure D.18.2: :

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D.18.2.1.1 Calculation of the torque limitation at clutch in case of wandler launch control error

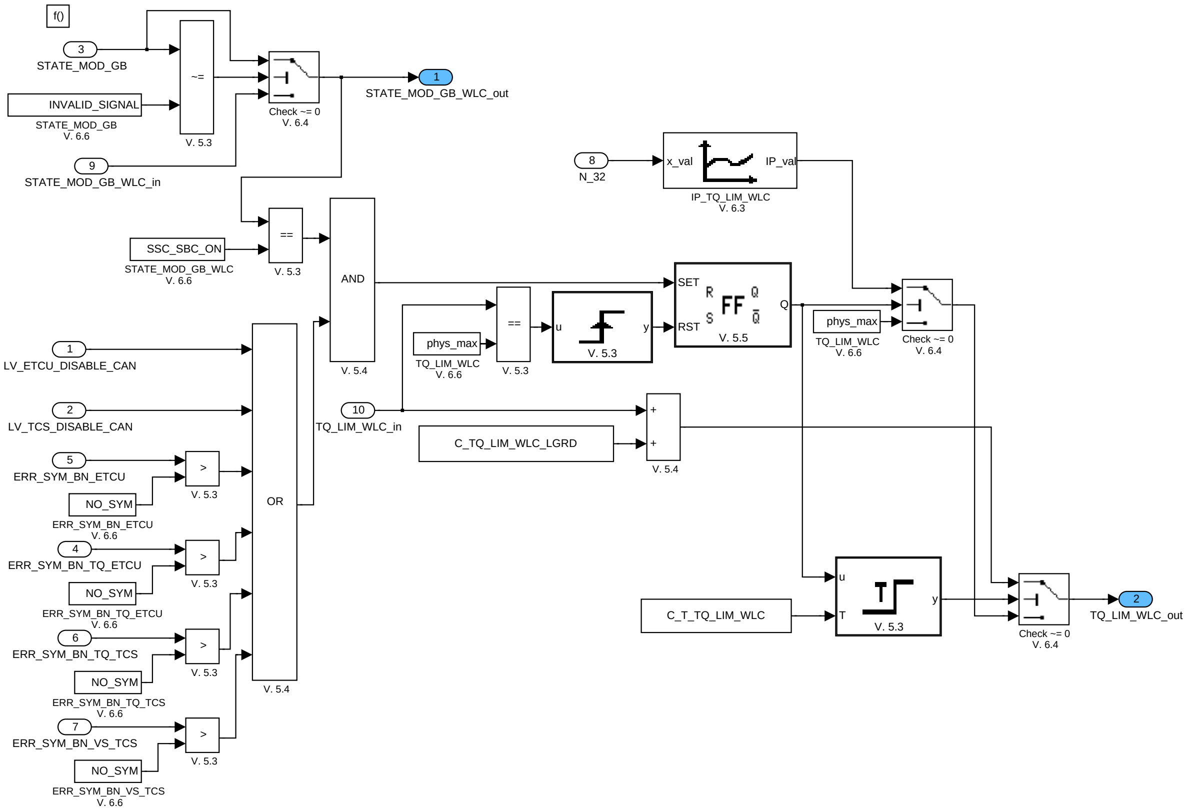

Figure D.18.3: :

D.18.2.2 Calculation of torque limitation for automatic shifted transmission

Maximum allowed torque at clutch in case of TCU limp home. Autarkic transmission protection for AT.

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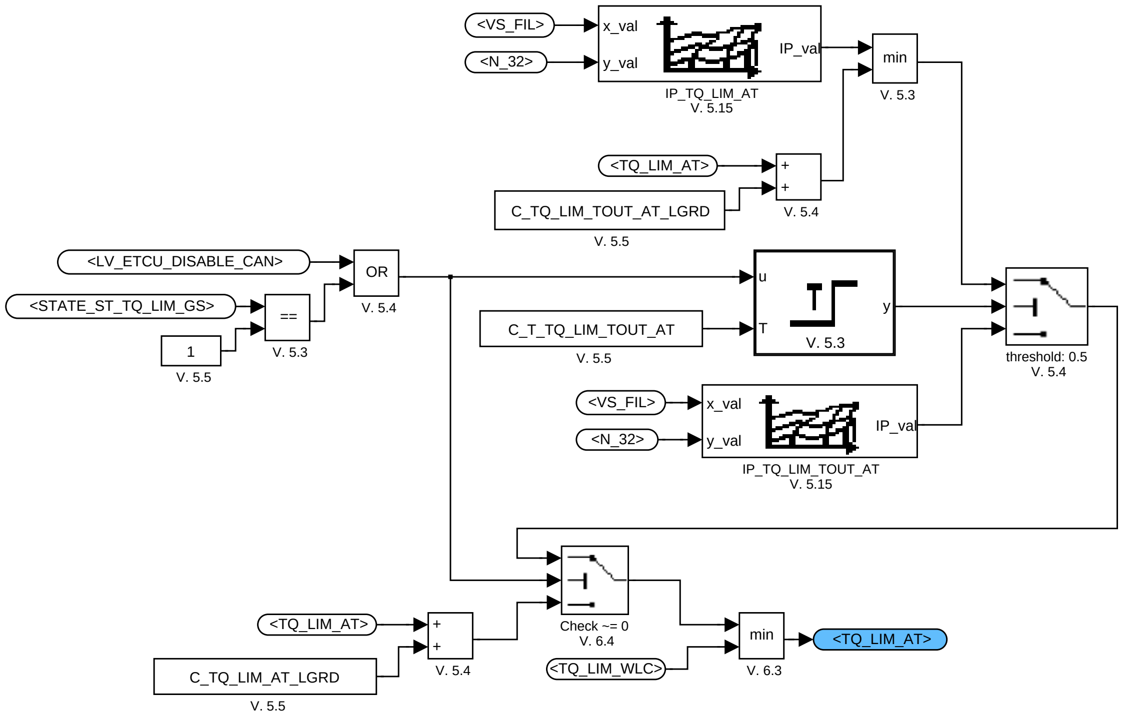

Figure D.18.4: :

D.18.2.3 Calculation of torque limitation for twin clutch transmission

Maximum allowed torque at clutch in case of TCU limp home. Autarkic transmission protection for TCT.

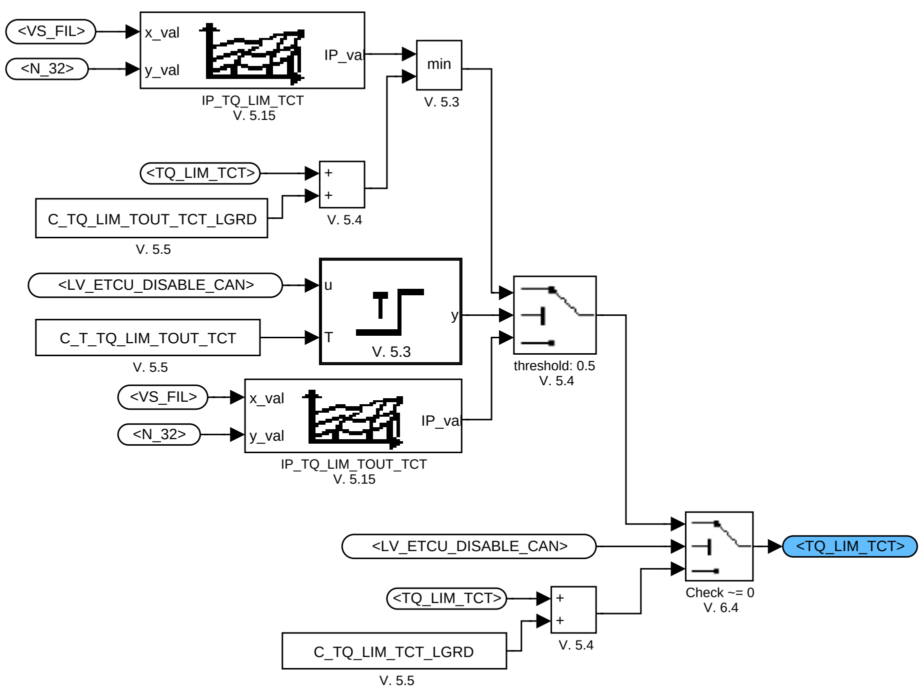

Figure D.18.5: :

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D.18.2.4 Calculation of TQI_P_MAX_CLC

Calculation of the maximum indicated engine torque proportional part.

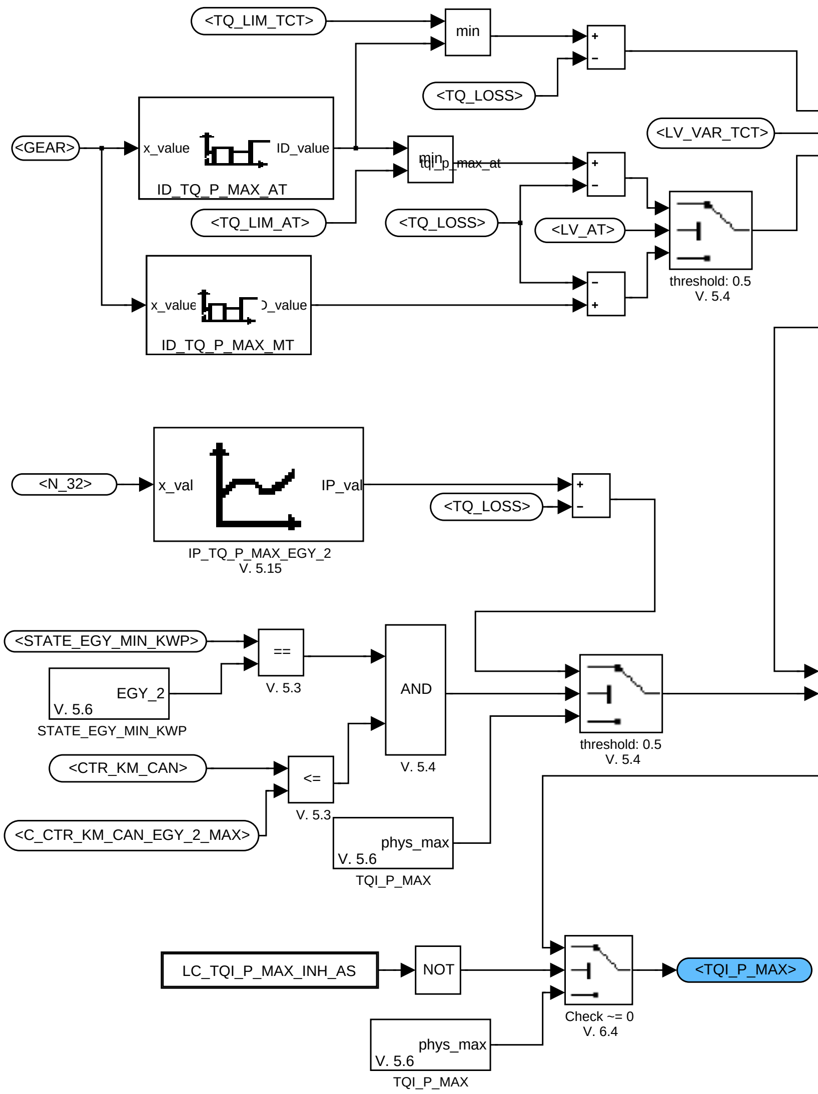

Figure D.18.6: :

D.18.2.5 Calculation of TQI_PBR_MAX

Calculation of the maximum indicated engine torque for PBR.

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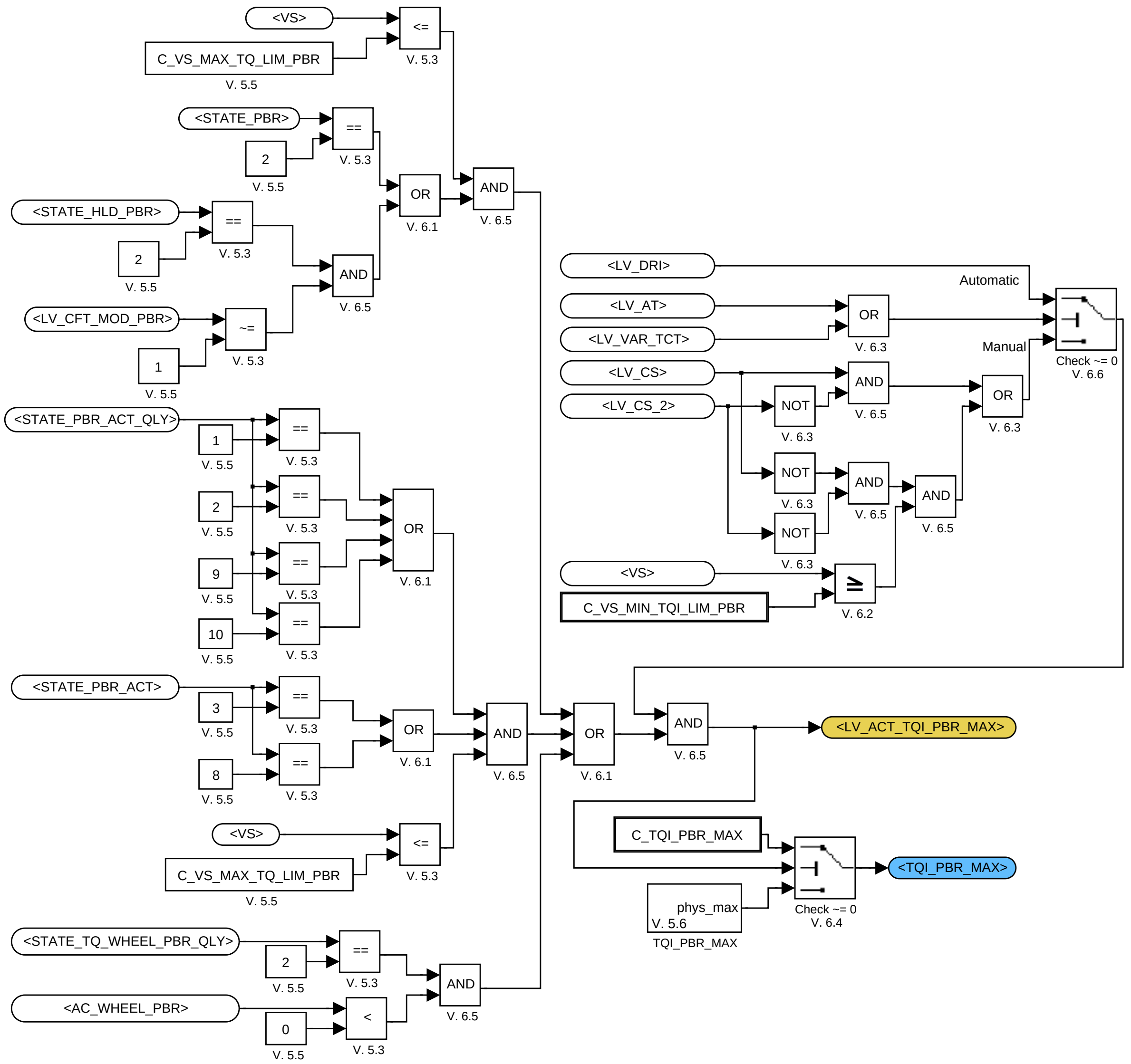

Figure D.18.7: :

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D.19 Torque request at clutch general

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_REQ	O/V	0... FFFFH	0... 1.99996948	30.5175e-6	-
Torque factor from pedal value interpretation and cruise control					
FAC_TQ_REQ_CLU	O/V	0... FFFFH	0... 1.99996948	30.5175e-6	-
Torque scaling factor for calculation requested torque at clutch					
FAC_TQ_REQ_CLU_LDM	O/V	0... FFFFH	0... 1.99996948	30.5175e-6	-
Torque scaling factor for calculation requested torque at clutch for LDM					
LV_TQ_CRU_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable cruise control active					

Input data:

FAC_TQ_REQ_CRU {p. 6737}	FAC_TQ_REQ_DCC {p. 6737}	FAC_TQ_REQ_DRIV {p. 6570}	LV_LDM_ENA {p. 6615}
LV_MAF_BLS_DIAG {p. 4820}			

D.19.1 TQSP_MD00L

General information:

The module "Torque Request at Clutch General" supplies the BMW torque structure with the torque scaling factor FAC_TQ_REQ_CLU from the driver or a cruise control.
FAC_TQ_REQ is exported and can be used from a transmission control unit for calculation of gear shifting points.
If a MAF error is detected and brake is active then the torque request is set to zero.

Application conditions

Initialisation: `all = 0 at reset`

Recurrence: `10 ms`

Activation: `at every engine state`

Deactivation: `-`

Application Condition

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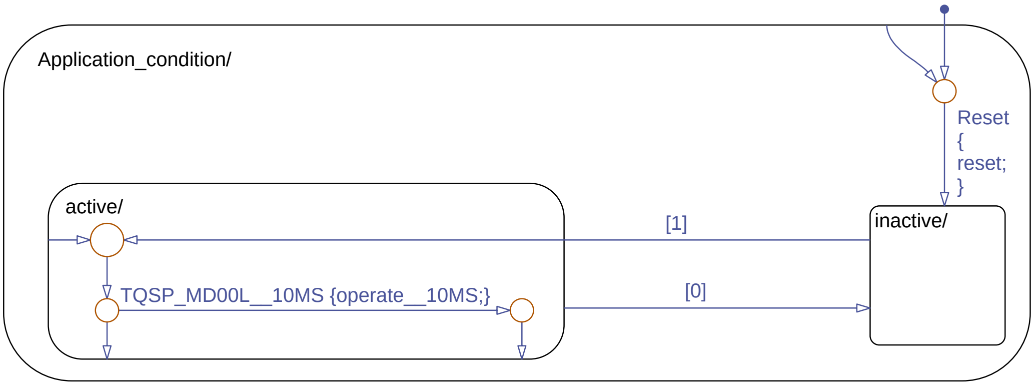

Figure D.19.1: TQSP_MD00L/APP_CDN/APPCND

Function Description

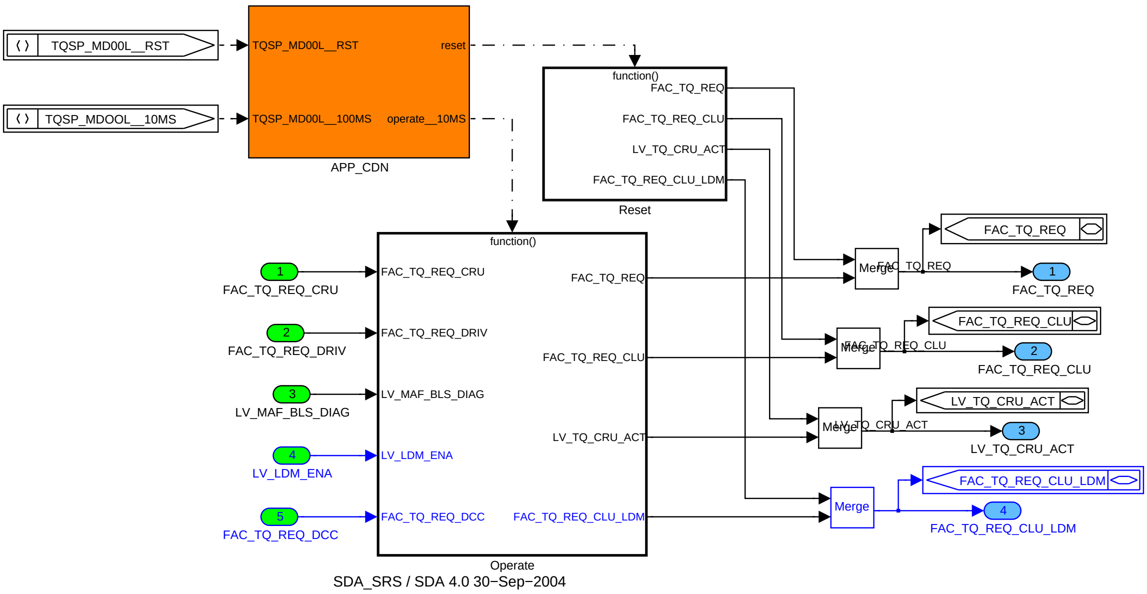

Figure D.19.2: TQSP_MD00L

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D.19.1.1 SUBFUNCTION: Operate

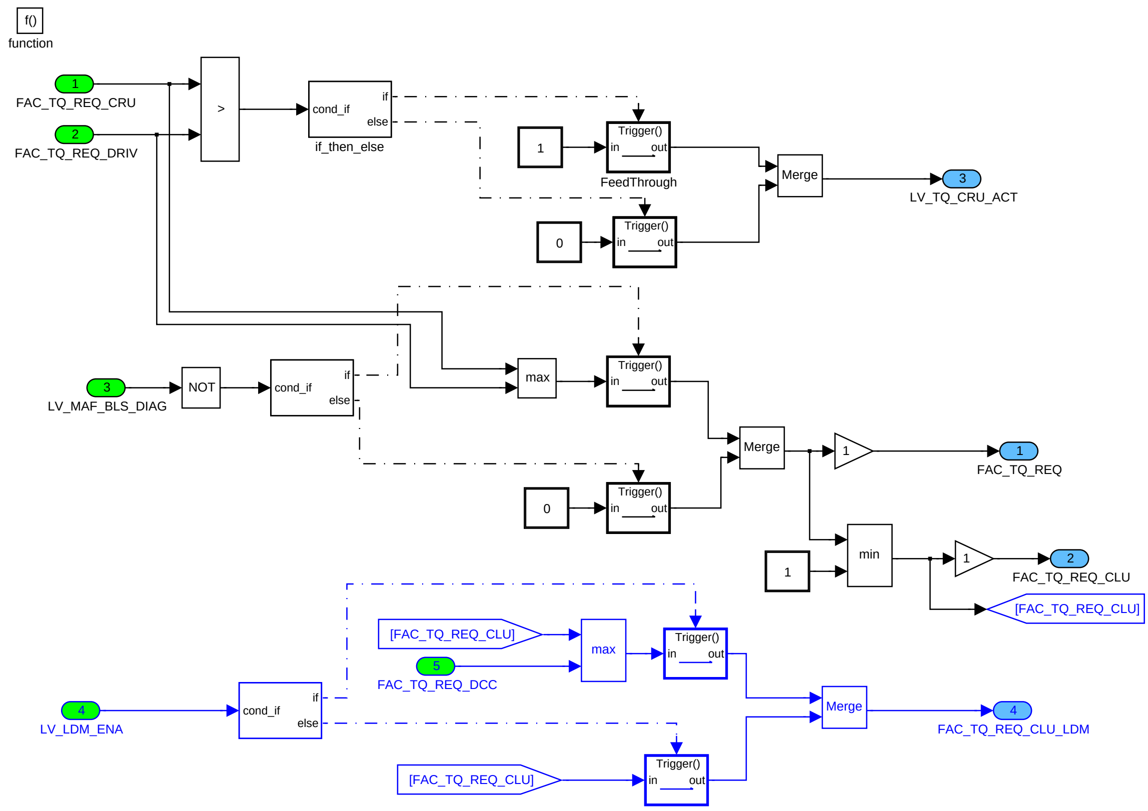

Figure D.19.3: TQSP_MD00L/Operate

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D.19.1.2 SUBFUNCTION: Reset

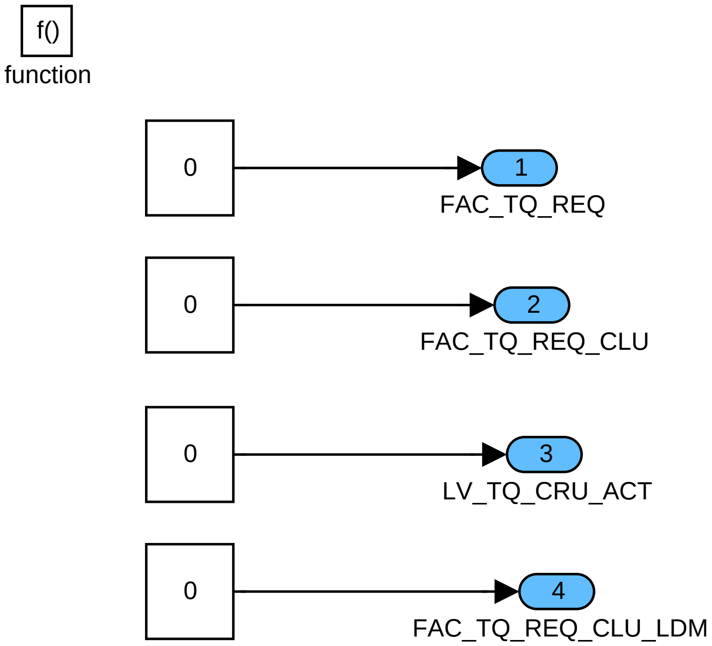

Figure D.19.4: TQSP_MD00L/Reset

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D.20 Converter torque

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_DIF_IS_AD_CONV_LGRD	V	0... FFFFH	0 ...1	15.3e-6	-
Convergence factor for ramping of TQ_DIF_IS_AD_CONV in case of LV_DRI=1					
LV_DLY_N_SP_IS	O/V	0... 1H	0 ...1	1	-
Logical variable idle speed setpoint change					
LV_TOUT_CONV	V	0... 1H	0 ...1	1	-
Logical variable to start deactivation of torque reserve and condition for switch off TQ_CONV calculation					
LV_TOUT_TCT	V	0... 1H	0 ...1	1	-
Logical variable to start deactivation of torque reserve and condition for switch off TCT calculation					
LV_TQ_DIF_IS_AD_CONV_ACT	V	0... 1H	0 ...1	1	-
Flag indicating IS adaptation value TQ_DIF_IS_AD_CONV is included in TQ_CONV					
T_CONV	V	0... 1FEH	0... 5.1	0.01	s
Timer for duration of transient TQ_LOSS_CONV correction					
T_TCT	V	0... 1FEH	0... 5.1	0.01	s
Timer for duration of transient TQ_ADD_TCT correction					
TQ_ADD_CONV	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for switching converter Torque					
TQ_ADD_CONV_2	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for switching converter Torque					
TQ_ADD_TCT	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for TCT					
TQ_ADD_TRANS	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for Transmission					
TQ_CONV	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Converter torque					
TQ_CONV_CAN_1	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Converter torque of CAN					
TQ_CONV_STN	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Calculated converter torque					

Input data:

AC_CRU {p. 7215}	GR_AT {p. 1302}	LV_AT {p. 654}	LV_DRI {p. 1302}
LV_ERR_BN_TQ_ETCU {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_TOUT_ETCU_1 {p. 802}	LV_ST {p. 1720}
LV_VAR_TCT {p. 656}	N_32 {p. 1525}	N_GRD {p. 1525}	N_SP_IS {p. 1122}
STATE_ETCU_CLU {p. 1573}	STATE_TCT_INTV {p. 1578}	TOIL {p. 8204}	TQ_ADD_CONV {p. 6710}
TQ_ADD_CONV_2 {p. 6710}	TQ_ADD_TCT {p. 6710}	TQ_CONV_CAN {p. 1581}	TQ_DIF_IS_AD_CONV {p. 3519}

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TQ_TCT_CAN {p. 1582}	VS {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_TQ_DIF_IS_AD_CONV_LGRD	-	0... FFFFH	0 ...1	15.3e-6	-
Convergence factor (delta per sample) for ramping of TQ_DIF_IS_AD_CONV in case of LV_DRI=1					
C_TQ_ADD_CONV_LGRD	-	0... 7FFFH	0... 1023.97	0.03125	Nm
Limitation gradient for TQ_ADD_CONV decrease after deactivation					
C_TQ_ADD_TCT_LGRD	-	0... 7FFFH	0... 1023.97	0.03125	Nm
Limitation gradient for TQ_ADD_TCT decrease after deactivation					
C_TQ_CONV_CAN_THD	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Threshold for TQ_CONV_CAN regarding the consideration of TQ_DIF_IS_AD_CONV in case of LV_DRI=1					
C_TQ_TCT_CAN_THD_CONV	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Threshold for TQ_TCT_CAN to detect transmission not in gear					
IP_FAC_CONV__TOIL	-	0... FFFFH	0... 0.00048	7.4464e-9	Nm/ rpm**2
LDP_TOIL__FAC_CONV	8	0... C8H	-40 ...160	1	°C
Converter characteristic at P /N (LV_DRI = 0)					
IP_FAC_CONV_DRI__TOIL	-	0... FFFFH	0... 0.00048	7.4464e-9	Nm/ rpm**2
LDP_TOIL__FAC_CONV	8	0... C8H	-40 ...160	1	°C
Converter characteristic at engaged gear					
IP_FAC_TQ_ADD_CONV_TOIL	-	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_TOIL_TQ_ADD_CONV	6	0... C8H	-40 ...160	1	°C
Torque reserve for switch GS					
IP_FAC_TQ_CONV__N_RATIO_CONV	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_N_RATIO__CONV_FAC_TQ_CONV	8	0... FFH	0... 0.99609	3.9063e-3	-
Torque request factor					
IP_N_TUR__GR_AT__VS	V	0... FFFFH	0... 65535	1	rpm
LDP_GR_AT__N_TUR	9	0... 8H	0 ...8	1	-
LDP_VS__N_TUR	2	0... FFH	0... 255	1	km/h
turbine speed					
IP_T_DLY_CONV__TOIL	-	0... FFH	0... 2550	10	ms
LDP_TOIL__T_DLY_CONV	8	0... C8H	-40 ...160	1	°C
time delay for TQ_CONV activation					
IP_T_DLY_N_SP_IS__TOIL	-	0... FFH	0... 2550	10	ms
LDP_TOIL__T_DLY_N_SP_IS	8	0... C8H	-40 ...160	1	°C
time delay for change of idle speed setpoint					
IP_T_RAMP_CONV_NEG__TOIL	-	0... FFH	0... 2550	10	ms
LDP_TOIL__T_RAMP_CONV_NEG	8	0... C8H	-40 ...160	1	°C
ramp after shift disengaging					
IP_T_RAMP_CONV_POS__TOIL	-	0... FFH	0... 2550	10	ms
LDP_TOIL__T_RAMP_CONV_POS	8	0... C8H	-40 ...160	1	°C
ramp after shift engaging					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TQ_ADD_CONV	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32_IP_TQ_ADD_ACC	6	0... FFH	0... 8160	32	rpm
LDPM_TOIL_TQ_ADD_CONV	6	0... C8H	-40 ...160	1	°C
Torque reserve for switch GS					
IP_TQ_ADD_CONV_AC	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_AC_CRU_TQ_ADD_CONV	6	0... FFFFH	-15.72... 15.71952	479.7e-6	m/s**2
LDPM_VS_TQ_ADD_CONV	6	0... FFH	0... 255	1	km/h
Torque reserve for switch GS by AC_CRU					
IP_TQ_ADD_CONV_N_GRD	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_GRD_TQ_ADD_CONV	6	0... FFH	-4096 ...4064	32	rpm/s
LDPM_VS_TQ_ADD_CONV	6	0... FFH	0... 255	1	km/h
Torque reserve for switch GS by N_GRD					
IP_TQ_ADD_TCT	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32__IP_TQ_ADD_ACC	6	0... FFH	0... 8160	32	rpm
Torque reserve for TCT					
IP_TQ_CONV_CAN	V	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_32__TQ_CONV	8	0... FFH	0... 8160	32	rpm
LDP_TQ_CONV_CAN__TQ_CONV	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Corrected Converter torque via N_32					
LC_TQ_CONV_CAN_INH	-	0... 1H	0 ...1	1	-
Logical constant converter torque by CAN-interface inhibit					
LC_TQ_CONV_DRI_INH	-	0... 1H	0 ...1	1	-
Logical constant converter torque calculation at LV_DRI = 0 inhibit					

FUNCTION DESCRIPTION:

General information:

TQ_CONV describes the hydraulic torque losses inside the converter of an automatic gearbox due to speed difference between converter turbine and pump. There are two kinds of transmission types with and w/o a relevant torque loss at P/N. So the calculation of TQ_CONV_STN at LV_DRI = 0 (= P/N) can be inhibited by LC_TQ_CONV_DRI_INH = 1. Additional to the calculated converter torque TQ_CONV_STN a converter torque transmitted via CAN TQ_CONV_CAN can be used by setting LC_TQ_CONV_CAN_INH to zero. In case of TQ_CONV_CAN is enabled (LC_TQ_CONV_CAN_INH = 0) and a timeout CAN-message ETCU1- or CAN bus off error is recogniced TQ_CONV = TQ_CONV_STN as calculated in ECU.

In order to assist the idle speed controller, TQ_CONV_STN is calculated for a reference condition with an engine speed set to N_SP_IS. As a result, TQ_CONV_STN is bigger than the real converter torque for N < N_SP_IS and smaller for N > N_SP_IS.

The converter torque adaptation TQ_DIF_IS_AD_CONV is calculated in the idle speed adaptation module.

After a delay of IP_T_DLY_CONV, TQ_CONV is reached following a ramp with the length IP_T_RAMP_CONV_POS (The calibration parameter IP_T_RAMP_CONV_POS is used to calculate the ramp gradi-

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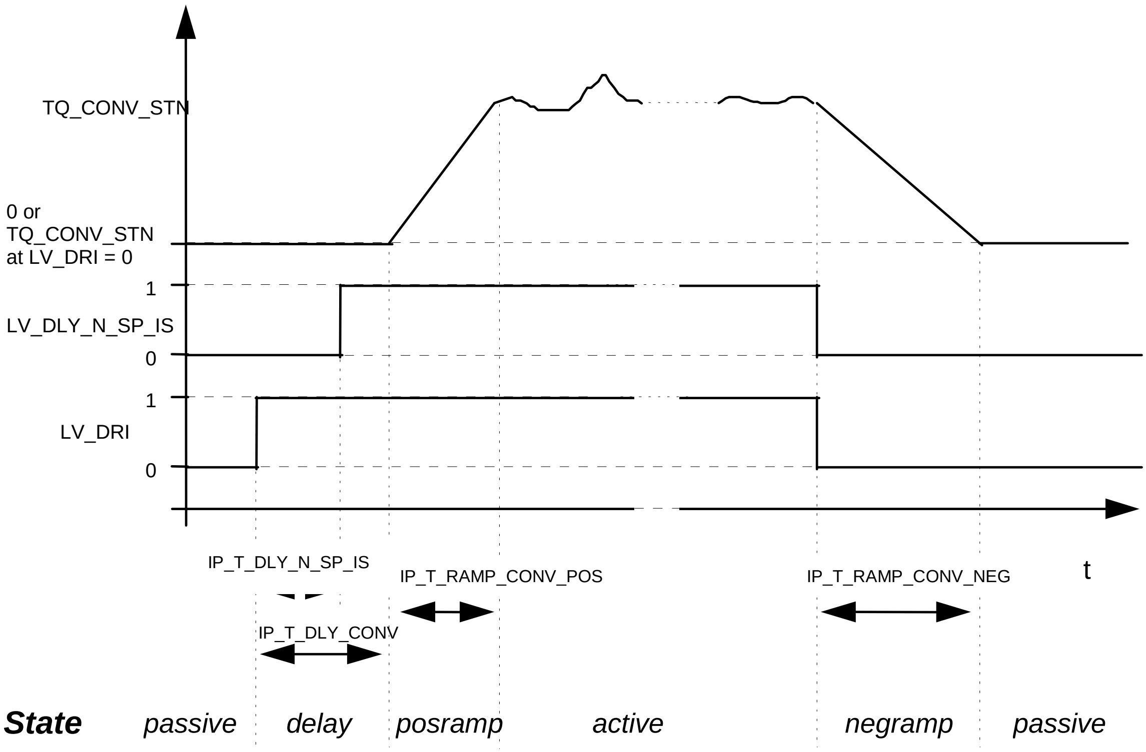
ent, which is kept constant for this ramp, even if TQ_CONV_STN changes during this time. Therefore, the observed ramp length may differ from IP_T_RAMP_CONV_POS). After disengaging the gear it is suppressed without any time delay, following a ramp with the length IP_T_RAMP_CONV_NEG. In case of LC_TQ_CONV_CAN_INH = 0 no ramps are calculated!
The change of the idle speed setpoint N_SP_IS during gearshift is synchronised with the converter torque request by application of a time delay T_DLY_N_SP_IS after engaging the gear.
The present model is valid for open converter clutch only. However, the latter normally can be closed or slips only in an operating range N >> N_SP_IS, in which TQ_CONV_STN -> 0 (or TQ_CONV_STN in case of LC_TQ_CONV_DRI_INH = 0).



Application conditions:

Activation: at every engine state (LV_AT = 1 or LV_VAR_TCT = 1)
Deactivation: -
Initialisation: at reset
TQ_CONV = 0 Nm
LV_DLY_N_SP_IS = 0
TQ_CONV_STN = 0 Nm
TQ_CONV_CAN_1 = 0 Nm
FAC_TQ_DIF_IS_AD_CONV_LGRD = 0
LV_TQ_DIF_IS_AD_CONV_ACT = 0
Update rate: 10 ms

Formula section:

selection of converter torque interface :
if LV_VAR_TCT = 0
then **if** LV_ERR_TOUT_ETCU_1 = 0
and LV_ERR_BN_TQ_ETCU = 0

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and LV_ERR_CAN_BOFF = 0
and LC_TQ_CONV_CAN_INH = 0
then **if** LV_DRI = 1
and TQ_CONV_CAN $>$ C_TQ_CONV_CAN_THD
then **if** (1 - FAC_TQ_DIF_IS_AD_CONV_LGRD$_{n-1}$) $>=$
C_FAC_TQ_DIF_IS_AD_CONV_LGRD
then FAC_TQ_DIF_IS_AD_CONV_LGRD$_n$ =
FAC_TQ_DIF_IS_AD_CONV_LGRD$_{n-1}$
+ C_FAC_TQ_DIF_IS_AD_CONV_LGRD
TQ_CONV = TQ_CONV_CAN_1 +
(TQ_DIF_IS_AD_CONV
* FAC_TQ_DIF_IS_AD_CONV_LGRD$_n$)
else TQ_CONV = TQ_CONV_CAN_1 +
TQ_DIF_IS_AD_CONV
FAC_TQ_DIF_IS_AD_CONV_LGRD$_n$ = 1
endif
else TQ_CONV = TQ_CONV_CAN_1
FAC_TQ_DIF_IS_AD_CONV_LGRD$_n$ = 0
endif
else TQ_CONV = TQ_CONV_STN
endif
else **if** STATE_TCT_INTV = 06h (N_REGULATION)
then TQ_CONV$_n$ = TQ_CONV$_{n-1}$
LV_TQ_DIF_IS_AD_CONV_ACT$_n$= LV_TQ_DIF_IS_AD_CONV_ACT$_{n-1}$
else **if** LV_DRI = 1 **and** TQ_TCT_CAN $<>$ 0
then LV_TQ_DIF_IS_AD_CONV_ACT$_n$ = 1
endif
if LV_DRI = 0 **and** TQ_TCT_CAN $<=$ C_TQ_TCT_CAN_THD_CONV
then LV_TQ_DIF_IS_AD_CONV_ACT$_n$ = 0
endif
if LV_TQ_DIF_IS_AD_CONV_ACT$_n$ = 1
then TQ_CONV$_n$ = TQ_TCT_CAN + TQ_DIF_IS_AD_CONV
else TQ_CONV$_n$ = TQ_TCT_CAN
endif
endif
endif

TQ_CONV_CAN_1 = IP_TQ_CONV_CAN

if LV_DRI = 0 **and** LC_TQ_CONV_DRI_INH = 0
then TQ_CONV_STN = IP_FAC_CONV * IP_FAC_TQ_CONV * N_SP_IS^2
+ TQ_DIF_IS_AD_CONV
else TQ_CONV_STN = IP_FAC_CONV_DRI * IP_FAC_TQ_CONV * N_SP_IS^2
+ TQ_DIF_IS_AD_CONV
endif

IP_FAC_TQ_CONV = f (N_RATIO_CONV)
N_RATIO_CONV = IP_N_TUR /N_SP_IS
IP_N_TUR = f (GR_AT,VS)

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D.20.1 Torque Reserve for Transmission

D.20.1.1 Determination of Torque reserve for AT Transmission

FUNCTION DESCRIPTION:

General information:

To guarantee idle quality during gear shift a positive torque reserve can be requested.

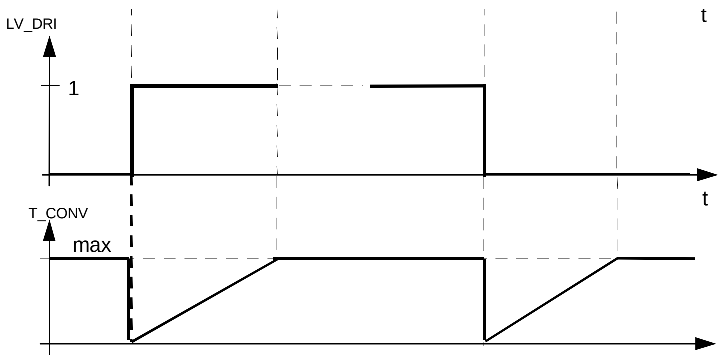
Application conditions

Initialisation: at reset
TQ_ADD_CONV = 0 Nm
LV_TOUT_CONV = 0
T_CONV = 0 s
TQ_ADD_CONV_2 = 0 Nm

Recurrence: *10 ms*

Activation: *LV_DRI= 1* ***and*** *LV_ST = 0 and LV_AT = 1*

Deactivation: **[** LV_DRI= 0 **and** TQ_ADD_CONV= 0 Nm **and** TQ_ADD_CONV_2 = 0Nm**]**



Formula section:

IF T_CONV < 1FEH
Then LV_TOUT_CONV = 0
Else LV_TOUT_CONV = 1
endif

if [LV_DRI = 1 **and** LV_TOUT_CONV = 0 **]**
then TQ_ADD_CONV = **max [** IP_TQ_ADD_CONV; 0 Nm **]**
TQ_ADD_CONV_2 = MAX (IP_TQ_ADD_CONV_N_GRD;
IP_TQ_ADD_CONV_AC * IP_FAC_TQ_ADD_CONV_TOIL

else TQ_ADD_CONV $_N$ = **max [(** TQ_ADD_CONV $_{N-1}$- C_TQ_ADD_CONV_LGRD **)**;
0 Nm **]**
TQ_ADD_CONV_2 $_N$ =
max [(TQ_ADD_CONV_2 $_{N-1}$- C_TQ_ADD_CONV_LGRD **)**;
0 Nm **]**

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endif

D.20.1.2 Determination of Torque reserve for TCT

FUNCTION DESCRIPTION:

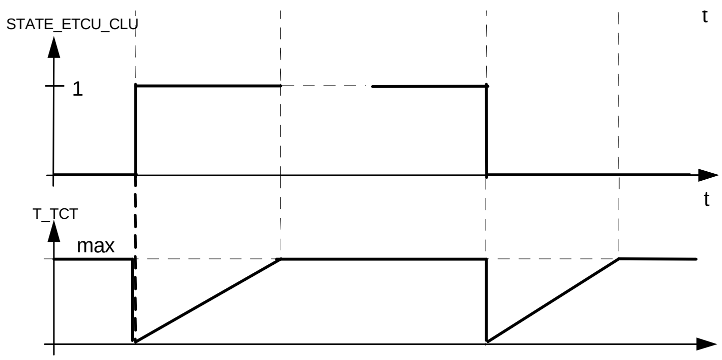
General information:

To guarantee idle quality during gear shift a positive torque reserve can be requested.

Application conditions

Initialisation:
```
at reset
TQ_ADD_TCT = 0 Nm
   LV_TOUT_TCT = 0
T_TCT = 0 s
```
Recurrence: *10 ms*

Activation:
```
{[STATE_ETCU_CLU = 1 and LV_ST = 0]
and  LV_VAR_TCT = 1}
```



Formula section:

IF T_TCT < 1FEH
Then LV_TOUT_TCT = 0
Else LV_TOUT_TCT = 1
endif

if LV_TOUT_TCT = 0
then TQ_ADD_TCT = **max [** IP_TQ_ADD_TCT; 0 Nm **]**
else TQ_ADD_TCT $_N$ = **max [(** TQ_ADD_TCT $_{N-1}$ - C_TQ_ADD_TCT_LGRD **)**;
0 Nm **]**
endif

D.20.1.3 Determination of Torque reserve for GS Transmission

To serve the torque reserve interface it is switch between TCT and AT transmissions.
Initialisation: at reset

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TQ_ADD_TRANS = 0 Nm

Recurrence: 10 ms

Activation: LV_AT = 1 or LV_VAR_TCT = 1

Formula section:

IF LV_VAR_TCT = 1
Then TQ_ADD_TRANS = TQ_ADD_TCT
Else IF LV_AT = 1
Then TQ_ADD_TRANS = TQ_ADD_CONV + TQ_ADD_CONV_2
Else TQ_ADD_TRANS = 0Nm
endif

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D.21 Gearbox torque intervention

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ETCU_DISABLE	O/V	0... 1H	0 ...1	1	-
Logical variable for disabling GS intervention due to EMS error					
LV_ETCU_DISABLE_CAN	O/V	0... 1H	0 ...1	1	-
Logical variable for disabling GS intervention due to CAN error					
LV_GS_DEC_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention due to gear shift					
LV_GS_DEC_LIH	V	0... 1H	0 ...1	1	-
Logical variable for torque intervention LIH due to gear shift					
LV_GS_ENA	V	0... 1H	0 ...1	1	-
Logical variable for gear shift intervention enabling					
LV_GS_ENA_DEC	O/V	0... 1H	0 ...1	1	-
Logical variable for decreased torque intervention due to gear shift					
LV_GS_ENA_INC	O/V	0... 1H	0 ...1	1	-
Logical variable for increased torque intervention due to gear shift					
LV_GS_INC_ACT	O/V	0... 1H	0 ...1	1	-
Togical variable for torque intervention due to gear shift					
LV_GS_INC_LIH	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention LIH due to gear shift					
LV_INH_FCUT_GS	O/V	0... 1H	0 ...1	1	-
Logical variable inhibiting FCUT during TCT-intervention					
STATE_TQ_ETCU_PLAUS	O/V	0... FFH	0... 255	1	-
Bitwise coded State for ETCU intervention state					
T_GS_DEC_LIH_CTR	V	0... FFH	0... 2.55	0.01	s
Delay time for activation of GS emergency ramp function					
T_GS_INC_LIH_CTR	V	0... FFH	0... 2.55	0.01	s
Delay time for activation of GS emergency ramp function					
T_TQR_GS_INTV	V	0... FFFFH	0... 655.35	0.01	s
Duration of gear shift torque intervention					
TQI_GS_FAST_DEC	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque decrement for fast torque intervention during gear shift					
TQI_GS_FAST_DEC_REQ	V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque decrement for fast torque intervention during gear shift					
TQI_GS_FAST_DEC_REQ_1	O	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque decrement for fast torque intervention during gear shift					
TQI_GS_FAST_INC	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque increase for fast torque intervention during gear shift					
TQI_GS_FAST_INC_REQ	V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque increase for fast torque intervention during gear shift					
TQI_GS_FAST_INC_REQ_1	O	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque increase for fast torque intervention during gear shift					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_GS_SLOW_DEC	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque decrement for slow torque intervention during gear shift					
TQI_GS_SLOW_DEC_REQ	V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque decrement for slow torque intervention during gear shift					
TQI_GS_SLOW_DEC_REQ_1	O	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque decrement for slow torque intervention during gear shift					
TQI_GS_SLOW_INC	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque increase for slow torque intervention during gear shift					
TQI_GS_SLOW_INC_REQ	O/V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque increase for slow torque intervention during gear shift					
TQI_GS_SLOW_INC_REQ_1	O	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque increase for slow torque intervention during gear shift					

Input data:

LV_AT {p. 654}	LV_CDN_VB_CAN_TQ_ DIAG {p. 1185}	LV_DI_TQ_REQ_CAN_ MPI_GDI {p. 800}	LV_ERR_BN_ETCU {p. 4870}
LV_ERR_BN_TQ_ETCU {p. 4871}	LV_ERR_BN_TQ_TCT {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_TOUT_ETCU_1 {p. 802}
LV_ERR_TOUT_ETCU_2 {p. 802}	LV_ES {p. 1720}	LV_ETCU_LIH_CAN {p. 1565}	LV_IGK {p. 906}
LV_ST {p. 1720}	LV_TCT_LIH_CAN {p. 1568}	LV_TQ_GS_DEC_REQ {p. 1568}	LV_TQ_GS_INC_REQ {p. 1568}
LV_TQI_REQ_CAN_INH {p. 6687}	LV_VAR_BN {p. 655}	LV_VAR_TCT {p. 656}	TQ_GS_FAST_BN {p. 1581}
TQ_GS_FAST_DEC_BN {p. 1710}	TQ_GS_FAST_INC_BN {p. 1710}	TQ_GS_SLOW_BN {p. 1581}	TQ_GS_SLOW_DEC_BN {p. 1710}
TQ_GS_SLOW_INC_BN {p. 1710}	TQ_LOSS {p. 8385}	TQI_GS_FAST_REQ {p. 810}	TQI_GS_FAST_REQ_CAN {p. 810}
TQI_GS_SLOW_REQ {p. 810}	TQI_GS_SLOW_REQ_ CAN {p. 810}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LGRD_LIH_GS_DEC	-	0... 7FFFH	0... 1023.96875	0.03125	Nm/10ms
Limiting gradient for GS emergency ramp function (default 0.6 Nm/10ms)					
C_LGRD_LIH_GS_INC	-	0... 7FFFH	0... 1023.96875	0.03125	Nm/10ms
Limiting gradient for GS emergency ramp function (default 0.6 Nm/10ms)					
C_T_DLY_LIH_GS_DEC	-	0... FFH	0... 2.55	0.01	s
Delay time for activation of GS emergency ramp function (default 0s)					
C_T_DLY_LIH_GS_INC	-	0... FFH	0... 2.55	0.01	s
delay time for activation of GS emergency ramp function (default 0s)					
C_T_MAX_TQR_GS_INTV	-	0... FFFFH	0... 655.35	0.01	s
Maximum duration of torque reduction due gear shift intervention					
C_TQ_TCT_FAST_INH_FCUT	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Threshold for inhibiting FCUT during TCT intervention					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQ_TCT_SLOW_INH_FCUT	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Threshold for inhibiting FCUT during TCT intervention					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_GS_ENA_INC_DEC	-	0H 1H 2H 3H	NO DEC INC DEC_INC	-	-
Enable switch GS intervention					

FUNCTION DESCRIPTION:

General information:

There are two different gearbox control units: the common electronic transmissiom control unit (LV_AT) and the twin clutch transmission control unit (LV_VAR_TCT). Depending which variant is active the torque request for gear shift is requested by AT or TCT.
During a gear shift operation of the automatic transmission a low engine torque helps the transmission to perform a smooth gear shift and avoids sudden changes of wheel slip that could cause problems on certain road surfaces, i.e. wet or icy roads. A transmission control unit (ETCU) torque reduction or increase demand via CAN is realized by spark retard (fast path) or charge intervention by ETC (slow path). A decision can be done which path is realized. Normally the intervention is done only by spark retard. By configuration of BN 2000 the Slow and fast path are own signals of CAN messages.
Some plausibilities are done for validation and limitation of torque requests.

Signal flow diagram:

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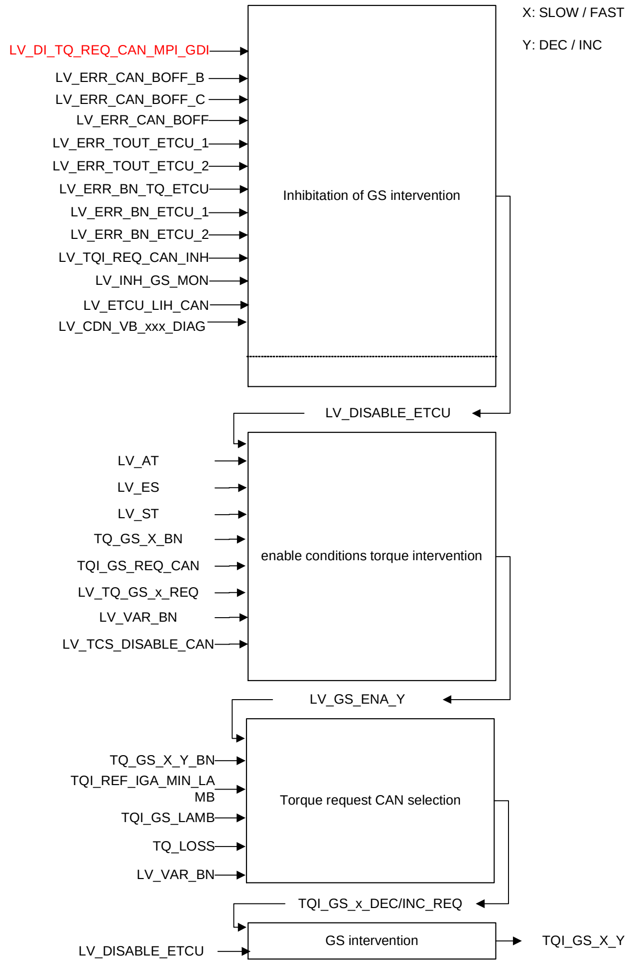

D.21.1 Enable conditions

D.21.1.1 Inhibitation GS intervention

FUNCTION DESCRIPTION:

If the EMS detects a safety relevant error at throttle, no automatic transmission vehicle or pedal value sensor the logical variable LV_ETCU_DISABLE is set to 1 in order to indicate a static EMS error.
Gear shift intervention function is enabled if engine state is not “engine stopped”, “start” or “idle speed”, if LV_ETCU_DISABLE is not set, no CAN error is present and automatic transmission is detected. Additional a time condition during torque intervention is check which limits the duration of torque intervention.

Application conditions

Initialisation: *LV_ETCU_DISABLE / CAN = 0;* ***at reset***

Recurrence: *10 ms*

Activation: *(LV_AT = 1* ***or*** *LV_VAR_TCT = 1)* ***and*** *LV_IGK = 1*

Deactivation: –

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Formula section:

CAN enviroment error GS inhibition:

if LV_ERR_CAN_BOFF = 1 **or** LV_ERR_TOUT_ETCU_1 = 1 **or** LV_ERR_TOUT_ETCU_2 = 1 **or** LV_ERR_BN_TQ_ETCU = 1 **or** LV_ERR_BN_TQ_TCT = 1 **or** LV_ERR_BN_ETCU = 1 **or** LV_CDN_VB_CAN_TQ_DIAG = 0

then LV_ETCU_DISABLE_CAN = 1
else LV_ETCU_DISABLE_CAN = 0
endif

Generell GS inhibition:

if LV_TQI_REQ_CAN_INH = 1 **or**
LV_DI_TQ_REQ_CAN_MPI_GDI = 1 **or**
LV_ERR_GS_INH_MON = 1 **or**
LV_ETCU_DISABLE_ CAN = 1 **or**
LV_ETCU_LIH_CAN = 1 **or**
LV_TCT_LIH_CAN = 1

then LV_ETCU_DISABLE = 1
else LV_ETCU_DISABLE = 0
endif

D.21.1.2 enable conditions torque intervention

FUNCTION DESCRIPTION:

Depending on the configuration and plausible torque interfaces an inc. or decreased torque intervention is possible.
The State STATE_TQ_ETCU_PLAUS indicates the interrupted condition which is responsible for enable Bit = 0. The [x] Value shows the HEX adress inside the Bitwise coded State.

Application conditions

Initialisation: *LV_GS_ENA/ _INC/ _DEC = 0* ***at reset***

Recurrence: *10 ms*

Activation: (LV_AT = 1 **or** LV_VAR_TCT = 1) **and** LV_IGK = 1 and C_GS_ENA_INC_DEC = not 0H

Formula section:

C_GS_ENA_INC_DEC = No — no GS Torque intervention
DEC — only decreasing torque intervention possible
INC — only increasing torque intervention possible
DEC_INC — both interventions possible

Enable conditions for GS intervention:

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```
if      (LV_AT = 1 or LV_VAR_TCT = 1) and
   LV_ES  = 0                          and
   LV_ST  = 0                          and
   LV_ETCU_DISABLE =   0
then            LV_GS_ENA = 1
else            LV_GS_ENA = 0
endif
```

Torque decrease intervention:

```
IF(1)           (C_GS_ENA_INC_DEC = 1H or 3H )            and
                 LV_GS_ENA    =1                          and
                 LV_TQ_GS_DEC_REQ = 1                     and
                 ((T_TQR_GS_INTV < C_T_MAX_TQR_GS_INTV) OR LV_AT = 0)
Then(1) IF(2)           LV_VAR_BN = 1
        Then(2) IF(3)           TQ_GS_SLOW_BN    <> 8000H        and                   TQ_
GS_FAST_BN        <> 8000H
                 Then (3)          LV_GS_ENA_DEC = 1
                 Else(3)           LV_GS_ENA_DEC = 0
                 Endif (3)
        Else(2) IF(4) TQI_GS_SLOW_REQ_CAN ≠ FFH    and
                          TQI_GS_FAST_REQ_CAN ≠ FFH
                 Then(4)           LV_GS_ENA_DEC = 1
                 Else(4)           LV_GS_ENA_DEC = 0
                 Endif(4)
        Endif(2)
Else(1)         LV_GS_ENA_DEC = 0
Endif
```

Torque increase intervention:

```
IF(1)           C_GS_ENA_INC_DEC = 2H or 3H                       and
                 LV_GS_ENA    =1                                  and
                LV_TQ_GS_INC_REQ = 1
Then(1) IF(2)           LV_VAR_BN = 1
        Then(2) IF(3)           TQ_GS_SLOW_BN    <> 8000H        and
                          TQ_GS_FAST_BN     <> 8000H
                 Then (3)          LV_GS_ENA_INC = 1
                 Else(3)           LV_GS_ENA_INC = 0
                 Endif(3)
        Else(2)  IF(5) TQI_GS_SLOW_REQ_CAN ≠ FFH    and
                          TQI_GS_FAST_REQ_CAN ≠ FFH
                 Then(5)           LV_GS_ENA_INC = 1
                 Else(5)           LV_GS_ENA_INC = 0
                 Endif(5)
        Endif(2)
Else(1)         LV_GS_ENA_INC = 0
Endif(1)
```

STATE_TQ_ETCU_PLAUS:

```
if      LV_GS_ENA = 0                                          BIT [0] is set
IF      LV_TQ_GS_DEC_REQ = 1                and
        T_TQR_GS_INTV > = C_T_MAX_TQR_GS_INTV                    BIT [2] is set
```

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IF(1) LV_TQ_GS_DEC_REQ = 1
Then(1) IF(2) LV_VAR_BN = 1
Then(2) IF(3) TQ_GS_SLOW_BN == 8000H **or** BIT [3] is set T
GS_FAST_BN == 8000H
Else(2) IF(4) TQI_GS_SLOW_REQ_CAN == FFH **or** BIT [3] is set
TQI_GS_FAST_REQ_CAN ==FFH
Endif(2)
Else(1) BIT [01] set
Endif
IF LV_TQ_GS_INC_REQ = =1
Then IF(2) LV_VAR_BN = 1
Then(2) IF(3) TQ_GS_SLOW_BN == 8000H BIT [3] is set
TQ_GS_FAST_BN == 8000H
Else(2) IF(4) TQI_GS_SLOW_REQ_CAN == FFH **or** BIT [3] is set
TQI_GS_FAST_REQ_CAN ==FFH
Endif(2)
Else BIT [4] is set
Endif

D.21.2 Torque request CAN selection

FUNCTION DESCRIPTION:

If one of the GS interventions enabled (LV_GS_ENA_DEC/INC = 1), the torque request is received from CAN and copied into TQI_GS_FAST_DEC/INC. At CAN 11H the requested torque is adjusted by ignition retardation. Only if ignition retardation is not sufficient for the requested torque reduction, TQI_GS_SLOW_DEC is set to TQI_GS_REQ. So the throttle is used too. At BN the slow and fast path are different messages.
After LV_GS_ACT_DEC/INC changes back to 0, both TQI_GS_FAST_DEC/INC and TQI_GS_SLOW_DEC/INC become their maximum/minimum value again.

Application conditions

Initialisation: **at reset** TQI_GS_FAST_DEC_REQ = 1023,97Nm
TQI_GS_SLOW_DEC_REQ = 1023,97Nm
TQI_GS_FAST_INC_REQ = 0 Nm
TQI_GS_SLOW_INC_REQ = 0 Nm

Recurrence: 10 ms

Activation: (LV_AT = 1 **or** LV_VAR_TCT = 1) **and** at LV_IGK = 1

Deactivation: –

Formula section:

if LV_VAR_BN = 1
then TQI_GS_SLOW_DEC_REQ_1 = TQ_GS_SLOW_DEC_BN - TQ_LOSS
TQI_GS_FAST_DEC_REQ_1 = TQ_GS_FAST_DEC_BN - TQ_LOSS
TQI_GS_SLOW_INC_REQ_1 = TQ_GS_SLOW_INC_BN - TQ_LOSS
TQI_GS_FAST_INC_REQ_1 = TQ_GS_FAST_INC_BN - TQ_LOSS
Else TQI_GS_SLOW_INC_REQ_1 = TQI_GS_SLOW_REQ
TQI_GS_FAST_INC_REQ_1 = TQI_GS_FAST_REQ
TQI_GS_SLOW_DEC_REQ_1 = TQI_GS_SLOW_REQ

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```
                 TQI_GS_FAST_DEC_REQ_1 =TQI_GS_FAST_REQ
endif

IF               LV_GS_ENA_DEC = 1
Then             TQI_GS_SLOW_DEC_REQ = TQI_GS_SLOW_DEC_REQ_1
                 TQI_GS_FAST_DEC_REQ = TQI_GS_FAST_DEC_REQ_1
Else             TQI_GS_SLOW_DEC_REQ = 7FFFH
                 TQI_GS_FAST_DEC_REQ = 7FFFH
endif
IF               LV_GS_ENA_INC = 1
Then             TQI_GS_SLOW_INC_REQ = TQI_GS_SLOW_INC_REQ_1
                 TQI_GS_FAST_INC_REQ = TQI_GS_FAST_INC_REQ_1
Else             TQI_GS_SLOW_INC_REQ = 0 Nm
                 TQI_GS_FAST_INC_REQ = 0 Nm
endif
```

D.21.3 Determination of gear shift torque intervention duration (CAN11H only)

FUNCTION DESCRIPTION:

The duration of decreased gear shift torque intervention T_TQR_GS_INTV is measured beginning at transition of LV_GS_DEC_ACT from 0 to 1. T_TQR_GS_INTV is needed for limitation of gear shift intervention duration during enable conditions. T_TQR_GS_INTV is reseted to 0 if TQI_GS_SLOW_REQ_CAN or TQI_GS_FAST_REQ_CAN = FFH .

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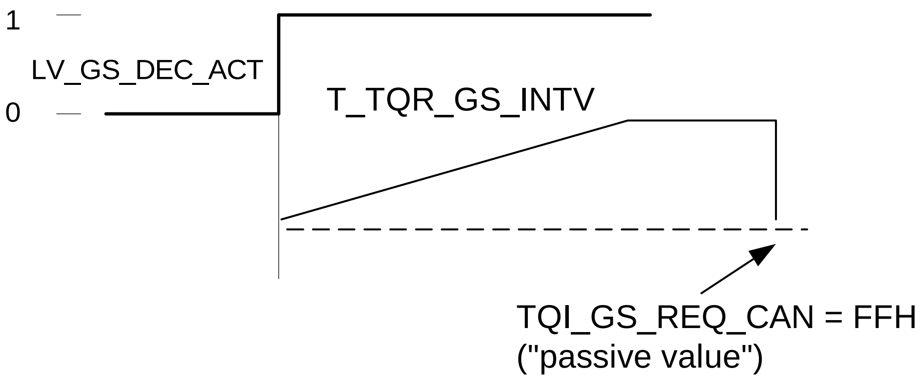

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Signal flow diagram:

Application conditions

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Initialisation: *T_TQR_GS_INTV = 0 at reset **or** at transition LV_IGK 0 - -> 1*

Recurrence: *10 ms*

Activation: *at LV_IGK = 1 and LV_VAR_BN = 0*

Deactivation: -

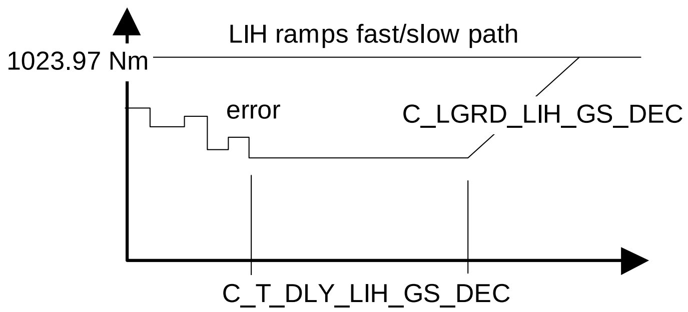
D.21.4 GS intervention

D.21.4.1 GS decreased intervention and emergency operation

FUNCTION DESCRIPTION:

If during an active GS intervention an GS error or an EMS error occurs, the current torque reduction is continued for the time C_T_DLY_LIH_GS_DEC and then subsequently increased to TQI_GS_FAST_DEC = TQI_GS_SLOW_DEC = 1023,97 Nm using C_LGRD_LIH_GS_DEC.
At transition from Limp home condition active to passive after torque inrease to TQI_GS_FAST_DEC = TQI_GS_SLOW_DEC = 1023,97 Nm at limp home operation the counter T_GS_LIH_CTR is stopped and set to 0.

Signal flow diagram:



Application conditions

Initialisation:
```
at reset or  at transition LV_IGK 0 - -> 1
LV_GS_DEC_LIH   = 0
  LV_GS_DEC_ACT  = 0
TQI_GS_FAST_DEC = TQI_GS_SLOW_DEC = 1023.97 Nm
T_GS_DEC_LIH_CTR = 0
```

Recurrence: *10 ms*

Activation: (LV_AT = 1 **or** LV_VAR_TCT = 1) **and** LV_IGK = 1

Deactivation:

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Formula section:

GS_DEC intervention and detection of GS_DEC limp home operation :

If (1a) LV_ETCU_DISABLE_CAN = 1
then (1a)
if (1b) TQI_GS_FAST_DEC $<$ 1023.97 Nm **or**
TQI_GS_SLOW_DEC $<$ 1023.97 Nm
Then (1b) LV_GS_DEC_LIH = 1
T_GS_DEC_LIH_CTR $_N$ = T_GS_DEC_LIH_CTR $_{N-1}$+ 10 ms
(till T_DEC_GS_LIH_CTR = C_T_DLY_LIH_GS_DEC)
if (2) T_GS_DEC_LIH_CTR $<$ = C_T_DLY_LIH_GS_DEC (*time delay*)
then (2)TQI_GS_FAST_DEC $_N$ = TQI_GS_FAST_DEC $_{N-1}$ (*last valid value*)
TQI_GS_SLOW_DEC $_N$ = TQI_GS_SLOW_DEC $_{N-1}$ (*last valid value*)
else (2)TQI_GS_FAST_DEC $_N$ = TQI_GS_FAST_DEC $_{N-1}$ + C_LGRD_LIH_GS_DEC
(till TQI_GS_FAST_DEC = 1023.97 Nm)
TQI_GS_SLOW_DEC $_N$ = TQI_GS_FAST_DEC $_N$
Endif (2)
Else (1b) LV_GS_DEC_LIH = 0
T_GS_LIH_CTR = 0
Endif (1b)
else (1a) LV_GS_DEC_LIH = 0
T_GS_LIH_CTR = 0
TQI_GS_FAST_DEC = TQI_GS_FAST_DEC_REQ
TQI_GS_SLOW_DEC = TQI_GS_SLOW_DEC_REQ
Endif(1a)

GS intervention active (LV_GS_DEC_ACT) :

if TQI_GS_FAST_DEC $<$ 1023.97 Nm
then LV_GS_DEC_ACT = 1
else LV_GS_DEC_ACT = 0
endif

D.21.4.2 GS increased intervention and emergency operation

FUNCTION DESCRIPTION:

If during an active GS intervention an GS error or an EMS error occurs, the current torque offset is continued for the time C_T_DLY_LIH_GS_INC and then subsequently decreased to TQI_GS_FAST_INC = TQI_GS_SLOW_INC = 0 Nm using C_LGRD_LIH_GS_INC.
At transition from Limp home condition active to passive after torque decrease to TQI_GS_FAST_INC = TQI_GS_SLOW_INC = 0 Nm at limp home operation the counter T_GS_LIH_CTR is stopped and set to 0.

Signal flow diagram:

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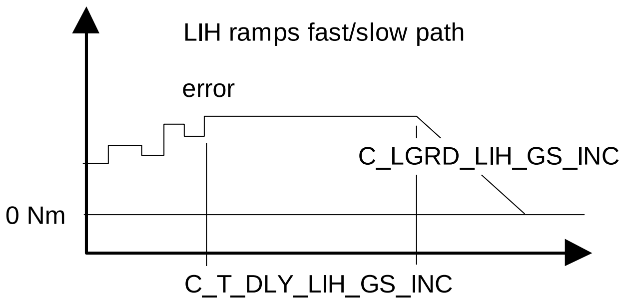

Application conditions

Initialisation: `at reset` **or** `at transition LV_IGK 0 - -> 1`

```
LV_GS_LIH_INC     = 0
  LV_GS_INC_ACT   = 0
TQI_GS_FAST_INC = TQI_GS_SLOW_INC = 0 Nm
T_GS_INC_LIH_CTR = 0
```

Recurrence: *10 ms*

Activation: `(LV_AT = 1` **or** `LV_VAR_TCT = 1)` **and** `LV_IGK = 1`

Formula section:

GS_INC intervention and detection of GS_INC limp home operation :

If (1a) LV_ETCU_DISABLE_CAN = 1
then (1a)
if(1b) TQI_GS_FAST_INC $>$ 0 **or**
TQI_GS_SLOW_INC $>$ 0
Then(1b) LV_GS_INC_LIH = 1
T_GS_INC_LIH_CTR $_N$ = T_GS_INC_LIH_CTR $_{N-1}$+ 10 ms
(till T_GS_INC_LIH_CTR = C_T_DLY_LIH_GS_INC)
if (2) T_GS_INC_LIH_CTR $<$ = C_T_DLY_LIH_GS_INC (*time delay*)
then (2)TQI_GS_FAST_INC $_N$ = TQI_GS_FAST_INC $_{N-1}$ (*last valid value*)
and TQI_GS_SLOW_INC $_N$ = TQI_GS_SLOW_INC $_{N-1}$ (*last valid value*)
else (2)TQI_GS_FAST_INC $_N$ = TQI_GS_FAST_INC $_{N-1}$ -
C_LGRD_LIH_GS_INC
(till TQI_GS_FAST_INC = 0Nm)
TQI_GS_SLOW_INC $_N$ = TQI_GS_FAST_INC $_N$
endif (2)
Else(1b) LV_GS_INC_LIH = 0
T_GS_LIH_CTR = 0
Endif(1b)
else (1a) LV_GS_INC_LIH = 0
T_GS_LIH_CTR = 0
TQI_GS_FAST_INC = TQI_GS_FAST _INC_REQ
TQI_GS_SLOW_INC = TQI_GS_SLOW _INC_REQ
endif (1a)

GS intervention active (LV_GS_INC_ACT) :

if TQI_GS_FAST_INC $>$ 0 Nm

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then LV_GS_INC_ACT = 1
else LV_GS_INC_ACT = 0
endif

D.21.4.3 Inhibiting fuel cut off during TCT-intervention

FUNCTION DESCRIPTION:

In order to avoid an increasing emission for very low emission vehicles the fuel cut off is inhibited. As result during TCT-intervention the SCC is suppressed in order to meet ULEV2 limits. In that case the reduction of the moment should only be done via spark retard.

Application conditions

Initialisation: `at reset` **or** `at transition LV_IGK 0 - -> 1`
`LV_INH_FCUT_GS = 0`

Recurrence: *10 ms*

Activation: `LV_IGK = 1` **and** `LV_VAR_TCT = 1`

Deactivation: -

FCUT inhibitation during TCT intervention active:
If TQ_GS_FAST_BN >
TQ_LOSS **-** C_TQ_TCT_FAST INH_FCUT **AND**
TQ_GS_SLOW_BN >
TQ_LOSS **+** C_TQ_TCT_SLOW_INH_FCUT
then LV_INH_FCUT_GS = 1
else LV_INH_FCUT_GS = 0
Endif

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D.22 Torque request for distance cruise control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_DCC_DISABLE_CAN	O/V	0... 1H	0 ...1	1	-
Logical variable for disabling DCC intervention due to CAN error					
LV_DCC_ENA_INC	O/V	0... 1H	0 ...1	1	-
Logical variable for increased torque intervention due to DCC					
LV_DCC_INC_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention due to DCC or LDM					
LV_DCC_INC_LIH	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention LIH due to DCC					
STATE_TQ_DCC_PLAUS	O/V	0... FFH	0... 255	1	-
Bitwise coded State for DCC intervention state					
T_DCC_LIH_CTR	V	0... FFH	0... 2.55	0.01	s
Time counter delay time					
TQI_DCC_FAST_INC	O/V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for fast torque intervention during DCC					
TQI_DCC_FAST_INC_REQ	V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for fast torque intervention during DCC					
TQI_DCC_FAST_INC_REQ_1	V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for fast torque intervention during DCC					
TQI_DCC_SLOW_INC	O/V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for slow torque intervention during DCC					
TQI_DCC_SLOW_INC_REQ	V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for slow torque intervention during DCC					
TQI_DCC_SLOW_INC_REQ_1	V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for slow torque intervention during DCC					

Input data:

LV_CDN_VB_CAN_TQ_ DIAG {p. 1185}	LV_DCC_ENA_INC {p. 6731}	LV_DCC_LIH_CAN {p. 1565}	LV_DCC_OFF_ECU {p. 5051}
LV_ERR_BN_TQ_DCC {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_DCC_INH_MON {p. 6983}	LV_IGK {p. 906}
LV_TQ_DCC_INC_REQ {p. 1568}	LV_VAR_DCC {p. 655}	STATE_DCC_OFF_REQ {p. 1572}	STATE_DCC_PUC_INH {p. 1572}
TQ_DCC_FAST_BN {p. 1581}	TQ_DCC_FAST_INC_BN {p. 1710}	TQ_DCC_SLOW_BN {p. 1581}	TQ_DCC_SLOW_INC_BN {p. 1710}
TQ_LOSS {p. 8385}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LGRD_LIH_DCC_INC	-	0... 7FFFH	0... 1023.96875	0.03125	Nm/10ms
Limiting gradient for DCC emergency ramp function (default 0.6 Nm/10ms)					
C_T_DLY_LIH_DCC_INC	-	0... FFH	0... 2.55	0.01	s
Delay time for activation of DCC emergency ramp function (default 0s)					

General information:

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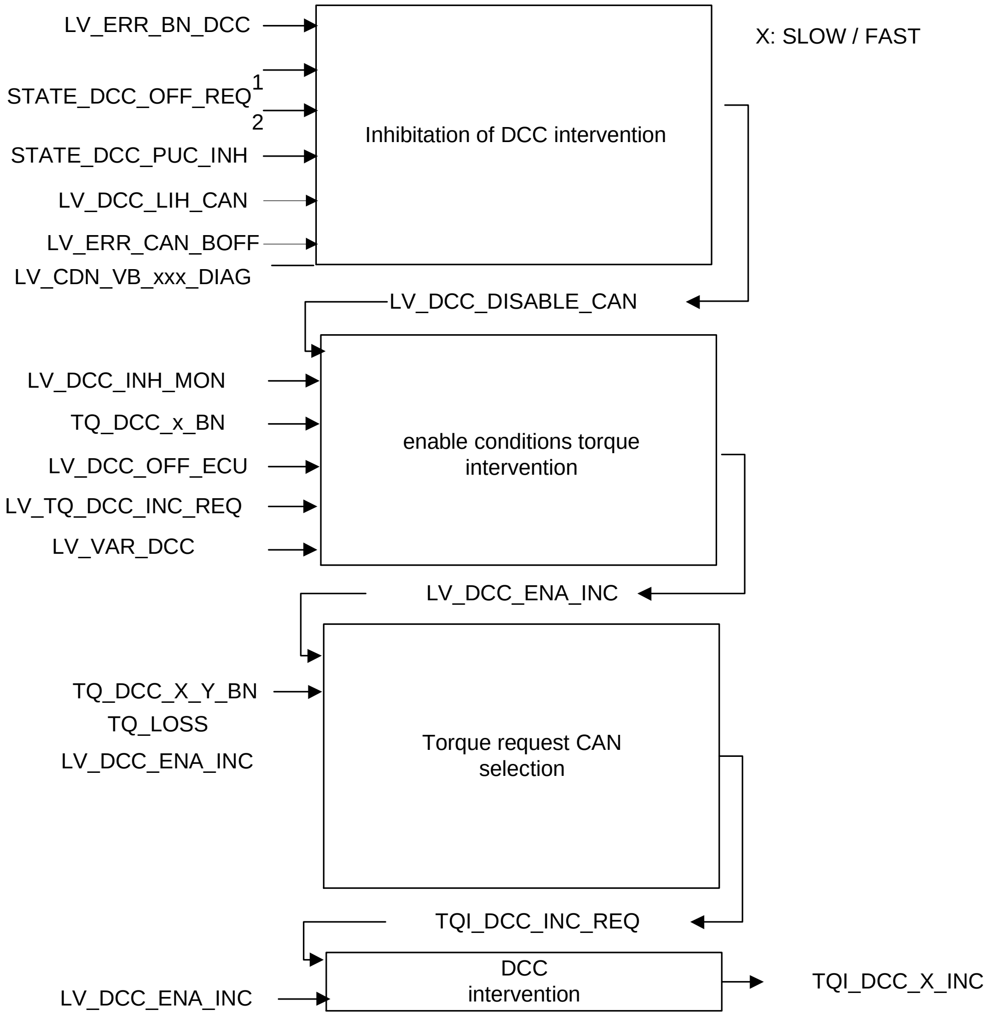
The DCC unit delivers a torque request via BN this module serves the enable conditions and the torque request witch will used in the torque request selection.



Signal flow diagram:

D.22.1 Enable conditions

D.22.1.1 Inhibitation DCC intervention

FUNCTION DESCRIPTION:

If the EMS detects an error on the CAN messages, the logical variable LV_DCC_DISABLE_CAN is set to 1.

Application conditions

Initialisation: at reset and at transition LV_IGK off –-> on
LV_DCC_DISABLE_CAN = 0

Recurrence: *10 ms*

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Activation: *LV_IGK = 1 and LV_VAR_DCC = 1*

Deactivation: –

Formula section:

CAN enviroment DCC inhibition:

```
if      LV_ERR_BN_TQ_DCC        = 1     or
        LV_ERR_CAN_BOFF         = 1     or
        LV_DCC_LIH_CAN          = 1     or
        STATE_DCC_PUC_INH       = 03H   or
        STATE_DCC_OFF_REQ         02H   or
        LV_CDN_VB_CAN_TQ_DIAG = 0

then    LV_DCC_DISABLE_CAN      = 1
else    LV_DCC_DISABLE_CAN      = 0
endif
```

D.22.1.2 enable conditions torque intervention

FUNCTION DESCRIPTION:

Depending on the configuration and plausible torque interfaces an increaced torque intervention is possible.

Application conditions

Initialisation: at reset and at transition LV_IGK off - -> on
LV_DCC_ENA_INC = 0

Recurrence: *10 ms*

Activation: *LV_IGK = 1 and LV_VAR_DCC =1*

Formula section:

Torque increase intervention:

```
if      LV_DCC_OFF_ECU = 0                  and
        LV_TQ_DCC_INC_REQ = 1               and
        LV_DCC_DISABLE_CAN =   0            and
        TQ_DCC_SLOW_BN        <> 8000H      and
        TQ_DCC_FAST_BN        <> 8000H      and
        LV_ERR_DCC_INH_MON = 0
then    LV_DCC_ENA_INC          = 1
else    LV_DCC_ENA_INC          = 0
endif
```

STATE_TQ_DCC_PLAUS

```
if      LV_DCC_LIH_CAN          = 1     or      BIT [00] set
        STATE_DCC_PUC_INH       = 03H   or      BIT [01] set
        STATE_DCC_OFF_REQ         02H   or      BIT [02] set
```

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if LV_DCC_OFF_ECU = 1 BIT [03] set
if LV_TQ_DCC_INC_REQ = 1
Then IF TQ_DCC_SLOW_BN == 8000H BIT [05] set
TQ_DCC_FAST_BN == 8000H
else BIT [04] set
endif

D.22.2 Torque request CAN selection

FUNCTION DESCRIPTION:

If the DCC interventions enabled (LV_DCC_ENA_INC = 1), the torque request is received from CAN and copied into TQI_DCC_FAST/SLOW_INC. The slow and fast path are different messages.
After LV_DCC_INC_ACT changes back to 0, both TQI_DCC_FAST_INC and TQI_DCC_SLOW_INC becomes their minimum values again.

Application conditions

Initialisation: at reset and at transition LV_IGK off -> on
TQI_DCC_FAST_INC_REQ / _1 = 0 Nm
TQI_DCC_SLOW_INC_REQ / _1 = 0 Nm

Recurrence: *10 ms*

Activation: *at LV_IGK = 1 and LV_VAR_DCC = 1*

Deactivation: -

Formula section:

TQI_DCC_SLOW_INC_REQ_1 = TQ_DCC_SLOW_INC_BN - TQ_LOSS
TQI_DCC_FAST_INC_REQ_1 = TQ_DCC_FAST_INC_BN - TQ_LOSS
IF LV_DCC_ENA_INC = 1
Then TQI_DCC_SLOW_INC_REQ = TQI_DCC_SLOW_INC_REQ_1
TQI_DCC_FAST_INC_REQ = TQI_DCC_FAST_INC_REQ_1
Else TQI_DCC_SLOW_INC_REQ = 0 Nm
TQI_DCC_FAST_INC_REQ = 0 Nm
Endif

D.22.2.1 DCC increased intervention and emergency operation

FUNCTION DESCRIPTION:

If during an active DCC intervention an DCC or an EMS error occurs, the current torque offset is continued for the time C_T_DLY_LIH_DCC_INC and then subsequently decreased to TQI_DCC_FAST_INC = TQI_DCC_SLOW_INC = 0 Nm using C_LGRD_LIH_DCC_INC. The DCC unit itself controls the torque leading during active LV_TQ_DCC_INC_REQ. therefore you will haven't a plausible Torque request without LV_DCC_ENA_INC.

Signal flow diagram:

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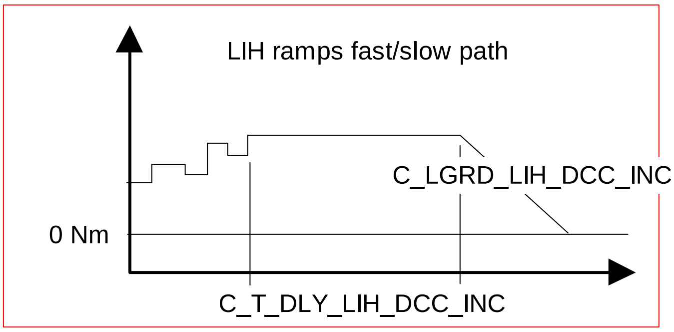

Application conditions

Initialisation: at reset and at transition LV_IGK off - -> on
LV_DCC_INC_LIH = 0
LV_DCC_INC_ACT = 0
TQI_DCC_FAST_INC = TQI_DCC_SLOW_INC = 0Nm
T_DCC_LIH_CTR = 0

Recurrence: *10 ms*

Activation: LV_IGK = 1 **and** LV_VAR_DCC = 1

Formula section:

DCC_INC intervention and detection of DCC_INC limp home operation :

If(1) TQI_DCC_FAST_INC_REQ_1 0 Nm **and**
TQI_DCC_SLOW_INC_REQ_1 0 Nm **and**
LV_DCC_ENA_INC = 0
then(1)
if(2) TQI_DCC_FAST_INC $>$ 0 Nm **or** TQI_DCC_SLOW_INC $>$ 0 Nm
then(2) LV_DCC_INC_LIH = 1
T_DCC_LIH_CTR $_N$ = T_DCC_LIH_CTR $_{N-1}$ + 10 ms
(till T_DCC_LIH_CTR = C_T_DLY_LIH_DCC_INC)
if(3) T_DCC_LIH_CTR $<$ C_T_DLY_LIH_DCC_INC (*time delay*)
then(3) TQI_DCC_FAST_INC $_N$ = TQI_DCC_FAST_INC $_{N-1}$ (*last valid value*)
TQI_DCC_SLOW_INC $_N$ = TQI_DCC_SLOW_INC $_{N-1}$ (*last valid value*)
else(3) TQI_DCC_FAST_INC $_N$ = TQI_DCC_FAST_INC $_{N-1}$ - C_LGRD_LIH_DCC_INC
(till TQI_DCC_FAST_INC = 0Nm)
TQI_DCC_SLOW_INC $_N$ = TQI_DCC_FAST_INC $_N$
endif(3)

else(2) LV_DCC_INC_LIH = 0
T_DCC_LIH_CTR = 0
endif(2)
else(1) LV_DCC_INC_LIH = 0
T_DCC_LIH_CTR = 0

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TQI_DCC_FAST_INC = TQI_DCC_FAST_INC_REQ
TQI_DCC_SLOW_INC = TQI_DCC_SLOW _INC_REQ
endif(1)

DCCT intervention active (LV_DCC_ACT_INC) :

if TQI_DCC_SLOW_INC > 0 Nm **or**
TQI_DCC_FAST_INC > 0 Nm
then LV_DCC_INC_ACT = 1
else LV_DCC_INC_ACT = 0
endif

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D.23 Torque request for cruise control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_REQ_CRU	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Scaling factor for requested torque at clutch from cruise control					
FAC_TQ_REQ_DCC	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Scaling factor of inverse DCC model					
LV_TQ_DCC_ACT	V	0... 1H	0 ...1	1	-
Torque structure leaded by driver but DCC intervention overtaking					
STATE_TQ_DCC	O/V	0H 1H 8H 9H AH BH	0 1 2 3 4 5	-	-
State of DCC torque intervention					
STATE_TQ_LDM	O/V	0H 1H 8H 9H AH BH	0 1 2 3 4 5	-	-
State of LDM torque intervention					
TQ_DELTA_MAX_CLU	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Difference between TQ_MAX_CLU and TQ_MIN_CLU					

Input data:

FAC_TQ_CRU {p. 7237}	FAC_TQ_CRU_INI {p. 7237}	FAC_TQ_REQ_DRIV {p. 6570}	GR_DT {p. 8285}
LV_CRU_ACT {p. 7227}	LV_DCC_ENA_INC {p. 6731}	LV_IGK {p. 906}	LV_KD {p. 1269}
LV_LDM_DRIV_ACT {p. 8286}	LV_LDM_ENA {p. 6615}	LV_TQ_WHEEL_LDM_BN_ERR {p. 1568}	LV_VAR_BN_LDM {p. 655}
LV_VAR_DCC {p. 655}	PV_AV {p. 1269}	TQ_LOSS {p. 8385}	TQ_MAX_CLU {p. 8380}
TQ_MIN_CLU {p. 8380}	TQ_WHEEL_LDM_BN {p. 1582}	TQI_DCC_FAST_INC {p. 6731}	TQI_REQ_TRA {p. 8192}
VS_FIL {p. 1176}	VS_SP_DRIV_CRU {p. 7237}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_DCC_FL	-	0... 8000H	0 ...1	30.5e-6	-
Full load detection of DCC					
C_LGRD_TQ_CRU_INC_1	-	0... FFFFH	0... 1.99996	30.5e-6	-
Change limitation for cruise control requesrt out of lower vehicle speed					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LGRD_TQ_CRU_INC_2	-	0... FFFFH	0... 1.99996	30.5e-6	-
Change limitation for cruise control requesrt out of higher vehicle speed					

D.23.1 Torque request of DME internal Cruise control

General information:

Depending on the cruise controller manipulated variable FAC_TQ_CRU the interpretation of torque request is calculated. Regarding the different resolutions the output of cruise control is converted to resolutions at the torque structure interface.

Application conditions

Activation: every engine state and LV_VAR_DCC = 0 and LV_VAR_BN_LDM = 0

Recurrence: 100 ms

Initialization: FAC_TQ_REQ_CRU = 0 at reset

Formula section:

General calculation after initialisation:

$$FAC\_TQ\_REQ\_CRU = \frac{FAC\_TQ\_CRU}{99{,}6\%}$$

At initialisation of Cruise control:

To get a smoothing transition into cruise controlled drive the initialisation ramp is depends on vehicle speed in relation the vehicle speed demand by driver:

This query once :

IF (1) LV_CRU_ACT = 0 to 1
FAC_TQ_CRU /99,6% > FAC_TQ_REQ_DRIV

Then (1.1) at the first time FAC_TQ_REQ_CRU = FAC_TQ_REQ_DRIV

This query until the end condition (until (1)) is fulfilled:

IF (2) VS_FIL ≤ VS_SP_DRIV_CRU

Then (2)
FAC_TQ_REQ_CRU = FAC_TQ_REQ_CRU + C_LGRD_TQ_CRU_INC_1

Else (2)
FAC_TQ_REQ_CRU = FAC_TQ_REQ_CRU + C_LGRD_TQ_CRU_INC_2

Until (1.1) FAC_TQ_REQ_CRU FAC_TQ_CRU /99,6%

Else (1)

$$FAC\_TQ\_REQ\_CRU = \frac{FAC\_TQ\_CRU}{99{,}6\%}$$

Endif

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D.23.2 Torque request an STATE of DCC and STATE of LDM

FUNCTION DESCRIPTION:

General information:

The distance cruise control, the LDM and the transmission unit needs an information witch system (driver, DCC, LDM or CRU) leads the torque system. Therefore the compare between driver which and DCC/LDM is done.

Application conditions

Initialisation: STATE_TQ_DCC = 08H
STATE_TQ_LDM = 08H
FAC_TQ_REQ_DCC = 0

Recurrence: *10 ms*

Activation: *LV_VAR_DCC = 1* ***or*** *LV_VAR_BN_LDM = 1 (and LV_IGK = 1)*

Formula section:

State of DCC/LDM in DME:

IF(1) LV_VAR_DCC = 1
Then(1) **IF (2a)** LV_KD = 0
Then(2a) **IF(3)** LV_DCC_ENA_INC = 1 // "active"
Then (3) IF (4) PV_AV > 0 %
Then(4) IF(5) (TQI_REQ_TRA > TQI_DCC_FAST_INC)**or**
(FAC_TQ_REQ_DRIV > C_FAC_DCC_FL)
Then(5) STATE_TQ_DCC = 0AH
" DCC active overtaking by driver"
Else (5) STATE_TQ_DCC = 01H
" DCC and Driver active"
Endif(5)
Else(4) STATE_TQ_DCC = 00H
" driver passive DCC active"
Endif(4)
Else (3) If(6) PV_AV = 0 %
Then(6) STATE_TQ_DCC = 08H
" driver DCC passive"
Else(6) STATE_TQ_DCC = 09H
" active driver no DCC"
Endif(6)
Endif(3)
Else(2a) STATE_TQ_DCC = 0BH "Kickdown active"
Endif(2a)
IF(2b) STATE_TQ_DCC = 0AH
Then(2b) LV_TQ_DCC_ACT = 1
Else(2b) LV_TQ_DCC_ACT = 0
Endif(2b)
Else (1) **if(7)** LV_VAR_BN_LDM = 1
Then(7) **IF (8)** LV_KD = 0

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```
                        Then(8) IF(9) LV_LDM_ENA = 1      // "active"
                           Then (9) IF (10) PV_AV > 0 %
                                Then(10)   IF(11) LV_LDM_DRIV_ACT = 0
                                             Then(11) STATE_TQ_LDM = 0AH
                                               " LDM active overtaking by driver"
                                           Else (11) STATE_TQ_LDM = 01H
                                               " LDM and Driver active"
                                               Endif(11)
                              Else(10)         STATE_TQ_LDM = 00H
                                           " driver passive LDM active"
                              Endif(10)
                          Else (9) If(12) IF PV_AV = 0 %
                              Then(12) STATE_TQ_LDM = 08H
                                           " driver LDM passive"
                              Else(12) STATE_TQ_LDM = 09H
                                           " active driver no LDM"
                              Endif(12)
                          Endif(9)
                        Else(8) STATE_TQ_LDM = 0BH "Kickdown active"
                        Endif(8)
           Endif(7)
Endif(1)
```

Inverse DCC Torque request model:

TQ_REQ_DCC = TQI_DCC_FAST_INC + TQ_LOSS
TQ_DELTA_MAX_CLU = TQ_MAX_CLU - TQ_MIN_CLU
TQ_LDM_BN_CLU = TQ_WHEEL_LDM_BN /GR_DT

```
If(1)              (LV_VAR_BN_LDM = 1   and   LV_TQ_WHEEL_LDM_BN_ERR = 0)
Then(1)    FAC_TQ_REQ_DCC =
             MIN(1;((TQ_LDM_BN_CLU -TQ_MIN_CLU) /TQ_DELTA_MAX_CLU))
Else(1)
  If(2)            (LV_VAR_DCC = 1   and   LV_DCC_ENA_INC = 1)
  Then(2)      FAC_TQ_REQ_DCC =
                   MIN(1;((TQ_REQ_DCC-TQ_MIN_CLU) /TQ_DELTA_MAX_CLU))
  Else(2)      FAC_TQ_REQ_DCC = 0
  EndIf(2)
EndIf(1)
```

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D.24 Torque request for traction control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ASR_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention due to TCS					
LV_ASR_ENA	V	0... 1H	0 ...1	1	-
Logical variable for ASR intervention enabling					
LV_ASR_LIH	V	0... 1H	0 ...1	1	-
Logical variable for torque intervention LIH due to TCS					
LV_MSR_ACT	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention due to MSR					
LV_MSR_ENA	V	0... 1H	0 ...1	1	-
Logical variable for MSR intervention enabling					
LV_MSR_LIH	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention LIH due to MSR					
LV_TCS_DISABLE	O/V	0... 1H	0 ...1	1	-
Logical variable for disabling TCS intervention due to EMS error					
LV_TCS_DISABLE_CAN	O/V	0... 1H	0 ...1	1	-
Logical variable for disabling TCS intervention due to EMS CAN error					
LV_TCS_ENA	V	0... 1H	0 ...1	1	-
Logical variable for basically TCS intervention enabling					
SF_TQD	O/V	0... 3H	0 ...3	1	-
Status flag driving torque at clutch					
STATE_TQ_TCS_PLAUS	O/V	0... FFH	0... 255	1	-
Bitwise coded State for TCS intervention state					
T_ASR_LIH_CTR	V	0... FFH	0... 2.55	0.01	s
Delay time					
T_MSR_LIH_CTR	V	0... FFH	0... 2.55	0.01	s
Delay time					
TQI_ASR_FAST	O/V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque decrement for fast torque intervention during TCS					
TQI_ASR_FAST_REQ	V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque decrement for fast torque intervention during TCS					
TQI_ASR_FAST_REQ_1	O	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque decrement for fast torque intervention during TCS					
TQI_ASR_SLOW	O/V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque decrement for slow torque intervention during TCS					
TQI_ASR_SLOW_REQ	V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque decrement for slow torque intervention during TCS					
TQI_ASR_SLOW_REQ_1	O	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque decrement for slow torque intervention during TCS					
TQI_MSR_FAST	O/V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for fast torque intervention during MSR					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_MSR_FAST_REQ	V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for fast torque intervention during TCS					
TQI_MSR_FAST_REQ_1	O	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for fast torque intervention during TCS					
TQI_MSR_SLOW	O/V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for slow torque intervention during MSR					
TQI_MSR_SLOW_REQ	V	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for slow torque intervention during TCS					
TQI_MSR_SLOW_REQ_1	O	0... 7FFFH	0... 1023.97	31.2999e-3	Nm
Torque increase for slow torque intervention during gear shift					

Input data:

IGA_MIN_H_RNG {p. 1828}	IGA_SP_H_RNG {p. 1948}	LV_ASR_PLAUS {p. 799}	LV_CDN_VB_CAN_TQ_ DIAG {p. 1185}
LV_DI_TQ_REQ_CAN_ MPI_GDI {p. 800}	LV_DT {p. 1310}	LV_ERR_BN_TCS {p. 4870}	LV_ERR_BN_TQ_TCS {p. 4871}
LV_ERR_BN_VS_TCS {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_MSR_INH_MON {p. 6983}	LV_ERR_TOUT_ASR_1 {p. 802}
LV_ERR_TOUT_ASR_3 {p. 802}	LV_ES {p. 1720}	LV_IGK {p. 906}	LV_MSR_PLAUS {p. 804}
LV_MTC_CUR_OFF {p. 6565}	LV_OFF_MTC_MON {p. 6877}	LV_PL {p. 1720}	LV_PU {p. 1720}
LV_SF_TQD_MON {p. 6791}	LV_ST {p. 1720}	LV_TCS_LIH_CAN {p. 1567}	LV_TQ_ASR_REQ {p. 1568}
LV_TQ_LIM_INTV {p. 6692}	LV_TQ_MSR_REQ {p. 1568}	LV_TQI_REQ_CAN_INH {p. 6687}	LV_VAR_ASR {p. 655}
LV_VAR_BN {p. 655}	STATE_ETC_LIH {p. 4982}	TQ_ASR_FAST_DEC_BN {p. 1710}	TQ_ASR_SLOW_DEC_BN {p. 1710}
TQ_LOSS {p. 8385}	TQ_MSR_FAST_INC_BN {p. 1711}	TQ_MSR_SLOW_INC_BN {p. 1711}	TQ_TCS_FAST_BN {p. 1582}
TQ_TCS_SLOW_BN {p. 1582}	TQI_ASR_FAST_REQ_ CAN {p. 810}	TQI_ASR_SLOW_REQ_ CAN {p. 810}	TQI_MSR_REQ_CAN {p. 811}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LGRD_LIH_ASR	-	0... 7FFFH	0... 1023.96875	0.03125	Nm/10ms
Limiting gradient for ASR emergency ramp function (default 0.6 Nm/10ms)					
C_LGRD_LIH_MSR	-	0... 7FFFH	0... 1023.96875	0.03125	Nm/10ms
Limiting gradient for MSR emergency ramp function (default 0.6 Nm/10ms)					
C_T_DLY_LIH_ASR	-	0... FFH	0... 2.55	0.01	s
Delay time for activation of ASR emergency ramp function (default 0s)					
C_T_DLY_LIH_MSR	-	0... FFH	0... 2.55	0.01	s
Delay time for activation of MSR emergency ramp function (default 0s)					
C_TQ_MAX_MSR	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Limiting torque for MSR					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_ASR_DISABLE	-	0... 1H	0 ...1	1	-
Locical constant to disable ASR interventions					
LC_MSR_DISABLE	-	0... 1H	0 ...1	1	-
Locical constant to disable MSR interventions					

FUNCTION DESCRIPTION:

Traction control function avoids wheel spinning on e.g. icy surfaces by reducing the engine torque in addition to brake the wheel. The ECU permanently checks, if a probable traction control torque intervention request can be executed, by checking, if an error at one or several of the relevant components for torque intervention occurred (LV_TCS_DISABLE). If no error is recognized and an actual traction control request is received, a check is done, if at actual engine operating condition a torque intervention allowed (LV_ASR_ENA or LV_MSR_ENA). Both torque request values, for fast and slow torque intervention are handed over to relevant torque coordination functions to adjust the engine torque.
MSR function avoids the vehicle from skidding on e.g. icy surfaces by reducing the drag torque of the engine at trailing throttle and trailing throttle fuel cut off. For to reach a higher lateral stability of the wheels the indicated engine torque is increased to reduce wheel slip.

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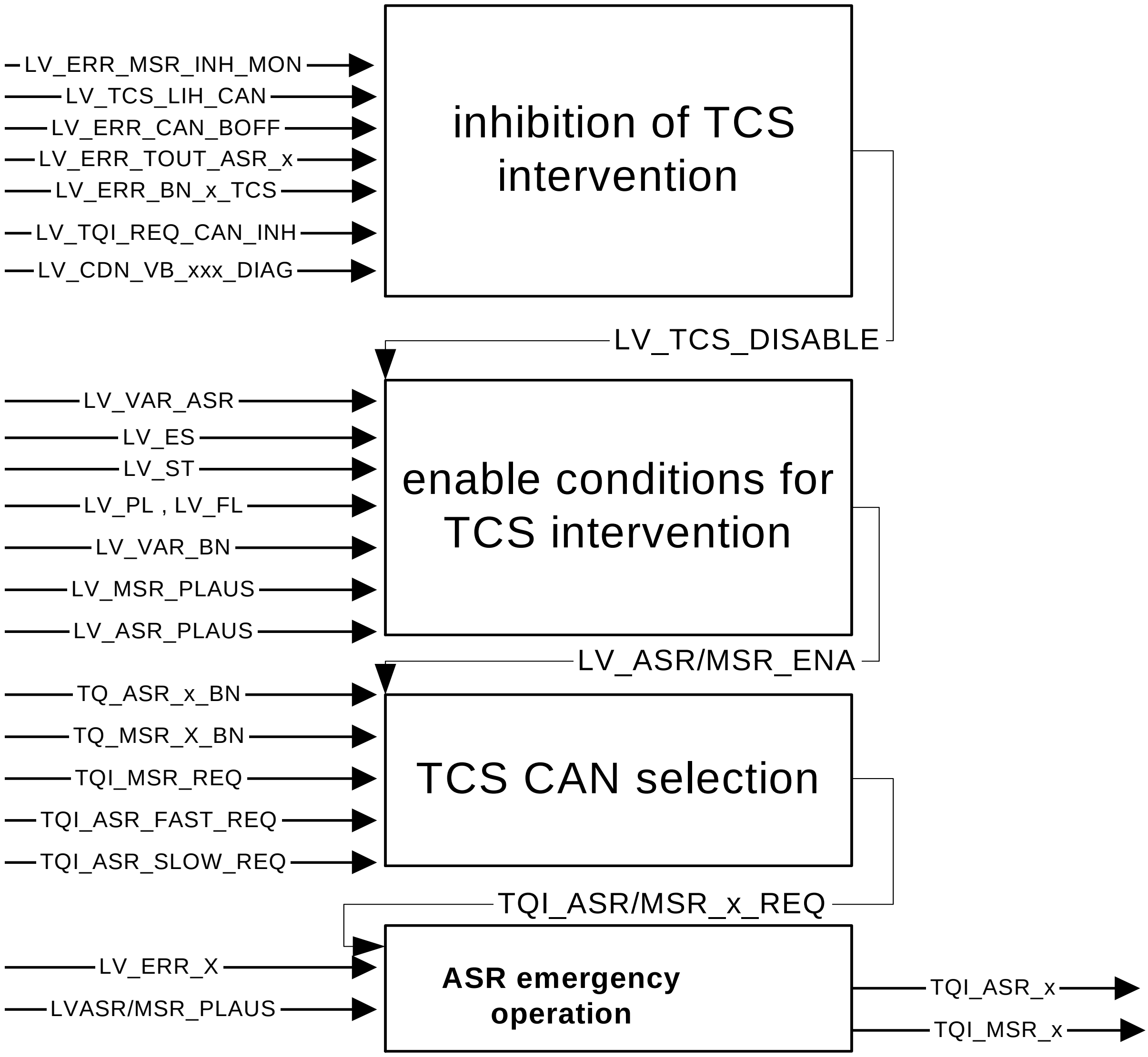

Signal flow diagram:

D.24.1 inhibition TCS intervention

FUNCTION DESCRIPTION:

If the EMS detects a safety relevant error at throttle the logical variable LV_TCS_DISABLE is set to 1 in order to indicate a static EMS error.

Application conditions

Initialisation: *LV_TCS_DISABLE = 0 ; LV_TCS_DISABLE_CAN = 0 at reset*

Recurrence: *10 ms*

Activation: *every engine operating state*

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Deactivation: –

Formula section:

```
if          LV_ERR_CAN_BOFF          = 1
      or    LV_ERR_TOUT_ASR_1        = 1
      or    LV_ERR_TOUT_ASR_3        = 1
      or    LV_ERR_BN_TQ_TCS         = 1
      or    LV_ERR_BN_VS_TCS         = 1
      or    LV_ERR_BN_TCS            = 1
      or    LV_CDN_VB_CAN_TQ_DIAG = 0
then    LV_TCS_DISABLE_CAN       = 1
else    LV_TCS_DISABLE _CAN      = 0
endif

if          LV_TQI_REQ_CAN_INH        = 1
     or     LV_DI_TQ_REQ_CAN_MPI_GDI = 1
     or     LV_ERR_MSR_INH_MON        = 1
      or    LV_TCS_LIH_CAN            = 1
      or    LV_TCS_DISABLE_CAN        = 1
then    LV_TCS_DISABLE            = 1
else    LV_TCS_DISABLE            = 0
endif
```

D.24.2 Enable conditions for TCS torque intervention

FUNCTION DESCRIPTION:

General information:

Depending on the configuration and plausible torque interfaces an inc (MSR). or decreaced (ASR) torque intervention is possible.
The State STATE_TQ_TCS_PLAUS indicates the interrupted condition witch is responsible for enable Bit = 0. The [x] Value shows the HEX adress inside the Bitwise coded State.

Application conditions

Initialisation: *LV_ASR/ TCS/ MSR_ENA = 0;* STATE_TQ_TCS_PLAUS = 0 *at reset*

Recurrence: *10 ms*

Activation: *every engine operating state*

Formula section:

```
If          LV_VAR_ASR = 1          and
           LV_TCS_DISABLE = 0      and
           LV_ES=0                 and
           LV_ST = 0               and
Then    LV_TCS_ENA = 1
Else    LV_TCS_ENA = 0
```

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```
Endif

IF(1) LV_VAR_BN = 0

Then(1)if(2)          LC_ASR_DISABLE = 0
            and          LV_TCS_ENA =1
                and          [ LV_PL = 1    or    LV_PU = 1]
                and          LV_ASR_PLAUS = 1
            and          LV_TQ_ASR_REQ = 1
  then(2)          LV_ASR_ENA = 1
  else(2)                  LV_ASR_ENA = 0

else(1) if(3)          LC_ASR_DISABLE = 0
                and          LV_TCS_ENA =1
                and          [ LV_PL = 1    or    LV_PU = 1]
                and          TQ_TCS_FAST_BN <> 8000 H
                and          TQ_TCS_SLOW_BN <>   8000 H
            and          LV_TQ_ASR_REQ = 1
  then(3)          LV_ASR_ENA = 1
  else(3)                  LV_ASR_ENA = 0
endif

IF(1) LV_VAR_BN = 0
Then(1) if          (2)          LC_MSR_DISABLE = 0
            and          LV_TCS_ENA =1
                and          LV_MSR_PLAUS = 1
            and          LV_TQ_MSR_REQ = 1
        then (2)      LV_MSR_ENA = 1
        else (2)      LV_MSR_ENA = 0

else(1) if(3)          LC_MSR_DISABLE = 0
            and          LV_TCS_ENA =1
        and          TQ_TCS_FAST_BN          <>          8000 H
        and          TQ_TCS_SLOW_BN <>          8000 H
            and          LV_TQ_MSR_REQ = 1
        then (3)      LV_MSR_ENA = 1
        else (3)      LV_MSR_ENA = 0
endif
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

STATE_TQ_TCS_PLAUS:

```
If          LV_TCS_ENA = 0                                        BIT [00] set
IF[ LV_PL = 0    and   LV_PU = 0]                                   BIT [01] set
IF LV_TQ_ASR_REQ = 1
Then IF     LV_VAR_BN = 0
                Then          IF LV_ASR_PLAUS = 0                          BIT [02] set
                elseIF   TQ_TCS_FAST_BN ==     8000 H or          BIT [02] set
                         TQ_TCS_SLOW_BN ==   8000 H
else                                                        BIT [03] set
endif
If          LV_TCS_ENA = 0                                        BIT [00] set
IF[ LV_PL = 0    and   LV_PU = 0]                                   BIT [01] set
IF LV_TQ_MSR_REQ = 1
```

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Then IF LV_VAR_BN = 0
Then **IF** LV_MSR_PLAUS = 0 BIT [02] set
elseIF TQ_TCS_FAST_BN == 8000 H **or** BIT [02] set
TQ_TCS_SLOW_BN == 8000 H
else BIT [04] set
endif
- -

D.24.3 Torque request CAN selection

FUNCTION DESCRIPTION:

If one of the TCS interventions enabled (LV_ASR/MSR_ENA = 1), the torque request is received from CAN and copied into TQI_ASR/MSR_FAST. The slow and fast path are different messages.
After LV_ASR/MSR_ACT changes back to 0, both TQI_ASR/MSR_FAST and TQI_ASR/MSR_SLOW become their maximum/minimum value again.

Application conditions

Initialisation: `at reset` TQI_ASR_FAST_REQ = 1023.97 Nm
TQI_ASR_SLOW_REQ = 1023.97 Nm
TQI_MSR_FAST_REQ = 0 Nm
TQI_MSR_SLOW_REQ = 0 Nm

Recurrence: *10 ms*

Activation: *at LV_IGK = 1*

Deactivation: –

Formula section:

if LV_VAR_BN = 1
then TQI_ASR_SLOW_REQ_1 = TQ_ASR_SLOW_DEC_BN - TQ_LOSS
TQI_ASR_FAST_REQ_1 = TQ_ASR_FAST_DEC_BN - TQ_LOSS
TQI_MSR_SLOW_REQ_1 = TQ_MSR_SLOW_INC_BN - TQ_LOSS
TQI_MSR_FAST_REQ_1 = TQ_MSR_FAST_INC_BN - TQ_LOSS
Else TQI_MSR_SLOW_REQ_1 = TQI_MSR_REQ_CAN
TQI_MSR_FAST_REQ_1 = TQI_MSR_REQ_CAN
TQI_ASR_FAST_REQ_1 = TQI_ASR_FAST_REQ_CAN
TQI_ASR_SLOW_REQ_1 =TQI_ASR_SLOW_REQ_CAN
endif
IF LV_ASR_ENA= 1
Then TQI_ASR_SLOW_REQ = TQI_ASR_SLOW_REQ_1
TQI_ASR_FAST_REQ = TQI_ASR_FAST_REQ_1
Else TQI_ASR_SLOW_REQ = 1023.97 Nm
TQI_ASR_FAST_REQ = 1023.97 Nm
endif
IF LV_MSR_ENA = 1
Then TQI_MSR_SLOW_REQ = TQI_MSR_SLOW_REQ_1
TQI_MSR_FAST_REQ = TQI_MSR_FAST_REQ_1
Else TQI_MSR_SLOW_REQ = 0 Nm
TQI_MSR_FAST_REQ = 0 Nm
endif

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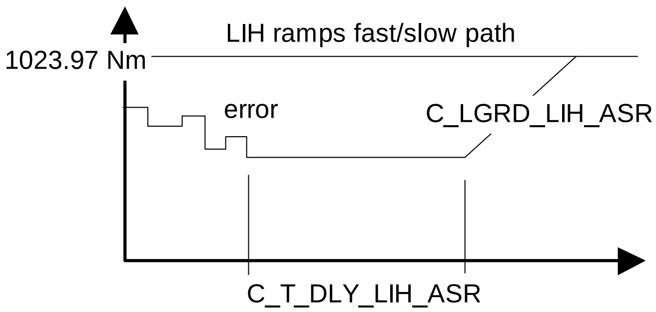
D.24.4 TCS intervention

D.24.4.1 ASR intervention and emergency operation

FUNCTION DESCRIPTION:

If during an active TCS intervention an TCS error or an EMS error occurs, the current torque reduction is continued for the time C_T_DLY_LIH_ASR and then subsequently increased to TQI_ASR_FAST = TQI_ASR_SLOW = 1023,97 Nm using C_LGRD_LIH_ASR.
At transition from limp home condition active to passive after torque increase to TQI_ASR_FAST = TQI_ASR_SLOW = 1023,97 Nm at limp home operation the counter T_TCS_LIH_CTR is stopped and set to 0.

Signal flow diagram:



Application conditions

Initialisation:

```
at reset or  at transition LV_IGK 0 --> 1
LV_ASR_LIH      = 0
   LV_ASR_ACT      = 0
TQI_ASR_FAST = TQI_ASR_SLOW = 1023.97 Nm
T_ASR_LIH_CTR = 0
```

Recurrence: *10 ms*

Activation: LV_IGK = 1

Formula section:

ASR intervention and detection of ASR limp home operation :

If (1) LV_TCS_DISABLE_CAN = 1 **or**
(LV_VAR_BN = 0 and LV_ASR_PLAUS = 0 and LV_TQ_ASR_REQ = 1) **or**
(LV_VAR_BN = 1 and LV_TQ_ASR_REQ = 0 **and** LV_TQ_MSR_REQ = 0 and TQ_TCS_FAST_BN <> 8000 H and TQ_TCS_SLOW_BN <> 8000 H)

then (1) **if(1b)** TQI_ASR_FAST < 7FFFH **or**
TQI_ASR_SLOW < 7FFFH
Then(1b) LV_ASR_LIH = 1
If(1c) T_ASR_LIH_CTR < C_T_DLY_LIH_ASR (*time delay*)
Then(1c) $TQI\_ASR\_FAST_{N}$ = $TQI\_ASR\_FAST_{N-1}$ (*last valid value*)

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TQI_ASR_SLOW $_N$ = TQI_ASR_SLOW $_{N-1}$(*last valid value*)

T_ASR_LIH_CTR $_N$ = T_ASR_LIH_CTR $_{N-1}$+ 10 ms

(till T_TCS_LIH_CTR = C_T_DLY_LIH_ASR)

Else(1c) TQI_ASR_FAST $_N$ = TQI_ASR_FAST $_{N-1}$ + C_LGRD_LIH_ASR

(till TQI_TCS_FAST = 1023.97 Nm)

TQI_ASR_SLOW $_N$ = TQI_ASR_FAST $_N$

Endif(1c)

else(1b) LV_ASR_LIH = 0

T_TCS_LIH_CTR = 0

Endif(1b)

Else(1) LV_ASR_LIH = 0

T_TCS_LIH_CTR = 0

TQI_ASR_FAST = TQI_ASR_FAST_REQ

TQI_ASR_SLOW = TQI_ASR_SLOW_REQ

endif (1)

ASR intervention active (LV_ASR_ACT) :

if TQI_ASR_SLOW $<$ 1023.97 Nm **or**

TQI_ASR_FAST $<$ 1023.97 Nm

then LV_ASR_ACT = 1

else LV_ASR_ACT = 0

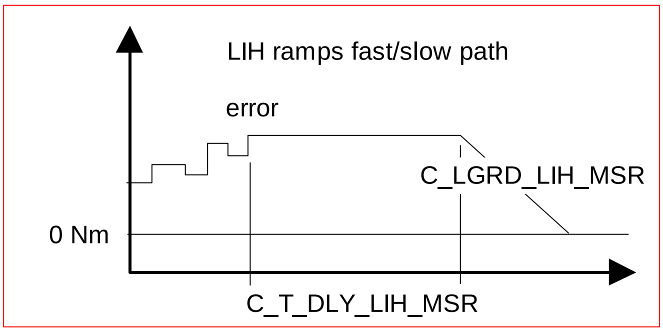
endif

D.24.4.2 MSR intervention and emergency operation

FUNCTION DESCRIPTION:

If during an active MSR intervention an TCS error or an EMS error occurs, the current torque offset is continued for the time C_T_DLY_LIH_MSR and then subsequently decreased to TQI_MSR_FAST = TQI_MSR_SLOW = 0 Nm using C_LGRD_LIH_MSR.
At transition from limp home condition active to passive after torque decrease to TQI_MSR_FAST = TQI_MSR_SLOW = 0 Nm at limp home operation the counter T_TCS_LIH_CTR is stopped and set to 0.

Signal flow diagram:



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Application conditions

Initialisation: `at reset or at transition LV_IGK 0 - -> 1`
```
LV_MSR_LIH      = 0
   LV_MSR_ACT      = 0
TQI_MSR_FAST = TQI_MSR_SLOW = 0 Nm
T_MSR_LIH_CTR = 0
```

Recurrence: *10 ms*

Activation: `LV_IGK = 1`

Formula section:

MSR intervention and detection of MSR limp home operation :

If (1) LV_TCS_DISABLE_CAN = 1 **or**
(LV_VAR_BN = 0 and LV_MSR_PLAUS = 0 and LV_TQ_MSR_REQ = 1) **or**
(LV_VAR_BN = 1 and LV_TQ_MSR_REQ = 0 **and** LV_TQ_ASR_REQ = 0 and
TQ_TCS_FAST_BN <> 8000 H and TQ_TCS_SLOW_BN <> 8000 H)

then (1)

if (1b) TQI_MSR_FAST > 0 **or**
TQI_MSR_SLOW > 0

Then (1b) LV_MSR_LIH = 1

if (2) T_MSR_LIH_CTR < = C_T_DLY_LIH_MSR (*time delay*)

then (2) $TQI\_MSR\_FAST_{N}$ = $TQI\_MSR\_FAST_{N-1}$ (*last valid value*)
$TQI\_MSR\_SLOW_{N}$ = $TQI\_MSR\_SLOW_{N-1}$ (*last valid value*)
$T\_MSR\_LIH\_CTR_{N}$ = $T\_MSR\_LIH\_CTR_{N-1}$ + 10 ms
(till T_MSR_LIH_CTR = C_T_DLY_LIH_MSR)

else (2) $TQI\_MSR\_FAST_{N}$ = $TQI\_MSR\_FAST_{N-1}$ - C_LGRD_LIH_MSR
(till TQI_MSR_FAST = 0Nm)
$TQI\_MSR\_SLOW_{N}$ = $TQI\_MSR\_FAST_{N}$

endif (2)

Endif (1b)

else (1) LV_MSR_LIH = 0
T_TCS_LIH_CTR = 0
TQI_MSR_FAST = min((C_TQ_MAX_MSR - TQ_LOSS); TQI_MSR_FAST_REQ)
TQI_MSR_SLOW = min((C_TQ_MAX_MSR - TQ_LOSS); TQI_MSR_SLOW_REQ)

endif (1)

MSR intervention active (LV_MSR_ACT) :

if TQI_MSR_SLOW > 0 Nm **or**
TQI_MSR_FAST > 0 Nm
then LV_MSR_ACT = 1
else LV_MSR_ACT = 0
endif

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D.24.5 Status flag driving torque at clutch SF_TQD

Application conditions

Initialisation: *SF_TQD = 0* ***at reset***

Recurrence: *10 ms*

Activation: *at LV_IGK = 1*

Deactivation: -

Formula section:

If (1) STATE_ETC_LIH = ETC_LIH_1 **or**
STATE_ETC_LIH = ETC_LIH_2_REV **or**
STATE_ETC_LIH = ETC_LIH_2 **or**
LV_OFF_MTC_MON = 1
(see Chapter: "Applc. Inc of process monitoring" and
"Fault reaction of Process monitoring") **or**
LV_SF_TQD_MON = 1

then (1) SF_TQD = 03H
else(1)If(2) IGA_SP_H_RNG <= IGA_MIN_H_RNG **or**
LV_TQ_LIM_INTV = 1
Then (2) SF_TQD = 01H
Else (2) SF_TQD = 00H
Endif(2)
Endif(1)

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E - Monitoring Concept

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E.1 Actual efficiencies

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_IGA_HOM_MON	V	0... FFH	0... 1.9921875	7.8125e-3	-
ignition efficiency in homogeneous (process monitoring)					
EFF_IGA_HOMS_MON	V	0... FFH	0... 1.9921875	7.8125e-3	-
ignition efficiency in multiple homogeneous-stratified (process monitoring)					
EFF_IGA_S_MON	V	0... FFH	0... 1.9921875	7.8125e-3	-
ignition efficiency in stratified (process monitoring)					
EFF_LAMB_HOM_MON	V	0... FFH	0... 1.9921875	7.8125e-3	-
lambda efficiency in homogeneous (process monitoring)					
EFF_LAMB_HOMS_MON	V	0... FFH	0... 1.9921875	7.8125e-3	-
lambda efficiency in homogeneous-stratified (process monitoring)					
EFF_LAMB_S_MON	V	0... FFH	0... 1.9921875	7.8125e-3	-
lambda efficiency in stratified homogeneous (process monitoring)					
EFF_TOT_MON	O/V	0... FFH	0... 1.9921875	7.8125e-3	-
total actual efficiencies					
IGA_DIF_AV_H_RNG_HOM_MON	V	0... B40H	0... -180	-0.0625	°CRK
difference from reference to actual ignition angle in homogeneous (process monitoring)					
IGA_DIF_AV_H_RNG_HOMS_MON	V	0... B40H	0... -180	-0.0625	°CRK
difference from reference to actual ignition angle in homogeneous_stratified (process monitoring)					
IGA_DIF_AV_HOM_MON	-	0... B40H	0... -180	-0.0625	°CRK
difference from reference to actual ignition angle in homogeneous (process monitoring)					

Input data:

IGA_IGC_H_RNG [NC_CYL_NR] {p. 1876}	IGA_REF_HOM_COR_EXT_MON {p. 6789}	IGA_REF_HOMS_COR_EXT_MON {p. 6789}	LAMB_MON {p. 6777}
LV_TQI_MON_ACT_MON {p. 6791}	MFF_LAMB_REF_IGA_MON {p. 6791}	MFF_TQ_MON {p. 6760}	N_32_MON {p. 7002}
OPM_AV_MON {p. 6792}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_EFF_IGA_HOM_MON	-	0... FFH	0... 99.609375	0.390625	%
LDPM_IGA_DIF_AV_MON_IP_EFF_MON	8	0... B40H	0... -180	-0.0625	°CRK
actual ignition efficiency in homogeneous (process monitoring)					
IP_EFF_IGA_HOMS_MON	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDPM_IGA_DIF_AV_MON_IP_EFF_MON	8	0... B40H	0... -180	-0.0625	°CRK
actual ignition efficiency in homogeneous_stratified (process monitoring)					
IP_EFF_LAMB_HOM_MON	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_LAMB_HOM_MON_IP_EFF_MON	8	0... 7FFFH	0... 31.9990234375	976.563e-6	-
lambda efficiency in homogeneous (process monitoring)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_EFF_LAMB_HOMS_MON	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_LAMB_HOMS_MON_IP_EFF_MON	8	0... 7FFFH	0... 31.9990234375	976.563e-6	-
lambda efficiency in homogeneous-stratified (process monitoring)					
IP_EFF_LAMB_S_MON	-	0... FFH	0... 1.9921875	7.8125e-3	-
LDP_LAMB_S_MON_IP_EFF_MON	8	0... 7FFFH	0... 31.9990234375	976.563e-6	-
lambda efficiency in stratified (process monitoring)					
IP_FAC_EFF_IGA_MON	V	0... FFH	0... 15.9375	0.0625	-
LDP_N_32_MON_IP_FAC_EFF_IGA_MON	6	0... FFH	0... 8160	32	rpm
LDP_MFF_MON_IP_FAC_EFF_IGA_MON	6	0... FFFFH	0... 1389	0.0211948	mg/stk
Factor ignition efficiency (process monitoring)					
IP_IGA_REF_HOM_MON	V	0... B40H	-90 ...90	0.0625	°CRK
LDPM_N_32_MON_IP_IGA_REF_MON	8	0... FFH	0... 8160	32	rpm
LDP_MFF_MON_IP_IGA_REF_HOM_MON	8	0... FFFFH	0... 1389	0.0211948	mg/stk
reference ignition angle in homogeneous (process monitoring)					
IP_IGA_REF_HOMS_MON	V	0... B40H	-90 ...90	0.0625	°CRK
LDPM_N_32_MON_IP_IGA_REF_MON	8	0... FFH	0... 8160	32	rpm
LDP_MFF_MON_IP_IGA_REF_HOMS_MON	8	0... FFFFH	0... 1389	0.0211948	mg/stk
reference ignition angle in homogeneous_stratified (process monitoring)					

General Information

ACTION_ECM3_Service15TaskPfm(IN<>)
ACTION_ECM3_Service16TaskPfm(IN<>)
ACTION_ECM3_Service17TaskPfm(IN<>)

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 3.

ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service15TaskPfm() and ACTION_ECM3_Service16TaskPfm().

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ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode O and history variables in modules of the Process Monitoring have to be checked by the cyclical RAM test.

Hint Application Conditions Initialisation: for condition see 'Application incidences of process monitoring'

Application Conditions

Initialization: RST
Recurrence: 40MS
Activation: LV_TQI_MON_ACT_MON
Deactivation: !LV_TQI_MON_ACT_MON

Function description

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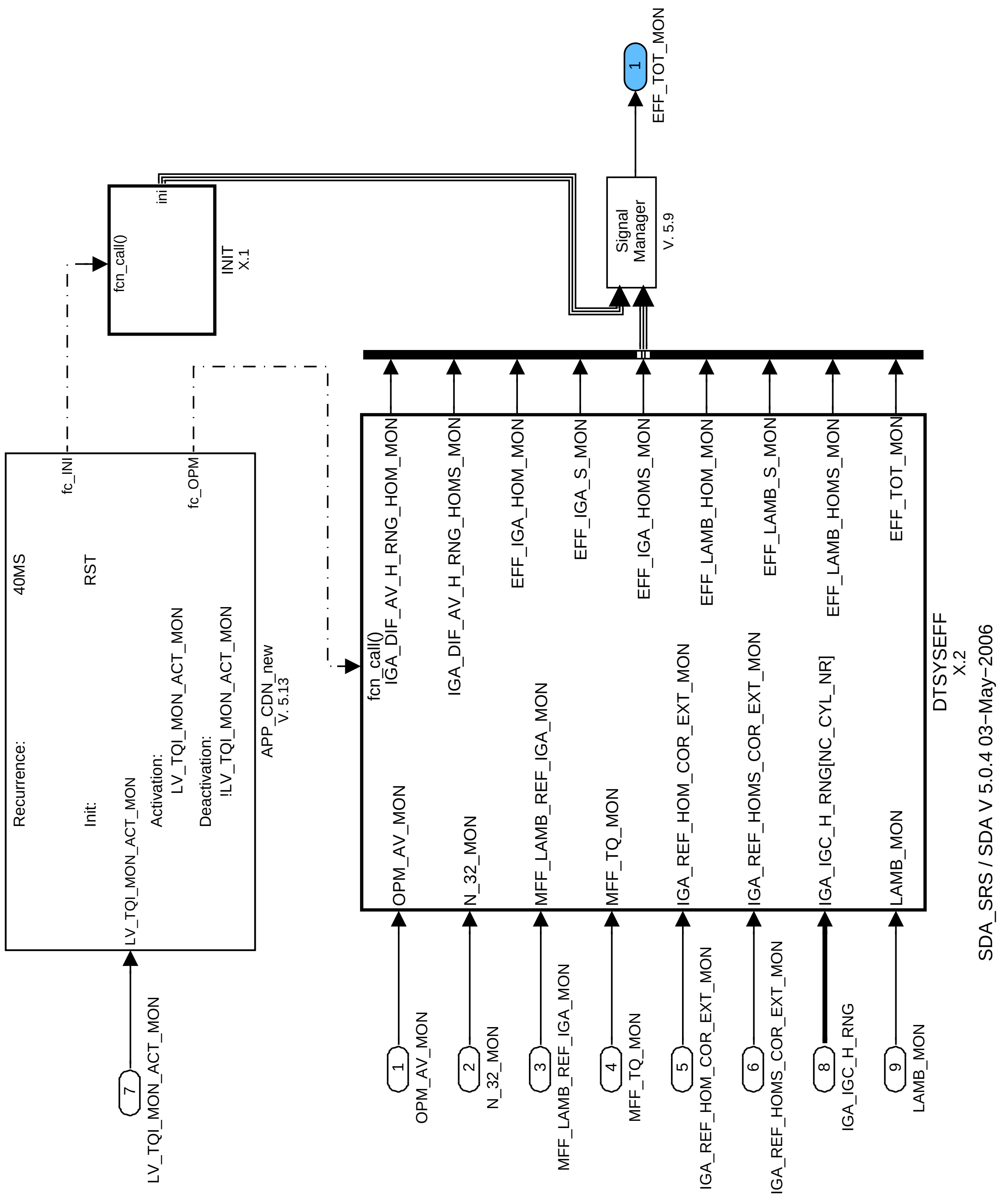

Figure E.1.1: : Path: ECM2_DTSYSEFF

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E.1.1 ECM2_DTSYSEFF/INIT

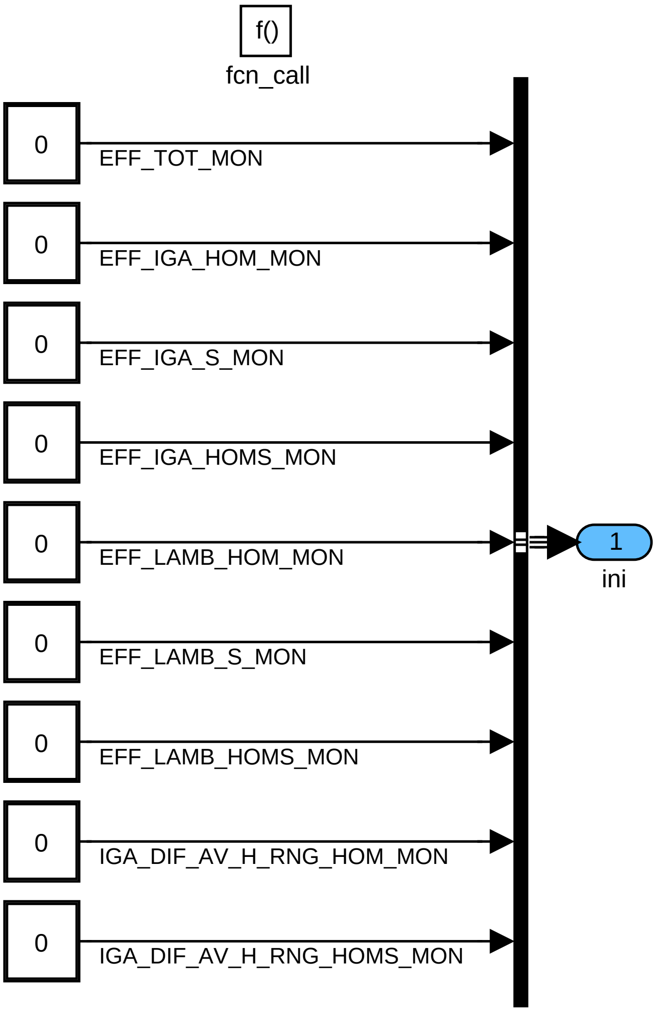

Figure E.1.2: : Path: ECM2_DTSYSEFF/INIT

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E.1.2 ECM2_DTSYSEFF/DTSYSEFF

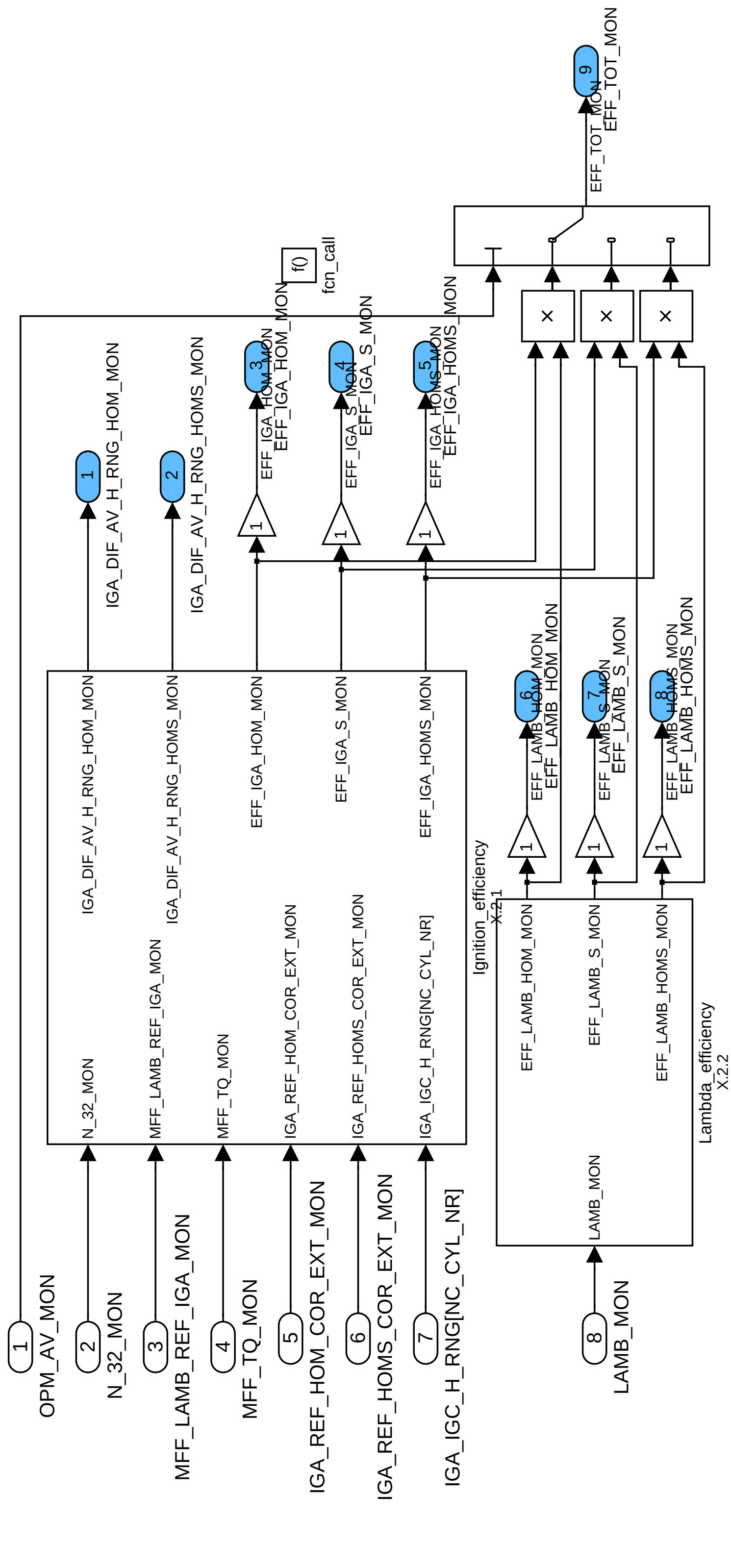

Figure E.1.3: : Path: ECM2_DTSYSEFF/DTSYSEFF

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E.1.2.1 ECM2_DTSYSEFF/DTSYSEFF/IGNITION_EFFICIENCY

<CONTENT VIEW="ANY">

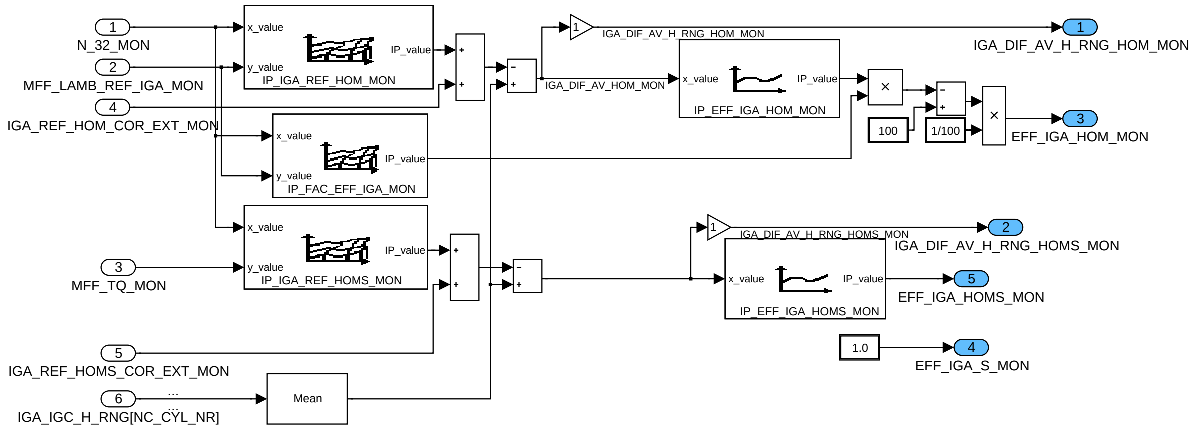

Figure E.1.4: : Path: ECM2_DTSYSEFF/DTSYSEFF/Ignition_efficiency

E.1.2.2 ECM2_DTSYSEFF/DTSYSEFF/LAMBDA_EFFICIENCY

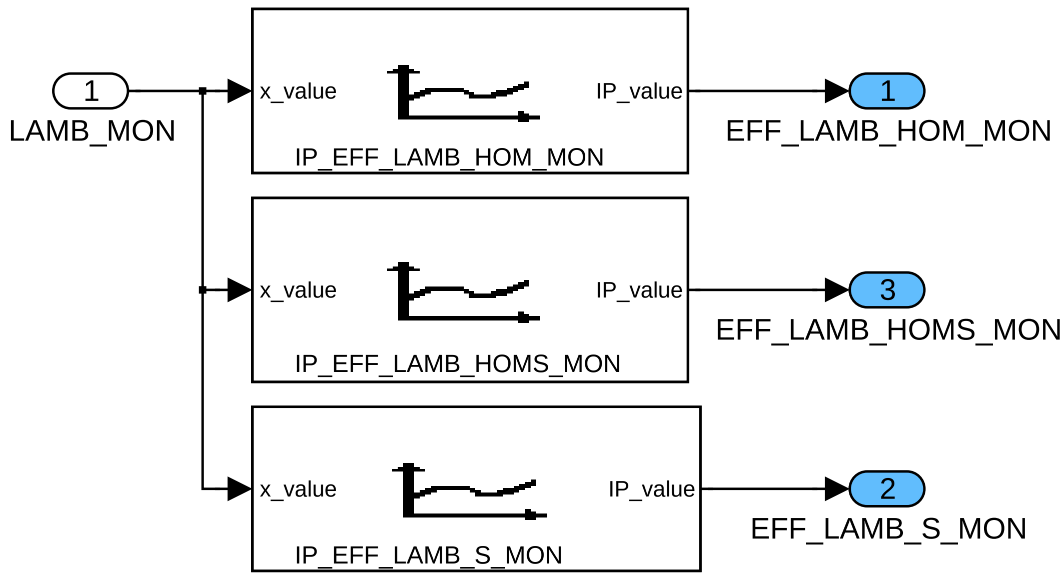

Figure E.1.5: : Path: ECM2_DTSYSEFF/DTSYSEFF/Lambda_efficiency

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E.2 Actual fuel mass flow

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
EFF_SCC_MON	O/V	0... FFH	0... 1.99218	0.0078125	-
Actual efficiency of cylinder cut-off for torque monitoring					
FAC_PREV_STATE_IV_MON	V	0... FFH	0... 1.99218	0.0078125	-
Actual efficiency of cylinder cut-off from previous state					
LV_ENA_GRD_TI_IDX_MON	V	0... 1H	0 ...1	1	-
flag indicating stable dynamic conditions					
LV_IDX_TI_PLAUS_MON	O/V	0... 1H	0 ...1	1	-
Flag for unplausible injection index					
LV_IV_EGY_POST_MON	V	0... 1H	0 ...1	1	-
determination of energy level for post pulse					
MFF_IV_1_MON	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass Fuel Flow, first Pulse					
MFF_IV_2_MON	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass Fuel Flow, second Pulse					
MFF_IV_POST_MON	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass Fuel Flow, post pulse					
MFF_LAMB_MON	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Lambda relevant mass fuel flow					
MFF_LAMB_REF_MON	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Lambda relevant Mass Fuel Flow for stoichometric conditions					
MFF_TQ_MON	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Torque relevant Mass Fuel Flow					
NR_CTR_IDX_MON	V	0... FFH	0... 255	1	-
counter for maximal transient jitter					
PRS_DIF_IV_1_MON	V	0... FFFFH	0... 347776	5.3067216	hPa
pressure difference at injector for first pulse					
PRS_DIF_IV_2_MON	V	0... FFFFH	0... 347776	5.3067216	hPa
pressure difference at injector for second pulse					
PRS_DIF_IV_POST_MON	V	0... FFFFH	0... 347776	5.3067216	hPa
pressure difference at injector for post pulse					
TI_1_MES_IDX_MON	V	0... FFFFH	0... 65.535	0.001	ms
Actual performed injection time for first pulse, based on IDX_TI					
TI_DIF_MES_IDX_MON	V	0... FFFFH	0... 65.535	0.001	ms
difference between measured and indexed signal					
TI_IDX_1_MON	V	0... FFFFH	0... 65.535	0.001	ms
IDX- based, virtual injection time, first pulse					
TI_IDX_2_MON	V	0... FFFFH	0... 65.535	0.001	ms
IDX- based, virtual injection time, second pulse					
TI_IDX_POST_MON	V	0... FFFFH	0... 65.535	0.001	ms
IDX- based, virtual injection time, post injection pulse					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TI_IV_1_COR_MON	V	0... FFFFH	0... 65.535	0.001	ms
standardized injection time for first pulse					
TI_IV_2_COR_MON	V	0... FFFFH	0... 65.535	0.001	ms
standardized injection time for second pulse					
TI_IV_POST_COR_MON	V	0... FFFFH	0... 65.535	0.001	ms
standardized injection time for post pulse					

Input data:

CHA_IV_1_MES [NC_CYL_NR] {p. 2035}	CHA_IV_2_MES [NC_CYL_NR] {p. 2035}	CHA_IV_POST_MES [NC_CYL_NR] {p. 2035}	EFF_SCC_AV {p. 6665}
EOI_1_MES [NC_CYL_NR] {p. 2036}	EOI_2_MES [NC_CYL_NR] {p. 2036}	EOI_POST_MES [NC_CYL_NR] {p. 2037}	FAC_LAM_AD_BAL [NC_CBK_EX_NR] {p. 1014}
FAC_LAM_LIM_FIL [NC_CBK_EX_NR] {p. 1014}	FAC_LAM_PCTL [NC_CBK_EX_NR] {p. 2462}	FAC_MFF_COR_INJ_MOD {p. 8241}	FAC_MFF_DIF_MV {p. 2260}
FAC_MFF_TFU {p. 2224}	FAC_MFF_WUP_CUS_MON {p. 6789}	FAC_TI_L_PRS {p. 3327}	FAC_TI_PRS_COR_1 {p. 1999}
FAC_TI_PRS_COR_2 {p. 1999}	FAC_TI_PRS_COR_3 {p. 2000}	FUP {p. 1283}	IDX_TI_1_MON [NC_CYL_NR] {p. 6789}
IDX_TI_2_MON [NC_CYL_NR] {p. 6789}	IDX_TI_POST_MON [NC_CYL_NR] {p. 6789}	IGA_IGC_H_RNG [NC_CYL_NR] {p. 1876}	LC_CUR_SHP_INJ_ENA_MON {p. 6803}
LV_IV_EGY_RNG_1 {p. 2261}	LV_IV_EGY_RNG_2 {p. 2261}	LV_IV_EGY_RNG_3 {p. 2261}	LV_TQI_MON_ACT_MON {p. 6791}
MAP_MES {p. 1198}	MFF_ADD_CYL_CP {p. 3692}	MFF_ADD_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2464}	MFF_ADD_WF {p. 8242}
MFF_SP_1_EXT_COR [NC_CYL_NR] {p. 8242}	MFF_SP_2_EXT_COR [NC_CYL_NR] {p. 8242}	MFF_SP_3_EXT_COR [NC_CYL_NR] {p. 8242}	N_32_MON {p. 7002}
NC_CRK_INJ_BAS_REF {p. 626}	NC_CRK_INJ_REF_TDC {p. 626}	NC_CYL_NR {p. 1526}	PREV_STATE_IV {p. 2039}
SOI_1_MES [NC_CYL_NR] {p. 2039}	SOI_2_MES [NC_CYL_NR] {p. 2039}	SOI_POST_MES [NC_CYL_NR] {p. 2039}	TI_1_MES [NC_CYL_NR] {p. 2040}
TI_1_MON [NC_CYL_NR] {p. 6793}	TI_2_MES [NC_CYL_NR] {p. 2040}	TI_2_MON [NC_CYL_NR] {p. 6793}	TI_CAST {p. 2100}
TI_POST_MES [NC_CYL_NR] {p. 2041}	TI_POST_MON [NC_CYL_NR] {p. 6793}	TI_TUN_ADD_IV [NC_CYL_NR] {p. 2233}	TI_TUN_IV [NC_CYL_NR] {p. 2233}
TI_WUP {p. 2109}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_THD_FUP_DLY_1_MON	-	0... FFH	0... 8160	32	rpm
engine speed threshold for delay of FUP					
C_N_THD_FUP_DLY_2_MON	-	0... FFH	0... 8160	32	rpm
engine speed threshold for delay of FUP					
C_THD_GRD_TI_IDX_MON	-	8000... 7FFFH	-32.768 ...32.767	0.001	ms
gradient limit for stable dynamic conditions					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_THD_MFF_AD_ADD_MAX_MON	-	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
Threshold for offset from Lambda adaptation					
C_THD_MFF_AD_FAC_MAX_MON	-	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
Threshold for offset from Lambda adaptation					
C_THD_MIN_CHA_IV_MON	-	0... 3FFH	0... 2272.6968	2.2216	µAs
Threshold for minimal injector charge					
C_THD_MIN_N_IDX_MON	-	0... FFH	0... 8160	32	rpm
engine speed threshold for index plausibilisation					
C_THD_MIN_TI_MES_MON	-	0... FFFFH	0... 65.535	0.001	ms
boundary for minimal injector opening					
C_THD_NR_CTR_IDX_MON	-	0... FFH	0... 255	1	-
threshold for maximal transient jitter					
C_THD_SOI_POST_MON	-	FC40... 3C0H	-360 ...360	0.375	°CRK
Threshold for torque participation of post pulse					
C_TI_MES_OFS_MON	-	8000... 7FFFH	-32.768 ...32.767	0.001	ms
Injection time offset for low needle lift pulses that exceed special timing parameter calculation.					
IP_FAC_TI_PRS_CYL_L_MON	-	0... FFFFH	0... 15.99975	244.1e-6	-
LDPM_PRS_IP_FAC_TI_PRS_CYL_MON	12	0... FFFFH	0... 347776	5.3067216	hPa
correction of counter pressure on low needle lift					
IP_FAC_TI_PRS_CYL_MON	-	0... FFFFH	0... 15.99975	244.1e-6	-
LDPM_PRS_IP_FAC_TI_PRS_CYL_MON	12	0... FFFFH	0... 347776	5.3067216	hPa
correction of counter pressure on needle lift					
IP_MFF_TI_PRS_EGY_H_MON	V	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_TI_IP_MFF_EGY_H_MON	18	0... FFFFH	0... 65.535	0.001	ms
LDPM_PRS_DEC_INJ_MON	12	0... FFFFH	0... 347776	5.3067216	hPa
injector characteristic at high energy level					
IP_MFF_TI_PRS_EGY_L_MON	V	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_TI_IP_MFF_EGY_L_MON	18	0... FFFFH	0... 65.535	0.001	ms
LDPM_PRS_DEC_INJ_MON	12	0... FFFFH	0... 347776	5.3067216	hPa
injector characteristic at low energy level					
IP_PRS_INC_CMP_MON	V	0... FFFFH	0... 31.99951	488.299e-6	-
LDP_EOI_IP_PRS_INC_CMP_MON	12	0... 780H	0... 720	0.375	°CRK
LDP_CRK_INJ_IP_PRS_INC_CMP_MON	16	0... 780H	0... 720	0.375	°CRK
influence of the varying pressure increase inside the cylinder					
IP_THD_IDX_TI_MES_MON	-	0... FFFFH	0... 65.535	0.001	ms
LDP_TI_MES_IP_THD_IDX_MON	6	0... FFFFH	0... 65.535	0.001	ms
treshold for deviation between TI_MES and TI_IDX					
IP_TI_H_MON	-	0... FFFFH	0... 65.535	0.001	ms
LDP_IDX_TI_1_INJR_MON	8	0... FFFFH	0... 65535	1	-
Injection time for high injector needle lift.					
IP_TI_L_MON	-	0... FFFFH	0... 65.535	0.001	ms
LDP_IDX_TI_2_INJR_MON	8	0... FFFFH	0... 65535	1	-
Injection time for low injector needle lift.					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_IV_POST_EGY_RNG_MON	-	0... 1H	0 ...1	1	-
Logical constant for high or low energy post pulse					
LC_THD_SOI_POST_MON	-	0... 1H	0 ...1	1	-
Selection of the reference angle for post pulse recognition					

Import actions:

ACTION_ECM3_Service15TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service16TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service17TaskPfm (**IN**<No Name available>)

E.2.1 ECM2_DTSYSMFFAC

This specification has to be coded according to the following method description: "M730204: Coding rules for process monitoring SW - ECM2.
Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 1.

ACTION_ECM3_McChkStack()

Note: These actions are defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service15TaskPfm() and ACTION_ECM3_Service16TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode “O” and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

General information:

The ETC safety concept uses the mass-fuel-flow signal as a basis for the generation of a actual indicated engine torque. Therefore not the complete injection is seen as torque relevant. The post- pulse especially becomes weighted with a factor, which depends on its phasing. The sum of first, second and the weighted post- pulse (MFF_TQ_MON) is input for the determination of the actual engine torque. The un-weighted sum of all pulses (MFF_LAMB_MON) becomes corrected by elimination of all enrichments (e.g. WUP, CAST, etc.) with the aim to create a Lambda signal, which is comparable against the reference Lambda (see also ’Actual lambda deviation’).

Description:

The fuel mass flow is determined by a summation of all injection pulses for every cylinder with an arithmetic mean- value calculation afterwards. From I/O- Software the feedback- signal for the opening duration of the injectors (TI_X_MES) is supplied to the monitoring level as well as the the charge CHA_IV_X_MES. The energy which was put into the injector’s piezo- stack is taken as representative for the

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needle lift. After correction of these signals to standard conditions, a characteristic curve for a dedicated energy level, delivers the correspondence between injection time and mass-fuel-flow.
Hint!! Application Conditions - Initialisation: for condition see ’Application incidences of process monitoring’

Application Condition

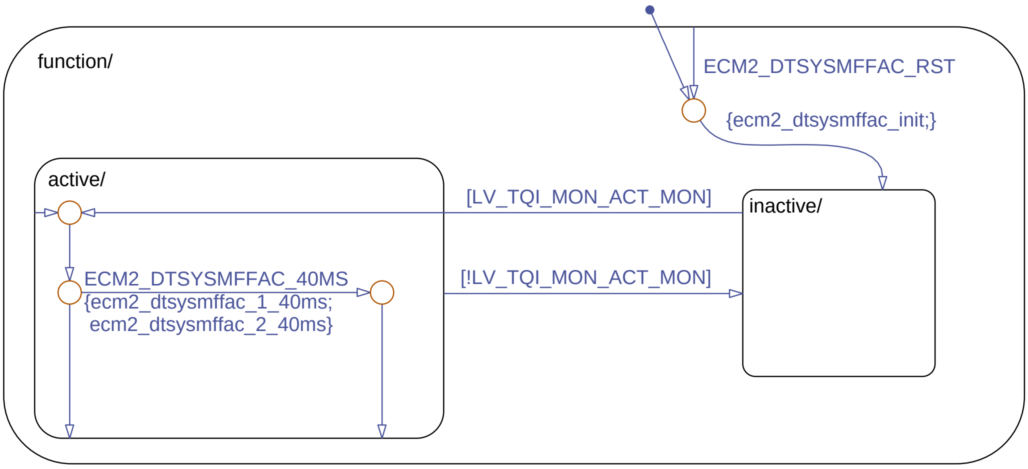

Figure E.2.1: ECM2_DTSYSMFFAC/APP_CDN/Chart1

Function Description

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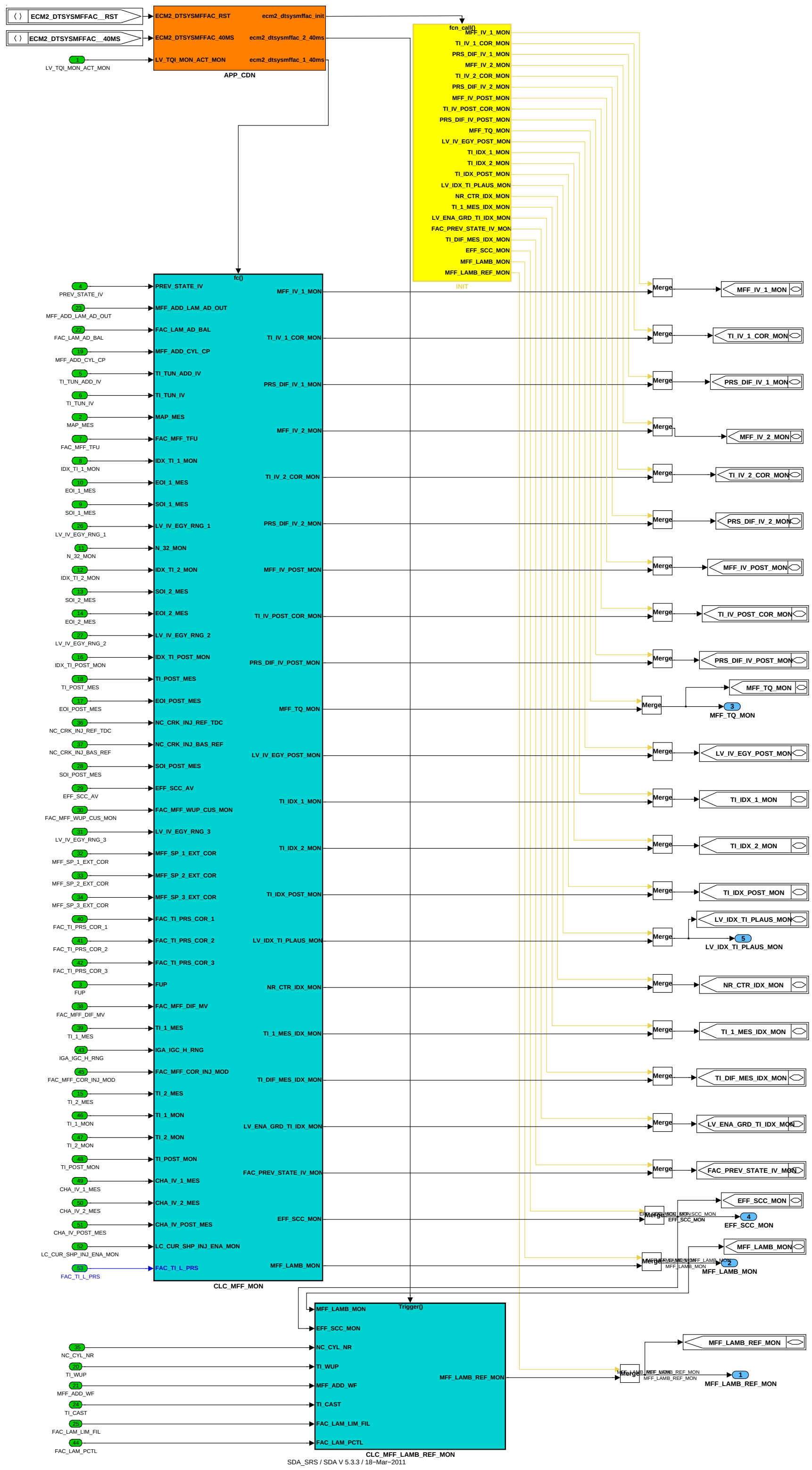

Figure E.2.2: ECM2_DTSYSMFFAC

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E.2.1.1 SUBFUNCTION: INIT

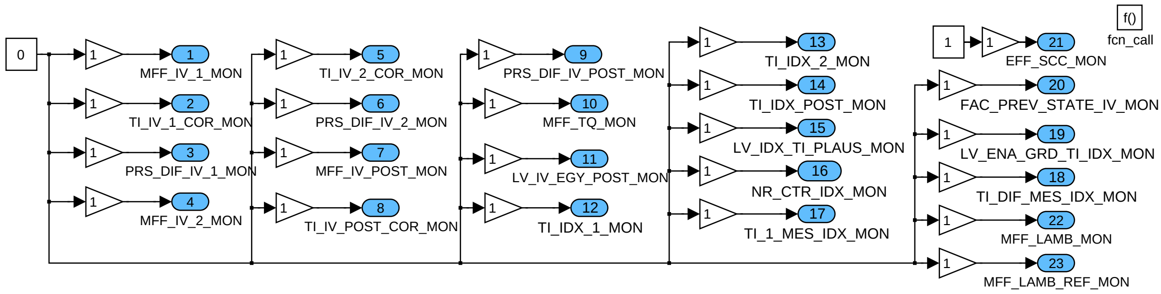

Figure E.2.3: ECM2_DTSYSMFFAC/INIT

E.2.1.2 SUBFUNCTION: CLC_MFF_LAMB_REF_MON

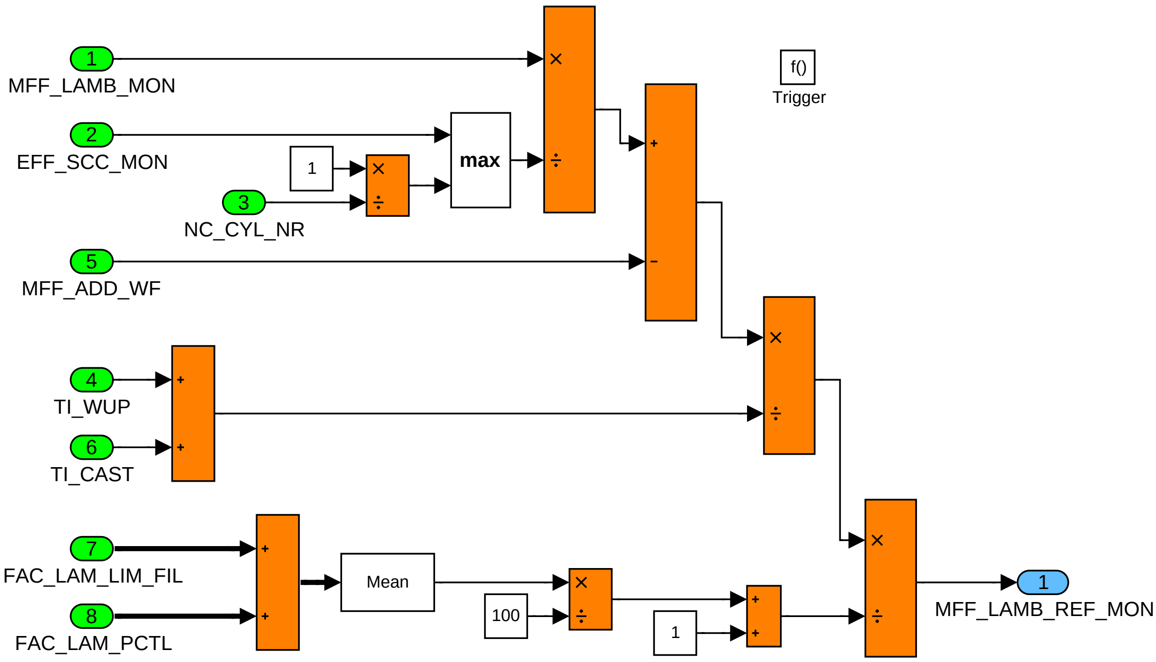

Figure E.2.4: ECM2_DTSYSMFFAC/CLC_MFF_LAMB_REF_MON

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E.2.1.3 SUBFUNCTION: CLC_MFF_MON

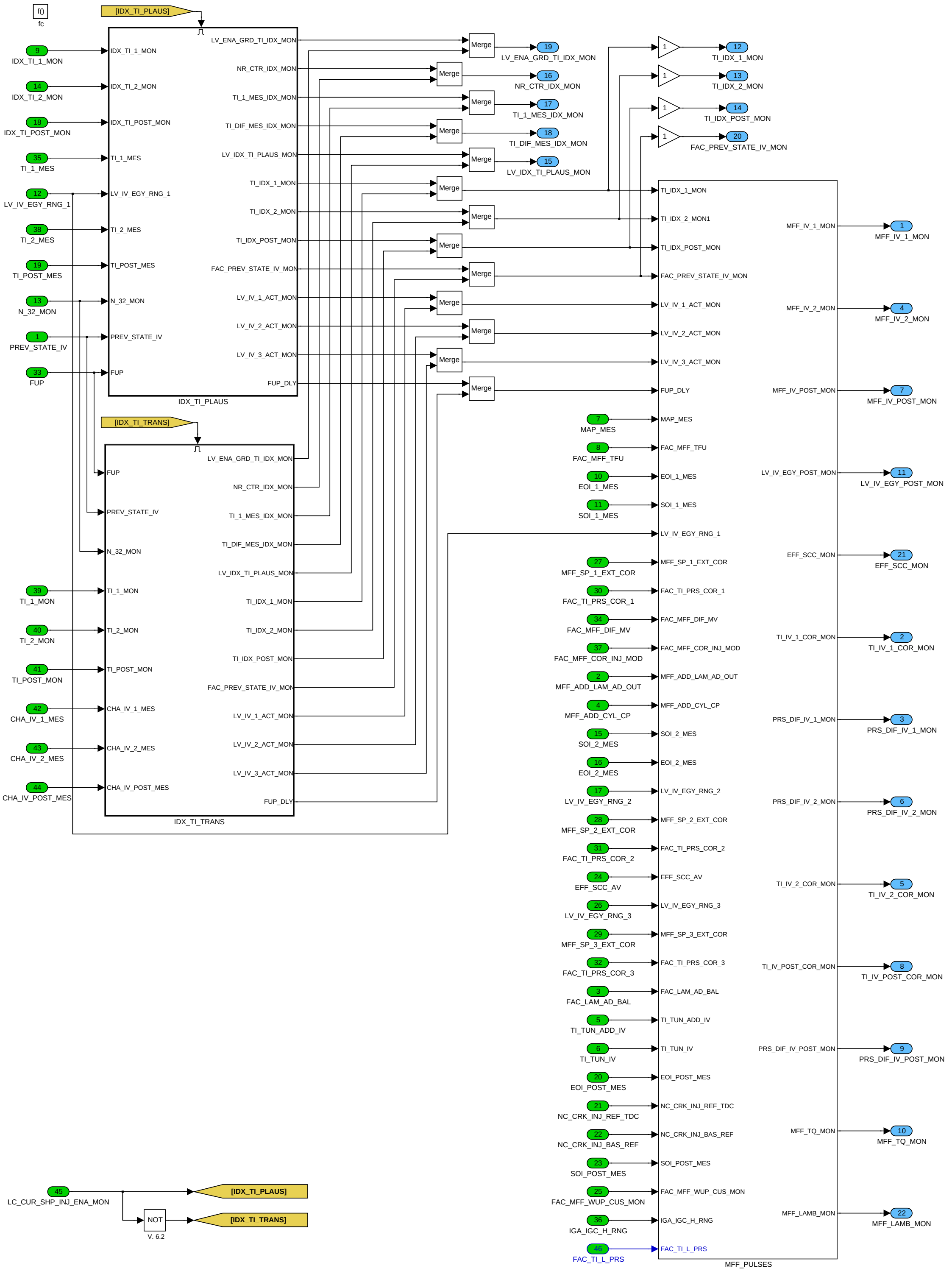

Figure E.2.5: ECM2_DTSYSMFFAC/CLC_MFF_MON

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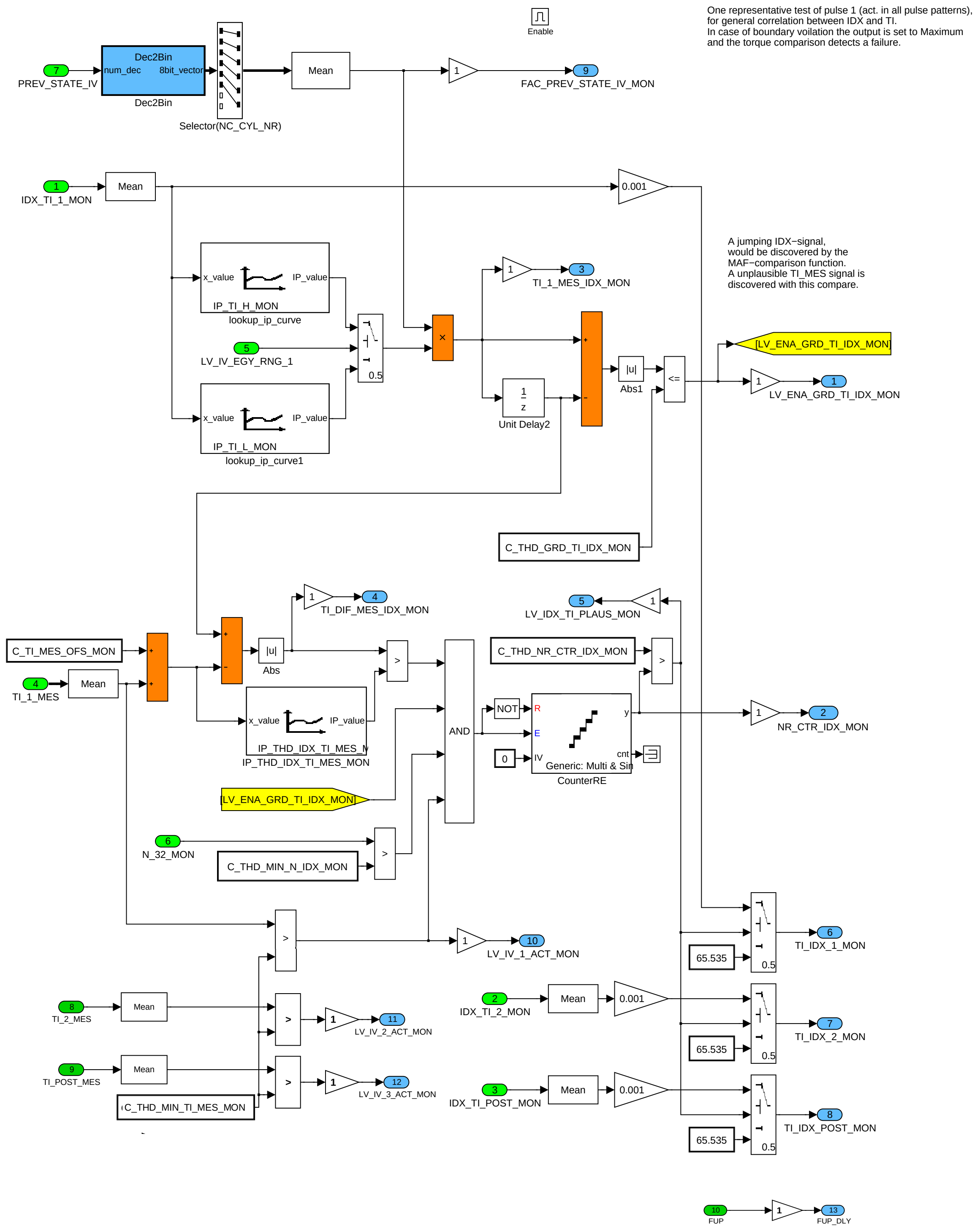

Figure E.2.6: ECM2_DTSYSMFFAC/CLC_MFF_MON/IDX_TI_PLAUS

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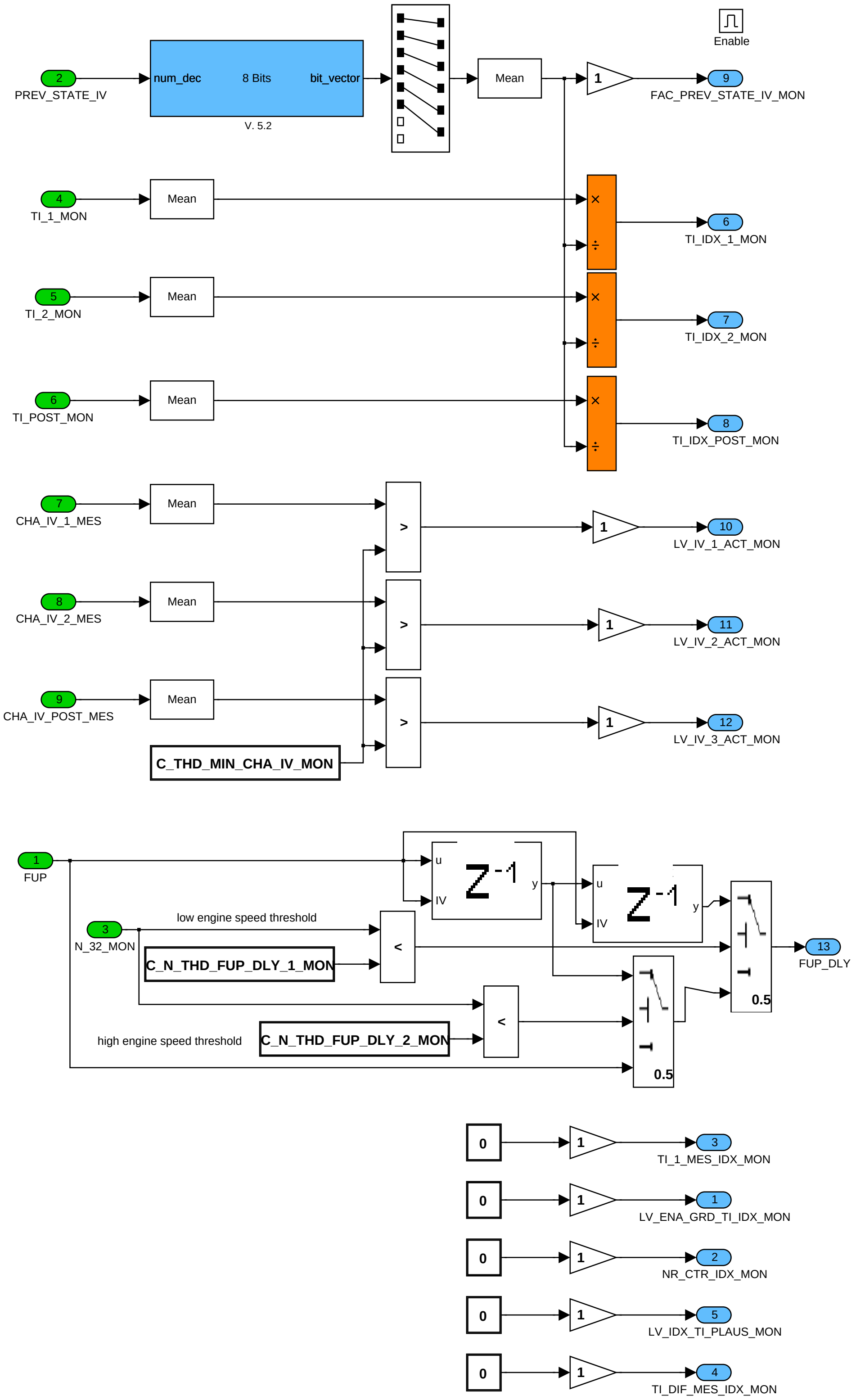

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Figure 7 ECM2_DTSYSMFFAC/ CLC_MFF_MON/ IDX_TI_TRANS

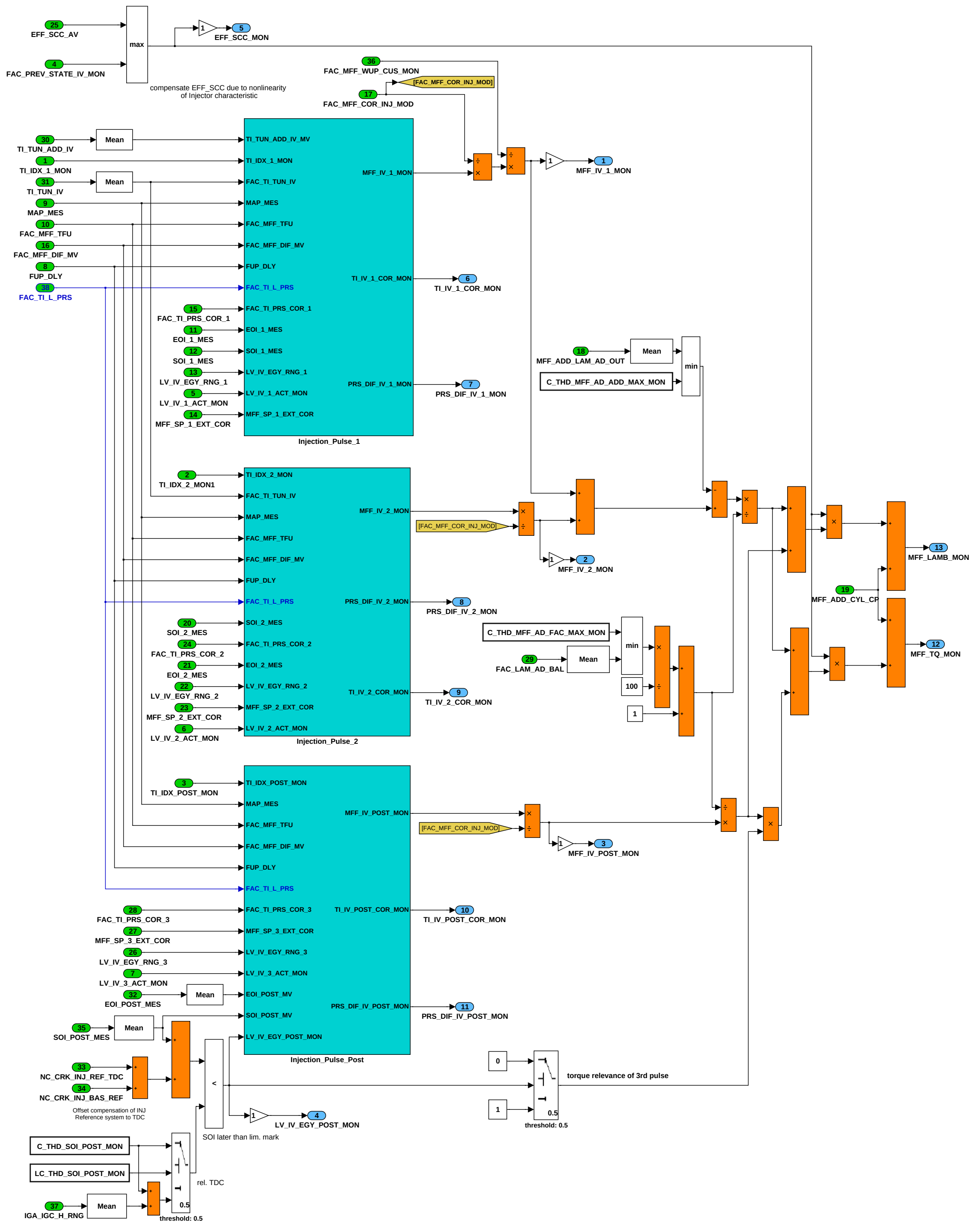

Figure E.2.7: ECM2_DTSYSMFFAC/CLC_MFF_MON/MFF_PULSES

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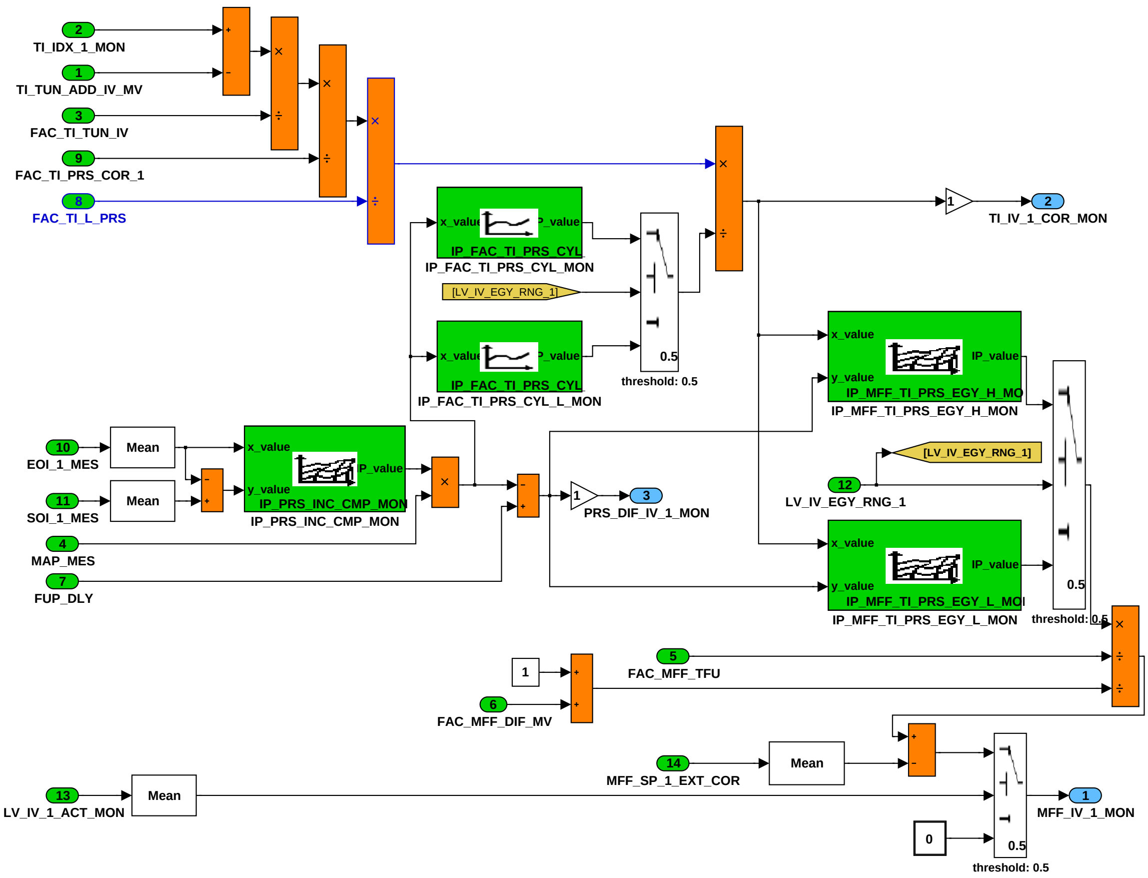

Figure E.2.8: ECM2_DTSYSMFFAC/CLC_MFF_MON/MFF_PULSES/Injection_Pulse_1

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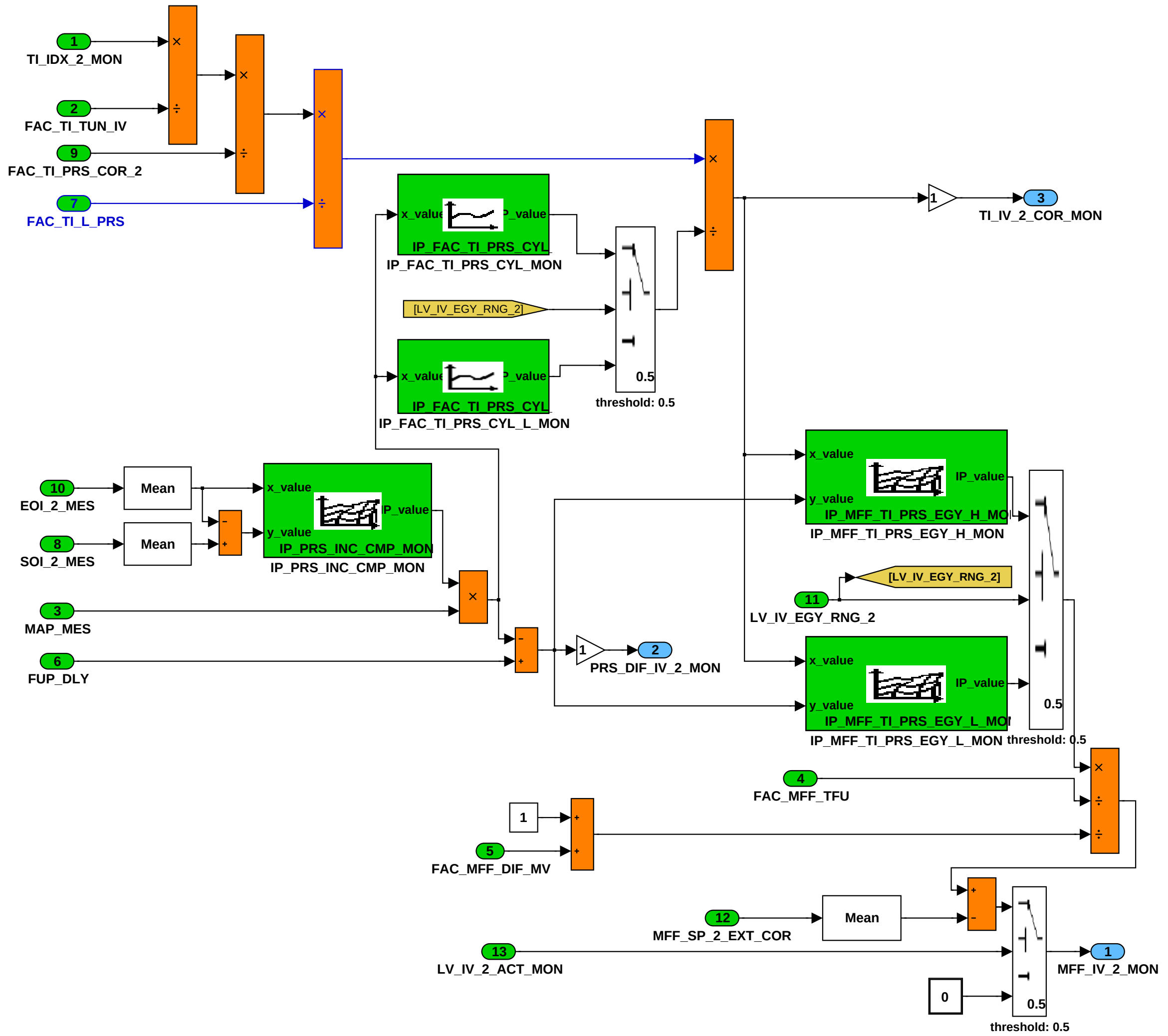

Figure E.2.9: ECM2_DTSYSMFFAC/CLC_MFF_MON/MFF_PULSES/Injection_Pulse_2

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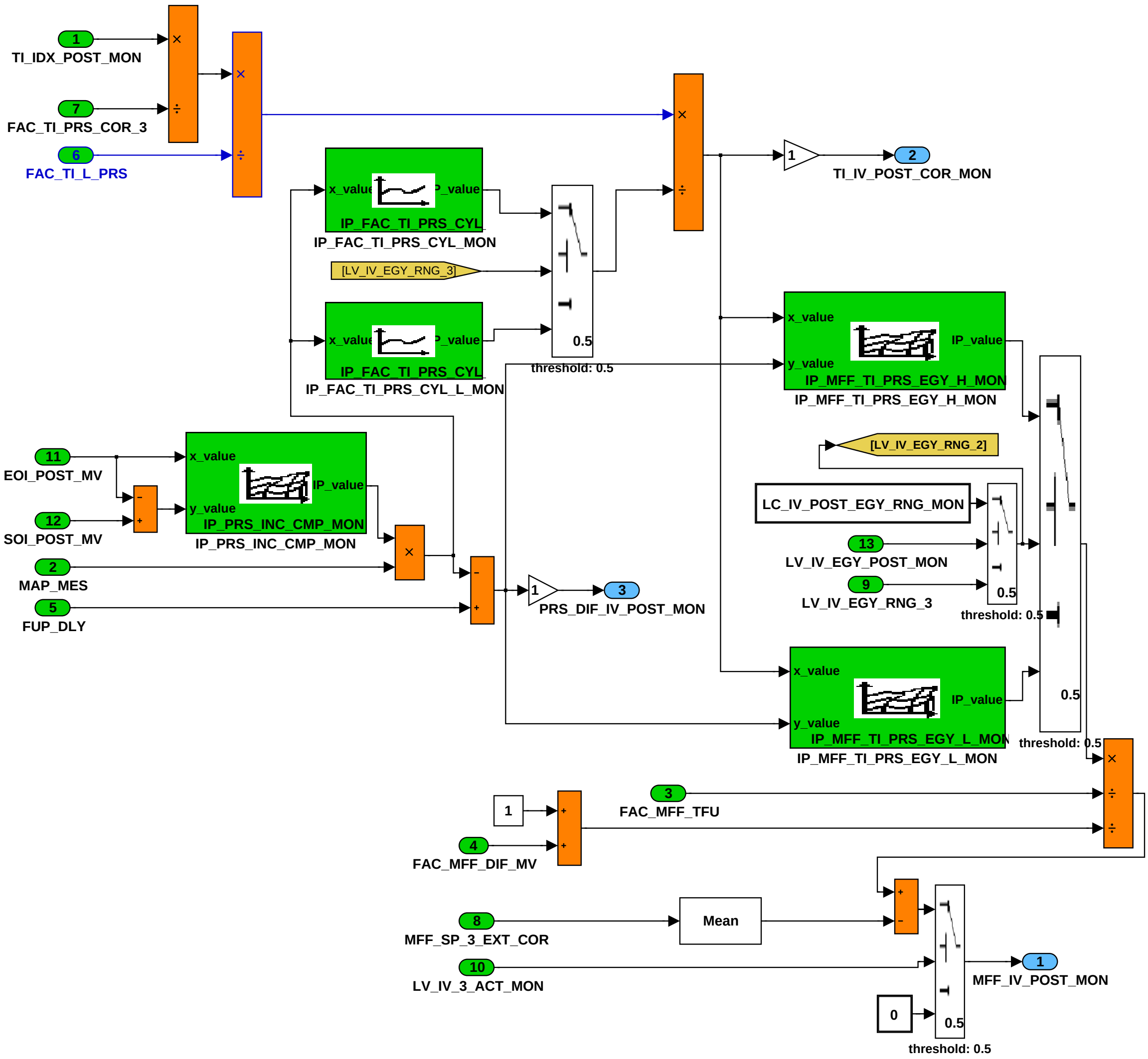

Figure E.2.10: ECM2_DTSYSMFFAC/CLC_MFF_MON/MFF_PULSES/Injection_Pulse_Post

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E.3 Actual indicated engine torque

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_AV_MON	O/V	0... FFH	0... 510	2	Nm
Actual indicated engine torque (process monitoring)					

Input data:

EFF_MFF_TQ_COR_MON {p. 6789}	EFF_TOT_MON {p. 6753}	LV_TQI_MON_ACT_MON {p. 6791}	MFF_TQ_MON {p. 6760}
N_32_MON {p. 7002}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TQI_CUS_MON	V	0... FFH	0... 510	2	Nm
LDP_N_32_MON_IP_TQI_CUS_MON	6	0... FFH	0... 8160	32	rpm
LDP_MFF_MON_IP_TQI_CUS_MON	8	0... FFFFH	0... 1389	0.02119478	mg/stk
Customer specific engine torque (process monitoring)					

Import actions:

ACTION_ECM3_ChkCpl (**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_McChkStack ()
ACTION_ECM3_ReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_Service3TaskPfm (**IN**<PRM_K>)
ACTION_ECM3_Service4TaskPfm (**IN**<PRM_K>)
ACTION_ECM3_Service5TaskPfm (**IN**<PRM_K>)
ACTION_ECM3_WriteChkCpl (**INOUT**<PRM_VAR>,**OUT**<PRM_VAR_CPL>,**IN**<PRM_VALUE>)

General information

ACTION_ECM3_Service3TaskPfm(IN<>)
ACTION_ECM3_Service4TaskPfm(IN<>)
ACTION_ECM3_Service5TaskPfm(IN<>)

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 4.

ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service3TaskPfm() and ACTION_ECM3_Service4TaskPfm().

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ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode “O” and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.
This module calculates the actual indicated engine torque TQI_AV_MON. The map represents a simplified versions of the original map of the corresponding functions in the control level.

Application conditions:

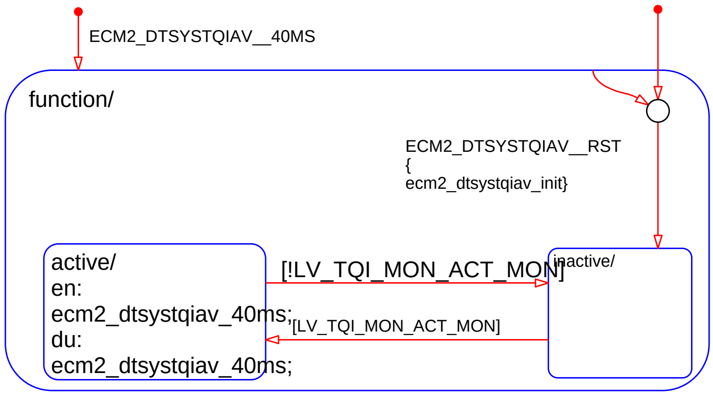

Figure E.3.1: ECM2_DTSYSTQIAV/APP_CDN/Chart

Function description:

Signal flow diagram:

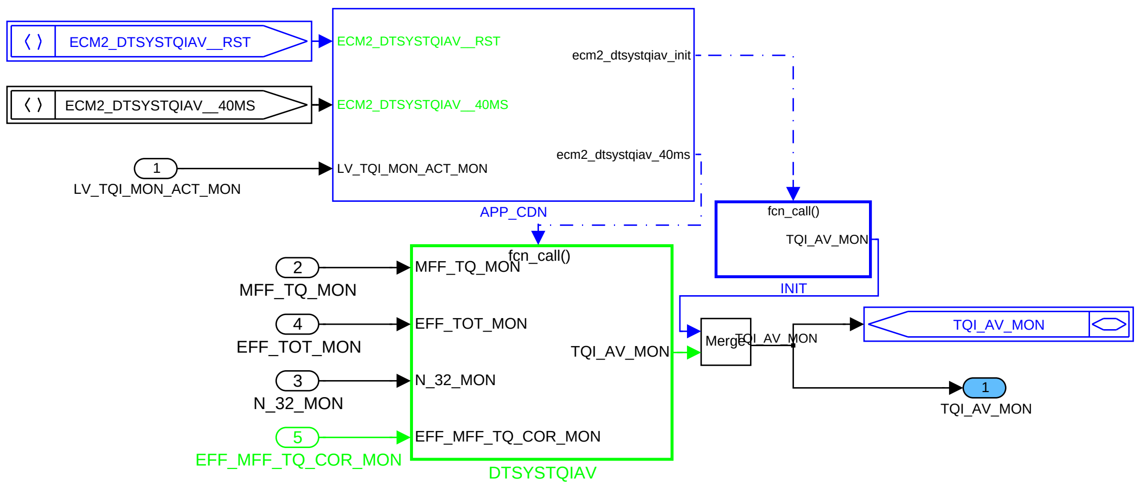

Figure E.3.2: ECM2_DTSYSTQIAV

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Formula section:

E.3.1 INIT

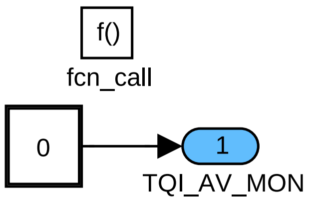

Figure E.3.3: ECM2_DTSYSTQIAV/INIT

E.3.2 DTSYSTQIAV

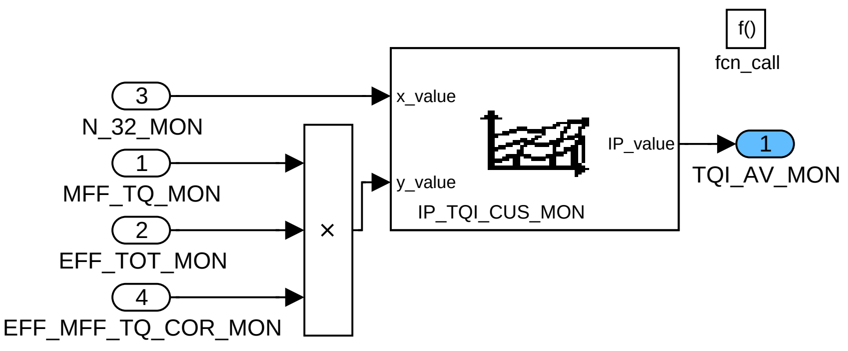

Figure E.3.4: ECM2_DTSYSTQIAV/DTSYSTQIAV

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E.4 Actual lambda deviation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_DIF_MON	O/V	8000... 7FFFH	-32... 31.99902	976.599e-6	-
Deviation between actual and modeled Lambda					
LAMB_DLY_MON	V	0... 7FFFH	0... 31.99902	976.599e-6	-
delayed LAMB_MON signal					
LAMB_MDL_MON	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
modeled lambda					
LAMB_MDL_REF_MON	V	0... 7FFFH	0... 31.99902	976.599e-6	-
Modeled lambda at reference conditions					
LAMB_MON	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Modeled Lambda					
MAF_DLY_MON	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Phase shifted MAF signal					
MAF_MON	O/V	0... FFH	0... 1389	5.4470588	mg/stk
Mass air flow signal used monitoring level					
MFF_TI_MON	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass flow, derived from fuel path					

Input data:

EFF_SCC_MON {p. 6760}	FAC_COR_MFF_EXT_ADJ [NC_CYL_NR] {p. 798}	FAC_COR_MFF_EXT_ADJ_NVMY [NC_CYL_NR] {p. 798}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}
LV_FAC_COR_MFF_EXT_ADJ {p. 803}	LV_LAMB_LS_UP_VLD_MON [NC_CBK_EX_NR] {p. 6790}	LV_TQI_MON_ACT_MON {p. 6791}	MAF {p. 8277}
MAF_EGR_NEUT_GAS {p. 8278}	MAF_SCAV_EXT {p. 8278}	MFF_LAMB_MON {p. 6760}	MFF_LAMB_REF_MON {p. 6760}
OPM_AV_MON {p. 6792}	T_DLY_SOI_LSL_POS [NC_CBK_EX_NR] {p. 2464}	T_SEG_SW_MON {p. 7002}	T1_LSL_UP_OPT [NC_CBK_EX_NR] {p. 2464}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_DIF_LS_UP_LAMB_MON	-	8000... 7FFFH	-32... 31.99902	976.599e-6	-
offset added on LAMB_MON					
C_FAC_MFF_MAF_MON	-	0... FFFFH	0... 15.99975	244.1e-6	-
Stoichiometric Constant for Lambda calculation					
C_FAC_T_SEG_MON	-	0... FFH	0... 15.9375	0.0625	-
Factor for multiple segment delay					
C_FAC_T1_LSL_UP_MON	-	0... 7FFFH	0... 31.99902	976.599e-6	-
adaptation factor for first order time lag of sensor					
C_LAMB_REF_MON	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Adjustable lambda reference					
C_T_INJ_REAC_HOM_MON	-	0... FFH	0... 10.2	0.04	s
maximal delay after reactivation at HOM					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_INJ_REAC_MON	-	0... FFH	0... 10.2	0.04	s
maximal delay after reactivation from PUC					
C_T_MIN_PUC_MON	-	0... FFH	0... 10.2	0.04	s
Time for minimal PUC duration					
C_THD_EFF_SCC_MIN_MON	-	0... FFH	0... 1.99218	0.0078125	-
Threshold for minimal pattern efficiency					
C_THD_MAX_LAMB_MON	-	8000... 7FFFH	-32... 31.99902	976.599e-6	-
Maximum treshold for modeled lambda					
C_THD_MAX_LAMB_SENS_MON	-	8000... 7FFFH	-32... 31.99902	976.599e-6	-
Maximum treshold for sensor synchronisation					
LC_FAC_COR_MFF_EXT_MON	-	0... 1H	0 ...1	1	-
Switch to disable correction factor for OBD-demo					
LC_LAMB_DLY_INI_MON	-	0... 1H	0 ...1	1	-
Initialisation switch of Pade filter					
LC_PUC_LAMB_MON	-	0... 1H	0 ...1	1	-
enable check of sensor signal during PUC					
LC_T_MIN_PUC_MON	-	0... 1H	0 ...1	1	-
Selector for minimal PUC duration					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_T_SAMPLE_MON	-	0... FFH	0... 255	1	ms
monitoring sample time					

Import actions:

ACTION_ECM3_Service15TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service16TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service17TaskPfm (**IN**<No Name available>)

E.4.1 ECM2_DTSYSLADIF

This specification has to be coded according to the following method description: "M730204: Coding rules for process monitoring SW ECM2.

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 2.

```
ACTION_ECM3_McChkStack()
```

Note: These actions are defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service15TaskPfm() and ACTION_ECM3_Service16TaskPfm().

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ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

General information:

The objective of this module is the determination of the deviation between the modelled Lambda and the sensor signal during stratified combustion or the deviation between the modelled Lambda and the reference Lambda during homogeneous combustion.

Description:

Homogeneous combustion: The MFF_LAMB_MON signal has to be corrected by subtracting all enrichments (e.g. WUP, CAST, etc.) because after modelling the resulting Lambda by using MAF from Level1, a compare against the reference Lambda (normally 1) takes place. For this injection mode no Lambda sensor is necessary then.

Stratified combustion: The MFF_LAMB_MON signal has not to be corrected by enrichments, because the sensor signal is used here directly for the plausibility check. Due to physical transport delay of the exhaust gas the modelled Lambda signal has also to be delayed. This is done with a 'PADE Filter'. Further the sensor behaviour itself has to be modelled by using a PT1 Filter. The resulting signal is compared with a mean value of both sensors or with the remaining, if one sensor is defect (in case of 2bank engine).

Hint!! Application Conditions Initialisation: for condition see 'Application incidences of process monitoring'

Application Condition

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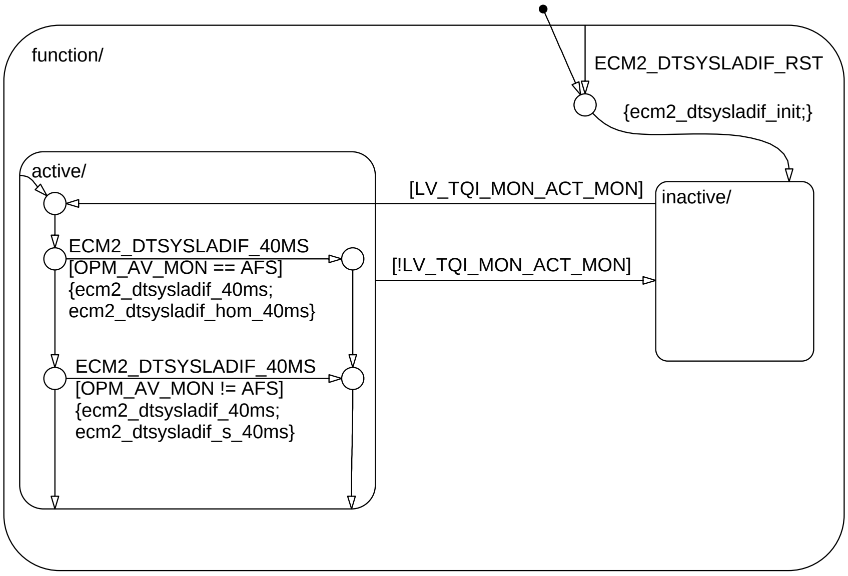

Figure E.4.1: ECM2_DTSYSLADIF/APP_CDN/Chart

Function Description

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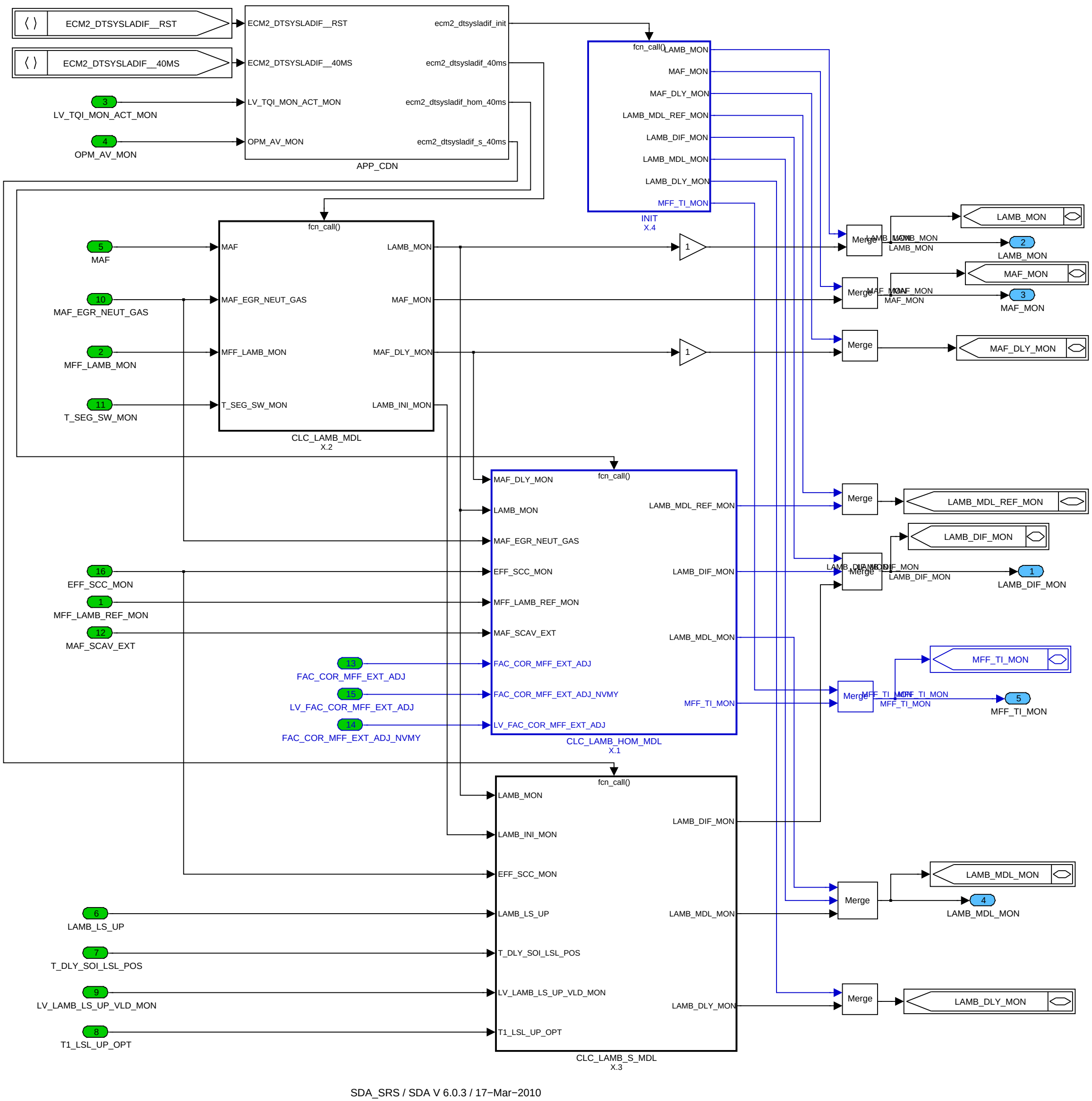

Figure E.4.2: ECM2_DTSYSLADIF

E.4.1.1 SUBFUNCTION: INIT

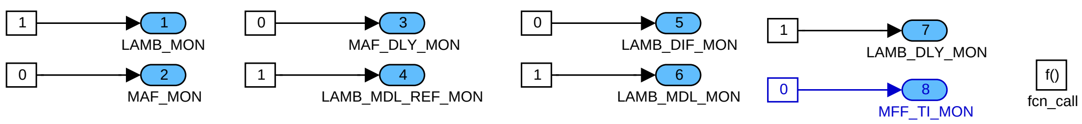

Figure E.4.3: ECM2_DTSYSLADIF/INIT

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E.4.1.2 ECM2_DTSYSLADIF/CLC_LAMB_MDL

The Z-Block for the LAMB_MON delay should be initialized with 1 at every function activation.

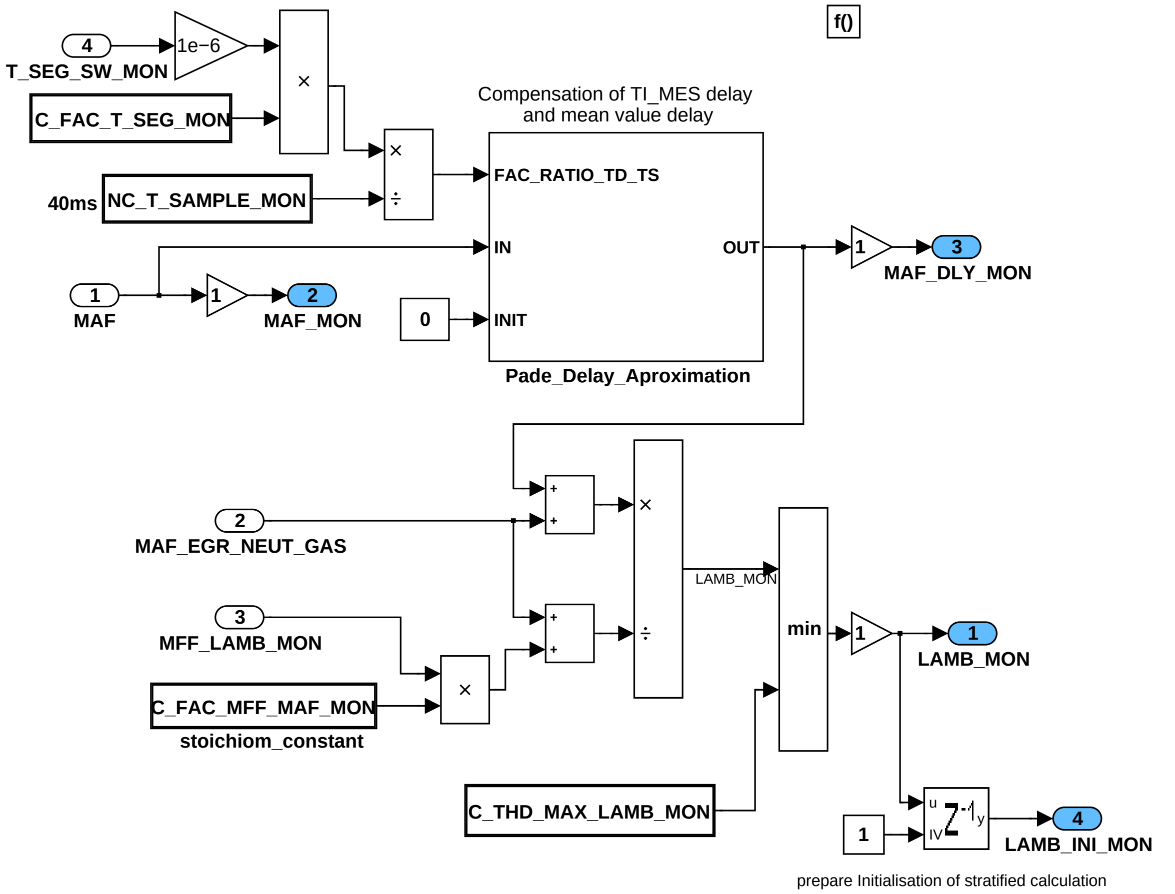

Figure E.4.4: ECM2_DTSYSLADIF/CLC_LAMB_MDL

E.4.1.3 ECM2_DTSYSLADIF/CLC_LAMB_HOM_MDL

Note: Once **at every activation of CLC_LAMB_HOM_MDL** the T_INJ_REAC_MON timer should be initialized with C_T_INJ_REAC_HOM_MON.

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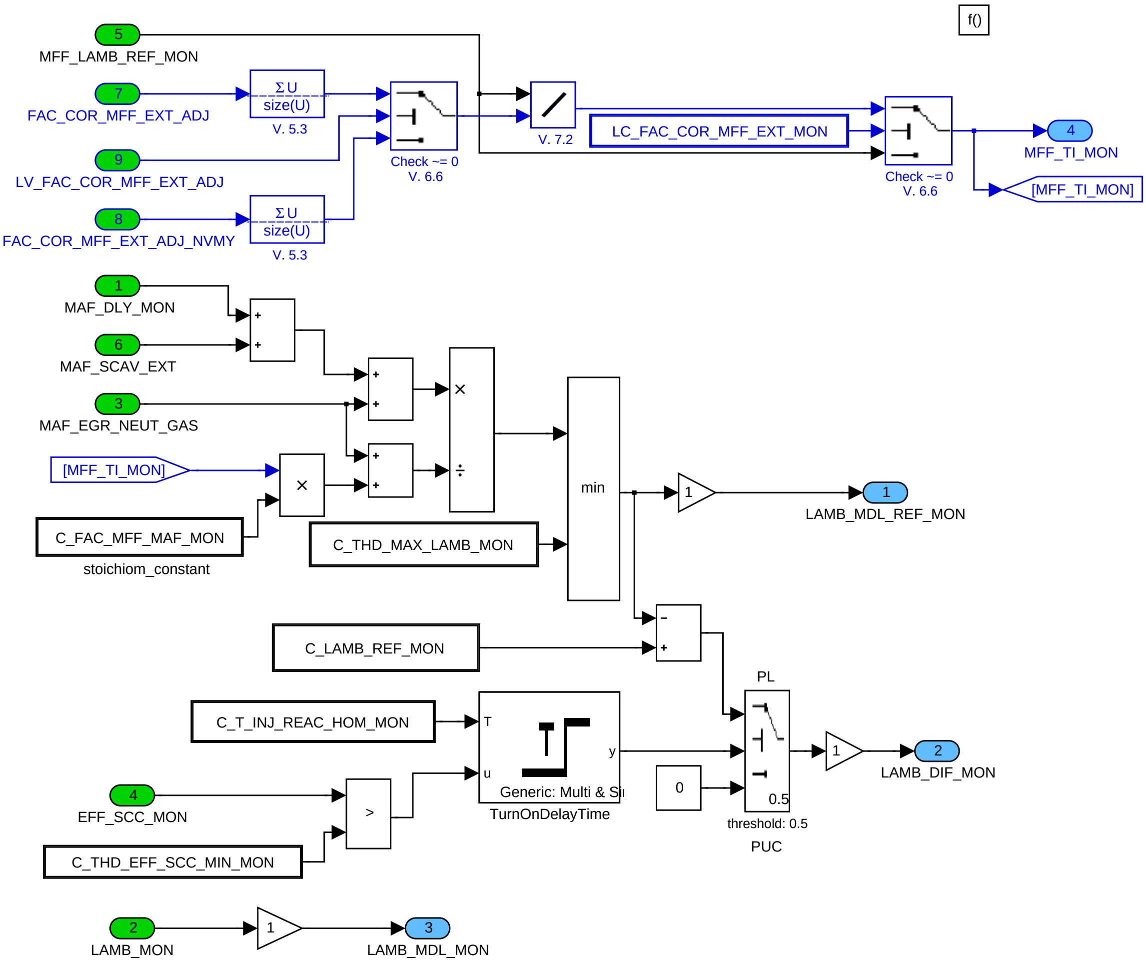

Figure E.4.5: ECM2_DTSYSLADIF/CLC_LAMB_HOM_MDL

E.4.1.4 ECM2_DTSYSLADIF/CLC_LAMB_S_MDL

Note: All internal values of the Padefilter and the digital lowpass filter, shall be set to Init value, once **at every activation of CLC_LAMB_S_MDL**. Also the T_INJ_REAC_MON timer should be initialized with C_T_INJ_REAC_MON. Also the T_MIN_PUC_MON timer should be set to 0, its output Y to 1. Further the Q output should be set to 1 at this time. The Reset input of the RSFlipFlop should have higher priority than the Set input.

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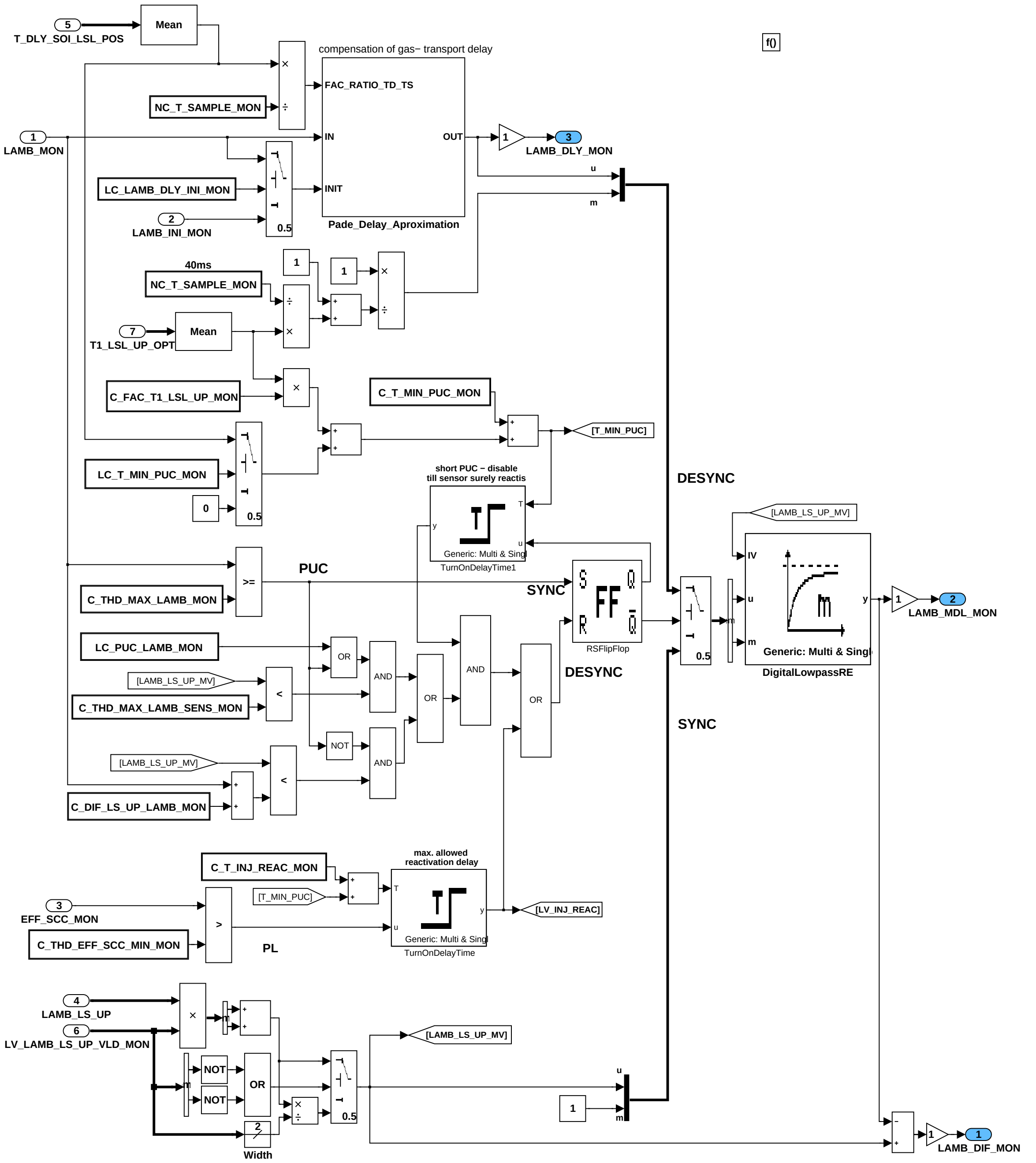

Figure E.4.6: ECM2_DTSYSLADIF/CLC_LAMB_S_MDL

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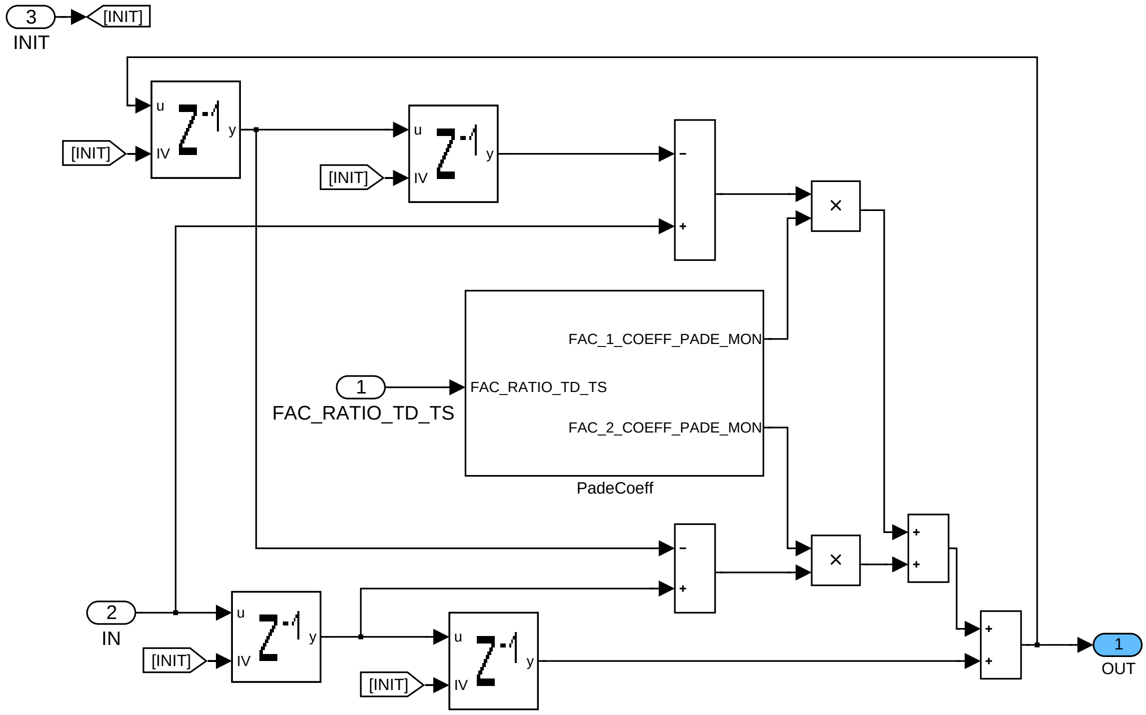

Figure E.4.7: ECM2_DTSYSLADIF/CLC_LAMB_S_MDL/Pade_Delay_Aproximation

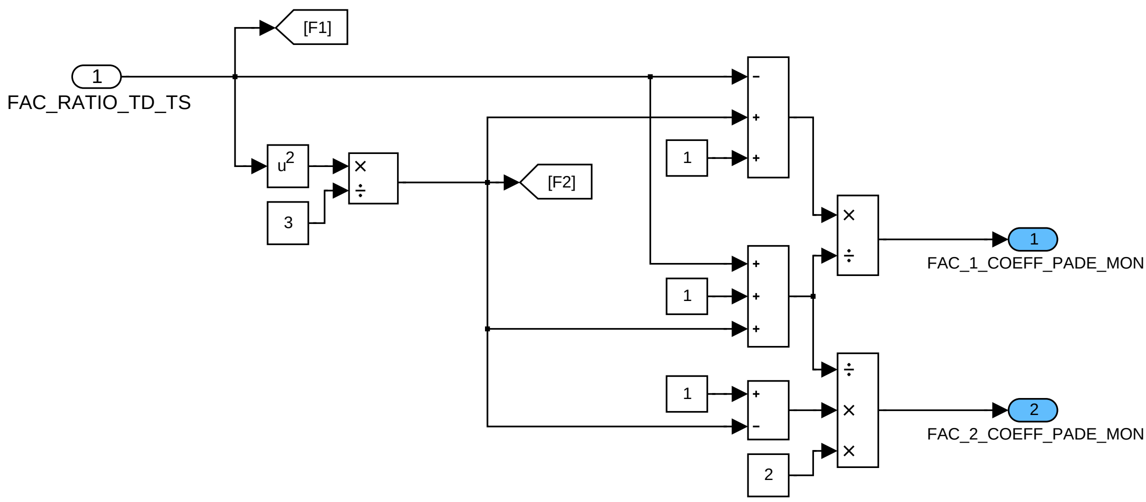

Figure E.4.8: ECM2_DTSYSLADIF/CLC_LAMB_S_MDL/Pade_Delay_Aproximation/PadeCoeff

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E.5 Combustion mode switch requests

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SWI_AFS_MON	O/V	0... 1H	0 ...1	1	-
Flag for switching to HOM_AFS due to non-HOM_AFS					

Input data:

LV_SWI_AFS_LAMB_MON {p. 6791}	LV_SWI_AFS_MFF_MON {p. 6943}	LV_SWI_AFS_POST_INJ_MON {p. 6791}	LV_SWI_AFS_TQI_MON {p. 6899}
LV_TQI_MON_ACT_MON {p. 6791}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_SWI_AFS_MON	-	0... 1H	0 ...1	1	-
Switch to force engine into AFS mode (process monitoring)					

Import actions:

ACTION_ECM3_Service15TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service16TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service17TaskPfm (**IN**<No Name available>)

E.5.1 ECM2_DTSYSCMB

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 4.

ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service15TaskPfm() and ACTION_ECM3_Service16TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

General information:

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This module combines all combustion mode switch requests from level 2 to switch to homogeneous stoichiometric mode in case of faults, which occured in non HOM_AFS mode.

E.5.2 FUNCTION PART: ECM2_DTSYSCMB

Application Condition

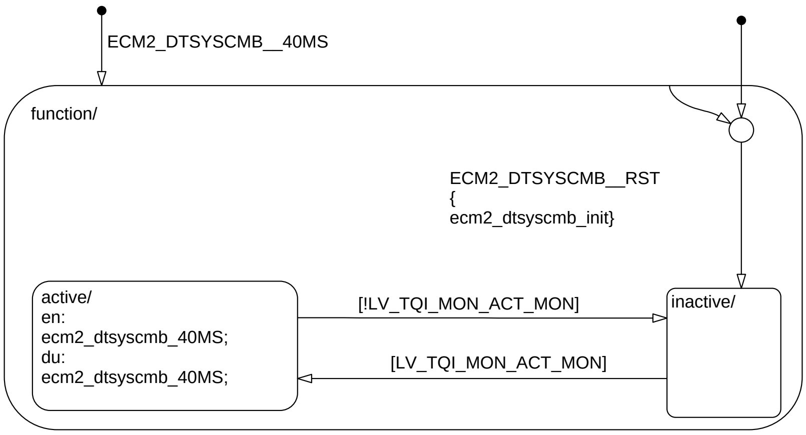

Figure E.5.1: ECM2_DTSYSCMB/APP_CDN/CHART

Function Description

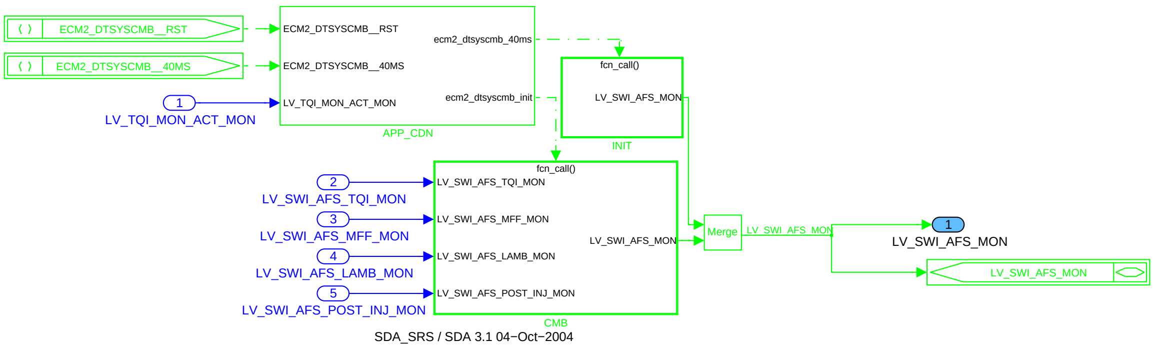

Figure E.5.2: ECM2_DTSYSCMB

E.5.2.1 SUBFUNCTION: INIT

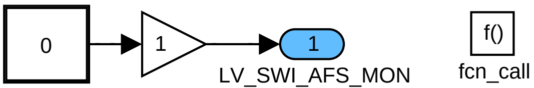

Figure E.5.3: ECM2_DTSYSCMB/INIT

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E.5.2.2 SUBFUNCTION: CMB

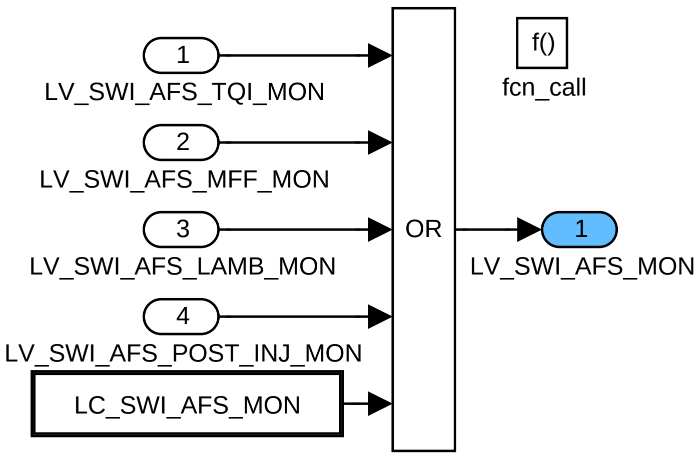

Figure E.5.4: ECM2_DTSYSCMB/CMB

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E.6 Configuration of process monitoring (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_SOF_INH_MON	V	0... FFH	0... 255	1	-
error flag sport-mode switch request monitoring					
CTR_N_SP_IS_EXT_REQ_DEC_MON	V	0... FFH	0... 255	1	-
Counter of iteration to allow N_SP_IS_EXT_REQ_MON decrementation					
CTR_OPM_AV_PLAUS_MON	V	0... FFH	0... 255	1	-
Debounce counter for error detection of OPM_AV					
CUR_ALTER_MON	V	0... FFH	0... 255	1	A
currency torque losses monitoring					
DFFGEN_FIL_MON	V	0... FFH	0... 99.60937	0.390625	%
currency torque losses monitoring					
EFF_MFF_TQ_COR_MON	O/V	0... FFH	0... 1.99218	0.0078125	-
efficiency on torque relevant mass fuel flow					
FAC_MFF_WUP_CUS_MON	O/V	0... FFH	0... 1.99218	0.0078125	-
OPM dependent mass fuel flow correction in warm-up phase (Monitoring level)					
FAC_PV_BAS_COR_MON	V	0... FFFFH	0... 1.99996	30.5e-6	-
basic correction - monitoring level					
FAC_PV_COR_MON	V	0... FFFFH	0... 1.99996	30.5e-6	-
Summation of corrections - monitoring level					
FAC_RAMP_NEG_P_D_IS_MON	O/V	0... FA0H	0... 0.5	0.000125	-
Factor for monitoring negative PD deactivation-ramp operations					
GR_DT_MDL_MON	V	0... FFFFH	0... 63.99902	976.599e-6	-
Modelled gear ratio for monitoring					
GR_DT_MON	O/V	0... FFFFH	0... 63.99902	976.599e-6	-
Gear ratio factor for monitoring					
GR_MT_MON	V	0... FFH	0... 255	1	-
Monitored value of manual transmission gear					
IDX_TI_1_MON [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Counting factor index for first pulse (monitoring)					
IDX_TI_2_MON [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Counting factor index for second pulse (monitoring)					
IDX_TI_POST_MON [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Counting factor index for post pulse (monitoring)					
IGA_REF_HOM_COR_EXT_MON	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Correction of reference ignition angle in homogeneous (for external functions e.g. VVT, EGR...)					
IGA_REF_HOMS_COR_EXT_MON	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Correction of reference ignition angle in homogeneous-stratified (for external functions e.g. VVT, EGR...)					
INT_TQI_N_CTL_TCT_MON	O/V	0... FFFFH	0... 204.79687	0.003125	Nm*s
Integrated torque request from TCT					
LV_ACT_N_SP_IS_EXT_ADJ_MON	V	0... 1H	0 ...1	1	-
LV for the displace of N_SP_IS_MON by tester demand					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACT_N_SP_IS_POIL_EXT_MON	V	0... 1H	0 ...1	1	-
Condition for enabling oil pressure diagnosis by external request (monitoring)					
LV_AT_MON	O/V	0... 1H	0 ...1	1	-
Monitoring bit for AT coded					
LV_BRAKE_MON	O/V	0... 1H	0 ...1	1	-
Brake active or brake fault present					
LV_CDN_RNG_L_REQ_MON	V	0... 1H	0 ...1	1	-
Condition for transition to low-range-mode in monitoring level					
LV_CS_MON	V	0... 1H	0 ...1	1	-
clutch switch level 2					
LV_CT_MON	O/V	0... 1H	0 ...1	1	-
Logical bit for detecion of driver request passive					
LV_ERR_CRU_INH_MON	O/V	0... 1H	0 ...1	1	-
Logival variable for inhibition of cruise control					
LV_ERR_OPM_AV_MON	O/V	0... 1H	0 ...1	1	-
Error in engine operation mode					
LV_ERR_SOF_INH_MON	O/V	0... 1H	0 ...1	1	-
error flag sport-mode switch request monitoring					
LV_ERR_VCC_PVS_1_MON	O/V	0... 1H	0 ...1	1	-
Fault in power supply for PVS_1 present					
LV_ERR_VCC_PVS_2_MON	O/V	0... 1H	0 ...1	1	-
Fault in power supply for PVS_2 present					
LV_ERR_VCC_PVS_MON	O/V	0... 1H	0 ...1	1	-
Fault in power supply for PVS present					
LV_IGK_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for ignition key on					
LV_INH_TQI_N_CTL_TCT_MON	V	0... 1H	0 ...1	1	-
General Inhibition bit of external torque request from TCT					
LV_INT_TQI_N_CTL_TCT_MON	V	0... 1H	0 ...1	1	-
Inhibition of external torque request from TCT due to integral check					
LV_LAMB_LS_UP_VLD_MON [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Boolean flag indicating that lambda signal from WRAF system is reliable and up-to-date (process monitoring)					
LV_MSR_ACT_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for torque intervention due to MSR for monitoring use					
LV_N_LIM_ETC_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for activation of engine speed limitation monitoring					
LV_NT_SO2P_EXT_ADJ_ENA_MON	V	0... 1H	0 ...1	1	-
Condition for enabling desulfation by external request (monitoring)					
LV_OFF_IV_N_LIM_ETC_MON	O/V	0... 1H	0 ...1	1	-
Reversible fuel Cut Off Switch for all cylinders					
LV_PAS_RAMP_ACT_I_CHG_MON	O/V	0... 1H	0 ...1	1	-
Activation bit for initialisation of I-ramp					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_PAS_RAMP_ACT_P_D_CHG_MON	O/V	0... 1H	0 ...1	1	-
Activation bit for initialisation of PD-ramp					
LV_RNG_L_AT_MON	O/V	0... 1H	0 ...1	1	-
logical variable for engaged low range AT monitoring					
LV_RNG_L_MON	O/V	0... 1H	0 ...1	1	-
logical variable for engaged low range monitroring					
LV_SF_TQD_MON	O/V	0... 1H	0 ...1	1	-
Flag indicating level 2/3 error					
LV_SOF_SWI_MON	V	0... 1H	0 ...1	1	-
Sport-mode switch acting					
LV_SOF_SWI_REQ_MON	O/V	0... 1H	0 ...1	1	-
Sport-mode required by switch					
LV_SWI_AFS_LAMB_MON	O/V	0... 1H	0 ...1	1	-
Flag for switching to AFS mode					
LV_SWI_AFS_POST_INJ_MON	O/V	0... 1H	0 ...1	1	-
Flag for switching to AFS mode					
LV_SWI_FAC_TQ_REQ_MON	O/V	0... 1H	0 ...1	1	-
logical variable for switching to other factors for requested torque at clutch					
LV_SWI_TQ_MIN_CLU_MON	O/V	0... 1H	0 ...1	1	-
Idle speed setpoint from external influences					
LV_T_MAX_TQI_N_CTL_TCT_MON	V	0... 1H	0 ...1	1	-
Inhibition of external torque request from TCT due to maximal time check					
LV_TCHA_DIAG_REQ_MON	V	0... 1H	0 ...1	1	-
Condition for enabling charger diagnosis by external request (monitoring)					
LV_TQ_DROF_ACT_MON	V	0... 1H	0 ...1	1	-
function active					
LV_TQ_MAX_TQI_N_CTL_TCT_MON	V	0... 1H	0 ...1	1	-
Inhibition of external torque request from TCT due to maximal torque check					
LV_TQI_MON_ACT_MON	O/V	0... 1H	0 ...1	1	-
Activation condition for fuel cut off monitoring fulfilled - generic interface					
LV_VAR_TCT_MON	O/V	0... 1H	0 ...1	1	-
TCT-transmission recognized					
MFF_LAMB_REF_IGA_MON	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Lambda relevant Mass Fuel Flow for stoichometric conditions (corrected by scavaging effect)					
N_ALTER_MON	V	0... FFFFH	0... 65535	1	rpm
currency torque losses monitoring					
N_DIF_COR_MON	V	0... FFH	-4096 ...4064	32	rpm
Idle speed control variable					
N_DIF_DROF_MON	V	0... FFH	-4096 ...4064	32	rpm
Engine speed difference effective for TQ_DROF					
N_DIF_MMV_MON	V	0... FFH	-4096 ...4064	32	rpm
N_DIF moving mean value					
N_DIF_MON	O/V	80... 7FH	-4096 ...4064	32	rpm
Engine speed deviation N_SP_IS - N					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
N_DIF_SP_IS_MON	O/V	80... 7FH	-4096 ...4064	32	rpm
Deviation of actual engine speed from idle speed setpoint					
N_SP_IS_BAS_MON	V	0... FFH	0... 8160	32	rpm
Monitored basis idle-speed setpoint					
N_SP_IS_CS_MON	V	0... FFH	0... 8160	32	rpm
Idle-speed setpoint given by DROF					
N_SP_IS_EXT_ADJ_MON	V	0... FFH	0... 8160	32	rpm
Idle speed setpoint from external influences					
N_SP_IS_EXT_REQ_MON	V	0... FFH	0... 8160	32	rpm
Plausible basis idle-speed setpoint while DROF or external tester demand active					
N_SP_IS_MON	O/V	0... FFH	0... 8160	32	rpm
Monitored value of idle speed setpoint					
N_SP_IS_RATIO_MON	O/V	0... FFFFH	0... 7.99987	122.1e-6	-
Ratio between actual engine speed and idle speed setpoint					
N_VS_RATIO_MON	V	0... FFH	0... 255	1	rpm/(km/h)
Monitored engine speed /vehicle speed ratio					
OPM_AV_MON	O/V	0H 1H 2H 3H 8H	- S AFS AFL LIH	-	-
actual engine operation mode (process monitoring)					
PV_AV_AD_MON	O/V	0... FFH	0... 99.60937	0.390625	%
Modified pedal value signal					
STATE_ERR_DET_TQ_MIN_MON	O/V	0H 1H 2H	PU NON_PU PASSIVE	-	-
Error-detection-state for monitoring of minimum torque at clutch					
STATE_PAS_RAMP_ACT_I_IS_MON	O/V	0... FFH	0... 255	1	-
Circular buffer indicating statuts of I-part deactivation ramp					
STATE_PAS_RAMP_ACT_P_D_IS_MON	O/V	0... FFH	0... 255	1	-
Circular buffer indicating statuts of PD-part deactivation ramp					
STATE_REQ_ISC_MON	O/V	0H 1H 2H 3H	NOT_ACTIVE IDLE TRAILING_ THR PART_LOAD	-	-
State of idle speed controller monitoring					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_TQI_N_CTL_TCT_MAX_MON	V	0... FFH	0... 10.2	0.04	s
Duration of external torque request from TCT over the maximum allowed					
T_TQI_N_CTL_TCT_MON	V	0... FFH	0... 10.2	0.04	s
Duration of external torque request from TCT					
T_TQI_OFS_ST_MON	V	0... FFH	0... 10.2	0.04	s
Timer for start offset					
TI_1_MON [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Actual performed cylinder individual injection time, first pulse (monitoring level)					
TI_2_MON [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Actual performed cylinder individual injection time, second pulse or additional pulse (monitoring level)					
TI_POST_MON [NC_CYL_NR]	O/V	0... FFFFH	0... 65.535	0.001	ms
Actual performed cylinder individual injection time, post injection pulse (monitoring level)					
TQ_ADD_MIN_CLU_MON	O	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Additional torque request from external sources					
TQ_AV_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
effective torque					
TQ_CONV_MAX_MDL_MON	V	0... FFH	0... 510	2	Nm
Maximum converter torque losses					
TQ_CONV_MAX_MON	O/V	0... FFH	0... 510	2	Nm
Monitored value of converter torque losses					
TQ_DIF_P_D_IS_MAX_2_MON	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Temporary variable					
TQ_DIF_P_D_IS_MAX_MON	O/V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum value of PD-part					
TQ_DIF_P_D_IS_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Monitored PD-part of the idle speed controller					
TQ_DROF_MDL_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
drive off model value					
TQ_DROF_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
TQ request for drive off assistance					
TQ_LOSS_ACC_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Air conditioning compressor torque losses					
TQ_LOSS_ADD_FIL_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Filtered additional torque losses					
TQ_LOSS_ADD_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Additional torque losses					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_LOSS_ALTER_MDL_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Modelled alternator torque losses					
TQ_LOSS_ALTER_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Alternator torque losses					
TQ_LOSS_ARS_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Anti roll stabilisation torque losses					
TQ_LOSS_FIL_MMV_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Filtered additional torque losses (monitoring)					
TQ_LOSS_PSTE_1_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
steering wheel compressor torque losses					
TQ_LOSS_PSTE_2_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
steering wheel compressor torque losses					
TQ_LOSS_PSTE_3_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
power steering torque losses pste_3					
TQ_LOSS_PSTE_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
steering wheel compressor torque losses					
TQ_LOSS_SA_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
secundary air torque losses					
TQ_REQ_CLU_GRD_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Gradient of driver requested torque at clutch (monitoring)					
TQ_REQ_CLU_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Monitored driver requested torque at clutch*					
TQI_INC_CAN_MON	O/V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Torque demand from external CAN signals					
TQI_INC_EXT_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Monitored external torque demands					
TQI_MIN_PU_MAX_MON	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Monitoring threshold for minimum indicated torque in PU phase					
TQI_MIN_PU_MON	O/V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Plausiblised L2 value of Minimum indicated torque in PU phase					
TQI_N_CTL_TCT_MON	O/V	0... FFH	0... 510	2	Nm
Monitored external torque request from TCT					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_OFS_ST_MON	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Start offset for TQI_MIN_PU					
V_TPS_1_MON	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Adapted TPS signal channel 1					
V_TPS_2_MON	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Adapted TPS signal channel 2					
VS_MON	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
vehicle speed for monitoring PSTE_2					

Input data:

ANG_PSTE_STND {p. 1420}	C_FAC_MFF_MAF_MON {p. 6777}	C_N_DIF_HYS_IS_PU_MON {p. 6799}	C_N_DIF_MAX_IS_MON {p. 6799}
C_THD_MAX_LAMB_MON {p. 6778}	CONF_SOF_SWI {p. 654}	EFF_SCC_MON {p. 6760}	FAC_MFF_TQ_COR_SCAV {p. 8193}
FAC_MFF_WUP_HOMS {p. 8241}	FAC_MFF_WUP_S {p. 8241}	FAC_TQ_REQ_DRIV_MON {p. 6851}	FAC_TQ_REQ_MON {p. 6851}
GEAR {p. 1302}	GEAR_INFO {p. 1564}	GR_DT {p. 8285}	GR_DT_MON {p. 6789}
IDX_TI_1_HOM_CLC [NC_CYL_NR] {p. 2000}	IDX_TI_1_S_CLC [NC_CYL_NR] {p. 2000}	IDX_TI_2_HOM_CLC [NC_CYL_NR] {p. 2000}	IDX_TI_2_S_CLC [NC_CYL_NR] {p. 2000}
IDX_TI_3_HOM_CLC [NC_CYL_NR] {p. 2000}	IDX_TI_3_S_CLC [NC_CYL_NR] {p. 2000}	IGA_REF_EGR_HOM_COR {p. 8266}	IGA_REF_EGR_HOMS_COR {p. 8266}
IGA_REF_LAMB_COR {p. 8266}	IGA_REF_TEMP_COR {p. 8266}	LAMB_MON {p. 6777}	LC_VAR_SPT_SWI {p. 659}
LV_ACT_N_SP_IS_EXT_ADJ {p. 7763}	LV_ARS_ENA {p. 6650}	LV_AT {p. 654}	LV_CITY {p. 799}
LV_CLU_SWI {p. 996}	LV_CS_MON {p. 6790}	LV_CT {p. 1442}	LV_CT_MON {p. 6790}
LV_ERR_ALTER_COM {p. 4834}	LV_ERR_AMT_INH_MON {p. 6983}	LV_ERR_BLS_PLAUS {p. 4209}	LV_ERR_BN_ETCU {p. 4870}
LV_ERR_BN_GEAR_REV {p. 4870}	LV_ERR_BN_VEH_MOD {p. 4871}	LV_ERR_BN_VS_TCS {p. 4871}	LV_ERR_BSD {p. 4834}
LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_CONV_MON {p. 6894}	LV_ERR_CRK {p. 4455}	LV_ERR_CRU_INH_MON {p. 6790}
LV_ERR_CRU_MON {p. 6912}	LV_ERR_DCC_INH_MON {p. 6983}	LV_ERR_GEN {p. 1061}	LV_ERR_GEN_DIAG {p. 4924}
LV_ERR_GS_INH_MON {p. 6983}	LV_ERR_LDM_INH_MON {p. 6983}	LV_ERR_MFF_MON {p. 6943}	LV_ERR_MSR_INH_MON {p. 6983}
LV_ERR_MU_MC {p. 7072}	LV_ERR_N_32_MON {p. 7002}	LV_ERR_PVS {p. 4216}	LV_ERR_PVS_MON {p. 6961}
LV_ERR_PVS_RATIO_MON {p. 6961}	LV_ERR_SOF_REQ {p. 4911}	LV_ERR_TQI_AV_MON {p. 6899}	LV_ERR_TQI_N_MAX_MON {p. 6917}

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LV_ERR_V_REF_1 {p. 4216}	LV_ERR_V_REF_2 {p. 4216}	LV_ERR_VS {p. 5021}	LV_ERR_VS_CAN {p. 1565}
LV_ETCU_SPT_SWI {p. 1565}	LV_IGK {p. 906}	LV_IM_BLS_MON {p. 852}	LV_IM_BTS_MON {p. 852}
LV_ISC_OFF_DROF {p. 1112}	LV_LAMB_LS_UP_VLD [NC_CBK_EX_NR] {p. 2352}	LV_MPL_INJ_ACT [NC_CBK_EX_NR] {p. 3379}	LV_MSR_ACT {p. 6741}
LV_MTC_CUR_OFF {p. 6565}	LV_N_LIM_ETC_LIH {p. 4982}	LV_N_LIM_ETC_LIH_REV {p. 4982}	LV_N_LIM_REQ_MON {p. 6877}
LV_N_LIM_REQ_RST_ CHK {p. 4230}	LV_N_SP_IS_LIH_ACT {p. 4216}	LV_NT_SO2P_EXT_ADJ_ ACT {p. 3144}	LV_POIL_EXT_ADJ_ACT {p. 7763}
LV_POST_INJ_ACT {p. 2179}	LV_PSTE_2_ENA {p. 6621}	LV_PSTE_3_ENA {p. 6621}	LV_PSTE_ENA {p. 6621}
LV_PUC {p. 1720}	LV_REQ_ISC {p. 3501}	LV_RNG_L_REQ {p. 6570}	LV_SAP {p. 804}
LV_TCHA_DIAG_REQ {p. 8233}	LV_TQ_DROF_ACT_MON {p. 6791}	LV_TQI_MON_ACT_MON {p. 6791}	LV_VAR_AMT {p. 655}
LV_VAR_BN {p. 655}	LV_VAR_ETCU_SPT {p. 656}	LV_VAR_PSTE_2 {p. 656}	LV_VAR_PSTE_3 {p. 656}
LV_VAR_TCT {p. 656}	MAF_SCAV_EXT {p. 8278}	MFF_ADD_CYL_CP {p. 3692}	MFF_ADD_TQ_CP {p. 8229}
MFF_LAMB_REF_MON {p. 6760}	MFF_TQ_MON {p. 6760}	N_32_MON {p. 7002}	N_SP_IS {p. 1122}
N_SP_IS_BRAKE {p. 8212}	N_SP_IS_CS {p. 1122}	N_SP_IS_EXT_ADJ {p. 7763}	N_SP_IS_POIL_CTL {p. 8212}
OPM_AV {p. 8137}	POW_REL_ALTER_CLC {p. 8368}	PV_AV_GRD {p. 1269}	PV_AV_MON {p. 6961}
STATE_EOL_KWP_N_SP_ IS {p. 7764}	STATE_ETCU_PROG_ INFO {p. 1574}	STATE_GEAR_REV_AT_ AMT {p. 1302}	STATE_GEAR_REV_CAN {p. 1574}
STATE_PAS_RAMP_ACT_ I_IS {p. 3441}	STATE_PAS_RAMP_ACT_ P_D_IS {p. 3441}	STATE_SPT_DISP_CAN {p. 8289}	STATE_VEH_MOD {p. 1578}
T_CTR_PU_ISC_ACT {p. 3501}	TCO_MON {p. 6903}	TI_1_MES [NC_CYL_NR] {p. 2040}	TI_2_MES [NC_CYL_NR] {p. 2040}
TI_POST_INJ [NC_CYL_NR] {p. 2179}	TI_POST_MES [NC_CYL_NR] {p. 2041}	TQ_AMT_MON {p. 6984}	TQ_CONV {p. 6710}
TQ_DCC_MON {p. 6984}	TQ_DIF_P_D_FAST_IS {p. 3441}	TQ_DIF_P_D_SLOW_IS {p. 3442}	TQ_DROF_FAST {p. 1112}
TQ_DROF_SLOW {p. 1112}	TQ_GS_MON {p. 6984}	TQ_LOSS_ACC {p. 6602}	TQ_LOSS_ADD_FIL {p. 8193}
TQ_LOSS_ALTER {p. 8369}	TQ_LOSS_ARS {p. 6650}	TQ_LOSS_MON {p. 6975}	TQ_LOSS_PSTE_1 {p. 6622}
TQ_LOSS_PSTE_2 {p. 6622}	TQ_LOSS_PSTE_3 {p. 6622}	TQ_MSR_MON {p. 6984}	TQ_REQ_CLU {p. 8390}

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TQ_REQ_CLU_GB {p. 8193}	TQ_WHEEL_LDM_MON {p. 6984}	TQI_AMT_MON {p. 6984}	TQI_AV_MON {p. 6774}
TQI_GS_MON {p. 6984}	TQI_INC_CAN_MON {p. 6794}	TQI_MSR_MON {p. 6984}	TQI_N_CTL_TCT_FAST {p. 8193}
TQI_N_CTL_TCT_SLOW {p. 8193}	V_SOF_SWI_MON {p. 831}	VS {p. 1176}	VS_CAN {p. 1582}
VS_FIL {p. 1176}	VS_MON {p. 6795}	VS_SENS {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_SOF_INH_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_MAX_SOF_INH_MON	-	1... FFH	1... 255	1	-
Anti bounce counter max value					
C_CRLC_ALTER_MON	-	0... FFH	0... 0.99609	3.9063e-3	-
Alternator torque losses low pass					
C_CRLC_TQI_N_CTL_TCT_PLAUS_MON	-	0... FFH	0 ...1	3.9216e-3	-
Correlation factor for calculation of integrated torque request from TCT					
C_CTR_N_SP_IS_REQ_DEC_MAX_MON	-	0... FFH	0... 255	1	-
Maximum for counter of iteration to allow N_SP_IS_EXT_REQ_MON decrementation					
C_DEC_INT_TQI_N_CTL_TCT_MON	-	0... FFFFH	0... 204.79687	0.003125	Nm*s
Decrement of integrated torque request from TCT					
C_DEC_OPM_AV_PLAUS_MON	-	0... FFH	0... 255	1	-
Debounce decrement for plausibilisation of OPM_AV error					
C_DEC_T_TQI_N_CTL_TCT_MAX_MON	-	0... FFH	0... 10.2	0.04	s
Decrement of time for torque request from TCT over the maximum allowed					
C_DEC_T_TQI_N_CTL_TCT_MON	-	0... FFH	0... 10.2	0.04	s
Decrement of time for torque request from TCT					
C_DLY_LAMB_LS_UP_NOT_VLD_MON	-	0... FFH	0... 255	1	-
Delay (in samples) for switching LV_LS_UP_VLD_MON from1 to 0					
C_FAC_EFF_ALTER_MON	-	0... FFH	0... 7.96875	0.03125	-
Alternator torque losses low pass					
C_FAC_GR_DIF_MON	-	0... FFH	0... 1.99218	0.0078125	-
Max. permitted difference in gear ratio					
C_FAC_GR_MAX_MON	-	0... FFH	0... 31.875	0.125	-
Max. value for gear ratio (shortest gear step)					
C_FAC_GR_MIN_MON	-	0... FFH	0... 31.875	0.125	-
Min. value for gear ratio (longest gear step)					
C_FAC_GR_MON	-	0... FFH	0... 2.55	0.01	-
1 /Wheel circumference					
C_FAC_MFF_ADD_CP_MIN_MON	-	0... FFH	0... 1.99218	0.0078125	-
weighting factor to limit torque relevant MFF_CP in stratified					
C_FAC_MFF_TQ_COR_SCAV_MIN_MON	-	0... FFH	0... 199.21875	0.78125	%
Minimal efficiency correction factor for scavenging					
C_FAC_N_ALTER_MON	-	0... FFH	0... 7.96875	0.03125	-
-					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_RAMP_P_D_MON	-	0... FA0H	0... 0.5	0.000125	-
Factor for monitoring negative DROF deactivation-ramp operation					
C_FAC_RAX_MON	-	0... FFH	0... 7.96875	0.03125	-
Gear ratio rear axle					
C_FAC_TQ_REQ_DRIV_SOF_MAX_MON	-	0... FFH	0... 1.99218	0.0078125	-
scaling factor treshold for activation IP_FAC_TQ_REQ_DRIV_RNG_L_MON					
C_FIL_TQ_P_D_IS_MAX_MON	-	0... FFFFH	0... 0.99998	15.3e-6	-
Filter correlation constant for PD-part torque threshold					
C_H_RNG_THD_OPM_AV_PLAUS_MON	-	0... 7FFFH	0... 31.99902	976.599e-6	-
High threshold to detect unplausible OPM_AV					
C_IGA_REF_EGR_HOM_COR_LIM_MON	-	0... B40H	-90 ...90	0.0625	°CRK
Correction of reference ignition angle limitation EGR in HOM					
C_IGA_REF_EGR_HOMS_COR_LIM_MON	-	0... B40H	-90 ...90	0.0625	°CRK
Correction of reference ignition angle limitation EGR in HOMS					
C_IGA_REF_LAMB_COR_LIM_MON	-	0... B40H	-90 ...90	0.0625	°CRK
Correction of reference ignition angle limitation LAMB_SP					
C_IGA_REF_TEMP_COR_LIM_MON	-	0... B40H	-90 ...90	0.0625	°CRK
Correction of reference ignition angle limitation TEMP					
C_INC_OPM_AV_PLAUS_MON	-	0... FFH	0... 255	1	-
Debounce increment for plausibilisation of OPM_AV error					
C_INT_MAX_TQI_N_CTL_TCT_MON	-	0... FFFFH	0... 204.79687	0.003125	Nm*s
Maximum value of integrated torque request from TCT					
C_INT_MIN_TQI_N_CTL_TCT_MON	-	0... FFFFH	0... 204.79687	0.003125	Nm*s
Minimum value of integrated torque request from TCT					
C_L_RNG_THD_OPM_AV_PLAUS_MON	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Low threshold to detect unplausible OPM_AV					
C_MIN_TQI_N_CTL_TCT_MON	-	0... FFH	0... 510	2	Nm
Threshold for monitoring of external torque request from TCT					
C_MIN_VS_RATIO_MON	-	0... FFH	0... 255	1	km/h
Minimum engine speed for the calculation of the monitored engine speed /vehicle speed ratio					
C_N_32_TQ_DROF_MAX_MON	-	0... FFH	0... 8160	32	rpm
min threshold N_DIF_DROF_MON					
C_N_DIF_ADD_DROF_MON	-	0... FFH	-4096 ...4064	32	rpm
offset threshold N_DIF_DROF_MON					
C_N_DIF_CRLC_HIGH_MON	-	0... FFH	0... 0.99609	3.9063e-3	-
Correlation factor for N_DIF_MMV calculation					
C_N_DIF_CRLC_LOW_MON	-	0... FFH	0... 0.99609	3.9063e-3	-
Correlation factor for N_DIF_MMV calculation					
C_N_DIF_DROF_MAX_MON	-	0... FFH	-4096 ...4064	32	rpm
max threshold N_DIF_DROF_MON					
C_N_DIF_DROF_MIN_MON	-	0... FFH	-4096 ...4064	32	rpm
min threshold N_DIF_DROF_MON					
C_N_DIF_FAC_MON	-	0... FFH	0... 0.99609	3.9063e-3	-
Multiplicative factor for N_DIF_COR calculation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_DIF_HYS_IS_PU_MON	-	80... 7FH	-4096 ...4064	32	rpm
N_DIF_MON hysteresis before state PU					
C_N_DIF_MAX_IS_MON	-	80... 7FH	-4096 ...4064	32	rpm
Maximum idle speed setpoint deviation for active PD-part					
C_N_DIF_MAX_PL_ACT_MON	-	80... 7FH	-4096 ...4064	32	rpm
Maximum idle-speed deviation allowed for active ISC in PL					
C_N_IS_SO2P_MIN_MON	-	0... FFH	0... 8160	32	rpm
Threshold for detecting running engine (Monitoring)					
C_N_MAX_KWP_MON	-	0... FFH	0... 8160	32	rpm
Maximum engine speed for accepting the EOL- N_SP_IS_MON displace service					
C_N_NT_SO2P_EXT_ADJ_ACT_MON	-	0... FFH	0... 8160	32	rpm
Idle speed setpoint for SO2P in service (monitoring)					
C_N_POIL_EXT_ADJ_MAX_MON	-	0... FFH	0... 8160	32	rpm
Maximum idle speed setpoint for oil pressure diagnosis in service (monitoring)					
C_N_SP_IS_BAS_DIF_MAX_MON	-	0... 7FH	0... 4064	32	rpm
Idle speed gradient limitation					
C_N_SP_IS_CS_MAX_MON	-	0... FFH	0... 8160	32	rpm
Max. selection of Idle speed setpoint for drive-off-support					
C_N_SP_IS_LIH_MAX_MON	-	0... FFH	0... 8160	32	rpm
Maximum idle-speed setpoint when error with acclerator pedal module detected					
C_N_SP_IS_MAX_EXT_ADJ_MON	-	0... FFH	0... 8160	32	rpm
Maximum idle-speed setpoint when external Tester demand is active					
C_N_SP_IS_MAX_PL_ACT_MON	-	0... FFH	0... 8160	32	rpm
Maximum allowed idle-speed for active ISC in PL					
C_N_SP_LGRD_IS_EXT_REQ_DEC_MON	-	0... FFH	0... 8160	32	rpm
Decrement for idle speed SP for external request (Monitoring)					
C_N_SP_LGRD_IS_EXT_REQ_INC_MON	-	0... FFH	0... 8160	32	rpm
Increment for idle speed SP for external request (Monitoring)					
C_N_ST_MIN_MON	-	0... FFH	0... 8160	32	rpm
Enginespeed to activate startoffset for TQI_MIN_PU					
C_N_TCHA_DIAG_REQ_MAX_MON	-	0... FFH	0... 8160	32	rpm
Maximum idle speed setpoint for charger diagnosis in service (monitoring)					
C_N_THD_FCUT_N_LIM_ETC_MON	-	0... FFH	0... 8160	32	rpm
Engine speed threshold for forced injection cut off in SAS mode					
C_OPM_AV_PLAUS_MAX_MON	-	1... FFH	1... 255	1	-
Threshold for detection of OPM_AV error					
C_PV_AV_GRD_SOF_MAX_MON	-	0... FFH	-1250... 1240.23437	9.765625	%/s
Pedal value gradient threshold for recognition of LV_RNG_L_MON					
C_PV_AV_SOF_MIN_MON	-	0... FFH	0... 99.60937	0.390625	%
PV_AV threshold for activation IP_FAC_TQ_REQ_DRIV_RNG_L_MON					
C_PV_POIL_EXT_ADJ_MAX_MON	-	0... FFH	0... 99.60937	0.390625	%
Accelerator pedal threshold for disabling external request for oil pressure diagnosis (Monitoring)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_PV_SO2P_EXT_MAX_MON	-	0... FFH	0... 99.60937	0.390625	%
Accelerator pedal threshold for disabling external request for desulfation (Monitoring)					
C_PV_TCHA_DIAG_EXT_MAX_MON	-	0... FFH	0... 99.60937	0.390625	%
Accelerator pedal threshold for disabling external request for charger diagnosis (Monitoring)					
C_STATE_ETCU_PROG_INFO_MON	-	0... FFH	0... 255	1	-
Manual activation of low range mode AT					
C_SWI_OPM_AV_MON	-	0... 3H	0 ...3	1	-
manual demand OPM_AV_MON					
C_T_MAX_TQI_N_CTL_TCT_MAX_MON	-	0... FFH	0... 10.2	0.04	s
Maximum time for torque request from TCT over the maximum allowed					
C_T_MAX_TQI_N_CTL_TCT_MON	-	0... FFH	0... 10.2	0.04	s
Maximum time for torque request from TCT					
C_T_PV_AV_GRD_SOF_MAX_MON	-	0... FFH	0... 10.2	0.04	s
Minimum time for pedal value gradient for recognition of LV_RNG_L_MON					
C_T_TQI_OFS_ST_MON	-	0... FFH	0... 10.2	0.04	s
Timer for TQI_MIN_PU startoffset					
C_THD_MIN_FAC_TQ_REQ_MON	-	0... FFH	0... 1.99218	0.0078125	-
Minimum threshold for driver request in order to detect PL					
C_TQ_DIF_IS_AD_CONV_MAX_MON	-	0... FFH	0... 510	2	Nm
Max. limitation for converter torque adaptation					
C_TQ_LOSS_ADD_ACC_MIN_MON	-	8000... 0H	-1024 ...0	0.03125	Nm
Minimum additional torque loss for ACC active					
C_TQ_LOSS_ADD_FIL_DIF_MAX_MON	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
Maximum allowed difference between L2 and L1 filtered additional torque losses					
C_TQ_LOSS_ALTER_MIN_MON	-	8000... 0H	-1024 ...0	0.03125	Nm
Minimum additional torque loss for alternator					
C_TQ_LOSS_ARS_MIN_MON	-	8000... 0H	-1024 ...0	0.03125	Nm
Minimum additional torque loss for ARS active					
C_TQ_LOSS_FIL_MMV_INI_MIN_MON	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Minimum filtered additional torque losses used for initalisation of filtering function					
C_TQ_LOSS_PSTE_1_MIN_MON	-	8000... 0H	-1024 ...0	0.03125	Nm
Minimum additional torque loss for PSTE_1 active					
C_TQ_LOSS_PSTE_LIH_MON	-	8000... 0H	-1024 ...0	0.03125	Nm
Default value torque losses if no PSTE enabled					
C_TQ_LOSS_SA_MIN_MON	-	8000... 0H	-1024 ...0	0.03125	Nm
Minimum additional torque loss for SA active					
C_TQ_REQ_CLU_GB_MAX_MON	-	0... FFH	0... 510	2	Nm
Max. limitation for torque request from gearbox					
C_TQI_OFS_ST_MON	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
TQI_MIN_PU startoffset					
C_V_SOF_SWI_MAX_MON	-	0... 3FFH	0... 4.99511	4.88e-3	V
input voltage threshold max					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_SOF_SWI_MIN_MON	-	0... 3FFH	0... 4.99511	4.88e-3	V
input voltage threshold min					
C_V_SOF_SWI_ON_BOL_MON	-	0... 3FFH	0... 4.99511	4.88e-3	V
Voltage-Threshold bottom limit for sport mode ON					
C_V_SOF_SWI_ON_TOL_MON	-	0... 3FFH	0... 4.99511	4.88e-3	V
Voltage-Threshold top limit for sport mode ON					
C_V_TPS_1_LIH_MON	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold for detection of throttle position 1 outside limp home position					
C_V_TPS_2_LIH_MON	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Threshold for detection of throttle position 2 outside limp home position					
C_V_TQ_ALTER_MON	-	0... FFH	0... 25.89843	0.1015625	V
Voltage range of monitoring					
C_VS_DIF_MAX_MON	-	0... FFFFH	0... 511.99218	0.0078125	km/h
minimum additional torque loss for SA active					
C_VS_LIH_MON	-	0... FFFFH	0... 511.99218	0.0078125	km/h
minimum additional torque loss for SA active					
C_VS_MAX_KWP_MON	-	0... FFH	0... 255	1	km/h
Maximum vehicle speed for accepting the EOL- N_SP_IS_MON displace service					
C_VS_POIL_EXT_ADJ_MAX_MON	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed threshold for disabling external request for oil pressure diagnosis (Monitoring)					
C_VS_SO2P_EXT_MAX_MON	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for disabling external request for desulfation (Monitoring)					
C_VS_TCHA_DIAG_EXT_MAX_MON	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed threshold for disabling external request for charger diagnosis (Monitoring)					
ID_GR_MT_MON	-	0... FFH	0... 255	1	-
LDP_N_VS_RATIO_MON_GR_MT_MON	13	0... FFH	0... 255	1	rpm/(km/h)
Index table for Gear Ratio detection in the monitoring level					
ID_TQ_DROF_ENA_MON	-	0... 1H	0 ...1	1	-
LDP_N_DIF_DROF_MON__ID_TQ_DROF	3	0... FFH	-4096 ...4064	32	rpm
table for activation/deactivation of DROF					
IP_CUR_ALTER_MON	V	0... FFH	0... 255	1	A
LDP_DFFGEN_FIL_MON__LOSS_MON	6	0... FFH	0... 99.60937	0.390625	%
LDPM_N_ALTER_MON__TQ_LOSS_MON	6	0... FFFFH	0... 65535	1	rpm
Alternator torque losses					
IP_EFF_ALTER_MON	V	0... FFH	0... 0.99609	3.9063e-3	-
LDPM_N_ALTER_MON__TQ_LOSS_MON	6	0... FFFFH	0... 65535	1	rpm
LDP_CUR_ALTER_MON__TQ_LOSS_MON	6	0... FFH	0... 255	1	A
Alternator torque losses					
IP_FAC_CONV_MON	-	0... FFFFH	0... 0.00048	7.4464e-9	Nm/rpm**2
LDP_TCO_MON_IP_FAC_CONV_MON	6	0... FEH	-48... 142.5	0.75	°C
Converter torque characteristics					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_N_GRD_TQ_AV_MON	-	0... FFH	0... 1.99218	0.0078125	-
LDP_TQ_AV_MON__TQ_DROF	4	0... FFFFH	-1024... 1023.96875	0.03125	Nm
N_DIF correction					
IP_FAC_PV_BAS_COR_MON	V	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_N_32_MON__FAC_PV_COR_MON	6	0... FFH	0... 8160	32	rpm
LDPM_PV_AV_MON__FAC_PV_COR_MON	6	0... FFH	0... 99.60937	0.390625	%
Basic correction for PV_AV_MON					
IP_FAC_TQ_DIF_P_D_IS_MON	-	0... FFH	0... 1.99218	0.0078125	-
LDP_TCO_MON_IP_FAC_TQ_P_D_MON	5	0... FEH	-48... 142.5	0.75	°C
Maximum scaling factor due to separation of PD-part					
IP_FAC_TQ_DROF_FAC_TQ_REQ_MON	-	0... FFH	0... 1.99218	0.0078125	-
LDP_FAC_TQ_REQ_MON__TQ_DROF	6	0... FFH	0... 1.99218	0.0078125	-
correction FAC_TQ_REQ_MON					
IP_FAC_TQ_DROF_VS_MON	V	0... FFH	0... 1.99218	0.0078125	-
LDP_VS_MON__TQ_DROF	6	0... FFFFH	0... 511.99218	0.0078125	km/h
LDP_N_32_MON__TQ_DROF	6	0... FFH	0... 8160	32	rpm
correction depending on VS and N_32					
IP_FAC_TQ_LOSS_ADD_FIL_MON	V	0... FFH	0... 0.99609	3.9062e-3	-
LDP_TQ_REQ_CLU__ADD_FIL_MON	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_TQ_REQ_CLU_GRD__ADD_FIL_MON	8	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Filter constant determination					
IP_FAC_VS_PV_BAS_COR_MON	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_VS_MON__FAC_PV_COR_MON	8	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed correction for PV_AV_MON					
IP_N_SP_IS_BAS_MAX_MON	-	0... FFH	0... 8160	32	rpm
LDP_TCO_MON_IP_N_SP_IS_MON	5	0... FEH	-48... 142.5	0.75	°C
Maximum basis idle speed setpoint depending on coolant temperature					
IP_TQ_DIF_P_D_IS_MAX_MON	-	0... FFH	0... 510	2	Nm
LDP_N_DIF_SP_IS_MON_IP_TQ_MON	6	0... FFH	-4096 ...4064	32	rpm
Maximum PD-part depending on speed deviation to idle speed setpoint					
IP_TQ_DROF_GRD_DEAC_MON	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDP_TQ_DROF_MDL_MON_1	3	0... FFFFH	-1024... 1023.96875	0.03125	Nm
Decrement for the termination ramp of TQ_DROF_MDL_MON					
IP_TQ_DROF_MON	-	0... FFFFH	-1024... 1023.96875	0.03125	Nm
LDP_N_DIF_DROF_MON__TQ_DROF	6	0... FFH	-4096 ...4064	32	rpm
drive off torque request					
IP_TQ_LOSS_PSTE_2_MIN_MON	V	0... 8000H	-1024 ...0	0.03125	Nm
LDP_VS_MON__TQ_LOSS_MON	6	0... FFFFH	0... 511.99218	0.0078125	km/h

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDP_ANG_PSTE_STND__TQ_LOSS_MON	6	0... FFFFH	-100... 99.99694	3.0518e-3	%
minimum additional torque loss for PSTE_2 active					
IP_TQ_LOSS_PSTE_3_MIN_MON	V	0... 8000H	-1024 ...0	0.03125	Nm
LDP_VS_MON__TQ_LOSS_PSTE3_MON	6	0... FFFFH	0... 511.99218	0.0078125	km/h
LDP_ANG_PSTE_STND__TQ_PSTE3_MON	6	0... FFFFH	-100... 99.99694	3.0518e-3	%
minimum additional torque loss for PSTE_3 active					
IP_TQ_MAX_TQI_N_CTL_TCT_MON	-	0... FFH	0... 510	2	Nm
LDP_N_32__TQI_N_CTL_TCT_MON	6	0... FFH	0... 8160	32	rpm
Threshold for activation of maximal torque check for torque request from TCT					
IP_TQI_MIN_PU_MAX_MON	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDP_N_32_MON_IP_TQI_PU_MAX_MON	6	0... FFH	0... 8160	32	rpm
LDP_TCO_MON_IP_TQI_PU_MAX_MON	3	0... FEH	-48... 142.5	0.75	°C
Monitoring threshold for minimum indicated torque in PU phase					
LC_CONF_CITY_ENA_MON	-	0... 1H	0 ...1	1	-
Enable City mode off condition (1 on /0 off, 2 AMT on)					
LC_CUR_SHP_INJ_ENA_MON	-	0... 1H	0 ...1	1	-
Switch to enable injection current shaping via IDX_TI calculation.					
LC_INH_PU_REQ_MON	-	0... 1H	0 ...1	1	-
Logical bit to inhibit LV_PU in calculation of TQ_MIN_CLU_MDL_MON					
LC_N_SP_IS_CLC_INH_MON	-	0... 1H	0 ...1	1	-
Logical bit for switching between two engine-speed-deviation calculation paths(N_DIF_COR_x_MON)					
LC_OPM_AV_PLAUS_ENA_MON	-	0... 1H	0 ...1	1	-
Enable plausibilisation of OPM_AV					
LC_RNG_L_MAN_AS_MON	-	0... 1H	0 ...1	1	-
Calibration constant for to activate IP_FAC_TQ_REQ_DRIV_RNG_L (low range mode) in case if LV_RNG_L = 0 (default value = 0)					
LC_RNG_L_MON	-	0... 1H	0 ...1	1	-
Manual switch for low range detection monitoring					
LC_SWI_OPM_AV_MON	-	0... 1H	0 ...1	1	-
switch between OPM_AV (level 1) and predetermined state					
LC_TQ_DROF_ISC_OFF_MON	-	0... 1H	0 ...1	1	-
Boolean to enable/disable idle speed controller activation during drive off; 1=disabled (monitoring)					
LC_TQ_LOSS_ADD_FIL_MON	-	0... 1H	0 ...1	1	-
Switch for TQ_LOSS_ADD_FIL_MON calculation					
LC_VAR_SOF_SWI_MON	-	0... 1H	0 ...1	1	-
Calibration sport Switch (1 on /0 off, 2 AMT on)					

Import actions:

ACTION_ECM3_Service0TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service1TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service2TaskPfm (**IN**<No Name available>)

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The input arguments have the values 1, 2, 3 and 4.
For further information concerning the order of action calls compared to the specified functions, please have a look on the following page.

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ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service0TaskPfm() and ACTION_ECM3_Service1TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

ACTION_INFR_GetVTPSMON(OUT <V_tps_1_mon>, OUT<V_tps_2_mon>)

Note: This action is defined in chapter "ECM2 - Requirements to infrastructure interface".

Order of action calls:

Application Incidences and Configuration or Process Monitoring
Initialization conditions
ACTION_ECM3_Service0TaskPfm(1)
ACTION_ECM3_McChkStack()
ACTION_ECM3_Service1TaskPfm(1)
Application incidences for the activation conditions of process monitoring
Application incidences for monitoring of torque demand from idle speed controller
        1.16.1 Acquisition of sport-mode-switch for monitoring
    1.20 Application incidences for actual fuel mass flow
ACTION_ECM3_Service2TaskPfm(1)

ACTION_ECM3_Service0TaskPfm(2)
ACTION_ECM3_McChkStack()
ACTION_ECM3_Service1TaskPfm(2)
Application incidences for monitoring of pedal value signals
        1.5 Adaptation of OPM_AV to OPM_AV_MON
Application incidences for the monitoring of torque losses
Appl. Inc. for actual lambda deviation
        1.16.1 Acquisition of sport-mode-switch for monitoring

ACTION_ECM3_Service2TaskPfm(2)

ACTION_ECM3_Service0TaskPfm(3)
ACTION_ECM3_McChkStack()
ACTION_ECM3_Service1TaskPfm(3)
Forced injection shut off for Level 2 - engine speed limitation
State of torque intervention when level 2/3 error is detected
Application incidences for cruise control input
Application incidences for IPM monitoring
Application incidences for monitoring of CAN signals

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Application incidences for monitoring of minimum torque at clutch
Application incidences for the actual efficiencies
Application incidences for the actual indicated engine torque
1.16.1 Acquisition of sport-mode-switch for monitoring
ACTION_ECM3_Service2TaskPfm(3)

ACTION_ECM3_Service0TaskPfm(4)
ACTION_ECM3_McChkStack()
ACTION_ECM3_Service1TaskPfm(4)
Sport switch monitoring
Driving off assistance
Application incidences for desired indicated engine torque
Application incidences for the combustion mode switch request
ACTION_ECM3_Service2TaskPfm(4)

E.6.1 Initialization conditions

FUNCTION DESCRIPTION:

General information:

The application condition for the initialization of e.g. the error bits, the anti-bounce-counters and other variables of the process monitoring is commonly defined here for all modules of the process monitoring. There is only a reference to the following definition of the application conditions in the different modules.

The error bits, anti-bounce-counters and other variables are initialized

1. at reset
2. at transition from LV_IGK = 0 to 1
3. at clearing of the failure memory
4. with physical "0" if not defined differently!

There is one exception from the rule above. If the reset counter at the monitoring unit increased up to 7 resets, the fault reaction of the monitoring unit will be continued until the power supply of the monitoring unit is switched off.

E.6.2 Application incidences for the activation conditions of process monitoring

FUNCTION DESCRIPTION:

General information:

The logical variable LV_N_LIM_ETC_MON indicates, that any etc-safety-function of level 1, 2 or 3 has requested engine speed limitation or ignition key is switched off. The monitoring of the engine speed limitation is also active, when

1. any fault of the ETC-system (pedal value sensor, throttle position sensor, throttle actuator, power stage, idle speed actuator) is present and the driver demand is zero
2. throttle is disabled and at least one throttle position signal is outside the specified limp home position

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3. after a warm reset in case any etc-safety-function of level 1, 2 or 3 had requested engine speed limitation before the warm reset

The torque monitoring can only be active, when the ignition key is on and the throttle is not disabled and no mechanical/electrical error of the idle speed actuator is detected. Otherwise the control of the torque is not possible and torque monitoring is forbidden. This is not a risk, because engine is switched off or in limp home mode then, and the monitoring of the engine speed limitation is active in most cases (at least when the driver releases the pedal).

The logical variable LV_IGK is copied to level 2 in the variable LV_IGK_MON, because it is used as a deactivation condition for the monitoring of PVS in level 2. In order to ensure the safety, the variable LV_IGK_MON is also used for the calculation of the global activation conditions LV_N_LIM_ETC_MON and LV_TQI_MON_ACT_MON.

Application conditions

Activation: `at every engine state`

Update Rate: `40ms`

Formula section:

LV_IGK_MON = LV_IGK

If LV_IGK_MON = 0 **Or**
LV_N_LIM_REQ_MON = 1 **Or** (request from level 2, 3)
LV_N_LIM_ETC_LIH = 1 **Or** (requests from level 1)
LV_N_LIM_ETC_LIH_REV = 1 **Or** (rev. SAS active, level 1)
LV_N_LIM_REQ_RST_CHK = 1 **Or** (reset resisting LIH)

(LV_MTC_CUR_OFF = 1 **And**
PV_AV_MON = 0) **Or**

(LV_MTC_CUR_OFF = 1 **And**
(V_TPS_1_MON > C_V_TPS_1_LIH_MON **Or**
V_TPS_2_MON < C_V_TPS_2_LIH_MON))

Then
LV_N_LIM_ETC_MON = 1
Else
LV_N_LIM_ETC_MON = 0
Endif

If LV_IGK_MON = 1 **And** (ignition key on)
LV_MTC_CUR_OFF = 0 **And** (MTC NOT switched off)
LV_N_LIM_ETC_LIH_REV = 0
Then
LV_TQI_MON_ACT_MON = 1
Else
LV_TQI_MON_ACT_MON = 0
Endif

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E.6.3 Application incidences for monitoring of torque demand from idle speed controller

E.6.3.1 Application incidences for monitoring driver request passive

FUNCTION DESCRIPTION:

The aim of this chapter is the monitoring of the variable LV_CT which indicates whether a driver request is present or not where the request can be not only from the driver but also from other sources like cruise control or vehicle speed limitation functionality.
As long as the impact between LV_CT = 0 and LV_CT = 1 can be tolerated in terms of torque thresholds, the value can be copied to L2 without plausibility check.

Application conditions

Activation: LV_TQI_MON_ACT_MON = 1

Deactivation: otherwise

Initialisation: for condition see Application Incidences of Process Monitoring
LV_CT_MON = 1

Update Rate: 40 ms

Formula section:

LV_CT_MON = LV_CT

E.6.3.2 Application incidences for monitoring of idle speed setpoint

General information:

The objective of this function is the monitoring of the idle speed setpoint (N_SP_IS) and the corrected idle speed setpoint. Both of these values have to be monitored because they are important inputs for the torque monitoring functionalities. This function consists of two sections.
The first section involves the monitoring of the basis idle-speed setpoint and external offsets (driving-off assistance, CVT etc.) that might be added depending on certain activation conditions. In the second part of this functionality, the Level 2 model value for the idle-speed setpoint and other torque monitoring relevant variables (engine speed deviation, engine speed ratio etc.) are calculated.

Application conditions

Activation: LV_TQI_MON_ACT_MON = 1

Deactivation: otherwise

Initialisation:

```
(for condition see  Application Incidences of Process Monitoring
  ORLV_TQI_MON_ACT_MON = 0   1)
  N_DIF_SP_IS_MON   = 0 rpm
  N_SP_IS_RATIO_MON = 0 rpm
  N_SP_IS_MON         = 0 rpm
  N_DIF_MON        = 0 rpm
  N_DIF_MMV_MON = 0 rpm
  N_SP_IS_BAS_MON= min(N_SP_IS, IP_N_SP_IS_BAS_MAX_MON)
  FAC_RAMP_NEG_P_D_IS_MON = 0
  LV_AT_MON =  LV_AT
  LV_VAR_TCT_MON = LV_VAR_TCT
```

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```
  N_SP_IS_EXT_ADJ_MON = min(N_SP_IS, C_N_SP_IS_MAX_EXT_ADJ_
MON)
  LV_ACT_N_SP_IS_EXT_ADJ_MON = 0
  GR_MT_MON = 0 at  [ LV_ES = 1  or   LV_ST = 1  or  LV_CS
= 1 ]
  N_VS_RATIO_MON = 0
  N_SP_IS_CS_MON = min(N_SP_IS, C_N_SP_IS_CS_MAX_MON)
  N_SP_IS_EXT_REQ_MON K  = min(N_SP_IS, IP_N_SP_IS_BAS_MAX_
MON)
  N_SP_IS_EXT_REQ_MON K-1= min(N_SP_IS, IP_N_SP_IS_BAS_MAX_
MON)
  N_DIF_COR_MON = 0
  LV_NT_SO2P_EXT_ADJ_ENA_MON= 0
  CTR_N_SP_IS_EXT_REQ_DEC_ MON K  = 0
  CTR_N_SP_IS_EXT_REQ_DEC_ MON K-1  = 0
  LV_TCHA_DIAG_REQ_MON = 0
  LV_ACT_N_SP_IS_POIL_EXT_MON = 0
```

Update rate: 40 ms

E.6.3.2.1 Plausibilisation of basis idle-speed setpoint and external-influences

General information:

The basis idle speed setpoint is limited by a coolant temperature dependent maximum value, IP_N_SP_IS_BAS_MAX_MON. Under certain circumstances (for e.g. driving off situation i.e. the driver is slightly on the gas pedal and releases the clutch abruptly - -> can lead to engine stalling), to assist the driver in this situation, N_SP_IS_MON is raised to achieve a torque increasing demand from ISC. In case of an error, such external influences can lead to relatively large unwanted acceleration which makes the monitoring of the relevant activation conditions imperative.

Formula section:

{N_SP_IS_LIM_MON represents the basis idle-speed setpoint plus any offsets (for e.g. catalyst heating or low battery voltage) that might be added in L1 based on certain activation conditions.}

N_SP_IS_LIM_MON = N_SP_IS

{Model value of maximum basis setpoint}
N_SP_IS_BAS_MAX_MON = IP_N_SP_IS_BAS_MAX_MON(TCO_MON)

{Idle speed setpoint plausibilisation through gradient limitation}
IF|N_SP_IS_LIM_MON$_k$ - N_SP_IS_BAS_MON$_{k-1}$**|** $>$ C_N_SP_IS_BAS_DIF_MAX_MON
THEN N_SP_IS_BAS_MON$_k$ = **min(**N_SP_IS_BAS_MON$_{k-1}$, N_SP_IS_BAS_MAX_MON**)**
ELSE N_SP_IS_BAS_MON$_k$ = **min(**N_SP_IS_LIM_MON$_k$, N_SP_IS_BAS_MAX_MON**)**
ENDIF

FAC_RAMP_NEG_P_D_IS_MON = C_FAC_RAMP_P_D_MON

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E.6.3.2.2 Calculation of idle-speed setpoint model value

The outputs of the function are:

- ratio between idle speed setpoint and actual engine speed - **N_SP_IS_RATIO_MON**
- deviation of actual engine speed from idle speed setpoint - **N_DIF_SP_IS_MON**
- deviation of actual engine speed from N_SP_IS - **N_DIF_MON**

Formula section:

Plausibility check for IS_SP request from external tester (KWP-Service)

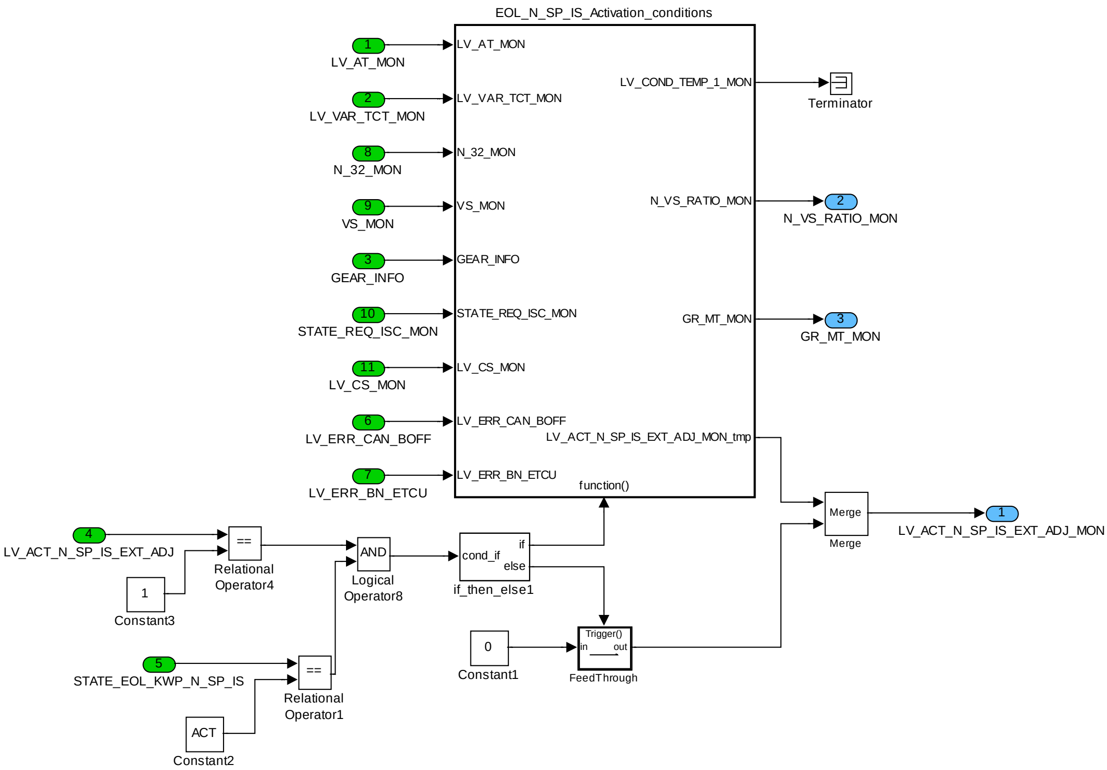

Figure E.6.1: .: ECM2_CONFIACPR/EOLService_N_SP_IS_Displace

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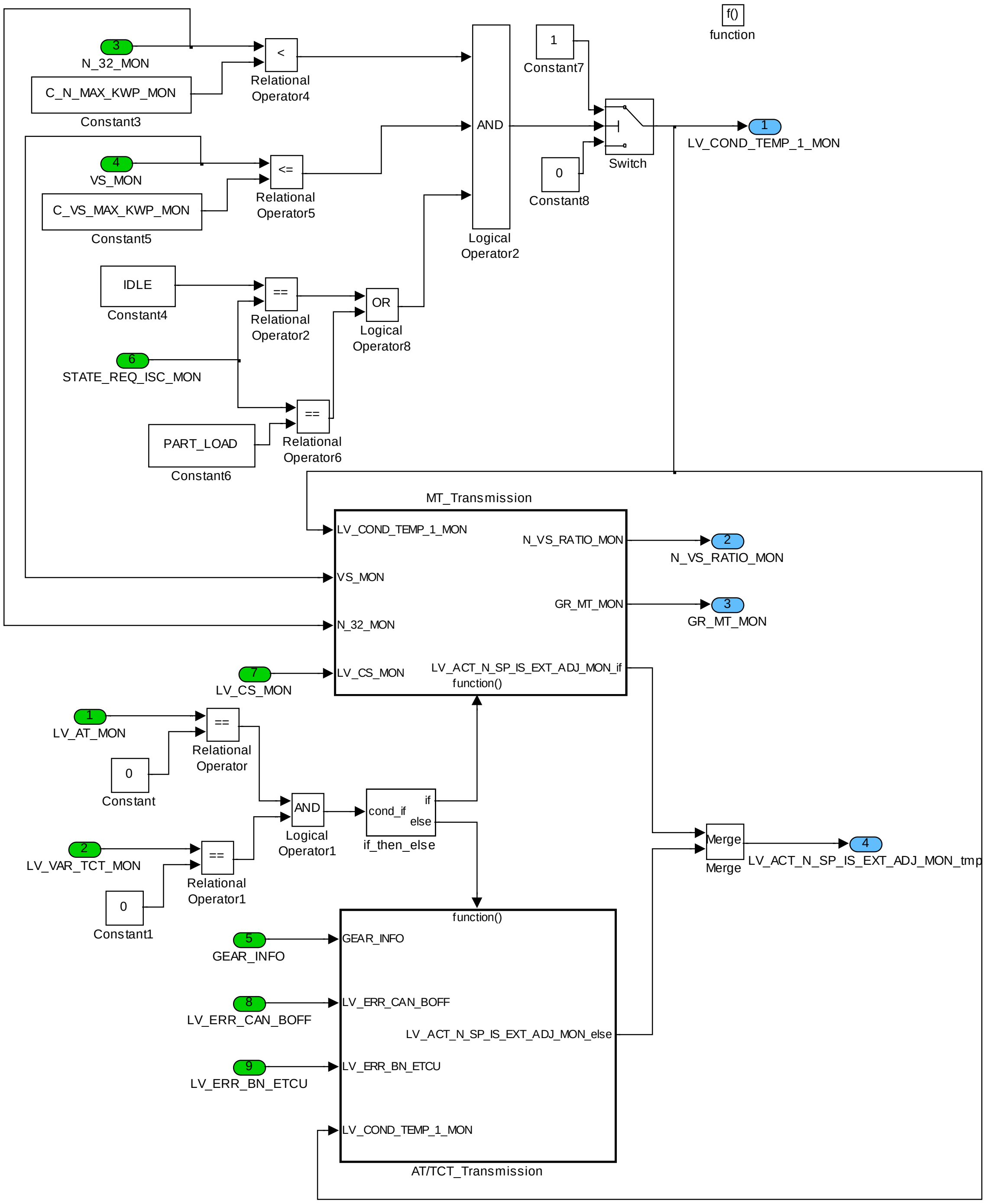

Figure E.6.2: .:
ECM2_CONFIACPR/EOLService_N_SP_IS_Displace/EOL_N_SP_IS_Activation_conditions

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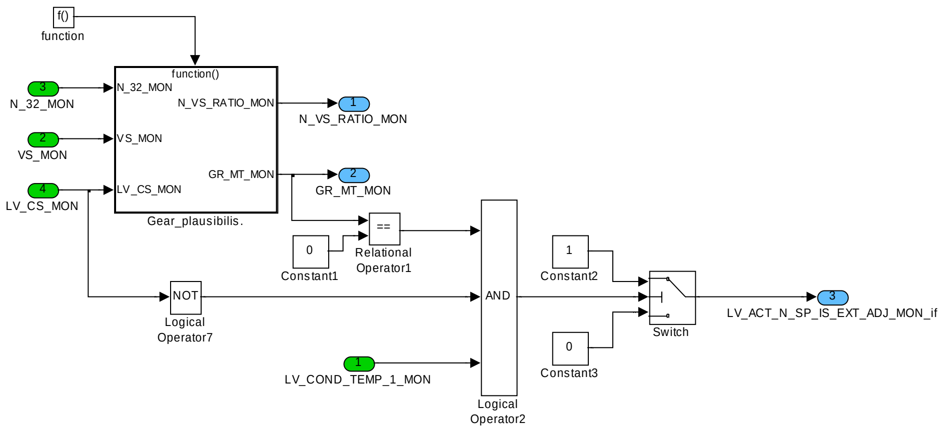

Figure E.6.3: .: ECM2_CONFIACPR/EOLService_N_SP_IS_Displace/
EOL_N_SP_IS_Activation_conditions/MT_Transmission

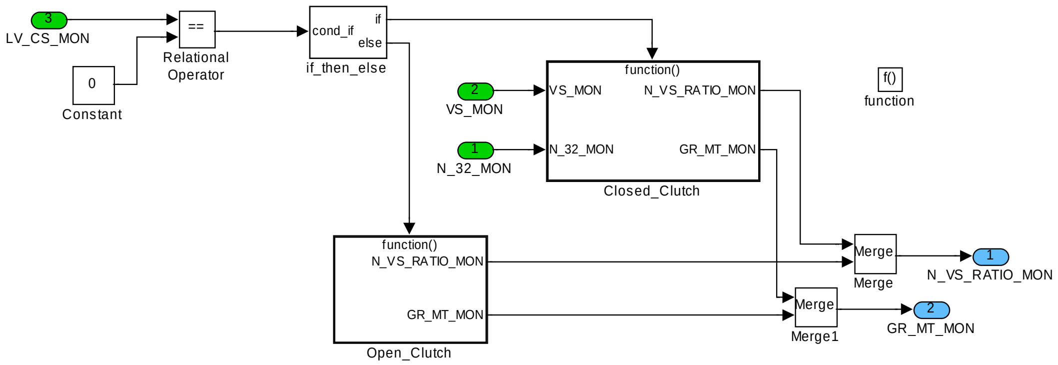

Figure E.6.4: .: ECM2_CONFIACPR/EOLService_N_SP_IS_Displace/
EOL_N_SP_IS_Activation_conditions/MT_Transmission/Gear_plausibilis.

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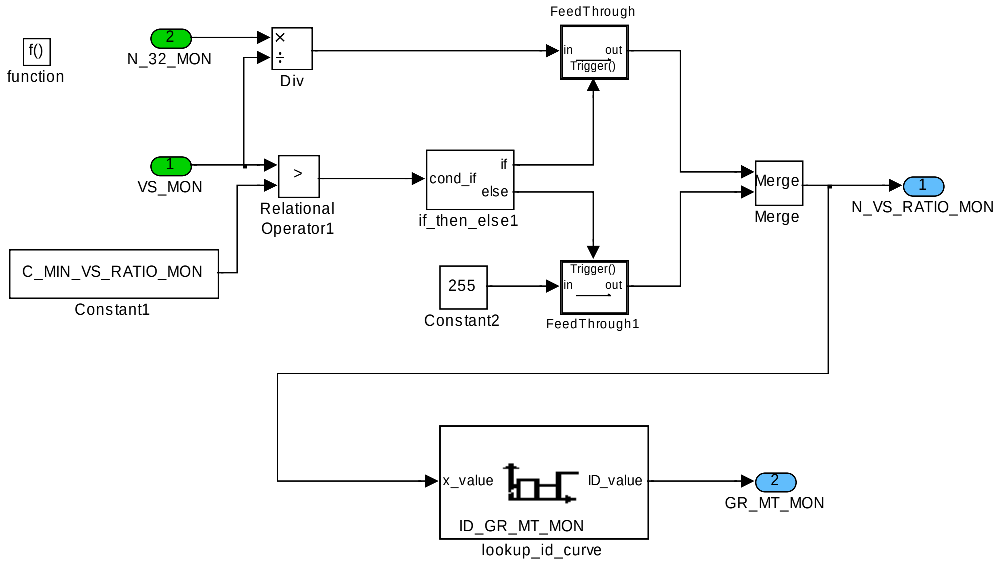

Figure E.6.5: .: ECM2_CONFIACPR/EOLService_N_SP_IS_Displace/
EOL_N_SP_IS_Activation_conditions/MT_Transmission/Gear_plausibilis./Closed_Clutch

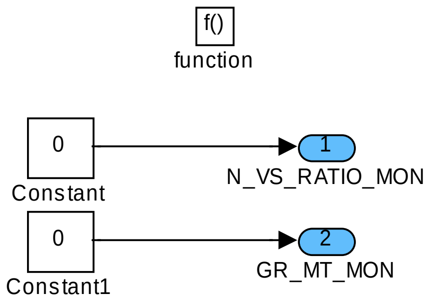

Figure E.6.6: .: ECM2_CONFIACPR/EOLService_N_SP_IS_Displace/
EOL_N_SP_IS_Activation_conditions/MT_Transmission/Gear_plausibilis./Open_Clutch

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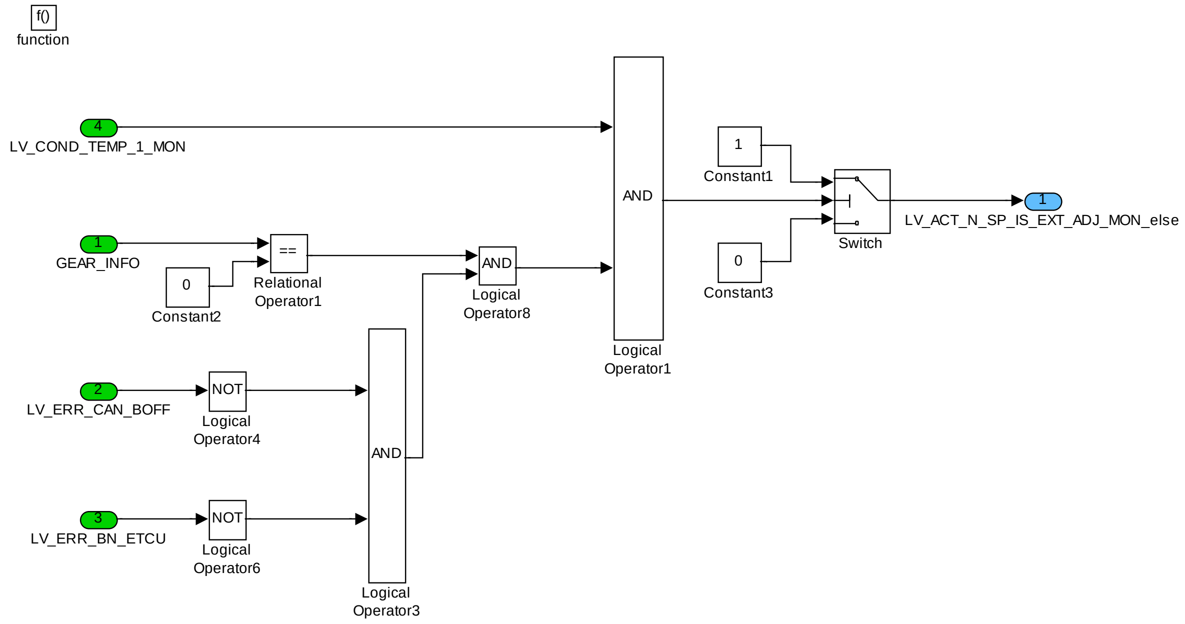

Figure E.6.7: .: ECM2_CONFIACPR/EOLService_N_SP_IS_Displace/ EOL_N_SP_IS_Activation_conditions/AT/TCT_Transmission

Calculation of LV_NT_SO2P_EXT_ADJ_ENA_MON

(raised idle speed SP due to external demand for desulfation)

If LV_NT_SO2P_EXT_ADJ_ACT = 1 AND
N_32_MON >= C_N_IS_SO2P_MIN_MON AND
GEAR = 0 AND
STATE_GEAR_REV_AT_AMT = 0 AND
LV_CLU_SWI = 0 AND
VS_MON <= C_VS_SO2P_EXT_MAX_MON AND
PV_AV_MON <= C_PV_SO2P_EXT_MAX_MON

Then

LV_NT_SO2P_EXT_ADJ_ENA_MON = 1

Else

LV_NT_SO2P_EXT_ADJ_ENA_MON = 0

Endif

Calculation of LV_TCHA_DIAG_REQ_MON

(raised idle speed SP due to external demand for charger diagnosis)

If LV_TCHA_DIAG_REQ = 1 AND
LV_CLU_SWI = 0 AND
VS_MON < C_VS_TCHA_DIAG_EXT_MAX_MON AND
PV_AV_MON < C_PV_TCHA_DIAG_EXT_MAX_MON

Then

LV_TCHA_DIAG_REQ_MON = 1

Else

LV_TCHA_DIAG_REQ_MON = 0

Endif

Calculation of LV_ACT_N_SP_IS_POIL_EXT_MON

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(raised idle speed SP due to external demand for oil pressure diagnosis)

If LV_POIL_EXT_ADJ_ACT = 1 AND
GEAR = 0 AND
STATE_GEAR_REV_AT_AMT = 0 AND
LV_CLU_SWI = 0 AND
VS_MON < C_VS_POIL_EXT_ADJ_MAX_MON AND
PV_AV_MON < C_PV_POIL_EXT_ADJ_MAX_MON
Then
LV_ACT_N_SP_IS_POIL_EXT_MON = 1
Else
LV_ACT_N_SP_IS_POIL_EXT_MON = 0
Endif

Calculation of N_SP_IS_CS_MON (only if LV_TQ_DROF_ACT_MON = 1)
(raised idle speed SP due to DROF active)

{MAX-limitation}
N_SP_IS_CS_MON = min(N_SP_IS_CS, C_N_SP_IS_CS_MAX_MON)

Calculation of N_SP_IS_EXT_ADJ_MON
(only if LV_ACT_N_SP_IS_EXT_ADJ_MON = 1)

(raised idle speed SP due to external tester demand via K-line active)

{MAX-limitation}
N_SP_IS_EXT_ADJ_MON = min(N_SP_IS_EXT_ADJ,
C_N_SP_IS_MAX_EXT_ADJ_MON)

Calculation of N_SP_IS_EXT_REQ_MON
(idle speed SP due to active DROF or external tester demand)

IF LV_ACT_N_SP_IS_EXT_ADJ_MON = 1

THEN N_SP_IS_EXT_REQ_MON = N_SP_IS_EXT_ADJ_MON

ELSE IF LV_TQ_DROF_ACT_MON = 1

THEN N_SP_IS_EXT_REQ_MON = N_SP_IS_CS_MON

ELSE IF LV_NT_SO2P_EXT_ADJ_ENA_MON = 1

THEN N_SP_IS_EXT_REQ_MON = C_N_NT_SO2P_EXT_ADJ_ACT_MON

ELSE IF LV_TCHA_DIAG_REQ_MON = 1

THEN N_SP_IS_EXT_REQ_MON = **min(**N_SP_IS_BRAKE,
C_N_TCHA_DIAG_REQ_MAX_MON**)**

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ELSE IF LV_ACT_N_SP_IS_POIL_EXT_MON = 1

THEN N_SP_IS_EXT_REQ_MON = **min(**N_SP_IS_POIL_CTL, C_N_POIL_EXT_ADJ_MAX_MON**)**

ELSE N_SP_IS_EXT_REQ_MON = N_SP_IS_BAS_MON

END IF

{gradient limitation}
IF(1) N_SP_IS_EXT_REQ_MON $_K$ $<$ N_SP_IS_EXT_REQ_MON $_{K-1}$

THEN(1)

IF(2) CTR_N_SP_IS_EXT_REQ_DEC_MON $_{K-1}$ $>$= C_CTR_N_SP_IS_REQ_DEC_MAX_MON

THEN(2)

CTR_N_SP_IS_EXT_REQ_DEC_MON $_K$ = 0
N_SP_IS_EXT_REQ_MON $_K$ = **min(**N_SP_IS,N_SP_IS_EXT_ REQ _MON $_{K-1}$ - C_N_SP_LGRD_IS_EXT_REQ_DEC_MON**)**

ELSE(2)

CTR_N_SP_IS_EXT_REQ_DEC_MON $_K$ = CTR_N_SP_IS_EXT_REQ_DEC_MON $_{K-1}$ + 1
N_SP_IS_EXT_REQ_MON $_K$= N_SP_IS_EXT_REQ_MON $_{K-1}$

END IF(2)

ELSE IF(1) N_SP_IS_EXT_REQ_MON $_K$ $>$ N_SP_IS_EXT_REQ_MON $_{K-1}$
THEN(1)
CTR_N_SP_IS_EXT_REQ_DEC_MON $_K$ = 0
N_SP_IS_EXT_REQ_MON$_K$ = **min(**N_SP_IS, N_SP_IS_EXT_REQ_MON$_{K-1}$ + C_N_SP_LGRD_IS_EXT_REQ_INC_MON**)**

ELSE(1)
CTR_N_SP_IS_EXT_REQ_DEC_MON $_K$ = 0
END IF(1)

{Calculation of final L2 idle-speed setpoint model value}

IF (LV_N_SP_IS_LIH_ACT==1) **AND** (LV_ERR_PVS_RATIO_MON==1)

THEN N_SP_IS_MON = **min(**N_SP_IS, C_N_SP_IS_LIH_MAX_MON**)**

ELSE N_SP_IS_MON = **max(**N_SP_IS_BAS_MON, N_SP_IS_EXT_REQ_MON**)**

ENDIF

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N_SP_IS_RATIO_MON = N_32_MON /N_SP_IS_MON **{Idle-speed setpoint ratio}**

{Deviation between engine speed idle-speed setpoint}

N_DIF_MON = N_SP_IS_MON - N_32_MON
{Calculation of engine speed deviation - N_DIF_COR_MON}
IF LC_N_SP_IS_CLC_INH_MON == 1
THEN **{Calculation of engine speed deviation from idle setpoint}**
N_DIF_COR_MON = N_SP_IS_MON - N_32_MON
ELSE **{Limitation of corrected idle speed setpoint between min& max thresholds}**
IF N_32_MON > N_SP_IS_MON
THEN N_DIF_CRLC_MON = C_N_DIF_CRLC_HIGH_MON
ELSE N_DIF_CRLC_MON = C_N_DIF_CRLC_LOW_MON
ENDIF
N_DIF_MMV_MON (n) = N_DIF_MMV_MON (n-1) + (N_DIF_MON - N_DIF_MMV_MON(n-1)) * N_DIF_CRLC_MON
{Calculation of engine speed deviation from corrected idle setpoint}

N_DIF_COR_MON = N_DIF_MON - N_DIF_MMV_MON * C_N_DIF_FAC_MON
ENDIF
{Deviation between engine speed and corrected idle-speed setpoint - input for ISC}
N_DIF_SP_IS_MON =N_DIF_COR_MON

E.6.3.3 Monitoring of Idle-speed controller activation conditions

Application conditions

Activation: LV_TQI_MON_ACT_MON = 1

Deviation: otherwise

Initialisation: (for condition see Application Incidences of Process Monitoring
OR LV_TQI_MON_ACT_MON = 0 1)
STATE_REQ_ISC_MON = NOT_ACTIVE
TQ_DIF_P_D_IS_MAX_2_MON = **max**(TQ_DIF_P_D_SLOW_IS$_k$, TQ_DIF_P_D_FAST_IS$_k$)
TQ_DIF_P_D_IS_MON = 0 Nm
TQ_DIF_P_D_IS_MAX_MON = **max**(TQ_DIF_P_D_SLOW_IS$_k$, TQ_DIF_P_D_FAST_IS$_k$)
STATE_PAS_RAMP_ACT_P_D_IS_MON = 0
STATE_PAS_RAMP_ACT_I_IS_MON = 0
LV_PAS_RAMP_ACT_P_D_CHG_MON = 0
LV_PAS_RAMP_ACT_I_CHG_MON = 0

Update Rate: 40 ms

General information:

The ISC can be active either when the engine state idle is requested(LV_REQ_ISC =1) or when the DROF functionality is active or under certain conditions in trailing-throttle state (LV_PU=1) and part-load state (LV_PL=1) and. So all of these possible ISC-active phases have to be monitored. The activation conditions are based on the L1 ISC activation conditions as described in the module Application incidences for the idle speed controller . In addition to the normal activation states, a NOT_ACTIVE state is generated in order to be able to monitor the ISC if the activation information from the function level is faulty.

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Formula section:

{The L1 ISC-Torque demand signal is copied to the process monitoring (L2) RAM} TQ_DIF_P_D_IS_MON$_k$ = **max**(TQ_DIF_P_D_SLOW_IS$_k$, TQ_DIF_P_D_FAST_IS$_k$)
{L2 threshold of normal PD-part torque request}
TQ_DIF_P_D_IS_MAX_1_MON = IP_TQ_DIF_P_D_IS_MAX_MON(N_DIF_SP_IS_MON$_k$)
{Calculation of monitoring threshold for PD-part and corresponding filter parameters. Filtering only in falling direction.}

IF TQ_DIF_P_D_IS_MAX_1_MON$_k$ < TQ_DIF_P_D_IS_MAX_2_MON$_{k-1}$
THEN TQ_DIF_P_D_IS_MAX_2_MON$_k$ =
[C_FIL_TQ_P_D_IS_MAX_MON * TQ_DIF_P_D_IS_MAX_1_MON$_k$
+ (1- C_FIL_TQ_P_D_IS_MAX_MON) * TQ_DIF_P_D_IS_MAX_2_MON$_{k-1}$**]**
ELSE TQ_DIF_P_D_IS_MAX_2_MON$_k$ = TQ_DIF_P_D_IS_MAX_1_MON$_k$
ENDIF
TQ_DIF_P_D_IS_MAX_MON$_k$ = TQ_DIF_P_D_IS_MAX_2_MON$_k$
* IP_FAC_TQ_DIF_P_D_IS_MON(TCO_MON)

{Evaluation of ISC-deactivation-ramp status in L1 to check for activation during current recurrence or between two L2 recurrences. To simplify the usage of individual Bit positions in the formula section, the following representation will be used:
STATE_PAS_RAMP_ACT_P_D_IS_MON(i) = STATE_PAS_RAMP_ACT_P_D_IS_MON : Bit i where i=0 ... 4
*STATE_PAS_RAMP_ACT_I_IS_MON (j) = STATE_PAS_RAMP_ACT_I_IS_MON : Bit j where j=0 ... 2***}**

STATE_PAS_RAMP_ACT_P_D_IS_MON = STATE_PAS_RAMP_ACT_P_D_IS
IF {(STATE_PAS_RAMP_ACT_P_D_IS_MON (0) == 1
AND STATE_PAS_RAMP_ACT_P_D_IS_MON (4)== 0)
OR [(STATE_PAS_RAMP_ACT_P_D_IS_MON (0) == 1
AND STATE_PAS_RAMP_ACT_P_D_IS_MON (4) == 1)
AND (STATE_PAS_RAMP_ACT_P_D_IS_MON (1) == 0
OR STATE_PAS_RAMP_ACT_P_D_IS_MON (2) == 0
OR STATE_PAS_RAMP_ACT_P_D_IS_MON (3) == 0) **]**
OR (LV_TQI_MON_ACT_MON = 0 1 **AND** STATE_PAS_RAMP_ACT_P_D_IS_MON (0) == 1)}
THEN LV_PAS_RAMP_ACT_P_D_CHG_MON = 1
ELSE LV_PAS_RAMP_ACT_P_D_CHG_MON = 0
ENDIF

STATE_PAS_RAMP_ACT_I_IS_MON = STATE_PAS_RAMP_ACT_I_IS
IF (STATE_PAS_RAMP_ACT_I_IS_MON (0)==1
AND STATE_PAS_RAMP_ACT_I_IS_MON(2)==0)
OR [STATE_PAS_RAMP_ACT_I _IS_MON (0) ==1
AND STATE_PAS_RAMP_ACT_I _IS_MON (2) == 1
AND STATE_PAS_RAMP_ACT_I _IS_MON (1) == 0 **]**
OR (LV_TQI_MON_ACT_MON = 0 1 **AND** STATE_PAS_RAMP_ACT_I_IS_MON (0)==1)
THEN LV_PAS_RAMP_ACT_I_CHG_MON = 1
ELSE LV_PAS_RAMP_ACT_I_CHG_MON = 0
ENDIF

{Plausibilisation of ISC activation conditions}
IF[(N_DIF_MON C_N_DIF_MAX_IS_MON) **AND** (LV_CT_MON == 1)
AND (LV_REQ_ISC == 1)**]**

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THENSTATE_REQ_ISC_MON = IDLE
ELSE IF[(N_DIF_MON < C_N_DIF_MAX_IS_MON - C_N_DIF_HYS_IS_PU_MON)
AND (LV_CT_MON = 1) **AND** (T_CTR_PU_ISC_ACT == 0)**]**
THEN STATE_REQ_ISC_MON = TRAILING_THR
ELSE IF (LV_TQ_DROF_ACT_MON == 1 **AND** LC_TQ_DROF_ISC_OFF_MON == 0**)**
OR ((N_SP_IS_MON < C_N_SP_IS_MAX_PL_ACT_MON) AND (LV_CT_MON == 0) AND (N_DIF_MON > C_N_DIF_MAX_PL_ACT_MON)**)**
OR LV_MSR_ACT_MON = 1
THENSTATE_REQ_ISC_MON = PART_LOAD
ELSE STATE_REQ_ISC_MON = NOT_ACTIVE
ENDIF
ENDIF
ENDIF

E.6.4 Application incidences for monitoring of pedal value signals

FUNCTION DESCRIPTION:

General information:

In order to be able to use the generic module for the monitoring of the pedal value signals in level 2, different information about the state of the brake are combined to one resulting information LV_BRAKE_MON. It is set, when at least one sensor (brake light switch or brake test switch) indicates an activated brake or a fault of a brake switch has been detected. The switch signals are read directly from port.

Application conditions

Activation: at every engine state

Deactivation: otherwise

Initialisation: for condition see Application Incidences of Process Monitoring

Update Rate: 40 ms

Formula section:

If (LV_IM_BLS_MON = 1) **Or**
(LV_IM_BTS_MON = 1) **Or**
(LV_ERR_BLS_PLAUS = 1)
Then LV_BRAKE_MON = 1
Else LV_BRAKE_MON = 0
Endif

Supply voltage error bits:
LV_ERR_VCC_PVS_1_MON = LV_ERR_V_REF_1
LV_ERR_VCC_PVS_2_MON = LV_ERR_V_REF_2
LV_ERR_VCC_PVS_MON = 0

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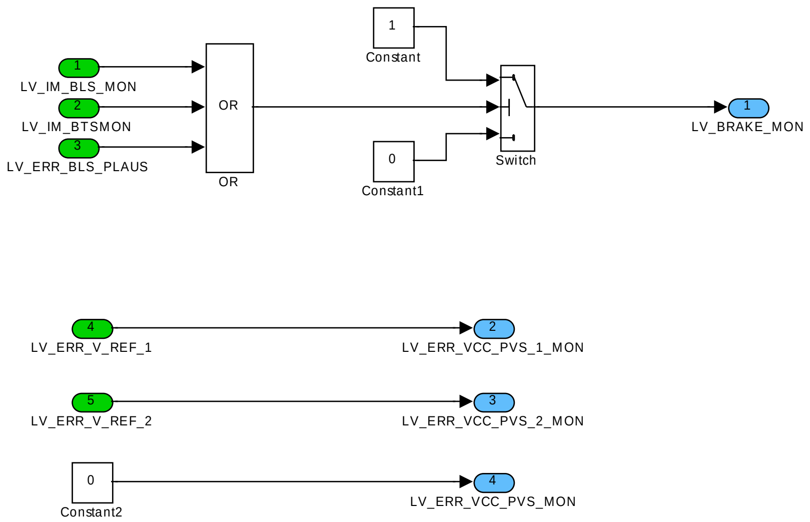

E.6.5 Adaptation of OPM_AV to OPM_AV_MON

General information:

Application conditions

Activation: LV_TQI_MON_ACT_MON = 1

Deactivation: otherwise

Initialisation: for condition see Application Incidences of Process Monitoring
And at LV_TQI_MON_ACT_MON 1 -> 0 OPM_AV_MON is set to AFS

Update Rate: 40 ms

FUNCTION DESCRIPTION:

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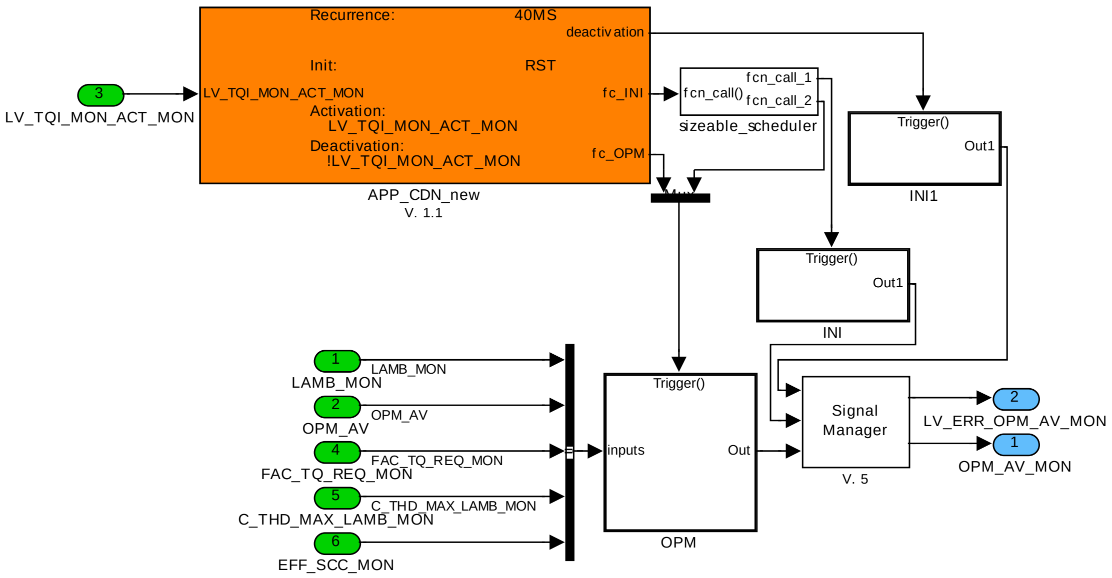

Figure 1: ECM2_DTSYSMODULE

E.6.5.1 SUBFUNCTION: INIT

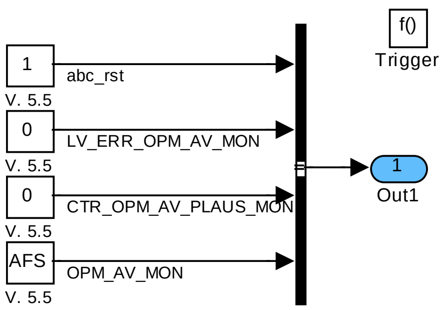

Figure E.6.8: : ECM2_DTSYSMODULE/INIT

E.6.5.2 SUBFUNCTION: INIT1

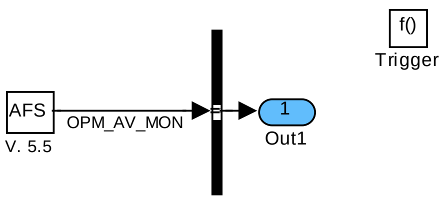

Figure E.6.9: : ECM2_DTSYSMODULE/INIT1

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E.6.5.3 SUBFUNCTION: OPM

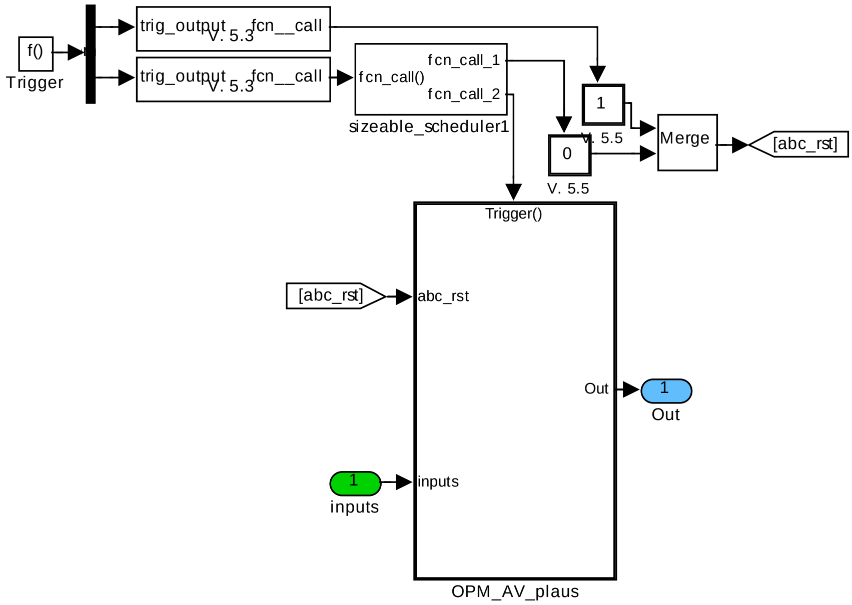

Figure E.6.10: : ECM2_DTSYSMODULE /OPM

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E.6.5.4 SUBFUNCTION: OPM_AV_plaus

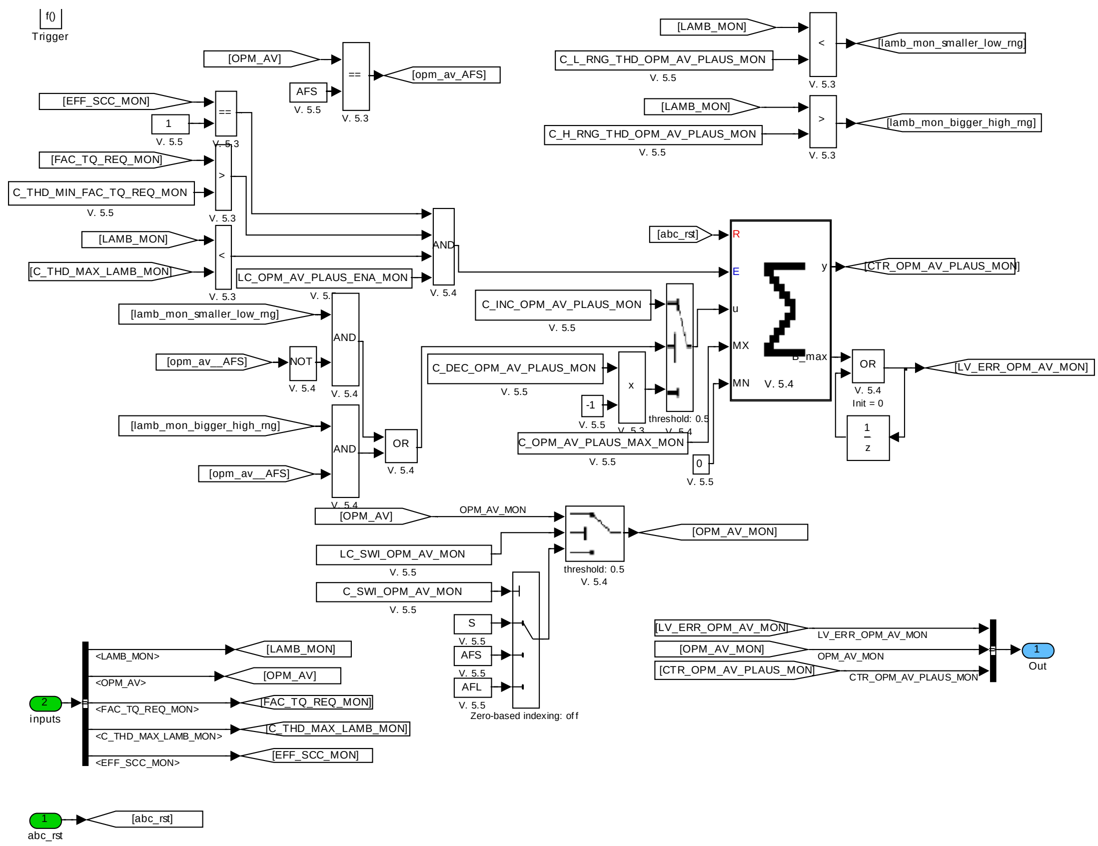

Figure E.6.11: : ECM2_DTSYSMODULE /OPM/OPM_AV_PLAUS

E.6.6 Application incidences for the monitoring of torque losses

FUNCTION DESCRIPTION:

General information:

In order to be able to use module for the monitoring of torque losses in level 2 the not engine related additional torque losses are calculated here.
The level 1 value of each additional torque loss will be compared with a modelled one. The larger value (minimum absolute Torque value) of the two is added to the sum TQ_LOSS_ADD_MON.

Application conditions

Activation: LV_TQI_MON_ACT_MON = 1

Deactivation: otherwise

Initialisation: for condition see Application Incidences of Process Monitoring

```
TQ_LOSS_ADD_MON = 0
VS_MON = 0 km/ h
TQ_LOSS_ADD_FIL_MON = 0
TQ_REQ_CLU_MON = 0
```

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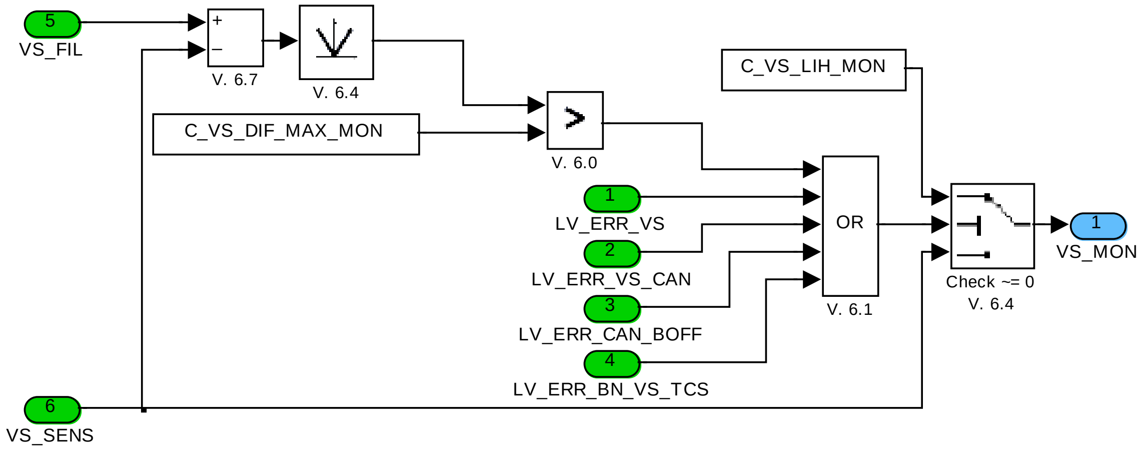
```
TQ_REQ_CLU_GRD_MON = 0
TQ_LOSS_FIL_MMV_MON =
max(TQ_LOSS_ADD_FIL , C_TQ_LOSS_FIL_MMV_INI_MIN_MON)
```

Recurrence: 40 ms

Signal flow diagram:

E.6.6.1 Monitoring of vehicule speed



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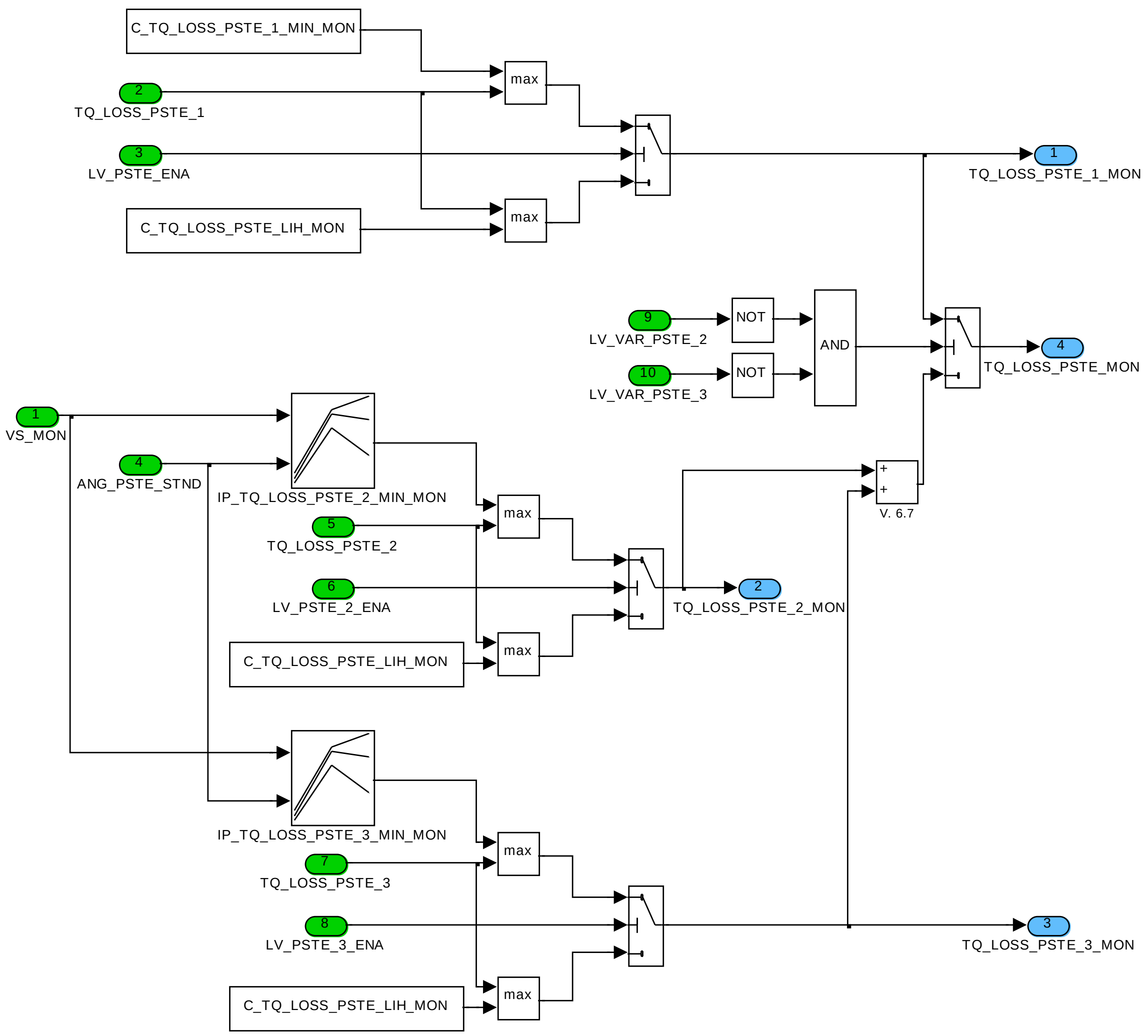
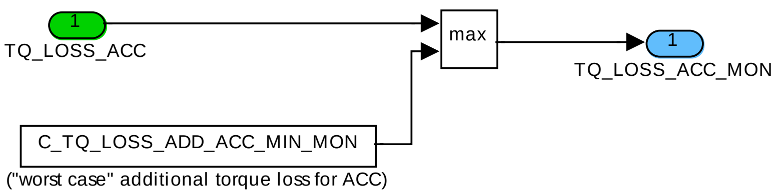
E.6.6.2 Monitoring of torque losses for powersteering



E.6.6.3 Monitoring of torque losses for ACC



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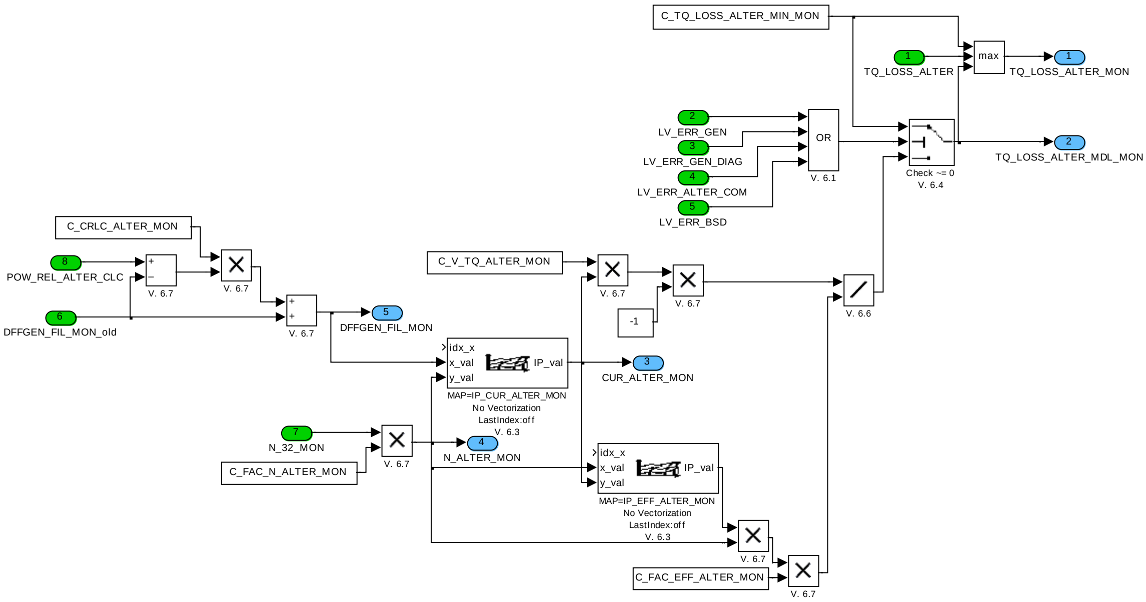
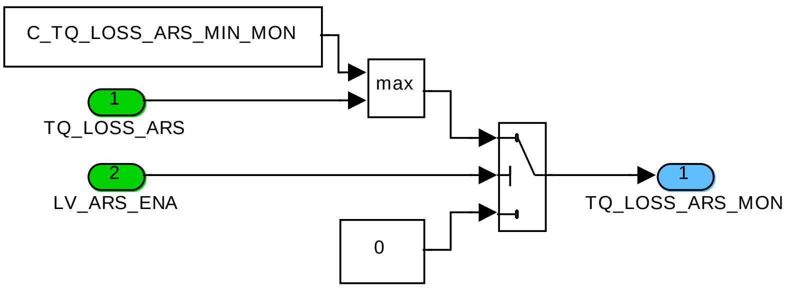
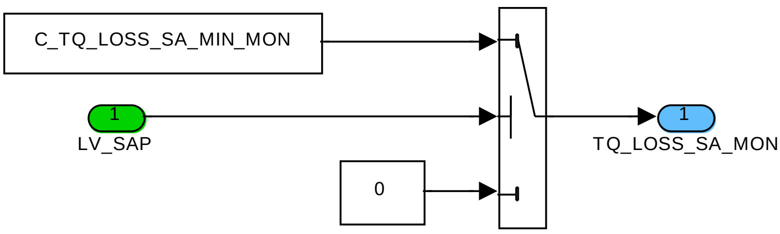
E.6.6.4 Monitoring of torque losses for alternator



E.6.6.5 Monitoring of torque losses for anti roll stabilisation



E.6.6.6 Monitoring of torque losses for secundary air



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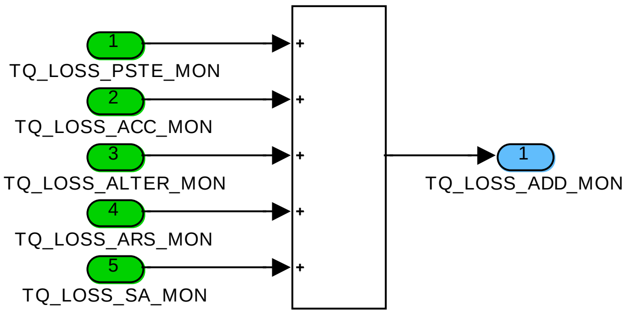
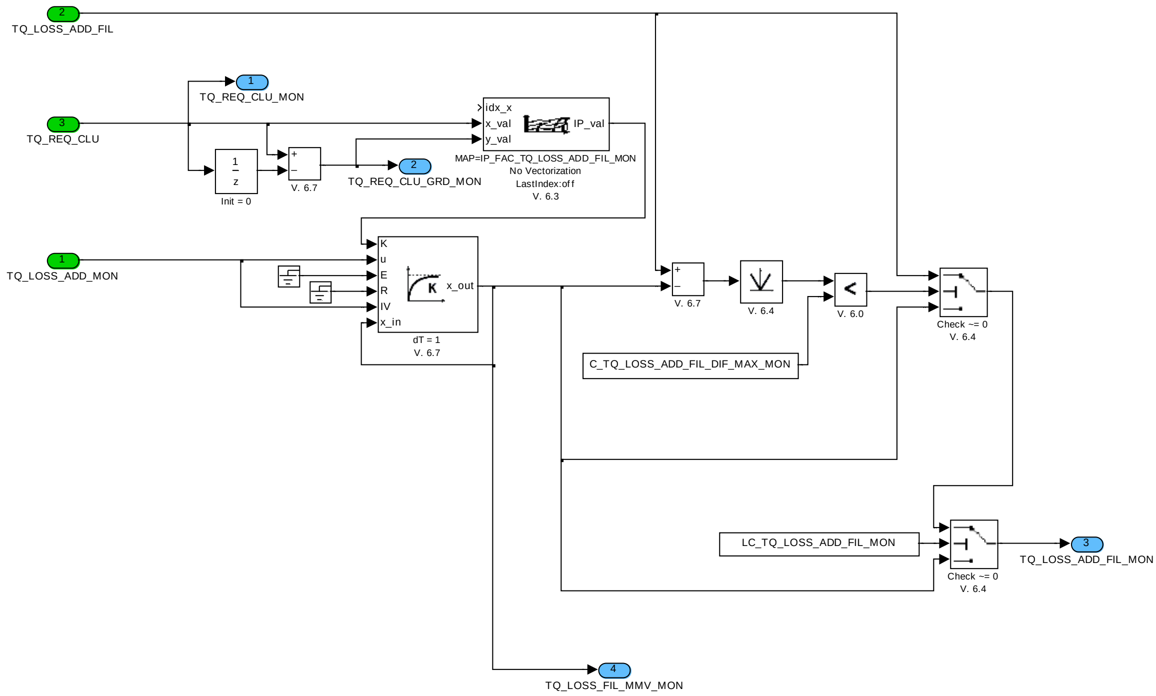
E.6.6.7 Calculation of the additionnal torque losses



E.6.6.8 Calculation of the filtered additionnal torque losses



E.6.7 Application incidences for the actual lambda deviation

E.6.7.1 ECM2_DTSYSLADIF

General information:

Application conditions

Activation: `LV_TQI_MON_ACT_MON = 1`

Deactivation: `otherwise`

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Initialisation: `for condition see  Application Incidences of Process Monitoring`

Update Rate: `40 ms`

FUNCTION DESCRIPTION:

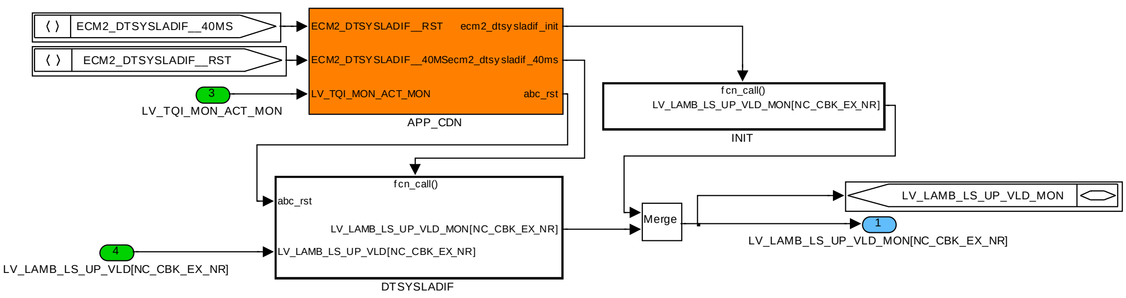

Figure E.6.12: : ECM2_DTSYSLADIF

E.6.7.1.1 SUBFUNCTION: INIT

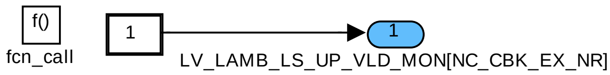

Figure E.6.13: : ECM2_DTSYSLADIF/INIT

E.6.7.1.2 SUBFUNCTION: determination_of_act_lamb_dev_value

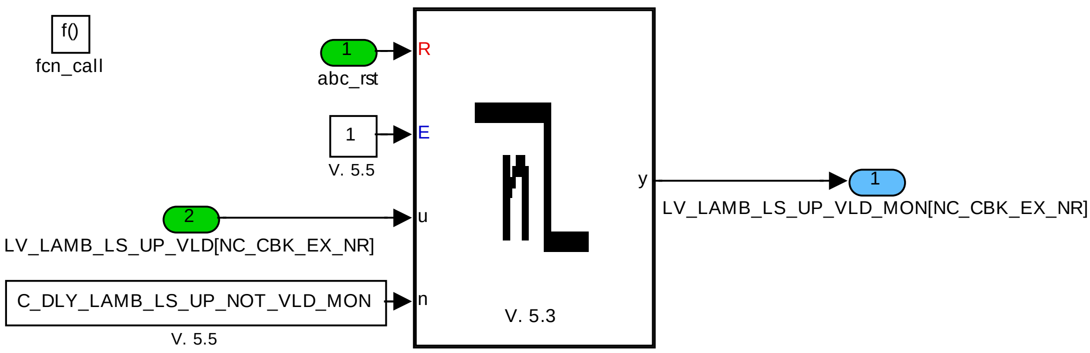

Figure E.6.14: : ECM2_DTSYSLADIF/determination_of_act_lamb_dev_value

E.6.8 Forced injection shut-off for Level 2 - engine speed limitation

FUNCTION DESCRIPTION:

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General information:

In order to ensure a safe injection cut off while engine speed limitation is active (LV_N_LIM_ETC_MON == 1) and engine speed is above the threshold C_N_THD_FCUT_N_LIM_ETC_MON, the resulting logical variable LV_OFF_IV_N_LIM_ETC_MON is used at individual cylinder shut off functionality (same use and priority as LV_OFF_IV_MON).

Application conditions

Activation: at every engine state

Deactivation: otherwise

Initialisation: for condition see Application Incidences of Process Monitoring
LV_OFF_IV_N_LIM_ETC_MON = 0

Update Rate: 40 ms

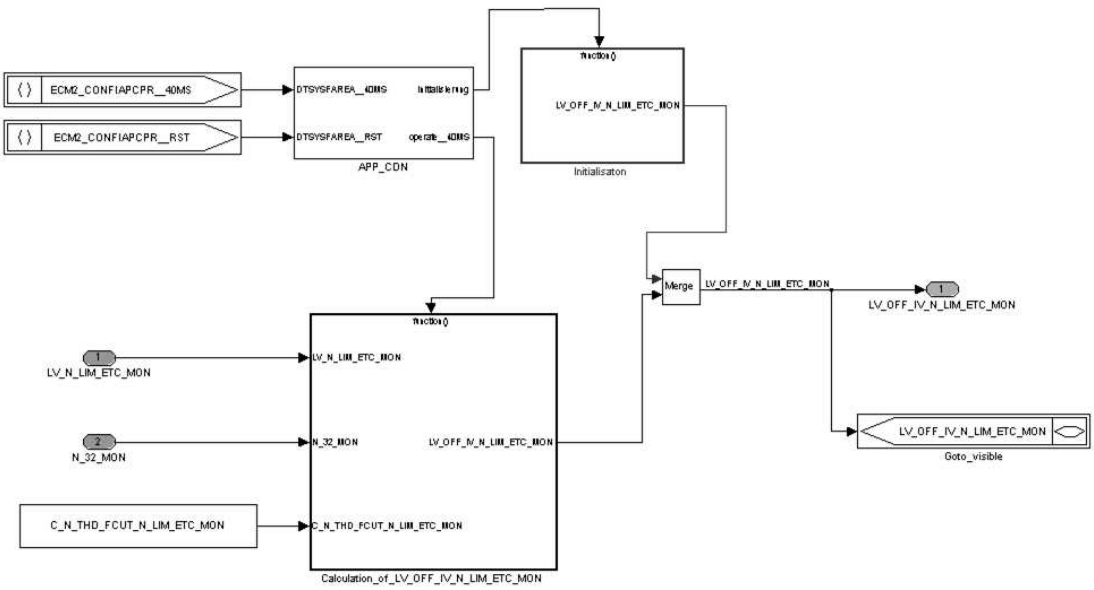

Figure E.6.15: : CONFIAPCPR

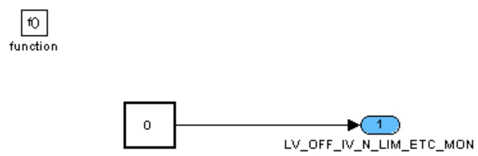

Figure E.6.16: : CONFIAPCPR /Initialisation

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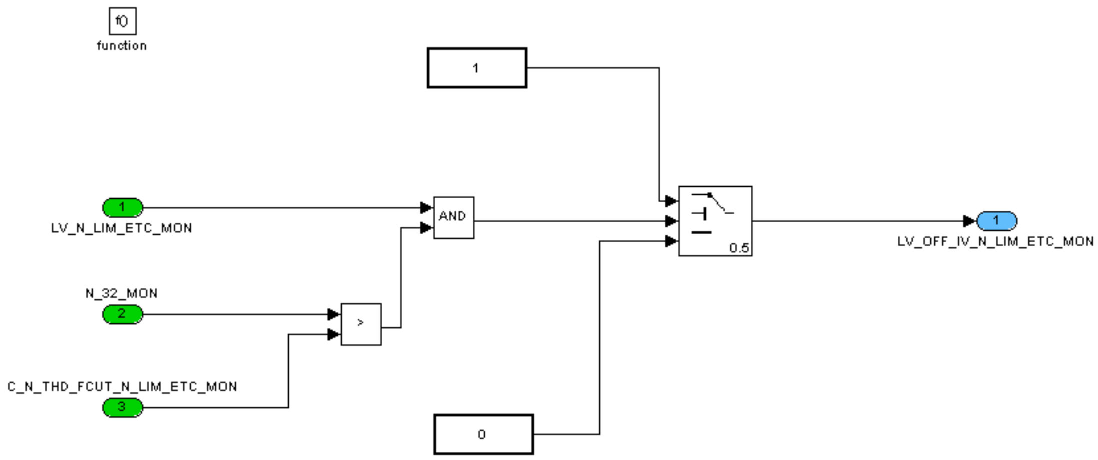

Figure E.6.17: : CONFIAPCPR/Calculation_of_LV_OFF_IV_N_LIM_ETC_MON

E.6.9 State of torque intervention when level 2/3 error is detected

General information:

When a level 2/3 error is present except monitoring of cruise control the CAN status flag SF_TQD = 3 is set via LV_SF_TQD_MON = 1:

Formula section:

Error bit	SF_TQD
LV_ERR_CONV_MON	LV_SF_TQD_MON = 1
LV_ERR_MSR_INH_MON	LV_SF_TQD_MON = 1
LV_ERR_N_32_MON	LV_SF_TQD_MON = 1
LV_ERR_PVS_MON	LV_SF_TQD_MON = 1
LV_ERR_MFF_MON	LV_SF_TQD_MON = 1
LV_ERR_CRU_INH_MON	LV_SF_TQD_MON = 0
LV_ERR_TQI_AV_MON	LV_SF_TQD_MON = 1
LV_ERR_TQI_N_MAX_MON	LV_SF_TQD_MON = 1
LV_ERR_MU_MC	LV_SF_TQD_MON = 1
LV_ERR_DCC_INH_MON	LV_SF_TQD_MON = 1
LV_ERR_AMT_INH_MON	LV_SF_TQD_MON = 1
LV_ERR_GS_INH_MON	LV_SF_TQD_MON = 1
LV_ERR_LDM_INH_MON	LV_SF_TQD_MON = 1

E.6.10 Application incidences for the cruise control input

Formula section:

LV_ERR_CRU_INH_MON = LV_ERR_CRU_MON

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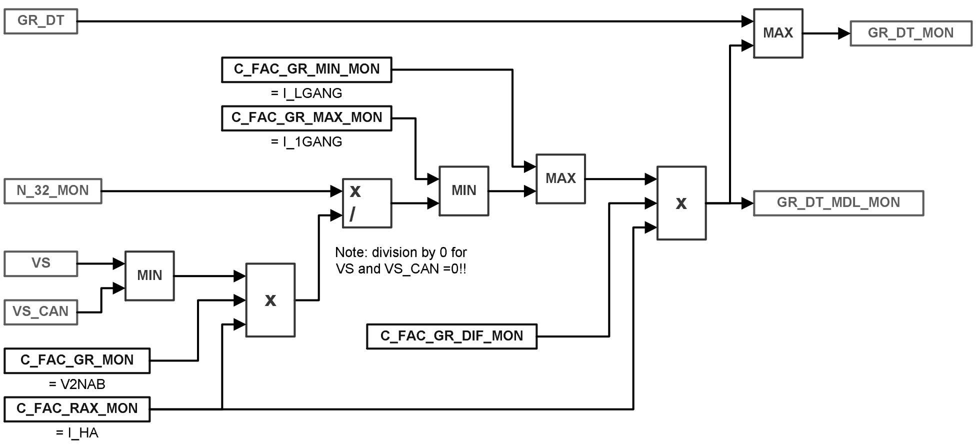
E.6.11 Application incidences for the IPM-monitoring

FUNCTION DESCRIPTION:

General information:

For the monitoring of the torque request from IPM (intelligent powertrain management) it is necessary to determine the gear ratio factor GR_DT_MON.

Signal flow diagram:



Application conditions

Activation: LV_TQI_MON_ACT_MON = 1

Deactivation: otherwise

Initialisation: for condition see Application Incidences of Process Monitoring
GR_DT_MON = 1
GR_DT_MDL_MON = 1

Update Rate: 40 ms

Formula section:

Gear ratio of gear box:

GR_DT_MDL_MON_1 = (N_32_MON /60) / ((MIN (VS ; VS_CAN) /3.6) * C_FAC_GR_MON * C_FAC_RAX_MON)

N_32 in [1/sec]
VS in [m/sec]
1/wheelcircumference
gear ratio rear axle

Note: for VS and VS_CAN = 0 there is a devision by zero!

Limitation of gear ratio of gear box:

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GR_DT_MDL_MON_2 = MAX (C_FAC_GR_MIN_MON ; *limit longest gear*
MIN (C_FAC_GR_MAX_MON; *limit shortest gear*
GR_DT_MDL_MON_1))

Modelled total gear ratio of powertrain
GR_DT_MDL_MON = GR_DT_MDL_MON_2 *
C_FAC_GR_DIF_MON *
C_FAC_RAX_MON

Powertrain gear ratio used for monitoring:
GR_DT_MON = MAX (GR_DT ; GR_DT_MDL_MON)

E.6.12 Application incidences for the monitoring of CAN signals

Application conditions

Activation: LV_TQI_MON_ACT_MON = 1

Deactivation: otherwise

Initialisation: for condition see Application Incidences of Process Monitoring

Recurrence: 40ms

Formula section:

Plausibilisation of active MSR
IF LV_MSR_ACT = 1 **AND(**TQI_MSR_MON > 0 **OR** TQ_MSR_MON > 0**)**
THEN LV_MSR_ACT_MON = 1
ELSE LV_MSR_ACT_MON = 0
ENDIF

Torque demand from external CAN signals
IF(1) LV_VAR_BN = 0
THEN(1) TQI_INC_CAN_MON = max (TQI_MSR_MON, TQI_AMT_MON, TQI_GS_MON)
ELSEIF(1) (LV_VAR_BN = 1)
IF(2) TQ_MSR_MON = 0 **AND**
TQ_DCC_MON = 0 **AND**
TQ_WHEEL_LDM_MON = 0 **AND**
TQ_AMT_MON = 0 **AND**
TQ_GS_MON = 0
THEN(2) TQI_INC_CAN_MON = 0
ELSE(2) TQI_INC_CAN_MON =
[max (TQ_MSR_MON, TQ_DCC_MON,
TQ_WHEEL_LDM_MON /GR_DT_MON, TQ_AMT_MON,
TQ_GS_MON)] - TQ_LOSS_MON
ENDIF(2)
ENDIF(1)

E.6.13 Application incidences for the monitoring of minimum torque at clutch

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FUNCTION DESCRIPTION:

General information:

The objective of this function is the determination of the error-detection paths of the minimum torque at clutch. The error-detection is divided into PU state and non-PU state. This separation is done because the biggest influence on the value of the minimum torque that is available at the clutch is the self-stabilising factor FAC_N_SP_IS_RATIO_MON and this has a parabolic trajectory where the transition point from the positive values to TQ_LOSS_MON is around the idle-speed setpoint (N_SP_IS_MON). STATE_ERR_DET_TQ_MIN_MON is an input into the module Monitoring of minimum torque at clutch .

Application conditions

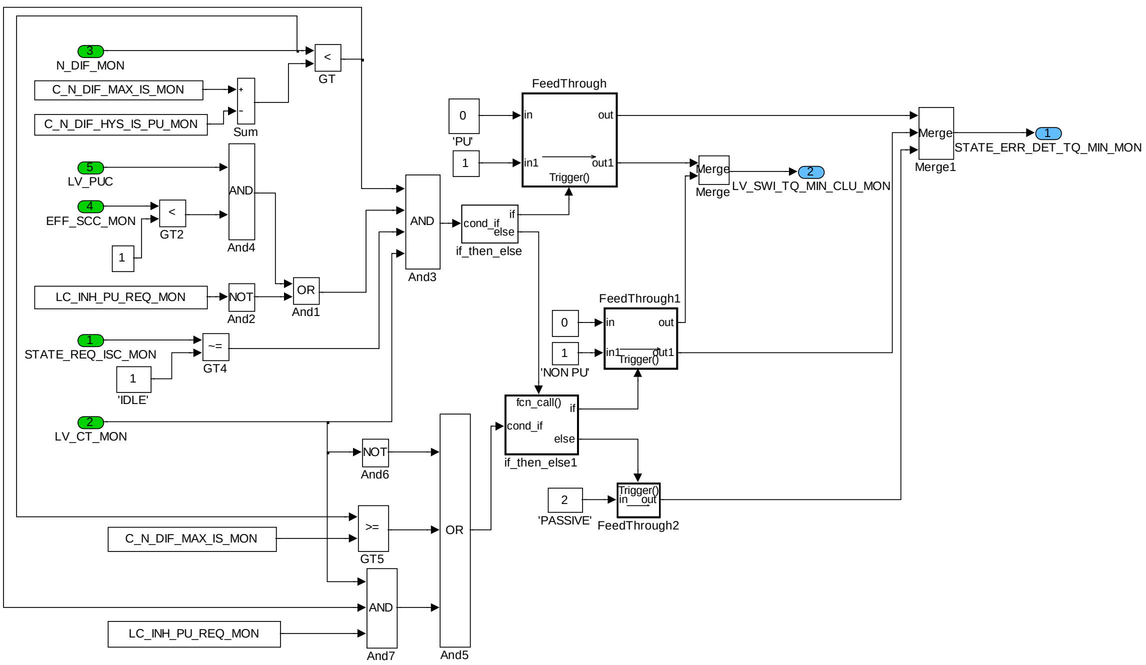
Activation: LV_TQI_MON_ACT_MON = 1

Deactivation: otherwise

Initialisation: for condition see Application Incidences of Process Monitoring
STATE_ERR_DET_TQ_MIN_MON = PASSIVE
TQ_ADD_MIN_CLU_MON = 0 Nm
TQ_CONV_MAX_MON = 0 Nm
TQ_CONV_MAX_MDL_MON = 0 Nm
LV_SWI_TQ_MIN_CLU_MON = 0

Update Rate: 40 ms

Formula section:



{Calculation of Maximum Converter Torque
If a CVT system is used, then the torque demand/engine load resulting from the transmission has to be considered here. If this value is transmitted from the TCU via CAN, then it has to be checked first in the module Monitoring of CAN-signals and only then used here. If a normal automatic transmission is

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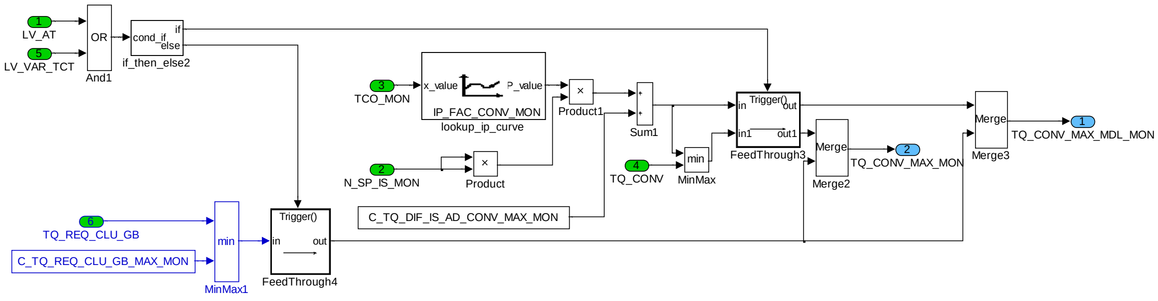
used, then the torque losses resulting from the converter can be calculated as given below. The torque request of the manual gearbox is considered here. }



Application incidences for the actual efficiencies

E.6.13.1 CONFIAPCPR

General information:

The calculation of IGA_REF_HOM_COR_EXT_MON and IGA_REF_HOMS_COR_EXT_MON is an additive combination of limited values of level 1. The limitation of each single value allows having a close tolerance range for monitoring.
Furthermore, MFF_LAMB_REF_IGA_MON has to be provided for the "Actual Efficiencies" as scavaging corrected MFF-value.

Application conditions:

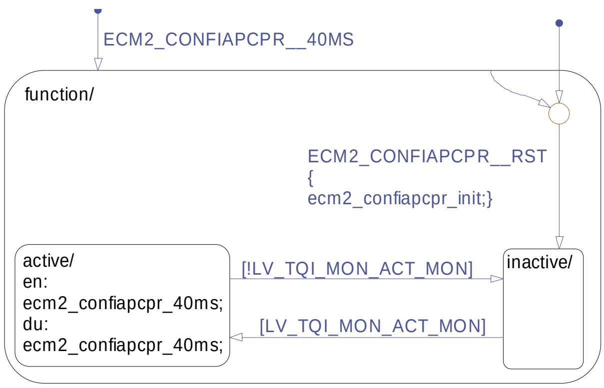


Figure E.6.18: : ECM2_CONFIAPCPR/APP_CDN_Chart

FUNCTION DESCRIPTION:

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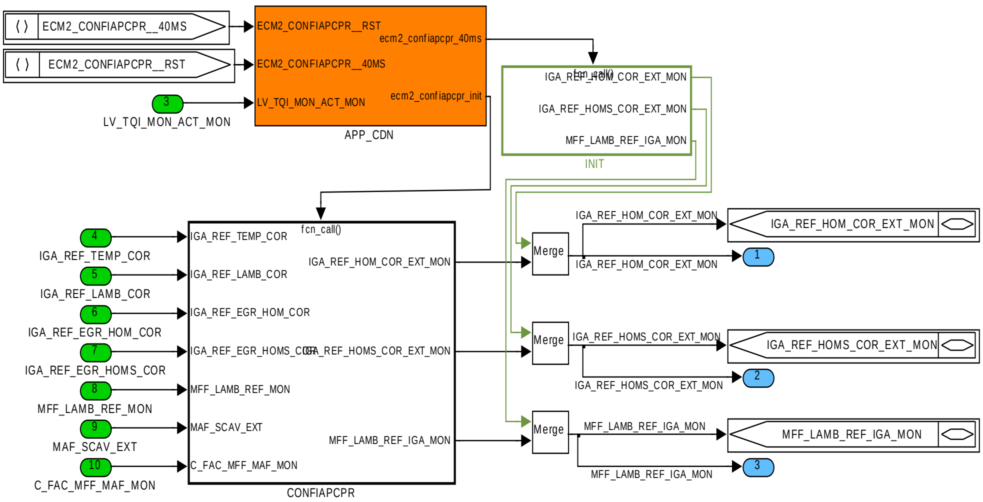

Figure E.6.19: : ECM2_CONFIAPCPR

E.6.13.1.1 SUBFUNCTION: INIT

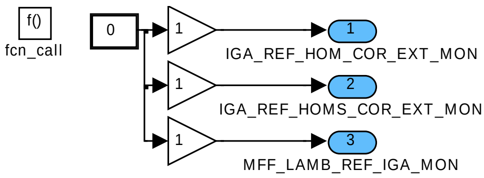

Figure E.6.20: : ECM2_CONFIAPCPR/INIT

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E.6.13.1.2 SUBFUNCTION: CONFIAPCPR

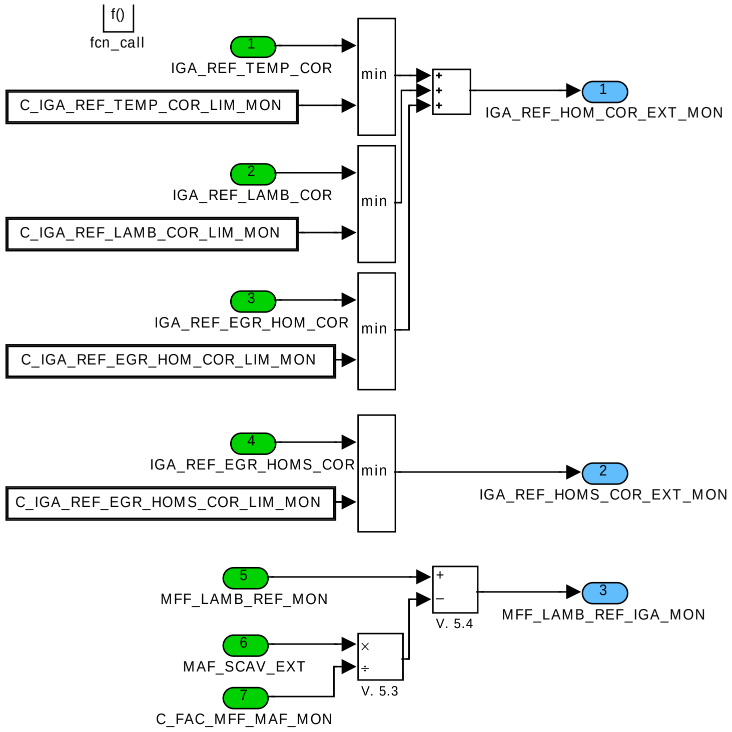

Figure E.6.21: : ECM2_CONFIAPCPR/CONFIAPCPR

E.6.14 Application incidences for the actual indicated engine torque

E.6.14.1 CONFIAPCPR

General information:

Application conditions:

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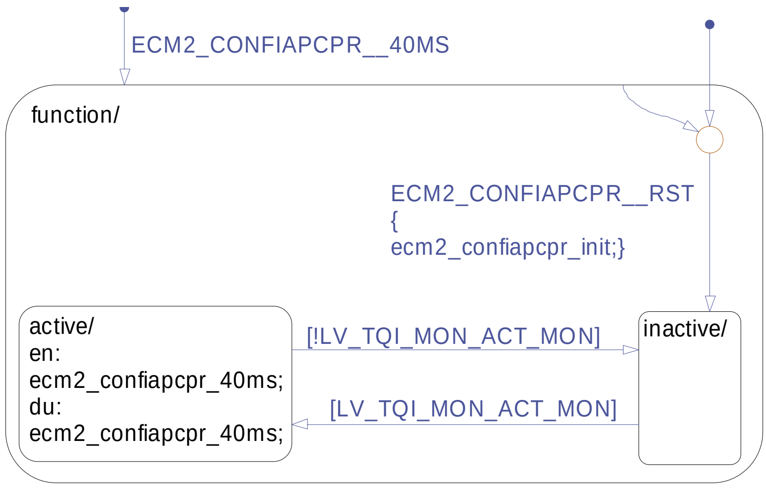

Figure E.6.22: : ECM2_CONFIAPCPR/APP_CDN_Chart

FUNCTION DESCRIPTION:

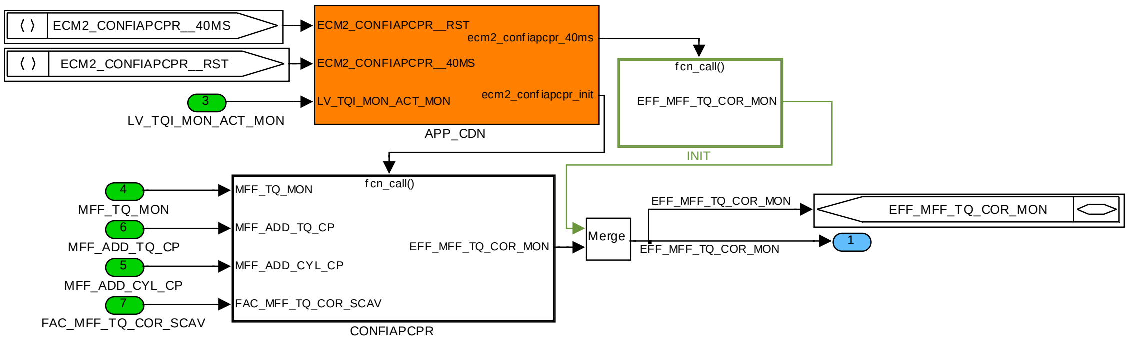

Figure E.6.23: : ECM2_CONFIAPCPR

E.6.14.1.1 SUBFUNCTION: INIT

Figure E.6.24: : ECM2_CONFIAPCPR/INIT

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E.6.14.1.2 SUBFUNCTION: CONFIAPCPR

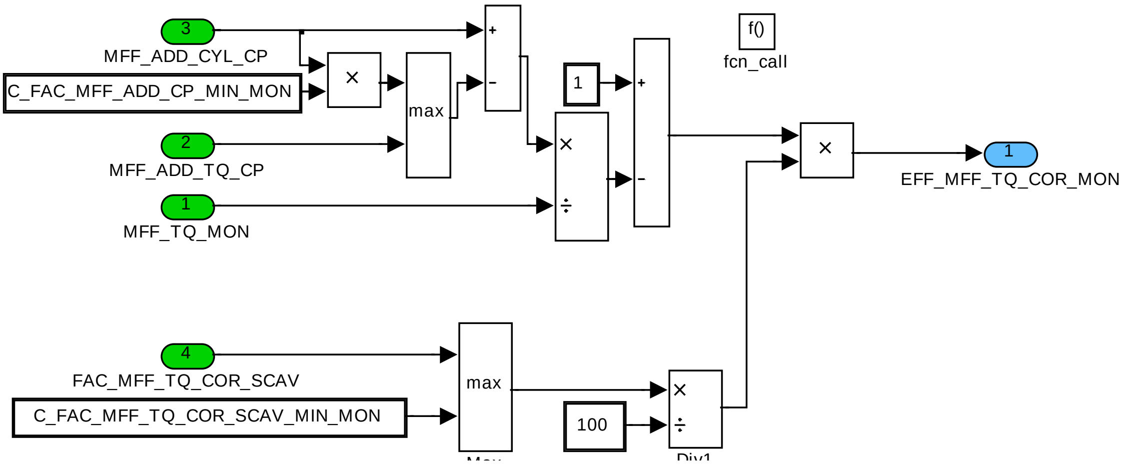

Figure E.6.25: : ECM2_CONFIAPCPR/CONFIAPCPR

E.6.15 Sport switch monitoring

E.6.15.1 Acquisition of sport-mode-switch for monitoring

General information:

Calculation of the sport-mode request by taking the voltage of the sport-mode-switch and at BN 2000 variants on CAN message.
The request acts according to the rising edge of the voltage signal. This monitoring function connects to the level 1 function Chapter 9.

Application conditions

Activation: LV_TQI_MON_ACT_MON ==1

Deactivation: otherwise

Initialisation: for condition see Application Incidences of Process Monitoring In case of switch off the engine LV_ES = 0 to 1 or reset: LV...MON = 0

Update Rate: 40 ms in general, exception voltage switch detection in 10 ms (this is realised by calling chapter 1.16.1 Acquisition of sport-mode-switch for monitoring" within each service task (see "Order of actions calls" at the beginning of this document)

Formula section:

Detection of tip switch position:

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Application conditions:

Update rate: 10ms this in necessary to connect to level 1 because of monitoring 3 evaluation Cycles.

if (1) LV_VAR_BN = 0
then (1)
if (2) LV_ERR_SOF_REQ = 0
then (2)
if (3) (V_SOF_SWI_MON$_{n-1}$ $>$ C_V_SOF_SWI_ON_TOL_MON) changes to (C_V_SOF_SWI_ON_BOL_MON $\leq$ V_SOF_SWI_MON$_{n}$ $\leq$ C_V_SOF_SWI_ON_TOL_MON)
(equal to 0 ->1)
and *this result is valid for 3 evaluations*
then (3) LV_SOF_SWI_MON **= !** LV_SOF_SWI_MON
endif (3)
else (2) LV_SOF_SWI_MON = 0
endif (2)
else (1)
if (4) LV_ERR_BN_VEH_MOD = 0 **and**
LV_ERR_CAN_BOFF = 0 **and**
LV_ERR_BN_GEAR_REV = 0 **and**
(STATE_VEH_MOD = 2H OR ((LC_VAR_SPT_SWI=1) AND (STATE_SPT_DISP_CAN=1H)))
then (4) LV_SOF_SWI_MON= 1
else (4) LV_SOF_SWI_MON = 0
endif (4)
endif (1)

Calculation of LV_SOF_SWI_REQ_MON:
If (LV_CITY = 0 or LC_CONF_CITY_ENA_MON =1) **and**
CONF_SOF_SWI 2 **and**
LC_VAR_SOF_SWI_MON = 1 **and**
LV_ERR_SOF_INH_MON = 0 **and**
LV_SOF_SWI_MON = 1
then LV_SOF_SWI_REQ_MON = 1
else LV_SOF_SWI_REQ_MON = 0
endif

E.6.15.2 Low range detection (LV_RNG_L)

Description:

Depending on LC_RNG_L_MON, the sport-switch and the LV_RNG_L_AT_MON -request from EGS the bit LV_RNG_L_MON will be activated.

Meaning of C_STATE_ETCU_PROG_INFO_MON:

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Bit	LV_RNG_L_AT_MON will be set at condition:
0	*AT / TCT in "S" / "DS" ("comfort transmission"; LV_VAR_ETCU_SPT=0)*
1	*AT / TCT in manual mode "M1 ... 6" ("comfort transmission"; LV_VAR_ETCU_SPT=0)*
2	*AT- / TCT-sport-switch in "S" / "DS" ("sport transmission"; LV_VAR_ETCU_SPT=1)*
3	*AT- / TCT-sport-switch in manual mode "M1 ... 6" ("sport transmission"; LV_VAR_ETCU_SPT=1)*
4	*Gearbox-sportswitch active and AT / TCT ("comfort transmission"; LV_VAR_ETCU_SPT=0)*
5	*Gearbox-sportswitch active and AT / TCT ("sport transmission"; LV_VAR_ETCU_SPT=1)*
6	*always with MT*
7	*not used*

Formula section:

If

AT /TCT "comfort" in "S-mode"
[STATE_ETCU_PROG_INFO = 1H **and**
LV_VAR_ETCU_SPT = 0 **and**
Bit 0 of C_STATE_ETCU_PROG_INFO_MON is set**]** **or**

AT /TCT "comfort" in "M-mode"
[STATE_ETCU_PROG_INFO = 2H **and**
LV_VAR_ETCU_SPT = 0 **and**
Bit 1 of C_STATE_ETCU_PROG_INFO_MON is set**]** **or**

AT/TCT "sport" in "S-mode"
[STATE_ETCU_PROG_INFO = 1H **and**
LV_VAR_ETCU_SPT = 1 **and**
Bit 2 of C_STATE_ETCU_PROG_INFO_MON is set**]** **or**

AT/TCT "sport" in "M-mode"
[STATE_ETCU_PROG_INFO = 2H **and**
LV_VAR_ETCU_SPT = 1 **and**
Bit 3 of C_STATE_ETCU_PROG_INFO_MON is set**]** **or**

AT /TCT "comfort" in "sport-mode-gearbox"
[LV_VAR_ETCU_SPT = 0 **and**
LV_ETCU_SPT_SWI = 1 **and**
Bit 4 of C_STATE_ETCU_PROG_INFO_MON is set**]** **or**

AT /TCT "sport" in "sport-mode-gearbox"
[LV_VAR_ETCU_SPT = 1 **and**
LV_ETCU_SPT_SWI = 1 **and**
Bit 5 of C_STATE_ETCU_PROG_INFO_MON is set**]** **or**

MT continious in "sport"-mode
[LV_AT = 0 **and** LV_VAR_AMT = 0 **and** LV_VAR_TCT = 0 **and**
Bit 6 of C_STATE_ETCU_PROG_INFO_MON is set**]**

Then LV_RNG_L_AT_MON = 1
Else LV_RNG_L_AT_MON = 0
Endif

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IF LC_RNG_L_MON = 1 **or** *// request from application system*
LV_SOF_SWI_REQ_MON = 1 **or** *// request from sport switch*
LV_RNG_L_AT_MON = 1 *// request from gearbox*
Then LV_RNG_L_MON = 1
Else LV_RNG_L_MON= 0
Endif

E.6.15.3 Pedal value interpretation for monitoring

FUNCTION DESCRIPTION:

General information:

Depending on gear mode LV_RNG_L_MON (LV_RNG_L_MON =1) two maps can be calibrated with different pedal value interpretation for normal and low range mode. For this the switch condition LV_SWI_FAC_TQ_REQ_MON is triggered.
Because of the different recurrences of level 1 (10ms) and level 2 (40 ms) and the not regarded driver progression correction of level 1, the switch to the RNG_L_MON progression of monitoring follows by fulfilled conditions after switch of level 1 LV_RNG_L_REQ.

Application conditions

Activation: LV_TQI_MON_ACT_MON = 1
Deactivation: otherwise
Initialisation: for condition see Application Incidences of Process Monitoring
LV_SWI_FAC_TQ_REQ_MON= 0
Update Rate: 40 ms

Formula section:

IF PV_AV_MON < C_PV_AV_SOF_MIN_MON **or**
FAC_TQ_REQ_DRIV_MON > C_FAC_TQ_REQ_DRIV_SOF_MAX_MON **or**
PV_AV_GRD > C_PV_AV_GRD_SOF_MAX_MON
for at least C_T_PV_AV_GRD_SOF_MAX_MON
THEN LV_CDN_RNG_L_REQ_MON = 1
ELSE LV_CDN_RNG_L_REQ_MON = 0
ENDIF

IF (LV_RNG_L_MON = 1 **or** LC_RNG_L_MAN_AS_MON = 1)
and
(STATE_GEAR_REV_CAN = 0
and
STATE_GEAR_REV_AT_AMT = 0 (no reverse gear active))
and
LV_RNG_L_REQ = 1 (Level 1 has switched))
and
{ *To activate IP_FAC_TQ_REQ_DRIV_1_MON following conditions has to be checked. After activating this conditions are not used any more.*
LV_SWI_FAC_TQ_REQ_MON = 0
and

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[LV_SOF_SWI_REQ_MON changes from 0 -> 1 **or**
LV_RNG_L_AT_MON changes from 0 -> 1 **or**
STATE_GEAR_REV_CAN changes from 1 -> 0 **or**
STATE_GEAR_REV_AT_AMT changes from 1 -> 0**]**
and
[LV_CDN_RNG_L_REQ_MON = 1 **or**
LV_CDN_RNG_L_REQ_MON $_{n-1}$ = 1 **]}**

THEN LV_SWI_FAC_TQ_REQ_MON = 1
ELSE
IF(2) **(**STATE_GEAR_REV_CAN = 1 **OR**
STATE_GEAR_REV_AT_AMT = 1 (reverse gear active) **OR**
LV_RNG_L_REQ = 0**)**
THEN(2)
LV_SWI_FAC_TQ_REQ_MON = 0
ENDIF(2)
ENDIF

E.6.15.4 Sport switch voltage range check monitoring diagnosis

FUNCTION DESCRIPTION:

General information:

This diagnosis is for checking the range of input signal voltage from the sport-mode-switch in compare to level one diagnosis.

Application conditions

Activation: `LV_VAR_BN = 0` **and**
`LV_IGK_MON = 1` **and**
`CONF_SOF_SWI = 1` **and**
`LV_ERR_BN_GEAR_REV = 0` **and**
`LV_ERR_SOF_REQ = 0`

Deactivation: `otherwise`

Initialisation: `for condition see Application Incidences of Process Monitoring`
at reset or LV_IGK_MON = 0 1 all 0

Update Rate: `40 ms`

Formula section:

If **[**(V_SOF_SWI_MON < C_V_SOF_SWI_MIN_MON (Short circuit to ground)
AND
CONF_SOF_SWI = 1)
or
V_SOF_SWI_MON > C_V_SOF_SWI_MAX_MON (Short circuit to Ubatt or open line)**]**
and
LV_ERR_SOF_REQ = 0
Then LV_ERR_SOF_INH_MON = 1 after debounce
The ETC Monitoring "Debounce mechanism" is used
Endif

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E.6.16 Driving off assistance monitoring

FUNCTION DESCRIPTION:

The function Driving off assistance shall prevent the engine from stalling at driving off. This is shown by LV_N_SP_IS_CS = 1.
An extra torque request is calculated under individual conditions. While this extra torque is effective. Using the handshake to level 1 Please verify that LV_ISC_OFF_DROF in Level one is calibrated to 1.

Application conditions

Activation: LV_TQI_MON_ACT_MON = 1 **and** LV_ERR_CRK = 0 **and**LV_AT = 0 **and** LV_ERR_VS = 0 **and** LV_ERR_PVS = 0 **and** LV_VAR_AMT = 0 **and**
LV_VAR_TCT = 0 **and** N_32_MON < C_N_32_TQ_DROF_MAX_MON

Deactivation: LV_TQI_MON_ACT_MON = 0 **or** LV_ERR_CRK = 1 **or** LV_AT = 1***or***
LV_ERR_VS = 1 **or** LV_ERR_PVS = 1 **or** LV_VAR_AMT = 1 **or**
LV_VAR_TCT = 1 **or** N_32_MON C_N_32_TQ_DROF_MAX_MON

Initialisation: at ECU-reset **or** at function deactivation:
all = 0 (phy)

Recurrence: 40 ms

Formula section:

LV_CS_MON is read direct on the clutch switch pinning input.
TQ_AV_MON = TQI_AV_MON + TQ_LOSS_MON
N_DIF_DROF_MON = IP_FAC_N_GRD_TQ_AV_MON * C_N_DIF_ADD_DROF_MON +
N_DIF_SP_IS_MON

If N_DIF_DROF_MON <= C_N_DIF_DROF_MAX_MON **and**
N_DIF_DROF_MON >= C_N_DIF_DROF_MIN_MON **and**
LV_CS_MON ==1 **and**
ID_TQ_DROF_ENA_MON == 1 **and**
LV_ISC_OFF_DROF == 1 /*check if level 1 is active*/
Then LV_TQ_DROF_ACT_MON == 1
Else LV_TQ_DROF_ACT_MON == 0
Endif
If LV_TQ_DROF_ACT_MON == 1
Then TQ_DROF_MDL_MON = IP_TQ_DROF_MON *
IP_FAC_TQ_DROF_FAC_TQ_REQ_MON *
IP_FAC_TQ_DROF_VS_MON
Else TQ_DROF_MDL_MON $_{n}$= TQ_DROF_MDL_MON $_{n-1}$ -
IP_TQ_DROF_GRD_DEAC_MON
Endif
TQ_DROF_MON =
MIN(MAX(TQ_DROF_FAST;TQ_DROF_SLOW);TQ_DROF_MDL_MON)

E.6.17 Application incidences for the desired indicated engine torque

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FUNCTION DESCRIPTION:

General information:

The torque demands from cruise control, electronic gear shift control and the electronic stability program are set to zero, if these functions are not available. Otherwise, the torque demands have to be copied to the corresponding variable of level 2 and these variables have to be checked for plausibility (e.g. CAN monitoring, CRU monitoring, control units [ESP, EGS] with internal plausibility check).
For torque request at trailing throttle (TQI_MIN_PU_MON) the map output TQI_MIN_PU_MAX_MON (monitoring threshold) will be taken into account. For consideration of the torque setpoint offset at engine start the corresponding torque value is added to TQI_MIN_PU_MAX_MON. After engine start this value is set to "0".

Application conditions

Activation: LV_TQI_MON_ACT_MON = 1
Deactivation: otherwise
Initialisation: All 0 for condition see Application Incidences of Process Monitoring
Update Rate: 40 ms

Formula section:

E.6.17.1 Calculation of PV_AV_AD_MON

FAC_PV_BAS_COR_MON = IP_FAC_PV_BAS_COR_MON (N32_MON; PV_AV_MON) *IP_FAC_VS_PV_BAS_COR_MON (VS_MON)
FAC_PV_COR_MON = min(1;max(0;FAC_PV_BAS_COR_MON))
PV_AV_AD_MON = PV_AV_MON*(1 - FAC_PV_COR_MON)

E.6.17.2 Calculation of external torque demand from TCT

TQI_N_CTL_TCT_MON = max (TQI_N_CTL_TCT_FAST ; TQI_N_CTL_TCT_SLOW)

E.6.17.2.1 Integrated torque request monitoring

If TQI_N_CTL_TCT_MON >= C_MIN_TQI_N_CTL_TCT_MON
Then INT_TQI_N_CTL_TCT_MON = **MIN{**C_INT_MAX_TQI_N_CTL_TCT_MON;
MAX(C_INT_MIN_TQI_N_CTL_TCT_MON ;
INT_TQI_N_CTL_TCT_MON$_{k-1}$ + (TQI_N_CTL_TCT_MON *
(C_CRLC_TQI_N_CTL_TCT_PLAUS_MON * 0,04s)))**}**
Else INT_TQI_N_CTL_TCT_MON = **MIN{** C_INT_MAX_TQI_N_CTL_TCT_MON;
MAX(C_INT_MIN_TQI_N_CTL_TCT_MON ;
INT_TQI_N_CTL_TCT_MON$_{k-1}$ -
C_DEC_INT_TQI_N_CTL_TCT_MON)**}**
Endif
If INT_TQI_N_CTL_TCT_MON = C_INT_MAX_TQI_N_CTL_TCT_MON
Then LV_INT_TQI_N_CTL_TCT_MON = 1
Else LV_INT_TQI_N_CTL_TCT_MON = 0
Endif

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E.6.17.2.2 Maximum request time monitoring

If TQI_N_CTL_TCT_MON $>=$ C_MIN_TQI_N_CTL_TCT_MON
Then T_TQI_N_CTL_TCT_MON$_k$ =
MIN(T_TQI_N_CTL_TCT_MON$_{k-1}$ + 40 ms ;
C_T_MAX_TQI_N_CTL_TCT_MON)
Else T_TQI_N_CTL_TCT_MON$_k$ = T_TQI_N_CTL_TCT_MON$_{k-1}$ -
C_DEC_T_TQI_N_CTL_TCT_MON
Endif

If T_TQI_N_CTL_TCT_MON = C_T_MAX_TQI_N_CTL_TCT_MON
Then LV_T_MAX_TQI_N_CTL_TCT_MON = 1
Else LV_T_MAX_TQI_N_CTL_TCT_MON = 0
Endif

E.6.17.2.3 Maximum torque request monitoring

IF TQI_N_CTL_TCT_MON $>$ IP_TQ_MAX_TQI_N_CTL_TCT_MON
Then T_TQI_N_CTL_TCT_MAX_MON$_k$ =
MIN(T_TQI_N_CTL_TCT_MAX_MON$_{k-1}$ + 40 ms ;
C_T_MAX_TQI_N_CTL_TCT_MAX_MON)
Else T_TQI_N_CTL_TCT_MAX_MON$_k$ = T_TQI_N_CTL_TCT_MAX_MON$_{k-1}$ -
C_DEC_T_TQI_N_CTL_TCT_MAX_MON
Endif

IF T_TQI_N_CTL_TCT_MAX_MON = C_T_MAX_TQI_N_CTL_TCT_MAX_MON
Then LV_TQ_MAX_TQI_N_CTL_TCT_MON = 1
Else LV_TQ_MAX_TQI_N_CTL_TCT_MON = 0
Endif

E.6.17.2.4 Inbhibition of external torque demand from TCT

IF LV_INT_TQI_N_CTL_TCT_MON = 1 or
LV_T_MAX_TQI_N_CTL_TCT_MON = 1 or
LV_TQ_MAX_TQI_N_CTL_TCT_MON = 1
Then LV_INH_TQI_N_CTL_TCT_MON = 1
TQI_N_CTL_TCT_MON = 0 Nm
Endif

E.6.17.3 Calculation of external torque demands

TQI_INC_EXT_MON = MAX(TQI_INC_CAN_MON ; TQI_N_CTL_TCT_MON)

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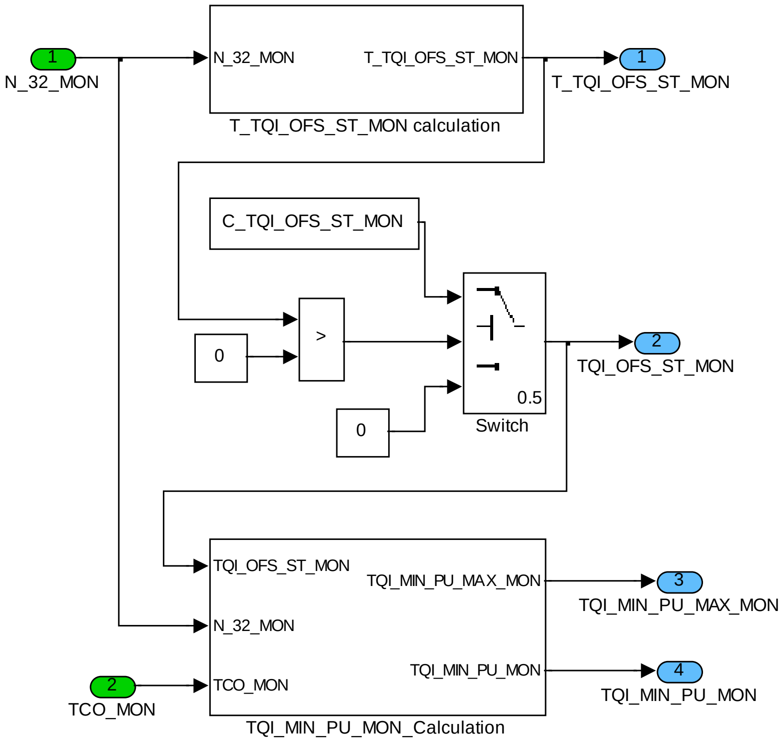
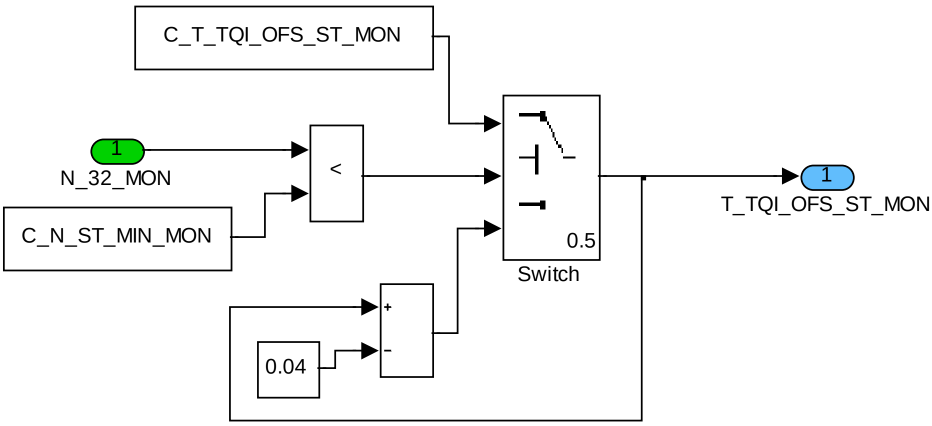
E.6.17.4 Minimum indicated engine torque in trailing throttle with consideration of torque setpoint offset at engine start



Appl.INC_Desired_indicated_torque/Plausibilis. of minimum indicated torque in PU



Appl.INC_Desired_indicated_torque/Plausibilis. of minimum indicated torque in PU/T_TQI_OFS_ST_MON calculation

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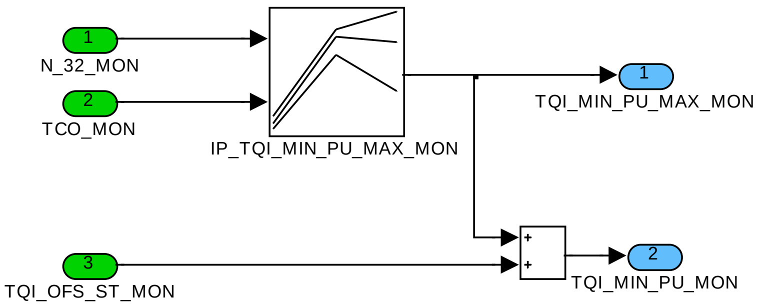

Appl.INC_Desired_indicated_torque/Plausibilis. of minimum indicated torque in PU/TQI_MIN_PU_MON_ Calculation

E.6.18 Application incidences for the combustion mode switch request

General information:

FUNCTION DESCRIPTION:

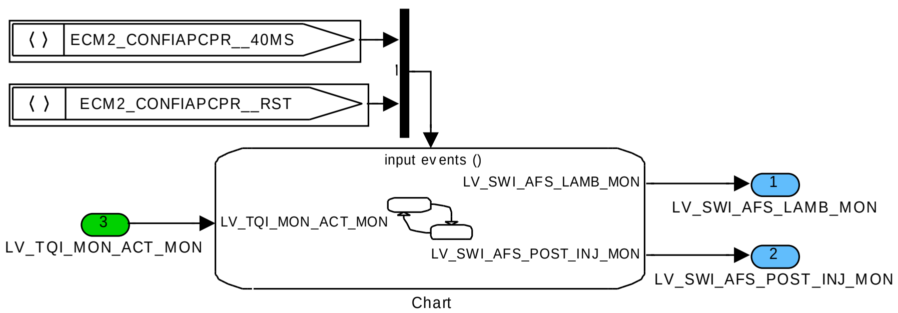

Figure E.6.26: : ECM2_CONFIAPCPR

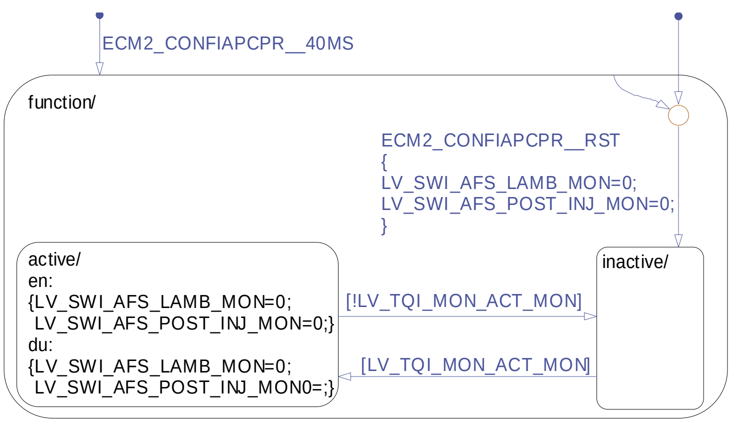

Figure E.6.27: : ECM2_CONFIAPCPR/Chart

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E.6.19 Application incidences for the actual fuel mass flow

Application conditions

Activation: LV_TQI_MON_ACT_MON = 1

Deactivation: LV_TQI_MON_ACT_MON = 0

Initialisation: for condition see Application Incidences of Process Monitoring
FAC_MFF_WUP_CUS_MON = 1
IDX_TI_1_MON = 0
IDX_TI_2_MON = 0
IDX_TI_POST_MON = 0
TI_1_MON = 0
TI_2_MON = 0
TI_POST_MON = 0

Recurrence: 40ms

FUNCTION DESCRIPTION:

General information:

Dependent from OPM_AV_MON different fuel mass flow corrections for the warm-up phase are considered in FAC_MFF_WUP_CUS_MON.
According to LC_CUR_SHP_INJ_ENA_MON either IDX_TI_x_MON or TI_x_MON are used for the module actual fuel mass flow.
When MFMA is activated, is:
Either
IDX_TI_1_MON the total monitored injection index
Or
TI_1_MON the total monitored injection time.

Signal flow diagram:

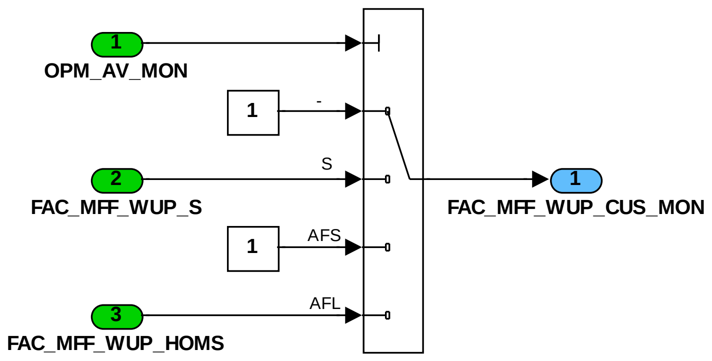

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Figure E.6.28: : FAC_MFF_WUP_CUS_MON

IDX_TI_x_MON/TI_x_MON calculation:

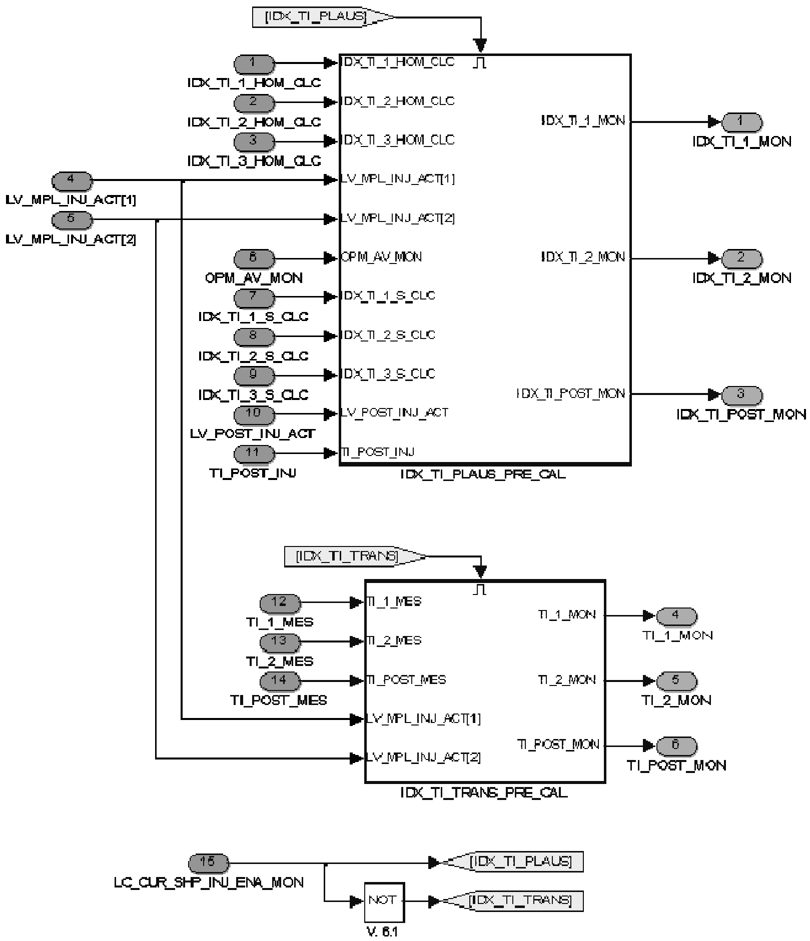

Figure E.6.29: : IDX_INDEX_CALCULATION

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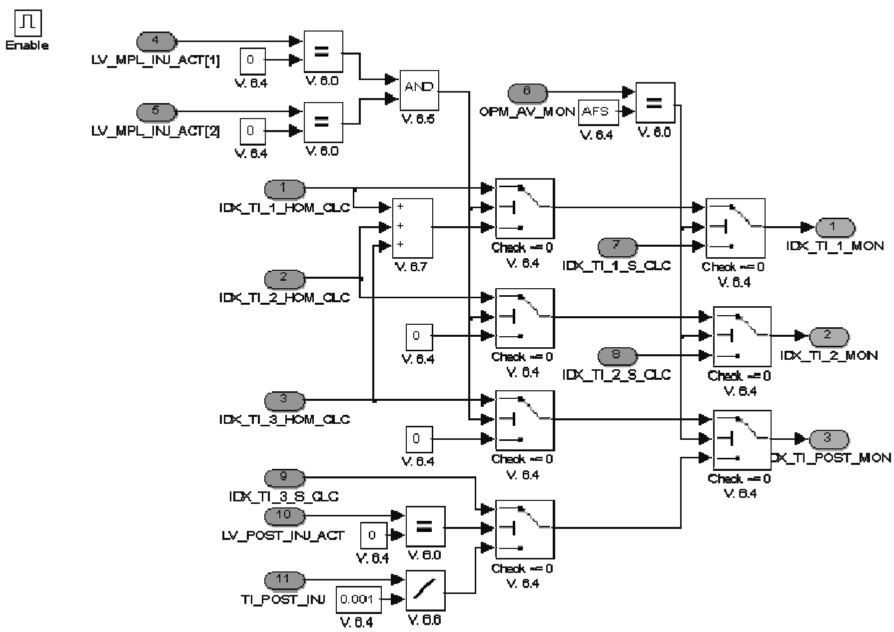

Figure E.6.30: : IDX_TI_PLAUS_PRE_CAL

In the Figure 3. the determination of LV_POST_INJ_ACT is only done for stratified mode, because in the active homogenous mode it is not active. The Lambda adaption is only carried out in the homogenous state, then the part of LV_MPL_INJ_ACT for stratified mode is deleted in compare to the earlier version

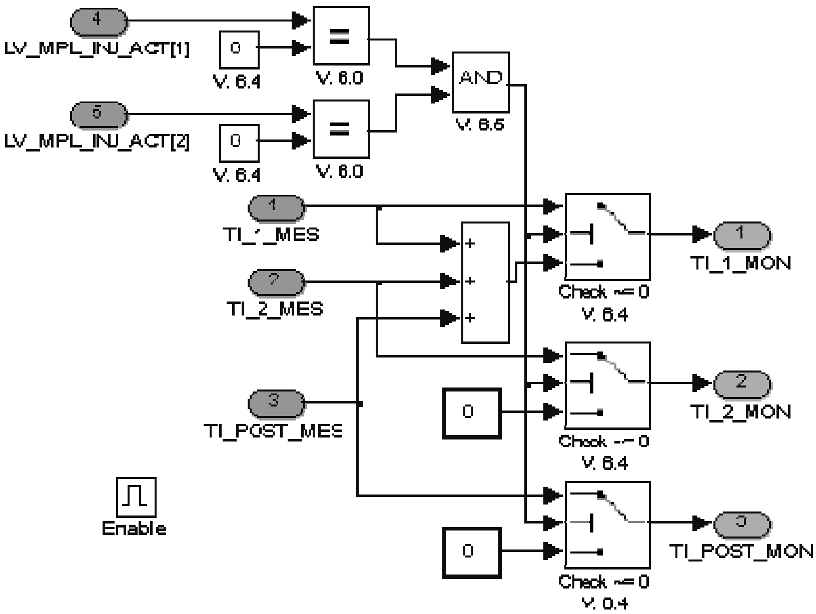

Figure E.6.31: : IDX_TI_TRANS_PRE_CAL

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E.7 Debounce mechanism

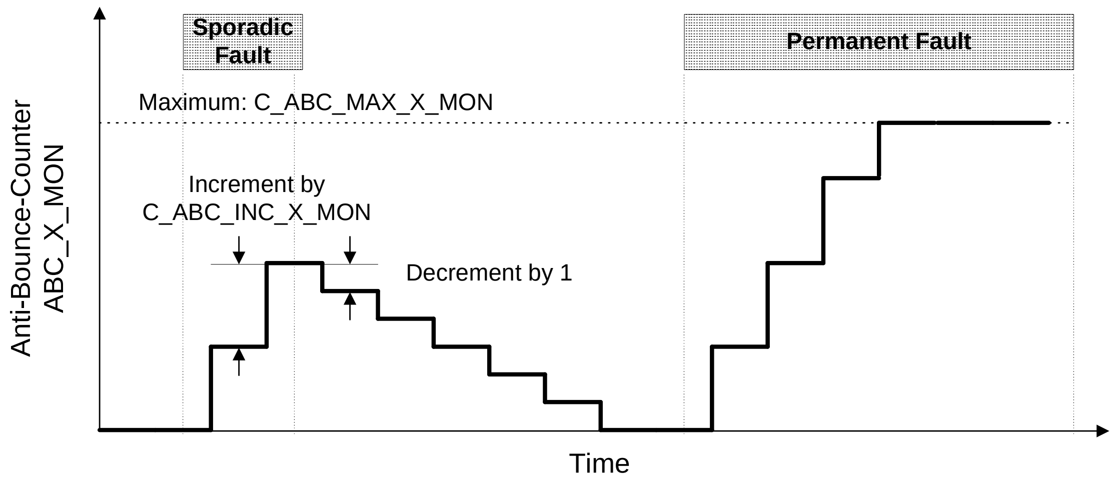
FUNCTION DESCRIPTION:

General information:

Many diagnosis algorithms need a debounce mechanism in order to avoid a faulty diagnosis caused by normal disturbances. Since the process monitoring is intended to represent redundancy to the functions of level 1, there is also a redundant debounce mechanism required. That means an algorithm with separate code, ROM- and RAM data. The debounce algorithm is used for the functions of level 2 and 2 (copy of process monitoring).

Description:

The anti-bounce-counter ABC_X_MON is increased by C_ABC_INC_X_MON, if the conditions for fault detection are fulfilled. Otherwise, the anti-bounce counter is decremented by 1. If the anti-bounce-counter ABC_X_MON exceeds its threshold C_ABC_MAX_X_MON the first time during this engine running, the relating error-flag is set and a fault can be stored in the customer error memory.



Application conditions:

The activation, deactivation and recurrency of this module depends on the data of the related diagnosis function.

Formula section:

IF (Fault detection condition fulfilled)
THEN
    Increment ABC_X_MON by C_ABC_INC_X_MON
    (limited to C_ABC_MAX_X_MON)
ELSE
    Decrement ABC_X_MON by 1 (limited to 0)

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E.8 Desired indicated engine torque

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_REQ_DRIV_MON	O/V	0... FFH	0... 1.99218	0.0078125	-
Scaling factor for requested torque at clutch from driver					
FAC_TQ_REQ_MON	O/V	0... FFH	0... 1.99218	0.0078125	-
Scaling factor for requested torque at clutch from driver and cruise control					
T_TQI_MON	V	0... FFH	0... 10.2	0.04	s
dead time counter for torque decrease					
TQI_REQ_TOT_MON	V	0... FFH	0... 510	2	Nm
Desired non-filtered indicated engine torque					
TQI_SP_MON	O/V	0... FFH	0... 510	2	Nm
Desired indicated engine torque					

Input data:

FAC_TQ_REQ_CRU_MON {p. 6912}	LV_SWI_FAC_TQ_REQ_MON {p. 6791}	LV_TQI_MON_ACT_MON {p. 6791}	N_32_MON {p. 7002}
PV_AV_AD_MON {p. 6792}	TQ_DIF_P_D_IS_MON {p. 6793}	TQ_DROF_MON {p. 6793}	TQ_LOSS_MON {p. 6975}
TQ_MAX_CLU_MON {p. 6938}	TQ_MIN_CLU_MON {p. 6952}	TQI_INC_EXT_MON {p. 6794}	TQI_MIN_PU_MON {p. 6794}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_TQI_SP_MON	-	0... FFH	0... 0.99609	3.9063e-3	-
filter constant for realization of first order filter					
C_T_TQI_MON	-	0... FFH	0... 10.2	0.04	s
Dead time for torque decrease					
IP_FAC_TQ_REQ_DRIV_1_MON	V	0... FFH	0... 1.99218	0.0078125	-
LDPM_N_32_MON_IP_FAC_TQ_MON	8	0... FFH	0... 8160	32	rpm
LDPM_PV_AV_AD_MON_IP_FAC_MON	8	0... FFH	0... 99.60937	0.390625	%
Scaling factor for requested torque at clutch from driver in other mode					
IP_FAC_TQ_REQ_DRIV_MON	V	0... FFH	0... 1.99218	0.0078125	-
LDPM_N_32_MON_IP_FAC_TQ_MON	8	0... FFH	0... 8160	32	rpm
LDPM_PV_AV_AD_MON_IP_FAC_MON	8	0... FFH	0... 99.60937	0.390625	%
Scaling factor for requested torque at clutch from driver					

Import actions:

ACTION_ECM3_Service6TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service7TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service8TaskPfm (**IN**<No Name available>)

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E.8.1 ECM2_DTSYSTQISP

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The argument has the value 4.

ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service6TaskPfm() and ACTION_ECM3_Service7TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT<>,OUT<>,IN<>)
ACTION_ECM3_ChkCpl(IN<>, IN<>)
ACTION_ECM3_ReadChkCpl(OUT<>,IN<>, IN<>)

Note: This actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

General information:

The objective of this module is to calculate the desired indicated engine torque which derives from the function level (level 1). All torque increasing demands are taken into account. The different parts are:

- calculation of scaling factor for requested torque at clutch from driver (FAC_TQ_REQ_MON) in different operation modes, depending on engine speed (N_32_MON) and adapted accelerator pedal activation degree (PV_AV_AD_MON)
- calculation of requested torque at clutch from driver
- switch from brake torque to indicated torque demands
- adding the torque request for drive off assistance
- filtering the raw torque demand in falling direction to take into account the system response time
- maximum choice between internal and external torque demands
- If the engine is in the trailing throttle state i.e. no driver demand but limitation on indicated engine torque to ensure a safe combustion at low load conditions, then the torque setpoint in L2 is limited by TQI_MIN_PU_MON.
- adding internal increasing torque demands (TQ_DIF_P_D_IS_MON)

Application Condition

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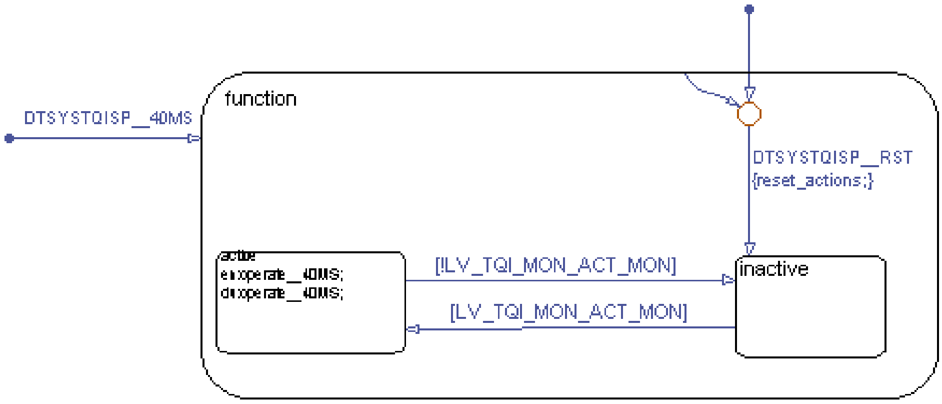

Initialisation(DTSYSTQISP__RST): for condition see Application Incidences of Process Monitoring .

Function Description

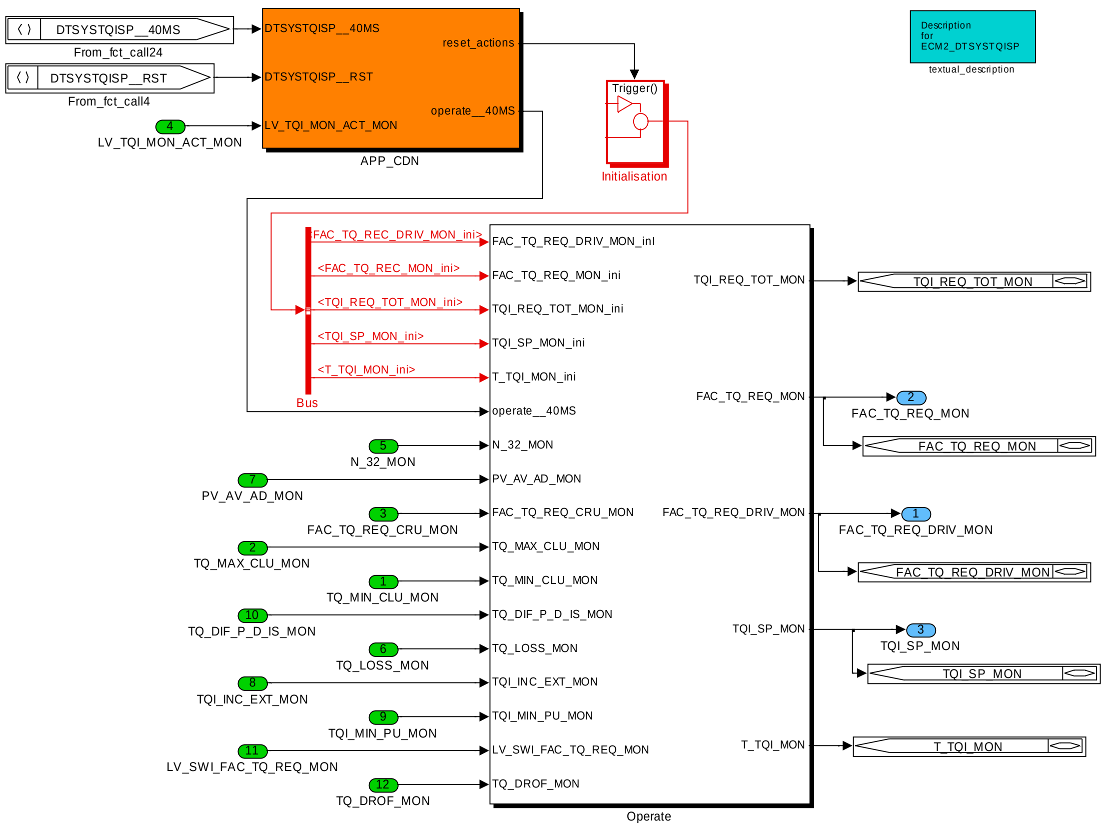

Figure E.8.1: ECM2_DTSYSTQISP

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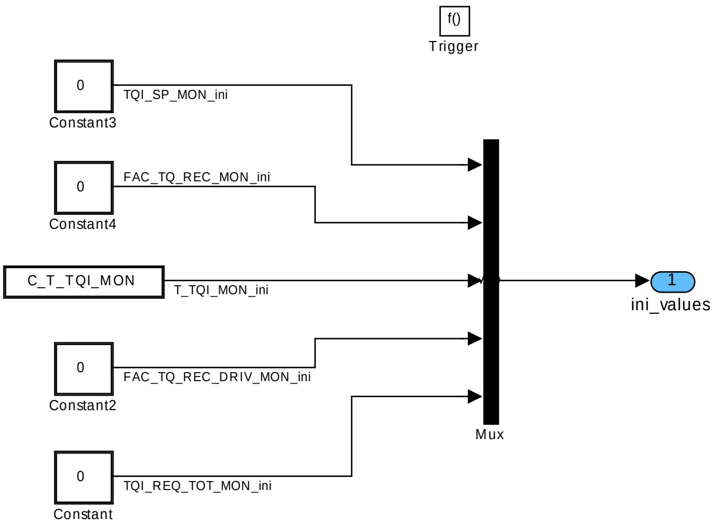

Figure E.8.2: ECM2_DTSYSTQISP/Initialisation

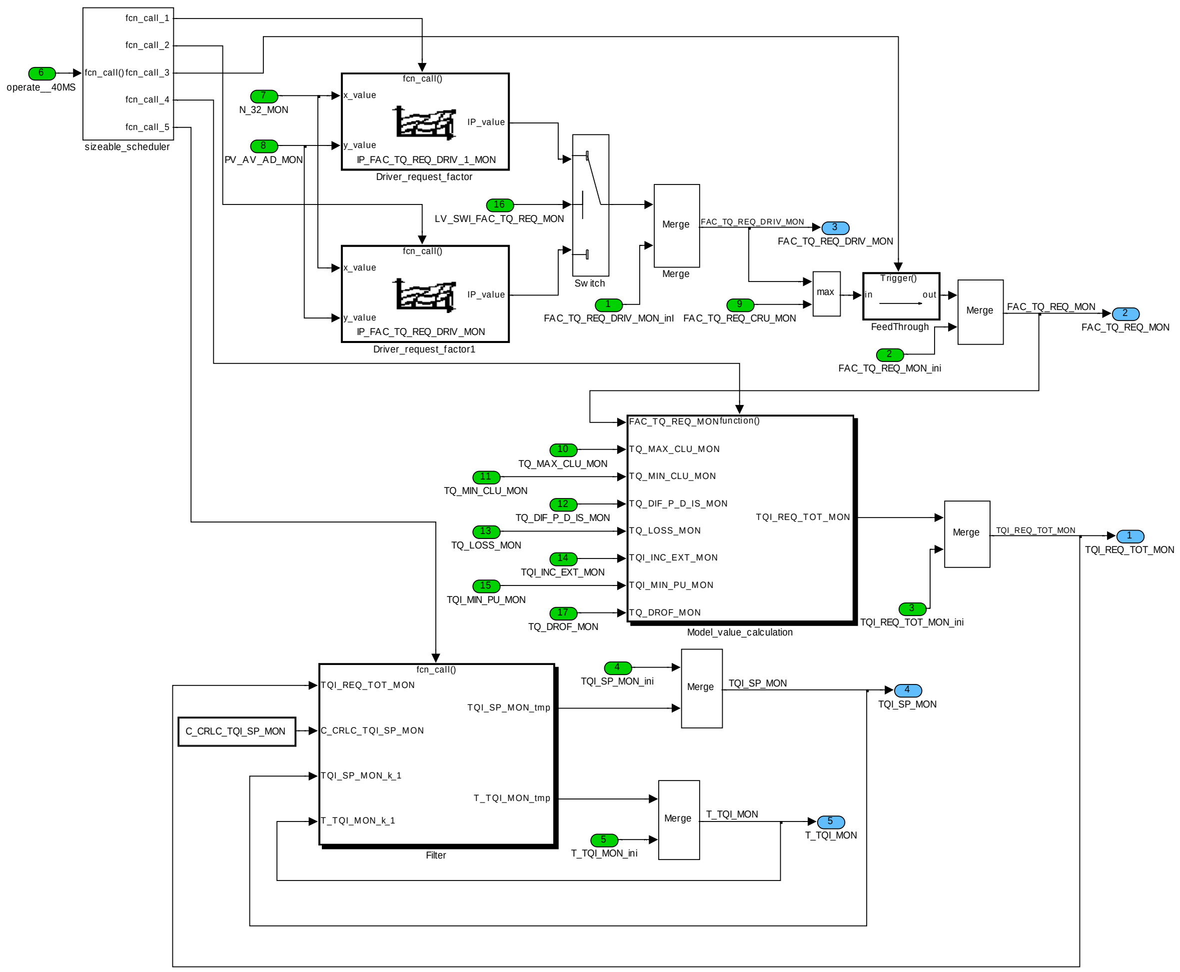

Figure E.8.3: ECM2_DTSYSTQISP/Operate

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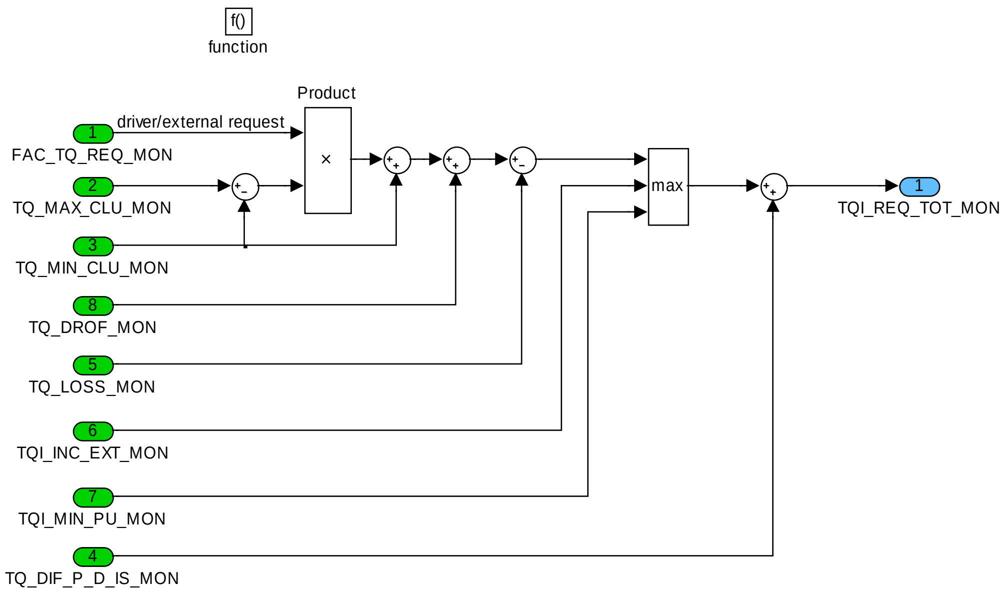

Figure E.8.4: ECM2_DTSYSTQISP/Operate/Model_value_calculation

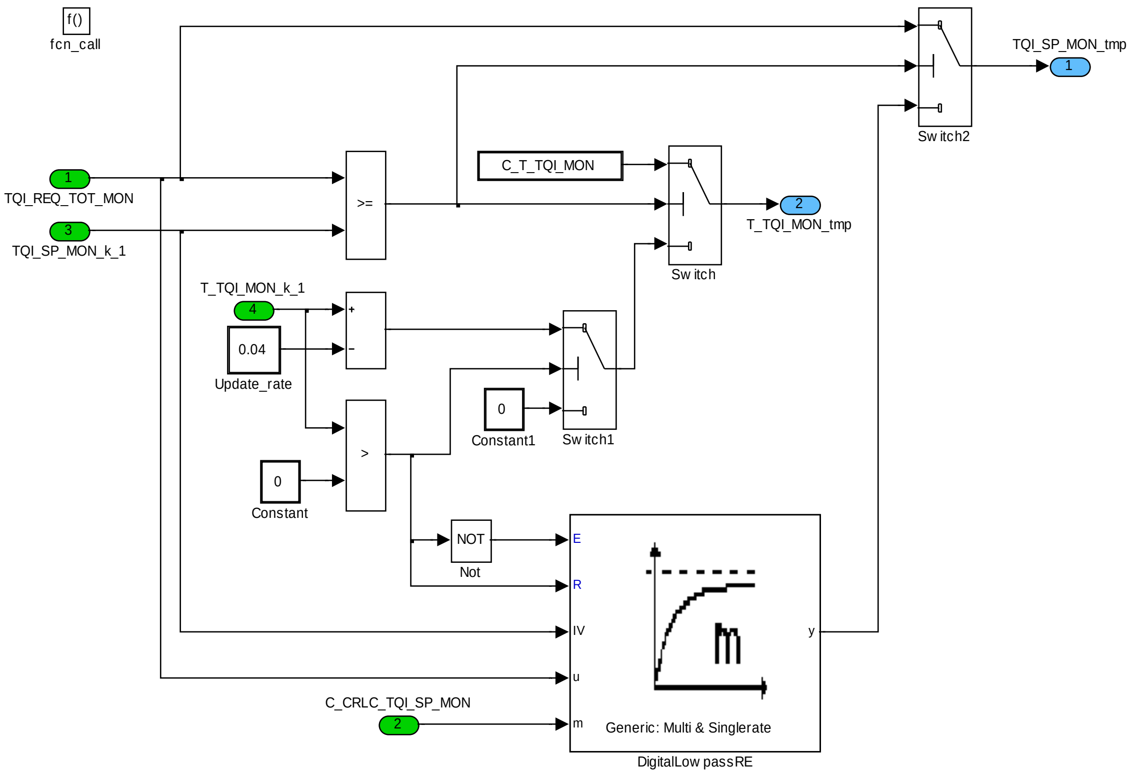

Figure E.8.5: ECM2_DTSYSTQISP/Operate/Filter

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E.9 Error memory management of process monitoring

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_SWI_AFS_MON	O/V/S	0... FFH	0... 255	1	-
Reset resistant counter for number of AFS requests by monitoring					
ERR_SYM_CONV_MON_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom A/D conversion Monitoring error reflect to level 1					
ERR_SYM_CRU_INH_MON_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom CRU Monitoring error reflect to level 1					
ERR_SYM_MFF_MON_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom for mass fuel flow monitoring error					
ERR_SYM_N_32_MON_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom Engine speed Monitoring error reflect to level 1					
ERR_SYM_PVS_MON_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom PVS Monitoring error reflect to level 1					
ERR_SYM_SWI_AFS_MON	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
For each symptom : status of failure (set to 1 when failure symptom detected)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ERR_SYM_TPS_MON_1	O/V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom TPS Monitoring error reflect to level 1					
ERR_SYM_TQ_DIF_ISC_MON_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom ISC Monitoring error reflect to level 1					
ERR_SYM_TQ_EXT_MON_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom Max Torque at Clutch Monitoring error reflect to external torque level 1					
ERR_SYM_TQ_REQ_MON_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom Min torque at Clutch Monitoring error reflect to level 1					
ERR_SYM_TQI_AV_MON_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom Actual indicated engine torque Monitoring error reflect to level 1					
ERR_SYM_TQI_N_MAX_MON_1	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom Torque limitation Monitoring error reflect to level 1					
LV_CDN_DIAG_CONV_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition A/D conversion Monitoring error reflect to level 1					
LV_CDN_DIAG_CRU_INH_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition CRU Monitoring error reflect to level 1					
LV_CDN_DIAG_MFF_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition mass fuel flow monitoring error reflect to level 1					
LV_CDN_DIAG_N_32_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition Engine speed Monitoring error reflect to level 1					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CDN_DIAG_PVS_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition PVS Monitoring error reflect to level 1					
LV_CDN_DIAG_SWI_AFS_MON	O/V	0... 1H	0 ...1	1	-
Diagnostic condition to start symptom detection (set to 1 when condition is fulfilled)					
LV_CDN_DIAG_TPS_MON_1	O/V	0... 1H	0 ...1	1	-
Diagnosis condition TPS Monitoring error reflect to level 1					
LV_CDN_DIAG_TQ_DIF_ISC_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition ISC Monitoring error reflect to level 1					
LV_CDN_DIAG_TQ_EXT_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition Max Torque at Clutch Monitoring error reflect to external torque level 1					
LV_CDN_DIAG_TQ_REQ_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition Min torque at Clutch Monitoring error reflect to level 1					
LV_CDN_DIAG_TQI_AV_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition Actual indicated engine torque Monitoring error reflect to level 1					
LV_CDN_DIAG_TQI_N_MAX_MON_1	V	0... 1H	0 ...1	1	-
Diagnosis condition Torque limitation Monitoring error reflect to level 1					
LV_END_DIAG_CONV_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis 1 A/D conversion Monitoring error reflect to level 1					
LV_END_DIAG_CRU_INH_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis CRU Monitoring error reflect to level 1					
LV_END_DIAG_MFF_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis of mass fuel flow monitoring error reflect to level 1					
LV_END_DIAG_N_32_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis Engine speed Monitoring error reflect to level 1					
LV_END_DIAG_PVS_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis PVS Monitoring error reflect to level 1					
LV_END_DIAG_SWI_AFS_MON	O/V	0... 1H	0 ...1	1	-
Diagnostic of AFS request by monitoring performed at least one time					
LV_END_DIAG_TPS_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis TPS Monitoring error reflect to level 1					
LV_END_DIAG_TQ_DIF_ISC_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis ISC Monitoring error reflect to level 1					
LV_END_DIAG_TQ_EXT_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis Max Torque at Clutch Monitoring error reflect to external torque level 1					
LV_END_DIAG_TQ_REQ_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis Min torque at Clutch Monitoring error reflect to level 1					
LV_END_DIAG_TQI_AV_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis Actual indicated engine torque Monitoring error reflect to level 1					
LV_END_DIAG_TQI_N_MAX_MON_1	O/V	0... 1H	0 ...1	1	-
End of diagnosis Torque limitation Monitoring error reflect to level 1					
LV_ERR_CONV_MON_1	O/V	0... 1H	0 ...1	1	-
A/D conversion Monitoring error reflect to level 1					
LV_ERR_CRU_INH_MON_1	O/V	0... 1H	0 ...1	1	-
CRU Monitoring error reflect to level 1					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_MFF_MON_1	O/V	0... 1H	0 ...1	1	-
Mass fuel flow monitoring error reflect to level 1					
LV_ERR_N_32_MON_1	O/V	0... 1H	0 ...1	1	-
Engine speed Monitoring error reflect to level 1					
LV_ERR_PVS_MON_1	O/V	0... 1H	0 ...1	1	-
PVS Monitoring error reflect to level 1					
LV_ERR_SWI_AFS_MON	O/V	0... 1H	0 ...1	1	-
Indicator: maximum number of AFS request by MFF-monitoring has been reached					
LV_ERR_TPS_MON_1	O/V	0... 1H	0 ...1	1	-
TPS Monitoring error reflect to level 1					
LV_ERR_TQ_DIF_ISC_MON_1	O/V	0... 1H	0 ...1	1	-
ISC Monitoring error reflect to level 1					
LV_ERR_TQ_EXT_MON_1	O/V	0... 1H	0 ...1	1	-
Max Torque at Clutch Monitoring error reflect to external torque level 1					
LV_ERR_TQ_REQ_MON_1	O/V	0... 1H	0 ...1	1	-
Min torque at Clutch Monitoring error reflect to level 1					
LV_ERR_TQI_AV_MON_1	O/V	0... 1H	0 ...1	1	-
Actual indicated engine torque Monitoring error reflect to level 1					
LV_ERR_TQI_N_MAX_MON_1	O/V	0... 1H	0 ...1	1	-
Torque limitation Monitoring error reflect to level 1					
LV_ERR_TQI_N_MAX_MON_1_SAVE	R2	0... 1H	0 ...1	1	-
N_LIM monitoring error saved reset resistant					

Input data:

LV_ERR_AMT_INH_MON {p. 6983}	LV_ERR_CONV_MON {p. 6894}	LV_ERR_CRU_MON {p. 6912}	LV_ERR_DCC_INH_MON {p. 6983}
LV_ERR_GS_INH_MON {p. 6983}	LV_ERR_LDM_INH_MON {p. 6983}	LV_ERR_MFF_MON {p. 6943}	LV_ERR_MSR_INH_MON {p. 6983}
LV_ERR_N_32_MON {p. 7002}	LV_ERR_OPM_AV_MON {p. 6790}	LV_ERR_PVS_MON {p. 6961}	LV_ERR_SOF_INH_MON {p. 6790}
LV_ERR_TPS_MON {p. 6943}	LV_ERR_TQ_DIF_I_IS_ MON {p. 6921}	LV_ERR_TQ_DIF_P_D_IS_ MON {p. 6921}	LV_ERR_TQ_LOSS_MON {p. 6975}
LV_ERR_TQ_MAX_CLU_ MON {p. 6938}	LV_ERR_TQ_MIN_CLU_ MON {p. 6952}	LV_ERR_TQI_AV_MON {p. 6899}	LV_ERR_TQI_N_MAX_ MON {p. 6917}
LV_SWI_AFS_MFF_MAX_ MON {p. 6943}	LV_TQI_MON_ACT_MON {p. 6791}	VB {p. 1185}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_SWI_AFS_MON	V	0... FFH	0... 255	1	-
Antibounce counter increment					
C_ABC_MAX_SWI_AFS_MON	V	1... FFH	1... 255	1	-
Maximum value for antibounce counter					
C_VB_MIN_MON_DIAG	V	0... FFH	0... 25.8984375	0.1015625	V
VB Threshold for activation of monitoring diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Import actions:

ACTION_ERRM_NoFilterReset (**IN**<PRM_IDX_DIAG>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_NoFilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_LV_ERR_SET>,**IN**<PRM_LV_ERR_RST>,**IN**<PRM_LV_END_DIAG>,**OUT**<PRM_LV_ERR>)

General information

FUNCTION DESCRIPTION:

General information:

When a fault is detected by the level 2 of the ETC-Monitoring concept and the reaction is released in the module 'fault reaction of process monitoring', the fault is transferred to the error memory management.
The memory area of all output data variables of this module is not permanently RAM tested,
the memory area of this module is not cyclic ROM tested.

Description:

Since the different faults can occur in a successive way, they are stored in different locations of the error memory.

All faults LV_ERR_XX_MON_1 are stored in separate locations, in order to be able to analyze a scenario of successive faults. If more than one errors stored in one location, then it will be detected by different error symptoms.

The information whether a warning lamp (ETC MIL) is switched on in case of an error can be found in the general OBD error code table.

Application conditions:

Initialisation:

```
- for condition see 'Application Incidences of Process Monitoring chapter 1.1'
-ACTION_ERRM_NoFilterReset(IN<CONV_MON>, OUT<LV_ERR_CONV_MON_1>)
-ACTION_ERRM_NoFilterReset(IN<N_32_MON>, OUT<LV_ERR_N_32_MON_1>)
-ACTION_ERRM_NoFilterReset(IN<TPS_MON>, OUT<LV_ERR_TPS_MON_1>)
-ACTION_ERRM_NoFilterReset(IN<PVS_MON>, OUT<LV_ERR_PVS_MON_1>)
-ACTION_ERRM_NoFilterReset(IN<CRU_INH_MON>, OUT<LV_ERR_CRU_INH_MON_1>)
-ACTION_ERRM_NoFilterReset(IN<MFF_MON>, OUT<LV_ERR_MFF_MON_1>)
-ACTION_ERRM_NoFilterReset(IN<TQ_DIF_ISC_MON>, OUT<LV_ERR_TQ_DIF_ISC_MON_1>)
-ACTION_ERRM_NoFilterReset(IN<TQ_REQ_MON>, OUT<LV_ERR_TQ_REQ_MON_1>)
-ACTION_ERRM_NoFilterReset(IN<TQ_EXT_MON>, OUT<LV_ERR_TQ_EXT_MON_1>)
-ACTION_ERRM_NoFilterReset(IN<TQI_AV_MON>, OUT<LV_ERR_TQI_AV_MON_1>)
```

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```
-ACTION_ERRM_NoFilterReset(IN<TQI_N_MAX_MON>, OUT<LV_ERR_
TQI_N_MAX_MON_1>)

 (these actions erases filter data (LV_CDN_DIAG_xx = 0, LV_
ERR_xx = 0, ERR_SYM_xx = NO_SYM
- For LV_ERR_N_MAX_MON_SAVE = 0, if a power up is recognized.
A power up is detected, if the variables in the reset safe
RAM are not consistent.
```

Activation: at every engine state

Deactivation: -

Recurrence: 40 ms

Function description:

Formula section:

E.9.1 Environmental data Calculation

Formula section:

Set Environment Data for status bytes according to
Chapter 1.1 Definition of Statusbytes of *Error Memory Management of Process Monitoring (Appl.Inc.)*

E.9.2 Error memory management of LV_ERR_CONV_MON_1

Formula section:

```
LV_CDN_DIAG_CONV_MON_1 = 1

If     LV_ERR_CONV_MON = 1
Then
      lv_err_reset_CONV_MON_1 = 0;
      lv_err_set_CONV_MON_1 = 1;    {failure detected}
      ERR_SYM_CONV_MON_1 = SYM_3;
      LV_END_DIAG_CONV_MON_1 = 1;
Else
      lv_err_set_CONV_MON_1 = 0;
      lv_err_reset_CONV_MON_1 = 1;  {no failure detected}
      ERR_SYM_CONV_MON_1 = NO_SYM;
      If  { delay 520ms } then
      / * After the level2 fault reaction time of 500ms the errors are updated
*/
         LV_END_DIAG_CONV_MON_1 = 1;
     Endif
Endif
```

For error management treatment the following action is called:
ACTION_ERRM_NoFilterSymptom(IN<CONV_MON>, IN<LV_CDN_DIAG_CONV_MON_1>, IN<ERR_SYM_CONV_MON_1>, IN<lv_err_set_CONV_MON_1>, IN<lv_err_reset_CONV_MON_1>, IN<LV_END_DIAG_CONV_MON_1>, OUT<LV_ERR_CONV_MON_1>)

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E.9.3 Error memory management of LV_ERR_N_32_MON_1

```
Formula section:

LV_CDN_DIAG_N_32_MON_1 = 1

If     LV_ERR_N_32_MON = 1
Then
       lv_err_reset_N_32_MON_1 = 0;
       lv_err_set_N_32_MON_1 = 1;      {failure detected}
       ERR_SYM_N_32_MON_1 = SYM_3;
       LV_END_DIAG_N_32_MON_1 = 1;
Else
       lv_err_set_N_32_MON_1 = 0;
       lv_err_reset_N_32_MON_1 = 1;    {no failure detected}
       ERR_SYM_N_32_MON_1 = NO_SYM;
       If  { delay 520ms } then
        / * After the level2 fault reaction time of 500ms the errors are updated
*/
           LV_END_DIAG_N_32_MON_1 = 1;
       Endif
Endif
```

For error management treatment the following action is called:
ACTION_ERRM_NoFilterSymptom(IN<N_32_MON>, IN<LV_CDN_DIAG_N_32_MON_1>, IN<ERR_SYM_N_32_MON_1>, IN<lv_err_set_N_32_MON_1>, IN<lv_err_reset_N_32_MON_1>, IN<LV_END_DIAG_N_32_MON_1>, OUT<LV_ERR_N_32_MON_1>)

E.9.4 Error memory management of LV_ERR_TPS_MON_1

```
Formula section:

If     LV_TQI_MON_ACT_MON = 1
Then   LV_CDN_DIAG_TPS_MON_1 = 1

If     LV_ERR_TPS_MON = 1
Then
       lv_err_reset_TPS_MON_1 = 0;
       lv_err_set_TPS_MON_1 = 1;      {failure detected}
       ERR_SYM_TPS_MON_1 = SYM_3;
       LV_END_DIAG_TPS_MON_1 = 1;
Else
       lv_err_set_TPS_MON_1 = 0;
       lv_err_reset_TPS_MON_1 = 1;    {no failure detected}
       ERR_SYM_TPS_MON_1 = NO_SYM;
       If  { delay 520ms } then
          / * After the level2 fault reaction time of 500ms the errors are updated
*/
          LV_END_DIAG_TPS_MON_1 = 1;
       Endif
Endif
```

For error management treatment the following action is called:
ACTION_ERRM_NoFilterSymptom(IN<TPS_MON>, IN<LV_CDN_DIAG_TPS_MON_1>, IN<ERR_SYM_TPS_MON_1>, IN<lv_err_set_TPS_MON_1>, IN<lv_err_reset_TPS_MON_1>, IN<LV_END_DIAG_TPS_MON_1>, OUT<LV_ERR_TPS_MON_1>)

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E.9.5 Error memory management of LV_ERR_PVS_MON_1

Formula section:

```
LV_CDN_DIAG_PVS_MON_1 = 1

If      LV_ERR_PVS_MON = 1
Then
        lv_err_reset_PVS_MON_1 = 0;
        lv_err_set_PVS_MON_1 = 1;       {failure detected}
        ERR_SYM_PVS_MON_1 = SYM_3;
        LV_END_DIAG_PVS_MON_1 = 1;
Else
        lv_err_set_PVS_MON_1 = 0;
        lv_err_reset_PVS_MON_1 = 1;     {no failure detected}
        ERR_SYM_PVS_MON_1 = NO_SYM;
        If   { delay 520ms } then
           / * After the level2 fault reaction time of 500ms the errors are updated
*/
           LV_END_DIAG_PVS_MON_1 = 1;
         Endif
Endif
```

For error management treatment the following action is called:
ACTION_ERRM_NoFilterSymptom(IN<PVS_MON>, IN<LV_CDN_DIAG_PVS_MON_1>, IN<ERR_SYM_PVS_MON_1>, IN<lv_err_set_PVS_MON_1>, IN<lv_err_reset_PVS_MON_1>, IN<LV_END_DIAG_PVS_MON_1>, OUT<LV_ERR_PVS_MON_1>)

E.9.6 Error memory management of LV_ERR_CRU_INH_MON_1

Formula section:

```
If       LV_TQI_MON_ACT_MON = 1
Then     LV_CDN_DIAG_CRU_INH_MON_1 = 1;

If       (LV_ERR_CRU_MON = 1)
Then
         lv_err_reset_CRU_INH_MON_1 = 0;
         lv_err_set_CRU_INH_MON_1 = 1;      {failure detected}
         ERR_SYM_CRU_INH_MON_1 = SYM_0;
         LV_END_DIAG_CRU_INH_MON_1 = 1;
Elseif   (LV_ERR_DCC_INH_MON = 1)
Then
         lv_err_reset_CRU_INH_MON_1 = 0;
         lv_err_set_CRU_INH_MON_1 = 1;      {failure detected}
         ERR_SYM_CRU_INH_MON_1 = SYM_1;
         LV_END_DIAG_CRU_INH_MON_1 = 1;
Elseif   (LV_ERR_LDM_INH_MON = 1)
Then
         lv_err_reset_CRU_INH_MON_1 = 0;
         lv_err_set_CRU_INH_MON_1 = 1;      {failure detected}
         ERR_SYM_CRU_INH_MON_1 = SYM_2;
         LV_END_DIAG_CRU_INH_MON_1 = 1;
Else
         lv_err_set_CRU_INH_MON_1 = 0;
         lv_err_reset_CRU_INH_MON_1 = 1;    {no failure detected}
         ERR_SYM_CRU_INH_MON_1 = NO_SYM;
         If   { delay 520ms } then
            / * After the level2 fault reaction time of 500ms the errors are updated
*/
            LV_END_DIAG_CRU_INH_MON_1 = 1;
         Endif
Endif
```

For error management treatment the following action is called:
ACTION_ERRM_NoFilterSymptom(IN<CRU_INH_MON>, IN<LV_CDN_DIAG_CRU_INH_MON_1>, IN<ERR_SYM_CRU_INH_MON_1>, IN<lv_err_set_CRU_INH_MON_1>, IN<lv_err_reset_CRU_INH_MON_1>, IN<LV_END_DIAG_CRU_INH_MON_1>, OUT<LV_ERR_CRU_INH_MON_1>)

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E.9.7 Error memory management of LV_ERR_TQI_AV_MON_1

Formula section:

```
If     LV_TQI_MON_ACT_MON = 1
Then   LV_CDN_DIAG_TQI_AV_MON_1 = 1;

If     (LV_ERR_TQI_AV_MON = 1)
Then
       lv_err_reset_TQI_AV_MON_1 = 0;
       lv_err_set_TQI_AV_MON_1 = 1;       {failure detected}
       ERR_SYM_TQI_AV_MON_1 = SYM_3;
       LV_END_DIAG_TQI_AV_MON_1 = 1;
Else
       lv_err_set_TQI_AV_MON_1 = 0;
       lv_err_reset_TQI_AV_MON_1 = 1;     {no failure detected}
       ERR_SYM_TQI_AV_MON_1 = NO_SYM;
       If  { delay 520ms }  then
          / * After the level2 fault reaction time of 500ms the errors are updated
*/
          LV_END_DIAG_TQI_AV_MON_1 = 1;
       Endif
Endif
```

For error management treatment the following action is called:
ACTION_ERRM_NoFilterSymptom(IN<TQI_AV_MON>, IN<LV_CDN_DIAG_TQI_AV_MON_1>, IN<ERR_SYM_TQI_AV_MON_1>, IN<lv_err_set_TQI_AV_MON_1>, IN<lv_err_reset_TQI_AV_MON_1>, IN<LV_END_DIAG_TQI_AV_MON_1>, OUT<LV_ERR_TQI_AV_MON_1>)

E.9.8 Error memory management of LV_ERR_TQI_N_MAX_MON_1

The error LV_ERR_TQI_N_MAX_MON_1 triggers the redundant switch off path (see "Fault Reaction of Process Monitoring") during the actual duty cycle. This finally leads to a reset after debouncing (see "Processor Monitoring"). The entry into the error memory has to be performed past reset. Therefore it is needful to store the error information reset safe; LV_ERR_TQI_N_MAX_MON_1_SAVE is located in the reset safe RAM area. The entry into the error memory is done past reset by evaluation of the information stored before reset.

Application conditions:

Initialisation: LV_ERR_TQI_N_MAX_MON_1_SAVE = 0
only after power up, no initialization after reset

Formula section:

```
If      LV_IGK = 1 and VB > C_VB_MIN_MON_DIAG
Then    LV_CDN_DIAG_TQI_N_MAX_MON_1 = 1;

If(1)   (LV_ERR_TQI_N_MAX_MON_1_SAVE = 1)/ * error detected last duty cycle */

Then(1)
        / * error not jet passed to ERRM =>  transfer error information to ERRM*/

        lv_err_reset_TQI_N_MAX_MON_1 = 0;
        lv_err_set_TQI_N_MAX_MON_1 = 1;
        ERR_SYM_TQI_N_MAX_MON_1 = SYM_3;
        / * environment data are already reset safe stored before reset */
        LV_END_DIAG_TQI_N_MAX_MON_1 = 1;
        / * avoid more than one entry into error memory */
```

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```
        If (2) {delay 120ms}
        Then(2)
            / * this delay time period depends on Processor Monitoring */
            / * After this time period the reset has to be carried out */
            LV_ERR_TQI_N_MAX_MON_1_SAVE = 0;
        Endif(2)
Else(1)         / * error not detected last duty cycle */
        If   (3)   (LV_ERR_TQI_N_MAX_MON_1 = 1)
        Then(3) / * error was stored last recurrence */
                lv_err_reset_TQI_N_MAX_MON_1 = 0;
                lv_err_set_TQI_N_MAX_MON_1 = 1;
                ERR_SYM_TQI_N_MAX_MON_1 = SYM_3;
                LV_END_DIAG_TQI_N_MAX_MON_1 = 1;
        Else(3)
                lv_err_set_TQI_N_MAX_MON_1 = 0;
                lv_err_reset_TQI_N_MAX_MON_1 = 1;    {no failure detected}
                ERR_SYM_TQI_N_MAX_MON_1 = NO_SYM;
                If   (4){ delay 520ms }
                Then(4)
                      / * After the level2 fault reaction time of 500ms the errors
are updated */
                      LV_END_DIAG_TQI_N_MAX_MON_1 = 1;
                Endif(4)
        Endif(3)
Endif(1)
If(5)     (LV_ERR_TQI_N_MAX_MON = 1)
Then(5)   / * error detected in actual duty cycle */
        If(6)     (LV_ERR_TQI_N_MAX_MON_1_SAVE = 0)
        Then(6)
                 Set Environment Data for status bytes LV_ERR_TQI_N_MAX_MON_1
according  to chapter 1.2 of  Error Memory Management of Process Monitoring (Appl.Inc.)
        Endif(6)
/ * store information reset save and avoid saving environment data next recurrence
*/
LV_ERR_TQI_N_MAX_MON_1_SAVE =1;
Endif(5)
```

For error management treatment the following action is called:

ACTION_ERRM_NoFilterSymptom(IN<TQI_N_MAX_MON>, IN<LV_CDN_DIAG_TQI_N_MAX_MON_1>, IN<ERR_SYM_TQI_N_MAX_MON_1>, IN<lv_err_set_TQI_N_MAX_MON_1>, IN<lv_err_reset_TQI_N_MAX_MON_1>, IN<LV_END_DIAG_TQI_N_MAX_MON_1>, OUT<LV_ERR_TQI_N_MAX_MON_1>)

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E.9.9 Error memory management of LV_ERR_MFF_MON_1

Formula section:

```
If      LV_TQI_MON_ACT_MON = 1
Then    LV_CDN_DIAG_MFF_MON_1 = 1;

If      (LV_ERR_MFF_MON = 1)
Then
        lv_err_reset_MFF_MON_1 = 0;
        lv_err_set_MFF_MON_1 = 1;        {failure detected}
        ERR_SYM_MFF_MON_1 = SYM_3;
        LV_END_DIAG_MFF_MON_1 = 1;
Elseif (LV_ERR_OPM_AV_MON = 1)
Then
        lv_err_reset_MFF_MON_1 = 0;
        lv_err_set_MFF_MON_1 = 1;        {failure detected}
        ERR_SYM_MFF_MON_1 = SYM_2;
        LV_END_DIAG_MFF_MON_1 = 1;
Else
        lv_err_set_MFF_MON_1 = 0;
        lv_err_reset_MFF_MON_1 = 1;      {no failure detected}
        ERR_SYM_MFF_MON_1 = NO_SYM;
        If  { delay 520ms }
        Then
            / * After the level2 fault reaction time of 500ms the errors are updated
*/
            LV_END_DIAG_MFF_MON_1 = 1;
        Endif
Endif
```

For error management treatment the following action is called:
ACTION_ERRM_NoFilterSymptom(IN<MFF_MON>, IN<LV_CDN_DIAG_MFF_MON_1>, IN<ERR_SYM_MFF_MON_1>, IN<lv_err_set_MFF_MON_1>, IN<lv_err_reset_MFF_MON_1>, IN<LV_END_DIAG_MFF_MON_1>, OUT<LV_ERR_MFF_MON_1>)

E.9.10 Error memory management of LV_ERR_TQ_DIF_ISC_MON_1

Formula section:

```
If      LV_TQI_MON_ACT_MON = 1
Then    LV_CDN_DIAG_TQ_DIF_ISC_MON_1 = 1;

If       (LV_ERR_TQ_DIF_I_IS_MON = 1)
Then
        lv_err_reset_TQ_DIF_ISC_MON_1 = 0;
        lv_err_set_TQ_DIF_ISC_MON_1 = 1;      {failure detected}
        ERR_SYM_TQ_DIF_ISC_MON_1 = SYM_2;
        LV_END_DIAG_TQ_DIF_ISC_MON_1 = 1;
Elseif (LV_ERR_TQ_DIF_P_D_IS_MON = 1)
then
        lv_err_reset_TQ_DIF_ISC_MON_1 = 0;
        lv_err_set_TQ_DIF_ISC_MON_1 = 1;      {failure detected}
        ERR_SYM_TQ_DIF_ISC_MON_1 = SYM_3;
        LV_END_DIAG_TQ_DIF_ISC_MON_1 = 1;
Else
        lv_err_set_TQ_DIF_ISC_MON_1 = 0;
        lv_err_reset_TQ_DIF_ISC_MON_1 = 1;    {no failure detected}
        ERR_SYM_TQ_DIF_ISC_MON_1 = NO_SYM;
        If  { delay 520ms }
        then
```

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```
          / * After the level2 fault reaction time of 500ms the errors are updated
*/
          LV_END_DIAG_TQ_DIF_ISC_MON_1 = 1;
       Endif
Endif
```

For error management treatment the following action is called:
ACTION_ERRM_NoFilterSymptom(IN<TQ_DIF_ISC_MON>, IN<LV_CDN_DIAG_TQ_DIF_ISC_MON_1>, IN<ERR_SYM_TQ_DIF_ISC_MON_1>, IN<lv_err_set_TQ_DIF_ISC_MON_1>, IN<lv_err_reset_TQ_DIF_ISC_MON_1>, IN<LV_END_DIAG_TQ_DIF_ISC_MON_1>, OUT<LV_ERR_TQ_DIF_ISC_MON_1>)

E.9.11 Error memory management of LV_ERR_TQ_REQ_MON_1

Formula section:

```
If      LV_TQI_MON_ACT_MON = 1
Then    LV_CDN_DIAG_TQ_REQ_MON_1 = 1;

If       (LV_ERR_TQ_MAX_CLU_MON = 1)
Then
        lv_err_reset_TQ_REQ_MON_1 = 0;
        lv_err_set_TQ_REQ_MON_1 = 1;        {failure detected}
        ERR_SYM_TQ_REQ_MON_1 = SYM_0;
        LV_END_DIAG_TQ_REQ_MON_1 = 1;
Elseif (LV_ERR_TQ_MIN_CLU_MON = 1)
then
        lv_err_reset_TQ_REQ_MON_1 = 0;
        lv_err_set_TQ_REQ_MON_1 = 1;        {failure detected}
        ERR_SYM_TQ_REQ_MON_1 = SYM_1;
        LV_END_DIAG_TQ_REQ_MON_1 = 1;
Elseif (LV_ERR_TQ_LOSS_MON = 1)
then
        lv_err_reset_TQ_REQ_MON_1 = 0;
        lv_err_set_TQ_REQ_MON_1 = 1;        {failure detected}
        ERR_SYM_TQ_REQ_MON_1 = SYM_2;
        LV_END_DIAG_TQ_REQ_MON_1 = 1;
Elseif (LV_ERR_SOF_INH_MON = 1)
then
        lv_err_reset_TQ_REQ_MON_1 = 0;
        lv_err_set_TQ_REQ_MON_1 = 1;        {failure detected}
        ERR_SYM_TQ_REQ_MON_1 = SYM_3;
        LV_END_DIAG_TQ_REQ_MON_1 = 1;
Else
        lv_err_set_TQ_REQ_MON_1 = 0;
        lv_err_reset_TQ_REQ_MON_1 = 1;      {no failure detected}
        ERR_SYM_TQ_REQ_MON_1 = NO_SYM;
        If  { delay 520ms }
        then
          / * After the level2 fault reaction time of 500ms the errors are updated
*/
          LV_END_DIAG_TQ_REQ_MON_1 = 1;
        Endif
Endif
```

For error management treatment the following action is called:
ACTION_ERRM_NoFilterSymptom(IN<TQ_REQ_MON>, IN<LV_CDN_DIAG_TQ_REQ_MON_1>, IN<ERR_SYM_TQ_REQ_MON_1>, IN<lv_err_set_TQ_REQ_MON_1>, IN<lv_err_reset_TQ_REQ_MON_1>, IN<LV_END_DIAG_TQ_REQ_MON_1>, OUT<LV_ERR_TQ_REQ_MON_1>)

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E.9.12 Error memory management of LV_ERR_TQ_EXT_MON_1

Formula section:

```
If      LV_TQI_MON_ACT_MON = 1
Then    LV_CDN_DIAG_TQ_EXT_MON_1 = 1;

If       (LV_ERR_MSR_INH_MON = 1)
Then
        lv_err_reset_TQ_EXT_MON_1 = 0;
        lv_err_set_TQ_EXT_MON_1 = 1;      {failure detected}
        ERR_SYM_TQ_EXT_MON_1 = SYM_0;
        LV_END_DIAG_TQ_EXT_MON_1 = 1;
Elseif (LV_ERR_AMT_INH_MON = 1)
then
        lv_err_reset_TQ_EXT_MON_1 = 0;
        lv_err_set_TQ_EXT_MON_1 = 1;      {failure detected}
        ERR_SYM_TQ_EXT_MON_1 = SYM_2;
        LV_END_DIAG_TQ_EXT_MON_1 = 1;
Elseif (LV_ERR_GS_INH_MON = 1)
then
        lv_err_reset_TQ_EXT_MON_1 = 0;
        lv_err_set_TQ_EXT_MON_1 = 1;      {failure detected}
        ERR_SYM_TQ_EXT_MON_1 = SYM_3;
        LV_END_DIAG_TQ_EXT_MON_1 = 1;
Else
        lv_err_set_TQ_EXT_MON_1 = 0;
        lv_err_reset_TQ_EXT_MON_1 = 1;    {no failure detected}
        ERR_SYM_TQ_EXT_MON_1 = NO_SYM;
        If  { delay 520ms }
        then
            / * After the level2 fault reaction time of 500ms the errors are updated
*/
            LV_END_DIAG_TQ_EXT_MON_1 = 1;
        Endif
Endif
```

For error management treatment the following action is called:
ACTION_ERRM_NoFilterSymptom(IN<TQ_EXT_MON>, IN<LV_CDN_DIAG_TQ_EXT_MON_1>, IN<ERR_SYM_TQ_EXT_MON_1>, IN<lv_err_set_TQ_EXT_MON_1>, IN<lv_err_reset_TQ_EXT_MON_1>, IN<LV_END_DIAG_TQ_EXT_MON_1>, OUT<LV_ERR_TQ_EXT_MON_1>)

E.9.13 Diagnosis for AFS request by monitoring (Diagnostic file – STD_INI filter)

FUNCTION DESCRIPTION:

General information:
CTR_SWI_AFS_MON needs to be saved reset resistant AND in NVMY !

Description:
The MFF-monitoring-functionality is able to send requests for switching the engine to AFS-mode in case of detected unplausibilities in non-AFS-modes.

In order to gain information about the number of interventions of the MFF-monitoring- functionality during vehicle/ECU-lifetime, this diagnosis has been introduced.

The flag LV_SWI_AFS_MFF_MAX_MON represents that the maximum allowed number of requests by MFF-monitoring to switch to AFS-mode has been reached.

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CTR_SWI_AFS_MON is used to count these events.

Additionally, the indicator flag LV_ERR_SWI_AFS_MON is set. It is used to call the ERRM and store the indicator with environmental data (e.g. with the value of CTR_SWI_AFS_MON) for further examination.

Error-symptoms and conditions: are defined to this diagnosis function as following

```
┌─┬─┬─┬─┐
└─┴─┴─┴─┘
 │ │ │ └─> LV_SWI_AFS_MFF_MAX_MON detected   (= SYM_0)
 │ │ └───> not used                          (= SYM_1)
 │ └─────> not used                          (= SYM_2)
 └───────> not used                          (= SYM_3)
```

Application conditions:

Activation: **If** LV_TQI_MON_ACT_MON = 1
Then LV_CDN_DIAG_SWI_AFS_MON = 1
Endif

Deactivation: When the activation condition is not fulfilled then LV_CDN_DIAG_SWI_AFS_MON = 0.
Initialisation: LV_CDN_DIAG_SWI_AFS_MON = STD_INI
LV_END_DIAG_SWI_AFS_MON = STD_INI
LV_ERR_SWI_AFS_MON = STD_INI
ERR_SYM_SWI_AFS_MON = STD_INI
at first power up/on saved RAM lost (or reprogramming): CTR_SWI_AFS_MON = 0
at reset: CTR_SWI_AFS_MON = restored from NVMY
Recurrence: 40ms

Formula section:

```
Symptoms calculation :
If      LV_SWI_AFS_MFF_MAX_MON changes from 0 - ->1
Then
        ERR_SYM_SWI_AFS_MON = SYM_0
        CTR_SWI_AFS_MON = CTR_SWI_AFS_MON +1
Else
        ERR_SYM_SWI_AFS_MON = NO_SYM      { No failure has been detected }
Endif

Symptoms are unchanged  if condition for doing symptom detection is not fulfilled.
```

Configuration for diagnostic symptoms:

Diagnostic SWI_AFS_MON	Symptom description	Symptom	Filter type
AFS request by monitoring diagnosis	LV_SWI_AFS_MFF_MAX_MON	*SYM_0*	STD_INI
	not used	*SYM_1*	
	not used	*SYM_2*	
	not used	*SYM_3*	

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E.10 Error memory management of process monitoring (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
N_32_MON_SAVE	O/V/S	0... FFH	0... 8160	32	rpm
Engine speed (monitoring level, reset save)					
PREV_STATE_IV_SAVE	O/V/S	0... FFH	0... 255	1	-
status word disable injectors (reset save)					
STATE_LV_ERR_CRU_INH_MON_1	O/V	0... FFH	0... 255	1	-
Statusbyte of LV_ERR_CRU_INH_MON_1 (monitoring level)					
STATE_LV_ERR_MFF_MON_1	O/V	0... FFH	0... 255	1	-
Statusbyte of LV_ERR_MFF_MON_1 (monitoring level)					
STATE_LV_ERR_TQ_DIF_ISC_MON_1	O/V	0... FFH	0... 255	1	-
Statusbyte of LV_ERR_TQ_DIF_ISC_MON_1 (monitoring level)					
STATE_TQI_N_MAX_MON_1_1_SAVE	O/V/S	0... FFH	0... 255	1	-
Statusbyte1 of LV_ERR_TQI_N_MAX_MON_1 (monitoring level, reset save)					
STATE_TQI_N_MAX_MON_1_2_SAVE	O/V/S	0... FFH	0... 255	1	-
Statusbyte2 of LV_ERR_TQI_N_MAX_MON_1 (monitoring level, reset save)					

Input data:

Ba_ist {p. 8154}	LV_BRAKE_MON {p. 6790}	LV_CRU_ACT {p. 7227}	LV_CRU_MAIN_SWI {p. 7220}
LV_ERR_CONV_MON {p. 6894}	LV_ERR_MFF_MON {p. 6943}	LV_ERR_MSR_INH_MON {p. 6983}	LV_ERR_N_32_MON {p. 7002}
LV_ERR_OPM_AV_MON {p. 6790}	LV_ERR_PVS {p. 4216}	LV_ERR_PVS_MON {p. 6961}	LV_ERR_TPS {p. 4982}
LV_ERR_TPS_MON {p. 6943}	LV_ERR_TQ_DIF_I_IS_MON {p. 6921}	LV_ERR_TQ_DIF_P_D_IS_MON {p. 6921}	LV_ERR_TQ_LOSS_MON {p. 6975}
LV_ERR_TQ_MAX_CLU_MON {p. 6938}	LV_ERR_TQ_MIN_CLU_MON {p. 6952}	LV_ERR_TQI_AV_MON {p. 6899}	LV_IGK_MON {p. 6790}
LV_IS {p. 1720}	LV_LAMB_LS_UP_VLD_MON [NC_CBK_EX_NR] {p. 6790}	LV_MTC_CUR_OFF {p. 6565}	LV_N_LIM_ETC_LIH {p. 4982}
LV_PAS_RAMP_ACT_I_CHG_MON {p. 6790}	LV_PAS_RAMP_ACT_P_D_CHG_MON {p. 6791}	LV_REQ_ISC {p. 3501}	LV_TQ_DCC_INC_REQ {p. 1568}
LV_TQ_WHEEL_LDM_REQ {p. 1568}	LV_TQI_MON_ACT_MON {p. 6791}	N_32_MON {p. 7002}	PREV_STATE_IV {p. 2039}
PV_AV_MON {p. 6961}			

FUNCTION DESCRIPTION:

General information:

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For every fault, the environmental conditions are stored in the environmental data variables. The error symptom is used for encoding the type of the fault if more than one level 2 error could nead to the errror. The variables are chosen such that the fault scenario can be analyzed.

The memory area of all output data variables of this module is not cyclical RAM tested,
the memory area of this module is not cyclic ROM tested.

Application conditions

Initialization: –

Activation: according to "Error Memory management of Process Monitoring"

Update Rate: according to "Error Memory management of Process Monitoring"

Formula section:

Since the different faults can occur in a successive way, they are stored in different locations of the failure memory.

E.10.1 Definition of Statusbytes

The bit values for the ENVD of each error (that actually uses bit values within its ENVD) are represented by a statusbyte. The definition of these statusbytes is listed below.

STATE_LV_ERR_MFF_MON_1 :

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```
BIT7 ┌─┬─┬─┬─┬─┬─┬─┬─┐ BIT0
     └─┴─┴─┴─┴─┴─┴─┴─┘
      │ │ │ │ │ │ │ │
      │ │ │ │ │ │ │ └────> LV_TQI_MON_ACT_MON
      │ │ │ │ │ │ └──────> LV_LAMB_LS_UP_VLD_MON[1]
      │ │ │ │ │ └────────> LV_LAMB_LS_UP_VLD_MON[2]
      │ │ │ │ └──────────> Ba_ist (Bit 0)
      │ │ │ └────────────> Ba_ist (Bit 1)
      │ │ └──────────────> Ba_ist (Bit 2)
      │ └────────────────> Ba_ist (Bit 3)
      └──────────────────> Ba_ist (Bit 4)
```

STATE_LV_ERR_TQ_DIF_ISC_MON_1 :

```
BIT7 ┌─┬─┬─┬─┬─┬─┬─┬─┐ BIT0
     └─┴─┴─┴─┴─┴─┴─┴─┘
      │ │ │ │ │ │ │ │
      │ │ │ │ │ │ │ └────> LV_REQ_ISC
      │ │ │ │ │ │ └──────> LV_PAS_RAMP_ACT_I_CHG_MON
      │ │ │ │ │ └────────> LV_PAS_RAMP_ACT_P_D_CHG_MON
      │ │ │ │ └──────────> LV_IS
      │ │ │ └────────────> LV_TQI_MON_ACT_MON
      │ │ └──────────────> 0
      │ └────────────────> 0
      └──────────────────> 0
```

STATE_LV_ERR_CRU_INH_MON_1 :

```
BIT7 ┌─┬─┬─┬─┬─┬─┬─┬─┐ BIT0
     └─┴─┴─┴─┴─┴─┴─┴─┘
      │ │ │ │ │ │ │ │
      │ │ │ │ │ │ │ └────> LV_CRU_MAIN_SWI
      │ │ │ │ │ │ └──────> LV_BRAKE_MON
      │ │ │ │ │ └────────> LV_CRU_ACT
      │ │ │ │ └──────────> LV_TQ_WHEEL_LDM_REQ
      │ │ │ └────────────> LV_TQ_DCC_INC_REQ
      │ │ └──────────────> LV_TQI_MON_ACT_MON
      │ └────────────────> 0
      └──────────────────> 0
```

E.10.2 Definition of non volantile ENVD for LV_ERR_TQI_N_MAX_MON_1

As the error LV_ERR_TQI_N_MAX_MON leads to a reset of the ECU, its environmental data need to be stored reset save before the reset. Therefore the ENVD of this error is copied to reset save labels. This is only done one time when the error occurs (refer to "ERRM of process monitoring": ERRM of LV_ERR_TQI_N_MAX_MON_1).

N_32_MON_SAVE = N_32_MON
PREV_STATE_IV_SAVE = PREV_STATE_IV

STATE_TQI_N_MAX_MON_1_1_SAVE :

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```
BIT7 ┌┬┬┬┬┬┬┬┐ BIT0
     └┴┴┴┴┴┴┴┘
      │ │ │ │ │ │ │ │
      │ │ │ │ │ │ │ └──> LV_ERR_TQI_AV_MON
      │ │ │ │ │ │ └────> LV_IGK_MON
      │ │ │ │ │ └──────> LV_ERR_TPS
      │ │ │ │ └────────> LV_ERR_PVS
      │ │ │ └──────────> LV_MTC_CUR_OFF
      │ │ └────────────> (PV_AV_MON = 0)
      │ └──────────────> LV_N_LIM_ETC_LIH
      └────────────────> (LV_ERR_TQ_LOSS_MON=1 OR LV_ERR_TQ_MIN_CLU_MON=1 OR
                          LV_ERR_TQ_MAX_CLU_MON=1)
```

STATE_TQI_N_MAX_MON_1_2_SAVE :

```
BIT7 ┌┬┬┬┬┬┬┬┐ BIT0
     └┴┴┴┴┴┴┴┘
      │ │ │ │ │ │ │ │
      │ │ │ │ │ │ │ └──> LV_ERR_CONV_MON
      │ │ │ │ │ │ └────> LV_ERR_MSR_INH_MON
      │ │ │ │ │ └──────> LV_ERR_N_32_MON
      │ │ │ │ └────────> (LV_ERR_TQ_DIF_P_D_IS_MON=1 OR LV_ERR_TQ_DIF_I_IS_MON=1)
      │ │ │ └──────────> LV_ERR_PVS_MON
      │ │ └────────────> LV_ERR_TPS_MON
      │ └──────────────> LV_ERR_MFF_MON
      └ ─ ─ ─ ─ ─ ─ ─ -> 0
```

To save some locations in failure memory some of the level 2 errors collect in one error ,location as different symtoms, this is shown in the next table. In addition to the information above, for every fault environmental data is stored. This datas are tuneable. The following table is only a recommendation of enviromental datas.

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Error	SYM	Error Cause	Recommendation of environmental data			
Error bit level1		Error bit level2	First byte	Second Byte	Third byte	Fourth byte
LV_ERR_CONV_MON_1	3	LV_ERR_CONV_MON	N_32_MON	VP_MC_AN_DIG_MON_KWP	VP_MU_AN_DIG_MON_KWP	VB
LV_ERR_N_32_MON_1	3	LV_ERR_N_32_MON	N_32	N_32_MON	N_32_SUB_MON	T_SEG_SW_MON
LV_ERR_TPS_MON_1	3	LV_ERR_TPS_MON	TPS_AV	TPS_AV_MON	V_TPS_1_MON	V_TPS_2_MON
LV_ERR_PVS_MON_1	3	LV_ERR_PVS_MON	STATE_LV_ERR_CRU_INH_MON_1	PV_AV_MON	V_PVS_1_MON_KWP	V_PVS_2_MON_KWP
LV_ERR_CRU_INH_MON_1	0 or 1 or 2	LV_ERR_CRU_MON or LV_ERR_DCC_INH_MON or LV_ERR_LDM_INH_MON	STATE_LV_ERR_CRU_INH_MON_1	TQ_WHEEL_LDM_MON	FAC_TQ_REQ_CRU	TQ_DCC_MON
LV_ERR_TQI_AV_MON_1	3	LV_ERR_TQI_AV_MON	N_32_MON	TQI_SP_MON	TQI_AV_MON	TQI_SP_KWP
LV_ERR_TQI_N_MAX_MON_1	3	LV_ERR_TQI_N_MAX_MON	N_32_MON_SAVE	PREV_STATE_IV_SAVE	STATE_TQI_N_MAX_MON_1_1_SAVE	STATE_TQI_N_MAX_MON_1_2_SAVE
LV_ERR_MFF_MON_1	2 or 3	LV_ERR_OPM_AV_MON or LV_ERR_MFF_MON	STATE_LV_ERR_MFF_MON_1	MAF	MFF_SP_MV_KWP	LAMB_LS_UP_MV_KWP
LV_ERR_TQ_DIF_ISC_MON_1	2 or 3	LV_ERR_TQ_DIF_I_IS_MON or LV_ERR_TQ_DIF_P_D_IS_MON	STATE_LV_ERR_TQ_DIF_ISC_MON_1	N_DIF_SP_IS_MON	TQ_DIF_I_IS_MON	TQ_DIF_P_D_IS_MON
LV_ERR_TQ_REQ_MON_1	0 or 1 or 2 or 3	LV_ERR_TQ_MAX_CLU_MON or LV_ERR_TQ_MIN_CLU_MON or LV_ERR_TQ_LOSS_MON or LV_ERR_SOF_INH_MON	TQ_MAX_CLU_DIF_MON	TQ_MIN_CLU_DIF_MON	TQ_LOSS_DIF_MON	STATE_ENG
LV_ERR_TQ_EXT_MON_1	0 or 2 or 3	LV_ERR_MSR_INH_MON or LV_ERR_AMT_INH_MON or LV_ERR_GS_INH_MON	BIT 0: LV_MSR_PLAUS BIT 2: LV_TQ_AMT_INC_REQ BIT 3: LV_TQ_GS_INC_REQ	TQI_MSR_CAN	TQ_GS_MON	STATE_ERR_AMT_MON

The information whether a warning lamp (ETC MIL) is switched on in case of an error can be found in the general OBD error code table.
In case of more than one error cause occurs, always the first error (according to the table above; see BIT 0...4 of first Byte for the order) is taken into account.

E.10.3 List of error codes and symptoms

The list of error codes and the list of error symptoms can be found in the chapter "Table of failures".

Configuration diagnostic symptoms:

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Diagnosis XX	Symptom	Nr	ABC type
Diagnosis description: A/D monitoring error	*no error*	*NO_ SYM*	NO
CONV_MON	*A/D monitoring error*	*SYM _3*	
Diagnosis description: Engine speed monitoring error	*no error*	*NO_ SYM*	NO
N_32_MON	*Engine speed monitoring error*	*SYM _3*	
Diagnosis description: TPS monitoring error	*no error*	*NO_ SYM*	NO
TPS_MON	*TPS monitoring error*	*SYM _3*	
Diagnosis description: PVS monitoring error	*no error*	*NO_ SYM*	NO
PVS_MON	*PVS monitoring error*	*SYM _3*	
Diagnosis description: Cruise control monitoring error	*no error*	*NO_ SYM*	NO
CRU_INH_MON	*Cruise control monitoring error*	*SYM _0*	
	Distance cruise control monitoring error	*SYM _1*	
	LDM monitoring error	*SYM _2*	
Diagnosis description: Torque monitoring error	*no error*	*NO_ SYM*	NO
TQI_AV_MON	*Torque monitoring error*	*SYM _3*	
Diagnosis description: N_LIM monitoring error	*no error*	*NO_ SYM*	NO
TQI_N_MAX_MON	*N_LIM monitoring error*	*SYM _3*	
Diagnosis description: Mass fuel flow monitoring error	*no error*	*NO_ SYM*	NO
MFF_MON	*Error in engine operation mode*	*SYM _2*	
	Mass fuel flow monitoring error	*SYM _3*	
Diagnosis description: ISC monitoring error	*no error*	*NO_ SYM*	NO
ISC_MON	*ISC I part monitoring error*	*SYM _2*	
	ISC P-D part monitoring error	*SYM _3*	
Diagnosis description: Torque req. monitoring error	*no error*	*NO_ SYM*	NO
TQ_REQ_MON	*TQ_MAX_CLU monitoring error*	*SYM _0*	
	TQ_MIN_CLU monitoring error	*SYM _1*	

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	Torque loss monitoring error	*SYM_2*	
	Sound flap monitoring error	*SYM_3*	
Diagnosis description: *External torque req. control monitoring error*	*no error*	*NO_SYM*	NO
TQ_EXT_MON	*Deceleration slip control monitoring error*	*SYM_0*	
	Automated manual transmission monitoring error	*SYM_2*	
	Gear shift monitoring error	*SYM_3*	

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E.11 Fault reaction of process monitoring

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ERR_TRAN_1_MON	V	0... 1H	0 ...1	1	-
Flag for temporary fault 1 (exclusive fault of L3) during last recurrency					
LV_ERR_TRAN_2_MON	V	0... 1H	0 ...1	1	-
Flag for temporary fault 2 (together with fault of L2) during last recurrency					
LV_N_LIM_REQ_MON	O/V	0... 1H	0 ...1	1	-
Request for engine speed limitation					
LV_OFF_IV_MON	O/V	0... 1H	0 ...1	1	-
Request for disable of IV power stage by main controller					
LV_OFF_IV_N_LIM_ETC_TMP_MON	V	0... 1H	0 ...1	1	-
Flag for temporary injection cut off during last recurrency					
LV_OFF_MTC_MON	O/V	0... 1H	0 ...1	1	-
Request for disable of MTC power stage by main controller					

Input data:

LV_ERR_CONV_MON {p. 6894}	LV_ERR_MFF_MON {p. 6943}	LV_ERR_MU_MC {p. 7072}	LV_ERR_N_32_MON {p. 7002}
LV_ERR_OPM_AV_MON {p. 6790}	LV_ERR_PVS_MON {p. 6961}	LV_ERR_TMP_MU_MC {p. 7072}	LV_ERR_TPS_MON {p. 6943}
LV_ERR_TQ_DIF_I_IS_ MON {p. 6921}	LV_ERR_TQ_DIF_P_D_IS_ MON {p. 6921}	LV_ERR_TQ_LOSS_MON {p. 6975}	LV_ERR_TQ_MAX_CLU_ MON {p. 6938}
LV_ERR_TQ_MIN_CLU_ MON {p. 6952}	LV_ERR_TQI_AV_MON {p. 6899}	LV_ERR_TQI_N_MAX_ MON {p. 6917}	LV_OFF_IV_N_LIM_ETC_ MON {p. 6790}

Action definition

ACTION_ECM2_LockPws ()	Mode: O
Disable power stages by process monitoring (used when no ECM2 tasks executed).	

ACTION_ECM2_ResetErrorFlags ()	Mode: O
Enable power stages unless fault reaction already active.	

ACTION_ECM2_UnlockPws ()	Mode: O
Enable power stages by process monitoring for exactly one time (used when ECM2 tasks executed)	

Import actions:

ACTION_ECM3_Service12TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service13TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service14TaskPfm (**IN**<No Name available>)

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Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 4.

ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service12TaskPfm() and ACTION_ECM3_Service13TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

ACTION_ECM3_RedSwitchOffPath()

Note: This action is defined in chapter "Processor Monitoring", subsection "The redundant switch off path".

Description for ACTION_ECM2_LockPws():

Description:

Syntax: ACTION_ECM2_LockPws()

Formula section:

LV_OFF_IV_MON = 1;
LV_OFF_MTC_MON = 1;
/* Disable injection and H-bridge */

Description for ACTION_ECM2_UnlockPws():

Description:

Syntax: ACTION_ECM2_UnlockPws()

Formula section:

LV_OFF_IV_MON = 0;
LV_OFF_MTC_MON = 0;
/* Enable injection and H-bridge for exactly one time */

Description for ACTION_ECM2_ResetErrorFlags():

Description:

Syntax: ACTION_ECM2_ ResetErrorFlags()

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Formula section:

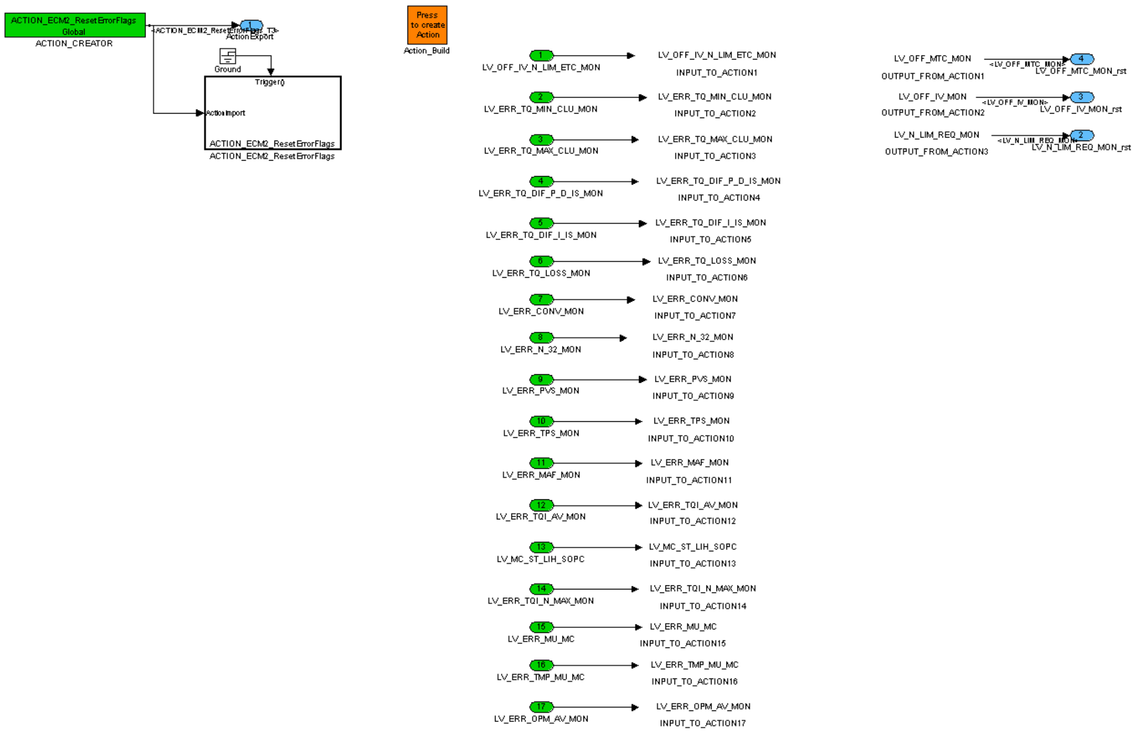

Figure E.11.1: ECM2_DTSYSFAREA /ACTIONDEF_ECM2_ResetErrorFlags

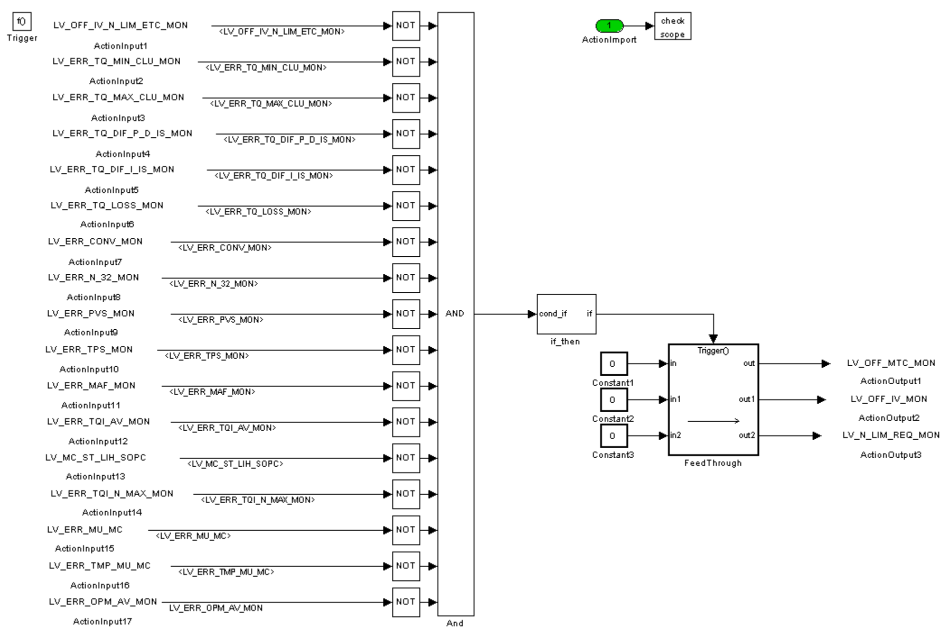

Figure E.11.2: ECM2_DTSYSFAREA /ACTIONDEF_ECM2_ResetErrorFlags/ACTION_ECM2_ResetErrorFlags

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/* Reset of ECM2 error flags to enable power stages unless fault reaction already active */

General description:

The objective of this module is to react on faults detected by the process and processor monitoring of the etcmonitoringconcept. The following actions are introduced depending on the error level and the degree of degradation.
disable of throttle power stage (LV_OFF_MTC_MON)
disable of injection power stage (LV_OFF_IV_MON)
transmission of wrong answers from level 2 to the monitoring processor in order to force the monitoring unit to reset the main controller and switch off the throttle and the injection power stages (ACTION_ECM3_RedSwitchOffPath())

The faults taken into account are listed in the following:
monitoring of A/Dconverter (LV_ERR_CONV_MON)
monitoring of engine speed (LV_ERR_N_32_MON)
monitoring of the PDshare of the idle speed controller (LV_ERR_TQ_DIF_P_D_IS_MON)
monitoring of the Ishare of the idle speed controller (LV_ERR_TQ_DIF_I_IS_MON)
monitoring of torque losses (LV_ERR_TQ_LOSS_MON)
monitoring of minimum torque at clutch (LV_ERR_TQ_MIN_CLU_MON)
monitoring of maximum torque at clutch (LV_ERR_TQ_MAX_CLU_MON)
monitoring of pedal value signal (LV_ERR_PVS_MON)
monitoring of mass fuel flow signal (LV_ERR_MFF_MON)
torque monitoring (LV_ERR_TQI_AV_MON)
monitoring of engine speed limitation (LV_ERR_TQI_N_MAX_MON)
processor monitoring on the main controller, continuous fault (LV_ERR_MU_MC)
processor monitoring on the main controller, temporary fault (LV_ERR_TMP_MU_MC)

Additionally the engine speed limitation is carried out by forced fuel cutoff function (see appl. inc. of process monitoring) where the LV_OFF_IV_MON is reversibly set, if LV_OFF_IV_N_LIM_ETC_MON is active.

Most of the faults lead to a request for the engine speed limitation and a disable of the throttle power stage. The engine speed limitation is carried out inside the application incidences and returns a bit LV_OFF_IV_N_LIM_ETC_MON, if injection has to be cut off..
A fault in the engine speed limitation detected by the etc safety concept and a fault detected by the processor monitoring of the main controller (after several unsuccessful resets) will lead to an immediate disable of the throttle and injection power stages. In addition, for a fault in the engine speed limitation, the transmission of wrong answers from level 2 to the monitoring unit will be forced in order to achieve the injection cutoff by the redundant disable path of the monitoring unit.
The error flags except LV_ERR_TMP_MU_MC are not reset until next ignition key on (transition from LV_IGK = 0 to 1).
If the temporary error bit LV_ERR_TMP_MU_MC was exclusively set in the last sampling instant (represented by LV_ERR_TRAN_1_MON = 1) and LV_ERR_TMP_MU_MC is reset (=0) in the actual sampling instant and no other fault request for the same fault reactions, the request for a disable of the main throttle control (MTC) and the injection valves (IV) is reset (LV_OFF_MTC_MON = 0 and LV_OFF_IV_MON = 0). If LV_ERR_TMP_MU_MC was set in the last sampling instant with one or more other faults <u>excepting</u> LV_ERR_MU_MON and LV_ERR_N_MAX_MON (represented by LV_ERR_TRAN_2_MON = 1) and LV_ERR_TMP_MU_MC is reset (=0) in the actual sampling instant the request for a disable the injection valves (IV) is reset (LV_OFF_IV_MON = 0)

The following table shows the fault reactions corresponding to the underlying faults. No fault reaction is reset until next ignition key on (transition from LV_IGK = 0 to 1). There are only two exceptions, 1.) for

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a temporary fault detected by the processor monitoring on the main controller (LV_ERR_TMP_MU_MC) and 2.) for injection cut off (LV_OFF_IV_MON) during engine speed limitation.

Fault reaction / **Faults**	Disable of MTC via main controller (LV_OFF_MTC_MON = 1)	Request engine speed limitation (LV_N_LIM_REQ_MON = 1)	Disable of IV via main controller (LV_OFF_IV_MON = 1)	Disable of MTC and IV via monitoring unit (ACTION_ECM3_RedSwitchOffPath())
LV_ERR_CONV_MON	X	X	Z	Z
LV_ERR_N_32_MON	X	X	Z	Z
LV_ERR_TQ_DIF_P_D_IS_MON	X	X	Z	Z
LV_ERR_TQ_DIF_I_IS_MON	X	X	Z	Z
LV_ERR_TQ_LOSS_MON	X	X	Z	Z
LV_ERR_TQ_MIN_CLU_MON	X	X	Z	Z
LV_ERR_TQ_MAX_CLU_MON	X	X	Z	Z
LV_ERR_OPM_AV_MON	X	X	Z	Z
LV_ERR_PVS_MON	X	X	Z	Z
LV_ERR_TPS_MON	X	X	Z	Z
LV_ERR_MFF_MON	X	X	Z	Z
LV_ERR_TQI_AV_MON	X	X	Z	Z
LV_OFF_IV_N_LIM_ETC_MON*	Z	Z	X/0	Z
LV_ERR_TQI_N_MAX_MON	X	Z	X	X
LV_ERR_MU_MC	X	Z	X	Z
LV_ERR_TMP_MU_MC*	X	Z	X	Z

* reversible during present driving cycle, for actions after reset see formulas or model description

The map shows resulting states of output bits. The proceeding is topdown, e.g. the undermost set fault bit of a column defines the resulting state. Symbol x means the related bit is set, z the former result of present recurrence will not be changed and 0 resets the related bit, if the fault is not set.

LV_OFF_IV_MON must be calculated first by LV_OFF_IV_N_LIM_ETC_MON and than by non reversible fault reactions to be sure that a wrong write operation with LV_OFF_IV_MON = 0 is less prior than fault reactions with permanent fuel cutoff.

Application Condition

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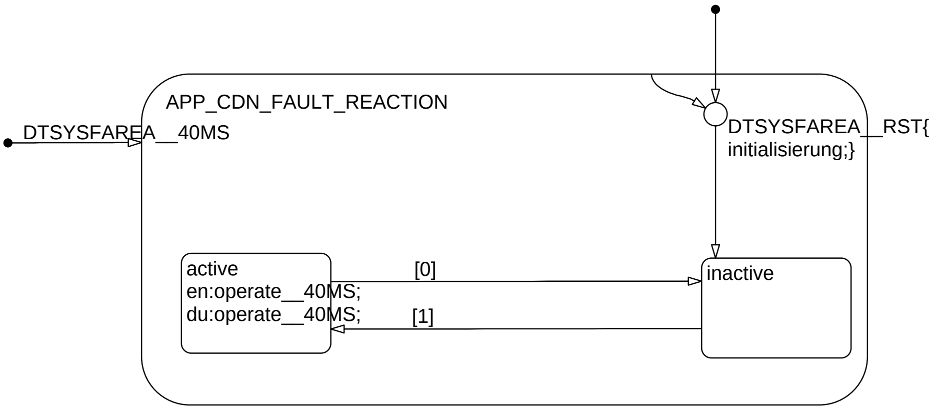

Figure E.11.3: FAREA/APP_CDN/STATEFLOW_CHART

Function Description

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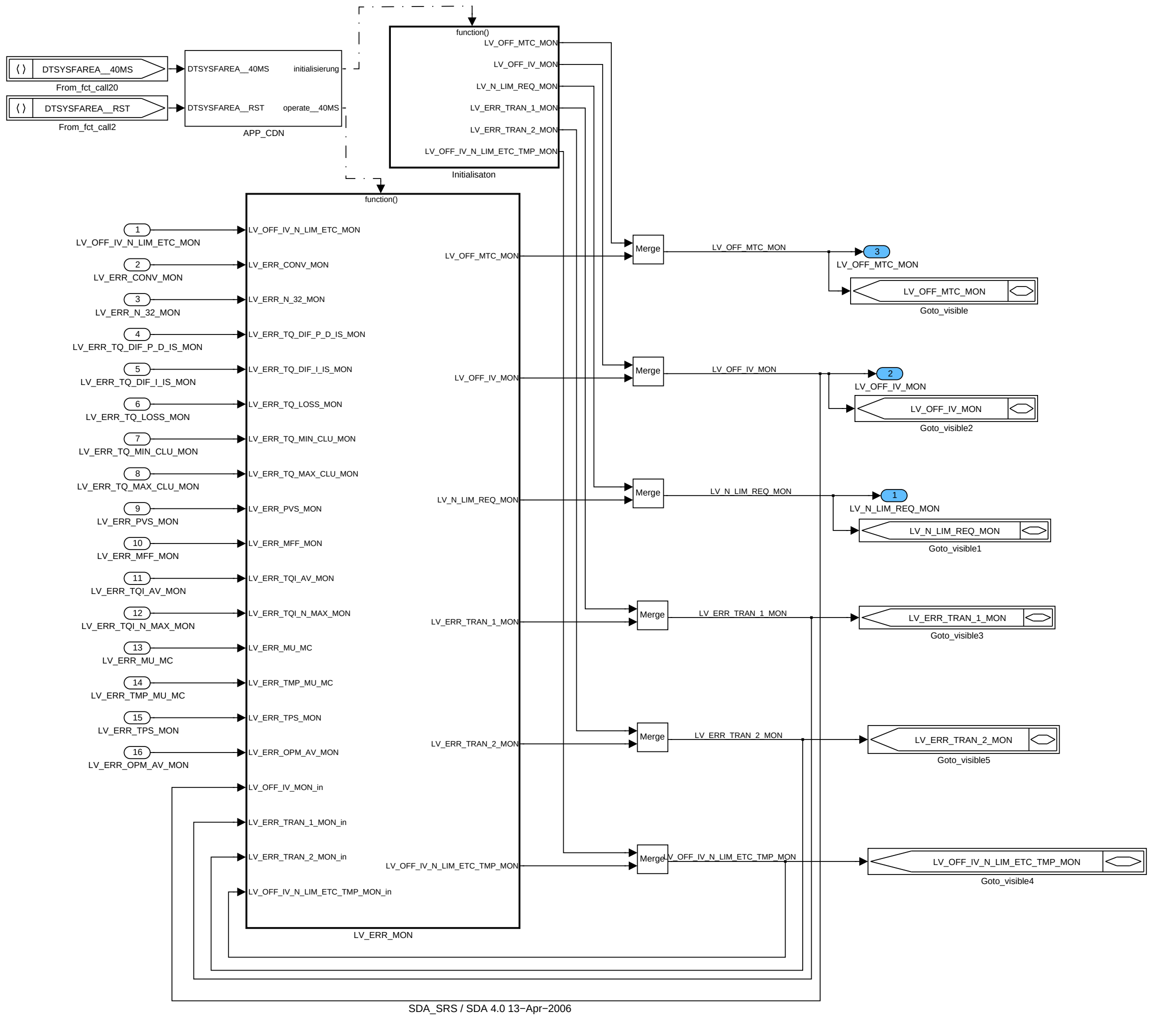

Figure E.11.4: FAREA

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E.11.1 SUBFUNCTION: Initialisaton

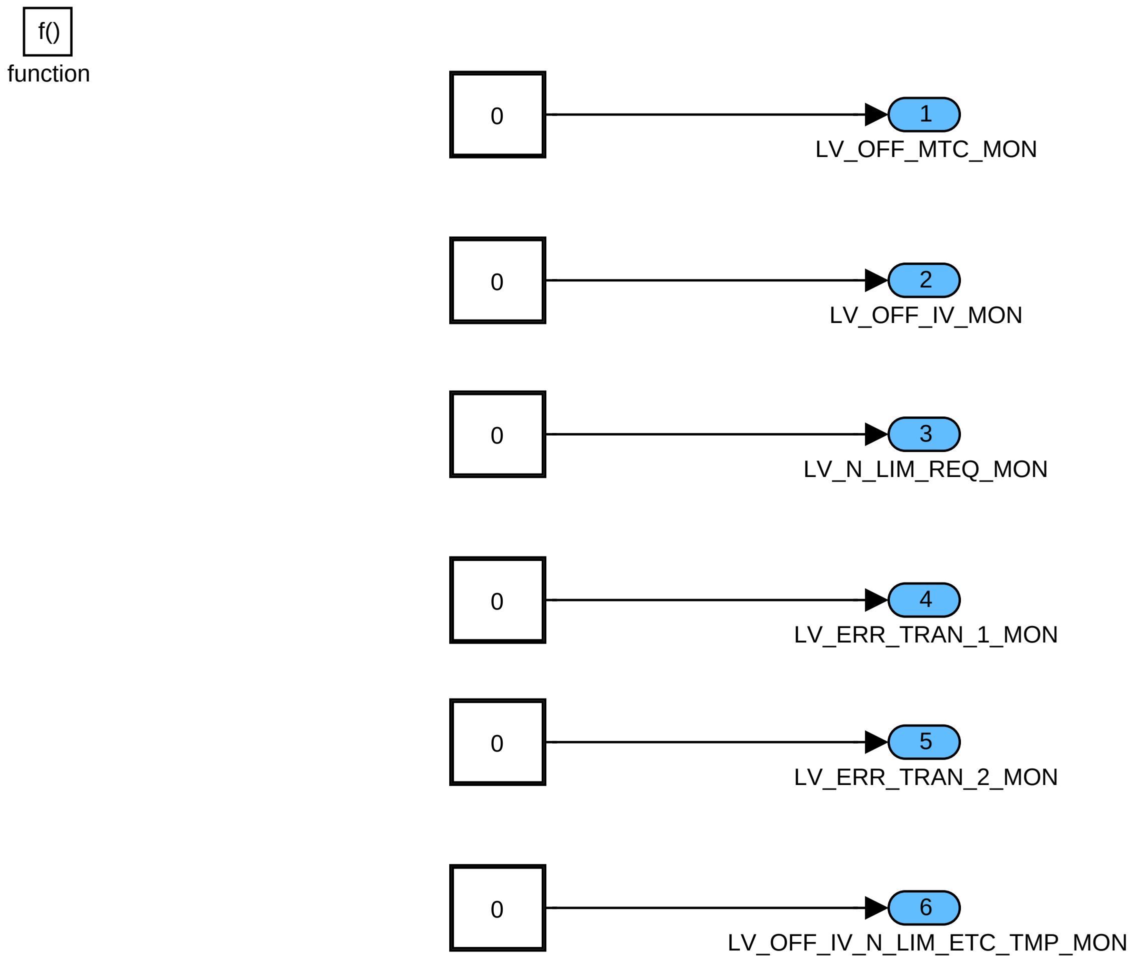

Figure E.11.5: FAREA/INITIALISATON

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E.11.2 SUBFUNCTION: LV_ERR_MON

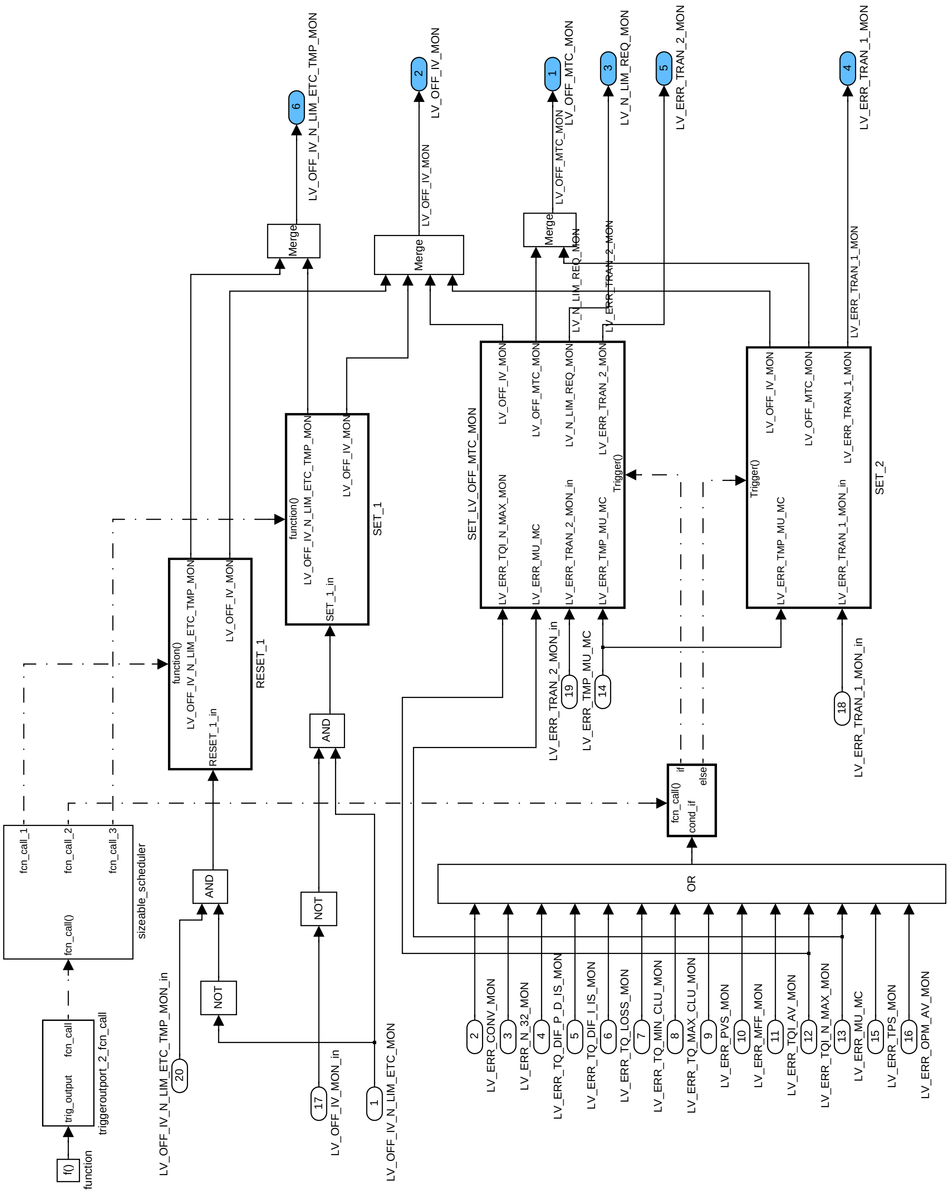

Figure E.11.6: FAREA/LV_ERR_MON

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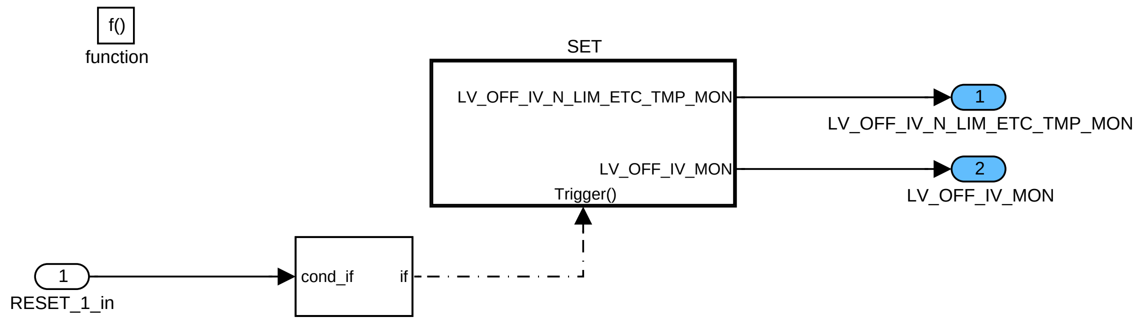

Figure E.11.7: FAREA/LV_ERR_MON/RESET_1

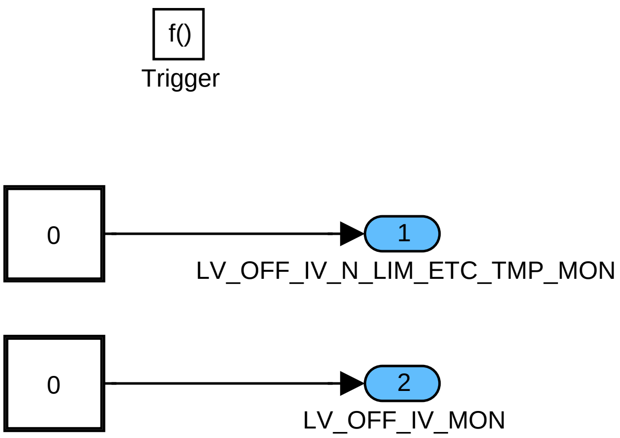

Figure E.11.8: FAREA/LV_ERR_MON/RESET_1/SET

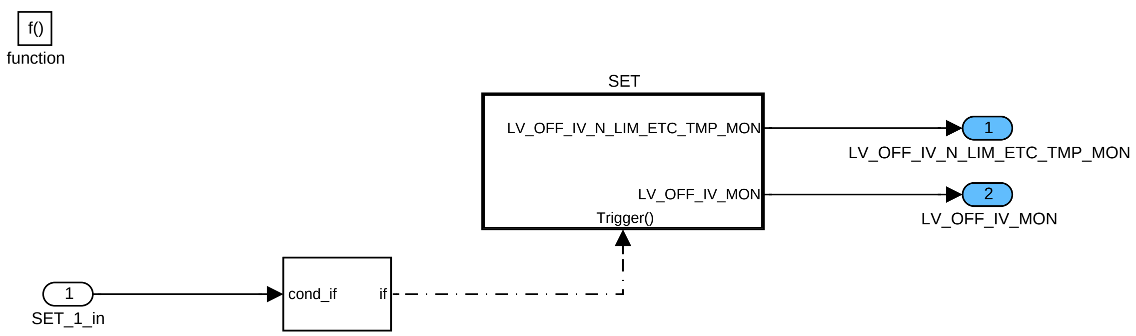

Figure E.11.9: FAREA/LV_ERR_MON/SET_1

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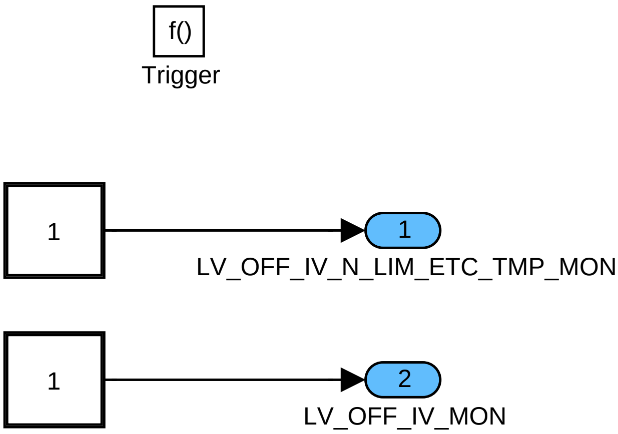

Figure E.11.10: FAREA/LV_ERR_MON/SET_1/SET

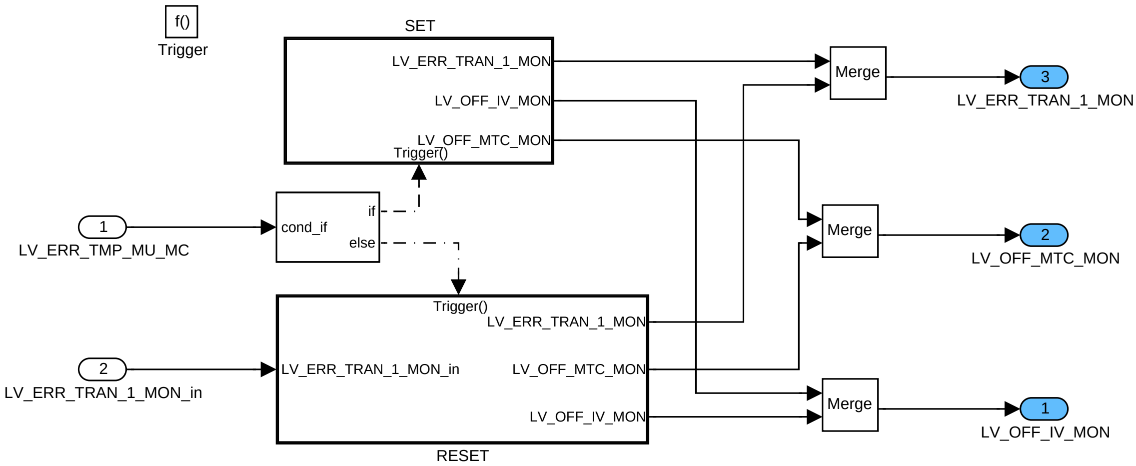

Figure E.11.11: FAREA/LV_ERR_MON/SET_2

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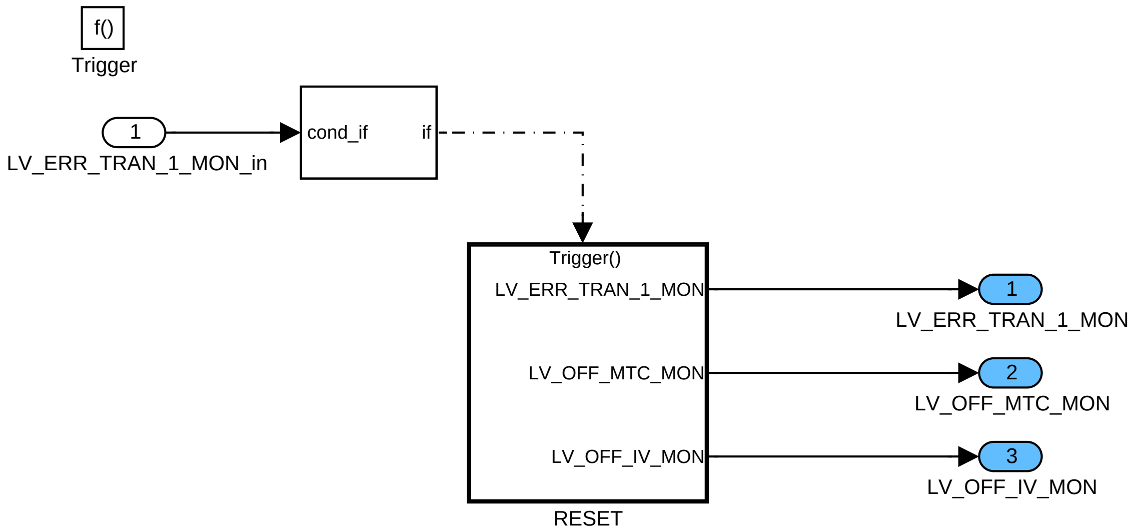

Figure E.11.12: FAREA/LV_ERR_MON/SET_2/RESET

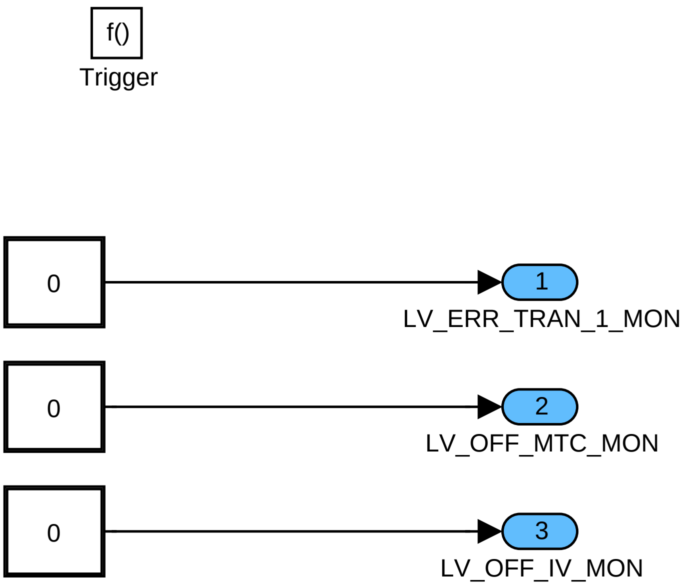

Figure E.11.13: FAREA/LV_ERR_MON/SET_2/RESET/RESET

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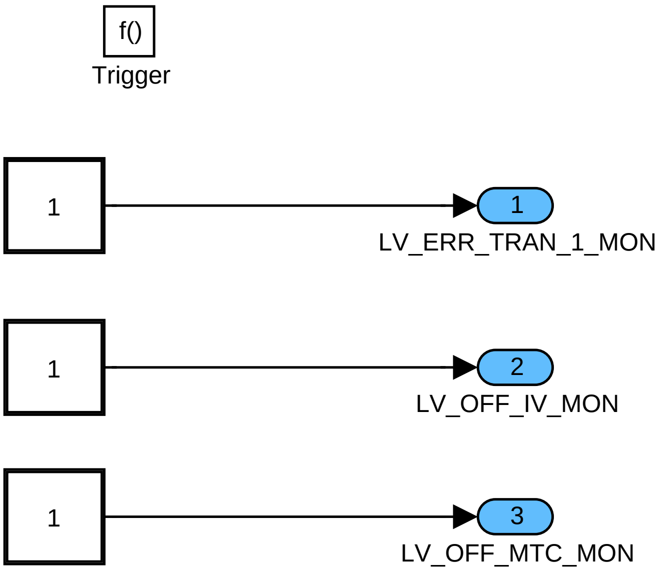

Figure E.11.14: FAREA/LV_ERR_MON/SET_2/SET

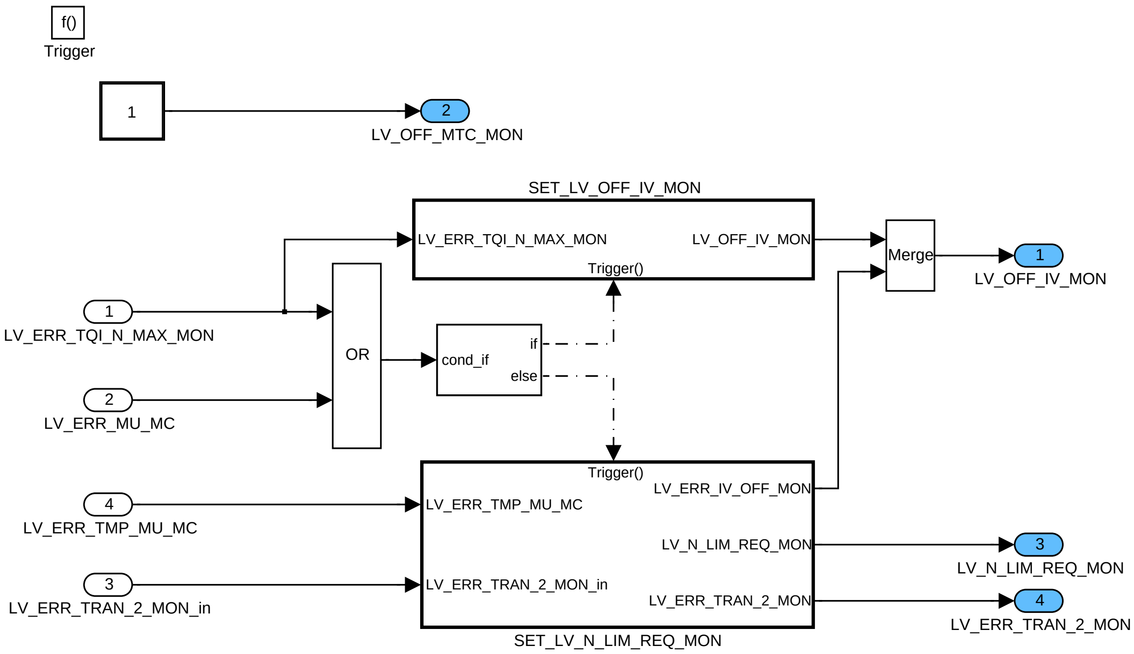

Figure E.11.15: FAREA/LV_ERR_MON/SET_LV_OFF_MTC_MON

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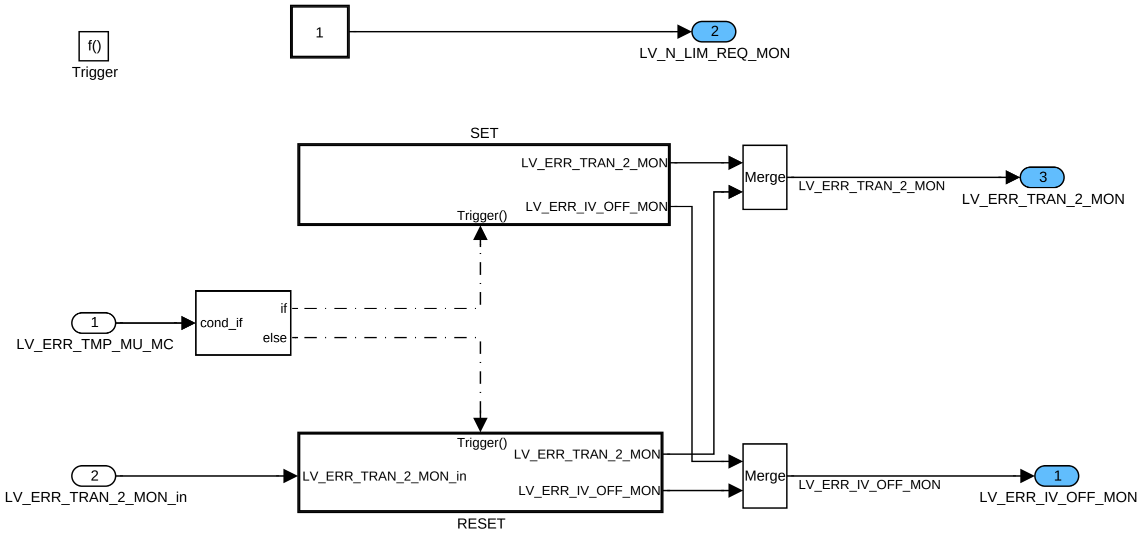

Figure E.11.16: FAREA/LV_ERR_MON/SET_LV_OFF_MTC_MON/SET_LV_N_LIM_REQ_MON

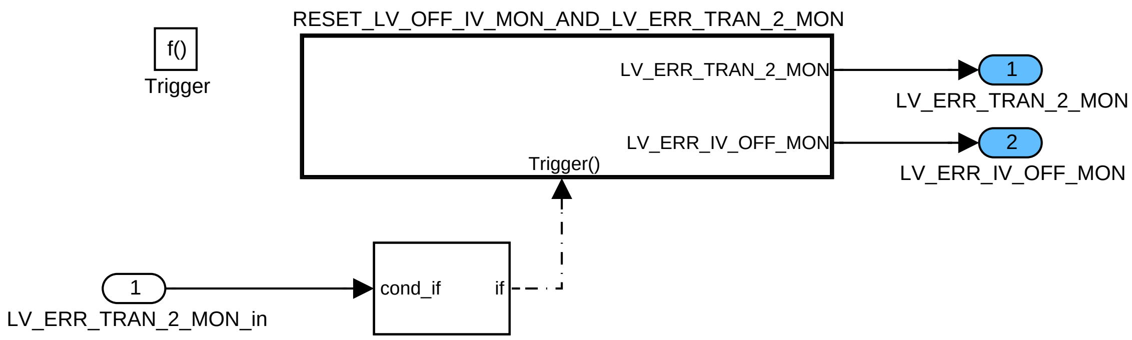

Figure E.11.17:
FAREA/LV_ERR_MON/SET_LV_OFF_MTC_MON/SET_LV_N_LIM_REQ_MON/RESET

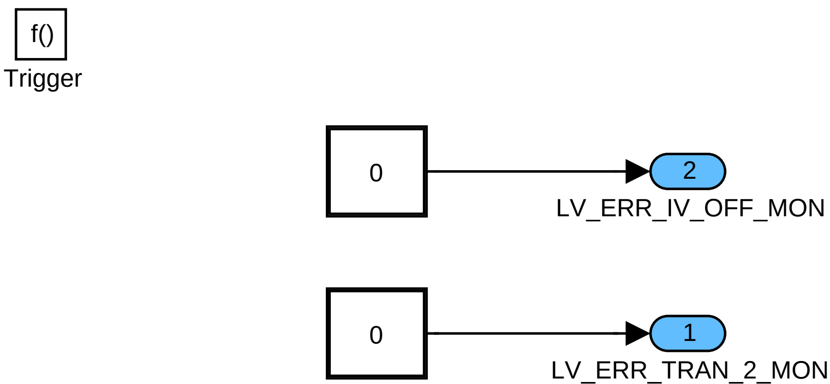

Figure E.11.18: FAREA/LV_ERR_MON/SET_LV_OFF_MTC_MON/SET_LV_N_LIM_REQ_MON/
RESET/RESET_LV_OFF_IV_MON_AND_LV_ERR_TRAN_2_MON

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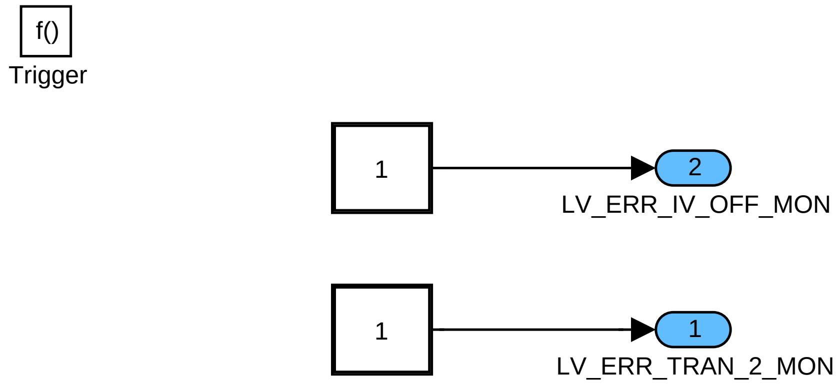

Figure E.11.19: FAREA/LV_ERR_MON/SET_LV_OFF_MTC_MON/SET_LV_N_LIM_REQ_MON/SET

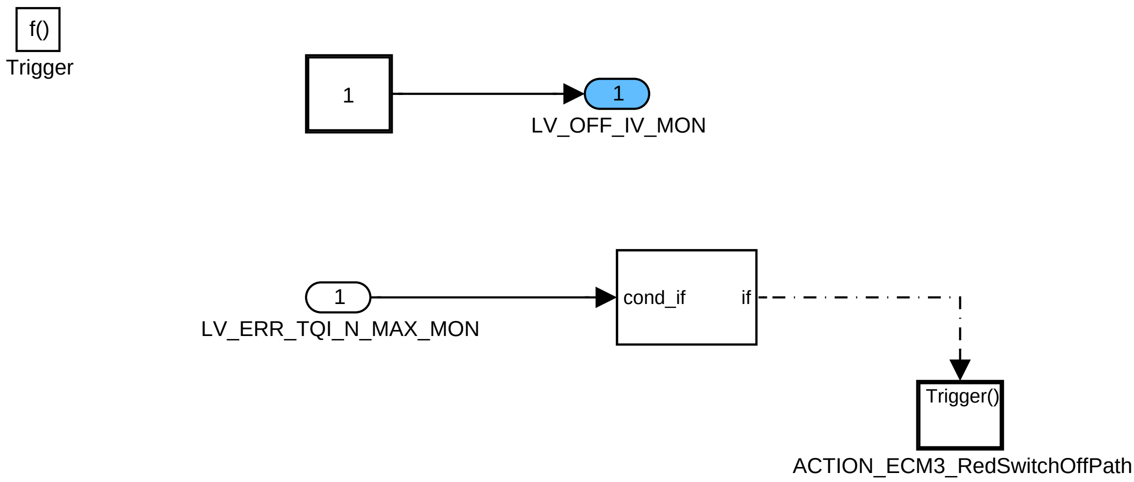

Figure E.11.20: FAREA/LV_ERR_MON/SET_LV_OFF_MTC_MON/SET_LV_OFF_IV_MON

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E.12 General

E.12.1 Basic Idea

The Monitoring Concept has to prevent an ETC system from dangerous behaviour like sudden acceleration against the driver's intent. At first faults, this must be without intervention of the driver. To avoid immobile cars at first faults, a limited limp home function is activated. This means the dynamic behaviour of the car is limited, and so in case of another (second) fault, the driver must possibly react (activation of brake pedal). The accepted fault reaction time is 500 ms. Minor deviations in the order of about 5% are possible due to run time fluctuations, aging effects and temperature influences. No or low engine power is seen as a safe state.
The Siemens ETC-Monitoring-Concept is based on the ETC-Safety-Concept of VDA Arbeitskreis E-Gas using the following main modification:
Additional, diverse AD-converter in monitoring unit (MU) for monitoring af A/D conversion. The used analog voltage must be non-constant, the frequency of the voltage changes must match to the synchronisation constraints given in the Processor Monitoring.
The monitoring concept consists of three levels, as shown in the following figure:

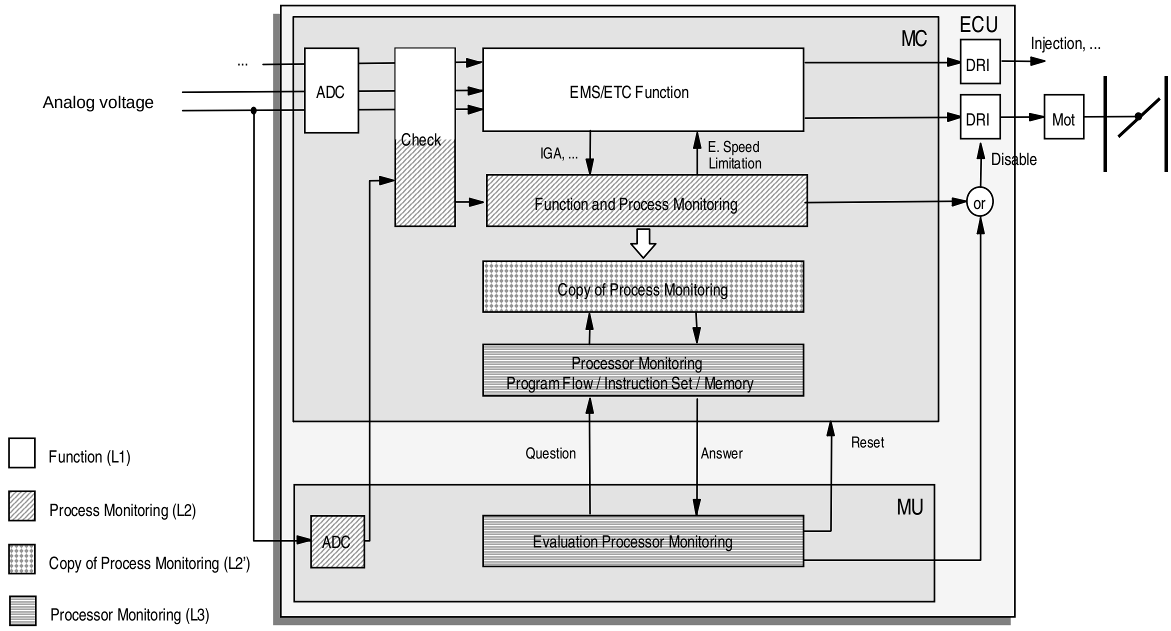

Figure E.12.1: : The three levels of the monitoring concept.

1. The function level is located on the main processor (MC).
2. The function/process monitoring level is also located on the main processor.
3. The processor monitoring level is located on the main processor and on the monitoring processor (MU).

E.12.1.1 Function Level (VDA-name: Level 1)

The function level performs standard EMS functions including ETC functionality (description *not* to be found in this chapter):

1. Determination of the drivers demand (via PVS) including standard diagnosis (signal range check, ...)
2. Determination of throttle position (via TPS) including standard diagnosis (signal range check, ...)

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3. Receiving external torque requests (e.g. ASR, MSR, ...) including standard diagnosis (e.g. monitoring CAN by parity bit, ...). External modules must generate correct torque requests (safety requirement!) the ECU can only check, whether the transmission of this request was without faults.
4. Internal calculation of torque requests (ISC, Cruise Control)
5. Co-ordination and realisation of requested torque

- output: throttle position, ignition angle, injection time and cylinder cut off

E.12.1.2 Process Monitoring Level (VDA-name: Level 2)

The process monitoring performs monitoring of sensors, actuators, torque effective functions, torque co-ordination, and torque realization as a check of the function level.
The description can be found in the modules:

1. Process Monitoring
2. Monitoring Sensor Signals (e.g. PVS, TCO, ...)
3. Monitoring Internal Signals (e.g. MAF, N_32, ...)
4. Monitoring CAN Signals
5. Torque Monitoring
6. Fault Reaction

E.12.1.3 Processor Monitoring Level (VDA-name: Level 3)

The processor monitoring monitors proper processor function: memory, operations of the processor, program flow, analog digital conversion
The description can be found in the modules:

1. Processor Monitoring
2. Communication between MC and MU
3. Fault Reaction

There are additional port extensions located on the monitoring unit. Note that this functionality is not a core functionality of level 3:

1. Input /Output (Description of port extension facility of the monitoring unit)

E.12.2 Hardware Safety Module

The main-processor (MC) and the monitoring processor (MU, incl. port extensions) are connected via an internal communication. MU has its own oscillator (ceramic resonator).
When resetting, MC gives a reset signal to MU so it will also reset. This enables synchronisation between them.
Via the internal communication informations are excanged. This informations belongs to: test calculations (level 2'), program flow of MC, monitoring of ADC, port extensions.
For the purpose of test calculations answers are compared to known results on MU. In case of faults, the power stages of the throttle and the injectors are disabled.
One analog voltage is connected with the first AD-channel of MU and the dedicated channel on MC. The MU value is transmitted to MC only to check the ADCs. Remaining AD-channels and digital outputs can be used as port extension (no monitoring function, but it has to be assured, that no damaging voltage is fed to the ports in case of any fault).

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E.13 Monitoring of A/D conversion

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_CONV_MON	O/V	0... FFH	0... 255	1	-
Anti-bounce counter for ADC error					
LV_ERR_CONV_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for ADC error					

Input data:

VP_MC_AN_DIG_MON {p. 7135}	VP_MU_AN_DIG_MON {p. 7135}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_CONV_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment (additive value in case of ADC error)					
C_ABC_MAX_CONV_MON	-	1... FFH	1... 255	1	-
Value at which ADC error is recognised when reached					
C_STATE_AN_DIG_ERR_ACT_MON	-	0... FFH	0... 255	1	-
Calibratable value used for provoking an error of the A/D conversion: if C_STATE_AN_DIG_ERR_ACT_MON has value F8H (=248) then the constant value 0, instead of ACQ_MU_0_MON is used as input for the comparison, resulting in an error.					
C_VP_ACQ_CONV_HYS_MON	-	0... 7FFFH	0... 4.999847	152.588e-6	V
Maximal allowed difference between the voltages on main controller and monitoring unit					

Import actions:

ACTION_ECM3_Service3TaskPfm (**IN**<PRM_K>)
ACTION_ECM3_Service4TaskPfm (**IN**<PRM_K>)
ACTION_ECM3_Service5TaskPfm (**IN**<PRM_K>)

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 1.

ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service3TaskPfm() and ACTION_ECM3_Service4TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

General information:

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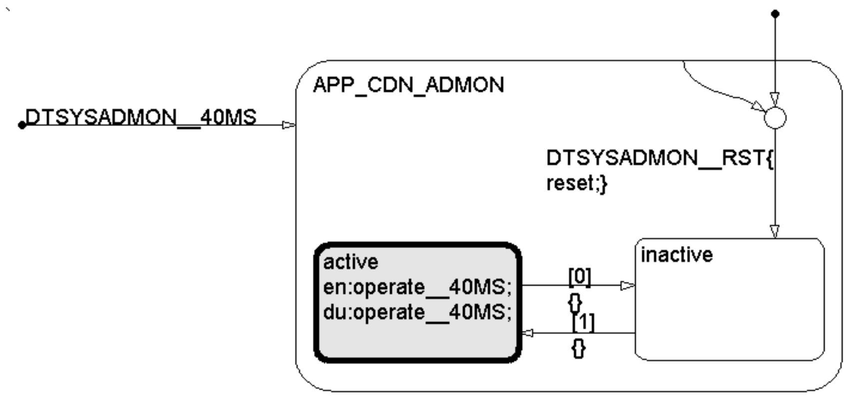
The analogue-digital-converter (ADC) diagnosis is performed by comparing two digital signals. The according analog signal is the same, it is converted once on the main controller (VP_MC_AN_DIG_MON) and also on the monitoring unit (VP_MU_ AN_DIG_MON).
On an error free system, both values are not allowed to differ more than the hysteresis C_VP_ACQ_CONV_HYS_MON.
This hysteresis also covers differences caused by the different sampling times.
There is the possibility to test whether the A/D monitoring works; this can be achieved by setting C_STATE_AN_DIG_ERR_ACT_MON to the value 248 (=F8H), resulting in the fact that the constant 0 (instead of VP_MU_AN_DIG_MON) is used as one of the inputs for the comparison, provoking a fault reaction of the ADC monitoring.

Application Condition



Module_ECM2_DTSYSADMON/APP_CDN/Chart

Function Description

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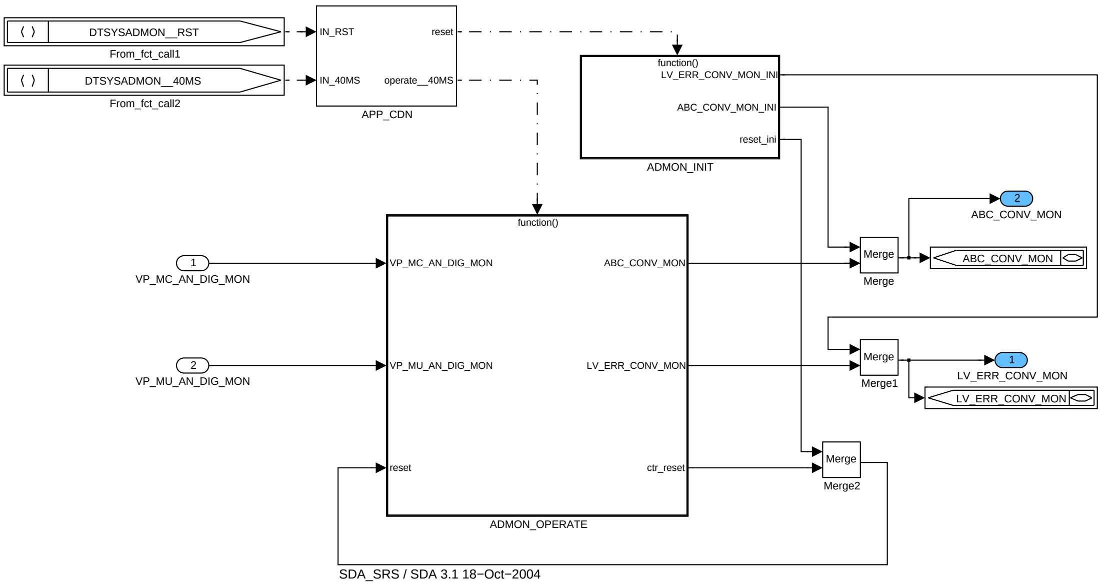
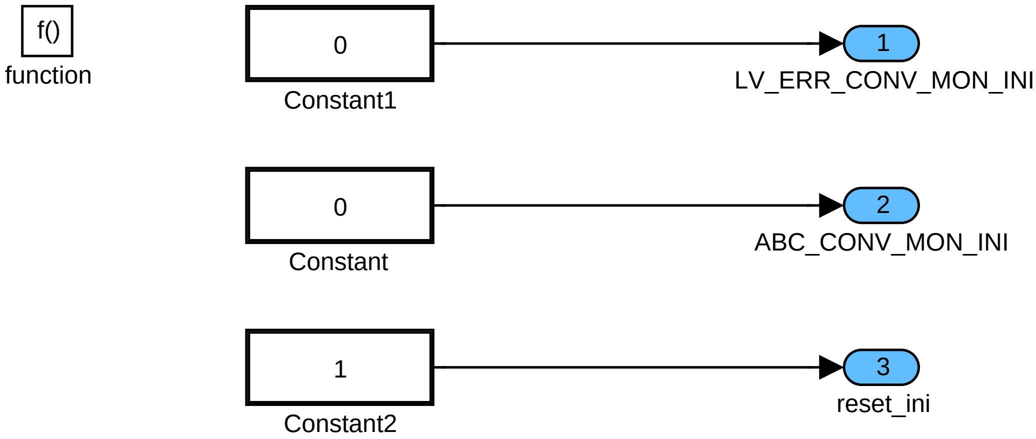


ECM2_DTSYSADMON



ECM2_DTSYSADMON/ADMON_INIT

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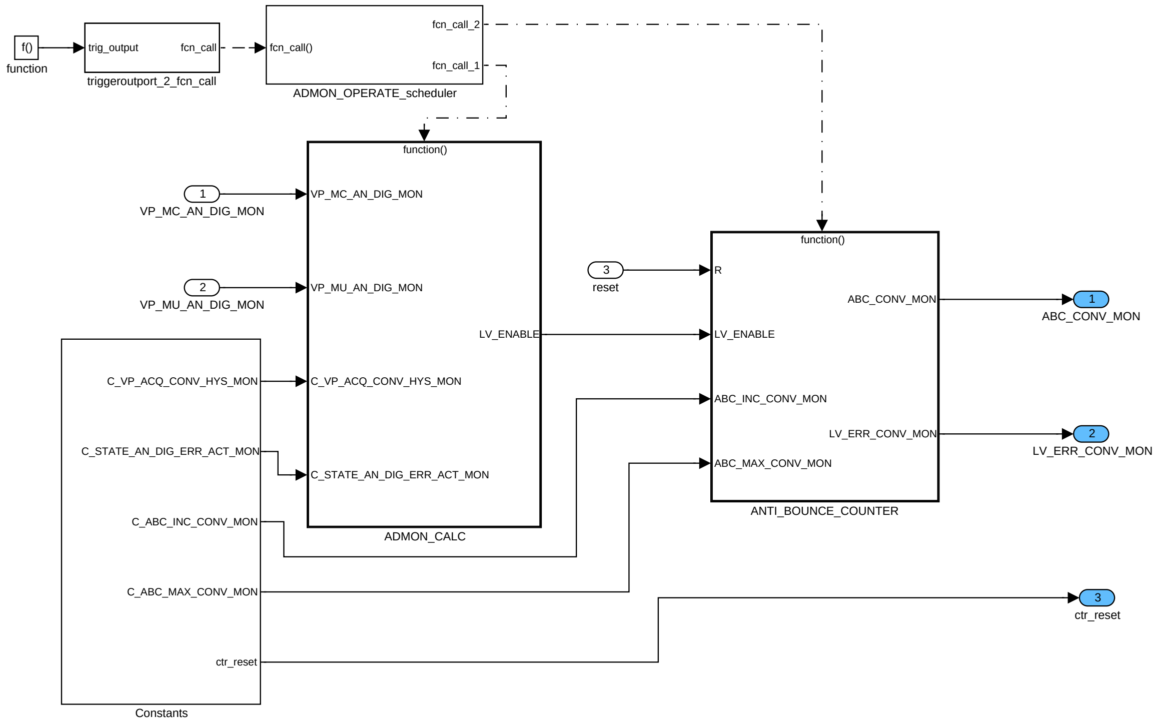
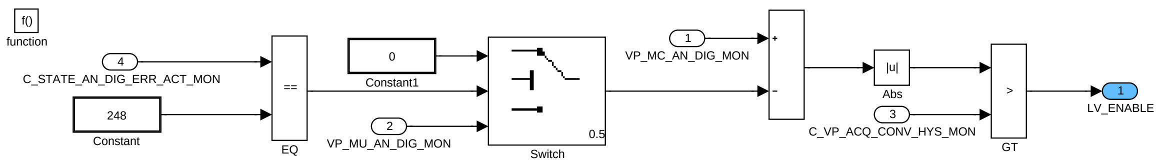
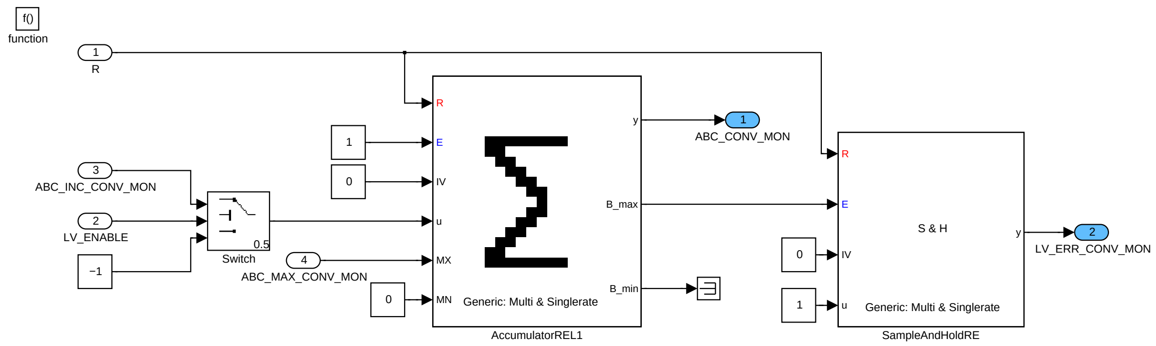


ECM2_DTSYSADMON/ADMON_OPERATE



ECM2_DTSYSADMON/ADMON_OPERATE/ADMON_CALC



ECM2_DTSYSADMON/ADMON_OPERATE/ANTI_BOUNCE_COUNTER

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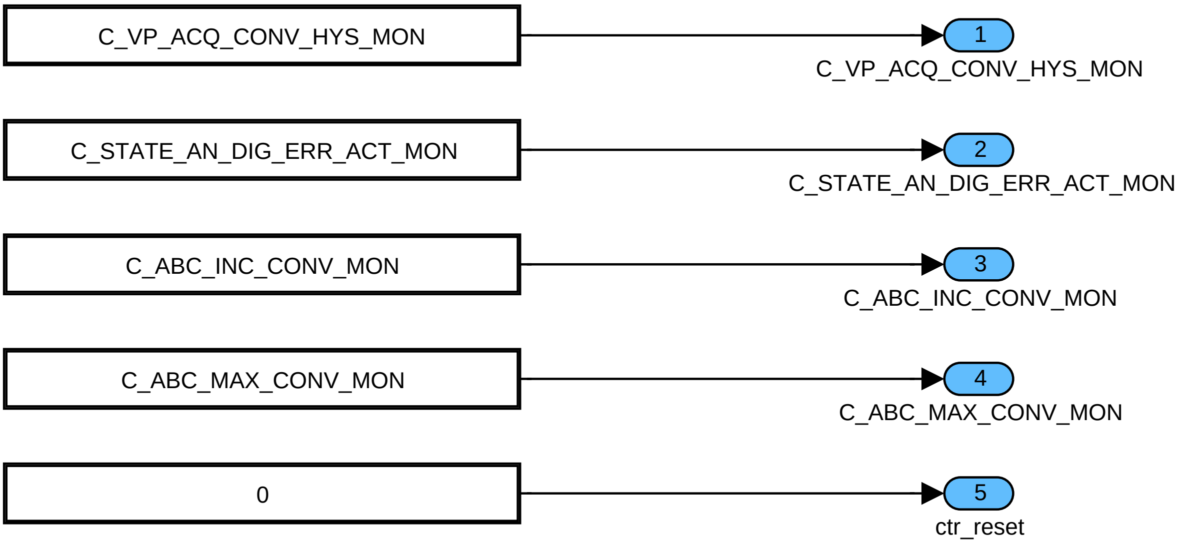

ECM2_DTSYSADMON/ADMON_OPERATE/Constants

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E.14 Monitoring of actual indicated engine torque

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_SWI_AFS_TQI_MON	V	0... FFH	0... 255	1	-
Anit-bounce-counter for request to AFS (TQI_DIF above allowed threshold)					
ABC_TQI_AV_AFS_MON	V	0... FFH	0... 255	1	-
Anti-bounce-counter for fault in torque generation (AFS-mode)					
LV_ERR_TQI_AV_MON	O/V	0... 1H	0 ...1	1	-
Fault currently present in torque generation					
LV_SWI_AFS_TQI_MON	O/V	0... 1H	0 ...1	1	-
Switch to AFS (TQI_DIF above allowed threshold)					
TQI_DIF_AV_MON	V	0... FFH	0... 510	2	Nm
deviation between actual and desired indicated engine torque					
TQI_DIF_MAX_MON	V	0... FFH	0... 510	2	Nm
permitted deviation between actual and desired indicated engine torque					
TQI_DIF_SP_MON	V	0... FFH	0... 510	2	Nm
deviation between torque setpoint and desired indicated engine torque					

Input data:

LV_TQI_MON_ACT_MON {p. 6791}	N_32_MON {p. 7002}	OPM_AV_MON {p. 6792}	TQI_AV_MON {p. 6774}
TQI_SP {p. 8391}	TQI_SP_MON {p. 6851}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_SWI_AFS_TQI_MON	-	0... FFH	0... 255	1	-
ABC increment for request to AFS (TQI_DIF above allowed threshold)					
C_ABC_INC_TQI_AV_AFS_MON	-	0... FFH	0... 255	1	-
ABC increment at TQI_DIF above allowed treshold (AFS-mode)					
C_ABC_MAX_SWI_AFS_TQI_MON	-	1... FFH	1... 255	1	-
Value at which OPM will be switched to AFS at TQI_DIF above allowed treshold					
C_ABC_MAX_TQI_AV_AFS_MON	-	1... FFH	1... 255	1	-
Value at which TQI_AV_MON error is recognized. when reached (AFS-mode)					
C_GAIN_TQI_DIF_MAX_MON	-	0... FFH	0... 63.75	0.25	-
Factor for threshold diagnosis with TQI_SP					
IP_TQI_DIF_MAX_MON	V	0... FFH	0... 510	2	Nm
LDP_N_32_IP_TQI_DIF_MAX_MON	4	0... FFH	0... 8160	32	rpm
LDP_TQI_SP_IP_TQI_DIF_MAX_MON	4	0... FFH	0... 510	2	Nm
Threshold for diagnosis of engine torque overflow					

Import actions:

ACTION_ECM3_Service10TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service11TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service9TaskPfm (**IN**<No Name available>)

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E.14.1 DTSYSTQMON

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 4.

ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service9TaskPfm() and ACTION_ECM3_Service10TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

General information:

The objective of this module is the comparison of the desired indicated engine torque TQI_SP_MON (feedforward path) and the actual indicated engine torque TQI_AV_MON (feedback path). In the fault free case, the actual indicated engine torque should not exceed the desired indicated engine torque. A fault is detected after debouncing, when the actual indicated engine torque exceeds the setpoint value by more than a threshold value TQI_DIF_MAX_MON depending on engine speed and the desired torque. If the operation mode is not equal to AFS a request for AFS will be debounced.
TQI_AV_MON depends on the dynamics of the intake manifold and on the dynamics of the lambda sensor which means that a possible fault cannot be detected before a certain time. Hence for a fast diagnosis TQI_AV_MON is not suitable but can be replaced by TQI_SP which is compared to TQI_SP_MON. In case that TQI_SP_MON differs from TQI_SP by more than a certain value, the error bit LV_ERR_TQI_AV_MON is set.

Application Condition

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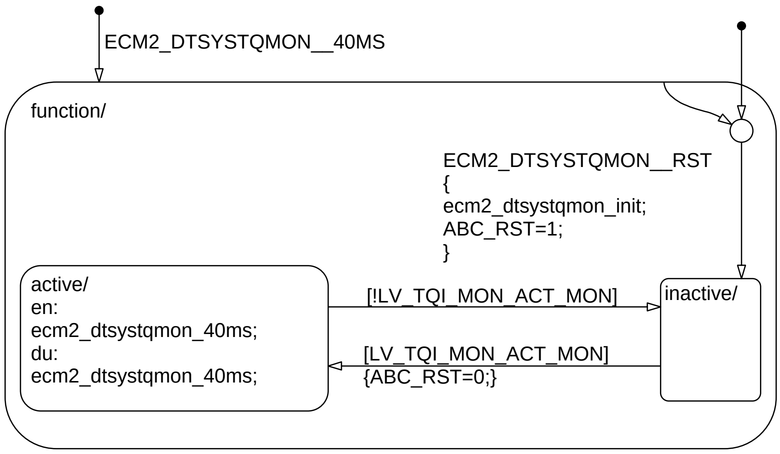

Figure E.14.1: ECM2_DTSYSTQMON/APP_CDN/CHART

Function Description

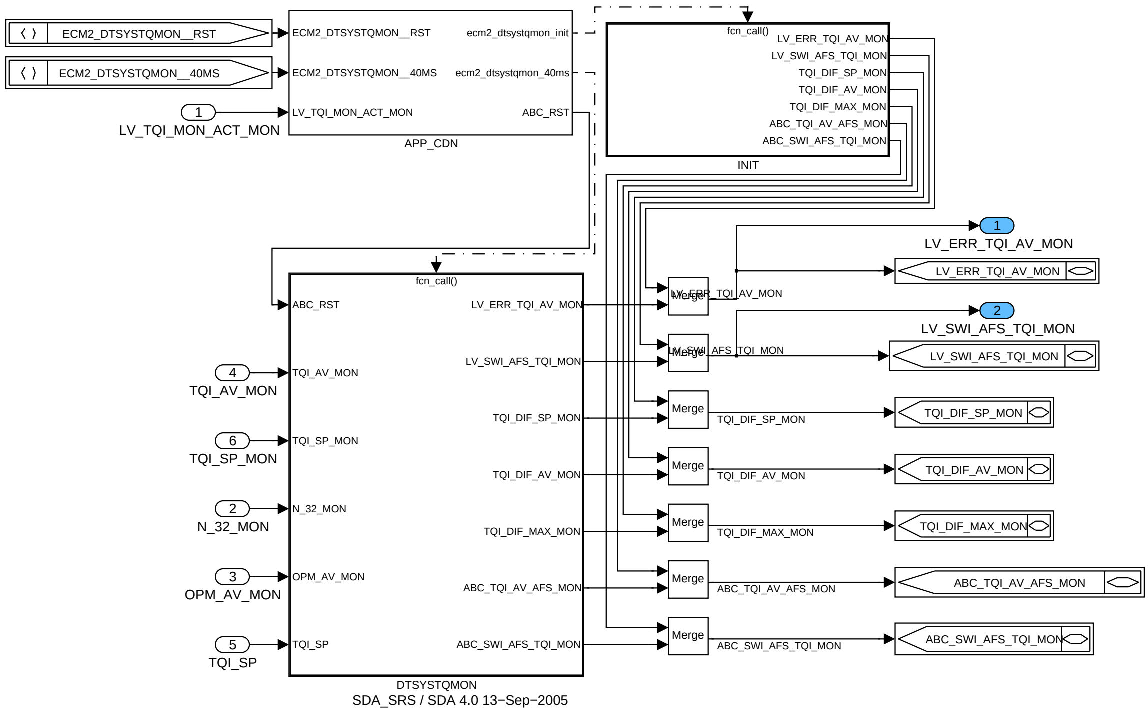

Figure E.14.2: ECM2_DTSYSTQMON

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E.14.1.1 SUBFUNCTION: INIT

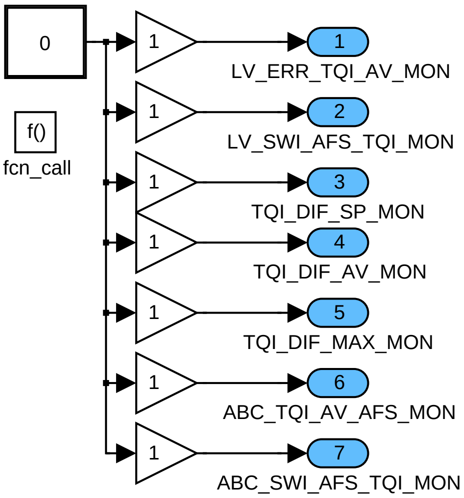

Figure E.14.3: ECM2_DTSYSTQMON/INIT

E.14.1.2 SUBFUNCTION: DTSYSTQMON

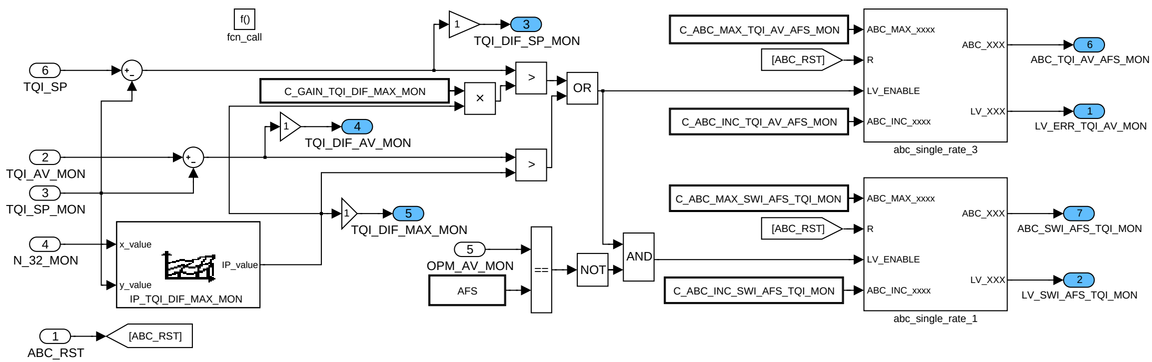

Figure E.14.4: ECM2_DTSYSTQMON/DTSYSTQMON

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E.15 Monitoring of coolant temperature

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_TCO_GRD_MON	V	0... FFH	0... 10.2	0.04	s
Timer for negative TCO gradient limitation					
TCO_MON	O/V	0... FEH	-48... 142.5	0.75	°C
Coolant temperature (monitoring level)					

Input data:

LV_TQI_MON_ACT_MON {p. 6791}	TCO {p. 1100}	TCO_SUB {p. 1105}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_TCO_GRD_MAX_MON	-	0... FFH	0... 10.2	0.04	s
Minimum time before a new change of TCO_MON is allowed					
C_TCO_GRD_MAX_MON	-	0... FEH	0... 190.5	0.75	°C
Maximum negative gradient for the coolant temperature					
C_TCO_SUB_THD_MAX_MON	-	0... FE00H	-48... 142.5	2.9297e-3	°C
Threshold for the max. TCO_SUB temperature while TCO is lower than C_TCO_THD_MIN_MON					
C_TCO_THD_MIN_MON	-	0... FEH	-48... 142.5	0.75	°C
Threshold for the min. TCO temperature while TCO_SUB is higher than C_TCO_SUB_THD_MAX_MON					

Import actions:

ACTION_ECM3_Service6TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service7TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service8TaskPfm (**IN**<No Name available>)

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 1.

ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service6TaskPfm() and ACTION_ECM3_Service7TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

E.15.1 FUNCTION PART: ECM2_DTSYSTCO

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General information:

A sudden decrease in the coolant temperature TCO caused by a fault can lead to an undesired increase of the torque demand and thus to an undesired acceleration of the car because of the temperature dependent friction compensation. Therefore the negative temperature gradient of TCO shall be limited in the function level. In order to detect process faults, the gradient of the coolant temperature which is copied to the process monitoring level is also limited, i.e. to C_TCO_GRD_MAX_MON. Also the diagnosis for a too low TCO-sensor temperature is monitored. The resulting value TCO_MON is then used within the monitoring level. If a fault in TCO leads to an increased engine torque in the idle speed controller the module Monitoring of idle speed controller detects this fault as an increased torque demand from the idle speed controller.

In case of an error free system the temperature TCO_MON used in the monitoring level should be the same as the temperature TCO used in the function level.

An additional timer is needed to compensate the different recurrencies of level 1 and level 2. The maximum counter threshold C_T_TCO_GRD_MAX_MON and the maximum negative temperature gradient C_TCO_GRD_MAX_MON need to be adapted in regard to the function recurrency and to C_TCO_GRD_MAX of level 1.

The resolution of T_TCO_GRD_MON and C_T_TCO_GRD_MAX_MON depend on the update rate of the module.

Application conditions:

Activation: *LV_TQI_MON_ACT_MON = 1*
Deactivation: *otherwise*
Initialization: *for condition see Application Incidences of Process Monitoring ;*
moreover, at deactivation:
TCO_MON(k) = TCO
T_TCO_GRD_MON = 0.0
Update Rate: 40 msec

Application Condition

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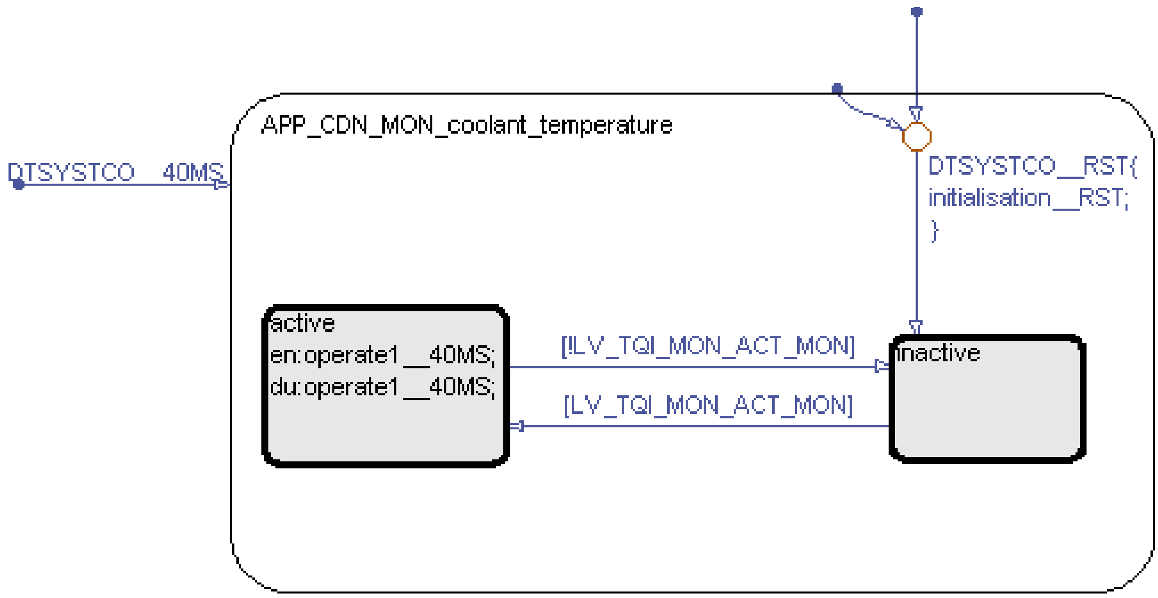

Note: DTSYSTCO__RST includes the function calls as defined in application incidences.

Function Description

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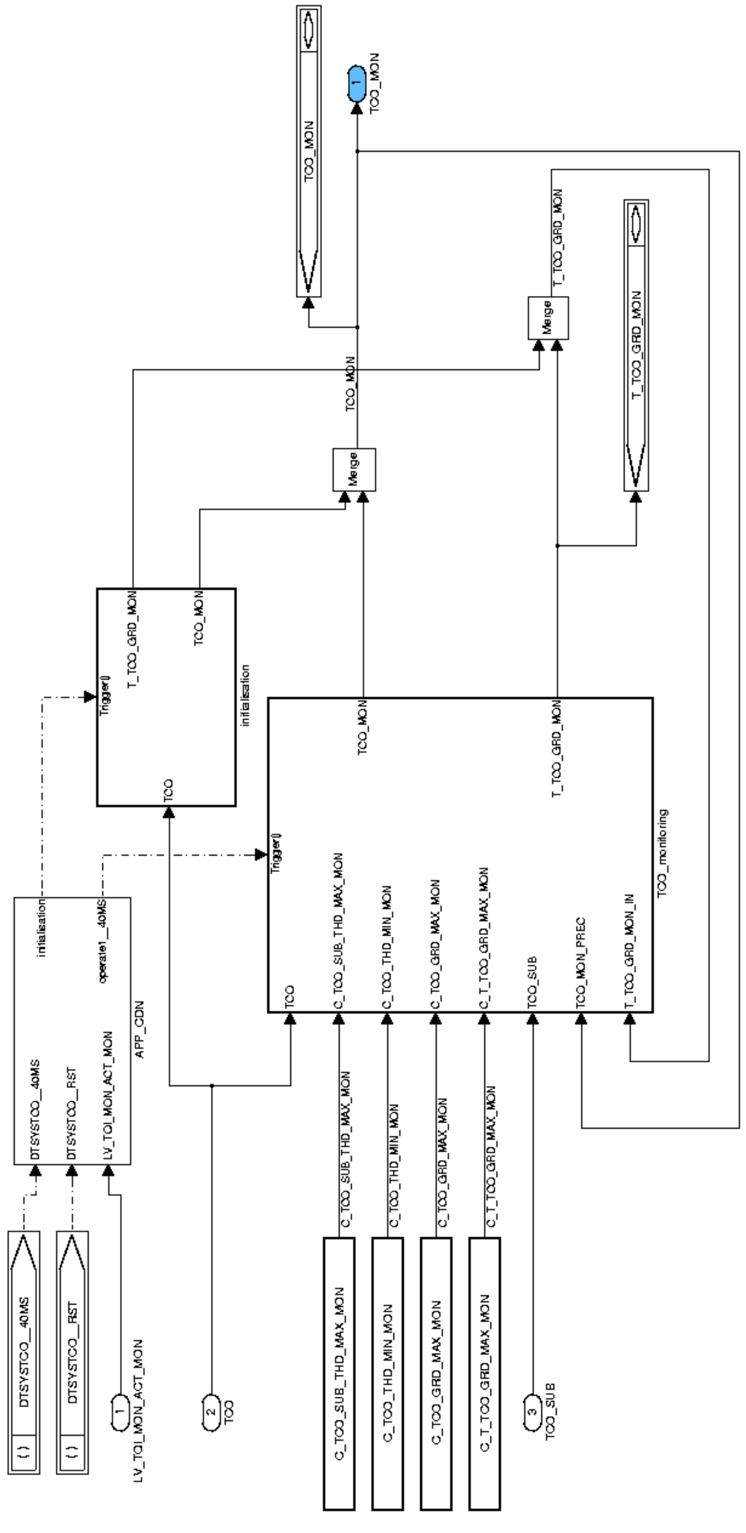

Figure E.15.1: ECM2_DTSYSTCO

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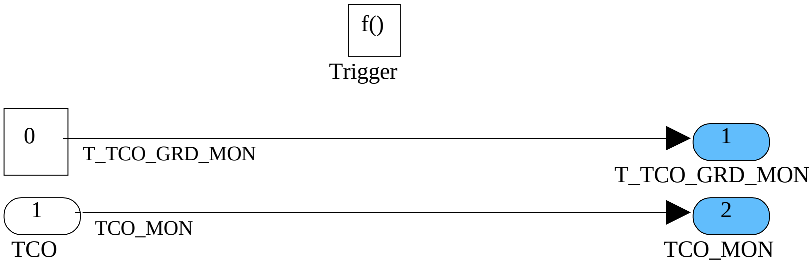

Figure E.15.2: ECM2_DTSYSTCO/INITIALISATION

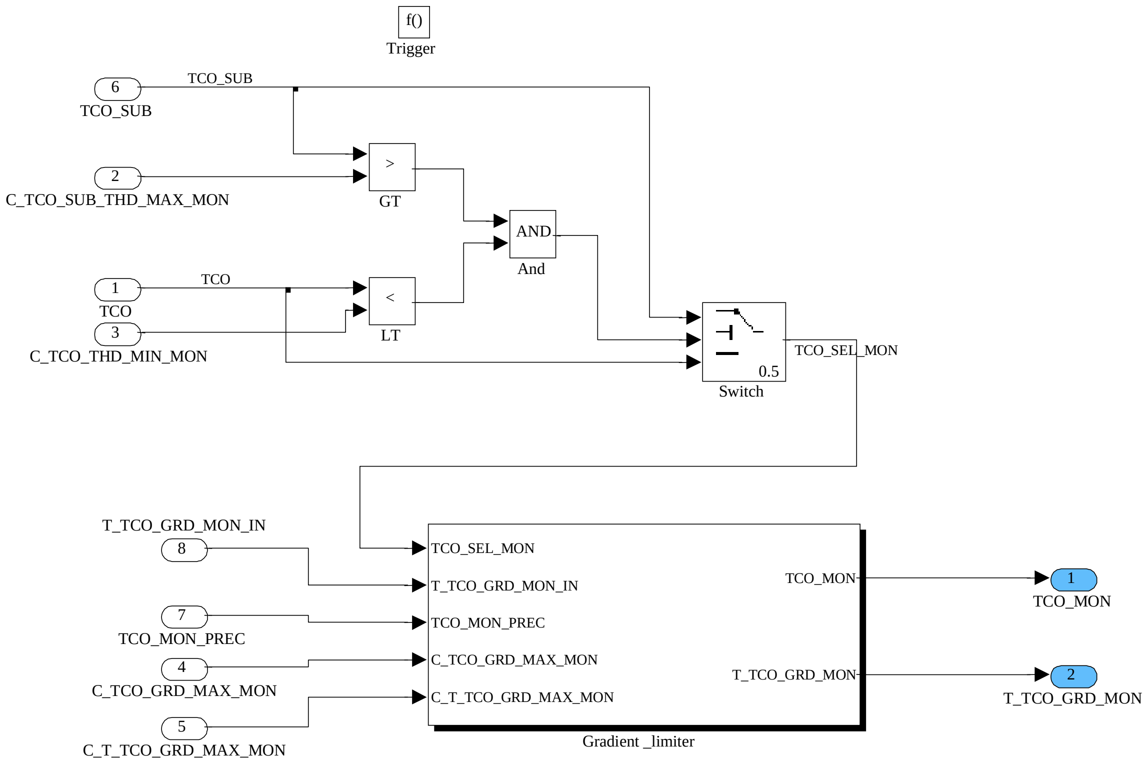

Figure E.15.3: ECM2_DTSYSTCO/TCO_MONITORING

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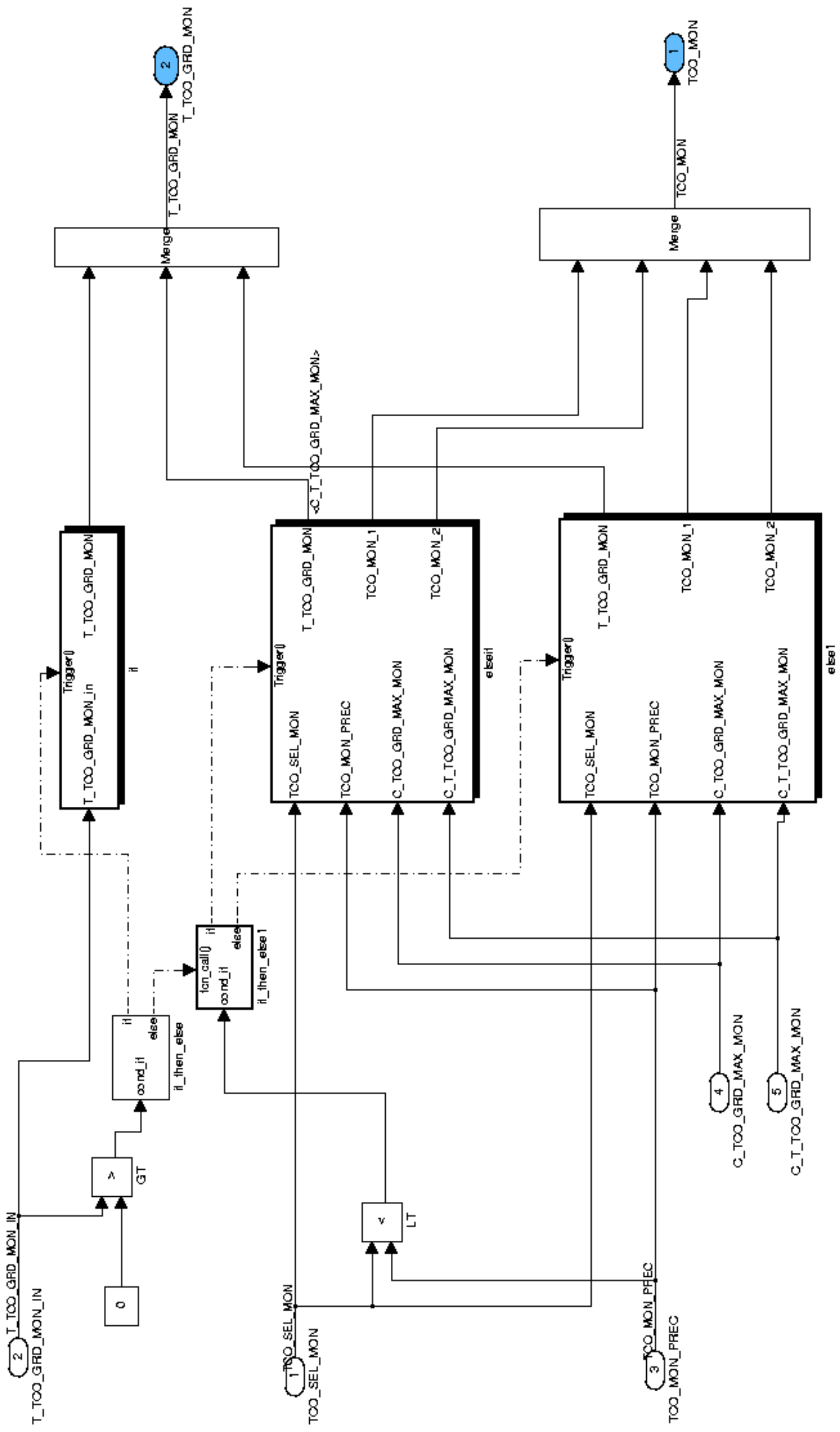

Figure E.15.4: ECM2_DTSYSTCO/TCO_MONITORING/GRADIENT _LIMITER

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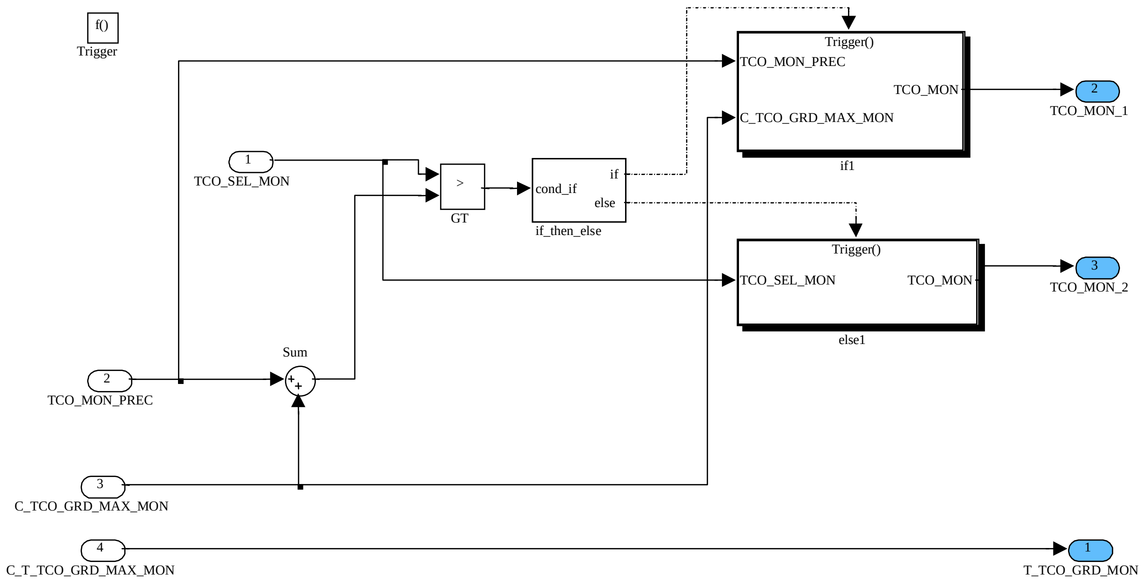

Figure 5 ECM2_DTSYSTCO/ TCO_monitoring/ Gradient _limiter/ else1

Figure E.15.5: ECM2_DTSYSTCO/TCO_monitoring/Gradient _limiter/else1/else1

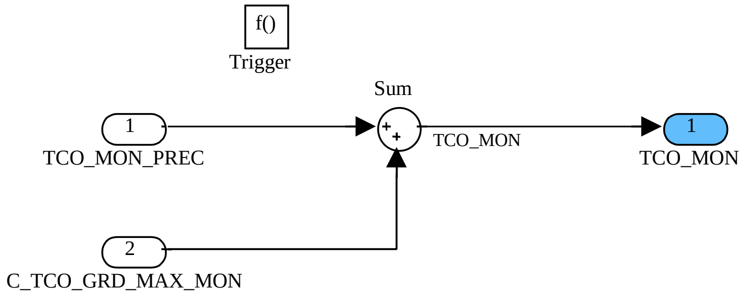

Figure E.15.6: ECM2_DTSYSTCO/TCO_monitoring/Gradient _limiter/else1/if1

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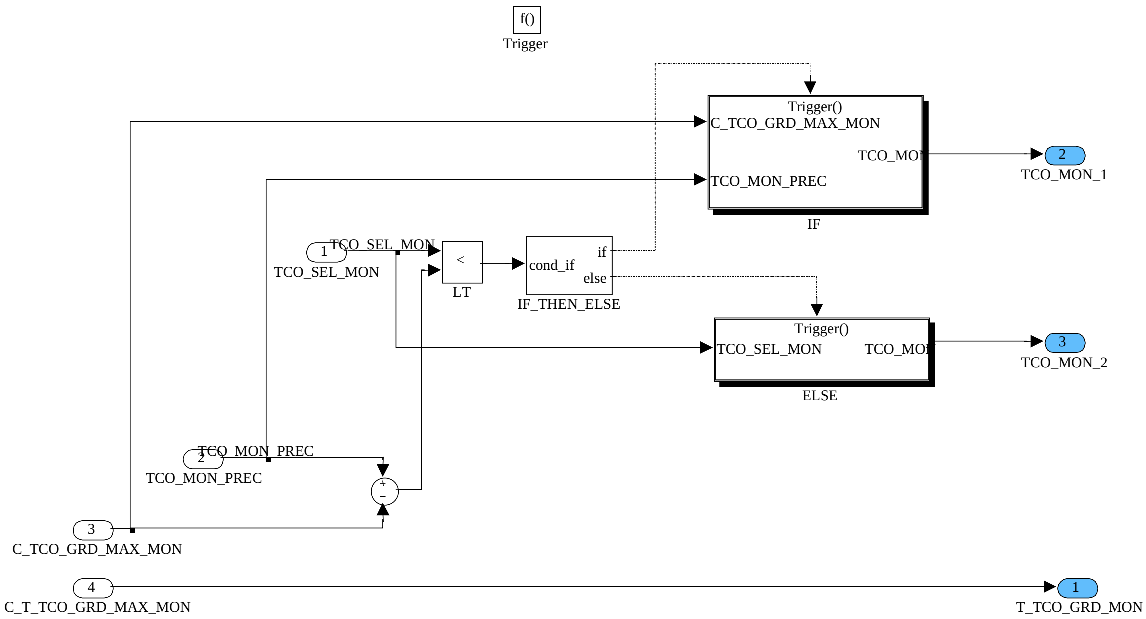

Figure E.15.7: ECM2_DTSYSTCO/TCO_monitoring/Gradient _limiter/elseif

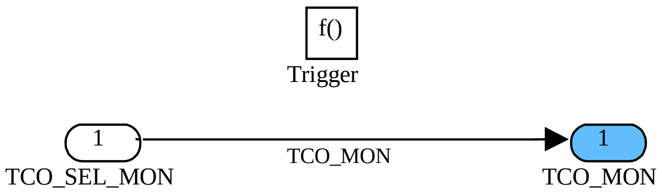

Figure E.15.8: ECM2_DTSYSTCO/TCO_monitoring/Gradient _limiter/elseif/ELSE

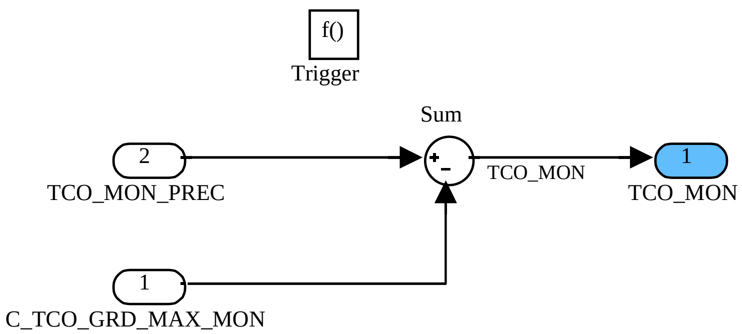

Figure E.15.9: ECM2_DTSYSTCO/TCO_monitoring/Gradient _limiter/elseif/IF

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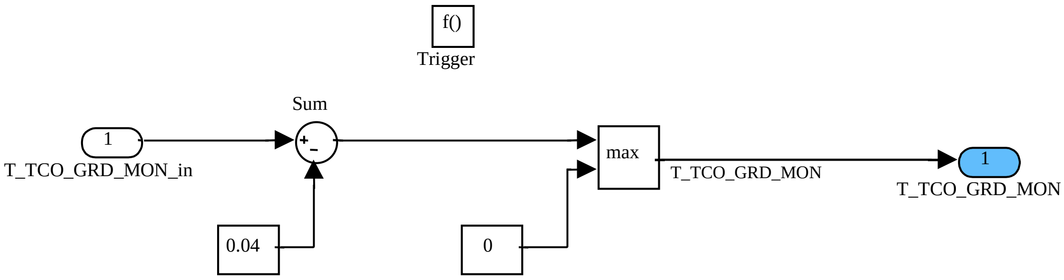

Figure E.15.10: ECM2_DTSYSTCO/TCO_monitoring/Gradient _limiter/if

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E.16 Monitoring of cruise control conditions

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_CRU_TQ_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for monitoring of cruise control conditions					
FAC_TQ_REQ_CRU_MON	O/V	0... FFH	0... 1.99218	0.0078125	-
Scaling factor of cruise control torque demand in monitoring level					
LV_CRU_INH_MON	O/V	0... 1H	0 ...1	1	-
logical variable for inhibition of cruise control					
LV_ERR_CRU_MON	O/V	0... 1H	0 ...1	1	-
Fault in Cruise Control present					
T_CRU_INH_MON	V	0... FFH	0... 10.2	0.04	s
Timer for inhibition of cruise control torque demand in monitoring level					

Input data:

FAC_TQ_REQ_CRU {p. 6737}	LV_BRAKE_MON {p. 6790}	LV_CRU_ACT {p. 7227}	LV_CRU_MAIN_SWI {p. 7220}
LV_ERR_MSW_2 {p. 5058}	LV_ERR_MSW_3 {p. 5058}	LV_ERR_MSW_TOG {p. 5058}	LV_TQI_MON_ACT_MON {p. 6791}
VS_FIL {p. 1176}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_CRU_TQ_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment for cruise torque request					
C_ABC_MAX_CRU_TQ_MON	-	1... FFH	1... 255	1	-
Maximum value of the anti - bounce counter					
C_T_CRU_INH_MON	-	0... FFH	0... 10.2	0.04	s
Delay time for disable of cruise control in monitoring level					
C_VS_MIN_CRU_MON	-	0... FFH	0... 510	2	km/h
Minimum threshold for vehicle speed control active					

Import actions:

ACTION_ECM3_Service10TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service11TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service9TaskPfm (**IN**<No Name available>)

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Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 3.

ACTION_ECM3_McChkStack( )

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service9TaskPfm() and ACTION_ECM3_Service10TaskPfm().

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ACTION_ECM3_WriteChkCpl(INOUT < >, OUT < >, IN < >)
ACTION_ECM3_ChkCpl(IN < >, IN < >)
ACTION_ECM3_ReadChkCpl(OUT < >, IN < >, IN < >)

Note: All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

ECM2_DTSYSCRU: General information:

The cruise control function is able to request a lot of torque and to accelerate the car up to high speed. In order to avoid dangerous situations caused by a fault of the cruise control function. the main activation/ deactivation conditions are monitored within the etc safety concept. Therefore the basic signals from the master control (Hauptschalter) and the brake are evaluated.
In a cruise control function including active deceleration also the conditions for deceleration enabling have to be monitored.

Application Condition

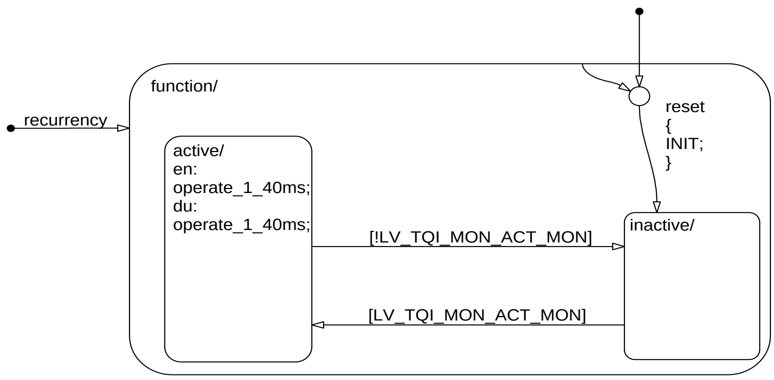

Figure E.16.1: ECM2_DTSYSCRU/APP_CDN/Chart

E.16.1 SUBFUNCTION: INIT

For condition see ’Application Incidences of Process Monitoring’

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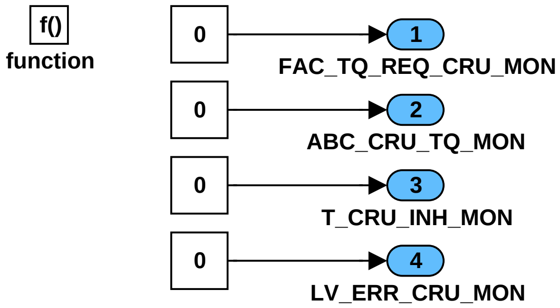

Figure E.16.2: ECM2_DTSYSCRU /INIT

Function Description

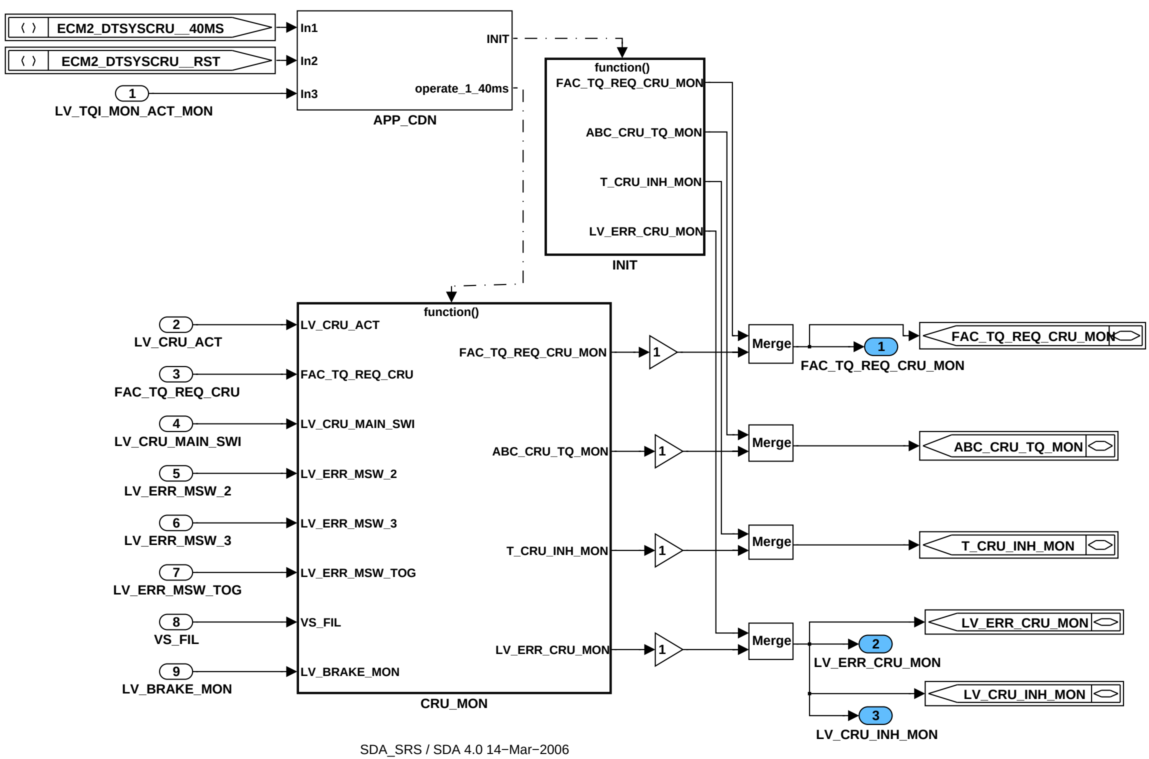

Figure E.16.3: ECM2_DTSYSCRU

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E.16.2 SUBFUNCTION: ME00B_CRU_MON

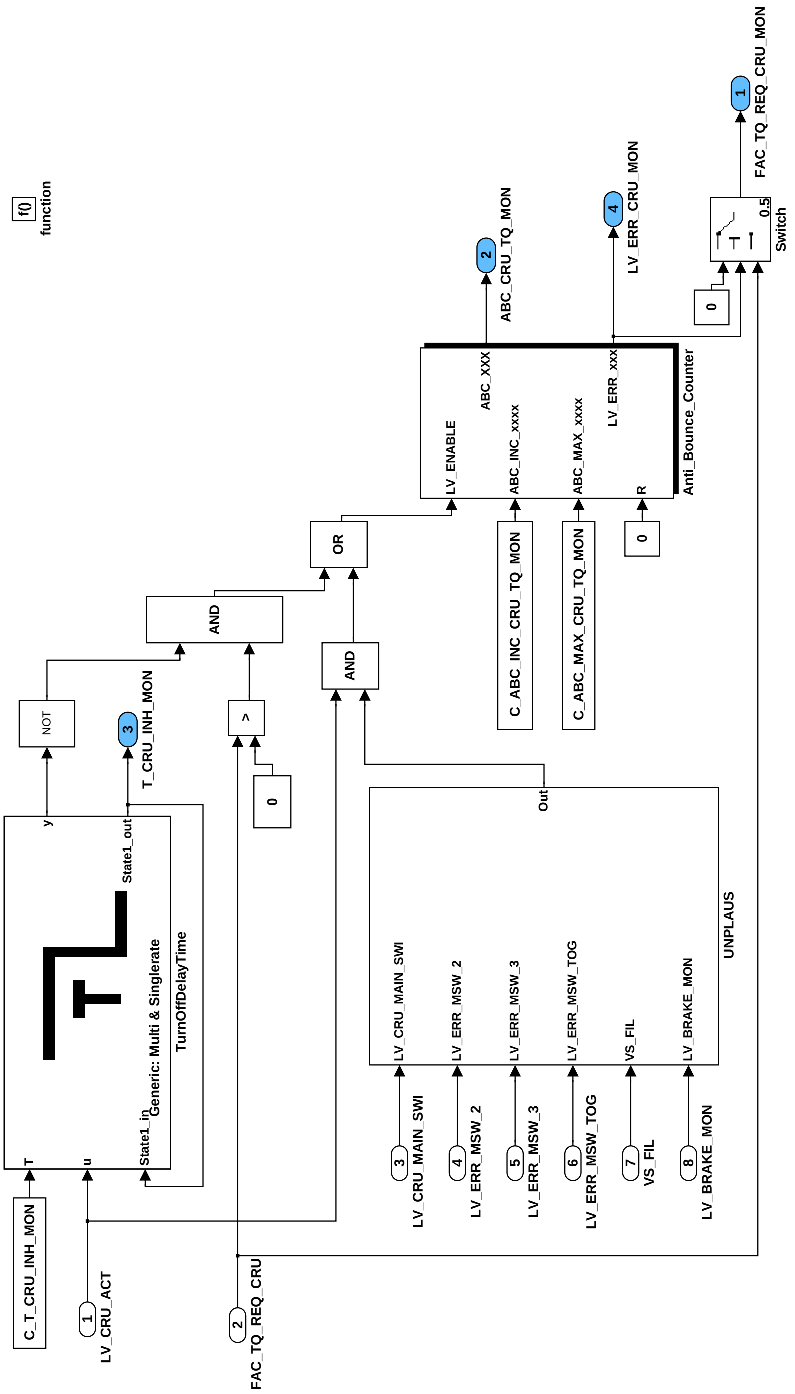

Figure E.16.4: ECM2_DTSYSCRU /ME00B_CRU_MON

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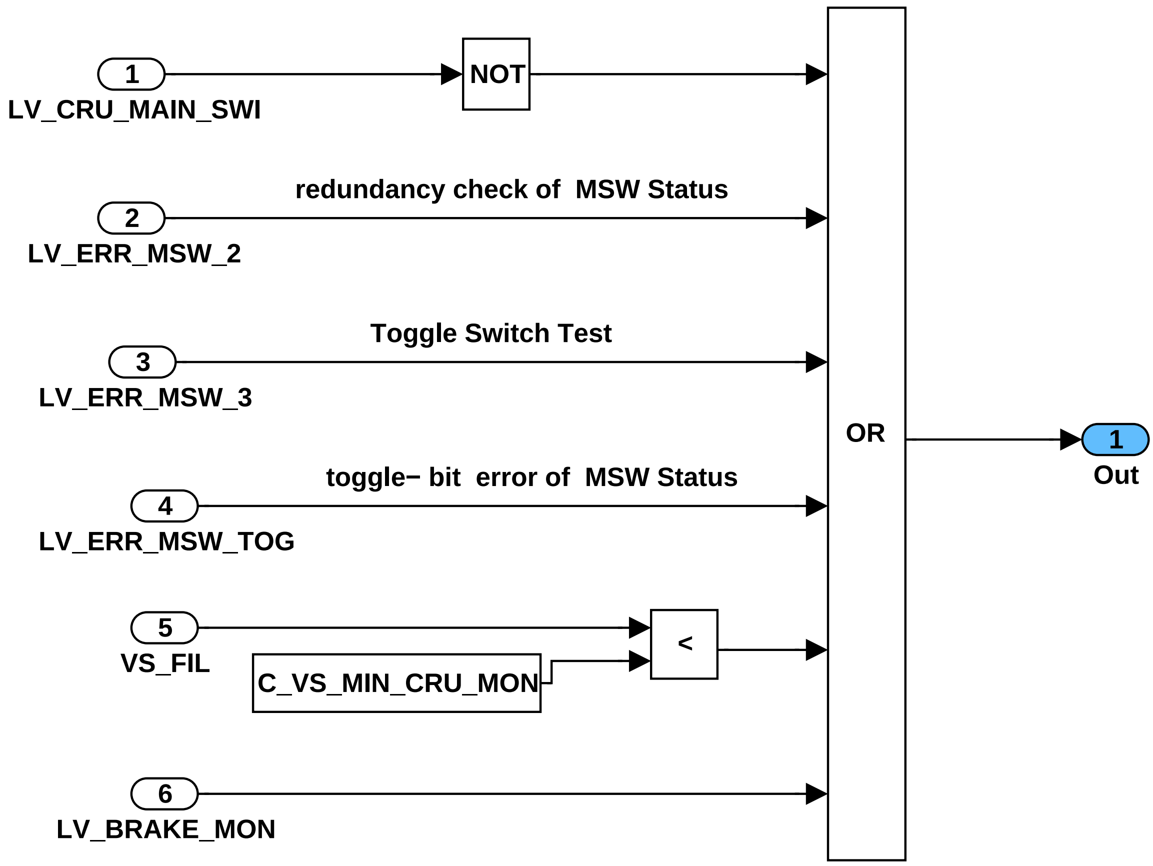

Figure E.16.5: ECM2_DTSYSCRU /ME00B_CRU_MON/UNPLAUS

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E.17 Monitoring of engine speed limitation

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_TQI_N_MAX_MON	O/V	0... FFH	0... 255	1	-
Anti-bounce-counter for fault in engine speed limitation					
LV_ERR_TQI_N_MAX_MON	O/V	0... 1H	0 ...1	1	-
Fault currently present in engine speed limitation					

Input data:

LV_N_LIM_ETC_MON {p. 6790}	N_32_MON {p. 7002}	PREV_STATE_IV {p. 2039}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TQI_N_MAX_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_MAX_TQI_N_MAX_MON	-	1... FFH	1... 255	1	-
Maximum value of anti-bounce counter					
C_N_MAX_MTC_LIH_THD_MON	-	0... FFH	0... 8160	32	rpm
Speed threshold for the detection of a fault in the engine speed limitation					

Import actions:

ACTION_ECM3_Service3TaskPfm (**IN**<PRM_K>)
ACTION_ECM3_Service4TaskPfm (**IN**<PRM_K>)
ACTION_ECM3_Service5TaskPfm (**IN**<PRM_K>)

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 3.

ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service3TaskPfm() and ACTION_ECM3_Service4TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

FUNCTION DESCRIPTION:

General information:

The objective of this module is to verify that the related level 1 function 'Engine speed limitation' works correctly. In case that the engine speed exceeds a certain speed level, the level 1 function activates ETC limp home mode (safety fuel cut-off) to protect the engine.

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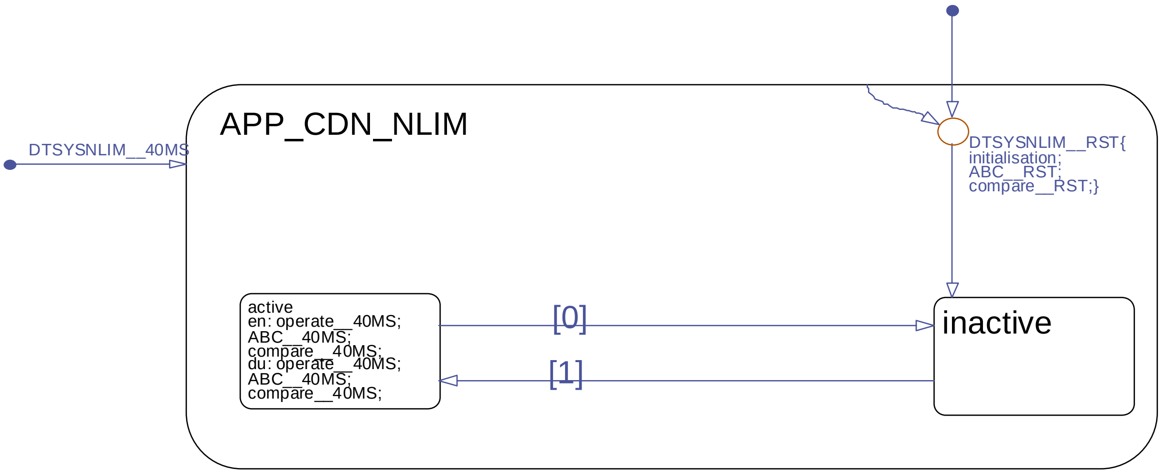
The level 2 function 'Monitoring of engine speed limitation' considers the status of the injection of all cylinders and the engine speed value and the ETC request flag (LV_N_LIM_ETC_MON). This flag is set to 1 if any function requests limp home activation.

In case that the engine speed exceeds the defined level 2 value C_N_MAX_MTC_LIH_THD_MON and limphome mode is requested (LV_N_LIM_ETC_MON = 1) and injection is active in at least one cylinder (PREV_STATE_IV   0; fuel cut-off is not active!), the related error bit LV_ERR_TQI_N_MAX_MON is set after having waited a certain debounce time defined by C_ABC_MAX_TQI_N_MAX_MON and C_ABC_INC_TQI_N_MAX_MON.
The injection status has to be checked to avoid that level 2 detects a failure in case that the engine speed exceeds the threshold although fuel cut-off has been put into action. This could happen if the vehicle is running down a hill and the engine speed increases because of the engine directly linked to the transmission.

E.17.1 FUNCTION PART: NLIM

Application Condition



Note: DTSYSNLIM__RST includes the function calls as defined in application incidences.

Function Description

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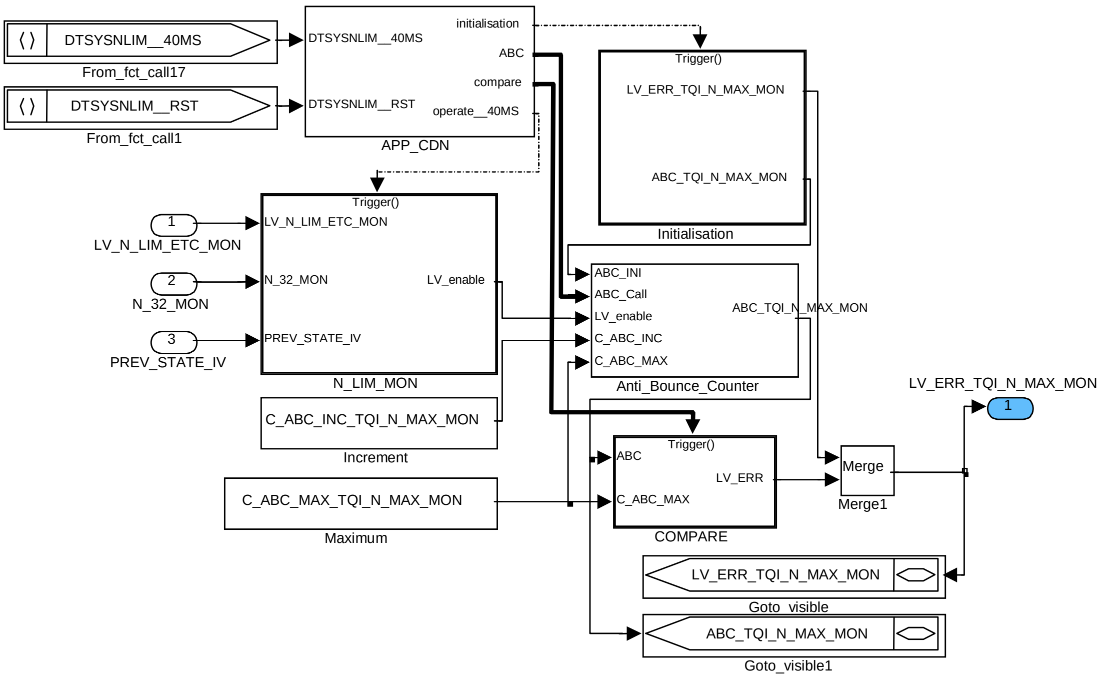

Figure E.17.1: NLIM

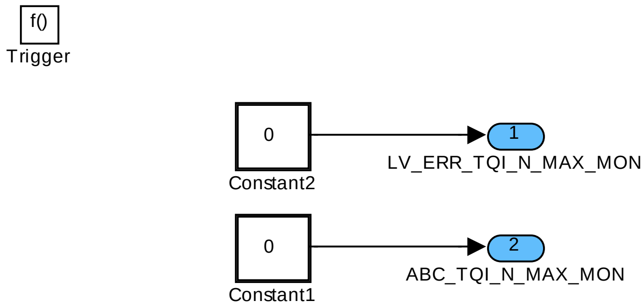

Figure E.17.2: NLIM/INITIALISATION

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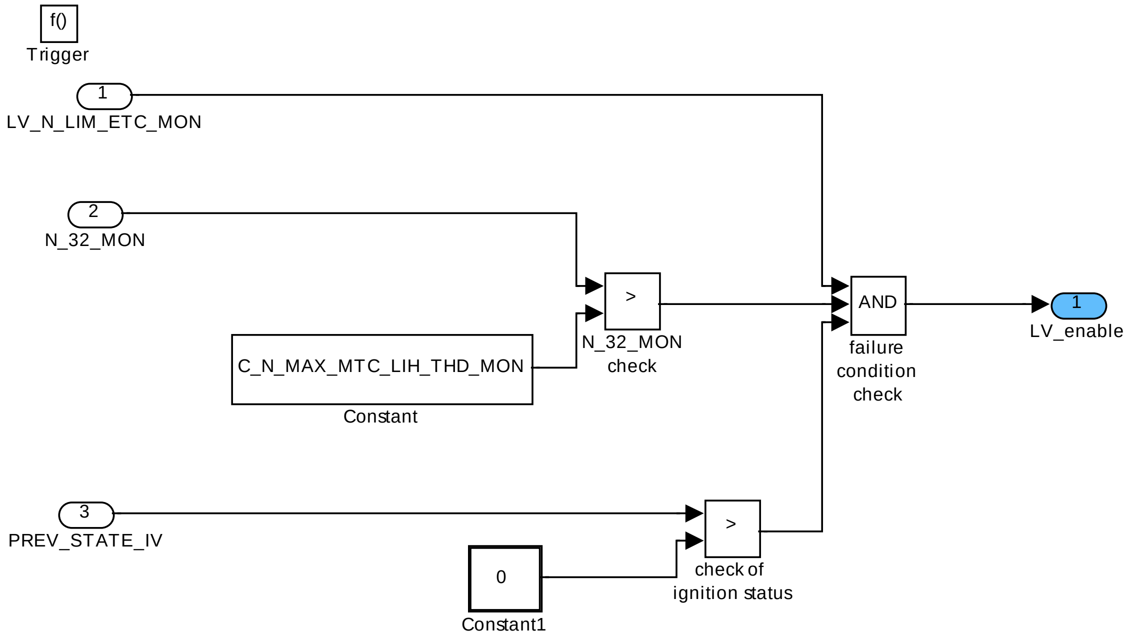

Figure E.17.3: NLIM/N_LIM_MON

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E.18 Monitoring of idle speed controller

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_TQ_DIF_I_IS_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for monitoring of I_PART of idle speed controller					
ABC_TQ_DIF_P_D_IS_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for monitoring of idle speed controller - PD-part					
LV_ERR_TQ_DIF_I_IS_MON	O/V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom "idle speed controller - I-part"					
LV_ERR_TQ_DIF_P_D_IS_MON	O/V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom "idle speed controller - PD-part"					
LV_RAMP_P_D_BEG_VALUE_WRG_MON	V	0... 1H	0 ...1	1	-
Logical bit indicating wrong start value of PD-ramp					
STATE_ERR_TQ_DIF_I_IS_MON	O/V	0H 1H 2H 3H 4H	NO_ERROR ERROR_PATH1 ERROR_PATH2 ERROR_PATH3 ERROR_PATH4	-	-
State variable for fault detection in torque generation, symptom idle speed controller - I-part					
STATE_ERR_TQ_DIF_P_D_IS_MON	O/V	0H 1H 2H 3H 4H	NO_ERROR ERROR_PATH1 ERROR_PATH2 ERROR_PATH3 ERROR_PATH4	-	-
State variable for fault detection in torque generation, symptom idle speed controller - PD-part					
TQ_ADD_I_IS_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Decrement for modelled I-part during ramp function					
TQ_ADD_P_D_IS_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Decrement for modelled PD-part during ramp function					
TQ_DIF_I_IS_DIF_MON	V	80... 7FH	-256 ...254	2	Nm
Difference between monitored and modelled I-part					
TQ_DIF_I_IS_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Monitored I-part of the idle speed controller					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_DIF_I_IS_RAMP_MON	V	8000... 7FFFH	-256... 255.99218	0.0078125	Nm
Modelled I-part during ramp function					
TQ_DIF_P_D_IS_DIF_MON	V	80... 7FH	-256 ...254	2	Nm
Difference between monitored and modelled PD-part					
TQ_DIF_P_D_IS_RAMP_MON	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
Modelled PD-part during ramp function					

Input data:

FAC_RAMP_NEG_P_D_IS_MON {p. 6789}	LV_PAS_RAMP_ACT_I_CHG_MON {p. 6790}	LV_PAS_RAMP_ACT_P_D_CHG_MON {p. 6791}	LV_REQ_ISC {p. 3501}
LV_TQI_MON_ACT_MON {p. 6791}	STATE_PAS_RAMP_ACT_I_IS_MON {p. 6792}	STATE_PAS_RAMP_ACT_P_D_IS_MON {p. 6792}	STATE_REQ_ISC_MON {p. 6792}
TQ_DIF_I_IS {p. 3441}	TQ_DIF_P_D_IS_MAX_MON {p. 6793}	TQ_DIF_P_D_IS_MON {p. 6793}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TQ_DIF_I_IS_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_INC_TQ_DIF_P_D_IS_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_MAX_TQ_DIF_I_IS_MON	-	1... FFH	1... 255	1	-
Maximum of anti bounce counter					
C_ABC_MAX_TQ_DIF_P_D_IS_MON	-	1... FFH	1... 255	1	-
Maximum of anti bounce counter					
C_FAC_RAMP_NEG_I_IS_MON	-	0... FA0H	0... 0.5	0.000125	-
Factor for monitoring negative ISC deactivation-ramp of I-part					
C_TQ_DIF_I_IS_ADD_MON	-	0... FFH	0... 255	1	Nm
Additive constant for I-part model value					
C_TQ_DIF_I_IS_MAX_MON	-	0... FFH	0... 255	1	Nm
Maximum I-part					
C_TQ_DIF_P_D_IS_ADD_MON	-	0... FFH	0... 255	1	Nm
Additive constant for PD-part model value					
C_TQ_DIF_P_D_RAMP_CHK_OFS_MON	-	0... FFH	0... 255	1	Nm
Offset for monitoring ramp start value					
C_TQ_I_ISC_NOT_ACT_MAX_MON	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum I-Part allowed when ISC not active					
C_TQ_P_D_ISC_NOT_ACT_MAX_MON	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum PD-part allowed when ISC not active					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TQ_PAS_I_IS_MON	-	0... FFH	0... 255	1	Nm
Target value for monitoring ISC deactivation-ramp operation					

Import actions:

ACTION_ECM3_Service12TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service13TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service14TaskPfm (**IN**<No Name available>)

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 1.

ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service12TaskPfm() and ACTION_ECM3_Service13TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: These actions are defined in chapter "Processor Monitroing", subsection "RAM test on MC for processor monitoring". All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

Function Description

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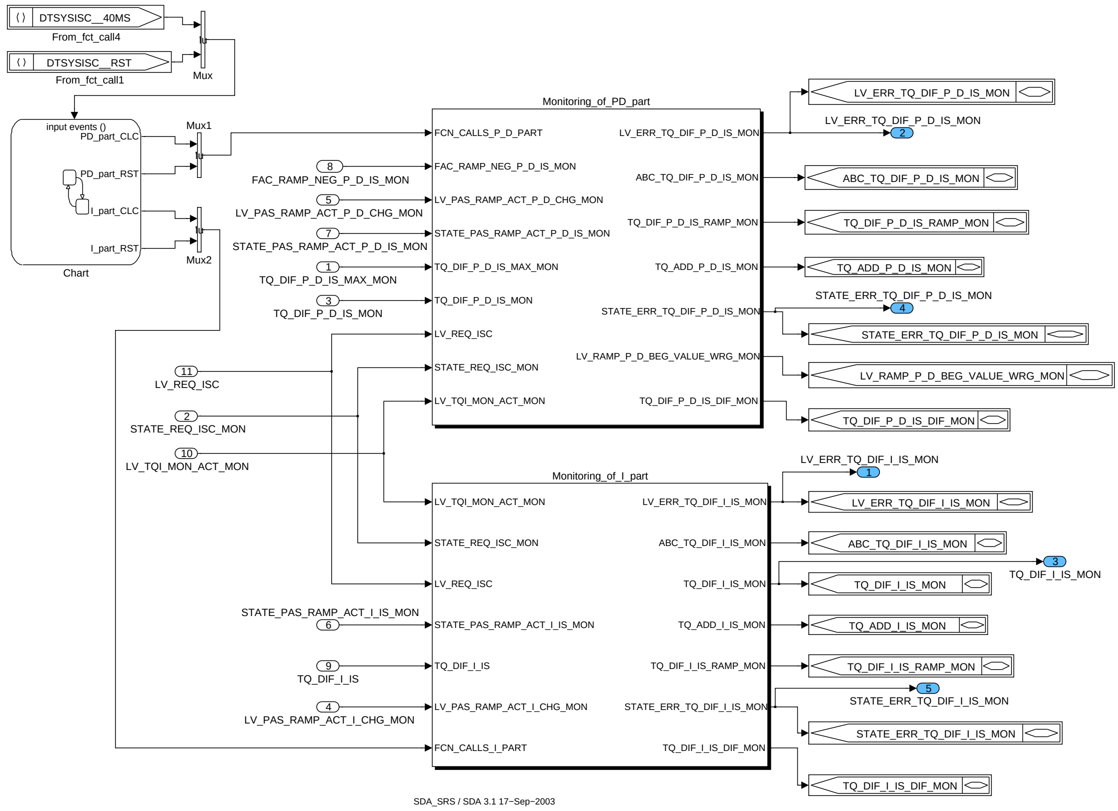

Figure E.18.1: ECM2_DTSYSISC

E.18.1 Monitoring of PD controller

General information:

The objective of this function is the monitoring of the torque demand from the PDpart of the idle speed controller function. Depending on the speed deviation to the idle speed setpoint and the coolant temperature a maximum PDpart is generated (the worst case values for the PDpart in the function level, i.e. great PDpart values are allowed for the most negative speed gradients => for N < N_SP_IS_MON and for N > N_SP_IS_MON small PDpart values are allowed). To additionally monitor the activation of the idle-speed controller in L1, a model value STATE_REQ_ISC_MON) of the activation status is calculated in the module Application incidences of process monitoring . To effectively plausiblise the values of TQ_DIF_P_D_IS and TQ_DIF_I_IS from the function level, both the monitoring thresholds as well as the activation condition model value are used.

The functionality that is depicted in the following pages consists of two fault scenarios:

Error Path - ISC not active:

Case 1: If the ISC is in the ramp limit operation due to deactivation of ISC, this ramp function is monitored. If LV_PAS_RAMP_ACT_P_D_CHG_MON is 1(i.e. indicates a change of STATE_PAS_RAMP_ACT_P_D_IS(0) from 0 to 1 or a flank change between two L2 sample times), the ramp calculation is triggered. It is first checked if the L1 ramp start-value is below the maximum PD-part. If this is the case, a ramp decrement TQ_ADD_P_D_ IS_MON is calculated and the L1 start-value,TQ_DIF_P_D_IS_MON, plus a calibratable additive constant is copied to TQ_DIF_P_D_IS_RAMP_MON. During the ramp operation, the ramp model value is calculated by adding the ramp decrement to the model value (TQ_DIF_P_D_IS_RAMP $\_MON_{k1}$) from the previous recurrency. If however the ramp start-value is greater than the threshold, TQ_DIF_P_D_IS_MAX_MON, then LV_RAMP_P_D_BEG_VALUE_WRG_

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MON is set to one. The difference between monitored and modelled PDpart is set as a visible variable for application work.
In the error detection part of this functionality, either TQ_DIF_P_D_IS_MON$_k$ $>$ TQ_DIF_P_D_IS_RAMP_MON or LV_RAMP_P_D_BEG_VALUE_WRG_MON==1 will lead to the error flag STATE_ERR_TQ_DIF_P_D_IS_MON being set.

Function Description

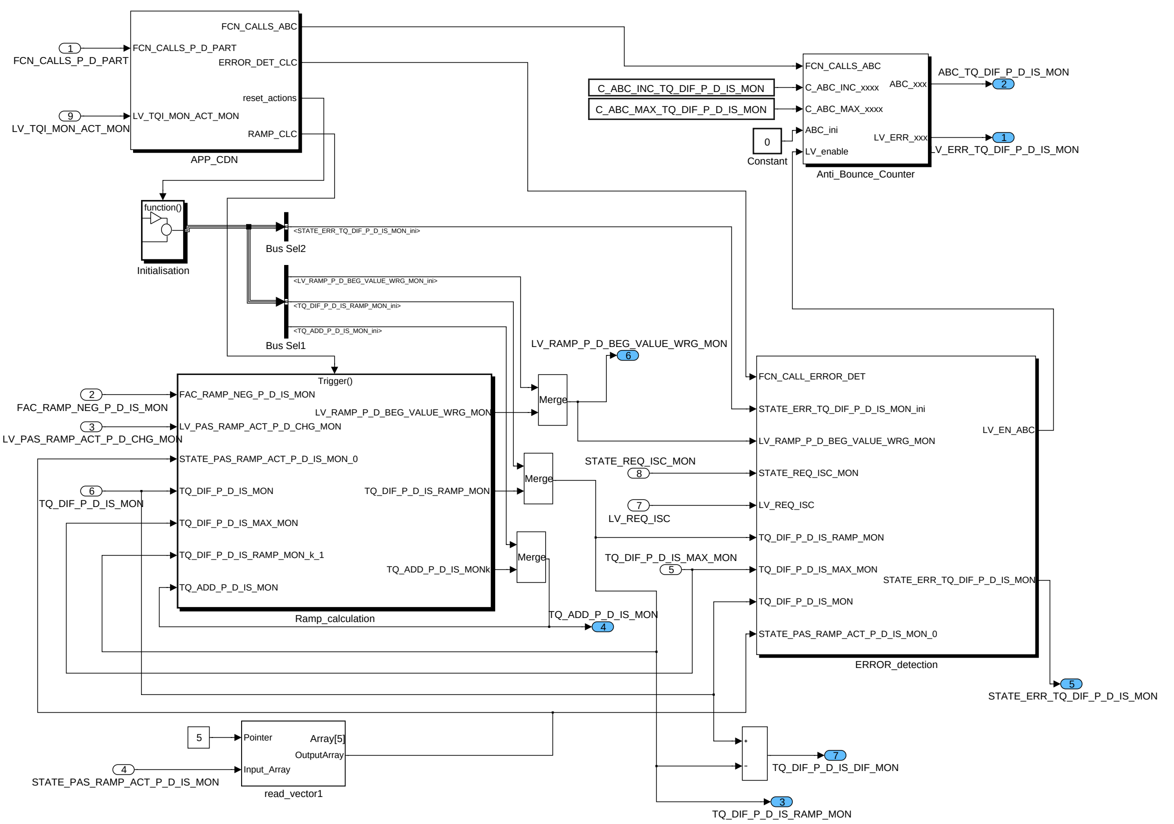

Figure E.18.2: ECM2_DTSYSISC/Monitoring_of_PD_part

Case 2: If the deactivation ramp is over, a torque demand from the PDpart of the controller greater than the passive value of zero indicates an error in the function level.
Error Path - ISC active:
Case 1: The ISC is when the engine is in idle state(LV_IS=1) or under certain conditions also in trailingthrottle(LV_PU=1) or partload(LV_PL=1). So all of these possible ISCactive phases have to be monitored. A fault is set, if L1 declares the ISC be active and if L2 also detects the same based on plausiblised activation conditions (STATE_ REQ_ISC_MON = IDLE or TRAILING_THR or PART_LOAD) and if the monitored PDpart TQ_DIF_P_D_IS_MON exceeds the maximum PDpart TQ_DIF_P_D_IS_MAX_ MON.
Case 2: If in L1 the ISC is active(LV_REQ_ISC=1) but the activation conditions in L2 are not fulfilled i.e. STATE_ REQ_ISC_MON IDLE or TRAILING_THR or PART_LOAD, then if TQ_DIF_P_D_IS_MON is greater than a threshold value (C_TQ_P_D_ISC_NOT_ ACT_MAX_MON), the error-flag STATE_ERR_TQ_DIF_P_D_IS_MON is set .
If one of the errors above is detected, a fault is declared after debouncing by the idle speed controller montoring.

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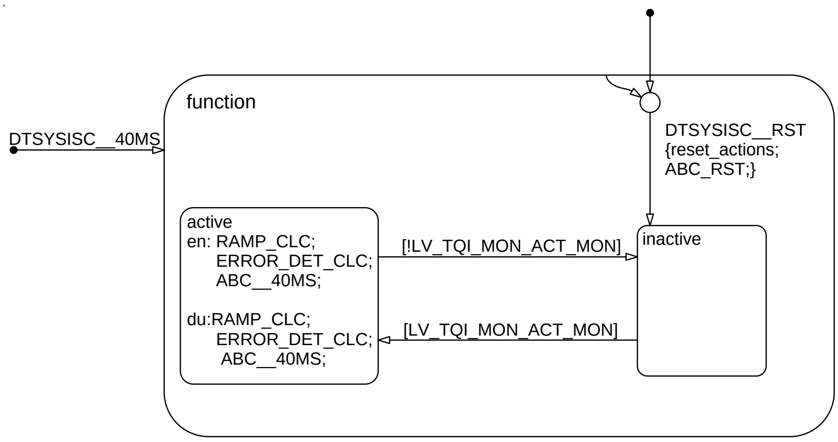

Figure E.18.3: Initialisation (DTSYSISC__RST): for condition see Application Incidences of Process Monitoring .

Figure 3 ECM2_DTSYSISC/Monitoring_of_PD_part/APP_CDN/Chart

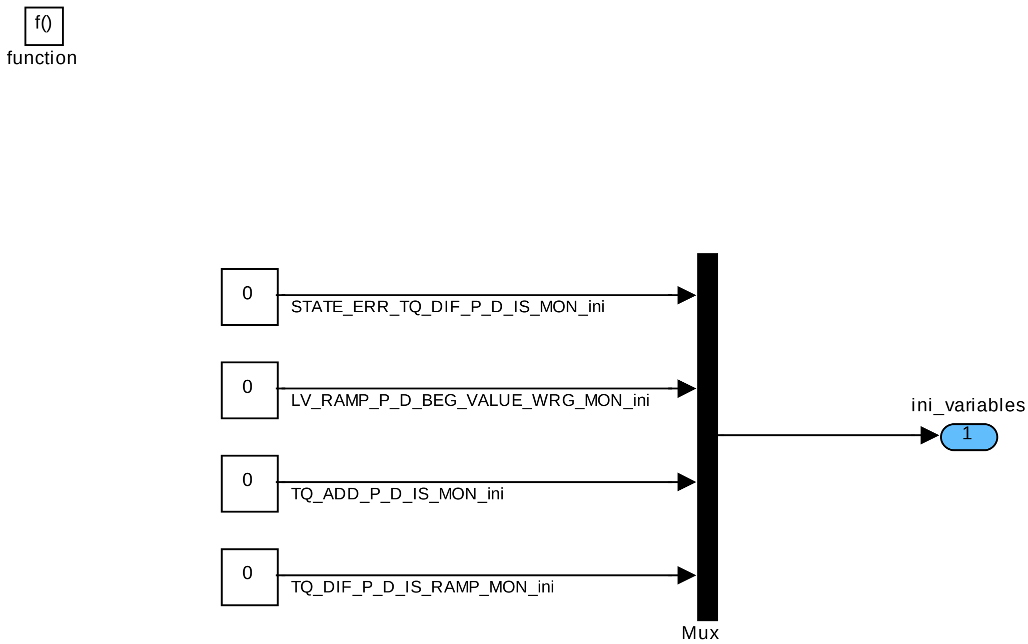

Figure E.18.4: ECM2_DTSYSISC/Monitoring_of_PD_part/Initialisation

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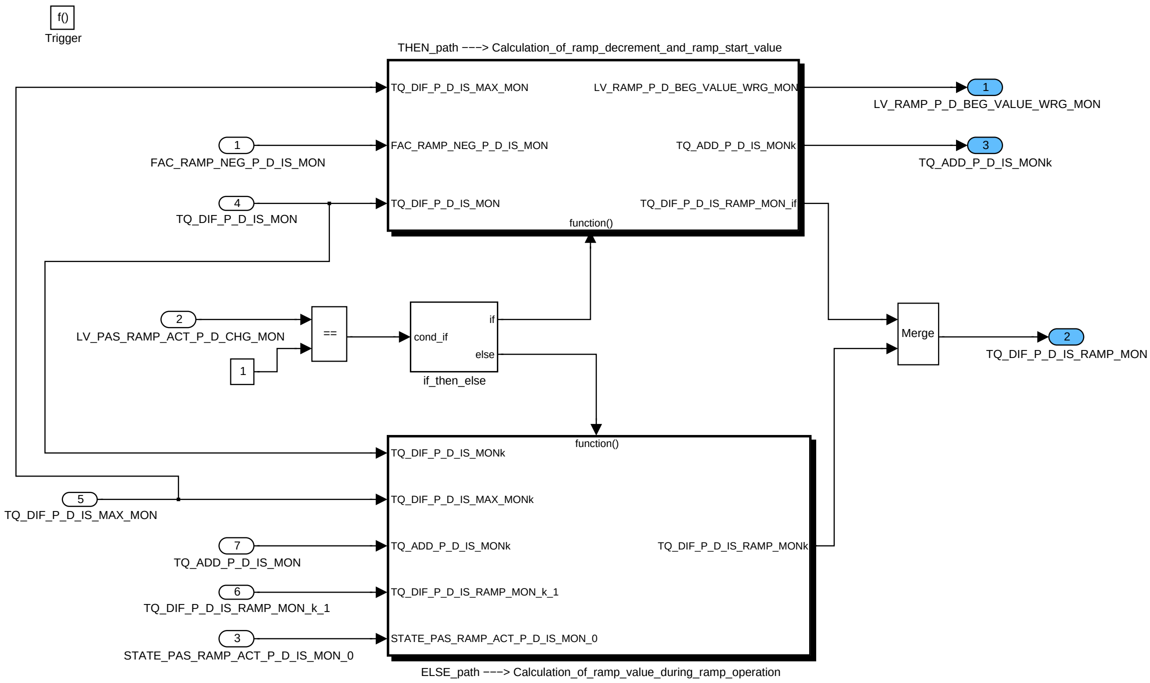

Figure E.18.5: ECM2_DTSYSISC/Monitoring_of_PD_part/Ramp_calculation

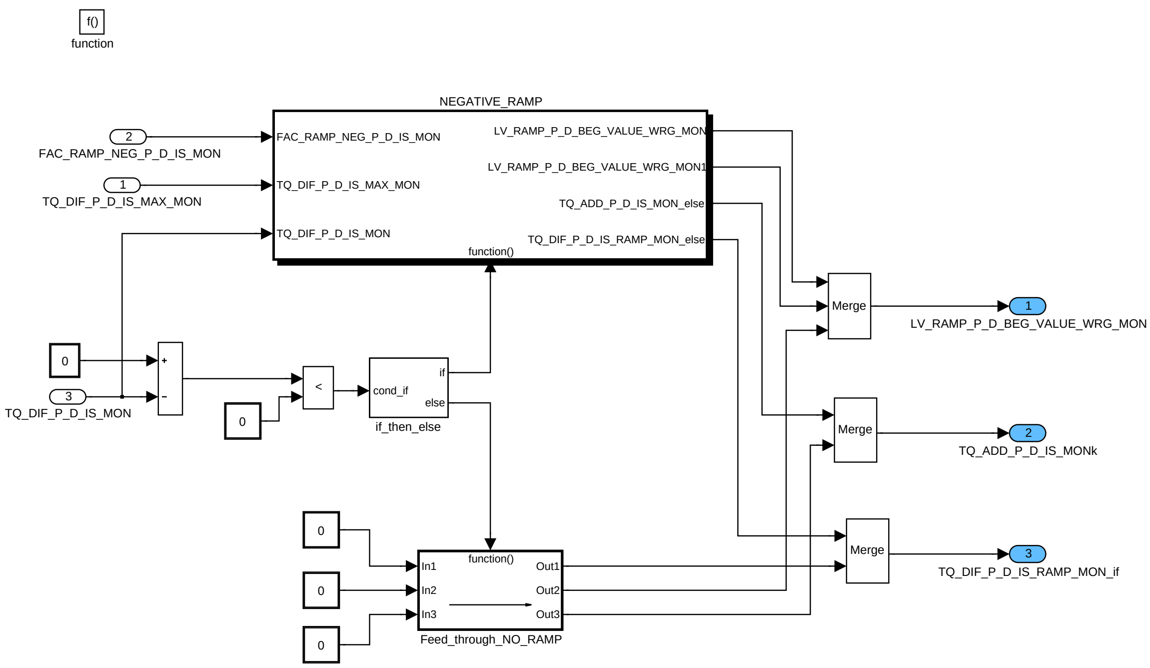

Figure E.18.6: ECM2_DTSYSISC/Monitoring_of_PD_part/Ramp_calculation/THEN_ path

NOTE: The minimum PDramp increment/decrement is equal to the resolution of TQ_ADD_P_D_ IS_ MON. If the theoretically calculated *absolute value* of TQ_ADD_P_D_IS_ MON **is *smaller* than the resolution and not equal to zero**, then is to be limited to the resolution. This would lead to a slower/faster descent of the deactivation ramp i.e. a shorterramp time. If the theoretical value of TQ_ ADD_P_D_IS_MON is equal to zero, this value is then maintained.

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UNSUPPORTED IMAGE FORMAT

For e.g: theoretical value = 0.04 Nm > Limited value = 0.03125 Nm

theoretical value = 0.01 Nm > Limited value = 0.03125 Nm

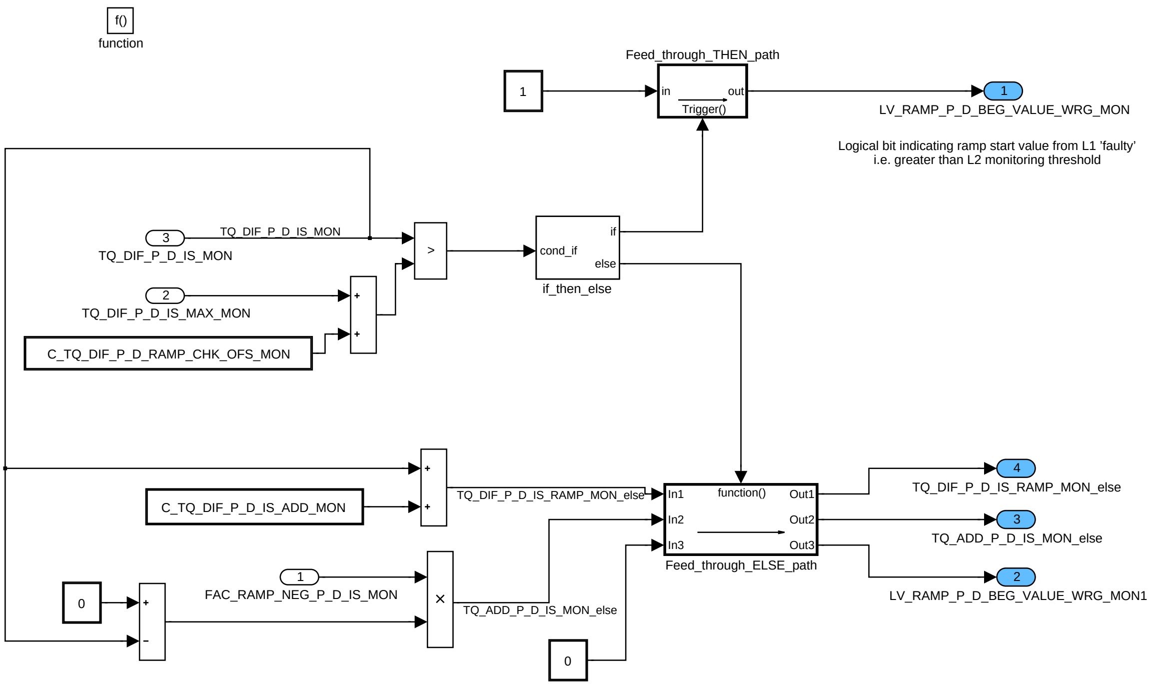

Figure E.18.7:
ECM2_DTSYSISC/Monitoring_of_PD_part/Ramp_calculation/THEN_ path/NEGATIVE_RAMP

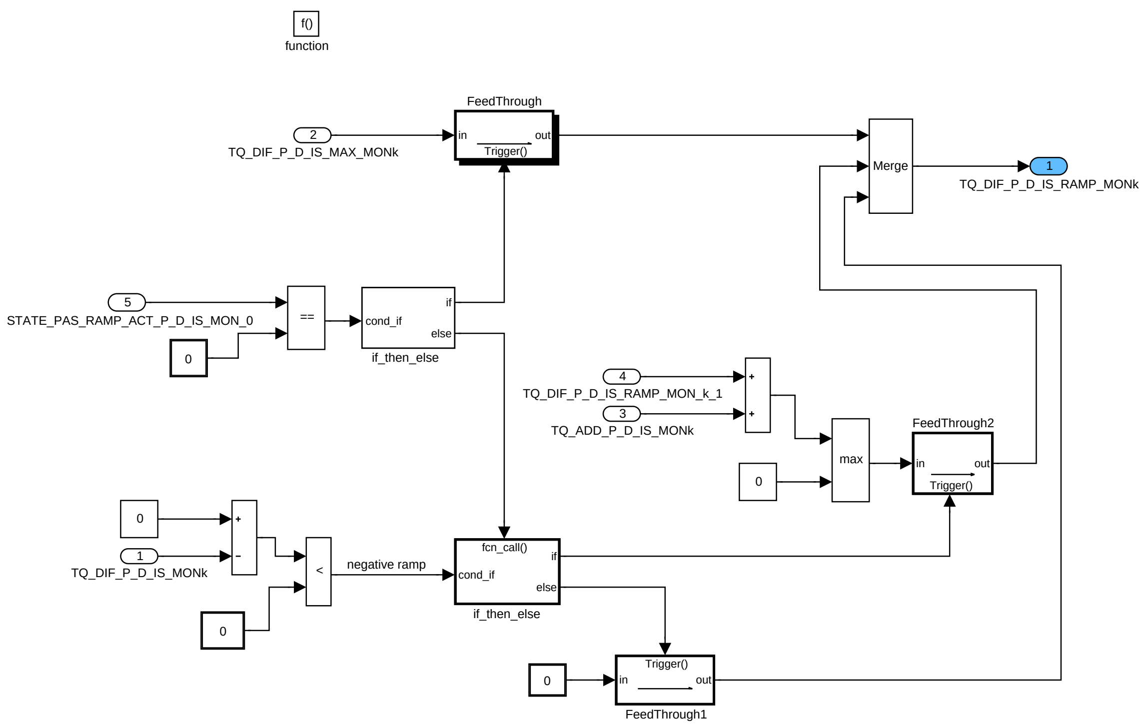

Figure E.18.8: ECM2_DTSYSISC/Monitoring_of_PD_part/Ramp_calculation/ELSE_ path

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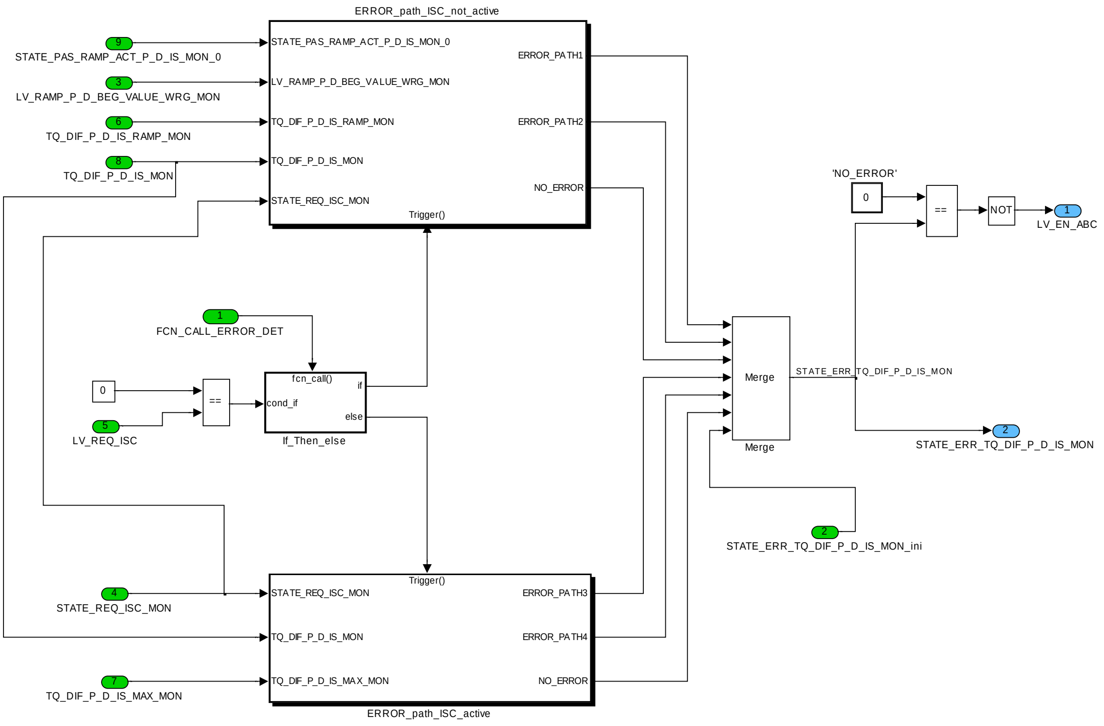

Figure E.18.9: ECM2_DTSYSISC/Monitoring_of_PD_part/ERROR_detection

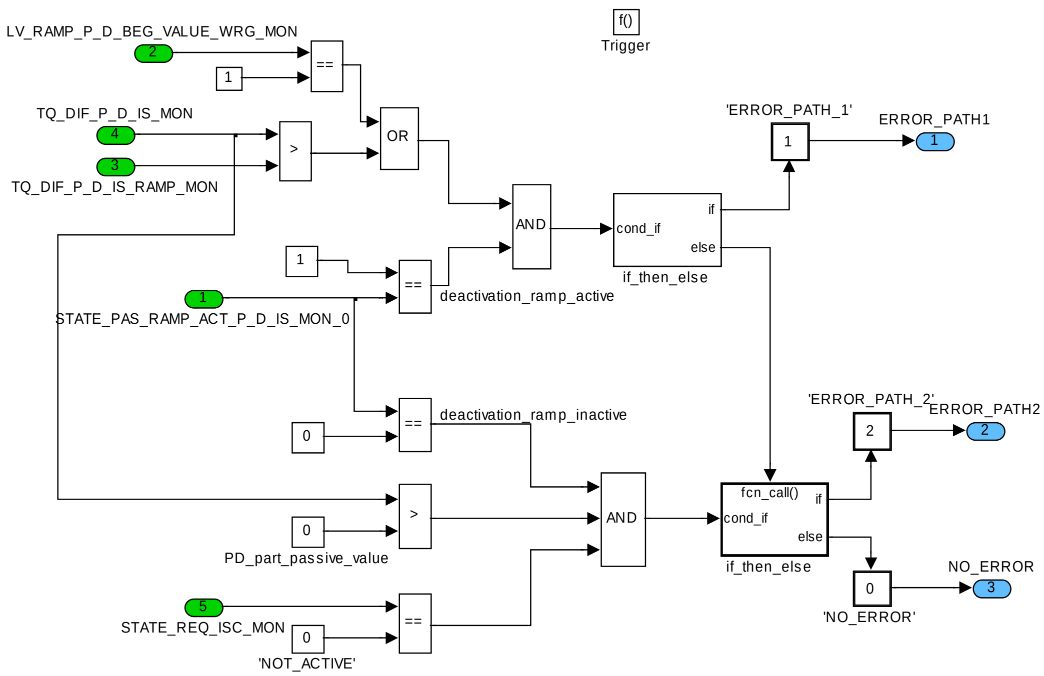

Figure E.18.10:
ECM2_DTSYSISC/Monitoring_of_PD_part/ERROR_detection/ERROR_ path_ISC_not_active

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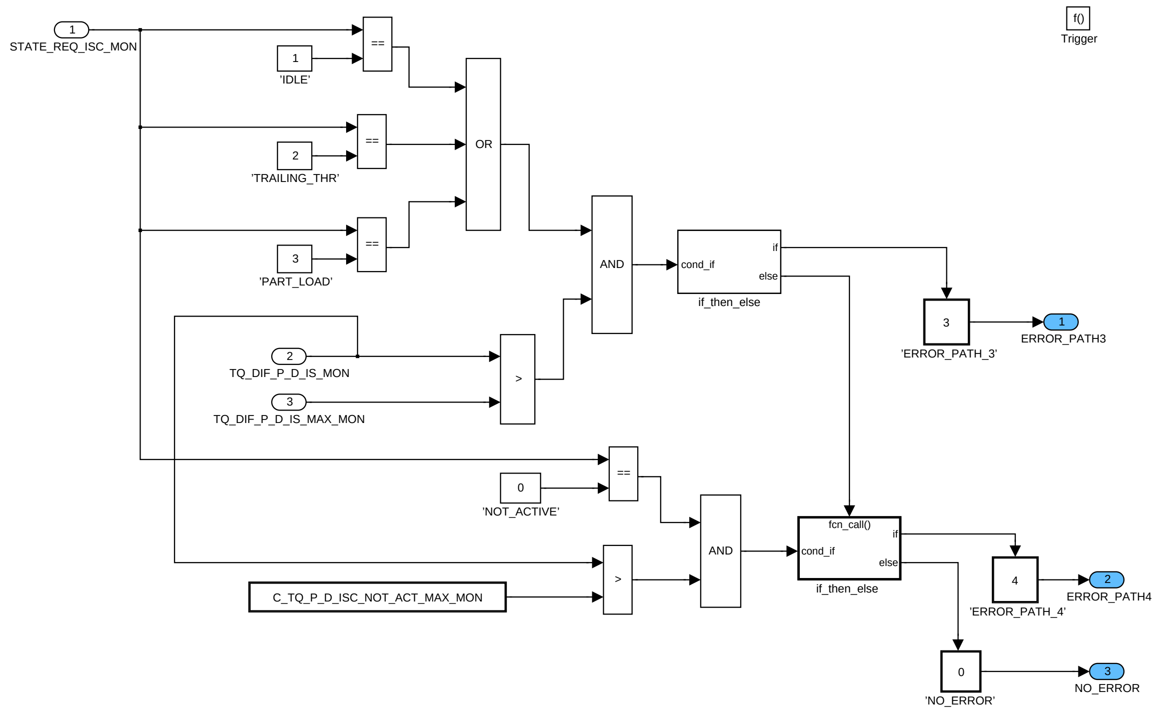

Figure E.18.11:
ECM2_DTSYSISC/Monitoring_of_PD_part/ERROR_detection/ERROR_ path_ISC_active

E.18.2 Monitoring of I controller

General information:

The objective of this function is the monitoring of the torque demand from the Ipart of the idle speed controller function. Two different faults scenarios are considered:
Error Path - ISC not active:
Case 1: If the ISC is actually in the ramp limit operation due to deactivation of ISC, this ramp function is monitored. If LV_PAS_RAMP_ACT_I_CHG_MON is 1(i.e. indicates a change of STATE_PAS_RAMP_ ACT_I_IS(0) from 0 to 1 or a flank change between two L2 sample times), a ramp decrement (TQ_ ADD_I_IS_MON) is calculated and the actual Ipart (TQ_DIF_I_IS_MON) plus a calibratable additive constant is copied to TQ_DIF_I_IS_RAMP_MON. Further on, TQ_DIF_I_IS_RAMP_MON is calculated by adding the calculated ramp decrement to the last delayed value. A fault is set, if TQ_DIF_I_IS_MON > TQ_DIF_I_IS_RAMP_MON or greater than the monitoring threshold C_TQ_DIF_I_IS_MAX_MON. If one of the errors is detected, a fault is declared after debouncing. The difference between monitored and modelled value is declared as a visible variable for application purposes.
Case 2: If in L2 idle speed controller is not active i.e. STATE_ REQ_ISC_MON = NOT_ ACTIVE but the Ipart in the function level has not reached the passive value C_TQ_PAS_ I_IS_MON at the end the deactivation ramp, then an error is declared.
Error Path - ISC active:
Case 1: The ISC can be active either when the engine is in idle state (LV_IS=1) or under certain conditions in trailingthrottle state (LV_PU=1) and partload state (LV_PL=1).So all of these possible ISCactive phases have to be monitored. A fault is set, if L1 declares the ISC be active and if L2 also detects the same based on plausiblised activation conditions (STATE_ REQ_ISC_MON = IDLE or TRAILING_THR or PART_LOAD) and if torque demand fromL1, TQ_DIF_I_IS_MON, exceeds a threshold value C_TQ_ DIF_I_IS_MAX _MON.

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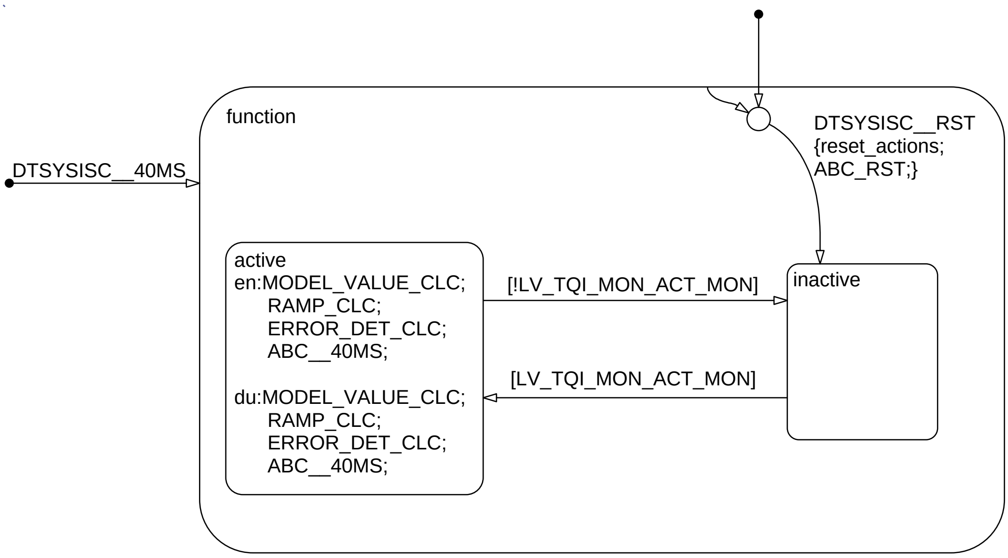
Case 2: If in L1 the ISC is active (LV_REQ_ISC=1) but the monitoring functionality detects this activation to be faulty i.e. (STATE_ REQ_ISC_MON IDLE or TRAILING_THR or PART_LOAD), then an Ipart torque demand from L1 greater than a threshold value (C_TQ_I_ISC_NOT _ACT_MAX_MON) will lead to an error detection.
If one of the errors above is detected, a fault is declared after debouncing by the idle speed controller montoring.

Note: The value of STATE_PAS_RAMP_ACT_I_IS (bit coded byte) and STATE_PAS_RAMP_ ACT_ P_D_IS(bit coded byte) for the current recurrency (represented by STATE_PAS_RAMP_ACT_I_IS_0 and STATE_PAS_ RAMP_ACT_P_D_IS_0 respectively in the signal flow diagrams) are stored in the bit position 1.



Initialisation (DTSYSISC__RST)**:** for condition see Application Incidences of Process Monitoring .

Figure 12 ECM2_DTSYSISC/Monitoring_of_I_part/APP_CDN/Chart

Function Description

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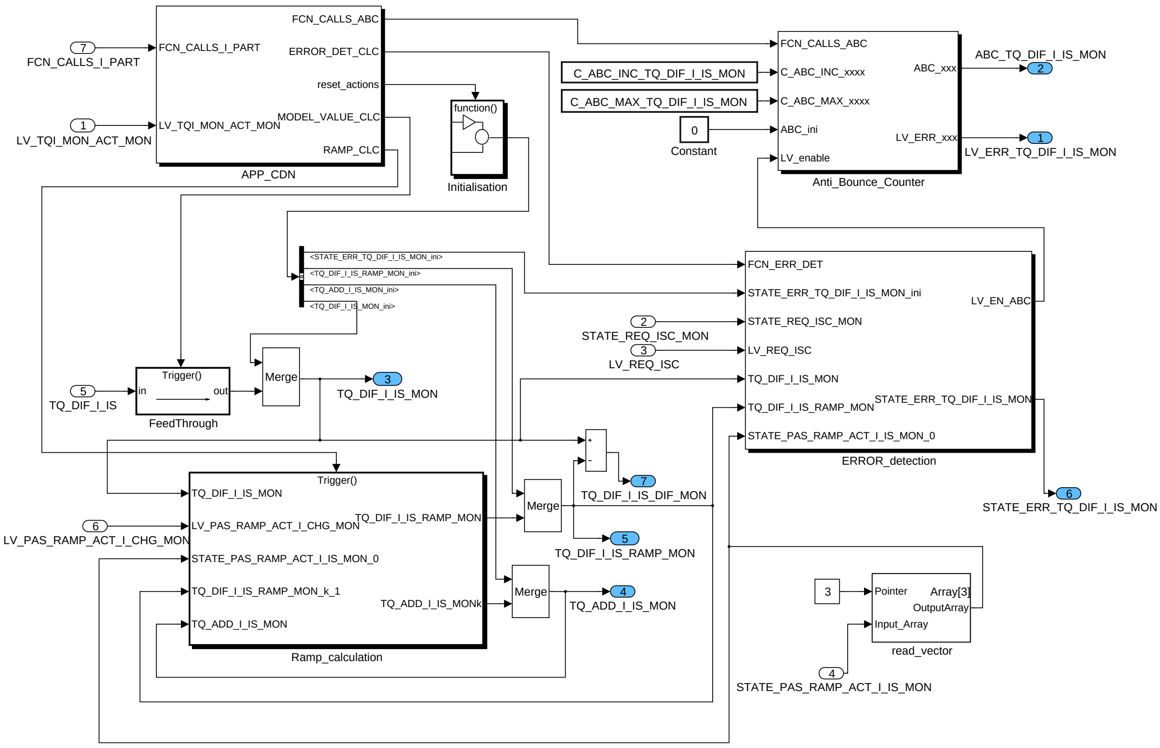

Figure E.18.12: ECM2_DTSYSISC/Monitoring_of_I_part

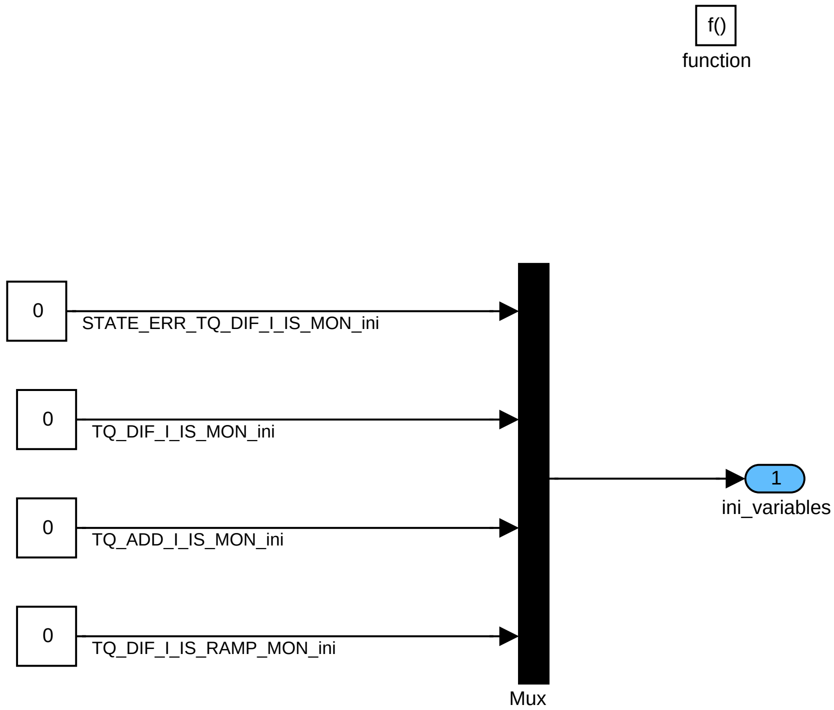

Figure E.18.13: ECM2_DTSYSISC/Monitoring_of_I_part/Initialisation

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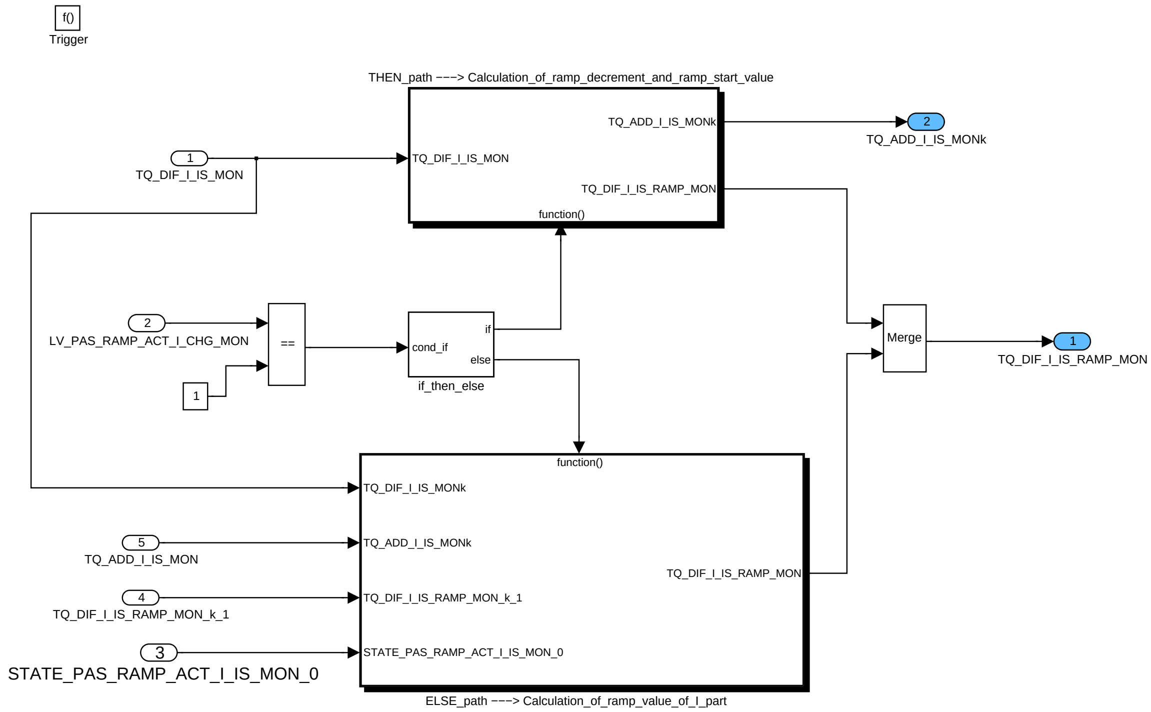

Figure E.18.14: ECM2_DTSYSISC/Monitoring_of_I_part/Ramp_calculation

Note: The minimum Iramp increment/decrement is equal to the resolution of TQ_ADD_I_IS_MON (0.03125Nm). If the theoretically calculated **absolutevalue** of TQ_ADD_I_IS_MON is ***smaller* than the resolution and not equal to zero**, then is to be limited to the resolution.This would lead to a faster ascent/descent of the deactivation ramp i.e. shorterramp time. If the theoretical value of TQ_ADD_I_IS_MON is equal to zero, this value is then maintained.

For e.g: theoretical value = 0.04 Nm > Limited value = 0.03125 Nm
theoretical value = 0.01 Nm > Limited value = 0.03125 Nm
theoretical value = 0.04 Nm > Limited value = 0.0625 Nm
theoretical value = 0.01 Nm > Limited value = 0.03125 Nm

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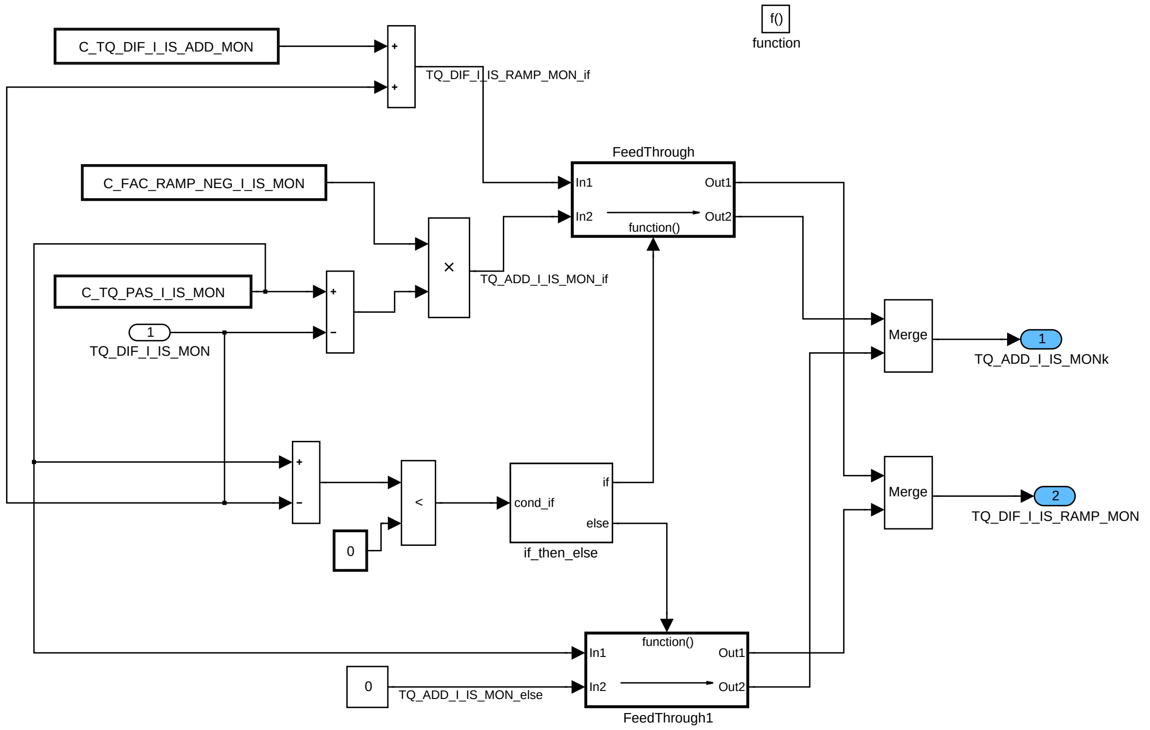

Figure E.18.15: ECM2_DTSYSISC/Monitoring_of_I_part/Ramp_calculation/THEN_ path

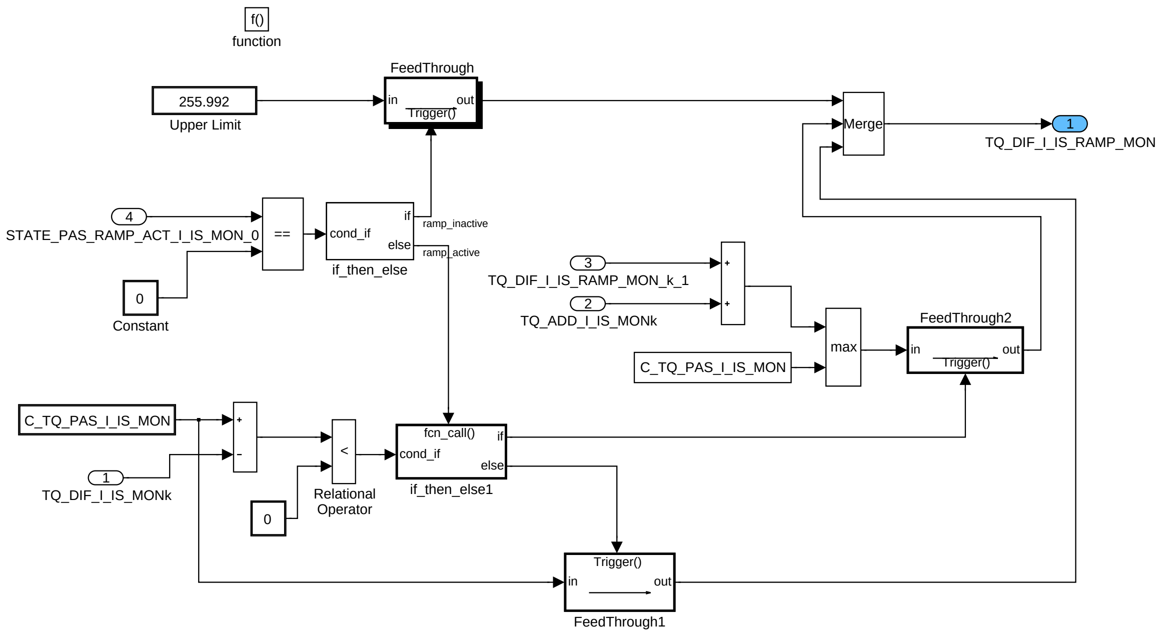

Figure E.18.16: ECM2_DTSYSISC/Monitoring_of_I_part/Ramp_calculation/ELSE_ path

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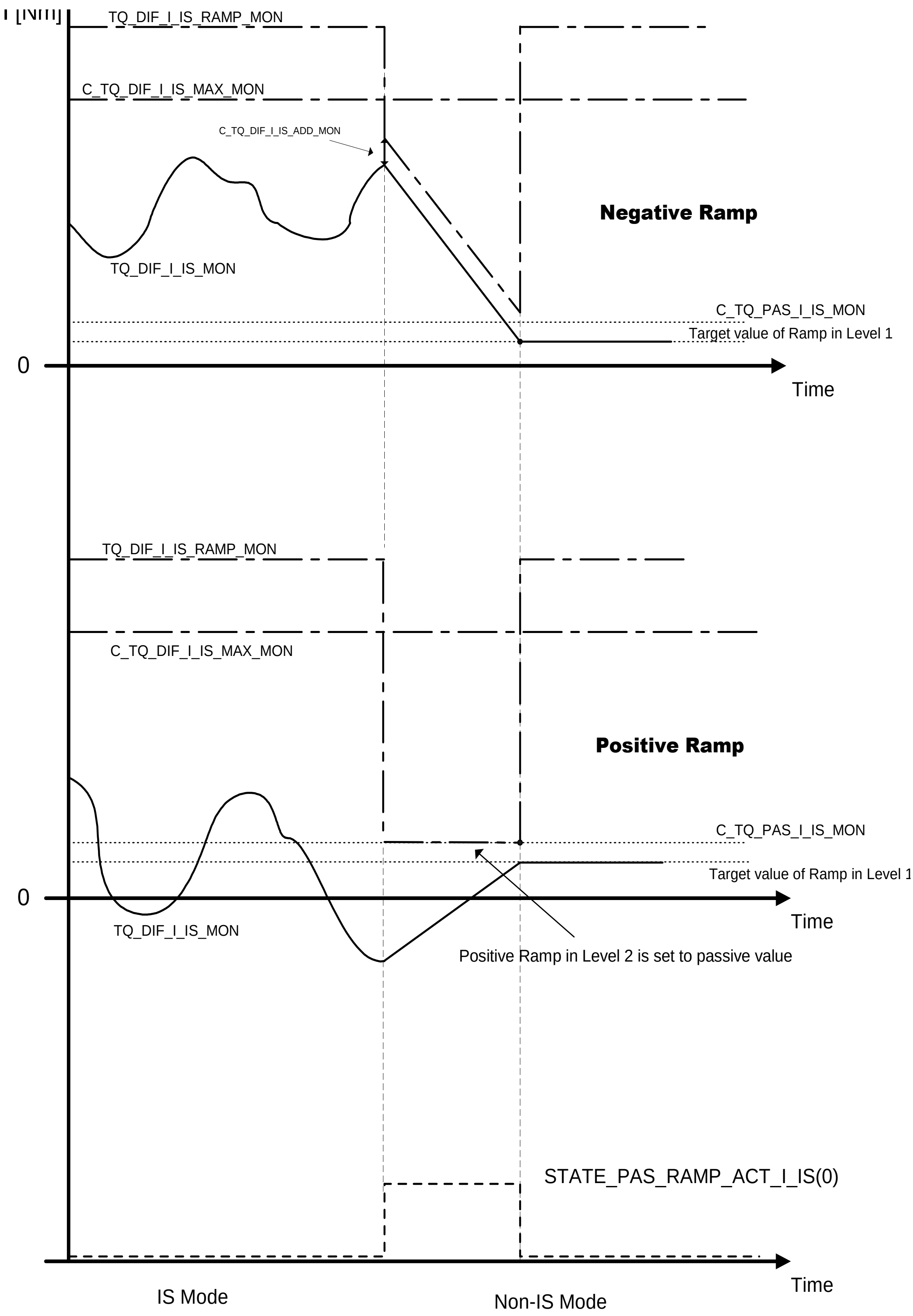

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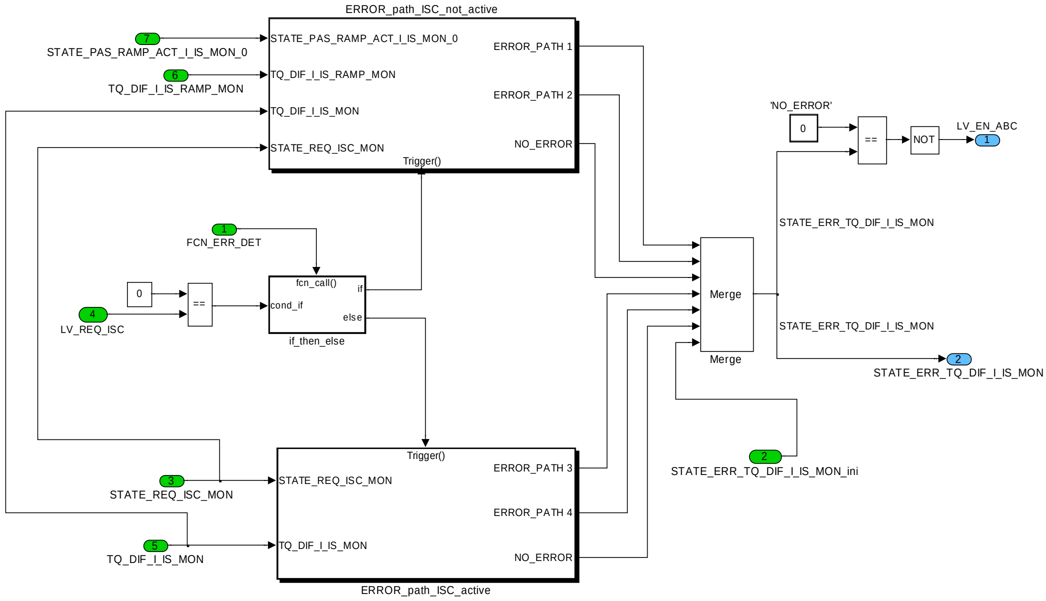

Figure E.18.17: ECM2_DTSYSISC/Monitoring_of_I_part/ERROR_detection

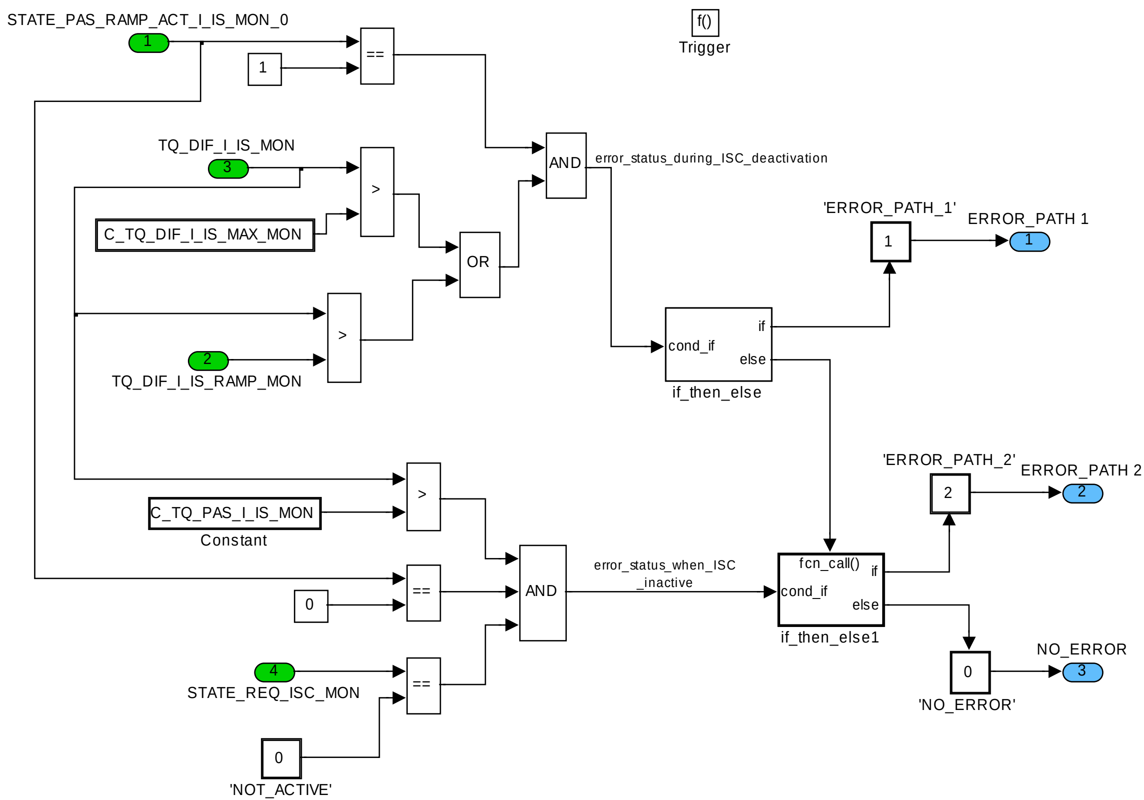

Figure E.18.18:
ECM2_DTSYSISC/Monitoring_of_I_part/ERROR_detection/ERROR_ path_ISC_not_active

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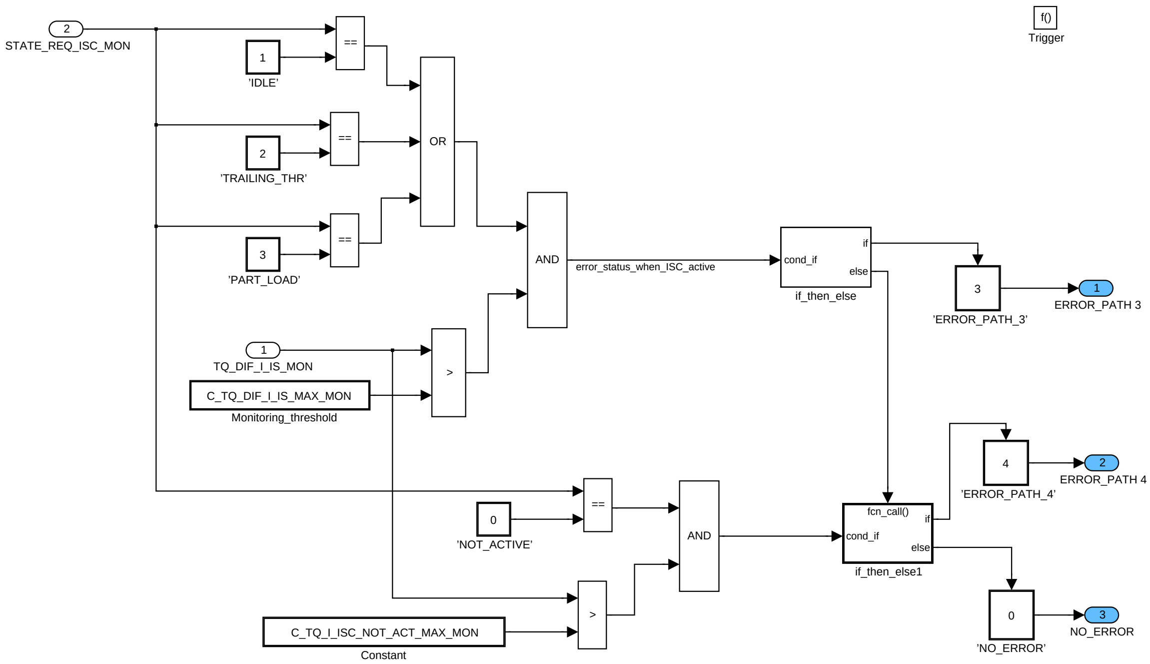

Figure E.18.19: ECM2_DTSYSISC/Monitoring_of_I_part/ERROR_detection/ERROR_ path_ISC_active

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E.19 Monitoring of maximum torque at clutch

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_TQ_MAX_CLU_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for monitoring of maximum torque at clutch					
FAC_CHA_MAX_MON	V	0... FFFFH	0... 1.99996	30.5e-6	-
Ratio between the optimal and real air efficiency					
FAC_CUS_TQ_MAX_MON	V	0... FFFFH	0... 1.99996	30.5e-6	-
Model value of the ouput factor from the crossfade calculation					
LV_ERR_TQ_MAX_CLU_MON	O/V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom "maximum torque at clutch"					
TQ_MAX_CLU_DIF_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Difference between monitored and modelled maximum torque at clutch					
TQ_MAX_CLU_MAX_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Model value for maximum torque at clutch					
TQ_MAX_CLU_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
monitored maximum torque at clutch					

Input data:

FAC_TQ_REQ_MON {p. 6851}	LV_TQI_MON_ACT_MON {p. 6791}	N_32_MON {p. 7002}	TQ_LOSS_REQ_CLU_MON {p. 6975}
TQ_MAX_CLU {p. 8380}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TQ_MAX_CLU_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_MAX_TQ_MAX_CLU_MON	-	1... FFH	1... 255	1	-
Maximum of anti bounce counter					
C_OFS_TIA_MON	-	0... FFFFH	0... 1.99996	30.5e-6	-
Offset reflecting the sound velocity influence					
IP_FAC_CHA_MAX_1_MON	-	0... FFFFH	-327.68 ...327.67	0.01	%
LDPM_N_32_MON__FAC_CHA_MON	11	0... FFH	0... 8160	32	rpm
Maximum realtive cylinder filling by full load under normal conditions					
IP_FAC_CHA_MAX_2_MON	-	0... FFFFH	-327.68 ...327.67	0.01	%
LDPM_N_32_MON__FAC_CHA_MON	11	0... FFH	0... 8160	32	rpm
Maximum realtive cylinder filling					
IP_FAC_CHA_MAX_FAC_TQ_REQ_MON	-	0... FFH	0... 0.99609	3.9063e-3	-
LDP_FAC_TQ_REQ_MON__TQ_MAX_MON	6	0... FFH	0... 1.99218	0.0078125	-
Weighting factor for TQ_MAX_MON correction					
IP_TQI_REF_MAX_MON	-	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDP_N_32_MON_IP_TQI_MAX_MON	7	0... FFH	0... 8160	32	rpm
Maximum reference indicated engine torque					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Import actions:

ACTION_ECM3_Service12TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service13TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service14TaskPfm (**IN**<No Name available>)

E.19.1 ECM2_DTSYSTQMAX

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The argument has the value 2.

ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service12TaskPfm() and ACTION_ECM3_Service13TaskPfm().

ACTION_ECM3_WriteChkCpl (INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN<>, IN<>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: These actions are defined in chapter "Processor Monitroing", subsection "RAM test on MC for processor monitoring". All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

General information:

The objective of this function is the monitoring of the maximum torque at clutch. The maximum torque at clutch is compared to a model threshold value (TQ_MAX_CLU_MAX_MON). The factors influencing this threshold are: IP_TQI_REF_MAX_MON (the worst case condition i.e. maximum possible fresh air entering in the cylinder is taken into account inside this map), TQ_LOSS_REQ_CLU_MON and driver request influence as a weighting factor in a crossfade calculation. A fault is detected after debouncing, if the maximum torque at clutch exceeds this threshold.

Application Condition

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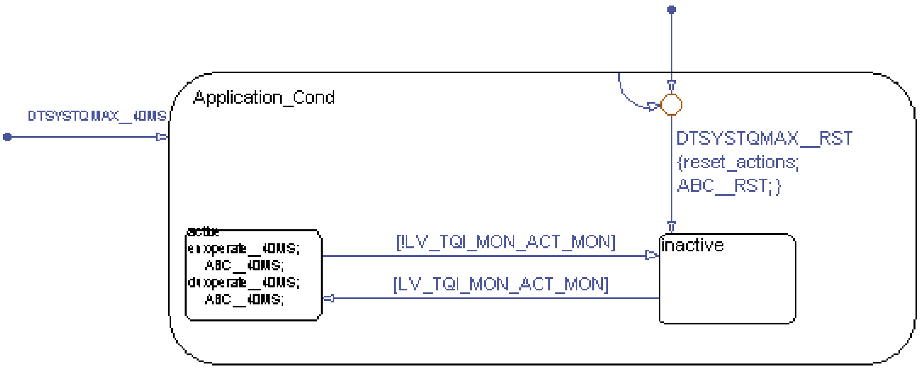

***Initialisation(DTSYSTQMAX__RST)*:** for condition see Application Incidences of Process Monitoring

Function Description

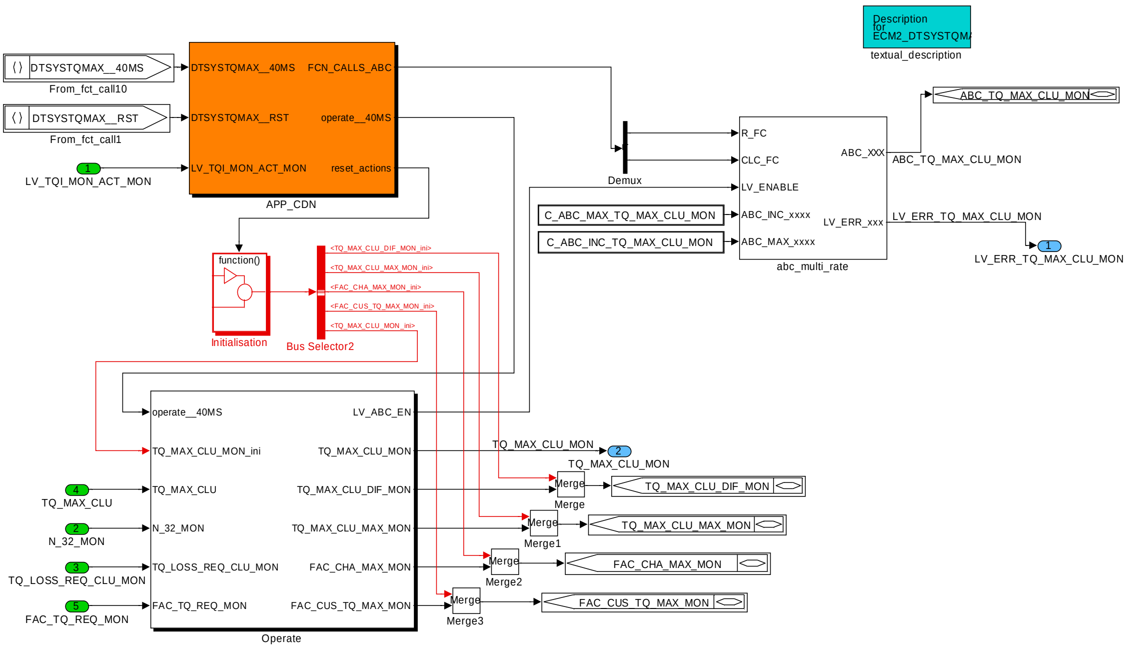

Figure E.19.1: ECM2_DTSYSTQMAX

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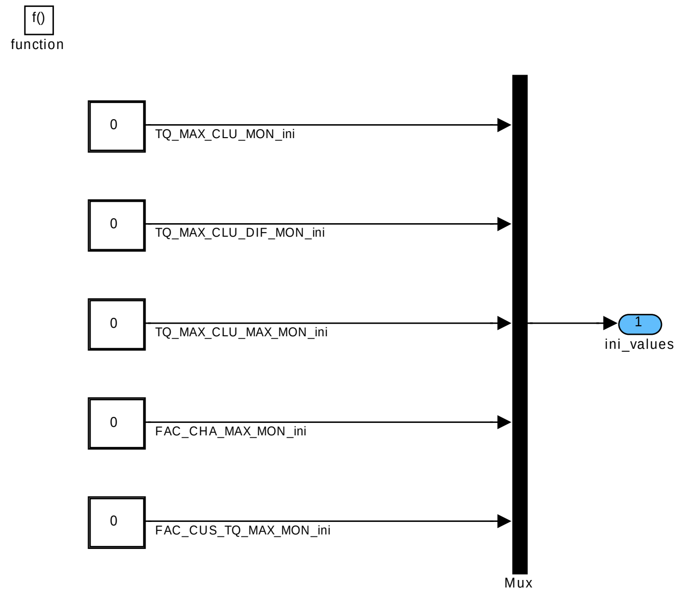

Figure E.19.2: ECM2_DTSYSTQMAX/Initialisation

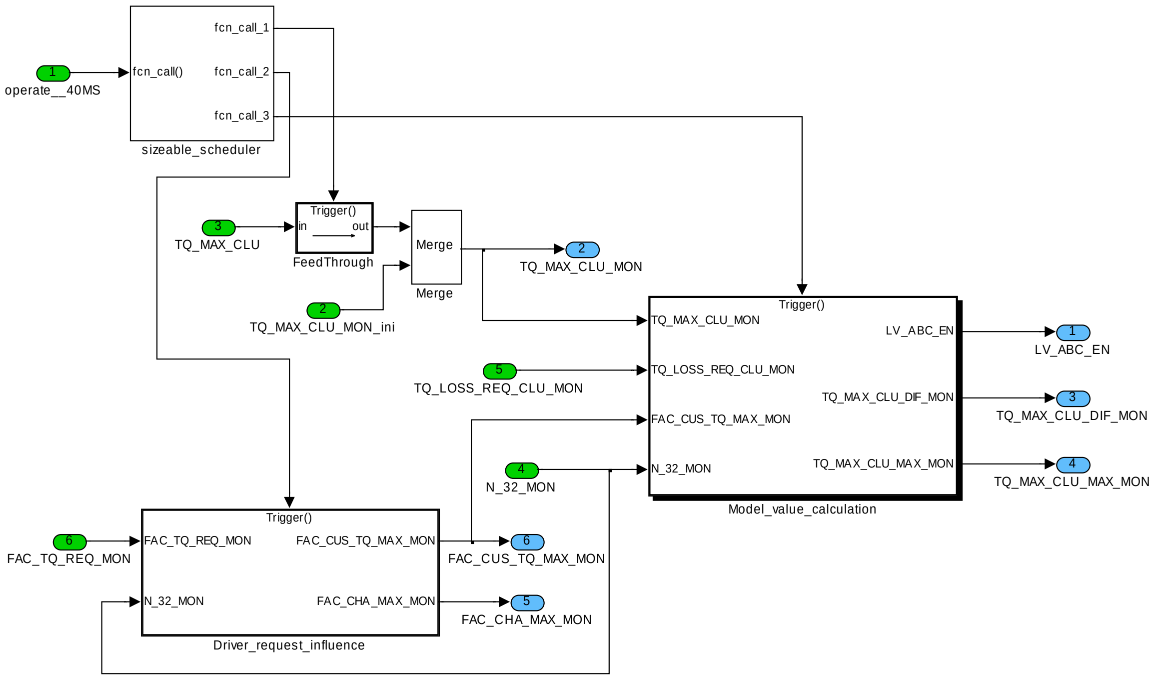

Figure E.19.3: ECM2_DTSYSTQMAX/Operate

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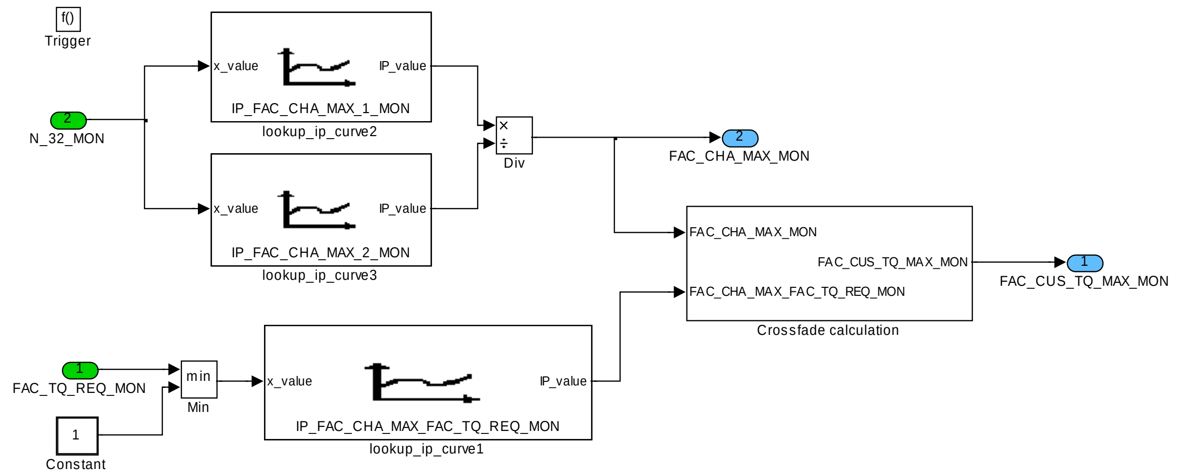

Figure E.19.4: ECM2_DTSYSTQMAX/Operate/Driver_request_influence

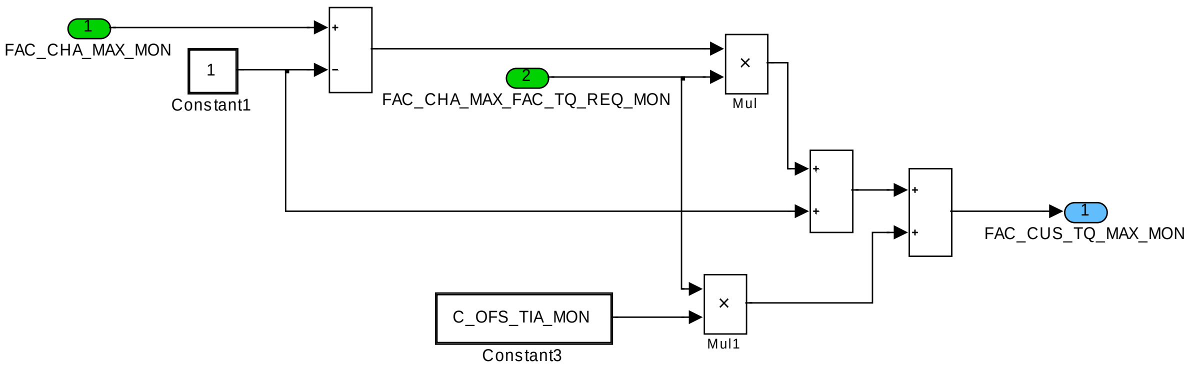

Figure E.19.5: ECM2_DTSYSTQMAX/Operate/Driver_request_influence/Crossfade calculation

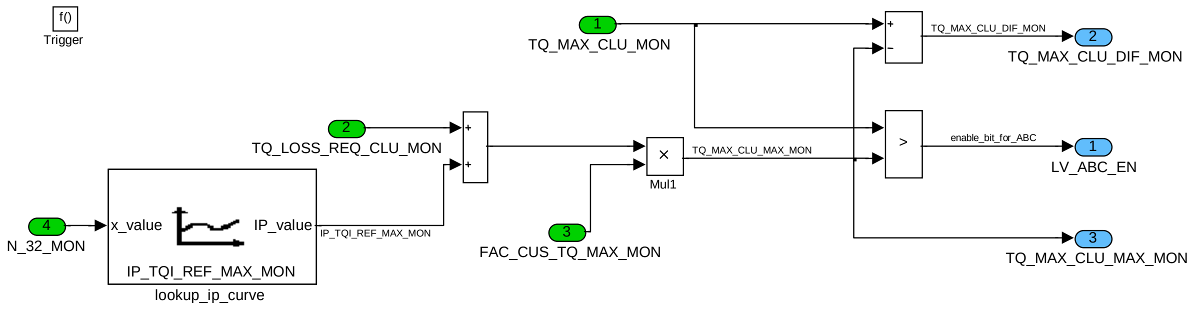

Figure E.19.6: ECM2_DTSYSTQMAX/Operate/Model_value_calculation

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E.20 Monitoring of mass fuel flow signal

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_LAMB_DIF_NEG_MON	V	0... FFH	0... 255	1	-
Anti bounce counter LAMB_DIF too small					
ABC_LAMB_DIF_POS_MON	V	0... FFH	0... 255	1	-
Anti bounce counter LAMB_DIF too high					
ABC_MFF_NOT_AFS_MON	V	0... FFH	0... 255	1	-
Anti bounce for fault in MFF signal (not AFS-mode)					
ABC_TPS_RATIO_MON	V	0... FFH	0... 255	1	-
Anti bounce counter TPS ratio diagnosis error					
LAMB_DIF_FIL_MON	V	8000... 7FFFH	-32... 31.9990234375	976.563e-6	-
Deviation between actual and modeled Lambda (low pass filtered)					
LAMB_DIF_NEG_MON	V	8000... 7FFFH	-32... 31.9990234375	976.563e-6	-
allowed negative LAMB_DIF threshold					
LAMB_DIF_POS_MON	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
allowed positive LAMB_DIF threshold					
LV_ERR_MFF_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for error in mass fuel flow signal					
LV_ERR_TPS_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for different TPS diagnosis between L1 and L2					
LV_SWI_AFS_MFF_MAX_MON	V	0... 1H	0 ...1	1	-
allowed maximum number of transitions to AFS mode exceeded					
LV_SWI_AFS_MFF_MON	O/V	0... 1H	0 ...1	1	-
Flag for switching to AFS mode					
T_ACT_SWI_AFS_MFF_MON	V	0... FFFFH	0... 2621.4	0.04	s
active time for switch to AFS mode					
V_TPS_AD_1_MON	V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Adapted TPS signal channel 1					
V_TPS_AD_2_MON	V	0... 3FFH	0... 4.9951171875	4.88281e-3	V
Adapted TPS signal channel 2					

Input data:

C_FAC_MFF_MAF_MON {p. 6777}	LAMB_DIF_MON {p. 6777}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_MDL_MON {p. 6777}
LV_ERR_FUP {p. 4717}	LV_ERR_MAP {p. 982}	LV_ERR_TPS_1 {p. 4990}	LV_ERR_TPS_2 {p. 4990}
LV_ERR_TPS_MAF_1 {p. 4990}	LV_ERR_TPS_MAF_2 {p. 4990}	LV_ERR_TPS_RATIO {p. 4990}	LV_LAMB_LS_UP_VLD_MON [NC_CBK_EX_NR] {p. 6790}
LV_TQI_MON_ACT_MON {p. 6791}	MAF_MON {p. 6777}	MFF_LAMB_MON {p. 6760}	N_32_MON {p. 7002}

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OPM_AV_MON {p. 6792}	STATE_ERR_IV {p. 4803}	TQI_SP_MON {p. 6851}	V_TPS_1_MON {p. 6795}
V_TPS_2_MON {p. 6795}	V_TPS_AD_EL_BOL_1 {p. 4952}	V_TPS_AD_EL_BOL_2 {p. 4952}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_LAMB_DIF_NEG_MON	-	0... FFH	0... 255	1	-
ABC increment in case of act. Lambda smaller than reference Lambda					
C_ABC_INC_LAMB_DIF_POS_MON	-	0... FFH	0... 255	1	-
ABC increment in case of act. Lambda greater than reference Lambda					
C_ABC_INC_MFF_NOT_AFS_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment in case of MFF error (not AFS-mode)					
C_ABC_INC_TPS_RATIO_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment (additive value in case of ratio diagnosis error)					
C_ABC_MAX_LAMB_DIF_NEG_AFS_MON	-	1... FFH	1... 255	1	-
Value at which negative LAMB_DIF error is recognised, when reached (AFS-mode)					
C_ABC_MAX_LAMB_DIF_NEG_S_MON	-	1... FFH	1... 255	1	-
Value at which negative LAMB_DIF error is recognised, when reached (not AFS-mode)					
C_ABC_MAX_LAMB_DIF_POS_MON	-	1... FFH	1... 255	1	-
Value at which positive LAMB_DIF error is recognised, when reached					
C_ABC_MAX_MFF_NOT_AFS_MON	-	1... FFH	1... 255	1	-
Value at which MFF error is recognised. when reached (not AFS-mode)					
C_ABC_MAX_TPS_RATIO_MON	-	1... FFH	1... 255	1	-
Value at which ratio diagnosis error is recognized. when reached					
C_CRLC_LAMB_DIF_MON	-	0... FFH	0... 0.99609375	3.90625e-3	-
correlation constant for LAMB_DIF filter					
C_CTR_MAX_SWI_AFS_MFF_MON	-	0... FFH	0... 255	1	-
maximum number of transitions to AFS mode					
C_N_MIN_TPS_DIAG_MON	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for diagnosis of TPS ratio error					
C_T_ACT_SWI_AFS_MFF_MON	-	0... FFFFH	0... 2621.4	0.04	s
time out threshold for canceling AFS mode					
C_V_TPS_RATIO_HYS_MON	-	0... FFH	0... 4.98046875	0.0195313	V
Maximum TPS ratio error allowed					
IP_LAMB_DIF_ADD_1_MON	V	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDP_N_32_MON_IP_LAMB_DIF_MON	4	0... FFH	0... 8160	32	rpm
LDP_TQI_SP_MON_IP_LAMB_DIF_MON	4	0... FFH	0... 510	2	Nm
map for expanding the allowed LAMB_DIF threshold based on TQI_SP_MON and N_32_MON					
IP_LAMB_DIF_ADD_2_MON	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDP_MFF_MON_IP_LAMB_DIF_ADD_MON	4	0... FFFFH	0... 1389	0.0211948	mg/stk
map for expanding the allowed LAMB_DIF threshold based on MFF					
IP_LAMB_DIF_NEG_MON	-	0... FFFFH	-32... 31.9990234375	976.563e-6	-

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LDPM_LAMB_MON_IP_LAMB_DIF_MON	8	0... 7FFFH	0... 31.9990234375	976.563e-6	-
map for allowed negative LAMB_DIF threshold					
IP_LAMB_DIF_POS_MON	-	0... 7FFFH	0... 31.9990234375	976.563e-6	-
LDPM_LAMB_MON_IP_LAMB_DIF_MON	8	0... 7FFFH	0... 31.9990234375	976.563e-6	-
map for allowed positive LAMB_DIF threshold					
LC_LAMB_SEL_MON	-	0... 1H	0 ...1	1	-
logical constant for selection of lambda value					
LC_RST_SWI_AFS_MFF_MON	-	0... 1H	0 ...1	1	-
Switch to disable LV_SWI_AFS_MFF_MON					

General Information

ACTION_ECM3_Service18TaskPfm(IN<>)
ACTION_ECM3_Service19TaskPfm(IN<>)
ACTION_ECM3_Service20TaskPfm(IN<>)

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 2.

ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service18TaskPfm() and ACTION_ECM3_Service19TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode O and history variables in modules of the Process Monitoring have to be checked by the cyclical RAM test.

General information:

The variable MFF_TQ_MON (represented via LAMB_DIF_MON) is needed for calculation of TQI_AV_MON. The modul checks the plausibility of MFF_TQ_MON (calculated in "Actual fuel mass flow"). Therefore LAMB_DIF_MON (actual Lambda reference Lambda) is checked against borders dependent on

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actual Lambda. The critical case will be, if LAMB_DIF_MON gets to small in nonAFS_mode (equivalent to acceleration). Additionally, LV_ERR_... coming from Level 1 are considered. If there is an implausible state during non AFSmode, OPM will be switched to AFS first.

An additional TPS ratio check is performed. This function checks if any TPS failure has been detected in level 1 when a TPS ratio error is recognized in level 2.

Hint!! Application Conditions - Initialisation: for condition see 'Application incidences of process monitoring'

Application Conditions

Initialization: RST
Recurrence: 40MS
Activation: LV_TQI_MON_ACT_MON
Deactivation: !LV_TQI_MON_ACT_MON

Function description

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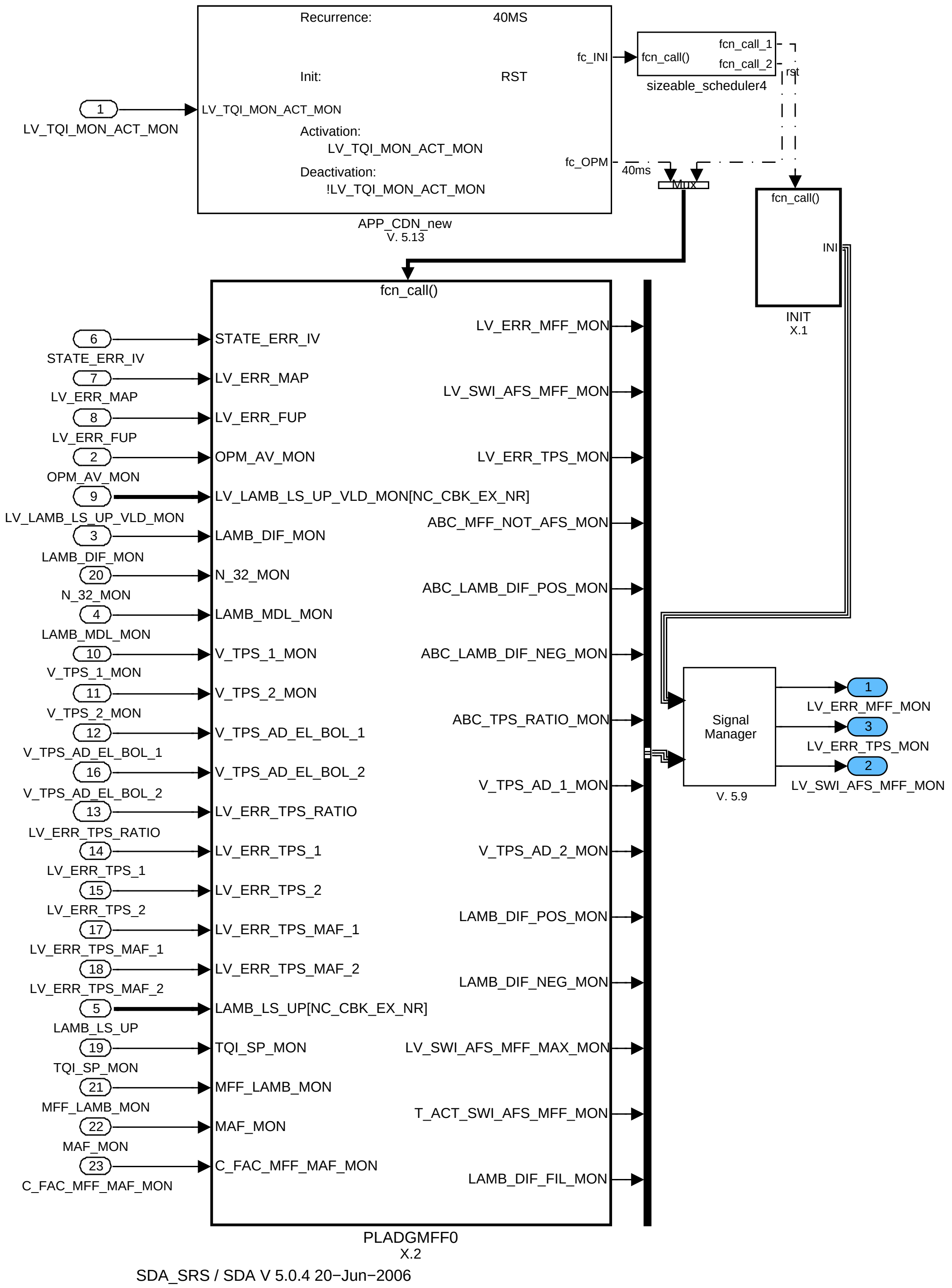

Figure E.20.1: : Path: ECM2_PLADGMFF0

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E.20.1 ECM2_PLADGMFF0/INIT

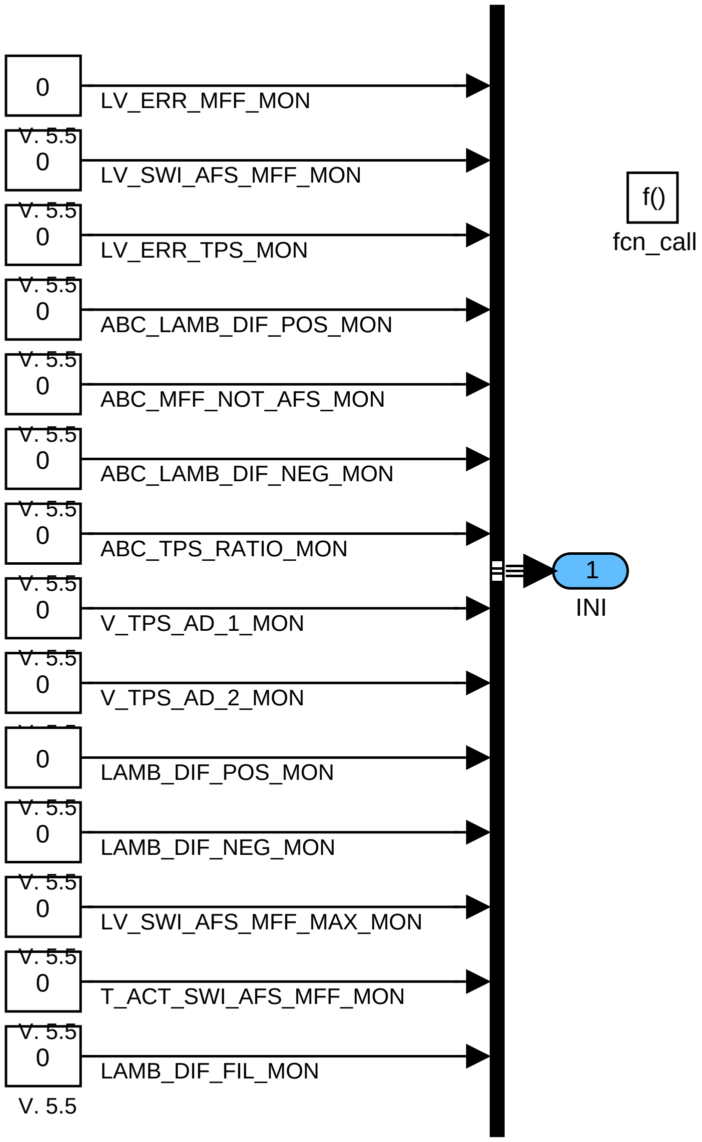

Figure E.20.2: : Path: ECM2_PLADGMFF0/INIT

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E.20.2 ECM2_PLADGMFF0/PLADGMFF0

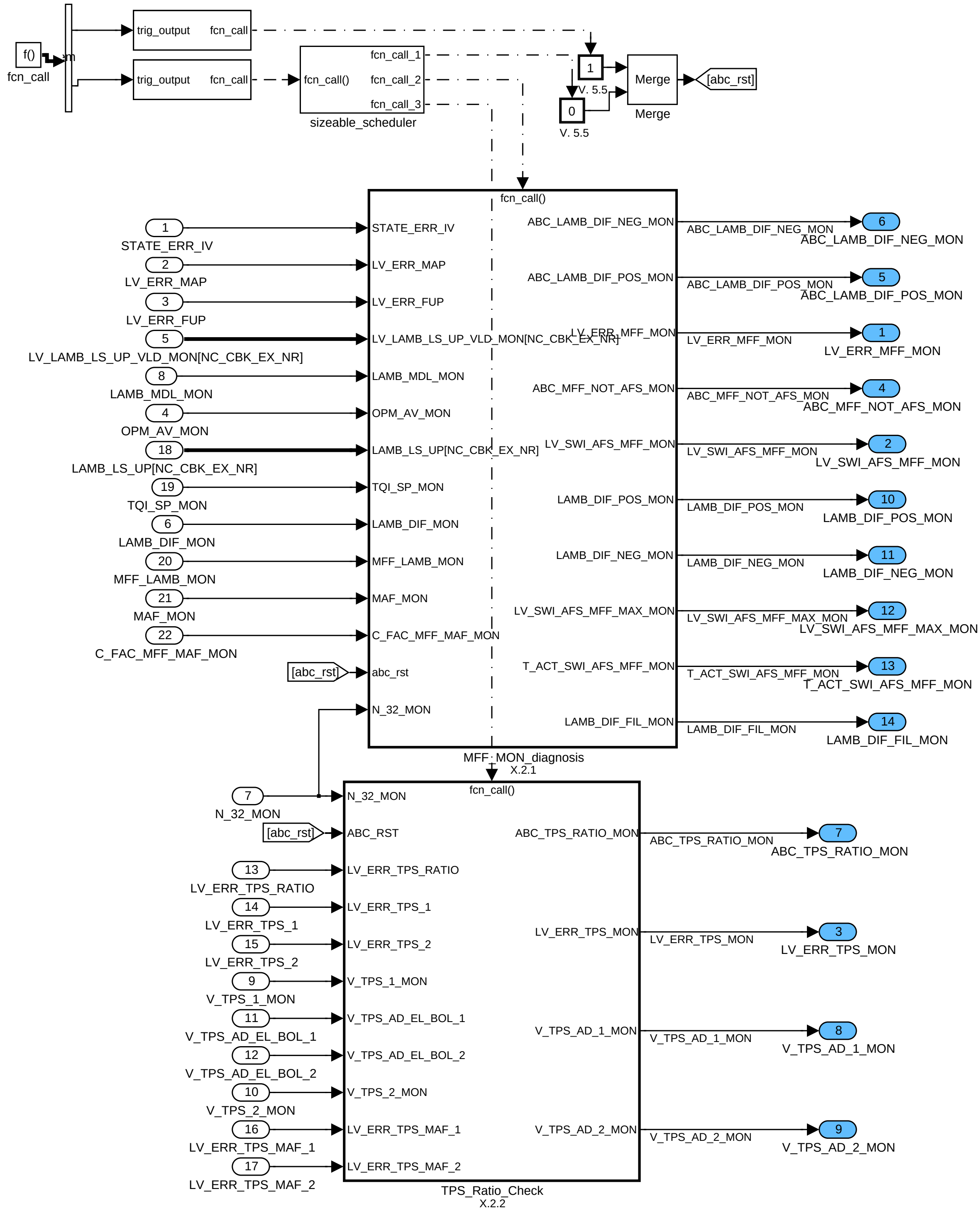

Figure E.20.3: : Path: ECM2_PLADGMFF0/PLADGMFF0

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E.20.2.1 ECM2_PLADGMFF0/PLADGMFF0/MFF_MON_DIAGNOSIS

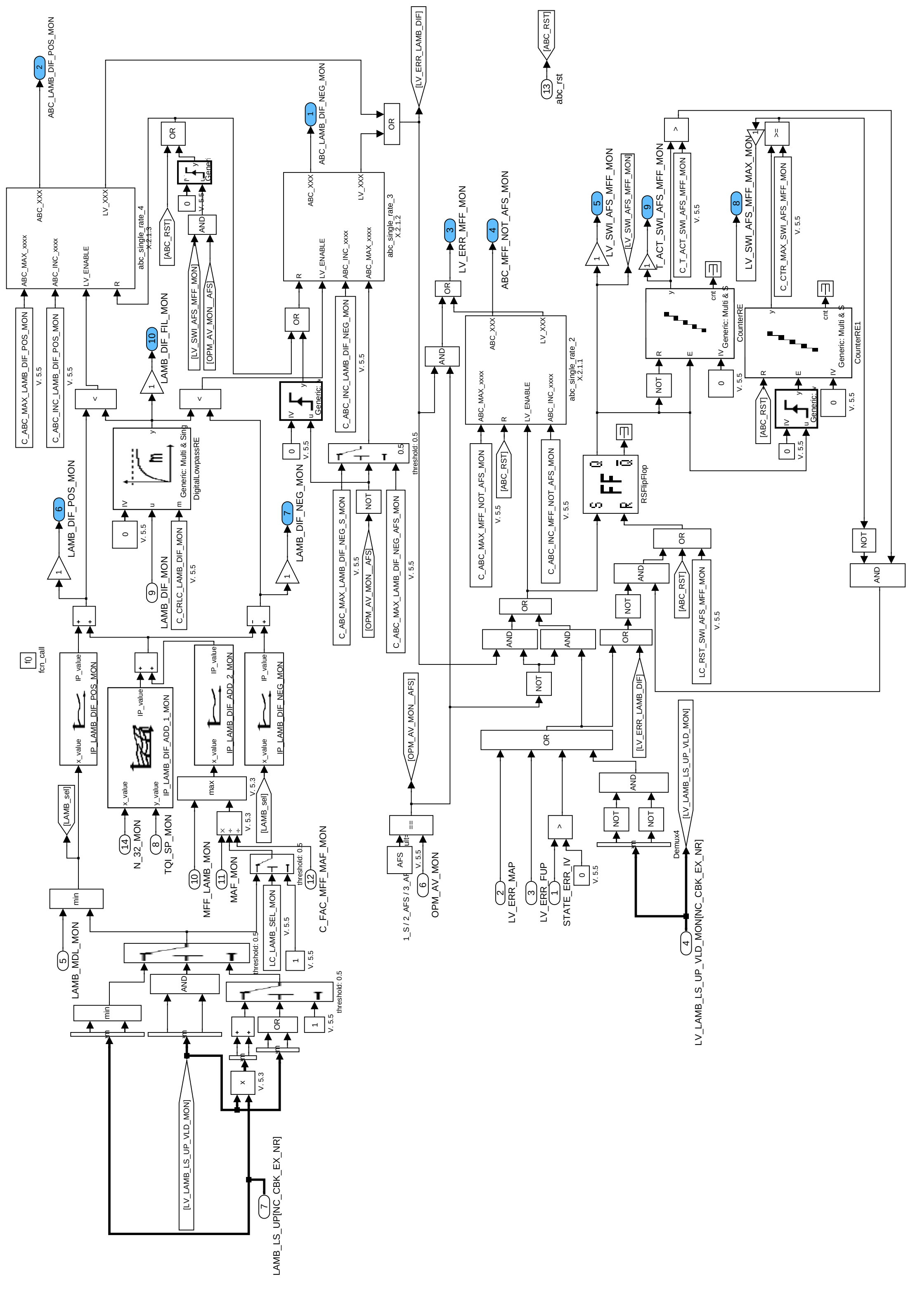

Figure E.20.4: : Path: ECM2_PLADGMFF0/PLADGMFF0/MFF_MON_diagnosis

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E.20.2.2 ECM2_PLADGMFF0/PLADGMFF0/TPS_RATIO_CHECK

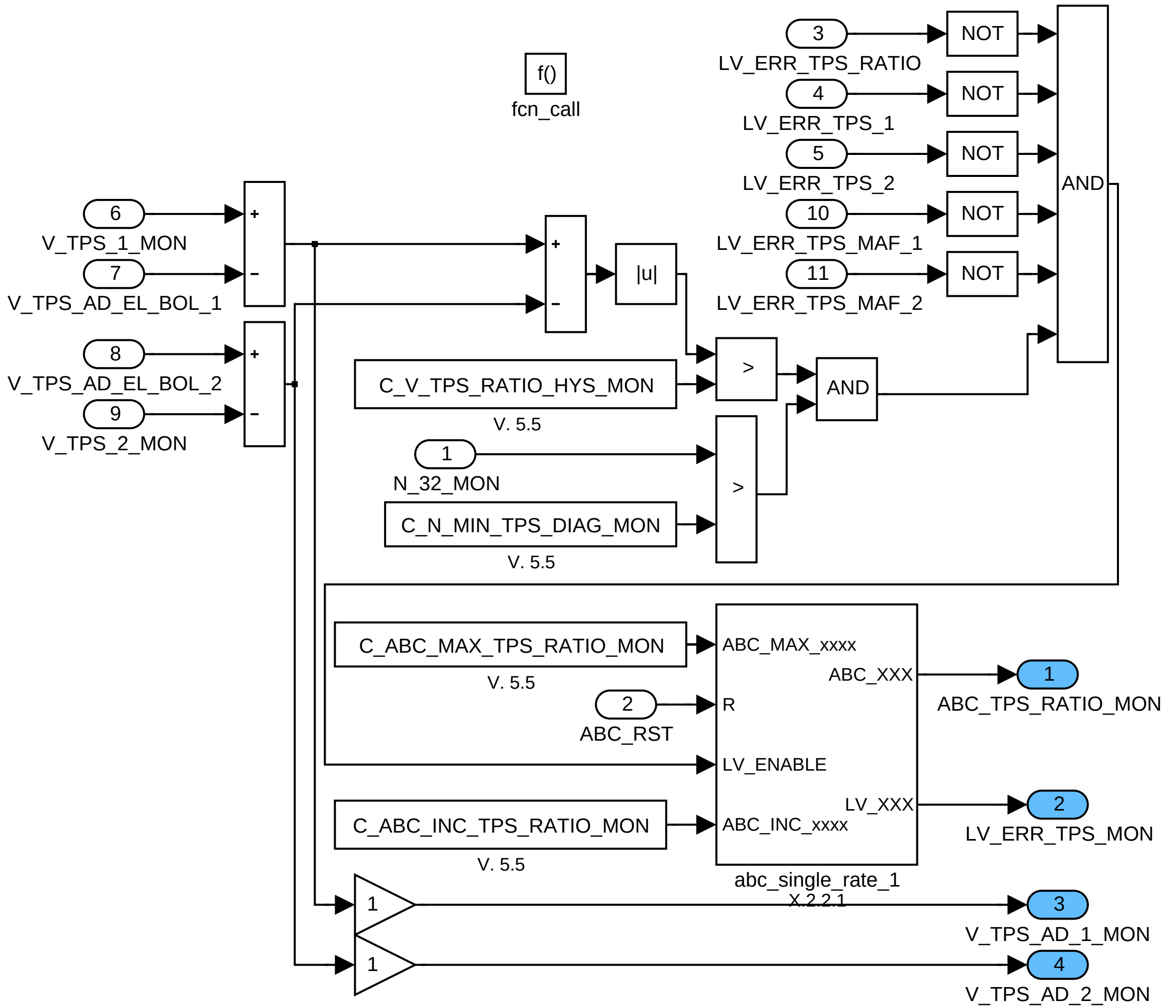

Figure E.20.5: : Path: ECM2_PLADGMFF0/PLADGMFF0/TPS_Ratio_Check

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E.21 Monitoring of minimum torque at clutch

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_TQ_MIN_CLU_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for monitoring of minimum torque at clutch					
CTR_DLY_TQ_ST_MON	V	0... FFH	0... 10.2	0.04	s
Delay time counter for holding start torque influence					
FAC_N_SP_IS_RATIO_MON	V	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Model of control factor for engine self-stabilising effect					
LV_ERR_TQ_MIN_CLU_MON	O/V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom "minimum torque at clutch"					
STATE_ERR_TQ_MIN_CLU_MON	O/V	0H 1H 2H	NO_ERROR ERROR_PATH1 ERROR_PATH2	-	-
State variable indicating origin of error resulting from monitoring of L1 torque value					
TQ_MIN_CLU_DIF_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
difference of monitored and modelled minimum torque at clutch					
TQ_MIN_CLU_MDL_2_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Temporary variable 2 for calculation of modelled minimum torque at clutch					
TQ_MIN_CLU_MDL_5_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Temporary variable 4 for calculation of modelled minimum torque at clutch					
TQ_MIN_CLU_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
monitored minimum torque at clutch					
TQ_ST_MON	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
modelled value of start torque					

Input data:

LV_SWI_TQ_MIN_CLU_MON {p. 6791}	LV_TQ_MIN_CLU {p. 8379}	LV_TQI_MON_ACT_MON {p. 6791}	N_32_MON {p. 7002}
N_SP_IS_RATIO_MON {p. 6792}	STATE_ERR_DET_TQ_MIN_MON {p. 6792}	TCO_MON {p. 6903}	TQ_ADD_MIN_CLU_MON {p. 6793}
TQ_CONV_MAX_MON {p. 6793}	TQ_DIF_I_IS_MON {p. 6921}	TQ_LOSS_MON {p. 6975}	TQ_LOSS_REQ_CLU_MON {p. 6975}
TQ_MIN_CLU {p. 8380}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TQ_MIN_CLU_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_MAX_TQ_MIN_CLU_MON	-	1... FFH	1... 255	1	-
Maximum of anti bounce counter					
C_DLY_TQ_ST_MON	-	0... FFH	0... 10.2	0.04	s
Time delay to hold influence of start torque on TQ_MIN_CLU model value					
C_N_ST_MAX_MON	-	0... FFH	0... 8160	32	rpm
maximum start end speed					
C_TQ_MIN_CLU_MDL_OFS_MON	-	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Offset for L2 model value of minimum torque at clutch					
IP_FAC_N_SP_IS_RATIO_MON	-	0... FFFFH	-8... 7.99975	244.1e-6	-
LDP_N_SP_IS_RATIO_MON_IP_MON	5	0... FFFFH	0... 7.99987	122.1e-6	-
Idle self stabilising factor					
IP_TQI_MIN_REQ_PU_MON	V	0... 7FFFH	0... 1023.96875	0.03125	Nm
LDP_N_32_MON_IP_TQI_MIN_MON	6	0... FFH	0... 8160	32	rpm
LDP_TCO_MON_IP_TQI_MIN_PU_MON	4	0... FEH	-48... 142.5	0.75	°C
Minimum requested indicated torque in PU phase					

Import actions:

ACTION_ECM3_Service12TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service13TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service14TaskPfm (**IN**<No Name available>)

E.21.1 FUNCTION PART: ECM2_DTSYSTQMIN

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The argument has the value 3.

ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service12TaskPfm() and ACTION_ECM3_Service13TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT<>, OUT<>, IN <>)
ACTION_ECM3_ChkCpl(IN<>, IN<>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN<>, IN<>)

Note:These actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

General information:

The objective of this function is the monitoring of the minimum torque at clutch. The model takes into account that a great part of the minimum torque at clutch could be the integral part of the ISC. Therefore the difference of monitored minimum torque at clutch and Ipart of ISC is compared to a torque *threshold*

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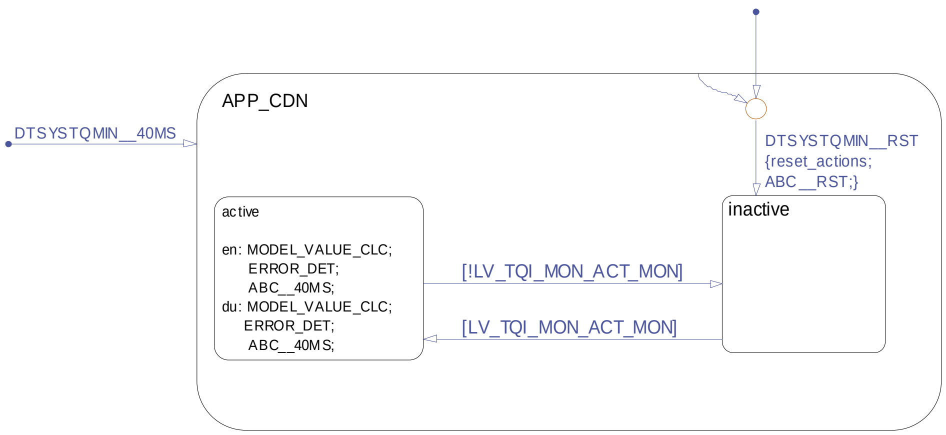
which is dependent on:**1)** the engine self stabilising factor (function of ratio between engine speed and idle speed setpoint) **2)** TQ_LOSS_REQ_ CLU_MON and **3)** TQ_CONV_MAX_MON. For engine speeds above idle speed setpoint this difference must be negative. For speeds below idle speed setpoint great values for minimum torque at clutch are allowed.
One exception of the above mentioned rule is at engine start. If the engine is in start phase, an constant additive term is taken into account for the threshold (see also "Chapter D - Minimum Torque at Clutch"). To monitor this start torque term, the actual engine speed is compared to an upper threshold for the engine start endspeed. In addition to the Ipart of ISC, the two other factors influencing the minimum torque at clutch are hydraulic torque losses inside the converter of an automatic gearbox TQ_CONV_MAX_MON (which depends on coolant temperature and idle speed setpoint) and the minimum requested indicated torque in the PU phase TQI_MIN_REQ_PU_MON. However, if the engine is in PU or PUC mode TQ_MIN_ CLU_MDL is set to minimum possible torque that the driver can request i.e. TQ_LOSS_MON.
The plausiblisation of the L1 value, TQ_MIN_CLU, against a L2 model value is done based on current engine state. The variable STATE_ERR_DET_TQ_MIN_MON (calculated in the module Application incidences of process monitoring) is used to switch between the different errordetection paths. If the engine is in PU or PUC and the L1 minimum torque at clutch value is greater than TQ_LOSS_MON, then an error state is set. If however the engine is neither in PU or PUC, then the L1 value is compared to the L2 model value TQ_MIN_CLU_MDL_4_MON. If any of the error states are set, a fault is detected after debouncing.

Application Conditions



***Initialisation(DTSYSTQMIN__RST)*:** for condition see Application Incidences of Process Monitoring

Function Description

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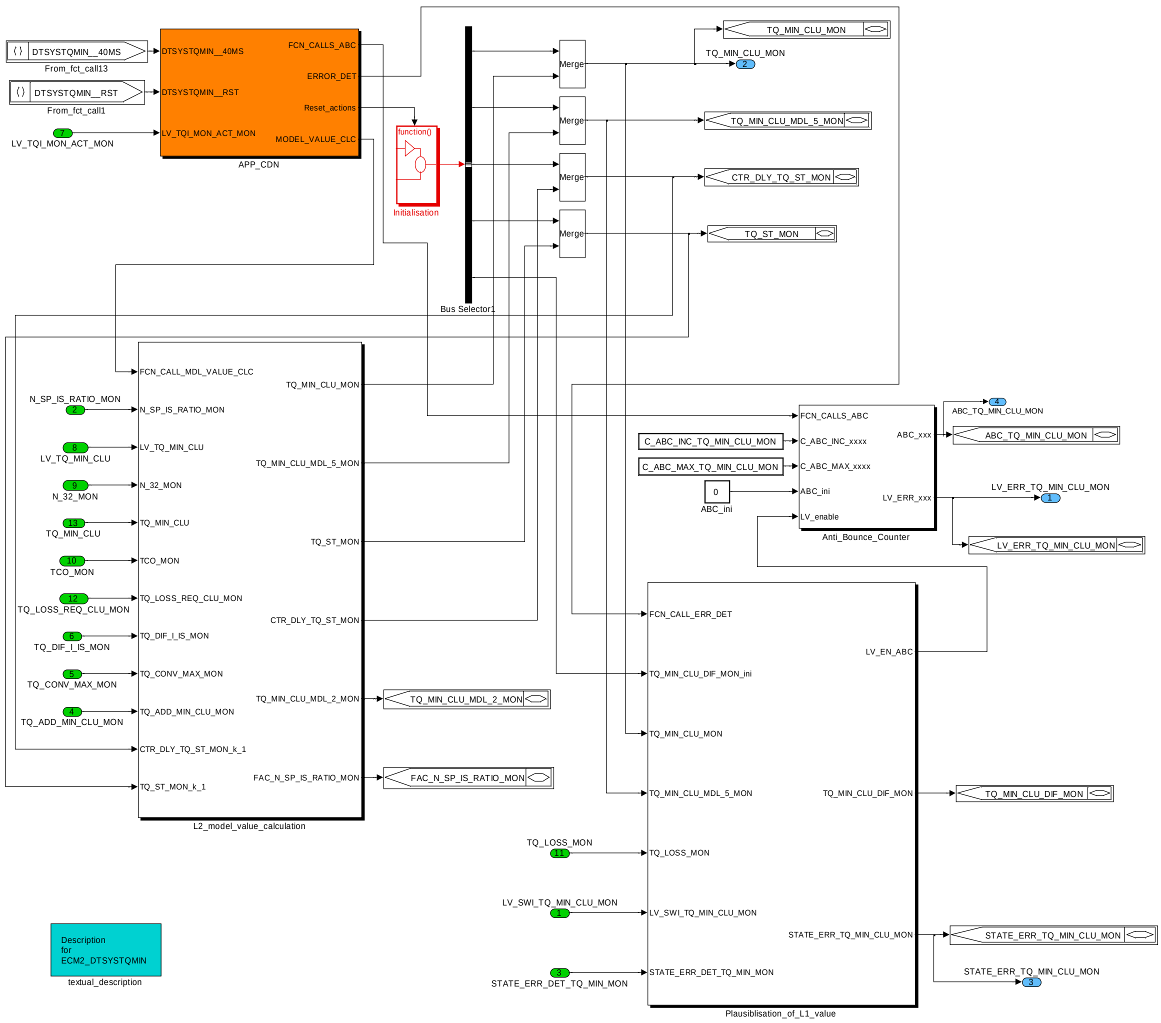

Figure E.21.1: ECM2_DTSYSTQMIN

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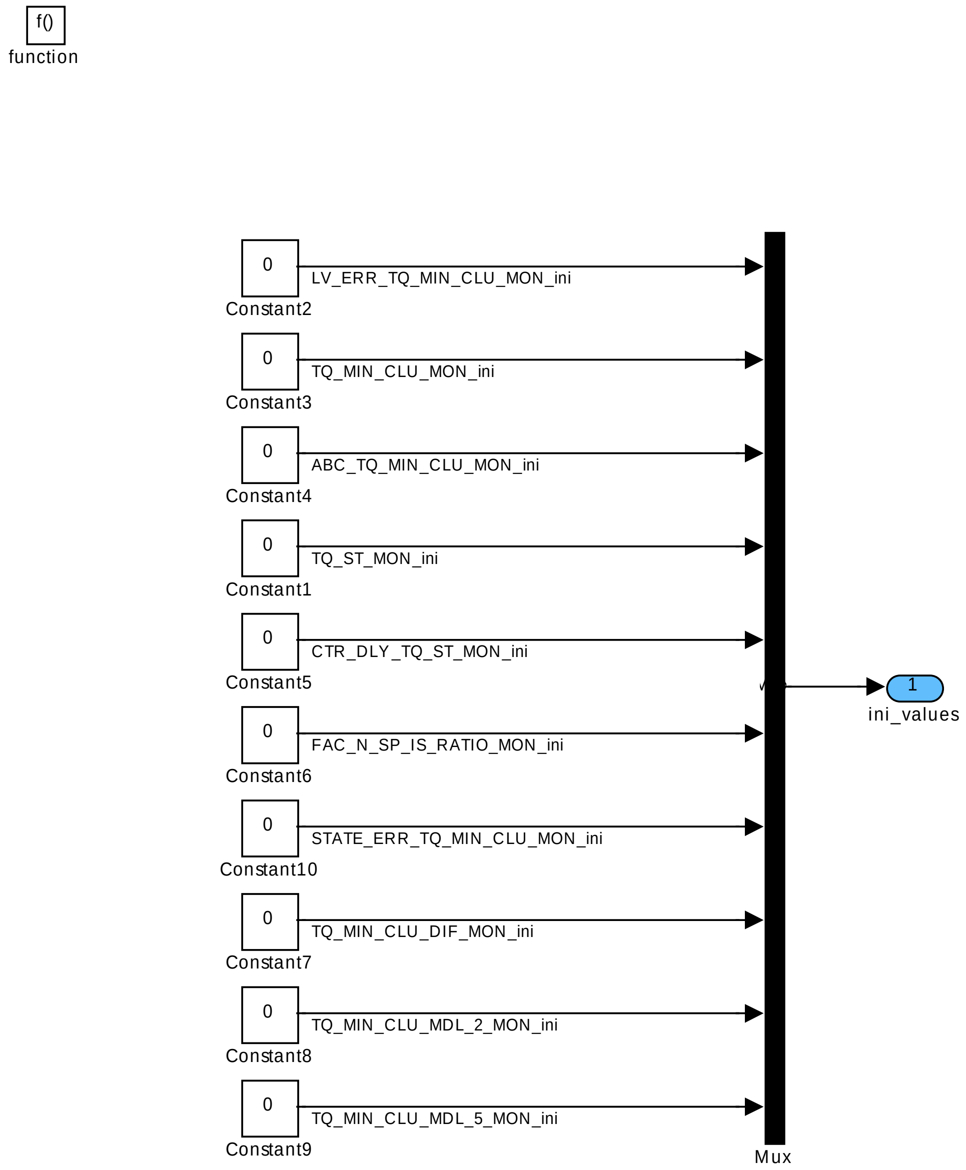

Figure E.21.2: ECM2_DTSYSTQMIN/Initialisation

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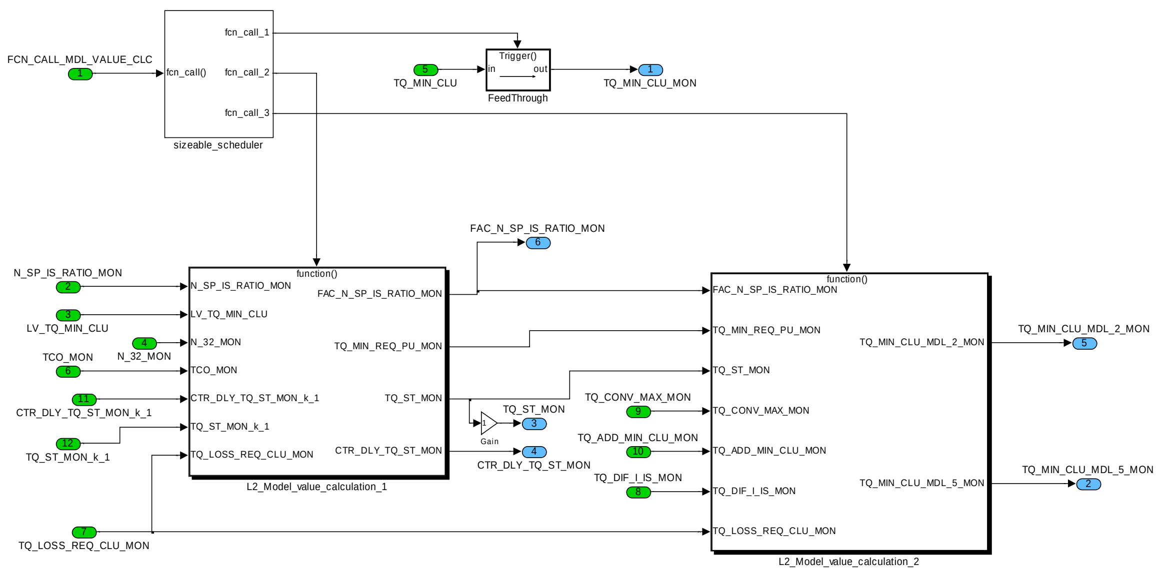

Figure E.21.3: ECM2_DTSYSTQMIN/L2_model_value_calculation

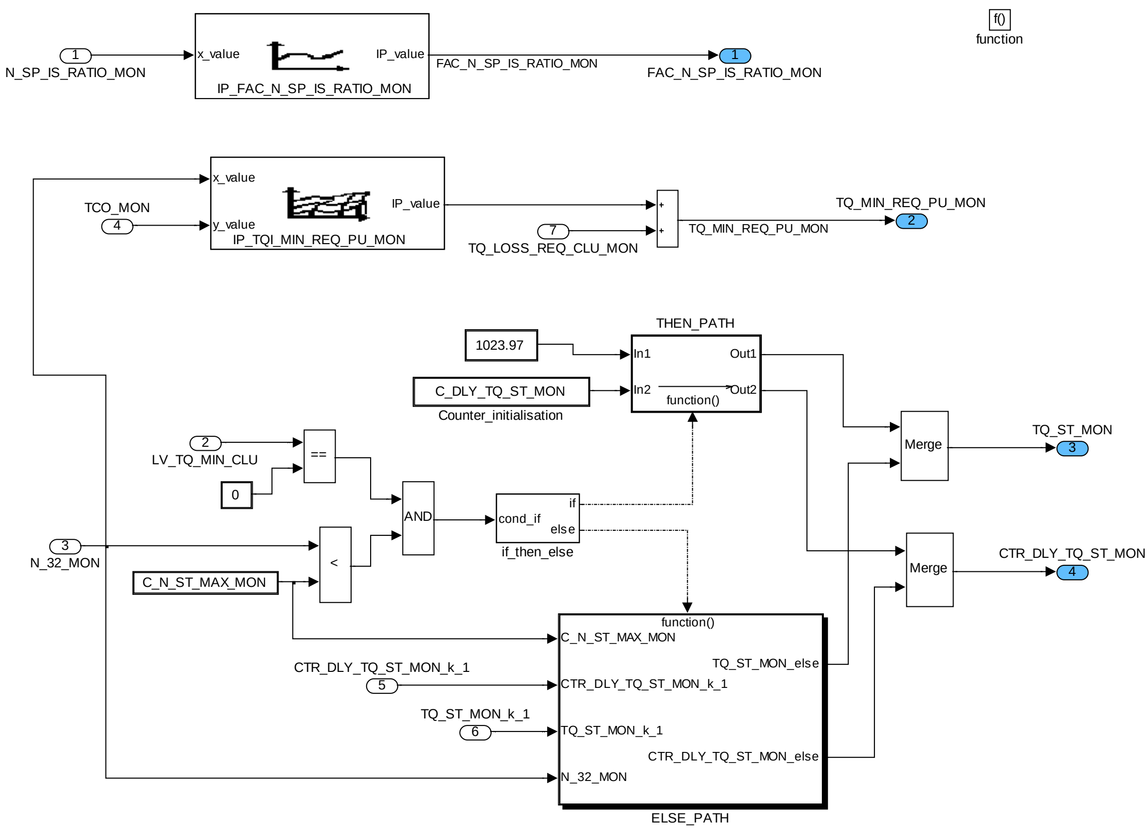

Figure E.21.4: ECM2_DTSYSTQMIN/L2_Model_value_calculation /L2_Model_value_calculation_1

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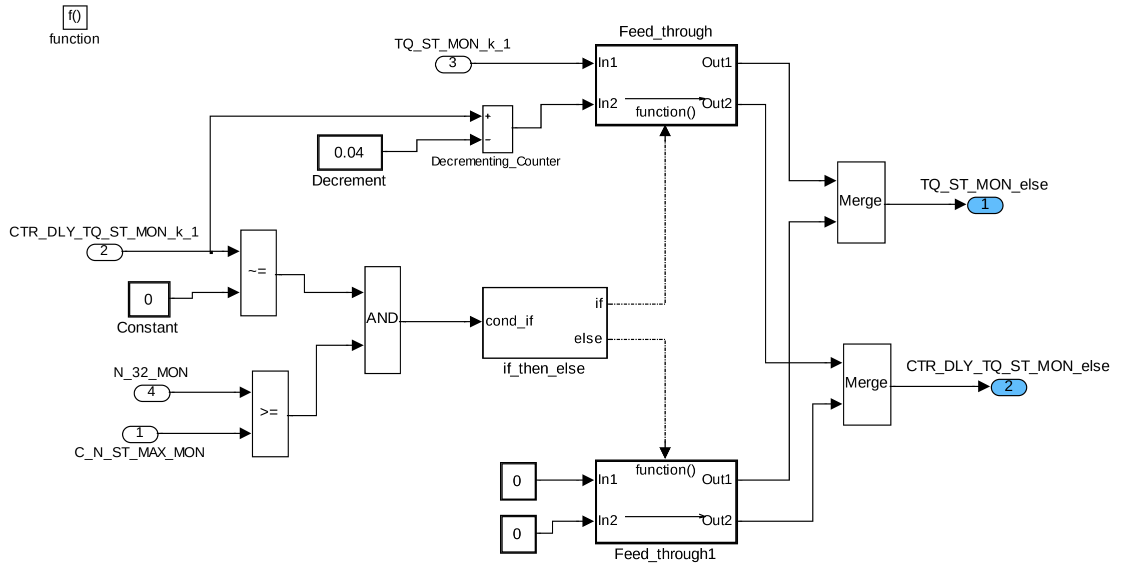

Figure E.21.5: ECM2_DTSYSTQMIN/L2_Model_value_calculation /L2_Model_value_calculation_1/ELSE_ path

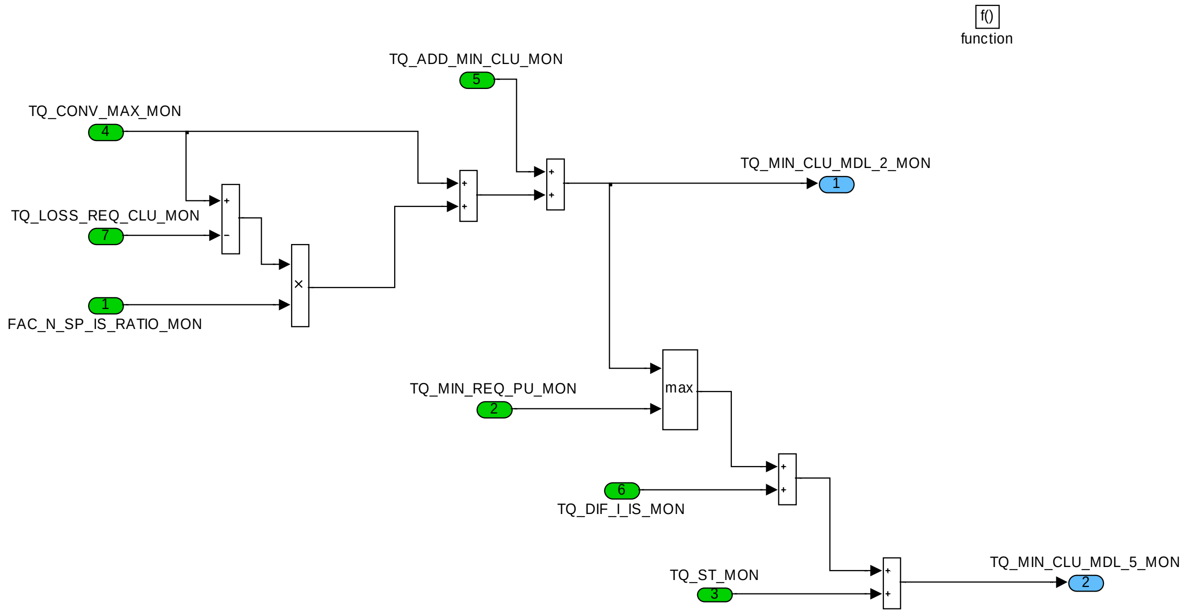

Figure E.21.6: ECM2_DTSYSTQMIN/L2_model_value_calculation/L2_Model_value_calculation_2

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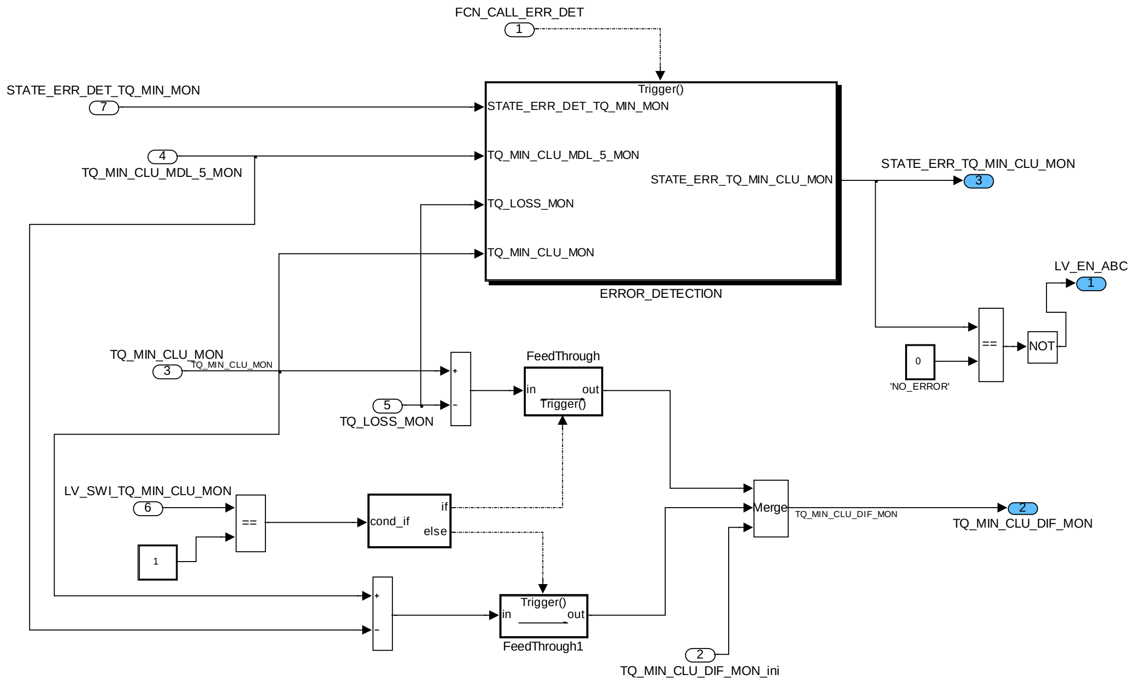

Figure E.21.7: ECM2_DTSYSTQMIN/Plausibilisation_of_L1_value

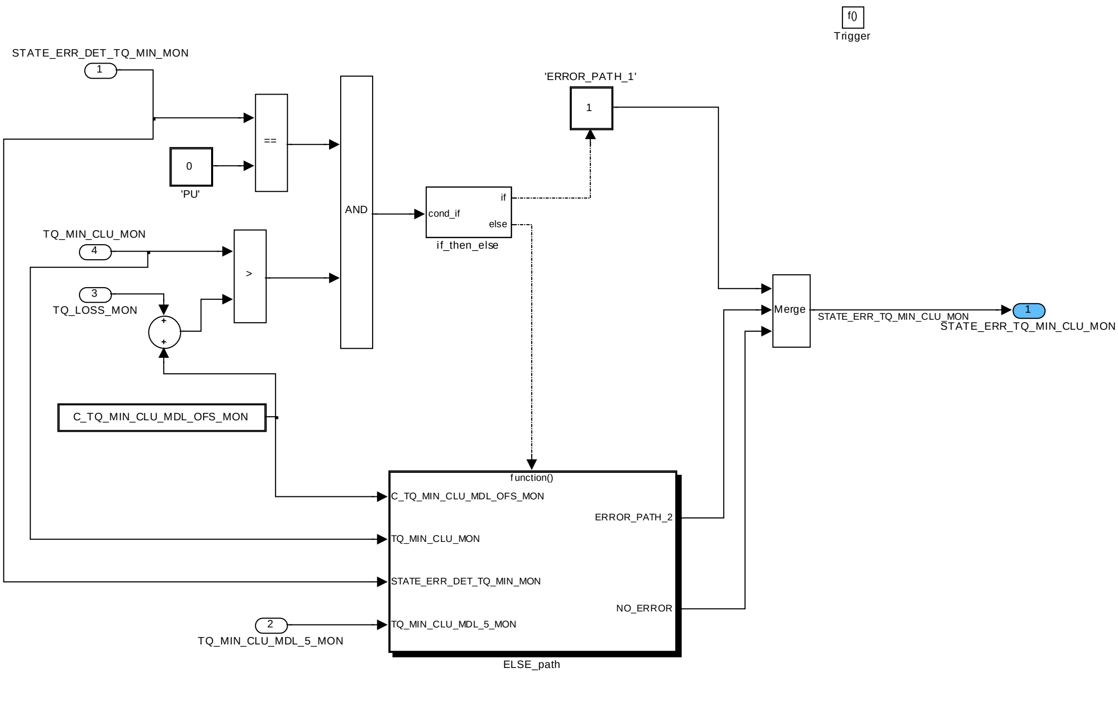

Figure E.21.8: ECM2_DTSYSTQMIN/Plausibilisation_of_L1_value /ERROR_DETECTION

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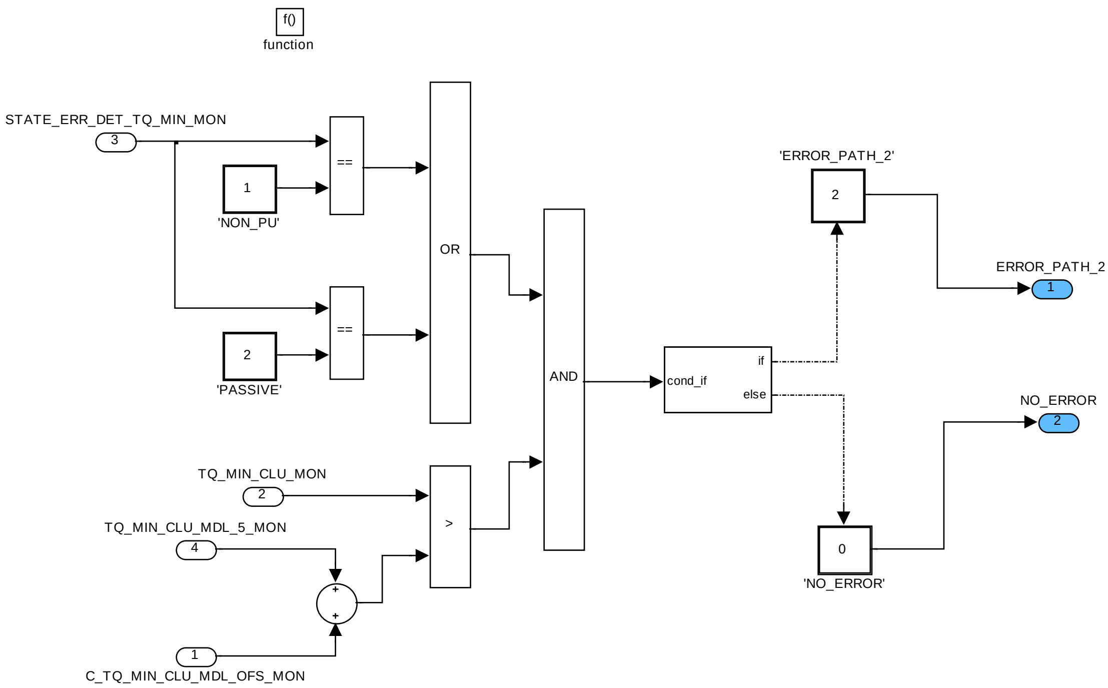

Figure E.21.9: ECM2_DTSYSTQMIN/Plausiblisation_of_L1_value/ERROR_DETECTION/ELSE_ path

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E.22 Monitoring of pedal value signal

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_PVS_RATIO_MON	O/V	0... FFH	0... 255	1	-
Anti bounce counter PVS ratio error					
FAC_V_SLOP_PVS_MON	V	0... FFH	0... 3.984375	0.015625	-
Factor for correction of slop of channel 2 in ratio check					
LV_ERR_PVS_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for different PVS diagnosis between L1 and L2					
LV_ERR_PVS_RATIO_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for ratio error between PVS channel 1 and 2					
PV_AV_1_MON	V	0... FFH	0... 99.609375	0.390625	%
Degree of activation of the accelerator pedal (channel 1)					
PV_AV_2_MON	V	0... FFH	0... 99.609375	0.390625	%
Degree of activation of the accelerator pedal (channel 2)					
PV_AV_MON	O/V	0... FFH	0... 99.609375	0.390625	%
Level 2 degree of activation of the accelerator pedal					
V_PVS_1_MON	O/V	0... 3FFH	0... 4.995117	0.00488281	V
Pedal value sensor 1 raw acquisition					
V_PVS_2_MON	O/V	0... 3FFH	0... 4.995117	0.00488281	V
Pedal value sensor 1 raw acquisition					

Input data:

LV_BRAKE_MON {p. 6790}	LV_ERR_PVS_1 {p. 4216}	LV_ERR_PVS_2 {p. 4216}	LV_ERR_PVS_RATIO {p. 4216}
LV_ERR_VCC_PVS_1_ MON {p. 6790}	LV_ERR_VCC_PVS_2_ MON {p. 6790}	LV_ERR_VCC_PVS_MON {p. 6790}	LV_IGK_MON {p. 6790}
N_32_MON {p. 7002}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_PVS_RATIO_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment (additive value in case of error)					
C_ABC_MAX_PVS_RATIO_MON	-	1... FFH	1... 255	1	-
Value at which ratio error is recognized, when reached					
C_N_MIN_PVS_DIAG_MON	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for PVS diagnosis					
C_PV_LIH_MAX_MON	-	0... FFH	0... 99.609375	0.390625	%
Max. pedal position on case of any PVS error					
C_V_PVS_IS_THD_1_MON	-	0... 3FFH	0... 4.995117	0.00488281	V
Threshold for idle speed PVS channel 1					
C_V_PVS_IS_THD_2_MON	-	0... 3FFH	0... 4.995117	0.00488281	V
Threshold for idle speed PVS channel 2					
C_V_PVS_SLOP_1_MON	-	0... FFH	0... 79.6875	0.3125	%/V
Slope of the PVS channel 1					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_V_PVS_SLOP_2_MON	-	0... FFH	0... 159.375	0.625	%/V
Slope of the PVS channel 2					
IP_V_THD_RATIO_CHK_PVS_MON	-	0... FFH	0... 4.98046875	0.01953125	V
LDP_V_MIN_PV_MON_IP_V_PVS_MON	6	0... FFH	0... 4.98046875	0.01953125	V
Maximum PV ratio error allowed					

Import actions:

ACTION_ECM3_Service3TaskPfm (**IN**<PRM_K>)
ACTION_ECM3_Service4TaskPfm (**IN**<PRM_K>)
ACTION_ECM3_Service5TaskPfm (**IN**<PRM_K>)

E.22.1 ECM2_DTSYSPVS

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 2.

ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service3TaskPfm() and ACTION_ECM3_Service4TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

ACTION_INFR_GetVPVSMON(OUT<V_PVS_1_MON>, OUT<V_PVS_2_MON>)

Note: These actions is defined in IRS, it is responible for providing voltages from PVS channel 1 & & 2

General information:

The pedal value diagnosis is made in the monitoring level in order to check the V_PVS input value of the torque monitoring function (level 2).

After the diagnosis, a resulting pedal value PV_AV_MON is used as input for the torque monitoring function.

A malfunction of level 1 will be assumed, if a ratio error of the two redundant pedal values is diagnosed after debouncing, yet no PVS failure was detected previously by the PVS diagnosis function of level 1.

The following errors were detected:

The difference between the values V_PVS_1_MON and V_PVS_2_MON is too large.

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The diagnosis system of level 2 detects a PVS ratio fault and no fault is detected by the diagnosis of level 1.
Any PVS errorBIT of the PVS diagnosis in level 1 has been reset without permission.

To ensure that the PVS diagnosis of level 1 detects a fault earlier than the PVS ratio diagnosis of level 2, the fault detection time of the diagnosis function in level 2 has to be adjusted that it exceeds the fault detection time of level 1. Therefore, all level 1 PVS diagnosis thresholds, all constants of the debounce counters and the cycle time have to be taken into account.

Application Condition

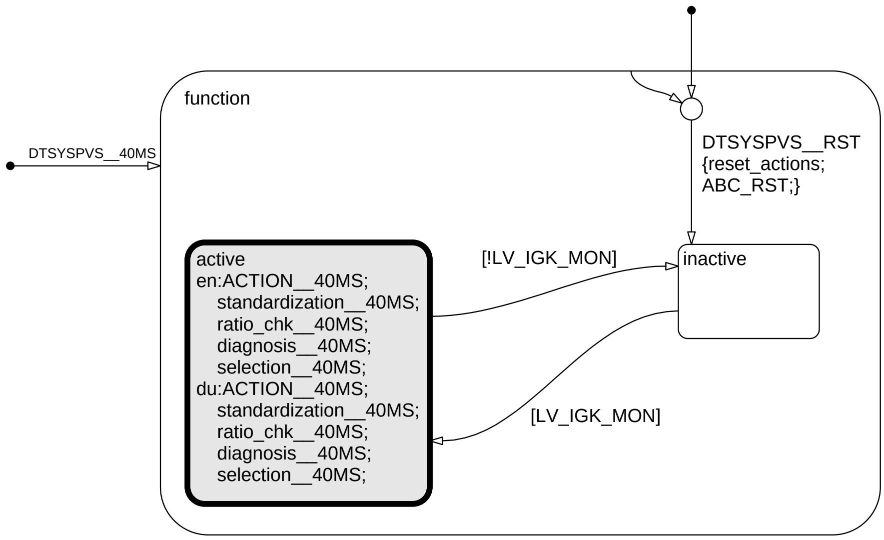

Figure E.22.1: ECM2_DTSYSPVS/APP_CDN/Chart

Function Description

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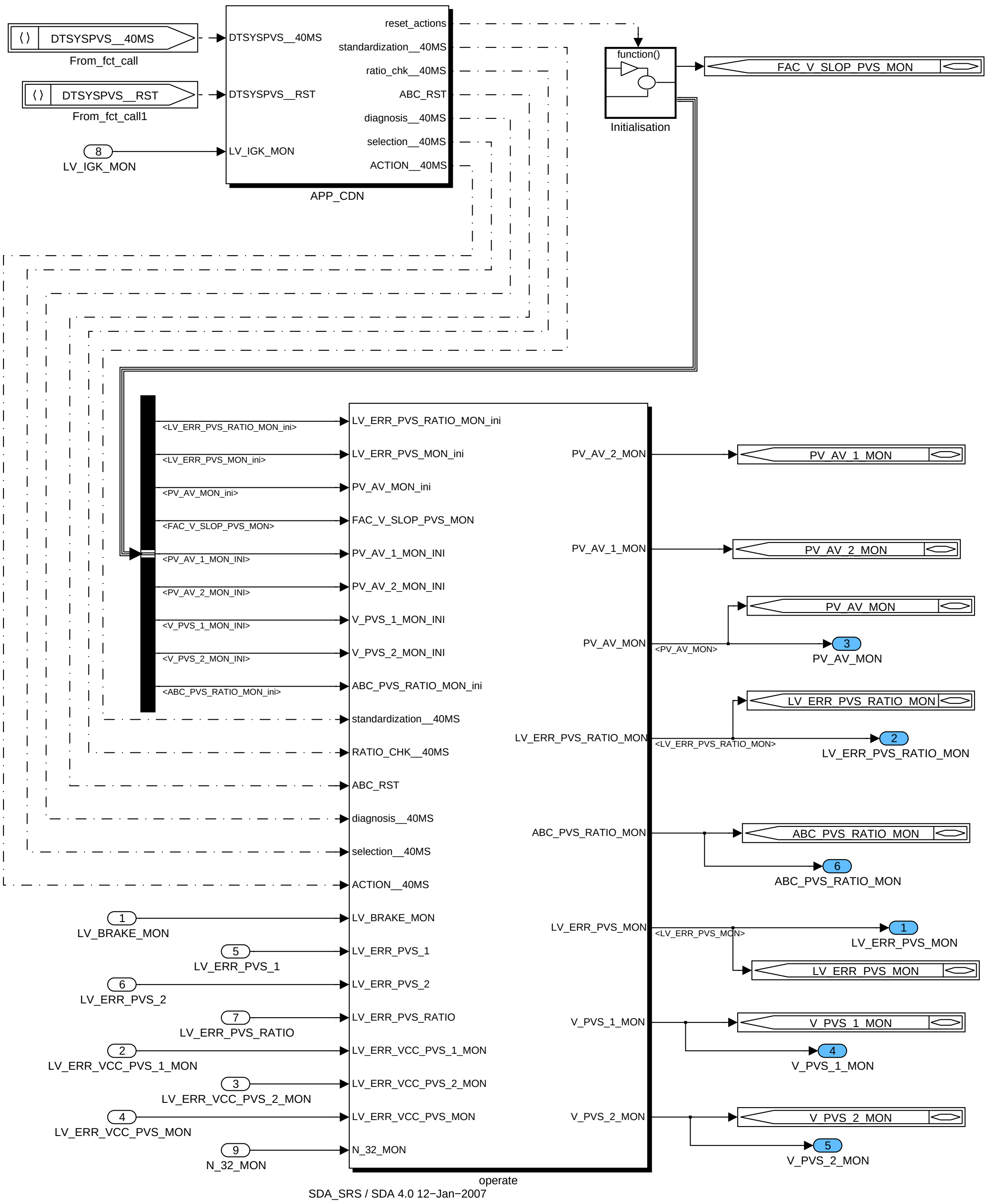

Figure E.22.2: ECM2_DTSYSPVS

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E.22.1.1 SUBFUNCTION: Initialisation

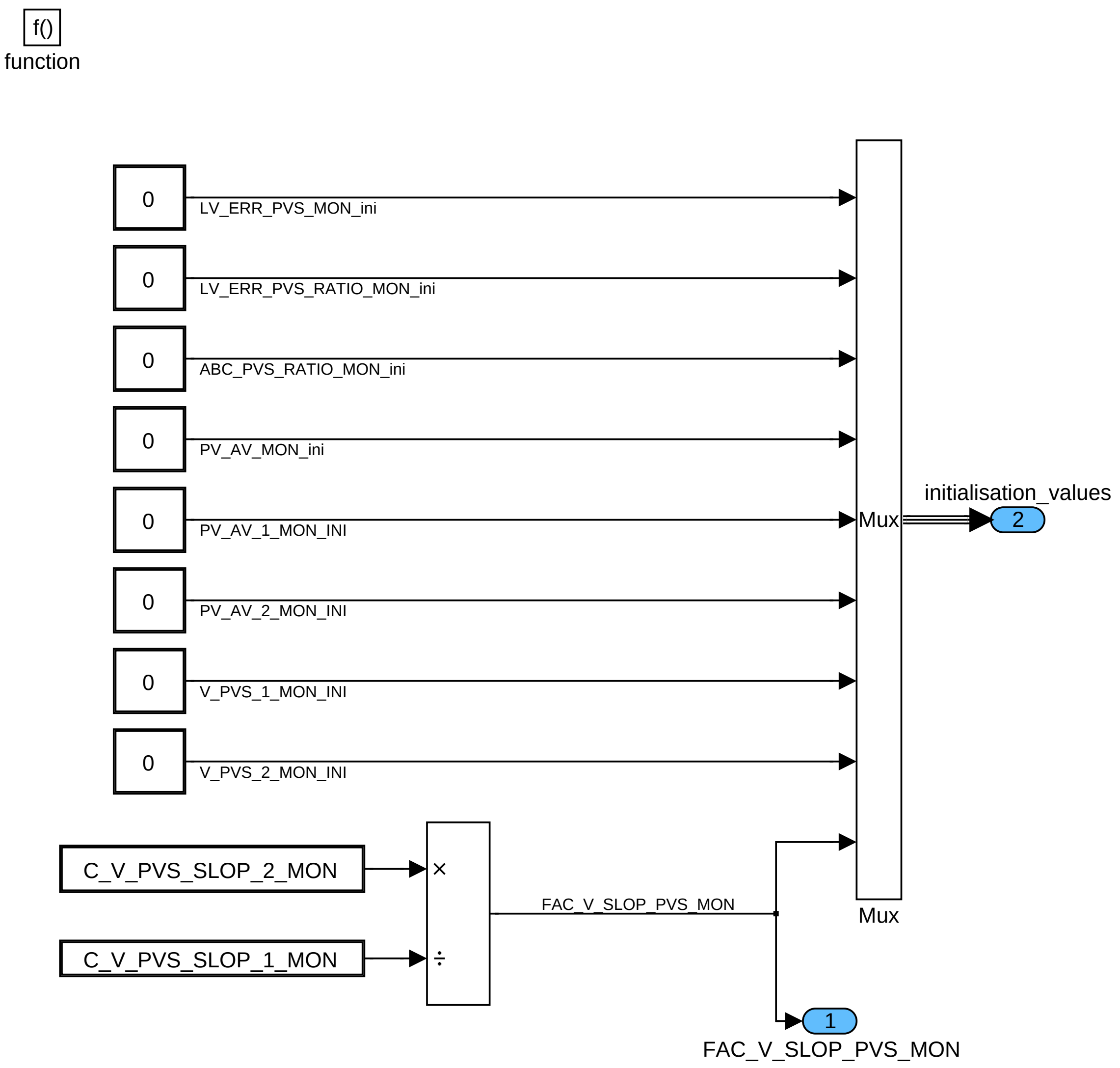

Figure E.22.3: ECM2_DTSYSPVS/Initialisation

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E.22.1.2 SUBFUNCTION: operate

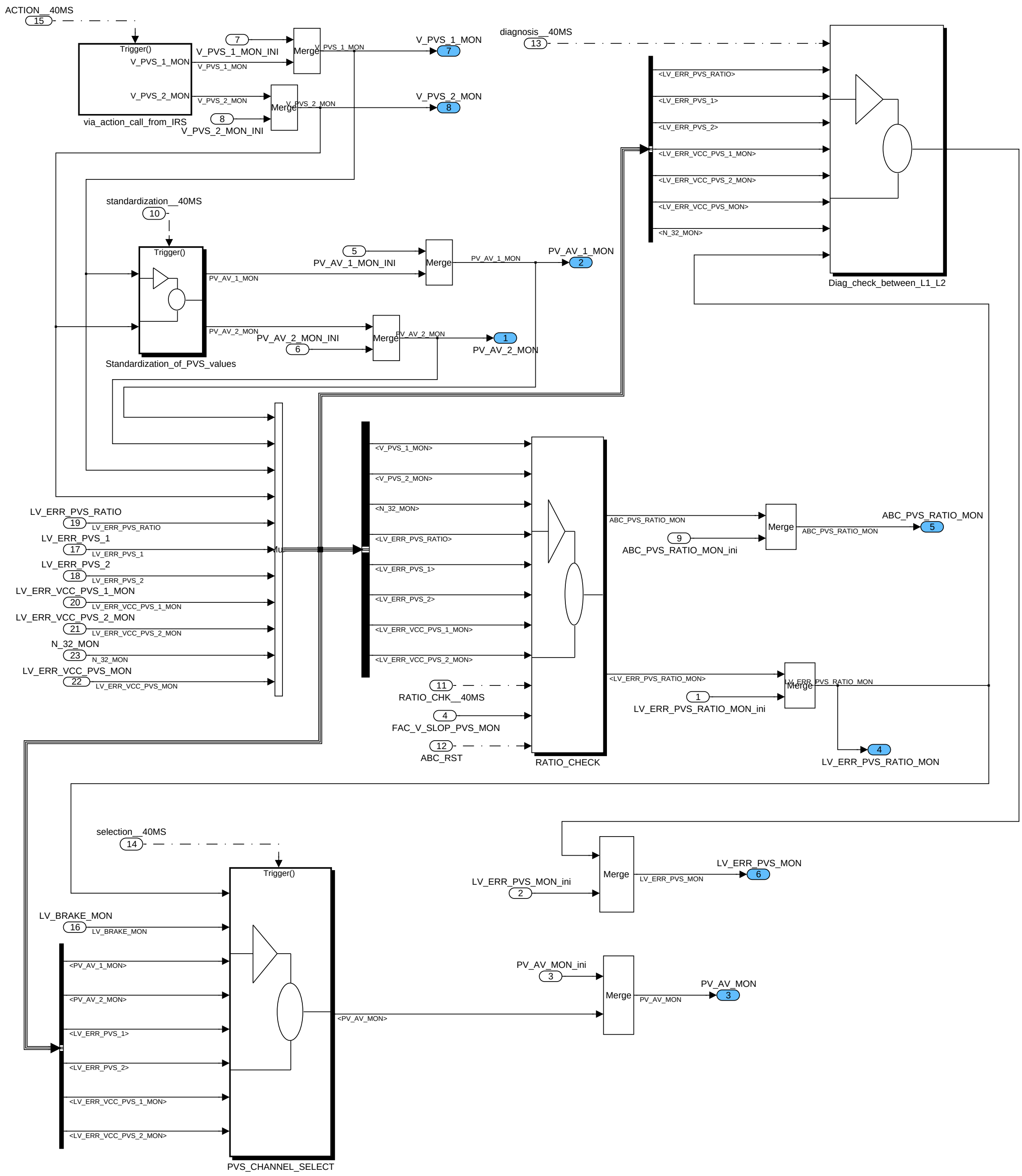

Figure E.22.4: ECM2_DTSYSPVS/operate

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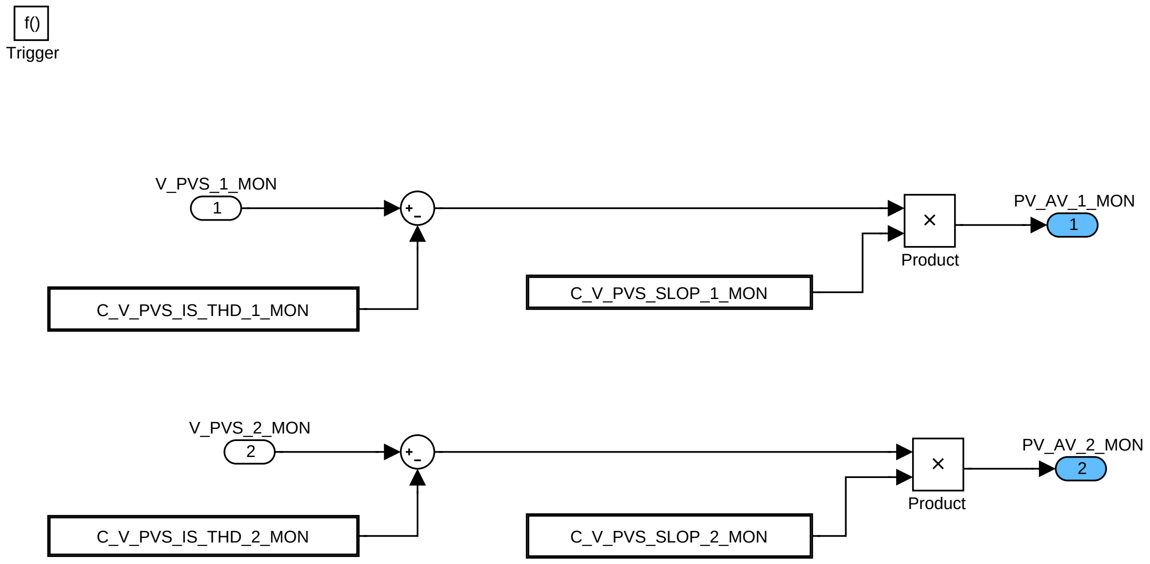

Figure E.22.5: ECM2_DTSYSPVS/operate/Standardization_of_PVS_values

ECM2_DTSYSPVS/OPERATE/RATIO_CHECK

In case of an error free system (no siganl range error detected), the difference between V_PVS_1_MON and V_PVS_2_MON is not allowed to be greater than IP_V_THD_RATIO_CHK_PVS_MON.

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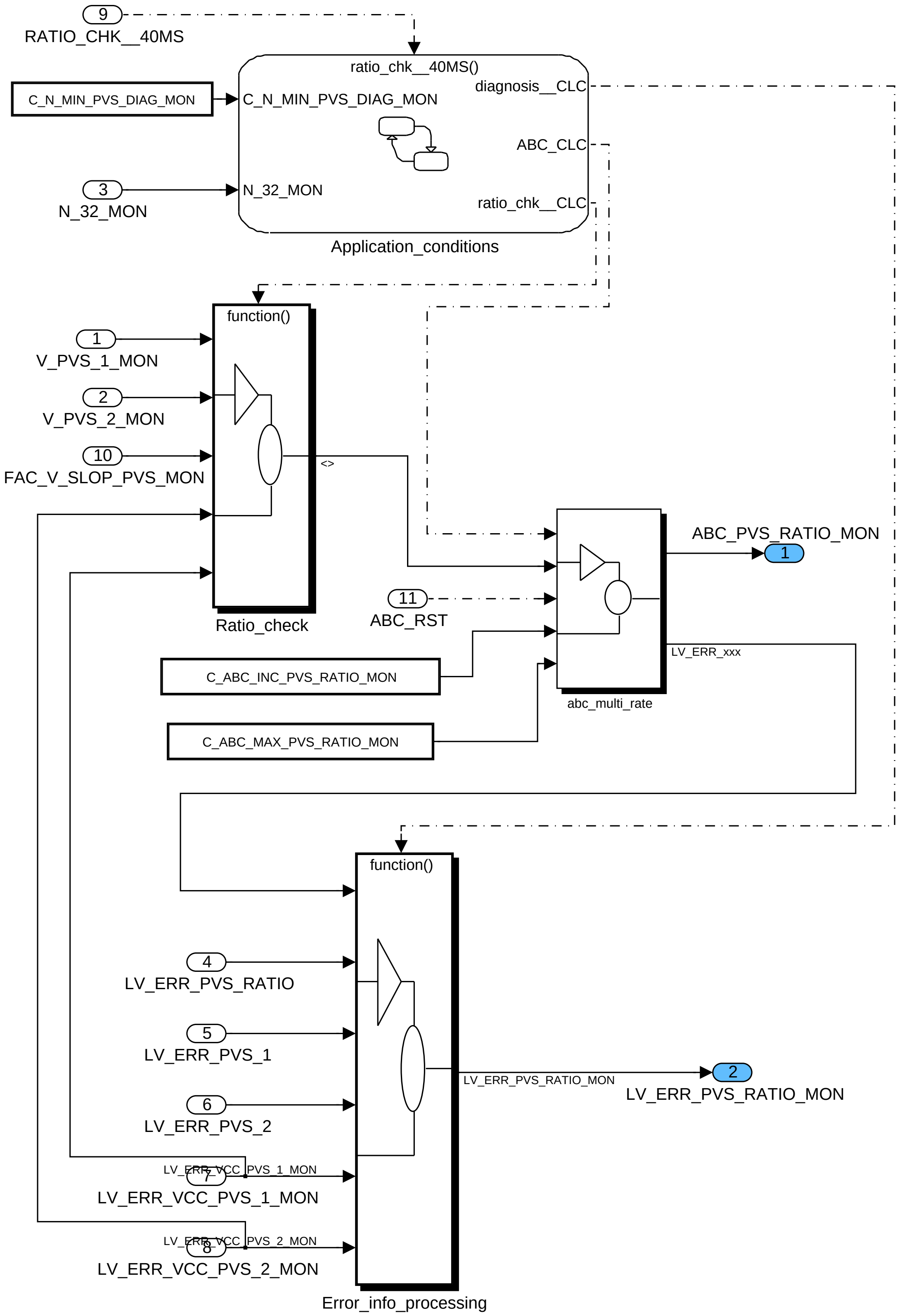

Figure E.22.6: ECM2_DTSYSPVS/operate/RATIO_CHECK

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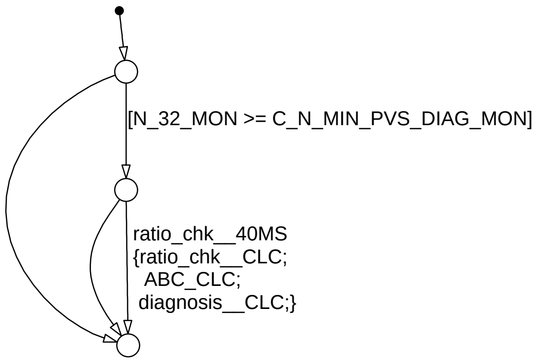

Figure E.22.7: ECM2_DTSYSPVS/operate/RATIO_CHECK/Application_conditions

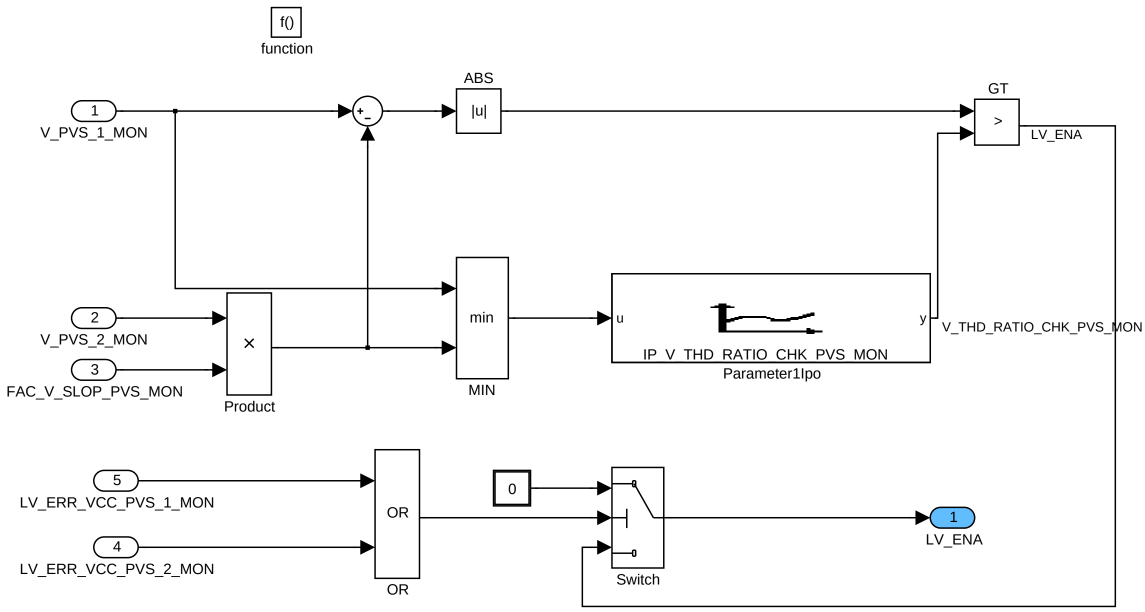

Figure E.22.8: ECM2_DTSYSPVS/operate/RATIO_CHECK/Ratio_check

ECM2_DTSYSPVS/OPERATE/RATIO_CHECK/ERROR_INFO_PROCESSING

The Bits LV_ERR_VCC_PVS_1_MON and LV_ERR_VCC_PVS_2_MON are reversible like the corresp-ndent failure bits from level 1. That means, the output LV_ERR_PVS_RATIO_MON has to be reversible also depending of these two error bits.
All PVS error information of the function level is considered. This allows the different process levels to be based on the same error information:

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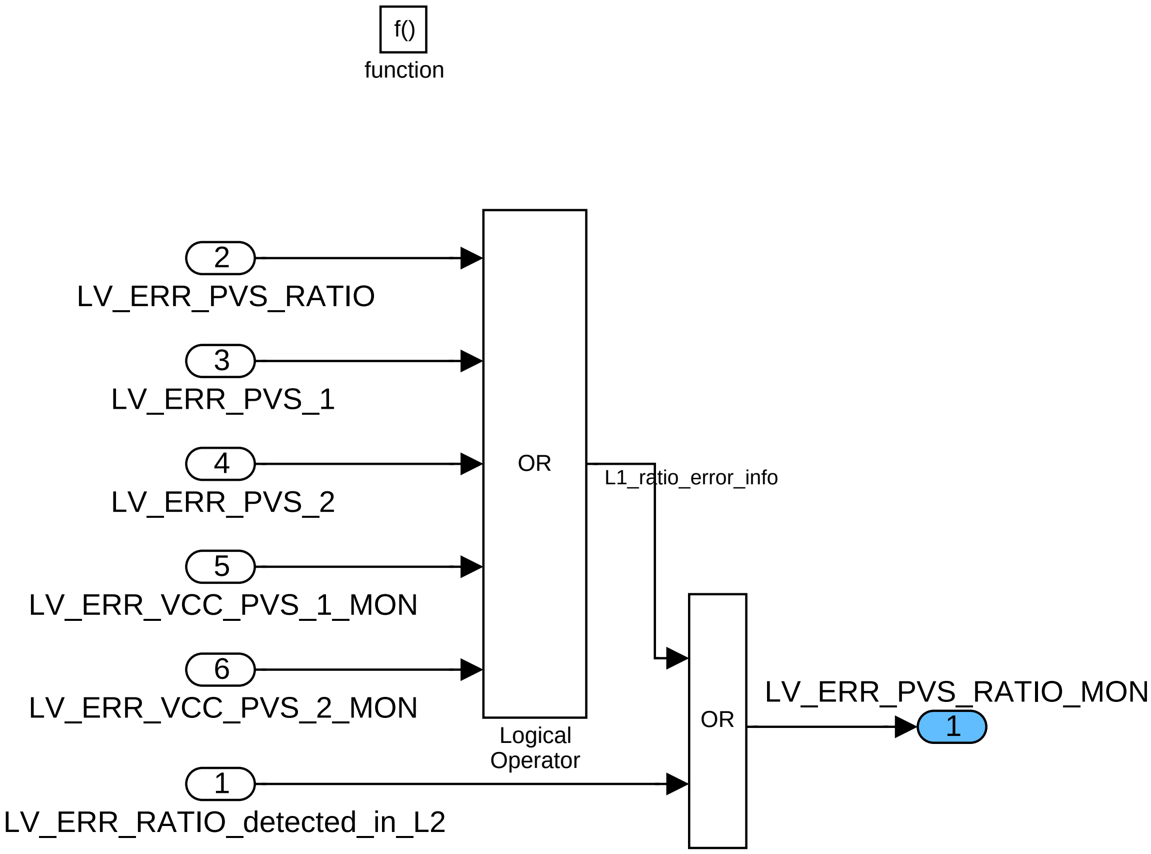

Figure E.22.9: ECM2_DTSYSPVS/operate/RATIO_CHECK/Error_info_processing

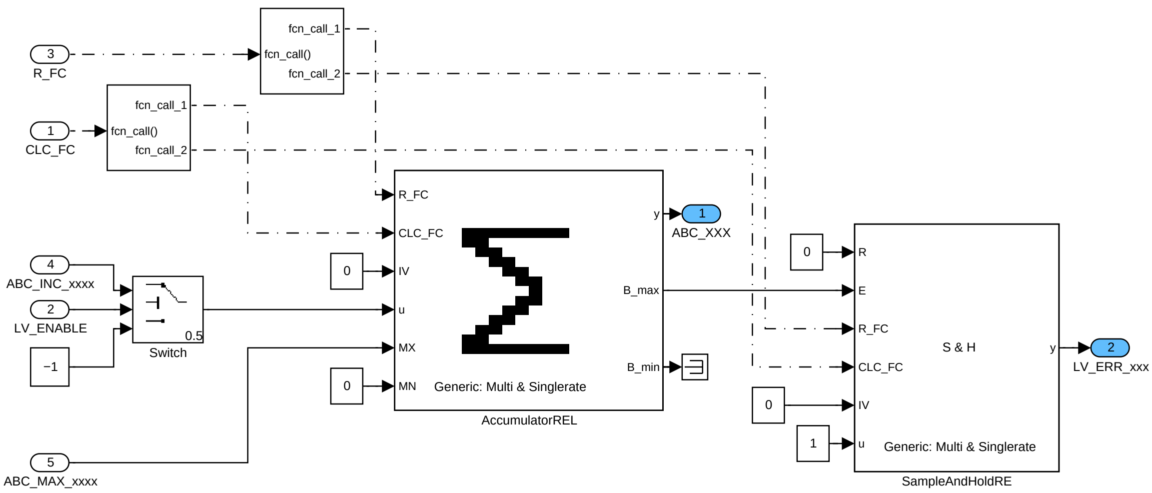

Figure E.22.10: ECM2_DTSYSPVS/operate/RATIO_CHECK/abc_multi_rate

ECM2_DTSYSPVS/OPERATE/DIAG_CHECK_BETWEEN_L1_L2

If any PVS ratio error is detected in level 2 and no PVS error is detected in level 1, a fault of the PVS diagnosis in level 1 will be assumed.

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There is also a check, whether an errorBIT of the PVS diagnosis in level 1 was reset without permission. This is done by using the result of LV_ERR_PVS_RATIO_MON of the last recurrence.

LV_ERR_VCC_PVS_MON is assumed to be a PVS supply voltage error flag of a level 2 diagnosis in case of any PVS supply voltage error.

LV_ERR_VCC_PVS_1_MON and LV_ERR_VCC_PVS_2_MON are error flags that result from Level 1 diagnosis of PVS1 and PVS2 supply voltage and are assigned to the LV_ERR_VCC_PVS_1_MON and LV_ERR_VCC_PVS_1_MON respectively in the application incidences of process monitoring.
If an PVS?monitoring error is detected and the error bit LV_ERR_PVS_MON is set, then this bit muts not be reversible.

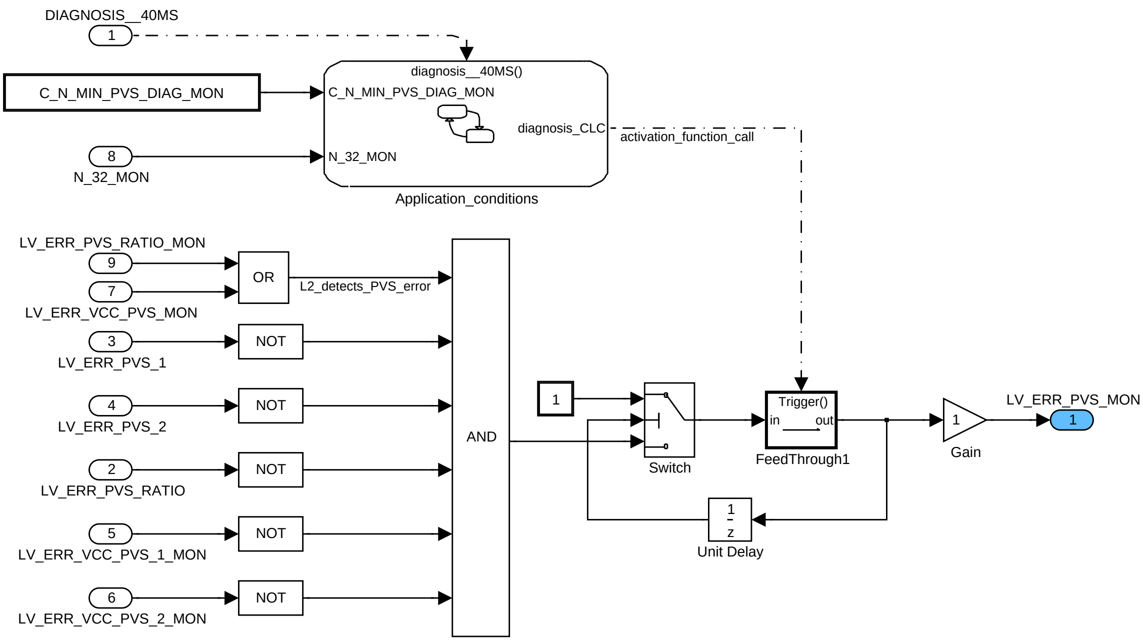

Figure E.22.11: ECM2_DTSYSPVS/operate/Diag_check_between_L1_L2

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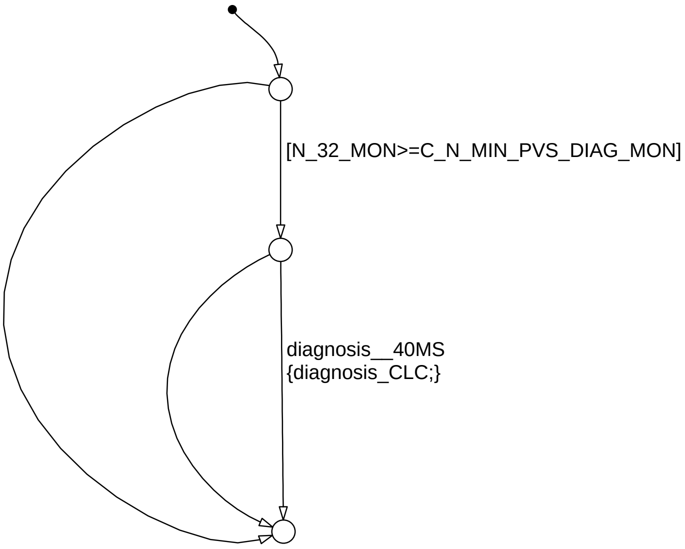

Figure E.22.12: ECM2_DTSYSPVS/operate/Diag_check_between_L1_L2/Application_conditions

ECM2_DTSYSPVS/OPERATE/PVS_CHANNEL_SELECT

Depending on the plausibility, the degree of pedal activation PV_AV_MON is defined by the signals PV_AV_1_MON and PV_AV_2_MON, as follows:

Error Level	Error bits set	Analysis, error handling
0	-	PV_AV_MON = MIN(PV_AV_1_MON,PV_AV_2_MON)
1	LV_ERR_PVS_RATIO_MON	PV_AV_MON = MIN(PV_AV_1_MON, PV_AV_2_MON) (minimum)
2	LV_ERR_PVS_1 **OR** LV_ERR_VCC_PVS_1_MON	PV_AV_MON = PV_AV_2_MON (selection)
3	LV_ERR_PVS_2 **OR** LV_ERR_VCC_PVS_2_MON	PV_AV_MON = PV_AV_1_MON (selection)
4	(LV_ERR_PVS_1 OR LV_ERR_VCC_PVS_1_MON) **AND** (LV_ERR_PVS_2 OR LV_ERR_VCC_PVS_2_MON)	PV_AV_MON = 0 driver demand not recoganizable

If any PVS errorBIT is set:
PV_AV_MON will be limited to C_PV_LIH_MAX_MON.
Use of the brake as a redundant driver demand:

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IF (LV_BRAKE_MON = 1)
THEN
PV_AV_MON = 0 (same as Error level 4)

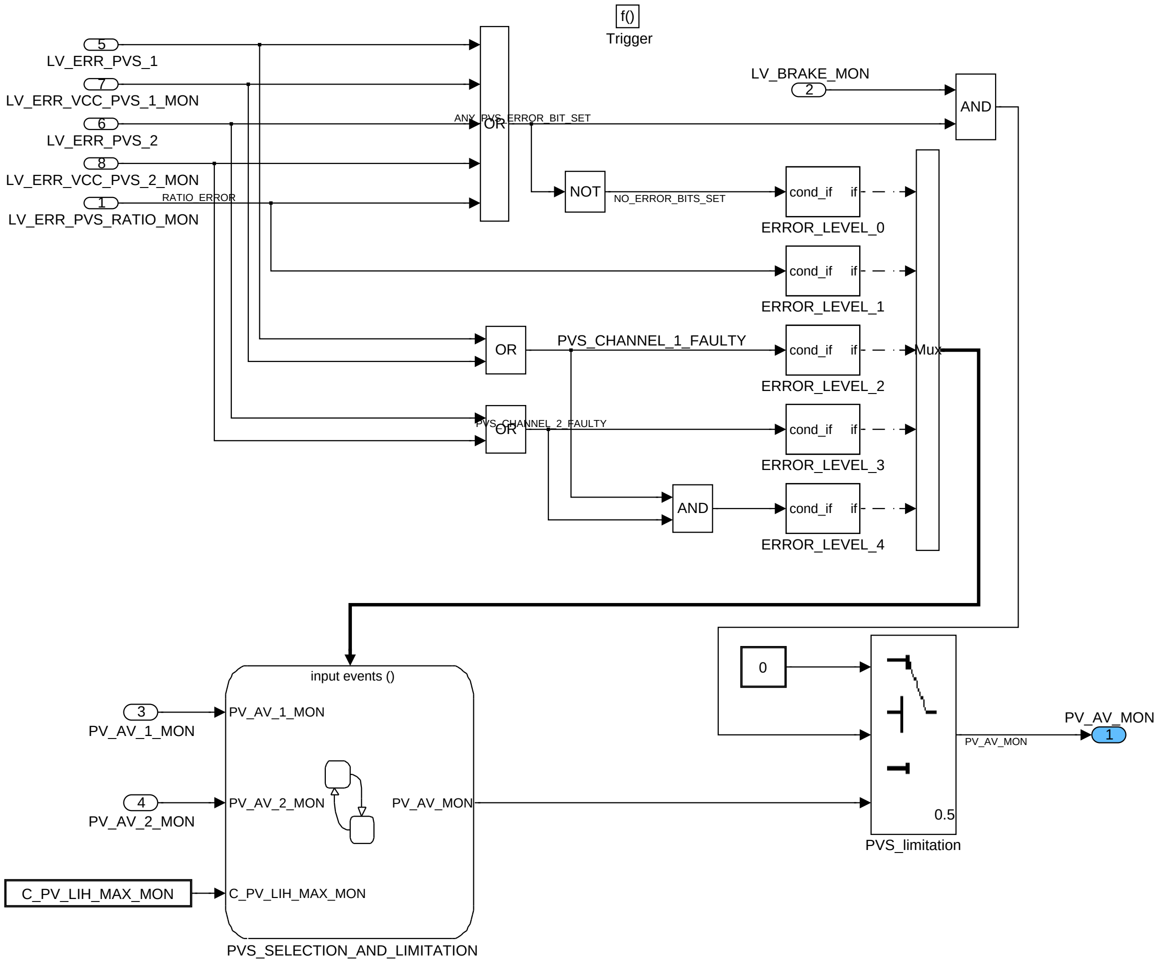

Figure E.22.13: ECM2_DTSYSPVS/operate/PVS_CHANNEL_SELECT

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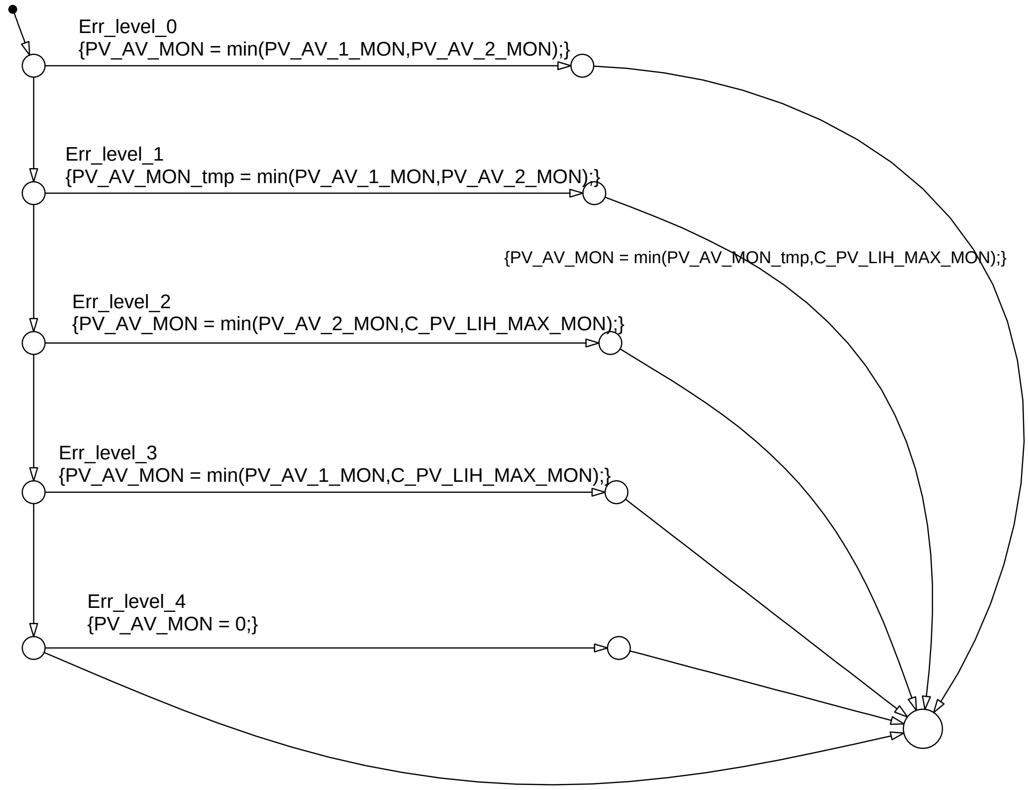

Figure E.22.14:
ECM2_DTSYSPVS/operate/PVS_CHANNEL_SELECT/PVS_SELECTION_AND_LIMITATION

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E.23 Monitoring of torque losses

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_TQ_LOSS_MON	O/V	0... FFH	0... 255	1	-
Anti bounce counter for monitoring of torque losses					
LV_ERR_TQ_LOSS_MON	O/V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom "torque losses"					
TQ_LOSS_MDL_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Modelled torque losses					
TQ_LOSS_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque losses					
TQ_LOSS_REQ_CLU_MDL_MON	V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Modelled filtered torque losses					
TQ_LOSS_REQ_CLU_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque losses without pumping losses					

Input data:

LV_TQI_MON_ACT_MON {p. 6791}	MAF_MON {p. 6777}	N_32_MON {p. 7002}	TCO_MON {p. 6903}
TQ_DIF_IS_AD {p. 3518}	TQ_LOSS {p. 8385}	TQ_LOSS_ADD_FIL_MON {p. 6793}	TQ_LOSS_ADD_MON {p. 6793}
TQ_LOSS_REQ_CLU {p. 8385}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_TQ_LOSS_MON	-	0... FFH	0... 255	1	-
anti bounce counter increment					
C_ABC_MAX_TQ_LOSS_MON	-	1... FFH	1... 255	1	-
maximum of anti bounce counter					
C_MAF_STK_CYL_REF_MON	-	0... FFH	0... 1389	5.4470588	mg/stk
Constant for the determination of the monitored engine friction losses					
C_TQ_IS_AD_MIN_MON	-	80... 7FH	-256 ...254	2	Nm
Min. limitation of engine torque losses adaptation					
IP_TQFR_ADD_MON	-	0... FFH	0... 510	2	Nm
LDP_TCO_MON_IP_TQFR_ADD_MON	5	0... FEH	-48... 142.5	0.75	°C
Coolant temperature correction of friction torque					
IP_TQFR_MON	V	0... FFH	0... 510	2	Nm
LDP_N_32_MON_IP_TQFR_MON	5	0... FFH	0... 8160	32	rpm
LDP_MAF_MON_IP_TQFR_MON	5	0... FFH	0... 1389	5.4470588	mg/stk
Base friction torque and pumping losses					

Import actions:

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ACTION_ECM3_ChkCpl (**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_McChkStack ()
ACTION_ECM3_ReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_Service10TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service11TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service9TaskPfm (**IN**<No Name available>)
ACTION_ECM3_WriteChkCpl (**INOUT**<PRM_VAR>,**OUT**<PRM_VAR_CPL>,**IN**<PRM_VALUE>)

General Information

ACTION_ECM3_Service9TaskPfm(IN< >)
ACTION_ECM3_Service10TaskPfm(IN< >)
ACTION_ECM3_Service11TaskPfm(IN< >)

Note: This actions are defined in chapter "Processor Monitoring", subsection "Program Flow Monitoring services for Process Monitoring". The first action has to be executed as first instruction in this module, the second action has to be executed as last instruction of this module. The argument n has the value 2.

ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service9TaskPfm() and ACTION_ECM3_Service10TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT < >, OUT < >, IN < >)
ACTION_ECM3_ChkCpl(IN < >, IN < >)
ACTION_ECM3_ReadChkCplOUT < >, IN < >, IN < >)

Note: This actions are defined in chapter "Processor Monitoring", subsection "RAM test on MC for processor monitoring". All variables with Mode O and history variables in modules of the Process Monitoring have to be checked by the cyclical RAM test.

General information:
The objective of this function is the monitoring of the torque losses. It observes both level 1 values, TQ_LOSS and TQ_LOSS_REQ_CLU (filtered TQ_LOSS without pumping losses), that is exclusively used for the determination of TQ_MIN_CLU and TQ_MAX_CLU.

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It has to be distinguished between engine immanent torque losses (e.g. TQFR) and not engine immanent torque losses (e.g. TQ_LOSS_ACC), that are determined in the module "Appl. Inc. and configuration of process monitoring".
A fault is detected after debouncing, if the monitored TQ_LOSS is smaller than the modelled one (TQ_LOSS_MDL_MON) or if the monitored TQ_LOSS_REQ_CLU is smaller than the modelled one (TQ_LOSS_REQ_CLU_MDL_MON).

Application Conditions

Initialization: RST
Recurrence: 40MS
Activation: LV_TQI_MON_ACT_MON
Deactivation: !LV_TQI_MON_ACT_MON

Function description

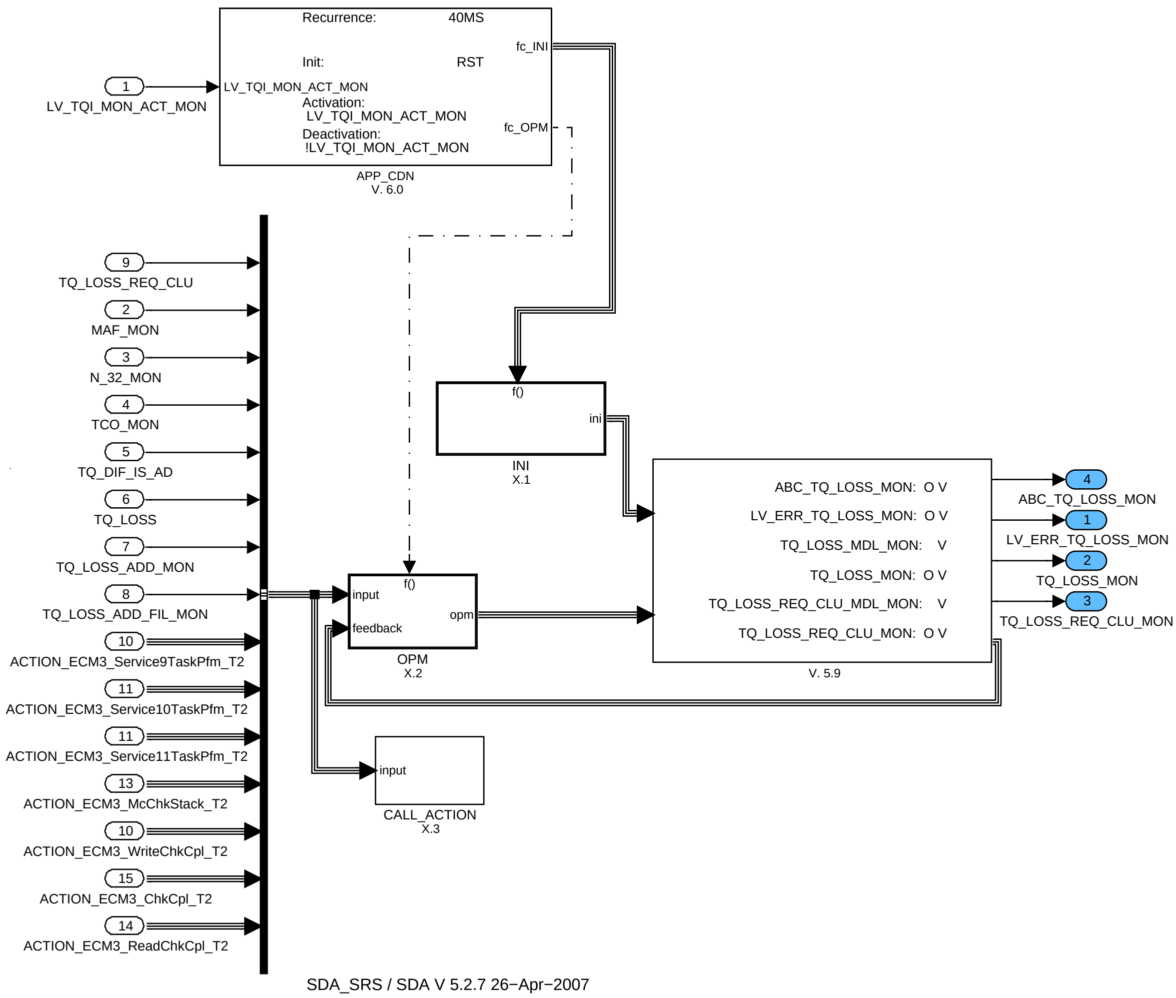

Figure E.23.1: :

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E.23.1 Initialization

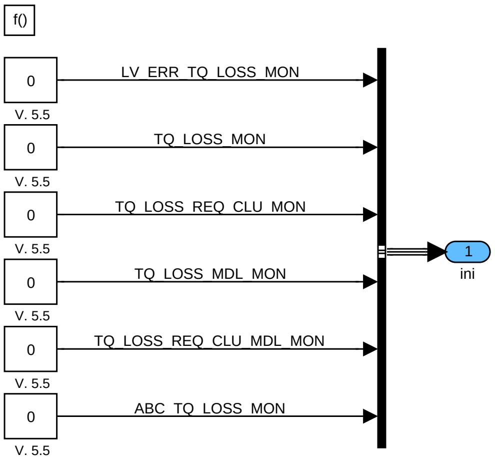

Figure E.23.2: :

E.23.2 Formula section

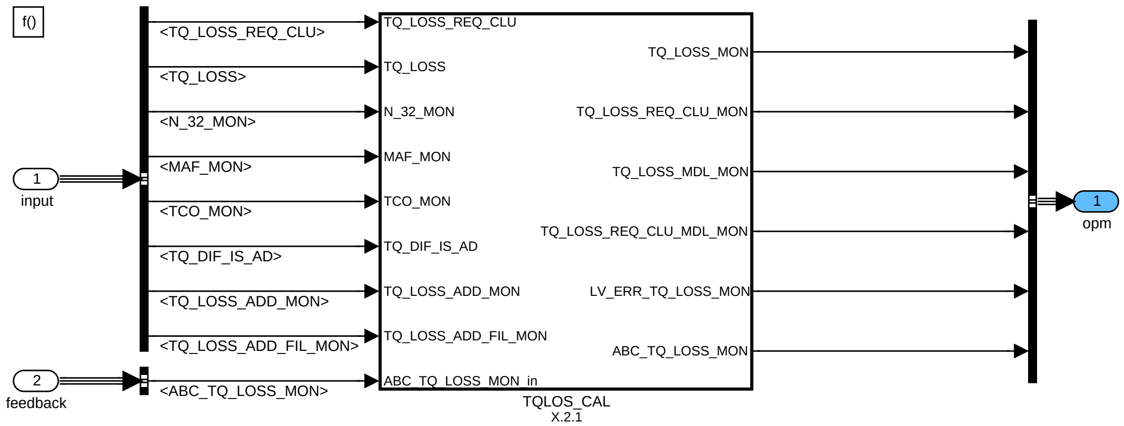

Figure E.23.3: :

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E.23.2.1 Torque Loss calculation

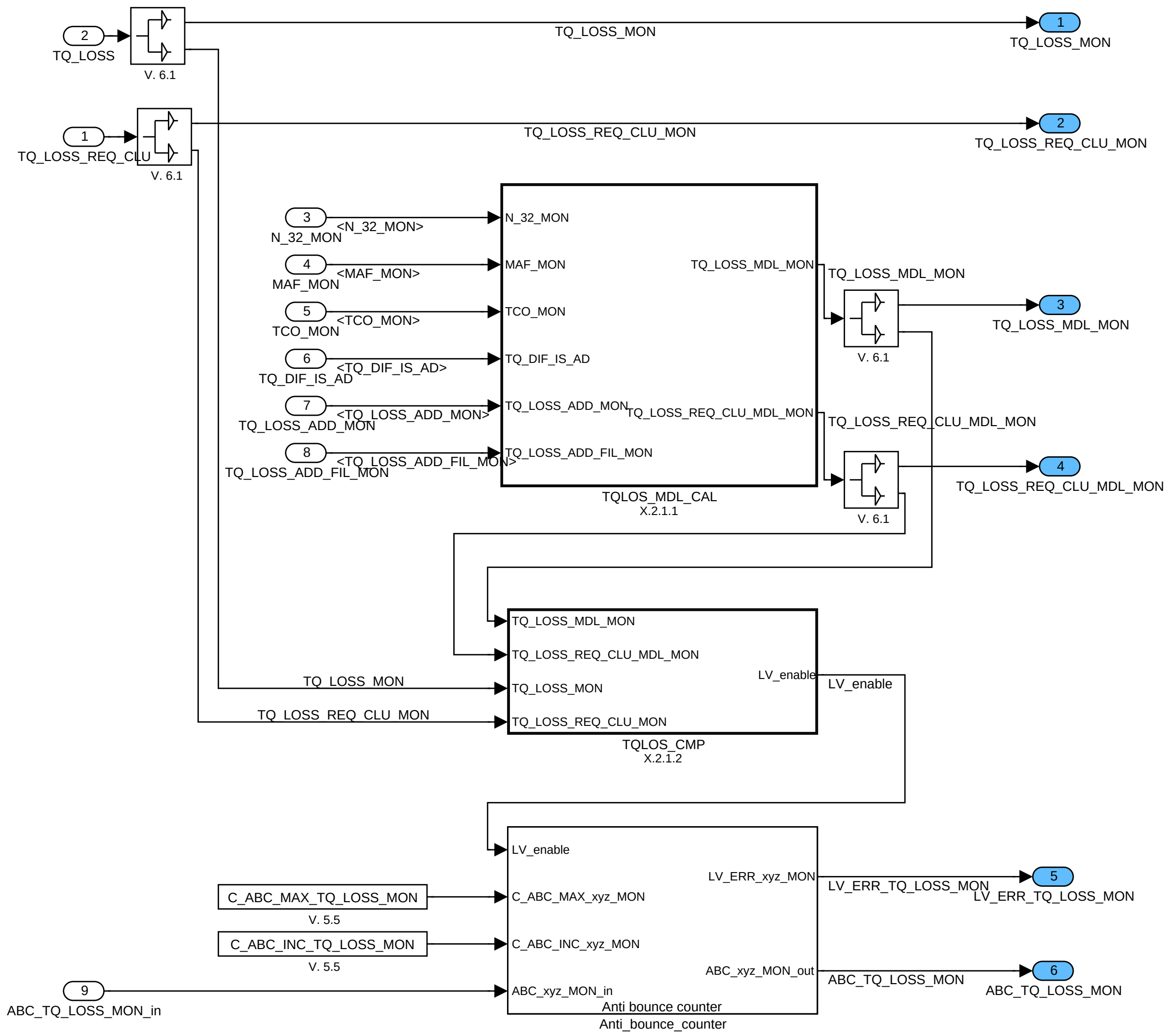

Figure E.23.4: :

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E.23.2.1.1 Torque Loss - Modeled

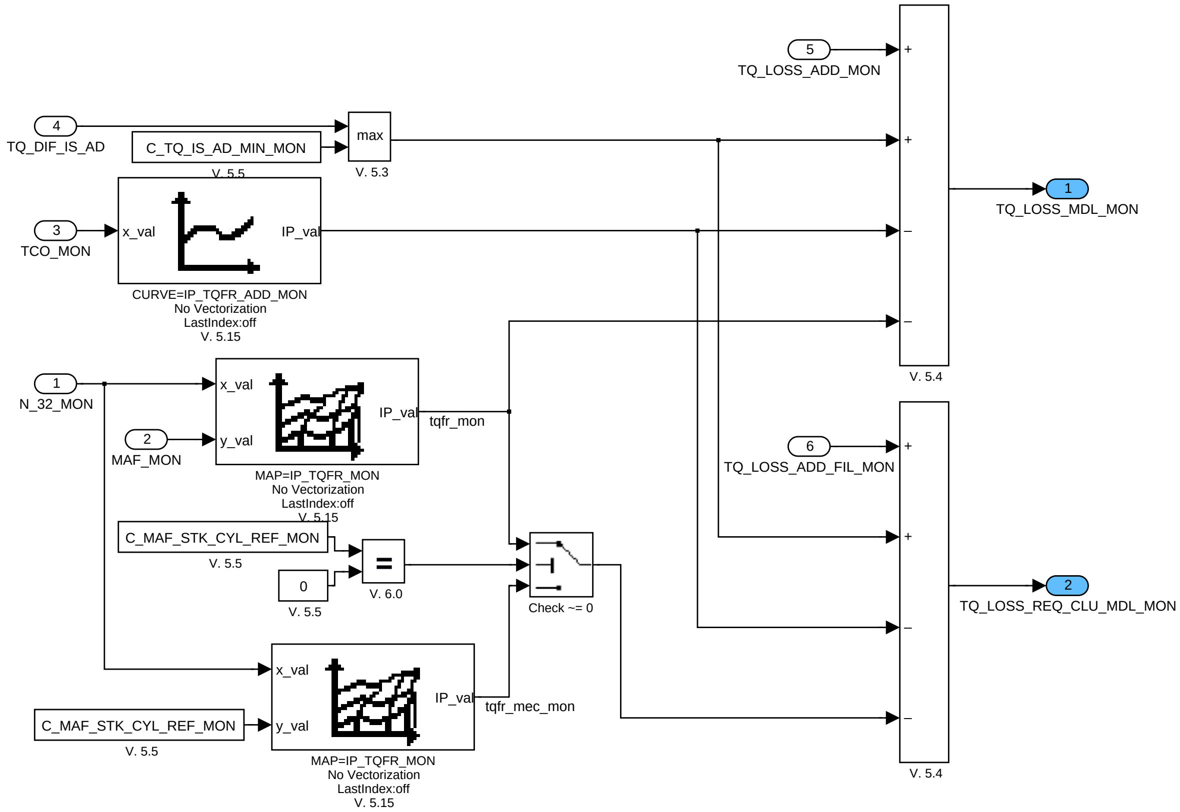

Figure E.23.5: :

E.23.2.1.2 Torque Loss detection flag

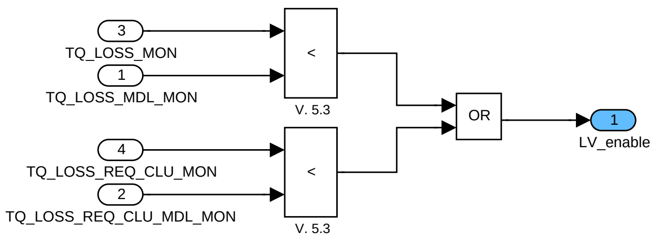

Figure E.23.6: :

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E.23.3 Call Action

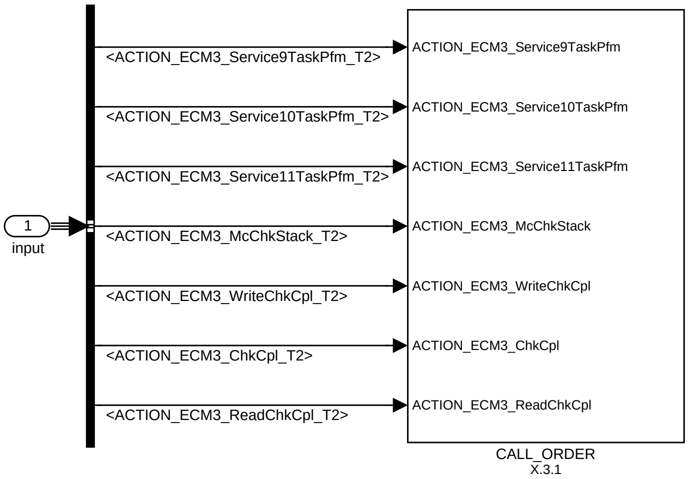

Figure E.23.7: :

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E.23.3.1 Call order

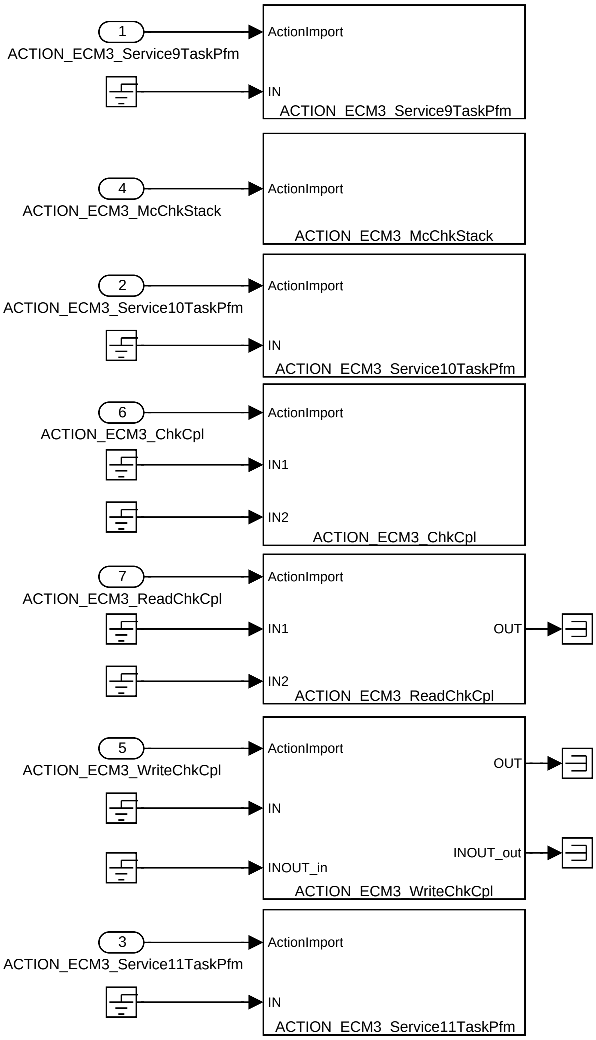

Figure E.23.8: :

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E.24 Monitoring CAN signals

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_AMT_INH_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for fault in AMT present					
ABC_DCC_INH_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for fault in DCC present					
ABC_GS_INH_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for fault in GS present					
ABC_LDM_INH_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for fault in LDM present					
ABC_MSR_INH_MON	V	0... FFH	0... 255	1	-
Anti bounce counter for fault in MSR present					
LV_DCC_OFF_ECU_MON	V	0... 1H	0 ...1	1	-
Irreversible DCC error mon					
LV_ERR_AMT_INH_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for fault in MSR present					
LV_ERR_DCC_INH_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for fault in DCC present					
LV_ERR_DCC_IRREV_MON	V	0... 1H	0 ...1	1	-
Irreversible DCC error mon					
LV_ERR_DCC_REV_MON	V	0... 1H	0 ...1	1	-
Reversible DCC error mon					
LV_ERR_GS_INH_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for fault in GS present					
LV_ERR_LDM_INH_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for fault in LDM present					
LV_ERR_LDM_MON	V	0... 1H	0 ...1	1	-
LDM error mon					
LV_ERR_MSR_INH_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for fault in MSR present					
LV_LDM_OFF_ECU_1_MON	V	0... 1H	0 ...1	1	-
LDM Irreversible off mon					
LV_LDM_OFF_ECU_2_MON	V	0... 1H	0 ...1	1	-
LDM reversible off mon					
LV_LDM_OFF_ECU_MON	V	0... 1H	0 ...1	1	-
LDM off mon					
STATE_AMT_OLD_MON	V	0... 3H	0 ...3	1	-
Previos shift phase3					
STATE_ERR_AMT_MON	V	0... FFH	0... 255	1	-
State of AMT Error intervention					
T_AMT_INH_MON	O/V	0... FFH	0... 10.2	0.04	s
Timer for inhibition of AMT torque demand in monitoring level					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
T_DCC_BRAKE_DET_MON	V	0... FFH	0... 10.2	0.04	s
Brake delay timer mon					
T_DCC_INH_MON	V	0... FFH	0... 10.2	0.04	s
Timer for inhibition of DCC torque demand in monitoring level					
T_GS_INH_MON	O/V	0... FFH	0... 10.2	0.04	s
Timer for inhibition of GS torque demand in monitoring level					
T_LDM_BRAKE_DET_MON	V	0... FFH	0... 10.2	0.04	s
Brake delay timer mon					
T_LDM_INH_MON	V	0... FFH	0... 10.2	0.04	s
Timer for inhibition of LDM torque demand in monitoring level					
T_MSR_INH_MON	O/V	0... FFH	0... 10.2	0.04	s
Timer for inhibition of MSR torque demand in monitoring level					
T_STATE_AMT_1_DIAG_MON	V	0... FFH	0... 10.2	0.04	s
Intervention in shift phase 1					
T_STATE_AMT_2_DIAG_MON	V	0... FFH	0... 10.2	0.04	s
Intervention in shift phase 2					
T_STATE_AMT_3_DIAG_MON	V	0... FFH	0... 10.2	0.04	s
Intervention in shift phase 2					
T_STATE_CLU_AMT_DIAG_MON	V	0... FFH	0... 10.2	0.04	s
Timer clutch state 3					
T_TQI_AMT_DIAG_MON	V	0... FFH	0... 10.2	0.04	s
Intervention timer 1 or 3					
TQ_AMT_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque demand from drag control BN 2000					
TQ_DCC_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
DCC torque request for monitoring					
TQ_GS_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque demand from drag control BN 2000					
TQ_MSR_MON	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque demand from drag control BN 2000					
TQ_WHEEL_LDM_MON	O/V	8000... 7FFFH	-32768 ...32767	1	Nm
LDM torque request for monitoring					
TQI_AMT_MON	O/V	0... FFH	0... 510	2	Nm
Torque demand from AMT control CAN 11H					
TQI_AMT_PLAUS_MON	V	0... FFH	0... 510	2	Nm
Plausibility torque					
TQI_GS_MON	O/V	0... FFH	0... 510	2	Nm
Torque demand from drag control CAN 11H					
TQI_MSR_MON	O/V	0... FFH	0... 510	2	Nm
Torque demand from drag control CAN 11H					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Input data:

ERR_SYM_BN_ETCU {p. 4861}	ERR_SYM_BN_LDM {p. 4862}	ERR_SYM_BN_TQ_AMT {p. 4864}	ERR_SYM_BN_TQ_DCC {p. 4864}
ERR_SYM_TOUT_AMT_1	GR_DT {p. 8285}	LV_AMT_ES {p. 1564}	LV_AMT_INC_ACT {p. 799}
LV_AT {p. 654}	LV_BRAKE_MON {p. 6790}	LV_CDN_VB_CAN_TQ_DIAG {p. 1185}	LV_DCC_INC_ACT {p. 6731}
LV_DCC_LIH_CAN {p. 1565}	LV_DCC_OFF_ACK {p. 1565}	LV_DCC_OFF_ECU {p. 5051}	LV_DI_TQ_REQ_CAN_MPI_GDI {p. 800}
LV_ERR_BLS_PLAUS {p. 4209}	LV_ERR_BN_ETCU {p. 4870}	LV_ERR_BN_LDM {p. 4870}	LV_ERR_BN_TCS {p. 4870}
LV_ERR_BN_TQ_AMT {p. 4870}	LV_ERR_BN_TQ_DCC {p. 4870}	LV_ERR_BN_TQ_ETCU {p. 4871}	LV_ERR_BN_TQ_TCS {p. 4871}
LV_ERR_BN_VS_TCS {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_CRK {p. 4455}	LV_ERR_CS {p. 5015}
LV_ERR_PVS {p. 4216}	LV_ERR_TOUT_AMT_1 {p. 802}	LV_ERR_TOUT_ASR_1 {p. 802}	LV_ERR_TOUT_ASR_3 {p. 802}
LV_ERR_TOUT_ETCU_1 {p. 802}	LV_ERR_TOUT_ETCU_2 {p. 802}	LV_ES {p. 1720}	LV_ETCU_DISABLE_CAN {p. 6718}
LV_ETCU_LIH_CAN {p. 1565}	LV_GS {p. 1565}	LV_GS_ENA_INC {p. 6718}	LV_GS_INC_ACT {p. 6718}
LV_IGK_MON {p. 6790}	LV_LDM_ACT {p. 6615}	LV_LDM_CAN_INI {p. 1566}	LV_LDM_ENA_PLAUS_ERR {p. 5054}
LV_LDM_LIH_CAN {p. 1566}	LV_LDM_OFF_ECU {p. 5054}	LV_MSR_ACT {p. 6741}	LV_TCS_LIH_CAN {p. 1567}
LV_TCT_LIH_CAN {p. 1568}	LV_TQ_AMT_DEC_REQ {p. 1568}	LV_TQ_AMT_INC_REQ {p. 1568}	LV_TQ_ASR_REQ {p. 1568}
LV_TQ_GS_INC_REQ {p. 1568}	LV_TQ_MSR_REQ {p. 1568}	LV_TQ_WHEEL_LDM_BN_ERR {p. 1568}	LV_TQ_WHEEL_LDM_REQ {p. 1568}
LV_TQI_MON_ACT_MON {p. 6791}	LV_TQI_REQ_CAN_INH {p. 6687}	LV_VAR_BN {p. 655}	LV_VAR_DCC {p. 655}
LV_VAR_TCT {p. 656}	STATE_AMT {p. 1570}	STATE_DCC_INTV {p. 1572}	STATE_DCC_OFF_REQ {p. 1572}
STATE_DCC_PUC_INH {p. 1572}	TQ_AMT_FAST_BN {p. 1580}	TQ_AMT_SLOW_BN {p. 1581}	TQ_DCC_FAST_BN {p. 1581}
TQ_DCC_SLOW_BN {p. 1581}	TQ_GS_FAST_BN {p. 1581}	TQ_GS_FAST_INC_BN {p. 1710}	TQ_GS_SLOW_BN {p. 1581}
TQ_LOSS_MON {p. 6975}	TQ_SP_WHEEL {p. 6615}	TQ_TCS_FAST_BN {p. 1582}	TQ_TCS_SLOW_BN {p. 1582}

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TQ_WHEEL_LDM_BN {p. 1582}	TQI_AMT_FAST_DEC {p. 810}	TQI_AMT_FAST_INC {p. 810}	TQI_AMT_REQ_CAN {p. 810}
TQI_ASR_FAST_CAN {p. 810}	TQI_DCC_FAST_INC {p. 6731}	TQI_GS_FAST_INC {p. 6718}	TQI_GS_FAST_REQ_CAN {p. 810}
TQI_MSR_CAN {p. 811}	TQI_MSR_FAST {p. 6741}	TQI_REQ_FAST_SEL {p. 8391}	TQI_REQ_TRA_FAST {p. 8391}
VB {p. 1185}	VS_FIL {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_AMT_INH_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_INC_DCC_INH_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_INC_DCC_IRREV_MON	-	0... FFH	0... 255	1	-
Increment counter					
C_ABC_INC_DCC_REV_MON	-	0... FFH	0... 255	1	-
Increment counter					
C_ABC_INC_GS_INH_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_INC_LDM_INH_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_INC_LDM_MON	-	0... FFH	0... 255	1	-
Increment counter					
C_ABC_INC_MSR_INH_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_MAX_AMT_INH_MON	-	1... FFH	1... 255	1	-
Maximum value of anti-bounce counter					
C_ABC_MAX_DCC_INH_MON	-	1... FFH	1... 255	1	-
Maximum value of anti-bounce counter					
C_ABC_MAX_DCC_IRREV_MON	-	1... FFH	1... 255	1	-
Maximum counter					
C_ABC_MAX_DCC_REV_MON	-	1... FFH	1... 255	1	-
Maximum counter					
C_ABC_MAX_GS_INH_MON	-	1... FFH	1... 255	1	-
Maximum value of anti-bounce counter					
C_ABC_MAX_LDM_INH_MON	-	1... FFH	1... 255	1	-
Maximum value of anti-bounce counter					
C_ABC_MAX_LDM_MON	-	1... FFH	1... 255	1	-
Maximum counter					
C_ABC_MAX_MSR_INH_MON	-	1... FFH	1... 255	1	-
Maximum value of anti-bounce counter					
C_CAN_VB_MIN_DIAG_MON	-	0... FFH	0... 25.89843	0.1015625	V
Threshold of battery voltage for CAN diagnosis					
C_T_AMT_INH_MON	-	0... FFH	0... 10.2	0.04	s
Delay time for disable of AMT torque demand in monitoring level					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_DCC_INH_MON	-	0... FFH	0... 10.2	0.04	s
Delay time for disable of DCC torque demand in monitoring level					
C_T_DLY_AMT_INH_MON	-	0... FFH	0... 10.2	0.04	s
Delay time for incrementing ABC-counter - AMT monitoring level					
C_T_DLY_GS_INH_MON	-	0... FFH	0... 10.2	0.04	s
Delay time for incrementing ABC-counter - GS monitoring level					
C_T_GS_INH_MON	-	0... FFH	0... 10.2	0.04	s
Delay time for disable of GS torque demand in monitoring level					
C_T_LDM_INH_MON	-	0... FFH	0... 10.2	0.04	s
Delay time for disable of LDM torque demand in monitoring level					
C_T_MAX_BRAKE_DET_DCC_MON	-	0... FFH	0... 10.2	0.04	s
Maximum Brake delay timer					
C_T_MAX_BRAKE_DET_LDM_MON	-	0... FFH	0... 10.2	0.04	s
Maximum Brake delay timer					
C_T_MAX_STATE_AMT_1_DIAG_MON	-	0... FFH	0... 10.2	0.04	s
Max Intervention in shift phase 1					
C_T_MAX_STATE_AMT_2_DIAG_MON	-	0... FFH	0... 10.2	0.04	s
Max Intervention in shift phase 2					
C_T_MAX_STATE_AMT_3_DIAG_MON	-	0... FFH	0... 10.2	0.04	s
Max Intervention in shift phase 3					
C_T_MAX_STATE_CLU_AMT_DIAG_MON	-	0... FFH	0... 10.2	0.04	s
Max. time at clutch					
C_T_MAX_TQI_AMT_DIAG_MON	-	0... FFH	0... 10.2	0.04	s
Max. timer shift intervention phase 1or 3					
C_T_MSR_INH_MON	-	0... FFH	0... 10.2	0.04	s
Delay time for disable of MSR torque demand in monitoring level					
C_TQI_AMT_CAN_ES_MON	-	0... FFH	0... 510	2	Nm
Torque at engine stop					
C_TQI_AMT_COND_DIAG_MON	-	0... FFH	0... 510	2	Nm
Torque at shift phase 0					
C_TQI_AMT_DIAG_MON	-	0... FFH	0... 510	2	Nm
Plausibility torque intervention hysteresis					
C_TQI_STND_MON	-	0... FFH	0... 510	2	Nm
Maximum indicated engine torque (scaling factor for torque demands from CAN)					
C_VS_FIL_AMT_MON	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed threshold engine stop					

Import actions:

ACTION_ECM3_ChkCpl (**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_ReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_Service6TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service7TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service8TaskPfm (**IN**<No Name available>)
ACTION_ECM3_WriteChkCpl (**INOUT**<PRM_VAR>,**OUT**<PRM_VAR_CPL>,**IN**<PRM_VALUE>)

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Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The argument n has the value 3.

ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service6TaskPfm() and ACTION_ECM3_Service7TaskPfm().
Note: All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

E.24.1 MSR monitoring

FUNCTION DESCRIPTION:

General information:
The torque demands received by the CAN-bus are monitored.
The input signals are read direct from CAN.

Application conditions

Activation: `LV_TQI_MON_ACT_MON = 1`

Deactivation: `otherwise`

Initialization:
```
TQI_MSR_MON   = 0
   LV_ERR_MSR_INH_MON  = 0
   T_MSR_INH_MON  = 0
   ABC_MSR_INH_MON     = 0
   TQ_MSR_MON = -1024 Nm
```

Update Rate: `40 msec`

Formula section:

LV_VAR_BN = 0:

IF LV_ERR_MSR_INH_MON = 0
THEN
TQI_MSR_MON = C_TQI_STND_MON * TQI_MSR_CAN
IF LV_MSR_ACT = 1 **and**
LV_ERR_TOUT_ASR_1 = 0 **and**
LV_ERR_TOUT_ASR_3 = 0 **and**
LV_DI_TQ_REQ_CAN_MPI_GDI = 0 **and**
LV_TQI_REQ_CAN_INH = 0 **and**
LV_TCS_LIH_CAN = 0 **and**
LV_CDN_VB_CAN_TQ_DIAG = 1

THEN
Initialize Timer: T_MSR_INH_MON = C_T_MSR_INH_MON
IF (LV_TQ_ASR_REQ = 1) **OR**
(LV_TQ_MSR_REQ= 0) **OR**
(TQI_MSR_CAN = 0) **OR**
((TQI_ASR_FAST_CAN + TQI_MSR_CAN) $\neq$ FFH) **OR**
((VB $>$ C_CAN_VB_MIN_DIAG_MON) **AND** (LV_ERR_CAN_BOFF=1))
THEN after debouncing with ABC_MSR_INH_MON
Inhibit MSR non reversible until the initialization conditions for error bits are fulfilled (see application incidences for process monitoring):

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```
                LV_ERR_MSR_INH_MON = 1
                TQI_MSR_MON = 0
                T_MSR_INH_MON = 0
          ENDIF
  ELSE
          IF      T_MSR_INH_MON = 0
          THEN  TQI_MSR_MON = 0
          ELSE  Decrement Timer T_MSR_INH_MON
          ENDIF
     ENDIF

ELSE
     TQI_MSR_MON = 0
  T_MSR_INH_MON = 0
ENDIF
```

LV_VAR_BN = 1:

```
IF    LV_ERR_MSR_INH_MON = 0
THEN
  TQ_MSR_MON = TQ_TCS_FAST_BN
  IF      LV_MSR_ACT = 1                                  and
          LV_DI_TQ_REQ_CAN_MPI_GDI   = 0                  and
             LV_TQI_REQ_CAN_INH = 0                       and
          LV_TCS_LIH_CAN = 0                              and
          LV_ERR_BN_TQ_TCS = 0                            and
          LV_ERR_BN_VS_TCS = 0                            and
          LV_ERR_BN_TCS = 0                               and
          LV_CDN_VB_CAN_TQ_DIAG        = 1

  THEN
          Initialize Timer: T_MSR_INH_MON = C_T_MSR_INH_MON
          IF      (LV_TQ_ASR_REQ = 1)                       OR
                  (LV_TQ_MSR_REQ= 0)                        OR
                  (TQ_TCS_FAST_BN = 8000H)                  OR
                  (TQ_TCS_SLOW_BN = 8000H)                  OR
                  ((VB > C_CAN_VB_MIN_DIAG_MON) AND (LV_ERR_CAN_BOFF = 1))
          THEN  after debouncing with ABC_MSR_INH_MON
                Inhibit MSR non reversible until the initialization conditions for error bits are fulfilled
                (see application incidences for process monitoring):
                LV_ERR_MSR_INH_MON = 1
                TQ_MSR_MON = -1024 Nm
                T_MSR_INH_MON = 0
          ENDIF
  ELSE
          IF      (T_MSR_INH_MON = 0)
          THEN  TQ_MSR_MON = -1024 Nm
          ELSE  Decrement Timer T_MSR_INH_MON
          ENDIF
ELSE
     TQ_MSR_MON = -1024 Nm
```

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T_MSR_INH_MON = 0
ENDIF

Explanation of some MSR inhibit conditions listed above:
On an error free CAN 11H transmission: TQI_ASR_FAST_CAN is the same, but bitinverse value of TQI_MSR_CAN
The CAN-interface is directly checked for the CAN-Bus OFF fault

Anti-bounce counter: ABC_MSR_INH_MON
Anti-bounce counter increment: C_ABC_INC_MSR_INH_MON
Anti-bounce counter maximum: C_ABC_MAX_MSR_INH_MON

E.24.2 DCC monitoring

E.24.2.1 DCCTorque monitoring

FUNCTION DESCRIPTION:

General information:
The torque demands received by the CAN-bus are monitored.
The input signals are read direct from CAN.

Application conditions

Activation: `LV_TQI_MON_ACT_MON = 1`

Deactivation: `otherwise`

Initialization:
```
TQ_DCC_MON   = -1024Nm
   LV_ERR_DCC_INH_MON  = 0
   T_DCC_INH_MON  = 0
   ABC_DCC_INH_MON     = 0
```

Update Rate: `40 msec`

Formula section:

LV_VAR_DCC = 1:

IF LV_ERR_DCC_INH_MON = 0
THEN
TQ_DCC_MON = TQ_DCC_FAST_BN (physical converted)
IF LV_DCC_INC_ACT = 1 **and**
LV_ERR_BN_TQ_DCC = 0 **and**
LV_DCC_LIH_CAN = 0 **and**
LV_ERR_CAN_BOFF = 0 **and**
STATE_DCC_PUC_INH < 03H **and**
STATE_DCC_OFF_REQ = 02 H **and**
LV_DCC_OFF_ECU = 0 **and**
LV_CDN_VB_CAN_TQ_DIAG = 1
THEN
Initialize Timer: T_DCC_INH_MON = C_T_DCC_INH_MON
IF (LV_TQ_DCC_INC_REQ= 0) **OR**
(TQ_DCC_FAST_BN = 8000H) **OR**
(TQ_DCC_SLOW_BN = 8000H) **OR**

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LV_DCC_OFF_ECU_MON = 1 **OR**
((VB > C_CAN_VB_MIN_DIAG_MON) **AND** (LV_ERR_CAN_BOFF = 1))
THEN after debouncing with ABC_DCC_INH_MON
Inhibit DCC non reversible until the initialization conditions for error bits are fulfilled (see application incidences for process monitoring):
LV_ERR_DCC_INH_MON = 1
TQ_DCC_MON = -1024 Nm
T_DCC_INH_MON = 0
ENDIF
ELSE
IF T_DCC_INH_MON = 0
THEN TQ_DCC_MON = -1024 Nm
ELSE Decrement Timer T_DCC_INH_MON
ENDIF
ENDIF
ELSE
TQ_DCC_MON = -1024 Nm
T_DCC_INH_MON = 0
ENDIF

E.24.2.2 DCC Plausibility Monitoring

FUNCTION DESCRIPTION:

Description:

The Conditions for DCC in the function level are devided in reversible and irreversible conditions. This function is monitored in the DCC torque monitoring.

Application conditions

Initialisation: *all 0 at reset or LV_IGK 0 -> 1 or clear FMY*

Recurrence: *40 ms*

Activation: LV_TQI_MON_ACT_MON = 1; LV_VAR_DCC = 1

Deactivation: -

Formula section:

IF (LV_ERR_BN_TQ_DCC = 1 **AND** ERR_SYM_BN_TQ_DCC = SYM_2) **or**
"only timeout"
LV_ERR_BLS_PLAUS = 1 **or**
LV_ERR_CS = 1 **or**
LV_DI_TQ_REQ_CAN_MPI_GDI =1 **or**
LV_ERR_CRK = 1
Then LV_ERR_DCC_REV_MON = 1 after debounce
Else IF LV_ERR_DCC_REV_MON = 0 ("not debounced yet")
Then reset counter to 0 *// reset counter to 0, no rebouncing!*
Else **IF** LV_DCC_OFF_ACK = 1
then LV_ERR_DCC_REV_MON = 0 *// reset error and counter to 0, no rebouncing!*

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reset counter to 0
else unchanged
endif

IF LV_BRAKE_MON = 1
Then $T\_DCC\_BRAKE\_DET\_MON_n$ = $T\_DCC\_BRAKE\_DET\_MON_{n-1}$ + 40 ms
else $T\_DCC\_BRAKE\_DET\_MON_n$ =0 ms
endif

IF (LV_ERR_BN_TQ_DCC = 1 **AND** ERR_SYM_BN_TQ_DCC = SYM_1 **or** SYM_3) **or**
"ONLY ALIVE AND CHECKSUM ERRORS"
LV_TQI_REQ_CAN_INH = 1 **or**
LV_ERR_PVS = 1 **or**
[(T_DCC_BRAKE_DET_MON > C_T_MAX_BRAKE_DET_DCC_MON) **and**
STATE_DCC_INTV == 01H]
Then LV_ERR_DCC_IRREV_MON = 1 after debounce
Endif

IF LV_ERR_DCC_IRREV_MON = 1 **or** LV_ERR_DCC_REV _MON = 1
Then LV_DCC_OFF_ECU_MON = 1
Else IF LV_DCC_OFF_ACK = 1
Then LV_DCC_OFF_ECU_MON = 0
Else unchanged
Endif

E.24.3 LDM monitoring

E.24.3.1 LDM Torque monitoring

FUNCTION DESCRIPTION:

General information:
The torque demands received by the CAN-bus are monitored.
The input signals are read direct from CAN.

Application conditions

Activation: `LV_TQI_MON_ACT_MON = 1`

Deactivation: `otherwise`

Initialization:
```
TQ_WHEEL_LDM_MON   = -32000 Nm
   LV_ERR_LDM_INH_MON  = 0
   T_LDM_INH_MON       = 0
   ABC_LDM_INH_MON    = 0
```

Update Rate: `40 msec`

Formula section:

LV_VAR_BN_LDM = 1:

IF LV_ERR_LDM_INH_MON = 0
THEN

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```
        TQ_WHEEL_LDM_MON = TQ_WHEEL_LDM_BN
  IF        LV_LDM_ACT = 1                                  and
               LV_ERR_BN_LDM = 0                            and
               LV_LDM_LIH_CAN = 0                           and
               LV_ERR_CAN_BOFF = 0                          and
               LV_LDM_OFF_ECU = 0                           and
               LV_CDN_VB_CAN_TQ_DIAG       = 1

        THEN
               Initialize Timer: T_LDM_INH_MON = C_T_LDM_INH_MON
               IF      (LV_TQ_WHEEL_LDM_REQ= 0)                        OR
                       (LV_TQ_WHEEL_LDM_BN_ERR = 1)                OR
                       LV_LDM_OFF_ECU_MON = 1                          OR
                       ((VB > C_CAN_VB_MIN_DIAG_MON) AND (LV_ERR_CAN_BOFF = 1))
               THEN   after debouncing with ABC_LDM_INH_MON
                      Inhibit LDM non reversible until the initialization conditions for error bits are fulfilled
                      (see application incidences for process monitoring):
                      LV_ERR_LDM_INH_MON = 1
                      TQ_WHEEL_LDM_MON = -32000Nm
                      T_LDM_INH_MON = 0
               ENDIF

  ELSE
               IF      T_LDM_INH_MON = 0
               THEN  TQ_WHEEL_LDM_MON = -32000Nm
               ELSE   Decrement Timer T_LDM_INH_MON
               ENDIF
        ENDIF

ELSE
        TQ_WHEEL_LDM_MON = -32000Nm
        T_LDM_INH_MON = 0
ENDIF
```

E.24.3.2 LDM Plausibility Monitoring

FUNCTION DESCRIPTION:

Description:

The Conditions for LDM in the function level are devided in reversible and irreversible conditions. This function is monitored in the LDM torque monitoring.

Application conditions

Initialisation: *all 0 at reset or LV_IGK 0 - -> 1 or clear FMY*

Recurrence: *40 ms*

Activation:
LV_TQI_MON_ACT_MON = 1 and
LV_VAR_BN_LDM = 1 **and**
LV_LDM_CAN_INI = 0

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Deactivation: –

Formula section:

IF LV_BRAKE_MON = 1
Then $T\_LDM\_BRAKE\_DET\_MON_n$ = $T\_LDM\_BRAKE\_DET\_MON_{n-1}$ + 40 ms
else $T\_LDM\_BRAKE\_DET\_MON_n$ =0 ms
endif

IF [(T_LDM_BRAKE_DET_MON $>$ C_T_MAX_BRAKE_DET_LDM_MON)
and STATE_LDM_INTV == 01H] **or**
(LV_LDM_ENA_PLAUS_ERR = 1
and LC_LDM_ENA_PLAUS_ERR = 1)
Then LV_ERR_LDM_MON = 1 after debounce
Else **If** LV_ERR_LDM_MON = 0 ("not debounced yet")
Then rebounce counter to 0
Else LV_ERR_LDM_MON = 0
after rebounce
endif
Endif

Calculation of LDM irrversible off

IF (LV_ERR_BN_LDM = 1 **AND** ERR_SYM_BN_LDM = SYM_1 **or** SYM_3) **or**
"ONLY ALIVE AND CHECKSUM ERRORS"
LV_TQI_REQ_CAN_INH = 1 **or**
LV_ERR_PVS = 1 **or**
LV_ERR_LDM_MON = 1
Then LV_LDM_OFF_ECU_1_MON = 1 *//LDM irreversible off*
Endif

Calculation of reversible off

IF (LV_ERR_BN_LDM = 1 **AND** ERR_SYM_BN_LDM = SYM_2) **or**
"only timeout"
LV_ERR_BLS_PLAUS = 1 **or**
LV_ERR_CS = 1 **or**
LV_ERR_CRK = 1 **or**
LV_DI_TQ_REQ_CAN_MPI_GDI = 1 **or**
LV_ETCU_DISABLE_CAN = 1

Then LV_LDM_OFF_ECU_2_MON = 1 *//LDM reversible LDM off*
Else LV_LDM_ÓFF_ECU_2_MON = 0
Endif

IF LV_LDM_OFF_ECU_1_MON = 1 **or** LV_LDM_OFF_ECU_2_MON = 1

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Then LV_LDM_OFF_ECU_MON = 1
Else LV_LDM_OFF_ECU_MON = 0
Endif

E.24.4 AMT monitoring

E.24.4.1 AMT torque monitoring

<u>**Application conditions**</u>

Activation: `LV_TQI_MON_ACT_MON = 1`

Deactivation: `otherwise`

Initialization:
```
TQI_AMT_MON   = 0
   LV_ERR_AMT_INH_MON   = 0
   T_AMT_INH_MON   = 0
   ABC_AMT_INH_MON = 0
   TQ_AMT_MON = -1024 Nm
```

Update Rate: `40 msec`

<u>LV_VAR_BN = 0:</u>

IF LV_ERR_AMT_INH_MON = 0
THEN
TQI_AMT_MON = C_TQI_STND_MON * TQI_AMT_REQ_CAN
IF LV_AMT_INC_ACT = 1 **and**
LV_TQI_REQ_CAN_INH = 0 **and**
LV_ERR_TOUT_AMT_1 = 0 **and**
LV_AMT_LIH_CAN = 0 **and**
LV _DI_TQ_REQ_CAN_MPI_GDI = 0 **and**
LV_CDN_VB_CAN_TQ_DIAG = 1

THEN
Initialize Timer: T_AMT_INH_MON = C_T_AMT_INH_MON
IF (LV_TQ_AMT_INC_REQ = 0) **OR**
TQI_AMT_REQ_CAN = FFH **OR**
(STATE_ERR_AMT_MON> 00H
for C_T_DLY_AMT_INH_MON) **OR**
((VB > C_CAN_VB_MIN_DIAG_MON) **AND** (LV_ERR_CAN_BOFF=1))
THEN after debouncing with ABC_AMT_INH_MON
Inhibit AMT non reversible until the initialization conditions for error bits are fulfilled (see application incidences for process monitoring):
LV_ERR_AMT_INH_MON = 1
TQI_AMT_MON = 0
T_AMT_INH_MON = 0
ENDIF

ELSE
IF (T_AMT_INH_MON = 0)
THEN TQI_AMT_MON = 0
ELSE Decrement Timer T_AMT_INH_MON
ENDIF
ENDIF

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ELSE
TQI_AMT_MON = 0
T_AMT_INH_MON = 0
ENDIF

LV_VAR_BN = 1:

IF LV_ERR_AMT_INH_MON = 0
THEN
TQ_AMT_MON = TQ_AMT_FAST_BN
IF LV_AMT_INC_ACT = 1 **and**
LV_ERR_BN_TQ_AMT = 0 **and**
LV_ERR_BN_ETCU = 0 **and**
LV_TQI_REQ_CAN_INH = 0 **and**
LV_AMT_LIH_CAN = 0 **and**
LV_DI_TQ_REQ_CAN_MPI_GDI = 0 **and**
LV_CDN_VB_CAN_TQ_DIAG = 1

THEN
Initialize Timer: T_AMT_INH_MON = C_T_AMT_INH_MON
IF (LV_TQ_AMT_INC_REQ = 0) **OR**
(TQ_AMT_FAST_BN = 8000H) **OR**
(TQ_AMT_SLOW_BN = 8000H) **OR**
(STATE_ERR_AMT_MON> 00H
for C_T_DLY_AMT_INH_MON) **OR**
((VB > C_CAN_VB_MIN_DIAG_MON) **AND** (LV_ERR_CAN_BOFF = 1))
THEN after debouncing with ABC_AMT_INH_MON
Inhibit AMT non reversible until the initialization conditions for error bits are fulfilled (see application incidences for process monitoring):
LV_ERR_AMT_INH_MON = 1
TQ_AMT_MON = -1024 Nm
T_AMT_INH_MON = 0
ENDIF

ELSE
IF (T_AMT_INH_MON = 0)
THEN TQ_AMT_MON = -1024 Nm
ELSE Decrement Timer T_AMT_INH_MON
ENDIF
ENDIF

ELSE
TQ_AMT_MON = -1024 Nm
T_AMT_INH_MON = 0
ENDIF

The CAN-interface is directly checked for the CAN-Bus OFF fault

Anti-bounce counter: ABC_AMT_INH_MON
Anti-bounce counter increment: C_ABC_INC_AMT_INH_MON
Anti-bounce counter maximum: C_ABC_MAX_AMT_INH_MON

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E.24.4.2 AMT plausibility monitoring

FUNCTION DESCRIPTION:

General information:

To supress incorrect Torque request of transmission unit a monitoring of messages is done.

Application conditions

Initialization: 0

Recurrence: 40 ms

Activation: LV_TQI_MON_ACT_MON = 1 and LV_IGK_MON = 1

Signal flow diagram:

The structure is like the Level 1 function "AMT intervention plausibility"

Formula section:

```
If LV_VAR_BN = 0
Then        TQI_AMT_PLAUS_MON = TQI_AMT_MON
Else IF     LV_TQ_AMT_DEC_REQ = 1
     Then   TQI_AMT_PLAUS_MON =    TQI_AMT_FAST_DEC
else        TQI_AMT_PLAUS_MON =    TQI_AMT_FAST_INC
endif
```

Plausibility of shift phase:

```
If     LV_GS = 0
Then if   STATE_AMT = 0 and (TQI_AMT_PLAUS_MON <
                                          C_TQI_AMT_COND_DIAG_MON)
                        Then   STATE_ERR_AMT_MON = 00H
                        Else   STATE_ERR_AMT_MON = 01H
  End if
Else if     STATE_AMT = 0
      Then  if     LV_AMT_ES > 0
            Then  if     TQI_AMT_PLAUS_MON ≤ C_TQI_AMT_CAN_ES_MON and
                        VS_FIL < C_VS_FIL_AMT
                  Then   STATE_ERR_AMT_MON = 00H ; LV_AMT_ES_REQ =1
                  Else   STATE_ERR_AMT_MON = 10H
                  End if
            Else  STATE_ERR_AMT_MON = 11H
            End if
     Else   if     STATE_AMT = 1
            Then  if     STATE_AMT_OLD_MON = 1
                 Then  T_STATE_AMT_1_DIAG_MON = T_STATE_AMT_1_DIAG_MON + 40 ms

                 Else   T_STATE_AMT_1_DIAG_MON = 0
                        T_TQI_AMT_DIAG_MON = 0
                 End if
```

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```
Else   if        STATE_AMT = 2
         Then   if        STATE_AMT_OLD_MON = 2
                Then   T_STATE_AMT_2_DIAG_MON = T_STATE_AMT_2_DIAG_MON
  +
                                                           40 ms
                Else   T_STATE_AMT_2_DIAG_MON = 0
                       T_STATE_CLU_AMT_DIAG_MON = 0
                End if
         Else   if        STATE_AMT_OLD_MON = 3
                Then   T_STATE_AMT_3_DIAG_MON = T_STATE_AMT_3_DIAG_MON
  +
                                                           40 ms
                Else   T_STATE_AMT_3_DIAG_MON = 0
                       T_TQI_AMT_DIAG_MON = 0
                End if

If T_STATE_AMT_1_DIAG_MON > C_T_MAX_STATE_AMT_1_DIAG_MON   OR
   T_STATE_AMT_2_DIAG_MON > C_T_MAX_STATE_AMT_2_DIAG _MON OR
 T_STATE_AMT_3_DIAG_MON > C_T_MAX_STATE_AMT_3_DIAG_MON
Then   STATE_ERR_AMT_MON = 20H
Else   if        STATE_AMT = 1 or 3
         Then   if   TQI_AMT_PLAUS_MON >
                       MAX(TQI_REQ_TRA_FAST; -1* TQ_LOSS_MON; TQI_MSR_FAST;
                   TQI_DCC_FAST_INC; (TQ_SP_WHEEL/GR_DT)) +
                                             C_TQI_AMT_DIAG_MON
               Then   T_TQI_AMT_PLAUS_MON_DIAG =
                                 T_TQI_AMT_DIAG_MON + 40 ms
               else   T_TQI_AMT_PLAUS_MON_DIAG =
                                 T_TQI_AMT_DIAG_MON
                End if

                If   T_TQI_AMT_PLAUS_MON_DIAG >
                                 C_T_MAX_TQI_AMT_DIAG_MON
                Then   STATE_ERR_AMT_MON = 21H
               Else   STATE_ERR_AMT_MON = 00H
               End if
         Else   if        STATE_CLU_AMT = 3
                Then   T_STATE_CLU_AMT_DIAG_MON =
                                     T_STATE_CLU_AMT_DIAG_MON + 40
                                ms
               Else   T_STATE_CLU_AMT_DIAG_MON =
                                 T_STATE_CLU_AMT_DIAG_MON
                End if
                if        T_STATE_CLU_AMT_DIAG_MON >
                                C_T_MAX_STATE_CLU_AMT_DIAG_MON
               Then   STATE_ERR_AMT_MON = 22H
               Else   STATE_ERR_AMT_MON = 00H
               End if
         End if
      End if
  End if
```

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End if

- -

STATE_AMT_OLD_MON = STATE_AMT
The flag LV_AMT_ES_REQ will be set until the end of driving cycle
IF LV_ES = 1 **and** LV_IGK_MON = 0 to 1
Then LV_AMT_ES_REQ = 0
Endif

<u>Plausibility of Torque intervention about message counter</u>:
IF ERR_SYM_TOUT_AMT_1 or_BN_TQ_AMT or BN_ETCU = "SYM_2"
Then STATE_ERR_AMT_MON = 40H (timeout CAN)
Else if ERR_SYM_TOUT_AMT_1 or_BN_TQ_AMT or BN_ETCU = "SYM_1"
Then STATE_ERR_AMT_MON = 50H (timeout CAN)
Else **if** ERR_SYM_TOUT_AMT_1 or_BN_TQ_AMT or BN_ETCU = "SYM_3"
then STATE_ERR_AMT_MON = 30H (timeout CAN)
else STATE_ERR_AMT_MON remains
endif

E.24.5 GS monitoring

E.24.5.1 GS torque monitoring

FUNCTION DESCRIPTION:

<u>General information:</u>
The torque demands received by the CAN-bus are monitored.
The input signals are read direct from CAN.

Application conditions

Activation: LV_TQI_MON_ACT_MON = 1 **and** (LV_AT = 1 **or** LV_VAR_TCT = 1)

Deactivation: otherwise

Initialization: TQI_GS_MON = 0
LV_ERR_GS_INH_MON = 0
T_GS_INH_MON = 0
ABC_GS_INH_MON = 0
TQ_GS_MON = -1024 Nm

Update Rate: 40 msec

Formula section:

<u>LV_VAR_BN = 0:</u>

IF LV_ERR_GS_INH_MON = 0
THEN
TQI_GS_MON = C_TQI_STND_MON * TQI_GS_FAST_REQ_CAN
IF LV_GS_INC_ACT = 1 **and**
LV_DI_TQ_REQ_CAN_MPI_GDI = 0 **and**
LV_ETCU_LIH_CAN = 0 **and**
LV_ERR_TOUT_ETCU_1 = 0 **and**
LV_ERR_TOUT_ETCU_2 = 0 **and**

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```
            LV_TQI_REQ_CAN_INH       = 0                      and
            LV_CDN_VB_CAN_TQ_DIAG    = 1

    THEN
            Initialize Timer: T_GS_INH_MON = C_T_GS_INH_MON
            IF      (LV_TQ_GS_INC_REQ = 0)                          OR
                    (TQI_GS_FAST_REQ_CAN = FFH)                     OR
                    [(VB > C_CAN_VB_MIN_DIAG_MON) AND (LV_ERR_CAN_BOFF=1)]
                    for C_T_DLY_GS_INH_MON}
            THEN  after debouncing with ABC_GS_INH_MON
                  Inhibit GS non reversible until the initialization conditions for error bits are fulfilled
                  (see application incidences for process monitoring):
                  LV_ERR_GS_INH_MON = 1
                  TQI_GS_MON = 0
                  T_GS_INH_MON = 0
            ENDIF

  ELSE
            IF      T_GS_INH_MON = 0
            THEN  TQI_GS_MON = 0
            ELSE  Decrement Timer T_GS_INH_MON
            ENDIF
  ENDIF

ELSE
    TQI_GS_MON = 0
    T_GS_INH_MON = 0
ENDIF
```

<u>*LV_VAR_BN = 1:*</u>

```
IF   LV_ERR_GS_INH_MON = 0
THEN
    TQ_GS_MON = TQ_GS_FAST_BN
  IF      LV_GS_INC_ACT              = 1                      and
            LV_ERR_BN_TQ_ETCU        = 0                      and
            LV_ERR_BN_ETCU           = 0                      and
            LV_ETCU_LIH_CAN          = 0                      and
            LV_TCT_LIH_CAN           = 0                      and
            LV_TQI_REQ_CAN_INH       = 0                      and
            LV_DI_TQ_REQ_CAN_MPI_GDI      = 0                 and
            LV_CDN_VB_CAN_TQ_DIAG         = 1

    THEN
            Initialize Timer: T_GS_INH_MON = C_T_GS_INH_MON
            IF      (LV_TQ_GS_INC_REQ = 0)                          OR
                    (TQ_GS_FAST_BN = 8000H)                         OR
                    (TQ_GS_SLOW_BN = 8000H)                         OR
                    [(VB > C_CAN_VB_MIN_DIAG_MON) AND (LV_ERR_CAN_BOFF=1)]
                    for C_T_DLY_GS_INH_MON}
```

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THEN after debouncing with ABC_GS_INH_MON
Inhibit GS non reversible until the initialization conditions for error bits are fulfilled (see application incidences for process monitoring):
LV_ERR_GS_INH_MON = 1
TQ_GS_MON = -1024 Nm
T_GS_INH_MON = 0
ENDIF

ELSE
IF T_GS_INH_MON = 0
THEN TQ_GS_MON = -1024 Nm
ELSE Decrement Timer T_GS_INH_MON
ENDIF
ENDIF

ELSE
TQ_GS_MON = -1024 Nm
T_GS_INH_MON = 0
ENDIF

The CAN-interface is directly checked for the CAN-Bus OFF fault

Anti-bounce counter: ABC_GS_INH_MON
Anti-bounce counter increment: C_ABC_INC_GS_INH_MON
Anti-bounce counter maximum: C_ABC_MAX_GS_INH_MON

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E.25 Monitoring of engine speed

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_N_32_MON	V	0... FFH	0... 255	1	-
Anti bounce counter N_32 ratio error					
LV_ERR_N_32_MON	O/V	0... 1H	0 ...1	1	-
Logical variable for ratio error between N_32 and N_32_SUB_MON					
N_32_DIF_REL_MON	V	0... FFFFH	0... 255	3.8911e-3	-
Relative engine speed deviation monitoring level					
N_32_MON	O/V	0... FFH	0... 8160	32	rpm
Engine speed (monitoring level)					
N_32_SUB_MON	V	0... FFH	0... 8160	32	rpm
Engine speed substitute monitoring level					
T_SEG_SW_MON	O/V	0... FFFFFFFH	0... 268435	1	µs
Timer for engine speed monitoring					

Input data:

N_32 {p. 1525}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_N_32_MON	-	0... FFH	0... 255	1	-
Anti bounce counter increment (additive value in case of N_32 ratio error)					
C_ABC_MAX_N_32_MON	-	1... FFH	1... 255	1	-
Value at which N_32 ratio error is recognized, when reached					
C_N_32_DIF_REL_MAX_MON	-	0... FFFFH	0... 255	3.8911e-3	-
Maximum relative difference between N_32 and N_32_SUB_MON					
C_N_32_LIM_MON	-	1... FFH	32... 8160	32	rpm
Lower limit of denominator for relative error calculation (initial value: 32)					
C_N_32_MIN_MON	-	0... FFH	0... 8160	32	rpm
Lower limit for using the relative error concept					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_T_SEG_N_32_CLC	-	0... FFFFFFFFH	0 ...0	32	rpm*µs
Non calibratable data for N_32_SUB_MON calculation					

Import actions:

ACTION_ECM3_Service10TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service11TaskPfm (**IN**<No Name available>)
ACTION_ECM3_Service9TaskPfm (**IN**<No Name available>)

Note: These actions are defined in chapter "Processor Monitoring". The first action shall be executed as first instruction in this module, the second after the stack check, and the third action as last instruction of this module. The arguments shall have value 1.

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ACTION_ECM3_McChkStack()

Note: This action is defined in chapter "Processor Monitoring" and implements a stack check. It shall be executed between ACTION_ECM3_Service9TaskPfm() and ACTION_ECM3_Service10TaskPfm().

ACTION_ECM3_WriteChkCpl(INOUT <>, OUT <>, IN <>)
ACTION_ECM3_ChkCpl(IN <>, IN <>)
ACTION_ECM3_ReadChkCpl(OUT <>, IN <>, IN <>)

Note: All variables with Mode O and history variables in modules of the *Process Monitoring* have to be checked by the cyclical RAM test.

ACTION_INFR_GetTSEGSWMON(OUT <>)

Note: This action is defined in chapter "Basic SW Inputs and Outputs " (IRS).

E.25.1 FUNCTION PART: ECM2_DTSYSN

General information:

The comparison of the engine speed N_32 to an engine speed substitute N_32_SUB_MON, calculated in the monitoring level, performs the monitoring of the engine speed used in the monitoring level.

N_32_SUB_MON is calculated from a segment timing information that is generated by a software timer solution in the BSW (T_SEG_SW_MON). The software timer is triggered by crankshaft segments and produces time stamps for the trigger events. From these timing informations the signal T_SEG_SW_MON is determined (resolution: 1µs).

The engine speed signals N_32 and N_32_SUB_MON are compared to each other by means of a relative deviation. The ratio of the difference of N_32 and N_32_SUB_MON related to the minimum of the two values is not allowed to deviate more than the maximum difference C_N_32_DIF_REL_MAX_MON. Otherwise a process fault is assumed. Since for a small engine speed the relative error concept is leading to a rather small permitted absolute difference between N_32 and N_32_SUB_MON, the monitoring could be too tight here. Therefore, as soon as both engine speed signals are smaller than a limit C_N_32_MIN_MON, the relative error is calculated by relating the absolute difference to the constant C_N_32_LIM_MON.

On an error free system N_32 is copied to N_32_MON. If an engine speed error is detected, the maximum value of N_32 and N_32_SUB_MON is copied to N_32_MON to prevent from a sleeping fault in the module Monitoring of engine speed limitation .

Note: This version of engine speed monitoring is for systems where a second hardware timer, which in other versions was delivering the signal SEG_T_MES, is not available on the ECU and where the missing timer is substituted by a software timer solution in the BSW.

For configuration data:

NC_T_SEG_N_32_CLC is a constant for the calculation of N_32_SUB_MON from T_SEG_SW:
UNSUPPORTED IMAGE FORMAT

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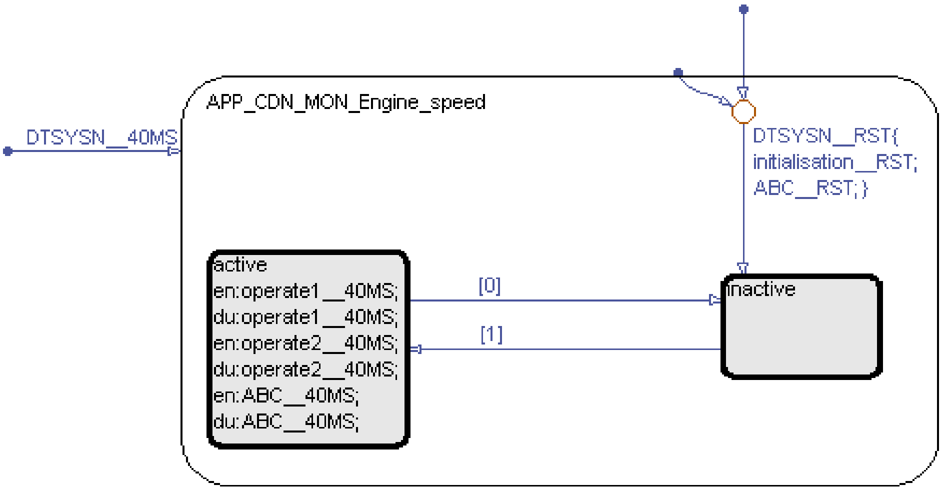
with *NC_CYL_NR* : number of cylinders

Application Condition



Note:DTSYSN__RST includes the function calls as defined in application incidences.

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Function Description

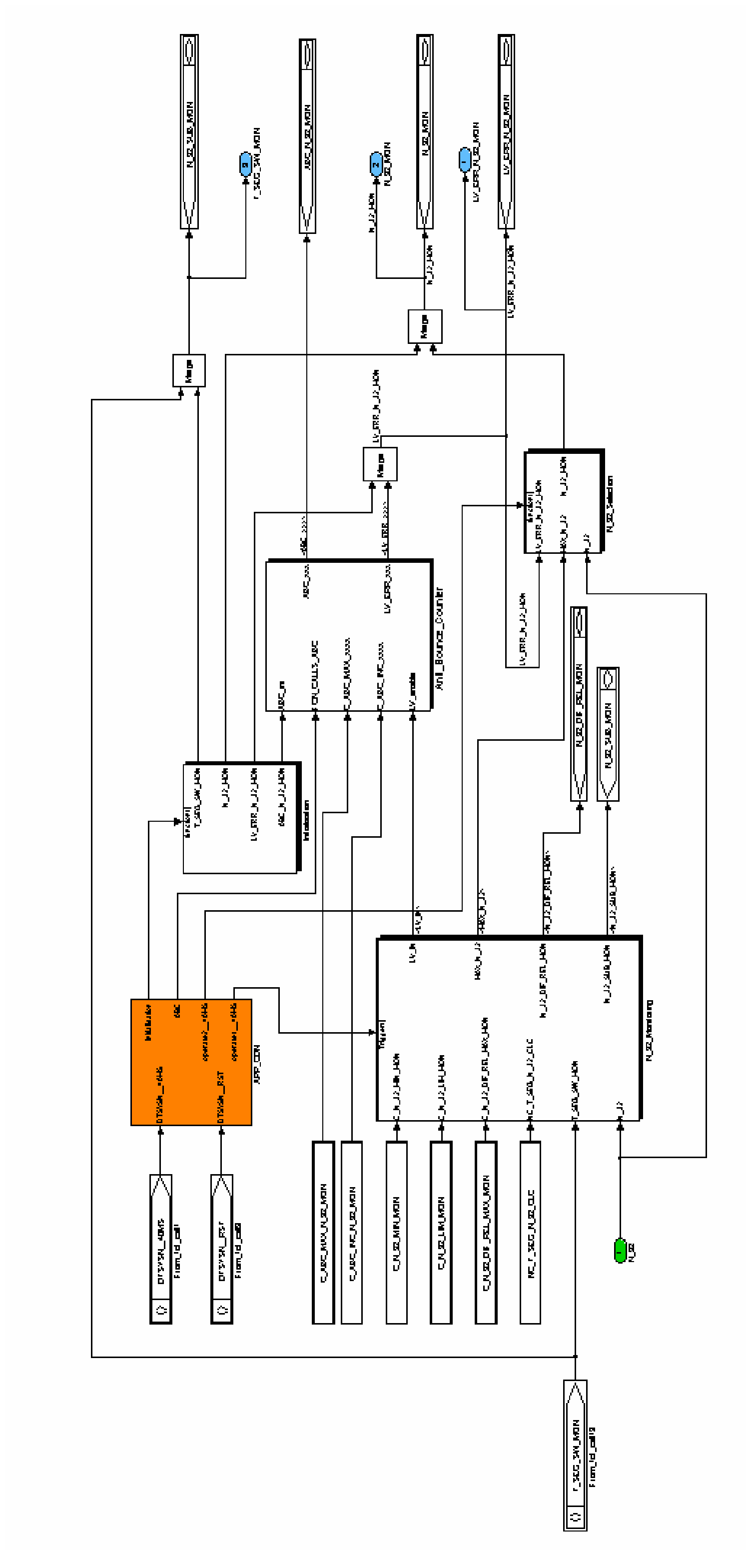

Figure E.25.1: ECM2_DTSYSN

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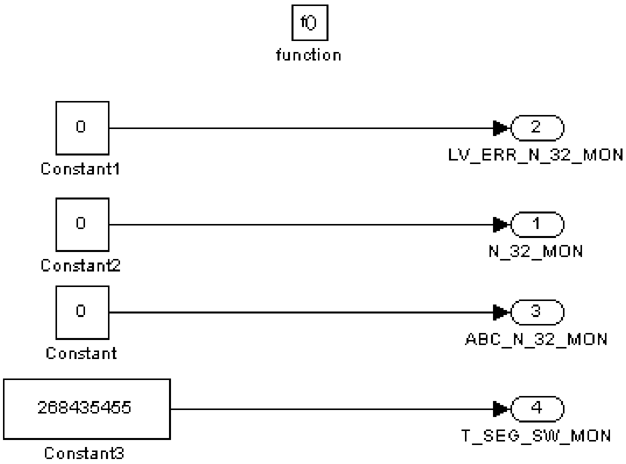

Figure E.25.2: ECM2_DTSYSN/INITIALISATION

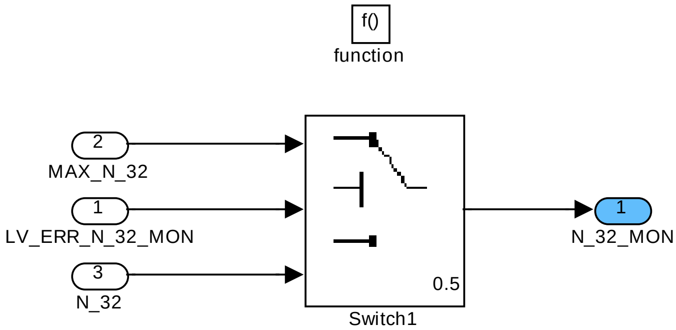

Figure E.25.3: ECM2_DTSYSN/N_32_MON_Selection

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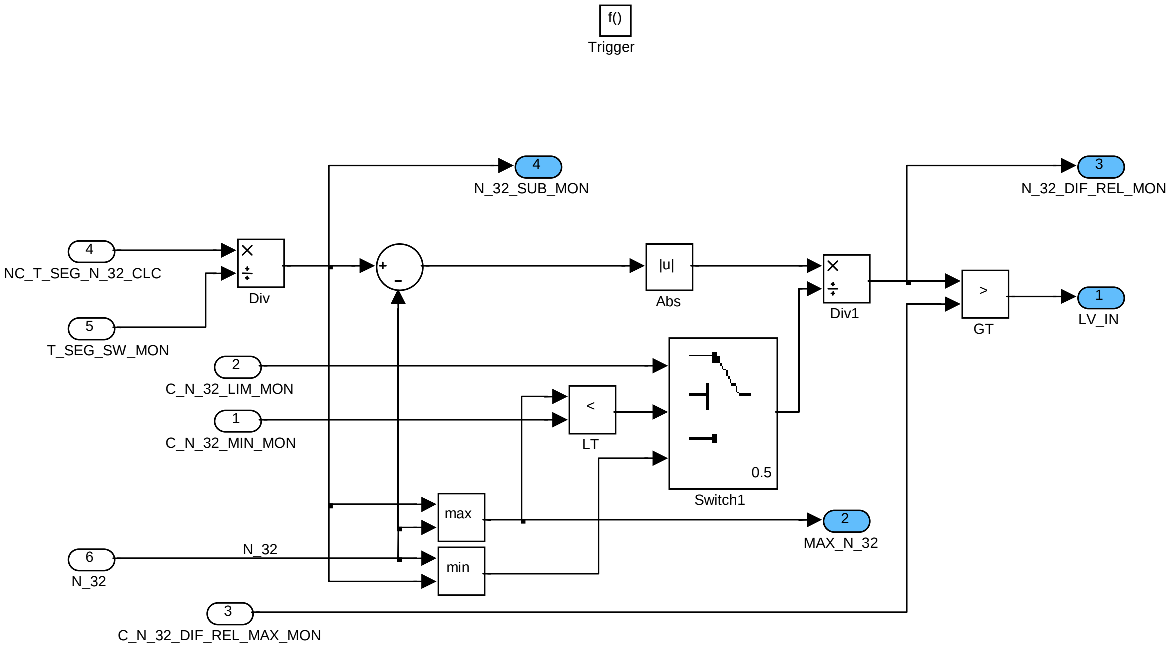

Figure E.25.4: ECM2_DTSYSN/N_32_MONITORING

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E.26 Process monitoring

Input data:

LV_DIAG_END_RLY_ MAIN_DLY {p. 4933}	LV_RLY_MAIN_DLY_ERR {p. 4933}		

Import actions:

ACTION_ECM3_ServicePfm (**IN**<No Name available>)

Note: This action is defined in chapter "Processor Monitoring", subsection "Program Flow Monitoring services for Process Monitoring". This action has to be executed as last instruction after all tasks have been executed. After the first block of tasks, the action has to be called with argument 1, after the second with 2, after the third with 3 and after the fourth with 4. At the very end of the scheduler finally the action has to be called with argument 0, 6, and 7.

ACTION_ECM2_LockPws()
ACTION_ECM2_UnlockPws()

Note: These two actions are defined in module "Fault Reaction of process monitoring".

General information:

The task of process monitoring is to check whether ETC /torque functions (located in function level) work properly and to take a fault reaction, if not. This is described in the following modules:

1. Limitation of Negative Temperature Gradient

Engine Losses depend on engine temperature (indicated by TOIL or TCO). Cold temperature means big losses. These losses are compensated by the torque structure. This means faults like a temperature step from hot to cold within permitted signal range lead to miscompensation of losses (undesired torque increase). To avoid this, the max. negative temperature gradient is limited to (small) values, given by physics.

1. Monitoring Sensor Signals

Sensor Signals (PVS, TPS) are checked a second time in process monitoring. This is done by using bigger tolerances and longer debouncing times. Having detected a fault in process monitoring, but not in function level, means a faulty function level. Fault reaction is done as described below. A fault, detected in function level earlier than in process monitoring or at the same time, means normal working of function level, therefore standard reaction of function level is done.

1. Monitoring CAN Signals

CAN signals are only checked against protocol (parity bit, message counter, ...). No plausibilisation of values is possible. CAN monitoring performed in process monitoring is a subset of CAN monitoring performed in function level.

1. Monitoring Internal Signals

Internal signals (engine speed, torque demand of idle speed controller, torque demand of Cruise Control, cylinder-cut-off efficiency, ...) are partly moved from function level to process monitoring as value and its complement (engine speed); partly a plausibility check of the values is done (Cruise Control request) or the values are computed a second time (idle speed controller). Fault reaction is done as described below.

1. Torque Monitoring

The desired maximum indicated engine torque is calculated from individual torque requests and compared to the actual indicated engine torque, calculated from MFF, engine speed, ignition angle- and

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other efficiencies. If the actual torque exceeds the desired torque by more than a certain threshold, a fault reaction is done as described below.

1. Fault Reaction

Standard fault reaction of process monitoring is disabling of throttle actuator and engine speed limitation, commanded to function level. As function level is detected to be faulty, the commanded limitation is monitored and if it is not realized properly, a command is given to send wrong answers to the monitoring processor. This means, the monitoring processor will cut off throttle actuator and injector valves directly.
In case of faults detected when transmitting values and their complement (fault in memory or in instruction set), powerstages are disabled and a reset is performed.

Formula Section:

IF LV_DIAG_END_RLY_MAIN_DLY == 1 **AND** LV_RLY_MAIN_DLY_ERR == 0
THEN
ACTION_ECM2_UnlockPws();
/* Hasto be executed exactly once! */
Tasks/ECM2-functions activated according to table 1 starting with task "1";
ELSE ACTION_ECM2_LockPws();
ENDIF

E.26.1 Task scheduler

The process monitoring functionality is executed with an update rate of 40 ms. In order to achieve a balanced computational load of the controller, the functionality of the process monitoring is divided into 4 tasks (see following Table 1). For each task the first called module is the related part of Application Incidences of process monitoring.

Table 1: Distribution of the process monitoring functionality over four tasks. The task scheduler is executed every 10 ms. Within one task, the different functions are executed in the order according to the rows of the table.

Task 1 (k)	Task 2 (k+10 ms)	Task 3 (k+20 ms)	Task 4 (k+30 ms)
Application incidences of process monitoring(k)	Application incidences of process monitoring(k+10ms)	Application incidences of process monitoring(k+20ms)	Application incidences of process monitoring(k+30ms)
Monitoring of A/D-conversion	Monitoring of pedal value signals	Monitoring of engine speed limitation	Actual indicated engine torque
Monitoring of TCO		Monitoring of CAN signals	Desired indicated engine torque
Monitoring of engine speed	Monitoring of torque losses	Monitoring of cruise control conditions	Monitoring of actual indicated engine torque
Monitoring of idle speed controller	Monitoring of maximum torque at clutch	Monitoring of minimum torque at clutch	Fault reaction of process monitoring
Actual Fuel Mass Flow	Actual lambda deviation	Actual efficiencies	Combustion mode switch request
ACTION_ECM3_ServicePfm(1)	Monitoring of Mass Fuel Flow		ACTION_ECM3_ServicePfm(4)
ACTION_ECM3_ServicePfm(0)	ACTION_ECM3_ServicePfm(2)	ACTION_ECM3_ServicePfm(3)	Error memory management of process monitoring
	ACTION_ECM3_ServicePfm(0)	ACTION_ECM3_ServicePfm(0)	ACTION_ECM3_ServicePfm(0)

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E.27 Processor monitoring by copy of process monitoring

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_SWI_AFS_TQI_MON2	V	0... FFH	0... 255	1	-
Anit bounce counter for request to AFS (TQI_DIF above allowed threshold)					
ABC_TQI_AV_AFS_MON2	V	0... FFH	0... 255	1	-
Anti bounce counter for fault in torque generation (AFS mode)					
ABC_TQI_N_MAX_MON2	V	0... FFH	0... 255	1	-
Anti bounce counter for fault in engine speed limitation					
EFF_IGA_HOM_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
ignition efficiency in homogeneous (process monitoring)					
EFF_IGA_HOMS_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
ignition efficiency in multiple homogeneous stratified (process monitoring)					
EFF_IGA_S_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
ignition efficiency in stratified (process monitoring)					
EFF_LAMB_HOM_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
lambda efficiency in homogeneous (process monitoring)					
EFF_LAMB_HOMS_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
lambda efficiency in homogeneous stratified (process monitoring)					
EFF_LAMB_S_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
lambda efficiency in stratified homogeneous (process monitoring)					
EFF_MFF_TQ_COR_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
efficiency on torque relevant mass fuel flow					
EFF_TOT_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
total actual efficiencies					
FAC_TQ_REQ_CRU_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
Torque demand from cruise control					
FAC_TQ_REQ_DRIV_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
Scaling factor for requested torque at clutch from driver					
FAC_TQ_REQ_MON2	V	0... FFH	0... 1.9921875	0.0078125	-
Scaling factor for requested torque at clutch from driverand and cruise control					
IGA_DIF_AV_H_RNG_HOM_MON2	V	0... B40H	0 ...0	0.0625	°CRK
difference from reference to actual ignition angle in homogeneous (process monitoring)					
IGA_DIF_AV_H_RNG_HOMS_MON2	V	0... B40H	0 ...0	0.0625	°CRK
difference from reference to actual ignition angle in homogeneous stratified (process monitoring)					
IGA_IGC_H_RNG_MON2 [NC_CYL_NR]	V	FA60... 5A0H	0... 90	0.0625	°CRK
Actual ignition angle high range					
IGA_REF_HOM_COR_EXT_MON2	V	FA60... 5A0H	0... 90	0.0625	°CRK
Correction of reference ignition angle in homogeneous (for external functions e.g. VVT, EGR...)					
IGA_REF_HOMS_COR_EXT_MON2	V	FA60... 5A0H	0... 90	0.0625	°CRK
Correction of reference ignition angle in homogeneous stratified (for external functions e.g. VVT, EGR...)					
LAMB_MON2	V	0... 7FFFH	0... 31.9990234	97.6563e3	-
Modeled Lambda					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LF_4_MON2	V	0... FFH	0... 255	1	-
Byte of logical starting values 4					
LV_DR_OFF_MU_MON2	V	0... 1H	0 ...1	1	-
Request for wrong answers of the level 2 test calcualtions to the monitoring unit in order to disable MTC and IV					
LV_ERR_CONV_MON2	V	0... 1H	0 ...1	1	-
Fault in A/D conversion present					
LV_ERR_MFF_MON2	V	0... 1H	0 ...1	1	-
Logical variable for error in mass fuel flow signal					
LV_ERR_MU_MC_MON2	V	0... 1H	0 ...1	1	-
Fault detected by processor monitoring (continuous)					
LV_ERR_N_32_MON2	V	0... 1H	0 ...1	1	-
Fault in engine speed present					
LV_ERR_OPM_AV_MON2	V	0... 1H	0 ...1	1	-
Level2 error for wrong plausibilisation of engine operation mode					
LV_ERR_PVS_MON2	V	0... 1H	0 ...1	1	-
Fault in pedal value signal present					
LV_ERR_TMP_MU_MC_MON2	V	0... 1H	0 ...1	1	-
Fault detected by processor monitoring (temporary)					
LV_ERR_TPS_MON2	V	0... 1H	0 ...1	1	-
Fault in TPS present					
LV_ERR_TQ_DIF_I_IS_MON2	V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom "idle speed controller I part"					
LV_ERR_TQ_DIF_P_D_IS_MON2	V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom "idle speed controller PD part"					
LV_ERR_TQ_LOSS_MON2	V	0... 1H	0 ...1	1	-
Fault in torque losses present					
LV_ERR_TQ_MAX_CLU_MON2	V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom "maximum torque at clutch"					
LV_ERR_TQ_MIN_CLU_MON2	V	0... 1H	0 ...1	1	-
Fault currently present in torque generation, symptom ‘minimum torque at clutch					
LV_ERR_TQI_AV_MON2	V	0... 1H	0 ...1	1	-
Fault currently present in torque generation					
LV_ERR_TQI_N_MAX_MON2	V	0... 1H	0 ...1	1	-
Fault currently present in engine speed limitation					
LV_ERR_TRAN_1_MON2	V	0... 1H	0 ...1	1	-
Flag for temporary fault 1 (exclusive fault of L3) during last recurrency					
LV_ERR_TRAN_2_MON2	V	0... 1H	0 ...1	1	-
Flag for temporary fault 2 (together with fault of L2) during last recurrency					
LV_N_LIM_ETC_MON2	V	0... 1H	0 ...1	1	-
Engine speed limitation request					
LV_N_LIM_REQ_MON2	V	0... 1H	0 ...1	1	-
Request for engine speed limitation					
LV_OFF_IV_MON2	V	0... 1H	0 ...1	1	-
Request for disable of IV power stage by main controller					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_OFF_IV_N_LIM_ETC_MON2	V	0... 1H	0 ...1	1	-
Reversible fuel Cut Off Switch for all cylinders					
LV_OFF_IV_N_LIM_ETC_TMP_MON2	V	0... 1H	0 ...1	1	-
Flag for temporary injection cut off during last recurrency					
LV_OFF_MTC_MON2	V	0... 1H	0 ...1	1	-
Request for disable of MTC power stage by main controller					
LV_SWI_AFS_TQI_MON2	V	0... 1H	0 ...1	1	-
Switch to AFS (TQI_DIF above allowed threshold)					
LV_SWI_FAC_TQ_REQ_MON2	V	0... 1H	0 ...1	1	-
logical variable for switching to other factors for requested torque at clutch					
LV_TQI_MON_ACT_MON2	V	0... 1H	0 ...1	1	-
Logical variable for torque monitoring active					
MFF_LAMB_REF_IGA_MON2	V	0... FFFFH	0... 1389	0.02119478	mg/stk
Lambda relevant Mass Fuel Flow for stoichometric conditions corrected by SCAV for EFF_IGA_MON					
MFF_TQ_MON2	V	0... FFFFH	0... 1389	0.02119478	mg/stk
Torque relevant Mass Fuel Flow					
N_32_MON2	V	0... FFH	0... 8160	32	rpm
Engine speed					
OPM_AV_MON2	V	1H 2H 3H 8H	S AFS AFL LIH	-	-
actual engine operation mode (process monitoring)					
PREV_STATE_IV_MON2	V	0... FFH	0... 255	1	-
State of injection valves at previous cycle					
PV_AV_AD_MON2	V	0... FFH	0... 99.609375	0.390625	%
Pedal value adaptation					
RESP_MON2	O/V	0... FFFFH	0... 65535	1	-
Answer of copy of process monitoring (Level 2)					
T_TQI_MON2	V	0... FFH	0... 10.2	0.04	s
Dead time for delay of desired indicated engine torque					
TQ_DIF_P_D_IS_MON2	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
P and D controller output for idle speed control					
TQ_DROF_MON2	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Torque demand from drive off assistant					
TQ_LOSS_MON2	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Torque losses					
TQ_MAX_CLU_MON2	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Monitored maximum torque at clutch					
TQ_MIN_CLU_MON2	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Monitored minimum torque at clutch					
TQI_AV_MON2	V	0... FFH	0... 510	2	Nm
Actual indicated engine torque (process monitoring)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_DIF_AV_MON2	V	0... FFH	0... 510	2	Nm
deviation between actual and desired indicated engine torque					
TQI_DIF_MAX_MON2	V	0... FFH	0... 510	2	Nm
Permitted deviation between actual and desired indicated engine torque					
TQI_DIF_SP_MON2	V	0... FFH	0... 510	2	Nm
deviation between torque setpoint and desired indicated engine torque					
TQI_INC_EXT_MON2	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
External torque request					
TQI_MIN_PU_MON2	V	0... 7FFFH	0... 1023.97	0.03125	Nm
Torque for trailing throttle					
TQI_REQ_TOT_MON2	V	0... FFH	0... 510	2	Nm
Desired non delayed indicated engine torque					
TQI_SP_MON_MON2	V	0... FFH	0... 510	2	Nm
Desired indicated engine torque					
TQI_SP_MON2	V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Setpoint indicated engine torque (function level)					

Input data:

NC_CYL_NR {p. 1526}	NC_TEST_REC_IDX_ MAX_MON2 {p. 7101}	TEST_REC_IDX_MON2 {p. 7100}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_INC_SWI_AFS_TQI_MON2	-	0... FFH	0... 255	1	-
ABC increment for request to AFS (TQI_DIF above allowed threshold)					
C_ABC_INC_TQI_AV_AFS_MON2	-	0... FFH	0... 255	1	-
ABC increment at TQI_DIF above allowed treshold (AFS mode)					
C_ABC_INC_TQI_N_MAX_MON2	-	0... FFH	0... 255	1	-
Anti bounce counter increment					
C_ABC_MAX_SWI_AFS_TQI_MON2	-	1... FFH	1... 255	1	-
Value at which OPM will be switched to AFS at TQI_DIF above allowed treshold					
C_ABC_MAX_TQI_AV_AFS_MON2	-	1... FFH	1... 255	1	-
Value at which TQI_AV_MON error is recognized. when reached (AFS mode)					
C_ABC_MAX_TQI_N_MAX_MON2	-	1... FFH	1... 255	1	-
Maximum value of anti bounce counter					
C_CRLC_TQI_SP_MON2	-	0... FFH	0... 0.99609375	0.00390625	-
filter constant for realization of first order filter					
C_GAIN_TQI_DIF_MAX_MON2	-	0... FFH	0... 63.75	0.25	-
Factor for threshold diagnosis with TQI_SP					
C_N_MAX_MTC_LIH_THD_MON2	-	0... FFH	0... 8160	32	rpm
Speed threshold for the detection of a fault in the engine speed limitation					
C_STATE_RESP_MON2_RST_ACT_MON2	-	0... FFH	0... 255	1	-
Constant for reset activation via L2					
C_T_TQI_MON2	-	0... FFH	0... 10.2	0.04	s
Dead time for torque decrease					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_ABC_SWI_AFS_TQI_MON2	O/S	0... FFH	0... 255	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Anit bounce counter for request to AFS (TQI_DIF above allowed threshold)					
ID_ABC_TQI_AV_AFS_MON2	O/S	0... FFH	0... 255	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Anti bounce counter for fault in torque generation (AFS mode)					
ID_ABC_TQI_N_MAX_MON2	O/S	0... FFH	0... 255	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Anti bounce counter for monitoring of engine speed limitation					
ID_EFF_MFF_TQ_COR_MON2	O/S	0... FFH	0... 1.9921875	0.0078125	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
efficiency on torque relevant mass fuel flow					
ID_FAC_TQ_REQ_CRU_MON2	O/S	0... FFH	0... 1.9921875	0.0078125	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Torque demand from cruise control					
ID_IGA_IGC_H_RNG_MON2	O/S	FA60... 5A0H	0... 90	0.0625	°CRK
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Actual ignition angle					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_IGA_REF_HOM_COR_EXT_MON2	O/S	FA60... 5A0H	0... 90	0.0625	°CRK
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Correction of reference ignition angle in homogeneous (for external functions e.g. VVT, EGR...)					
ID_IGA_REF_HOMS_COR_EXT_MON2	O/S	FA60... 5A0H	0... 90	0.0625	°CRK
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Correction of reference ignition angle in homogeneous stratified (for external functions e.g. VVT, EGR...)					
ID_LAMB_MON2	O/S	0... 7FFFH	0... 31.9990234	97.6563e3	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Modeled Lambda					
ID_LF_1_MON2	O/S	0... FFH	0... 255	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Table of logical starting values 1					
ID_LF_2_MON2	O/S	0... FFH	0... 255	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Table of logical starting values 2					
ID_LF_3_MON2	O/S	0... FFH	0... 255	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Table of logical starting values 3					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_LF_4_MON2	O/S	0... FFH	0... 255	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Table of logical starting values 4					
ID_MFF_LAMB_REF_IGA_MON2	O/S	0... FFFFH	0... 1389	0.02119478	mg/stk
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Lambda relevant Mass Fuel Flow for stoichometric conditions corrected by SCAV for EFF_IGA_MON					
ID_MFF_TQ_MON2	O/S	0... FFFFH	0... 1389	0.02119478	mg/stk
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Torque relevant Mass Fuel Flow					
ID_N_32_MON2	O/S	0... FFH	0... 8160	32	rpm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Engine speed (monitoring level)					
ID_OPM_AV_MON2	O/S	1H 2H 3H 8H	S AFS AFL LIH	-	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
actual engine operation mode (process monitioring)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_PREV_STATE_IV_MON2	O/S	0... FFH	0... 255	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
State of injection valves at previous cycle					
ID_PV_AV_AD_MON2	O/S	0... FFH	0... 99.609375	0.390625	%
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Pedal value adaptation					
ID_RESP_MON2	O/S	0... FFFFH	0... 65535	1	-
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Assignment table for answer decoder of copy of process monitoring					
ID_T_TQI_MON2	O/S	0... FFH	0... 10.2	0.04	s
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Dead time for delay of desired indicated engine torque, old value					
ID_TQ_DIF_P_D_IS_MON2	O/S	8000... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
P and D controller output for idle speed control					
ID_TQ_DROF_MON2	O/S	8000... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
TQ request for drive off assistance					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_TQ_LOSS_MON2	O/S	8000... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Torque losses					
ID_TQ_MAX_CLU_MON2	O/S	8000... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Monitored maximum torque at clutch					
ID_TQ_MIN_CLU_MON2	O/S	8000... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Monitored minimum torque at clutch					
ID_TQI_INC_EXT_MON2	O/S	8000... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
External torque request					
ID_TQI_MIN_PU_MON2	O/S	0... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Torque for trailing throttle					
ID_TQI_SP_MON_MON2	O/S	0... FFH	0... 510	2	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Resulting desired indicated engine torque, old value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_TQI_SP_MON2	O/S	8000... 7FFFH	0... 1023.97	0.03125	Nm
LDPM_TEST_REC_IDX_MON2	NC_ TEST_ REC_ IDX_ MAX_ MON2	0... FH	0... 15	1	-
Setpoint indicated engine torque					
IP_EFF_IGA_HOM_MON2	-	0... FFH	0... 99.609375	0.390625	%
LDPM_IGA_DIF_AV_MON2_IP_MON2	8	0... B40H	0 ...0	0.0625	°CRK
actual ignition efficiency in homogeneous (process monitoring)					
IP_EFF_IGA_HOMS_MON2	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_IGA_DIF_AV_MON2_IP_MON2	8	0... B40H	0 ...0	0.0625	°CRK
actual ignition efficiency in homogeneous_stratified (process monitoring)					
IP_EFF_LAMB_HOM_MON2	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_LAMB_HOM_MON2_IP_EFF_MON2	8	0... 7FFFH	0... 31.9990234	97.6563e3	-
lambda efficiency in homogeneous (process monitoring)					
IP_EFF_LAMB_HOMS_MON2	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_LAMB_HOMS_MON2_IP_EFF_MON2	8	0... 7FFFH	0... 31.9990234	97.6563e3	-
lambda efficiency in homogeneous stratified (process monitoring)					
IP_EFF_LAMB_S_MON2	-	0... FFH	0... 1.9921875	0.0078125	-
LDP_LAMB_S_MON2_IP_EFF_MON2	8	0... 7FFFH	0... 31.9990234	97.6563e3	-
lambda efficiency in stratified (process monitoring)					
IP_FAC_EFF_IGA_MON2	-	0... FFH	0... 15.9375	0.0625	-
LDP_N_32_MON2_IP_FAC_EFF_MON2	6	0... FFH	0... 8160	32	rpm
LDP_MFF_MON2_IP_FAC_EFF_MON2	6	0... FFFFH	0... 1389	0.02119478	mg/stk
Factor ignition efficiency (process monitoring)					
IP_FAC_TQ_REQ_DRIV_1_MON2	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_N_32_MON2_IP_FAC_TQ_MON2	8	0... FFH	0... 8160	32	rpm
LDPM_PV_AV_AD_MON2_IP_FAC_MON2	8	0... FFH	0... 99.609375	0.390625	%
Scaling factor for requested torque at clutch from driver in other mode					
IP_FAC_TQ_REQ_DRIV_MON2	-	0... FFH	0... 1.9921875	0.0078125	-
LDPM_N_32_MON2_IP_FAC_TQ_MON2	8	0... FFH	0... 8160	32	rpm
LDPM_PV_AV_AD_MON2_IP_FAC_MON2	8	0... FFH	0... 99.609375	0.390625	%
Scaling factor for requested torque at clutch from driver					
IP_IGA_REF_HOM_MON2	-	0... B40H	0... 90	0.0625	°CRK
LDPM_N_32_MON2_IP_IGA_REF_MON2	8	0... FFH	0... 8160	32	rpm
LDP_MFF_MON2_IP_IGA_HOM_MON2	8	0... FFFFH	0... 1389	0.02119478	mg/stk
reference ignition angle in homogeneous (process monitoring)					
IP_IGA_REF_HOMS_MON2	-	0... B40H	0... 90	0.0625	°CRK
LDPM_N_32_MON2_IP_IGA_REF_MON2	8	0... FFH	0... 8160	32	rpm
LDP_MFF_MON2_IP_IGA_HOMS_MON2	8	0... FFFFH	0... 1389	0.02119478	mg/stk
reference ignition angle in homogeneous stratified (process monitoring)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_TQI_CUS_MON2	-	0... FFH	0... 510	2	Nm
LDP_N_32_MON2_IP_TQI_CUS_MON2	6	0... FFH	0... 8160	32	rpm
LDP_MFF_MON2_IP_TQI_CUS_MON2	8	0... FFFFH	0... 1389	0.02119478	mg/stk
Customer specific engine torque (process monitoring)					
IP_TQI_DIF_MAX_MON2	-	0... FFH	0... 510	2	Nm
LDP_N_32_MON2_IP_TQI_DIF_MON2	4	0... FFH	0... 8160	32	rpm
LDP_TQI_SP_MON_MON2_IP_MON2	4	0... FFH	0... 510	2	Nm
Threshold for diagnosis of engine torque overflow					

E.27.1 ECM2_DTSYSCOPPRHPDI

Attention: All Level 2’ calibration data are set to INVISIBLE and NOT TUNABLE epxect for C_STATE_RESP_MON2_RST_ACT_MON2. This is necessary in order to get a more robust calibration process in case of software or calibration data updates. C_STATE_RESP_MON2_RST_ACT_MON2 has to be visible and tunable in the calibration system in order to generate an L2’ reset for test cases.

General information:
A copy of the main part of the process monitoring (level 2) is built (called level 2) and used as a set of test calculations. The target is to verify the correct behaviour of the process monitoring at any time using predefined test data and comparing the resulting answer to the expected answer stored in a predefined table. Moreover there is a special calculation routine responsible for checking the correct data transfer between registers and stack in case of interrupts during the calculation.
This processor monitoring function includes the monitoring functions described in the table below. However, no real fault reaction like disabling of throttle etc. is released.
Since the answers of these test calculations will be compared to the predefined table ID_RESP_MON2 (see processor monitoring), it is important to generate a different answer for every index of starting values (NC_TEST_REC_IDX_MAX_MON2 different answers overall). The list of data points for the starting values must contain the indices 0...NC_TEST_REC_IDX_MAX_MON21 in ascending order. For details see also "Processor Monitoring" and "Processor Monitoring (Appl.Inc.)".

Table of softwarecode of level 2 modules that is included in level 2 :

Module:	Specification:
Desired indicated engine torque	30E00K01.00I
Actual efficiencies	30E01401.00J
Actual indicated engine torque	30E00L01.00E
Monitoring of actual indicated engine torque	30E00M01.00E
Monitoring of engine speed limitation	30E00I01.00F
Fault reaction of process monitoring	30E00G01.00J

The softwarecode of the level 2 submodules is an exact copy of softwarecode of the level 2 modules listed in the table above, with exceptions described in the following sub chapters.
The following Application Condition takes into consideration that the level 2’ module is triggered by Processor Monitoring (level 3).

Application Condition

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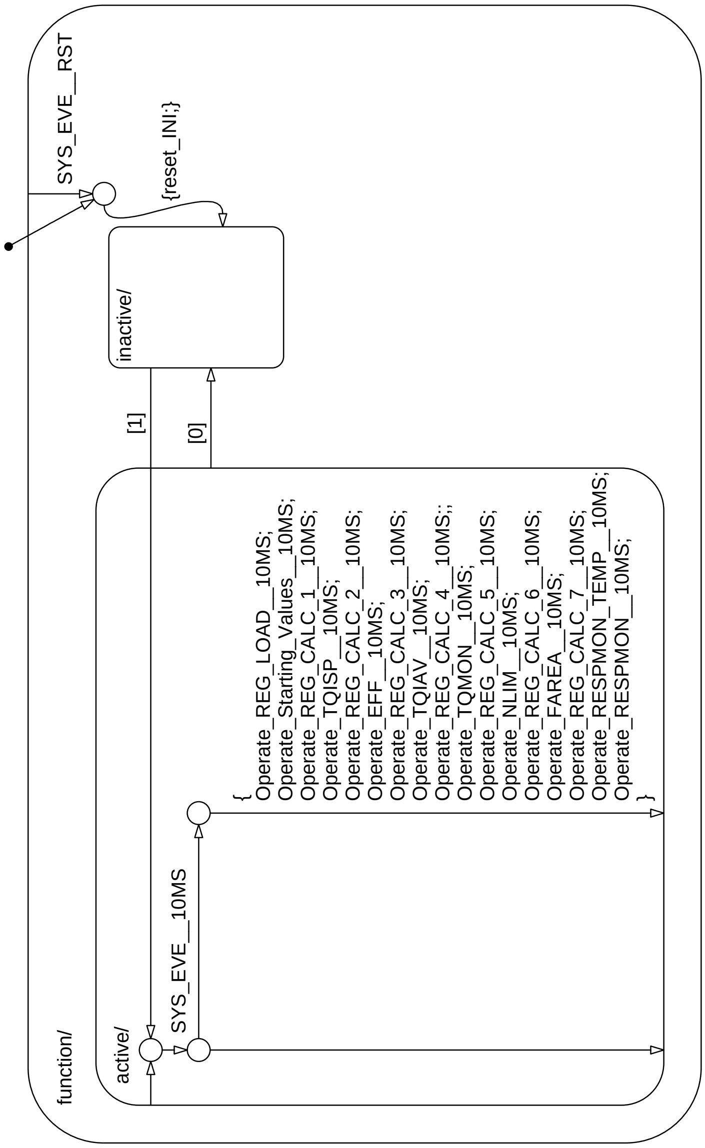

Figure E.27.1: ECM2_DTSYSCOPPRHPDI/APP_CDN/Chart

Function Description

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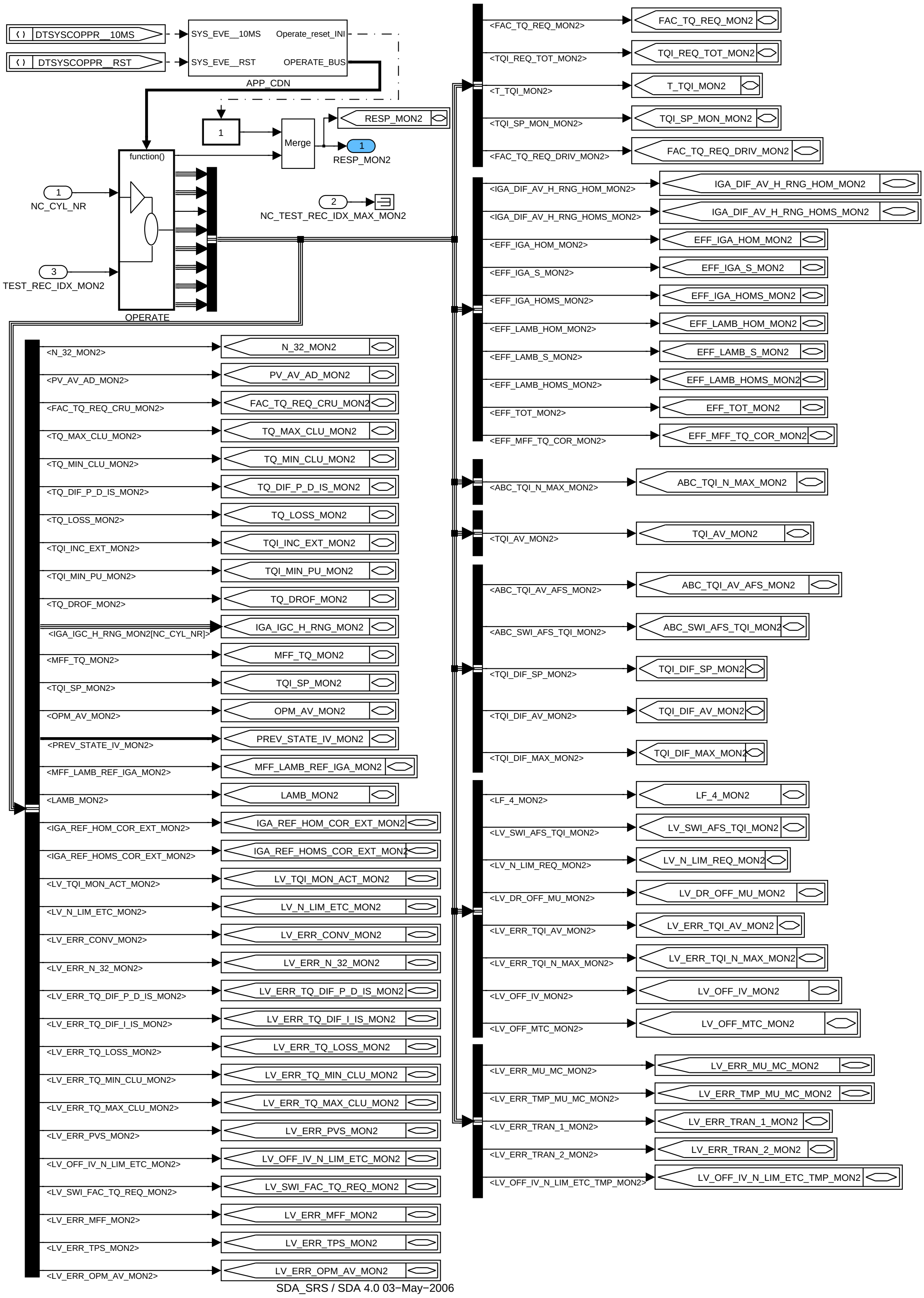

Figure E.27.2: ECM2_DTSYSCOPPRHPDI

E.27.1.1 OPERATE

General information:

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Based on the number of the question asked by the monitoring unit a corresponding set of starting values for the test calculation is selected from the lists of starting values.
The values of LDPM_TEST_REC_IDX_MON2 are fixed. They depend on the maximum NC_TEST_REC_IDX_MAX_MON2 of the generated index TEST_REC_IDX_MON2. The hex and physical limits are defined with static values which depend on the possible number of questions in the HW.

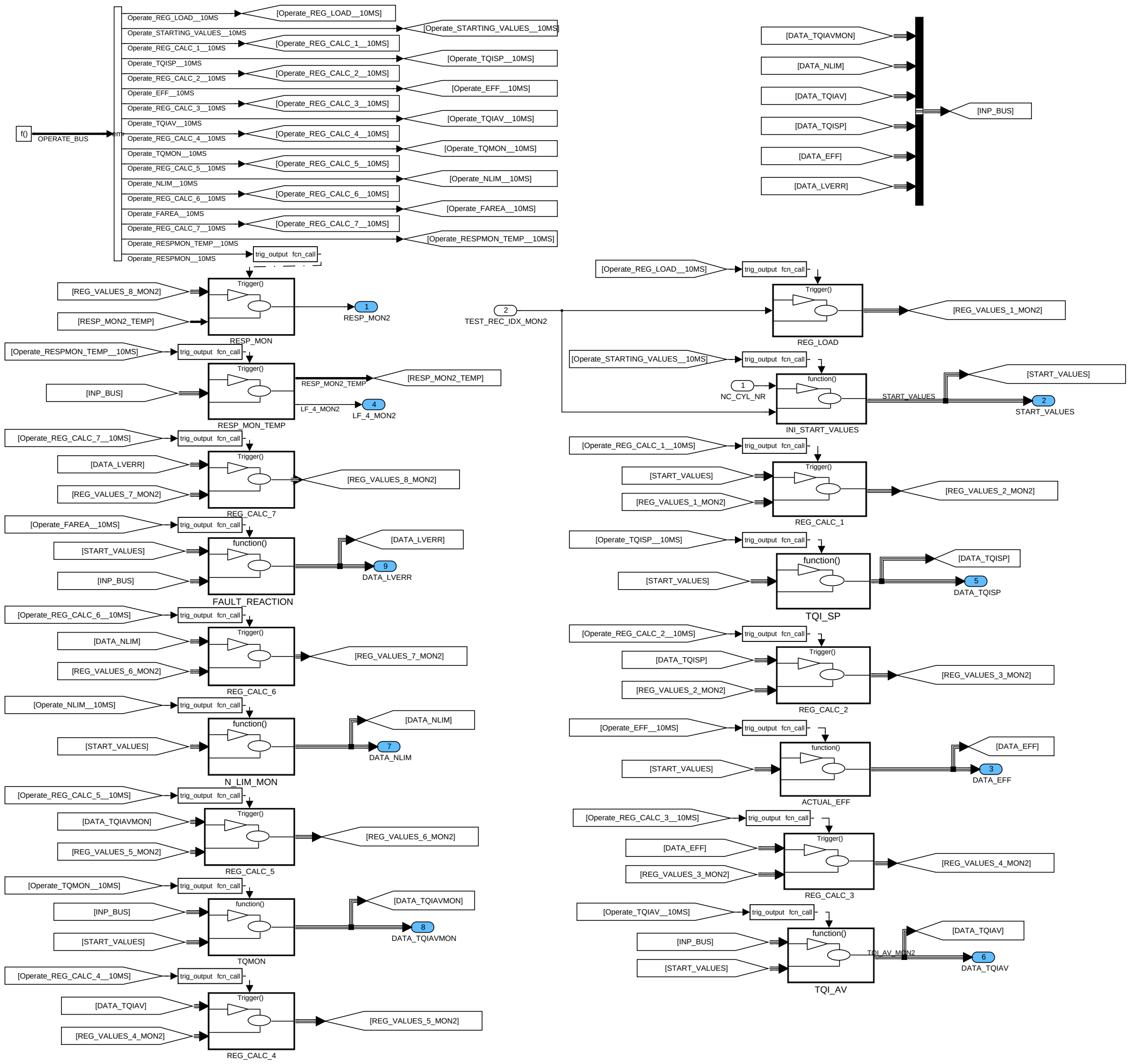

Figure E.27.3: ECM2_DTSYSCOPPRHPDI/OPERATE

Register LOAD for checking Interrupt routine

In order to simulate an interrupt at first all registers and some cells of the user stack (if available) will be loaded with some defined initial values (see figure below).
The data type for these values has to be signed 32 bit. It is not allowed to use arrays for the load values: after the first calculation every register or user stack value has to be stored separately.
After the calculation, the function call of the first module out of the L2 copied functions shall be carried out; thereby, the current register values will be copied onto the stack.

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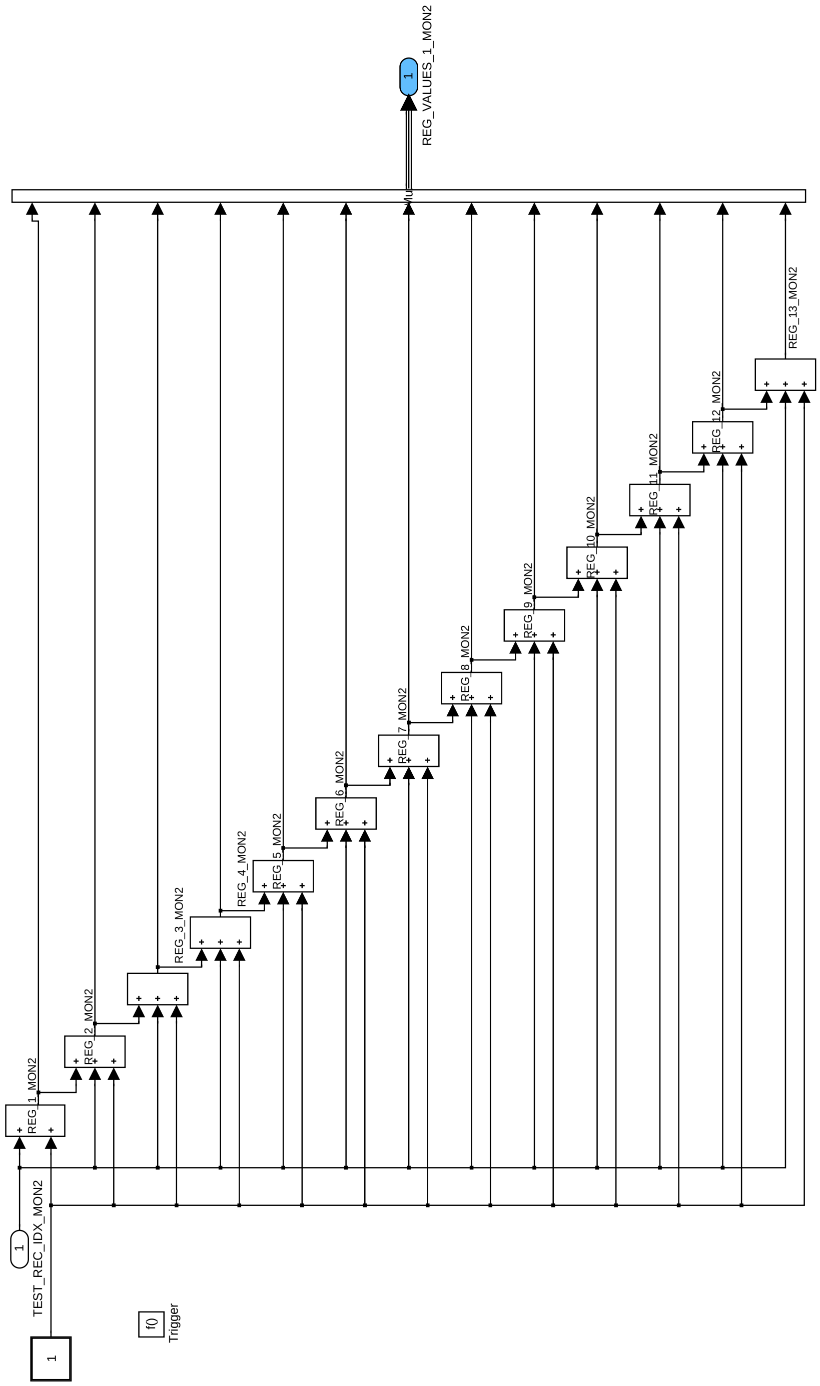

Figure E.27.4: ECM2_DTSYSCOPPRHPDI/OPERATE/REG_LOAD

ECM2_DTSYSCOPPRHPDI/OPERATE/INI_START_VALUES

Initialization of variables from the lists of starting values
In order to ensure an unambiguous final result for RESP_MON2 the values TQI_AV_MON2, TQI_REQ_TOT_MON2, EFF_TOT_MON2 and FAC_TQ_REQ_MON2 have to be initialized with zero.

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All logical variables are stored in tables of status bytes. In every recurrence, the information is copied from the table into the status bytes LF_1_MON2, LF_2_MON2, LF_3_MON2 and LF_4_MON2 respectively.

The position of the logical variables LV_xyz_MON2 within the status bytes are shown in the figures before:

HINT: The curve ID_RESP_MON2 is calibrated in this module. But the values depending on TEST_REC_IDX_MON2 are used in L3 (processor monitoring). Therefore, the output of this ID is terminated in this simulation.

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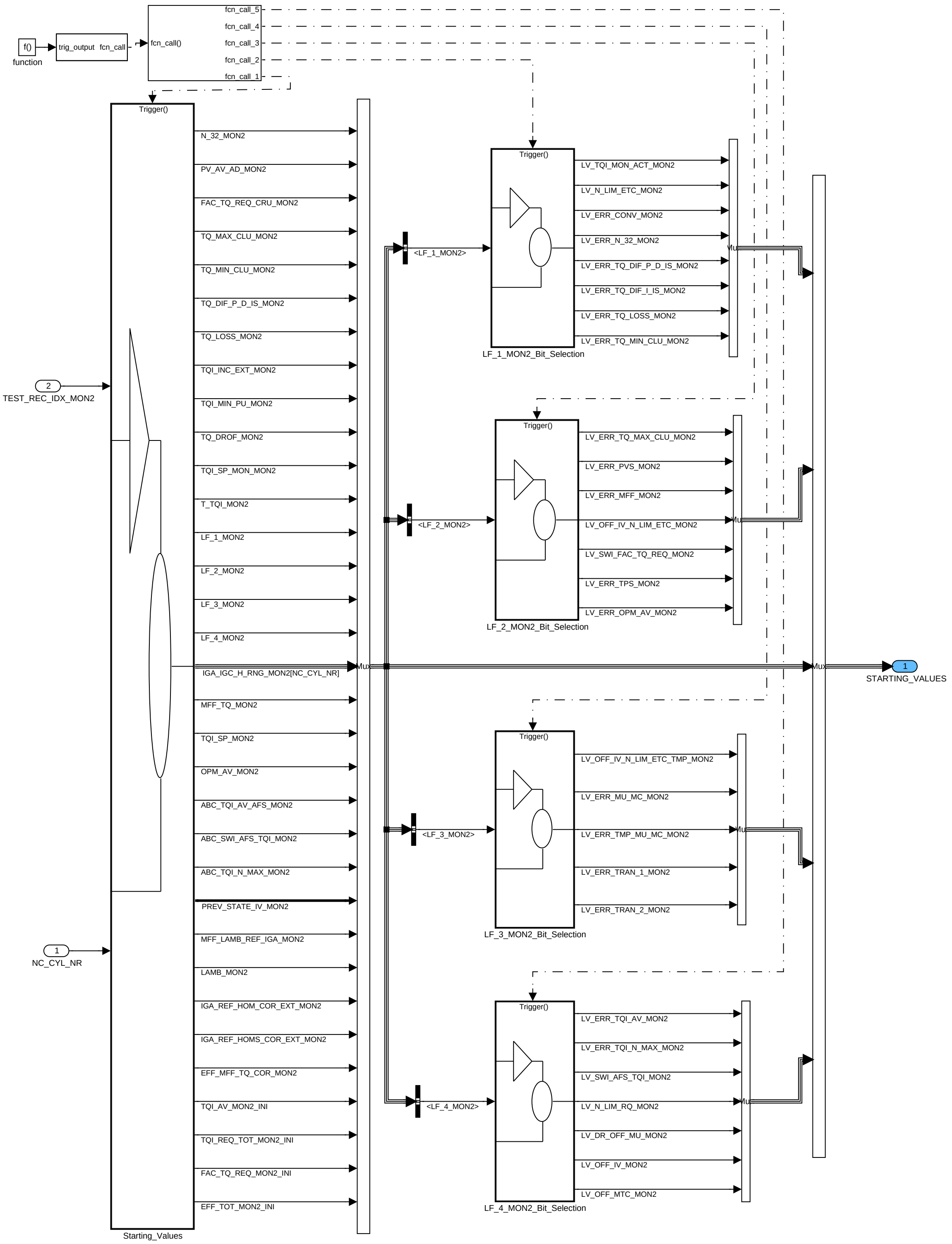

Figure E.27.5: ECM2_DTSYSCOPPRHPDI/OPERATE/INI_START_VALUES

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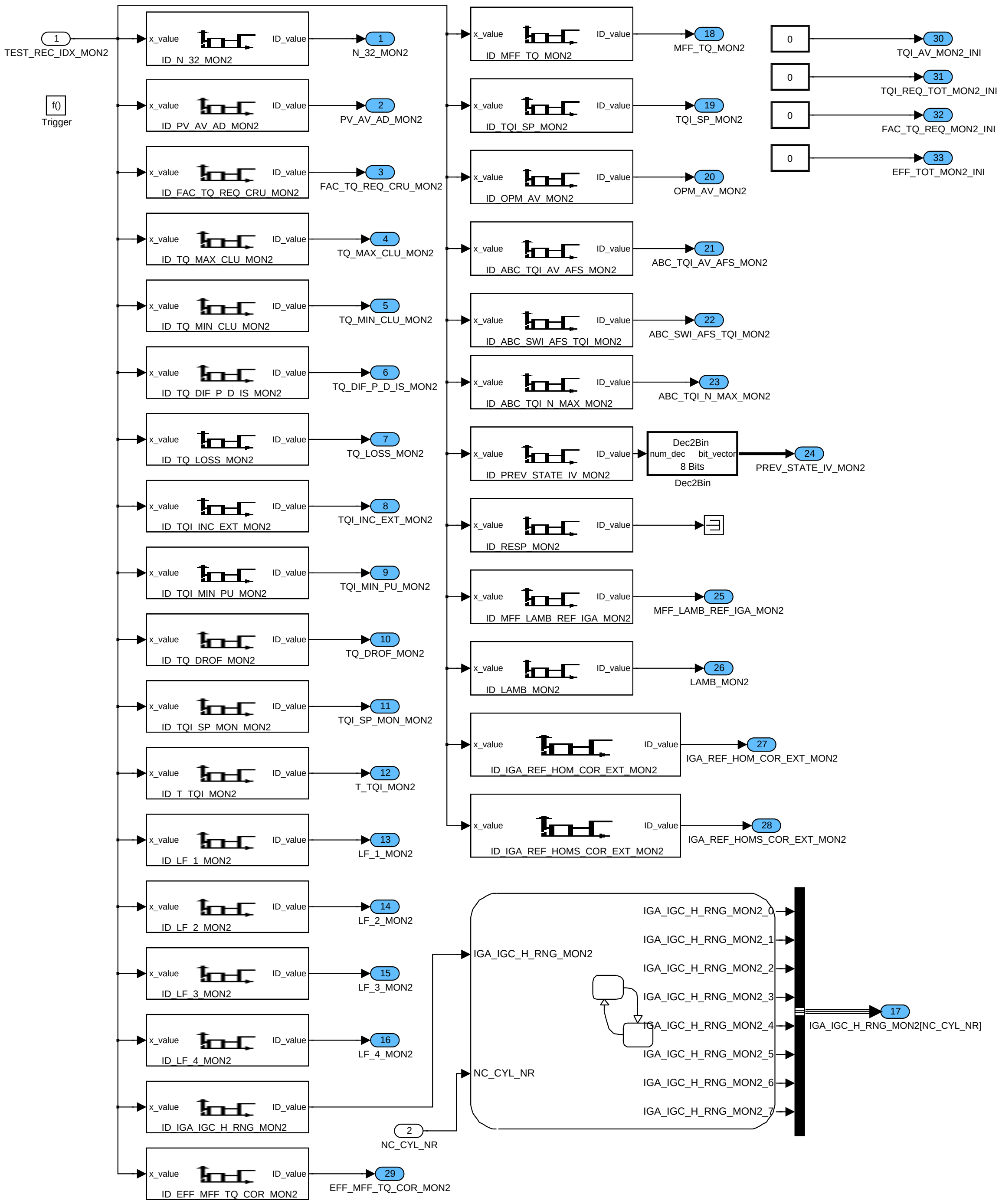

Figure E.27.6: ECM2_DTSYSCOPPRHPDI/OPERATE/INI_START_VALUES/Starting_Values

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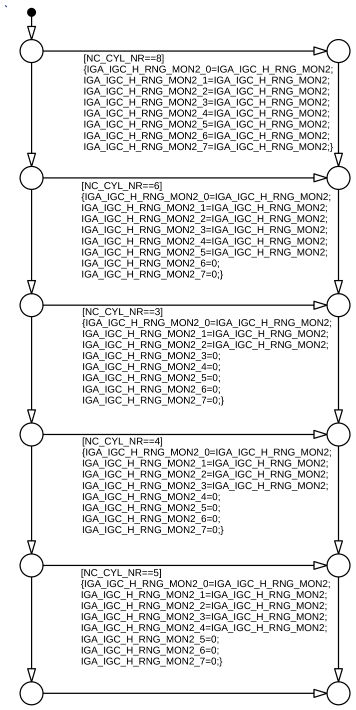

Figure E.27.7: ECM2_DTSYSCOPPRHPDI/OPERATE/INI_START_VALUES/Starting_Values/Chart1

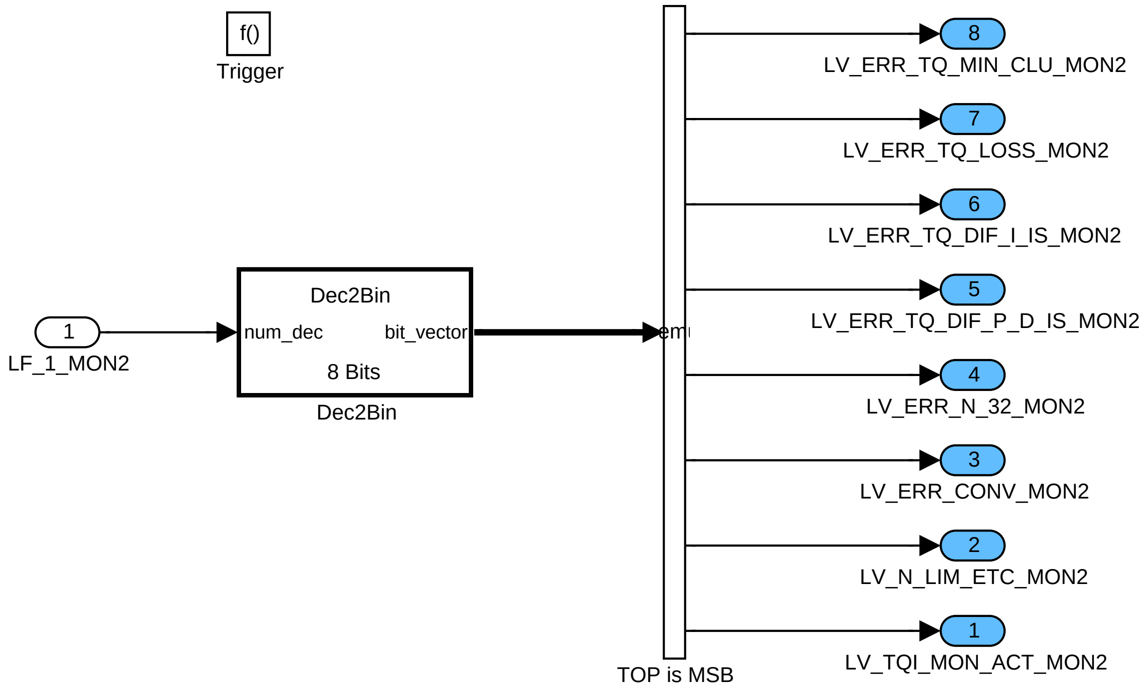

Figure E.27.8:
ECM2_DTSYSCOPPRHPDI/OPERATE/INI_START_VALUES/LF_1_MON2_Bit_Selection

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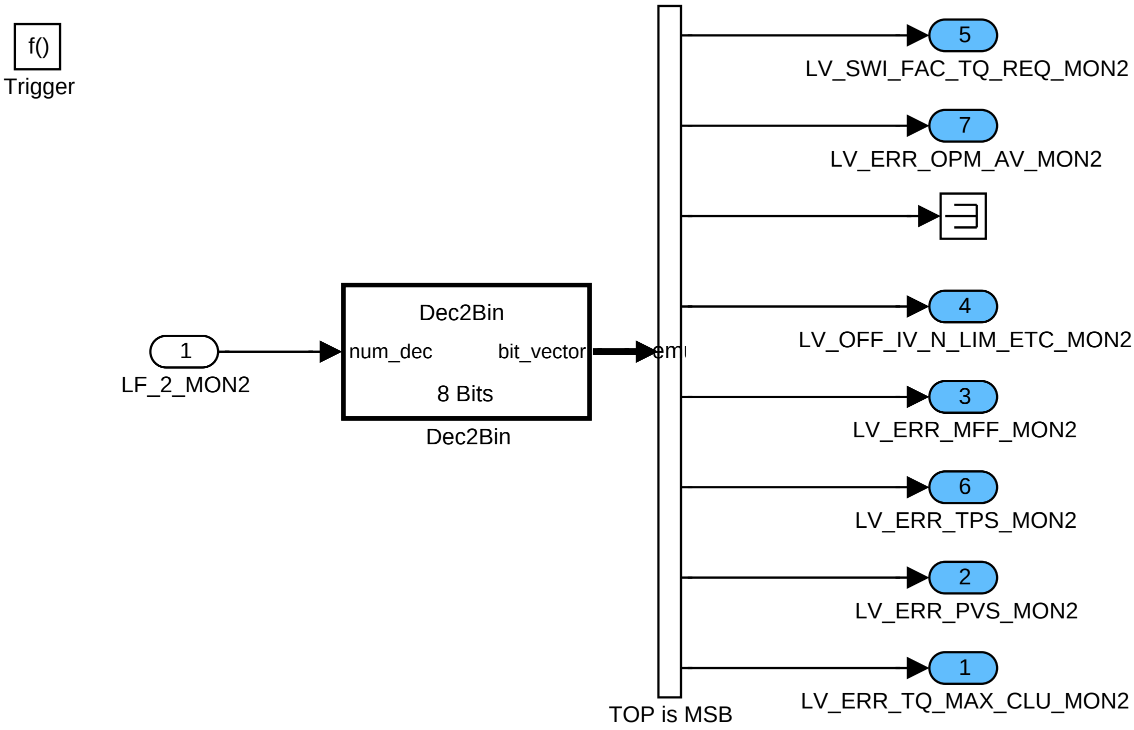

Figure E.27.9:
ECM2_DTSYSCOPPRHPDI/OPERATE/INI_START_VALUES/LF_2_MON2_Bit_Selection

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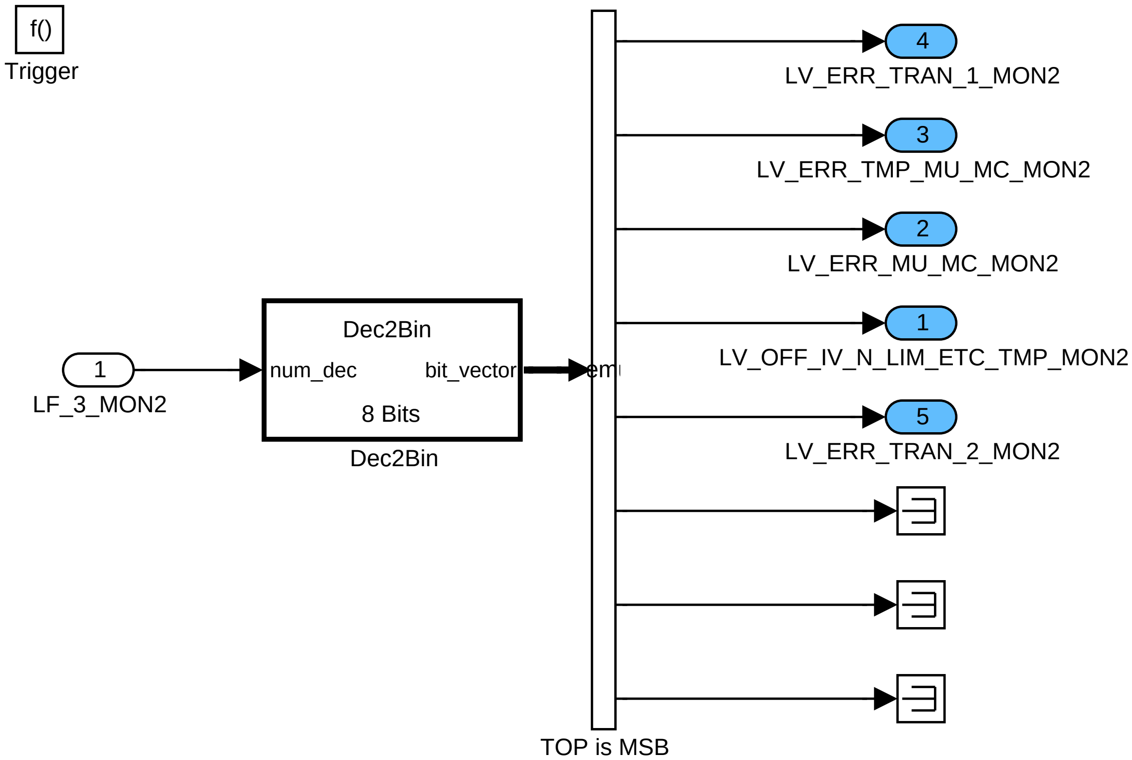

Figure E.27.10:
ECM2_DTSYSCOPPRHPDI/OPERATE/INI_START_VALUES/LF_3_MON2_Bit_Selection

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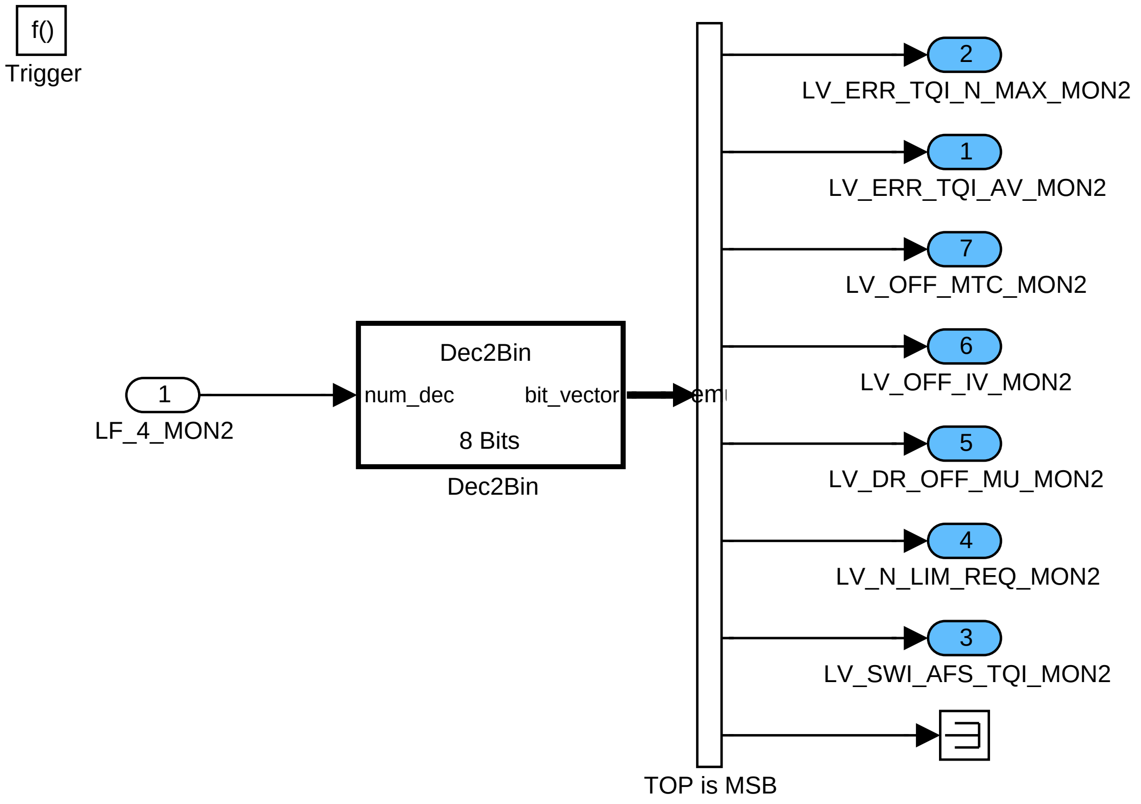

Figure E.27.11:
ECM2_DTSYSCOPPRHPDI/OPERATE/INI_START_VALUES/LF_4_MON2_Bit_Selection

Register calculation 1 for checking Interrupt routine

After reloading the register values REG_x_MON2 from the stack, N_32_MON2 from the submodule INI_START_VALUE shall be added to every REG_x_MON2.

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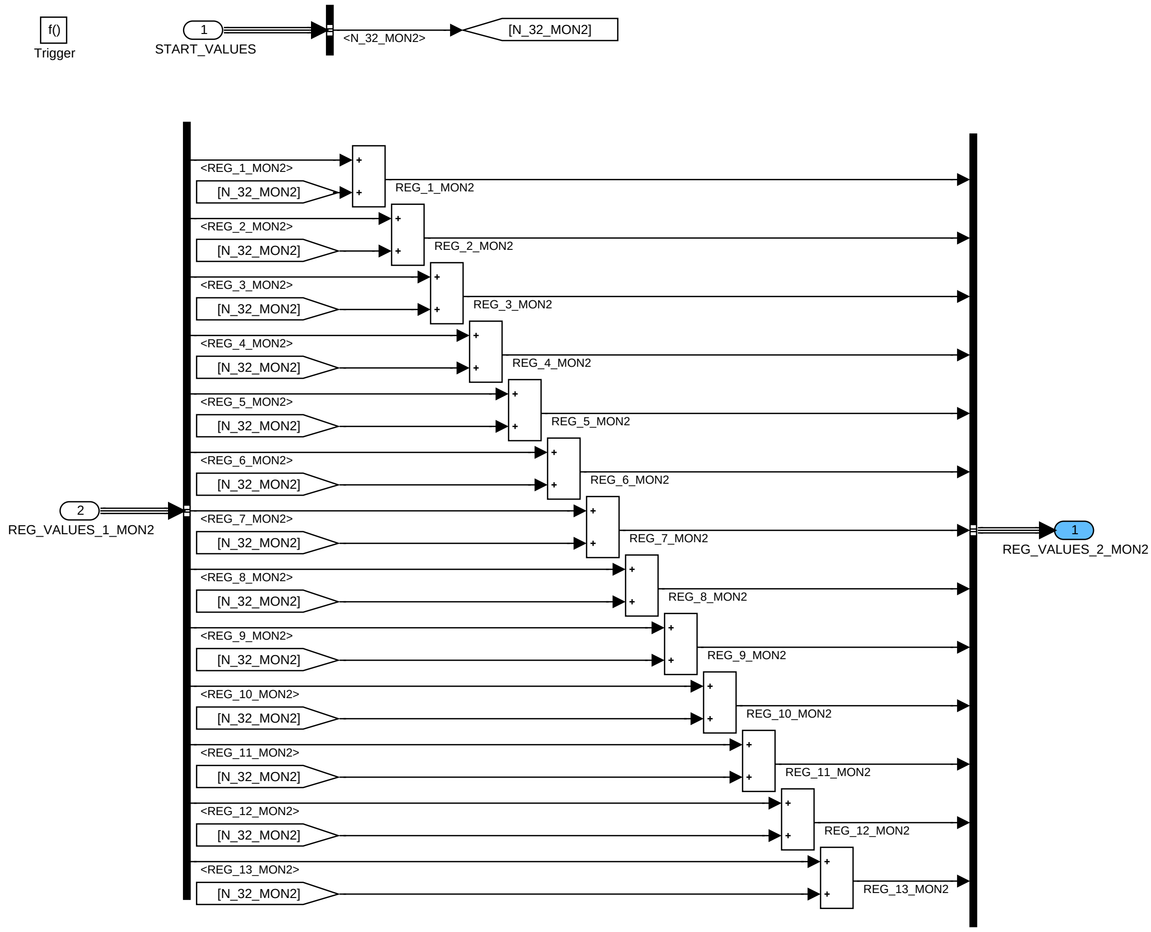

Figure E.27.12: ECM2_DTSYSCOPPRHPDI/OPERATE/REG_CALC_1

ECM2_DTSYSCOPPRHPDI/OPERATE/TQI_SP

General information:

The module has exactly the same functionality than the corresponding module Desired indicated engine torque of level 2 (30E00K01.00I) except:
No RAM test of output data performed
No initialisation section included
TQI_SP_MON (output) renamed to TQI_SP_MON_MON2
All input data, output data and calibration data renamed to level 2 naming
Example: xyz_MON renamed to xyz_MON2

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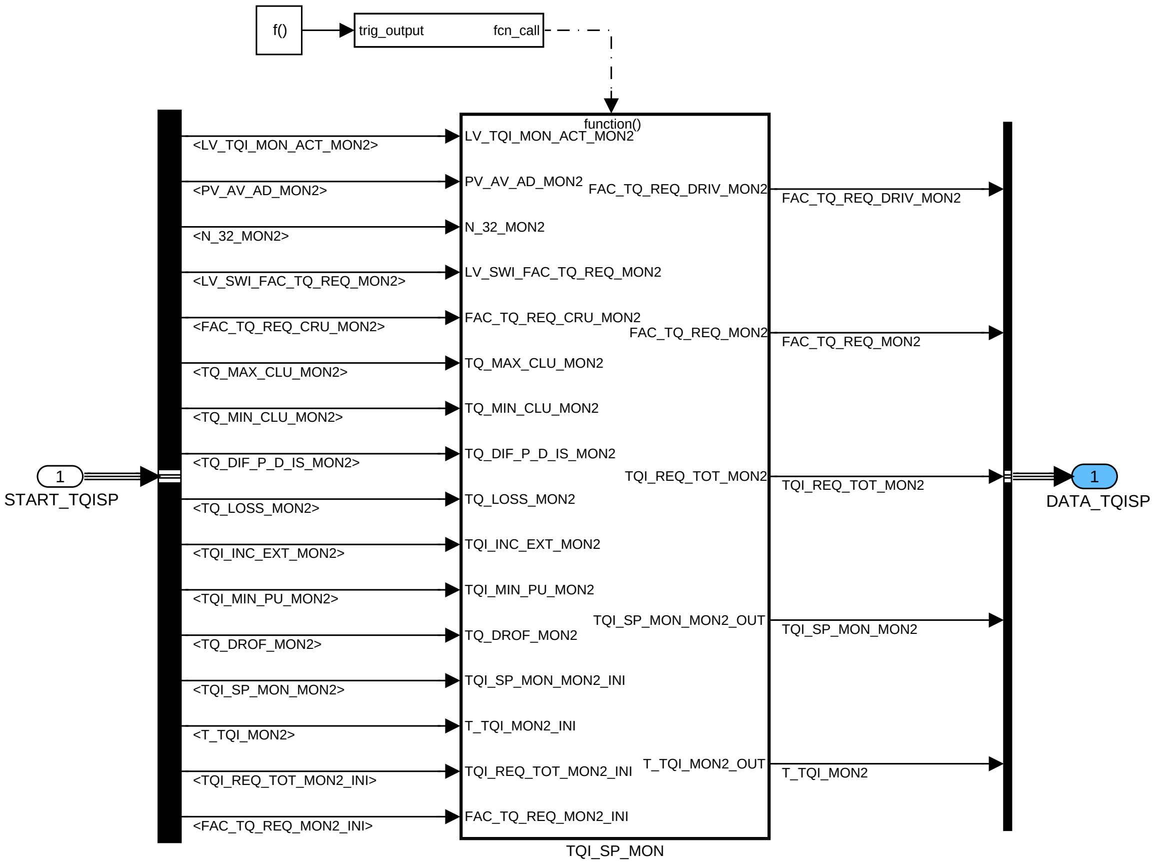

Figure E.27.13: ECM2_DTSYSCOPPRHPDI/OPERATE/TQI_SP

Register calculation 2 for checking Interrupt routine

After reloading the register values REG_x_MON2 from the stack, TQI_SP_MON_MON2 from the sub-module TQI_SP shall be added to every REG_x_MON2.

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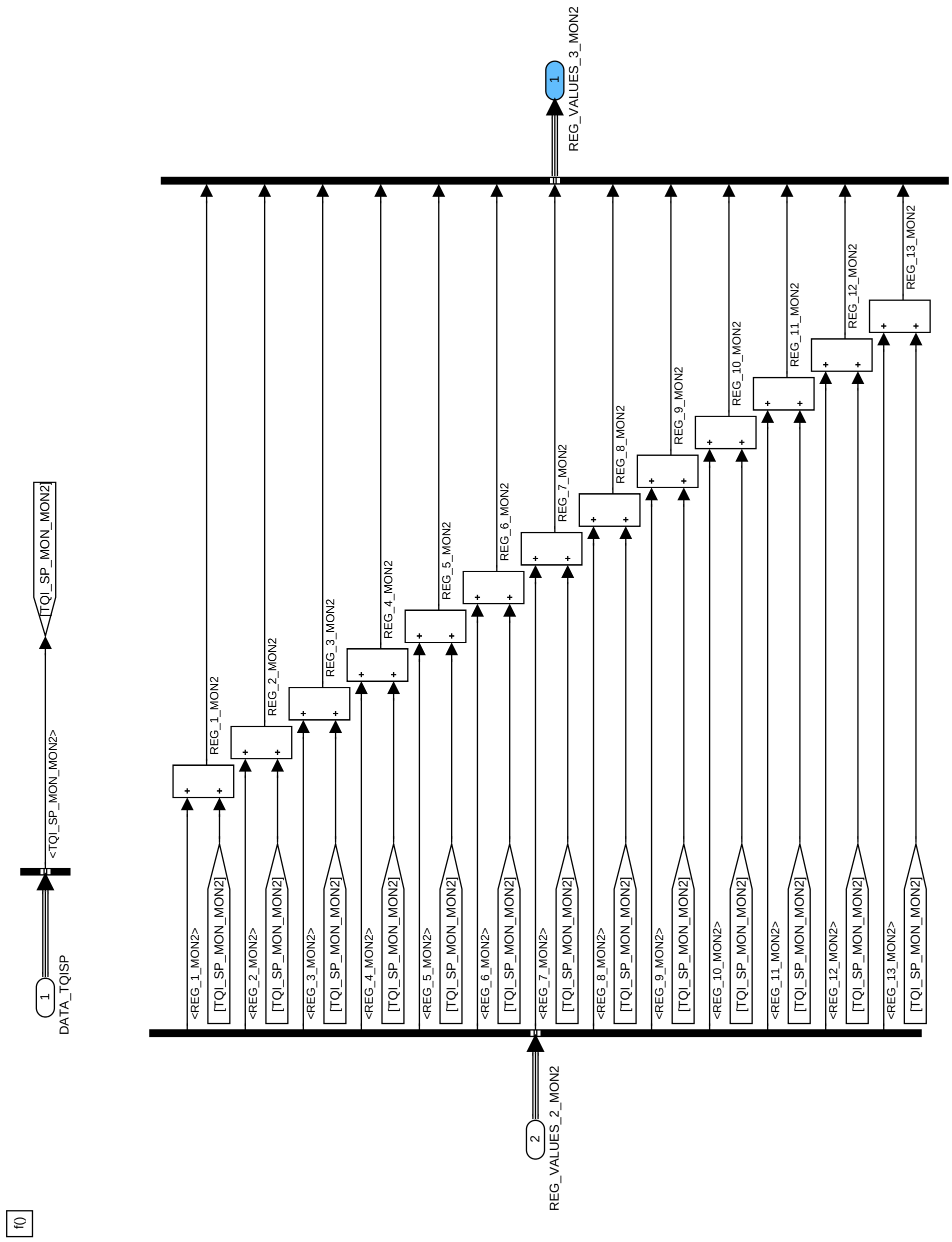

Figure E.27.14: ECM2_DTSYSCOPPRHPDI/OPERATE/REG_CALC_2

ECM2_DTSYSCOPPRHPDI/OPERATE/ACTUAL_EFF

General information:

The module has exactly the same functionality than the corresponding module Actual efficiencies of level 2 (30E01401.00J) except:
No RAM test of output data performed
No initialisation section included
All input data, output data and calibration data renamed to level 2 naming
Example: xyz_MON renamed to xyz_MON2

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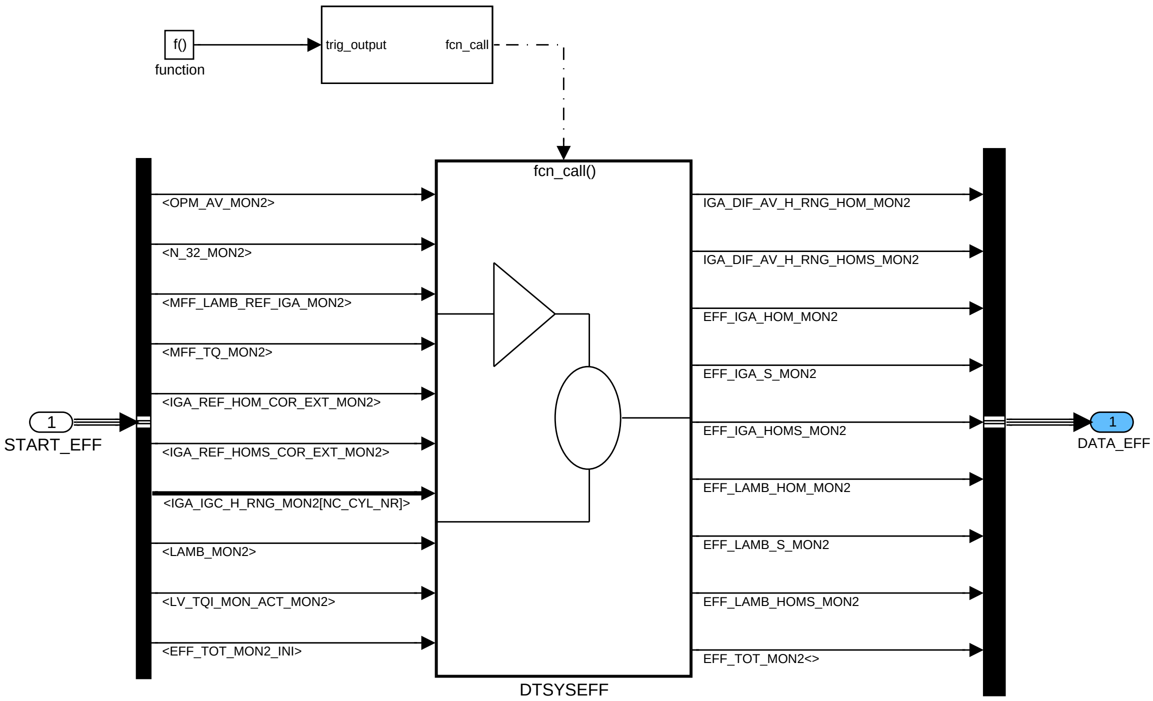

Figure E.27.15: ECM2_DTSYSCOPPRHPDI/OPERATE/ACTUAL_EFF

Register calculation 3 for checking Interrupt routine

After reloading the register values REG_x_MON2 from the stack, EFF_TOT_MON2 from the submodule ACTUAL_EFF shall be added to every REG_x_MON2.

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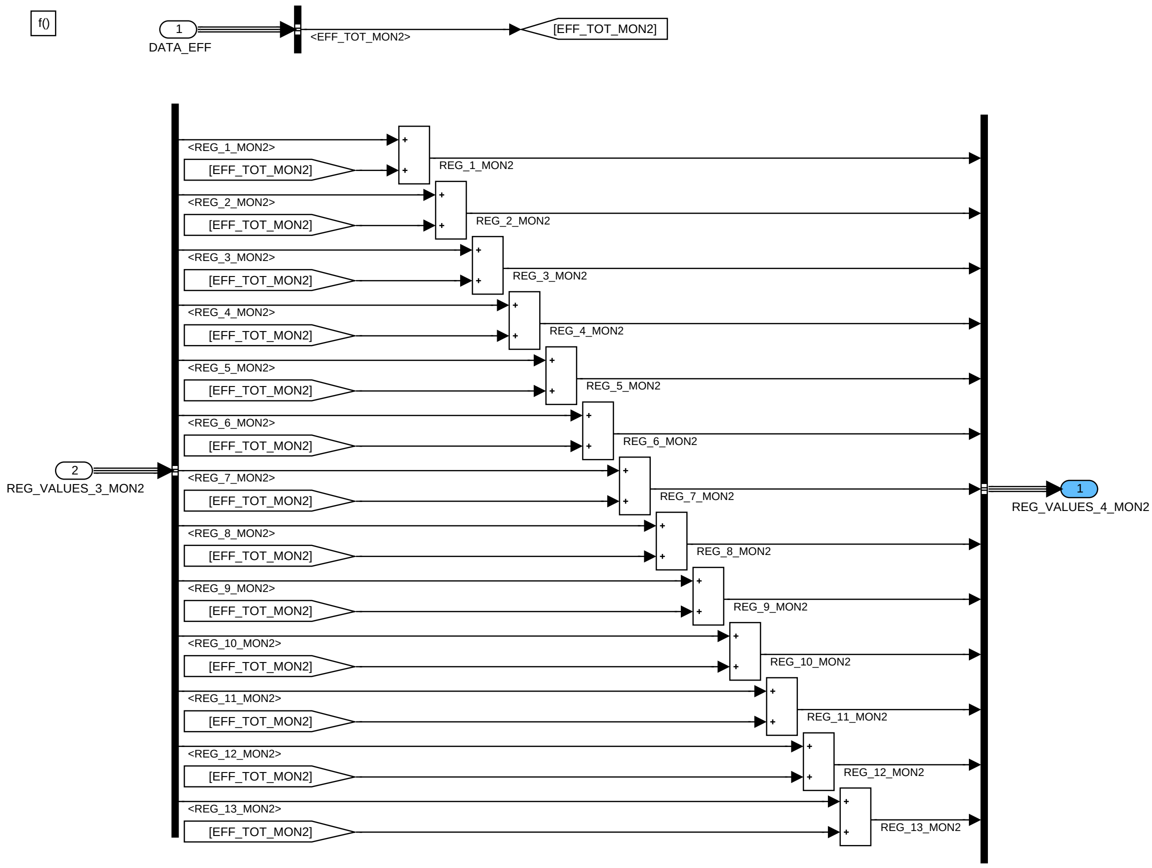

Figure E.27.16: ECM2_DTSYSCOPPRHPDI/OPERATE/REG_CALC_3

ECM2_DTSYSCOPPRHPDI/OPERATE/TQI_AV

General information:

The module has exactly the same functionality than the corresponding module Actual indicated engine torque of level 2 (30E00L01.00E) except:
No RAM test of output data performed
No initialisation section included
All input data, output data and calibration data renamed to level 2 naming
Example: xyz_MON renamed to xyz_MON2

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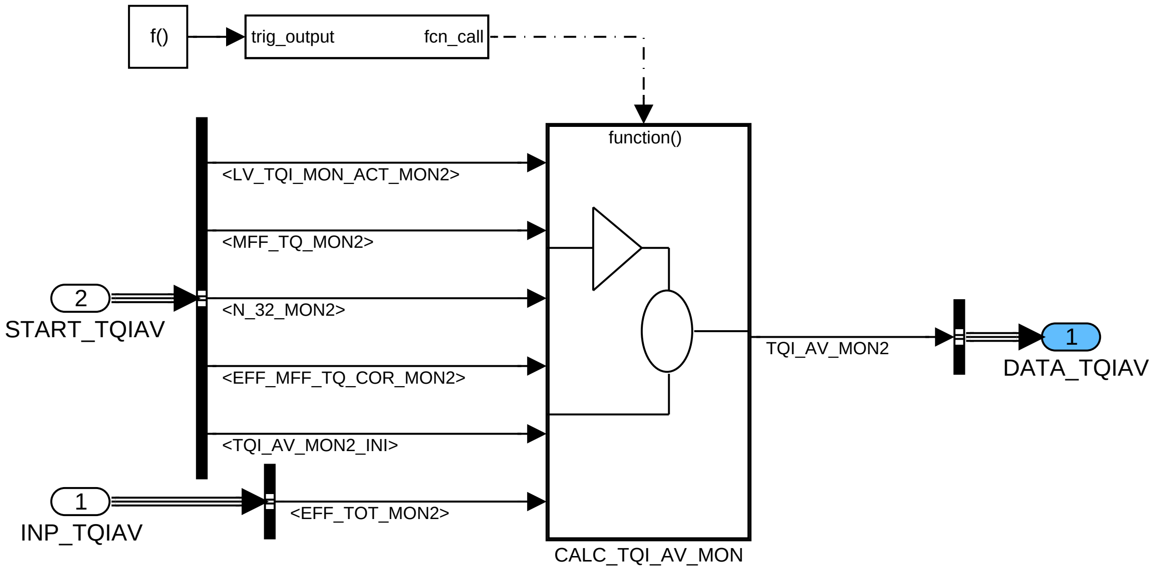

Figure E.27.17: ECM2_DTSYSCOPPRHPDI/OPERATE/TQI_AV

Register calculation 4 for checking Interrupt routine

After reloading the register values REG_x_MON2 from the stack, TQI_AV_MON2 from the submodule TQI_AV shall be added to every REG_x_MON2.

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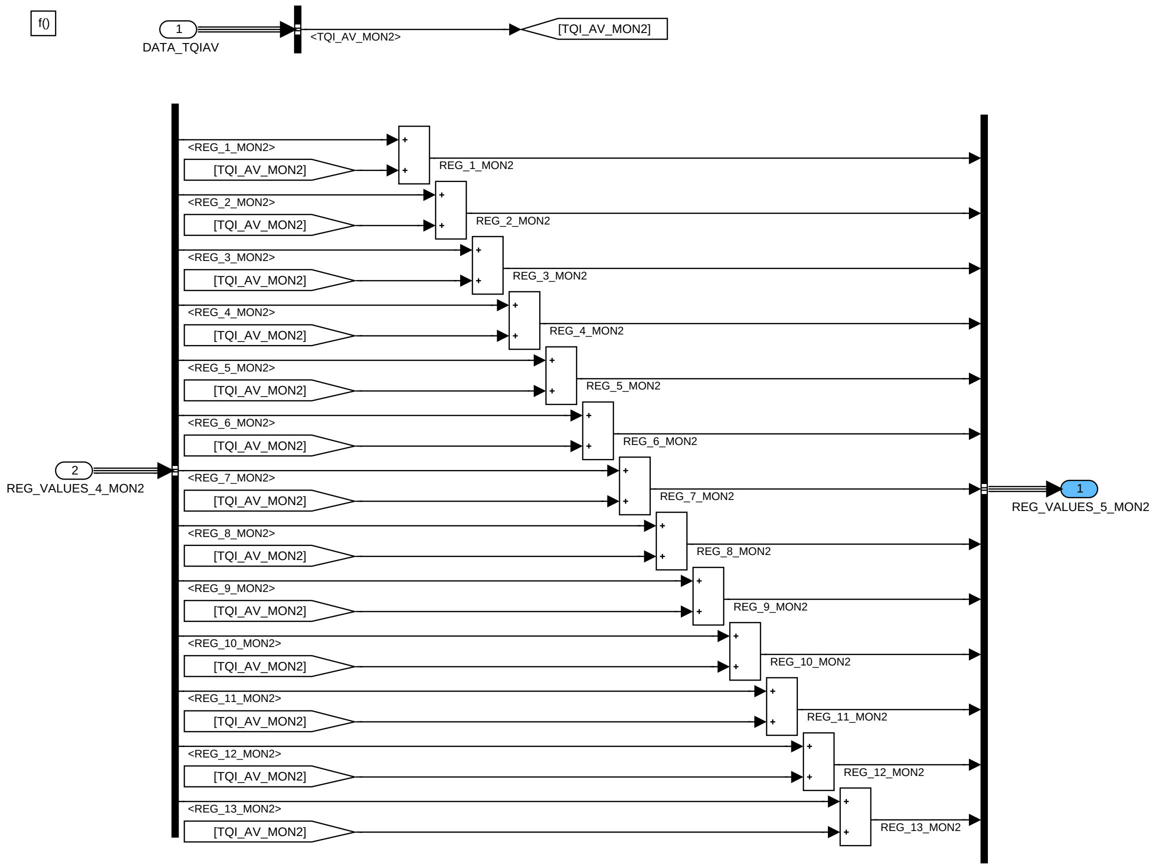

Figure E.27.18: ECM2_DTSYSCOPPRHPDI/OPERATE/REG_CALC_4

ECM2_DTSYSCOPPRHPDI/OPERATE/TQMON

General information:
The module has exactly the same functionality than the corresponding module Monitoring of actual indicated engine torque of level 2 (30E00M01.00E) except:
No RAM test of output data performed
No initialisation section included
TQI_SP_MON (input) renamed to TQI_SP_MON_MON2
All input data, output data and calibration data renamed to level 2 naming
Example: xyz_MON renamed to xyz_MON2

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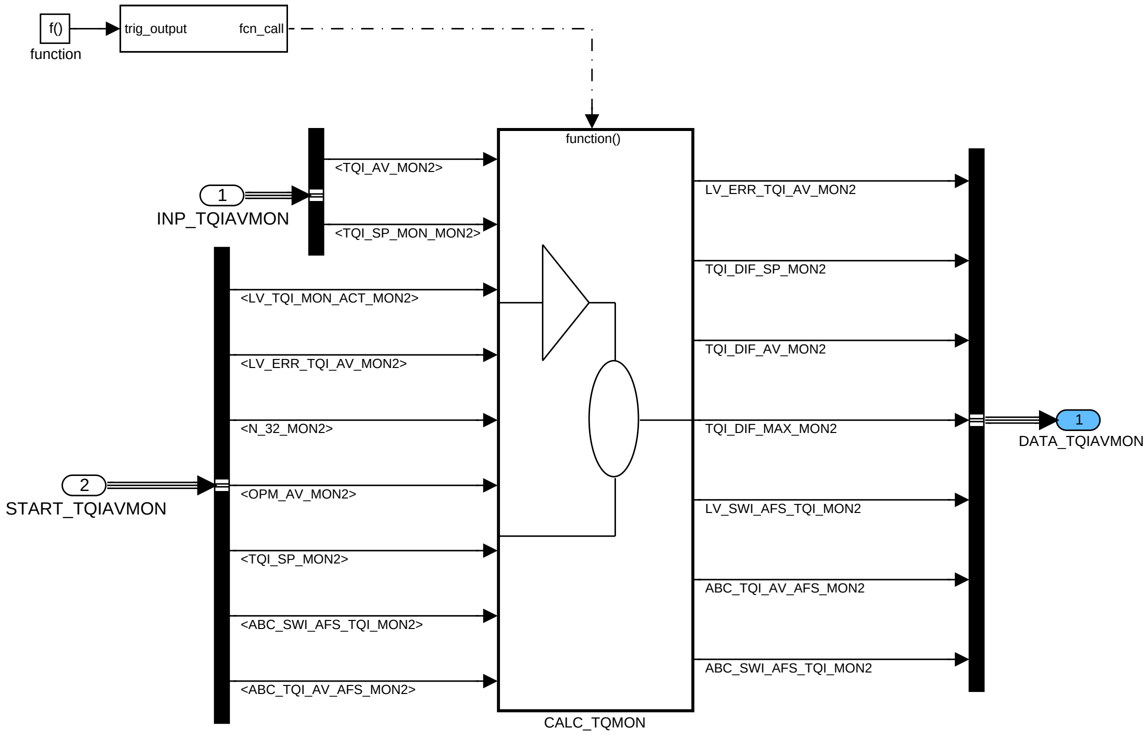

Figure E.27.19: ECM2_DTSYSCOPPRHPDI/OPERATE/TQMON

Register calculation 5 for checking Interrupt routine

After reloading the register values REG_x_MON2 from the stack, ABC_TQI_AV_AFS_MON2 from the submodule TQMON shall be added to every REG_x_MON2.

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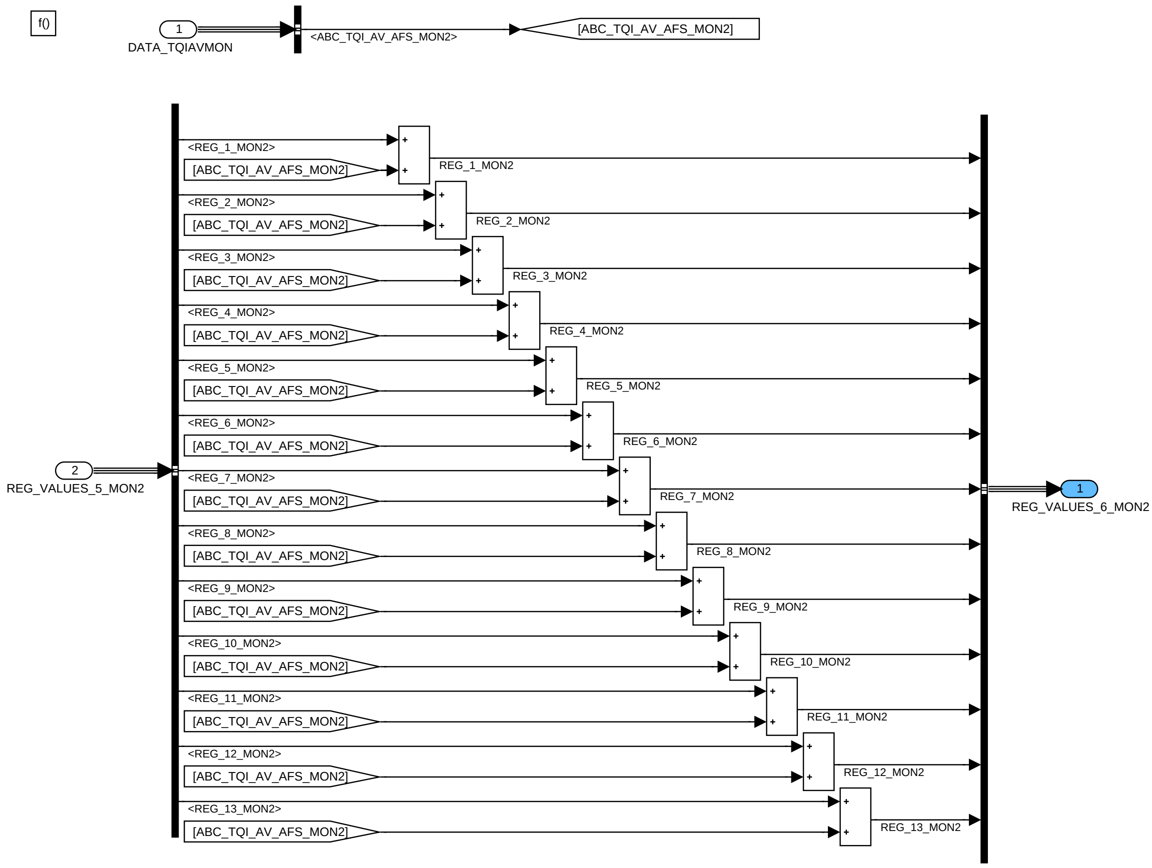

Figure E.27.20: ECM2_DTSYSCOPPRHPDI/OPERATE/REG_CALC_5

ECM2_DTSYSCOPPRHPDI/OPERATE/N_LIM_MON

General information:
The module has exactly the same functionality than the corresponding module Monitoring of engine speed limitation of level 2 (30E00I01.00F) except:
No RAM test of output data performed
No initialisation section included
All input data, output data and calibration data renamed to level 2 naming
Example: xyz_MON renamed to xyz_MON2

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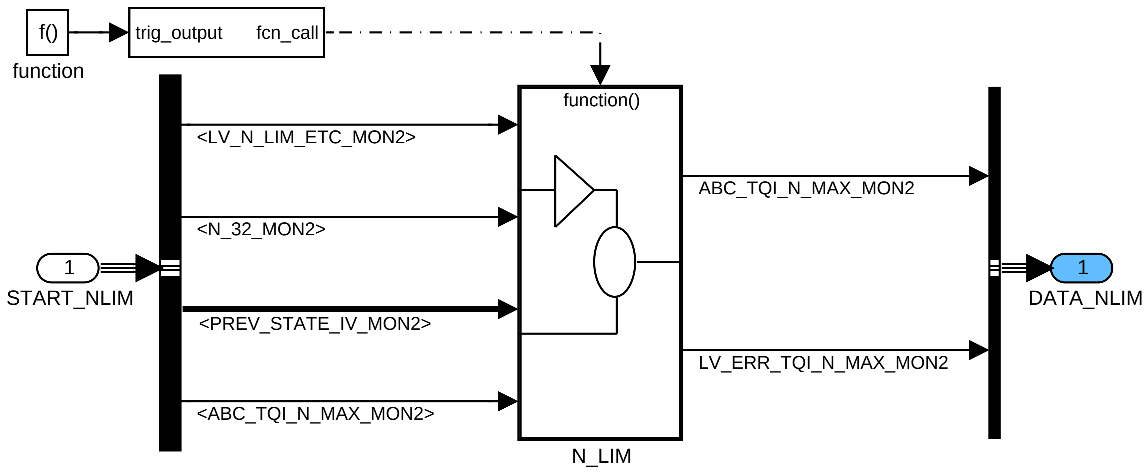

Figure E.27.21: ECM2_DTSYSCOPPRHPDI/OPERATE/N_LIM_MON

Register calculation 6 for checking Interrupt routine

After reloading the register values REG_x_MON2 from the stack, ABC_TQI_N_MAX_MON2 from the submodule N_LIM_MON shall be added to every REG_x_MON2.

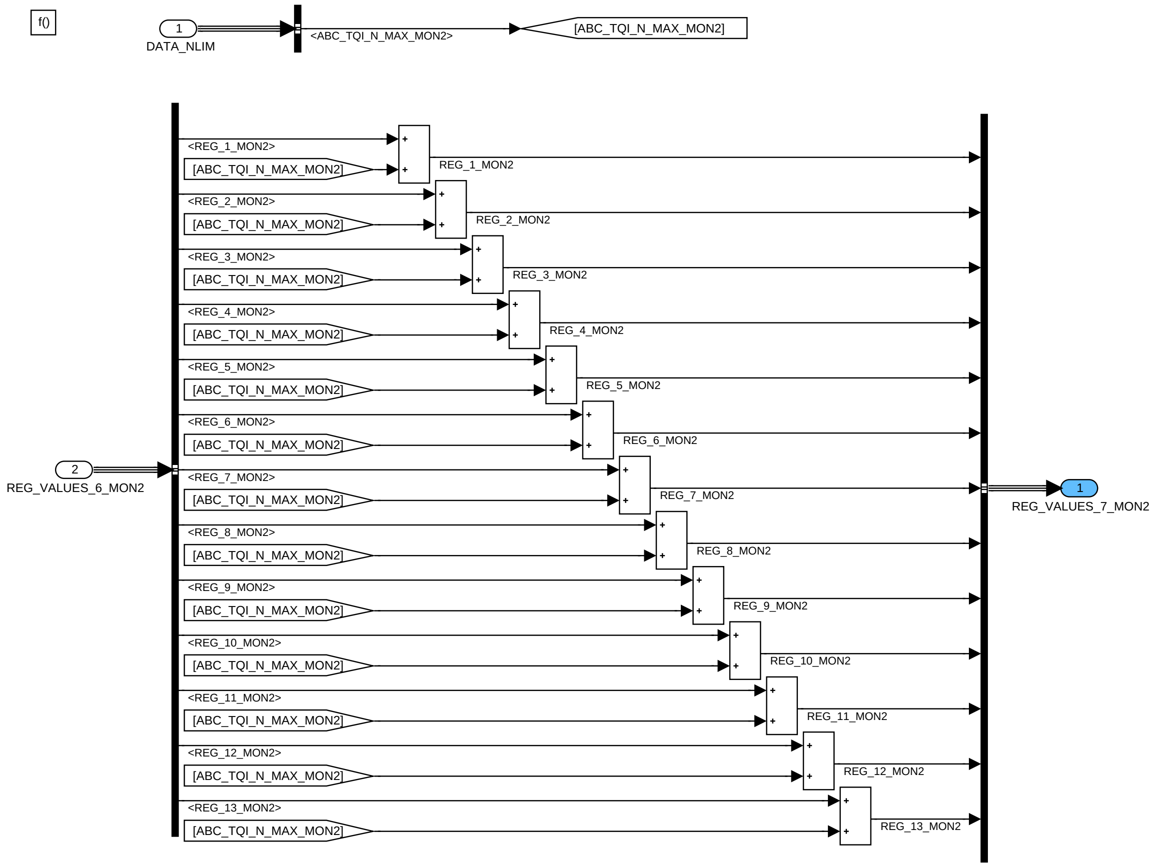

Figure E.27.22: ECM2_DTSYSCOPPRHPDI/OPERATE/REG_CALC_6

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ECM2_DTSYSCOPPRHPDI/OPERATE/FAULT_REACTION

General information:

The module has exactly the same functionality than the corresponding module Fault reaction of process monitoring of level 2 (30E00G01.00J) except:
No RAM test of output data performed
No initialisation section included
All input data, output data and calibration data renamed to level 2 naming
Example: xyz_MON renamed to xyz_MON2
The ACTION_ECM3_RedSwitchOffPath() is replaced, instead of the original action call LV_DR_OFF_MU_MON2 is set to 1.
The byte LF_4_MON2 is updated with the output flags after execution.

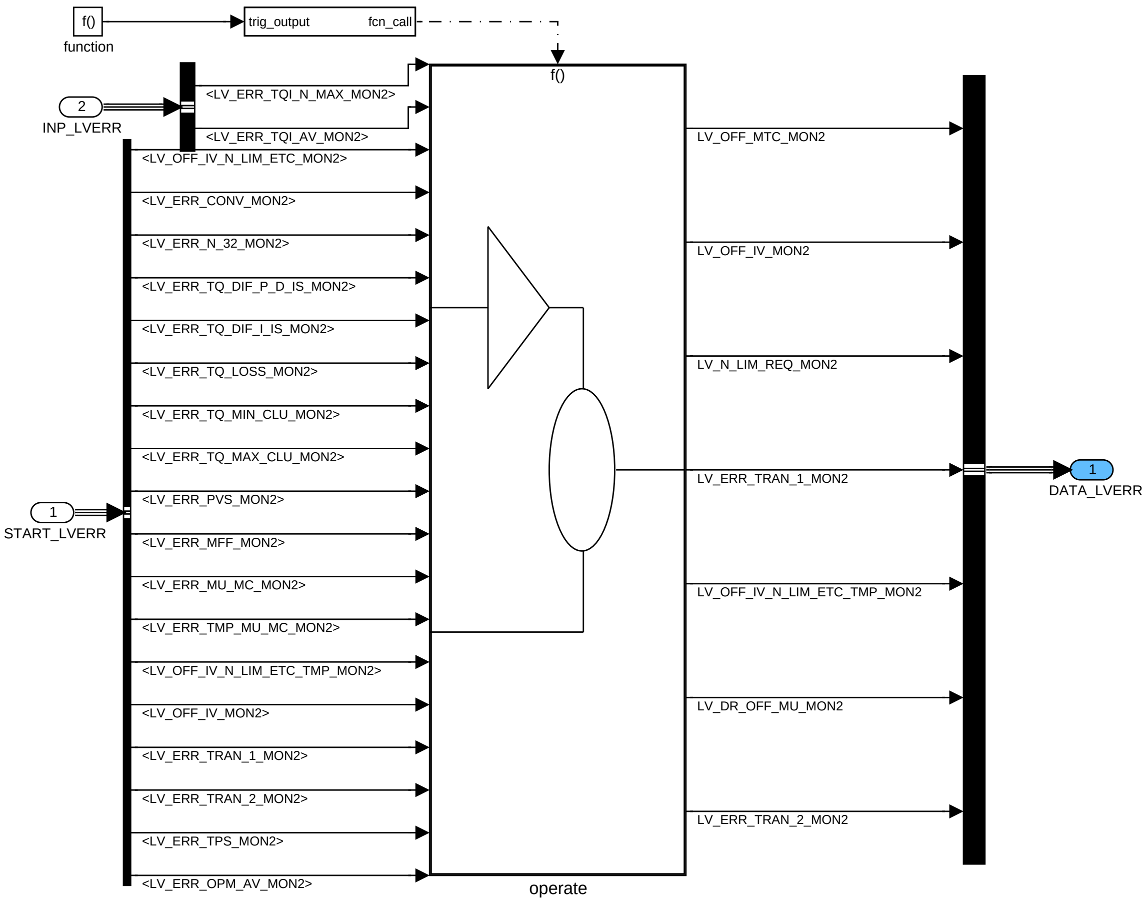

Figure E.27.23: ECM2_DTSYSCOPPRHPDI/OPERATE/FAULT_REACTION

Register calculation 7 for checking Interrupt routine

After reloading the register values REG_x_MON2 from the stack, LV_OFF_IV_MON2 from the submodule FAREA shall be added to every REG_x_MON2.

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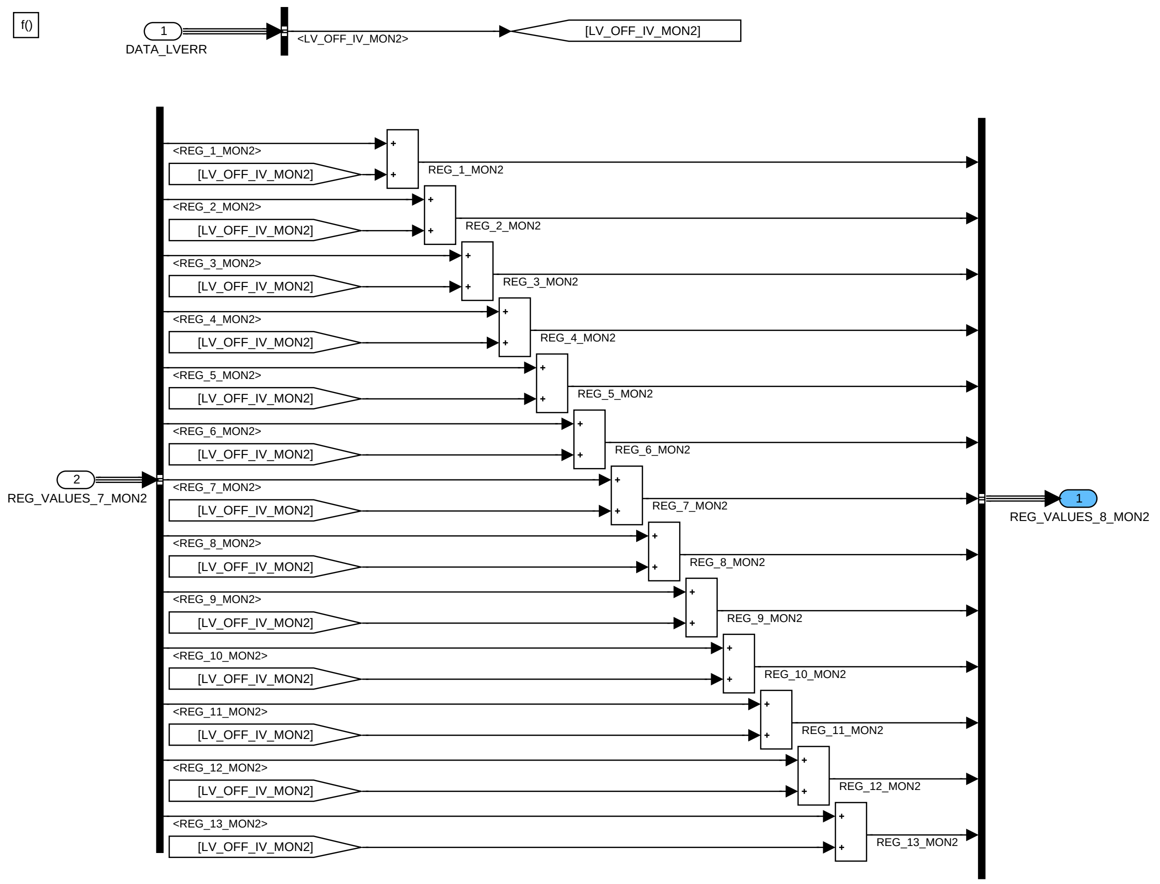

Figure E.27.24: ECM2_DTSYSCOPPRHPDI/OPERATE/REG_CALC_7

ECM2_DTSYSCOPPRHPDI/OPERATE/RESP_MON_TEMP

General information:
The byte LF_4_MON2 is updated with the output flags after execution.
There is a possibility for faults, which leads to wrong interim results but to a correct final result of the test calculation. In order to ensure that such a kind of fault is detectable, the final result is composed of several intermediate ones coming out of different parts of the test calculation.
Formula section:

RESP_MON2_TEMP = (TQI_SP_MON_MON2
TQI_AV_MON2
\+ TQI_REQ_TOT_MON2
\+ FAC_TQ_REQ_MON2
\+ ABC_TQI_AV_AFS_MON2
\+ 256 * ABC_TQI_N_MAX_MON2)
XOR (256 * LF_4_MON2)

All operations are performed with hexadecimal values only. The different units are not taken into account. The result of the operations and all intermediate results are 32 Bit word size.
ID_RESP_MON2 [TEST_REC_IDX_MON2] must fit to RESP_MON2 if the test calculation with index TEST_REC_IDX_MON2 has been executed correctly.

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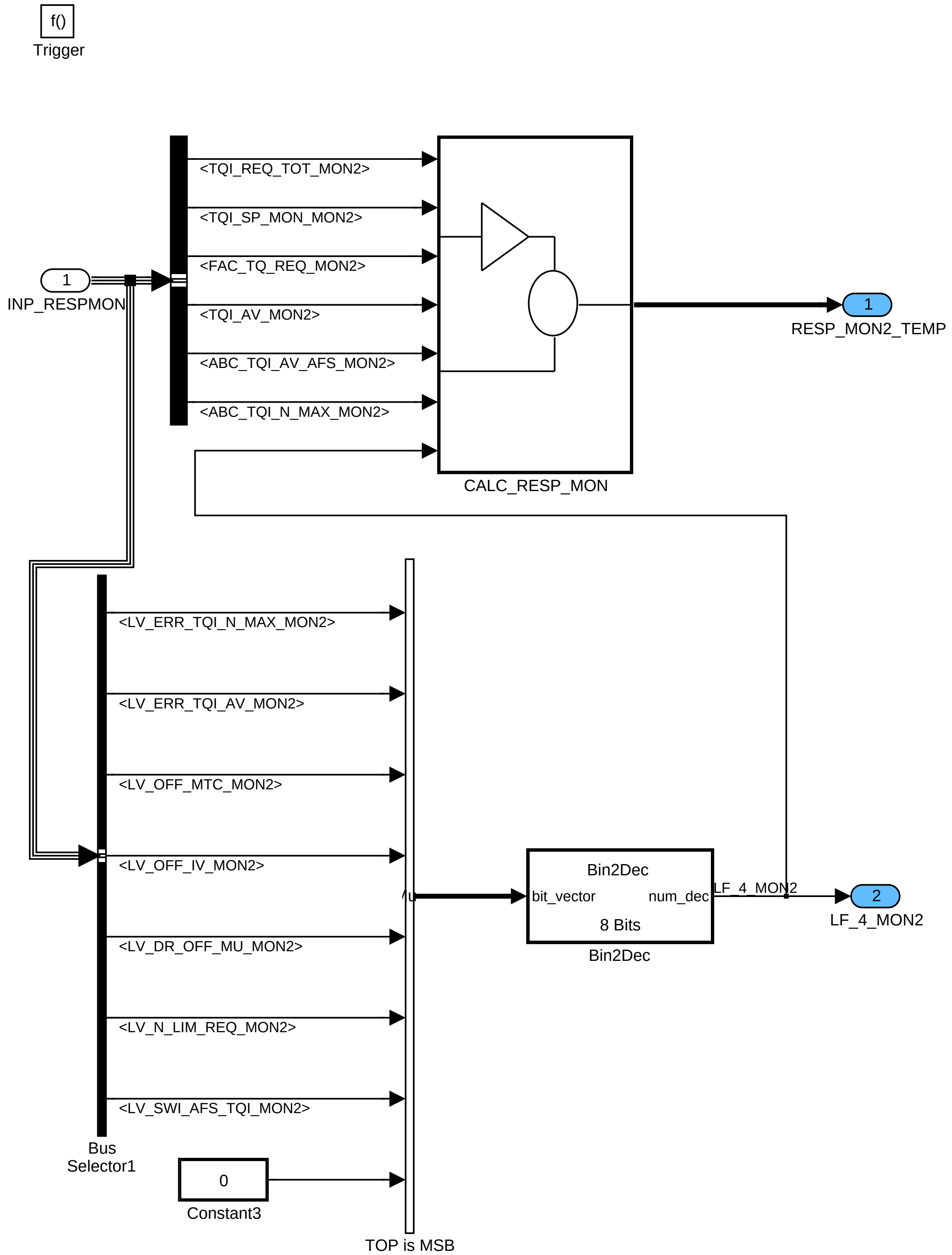

Figure E.27.25: ECM2_DTSYSCOPPRHPDI/OPERATE/RESP_MON_TEMP

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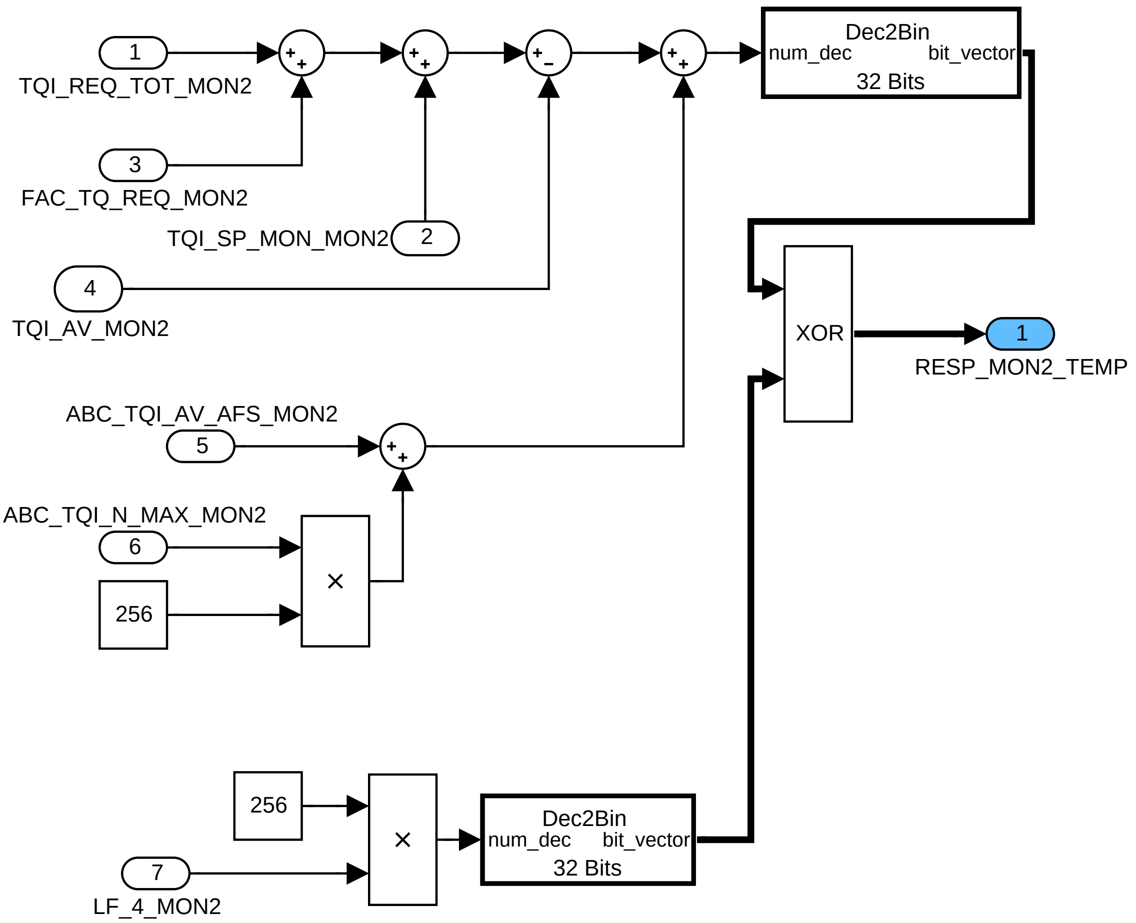

Figure E.27.26: ECM2_DTSYSCOPPRHPDI/OPERATE/RESP_MON_TEMP/CALC_RESP_MON

ECM2_DTSYSCOPPRHPDI/OPERATE/RESP_MON

For the final calculation of RESP_MON2, the 32 bit values used so far have to be encoded into a 16 bit value. Therefore, after adding the register values, the high and the low 16 bit values of the resulting sum shall be combined by an XOR. The same procedure shall be applied to the temporary result RESP_MON2_TEMP which shall the additionally also be XORed with the final result of the register operations.

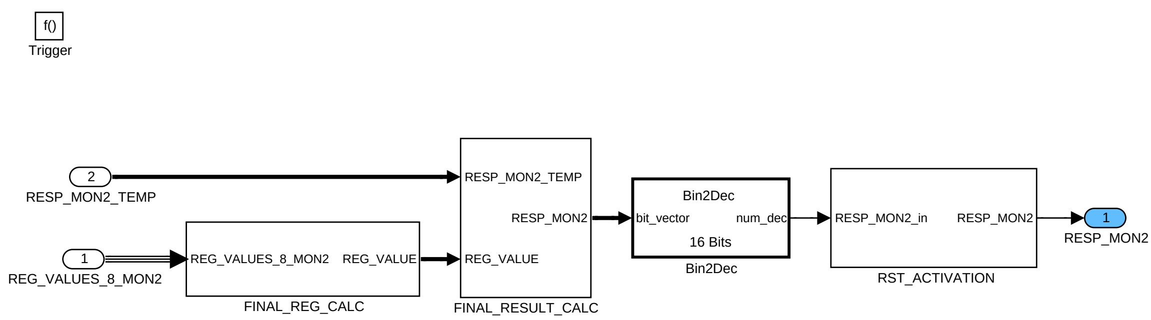

Figure E.27.27: ECM2_DTSYSCOPPRHPDI/OPERATE/RESP_MON

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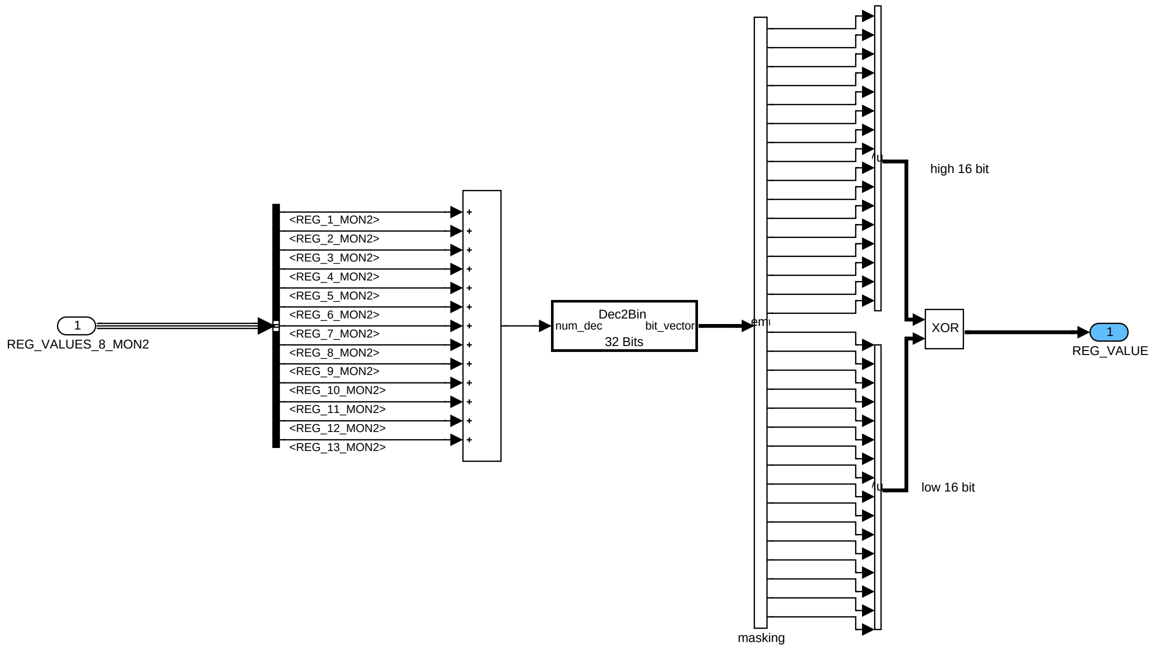

Figure E.27.28: ECM2_DTSYSCOPPRHPDI/OPERATE/RESP_MON/FINAL_REG_CALC

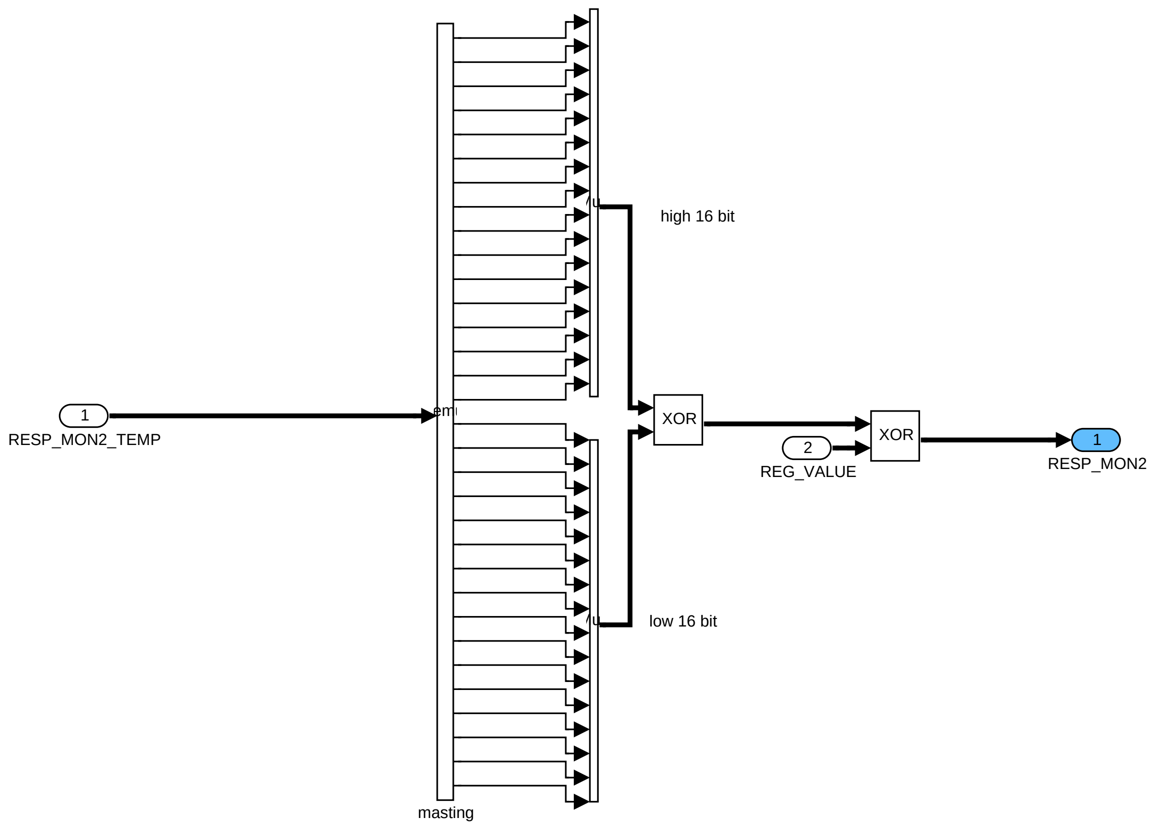

Figure E.27.29: ECM2_DTSYSCOPPRHPDI/OPERATE/RESP_MON/FINAL_RESULT_CALC

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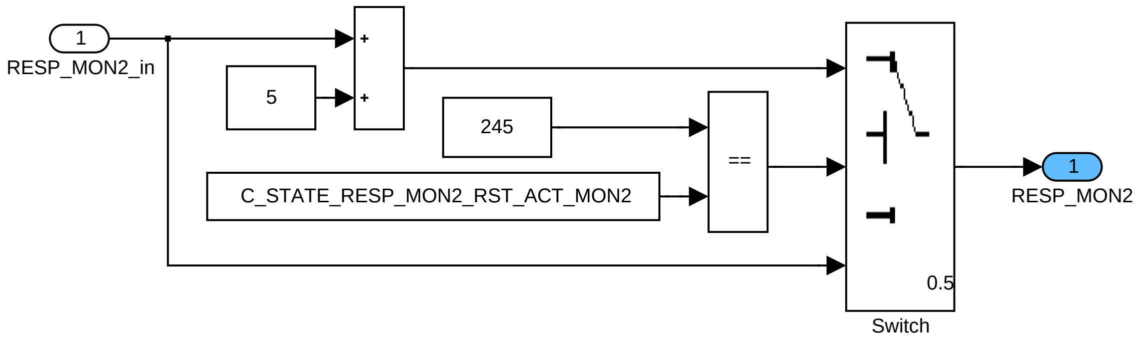

Figure E.27.30: ECM2_DTSYSCOPPRHPDI/OPERATE/RESP_MON/RST_ACTIVATION

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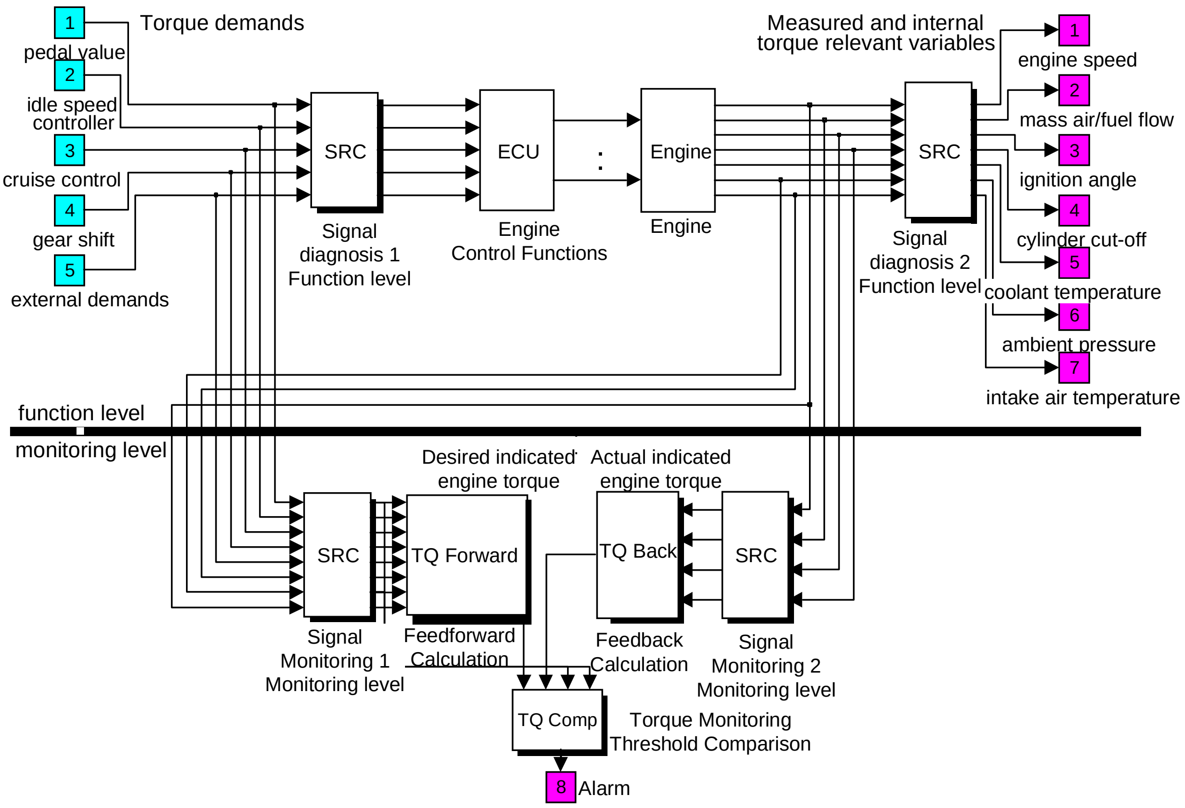
E.28 Torque monitoring overview

In the function level the various torque demands coming from the driver, the idle speed controller etc. are co-ordinated to a resulting quantfied charge setpoint. At the same time the actual indicated engine torque is calculated based on several measured and internal torque relevant variables.
The aim of the torque monitoring is to detect an increased actual indicated engine torque compared to the desired indicated engine torque. Therefore the co-ordination of the various torque demands and the calculation of the actual indicated engine torque done in the function level (level 1) is performed once again in the monitoring level (level 2), however with a simplified structure. Then the deviation between the actual (TQI_AV_MON) and the desired indicated engine torque (TQI_SP_MON) is checked for exceeding a threshold.

Signal flow diagram:

Overview



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E.29 Communication MC - MU

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_MU_READY	-	0... FFH	0... 255	1	-
Local variable: counter for attempts of check of MU readiness					
LV_MC_CKS_OK	-	0... 1H	0 ...1	1	-
Local variable: flag indicating whether the (XOR) checksum of the data received from the MU is correct					
LV_MC_CKS_OK_CPL	-	0... 1H	0 ...1	1	-
Local variable: complement of LV_MC_CKS_OK					
LV_MC_COM_ERR	O/V	0... 1H	0 ...1	1	-
Error flag indicating any communication error (checksum, header, or parity)					
LV_MC_COM_ERR_CPL	O/V	0... 1H	0 ...1	1	-
Complement of LV_MC_COM_ERR					
LV_MC_HD_OK	-	0... 1H	0 ...1	1	-
Local variable: flag indicating whether the received header was correct or not					
LV_MC_HD_OK_CPL	-	0... 1H	0 ...1	1	-
Local variable: complement of LV_MC_HD_OK					
LV_MC_PAR_OK	-	0... 1H	0 ...1	1	-
Local variable: flag indicating whether the data received from the MU had the correct (even) parity					
LV_MC_PAR_OK_CPL	-	0... 1H	0 ...1	1	-
Local variable: complement of LV_MC_PAR_OK					
LV_MU_READY	O/V	0... 1H	0 ...1	1	-
Flag indicating whether MU is ready (=1) or not (=0)					
STATE_MU_TMP	O/V/S	0... FFH	0... 255	1	-
Header byte of MU as sent to MC (stored in reset-safe manner)					
STATE_MU_TMP_CPL	O/S	0... FFH	0... 255	1	-
Complement of STATE_MU_TMP (stored in reset-safe manner)					

Input data:

NC_ABC_MC_CKS {p. 7073}	NC_ABC_MC_HD {p. 7074}	NC_ERR_COD_MC_CKS {p. 7077}	NC_ERR_COD_MC_HD {p. 7077}
NC_ERR_COD_MC_MU_READY {p. 7077}	NC_ERR_COD_MC_PAR {p. 7077}	NC_STATE_MC_CONF {p. 7136}	NC_STATE_MC_DI {p. 7136}
NC_STATE_MC_INI {p. 7136}	NC_STATE_MC_NORM {p. 7136}	NC_STATE_MC_NOT_VLD {p. 7136}	NC_STATE_MC_PRDR {p. 7136}
STATE_MC {p. 7135}			

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CTR_MU_READY_MAX	-	0... FFH	0... 255	1	-
Maximal number how often the check for MU readiness shall be performed before triggering a fault reaction					
NC_T_MC_COM_CYC	-	0... FFH	0... 255	1	-
Time between triggering two communications					

Import actions:

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ACTION_ECM3_ChkCpl (**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_McDecAbc (**IN**<PRM_ABC_ID>)
ACTION_ECM3_McFaultReaction (**IN**<PRM_ERR_COD>)
ACTION_ECM3_McIncAbc (**IN**<PRM_ABC_ID>,**IN**<PRM_ERR_COD>)
ACTION_ECM3_McReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>,**IN**<PRM_DFT_VALUE>)
ACTION_ECM3_McReadChkState (**OUT**<PRM_STATE_MC_TMP>)
ACTION_ECM3_ReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_WriteChkCpl (**INOUT**<PRM_VAR>,**OUT**<PRM_VAR_CPL>,**IN**<PRM_VALUE>)
ACTION_INFR_McChkCks (**OUT**<No Name available>)
ACTION_INFR_McChkPar (**OUT**<No Name available>)
ACTION_INFR_McGetHd (**OUT**<PRM_STATE_MU>)
ACTION_INFR_McStartCom (**IN**<No Name available>)
ACTION_INFR_MuReady (**OUT**<No Name available>)
ACTION_INFR_StartMuReadyChk ()

FUNCTION DESCRIPTION:

General information:

This module describes all functions related to monitoring of communications on the MC.
The complete function is split according to the states where the communication occurs, and also there is a second split between triggering a communication, and monitoring the data from a preceding communication; functions for communication monitoring are triggered after the communication between MC and MU is finished.
Note that header-byte monitoring, in case a DISABLE header is received from the MU, only performs the consecutive parity-bit checking; the transition to DISABLE, which is also a consequence of the received header, is specified in the function "G5.1 Disable request by MU" (cf. R5.1_1.1).
A noteworthy point for communications in the states NORMAL and DISABLE is that the preparation of the next communication needs to be performed at a certain point *when all the necessary other functions have been executed and completed* as they prepare the data to be sent in the next communication; this can be contrasted to the two functions for CONFIG and PREDRIVE which are essentially triggered by state changes (with the additional point that certain data have to be sent to the infrastructure so that the correct values are transmitted to the MU).

E.29.1 Check of MU readiness

FUNCTION DESCRIPTION:

General information:

The start-up on MC and MU is done asynchronously, so potentially the MC could already be willing to trigger the first communication while the MU has not yet completed its start-up. A communication error would be the consequence, even if the communication itself was performed without any problem - the MU simply was not yet ready and had, e.g., not yet properly prepared the data for the first communication.

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In order to avoid such situations, the MC - as the master of the communication - shall first check whether the MU is ready. If the MU is ready, the first communication shall be triggered. Otherwise, the MU readiness check shall be repeated for a certain number of times, and if the MU is still not ready after a configurable number of attempts, a fault reaction shall be performed.

The configuration can be adjusted in such a way that the readiness check shall be performed forever without ever becoming actually ready; this is intended for such situations where no MU is available in the HW.

Description:

The function shall incorporate the following requirements:

G57 Check of MU readiness

R57_1: The MC shall trigger the readiness check by calling the action ACTION_INFR_StartMuReady-Chk().

R57_2: In the next recurrence, the MC shall fetch the result of the MU readiness check by calling the action ACTION_INFR_MuReady() with argument LV_MU_READY.

R57_3: If LV_MU_READY = 1, the MU is ready; this information is used as one of the conditions for enabling the transition from INIT to CONFIG (where the first communication will then be triggered, cf. G12).

R57_4: If LV_MU_READY = 0, CTR_MU_READY shall be increased by 1.

R57_5: If CTR_MU_READY > NC_CTR_MU_READY_MAX, the central fault reaction shall be triggered by calling ACTION_ECM3_McFaultReaction() with argument NC_ERR_COD_MC_MU_READY.

R57_6: If CTR_MU_READY <= NC_CTR_MU_READY_MAX, the sequence shall be started again from R57_1 onwards, i.e., calling ACTION_INFR_StartMuReadyChk() still in the same recurrence.

Application conditions

Initialisation:	`LV_MU_READY = 0;` `CTR_MU_READY = 0;`
Recurrence:	The **initialisation** shall be performed **after each power-up or reset.** The **function itself** shall be executed **every NC_T_MC_COM_CYC ms.**
Activation:	*(STATE_MC = NC_STATE_MC_INI)* ***AND*** *(LV_MU_READY <> 1)* (only active in INIT state and when the check has not yet been finished)
Deactivation:	*Otherwise*

E.29.2 Trigger CONFIG communication

FUNCTION DESCRIPTION:

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General information:

This function describes the triggering of the CONFIG communication by the MC.

Description:

The function incorporates the following requirements:

G12 Trigger CONFIG communication

R12_1: In the CONFIG communication, the following data are sent from the MC to the MU:

- error code;
- error indication;
- reset counter;
- configuration data for MU (plus their complements).

(See the description of the communication protocol; further note that these data are *not* imported here because sending them to the infrastructure so that they are available for the communication is the task of the corresponding modules where the data are exported)

R12_2: The communication is triggered by the MC once these data have been sent to the infrastructure by the responsible modules ("Central fault reaction", "State of fault reaction and up-to-dateness of error code", "Configuration of MU"); this shall be achieved by calling the action ACTION_INFR_McStartCom() with argument STATE_MC.

Application conditions

Initialisation: –

Recurrence: *The* ***function*** *shall be* ***activated after the relevant data*** *(see R12_1 above)* ***have been transported to the infrastructure.***

Activation: *STATE_MC = NC_STATE_MC_CONF* (only active in CONFIG state)

Deactivation: *Otherwise*

E.29.3 Communication monitoring in CONFIG state

FUNCTION DESCRIPTION:

General information:

This function describes how the CONFIG communication is monitored on the MC in the CONFIG state. Note that this really only refers to communication monitoring but not to evaluation of the received data: in case an error was encountered, an error flag (LV_MC_COM_ERR) shall be set which is subsequently exported to other processor monitoring functions so that those do not get activated in case of a communication error.

Description:

The function incorporates the following requirements:

G13 Communication monitoring in CONFIG state

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R13_1: The sequence of checks shall be communication checksum monitoring, followed by communication header-byte monitoring, and finally parity-bit checking.

R13_2: For communication checksum monitoring:
R13_2.1: the action ACTION_INFR_McChkCks() shall be called returning the flag LV_MC_CKS_OK (which is set if the checksum was correct);
R13_2.2: the variable LV_MC_CKS_OK shall be stored together with its complement LV_MC_CKS_OK_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION_ECM3_WriteChkCpl(), ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl(); its default value shall be 0;
R13_2.3: in case of a checksum error:
R13_2.3.1: an immediate fault reaction shall be carried out by calling ACTION_ECM3_McFaultReaction() with error code NC_ERR_COD_MC_CKS;
R13_2.3.2: LV_MC_COM_ERR shall be set;
R13_2.3.3: no further communication monitoring shall be performed.

R13_3: For communication header-byte monitoring:
R13_3.1: the action ACTION_INFR_McGetHd() shall be called returning the header byte STATE_MU_TMP sent by the MU in the preceding communication; STATE_MU_TMP shall be stored together with its complement STATE_MU_TMP_CPL; both variables shall be stored in a reset-safe manner;
R13_3.2: the only acceptable header bytes are CONFIG and DISABLE;
R13_3.3: in case a CONFIG header is received, LV_MC_HD_OK shall be set and the communication monitoring shall continue (with parity-bit checking);
R13_3.4: in case a DISABLE header is received, the flag LV_MC_HD_OK shall be set and parity-bit checking shall be performed as for DISABLE communications (see section "Communication monitoring in DISABLE state" R4);
R13_3.5: in case of receiving a header-byte other than CONFIG or DISABLE:
R13_3.5.1: an immediate fault reaction shall be triggered by calling ACTION_ECM3_McFaultReaction with error code NC_ERR_COD_MC_HD;
R13_3.5.2: the flag LV_MC_HD_OK shall be reset;
R13_3.5.3: LV_MC_COM_ERR shall be set;
R13_3.5.4: no further communication monitoring shall be performed;
R13_3.6: the variable LV_MC_HD_OK shall be stored together with its complement LV_MC_HD_OK_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION_ECM3_WriteChkCpl(), ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl(); its default value shall be 0.

R13_4: For parity-bit checking:
R13_4.1: the action ACTION_INFR_McChkPar() shall be used which returns the flag LV_MC_PAR_OK (which is set of the parity was correct);
R13_4.2: the variable LV_MC_PAR_OK shall be stored together with its complement LV_MC_PAR_OK_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION_ECM3_WriteChkCpl(), ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl(); its default value shall be 0;
R13_4.3 in case of a parity error:
R13_4.3.1: an immediate fault reaction shall be triggered by calling ACTION_ECM3_McFaultReaction with error code NC_ERR_COD_MC_PAR;
R13_4.3.2: LV_MC_COM_ERR shall be set.

R13_5: The variable LV_MC_COM_ERR shall be stored together with its complement LV_MC_COM_ERR_CPL and accessed using the actions ACTION_ECM3_WriteChkCpl(),ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl() from section "RAM check service actions of processor monitoring on MC"; its default value shall be 1.

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Application conditions

Initialisation: */ * After each power-up */*
STATE_MU_TMP = NC_STATE_MC_INI;
*/ * After each power-up or reset, using the RAM check service actions */*
LV_MC_CKS_OK = 0;
LV_MC_HD_OK = 0;
LV_MC_PAR_OK = 0;
LV_MC_COM_ERR = 0;

Recurrence: The **initialisation** shall be performed **after each power-up or reset (as indicated above).**
The **function itself** shall be triggered **after the communication between MC and MU is finished.**

Activation: *STATE_MC = NC_STATE_MC_CONF* (only active in CONFIG state)

Deactivation: *Otherwise*

E.29.4 Trigger PREDRIVE communication

FUNCTION DESCRIPTION:

General information:

This function describes the triggering of the PREDRIVE communication by the MC.

Description:

The function incorporates the following requirements:

G14 Trigger PREDRIVE communication

R14_1: In the PREDRIVE communication, the following data are sent from the MC to the MU:

- compatibility number;
- configuration data for MU (plus their complements).

(See the description of the communication protocol; further note that these data are *not* imported here because sending them to the infrastructure so that they are available for the communication is the task of the corresponding modules where the data are exported)

R14_2: The communication is triggered by the MC once these data have been sent to the infrastructure by the responsible modules ("Version compatibility check", "Configuration of MU"); this shall be achieved by calling the action ACTION_INFR_McStartCom() with argument STATE_MC.

Application conditions

Initialisation: -

Recurrence: *The **function** shall be **activated after the relevant data** (see R1 above) have **been transported to the infrastructure** and **if NC_T_MC_COM_CYC ms have passed since the last communication.***

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Activation: *STATE_MC = NC_STATE_MC_PRDR* (only active in PREDRIVE state)

Deactivation: *Otherwise*

E.29.5 Communication monitoring in PREDRIVE state

FUNCTION DESCRIPTION:

General information:

This function describes how the PREDRIVE communication is monitored on the MC in the PREDRIVE state. Note that this really only refers to communication monitoring but not to evaluation of the received data: in case an error was encountered, an error flag (LV_MC_COM_ERR) shall be set which is subsequently exported to other processor monitoring functions so that those do not get activated in case of a communication error.

Description:

The function incorporates the following requirements:

G15 Communication monitoring in PREDRIVE state

R15_1: The sequence of checks shall be communication checksum monitoring, followed by communication header-byte monitoring.

R15_2: For communication checksum monitoring:
R15_2.1: the action ACTION_INFR_McChkCks() shall be called returning the flag LV_MC_CKS_OK (which is set if the checksum was correct);
R15_2.2: the variable LV_MC_CKS_OK shall be stored together with its complement LV_MC_CKS_OK_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION_ECM3_WriteChkCpl(), ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl(); its default value shall be 0;
R15_2.3: in case of a checksum error:
R15_2.3.1: an immediate fault reaction shall be carried out by calling ACTION_ECM3_McFaultReaction with error code NC_ERR_COD_MC_CKS;
R15_2.3.2: LV_MC_COM_ERR shall be set;
R15_2.3.3: no further communication monitoring shall be performed.

R15_3: For communication header-byte monitoring:
R15_3.1: the action ACTION_INFR_McGetHd() shall be called returning the header byte STATE_MU_TMP sent by the MU in the preceding communication; STATE_MU_TMP shall be stored together with its complement STATE_MU_TMP_CPL; both variables shall be stored in a reset-safe manner;
R15_3.2: the only acceptable header bytes are PREDRIVE and DISABLE;
R15_3.3: in case a PREDRIVE header is received, LV_MC_HD_OK shall be set and communication monitoring is finished;
R15_3.4: in case a DISABLE header is received, LV_MC_HD_OK shall be set and parity-bit checking shall be performed as for DISABLE communications (see section "Communication monitoring in DISABLE state" R19_4);
R15_3.5: in case of receiving a header-byte other than PREDRIVE or DISABLE:
R15_3.5.1: an immediate fault reaction shall be triggered by calling ACTION_ECM3_McFaultReaction with error code NC_ERR_COD_MC_HD;
R15_3.5.2: the flag LV_MC_HD_OK shall be reset;

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R15_3.5.3: LV_MC_COM_ERR shall be set;
R15_3.5.4: no further communication monitoring shall be performed;
R15_3.5.5: the variable LV_MC_HD_OK shall be stored together with its complement LV_MC_HD_OK_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION_ECM3_WriteChkCpl(), ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl(); its default value shall be 0.

R15_4: The variable LV_MC_COM_ERR shall be stored together with its complement LV_MC_COM_ERR_CPL and accessed using the actions ACTION_ECM3_WriteChkCpl(),ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl() from section "RAM check service actions of processor monitoring on MC."

Application conditions

Initialisation: *`/ * Using the RAM check actions */`*
`LV_MC_COM_ERR = 0;`

Recurrence: The **initialisation** shall be performed **before the PREDRIVE communication is triggered.**
The **function itself** shall be triggered **after the communication between MC and MU is finished.**

Activation: *STATE_MC = NC_STATE_MC_PRDR* (only active in PREDRIVE state)

Deactivation: *Otherwise*

E.29.6 Trigger NORMAL communication

FUNCTION DESCRIPTION:

General information:

This function describes the triggering of the NORMAL communication by the MC.

Description:

The function incorporates the following requirements:

G16 Trigger NORMAL communication

R16_1: In the NORMAL communication, the following data are sent from the MC to the MU:

- the PFM response;
- the FS-IST response;
- the value of the ignition key;
- the flag for the redundant switch-off path.

(See the description of the communication protocol; further note that these data are *not* imported here because sending them to the infrastructure so that they are available for the communication is the task of the corresponding modules where the data are exported)

R16_2: The communication is triggered by the MC once these data have been sent to the infrastructure by the responsible modules ("Post-processing of PFM response before communications", "Post-processing of the FS-IST data on MC for transmission to MU", "Exporting the value of the ignition key",

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"The redundant switch-off path"); this shall be achieved by calling the action ACTION_INFR_McStart-Com() with argument STATE_MC (note that the function can be called either shortly after the transition PREDRIVE→NORMAL, or after all other functions in NORMAL have been executed in case the NORMAL state is not left).

Application conditions

Initialisation: –

Recurrence: *The* ***function*** *shall be* ***activated after the relevant data*** *(see R16_1 above)* ***have been transported to the infrastructure*** *and* ***if NC_T_MC_COM_CYC ms have passed since the last communication.***

Activation: *STATE_MC = NC_STATE_MC_NORM* (only active in NORMAL state)

Deactivation: *Otherwise*

E.29.7 Communication monitoring in NORMAL state

FUNCTION DESCRIPTION:

General information:

This function describes how the NORMAL communications are monitored on the MC in the NORMAL state. Note that this really only refers to communication monitoring but not to evaluation of the received data: in case an error was encountered, an error flag (LV_MC_COM_ERR) shall be set which is subsequently exported to other processor monitoring functions so that those do not get activated in case of a communication error.

Description:

The function incorporates the following requirements:

G17 Communication monitoring in NORMAL state

R17_1: The sequence of checks shall be communication checksum monitoring, followed by communication header-byte monitoring.

R17_2: For communication checksum monitoring:
R17_2.1: the action ACTION_INFR_McChkCks() shall be called which returns the flag LV_MC_CKS_OK (which is set if the checksum was correct);
R17_2.2: the variable LV_MC_CKS_OK shall be stored together with its complement LV_MC_CKS_OK_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION_ECM3_WriteChkCpl(), ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl(); its default value shall be 0;
R17_2.3: in case of a checksum error, a debounced fault reaction shall be carried out:
R17_2.3.1: in case the checksum is wrong, the corresponding anti-bounce counter shall be increased (potentially triggering a fault reaction) by calling ACTION_ECM3_McIncAbc() with anti-bounce counter identifier NC_ABC_MC_CKS and error code NC_ERR_COD_MC_CKS;
R17_2.3.2: LV_MC_COM_ERR shall be set;
R17_2.3.3: no further communication monitoring shall be performed;
R17_2.4: in case the checksum is correct, the corresponding anti-bounce counter shall be decreased by calling ACTION_ECM3_McDecAbc() with anti-bounce counter identifier NC_ABC_MC_CKS.

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R17_3: For communication header-byte monitoring:
R17_3.1: the action ACTION_INFR_McGetHd() shall be called returning the header byte STATE_MU_TMP sent by the MU in the preceding communication; STATE_MU_TMP shall be stored together with its complement STATE_MU_TMP_CPL; both variables shall be stored in a reset-safe manner;
R17_3.2: the only acceptable header bytes are NORMAL and DISABLE;
R17_3.3: in case a NORMAL header is received, LV_MC_HD_OK shall be set and communication monitoring is finished;
R17_3.4: in case a DISABLE header is received, LV_MC_HD_OK shall be set and parity bit checking shall be performed as for DISABLE communications (see section "Communication monitoring in DISABLE state" R19_4);
R17_3.5: in case of receiving a header-byte different from NORMAL or DISABLE, a debounced fault reaction shall be carried out:
R17_3.5.1: in case the header-byte is wrong, the corresponding anti-bounce counter shall be increased (potentially triggering a fault reaction) by calling ACTION_ECM3_McIncAbc() with anti-bounce counter identifier NC_ABC_MC_HD and error code NC_ERR_COD_MC_HD;
R17_3.5.2: the flag LV_MC_COM_ERR shall be set;
R17_3.5.3: no further communication monitoring shall be performed;
R17_3.5.4: the flag LV_MC_HD_OK shall be reset (in case the fault reaction is not correctly performed);
R17_3.6: in case the header-byte is NORMAL, the corresponding anti-bounce counter shall be decreased by calling ACTION_ECM3_McDecAbc() with anti-bounce counter identifier NC_ABC_MC_HD;
R17_3.7: the variable LV_MC_HD_OK shall be stored together with its complement LV_MC_HD_OK_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION_ECM3_WriteChkCpl(), ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl(); its default value shall be 0.

R17_4: The variable LV_MC_COM_ERR shall be stored together with its complement LV_MC_COM_ERR_CPL and accessed using the actions ACTION_ECM3_WriteChkCpl(),ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl() from section "RAM check service actions of processor monitoring on MC."

Application conditions

Initialisation: *`/ * Initialise LV_MC_COM_ERR using the RAM check actions */`*

`LV_MC_COM_ERR = 0;`

Recurrence: The **initialisation** shall be performed **before a NORMAL communication is triggered.**
The **function itself** shall be triggered **after the communication between MC and MU is finished.**

Activation: *STATE_MU = NC_STATE_MU_NORM* (only active in NORMAL state)

Deactivation: *Otherwise*

E.29.8 Trigger DISABLE communication

FUNCTION DESCRIPTION:

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General information:

This function describes the triggering of the DISABLE communication by the MC.

Description:

The function incorporates the following requirements:

G18 Trigger DISABLE communication

R18_1: In the DISABLE communication, the following data are sent from the MC to the MU:

- error code;
- error indication;
- reset counter;
- the value of the ignition key;

(See the description of the communication protocol; further note that these data are *not* imported here because sending them to the infrastructure so that they are available for the communication is the task of the corresponding modules where the data are exported)

R18_2: The communication is triggered by the MC once these data have been sent to the infrastructure by the responsible modules ("Exporting the value of the ignition key", "The redundant switch-off path"); this shall be achieved by calling the action ACTION_INFR_McStartCom() with argument STATE_MC (note that the function can be called either shortly after the transition into DISABLE from a different state, or after all other functions in DISABLE have been executed in case the DISABLE state is not left).

Application conditions

Initialisation: –

Recurrence: *The* ***function*** *shall be acti****vated after the relevant data*** *(see R18_1 above)* ***have been transported to the infrastructure*** *and* ***if NC_T_MC_COM_CYC ms have passed since the last communication.***

Activation: *STATE_MC = NC_STATE_MC_DI* (only active in DISABLE state)

Deactivation: *Otherwise*

E.29.9 Communication monitoring in DISABLE state

FUNCTION DESCRIPTION:

General information:

This function describes how the DISABLE communication is monitored on the MC in the DISABLE state. Note that this really only refers to communication monitoring but not to evaluation of the received data: in case an error was encountered, an error flag (LV_MC_COM_ERR) shall be set which is subsequently exported to other processor monitoring functions so that those do not get activated in case of a communication error.

Description:

The function incorporates the following requirements:

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G19 Communication monitoring in DISABLE state

R19_1: The sequence of checks shall be communication checksum monitoring, followed by communication header-byte monitoring, and finally parity-bit checking.

R19_2: For communication checksum monitoring:
R19_2.1: the action ACTION_INFR_McChkCks() shall be called which returns the flag LV_MC_CKS_OK (which is set if the checksum was correct);
R19_2.2: the variable LV_MC_CKS_OK shall be stored together with its complement LV_MC_CKS_OK_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION_ECM3_WriteChkCpl(), ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl(); its default value shall be 0;
R19_2.3: in case of a checksum error, no fault reaction shall be carried out, only LV_MC_COM_ERR shall be set and no further communication monitoring shall be performed.

R19_3: For communication header-byte monitoring:
R19_3.1: the action ACTION_INFR_McGetHd() shall be called returning the header byte STATE_MU_TMP sent by the MU in the preceding communication; STATE_MU_TMP shall be stored together with its complement STATE_MU_TMP_CPL; both variables shall be stored in a reset-safe manner;
R19_3.2: the only acceptable header bytes is DISABLE;
R19_3.3: in case a DISABLE header is received, LV_MC_HD_OK shall be set and the communication monitoring shall continue (with parity-bit checking);
R19_3.4: in case of receiving a header-byte different from DISABLE, no fault reaction shall be carried out, only LV_MC_COM_ERR shall be set and no further communication monitoring shall be performed; furthermore, also the flag LV_MC_HD_OK shall be reset;
R19_3.5: the variable LV_MC_HD_OK shall be stored together with its complement LV_MC_HD_OK_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring" ACTION_ECM3_WriteChkCpl(), ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl(); its default value shall be 0.

R19_4: For parity-bit checking:
R19_4.1: the action ACTION_INFR_McChkPar() shall be used which returns the flag LV_MC_PAR_OK (which is set of the parity was correct);
R19_4.2: the variable LV_MC_PAR_OK shall be stored together with its complement LV_MC_PAR_OK_CPL and it shall be accessed using the actions from section "RAM check service actions of Processor Monitoring"; its default value shall be 0 ACTION_ECM3_WriteChkCpl(), ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl();
R19_4.3: in case of a parity error, no fault reaction shall be triggered, only LV_MC_COM_ERR shall be set, and no further communication monitoring shall be performed.

R19_5: The variable LV_MC_COM_ERR shall be stored together with its complement LV_MC_COM_ERR_CPL and accessed using the actions ACTION_ECM3_WriteChkCpl(),ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl() from section "RAM check service actions of processor monitoring on MC."

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Application conditions

Initialisation:

```
/ * Initialise LV_MC_COM_ERR using the RAM check actions */

 LV_MC_COM_ERR = 0;
```

Recurrence: The **initialisation** shall be performed **before a DISABLE communication is triggered.**
The **function itself** shall be triggered **after the communication between MC and MU is finished.**

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Activation: *STATE_MU = NC_STATE_MU_DI* (only active in DISABLE state)

Deactivation: *Otherwise*

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E.30 Error memory management of processor monitoring

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_RST_ERR_MEM_ACT	V/S	0... FFH	0... 255	1	-
Local variable: current value of reset counter for error memory management, plus potentially additional information					
CTR_RST_ERR_MEM_OLD	V/S	0... FFH	0... 255	1	-
Local variable: old value of reset counter for error memory management, plus potentially additional information					
ERR_COD_ERR_MEM_ACT	V/S	0... 1FH	0... 31	1	-
Local variable: current value of error code for error memory management					
ERR_COD_ERR_MEM_OLD	V/S	0... 1FH	0... 31	1	-
Local variable: old value of error code for error memory management					
LV_MC_CPT_ERR_MEM_ACT	V/S	0... 1H	0 ...1	1	-
Local variable: flag indicating whether the current error code for error memory management belongs to MC (=1) or MU(=0)					
LV_MC_CPT_ERR_MEM_OLD	V/S	0... 1H	0 ...1	1	-
Local variable: flag indicating whether the old error code for error memory management belongs to MC (=1) or MU(=0)					
LV_MC_UPD_ERR_MEM_MC	-	0... 1H	0 ...1	1	-
Local variable: update flag for MC entries into error history (used as activation condition)					
LV_MC_UPD_ERR_MEM_MU	-	0... 1H	0 ...1	1	-
Local variable: update flag for MU entries into error history (used as activation condition)					
STATE_ERR_IDC_ERR_MEM_ACT	V/S	0... 3H	0 ...3	1	-
Local variable: current error indication for error memory management					
STATE_ERR_IDC_ERR_MEM_OLD	V/S	0... 3H	0 ...3	1	-
Local variable: old error indication for error memory management					

Input data:

CTR_RST_MC {p. 7072}	CTR_RST_MC_CPL {p. 7072}	CTR_RST_MU {p. 7072}	ERR_COD_MC {p. 7072}
ERR_COD_MU {p. 7072}	IDX_STATE_SOPC {p. 7186}	IDX_STATE_SOPC_CPL {p. 7186}	LV_ABC_MC_ERR_COM {p. 7072}
LV_ABC_MC_ERR_FCT_SPC_IST {p. 7072}	LV_ABC_MC_ERR_PFM {p. 7072}	LV_ABC_MC_ERR_PFM_6 {p. 7072}	LV_V_H_DET_MU {p. 7073}
LV_V_L_DET_MU {p. 7073}	NC_CTR_RST_MC_THD {p. 7077}	NC_ERR_COD_MC_HD {p. 7077}	NC_ERR_COD_MC_NOT_ERR {p. 7077}
NC_ERR_COD_MC_SOPC {p. 7078}	NC_ERR_COD_MU_V_H {p. 7079}	NC_ERR_COD_MU_V_L {p. 7079}	NC_ERR_COD_MU_V_L_H {p. 7079}
NC_STATE_ERR_IDC_MC_NOT_PRES {p. 7079}	NC_STATE_MC_CONF {p. 7136}	NC_STATE_MC_DI {p. 7136}	NC_STATE_MC_NORM {p. 7136}
NC_STATE_MC_NOT_VLD {p. 7136}	NC_STATE_MC_PRDR {p. 7136}	STATE_ERR_IDC_MC {p. 7073}	STATE_ERR_IDC_MU {p. 7073}
STATE_MC {p. 7135}	STATE_MU_TMP {p. 7049}	STATE_MU_TMP_CPL {p. 7049}	

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Action definition

ACTION_ECM3_McSetErrmUpdateFlag (IN<PRM_CPT>)	Mode: O
This action sets the update flag LV_MC_UPD_ERR_MEM_cpt (=0 means MU, =1 means MC) for error memory information.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_CPT	in	0... 1H	0 ...1	1	-
This action sets the update flag LV_MC_UPD_ERR_MEM_cpt (=0 means MU, =1 means MC) for error memory information.					

Import actions:

ACTION_ECM3_ChkCpl (**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_McErrmService (**IN**<No Name available>,**IN**<No Name available>,**IN**<No Name available>,**IN**<No Name available>, **IN**<No Name available>,**IN**<No Name available>,**IN**<No Name available>,**IN**<No Name available>)
ACTION_ECM3_McReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>,**IN**<PRM_DFT_VALUE>)
ACTION_ECM3_McReadChkState (**OUT**<PRM_STATE_MC_TMP>)
ACTION_ECM3_ReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_WriteChkCpl (**INOUT**<PRM_VAR>,**OUT**<PRM_VAR_CPL>,**IN**<PRM_VALUE>)

Note: data with mode "S" shall only be stored in a reset-safe manner, not in NVMY!
Note: the last action is defined in the application incidences and hence its functional content can be adjusted to project-specific needs/requirements.

FUNCTION DESCRIPTION:

General information:

This module serves as the interface between the processor monitoring and the error memory management: as such, it provides an action call by which the current error information (error code, error indication, reset counter, and whether the data stem from MC or MU) get stored in a history-like fashion; furthermore, an action is imported (from the application incidences of processor monitoring to allow project-specific adaptations to different error memory concepts) and called after the saved values have been updated; this imported action performs the actual triggering of the error memory management with the current failure state.

Description:

The module provides the action ACTION_ECM3_McSetErrmUpdateFlag() which sets one of the update flags LV_MC_UPD_ERR_MEM_MC and LV_MC_UPD_ERR_MEM_MU, depending on the value of its argument.

This flag then, in turn, serves as (one of) the activation condition(s) for the functions described here, which then create/continue an error history using the variables in the output table.

The error history records which component has triggered the update of error memory information: the MC in INIT and after a fault reaction leading to permanent disabling of the power stages; the MU after a successful CONFIG communication and after receiving a DISABLE header from the MU in a state different from DISABLE.

The history stores the current value of reset counter, error code, error indication, and component (MC or MU), plus the corresponding old values (the length of the history is only two).

After the history is potentially updated, the project-specific function ACTION_ECM3_McErrmService(), which is imported from the application incidences (where it is defined), shall be called; this is taken

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care of by another sub-function, since the action shall be called *always* even when none of the update functions is actually executed due to unsatisfied activation conditions: this is necessary to inform the error memory management not only in the case that an error is present but also in the case that no error is present.

Description of ACTION_ECM3_McSetErrmUpdateFlag

Description:

Syntax: ACTION_ECM3_McSetErrmUpdateFlag (IN <cpt>)
Parameter (IN): cpt Component: 0 means MU, 1 means MC
Short description: This action sets one of the two flags LV_MC_UPD_ERR_MEM_MU (if cpt = 0) or LV_MC_UPD_ERR_MEM_MC (if cpt = 1); note that only setting the flag is prompted by other modules, the actual update of the data is done in this module (using the flags as activation conditions).

Application conditions

Initialisation:

```
After power-up:
   / * Initialise the information for error memory management
*/
   CTR_RST_ERR_MEM_ACT = 0;
   CTR_RST_ERR_MEM_OLD = 0;
   ERR_COD_ERR_MEM_ACT = NC_ERR_COD_MC_NOT_ERR;
   ERR_COD_ERR_MEM_OLD = NC_ERR_COD_MC_NOT_ERR;
   STATE_ERR_IDC_ERR_MEM_ACT =
     NC_STATE_IDC_MC_NOT_PRES;
   STATE_ERR_IDC_ERR_MEM_OLD =
     NC_STATE_IDC_MC_NOT_PRES;
   LV_MC_CPT_ERR_MEM = 0;
   LV_MC_CPT_ERR_MEM_OLD = 0;
   LV_MC_UPD_ERR_MEM_MC = 0;
   LV_MC_UPD_ERR_MEM_MU = 0;
   After reset:
/ * No initialisation of error memory data necessary, update
will be performed, if necessary, by means of an action call
*/
   LV_MC_UPD_ERR_MEM_MC = 0;
   LV_MC_UPD_ERR_MEM_MU = 0;
```

Recurrence: *The* ***initialisation*** *shall be* ***performed after each power-up or reset.***

Activation: –

Deactivation: –

E.30.1 Update of error memory information with MU data

FUNCTION DESCRIPTION:

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General information:

This sub-function describes when and how the error history for the error memory gets updated with new data from the MU.

There are two cases for this:

1. after a successful CONFIG communication, when the error information sent from the MU have been evaluated on the MC (including the treatment of under- and over-voltage having been detected on the MU);
2. after a successful communication in which the MU sent a DISABLE header while the MC was (prior to the communication) not yet in DISABLE, and the error information sent from the MU has been evaluated on the MC.

Since the subsequent actions are slightly different and would only lead to complicated case distinctions, the two cases will be represented by two sub-functions.

E.30.1.1 Update of error memory information with MU data after CONFIG communication

FUNCTION DESCRIPTION:

General information:

This sub-function describes how the error memory gets updated with new data from the MU after a successful CONFIG communication, taking into account potentially set under-/over-voltage flags.

Description:

The function incorporates the following requirements:

G39 Update of error memory information with MU data after CONFIG communication

R39_1: If

- **LV_MC_V_L_DET_MU =1** or **LV_MC_V_L_DET_MU =1** *(i.e., a voltage monitoring error has been detected by the MU before the previous reset)*, and
- the _ACT-variables *(describing the most recently stored error)* indicate an error which is **different from the same (combination of) voltage monitoring error(s) as currently detected by the MU** (*i.e., LV_MC_CPT_ERR_MEM_ACT <> 0 or ERR_COD_ERR_MEM_ACT not equal to NC_ERR_COD_MU_V_L, NC_ERR_COD_MU_V_H, or NC_ERR_COD_MU_V_L_H, respectively, depending on the three possible combinations where at least one of the two flags is set)*:

R39_1.1: the values of the _ACT-variables of error memory information shall be saved in the corresponding _OLD-variables;
R39_1.2: ERR_COD_ERR_MEM_ACT shall be set to NC_ERR_COD_MU_V_L, NC_ERR_COD_MU_V_H, or NC_ERR_COD_MU_V_L_H, respectively, depending on the three possible combinations where at least one of the two flags is set;
R39_1.3: CTR_RST_ERR_MEM_ACT shall be set to 0;
R39_1.4: STATE_ERR_IDC_ERR_MEM_ACT shall be set to NC_STATE_IDC_MC_NOT_PRES;
R39_1.5: LV_MC_CPT_ERR_MEM_ACT shall be set to 0, i.e., the active component shall be set to MU.

R39_2: If R39_1 does not apply but:

- **LV_MC_CPT_ERR_MEM_ACT <> 0** *(most recently stored error not an MU error)*, or

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- **ERR_COD_ERR_MEM_ACT** <> **ERR_COD_MU** *(most recently stored error has different error code)*, or
- **CTR_RST_ERR_MEM_ACT (four LSBs)** > **CTR_RST_MU** *(most recently stored reset counter greater than current reset counter on MU, i.e., even though potentially the same error has occurred again, the decreased actual value of the reset counter indicates that the reset counter must have healed in between)*:

R39_2.1: the values of the _ACT-variables of error memory information shall be saved in the corresponding _OLD-variables;
R39_2.2: the values of ERR_COD_MU, STATE_ERR_IDC_MU, and CTR_RST_MU shall be saved to the _ACT-variables, and the active component shall be set to MU, i.e., LV_MC_CPT_ERR_MEM_ACT shall be set to 0.

R39_3: If R39_1 and R39_2 both do not apply but **CTR_RST_ERR_MEM_ACT (four LSBs)** < **CTR_RST_MU** *(i.e., the same MU error has occurred at least one more time which led to the increment of the reset counter since the storage)*, then the _ACT-variables shall be updated with the values of ERR_COD_MU, STATE_ERR_IDC_MU, and CTR_RST_MU, and LV_MC_CPT_ERR_MEM_ACT shall be set to 0, i.e., the active component shall be set to MU.

R39_4: The update flag LV_MC_UPD_ERR_MEM_MU shall be reset.

Application conditions

Initialisation: –

Recurrence: *The function shall be executed after the function "Evaluation of error information from MU on MC" (when potentially new data from the MU are available on the MC).*

Activation: *(STATE_MC = NC_STATE_MC_CONF)* ***AND*** *(LV_MC_UPD_ERR_MEM_MU = 1)* ***AND***
((STATE_ERR_IDC_MU <> NC_STATE_ERR_IDC_MC_NOT_PRES) ***OR*** *(LV_V_L_DET_MU = 1)* ***OR*** *(LV_V_H_DET_MU = 1))*
(only active in CONFIG if update flag for MU is set and if any of the following conditions is true: the error indication of the MU is different from "no error present"; the UVD flag is set; the OVD flag is set)

Deactivation: *Otherwise*

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E.30.1.2 Update of error memory information with MU data after DISABLE communication

FUNCTION DESCRIPTION:

General information:

This sub-function describes how the error memory gets updated with new data from the MU after a successful communication in which the MU sent a DISABLE header but the MC was, prior to the communication, not in DISABLE state (meanwhile, it is also in DISABLE).

Description:

The function incorporates the following requirements:

G40 Update of error memory information with MU data after DISABLE communication

R40_1: If

- **LV_MC_CPT_ERR_MEM_ACT** <> **0** *(most recently stored error not an MU error)*, or
- **ERR_COD_ERR_MEM_ACT** <> **ERR_COD_MU** *(most recently stored error has different error code)*, or
- **CTR_RST_ERR_MEM_ACT (four LSBs)** > **CTR_RST_MU** *(most recently stored reset counter greater than counter on MU, i.e., even though potentially the same error has occurred again, the decreased actual value of the reset counter indicates that the reset counter must have healed in between)*

R40_1.1: the values of the _ACT-variables of error memory information shall be saved in the corresponding _OLD-variables;
R40_1.2: the values of ERR_COD_MU, STATE_ERR_IDC_MU, and CTR_RST_MU shall be saved to the _ACT-variables, and the active component shall be set to MU, i.e., LV_MC_CPT_ERR_MEM_ACT shall be set to 0.

R40_2: If R40_1 does not apply, but **CTR_RST_ERR_MEM_ACT (four LSBs)** < **CTR_RST_MU** *(i.e., the same MU error has occurred at least one more time which led to the increment of the reset counter since the storage)*, then the _ACT-variables shall be updated with the values of ERR_COD_MU, STATE_ERR_IDC_MU, and CTR_RST_MU, and LV_MC_CPT_ERR_MEM_ACT shall be set to 0, i.e., the active component shall be set to MU.

R40_3: The update flag LV_MC_UPD_ERR_MEM_MU shall be reset.

Application conditions

Initialisation:	–
Recurrence:	*The function shall be executed after the function "Evaluation of error information from MU on MC" (when potentially new data from the MU are available on the MC).*
Activation:	*(STATE_MC = NC_STATE_MC_DI)* ***AND*** *(LV_MC_UPD_ERR_MEM_MU = 1)* ***AND*** *(STATE_ERR_IDC_MU <> NC_STATE_ERR_IDC_MC_NOT_PRES)* (only active in DISABLE if update flag for MU is set and error indication different from "no error present")
Deactivation:	*Otherwise*

E.30.2 Update of error memory information with MC data

FUNCTION DESCRIPTION:

General information:

This sub-function describes when and how the error history for the error memory gets updated with new data from the MC.

There are two cases for this:

1. in INIT (potentially after the error indication has been changed from "ECU restart request" to "ECU restart was requested");
2. after a fault reaction on the MC leading to permanent disabling (i.e., CTR_RST_MC = NC_CTR_RST_MC_THD + 1, error indication "disable request").

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In the first case, the update function is only called if the error indication is different from "no error present". Note that this condition is also satisfied in the second case, and in both cases, the update flag LV_MC_UPD_ERR_MEM_MC has been set by the corresponding modules ("State of fault reaction and up-to-dateness of error code" and "Central fault reaction", respective).

Consequently, the activation conditions for the function are that LV_MC_UPD_ERR_MEM_MC is set and that the error indication is different from "no error present."

Description:

The function incorporates the following requirements:

G41 Update of error memory information with MC data

R41_1: If

- **LV_MC_CPT_ERR_MEM_ACT** <> **1** *(most recently stored error not an MC error)*, or
- **ERR_COD_ERR_MEM_ACT** <> **ERR_COD_MC** *(most recently stored error has different error code)*, or
- **CTR_RST_ERR_MEM_ACT (four LSBs)** > **CTR_RST_MC** *(most recently stored reset counter greater than counter on MC, i.e., even though potentially the same error has occurred again, the decreased actual value of the reset counter indicates that the reset counter must have healed in between)*:

R41_1.1: the values of the _ACT-variables of error memory information shall be saved in the corresponding _OLD-variables;
R41_1.2: the values of ERR_COD_MC, STATE_ERR_IDC_MC, and CTR_RST_MC (after a consistency check with its complement CTR_RST_MC_CPL using ACTION_ECM3_ReadChkCpl()) shall be saved to the _ACT-variables, and the active component shall be set to MC, i.e., LV_MC_CPT_ERR_MEM_ACT shall be set to 1;
R41_1.3: if ERR_COD_MC = NC_ERR_COD_MC_SOPC *(i.e., an error in the switch-off path check was detected)*, IDX_STATE_SOPC shall be encoded into the four MSBs of CTR_RST_ERR_MEM_ACT (CTR_RST_MC uses only the four LSBs); IDX_STATE_SOPC shall be accessed using the RAM check service actions (complement check with IDX_STATE_SOPC_CPL);
R41_1.4: if ERR_COD_MC = NC_ERR_COD_MC_HD *(i.e., an invalid header-byte has been sent by the MU)*, the value of STATE_MU_TMP shall be encoded into the four MSBs of CTR_RST_ERR_MEM_ACT (CTR_RST_MC uses only the four LSBs); the value encoded in CTR_RST_ERR_MEM_ACT shall be as shown in the following table:

Value of STATE_MU_TMP	Encoded value (dec.)
NC_STATE_MC_CONF	1
NC_STATE_MC_PRDR	2
NC_STATE_MC_NORM	3
NC_STATE_MC_DI	4
NC_STATE_MC_NOT_VLD	5
00H	6
FFH	7
Otherwise	15

R41_1.5: if ERR_COD_MC <> NC_ERR_COD_MC_SOPC and ERR_COD_MC <> NC_ERR_COD_MC_HD *(i.e., neither an SOPC nor a header error has occurred)*, the flags LV_ABC_MC_ERR_COM, LV_ABC_MC_ERR_PFM, LV_ABC_MC_ERR_PFM_6 and LV_ABC_MC_ERR_FCT_SPC_IST shall be encoded into the four MSBs of CTR_RST_ERR_MEM_ACT (CTR_RST_MC uses only the four LSBs) as follows:

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Bit 3	Bit 2	Bit 1	Bit 0
LV_ABC_MC_ERR_FCT_SPC_IST	LV_ABC_MC_ERR_PFM_6	LV_ABC_MC_ERR_PFM	LV_ABC_MC_ERR_COM

R41_2: If R41_1 does not apply but **CTR_RST_ERR_MEM_ACT (four LSBs)** $<$ **CTR_RST_MC** *(i.e., the same MC error has occurred at least one more time which led to the increment of the reset counter since the storage)*:
R41_2.1: the _ACT-variables shall be updated with the values of ERR_COD_MC, STATE_ERR_IDC_MC, and CTR_RST_MC (after a consistency check with its complement CTR_RST_MC_CPL using ACTION_ECM3_ReadChkCpl()), and LV_MC_CPT_ERR_MEM_ACT shall be set to 1, i.e., the active component shall be set to 1;
R41_2.2: if ERR_COD_MC = NC_ERR_COD_MC_SOPC *(i.e., an error in the switch-off path check was detected)*, IDX_STATE_SOPC shall be encoded into the four MSBs of CTR_RST_ERR_MEM_ACT (CTR_RST_MC uses only the four LSBs); IDX_STATE_SOPC shall be accessed using the RAM check service actions (complement check with IDX_STATE_SOPC_CPL);
R41_2.3: if ERR_COD_MC = NC_ERR_COD_MC_HD *(i.e., an invalid header-byte has been sent by the MU)*, the value of STATE_MU_TMP shall be encoded into the four MSBs of CTR_RST_ERR_MEM_ACT (CTR_RST_MC uses only the four LSBs); the value encoded in CTR_RST_ERR_MEM_ACT shall be as shown in above table;
R41_2.4: if ERR_COD_MC <> NC_ERR_COD_MC_SOPC and ERR_COD_MC <> NC_ERR_COD_MC_HD *(i.e., neither an SOPC nor a header error has occurred)*, the flags LV_ABC_MC_ERR_COM, LV_ABC_MC_ERR_PFM, LV_ABC_MC_ERR_PFM_6 and LV_ABC_MC_ERR_FCT_SPC_IST shall be encoded into the four MSBs of CTR_RST_ERR_MEM_ACT (CTR_RST_MC uses only the four LSBs) as shown in the table above.

R41_3: The update flag LV_MC_UPD_ERR_MEM_MC shall be reset.

Application conditions

Initialisation: –

Recurrence: *After the functions "State of fault reaction and up-to-dateness of error code" and "Central fault reaction"*

Activation: *(LV_MC_UPD_ERR_MEM_MC = 1)* ***AND*** *(STATE_ERR_IDC_MC <> NC_STATE_ERR_IDC_NOT_PRES)*

Deactivation: *Otherwise*

E.30.3 Activation of project-specific function calling the error memory management

FUNCTION DESCRIPTION:

General information:

This sub-function simply calls the project-specific function ACTION_ECM3_McErrmService() which uses hands error history to the error memory management and sets the necessary diagnosis flags.

The action shall be called every time when potentially an update of the error history could have been performed, regardless of an actual update; this is done because the error memory also needs to be informed of the case where *no* error is present/detected.

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Description:

The sub-function incorporates the following requirements:

G42 Activation of project-specific function calling the error memory management

R42_1: The project-specific action ACTION_ECM3_McErrmService() shall be called in CONFIG or DISABLE with the complete error history after any of the update functions above has been called ***regardless of whether the update function actually was activated***.

R42_2: In DISABLE, ACTION_ECM3_McErrmService() shall only be called once.

Application conditions

Initialisation: –

Recurrence: *The function shall be called each time after one of the update functions could be have been activated, regardless of the actual activation of the update function.*

Activation: *(STATE_MC = NC_STATE_MC_CONF)* ***OR***
(STATE_MC = NC_STATE_MC_DI) ***OR***
("LV_MC_UPD_ERR_MEM_MC or LV_MC_UPD_ERR_MEM_MU were previously set")
(activated only in CONFIG and DISABLE after an update function could have been called)

Deactivation: –

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E.31 Fault reaction of processor monitoring

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_MC_CKS	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for checksum monitoring					
ABC_MC_CONF_DIF	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for receiving wrong configuration data from MU in NORMAL state					
ABC_MC_HD	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for header-byte monitoring					
ABC_MC_NOT_DEC	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not decreasing the anti-bounce counter for FS-IST answers correctly					
ABC_MC_PFM_0_RESP	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not reacting to wrongly transmitted PFM bit of task 0					
ABC_MC_PFM_0_TOG	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not toggling the PFM bit of task 0 in time					
ABC_MC_PFM_1_RESP	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not reacting to wrongly transmitted PFM bit of task 1					
ABC_MC_PFM_1_TOG	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not toggling the PFM bit of task 1 in time					
ABC_MC_PFM_2_RESP	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not reacting to wrongly transmitted PFM bit of task 2					
ABC_MC_PFM_2_TOG	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not toggling the PFM bit of task 2 in time					
ABC_MC_PFM_3_RESP	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not reacting to wrongly transmitted PFM bit of task 3					
ABC_MC_PFM_3_TOG	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not toggling the PFM bit of task 3 in time					
ABC_MC_PFM_4_RESP	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not reacting to wrongly transmitted PFM bit of task 4					
ABC_MC_PFM_4_TOG	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not toggling the PFM bit of task 4 in time					
ABC_MC_PFM_5_RESP	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not reacting to wrongly transmitted PFM bit of task 5					
ABC_MC_PFM_5_TOG	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not toggling the PFM bit of task 5 in time					
ABC_MC_PFM_6_RESP	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not reacting to wrongly transmitted PFM bit of task 6					
ABC_MC_PFM_6_TOG	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not toggling the PFM bit of task 6 in time					
ABC_MC_WRG_IDX	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not sending expected FS-IST test index (question)					
ABC_MC_WRG_RESP	S	0... FH	0... 15	1	-
Local variable: anti-bounce counter for MU not reacting correctly to wrong FS-IST answers					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_COM_CYC_MC_DEC_RST	-	0... 3FFH	0... 1023	1	-
Local variable: communication cycle counter for healing of reset counter and error information					
CTR_COM_CYC_MC_DR_DI_TMP	V	0... FFH	0... 255	1	-
Communication cycle counter used for temporary disabling of power stages by Processor Monitoring					
CTR_MU_DI	-	0... FH	0... 15	1	-
Local variable: counter for time-out of disable request (counts number of communications since the DISABLE header was sent to the MU)					
CTR_RST_MC	O/V/S	0... FH	0... 15	1	-
Reset counter on MC					
CTR_RST_MC_CPL	O/S	0... FH	0... 15	1	-
Complement of CTR_RST_MC					
CTR_RST_MU	O/V/S	0... FH	0... 15	1	-
Value of reset counter of MU					
ERR_COD_MC	O/V/S	0... 1FH	0... 31	1	-
Error code of the MC					
ERR_COD_MU	O/V/S	0... 1FH	0... 31	1	-
Error code of the MU					
LV_ABC_MC_ERR_COM	O/V	0... 1H	0 ...1	1	-
Flag indicating that an anti-bounce counter for communication monitoring is greater than 0 after reset					
LV_ABC_MC_ERR_FCT_SPC_IST	O/V	0... 1H	0 ...1	1	-
Flag indicating that an anti-bounce counter for FS-IST is greater than 0 after reset					
LV_ABC_MC_ERR_PFM	O/V	0... 1H	0 ...1	1	-
Flag indicating that an anti-bounce counter for PFM tasks 0...5 (not for task 6!) is greater than 0 after reset					
LV_ABC_MC_ERR_PFM_6	O/V	0... 1H	0 ...1	1	-
Flag indicating that an anti-bounce counter for PFM task 6 is greater than 0 after reset					
LV_ERR_MU_MC	O/V	0... 1H	0 ...1	1	-
Error flag requesting and indicating permanent disabling of power stages by Processor Monitoring (MU and MC)					
LV_ERR_MU_MC_CPL	O	0... 1H	0 ...1	1	-
Complement of LV_ERR_MU_MC					
LV_ERR_TMP_MU_MC	O/V	0... 1H	0 ...1	1	-
Error flag requesting and indicating temporary disabling of power stages by Processor Monitoring (MU and MC)					
LV_ERR_TMP_MU_MC_CPL	O	0... 1H	0 ...1	1	-
Complement of LV_ERR_TMP_MU_MC					
LV_INJ_OFF_TMR_INJ_ENA_TMP	O/V	0... 1H	0 ...1	1	-
Temporary flag indicating enabling of injection by the injection off timer of MU					
LV_MC_DR_OFF	O/V	0... 1H	0 ...1	1	-
Flag indicating whether the redundant switch-off path was triggered					
LV_MC_DR_OFF_CPL	O	0... 1H	0 ...1	1	-
Complement of LV_MC_DR_OFF					
LV_MC_INH_SOPC	O/V	0... 1H	0 ...1	1	-
Flag indicating that the MC-part of the SOPC has to be delayed since the MU is still disabling					
LV_MU_DI_ACT	-	0... 1H	0 ...1	1	-
Local variable: flag indicating whether the DISABLE request is active (prompting a manipulated value for the reset counter to be sent to MU)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MU_DI_OUT_0	O/V	0... 1H	0 ...1	1	-
Flag indicating (in inverse logic!) whether the MU disables power stage 0 or not					
LV_MU_DI_OUT_1	O/V	0... 1H	0 ...1	1	-
Flag indicating (in inverse logic!) whether the MU disables power stage 1 or not					
LV_V_H_DET_MU	O/V	0... 1H	0 ...1	1	-
Flag indicating that over-voltage was detected by the MU					
LV_V_L_DET_MU	O/V	0... 1H	0 ...1	1	-
Flag indicating that under-voltage was detected by the MU					
MU_DI_STATE	O/V	0H 1H 2H 3H	MU_DI_NOT_REQ MU_DI_BUSY MU_DI_ERR MU_DI_OK	-	-
State of MU Disable request					
STATE_ERR_IDC_MC	O/V/S	0... 3H	0 ...3	1	-
Error indication on MC					
STATE_ERR_IDC_MU	O/V/S	0... 3H	0 ...3	1	-
Error indication of MU					

Input data:

LV_MC_COM_ERR {p. 7049}	LV_MC_COM_ERR_CPL {p. 7049}	LV_MC_PFM_WRG_RESP_ACT_6 {p. 7117}	LV_MC_ROM_CHK_READY {p. 7135}
LV_MC_ROM_CHK_READY_CPL {p. 7135}	LV_MC_SOPC_ACT {p. 7186}	LV_MU_IGN_KEY {p. 7135}	NC_STATE_MC_CONF {p. 7136}
NC_STATE_MC_DI {p. 7136}	NC_STATE_MC_INI {p. 7136}	NC_STATE_MC_NORM {p. 7136}	NC_STATE_MC_PRDR {p. 7136}
NLC_MU_INJ_OFF_TMR_ENA {p. 7136}	STATE_MC {p. 7135}		

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ABC_MC_CKS	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to checksum monitoring					
NC_ABC_MC_CKS_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to checksum monitoring					
NC_ABC_MC_CKS_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to checksum monitoring					
NC_ABC_MC_CKS_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to checksum monitoring					
NC_ABC_MC_CONF_DIF	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to receiving different configuration data from MU					
NC_ABC_MC_CONF_DIF_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to receiving different configuration data from MU					
NC_ABC_MC_CONF_DIF_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to receiving different configuration data from MU					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ABC_MC_CONF_DIF_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to receiving different configuration data from MU					
NC_ABC_MC_HD	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to header-byte monitoring					
NC_ABC_MC_HD_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to header-byte monitoring					
NC_ABC_MC_HD_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to header-byte monitoring					
NC_ABC_MC_HD_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to header-byte monitoring					
NC_ABC_MC_NOT_DEC	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter for MU not decreasing the anti-bounce counter for FS-IST answers correctly					
NC_ABC_MC_NOT_DEC_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter for MU not decreasing the anti-bounce counter for FS-IST answers correctly					
NC_ABC_MC_NOT_DEC_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter for MU not decreasing the anti-bounce counter for FS-IST answers correctly					
NC_ABC_MC_NOT_DEC_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter for MU not decreasing the anti-bounce counter for FS-IST answers correctly					
NC_ABC_MC_PFM_0_RESP	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 0					
NC_ABC_MC_PFM_0_RESP_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 0					
NC_ABC_MC_PFM_0_RESP_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 0					
NC_ABC_MC_PFM_0_RESP_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 0					
NC_ABC_MC_PFM_0_TOG	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not toggling the PFM bit of task 0 in time					
NC_ABC_MC_PFM_0_TOG_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not toggling the PFM bit of task 0 in time					
NC_ABC_MC_PFM_0_TOG_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 0 in time					
NC_ABC_MC_PFM_0_TOG_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 0 in time					
NC_ABC_MC_PFM_1_RESP	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 1					
NC_ABC_MC_PFM_1_RESP_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 1					
NC_ABC_MC_PFM_1_RESP_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 1					
NC_ABC_MC_PFM_1_RESP_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 1					
NC_ABC_MC_PFM_1_TOG	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not toggling the PFM bit of task 1 in time					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ABC_MC_PFM_1_TOG_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not toggling the PFM bit of task 1 in time					
NC_ABC_MC_PFM_1_TOG_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 1 in time					
NC_ABC_MC_PFM_1_TOG_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 1 in time					
NC_ABC_MC_PFM_2_RESP	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 2					
NC_ABC_MC_PFM_2_RESP_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 2					
NC_ABC_MC_PFM_2_RESP_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 2					
NC_ABC_MC_PFM_2_RESP_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 2					
NC_ABC_MC_PFM_2_TOG	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not toggling the PFM bit of task 2 in time					
NC_ABC_MC_PFM_2_TOG_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not toggling the PFM bit of task 2 in time					
NC_ABC_MC_PFM_2_TOG_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 2 in time					
NC_ABC_MC_PFM_2_TOG_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 2 in time					
NC_ABC_MC_PFM_3_RESP	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 3					
NC_ABC_MC_PFM_3_RESP_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 3					
NC_ABC_MC_PFM_3_RESP_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 3					
NC_ABC_MC_PFM_3_RESP_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 3					
NC_ABC_MC_PFM_3_TOG	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not toggling the PFM bit of task 3 in time					
NC_ABC_MC_PFM_3_TOG_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not toggling the PFM bit of task 3 in time					
NC_ABC_MC_PFM_3_TOG_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 3 in time					
NC_ABC_MC_PFM_3_TOG_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 3 in time					
NC_ABC_MC_PFM_4_RESP	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 4					
NC_ABC_MC_PFM_4_RESP_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 4					
NC_ABC_MC_PFM_4_RESP_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 4					

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NC_ABC_MC_PFM_4_RESP_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 4					
NC_ABC_MC_PFM_4_TOG	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not toggling the PFM bit of task 4 in time					
NC_ABC_MC_PFM_4_TOG_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not toggling the PFM bit of task 4 in time					
NC_ABC_MC_PFM_4_TOG_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 4 in time					
NC_ABC_MC_PFM_4_TOG_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 4 in time					
NC_ABC_MC_PFM_5_RESP	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 5					
NC_ABC_MC_PFM_5_RESP_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 5					
NC_ABC_MC_PFM_5_RESP_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 5					
NC_ABC_MC_PFM_5_RESP_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 5					
NC_ABC_MC_PFM_5_TOG	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not toggling the PFM bit of task 5 in time					
NC_ABC_MC_PFM_5_TOG_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not toggling the PFM bit of task 5 in time					
NC_ABC_MC_PFM_5_TOG_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 5 in time					
NC_ABC_MC_PFM_5_TOG_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 5 in time					
NC_ABC_MC_PFM_6_RESP	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 6					
NC_ABC_MC_PFM_6_RESP_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 6					
NC_ABC_MC_PFM_6_RESP_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 6					
NC_ABC_MC_PFM_6_RESP_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not reacting to wrongly transmitted PFM bit of task 6					
NC_ABC_MC_PFM_6_TOG	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not toggling the PFM bit of task 6 in time					
NC_ABC_MC_PFM_6_TOG_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not toggling the PFM bit of task 6 in time					
NC_ABC_MC_PFM_6_TOG_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 6 in time					
NC_ABC_MC_PFM_6_TOG_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not toggling the PFM bit of task 6 in time					
NC_ABC_MC_WRG_IDX	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter corresponding to MU not sending the expected FS-IST test index (question)					

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NC_ABC_MC_WRG_IDX_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter corresponding to MU not sending the expected FS-IST test index (question)					
NC_ABC_MC_WRG_IDX_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter corresponding to MU not sending the expected FS-IST test index (question)					
NC_ABC_MC_WRG_IDX_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter corresponding to MU not sending the expected FS-IST test index (question)					
NC_ABC_MC_WRG_RESP	-	0... 1FH	0... 31	1	-
Indicator for anti-bounce counter for MU not reacting correctly to wrong FS-IST answers					
NC_ABC_MC_WRG_RESP_INC	-	0... FH	0... 15	1	-
Increment for anti-bounce counter for MU not reacting correctly to wrong FS-IST answers					
NC_ABC_MC_WRG_RESP_INI	-	0... FH	0... 15	1	-
Initial value for anti-bounce counter for MU not reacting correctly to wrong FS-IST answers					
NC_ABC_MC_WRG_RESP_MAX	-	0... FH	0... 15	1	-
Maximal value for anti-bounce counter for MU not reacting correctly to wrong FS-IST answers					
NC_CTR_COM_CYC_MC_DEC_RST_INI	-	0... 3FFH	0... 1023	1	-
Initial value for communication cycle counter for healing of reset counter and error information					
NC_CTR_MU_DI_MAX	-	0... FH	0... 15	1	-
Maximal value for counter for disable request					
NC_CTR_RST_MC_DI	-	0... FH	0... 15	1	-
Value of reset counter to be sent to MU in case of a disable request					
NC_CTR_RST_MC_THD	-	0... FH	0... 15	1	-
Threshold for reset counter on MU, RST_CTR_MC, the reaching of which shall prompt the MU to irreversibly (for the current driving cycle) disable the power stages					
NC_CYCNR_MC_DR_DI_TMP	-	1... FFH	1... 255	1	-
Number of communication cycles (<>0) for temporary disabling after the PREDRIVE communication					
NC_ERR_COD_MC_CKS	-	0... 1FH	0... 31	1	-
Error code for "checksum of received data is wrong"					
NC_ERR_COD_MC_COMP_NR	-	0... 1FH	0... 31	1	-
Error code for "MU is incompatible to MC software"					
NC_ERR_COD_MC_CONF_DIF	-	0... 1FH	0... 31	1	-
Error code for "configuration data different from previously sent data"					
NC_ERR_COD_MC_HD	-	0... 1FH	0... 31	1	-
Error code for "header byte invalid or disallowed transition					
NC_ERR_COD_MC_MU_READY	-	0... 1FH	0... 31	1	-
Error code for "MU not ready"					
NC_ERR_COD_MC_NOT_DEC	-	0... 1FH	0... 31	1	-
Error code for "MU does not decrease the anti-bounce counter for FS-IST correctly"					
NC_ERR_COD_MC_NOT_ERR	-	0... 1FH	0... 31	1	-
Error code for "no error"					
NC_ERR_COD_MC_NOT_VLD_TRAN	-	0... 1FH	0... 31	1	-
Error code for "invalid or more than one state active (invalid transition) on MC"					
NC_ERR_COD_MC_PAR	-	0... 1FH	0... 31	1	-
Error code for "parity error in received data"					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ERR_COD_MC_PFM_0_RESP	-	0... 1FH	0... 31	1	-
Error code for "MU does not respond to wrongly toggled bit 0 in PFM response"					
NC_ERR_COD_MC_PFM_0_TOG	-	0... 1FH	0... 31	1	-
Error code for "MU does not toggle bit 0 in the PFM synchronisation byte with the correct recurrence"					
NC_ERR_COD_MC_PFM_1_RESP	-	0... 1FH	0... 31	1	-
Error code for "MU does not respond to wrongly toggled bit 1 in PFM response"					
NC_ERR_COD_MC_PFM_1_TOG	-	0... 1FH	0... 31	1	-
Error code for "MU does not toggle bit 1 in the PFM synchronisation byte with the correct recurrence"					
NC_ERR_COD_MC_PFM_2_RESP	-	0... 1FH	0... 31	1	-
Error code for "MU does not respond to wrongly toggled bit 2 in PFM response"					
NC_ERR_COD_MC_PFM_2_TOG	-	0... 1FH	0... 31	1	-
Error code for "MU does not toggle bit 2 in the PFM synchronisation byte with the correct recurrence"					
NC_ERR_COD_MC_PFM_3_RESP	-	0... 1FH	0... 31	1	-
Error code for "MU does not respond to wrongly toggled bit 3 in PFM response"					
NC_ERR_COD_MC_PFM_3_TOG	-	0... 1FH	0... 31	1	-
Error code for "MU does not toggle bit 3 in the PFM synchronisation byte with the correct recurrence"					
NC_ERR_COD_MC_PFM_4_RESP	-	0... 1FH	0... 31	1	-
Error code for "MU does not respond to wrongly toggled bit 4 in PFM response"					
NC_ERR_COD_MC_PFM_4_TOG	-	0... 1FH	0... 31	1	-
Error code for "MU does not toggle bit 4 in the PFM synchronisation byte with the correct recurrence"					
NC_ERR_COD_MC_PFM_5_RESP	-	0... 1FH	0... 31	1	-
Error code for "MU does not respond to wrongly toggled bit 5 in PFM response"					
NC_ERR_COD_MC_PFM_5_TOG	-	0... 1FH	0... 31	1	-
Error code for "MU does not toggle bit 5 in the PFM synchronisation byte with the correct recurrence"					
NC_ERR_COD_MC_PFM_6_RESP	-	0... 1FH	0... 31	1	-
Error code for "MU does not respond to wrongly toggled bit 6 in PFM response"					
NC_ERR_COD_MC_PFM_6_TOG	-	0... 1FH	0... 31	1	-
Error code for "MU does not toggle bit 6 in the PFM synchronisation byte with the correct recurrence"					
NC_ERR_COD_MC_RAM_LEVEL_1	-	0... 1FH	0... 31	1	-
Error code for "error in standard RAM check (for level 1)"					
NC_ERR_COD_MC_RAM_LEVEL_2	-	0... 1FH	0... 31	1	-
Error code for "error in cyclic RAM check for level 2"					
NC_ERR_COD_MC_ROM_LEVEL_1	-	0... 1FH	0... 31	1	-
Error code for "error in standard ROM check (for level 1)"					
NC_ERR_COD_MC_ROM_LEVEL_2	-	0... 1FH	0... 31	1	-
Error code for "error in cyclic ROM check for level 2"					
NC_ERR_COD_MC_SOPC	-	0... 1FH	0... 31	1	-
Error code for "error in switch-off path check"					
NC_ERR_COD_MC_WRG_IDX	-	0... 1FH	0... 31	1	-
Error code for "MU does not send expected test index (question)"					
NC_ERR_COD_MC_WRG_RESP	-	0... 1FH	0... 31	1	-
Error code for "MU does not react to wrong FS-IST answers"					
NC_ERR_COD_MU_FCT_SPC_IST	-	0... 1FH	0... 31	1	-
Error code for "MU has detected a wrong FS-IST answer"					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ERR_COD_MU_V_H	-	0... 1FH	0... 31	1	-
Error code for "MU has detected over-voltage"					
NC_ERR_COD_MU_V_L	-	0... 1FH	0... 31	1	-
Error code for "MU has detected under-voltage"					
NC_ERR_COD_MU_V_L_H	-	0... 1FH	0... 31	1	-
Error code for "MU has detected both under- and over-voltage"					
NC_STATE_ERR_IDC_MC_DI_REQ	-	0... 3H	0 ...3	1	-
Error indication "DISABLE request"					
NC_STATE_ERR_IDC_MC_NOT_PRES	-	0... 3H	0 ...3	1	-
Error indication "no error present"					
NC_STATE_ERR_IDC_MC_PREV_REST	-	0... 3H	0 ...3	1	-
Error indication "ECU restart was requested"					
NC_STATE_ERR_IDC_MC_REST_REQ	-	0... 3H	0 ...3	1	-
Error indication "ECU restart request"					

Action definition

ACTION_ECM3_DisableReq (**IN**<PRM_DI_OK>)	Mode: O
This action changes the state of processor monitoring on both MC and MU into DISABLE state	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_DI_OK	in	0... 1H	0 ...1	1	-
Parameter indication whether Disable request is completed by MU and MC. 1: Disable oK 0: Disable not finished					

ACTION_ECM3_McDecAbc (**IN**<PRM_ABC_ID>)	Mode: O
This action decreases the value of the indicated anti-bounce counter by 1.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_ABC_ID	in	0... FFH	0... 255	1	-
Identifier for index of anti-bounce counter					

ACTION_ECM3_McFaultReaction (**IN**<PRM_ERR_COD>)	Mode: O
This action immediately performs the central fault reaction storing the given error code.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_ERR_COD	in	0... FFH	0... 255	1	-
Error code to be stored in case of debouncing finished					

ACTION_ECM3_McIncAbc (**IN**<PRM_ABC_ID>,**IN**<PRM_ERR_COD>)	Mode: O
This action increases the value of the indicated anti-bounce counter by its corresponding increment; if the	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_ABC_ID	in	0... FFH	0... 255	1	-
Identifier for index of anti-bounce counter					
PRM_ERR_COD	in	0... FFH	0... 255	1	-
Error code to be stored in case of debouncing finished					

ACTION_ECM3_RedSwitchOffPath ()	Mode: O
This action sets the flag LV_MC_DR_OFF and, in doing so, activates the redundant switch-off path.	

ACTION_ECM3_ShutDown (**IN**<PRM_DI_OK>)	Mode: O

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This action changes the state of processor monitoring on both MC and MU into DISABLE state, eventually triggering a restart of the ECU (exported to ASW) ; the flag returns "false" in case the request has not been completed (with or without error).

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_DI_OK	in	0... 1H	0 ...1	1	-
Parameter indication whether Disable request is completed by MU and MC. 1: Disable oK 0: Disable not finished					

Import actions:

ACTION_ECM2_LockPws ()
ACTION_ECM2_ResetErrorFlags ()
ACTION_ECM3_ChkCpl (**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_McCancelSopc ()
ACTION_ECM3_McChangeState (**IN**<PRM_STATE_MC_NEW>)
ACTION_ECM3_McReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>,**IN**<PRM_DFT_VALUE>)
ACTION_ECM3_McReadChkState (**OUT**<PRM_STATE_MC_TMP>)
ACTION_ECM3_McResetRomChkFlags ()
ACTION_ECM3_McSetErrmUpdateFlag (**IN**<PRM_CPT>)
ACTION_ECM3_McUnlockPwlResource ()
ACTION_ECM3_ReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_WriteChkCpl (**INOUT**<PRM_VAR>,**OUT**<PRM_VAR_CPL>,**IN**<PRM_VALUE>)
ACTION_INFR_McGetErrByte (**OUT**<PRM_IF_MU_ERR_BYTE>)
ACTION_INFR_McGetHd (**OUT**<PRM_STATE_MU>)
ACTION_INFR_McGetNdis0 (**OUT**<PRM_LV_MU_DI_OUT_0>)
ACTION_INFR_McGetNdis1 (**OUT**<PRM_LV_MU_DI_OUT_1>)
ACTION_INFR_McGetOvdFlag (**OUT**<PRM_LV_V_H_DET_MU>)
ACTION_INFR_McGetRstCtr (**OUT**<PRM_CTR_RST_MU>)
ACTION_INFR_McGetUvdFlag (**OUT**<PRM_LV_V_L_DET_MU>)
ACTION_INFR_McRestart ()
ACTION_INFR_McSendErrInfo (**IN**<PRM_ERR_COD_MC>,**IN**<PRM_STATE_ERR_IDC_MC>,**IN**<PRM_CTR_RST_MC>)

General information

This module contains several functions related to the fault reaction of processor monitoring on the MC. Note that several functions might change the value of several of the output variables (e.g., the value of the reset counter of the MC, CTR_RST_MC, is changed by both the central fault reaction and the healing of reset counter and error information) but that always, at any given time, only **one** of the sub-functions is active so the variables simply have the value of the last update that they received (thereby acting as a kind of “merge” block).

Note: The four error codes(NC_ERR_COD_MU_V_L,NC_ERR_COD_MU_V_H, NC_ERR_COD_MU_V_L_H and NC_ERR_COD_MU_FCT_SPC_IST) are MU error codes and are only used in connection with error memory and the under-/over-voltage flags sent from the MU (see section "Acquisition of under-/over-voltage flags").

E.31.1 Central fault reaction

General information:

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This function contains the central fault reaction of processor monitoring on the MC. Since this function is not activated with a fixed recurrence but only called when an error has actually occurred, the complete functionality is encapsulated in the action ACTION_ECM3_McFaultReaction() which can be imported and called by other functions, should they require to trigger an immediate fault reaction (debounced fault reactions are handled via G21 "Debounce mechanism").

In order to avoid recursive calls of the fault reaction:

- **no monitoring of state machine shall be performed**
- **no complement checks shall be performed, only the complements shall be written**
- **for all calls of external functions (e.g. for disabling power stages), it has to be ensured that they cannot lead to recursive calls of the fault reaction**

Description:

The function, via the action ACTION_ECM3_McFaultReaction(), incorporates the following requirements:

G1 Central fault reaction

R1_1: Concerning the activation of the fault reaction:

- **a fault reaction shall only be performed in a state different from DISABLE (i.e., STATE_MC <> NC_STATE_MC_DI);**
- **if STATE_MC = NC_STATE_MC_DI when the fault reaction is triggered, nothing shall be done;**
- **therefore, the following requirements only refer to the case that the fault reaction is actually performed (i.e., STATE_MC <> NC_STATE_MC_DI).**

R1_2: The action ACTION_ECM3_McCancelSopc() shall be called in order to ensure that the power stages can be disabled.

R1_3: The power stages shall be disabled, see G22 "Disabling of power stages"; **this shall only be done if the fault reaction was activated in a state different from DISABLE (i.e., STATE_MC <> NC_STATE_MC_DI) to avoid recursive calls to the fault reaction (via ACTION_ECM2_LockPws())**.

R1_4: A transition into the DISABLE state shall be performed, using ACTION_ECM3_McChangeState(); this shall be done before the power stages are disabled (due to R22_8, the power stages will anyway be
disabled in DISABLE, even if there is a problem during the execution of the fault reaction).

R1_5: If the reset counter CTR_RST_MC on the MC is strictly less than the threshold NC_CTR_RST_MC_THD:
R1_5.1: the reset counter shall be incremented by 1; this value shall be stored with complement CTR_RST_MC_CPL in a reset-safe area; the default value for CTR_RST_MC shall be NC_CTR_RST_MC_THD + 1 (in case of data corruption, assume permanent disabling).

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R1_5.2: an MC error code which corresponds to the error location shall be stored, together with the indicator ”ECU restart request”; this value shall be stored in a reset-safe area.
R1_5.3: There shall be an attempt to restart the ECU, using the action ACTION_INFR_McRestart().

R1_6: If the reset counter is greater than or equal to the threshold NC_CTR_RST_MC_THD:
R1_6.1: the reset counter shall be set to NC_CTR_RST_MC_THD + 1; this value shall be stored with complement CTR_RST_MC_CPL in a reset-safe area; the default value for CTR_RST_MC shall be NC_CTR_RST_MC_THD + 1 (in case of data corruption, assume permanent disabling).
R1_6.2: an MC error code which corresponds to the error location shall be stored, together with the indicator ”DISABLE request”; this value shall be stored in a reset-safe area.
R1_6.3: the update flag for MC error memory information shall be set by calling ACTION_ECM3_Mc-SetErrmUpdateFlag(1).
R1_6.4: there shall be no attempt to restart the MC.

R1_7: No monitoring of state machine or complement checks using the RAM check service actions shall
be performed in order to avoid recursive calls of the fault reaction; for complements, the check shall be performed manually and in case of inconsistency, the default value shall be used.

R1_8: The power latch resource for the Standard ROM check shall be unlocked by calling ACTION_ECM3_McUnlockPwlResource().

Application conditions:

Initialisation:

```
/ * Using the RAM check actions (where applicable) */

CTR_RST_MC = 0;
ERR_COD_MC = NC_ERR_COD_MC_NOT_ERR;
```

Activation: –

Deactivation: –

Recurrence: The **initialisation** shall be **performed after each power-up.** The **function** itself is **called when required.**

Function description:

Formula section:

E.31.2 Healing of reset counter and error information

General information:

If the MC is in NORMAL state (which indicates that there is no error present) for a certain time (4s), then the reset counter is decreased by 1 since the system has been stable long enough to assume that there is currently no problem present; if this decreasing results in a reset counter of 0, also the error code and the error indication shall be cleared.

Description:

This function incorporates the following requirements:

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G2 Healing of reset counter and error code

R2_1: The reset counter shall be decreased by 1 after 4000ms have passed.

R2_2: If the reset counter is decremented to 0, the error code shall be cleared, i.e., set to 0, and the error indication shall be changed to “no error present.”

R2_3: The function shall only be active in NORMAL state, and if LV_MC_ROM_CHK_READY is set (i.e., after the standard ROM check has been completed and no reset or transition to DISABLE has occurred, hence the ROM check must have been successful); LV_MC_ROM_CHK_READY has to be accessed together with its complement LV_MC_ROM_CHK_READY_CPL, using the actions from "RAM check service
actions of processor monitoring on MC."

R2_4: The time measurement shall be performed by counting communication cycles, rather than actually measuring elapsed time, counting backwards starting from NC_CTR_COM_CYC_MC_DEC_RST_INI (see initialisation below).

R2_5: Additionally, the healing shall only take place if LV_MC_PFM_WRG_RESP_ACT_6 is set to one indicating that the wrong response test for PFM task 6 has been performed at least once (to avoid endless resets due to wrong PFM in task 6).

R2_6: While LV_MC_SOPC_ACT = 1, no healing shall take place (to prohibit healing while the SOPC has not yet been completed).

Application conditions:

Initialisation:

*/ * Initialise communication cycle counter */*

```
CTR_COM_CYC_MC_DEC_RST =
NC_ CTR_COM_CYC_MC_DEC_RST_INI;
```

Activation:

(STATE_MC = NC_STATE_MC_NORM) **AND**
(LV_MC_ROM_CHK_READY = 1) **AND**
(LV_MC_PFM_WRG_RESP_ACT_6 = 1) **AND**
(LV_MC_SOPC_ACT = 0)
(only active in NORMAL AND after standard ROM check was completed AND
wrong response test for PFM task 6 has been performed once AND SOPC has
been completed)

Deactivation:

Otherwise

Recurrence:

The **initialisation** shall be performed **after each power-up or reset.**

The **function itself** shall be **activated after the data from NORMAL communications have been evaluated successfully.**

Function description:

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Formula section:

E.31.3 State of fault reaction and up-to-dateness of error code

General information:

The error indication describes the current state of the fault reaction in the sense that, if the fault reaction is triggered and it is decided that the ECU should be restarted, the error indication is set to “ECU restart request”, while an (irreversible for the current driving cycle) DISABLE request leads to the error indication “DISABLE request” (the decision between these two choices depends of the value of the reset counter CTR_RST_MC, see section “Central fault reaction”).

Description:

This function incorporates the following requirements.

G3 State of fault reaction and up-to-dateness of error code

R3_1: In addition to the error code, there shall be the error indication STATE_ERR_IDC_MC which indicates the state of the fault reaction and the up-to-dateness of the error code:

- “No error present” shall be indicated while no error is present (including the case that the reset counter is being decremented);
- “ECU restart request” shall be indicated if fault reaction currently requests ECU restart (i.e., the reset counter has not yet reached a certain defined value);
- “DISABLE request” shall be indicated if fault reaction requests DISABLE instead of ECU restart (i.e., the reset counter has reached the defined value);
- “ECU restart was requested” (“previous restart request”) shall be indicated after ECU has been restarted due to an ECU restart request from the fault reaction.

R3_2: The error indication shall be stored in a reset-safe RAM area.
R3_3: After a reset but not after power-up, if the current error indication is “ECU restart request,” this shall
be changed to “ECU restart was requested”: a restart must have actually been performed because otherwise the INIT state could not have been reached (see initialisation below).

R3_4: In INIT (i.e., STATE_MC = NC_STATE_MC_INI), the update flag for MC error memory informa-tion
shall always be set by calling ACTION_ECM3_McSetErrmUpdateFlag(1); this shall be done after the potential change of the error indication described by R3_3.

R3_5: Once the CONFIG communication has been prepared, i.e., after ACTION_INFR_McSendEr-rInfo() has been called, if the state of the fault reaction on the MC indicated “ECU restart was requested”, it shall be changed to “No error present” by setting STATE_ERR_IDC_MC to NC_STATE_ERR_IDC_MC_NOT_PRES.

Application conditions:

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Initialisation:

```
After power-up:

/ * After power-up, initialise the error indication to
   "no error present" */
STATE_ERR_IDC_MC =
          NC_STATE_ERR_IDC_MC_NOT_PRES;

After reset:

/ * After reset, if "ECU restart request" is indicated, this
shall be
changed to "restart was requested":  the restart request has
been
carried out successfully, see R3_3 above */

IF   (STATE_ERR_IDC_MC =
        NC_STATE_ERR_IDC_MC_REST_REQ)
THEN
        STATE_ERR_IDC_MC =
            NC_STATE_ERR_IDC_MC_PREV_REST;
FI
```

Activation: –

Deactivation: –

Recurrence: The **initialisation** shall be performed **after each power-up or reset.**

The **function itself** shall be **called.**

Function description:

Formula section:

E.31.4 Transmission of error information from MC to MU

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General information:

This function describes how the error information (reset counter, error code, and error indication) are sent
from MC to MU.

Description:

This function incorporates the following requirements:

G4.1 Transmission of error information from MC to MU

R4.1_1: The MC shall send reset counter, error code, and error indication to the MU in the communications in the states CONFIG and DISABLE using the action call ACTION_INFR_McSendErrInfo(), before the respective communications are triggered, with arguments ERR_COD_MC, STATE_ERR_IDC_MC, and CTR_RST_MC.

R4.1_2: When preparing the data for a DISABLE communication, i.e., if STATE_MC = NC_STATE_MC_DI,
and LV_MU_DI_ACT is set (i.e., if a disable request for the MU is still active, see "Disable request by external software"), the value NC_CTR_RST_MU_DI shall be used as one argument to ACTION_INFR_McSendErrInfo(), instead of CTR_RST_MC; NC_CTR_RST_MU_DI must be different from 0.

Application conditions:

Initialisation:	–
Activation:	(STATE_MC = NC_STATE_MC_CONF) **OR** (STATE_MC = NC_STATE_MC_DI) *(only active in CONFIG and DISABLE state)*
Deactivation:	Otherwise
Recurrence:	The **function** shall be **executed before a communication is triggered.**

Function description:

Formula section:

E.31.5 Evaluation of error information from MU on MC

General information:

This function describes when and how the error information (reset counter, error code, and error indication) sent from the MU is evaluated on the MC.

Description:

This function incorporates the following requirements:

G4.2 Evaluation of error information from MU on MC

R4.2_1: In CONFIG and DISABLE, if communication monitoring indicates no error, i.e., LV_MC_COM_ERR = 0 (and its complement LV_MC_COM_ERR_CPL=1):
R4.2_1.1: the MC shall obtain the reset counter CTR_RST_MU of the MU using the action ACTION_INFR_McGetRstCtr();
R4.2_1.2: the MC shall obtain the error code ERR_COD_MU of the MU using the action ACTION_INFR_McGetErrCode();
R4.2_1.3: the MC shall obtain the error indication STATE_ERR_IDC_MU of the MU using the action ACTION_INFR_McGetErrIdc().

R4.2_2: The update flag for MU error memory information shall be set by calling ACTION_EMC3_McSetErrmUpdateFlag(0).

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Application conditions:

Initialisation:

```
/ * Initialise MU error information */

CTR_RST_MU = 0;
ERR_COD_MU = NC_ERR_COD_MC_NOT_ERR;
STATE_ERR_IDC_MU = NC_STATE_ERR_IDC_MC_NOT_PRES;
```

Activation:

```
((STATE_MC = NC_STATE_MC_CONF) OR
(STATE_MC = NC_STATE_MC_DI)) AND
(LV_MC_COM_ERR = 0)
(only active after CONFIG or DISABLE communications, and if
no
communication error was detected)
```

Deactivation: Otherwise

Recurrence: The **initialisation** shall be performed **after each power-up or reset.**

The **function itself** shall be executed **after the communication monitoring functions** and **after G5.1 "Disable request by MU."**

Function description:

Formula section:

E.31.6 Disable request by MU

General information:

This function deals with the case when the MU sends a DISABLE header. Receiving a DISABLE header from the MU always causes a transition to DISABLE and disabling of power stages.

Description:

This function incorporates the following requirements:

G5.1 Disable request by MU

R5.1_1: If the MC is in a state different from DISABLE (i.e., STATE_MC <> NC_STATE_MC_DI) and a DISABLE header is received from the MU (i.e., ACTION_ECM3_McGetHd() returns NC_STATE_MC_DI):
R5.1_1.1: a transition into DISABLE shall be performed, using ACTION_ECM3_McChangeState();
R5.1_1.2: the power-latch resource for the Standard ROM check shall be unlocked by calling ACTION_ECM3_McUnlockPwlResource();

R5.1_1.3: **for production SW**, if the MU sends the error indication "ECU restart request" (i.e., if ACTION_ECM3_McGetErrIdc() returns NC_STATE_ERR_IDC_MC_REST_REQ), the MC shall attempt to restart the ECU by calling the action ACTION_INFR_McRestart() (the error indication expresses that the MU has performed a fault reaction which should have triggered a reset but the reset was not performed); **for development SW**, no restart shall be attempted.

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R5.1_2: If the value of MU_DI_STATE is different from "MU_DI_ERR", it shall be set to "MU_DI_OK" (if a corresponding disable request had already timed out, this shall not be masked by the MU finally responding with a DISABLE header).

R5.1_3: No monitoring of state machine shall be performed (since anyway a change into DISABLE is the consequence).

Application conditions:

Initialisation: –

Activation: always

Deactivation: –

Recurrence: The **function** shall be **executed after the communication monitoring functions.**

Function description:

Formula section:

E.31.7 Disable request by external software

General information:

This function provides an interface for the application software in order to force both MC and MU into DISABLE state (in particular to be able to re-program the ECU without having to worry about time-out monitoring, PFM, FS-IST etc.).

Description:

This function incorporates the following requirements:

G5.2 Disable request by external software

R5.2_1: Processor monitoring shall export an interface to the application software in order to force a transition of the processor monitoring on the MC into DISABLE state using ACTION_ECM3_McChangeState(); if already in DISABLE, the MC shall stay there.

R5.2_2: The MC shall clear its error information, i.e., CTR_RST_MC, ERR_COD_MC, and STATE_ERR_IDC_MC.

R5.2_3: The disable request has four different states, recorded in MU_DI_STATE:

- "MU_DI_NOT_REQ" meaning "no disable request"
- "MU_DI_BUSY" meaning "MU has not yet responded, the request is still busy"

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- "MU_DI_ERR" meaning "MU response has timed out"
- "MU_DI_OK" meaning "MU has responded in time"

R5.2_4: The interface shall be provided in the form of the action call ACTION_ECM3_DisableReq()
R5.2_4.1: when ACTION_ECM3_DisableReq() is called, and MU_DI_STATE is equal to "MU_DI_NOT_REQ", it shall be set to "MU_DI_BUSY"; *hence, if MU_DI_STATE is different from "MU_DI_NOT_REQ", it shall remain unchanged*;
R5.2_4.2: the flag LV_MU_DI_ACT shall be set (prompting sending NC_CTR_RST_MU_DI instead of the value of CTR_RST_MC (which is 0, see R2) to the MU in subsequent DISABLE communications, see "Transmission of error information from MC to MU" R3);
R5.2_4.3: ACTION_ECM3_DisableReq() shall return "false" in case MU_DI_STATE is equal to "MU_DI_BUSY" and true otherwise.

R5.2_5: After each subsequent communication, in case the MU has not responded with a DISABLE header (which leads to MU_DI_STATE being set to "MU_DI_OK", see "Disable request by MU" R2), i.e., if MU_DI_STATE is equal to "MU_DI_BUSY", the counter CTR_MU_DI shall be increased by one.

R5.2_6: When the counter CTR_MU_DI reaches the value NC_CTR_MU_DI_MAX, this shall be considered as a time-out, i.e., STATE_MU_DI shall be set to "MU_DI_ERR" (which also counts as the disable request being finished, however unsuccessfully).

R5.2_7: The action ACTION_ECM3_McResetRomChkFlags() shall be called (resetting the flags for the Standard ROM check).

R5.2_8: In CONFIG, just before triggering the CONFIG communication, MU_DI_STATE shall be changed from "MU_DI_OK" (the initialisation value) to "MU_DI_NOT_REQ"; in this way, as long as the transition from INIT to CONFIG has not yet been performed, the return value of ACTION_ECM3_DisableReq() will be 1 (instead of 0, cf. R5.2_4.1 and R5.2_4.3).

R5.2_9: In case ACTION_ECM3_DisableReq() is called, the power-latch resource for the Standard ROM check shall be unlocked by calling ACTION_ECM3_McUnlockPwlResource().

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Application conditions:

Initialisation:
```
MU_DI_STATE = "MU_DI_OK";
CTR_MU_DI = 0;
LV_MU_DI_ACT = 0;
```

Activation: -

Deactivation: -

Recurrence: The **initialisation** shall be **performed after each power-up or reset.**

The **function itself** shall be **called via ACTION_ECM3_DisableReq().**

Function description:

Formula section:

E.31.8 Shutdown request by external software

General information:

This function provides an interface for the application software in order to restart the ECU.

Description:

This function incorporates the following requirements:

G5.3 Shutdown request by external software

R5.3_1: Processor monitoring shall export an interface to the application software in order to force restart
of the ECU via the MU.

R5.3_2: The interface shall be provided in the form of the action call ACTION_ECM3_ShutDown().

R5.3_3: It behaves exactly like ACTION_ECM3_DisableReq() with the one exception that the flag LV_MU_DI_ACT is not set, i.e., in subsequent DISABLE communications, the real value of CTR_RST_MC (which is 0 since it has been reset by the shutdown/disable request) is sent; this will first force the MU into DISABLE, clearing its error information in the process, and eventually to restart the ECU (unless the MU has not detected an error on its own, and also the state of the ignition key plays a role in how the MU reacts to the request).

Application conditions:

Initialisation:	–
Activation:	–
Deactivation:	–
Recurrence:	The **function itself** shall be **called via ACTION_ECM3_ShutDown().**

Function description:

Formula section:

E.31.9 The redundant switch-off path

General information:

In case process or processor monitoring on the MC detect a fatal error and attempt to disable the safety-relevant power stages, they can also use the switch-off paths on the monitoring unit to redundantly perform the switching-off. This is done via an action call (from within process monitoring) which sets a flag in the processor monitoring that forces the MC to deliberately send wrong FS-IST answers to the

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MU which in turn, potentially after some debouncing, leads to a fault reaction on the MU and in particular to disabling the safety-relevant power stages (hence the name “redundant switch-off path” as the MU is eventually prompted to also disable the power stages).

Description:

This function incorporates the following requirements:

G20 Redundant switch-off path

R20_1: There shall be an interface between process and processor monitoring which, when used, causes the processor monitoring on the MC to permanently send wrong FS-IST answers to the MU, in this way eventually (after debouncing) resulting in a fault reaction of the MU.

R20_2: This interface shall be realised by providing the action call ACTION_ECM3_RedSwitchOffPath() to process monitoring which shall set the flag LV_MC_DR_OFF; LV_MC_DR_OFF shall be stored as together with its complement LV_MC_DR_OFF_CPL and shall only be accessed via the actions ACTION_ECM3_WriteChkCpl(), ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl() from "RAM check service actions of processor monitoring on MC"; its default value in case of a RAM error shall be 1, indicating that the redundant switch-off path has been triggered.

Application conditions:

Initialisation:

```
/ * Using the RAM check service actions */
LV_MC_DR_OFF = 0;
```

Activation: –

Deactivation: –

Recurrence: The **initialisation** shall be performed **after each power-up or reset.**

The **function itself** shall be called via ACTION_ECM3_RedSwitchOffPath().

Function description:

Formula section:

E.31.10 Debounce mechanism

General information:

Debouncing is a very common task for many functions of processor monitoring. Hence this module exports actions which perform the two necessary tasks to do with debouncing: increasing one of these anti-bounce counters by a predefined increment, and decreasing such a counter with a predefined decrement. Note that increasing an anti-bounce counter can trigger a fault reaction (viz., if its maximal value is reached).

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Note that values of anti-bounce counters are not exported directly!

Description:

In the following, let xxx range over all possible identifiers for anti-bounce counters which are used on the MC (e.g., one possible value is HD for header-byte monitoring). The function incorporates the following requirements:

G21 Debounce mechanism

R21_1: If an error has been detected the anti-bounce counter of the corresponding error location shall be increased by the corresponding increment NC_ABC_MC_xxx_INC without creating an overflow; this shall be achieved by calling ACTION_ECM3_McIncAbc().

R21_2: If the anti-bounce counter reaches a corresponding maximum value NC_ABC_MC_xxx_MAX a fault reaction shall be triggered.

R21_3: If no error is detected and the anti-bounce counter of the corresponding error location is greater than 0, the anti-bounce counter shall be decreased by the corresponding decrement NC_ABC_MC_xxx_DEC without creating an underflow; this shall be achieved by calling ACTION_ECM3_McDecAbc().

R21_4: In general, if not specified otherwise, the following configuration shall be used: NC_ABC_MC_xxx_INI = 0, NC_ABC_MC_xxx_INC = 2, NC_ABC_MC_xxx_DEC = 1, NC_ABC_MC_xxx_MAX = 6.

R21_5: After a reset, in INIT state, i.e., STATE_MC = NC_STATE_MC_INI:
R21_5.1: if any anti-bounce counter of communication monitoring (xxx=HD, CKS, CONF_DIF) is greater than 0, the flag LV_ABC_MC_ERR_COM shall be set to 1, otherwise it shall be set to 0;
R21_5.2: if any anti-bounce counter of PFM **except for task 6** (xxx=PFM_*k*_TOG, PFM_*k*_RESP **for 0 <=*k*<= 5**) is greater than 0, the flag LV_ABC_MC_ERR_PFM shall be set to 1, otherwise it shall be set to 0;
R21_5.3: if one of the two anti-bounce counters PFM_6_TOG or PFM_6_RESP **for task 6** is greater than 0, the flag LV_ABC_MC_ERR_PFM_6 shall be set to 1, otherwise it shall be set to 0;
R21_5.4: if any anti-bounce counter of FS-IST is greater than 0 (xxx=WRG_IDX, WRG_RESP) or greater
than 2 (in case of xxx=NOT_DEC), the flag LV_ABC_MC_ERR_FCT_SPC_IST shall be set to 1, otherwise it shall be set to 0;
R21_5.5: after evaluation, the anti-bounce counters shall be initialised to their corresponding INI values NC_ABC_MC_xxx_INI.

Application conditions:

Initialisation:

```
After each power-up:

All anti-bounce counters are initialised to their corresponding
INI values.

After each power-up and reset:

LV_ ABC_MC_ERR_COM = 0;
LV_ ABC_MC_ERR_PFM = 0;
LV_ ABC_MC_ERR_PFM_6 = 0;
LV_ ABC_MC_ERR_FCT_SPC_IST = 0;
```

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Activation: `in all states (in particular in in INIT state!)`

Deactivation: –

Recurrence: The **initialisation** shall be performed **after each power-up and reset**
(see above).

Afterwards, **increasing** or **decreasing** of anti-bounce counters shall be
done **via action calls.**

Function description:

Formula section:

E.31.11 Disabling of power stages

General information:

This function describes how and when the MC disables the power stages it is connected to, separatelyfor each state.

The phrase "enabling of power stages" shall be used to denote the fact that the MC no longer *disables*; however, this does not imply anything regarding *actively using* the power stages.

Note that on the MC, there are two ways of disabling: one is by SW done via flags which lead to no active signals being generated (e.g., no injection patterns); the second one is via HW where dedicated HW lines are used to disable power stages (the MU only has such HW disable lines).

Description:

The complete function satisfies the following requirements:

G22 Disabling of power stages

R22_1: The MC shall:
R22_1.1: permanently disable the power stages by setting LV_ERR_MU_MC = 1 (it has to be ensured that LV_ERR_MU_MC, after being set once, is not reset again), plus additionally calling ACTION_ECM2_LockPws() (in order to ensure that process monitoring also disables the power stages);
R22_1.2: temporarily disable the power stages by setting LV_ERR_TMP_MU_MC = 1, plus additionally calling ACTION_ECM2_LockPws() (in order to ensure that process monitoring also disables the power stages);
R22_1.3: enable the power stages by setting LV_ERR_TMP_MU_MC = 0 and LV_ERR_MU_MC = 0 (cf. remark above!), plus additionally calling the action ACTION_ECM2_ResetErrorFlags() (in order to ensure that process monitoring also stops disabling the power stages if appropriate).

R22_2: Both error flags shall be stored together with their respective complements, LV_ERR_MU_MC_CPL and LV_ERR_TMP_MU_MC_CPL, and shall be accessed using the imported RAM check service actions ACTION_ECM3_WriteChkCpl(), ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl() (see "RAM check service actions of processor monitoring on MC");

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their default values in case of a RAM error shall be 1, i.e., indicating that the power stages shall be disabled.

R22_3: The power stages shall be disabled depending on the reset counters of both MC and MU, and the current state of the monitoring concept.

R22_4: In INIT, the MC shall temporarily disable the power stages.

R22_5: In CONFIG, the MC shall temporarily disable the power stages.

R22_6: In PREDRIVE:
R22_6.1: the MC shall temporarily disable the power stages;
R22_6.2: before the PREDRIVE communication, if any of the two reset counters (CTR_RST_MC, or CTR_RST_MU) is > 1, the MC shall set CTR_COM_CYC_MC_DR_DI_TMP to NC_CYCNR_MC_DR_DI_TMP (this counter shall be used to temporarily disable the power stages until in total NC_CYCNR_MC_DR_DI_TMP + 2 communication cycles have been performed).

R22_7: In NORMAL:
R22_7.1: if CTR_COM_CYC_MC_DR_DI_TMP is not active (i.e., = 0), the MC shall enable the power stages (see signal flow diagram); this only holds if no pre-condition of any other requirement is satisfied (cf. in particular R22_9 and R22_10).
R22_7.2.: if CTR_COM_CYC_MC_DR_DI_TMP is active (i.e., <> 0):
R22_7.2.1: the MC shall temporarily disable the power stages;
R22_7.2.2: CTR_COM_CYC_MC_DR_DI_TMP shall be decreased by one without creating an underflow.

R22_8: In DISABLE, the MC shall permanently and temporarily disable the power stages.

R22_9: In PREDRIVE and NORMAL, the MC shall consider the status of the disable outputs of the MU regarding disabling the power stages:
R22_9.1: the MC shall call the actions ACTION_INFR_McGetNdisOut0() and ACTION_INFR_McGetNdisOut1() to obtain the status informationand store the results in LV_MU_DI_OUT_0 and LV_MU_DI_OUT_1 (note that disabling means status = 0, enabling means status = 1);
R22_9.2: the information about the status of the MU disable outputs shall be used as follows:
R22_9.2.1: if LV_MU_DI_OUT_0 = 0 and LV_MU_DI_OUT_1 = 1 and LV_MU_IGN_KEY = 0 and NLC_MU_INJ_OFF_TMR_ENA = 1, the injection-off timer (IOT) in the MU shall be assumed to be active; hence, the following assignment shall be performed:

- LV_INJ_OFF_TMR_INJ_ENA_TMP = 0 *(IOT active, no enabling of injection)*;

R22_9.2.2: if LV_MU_DI_OUT_0 = 0 and LV_MU_DI_OUT_1 = 0, the MU disables both its disable outputs; hence, the following assignment shall be performed:

- LV_ERR_TMP_MU_MC = 1 *(temporary disabling)*

R22_9.2.3: if LV_MU_DI_OUT_0 = 1 and LV_MU_DI_OUT_1 = 1, the MU enables its disable outputs; hence, the IOT must be inactive and the following assignment shall be performed:

- LV_INJ_OFF_TMR_INJ_ENA_TMP = 1 *(IOT inactive, enabling of injection)*;

R22_9.2.4: otherwise, the following assignment shall be performed:

- LV_ERR_TMP_MU_MC = 1 *(temporary disabling)*

R22_10: In NORMAL, while LV_MC_SOPC_ACT = 1 (i.e., the MC-part of the SOPC has not yet been finished), the MC shall temporarily disable the power stages.

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R22_11: In PREDRIVE and NORMAL, if the MU indicates disabling any of its power stages (i.e., LV_MU_DI_OUT_0 or LV_MU_DI_OUT_1 = 0), the flag LV_MC_INH_SOPC shall be set to 1; otherwise, it shall be set to 0; the flag being set consequently indicates that the MU still disables the power stages (and therefore prompts a delay the MC-part of the SOPC).

Application conditions:

Initialisation:

```
/ * Initialise communication cycle counter for temporary disabling
to "no temporary disabling" */

CTR_COM_CYC_MC_DR_DI_TMP = 0;

/ * Delay of MC-part of SOPC (not yet) necessary */

LV_MC_INH_SOPC = 0;

/ * Using the RAM check service actions:  temp.  disabling
*/

LV_ERR_MU_MC = 0;
LV_ERR_TMP_MU_MC = 1;
LV_MU_DI_OUT_0 = 0;
LV_MU_DI_OUT_1 = 0;

/ * Power stages disabled after reset */

LV_INJ_OFF_TMR_ENA_INJ_TMP = 0;
```

Activation: always

Deactivation: –

Recurrence: The **initialisation** shall be performed **after each power-up or reset.**

The **function itself** is **active in all states.**

Function description:

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Signal flow diagram:

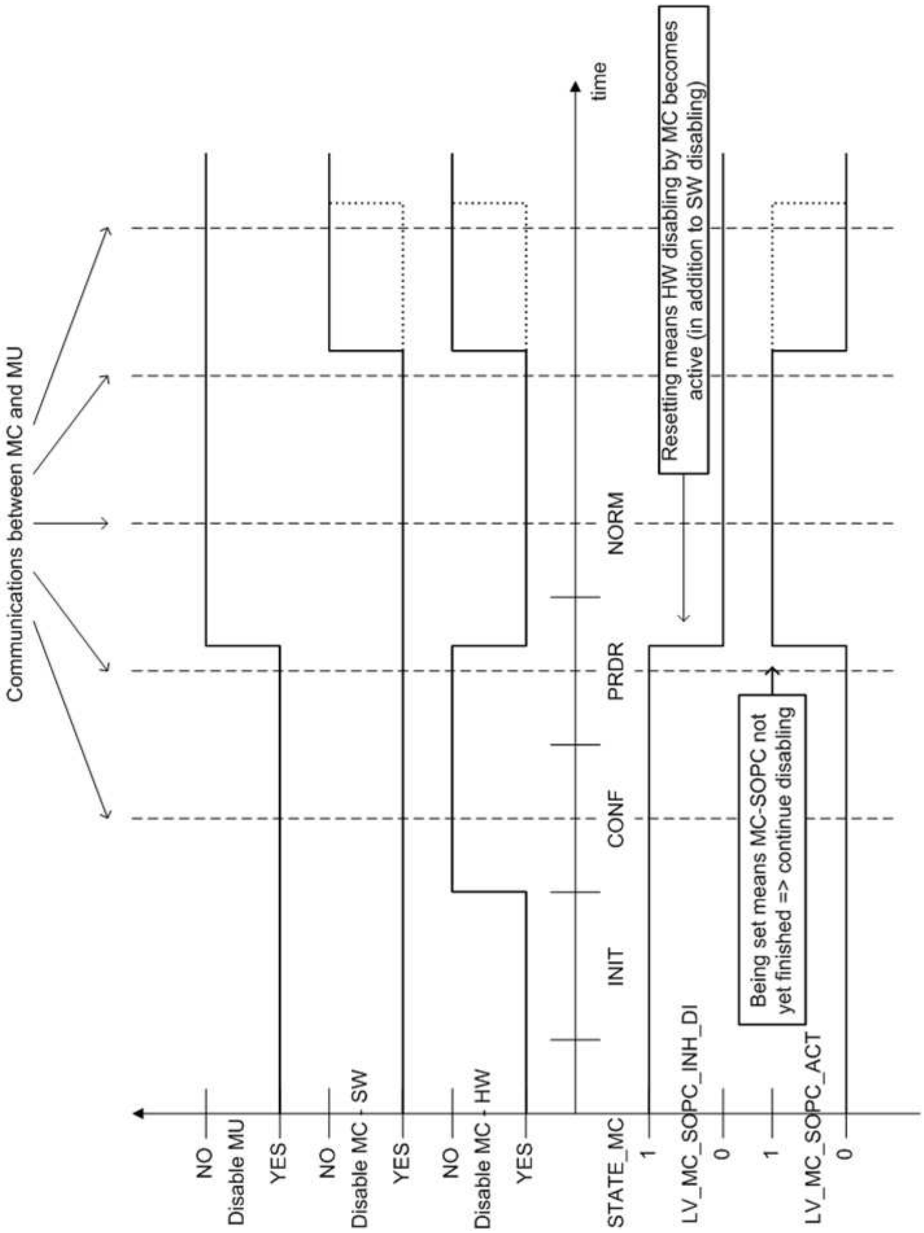

Figure E.31.1:

Note that the diagram only shows the case when no temporary disabling is performed; the distinction between SW and HW disabling on the MC is managed by the switch-off path check.

Formula section:

E.31.12 Acquisition of under-/over-voltage flags

General information:

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The MU contains detection mechanisms for both under- and over-voltage conditions in case its voltage leaves its operating range.

This is, amongst others, prompts a reset (which is held for as long as either condition persists) of MC and MU.

If the under- or over-voltage condition is present long enough, one of the flags LV_V_L_DET_MU or LV_V_H_DET_MU (as appropriate) is set. Once the voltage returns to its normal range, the system starts up and the two flags (which have been stored in a reset-safe area) are sent to the MC.

Description:

The function incorporates the following requirement:

G24 Acquisition of under-/over-voltage flags

R24_1: If no errors were detected in the CONFIG communication, i.e., if LV_MC_COM_ERR = 0 (and its complement LV_MC_COM_ERR_CPL = 1), the flags LV_V_L_DET_MU and LV_V_H_DET_MU shall be assigned the values sent by the MU, using the actions ACTION_INFR_McGetUvdFlag() and ACTION_INFR_McGetOvdFlag(), respectively.

Application conditions:

Initialisation: LV_V_H_DET_MU = 0;
LV_V_L_DET_MU = 0;

Activation: (STATE_MC = NC_STATE_MC_CONF) **AND**
(LV_MC_COM_ERR = 0)
(only active in CONFIG and if no communication error was detected)

Deactivation: Otherwise

Recurrence: The **initialisation** shall be performed **after each power-up or reset.**

The **function itself** shall be executed **after the communication monitoring functions.**

Function description:

Formula section:

E.31.13 ACTION_ECM3_McFaultReaction

Description:

Syntax: ACTION_ECM3_McFaultReaction(IN <err_cod>)

Parameter (IN): err_cod error code indicating the cause of the fault reaction

Short description: This action performs the central fault reaction of processor monitoring on MC (as specified in "G1 Central fault reaction" above).

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E.31.14 ACTION_ECM3_DisableReq

Description:

Syntax: ACTION_ECM3_DisableReq()

Parameter (OUT): flag Indication whether the disable request has been completed (perhaps with error, cf. R5.2_4.3 above)

Short description: This action implements the disable request as specified above in "G5.2 Disable request by external software."

E.31.15 ACTION_ECM3_ShutDown

Description:

Syntax: ACTION_ECM3_ShutDown()

Parameter (OUT): flag Indication whether the shutdown request has been finished (with or without error, cf. R5.2_4.3 above)

Short description: This action requests a restart of the ECU via the MU as specified above in "G5.3 Shutdown request by external software" (whether this is actually done depends on the internal state of the MU).

E.31.16 ACTION_ECM3_RedSwitchOffPath

Description:

Syntax: ACTION_ECM3_RedSwitchOffPath()

Short description: This action triggers the redundant switch-off path by setting the flag LV_MC_DR_OFF using the action ACTION_ECM3_WriteChkCpl() (see “RAM check service actions of processor monitoring on MC”).

E.31.17 ACTION_ECM3_McIncAbc

Description:

Syntax: ACTION_ECM3_McIncAbc(
IN <abc_id>,
IN <err_cod>)

Parameter (IN): abc_id identifier for the anti-bounce counter to be increased

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Parameter (IN): err_cod error code for a potential fault reaction

Short description: This action increases the value of the specified anti-bounce counter by the corresponding increment without creating an overflow; if the corresponding maximal value is reached, a fault reaction shall be triggered by calling ACTION_ECM3_McFaultReaction().

E.31.18 ACTION_ECM3_McDecAbc

Description:

Syntax: ACTION_ECM3_McDecAbc(IN <abc_id>)

Parameter (IN): abc_id identifier for the anti-bounce counter to be increased

Short description: This action decreases the value of the specified anti-bounce counter by 1 without creating an underflow.

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E.32 Function specific instruction set test

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ABC_LID_MC_FCT_SPC_IST	V	0... FH	0... 15	1	-
Local variable: value of MU anti-bounce counter for FS-IST (obtained from ABC_RCV_MC_FCT_SPC_IST)					
ABC_LID_MC_FCT_SPC_IST_OLD	-	0... FH	0... 15	1	-
Local variable: saved value of MU anti-bounce counter for FS-IST from preceding communication cycle					
ABC_RCV_MC_FCT_SPC_IST	-	0... FH	0... 15	1	-
Local variable: value of FS-IST anti-bounce counter on MU (obtained via infrastructure)					
IDX_NR	-	0... 1FH	0... 31	1	-
Local variable: index for decoding of MU question					
IDX_NR_ERR_MC_FCT_SPC_IST	V	0... FFH	0... 255	1	-
Local variable: "marker" of index for which second calculation of copy of process monitoring failed					
IDX_NR_LID_MC_FCT_SPC_IST	-	0... 1FH	0... 31	1	-
Local variable: question number corresponding to MU question (IDX_TEST_RCV_MC_FCT_SPC_IST)					
IDX_NR_LID_MC_FCT_SPC_IST_OLD	-	0... 1FH	0... 31	1	-
Local variable: saved question number from previous communication cycle					
IDX_NR_LID_MC_FCT_SPC_IST_PRED	-	0... 1FH	0... 31	1	-
Local variable: predicted question number (for monitoring of question sent by MU)					
IDX_NR_RESP_MC_FCT_SPC_IST	-	0... 1FH	0... 31	1	-
Local variable: answer number of answer from level 2'					
IDX_TEST_RCV_MC_FCT_SPC_IST	-	0... 1FH	0... 31	1	-
Local variable: question sent by MU (obtained via infrastructure; to be decoded into question number)					
LV_MC_FCT_SPC_IST_ACT	-	0... 1H	0 ...1	1	-
Local variable: flag indicating whether FS-IST is active in current communication cycle					
LV_MC_FCT_SPC_IST_WRG_RESP_ACT	V	0... 1H	0 ...1	1	-
Local variable: flag indicating whether sending of wrong FS-IST answers is active or not					
TCC_MC_FCT_SPC_IST_WRG_RESP	-	0... 1FH	0... 31	1	-
Local variable: test cycle counter for sending wrong FS-IST answers to MU					
TEST_REC_IDX_MON2	O/V	0... 1FH	0... 31	1	-
Question number ("test index") exported to the copy of process monitoring					

Input data:

ID_RESP_MON2 {p. 7017}	LDPM_TEST_REC_IDX_MON2	LV_MC_DR_OFF {p. 7072}	LV_MC_DR_OFF_CPL {p. 7072}
NC_ABC_MC_NOT_DEC {p. 7074}	NC_ABC_MC_WRG_IDX {p. 7076}	NC_ABC_MC_WRG_RESP {p. 7077}	NC_ERR_COD_MC_NOT_DEC {p. 7077}
NC_ERR_COD_MC_WRG_IDX {p. 7078}	NC_ERR_COD_MC_WRG_RESP {p. 7078}	NC_STATE_MC_NORM {p. 7136}	NC_STATE_MC_PRDR {p. 7136}
RESP_MON2 {p. 7012}	STATE_MC {p. 7135}		

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_NR_WRG_MC_FCT_SPC_IST	-	0... 1FH	0... 31	1	-
Constant for invalid question number (used in the decoding processes)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_RESP_MC_FCT_SPC_IST [NC_TEST_REC_IDX_MAX_MON2]	-	0... 3FH	0... 63	1	-
Array of answers to be sent to MU					
NC_IDX_RESP_WRG_MC_FCT_SPC_IST	-	0... 3FH	0... 63	1	-
Constant for invalid answer					
NC_IDX_TEST_MC_FCT_SPC_IST [NC_TEST_REC_IDX_MAX_MON2]	-	0... 3FH	0... 63	1	-
Array of valid questions; compared to actual questions sent from MU					
NC_TCC_MC_IST_WRG_RESP_CHK	-	0... 1FH	0... 31	1	-
Value of test cycle counter when MU reaction to sending of wrong answer should be checked					
NC_TCC_MC_IST_WRG_RESP_REQ	-	0... 1FH	0... 31	1	-
Value of test cycle counter when sending of wrong answer should be requested					
NC_TEST_REC_IDX_MAX_MON2	-	0... 1FH	0... 31	1	-
(NC_TEST_REC_IDX_MAX_MON2-1) is the maximal value for the question number exported to the test calculations in level 2’					

Import actions:

ACTION_ECM3_ChkCpl (**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_McDecAbc (**IN**<PRM_ABC_ID>)
ACTION_ECM3_McIncAbc (**IN**<PRM_ABC_ID>,**IN**<PRM_ERR_COD>)
ACTION_ECM3_McReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>,**IN**<PRM_DFT_VALUE>)
ACTION_ECM3_McReadChkState (**OUT**<PRM_STATE_MC_TMP>)
ACTION_ECM3_ReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_WriteChkCpl (**INOUT**<PRM_VAR>,**OUT**<PRM_VAR_CPL>,**IN**<PRM_VALUE>)
ACTION_INFR_McGetFsistAbcVal (**OUT**<abc_rcv_mc_fct_spc_ist>)
ACTION_INFR_McGetFsistIdx (**OUT**<idx_test_rcv_mc_fct_spc_ist>)
ACTION_INFR_McSendDrOff (**IN**<lv_mc_dr_off>)
ACTION_INFR_McSendFsistResp (**IN**<idx_resp_trm_mc_fct_spc_ist>)

FUNCTION DESCRIPTION:

General information:

The function-specific instruction set test (FS-IST) complements the program flow monitoring (PFM) functionality in an effort to obtain as complete a monitoring of the proper functioning of the main controller (MC) as possible. The goal of the FS-IST is to check whether the MC is capable of correctly performing the calculations necessary for the most important safety-relevant functions in the *process monitoring* ("VDA level 2") - hence the name *function-specific* instruction-set test: only computations with relevance for the monitoring concept (the ‘function’ under consideration) are tested, as opposed to a complete instruction-set test.
As already stated, the FS-IST checks whether certain safety-relevant calculations are performed correctly. These so-called test calculations are performed by a copy of the relevant modules of process monitoring (so as not to ‘disturb’ the action process monitoring by the test calculations); these copied level 2 modules constitute the so-called copy of process monitoring, or level 2’. Although conceptually part of processor monitoring, the level 2’ are in practise more closely associated to process monitoring than to processor monitoring: each change of a process monitoring module a copy of which is part of level 2’ has to be carried out also for the corresponding level 2’ module.

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Since the test calculations are also performed on the MC, i.e., by the same processor that performs the actual (level 2) calculations, the monitoring unit (MU) is used to initiate the FS-IST and check whether the calculations arrive at the correct results (otherwise no reasonable way of detecting faults is possible).

Concretely, the FS-IST is performed in the following way (there are some points to note about the timing which will be explained after the description of the basic algorithm):

- on the MU, there exists an array of test indices, or questions; these questions are simply bit patterns which are cyclically sent to the MC, i.e., at the beginning, the first entry of the array is sent, then the second, and so on (in the error-free case, the case of errors will be described later); for these question, there are corresponding answers, or responses, which are also stored in an array on the MU
- these test indices, once they have been received by the MC-part of processor monitoring, are then sent to the level 2' via an interface which, depending on the question from the MU, determines the starting values (i.e., values of inputs, etc.) for the level 2' modules;
- using this chosen starting values, level 2' calculates according to the modules, depending on the ability of the processor, yielding a specific actual output value that is then forwarded to the MC-part of processor monitoring, again via the interface, together with the expected result for this particular test index;
- the MC-part of processor monitoring then determines (by comparing the actual with the expected output value) whether the test calculation was performer successfully before sending a response, or answer, back to the MU; note that this answer is also influenced by other factors (e.g., if a fault by the MC-side of processor monitoring was detected, this answer is forced to be false from the expected answer on the MU)
- the MU receives the answer of the MC-part of processor monitoring and compares that to the entry in its array of expected results at the position corresponding to the sent test index;
- if this comparison has a positive result, and anti-bounce counter shall be decreased (without creating an underflow, i.e., if its value is already 0 nothing shall happen, see “G21 Debounce mechanism”) and the procedure shall continue as described before;
- if the comparison shows that a wrong answer has been received, an anti-bounce counter shall be increased; upon reaching its maximal value, the central fault reaction (“G1 central fault reaction”) shall be triggered; if the maximal value is not reached when increasing the anti-bounce counter, the particular question that was wrongly answered shall be re-sent to the MC for as long as the anti-bounce has not reached 0, i.e., if a question was answered wrongly and the value of the anti-bounce counter has value 4, the same question is sent (at least) 4 times before the next question is sent.

Note the possibility to distinguish between questions and question numbers: in this way, the algorithm for obtaining the new test index can be very simple, viz., the question number simply needs to be increased by with every correct answer (or set to if all possible numbers have been run through), while the actual bit patterns denoting the questions (to be found in a predefined array) can be chosen in such a way as to decrease (if not completely eliminate) the probability of corruption during the communication and also to be able to distinguish between question and answers in EMS and TCU mode of the MU. As stated before, some words regarding timing are necessary at this point:

- when the MU is used for monitoring of EMSs, the level 2' answers are only checked every second communication cycle;
- when the MU is used for monitoring of TCUs, the level 2' answers are checked every communication cycle;
- in NORMAL state, whenever the MU sends any question to the MC, the response received in that very communication (regardless of the chosen variant, EMS or TCU) is the answer corresponding to a previous question, i.e., in order to find out whether a question has been answered wrongly, the freshly received answer must be compared to the stored answer corresponding to the previous question;
- if an answer was wrong, the previously described timing situation leads to the fact that, before repeating the wrongly answered question, there will be one transmission of a new question (viz., in the communication where the wrong answer was received); for instance, assuming that both questions and question numbers are simply 0,1,2,... and question 3 is permanently answered wrongly by the MC, the following sequence of questions arises: 0,1,2,3,4,3,3,3... trigger “G1

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Central fault reaction", i.e., question 3 repeated until increasing the anti-bounce counter triggers a fault reaction; the answer to question 4 is simply ignored because the fact that the answer to question 3 was wrong only becomes apparent after question 4 has already been transmitted to the MC.

On the MC, for sending the response, there is a similar split into "answer" and "answer number" in order to facilitate the distinction between the responses from level 2' and for the MU.

Signal flow diagram:

A schematic overview of the FS-IST functionality is given in the following diagram (note that the picture only depicts the control flow, one should not forget that time passes when the communications are performed, the level 2' calculations are performed etc.):

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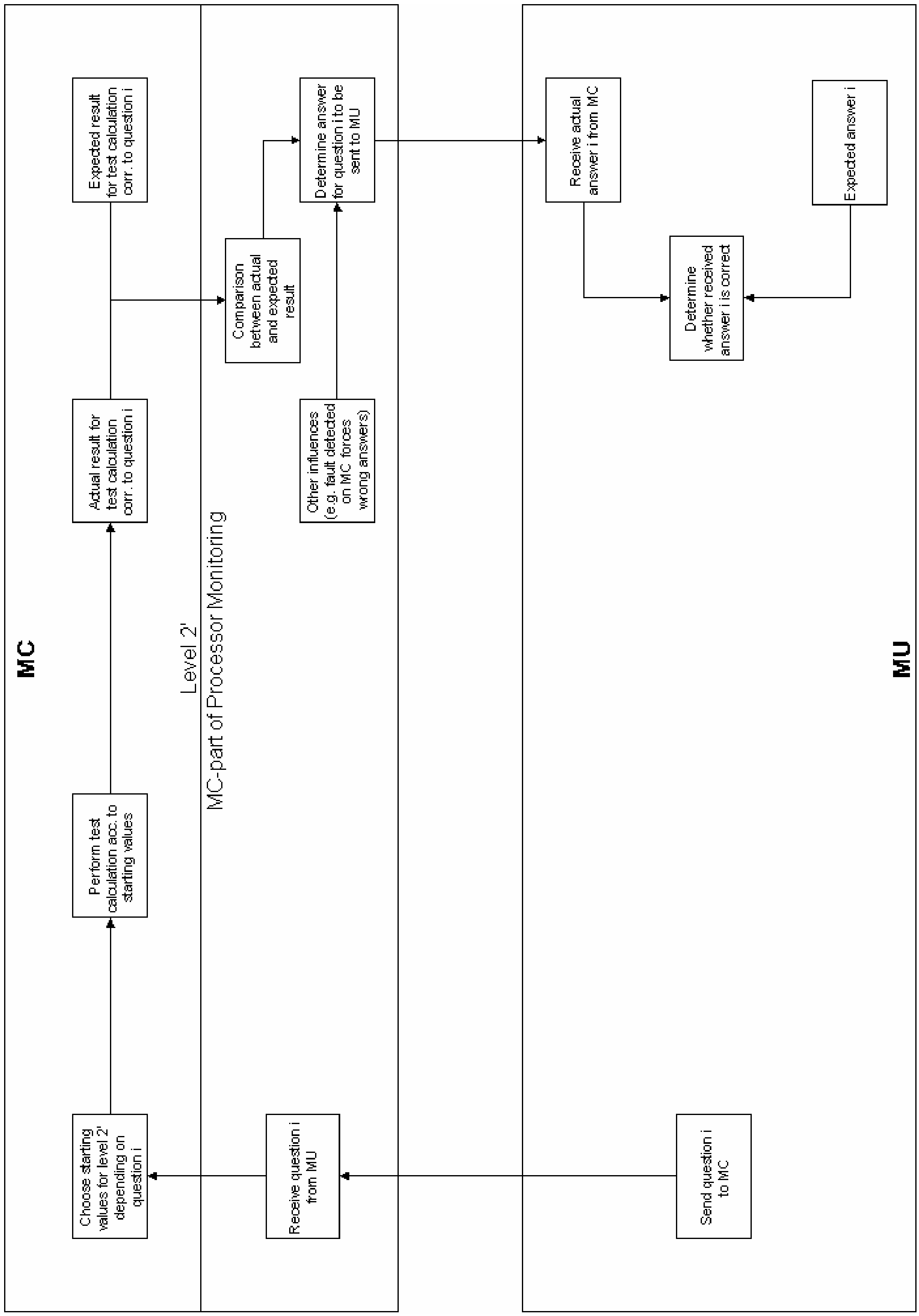

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E.32.1 Pre-processing of the FS-IST data received from MU

FUNCTION DESCRIPTION:

General information:

This function pre-processes the data sent by the MU.

In PREDRIVE and NORMAL communications, the MU sends an FS-IST question and, only in NORMAL communications, additionally also the value of the anti-bounce counter for wrong FS-IST answers on the MU (it is not necessary to send that value in PREDRIVE because then its value is 0).

Description:

The function incorporates the following requirements:

G33 Pre-processing of the FS-IST data received from MU

The inputs to this function are IDX_TEST_RCV_MC_FCT_SPC_IST, the question as it was sent from the MU (via the infrastructure) and, in NORMAL communications, ABC_RCV_MC_FCT_SPC_IST, the value of the anti-bounce counter on the MU used for debouncing wrongly answered FS-IST questions.

Since the first MU anti-bounce counter value is only sent in NORMAL communications but the initial value of 0 is already known and used in PREDRIVE, it is necessary to use the local identifier ABC_LID_MC_FCT_SPC_IST to be used in all other MC FS-IST functions both in PREDRIVE and NORMAL; this variable is initialised to 0 before the PREDRIVE communication and then updated with the actual value sent by the MU after NORMAL communications.

As for the question sent by the MU, it is more efficient to instead use the corresponding *question number* (which is nothing but the appropriate index into the array NC_IDX_TEST_MC_FCT_SPC_IST[] of questions on the MC), in particular to simplify handing data to level 2'. Therefore, a decode step has to be taken after received the question on the MC: the received question IDX_TEST_RCV_MC_FCT_SPC_IST is simply compared to all entries in the array NC_IDX_TEST_MC_FCT_SPC_IST[] in order to find whether the transmitted question does indeed correspond to a known index on the MC, which is then stored in IDX_NR_LID_MC_FCT_SPC_IST; in order to detect when this decoding step fails, IDX_NR_LID_MC_FCT_SPC_IST is initialised to a specific value, NC_IDX_NR_WRG_MC_FCT_SPC_IST, indicating an invalid question number, and if no corresponding question number is found, this remains the value of IDX_NR_LID_MC_FCT_SPC_IST.

In this way, after both PREDRIVE and NORMAL communication(s), all data are always present for the other FS-IST functions.

Application conditions

Initialisation:

```
/ * Initialise the value of the MU anti-bounce counter sent
by the MU */
 ABC_RCV_MC_FCT_SPC_IST = 0;
 / * Initialise the value of the MU anti-bounce counter on
the MC */
 ABC_LID_MC_FCT_SPC_IST = 0;
 / * Initialise question number for question sent by MU to
wrong number */
IDX_NR_LID_MC_FCT_SPC_IST =
NC_IDX_NR_WRG_MC_FCT_SPC_IST;
/ * Initialise index number */
IDX_NR = 0;
 / * Initialise question sent by MU */
 IDX_TEST_RCV_MC_FCT_SPC_IST = 0;
```

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Recurrence: The **initialisation** shall be performed **after each power-up or reset.**
The **formula section** shall be **executed after the functions "Communication monitoring and evaluation of received data in PREDRIVE state" and "Communication monitoring and evaluation of received data in NORMAL state" have been finished.**

Activation: *((STATE_MC = NC_STATE_MC_PRDR)* ***OR***
(STATE_MC = NC_STATE_MC_NORM)) ***AND***
"no errors during the evaluation following the communications"

Deactivation: *Otherwise*

Formula section:

/ Get question sent by MU from infrastructure */*
ACTION_INFR_McGetFsistIdx(*OUT* IDX_TEST_RCV_MC_FCT_SPC_IST);
/ Initialise local identifier for question number */*
IDX_NR_LID_MC_FCT_SPC_IST = NC_IDX_NR_WRG_MC_FCT_SPC_IST;
/ In NORMAL, change the value of the MU anti-bounce counter to the received value */*
IF (STATE_MC = NC_STATE_MC_NORM)
THEN */* In PREDRIVE, MC value of MU anti-bounce counter is set in initialisation*/*
/ Get value of anti-bounce counter on MU from infrastructure */*
ACTION_INFR_McGetFsistAbcVal(*OUT* ABC_RCV_MC_FCT_SPC_IST);
ABC_LID_MC_FCT_SPC_IST = ABC_RCV_MC_FCT_SPC_IST;
FI
/ Check whether received question corresponds to a question number; if yes, set local identifier to the decoded question number */*
FOR IDX_NR = 0 **TO** NC_TEST_REC_IDX_MAX_MON2 - 1
DO */* Check all defined questions */*
IF (NC_IDX_TEST_MC_FCT_SPC_IST[IDX_NR] = IDX_TEST_LID_MC_FST_SPC_IST)
THEN */* Found the corresponding question number */*
IDX_NR_LID_MC_FCT_SPC_IST = IDX_NR;
FI
OD
/ If no matching question number is found, IDX_NR_LID_MC_FCT_SPC_IST will have value NC_IDX_NR_WRG_MC_FCT_SPC_IST */*
/ Has the number of the received question changed with this communication? */*
IF (IDX_NR_LID_MC_FCT_SPC_IST <> TEST_REC_IDX_MON2)
THEN
LV_MC_FCT_SPC_IST_ACT = 1;
FI */* Otherwise, LV_MC_FCT_SPC_IST_ACT remains unchanged */*

E.32.2 Test of MU reaction to wrong FS-IST answers

FUNCTION DESCRIPTION:

General information:

This sub-function, under certain conditions, indicates (to the post-processing sub-function) a deliberate sending of wrong FS-IST answers to the MU, similar to PFM, with the goal to test whether the MU, after

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an appropriate delay, reacts to the received wrong answer by sending an increased anti-bounce counter and repeating the wrongly answered question.

This sub-function is executed after the pre-processing function.

Description:

The function incorporates the following requirements:

G34 Test of MU reaction to wrong FS-IST answers

After the data received from the MU have been decoded and pre-processed, the newly received information (in particular about the value of the FS-IST anti-bounce counter on the MU) is used to determine whether it is possible to send a deliberately wrong FS-IST answer in the current system state.
In addition to the anti-bounce counter information from the MU, this system state includes the value of a test cycle counter TCC_MC_FCT_SPC_IST_WRG_RESP counting the number of times the function gets activated. There are two significant values of this counter, viz., NC_TCC_MC_IST_WRG_RESP_REQ and NC_TCC_MC_IST_WRG_RESP_CHK: the former means that sending a wrong answer is requested (this will eventually prompt setting a flag influencing the post-processing sub-function to export a bad answer); the latter value means that it is time to check whether the MU has reacted to a previously sent deliberately wrong answer (one has to allow for some delay because the MU only sends a new question every second communication cycle; consequently, the two values must necessarily be different). If the counter reaches a certain number then it is re-started, eventually triggering a new cycle of another wrong answer, check MU reaction to that and so on.
The sub-function consists of several sequential sub-tasks:

1. find out whether the MU anti-bounce counter sticks to a non-zero value (deploying a saved copy of its previous value);
2. test whether the MU has reacted (i.e., increased the anti-bounce counter accordingly) if the test cycle counter has reached value NC_TCC_MC_IST_WRG_RESP_CHK; this test also checks whether the MU anti-bounce counter sticks to 0 (complementing the previous test);
3. initiate sending a deliberately wrong FS-IST answer if the test cycle counter has reached value NC_TCC_MC_IST_WRG_RESP_REQ;
4. increase the value of the test cycle counter (including re-starting the counter when it is has reached its end value).

These sub-tasks shall be performed in this order; note that the second and third task cannot be activated at the same time anyway because their activation conditions are that the test cycle counter reaches two distinct values. As a consequence, they will be specified in one common formula section.
Note that for sub-task 3, (potentially) initiating the sending of a wrong FS-IST answer to the MU, is only performed of the MU anti-bounce counter is equal to 0, much like in the corresponding PFM functionality: sending a deliberately wrong answer must not trigger fault reaction. As a consequence, if the test cycle counter indicates that the MU should have reacted to a wrong answer (sub-task 2), it is tested whether the MU anti-bounce counter has value 2 which corresponds to exactly one increase of the MU anti-bounce counter (caused by the *deliberately* wrong answer).
It should furthermore be noted that, if during sub-task 2, it is found that the anti-bounce counter does not have the expected value, a wrong answer shall again be sent (this is achieved by setting the flag LV_MC_FCT_SPC_IST_WRG_RESP_ACT) and the test cycle counter shall be decrease by 1; the latter action is done because in sub-task 4, the test cycle counter is *unconditionally* increase by 1 so in the mentioned error case, the counter will, after the increase, still have value NC_TCC_MC_IST_WRG_RESP_CHK, i.e., after the next activation of the FS-IST, it will again be checked whether the MU has reacted to the wrong answer.

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Application conditions

Initialisation:

```
/ * FS-IST to be activated */
    LV_MC_FCT_SPC_IST_ACT = 1;
```


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```
 / * Initialise saved value of MU anti-bounce counter */
   ABC_LID_MC_FCT_SPC_IST_OLD = 0;
   / * Initially deactivate sending of wrong responses */
   LV_MC_FCT_SPC_IST_WRG_RESP_ACT = 0;
   / * Initially set test cycle counter to requesting a wrong
response */
TCC_MC_FCT_SPC_IST_WRG_RESP = NC_TCC_MC_IST_WRG_RESP_REQ
```

Recurrence: The **initialisation** shall be **performed after each power-up or reset.**
The **formula section** shall be **executed after the FS-IST sub-function "Pre-processing of FS-IST data received from MU" has been finished.**

Activation: *(LV_MC_FCT_SPC_IST_ACT = 1)* ***OR*** *("MU configured for TCU mode")*

Deactivation: *Otherwise*

Formula section:

/ Sub-task 1: checking whether the MU anti-bounce counter sticks to a non-zero value */*
IF (ABC_LID_MC_FCT_SPC_IST > 0)
THEN */* Does the MU anti-bounce counter stick to a non-zero value? */*
    IF (ABC_LID_MC_FCT_SPC_IST = ABC_LID_MC_FCT_SPC_IST_OLD)
    THEN */* Yes: increase MC anti-bounce counter */*
        ACTION_ECM3_McIncAbc(*IN* NC_ABC_MC_NOT_DEC,
            IN NC_ERR_COD_MC_NOT_DEC);
    ELSE */*Has the anti-bounce counter been decreased? */*
        IF (ABC_LID_MC_FCT_SPC_IST < ABC_LID_MC_FCT_SPC_IST_OLD)
        THEN */* Yes: decrease MC anti-bounce counter */*
            ACTION_ECM3_McDecAbc(*IN* NC_ABC_MC_NOT_DEC);
        FI */* Otherwise: no action as this behaviour of the MU anti-bounce counter might be caused by a (really, as opposed to deliberately) wrong level 2' response */*
    FI */* Note that sticking to 0 is tested later */*
ELSE */* No, MU anti-bounce counter is equal to 0: decrease MC anti-bounce counter */*
    ACTION_ECM3_McDecAbc(*IN* NC_ABC_MC_NOT_DEC);
FI
/ Sub-task 2: does the test cycle counter indicate checking the MU reaction? */*
IF (TCC_MC_FCT_SPC_IST_WRG_RESP = NC_TCC_MC_IST_WRG_RESP_CHK)
THEN */* Yes: check value of MU anti-bounce counter (should be equal to 2)*/*
    IF (ABC_LID_MC_FCT_SPC_IST = 2)
    THEN */* MU anti-bounce counter has the expected value: decrease corresponding MC anti-bounce counter */*
        ACTION_ECM3_McDecAbc(*IN* NC_ABC_MC_WRG_RESP);
    ELSE */* MU anti-bounce counter does not have expected value: increase corresponding MC anti-bounce counter */*
        ACTION_ECM3_McIncAbc(*IN* NC_ABC_MC_WRG_RESP,
            IN NC_ERR_COD_MC_WRG_RESP);
        / Does the MU anti-bounce counter stick to 0? */*
        IF (ABC_LID_MC_FCT_SPC_IST = 0)
        THEN */* Yes: re-activate sending of wrong answer, decrease test cycle counter */*
            LV_MC_FCT_SPC_IST_WRG_RESP_ACT = 1;
            TCC_MC_FCT_SPC_IST_WRG_RESP =
                TCC_MC_FCT_SPC_IST_WRG_RESP - 1;

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```
                FI
        FI
FI
/* Sub-task 3: request sending a wrong answer? */
IF ((TCC_MC_FCT_SPC_IST_WRG_RESP = NC_TCC_MC_IST_WRG_RESP_REQ)
THEN /* Yes: can we actually send a wrong answer (MU anti-bounce counter = 0)?*/
        IF (ABC_LID_MC_FCT_SPC_IST = 0)
        THEN /* Yes: set flag */
                LV_MC_FCT_SPC_IST_WRG_RESP_ACT = 1;
        ELSE /* No: try again in the next communication cycle */
                TCC_MC_FCT_SPC_IST_WRG_RESP =
                        TCC_MC_FCT_SPC_IST_WRG_RESP - 1;
        FI
FI
/* Sub-task 4: increase test cycle counter (including re-starting the counter) */
TCC_MC_FCT_SPC_IST_WRG_RESP =
                                (TCC_MC_FCT_SPC_IST_WRG_RESP + 1)
                        MOD   NC_TEST_REC_IDX_MAX_MON2 + 4;
/* Note that still LV_MC_FCT_SPC_IST_ACT = 1, i.e., the FS-IST is still active! */
```

E.32.3 Monitoring of FS-IST questions sent by MU

FUNCTION DESCRIPTION:

General information:

This sub-function monitors the sending of questions by the MU by comparing the question number corresponding to the actually sent question (in case it could be decoded) with a *predicted* question number (obtained as a function of the previous question number, plus the current and the saved state of the MU anti-bounce counter). In case of a discrepancy, a debounced fault reaction will be the result.

Description:

The function incorporates the following requirements:

G35 Monitoring of FS-IST questions sent by MU

After the data received from the MU have been pre-processed, in particular the newly sent question has been translated (if possible) into the matching question number on the MC, this function first predicts the expected question number; inputs for this are the previous, saved question number IDX_NR_LID_MC_FCT_SPC_IST_OLD, the current state of the MU anti-bounce counter ABC_LID_MC_FCT_SPC_IST, and the saved value ABC_LID_MC_FCT_SPC_IST_OLD of the MU anti-bounce counter, and the result of the prediction is stored in IDX_NR_LID_MC_FCT_SPC_IST_PRED.
Once the predicted question number has been obtained, a range check is performed for this decoded question number; in case it is found to be out of range (which means that the decode process detected an invalid question to which no matching question number could be found), a debounced fault reaction shall be performed and the *predicted* question number shall be saved (it is no use to save the invalid question number because the next prediction has to be based on a valid question number; moreover, the predicted question number is the one that should have been sent in the first place).
If the range check was successful, the predicted question number is compared with the decoded question number. If the two numbers disagree, a debounced fault reaction shall be performed, using the actions ACTION_ECM3_McIncAbc and ACTION_ECM3_McDecAbc, the anti-bounce counter NC_ABC_

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MC_WRG_IDX and (potentially) the error code NC_ERR_COD_MC_WRG_IDX. The difference to the previous case with the failed range check is the fact that in this case, the decoded question number will, despite not being the expected one, still be used as the basis for the next prediction: after all, it is a valid question number sent by the MU and it reflects the internal state of the MU (at least from the point of view of FS-IST). If the prediction for the next question number is to have any chance of being accurate, the decoded value has to be used because also the MU bases its internal calculation on it.

Note that the saved question number is initialised to the maximal question number because then it is only necessary to increase it by 1 (modulo the maximal question number, i.e., 0) to obtain the predicted question number in case the MU anti-bounce counter has current value 0 - as is the case in PREDRIVE when the function is active for the first time, and so the initial case does not require special treatment but can be handled just like any other case.

Now back to the calculation of the predicted question number. There are several cases, all distinguished by the interplay between saved value (ABC_LID_MC_FCT_SPC_IST_OLD) and newly transmitted value (ABC_LID_MC_FCT_SPC_IST) of the MU anti-bounce counter:

1. **ABC_LID_MC_FCT_SPC_IST $\leq$ 1:**

Then no error is present on the MU, hence the MU should send the next question, i.e.,

IDX_NR_LID_MC_FCT_SPC_IST_PRED =
(IDX_NR_LID_MC_FCT_SPC_IST_OLD + 1)
MOD NC_TEST_REC_IDX_MAX_MON2,

as always during normal operation (the modulo-operation is necessary to avoid overflows of the predicted question number); the fact that less than or equal to 1 is tested is connected to the fact that the MU repeats a wrongly answered question until this condition for its FS-IST anti-bounce counter is satisfied;

1. **(ABC_LID_MC_FCT_SPC_IST_OLD = 0) AND (ABC_LID_MC_FCT_SPC_IST = 2):**

This case expresses the fact that an error was detected on the MU between the last and the current activation of the FS-IST on the MC; consequently, it is expected that the MU simply repeats the wrongly answered question number, i.e.,

IDX_NR_LID_MC_FCT_SPC_IST_PRED =
(IDX_NR_LID_MC_FCT_SPC_IST_OLD - 1)
(for IDX_NR_LID_MC_FCT_SPC_IST_OLD $>$ 0)

and

IDX_NR_LID_MC_FCT_SPC_IST_PRED = NC_TEST_REC_IDX_MAX_MON2 - 1;
(for IDX_NR_LID_MC_FCT_SPC_IST_OLD = 0)

repeating the wrongly answered question means expecting the predecessor of the current question number because of the timing of fault detection in the FS-IST: in a certain communication, the MU receives an FS-IST answer *A(i)* from the MC to a question *Q(i)* with number *i* and, due to the bidirectional nature of the communication interface between MC and MU, in the very same communication it sends out the next question *Q(i+1)* (as the MU must assume that the received answer is correct because of system robustness issues); consequently, after the next activation of the FS-IST functions on the MC after this communication, *i+1* is stored in IDX_NR_LID_MC_FCT_SPC_IST_OLD; in the meantime, the MU has detected that *A(i)* was wrong: a debounced fault reaction is the consequence (responsible for the checked increase of the MU anti-bounce counter from 0 to 2), and in the next communication, the MU will repeat the question *Q(i)*, i.e., exactly as expressed in the formula for the predicted question number above;

1. **Otherwise (meaning that the current value is $>$1 and the saved value is $>$0):**

This means that the MU will repeat the same question number as the saved one, i.e., IDX_NR_LID_MC_FCT_SPC_IST_PRED = IDX_NR_LID_MC_FCT_SPC_IST_OLD, and the explanation is similar to the previous case: the constellation of saved and current value for the MU anti-bounce counter can only be present if there has been an error on the MU but not in the last communication because otherwise, the save value of the MU anti-bounce counter would be 0 (the previous case); consequently, the MU has already started to repeat a wrongly answered question, and *will continue to do so* until its anti-bounce counter reaches 1 (cf. the first case); hence it is expected to receive the same question number as in the communication before.

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Application conditions

Initialisation:

```
/ * Initialise predicted question number */
   IDX_NR_LID_MC_FCT_SPC_IST_PRED = 0;
 / * Initialise saved question number to last question number
(see above) */
   IDX_NR_LID_MC_FCT_SPC_IST_OLD =
                       NC_TEST_REC_IDX_MAX_MON2;
```

Recurrence: The **initialisation** shall be performed **after each power-up or reset.**
The **function** shall be performed **after the function "Pre-processing of FS-IST data received from MU" has been finished** *(it may run in parallel to the test whether the MU reacts to wrongs FS-IST answers).*

Activation: *(LV_MC_FCT_SPC_IST_ACT = 1)* ***OR*** *("MU configured for TCU mode")*

Deactivation: *Otherwise*

E.32.4 Export of the question number to level 2’

FUNCTION DESCRIPTION:

General information:

This sub-function provides the question number to level 2’ after all the required sub-functions have been activated; before calling level 2’, a range check for the to-be-exported data is performed, and level 2’ is not called in case the range check fails.

Description:

This sub-function incorporates the following requirements:

G36 Export of the question number to level 2’

R36_1: The current value ABC_LID_MC_FCT_SPC_IST of the MU anti-bounce counter shall be saved as ABC_LID_MC_FCT_SPC_IST_OLD for the next FS-IST activation.

R36_2: The current question number IDX_NR_LID_MC_FCT_SPC_IST shall be assigned to the variable TEST_REC_IDX_MON2 to be exported to level 2’.

R36_3: A range check on the latter value shall be performed (in order to avoid an invalid value to be exported to level 2’, in particular if it was not possible to decode the question sent by the MU; cf. G33).

R36_4: If the range check was successful, TEST_REC_IDX_MON2 shall be handed over to level 2’, otherwise nothing is done: level 2’ need not be activated with an invalid value (unnecessary computations), and there is no default value for it either (it is not clear what the MU expects in answer to a corrupted question).

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Application conditions

Initialisation: */ * Initialise exported question number to invalid value */*

TEST_REC_IDX_MON2 = NC_IDX_NR_WRG_MC_FCT_SPC_IST;

Recurrence: The **initialisation** shall be performed **after each power-up or reset**
. The **function itself** shall be performed **after both FS-IST functions "Test of MU reaction to wrong FS-IST answers" and "Monitoring of FS-IST questions sent by MU" have been finished.**

Activation: *(LV_MC_FCT_SPC_IST_ACT = 1)* ***OR*** *("MU configured for TCU mode")*

Deactivation: *Otherwise*

E.32.5 Export of the question number to level 2’ (second calculation)

FUNCTION DESCRIPTION:

General information:

This sub-function provides the question number to level 2’ after all the required sub-functions have been activated; before calling level 2’, a range check for the to-be-exported data is performed, and level 2’ is not called in case the range check fails.

Description:

This sub-function incorporates the following requirements:

G62 Export of the question number to level 2’ (second calculation)

R62_1: The current question number IDX_NR_LID_MC_FCT_SPC_IST shall be assigned to the variable TEST_REC_IDX_MON2 to be exported to level 2’.

R62_2: A range check on the latter value shall be performed (in order to avoid an invalid value to be exported to level 2’, in particular if it was not possible to decode the question sent by the MU; cf. G33).

R62_3: If the range check was successful, TEST_REC_IDX_MON2 shall be handed over to level 2’, otherwise nothing is done: level 2’ need not be activated with an invalid value (unnecessary computations), and there is no default value for it either (it is not clear what the MU expects in answer to a corrupted question).

Application conditions

Initialisation: –

Recurrence: *The **function** shall be executed **after both FS-IST functions "Test of MU reaction to wrong FS-IST answers" and "Monitoring of FS-IST questions sent by MU" have been finished (even if they were not activated).***

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Activation: *(LV_MC_FCT_SPC_IST_ACT = 0)* ***AND*** *("MU not configured for TCU mode")* / * note that this function is executed in those recurrences of Processor Monitoring where G36 is **not** executed */

Deactivation: *Otherwise*

E.32.6 Decoding of the result of the level 2' test calculation

FUNCTION DESCRIPTION:

General information:

This sub-function decodes the result of the test calculation from level 2' (a 16bit value) into an answer number that can then be used for generating the actual FS-IST answer sent to the MU (a 6bit value).

Description:

The sub-function incorporates the following requirements:

G37 Decoding of the result of the level 2' test calculation

R37_1: After finishing, the test calculation of level 2' shall export its result in the 16bit value RESP_MON2 (note: this is an *answer*, not an *answer number*, similar to the distinction between question and question number; RESP_MON2 cannot be sent to the MU directly: the 16bit value would not fit into the 6bit reserved in the communication protocol for the FS-IST answer from the MC; consequently, a decoding process, like the decoding of the MU question, has to be performed before the actual FS-IST answer can be obtained).

R37_2: The decoding process is performed utilising the 'conversion table' ID_RESP_MON2 and its axis LDPM_TEST_REC_IDX_MON2:
R37_2.1: the answer number IDX_NR_RESP_MC_FCT_SPC_IST shall be initialised to the invalid number NC_IDX_NR_WRG_MC_FCT_SPC_IST;
R37_2.2: then IDX_NR_RESP_MC_FCT_SPC_IST runs through the table ID_RESP_MON2 (using LDPM_TEST_REC_IDX_MON2) and an index is sought such that a lookup at that index in the conversion table ID_RESP_MON2 yields RESP_MON2 as the result;
R37_2.3: in this way, if an index into ID_RESP_MON2 corresponding to RESP_MON2 is found, IDX_NR_RESP_MC_FCT_SPC_IST is assigned this value or, if the level 2' response could not be decoded (i.e., if there is no matching table entry), IDX_NR_RESP_MC_FCT_SPC_IST is not updated and keeps the invalid number NC_IDX_NR_WRG_MC_FCT_SPC_IST as value (this information can then be used in the subsequent post-processing sub-function).

Application conditions

Initialisation:

```
/ * Initialise answer number to wrong number */
   IDX_NR_RESP_MC_FCT_SPC_IST =
       NC_IDX_NR_WRG_MC_FCT_SPC_IST;
```

Recurrence: The **initialisation** shall be performed **after each power-up or reset.**
The **function itself** shall be executed **after the FS-IST sub-function "Export of the question number to level 2'" has been finished.**

Activation: *(LV_MC_FCT_SPC_IST_ACT = 1)* ***OR*** *("MU configured for TCU mode")*

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Deactivation: `Otherwise`

E.32.7 Decoding of the result of the level 2’ test calculation (second calculation)

FUNCTION DESCRIPTION:

General information:

This sub-function decodes the result of the test calculation from level 2’ (a 16bit value) into an answer number that can then be used for generating the actual FS-IST answer sent to the MU (a 6bit value).

This is done for the "second calculation" with the same question number. It is necessary to store whether the result was correct or not; for this, we have to ensure that TEST_REC_IDX_MON2 is valid since otherwise level2’ would not have been activated (hence we have to perform a range check on TEST_REC_IDX_MON2).

Description:

The sub-function incorporates the following requirements:

G63 Decoding of the result of the level 2’ test calculation (second calculation)

R63_1: After finishing, the test calculation of level 2’ shall export its result in the 16bit value RESP_MON2 (note: this is an *answer*, not an *answer number*, similar to the distinction between question and question number; RESP_MON2 cannot be sent to the MU directly: the 16bit value would not fit into the 6bit reserved in the communication protocol for the FS-IST answer from the MC; consequently, a decoding process, like the decoding of the MU question, has to be performed before the actual FS-IST answer can be obtained).

R63_2: The decoding process is performed utilising the ’conversion table’ ID_RESP_MON2 and its axis LDPM_TEST_REC_IDX_MON2:
R63_2.1: the answer number IDX_NR_RESP_MC_FCT_SPC_IST shall be initialised to the invalid number NC_IDX_NR_WRG_MC_FCT_SPC_IST;
R63_2.2: then IDX_NR_RESP_MC_FCT_SPC_IST runs through the table ID_RESP_MON2 (using LDPM_TEST_REC_IDX_MON2) and an index is sought such that a lookup at that index in the conversion table ID_RESP_MON2 yields RESP_MON2 as the result;
R63_2.3: in this way, if an index into ID_RESP_MON2 corresponding to RESP_MON2 is found, IDX_NR_RESP_MC_FCT_SPC_IST is assigned this value or, if the level 2’ response could not be decoded (i.e., if there is no matching table entry), IDX_NR_RESP_MC_FCT_SPC_IST is not updated and keeps the invalid number NC_IDX_NR_WRG_MC_FCT_SPC_IST as value (this information can then be used in the subsequent post-processing sub-function).

R63_3: After the decoding, if

- TEST_REC_IDX_MON2 is in range *(level 2’ has in fact been activated with a defined question number)*, **AND**
- IDX_NR_RESP_MC_FCT_SPC_IST <> TEST_REC_IDX_MON2 *(the answer number from level 2’ does not correspond to current (valid!) question, e.g., if the level2’ answer RESP_MON2 could not be found in ID_RESP_MON2)*, **AND**
- IDX_NR_ERR_MC_FCT_SPC_IST is out of range, i.e., it has a value not between 0 and NC_TEST_REC_IDX_MAX_MON2-1 *(no "second calculation" has failed previously; this is done to repeat the* first *wrongly answered "second calculation")*,

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IDX_NR_ERR_MC_FCT_SPC_IST shall be set to TEST_REC_IDX_MON2 *(storing the (valid!) question number for which the second calculation failed for later reference; by the previous conditions, this is the smallest/earliest question number for which the "second calculation" failed)*; otherwise, nothing shall be done *(in particular, if IDX_NR_ERR_MC_FCT_SPC_IST is in range, it shall stay unchanged in order to remember the* first *question number for which the "second calculation" failed)*

Application conditions

Initialisation: */ * Initialise index for wrong second calculation to invalid number */*
```
IDX_NR_ERR_MC_FCT_SPC_IST =
    NC_IDX_NR_WRG_MC_FCT_SPC_IST;
```

Recurrence: The **initialisation** shall be performed **after each power-up or reset.**
The **function itself** shall be executed **after the FS-IST sub-function "Export of the question number to level 2' (second calculation)" has been finished.**

Activation: *(LV_MC_FCT_SPC_IST_ACT = 0)* ***AND*** *("MU not configured for TCU mode")* / * note that this function is executed in those recurrences of Processor Monitoring where G37 is **not** executed */

Deactivation: *Otherwise*

E.32.8 Post-processing of the FS-IST data on MC for transmission to MU

FUNCTION DESCRIPTION:

General information:

This sub-function performs the necessary post-processing steps regarding the FS-IST on the MC, most importantly sending of a wrong answer if this has previously been requested (whether deliberately, because the redundant switch-off path was triggered, or because any of the decoding steps has failed), and toggling the activation condition for the FS-IST (which is only activated every second communication cycle).

Description:

The sub-function incorporates the following requirements:

G38 Post-processing of the FS-IST data on MC for transmission to MU

R38_1: If any of the following errors is active:

- the redundant switch-off path has been triggered (LV_MC_DR_OFF = 1, LV_MC_DR_OFF_CPL = 0, checked using the RAM check service actions), or
- a deliberately wrong answer shall be sent to the MU (LV_MC_FCT_SPC_IST_WRG_RESP_ACT = 1), or
- the current MU question could not be decoded properly (TEST_REC_IDX_MON2 = NC_IDX_NR_WRG_MC_FCT_SPC_IST), or
- the current level 2' answer could not be decoded properely (IDX_NR_RESP_MC_FCT_SPC_IST = NC_IDX_NR_WRG_MC_FCT_SPC_IST), or
- the current question has been answered wrongly during the last "second calculation" (IDX_NR_RESP_MC_FCT_SPC_IST = IDX_NR_ERR_MC_FCT_SPC_IST),

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then a wrong answer shall be sent to the MU, calling the infrastructure action ACTION_INFR_McSendFsistResp() with NC_IDX_RESP_WRG_MC_FCT_SPC_IST as parameter.

R38_2: Otherwise, in case no error has been detected, the corresponding entry in the "answer array" NC_IDX_RESP_MC_FCT_SPC_IST[] shall be sent to the MU, calling the infrastructure action ACTION_INFR_McSendFsistResp() with NC_IDX_RESP_MC_FCT_SPC_IST[IDX_NR_RESP_MC_FCT_SPC_IST] as parameter.

R38_3: Finally, the active flag LV_MC_FCT_SPC_IST_ACT shall be toggled so that a new answer is only sent in the communication after the next communication cycle.

R38_4: The value of LV_MC_DR_OFF shall be written to the infrastructure using the action ACTION_INFR_McSendDrOff() so that it can be transmitted to the MU in NORMAL communications.

R38_5: The flag LV_MC_FCT_SPC_IST_WRG_RESP_ACT shall be reset to stop deliberately sending a wrong response.

R38_6: If IDX_NR_ERR_MC_FCT_SPC_IST = IDX_NR_RESP_MC_FCT_SPC_IST, IDX_NR_ERR_MC_FCT_SPC_IST shall be re-set to NC_IDX_NR_WRG_MC_FCT_SPC_IST *(a wrong answer for the previously "remembered" question number where the "second calculation" failed shall be sent to MU so the question will be repeated by the MU and hence the "marker" can be re-set to its initial value)*.

Application conditions

Initialisation: –

Recurrence: *The **function** shall be **executed after all other FS-IST sub-functions have been finished.***

Activation: *(LV_MC_FCT_SPC_IST_ACT = 1)* ***OR*** *("MU configured for TCU mode")*

Deactivation: Otherwise

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E.33 Program flow monitoring

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR	-	0... 7H	0 ...7	1	-
Local variable: counter for PFM tasks					
LF_MC_PFM_SYN_BYTE_CHG	-	0... 7FH	0... 127	1	-
Local variable: "change marker" recording the differences between a newly received synchronisation bytes and the previously received one (precisely those bits are set where the two synchronisation bytes differ)					
LF_MC_PFM_SYN_BYTE_CHG_OLD	-	0... 7FH	0... 127	1	-
Local variable: saved value of the previous "change marker"					
LF_MC_PFM_SYN_BYTE_MON	V	0... 7FH	0... 127	1	-
Local variable: PFM synchronisation byte which is updated synchronously to communications and used for monitoring the PFM data sent by the MU (timely updates, wrong response test)					
LF_MC_PFM_SYN_BYTE_TOG	V	0... 7FH	0... 127	1	-
Local variable: PFM synchronisation byte which is updated synchronously with monitored functionality (modified by PFM service actions)					
LF_MC_RCV_PFM_BYTE_MON	-	0... FFH	0... 255	1	-
Local variable: "raw" data sent by MU obtained via infrastructure (used for monitoring of MU)					
LF_MC_RCV_PFM_BYTE_TOG	-	0... FFH	0... 255	1	-
Local variable: "raw" data sent by MU obtained via infrastructure (used for PFM service actions)					
LF_MC_RESP_PFM	-	0... 7FH	0... 127	1	-
The PFM response of the MC (to be sent to the MU via the infrastructure)					
LF_MC_WRG_RESP_PFM_ACT	-	0... 7FH	0... 127	1	-
Local variable: bit field where a set bit k means that a wrong PFM response shall be sent out for task k					
LF_STATE_ABC_PFM_MU	-	0... 7FH	0... 127	1	-
Local variable: "status byte" recording, for each PFM anti-bounce counter on the MU, whether the counter has currently value 0 or not (updated using LF_MC_RCV_PFM_BYTE received from MU)					
LV_MC_CKS_OK_PFM	-	0... 1H	0 ...1	1	-
Local variable: flag indicating whether the (XOR) checksum of the data received from the MU is correct					
LV_MC_PFM_WRG_RESP_ACT_6	O/V	0... 1H	0 ...1	1	-
Flag indicating that the wrong response test for PFM task 6 has been performed at least once (needed for healing of reset counter and error information on the MC)					
STATE_MC_PFM_CTL_BYTE [NC_NR_MC_PFM]	-	0... FFH	0... 255	1	-
Local variable: array of PFM control bytes					
STATE_MU_TMP_PFM	-	0... FFH	0... 255	1	-
Local variable: header byte of MU as sent to MC					
TCC_MC_PFM_TOG [NC_NR_MC_PFM_TCC]	-	0... FFH	0... 255	1	-
Local variable: array of test cycle counters for monitoring the timely toggling of bits in the synchronisation byte by the MU for tasks 0 to 5					
TCC_MC_PFM_TOG_6	-	0... FFFFH	0... 65535	1	-
Local variable: test cycle counter for PFM task 6 (requires higher resolution than the others)					

Input data:

LV_MC_COM_ERR {p. 7049}	LV_MC_COM_ERR_CPL {p. 7049}	NC_ABC_MC_PFM_0_RESP {p. 7074}	NC_ABC_MC_PFM_0_TOG {p. 7074}

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NC_ABC_MC_PFM_1_RESP {p. 7074}	NC_ABC_MC_PFM_1_TOG {p. 7074}	NC_ABC_MC_PFM_2_RESP {p. 7075}	NC_ABC_MC_PFM_2_TOG {p. 7075}
NC_ABC_MC_PFM_3_RESP {p. 7075}	NC_ABC_MC_PFM_3_TOG {p. 7075}	NC_ABC_MC_PFM_4_RESP {p. 7075}	NC_ABC_MC_PFM_4_TOG {p. 7076}
NC_ABC_MC_PFM_5_RESP {p. 7076}	NC_ABC_MC_PFM_5_TOG {p. 7076}	NC_ABC_MC_PFM_6_RESP {p. 7076}	NC_ABC_MC_PFM_6_TOG {p. 7076}
NC_ERR_COD_MC_PFM_0_RESP {p. 7078}	NC_ERR_COD_MC_PFM_0_TOG {p. 7078}	NC_ERR_COD_MC_PFM_1_RESP {p. 7078}	NC_ERR_COD_MC_PFM_1_TOG {p. 7078}
NC_ERR_COD_MC_PFM_2_RESP {p. 7078}	NC_ERR_COD_MC_PFM_2_TOG {p. 7078}	NC_ERR_COD_MC_PFM_3_RESP {p. 7078}	NC_ERR_COD_MC_PFM_3_TOG {p. 7078}
NC_ERR_COD_MC_PFM_4_RESP {p. 7078}	NC_ERR_COD_MC_PFM_4_TOG {p. 7078}	NC_ERR_COD_MC_PFM_5_RESP {p. 7078}	NC_ERR_COD_MC_PFM_5_TOG {p. 7078}
NC_ERR_COD_MC_PFM_6_RESP {p. 7078}	NC_ERR_COD_MC_PFM_6_TOG {p. 7078}	NC_STATE_MC_NORM {p. 7136}	NC_STATE_MC_PRDR {p. 7136}
STATE_MC {p. 7135}			

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_MC_PFM	-	0... FFH	0... 255	1	-
Number of PFM tasks					
NC_NR_MC_PFM_TCC	-	0... FFH	0... 255	1	-
Size of arrays TCC_MC_PFM_TOG[] and NC_TCC_MC_PFM_TOG_MAX[]					
NC_TCC_MC_PFM_TOG_6_MAX	-	0... FFFFH	0... 65535	1	-
Maximal number of communication cycles for the MU to perform the toggling of the PFM bit for task 6					
NC_TCC_MC_PFM_TOG_MAX [NC_NR_MC_PFM_TCC]	-	0... FFH	0... 255	1	-
Array containing the maximal number of communication cycles for the MU to perform the timely toggling of PFM bits for PFM tasks 0...NC_NR_MC_PFM_TCC					
NLF_MC_PFM_SYN_BYTE_INI	-	0... 7FH	0... 127	1	-
Initial value for the PFM synchronisation byte used for toggling by the service actions					

Action definition

ACTION_ECM3_Service0TaskPfm (**IN**<No Name available>)	Mode: O

ACTION_ECM3_Service10TaskPfm (**IN**<No Name available>)	Mode: O

ACTION_ECM3_Service11TaskPfm (**IN**<No Name available>)	Mode: O

ACTION_ECM3_Service12TaskPfm (**IN**<No Name available>)	Mode: O

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ACTION_ECM3_Service13TaskPfm (**IN**<No Name available>)	Mode: O

ACTION_ECM3_Service14TaskPfm (**IN**<No Name available>)	Mode: O

ACTION_ECM3_Service15TaskPfm (**IN**<No Name available>)	Mode: O

ACTION_ECM3_Service16TaskPfm (**IN**<No Name available>)	Mode: O

ACTION_ECM3_Service17TaskPfm (**IN**<No Name available>)	Mode: O

ACTION_ECM3_Service18TaskPfm (**IN**<k>)	Mode: O
Service action for "inspection point" 18 in task k.	

ACTION_ECM3_Service19TaskPfm (**IN**<k>)	Mode: O
Service action for "inspection point" 19 in task k.	

ACTION_ECM3_Service1TaskPfm (**IN**<No Name available>)	Mode: O

ACTION_ECM3_Service20TaskPfm (**IN**<k>)	Mode: O
Service action for "inspection point" 20 in task k.	

ACTION_ECM3_Service21TaskPfm (**IN**<k>)	Mode: O
Service action for "inspection point" 21 in task k.	

ACTION_ECM3_Service22TaskPfm (**IN**<k>)	Mode: O
Service action for "inspection point" 22 in task k.	

ACTION_ECM3_Service23TaskPfm (**IN**<k>)	Mode: O
Service action for "inspection point" 23 in task k.	

ACTION_ECM3_Service24TaskPfm (**IN**<k>)	Mode: O
Service action for "inspection point" 24 in task k.	

ACTION_ECM3_Service25TaskPfm (**IN**<k>)	Mode: O
Service action for "inspection point" 25 in task k.	

ACTION_ECM3_Service26TaskPfm (**IN**<k>)	Mode: O
Service action for "inspection point" 26 in task k.	

ACTION_ECM3_Service27TaskPfm (**IN**<k>)	Mode: O
Service action for "inspection point" 27 in task k.	

ACTION_ECM3_Service28TaskPfm (**IN**<k>)	Mode: O
Service action for "inspection point" 28 in task k.	

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ACTION_ECM3_Service29TaskPfm (IN<k>)	Mode: O
Service action for "inspection point" 29 in task k.	

ACTION_ECM3_Service2TaskPfm (IN<No Name available>)	Mode: O

ACTION_ECM3_Service3TaskPfm (IN<PRM_K>)	Mode: O
Service action for "inspection point" 3 in task k.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_K	in	0... FFH	0... 255	1	-
task number					

ACTION_ECM3_Service4TaskPfm (IN<PRM_K>)	Mode: O
Service action for "inspection point" 4 in task k.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_K	in	0... FFH	0... 255	1	-
task number					

ACTION_ECM3_Service5TaskPfm (IN<PRM_K>)	Mode: O
Service action for "inspection point" 5 in task k.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_K	in	0... FFH	0... 255	1	-
task number					

ACTION_ECM3_Service6TaskPfm (IN<No Name available>)	Mode: O

ACTION_ECM3_Service7TaskPfm (IN<No Name available>)	Mode: O

ACTION_ECM3_Service8TaskPfm (IN<No Name available>)	Mode: O

ACTION_ECM3_Service9TaskPfm (IN<No Name available>)	Mode: O

ACTION_ECM3_ServicePfm (IN<No Name available>)	Mode: O

Import actions:

ACTION_ECM3_ChkCpl (**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_McDecAbc (**IN**<PRM_ABC_ID>)
ACTION_ECM3_McIncAbc (**IN**<PRM_ABC_ID>,**IN**<PRM_ERR_COD>)
ACTION_ECM3_McReadChkState (**OUT**<PRM_STATE_MC_TMP>)

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ACTION_ECM3_ReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_WriteChkCpl (**INOUT**<PRM_VAR>,**OUT**<PRM_VAR_CPL>,**IN**<PRM_VALUE>)
ACTION_INFR_McChkCks (**OUT**<No Name available>)
ACTION_INFR_McGetHd (**OUT**<PRM_STATE_MU>)
ACTION_INFR_McGetPfmByte (**OUT**<lf_mc_rcv_pfm_byte>)
ACTION_INFR_McSendPfmResp (**IN**<lf_mc_resp_pfm>)

FUNCTION DESCRIPTION:

General information:

Program flow monitoring (PFM) is one of the ways in which the processor monitoring functionality monitors whether the MC-SW, most importantly the process monitoring, is still executed “properly.” From the perspective of PFM, “properly” means that the safety-relevant functions of process monitoring are executed with the correct recurrence and in the correct sequence. The basic algorithm of PFM works as follows.

The MU sends a bit pattern, the so-called *PFM synchronisation byte*, to the MC: this synchronisation byte contains one bit for each of 7 *PFM tasks* (numbered from 0 to 6) to be monitored. Here, “PFM task” denotes a collection of software modules (=functions), in particular of process monitoring, which have to be executed in a defined order and which have to be executed in the same time grid. There can be up to 30 "inspection points" in each of the monitored tasks (e.g., if 3 inspections per module are performed, this means up to 10 modules per task).

Having been received by the MC, the synchronisation byte is used to obtain the so-called *PFM response byte*: if the monitored modules (of process monitoring or others) from one task *are executed* and, furthermore, if they are *executed in the correct order* (note that these are two different constraints!), they manipulate the bit in the response byte corresponding to ‘their’ task in such a way that it is finally toggled. The (thus potentially updated) response byte is sent back to the MU. In how far the sent response byte (MC $\rightarrow$ MU) differs from the originally transmitted synchronisation byte (MU $\rightarrow$ MC) depends solely on which monitored modules were executed until the communication where the response byte was transmitted.

It should be noted that the MU sends two kinds of information: synchronisation bytes and status bytes, and that there is at least one status byte sent between two synchronisation bytes because of the toggle frequency on the MU. Such a status byte contains information about PFM anti-bounce counters on the MU: a set bit indicates that the corresponding counter has value > 0.

Meanwhile, on the MU, the synchronisation byte that was previously sent to the MC, is also manipulated: specific bits are toggled in a way in line with what is expected from the MC in terms of toggling the bits, assuming that the process monitoring tasks are executed “properly” in the sense explained above. When the PFM response of the MC (= a potential update by the MC of the original synchronisation byte) is received, it can thus be compared with the (now also on the MU manipulated) synchronisation byte on the MU.

Since the way the MU manipulates the synchronisation byte is the reference for how the MC should do the same task, a mismatch between the synchronisation byte and the PFM response of the MC indicates that the program execution on the MC is not performed in the prescribed way; as a consequence, a debounced fault reaction will be performed, using separate anti-bounce counters for each of the 7 tasks.

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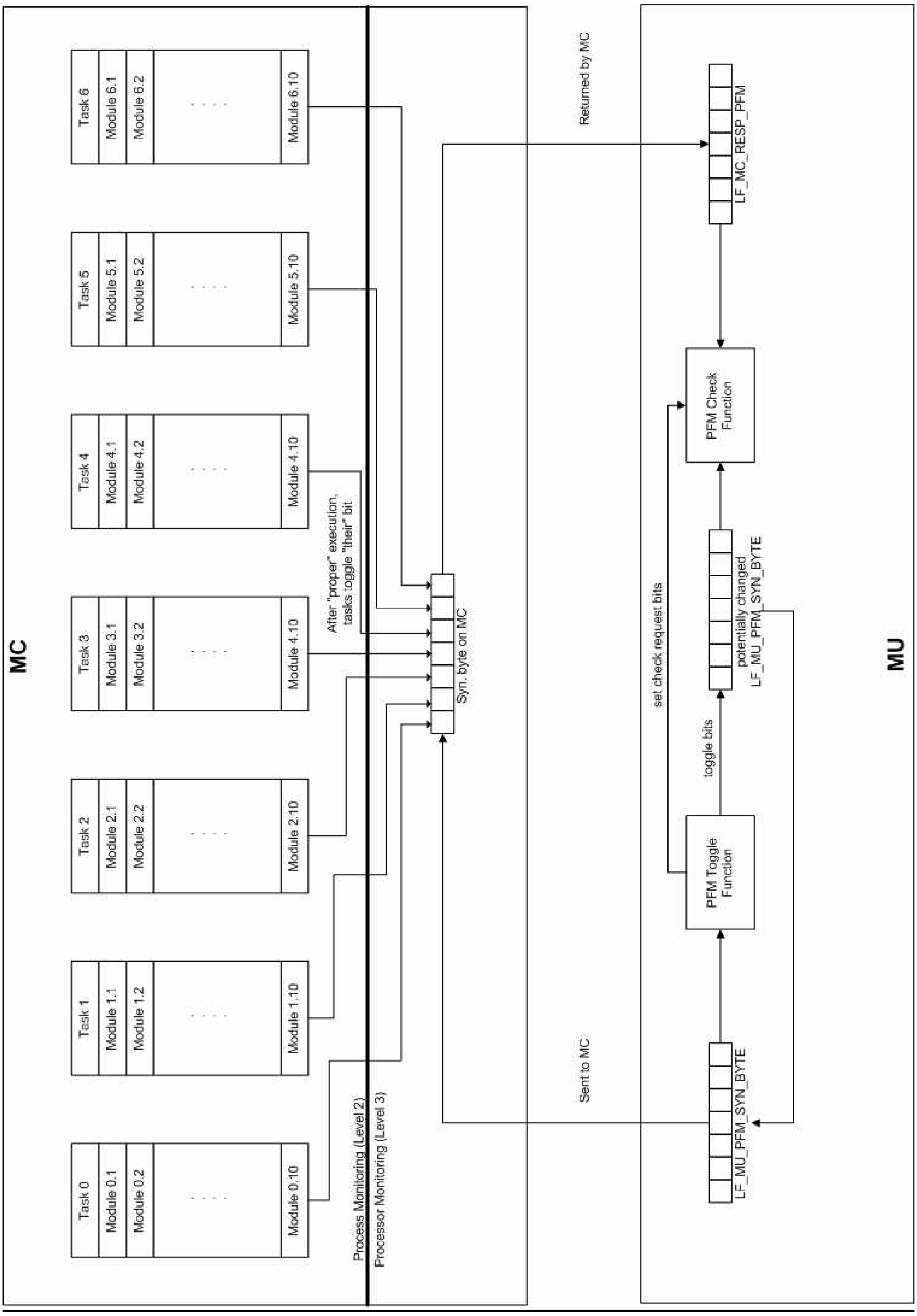
Signal flow diagram:



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Description:

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The PFM on the MC has the following main tasks:

1. decoding of PFM byte sent by the MU;
2. PFM service actions;
3. monitoring of timely updates of the synchronisation byte by the MU;
4. test MU reaction to wrong PFM responses;
5. post-processing of PFM response before communications.

These sub-tasks of PFM shall, in the following, be represented as the sub-functions of this module.

A special case arises for the first sub-function. It is possible that the monitored functionality (e.g., process monitoring) is running asynchronously to the communications between MC and MU. Therefore, the sub-function must be split in two: one function running synchronously with the communications dealing with testing the MU responses (timely updates and reaction to deliberately wrong responses); another one running synchronously with the fastest monitored task acquiring the synchronisation byte for toggling by the PFM service actions in the same time grid as the modules under PFM inspection.

The last sub-function which is responsible for preparing the PFM response sent to the MU only takes into account that synchronisation byte which used for the service actions since only this can provide the information which modules of the monitored tasks have been executed.

The sequencing of these sub-functions shall also be described (which is basically in the order in which they are presented above with the exception of the service actions which are independently executed by the modules/tasks which are put under the supervision of PFM).

E.33.1 Decoding of PFM byte sent by the MU used for monitoring of MU

FUNCTION DESCRIPTION:

General information:

This sub-function describes how the "raw" data received from the MU (via the infrastructure interface) are pre-processed for PFM on the MC.

Note that this sub-function deals with that instance of the synchronisation byte which is only evaluated to detect whether the MU is still processing its PFM functions properly.

Description:

The function incorporates the following requirements:

G28 Decoding of PFM byte sent by the MU used for monitoring of MU

R28_1: In PREDRIVE, i.e., STATE_MC = NC_STATE_MC_PRDR, in case no communication error was detected (i.e., LV_MC_COM_ERR = 0 and its complement LV_MC_COM_ERR_CPL = 1, checked using the RAM check service actions):
R28_1.1: the "raw" PFM data sent by the MU are obtained by calling the action ACTION_INFR_McGetPfmByte() and the return value shall be stored in the variable LF_MC_RCV_PFM_BYTE_MON;
R28_1.2: since the MU always sends a synchronisation byte as the first PFM byte, bits 0...6 of LF_MC_RCV_PFM_BYTE_MON shall be copied to the synchronisation byte on the MC, LF_MC_PFM_SYN_BYTE_MON.

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R28_2: In NORMAL, i.e., STATE_MC = NC_STATE_MC_NORM, in case no communication error was detected (i.e., LV_MC_COM_ERR = 0 and its complement LV_MC_COM_ERR_CPL = 1, checked using the RAM check service actions):
R28_2.1: the "raw" PFM data sent by the MU are obtained by calling the action ACTION_INFR_McGetPfmByte() and stored in the variable LF_MC_RCV_PFM_BYTE_MON.
R28_2.2: the change marker LF_MC_PFM_SYN_BYTE_CHG is saved in LF_MC_PFM_SYN_BYTE_CHG_OLD.
R28_2.3: depending on the value of the MSB (Most Significant Bit) of LF_MC_RCV_PFM_BYTE_MON, two cases arise:
R28_2.3.1: **MSB = 0** means the MU has sent an (updated) *synchronisation byte* as bits 0...6 of LF_MC_RCV_PFM_BYTE_MON.
R28_2.3.1.1: the change marker LF_MC_PFM_SYN_BYTE_CHG is updated, setting bit *k* if bit *k* in LF_MC_PFM_SYN_BYTE_MON <> bit *k* in LF_MC_RCV_PFM_BYTE_MON, and clearing bit *k* otherwise;
R28_2.3.1.2: bits 0...6 of LF_MC_RCV_PFM_BYTE_MON shall be copied to LF_MC_PFM_SYN_BYTE_MON;
R28_2.3.1.3: LF_STATE_ABC_PFM_MU shall not be updated.
R28_2.3.2: **MSB = 1** means the MU has sent a *status byte* of the PFM anti-bounce counters on the MU: bit 0 <= *k* <= 6 in LF_MC_RCV_PFM_BYTE_MON being set indicates that the value of the anti-bounce counter for PFM task *k* on the MU is strictly greater than 0.
R28_2.3.2.1: the change marker LF_MC_PFM_SYN_BYTE_CHG shall be reset to 0;
R28_2.3.2.2: bits 0...6 of LF_MC_RCV_PFM_BYTE_MON shall be copied to LF_STATE_ABC_PFM_MU.
R28_2.3.2.3: LF_MC_PFM_SYN_BYTE_MON shall not be updated.

Note:

Requirement R28_2.3.2.1 is based on the following equivalence:

any of the two "change markers" LF_MC_PFM_SYN_BYTE_CHG and LF_MC_PFM_SYN_BYTE_CHG_OLD is equal to 0

if and only if

the PFM byte from the corresponding communication (either the current one or the one before that) was a status byte.

This holds because the MU sends a PFM synchronisation byte *only if* it was actually updated, compared to the previously sent synchronisation byte: at least one bit must have changed and hence, in turn, at least one set bit in the corresponding change marker would have to be set on the MC.

Application conditions

Initialisation:

```
LF_MC_RCV_PFM_BYTE_MON = 0;
LF_MC_PFM_SYN_BYTE_MON = 0;
LF_STATE_ABC_PFM_MU = 0;
LF_MC_PFM_SYN_BYTE_CHG = 0;
LF_MC_PFM_SYN_BYTE_CHG_OLD = 0;
CTR = 0;
```

Recurrence: The **initialisation** shall be **executed after each power-up or reset.**
The **function itself** shall be **executed after the modules** "Communication monitoring in PREDRIVE state" or "Communication monitoring in NORMAL state", depending on the current state *(i.e., synchronously to the communications between MC and MU).*

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Activation: *((STATE_MC = NC_STATE_MC_PRDR)* ***OR***
(STATE_MC = NC_STATE_MC_NORM)) ***AND***
(LV_MC_COM_ERR = 0)
(active in both PREDRIVE and NORMAL, but only if no communication error was detected)

Deactivation: *Otherwise*

E.33.2 Decoding of PFM byte sent by the MU used for toggling by the PFM service actions

FUNCTION DESCRIPTION:

General information:

This sub-function describes how the "raw" data received from the MU (via the infrastructure interface) are pre-processed for PFM on the MC when used for the PFM service actions.

The function shall be executed **synchronously to, but before** the fastest monitored task: in case there has been an update of the synchronisation byte just before the execution of the monitored task, the PFM service actions will use the updated value of the synchronisation byte when determining the relevant bits in the PFM response LF_MC_RESP_PFM sent to the MU.

Since this function potentially runs asynchronously to the communications between MC and MU, it is necessary to perform the necessary communication monitoring (checksum, header-byte) specifically inside this function. In case an error is detected, no fault reaction shall be carried out, only the received data shall be ignored: eventually the "standard" communication monitoring will be performed and will detect the error and perform the defined reaction.

Description:

The function incorporates the following requirements:

G60 Decoding of PFM byte sent by the MU used for toggling by the PFM service actions

R60_1: In NORMAL, i.e., if MC_STATE = NC_STATE_MC_NORM:
R60_1.1: for **communication checksum monitoring**, the action ACTION_INFR_McChkCks() shall be called returning the flag LV_MC_CKS_OK_PFM (which is set if the checksum was correct);
R60_1.2: in case of a checksum error:
R60_1.2.1: no further communication monitoring shall be performed;
R60_1.2.2: no update of LF_MC_RCV_PFM_BYTE_TOG shall be performed;
R60_1.3: in case of correct checksum, for **communication header-byte monitoring**, the action ACTION_INFR_McGetHd() shall be called returning the header byte STATE_MU_TMP_PFM sent by the MU in the latest communication.
R60_1.4: If STATE_MU_TMP_PFM <> NC_STATE_MC_NORM, no update of LF_MC_RCV_PFM_BYTE_TOG shall be performed.
R60_1.5: If STATE_MU_TMP_PFM = NC_STATE_MC_NORM, the action ACTION_INFR_McGetPfmByte() shall be called and the return value shall be stored in the variable LF_MC_RCV_PFM_BYTE_TOG.
R60_1.6: Depending on the value of the MSB (Most Significant Bit) of LF_MC_RCV_PFM_BYTE_TOG, two cases arise:
R60_1.6.1: **MSB = 0** means the MU has sent an (updated) *synchronisation byte* as bits 0...6 of LF_MC_RCV_PFM_BYTE_TOG, which shall hence be copied to LF_MC_PFM_SYN_BYTE_TOG;

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R60_1.6.2: **MSB = 1** means the MU has sent a *status byte* of the PFM anti-bounce counters on the MU, hence no update of LF_MC_PFM_SYN_BYTE_TOG shall be performed.

Application conditions

Initialisation: *LF_MC_PFM_SYN_BYTE_TOG = NLF_MC_PFM_SYN_BYTE_INI;*
LF_MC_RCV_PFM_BYTE_TOG = 0;
STATE_MU_TMP_PFM = 0;
LV_MC_CKS_OK_PFM = 0;

Recurrence: The **initialisation** shall be **executed after each power-up or reset.**
The **function itself** shall be **executed synchronously to but before the fastest monitored task** *(i.e., potentially asynchronously to the communications between MC and MU).*

Activation: *(STATE_MC = NC_STATE_MC_NORM)* (only active in NORMAL)

Deactivation: *Otherwise*

E.33.3 PFM service actions

FUNCTION DESCRIPTION:

General information:

This sub-function describes the services to supervise the program flow in relevant modules/tasks (in particular those of process monitoring).

Description:

The function incorporates the following requirements:

G29 PFM service actions

In general, PFM works by providing "markers" in the form of actions to be called at certain points in the supervised modules/tasks, thus enabling the PFM function to analyse the correctness of the program flow inside those modules/tasks.

In the following, let k always range over 0 to 6, with the intended meaning that k corresponds to one of the 7 different PFM tasks, and let j range over 0 to 29, for maximally 30 "inspection points" spread over (the modules in any of) the 7 tasks.

The PFM inspection for a fixed task k works as follows.

There is a *PFM control byte* STATE_MC_PFM_CTL_BYTE[k] which, before the first PFM synchronisation byte is transmitted from the MU to the MC (in the PREDRIVE communication), is initialised to *nc_ctl_ini* (one initial value for the control bytes of all tasks).

The PFM service actions ACTION_ECM3_Service$j$TaskPfm(k) and ACTION_ECM3_ServicePfm(k) subsequently manipulate STATE_MC_PFM_CTL_BYTE[k], allowing the PFM function to track the program flow in the supervised tasks.

The idea behind the actions ACTION_ECM3_Service$j$TaskPfm(k) is to record the correct sequencing inside a task: STATE_MC_PFM_CTL_BYTE[k] is manipulated such that

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STATE_MC_PFM_CTL_BYTE[*k*] = *nc_ctl_end_k*
if and only if
all "inspection points" in the task were reached in their correct sequence *j* = 0,1,2,...,*max*
(*max* <= 29 and depends on the supervised task)

This yields the following error cases:

- **"inspection points" were reached in an incorrect order (e.g., 0,1,3,2,...),**
- **"inspection points" were skipped (e.g., 0,2,3,...),**
- **"inspection points" were reached repeatedly (e.g., 0,1,1,2,...),**
- **or arbitrary combinations thereof.**

In all of these cases, the control byte shall have a value different from *nc_ctl_end_k*, indicating an incorrect program flow in task *k*.

The action ACTION_ECM3_ServicePfm(*k*) shall implement a "*end of task*" marker by checking the current value of STATE_MC_PFM_CTL_BYTE[*k*] for equality with the expected end value *nc_ctl_end_k*.

This implies that this action must be executed *after all "inspection point" actions of task k have been executed,* i.e., it must be *the last PFM-relevant activity of the task k* under supervision; usually, it really is the last activity before the end of the task.

If the test is positive, i.e., all "inspection points" inside task *k* have been reached exactly once and in the correct sequence, bit *k* in the *PFM response* LF_MC_RESP_PFM shall be set to the negated value of bit *k* in the current synchronisation byte LF_MC_PFM_SYN_BYTE_TOG. Consequently, since the PFM response will eventually be transmitted to the MU, the MU will receive a bit which is toggled when compared to its original value in the synchronisation byte as sent from the MU.

If the test is negative, bit *k* in the synchronisation byte LF_MC_PFM_SYN_BYTE_TOG shall simply be copied to bit *k* in the PFM response (since the MU expects to receive this bit in its toggled state, this will eventually prompt a reaction by the MU).

Regardless of the test result, the control byte for task *k* shall be re-initialised to its start value *nc_ctl_ini* in order to prepare a new execution of task *k*.

Note: the common start value *nc_ctl_ini* and the individual end values *nc_ctl_end_k* for each of the control bytes are configurable so that they can be adapted to project-specific needs and NOT declared here.

Note: the PFM response is exclusively determined from the instance of the PFM synchronisation byte LF_MC_PFM_SYN_BYTE_TOG acquired synchronously with the fastest monitored task since only this instance should record the effect of any monitored modules being executed.

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Description of ACTION_ECM3_Service(j)TaskPfm

Description:

Syntax: ACTION_ECM3_Service(j)TaskPfm(IN <k>)
Parameter (IN): k task number
Short description: This action manipulates the control byte STATE_MC_PFM_CTL_BYTE[*k*] of task *k* in order to indicate the fact that the *j*-th "inspection point" in the task has been reached

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Description of ACTION_ECM3_ServicePfm

Description:

Syntax: ACTION_ECM3_ServicePfm(IN <k>)
Parameter (IN): k task number
Short description: This action provides an "*end of task*" marker, see formula section.

Formula section:

IF (STATE_MC_PFM_CTL_BYTE[k] = nc_ctl_end_k)
THEN /* *all "inspection points" reached correctly, stored inverted bit in PFM response* */
LF_MC_RESP_PFM.k = invert(LF_MC_PFM_SYN_BYTE_TOG.k)
ELSE /* *wrong program flow, store un-inverted bit in PFM response* */
LF_MC_RESP_PFM.k = LF_MC_PFM_SYN_BYTE_TOG.k
FI
/* *Reset control byte for task k* */
STATE_MC_PFM_CTL_BYTE[k] = nc_ctl_ini;

Application conditions

Initialisation:

```
/ * Set control bytes to their common start value */
  FOR k = 0 TO NC_NR_MC_PFM
  DO
      STATE_MC_PFM_CTL_BYTE[k] =       nc_ctl_ini;
  OD
```

Recurrence: The **initialisation** shall be **performed after each power-up or reset.**
The **actions** shall be **called from inside the supervised modules.**

Activation: –

Deactivation: –

E.33.4 Monitoring of timely updates of the synchronisation byte by the MU

FUNCTION DESCRIPTION:

General information:

This sub-function describes the mechanism by which the MC monitors whether the MU sends, in the corresponding intervals of time, synchronisation bytes where specific bits have been toggled at the right rate.
In this way it is possible to detect whether the MU is still running in "real-time" compared to the MC (in some ways, this is the dual of PFM which serves the purpose to detect whether the modules/tasks of process monitoring still run in "real-time").

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Description:

The function incorporates the following requirements:

G30 Monitoring of timely updates of the synchronisation byte by the MU

R30_1: From the point of view of the MC, the MU is supposed to send updated synchronisation bytes at certain rates; the rate is determined by the bit toggling function on the MU, additionally influenced by the communication recurrence.

R30_2: In order to check whether this toggling process on the MU still works correctly, there is the array TCC_MC_PFM_TOG[] (of size 6) plus TCC_MC_PFM_TOG_6 (for PFM task 6 which, due to its low recurrence, needs higher resolution), on the MC, for counting communication cycles between two updates of the corresponding bit in the synchronisation bytes sent by the MU.

R30_3: For each of the counters, there is a corresponding maximal value contained in the array NC_TCC_MC_PFM_TOG_MAX[], plus NC_TCC_MC_PFM_TOG_6_MAX, which is used for detecting whether an update of the synchronisation byte by the MU was performed too late.

Application conditions

Initialisation:

```
/ * Initialise the required data */
   FOR CTR = 0  TO NC_NR_MC_PFM_TCC
   DO
       TCC_MC_PFM_TOG[CTR] = 0;
   OD
   TCC_MC_PFM_TOG_6 = 0;
```

Recurrence: The **initialisation** shall be **performed after each power-up or reset.**
The **formula section** shall be **executed after the PFM sub-function "Decoding of PFM byte sent by MU used for monitoring of MU."**

Activation: *(STATE_MC = NC_STATE_MC_NORM)* (only performed in NORMAL after the PFM byte sent from the MU has been decoded; in PREDRIVE, the check does not make sense since there, the MU sends a synchronisa byte for the first time)

Deactivation: -

Formula section:

FOR CTR = 0 **TO** 5
DO
/ Has the bit in the synchronisation byte been updated? */*
IF (LF_MC_PFM_SYN_BYTE_CHG.CTR = 1)
THEN */* Yes: check value of test cycle counter */*
IF (TCC_MC_PFM_TOG[CTR] <
NC_TCC_MC_PFM_TOG_MAX[CTR])
THEN */* Bit toggled in time: decrease corresponding anti-bounce counter; reset test cycle counter*/*
ACTION_ECM3_McDecAbc(
IN NC_ABC_MC_PFM_[CTR]_TOG);
TCC_MC_PFM_TOG[CTR] = 0;
ELSE */* Bit not toggled in time: debounced fault reaction; reset test cycle counter */*

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```
                    ACTION_ECM3_McIncAbc(
                           IN        NC_ABC_MC_PFM_[CTR]_TOG,
                            IN        NC_ERR_COD_MC_PFM_[CTR]_TOG);
                    TCC_MC_PFM_TOG[CTR] = 0;
          FI
     /* Bit not updated; has the test cycle counter reached its maximal value? */
  ELSEIF (TCC_MC_PFM_TOG[CTR] ≥
                                   NC_TCC_MC_PFM_TOG_MAX[CTR])
     THEN /* Yes: debounced fault reaction; reset test cycle counter */
          ACTION_ECM3_McIncAbc(
                    IN        NC_ABC_MC_PFM_[CTR]_TOG,
                   IN        NC_ERR_COD_MC_PFM_[CTR]_TOG);
          TCC_MC_PFM_TOG[CTR] = 0;
  ELSE /* No: increase test cycle counter */
          TCC_MC_PFM_TOG[CTR] = TCC_MC_PFM_TOG[CTR] +1;
     FI
OD
```

/ Perform the same algorithm for task 6, using TCC_MC_PFM_TOG_6 and NC_TCC_MC_PFM_TOG_6_MAX */*

E.33.5 Test MU reaction to wrong PFM responses

General information:

If a correctly working MU receives a wrong PFM response (i.e., at least one bit in the PFM response sent by the MC is different from the corresponding bit in the synchronisation byte kept on the MU), it performs a debounced fault reaction: it increases its corresponding anti-bounce counter and, if the maximal value for that counter is reached, triggers a fault reaction. This sub-function aims at testing this mechanism by, under the appropriate circumstances, *deliberately* sending a wrong PFM response to the MU and the checking the eventual reaction to the wrong response.

This presupposes the presence of a mechanism on the MC to "notice" the fact that the MU has increased a PFM anti-bounce counter after a wrong PFM response. Furthermore, the robustness of the system must not be affected by a deliberately wrong PFM response, in particular such a wrong answer must not trigger a fault reaction.

For implementing this mechanism, it is crucial that the MU, whenever its synchronisation byte has not changed, sends status bytes establishing which of its PFM anti-bounce counters have value 0 and which do not. It follows that those with value 0 can be tested because (very importantly) there, a wrong answer is *guaranteed* not to trigger a fault reaction (for the others, this need not be true) and, equally important, the next time a status byte is sent, it can be checked whether the anti-bounce counter is still equal to 0 (meaning that the MU has *not* reacted to the wrong response) or not (meaning that the MU has increased the corresponding anti-bounce counter and hence reacted to the wrong response).

Note that this check cannot detect an anti-bounce counter on the MU which is stuck to a value between 0 and the maximal value: the status byte will always indicate that the anti-bounce counter is different from 0 so that there will never be a deliberately wrong PFM response for the corresponding task.

Description:

The function incorporates the following requirements:

G31 Test MU reaction to wrong PFM responses

The algorithm is described in the formula section the following points should be pointed out (note that these considerations do not take into account the presence of communication errors).

When activated for the first time (after the first NORMAL communication), the initial status byte of the MU anti-bounce counters has just been received: in the PREDRIVE communication, the MU always

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sends the initial synchronisation byte; consequently, in the first NORMAL communication, the current status of the PFM anti-bounce counters on the MU is transmitted to the MC.

Moreover, LF_MC_PFM_SYN_BYTE_CHG_OLD currently has value 0 since, after the PREDRIVE communication, LF_MC_PFM_SYN_BYTE_CHG is initialised to 0 and this value is stored in LF_MC_PFM_SYN_BYTE_CHG_OLD after the first NORMAL communication.

Consequently, the first condition is false for every *k*, and nothing happens until the test of LF_STATE_ABC_PFM_MU. If bit *k* of LF_STATE_ABC_PFM_MU is set, we do nothing (anti-bounce counter on MU not equal to 0, cannot risk sending a wrong response as this might trigger a fault reaction). If bit *k* is not set, this means that the anti-bounce counter on the MU for task *k* has value 0 so we activate sending wrong responses; this will result in a wrong bit in the PFM response in the next communication (in this case: the second NORMAL communication) sent out after the post-processing function has been executed. So a set bit in LF_MC_WRG_RESP_PFM_ACT indicates that a wrong response was sent or will be sent, depending on when the value is observed.

Now assume that normal operation has continued for some time. When the function gets activated, the same test as described above is performed, viz., it is checked whether the corresponding bit in LF_MC_WRG_RESP_PFM_ACT is set, which implies that in the previous communication, a wrong response has been sent out, and whether in the previous communication an updated synchronisation byte was transmitted by the MU; so the status of an MU anti-bounce counter is only checked after a bit was toggled on the MU and sent to the MC.

This test being successful implies that in the current communication, a status byte was sent and so it can be checked whether the status of the MU anti-bounce counter for a task *k* is not equal to 0.

If this is the case the previously sent wrong response was detected by the MU (since a wrong response is only sent out if the anti-bounce counter is equal to 0) and the corresponding anti-bounce counter on the MC can be decreased. However, if the value of the MU anti-bounce counter is equal to 0, this means that the previously sent wrong response was not detected and consequently, the corresponding anti-bounce counter on the MC must be increased, eventually leading to a debounced fault reaction.

If this increase of the MC anti-bounce counter has not yet triggered a fault reaction, it is then checked whether the MU anti-bounce counter status indicates a value of 0. If that is the case (i.e., either when really no error is present on the MU or when previously a wrong answer was sent out but the MU has not (yet) reacted to the wrong response), the flag corresponding bit in LF_MC_WRG_RESP_PFM_ACT is set in order to send a wrong PFM response.

Note that this implies sending a wrong PFM response until one communication after the MU next updates its synchronisation byte and sends it to the MC because before that it is not possible to de-activate sending of wrong responses, unless the MU anti-bounce counter is no longer equal to 0 which also implies that the MC must have updated its synchronisation byte.

Sending a wrong response for any task is done for the first time as soon as the corresponding status byte received from the MU indicates that the MU anti-bounce counter has value 0. Due to its slow recurrence and the described algorithmic pre-condition, a long time has to elapse before the wrong response test for task 6 can be performed (also due to the fact that the corresponding anti-bounce counter is initialised to a non-zero value to speed up fault detection for this task). On the other hand, the reset counter on the MC heals after a certain time period which should last longer than the duration all possible diagnostic tests inside Processor Monitoring. Consequently, the healing can only be performed after the wrong response test for PFM task 6 has been performed at least once. This is fact shall be indicated to the function "Healing of reset counter and error code" (G2) by the flag LV_MC_PFM_WRG_RESP_ACT_6: it shall be set when sending a wrong PFM response for task 6 is activated.

Application conditions

Initialisation: *∕ ∗ Deactivate sending wrong PFM responses for all tasks ∗∕*

```
LF_MC_WRG_RESP_PFM_ACT = 0;
LV_MC_PFM_WRG_RESP_ACT_6 = 0;
```

Recurrence: The **initialisation** shall be **performed after each power-up or reset.**

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The **formula section** shall be **executed after the PFM sub-function "Decoding of PFM byte sent by MU used for monitoring of MU."**

Activation: *(STATE_MC = NC_STATE_MC_NORM)* (only performed in NORMAL after the PFM byte sent from the MU has been decoded)

Deactivation: *Otherwise*

Formula section:

```
FOR CTR = 0 TO NC_NR_MC_PFM
DO /* Check whether sending of wrong responses for task k is active and whether the last communication, the bit for task k was toggled (=in the last communication, a synchronisation byte was sent so that now a status byte must have been received) */
    IF ((LF_MC_WRG_RESP_PFM_ACT.CTR = 1) AND (LF_MC_PFM_SYN_BYTE_CHG_OLD.CTR = 1))
    THEN /* Has MU-anti-bounce counter reacted to wrong response? */
            IF (LF_STATE_ABC_PFM_MU.CTR = 1)
            THEN /* Yes: decrease MC anti-bounce counter */
                    ACTION_ECM3_McDecAbc(
                            IN      NC_ABC_MC_PFM_[CTR]_RESP);
                    IF (CTR = 6)
                    THEN /* Sending of wrong responses for task 6 has been performed at least once: indicate this to the function "Healing of reset counter and error code" (G2) */
                            LV_MC_PFM_WRG_RESP_ACT_6 = 1;
                    FI
            ELSE /* No: increase MC anti-bounce counter */
                    ACTION_ECM3_McIncAbc(
                            IN      NC_ABC_MC_PFM_[CTR]_RESP,
                            IN      NC_ERR_COD_MC_PFM_[CTR]_RESP);
            FI
    FI
    /* Check if sending of wrong responses can be activated/stay active: is the MU anti-bounce counter equal to 0? */
    IF (LF_STATE_ABC_PFM_MU.CTR = 0)
    THEN /* Yes: activate sending of wrong responses */
            LF_MC_WRG_RESP_PFM_ACT.CTR = 1;
    ELSE /* No: deactivate sending of wrong responses; this also applies if previously a deliberately wrong answer was sent */
            LF_MC_WRG_RESP_PFM_ACT.CTR = 0;
    FI
OD
```

E.33.6 Post-processing of PFM response before communications

General information:

This sub-functions sets the value of the PFM response to be sent to the MU in the following (NORMAL) communication.

Description:

The function incorporates the following requirements:

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G32 Post-processing of PFM response before communications

Before the new PFM response can be sent to the MU, some post-processing of its current value might be necessary, viz., if sending of wrong PFM responses is active for a certain task, it must be ensured that the effect of the service actions (which, if executed properly, would result in a correct PFM response for the corresponding task) is overridden and explicitly a wrong bit in the PFM response is set.

By the way the checking mechanism on the MU works, this means that the bit in the PFM response has to be *equal* to the value of the respective in the current synchronisation byte on the MC (as the MU expects this bit to be sent back with its value *toggled*).

Finally, the (potentially modified) PFM response LF_MC_PFM_RESP has to be sent to the infrastructure so that it can be transmitted to the MU when the next communication is triggered.

To ensure this behaviour is precisely the task of this sub-function.

The function incorporates the following requirements:

R32_1: assuming the value CTR ranges from 0..6 (for 7 monitored tasks)

R32_2: the default PFM response bit **tmp_LF_MC_RESP_PFM.CTR** shall be exactly the reveived synchronization bit **LF_MC_PFM_SYN_BYTE_TOG.CTR** except the corresponding monitored level2 task was executed.

R32_3.1: refining R32_2, if a new synchronization bit was received (i.e. LF_MC_PFM_SYN_BYTE_CHG.CTR =1), then
R32_3.2: if level2 was executed (i.e. LF_MC_RESP_PFM.CTR has changed since last function activation) then the value LF_MC_PFM_SYN_BYTE_TOG.CTR has to be sent back
R32_3.3: otherwise the value of LF_MC_RESP_PFM.CTR has to be sent back.

R32_4.1: refining R32_2, if no new synchronization bit was received (i.e. LF_MC_PFM_SYN_BYTE_CHG.CTR =0), then the value of LF_MC_RESP_PFM.CTR has to be sent back.

R32_5: in case if sending of deliberatley wrong answer is not active (i.e. LF_MC_WRG_RESP_PFM_ACT.CTR = 0), the PFM response byte needs no further modifications.
R32_6: in case if sending of deliberatley wrong answer is active (i.e. LF_MC_WRG_RESP_PFM_ACT.CTR = 1)
R32_6.1 if a new synchronization bit was received (i.e. LF_MC_PFM_SYN_BYTE_CHG.CTR = 1), then the inverted value of LF_MC_PFM_SYN_BYTE_TOG.CTR has to be sent back
R32_6.2 if no new synchronization bit was received (i.e. LF_MC_PFM_SYN_BYTE_CHG.CTR = 0), then the value of LF_MC_PFM_SYN_BYTE_TOG.CTR has to be sent back.

R32_5: the sending of the final response byte **tmp_LF_MC_RESP_PFM** shall be initiated by calling ACTION_INFR_McSendPfmResp(*IN* ***tmp_LF_MC_RESP_PFM***);

Application conditions

Initialisation: *LF_MC_RESP_PFM = 0;*

Recurrence: The **initialisation** shall be **performed after each power-up or reset.**
The **formula section** shall be **executed just before the next communication is triggered.**

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Activation: *(STATE_MC = NC_STATE_MC_NORM)* (active in NORMAL state)

Deactivation: *Otherwise*

Formula section:

```
/*set locally, temporary calculated PFM response to default response tog*/
tmp_lf_mc_resp_pfm = LF_MC_PFM_SYN_BYTE_TOG;
FOR CTR = 0 TO 6
DO
  IF LF_MC_PFM_SYN_BYTE_CHG.CTR
  THEN /*synch. byte has changed*/
            IF LF_MC_WRG_RESP_PFM_ACT.CTR
            THEN /*response test is active, send inverted synch. byte*/
                  tmp_lf_mc_resp_pfm.CTR = !LF_MC_PFM_SYN_BYTE_TOG.CTR;
            ELSE
                  /*check if level 2 was executed*/
                  IF ecm3_lf_mc_resp_pfm_old.CTR != LF_MC_RESP_PFM.CTR
                  THEN /* do nothing, send default response - -> tog */
                  ELSE /*send level 2 response*/
                        tmp_lf_mc_resp_pfm.CTR = LF_MC_RESP_PFM.CTR;
                  FI
            FI
  ELSE /*synch. byte has not changed*/
            IF LF_MC_WRG_RESP_PFM_ACT.CTR
            THEN /* response test is active, do nothing, send default response - -> tog */
            ELSE /*send level 2 response*/
                  tmp_lf_mc_resp_pfm.CTR = LF_MC_RESP_PFM.CTR;
            FI
  FI
OD
ecm3_lf_mc_resp_pfm_old = LF_MC_RESP_PFM;
ACTION_INFR_McSendPfmResp(IN      tmp_lf_mc_resp_pfm);
```

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E.34 Processor monitoring

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LF_MU_CONF_BYTE	V	0... FFH	0... 255	1	-
Local variable: configuration data sent by MU (in PREDRIVE and NORMAL communications)					
LV_MC_ROM_CHK_OK	-	0... 1H	0 ...1	1	-
Flag indicating whether the level 1 ROM check was successful					
LV_MC_ROM_CHK_READY	O/V/S	0... 1H	0 ...1	1	-
Flag indicating whether the level 1 ROM check is ready					
LV_MC_ROM_CHK_READY_CPL	O/S	0... 1H	0 ...1	1	-
Complement of LV_MC_ROM_CHK_READY					
LV_MU_IGN_KEY	O/V	0... 1H	0 ...1	1	-
Ignition key signal redundantly acquired on MU (only useful in HW acquisition mode)					
NR_MU_COMP	O/V	0... 7H	0 ...7	1	-
Compatibility number sent by MU					
NR_MU_HW_VERS	O/V	0... 1FH	0... 31	1	-
Hardware version sent by MU					
STATE_MC	O/V	0... FFH	0... 255	1	-
Internal state of the MC (also used as header byte in communications)					
VP_MC_AN_DIG_MON	O/V	0... 7FFFH	0... 4.99984	152.6e-6	V
Result of A/D conversion on the MC (exported to process monitoring)					
VP_MC_AN_DIG_MON_CPL	O/V	0... 7FFFH	0... 4.99984	152.6e-6	V
Complement of V_MC_AN_DIG_MON (exported to process monitoring)					
VP_MC_AN_DIG_MON_TMP	-	8000... 7FFFH	-5... 4.99984	152.6e-6	V
Local variable: result of A/D conversion as fetched from infrastructure					
VP_MC_AN_DIG_MON_TMP_CPL	-	8000... 7FFFH	-5... 4.99984	152.6e-6	V
Local variable: complement of VP_MC_AN_DIG_MON_TMP					
VP_MU_AN_DIG_MON	O/V	0... 7FFFH	0... 4.99984	152.6e-6	V
Result of A/D conversion on the MU (exported to process monitoring)					
VP_MU_AN_DIG_MON_CPL	O/V	0... 7FFFH	0... 4.99984	152.6e-6	V
Complement of V_MU_AN_DIG_MON (exported to process monitoring)					

Input data:

CTR_RST_MC {p. 7072}	CTR_RST_MC_CPL {p. 7072}	LV_MC_COM_ERR {p. 7049}	LV_MC_COM_ERR_CPL {p. 7049}
LV_MC_IGN_KEY {p. 7158}	LV_MU_READY {p. 7049}	NC_ABC_MC_CONF_DIF {p. 7073}	NC_CTR_RST_MC_THD {p. 7077}
NC_ERR_COD_MC_COMP_NR {p. 7077}	NC_ERR_COD_MC_CONF_DIF {p. 7077}	NC_ERR_COD_MC_NOT_VLD_TRAN {p. 7077}	NC_ERR_COD_MC_RAM_LEVEL_1 {p. 7078}
NC_ERR_COD_MC_RAM_LEVEL_2 {p. 7078}	NC_ERR_COD_MC_ROM_LEVEL_1 {p. 7078}	NC_ERR_COD_MC_ROM_LEVEL_2 {p. 7078}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ERR_SWI_MC_LEVEL_2_CAL	-	0... FFH	0... 255	1	-
Switch to disregard ROM errors in the level 2 calibration data (when set to NC_ERR_SWI_MC_LEVEL_2_CAL)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ERR_SWI_MC_LEVEL_2_COD	-	0... FFH	0... 255	1	-
Switch to disregard ROM errors in the level 2 code (when set to NC_ERR_SWI_MC_LEVEL_2_COD)					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_ERR_SWI_MC_LEVEL_2_CAL	-	0... FFH	0... 255	1	-
Value for the switch which allows to disregard ROM errors in the level 2 calibration area					
NC_ERR_SWI_MC_LEVEL_2_COD	-	0... FFH	0... 255	1	-
Value for the switch which allows to disregard ROM errors in the level 2 code					
NC_NR_MC_COMP	-	0... 7H	0 ...7	1	-
Compatibility information of MC					
NC_STATE_MC_CONF	-	0... FFH	0... 255	1	-
Internal representation (and header byte) for CONFIG state					
NC_STATE_MC_DI	-	0... FFH	0... 255	1	-
Internal representation (and header byte) for DISABLE state					
NC_STATE_MC_INI	-	0... FFH	0... 255	1	-
Internal representation for INIT state					
NC_STATE_MC_NORM	-	0... FFH	0... 255	1	-
Internal representation (and header byte) for NORMAL state					
NC_STATE_MC_NOT_VLD	-	0... FFH	0... 255	1	-
Internal representation for invalid state					
NC_STATE_MC_PRDR	-	0... FFH	0... 255	1	-
Internal representation (and header byte) for PREDRIVE state					
NC_VP_MC_AN_DIG_MON_CPL_ERR	-	8000... 7FFFH	-5... 4.99984	152.6e-6	V
Constant indicating a complement error of the value of the A/D conversion on the MC acquired in the infrastructure					
NLC_MU_IGN_KEY_ACQ	-	0... 1H	0 ...1	1	-
Configuration for acquisition of IGK signal on the MU (by software=0 or hardware=1)					
NLC_MU_INJ_OFF_TMR_ENA	-	0... 1H	0 ...1	1	-
Configuration of MU for enabling/disabling the injection-off timer					
NLC_MU_MOD	-	0... 1H	0 ...1	1	-
Configuration of MU mode (monitoring of EMS=0 or TCU=1)					
NLC_MU_POW_OFF_TMR_ENA	-	0... 1H	0 ...1	1	-
Configuration of MU for enabling/disabling the power-off timer					

Action definition

ACTION_ECM3_ChkCpl (**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)	Mode: O
This action compares the value of var with its complement var_CPL.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_VAR	in	0... FFFFH	0... 65535	1	-
Variable					
PRM_VAR_CPL	in	0... FFFFH	0... 65535	1	-
Complement of variable					

ACTION_ECM3_McChangeState (**IN**<PRM_STATE_MC_NEW>)	Mode: O
This action changes the state of the MC to the given new state; when already in DISABLE, nothing is done.	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_STATE_MC_NEW	in	0... FFH	0... 255	1	-
Representation of state to be entered					

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ACTION_ECM3_McChkStack ()	Mode: O
This action triggers a check of the appropriate stack area by the infrastructure and evaluates its result.	

ACTION_ECM3_McReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>,**IN**<PRM_DFT_VALUE>)	Mode: O
This action checks that var and var_cpl are a valid value/complement pair; if no returns the supplied default value and triggers a fault reaction.	

Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_RESULT	out	0... FFFFH	0... 65535	1	-
Variable to be checked					
PRM_VAR	in	0... FFFFH	0... 65535	1	-
Variable for the complement of PRM_VAR					
PRM_VAR_CPL	in	0... FFFFH	0... 65535	1	-
Value to be stored					
PRM_DFT_VALUE	in	0... FFFFH	0... 65535	1	-
Default value for PRM_VAR in case an inconsistency is detected					

ACTION_ECM3_McReadChkState (**OUT**<PRM_STATE_MC_TMP>)	Mode: O
This action checks the current state for being valid.	

Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_STATE_MC_TMP	out	0... FFH	0... 255	1	-
Short description of the given parameter					

ACTION_ECM3_McResetRomChkFlags ()	Mode: O
This action resets the flags for the Standard ROM check in case this becomes necessary.	

ACTION_ECM3_ReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)	Mode: O
This action checks that var and var_CPL are a valid value-complement pair, and if yes, stores the value in result so that the value can be used in successive calculations.	

Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_RESULT	out	0... FFFFH	0... 65535	1	-
Result					
PRM_VAR	in	0... FFFFH	0... 65535	1	-
Variable					
PRM_VAR_CPL	in	0... FFFFH	0... 65535	1	-
Complement of variable					

ACTION_ECM3_WriteChkCpl (**INOUT**<PRM_VAR>,**OUT**<PRM_VAR_CPL>,**IN**<PRM_VALUE>)	Mode: O
This action writes the value into the RAM and cross-checks the written value; the complement is generated, stored, and the corresponding variable is returned.	

Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_VAR	inout	0... FFFFH	0... 65535	1	-
Variable					
PRM_VAR_CPL	out	0... FFFFH	0... 65535	1	-
Complement of variable					
PRM_VALUE	in	0... FFFFH	0... 65535	1	-
Value					

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Import actions:

ACTION_ECM3_McDecAbc (**IN**<PRM_ABC_ID>)
ACTION_ECM3_McFaultReaction (**IN**<PRM_ERR_COD>)
ACTION_ECM3_McIncAbc (**IN**<PRM_ABC_ID>,**IN**<PRM_ERR_COD>)
ACTION_ECM3_McLockPwlResource ()
ACTION_ECM3_McUnlockPwlResource ()
ACTION_ECM3_RedSwitchOffPath ()
ACTION_INFR_GetAnDigMonValMc (**OUT**<vp_mc_an_dig_mon>)
ACTION_INFR_GetAnDigMonValMu (**OUT**<vp_mu_an_dig_mon>)
ACTION_INFR_McChkStack (**OUT**<PRM_LV_CHK_OK>)
ACTION_INFR_McGetCompNr (**OUT**<nr_mu_comp>)
ACTION_INFR_McGetConfData (**OUT**<lf_mu_conf_byte>)
ACTION_INFR_McGetIgkMu (**OUT**<lv_mu_ign_key>)
ACTION_INFR_McGetVersNr (**OUT**<nr_mu_hw_vers>)
ACTION_INFR_McRomChkOk (**OUT**<lv_mc_rom_chk_ok>)
ACTION_INFR_McRomChkReady (**OUT**<lv_mc_rom_chk_ready>)
ACTION_INFR_McSendCompNr (**IN**<nr_mc_comp>)
ACTION_INFR_McSendConfData (**IN**<lv_mu_mod>,**IN**<lv_mu_ign_key_acq>,**IN**<lv_mu_pow_off_trm_ena>,**IN**<lv_mu_inj_off_trm_ena>)
ACTION_INFR_McSendIgk (**IN**<lv_igk>)

Description for actions:

ACTION_ECM3_McChangeState(PRM_STATE_MC_NEW)					
Change STATE_MC to new state.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_STATE_MC_NEW	IN	0...FFH	0...255	1	[-]
Representation of state to be entered					

ACTION_ECM3_WriteChkCpl(PRM_VAR, PRM_VAR_CPL, PRM_VALUE)					
see description in section "RAM check service actions of Processor Monitoring on MC"					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_VAR	INOUT	*any*	*any*	*any*	*any*
Variable to be checked					
PRM_VAR_CPL	OUT	*any*		*any*	*any*
Variable for the complement of PRM_VAR					
PRM_VALUE	IN	*any*	*any*	*any*	*any*
Value to be stored					

ACTION_ECM3_ChkCpl(PRM_VAR, PRM_VAR_CPL)					
see description in section "RAM check service actions of Processor Monitoring on MC"					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_VAR	IN	*any*	*any*	*any*	*any*
Variable to be checked					
PRM_VAR_CPL	IN	*any*		*any*	*any*
Variable for the complement of PRM_VAR					

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ACTION_ECM3_ReadChkCpl(PRM_RESULT, PRM_VAR, PRM_VAR_CPL)					
see description in section "RAM check service actions of Processor Monitoring on MC"					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_RESULT	OUT	*any*	*any*	*any*	*any*
Variable to be checked					
PRM_VAR	IN	*any*		*any*	*any*
Variable for the complement of PRM_VAR					
PRM_VAR_CPL	IN	*any*	*any*	*any*	*any*
Value to be stored					

ACTION_ECM3_McReadChkCpl(PRM_RESULT, PRM_VAR, PRM_VAR_CPL, PRM_DFT_VALUE)					
see description in section "RAM check service actions of Processor Monitoring on MC"					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_RESULT	OUT	*any*	*any*	*any*	*any*
Variable to be checked					
PRM_VAR	IN	*any*		*any*	*any*
Variable for the complement of PRM_VAR					
PRM_VAR_CPL	IN	*any*	*any*	*any*	*any*
Value to be stored					
PRM_DFT_VALUE	IN	*any*	*any*	*any*	*any*
Default value for PRM_VAR in case an inconsistency is detected					

ACTION_ECM3_McChkStack()					
The action triggers a stack check via an infrastructure action and evaluates the result of the check.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**

ACTION_ECM3_McReadChkState(<PRM_STATE_MC_TMP>)					
The action reads the internal representation of the current state (STATE_MC) and checks it for validity; in case of an inconsistency, the return value shall be NC_STATE_MU_DI (the representation for DISABLE state) and a fault reaction shall be triggered.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_STATE_MC_TMP	OUT	0...FFH	0...255	1	[-]
Short description of the given parameter					

ACTION_ECM3_McResetRomChkFlags()					
This action resets the flags LV_MC_ROM_CHK_READY and LV_MC_ROM_CHK_OK; this is used by DISABLE requests.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**

FUNCTION DESCRIPTION:

General information:

This module describes the main function of processor monitoring on the MC, in particular the state machine.

E.34.1 State machine on MC

FUNCTION DESCRIPTION:

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General information:

This function represents the main control flow in the MC; based on the current state of the MC, other modules/functions are activated or deactivated. The internal state machine of the MC governs which actions on the MC shall be performed, e.g.:

- which data are sent to the MU;
- which actions should be taken upon receiving data, in particular, whether the received data are acceptable and the MU is still in sync with the MC;
- whether the power stages should be disabled or enabled.

As described schematically in the signal flow diagram, given a state, there are only a certain number of other states reachable.

Signal flow diagram:

The following diagram shows the state machine of the MC with all the possible transitions.

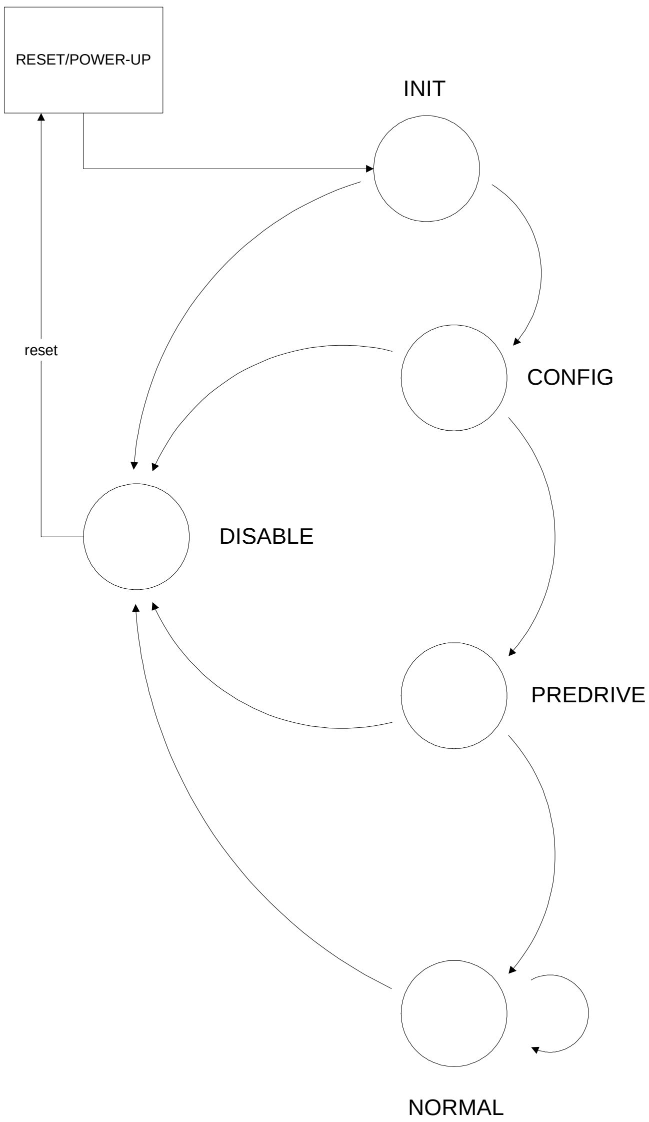

Figure E.34.1: State machine of the MC

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Description:

This function shall incorporate the following requirements:

G51 State machine on MC

R51_1: All state changes shall be performed using the action ACTION_ECM3_McChangeState().

R51_2: The possible state changes are described in the signal flow diagram above; no other transition between the states shall be performed.

R51_3: A valid transition from one state to the other (according to the signal flow diagram) shall be performed when all tasks of the given state are finished; an exception is the transition to DISABLE state: this shall be performed immediately when a transition condition is given (e.g., when a fault reaction on the MC is carried out, or when the MU sends a DISABLE header).
Note: a rough sequencing of tasks and state transitions can be given as follows

- evaluation of data from previous communication
- state transition (if necessary)
- preparation of new communication
- triggering of new communication

R51_4: The internal representations of states/header bytes shall be chosen in such a way that the minimum of the pair-wise hamming distances is as high as possible, i.e., in order to change from one valid representation of a state into another valid representation of a different state, several bits have to toggle at once.

R51_5: The same bit patterns shall be used for internal representation of states and for the corresponding header bytes sent to the MU.

R51_6: Concerning the transition from INIT to CONFIG:
R51_6.1: there shall be a project-specific transition condition (cf. G52);
R51_6.2: the transition shall only be performed if all tasks in INIT have been completed (cf. activation conditions) AND LV_MU_READY = 1 AND the project-specific condition is satisfied.
Note: the actual state change from INIT to CONFIG can be performed by the function G52 evaluating the project-specific transition condition; however, R51_6.2 then has to be ensured by the control flow (e.g., the project-specific condition is only evaluated if all other conditions like LV_MU_READY = 1 are already satisfied).

Description for ACTION_ECM3_McChangeState:

ACTION_ECM3_McChangeState(PRM_STATE_MC_NEW)					
Change STATE_MC to new state.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_STATE_MC_NEW	IN	0...FFH	0...255	1	[-]
Representation of state to be entered					

Formula section:

```
/* When already in DISABLE, no transition shall be possible: see signal flow diagram */
IF (STATE_MC <> NC_STATE_MC_DI)
THEN
  STATE_MC = PRM_STATE_MC_NEW;
FI
```

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Application conditions

Initialisation:
```
/ * Has the reset counter exceeded its threshold:  if so, perform
start-up in DISABLE; otherwise in INIT (note:  also CTR_RST_
MC_CPL has to be checked, using the actions from "RAM check
service actions of processor monitoring on MC") */
   STATE_MC = NC_STATE_MC_INI;
 IF  (CTR_RST_MC > NC_CTR_RST_MC_THD)
 THEN
     STATE_MC = NC_STATE_MC_DI;
   ELSE
```

Recurrence: The **initialisation** performed **after each power-up or reset. Afterwards,** the function is **called.**

Activation: –

Deactivation: –

E.34.2 Monitoring of state machine

FUNCTION DESCRIPTION:

Description:

This function shall incorporate the following requirements:

G9 Monitoring of state machine

R9_1: The state machine on the MC shall be monitored in by testing whether STATE_MC is still valid (i.e., that it is equal to one of NC_STATE_MC_INI, NC_STATE_MC_CONF, NC_STATE_MC_PRDR, NC_STATE_MC_NORM, NC_STATE_MC_DI).

R9_2: If it is detected that the MC is an undefined state:
R9_2.1: it shall be assumed to be in DISABLE state;
R9_2.2: an immediate fault reaction shall be performed by calling ACTION_ECM3_McFaultReaction() with error location NC_ERR_COD_MC_NOT_VLD_TRAN.

R9_3: The function shall be incorporated into the action ACTION_ECM3_McReadChkState() as described in the formula section below.

Description for ACTION_ECM3_McReadChkState:

ACTION_ECM3_McReadChkState(<PRM_STATE_MC_TMP>)					
The action reads the internal representation of the current state (STATE_MC) and checks it for validity; in case of an inconsistency, the return value shall be NC_STATE_MU_DI (the representation for DISABLE state) and a fault reaction shall be triggered.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_STATE_MC_TMP	OUT	0...FFH	0...255	1	[-]
Short description of the given parameter					

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Formula section:

IF ("STATE_MC is valid") */* see R9_1 */*
THEN
PRM_STATE_MC_TMP = STATE_MC
ELSE /* invalid state */
PRM_STATE_MC_TMP = NC_STATE_MC_DI;
ACTION_ECM3_McFaultReaction (*IN* NC_ERR_COD_MC_NOT_VLD_TRAN);
FI

Application conditions

Initialisation: –

Recurrence: The function is called via ACTION_ECM3_McReadChkState().

Activation: –

Deactivation: –

E.34.3 ROM checks of processor monitoring on MC

FUNCTION DESCRIPTION:

General information:

On the MC, there are two different ROM checks:

- the *standard ROM check* which checks the *whole* ROM (code, constants, calibration data with the exception of areas which can be changed during runtime like FLASH or EEPROM);
- the *cyclic ROM check for process monitoring* which checks the ROM of process monitoring (consisting of the code, constants, and calibration data of process monitoring, plus the code of all library functions called in the code of process monitoring).

The difference between the two ROM checks is the fact that the standard ROM check is performed only *once* after power-up (after reset only if the reset occurred before its successful completion) while the ROM check for process monitoring is *cyclic*, i.e., it is re-started after completion.

E.34.3.1 Standard ROM check on MC

FUNCTION DESCRIPTION:

General information:

This sub-function describes the standard ROM check (a.k.a. "level 1 ROM check") on the MC which is performed once per driving cycle directly after power-up or reset.

The two actions ACTION_ECM3_McLockPwlResource() and ACTION_ECM3_McUnlockPwlResource() are used to ensure that the ECU is not powered down before the ROM check has been completed at least once in the corresponding driving cycle.

Description:

The function incorporates the following requirements:

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G8.1 Standard ROM check on MC

R8.1_1: Every 1000ms:
R8.1_1.1: the action ACTION_INFR_McRomChkReady() shall be called;
R8.1_1.2: its return value shall be stored in the flag LV_MC_ROM_CHK_READY (indicating whether the Standard ROM check has been finished or not); the flag shall be stored in a reset-safe manner and together with a complement, LV_MC_ROM_CHK_READY_CPL which shall also be stored in a reset-safe manner; LV_MC_ROM_CHK_READY shall be accessed (read/write) using the actions ACTION_ECM3_WriteChkCpl(), ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl() defined in the section "RAM check service actions of processor monitoring on MC"; its default value in case of a RAM error shall be 0;
R8.1_1.3: if LV_MC_ROM_CHK_READY = 1:
R8.1_1.3.1: the corresponding power-latch resource shall be unlocked by calling ACTION_ECM3_McUnlockPwlResource();
R8.1_1.3.2: the action ACTION_INFR_McRomChkOk() shall be called;
R8.1_1.3.3: its return value shall be stored in the flag LV_MC_ROM_CHK_OK (indicating whether the checksum calculated by the standard ROM check is equal to the expected one);
R8.1_1.3.4: if LV_MC_ROM_CHK_OK = 0:
R8.1_1.3.4.1: LV_MC_ROM_CHK_READY shall be reset to 0 using the RAM check service actions;
R8.1_1.3.4.2: an immediate fault reaction shall be performed by calling ACTION_ECM3_McFaultReaction() with error code NC_ERR_COD_MC_ROM_LEVEL_1.

R8.1_2: This function shall be under PFM control using the 1000ms PFM task (note that this does only refer to the processor monitoring function which only evaluates the result of the standard ROM check; the actual checksum calculation itself is part of the infrastructure and as such cannot be controlled by PFM).

Description for ACTION_ECM3_McResetRomChkFlags:

ACTION_ECM3_McResetRomChkFlags()					
This action resets the flags LV_MC_ROM_CHK_READY and LV_MC_ROM_CHK_OK; this is used by DISABLE requests.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**

Formula section:

LV_MC_ROM_CHK_OK = 0;
/ Using the RAM check service actions */*
LV_MC_ROM_CHK_READY = 0;

Application conditions

Initialisation:

```
After power-up:
   / * Using the RAM check service actions */
   LV_MC_ROM_CHK_READY = 0;
   / * Lock power-latch resource */
   ACTION_ECM3_McLockPwlResource();
 After power-up or reset:
   LV_MC_ROM_CHK_OK = 0;
   / * Lock power-latch resource */
   ACTION_ECM3_McLockPwlResource();
```

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Recurrence: *Every 1000ms*

Activation: *(STATE_MC <> NC_STATE_MC_DI)* ***AND*** *(LV_MC_ROM_CHK_READY = 0)*

/ * using the RAM check service actions */
(not in DISABLE state and not yet completed)

Deactivation: *otherwise;*
at deactivation, call ACTION_ECM3_McUnlockPwlResource()
/ * after transition to DISABLE or after completion of ROM check: unlock power-latch resource */

E.34.3.2 Cyclic ROM check on MC for process monitoring

FUNCTION DESCRIPTION:

General information:

The cyclic ROM check for process monitoring ("level 2 ROM check") checks all level 2 ROM areas, which are different from the level 1 ROM areas, as well as the corresponding constant and calibration data, very much like the standard ROM check for the level 1 ROM areas. However, there are two differences between the two ROM checks.

First of all, while the level 1 ROM check is only executed *once* per driving cycle, the level 2 ROM check is performed cyclically, i.e., once it is finished, it starts again.

Secondly, the level 2 ROM check also takes into account all library functions (e.g., from the mathematics library) which might potentially called from within any level 2 function.

This can be achieved, e.g., by performing a *complete* check of those external libraries or by the use of so-called *inline functions* where only the code of those functions *which are actually called* is tested: the code of inline functions is directly copied to the place where the function is called, instead of performing a function call; concretely, the code of an inline function from the mathematics library called from a level 2 function thus becomes part of the level 2 code and is consequently tested by the level 2 code ROM check.

Note that the two mentioned ways to check external library functions were just chosen as examples: there might very well be other ways to include such libraries in the level 2 ROM check, it just has to be ensured that **each function called inside a level 2 function is included in the level 2 ROM check** (one way or another).

Description:

The function incorporates the following requirements:

G8.2 Cyclic ROM Check on MC for Process Monitoring

R8.2_1: The checksum shall be calculated by an addition checksum.

R8.2_2: Both the calculated checksum and its expected value shall be unsigned values obtained by adding unsigned values.

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R8.2_3: The areas to be checked are comprised of the **level 2 code** area, the **level 2 constant data**, the **level 2 calibration data**, and the **code of all functions from external libraries contained in the level 2 code**.

R8.2_4: For the level 2 code area, the following special mechanism shall be used:
R8.2_4.1: there shall be two sections of level 2 code;
R8.2_4.2: for one of the sections, there shall be a calibration switch C_ERR_SWI_MC_LEVEL_2_COD which, **for application software only**, allows ignoring errors in the level 2 code area if its value is set to NC_ERR_SWI_MC_LEVEL_2_COD; **for production software, this switch must be ignored!**
R8.2_4.3: for the second section of the code area, C_ERR_SWI_MC_LEVEL_2_COD must not have any effect: a checksum error in this section shall always lead to a fault reaction;
R8.2_4.4: the ROM areas where C_ERR_SWI_MC_LEVEL_2_COD and the expected checksum for the code area are stored shall not be part of the level 2 ROM check.

R8.2_5: For the level 2 calibration area, the following special mechanism shall be used:
R8.2_5.1: there shall be a calibration switch C_ERR_SWI_MC_LEVEL_2_CAL which, **for application software only**, allows ignoring errors in the level 2 calibration ROM area if its value is set to NC_ERR_SWI_MC_LEVEL_2_CAL; **for production software, this switch must be ignored!**
R8.2_5.2: the ROM areas where C_ERR_SWI_MC_LEVEL_2_CAL and the expected checksum for the calibration data area are stored shall not be part of the level 2 ROM check.

R8.2_6: In case a level 2 ROM error is detected, i.e., in case the calculated checksum does not agree with the expected one:
R8.2_6.1: the redundant switch-off path shall be triggered by calling the action ACTION_ECM3_RedSwitchOffPath();
R8.2_6.2: an immediate fault reaction shall be performed by calling the action ACTION_ECM3_McFaultReaction() with the error code NC_ERR_COD_MC_ROM_LEVEL_2;
R8.2_6.3: the flag LV_MC_ROM_CHK_READY shall be reset (using the RAM check service actions).

R8.2_7: The level 2 ROM check shall run in a fixed time grid and shall be called every **10ms**; the meaning of "running in a fixed time grid" is that the level 2 ROM check is activated with a fixed recurrence; when activated, it continues where it left off when called the time before, i.e., this does not mean that it has to be finished between two calls but simply that it is continued when called for the next time.

R8.2_8: One level 2 ROM check cycle shall be finished:
R8.2_8.1: in **EMS** mode, within the time for temporary disabling of power stages (see "G22 Disabling of power stages");
R8.2_8.2: in **TCU** mode, within 500ms.

R8.2_9: The cyclic ROM check for process monitoring shall be under PFM control (viz., the 40ms PFM task with task number 5)

Application conditions

Initialisation: *The checksum shall be set to a configurable initial value.*

Recurrence: The **initialisation** shall be performed **after each power-up or reset** and **after one cycle has been completed.**
The **function itself** shall be calculated **every 10ms.**

Activation: –

Deactivation: –

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E.34.4 RAM checks of processor monitoring on MC

FUNCTION DESCRIPTION:

General information:

Several RAM checks have to be performed on the MC to test the integrity of the RAM:

- there shall be a non-destructive RAM check for those data that have to be stored in a reset-safe way, and those RAM areas that are shared between BOOT and ECU software;
- for all remaining RAM areas, there shall be a destructive RAM check which also performs an initialisation to 0;
- additionally, there shall be a cyclic RAM check for the level 2 RAM areas and for some of the RAM areas of the processor monitoring: this is done by storing those variables as pair of value and complement and performing consistency checks when accessing the variables;
- in order to prevent faults due to interrupt handling while level 2 is active, also a stack check is implemented which checks the relevant memory area on the stack where the level 2 register content will be stored in case of an interrupt.

The first two kinds of RAM checks have to be performed in such a way as to be able to detect static errors like stuck bits/cells. The last two kinds of RAM check are used to detect dynamic errors like a bit toggling during runtime or one (process/processor monitoring) module corrupting the memory area of another one, or problems with the stack memory.

E.34.4.1 Standard RAM check on MC

FUNCTION DESCRIPTION:

General information:

Those variables which are to be stored in the reset-safe RAM area have to checked without destroying their contents.

Description:

The function incorporates the following requirements:

G6 Standard RAM check on MC (destructive/non-destructive)

R6_1: In case an error has been detected during the Standard RAM check, an immediate fault reaction shall be performed; however, the Standard RAM check is active at a time when calling ACTION_ECM3_McFaultReaction() with the error code NC_ERR_COD_MC_RAM_LEVEL_1 is not possible; therefore, the effect of the action shall be mimicked as much as possible (increase reset counter, set error code, trigger reset if reset counter has not yet passed a certain threshold etc.).

Application conditions

Initialisation:	–
Recurrence:	*Once before all other functions are started*
Activation:	*activated by the Standard RAM check*
Deactivation:	–

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E.34.4.2 RAM check service actions of processor monitoring on MC

FUNCTION DESCRIPTION:

General information:

In addition to the RAM checks described above which are only executed after power-up/reset, the processor monitoring on the MC also provides RAM check functionality which is used to protect data which is repeatedly used in both process and processor monitoring.

The functionality of the process monitoring (level 2) is calculated cyclically. The calculation and the storage of intermediate results of the process monitoring functions is performed using the registers of the processor as far as possible. The registers are tested by the function-specific instruction set test (see “MC function-specific instruction set test”).

Description:

The function, via the exported actions, incorporates the following requirements:

G7 RAM check service actions of processor monitoring on MC

R7_1: All variables of the process monitoring which are located in the RAM and used in the next recurrence of a task (e.g. anti-bounce-counters) or in a different successive task are stored as pairs consisting of the value and its complement.

R7_2: After execution of a level 2 module, its results have to be copied from registers into variables located in the RAM. After storing a value from an internal register in the RAM, together with its complement in a variable of the name var_CPL if the original variable was named var (example: LV_OFF_IV_MON_CPL contains the complement of LV_OFF_IV_MON), the value is read back from the RAM and compared with the original value of the register. This procedure is performed by the action ACTION_ECM3_WriteChkCpl() described below.

R7_3: At the beginning of the following recurrence of the task, the two complementary variables are checked for plausibility. Also intermediate results, which cannot be completely handled by the internal registers, are stored in value-complement pairs and checked for plausibility. This is done at the beginning of a level 2 module using the action ACTION_ECM3_ChkCpl() or ACTION_ECM3_ReadChkCpl(); the difference between these two actions is that the action ACTION_ECM3_ChkCpl() only performs a plausibility check for a variable and its complement variable without loading the actual value into a register, while ACTION_ECM3_ReadChkCpl() also loads a register with the value of the given variable.

R7_4: If a RAM fault is detected by these functions, an immediate fault reaction shall be performed via ACTION_ECM3_McFaultReaction(), using the error code NC_ERR_COD_MC_RAM_LEVEL_2.

R7_5: Additionally, there is also a variant of the level 2 RAM check service action ACTION_ECM3_ReadChkCpl() named ACTION_ECM3_McReadChkCpl() used for variables of processor monitoring; the difference to the level 2 service action is the presence of a default return value which shall be returned in case an inconsistency is detected (this is only meaningful for those variables which are stored in the reset-safe area, the others are initialised by the reset following the fault reaction).

R7_6: All RAM check service actions have to be implemented as macros to avoid function calls in the code of level 2 and processor monitoring.

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R7_7: All RAM check service actions have to be implemented in such a way that they are universally usable, in particular regardless of the type of their parameters.

Description for ACTION_ECM3_WriteChkCpl

ACTION_ECM3_WriteChkCpl(PRM_VAR, PRM_VAR_CPL, PRM_VALUE)					
see description in section "RAM check service actions of Processor Monitoring on MC"					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_VAR	INOUT	*any*	*any*	*any*	*any*
Variable to be checked					
PRM_VAR_CPL	OUT	*any*		*any*	*any*
Variable for the complement of PRM_VAR					
PRM_VALUE	IN	*any*	*any*	*any*	*any*
Value to be stored					

Formula section:

PRM_VAR = PRM_VALUE;
PRM_VAR_CPL = complement(PRM_VALUE);
IF (PRM_VAR != PRM_VALUE)
THEN
ACTION_ECM3_McFaultReaction(
IN NC_ERR_COD_MC_RAM_LEVEL_2);
FI

Description for ACTION_ECM3_ChkCpl

ACTION_ECM3_ChkCpl(PRM_VAR, PRM_VAR_CPL)					
see description in section "RAM check service actions of Processor Monitoring on MC"					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_VAR	IN	*any*	*any*	*any*	*any*
Variable to be checked					
PRM_VAR_CPL	IN	*any*		*any*	*any*
Variable for the complement of PRM_VAR					

Formula section:

IF (PRM_VAR != complement(PRM_VAR_CPL))
THEN
ACTION_ECM3_McFaultReaction(
IN NC_ERR_COD_MC_RAM_LEVEL_2);
FI

Description for ACTION_ECM3_ReadChkCpl

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ACTION_ECM3_ReadChkCpl(PRM_RESULT, PRM_VAR, PRM_VAR_CPL)					
see description in section "RAM check service actions of Processor Monitoring on MC"					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_RESULT	OUT	*any*	*any*	*any*	*any*
Variable to be checked					
PRM_VAR	IN	*any*		*any*	*any*
Variable for the complement of PRM_VAR					
PRM_VAR_CPL	IN	*any*	*any*	*any*	*any*
Value to be stored					

Formula section

PRM_RESULT = PRM_VAR;
IF (PRM_VAR != complement(PRM_VAR_CPL))
THEN
ACTION_ECM3_McFaultReaction(
IN NC_ERR_COD_MC_RAM_LEVEL_2);
FI

Description for ACTION_ECM3_McReadChkCpl

ACTION_ECM3_McReadChkCpl(PRM_RESULT, PRM_VAR, PRM_VAR_CPL, PRM_DFT_VALUE)					
see description in section "RAM check service actions of Processor Monitoring on MC"					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_RESULT	OUT	*any*	*any*	*any*	*any*
Variable to be checked					
PRM_VAR	IN	*any*		*any*	*any*
Variable for the complement of PRM_VAR					
PRM_VAR_CPL	IN	*any*	*any*	*any*	*any*
Value to be stored					
PRM_DFT_VALUE	IN	*any*	*any*	*any*	*any*
Default value for PRM_VAR in case an inconsistency is detected					

Formula section:

IF (PRM_VAR != complement(PRM_VAR_CPL))
THEN
PRM_RESULT = PRM_DFT_VALUE;
ACTION_ECM3_McFaultReaction(
IN NC_ERR_COD_MC_RAM_LEVEL_2);
ELSE
PRM_RESULT = PRM_VAR;
FI

Application conditions

Initialisation: *Before the first test of the complementary variables, all appropriate variables must be initialized properly using the action ACTION_ECM3_WriteChkCpl().*

Recurrence: *All the actions in this function are called.*

Activation: –

Deactivation: –

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E.34.4.3 Stack check service action of processor monitoring on MC

FUNCTION DESCRIPTION:

General information:

In addition to the RAM checks described above (the start-up checks described in G6 and the cyclic level 2 RAM check described in G7), there is another memory test to ensure the integrity of memory areas used by the stack. The motivation for the function is as follows.
While a process monitoring (level 2) module is executed, an interrupt might occur. Prompted by the interrupt, the current content of the registers, plus "logistic" data like a return address, are stored on the stack. Once the interrupt handling is finished, the register content is restored from the stack and program execution continues where it left off before the interrupt (the address is also determined from the data saved on the stack).
However, if the used stack memory is corrupted, the level 2 register content might be corrupted without being detected; this could either lead to a dormant fault (level 2 might not catch an existing error) or reduce the availability of the vehicle (a level 2 fault reaction might get triggered unnecessarily).
Finally, if the return address is corrupted by being stored on the stack, the level 2 module might not be completed (leading to a problem with program flow monitoring (PFM), again reducing availability), or some code passages of the level 2 module might be omitted (again leading to a dormant fault).
Consequently, at the beginning of each level 2 module, the relevant stack areas have to be checked so that in case of an interrupt during the execution of the module, the necessary data can be correctly stored and recovered.

Description:

The function incorporates the following requirements:

G49 Stack check service action of processor monitoring on MC

R49_1: The interface to level 2 shall be provided via the exported action ACTION_ECM3_McChk-Stack().
Remark:

- the action shall be called at the very beginning of each level 2 module in order to ensure that the relevant stack area is OK in case the level 2 module is interrupted;
- the action shall be "sandwiched" in between two PFM actions in order to ensure that the stack check action is entered and left properly since its code might not be completely ROM-checked.

R49_2: When ACTION_ECM3_McChkStack() is called, the infrastructure action ACTION_INFR_Mc-ChkStack() shall be called in order to perform the stack check; the requirements to this action shall be described in the IRS of Processor Monitoring.

R49_3: ACTION_INFR_McChkStack() shall return a flag indicating whether the stack check was successful or not.

R49_4: If ACTION_INFR_McChkStack() indicates that the stack check was unsuccessful, an immediate fault reaction shall be performed via ACTION_ECM3_McFaultReaction(), using the error code NC_ERR_COD_MC_RAM_LEVEL_2.

R49_5: The call and the execution of ACTION_ECM3_McChkStack() shall use no stack.

Application conditions

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Initialisation: –

Recurrence: *The function is called via ACTION_ECM3_McChkStack().*

Activation: –

Deactivation: –

E.34.5 Configuration of MU

FUNCTION DESCRIPTION:

General information:

The MU can be configured in various ways, e.g., whether it is used for monitoring of EMS or TCU application (a choice which has implications on timing etc.). The act of configuring is one of the tasks of the MC which sends these data in the first communication to the MU (and re-sends them in the second so that the data can be rendered plausible on the MU).

Since the configuration has far-reaching influences on the behaviour of the MU and the whole system (e.g., by enabling or disabling the injection-off timer) and each configuration information is simply a bit information, the MU keeps on sending its configuration to the MC in NORMAL communications so that a change in the configuration of the MU can be detected as quickly as possible.

Description:

The function incorporates the following requirements:

G10 Configuration of MU by MC

R10_1: In the CONFIG communication, the MC sends configuration information to the MU; the MU can be configured with respect to:

- general mode (EMS or TCU, NLC_MU_MOD)
- hardware (via the dedicated input pin) or software (only via information received from the MC) acquisition of ignition key signal (NLC_MU_IGN_KEY_ACQ)
- power-off timer enabled or disabled (NLC_MU_POW_OFF_TMR_ENA)
- injection-off timer enabled or disabled (NLC_MU_POW_OFF_TMR_ENA)
- end-of-line test enabled or not (always disabled)

This is achieved by calling the action ACTION_INFR_McSendConfData() with the above arguments; note that the end-of-line test configuration is not part of the argument list since it is always disabled.

R10_2: In the PREDRIVE communication, the MC shall re-send these data in order to confirm the previously sent data (note that, in case a discrepancy between the two sets of configuration data is detected, an immediate fault reaction on the MU shall be the consequence); since the arguments have already been sent to the infrastructure, there is no need to re-send them.

R10_3: The MC shall obtain the complete set of configuration information (including the end-of-line test configuration) from the MU after the PREDRIVE communication so that the MC knows what the MU believes to be configured for; the information shall be stored in LF_MU_CONF_BYTE acquired by calling the action ACTION_INFR_McGetConfData(), and compared to the data from R10_1 and R10_2; note that LF_MU_CONF_BYTE is a compressed representation where the bit values for the configuration data have to be extracted from.

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R10_4: The MC shall obtain the configuration information (excluding the end-of-line test configuration) from the MU after NORMAL communications; the information shall again be stored in LF_MU_CONF_BYTE acquired by calling the action ACTION_INFR_McGetConfData(), and compared to the data from R10_1 and R10_2.

R10_5: In case a configuration mismatch is detected on the MC:
R10_5.1: in PREDRIVE, there shall be an immediate fault reaction by calling ACTION_ECM3_McFaultReaction() with error code NC_ERR_COD_MC_CONF_DIF;
R10_5.2: in NORMAL, there shall be a debounced fault reaction, using the anti-bounce counter NC_ABC_MC_CONF_DIF, the error code NC_ERR_COD_MC_CONF_DIF, and the two actions ACTION_ECM3_McIncAbc() and ACTION_ECM3_McDecAbc().

Application conditions

Initialisation: *LF_MU_CONF_BYTE = 0;*

Recurrence: The **initialisation** shall be performed **after each power-up or reset.**
R10_1 shall be executed before the CONFIG communication is triggered; R10_2 does not require any activity; R10_3 shall be executed after the PREDRIVE communication and the corresponding communication monitoring function; R10_4 shall be executed after NORMAL communications and the corresponding communication monitoring function; R10_5 shall be executed after R10_3 and R10_4, as appropriate.

Activation: *For R10_3 and R10_4, LV_MC_COM_ERR = 0 must hold* (they are only executed if no communication error was detected; note that a consistency check with LV_MC_COM_ERR_CPL is necessary)

Deactivation: *Otherwise*

E.34.6 Version compatibility check

FUNCTION DESCRIPTION:

General information:

This functions describes when and how compatibility information is exchanged between MC and MU.

Description:

This function incorporates the following requirements:

G11 Version compatibility check

R11_1: After the CONFIG communication, if communication monitoring has not found an error, i.e., if LV_MC_COM_ERR = 0 (note that a consistency check with LV_MC_COM_ERR_CPL is necessary), the MC shall obtain the compatibility information sent by the MU (NR_COMP_MU; the hardware version NR_MU_HW_VERS is only sent for information purposes) by calling the actions ACTION_INFR_McGetCompNr() and ACTION_INFR_McGetVersNr().

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R11_2: If the compatibility information from the MU does not match the information on the MC (NC_NR_MC_COMP), an immediate fault reaction shall be triggered by calling ACTION_ECM3_McFaultReaction with error code NC_ERR_COD_MC_COMP_NR.

R11_3: In the PREDRIVE communication, the MC shall send compatibility information the MU (NC_NR_MC_COMP) by calling the action ACTION_INFR_McSendCompNr() before the PREDRIVE communication is triggered.

Application conditions

Initialisation: *NR_MU_COMP = 0;*
NR_MU_HW_VERS = 0;

Recurrence: The **initialisation** shall be performed **after each power-up or reset.**
R1 shall be executed after the CONFIG communication is completed and no communication error was detected; R2 shall be executed after R1, if necessary; R3 shall be executed before the PREDRIVE communication is triggered.

Activation: *For R1, LV_MC_COM_ERR = 0 must hold* (only executed if no communicatio error was no detected; note that a consistency check with LV_MC_COM_ERR_CPL is necessary)

Deactivation: *Otherwise*

E.34.7 Acquisition of values of A/D conversions

FUNCTION DESCRIPTION:

General information:

This functions describes when and how the result of the A/D conversions (both on MC and MU) shall be acquired and how it is exported to process monitoring.

A/D conversions are performed on both MC and MU, in both cases after a communication, starting with the end of the CONFIG communication.

However, since the value acquired on the MU can only be transmitted to the MC in the next communication, the data have to be synchronised: for example, the value acquired on the MU after the CONFIG communication is only transmitted to the MC in the PREDRIVE communication and hence only available on the MC after the end of the PREDRIVE communication; in the meantime, the MC also has acquired A/D values after the CONFIG and PREDRIVE communications; so it has to be ensured that the value from the MU sampled after the CONFIG communication is exported ("packaged") together with the value sampled on the MC after the CONFIG communication.

This can easily be achieved by simply buffering the value sampled on the MC until after the next communication (see signal flow diagram).

Signal flow diagram:

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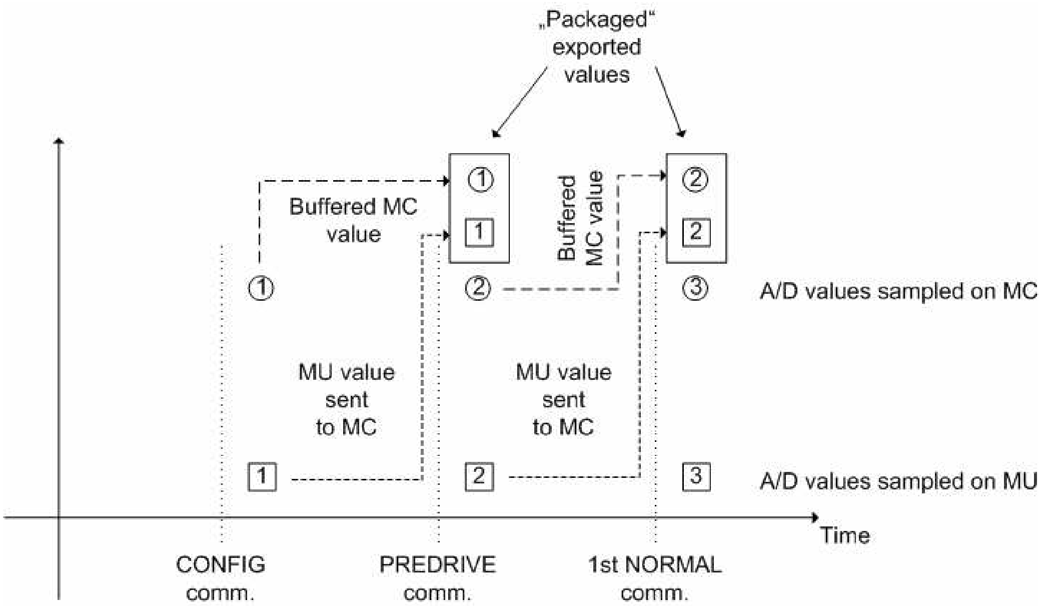

Description:

This function incorporates the following requirements:

G23 Acquisition of values of A/D conversions

R23_1: After each communication:
R23_1.1: the buffered A/D value VP_MC_AN_DIG_MON_TMP shall be copied into VP_MC_AN_DIG_MON;
R23_1.2: VP_MC_AN_DIG_MON_TMP and VP_MC_AN_DIG_MON shall be stored together with their complements VP_MC_AN_DIG_MON_TMP_CPL and VP_MC_AN_DIG_MON_CPL and only be accessed using the actions ACTION_ECM3_WriteChkCpl(), ACTION_ECM3_ChkCpl(), ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl() from section "RAM check service actions of processor monitoring on MC";
R23_1.3: their default values in case of a RAM error shall be 0.

R23_2: After storing the buffered value into the actual interface, the new value of the A/D conversion on the MC shall be fetched from the infrastructure by calling the action ACTION_INFR_GetAnDigMonValMc(), storing the result in VP_MC_AN_DIG_MON_TMP.

R23_3: If VP_MC_AN_DIG_MON_TMP is equal to NC_VP_MC_AN_DIG_MON_CPL_ERR:
R23_3.1: VP_MC_AN_DIG_MON_TMP shall be reset to 0 (using the RAM check actions);
R23_3.2: an immediate fault reaction shall be performed via ACTION_ECM3_McFaultReaction(), using the error code NC_ERR_COD_MC_RAM_LEVEL_2;
R23_3.3: otherwise, no action shall be performed.

R23_4: After each successful PREDRIVE, NORMAL, and DISABLE communication (i.e., LV_MC_ERR_COM = 0):
R23_4.1: the freshly transmitted value of the A/D conversion on the MU shall be fetched from the infrastructure via the action ACTION_INFR_GetAnDigMonValMu(), storing the result in VP_MU_AN_DIG_MON;
R23_4.2: VP_MU_AN_DIG_MON shall be stored together with its complement VP_MU_AN_DIG_MON_CPL and only be accessed using the actions ACTION_ECM3_WriteChkCpl(), ACTION_ECM3_ChkCpl(),

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ACTION_ECM3_ReadChkCpl(), and ACTION_ECM3_McReadChkCpl() from section "RAM check service actions of processor monitoring on MC";
R23_4.3: its default value in case of a RAM error shall be 0.

Note: the MU value VP_MU_AN_DIG_MON is only updated after a *successful* communication while the MC value is acquired after *each* communication; in the extreme case of no successful communications, the MU value will therefore freeze to the value obtained after the last correct communication, eventually leading to a fault reaction (of process monitoring, where the MC and MU values are compared); however, unsuccessful communications will (much faster) lead to a fault reaction of processor monitoring (by the communication monitoring functions).

Application conditions

Initialisation:

```
/ * Using the RAM check service actions */
   VP_MC_AN_DIG_MON = 0;
 VP_MU_AN_DIG_MON = 0;
 VP_MC_AN_DIG_MON_TMP = 0;
```

Recurrence: The **initialisation** shall be performed **after each power-up or reset.**
The **function itself** shall be executed **after the communication monitoring functions.**

Activation: For R23_1, R23_2, R23_3:
Always.
For R23_4:
((STATE_MC = NC_STATE_MC_PRDR) **OR** (STATE_MC = NC_STATE_MC_NORM) **OR** (STATE_MC = NC_STATE_MC_DI)) **AND** (LV_MC_COM_ERR = 0)
(active in PREDRIVE, NORMAL, and DISABLE state but only if the preceding communication was successful; note that a consistency check with LV_MC_COM_ERR_CPL is necessary)

Deactivation: *Otherwise*

E.34.8 Exchange of ignition key information between MC and MU

FUNCTION DESCRIPTION:

General information:

This function describes when and how information regarding the state of the ignition key is exchanged between MC and MU.

Description:

This function incorporates the following requirements:

G25 Exchange of ignition key information between MC and MU

R25_1: In each NORMAL and DISABLE communication, the MC sends the value of LV_MC_IGN_KEY to the MU; this is achieved by calling ACTION_INFR_McSendIgk() with argument LV_MC_IGN_KEY before the corresponding communications are triggered.

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R25_2: If the MU is configured for hardware acquisition of the ignition key signal, after each PREDRIVE, NORMAL, and DISABLE communication, the value of the ignition key input IGK_IN on the MU shall be acquired by calling the action ACTION_INFR_McGetIgkMu(), storing the result in LV_MU_IGN_KEY, but only if no communication error was detected, i.e., LV_MC_COM_ERR = 0 (note that a consistency check with LV_MC_COM_ERR_CPL is necessary).

Application conditions

Initialisation: *LV_MU_IGN_KEY = 0;*

Recurrence: The **initialisation** shall be performed **after each reset or power-up.** The **function** shall be **executed after the communication monitoring functions.**

Activation: *((STATE_MC = NC_STATE_MC_PRDR)* ***OR*** *(STATE_MC = NC_STATE_MC_NORM)* ***OR*** *(STATE_MC = NC_STATE_MC_DI))*
(only active in PREDRIVE, NORMAL, and DISABLE state)

Deactivation: *Otherwise*

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E.35 Processor Monitoring (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ENVD_0_MON_3	O/V/S	0... FFH	0... 255	1	-
Environmental data 0 for general processor monitoring error					
ENVD_1_MON_3	O/V/S	0... FFH	0... 255	1	-
Environmental data 1 for general processor monitoring error					
ENVD_2_MON_3	O/V/S	0... FFH	0... 255	1	-
Environmental data 2 for general processor monitoring error					
ENVD_3_MON_3	O/V/S	0... FFH	0... 255	1	-
Environmental data 3 for general processor monitoring error					
ERR_SYM_MON_3	V	0H 1H 2H 4H 8H	NO_SYM SYM_0 SYM_1 SYM_2 SYM_3	-	-
Error symptom extracted from ERR_COD_MC and ERR_COD_MU					
LV_CDN_DIAG_MON_3	V	0... 1H	0 ...1	1	-
Diagnosis condition for processor monitoring error					
LV_END_DIAG_MON_3	V	0... 1H	0 ...1	1	-
Indicates that diagnosis has been finished					
LV_ERR_MON_3	O/V	0... 1H	0 ...1	1	-
Error detected by processor monitoring					
LV_ERR_RAM_MON_3	O/V	0... 1H	0 ...1	1	-
RAM test error detected by processor monitoring					
LV_INJ_OFF_TMR_INJ_ENA	O/V	0... 1H	0 ...1	1	-
Indicates enabling of injection by injection off timer of MU					
LV_MC_IGN_KEY	O/V	0... 1H	0 ...1	1	-
Ignition key information to be sent from MC to MU					
LV_MC_ST_LIH_SOPC	O/V	0... 1H	0 ...1	1	-
Request to start in limp-home mode based on result of the switch-off path check					
LV_MC_ST_LIH_SOPC_CPL	O	0... 1H	0 ...1	1	-
Complement of LV_MC_ST_LIH_SOPC_CPL					
LV_MU_IGN_KEY_OLD	V	0... 1H	0 ...1	1	-
Flag used for storing value of ignition key signal on MU from last recurrence (needed for IOT handling)					

Input data:

ERR_COD_MC {p. 7072}	ERR_COD_MU {p. 7072}	IDX_STATE_SOPC {p. 7186}	LV_DIAG_END_RLY_MAIN_DLY {p. 4933}
LV_ERR_TMP_MU_MC {p. 7072}	LV_INJ_OFF_TMR_INJ_ENA_TMP {p. 7072}	LV_MU_IGN_KEY {p. 7135}	LV_RLY_MAIN_DLY_ERR {p. 4933}
NC_ABC_MC_CKS {p. 7073}	NC_ABC_MC_CKS_INC {p. 7073}	NC_ABC_MC_CKS_INI {p. 7073}	NC_ABC_MC_CKS_MAX {p. 7073}
NC_ABC_MC_CONF_DIF {p. 7073}	NC_ABC_MC_CONF_DIF_INC {p. 7073}	NC_ABC_MC_CONF_DIF_INI {p. 7073}	NC_ABC_MC_CONF_DIF_MAX {p. 7074}

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NC_ABC_MC_HD {p. 7074}	NC_ABC_MC_HD_INC {p. 7074}	NC_ABC_MC_HD_INI {p. 7074}	NC_ABC_MC_HD_MAX {p. 7074}
NC_ABC_MC_NOT_DEC {p. 7074}	NC_ABC_MC_NOT_DEC_INC {p. 7074}	NC_ABC_MC_NOT_DEC_INI {p. 7074}	NC_ABC_MC_NOT_DEC_MAX {p. 7074}
NC_ABC_MC_PFM_0_RESP {p. 7074}	NC_ABC_MC_PFM_0_RESP_INC {p. 7074}	NC_ABC_MC_PFM_0_RESP_INI {p. 7074}	NC_ABC_MC_PFM_0_RESP_MAX {p. 7074}
NC_ABC_MC_PFM_0_TOG {p. 7074}	NC_ABC_MC_PFM_0_TOG_INC {p. 7074}	NC_ABC_MC_PFM_0_TOG_INI {p. 7074}	NC_ABC_MC_PFM_0_TOG_MAX {p. 7074}
NC_ABC_MC_PFM_1_RESP {p. 7074}	NC_ABC_MC_PFM_1_RESP_INC {p. 7074}	NC_ABC_MC_PFM_1_RESP_INI {p. 7074}	NC_ABC_MC_PFM_1_RESP_MAX {p. 7074}
NC_ABC_MC_PFM_1_TOG {p. 7074}	NC_ABC_MC_PFM_1_TOG_INC {p. 7075}	NC_ABC_MC_PFM_1_TOG_INI {p. 7075}	NC_ABC_MC_PFM_1_TOG_MAX {p. 7075}
NC_ABC_MC_PFM_2_RESP {p. 7075}	NC_ABC_MC_PFM_2_RESP_INC {p. 7075}	NC_ABC_MC_PFM_2_RESP_INI {p. 7075}	NC_ABC_MC_PFM_2_RESP_MAX {p. 7075}
NC_ABC_MC_PFM_2_TOG {p. 7075}	NC_ABC_MC_PFM_2_TOG_INC {p. 7075}	NC_ABC_MC_PFM_2_TOG_INI {p. 7075}	NC_ABC_MC_PFM_2_TOG_MAX {p. 7075}
NC_ABC_MC_PFM_3_RESP {p. 7075}	NC_ABC_MC_PFM_3_RESP_INC {p. 7075}	NC_ABC_MC_PFM_3_RESP_INI {p. 7075}	NC_ABC_MC_PFM_3_RESP_MAX {p. 7075}
NC_ABC_MC_PFM_3_TOG {p. 7075}	NC_ABC_MC_PFM_3_TOG_INC {p. 7075}	NC_ABC_MC_PFM_3_TOG_INI {p. 7075}	NC_ABC_MC_PFM_3_TOG_MAX {p. 7075}
NC_ABC_MC_PFM_4_RESP {p. 7075}	NC_ABC_MC_PFM_4_RESP_INC {p. 7075}	NC_ABC_MC_PFM_4_RESP_INI {p. 7075}	NC_ABC_MC_PFM_4_RESP_MAX {p. 7076}
NC_ABC_MC_PFM_4_TOG {p. 7076}	NC_ABC_MC_PFM_4_TOG_INC {p. 7076}	NC_ABC_MC_PFM_4_TOG_INI {p. 7076}	NC_ABC_MC_PFM_4_TOG_MAX {p. 7076}
NC_ABC_MC_PFM_5_RESP {p. 7076}	NC_ABC_MC_PFM_5_RESP_INC {p. 7076}	NC_ABC_MC_PFM_5_RESP_INI {p. 7076}	NC_ABC_MC_PFM_5_RESP_MAX {p. 7076}
NC_ABC_MC_PFM_5_TOG {p. 7076}	NC_ABC_MC_PFM_5_TOG_INC {p. 7076}	NC_ABC_MC_PFM_5_TOG_INI {p. 7076}	NC_ABC_MC_PFM_5_TOG_MAX {p. 7076}
NC_ABC_MC_PFM_6_RESP {p. 7076}	NC_ABC_MC_PFM_6_RESP_INC {p. 7076}	NC_ABC_MC_PFM_6_RESP_INI {p. 7076}	NC_ABC_MC_PFM_6_RESP_MAX {p. 7076}
NC_ABC_MC_PFM_6_TOG {p. 7076}	NC_ABC_MC_PFM_6_TOG_INC {p. 7076}	NC_ABC_MC_PFM_6_TOG_INI {p. 7076}	NC_ABC_MC_PFM_6_TOG_MAX {p. 7076}

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NC_NR_MC_COMP {p. 7136}	NC_NR_MC_PFM {p. 7118}	NC_NR_MC_PFM_TCC {p. 7118}	NC_NR_RESP_SOPC {p. 7186}
NC_PWL_LOCK_CDN_ ROM_CHK {p. 3778}	NC_RESP_SOPC_1 [NC_NR_RESP_SOPC] {p. 7186}	NC_RESP_SOPC_2 [NC_NR_RESP_SOPC] {p. 7186}	NC_STATE_ERR_IDC_ MC_DI_REQ {p. 7079}
NC_STATE_ERR_IDC_ MC_NOT_PRES {p. 7079}	NC_STATE_ERR_IDC_ MC_PREV_REST {p. 7079}	NC_STATE_ERR_IDC_ MC_REST_REQ {p. 7079}	NC_STATE_MC_CONF {p. 7136}
NC_STATE_MC_DI {p. 7136}	NC_STATE_MC_INI {p. 7136}	NC_STATE_MC_NORM {p. 7136}	NC_STATE_MC_NOT_VLD {p. 7136}
NC_STATE_MC_PRDR {p. 7136}	NC_STATE_RESP_DR_ DFT {p. 7186}	NC_STATE_RESP_DR_DI {p. 7186}	NC_STATE_RESP_DR_ ENA {p. 7186}
NC_STATE_RESP_SOPC_ DFCT {p. 7186}	NC_STATE_RESP_SOPC_ OK {p. 7186}	NC_T_MC_COM_CYC {p. 7049}	NC_TCC_MC_IST_WRG_ RESP_CHK {p. 7101}
NC_TCC_MC_IST_WRG_ RESP_REQ {p. 7101}	NC_TCC_MC_PFM_TOG_ 6_MAX {p. 7118}	NC_TCC_MC_PFM_TOG_ MAX [NC_NR_MC_PFM_TCC] {p. 7118}	NC_TEST_REC_IDX_ MAX_MON2 {p. 7101}
NC_VP_MC_AN_DIG_ MON_CPL_ERR {p. 7136}	NLC_MU_IGN_KEY_ACQ {p. 7136}	NLC_MU_INJ_OFF_TMR_ ENA {p. 7136}	NLC_MU_MOD {p. 7136}
NLC_MU_POW_OFF_ TMR_ENA {p. 7136}	NLF_MC_PFM_SYN_ BYTE_INI {p. 7118}	PWL_LOCK_CDN {p. 3776}	STATE_MC {p. 7135}

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CTR_RST_THD_ERR_MEM	-	0... FH	0... 15	1	-
Threshold for reset counter of MC and MU when error memory entries shall be generated					

Action definition

ACTION_ CM3_McLockPwlResource ()	Mode: O
This action shall lock the power latch resource for the Standard ROM check to extend the power latch phase at least until the Standard ROM check has been completed.	

ACTION_ECM3_McErrmService (**IN**<No Name available>,**IN**<No Name available>,**IN**<No Name available>,**IN**<No Name available>,**IN**<No Name available>,**IN**<No Name available>,**IN**<No Name available>,**IN**<No Name available>)	Mode: O

ACTION_ECM3_McUnlockPwlResource ()	Mode: O
-	

Import actions:

ACTION_ECM3_ChkCpl (**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
Continued on next page

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ACTION_ECM3_McChangeState (**IN**<PRM_STATE_MC_NEW>)
ACTION_ECM3_McFaultReaction (**IN**<PRM_ERR_COD>)
ACTION_ECM3_McReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>,**IN**<PRM_DFT_VALUE>)
ACTION_ECM3_McReadChkState (**OUT**<PRM_STATE_MC_TMP>)
ACTION_ECM3_ReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_WriteChkCpl (**INOUT**<PRM_VAR>,**OUT**<PRM_VAR_CPL>,**IN**<PRM_VALUE>)
ACTION_SetRstInfo_Ecm3 ()

Error treatment:

Diagnostic **MON_3**	**Symptom description**	**Symptom**	**Filter type**
Diagnoses of Processor Monitoring	ROM error on MC	*SYM_0*	NO
	RAM error on MC	*SYM_1*	
	SOPC or unspecific error	*SYM_2*	
	FS-IST error on MU	*SYM_3*	

Note: it is recommended to configure MON_3 to "CARB CC"
Note: it is recommended to calibrate ENVD_x_MON_3 to be stored in the error memory when a MON_3 error occurs (ID_ERR_ENVD_MON_3).

Note: storage ENVD_x_MON_3 as non-volatile shall be ensured via the Error Memory Management.

E.35.1 Generic configuration - Value assignment for configuration data

FUNCTION DESCRIPTION:

General information:

This section describes the value assignment for the generic (i.e., project-independent) configuration data of Processor Monitoring (e.g., header-bytes, error codes etc.) for engine management systems (EMSs).
THESE ASSIGNMENTS CANNOT BE CHANGED BY PROJECTS!

Value assignment for configuration data of processor monitoring on MC:

/ State machine */*
NC_STATE_MC_INI = 241; */* F1H */*
NC_STATE_MC_CONF = 146; */* 92H */*
NC_STATE_MC_PRDR = 199; */* C7 */*
NC_STATE_MC_NORM = 173; */* ADH */*
NC_STATE_MC_DI = 59; */* 3BH */*
NC_STATE_MC_NOT_VLD = 2; */* 02H */*
/ Compatibility information of MC */*
NC_NR_MC_COMP = 0;
/ Value for calibration switch so that no fault reaction will be performed after a ROM error for level 2 calibration data (NOT TAKEN INTO ACCOUNT IN PRODUCTION SOWFTARE!) */*
NC_ERR_SWI_MC_LEVEL_2_CAL = 165 */* A5H */*

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/ Value for calibration switch so that no fault reaction will be performed after a ROM error for level 2 code (NOT TAKEN INTO ACCOUNT IN PRODUCTION SOWFTARE!) */*

```
NC_ERR_SWI_MC_LEVEL_2_COD = 165 /* A5H */
/* Threshold for reset counter for irreversibly disabling of power stages */
NC_CTR_RST_MC_THD = 7;
/* Error codes on MC*/
NC_ERR_COD_MC_NOT_ERR = 0;
NC_ERR_COD_MC_HD = 1;
NC_ERR_COD_MC_CKS = 2;
NC_ERR_COD_MC_PAR = 3;
NC_ERR_COD_MC_CONF_DIF = 4;
NC_ERR_COD_MC_SOPC = 5;
NC_ERR_COD_MC_COMP_NR = 6;
NC_ERR_COD_MC_ROM_LEVEL_1 = 7;
NC_ERR_COD_MC_RAM_LEVEL_1 = 8;
NC_ERR_COD_MC_ROM_LEVEL_2 = 9;
NC_ERR_COD_MC_RAM_LEVEL_2 = 10;
NC_ERR_COD_MC_WRG_IDX = 11;
NC_ERR_COD_MC_WRG_RESP = 12;
NC_ERR_COD_MC_NOT_DEC = 13;
NC_ERR_COD_MC_MU_READY = 14;
NC_ERR_COD_MC_PFM_0_TOG = 16;
NC_ERR_COD_MC_PFM_1_TOG = 17;
NC_ERR_COD_MC_PFM_2_TOG = 18;
NC_ERR_COD_MC_PFM_3_TOG = 19;
NC_ERR_COD_MC_PFM_4_TOG = 20;
NC_ERR_COD_MC_PFM_5_TOG = 21;
NC_ERR_COD_MC_PFM_6_TOG = 22;
NC_ERR_COD_MC_NOT_VLD_TRAN = 23;
NC_ERR_COD_MC_PFM_0_RESP = 24;
NC_ERR_COD_MC_PFM_1_RESP = 25;
NC_ERR_COD_MC_PFM_2_RESP = 26;
NC_ERR_COD_MC_PFM_3_RESP = 27;
NC_ERR_COD_MC_PFM_4_RESP = 28;
NC_ERR_COD_MC_PFM_5_RESP = 29;
NC_ERR_COD_MC_PFM_6_RESP = 30;

/* Error codes on MU (for evaluation of error information: only used for error memory management) */
NC_ERR_COD_MU_FCT_SPC_IST = 11; /* Wrong FS-IST answer */
NC_ERR_COD_MU_V_L = 13; /* Under-voltage detected on MU */
NC_ERR_COD_MU_V_H = 14; /* Over-voltage detected on MU */
NC_ERR_COD_MU_V_L_H = 15; /* Under- and over-voltage detected on MU */

/* Error indications */
NC_STATE_ERR_IDC_MC_NOT_PRES = 0;
NC_STATE_ERR_IDC_MC_REST_REQ = 1;
NC_STATE_ERR_IDC_MC_DI_REQ = 2;
NC_STATE_ERR_IDC_MC_PREV_REST= 3;
/* Debounce mechanism: indicators for anti-bounce counters */
NC_ABC_MC_HD = 0;
NC_ABC_MC_CKS = 1;
NC_ABC_MC_CONF_DIF = 2;
```

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NC_ABC_MC_WRG_IDX = 3;
NC_ABC_MC_WRG_RESP = 4;
NC_ABC_MC_NOT_DEC = 5;
NC_ABC_MC_PFM_0_TOG = 6;
NC_ABC_MC_PFM_1_TOG = 7;
NC_ABC_MC_PFM_2_TOG = 8;
NC_ABC_MC_PFM_3_TOG = 9;
NC_ABC_MC_PFM_4_TOG = 10;
NC_ABC_MC_PFM_5_TOG = 11;
NC_ABC_MC_PFM_6_TOG = 12;
NC_ABC_MC_PFM_0_RESP = 13;
NC_ABC_MC_PFM_1_RESP = 14;
NC_ABC_MC_PFM_2_RESP = 15;
NC_ABC_MC_PFM_3_RESP = 16;
NC_ABC_MC_PFM_4_RESP = 17;
NC_ABC_MC_PFM_5_RESP = 18;
NC_ABC_MC_PFM_6_RESP = 19;
/ Debounce mechanism: initial values for anti-bounce counters */*
NC_ABC_MC_HD_INI = 0;
NC_ABC_MC_CKS_INI = 0;
NC_ABC_MC_CONF_DIF_INI = 0;
NC_ABC_MC_WRG_IDX_INI = 0;
NC_ABC_MC_WRG_RESP_INI = 0;
NC_ABC_MC_NOT_DEC_INI = 0;
NC_ABC_MC_PFM_0_TOG_INI = 0;
NC_ABC_MC_PFM_1_TOG_INI = 0;
NC_ABC_MC_PFM_2_TOG_INI = 0;
NC_ABC_MC_PFM_3_TOG_INI = 0;
NC_ABC_MC_PFM_4_TOG_INI = 0;
NC_ABC_MC_PFM_5_TOG_INI = 0;
NC_ABC_MC_PFM_6_TOG_INI = 4;
NC_ABC_MC_PFM_0_RESP_INI = 0;
NC_ABC_MC_PFM_1_RESP_INI = 0;
NC_ABC_MC_PFM_2_RESP_INI = 0;
NC_ABC_MC_PFM_3_RESP_INI = 0;
NC_ABC_MC_PFM_4_RESP_INI = 0;
NC_ABC_MC_PFM_5_RESP_INI = 0;
NC_ABC_MC_PFM_6_RESP_INI = 0;
/ Debounce mechanism: increments for anti-bounce counters */*
NC_ABC_MC_HD_INC = 2;
NC_ABC_MC_CKS_INC = 2;
NC_ABC_MC_CONF_DIF_INC = 2;
NC_ABC_MC_WRG_IDX_INC = 2;
NC_ABC_MC_WRG_RESP_INC = 2;
NC_ABC_MC_NOT_DEC_INC = 2;
NC_ABC_MC_PFM_0_TOG_INC = 2;
NC_ABC_MC_PFM_1_TOG_INC = 2;
NC_ABC_MC_PFM_2_TOG_INC = 2;
NC_ABC_MC_PFM_3_TOG_INC = 2;
NC_ABC_MC_PFM_4_TOG_INC = 2;
NC_ABC_MC_PFM_5_TOG_INC = 2;
NC_ABC_MC_PFM_6_TOG_INC = 2;

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NC_ABC_MC_PFM_0_RESP_INC = 2;
NC_ABC_MC_PFM_1_RESP_INC = 2;
NC_ABC_MC_PFM_2_RESP_INC = 2;
NC_ABC_MC_PFM_3_RESP_INC = 2;
NC_ABC_MC_PFM_4_RESP_INC = 2;
NC_ABC_MC_PFM_5_RESP_INC = 2;
NC_ABC_MC_PFM_6_RESP_INC = 2;
/ Debounce mechanism: maximal values for anti-bounce counters */*
NC_ABC_MC_HD_MAX = 6;
NC_ABC_MC_CKS_MAX = 6;
NC_ABC_MC_CONF_DIF_MAX = 6;
NC_ABC_MC_WRG_IDX_MAX = 6;
NC_ABC_MC_WRG_RESP_MAX = 6;
NC_ABC_MC_NOT_DEC_MAX = 6;
NC_ABC_MC_PFM_0_TOG_MAX = 6;
NC_ABC_MC_PFM_1_TOG_MAX = 6;
NC_ABC_MC_PFM_2_TOG_MAX = 6;
NC_ABC_MC_PFM_3_TOG_MAX = 6;
NC_ABC_MC_PFM_4_TOG_MAX = 6;
NC_ABC_MC_PFM_5_TOG_MAX = 6;
NC_ABC_MC_PFM_6_TOG_MAX = 6;
NC_ABC_MC_PFM_0_RESP_MAX = 6;
NC_ABC_MC_PFM_1_RESP_MAX = 6;
NC_ABC_MC_PFM_2_RESP_MAX = 6;
NC_ABC_MC_PFM_3_RESP_MAX = 6;
NC_ABC_MC_PFM_4_RESP_MAX = 6;
NC_ABC_MC_PFM_5_RESP_MAX = 6;
NC_ABC_MC_PFM_6_RESP_MAX = 6;
/ Initial value for communication cycle counter for healing of reset counter */*
NC_CTR_COM_CYC_MC_DEC_RST_INI = 400; */* 190H */*
/ Maximal value for counter for disable request */*
NC_CTR_MU_DI_MAX = 6;
/ Value of reset counter to be sent to MU in case of a disable request */*
NC_CTR_RST_MC_DI = 15;
/ Number of communication cycles for temporary disabling after PREDRIVE communication */*
NC_CYCNR_MC_DR_DI_TMP = 50; */* 520ms of disabling in total */*
/ 10ms time between two communications */*
NC_T_MC_COM_CYC = 10;
/ Number of PFM tasks */*
NC_NR_MC_PFM = 7;
/ Number of PFM test cycle counters */*
NC_NR_MC_PFM_TCC = NC_NR_MC_PFM - 1;

/ Array containing the maximal number of communication cycles after which toggling of bits by the MU for the corresponding PFM tasks must have happened */*
NC_TCC_MC_PFM_TOG_MAX[NC_NR_MC_PFM_TCC] = [4, 8, 8, 8, 8, 8];
NC_TCC_MC_PFM_TOG_6_MAX = 428;
/ Initialisation value for the PFM synchronisation byte used for toggling by PFM service actions */*
NLF_MC_PFM_SYN_BYTE_INI = 37; */* 25H */*
/ FS-IST: maximal question/answer number */*
NC_TEST_REC_IDX_MAX_MON2 = 15;
/ FS-IST: array of expected questions */*

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NC_IDX_TEST_MC_FCT_SPC_IST[NC_TEST_REC_IDX_MAX_MON2] = [0, 33, 34, 3, 36, 5, 6, 39, 40, 9, 10, 43, 12, 45, 46];
/ FS-IST: array of corresponding answers */*
NC_IDX_RESP_MC_FCT_SPC_IST[NC_TEST_REC_IDX_MAX_MON2] = [19, 4, 21, 22, 7, 8, 25, 26, 11, 28, 13, 14, 31, 32, 49];
/ FS-IST: constant for invalid answer */*
NC_IDX_RESP_WRG_MC_FCT_SPC_IST = 62; */* 3EH */*
/ FS-IST: constant for invalid question number */*
NC_IDX_NR_WRG_MC_FCT_SPC_IST = 31;
/ FS-IST: value of test cycle counter when sending a wrong response shall be requested */*
NC_TCC_MC_IST_WRG_RESP_REQ = 1;
/ FS-IST: value of test cycle counter when reaction to wrong response shall be checked */*
NC_TCC_MC_IST_WRG_RESP_CHK = 3;
/ constant indicating a complement error of the value of the A/D conversion on the MC acquired in the infrastructure */*
NC_VP_MC_AN_DIG_MON_CPL_ERR = -0,000152587890625; */* FFFFH*/*

E.35.2 Project-specific configuration - Value assignment for configuration data

FUNCTION DESCRIPTION:

General information:

This section describes the value assignment for the project-specific configuration data of Processor Monitoring (e.g., configuration information for MU, etc.).

Value assignment for configuration data of Processor Monitoring:

/ Configuration */*
NLC_MU_MOD = 0; */* EMS */*
NLC_MU_IGN_KEY_ACQ = 1; */* HW acquisition */*
NLC_MU_POW_OFF_TMR_ENA = 0; */* POT inactive */*
NLC_MU_INJ_OFF_TMR_ENA = 1; */* IOT active */*
/ Common threshold for reset counter of MU and MC determining when error memory information shall be updated */*
NC_CTR_RST_THD_ERR_MEM = 1;
/ Maximal value for counter in check of MU readiness */*
NC_CTR_MU_READY_MAX = 3;

E.35.3 Project-specific configuration - Configuration of switch-off path check

FUNCTION DESCRIPTION:

General information:

This "sub-function" describes the configuration of the switch-off path check.

Description:

The function incorporates the following requirements:

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G27 Configuration of switch-off path check

R27_1: The following system configuration is assumed:

- the **MC is only connected to power stage 1 (H-bridge)**; the check result for its switch-off path to power stage 0 (injection) shall always be 0;
- the **MU is connected to both power stages 0 and 1**.

R27_2: There are two final results:

- "**no engine start**" with representation NC_STATE_RESP_SOPC_DFCT (00H = 0) which shall simply trigger a fault reaction of processor monitoring by calling ACTION_ECM3_McFaultReaction() with error code NC_ERR_COD_MC_SOPC
- "**engine start**" with representation NC_STATE_RESP_SOPC_OK (FFH = 255) which shall prompt no reaction, i.e., the system starts up as usual.

R27_3 : The SOPC threshold NC_CTR_RST_MC_THD_SOPC for the reset counter is set to 0: the lookup for the final result shall always be performed in NC_RESP_SOPC_2[].

R27_4: The values in the array NC_RESP_SOPC_2[] shall correspond to the following start-up behaviour:

Index	**MC**		**MU**		**Result**
	PWS0	**PWS1**	**PWS0**	**PWS1**	
0	0	0	0	0	**no start**
1	0	0	0	1	**no start**
2	0	0	1	0	**no start**
3	0	0	1	1	**no start**
4	0	1	0	0	**no start**
5	0	1	0	1	**no start**
6	0	1	1	0	**start**
7	0	1	1	1	**start**
8	1	0	0	0	**no start**
9	1	0	0	1	**no start**
10	1	0	1	0	**no start**
11	1	0	1	1	**no start**
12	1	1	0	0	**no start**
13	1	1	0	1	**no start**
14	1	1	1	0	**no start**
15	1	1	1	1	**no start**

In the above table, the first column represents the index IDX_STATE_SOPC, while the next 4 columns represent the feedback from the two power stages (in the way that they are used to obtain IDX_STATE_SOPC), and the last column described the entry in NC_RESP_SOPC_2[] at index IDX_STATE_SOPC.

R27_5: The MU-SPOC result for power stage 0 obtained before triggering the PREDRIVE communication has to be re-checked before triggering the first NORMAL communication: the status of this particular disable line can only be determined unequivocally if tested when disabled and enabled; this does not cause any conflict with the MC-part of the SOPC since the MC is not connected to power stage 0. The final check result of power stage 0 for the MU has to take into account both checks: only if the first result was "disabled" and the second was "enabled", the complete check was successful.

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Value assignment for configuration data of SOPC:

/ Size of arrays for switch-off path check */*
NC_NR_RESP_SOPC = 16;

```
/* always use NC_RESP_SOPC_2, never NC_RESP_SOPC_1 for lookup of the final result */
NC_CTR_RST_MC_THD_SOPC = 0;
/* SOPC result: no engine start possible */
NC_STATE_RESP_SOPC_DFCT = 0;
/* SOPC result regular engine start possible */
NC_STATE_RESP_SOPC_OK= 255;
/* not used: all entries are equal to NC_STATE_RESP_SOPC_DFCT */
NC_RESP_SOPC_1[NC_NR_RESP_SOPC] = [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]
/* see table and NCs for results above */
NC_RESP_SOPC_2[NC_NR_RESP_SOPC] = [0, 0, 0, 0, 0, 0, 255, 255, 0, 0, 0, 0, 0, 0, 0, 0]
/* Default value for IDX_STATE_SOPC: no switch-off path working */
NC_IDX_STATE_SOPC_DFCT = 0;
/* Diagnostic result from power stage "driver disabled" */
NC_STATE_RESP_DR_DI = 0;
/* Diagnostic result from power stage "driver enabled" */
NC_STATE_RESP_DR_ENA = 1;
/* Default diagnostic result from power stage ("status undefined") */
NC_STATE_RESP_DR_DFT = 3;
```

Application conditions

Initialisation: `/ * Using the RAM check service actions */`
`LV_MC_ST_LIH_SOPC = 0;`

Recurrence: *The* ***initialisation*** *shall be* ***executed after each power-up or reset.***

E.35.4 Project-specific configuration - Error memory service function

General information:

The function incorporates the following requirements:

G43 Error memory service function

The action ACTION_ECM3_McErrmService() shall be called when all the necessary information is available. When the action is called, it is first tested whether an update of the error history was performed right before the action was called. Since this is only done in case there currently is an error present, this means if no update was done the error symptom ERR_SYM_MON_3 can be set to "NO_SYM"; ERR_SYM_MON_3 consists of four bits:

Bit3 (SYM_3)	Bit2 (SYM_2)	Bit1 (SYM_1)	Bit0 (SYM_0, LSB)
8	4	2	1
FS-IST error on MU	SOPC error/ unspecific level 3 error	RAM error on MC	ROM error on MC

For every fault, environmental conditions are stored in the environmental data variables ENVD_x_MON_3; the stored content is chosen to help analysing the fault scenario afterwards; more information can be found in the formula section below.

Application conditions

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Initialisation:

```
/ * Initialise the interfaces to ERRM */
LV_ERR_MON_3 = 0;
LV_CDN_DIAG_MON_3 = 0;
LV_END_DIAG_MON_3 = 0;
ERR_SYM_MON_3 = NO_SYM / * No symptom */ ;
ENVD_0_MON_3 = 0;
ENVD_1_MON_3 = 0;
ENVD_2_MON_3 = 0;
ENVD_3_MON_3 = 0;
```

Recurrence: *The* ***initialisation*** *shall be* ***performed after each power-up and reset*** *and* ***at FMY reset.***

Activation: *This* ***sub-function*** *is* ***called.***

Description of ACTION_ECM3_McErrmService

Description:

Syntax: ACTION_ECM3_McErrmService(
IN <cpt_act>,
IN <err_cod_act>,
IN <err_idc_act>,
IN <ctr_rst_act>,
IN <cpt_old>,
IN <err_cod_old>,
IN <err_idc_old>,
IN <ctr_rst_old>
)

Parameter (IN): cpt_act component for current error information (1=MC, 0=MU)
Parameter (IN): err_cod_act current error code
Parameter (IN): err_idc_act current error indication
Parameter (IN): ctr_rst_act current value of reset counter
Parameter (IN): cpt_old component for previous error information (1=MC, 0=MU)
Parameter (IN): err_cod_old previous error code
Parameter (IN): err_idc_old previous error indication
Parameter (IN): ctr_rst_old previous value of reset counter
Short description: This action receives the current error history and provides the interface to the error memory management.

Formula section:

IF ((ctr_rst_act > 0) **OR** ((cpt_act = 0) **AND** ("err_cod_act indicates voltage monitoring error"))) */* reset counter of current error greater than 0* ***OR*** *current error is an MU error and the current error is a voltage monitoring error */*
THEN
ACTION_SetRstInfo_Ecm3; */* set reset-cause -> RST_DET */*
FI
IF (LV_ERR_MON_3 = 1) */* previously detected an error */*
THEN */* Initialise data to be able to potentially update the error symptom */*
LV_ERR_MON_3 = 0;
ERR_SYM_MON_3 = NO_SYM;
LV_CDN_DIAG_MON_3 = 1;
LV_END_DIAG_MON_3 = 1;

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Deliver the result to Error Management;
FI
IF ("no update of the error history has been performed before this call")
/ can be checked by comparing env. data to actual parameters */*
THEN
ERR_SYM_MON_3 = NO_SYM;
/ Otherwise attempt to set filtered error information ERR_SYM_MON_3 according evaluation of the given parameters */*
ELSEIF ((cpt_act = 1) **AND** (ctr_rst_act > NC_CTR_RST_THD_ERR_MEM))
/ current error is an MC error and reset counter above threshold */*
THEN
IF ("err_cod_act indicates a ROM error (level 1 or level 2)")
THEN
ERR_SYM_MON_3 = SYM_0; */* ROM error on MC */*
ELSEIF ("err_cod_act indicates a RAM error (level 1 or level 2)")
THEN
ERR_SYM_MON_3 = SYM_1; */* RAM error on MC */*
LV_ERR_RAM_MON_3 = 1;
ELSE */* Unspecific error */*
ERR_SYM_MON_3 = SYM_2
FI
ELSEIF ((cpt_act = 0) **AND** ((ctr_rst_act > NC_CTR_RST_THD_ERR_MEM) **OR** ("err_cod_act indicates **over-voltage** ")) */* current error is an MU error and reset counter above threshold OR* ***over-voltage was detected*** **/*
THEN
IF ("err_cod_act indicates FS-IST error detected by the MU")
THEN
ERR_SYM_MON_3 = SYM_3; */* FS-IST error on MU */*
ELSE
ERR_SYM_MON_3 = SYM_2; */* unspecific error */*
FI
FI
/ Now flags for error memory management can be set */*
IF (ERR_SYM_MON_3 = NO_SYM)
LV_ERR_MON_3 = 0; */* no error is present */*
ELSE
LV_ERR_MON_3 = 1; */* error signaled by ERR_SYM_MON_3 is present */*
/ Set environmental data, see table for exact bit positions */*
ENVD_0_MON_3 = "combine cpt_act, err_idc_act and err_cod_act into one byte";
ENVD_1_MON_3 = ctr_rst_act; */* this could include encoded additional information */*
ENVD_2_MON_3 = "combine cpt_old, err_idc_old and err_cod_old into one byte";
ENVD_3_MON_3 = ctr_rst_old; */* this could include encoded additional information */*

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<table>
<tr><th></th><th>Bit 7</th><th>Bit 6</th><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td>ENVD_0_MON_3</td><td><u>Current error</u>:
0 for MU error
1 for MC error</td><td colspan="2"><u>Current error</u>:
error indication
0 = no error
1 = restart request
2 = DISABLE request
3 = restart was requested</td><td colspan="5"><u>Current error</u>:
error code (see tables in "Processor monitoring general")</td></tr>
<tr><td>ENVD_1_MON_3</td><td colspan="4"><u>Current error</u>:
additional information (test results of switch-off paths, encoded wrong header byte, ABC status, cf. G41 "Update of error memory information with MC data")</td><td colspan="4"><u>Current error</u>:
reset counter</td></tr>
<tr><td>ENVD_2_MON_3</td><td><u>Old error</u>:
0 for MU error
1 for MC error</td><td colspan="2"><u>Old error</u>:
error indication
0 = no error
1 = restart request
2 = DISABLE request
3 = restart was requested</td><td colspan="5"><u>Old error</u>:
error code (see tables in "Processor monitoring general")</td></tr>
<tr><td>ENVD_3_MON_3</td><td colspan="4"><u>Old error</u>:
additional information (test results of switch-off paths, encoded wrong header byte, ABC status, cf. G41 "Update of error memory information with MC data")</td><td colspan="4"><u>Old error</u>:
reset counter</td></tr>
</table>

FI
LV_CDN_DIAG_MON_3 = 1;
LV_END_DIAG_MON_3 = 1; **{** *Diagnosis is finished* **}**
Deliver the result to Error Management;

E.35.5 Project-specific configuration - Initialisation of power stages after disabling by Processor Monitoring

FUNCTION DESCRIPTION:

General information:

Not used since this is done via polling in the relevant functions.

E.35.6 Project-specific configuration - Project-specific transition condition for the transition from INIT to CONFIG state

FUNCTION DESCRIPTION:

General information:

In order to prevent a start of Processor Monitoring SW while the "environmental condition" inside the ECU (e.g., the supply voltage for the H-bridge, which is supplied via the main relay) are not yet in a defined state, the transition from INIT to CONFIG (where the first communication is performed) can only be performed under specific conditions.

This functions describes a project-specific condition for the transition to be possible; other (generic) conditions might be defined in other specifications.

Description:

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This function incorporates the following requirements:

G52 Project-specific transition condition for the transition from INIT to CONFIG state

R52_1: If LV_DIAG_END_RLY_MAIN_DLY = 1 **AND** LV_RLY_MAIN_DLY_ERR = 0, the transition from INIT to CONFIG shall be possible.

R52_2: Otherwise, the transition shall not be possible.

Application conditions

Initialisation: –

Recurrence: *The* ***function*** *shall be* ***called by G51 "State machine on MC" for deciding if the transition from INIT to CONFIG can be performed.***

Activation: *STATE_MC = NC_STATE_MC_INI* (only active in INIT state)

Deactivation: *Otherwise*

E.35.7 Project-specific configuration - Acquisition of ignition key information on MC

FUNCTION DESCRIPTION:

General information:

In each NORMAL and DISABLE communication, the MC sends information about the status of the ignition key signal to the MU.

Usually, the ignition key information on the MC is available in LV_IGK; however, in some instances, a pre-processing step could possible/necessary (e.g., if the signal is available redundantly, it can be checked for plausibility and then the monitored value can be sent to the MU; another application could be to return the MU value in HW acquisition mode back to the MU so that only the pin value on the MU will determine the MU-internal ignition key information).

To support any such pre-processing, this project-specific function allows to freely define the value of LV_MC_IGN_KEY before it is sent to the MU.

Description:

This function incorporates the following requirements:

G54 Acquisition of ignition key information on MC

R54_1: The value of LV_MC_IGN_KEY shall be obtained by copying LV_MU_IGN_KEY.

Application conditions

Initialisation: *LV_MC_IGN_KEY = 0*

Recurrence: The **initialisation** shall be **performed after each power-up and reset.**

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The **function itself** shall be activated before G25 in NORMAL and DISABLE.

Activation: *(STATE_MC = NC_STATE_MC_NORM)* ***OR*** *(STATE_MC = NC_STATE_MC_DI)*

(active in NORMAL and DISABLE state)

Deactivation: Otherwise

Formula section:

/ send back MU value to MU to avoid problems with wrong detection thresholds */*
LV_MC_IGN_KEY = LV_MU_IGN_KEY

E.35.8 Project-specific configuration - Extension of power-latch phase for Standard ROM check

FUNCTION DESCRIPTION:

General information:

Since the Standard ROM check (G8.1) is calculated in the background, it is not pre-determined how long it will take to complete; however, there is the requirement that the ROM check has to be completed at least once per driving cycle. Consequently, in order to fulfil the mentioned requirement, the power latch phase (the phase after the ignition has been switched off, KL15 = 0, but before the ECU is switched off) shall be extended variably for (at least) as long the duration of one complete checksum calculation.

Description:

This function incorporates the following requirements:

G64 Extension of power-latch phase for Standard ROM check

Application conditions

Initialisation: –

Recurrence: *The **function itself** shall be activated via the action exported calls ACTION_ECM3_McLockPwlResources() and ACTION_ECM3_McUnlockPwlRes*

Description of ACTION_ECM3_McLockPwlResource

Description:

Syntax: ACTION_ECM3_McLockPwResource()

Formula section:

"set power-latch lock condition corresponding to NC_PWL_LOCK_CDN_ROM_CHK in PWL_LOCK_CDN"

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Description of ACTION_ECM3_McUnlockPwlResource

Description:

Syntax: ACTION_ECM3_McUnlockPwResource()

Formula section:

"reset power-latch lock condition corresponding to NC_PWL_LOCK_CDN_ROM_CHK in PWL_LOCK_CDN"

E.35.9 Project-specific configuration - Handling of injection-off timer functionality

FUNCTION DESCRIPTION:

General information:

The injection-off timer inside the MU can disable the injection power stage. This fact shall be indicated to other SW parts via the flag LV_INJ_OFF_TMR_INJ_ENA.

Description:

This function incorporates the following requirements:

G65 Handling of injection-off timer functionality

R65_1: The value of LV_INJ_OFF_TMR_INJ_ENA shall be obtained by checking a 0->1 transition of LV_MU_IGN_KEY between the last two recurrences, see formula section below (*due to unreliable disable information from the MU, the only reliable decision base is the ignition key information*).

NOTE: the ignition key signal is already low while the timer is active but not yet disabling the injection so the injection will be disabled immediately after the 1->0 transition of the ignition key signal!
NOTE: this is only a temporary solution and should be changed once the latest version of the MU is consistently used in the HW; then it will be sufficient to copy the value of LV_INJ_OFF_TMR_ENA_INJ_TMP to LV_INJ_OFF_TMR_ENA_INJ!

Application conditions

Initialisation:
```
LV_INJ_OFF_TMR_ENA_INJ = 0
   LV_MU_IGN_KEY_OLD = 0
```

Recurrence: The **initialisation** shall be **performed after each power-up and reset.**
The **function itself** shall be activated after G22.

Activation:
```
 (STATE_MC = NC_STATE_MC_CONF)
 OR   (STATE_MC = NC_STATE_MC_PRDR)
OR   (STATE_MC = NC_STATE_MC_NORM)
/ * only active in CONFIG; PREDRIVE, or NORMAL state */
```

Deactivation: *otherwise* / * inactive in INIT and DISABLE state: here, LV_ERR_TMP_MU_MC is set anyway and so the power stages are disabled regardless of the IOT */

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Formula section:

/ Enable injection if value of ignition key signal on MU, LV_MU_IGN_KEY, of current and last recurrence is high because then the IOT has been reliably reset inside the MU (wait-state needed due to delay stemming from SPI communication) */*
LV_INJ_OFF_TMR_INJ_ENA = LV_MU_IGN_KEY_OLD **AND** LV_MU_IGN_KEY;
/ Save current value for next recurrence */*
LV_MU_IGN_KEY_OLD = LV_MU_IGN_KEY;

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E.36 Processor monitoring general

E.36.1 System Overview

Based on the recommendations of the VDA (as expressed in the version 2.0 of the paper of the VDA ETC working group "Arbeitskreis EGAS"), the monitoring concept for electronic control units (ECUs) uses three levels; this document provides a more detailed description of the *processor monitoring* level (level 3 in VDA terms).

Based on the VDA guidelines, the processor monitoring level consists of two *separate* hardware components: the main controller (MC) and the monitoring unit (MU). The former is generally realised by a micro controller (µC), while the latter might just as well be realised by an application-specific integrated circuit (ASIC), i.e., some specifically designed piece of hardware; this MU is almost exclusively used for processor monitoring functionality (the only exception is the A/D converter on the MU which is used for the monitoring of the A/D conversion on the MC; this functionality is as such not part of the processor monitoring but of the process monitoring, or "level 2" in VDA terms).

The monitoring concept described here is *generic* in the sense that it works regardless of how the MU is realised in terms of actual hardware (µC vs. ASIC), and for both engine management systems (EMSs) for gasoline/diesel engines and transmission control units (TCUs).

The two system components, MC and MU, *mutually* monitor each other (just to be clear about the fact that not only the MU monitors the MC). For instance, assume that there is a failure in the calculations of the ALU (arithmetic logic unit) of the MC. This could produce potentially dangerous results: e.g., due to a faulty calculation, the ECU might increase the engine speed too much for the driver to control the car. Additionally, the MC itself might not be able to detect such a fault and react appropriately (e.g., perform a reset, or switch off the engine): after all, it cannot even be guaranteed that the processor notices the fault, a (from the external point of view) faulty processor might internally believe that the system, including itself, is functioning correctly.

In order to be able to detect such a case, the MU provides an *independent* (hardware) instance which can judge (as far as it is safety-relevant) whether the behaviour of the MC is appropriate according to actual environment conditions and demands (like the driver s wish expressed, e.g., in terms of pushing the accelerator pedal); the behaviour of the MU, in turn, is then monitored by the MC in order to ascertain that the MU is still able to perform its monitoring duties.

All of these mutual monitoring activities are achieved by means of a repeated *question and answer* (Q& A) game: the MU sends questions to the MC, and the MC sends back the respective answers. Based on the quality of the sent questions and received answers, *both* components can tell whether the respective other component is still working correctly.

If there are faults detected while the ECU is running (by whatever means available), appropriate fault reactions are carried out, either by the MC or by the MU, whichever detects the error. As most of the monitored functionalities are safety-critical, such fault reactions or processor monitoring necessitate (at least temporarily) disabling of the safety-relevant power stages in order to reach the so-called *safe state*. In order to be able to perform this type of fault reaction, there have to be corresponding connections (*switch-off paths*) on the hardware level between MC/MU and the relevant power stages (e.g., H-bridge and injectors for gasoline engines). Note that, if the MU detects a fault on the MC, disables the power stages, and triggers a reset of the MC (the standard fault reaction), this reset is then fed back from the MC to the MU so that the *complete* system is restarted (potentially utilising external components like, e.g., power supply).

It should be stressed at this point that, as far as safety is concerned, the **primary goal** of the **fault reaction** is to **disable the power stages**: this prevents an error to result in an undesired acceleration

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of the car (or, correspondingly, unwanted shifting of gears or erroneous opening/closing of the clutch in TCU applications). The fact that (up to a certain maximal number) a reset is triggered after this disabling is only done in order to increase the **availability** of the car (i.e., to potentially enable the driver to continue his driving relatively undisturbed without having to use the ignition key)!

Coming back to the main task of processor monitoring, in order to set up the aforementioned Q& A game, the two components need to exchange data: this *communication interface* is usually implemented in the form of the S*erial* P*eripheral* I*nterface* (SPI). In this way, MC and MU *synchronise* their progress and, in doing so, can monitor the performed actions.

As an immediate consequence of the separation on the hardware level, since each component has its own parameter memory for variables and is running its own algorithms (in case the MU is realised by an ASIC, this refers to the circuitry that is hard-wired into the chip), variables on the MU are, a priori, not visible (i.e., available) on the MC, and vice versa, unless they are specifically transferred to the other component via the communication interface: variables are *local* to the MU or the MC. Moreover, even after being transmitted from one component to the other, variables on the MC and the MU will usually have different names since the communication is based on *values*, not *names* (despite containing the same values!), and variable names reflect the content of the variables, which can very well be different on MC and MU.

It should furthermore be noted that any value exchanged between MC and MU can always only be a *snapshot* of a variable since it can only contain the actual value of the variable *at the time of the transmission*: consider the case a variable X is sent from the MU to the MC at a certain time t; if the variable is changed on the MU at time t+1, this update stays *local to the MU* in the sense that the MC only notices it if the changed X is re-transmitted to the MC after the update.

From a functional point of view, the main purpose of the processor monitoring is to monitor the proper functioning of the MC, thereby, continuing the layer-approach of the over-all system design (level 1 contains engine control functions and their diagnoses, level 2 monitors these functions and diagnoses by re-calculating the necessary values in an independent way to provide a means of judging their plausibility), in particular and most importantly, ensuring the proper functioning of the process monitoring. From this approach, the following main objectives of processor monitoring are derived:

- *memory checks on MC* (both RAM and ROM);
- *memory checks on MU* (RAM and ROM); this depends on the hardware realisation of the MU; on an ASIC, a RAM check shall be performed as usual; however, in place of a ROM check, there shall be a built-in self test (BIST) which tests the proper functioning of certain parts of the circuitry (mostly those parts responsible for triggering a fault reaction);
- *switch-off path check*: after each (re-)initialisation of the system, it must be checked whether the switch-off paths of the system work properly, viz., whether they can actually switch off the safety-relevant power stages should there be the need to do so later on;
- *program flow monitoring (PFM)*: it shall be checked that (monitoring-relevant) tasks (of level 2) on the MC are performed in the correct order and with the correct timing; here, task refers to a given and fixed sequence of modules running in the same nominal time grid (i.e., functionally connected parts of processor monitoring);
- *function-specific instruction set test (FS-IST)*: it shall be tested whether the processor correctly performs the (monitoring-relevant) calculations needed for the process monitoring on the MC; this shall be achieved by performing a number of *test calculations*; in order to avoid any effects of these (additional) test calculations on the actual monitoring functionality (and in line with VDA requirements), these test calculations are performed by a *copy* of some of the (monitoring-relevant) parts of the process monitoring located in separate memory on the MC which (being a copy of level 2 functionality) is also known as *level 2* (L2).

Note that PFM and the FS-IST complement each other to achieve as complete a monitoring of the processor functionality as possible: while PFM checks whether the necessary tasks are executed in the correct order and with the *correct timing*, the FS-IST additionally checks that the required *calculations are performed correctly* (so that the tasks can properly execute and calculate the right result

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- provided the employed algorithm is correct and correctly implemented: both PFM and L2 can only achieve formal or syntactic correctness, semantic correctness lies in the hands of the developer and cannot be tested (in this way)!).

A schematic overview of the system is presented in the following figure Sketch of processor monitoring with two power stages, including the required disable lines from the MC and the MU to the power stages; note that this picture does not include the redundant analogue input signal based on which the A/D conversion on the MU is performed and then sent to the MC in order to determine proper functioning of the A/D converter on the MC (by comparing the conversion result sent by the MU with the result obtained on the MC).

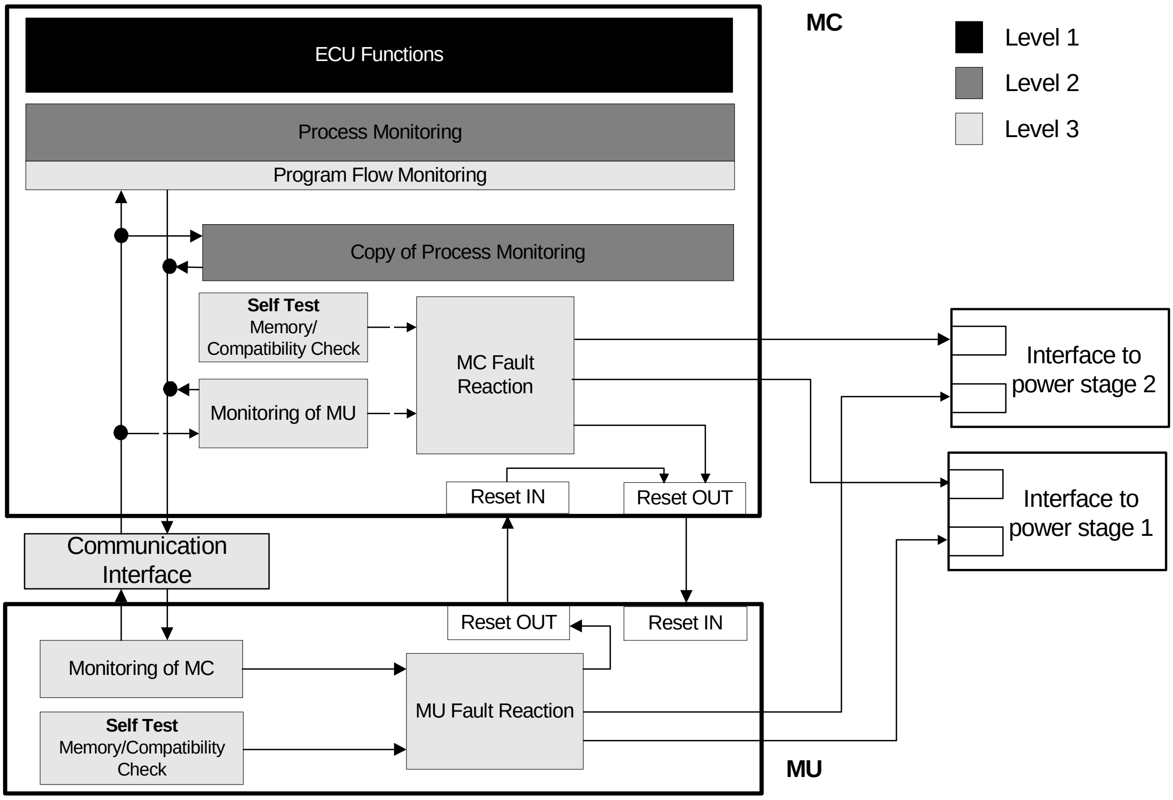

Figure 1: Sketch of processor monitoring with two power stages

E.36.2 States of the Components

The behavior of both components of the processor monitoring (i.e., MC and MU) is described by two *autonomous* state machines, reflecting the fact that both constitute separate components of a distributed system and as such should really have a separate state space.

Even so, the structure of the two state machines is basically identical, mostly because the two components have a common task, viz., perform the processor monitoring. Nevertheless, as the two parts run independently of each other, both could be in mismatching states; it is the task of the communication interface to prohibit such cases by ensuring that the components *synchronously* progress through their states in the correct order. The exception to this rule is the DISABLE state which is entered after a fault was detected (on the component which detected the fault); this knowledge can then only be propagated to the other component by means of a communication, e.g., it can be the case that, for one communication cycle, the MU is in DISABLE while the MC is still in NORMAL (after the next communication, the MC will also go to DISABLE).

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The basic layout of the two state machines is described the figure State machine layout. The figure contains the basic transitions sequence through the different states. We shall now describe the actions which are performed in each of the states (for the time being without distinguishing between which actions are performed on MC and MU, respectively). Communications between MC and MU are an integral part of the system s functionality and, in any case, information about the current state of a component is always part of the data exchanged by the communications.

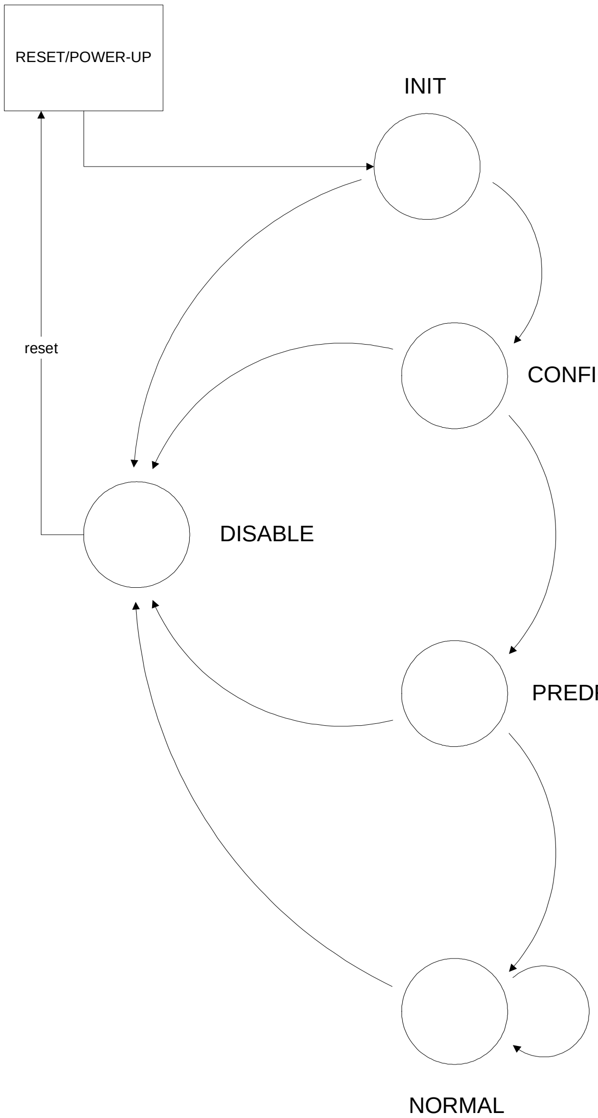

Figure E.36.1: : State machine layout

E.36.2.1 The INIT state

As indicated by its name, the INIT state is the initial state of the state machine, i.e., always after power-up or a reset, start-up tasks like data initialisation and several self tests on both MC and MU are performed in INIT. Note that there is *no* communication performed while the two components are in their respective INIT states.

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E.36.2.2 The CONFIG state

In the error free case, the next state is the CONFIG state which is mainly used to prepare and perform the first communication between MC and MU; consequently, the tasks carried out in this state are to prepare the communication, wait for it, and afterwards evaluate the received data. The exchanged data include error codes and reset counters, together with configuration and compatibility data; this communication is usually referred to as the CONFIG communication because if everything is working normally, both components will be in their respective CONFIG states.

E.36.2.3 The PREDRIVE state

In the PREDRIVE state, another communication (the PREDRIVE communication) is performed which serves the purpose to initialise the PFM (see section Program Flow Monitoring for both MC and MU) and the FS-IST (see module Function-Specific Instruction Set Test on both MC and MU) with the necessary data; also the configuration data transferred in the previous communication is sent back in order to double-check correct reception; additionally, from this state onwards, the monitored A/D conversion values are transferred from the MU to the MC so that the value obtained on the MC can be checked against the conversion values (of the same signal!) from the MU.

E.36.2.4 The NORMAL state

The NORMAL state is the state which is reached when all the previous actions (including communications) were performed successfully; it represents a properly functioning system. Since there are several tasks which have to be continuously performed (e.g., PFM, FS-IST), there are ongoing communications (NORMAL communication) in the NORMAL state which continue the exchange of the necessary data for such continuous tasks.

E.36.2.5 The DISABLE state

The DISABLE state is reached if an error occurs during any the actions in the other states, see Figure 2; such errors include communication errors or errors detected during the Switch-off Path Check (see section Switch-Off Path Check). Consequently, since the system is malfunctioning, *the power stages are disabled*, by the component that enters its respective DISABLE state. In a corresponding communication (DISABLE communication), error information (like reset counters and error codes) are then exchanged.

E.36.3 Communication protocol between MC and MU

In the following, the communication protocol between MC and MU shall be described where the communications in each state are described on after the other.

The description for each communication is given in such a way that always the data flow in both directions (MC to MU, and MU to MC) is depicted in a separate column.

Note that in following description of the communication protocol, all variables are named as they are known on the MC, the MU is regarded as a black-box.

A row in the tables corresponds to one byte, and where more than one data is sent in one byte together this indicated accordingly (e.g., in the CONFIG state communication, ERR_COD_MC and STATE_ERR_IDC_MC are sent in a combined form as byte1 of the data sent from the MC to the MU).

The first byte of each communication in both directions is always a header byte reflecting the internal state of the sending component.

The last byte of each communication in both directions is always the (XOR) checksum of the previous 5 bytes (incl. header-byte) to detect communication errors.

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E.36.3.1 CONFIG state communication

MC → MU	MU → MC
NC_STATE_MC_CONF	NC_STATE_MC_CONF
STATE_ERR_IDC_MC, ERR_COD_MC **(P)**	ERR_COD_MU, STATE_ERR_IDC_MU **(P)**
CTR_RST_MC **(P)**	LV_V_L_DET_MU, LV_V_H_DET_MU CTR_RST_MU **(P),**
<u>Configuration data 1:</u> NLC_MU_MOD NLC_MU_IGN_ACQ NLC_MU_INJ_OFF_TRM_ENA NLC_MU_POW_OFF_TRM_ENA <u>Configuration data 2:</u> 0 **(P)**	NR_MU_COMP, NR_MU_HW_VERS
Complement of configuration data 1 and 2 **(P)**	Empty (0x00)
Checksum	Checksum

(P) = Due to the high importance of the information, these data bytes are protected by a parity bit. A parity error (odd instead of even parity) is regarded as a communication error, see "G- Parity-bit checking."

- MC and MU exchange error codes, error indications, and reset counters (the error code and error indication of the MU are sent as LF_MU_ERR_BYTE and then "decoded" to ERR_COD_MU and STATE_ERR_IDC_MU).
- The flags LV_V_L_DET_MU and LV_V_H_DET_MU are set if under- or over-voltage, respectively, has been detected on the MU.
- Based on the compatibility information NC_MU_COMP and HW version NC_MU_HW_VERS which is sent by the MU, the MC can check whether its software is compatible to the MU.
- By sending configuration data 1 and 2 during the CONFIG communication, the MU is configured by the MC: monitoring an EMS or a TCU; the acquisition of the ignition key signal can be configured to HW or SW mode; the IOT and POT functionality can be enabled; the 0 in Configuration data 2 stands for not performing EOLT.

E.36.3.2 PREDRIVE state communication

MC → MU	MU → MC
NC_STATE_MC_PRDR	NC_STATE_MC_PRDR
NR_MC_COMP	LF_MC_RCV_PFM_BYTE
Empty (0x00)	LV_MU_DI_OUT_0, LV_MU_DI_OUT_1, IDX_TEST_RCV_MC_FCT_SPC_IST
<u>Configuration data 1:</u> NLC_MU_MOD, NLC_MU_IGN_ACQ, NLC_MU_INJ_OFF_TRM_ENA, NLC_MU_POW_OFF_TRM_ENA <u>Configuration data 2:</u> 0 **(P)**	LV_MU_IGN_KEY, LF_MU_CONF_BYTE_PRDR (combining Configuration data 1 and Configuration data 2)
Complement of configuration data 1 and 2 **(P)**	VP_MU_AN_DIG_MON
Checksum	Checksum

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(P) = Due to the high importance of the information, these data bytes are protected by a parity bit. A parity error (odd instead of even parity) is regarded as a communication error, see "G- Parity-bit checking."

- The MU sends the first PFM synchronisation byte LF_MC_RCV_PFM_BYTE, the first FS-IST question IDX_TEST_RCV_MC_FCT_SPC_IST, and the converted analogue value VP_MU_AN_DIG_MON.
- The configuration data 1 and 2 are confirmed by the MC: now the MU is completely configured.
- To ensure that the MU is always working in the correct mode, it reads back all of its internally stored configuration data and sends it back to the MC as LF_MU_CONF_BYTE_PRDR.
- Based on the compatibility information NR_MC_COMP sent by the MC, the MU can check whether it is compatible to the MC.
- The MU shall send the status of its disable outputs in LV_MU_DI_OUT_0 and LV_MU_DI_OUT_1.
- The MU sends the latched valued of its input for the ignition key signal as LV_MU_IGN_KEY (regardeless of whether it was configured for SW or HW acquisition of said signal).

E.36.3.3 NORMAL state communication

MC → MU	MU → MC
NC_STATE_MC_NORM	NC_STATE_MC_NORM
LF_MC_RESP_PFM	LF_MC_RCV_PFM_BYTE
LV_MC_DR_OFF, LV_IGK, IDX_RESP_TRM_FCT_SPC_IST	LV_MU_DI_OUT_0, LV_MU_DI_OUT_1, IDX_TEST_RCV_MC_FCT_SPC_IST
Empty (0x00)	LV_MU_IGN_KEY, LF_MU_CONF_BYTE_NORM, ABC_RCV_MC_FCT_SPC_IST
Empty (0x00)	VP_MU_AN_DIG_MON
Checksum	Checksum

- The MU keeps on sending FS-IST questions IDX_TEST_RCV_MC_FCT_SPC_IST, and additionally the FS-IST anti-bounce counter ABC_RCV_MC_FCT_SPC_IST, and the monitored analogue value VP_MU_AN_DIG_MON.
- LF_MC_RCV_PFM_BYTE is either an updated PFM synchronisation byte or a status byte where a set bit indicates that the corresponding PFM anti-bounce counter on the MU has value >0.
- The MC sends the PFM answer byte LF_MC_RESP_PFM and the FS-IST answer IDX_RESP_TRM_FCT_SPC_IST.
- Additionally, it is indicated whether wrong FS-IST answers are sent because the redundant switch off path is activated via the flag LV_MC_DR_OFF.
- As the information whether the ignition key is switched on or off is important information, as it is used to determine whether the injection will be switched off (via the IOT), the MC sends its information LV_IGK to the MU.
- If the ignition key is connected to the CAN bus, the state of the ignition key cannot be acquired by the MU. In this case the IGK acquisition of the MU must be configured to software acquisition, i.e., LV_IGK is used to determine whether the IOT or the POT has to be started.
- To ensure that the MU is always working in the correct mode, it reads back its internally stored configuration data 1 and sends it back to the MC in the form of LF_MU_CONF_BYTE_NORM.
- The MU shall send the status of its disable outputs in LV_MU_DI_OUT_0 and LV_MU_DI_OUT_1.
- The MU sends the latched valued of its input for the ignition key signal as LV_MU_IGN_KEY (regardeless of whether it was configured for SW or HW acquisition of said signal).

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E.36.3.4 DISABLE state communication

MC → MU	MU → MC
NC_STATE_MC_DI	NC_STATE_MC_DI
STATE_ERR_IDC_MC ERR_COD_MC **(P)**	LF_MU_ERR_BYTE **(P)** (Combining ERR_COD_MU and STATE_ERR_IDC_MU)
LV_IGK CTR_RST_MC **(P)**	CTR_RST_MU **(P)**
Empty (0x00)	LV_MU_IGN_KEY
Empty (0x00)	VP_MU_AN_DIG_MON
Checksum	Checksum

(P) = Due to the high importance of the information, these data bytes are protected by a parity bit. A parity error (odd instead of even parity) is regarded as a communication error, see "G- Parity-bit checking."

- MC and MU exchange error codes, error indications, and reset counters (the error code and error indication of the MU are sent as LF_MU_ERR_BYTE and then "decoded" to ERR_COD_MU and STATE_ERR_IDC_MU).
- The MC sends its value of the ignition key signal, so does the MU.
- The MU sends the monitored analogue value VP_MU_AN_DIG_MON.

E.36.4 Table of error codes of MC and MU

The following table shows the meanings of the different error codes of MC in order to make it easier to analyse them in case of an error detected by Processor Monitoring.

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Value	ERR_COD_MC	ERR_COD_MU
0	No error	No error
1	Header-byte error detected on MC	Header-byte error detected on MU
2	Checksum error detected on MC	Checksum error detected on MU
3	Parity error detected on MC	Parity error detected on MU
4	Wrong configuration data sent by MU	Wrong configuration data sent by MC
5	Error in switch-off path check	Error in complement check of configuration data
6	Error in compatibility check on MC	Error in compatibility check on MU
7	Error in Standard ROM check	Communication maximum time-out monitoring
8	Error in Standard RAM check	Communication minimum time-out monitoring
9	Error in Level 2 ROM check	Error detected by ignition key monitoring on MU
10	Error in Level 2 RAM check	NORMAL instead of EOLT header received
11	FS-IST: MU sent wrong question	FS-IST: MC sent wrong answer
12	FS-IST: MU does not react to deliberately wrong answer	Redundant switch-off path hsa been triggered
13	FS-IST: MU does not decrease its FS-IST anti-bounce counter	MU has detected under-voltage
14	Error in check of MU readiness	MU has detected over-voltage
15	- *(not used)*	MU has detected under- and over-voltage
16	PFM: MU does not toggle PFM bit 0 in time	PFM task 0 executed to slowly on MC
17	PFM: MU does not toggle PFM bit 1 in time	PFM task 1 executed to slowly on MC
18	PFM: MU does not toggle PFM bit 2 in time	PFM task 2 executed to slowly on MC
19	PFM: MU does not toggle PFM bit 3 in time	PFM task 3 executed to slowly on MC
20	PFM: MU does not toggle PFM bit 4 in time	PFM task 4 executed to slowly on MC
21	PFM: MU does not toggle PFM bit 5 in time	PFM task 5 executed to slowly on MC
22	PFM: MU does not toggle PFM bit 6 in time	PFM task 6 executed to slowly on MC
23	Invalid state transition or undefined state on MC	Invalid state transition or undefined state on MU
24	PFM: MU does not react to deliberately wrong PFM bit 0	- *(not used)*
25	PFM: MU does not react to deliberately wrong PFM bit 1	- *(not used)*
26	PFM: MU does not react to	- *(not used)*

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	deliberately wrong PFM bit 2	
27	PFM: MU does not react to deliberately wrong PFM bit 3	- *(not used)*
28	PFM: MU does not react to deliberately wrong PFM bit 4	- *(not used)*
29	PFM: MU does not react to deliberately wrong PFM bit 5	- *(not used)*
30	PFM: MU does not react to deliberately wrong PFM bit 6	- *(not used)*
31	- *(not used)*	- *(not used)*

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E.37 Switch off path check

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IDX_STATE_SOPC	O/V/S	0... FH	0... 15	1	-
Index into lookup table to determine the final result of the SOPC (stored in reset-safe manner)					
IDX_STATE_SOPC_CPL	O/S	0... FH	0... 15	1	-
Complement of IDX_STATE_SOPC (stored in reset-safe manner)					
LV_MC_SOPC_ACT	O/V	0... 1H	0 ...1	1	-
Flag indicating whether MC SOPC is still active (=1, i.e., not finished) or not (=0)					
LV_MC_SOPC_INH_DI	O/V	0... 1H	0 ...1	1	-
Flag indicating to other functions not to disable the power stages via HW disable lines because the MU-part of the SOPC is active					
LV_MC_SOPC_INH_DI_CPL	O	0... 1H	0 ...1	1	-
Complement of LV_MC_SOPC_INH_DI					
STATE_MC_RESP_SOPC	V	0... FFH	0... 255	1	-
Local variable: final result of the SOPC					

Input data:

CTR_RST_MC {p. 7072}	CTR_RST_MC_CPL {p. 7072}	LV_MC_INH_SOPC {p. 7072}	NC_STATE_MC_CONF {p. 7136}
NC_STATE_MC_DI {p. 7136}	NC_STATE_MC_INI {p. 7136}	NC_STATE_MC_NORM {p. 7136}	NC_STATE_MC_PRDR {p. 7136}
STATE_MC {p. 7135}			

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_CTR_RST_MC_THD_SOPC	-	0... FH	0... 15	1	-
SOPC threshold for reset counter determining from which lookup table the final result shall be obtained					
NC_IDX_STATE_SOPC_DFCT	-	0... FH	0... 15	1	-
Constant for lookup index indicating that no corresponding switch-off path is working (all defective)					
NC_NR_RESP_SOPC	-	0... FFH	0... 255	1	-
Size of arrays for switch-off path check					
NC_RESP_SOPC_1 [NC_NR_RESP_SOPC]	-	0... FFH	0... 255	1	-
Lookup table for final result if reset counter < SOPC threshold					
NC_RESP_SOPC_2 [NC_NR_RESP_SOPC]	-	0... FFH	0... 255	1	-
Lookup table for final result if reset counter >= SOPC threshold NC_CTR_RST_MC_THD_SOPC					
NC_STATE_RESP_DR_DFT	-	0... 3H	0 ...3	1	-
Diagnostic result of power stage (driver): default value "undefined" (i.e., no check could be performed)					
NC_STATE_RESP_DR_DI	-	0... 3H	0 ...3	1	-
Diagnostic result of power stage (driver): driver disabled (i.e., switch-off path is working)					
NC_STATE_RESP_DR_ENA	-	0... 3H	0 ...3	1	-
Diagnostic result of power stage (driver): driver enabled (i.e., switch-off path is not working)					
NC_STATE_RESP_SOPC_DFCT	-	0... FFH	0... 255	1	-
Constant indicating that the SOPC completely failed					
NC_STATE_RESP_SOPC_OK	-	0... FFH	0... 255	1	-
Constant indicating that the SOPC was completely successful					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Action definition

ACTION_ECM3_McCancelSopc ()	Mode: O
This action cancels the SOPC.	

Import actions:

ACTION_ECM3_ChkCpl (**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_McReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>,**IN**<PRM_DFT_VALUE>)
ACTION_ECM3_McReadChkState (**OUT**<PRM_STATE_MC_TMP>)
ACTION_ECM3_ReadChkCpl (**OUT**<PRM_RESULT>,**IN**<PRM_VAR>,**IN**<PRM_VAR_CPL>)
ACTION_ECM3_WriteChkCpl (**INOUT**<PRM_VAR>,**OUT**<PRM_VAR_CPL>,**IN**<PRM_VALUE>)
ACTION_INFR_McGetDiagPws0 (**OUT**<state_mc_sopc_dr_0>)
ACTION_INFR_McGetDiagPws1 (**OUT**<state_mc_sopc_dr_1>)

Note: mode "S" shall mean storage in reset-safe, but not necessarily non-volatile memory.

Description for actions:

ACTION_ECM3_McCancelSopc()

When called, this action resets LV_MC_SOPC_INH_DI in order to ensure that the power stages can be properly disabled by the MC; this is used inside G1 "Central Fault Reaction" which could be activated while the SOPC is not yet finished.

Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit

FUNCTION DESCRIPTION:

General information:

The switch-off path check (SOPC, previously also known as "Predrive Check") is part of the standard monitoring duties performed by the processor monitoring functions.
Its objective is to determine whether the system’s *switch-off paths*, i.e., dedicated physical connections with the purpose to disable the safety-relevant power stages are fully functional, in case an error should necessitate this action,.
Both MC and MU can have up to two such switch-off paths each connected to MC and MU.
The check itself is performed during the system’s start-up (see signal flow diagram below).
The principle idea of the check is that one of the two system components (MC or MU) attempts to disable the power stages it is connected to and then, after obtaining status information from the power stages, it is judged whether they are indeed disabled.
The status of the power stages during the SOPC shall be collected on the MC, simply because the MU cannot read back the status of the power stages.
It is clear that the SOPC has to be synchronised between the MC and the MU in order to avoid conflicts stemming from the need to unequivocally decide whether a given switch-off path works or not (e.g., the

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MC and MU paths must not be tested at the same time because it might not be possible to determine which component is actually responsible for the disabling or, should the disabling fail, which switch-off path to which component is broken).
Since communications constitute the main synchronisation mechanism between MC and MU, the SOPC is synchronised according to different communications between MC and MU.
This specification describes the generic procedure; any project-specific deviation or extension shall be specified in the application incidences, function "G27 Configuration for switch-off path check."

Signal flow diagram:

The sequencing of the switch-off path check with respect to the different communications is shown in the following diagram (note that the diagram only shows the case when no temporary disabling is performed):

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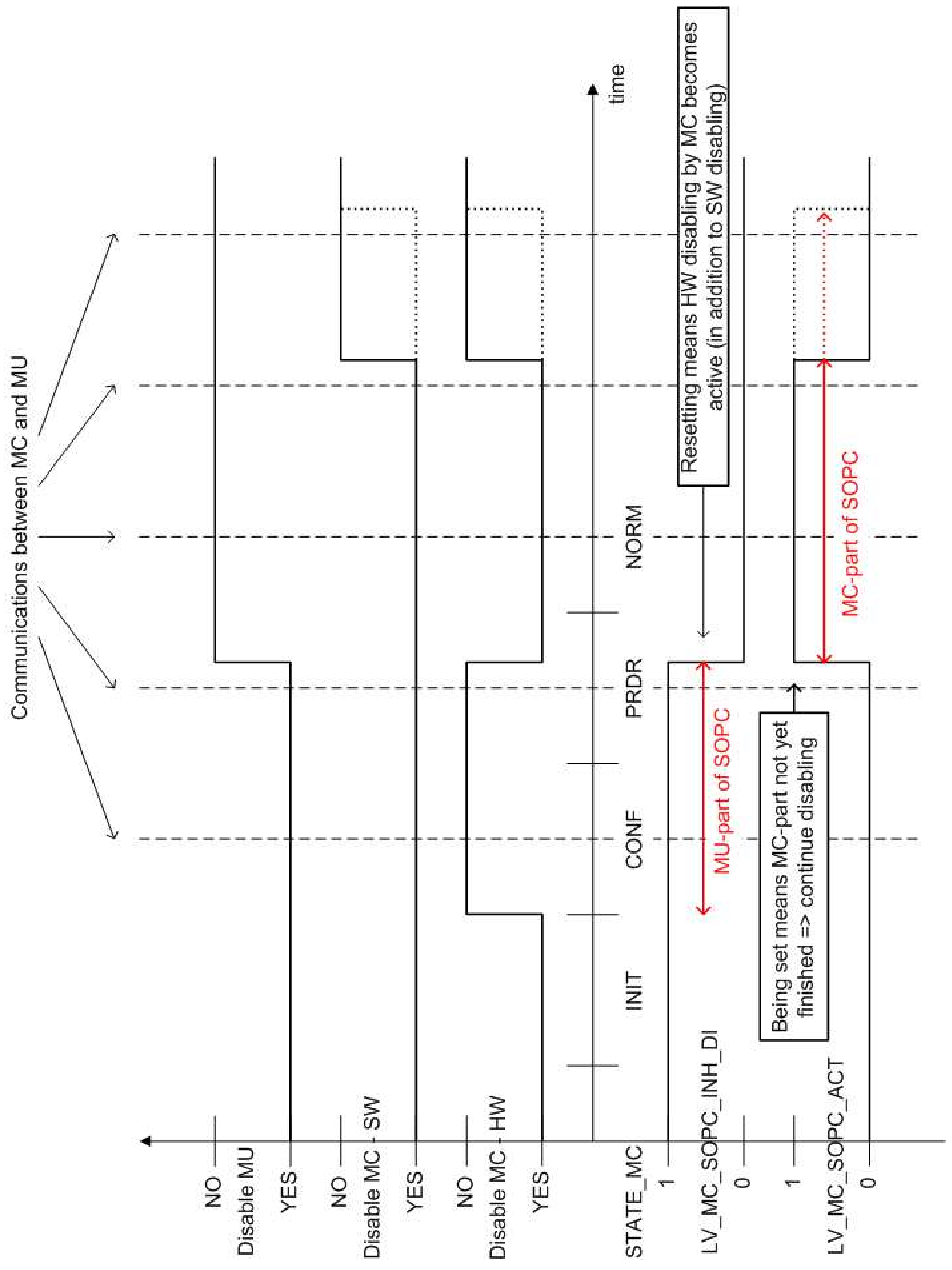

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Description:

The function shall incorporate the following requirements (always refer to the signal flow diagram):

G26 Switch-off path check

R26_1: The status information of a power stage shall be retrieved using the actions ACTION_INFR_McGetDiagPws0() and ACTION_INFR_McGetDiagPws1(); the requirements to these actions are described in the section "ECM3 - MC requirements to infrastructure interface."

R26_2: For the check of the MU switch-off paths:
R26_2.1: it shall be performed after the transition from INIT to CONFIG but before triggering the PREDRIVE communication (since, under regular circumstances, the MU stops disabling the power stages after the PREDRIVE communication, see signal flow diagram);
R26_2.2: if any of the two actions returns "undefined" as status information from a power stage, it shall be assumed that the corresponding switch-off path is not working;
R26_2.3: the result of the SOPC for the MU paths shall be stored as the two lower bits in the 4-bit vector IDX_STATE_SOPC, which shall be stored together with its complement IDX_STATE_SOPC_CPL (see "RAM check service actions of processor monitoring on MC"), its default value being NC_IDX_STATE_SOPC_DFCT (= no switch-off path working);
R26_2.4: the diagnostic result for power stage 0 shall be the MSB of the two bits reserved for the MU results;
R26_2.5: a set bit shall indicate that the switch-off path is working;
R26_2.6: when storing the two MU results, the upper two bits shall be reset (since IDX_STATE_SOPC is stored in reset-safe memory, these might still contain old data from a previous SOPC).

R26_3: The flag LV_MC_SOPC_INH_DI shall be handled as follows:
R26_3.1: it shall be set for the duration of the MU-part of the SOPC (from initialisation to shortly before the PREDRIVE communication);
R26_3.2: it shall be reset after the MU-part of the SOPC **but before the PREDRIVE communication**;
R26_3.3: it shall be stored together with its complement LV_MC_SOPC_INH_DI_CPL pair and accessed using the actions from "RAM check service actions of processor monitoring on the MC", with default value 0, indicating inactive SOPC.

R26_4: For the check of the MC switch-off paths:
R26_4.1: it shall be performed at some point after triggering the PREDRIVE communication (under regular circumstances, the MU then no longer disables the power stages);
R26_4.2: if any of the two actions returns "undefined" as status information from a power stage, it shall be assumed that the corresponding switch-off path is not working;
R26_4.3: the result of the SOPC for the MC paths shall be stored as the two upper bits in the 4-bit vector IDX_STATE_SOPC, which shall be stored together with its complement IDX_STATE_SOPC_CPL (see "RAM check service actions of processor monitoring on MC"), its default value being NC_IDX_STATE_SOPC_DFCT (= no switch-off path working);
R26_4.4: the diagnostic result for power stage 0 shall be the MSB of the two bits reserved for the MC results;
R26_4.5: a set bit shall indicate that the switch-off path is working.

R26_5: As for the exact timing of the MC-part of the SOPC:
R26_5.1: after the MU-part of the SOPC **but before the PREDRIVE communication**, LV_MC_SOPC_ACT shall be set to 1 in order to indicate that the MC-part of the SOPC has not yet been completed (this prompts disabling of power stages by the MC, cf. R22_10);
R26_5.2: the MC-part of the SOPC can only be performed if LV_MC_INH_SOPC = 0 (this indicates that the power stages are no longer temporarily disabled and that the MU no longer disables the power stages); under regular circumstances, this leaves time between after the PREDRIVE communication and before triggering the second NORMAL communication (cf. R22_7.1 and R22_9) to perform the check;
R26_5.3: otherwise, if LV_MC_INH_SOPC = 1, the MC-part of the SOPC has to be postponed until R26_5.2 becomes applicable (note that LV_MC_SOPC_ACT remains set!);

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R26_5.4: after the MC-part of the SOPC has been finished, LV_MC_SOPC_ACT shall be reset (allowing the power stages to be enabled, cf. R22_10).

R26_6: By the previous requirements R26_2 and R26_4, the index IDX_STATE_SOPC for the lookup in one of the result tables is generated by concatenating the results of MC and MU paths as depicted below:

Bit 3	Bit 2	Bit 1	Bit 0
MC result PSW0	MC result PWS1	MU result PWS0	MU result PWS1

R26_7: For determining the final result of the SOPC, depending on the value of CTR_RST_MC (for which a consistency check with its complement CTR_RST_MC_CPL using ACTION_ECM3_Read-ChkCpl() has to be performed), the following cases shall be distinguished:
R26_7.1: if CTR_RST_MC $<$ NC_CTR_RST_MC_THD_SOPC, the final result of the switch-off path check STATE_MC_RESP_SOPC shall be obtained by a lookup in the table NC_RESP_SOPC_1[] at index IDX_STATE_SOPC;
R26_7.2: if CTR_RST_MC = NC_CTR_RST_MC_THD_SOPC, the final result of the switch-off path check STATE_MC_RESP_SOPC shall be obtained by a lookup in the table NC_RESP_SOPC_2[] at index IDX_STATE_SOPC;
R26_7.3: the configuration of the lookup tables shall be described in the application incidences; in this way, the number of switch-off paths are connected to each component can be taken into account by putting dummy values into the lookup tables at appropriate positions.

R26_8: For the final result STATE_MC_RESP_SOPC:
R26_8.1: it shall be obtained by a lookup in one of the two tables NC_RESP_SOPC_x as described in R26_7;
then shall determine the behaviour of the system as a reaction to the SOPC results; it shall be stored as a value/complement pair and be accessed by the actions from "RAM check service actions of processor monitoring on MC", its default value being NC_STATE_RESP_SOPC_DFCT (indicating a complete failure of the SOPC); the two simple cases are: allowing the engine to start-up as usual in case the result is NC_STATE_RESP_SOPC_OK (the switch-off path check was completely successful); performing the central fault reaction of processor monitoring in case NC_STATE_RESP_SOPC_DFCT (in case the status of the switch-off paths would not permit reaching the safe state of the system in case of a safety-critical error); since other reactions might be desired, there can be up to 256 different values which (potentially) could correspond to 256 different engine start-up behaviours (but it should be noted that there are only up to 16 different configurations of the status information of the power stages); the considered values (in addition to the default cases NC_STATE_RESP_SOPC_DFCT and NC_STATE_RESP_SOPC_OK), plus the corresponding reactions, are also described in the application incidences.

R26_9: In DISABLE, the SOPC shall be cancelled; this means that LV_MC_SOPC_INH_DI shall be reset to 0 (and its complement set to 1) to indicate the end of the MU-part, and that LV_MC_SOPC_ACT shall be reset to 0 to indicate the end of the MC-part.

R26_10: If LV_MC_INH_SOPC performs a transition from 0 to 1 during the MC-part of the SOPC (including the determination of the result), the MC-part has to be restarted (see R26_5; the MC-part can only start anew when LV_MC_INH_SOPC = 0).

Description for action ACTION_ECM3_McCancelSopc:

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ACTION_ECM3_McCancelSopc()					
When called, this action resets LV_MC_SOPC_INH_DI in order to ensure that the power stages can be properly disabled by the MC; this is used inside G1 "Central Fault Reaction" which could be activated while the SOPC is not yet finished.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**

Formula section:

/* NOT using the RAM check service actions (to avoid recursion in fault reaction)! */
LV_MC_SOPC_INH_DI = 0;
LV_MC_SOPC_INH_DI_CPL = complement(0);

Application conditions

Initialisation:

```
After each power-up:
/ * Using the RAM check service actions */
 IDX_STATE_SOPC = NC_IDX_STATE_SOPC_DFCT;
```

After each power-up or reset:

/ Using the RAM check service actions */*
LV_MC_SOPC_INH_DI = 1;
STATE_MC_RESP_SOPC = NC_STATE_RESP_SOPC_DFCT;
/ MC-part of the SOPC not yet active, cf. R26_5.1*/*
LV_MC_SOPC_ACT = 0;

Recurrence: The **initialisation** shall be performed **after each power-up or reset (see above)**. The **function itself** is **spread over the states INIT, CONFIG, PREDRIVE, and NORMAL**, as depicted in the signal flow diagram.

Activation: STATE_MC <> NC_STATE_MC_DI *(inactive in DISABLE state)*

Deactivation: STATE_MC = NC_STATE_MC_DI *(inactive in DISABLE state)*

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F - Tuning functions

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F.1 Misfire tuning functions

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INH_IGC_MIS_GEN	O/V	0... FFH	0... 255	1	-
Identification of cylinders shut off by ignition misfire generator					
INH_IV_MIS_GEN	O/V	0... FFH	0... 255	1	-
Identification of cylinders shut off by injection misfire generator					
LV_MIS_GEN	V	0... 1H	0 ...1	1	-
Flag to indicate the missing ignition and/or injection (current segment)					
LV_MIS_GEN_DET	V	0... 1H	0 ...1	1	-
Flag to indicate the missing ignition and/or injection, delayed to be synchronised with misfire detection flags					

Input data:

EOI_LIM [NC_CYL_NR] {p. 797}	IGA_AV [NC_CYL_NR] {p. 1005}	N {p. 1525}	SEG_NR {p. 1525}
SOI_MAX {p. 807}	TD_IGC [NC_CYL_NR] {p. 1876}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MIS_RATE	-	0... FFH	0... 255	1	-
Misfire rate for regular misfire generator mode					
C_MIS_RATE_CYL [NC_CYL_NR]	-	0... FFH	0... 255	1	-
Misfire rate for cylinder regular misfire generator mode					
C_MOD_MIS_GEN	-	0... 2H	0 ...2	1	-
Misfire software generator function mode					
C_NR_TDC_DLY_MIS_GEN	-	0... FH	0... 15	1	-
Delay to synchronise LV_MIS_GEN_DET with misfire detection flags					
C_SEG_ST_MIS_GEN	-	0... 7H	0 ...7	1	-
Start segment for misfire software generator triggering					
ID_RND_PAT_MIS_GEN	V	0... 1H	0 ...1	1	-
LDP_X_ID_RND_PAT_MIS_GEN	16	0... FFH	0... 255	1	-
LDP_Y_ID_RND_PAT_MIS_GEN	16	0... FH	0... 15	1	-
Table of Boolean to define the pseudo random misfire sequence					
LC_IGN_OFF_MIS_GEN	-	0... 1H	0 ...1	1	-
Boolean for misfire generation with ignition cut-off (=1)					
LC_INJ_OFF_MIS_GEN	-	0... 1H	0 ...1	1	-
Boolean for misfire generation with injection cut-off (=1)					
LC_MIS_RATE_ENA_CYL [NC_CYL_NR]	-	0... 1H	0 ...1	1	-
Booleans to activate cylinder regular misfire generator mode per cylinder					
LC_REQ_MIS_GEN	-	0... 1H	0 ...1	1	-
Misfire software generator request					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_USE_MIS_GEN	-	0... 1H	0 ...1	1	-
Misfire software generator integration					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

F.1.1 Misfire software generator

FUNCTION DESCRIPTION:

According the project SI integration plan and/or customer requirements/wishes, a software misfire generator can be included on EMS softwares and used during integration validation and calibration stages. It is strongly recommended to remove this functionally on serial product software: integration choice via NLC_USE_MIS_GEN compilation switch.

Application conditions

Initialisation: at reset & engine stalling
LV_MIS_GEN = 0
LV_MIS_GEN_DET = 0
INH_IV_MIS_GEN = 0
INH_IGC_MIS_GEN = 0
No function calls to INJR & IGRE

Recurrence: *Segment*

Activation:

The regular or random misfiring generation is applied on ignition and/or injection sequences.

If LC_IGN_OFF_MIS_GEN = 1
Then Ignition cut-off mode
(using INH_IGC_MIS_GEN carrier, see Ignition misfire realisation)
LV_MIS_GEN is set to 1 according misfiring generation mode selected
(pseudo random or regular mode, see dedicated chapters below)
EndIf
If LC_INJ_OFF_MIS_GEN = 1
Then Injection cut-off mode
(using INH_IV_MIS_GEN carrier, see Injection misfire realisation)
LV_MIS_GEN is set to 1 according misfiring generation mode selected
(pseudo random or regular mode, see dedicated chapters below)
EndIf
If LC_IGN_OFF_MIS_GEN = 1
And LC_INJ_OFF_MIS_GEN = 1
Then Ignition and injection off modes (for the same TDC)
(using INH_IGC_MIS_GEN & INH_IV_MIS_GEN carrier)
LV_MIS_GEN is set to 1 according misfiring generation mode selected
(pseudo random or regular mode, see dedicated chapters below)
EndIf
If LC_IGN_OFF_MIS_GEN = 0
And LC_INJ_OFF_MIS_GEN = 0
Then No misfire generation allowed
LV_MIS_GEN = 0
INH_IV_MIS_GEN = 0
INH_IGC_MIS_GEN = 0
No function calls to INJR & IGRE
EndIf
LV_MIS_GEN_DET = LV_MIS_GEN delayed with C_NR_TDC_DLY_MIS_GEN tdc's

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F.1.1.1 Pseudo random misfiring generation mode

Application conditions:

The misfiring generation mode is authorised when the misfiring tuning function and the pseudo random misfiring tuning function are active.
This misfiring generation mode is global to all cylinders.
Recurrence: Segment
Activation:
If LC_REQ_MIS_GEN = 1
And C_MOD_MIS_GEN = 0
And SEG_NR = C_SEG_ST_MIS_GEN
Then Pseudo random misfiring generation is triggered
EndIf
Deactivation:
If LC_REQ_MIS_GEN = 0
Or C_MOD_MIS_GEN ? 0
Then Pseudo random misfiring generation mode is disabled
EndIf

Formula section:

A random ignition and/or injection is missing following the bitfield sequence ID_RND_PAT_MIS_GEN, where each bit corresponds to a TDC.
If the current bit value is 0 then the ignition and/or injection are missing; else ignition and injection are realised.
During the TDC where the ignition and/or injection are missing **And** if at least one of the cut-off mode is allowed (LC_IGN_OFF_MIS_GEN = 1 **Or** LC_INJ_OFF_MIS_GEN = 1), the flag LV_MIS_GEN is set to 1 else the flag LV_MIS_GEN is set to 0.

F.1.1.2 Regular misfiring generation mode

Application conditions:

This generation mode is authorised when the misfiring tuning function and the regular misfiring tuning function are active.
This misfiring generation mode is global to all cylinders.
Recurrence: Segment
Activation:
If LC_REQ_MIS_GEN = 1
And C_MOD_MIS_GEN = 1
And SEG_NR = C_SEG_ST_MIS_GEN
Then Regular misfiring generation mode is triggered
EndIf
Deactivation:
If LC_REQ_MIS_GEN = 0
Or C_MOD_MIS_GEN ? 1
Then Regular misfiring generation mode is disabled
EndIf

Formula section:

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Regular ignition and/or injection are missing every C_MIS_RATE tdc.
During the TDC where the ignition and/or injection are missing **And** if at least one of the cut-off mode is allowed (LC_IGN_OFF_MIS_GEN = 1 **Or** LC_INJ_OFF_MIS_GEN = 1), the flag LV_MIS_GEN is set to 1 else the flag LV_MIS_GEN is set to 0.

F.1.1.3 Cylinder regular misfiring generation mode

Application conditions:

This generation mode is authorised when the misfiring tuning function and the regular misfiring tuning function are active.
This misfiring mode is dedicated to specific cylinder generation.
Recurrence: Segment
Activation:
If LC_REQ_MIS_GEN = 1
And C_MOD_MIS_GEN = 2
And SEG_NR = C_SEG_ST_MIS_GEN
Then Cylilnder regular misfiring generation mode is triggered
EndIf
Deactivation:
If LC_REQ_MIS_GEN = 0
Or C_MOD_MIS_GEN ? 2
Then Cylinder regular misfiring generation mode is disabled
EndIf

Formula section:

If$_{(1)}$ LC_MIS_RATE_ENA_CYL[SEG_NR] = 1
Then$_{(1)}$ Ignition and/or injection are missing on cylinder SEG_NR every C_RATE_MIS_CYL[SEG_NR] tdc's.
If$_{(2)}$ During the TDC where the ignition **And/Or** injection are missing
And at least one of the cut-off mode is allowed (LC_IGN_OFF_MIS_GEN = 1 **Or** LC_INJ_OFF_MIS_GEN = 1),
Then$_{(2)}$ LV_MIS_GEN = 1
Else$_{(2)}$ LV_MIS_GEN = 0
EndIf$_{(2)}$
Else$_{(1)}$ No Ignition and/or injection are missing on cylinder SEG_NR
LV_MIS_GEN is set to 0
EndIf$_{(1)}$

F.1.1.4 Injection misfire realisation

Recurrence: *Every engine cycle, phased with required cylinder injection*

Formula section:

The injection misfire realisation is realised via the INH_IV_MIS_GEN carrier. This is an input for the Injection Cylinder Shut-Off Application Incidences file.
Cylinder switched off by injection software misfire generator is set to 1 within INH_IV_MIS_GEN carrier.
All others cylinder bits are reset to 0 only if not set by the misfire pattern defined for the current engine cycle

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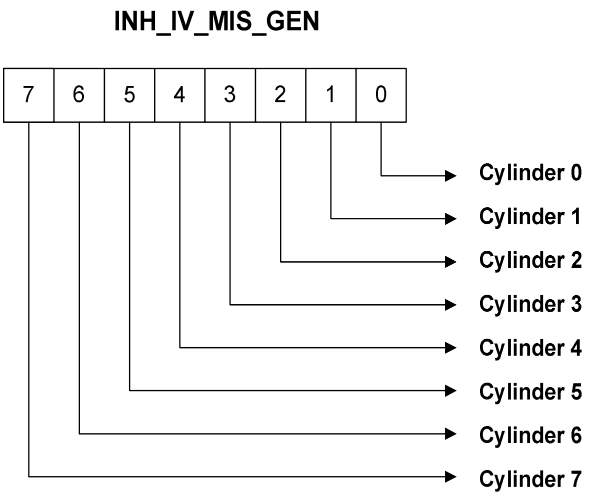
Important note on injection shut-off triggering:

To be effective, the injection shut-off on Cylinder x must be triggered before the injection time starts on this cylinder. To evaluate the correct phasing for the injection shut-off, the maximum SOI *(start of injection angle)* is evaluated.
INH_IV_MIS_GEN carrier must be updated at the segment just before the maximum start of injection (SOI_MAX + EOI_LIM[0]) to be strictly taken in account on this injection phase.



F.1.1.5 Ignition misfire realisation

Recurrence: *Every engine cycle, phased with required cylinder /coil ignition*

Formula section:

The ignition misfire realisation is realised via the INH_IGC_MIS_GEN carrier. This is an input for the Ignition Cylinder Shut-Off Application Incidences file.
Cylinder switched off by ignition software misfire generator is set to 1 within INH_IGC_MIS_GEN carrier.
All others cylinder bits are reset to 0 only if not set by the misfire pattern defined for the current engine cycle

Important note on ignition shut-off triggering:

To be effective, the ignition shut-off on cylinder x must be triggered on the segment before the dwell time on the coil y starts for this cylinder x.
To evaluate the correct phasing for the ignition shut-off, the period TD_IGC[x] must be converted in angle and added to the IGA_AV[x] angle to defined the correct segment for triggering.

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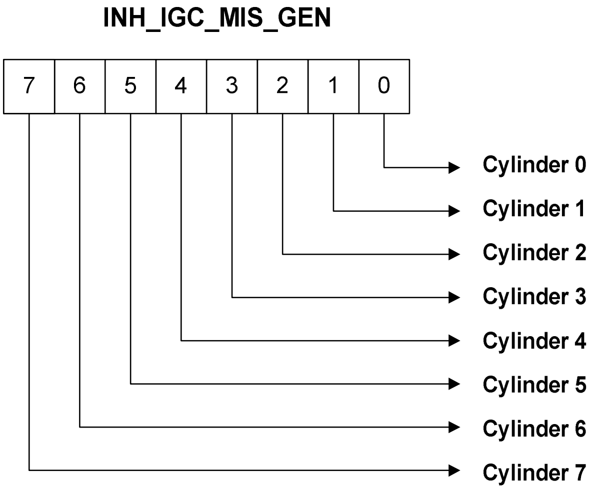

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G - Vehicle speed control

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G.1 Application conditions for cruise control

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
COUNT_VS_STEP	V	0... FFH	0... 255	1	-
Number of used Vehicle speed steps					
CTR_CRU_FLASH_LIGHT	-	0... FH	0... 15	1	-
Number of flash lights					
LV_CRU_DISP_HUD	O/V	0... 1H	0 ...1	1	-
Display on for HUD					
LV_PROG_STEP_1	O/V	0... 1H	0 ...1	1	-
Standing programming on					
LV_PROG_STEP_IF_ACT	V	0... 1H	0 ...1	1	-
Step Display on					
LV_STEP_ON	O/V	0... 1H	0 ...1	1	-
Step Display on					
LV_STEP_ON_ACT	O	0... 1H	0 ...1	1	-
Step Display on activation of resume					
LV_STEP_ON_ICL	O/V	0... 1H	0 ...1	1	-
Step Display on for instrument cluster					
NR_CRU_DIF_STEP	-	0... FFH	0... 255	1	-
Number of steps between VS_SP_DRIV_CRU_CAN and VS_MIN_CRU					
NR_STEP_ON	V	0... FFH	0... 255	1	-
Current vehicle speed step					
NR_VS_CRU	O/V	0... FFH	0... 255	1	-
Cycle numer of message IDX_NO					
VS_DIF_STEP_PROG	V	0... FFFFH	0... 511.99218	0.0078125	km/h
Differences between steps					
VS_IF_STEP_m	-	0... FFFFH	0... 511.9922	0.0078	km/h
Array of the vehicle speed steps depending on VEH_KEY_NR and Step number					
VS_SP_DRIV_CRU_CAN	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
Driver demand cruise control for INSTR					
VS_SP_DRIV_STEP	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
Active vehicle speed step for the controller					
VS_STEP_CAN_1	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed Step to the CAN i (1-3)					
VS_STEP_CAN_2	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed Step to the CAN i (1-3)					
VS_STEP_CAN_3	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed Step to the CAN i (1-3)					
VS_STEP_m	O/S	0... FFFFH	0... 511.9922	0.0078	km/h
Array of the vehicle speed steps depending on VEH_KEY_NR and Step number					

Input data:

C_T_CRUS_OFF {p. 7220}	LC_CRUS_OFF_SWI {p. 7221}	LV_CRU_ACT {p. 7227}	LV_CRU_MAIN_SWI {p. 7220}
LV_IGK {p. 906}	LV_MSG_PROG_STEP_CRU {p. 1566}	LV_ST {p. 1720}	LV_VAR_BN {p. 655}

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LV_VAR_BN_LDM {p. 655}	LV_VAR_DCC {p. 655}	NR_VS_CRU_IF {p. 1569}	REQ_MSW {p. 7220}
STATE_CRU {p. 7227}	STATE_VS_ICL_DISP {p. 1578}	VEH_KEY_NR {p. 1582}	VS_CRU {p. 7215}
VS_MIN_CRU {p. 7227}	VS_SP_CRU_MAX {p. 7237}	VS_SP_DRIV_CRU {p. 7237}	VS_STEP_IF_1 {p. 1582}
VS_STEP_IF_2 {p. 1582}	VS_STEP_IF_3 {p. 1582}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CTR_CRU_FLASH_LIGHT	-	1... FFH	1... 255	1	-
Counter flash lights					
C_MAX_STEP	-	0... FFH	0... 255	1	-
Maximum number of steps					
C_T_CRU_FLASH_LIGHT	-	0... FFH	0... 2.55	0.01	s
Flash light duration time					
C_T_DLY_CRU_TIP	-	0... FFH	0... 2.55	0.01	s
Time delay for display vehicle speed pointer					
C_T_MIN_CRU_CHG	-	0... FFH	0... 2.55	0.01	s
Look time for events					
C_T_MIN_PROG	-	0... FFH	0... 5.1	0.02	s
Time for programming detection					
C_T_PROG_STEP_IF_ACT	-	0... FFH	0... 2.55	0.01	s
Time out for programming mode					
C_VS_DIF_STEP_MIN_HYS	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Minimum between steps hysteresis					
C_VS_DIF_STEP_MIN_K	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Minimum between steps in case of Km ICL					
C_VS_DIF_STEP_MIN_M	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Minimum between steps in case of mile ICL					
C_VS_DIF_STEP_PROG_K	-	0... FFFFH	0... 511.99218	0.0078125	km/h
km.p.h step calibration					
C_VS_DIF_STEP_PROG_M	-	0... FFFFH	0... 511.99218	0.0078125	km/h
m.p.h step calibation					
C_VS_DIF_TIP_PROG_K	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Difference between tip steps of Km ICL					
C_VS_DIF_TIP_PROG_M	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Difference between tip steps in case of mile ICL					
C_VS_MIN_PROG	-	0... FFFFH	0... 511.99218	0.0078125	km/h
VS_CRU threshold stand programming detection					
LC_CRU_DISP_SWI	-	0... 1H	0 ...1	1	-
Configuration switch to switch off CRU display for HUD and ICL due to driver request					

General information:

The stage cruise control is an add-on function of the cruise control. If is available then it’s possible to program steps of vehicle speed witch are shown in the speedometer. The driver can used this function for jumps between fixed Steps during cruise control. The requirement is a steering lever with additional options MARK_UP and MARK_DOWN or the I drive functionality.
Basically there are two different ways of programming during drive or at standing vehicle.

The following assumptions of message from the CCC_MASK are done:

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- receiving only at different data's
- the message to the instrument will sent after a complete receive of CCC_MASK message
- depending on the calibration of C_MAX_STEP the quantity of evaluated NR_VS_CRU_IF is limited

Application conditions

Initialisation:

```
NR_STEP_ON = 0; COUNT_VS_STEP out of NVMY
VS_SP_DRIV_CRU_CAN = VS_MIN_CRU
LV_PROG_STEP_1 = 0
LV_STEP_ON = 0
  LV_CRU_DISP_HUD = 0
  LV_STEP_ON_ICL = 0
CTR_T_REQ_MSW_CON_MSG = 0
  VS_SP_DRIV_STEP = VS_MIN_CRU
 VS_STEP_m out of NVMY sorted depending on VEH_KEY_NR (if key
available)
  T_PROG_STEP_IF_ACT = 0
```

The vehicle key number is only reed once at Initialisation, at the moment only one array for the first Key is available.

Recurrence: 10 ms

Recurrence: of NR_VS_CRU , VS_STEP_CAN_i 100 *ms to be Synchron with CAN Message*

Activation: LV_VAR_BN = 1 and LV_VAR_DCC = 0 and LV_VAR_BN_LDM = 0

Signal flow diagram:

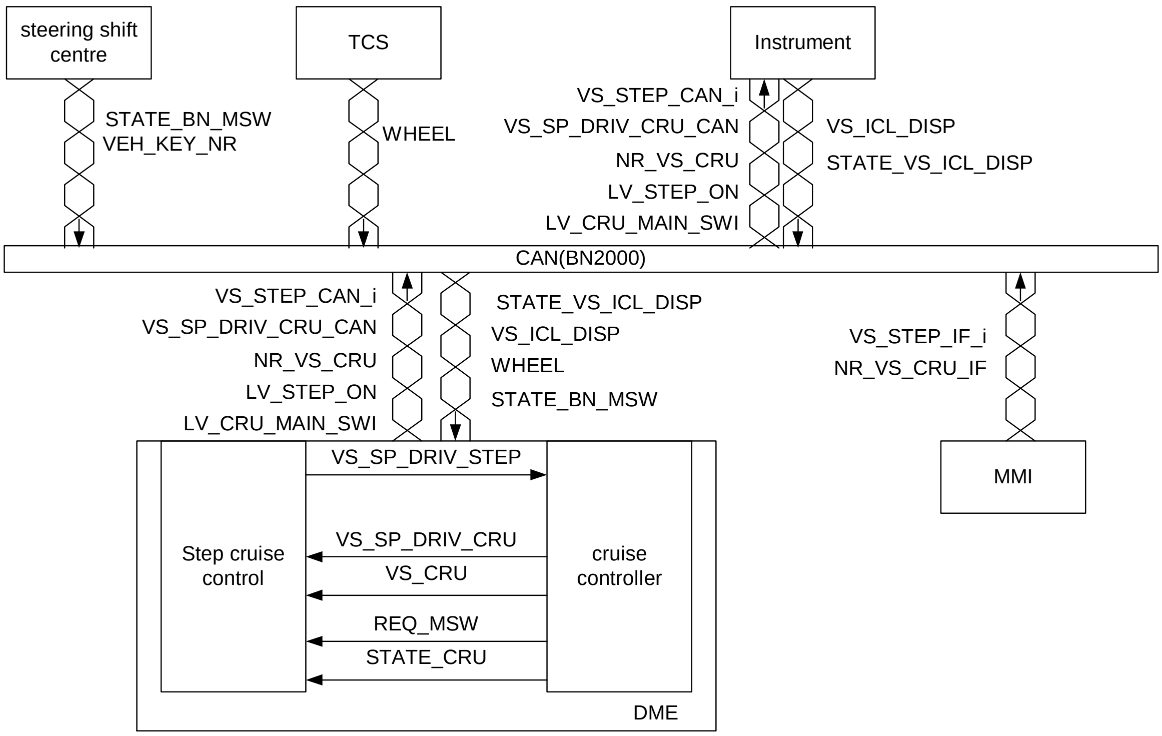

Figure G.1.1: : CAN structure for stage cruise control

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FUNCTION DESCRIPTION:

Description:

The different states at the step control are triggered only at transitions of respective REQ_MSW state at ramp to active. After detection of an event the respective REQ_MSW State (TIP_UP, DOWN; MARK_UP, DOWN) is looked. MARK_UP, DOWN for C_T_MIN_CRU_CHG or until idle is detected again, the exception is LV_PROG_STEP =0 to 1

Formula section:

Counter:

IF REQ_MSW = SOFT_OFF
THEN increment CTR_T_REQ_MSW_CON_MSG
ELSE CTR_T_REQ_MSW_CON_MSG = 0
ENDIF

Evaluation of CCC MASK massage information for programming:

Vehicle speed steps of CCC_MASK:

VS_IF_STEP_m: $m = \sum_{14}^{0}$

m: Step number (0...14)

IF LV_MSG_PROG_STEP_CRU == 1 (new data available)
LV_MSG_PROG_STEP_CRU needs to be acknowledged after taking data over.

Then LV_PROG_STEP_IF_ACT = 1
If LV_PROG_STEP_IF_ACT = 0 1
Then VS_IF_STEP_m(0...14) = 0
Else
Endif
VS_IF_STEP_m(0...14) = VS_STEP_IF_1
m = NR_VS_CRU_IF * 3 ; positions(0,3,6, 9,12)
VS_IF_STEP_m(0...14) = VS_STEP_IF_2
m = NR_VS_CRU_IF * 3+1 ; positions(1,4,7, 10,13)
VS_IF_STEP_m(0...14) = VS_STEP_IF_3
m = NR_VS_CRU_IF * 3+2 ; positions(2,5,8, 11,14)
else VS_STEP_m calculation of
endif
IF LV_PROG_STEP_IF_ACT = 1
Then T_PROG_STEP_IF_ACT ++
Endif
If receiving C_MAX_STEP /3 blocks **or**
T_PROG_STEP_IF_ACT C_T_PROG_STEP_IF_ACT
Then LV_PROG_STEP_IF_ACT = 0
T_PROG_STEP_IF_ACT = 0

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VS_STEP_m = VS_IF_STEP_m (update count_vs_step, note: receive data can be unsorted)

[nr_step_on = 0]

Endif

Evaluation of key and stage information for programming:

Vevicle speed steps:

VS_STEP_m: $m = \sum_{14}^{0}$

m: Step number (0...14)

		NR_VS_CRU			
	0	1	2	3	4
VS_STEP_CAN_1 =	VS_STEP_0	VS_STEP_3	VS_STEP_6	VS_STEP_9	VS_STEP_12
VS_STEP_CAN_2 =	VS_STEP_1	VS_STEP_4	VS_STEP_7	VS_STEP_10	VS_STEP_13
VS_STEP_CAN_3 =	VS_STEP_2	VS_STEP_5	VS_STEP_8	VS_STEP_11	VS_STEP_14

VS_STEP_m; m 0-14

VS_STEP_CAN_i (i = 1,2,3) = VS_STEP_m

Programed vehicle speed steps:

VS_STEP_k: $k = \sum VS\_STEP\_m$; for VS_STEP > 0 km. p. h.

"0 = kmph means there is no programed VS_CRU at this n_m step"

COUNT_VS_STEP = number of VS_STEP_k

NR_VS_CRU : If a VS_STEP_m is changed the NR_VS_CRU is updated to the respective column number. In other cases and at first activation of Steps the Numbers is cycling updated. Additional the instrument unit itselfs saves the steps internal.
NR_STEP_ON : current step number of sorted Vehicle speed steps.

Concerning some programming rules of the steps, it is necessary to vary some variables in dependancy on the equipped ICL. The difference is, whether the vehicle speed is announced in miles or kilometers.

IF STATE_VS_ICL_DISP = 1 "km/h; mph"
Then VS_DIF_STEP_MIN = C_VS_DIF_STEP_MIN_M
VS_DIF_TIP_PROG = C_VS_DIF_TIP_PROG_M
Else VS_DIF_STEP_MIN = C_VS_DIF_STEP_MIN_K
VS_DIF_TIP_PROG = C_VS_DIF_TIP_PROG_K
Endif

Signal flow diagram:

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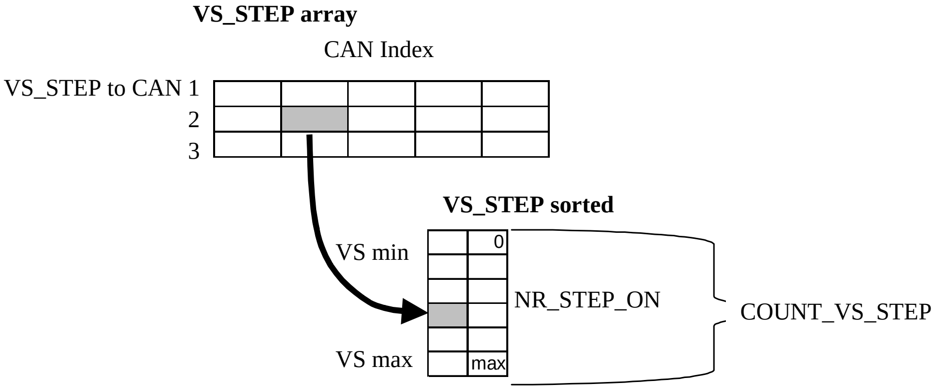

REQ_MSW = MARK UP:

IF STATE_VS_ICL_DISP = 1 "km/h; mph"

Then NR_CRU_DIF_STEP =

round down(VS_SP_DRIV_CRU_CAN /C_VS_DIF_STEP_PROG_M)

VS_DIF_STEP_PROG = C_VS_DIF_STEP_PROG_M *

(1 + NR_CRU_DIF_STEP) -

VS_SP_DRIV_CRU_CAN

VS_DIF_STEP_PROG = MAX (VS_DIF_STEP_MIN; VS_CRU_DIF_STEP)

Else

NR_CRU_DIF_STEP =

round down (VS_SP_DRIV_CRU_CAN /C_VS_DIF_STEP_PROG_K)

VS_DIF_STEP_PROG = C_VS_DIF_STEP_PROG_K *

(1 + NR_CRU_DIF_STEP) -

VS_SP_DRIV_CRU_CAN

VS_DIF_STEP_PROG = MAX (VS_DIF_STEP_MIN; VS_CRU_DIF_STEP)

End

REQ_MSW = MARK DOWN:

IF STATE_VS_ICL_DISP = 1 "km/h; mph"

Then NR_CRU_DIF_STEP =

round down(VS_SP_DRIV_CRU_CAN /C_VS_DIF_STEP_PROG_M)

VS_ CRU_DIF_STEP = -1*(C_VS_DIF_STEP_PROG_M *

NR_CRU_DIF_STEP -

VS_SP_DRIV_CRU_CAN)

IF VS_ CRU_DIF_STEP = =0 km/h

Then VS_DIF_STEP_PROG = C_VS_DIF_STEP_PROG_M

else VS_DIF_STEP_PROG = MAX (VS_DIF_STEP_MIN; VS_CRU_DIF_STEP)

Else NR_CRU_DIF_STEP =

round down(VS_SP_DRIV_CRU_CAN /C_VS_DIF_STEP_PROG_K)

VS_ CRU_DIF_STEP = -1*(C_VS_DIF_STEP_PROG_K *

NR_CRU_DIF_STEP -

VS_SP_DRIV_CRU_CAN)

IF VS_ CRU_DIF_STEP = =0 km/h

Then VS_DIF_STEP_PROG = C_VS_DIF_STEP_PROG_K

Else VS_DIF_STEP_PROG = MAX (VS_DIF_STEP_MIN; VS_CRU_DIF_STEP)

End

Standing vehicle programming detection LV_PROG_STEP_1:

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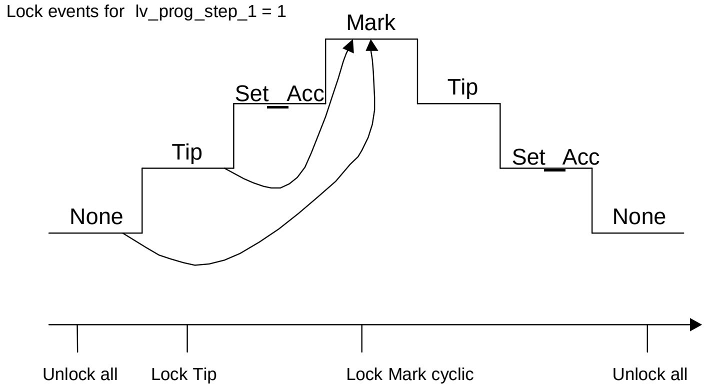
Hysteresis of PROG_STEP_1:

IF VS_CRU $<$ C_VS_MIN_PROG **and**
(REQ_MSW = MARK_UP or DOWN) **and**
LV_IGK = 1 **and**
LV_PROG_STEP_1 = 0
Then LV_PROG_STEP_1 = 1
LV_STEP_ON_PREV = LV_STEP_ON
After first cycle of NR_VS_CRU; then LV_STEP_ON = 1 "display on"
ElseIF LV_PROG_STEP_1 = 1 **and**
(VS_CRU $>$ C_VS_MIN_PROG **or** LV_IGK = 0 **or** LV_ST = 1 **or**
(CTR_T_REQ_MSW_CON_MSG $>$ C_T_CRUS_OFF **and**
LC_CRUS_OFF_SWI = 0)
Then LV_PROG_STEP_1 = 0
LV_STEP_ON = LV_STEP_ON_PREV
LV_STEP_ON_PREV = 0
Endif

G.1.1 Program conditions at Standing vehicle

Activation: LV_PROG_STEP_1 = 1
MSW detection:



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VS_SP_DRIV_CRU_CAN:
First initialisation of VS_SP_DRIV_CRU_CAN:

IF LV_PROG_STEP_1$_{n-1}$ = 0 LV_PROG_STEP_1$_{n}$ = 1
Then VS_SP_DRIV_CRU_CAN = VS_MIN_CRU
Else "no action"
Endif
Calculation of VS_SP_DRIV_CRU_CAN:

REQ_MSW = MARK_UP
#- –
No step available:
IF COUNT_VS_STEP = 0
Then VS_SP_DRIV_CRU_CAN = min((VS_SP_DRIV_CRU_CAN$_{(n-1)}$ +

VS_DIF_STEP_PROG); VS_SP_CRU_MAX)

- – -

step availible (goto next higher step):

ElseIF VS_SP_DRIV_CRU_CAN $<$ max (VS_STEP_m)

then VS_SP_DRIV_CRU_CAN = VS_STEP_m

[for m = $m = \sum_{k}^{0}$; min(abs(VS_SP_DRIV_CRU_CAN- VS_STEP_m)) **and**

VS_SP_DRIV_CRU_CAN $<$ VS_STEP_m]

Else **IF** COUNT_VS_STEP $<$ C_MAX_STEP

then VS_SP_DRIV_CRU_CAN = min((VS_SP_DRIV_CRU_CAN$_{(n-1)}$ +
VS_DIF_STEP_PROG); VS_SP_CRU_MAX)

Else *"NR_STEP_ON = C_MAX_STEP"*
VS_SP_DRIV_CRU_CAN $_{n}$ = VS_SP_DRIV_CRU_CAN $_{(n-1)}$

Endif

- –#

REQ_MSW = MARK_DOWN:

#- –

No step availible:

IF COUNT_VS_STEP = 0

Then VS_SP_DRIV_CRU_CAN = max ((VS_SP_DRIV_CRU_CAN$_{(n-1)}$ -
VS_DIF_STEP_PROG); VS_MIN_CRU)

- – -

step availible (goto next lower step):

ElseIF VS_SP_DRIV_CRU_CAN $>$ min (VS_STEP_m; m= 0 to k)

then VS_SP_DRIV_CRU_CAN = VS_STEP_m

[for m = $m = \sum_{k}^{0}$; min(abs(VS_SP_DRIV_CRU_CAN- VS_STEP_m)) **and**

VS_SP_DRIV_CRU_CAN $>$ VS_STEP_m]

Else **IF** COUNT_VS_STEP $<$ C_MAX_STEP

Then VS_SP_DRIV_CRU_CAN = max ((VS_SP_DRIV_CRU_CAN$_{(n-1)}$ -
VS_DIF_STEP_PROG); VS_MIN_
CRU)

Else VS_SP_DRIV_CRU_CAN $_{n}$ = VS_SP_DRIV_CRU_CAN $_{(n-1)}$

Endif

- –#

REQ_MSW = TIP_UP

#- –

No step availible:

IF COUNT_VS_STEP = 0

Then VS_SP_DRIV_CRU_CAN = (VS_SP_DRIV_CRU_CAN$_{(n-1)}$ +
VS_DIF_TIP_PROG)

- – -

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"step availible ":
ElseIF COUNT_VS_STEP < C_MAX_STEP
Then **"***tip up"*
VS_SP_DRIV_CRU_CAN = VS_SP_DRIV_CRU_CAN$_{(n-1)}$ +
VS_DIF_TIP_PROG
"Proofing of Step range catch function"
IF VS_SP_DRIV_CRU_CAN - VS_STEP_m < VS_DIF_STEP_MIN

[for m = $m = \sum_{k}^{0}$; min(abs(VS_SP_DRIV_CRU_CAN- VS_STEP_m)) **]**

Then **IF** VS_SP_DRIV_CRU_CAN < = VS_STEP_m
Then VS_SP_DRIV_CRU_CAN = VS_STEP_m
else VS_SP_DRIV_CRU_CAN =
VS_STEP_m + VS_DIF_STEP_MIN
IF VS_SP_DRIV_CRU_CAN >
VS_STEP_m (+1) - VS_DIF_STEP_MIN
Then VS_SP_DRIV_CRU_CAN = VS_STEP_m (m+1)
else **remains**
endif

else "*goto next higher step or stay on highest step"*
min (VS_SP_DRIV_CRU_CAN = VS_STEP_m ; max (VS_STEP_k))

[for m = $m = \sum_{k}^{0}$; min(abs(VS_SP_DRIV_CRU_CAN- VS_STEP_m)) **and**

VS_SP_DRIV_CRU_CAN < VS_STEP_m]
endif
endif
VS_SP_DRIV_CRU_CAN = min (VS_SP_DRIV_CRU_CAN; VS_SP_CRU_MAX)
- –#

REQ_MSW = SET/ACC:

Calculaion like "REQ_MSW = TIP_UP", but in a recurrency of the time delay C_T_DLY_CRU_TIP.
T= C_T_DLY_CRU_TIP
IF T = 0 ms
Then next cycle calculation
else T = T -10 ms
endif

REQ_MSW = TIP_DOWN:
#- –
No step availible:
IF COUNT_VS_STEP = 0
Then VS_SP_DRIV_CRU_CAN = (VS_SP_DRIV_CRU_CAN$_{(n-1)}$ - VS_DIF_TIP_PROG)
- –
"step availible tip down":
ElseIF COUNT_VS_STEP < C_MAX_STEP
Then **"***tip down"*

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VS_SP_DRIV_CRU_CAN = VS_SP_DRIV_CRU_CAN$_{(n-1)}$ -
VS_DIF_TIP_PROG

"Proofing of Step range catch function"

IF VS_SP_DRIV_CRU_CAN - VS_STEP_m < VS_DIF_STEP_MIN

[for m = $m = \sum_{k}^{0}$; min(abs(VS_SP_DRIV_CRU_CAN- VS_STEP_m))]

Then **IF** VS_SP_DRIV_CRU_CAN => VS_STEP_m
Then VS_SP_DRIV_CRU_CAN = VS_STEP_m
else VS_SP_DRIV_CRU_CAN =
VS_STEP_m - VS_DIF_STEP_MIN
IF VS_SP_DRIV_CRU_CAN < =
VS_STEP_m (-1) + VS_DIF_STEP_MIN
Then VS_SP_DRIV_CRU_CAN = VS_STEP_m (m-1)
else **remains**

endif

else "*goto next lower step or stay on lowest step"*
max (VS_SP_DRIV_CRU_CAN = VS_STEP_m ; MIN(VS_STEP_k))

[for m = $m = \sum_{k}^{0}$; min(abs(VS_SP_DRIV_CRU_CAN- VS_STEP_m)) **and**

VS_SP_DRIV_CRU_CAN > VS_STEP_m]

endif
endif
VS_SP_DRIV_CRU_CAN = max (VS_SP_DRIV_CRU_CAN ; VS_MIN_CRU)
- – #

REQ_MSW = DECC:

Calculaion like "REQ_MSW = TIP_DOWN", but in a recurrency of the time delay C_T_DLY_CRU_TIP.
T= C_T_DLY_CRU_TIP
IF T = 0 ms
Then next cycle calculation
else T = T -10 ms
endif

VS_SP_DRIV_CRU_CAN is allways limited in the range between VS_MIN_CRU and C_VS_SP_MAX_CRU.

<u>**Saving current Step VS_STEP_m:**</u>

(REQ_MSW = RES and LV_PROG_STEP_IF_ACT== 0)
for T > C_T_MIN_PROG

- –
Set:

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IF(3) VS_SP_DRIV_CRU_CAN =><= VS_STEP_m ;$(m = \sum_{k}^{0}\ ) \pm$ VS_DIF_STEP_MIN

Then(3) VS_STEP_m; m=k+1= VS_SP_DRIV_CRU_CAN
For index m : VS_STEP_$m_{(n-1)}$ = 0 km.p.h.

- -

erase:
Else(3) VS_STEP_m; m=k = 0 km.p.h (erase step)
Endif

G.1.2 Conditions at driving

Activation: LV_PROG_STEP_1 = 0:
Recurrence: 10 ms

Calculation of VS_SP_DRIV_CRU_CAN:

Depending on the State of cruise controller:

If LV_CRU_MAIN_SWI = 1
Then If LV_CRU_MAIN_SWI = 0 1 **or** STATE_CRU = Passiv active
Then VS_SP_DRIV_CRU_CAN = VS_SP_DRIV_CRU
Else if STATE_CRU ="SET_ACC / RETARD"
Then if REQ_MSW = ACC active
Then **if** VS_CRU VS_SP_DRIV_CRU_CAN
Then VS_SP_DRIV_CRU_CAN = MIN(VS_CRU; VS_SP_CRU_MAX)
Endif
Else **if** VS_CRU VS_SP_DRIV_CRU_CAN // DEC active
Then VS_SP_DRIV_CRU_CAN = MAX(VS_CRU; VS_MIN_CRU)
Endif
Endif
Else VS_SP_DRIV_CRU_CAN = VS_SP_DRIV_CRU
Endif
Endif
Endif

- -

Recurrence: 10 ms:

Calculation of vehicle speed steps:

(REQ_MSW = RES and LV_PROG_STEP_IF_ACT== 0 and VS_CRU VS_MIN_CRU)
for T $>$ C_T_MIN_PROG

Activation: LV_STEP_ON = 1 AND
LV_CRU_MAIN_SWI = 1 AND

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NOT (LV_CRU_ACT = 0 -> 1)

- -

Set:

IF VS_SP_DRIV_CRU_CAN >< VS_STEP_m ;$(m = \sum_{k}^{0})$ ± VS_DIF_STEP_MIN

Then **IF** COUNT_VS_STEP < C_MAX_STEP
Then VS_STEP_m; m=k+1= VS_SP_DRIV_CRU_CAN
For index m : VS_STEP_m$_{(n-1)}$ = 0 km.p.h.
Else
repeat
ignore of request, " number of steps are full"
" flashlight message triggered for "
LV_STEP_ON = 0 for C_T_CRU_FLASH_LIGHT then
LV_STEP_ON = 1 for C_T_CRU_FLASH_LIGHT then
CTR_CRU_FLASH_LIGHT + 1
until CTR_CRU_FLASH_LIGHT = C_CTR_CRU_FLASH_LIGHT
reset counter CTR_CRU_FLASH_LIGHT to 0

Else IF VS_SP_DRIV_CRU_CAN >< VS_STEP_m ;$(m = \sum_{k}^{0})$ ± (VS_DIF_STEP_MIN -
C_VS_DIF_STEP_MIN_HYS)

Then erease: - - - - - - - - - - - - - - - - - -
VS_STEP_m; m=k = 0 km.p.h (errase step)
- - - - - - - - - - - - - - - - - - -

else **repeat**
ignore of request, " flashlight message triggered for "
LV_STEP_ON = 0 for C_T_CRU_FLASH_LIGHT then
LV_STEP_ON = 1 for C_T_CRU_FLASH_LIGHT then
CTR_CRU_FLASH_LIGHT + 1
until CTR_CRU_FLASH_LIGHT = C_CTR_CRU_FLASH_LIGHT
reset counter CTR_CRU_FLASH_LIGHT to 0

endif
Endif

REQ_MSW = MARK_UP:

If LV_CRU_MAIN_SWI = 0 1 **or**
LV_CRU_ACT = 0 1
Then lock key permanent
If LV_STEP_ON = 0 **and**
Flashlight is not active
Then LV_STEP_ON = 1
Endif
Else lock key cyclic
IF LV_CRU_ACT = 1
Then IF COUNT_VS_STEP = 0
Then **If** LV_STEP_ON = 0 **and**
Flashlight is not active

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Then LV_STEP_ON = 1
Endif
VS_SP_DRIV_STEP = min((VS_SP_DRIV_CRU_CAN +
VS_DIF_STEP_PROG);
VS_SP_CRU_MAX)
LV_STEP_ON_ACT = 1
Else **If** LV_STEP_ON = 0 **and**
Flashlight is not active
Then LV_STEP_ON = 1
Lock key permanent
Else **IF** VS_SP_DRIV_CRU_CAN < max (VS_STEP_m)
Then VS_SP_DRIV_STEP = VS_STEP_m "next higher step"

[for m = $m = \sum_{k}^{0}$; min(abs(VS_SP_DRIV_CRU_CAN- VS_STEP_m)) **and**

VS_SP_DRIV_CRU_CAN < VS_STEP_m]
LV_STEP_ON_ACT = 1
Else no reaction LV_STEP_ON_ACT = 0
Endif
Endif
Endif
Else no reaction
Endif
Endif

REQ_MSW = MARK_DOWN:

If LV_CRU_MAIN_SWI = 0 1 **or**
LV_CRU_ACT = 0 1
Then lock key permanent
If LV_STEP_ON = 0 **and**
Flashlight is not active
Then LV_STEP_ON = 1
Endif
Else lock key cyclic
IF LV_CRU_ACT = 1
Then **IF** COUNT_VS_STEP = 0
Then **If** LV_STEP_ON = 0 **and**
Flashlight is not active
Then LV_STEP_ON = 1
Endif
VS_SP_DRIV_STEP = max((VS_SP_DRIV_CRU_CAN -
VS_DIF_STEP_PROG); VS_MIN_CRU)
LV_STEP_ON_ACT = 1
Else **If** LV_STEP_ON = 0 **and**
Flashlight is not active
Then LV_STEP_ON = 1
Lock key permanent

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Else **IF** VS_SP_DRIV_CRU_CAN > min (VS_STEP_m; m= 0 to k)

Then VS_SP_DRIV_STEP = VS_STEP_m "next lower step"

[for m = $m = \sum_{k}^{0}$; min(abs(VS_SP_DRIV_CRU_CAN - VS_STEP_m)) **and**

VS_SP_DRIV_CRU_CAN > VS_STEP_m]

LV_STEP_ON_ACT = 1

Else IF VS_SP_DRIV_CRU_CAN > VS_MIN_CRU

Then VS_SP_DRIV_STEP = VS_MIN_CRU

LV_STEP_ON_ACT = 1

else no reaction LV_STEP_ON_ACT = 0

Endif

Endif

Endif

Endif

Else no reaction

Endif

Endif

"regards phycial convertion of veh. Speeds"

reset of LV_STEP_ON during drive:

IF LV_CRU_MAIN_SWI = 0 and LV_PROG_STEP_1 = 0
Then LV_STEP_ON = 0; LV_STEP_ON_ACT = 0; stop flashlight
Endif

reset of LV_STEP_ON_ACT during drive:

If LV_STEP_ON_ACT = 1
Then CTR_STEP_ON_ACT ++
Else CTR_STEP_ON_ACT = 0
Endif
If CTR_STEP_ON_ACT > 100 ms
Then LV_STEP_ON_ACT = 0
CTR_STEP_ON_ACT = 0
Endif

setting of LV_CRU_DISP_HUD and LV_STEP_ON_ICL :

If LC_CRU_DISP_SWI = 1
Then **If** CTR_T_REQ_MSW_CON_MSG >C_T_CRUS_OFF **or**
LV_CRU_OFF_IRR = 1
Then LV_CRU_DISP_HUD = 0
LV_STEP_ON_ICL = 0
ElseIf LV_CRU_ACT = 1 **or** LV_PROG_STEP_1 = 1 **or** **(** REQ_MSW > 1H **and**
REQ_MSW != 7H **)**
Then LV_CRU_DISP_HUD = 1
LV_STEP_ON_ICL = LV_STEP_ON
Endif
Else
LV_STEP_ON_ICL = LV_STEP_ON
Endif

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G.2 Cruise control auxiliary functions

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AC_CRU	O/V	8000... 7FFFH	-15.72864 ...15.72816	0.00048	m/s^2
Vehicle acceleration in CRU					
FAC_TQ_REQ_DRIV_MMV	O/V	0... FFFFH	0... 1.999969	30.5175e-6	-
Mean moving value of driver torque demand					
LV_CRU_OFF_BY_ASR_ESP_CTL	O/V	0... 1H	0 ...1	1	-
Soft off condition depending on ASC interventions					
LV_VS_DIAG_NOT_PLAUS	O/V	0... 1H	0 ...1	1	-
VS_CRU not plausible					
N_VS_CRU	O/V	0... 1FE0H	0... 16320	2	rpm/(km/h)
Ratio between engine speed and vehicle speed					
VS_CRU	O/V	0... FFFFH	0... 511.9921875	0.0078125	km/h
Filtered vehicle speed					
VS_DIF_ICL_TCS	V	0... 1H	0 ...1	1	-
Difference of vehicle speed INSTR and TCS					

Input data:

FAC_TQ_REQ_DRIV {p. 6570}	LV_AT {p. 654}	LV_ERR_BN_ICL {p. 4870}	LV_ERR_BN_VS_TCS {p. 4871}
LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_VS {p. 5021}	LV_ERR_VS_CAN {p. 1565}	LV_PLAUS_ASR_CTL {p. 1567}
LV_PLAUS_ESP_CTL {p. 1567}	LV_TQ_ASR_REQ {p. 1568}	LV_VAR_AMT {p. 655}	LV_VAR_ASR {p. 655}
LV_VAR_BN_MSW {p. 655}	LV_VAR_TCT {p. 656}	N {p. 1525}	VS {p. 1176}
VS_FIL {p. 1176}	VS_ICL_DISP {p. 1582}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CRLC_VS_CRU_MMV	V	0... FFFFH	0... 0.9999847412109	15.2587e-6	km/h
Filter factor					
C_FAC_AC_CRU_MMV	V	0... FFFFH	0... 0.999985	15.3186e-6	-
Filtering AC_CRU					
C_FAC_TQ_REQ_DRIV_MMV	V	0... FFFFH	0... 0.999985	15.3186e-6	-
Filtering of driver demand					
C_FAC_VS_FIL	V	0... FFH	0... 255	1	-
Filter factor					
C_T_CRU_ASR_OFF	V	0... FFH	0... 25.5	0.1	s
Minimum time before cut-off CRU in case of ASR intervention					
C_T_CRU_ESP_BRAKE_OFF	V	0... FFH	0... 25.5	0.1	s
Minimum time before cut-off CRU in case of ESP intervention only with brake					
C_T_CRU_ESP_OFF	V	0... FFH	0... 25.5	0.1	s
Minimum time before cut-off CRU in case of ESP intervention					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_VS_DIAG_NOT_PLAUS	V	0... FFH	0... 25.5	0.1	s
debounce time for setting VS_CRU not plausible					
C_VS_MAX_DIAG	V	0... FFH	0... 255	1	km/h
Max. allowed deviation between VS_CRU and VS					
LC_VS_CRU_FIL	V	0... 1H	0 ...1	1	-
Filter factor activation					

General information

G.2.1 Runup lock

General information:

Application conditions:

Initialisation: `0 at reset`

Activation: `LV_AT = 0 and LV_VAR_AMT = 0 and LV_VAR_TCT = 0`

Deactivation: `LV_AT = 1` **or** `LV_VAR_AMT = 1` **or** `LV_VAR_TCT = 1`

Recurrence: `100 ms`

Function description:

Formula section:

In vehicles with manual transmission, the ratio between engine speed and vehicle speed is monitored on activating a function of the cruise control. At the start of a function, the ratio

N_VS_CRU = N /VS_FIL is stored.

The instantaneous ratio between engine speed and vehicle speed is formed in each cycle

$N\_VS\_CRU_n = N_n / VS\_FIL_n$

Remark:

If the percentage ratio exceeds the threshold value C_N_VS_MAX_CRU, hard cut-off has to ocurrs.

G.2.2 Filter of Vehicle Speed for Cruise control

General information:

With integration of stage cruise control the vehicle speed of instrument message is used. There is a deviation of DSC vehicle speed to the vehicle Speed of ICL therefore the visible signal has to be used to supress a shown deviation to the driver.

Application conditions:

Initialisation: `0 at reset`

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Activation: `LV_VAR_ASR = 1`

Deactivation: –

Recurrence: `100 ms`

Function description:

Formula section:

If LV_VAR_BN_MSW = 1 **and**
LC_VS_CRU_FIL =1 **and**
LV_ERR_CAN_BOFF = 0 **and**
LV_ERR_BN_VS_TCS = 0 **and**
LV_ERR_BN_ICL = 0
Then VS_DIF_ICL_TCS = VS_DIF_ICL_TCS$_{n-1}$ - C_CRLC_VS_CRU_MMV *
(VS_DIF_ICL_TCS$_{(n-1)}$ - VS_ICL_DISP + VS_FIL)
VS_CRU = VS_FIL + VS_DIF_ICL_TCS
(a physical conversion VS_ICL_DISP has be done)
Else VS_CRU = VS_FIL
Endif

G.2.3 Acceleration monitoring for the CRU mode

General information:

To monitor the vehicle dynamics in cruise control mode, the instantaneous acceleration of the vehicle is calculated in each computing cycle. The acceleration calculation is performed independently of the CRU mode with a 10 ms time pattern.

Application conditions:

Initialisation: `AC_CRU = 0 at reset`

Activation: –

Deactivation: –

Recurrence: `10ms`

Function description:

Formula section:

AC_CRU = AC_CRU + (VS_FILn - VS_FILn-1) /10ms * C_FAC_AC_CRU_MMV

Remark:
If the instantaneous acceleration exceeds the adjustable value C_AC_MAX_CRU, hard cut-off is performed, see chapter hard off conditions.

G.2.4 Plausibility check of the speed signal VS_FIL

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General information:

The vehicle speed is acquired through the CAN signal WHEEL. To detect possible errors - if WHEEL is currently received and identified as correct by the ASR control unit a plausibility check is performed. The filtered external vehicle speed VS_CRU is compared with the vehicle speed sensor signal. If a maximum allowed absolute deviation C_VS_MAX_DIAG is exceeded, there is an error entry.

Application conditions:

Initialisation: *0 at reset or LV_IGK = 0 → 1*

Activation: LV_VAR_ASR = 1

Deactivation: –

Recurrence: 100ms

Function description:

Formula section:

```
IF   LV_ERR_VS          = 1       or
     LV_ERR_CAN_BOFF    = 1       or
     LV_ERR_BN_VS_TCS   = 1       or
       LV_ERR_BN_ICL    = 1       or
       LV_ERR_VS_CAN    = 1
THEN   LV_VS_DIAG_NOT_PLAUS = 0
       T_VS_DIAG_NOT_PLAUS = 0
ELSE
   IF |VS_CRU - VS| >= C_VS_MAX_DIAG
   THEN   T_VS_DIAG_NOT_PLAUS ++
          IF   T_VS_DIAG_NOT_PLAUS > C_T_VS_DIAG_NOT_PLAUS
          THEN LV_VS_DIAG_NOT_PLAUS = 1
          ENDIF
   ELSE   LV_VS_DIAG_NOT_PLAUS = 0
              T_VS_DIAG_NOT_PLAUS = 0
    ENDIF
ENDIF
```

G.2.5 Recognition ASR/ESP-control and valid minimum time

General information:

Recognition ASR/ESP-control and valid minimum time :

LV_CRU_OFF_BY_ASR_ESP_CTL = active:

Recognition due to the combination of the signals LV_PLAUS_ASR_CTL, LV_ASR_REQ and LV_PLAUS_ESP_CTL of the CAN-message ASC3

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LV_PLAUS_ASR_CTL	LV_TQ_ASR_REQ	LV_PLAUS_ESP_CTL	function	minimum time before cut-off CRU
1	1	0	ASR-control	C_T_CRU_ASR_OFF
1	1	1	ESP-control	C_T_CRU_ESP_OFF
1	0	1	ESP-control only brake	C_T_CRU_ESP_ BRAKE_OFF

Application conditions:

Initialisation: 0 at reset

Activation: –

Deactivation: –

Recurrence: 100ms

Function description:

Formula section:

G.2.6 Mean moving value calculation of Driver demand:

General information:

For initialisation of I share of the cruise control function it is nessessary to calulate a very slow driver demand

Application conditions:

Initialisation: 0 at reset

Activation: –

Deactivation: –

Recurrence: 10ms

Function description:

Formula section:

$$FAC\_TQ\_REQ\_DRIV\_MMV = FAC\_TQ\_REQ\_DRIV\_MMV_{n-1} + (FAC\_TQ\_REQ\_DRIV - FAC\_TQ\_REQ\_DRIV\_MMV_{n-1}) * C\_FAC\_TQ\_REQ\_DRIV\_MMV$$

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G.3 Cruise control general

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CRU_MAIN_SWI	O/V	0... 1H	0 ...1	1	-
Indicate CRU readiness					
REQ_MSW	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H	HARD_OFF SOFT_OFF TIP_UP TIP_DOWN SET_AC- CELLERATE RESUME DECELERATE NONE MARK_HIGH MARK_DOWN	-	-
Evaluated Status of MSW request module					
STATE_MSW_CAN	O/V	0H 1H 2H 4H 7H	NONE SET__ACCEL- ERATE__TIP_ UP DECELERATE_ _TIP_DOWN OFF ERROR	-	-
Status of MSW to the CAN Message					

Input data:

C_VB_MIN_MSW_DIAG {p. 5059}	C_VS_MIN_PROG {p. 7202}	LV_CRU_ACT {p. 7227}	LV_CRU_MAIN_SWI {p. 7220}
LV_CRU_OFF_IRR {p. 7227}	LV_ERR_BN_MSW {p. 4870}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_MSW_2 {p. 5058}
LV_ERR_MSW_3 {p. 5058}	LV_ERR_MSW_TOG {p. 5058}	LV_IGK {p. 906}	LV_MSW_MSG_VLD {p. 5058}
LV_PROG_STEP_1 {p. 7201}	LV_VAR_BN_LDM {p. 655}	LV_VAR_BN_MSW {p. 655}	LV_VAR_DCC {p. 655}
LV_VAR_MSW {p. 656}	STATE_BN_MSW {p. 1571}	STATE_MSW_DATA {p. 5059}	V_IGK {p. 1185}
VS_CRU {p. 7215}	VS_MIN_CRU {p. 7227}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_CRUS	-	0... FFH	0... 2550	10	ms
Minimum time between switch on ready and switch off ready					
C_T_CRUS_OFF	-	0... FFH	0... 5100	20	ms
Minimum recognition time on actuating the OFF button to switch off the display at BN 2000					
C_T_CRUS_ON	-	0... FFH	0... 2550	10	ms
Minimum recognition time on actuating the OFF button					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_MIN_MSW	-	1... FFH	0.01 ...2.55	0.01	s
Time delay of REQ_MSW					
C_T_MIN_TIP_MSW	-	0... FFH	0... 2.55	0.01	s
Time delay of REQ_MSW TIP detection					
C_T_READY_CRU	-	64... FFH	1000 ...2550	10	ms
Delay time after control unit initialization					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_CRU_REQ_SWI	-	0... 1H	0 ...1	1	-
Configuration switch between MSW and steering lever					
LC_CRUS_OFF_SWI	-	0... 1H	0 ...1	1	-
Configuration switch to switch off the cruise control via MSW					

G.3.1 Summary

General information:

The cruise control (CRU) controls the vehicle speed by a P/I controller to the required target speed. The CRU button in the multifunction steering wheel activates the control functions, if no cut-off conditions or switch-on prohibitions are present. The WHEEL signal of the ASC 1 massage is evaluated as controlled variable. Corresponding to the existing control deviation, the value PV_CRU is calculated for controlling the charge intervention.
Using the system, the driver can activate a control for maintaining the desired speed set by him. The desired speed can be approached comfortably in positive and negative direction by setting the instantaneous speed or by additional functions. Controlled approach to a stored desired speed is also possible. The driver then can store or change his desired speed using the following functions:

- Setting/acceleration (SET/ACC)
- Deceleration (DEC)
- Resume (RES)
- Tip-up (TP_UP)
- Tip-down (TP_DOWN)
- OFF (OFF)

G.3.1.1 Constant drive

General information:

After reaching the desired speed, the vehicle speed is kept constant independent of driving resistance changes which act on the vehicle, e.g. rising and falling gradient or headwind, if there are no abnormal termination conditions and the engine power or the braking effect is sufficient.

G.3.1.2 Setting/acceleration (SET/ACC)

General information:

By activating the SET/ACC function, the driver can store the instantaneous speed as desired speed and thus switch on the CRU system. Also the speed can be changed with a defined acceleration from the

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controlled constant drive. After reaching the desired speed, the constant drive function of the control is active.

G.3.1.3 Deceleration (DEC)

General information:

If the controlled constant drive function is active, the speed reduction takes place in the DEC function by the driver. In this case the desired speed is reduced. If the driver ends the function, the achieved instantaneous speed is stored as new desired speed and the controlled constant drive function is adopted. It is not possible to switch the system on through the recognised DEC function.

G.3.1.4 Resume (RES)

General information:

When the driver activates the RES function, the vehicle is accelerated from the instantaneous speed with a defined acceleration to the stored desired speed. This applies both for larger and for smaller desired speeds compared with the instantaneous speed.

G.3.1.5 Tip-up

General information:

Proceeding from controlled constant drive, the driver can increase his desired speed in steps of 1 k.p.h. by activating the TP_UP function. This function can be selected several times consecutively, thus the vehicle can be brought to a new higher desired speed with a defined acceleration using the TP_UP function.

G.3.1.6 Tip-down

General information:

Proceeding from controlled constant drive, the driver can reduce his desired speed in steps of 1 k.p.h. by activating the TP_DOWN function. This function can be selected several times consecutively, thus the vehicle can be brought to a new lower desired speed with a defined deceleration using the TP_DOWN function.

G.3.1.7 Off

General information:

To switch the system off, the driver can select the OFF function of the multifunction steering wheel. In this way the cruise control system is switched off softly, whereby the achieved desired speed remains stored for later activation by RES. If the engine running is stopped (LV_IGK = 0, ES), then the readiness of CRU and the speed-setpoint are reduced to their initial values.

G.3.2 Ready state and display

General information:

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A prerequisite for activating the CRU functions is the CRU ready state. After ECU initialization, the CRU state is initially passive. C_T_READY_CRU after ignition key on LV_IGK = 1 can be transformed into the ready state by pressing the OFF button once. To indicate CRU readiness to the driver, the CAN signal LV_CRU_MAIN_SWI is set from 0 to 1. In this way the CRU ready lamp is activated in the CAN combination device.

The transition into the passive state occurs by pressing the OFF button once from the CRU ready state without controlled drive. The CRU ready lamp goes out.

For this functionality, the OFF button must be recognized for the minimum time of C_T_CRUS_ON on actuation; the OFF button must not be actuated for at least C_T_CRUS between switch on ready and switch off ready.

The ready state is then also ended (-> passive) if the MSW diagnosis is momentarily not possible or a MSW error is momentarily present, see "Diagnosis and limp home" chapter.

Depending on the vehicle configuration LC_CRU_REQ_SWI is switched between Multifunction steering wheel and Switch pack. The reason is, in a variant with switch pack is the main switch of cruise control on with LV_IGK = 1.

Application conditions

Initialisation: *LV_CRU_MAIN_SWI =0*

Recurrence: *10ms*

Formula section:

If (1) LV_IGK = 1 **and** T> C_T_READY_CRU **and**
(LC_CRU_REQ_SWI =0 and LV_VAR_BN_MSW = 0) **and** LV_CRU_OFF_IRR = 0
Then(1) If(2) LV_CRU _MAIN_SWI = 0
Then(2) If(3) REQ_MSW = SOFT_OFF (for T> C_T_CRUS_ON) **and**
Time between transition LV_CRU _MAIN_SWI = 0/1
(and vice versa)> C_T_CRUS
Then(3) LV_CRU _MAIN_SWI = 1
Else (2) IF(4) REQ_MSW = SOFT_OFF (for T> C_T_CRUS_ON) **and**
Time between transition LV_CRU _MAIN_SWI = 0/1
(and vice versa)> C_T_CRUS
Then(4)IF(5) LV_CRU_ACT = 0
Then (5) LV_CRU_MAIN_SWI = 0
Else (5) LV_CRU_MAIN_SWI = 1 (remains)
Else (1) **IF(6)**(LC_CRU_REQ_SWI = 0 **and** LV_VAR_BN_MSW = 1 **and**
LV_CRU_OFF_IRR = 0
Then(6) IF(7) (VS_CRU VS_MIN_CRU **and**
REQ_MSW = TIP_UP/_DOWN) **or**
(VS_CRU > C_VS_MIN_PROG **and**
REQ_MSW = MARK_UP/_DOWN)
Then(7) LV_CRU_MAIN_SWI = 1
Else(7) IF (REQ_MSW = SOFT_OFF (for T > C_T_CRUS_OFF) **and**
LC_CRUS_OFF_SWI = 0)
Then LV_CRU_MAIN_SWI = 0
Else LV_CRU_MAIN_SWI remains
Else (6) IF LC_CRU_REQ_SWI = 1
then LV_CRU_MAIN_SWI = 1
else "LV_CRU_OFF_IRR = =1"
LV_CRU_MAIN_SWI = 0

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Endif

G.3.3 Evaluation serial data line from the MSW

General information:

The buttons position of multifunction steering wheel (MSW) which is transferred digitally through a serial data line serves as interface between the driver and the CRU system (look at "Basic SW Inputs /Outputs"). The system interfaces are evaluated with a 10 ms time pattern.
A additional condition to the reception of a transfer pulse (see MSW interface in the Basic SW chapter) for reading the Output of the MSW-IC memory is further the MSW Diagnosis conditions.

Description:

The debounced and recognised function of the driver interface is evaluated only after the conditions for the CRU mode have been fulfilled. If no CRU mode is possible in the current driving cycle or at the moment, then "Hard cut-off" (FAC_TQ_CRU = 0) must be triggered.
According to the current status of the CRU and the recognised function of the driver interface, the functions OFF ("Soft cut-off"), resume, setting/acceleration, Tip-Up, Tip-Down, deceleration and the transition into the controlled constant drive can be triggered.
The function setting/acceleration (SET/ACC) is triggered if the CRU is ready, is in constant drive or another active function.
The deceleration function (DEC) is triggered accordingly, but requires that the CRU is in controlled drive, i.e. there is no setting mode in this case.
The tip functions Tip Up and Tip Down are triggered if the controlled constant drive or one of the two tip functions is active. Furthermore, a Tip-Up in CRU ready or with running resume triggers the setting function.
The Tip-Down function in active resume mode triggers only the abnormal termination of the running function and sets VS_SP_DRIV_CRU to the actual speed VS_FIL, but allows no setting in the above sense.
Precondition for a renewed activation of CRU-functions after cut-off or abnormal terminations are generally that the CRU mode is possible in principle and at least ’Rest’ (None) was recognised once. As soon as ’None’ or still no new function has be recognised after ’Setting/acceleration’ or ’Deceleration’, ’Transition into constant drive’ is triggered. This applies especially for the resume function (RES) which is interlocked until rest is recognised again.
Resume is triggered only at CRU ready without controlled drive.
The following applies in an overtaking process: The triggering for hard and soft cut-off comes through. The same applies for functions which increase the value FAC_TQ_CRU, such as acceleration and TIP UP, in order to is able to "overdrive" in this way PV_AV with the CRU. For all other functions, especially for "Deceleration" and "TIP DOWN", which reduce the FAC_TQ_CRU, the trigger is prevented, since the instantaneous driver wish via pedal is viewed as higher priority. With recognised RES position, triggering would make no sense.
For a possibly multiple actuation of buttons and superimposed CRU functions, priority must be given to the function recognition according to the following significance:

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Significance	Button/function
1	Brake light switch
1	Clutch switch
1	Transmission switch runup lock
2	OFF
3	Deceleration
4	Setting/acceleration
5	Resume

Significance 1 has highest priority

The function selection is made according to priority (see above). The tip functions are executed immediately after recognition. In this way the vehicle response should be improved for the driver, if he requests the SET/ACC or DEC function. In a pure tip request, rest (None) must be recognised between the individual tips.

Application conditions

Initialization: *STATE_MSW_CAN = "None"* *at reset and deactivation*
REQ_MSW / = "Hard_off"

Recurrence: *10ms*

Activation: LV_IGK = 1 and V_IGK > C_VB_MIN_MSW_DIAG
Time (since V_IGK > C_VB_MIN_MSW_DIAG) > C_T_READY_CRU
(Diagnosis conditions)
(LV_VAR_MSW = 1 **or** (LV_VAR_BN_MSW = 1**and** LV_VAR_DCC = 0 **and** LV_VAR_BN_LDM = 0))

Deactivation: otherwise

Formula section:

The evaluation of MSW is only done by CAN 11H variants. In BN 2000 the MSW requests are done by instument message.

IF LV_VAR_BN_MSW = 0

Then

The Signal of STATE_MSW_DATA has to be received multiple (LV_MSW_MSG_VLD = 1) before it is considered in the REQ_MSW evaluation. The following distinctions are made because of the evaluation of STATE_MSW_DATA and an additional time condition:

REQ_MSW		STATE_MSW_DATA
0.	HARD OFF:	MSW not allowed, ready or available
1.	SOFT OFF:	OFF pressed.
2.	TP_UP:	SET/ACC and no DEC pressed for C_T_MIN_MSW.
3.	TP_DOWN:	DEC and no SET/ACC pressed for C_T_MIN_MSW.
4.	SET/ACC:	SET/ACC and no DEC pressed for C_T_MIN_MSW.
5.	RES:	RES pressed.
6.	DEC:	DEC and no SET/ACC pressed for C_T_MIN_MSW .
7.	NONE:	SET/ACC and DEC and RES and OFF not pressed.

STATE_MSW_CAN		STATE_MSW_DATA
0.	None:	
1.	SET/ACC /TP_UP:	SET/ACC pressed.
2.	DEC /TP_DOWN:	DEC pressed.
3.	RES:	RES pressed.

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4. OFF: OFF pressed
5. not used
6. not used .
7. Error: LV_ERR_MSW_2 = 1; LV_ERR_MSW_3 = 1
LV_ERR_MSW_TOG = 1

else

REQ_MSW STATE_BN_MSW

0. HARD OFF: MSW message not valid (7FH or LV_ERR_BN_MSW ==1 or LV_ERR_CAN_BOFF == 1)
1. SOFT OFF: TIP UP or DOWN "OFF pressed"
2. TIP_UP: TIP_PRE pressed for (C_T_MIN_TIP_MSW.
and C_T_MIN_MSW.)

3. TIP_DOWN: TIP_POST pressed for (C_T_MIN_TIP_MSW.
and C_T_MIN_MSW.)

4. SET/ACC: TIP_PRE pressed for C_T_MIN_MSW.
5. RES: TIP_AXIAL.
6. DEC: TIP_POST pressed for C_T_MIN_MSW.

1. NONE: NONE
2. MARK_UP PRESS_PRE
3. MARK_DOWN PRESS_POST

The state REQ_MSW = TIP_UP/TIP_DOWN is held for minimum C_T_MIN_TIP_MSW.

endif

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G.4 Cruise control input

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CRU_ACT	O/V	0... 1H	0 ...1	1	-
Intervention of cruise control					
LV_CRU_ACT_INH	O/V	0... 1H	0 ...1	1	-
Intervention of cruise control inhibited due to environmental conditions					
LV_CRU_ACT_VLD	V	0... 1H	0 ...1	1	-
Indicating if driver wanted to activate CRU in DC at least once (BN2000), in 11hex always =1					
LV_CRU_OFF_IRR	O/V	0... 1H	0 ...1	1	-
Irreversible cut off conditions for cruise control					
LV_CRU_OVER_ACT	V	0... 1H	0 ...1	1	-
Overtaking function active					
REQ_CRU	V	0H 1H 2H 3H 4H 5H 6H 7H	HARD_OFF SOFT_OFF TIP_UP TIP_DOWN SET_ ACCELERATE RESUME DECELERATE NONE	-	-
Request of cruise control functionality					
STATE_CRU	V	0H 1H 3H 5H 7H 9H	PASSIVE CONST_DRIVE RESUME SET_ACC RETARD TIP	-	-
Status of current cruise control functionality					
STATE_CRU_CAN	O/V	1H 2H 3H 4H 7H	CONST_TIP - RES - DEC	-	-
Status of cruise control to the CAN- Message					
STATE_CRU_OFF_IRR	O/V/S	0... FFFFH	0... 65535	1	-
Status switch off condition irreversible					
STATE_CRU_OFF_REV	O/V/S	0... FFFFH	0... 65535	1	-
Status switch off condition reversible					
T_DLY_CRU	V	0... FFFFH	0... 655.35	0.01	s
Time counter overtaking					
VS_MIN_CRU	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
Minimal Vehicle speed condition for VS_CRU					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Input data:

AC_CRU {p. 7215}	C_FAC_TQ_REQ_CLU_IS_HYS {p. 1442}	FAC_TQ_REQ_CRU {p. 6737}	FAC_TQ_REQ_DRIV {p. 6570}
GEAR_INFO {p. 1564}	IP_FAC_TQ_REQ_CLU_IS__N_32 {p. 1442}	LC_N_MAX_VS_MAX_ACT {p. 1151}	LV_ACT_CRU_MEM_EXT_ADJ {p. 7482}
LV_AT {p. 654}	LV_BRAKE_DET {p. 4209}	LV_CRU_MAIN_SWI {p. 7220}	LV_CRU_OFF_BY_ASR_ESP_CTL {p. 7215}
LV_CRU_OVER_ACT_ACK {p. 7237}	LV_ERR_BLS_PLAUS {p. 4209}	LV_ERR_BN_ETCU {p. 4870}	LV_ERR_BN_ICL {p. 4870}
LV_ERR_BN_MSW {p. 4870}	LV_ERR_BN_TCS {p. 4870}	LV_ERR_BN_TQ_AMT {p. 4870}	LV_ERR_BN_TQ_ETCU {p. 4871}
LV_ERR_BN_TQ_TCS {p. 4871}	LV_ERR_BN_VS_TCS {p. 4871}	LV_ERR_CAN_BOFF {p. 4846}	LV_ERR_CRIT_OVL_ECU_VVL {p. 801}
LV_ERR_CRU_INH_MON {p. 6790}	LV_ERR_CS {p. 5015}	LV_ERR_CUR_H_VVL {p. 801}	LV_ERR_DR_SC_VVL {p. 801}
LV_ERR_MSW_2 {p. 5058}	LV_ERR_MSW_3 {p. 5058}	LV_ERR_MSW_TOG {p. 5058}	LV_ERR_OVL_ECU_VVL {p. 801}
LV_ERR_PVS {p. 4216}	LV_ERR_RLY_VVL {p. 801}	LV_ERR_TOUT_AMT_1 {p. 802}	LV_ERR_TOUT_ASR_1 {p. 802}
LV_ERR_TOUT_ASR_3 {p. 802}	LV_ERR_TOUT_ETCU_1 {p. 802}	LV_ERR_TOUT_ETCU_2 {p. 802}	LV_ERR_TQI_N_MAX_MON {p. 6917}
LV_ERR_VS {p. 5021}	LV_ERR_VS_CAN {p. 1565}	LV_ERR_VVL_ROT {p. 802}	LV_ES {p. 1720}
LV_IM_CS_PN {p. 852}	LV_N_LIM_REQ_MON {p. 6877}	LV_N_MAX {p. 3779}	LV_TQI_REQ_CAN_INH {p. 6687}
LV_VAR_AMT {p. 655}	LV_VAR_BN {p. 655}	LV_VAR_BN_LDM {p. 655}	LV_VAR_DCC {p. 655}
LV_VAR_TCT {p. 656}	LV_VS_DIAG_NOT_PLAUS {p. 7215}	LV_VS_MAX {p. 1148}	LV_VS_MAX_VSL {p. 7267}
N_VS_CRU {p. 7215}	REQ_MSW {p. 7220}	STATE_BN_MSW {p. 1571}	STATE_DHL_CTL {p. 1572}
STATE_IF_ICL_BN_MSW {p. 1574}	STATE_TCS_DECE {p. 1578}	STATE_VS_ICL_DISP {p. 1578}	T_ERR_VS_CAN {p. 1176}
VS_CRU {p. 7215}	VS_DIF_CRU {p. 7237}	VS_SP_CRU {p. 7237}	VS_SP_CRU_MAX {p. 7237}
VS_SP_DRIV_CRU {p. 7237}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AC_MAX_CRU	-	0... 7FFFH	0... 15.71952	479.7e-6	m/s**2
Max. acceleration					
C_FAC_TQ_REQ_HYS_CRU	-	0... FFFFH	0... 1.99996	30.5e-6	-
FAC_TQ_REQ hysteresis for start of the restart function					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_VS_MAX_CRU	-	0... FFH	0... 99.60937	0.390625	%
Threshold value for hard cut-off					
C_T_DLY_MAX_CRU	-	0... FFFFH	0... 655.35	0.01	s
Delay threshold for start of the restart function					
C_T_DLY_VS_SP_CRU_MAX	-	0... FFH	0... 255	1	s
Max .time for VS more than VS max at CRU					
C_VS_DIF_DLY_CRU_NEG	-	0... 7FFFH	0... 255.99218	0.0078125	km/h
Max. difference from VS_SP_DRIV_CRU and C_VS_DIF_DLY_CRU					
C_VS_DIF_DLY_CRU_POS	-	8000... 0H	-256 ...0	0.0078125	km/h
Max. difference from VS_SP_DRIV_CRU and C_VS_DIF_DLY_CRU					
C_VS_DIF_MIN_CRU_OVER	-	8000... 0H	-256 ...0	0.0078125	km/h
VS_DIF_CRU min value for finish overtaking function					
C_VS_MIN_CRU_K	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed condition for VS_CRU in case of Km - ICL					
C_VS_MIN_CRU_M	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed condition for VS_CRU in case of mile - ICL					
C_VS_MIN_PLAUS_CRU	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Vehicle speed condition for VS_CRU					
C_VS_SP_DIF_MAX_CRU	-	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Max. vehicle speed deviation					
C_VS_SP_DIF_MIN_CRU	-	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Min. vehicle speed deviation					

G.4.1 Terminology

CRU manipulated variable:
FAC_TQ_CRU

Reference input variable:
VS_SP_CRU

Target variable:
VS_SP_DRIV_CRU

Control deviation:
VS_DIF_CRU = VS_SP_CRU - VS

Reference input/target variable difference:
VS_SP_DIF_CRU = VS_SP_CRU - VS_SP_DRIV_CRU

G.4.2 Conditions for cruise control

FUNCTION DESCRIPTION:

The State of cruise control is the evaluation of the request and the cruise conditions.
If one of the following conditions is detected, no controller can be activated or an activated controller function is switched off. In this case a distinction is made between hard (FAC_TQ_CRU = 0) and soft cut-off (FAC_TQ_CRU through ramp function to zero).

Application conditions:

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Application conditions

Initialisation: *STATE_CRU_OFF_IRR, STATE_CRU_OFF_REV out of NVMY*
LV_CRU_ACT_VLD = 0 at LV_IGK 0->1 ***or*** *at reset*
all other outputs = 0

Recurrence: *10 ms*

Activation: *LV_VAR_DCC = 0 and LV_VAR_BN_LDM = 0*

Deactivation: LV_VAR_DCC = 1 or LV_VAR_BN_LDM = 1 then
Initialisation: STATE_CRU_OFF_IRR, STATE_CRU_OFF_REV =00H

Formula section:

STATE_CRU_CAN		STATE_CRU
0.	None:	PASSIVE
1.	CONST	CONST_DRIVE or TIP
2.		not used
3.	RES:	RES
4.		not used
5.	SET/ACC	SET/ACC
6.		not used
7.	DEC	DEC

If FAC_TQ_REQ_DRIV > FAC_TQ_REQ_CRU and STATE_CRU not "passive"
Then STATE_CRU_CAN = "None"
Endif

G.4.2.1 Conditions for hard cut-off

The control functions of the cruise control can be activated only if:

- CRU ready state present LV_CRU_MAIN_SWI = 1

Irreversible cut-off due to diagnosis failures

With the following diagnosis errors the CRU is irreversible hard cut off for this engine run. The CRU-readiness and the CRU readiness light are reseted. The CRU function can be activated by LV_IGK=0/1 change, as long as no running diagnosis errors are present. A distinction is done between the irreversible failures because of an error output for CAN message.

Formula section:

If STATE_VS_ICL_DISP = 1 "km/h; mph"
Then VS_MIN_CRU = C_VS_MIN_CRU_M
Else VS_MIN_CRU = C_VS_MIN_CRU_K
Endif

// Recognition if cruise control is really configuration of car (in Case of E90 LV_VAR_BN = 1 instead of no build in cruise control)
IF LV_VAR_BN = 1
THEN **IF** STATE_BN_MSW != No_action (0h) **and**

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```
                    STATE_BN_MSW != Invalid_signal (7h)
          THEN //set bit for recognising desired usage of cruise control by driver for first time in
          driving cycle:
                    LV_CRU_ACT_VLD = 1
          ENDIF
ELSE      in case of 11hex bit is always set:
          LV_CRU_ACT_VLD = 1
ENDIF
If   [7] LV_ERR_BLS_PLAUS = 1              or   /* Error in break light system */
  [12] LV_ERR_VS = 1                      or   /* Error in speed signal (sensor) */
     [11] LV_VS_DIAG_NOT_PLAUS = 1 or          /* Implausible speed signal VS_CRU */
     [10] LV_ERR_TQI_N_MAX_MON =1         or   /* Error Level 2 Monitoring */
  [10] LV_ERR_CRU_INH_MON =1              or   /* Error Level 2 Monitoring */
  [10] LV_N_LIM_REQ_MON =1                or   /* Error Level 2 Monitoring */
     [3] LV_ERR_CS = 1                    or   /* Error in clutch switch */
  [4] LV_ERR_MSW_2 = 1                    or   /* Multi-function steering wheel Error */
  [4] LV_ERR_MSW_3 = 1                    or   /* Multi-function steering wheel Error */
  [4] LV_ERR_MSW_TOG = 1                  or   /* Multi-function steering wheel Error */
  [4] LV_ERR_BN_MSW = 1                   or   /* Multi-function steering wheel Error */
     [9] LV_ERR_BN_ICL = 1                or   /* CAN bus fault ICL */
     [8] LV_ERR_CAN_BOFF = 1              or   /* CAN bus off */
     [13] LV_ERR_TOUT_ASR_1 = 1           or   /* CAN bus fault ASR */
     [13] LV_ERR_TOUT_ASR_3 = 1           or   /* CAN bus fault ASR */
     [14] LV_ERR_BN_TCS = 1               or   /* CAN bus fault TCS */
     [14] LV_ERR_BN_TQ_TCS = 1            or   /* CAN bus fault TCS */
  [14] LV_ERR_BN_VS_TCS =1                or   /* CAN bus fault TCS */
     [5] LV_ERR_TOUT_AMT_1 = 1            or   /* CAN bus fault AMT */
  [5] LV_ERR_BN_TQ_AMT = 1                or   /* CAN bus fault AMT */
     [6] LV_ERR_TOUT_ETCU_1 = 1           or   /* CAN bus fault ETCU */
      [6] LV_ERR_TOUT_ETCU_2 = 1          or   /* CAN bus fault ETCU */
     [6] LV_ERR_BN_ETCU = 1               or   /* CAN bus fault ETCU */
     [6] LV_ERR_BN_TQ_ETCU = 1            or   /* CAN bus fault ETCU */
     [2] LV_ERR_PVS = 1                   or   /* PVS-Error */
  [1] LV_ERR_CRIT_OVL_ECU_VVL = 1         or   /* critical VVL driver overload */
  [1] LV_ERR_DR_SC_VVL = 1                or   /* short circuit on VVL driver */
  [1] LV_ERR_OVL_ECU_VVL = 1              or   /* VVL driver overload */
  [1] LV_ERR_RLY_VVL = 1                  or   /* VVL relay error */
  [1] LV_ERR_VVL_ROT = 1                  or   /* VVL rotation sense error */
  [1] LV_ERR_CUR_H_VVL = 1                     /* VVL motor current critical high */
Then      IF        LV_CRU_ACT_VLD = 1
          THEN  LV_CRU_OFF_IRR = 1
          ELSE  LV_CRU_OFF_IRR = 0
          ENDIF
          REQ_CRU = Hard off
          (The cru readiness lamp is switched off.)
Endif
```

STATE_CRU_OFF_IRR :

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High Byte								Low Byte							
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		13	12			11	10	9	8	7	5	4	3	2	1
		14									6				
-----------------	-----------------	ASR/TCS-Error	Error VS	-----------------	-----------------	VS plausibility	Monitoring level 2	error instrument message	CAN Bus off	Brake error	AMT/ETCU-Error	MSW error	Error clutch switch	PVS-Error	VVL-Error

External adjustment:

If LV_ACT_CRU_MEM_EXT_ADJ = 1
Then STATE_CRU_OFF_IRR = 00H
STATE_CRU_OFF_REV = 00H
Endif

If LC_N_MAX_VS_MAX_ACT = 1
Then LV_VS_MAX_VSL_1 = LV_VS_MAX
Else LV_VS_MAX_VSL_1 = LV_VS_MAX_VSL
Endif

If one of the following conditions is current in active CRU function, CRU is transferred by hard cut-off (FAC_TQ_CRU = 0) into the ready state without controlled drive:

If LV_CRU_MAIN_SWI = 0 **or** /* main switch off */
[1] VS_CRU $<$ C_VS_MIN_PLAUS_CRU **or** /* speed under min. threshold */
LV_ES = 1 **or** /* Engine stop */
[2] LV_BRAKE_DET = 1 **or** /* Brake switch */
[3] LV_N_MAX = 1 **or** /* active engine speed limitation */
[4] **(**LV_AT = 0 **and** LV_VAR_AMT = 0 **and** LV_VAR_TCT = 0 **and**
|(N_VS_CRU$_n$ - N_VS_CRU$_{n-1}$) /N_VS_CRU$_{n-1}$| * 100 $>$ C_N_VS_MAX_CRU**)**
or /* implausible N/VS-ratio with MT*/
[5] **(**LV_CRU_OVER_ACT = 0 **and** |AC_CRU| $>$ C_AC_MAX_CRU**)**
or /* maximum acceleration exceeded

(not during overtaking function) */

(LV_AT = 0 **and** LV_VAR_AMT = 0 **and** LV_VAR_TCT = 0) **and**
LV_IM_CS_PN = 1**)** **or** /* clutch actuation with MT */
[6] **(**LV_ERR_VS_CAN = 1 **and**

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T_ERR_VS_CAN = 0) **or** /* Error on CAN signal VS_CAN */
((LV_AT = 1 **or** LV_VAR_AMT = 1 **or** LV_VAR_TCT = 1) **and**
GEAR_INFO = 0 or AH**)** **or**/*illegal gear info with AT or AMT/TCT*/
[7] REQ_MSW = "HARD_OFF" **or** /* MSW-request */
[8] **(**LV_CRU_OVER_ACT = 1 **and** LV_VS_MAX_VSL_1 = 1**)**
or
(LV_VAR_BN = 1 **and**
(STATE_TCS_DECE = 02H **or**
STATE_IF_ICL_BN_MSW = 001**))** **or**
[15] LV_TQI_REQ_CAN_INH = 1 or /* Error in TPS/ETC */
[16] (STATE_DHL_CTL > 0H **and** STATE_DHL_CTL < FH) /* hill descent control active */

Then REQ_CRU = Hard off
Endif

G.4.2.2 Conditions for soft cut-off:

General information:

If one of the following conditions is detected, the controller function is switched off. In this FAC_TQ_CRU is set through ramp function to zero.

Formula section:

If
[9] REQ_MSW = SOFT_OFF **or** /* MSW-request */
[10] [LV_CRU_OVER_ACT = 0 **and**
(VS_DIF_CRU > C_VS_SP_DIF_MAX_CRU **or**
VS_DIF_CRU < C_VS_SP_DIF_MIN_CRU)]
or /* control deviation too large */
[11] [LV_CRU_OVER_ACT = 1 **and**
((T_DLY_CRU   C_T_DLY_MAX_CRU) **or**
(VS_SP_DRIV_CRU - VS_CRU   C_VS_DIF_DLY_CRU_POS) **or**
(VS_SP_DRIV_CRU - VS_CRU < C_VS_DIF_DLY_CRU_NEG))]
or
[12] (VS_CRU   VS_SP_CRU_MAX for longer than C_T_DLY_VS_SP_CRU_MAX) *Remark: if this condition is interupted than time-counter is reset to 0*
or
[13] ASR- or ESP-control for minimum time active
(LV_CRU_OFF_BY_ASR_ESP_CTL = 1)

Then REQ_CRU = Soft off
Endif

STATE_CRU_OFF_REV :

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High Byte								Low Byte							
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
7	2	3	1	8	4	5	6		16	15	9	13	12	11	10
MSW request HARD_OFF	Brake detection	Engine speed limitation	VS_CRU to low	Overtaking and VS_MAX active	Runup lock	Acceleration monitoring	Error VS_CAN to long	-------------------------------	Hill descent control (HDC) active	TPS/ETC-Error	MSW request "off"	External TQ intervention	VS_SP_MAX to long	Overtaking Funct. To long or to high VS_DIF	To high VS deviation

G.4.2.3 Overtaking function

Description:

If the throttle wish FAC_TQ_REQ_DRIV $>$ FAC_TQ_REQ_CRU and $\geq$ IP_FAC_TQ_REQ_CLU_IS__N_32 , then the controlled detectes overtaking and the value VS_DIF_I_CRU remains stored as threshold value. The time for the overtaking function T_DLY_CRU is started. The adjustable time C_T_DLY_MAX_CRU states whether starting controlled constant drive is possible after ending the overtaking function.

During the overtaking function, 'Overdriving' FAC_TQ_REQ_DRIV by the acceleration (ACC) and Tip-up functions is possible.

If the time C_T_DLY_MAX_CRU or the max. Deviation from the stored target speed is exceeded, no automatic start of controlled constant drive is possible any more. The CRU mode is ended. The functions of the cruise control can be activated again exclusively by the multifunction steering wheel. At resume the after overtaking function is finished the resume function is activated with the initilisation calculation of VS_DIF_I_CRU.

During the overtaking function the calculation of FAC_TQ_CRU is calculated normal with freezed **I** -share and calculated P-Share.

Application conditions

Initialisation: *LV_CRU_OVER_ACT = 0*

Formula section:

If LV_CRU_OVER_ACT = 0
Then **If** (STATE_CRU = constant drive **or** tip) **and**
REQ_MSW != TIP_UP **and**
REQ_MSW != SET_ACC **and**
(REQ_MSW != TIP_DOWN **and**
REQ_MSW != DECE **or**
LV_VAR_BN = 0) **and** FAC_
TQ_REQ_DRIV $>$ FAC_TQ_REQ_CRU **and**
FAC_TQ_REQ_DRIV $>$ IP_FAC_TQ_REQ_CLU_IS__N_32
Then T_DLY_CRUn = T_DLY_CRUn-1 + 10 ms

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```
                    LV_CRU_OVER_ACT = 1
                    // "VS_DIF_I_CRU stored see calculation of I-Share"
            Endif
Endif

If     LV_CRU_OVER_ACT = 1
Then        If (FAC_TQ_REQ_DRIV < FAC_TQ_REQ_CRU -C_FAC_TQ_REQ_HYS_CRU
                FAC_TQ_REQ_DRIV < IP_FAC_TQ_REQ_CLU_IS__N_32 - C_FAC_TQ_REQ_
                CLU_IS_HYS)
                                              and
                 VS_DIF_CRU > C_VS_DIF_MIN_CRU_OVER
            Then  LV_CRU_OVER_ACT = 0
            Else  If       REQ_MSW = TIP_UP                    or
                          (REQ_MSW = TIP_DOWN   and
                          LV_VAR_BN = 1)
                  Then If          LV_CRU_OVER_ACT_ACK = = 1
                          Then  LV_CRU_OVER_ACT = 0
                          Endif
                         REQ_CRU = REQ_MSW
                  Endif
            Endif
Endif


If              LV_CRU_ACT = 0 → 1          and      VS_CRU ≤ VS_SP_CRU_MAX
Then        If         LV_VAR_BN = 1                      and
                 (REQ_MSW = TIP_DOWN   or
                 REQ_MSW = DECE          or
                REQ_MSW = MARK_UP       or
                REQ_MSW = MARK_DOWN)
            Then  REQ_CRU = SET_ACC
            Endif
Endif

If     LV_CRU_ACT = 1      and      LV_CRU_OVER_ACT = 0
Then        If         REQ_MSW = MARK_UP       or       REQ_MSW = MARK_DOWN
            Then  REQ_CRU = NONE
            Else   REQ_CRU = REQ_MSW
            Endif
Endif
```

G.4.2.4 Condition for cruise control intervention

Description:

The cruise control intervention is active if the vehicle is in operation depending of FAC_TQ_CRU. The Status is needed in the Cruise control monitoring of ETC Safety Unit.
If an MSW request is active but LV_CRU_ACT stays 0 due to environmental conditions (VS_CRU < VS_MIN_CRU, "Soft off", "Hard off" etc.) LV_CRU_ACT_INH is set.

Formula section:

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If LV_CRU_ACT = 0 **and**
(LV_MSW_IDLE = 1 **or**
(LV_CRU_MAIN_SWI = 0 → 1 **and**
LV_VAR_BN = 1)) **and**
VS_CRU >= VS_MIN_CRU **and**
((REQ_MSW = TIP_UP **or** SET/ACC) **or**
(LV_VAR_BN = 1 **and**
(REQ_MSW = TIP_DOWN **or** DECE **or** MARK_UP **or** MARK_DOWN)) **or**
(REQ_MSW = RES **and**
Triggering the RES function for plausible VS_SP_DRIV_CRU
(VS_MIN_CRU <= VS_SP_DRIV_CRU <= VS_SP_CRU_MAX)))
Then LV_CRU_ACT = 1
Endif

LV_CRU_ACT is reseted to 0 if an off condition is present.

If LV_CRU_ACT = 1 **and** REQ_CRU = "Soft off" or "Hard off"
Then LV_CRU_ACT = 0
Endif

If LV_CRU_ACT = 0 **and** REQ_MSW > 1H **and** REQ_MSW != 7H
and LV_CRU_OFF_IRR = 0
Then LV_CRU_ACT_INH = 1
Else LV_CRU_ACT_INH = 0
Endif

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G.5 Cruise control basic functions

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_CRU	O/V	0... FFFFH	0... 99.99847	1.53e-3	%
CRU control variable					
FAC_TQ_CRU_INI	V	0... FFFFH	0... 99.99847	1.53e-3	%
CRU control variable initialisation value					
FAC_VS_CTL_CRU	V	0... FFH	0... 1.99218	0.0078125	-
Correction factor for actuating the reference input variable					
FAC_VS_LGRD_CRU	V	0... FFH	0... 0.99609	3.91e-3	-
Factor for intercepting the reference input variable					
LV_CRU_OVER_ACT_ACK	O/V	0... 1H	0 ...1	1	-
Hand shake overtaking function					
STATE_I_CRU	V	1H 2H 3H	LIM FREEZE NORM	-	-
Condition of I Share VS_DIF_I_CRU					
T_CTL_CRU	V	0... FFH	0... 25.5	0.1	s
Time of the controlled acceleration					
VS_DIF_CRU	O/V	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Control deviation					
VS_DIF_I_CRU	V	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Sum of the control deviations					
VS_SP_CRU	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
Reference input variable of the controller					
VS_SP_CRU_MAX	O/V	0... FFFFH	0... 511.99218	0.0078125	km/h
maximum limitation of cruise control					
VS_SP_DEC_CRU	V	0... FFFFH	0... 511.99218	0.0078125	km/h
Decrement for VS_SP_CRU					
VS_SP_DIF_CRU	V	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Target variable/reference input variable difference					
VS_SP_DRIV_CRU	V	0... FFFFH	0... 511.99218	0.0078125	km/h
Driver wish target variable					
VS_SP_INC_CRU	V	0... FFFFH	0... 511.99218	0.0078125	km/h
Increment for VS_SP_CRU					

Input data:

AC_CRU {p. 7215}	C_FAC_TQ_REQ_CLU_IS_HYS {p. 1442}	FAC_TQ_REQ_CRU {p. 6737}	FAC_TQ_REQ_DRIV {p. 6570}
FAC_TQ_REQ_DRIV_MMV {p. 7215}	GEAR {p. 1302}	IP_FAC_TQ_REQ_CLU_IS__N_32 {p. 1442}	LV_AT {p. 654}

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LV_CRU_MAIN_SWI {p. 7220}	LV_CRU_OVER_ACT {p. 7227}	LV_IGK {p. 906}	LV_RNG_L_REQ {p. 6570}
LV_STEP_ON_ACT {p. 7201}	LV_VAR_BN {p. 655}	N {p. 1525}	N_32 {p. 1525}
REQ_CRU {p. 7227}	REQ_MSW {p. 7220}	STATE_CC {p. 1571}	STATE_CRU {p. 7227}
STATE_VS_ICL_DISP {p. 1578}	T_CTL_CRU {p. 7237}	VS_CRU {p. 7215}	VS_MIN_CRU {p. 7227}
VS_SP_DRIV_STEP {p. 7201}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_AC_NEG_CRU_DEACC	-	0... 5C28H	0... 511.9789	21.7e-3	m/s**2
Negative acceleration in deceleration					
C_AC_NEG_CRU_TIP	-	0... 5C28H	0... 511.9789	21.7e-3	m/s**2
Positive acceleration for Tip-up					
C_AC_POS_CRU_DEACC	-	0... 5C28H	0... 511.9789	21.7e-3	m/s**2
Positive acceleration					
C_AC_POS_CRU_TIP	-	0... 5C28H	0... 511.9789	21.7e-3	m/s**2
Positive acceleration for Tip-up					
C_FAC_AC_POS_CRU	-	0... FFH	0... 0.99609	3.91e-3	-
Maximum reduction of FAC_VS_LGRD_CRU					
C_FAC_AC_POS_CRU_RNG_L	-	0... FFH	0... 0.99609	3.91e-3	-
Maximum reduction of FAC_VS_LGRD_CRU at RNG_L					
C_FAC_TQ_CRU_LGRD	-	0... FFFFH	0... 99.99847	1.53e-3	%/100ms
Control variable limitation gradient					
C_FAC_TQ_CRU_MAX	-	0... FFFFH	0... 99.99847	1.53e-3	%
Maximum request of Cruise Control					
C_FAC_TQ_CRU_OFS	-	0... FFFFH	0... 99.99847	1.53e-3	%
Offset for cruise control variable					
C_FAC_VS_DIF_RNG_CRU	-	0... FFH	0... 0.99609	3.91e-3	-
Reduction factor for the control deviation VS_DIF_CRU					
C_T_MIN_CRU_CON	-	0... FFH	0... 25.5	0.1	s
Time condition for controlled acceleration					
C_T_MIN_PUC_CRU	-	0... FFH	0... 25.5	0.1	s
Time after entry into controlled constant drive					
C_VS_AC_MAX_CRU	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for acceleration valuation					
C_VS_AC_MIN_CRU	-	0... FFH	0... 255	1	km/h
Vehicle speed threshold for acceleration valuation					
C_VS_DIF_DELTA_I	-	0... FFH	0... 63.75	0.25	km/h
Positive acceleration					
C_VS_DIF_MAX_AC_CRU	-	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Condition for interrupting the incrementation or decrementation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VS_DIF_MAX_CRU	-	0... FFH	0... 31.875	0.125	km/h
Control difference threshold for incrementing VS_SP_CRU					
C_VS_DIF_MAX_IS_CRU	-	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Threshold of the control deviation for PUC end					
C_VS_DIF_MIN_AC_CRU	-	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Condition for interrupting the incrementation or decrementation					
C_VS_DIF_MIN_IS_CRU	-	8000... 7FFFH	-256... 255.99218	0.0078125	km/h
Threshold of the control deviation for zero setting of FAC_TQ_CRU					
C_VS_DIF_RNG_CRU	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Bandwidth for reducing the control deviation					
C_VS_DIF_TIP_K	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Km per tip in case of km - icl					
C_VS_DIF_TIP_M	-	0... FFFFH	0... 511.99218	0.0078125	km/h
Km per tip in case of mile - icl					
C_VS_SP_CRU_MAX_K	-	0... FFFFH	0... 511.99218	0.0078125	km/h
maximum limitation of cruise control in case of KM - ICL					
C_VS_SP_CRU_MAX_M	-	0... FFFFH	0... 511.99218	0.0078125	km/h
maximum limitation of cruise control in case of Mile - ICL					
ID_AC_POS_CRU_AC	-	0... 5C28H	0... 511.9789	0.0217014	m/s**2
LDPM_GEAR_CRU	8	0... FFH	0... 255	1	-
Positive acceleration in setting/acceleration depending on GEAR					
ID_AC_POS_CRU_AC_RNG_L	-	0... 5C28H	0... 511.9789	0.0217014	m/s**2
LDPM_GEAR_CRU	8	0... FFH	0... 255	1	-
Positive acceleration in setting/acceleration at RNG_L depending on GEAR					
ID_AC_POS_CRU_RESU	-	0... 5C28H	0... 511.9789	0.0217014	m/s**2
LDPM_GEAR_CRU	8	0... FFH	0... 255	1	-
Positive acceleration at CRU resume depending on GEAR					
ID_AC_POS_CRU_RESU_RNG_L	-	0... 5C28H	0... 511.9789	0.0217014	m/s**2
LDPM_GEAR_CRU	8	0... FFH	0... 255	1	-
Positive acceleration at CRU resume at RNG_L depending on GEAR					
IP_AC_NEG_CRU_AC__N__FAC_TQ_CRU	V	0... 5C28H	0... 511.9789	21.7e-3	m/s**2
LDPM_N_21	3	0... FFH	0... 8160	32	rpm
LDPM_FAC_TQ_CRU_1	3	0... FFFFH	0... 99.99847	1.53e-3	%
Negative acceleration in setting/acceleration					
IP_AC_NEG_CRU_RESU	V	0... 5C28H	0... 511.9789	21.7e-3	m/s**2
LDPM_N_21	3	0... FFH	0... 8160	32	rpm
LDPM_FAC_TQ_CRU_1	3	0... FFFFH	0... 99.99847	1.53e-3	%
Negative acceleration at CRU resume					
IP_FAC_CC_CRU_AC__T_CTL_CRU	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_T_CTL_CRU_1	5	0... FFH	0... 25.5	0.1	s
Correction factor of in/decrementing					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_CC_CRU_DECE__T_CTL_CRU	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_T_CTL_CRU_1	5	0... FFH	0... 25.5	0.1	s
Correction factor of in/decrementing					
IP_FAC_CRU_AC__T_CTL_CRU	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_T_CTL_CRU_1	5	0... FFH	0... 25.5	0.1	s
Correction factor of in/decrementing					
IP_FAC_CRU_DECE__T_CTL_CRU	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_T_CTL_CRU_1	5	0... FFH	0... 25.5	0.1	s
Correction factor of in/decrementing					
IP_FAC_CRU_REST__T_CTL_CRU	-	0... FFH	0... 1.99218	0.0078125	-
LDPM_T_CTL_CRU_1	5	0... FFH	0... 25.5	0.1	s
Correction factor of in/decrementing					
IP_FAC_LGRD_CRU_REST__VS_SP_DIF	-	0... FFH	0... 0.99609	3.91e-3	-
LDPM_VS_SP_DIF_CRU_1	5	0... FFFFH	-256... 255.99218	0.0078125	km/h
Interception factor of the in/decrementing (xx = REST, TIP)					
IP_FAC_LGRD_CRU_TIP__VS_SP_DIF	-	0... FFH	0... 0.99609	3.91e-3	-
LDPM_VS_SP_DIF_CRU_1	5	0... FFFFH	-256... 255.99218	0.0078125	km/h
Interception factor of the in/decrementing (xx = REST, TIP)					
IP_FAC_PROP_CRU	V	0... FFFFH	0... 49.99923	763e-6	%/(km/h)
LDPM_VS_SP_CRU__1	5	0... FFFFH	0... 511.99218	0.0078125	km/h
LDP_VS_DIF_CRU__FAC_PROP_CRU	4	0... FFFFH	-256... 255.99218	0.0078125	km/h
Proportional coefficient of the PI controller					
IP_FAC_TQ_CRU_DEC__N_32	-	0... FFFFH	0... 99.99847	1.53e-3	%
LDP_N_32__FAC_TQ_CRU	5	0... FFH	0... 8160	32	rpm
Decrement of the FAC_TQ_CRU					
IP_FAC_TQ_CRU_INI_ADD_AT	V	0... FFFFH	-200... 199.99389	6.1035e-3	%/(m/s**2)
LDP_AC_CRU__FAC_TQ_CRU	6	0... FFFFH	-15.72... 15.71952	479.7e-6	%
LDP_GEAR__FAC_TQ_CRU	12	0... FFH	0... 255	1	-
Additive torque based on gear and acceleration					
IP_FAC_TQ_CRU_INI_ADD_MT	V	0... FFFFH	-200... 199.99389	6.1035e-3	%/(m/s**2)
LDP_AC_CRU__FAC_TQ_CRU	6	0... FFFFH	-15.72... 15.71952	479.7e-6	%
LDP_GEAR__FAC_TQ_CRU	12	0... FFH	0... 255	1	-
Additive torque based on gear and acceleration					
IP_FAC_VS_DIF_I_CRU	V	0... FFFFH	0... 0.99998	15.3e-6	-
LDPM_VS_SP_CRU__1	5	0... FFFFH	0... 511.99218	0.0078125	km/h
LDP_VS_DIF_CRU__FAC_PROP_CRU	4	0... FFFFH	-256... 255.99218	0.0078125	km/h
Proportional coefficient of the PI controller					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_VS_SP_DIF_I_CRU	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDPM_VS_SP_CRU__1	5	0... FFFFH	0... 511.99218	0.0078125	km/h
Delta VS_SP_CRU correction					

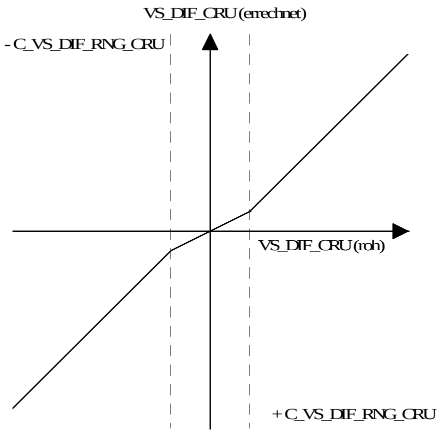
G.5.1 General calculation of cruise control and constant drive

Application conditions:

Recurrence: 100 ms
Initialisation: FAC_TQ_CRU = FAC_TQ_CRU_INI based on setting conditions

FUNCTION DESCRIPTION:

Description:
On setting in PU/PUC or with very small FAC_TQ_REQ_DRIV (driver gets off the pedal bevor setting Cruise Control), a very small I component setpoint (or 0) would be the results and it follows an undershooting below the required target speed. To prevent this, the I share set value is calculated depending on AC_CRU so that a minimum FAC_TQ_CRU results.



Formula section:

Basically calculation for all cruise states:

Total formula:
FAC_TQ_CRU = (VS_DIF_CRU + VS_DIF_I_CRU) * IP_FAC_PROP_CRU

Conditions for change limitations of FAC_TQ_CRU:

FAC_TQ_CRU$_{n-1}$- FAC_TQ_CRU$_{n}$ C_ FAC_TQ_CRU_LGRD
At driving by cruise control it should not be possible to request the maximum torque as well outside cruise control.
FAC_TQ_CRU <= C_ FAC_TQ_CRU_MAX

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The non-linearized value of the control deviation from the reference input variable VS_SP_CRU and the control variable VS_CRU is calculated as

VS_DIF_CRU (rough)= VS_SP_CRU - VS_CRU

To achieve a quiet control in the range of the target variable, the internal control deviation VS_DIF_CRU can be reduced in the adjustable bandwidth | C_VS_DIF_RNG_CRU | by an applicable factor C_FAC_VS_DIF_RNG_CRU.

IF(1) |VS_SP_CRU - VS_CRU | C_VS_DIF_RNG_CRU
Then(1) VS_DIF_CRU = (VS_SP_CRU - VS_CRU) * C_FAC_VS_DIF_RNG_CRU
Else(1) If(2) (VS_SP_CRU - VS_CRU) > C_VS_DIF_RNG_CRU
Then(2) VS_DIF_CRU = (VS_SP_CRU - VS_CRU) - C_VS_DIF_RNG_CRU + C_VS_DIF_RNG_CRU * C_FAC_VS_DIF_RNG_CRU.
Else(2) VS_DIF_CRU = (VS_SP_CRU - VS_CRU) + C_VS_DIF_RNG_CRU * C_FAC_VS_DIF_RNG_CRU.
Endif (2)
Endif(1)

<u>I share calculation:</u>

Basically there are 3 states of STATE_I_CRU: NORM, LIM and FREEZE (for detailed information see formula section below)
If the FAC_TQ_CRU is on limitation (max, min value or freeze at PUC) then the I share is freezed **STATE_I_CRU = LIM** until a normal calculation of FAC_TQ_CRU is possible again. At constant driving or LV_CRU_OVER_ACT = 1 the I share is freezed **STATE_I_CRU = LIM** but in the calculation of FAC_TQ_CRU there is no interupt.

Calculation in case of controller active:

If REQ_CRU = SOFT_OFF
Then STATE_I_CRU = LIM
Else **If** [STATE_CRU = DEC **AND**
(VS_DIF_I_CRU + C_VS_DIF_DELTA_I - IVS_DIF_CRUI >= 0)] **OR**
[STATE_CRU = CONST_DRIVE **AND**
LV_CRU_OVER_ACT = 0 **AND**
FAC_TQ_CRU > (IP_FAC_TQ_REQ_CLU_IS__N_32 -
C_FAC_TQ_REQ_CLU_IS_HYS) * 99,998%)
+ C_FAC_TQ_CRU_OFS **AND**
FAC_TQ_CRU < C_FAC_TQ_CRU_MAX]
Then // General calculation

STATE_I_CRU = NORM
VS_DIF_I_CRU $_N$ = VS_DIF_I_CRU $_{N-1}$ + VS_DIF_CRU * IP_FAC_VS_DIF_I_CRU
VS_SP_CRU$_{START}$= VS_SP_CRU
VS_DIF_I_CRU$_{START}$= VS_DIF_I_CRU
Else **If** STATE_CRU = SET_ACC **OR**
STATE_CRU = RESUME
Then *// Calculation during freeze of I share at SET/ACC, RES*

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STATE_I_CRU = FREEZE
VS_SP_CRU_STAT = VS_SP_CRU$_n$ - VS_SP_CRU$_{START}$
VS_DIF_I_CRU= VS_DIF_I_CRU$_{START}$ +
IP_FAC_VS_SP_DIF_I_CRU * VS_SP_CRU_STAT
Else *// Calculation during limitation of I share*

STATE_I_CRU = LIM
VS_SP_CRU$_{START}$= VS_SP_CRU
VS_DIF_I_CRU$_{START}$= VS_DIF_I_CRU
Endif
Endif
Endif

Calculation in case of controller passive:

Initialisation value calculated once on transition passive to active:

IF LV_AT = 0
Then FAC_TQ_CRU_INI = FAC_TQ_REQ_DRIV_MMV * 99,998 % +
IP_FAC_TQ_CRU_INI_ADD_MT * AC_CRU
Else FAC_TQ_CRU_INI = FAC_TQ_REQ_DRIV_MMV * 99,998 % +
IP_FAC_TQ_CRU_INI_ADD_AT * AC_CRU
endif
VS_DIF_I_CRU = FAC_TQ_CRU_INI /IP_FAC_PROP_CRU

VS_SP_CRU$_{START}$= VS_SP_CRU
VS_DIF_I_CRU$_{START}$= VS_DIF_I_CRU
Disable gradient limitation for FAC_TQ_CRU once

G.5.1.1 Controlled constant drive (CONST_DRIVE)

For controlled constant drive, the reference input variable VS_SP_CRU corresponds to the last target speed value reached, i.e. VS_SP_DRIV_CRU. No control of the reference input variable is performed in this range.
With the basic function of control, the vehicle speed is controlled corresponding to the required reference input variable VS_SP_CRU. This occurs until a cut-off condition arises or a condition for cruise control is infringed. The resume function is locked in the controlled constant drive. On recognition of other CRU functions, the reference input variable is controlled. To be able to trigger trailing throttle cut-off expediently, the value FAC_TQ_CRU is initially limited downwards to the value ((IP_FAC_TQ_REQ_CLU_IS__N_32 - C_FAC_TQ_REQ_CLU_IS_HYS)*99,998%). Thus there can be no IS output. Only if the control deviation VS_DIF_CRU drops below the applicable value C_VS_DIF_MIN_IS_CRU is FAC_TQ_CRU set equal to zero. However, this zero setting takes place at the earliest C_T_MIN_PUC_CRU seconds after entry into controlled constant drive. The trailing throttle cut-off is retained until the control deviation exceeds the applicable value C_VS_DIF_MAX_IS_CRU.

Formula section:

FAC_TQ_CRU conditions:
IF T_CONST_DRIVE < C_T_MIN_PUC_CRU
Then **If** FAC_TQ_CRU < ((IP_FAC_TQ_REQ_CLU_IS__N_32-
C_FAC_TQ_REQ_CLU_IS_HYS) * 99,998%)
+ C_FAC_TQ_CRU_OFS

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then FAC_TQ_CRU = ((IP_FAC_TQ_REQ_CLU_IS__N_32-
C_FAC_TQ_REQ_CLU_IS_HYS) * 99,998%)
+ C_FAC_TQ_CRU_OFS

endif

ElseIF VS_DIF_CRU $<$ C_VS_DIF_MIN_IS_CRU & &
FAC_TQ_CRU $<$ ((IP_FAC_TQ_REQ_CLU_IS__N_32-
C_FAC_TQ_REQ_CLU_IS_HYS) * 99,998%)
+ C_FAC_TQ_CRU_OFS

Then FAC_TQ_CRU = 0

Else **IF** VS_DIF_CRU $>$ C_VS_DIF_MAX_IS_CRU

Then **If** FAC_TQ_CRU $<$ ((IP_FAC_TQ_REQ_CLU_IS__N_32-
C_FAC_TQ_REQ_CLU_IS_HYS) * 99,998%)
+ C_FAC_TQ_CRU_OFS

Then FAC_TQ_CRU = ((IP_FAC_TQ_REQ_CLU_IS__N_32-
C_FAC_TQ_REQ_CLU_IS_HYS) * 99,998%)
+ C_FAC_TQ_CRU_OFS

Endif

Else calculation FAC_TQ_CRU $_n$= calculation FAC_TQ_CRU $_{n-1}$

Endif

G.5.1.2 Cut-off of the CRU function

General information:

Soft cut-off

In the soft cut-off of the cruise control, the cruise control wish FAC_TQ_REQ_CRU is reduced to the driver wish FAC_TQ_REQ_DRIV with the adjustable decrement IP_FAC_TQ_CRU_DEC __N_32 for FAC_TQ_REQ_DRIV $<$ FAC_TQ_REQ_CRU until the pedal driver demand is reached. FAC_TQ_CRU is then set to zero.

Hard cut-off

In the hard cut-off mode of the cruise control, the charge wish FAC_TQ_CRU is set equal to zero. There is no limitation gradient. The CRU State is readiness.

Application conditions:

Activation: see Capter:Cut -off Conditions and switch- on prohibitions

Formula section:

Soft cut-off

For FAC_TQ_REQ_DRIV $<$ FAC_TQ_REQ_CRU there results:

FAC_TQ_CRU = FAC_TQ_CRU n-1 - IP_FAC_TQ_CRU_DEC __N_32 until

FAC_TQ_REQ_DRIV = FAC_TQ_REQ_CRU

Hard cut-off

FAC_TQ_CRU = 0

Then, the CRU ready status is reached. Only now can the CRU mode be activated again.

G.5.2 Controlled acceleration

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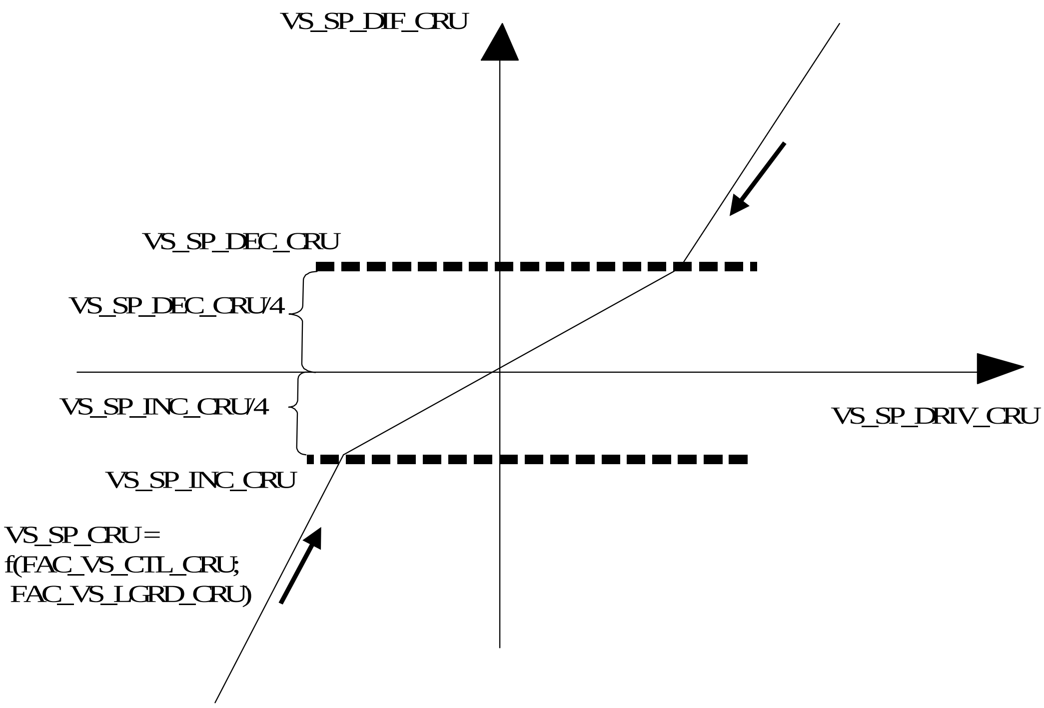
FUNCTION DESCRIPTION:

Application conditions:

Initialisation: VS_SP_CRU = VS_CRU

Description:



The reference input variable VS_SP_CRU is set equal to the instantaneous speed of the vehicle VS_CRU at the start of the function.
The controlled acceleration of the vehicle is performed by controlled in/decrementation of the reference input variable of the cruise control. On start of the function, the time T_CTL_CRU is started and incremented in each computing cycle.
Is VS_SP_CRU is brought close to VS_SP_DRIV_CRU with fixed increment (VS_SP_DEC_CRU/4 or VS_SP_INC_CRU/4).
A distinction is made between positive and negative acceleration.
FAC_VS_CTL_CRU and FAC_VS_LGRD_CRU are set by the momentarily active function of the cruise control, see following subchapter.

Formula section:

T_CTL_CRUn = T_CTL_CRUn-1 + 100 ms
VS_SP_DIF_CRU = VS_SP_CRU - VS_SP_DRIV_CRU
IF(1) 0 < VS_SP_DIF_CRU VS_SP_DEC_CRU
Then(1) VS_SP_CRUn = VS_SP_CRUn-1- VS_SP_DEC_CRU /4
Else(1)
IF(2) VS_SP_DIF_CRU > VS_SP_DEC_CRU > 0
Then(2) VS_SP_CRUn = VS_SP_CRUn-1
- VS_SP_DEC_CRU :Decrement
* FAC_VS_CTL_CRU :Factor for controlling
* FAC_VS_LGRD_CRU :Factor for intercepting
Else(2)
If(3) (-1 * VS_SP_INC_CRU) VS_SP_DIF_CRU < 0

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Then(3) VS_SP_CRUn = VS_SP_CRUn-1+ VS_SP_INC_CRU/4
Else(3)
If(4) VS_SP_DIF_CRU < (-1 * VS_SP_INC_CRU)
Then(4) VS_SP_CRUn = VS_SP_CRUn-1
+ VS_SP_INC_CRU :Increment
* FAC_VS_CTL_CRU :Factor for controlling
* FAC_VS_LGRD_CRU :Factor for intercepting
Endif

Set of VS_SP_CRU in case of driver intervention:
If (STATE_CRU = Set_acc **or** Retard) **and**
LV_VAR_BN = 1 **and**
FAC_TQ_REQ_DRIV > FAC_TQ_REQ_CRU **and**
FAC_TQ_REQ_DRIV > IP_FAC_TQ_REQ_CLU_IS__N_32 **and**
VS_CRU > VS_SP_CRU
Then VS_SP_CRU = Min(VS_CRU, VS_SP_CRU_MAX)
Endif

Dec /Incrementation is interrupted if
VS_DIF_CRU > C_VS_DIF_MAX_AC_CRU **or**
VS_DIF_CRU < C_VS_DIF_MIN_AC_CRU

Dec /Incrementation is continued if
VS_DIF_CRU C_VS_DIF_MAX_AC_CRU **or**
VS_DIF_CRU C_VS_DIF_MIN_AC_CRU

G.5.3 Actuating the reference input variable

General information:
The multiplicative correction factor FAC_VS_CTL_CRU for in/decrementation the reference input variable in the controlled acceleration is calculated in each case for the individual functions of the cruise control. Also for automatic transmission, a distinction is made partially whether the converter clutch is just open or closed. The correction factor depends upon the time T_CTL_CRU. While the actuation of this function is active, the calculation of the I component is interrupted. The sum of the I component thus remains constant.

Formula section:

FAC_VS_CTL_CRU = IP_FAC_XX_CRU_yy__T_CTL_CRU

A distinction is made between the following CRU functions:

Resume: IP_FAC_CRU_REST__T_CTL_CRU

Setting/acceleration: **IF** LV_AT = 0 **or** (LV_AT = 1 **and** STATE_CC != open)
Manual gear or automatic **Then** IP_FAC_CRU_AC__T_CTL_CRU
with closed converter clutch
Automatic with open converter **Else** IP_FAC_CC_CRU_AC__T_CTL_CRU
Clutch **Endif**

Deceleration: **IF** LV_AT = 0 **or** (LV_AT = 1 **and** STATE_CC != open)
Manual gear or automatic **Then** IP_FAC_CRU_DECE__T_CTL_CRU
with closed converter clutch
Automatic with open converter **Else** IP_FAC_CC_CRU_DECE__T_CTL_CRU

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Clutch **Endif**

G.5.4 Intercepting the reference input variable target acceleration

General information:

To take account of the vehicle dynamics, the positive accelerations for high speeds as from approx. 80 k.p.h. must be reduced in the setting/acceleration and resume functions. For this purpose, the accelerations must be valued with a factor FAC_VS_LGRD_CRU for in/decrementing the reference input variable. The acceleration is valued with 1 below the threshold C_VS_AC_MIN_CRU. If VS_SP_CRU exceeds this threshold, then the factor FAC_VS_LGRD_CRU is reduced linearly by a ramp function up to the upper threshold C_VS_AC_MAX_CRU. The maximum reduction can be set through the value C_FAC_AC_POS_CRU.

To achieve comfortable interception of the reference input variable, the multiplicative correction factor, which is limited dependent on speed, must be calculated when in/decrementing the reference input variable in each case for the individual functions of the cruise control. While the interception of the reference input variable function is active, the calculation of the I component is interrupted. The sum of the I component remains constant. The correction factor depends upon the difference between reference input variable and target variable.

Formula section:

IF VS_SP_CRU $<$ C_VS_AC_MIN_CRU
Then FAC_VS_LGRD_CRU = 1
Else If VS_SP_CRU $>$ C_VS_AC_MAX_CRU
Then **IF** LV_RNG_L_REQ = 1
Then FAC_VS_LGRD_CRU = C_FAC_AC_POS_CRU_RNG_L
Else FAC_VS_LGRD_CRU = C_FAC_AC_POS_CRU
Else FAC_VS_LGRD_CRU = FAC_VS_LGRD_CRU$_{vehicle-speed-dependent}$
* IP_FAC_LGRD_CRU_xx__VS_SP_DIF

During the acceleration IP_FAC_LGRD_CRU_xx__VS_SP_DIF = 1
(FAC_VS_LGRD_CRU = FAC_VS_LGRD_CRU$_{vehicle-speed-dependent}$)

- Resume (RES): IP_FAC_LGRD_CRU_REST__VS_SP_DIF
- Tip Up and Tip down: IP_FAC_LGRD_CRU_TIP__VS_SP_DIF
(TP_UP, TP_DOWN)

G.5.5 Interventions

Application conditions:

Initialisation: VS_SP_DRIV_CRU = VS_MIN_CRU at LV_IGK 0 to1

Formula section:

IF STATE_VS_ICL_DISP = 1 "km/h; mph"
Then VS_SP_CRU_MAX = C_VS_SP_CRU_MAX_M
Else VS_SP_CRU_MAX = C_VS_SP_CRU_MAX_K
Endif

G.5.5.1 Resume (RES)

Description:

When the resume function is activated, the vehicle is brought to the last target speed with the adjustable positive or negative acceleration. In this case the control basic function is activated and the reference input variable is controlled. When controlling the reference input variable VS_SP_CRU, a distinction is made between a resume to high speeds and a resume to the low speeds.

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In a resume to a target speed, the reference input variable is in /decremented per computing cycle (100 ms).
To achieve a comfortable transition from the CRU status of ready to CRU mode on start of the restart function, the I component of the P/I controller is preallocated depending upon the recognised acceleration of the vehicle. To achieve comfortable acceleration on activating the resume function and on reaching the stored target speed, the control and interception of the reference input variable functions are series connected with the controlled acceleration function. In these functions a multiplicative correction factor is calculated in each case for in/decrementing the reference input variable.
At resume the after overtaking function is finished the resume function is activated with the initilisation calculation of FAC_TQ_CRU.
The alghorithm for Step request is like the State resume. Only VS_SP_DRIV_CRU is set to the current select mark VS_SP_DRIV_STEP. Inside the controller a step request triggers the resume Function.

Formula section:

VS_SP_CRU = VS_CRU

IF VS_CRU $<$ VS_SP_DRIV_CRU
Then IF LV_RNG_L_REQ = 1
Then VS_SP_INC_CRU = 3.6 * ID_AC_POS_CRU_RESU_RNG_L * 100 ms
Else VS_SP_INC_CRU = 3.6 * ID_AC_POS_CRU_RESU * 100 ms
VS_SP_CRU = capter "calculation of controlled acceleration"
Else
If VS_CRU $>$ VS_SP_DRIV_CRU
Then VS_SP_DEC_CRU = 3.6 * IP_AC_NEG_CRU_RESU * 100 ms
VS_SP_CRU = capter "calculation of controlled acceleration"
Endif

G.5.5.2 CRU Step intervention

Formula section:

Normal operation

If LV_STEP_ON_ACT = 1
Then if STATE_CRU != Passiv
Then VS_SP_DRIV_CRU = VS_SP_DRIV_STEP
If VS_SP_DRIV_CRU $>$ VS_SP_CRU
Then **if** VS_SP_CRU $>$ VS_CRU
Then VS_SP_CRU remains unchanged
Else VS_SP_CRU = VS_CRU
Endif
Else **if** VS_SP_CRU $>$ VS_CRU
Then VS_SP_CRU = VS_CRU
Else VS_SP_CRU remains unchanged
Endif
Endif
STATE_CRU = Resume
Endif
Endif

Additional for Overtaking

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If STATE_CRU = Resume **and**
LV_VAR_BN **and**
VS_SP_DRIV_CRU $>$ VS_SP_CRU **and**
VS_SP_CRU$_{(n)}$ VS_SP_CRU$_{(n-1)}$ **and**
FAC_TQ_REQ_DRIV $>$ FAC_TQ_REQ_CRU **and**
FAC_TQ_REQ_DRIV $>$ IP_FAC_TQ_REQ_CLU_IS__N_32 **and**
VS_CRU $>$ VS_SP_CRU
Then VS_SP_CRU = VS_CRU
Endif

G.5.5.3 Setting/acceleration (SET/ACC)

Description:
On activating the setting/acceleration function from the CRU State of ready, the transition to controlled constant drive takes place. Reference input variable VS_SP_CRU and target variable VS_SP_DRIV_CRU are set to the current speed VS_CRU.
On activating the setting/acceleration function from readiness, a timer T_CTL_CRU is started. As long as SET/ACC recognizes that this timer reaches the value C_T_MIN_CRU_CON, the CRU state changes from controlled constant drive to controlled acceleration . The vehicle is brought to the required target speed with the adjustable positive ID_AC_POS_CRU_AC/_RNG_L or negative acceleration IP_AC_NEG_CRU_AC__N__FAC_TQ_CRU. In this case the control basic function is activated and the reference input variable VS_SP_CRU is controlled.

As long as the setting/acceleration function is detected, the incrementation of the reference input variable takes place per computing cycle (100 ms) with the controlled acceleration function.

On ending the setting/acceleration function, the target speed VS_SP_DRIV_CRU is set equal to the achieved vehicle speed VS_CRU. If the target speed VS_SP_DRIV_CRU stored in this way is greater than the instantaneous reference input variable VS_SP_CRU, then the value VS_SP_CRU is incremented further by the value VS_SP_INC_CRU through the controlled acceleration function. If the instantaneous reference input variable VS_SP_CRU is larger than the stored target speed VS_SP_DRIV_CRU, then the reference input variable is decremented with the controlled acceleration function.

Formula section:

REQ_MSW = ACC active:
IF LV_RNG_L_REQ = 1
Then VS_SP_INC_CRU = 3.6 * ID_AC_POS_CRU_AC_RNG_L * 100 ms
Else VS_SP_INC_CRU = 3.6 * ID_AC_POS_CRU_AC * 100 ms
Endif
VS_SP_CRUn = VS_SP_CRUn-1
+ VS_SP_INC_CRU :Increment
* FAC_VS_CTL_CRU :Factor for controlling
* FAC_VS_LGRD_CRU :Factor for intercepting

REQ_MSW = ACC passive:
VS_SP_DRIV_CRU = Min(VS_CRU, VS_SP_CRU_MAX)
IF T_CONST_DRIVE C_T_MIN_CRU_CON
Then IF VS_SP_CRU $<$ VS_SP_DRIV_CRU
Then IF LV_RNG_L_REQ = 1
Then VS_SP_INC_CRU = 3.6 * ID_AC_POS_CRU_AC_RNG_L * 100 ms
Else VS_SP_INC_CRU = 3.6 * ID_AC_POS_CRU_AC * 100 ms

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VS_SP_CRU = capter "calculation of controlled acceleration"
Else
If VS_SP_CRU > VS_SP_DRIV_CRU
Then VS_SP_DEC_CRU = 3.6 * IP_AC_NEG_CRU_AC__N__FAC_TQ_CRU* 100 ms
VS_SP_CRU = capter "calculation of controlled acceleration"
Endif
Endif
Endif

G.5.5.4 Tip-up

Description:

On activating the TIP_UP function, the vehicle is brought to the last target speed reached, i.e. VS_SP_DRIV_CRU plus C_VS_DIF_TIP_M/K [km/h] with the adjustable positive acceleration C_AC_POS_CRU_TIP. In this case the control basic function is activated and the reference input variable VS_SP_CRU is controlled. By each detection of the TIP_UP function, the target speed VS_SP_DRIV_CRU is increased by C_VS_DIF_TIP_M/K [km/h].

If the absolute amount of the difference VS_DIF_CRU is greater than or equal to C_VS_DIF_MAX_CRU, the reference input variable VS_SP_CRU is incremented per computing cycle (100 ms) with the controlled acceleration function by the value:

Formula section:

IF LV_CRU_OVER_ACT = 1 and REQ_CRU = "TIP_UP"
Then VS_SP_CRU = VS_SP_DRIV_CRU = MIN(VS_CRU, VS_SP_CRU_MAX)
LV_CRU_OVER_ACT_ACK = 1
else LV_CRU_OVER_ACT_ACK = 0
endif

IF VS_SP_DRIV_CRU VS_SP_CRU_MAX
Then VS_SP_DRIV_CRU = VS_SP_CRU_MAX
Else if STATE_VS_ICL_DISP = 1
Then VS_SP_DRIV_CRU = VS_SP_DRIV_CRU + C_VS_DIF_TIP_M [km/h]
Else VS_SP_DRIV_CRU = VS_SP_DRIV_CRU + C_VS_DIF_TIP_K [km/h]
Endif
Endif

IF VS_DIF_CRU C_VS_DIF_MAX_CRU
Then VS_SP_INC_CRU = 3.6 * C_AC_POS_CRU_TIP * 100 ms
VS_SP_CRUn = VS_SP_CRUn-1
\+ VS_SP_INC_CRU :Increment
* FAC_VS_CTL_CRU :Factor for controlling
* FAC_VS_LGRD_CRU :Factor for intercepting

Else if STATE_VS_ICL_DISP = 1
Then VS_SP_CRU = VS_SP_CRU + C_VS_DIF_TIP_M [km/h]
Else VS_SP_CRU = VS_SP_CRU + C_VS_DIF_TIP_K [km/h]
Endif
Endif

G.5.5.5 Tip-down

Description:

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On activating the TIP_DOWN function, the vehicle is brought to the last target speed reached, i.e. VS_SP_DRIV_CRU minus C_VS_DIF_TIP_M/K [km/h] by the adjustable negative acceleration C_AC_NEG_CRU_TIP. In this case the control basic function is activated and the reference input variable VS_SP_CRU is controlled. At each detection of the TIP_DOWN function, the target speed VS_SP_DRIV_CRU is reduced by C_VS_DIF_TIP_M/K [km/h].
VS_SP_CRU and VS_SP_DRIV_CRU cannot be less than VS_MIN_CRU.
If the absolute amount of the difference VS_DIF_CRU is greater than or equal to C_VS_DIF_MAX_CRU, the reference input variable VS_SP_CRU is decrements per computing cycle (100 ms) with the controlled acceleration function. The charge wish FAC_TQ_CRUis limited to the value (IP_FAC_TQ_REQ_CLU_IS__N_32*99,998%). so that no trailing throttle cut-off is triggered (except for: PUC was already active before TIP_DOWN).

<u>Formula section:</u>

```
IF              LV_CRU_OVER_ACT = 1          and        REQ_CRU = "TIP_DOWN"
Then        VS_SP_CRU = VS_SP_DRIV_CRU = MIN(VS_CRU; VS_SP_CRU_MAX)
                LV_CRU_OVER_ACT_ACK = 1
else        LV_CRU_OVER_ACT_ACK = 0
endif

IF              VS_SP_DRIV_CRU < VS_MIN_CRU
Then        VS_SP_DRIV_CRU = C_VS_SP_CRU_MIN
Else if      STATE_VS_ICL_DISP = 1
  Then        VS_SP_DRIV_CRU = VS_SP_DRIV_CRU - C_VS_DIF_TIP_M [km/h]
  Else        VS_SP_DRIV_CRU = VS_SP_DRIV_CRU - C_VS_DIF_TIP_K [km/h]
  Endif
Endif

IF              VS_DIF_CRU   C_VS_DIF_MAX_CRU
Then        VS_SP_DEC_CRU   =   3.6   *   C_AC_NEG_CRU_TIP   *   100 ms
        VS_SP_CRUn   =      VS_SP_CRUn-1
                              -  VS_SP_DEC_CRU              :Decrement
                              *  FAC_VS_CTL_CRU              :Factor for controlling
                                 *  FAC_VS_LGRD_CRU              :Factor for intercepting
Else if      STATE_VS_ICL_DISP = 1
  Then        VS_SP_CRU = VS_SP_CRU - C_VS_DIF_TIP_M [km/h]
  Else        VS_SP_CRU = VS_SP_CRU - C_VS_DIF_TIP_K [km/h]
  Endif
Endif
FAC_TQ_CRU   ((IP_FAC_TQ_REQ_CLU_IS__N_32 - C_FAC_TQ_REQ_CLU_IS_HYS) *
                                                        99,998%)
```

G.5.5.6 Deceleration

Description:
On activating the deceleration function, the vehicle is brought to the required target speed with the adjustable negative C_AC_NEG_CRU_DEACC or positive acceleration C_AC_POS_CRU_DEACC (for the steady state). In this case the control basic function is activated and the reference input variable VS_SP_CRU is controlled.
As long as the deceleration function is detected, the decrementation of the reference input variable takes place per computing cycle (100 ms) with the controlled acceleration function

On ending the deceleration function, the target speed VS_SP_DRIV_CRU is set equal with the reached vehicle speed VS_CRU. If the target speed VS_SP_DRIV_CRU thus stored is smaller than the instanta-

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neous reference input variable VS_SP_CRU, then the value VS_SP_CRU is decremented by the value VS_SP_DEC_CRU further via the controlled acceleration function. VS_SP_CRU and VS_SP_DRIV_CRU cannot be smaller than VS_MIN_CRU. If the instantaneous reference input variable VS_SP_CRU is smaller than the stored target speed VS_SP_DRIV_CRU, then the reference input variable is incremented with the controlled acceleration function.

Formula section:

REQ_MSW = DEC active:
VS_SP_DEC_CRU = 3.6 * C_AC_NEG_CRU_DEACC * 100 ms
VS_SP_CRUn = VS_SP_CRUn-1
- VS_SP_DEC_CRU : Decrement
* FAC_VS_CTL_CRU : Factor for controlling
* FAC_VS_LGRD_CRU : Factor for intercepting

REQ_MSW = DEC passive:
VS_SP_DRIV_CRU = Min(VS_CRU, VS_SP_CRU_MAX)
IF VS_SP_DRIV_CRU < VS_SP_CRU
Then VS_SP_DEC_CRU = 3.6 * C_AC_NEG_CRU_DEACC * 100 ms
VS_SP_CRU = capter "calculation of controlled acceleration"
Else VS_SP_INC_CRU = 3.6 * C_AC_POS_CRU_DEACC * 100 ms
VS_SP_CRU = capter "calculation of controlled acceleration"
Endif

As long as decrementing the reference input variable VS_SP_CRU is active, the calculation of the I component is released.

Calculation of VS_DIF_I_CRU until

VS_DIF_I_CRU + C_VS_DIF_DELTA_I < VS_DIF_CRU

G.5.5.7 OFF

In the OFF function, the last setpoint VS_SP_DRIV_CRU remains stored and soft cut-off is activated. If the engine running is stopped (LV_IGK, LV_ES) the CRU - readiness and the last speed-setpoint are to reset to their initial values.

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G.6 Vehicle speed limitation controller

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_VS_MAX_DIF_I	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Torque output of VS_MAX I Controller					
TQ_VS_MAX_DIF_P	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Torque output of VS_MAX P Controller					

Input data:

AC_VEH_MMV {p. 1158}	FAC_VS_LIM_I_DYN_VSL {p. 7259}	FAC_VS_LIM_P_DYN_VSL {p. 7259}	LV_IGK {p. 906}
LV_VS_MAX_VSL {p. 7267}	N_VS {p. 806}	TQI_REQ_TRA {p. 8192}	TQI_VS_MAX {p. 6659}
VS_DIF_LIM {p. 1158}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LGRD_TQ_VS_MAX_I	-	0... 7FFFH	0... 1023.97	0.03125	Nm
Negative Gradient Limiter for VS_MAX I term					
C_MASS_VEH	-	0... FFH	0... 2550	10	kg
Equivalent Vehicle Mass for acceleration calculation					

G.6.1 VHSL_MG009

This modules aims to limit the vehicle speed to C_VS_MAX. A PI controller is used to define the engine torque limitation. In order to minimise speed overshoot, a predicted vehicle speed is calculated and the I controller is initilised with a calculated torque reduction.

Application Condition

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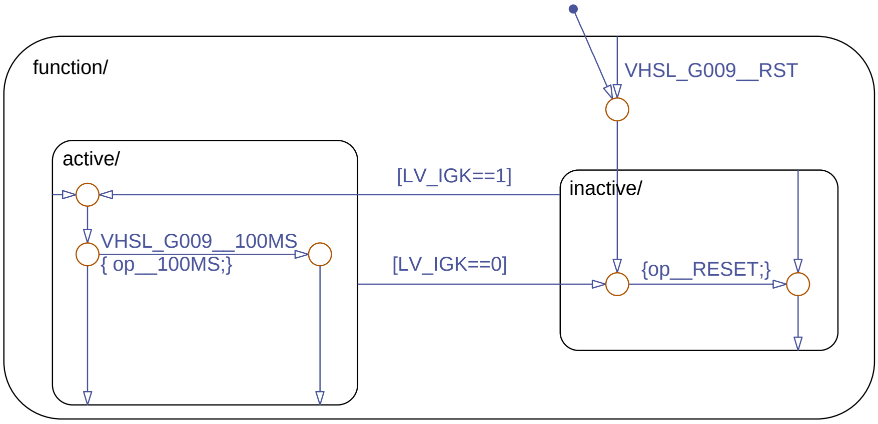

Figure G.6.1: VHSL_MG009/APP_CDN/Chart

Function Description

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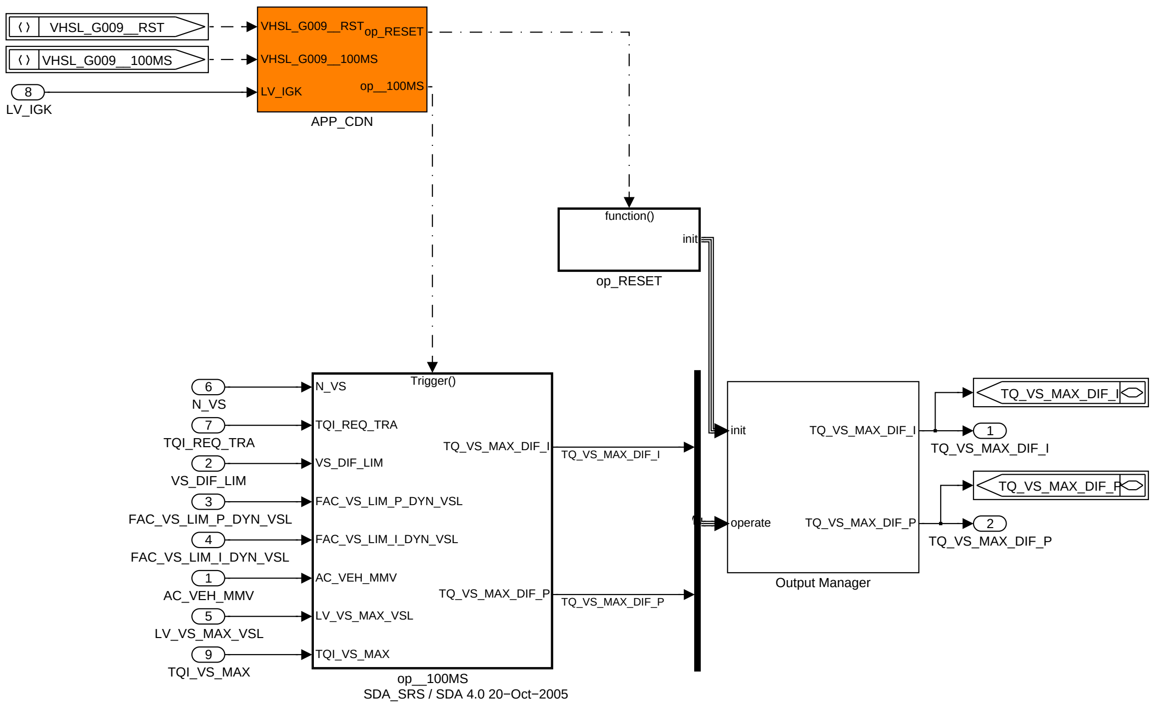

Figure G.6.2: VHSL_MG009

G.6.1.1 SUBFUNCTION: Output Manager

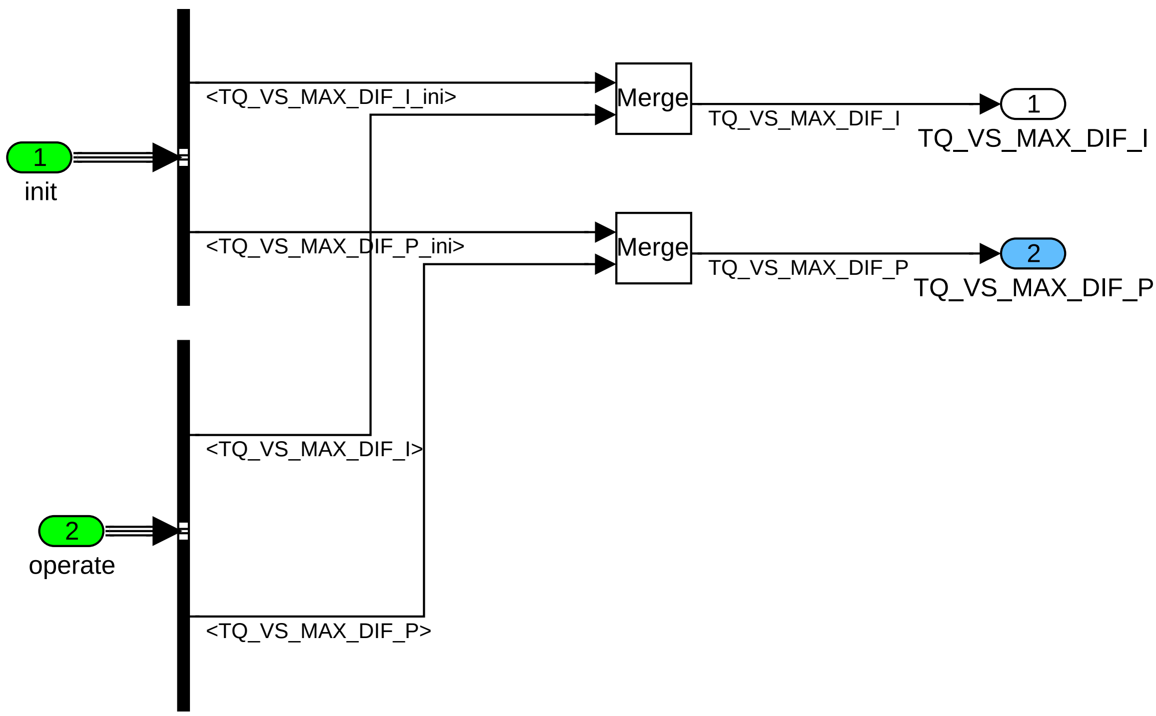

Figure G.6.3: VHSL_MG009/Output Manager

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G.6.1.2 SUBFUNCTION: op_RESET

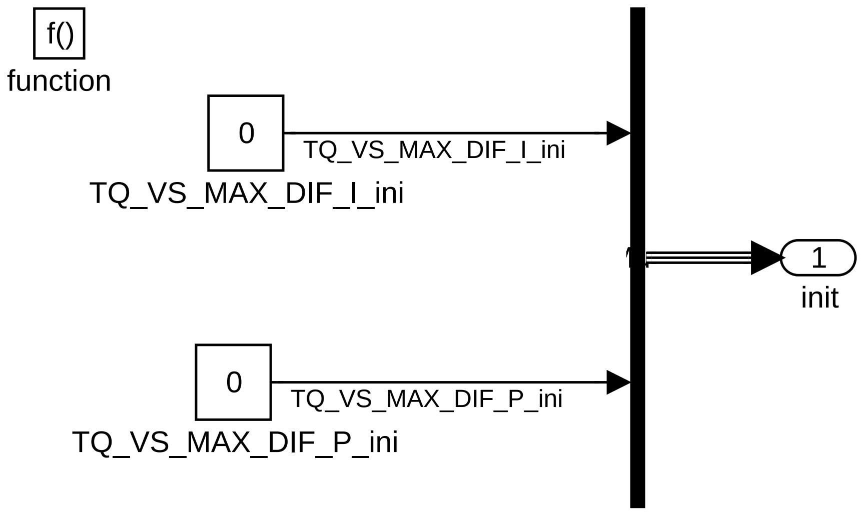

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Figure 4 VHSL_MG009/
op_RESET

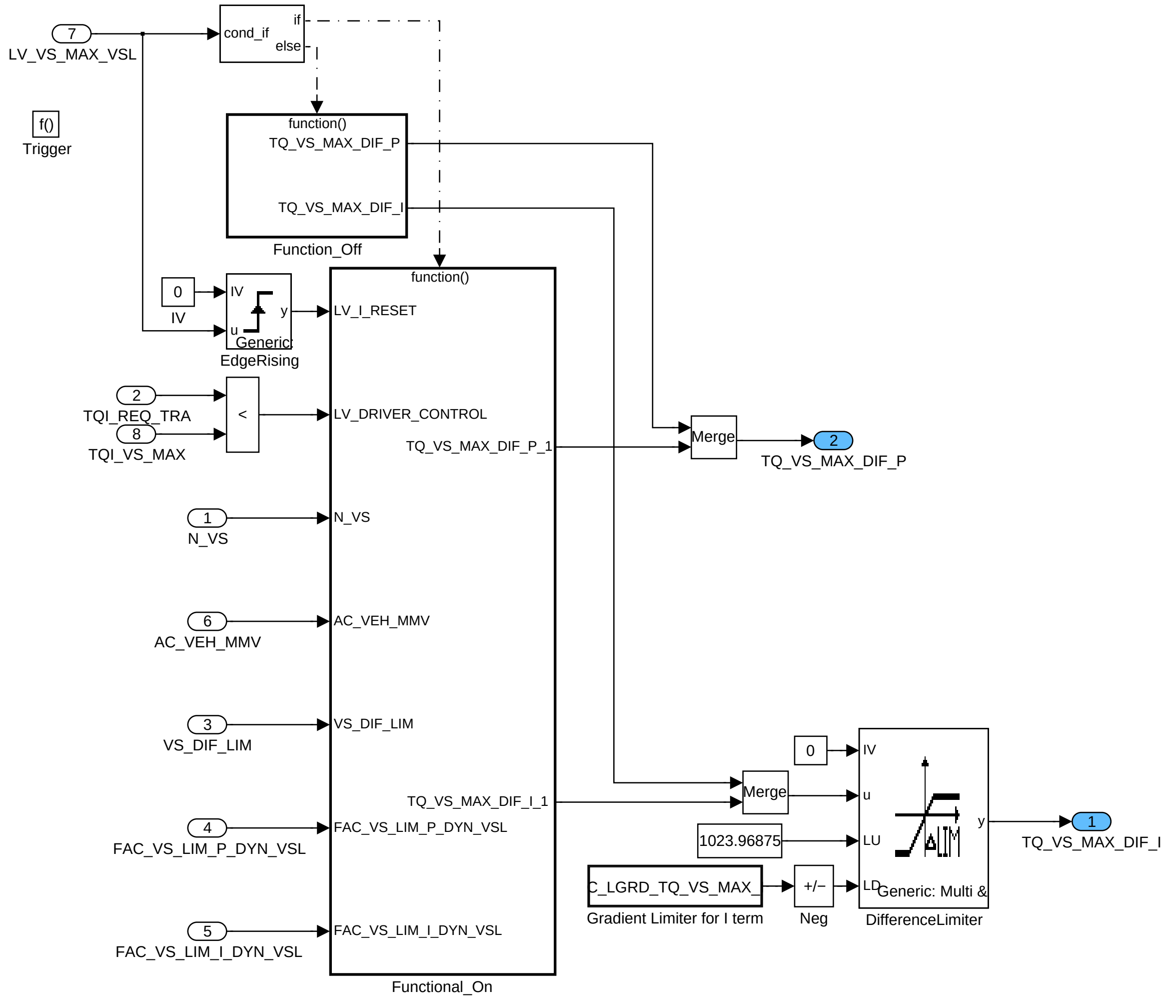

Figure G.6.4: VHSL_MG009/op__100MS

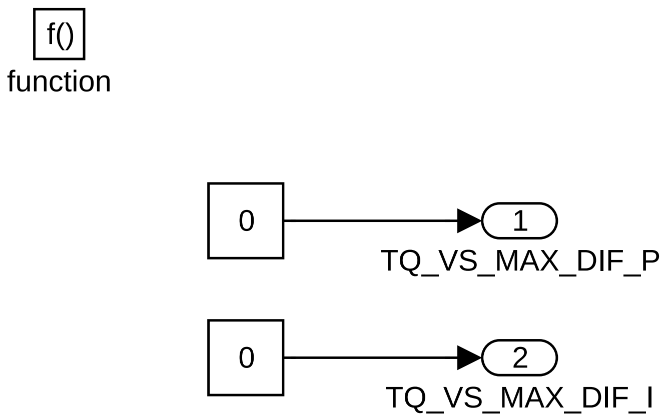

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Figure 6 VHSL_MG009/ op__100MS/
Function_Off

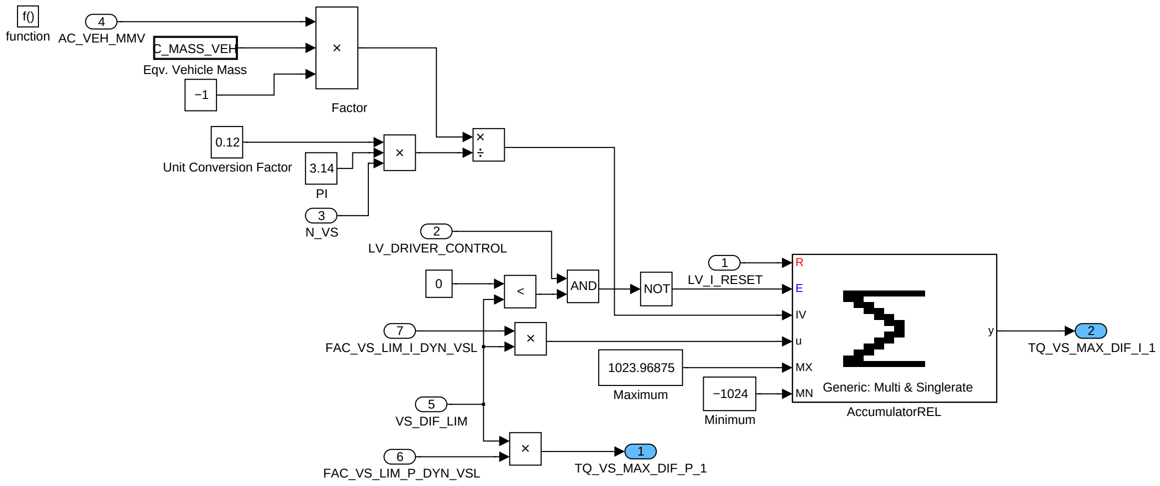

Figure G.6.5: VHSL_MG009/op__100MS/Functional_On

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G.7 Vehicle speed limitation controller (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_VS_LIM_I_DYN_VSL	O/V	0... 7FFFH	0... 255.992188	0.0078125	Nm/(km/h)
I control parameter for VS limitation					
FAC_VS_LIM_P_DYN_VSL	O/V	0... FFH	0... 127.5	0.5	Nm/(km/h)
P control parameter for VS limitation					
LV_FAC_CTL_DYN_CHG_VSL	V	0... 1H	0 ...1	1	-
flag indicating a change in the control dynamics					

Input data:

LV_IGK {p. 906}	LV_VS_MAX_VSL {p. 7267}	N_VS {p. 806}	VS_DIF_LIM {p. 1158}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_RAMP_VS_DEC_VSL	-	0... 400H	0 ...1	97.6563e3	-
ramp down constant (decrement)					
C_FAC_RAMP_VS_INC_VSL	-	0... 400H	0 ...1	97.6563e3	-
ramp up constant (increment)					
C_VS_THD_H_VSL	-	0... FFFFH	0... 655.35	0.01	km/h
upper limit of hysteresis for the vehicle speed					
C_VS_THD_L_VSL	-	0... FFFFH	0... 655.35	0.01	km/h
lower limit of hysteresis for the vehicle speed					
IP_FAC_VS_LIM_I_H_DYN_VSL	-	0... 7FFFH	0... 255.992188	0.0078125	Nm/(km/h)
LDPM_N_VS_LIM_VSL	8	0... FFH	0... 255	1	rpm/(km/h)
Gain for the integral term in high dynamics					
IP_FAC_VS_LIM_I_L_DYN_VSL	-	0... 7FFFH	0... 255.992188	0.0078125	Nm/(km/h)
LDPM_N_VS_LIM_VSL	8	0... FFH	0... 255	1	rpm/(km/h)
Gain for the integral term in low dynamics					
IP_FAC_VS_LIM_P_H_DYN_VSL	-	0... FFH	0... 127.5	0.5	Nm/(km/h)
LDPM_N_VS_LIM_VSL	8	0... FFH	0... 255	1	rpm/(km/h)
Gain for the proportional term in high dynamics					
IP_FAC_VS_LIM_P_L_DYN_VSL	-	0... FFH	0... 127.5	0.5	Nm/(km/h)
LDPM_N_VS_LIM_VSL	8	0... FFH	0... 255	1	rpm/(km/h)
Gain for the proportional term in low dynamics					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

G.7.1 VHSL_MG00O

The control dynamic is determined by LV_FAC_CTL_DYN_CHG_VSL. The I and PD control parameters are calculated based on the dynamic behaviour of the controller.

Application Condition

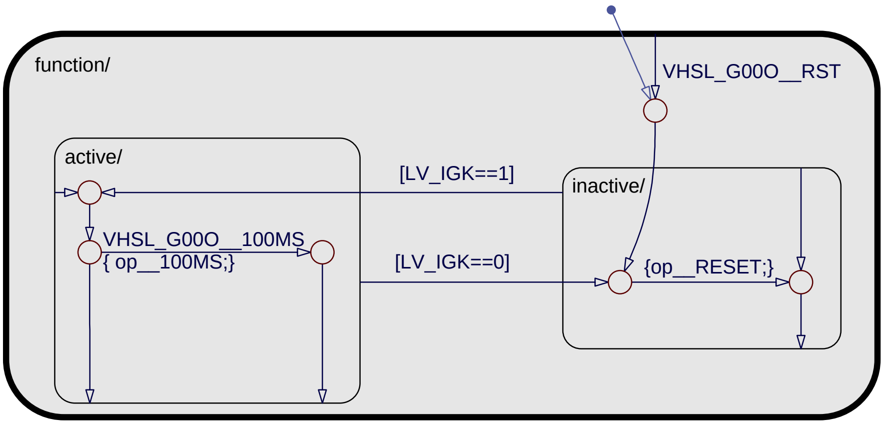

Figure G.7.1: VHSL_MG00O/APP_CDN/Chart

Function Description

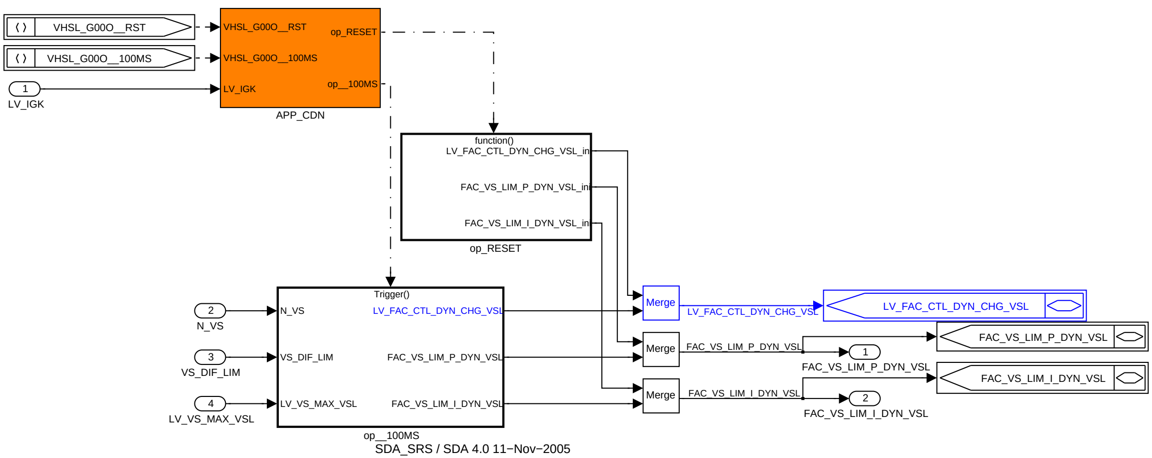

Figure G.7.2: VHSL_MG00O

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G.7.1.1 SUBFUNCTION: op_RESET

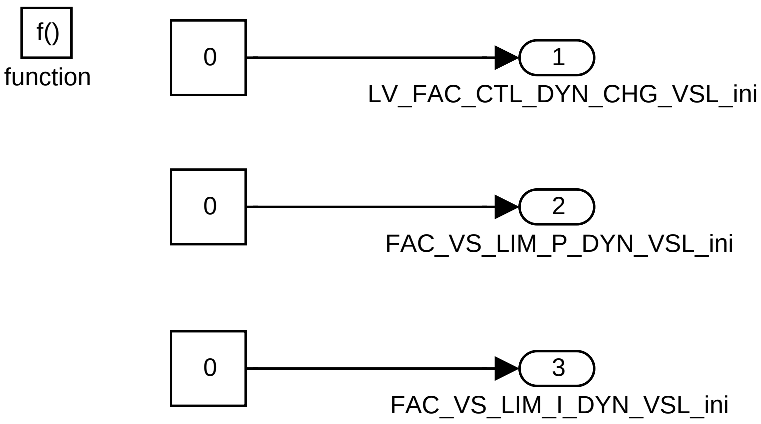

Figure G.7.3: VHSL_MG00O/op_RESET

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G.7.1.2 SUBFUNCTION: op__100MS

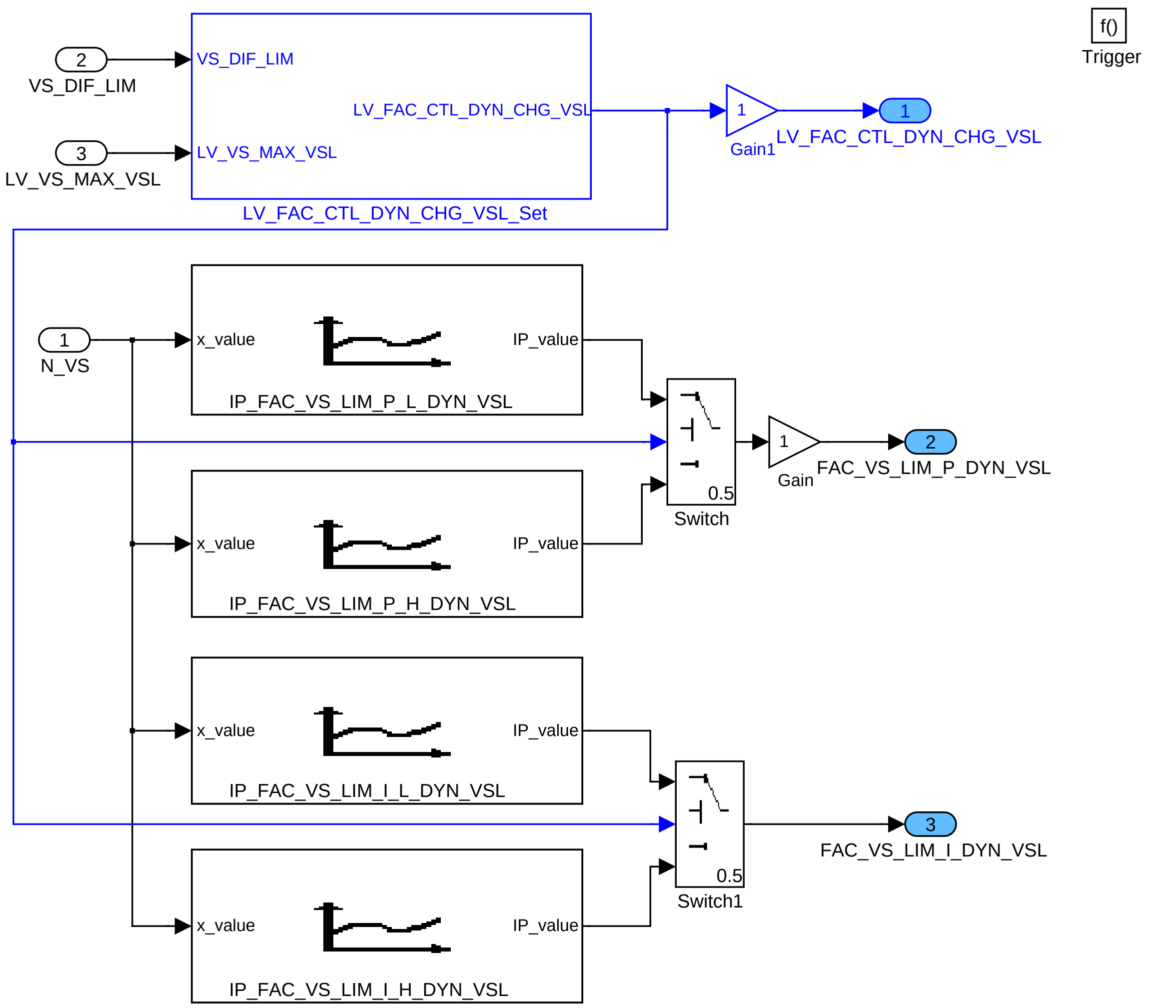

Figure G.7.4: VHSL_MG00O/op__100MS

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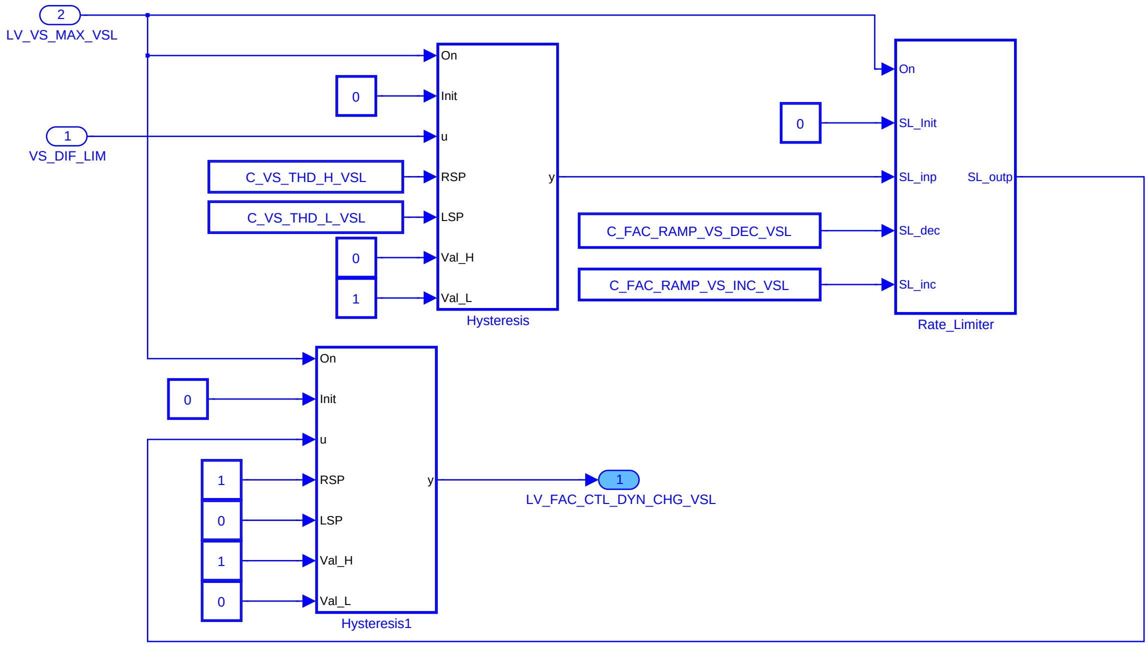

Figure G.7.5: VHSL_MG00O/op__100MS/LV_FAC_CTL_DYN_CHG_VSL_Set

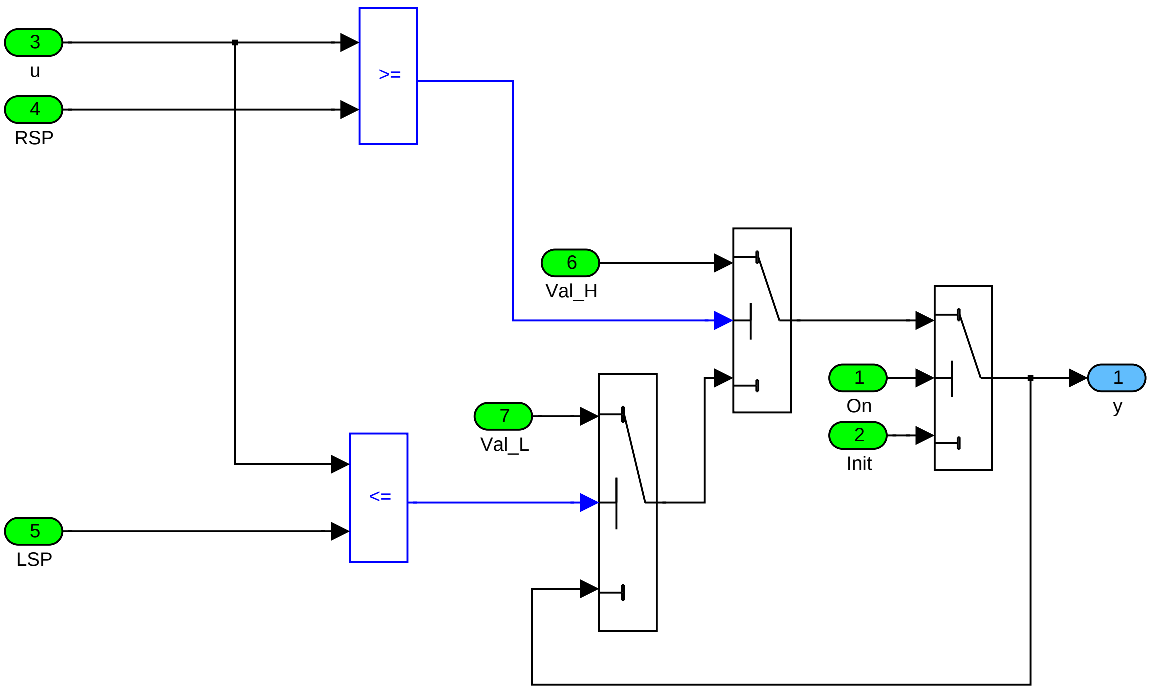

Figure G.7.6: VHSL_MG00O/op__100MS/LV_FAC_CTL_DYN_CHG_VSL_Set/Hysteresis

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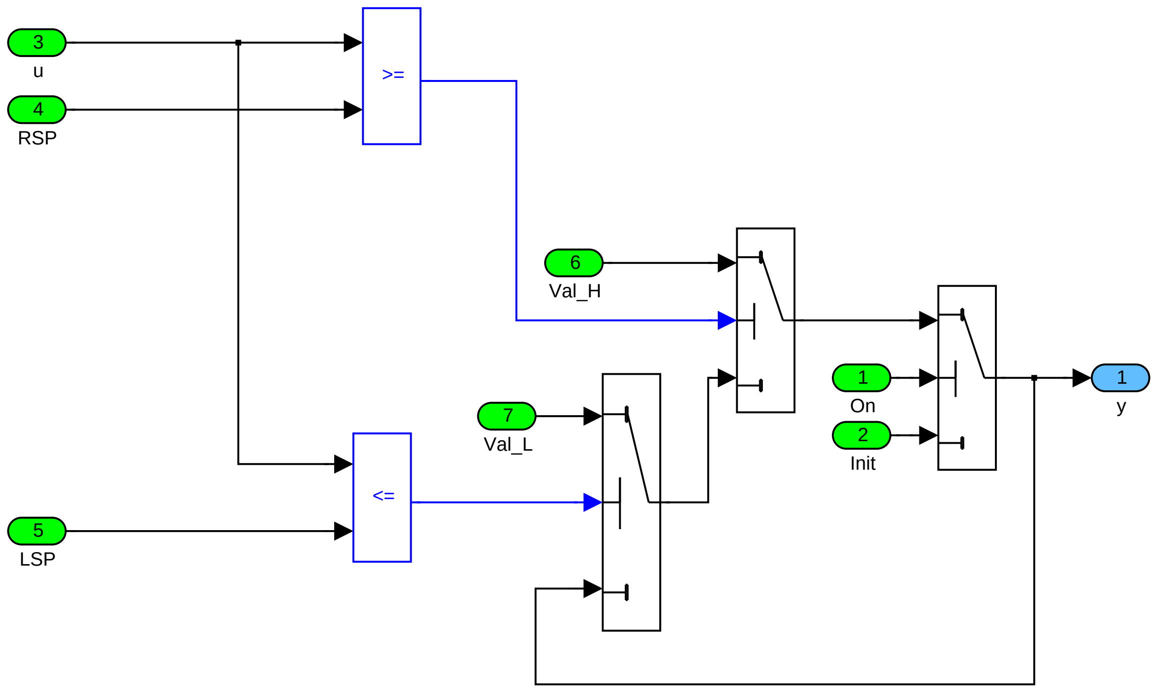

Figure G.7.7: VHSL_MG00O/op__100MS/LV_FAC_CTL_DYN_CHG_VSL_Set/Hysteresis1

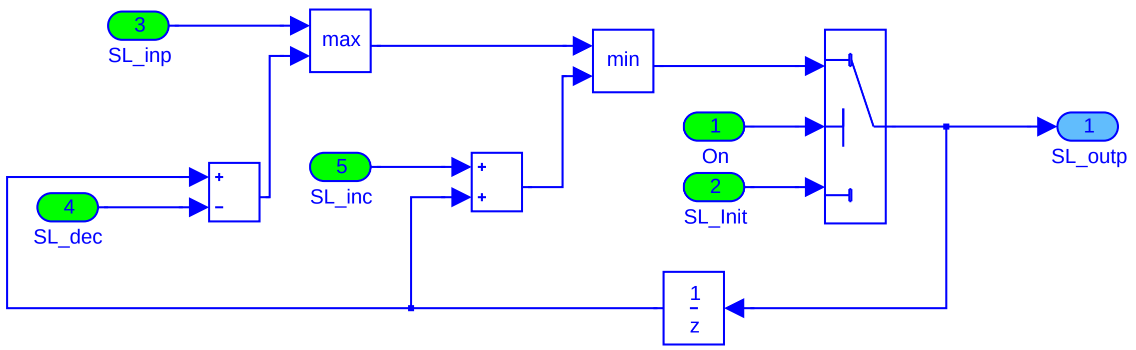

Figure G.7.8: VHSL_MG00O/op__100MS/LV_FAC_CTL_DYN_CHG_VSL_Set/Rate_Limiter

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G.8 Vehicle speed limitation manager

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_VSL	O	0... 4H	0 ...4	1	-
states of the vehicle limitation manager					

Input data:

LV_IGK {p. 906}	LV_VS_MAX_VSL {p. 7267}		

G.8.1 FUNCTION PART: VHSL_MG00D

Application Condition

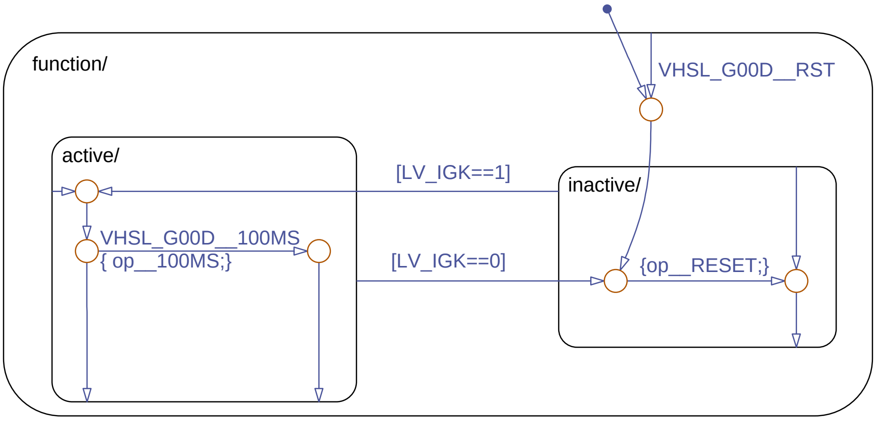

Figure G.8.1: VHSL_MG00D/APP_CDN/Chart

Function Description

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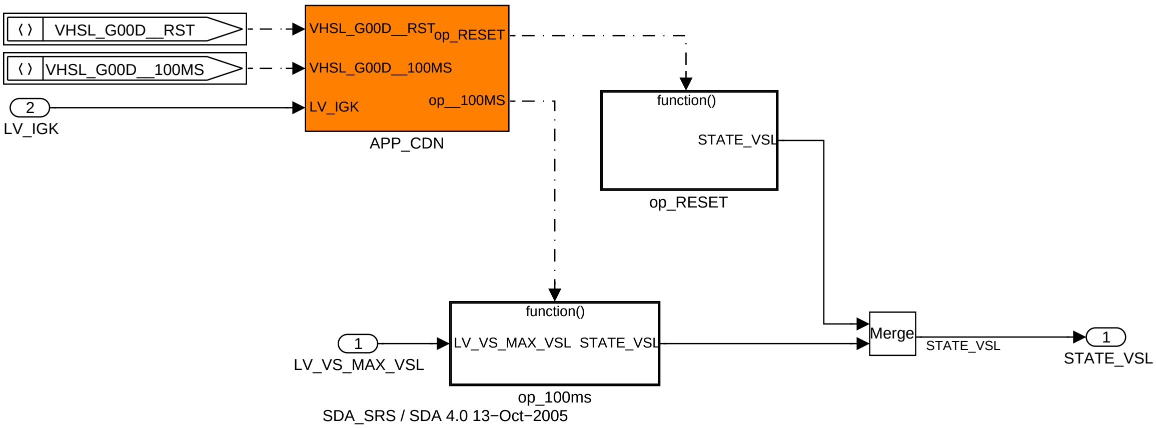

Figure G.8.2: VHSL_MG00D

G.8.1.1 SUBFUNCTION: op_100ms

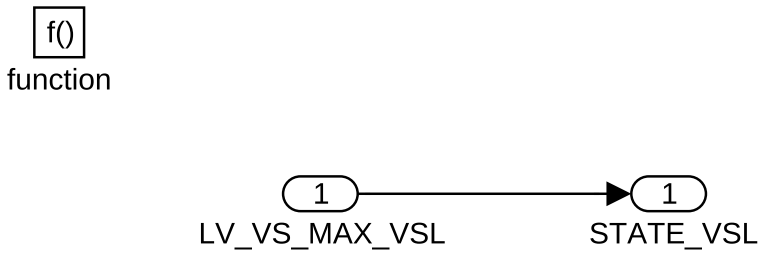

Figure G.8.3: VHSL_MG00D/OP_100MS

G.8.1.2 SUBFUNCTION: op_RESET

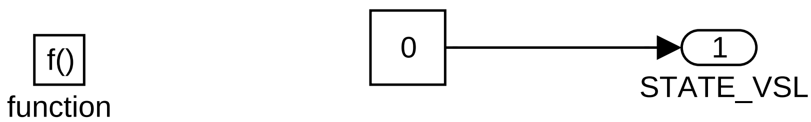

Figure G.8.4: VHSL_MG00D/OP_RESET

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G.9 Vehicle speed limitation manager (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_VS_MAX_VSL	O/V	0... 1H	0 ...1	1	-
Boolean for vehicle speed limitation active					

Input data:

LV_IGK {p. 906}	N_32 {p. 1525}	VS_MAX {p. 1158}	VS_PRED {p. 1158}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_MIN_VS_MAX	-	0... FFH	0... 8160	32	rpm
Minimum engine speed for VS_MAX function					
C_VS_MAX_HYS_OFF	-	0... 7FFFH	0... 327.67	0.01	km/h
Offset to turn off VS MAX limiter					
C_VS_MAX_HYS_ON	-	0... 7FFFH	0... 327.67	0.01	km/h
VS Offset to turn on VS MAX limiter					
LC_VS_MAX_VSL_MAN	-	0... 1H	0 ...1	1	-
Logical calibratable for the manually activation/deactivation of the vehicle speed limtation functionality					
LC_VSL_ACT_MAN	-	0... 1H	0 ...1	1	-
Manual switch to enable vehicle speed limiter					

General Information

This module deals with the activation of the fix vehicle speed limitation functionality. The function is switched on, LV_VS_MAX is set, when the predicted vehicle speed, VS_PRED exceeds the set point minus an offset, VS_MAX - C_VS_MAX_HYS_ON. On the other hand the function is reset, and turned off, when the predicted vehicle speed, VS_PRED drops below the set point minus a hysterisis VS_MAX - C_VS_MAX_HYS_OFF. An additional activation condition is that engine speed should be below of a threshold, C_N_MIN_VS_MAX. This threshold must be set to a low value away from the VS_MAX engine speed area. Application Condition

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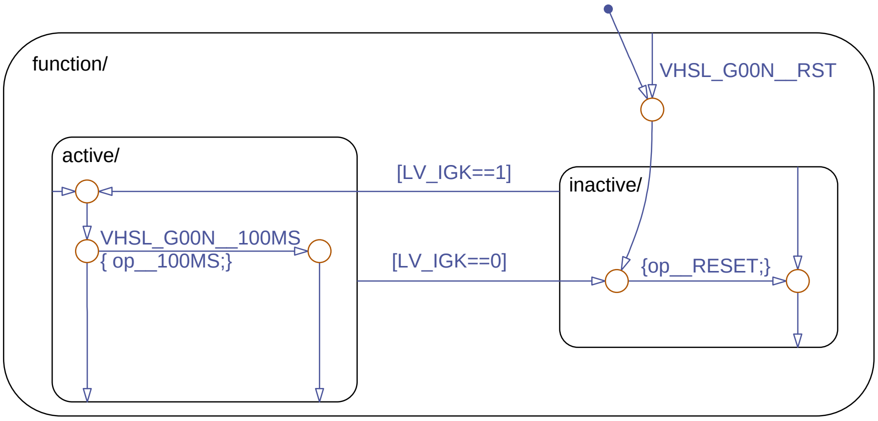

Figure G.9.1: VHSL_MG00N/APP_CDN/Chart

Function Description

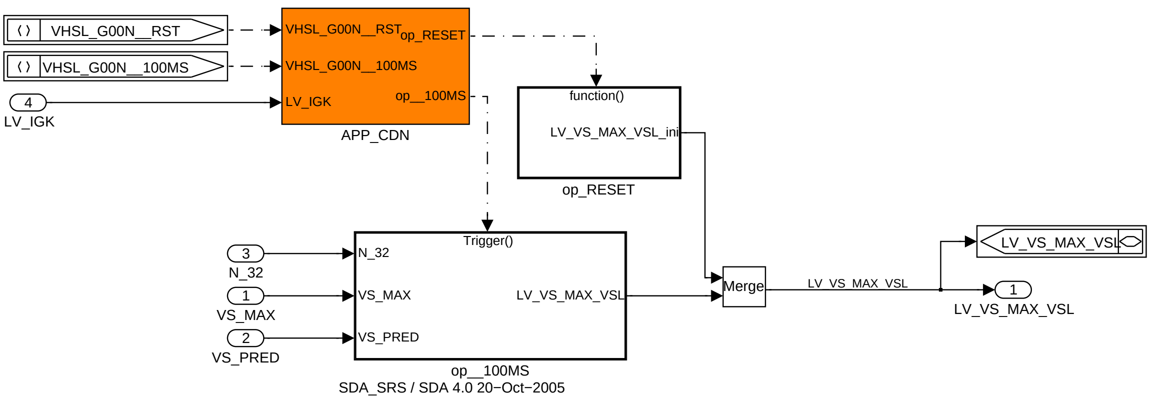

Figure G.9.2: VHSL_MG00N

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G.9.1 SUBFUNCTION: op_RESET

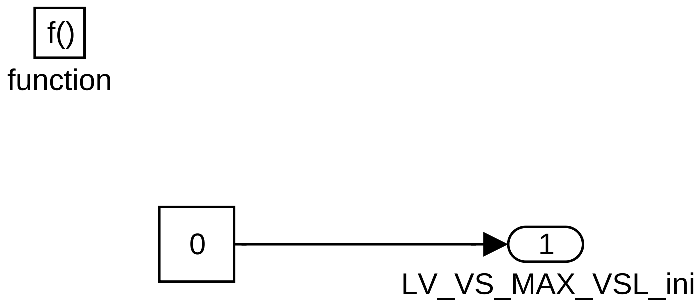

Figure G.9.3: VHSL_MG00N/op_RESET

G.9.2 VHSL_MG00N/OP__100MS

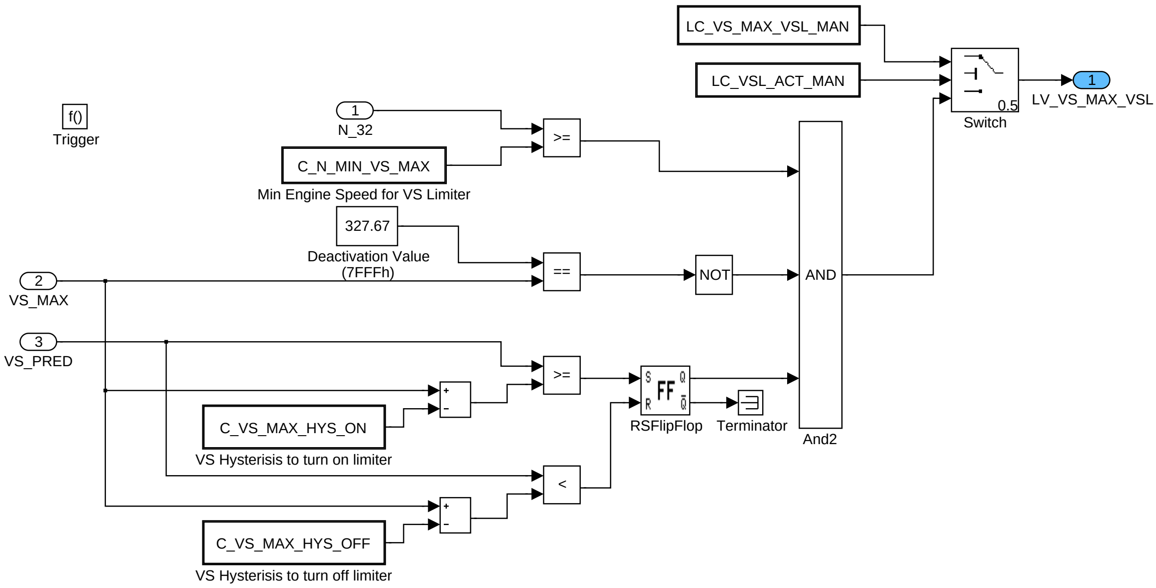

Figure G.9.4: VHSL_MG00N/op__100MS

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G.10 Vehicle speed limitation output

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_VS_MAX	O/V	0... 7FFFH	0... 1023.97	0.03125004	Nm
Torque request for vehicle speed limitation					

Input data:

LV_IGK {p. 906}	LV_VS_MAX_VSL {p. 7267}	TQ_VS_MAX_DIF_I {p. 7253}	TQ_VS_MAX_DIF_P {p. 7253}
TQI_AV {p. 981}	TQI_BAS_MAX {p. 810}	TQI_REQ_TRA {p. 8192}	

G.10.1 VHSL_MG00P

This functionality limits the engine torque output by TQI_VS_MAX. The value of TQI_VS_MAX is initialised with the current engine output torque requirement. This will be calculated as the maximum of TQI_AV and minimum of TQI_BAS_MAX, TQI_REQ_TRA. This starting value of TQI_VS_MAX is then stored.

Application Condition

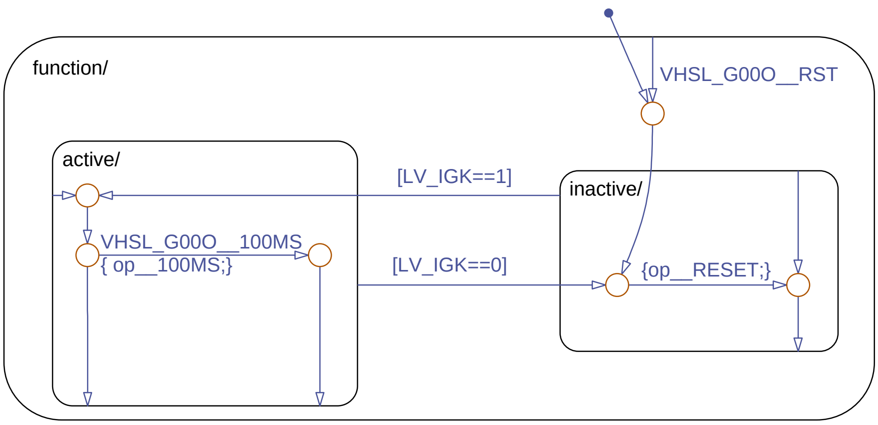

Figure G.10.1: VHSL_MG00P/APP_CDN/Chart

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Function Description

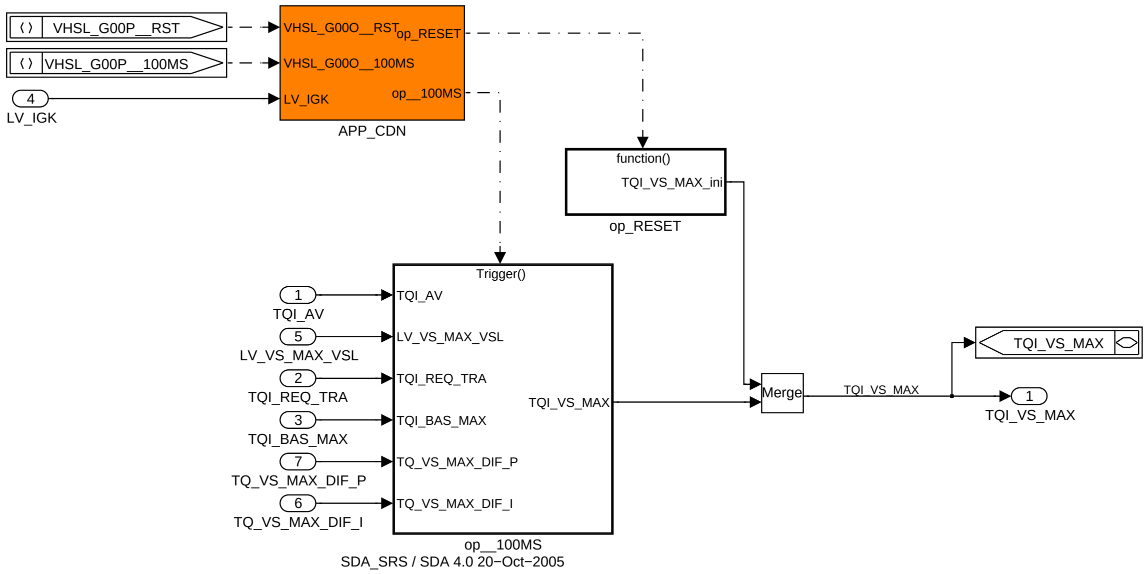

Figure G.10.2: VHSL_MG00P

G.10.1.1 SUBFUNCTION: op_RESET

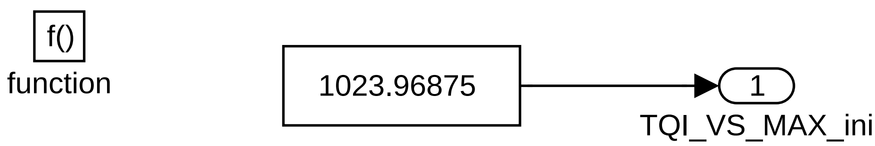

Figure 3 VHSL_MG00P/
op_RESET

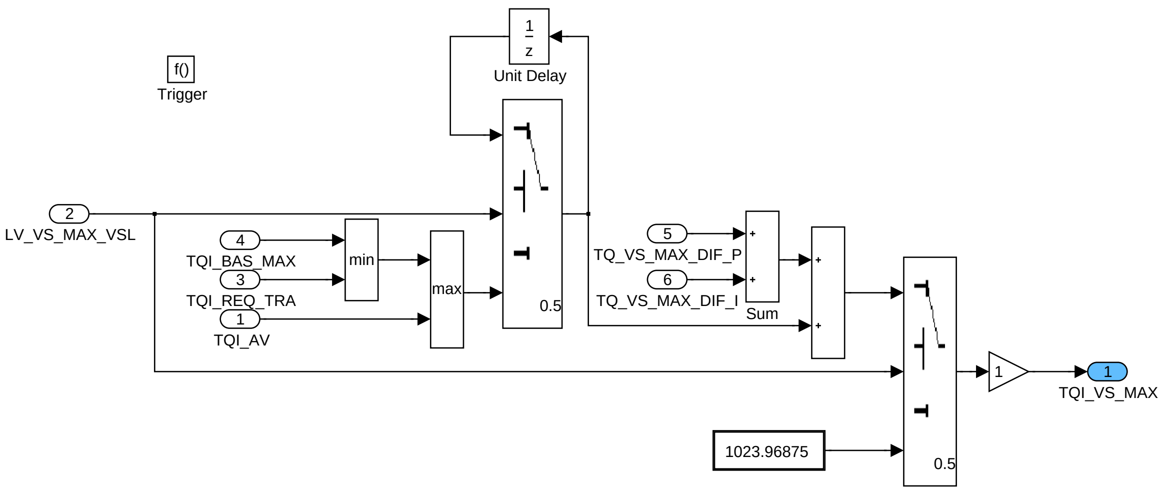

Figure G.10.3: VHSL_MG00P/op__100MS

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I - Serial Communication

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I.1 Error codes

Hex Value	*Response Code*	*Mnemonic*
10	generalReject	GR
11	serviceNotSupported	SNS
12	subFunctionNotSupported-invalidFormat	SFNS_IF
21	busy-repeatRequest	B_RR
22	conditionsNotCorrect /requestSequenceError	CNCORSE
23	routineNotComplete	RNC
31	requestOutOfRange	ROOR
33	securityAccessDenied/Required	SAD
35	invalidKey	IK
36	exceedNumberOfAttempts	ENOA
37	requiredTimeDelayNotExpired	RTDNE
40	downloadNotAccepted	DNA
41	improperDownloadType	IDT
42	can'tDownloadToSpecifiedAddress	CNDTSA
43	can'tDownloadNumberOfBytesRequested	CNDNOBR
50	uploadNotAccepted	UNA
51	improperUploadType	IUT
52	can'tUploadFromSpecifiedAddress	CNUFSA
53	can'tUploadNumberOfBytesRequested	CNUNOBR
71	transferSuspended	TS
72	transferAborted	TA
74	illegalAddressInBlockTransfer	IAIB
75	illegalByteCountInBlockTransfer	IBCIBT
76	illegalBlockTransferType	IBTT
78	requestCorrectlyReceived-ResponsePending	RCRRP
79	incorrectByteCountDuringBlockTransfer	IBCDBT
80	serviceNotSupportedInActiveDiagnosticMode	SNSIADM

I.1.1 General negative Responses

NegativeResponseCode	*Cause of Occurrence*
generalReject	selected diagnosticService is longer than the current receive buffer
serviceNotSupported	selected diagnosticService is not supported by the ECU
serviceNotSupportedInActiveDiagnosticMode	selected diagnosticService is not supported in the current diagnostic mode
securityAccessDenied/Required	selected diagnosticService is not supported in the current securityLevel
incorrectByteCountDuringBlockTransfer	Number of bytes of the telegram does not match to the given length
requestCorrectlyReceived-ResponsePending	the action to be performed by the selected diagnosticService may not be completed yet

1. These negative response codes are possible for all diagnostic services. The occurrence is depending on the system configuration.

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I.2 Error handling

I.2.1 Error handling during physical/functional Fast Initialization

I.2.1.1 Client(tester) Error handling during physical/functional Fast Initialization

Client(tester) detects an...	***Action***
... error in T_{idle} (W5 or P3min)	The client(tester) is responsible to keep to the idle time The server(ECU) is responsible to keep to the time P1min. In case of an error the client(tester) must wait for T_{idle} again.
... error in P1min	No observation necessary. P1min is always 0 ms.
... error in P1max (P1max timeout)	The client(tester) shall ignore the response and shall open a new timing window P2 to receive a directly repeated response from the same server(ECU) or a response from another server(ECU). If the server(ECU) doesn´t repeat the response, the client(tester) shall wait for P3max timeout and afterwards the client(tester) may start a new Initialization beginning with a wake-up-pattern (T_{idle}= 0 ms).
... error in P2min	No observation necessary. P2min is always 0 ms during Initialization.
... error in P2max (no valid response from any server (ECU))	If the client(tester) doesn´t receive any response, the client(tester) shall wait for P3max timeout and afterwards may start a new Initialization beginning with a wake-up-pattern (T_{idle}= 0 ms).
... error in StartCommunication Positive Response (Byte collision) (Response contents) (Response checksum)	The client(tester) shall ignore the response and shall open a new timing window P2 to receive a directly repeated response from the same server(ECU) or a response from another server(ECU). If the server(ECU) doesn´t repeat the response, the client(tester) shall wait for P3max timeout and afterwards the client(tester) may start a new Initialization beginning with a wake-up-pattern (T_{idle}= 0 ms).

Figure I.2.1: Client(tester) Error Handling during physical/functional Fast Initialization

I.2.1.2 Server(ECU) Error Handling during physical/functional Fast Initialization (normal timing only)

Server(ECU) detects an ...	***Action***
... error in T_{idle} (W5 or P3min)	No observation necessary. The client(tester) is responsible to keep to the idle time T_{idle}.
... error in wake-up-pattern	The server(ECU) shall not respond and shall be able to detect immediately a new wake-up-pattern sequence.
... error in P4min	No observation necessary. The client(tester) is responsible to keep to the time P4min
... error in P4max (P4max timeout)	The server(ECU) shall not respond and shall be able to detect immediately a new wake-up-pattern sequence.
... error in StartCommunication Request (checksum) (contents)	The server(ECU) shall not respond and shall be able to detect immediately a new wake-up-pattern sequence.
... error in StartCommunication Positive Response (Byte collision)	The server (ECU) shall repeat the response within a new timing window P2 considering arbitration.
... unknown tester(client) target address or server(ECU) source address	The server(ECU) shall not respond and shall be able to detect immediately a new wake-up-pattern sequence.

Figure I.2.2: Server(ECU) Error Handling during physical/functional Initialization

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I.2.2 Error handling after physical/functional Initialization

I.2.2.1 Client(tester) Error handling after physical/functional Initialization

Client(tester) detects an ...	***Action***
... error in P1min	No observation necessary P1min is always 0 ms.
... error in P1max (P1max timeout)	The client(tester) shall ignore the response and shall open a new timing window P2 to receive a directly repeated response from the same server(ECU) or a response from another server(ECU). If the server(ECU) doesn´t repeat the response, the client(tester) may repeat the same request in a new timing window P3.
... error in P2min	No observation necessary. The server(ECU) is responsible to keep to the time P2min.
... error in P2max (no valid response from any server (ECU) or missing responses)	The client(tester) may repeat the last request twice, each within in a new timing window P3. (i.e. three transmission total) any following appropriate action is client(tester) dependent if the client(tester) doesn´t receive a response.
... error in server(ECU) Response (checksum) (contents)	The client(tester) may repeat the last request twice, each within in a new timing window P3. (i.e. three transmission total) any following appropriate action is client(tester) dependent if the client(tester) doesn´t receive a response.

Figure I.2.3: Client(tester) communication Error Handling after physical/functional Initialization

I.2.2.2 Server(ECU) Error Handling after physical/functional Initialization

Server(ECU) detects an ...	***Action***
... error in P3min	No observation necessary. The client(tester) is responsible to keep to the time P3min.
... error in P3max (P3max timeout)	The server(ECU) shall reset communication and shall be able to detect immediately a new wake-up-pattern sequence.
... error in P4min	No observation necessary. The client(tester) is responsible to keep to the time P4min.
... error in P4max (P4max timeout)	The server(ECU) shall ignore the request and shall open a new timing window P3 to receive a new request from the client(tester).
... error in client(tester) request (contents) (checksum)	The server(ECU) shall ignore the request and shall open a new timing window P3 to receive a new request from the client(tester).
... unknown source or target address	The server(ECU) shall ignore the request and shall open a new timing window P3 to receive a new request from the client(tester).
... error in its own Response (byte collision)	If the server(ECU) detects a byte collision within its own response, it must repeat the response within a new timing window P2 considering the arbitration.

Figure I.2.4: Server(ECU) Error Handling after physical/functional Initialization

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I.3 Implemented Diagnostic services

Verwendete Abkürzungen:

CDI	ClearDiagnosticInformation	**RRRBLI**	RequestRoutineResultsByLocalIdentifier
DDLI	DynamicallyDefineLocalIdentifier	**STDS**	StartDiagnosticSession
DNMT	DisableNormalMessageTransmission	**STRBLI**	StartRoutineByLocalIdentifier
IOCBLI	InputOutputControlByLocalIdentifier	**SPRBLI**	StopRoutineByLocalIdentifier
RDBCI	ReadDataByCommonIdentifier	**WDBCI**	WriteDataByCommonIdentifier
RDBLI	ReadDataByLocalIdentifier		
REI	ReadEcuIdentification		

I.3.1 Overview for SID 10h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
10_81	Wechsel Diagnosemode Mode 81	STDS	ENA	DI	L5	DI	BOOT	X	X	X	X	X	X
10_82	Wechsel Diagnosemode Mode 82	STDS	ENA	DI	L5	DI	BOOT	X	X	X	X	X	X
10_85	Wechsel Diagnosemode Mode 85	STDS	DI	L3	L5	DI	BOOT	X	X	X	X	X	X
10_86	Wechsel Diagnosemode Mode 86	STDS	DI	DI	L5	DI	BOOT	X	X	X	X	X	X
10_89	Wechsel Diagnosemode Mode 89	STDS	DI	DI	L5	L4	BOOT	X	X	X	X	X	X

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I.3.2 Overview for SID 11h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
11_01	EcuReset	EcuReset	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X

I.3.3 Overview for SID 14h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
14_FF_FF	Fehlerspeicher löschen alle Gruppen	CDI	ENA	DI	L5	DI	ECU	X	X	X	X	X	X
14_FF_FB	Fehlerspeicher löschen Powertrain	CDI	ENA	DI	L5	DI	ECU	X	X	X	X	X	X

I.3.4 Overview for SID 17h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
17	Fsp. lesen, lang	readStatusOfDTC	ENA	DI	L5	DI	ECU	X	X	X	X	X	X

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I.3.5 Overview for SID 18h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
18	Fehlerspeicher lesen, kurz	read DTCBy Status	ENA	DI	L5	DI	ECU	X	X	X	X	X	X

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I.3.6 Overview for SID 1Ah

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
1A_80	Identifikation lesen ECUIDT	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_86	Identifikation lesen CUIFDI	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_87	Identifikation lesen PECUHN	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_89	Identifikation lesen SSECUSEN	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_8A	Identifikation lesen CRSCOTSN	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_8B	Identifikation lesen CPD	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_8C	Identifikation lesen SSBSN	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_8D	Identifikation lesen SSESN	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_8E	Identifikation lesen SSCN	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_8F	Identifikation lesen LDSA	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_90	Identifikation lesen VIN short	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_91	Identifikation lesen VMECUHN	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_92	supplierBootLogisticField lesen	REI	ENA	L3	L5	DI	BOOT	-	-	-	X	X	-
1A_96	Identifikation lesen EROTAN	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_97	Identifikation lesen SNOET	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_98	Identifikation lesen RSCOTSN	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_99	Identifikation lesen PD	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_9A	Identifikation lesen VMECUHVN	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_9B	Identifikation lesen VMCI	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_9C	Identifikation lesen VMDI	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_9D	Identifikation lesen DOECUM	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X

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SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
1A_9E	Identifikation lesen SSI	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X
1A_9F	Identifikation lesen VMECUSLVN	REI	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X

I.3.7 Overview for SID 20h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
20	Diagnosemode beenden	StopDiagnosticSession	ENA	L3	L5	L4	BOOT	X	X	X	X	X	X

I.3.8 Overview for SID 21h

Hint: overview for EOL-services taken from 17I03901.00O

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SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
21_01	read system specific adress	RDBLI	ENA	DI	L5	DI	BOOT	X	-	-	-	-	-
21_02	read overtemperature protection	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_03	read engine overspeed detection	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_05	read readiness flags	RDBLI	ENA	DI	L5	DI	ECU	X	X	X	X	X	X
21_06	receiving status of immobilizer	RDBLI	ENA	DI	L5	DI	ECU	-	-	-	-	-	-
21_07	read cruise control status	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_08	release of multiple start value programming	RDBLI	ENA	DI	L5	DI	ECU	-	-	-	-	-	-
21_09	read DIT_ACT_MIL	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_0A	read Error Memory with freeze frame data extra long	RDBLI	ENA	DI	L5	DI	ECU	X	X	X	X	X	X
21_20	Read Status EOL: Secondary air system	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_22	Read Status EOL: CPS	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_25	read INH_IV_KWP	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_26	Read Status EOL: Idle speed setpoint displace	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_27	Read Status EOL: VVL adaption	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_36	read air-conditioner status	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_3F	read idle speed status	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_41	read LSH 4 status	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_42	read LSH 3 status	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_43	read LSH 2 status	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_44	read LSH 1 status	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_49	read Immobilizer status	RDBLI	ENA	DI	L5	DI	ECU	-	-	-	-	-	-

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SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
21_4C	read basic injetion time cylinder 1	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_50	read engine speed	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_54	read intake air temperature	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_55	read coolant temperature	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_56	read ignition angle cylinder 1	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_57	read opening angle of the throttle valve (TPS_AV)	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_58	read mass air flow per segment measured (MAF_KGH_MES)	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_5B	read Pedal value sensor 1 raw acquisition (V_PVS_1_KWP)	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_71	read LV_KNK	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_A3	read VB	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_C0	read SAFM status	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_C1	read kva-factor	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_C3	read TRT	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_D5	Read Status EOL: ECRAS system test	RDBLI	ENA	DI	L5	DI	ECU	X	X	X	X	X	X
21_DA	Read Status EOL: DMTL	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_DF	Read Status EOL: Lambda sensors confused / wrong wired	RDBLI	ENA	DI	L5	DI	ECU	X	-	-	-	-	-
21_F0	DDLI handling	RDBLI	ENA	DI	L5	DI	ECU	X	X	X	X	X	X

I.3.9 Overview for SID 22h

Hint: overview taken from 17I00V0L.00R

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Overview for SID number	service	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
22_10_00	Read check stamp	ECU	X	X	X	X	X	X
22_10_01	Read value BOS	ECU	X	X	X	X	X	X
22_10_0A	Read Energy saving status	ECU	X	X	X	X	X	X
22_16_00	Read Anzahl Subbusteilnehmer	ECU	X	X	X	X	X	X
22_16_01	Read Identifikation Subbusteilnehmer 1 (normaly: Batteriesensensor)	ECU	X	X	X	X	X	X
22_16_02	Read Identifikation Subbusteilnehmer 2 (normaly:elktr. Wasserpumpe)	ECU	X	X	X	X	X	X
22_16_03	Read Identifikation Subbusteilnehmer 3 (normaly:Generator 1)	ECU	X	X	X	X	X	X
22_20_00	read failure memory short	ECU	X	X	X	X	X	X
22_21_00	Read History Memory	ECU	X	X	X	X	X	X
22_25_00	Programm Reference Backup	BOOT	X	X	X	X	X	X
22_25_01	Erasing time	BOOT	X	X	X	X	X	X
22_25_02	Hardware reference	BOOT	X	X	X	X	X	X
22_25_03	Programm reference	BOOT	X	X	X	X	X	X
22_25_04	Data reference	BOOT	X	X	X	X	X	X
22_25_06	Maximum of block length	Boot-/ECU	X	X	X	X	X	X
22_30_00	MIL Codierung lesen	ECU	X	X	X	X	X	X
22_30_01	Kat Codierung lesen	ECU	X	X	X	X	X	X
22_30_10	VMAX-Codierdaten lesen	ECU	X	X	X	X	X	X
22_30_20	OL/UL Codierung lesen	ECU	X	X	X	X	X	X
22_30_30	Status-Codierung-Protokoll lesen	ECU	X	X	X	X	X	X
22_32_00	Oelwechselintervall- Codierdaten lesen	ECU	X	X	X	X	X	X
22_32_10	IGR-Codierdaten lesen	ECU	X	X	X	X	X	X
22_32_11	Xenonverbau-Codierdaten lesen	ECU	X	X	X	X	X	X
22_32_20	SPA-Codierdaten lesen	ECU	X	X	X	X	X	X
22_32_30	BZE-Codierdaten lesen	ECU	X	X	X	X	X	X
22_32_40	Abgasklappe Codierdaten lesen	ECU	X	X	X	X	X	X
22_32_50	Codierung MSA lesen	ECU	-	X	-	X	-	-
22_32_60	Read CDASMOT	ECU	X	X	X	X	X	X
22_3F_FF	Aenderungsindex Codierdaten lesen	ECU	X	X	X	X	X	X
22_40_00	Read values 4000	ECU	X	X	X	X	X	X
22_40_01	Read values “batterie generator”	ECU	X	X	X	X	X	X
22_40_02	Read Switch Position	ECU	X	X	X	X	X	X
22_40_03	Read values of engine roughness	ECU	X	X	X	X	X	X

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Overview for SID number	service	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
22_40_06	Read CAMSHAFT-Sensor Adaption	ECU	X	X	X	X	X	X
22_40_07	Read State of Functions	ECU	X	X	X	X	X	X
22_40_08	Read Throttle and MAF-Adjustment Value	ECU	X	X	X	X	X	X
22_40_0A	Read mixture values	ECU	X	X	X	X	X	X
22_40_0B	VVT Messwerte auslesen	ECU	X	-	-	-	-	-
22_40_15	Read FASTA_Messwertblock 10	ECU	X	X	X	X	X	X
22_40_16	READ IGR-values	ECU	X	X	X	X	X	X
22_40_17	READ LEM-values	ECU	X	X	X	X	X	X
22_40_18	READ MSA-values	ECU	X	X	X	X	X	X
22_40_19	Fsp. Lesen mit Freeze Frame	ECU	X	X	X	X	X	X
22_40_1A	READ BZE-values	ECU	X	X	X	X	X	X
22_40_1B	Read: Results of intelligent alternator diagnosis	ECU	X	X	X	X	X	X
22_40_1C	Ringspeicher MSA lesen	ECU	X	X	X	X	X	X
22_40_1D	Read Verbredinfo	ECU	-	-	-	-	-	X
22_40_1E	Read CBS-Zündkerzen	ECU	-	X	X	X	X	-
22_40_1F	Read BMW-PST (BMW-Programmstandsinformation)	ECU	-	-	-	-	-	X
22_40_21	READ IBS-values	ECU	X	X	X	X	X	X
22_40_22	READ PM1 Status	ECU	X	X	X	X	X	X
22_40_23	READ PM2 Status	ECU	X	X	X	X	X	X
22_40_26	Rate Based Monitoring Mode 9 auslesen	ECU	X	X	X	X	X	X
22_40_27	Rate Based Monitoring Motorsteuerung MSV80 Block 1 auslesen	ECU	X	-	-	-	-	-
22_40_27	Rate Based Monitoring Motorsteuerung MSD8x Block 1 auslesen	ECU	-	X	X	X	X	X
22_40_28	Rate Based Monitoring Motorsteuerung MSV80 Block 2 auslesen	ECU	X	-	-	-	-	-
22_40_28	Rate Based Monitoring Motorsteuerung MSD8x Block 2 auslesen	ECU	-	X	X	X	X	X
22_40_2D	Messwerte Laufruhepruefung auslesen	ECU	X	X	X	X	X	X
22_40_2E	Nullgang-Erkennung lesen	ECU	X	X	X	X	X	X
22_40_2F	MSA lesen	ECU	X	X	X	X	X	X
22_40_30	FASTA_LVS_lesen	ECU	-	X	X	X	X	-
22_40_31	Laufruhe Verbesserungssystem Zylinderstatistik auslesen	ECU	-	X	X	X	X	-
22_40_32	MFMA (Kleinstmengenadaption)	ECU	-	X	X	X	X	X
22_5F_88	Adrecovery lesen	ECU	-	X	X	X	X	-

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Overview for SID number	service	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
22_5F_8B	read PM recovery	ECU	X	X	X	X	X	X
22_5F_8E	MSA deactivation lesen	ECU	X	X	X	X	X	X
22_5F_8F	MSA Abschaltverhinderer lesen	ECU	X	X	X	X	X	X
22_5F_90	IMAALLE lesen	ECU	-	X	X	X	X	X
22_5F_DE	VVT- Minhub lesen	ECU	X	-	-	-	-	-
22_5F_F0	Abgleichswert LL lesen	ECU	X	X	X	X	X	X
22_5F_F1	CO Abgleichswert lesen	ECU	X	-	-	-	-	-
22_5F_F2	Varianten lesen	ECU	X	X	X	X	X	X
22_5F_F3	Uebertemperatursicherung lesen	ECU	X	X	X	X	X	X
22_5F_F4	Fusshebelwerk Fehlbedienung lesen	ECU	X	X	X	X	X	-
22_5F_F6	Ueberdrehzahlsicherung lesen	ECU	X	X	X	X	X	X
22_5F_F7	Laufruhepruefung auslesen	ECU	X	X	X	X	X	-
22_5F_F8	Status Homogenbetrieb auslesen	ECU	-	X	X	X	X	-
22_C0_00	Read imob status (STATUS_EWS)	Boot-/ECU	X	X	X	X	X	X
22_C0_02	Read imob k_ews(tmp) (STATUS_EWS_SK)	Boot-/ECU	X	X	X	X	X	X

I.3.10 Overview for SID 23h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
23	Speicher lesen	ReadMemoryByAddress	ENA	L3	L5	DI	BOOT	X	X	X	X	X	X

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I.3.11 Overview for SID 28h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
28_01	Enable positive or negative respose	DNMT	ENA	DI	L5	DI	Boot-/ECU	X	X	X	X	X	X
28_02	Disable positive response	DNMT	ENA	DI	L5	DI	Boot-/ECU	X	X	X	X	X	X

I.3.12 Overview for SID 29h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
29	Enable positive respose	DNMT	ENA	DI	L5	DI	Boot-/ECU	X	X	X	X	X	X
29_01	Enable positive respose	DNMT	ENA	DI	L5	DI	Boot-/ECU	X	X	X	X	X	X
29_02	Disable positive response	DNMT	ENA	DI	L5	DI	Boot-/ECU	X	X	X	X	X	X

I.3.13 Overview for SID 2Ch

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
2C_F0_02	DefineByCommonIdentifier	DDLI	ENA	DI	L5	DI	ECU	X	X	X	X	X	X
2C_F0_03	DefineByMemoryAddress	DDLI	ENA	DI	L5	DI	ECU	X	X	X	X	X	X
2C_F0_04	ClearDynamicallyDefinedLocalIdentifier	DDLI	ENA	DI	L5	DI	ECU	X	X	X	X	X	X

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I.3.14 Overview for SID 2Eh

Hint: overview taken from 17I00W03.0AA

SID number	service	MSV_80	MSD_80 (6cyl)	MSD_80 (4cyl)	MSD_81 (6cyl)	MSD_81 (4cyl)	MSD85(L4)
2E_10_00	Prüfstempel schreiben	X	-	-	-	-	-
2E_10_01	BOS löschen via Tester	X	X	X	X	X	X
2E_30_00	MIL-OFF Codierung schreiben	X	X	X	X	X	X
2E_30_01	Kat Codierung schreiben	X	X	X	X	X	X
2E_30_10	VMAX Codierung schreiben	X	X	X	X	X	X
2E_30_20	OL/UL Codierung schreiben	X	X	X	X	X	X
2E_30_30	Codierung-Protokoll schreiben	X	X	X	X	X	X
2E_32_00	Oelwechselintervall- Codierdaten schreiben	X	X	X	X	X	X
2E_32_10	IGR-Codierdaten schreiben	X	X	X	X	X	X
2E_32_11	Xenonverbau - Codierdaten schreiben	X	X	X	X	X	X
2E_32_20	Codierung SPA schreiben	X	X	X	X	X	X
2E_32_30	Codierung BZE schreiben	X	X	X	X	X	X
2E_32_40	Abgasklappe Codierung schreiben	X	X	X	X	X	X
2E_32_50	Codierung MSA schreiben	-	-	X	-	X	-
2E_32_60	Codierung CDASMOTschreiben	X	X	X	X	X	X
2E_3F_FF	Aenderungsindex der Codierdaten schreiben	X	X	X	X	X	X
2E_5F_87	LaufruheVerbesserungssystem Zaehler Reset	-	X	X	X	X	-
2E_5F_88	Schreiben NOx-Adaptationswerte	-	X	X	X	X	-
2E_5F_89	Request Reset MSA-Tabellenspeicher	-	-	X	-	X	-
2E_5F_8A	Schreiben Nullgang-Lernwert	-	-	X	-	X	-
2E_5F_8B	PMB vorgeben	X	X	X	X	X	X
2E_5F_8E	MSA_DEAK schreiben	-	-	X	-	X	-
2E_5F_8F	MSA_DEAK_AV schreiben	-	-	X	-	X	-
2E_5F_90	IMAALLE schreiben	-	X	X	X	X	X
2E_5F_9x	IMA für Zylinder x schreiben	-	X	X	X	X	X
2E_5F_DE_00	VVT- Minhub Ansteuerung beenden	X	-	-	-	-	-
2E_5F_DE_07	VVT- Minhub ansteuern	X	-	-	-	-	-
2E_5F_DE_08	VVT- Minhub programmieren	X	-	-	-	-	-
2E_5F_F0_07	Abgleichswert LL ansteuern	X	X	X	X	X	X

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2E_5F_F0_08	Abgleichswert LL programmieren	X	X	X	X	X	X
2E_5F_F1_00	CO- Abgleich beenden	X	-	-	-	-	-
2E_5F_F1_04	CO- Abgleich Reset	X	-	-	-	-	-
2E_5F_F1_07	CO- Abgleich ansteuern	X	-	-	-	-	-
2E_5F_F1_08	CO- Abgleich programmieren	X	-	-	-	-	-
2E_5F_F2_04	Varianten loeschen	X	X	X	X	X	X
2E_5F_F3_04	Uebertemperatursicherung loeschen	X	X	X	X	X	X
2E_5F_F4_04	Fusshebelwerk Fehlbedienung loeschen	X	X	X	X	X	-
2E_5F_F5_04	Powermanagement Histogramm loeschen	X	X	X	X	X	X
2E_5F_F6_04	Ueberdrehzahlsicherung loeschen	X	X	X	X	X	X
2E_5F_F7_00	Laufruheprüfung Vorgeben beenden	X	-	-	-	-	-
2E_5F_F7_07	Laufruheprüfung vorgeben	X	-	-	-	-	-
2E_5F_F7_08	Laufruheprüfung programmieren	X	-	-	-	-	-
2E_5F_F8_00	Homogenbetrieb vorgeben beenden	-	X	X	X	X	-
2E_5F_F8_07	Homogenbetrieb vorgeben	-	X	X	X	X	-
2E_C0_01	Write k_ews4	X	X	X	X	X	X

I.3.15 Overview for SID 30h

Hint: overview taken from 17I00M21.00O

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Overview for SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_02_01	Bremslichtschalter auslesen	X	X	X	X	X	X
30_03_01	Bremslichttestschalter auslesen	X	X	X	X	X	X
30_04_01	Kupplungsschalter auslesen	X	X	X	X	X	X
30_05_01	Oeldruckschalter auslesen	X	X	X	X	X	X
30_06_01	Sporttaster auslesen	X	X	X	X	X	-
30_07_01	Nullgangssensor auslesen	-	X	-	X	-	-
30_0A_01	Ansauglufttemperatur 1 auslesen	X	X	X	X	X	X
30_0B_01	Ansauglufttemperatur 2 auslesen	-	-	-	-	-	X
30_0C_01	Motortemperatur auslesen	X	X	X	X	X	X
30_0D_01	Kuehlerauslasstemperatur auslesen	X	X	X	X	X	X
30_0E_01	Oelsensor auslesen	X	X	X	X	X	X
30_10_01	Steuergeraete-Innentemperatur auslesen	X	X	X	X	X	X
30_12_01	Abgastemperatur auslesen	-	X	X	X	X	X
30_13_01	Abgastemperatur 2 auslesen	-	-	-	-	-	X
30_17_01	Umgebungsdruck auslesen	X	X	X	X	X	X
30_18_01	Saugrohrdruck1 / Ladedruck1 auslesen	X	X	X	X	X	X
30_19_01	Saugrohrdruck2 / Ladedruck2 auslesen	-	X	X	X	X	X
30_1A_01	Raildrucksenor auslesen	-	X	X	X	X	X
30_1B_01	Kl.15 Spannung auslesen	X	X	X	X	X	X
30_1C_01	Kl.87 Spannung / Versorgung DME auslesen	X	X	X	X	X	X
30_1C_00/07	Kl.87 Spannung / Versorgung DME ansteuern	X	X	X	X	X	X
30_1E_01	Fahrerwunschversorgung 1 auslesen	X	X	X	X	X	X
30_1F_01	Fahrerwunschversorgung 2 auslesen	X	X	X	X	X	X
30_20_01	Versorgungsspannung VVL Sensor auslesen	X	-	-	-	-	-
30_20_01	Versorgung HPD5-Ventil auslesen	-	X	-	X	-	X
30_20_00/07	Versorgung HPD5-Ventil ansteuern	-	X	-	X	-	X
30_21_01	Lambdasonde vor Kat Bank 1 auslesen	X	X	X	X	X	X
30_22_01	Lambdasonde hinter Kat Bank 1 auslesen	X	X	X	X	X	X
30_23_01	Lambdasonde vor Kat Bank 2 auslesen	X	X	X	X	X	X
30_24_01	Lambdasonde hinter Kat Bank 2 auslesen	X	X	X	X	X	X
30_25_01	Luftmassenmesser 1 auslesen	X	X	X	X	X	X
30_27_01	Batteriesensor auslesen	X	X	X	X	X	X
30_28_01	Fahrerwunsch1 auslesen	X	X	X	X	X	X
30_29_01	Fahrerwunsch 2 auslesen	X	X	X	X	X	X

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Overview for SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_2A_01	Drosselklappe auslesen	X	X	X	X	X	X
30_2A_00/07	Drosselklappe ansteuern	X	X	X	X	X	X
30_2E_01	Sekundaerluft HFM auslesen	X	-	-	-	-	X
30_2F_01	Taster Tempomat	X	X	X	X	X	-
30_30_01	Klopfbaustein1 auslesen	X	X	X	X	X	X
30_31_01	Klopfbaustein 2 auslesen	X	X	X	X	X	X
30_32_01	Generator Sollspannung BSD auslesen	X	X	X	X	X	X
30_32_00/07	Generator Sollspannung BSD ansteuern	X	X	X	X	X	X
30_37_01	Oeldrucksensor auslesen	X	X	X	X	X	-
30_3B_01	NOx-Sensor auslesen	X	X	X	X	X	-
30_3F_01	Kraftsoffniederdrucksensor auslesen	-	X	X	X	X	X
30_40_01	Bremsunterdrucksensor auslesen	X	X	-	X	-	-
30_43_01	Raildrucksenor 2 auslesen	-	-	-	-	-	X
30_44_01	Klopfbaustein 3 auslesen	-	-	-	-	-	X
30_-_01	Klopfbaustein 4 auslesen	-	-	-	-	-	X
30_46_01	Luftmassenmesser 2 auslesen	-	-	-	-	-	X
30_80_01	Radiator shutter auslesen	-	-	X	-	X	-
30_80_00/07	Radiator shutter ansteuern	-	-	X	-	X	-
30_82_01	HPD-Relais auslesen	-	X	-	X	-	X
30_82_00/07	HPD-Relais ansteuern	-	X	-	X	-	X
30_83_01	Wasserpumpe Turbolader auslesen	-	-	-	-	-	X
30_83_00/07	Wasserpumpe Turbolader ansteuern	-	-	-	-	-	X
30_84_01	Drosselklappenstellergehäuseheizung 2 auslesen	-	-	-	-	-	X
30_84_00/07	Drosselklappenstellergehäuseheizung 2 ansteuern	-	-	-	-	-	X
30_85_01	Drosselklappe 2 auslesen	-	-	-	-	-	X
30_85_00/07	Drosselklappe 2 ansteuern	-	-	-	-	-	X
30_86_01	(second) HPD5-Mengensteuerventil auslesen	-	X	-	X	-	X
30_86_00/07	(second) HPD5-Mengensteuerventil ansteuern	-	X	-	X	-	X
30_87_01	Abgasklappe 2 auslesen	-	-	-	-	-	X
30_87_00/07	Abgasklappe 2 ansteuern	-	-	-	-	-	X
30_88_01	Vanos Einlass Ventil Bank2 auslesen	-	-	-	-	-	X
30_88_00/07	Vanos Einlass Ventil Bank2 ansteuern	-	-	-	-	-	X
30_89_01	Vanos Auslass Ventil Bank2 auslesen	-	-	-	-	-	X

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Overview for SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_89_00/07	Vanos Auslass Ventil Bank2 ansteuern	-	-	-	-	-	X
30_8A_01	Umluftventil Bank 2 auslesen	-	-	-	-	-	X
30_8A_00/07	Umluftventil Bank 2 ansteuern	-	-	-	-	-	X
30_8B_01	Sekundaerluftventil 2 auslesen	-	-	-	-	-	X
30_8B_00/07	Sekundaerluftventil 2 ansteuern	-	-	-	-	-	X
30_9E_01	Drosselklappenstellergehaeuseheizung auslesen	-	X	X	X	X	X
30_9E_00/07	Drosselklappenstellergehaeuseheizung ansteuern	-	X	X	X	X	X
30_A4_01	Gesteuerte Luftfuehrung (untere Klappe) auslesen	X	X	X	X	X	X
30_A4_00/07	Gesteuerte Luftfuehrung (untere Klappe) ansteuern	X	X	X	X	X	X
30_AB_01	Oel Druck Regelung auslesen	X	X	X	X	X	-
30_AB_00/07	Oel Druck Regelung ansteuern	X	X	X	X	X	-
30_AC_01	Oeldruckventil auslesen	X	X	X	X	X	-
30_AC_00/07	Oeldruckventil ansteuern	X	X	X	X	X	-
30_AD_01	Kurbelgehaeuseentlueftungsheizung auslesen	-	X	X	X	X	X
30_AD_00/07	Kurbelgehaeuseentlueftungsheizung ansteuern	-	X	X	X	X	X
30_AE_01	Variable Sauganlage (DISA) Klappe2 auslesen	X	X	X	X	X	-
30_AE_00/07	Variable Sauganlage (DISA) Klappe2 ansteuern	X	X	X	X	X	-
30_B2_01	Motorlagersteuerung auslesen	-	X	X	X	X	-
30_B2_00/07	Motorlagersteuerung ansteuern	-	X	X	X	X	-
30_B5_01	Umluftventil Bank 1 auslesen	-	-	-	-	-	X
30_B5_00/07	Umluftventil Bank 1 ansteuern	-	-	-	-	-	X
30_B6_01	Ladedrucksteller 1 auslesen	-	X	X	X	X	X
30_B6_00/07	Ladedrucksteller 1 ansteuern	-	X	X	X	X	X
30_B7_01	Ladedrucksteller 2 auslesen	-	X	X	X	X	X
30_B7_00/07	Ladedrucksteller 2 ansteuern	-	X	X	X	X	X
30_BD_01	Mengensteuerventil auslesen	-	X	X	X	X	X
30_BD_00/07	Mengensteuerventil ansteuern	-	X	X	X	X	X
30_BE_01	Abgasrückführungsventil auslesen	X	X	X	X	X	-
30_BE_00/07	Abgasrückführungsventil ansteuern	X	X	X	X	X	-
30_BF_01	elektr. Wasserpumpe ueber BSD auslesen	X	X	X	X	X	-
30_BF_00/07	elektr. Wasserpumpe ueber BSD ansteuern	X	X	X	X	X	-
30_C1_01	Abgasklappe auslesen	X	X	X	X	X	X
30_C1_00/07	Abgasklappe ansteuern	X	X	X	X	X	X
30_C2_01	Soundklappeauslesen	X	X	X	X	X	X

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Overview for SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_C2_00/07	Soundklappe ansteuern	X	X	X	X	X	X
30_C3_01	Gesteuerte Luftfuehrung auslesen	X	X	X	X	X	X
30_C3_00/07	Gesteuerte Luftfuehrung ansteuern	X	X	X	X	X	X
30_C4_01	Startrelais auslesen	X	X	X	X	X	X
30_C4_00/07	Startrelais ansteuern	X	X	X	X	X	X
30_C6_01	Variable Sauganlage (DISA) Klappe auslesen	X	X	X	X	X	-
30_C6_00/07	Variable Sauganlage (DISA) Klappe ansteuern	X	X	X	X	X	-
30_C7_01	Klimakompressor-Relais auslesen	X	X	X	X	X	-
30_C7_00/07	Klimakompressor-Relais ansteuern	X	X	X	X	X	-
30_C8_01	EBOX_Controlled_Fan auslesen	X	X	X	X	X	X
30_C8_00/07	EBOX_Controlled_Fan ansteuern	X	X	X	X	X	X
30_C9_01	Electr_Controlled_Thermostat auslesen	X	X	X	X	X	X
30_C9_00/07	Electr_Controlled_Thermostat ansteuern	X	X	X	X	X	X
30_CA_01	Sekundaerluftventil auslesen	X	-	-	-	-	X
30_CA_00/07	Sekundareluftventil ansteuern	X	-	-	-	-	X
30_CB_01	Sekundaerluftpumpe auslesen	X	-	-	-	-	X
30_CB_00/07	Sekundaerluftpumpe ansteuern	X	-	-	-	-	X
30_CC_01	Diagnosemodul-Tank Leckage Pumpe auslesen	X	-	X	-	X	X
30_CC_00/07	Diagnosemodul-Tank Leckage Pumpe ansteuern	X	-	X	-	X	X
30_CD_01	Diagnosemodul-Tank Leckage Ventil auslesen	X	-	X	-	X	X
30_CD_00/07	Diagnosemodul-Tank Leckage Ventil ansteuern	X	-	X	-	X	X
30_CE_01	Diagnosemodul-Tank Leckage Heizung auslesen	X	-	X	-	X	X
30_CE_00/07	Diagnosemodul-Tank Leckage Heizung ansteuern	X	-	X	-	X	X
30_CF_01	Canister_Purge_Solenoid auslesen	X	X	X	X	X	X
30_CF_00/07	Canister_Purge_Solenoid ansteuern	X	X	X	X	X	X
30_D0_01	Lambda_Sensor_Heating_Up_1 auslesen	X	X	X	X	X	X
30_D0_00/07	Lambda_Sensor_Heating_Up_1 ansteuern	X	X	X	X	X	X
30_D1_01	Lambda_Sensor_Heating_Down_1 auslesen	X	X	X	X	X	X
30_D1_00/07	Lambda_Sensor_Heating_Down_1 ansteuern	X	X	X	X	X	X
30_D2_01	Lambda_Sensor_Heating_Up_2 auslesen	X	X	X	X	X	X
30_D2_00/07	Lambda_Sensor_Heating_Up_2 ansteuern	X	X	X	X	X	X
30_D3_01	Lambda_Sensor_Heating_Down_2 auslesen	X	X	X	X	X	X
30_D3_00/07	Lambda_Sensor_Heating_Down_2 ansteuern	X	X	X	X	X	X
30_D4_01	Malfunction_Indicator_Lamp auslesen	X	X	X	X	X	X

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Overview for SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_D4_00/07	Malfunction_Indicator_Lamp ansteuern	X	X	X	X	X	X
30_D5_01	Fahrgeschwindigkeitsregler-Lampe auslesen	X	X	X	X	X	X
30_D5_00/07	Fahrgeschwindigkeitsregler-Lampe ansteuern	X	X	X	X	X	X
30_D6_01	EML_Lamp auslesen	X	X	X	X	X	X
30_D6_00/07	EML_Lamp ansteuern	X	X	X	X	X	X
30_D8_01	Electrical_Fuel_Pump auslesen	X	X	X	X	X	X
30_D8_00/07	Electrical_Fuel_Pump ansteuern	X	X	X	X	X	X
30_DA_01	E-Box-Luefter auslesen	X	X	X	X	X	X
30_DA_00/07	E-Box-Luefter ansteuern	X	X	X	X	X	X
30_DC_01	VVT-Entlastungsrelais auslesen	X	-	-	-	-	X
30_DC_00/07	VVT-Entlastungsrelais ansteuern	X	-	-	-	-	X
30_DD_01	ValveTronic Lift auslesen	X	-	-	-	-	X
30_DD_00/07	ValveTronic Lift ansteuern	X	-	-	-	-	X
30_E1_01	Einspritzventil 1 auslesen	X	X	X	X	X	X
30_E1_00/07	Einspritzventil 1 ansteuern	X	-	-	-	-	-
30_E2_01	Einspritzventil 2 auslesen	X	X	X	X	X	X
30_E2_00/07	Einspritzventil 2 ansteuern	X	-	-	-	-	-
30_E3_01	Einspritzventil 3 auslesen	X	X	X	X	X	X
30_E3_00/07	Einspritzventil 3 ansteuern	X	-	-	-	-	-
30_E4_01	Einspritzventil 4 auslesen	X	X	X	X	X	X
30_E4_00/07	Einspritzventil 4 ansteuern	X	-	-	-	-	-
30_E5_01	Einspritzventil 5 auslesen	X	-	X	-	X	X
30_E5_00/07	Einspritzventil 5 ansteuern	X	-	-	-	-	-
30_E6_01	Einspritzventil 6 auslesen	X	-	X	-	X	X
30_E6_00/07	Einspritzventil 6 ansteuern	X	-	-	-	-	-
30_E7_01	Einspritzventil 7 auslesen	-	-	-	-	-	X
30_E8_01	Einspritzventil 8 auslesen	-	-	-	-	-	X
30_ED_01	Vanos Einlass Ventil auslesen	X	X	X	X	X	X
30_ED_00/07	Vanos Einlass Ventil ansteuern	X	X	X	X	X	X
30_EE_01	Vanos Auslass Ventil auslesen	X	X	X	X	X	X
30_EE_00/07	Vanos Auslass Ventil ansteuern	X	X	X	X	X	X
30_EF_01	HPD5-Mengensteuerventil 1 auslesen	-	-	-	-	-	X
30_EF_00/07	HPD5-Mengensteuerventil 1 ansteuern	-	-	-	-	-	X

I.3.16 Overview for SID 31h

Hint: overview taken from 17I00N0D.0AB and 17I03901.00O

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SID number	service	Service Location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
31_01	ask checksums after reprogramming	BOOT	X	X	X	X	X	X
31_02	erase Memory	BOOT	X	X	X	X	X	X
31_03	erase History Memory	ECU	X	X	X	X	X	X
31_05	power down	ECU	X	X	X	X	X	X
31_07	start authentification	BOOT	X	X	X	X	X	X
31_08	check authentification	BOOT	X	X	X	X	X	X
31_09	check signature	BOOT	X	X	X	X	X	X
31_0A	report reprogramming status	BOOT	X	X	X	X	X	X
31_0C	energy spare mode	ECU	X	X	X	X	X	X
31_1F_EE	EWS4: Start calculation and storage	ECU	X	X	X	X	X	X
31_1F_E3	EWS4: Read out GXMODN data	ECU	X	X	X	X	X	X
31_1F_E4	EWS4: Read out length of GXMODN	ECU	X	X	X	X	X	X
31_1F_F1	EWS4: Transfer data of FSC to ECU	ECU	X	X	X	X	X	X
31_1F_F2	EWS4: Transfer length of ESC (FreiSchaltCode) to ECU	ECU	X	X	X	X	X	X
31_20	EOL Test ON: Secondary air system	ECU	X	X	X	X	X	X
31_22	EOL Test ON: CPS	ECU	X	X	X	X	X	X
31_25	switch off Injection valves	ECU	X	X	X	X	X	X
31_26	EOL Test ON: Idle speed setpoint displace	ECU	X	X	X	X	X	X
31_27	start VVL Adaptation	ECU	X	-	-	-	-	
31_2A	Start intelligent alternator test	ECU	X	X	X	X	X	X
31_2B	Start Ruhestrom test	ECU	X	X	X	X	X	X
31_2C	Start EOL test: Oil Pressure Regulation Diagnosis	ECU	X	X	X	X	X	-
31_2D	Start EOL test: Desulfatisierung	ECU	-	X	X	X	X	-
31_2E	Start Nullgang-Lernen	ECU	-	X	-	X	-	-
31_2F	Start Desulfatisierung Fahrbetrieb	ECU	-	X	X	X	X	-
31_30	delete selective adaption values	ECU	X	X	X	X	X	X
31_31	delete selective adaption values 2	ECU	-	X	X	X	X	X
31_CF	Start : Sperre Tankentlueftung	ECU	-	X	X	X	X	
31_D0	Start: Werkstattdiagnose ATL	ECU	-	X	X	X	X	X
31_D5	EOL Test ON: ECRAS system test	X	X	X	X	X	X	
31_D9	switch off Lambda controller	ECU	X	X	X	X	X	X
31_DA	EOL Test ON: DMTL	ECU	X	X	X	X	X	X
31_DF	EOL Test ON: Lambda sensors confused /	ECU	X	X	X	X	X	X

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SID number	service	Service Location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
	wrong wired							
31_E0	Ansteuern Eisy- Adaptionswerte (ungedrosselt)	ECU	X	-	-	-	-	-
31_E1	Ansteuern Eisy- Adaptionswerte (gedrosselt)	ECU	X	X	X	X	X	X
31_E2	Ansteuern Eisy- Adaptionswerte (gedrosselt mit Abgasrueckführung)	ECU	-	X	X	X	X	X
31_E3	Ansteuern Krann- Adaptionswerte	ECU	X	X	X	X	X	X
31_E4	Ansteuern Klann-Adaptionswerte	ECU	X	X	X	X	X	X
31_E5	Ansteuern AGR-Adaptionswerte	ECU	-	X	-	X	-	-
31_F0	Calculate checksum for IncaPC	ECU	X	-	-	-	-	-
31_F1	Programming of calibration data for IncaPC	ECU	X	-	-	-	-	-
31_F4	cruise control delete switch off conditions	ECU	X	X	X	X	X	X
31_F5	switch off Idle speed uplift	ECU	X	X	X	X	X	X
31_F6	set default values PM for BN-SS	ECU	X	X	X	X	X	X
31_F7	Intelligente Generatorregelung	ECU	X	X	X	X	X	
31_FA	supplier interner Service	ECU / BOOT	X	X	X	X	X	X
31_FB	supplier interner Service	ECU / BOOT	X	X	X	X	X	X
31_FC	supplier interner Service	ECU / BOOT	X	X	X	X	X	X
31_FE	Message using CAN message	ECU	X	-	-	-	-	-

I.3.17 Overview for SID 32h

Hint: overview takenfrom 17I00Z02.00F and 17I03901.00O

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SID number	service	Service Location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
32_20	EOL Test OFF: Secondary air system	ECU	X	-	-	-	-	X
32_22	EOL Test OFF: CPS	ECU	X	X	X	X	X	X
32_26	EOL Test OFF: Idle speed setpoint displace	ECU	X	X	X	X	X	X
32_27	Stop EOL - VVL Adaptation	ECU	X	-	-	-	-	-
32_2A	Stop intelligent alternator test	ECU	X	X	X	X	X	X
32_2C	Stop EOL test: Oil Pressure Regulation Diagnosis	ECU	X	X	X	X	X	-
32_2D	Stop EOL test: Desulfatisierung	ECU	-	X	X	X	X	-
32_2F	Stop Desulfatisierung Fahrbetrieb	ECU	-	X	X	X	X	-
32_CF	Stop : Sperre Tankentlueftung	ECU	-	X	X	X	X	-
32_D0	Stop: Werkstattdiagnose ATL	ECU	-	X	X	X	X	X
32_D5	Stop EOL: ECRAS system test	ECU	X	X	X	X	X	X
32_D9	stop switch off Lambda controller	ECU	-	X	X	X	X	X
32_DA	EOL Test OFF: DMTL	ECU	X	X	X	X	X	X
32_DF	EOL Test OFF: Lambda sensors confused / wrong wired	ECU	X	X	X	X	X	X
32_F0	stop checksum calculation for Inca PC	ECU	X	-	-	-	-	-
32_F1	stop programming of calibration data for IncaPC	ECU	X	-	-	-	-	-
32_F6	stop default values PM for BN-SS	ECU	-	X	X	X	X	X
32_F7	switch Intelligente Generatorregelung active	ECU	X	X	X	X	X	X

I.3.18 Overview for SID 33h

Hint: overview takenfrom 17I01101.00F and 17I03901.00O

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SID number	service	Service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85(8cyl)
33_20	**Report EOL results: Secondary air system**	ECU	**X**	**-**	**-**	**-**	**-**	**X**
33_22	**Report EOL results: CPS**	ECU	**X**	**X**	**X**	**X**	**X**	**X**
33_25	read INH_IV_KWP - Diagnos Status EV-Ausblendung	ECU	-	X	X	X	X	X
33_26	**Report EOL results: Idle speed setpoint displace**	ECU	**X**	**X**	**X**	**X**	**X**	**X**
33_27	**Read Status EOL: VVL adaptation**	ECU	**X**	**-**	**-**	**-**	**-**	**-**
33_2A	**Read Status: inteligent alternator test**	ECU	**X**	**X**	**X**	**X**	**X**	**X**
33_2B	Read result Ruhestrom Test	ECU	X	X	X	X	X	X
33_2F	Auslesen Desulfatisierung Fahrbetrieb	ECU	-	X	X	X	X	-
33_2C	**Read Status EOL test: Oil Pressure Regulation Diagnosis**	ECU	**X**	**X**	**X**	**X**	**X**	-
33_2D	**Read status EOL test: Desulfatisierung**	ECU	**-**	**X**	**X**	**X**	**X**	**-**
33_CF	**Read Statrus : Sperre Tankentlueftung**	ECU	**-**	**X**	**X**	**X**	**X**	**-**
33_D0	**Read Status: Werkstattdiagnose ATL**	ECU	**-**	**X**	**X**	**X**	**X**	**X**
33_D5	**Read Status EOL: ECRAS system test**	ECU	**X**	**X**	**X**	**X**	**X**	**X**
33_D9	Read Status: switch off lambda controller	ECU	-	X	X	X	X	X
33_DA	**Report EOL results: DMTL**	ECU	**X**	**X**	**X**	**X**	**X**	**X**
33_DF	**Report EOL results: Lambda sensors confused / wrong wired**	ECU	**X**	**X**	**X**	**X**	**X**	**X**
33_E0	Auslesen Eisy- Adaptionswerte (ungedrosselt)	ECU	X	-	-	-	-	-
33_E1	Auslesen Eisy- Adaptionswerte (gedrosselt)	ECU	X	X	X	X	X	X
33_E2	Auslesen Eisy- Adaptionswerte (gedrosselt mit Abgasrueckfuehrung)	ECU	-	X	X	X	X	X
33_E3	Auslesen Krann- Adaptionswerte	ECU	X	X	X	X	X	X
33_E4	Auslesen Klann-Adaptionswerte	ECU	X	X	X	X	X	X
33_E5	Auslesen AGR-Adaptionswerte	ECU	-	X	X	X	-	-
33_F0	Report results of checksum calculation for INCA PC	ECU	X	-	-	-	-	-
33_F1	Report results of programming the calibration data for INCA PC in the power latch phase	ECU	X	-	-	-	-	-
33_F6	Report Status: Steuern Messsemode stop default value	ECU	-	X	X	X	X	X
33_F7	report results of Intelligente Generatorregelung	ECU	X	X	X	X	X	X

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I.3.19 Overview for SID 34h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
34	Flash Programmierung	RequestDownload	DI	L3	L5	DI	BOOT	X	X	X	X	X	X

I.3.20 Overview for SID 35h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
35	Request upload	UploadRequest	DI	L3	L5	DI	BOOT	X	X	X	X	X	X

I.3.21 Overview for SID 36h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
36	Daten austauschen	TransferData	DI	L3	L5	DI	BOOT	X	X	X	X	X	X

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I.3.22 Overview for SID 37h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
37	Flash-Programmierung beenden	RequestTransferExit	DI	L3	L5	DI	BOOT	X	X	X	X	X	X

I.3.23 Overview for SID 3Bh

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
3B_90	Kurze Fahrgestellnummer schreiben	WriteDataByLocalIdentifier	ENA	DI	L5	DI	ECU	X	X	X	X	X	X
3B_C1	KVA-Faktor schreiben	WriteDataByLocalIdentifier	ENA	DI	L5	DI	ECU	X	X	X	X	X	X

I.3.24 Overview for SID 3Dh

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
3D	Speicher schreiben	WriteMemoryByAddress	DI	L3	L5	DI	BOOT	X	X	X	X	X	X

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I.3.25 Overview for SID 3Eh

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
3E	Enable positive response	TesterPresent	ENA	L3	L5	L4	Boot-/ECU	X	X	X	X	X	X
3E_01	Enable positive response	TesterPresent	ENA	ENA	ENA	ENA	BOO T	X	X	X	X	X	X
3E_02	Disable positive response	TesterPresent	ENA	ENA	ENA	ENA	BOO T	X	X	X	X	X	X

I.3.26 Overview for SID 80h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
80_90_00	K-Linie-Applikation-Tool Reference page	EscapeCode	ENA	DI	L5	DI	BOO T	X	-	-	-	-	-
80_90_01	K-Linie-Applikation-Tool Working page RAM	EscapeCode	ENA	DI	L5	DI	BOO T	X	-	-	-	-	-

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I.3.27 Overview for SID 81h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
81	Aufbau Testerverbindung	StartCommunication	ENA	DI	L5	DI	BOOT	X	-	-	-	-	-

I.3.28 Overview for SID 82h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
82	Abbau Testerverbindung	StopCommunication	ENA	L3	L5	L4	BOOT	X	-	-	-	-	-

I.3.29 Overview for SID 83h

SID number	service	type	Mode 81 Standard mode	Mode 85 programming mode	Mode 86 development mode	Mode 89 safety mode	service location	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD_85 (L4)
83_00	Read limits	AccessTimingParameter	ENA	L3	L5	DI	BOOT	X	-	-	-	-	-
83_01	Set parameter to default	AccessTimingParameter	ENA	L3	L5	DI	BOOT	X	-	-	-	-	-
83_02	Read activ parameters	AccessTimingParameter	ENA	L3	L5	DI	BOOT	X	-	-	-	-	-
83_03	Set parameter	AccessTimingParameter	ENA	L3	L5	DI	BOOT	X	-	-	-	-	-

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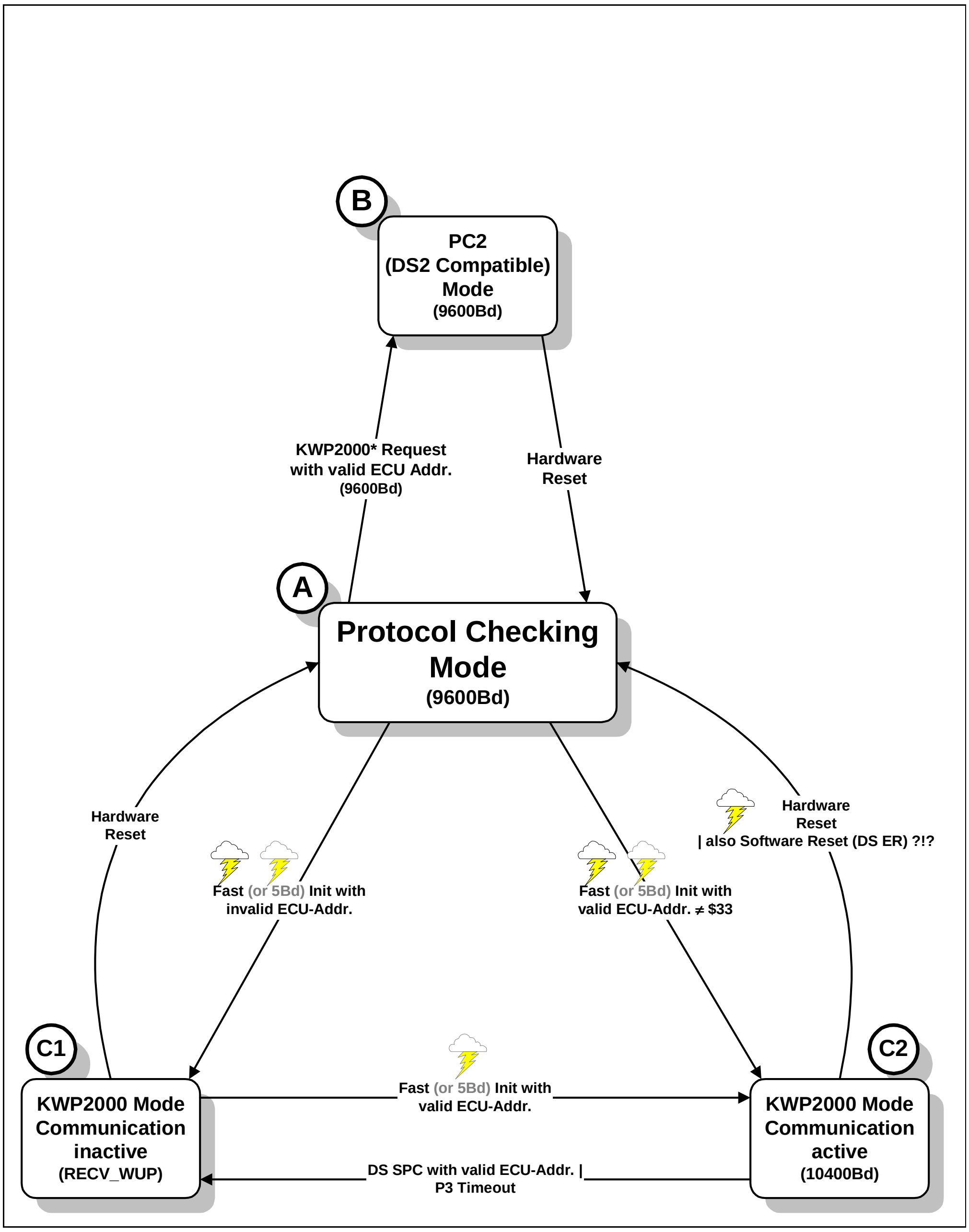
I.4 Initialisation and timing

I.4.1 Protocol Switching



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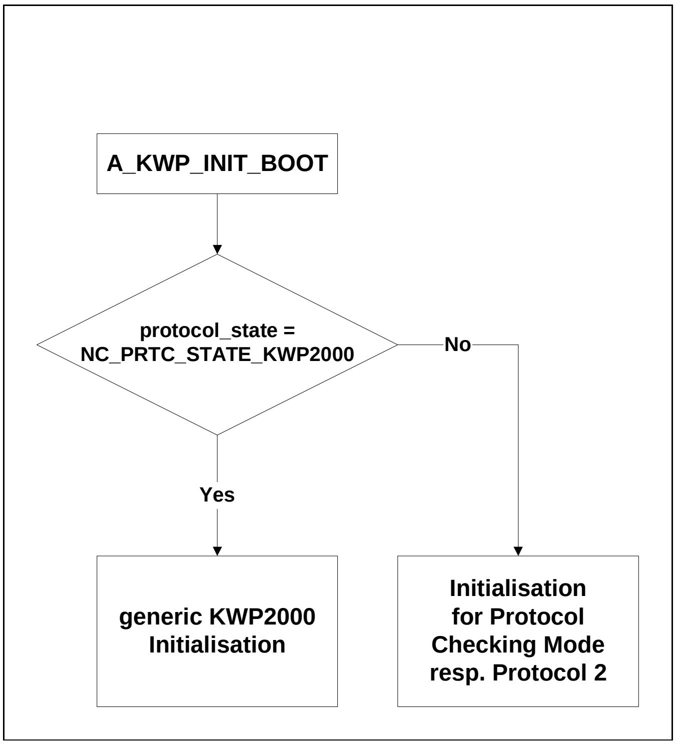
I.4.2 Initialisation of different protocols



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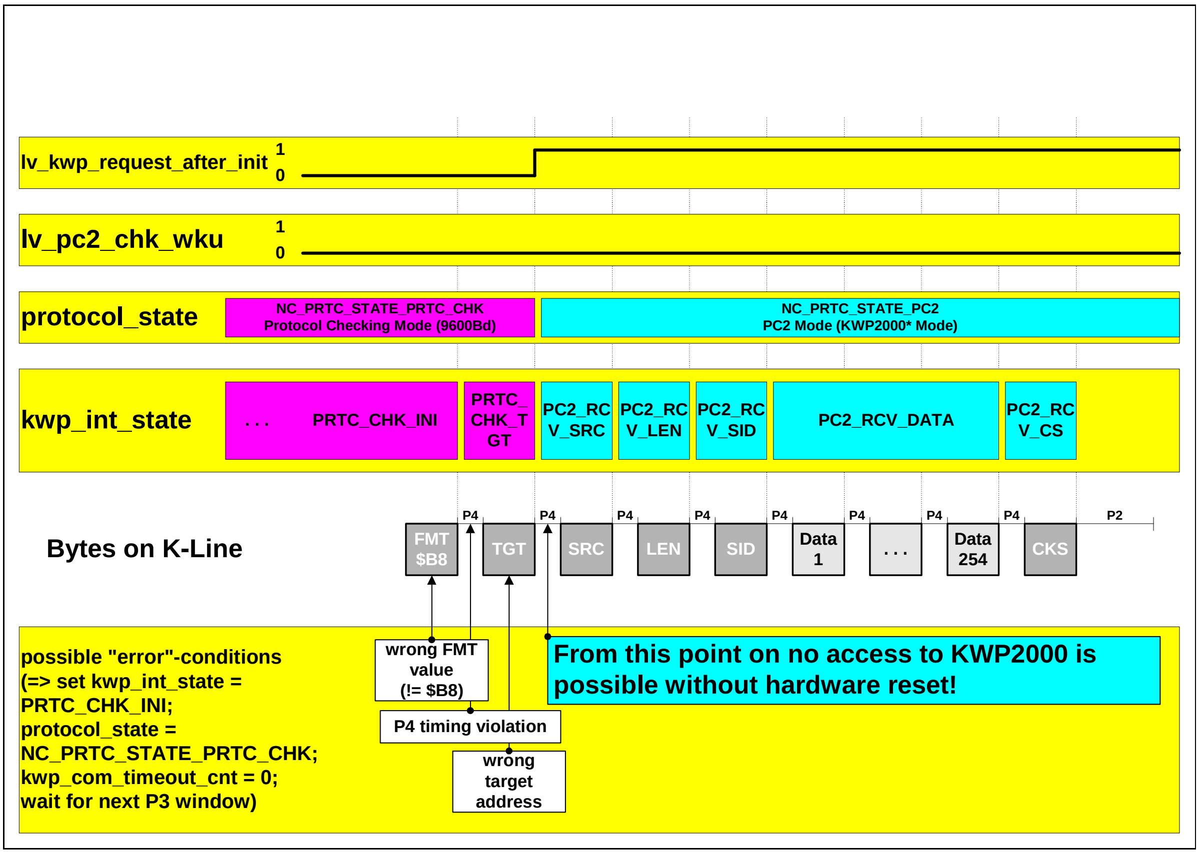
I.4.3 KWP* Detection



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I.4.4 WUP Detection for KWP

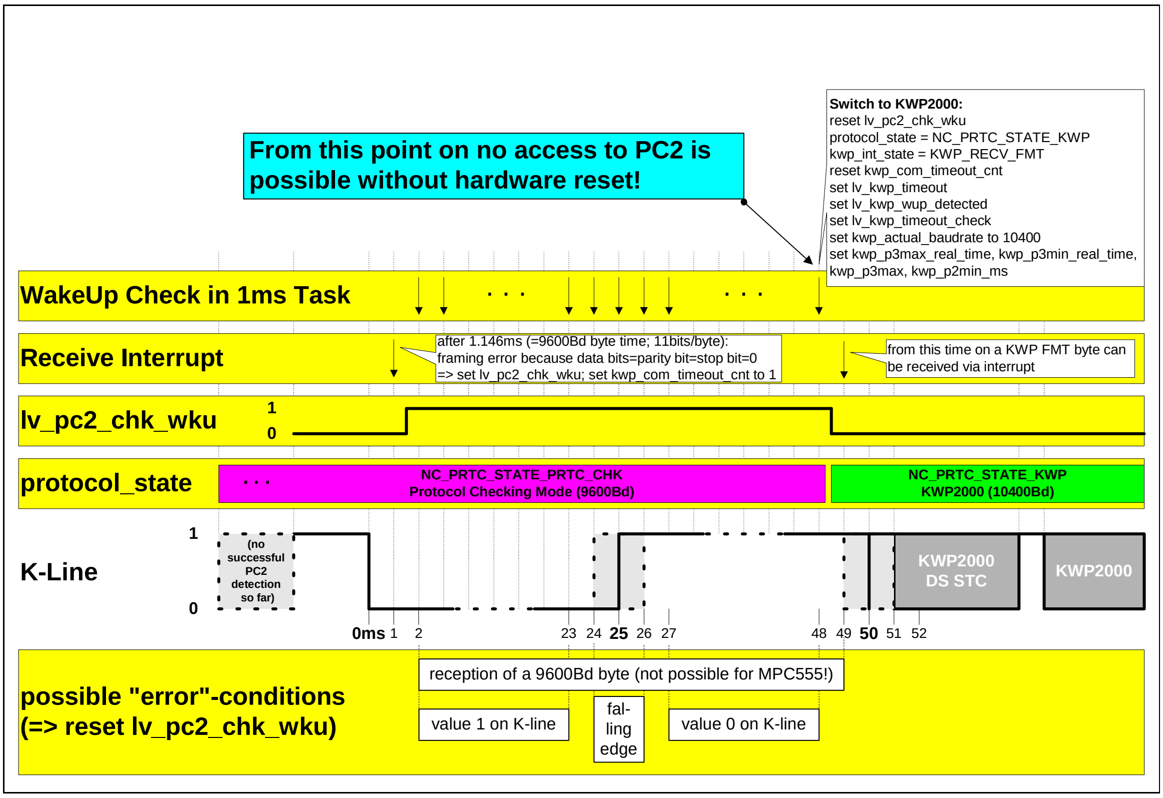

Figure I.4.1: Table Fast Initialization

1. The tester may use a baudrate of 10400 baud for initializatian (stc) and communication. For KWP2000* the baudrate is 9600 baud.
2. It is possible to change the baudrate with the service **s**tart**D**iagnostic**S**ession.

I.4.5 Timing

Timing	*lower limit values / ms*			*upper limit values / ms*		
Parameter	***min.***	***default***	***Resolution***	***default***	***max.***	***Resolution***
P1	0	0	-	20	20	-
P2	0	25	0,5	50 200ms for KWP*	6375	#25d; #FFh=6375ms
P3	0	55 25ms for KWP*	0.5	5000 infinity for KWP*	63750	#250d; #FFh=63750ms
P4	0	5	0.5	20	20	-
TWuP	49	50	-	-	51	-
TinL	24	25	-	-	26	-
TIdle	-	300	-	-	-	-

Figure I.4.2: Table - Normal Timing Parameter Set (for functional and physical addressing)

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Value	*Description*
P1	Inter byte time for ECU response
P2	Time between tester request and ECU response
P3	Time between end of ECU responses and start of new tester request
P4	Inter byte time for tester request
TWuP	High Low sequenz of the Wake-Up-Pattern
TiniL	Low sequenz of the Wake-Up-Pattern
Tidle (W5)	Idle Time

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I.5 Introduction

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
AMP_MES_KWP	V	0... FFH	0... 1353.19335	5.3066406	hPa
valid ambient pressure converted for DGNC					
CAM_IN_KWP	O/V	0... FFH	60... 155.625	0.375	°CRK
Actual position inlet CAM VVTI converted for KWP					
CAM_SP_IVVT_IN_KWP	O/V	0... FFH	60... 155.625	0.375	°CRK
Inlet CAM setpoint for VVTI converted for KWP					
CPU_LOAD_RST_DET_KWP	O/V	0... FFH	0... 99.60937	0.390625	%
CPU_LOAD_RST_DET[0] converted to KWP					
CTR_KM_CAN_KWP	O/V	0... FFH	0... 652800	2560	km
Vehicle kilometer reading from CAN message INSTR2, converted for KWP					
CUR_DMTL_COR_FIL_KWP	O/V	0... FFH	0... 49.80468	0.1953125	mA
Corrected and filtered pump current converted for KWP					
CUR_DMTL_REF_LEAK_KWP	O/V	0... FFH	0... 49.80468	0.1953125	mA
Pump current reference leakage converted for KWP					
CUR_DMTL_ROUGH_LEAK_MIN_KWP	O/V	0... FFH	0... 49.80468	0.1953125	mA
Min. pump current in case of rough leak measurement converted for KWP					
DIST_SO2P_END_KWP	O/V	0... FFH	0... 10200	40	km
Km - counter since last end of desulfation converted for KWP					
EFPPWM_KWP	O/V	0... FFH	0... 99.60937	0.390625	%
Pump speed of the electrical fuel pump as PWM signal converted for KWP					
FAC_MV_DIAG_DYN_LSL_UP_KWP [NC_CBK_EX_NR]	O/V	0... FFH	0... 1.02	0.004	-
Mean value of normalised single sensor signal amplitude converted for KWP					
FUP_EFP_KWP	O/V	0... FFH	0... 10825.7088	42.-376	hPa
Fuel pressure EFP converted for KWP					
FUP_KWP [NC_CBK_HPP_NR]	O/V	0... FFH	0... 346422	1358.5176	hPa
Fuel pressure converted for KWP					
LAMB_DELTA_I_LAM_ADJ_KWP [NC_CBK_EX_NR]	O/V	80... 7FH	-0.125... 0.12402	976.599e-6	-
LAMB_DELTA_I_LAM_ADJ converted for KWP					
LAMB_DIF_MON_KWP	O/V	80... 7FH	-2... 1.98437	0.015625	-
Deviation between actual and modeled Lambda for KWP					
LAMB_KWP [NC_CBK_EX_NR]	O/V	0... FFH	0... 1.99218	0.0078125	-
Signal value of lambda sensor					
LAMB_LS_UP_MV_KWP	O/V	0... FFH	0... 3.98437	0.015625	-
Mean value of lambda in multiple-branched exhaust gas lines converted for KWP					
LAMB_NOX_SENS_KWP	O/V	0... FFH	0... 3.98437	0.015625	-
Lambda value, measured by NOx sensor converted for KWP					
LAMB_SP_KWP [NC_CBK_EX_NR]	O/V	0... FFH	0... 1.99218	0.0078125	-
Lambda setpoint low byte value					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LOAD_MIN_MIS_KWP	O/V	0... FFH	0... 99.60937	0.390625	%
Nulllastwert für Aussetzererkennung					
LOAD_MIS_KWP	O/V	0... FFH	0... 99.60937	0.390625	%
Lastwert für Aussetzererkennung					
MAF_KGH_MES_BAS_KWP	V	0... FFH	0... 2040	8	kg/h
Raw air-mass flow measured (without correction, to be used for diagnosis only), converted for DGNC					
MAF_KWP	V	0... FFH	0... 1389	5.4470588	mg/stk
MAF converted to DGNC					
MFF_SP_MV_KWP	O/V	0... FFH	0... 1389	5.4470588	mg/stk
Mass fuel flow setpoint after combustion selection converted for KWP					
N_RST_DET_KWP	O/V	0... FFH	0... 8160	32	rpm
N_RST_DET[0] converted to KWP					
N_SAE_BYTE_KWP	O/V	0... FFH	0... 16320	64	rpm
Engine speed byte SAE J1979					
NOX_NS_KWP	O/V	FA... 5DH	-96... 1488	16	ppm
NOx concentration value, measured by NOx-Sensor for KWP					
NT_AGI_KWP	O/V	0... FFH	0 ...1	3.9216e-3	-
NOx trap aging factor converted for KWP					
NT_AGI_SUL_KWP	O/V	0... FFH	0... 0.99609	3.9062e-3	-
NOx trap aging factor due to sulphur load converted for KWP					
NT_SUL_KWP	O/V	0... FFH	0... 10444.8	40.96	mg
NOx trap sulphur loading					
OBD_AMP	O/V	0... FFH	0... 255	1	kPA
Barometric pressure SAE J1979					
OBD_FUP_RNG_H	O/V	0... FFFFH	0... 655350	10	kPA
High range Fuel pressure SAE J1979					
OBD_FUP_RNG_H_H	O/V	0... FFH	0... 652800	2560	kPA
High byte of OBD_FUP_RNG_H					
OBD_FUP_RNG_H_L	O/V	0... FFH	0... 2550	10	kPA
Low byte of OBD_FUP_RNG_H					
OBD_IGA_IGC	O/V	0... FFH	-64... 63.5	0.5	°CRK
Ignition time cylinder 1 SAE J1979					
OBD_LAM_COR [NC_CBK_EX_NR]	O/V	0... FFH	-100... 99.21875	0.78125	%
Lambda control factor SAE J1979					
OBD_LAMB_SP	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Lambda setpoint for display in mode 01 (PID $44)					
OBD_MAF	O/V	0... FFFFH	0... 655.35	0.01	g/s
Air mass SAE J1979					
OBD_N	O/V	0... 7F80H	0... 8160	0.25	rpm
Engine speed SAE J1979					
OBD_TCO	O/V	0... FFH	-40 ...215	1	°C
Engine coolant temperature SAE J1979					
OBD_TIA	O/V	0... FFH	-40 ...215	1	°C
Intake air temperature 1 SAE J1979					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
OBD_VB	O/V	0... FFFFH	0... 65.535	0.001	V
Control module voltage SAE J1979					
OPG_ACR_KWP	O/V	0... FFH	0... 99.60937	0.390625	%
Measured opening of the actuator valve converted for KWP					
OPG_SP_ACR_KWP	O/V	0... FFH	0... 99.60937	0.390625	%
Setpoint request after limitation for actuator position control converted for KWP					
P_OEL_IST_KWP	O/V	0... FFH	0... 8160	32	hPa
Oil pressure IST-value converted to KWP					
P_OEL_SOLL_KWP	O/V	0... FFH	0... 8160	32	hPa
Oil pressure soll-value converted to KWP					
PBSU_KWP	O/V	0... FFH	0... 1353.19335	5.3066406	hPa
Absolute pressure in the brake servo, converted for KWP					
PUT_KWP [NC_MAP_SENS_NR]	O/V	0... FFH	0... 255	1	kPA
Pressure upstream the throttle (Turbo) converted for KWP					
PWM_ACR_KWP	O/V	80... 7FH	-100... 99.21875	0.78125	%
Finally duty cycle of digital actuator control converted to KWP					
PWM_ETC_KWP [NC_ETC_NR]	O/V	80... 7FH	-100... 99.21875	0.78125	%
Duty cycle for ETC actuator control converted for KWP					
PWM_NEUT_PSN_GB_KWP	O/V	0... FFH	0... 99.60937	0.390625	%
Tastverhältnis Nullgangsensor converted for KWP					
Q_iruhe2_kwp	V	0... FFH	0... 127	0.4980392	Ah
Entladung während Ruhestromverletzung converted and limited for DGNC					
R_IT_LS_DOWN_KWP_H [NC_CBK_EX_NR]	O/V	0... FFH	0... 65280	256	Ohm
Internal resistance of downstream oxygen sensor (measured) - high byte					
R_IT_LS_DOWN_KWP_L [NC_CBK_EX_NR]	O/V	0... FFH	0... 255	1	Ohm
Internal resistance of downstream oxygen sensor (measured) - low byte					
R_IT_LS_UP_KWP_H [NC_CBK_EX_NR]	O/V	0... FFH	0... 16320	64	Ohm
Internal resistance of upstream oxygen sensor (measured) - high byte					
R_IT_LS_UP_KWP_L [NC_CBK_EX_NR]	O/V	0... FFH	0... 63.75	0.25	Ohm
Internal resistance of upstream oxygen sensor (measured) - low byte					
RATIO_NS_SHIFT_DIAG_KWP [NC_NOX_SENS_CONF]	V	80... 7FH	-1... 0.99218	0.0078125	-
NOx signal shift diagnosis value converted for diagnostic communication					
SEG_T_MES_KWP	O/V	0... FFFFH	0... 1999777	30.514648	µs
Laufunruhe Segmentzeit, converted for KWP					
SEG_T_MES_KWP_H	O/V	0... FFH	0... 1992115.794	7812.2188	µs
Laufunruhe Segmentzeit, converted for KWP, high byte					
SEG_T_MES_KWP_L	O/V	0... FFH	0... 7781.7024	30.51648	µs
Laufunruhe Segmentzeit, converted for KWP, low byte					
STATE_BYTE_SWI_KWP	O/V	0... FFH	0... 255	1	-
Carrierbyte switch states for KWP					
STATE_ECRAS_SYS_KWP_H	O/V	0... FFH	0... 255	1	-
Status Luftklappensystem High Byte					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_ECRAS_SYS_KWP_L	O/V	0... FFH	0... 255	1	-
Status Luftklappensystem Low Byte					
STATE_LRN_ECU_KWP	O/V	0H 11H 3DH 5AH 79H 97H A5H AEH BCH CBH D3H EAH FFHH	ROM_PLAUS LEARNING_ FAILED LOT8 LOT1 LOT5 LOT9 LOT2 LOT4 SERIAL_ECU LOT6 LOT7 LOT3 NOT_ LEARNED	-	-
Variant ECU for DGNC					
T_AST_SAE_KWP	V	0... FFH	0... 255	1	s
T_AST_SAE converted for DGNC (and limited to 255s if T_AST_SAE > 255s)					
T_batt_kwp	V	CE... 64H	-50 ...100	1	°C
Battery temperature converted and limited for DGNC					
T_CH_SO2P_ACT_KWP	O/V	0... FFH	0... 6528	25.6	s
Time with active catalyst heating for desulfation without active desulfation converted for KWP					
T_ES_CUS_KWP	O/V	0... FFH	0... 1020	4	min
Engine shut-off duration, not deleted at ST_END					
T_ES_KWP	O/V	0... FFH	0... 1020	4	min
Engine shut-off duration					
T_PER_MAF_FRQ_KWP	O/V	0... FFH	0... 8160	32	µs
arithmetric average of the period time converted for KWP					
T_PER_MAF_KWP	O/V	0... FFH	0... 1.02	0.004	ms
period time of air mass converted for KWP					
TCHIP_KWP	O/V	0... FFH	-48 ...207	1	°C
chip temperature of alternator converted for KWP					
TIA_TCHA_KWP	O/V	0... FFH	-48 ...207	1	°C
Air temperature up turbo charger converted for KWP					
Tn_abstellm_kwp	V	0... FFH	0... 255	1	min
Engine off duration time (resolution min) converted and limited for DGNC					
TPS_AD_STEP_KWP [NC_ETC_NR]	O/V	0... FFH	0... 255	1	-
TPS_AD_STEP shifted to BYTE from DWORD					
TPS_AV_KWP [NC_ETC_NR]	O/V	0... FFH	0... 119.04046	0.4668254	°TPS
Throttle flap opening angle with high resolution converted for KWP					
TQ_AX_MAX_KWP	V	80... 7FH	-1024 ...1016	8	Nm
Maximum torque converted for DGNC					
TQ_AX_MIN_KWP	V	80... 7FH	-1024 ...1016	8	Nm
minimum torque converted for DGNC					
TQI_AV_H_RNG_MON_KWP	O/V	0... FFH	0... 1020	4	Nm
TQI_AV_H_RNG_MON converted for KWP					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_SP_H_RNG_MON_KWP	O/V	0... FFH	0... 1020	4	Nm
Desired indicated engine torque converted for DGNC					
TQI_SP_KWP	O/V	80... 7FH	-256 ...254	2	Nm
Torque setpoint fast path for KWP					
U_gen_kwp	V	0... FFH	0... 25.5	0.1	V
Generatorspannung converted with limitation for DGNC					
V_ALTER_SP_KWP	O/V	0... FFH	0... 25.5	0.1	V
setpoint alternator 1 voltage converted for KWP					
V_AMP_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Voltage V_AMP shifted toi FFC0H					
V_DMTL_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Voltage V_DMTL shifted to KWP					
V_DUR_IGC_KWP [NC_CYL_NR]	O/V	0... FFH	0... 261.12	1.024	ms
Burn time duration for diagnosis validation, converted for KWP					
V_FUP_EFP_MV_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
mean value of low fuel pressure EFP sensor converted for KWP					
V_FUP_MV_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Mean value of the acquired sensor voltage converted for KWP					
V_IGK_BAS_KWP	O/V	0... FFH	0... 28.8	0.1129412	V
Voltage V_IGK_BAS converted to KWP					
V_PBSU_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Spannung Bremsunterdrucksensor converted to KWP					
V_PUT_KWP [NC_MAP_SENS_NR]	O/V	0... FFH	0... 4.98046	0.0195312	V
Voltage of the intake manifold pressure sensor up throttle (for diagnosis) converted for KWP					
V_PVS_1_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Pedal value sensor 1 raw acquisition converted for KWP					
V_PVS_1_MON_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Pedal value sensor 1 raw acquisition monitoring value converted for KWP					
V_PVS_2_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Pedal value sensor 2 raw acquisition converted for KWP					
V_PVS_2_MON_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Pedal value sensor 2 raw acquisition monitoring value converted for KWP					
V_SOF_SWI_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Voltage V_SOF_SWI_KWP - ADC-value					
V_TPS_1_KWP [NC_ETC_NR]	O/V	0... FFH	0... 4.98046	0.0195312	V
Throttle position sensor 1 raw acquisition converted for KWP					
V_TPS_2_KWP [NC_ETC_NR]	O/V	0... FFH	0... 4.98046	0.0195312	V
Throttle position sensor 2 raw acquisition converted for KWP					
VB_BAS_KWP	O/V	0... FFH	0... 28.8	0.1129412	V
Voltage VB_BAS converted for KWP					
VCC_PVS_1_KWP	O/V	0... FFH	0... 9.96093	0.0390625	V
Voltage supply for pedal value sensor 1 raw acquisition converted for KWP					
VCC_PVS_2_KWP	O/V	0... FFH	0... 9.96093	0.0390625	V
Voltage supply for pedal value sensor 2 raw acquisition converted for KWP					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
VFF_MFF_SP_FUP_CTL_KWP	O/V	0... FFH	0... 255	1	l/h
Volume fuel flow through the injectors converted for KWP					
VLS_DIF_LAM_ADJ_KWP [NC_CBK_EX_NR]	O/V	80... 7FH	-0.625... 0.62011	4.8828e-3	V
difference between set point and actual downstream LS signal converted for KWP					
VLS_DOWN_KWP [NC_CBK_EX_NR]	O/V	0... FFH	0... 4.98046	0.0195312	V
Downstream oxygen sensor voltage converted for KWP					
VLS_NOX_SENS_KWP [NC_NOX_SENS_CONF]	O/V	0... 578H	-200 ...1200	1	mV
Binary O2 signal voltage, raw value, measured by NOx-Sensor for KWP					
VLS_OFS_LSL_KWP [NC_CBK_EX_NR]	O/V	80... 7FH	-0.625... 0.62011	4.8828e-3	V
Output signal offset of linear lambda sensor for Ip gain16 converted for KWP					
VLS_UP_KWP [NC_CBK_EX_NR]	O/V	0... FFH	0... 4.98046	0.0195312	V
Upstream Oxygen sensor voltage converted for KWP					
VP_TCO_2_KWP [NC_NR_TCO_SENS]	O/V	0... FFH	0... 4.98046	0.0195312	V
Voltage of coolant temperature sensor (radiator outlet) converted for KWP					
VP_TCO_KWP [NC_NR_TCO_SENS]	O/V	0... FFH	0... 4.98046	0.0195312	V
Voltage of coolant temperature sensor shifted to FFC0H					
VP_TECU_KWP	O/V	0... FFH	0... 4.98046	0.0195312	V
Voltage VP_TECU shifted to FFC0H					
VP_TEG_PCAT_DOWN_KWP	O/V	0... FFH	0... 3.3	0.0129412	V
Catalyst temperature sensor raw acquisition converted for KWP					
VP_TIA_KWP [NC_SENS_NR_TIA_THR]	O/V	0... FFH	0... 4.98046	0.0195312	V
VP_TIA converted for KWP					
VP_TIA_TCHA_KWP	O/V	0... FFH	0... 3.3	0.0129412	V
Voltage for temperatur sensor up turbocharger converted for KWP					
VP_TPS_1_KWP [NC_ETC_NR]	O/V	80... 7FH	-5... 4.96	0.0390588	V
Signal voltage throttle position sensor 1, converted for KWP					
VP_TPS_2_KWP [NC_ETC_NR]	O/V	80... 7FH	-5... 4.96	0.0390588	V
Signal voltage throttle position sensor 1, converted for KWP					

Input data:

Absch_korr {p. 8154}	AMP_MES {p. 1163}	Atlr {p. 8154}	Atlvst {p. 8154}
B_bsdprot2 {p. 8366}	B_lrfoff {p. 8367}	B_vsean_loc {p. 8347}	Ba_ist {p. 8154}
Ba_wm_ist {p. 8155}	BRAKE_PRS {p. 1561}	Bsdgencv {p. 8367}	Bsdgenregv {p. 8367}
CAM_EX [NC_NR_CBK_IVVT] {p. 8399}	CAM_IN [NC_NR_CBK_IVVT] {p. 8399}	CAM_IN_H [NC_NR_CBK_IVVT]	CAM_SP_IVVT_EX {p. 8399}
CAM_SP_IVVT_IN {p. 8399}	CAM_SP_REF_EX {p. 8399}	CAM_SP_REF_IN {p. 8399}	CAN_ERR_NOX_SENS [NC_NOX_SENS_CONF] {p. 1398}
CAN_STATE_NOX_SENS [NC_NOX_SENS_CONF] {p. 1398}	CHA_IV_1_MES [NC_CYL_NR] {p. 2035}	CL_MMV_SAE {p. 5926}	CPPWM_ADD_AD_MEM {p. 3756}
CPPWM_CPS {p. 3749}	CPU_LOAD_MAX_RST_DET [NC_RST_DBG_LIST_SIZE] {p. 560}	CPU_LOAD_RST_DET [NC_RST_DBG_LIST_SIZE] {p. 560}	CTR_AD_COLD_LAM_AD_INJ {p. 3348}

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FAC_H_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_LAM_AD_BAL [NC_CBK_EX_NR] {p. 1014}	FAC_LAM_AD_CUS [NC_CBK_EX_NR] {p. 8308}
FAC_LAM_AD_OUT [NC_CBK_EX_NR] {p. 2461}	FAC_LAM_AD_SAE [NC_CBK_EX_NR] {p. 1014}	FAC_LAM_ADJ_COR_ LAM_AD_CUS [NC_CBK_EX_NR] {p. 8309}	FAC_LAM_CYL_SEL_ ADJ_CST [NC_CYL_NR] {p. 2731}
FAC_LAM_CYL_SEL_ ADJ_H_RNG [NC_CYL_NR] {p. 2731}	FAC_LAM_CYL_SEL_ ADJ_L_RNG [NC_CYL_NR] {p. 2731}	FAC_LAM_LIM [NC_CBK_EX_NR] {p. 2461}	FAC_LAM_MV_MMV [NC_CBK_EX_NR] {p. 2462}
FAC_LAM_TCO_A [NC_CBK_EX_NR] {p. 2677}	FAC_LAM_TCO_B [NC_CBK_EX_NR] {p. 2677}	FAC_LAM_TCO_C [NC_CBK_EX_NR] {p. 2677}	FAC_LAM_TCO_D [NC_CBK_EX_NR] {p. 2677}
FAC_LAM_TCO_E [NC_CBK_EX_NR] {p. 2677}	FAC_LSL_GAIN_AD [NC_CBK_EX_NR] {p. 2371}	FAC_MFF_ADD_FAC_ LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_NOX_NS_AD [NC_NOX_SENS_CONF] {p. 3189}
FAC_TI_AD_ER_BAL [NC_CYL_NR] {p. 3298}	FAC_TI_ER_BAL [NC_CYL_NR] {p. 3298}	FLOW_COR_CPS {p. 3635}	FTL {p. 1564}
FUP {p. 1283}	FUP_EFP {p. 1290}	FUP_EFP_SP {p. 3792}	FUP_MPL [NC_CBK_HPP_NR]
FUP_RNG_H_MES {p. 1283}	FUP_SP_MPL [NC_CBK_HPP_NR]	GEAR {p. 1302}	Gen_manufak {p. 8368}
Gen_typkenn {p. 8368}	I_gen {p. 8158}	Ierr {p. 8368}	Ierrfgrenz {p. 8368}
IGA_IGC [NC_CYL_NR] {p. 1005}	IVVTPWM_EX [NC_NR_CBK_IVVT]	IVVTPWM_IN [NC_NR_CBK_IVVT]	KNKS [NC_CYL_NR] {p. 849}
KNKS_REL_NL [NC_CYL_NR] {p. 849}	LAMB_BAS [NC_CBK_EX_NR] {p. 8340}	LAMB_DELTA_AD_LAM_ ADJ [NC_CBK_EX_NR] {p. 2622}	LAMB_DELTA_I_LAM_ADJ [NC_CBK_EX_NR] {p. 2589}
LAMB_DIF_MON {p. 6777}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_LS_UP_MV {p. 2313}	LAMB_NOX_SENS [NC_NOX_SENS_CONF] {p. 1380}
LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LAMB_SP_SAE {p. 1015}	LC_SWI_AEB_TYP {p. 4136}	LF_ERR_PLAUS_IV_EGY_ CAL {p. 4790}
LF_ERR_PLAUS_IV_MFF_ CAL {p. 4790}	LOAD_BAT {p. 8368}	LOAD_CLC {p. 5801}	LOAD_MIN_MIS {p. 6283}
LOAD_MIS {p. 6213}	LSHPWM_DOWN [NC_CBK_EX_NR] {p. 2421}	LSHPWM_UP [NC_CBK_EX_NR] {p. 2385}	LV_ACCOUT_RLY {p. 3589}
LV_CAN_TEMP_MIN_THD [NC_NOX_SENS_CONF] {p. 1399}	LV_CDN_DIAG_TCHA_ LEAK {p. 1057}	LV_CRU_MAIN_SWI {p. 7220}	LV_CS {p. 8394}

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N_EFP_AV {p. 1569}	N_GRD {p. 1525}	N_PERC_ECF {p. 8225}	N_REL_CWP {p. 4095}
N_REL_CWP_2_1	N_REL_CWP_2_1_DIF	N_REL_CWP_2_2	N_REL_CWP_2_2_DIF
N_REL_CWP_DIF {p. 4537}	N_REL_CWP_SP {p. 8225}	N_REL_CWP_SP_2	N_RST_DET [NC_RST_DBG_LIST_SIZE] {p. 560}
N_SP_IS {p. 1122}	NC_CBK_EX_NR {p. 1829}	NC_CBK_HPP_NR [1] {p. 812}	NC_CBK_IN_NR {p. 604}
NC_CYL_NR {p. 1526}	NC_ECF_NR {p. 576}	NC_MAP_SENS_NR	NC_NOX_SENS_CONF {p. 643}
NC_NR_CAM_CBK {p. 1507}	NC_NR_CBK_IVVT {p. 604}	NC_NR_CPS_CP	NC_NR_DBG_NVMY
NC_NR_STACK_ADR_RST	NC_NR_TCHA	NC_NR_TCO_SENS {p. 576}	NC_RST_DBG_BACKTRACE_SIZE {p. 561}
NC_RST_DBG_LIST_SIZE {p. 561}	NC_SENS_NR_TIA_THR	NL [NC_CYL_NR] {p. 1962}	NOX_NS [NC_NOX_SENS_CONF] {p. 992}
NOX_OFS_LOAD [NC_NOX_SENS_CONF] {p. 3193}	NOX_OFS_PUC [NC_NOX_SENS_CONF] {p. 3193}	NT_AGI {p. 3073}	NT_AGI_SUL {p. 3073}
NT_AGI_THERMO {p. 3073}	NT_SUL {p. 3113}	OBD_TAM {p. 1569}	OPG_ACR {p. 1097}
OPG_SP_ACR {p. 3573}	Oz_krzcnt {p. 8164}	Oz_krzor	Oz_kvbog {p. 8164}
Oz_kvbsm_ul {p. 8164}	Oz_lf1c {p. 8203}	Oz_lf1t {p. 8164}	Oz_lf2c {p. 8203}
Oz_lf2t {p. 8164}	Oz_lgmwcnt {p. 8164}	Oz_lp {p. 8164}	Oz_lv {p. 8164}
Oz_nivakt {p. 8164}	Oz_nivkrzt {p. 8164}	Oz_nivlangt {p. 8164}	Oz_nivr {p. 8203}
Oz_oelkm {p. 8164}	Oz_oelzeit {p. 8164}	Oz_oricnt {p. 8164}	Oz_permakt {p. 8164}
Oz_permbog {p. 8164}	Oz_permex {p. 8164}	Oz_permlow {p. 8165}	Oz_permoff {p. 8165}
Oz_permr {p. 8203}	Oz_rwkvb {p. 8165}	Oz_rwperm {p. 8165}	Oz_tempakt {p. 8165}
Oz_tempr {p. 8203}	Oz_vormw {p. 8165}	Oz_vormwcnt {p. 8165}	P_oel_ist {p. 8203}
P_oel_soll {p. 8165}	PBSU {p. 807}	Pldr_soll {p. 8165}	POIL_PWM {p. 8203}
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PSN_CAM_EX [NC_NR_CAM_CBK] {p. 1533}	PSN_CAM_IN [NC_NR_CAM_CBK] {p. 1533}	PUT {p. 1209}	PV_AV {p. 1269}
PV_AV_1 {p. 1269}	PV_AV_2 {p. 1269}	PV_AV_MON {p. 6961}	PV_AV_RAW {p. 1269}
Pvdkds {p. 8279}	PWM_ACR {p. 3580}	PWM_ETC [NC_ETC_NR]	Q_iruhe2
R_IT_LS_UP [NC_CBK_EX_NR] {p. 1320}	RATIO_MMV_NS_SHIFT_DIAG [NC_NOX_SENS_CONF] {p. 6412}	RATIO_NS_SHIFT_DIAG [NC_NOX_SENS_CONF] {p. 6412}	REL_CWP_2_1_PWR

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TEMP_EL_CWP_2_2	Tget_b1 {p. 8177}	Tget_b2 {p. 8177}	Tget_b3 {p. 8177}
Tget_b4 {p. 8177}	Tget_b5 {p. 8177}	TI_1_MES [NC_CYL_NR] {p. 2040}	TIA {p. 1226}
TIA_MES {p. 1226}	TIA_ST {p. 1226}	TIA_TCHA {p. 1226}	Tlrfgen {p. 8369}
Tmot_b1 {p. 8177}	Tmot_b2 {p. 8177}	Tmot_b3 {p. 8177}	Tmot_b4 {p. 8177}
Tmot_b5 {p. 8177}	Tn_abstellm {p. 8221}	Toel {p. 8177}	Toel_b1 {p. 8177}
Toel_b2 {p. 8177}	Toel_b3 {p. 8177}	Toel_b4 {p. 8177}	Toel_b5 {p. 8178}
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TPS_AV_2 {p. 1169}	TPS_SP {p. 6555}	TPS_SP_MDL {p. 8377}	TQ_AX_MAX
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TQ_LOSS_MON {p. 6975}	TQ_MAX_CLU_DIF_MON {p. 6938}	TQ_MIN_CLU_DIF_MON {p. 6952}	TQ_REQ_CLU {p. 8390}
TQI_AV {p. 981}	TQI_AV_H_RNG_MON	TQI_AV_MON {p. 6774}	TQI_GS_FAST_DEC {p. 6718}
TQI_MSR_CAN {p. 811}	TQI_SP {p. 8391}	TQI_SP_H_RNG_MON	TQI_SP_MON {p. 6851}
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Tumg_b2 {p. 8178}	Tumg_b3 {p. 8178}	Tumg_b4 {p. 8178}	Tumg_b5 {p. 8178}
Tvngang {p. 8291}	U_batt {p. 8178}	U_fgen {p. 8369}	U_gen {p. 8178}
Ubt {p. 8179}	Uregnom {p. 8369}	V_ACR {p. 1097}	V_ACR_AD_BOL {p. 4320}
V_ACR_AD_BOL_0 {p. 4320}	V_ACR_AD_TOL {p. 4320}	V_ALTER_SP {p. 8369}	V_AMP {p. 831}
V_CWP {p. 4096}	V_CWP_2_1	V_CWP_2_2	V_DMTL
V_FUP_EFP {p. 1290}	V_FUP_EFP_MV {p. 1290}	V_FUP_MV {p. 1283}	V_IGK_BAS {p. 831}
V_IGK_MES {p. 847}	V_IV_1_MES [NC_CYL_NR] {p. 2041}	V_MAF {p. 811}	V_MAP {p. 1198}
V_PBSU	V_PUT {p. 1198}	V_PVS_1 {p. 831}	V_PVS_1_MON {p. 6961}
V_PVS_2 {p. 831}	V_PVS_2_MON {p. 6961}	V_SOF_SWI {p. 831}	V_TPS_1 {p. 831}
V_TPS_2 {p. 831}	VB {p. 1185}	VB_BAS {p. 831}	VB_RLY_HPDI
VCC_PVS_1 {p. 831}	VCC_PVS_2 {p. 832}	VFF_EFP {p. 989}	VFF_MFF_SP_FUP_CTL {p. 3881}
VIM_AV {p. 3622}	VIMPWM_1 {p. 3622}	VIMPWM_2 {p. 3622}	VLS_DIF_LAM_ADJ [NC_CBK_EX_NR] {p. 2590}
VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VLS_DOWN_PUE_MMV [NC_CBK_EX_NR] {p. 5170}	VLS_DOWN_PUE_SAVE_MAX [NC_CBK_EX_NR] {p. 5170}	VLS_DOWN_PUE_SAVE_MIN [NC_CBK_EX_NR] {p. 5170}
VLS_DOWN_PUE_STD [NC_CBK_EX_NR] {p. 5170}	VLS_NOX_SENS [NC_NOX_SENS_CONF] {p. 1382}	VLS_OFS_LSL [NC_CBK_EX_NR] {p. 2315}	VLS_UP [NC_CBK_EX_NR] {p. 1341}

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General information:

This specification is based on the on actual program version of Basic-Software.
All project specific implemented services and parameter of diagnostic communication protocol are listed below.

In the attached chapters, the displayed telegram structure is without the header for e.g. KWP2000, KWP2000* or BMW-FAST Protocol.
The structure from the service ID is the same in all cases.

Below the differences between KWP2000, KWP2000* and BMW-FAST Protocol are described.

KWP2000:

Baudrate: 10 400
Header:

Data Byte	*Byte #*	*Parameter Name*	*CVT*	*Value*	*Mnemonic*
	#1d	**Format byte**	**M**	**#AALLLLLLb**	**FMT**
	#2d	**Target address byte**	**C**	**#12h/#EAh/#EDh/#EFh /#33h**	**TGT**
	#3d	**Source address byte**	**C**	**#F1h**	**SRC**
	#4d	**Additional length byte**	**C**	**#01h-#FFh**	**LEN**
#1d	#5d	Service ID Byte	M	#XXh	SID
• • • • #255d	#6d • • • #259d	Data Byte #02h • • • Data Byte #255d	C • • • C	#XXh • • • #XXh	DATA
	#260d	addition Checksum	M	#00h-#FFh	CS

KWP2000*:

Baudrate: 9 600
Header:

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Data Byte	*Byte #*	*Parameter Name*	*CVT*	*Value*	*Mnemonic*
	#1d	**Format byte**	**M**	**#B8h**	**FMT**
	#2d	**Target address byte**	**C**	**#12h**	**TGT**
	#3d	**Source address byte**	**C**	**#F1h**	**SRC**
	#4d	**length byte calculated by the tool**	**C**	**#01h-#FFh**	**LEN**
#1d	#5d	Service ID Byte	M	#XXh	SID
• • • • #255d	#6d • • • #259d	Data Byte #02h • • • Data Byte #255d	C • • • C	#XXh • • • #XXh	DATA
	#260d	exor Checksum	M	#00h-#FFh	CS

BMW-FAST:

Baudrate: 115 200
Header:

Data Byte	*Byte #*	*Parameter Name*	*CVT*	*Value*	*Mnemonic*
	#1d	**Format byte**	**M**	**#AALLLLLLb**	**FMT**
	#2d	**Target address byte**	**C**	**#12h/#EAh/#EDh/#EFh /#33h**	**TGT**
	#3d	**Source address byte**	**C**	**#F1h**	**SRC**
	#4d	**Additional length byte**	**C**	**#01h-#FFh**	**LEN**
#1d	#5d	Service ID Byte	M	#XXh	SID
• • • • #255d	#6d • • • #259d	Data Byte #02h • • • Data Byte #255d	C • • • C	#XXh • • • #XXh	DATA
	#260d	addition Checksum	M	#00h-#FFh	CS

BMW-FAST is identical to KWP2000 except baudrate.

I.5.1 Normative reference

This implementation and the description of diagnostic communication protocol KWP2000 is based on the following standards:

ISO /FDIS 14229: 1996 Road Vehicles-Diagnostic systems - DiagnosticServices Specification

ISO /FDIS 14230-1:1996 Road Vehicles - Diagnostic systems -Keyword Protocol 2000 - Part 1:

Physical Layer

ISO/FDIS 14230-2:1996 Road Vehicles - Diagnostic systems-Keyword Protocol 2000 - Part 2: Data Link Layer

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ISO /FDIS 14230-3:1996 Road Vehicles - Diagnostic systems -Keyword Protocol 2000 - Part 3: Implementation

ISO/DIS 14230-4 Road Vehicles - Diagnostic Systems Keyword Protocol 2000 - Part 4

KWP 2000 Requirements for emission-related systems

VDA /WD 14230-2: 1997 Keyword Protocol 2000 - Part 2 Data Link Layer
VDA - Recommended Practice

VDA /WD 14230-3: 1997 Keyword Protocol 2000 - Part 3 Implementation
VDA - Recommended Practice

Diagnosekommunikation mit KWP 2000(*) in Motorsteuerungen Revision 1.2
Ident.Nummer **1 430 227 Index d NÄL.-Nr.: E2263.N**

I.5.2 Convention

M: Mandatory

C: Conditional; the presence of the parameter depend on other parameters within the service

CVT: Conventions

#XXh: hexadecimal number

#XXd: decimal number

#XXb: binary number

These values are necessary for the services - read failure memory extra long (21_0A and 17h) and DDLI and for the freeze frame.
When system values (Word) are used for DDLI output as a Byte, then the lowbyte is cut off, so only the high byte is the output. In this case a selection for the environmental value (FMY) is necessary, only the high Byte from the Word is the output.
When system values (Byte) are used for DDLI output as a Word, the Byte is shifted to the high Byte and the low Byte is filled with 00h.
Analog values e.g. 0...3FFh = 0...5V, are shifted 4 Bits to FFC0h.
When these analog values (FFC0h) are used for DDLI output as a Byte, then the lowbyte is cut off, so only the high byte is the output. In this case a selection for the environmental value (FMY) is necessary, only the high Byte from the Word is the output.
List for selection of the environmental datas for each failure also for DDLI service 2C
cross out ist not supportet yet!

I.5.3 Actuator Diagnosis - Timeouts

I.5.3.1 Diagnostic Timeout

The standard timeout of KWP2000 is defined by P3 max.
In KWP2000(*) is no timeout requested.

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	P3 max
Default	5000ms infinity for KWP*
Extended	250ms
Programming	16s
Periodic transmission	250ms

After a diagnostic timeout occurs all actual actuator services are stopped.

I.5.3.2 TIMEOUT_TIME_XX_KWP

This timeout is sent by the protocoll from the tester to the ECU. It can be different for each actuator service.
After the timeout TIMEOUT_TIME_XX_KWP occurs the corresponding actuator services is stopped.

If TIMEOUT_TIME_XX_KWP is greater than the diagnostic timeout, the tester has to take special care to sent tester present service.

I.5.4 Definitions for EOL Tests

The status STATE_EOL_KWP_xxx should be defined with the single Bits from the table below.
Only supported (necessary) states can be described as followed:

Definitions for EOL Tests: see BMW LH 7 507 660	**values of the status if the function supported the singel one**	
SIEMENSVDO_ SW_NAME	**remark**	**hex value**
EOL_TEST_ACT	test currently running -function active	00h **(other)** 05H **(MSD8x)**
EOL_TEST_ST_INH	start of test not allowed - start-/control - conditions not correct	01h
EOL_TEST_PAR_NOT_PLAUS	hand over parameter not plausible- parameter not correct	02h
EOL_TEST_WAIT_REL	function waiting for release	03h
not used	not used	04h
EOL_TEST_NOT ST	test not yet started (default state) - function not started yet	00h (**MSD8x)** 05h **(other)**
EOL_TEST_END_WOUT_RESULT	function finished - without failures otherwise see 08h or 09h	06h
EOL_TEST_ABORTED	test aborted - function stopped	07h
EOL_TEST_END_WOUT_ERR	test finished without errors - function complete, no errors	08h
EOL_TEST_ END_WITH_ERR	test finished with errors - function complete, with errors	09h

Example (this is not a output section!):

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_EOL_KWP_XXX	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H	**MSD8x**: EOL_TEST_NOT_ST Other : EOL_TEST_ACT EOL_TEST_ST_INH EOL_TEST_PAR_NOT_PLAUS EOL_TEST_WAIT_REL not used **MSD8x**: EOL_TEST_ACT Other : EOL_TEST_NOT_ST EOL_TEST_END_WOUT_RESULT EOL_TEST_ABORTED EOL_TEST_END_WOUT_ERR EOL_TEST_END_WITH_ERR	1	-
State variable for end of line test XXX					

I.5.5 Variable conversion for KWP2000 /KWP2000(*)

Description of Basic Equations for conversion:

The general equation for conversion from Siemens internal Range to Customer Range is

General Equation:

$Var_{cus-hex}$ = $m(Var_{int-hex} - C)$ --------------------------(1)

Calculation of m and C:

m = resolution of Customer / resolution of Siemens ---------------------------(2)

C = $0_{int-hex} - 0_{cus-hex} /m$ ----------------------------(3)

$Var_{int-hex}$ = the hex value of the variable in Siemens internal Range
$Var_{cus-hex}$ = the hex value of the variable in customer Range

m = the slope of conversion from $Var_{int-hex}$ to $Var_{cus-hex}$.
C = the offset of conversion from $Var_{int-hex}$ to $Var_{cus-hex}$.

$0_{int-hex}$ = the hex. value for a phys. value 0 in Siemens Range.
$0_{cus-hex}$ = the hex. value for a phys. value 0 in Customer Range.

Derivation of Equations

To derive the above equations, consider two instances(a1 and a2) of the equation(1),

$a1_{cus-hex}$ = $m(a1_{int-hex} - C)$ ----------(4)
$a2_{cus-hex}$ = $m(a2_{int-hex} - C)$ ----------(5)

Subtracting (4) from (5) and rearranging, we get

$$m = \frac{(a1_{cus-hex} - a2_{cus-hex})}{(a1_{int-hex} - a2_{int-hex})}$$

$$= \frac{(a1_{cus-hex} - a2_{cus-hex}) /(a1_{phy} - a2_{phy})}{(a1_{int-hex} - a2_{int-hex}) /(a1_{phy} - a2_{phy})}$$

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resolution of Customer
= - - - - - - - - - - - - - - - - - - , Hence (2) is proved.
resolution of Siemens

From (4), we get
C = $a1_{int-hex}$ - $a1_{cus-hex}$/m
The equation (3) is obtained when a1=0. Hence (3) is proved.

where
$a1_{int-hex}$ = the hex. value of the instance *a1* in Siemens Range.
$a1_{cus-hex}$ = the hex. value of the instance *a1* in Customer Range.
$a2_{int-hex}$ = the hex. value of the instance *a2* in Siemens Range.
$a2_{cus-hex}$ = the hex. value of the instance *a2* in Customer Range.
$a1_{phy}$ = the phys. value of the instance *a1* .
$a2_{phy}$ = the phys. value of the instance *a2* .

I.5.6 DDLI- List for environmental data and ERRM

!!! Attention !!!
!!! The output variables above are only calculated at tester request. They are present in the a2l-file and visible in INCA, but no reasonable values will be displayed. !!!

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I.5.6.1 DDLI basic List

ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
5800	00	Zeit nach Start	T_AST_SAE		X	X	X	X	-	-	-
			T_AST_SAE_KWP	T_AST_SAE converted for DGNC (and limited to 255s if T_AST_SAE > 255s)	-	-	-	-	X	X	X
5801	01	Umgebungsdruck	OBD_AMP	AMP_MES converted for KWP	X	X	X	X	X	X	X
5802	02	Zustand Lambdaregelung Bank 1	STATE_LS_SAE[1]		X	X	X	X	X	X	X
5803	03	Zustand Lambdaregelung Bank 2	STATE_LS_SAE[2]		X	X	X	X	X	X	X
5804	04	Berechneter Lastwert	LOAD_CLC		X	X	X	X	X	X	X
5805	05	Kühlmitteltemperatur	OBD_TCO	TCO_MES converted for KWP	X	X	X	X	X	X	X
5806	06	Lambda Integrator Gruppe 1	OBD_LAM_COR[1]	FAC_LAM_LIM_SAE[1] converted for KWP	X	X	X	X	X	X	X
5807	07	Lambda Adaption multiplikativ Gruppe 1	FAC_LAM_AD_SAE[1]		X	X	X	X	X	X	X
5808	08	Lambda Integrator Gruppe 2	OBD_LAM_COR[2]	FAC_LAM_LIM_SAE[2] converted for KWP	X	X	X	X	X	X	X
5809	09	Lambda Adaption multiplikativ Gruppe 2	FAC_LAM_AD_SAE[2]		X	X	X	X	X	X	X
580A	0A	Mass fuel flow setpoint after combustion selection	MFF_SP_MV_KWP	MFF_SP_MV converted for KWP	X	X	X	X	-	-	-
		Wasserpumpe Spannung; CWP_2_2	V_CWP_2_2		-	-	-	-	X	X	-
580B	0B	Saugrohrdruck	MAP_SAE		X	X	X	X	X	X	X
580C	0C	Drehzahl	OBD_N	N converted for KWP	X	X	X	X	X	X	X
580D	0D	Geschwindigkeit	VS		X	X	X	X	X	X	X
580E	0E	Zündzeitpunkt Zylinder 1	OBD_IGA_IGC	IGA_IGC[0] converted for KWP	X	X	X	X	X	X	X
580F	0F	Ansauglufttemperatur	OBD_TIA	TIA_MES converted for KWP	X	X	X	X	-	-	-
				TIA_MES[1] converted for KWP	-	-	-	-	X	X	X
5810	10	Luftdurchsatz OBD	OBD_MAF	MAF_KGH_MES converted for KWP	X	X	X	X	-	-	-
		Luftdurchsatz OBD	OBD_MAF	MAF_KGH_MES[0] converted for KWP	-	-	-	-	X	X	X
5811	11	Motordrehzahl	N_32		X	X	X	X	X	X	X
5812	12	Luftmasse gemessen	MAF_KGH_MES_BAS		X	X	X	X	-	-	-
			MAF_KGH_MES_BAS_KWP[1]	MAF_KGH_MES_BAS[1] converted to DGNC	-	-	-	-	X	X	X
5813	13	Relative Last	Rf		X	X	X	X	X	X	X
5814	14	Fahrpedalwert	PV_AV_RAW		X	X	X	X	X	X	X
5815	15	Batteriespannung	OBD_VB	VB converted for KWP	X	X	X	X	X	X	X
5816	16	Lambda Setpoint	OBD_LAMB_SP	LAMB_SP_SAE converted for KWP	X	X	X	X	X	X	X
5817	17	Umgebungstemperat	OBD_TAM		X	X	X	X	X	X	X

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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
		ur									
5818	18	Luftmasse gerechnet	MAF		X	X	X	X	-	-	-
			MAF_KWP	MAF converted for DGNC	-	-	-	-	X	X	X
5819	19	Drehzahl OBD Byte	N_SAE_BYTE_KWP	N converted for KWP	X	X	X	X	X	X	X
581A	1A	Nockenwelle Einlass	CAM_IN_KWP	CAM_IN[1] converted for KWP	X	X	X	X	-	-	-
		Spannung Drosselklappe Poti 1, Bank1	VP_TPS_1_KWP[1]	VP_TPS_1[1] converted for KWP	-	-	-	-	X	X	X
581B	1B	Nockenwelle Einlass Sollwert	CAM_SP_IVVT_IN_KWP	CAM_SP_IVVT_IN converted for KWP	X	X	X	X	-	-	-
		Spannung Drosselklappe Poti 2, Bank1	VP_TPS_2_KWP[1]	VP_TPS_2[1] converted for KWP	-	-	-	-	X	X	X
581C	1C	Nockenwelle Auslass	CAM_EX[1]		X	X	X	X	-	-	-
		Spannung Drosselklappe Poti 1, Bank2	VP_TPS_1_KWP[2]	VP_TPS_1[2] converted for KWP	-	-	-	-	X	X	X
581D	1D	Nockenwelle Auslass Sollwert	CAM_SP_IVVT_EX		X	X	X	X	-	-	-
		Wasserpumpe Stromaufnahme, CWP_2_1	CUR_CNS_CWP_2_1		-	-	-	-	X	X	-
581E	1E	Ansauglufttemperatur	TIA_MES		X	X	X	X	-	-	-
		Spannung Drosselklappe Poti 2, Bank2	VP_TPS_2_KWP[2]	VP_TPS_2[2] converted for KWP	-	-	-	-	X	X	X
581F	1F	Motortemperatur	TCO_MES		X	X	X	X	X	X	X
5820	20	Kühlmitteltemperatur Kühlerausgang	TCO_2_MES		X	X	X	X	X	X	X
5821	21	Steuergerät Innentemperatur	TECU		X	X	X	X	X	X	X
5822	22	(Motor) - Öltemperatur	TOIL_MES		X	X	X	X	X	X	X
5823	23	Zeit Motor steht	T_ES		X	X	X	X	-	-	-
			T_ES_KWP	T_ES converted for DGNC	-	-	-	-	X	X	X
5824	24	Umgebungstemperatur	TAM		X	X	X	X	X	X	X
5825	25	Zeit Motor steht	T_ES_CUS_KWP	T_ES_CUS converted for KWP	X	X	X	X	X	X	X
5826	26	Drosselklappe Sensor 1	TPS_AV_1		X	X	X	X	-	-	-
		Drosselklappe 2 Sollwert	TPS_SP[2]		-	-	-	-	X	X	X
5827	27	Lambdasonden Heizung Vorkat 1	LSHPWM_UP[1]		X	X	X	X	X	X	X
5828	28	Lambdasonden Heizung Vorkat 2	LSHPWM_UP[2]		X	X	X	X	X	X	X
5829	29	Lambdasonden Heizung Hinterkat 1	LSHPWM_DOWN[1]		X	X	X	X	X	X	X

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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
582A	2A	Lambdasonden Heizung Hinterkat 2	LSHPWM_DOWN[2]		X	X	X	X	X	X	X
582B	2B	Drehmomenteingriff über CAN	STATE_TQ_CAN_PLAUS		X	X	X	X	X	X	X
582C	2C	number of invalid INIT_REG_x write validation cycles	CTR_ERR_LSL_IF_SPI_WR[1]		X	X	X	X	X	X	X
582D	2D	number of invalid INIT_REG_x write validation cycles	CTR_ERR_LSL_IF_SPI_WR[2]		X	X	X	X	X	X	X
582E	2E	Adaptionsfaktor Sensor Zeitkonstante vor Kat Bank 1	FAC_DIAG_DYN_LSL_UP[1]		X	X	X	X	X	X	X
582F	2F	Adaptionsfaktor Sensor Zeitkonstante vor Kat Bank 2	FAC_DIAG_DYN_LSL_UP[2]		X	X	X	X	X	X	X
5830	30	Mean value of normalised single sensor signal amplitude	FAC_MV_DIAG_DYN_LSL_UP_KWP[1]	FAC_MV_DIAG_DYN_LSL_UP[1] converted for KWP	X	X	X	X	X	X	X
5831	31	Mean value of normalised single sensor signal amplitude	FAC_MV_DIAG_DYN_LSL_UP_KWP[2]	FAC_MV_DIAG_DYN_LSL_UP[2] converted for KWP	X	X	X	X	X	X	X
5832	32	Motor Status	STATE_ENG		X	X	X	X	X	X	X
5833	33	Umgebungstemperatur beim Start	TAM_ST		X	X	X	X	X	X	X
5834	34	Umgebungsdruck	AMP_MES		X	X	X	X			
			AMP_MES_KWP	AMP_MES converted for DGNC	-	-	-	-	X	X	X
5835	35	manufacturer identifier alternator	Gen_manufak		X	X	X	X	X	X	X
5836	36	Drehzahlgradient	N_GRD		X	X	X	X	X	X	X
5837	37	Status OBD-I Fehler vor Kat Bank 1	STATE_ERR_EL_LSL_UP[1]		X	X	X	X	X	X	X
5838	38	Status OBD-I Fehler vor Kat Bank 2	STATE_ERR_EL_LSL_UP[2]		X	X	X	X	X	X	X
5839	39	Status Drosselklappe Notlauf	STATE_N_LIM_ETC_REQ		X	X	X	X	X	X	X
583A	3A	Ansauglufttemperatur beim Start	TIA_ST		X	X	X	X	X	X	X
583B	3B	Kraftstofftank Füllstand	FTL		X	X	X	X	X	X	X
583C	3C	Spannung Kl. 87	VB		X	X	X	X	X	X	X
583D	3D	Reset type	RST_CLAS_TYP[0]		X	X	X	X	-	-	-
		Reset typ / RESET SAFE	STATE_RST_TYPE[0]		-	-	-	-	X	X	X
583E	3E	Motordrehzahl bei Reset	N_RST_DET_KWP	N_RST_DET[0] converted to KWP	X	X	X	X	X	X	X
583F	3F	Drosselklappe Sollwert	TPS_SP		X	X	X	X	-	-	-
		Drosselklappe	TPS_SP[1]		-	-	-	-	X	X	X

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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
		Sollwert									
5840	40	CPU Last bei Reset	CPU_LOAD_RST_DE T_KWP		X	X	X	X	X	X	X
5841	41	SG-Innentemperatur Rohwert	VP_TECU_KWP	VP_TECU converted for KWP	X	X	X	X	X	X	X
5842	42	type identifier alternator	Gen_typkenn		X	X	X	X	X	X	X
5843	43	Versorgung FWG 1	VCC_PVS_1_KWP	VCC_PVS_1 converted for KWP	X	X	X	X	X	X	X
5844	44	chip temperature alternator	TCHIP_KWP	Tchip converted for KWP	X	X	X	X	X	X	X
58-	-	Spannung Lambdasonde VorKat 1	VLS_UP_KWP[1]	VLS_UP[1] converted for KWP	X	X	X	X	X	X	X
5846	46	Spannung Pedalwertgeber 1	V_PVS_1_KWP	V_PVS_1 converted for KWP	X	X	X	X	X	X	X
5847	47	Spannung Pedalwertgeber 2	V_PVS_2_KWP	V_PVS_2 converted for KWP	X	X	X	X	X	X	X
5848	48	Spannung Lambdasonde VorKat 2	VLS_UP_KWP[2]	VLS_UP[2] converted for KWP	X	X	X	X	X	X	X
5849	49	Spannung Lambdasonde HinterKat 1	VLS_DOWN_KWP[1]	VLS_DOWN[1] converted for KWP	X	X	X	X	X	X	X
584A	4A	Spannung Kl. 15 Rohwert	V_IGK_BAS_KWP	V_IGK_BAS converted for KWP	X	X	X	X	X	X	X
584B	4B	Spannung Lambdasonde HinterKat 2	VLS_DOWN_KWP[2]	VLS_DOWN[2] converted for KWP	X	X	X	X	X	X	X
584C	4C	Spannung Drosselklappe Poti 2	V_TPS_2_KWP	V_TPS_2 converted for KWP	X	X	X	X	-	-	-
		DK-Adaptionsschritt Drosselklappe 2	TPS_AD_STEP_KWP[2]	TPS_AD_STEP[2] converted for KWP	-	-	-	-	X	X	X
584D	4D	korrigierter Sollwert Durchfluss Tankentlüftung	FLOW_COR_CPS		X	X	X	X	X	X	X
584E	4E	Spannung Drosselklappe Poti 1	V_TPS_1_KWP	V_TPS_1 converted for KWP	X	X	X	X	-	-	-
		Throttle flap opening angle with high resolution	TPS_AV_KWP[2]	TPS_AV[2] converted for KWP	-	-	-	-	X	X	X
584F	4F	Spannung Luftmasse	V_MAF		X	X	X	-	-	-	-
		Spannung Ansauglufttemperatur , Sensor 2	VP_TIA_KWP[2]	VP_TIA[2] converted for KWP	-	-	-	-	X	X	X
5850	50	Spannung Motortemperatur	VP_TCO_KWP	VP_TCO[0] converted for KWP	X	X	X	X	X	X	X
5851	51	Spannung Ansauglufttemperatur	VP_TIA_KWP	VP_TIA convewrted for KWP	X	X	X	X	-	-	-
		Spannung Ansauglufttemperatur , Sensor 1	VP_TIA_KWP[1]	VP_TIA[1] converted for KWP	-	-	-	-	X	X	X

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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
5852	52	Kühlmitteltemperatur Kühlerausgang Rohwert	V_TCO_2_KWP	VP_TCO[1] converted for KWP	X	X	X	X	X	X	X
5853	53	Spannung Kl.87 Rohwert	VB_BAS_KWP	VB_BAS converted for KWP	X	X	X	X	X	X	X
5854	54	Versorgung FWG 2	VCC_PVS_2_KWP	VCC_PVS_2 converted for KWP	X	X	X	X	X	X	X
5855	55	Mittelwert Bank 1	FAC_LAM_MV_MMV[1]		X	X	X	X	X	X	X
5856	56	Mittelwert Bank 2	FAC_LAM_MV_MMV[2]		X	X	X	X	X	X	X
5857	57	exciting current alternator	Ierr		X	X	X	X	X	X	X
5858	58	Drosselklappe aktueller Wert	TPS_AV		X	X	X	X	-	-	-
		Throttle flap opening angle with high resolution, bank 1	TPS_AV_KWP[1]	TPS_AV[1] converted for KWP	-	-	-	-	X	X	X
5859	59	DMTL Strom Referenzleck	CUR_DMTL_REF_LE AK_KWP	CUR_DMTL_REF_LEAK converted for KWP	X	X	X	X	X	X	X
585A	5A	DMTL Strom Grobleck	CUR_DMTL_ROUGH_ LEAK_MIN_KWP	CUR_DMTL_ROUGH_LEAK_MI N converted for KWP	X	X	X	X	X	X	X
585B	5B	DMTL Strom Diagnoseende	CUR_DMTL_COR_FIL _KWP	CUR_DMTL_COR_FIL converted for KWP	X	X	X	X	X	X	X
585C	5C	Widerstand Lambdasonde NK 1	R_IT_LS_DOWN_KW P_H[1]	HIGH BYTE (R_IT_LS_DOWN[1])	X	X	X	X	X	X	X
585D	5D	Widerstand Lambdasonde NK 2	R_IT_LS_DOWN_KW P_H[2]	HIGH BYTE (R_IT_LS_DOWN[2])	X	X	X	X	X	X	X
585E	5E	unteres Byte Widerstand Lambdasonde NK 1	R_IT_LS_DOWN_KW P_L[1]	LOW BYTE (R_IT_LS_DOWN[1])	X	X	X	X	X	X	X
585F	5F	unteres Byte Widerstand Lambdasonde NK 2	R_IT_LS_DOWN_KW P_L[2]	LOW BYTE (R_IT_LS_DOWN[2])	X	X	X	X	X	X	X
5860	60	Widerstand Lambdasonde VK 1	R_IT_LS_UP_KWP_H [1]	HIGH BYTE (R_IT_LS_UP[1])	X	X	X	X	X	X	X
5861	61	Widerstand Lambdasonde VK 2	R_IT_LS_UP_KWP_H [2]	HIGH BYTE (R_IT_LS_UP[2])	X	X	X	X	X	X	X
5862	62	Öldruck Sollwert	P_OEL_SOLL_KWP	P_oel_soll converted to KWP	X	X	X	X	-	-	-
5863	63	untere Byte Widerstand Lambdasonde VK 1	R_IT_LS_UP_KWP_L[1]	LOW BYTE (R_IT_LS_UP[1])	X	X	X	X	X	X	X
5864	64	untere Byte Widerstand Lambdasonde VK 2	R_IT_LS_UP_KWP_L[2]	LOW BYTE (R_IT_LS_UP[2])	X	X	X	X	X	X	X
5865	65	Oelstand Mittelwert Langzeit	Oz_nivlangt		X	X	X	X	X	X	X
5866	66	Füllstand Motoröl	Oz_lp		X	X	X	X	X	X	X
5867	67	Kilometerstand	CTR_KM_CAN_KWP	CTR_KM_CAN (high byte)	X	X	X	X	X	X	X
5868	68	Status Standverbraucher registriert Teil 1	Stat_sv_reg1		X	X	X	X	X	X	X
5869	69	Status	Stat_sv_reg2		X	X	X	X	X	X	X

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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
		Standverbraucher registriert Teil 2									
586A	6A	Batteriespannung von IBS gemessen	U_batt		X	X	X	X	X	X	X
586B	6B	Zeit mit Ruhestrom 80 - 200 mA	T2histshort		X	X	X	X	X	X	X
586C	6C	Zeit mit Ruhestrom 200 - 1000 mA	T3histshort		X	X	X	X	X	X	X
586D	6D	Zähler Erkennung schlechte Strasse	SUM_RR		X	X	X	X	X	X	X
586E	6E	Zeit mit Ruhestrom >1000 mA	T4histshort		X	X	X	X	X	X	X
586F	6F	Ist-Öldruck	P_OEL_IST_KWP	P_oel_ist converted to KWP	X	X	X	X	X	X	X
5870	70	Spannung DME Umgebungsdruck	V_AMP_KWP	V_AMP converted for KWP	X	X	X	X	X	X	X
5871	71	Lambda-Sollwert Gruppe 1	LAMB_SP_KWP[1]	LAMB_SP[1] converted for KWP	X	X	X	X	X	X	X
5872	72	controller version alternator	Bsdgenregv		X	X	X	X	X	X	X
5873	73	Lambda-Sollwert Gruppe 2	LAMB_SP_KWP[2]	LAMB_SP[2] converted for KWP	X	X	X	X	X	X	X
5874	74	Spannung Strommessung DMTL	V_DMTL_KWP	V_DMTL converted for KWP	X	X	X	X	X	X	X
5875	75	Sollwert Motormoment	TQI_SP_KWP	TQI_SP converted to TQI_SP_KWP	X	X	X	X	X	X	X
5876	76	OBD high range fuel pressure (high byte)	OBD_FUP_RNG_H_H (high byte of OBD_FUP_RNG_H))	FUP_RNG_H_MES converted to OBD_FUP_RNG_H	X	X	X	X	X	X	X
5877	77	OBD high range fuel pressure (low byte)	OBD_FUP_RNG_H_L (low byte of OBD_FUP_RNG_H)	FUP_RNG_H_MES converted to OBD_FUP_RNG_H	X	X	X	X	X	X	X
5878	78	Lambdaverschiebung Rückführregler 1	LAMB_DELTA_I_LAM_ADJ_KWP[1]	LAMB_DELTA_I_LAM_ADJ_[1] converted for KWP	X	X	X	X	X	X	X
5879	79	Lambdaverschiebung Rückführregler 2	LAMB_DELTA_I_LAM_ADJ_KWP[2]	LAMB_DELTA_I_LAM_ADJ_[2] converted for KWP	X	X	X	X	X	X	X
587A	7A	Status FGR	STATE_CRU		X	X	X	X	X	X	X
587B	7B	Abgleich AGR-Modell (Faktor)	Eisyagr_korfak_b		X	X	X	X	-	-	-
		Wasserpumpe Leistung, relativ CWP_2_2	REL_CWP_2_2_PWR		-	-	-	-	X	X	-
587C	7C	Status Motorsteuerung	ECU_STATE		X	X	X	X	X	X	X
587D	7D	Symptom bei Schubabschaltung Sonde vor Kat Bank1	STATE_SYM_DIAG_PUC_LSL_UP[1]		X	X	X	X	X	X	X
587E	7E	Symptom bei Schubabschaltung	STATE_SYM_DIAG_PUC_LSL_UP[2]		X	X	X	X	X	X	X

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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
		Sonde vor Kat Bank2									
587F	7F	Tastverhaeltnis E-Lüfter	ECFPWM[0]		X	X	X	X	X	X	X
5880	80	Tastverhältnis: Luftklappe	ECRASPWM		X	X	X	X			
		Ansteuerung Luftklappe unten	LV_ECRAS_DOWN_1		-	-	-	-	X	X	X
5881	81	berechneter Gang	GEAR		X	X	X	X	X	X	X
5882	82	Motortemperatur beim Start	TCO_ST		X	X	X	X	X	X	X
5883	83	Spannung Klopfwerte Zylinder 1	NL[0]		X	X	X	X	X	X	X
5884	84	Actual value exciting current limitation alternator	Ierrfgrenz		X	X	X	X	X	X	X
5885	85	Spannung Klopfwerte Zylinder 3	NL[2]		X	X	X	X	X	X	X
5886	86	Spannung Klopfwerte Zylinder 6	NL[3]		X	X	X	X	X	X	X
5887	87	occupancy of alternator	Dfsiggen		X	X	X	X	X	X	X
5888	88	Spannung Klopfwerte Zylinder 4	NL[5]		X	X	X	X	X	X	X
5889	89	Lambda-Istwert Gruppe 1	LAMB_KWP[1]	LAMB_LS_UP[1] converted to KWP	X	X	X	X	X	X	X
588A	8A	Lambda-Istwert Gruppe 2	LAMB_KWP[2]	LAMB_LS_UP[2] converted to KWP	X	X	X	X	X	X	X
588B	8B	Zeit seit Startende	T_AST		X	X	X	X	X	X	X
588C	8C	Keramiktemperatur Lambdasonde VK 1	TTIP_MES_LS_UP[1]		X	X	X	X	X	X	X
588D	8D	aktuelle Zeit DMTL Leckmessung	T_ACT_LEAK_MES		X	X	X	X	X	X	X
588E	8E	Pumpenstrom bei DMTL Pumpenprüfung	CUR_DMTL_DMTLS_TEST		X	X	X	X	X	X	X
588F	8F	Keramiktemperatur Lambdasonde VK 2	TTIP_MES_LS_UP[2]		X	X	X	X	X	X	X
5890	90	Spannung Bremsunterdrucksensor	V_PBSU_KWP	V_PBSU converted for KWP	X	X	X	X	_	_	_
		Wasserpumpe Elektronik Temperatur, CWP_2_2	TEMP_EL_CWP_2_2		-	-	-	-	X	X	-
5891	91	Momentanforderung an der Kupplung	TQ_REQ_CLU		X	X	X	X	X	X	X
5892	92	Bremsunterdruck	PBSU_KWP	For 4cyl:PBSU converted for KWP For 6cyl: stub with 0 hPa	X	X	X	X	_	_	_
		Wasserpumpe Stromaufnahme,	CUR_CNS_CWP_2_2		-	-	-	-	X	X	-

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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
		CWP_2_2									
5893	93	Drehmomentabfall schnell bei Gangwechsel	TQI_GS_FAST_DEC		X	X	X	X	X	X	X
5894	94	Symptom Lambdasondenheizung vor Kat Bank 1	STATE_SYM_OBD_LSL_LSH_UP[1]		X	X	X	X	X	X	X
5895	95	Symptom Lambdasondenheizung vor Kat Bank 2	STATE_SYM_OBD_LSL_LSH_UP[2]		X	X	X	X	X	X	X
5896	96	Abgastemperatur nach Kat Bank 1	TEG_CAT_DOWN_MDL[1]		X	X	X	X	X	X	X
5897	97	Abgastemperatur nach Kat Bank 2	TEG_CAT_DOWN_MDL[2]		X	X	X	X	X	X	X
5898	98	Generator Sollspannung	V_ALTER_SP_KWP	V_ALTER_SP converted for KWP	X	X	X	X	X	X	X
5899	99	DISA Position	VIM_AV		X	X	X	X	-	-	-
		Wasserpumpe Ist-Drehzahl, CWP_2_2	N_REL_CWP_2_2		-	-	-	-	X	X	-
589A	9A	Tastverhältnis Nullgangsensor	PWM_NEUT_PSN_GB_KWP	PWM_NEUT_PSN_GB converted for KWP	X	X	X	X	-	-	-
		Wasserpumpe Soll-Drehzahl CWP_2_1/2	N_REL_CWP_SP_2		-	-	-	-	X	X	-
589B	9B	Spannungsoffset Signalpfad CJ120 1	VLS_OFS_LSL_KWP[1]	VLS_OFS_LSL[1] converted for KWP	X	X	X	X	X	X	X
589C	9C	Spannungsoffset Signalpfad CJ120 2	VLS_OFS_LSL_KWP[2]	VLS_OFS_LSL[2] converted for KWP	X	X	X	X	X	X	X
589D	9D	Abweichung Lambdasonde zu Modellwert: Überwachung	LAMB_DIF_MON_KWP	LAMB_DIF_MON converted to LAMB_DIF_MON_KWP	X	X	X	X	X	X	X
589E	9E	NOx trap aging factor due to sulphor load	NTA_GI_SUL_KWP	NT_AGI_SUL converted for KWP	X	X	X	X	-	-	-
		State variable of the TPS diagnoses	STATE_TPS_DIAG[1]		-	-	-	-	X	X	X
589F	9F	Time with active catalyst heating for desulfation without active desulfation	T_CH_SO2P_ACT_KWP	T_CH_SO2P_ACT converted for KWP	X	X	X	X	-	-	-
		State variable of the TPS diagnoses	STATE_TPS_DIAG[2]		-	-	-	-	X	X	X
58A0	A0	Km - counter since last end of desulfation	DIST_SO2P_END_KWP	DIST_SO2P_END converted for KWP	X	X	X	X	-	-	-
		Duty cycle for ETC actuator control	PWM_ETC_KWP[0]	PWM_ETC[0] converted for KWP	-	-	-	-	X	X	X

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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
58A1	A1	NOx-Konzentration	NOX_NS_KWP	NOX_NS[1] conv erted for KWP	X	X	X	X	-	-	-
		Duty cycle for ETC actuator control	PWM_ETC_KWP[1]	PWM_ETC[1] converted for KWP	-	-	-	-	X	X	X
58A2	A2	Lineares Lambdasignal NOx-Sensor	LAMB_NOX_SENS_KWP	LAMB_NOX_SENS[1] converted for KWP	X	X	X	X	-	-	-
		required current of the electrical water pump	CUR_CNS_CWP		-	-	-	-	-	-	X
58A3	A3	binäres Spannungssignal NOx-Sensor	VLS_NOX_SENS_KWP	VLS_NOX_SENS[1] converted for KWÜ	X	X	X	X	-	-	-
		relative CWP power	REL_CWP_PWR		-	-	-	-	-	-	X
58A4	A4	Status NOx-Sensor	CAN_STATE_NOX_SENS_KWP[1]		X	X	X	X	-	-	-
		Status Generator	St_gen		-	-	-	-	X	X	X
58A5	A5	NOx trap sulphur loading	NT_SUL_KWP	NT_SUL converted for KWP	X	X	X	X	-	-	-
		calculated DF-signal from alternator	Dffgen		-	-	-	-	X	X	X
58A6	A6	NOx trap aging factor	NT_AGI_KWP	NT_AGI converted for KWP	X	X	X	X	-	-	-
			U_gen_kwp	U_gen converted with limitation for DGNC	-	-	-	-	X	X	X
58A7	A7	Mean value of lambda in multiple-branched exhaust gas lines	LAMB_LS_UP_MV_KWP	LAMB_LS_UP_MV converted for KWP	X	X	X	X	-	-	-
		Engine off duration time (resolution min)	Tn_abstellm_kwp	Tn_abstellm converted with limitation for DGNC	-	-	-	-	X	X	X
58A8	A8	Motorabstellzeit	T_ES_KWP	T_ES converted for KWP	X	X	X	X	X	X	X
58A9	A9	Resetzähler Überwachungsrechner: alter Wert	ENVD_3_MON_3		X	X	X	X	X	X	X
58AA	AA	Resetzähler Hauptrechner: alter Wert	ENVD_2_MON_3		X	X	X	X	X	X	X
58AB	AB	Engine speed	N_32		-	-	-	-	X	X	X
		Abweichung gemessener DK-Poti1 und modelllierter DK-Poti	TPS_DIF_DIAG_COR_1_KWP	TPS_DIF_DIAG_COR_1 converted for KWP	X	X	X	X	_	_	_
58AC	AC	Batterietemperatur	T_batt_kwp	T_batt converted and limited for DGNC	-	-	-	-	X	X	X
		Abweichung gemessener DK-Poti2 und modelllierter DK-Poti	TPS_DIF_DIAG_COR_2_KWP	TPS_DIF_DIAG_COR_2 converted for KWP	X	X	X	X	_	_	_

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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
58AD	AD	Pedalwertgeber 1	PV_AV_1		X	X	X	X	X	X	X
58AE	AE	Periodendauer Luftmasse	T_PER_MAF_FRQ_KWP	T_PER_MAF_FRQ_AV[0] converted for KWP	X	X	X	X	-	-	-
		Periodendauer Luftmasse	T_PER_MAF_FRQ_KWP	T_PER_MAF_FRQ_AV[0]	-	-	-	-	X	X	X
58AF	AF	Kraftstoff Anforderung an Pumpe	VFF_EFP		X	X	X	X	X	X	X
58B0	B0	DK-Adaptionsschritt	TPS_AD_STEP_KWP	TPS_AD_STEP converted for KWP	X	X	X	X	-	-	-
		DK-Adaptionsschritt, Drosselklappe 1	TPS_AD_STEP_KWP[1]	TPS_AD_STEP[1] converted for KWP	-	-	-	-	X	X	X
58B1	B1	Funkenbrenndauer logical Zylinder 1	V_DUR_IGC_KWP[0]	V_DUR_IGC[0] converted for KWP	X	X	X	X	X	X	X
58B2	B2	Funkenbrenndauer logical Zylinder 2	V_DUR_IGC_KWP[1]	V_DUR_IGC[1] converted for KWP	X	X	X	X	X	X	X
58B3	B3	Funkenbrenndauer logical Zylinder 3	V_DUR_IGC_KWP[2]	V_DUR_IGC[2] converted for KWP	X	X	X	X	X	X	X
58B4	B4	Funkenbrenndauer logical Zylinder 4	V_DUR_IGC_KWP[3]	V_DUR_IGC[3] converted for KWP	X	X	X	X	X	X	X
58B5	B5	Funkenbrenndauer logical Zylinder 5	V_DUR_IGC_KWP[4]	V_DUR_IGC[4] converted for KWP	-	-	X	X	X	X	X
58B6	B6	Funkenbrenndauer logical Zylinder 6	V_DUR_IGC_KWP[5]	V_DUR_IGC[5] converted for KWP	-	-	X	X	X	X	X
58B7	B7	Bremsdruck	BRAKE_PRS		X	X	X	X	X	X	X
58B8	B8	Drehzahl Überwachung	N_32_MON		X	X	X	X	X	X	X
58B9	B9	Pedalwert Überwachung	PV_AV_MON		X	X	X	X	X	X	X
58BA	BA	Volume fuel flow through the injectors	VFF_MFF_SP_FUP_CTL_KWP	VFF_MFF_SP_FUP_CTL (high byte)	X	X	X	X	X	X	X
58BB	BB	Pump speed of the electrical fuel pump as PWM signal	EFPPWM_KWP	EFPPWM converted for KWP	X	X	X	X	X	X	X
58BC	BC	Luftmasse Überwachung	MAF_MON		X	X	X	X	X	X	X
58BD	BD	Zähler für Eisdetection in der Drosselklappe (high byte)	CTR_TPS_JAM_DET_ACT_KWP_H	CTR_TPS_JAM_DET_ACT (high byte)	X	X	X	X	_	_	_
		Funkenbrenndauer logical Zylinder 7	V_DUR_IGC_KWP[6]	V_DUR_IGC[6] converted for KWP	-	-	-	-	X	X	X
58BE	BE	Funkenbrenndauer logical Zylinder 8	V_DUR_IGC_KWP[7]	V_DUR_IGC[7] converted for KWP	-	-	-	-	X	X	X

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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
		Zähler für Eisdetection in der Drosselklappe (low byte)	CTR_TPS_JAM_DET_ACT_KWP_L	CTR_TPS_JAM_DET_ACT (low byte)	X	X	X	X	_	_	_
58BF	BF	relative Momentenforderung von MSR über CAN	TQI_MSR_CAN		X	X	X	X	X	X	X
58C0	C0	Motordrehzahl Eratztwert Überwachung	N_32_SUB_MON		X	X	X	X	X	X	X
58C1	C1	Laufunruhe Segmentzeit	SEG_T_MES (high Byte)		X	X	X	X	-	-	-
			SEG_T_MES_KWP_H	SEG_T_MES converted to SEG_T_MES_KWP, high byte	-	-	-	-	X	X	X
58C2	C2	Statusbyte MFF-Monitoring	STATE_LV_ERR_MFF_MON_1		X	X	X	X	X	X	X
58C3	C3	Statusbyte ISC-Monitoring	STATE_LV_ERR_TQ_DIF_ISC_MON_1		X	X	X	X	X	X	X
58C4	C4	Statusbyte CRU-Monitoring	STATE_LV_ERR_CRU_INH_MON_1		X	X	X	X	X	X	X
58C5	C5	Drehzahl Überwachung (resetsicher)	N_32_MON_SAVE		X	X	X	X	X	X	X
58C6	C6	Status Einspritzventile (resetsicher)	PREV_STATE_IV_SAVE		X	X	X	X	X	X	X
58C7	C7	LL-Solldrehzahlabweichung Überwachung	N_DIF_SP_IS_MON		X	X	X	X	X	X	X
58C8	C8	I-Anteil Momentdifferenz Überwachung und Modell	TQ_DIF_I_IS_MON		X	X	X	X	X	X	X
58C9	C9	I-Anteil LL passive Rampe aktiv	LV_PAS_RAMP_ACT_I_IS		X	X	X	X	X	X	X
58CA	CA	PD-Anteil langsam Leerlaufregelung	TQ_DIF_P_D_SLOW_IS		X	X	X	X	X	X	X
58CB	CB	PD-Anteil schnell Leerlaufregelung	TQ_DIF_P_D_FAST_IS		X	X	X	X	X	X	X
58CC	CC	Verlustmoment Überwachung	TQ_LOSS_MON		X	X	X	X	X	X	X
58CD	CD	Entladung während Ruhestromverletzung	Q_iruhe2_kwp	Q_iruhe2 converted and limted for DGNC	-	-	-	-	X	X	X
58CE	CE	Carrierbyte Schalterstati	STATE_BYTE_SWI_KWP	0x01 LV_IM_BLS 0x02 LV_IM_BTS 0x10 LV_SOF_SWI_REQ 0x80 LV_PAS_RAMP_ACT_I_IS	X	X	X	X	X	X	X
58CF	CF	Motormoment Sollwert	TQI_SP_MON		X	X	X	X	-	-	-

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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
		Überwachung									
58CF	CF	Motormoment Sollwert Überwachung	TQI_SP_H_RNG_MON_KWP	TQI_SP_H_RNG_MON converted for KWP	-	-	-	-	X	X	X
58D0	D0	Motormoment Istwert Überwachung	TQI_AV_MON		X	X	X	X	-	-	-
58D0	D0	Motormoment Istwert Überwachung	TQI_AV_H_RNG_MON_KWP	TQI_AV_H_RNG_MON converted for KWP	-	-	-	-	X	X	X
58D1	D1	Moment aktueller Wert	TQI_AV		X	X	X	X	X	X	X
58D2	D2	Status Luftklappensystem High Byte	STATE_ECRAS_SYS_KWP_H	high byte of STATE_ECRAS_SYS	X	X	X	X	X	X	X
58D3	D3	Status Luftklappensystem Low Byte	STATE_ECRAS_SYS_KWP_L	low byte of STATE_ECRAS_SYS	X	X	X	X	X	X	X
58D4	D4	Abweichung maximales Moment an Kupplung Überwachung	TQ_MAX_CLU_DIF_MON		X	X	X	X	X	-	X
		maximum torque	TQ_AX_MAX_KWP	TQ_AX_MAX converted for DGNC	-	-	-	-	-	X	-
58D5	D5	Air temperature up turbo charger	TIA_TCHA_KWP	TIA_TCHA converted for KWP	X	X	X	X	-	-	-
58D6	D6	Abweichung minimales Moment an Kupplung Überwachung	TQ_MIN_CLU_DIF_MON		X	X	X	X	X	-	X
		minimum torque	TQ_AX_MIN_KWP	TQ_AX_MIN converted for DGNC	-	-	-	-	-	X	-
58D7	D7	Voltage for temperatur sensor up turbocharger	VP_TIA_TCHA_KWP	VP_TIA_TCHA converted for KWP	X	X	X	X	-	-	-
		Pressure upstream the throttle (Turbo)	PUT_KWP[2]	PUT_MES_BAS[2] converted for KWP	-	-	-	-	X	X	X
58D8	D8	Catalyst temperature sensor raw acquisition	VP_TEG_PCAT_DOWN_KWP	VP_TEG_PCAT_DOWN converted for KWP	X	X	X	X	-	-	-
		Voltage of the intake manifold pressure sensor up throttle (for diagnosis)	V_PUT_KWP[2]	V_PUT[2] converted for KWP	-	-	-	-	X	X	X
58D9	D9	Fehlercode Rechnerüberwachung : aktueller Wert	ENVD_0_MON_3		X	X	X	X	X	X	X
58DA	DA	Resetzähler Rechnerüberwachung : aktueller Wert	ENVD_1_MON_3		X	X	X	X	X	X	X

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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
58DB	DB	Inhalt Statusbyte1 Drehzahlüberwachung (resetsicher)	STATE_TQI_N_MAX_MON_1_1_SAVE		X	X	X	X	X	X	X
58DC	DC	Inhalt Statusbyte2 Drehzahlüberwachung (resetsicher)	STATE_TQI_N_MAX_MON_1_2_SAVE		X	X	X	X	X	X	X
58DD	DD	Pressure upstream the throttle (Turbo)	PUT_KWP	PUT converted for KWP	X	X	X	X	-	-	-
		Pressure upstream the throttle (Turbo)	PUT_KWP[1]	PUT_MES_BAS[1] converted for KWP	-	-	-	-	X	X	X
58DE	DE	Voltage of the intake manifold pressure sensor up throttle (for diagnosis)	V_PUT_KWP	V_PUT converted for KWP	X	X	X	X	-	-	-
		Voltage of the intake manifold pressure sensor up throttle (for diagnosis)	V_PUT_KWP[1]	V_PUT[1] converted for KWP	-	-	-	-	X	X	X
58DF	DF	Spannung Sportschalter	V_SOF_SWI_KWP	V_SOF_SWI converted for KWP	X	X	X	X	-	-	-
		Wasserpumpe Leistung, relativ CWP_2_1	REL_CWP_2_1_PWR		-	-	-	-	X	X	-
58E0	E0	Abgleich Drossel-klappenmodell (Faktor)	Eisydk_korfak_b		X	X	X	X	X	X	X
58E1	E1	Abgleich Drossel-klappenmodell (Offset)	Eisydk_koroff_b		-	-	X	X	X	X	X
		Status Nullgangerkennung	St_ngang		X	X	-	-	-	-	-
58E2	E2	Abgleich Einlassventilmodell (Faktor)	Eisyev_korfak_b		X	X	X	X	X	X	X
58E3	E3	NOx signal shift diagnosis value	RATIO_NS_SHIFT_DIAG_KWP[1]	RATIO_NS_SHIFT_DIAG[1] converted for KWP	X	X	X	X	-	-	-
		Abgleich Einlassventilmodell (Offset)	Eisyev_koroff_b		-	-	-	-	X	X	X
58E4	E4	Betriebsart Istwert	Ba_ist		X	X	X	X	X	X	X
58E5	E5	Lastwert für Aussetzererkennung	LOAD_MIS_KWP	LOAD_MIS converted for KWP	X	X	X	X	X	X	X
58E6	E6	Nulllastwert für Aussetzererkennung	LOAD_MIN_MIS_KWP	LOAD_MIN_MIS converted for KWP	X	X	X	X	X	X	X
58E7	E7	Spannung Pedalwertgeber 1: Überwachung	V_PVS_1_MON_KWP	V_PVS_1_MON converted to V_PVS_1_MON_KWP	X	X	X	X	X	X	X
58E8	E8	Spannung Pedalwertgeber 2: Überwachung	V_PVS_2_MON_KWP	V_PVS_2_MON converted to V_PVS_2_MON_KWP	X	X	X	X	X	X	X
58E9	E9	Wasserpumpe Spannung	V_CWP		X	X	X	X	-	-	X

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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
		Wasserpumpe Spannung; CWP_2_1	V_CWP_2_1		-	-	-	-	X	X	-
58EA	EA	Wasserpumpe Drehzahl	N_REL_CWP		X	X	X	X	-	-	X
		Wasserpumpe Ist-Drehzahl, CWP_2_1	N_REL_CWP_2_1		-	-	-	-	X	X	-
58EB	EB	Wasserpumpe Drehzahl Soll-Ist-Differenz	N_REL_CWP_DIF		X	X	X	X	-	-	X
		Wasserpumpe Drehzahl Soll-Ist-Differenz, CWP_2_1	N_REL_CWP_2_1_DIF		-	-	-	-	X	X	-
58EC	EC	Wasserpumpe Temperatur Elektronik	TEMP_EL_CWP		X	X	X	X	-	-	X
		Wasserpumpe Elektronik Temperatur, CWP_2_1	TEMP_EL_CWP_2_1		-	-	-	-	X	X	-
58ED	ED	Wasserpumpe Stromaufnahme	CUR_CNS_CWP		X	X	X	X	-	-	-
		gemittelter Raildruck Bank 1	V_FUP_MV_0_KWP	V_FUP_MV[0] converted for KWP	-	-	-	-	X	X	X
58EE	EE	Wasserpumpe leistungsreduziert	REL_CWP_PWR		X	X	X	X	-	-	-
		gemittelter Raildruck Bank 2	V_FUP_MV_1_KWP	V_FUP_MV[1] converted for KWP	-	-	-	-	X	X	X
58EF	EF	Mean value of the acquired sensor voltage	V_FUP_MV_KWP	V_FUP_MV converted for KWP	X	X	X	X	-	-	-
		gemittelter Raildruck Bank 2	FUP_KWP[1]	FUP_MPL[1] converted for KWP	-	-	-	-	X	X	X
58F0	F0	Fuel pressure	FUP_KWP	FUP (high byte)	X	X	X	X	-	-	-
		gemittelter Raildruck Bank 1	FUP_KWP[0]	FUP_MPL[0] converted for KWP	-	-	-	-	X	X	X
58F1	F1	DME - Losnummer	STATE_LRN_ECU_KWP	STATE_LRN_ECU (high byte)	X	X	X	X	X	X	X
58F2	F2	PWM signal for the VCV	PWM_VCV_KWP	PWM_VCV (high byte)	X	X	X	X	-	-	-
		Wasserpumpe Drehzahl Soll-Ist-Differenz, CWP_2_2	N_REL_CWP_2_2_DIF		-	-	-	-	X	X	-
58F3	F3	Fuel pressure EFP	FUP_EFP_KWP	FUP_EFP converted for KWP	X	X	X	X	X	X	X
58F4	F4	mean value of low fuel pressure EFP sensor	V_FUP_EFP_MV_KWP	V_FUP_EFP_MV converted for KWP	X	X	X	X	X	X	X
58F5	F5	Eingangssignal Rückführregler 1	VLS_DIF_LAM_ADJ_KWP[1]	VLS_DIF_LAM_ADJ[1] converted for KWP	X	X	X	X	X	X	X
58F6	F6	Eingangssignal Rückführregler 2	VLS_DIF_LAM_ADJ_KWP[2]	VLS_DIF_LAM_ADJ[2] converted for KWP	X	X	X	X	X	X	X

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ID_ long	ID	Description	Label	Conversion	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 - S63	MSD85 - E72	MSD85 (L4)
58F7	F7	Measured opening of the actuator valve	OPG_ACR_KWP	OPG_ACR converted for KWP	X	X	X	X	-	-	-
		Laufunruhe Segmentzeit	SEG_T_MES_KWP_L	SEG_T_MES converted to SEG_T_MES_KWP, low byte	-	-	-	-	X	X	X
58F8	F8	Segmentadaption Laufunruhe Zyl. 5	SEG_AD_MMV_ER[1]		X	X	X	X	X	X	X
58F9	F9	Segmentadaption Laufunruhe Zyl. 3	SEG_AD_MMV_ER[2]		X	X	X	X	X	X	X
58FA	FA	canister load fc cps	CL_MMV_SAE		X	X	X	X	X	X	X
58FB	FB	counter of N-events fc cps (step 2)	SUM_DIAG_DIAGCPS _SAE		X	X	X	X	X	X	X
58FC	FC	Setpoint request after limitation for actuator position control	OPG_SP_ACR_KWP	OPG_SP_ACR converted for KWP	X	X	X	X	-	-	-
		Warm up functions active	LV_WUP		-	-	-	-	X	X	X
58FD	FD	Finally duty cycle of digital actuator control	PWM_ACR_KWP	PWM_ACR converted for KWP	X	X	X	X	-	-	-
58FE	FE	Zähler für Umschaltungen nach HOM durch Monitoring	CTR_SWI_AFS_MON		X	X	X	X	-	-	-
58FF	FF	-	-	-	-	-	-	-	-	-	-

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I.5.6.2 Further DDLI- Lists (not for ERRM)

ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
200	**Luft / Air**			-	-	-	-	-	-	-
4200	00	TIA	Ansauglufttemperatur 1	X	X	X	X	X	X	X
4201	01	AMP_MES	Umgebungsdruck	X	X	X	X	X	X	X
4202	02	MAP_MES	Saugrohrdruck	X	X	X	X	X	X	X
4203	03	MAF_KGH_MES	Massenstrom vom HFM	X	X	X	X	-	-	-
4204	04	TAM	Umgebungstemperatur	X	X	X	X	X	X	X
4205	05	MAP_DIP_MES_BAS	Saugrohrdruck1 / Ladedruck1	X	X	X	X	-	-	-
4206	06	MAF_KGH_MES_BAS[1]	Saugrohrdruck 1 / Ladedruck 1	-	-	-	-	X	X	X
4207	07	MAF_KGH_MES_BAS[2]	Saugrohrdruck 2 / Ladedruck 2	-	-	-	-	X	X	X
4208	08	MAF_KGH_MES[1]	Massenstrom vom HFM Bank 1	-	-	-	-	X	X	X
4209	09	MAF_KGH_MES[2]	Massenstrom vom HFM Bank 2	-	-	-	-	X	X	X
				-	-	-	-	-	-	-
300	**Wasser / Water**			-	-	-	-	-	-	-
4300	00	TCO	Kühlwassertemperatur	X	X	X	X	X	X	X
4301	01	TCO_2	Kuehlerauslasstemperatur	X	X	X	X	X	X	X
4302	02	REL_CWP_PWR	Wasserpumpe Leistung ueber BSD (Bit Serielle Datenschnittstelle)	X	X	X	X	-	-	X
4303	03	TEMP_EL_CWP	Wasserpumpe Elektronik Temperatur	X	X	X	X	-	-	X
4304	04	CUR_CNS_CWP	Wasserpumpe Strom	X	X	X	X	-	-	X
4305	05	N_REL_CWP	Wasserpumpe Drehzahl Ist	X	X	X	X	-	-	X
4306	06	N_REL_CWP_SP	Wasserpumpe Drehzahl Soll	X	X	X	X	-	-	X
4307	07	Ba_wm_ist	Betriebsart Wasserpumpe	X	X	X	X	X	X	X
4308	08			-	-	-	-	-	-	-
4309	09			-	-	-	-	-	-	-
430A	0A			-	-	-	-	-	-	-
430B	0B			-	-	-	-	-	-	-
430C	0C			-	-	-	-	-	-	-
430D	0D			-	-	-	-	-	-	-
430E	0E			-	-	-	-	-	-	-
430F	0F			-	-	-	-	-	-	-
4310	10	REL_CWP_2_1_PWR	Wasserpumpe Leistung, relativ CWP_2_1	-	-	-	-	X	X	-
4311	11	REL_CWP_2_2_PWR	Wasserpumpe Leistung, relativ CWP_2_2	-	-	-	-	X	X	-
4312	12	TEMP_EL_CWP_2_1	Wasserpumpe Elektronik Temperatur, CWP_2_1	-	-	-	-	X	X	-
4313	13	TEMP_EL_CWP_2_2	Wasserpumpe Elektronik Temperatur, CWP_2_2	-	-	-	-	X	X	-
4314	14	CUR_CNS_CWP_2_1	Wasserpumpe Stromaufnahme, CWP_2_1	-	-	-	-	X	X	-
4315	15	CUR_CNS_CWP_2_2	Wasserpumpe Stromaufnahme, CWP_2_2	-	-	-	-	X	X	-
4316	16	N_REL_CWP_2_1	Wasserpumpe Ist-Drehzahl, CWP_2_1	-	-	-	-	X	X	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
4317	17	N_REL_CWP_2_2	Wasserpumpe Ist-Drehzahl, CWP_2_2	-	-	-	-	X	X	-
4318	18	N_REL_CWP_SP_2	Wasserpumpe Soll-Drehzahl, CWP_2_1	-	-	-	-	X	X	-
4319	19	N_REL_CWP_SP_2	Wasserpumpe Soll-Drehzahl, CWP_2_2	-	-	-	-	X	X	-
431A	1A	V_CWP_2_1	Wasserpumpe Spannung; CWP_2_1	-	-	-	-	X	X	-
431B	1B	V_CWP_2_2	Wasserpumpe Spannung; CWP_2_2	-	-	-	-	X	X	-
431C	1C	N_REL_CWP_2_1_DIF	Wasserpumpe Drehzahl Soll-Ist-Differenz, CWP_2_1	-	-	-	-	X	X	-
431D	1D	N_REL_CWP_2_2_DIF	Wasserpumpe Drehzahl Soll-Ist-Differenz, CWP_2_2	-	-	-	-	X	X	-
				-	-	-	-	-	-	-
400	**Öl / Oil**			-	-	-	-	-	-	-
4400	00	Oz_nivlangt	Ölstand Mittelwert Langzeit	X	X	X	X	X	X	X
4401	01	Oz_lp	Füllstand Motoröl	X	X	X	X	X	X	X
4402	02	Toel	Öltemperatur	X	X	X	X	X	X	X
4403	03	Oz_kvbsm_ul	Kraftstoff-Verbrauch seit letztem Service	X	X	X	X	X	X	X
4404	04	Oz_oelkm	km seit letztem Service	X	X	X	X	X	X	X
4405	05	Oz_nivr	Oelsensor Niveau Rohwert	X	X	X	X	X	X	X
4406	06	Oz_permr	Oelsensor Qualität Rohwert	X	X	X	X	X	X	X
4407	07	Oz_tempr	Oelsensor Temperatur Rohwert	X	X	X	X	X	X	X
4408	08	Oz_tempakt	Oelsensor Temperatur	X	X	X	X	X	X	X
4409	09	Oz_nivakt	Oelsensor Niveau	X	X	X	X	X	X	X
440A	0A	Oz_permakt	Oelsensor Qualität	X	X	X	X	X	X	X
440B	0B	Oz_lf1c	Länderfaktor 1 codiert	X	X	X	X	X	X	X
440C	0C	Oz_lf2c	Länderfaktor 2 codiert	X	X	X	X	X	X	X
440D	0D	Oz_lf1t	Länderfaktor 1	X	X	X	X	X	X	X
440E	0E	Oz_lf2t	Länderfaktor 2	X	X	X	X	X	X	X
440F	0F	Oz_nivkrzt	Kurzmittelwert-Niveau für den Tester	X	X	X	X	X	X	X
4410	10	Oz_rwperm	Restweg aus Permittivität abgeleitet	X	X	X	X	X	X	X
4411	11	Oz_rwkvb	Restweg aus Kraftstoffverbrauch abgeleitet	X	X	X	X	X	X	X
4412	12	Oz_oelzeit	Oel-Alter in Monate	X	X	X	X	X	X	X
4413	13	Oz_permlow	aufbereitete Permittivität bei letztem Ölwechsel	X	X	X	X	X	X	X
4414	14	Oz_permex	Permittivität für Bewertung aufbereitet (extrapoliert)	X	X	X	X	X	X	X
4415	15	Oz_permoff	Offset für Permittivitätskorrektur	X	X	X	X	X	X	X
4416	16	Oz_kvbog	zugeteilte Bonuskraftstoffmenge	X	X	X	X	X	X	X
4417	17	Oz_permbog	zugeteilter Permittivitätsbonus	X	X	X	X	X	X	X
4418	18	Oz_lv	Status Peilstabanzeige	X	X	X	X	X	X	X
4419	19	-	-	-	-	-	-	-	-	-
441A	1A	-	-	-	-	-	-	-	-	-
441B	1B	-	-	-	-	-	-	-	-	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
441C	1C			-	-	-	-	-	-	-
441D	1D			-	-	-	-	-	-	-
441E	1E	Oz_krzor	Kurzzeitmittelwert	-	-	-	-	X	X	X
441F	1F	Oz_vormw	Vormittelwert	-	-	-	-	X	X	X
4420	20			-	-	-	-	-	-	-
4421	21	Oz_oricnt	Orientierungswert Counter	-	-	-	-	X	X	X
4422	22	Oz_vormwcnt	Vormittelwert Counter	-	-	-	-	X	X	X
4423	23	Oz_krzcnt	Kurzzeitmittelwert Counter	-	-	-	-	X	X	X
4424	24	Oz_lgmwcnt	Langzeitmittelwert Counter	-	-	-	-	X	X	X
4425	25			-	-	-	-	-	-	-
				-	-	-	-	-	-	-
500	**MotorBauteile intern / Engine parts intern**			-	-	-	-	-	-	-
-00	00			-	-	-	-	-	-	-
-01	01			-	-	-	-	-	-	-
-02	02			-	-	-	-	-	-	-
-03	03			-	-	-	-	-	-	-
-04	04			-	-	-	-	-	-	-
-05	05	CAM_SP_IVVT_IN	Sollwert Einlassspreizung	X	X	X	X	-	-	-
-06	06	PSN_CAM_IN[1]	Nockenwellenposition Einlass	X	X	X	X	X	X	X
-07	07	PSN_CAM_EX[1]	Nockenwellenposition Auslass	X	X	X	X	X	X	X
-08	08	CAM_IN[1]	Istwert Einlassspreizung	X	X	X	X	-	-	-
-09	09	CAM_EX[1]	Istwert Auslassspreizung	X	X	X	X	X	X	X
-0A	0A	CAM_SP_REF_EX	Normspreizung Auslass	X	X	X	X	-	-	-
-0B	0B	CAM_SP_REF_IN	Normspreizung Einlass	X	X	X	X	-	-	-
-0C		IVVTPWM_IN[0]	VANOS PWM Wert Einlass Bank 1	-	-	-	-	X	X	X
-0D		IVVTPWM_IN[1]	VANOS PWM Wert Einlass Bank 2	-	-	-	-	X	X	X
-0E		IVVTPWM_EX[0]	VANOS PWM Wert Auslass Bank 1	-	-	-	-	X	X	X
-0F		IVVTPWM_EX[1]	VANOS PWM Wert Auslass Bank 2	-	-	-	-	X	X	X
-10		CAM_IN_H[1]	Istwert Einlassspreizung Bank 1	-	-	-	-	X	X	X
-11		CAM_IN_H[2]	Istwert Einlassspreizung Bank 2	-	-	-	-	X	X	X
-12		CAM_EX[2]	Istwert Auslassspreizung Bank 2	-	-	-	-	X	X	X
-13		CAM_SP_IVVT_IN	Sollwert Einlassspreizung Bank 1	-	-	-	-	X	X	X
-14		CAM_SP_IVVT_IN	Sollwert Einlassspreizung Bank 2	-	-	-	-	X	X	X
-15		CAM_SP_IVVT_EX	Sollwert Auslassspreizung Bank 1	-	-	-	-	X	X	X
-16		CAM_SP_IVVT_EX	Sollwert Auslassspreizung Bank 2	-	-	-	-	X	X	X
-17		CAM_SP_REF_IN	Normspreizung Einlass Bank 1	-	-	-	-	X	X	X
-18		CAM_SP_REF_IN	Normspreizung Einlass Bank 2	-	-	-	-	X	X	X
-19		CAM_SP_REF_EX	Normspreizung Auslass Bank 1	-	-	-	-	X	X	X
-1A		CAM_SP_REF_EX	Normspreizung auslass Bank 2	-	-	-	-	X	X	X
-1B		PSN_CAM_IN[2]	Nockenwellenposition Einlass Bank 2	-	-	-	-	X	X	X
-1C		PSN_CAM_EX[2]	Nockenwellenposition Auslass Bank 2	-	-	-	-	X	X	X
-1D		PSN_AD_CAM_EX[2]	Adaptionswert Nockenwelle Auslass Bank 2	-	-	-	-	X	X	X

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
-1E		PSN_AD_CAM_IN[2]	Adaptionswert Nockenwelle Einlass Bank 2	-	-	-	-	X	X	X
				-	-	-	-	-	-	-
600	**MotorBauteile extern / Engine parts extern**			-	-	-	-	-	-	-
4600	00	TPS_AV	aktueller Drosselklappenwinkel	X	X	X	X	-	-	-
4601	01	TPS_SP_MDL	Drosselklappe Sollwert	X	X	X	X	-	-	-
4602	02	V_ALTER_SP	Generator Sollspannung BSD (Bit Serielle Datenschnittstelle)	X	X	X	X	X	X	X
4603	03	Tchip	Chiptemperatur Generator1	X	X	X	X	X	X	X
4604	04	I_gen	Generator Strom	X	X	X	X	X	X	X
4605	05	Bsdgencv	Chipversion Generator1	X	X	X	X	X	X	X
4606	06	Bsdgenregv	Reglerversion Generator1	X	X	X	X	X	X	X
4607	07	Gen_manufak	Herstellercode Generator1	X	X	X	X	X	X	X
4608	08	Gen_typkenn	Kennung Generatortyp Generator1	X	X	X	X	X	X	X
4609	09	VB	Kl.87 Spannung / Versorgung DME (Digitale Motor Elektronik)	X	X	X	X	X	X	X
460A	0A	Ubt	Batteriespannung aktuell	X	X	X	X	X	X	X
460B	0B	U_batt	Batteriespannung von IBS gemessen	X	X	X	X	X	X	X
460C	0C	VB_BAS	Batteriespannung vom AD-Wandler DME	X	X	X	X	X	X	X
460D	0D	Absch_korr	Korrekturwert Abschaltung	X	X	X	X	X	X	X
460E	0E	D_soc	Abstand zur Startfähigkeitsgrenze	X	X	X	X	X	X	X
460F	0F	LOAD_BAT	Batterielast	X	X	X	X	X	X	X
4610	10	VIM_AV	aktuelle Position Disaklappen	X	X	X	X	-	-	-
4611	11	N_PERC_ECF	Sollwert E-Lüfter als PWM Wert	X	X	X	X	X	X	X
4612	12	Ierr	Erregerstrom Generator1	X	X	X	X	X	X	X
4613	13	U_fgen	Kopierter Wert von zum Generator gesendete Sollspannung Generator 1	X	X	X	X	X	X	X
4614	14	Dfsiggen	Auslastungsgrad Generator 1	X	X	X	X	X	X	X
4615	15	Ierrfgrenz	Kopie begrenzter Erregerstrom Generator 1	X	X	X	X	X	X	X
4616	16	Tlrfgen	Kopier Generator1 LR Vorgabe auf Bus gelegt	X	X	X	X	X	X	X
4617	17	Md_gennm_na	gefiltertes Generatormoment absolut Ausgang	X	X	X	X	X	X	X
4618	18	B_lrfoff	Kopie Drehzahlschwelle für LR-Funktion Generator 1 aktiv	X	X	X	X	X	X	X
4619	19	B_bsdprot2	condition for BSD protocol controller type 2	X	X	X	X	X	X	X
461A	1A	Uregnom	nominal voltage alternator	X	X	X	X	X	X	X
				-	-	-	-	-	-	-
700	**Lambda**			-	-	-	-	-	-	-
4700	00	LV_IPLSL_VLD[1]	WRAF sensor pump current is valid Bank1	X	X	X	X	X	X	X
4701	01	LV_IPLSL_VLD[2]	WRAF sensor pump current is valid Bank2	X	X	X	X	X	X	X

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
4702	02	VLS_UP_COR[1]	Spannung Lambdasonde Vorkat Bank 1 mit Offsetkorrektur	X	X	X	X	X	X	X
4703	03	VLS_UP_COR[2]	Spannung Lambdasonde Vorkat Bank 2 mit Offsetkorrektur	X	X	X	X	X	X	X
4704	04	LAMB_BAS[1]	Lambda Sollwert Bank1	X	X	X	X	X	X	X
4705	05	LAMB_BAS[2]	Lambda Sollwert Bank2	X	X	X	X	X	X	X
4706	06			-	-	-	-	-	-	-
4707	07	RFPPWM[1]	PWM output recirculation flap, Bank1	-	-	-	-	X	X	X
4708	08	RFPPWM[2]	PWM output recirculation flap, Bank 2	-	-	-	-	X	X	X
4709	09	LV_RLY_HPDI	HPDI relay control command state	-	-	-	-	X	X	X
470A	0A	VB_RLY_HPDI	Voltage HPDI relay	-	-	-	-	X	X	X
				-	-	-	-	-	-	-
4710	10	MFF_ADD_COLD_LAM_AD_INJ[0]		X	X	X	X	-	-	-
4711	11	MFF_ADD_COLD_LAM_AD_INJ[1]		X	X	X	X	-	-	-
4712	12	MFF_ADD_COLD_LAM_AD_INJ[2]		X	X	X	X	-	-	-
4713	13	MFF_ADD_COLD_LAM_AD_INJ[3]		X	X	X	X	-	-	-
4714	14	MFF_ADD_COLD_LAM_AD_INJ[4]		-	-	X	X	-	-	-
4715	15	MFF_ADD_COLD_LAM_AD_INJ[5]		-	-	X	X	-	-	-
4716	16	MFF_ADD_HOT_LAM_AD_INJ[0]		X	X	X	X	-	-	-
4717	17	MFF_ADD_HOT_LAM_AD_INJ[1]		X	X	X	X	-	-	-
4718	18	MFF_ADD_HOT_LAM_AD_INJ[2]		X	X	X	X	-	-	-
4719	19	MFF_ADD_HOT_LAM_AD_INJ[3]		X	X	X	X	-	-	-
471A	1Â	MFF_ADD_HOT_LAM_AD_INJ[4]		-	-	X	X	-	-	-
471B	1B	MFF_ADD_HOT_LAM_AD_INJ[5]		-	-	X	X	-	-	-
471C	1C	DIST_LAM_AD_INJ_COLD		X	X	X	X	-	-	-
471D	1D	DIST_LAM_AD_INJ_HOT		X	X	X	X	-	-	-
471E	1E	CTR_AD_COLD_LAM_AD_INJ		X	X	X	X	-	-	-
471F	1F	CTR_AD_HOT_LAM_AD_INJ		X	X	X	X	-	-	-
4720	20	RATIO_MMV_NS_SHIFT_DIAG[1]	NOx signal shift diagnosis mean value	X	X	X	X	-	-	-
4721	21	CTR_NS_SHIFT_CYC[1]	Counter of finished NOx signal shift diagnosis	X	X	X	X	-	-	-
4721	22	DIST_NT_NS_SHIFT[1]	Distance saved at last successful NOx signal shift diagnosis	X	X	X	X	-	-	-
				-	-	-	-	-	-	-
800	**Sonstiges / Other**				-	-	-	-	-	-
4800	00	LV_CS	Kupplungsschalter Status	X	X	X	X	X	X	X
4801	01	LV_CS_CUS	Kupplungsschalter vorhanden	X	X	X	X	X	X	X
4802	02	LV_SOF_SWI	Sporttaster aktiv	X	X	X	X	X	X	X
4803	03	STATE_ACIN_CAN	Status Klima ein	X	X	X	X	X	X	X
4804	04			-	-	-	-	-	-	-
4805	05	LV_RLY_ST_CAN	Startrelais über CAN aktiv	X	X	X	X	X	X	X
4806	06	TECU	Steuergeraete-Innentemperatur	X	X	X	X	X	X	X
4807	07	N	Motor Drehzahl	X	X	X	X	X	X	X

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
4808	08	N_SP_IS	Leerlauf Solldrehzahl	X	X	X	X	X	X	X
4809	09	LV_IS	Status LL	X	X	X	X	X	X	X
480A	0A	CTR_KM_BN	Kilometerstand Auflösung 1 km	X	X	X	X	X	X	X
480B	0B	PV_AV	Pedalwert Fahrerwunsch in %	X	X	X	X	X	X	X
480C	0C	VP_TIA[1]	Spannung Ansauglufttemperatur 1	-	-	-	-	X	X	X
480D	0D	VP_TIA[2]	Spannung Ansauglufttemperatur 2	-	-	-	-	X	X	X
480E	0E	TIA_MES[1]	Rohwert Ansauglufttemperatur 1	-	-	-	-	X	X	X
480F	0F	TIA_MES[2]	Rohwert Ansauglufttemperatur 2	-	-	-	-	X	X	X
4810	10	-	-	-	-	-	-	-	-	-
4811	11	-	-	-	-	-	-	-	-	-
4812	12	-	-	-	-	-	-	-	-	-
4813	13	-	-	-	-	-	-	-	-	-
4814	14	Pvdkds_i[0]	Druck vor Drosselklappe Bank 1	-	-	-	-	X	X	X
4815	15	Ps_ist_i[0]	Druck nach Drosselklappe Bank 1	-	-	-	-	X	X	X
4816	16	Tans_i[0]	Temperatur vor Drosselklappe Bank 1	-	-	-	-	X	X	X
4817	17	Pvdksd_i[1]	Druck vor Drosselklappe Bank 2	-	-	-	-	X	X	X
4818	18	Ps_ist_i[1]	Druck nach Drosselklappe Bank 2	-	-	-	-	X	X	X
4819	19	Tans_i[1]	Temperatur vor Drosselklappe Bank 2	-	-	-	-	X	X	X
481A	1A	FUP_H_MPL[0]	Raildruck Bank 1	-	-	-	-	X	X	X
481B	1B	FUP_H_MPL[1]	Raildruck Bank 2	-	-	-	-	X	X	X
481C	1C	VP_TPS_1[1]	ADC-Wert1 Drosselklappe Bank 1	-	-	-	-	X	X	X
481D	1D	VP_TPS_2[1]	ADC-Wert2 Drosselklappe Bank 1	-	-	-	-	X	X	X
481E	1E	VP_TPS_1[2]	ADC-Wert1 Drosselklappe Bank 2	-	-	-	-	X	X	X
481F	1F	VP_TPS_2[2]	ADC-Wert2 Drosselklappe Bank 2	-	-	-	-	X	X	X
4820	20	TPS_AV[1]	Drosselklappenwinkel Bank 1	-	-	-	-	X	X	X
4821	21	TPS_AV[2]	Drosselklappenwinkel Bank 2	-	-	-	-	X	X	X
4822	22	TPS_SP_MDL[1]	Drosselklappe Sollwert Bank 1	-	-	-	-	X	X	X
4823	23	TPS_SP_MDL[2]	Drosselklappe Sollwert Bank 2	-	-	-	-	X	X	X
4824	24			-	-	-	-	-	-	-
4825	25			-	-	-	-	-	-	-
4826	26			-	-	-	-	-	-	-
4827	27			-	-	-	-	-	-	-
4828	28			-	-	-	-	-	-	-
4829	29			-	-	-	-	-	-	-
482A	2A			-	-	-	-	-	-	-
482B	2B			-	-	-	-	-	-	-
482C	2C	TPS_SP[1]	Drosselklappe Sollwert Bank 1	-	-	-	-	X	X	X
482D	2D	TPS_SP[2]	Drosselklappe Sollwert Bank 2	-	-	-	-	X	X	X
482E	2E	LV_PWL_CWP	HPDI relay control command state	-	-	-	-	X	X	X
482F				-	-	-	-	-	-	-
4830	30	CTR_NR_DIAG_PUE_LS_DOWN[1]	Counter for completed gradient monitoring diagnosis, Bank 1	X	X	X	X	X	X	X
4831	31	CTR_NR_DIAG_PUE_LS_DOWN[2]	Counter for completed gradient	X	X	X	X	X	X	X

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
			monitoring diagnosis, Bank2							
4832	32	VLS_DOWN_PUE_MMV[1]	Moving mean value of gradient monitoring, Bank1	X	X	X	X	X	X	X
4833	33	VLS_DOWN_PUE_MMV[2]	Moving mean value of gradient monitoring, Bank2	X	X	X	X	X	X	X
4834	34	VLS_DOWN_PUE_SAVE_MAX[1]	Saved maximum gradient of oxygen sensor downstream of all driving cycles , Bank1	X	X	X	X	X	X	X
4835	35	VLS_DOWN_PUE_SAVE_MAX[2]	Saved maximum gradient of oxygen sensor downstream of all driving cycles , Bank2	X	X	X	X	X	X	X
4836	36	VLS_DOWN_PUE_SAVE_MIN[1]	Saved miniimum gradient of oxygen sensor downstream of all driving cycles , Bank1	X	X	X	X	X	X	X
4837	37	VLS_DOWN_PUE_SAVE_MIN[2]	Saved minimum gradient of oxygen sensor downstream of all driving cycles , Bank1	X	X	X	X	X	X	X
4838	38	VLS_DOWN_PUE_STD[1]	Squared standard deviation of gradient monitoring, Bank1	X	X	X	X	X	X	X
4839	39	VLS_DOWN_PUE_STD[2]	Squared standard deviation of gradient monitoring, Bank2	X	X	X	X	X	X	X
483A	3A			-	-	-	-	-	-	-
483B	3B			-	-	-	-	-	-	-
483C	3C			-	-	-	-	-	-	-
483D	3D			-	-	-	-	-	-	-
483E	3E			-	-	-	-	-	-	-
483F	3F			-	-	-	-	-	-	-
4840	40	FUP_SP_MPL[0]	berechneter Hochdrucksollwert, Bank 1	-	-	-	-	X	X	X
4841	41	FUP_SP_MPL[1]	berechneter Hochdrucksollwert, Bank 2	-	-	-	-	X	X	X
4841	42	N_EFP_AV	Drehzahl Kraftsstoffpumpe	-	-	-	-	X	X	X
4843	43	prdr_w_rb[0]	Hochdruckreglerwert Ausgang, Bank 1	-	-	-	-	X	X	X
4844	44	prdr_w_rb[1]	Hochdruckreglerwert Ausgang, Bank 2	-	-	-	-	X	X	X
48-	-			-	-	-	-	-	-	-
4846	46			-	-	-	-	-	-	-
4847	47			-	-	-	-	-	-	-
4848	48			-	-	-	-	-	-	-
4849	49			-	-	-	-	-	-	-
484A	4A			-	-	-	-	-	-	-
484B	4B			-	-	-	-	-	-	-
484C	4C			-	-	-	-	-	-	-
484D	4D			-	-	-	-	-	-	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
484E	4E			-	-	-	-	-	-	-
484F	4F			-	-	-	-	-	-	-
4850	50	CTR_MIS_DET_CYL[1]	Number of lifetime misfire events for logical cylinder 1	X	X	X	X	X	X	X
4851	51	CTR_MIS_DET_CYL[2]	Number of lifetime misfire events for logical cylinder 2	X	X	X	X	X	X	X
4852	52	CTR_MIS_DET_CYL[3]	Number of lifetime misfire events for logical cylinder 3	X	X	X	X	X	X	X
4853	53	CTR_MIS_DET_CYL[4]	Number of lifetime misfire events for logical cylinder 4	X	X	X	X	X	X	X
4854	54	CTR_MIS_DET_CYL[5]	Number of lifetime misfire events for logical cylinder 5	-	-	X	X	X	X	X
4855	55	CTR_MIS_DET_CYL[6]	Number of lifetime misfire events for logical cylinder 6	-	-	X	X	X	X	X
4856	56	CTR_MIS_DET_CYL[7]	Number of lifetime misfire events for logical cylinder 7	-	-	-	-	X	X	X
4857	57	CTR_MIS_DET_CYL[8]	Number of lifetime misfire events for logical cylinder 8	-	-	-	-	X	X	X
				-	-	-	-	-	-	-
4880	80	EFF_IGA_CST_QUO_IS_MAX	Maximum quotient of ignition angle efficiency integral and time at idle speed (relative to the maximum threshold in percent)	X	X	X	X	X	X	X
4881	81	EFF_IGA_CST_QUO_PL_MAX	Maximum quotient of ignition angle efficiency integral and time at part load (relative to the maximum threshold in percent)	X	X	X	X	X	X	X
5A	**MSx specific**				-	-	-	-	-	-
5A00	00	VCC_PVS_1	Versorgung FWG 1	X	X	X	X	X	X	X
5A01	01	VCC_PVS_2	Versorgung FWG 2	X	X	X	X	X	X	X
5A02	02	LV_CDN_DIAG_TCHA_LEAK	Boolean for diagnosis condition present on charger leakage diagnosis	X	X	X	X	-	-	-
		LV_CDN_DIAG_TCHA_LEAK[1]	Boolean for diagnosis condition present on charger leakage diagnosis, Bank1	-	-	-	-	X	X	X
5A03	03	LV_END_DIAG_TCHA_LEAK	End of diagnosis charger leakage diagnosis	X	X	X	X	-	-	-
		LV_END_DIAG_TCHA_LEAK[1]	End of diagnosis charger leakage diagnosis, Bank 1	-	-	-	-	X	X	X
5A04	04	V_PVS_1	Spannung Pedalwertgeber 1	X	X	X	X	X	X	X
5A05	05	V_PVS_2	Spannung Pedalwertgeber 2	X	X	X	X	X	X	X
5A06	06	V_TPS_1	Spannung Drosselklappe Poti 1	X	X	X	X	-	-	-
		LV_CDN_DIAG_TCHA_LEAK[2]	Boolean for diagnosis condition present on charger leakage diagnosis, Bank 2	-	-	-	-	X	X	X
5A07	07	V_TPS_2	Spannung Drosselklappe Poti 2	X	X	X	X	-	-	-
		LV_END_DIAG_TCHA_LEAK[2]	End of diagnosis charger leakage diagnosis, Bank2	-	-	-	-	X	X	X
5A08	08	V_TIA	Spannung Ansauglufttemperatur	X	X	X	X	-	-	-

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5A09	09	V_TCO	Spannung Motortemperatur	X	X	X	X	_	_	_
		VP_TCO[1]	Spannung Motortemperatur	-	-	-	-	X	X	X
5A0A	0A	V_TCO_2	Spannung Kühlmitteltemperatur Kühlerausgang	X	X	X	X	_	_	_
		VP_TCO[2]	Spannung Kühlmitteltemperatur Kühlerausgang	-	-	-	-	X	X	X
5A0B	0B	V_AMP	Spannung DME Umgebungsdruck	X	X	X	X	X	X	X
5A0C	0C	V_MAF	Spannung Luftmasse	X	X	X	-	-	-	-
5A0D	0D	V_SAF	Spannung Sekundärluft	X	X	X	X	-	-	-
5A0E	0E	VP_TECU	Spannung SG-Innentemperatur	X	X	X	X	X	X	X
5A0F	0F	V_IGK_BAS	Spannung Kl.15	X	X	X	X	X	X	X
5A10	10	V_IGK_MES	Spannung Kl15	X	X	X	X	X	X	X
5A11	11	VLS_UP[1]	Spannung Lambdasonde VorKat 1	X	X	X	X	X	X	X
5A12	12	VLS_UP[2]	Spannung Lambdasonde VorKat 2	X	X	X	X	X	X	X
5A13	13	VLS_DOWN[1]	Spannung Lambdasonde HinterKat 1	X	X	X	X	X	X	X
5A14	14	VLS_DOWN[2]	Spannung Lambdasonde HinterKat 2	X	X	X	X	X	X	X
5A15	15	LV_END_DIAG_TCHA_PRS_LOW	End of diagnosis charger pressure to low diagnosis	-	-	X	X	-	-	-
		LV_END_DIAG_TCHA_PRS_LOW[1]	End of diagnosis charger pressure to low diagnosis, Bank 1	-	-	-	-	X	X	X
5A16	16	V_PBSU	Spannung Bremsunterdrucksensor	X	X	-	-	-	-	-
		LV_END_DIAG_TCHA_PRS_HIGH	End of diagnosis charger pressure to high diagnosis	-	-	X	X	-	-	-
		LV_END_DIAG_TCHA_PRS_HIGH[1]	End of diagnosis charger pressure to high diagnosis, Bank 1	-	-	-	-	X	X	X
5A17	17	V_DMTL	Spannung Strommessung DMTL	X	X	X	X	X	X	X
5A18	18	VP_TEG_PCAT_DOWN	Spannung Katalysator-Temperatursensor	X	X	X	X	-	-	-
		LV_END_DIAG_TCHA_PRS_LOW[2]	End of diagnosis charger pressure to low diagnosis, Bank 2	-	-	-	-	X	X	X
5A19	19	LV_END_DIAG_TCHA_PRS_HIGH[2]	End of diagnosis charger pressure to high diagnosis, Bank 2	-	-	-	-	X	X	X
5A1A	1A			-	-	-	-	-	-	-
5A1B	1B			-	-	-	-	-	-	-
5A1C	1C			-	-	-	-	-	-	-
5A1D	1D			-	-	-	-	-	-	-
5A1E	1E	PBSU	Bremsunterdruck	X	X	X	X	_	_	_
5A1F	1F	TEG_PCAT_DOWN_1	Abgastemperatur	X	X	X	X	-	-	-
5A20	20	PWM_NEUT_PSN_GB	Tastverhältnis Nullgangssensor	X	X	X	X	-	-	-
5A21	21	TCO_2_MES	Kühlmitteltemperatur Kühlerausgang	X	X	X	X	X	X	X
5A22	22	TECU	Steuergerät Innentemperatur	X	X	X	X	X	X	X
5A23	23	P_oel_soll	Sollwert Öldruck	X	X	X	X	-	-	-
5A24	24	TPS_SP	Drosselklappe Sollwert	X	X	X	X	-	-	-
5A25	25	P_oel_ist	Istwert Öldruck	X	X	X	X	-	-	-
5A26	26	MAP	Umgebungsdruck	X	X	X	X	X	X	X
5A27	27	PV_AV_1	Pedalwertgeber Poti1	X	X	X	X	X	X	X

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5A28	28	PV_AV_2	Pedalwertgeber Poti2	X	X	X	X	X	X	X
5A29	29	PV_AV_RAW	Fahrpedalwert	X	X	X	X	X	X	X
5A2A	2A	FUP_EFP_SP	Sollwert Kraftstoffpumpe	-	-	-	-	X	X	X
5A2B	2B	Tans	Temperatur vor Drosselklappe	X	X	X	X	-	-	-
5A2C	2C	Pvdkds	Druck vor Drosselklappe	X	X	X	X	-	-	-
5A2D	2D	Ps_ist	Druck nach Drosselklappe	X	X	X	X	_	_	_
5A2E	2E	FUP_EFP	Kraftstoffniederdrucksensor	X	X	X	X	X	X	X
5A2F	2F	FUP	Raildruck	X	X	X	X	-	-	-
		FUP_RNG_H_MES	measured fuel pressure	-	-	-	-	X	X	X
5A30	30	ER_CYL[0]	Laufunruhe lZylinder 1	X	X	X	X	X	X	X
5A31	31	ER_CYL[4]	Laufunruhe Zylinder 2 (only 6cyl)	X	X	X	X	X	X	X
5A32	32	ER_CYL[2]	Laufunruhe Zylinder 3 (6cyl) Laufunruhe Zylinder 4 (4cyl)	X	X	X	X	X	X	X
5A33	33	ER_CYL[5]	Laufunruhe Zylinder 4 (only 6cyl)	X	X	X	X	X	X	X
5A34	34	ER_CYL[1]	Laufunruhe Zylinder 5 (6cyl) Laufunruhe Zylinder 3 (4cyl)	X	X	X	X	X	X	X
5A35	35	ER_CYL[3]	Laufunruhe Zylinder 6 (6cyl) Laufunruhe Zylinder 2 (4cyl)	X	X	X	X	X	X	X
5A36	36	LV_KNK	Status Klopfen	X	X	X	X	X	X	X
5A37	37	NL[0]	Spannung Klopfwerte Zylinder 1	X	X	X	X	X	X	X
5A38	38	NL[4]	Spannung Klopfwerte Zylinder 2 (only 6cyl)	X	X	X	X	X	X	X
5A39	39	NL[2]	Spannung Klopfwerte Zylinder 3 (6cyl) Spannung Klopfwerte Zylinder 4 (4cyl)	X	X	X	X	X	X	X
5A3A	3A	NL[5]	Spannung Klopfwerte Zylinder 4 (only 6cyl)	X	X	X	X	X	X	X
5A3B	3B	NL[1]	Spannung Klopfwerte Zylinder 5 (6cyl) Spannung Klopfwerte Zylinder 3 (4cyl)	X	X	X	X	X	X	X
5A3C	3C	NL[3]	Spannung Klopfwerte Zylinder 6 (6cyl) Spannung Klopfwerte Zylinder 2(4cyl)	X	X	X	X	X	X	X
5A3D	3D	KNKS[0]	Klopfsignal Zylinder 1	X	X	X	X	X	X	X
5A3E	3E	KNKS_REL_NL[0]	Klopfsignal Zylinder 1 relativ	X	X	X	X	-	-	-
		KNKS[1]	Klopfsignal Zylinder 5	-	-	-	-	X	X	X
5A3F	3F	KNKS[5]	Klopfsignal Zylinder 3 (for 4cyl. machine: 0ffh -not relevant)	X	X	X	X	X	X	X
5A40	40	KNKS_REL_NL[5]	Klopfsignal Zylinder 6 relativ (for 4cyl. machine: 0ffh -not relevant)	X	X	X	X	-	-	-
		KNKS[2]	Klopfsignal Zylinder 4	-	-	-	-	X	X	X
5A41	41	NT_AGI_SUL	NOx trap aging factor due to sulphur load	X	X	X	X	-	-	-
		KNKS[3]		-	-	-	-	X	X	X
5A42	42	NT_AGI	NOx trap aging factor	X	X	X	X	-	-	-
		KNKS[4]	Klopfsignal Zylinder	-	-	-	-	X	X	X
5A43	43	NT_AGI_THERMO	NOx trap aging factor due to thermal aging	X	X	X	X	-	-	-
		KNKS[6]	Klopfsignal Zylinder 7	-	-	-	-	X	X	X
5A44	44	LV_SO2P_REQ_2	Request of a desulfation (forces catalyst heating)	X	X	X	X	-	-	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
		KNKS[7]	Klopfsignal Zylinder 2	-	-	-	-	X	X	X
5A-	-	CTR_CH_SO2P	Counter of not effectual trials to heat the NOx - Trap for desulfation	X	X	X	X	-	-	-
		ER_CYL[6]	Laufunruhe Zylinder 7	-	-	-	-	X	X	X
5A46	46	DIST_SO2P_END	Km - counter since last end of desulfation	X	X	X	X	-	-	-
		ER_CYL[7]	Laufunruhe Zylinder 8	-	-	-	-	X	X	X
5A47	47	T_CH_SO2P_ACT	Time with active catalyst heating for desulfation without active desulfation	X	X	X	X	-	-	-
		NL[6]	Spannung Klopfwerte Zylinder 7	-	-	-	-	X	X	X
5A48	48	NL[7]	Spannung Klopfwerte Zylinder 2	-	-	-	-	X	X	X
		LC_SWI_AEB_TYP	Active engine brackets switch for different engine type	X	X	X	X	-	-	-
5A49	49	IGA_IGC[0]	Zündwinkel Zylinder1	X	X	X	X	X	X	X
5A4A	4A			-	-	-	-	-	-	-
5A4B	4B	LOAD_CLC	Berechneter Lastwert	X	X	X	X	X	X	X
5A4C	4C	STATE_MTC_HEAT	Status Drosselklappenheizungsrelais	X	X	X	X	_	_	_
5A4D	4D	LV_RLY_MTC_HEAT	Drosselklappenheizung EIN	X	X	X	X	_	_	_
5A4E	4E	LV_ACCOUT_RLY	Klimakompressorrelais Ein	X	X	X	X	X	X	X
5A4F	4F			-	-	-	-	-	-	-
5A50	50	LAMB_LS_UP[1]	Lambdawert vor Kat Bank1	X	X	X	X	X	X	X
5A51	51	LAMB_LS_UP[2]	Lambdawert vor Kat Bank2	X	X	X	X	X	X	X
5A52	52	LV_LS_DOWN_READY[1]	Status LS nach Kat Bank1	X	X	X	X	X	X	X
5A53	53	LV_LS_DOWN_READY[2]	Status LS nach Kat Bank2	X	X	X	X	X	X	X
5A54	54	STATE_LSH_DOWN[1]	Status LS Heizung nach Kat Bank1	X	X	X	X	X	X	X
5A55	55	STATE_LSH_DOWN[2]	Status LS Heizung nach Kat Bank2	X	X	X	X	X	X	X
5A56	56	STATE_LSH_UP[1]	Status LS Heizung vor Kat Bank1	X	X	X	X	X	X	X
5A57	57	STATE_LSH_UP[2]	Status LS Heizung vor Kat Bank2	X	X	X	X	X	X	X
5A58	58	LSHPWM_UP[1]	Lambdasondenheizung PWM vor Kat Bank 1	X	X	X	X	X	X	X
5A59	59	LSHPWM_DOWN[1]	Lambdasondenheizung PWM nach Kat Bank 1	X	X	X	X	X	X	X
5A5A	5A	LSHPWM_UP[2]	Lambdasondenheizung PWM vor Kat Bank 2	X	X	X	X	X	X	X
5A5B	5B	LSHPWM_DOWN[2]	Lambdasondenheizung PWM nach Kat Bank 2	X	X	X	X	X	X	X
5A5C	5C	ERR_VIMPWM_1_FB	Aktive Fehlerrückmeldung DISA-Klappe 1	X	X	X	X	-	-	-
5A5D	5D	CTR_VIMPWM_1_EDGE	Schalthäufigkeitszähler DISA-Klappe 1	X	X	X	X	-	-	-
5A5E	5E	ERR_VIMPWM_2_FB	Aktive Fehlerrückmeldung DISA-Klappe 2	X	X	X	X	-	-	-
5A5F	5F	CTR_VIMPWM_2_EDGE	Schalthäufigkeitszähler DISA-Klappe 2	X	X	X	X	-	-	-
5A60	60	LV_IM_BLS	Bremslichtschalter Ein	X	X	X	X	X	X	X
5A61	61	LV_IM_BTS	Bremslichttestschalter Ein	X	X	X	X	X	X	X

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5A62	62	LV_POIL_SWI	Öldruck erreicht, Schalter o. Sensor (4Zyl)	X	X	X	X	X	X	X
5A63	63	LV_EBOX_CFA	E-Boxlüfter Ein	X	X	X	X	X	X	X
5A64	64	LV_SWI_AEB	Motorlager weiche Dämpfung	X	X	X	X	-	-	-
5A65	65	LV_EF	Abgasklappe Ein	X	X	X	X	-	-	-
5A66	66	LV_DMTL_PUMP	DMTL Pumpe Ein	X	X	X	X	X	X	X
5A67	67	LV_DMTLS	DMTL Ventil Ein	X	X	X	X	X	X	X
5A68	68	LV_HDMTL_ON	DMTL Heizung Ein	X	X	X	X	X	X	X
5A69	69	LV_MIL_CAN	MIL Lampe Ein	X	X	X	X	X	X	X
5A6A	6A	LV_CRU_MAIN_SWI	Lampe FGR Ein	X	X	X	X	X	X	X
5A6B	6B	LV_WAL_1_CAN	Lampe Check Engine Ein	X	X	X	X	X	X	X
5A6C	6C	FAC_FCO_KWP	Verbrauchskorrekturfktor	X	X	X	X	X	X	X
5A6D	6D	STATE_MSW_CAN	Status Taste FGR	X	X	X	X	X	X	X
5A6E	6E	STATE_CRU_OFF_IRR	Status für irreversible Abschaltbedingung	X	X	X	X	X	X	X
5A6F	6F	STATE_CRU_OFF_REV	Status für reversible Abschaltbedingung	X	X	X	X	X	X	X
5A70	70	LV_SOF	Soundklappe Zustand	X	X	X	X	-	-	-
5A71	71	VIMPWM_1	DISA1 PWM (große/obere Klappe)	X	X	X	X	-	-	-
5A72	72	VIMPWM_2	DISA2 PWM (kleine/untere Klappe)	X	X	X	X	-	-	-
5A73	73	LV_RLY_CRCV_HEAT	Kurbelgehaeuseentlueftungsheizung	X	X	X	X	X	X	X
5A74	74	ECTPWM	Beheizter Thermostat PWM	X	X	X	X	X	X	X
5A75	75			-	-	-	-	-	-	-
5A76	76	CPPWM_ADD_AD_MEM	Adaption Öffnungspunkt Tankentlüftungsventil	X	X	X	X	-	X	X
		CPPWM_ADD_AD_MEM[0]	Adaption Öffnungspunkt Tankentlüftungsventil	-	-	-	-	X	-	-
5A77	77	CPPWM_CPS	TankEntlüftungsVentil TEV PWM	X	X	X	X	X	X	X
5A78	78	LV_EF	Abgasklappe Ansteuerung	X	X	X	X	-	-	-
5A79	79	ECFPWM[0]	E-Lüfter PWM	X	X	X	X	X	X	X
5A7A	7A	IVVTPWM_IN[0]	VANOS PWM Wert Einlass	X	X	X	X	-	-	-
		ECFPWM_REQ	Requested pulse width modulated for ECF	-	-	-	-	X	X	X
5A7B	7B	IVVTPWM_EX[1]	VANOS PWM Wert Auslass	X	X	X	X	-	-	-
		LV_ECF_RLY_ACT	Boolean for activation ECF relais	-	-	-	-	X	X	X
5A7C	7C	FAC_NOX_NS_AD[1]	Adaptation of the NOx sensor characteristic shift	X	X	X	X	-	-	-
		LV_ERR_ECFPWM_FB_3	Error currently present, indicated by failure feedback from ECF control unit	-	-	-	-	X	X	X
5A7D	7D	CTR_NS_AD_CYC[1]	Counter of NOx signal gain adaptations	X	X	X	X	-	-	-
		LV_ERR_ECFPWM_FB_4	Error currently present, indicated by failure feedback from ECF control uni	-	-	-	-	X	X	X
5A7E	7E	DIST_NT_NS_AD[1]	Current distance from last NOx signal gain adaptation	X	X	X	X	-	-	-
5A7F	7F	DELTA_CRK_CYL_LAM[1]	adapted phase displacement, bank1	X	X	X	X	X	X	X
5A80	80	DELTA_CRK_CYL_LAM[2]	adapted phase displacement, bank 2	X	X	X	X	X	X	X

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5A81	81	FAC_LAM_LIM[1]	Integrator Bank1	X	X	X	X	X	X	X
5A82	82	FAC_LAM_LIM[2]	Integrator Bank2	X	X	X	X	X	X	X
5A83	83	MFF_ADD_LAM_AD_OUT[1]	Adaption Offset Lambda Bank1	X	X	X	X	X	X	X
5A84	84	MFF_ADD_LAM_AD_OUT[2]	Adaption Offset Lambda Bank2	X	X	X	X	X	X	X
5A85	85	FAC_LAM_AD_CUS[1]	Adaption Multiplikation Lambda Bank1	X	X	X	X	X	X	X
5A86	86	FAC_LAM_AD_CUS[2]	Adaption Multiplikation Lambda Bank2	X	X	X	X	X	X	X
5A87	87	LAMB_DELTA_AD_LAM_ADJ[1]	Adaptionswert Trimregelung Bank1	X	X	X	X	X	X	X
5A88	88	LAMB_DELTA_AD_LAM_ADJ[2]	Adaptionswert Trimregelung Bank2	X	X	X	X	X	X	X
5A89	89	FAC_H_RNG_LAM_AD[1]	multiplikative Gemischadaption hohe Last Bank1	X	X	X	X	X	X	X
5A8A	8A	FAC_H_RNG_LAM_AD[2]	multiplikative Gemischadaption hohe Last Bank2	X	X	X	X	X	X	X
5A8B	8B	FAC_L_RNG_LAM_AD[1]	multiplikative Gemischadaption niedrige Last Bank1	X	X	X	X	X	X	X
5A8C	8C	FAC_L_RNG_LAM_AD[2]	multiplikative Gemischadaption niedrige Last Bank2	X	X	X	X	X	X	X
5A8D	8D	MFF_ADD_LAM_AD[1]	additive Gemischadaption Leerlauf Bank1	X	X	X	X	X	X	X
5A8E	8E	MFF_ADD_LAM_AD[2]	additive Gemischadaption Leerlauf Bank2	X	X	X	X	X	X	X
5A8F	8F	FAC_LSL_GAIN_AD[1]	Adaption Schubabgleich Bank 1	X	X	X	X	X	X	X
5A90	90	FAC_LSL_GAIN_AD[2]	Adaption Schubabgleich Bank 2	X	X	X	X	X	X	X
5A91	91	EFF_CAT_DIAG_OBD[1]	Katalysatordiagnosewert Bank1	X	X	X	X	X	X	X
5A92	92	EFF_CAT_DIAG_OBD[2]	Katalysatordiagnosewert Bank2	X	X	X	X	X	X	X
5A93	93	CTR_GB_NEUT_NOT_PLAUS_SUM		X	X	X	X	-	-	-
5A94	94	CAM_SP_IVVT_EX	Nockenwelle Auslass Sollwert	X	X	X	X	-	-	-
5A95	95	PSN_AD_CAM_EX[1]	Adaptionswert Nockenwelle Auslaß	X	X	X	X	X	X	X
5A96	96	PSN_AD_CAM_IN[1]	Adaptionswert Nockenwelle Einlaß	X	X	X	X	X	X	X
5A97	97	B_vsean_loc	E-VANOS im Anschlag bei letztem Abstellen	X	X	X	X	X	X	X
5A98	98			-	-	-	-	-	-	-
5A99	99	LV_SEG_AD_AVL_ER	Kurbelwellen Adaption beendet	X	X	X	X	X	X	X
5A9A	9A	LV_VAR_MAF_LEARNT	HFM learning function has been carried out	X	X	X	X	-	-	-
5A9B	9B	FAC_LAM_AD_BAL[1]	Lambda adaption output to be used in the MFF correction, bank1	X	X	X	X	-	-	-
5A9C	9C	FAC_LAM_AD_BAL[2]	Lambda adaption output to be used in the MFF correction, bank2	X	X	X	X	-	-	-
5A9D	9D	FAC_LAM_AD_OUT[1]	fuel mass set point factor, output from lambda adaptation, bank 1	X	X	X	X	-	-	-
5A9E	9E	FAC_LAM_AD_OUT[2]	fuel mass set point factor, output from lambda adaptation, bank 2	X	X	X	X	-	-	-
5A9F	9F	FAC_LAM_ADJ_COR_LAM_AD_CUS[1	Corrected value of the Long term	X	X	X	X	-	-	-

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		]	customer Lambda Adaption (multiplicative share), bank1							
5AA0	A0	FAC_LAM_ADJ_COR_LAM_AD_CUS[2]	Corrected value of the Long term customer Lambda Adaption (multiplicative share), bank2	X	X	X	X	-	-	-
5AA1	A1	STATE_EOL_KWP_CPS	Status Diagnose TEV	X	X	X	X	-	-	-
5AA2	A2	STATE_EOL_KWP_DMTL	Status Diagnose DMTL	X	X	X	X	-	-	-
5AA3	A3	STATE_EOL_KWP_VLS	Status Diagnose Lambdasonden	X	X	X	X	-	-	-
5AA4	A4	STATE_EOL_KWP_N_SP_IS	Status Diagnose Leerlaufdrehzahlverstellung	X	X	X	X	-	-	-
5AA5	A5	STATE_EOL_KWP_SA	Status Diagnose Sekundärluft	X	X	X	X	-	-	-
5AA6	A6			-	-	-	-	-	-	-
5AA7	A7	Msnlgofs_tmp	Leckluftadaptation Istwert	X	X	X	X	X	X	X
5AA8	A8	STATE_ECRAS_SYS	Status Luftklappensystem	X	X	X	X	X	X	X
5AA9	A9	ECRASPWM	Tastverhältnis Luftklappe	X	X	X	X	X	X	X
5AAA	AA	POIL_PWM	Oilpressure PWM	X	X	X	X	_	_	_
5AAB	AB	WGPWM[0]	Wastegate 1 PWM	X	X	X	X	X	X	X
5AAC	AC	WGPWM[1]	Wastegate 2 PWM	X	X	X	X	X	X	X
5AAD	AD	Atlvst	Vorsteuerung Ladedruckregelung	X	X	X	X	X	X	X
5AAE	AE	Atlr	Reglerausgang und Vorsteuerung	X	X	X	X	X	X	X
5AAF	AF	F_atlad	Adaptionswert von der Ladedruckregelung	X	X	X	X	X	X	X
5AB0	B0	Pldr_soll	Solladedruck	X	X	X	X	X	X	X
5AB1	B1	VS	Geschwindigkeit	X	X	X	X	X	X	X
5AB2	B2	T_PER_MAF_FRQ[0]	Periodendauer Luftmasse	X	X	X	X	X	X	X
5AB3	B3	DIST_ACT_MIL	Fahrstreck mit MIL an	X	X	X	X	X	X	X
5AB4	B4	TRT	Betriebsstundenzähler	X	X	X	X	X	X	X
5AB5	B5	T_PER_MAF_FRQ[1]	Periodendauer Luftmasse 2	-	-	-	-	X	X	X
5AB6	B6	TIA_MES	Rohwert Ansauglufttemperatur 1	X	X	X	X	-	-	-
5AB7	B7	TCO_MES	Rohwert Kühlwassertemperatur	X	X	X	X	X	X	X
5AB8	B8	V_MAP	Spannung Saugrohrdruck	X	X	X	X	-	-	-
		V_MAP[0]	Spannung Saugrohrdruck 1	-	-	-	-	X	X	X
5AB9	B9	V_SOF_SWI	Spannung Sportschalter	X	X	X	X	-	-	-
5ABA	BA			-	-	-	-	-	-	-
5ABB	BB	V_MAP[1]	Spannung Saugrohrdruck 2	-	-	-	-	X	X	X
5ABC	BC	MAF_KGH_MES_BAS	Luftmasse	X	X	X	X	-	-	-
5ABD	BD	LV_RLY_ST	Starterrelais aktiv	X	X	X	X	X	X	X
5ABE	BE	EFPPWM_I	I-Anteil Kraftstoffpumpen-PWM	-	-	-	-	X	X	X
5ABF	BF			-	-	-	-	-	-	-
5AC0	C0			-	-	-	-	-	-	-
5AC1	C1			-	-	-	-	-	-	-

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5AC2	C2	RST_DBG_BACKTRACE_ADDRESS[0][0]	Info last available caller address (default 0)	X	X	X	X	-	-	-
		STACK_ADR_RST[0][0]	Info last available caller addresses (default 0) / RESET SAFE	-	-	-	-	X	X	X
5AC3	C3	CTR_TPS_JAM_DET_ACT	Zähler für Eisdetection in der Drosselklappe	X	X	X	X	_	_	_
5AC4	C4	EFPPWM_MIN_AD	Minimum pump speed of the electrical fuel pump as PWM signal	X	X	X	X	X	X	X
5AC5	C5	EFPPWM_I_AD	Adaptive I-Part of the controller	X	X	X	X	X	X	X
5AC6	C6	V_ACR	Sensorspannung AGR	X	X	X	X	-	-	-
5AC7	C7	OPG_ACR	Hub des AGR-Tellerventils	X	X	X	X	-	-	-
5AC8	C8	V_ACR_AD_TOL	Adaptionswert oberer Anschlag (einmalig gelernt)	X	X	X	X	-	-	-
5AC9	C9	V_ACR_AD_BOL	Adaptionswert unterer Anschlag (immer wieder neu gelernt)	X	X	X	X	-	-	-
5ACA	CA	V_ACR_AD_BOL_0	Adaptionswert unterer Anschlag (einmalig am Anfang gelernt, Uradaption)	X	X	X	X	-	-	-
5ACB	CB	STATE_ACR_AD	Status des Erlernens der AGR-Adaption	X	X	X	X	-	-	-
5ACC	CC	CTR_STC_TECU_1	DME-Temperaturstatistik, Zähler 1	X	X	X	X	-	-	-
5ACD	CD	CTR_STC_TECU_2	DME-Temperaturstatistik, Zähler 2	X	X	X	X	-	-	-
5ACE	CE	CTR_STC_TECU_3	DME-Temperaturstatistik, Zähler 3	X	X	X	X	-	-	-
5ACF	CF	CTR_STC_TECU_4	DME-Temperaturstatistik, Zähler 4	X	X	X	X	-	-	-
5AD0	D0	CTR_STC_TECU_5	DME-Temperaturstatistik, Zähler 5	X	X	X	X	-	-	-
5AD1	D1	CTR_STC_TECU_6	DME-Temperaturstatistik, Zähler 6	X	X	X	X	-	-	-
5AD2	D2	CTR_STC_TECU_7	DME-Temperaturstatistik, Zähler 7	X	X	X	X	-	-	-
5AD3	D3	CTR_STC_TECU_8	DME-Temperaturstatistik, Zähler 8	X	X	X	X	-	-	-
5AD4	D4			-	-	-	-	-	-	-
5AD5	D5	LV_RAS_OUT		-	-	X	X	-	-	-
		CTR_STC_TECU_1	DME-Temperaturstatistik, Zähler 1	-	-	-	-	X	X	X
5AD6	D6	NOX_OFS_PUC[1]	Fuel Cut Off = Schubabschaltung	X	X	X	X	-	-	-
		CTR_STC_TECU_2	DME-Temperaturstatistik, Zähler 2	-	-	-	-	X	X	X
5AD7	D7	NOX_OFS_LOAD[1]	Beladungsbetrieb NOx-Kat.	X	X	X	X	-	-	-
		CTR_STC_TECU_3	DME-Temperaturstatistik, Zähler 3	-	-	-	-	X	X	X
5AD8	D8	NOX_NS[1]	NOx-Konzentration	X	X	X	X	-	-	-
		CTR_STC_TECU_4	DME-Temperaturstatistik, Zähler 4	-	-	-	-	X	X	X
5AD9	D9	LAMB_NOX_SENS[1]	Lineares Lambdasignal NOx-Sensor	X	X	X	X	-	-	-
		CTR_STC_TECU_5	DME-Temperaturstatistik, Zähler 5	-	-	-	-	X	X	X
5ADA	DA	VLS_NOX_SENS[1]	binäres Spannungssignal NOx-Sensor	X	X	X	X	-	-	-
		CTR_STC_TECU_6	DME-Temperaturstatistik, Zähler 6	-	-	-	-	X	X	X
5ADB	DB	CAN_STATE_NOX_SENS[1]	Status NOx-Sensor	X	X	X	X	-	-	-
		CTR_STC_TECU_7	DME-Temperaturstatistik, Zähler 7	-	-	-	-	X	X	X

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5ADC	DC	CAN_ERR_NOX_SENS[1]	NOx-Sensor Error Byte	X	X	X	X	-	-	-
		CTR_STC_TECU_8	DME-Temperaturstatistik, Zähler 8	-	-	-	-	X	X	X
5ADD	DD			-	-	-	-	-	-	-
5ADE	DE			-	-	-	-	-	-	-
5ADF	DF	LV_CAN_TEMP_MIN_THD[1]	Taupunkterkennung für NOx-Sensor	X	X	X	X	-	-	-
5AE0	E0	RST_SEC	Status-byte: security info for atypical reset (reset-save memory)	X	X	X	X	-	-	-
5AE1	E1	RST_CTR	For ECU without generic DBG driver: Number of atypical warm-resets since last power-up (reset-save memory)	X	X	X	X	-	-	-
5AE2	E2	RST_TYP	reset type of last reset	X	X	X	X	-	-	-
		STATE_RST_TYP_ACT	reset type of last reset	-	-	-	-	X	X	X
5AE3	E3	RST_DBG_BACK_INFO_VLD[0]	background info for last reset valid	X	X	X	X	-	-	-
		LV_DBG_INFO_VLD[0]	background info for last reset valid / RESET SAFE	-	-	-	-	X	X	X
5AE4	E4	RST_INFO_ADD[0]	Additional reset info (cause)	X	X	X	X	-	-	-
		STATE_RST_INFO_ADD[0]	Additional reset info (cause) / RESET SAFE	-	-	-	-	X	X	X
5AE5	E5	DIST_RST_DET[0]	Mileage counter at reset	X	X	X	X	X	X	X
5AE6	E6	TRT_RST_DET[0]	Total runtime at reset	X	X	X	X	X	X	X
5AE7	E7	CPU_LOAD_MAX_RST_DET[0]	Max. CPU load from reset detection	X	X	X	X	X	X	X
5AE8	E8	N_CPU_LOAD_MAX_RST_DET[0]	Engine speed at max. cpu load from reset detection	X	X	X	X	X	X	X
5AE9	E9	RST_CLAS_SEC[0]	Security info	X	X	X	X	-	-	-
5AEA	EA	RST_INFO_CTR	Number of atypical warm-resets since last power-up (BSW)	X	X	X	X	-	-	-
		CTR_WRST	Number of atypical warm-resets since last power-up (from BSW) / RESET SAFE	-	-	-	-	X	X	X
5AEB	EB	Tmot_b1	Kühlmitteltemperatur < 98°C	X	X	X	X	-	-	-
5AEC	EC	Tmot_b2	98°C =< Kühlmitteltemperatur =< 112°C	X	X	X	X	-	-	-
5AED	ED	Tmot_b3	113°C =< Kühlmitteltemperatur =< 120°C	X	X	X	X	-	-	-
5AEE	EE	Tmot_b4	121°C =< Kühlmitteltemperatur =< 125°C	X	X	X	X	-	-	-
5AEF	EF	Tmot_b5	Kühlmitteltemperatur > 125°C	X	X	X	X	-	-	-
5AF0	F0	Toel_b1	Motoröltemperatur < 80°C	X	X	X	X	-	-	-
5AF1	F1	Toel_b2	80°C =< Motoröltemperatur =< 110°C	X	X	X	X	-	-	-
5AF2	F2	Toel_b3	110°C =< Motoröltemperatur =< 135°C	X	X	X	X	-	-	-
5AF3	F3	Toel_b4	135°C =< Motoröltemperatur =< 150°C	X	X	X	X	-	-	-
5AF4	F4	Toel_b5	Motoröltemperatur > 150°C	X	X	X	X	-	-	-
5AF5	F5	Tget_b1	Getriebeöltemperatur < 80°C	X	X	X	X	-	-	-
5AF6	F6	Tget_b2	80°C =< Getriebeöltemperatur =< 109°C	X	X	X	X	-	-	-

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5AF7	F7	Tget_b3	110°C =< Getriebeöltemperatur =< 124°C	X	X	X	X	-	-	-
5AF8	F8	Tget_b4	125°C =< Getriebeöltemperatur =< 129°C	X	X	X	X	-	-	-
5AF9	F9	Tget_b5	Getriebeöltemperatur > 129°C	X	X	X	X	-	-	-
5AFA	FA	Tumg_b1	Umgebungstemperatur < 3°C	X	X	X	X	-	-	-
5AFB	FB	Tumg_b2	3°C <= Umgebungstemperatur =< 19°C	X	X	X	X	-	-	-
5AFC	FC	Tumg_b3	20°C <= Umgebungstemperatur =< 29°C	X	X	X	X	-	-	-
5AFD	FD	Tumg_b4	30°C <= Umgebungstemperatur =< 39°C	X	X	X	X	-	-	-
5AFE	FE	Tumg_b5	Umgebungstemperatur > 39°C	X	X	X	X	-	-	-
				-	-	-	-	-	-	-
5B MSD8x spezifisch				-	-	-	-	-	-	-
5B00	00	TI_1_MES[0]	Einspritzzeit Zylinder 1 von der Endstufe rückgemessen	X	X	X	X	X	X	X
5B01	01	TI_1_MES[4]	Einspritzzeit Zylinder 2 von der Endstufe rückgemessen (for 4cyl and 6cyl) Einspritzzeit Zylinder 6 von der Endstufe rückgemessen (for 8cyl)	X	X	X	X	X	X	X
5B02	02	TI_1_MES[2]	Einspritzzeit Zylinder 3 von der Endstufe rückgemessen (for 6cyl) Einspritzzeit Zylinder 4 von der Endstufe rückgemessen (for 4cyl and 8cyl)	X	X	X	X	X	X	X
5B03	03	TI_1_MES[5]	Einspritzzeit Zylinder 4 von der Endstufe rückgemessen (for 4cyl and 6cyl) Einspritzzeit Zylinder 3 von der Endstufe rückgemessen (for 8cyl)	X	X	X	X	X	X	X
5B04	04	TI_1_MES[1]	Einspritzzeit Zylinder 5 von der Endstufe rückgemessen (for 6cyl and 8cyl) Einspritzzeit Zylinder 3 von der Endstufe rückgemessen (for 4cyl)	X	X	X	X	X	X	X
5B05	05	TI_1_MES[3]	Einspritzzeit Zylinder 6 von der Endstufe rückgemessen (for 6cyl) Einspritzzeit Zylinder 2 von der Endstufe rückgemessen (for 4cyl) Einspritzzeit Zylinder 8 von der Endstufe rückgemessen (for 8cyl)	X	X	X	X	X	X	X
5B06	06	TI_1_MES[6]	Einspritzzeit Zylinder 7 von der Endstufe rückgemessen	-	-	-	-	X	X	X
5B07	07	TI_1_MES[7]	Einspritzzeit Zylinder 2 von der Endstufe rückgemessen (for 8cyl)	-	-	-	-	X	X	X
5B08	08			-	-	-	-	-	-	-
5B09	09			-	-	-	-	-	-	-
5B0A	0A			-	-	-	-	-	-	-
5B0B	0B			-	-	-	-	-	-	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5B0C	0C			-	-	-	-	-	-	-
5B0D	0D			-	-	-	-	-	-	-
5B0E	0E			-	-	-	-	-	-	-
5B0F	0F			-	-	-	-	-	-	-
5B10	10	EGY_STEP_INJ_CHA_GRD[0]	Tastverhältnis Injektor 1 von der Endstufe rückgemessen	X	X	X	X	X	X	X
5B11	11	EGY_STEP_INJ_CHA_GRD[4]	Tastverhältnis Injektor 2 von der Endstufe rückgemessen (for 6cyl) Tastverhältnis Injektor 6 von der Endstufe rückgemessen (for 8cyl)	-	-	X	X	X	X	X
5B12	12	EGY_STEP_INJ_CHA_GRD[2]	Tastverhältnis Injektor 3 von der Endstufe rückgemessen (for 6cyl) Tastverhältnis Injektor 4 von der Endstufe rückgemessen (for 4cyl and 8cyl)	X	X	X	X	X	X	X
5B13	13	EGY_STEP_INJ_CHA_GRD[5]	Tastverhältnis Injektor 4 von der Endstufe rückgemessen (for 6cyl) Tastverhältnis Injektor 3 von der Endstufe rückgemessen (for 8cyl)	-	-	X	X	X	X	X
5B14	14	EGY_STEP_INJ_CHA_GRD[1]	Tastverhältnis Injektor 5 von der Endstufe rückgemessen (for 4cyl and 8cyl) Tastverhältnis Injektor 3 von der Endstufe rückgemessen (for 4cyl)	X	X	X	X	X	X	X
5B15	15	EGY_STEP_INJ_CHA_GRD[3]	Tastverhältnis Injektor 6 von der Endstufe rückgemessen (for 6cyl) Tastverhältnis Injektor 2 von der Endstufe rückgemessen (for 4cyl) Tastverhältnis Injektor 8 von der Endstufe rückgemessen (for 8cyl)	X	X	X	X	X	X	X
5B16	16	EGY_STEP_INJ_CHA_GRD[6]	Tastverhältnis Injektor 7 von der Endstufe rückgemessen	-	-	-	-	X	X	X
5B17	17	EGY_STEP_INJ_CHA_GRD[7]	Tastverhältnis Injektor 2 von der Endstufe rückgemessen (for 8cyl)	-	-	-	-	X	X	X
5B18	18			-	-	-	-	-	-	-
5B19	19			-	-	-	-	-	-	-
5B1A	1A			-	-	-	-	-	-	-
5B1B	1B			-	-	-	-	-	-	-
5B1C	1C			-	-	-	-	-	-	-
5B1D	1D			-	-	-	-	-	-	-
5B1E	1E			-	-	-	-	-	-	-
5B1F	1F			-	-	-	-	-	-	-
5B20	20	CHA_IV_1_MES[0]	Elektrische Ladung Injektor 1	X	X	X	X	X	X	X
5B21	21	CHA_IV_1_MES[4]	Elektrische Ladung Injektor 2 (for 6cyl) Elektrische Ladung Injektor 6 (for 8cyl)	-	-	X	X	X	X	X
5B22	22	CHA_IV_1_MES[2]	Elektrische Ladung Injektor 3 (for 6cyl) Elektrische Ladung Injektor 4 (for 4cyl	X	X	X	X	X	X	X

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
			and 8cyl)							
5B23	23	CHA_IV_1_MES[5]	Elektrische Ladung Injektor 4 (for 6cyl) Elektrische Ladung Injektor 3 (for 8cyl)	-	-	X	X	X	X	X
5B24	24	CHA_IV_1_MES[1]	Elektrische Ladung Injektor 5 (for 6cyl and 8cyl) Elektrische Ladung Injektor 3 (for 4cyl)	X	X	X	X	X	X	X
5B25	25	CHA_IV_1_MES[3]	Elektrische Ladung Injektor 6 (for 6cyl) Elektrische Ladung Injektor 2 (for 4cyl) Elektrische Ladung Injektor 8 (for 8cyl)	X	X	X	X	X	X	X
5B26	26	CHA_IV_1_MES[6]	Elektrische Ladung Injektor 7	-	-	-	-	X	X	X
5B27	27	CHA_IV_1_MES[7]	Elektrische Ladung Injektor 2 (for 8cyl)	-	-	-	-	X	X	X
5B28	28			-	-	-	-	-	-	-
5B29	29			-	-	-	-	-	-	-
5B2A	2A			-	-	-	-	-	-	-
5B2B	2B			-	-	-	-	-	-	-
5B2C	2C			-	-	-	-	-	-	-
5B2D	2D			-	-	-	-	-	-	-
5B2E	2E			-	-	-	-	-	-	-
5B2F	2F			-	-	-	-	-	-	-
5B30	30	V_IV_1_MES[0]	Spannung Injektor 1	X	X	X	X	X	X	X
5B31	31	V_IV_1_MES[4]	Spannung Injektor 2 (for 6cyl) Spannung Injektor 6 (for 8cyl)	-	-	X	X	X	X	X
5B32	32	V_IV_1_MES[2]	Spannung Injektor 3 (for 6cyl) Spannung Injektor 4 (for 4cyl and 8cyl)	X	X	X	X	X	X	X
5B33	33	V_IV_1_MES[5]	Spannung Injektor 4 (for 6cyl) Spannung Injektor 3 (for 8cyl)	-	-	X	X	X	X	X
5B34	34	V_IV_1_MES[1]	Spannung Injektor 5 (for 6cyl and 8cyl) Spannung Injektor 3 (for 4cyl)	X	X	X	X	X	X	X
5B35	35	V_IV_1_MES[3]	Spannung Injektor 6 (for 6cyl) Spannung Injektor 2 (for 4cyl) Spannung Injektor 8 (for 8cyl)	X	X	X	X	X	X	X
5B36	36	V_IV_1_MES[6]	Spannung Injektor 7 (for 8cyl)	-	-	-	-	X	X	X
5B37	37	V_IV_1_MES[7]	Spannung Injektor 2 (for 8cyl)	-	-	-	-	X	X	X
5B38	38			-	-	-	-	-	-	-
5B39	39			-	-	-	-	-	-	-
5B3A	3A			-	-	-	-	-	-	-
5B3B	3B			-	-	-	-	-	-	-
5B3C	3C			-	-	-	-	-	-	-
5B3D	3D			-	-	-	-	-	-	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5B3E	3E			-	-	-	-	-	-	-
5B3F	3F			-	-	-	-	-	-	-
5B40	40	FAC_EGY_PWM_AD[0]	Adaptationswert der Endstufe 1	X	X	X	X	X	X	X
5B41	41	FAC_EGY_PWM_AD[4]	Adaptationswert der Endstufe 2 (for 6cyl) Adaptationswert der Endstufe 6 (for 8cyl)	-	-	X	X	X	X	X
5B42	42	FAC_EGY_PWM_AD[2]	Adaptationswert der Endstufe 3 (for 6cyl) Adaptationswert der Endstufe 4 (for 4cyl and 8cyl)	X	X	X	X	X	X	X
5B43	43	FAC_EGY_PWM_AD[5]	Adaptationswert der Endstufe 4 (for 6cyl) Adaptationswert der Endstufe 3 (for 8cyl)	-	-	X	X	X	X	X
5B44	44	FAC_EGY_PWM_AD[1]	Adaptationswert der Endstufe 5 von der Endstufe rückgemessen (for 4cyl and 8cyl) Adaptationswert der Endstufe 3 (for 4cyl)	X	X	X	X	X	X	X
5B-	-	FAC_EGY_PWM_AD[3]	Adaptationswert der Endstufe 6 (for 6cyl) Adaptationswert der Endstufe 2 (for 4cyl) Adaptationswert der Endstufe 8 (for 8cyl)	X	X	X	X	X	X	X
5B46	46	FAC_EGY_PWM_AD[6]	Adaptationswert der Endstufe 7 (for 8cyl)	-	-	-	-	X	X	X
5B47	47	FAC_EGY_PWM_AD[7]	Adaptationswert der Endstufe 2 (for 8cyl)	-	-	-	-	X	X	X
5B48	48			-	-	-	-	-	-	-
5B49	49			-	-	-	-	-	-	-
5B4A	4A			-	-	-	-	-	-	-
5B4B	4B			-	-	-	-	-	-	-
5B4C	4C			-	-	-	-	-	-	-
5B4D	4D			-	-	-	-	-	-	-
5B4E	4E			-	-	-	-	-	-	-
5B4F	4F			-	-	-	-	-	-	-
5B50	50	FAC_CYL_LAM_COR[0]	Momentan eingerechnete CILC-Werte Injektor 1	X	X	X	X	-	-	-
5B51	51	FAC_CYL_LAM_COR[4]	Momentan eingerechnete CILC-Werte Injektor 2 (for 6cyl) Momentan eingerechnete CILC-Werte Injektor 6 (for 8cyl)	-	-	X	X	-	-	-
5B52	52	FAC_CYL_LAM_COR[2]	Momentan eingerechnete CILC-Werte Injektor 3 (for 6cyl) Momentan eingerechnete CILC-Werte Injektor 4 (for 4cyl and 8cyl)	X	X	X	X	-	-	-
5B53	53	FAC_CYL_LAM_COR[5]	Momentan eingerechnete CILC-Werte Injektor 4 (for 6cyl) Momentan eingerechnete CILC-Werte	-	-	X	X	-	-	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
			Injektor 3 (for 8cyl)							
5B54	54	FAC_CYL_LAM_COR[1]	Momentan eingerechnete CILC-Werte Injektor 5 (for 6cyl and 8cyl) Momentan eingerechnete CILC-Werte Injektor 3 (for 4cyl)	X	X	X	X	-	-	-
5B55	55	FAC_CYL_LAM_COR[3]	Momentan eingerechnete CILC-Werte Injektor 6 (for 6cyl) Momentan eingerechnete CILC-Werte Injektor 2 (for 4cyl) Momentan eingerechnete CILC-Werte Injektor 8 (for 8cyl)	X	X	X	X	-	-	-
5B56	56			-	-	-	-	-	-	-
5B57	57			-	-	-	-	-	-	-
5B58	58			-	-	-	-	-	-	-
5B59	59			-	-	-	-	-	-	-
5B5A	5A			-	-	-	-	-	-	-
5B5B	5B			-	-	-	-	-	-	-
5B5C	5C			-	-	-	-	-	-	-
5B5D	5D			-	-	-	-	-	-	-
5B5E	5E			-	-	-	-	-	-	-
5B5F	5F			-	-	-	-	-	-	-
5B60	60	FAC_LAM_CYL_SEL_ADJ_CST[0]	CILC-Adaption kalt Injektor 1	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_IS_ER_BAL_HOM[0]	Extended idle speed range correction factor adaptation value for cylinder balancing homogenous, injector 1	-	-	-	-	X	X	X
5B61	61	FAC_LAM_CYL_SEL_ADJ_CST[4]	CILC-Adaption kalt Injektor 2 (for 6cyl) CILC-Adaption kalt Injektor 6 (for 8cyl)	-	-	X	X	-	-	-
		FAC_COR_AD_RNG_IS_ER_BAL_HOM[1]	Extended idle speed range correction factor adaptation value for cylinder balancing homogenous, injector 2	-	-	-	-	X	X	X
5B62	62	FAC_LAM_CYL_SEL_ADJ_CST[2]	CILC-Adaption kalt Injektor 3 (for 6cyl) CILC-Adaption kalt Injektor 4 (for 4cyl and 8cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_IS_ER_BAL_HOM[2]	Extended idle speed range correction factor adaptation value for cylinder balancing homogenous, injector 3	-	-	-	-	X	X	X
5B63	63	FAC_LAM_CYL_SEL_ADJ_CST[5]	CILC-Adaption kalt Injektor 4 (for 6cyl) CILC-Adaption kalt Injektor 3 (for 8cyl)	-	-	X	X	-	-	-
		FAC_COR_AD_RNG_IS_ER_BAL_HOM[3]	Extended idle speed range correction factor adaptation value for cylinder balancing homogenous, injector 4	-	-	-	-	X	X	X

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5B64	64	FAC_LAM_CYL_SEL_ADJ_CST[1]	CILC-Adaption kalt Injektor 5 (for 6cyl and 8cyl) CILC-Adaption kalt Injektor 3 (for 4cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_IS_ER_BAL_HOM[4]	Extended idle speed range correction factor adaptation value for cylinder balancing homogenous, injector 5	-	-	-	-	X	X	X
5B65	65	FAC_LAM_CYL_SEL_ADJ_CST[3]	CILC-Adaption kalt Injektor 6 (for 6cyl) CILC-Adaption kalt Injektor 2 (for 4cyl) CILC-Adaption kalt Injektor 8 (for 8cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_IS_ER_BAL_HOM[5]	Extended idle speed range correction factor adaptation value for cylinder balancing homogenous, injector 6	-	-	-	-	X	X	X
5B66	66	FAC_COR_AD_RNG_IS_ER_BAL_HOM[6]	Extended idle speed range correction factor adaptation value for cylinder balancing homogenous, injector 7	-	-	-	-	X	X	X
5B67	67	FAC_COR_AD_RNG_IS_ER_BAL_HOM[7]	Extended idle speed range correction factor adaptation value for cylinder balancing homogenous, injector 8	-	-	-	-	X	X	X
5B68	68			-	-	-	-	-	-	-
5B69	69			-	-	-	-	-	-	-
5B6A	6A			-	-	-	-	-	-	-
5B6B	6B			-	-	-	-	-	-	-
5B6C	6C			-	-	-	-	-	-	-
5B6D	6D			-	-	-	-	-	-	-
5B6E	6E			-	-	-	-	-	-	-
5B6F	6F			-	-	-	-	-	-	-
5B70	70	MFF_ADD_AD_ER_BAL[0]	ER-Adaption TI-additiv im LL Schicht für Injektor 1	X	X	X	X	-	-	-
5B71	71	MFF_ADD_AD_ER_BAL[4]	ER-Adaption TI-additiv im LL Schicht für Injektor 2(for 6cyl)	-	-	X	X	-	-	-
5B72	72	MFF_ADD_AD_ER_BAL[2]	ER-Adaption TI-additiv im LL Schicht für Injektor 3 ER-Adaption TI-additiv im LL Schicht für Injektor 4(for 4cyl)	X	X	X	X	-	-	-
5B73	73	MFF_ADD_AD_ER_BAL[5]	ER-Adaption TI-additiv im LL Schicht für Injektor 4(for 6cyl)	-	-	X	X	-	-	-
5B74	74	MFF_ADD_AD_ER_BAL[1]	ER-Adaption TI-additiv im LL Schicht für Injektor 5 ER-Adaption TI-additiv im LL Schicht für Injektor 3 (for 4cyl N43)	X	X	X	X	-	-	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5B75	75	MFF_ADD_AD_ER_BAL[3]	ER-Adaption TI-additiv im LL Schicht für Injektor 6 ER-Adaption TI-additiv im LL Schicht für Injektor 2 (for 4cyl N43)	X	X	X	X	-	-	-
5B76	76			-	-	-	-	-	-	-
5B77	77			-	-	-	-	-	-	-
5B78	78			-	-	-	-	-	-	-
5B79	79			-	-	-	-	-	-	-
5B7A	7A			-	-	-	-	-	-	-
5B7B	7B			-	-	-	-	-	-	-
5B7C	7C			-	-	-	-	-	-	-
5B7D	7D			-	-	-	-	-	-	-
5B7E	7E			-	-	-	-	-	-	-
5B7F	7F			-	-	-	-	-	-	-
5B80	80	MFF_ADD_ER_BAL[0]	ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert) für Injektor 1	X	X	X	X	-	-	-
5B81	81	MFF_ADD_ER_BAL[4]	ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert) für Injektor 2 (for 6cyl)	-	-	X	X	-	-	-
5B82	82	MFF_ADD_ER_BAL[2]	ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert) für Injektor 3(for 6cyl) ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert) für Injektor 4 (for 4cyl)	X	X	X	X	-	-	-
5B83	83	MFF_ADD_ER_BAL[5]	ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert) für Injektor 4 (for 6cyl)	-	-	X	X	-	-	-
5B84	84	MFF_ADD_ER_BAL[1]	ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert) für Injektor 5 (for 6cyl) ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert) für Injektor 3 (for 4cyl)	X	X	X	X	-	-	-
5B85	85	MFF_ADD_ER_BAL[3]	ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert) für Injektor 6 (for 6cyl) ER_MFF_additiv im LL-Schicht (momentan eingerechnetr Wert) für Injektor 2 (for 4cyl)	X	X	X	X	-	-	-
5B86	86			-	-	-	-	-	-	-
5B87	87			-	-	-	-	-	-	-
5B88	88			-	-	-	-	-	-	-
5B89	89			-	-	-	-	-	-	-
5B8A	8A			-	-	-	-	-	-	-
5B8B	8B			-	-	-	-	-	-	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5B8C	8C			-	-	-	-	-	-	-
5B8D	8D			-	-	-	-	-	-	-
5B8E	8E			-	-	-	-	-	-	-
5B8F	8F			-	-	-	-	-	-	-
5B90	90	FAC_TI_AD_ER_BAL[0]	ER-Adaptionsfaktor in Schicht Teillast für Injektor 1	X	X	X	X	-	-	-
5B91	91	FAC_TI_AD_ER_BAL[4]	ER-Adaptionsfaktor in Schicht Teillast für Injektor 2 (for 6cyl)	-	-	X	X	-	-	-
5B92	92	FAC_TI_AD_ER_BAL[2]	ER-Adaptionsfaktor in Schicht Teillast für Injektor 3 (for 6cyl) ER-Adaptionsfaktor in Schicht Teillast für Injektor 4 (for 4cyl)	X	X	X	X	-	-	-
5B93	93	FAC_TI_AD_ER_BAL[5]	ER-Adaptionsfaktor in Schicht Teillast für Injektor 4(for 6cyl)	-	-	X	X	-	-	-
5B94	94	FAC_TI_AD_ER_BAL[1]	ER-Adaptionsfaktor in Schicht Teillast für Injektor 5 (for 6cyl) ER-Adaptionsfaktor in Schicht Teillast für Injektor 3 (for 4cyl)	X	X	X	X	-	-	-
5B95	95	FAC_TI_AD_ER_BAL[3]	ER-Adaptionsfaktor in Schicht Teillast für Injektor 6 (for 6cyl) ER-Adaptionsfaktor in Schicht Teillast für Injektor 2 (for 4cyl)	X	X	X	X	-	-	-
5B96	96			-	-	-	-	-	-	-
5B97	97			-	-	-	-	-	-	-
5B98	98			-	-	-	-	-	-	-
5B99	99			-	-	-	-	-	-	-
5B9A	9A			-	-	-	-	-	-	-
5B9B	9B			-	-	-	-	-	-	-
5B9C	9C			-	-	-	-	-	-	-
5B9D	9D			-	-	-	-	-	-	-
5B9E	9E			-	-	-	-	-	-	-
5B9F	9F			-	-	-	-	-	-	-
5BA0	A0	FAC_TI_ER_BAL[0]	ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 1	X	X	X	X	-	-	-
5BA1	A1	FAC_TI_ER_BAL[4]	ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 2 (for 6cyl)	-	-	X	X	-	-	-
5BA2	A2	FAC_TI_ER_BAL[2]	ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 3 (for 6cyl) ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 4 (for 4cyl N43)	X	X	X	X	-	-	-
5BA3	A3	FAC_TI_ER_BAL[5]	ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 4(for 6cyl)	-	-	X	X	-	-	-
5BA4	A4	FAC_TI_ER_BAL[1]	ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 5(for 6cyl)	X	X	X	X	-	-	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
			ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 3 (for 4cyl)							
5BA5	A5	FAC_TI_ER_BAL[3]	ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 6 (for 6cyl) ER-Faktor in Schicht Teillast momentan eingerechnet für Injektor 2 (for 4cyl)	X	X	X	X	-	-	-
5BA6	A6			-	-	-	-	-	-	-
5BA7	A7			-	-	-	-	-	-	-
5BA8	A8			-	-	-	-	-	-	-
5BA9	A9			-	-	-	-	-	-	-
5BAA	AA			-	-	-	-	-	-	-
5BAB	AB			-	-	-	-	-	-	-
5BAC	AC			-	-	-	-	-	-	-
5BAD	AD			-	-	-	-	-	-	-
5BAE	AE			-	-	-	-	-	-	-
5BAF	AF			-	-	-	-	-	-	-
5BB0	B0	LV_CYL_BAL_LAM_AD_EOL	Lambdaadaption am Bandende hat fertig gelernt	X	X	X	X	-	-	-
5BB1	B1	LV_CYL_BAL_ER_AD_ADD_EOL	ER-Balancing am Bandende hat additiv adaptiert	X	X	X	X	-	-	-
5BB2	B2	LV_CYL_BAL_LAM_AD_DC	Lambdaadaption ist nötig, zyklisch während Motorbetrieb zu 1 gesetzt	X	X	X	X	-	-	-
5BB3	B3	LV_CYL_BAL_ER_AD_FAC_EOL	ER-Balancing am Bandende hat den Faktor adaptiert	X	X	X	X	-	-	-
5BB4	B4	LV_CYL_BAL_AD_HOM_REQ_DC	Zylindersel. Lambdaregelung fordert homogen an, zyklisch während dem Motorbetrieb zu 1 gesetzt	X	X	X	X	-	-	-
5BB5	B5	LV_CYL_BAL_LAM_SEL_AD_COLD_EOL	Zylindersel. Lambdaregelung kalt am Bandende hat fertig adaptiert	X	X	X	X	-	-	-
5BB6	B6	LV_CYL_BAL_LAM_SEL_AD_HOT_EOL	Zylindersel. Lambdaregelung warm am Bandende hat fertig adaptiert	X	X	X	X	-	-	-
5BB7	B7	LV_CYL_BAL_LAM_SEL_AD_HOT_DC	Zylindersel. Lambdaregelung warm ist nötig, zyklisch während Motorbetrieb zu 1 gesetzt	X	X	X	X	-	-	-
5BB8	B8	LV_CYL_BAL_AD_WG_OPEN_REQ[1]	Zylindersel. Lambdaregelung fordert öffne WG an, zyklisch während dem Motorbetrieb zu 1 gesetzt	X	X	X	X	-	-	-
5BB9	B9	LV_CYL_BAL_AD_WG_OPEN_REQ[2]	Zylindersel. Lambdaregelung fordert öffnen WG2 an, zyklisch während dem Motorbetrieb zu 1 gesetzt	X	X	X	X	-	-	-
5BBA	BA	Rt_bastatg_h	Relative Zeit Homogen-Betrieb gesamter Motorlauf	X	X	X	X	-	-	-
5BBB	BB	Rt_bastatg_hs	Relative Zeit Homogen-Schicht-Betrieb gesamter Motorlauf	X	X	X	X	-	-	-
5BBC	BC	Rt_bastatg_s	Relative Zeit Schicht-Betrieb gesamter Motorlauf	X	X	X	X	-	-	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5BBD	BD	Rt_bastatg_sa	Relative Zeit Homogen-Betrieb gesamter Motorlauf	X	X	X	X	-	-	-
5BBE	BE	LF_ERR_PLAUS_IV_EGY_CAL	cylinder individuell bit coded not plausible injector valve coding values "Energie" (1 - not plausible, 0 - plausible)	X	X	X	X	X	X	X
5BBF	BF	LF_ERR_PLAUS_IV_MFF_CAL	cylinder individuell bit coded not plausible injector valve coding values "Kleinmenge" (1 - not plausible, 0 - plausible)	X	X	X	X	X	X	X
5BC0	C0			-	-	-	-	-	-	-
5BC1	C1			-	-	-	-	-	-	-
5BC2	C2			-	-	-	-	-	-	-
5BC3	C3			-	-	-	-	-	-	-
5BC4	C4			-	-	-	-	-	-	-
5BC5	C5			-	-	-	-	-	-	-
5BC6	C6			-	-	-	-	-	-	-
5BC7	C7			-	-	-	-	-	-	-
5BC8	C8			-	-	-	-	-	-	-
5BC9	C9			-	-	-	-	-	-	-
5BCA	CA	FAC_LAM_TCO_A[1]	Lambda-Teillastadaption Bank 1 im Kühlmitteltemperaturmesspunkt A	X	X	X	X	X	X	X
5BCB	CB	FAC_LAM_TCO_A[2]	Lambda-Teillastadaption Bank 2 im Kühlmitteltemperaturmesspunkt A	X	X	X	X	X	X	X
5BCC	CC	FAC_LAM_TCO_B[1]	Lambda-Teillastadaption Bank 1 im Kühlmitteltemperaturmesspunkt B	X	X	X	X	X	X	X
5BCD	CD	FAC_LAM_TCO_B[2]	Lambda-Teillastadaption Bank 2 im Kühlmitteltemperaturmesspunkt B	X	X	X	X	X	X	X
5BCE	CE	FAC_LAM_TCO_C[1]	Lambda-Teillastadaption Bank 1 im Kühlmitteltemperaturmesspunkt C	X	X	X	X	X	X	X
5BCF	CF	FAC_LAM_TCO_C[2]	Lambda-Teillastadaption Bank 2 im Kühlmitteltemperaturmesspunkt C	X	X	X	X	X	X	X
5BD0	D0	FAC_LAM_TCO_D[1]	Lambda-Teillastadaption Bank 1 im Kühlmitteltemperaturmesspunkt D	X	X	X	X	X	X	X
5BD1	D1	FAC_LAM_TCO_D[2]	Lambda-Teillastadaption Bank 2 im Kühlmitteltemperaturmesspunkt D	X	X	X	X	X	X	X
5BD2	D2	FAC_LAM_TCO_E[1]	Lambda-Teillastadaption Bank 1 im Kühlmitteltemperaturmesspunkt E	X	X	X	X	X	X	X
5BD3	D3	FAC_LAM_TCO_E[2]	Lambda-Teillastadaption Bank 2 im Kühlmitteltemperaturmesspunkt E	X	X	X	X	X	X	X
5BD4	D4			-	-	-	-	-	-	-
5BD5	D5			-	-	-	-	-	-	-
5BD6	D6			-	-	-	-	-	-	-
5BD7	D7			-	-	-	-	-	-	-
5BD8	D8			-	-	-	-	-	-	-
5BD9	D9			-	-	-	-	-	-	-
5BDA	DA			-	-	-	-	-	-	-
5BDB	D			-	-	-	-	-	-	-

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
	B									
5BDC	DC			-	-	-	-	-	-	-
5BDD	DD			-	-	-	-	-	-	-
5BDE	DE			-	-	-	-	-	-	-
5BDF	DF			-	-	-	-	-	-	-
5BE0	E0	FAC_LAM_CYL_SEL_ADJ_H_RNG[0]	CILC-Adaptionswert warm High-Range Injektor 1	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_H_ER_BAL_HOM[0]	Extended high range correction factor adaptation value for cylinder balancing homogenous, logical injektor 1	-	-	-	-	X	X	X
5BE1	E1	FAC_LAM_CYL_SEL_ADJ_H_RNG[4]	CILC-Adaptionswert warm High-Range Injektor 2 (for 6cyl) CILC-Adaptionswert warm High-Range Injektor 6 (for 8cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_H_ER_BAL_HOM[1]	Extended high range correction factor adaptation value for cylinder balancing homogenous, logical injector 2	-	-	-	-	X	X	X
5BE2	E2	FAC_LAM_CYL_SEL_ADJ_H_RNG[2]	CILC-Adaptionswert warm High-Range Injektor 3 (for 6cyl) CILC-Adaptionswert warm High-Range Injektor 4 (for 4cyl and 8cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_H_ER_BAL_HOM[2]	Extended high range correction factor adaptation value for cylinder balancing homogenous, logical injector 3	-	-	-	-	X	X	X
5BE3	E3	FAC_LAM_CYL_SEL_ADJ_H_RNG[5]	CILC-Adaptionswert warm High-Range Injektor 4 (for 6cyl) CILC-Adaptionswert warm High-Range Injektor 3 (for 8cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_H_ER_BAL_HOM[3]	Extended high range correction factor adaptation value for cylinder balancing homogenous, logical injector 4	-	-	-	-	X	X	X
5BE4	E4	FAC_LAM_CYL_SEL_ADJ_H_RNG[1]	CILC-Adaptionswert warm High-Range Injektor 5 (for 6cyl and 8cyl) CILC-Adaptionswert warm High-Range Injektor 3 (for 4cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_H_ER_BAL_HOM[4]	Extended high range correction factor adaptation value for cylinder balancing homogenous, logical injector 5	-	-	-	-	X	X	X

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
5BE5	E5	FAC_LAM_CYL_SEL_ADJ_H_RNG[3]	CILC-Adaptionswert warm High-Range Injektor 6 (for 6cyl) CILC-Adaptionswert warm High-Range Injektor 2 (for 4cyl) CILC-Adaptionswert warm High-Range Injektor 8 (for 8cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_H_ER_BAL_HOM [5]	Extended high range correction factor adaptation value for cylinder balancing homogenous, logical injector 6	-	-	-	-	X	X	X
5BE6	E6	FAC_COR_AD_RNG_H_ER_BAL_HOM [6]	Extended high range correction factor adaptation value for cylinder balancing homogenous, logical injector 7	-	-	-	-	X	X	X
5BE7	E7	FAC_COR_AD_RNG_H_ER_BAL_HOM [7]	Extended high range correction factor adaptation value for cylinder balancing homogenous, logical injector 8	-	-	-	-	X	X	X
5BE8	E8			-	-	-	-	-	-	-
5BE9	E9			-	-	-	-	-	-	-
5BEA	EA			-	-	-	-	-	-	-
5BEB	EB			-	-	-	-	-	-	-
5BEC	EC			-	-	-	-	-	-	-
5BED	ED			-	-	-	-	-	-	-
5BEE	EE			-	-	-	-	-	-	-
5BEF	EF			-	-	-	-	-	-	-
5BF0	F0	FAC_LAM_CYL_SEL_ADJ_L_RNG[0]	CILC-Adaptionswert warm Low-Range Injektor 1	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_L_ER_BAL_HOM [0]	Extended low range correction factor adaptation value for cylinder balancing homogenous, logical injektor 1	-	-	-	-	X	X	X
5BF1	F1	FAC_LAM_CYL_SEL_ADJ_L_RNG[4]	CILC-Adaptionswert warm Low-Range Injektor 2 (for 6cyl) CILC-Adaptionswert warm Low-Range Injektor 6 (for 8cyl)	-	-	X	X	-	-	-
		FAC_COR_AD_RNG_L_ER_BAL_HOM [1]	Extended low range correction factor adaptation value for cylinder balancing homogenous, logical injektor 2	-	-	-	-	X	X	X
5BF2	F2	FAC_LAM_CYL_SEL_ADJ_L_RNG[2]	CILC-Adaptionswert warm Low-Range Injektor 3 (for 6cyl) CILC-Adaptionswert warm Low-Range Injektor 4 (for 4cyl and 8cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_L_ER_BAL_HOM [2]	Extended low range correction factor adaptation value for cylinder balancing homogenous, logical	-	-	-	-	X	X	X

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ID long	ID	Label	Description	MSD80 (4cyl)	MSD81 (4cyl)	MSD80 (6cyl)	MSD81 (6cyl)	MSD85 -S63	MSD85 -E72	MSD85 (L4)
			injektor 3							
5BF3	F3	FAC_LAM_CYL_SEL_ADJ_L_RNG[5]	CILC-Adaptionswert warm Low-Range Injektor 4 (for 6cyl) CILC-Adaptionswert warm Low-Range Injektor 3 (for 8cyl)	-	-	X	X	-	-	-
		FAC_COR_AD_RNG_L_ER_BAL_HOM [3]	Extended low range correction factor adaptation value for cylinder balancing homogenous, logical injektor 4	-	-	-	-	X	X	X
5BF4	F4	FAC_LAM_CYL_SEL_ADJ_L_RNG[1]	CILC-Adaptionswert warm Low-Range Injektor 5 (for 6cyl and 8cyl) CILC-Adaptionswert warm Low-Range Injektor 3 (for 4cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_L_ER_BAL_HOM [4]	Extended low range correction factor adaptation value for cylinder balancing homogenous, logical injektor 5	-	-	-	-	X	X	X
5BF5	F5	FAC_LAM_CYL_SEL_ADJ_L_RNG[3]	CILC-Adaptionswert warm Low-Range Injektor 6 (for 6cyl) CILC-Adaptionswert warm Low-Range Injektor 2 (for 4cyl) CILC-Adaptionswert warm Low-Range Injektor 8 (for 8cyl)	X	X	X	X	-	-	-
		FAC_COR_AD_RNG_L_ER_BAL_HOM [5]	Extended low range correction factor adaptation value for cylinder balancing homogenous, logical injektor 6	-	-	-	-	X	X	X
5BF6	F6	FAC_COR_AD_RNG_L_ER_BAL_HOM [6]	Extended low range correction factor adaptation value for cylinder balancing homogenous, logical injektor 7	-	-	-	-	X	X	X
5BF7	F7	FAC_COR_AD_RNG_L_ER_BAL_HOM [7]	Extended low range correction factor adaptation value for cylinder balancing homogenous, logical injektor 8	-	-	-	-	X	X	X
5BF8	F8			-	-	-	-	-	-	-
5BF9	F9			-	-	-	-	-	-	-
5BFA	FA			-	-	-	-	-	-	-
5BFB	FB			-	-	-	-	-	-	-
5BFC	FC			-	-	-	-	-	-	-
5BFD	FD			-	-	-	-	-	-	-
5BFE	FE			-	-	-	-	-	-	-
5BFF	FF			-	-	-	-	-	-	-
				-	-	-	-	-	-	-

I.5.6.3 Further manual definable DDLI- List (not for ERRM)

In the dataset one more DDLI- list is implemented. In this list further variables for DDLI- read can be inserted without a software change. The insertion must be done with help of a hex editior. It is necessary to get the start address of the table DDLI_table_cal from the map- file, open the dataset (*.s19- file) and edit it from the start address on. In the hex- file is always the same character string behind the table identifier. It contains the following information:

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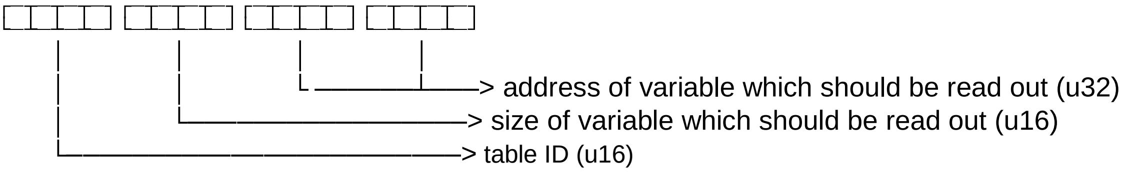

On third position (byte 5 - 8) you have to insert the address of the wanted variable. The address can be taken from the map- file of the corresponding software and must be changed at every software change, too. On second position the correct size of the variable has to be inserted (e.g. 8 for a byte- variable).

5Fxx	**DDLI- List in dataset for auxiliary variables**		
5FE0	E0	nn	nn
5FE1	E1	nn	nn
5FE2	E2	nn	nn
5FE3	E3	nn	nn
5FE4	E4	nn	nn
5FE5	E5	nn	nn
5FE6	E6	nn	nn
5FE7	E7	nn	nn
5FE8	E8	nn	nn
5FE9	E9	nn	nn
5FEA	EA	nn	nn
5FEB	EB	nn	nn
5FEC	EC	nn	nn
5FED	ED	nn	nn
5FEE	EE	nn	nn
5FEF	EF	nn	nn
5FF0	F0	nn	nn
5FF1	F1	nn	nn
5FF2	F2	nn	nn
5FF3	F3	nn	nn
5FF4	F4	nn	nn
5FF5	F5	nn	nn
5FF6	F6	nn	nn
5FF7	F7	nn	nn
5FF8	F8	nn	nn
5FF9	F9	nn	nn
5FFA	FA	nn	nn
5FFB	FB	nn	nn
5FFC	FC	nn	nn
5FFD	FD	nn	nn
5FFE	FE	nn	nn
5FFF	FF	nn	nn

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I.6 KWP2000 - SID 10h: startDiagnosticSession Service

Input data:

LV_IGK {p. 906}			

General information:

This function is the first function when a diagnostic session starts.
Changing the diagnostic mode or switch over to another baudrate is possible after the command stop or reset KWP2000 inactive mode is set.

StartDiagnosticSession Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startDiagnosticSessionRequest Service Id**	**M**	**#10h**	**STDS**
#2d	diagnosticMode= [Stdandard Diag.Mode Periodic Transmission Mode ECU Programming Mode Development Mode safty mode]	M	#XXh= [#81h #82h #85h #86h #89h]	DCM
#3d	baudrateIdentifier (#XXh) = [9600 Baud 19200 Baud 38400 Baud 57600 Baud 115200 Baud (113636 Baud) (*) by tester]	C	#XXh= [#01h #02h #03h #04h #05h #06h]	BI
#4d	Baud rate high byte (if baudrateidentifier = 6)	C	#XXh	#XX
#5d	Baud rate middle byte (if baudrateidentifier = 6)	C	#XXh	#XX
#6d	Baud rate low byte (if baudrateidentifier = 6)	C	#XXh	#XX

Figure I.6.1: Table startDiagnosticSession Request Message

(*) : With the MPC555 controller and a frequency of 40 MHz it is not possible to generate 115200baud with the desired tolerance range of -+1%.
The baudrate, which can be generated exactly by MPC555 and 40MHz, is 113636Baud.

1. Is the current DiagnosticSession different from StandardDiagnosticSession, it is not possible to get a positive response with the request stopCommunication. To stop the communication the ECU has to be turned back in the StandardDiagnosticSession with stopDiagnosticSession (SPDS) or the startDiagnosticSession (STDS [DCM #81h]) request.
2. Is the startDiagnosticSession request used without a baudrateMode or is the current request answered by negative response, the last selected baudrate and mode are still active.

StartDiagnosticSession positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**startDiagnosticSession Positive response**	**M**	**#50h**	**STDSPR**
#2d	diagnosticMode= [Std.Diagnostic Mode Periodic Transmission Mode ECU Programming Mode Development mode safty mode]	M	#XXh= [#81h #82h #85h #86h #89h]	DCM
#3d	BaudrateIdentifier (#XXh) = [f_{CPU} =16MHz f_{CPU} =20 MHz f_{CPU} =24 MHz 9600 Baud + 0,2% + 0,2% + 0,2% 19200 Baud + 0,2% + 1,7% + 0,2% 38400 Baud + 0,2% + 1,7% + 2,8% 57600 Baud + 8,5% + 8,5% + 0,2% 115200 Baud + 8,5% + 8,5% + 8,5% by tester]	C	#XXh= [#01h #02h #03h #04h #05h #06h]	BI
#4d	Baud rate high byte	C	#XXh	#XX
#5d	Baud rate middle byte	C	#XXh	#XX
#6d	Baud rate low byte	C	#XXh	#XX

Figure I.6.2: Table startDiagnosticSession Positive Response Message

StartDiagnosticSession negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	startDiagnosticSessionRequest Service Id	M	#10h	STDS
#3d	responseCode= [conditionsNotCorrect, requestOutOfRange, wrong baud rate]	M	#XXh= [#22h, #31h,]	RC

Figure I.6.3: Table startDiagnosticSession Negative Response Message

NegativeResponseCode	Cause of Occurrence
conditionsNotCorrect	selected diagnosticMode is not supported
requestOutOfRange	selected baudrate is not supported

Message flow Diagnostic Session

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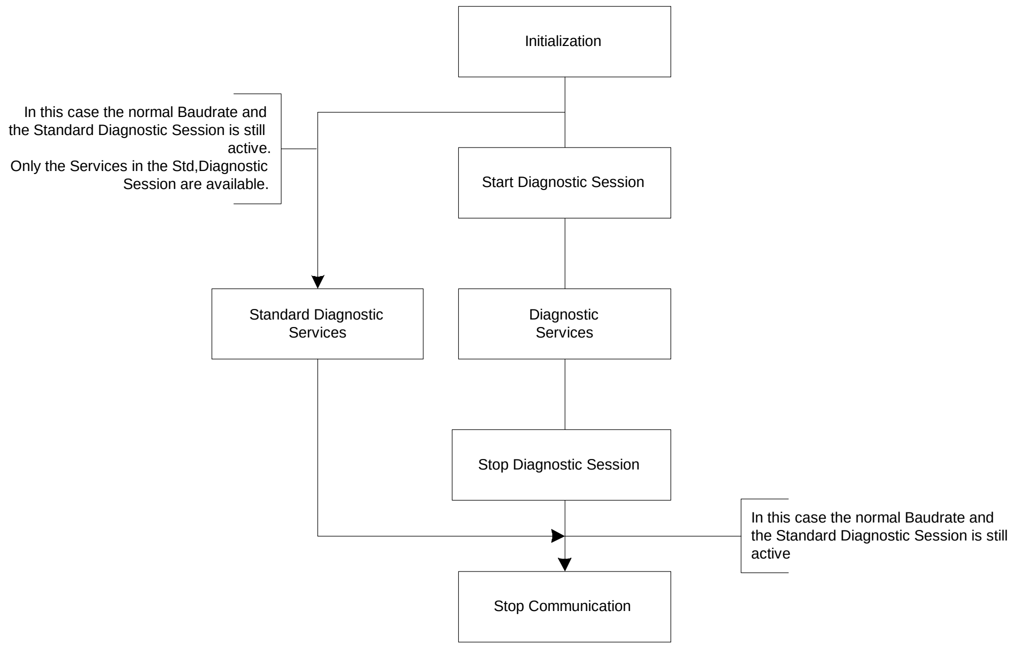

StartDiagnosticSession (Periodic Transmission mode #82h)
Is only supported for KWP

KWP2000 Periodic Transmission Mode Message Flow
This section specifies the conditions to enable the ***Periodic Transmission*** mode ($82) in the client (tester) and the server (ECU).
It also specifies the use of the service ***accessTimingParameter*** within this mode to modify the ***PeriodicTransmission mode*** default timing.

Periodic Transmission Mode Message Flow

time	*Client (tester) Request Message*	*Hex*
	startCommunication Request Service ID	**#81h**

time	*Server (ECU) PosResponse Message #2*	*Hex*
P2	**startCommunication PosRspSId** [Key byte 1 Key byte 2]	**#C1h** #XXh #XXh
	goto STEP#1 or STEP#2	

STEP#1 dynamicallyDefineLocalIdentifier Request Service() (optinal)

time	*Client (tester) Request Message*	*Hex*
P3*	**dynamicallyDefineLocalIdentifier Request Service ID** [possible parameter see service description] *define the DDLI #F0h*	**#2Ch** #XXh

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time	Server (ECU) PosResponse Message #2	Hex
P2	**dynamicallyDefineLocalIdentifier PosRspSId=** [...]	**#C3h** #XXh
	goto STEP#2	

Server (ECU) NegResponse Message	Hex
negRespSId **dynamicallyDefineLocalIdentifier ReqSId** [responseCode { see service description]]	**#7Fh** **#2Ch** #XXh

:
:

STEP#2 startDiagnosticSession(DM_PeriodicTransmission)

time	Client (tester) Request Message	Hex
P3	**startDiagnosticSession Request Service ID=** [diagnosticMode = PeriodicTransmission SDMWPT]	**#10h** #82h

time	Server (ECU) PosResponse Message #1	Hex
P2	**startDiagnosticSession PosRspSId=** [**diagnosticMode = SDMWPT** PeriodicTransmission Mode]	**#50h** #82h

Server (ECU) NegResponse Message	Hex
negResponseSId **startDiagnosticSession ReqSId=** [responseCode { see service description]]	**#7Fh** **#21h** #XXh

*** **PeriodicTransmission mode** with default timing enabled ***

time	Server (ECU) PosResponse Message #2	Hex
P2	**startDiagnosticSession PosRspSId=** [diagnosticMode = SDMWPT]	**#50h** #82h

:

time	Server (ECU) PosResponse Message #n	Hex
P2	**startDiagnosticSession PosRspSId=** [diagnosticMode = SDMWPT]	**#50h** #82h
	goto STEP#2 or STEP #3	

:

STEP#2 accessTimingParameters(readLimitsOfPossibleValues) (optional)

time	Client (tester) Request Message	Hex
P3*	**accessTimingParameters Request Service ID =** [TPI = readLimitsOfPossibleValues]	**#83h** #00h

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time	Server (ECU) PosResponse Message #1	Hex
P2	**accessTimingParameters PosRspSId=** [...]	**#C3h** #XXh
	goto STEP#3 or to STEP#4	

Server (ECU) NegResponse Message	Hex
negRespSId **accessTimingParameters ReqSId=** [responseCode { see service description]]	**#7Fh** **#83h** #XXh

: :

time	Server (ECU) PosResponse Message #n	Hex
P2	**accessTimingParameters PosRspSId=** [...]	**#C3h** #XXh
	goto STEP#3 or to STEP#4	

: :

STEP#3 accessTimingParameters(setParameters) (optional)

time	Client (tester) Request Message	Hex
P3*	**accessTimingParameters Request Service ID =** [TPI = setParameters ....:]	**#83h** #03h #XXh

time	Server (ECU) PosResponse Message #1	Hex
P2	**accessTimingParameters PosRspSId=** [TPI = setParameters]	**#C3h** #03h
	goto STEP#5	

Server (ECU) NegResponse Message	Hex
negRespSId **accessTimingParameters ReqSId** [responseCode { see service description]]	**#7Fh** **#83h** #XXh

*** **modified** standardDiagnosticMode timing parameter active ***

: :

time	Server (ECU) PosResponse Message #n	Hex
P2	**accessTimingParameters PosRspSId=** [TPI = setParameters]	**#C3h** #03h
	goto STEP#4	

STEP#4 periodic transmission diagnostic service s(possible services refer to chapter)

time	Client (tester) Request Message	Hex
P3*	**periodic transmission diagnostic service**	**#XXh**

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time	Server (ECU) PosResponse Message #1	Hex
P2	**periodic transmission diagnostic service PosRspSId=** [record values]	**#XXh** ...
	to STEP#5	

Server (ECU) NegResponse Message	Hex
negRespSId **periodic transmission diagnostic service** [responseCode { see service description }]	**#7Fh** **#XXh** #XXh

: :

time	Server (ECU) PosResponse Message #1	Hex
P2	**periodic transmission diagnostic service PosRspSId=** [record values]	**#XXh** ...
	to STEP#5	

: :

STEP#5 stopDiagnosticSession(DM_PeriodicTransmission)

time	Client (tester) Request Message	Hex
P3	**stopDiagnosticSession Requset Service Id**	**#20h**

time	Server (ECU) PosResponse Message #1	Hex
P2	**stopDiagnosticSession PosRspSId**	**#60h**
	to STEP#6	

Server (ECU) NegResponse Message	Hex
negRespSId **stopDiagnosticSession.ReqSId=** [responseCode { see service description }]	**#7Fh** **#20h** #XXh

*** ***standardDiagnosticModeWithPeriodicTransmission*** disabled ***
default diagnostic session enabled and normal timing default values active

STEP#6 stopCommunication

time	Client (tester) Request Message	Hex
P3*	**stopCommunication Requst Service Id**	**#82h**

time	Server (ECU) PosResponse Message	Hex
P2	**stopCommunication PosRspSId**	**#C2h**

Server (ECU) NegResponse Message	Hex
negativeResponse Service Identifier **stopCommunication.ReqSId=** [responseCode { see service description }]	**#7Fh** **#82h** #XXh

Possible Periodic Transmission Services

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Possible services in the Periodic Transmission mode	***Mnemonic***	***SID***	***Description***
ReadDataByLocalIdentifier	RDBLI	#21h	Read of previous defined „dynamically defined local id“ (#F0h) or snapshot information.
ReadMemoryByAdress	RMBA	#23h	Read of memory contents
ReadStatusOfDiagnosticTroubleCodes	RSODTC	#17h	Read all Diagnostic Trounble Codes
ReadDiagnosticTroubleCodesByStatus	RDTCBS	#18h	Read one Diagnostic Trounble Codes with System Supplier Data
TesterPresent	TP	#3Eh	Tester Present without contents

NOTE: In case the Tester has defined a DynamicallyDefinedLocal ID (#F0h) all other services in the periodic transmission mode are blocked except the ReadDataByLocalID (#F0). With the service DDLI (sub identifier clear DDLI) in the Standart Diagnostic Mode the Tester can release all other services for the periodic transmission mode again.

Periodic Transmission Message Flow Examples

NOTE: In the column Activity markes with the black row the Tester request messages and with the shaded row the ECU responses.

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Periodic Transmission with ATP and 3 Byte Header

Time in ms	*Hex values*	*Mnemonic*	*Activity*
49.2	81.		
5.1	11		
5.1	F1		
5.1	81	STC	
5.1	04		
28.5	83		
0.0	F1		
0.0	11		
0.0	C1	STC_PR	
0.0	EF		
0.0	8F		
0.0	C4		
194.9	82		
5.1	11		
5.1	F1		
5.1	10	STDS	
5.1	82		
5.1	16		
24.7	82		
0.0	F1		
0.0	11		
0.0	50	STDS_PR	
0.0	82		
0.0	56		
14.0	82		
5.1	11		
5.1	F1		
5.1	83	ATP	
5.1	00		
5.1	07		
29.1	89		
0.0	F1		
0.0	11		
0.0	C3	ATP_PR	
0.0	00		
0.0	08		
0.0	01		
0.0	00		
0.0	14		
0.0	00		
0.0	69		
29.5	87		
0.0	F1		
0.0	11		
0.0	C3	ATP_PR	
0.0	00		
0.0	08		
0.0	01		
0.0	00		
0.0	14		
0.0	00		
0.0	69		
:			:

Figure I.6.4: Periodic Transmission with DDLI and 1 Byte Header

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Periodic Transmission with DDLI and 1 Byte Header

Time in ms	Hex values	Mnemonic	Activity
49.2	01		
5.1	81	STC	
5.1	82		
27.0	03		
0.0	C1	STC_PR	
0.0	EF		
0.0	8F		
0.0	42		
192.9	08		
5.1	2C	DDLI	
5.1	F0		
5.1	03		
5.1	01		
5.1	01		
5.1	00		
5.1	00		
5.1	00		
5.1	29		
27.0	02		
0.0	6C	DDLI_PR	
0.0	F0		
0.0	5E		
118.4	02		
5.1	10	STDS	
5.1	82		
5.1	94		
28.8	02		
0.0	50	STDS_PR #1	
0.0	82		
0.0	D4		
:			:
26.0	02		
0.0	50	STDS_PR #n	
0.0	82		
0.0	D4		
:			:

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Time in ms	Hex value	Mnemonic	Activity
:			:
5.1	11		
5.1	F1		
5.1	83	ATP	
5.1	03		
5.1	08		
5.1	01		
5.1	00		
5.1	14		
5.1	00		
5.1	2C		
32.5	82		
0.0	F1		
0.0	11		
0.0	C3	ATP_PR #1	
0.0	03		
0.0	4A		
:			:
4.0	82		
0.0	F1		
0.0	11		
0.0	C3	ATP_PR #n	
0.0	03		
0.0	4A		
1.0	82		
0.2	11		
0.2	F1		
0.2	83	ATP	
0.2	01		
0.2	08		
6.4	82		
0.0	F1		
0.0	11		
0.0	C3	ATP_PR #1	
0.0	01		
0.0	48		
34.3	82		
0.0	F1		
0.0	11		
0.0	C3	ATP_PR #2	
0.0	01		
0.0	48		
:			:

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Time in ms	Hex value	Mnemonic	Activity
:			:
14,4	02		
5,1	21	RDBLI	
5,1	F0		
5.1	13		
32.8	03		
0.0	61	RDBLI_PR #1	
0.0	F0		
0.0	FA		
0.0	4E		
25.0	03		
0.0	61	RDBLI_PR #2	
0.0	F0		
0.0	FB		
0.0	4F		
:			:
25.4	03		
0.0	61	RDBLI_PR #n	
0.0	F0		
0.0	FC		
0.0	50		
6.0	01		
5.1	20	SPDS	
5.1	21		
26.1	01		
0.0	60	SPDS_PR	
0.0	61		
88.9	01		
5.1	82	SPC	
5.1	83		
25.3	01		
0.0	C2	SPC_PR	
0.0	C3		

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I.7 KWP2000 - SID 17h: readStatusOfDTC Service

Input data:

CTR_ERR_DYN_NR {p. 5767}	CTR_FRC [NC_NR_ERR_DYN] {p. 5767}	CTR_WUP_CYC [NC_NR_ERR_DYN] {p. 5767}	ENVD_CUS_SET_CMN [NC_NR_ENVD_CUS_SET_CMN][NC_NR_FRF_SET][NC_NR_ERR_DYN] {p. 5792}
ENVD_CUS_SET_SPC [NC_NR_ENVD_CUS_SET_SPC][NC_NR_FRF_SET][NC_NR_ERR_DYN] {p. 5792}	ERR_DTC [NC_NR_ERR_DYN] {p. 5756}	ERR_TYPE_BYTE [NC_NR_ERR_DYN] {p. 5744}	ERR_TYPE_EXT_BYTE [NC_NR_ERR_DYN] {p. 5744}
LV_IGK {p. 906}			

I.7.1 17h - Read Error Memory long version - ReadStatusOfDiagnosticTroubleCodes service

General information:

This function allows to read out the numbers of CDK s , list of CDK s, the CDK status and the index of the environmental values. The index [x] represents the actual requested CDK (customer diagnostic key).

Application conditions

Initialisation: at reset

Activation: LV_IGK = 1

Deactivation: LV_IGK = 0
Diagnostic timeout
Service location: ECU-SW

Formula section:

IF ERR_DTC[x] =0000h **or**
ERR_DTC[x] =FFFFh
THEN RESPONSE=NEGATIVE RESPONSE
ELSE RESPONSE=POSITIVE RESPONSE

readStatusOfDTC Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**ReadStatusOfDiagnosticTroubleCodes Request SId**	**M**	**#17h**	**RSODTC**
  #2d #3d	DiagnosticTroubleCode [CDK HighByte CDK LowByte]	 M M	#XXh,#XXh= [#00h - #39h #01h - #99h]	GODTC

Figure I.7.1: Table ReadStatusOfDiagnosticTroubleCodes Request Message

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readStatusOfDTC positive Response

Data Byte	Parameter Name		Cvt	Hex Value	Mnemonic
#1d	**ReadStatusOfDiagnosticTroubleCodes Pos. Response SId**		**M**	**#57h**	**RSODTCPR**
#2d	numberOfDTC	CTR_ERR_DYN_NR	M	#XXh	NRODTC
	listOfDTCAndStatus=				LODTCAS
	[			[	
#3d	Error code CDK (high byte)	ERR_DTC[x]	M	#XXh	
#4d	Error code CDK (low byte)	ERR_DTC[x]	M	#XXh	
#5d	statusOfDTC	ERR_TYPE_BYTE[x]	M	#XXh	
#6d	extended StatusOfDTC	ERR_TYPE_EXT_BYTE[x]	M	#XXh	
#7d	P - code DTC (high byte)	ACTION_ERRM_ReadDTCLevelByDTCLevel	M	#XXh	
#8d	P - code DTC (low byte)	ACTION_ERRM_ReadDTCLevelByDTCLevel	M	#XXh	
#9d	frequency counter	CTR_FRC[x]	M	#XXh	
#10d	warmup counter	CTR_WUP_CYC[x]	M	#XXh	
#11d	km value by first occur (high byte)	ENVD_CUS_SET_CMN[2][1]	M	#XXh	
#12d	km value by first occur (low byte)	ENVD_CUS_SET_CMN[3][1]	M	#XXh	
#13d	1 environmental value first occur	ENVD_CUS_SET_SPC[1][1]	M	#XXh	
#14d	2 environmental value first occur	ENVD_CUS_SET_SPC[2][1]	M	#XXh	
#15d	3 environmental value first occur	ENVD_CUS_SET_SPC[3][1]	M	#XXh	
#16d	4 environmental value first occur	ENVD_CUS_SET_SPC[4][1]	M	#XXh	
#17d	km value by second occur (high byte)	ENVD_CUS_SET_CMN[2][2]	M	#XXh	
#18d	km value by second occur (low byte)	ENVD_CUS_SET_CMN[3][2]	M	#XXh	
#19d	1 environmental value second occur	ENVD_CUS_SET_SPC[1][2]	M	#XXh	
#20d	2 environmental value second occur	ENVD_CUS_SET_SPC[2][2]	M	#XXh	
#21d	3 environmental value second occur	ENVD_CUS_SET_SPC[3][2]	M	#XXh	
#22d	4 environmental value second occur	ENVD_CUS_SET_SPC[4][2]	M	#XXh	
#23d	km value by third occur (high byte)	ENVD_CUS_SET_CMN[2][3]	M	#XXh	
#24d	km value by third occur (low byte)	ENVD_CUS_SET_CMN[3][3]	M	#XXh	
#25d	1 environmental value third occur	ENVD_CUS_SET_SPC[1][3]	M	#XXh	
#26d	2 environmental value third occur	ENVD_CUS_SET_SPC[2][3]	M	#XXh	
#27d	3 environmental value third occur	ENVD_CUS_SET_SPC[3][3]	M	#XXh	
#28d	4 environmental value third occur	ENVD_CUS_SET_SPC[4][3]	M	#XXh	
	]			]	

Figure I.7.2: Table ReadStatusOfDiagnosticTroubleCodes Positive Response Message if the error is entered in error memory

Data Byte	Parameter Name		Cvt	Hex Value	Mnemonic
#1d	**ReadStatusOfDiagnosticTroubleCodes Pos. Response SId**		**M**	**#57h**	**RSODTCPR**
#2d	numberOfDTC	CTR_ERR_DYN_NR	M	#01h	NRODTC
	listOfDTCAndStatus=				LODTCAS
	[			[	
#3d	Error code CDK (high byte)		M	#XXh	
#4d	Error code CDK (low byte)		M	#XXh	
#5d	CDK not entered or not defined		M	#00h	
	]			]	

Table ReadStatusOfDiagnosticTroubleCodes Positive Response Message Message if the error is not entered in error memory

readStatusOfDTC negative Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**S**	**#7Fh**	**NR**
#2d	ReadStatusOfDiagnosticTroubleCodes Request SId	M	#17h	RSODTC
#3d	responseCode= [subFunctionNotSupported-invalidFormat, incorrectByteCountDuringBlockTransfer]	M	#XXh= [#12h, #79h]	RC

Figure I.7.3: Table ReadStatusOfDiagnosticTroubleCodes Negative Response Message

Request and Response (Example)

This table lists the possible responses depending on the requestByFunction or requestByDTC. The CDK values 0xFFFF & 0x0000 are reserved for special purposes(not yet defined now).

Tester Request	*ECU response*
CDK value = 0x0000 or 0xFFFF	• Negative response: Sub-Function Not Supported Or Invalid Format
CDK of a failure which is entered in dynamic layer	• Positive response • number of CDKs entered in fsp_sequ and with matching CDK, i.e. 1 • CDK high • CDK low • statusOfCDK • extended StatusOfDTC • frequency counter • warmup counter • ....
CDK which doesn't fall under any of the previous cases	• Positive Response • number of CDKs • CDK high • CDK low • CDK low • 0

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I.8 KWP2000 - SID 18h: readDTCByStatus Service

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_ERR_DYN_NR_OBD	V	0... FFH	0... 255	1	-
Number of failures stored in dynamic memory (2 nd layer) with error class >=10h					

Input data:

C_ERR_CLAS_XX {p. 5811}	CTR_ERR_DYN_NR {p. 5767}	ERR_DTC [NC_NR_ERR_DYN] {p. 5756}	ERR_TYPE_BYTE [NC_NR_ERR_DYN] {p. 5744}
LV_IGK {p. 906}	NC_NR_ERR_DYN {p. 5768}		

I.8.1 18h - read failure memory short - ReadDiagnosticTroubleCodesByStatus service

General information:

This function is to read out the numbers of faults in the error memory and the status of CDK (see also "Fault-type-byte and fault-type extension byte" (chapter OBDII functions)). Only failures with error class of >**= 10h** are considered.

Application conditions

Initialisation: `at reset`

Activation: `LV_IGK = 1`

Deactivation: `LV_IGK = 0`
`Diagnostic timeout`
Service location: see "list of implemented diagnostic services"

Formula section:

CTR_ERR_DYN_NR_OBD = CTR_ERR_DYN_NR - errors with C_ERR_CLAS_XX < 10h

Example:
CTR_ERR_DYN_NR = 3

1. *DIAG_INST[0] = TCO_EL* *C_ERR_CLAS_TCO_EL* *= 11H*
2. *DIAG_INST[1] = VS* *C_ERR_CLAS_VS* *= 5H*
3. *DIAG_INST[2] = CAT_DIAG_1* *C_ERR_CLAS_CAT_DIAG_1* *= 33H*

=> *CTR_ERR_DYN_NR_OBD = 3 - 1 =* ***2***

If C_ERR_CLAS_XX from error [NC_NR_ERR_DYN] is calibrated with >**= 10h**
Then error is considered for SID18
Else error is not considered for SID18
Endif

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ReadDiagnosticTroubleCodesByStatus Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**ReadDiagnosticTroubleCodesByStatus Request SId**	**M**	**#18h**	**RCDKBS**
#2d	statusOfCDK - If the value in the telegram is not 02h, a value "00H" is given out on the reading of memory long;	M	#02h	SOCDK
  #3d,#4d #3d,#4d	groupOfDiagnosticInformation (HighByte,LowByte) [Read CDK´s in all Group`s Read CDK´s only powertrain faults]	 M,M	#XXh,#XXh= [#FFh,#FFh #FFh,#FBh]	GOCDK

Figure I.8.1: Table ReadDiagnosticTroubleCodesByStatus Request Message

ReadDiagnosticTroubleCodesByStatus positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**ReadDiagnosticTroubleCodesByStatus Pos. Response SId**	**M**	**#58h**	**RCDKBSPR**
#2d	numberOfCDK - CTR_ERR_DYN_NR_OBD	M	#01h-#XXh	#NROCDK
  #3d #4d #5d #6d #7d #8d . . . #22d #23d #24d	ListOfCDKAndStatus= [CDK#0 high byte ERR_DTC[0] CDK#0 low byte ERR_DTC[0] statusOfCDK #1 ERR_TYPE_BYTE[0] CDK#1 high byte ERR_DTC[1] CDK#1 low byte ERR_DTC[1] statusOfCDK #2 ERR_TYPE_BYTE[1] . . . CDK#(NC_NR_ERR_DYN - 1) CDK#(NC_NR_ERR_DYN - 1) statusOfCDK #n ERR_TYPE_BYTE[NC_NR_ERR_DYN - 1]]	 C C C C C C . . . C C C	 [#XXh #XXh #XXh #XXh #XXh #XXh . . . #XXh #XXh #XXh]	LOCDKAS

Figure I.8.2: Table ReadDiagnosticTroubleCodesByStatus Positive Response Message

ReadDiagnosticTroubleCodesByStatus negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**S**	**#7Fh**	**NR**
#2d	ReadDiagnosticTroubleCodesByStatus Request SId	M	#18h	RCDKBS
#3d	responseCode= [subFunctionNotSupported-invalidFormat, requestOutOfRange, general response codes]	M	#XXh= [#12h, #31h, #XXh]	RC

Figure I.8.3: Table ReadDiagnosticTroubleCodesByStatus Negative Response Message

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I.9 KWP2000 - SID 1Ah: readECUIdentification Service

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ecu_type [16]	O	0	ASCII	1	-
first customer-spezific part of SiemensBootLogisticInformationField					
sample_details [16]	O	0	ASCII	1	-
second customer-spezific part of SiemensBootLogisticInformationField					
tester_control [16]	O	0	ASCII	1	-
third customer-spezific part of SiemensBootLogisticInformationField					

Input data:

C_IDX_COD_CONV {p. 4946}	LV_IGK {p. 906}	VIN_SHO [7] {p. 7541}	

General information:

This function reads out from the ECU specific logistic values.

Application conditions

Initialisation: `at reset`

Activation: `LV_IGK = 1`

Deactivation:
```
LV_IGK = 0
Diagnostic timeout
Service location:  see "list of implemented diagnostic services"
```

Formula section:

ReadEcuIdentification Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readEcuIdentification Request Service Id**	**M**	**#1Ah**	**REI**
#2d	identificationOption	M	#XXh	IO

Figure I.9.1: Table readEcuIdentification Request Message

ReadEcuIdentification positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readEcuIdentification Request Service Id**	**M**	**#5Ah**	**REI**
#2d	identificationOption	M	#XXh	IO
#3d	Data 1 for identification option	M	#XXh	
#3d + 1	Data 2 for identification option			
#3d + n	Data n for identification option	M	#XXh	

Figure I.9.2: Table ReadEcuIdentification Positive Response Message

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ReadEcuIdentification negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	readEcuIdentification Request Service Id	M	#1Ah	REI
#3d	responseCode= [general response code ECU ID not supported]	M	#XXh= [#XXh #12]	RC

Figure I.9.3: Table ReadEcuIdentification Negative Response Message

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I.9.1 Supported identification options

Identification Option nr.	SW name	Size / byte
ECUIDT 80 h Ecu Identification Data Table Info: 91h: VMECUHN only 1x output	Reading of the Identification options: 91h,9Ah,9Bh,9Ch,97h,9Dh,9Eh,9FH exactly in this order	Compare the single identification options
CUIFDT 86 h actual BMW user information field	bmw_uif	32 blocks a 64 byte
PECUHN 87 h BMW physical HW number	kwp_io_pecuhn	18
SSECUSEN 89 h systemSupplierECUSerialNumber	serial_number	9
CRSCOTSN 8A h Calib.RepairShopCodeOrTesterSerialNr	NC_KWP_IO_CRSCOTSN	10
CPD 8B h Calib.ProgrammingDate	NC_KWP_IO_CPD	4
SSBSN 8C h SubSystemBootSoftwareNumber	sub_sys_boot_sw_nr	12
SSESN 8D h SubSystemECUSoftwareNumber	sub_sys_ecu_sw_nr	12
SSCN 8E h SubSystemCalibrationNumber	cal_customer_if	12
LDSA 8F h reportLogisticDataStartAddress	NC_KWP_IO_LDSA	8
VIN short 90 h short VehicleIdentificationNumber	VIN_SHO[7]	7
VMECUHN 91 h VehicleManufactureECUHWnumber VMECUHN 3 x output	bmw_hw_nr	18
SBLIF 92h customer specific part of supplierBootLogisticInformationField	in this order: ecu_type[16] sample_details[16] tester_control[16]	48
EROTAN 96 h exhaustRegulationOrTypeApprovalnumber	kwp_io_erotan	6
SNOET 97 h systemNameOrEngineType	kwp_io_snoet kwp_io_snoet_cal (if ECU SW is active)	2
RSCOTSN 98 h RepairShopCodeOrTesterSerialNumber	kwp_io_rscatsn	8
PD 99 h ProgrammingDate	kwp_io_pd	4
VMECUHVN 9A h vehicleManufacturerECUHWversionNo.	kwp_io_vmecuhvn	1
VMCI 9B h vehicleManufacturerCodingIndex	C_IDX_COD_CONV	1
VMDI 9C h vehicleManufacturerDiagnosticIndex	kwp_io_vmdi	2
DOECUM 9D h	date_of_final_test	4

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dateOfECUManufacturing		
SSI 9E h systemSupplierndex	supplier_index	1
VMECUSLVN 9F h VMECUSoftwareLayerVersionNumber	bmw_sw_nr	12

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I.10 KWP2000 - SID 20h: stopDiagnosticSession Service

General information:

This function is for ending a diagnostic session.

stopDiagnostic Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**stopDiagnosticSessionRequest Service Id**	**M**	**#20h**	**SPDS**

Figure I.10.1: Table stopDiagnostic Request Message

StopDiagnosticSession positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	stopDiagnosticSession Positive response	M	#60h	SPDSPR

Figure I.10.2: Table ecuReset Positive Response Message

1. After positive response, the Standard Diagnostic Session, the default timing and baudrate(10400 baud for KWP and 9600baud for KWP*) are active !

StopDiagnosticSession negative Response

1. A negative response after StopDiagnosticSession is not possible!

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I.11 KWP2000 - SID 21h: readDataByLocalIdentifier Service

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
RLS_MPL_VALUE_PROG	O/V	0... 5H	0 ...5	1	-
release of multiple start value programming - only updated when service ist requested					
STATE_IMOB	O/V	0... FFH	0... 255	1	-
State of the immobilizer - only updated when service ist requested					

Input data:

C_ERR_CLAS_XX {p. 5811}	C_STATE_READY_OBD_2 {p. 5695}	CTR_DC [NC_NR_ERR_DYN] {p. 5767}	CTR_ERR_DYN_NR {p. 5767}
CTR_FRC [NC_NR_ERR_DYN] {p. 5767}	CTR_KM_N_MAX {p. 4462}	CTR_N_MAX {p. 4462}	CTR_TOIL_MAX {p. 1223}
CTR_WUP_CYC [NC_NR_ERR_DYN] {p. 5767}	DIST_ACT_MIL {p. 5899}	DIST_TOIL_MAX {p. 1223}	ENVD_CUS_CMN [NC_NR_ENVD_CUS_CMN][NC_NR_ERR_DYN] {p. 5792}
ENVD_CUS_SET_CMN [NC_NR_ENVD_CUS_SET_CMN][NC_NR_FRF_SET][NC_NR_ERR_DYN] {p. 5792}	ENVD_CUS_SET_SPC [NC_NR_ENVD_CUS_SET_SPC][NC_NR_FRF_SET][NC_NR_ERR_DYN] {p. 5792}	ENVD_OBD [NC_NR_ENVD_OBD][NC_NR_ERR_DYN] {p. 5792}	ERR_DTC [NC_NR_ERR_DYN] {p. 5756}
ERR_TYPE_BYTE [NC_NR_ERR_DYN] {p. 5744}	ERR_TYPE_EXT_BYTE [NC_NR_ERR_DYN] {p. 5744}	FAC_FCO_KWP {p. 7541}	GEAR_EF_N_MAX {p. 4462}
GEAR_TOIL_MAX {p. 1223}	IGA_IGC [NC_CYL_NR] {p. 1005}	INH_IV_KWP {p. 7482}	LV_ACCOUT_RLY {p. 3589}
LV_CS_N_MAX {p. 4462}	LV_CS_TOIL_MAX {p. 1223}	LV_IGK {p. 906}	LV_IS {p. 1720}
LV_KNK {p. 1961}	LV_LOCK_IMOB	MAF_KGH_MES {p. 1192}	N {p. 1525}
N_GRD_N_MAX {p. 4462}	N_MAX {p. 4462}	N_TOIL_MAX {p. 1223}	NR_PAT_SCC_N_MAX {p. 4462}
PV_AV_N_MAX {p. 4462}	PV_AV_TOIL_MAX {p. 1223}	STATE_CRU_OFF_IRR {p. 7227}	STATE_CRU_OFF_REV {p. 7227}
STATE_DIAG_SA_SAFM {p. 808}	STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	STATE_MSW_CAN {p. 7220}
T_N_MAX {p. 4462}	T_SUM_N_MAX {p. 4462}	TAM_TOIL_MAX {p. 1223}	TCO_MES {p. 1100}
TCO_TOIL_MAX {p. 1223}	TI_1_HOM [NC_CYL_NR] {p. 2002}	TIA_MES {p. 1226}	TOIL_MAX_WARN {p. 1223}
TOIL_THD_TOIL_MAX {p. 1223}	TPS_AV {p. 1169}	TQI_AV_TOIL_MAX {p. 1223}	TRT {p. 1504}

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TRT_N_MAX {p. 4462}	V_PVS_1_KWP {p. 7311}	VB {p. 1185}	VS_N_MAX {p. 4462}
VS_TOIL_MAX {p. 1223}			

Import actions:

ACTION_ERRM_ReadReadinessCode (**INOUT**<PRM_READINESSCODE>,**OUT**<PRM_RESULTREADINESSCODE>)

General information:

All implemented SID 21h services are described below.

Formula section:

I.11.1 Global negative Responses

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.11.1: Table: readDataByLocalIdentifier Negative Response Message

Remark:
The detailed message of the negative response code is described in chapter "Introduction".

I.11.2 21_01 - read system specific adress - ReadDataByLocalIdentifier service

General information:

This function allows to read out the system specific adresses. They are necessary e.g. reprogramming the ECU with the NPS.

Application conditions

Initialisation: *at reset*

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read system specific adress	M	#01h	RLI_

Figure I.11.2: Table readDataByLocalIdentifier Request Message

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ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier= system specific adress	M	#01h	RLI_UEB
#3d	RecordValue #1high byte = Programming voltage 0V	M	#XXh	Not supported
#4d	RecordValue #2 middle byte= Programming voltage 0V	M	#XXh	Not supported
#5d	RecordValue #3 low byte = Programming voltage 0V	M	#XXh	Not supported
#6d	RecordValue #4high byte = Dummy for DP1	M	#FFh	
#7d	RecordValue #5 middle byte = Dummy for DP1	M	#FFh	
#8d	RecordValue #6 low byte = Dummy for DP1	M	#FFh	
#9d	RecordValue #7high byte = Dummy for DP2	M	#FFh	
#10d	RecordValue #8 middle byte = Dummy for DP2	M	#FFh	
#11d	RecordValue #9 low byte = Dummy for DP2	M	#FFh	
#12d	RecordValue #10 high byte = Dummy for DP3	M	#FFh	
#13d	RecordValue #11 middle byte = Dummy for DP3	M	#FFh	
#14d	RecordValue #12 low byte = Dummy for DP3	M	#FFh	
#15d	RecordValue #13 high byte = Dummy for DP4	M	#FFh	
#16d	RecordValue #14 middle byte = Dummy for DP4	M	#FFh	
#17d	RecordValue #15 low byte = Dummy for DP4	M	#FFh	
#18d	RecordValue #16 high byte = Dummy for DP5	M	#FFh	
#19d	RecordValue #17 middle byte = Dummy for DP5	M	#FFh	
#20d	RecordValue #18 low byte = Dummy for DP5	M	#FFh	
#21d	RecordValue #19 high byte = Dummy for DP6	M	#FFh	
#22d	RecordValue #20 middle byte = Dummy for DP6	M	#FFh	
#23d	RecordValue #21 low byte = Dummy for DP6	M	#FFh	
#24d	RecordValue #22 high byte = Dummy for DP7	M	#FFh	
#25d	RecordValue #23 middle byte = Dummy for DP7	M	#FFh	
#26d	RecordValue #24 low byte = Dummy for DP7	M	#FFh	
#27d	RecordValue #25 high byte = Dummy for DP8	M	#FFh	
#28d	RecordValue #26 middle byte = Dummy for DP8	M	#FFh	
#29d	RecordValue #27 low byte = Dummy for DP8	M	#FFh	
#30d	RecordValue #28 high byte = Dummy for DP9	M	#FFh	
#31d	RecordValue #29 middle byte = Dummy for DP9	M	#FFh	
#32d	RecordValue #30 low byte = Dummy for DP9	M	#FFh	
#33d	RecordValue #31 high byte = Dummy for DP10	M	#FFh	
#34d	RecordValue #32 middle byte = Dummy for DP10	M	#FFh	
#35d	RecordValue #33 low byte = Dummy for DP10	M	#FFh	
#36d	RecordValue #34 high byte = Dummy for DP11	M	#FFh	
#37d	RecordValue #35 middle byte = Dummy for DP11	M	#FFh	
#38d	RecordValue #36 low byte = Dummy for DP11	M	#FFh	
#39d	RecordValue #37 high byte = Dummy for DP12	M	#FFh	
#40d	RecordValue #38 middle byte = Dummy for DP12	M	#FFh	
#41d	RecordValue #39 low byte = Dummy for DP12	M	#FFh	
#42d	RecordValue #40 high byte = Dummy for DSK	M	#FFh	
#43d	RecordValue #41 middle byte = Dummy for DSK	M	#FFh	
#44d	RecordValue #42 low byte = Dummy for DSK	M	#FFh	
#-d	RecordValue #43 high byte = Dummy for WCODE	M	#FFh	
#46d	RecordValue #44 middle byte = Dummy for WCODE	M	#FFh	
#47d	RecordValue #- low byte = Dummy for WCODE	M	#FFh	
#48d	RecordValue #46 high byte = cal_ref_nr data reference	M	#XXh	
#49d	RecordValue #47 middle byte = cal_ref_nr data reference	M	#XXh	

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#50d	RecordValue #48 low byte = cal_ref_nr data reference	M	#XXh	
#51d	RecordValue #49 high byte = cif_backup	M	#XXh	
#52d	RecordValue #50 middle byte = cif_backup	M	#XXh	
#53d	RecordValue #51 low byte = cif_backup	M	#XXh	
#54d	RecordValue #52 high byte = del_time_max erasing time	M	#XXh	
#55d	RecordValue #53 middle byte = del_time_max erasing time	M	#XXh	
#56d	RecordValue #54 low byte = del_time_max erasing time	M	#XXh	
#57d	RecordValue #55 high byte = hw_reference	M	#XXh	
#58d	RecordValue #56 middle byte = hw_reference	M	#XXh	
#59d	RecordValue #57 low byte = hw_reference	M	#XXh	
#60d	RecordValue #58 high byte = ecu_sw_reference programm-reference	M	#XXh	
#61d	RecordValue #59 middle byte = ecu_sw_reference programm-reference	M	#XXh	
#62d	RecordValue #60 low byte = ecu_sw_reference programm-reference	M	#XXh	
#63d	RecordValue #61 high byte = bmw_uif user info field	M	#XXh	
#64d	RecordValue #62 middle byte = bmw_uif user info field	M	#XXh	
#65d	RecordValue #63 low byte = bmw_uif user info field	M	#XXh	
#66d	RecordValue #64 high byte = kwp_buf_len_max max. length of data	M	#XXh	
#67d	RecordValue #65 middle byte = kwp_buf_len_max max. length of data	M	#XXh	
#68d	RecordValue #66 low byte = kwp_buf_len_max max. length of data	M	#XXh	
#69d	RecordValue #67 high byte = date_of_final_test	M	#XXh	
#70d	RecordValue #68 middle byte = date_of_final_test	M	#XXh	
#71d	RecordValue #69 low byte = date_of_final_test	M	#XXh	
#72d	RecordValue #70 high byte = Dummy for the Baud rate table	M	#FFh	
#73d	RecordValue #71 middle byte = Dummy for the Baud rate table	M	#FFh	
#74d	RecordValue #72 low byte = Dummy for the Baud rate table	M	#FFh	

Table readDataByLocalIdentifier Positive Response Message
ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.3 21_02 - read overtemperature protection - ReadDataByLocalIdentifier service

General information:

Exact description of the Function see file 14400S02.

Application conditions

Initialisation: at reset the values from the NVMY

Activation: LV_IGK=1

Deactivation: LV_IGK=0
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read overtemperature protection	M	#02h	RLI_UET

Figure I.11.3: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier= read overtemperature protection	M	#02h	RLI_UEB
#3d	RecordValue # = TOIL_MAX_WARN	M	#XXh	RV_
#4d	RecordValue # = VS_TOIL_MAX	M	#XXh	RV_
#5d	RecordValue # = N_TOIL_MAX high byte	M	#XXh	RV_
#6d	RecordValue # = N_TOIL_MAX low byte	M	#XXh	RV_
#7d	RecordValue # = GEAR_TOIL_MAX	M	#XXh	RV_
#8d	RecordValue # = TQI_AV_TOIL_MAX high byte	M	#XXh	RV_
#9d	RecordValue # = TQI_AV_TOIL_MAX low byte	M	#XXh	RV_
#10d	RecordValue # = TAM_TOIL_MAX	M	#XXh	RV_
#11d	RecordValue # = CTR_TOIL_MAX	M	#XXh	RV_
#12d	RecordValue # = TCO_TOIL_MAX	M	#XXh	RV_
#13d	RecordValue # = DIST_TOIL_MAX high byte	M	#XXh	RV_
#14d	RecordValue # = DIST_TOIL_MAX low byte	M	#XXh	RV_
#15d	RecordValue # = PV_AV_TOIL_MAX	M	#XXh	RV_
#16d	RecordValue # = LV_CS_TOIL_MAX	M	#XXh	RV_
#17d	RecordValue # = TOIL_THD_TOIL_MAX	M	#XXh	RV_

Figure I.11.4: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.4 21_03 - read engine overspeed detection - ReadDataByLocalIdentifier service

General information:

Exact description of the Function see file 14A06301.
Detection of an overreving event and non-volatile storage of:
An overreving event starts at exceeding the engine speed C_N_LIM_MIN and active engine speed limitation (LV_N_MAX = 1).
At each overreving event, the event frequency counter is incremented by 1. The highest engine speed reached N_MAX and the associated total running time in case of highest engine speed reached TRT_N_MAX is only overwritten if a higher engine speed was reached.

Application conditions

Initialisation: *at reset the values from the NVMY*

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see list of implemented diagnostic services

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ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read engine overspeed detection	M	#03h	RLI_UEB

Figure I.11.5: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier= read engine overspeed detection	M	#03h	RLI_UEB
#3d	RecordValue # = N_MAX high byte	M	#XXh	RV_
#4d	RecordValue # = N_MAX low byte	M	#XXh	RV_
#5d	RecordValue # = TRT_N_MAX high word high byte	M	#XXh	RV_
#6d	RecordValue # = TRT_N_MAX high word low byte	M	#XXh	RV_
#7d	RecordValue # = TRT_N_MAX low word high byte	M	#XXh	RV_
#8d	RecordValue # = TRT_N_MAX low word low byte	M	#XXh	RV_
#9d	RecordValue # = CTR_N_MAX	M	#XXh	RV_
#10d	RecordValue # = CTR_KM_N_MAX high byte	M	#XXh	RV_
#11d	RecordValue # = CTR_KM_N_MAX low byte	M	#XXh	RV_
#12d	RecordValue # = N_GRD_N_MAX	M	#XXh	RV_
#13d	RecordValue # = VS_N_MAX	M	#XXh	RV_
#14d	RecordValue # = PV_AV_N_MAX	M	#XXh	RV_
#15d	RecordValue # = GEAR_EF_N_MAX	M	#XXh	RV_
#16d	RecordValue # = LV_CS_N_MAX	M	#XXh	RV_
#17d	RecordValue # = T_SUM_N_MAX high byte	M	#XXh	RV_
#18d	RecordValue # = T_SUM_N_MAX low byte	M	#XXh	RV_
#19d	RecordValue # = T_N_MAX high byte	M	#XXh	RV_
#20d	RecordValue # = T_N_MAX low byte	M	#XXh	RV_
#21d	RecordValue # = NR_PAT_SCC_N_MAX	M	#XXh	RV_

Figure I.11.6: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response

Global Negative Responses

I.11.5 21_05 - read readiness flags - ReadDataByLocalIdentifier service

General information:

With this comand the readiness flags described in the chapter   Readiness codes   are shown.
The flags (bit) are default 1 and when the diagnosis is done well, the flag is switched to 0.

Description:

For reading readiness code see chapter   OBD Error management - Communication interface .

Application conditions

Initialisation: *at reset with 00h*

Activation: LV_IGK=1 (Kl.15 on)

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Deactivation: LV_IGK=0 (Kl.15 off) or
Diagnostic timeout
Service location: ECU-SW

Formula section:

IF service 21_05 is received.....
THEN
ACTION_ERRM_ReadReadinessCode(STATE_READY_OBD_1, STATE_READY_OBD_2)
The values
STATE_READY_OBD_1 *XXh*
STATE_READY_OBD_2 *XXh*
will be sent from the ECU to the tester

ENDIF

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read readiness	M	#05h	RLI_REA

Figure I.11.7: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service with RLI = #05h

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier	M	#05h	RLI_REA
#3d	RecordValue # 1 STATE_READY_OBD_1	M	#XXh	RV_EVS
#4d	RecordValue # 2 STATE_READY_OBD_2	M	#XXh	RV_REA
#5d	RecordValue # 3 C_STATE_READY_OBD_2	M	#XXh	RV_REA

Figure I.11.8: Table readDataByLocalIdentifier Positive Response Message

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Byte #	Name	Size	Conversion (hex/bin)	Conversion (physical)	Resol.
#3d	RecordValue # 1 = STATE_READY_OBD_1	1	xxxxxxxX b xxxxxxXx b xxxxxXxx b xxxxXxxx b xxxXxxxx b xxXxxxxx b xXxxxxxx b Xxxxxxxx b	Missfire monitoring supported Fuel system monitoring supported Comprehensive component monitoring supported Not used Missfire monitoring status Fuel system monitoring status Comprehensive component monitoring status Not used	
Byte #	**Name**	**Size**	**Conversion (hex/bin)**	**Conversion (physical)**	**Resol.**
#4d	RecordValue # 2 = STATE_READY_OBD_2	1	xxxxxxxX b xxxxxxXx b xxxxxXxx b xxxxXxxx b xxxXxxxx b xxXxxxxx b xXxxxxxx b Xxxxxxxx b	Catalyst monitoring Heated catalystComprehensive Evaporative system monitoring Secundary air system monitoring A/C system refigerant monitoring Oxygen sensor monitoring Oxygen sensor heater monitoring EGR system monitorimg	

Figure I.11.9: Table readDataByLocalIdentifier Positive Response Message Bit information

ReadDataByLocalIdentifier negative Response

Global Negative Responses

I.11.6 21_06 - receiving status of immobilizer - ReadDataByLocalIdentifier service

General information:

This function gives the actual status of the immobilizer back. The ecu reports to the tester whether the new start value is accepted or if the actual saved start value is identical with the one from the immobilizer. If there is a problem, the error information during synchronisation is also reported to the tester.

The ecu answers the question as long with the respective status until for the first time the answer is 01 or 02. When this answer is received, the ecu can activate this answer again after a Kl.15 change and the ecu power latch is over.

Parameter 04 process is running in the positive response switch after timeout occur to 03 Interface failure D_EWS: frame or parity or no signal (timeout)

In case of an destroyed IMOB CODE STATUS the positive response should be 21h, the same as for -2-out-of-3 start values in the flash memory not OK;

Application conditions

Initialisation: `at reset`

Activation: `Kl.15 on`

Deactivation: `Kl.15 off`
`Diagnostic timeout`
`Service location: see list of implemented diagnostic services`

ReadDataByLocalIdentifier Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read status of receiving immobilizer	M	#06h	RLI_

Figure I.11.10: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier	M	#06h	RLI_
#3d	RecordValue # 1 = STATE_IMOB [-start value programming or reset to start value was successful -wrong start value at reset attempt (Immob. and ECU do not match) -telegram contents was no start value (perhaps rolling code) -Interface failure D_EWS: frame or parity or no signal (timeout) -process is running " busy" -programming of start value or reset to start value doesn´t happen in this Kl.15 cycle -same random number as by the last reset to start value despite of already done code switching -no start value programmed -2-out-of-3 start values in the flash memory not OK (only when UC is programmed e.g. after a power latch phase) or the IMOB_CODE_STATUS is destroyed]	M	#XXh [#00h, #01h, #02h, #03h, #04h, #05h, #06h, #07h, #21h,]	RV_

Figure I.11.11: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.7 21_07 - read cruise control status - ReadDataByLocalIdentifier service

General information:

With this comand the status described in the chapter Vehicle speed control are distributed.

Application conditions

Initialisation: `at reset`

Activation: `Kl.15 on (LV_IGK=1)`

Deactivation: `Kl.15 off (LV_IGK=0)`
`Diagnostic timeout`
`Service location: see list of implemented diagnostic services`

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read cruise control status	M	#07h	RLI_

Figure I.11.12: Table readDataByLocalIdentifier Request Message

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ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier= cruise control status	M	#07h	RLI_
#3d	RecordValue # 1 = STATE_MSW_CAN	M	#XXh	RV_
#4d	RecordValue # 2 = STATE_CRU_OFF_IRR high byte	M	#XXh	RV_
#5d	RecordValue # 3 = STATE_CRU_OFF_IRR low byte	M	#XXh	RV_
#6d	RecordValue # 4 = STATE_CRU_OFF_REV high byte	M	#XXh	RV_
#7d	RecordValue # 5 = STATE_CRU_OFF_REV low byte	M	#XXh	RV_

Figure I.11.13: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.8 21_08 - release of multiple start value programming - ReadDataByLocalIdentifier service

General information:

This function gives the actual status of release of multiple start value programming.
This service should give always a response as well if the total running time t>90min!

If the response is sent to the ECU by TRT>90 minutes then a negative response 7F_21_22- conditions not correct occur.
Meaning of RLS_MPL_VALUE_PROG:
RLS_MPL_VALUE_PROG=00h - release of multiple start value programming available
RLS_MPL_VALUE_PROG=01h - release of multiple start value programming not available
RLS_MPL_VALUE_PROG=04h - relase process for start value programming is going on
RLS_MPL_VALUE_PROG=05h - no release process for start value programming done in this cycle

Application conditions

Initialisation: *RLS_MPL_VALUE_PROG=00h* *at reset*

Activation: LV_IGK=1 (Kl.15 on) and
Authenticity check and
TRT<90min

Deactivation: LV_IGK=0 (Kl.15 off) or
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = release of multiple start value programming	M	#08h	RLI_FEWS

Figure I.11.14: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	RecordLocalIdentifier= release of multiple start value programming	M	#08h	RLI_FEWS
#3d	RecordValue # 1 = RLS_MPL_VALUE_PROG [- release of multiple start value programming available - release of multiple start value programming not available - release process for start value programming is going on - no release process for start value programming done in this cycle]	M	#XXh [#00h, #01h, #04h, #05h]	RV_FEWS

Figure I.11.15: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response

Global Negative Responses

I.11.9 21_09 - read DIST_ACT_MIL - ReadDataByLocalIdentifier service

General information:

This funktion reports the value of the distance MIL is active .

Application conditions

Initialisation: at reset

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) or
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier DIST_ACT_MIL	M	#09h	RLI_DIST_ACT_MIL

Figure I.11.16: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier DIST_ACT_MIL	M	#09h	RLI_
#3d	RecordValue = DIST_ACT_MIL high byte high word	M	#XXh	RV_S_
#4d	RecordValue = DIST_ACT_MIL low byte high word	M	#XXh	RV_S_
#5d	RecordValue = DIST_ACT_MIL high byte low word	M	#XXh	RV_S_
#6d	RecordValue = DIST_ACT_MIL low byte low word	M	#XXh	RV_S_

Figure I.11.17: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response

Global Negative Responses

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I.11.10 21_0A - read Error Memory with freeze frame data extra long - ReadDataByLocalIdentifier service

General information:

This function is created to read out the failure memory with all the errors including the freeze frame data. The index of the environment values allows a classification to the list of the environment values from BMW.

Record Common Identifier table usage and reading:

- RCI usage as BYTE Values (Freeze Frame, Umweltbedingung, DDLI etc.) should support the full range 0x00 to 0xFF as VALID. A value that is not supported will be transmitted as 0xFF
- RCI usage as WORD Values (DDLI etc.) should support the range 0x0000 to 0xFFFE as VALID. Invalid is shown with 0xFFFF.

This should enable the full range of internal Byte values to be used with no compromise, but still allow the diagnostic equipment to recognise if a value is available or not.

Application conditions

Initialisation: *at reset with 00h*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) **or** Diagnostic timeout

Service location: see list of implemented diagnostic services

Formula section:

IF ERR_DTC[x] = 0000h **or** ERR_DTC[x] = FFFFh

THEN RESPONSE=NEGATIVE RESPONSE

ELSE RESPONSE=POSITIVE RESPONSE

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = Read Error Memory with freeze frame data	M	#0Ah	RLI_
#3d	Value = Error code ERR_DTC[x] high byte	M	#XXh	RV_
#4d	Value = Error code ERR_DTC[x] low byte	M	#XXh	RV_

Figure I.11.18: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier	M	#0Ah	RLI_
#3d	RecordValue # 1 = Error counter total CTR_ERR_DYN_NR	M	#XXh	RV_
#4d	RecordValue # 2 = Error code ERR_DTC[x] high byte	M	#XXh	RV_
#5d	RecordValue # 3 = Error code ERR_DTC[x] low byte	M	#XXh	RV_
#6d	RecordValue # 4 = status DTC#1 ERR_TYPE_BYTE[x]	M	#XXh	RV_
#7d	RecordValue # 5 = Cycle flag ERR_TYPE_EXT_BYTE[x]	M	#XXh	RV_
#8d	RecordValue # 8 = Frequency counter CTR_FRC[x]	M	#XXh	RV_
#9d	RecordValue # 9 = Error recover counter (HLC) CTR_DC[x]	M	#XXh	RV_
#10d	RecordValue # 10 = km-value by first occur high byte ENVD_CUS_SET_CMN[2][1]	M	#XXh	RV_
#11d	RecordValue # 11 = km-value by first occur low byte ENVD_CUS_SET_SPC[3][1]	M	#XXh	RV_
#12d	RecordValue # 12 = 1.environmental value first occur ENVD_CUS_SET_SPC[1][1]	M	#XXh	RV_
#13d	RecordValue # 13 = Index for 1.environmental value	M	#XXh	RV_
#14d	RecordValue # 14 = 2.environmental value first occur ENVD_CUS_SET_SPC[2][1]	M	#XXh	RV_
#15d	RecordValue # 15 = Index for 2.environmental value	M	#XXh	RV_
#16d	RecordValue # 16= 3.environmental value first occur ENVD_CUS_SET_SPC[3][1]	M	#XXh	RV_
#17d	RecordValue # 17 = Index for 3.environmental value	M	#XXh	RV_
#18d	RecordValue # 18 = 4.environmental value first occur ENVD_CUS_SET_SPC[4][1]	M	#XXh	RV_
#19d	RecordValue # 19 = Index for 4.environmental value	M	#XXh	RV_
#20d	RecordValue # 20 = km-value by second occur high byte ENVD_CUS_SET_SPC[2][2]	M	#XXh	RV_
#21d	RecordValue # 21= km-value by second occur low byte ENVD_CUS_SET_SPC[3][2]	M	#XXh	RV_
#22d	RecordValue # 22 = 1.environmental value second occur ENVD_CUS_SET_SPC[1][2]	M	#XXh	RV_
#23d	RecordValue # 23 = 2.environmental value second occur ENVD_CUS_SET_SPC[2][2]	M	#XXh	RV_
#24d	RecordValue # 24 = 3.environmental value second occur ENVD_CUS_SET_SPC[3][2]	M	#XXh	RV_
#25d	RecordValue # 25 = 4.environmental value second occur ENVD_CUS_SET_SPC[4][2]	M	#XXh	RV_
#26d	RecordValue # 26 = km-value by last occur high byte ENVD_CUS_SET_SPC[2][3]	M	#XXh	RV_
#27d	RecordValue # 27 = km-value by last occur low byte ENVD_CUS_SET_SPC[3][3]	M	#XXh	RV_
#28d	RecordValue # 28 = 1.environmental value last occur ENVD_CUS_SET_SPC[1][3]	M	#XXh	RV_
#29d	RecordValue # 29= 2.environmental value last occur ENVD_CUS_SET_SPC[2][3]	M	#XXh	RV_
#30d	RecordValue # 30= 3.environmental value last occur ENVD_CUS_SET_SPC[3][3]	M	#XXh	RV_
#31d	RecordValue # 31 = 4.environmental value last occur ENVD_CUS_SET_SPC[4][3]	M	#XXh	RV_
#32d	RecordValue # 32= Error class C_ERR_CLAS_XX	M	#00h	RV_
#33d	RecordValue # 33 = Importance counter TSF (not def. yet)	M	#00h	RV_
#34d	RecordValue # 34 = Debounce counter (MIL on) FLC FLC = DC_MAX_XX - CTR_DC[x]	M	#XXh	RV_

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#35d	RecordValue # 35= Deleting counter DLC CTR_WUP_CYC[x]	M	#XXh	RV_
#36d	RecordValue # 36 = Freeze frame data 0 - lambda control state bench 1 ENVD_OBD[1][NC_NR_ERR_DYN]	M	#XXh	RV_
#37d	RecordValue # 37 = Freeze frame data 1 - lambda control state bench 2 ENVD_OBD[2][NC_NR_ERR_DYN]	M	#XXh	RV_
#38d	RecordValue # 38 = Freeze frame data 2 - relative air mass ENVD_OBD[3][NC_NR_ERR_DYN]	M	#XXh	RV_
#39d	RecordValue # 39 = Freeze frame data 3 - engine coolent temperature ENVD_OBD[4][NC_NR_ERR_DYN]	M	#XXh	RV_
#40d	RecordValue # 40 = Freeze frame data 4 - variable factor bench 1 ENVD_OBD[5][NC_NR_ERR_DYN]	M	#XXh	RV_
#41d	RecordValue # 41 = Freeze frame data 5 - adaptions factor bench 1 ENVD_OBD[6][NC_NR_ERR_DYN]	M	#XXh	RV_
#42d	RecordValue # 40 = Freeze frame data 6 - variable factor bench 2 ENVD_OBD[7][NC_NR_ERR_DYN]	M	#XXh	RV_
#43d	RecordValue # 43 = Freeze frame data 7 - adaptions factor bench 2 ENVD_OBD[8][NC_NR_ERR_DYN]	M	#XXh	RV_
#44d	RecordValue # 44= Freeze frame data 8 - intake air pressure ENVD_OBD[10][NC_NR_ERR_DYN]	M	#XXh	RV_
#-d	RecordValue # - = Freeze frame data 9 - engine speed ENVD_CUS_CMN[1][NC_NR_ERR_DYN]	M	#XXh	RV_
#46d	RecordValue # 46 = Freeze frame data 10 - vehicle speed ENVD_CUS_CMN[13][NC_NR_ERR_DYN]	M	#XXh	RV_
#47d	RecordValue # 6 = P code DTC " high byte ACTION_ERRM_ReadDTCLevelByDTCLevel	M	#XXh	RV_
#48d	RecordValue # 7 = P code DTC " low byte ACTION_ERRM_ReadDTCLevelByDTCLevel	M	#XXh	RV_
#49d	RecordValue # 49 = Checksum for each error	M	#00h	RV_

Table readDataByLocalIdentifier Positive Response Message
ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.11 21_25 - read INH_IV_KWP - ReadDataByLocalIdentifier service

General information:

This funktion reports the value of the switch off pattern of the injection valves .

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) or
Diagnostic timeout

Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier INH_IV_KWP	M	#25h	RLI_INH_IV_KWP

Figure I.11.19: Table readDataByLocalIdentifier Request Message

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ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier INH_IV_KWP	M	#25h	RLI_
#3d	RecordValue = INH_IV_KWP	M	#XXh	RV_S_

Figure I.11.20: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.12 21_36 - read air-conditioner status - ReadDataByLocalIdentifier service

General information:

With this comand the LV to activate the ACC-relay is distributed.

Application conditions

Initialisation: *at reset*

Activation: Kl.15 on (LV_IGK=1)

Deactivation: Kl.15 off (LV_IGK=0) or
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read air-conditioner status	M	#36h	RLI_

Figure I.11.21: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier= read air-conditioner status	M	#36h	RLI_
#3d	RecordValue # 1 = LV_ACCOUT_RLY	M	#XXh	RV_

Figure I.11.22: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.13 21_3F - read idle speed status - ReadDataByLocalIdentifier service

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General information:

With this comand the status of the Idle Speed is hand over.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1

Deactivation: LV_IGK=0
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read Idle Speed “Switch” status - LV_IS	M	#3Fh	RLI_IS

Figure I.11.23: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier	M	#3Fh	RLI_
#3d	RecordValue = LV_IS	M	#XXh	RV_IS

Figure I.11.24: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.14 21_41 - read LSH 4 status - ReadDataByLocalIdentifier service

General information:

With this comand the status of the lambda sensor heating 4 is distributed.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read LSH 4 status	M	#41h	RLI_

Figure I.11.25: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier= read LSH 4 status	M	#41h	RLI_
#3d	RecordValue # 1 = STATE_LSH_DOWN[2]	M	#XXh	RV_
#4d	RecordValue # 2 = dummy value fix	M	#FFh	RV_
#5d	RecordValue # 3 = dummy value fix	M	#FFh	RV_
#6d	RecordValue # 4 = dummy value fix	M	#FFh	RV_

Figure I.11.26: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.15 21_42 - read LSH 3 status - ReadDataByLocalIdentifier service

General information:

With this comand the status of the lambda sensor heating 3 is distributed.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read LSH 3 status	M	#42h	RLI_

Figure I.11.27: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier= read LSH 3 status	M	#42h	RLI_
#3d	RecordValue # 1 = STATE_LSH_DOWN[1]	M	#XXh	RV_
#4d	RecordValue # 2 = dummy value fix	M	#FFh	RV_
#5d	RecordValue # 3 = dummy value fix	M	#FFh	RV_
#6d	RecordValue # 4 = dummy value fix	M	#FFh	RV_

Figure I.11.28: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.16 21_43 - read LSH 2 status - ReadDataByLocalIdentifier service

General information:

With this comand the status of the lambda sensor heating 2 is distributed.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read LSH 2 status	M	#43h	RLI_

Figure I.11.29: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier= read LSH 2 status	M	#43h	RLI_
#3d	RecordValue # 1 = STATE_LSH_UP[2]	M	#XXh	RV_
#4d	RecordValue # 2 = dummy value fix	M	#FFh	RV_
#5d	RecordValue # 3 = dummy value fix	M	#FFh	RV_
#6d	RecordValue # 4 = dummy value fix	M	#FFh	RV_

Figure I.11.30: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

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I.11.17 21_44 - read LSH 1 status - ReadDataByLocalIdentifier service

General information:

With this comand the status of the lambda sensor heating 1 is distributed.

Application conditions

Initialisation: at reset

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read LSH 1 status	M	#44h	RLI_

Figure I.11.31: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier= read LSH 1 status	M	#44h	RLI_
#3d	RecordValue # 1 = STATE_LSH_UP[1]	M	#XXh	RV_
#4d	RecordValue # 2 = dummy value fix	M	#FFh	RV_
#5d	RecordValue # 3 = dummy value fix	M	#FFh	RV_
#6d	RecordValue # 4 = dummy value fix	M	#FFh	RV_

Figure I.11.32: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.18 21_49 - read Immobilizer status - ReadDataByLocalIdentifier service

General information:

With this comand the status of the Immobilizer is distributed.

Application conditions

Initialisation: at reset

Activation: Kl.15 on (LV_IGK=1)

Deactivation: Kl.15 off (LV_IGK=0)
Diagnostic timeout
Service location: see list of implemented diagnostic services

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ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read Immobilizer status	M	#49h	RLI_

Figure I.11.33: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier= read Immobilizer status	M	#49h	RLI_
#3d	RecordValue # 1 =LV_LOCK_IMOB	M	#XXh	RV_

Figure I.11.34: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.19 21_4C - Read basic injection time cylinder 1 - ReadDataByLocalIdentifier service

General information:

This funktion reports the value of the injection time cylinder logical .

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) or
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier TI_1_HOM[0]	M	#4Ch	RLI_BIOS_TI_0

Figure I.11.35: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier TI_1_HOM[0]	M	#4Ch	RLI_
#3d	RecordValue = TI_1_HOM[0] high byte	M	#XXh	RV_S_
#4d	RecordValue = TI_1_HOM[0] low byte	M	#XXh	RV_S_

Figure I.11.36: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response

Global Negative Responses

I.11.20 21_50 - read engine speed - ReadDataByLocalIdentifier service

General information:

This service reports the actual value of the engine speed.

Application conditions

Initialisation: *at reset with 00h*

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read engine speed	M	#50h	RLI_

Figure I.11.37: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier= engine speed	M	#50h	RLI_
#3d	RecordValue # = N high byte	M	#XXh	RV_
#4d	RecordValue # = N low byte	M	#XXh	RV_

Figure I.11.38: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response

Global Negative Responses

I.11.21 21_54 - read intake air temperature - ReadDataByLocalIdentifier service

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General information:

This service reports the actual value of the intake air temperature.

Application conditions

Initialisation: at reset with 00h

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read intake air temperature	M	#54h	RLI_

Figure I.11.39: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier= intake air temperature	M	#54h	RLI_
#3d	RecordValue = TIA_MES	M	#XXh	RV_

Figure I.11.40: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.22 21_55 - read coolant temperature - ReadDataByLocalIdentifier service

General information:

This service reports the actual value of the coolant temperature.

Application conditions

Initialisation: at reset with 00h

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read coolant temperature	M	#55h	RLI_

Figure I.11.41: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier= coolant temperature	M	#55h	RLI_
#3d	RecordValue = TCO_MES	M	#XXh	RV_

Figure I.11.42: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response

Global Negative Responses

I.11.23 21_56 - Read ignition angle cylinder 1 - ReadDataByLocalIdentifier service

General information:

This funktion reports the value of the Ignition angle applied on cylinder log.0 (phys1) .

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) or Diagnostic timeout

Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier IGA_IGC[0]	M	#56h	RLI_IGA_IGC_0

Figure I.11.43: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier IGA_IGC[0]	M	#56h	RLI_
#3d	RecordValue = IGA_IGC[0]	M	#XXh	RV_S_

Figure I.11.44: Table readDataByLocalIdentifier Positive Response Message

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ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.24 21_57 - read opening angle of the throttle valve (TPS_AV) - ReadDataByLocalIdentifier service

General information:

This service reports the actual value of the opening angle of the throttle valve (TPS_AV).

Application conditions

Initialisation: *at reset with 00h*

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read opening angle of the throttle valve (TPS_AV)	M	#57h	RLI_

Figure I.11.45: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier= opening angle of the throttle valve (TPS_AV)	M	#57h	RLI_
#3d	RecordValue # = TPS_AV high Byte	M	#XXh	RV_
#4d	RecordValue # = TPS_AV low Byte	M	#XXh	RV_

Figure I.11.46: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.25 21_58 - read mass air flow per segment measured (MAF_KGH_MES) - ReadDataByLocalIdentifier service

General information:

This service reports the actual value of the mass air flow per segment measured (MAF_KGH_MES)

Application conditions

Initialisation: *at reset with 00h*

Activation: LV_IGK=1 (Kl.15 on)

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Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read mass air flow per segment measured (MAF_KGH_MES)	M	#58h	RLI_

Figure I.11.47: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier= mass air flow per segment measured (MAF_KGH_MES)	M	#58h	RLI_
#3d	RecordValue # = MAF_KGH_MES high Byte	M	#XXh	RV_
#4d	RecordValue # = MAF_KGH_MES low Byte	M	#XXh	RV_

Figure I.11.48: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.26 21_5B - read Pedal value sensor 1 raw acquisition (V_PVS_1_KWP) - ReadDataByLocalIdentifier service

General information:

This service reports the actual value of the Pedal value sensor 1 raw acquisition of the accelerator pedal (V_PVS_1_KWP).
V_PVS_1_KWP is defined within the DDLI values.

Application conditions

Initialisation: *at reset with 00h*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = V_PVS_1_KWP	M	#5Bh	RLI_

Figure I.11.49: Table readDataByLocalIdentifier Request Message

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ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier= V_PVS_1_KWP	M	#5Bh	RLI_
#3d	RecordValue # = V_PVS_1_KWP	M	#XXh	RV_

Figure I.11.50: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.27 21_71 - read LV_KNK - ReadDataByLocalIdentifier service

General information:

This funktion reports the value of the Ignition angle applied on cylinder log.0 (phys1) .

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) or
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier LV_KNK	M	#71h	RLI_LV_KNK

Figure I.11.51: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier LV_KNK	M	#71h	RLI_
#3d	RecordValue = LV_KNK	M	#XXh	RV_S_

Figure I.11.52: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.28 21_A3 - read VB - ReadDataByLocalIdentifier service

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General information:

This funktion reports the value of the battery voltage .

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) or
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier VB	M	#A3h	RLI_VB

Figure I.11.53: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier VB	M	#A3h	RLI_
#3d	RecordValue = VB	M	#XXh	RV_S_

Figure I.11.54: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response

Global Negative Responses

I.11.29 21_C0 - read SAFM status - ReadDataByLocalIdentifier service

General information:

With this comand the status of the secondary air mass sensor is distributed.

Application conditions

Initialisation: *at reset*

Activation: Kl.15 on (LV_IGK=1)

Deactivation: Kl.15 off (LV_IGK=0)
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = read SAFM status	M	#C0h	RLI_

Figure I.11.55: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier= read SAFM status	M	#C0h	RLI_
#3d	RecordValue # 1 = STATE_DIAG_SA_SAFM	M	#XXh	RV_

Figure I.11.56: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.30 21_C1 - read kva-factor - ReadDataByLocalIdentifier service

General information:

This funktion shows the additive part of the correctionfactor for the consumption - displayed in the combi - for the customer service.

Application conditions

Initialisation: *at reset*

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = KVA-factor	M	#C1h	RLI_KVA

Figure I.11.57: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier	M	#C1h	RLI_KVA
#3d	RecordValue = FAC_FCO_KWP [remain the same negative displace max.12.8% positive displace max.12.7% (1h=0.001/bit)]	M	#XXh [#00h, #80h-FFh #01h-7Fh]	RV_

Figure I.11.58: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

I.11.31 21_C3 - read TRT - ReadDataByLocalIdentifier service

General information:

This funktion reports the value of the Total running time .

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) or
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier TRT	M	#C3h	RLI_TRT

Figure I.11.59: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier TRT	M	#C3h	RLI_
#3d	RecordValue = TRT high byte high word	M	#XXh	RV_S_
#4d	RecordValue = TRT low byte high word	M	#XXh	RV_S_
#5d	RecordValue = TRT high byte low word	M	#XXh	RV_S_
#6d	RecordValue = TRT low byte low word	M	#XXh	RV_S_

Figure I.11.60: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response
Global Negative Responses

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I.11.32 21_F0 - DDLI handling - ReadDataByLocalIdentifier service

General information:

This function is created to read the DDLI, which has to be defined before with the service 2Ch.

Application conditions

Initialisation: `at reset`

Activation: `Kl.15 on`

Deactivation:
```
Kl.15 off
 Diagnostic timeout
Service location:  see list of  implemented diagnostic services
```

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = DDLI	M	#F0h	DDLI

Figure I.11.61: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response

Example 1: DDLIDefinitonMode=DefineByCommonIdentifier and MemorySize=01

Information, which is given by the DDLI service (compare specification DynamicallyDefineLocalIdentifier service - 2Ch).

MemorySize: fixed to 01
PIDDDLI_x : PositionInDynamicallyDefinedLocalIdentifier x
RCI_x : RecordCommonID *(according to IO-data list) x*

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**ReadDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier = DDLI	M	#F0h	RLI_
..	..	..	..	..
..	..	..	..	..
#2d+ PIDDDLI_1	Contents of IO-data given by the number in RCI_1 *(compare IO-data list)* in byte format	M	#XXh	
..	..	..	..	..
..	..	..	..	..
..	..	..	..	..
#2d+ PIDDDLI_x	Contents of IO-data given by the number in RCI_x *(compare IO-data list)* in byte format	M	#XXh	

Figure I.11.62: Table readDataByLocalIdentifier Positive Response Message

Example 2: DDLIDefinitonMode=DefineByCommonIdentifier and MemorySize=02

Information, which is given by the DDLI service (compare specification DynamicallyDefineLocalIdentifier service - 2Ch).

MemorySize: fixed to 02
PIDDDLI_x : PositionInDynamicallyDefinedLocalIdentifier x

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RCI_x : RecordCommonID *(according to IO-data list) x*

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**ReadDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier = DDLI	M	#F0h	RLI_
..	..	..	..	..
..	..	..	..	..
#2d+ PIDDDLI_1	Contents of IO-data given by the number in RCI_1 *(compare IO-data list)* high byte	M	#XXh	
#2d+ 1+ PIDDDLI_1	Contents of IO-data given by the number in RCI_1 *(compare IO-data list)* low byte	M	#XXh	
..	..	..	..	..
..	..	..	..	..
#2d+ PIDDDLI_x	Contents of IO-data given by the number in RCI_x *(compare IO-data list)* high byte	M	#XXh	
#2d+ 1+ PIDDDLI_x	Contents of IO-data given by the number in RCI_x *(compare IO-data list)* low byte	M	#XXh	

Figure I.11.63: Table readDataByLocalIdentifier Positive Response Message

Example 3: DDLIDefinitonMode= DefineByMemoryAddress
Information, which is given by the DDLI service (compare specification DynamicallyDefineLocalIdentifier service - 2Ch).

MemorySize_x
PIDDDLI_x : PositionInDynamicallyDefinedLocalIdentifier x
MemoryAddress_x
MemoryTypeIdentifier_x

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**ReadDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	RecordLocalIdentifier = DDLI	M	#F0h	RLI_
..	..	..	..	..
..	..	..	..	..
#2d+ PIDDDLI_1	Contents of MemoryAddress_1 in MemoryTypeIdentifier_1 section	M	#XXh	
#2d+ 1 + PIDDDLI_1	Contents of MemoryAddress_1+1 in MemoryTypeIdentifier_1 section	M	#XXh	
#2d+ MemorySize_ 1+ PIDDDLI_1	Contents of MemoryAddress_1+MemorySize_1 in MemoryTypeIdentifier_1 section	M	#XXh	
..	..	..	..	..
..	..	..	..	..
#2d+ PIDDDLI_x	Contents of MemoryAddress_x in MemoryTypeIdentifier_x section	M	#XXh	
#2d+ 1 + PIDDDLI_x	Contents of MemoryAddress_x+1 in MemoryTypeIdentifier_x section	M	#XXh	
#2d+ MemorySize_ x+ PIDDDLI_x	Contents of MemoryAddress_x+MemorySize_x in MemoryTypeIdentifier_x section	M	#XXh	

Figure I.11.64: Table readDataByLocalIdentifier Positive Response Message

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ReadDataByLocalIdentifier negative Response

Global Negative Responses

NegativeResponseCode	***Cause of Occurrence***
SubFunctionNotSupported-invalidFormat	- selected RCI is not supported - selected DDDLI is not supported

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I.12 KWP2000 - SID 28h: disableNormalMessageTrm Services

Input data:

LV_IGK {p. 906}			

I.12.1 28h - DisableNormalMessageTransmission service

General information:

This command is used to inhibit J1850 normal message transmission from PCM (intersystem) while still performing other functions normally. That means, that PCM should still receive all its J1850 messages and process them as required.

Description:

The parameter ***responseRequired*** is used in the DisableNormalMessageTransmission request message. It indicates to the server(s) whether a positive response message is required or not.
A negative response shall even be sent if responseRequired is set to no

If the responseRequired parameter in the DisableNormalMessageTransmission request message is missing, the server(s) shall sent a response message.

The DisableNormalMessageTransmission service shall be used by a client to stop the normal (non diagnostic) and network management message transmission from the vehicle server(s).

Fault detection and storage is also disabled by this service.

The DisableNormalMessageTransmission request messagecan be used with both physical and functional addressing to stop the message transmission from an individual server or a group of servers. The server(s) being addresed shall respond with a DisableNormalMessageTransmission positive response massage if the response option is set so or, if unable to stop the message transmission, respond with a DisableNormalMessageTransmission negative response message.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout
Service location: see "list of implemented diagnostic services"

DisableNormalMessageTransmission service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	DisableNormalMessageTransmission service	**M**	**#28h**	**DNMT**
#2d	DisableNormalMessageTransmission [**yes** - server shall send a positive or negative response to the request message **no** - server shall not send a positive response to the request]	M	#XXh [#01h, #02h]	

Figure I.12.1: Table ReadDataByCommonIdentifier Request Message

DisableNormalMessageTransmission positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	DisableNormalMessageTransmission service Response Service Id	**M**	**#68h**	

Figure I.12.2: Table ReadDataByCommonIdentifier Positive Response Message

DisableNormalMessageTransmission negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	ReadDataByCommonIdentifier Request Service Id	M	#28h	
#3d	responseCode=only general response code	M	#XXh	

Figure I.12.3: Table: ReadDataByCommonIdentifier Negative Response Message

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I.13 KWP2000 - SID 29h: enableNormalMessageTrm Services

Input data:

LV_IGK {p. 906}			

I.13.1 29h - EnableNormalMessageTransmission service

General information:

This command is used to cancel a mode 28h DisableNormalMessageTransmission request.
The parameter responseRequired is used in the EnableNormalMessageTransmission request message. It Indicates to the server(s) whether a positive response message is required or not. IA negative response shall even be sent if responseRequired is set to no.

Description:

The EnableNormalMessageTransmission request message shall be used to indicate to the server that normal transmission shall be resumed. The service is used in combination with the DisableNormalMessageTransmission service to once again start the normal and network management message transmission from the server.

Fault detection and storage is also Enabled by this service.

The EnableNormalMessageTransmission request message can be used with both physical and functional addressing to resume normal messages transmission friom an individual server or a group of servers.
The server(s) being addresed shall respond with a EnableNormalMessageTransmission negative response message.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see "list of implemented diagnostic services"

EnableNormalMessageTransmission service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	EnableNormalMessageTransmission service	**M**	**#29h**	**DNMT**
#2d	EnableNormalMessageTransmission [no parameter or #01h: ECU shall send a positive response #02h: ECU shall not send a positive response] **Remark:** A negative response shall be sent in any case if an error occurs	M	#XXh [-- / #01h, #02h]	

Figure I.13.1: Table ReadDataByCommonIdentifier Request Message

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EnableNormalMessageTransmission positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	EnableNormalMessageTransmission service Response Service Id	**M**	**#69h**	

Figure I.13.2: Table ReadDataByCommonIdentifier Positive Response Message

EnableNormalMessageTransmission negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	ReadDataByCommonIdentifier Request Service Id	M	#29h	
#3d	responseCode=only general response code	M	#XXh	

Figure I.13.3: Table: ReadDataByCommonIdentifier Negative Response Message

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I.14 KWP2000 - SID 2Ch: dynamicallyDefineLocalIdentifier Service

see introduction
see introduction

General information:

This function is used to define /clear single or multiple data that can be read as one complete block by ReadDataByLocalId service 21_F0 after block definition.
Data definition can be made either directly by address or by common identifier RCI from DDLI table (see specification 17I00101, "Introduction") defined inside ECU-SW.

Application conditions

Initialisation: at reset

Activation: LV_IGK = 1

Deactivation: LV_IGK = 0
Diagnostic timeout
Service location: see "list of implemented diagnostic services"

I.14.1 DynamicallyDefineLocalIdentifier Request - DefineByCommonIdentifier - 2C_02

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**DynamicallyDefineLocalIdentifier Request Service Id**	**M**	**#2Ch**	**DDLI**
#2d	DynamicallyDefinedLocalIdentifier	M	#F0h	DDDLI
#3d	DefinitionMode=XX [DefineByCommonID]	M	#XXh= [#02h]	DNM DBLI
#4d	PositionInDynamicallyDefinedLocalIdentifier	M	#XXh	PIDDDLI
#5d	MemorySize	M	#XXh	MS
#6d	RecordCommonID (high byte) *(Index according to DDLI data list)*	M	#XXh	RCI_HB
#7d	RecordCommonID (low byte) *(Index according to DDLI data list)*	M	#XXh	RCI_LB
#8d	PositionInRecordCommonIdentifier	M	#01h	PIRCI
...	...	C	...	
#n-5d	DefinitionMode=XX [DefineByCommonID]	C	#XXh= [#02h]	DNM
#n-4d	PositionInDynamicallyDefinedLocalIdentifier	C	#XXh	PIDDDLI
#n-3d	MemorySize	C	#XXh	MS
#n-1d	RecordCommonID (high byte) *(Index according to DDLI data list)*	C	#XXh	RCI_HB
#n-1d	RecordCommonID (low byte) *(Index according to DDLI data list)*	C	#XXh	RCI_LB
#nd	PositionInRecordCommonIdentifier	C	#01h	PICLI

Figure I.14.1: Table DynamicallyDefineLocalIdentifier Request Message - 2C_02

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I.14.2 DynamicallyDefineLocalIdentifier Request - DefineByMemoryAddress - 2C_ 03

(3-byte addressing)

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**DynamicallyDefineLocalIdentifier Request Service Id**	**M**	**#2Ch**	**DDLI**
#2d	DynamicallyDefinedLocalIdentifier	M	#F0h	DDDLI
#3d	DefinitionMode=XX [DefineByMemoryAddress]	M	#XXh= [#03h]	DNM DBMA
#4d	PositionInDynamicallyDefinedLocalIdentifier	M	#XXh	PIDDDLI
#5d	MemorySize	M	#XXh	MS
#6d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#7d	MemoryAddress (Middle Byte)	M	#XXh	MA_MB
#8d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
(#9d)	MemoryTypeIdentifier **(optional)** [linear type external FLASH external RAM internal FLASH user information field UIF]	U	#XXh [#00h #02h #05h #06h #07h]	MTI
...	...	C	...	
#n-6d	DefinitionMode=XX [DefineByMemoryAddress]	C	#XXh= [#03h]	DNM DBMA
#n-5d	PositionInDynamicallyDefinedLocalIdentifier	C	#XXh	PIDDDLI
#n-4d	MemorySize	C	#XXh	MS
#n-3d	MemoryAddress (High Byte)	C	#XXh	MA_HB
#n-2d	MemoryAddress (Middle Byte)	C	#XXh	MA_MB
#n-1d	MemoryAddress (Low Byte)	C	#XXh	MA_LB
(#nd)	MemoryTypeIdentifier **(optional)** [linear type external FLASH external RAM internal FLASH user information field UIF]	U	#XXh [#00h #02h #05h #06h #07h]	MTI

Figure I.14.2: Table DynamicallyDefineLocalIdentifier Request Message - 2C_03 (3-byte addressing)

I.14.3 DynamicallyDefineLocalIdentifier Request - DefineByMemoryAddress - 2C_ 03

(4-byte addressing)

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**DynamicallyDefineLocalIdentifier Request Service Id**	**M**	**#2Ch**	**DDLI**
#2d	DynamicallyDefinedLocalIdentifier	M	#F0h	DDDLI
#3d	DefinitionMode=XX [DefineByMemoryAddress]	M	#XXh= [#03h]	DNM DBMA
#4d	PositionInDynamicallyDefinedLocalIdentifier	M	#XXh	PIDDDLI
#5d	MemorySize	M	#XXh	MS
#6d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#7d	MemoryAddress (MiddleHigh Byte)	M	#XXh	MA_MHB
#8d	MemoryAddress (MiddleLow Byte)	M	#XXh	MA_MLB
#9d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
#10d	MemoryTypeIdentifier **(mandatory, but not evaluated)** [00h ... FFh]	M	#XXh [#XXh]	MTI
...	...	C	...	
#n-7d	DefinitionMode=XX [DefineByMemoryAddress]	C	#XXh= [#03h]	DNM DBMA
#n-6d	PositionInDynamicallyDefinedLocalIdentifier	C	#XXh	PIDDDLI
#n-5d	MemorySize	C	#XXh	MS
#n-4d	MemoryAddress (High Byte)	C	#XXh	MA_HB
#n-3d	MemoryAddress (MiddleHigh Byte)	M	#XXh	MA_MHB
#n-2d	MemoryAddress (MiddleLow Byte)	M	#XXh	MA_MLB
#n-1d	MemoryAddress (Low Byte)	C	#XXh	MA_LB
#nd	MemoryTypeIdentifier **(mandatory, but not evaluated)** [00h ... FFh]	M	#XXh [#XXh]	MTI

Figure I.14.3: Table DynamicallyDefineLocalIdentifier Request Message - 2C_03 (4-byte addressing)

Remark:

For **3-byte addressing** independent from delivery of a MemoryTypeIdentifier (byte 9) by the tester´s request, the ECU automatically adds an offset to the requested memory address.
If no MemoryTypeIdentifier is delivered, the same offset as for MemoryTypeIdentifier 00h (linear addressing) is used.
This base memory offset must be subtracted from any memory address taken from the MAP- /A2L- file if 3-byte addressing is not sufficient for the address range!

For **4-byte addressing** a MemoryTypeIdentifier (byte 10) must be delivered by the tester´s request. Though it is not evaluated or used within the ECU for this absolute addressing mode, it is necessary to decide between 3- /4-byte addressing mode.
In this 4-byte mode the absolute address delivered by the tester is used by the ECU without any memory offset.

For MSx80 (TriCore) the base memory offsets for **3-byte addressing** are:

MemoryTypeIdentifier:		Memory offset:	
none	(linear)	C000 0000h	
00h	(linear)	C000 0000h	
02h	(ext. FLASH)	8000 0000h	(the same as for int. FLASH)
05h	(ext. RAM)	D000 0000h	

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06h (int. FLASH) 8000 0000h
07h (UIF) 8000 xxxxh not fixed yet, address might still change !!!

The DDLI Service with the definitionMode "defineByMemoryAddress" can only read memory areas, which are also readable by RMBA-service (for details about allowed memory areas see specification 17I00J02, "SID23h: ReadMemoryByAddress").

I.14.4 DynamicallyDefineLocalIdentifier Request - ClearDDLI - 2C_04

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**DynamicallyDefineLocalIdentifier Request Service Id**	**M**	**#2Ch**	**DDLI**
#2d	DynamicallyDefinedLocalIdentifier	M	#F0h	DDDLI
#3d	DefinitionMode=XX [ClearDynamicallyDefinedLocalIdentifier]	M	#XXh= [#04h]	DNM CDDDLI

Figure I.14.4: Table DynamicallyDefineLocalIdentifier Request Message - 2C_04

I.14.5 DynamicallyDefineLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**DynamicallyDefineLocalIdentifier Positive Response Id**	**M**	**#6Ch**	**DDLIPR**
#2d	DynamicallyDefinedLocalIdentifier	M	#F0h	DDDLI

Figure I.14.5: Table DynamicallyDefineLocalIdentifier Positive Response Message

I.14.6 DynamicallyDefineLocalIdentifier negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	DynamicallyDefineLocalIdentifier Request Service Id	M	#2Ch	DDLI
#3d	responseCode= [subFunctionNotSupported-invalidFormat, conditionNotCorrect, requestOutOfRange, uploadNotAccepted, can'tUploadNumberOfBytesRequested, general response codes]	M	#XXh= [#12h, #22h, #31h, #50h, #53h, #XXh]	RC

Figure I.14.6: Table DynamicallyDefineLocalIdentifier Negative Response Message

NegativeResponseCode	*Cause of Occurrence*
SubFunctionNotSupported-invalidFormat	- selected RCI is not supported - selected DDDLI is not supported
ConditionNotCorrect	selected DNM is not supported
RequestOutOfRange	selected PIRCI does not exist
UploadNotAccepted	error in PIDDDLI information (outside DDLI area)
can'tUploadNumberOfBytesRequested	the requested information is bigger than the reserved buffer

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I.15 KWP2000 - SID 30h: inputOutputControlByLocalID Service

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ANG_SP_EXT_ADJ_VVL	O/V	0... FFH	0... 179.29687	0.703125	°
Valvtronic lift setpoint from the tester to valveronic controller					
arqtmsv_w_rb	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°CRK
Control value of VCV via tester					
arqtmsv_w_rb [NC_CBK_HPP_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°CRK
Control value of VCV via tester					
B_rqtmsv_rb	O/V	0... 1H	0 ...1	1	-
Condition VCV control via tester request					
B_rqtmsv_rb [NC_CBK_HPP_NR]	O/V	0... 1H	0 ...1	1	-
Condition VCV control via tester request					
CAM_SP_2_EX_EXT_ADJ	O/V	0... FFFFH	-128... 52300	0.8	°CRK
Output signal from the module actuator diagnosis to the function					
CAM_SP_2_IN_EXT_ADJ	O/V	0... FFFFH	-128... 52300	0.8	°CRK
Output signal from the module actuator diagnosis to the function					
CAM_SP_EX_EXT_ADJ	O/V	0... FFFFH	-128... 52300	0.8	°CRK
Output signal from the module actuator diagnosis to the function					
CAM_SP_IN_EXT_ADJ	O/V	0... FFFFH	-128... 52300	0.8	°CRK
Output signal from the module actuator diagnosis to the function					
CPPWM_EXT_ADJ	O/V	0... FFH	0... 99.60937	0.390625	%
CPPWM requested by service tool					
ECFPWM_ECF_EXT_ADJ	O/V	0... FFH	0... 99.60937	0.390625	%
Electric fan control pulse width modulation-signal for the function InputOutputControl					
ECTPWM_EXT_ADJ	O/V	0... FFH	0... 99.60937	0.390625	%
PWM output signal for the electronic controlled thermostat in case of external adjustment					
EFPPWM_EXT_ADJ	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
EFPPWM while external controling by service tool					
FUP_SP_EXT_ADJ	O/V	0... FFFFH	0... 347776	5.3067216	hPa
fuel pressure setpoint requested via KWP					
IV_EXT_ADJ [NC_CYL_NR]	O/V	0... FFH	0... 20.4	0.08	ms
Injection time cylinder individual at external adjustment					
IV_PER_EXT_ADJ [NC_CYL_NR]	O/V	0... FFH	0... 2550	10	ms
Injection period cylinder individual at external adjustment					
LSHPWM_DOWN_EXT_ADJ [NC_CBK_EX_NR]	O/V	0... FFH	0... 99.60937	0.390625	%
PWM-signal for the function InputOutputControl					
LSHPWM_UP_EXT_ADJ [NC_CBK_EX_NR]	O/V	0... FFH	0... 99.60937	0.390625	%
PWM-signal for the function InputOutputControl					
LV_ACCOUT_RLY_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACT_ACCOUT_RLY_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for ACC-Relay 0=off, 1=on					
LV_ACT_CRU_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
switch for the function InputOutputControl 1 = active 0 = deactive					
LV_ACT_DMTL_PUMP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for DMTL pump 0 = off, 1 = on					
LV_ACT_DMTLH_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for DMTL heater 0 = off, 1 = on					
LV_ACT_DMTLS_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for DMTL solenoid 0 = off, 1 = on					
LV_ACT_EBOX_CFA_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for ebox cooling fan 0 = off, 1 = on					
LV_ACT_ECRAS_DOWN_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Bit used to determine ECRASPWM by external adjustment					
LV_ACT_ECRAS_UP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Bit used to determine ECRASPWM by external adjustment					
LV_ACT_EF_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for second Exhaust Flap 0=off, 1=on					
LV_ACT_EF_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for Exhaust Flap 0=off, 1=on					
LV_ACT_MIL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for MIL 1 = active 0 = inactive					
LV_ACT_RAS_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for the radiator shutter (0 = off, 1 = on)					
LV_ACT_RLY_CRCV_HEAT_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for crankcase ventilation heater relay 0 = closed, 1 = open					
LV_ACT_RLY_HPDI_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Command from tester for switching Piezo relay (0=off, 1=on)					
LV_ACT_RLY_MAIN_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Command from tester for switching main relay (0 = off, 1 = on)					
LV_ACT_RLY_MTC_2_HEAT_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for second throttle housing heater relay 0 = closed, 1 = open					
LV_ACT_RLY_MTC_HEAT_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for throttle housing heater relay 0 = closed, 1 = open					
LV_ACT_RLY_ST_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for starter relay 0 = off, 1 = on					
LV_ACT_RLY_VCV_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for VCV relay 0 = off, 1 = on					
LV_ACT_RLY_VVL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for VVL relay 0 = off, 1 = on					
LV_ACT_SAP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Logical variable for SAP actuator test, set if request from service tool is accepted					
LV_ACT_SAV_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Logical variable for second SAV actuator test, set if request from service tool is accepted					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACT_SAV_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Logical variable for SAV actuator test, set if request from service tool is accepted					
LV_ACT_SOF_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for sound flap 0=off, 1=on					
LV_ACT_VIM_1_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for DISA1 0 = closed, 1 = open					
LV_ACT_VIM_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for DISA2 0 = closed, 1 = open					
LV_ACT_WAL_1_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for SAP 0 = off, 1 = on					
LV_AD_DIS_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
boolean for disable adaptions while active external adjust					
LV_ANG_SP_EXT_ADJ_VVL	O/V	0... 1H	0 ...1	1	-
Valvtronic lift setpoint from the tester to valveronic controller active					
LV_CAM_SP_2_EX_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_CAM_SP_2_IN_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_CAM_SP_EX_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_CAM_SP_IN_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_CPPWM_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Activation of external adjustment of CPPWM by InputOutputControl					
LV_CRU_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of readiness of the function InputOutputControl					
LV_DMTL_PUMP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_DMTLH_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_DMTLS_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_EBOX_CFA_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_ECFPWM_ECF_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_ECRAS_DOWN_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Bit indicating that external adjustment of ECRAS_DOWN is active					
LV_ECRAS_UP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Bit indicating that external adjustment of ECRAS_UP is active					
LV_ECTPWM_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of the external adjustment by InputOutputControl					
LV_EF_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Activation of external adjustment by InputOutputControl					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_EF_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Activation of external adjustment by InputOutputControl					
LV_EFP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Status of electrical fuel pump requested by service tool					
LV_FUP_SP_REQ_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
request of external adjustement of fuel pressure					
LV_IV_EXT_ADJ [NC_CYL_NR]	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_LSHPWM_DOWN_EXT_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_LSHPWM_UP_EXT_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_N_REL_CWP_SP_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_N_REL_CWP_SP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_OPG_SP_ACR_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Logical variable to activate the actuator setpoint adjustment by service tester					
LV_POIL_PWM_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_POIL_SP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_RAS_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
adjustment value for the radiator shutter (0 = off, 1 = on)					
LV_RFPPWM_EXT_ADJ [NC_NR_TCHA]	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_RLY_CRCV_HEAT_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_RLY_HPDI_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
HPDI relay control command state (0H = relay shall be switched off, 1H = relay shall be switched on)					
LV_RLY_MAIN_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Request of tester for main relay adjustment					
LV_RLY_MTC_2_HEAT_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_RLY_MTC_HEAT_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_RLY_ST_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_RLY_VCV_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Request of tester for VCV-relay adjustment					
LV_RLY_VVL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_SAP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Status of SAP requested by service tool					
LV_SAV_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Status of second SAV requested by service tool					
LV_SAV_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Status of SAV requested by service tool					
LV_SOF_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_SWI_AEB_ACT_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Adjustment value for the activation of AEB (0= Off, 1 = On)					
LV_SWI_AEB_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Adjustment value for active engine bracket (0= Off, 1 = On)					
LV_TPS_SP_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Logical variable indicates an second ETC setpoint request by external device					
LV_TPS_SP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Logical variable indicates an ETC setpoint request by external device					
LV_V_ALTER_SP_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_VIM_1_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_VIM_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_WAL_1_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by InputOutputControl					
LV_WGPWM_EXT_ADJ [NC_NR_TCHA]	O/V	0... 1H	0 ...1	1	-
activation of external adjustment "Ladedrucksteller ansteuern"					
N_REL_CWP_SP_2_EXT_ADJ	O/V	0... FFH	0... 99.60937	0.390625	%
adjustment value for speed of electrical water pump					
N_REL_CWP_SP_EXT_ADJ	O/V	0... FFH	0... 99.60937	0.390625	%
adjustment value for speed of electrical water pump					
OPG_SP_ACR_EXT_ADJ	O/V	0... FFFH	0... 99.97558	0.0244141	%
Actuator setpoint requested by service tester					
POIL_PWM_EXT_ADJ	O/V	0... FFH	0... 99.60937	0.390625	%
adjustment value for Oilpressure solenoid setpoint					
POIL_SP_EXT_ADJ	O/V	0... FFH	0... 8160	32	hPa
adjustment value for Oilpressure setpoint					
RFPPWM_EXT_ADJ [NC_NR_TCHA]	O/V	0... FFH	0... 99.60937	0.390625	%
adjustment value for RFP setpoint					
TIMEOUT_TIME_1C_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_20_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_2A_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TIMEOUT_TIME_32_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_80_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_82_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_83_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_84_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_85_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_87_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_88_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_89_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_8A_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_8B_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_9E_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_A4_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_AB_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_AC_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_AD_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_AE_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_B2_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_B5_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_B6_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_B7_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_BF_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TIMEOUT_TIME_C1_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_C2_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_C3_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_C4_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_C6_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_C7_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_C8_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_C9_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_CA_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_CB_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_CC_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_CD_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_CE_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_CF_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_D0_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_D1_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_D2_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_D3_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_D4_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_D5_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_D6_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_D8_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TIMEOUT_TIME_DA_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_DC_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_DD_KWP	O	0... FFH	0... 510	2	s
Timeout for tester request for valvetronic					
TIMEOUT_TIME_E1_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_E2_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_E3_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_E4_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_E5_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_E6_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_E7_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_E8_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_ED_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_EE_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TIMEOUT_TIME_EF_KWP	O	0... FFH	0... 510	2	s
timeout time for stopping a started service actuator diagnosis					
TPS_SP_2_EXT_ADJ	O/V	0... FFH	0... 99.60937	0.390625	%
second throttle position setpoint from tester					
TPS_SP_EXT_ADJ	O/V	0... FFH	0... 99.60937	0.390625	%
Throttle position setpoint from tester					
V_ALTER_SP_EXT_ADJ	O/V	0... FFFFH	0... 6553.5	0.1	V
adjustment value for alternator voltage setpoint					
WGPWM_EXT_ADJ [NC_NR_TCHA]	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
PWM output wastegate[NC_CBK_EX_NR]					

Input data:

Ba_ist {p. 8154}	FUP {p. 1283}	GEAR_INFO {p. 1564}	LV_AT {p. 654}
LV_BRAKE_DET {p. 4209}	LV_CS {p. 8394}	LV_ES {p. 1720}	LV_IGK {p. 906}
LV_IS {p. 1720}	LV_TEMP_MAX_SAP_COIL {p. 805}	LV_VAR_AMT {p. 655}	LV_VAR_TCT {p. 656}
N {p. 1525}	N_EFP_AV {p. 1569}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}
NC_NR_TCHA	POIL {p. 903}	STATE_MTC_HEAT {p. 6532}	STATE_SA {p. 808}
TCO {p. 1100}	VB {p. 1185}	VS {p. 1176}	

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Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FUP_MAX_KWP	-	0... FFFFH	0... 347776	5.3067216	hPa
maximum fuel pressure for external adjustment					
C_FUP_MIN_KWP	-	0... FFFFH	0... 347776	5.3067216	hPa
minimum fuel pressure for external adjustment					
C_N_MAX_KWP	-	0... 1FE0H	0... 8160	1	rpm
max engine speed for accepting a KWP2000(*) service					
C_N_MAX_KWP_POIL	-	0... 1FE0H	0... 8160	1	rpm
maximum engine speed for external adjustment with poil dependence					
C_N_MIN_KWP	-	0... 1FE0H	0... 8160	1	rpm
minimum engine speed for external adjustment					
C_N_MIN_KWP_POIL	-	0... 1FE0H	0... 8160	1	rpm
minimum engine speed for external adjustment with poil dependence					
C_POIL_MAX_KWP	-	0... FFFFH	0... 10868	0.165835	hPa
Maximum threshold for oil pressure KWP					
C_POIL_MIN_KWP	-	0... FFFFH	0... 10868	0.165835	hPa
Maximum threshold for oil pressure KWP					
C_TCO_MAX_KWP	-	0... FEH	-48... 142.5	0.75	°C
maximum TCO threshold for activation of external adjustment					
C_TCO_MIN_KWP	-	0... FEH	-48... 142.5	0.75	°C
minimum TCO threshold for activation of external adjustment					
C_VB_MIN_KWP	-	0... FFH	0... 25.89843	0.1015625	V
minimum battery voltage for external adjustment					
C_VS_MAX_KWP	-	0... FFH	0... 255	1	km/h
maximum vehicle speed for accepting the service					
ID_IDX_ACT_DS_CONF	V	0... FFFFH	0... 65535	1	-
LDP_IDX_DS_ID_IDX_ACT_DS_CONF	70	0... FFH	0... 255	1	-
LDP_IDX_ENVD_ID_IDX_ACT_DS_CONF	6	0... FFH	0... 255	1	-
calibratable index of activation conditions and output variables for SID 30h services					

General information:

All implemented SID 30h services are described below.

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I.15.1 Overview of implemented subservices

SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_02_01	Bremslichtschalter auslesen	X	X	X	X	X	X
30_03_01	Bremslichttestschalter auslesen	X	X	X	X	X	X
30_04_01	Kupplungsschalter auslesen	X	X	X	X	X	X
30_05_01	Oeldruckschalter auslesen	X	X	X	X	X	X
30_06_01	Sporttaster auslesen	X	X	X	X	X	-
30_07_01	Nullgangssensor auslesen	-	X	-	X	-	-
30_0A_01	Ansauglufttemperatur 1 auslesen	X	X	X	X	X	X
30_0B_01	Ansauglufttemperatur 2 auslesen	-	-	-	-	-	X
30_0C_01	Motortemperatur auslesen	X	X	X	X	X	X
30_0D_01	Kuehlerauslasstemperatur auslesen	X	X	X	X	X	X
30_0E_01	Oelsensor auslesen	X	X	X	X	X	X
30_10_01	Steuergeraete-Innentemperatur auslesen	X	X	X	X	X	X
30_12_01	Abgastemperatur auslesen	-	X	X	X	X	X
30_13_01	Abgastemperatur 2 auslesen	-	-	-	-	-	X
30_17_01	Umgebungsdruck auslesen	X	X	X	X	X	X
30_18_01	Saugrohrdruck1 / Ladedruck1 auslesen	X	X	X	X	X	X
30_19_01	Saugrohrdruck2 / Ladedruck2 auslesen	-	X	X	X	X	X
30_1A_01	Raildrucksenor auslesen	-	X	X	X	X	X
30_1B_01	Kl.15 Spannung auslesen	X	X	X	X	X	X
30_1C_01	Kl.87 Spannung / Versorgung DME auslesen	X	X	X	X	X	X
30_1C_00/07	Kl.87 Spannung / Versorgung DME ansteuern	X	X	X	X	X	X
30_1E_01	Fahrerwunschversorgung 1 auslesen	X	X	X	X	X	X
30_1F_01	Fahrerwunschversorgung 2 auslesen	X	X	X	X	X	X
30_20_01	Versorgungsspannung VVL Sensor auslesen	X	-	-	-	-	-
30_20_01	Versorgung HPD5-Ventil auslesen	-	X	-	X	-	X
30_20_00/07	Versorgung HPD5-Ventil ansteuern	-	X	-	X	-	X
30_21_01	Lambdasonde vor Kat Bank 1 auslesen	X	X	X	X	X	X
30_22_01	Lambdasonde hinter Kat Bank 1 auslesen	X	X	X	X	X	X
30_23_01	Lambdasonde vor Kat Bank 2 auslesen	X	X	X	X	X	X
30_24_01	Lambdasonde hinter Kat Bank 2 auslesen	X	X	X	X	X	X
30_25_01	Luftmassenmesser 1 auslesen	X	X	X	X	X	X
30_27_01	Batteriesensor auslesen	X	X	X	X	X	X
30_28_01	Fahrerwunsch1 auslesen	X	X	X	X	X	X
30_29_01	Fahrerwunsch 2 auslesen	X	X	X	X	X	X
30_2A_01	Drosselklappe auslesen	X	X	X	X	X	X

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SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_2A_00/07	Drosselklappe ansteuern	X	X	X	X	X	X
30_2E_01	Sekundaerluft HFM auslesen	X	-	-	-	-	X
30_2F_01	Taster Tempomat	X	X	X	X	X	-
30_30_01	Klopfbaustein1 auslesen	X	X	X	X	X	X
30_31_01	Klopfbaustein 2 auslesen	X	X	X	X	X	X
30_32_01	Generator Sollspannung BSD auslesen	X	X	X	X	X	X
30_32_00/07	Generator Sollspannung BSD ansteuern	X	X	X	X	X	X
30_37_01	Oeldrucksensor auslesen	X	X	X	X	X	-
30_3B_01	NOx-Sensor auslesen	X	X	X	X	X	-
30_3F_01	Kraftsoffniederdrucksensor auslesen	-	X	X	X	X	X
30_40_01	Bremsunterdrucksensor auslesen	X	X	-	X	-	-
30_43_01	Raildrucksenor 2 auslesen	-	-	-	-	-	X
30_44_01	Klopfbaustein 3 auslesen	-	-	-	-	-	X
30_45_01	Klopfbaustein 4 auslesen	-	-	-	-	-	X
30_46_01	Luftmassenmesser 2 auslesen	-	-	-	-	-	X
30_80_01	Radiator shutter auslesen	-	-	X	-	X	-
30_80_00/07	Radiator shutter ansteuern	-	-	X	-	X	-
30_82_01	HPD-Relais auslesen	-	X	-	X	-	X
30_82_00/07	HPD-Relais ansteuern	-	X	-	X	-	X
30_83_01	Wasserpumpe Turbolader auslesen	-	-	-	-	-	X
30_83_00/07	Wasserpumpe Turbolader ansteuern	-	-	-	-	-	X
30_84_01	Drosselklappenstellergehäuseheizung 2 auslesen	-	-	-	-	-	X
30_84_00/07	Drosselklappenstellergehäuseheizung 2 ansteuern	-	-	-	-	-	X
30_85_01	Drosselklappe 2 auslesen	-	-	-	-	-	X
30_85_00/07	Drosselklappe 2 ansteuern	-	-	-	-	-	X
30_86_01	(second) HPD5-Mengensteuerventil auslesen	-	X	-	X	-	X
30_86_00/07	(second) HPD5-Mengensteuerventil ansteuern	-	X	-	X	-	X
30_87_01	Abgasklappe 2 auslesen	-	-	-	-	-	X
30_87_00/07	Abgasklappe 2 ansteuern	-	-	-	-	-	X
30_88_01	Vanos Einlass Ventil Bank2 auslesen	-	-	-	-	-	X
30_88_00/07	Vanos Einlass Ventil Bank2 ansteuern	-	-	-	-	-	X
30_89_01	Vanos Auslass Ventil Bank2 auslesen	-	-	-	-	-	X
30_89_00/07	Vanos Auslass Ventil Bank2 ansteuern	-	-	-	-	-	X
30_8A_01	Umluftventil Bank 2 auslesen	-	-	-	-	-	X
30_8A_00/07	Umluftventil Bank 2 ansteuern	-	-	-	-	-	X

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SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_8B_01	Sekundaerluftventil 2 auslesen	-	-	-	-	-	X
30_8B_00/07	Sekundaerluftventil 2 ansteuern	-	-	-	-	-	X
30_9E_01	Drosselklappenstellergehaueseheizung auslesen	-	X	X	X	X	X
30_9E_00/07	Drosselklappenstellergehaueseheizung ansteuern	-	X	X	X	X	X
30_A4_01	Gesteuerte Luftfuehrung (untere Klappe) auslesen	X	X	X	X	X	X
30_A4_00/07	Gesteuerte Luftfuehrung (untere Klappe) ansteuern	X	X	X	X	X	X
30_AB_01	Oel Druck Regelung auslesen	X	X	X	X	X	-
30_AB_00/07	Oel Druck Regelung ansteuern	X	X	X	X	X	-
30_AC_01	Oeldruckventil auslesen	X	X	X	X	X	-
30_AC_00/07	Oeldruckventil ansteuern	X	X	X	X	X	-
30_AD_01	Kurbelgehaeuseentlueftungsheizung auslesen	-	X	X	X	X	X
30_AD_00/07	Kurbelgehaeuseentlueftungsheizung ansteuern	-	X	X	X	X	X
30_AE_01	Variable Sauganlage (DISA) Klappe2 auslesen	X	X	X	X	X	-
30_AE_00/07	Variable Sauganlage (DISA) Klappe2 ansteuern	X	X	X	X	X	-
30_B2_01	Motorlagersteuerung auslesen	-	X	X	X	X	-
30_B2_00/07	Motorlagersteuerung ansteuern	-	X	X	X	X	-
30_B5_01	Umluftventil Bank 1 auslesen	-	-	-	-	X	X
30_B5_00/07	Umluftventil Bank 1 ansteuern	-	-	-	-	X	X
30_B6_01	Ladedrucksteller 1 auslesen	-	X	X	X	X	X
30_B6_00/07	Ladedrucksteller 1 ansteuern	-	X	X	X	X	X
30_B7_01	Ladedrucksteller 2 auslesen	-	X	X	X	X	X
30_B7_00/07	Ladedrucksteller 2 ansteuern	-	X	X	X	X	X
30_BD_01	Mengensteuerventil auslesen	-	X	X	X	X	X
30_BD_00/07	Mengensteuerventil ansteuern	-	X	X	X	X	X
30_BE_01	Abgasrückführungsventil auslesen	X	X	X	X	X	-
30_BE_00/07	Abgasrückführungsventil ansteuern	X	X	X	X	X	-
30_BF_01	elektr. Wasserpumpe ueber BSD auslesen	X	X	X	X	X	-
30_BF_00/07	elektr. Wasserpumpe ueber BSD ansteuern	X	X	X	X	X	-
30_C1_01	Abgasklappe auslesen	X	X	X	X	X	X
30_C1_00/07	Abgasklappe ansteuern	X	X	X	X	X	X
30_C2_01	Soundklappeauslesen	X	X	X	X	X	X
30_C2_00/07	Soundklappe ansteuern	X	X	X	X	X	X
30_C3_01	Gesteuerte Luftfuehrung auslesen	X	X	X	X	X	X
30_C3_00/07	Gesteuerte Luftfuehrung ansteuern	X	X	X	X	X	X

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SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_C4_01	Startrelais auslesen	X	X	X	X	X	X
30_C4_00/07	Startrelais ansteuern	X	X	X	X	X	X
30_C6_01	Variable Sauganlage (DISA) Klappe auslesen	X	X	X	X	X	-
30_C6_00/07	Variable Sauganlage (DISA) Klappe ansteuern	X	X	X	X	X	-
30_C7_01	Klimakompressor-Relais auslesen	X	X	X	X	X	-
30_C7_00/07	Klimakompressor-Relais ansteuern	X	X	X	X	X	-
30_C8_01	EBOX_Controlled_Fan auslesen	X	X	X	X	X	X
30_C8_00/07	EBOX_Controlled_Fan ansteuern	X	X	X	X	X	X
30_C9_01	Electr_Controlled_Thermostat auslesen	X	X	X	X	X	X
30_C9_00/07	Electr_Controlled_Thermostat ansteuern	X	X	X	X	X	X
30_CA_01	Sekundaerluftventil auslesen	X	-	-	-	-	X
30_CA_00/07	Sekundareluftventil ansteuern	X	-	-	-	-	X
30_CB_01	Sekundaerluftpumpe auslesen	X	-	-	-	-	X
30_CB_00/07	Sekundaerluftpumpe ansteuern	X	-	-	-	-	X
30_CC_01	Diagnosemodul-Tank Leckage Pumpe auslesen	X	-	X	-	X	X
30_CC_00/07	Diagnosemodul-Tank Leckage Pumpe ansteuern	X	-	X	-	X	X
30_CD_01	Diagnosemodul-Tank Leckage Ventil auslesen	X	-	X	-	X	X
30_CD_00/07	Diagnosemodul-Tank Leckage Ventil ansteuern	X	-	X	-	X	X
30_CE_01	Diagnosemodul-Tank Leckage Heizung auslesen	X	-	X	-	X	X
30_CE_00/07	Diagnosemodul-Tank Leckage Heizung ansteuern	X	-	X	-	X	X
30_CF_01	Canister_Purge_Solenoid auslesen	X	X	X	X	X	X
30_CF_00/07	Canister_Purge_Solenoid ansteuern	X	X	X	X	X	X
30_D0_01	Lambda_Sensor_Heating_Up_1 auslesen	X	X	X	X	X	X
30_D0_00/07	Lambda_Sensor_Heating_Up_1 ansteuern	X	X	X	X	X	X
30_D1_01	Lambda_Sensor_Heating_Down_1 auslesen	X	X	X	X	X	X
30_D1_00/07	Lambda_Sensor_Heating_Down_1 ansteuern	X	X	X	X	X	X
30_D2_01	Lambda_Sensor_Heating_Up_2 auslesen	X	X	X	X	X	X
30_D2_00/07	Lambda_Sensor_Heating_Up_2 ansteuern	X	X	X	X	X	X
30_D3_01	Lambda_Sensor_Heating_Down_2 auslesen	X	X	X	X	X	X
30_D3_00/07	Lambda_Sensor_Heating_Down_2 ansteuern	X	X	X	X	X	X
30_D4_01	Malfunction_Indicator_Lamp auslesen	X	X	X	X	X	X
30_D4_00/07	Malfunction_Indicator_Lamp ansteuern	X	X	X	X	X	X

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SID number	service	MSV_80	MSD_80 (4cyl)	MSD_80 (6cyl)	MSD_81 (4cyl)	MSD_81 (6cyl)	MSD85 (L4)
30_D5_01	Fahrgeschwindigkeitsregler-Lampe auslesen	X	X	X	X	X	X
30_D5_00/07	Fahrgeschwindigkeitsregler-Lampe ansteuern	X	X	X	X	X	X
30_D6_01	EML_Lamp auslesen	X	X	X	X	X	X
30_D6_00/07	EML_Lamp ansteuern	X	X	X	X	X	X
30_D8_01	Electrical_Fuel_Pump auslesen	X	X	X	X	X	X
30_D8_00/07	Electrical_Fuel_Pump ansteuern	X	X	X	X	X	X
30_DA_01	E-Box-Luefter auslesen	X	X	X	X	X	X
30_DA_00/07	E-Box-Luefter ansteuern	X	X	X	X	X	X
30_DC_01	VVT-Entlastungsrelais auslesen	X	-	-	-	-	X
30_DC_00/07	VVT-Entlastungsrelais ansteuern	X	-	-	-	-	X
30_DD_01	ValveTronic Lift auslesen	X	-	-	-	-	X
30_DD_00/07	ValveTronic Lift ansteuern	X	-	-	-	-	X
30_E1_01	Einspritzventil 1 auslesen	X	X	X	X	X	X
30_E1_00/07	Einspritzventil 1 ansteuern	X	-	-	-	-	-
30_E2_01	Einspritzventil 2 auslesen	X	X	X	X	X	X
30_E2_00/07	Einspritzventil 2 ansteuern	X	-	-	-	-	-
30_E3_01	Einspritzventil 3 auslesen	X	X	X	X	X	X
30_E3_00/07	Einspritzventil 3 ansteuern	X	-	-	-	-	-
30_E4_01	Einspritzventil 4 auslesen	X	X	X	X	X	X
30_E4_00/07	Einspritzventil 4 ansteuern	X	-	-	-	-	-
30_E5_01	Einspritzventil 5 auslesen	X	-	X	-	X	X
30_E5_00/07	Einspritzventil 5 ansteuern	X	-	-	-	-	-
30_E6_01	Einspritzventil 6 auslesen	X	-	X	-	X	X
30_E6_00/07	Einspritzventil 6 ansteuern	X	-	-	-	-	-
30_E7_01	Einspritzventil 7 auslesen	-	-	-	-	-	X
30_E8_01	Einspritzventil 8 auslesen	-	-	-	-	-	X
30_ED_01	Vanos Einlass Ventil auslesen	X	X	X	X	X	X
30_ED_00/07	Vanos Einlass Ventil ansteuern	X	X	X	X	X	X
30_EE_01	Vanos Auslass Ventil auslesen	X	X	X	X	X	X
30_EE_00/07	Vanos Auslass Ventil ansteuern	X	X	X	X	X	X
30_EF_01	HPD5-Mengensteuerventil 1 auslesen	-	-	-	-	-	X
30_EF_00/07	HPD5-Mengensteuerventil 1 ansteuern	-	-	-	-	-	X

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Application conditions (expect services 30_xx_00/01, 30_BD_07, 30_CB_07):

***Initialisation**:* 0 at reset

***Activation**:* depending on calibratable conditions
see chapter "Activation conditions for SID 30_xx_07h services"

Deactivation: not activation

Service location: for each project depending on calibration data ID_IDX_ACT_DS_CONF

Global negative Responses

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**negativeResponse Service Id**	**M**	**7Fh**	**NR**
2d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOBLID
3d	responseCode= only general response code	M	XXh	RC

The detailed message of the negative response code is described in chapter "Error-Codes".

I.15.2 Flag for disable adaptions while external adjust with SID 30_xx_07h services

General information:

The flag LV_AD_DIS_EXT_ADJ is set when an external adustment is done. The flag is set back to zero at ECU reset.

Application conditions

Initialisation: *0 at reset*

Activation: *if a SID 30,xx,07 job is received*

Formula section:

LV_AD_DIS_EXT_ADJ = 1 *// if a SID 30,xx,07 job is received*

I.15.3 Activation conditions for SID 30_xx_07h services

General information:

All SID 30_xx_07 services (external adjust of actuators) are only allowed if several activation conditions are fulfilled. The activation condition(s), which has/have to be fulfilled, can be chosen for every adjustment service via a calibratable bitmask in the table ID_IDX_ACT_DS_CONF. In this table one axis is the identifier of the service. On the other axis on position 0 a word can be calibrated for every service (positions 1...5 in the table are reserved for maximal 5 variables from the DDLI- lists for the read- services, see chapter "actuator diagnosis read value " below). The activation- condition- word must be calibrated in the following way: In the bitmask every activation condition, which has to be checked, must be set to "1". The possible conditions with their positions are listed in the table below. The combination of the conditions gives the hex- value of the word, which has to be written to ID_IDX_ACT_DS_CONF (on position 0 and position with service identifier).
Example: On Position (A1;0) in the table ID_IDX_ACT_DS_CONF 1h (= 0000 0000 0000 0001 bin) is calibrated. So the service 30_A1_07 is only activated if LV_IGK = 1.
If position (A1;0) is calibrated with 81h (0000 0000 1000 0001 bin), service 30_A1_07 is only activated if LV_IGK = 1 and VB > C_VB_MIN_KWP.

Formula section:

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Condition name	BitValue	Conditions that have to be fullfilled
Diagnosis (always checked)	00 00	N < C_N_MAX_KWP
Kl15 ON	00 01	LV_IGK = 1
N = 0	00 02	LV_ES = 1
Idle speed	00 04	LV_IS = 1
N > N_MIN	00 08	N > C_N_MIN_KWP
v = 0	00 10	VS < C_VS_MAX_KWP
Engine warm	00 20	TCO > C_TCO_MIN_KWP
Engine temperature normal	00 40	TCO < C_TCO_MAX_KWP
Batt normal	00 80	VB > C_VB_MIN_KWP
NEUTRAL	01 00	**If(1)** GEAR_INFO = 0 **Then(1)** **If(2)** LV_AT = 0 **and** LV_VAR_AMT = 0 **and** LV_VAR_TCT = 0 **Then(2)** **If(3)** LV_CS = 0 **Then(3)** activation **Endif(3)** **Else(2)** **If(3)** LV_VAR_AMT = 1 **or** LV_VAR_TCT = 1 **Then(3)** **If(4)** LV_BRAKE_DET = 0 **Then(4)** activation **Endif(4)** **Else(3)** **If(4)** LV_AT = 1 **Then(4)** activation **Endif(4)** **Endif(3)** **Endif(2)** **Endif(1)**
Fuel pump OFF	02 00	LV_ES = 1 **AND** N_EFP_AV = 0
Minimum oil pressure	04 00	POIL > C_POIL_MIN_KWP and N> C_N_MIN_KWP_POIL
Maxmum oil pressure	08 00	POIL < C_POIL_MAX_KWP and N< C_N_MAX_KWP_POIL
Minimum fuel pressure	10 00	FUP > C_FUP_MIN_KWP
Maxmum fuel pressure	20 00	FUP < C_FUP_MAX_KWP
nn	40 00	0
nn	80 00	0

I.15.4 30_xx_01h - actuator diagnosis read value -

General information:

With this service actual actuator values can be read. The variable(s), which has to be read, can be choosen out of several tables in software (DDLI- lists) via a calibratable identifier. The DDLI- lists are described in the chapter "Introduction." The identifier is a word value which represents the place in the DDLI- list. The calibration can be done within the table ID_IDX_ACT_DS_CONF. In this table one axis is the identifier of the service. On the other axis on positions 1...3 maximal 3 variables from the DDLI- lists can be chosen via the DDLI- identifier. (Position 0 in the table is reserved for activation conditions of adjustment jobs 30_xx_07; see chapter "activation conditions" above.)

The telegram length is variable and depends on the number and length (byte, word) of the chosen variable(s). If an illegal identifier is calibrated on position 1...3 in the table ID_IDX_ACT_DS_CONF (e.g. not defined identifiers) the service does not give back an error message! Instead of this the next valid calibrated variable is given on the next position in telegram.

Example: If the first variable is calibrated valid, it becomes the first position in the telegram (depending on the length of the variable (byte or word) this can be the first one or the first two data bytes of the telegramm.) The second position is not calibrated valid, but the third is. So the variable, calibrated on third position is given back on second position in telegram.

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Application conditions

Initialisation: 0 at reset

Activation: LV_IGK =1

Deactivation: not activation

Service location: see list of "implemented diagnostic services"

InputOutputControlByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2	InputOutputLocalIdentifier -	M	XXh	IOLI_
	[			
	Bremslichtschalter		02h	
	Bremslichttestschalter		03h	
	Kupplungsschalter		04h	
	Oeldruckschalter		05h	
	Sporttaster		06h	
	Nullgangssensor		07h	
	Ansauglufttemperatur 1		0Ah	
	Ansauglufttemperatur 2		0Bh	
	Motortemperatur		0Ch	
	Kuehlerauslasstemperatur		0Dh	
	Oelsensor		0Eh	
	Steuergeraete-Innentemperatur		10h	
	Abgastemperatur		12h	
	Abgastempertur 2		13h	
	Umgebungsdruck		17h	
	Saugrohrdruck1 / Ladedruck1		18h	
	Saugrohrdruck2 / Ladedruck2		19h	
	Raildrucksenor		1Ah	
	Kl.15 Spannung		1Bh	
	Kl.87 Spannung / Versorgung DME (Digitale Motor Elektronik)		1Ch	
	Fahrerwunschversorgung 1		1Eh	
	Fahrerwunschversorgung 2		1Fh	
	Versorgungsspannung VVL Sensor (not MSD85)		20h	
	Versorgung HPDI-Ventil (only MSD85)		20h	
	Lambdasonde vor Kat Bank1		21h	
	Lambdasonde hinter Kat Bank1		22h	
	Lambdasonde vor Kat Bank2		23h	
	Lambdasonde hinter Kat Bank2		24h	
	Luftmassenmesser 1		25h	
	Batteriesensor		27h	
	Fahrerwunsch 1		28h	
	Fahrerwunsch 2		29h	

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	Drosselklappe		2Ah	
	Sekundaerluft HFM (Heissfilm Luftmassenmesser)		2Eh	
	Taster Tempomat		2Fh	
	Klopfbaustein 1		30h	
	Klopfbaustein 2		31h	
	Generator Sollspannung BSD (Bit Serielle Datenschnittstelle)		32h	
	Oeldrucksensor		37h	
	NOx-Sensor		3Bh	
	Kraftsoffniederdrucksensor		3Fh	
	Bremsunterdrucksensor		40h	
	Raildrucksensor 2		43h	
	Klopfbaustein 3		44h	
	Klopfbaustein 4		45h	
	Mass air flow 2		46h	
	Radiator shutter		80h	
	HPD-Relais		82h	
	Wasserpumpe Turbolader		83h	
	Drosselklappenstellergehäuseheizung 2		84h	
	Drosselklappe 2		85h	
	(second) HPD5-Mengensteuerventil		86h	
	Abgasklappe 2		87h	
	Vanos Einlass Ventil Bank2		88h	
	Vanos Auslass Ventil Bank2		89h	
	Umluftventil Bank2		8Ah	
	second Sekundaerluftventil		8Bh	
	Drosselklappenstellergehäuseheizung		9Eh	
	Gesteuerte Luftfuehrung (untere Klappe)		A4h	
	Oeldruck-Regelung		ABh	
	Oeldruckventil		ACh	
	Kurbelgehaeuseentlueftungsheizung		ADh	
	Variable Sauganlage (DISA) Klappe2		Aeh	
	Motorlager		B2h	
	Umluftventil Bank1		B5h	
	Mengensteuerventil		BDh	
	Abgasrückführungsventil		BEh	
	elektr. Wasserpumpe ueber BSD (Bit Serielle Datenschnittstelle)		BFh	
	Abgasklappe		C1h	
	Soundklappe		C2h	
	Gesteuerte Luftfuehrung (obere Klappe)		C3h	
	Startrelais		C4h	
	Variable Sauganlage (DISA) Klappe		C6h	
	Klimakompressor-Relais		C7h	
	E-Box-Luefter		C8h	
	Kennfeldthermostat		C9h	
	Sekundaerluftventil		CAh	
	Sekundaerluftpumpe		CBh	
	Diagnosemodul-Tank Leckage Pumpe		CCh	
	Diagnosemodul-Tank Leckage Ventil		CDh	
	Diagnosemodul-Tank Leckage Heizung		CEh	
	Tankentlueftungsventil		CFh	
	Lambdasondenheizung vor Kat Bank1		D0h	
	Lambdasondenheizung hinter Kat Bank1		D1h	
	Lambdasondenheizung vor Kat Bank2		D2h	
	Lambdasondenheizung hinter Kat Bank2		D3h	
	MIL (Malfunction Indicator Lamp)		D4h	
	Fahrgeschwindigkeitsregler-Lampe		D5h	
	EML (Engine Malfunction Lamp)		D6h	
	Elektrische Kraftstoffpumpe 1		D8h	
	E-Box-Luefter		DAh	
	VVT-Entlastungsrelais		DCh	
	VVT		DDh	
	Einspritzventil 1		E1h	
	Einspritzventil 2		E2h	
	Einspritzventil 3		E3h	
	Einspritzventil 4		E4h	
	Einspritzventil 5		E5h	
	Einspritzventil 6		E6h	
	Einspritzventil 7		E7h	
	Einspritzventil 8		E8h	
	Vanos Einlass Ventil		EDh	
3	inputOutputControlParameter	M	01h	IOCP_RCS

InputOutputControlByLocalIdentifier positive Response

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Data Byte	***Parameter Name***	***Cvt***	***Hex Value***	***Mnemonic***
1	**inputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2	InputOutputLocalIdentifier -	M	XXh	IOLID
	[			
	Bremslichtschalter		02h	
	Bremslichttestschalter		03h	
	Kupplungsschalter		04h	
	Oeldruckschalter		05h	
	Sporttaster		06h	
	Nullgangssensor		07h	
	Ansauglufttemperatur 1		0Ah	
	Ansauglufttemperatur 2		0Bh	
	Motortemperatur		0Ch	
	Kuehlerauslasstemperatur		0Dh	
	Oelsensor		0Eh	
	Steuergeraete-Innentemperatur		10h	
	Abgastemperatur		12h	
	Abgastempertatur 2		13h	
	Umgebungsdruck		17h	
	Saugrohrdruck1 / Ladedruck1		18h	
	Saugrohrdruck2 / Ladedruck2		19h	
	Raildrucksenor		1Ah	
	Kl.15 Spannung		1Bh	
	Kl.87 Spannung / Versorgung DME (Digitale Motor Elektronik)		1Ch	
	Fahrerwunschversorgung 1		1Eh	
	Fahrerwunschversorgung 2		1Fh	
	Versorgungsspannung VVL Sensor (not MSD85)		20h	
	Versorgung HPDI-Ventil (only MSD85)		20h	
	Lambdasonde vor Kat Bank1		21h	
	Lambdasonde hinter Kat Bank1		22h	
	Lambdasonde vor Kat Bank2		23h	
	Lambdasonde hinter Kat Bank2		24h	
	Luftmassenmesser 1		25h	
	Batteriesensor		27h	
	Fahrerwunsch 1		28h	
	Fahrerwunsch 2		29h	
	Drosselklappe		2Ah	
	Sekundaerluft HFM (Heissfilm Luftmassenmesser)		2Eh	
	Taster Tempomat		2Fh	
	Klopfbaustein 1		30h	
	Klopfbaustein 2		31h	
	Generator Sollspannung BSD (Bit Serielle Datenschnittstelle)		32h	
	Oeldrucksensor		37h	
	NOx-Sensor		3Bh	
	Kraftsoffniederdrucksensor		3Fh	
	Bremsunterdrucksensor		40h	
	Raildrucksensor 2		43h	
	Klopfbaustein 3		44h	
	Klopfbaustein 4		45h	
	Mass air flow 2		46h	
	Radiator shutter		80h	
	HPD-Relais		82h	
	Wasserpumpe Turbolader		83h	
	Drosselklappenstellergehäuseheizung 2		84h	
	Drosselklappe 2 ansteuern		85h	
	(second) HPD5-Mengensteuerventil		86h	
	Abgasklappe 2		87h	
	Vanos Einlass Ventil Bank2		88h	
	Vanos Auslass Ventil Bank2		89h	
	Umluftventil Bank2		8Ah	
	second Sekundaerluftventil		8Bh	
	Drosselklappenstellergehäuseheizung		9Eh	
	Gesteuerte Luftfuehrung (untere Klappe)		A4h	
	Oeldruck-Regelung		ABh	
	Oeldruckventil		ACh	
	Kurbelgehaeuseentlueftungsheizung		ADh	
	Variable Sauganlage (DISA) Klappe2		AEh	
	Motorlager		B2h	
	Umluftventil Bank1		B5h	
	Mengensteuerventil		BDh	
	Abgasrückführungsventil		BEh	
	elektr. Wasserpumpe ueber BSD (Bit Serielle Datenschnittstelle)		BFh	

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	Fahrgeschwindigkeitsregler-Lampe EML (Engine Malfunction Lamp) Elektrische Kraftstoffpumpe 1 E-Luefter VVT-Entlastungsrelais VVT Einspritzventil 1 Einspritzventil 2 Einspritzventil 3 Einspritzventil 4 Einspritzventil 5 Einspritzventil 6 Einspritzventil 7 Einspritzventil 8 Vanos Einlass Ventil Vanos Auslass Ventil HPD5-Mengensteuerventil 1]		D5h D6h D8h DAh DCh DDh E1h E2h E3h E4h E5h E6h E7h E8h EDh EEh EFh]	
3	inputOutputControlParameter	M	01h	IOCP_RCS
4	Data Byte depending on calibration	M	XXh	xx
...	...	...	...	...
n	Data Byte depending on calibration	M	XXh	xx

Table InputOutputControlByLocalIdentifier positive response message

InputOutputControlByLocalIdentifier negative Response
Global Negative Responses

I.15.5 30_xx_00h - stop actuator diagnosis -

General information:

When this service is received, the actuator diagnosis function stops and control is given back to the ECU control.
xx in the headline represents the identifier (00 ... FFh) of the actuator diagnosis service.

Application conditions

Initialisation: 0 at reset

Activation: LV_IGK =1

Deactivation: not activation

Service location: see list of "implemented diagnostic services"

InputOutputControlByLocalIdentifier Request
.

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLID

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2	InputOutputLocalIdentifier - [Kl.87 Spannung / Versorgung DME (Digitale Motor Elektronik) Versorgung HPDI-Ventil Drosselklappe Generator Sollspannung BSD (Bit Serielle Datenschnittstelle) Radiator shutter HPD-Relais Wasserpumpe Turbolader Drosselklappenstellergehäuseheizung 2 Drosselklappe 2 (second) HPD5-Mengensteuerventil Abgasklappe 2 Vanos Einlass Ventil Bank2 Vanos Auslass Ventil Bank2 Umluftventil Bank2 second Sekundaerluftventil Drosselklappenstellergehäuseheizung Gesteuerte Luftfuehrung (untere Klappe) Oeldruck-Regelung Oeldruckventil Kurbelgehaeuseentlueftungsheizung Variable Sauganlage (DISA) Klappe2 Motorlager Umluftventil Bank1 Ladedrucksteller 1 Ladedrucksteller 2 Mengensteuerventil Abgasrückführungsventil elektr. Wasserpumpe ueber BSD (Bit Serielle Datenschnittstelle) Abgasklappe Soundklappe Gesteuerte Luftfuehrung (obere Klappe) Startrelais Variable Sauganlage (DISA) Klappe Klimakompressor-Relais E-Box-Luefter Kennfeldthermostat Sekundaerluftventil Sekundaerluftpumpe Diagnosemodul-Tank Leckage Pumpe Diagnosemodul-Tank Leckage Ventil Diagnosemodul-Tank Leckage Heizung Tankentlueftungsventil Lambdasondenheizung vor Kat Bank1 Lambdasondenheizung hinter Kat Bank1 Lambdasondenheizung vor Kat Bank2 Lambdasondenheizung hinter Kat Bank2 MIL (Malfunction Indicator Lamp) Fahrgeschwindigkeitsregler-Lampe EML (Engine Malfunction Lamp) Elektrische Kraftstoffpumpe 1 E-Box-Luefter VVT-Entlastungsrelais VVT Einspritzventil 1 Einspritzventil 2 Einspritzventil 3 Einspritzventil 4 Einspritzventil 5 Einspritzventil 6 Vanos Einlass Ventil Vanos Auslass Ventil HPD5-Mengensteuerventil 1]	M	XXh [1Ch 20h 2Ah 32h 80h 82h 83h 84h 85h 86h 87h 88h 89h 8Ah 8Bh 9Eh A4h ABh ACh ADh AEh B2h B5h B6h B7h BDh BEh BFh C1h C2h C3h C4h C6h C7h C8h C9h CAh CBh CCh CDh CEh CFh D0h D1h D2h D3h D4h D5h D6h D8h DAh DCh DDh E1h E2h E3h E4h E5h E6h EDh EEh EFh]	IOLI_XX

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3	inputOutputControlParameter	M	00h	IOCP_RCTECU

InputOutputControlByLocalIdentifier positive Response

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.

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**inputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**

2	InputOutputLocalIdentifier - [Kl.87 Spannung / Versorgung DME (Digitale Motor Elektronik) Versorgung HPDI-Ventil Drosselklappe Generator Sollspannung BSD (Bit Serielle Datenschnittstelle) Radiator shutter HPD-Relais Wasserpumpe Turbolader Drosselklappenstellergehäuseheizung 2 Drosselklappe 2 (second) HPD5-Mengensteuerventil Abgasklappe 2 Vanos Einlass Ventil Bank2 Vanos Auslass Ventil Bank2 Umluftventil Bank2 second Sekundaerluftventil Drosselklappenstellergehäuseheizung Gesteuerte Luftfuehrung (untere Klappe) Oeldruck-Regelung Oeldruckventil Kurbelgehaeuseentlueftungsheizung Variable Sauganlage (DISA) Klappe2 Motorlager Umluftventil Bank1 Ladedrucksteller 1 Ladedrucksteller 2 Mengensteuerventil Abgasrückführungsventil elektr. Wasserpumpe ueber BSD (Bit Serielle Datenschnittstelle) Abgasklappe Soundklappe Gesteuerte Luftfuehrung (obere Klappe) Startrelais Variable Sauganlage (DISA) Klappe Klimakompressor-Relais E-Box-Luefter Kennfeldthermostat Sekundaerluftventil Sekundaerluftpumpe Diagnosemodul-Tank Leckage Pumpe Diagnosemodul-Tank Leckage Ventil Diagnosemodul-Tank Leckage Heizung Tankentlueftungsventil Lambdasondenheizung vor Kat Bank1 Lambdasondenheizung hinter Kat Bank1 Lambdasondenheizung vor Kat Bank2 Lambdasondenheizung hinter Kat Bank2 MIL (Malfunction Indicator Lamp) Fahrgeschwindigkeitsregler-Lampe EML (Engine Malfunction Lamp) Elektrische Kraftstoffpumpe 1 E-Luefter VVT-Entlastungsrelais VVT Einspritzventil 1 Einspritzventil 2 Einspritzventil 3 Einspritzventil 4 Einspritzventil 5 Einspritzventil 6 Vanos Einlass Ventil Vanos Auslass Ventil HPD5-Mengensteuerventil 1]	M	XXh [1Ch 20h 2Ah 32h 80h 82h 83h 84h 85h 86h 87h 88h 89h 8Ah 8Bh 9Eh A4h ABh ACh ADh AEh B2h B5h B6h B7h BDh BEh BFh C1h C2h C3h C4h C6h C7h C8h C9h CAh CBh CCh CDh CEh CFh D0h D1h D2h D3h D4h D5h D6h D8h DAh DCh DDh E1h E2h E3h E4h E5h E6h EDh EEh EFh]	IOLI_

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3	inputOutputControlParameter	M	00h	IOCP_RCTECU

InputOutputControlByLocalIdentifier negative Response
Global Negative Responses

I.15.6 30_1C07 - Kl.87 Spannung /Versorgung DME (Digitale Motor Elektronik) ansteuern

Formula section:

InputOutputControlByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Kl.87 Spannung / Versorgung	M	1Ch	IOLI_UVSG
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_UVSG
5d	InputOutputControlParameter - LV_RLY_MAIN_EXT_ADJ	M	XXh	CS_TV_UVSG
6d	InputOutputControlParameter - TIMEOUT_TIME_1C_KWP	M	XXh	CS_TO_UVSG

Figure I.15.1: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	1Ch	IOLI_UVSG
3d	InputOutputControlParameter	M	07h	IOCP_UVSG

Figure I.15.2: Table InputOutputControlByLocalIdentifier positive response message

InputOutputControlByLocalIdentifier negative Response
Global Negative Responses

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I.15.7 30_2007 - Versorgung HPDI-Ventil steuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	20h	IOLI_UVLSS
3	inputOutputControlParameter	M	07h	IOCP_STA
4	InputOutputControlParameter -not used	M	FFh	CS_PD_UVLSS
5	InputOutputControlParameter - LV_RLY_HPDI_EXT_ADJ	M	xxh	CS_LV_RLY_HPDI_EXT_ADJ
6	InputOutputControlParameter - TIMEOUT_TIME_20_KWP	M	xxh	CS_TO_UVLSS

InputOutputControlByLocalIdentifier Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**InputOutputControlByLocalIdentifier Response SId**	**M**	**70h**	**IOCBLIDPR**
2	InputOutputLocalIdentifier	M	20h	IOLI_UVLSS
3	InputOutputControlParameter	M	07h	IOCP_STA

I.15.8 30_2A07 - Drosselklappe ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLI**
2d	InputOutputLocalIdentifier - Drosselklappe	M	2Ah	IOLI_DK
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_DK
5d	InputOutputControlParameter - TPS_SP_EXT_ADJ	M	XXh	CS_TV_DK
6d	InputOutputControlParameter - TIMEOUT_TIME_2A_KWP	M	XXh	CS_TO_DK

Figure I.15.3: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	2Ah	IOLI_DK
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.4: Table InputOutputControlByLocalIdentifier positive response message

I.15.9 30_3207 - Generator Sollspannung BSD (Bit Serielle Datenschnittstelle) ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Generator Sollspannung BSD	M	32h	IOLI_UGEN
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PHY_UGEN
5d	inputOutputControlParameter - V_ALTER_SP_EXT_ADJ high byte	M	XXh	CS_PHY_UGEN
6d	InputOutputControlParameter - V_ALTER_SP_EXT_ADJ low byte	M	XXh	CS_PHY_UGEN
7d	InputOutputControlParameter - TIMEOUT_TIME_32_KWP	M	XXh	CS_TO_UGEN

Figure I.15.5: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	32h	IOLI_UGEN
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.6: Table InputOutputControlByLocalIdentifier positive response message

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I.15.10 30_8007 - Radaitor shutter ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	80h	IOLI_HPDR
3	inputOutputControlParameter	M	07h	IOCP_STA
4	InputOutputControlParameter -not used	M	FFh	CS_PD_RAS
5	InputOutputControlParameter - LV_ACT_RAS_EXT_ADJ	M	xxh	CS_TV_RAS
6	InputOutputControlParameter - TIMEOUT_TIME_80_KWP	M	xxh	CS_TO_RAS

InputOutputControlByLocalIdentifier Positive Response

Data Byte	***Parameter Name***	***Cvt***	***Hex Value***	***Mnemonic***
1	**InputOutputControlByLocalIdentifier Response SId**	**M**	**70h**	**IOCBLIDPR**
2	InputOutputLocalIdentifier	M	80h	IOLI_RAS
3	InputOutputControlParameter	M	07h	IOCP_RAS

InputOutputControlByLocalIdentifier Negative Response

I.15.11 30_8207 - HPD-Relais steuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	82h	IOLI_HPDR
3	inputOutputControlParameter	M	07h	IOCP_STA
4	InputOutputControlParameter -not used	M	FFh	CS_PD_HPDR
5	InputOutputControlParameter - LV_ACT_RLY_VCV_EXT_ADJ	M	xxh	CS_TV_HPDR
6	InputOutputControlParameter - TIMEOUT_TIME_82_KWP	M	xxh	CS_TO_HPDR

InputOutputControlByLocalIdentifier Positive Response

Data Byte	***Parameter Name***	***Cvt***	***Hex Value***	***Mnemonic***
1	**InputOutputControlByLocalIdentifier Response SId**	**M**	**70h**	**IOCBLIDPR**
2	InputOutputLocalIdentifier	M	82h	IOLI_HPDR
3	InputOutputControlParameter	M	07h	IOCP_HPDR

I.15.12 30_8307 - Wasserpumpe Turbolader steuern

InputOutputControlByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	83h	IOLI_WAPUT
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter -not used	M	FFh	CS_PD_WAPUT
5	InputOutputControlParameter - N_REL_CWP_SP_2_EXT_ADJ	M	xxh	CS_TV_WAPUT
6	InputOutputControlParameter - TIMEOUT_TIME_83_KWP	M	xxh	CS_TO_WAPUT

InputOutputControlByLocalIdentifier Positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**InputOutputControlByLocalIdentifier Response SId**	**M**	**70h**	**IOCBLIDPR**
2	InputOutputLocalIdentifier	M	83h	IOLI_WAPUT
3	InputOutputControlParameter	M	07h	IOCP_STA

I.15.13 30_8407 - Drosselklappenstellergehaeuseheizung 2 ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Drosselklappenstellergehäuseheizung 2	M	84h	IOLI_DKH2
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_DKH2
5d	InputOutputControlParameter - LV_ACT_RLY_MTC_2_HEAT_EXT_ADJ	M	XXh	CS_TV_DKH2
6d	InputOutputControlParameter - TIMEOUT_TIME_84_KWP	M	XXh	CS_TO_DKH2

Figure I.15.7: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	84h	IOLI_DKH2
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.8: Table InputOutputControlByLocalIdentifier positive response message

I.15.14 30_8507 - Drosselklappe 2 steuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	85h	IOLI_DKP2
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter - not used	M	FFh	CS_PD_DKP2
5	InputOutputControlParameter - TPS_SP_2_EXT_ADJ	M	xxh	CS_TPS_SP_EXT_ADJ[2]
6	InputOutputControlParameter -TIMEOUT_TIME_85_KWP	M	xxh	CS_TO_DKH2

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InputOutputControlByLocalIdentifier Positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**InputOutputControlByLocalIdentifier Response SId**	**M**	**70h**	**IOCBLIDPR**
2	InputOutputLocalIdentifier	M	85h	IOLI_DKP2
3	InputOutputControlParameter	M	07h	IOCP_STA

I.15.15 30_8607 - (second) HPD5-Mengensteuerventil steuern

Second HPD5-Menegensteuerventil for MSD85 only:

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	85h	IOLI_MSV2
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter - not used	M	FFh	CS_PD_MSV2
5	InputOutputControlParameter - arqtmsv_w_rb[2] (high byte)	M	xxh	CS_
6	InputOutputControlParameter - arqtmsv_w_rb[2] (low byte)	M	xxh	
7	InputOutputControlParameter -TIMEOUT_TIME_86_KWP	M	xxh	CS_TO_MSV2

Hint: activation with B_rqtmsv_rb[2]

InputOutputControlByLocalIdentifier Positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**InputOutputControlByLocalIdentifier Response SId**	**M**	**70h**	**IOCBLIDPR**
2	InputOutputLocalIdentifier	M	86h	IOLI_MSV2
3	InputOutputControlParameter	M	07h	IOCP_STA

HPD5-Mengensteuerventil for MSD80 4cyl only:

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	85h	IOLI_MSV2
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter - not used	M	FFh	CS_PD_MSV2
5	InputOutputControlParameter - arqtmsv_w_rb (high byte)	M	xxh	CS_
6	InputOutputControlParameter - arqtmsv_w_rb (low byte)	M	xxh	
7	InputOutputControlParameter -TIMEOUT_TIME_86_KWP	M	xxh	CS_TO_MSV2

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Hint: activation with B_rqtmsv_rb

InputOutputControlByLocalIdentifier Positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	86h	IOLI_MSV2
3	InputOutputControlParameter	M	07h	IOCP_STA

I.15.16 30_8707 - Abgasklappe 2 steuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	87	IOLI_AGK2
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter - not used	M	FFh	CS_PD_AGK2
5	InputOutputControlParameter - LV_ACT_EF_2_EXT_ADJ	M	xxh	CS_LV_ACT_EF_EXT_ADJ[2]
6	InputOutputControlParameter - TIMEOUT_TIME_87_KWP	M	xxh	CS_TO_AGK2

InputOutputControlByLocalIdentifier Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	87h	IOLI_AGK2
3	InputOutputControlParameter	M	07h	IOCP_STA

I.15.17 30_8807 - Vanos Einlass Ventil Bank2 steuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	88	IOLI_ENWS2
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter -	M	FFh	CS_PD_ENWS2
5	InputOutputControlParameter - CAM_SP_2_IN_EXT_ADJ (high byte)	M	Xxh	CS_CAM_SP_2_IN_EXT_ADJ
6	InputOutputControlParameter - CAM_SP_2_IN_EXT_ADJ (low byte)	M	Xxh	
7	InputOutputControlParameter - TIMEOUT_TIME_88_KWP	M	Xxh	CS_TO_ENWS2

InputOutputControlByLocalIdentifier Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	88h	IOLI_ENWS2
3	InputOutputControlParameter	M	07h	IOCP_STA

I.15.18 30_8907 - Vanos Auslass Ventil Bank 2 steuern

InputOutputControlByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	89	IOLI_ANSW2
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter - Periodendauer Bank 2	M	FFh	CS_PD_ANSW2
5	InputOutputControlParameter - CAM_SP_2_EX_EXT_ADJ (high byte)	M	xxh	CS_CAM_SP_2_EX_EXT_ADJ
6	InputOutputControlParameter - CAM_SP_2_EX_EXT_ADJ (low byte)	M	xxh	
7	InputOutputControlParameter - TIMEOUT_TIME_89_KWP	M	xxh	CS_TO_ANWS2

InputOutputControlByLocalIdentifier Positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	89h	IOLI_ANSW2
3	InputOutputControlParameter	M	07h	IOCP_STA

I.15.19 30_8A07 - Umluftventil Bank 2 steuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	8A	IOLI_ULV2
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter - not used	M	FFh	CS_PD_ULV2
5	InputOutputControlParameter - RFPPWM_EXT_ADJ[2]	M	xxh	CS_TS_ULV2
6	InputOutputControlParameter - TIMEOUT_TIME_8A_KWP	M	xxh	CS_TO_ULV2

InputOutputControlByLocalIdentifier Positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	8Ah	IOLI_ULV2
3	InputOutputControlParameter	M	07h	IOCP_STA

I.15.20 30_8B07 - Sekundearluftventil 2 ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Sekundearluftventil 2	M	8Bh	IOLI_SLV2
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_SLV2
5d	InputOutputControlParameter - LV_ACT_SAV_2_EXT_ADJ	M	XXh	CS_TV_SLV2
6d	InputOutputControlParameter - TIMEOUT_TIME_8B_KWP	M	XXh	CS_TO_SLV2

Figure I.15.9: Table InputOutputControlByLocalIdentifier request message

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InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	CAh	IOLI_SLV2
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.10: Table InputOutputControlByLocalIdentifier positive response message

I.15.21 30_9E07 - Drosselklappenstellergehäuseheizung ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Drosselklappenstellergehäuseheizung	M	9Eh	IOLI_DKH
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_DKH
5d	InputOutputControlParameter - LV_ACT_RLY_MTC_HEAT_EXT_ADJ	M	XXh	CS_TV_DKH
6d	InputOutputControlParameter - TIMEOUT_TIME_9E_KWP	M	XXh	CS_TO_DKH

Figure I.15.11: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	9Eh	IOLI_DKH
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.12: Table InputOutputControlByLocalIdentifier positive response message

I.15.22 30_A407 - Gesteuerte Luftfuehrung (untere Klappe) ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLI**
2d	InputOutputLocalIdentifier - Gesteuerte Luftfuehrung ansteuern	M	A4h	IOLI_GLF2
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_GLF2
5d	InputOutputControlParameter - LV_ACT_ECRAS_DOWN_EXT_ADJ	M	XXh	CS_TV_GLF2
6d	InputOutputControlParameter - TIMEOUT_TIME_A4_KWP	M	XXh	CS_TO_GLF2

Figure I.15.13: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIPR**
2d	InputOutputLocalIdentifier	M	A4h	IOLI_GLF2
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.14: Table InputOutputControlByLocalIdentifier positive response message

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I.15.23 30_AB07 - Oeldruck-Regelung (Geregeltes Oeldrucksystem) ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request Sid**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Ölsolldruck	M	ABh	IOLI_ODR
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_P_OELSOL_TST
5d	inputOutputControlParameter - POIL_SP_EXT_ADJ	M	XXh	CS_P_OELSOL_TST
7d	InputOutputControlParameter - TIMEOUT_TIME_AB_KWP	M	XXh	CS_TO_ODR

Figure I.15.15: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	ABh	IOLI_ODR
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.16: Table InputOutputControlByLocalIdentifier positive response message

I.15.24 30_AC07 - Oeldruckventil (Geregeltes Oeldrucksystem) ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Generator Sollspannung BSD	M	ACh	IOLI_ODV
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_ODV
5d	inputOutputControlParameter - POIL_PWM_EXT_ADJ	M	XXh	CS_PD_ODV
6d	InputOutputControlParameter - TIMEOUT_TIME_AC_KWP	M	XXh	CS_TO_ODV

Figure I.15.17: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	ACh	IOLI_ODV
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.18: Table InputOutputControlByLocalIdentifier positive response message

I.15.25 30_AD07 - Kurbelgehaeuseentlueftungsheizung ansteuern

InputOutputControlByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Kurbelgehaeuseentlueftungsheizung	M	ADh	IOLI_KGEH
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_KGEH
5d	InputOutputControlParameter - LV_ACT_RLY_CRCV_HEAT_EXT_ADJ	M	XXh	CS_TV_KGEH
6d	InputOutputControlParameter - TIMEOUT_TIME_AD_KWP	M	XXh	CS_TO_KGEH

Figure I.15.19: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	ADh	IOLI_KGEH
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.20: Table InputOutputControlByLocalIdentifier positive response message

I.15.26 30_AE07 - Variable Sauganlage (DISA) Klappe2 ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Variable Sauganlage (DISA) Klappe2	M	AEh	IOLI_DISA2
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_DISA2
5d	InputOutputControlParameter - LV_VIM_2_EXT_ADJ	M	XXh	CS_TV_DISA2
6d	InputOutputControlParameter - TIMEOUT_TIME_AE_KWP	M	XXh	CS_TO_DISA2

Figure I.15.21: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	AEh	IOLI_DISA2
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.22: Table InputOutputControlByLocalIdentifier positive response message

I.15.27 30_B207 - Motorlager ansteuern

InputOutputControlByLocalIdentifier Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Kurbelgehaeuseentlueftungsheizung	M	B2h	IOLI_
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_
5d	inputOutputControlParameter - LV_SWI_AEB_EXT_ADJ	M	XXh	CS_
6d	InputOutputControlParameter - TIMEOUT_TIME_B2_KWP	M	XXh	CS_TO_

Figure I.15.23: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	B2h	IOLI_KGEH
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.24: Table InputOutputControlByLocalIdentifier positive response message

I.15.28 30_B507 - Umluftventil Bank 1 steuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2	inputOutputLocalID	M	B5	IOLI_ULV
3	inputOutputControlParameter	M	07	IOCP_STA
4	InputOutputControlParameter - not used	M	FFh	CS_PD_ULV
5	InputOutputControlParameter - - RFPPWM_EXT_ADJ[1]	M	xxh	CS_TV_ULV
6	InputOutputControlParameter - TIMEOUT_TIME_B5_KWP	M	xxh	CS_TO_ULV

InputOutputControlByLocalIdentifier Positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	InputOutputControlByLocalIdentifier Response SId	M	70h	IOCBLIDPR
2	InputOutputLocalIdentifier	M	xxh	IOLI_ULV
3	InputOutputControlParameter	M	07h	IOCP_STA

I.15.29 30_B607 - Ladedrucksteller 1 ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Kurbelgehaeuseentlueftungsheizung	M	B6h	IOLI_
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_
5d	inputOutputControlParameter - WGPWM_EXT_ADJ[1] (high byte)	M	XXh	CS_
6d	InputOutputControlParameter - WGPWM_EXT_ADJ[1] (low byte)	M	XXh	CS_
7d	InputOutputControlParameter - TIMEOUT_TIME_B6_KWP	M	XXh	CS_TO_

Figure I.15.25: Table InputOutputControlByLocalIdentifier request message

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InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	B6h	IOLI_KGEH
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.26: Table InputOutputControlByLocalIdentifier positive response message

I.15.30 30_B707 - Ladedrucksteller 2 ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Kurbelgehaeuseentlueftungsheizung	M	B7h	IOLI_
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_
5d	inputOutputControlParameter - WGPWM_EXT_ADJ[2] (high byte)	M	XXh	CS_
6d	InputOutputControlParameter - WGPWM_EXT_ADJ[2] (low byte)	M	XXh	CS_
7d	InputOutputControlParameter - TIMEOUT_TIME_B7_KWP	M	XXh	CS_TO_

Figure I.15.27: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	B7h	IOLI_KGEH
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.28: Table InputOutputControlByLocalIdentifier positive response message

I.15.31 30_BD07 - Mengensteuerventil ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Kurbelgehaeuseentlueftungsheizung	M	BDh	IOLI_
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_
5d	inputOutputControlParameter - FUP_SP_EXT_ADJ (high byte)	M	XXh	CS_
6d	InputOutputControlParameter - FUP_SP_EXT_ADJ (low byte)	M	XXh	CS_
7d	InputOutputControlParameter - TIMEOUT_TIME_AD_KWP	M	XXh	CS_TO_

Figure I.15.29: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	BDh	IOLI_KGEH
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.30: Table InputOutputControlByLocalIdentifier positive response message

I.15.32 30_BE07 - Abgasrückführungsventil ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Kurbelgehaeuseentlueftungsheizung	M	BDh	IOLI_
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_
5d	inputOutputControlParameter - OPG_SP_ACR_EXT_ADJ (high byte)	M	XXh	CS_
6d	InputOutputControlParameter - OPG_SP_ACR_EXT_ADJ (low byte)	M	XXh	CS_
7d	InputOutputControlParameter - TIMEOUT_TIME_AD_KWP	M	XXh	CS_TO_

Figure I.15.31: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	BDh	IOLI_KGEH
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.32: Table InputOutputControlByLocalIdentifier positive response message

I.15.33 30_BF07 - elektr. Wasserpumpe ueber BSD (Bit Serielle Datenschnittstelle) ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - elektr. Wasserpumpe ueber BSD	M	BFh	IOLI_EWAP
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_EWAP
5d	InputOutputControlParameter - N_REL_CWP_SP_EXT_ADJ	M	XXh	CS_TV_EWAP
6d	InputOutputControlParameter - TIMEOUT_TIME_BF_KWP	M	XXh	CS_TO_EWAP

Figure I.15.33: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	BFh	IOLI_EWAP
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.34: Table InputOutputControlByLocalIdentifier positive response message

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I.15.34 30_C107 - Abgasklappe ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Abgasklappe ansteuern	M	C1h	IOLI_AGK
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_AGK
5d	InputOutputControlParameter - LV_ACT_EF_EXT_ADJ	M	XXh	CS_TV_AGK
6d	InputOutputControlParameter - TIMEOUT_TIME_C1_KWP	M	XXh	CS_TO_AGK

Figure I.15.35: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	C1h	IOLI_AGK
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.36: Table InputOutputControlByLocalIdentifier positive response message

I.15.35 30_C207 - Soundklappe ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Soundklappe ansteuern	M	C2h	IOLI_SOK
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_SOK
5d	InputOutputControlParameter - LV_ACT_SOF_EXT_ADJ	M	XXh	CS_TV_SOK
6d	InputOutputControlParameter - TIMEOUT_TIME_C2_KWP	M	XXh	CS_TO_SOK

Figure I.15.37: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	C2h	IOLI_SOK
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.38: Table InputOutputControlByLocalIdentifier positive response message

I.15.36 30_C307 - Gesteuerte Luftfuehrung ansteuern (obere Klappe)

InputOutputControlByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLI**
2d	InputOutputLocalIdentifier - Gesteuerte Luftfuehrung ansteuern	M	C3h	IOLI_GLF
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_GLF
5d	InputOutputControlParameter - LV_ACT_ECRAS_UP_EXT_ADJ	M	XXh	CS_TV_GLF
6d	InputOutputControlParameter - TIMEOUT_TIME_C3_KWP	M	XXh	CS_TO_GLF

Figure I.15.39: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIPR**
2d	InputOutputLocalIdentifier	M	C3h	IOLI_GLF
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.40: Table InputOutputControlByLocalIdentifier positive response message

I.15.37 30_C407 - Startrelais ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Startrelais ansteuern	M	C4h	IOLI_SR
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_SR
5d	InputOutputControlParameter - LV_ACT_RLY_ST_EXT_ADJ	M	XXh	CS_TV_SR
6d	InputOutputControlParameter - TIMEOUT_TIME_C4_KWP	M	XXh	CS_TO_SR

Figure I.15.41: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	C4h	IOLI_SR
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.42: Table InputOutputControlByLocalIdentifier positive response message

I.15.38 30_C607 - Variable Sauganlage (DISA) Klappe ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Variable Sauganlage (DISA) Klappe	M	C6h	IOLI_DISA
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_DISA
5d	InputOutputControlParameter - LV_VIM_1_EXT_ADJ	M	XXh	CS_TV_DISA
6d	InputOutputControlParameter - TIMEOUT_TIME_C6_KWP	M	XXh	CS_TO_DISA

Figure I.15.43: Table InputOutputControlByLocalIdentifier request message

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InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	C6h	IOLI_DISA
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.44: Table InputOutputControlByLocalIdentifier positive response message

I.15.39 30_C707 - Klimakompressor-Relais ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Klimakompressor-Relais ansteuern	M	C7h	IOLI_KOREL
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_KOREL
5d	InputOutputControlParameter - LV_ACT_ACCOUT_RLY_EXT_ADJ	M	XXh	CS_TV_KOREL
6d	InputOutputControlParameter - TIMEOUT_TIME_C7_KWP	M	XXh	CS_TO_KOREL

Figure I.15.45: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	C7h	IOLI_KOREL
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.46: Table InputOutputControlByLocalIdentifier positive response message

I.15.40 30_C807 - E-Box-Luefter ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - E-Box-Luefter	M	C8h	IOLI_EBL
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_EBL
5d	InputOutputControlParameter - LV_ACT_EBOX_CFA_EXT_ADJ	M	XXh	CS_TV_EBL
6d	InputOutputControlParameter - TIMEOUT_TIME_C8_KWP	M	XXh	CS_TO_EBL

Figure I.15.47: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	C8h	IOLI_EBL
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.48: Table InputOutputControlByLocalIdentifier positive response message

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I.15.41 30_C907 - Kennfeldthermostat ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Kennfeldthermostat	M	C9h	IOLI_KFT
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_KFT
5d	InputOutputControlParameter - ECTPWM_EXT_ADJ	M	XXh	CS_TV_KFT
6d	InputOutputControlParameter - TIMEOUT_TIME_C9_KWP	M	XXh	CS_TO_KFT

Figure I.15.49: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	C9h	IOLI_KFT
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.50: Table InputOutputControlByLocalIdentifier positive response message

I.15.42 30_CA07 - Sekundarluftventil ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Sekundarluftventil	M	CAh	IOLI_SLV
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_SLV
5d	InputOutputControlParameter - LV_ACT_SAV_EXT_ADJ	M	XXh	CS_TV_SLV
6d	InputOutputControlParameter - TIMEOUT_TIME_1C_KWP	M	XXh	CS_TO_SLV

Figure I.15.51: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	CAh	IOLI_SLV
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.52: Table InputOutputControlByLocalIdentifier positive response message

I.15.43 30_CB07 - Sekundaerluftpumpe ansteuern

Additional Application conditions:

Initialisation: 0 at reset

Activation: depending on calibratable conditions
see chapter "activation conditions" above

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IF LV_TEMP_MAX_SAP_COIL = 0 **and**
[STATE_SA = INACTIVE **or**
STATE_SA = FINISHED **or**
STATE_SA = CANCELED **or**
STATE_SA = EXT_ADJ **or**
STATE_SA = EXT_ADJ_FIN **or**
STATE_SA = EOL_SA_FIN]

Deactivation: not activation

Service location: see list of “implemented diagnostic services”

InputOutputControlByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**inputOutputControlByLocalIdentifier Request Sid**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Sekundaerluftpumpe	M	CBh	IOLI_SLP
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_SLP
5d	InputOutputControlParameter - LV_ACT_SAP_EXT_ADJ	M	XXh	CS_TV_SLP
6d	InputOutputControlParameter - TIMEOUT_TIME_CB_KWP	M	XXh	CS_TO_SLP

Figure I.15.53: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**InputOutputControlByLocalIdentifier Positive Response Sid**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	CBh	IOLI_SLP
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.54: Table InputOutputControlByLocalIdentifier positive response message

I.15.44 30_CC07 - Diagnosemodul-Tank Leckage Pumpe ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Diagnosemodul-Tank Leckage Pumpe	M	CCh	IOLI_DMTL_P
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_DMTL_P
5d	InputOutputControlParameter - LV_ACT_DMTL_PUMP_EXT_ADJ	M	XXh	CS_TV_DMTL_P
6d	InputOutputControlParameter - TIMEOUT_TIME_CC_KWP	M	XXh	CS_TO_DMTL_P

Figure I.15.55: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	CCh	IOLI_DMTL_P
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.56: Table InputOutputControlByLocalIdentifier positive response message

I.15.45 30_CD07 - Diagnosemodul-Tank Leckage Ventil ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Kl.87 Spannung / Versorgung	M	CDh	IOLI_DMTL_V
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_DMTL_V
5d	InputOutputControlParameter - LV_ACT_DMTLS_EXT_ADJ	M	XXh	CS_TV_DMTL_V
6d	InputOutputControlParameter - TIMEOUT_TIME_CD_KWP	M	XXh	CS_TO_DMTL_V

Figure I.15.57: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	CDh	IOLI_DMTL_V
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.58: Table InputOutputControlByLocalIdentifier positive response message

I.15.46 30_CE07 - Diagnosemodul-Tank Leckage Heizung ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Diagnosemodul-Tank Leckage Heizung	M	CEh	IOLI_DMTLH
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_DMTLH
5d	InputOutputControlParameter - LV_ACT_DMTLH_EXT_ADJ	M	XXh	CS_TV_DMTLH
6d	InputOutputControlParameter - TIMEOUT_TIME_CE_KWP	M	XXh	CS_TO_DMTLH

Figure I.15.59: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	CEh	IOLI_DMTLH
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.60: Table InputOutputControlByLocalIdentifier positive response message

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I.15.47 30_CF07 - Tankentlueftungsventil ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier Tankentlueftungsventil ansteuern	M	CFh	IOLI_TEV
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_TEV
5d	InputOutputControlParameter - CPPWM_EXT_ADJ	M	XXh	CS_TV_TEV
6d	InputOutputControlParameter - TIMEOUT_TIME_CF_KWP	M	XXh	CS_TO_TEV

Figure I.15.61: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	CFh	IOLI_TEV
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.62: Table InputOutputControlByLocalIdentifier positive response message

I.15.48 30_D007 - Lambdasondenheizung vor Kat Bank1 ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Lambdasondenheizung vor Kat Bank1	M	D0h	IOLI_LSH1
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_LSH1
5d	InputOutputControlParameter - LSHPWM_UP_EXT_ADJ[1]	M	XXh	CS_TV_LSH1
6d	InputOutputControlParameter - TIMEOUT_TIME_D0_KWP	M	XXh	CS_TO_LSH1

Figure I.15.63: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	D0h	IOLI_LSH1
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.64: Table InputOutputControlByLocalIdentifier positive response message

I.15.49 30_D107 - Lambdasondenheizung hinter Kat Bank1 ansteuern

InputOutputControlByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Lambdasondenheizung hinter Kat Bank1	M	D1h	IOLI_LSH2
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_LSH2
5d	InputOutputControlParameter - LSHPWM_DOWN_EXT_ADJ[1]	M	XXh	CS_TV_LSH2
6d	InputOutputControlParameter - TIMEOUT_TIME_D1_KWP	M	XXh	CS_TO_LSH2

Figure I.15.65: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	D1h	IOLI_LSH2
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.66: Table InputOutputControlByLocalIdentifier positive response message

I.15.50 30_D207 - Lambdasondenheizung vor Kat Bank2 ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Lambdasondenheizung vor Kat Bank2	M	D2h	IOLI_LSH3
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_LSH3
5d	InputOutputControlParameter - LSHPWM_UP_EXT_ADJ[2]	M	XXh	CS_TV_LSH3
6d	InputOutputControlParameter - TIMEOUT_TIME_D2_KWP	M	XXh	CS_TO_LSH3

Figure I.15.67: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	D2h	IOLI_LSH3
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.68: Table InputOutputControlByLocalIdentifier positive response message

I.15.51 30_D307 - Lambdasondenheizung hinter Kat Bank2 ansteuern

InputOutputControlByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Lambdasondenheizung hinter Kat Bank2	M	D3h	IOLI_LSH4
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_LSH4
5d	InputOutputControlParameter - LSHPWM_DOWN_EXT_ADJ[2]	M	XXh	CS_TV_LSH4
6d	InputOutputControlParameter - TIMEOUT_TIME_D3_KWP	M	XXh	CS_TO_LSH4

Figure I.15.69: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	D3h	IOLI_LSH4
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.70: Table InputOutputControlByLocalIdentifier positive response message

I.15.52 30_D407 - MIL (Malfunction Indicator Lamp) ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - MIL (Malfunction Indicator Lamp)	M	D4h	IOLI_MIL
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_MIL
5d	InputOutputControlParameter - LV_ACT_MIL_EXT_ADJ	M	XXh	CS_TV_MIL
6d	InputOutputControlParameter - TIMEOUT_TIME_D4_KWP	M	XXh	CS_TO_MIL

Figure I.15.71: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	D4h	IOLI_MIL
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.72: Table InputOutputControlByLocalIdentifier positive response message

I.15.53 30_D507 - Fahrgeschwindigkeitsregler-Lampe ansteuern

InputOutputControlByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier Fahrgeschwindigkeitsregler-Lampe	M	D5h	IOLI_FGRL
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_FGRL
5d	InputOutputControlParameter - LV_ACT_CRU_EXT_ADJ	M	XXh	CS_TV_FGRL
6d	InputOutputControlParameter - TIMEOUT_TIME_D5_KWP	M	XXh	CS_TO_FGRL

Figure I.15.73: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	D5h	IOLI_FGRL
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.74: Table InputOutputControlByLocalIdentifier positive response message

I.15.54 30_D607 - EML (Engine Malfunction Lamp) ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - EML (Engine Malfunction Lamp)	M	D6h	IOLI_EML
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_EML
5d	InputOutputControlParameter - LV_ACT_WAL_1_EXT_ADJ	M	XXh	CS_TV_EML
6d	InputOutputControlParameter - TIMEOUT_TIME_D6_KWP	M	XXh	CS_TO_EML

Figure I.15.75: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	D6h	IOLI_EML
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.76: Table InputOutputControlByLocalIdentifier positive response message

I.15.55 30_D807 - Elektrische Kraftstoffpumpe ansteuern

InputOutputControlByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Elektrische Kraftstoffpumpe	M	D8h	IOLI_EKP1
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_EKP1
5d	InputOutputControlParameter - EFPPWM_EXT_ADJ	M	XXh	CS_TV_EKP1
6d	InputOutputControlParameter - TIMEOUT_TIME_D8_KWP	M	XXh	CS_TO_EKP1

Figure I.15.77: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	D8h	IOLI_EKP1
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.78: Table InputOutputControlByLocalIdentifier positive response message

I.15.56 30_DA07 - E-Luefter ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - E-Luefter	M	DAh	IOLI_ELUE
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_ELUE
5d	InputOutputControlParameter - ECFPWM_ECF_EXT_ADJ	M	XXh	CS_TV_ELUE
6d	InputOutputControlParameter - TIMEOUT_TIME_DA_KWP	M	XXh	CS_TO_ELUE

Figure I.15.79: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	DAh	IOLI_ELUE
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.80: Table InputOutputControlByLocalIdentifier positive response message

I.15.57 30_DC07 - VVT-Entlastungsrelais ansteuern

InputOutputControlByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - VVT-Entlastungsrelais ansteuern	M	DCh	IOLI_VVTR
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_VVTR
5d	InputOutputControlParameter - LV_RLY_VVL_EXT_ADJ	M	XXh	CS_TV_VVTR
6d	InputOutputControlParameter - TIMEOUT_TIME_DC_KWP	M	XXh	CS_TO_VVTR

Figure I.15.81: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	DCh	IOLI_VVTR
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.82: Table InputOutputControlByLocalIdentifier positive response message

I.15.58 30_DD07 - VVT ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - VVT	M	DDh	IOLI_VVT
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_VVT
5d	inputOutputControlParameter - ANG_SP_EXT_ADJ_VVL	M	XXh	CS_PHY_VVT
6d	InputOutputControlParameter - TIMEOUT_TIME_DD_KWP	M	XXh	CS_TO_VVT

Figure I.15.83: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	DDh	IOLI_VVT
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.84: Table InputOutputControlByLocalIdentifier positive response message

I.15.59 30_E107 - Einspritzventil 1 ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Einspritzventil 1	M	E1h	IOLI_EV1
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - IV_PER_EXT_ADJ[0]	M	XXh	CS_PD_EV1
5d	InputOutputControlParameter - IV_EXT_ADJ[0]	M	XXh	CS_TV_EV1
6d	InputOutputControlParameter - TIMEOUT_TIME_E1_KWP	M	XXh	CS_TO_EV1

Figure I.15.85: Table InputOutputControlByLocalIdentifier request message

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InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	E1h	IOLI_EV1
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.86: Table InputOutputControlByLocalIdentifier positive response message

I.15.60 30_E207 - Einspritzventil 2 ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Einspritzventil 2	M	E2h	IOLI_EV1
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - IV_PER_EXT_ADJ[4]	M	XXh	CS_PD_EV2
5d	InputOutputControlParameter - IV_EXT_ADJ[4]	M	XXh	CS_TV_EV2
6d	InputOutputControlParameter - TIMEOUT_TIME_E2_KWP	M	XXh	CS_TO_EV2

Figure I.15.87: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	E2h	IOLI_EV2
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.88: Table InputOutputControlByLocalIdentifier positive response message

I.15.61 30_E307 - Einspritzventil 3 ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Einspritzventil 3	M	E3h	IOLI_EV1
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - IV_PER_EXT_ADJ[2]	M	XXh	CS_PD_EV3
5d	InputOutputControlParameter - IV_EXT_ADJ[2]	M	XXh	CS_TV_EV3
6d	InputOutputControlParameter - TIMEOUT_TIME_E3_KWP	M	XXh	CS_TO_EV3

Figure I.15.89: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	E3h	IOLI_EV3
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.90: Table InputOutputControlByLocalIdentifier positive response message

I.15.62 30_E407 - Einspritzventil 4 ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Einspritzventil 4	M	E4h	IOLI_EV1
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - IV_PER_EXT_ADJ[5]	M	XXh	CS_PD_EV4
5d	InputOutputControlParameter - IV_EXT_ADJ[5]	M	XXh	CS_TV_EV4
6d	InputOutputControlParameter - TIMEOUT_TIME_E4_KWP	M	XXh	CS_TO_EV4

Figure I.15.91: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	E4h	IOLI_EV4
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.92: Table InputOutputControlByLocalIdentifier positive response message

I.15.63 30_E507 - Einspritzventil 5 ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Einspritzventil 5	M	E5h	IOLI_EV1
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - IV_PER_EXT_ADJ[1]	M	XXh	CS_PD_EV5
5d	InputOutputControlParameter - IV_EXT_ADJ[1]	M	XXh	CS_TV_EV5
6d	InputOutputControlParameter - TIMEOUT_TIME_E5_KWP	M	XXh	CS_TO_EV5

Figure I.15.93: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	E5h	IOLI_EV5
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.94: Table InputOutputControlByLocalIdentifier positive response message

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I.15.64 30_E607 - Einspritzventil 6 ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Einspritzventil 6	M	E6h	IOLI_EV1
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - IV_PER_EXT_ADJ[3]	M	XXh	CS_PD_EV6
5d	InputOutputControlParameter - IV_EXT_ADJ[3]	M	XXh	CS_TV_EV6
6d	InputOutputControlParameter - TIMEOUT_TIME_E6_KWP	M	XXh	CS_TO_EV6

Figure I.15.95: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	E6h	IOLI_EV6
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.96: Table InputOutputControlByLocalIdentifier positive response message

I.15.65 30_ED07 - Vanos Einlass Ventil ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Vanos Einlass Ventil	M	EDh	IOLI_ENWS
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_ENWS
5d	inputOutputControlParameter - CAM_SP_IN_EXT_ADJ high byte	M	XXh	CS_PD_ENWS
6d	InputOutputControlParameter - CAM_SP_IN_EXT_ADJ low byte	M	XXh	CS_TV_ENWS
7d	InputOutputControlParameter - TIMEOUT_TIME_ED_KWP	M	XXh	CS_TO_ENWS

Figure I.15.97: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	EDh	IOLI_ENWS
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.98: Table InputOutputControlByLocalIdentifier positive response message

I.15.66 30_EE07 - Vanos Auslass Ventil ansteuern

InputOutputControlByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30h**	**IOCBLID**
2d	InputOutputLocalIdentifier - Vanos Auslass Ventil	M	EEh	IOLI_ANWS
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	inputOutputControlParameter - not used	M	FFh	CS_PD_ANWS
5d	inputOutputControlParameter - CAM_SP_EX_EXT_ADJ high byte	M	XXh	CS_PD_ANWS
6d	InputOutputControlParameter - CAM_SP_EX_EXT_ADJ low byte	M	XXh	CS_TV_ANWS
7d	InputOutputControlParameter - TIMEOUT_TIME_EE_KWP	M	XXh	CS_TO_ANWS

Figure I.15.99: Table InputOutputControlByLocalIdentifier request message

InputOutputControlByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**InputOutputControlByLocalIdentifier Positive Response SId**	**M**	**70h**	**IOCBLIDPR**
2d	InputOutputLocalIdentifier	M	EEh	IOLI_ANWS
3d	InputOutputControlParameter	M	07h	IOCP_STA

Figure I.15.100: Table InputOutputControlByLocalIdentifier positive response message

I.15.67 30_EF07 - HPD5 Mengensteuerventil 1 ansteuern

InputOutputControlByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	inputOutputControlByLocalIdentifier Request SId	M	30h	IOCBLI
2d	inputOutputLocalID	M	EFh	IOLI_HDP5
3d	inputOutputControlParameter	M	07h	IOCP_STA
4d	InputOutputControlParameter -not used	M	FFh	CS_PD_HDP5
5d	InputOutputControlParameter - arqtmsv_w_rb[1] (high byte)	M	xxh	CS_TV_HDP5
6d	InputOutputControlParameter - arqtmsv_w_rb [1](low byte)	M	xxh	CS_TV_HDP5
7d	InputOutputControlParameter - TIMEOUT_TIME_EF_KWP	M	xxh	CS_TO_HDP5

Figure I.15.101: Hint: activation with B_rqtmsv_rb[1]

InputOutputControlByLocalIdentifier Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**InputOutputControlByLocalIdentifier Response SId**	**M**	**70h**	**IOCBLIDPR**
2	InputOutputLocalIdentifier	M	EFh	IOLI_HDP5
3	InputOutputControlParameter	M	07h	IOCP_STA

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I.16 KWP2000 - SID 31h: startRoutineByLocalIdentifier Service

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_ecojob1	O/V	0... 1H	0 ...1	1	-
Ecos Job1 aktiv					
B_ecojob2	O/V	0... 1H	0 ...1	1	-
Ecos Job2 aktiv					
B_lvs_neustart	O/V/S	0... 1H	0 ...1	1	-
Rücksetzen der LVS					
B_nglern	O/V	0... 1H	0 ...1	1	-
Learning of neutral gear sensor					
Eco_max [_i]	O/V	0... FFH	0... 0.31875	0.00125	A
Max. Ruhestromschwelle					
Eco_msb	O/V	0... FFH	0... 12.75	0.05	s
Ecos Messtartbedingung					
Eco_mz	O/V	0... FFH	0... 12.75	0.05	s
Dauer Mittelwertmessung					
Eco_timo	O/V	0... FFH	0... 255	1	s
Ecos Messung Timeout					
EFF_IGA_CST_LIM_EXT_ADJ	O/V	0... FFFFH	0... 1.99996	0.0000305	-
External efficiency limitation adjusted by external device					
FAC_CH_DIAG_EXT_ADJ_IS	O/V	0... FFH	0... 1.99218	0.0078125	-
Manipulation factor of CH torque reserve for ignition angle efficiency monitoring - demo-mode IS					
FAC_CH_DIAG_EXT_ADJ_PL	O/V	0... FFH	0... 1.99218	0.0078125	-
Manipulation factor of CH torque reserve for ignition angle efficiency monitoring - demo-mode PL					
INH_IV_KWP	O/V	0... 3FH	0... 63	1	-
Shut off request for cylinder x - – – -1=enabled /0=disabledBit0=cylinder 0 (log) Bit1=cylinder 1 (log)Bit2=cylinder 2 (log)Bit3=cylinder 3 (log)Bit4=cylinder 4 (log)Bit5=cylinder 5 (log)					
LV_ACT_CRU_MEM_EXT_ADJ	O	0... 1H	0 ...1	1	-
deleting value for STATE_CRU_OFF_IRR and STATE_CRU_OFF_REV =01h					
LV_AD_CLR_LONG_LAM_EXT_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
tester request for initializing Long Term Lambda Adaptation					
LV_ALTER_CTL_EXT_ADJ	O/V/S	0... 1H	0 ...1	1	-
Set alternator control passiv					
LV_AUTH_L3_ENA	O	0... 1H	0 ...1	1	-
Level 3 authorisation was sucessfull					
LV_CH_DIAG_EXT_REQ	O/V	0... 1H	0 ...1	1	-
External request for ignition angle efficiency monitoring - demo-mode					
LV_CTR_CYL_BAL_RST_EXT	O/V	0... 1H	0 ...1	1	-
Reset request by service tool intervention - used by cylinder balancing OBDII diagnosis					
LV_CTR_TPS_JAM_DET_ACT_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
boolean for reset of jam counter when throttle changed in service					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_CYL_BAL_AD_DC_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
request to clear flags for cylinder balancing lambda adaptation at active driving cycle					
LV_CYL_BAL_AD_EOL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
request to clear flags for cylinder balancing lambda adaptation at end of line					
LV_EFP_CTL_AD_CLR_EXT_REQ	O/V	0... 1H	0 ...1	1	-
Logical variable indicating external request for deleting of EFP adaptation values					
LV_ER_BAL_HOM_RNG_IS_ENA_KWP	O/V	0... 1H	0 ...1	1	-
Request from KWP to enable cylinder balancing homogenous at range idle speed					
LV_FAC_ER_BAL_HOM_EXT_ADJ_KWP	O/V	0... 1H	0 ...1	1	-
Request from KWP to enable cylinder balancing homogenous external adjustment					
LV_HPP_CTL_AD_CLR_EXT_REQ	O/V	0... 1H	0 ...1	1	-
External adjustment to reset the adaptation values of high pressure fuel system					
LV_INH_LAM_KWP	O/V	0... 1H	0 ...1	1	-
Switch off condition for lambda control via KWP2000 /01= disabled 00=enabled					
LV_LAM_AD_INJ_CLR_AD_EXT	O/V	0... 1H	0 ...1	1	-
Clear non-volatile data of lambda adapation via injection mode with service tester					
LV_LAM_CYL_SEL_ADJ_RST_IV_EXT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
external adjustment to reset the injector speciific lambda adaptation values					
LV_MFF_ADD_AD_ER_BAL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
request to clear additive adaptation value for cylinder balancing via TI intervention					
LV_MFF_FAC_AD_ER_BAL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
request to clear multiple adaptation value for cylinder balancing via TI intervention					
LV_POW_MNG_BAT_CHG	O/V	0... 1H	0 ...1	1	-
condition for function requested of powermanagement register					
LV_POW_MNG_MES_MOD	O/V/S	0... 1H	0 ...1	1	-
set default values PM for BN-SS - set default vaule=01h					
LV_PWL_LOCK_CDN_CUS_INH	O/V	0... 1H	0 ...1	1	-
PWL_LOCK_CDN for customer functions (IBS) disabled due to powerdown-service					
LV_RON_STC_CLR_KWP	O/V	0... 1H	0 ...1	1	-
Flag to reset RON statistical data via tester command.					
LV_TQ_LOSS_AD_CLR_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Request to clear the adaptation values for torque losses					
STATE_EGY_MIN_KWP	O/V/S	0H 1H 2H 3H	PASSIVE EGY_1 EGY_2 EGY_3	-	-
State of FeTraWe /01= Fertigung 02= Transport 03= Werkstatt					
STATE_KWP_IMOB_STORE_K_EWS_ENA	O	0... FFH	0... 255	1	-
State calculation and storage of K_EWS4					

Input data:

C_FAC_EGY_PWM_MAN [NC_CYL_NR] {p. 2279}	C_N_MAX_KWP {p. 7439}	CRK_CYL_LAM_DELTA_INI [NC_CBK_EX_NR] {p. 2838}	CTR_ERR_OBD_DIAG_CYL_BAL_ER {p. 5112}
CTR_ERR_OBD_DIAG_CYL_BAL_LAM [NC_CBK_EX_NR] {p. 5112}	CTR_MIS_DET_CYL [NC_CYL_NR] {p. 6263}	CTR_PHA_SHIFT_AD_TRIG [NC_CBK_EX_NR] {p. 2838}	DELTA_CRK_CYL_LAM [NC_CBK_EX_NR] {p. 2838}

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FAC_COR_AD_RNG_H_ ER_BAL_HOM [NC_CYL_NR]	FAC_COR_AD_RNG_IS_ ER_BAL_HOM [NC_CYL_NR]	FAC_COR_AD_RNG_L_ ER_BAL_HOM [NC_CYL_NR]	FAC_LAM_CYL_SEL_ ADJ_CST [NC_CYL_NR] {p. 2731}
FAC_LAM_CYL_SEL_ ADJ_H_RNG [NC_CYL_NR] {p. 2731}	FAC_LAM_CYL_SEL_ ADJ_L_RNG [NC_CYL_NR] {p. 2731}	FAC_TI_AD_ER_BAL [NC_CYL_NR] {p. 3298}	LC_AD_CLR_CPS {p. 812}
LC_AD_CLR_EGCP {p. 526}	LC_AD_CLR_EGR {p. 526}	LC_AD_CLR_ENRD {p. 526}	LC_AD_CLR_ENSD {p. 526}
LC_AD_CLR_IDLE {p. 812}	LC_AD_CLR_IMM {p. 812}	LC_AD_CLR_INSY {p. 526}	LC_AD_CLR_LACO {p. 527}
LC_AD_CLR_LAM {p. 527}	LC_AD_CLR_N_SP_IS {p. 527}	LC_AD_CLR_RON {p. 527}	LC_AD_CLR_SA {p. 812}
LC_AD_CLR_THRO	LC_AD_CLR_TPS {p. 527}	LC_AD_CLR_VAR {p. 528}	LC_AD_CLR_VVL_STATE_ NVMY {p. 812}
LV_ACT_N_SP_IS_BAS_ EXT_ADJ {p. 7680}	LV_CYL_BAL_AD_HOM_ REQ_DC {p. 4066}	LV_CYL_BAL_AD_WG_ OPEN_REQ [NC_CBK_EX_NR] {p. 4066}	LV_CYL_BAL_ER_AD_ ADD_EOL {p. 4043}
LV_CYL_BAL_ER_AD_ FAC_EOL {p. 4043}	LV_CYL_BAL_LAM_AD_ DC {p. 4066}	LV_CYL_BAL_LAM_AD_ EOL {p. 4043}	LV_CYL_BAL_LAM_SEL_ AD_COLD_EOL {p. 4043}
LV_CYL_BAL_LAM_SEL_ AD_HOT_DC {p. 4066}	LV_CYL_BAL_LAM_SEL_ AD_HOT_EOL {p. 4043}	LV_ES {p. 1720}	LV_IGK {p. 906}
LV_LAM_AD_INJ_EXT_ ENA {p. 3349}	LV_LAM_CYL_SEL_ADJ_ H_RNG_VLD [NC_CBK_EX_NR] {p. 2732}	LV_LAM_CYL_SEL_ADJ_ L_RNG_VLD [NC_CBK_EX_NR] {p. 2732}	MFF_ADD_AD_ER_BAL [NC_CYL_NR] {p. 3269}
MFF_ADD_CYL_LAM_ COR [NC_CYL_NR] {p. 2732}	N {p. 1525}	NC_CBK_EX_NR {p. 1829}	NC_CONF_DGNC_31_1F
NC_CYL_NR {p. 1526}	STATE_ENG {p. 1720}	STATE_LAMB_CYL_SEL_ CQ_SLOP [NC_CBK_EX_NR] {p. 2733}	TRT {p. 1504}
Tvneutrin {p. 7683}	VS {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_EGY_MIN_KWP	-	0... 1H	0 ...1	1	-
Switch to enable the configuration of FeTraWe-Mode in ECU /enable = 1					

General information:

All implemented SID 31h services are described below.

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I.16.1 Overview of supported subservices

SID number	service	Service Location	MSD_81 (4cyl)	MSD_81 (6cyl)
31_01	ask checksums after reprogramming	BOOT	X	X
31_02	erase Memory	BOOT	X	X
31_03	erase History Memory	ECU	X	X
31_05	power down	ECU	X	X
31_07	start authentification	BOOT	X	X
31_08	check authentification	BOOT	X	X
31_09	check signature	BOOT	X	X
31_0A	report reprogramming status	BOOT	X	X
31_0C	energy spare mode	ECU	X	X
31_1F_E5	SWT: SetVin	ECU	-	X
31_1F_E6	SWT: GetVin	ECU	-	X
31_1F_EA	SWT: PeriodicalCheck	ECU	-	X
31_1F_EB	SWT:GetFSC	ECU	-	X
31_1F_EC	SWT: GetFSCLen	ECU	-	X
31_1F_ED	SWT:DisableFSC	ECU	-	X
31_1F_EE	SWT: Check FSC (Freischaltcode)	ECU	X	X
31_1F_F1	SWT: Transfer data of FSC to ECU	ECU	X	X
31_1F_F2	SWT: Transfer length of FSC to ECU	ECU	X	X
31_1F_F6	SWT: GetStatus	ECU	-	X
31_1F_F8	SWT: GetSoftwareId	ECU	-	X
31_1F_F9	SWT: GetSoftwareIdFunc	ECU	-	X
31_25	switch off Injection valves	ECU	X	X
31_2B	Start Ruhestrom test	ECU	X	X
31_2E	Start Nullgang-Lernen	ECU	X	-
31_2F	Start Desulfatisierung Fahrbetrieb	ECU	X	X
31_30	delete selective adaption values	ECU	X	X
31_31	delete selective adaption values 2	ECU	X	X
31_34	Ansteuern Zylinder Gleichstellung Homogen	ECU	-	-
31_3A	Start CSERS-Diagnose	ECU	-	X
31_D9	switch off Lambda controller	ECU	X	X
31_E1	Ansteuern Eisy- Adaptionswerte (gedrosselt)	ECU	X	X
31_E2	Ansteuern Eisy- Adaptionswerte (gedrosselt mit Abgasrueckführung)	ECU	X	X
31_E3	Ansteuern Krann- Adaptionswerte	ECU	X	X

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31_E4	**Ansteuern Klann-Adaptionswerte**	**ECU**	**X**	**X**
31_E5	**Ansteuern AGR-Adaptionswerte**	**ECU**	**X**	**-**
31_F4	**cruise control delete switch off conditions**	**ECU**	**X**	**X**
31_F5	**switch off Idle speed uplift**	**ECU**	**X**	**X**
31_F6	**set default values PM for BN-SS**	**ECU**	**X**	**X**
31_F7	**Intelligente Generatorregelung**	**ECU**	**X**	**X**
31_FA	**Siemens interner Service**	**ECU / BOOT**	**X**	**X**
31_FB	**Siemens interner Service**	**ECU / BOOT**	**X**	**X**
31_FC	**Siemens interner Service**	**ECU / BOOT**	**X**	**X**

I.16.2 Global negative Responses

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**NegativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	StartRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	ResponseCode=only general response code	M	#XXh	RC

Figure I.16.1: Table StartRoutineByLocalIdentifier Negative Response Message

Remark:
The detailed message of the negative response code is described in chapter "Introduction".

I.16.3 Standard Application conditions

Initialisation **at reset** : zero, expect: nonvolataile data read from non-volataile memory
Activation: LV_IGK = 1

Deactivation: LV_IGK = 0
Diagnostic timeout

Service location: see list of Overview of supported subservices

I.16.4 31_01 ask checksums after reprogramming

General information:

This function is created to report the checksums after a reprogramming session in order to write the security keys
A negativ response is only possible by a wrong parameter.

Application conditions

Initialisation: `at reset`
Activation: `Kl.15 on`
Deactivation: `Kl.15 off`
`Diagnostic timeout`

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Service location: see list of implemented diagnostic services

StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier = ask for reprogramming ckecksum	M	#01h	RELI

Figure I.16.2: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = ask for reprogramming ckecksum	M	#01h	RELI_
#3d	routineLocalIdentifier = state of checksum] OK Checksum failure within Boot-SW Checksum failure within ECU-SW Checksum failure within caklibration data]	M	#XXh= [#00h, #01h, #02h, #04h]	RELI_

Figure I.16.3: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.16.5 31_02 erase Memory (not for Tricore-ECU)

General information:

This function is created to erase the memory for not Tricore-ECUs before a update is programmed.

Application conditions

Initialisation: at reset

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout

Service location: see list of implemented diagnostic services

StartRoutineByLocalIdentifier Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier = Erase Memory 31_02	M	#02h	RELI
#3d	routineLocalIdentifier = Memory adress high byte	M	#XXh	RELI_
#4d	routineLocalIdentifier = Memory adress middle byte	M	#XXh	RELI_
#5d	routineLocalIdentifier = Memory adress low byte	M	#XXh	RELI_
#6d	routineLocalIdentifier = Memory type 00=linear adress area 02= (external) Flash 06= (internal)Flash	M	#XXh	RELI_
#7d	routineLocalIdentifier = number of bytes - high byte	M	#XXh	RELI_
#8d	routineLocalIdentifier = number of bytes - middle byte	M	#XXh	RELI_
#9d	routineLocalIdentifier = number of bytes - low byte	M	#XXh	RELI_

Figure I.16.4: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = erase memory	M	#02h	RELI_
#3d	routineLocalIdentifier = [deleting o.k. deleting not o.k.]	M	#XXh= [#01h, #02h,]	RELI_

Figure I.16.5: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Global Negative Responses

I.16.6 31_02 erase memory (for TRICORE ECUs)

General information:

This services is used to erase the FLASH memory of Tricore-ECUs for reprogramming.

Application conditions

Initialisation: *at reset*

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see list of implemented diagnostic services

StartRoutineByLocalIdentifier Request (3-byte addressing)

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**StartRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	RoutineLocalIdentifier = erase memory	M	#02h	RELI
#3d	RoutineLocalIdentifier = MemoryAddress (High Byte)	M	#XXh	RELI_
#4d	RoutineLocalIdentifier = MemoryAddress (Middle Byte)	M	#XXh	RELI_
#5d	RoutineLocalIdentifier = MemoryAddress (Low Byte)	M	#XXh	RELI_
(#6d)	RoutineLocalIdentifier = MemoryTypeIdentifier [02 = external FLASH 06 = internal FLASH]	U	#XXh= [#02h, #06h]	RELI_
#6d / (#7d)	RoutineLocalIdentifier = MemorySize (High Byte)	U	#XXh	RELI_
#7d / (#8d)	RoutineLocalIdentifier = MemorySize (Middle Byte)	U	#XXh	RELI_
#8d / (#9d)	RoutineLocalIdentifier = MemorySize (Low Byte)	U	#XXh	RELI_

Figure I.16.6: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier Request (4-byte addressing)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**StartRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	RoutineLocalIdentifier = erase memory	M	#02h	RELI
#3d	RoutineLocalIdentifier = MemoryAddress (High Byte)	M	#XXh	RELI_
#4d	RoutineLocalIdentifier = MemoryAddress (MiddleHigh Byte)	M	#XXh	RELI_
#5d	RoutineLocalIdentifier = MemoryAddress (MiddleLow Byte)	M	#XXh	RELI_
#6d	RoutineLocalIdentifier = MemoryAddress (Low Byte)	M	#XXh	RELI_
#7d	MemoryTypeIdentifier **(mandatory, but not evaluated)** [00h ... FFh]	M	#XXh= [#XXh]	RELI_
#8d	RoutineLocalIdentifier = MemorySize (High Byte)	U	#XXh	RELI_
#9d	RoutineLocalIdentifier = MemorySize (MiddleHigh Byte)	U	#XXh	RELI_
#10d	RoutineLocalIdentifier = MemorySize (MiddleLow Byte)	U	#XXh	RELI_
#11d	RoutineLocalIdentifier = MemorySize (Low Byte)	U	#XXh	RELI_

Figure I.16.7: Table StartRoutineByLocalIdentifier Request Message

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Remark:

For **3-byte addressing** independent from delivery of a MemoryTypeIdentifier (byte 6) by the tester s request, the ECU automatically adds an offset to the requested memory address.
If no MemoryTypeIdentifier is delivered, the same offset as for MemoryTypeIdentifier 02h (external FLASH) or 06h (internal FLASH) is used. For compatibility reasons both MemoryTypeIdentifiers are supported.
This base memory offset must be subtracted from any memory address taken from the MAP- /A2L- file if 3-byte addressing is used!

For **4-byte addressing** a MemoryTypeIdentifier (byte 7) must be delivered by the tester s request.
Though it is not evaluated or used within the ECU for this absolute addressing mode, it is necessary to decide between 3- /4-byte addressing mode.
In this 4-byte mode the absolute address delivered by the tester is used by the ECU without any memory offset.

For MSx80 (TriCore) the base memory offset for **3-byte addressing** mode of this service is independent from MemoryTypeIdentifier :

MemoryTypeIdentifier:		**Memory offset:**
none	(short)	8000 0000h
02h	(ext. FLASH)	8000 0000h
06h	(int. FLASH)	8000 0000h

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	StartRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	RoutineLocalIdentifier = erase memory	M	#02h	RELI_
#3d	RoutineLocalIdentifier = [erasing o.k. erasing not o.k.]	M	#XXh= [#01h, #02h]	RELI_

Figure I.16.8: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.16.7 31_03 erase History Memory

General information:

This function is to erase the history memory (max. 10, see also History memory (chapter OBDII functions)), then the RAM-Memory is erased during the engine run.
If not, the content of the RAM is transferred to the non volatile memory at the end of the Power latch phase.

Application conditions

Initialisation: *at reset*

Activation: `Kl.15 on`

Deactivation: `Kl.15 off`
`Diagnostic timeout`
`Service location:` `see list of implemented diagnostic services`

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= [erase History Memory]	M	#XXh= [#03h,]	RELI

Figure I.16.9: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier erase history memory	M	#03h	RELI_

Figure I.16.10: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.16.8 31_05 power down

General information:

This function is created to switches the ECU to the power down mode..

Special Application conditions:

***Initialisation* at reset or LV_IGK 0 - -> 1:**
LV_PWL_LOCK_CDN_CUS_INH = 0

Activation: LV_IGK=0 (Kl.15 off)

Deactivation: LV_IGK=1 (Kl.15 on)
Diagnostic timeout

Formula section:

IF LV_IGK = 0 **AND**
VS = 0 **AND**
LV_ES = 01H (engine stopped)
THEN **IF** service 31_05 is received
THEN
LV_PWL_LOCK_CDN_CUS_INH = 1
(reset *PWL-lock-condition for customer)*
set Sleep-Indication-Bit and
wait for NM-Ackknowledge-Bit
to shut down operating system
ENDIF
ENDIF

StartRoutineByLocalIdentifier Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier = power down mode	M	#05h	RELI
#3d	routineLocalIdentifier [$00h=switch all ecu´s into the power down mode $01h= switch all ecu´s except the power module into the power down mode]	M	#XXh [00h, 01h]	RELI_

Figure I.16.11: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = power down mode	M	#05h	RELI_
#3d	routineLocalIdentifier [$00h=switch all ecu´s into the power down mode $01h= switch all ecu´s except the power module into the power down mode]	M	#XXh [00h, 01h]	RELI_

Figure I.16.12: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Global Negative Responses

Remark: regarding the BMW LH 8 385 774.4 chapter 10.1.1 table 10.1.1- if within 5s power down is not fullfilled, a negative Response 22h is sent to the tester.

I.16.9 31_07 start authentification

General information:

With this command the authentification procedure is started and the ECU sends the challenge key to the tester.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

StartRoutineByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**StartRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	RoutineLocalIdentifier = start authentification	M	#07h	RELI_SA
#3d	RoutineEntryOption (security level) = [security level 3 security level 4 security level 5]	M	#XXh [#03h, #04h, #05h]	REYO_01
#4d	RoutineEntryOption (user-ID byte_1)	M	#XXh	REYO_02
#5d	RoutineEntryOption (user-ID byte_2)	M	#XXh	REYO_03
#6d	RoutineEntryOption (user-ID byte_3)	M	#XXh	REYO_04
#7d	RoutineEntryOption (user-ID byte_4)	M	#XXh	REYO_05

Figure I.16.13: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StartRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	RoutineLocalIdentifier = start authentification	M	#07h	RELI_SA
#3d	RoutineEntryStatus (challenge-key byte_1)	M	#XXh	REYS_01
#4d	RoutineEntryStatus (challenge-key byte_2)	M	#XXh	REYS_02
#5d	RoutineEntryStatus (challenge-key byte_3)	M	#XXh	REYS_03
#6d	RoutineEntryStatus (challenge-key byte_4)	M	#XXh	REYS_04
#7d	RoutineEntryStatus (challenge-key byte_5)	M	#XXh	REYS_05
#8d	RoutineEntryStatus (challenge-key byte_6)	M	#XXh	REYS_06
#9d	RoutineEntryStatus (challenge-key byte_7)	M	#XXh	REYS_07
#10d	RoutineEntryStatus (challenge-key byte_8)	M	#XXh	REYS_08

Figure I.16.14: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.16.10 31_08 check authentification

General information:

With this command the RSA 512 authentification key delivered by the tester is checked inside the ECU.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

StartRoutineByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**StartRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	RoutineLocalIdentifier = check authentification	M	#08h	RELI_CA
#3d	RoutineEntryOption = authentification key length (high byte)	M	#00h	REYO_01
#4d	RoutineEntryOption = authentification key length (mid_high byte)	M	#00h	REYO_02
#5d	RoutineEntryOption = authentification key length (mid_low byte)	M	#00h	REYO_03
#6d	RoutineEntryOption = authentification key length (low byte)	M	#10h	REYO_04
#7d	RoutineEntryOption = authentification key_1 (high byte)	M	#XXh	REYO_05
#8d	RoutineEntryOption = authentification key_1 (mid_high byte)	M	#XXh	REYO_06
#9d	RoutineEntryOption = authentification key_1 (mid_low byte)	M	#XXh	REYO_07
#10d	RoutineEntryOption = authentification key_1 (low byte)	M	#XXh	REYO_08
#11d	RoutineEntryOption = authentification key_2 (high byte)	M	#XXh	REYO_09
#12d	RoutineEntryOption = authentification key_2 (mid_high byte)	M	#XXh	REYO_10
#13d	RoutineEntryOption = authentification key_2 (mid_low byte)	M	#XXh	REYO_11
#14d	RoutineEntryOption = authentification key_2 (low byte)	M	#XXh	REYO_12
#xxd	...	M	#XXh	REYO_xx
#xxd	...	M	#XXh	REYO_xx
#xxd	...	M	#XXh	REYO_xx
#xxd	...	M	#XXh	REYO_xx
#67d	RoutineEntryOption = authentification key_16 (high byte)	M	#XXh	REYO_65
#68d	RoutineEntryOption = authentification key_16 (mid_high byte)	M	#XXh	REYO_66
#69d	RoutineEntryOption = authentification key_16 (mid_low byte)	M	#XXh	REYO_67
#70d	RoutineEntryOption = authentification key_16 (low byte)	M	#XXh	REYO_68

Figure I.16.15: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StartRoutineByLocalIdentifier Positive Response Sid	M	#71h	STRBLIPR
#2d	RoutineLocalIdentifier = check authentification	M	#08h	RELI_CA
#3d	RoutineEntryStatus = [authentification denied authentification accepted]	M	#XXh [#00h, #01h]	REYS_01

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Figure I.16.16: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.16.11 31_09 check signature

General information:

With this command the signature check for ECU-SW or calibration data is started.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on) AND
ECU running in Boot-SW

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout
Service location: see list of implemented diagnostic services

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**StartRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	RoutineLocalIdentifier = check signature	M	#09h	RELI_CS
#3d	RoutineEntryOption = [check signature for ECU-SW check signature for calibration data]	M	#XXh [#02h, #04h]	REYO_01

Figure I.16.17: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	StartRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = check signature	M	#09h	RELI_CS
#3d	routineEntryStatus = [signature wrong signature correct]	M	#XXh [#00h, #01h]	REYS_01

Figure I.16.18: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.16.12 31_0A report reprogramming status

General information:

This funktion check the reprogramming status of the ecu.

Application conditions

Initialisation: *at reset*

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see list of implemented diagnostic services

StartRoutineByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= [report reprogramming status]	M	#XXh= [#0Ah,]	RELI_CPSP ROGS

Figure I.16.19: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = PSL	M	#0Ah	
#3d	RoutineEntryStatus = reprogramming status: HW reference not ok = 09h Program not complete = 0Ch Program reference not ok = 0Ah Signature pattern PAF not ok = 05h HW reference does not fit to program reference = 0Bh No calibration data available at all = 00h Calibration data not complete = 0Fh Calibration data reference not ok = 0Dh Signature pattern DAF not ok = 06h Program reference does not fit to calibration data ref = 0Eh ECU is correct programed = 01h	M	#XXh	CS_PS

Figure I.16.20: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.16.13 31_0C energy spare mode

FUNCTION DESCRIPTION:

This module handles the activation of the energy spare mode "FeTraWe". The mode is controlled by external tester and combined with an engine speed limit. The mode is regarded in dynamic error management.
With the received command an engine speed setpoint can be activated. The general function is described in the chapter engine speed limit coordination . The set energy spare mode includes either the activated "Fertigungs- /Transport- or Werkstattmode".
The mode is kept in ECU after disconnection of the tester. The same is applied in case of lost power supply.

Special Application conditions:

***Initialisation at reset or at* LV_IGK 0-**> **1**: read from non-volatile memory

Activation: LV_IGK=1 **and** LC_EGY_MIN_KWP = 1

Deactivation: LV_IGK=0 **or** LC_EGY_MIN_KWP = 0
Diagnostic timeout

Formula section:

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IF activation identifier of service $31_0C_01 is received ***FeTraWe***
THEN STATE_EGY_MIN_KWP = 1h
send positive response

ELSEIF activation identifier of service $31_0C_02 is received ***FeTraWe***
THEN STATE_EGY_MIN_KWP = 2h
send positive response

ELSEIF activation identifier of service $31_0C_04 is received ***FeTraWe***
THEN STATE_EGY_MIN_KWP = 3h
send positive response

ELSEIF deactivation identifier of service $31_0C_00 is received
THEN STATE_EGY_MIN_KWP = 0h
send positive response

Save STATE_EGY_MIN_KWP in non-volatile memory

ELSE remains unchanged send negative response

ENDIF

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	**routineLocalIdentifier = energie spare mode**	**M**	**#0Ch**	
#3d	routineLocalIdentifier = set STATE_EGY_MIN_KWP [passive Fertigungsmodus Transportmodus Werkstattmodus]	M	#XXh [#00h #01h #02h #04h]	RELI_

Figure I.16.21: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response SId**	**M**	**#71h**	**STRBLIPR**
#2d	**startRoutineByLocalIdentifier = enery spare mode**	**M**	**#0Ch**	
#3d	Routine entry status = FeTraWe [not used Fertigungsmodus Transportmodus Werkstattmodus]	M	#XXh [#00h #01h #02h #04h]	RELI_

Figure I.16.22: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Global Negative Responses

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I.16.14 31_1F Sweeping Technology SWT

Additional Application condition:

Activation: LV_ES = 1
Deactivation: LV_ES = 0

I.16.14.1 31_1F_E5 SWT: SetVin

General information:

Simulation of setting VIN to ECU. Returns Flash write error if the VIN is not the same as stored in ECU.
Formula Section:
If(1) service 31_1F_E5 is received
Then(1)
#If(2) NC_CONF_DGNC_31_1F = 0
#Then(2)
send negative response "RequestOutOfRange"
#Else(2)
LOC_FSC_LEN = 0
ACTION_SWT_SetVin(IN VIN short[], OUT Result status)
Send positive response
#Endif(2)
Endif(1)

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	SWT_SetVin	M	#E5h	RELI
#4d	VIN short[1]	M	#XXh	RELI
#5d	VIN short[2]	M	#XXh	RELI
#6d	VIN short[3]	M	#XXh	RELI
#7d	VIN short[4]	M	#XXh	RELI
#8d	VIN short[5]	M	#XXh	RELI
#9d	VIN short[6]	M	#XXh	RELI
#10d	VIN short[7]	M	#XXh	RELI

Figure I.16.23: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	SWT_SetVin	M	#E5h	RELI_
#4d	Result status] Unknown error Flash write error No L3 authentication Wrong parameter ok]	M	#XXh [#FFh, #E0h, #D9h, #D6h, #00h,]	RELI_

Figure I.16.24: Table StartRoutineByLocalIdentifier Positive Response Message

I.16.14.2 31_1F_E6 SWT: GetVin

General information:

Get VIN from ECU

Formula Section:

If(1) service 31_1F_E6 is received

Then(1)

#If(2) NC_CONF_DGNC_31_1F = 0

#Then(2)

send negative response "RequestOutOfRange"

#Else(2)

LOC_FSC_LEN = 0

ACTION_SWT_GetVin(OUTVIN short[], OUT Result status**)**

Send positive response

#Endif(2)

Endif(1)

StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	SWT_GetVin	M	#E6h	RELI

Figure I.16.25: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	SWT_GetFsc	M	#E6h	RELI_
#4d	routineLocalIdentifier = Result status] Unknown error ok]	M	#XXh [#FFh, #00h,]	RELI_
#5d	VIN short[1]	M	#XXh	RELI
#6d	VIN short[2]	M	#XXh	RELI
#7d	VIN short[3]	M	#XXh	RELI
#8d	VIN short[4]	M	#XXh	RELI
#9d	VIN short[5]	M	#XXh	RELI
#10d	VIN short[6]	M	#XXh	RELI
#11d	VIN short[7]	M	#XXh	RELI

Figure I.16.26: Table StartRoutineByLocalIdentifier Positive Response Message

I.16.14.3 31_1F_EA SWT: PeriodicalCheck

General information:

Manual triggered check for testing requirements.

Formula Section:
/* only on request */
If(1) service 31_1F_EA is received
Then(1)
#If(2) NC_CONF_DGNC_31_1F = 0
#Then(2)
send negative response "RequestOutOfRange"
#Else(2)
LOC_FSC_LEN = 0
If(3) Level 3 authorisation was sucessfull
Then(3)
LV_AUTH_L3_ENA = 1
Else(3)
LV_AUTH_L3_ENA = 0
Endif(3)
ACTION_SWT_ChkFsc(IN SWID, OUT Result status);
If(3) Result status = "still in work"
Then(3)
Init 78h response every 10ms

Else(3)
send positive response
Endif(3)
#Endif(2)
Endif(1)

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/* at every 10ms if 78h response is active */

#If(1) NC_CONF_DGNC_31_1F <> 0
#Then(1)
If(2) Level 3 authorisation was sucessfull
Then(2)
LV_AUTH_L3_ENA = 1
Else(2)
LV_AUTH_L3_ENA = 0
Endif(2)
ACTION_SWT_ChkFsc(IN SWID, OUT Result status);
If(2) Result status = "still in work"
Then(2)
Do nothing
Else(2)
stop 78h response
send positive response
Endif(2)
#Endif(1)

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	SWT_PeriodicalChecks	M	#EAh	RELI
#4d	SWID Highword Highbyte	M	#XXh	RELI_
#5d	SWID Highword Lowbyte	M	#XXh	RELI_
#6d	SWID Lowword Highbyte	M	#XXh	RELI_
#7d	SWID Lowword Lowbyte	M	#XXh	RELI_

Figure I.16.27: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	SWT_PeriodicalChecks	M	#EAh	RELI_
#4d	routineLocalIdentifier = Result status] Unknown error SWID not available SWID check faiure Signature invalid FSC not available FSC rejected FSC cancelled Flash read error VIN checked failed No L3 authentication VIN can not be found in ECU ok]	M	#XXh [#FFh, #FEh #FCh #F9h #F6h, #F5h, #F4h, #DFh, #DEh, #D9h, #D2h, #00h,]	RELI_

Figure I.16.28: Table StartRoutineByLocalIdentifier Positive Response Message

I.16.14.4 31_1F_EB SWT: GetFSC

General information:

Returns a FSC indentified by its CALLID.

Formula Section:

If(1) service 31_1F_EB is received
Then(1)
  #If(2) NC_CONF_DGNC_31_1F = 0
  #Then(2)
    send negative response "RequestOutOfRange"
  #Else(2)
    ACTION_SWT_CallidToSwid(IN CALL_ID, OUT TMP_SWID)
    ACTION_SWT_GetFsc
      (IN TMP_SWID,OUT FSC or part of FSC, OUT Result status)
    If(3) LOC_FSC_LEN = 0
    Then(3) Result status =" Wrong parameter"
    Endif(3)
    Send positive response
  #Endif(2)
Endif(1)

StartRoutineByLocalIdentifier Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	SWT_GetFsc	M	#EBh	RELI
#4d	Telegramm no	M	#XXh	RELI_
#5d	CALL_ID Highbyte	M	#XXh	RELI_
#6d	CALL_ID Lowbyte	M	#XXh	RELI_

Figure I.16.29: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	SWT_GetFsc	M	#EBh	RELI_
#4d	Result status] Unknown Error Wrong parameter ok]	M	#XXh [#FFh, #D6h, #00h,]	RELI_
#5d	Telegramm no	M	#XXh	RELI_
#6d..#XXd	FSC or part of FSC	M	#XXh	RELI_

Figure I.16.30: Table StartRoutineByLocalIdentifier Positive Response Message Hint: If FSCLen = 0 the length of positve response is #5d

I.16.14.5 31_1F_EC SWT: GetFSCLen

General information:

Returns the length of a FSC identiefied by its SWID and generates a CALLID.

Formula Section:

If(1) service 31_1F_EC is receive
Then(1)
#If(2) NC_CONF_DGNC_31_1F = 0
#Then(2)
send negative response "RequestOutOfRange"
#Else(2)
ACTION_SWT_GetFscLen(INSWID**,** OUTFSCLen**,** OUTResult status**)**
LOC_FSC_LEN = FSCLen
ACTION_SWT_SwidToCallid(IN SWID, OUT CALL_ID)
Send positive response
#Endif(2)
Endif(1)

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StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	SWT_GetFscLen	M	#ECh	RELI
#4d	SWID Highword Highbyte	M	#XXh	RELI_
#5d	SWID Highword Lowbyte	M	#XXh	RELI_
#6d	SWID Lowword Highbyte	M	#XXh	RELI_
#7d	SWID Lowword Lowbyte	M	#XXh	RELI_

Figure I.16.31: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	SWT_GetFscLen	M	#ECh	RELI_
#4d	Result status] Unknown error SWID not available FSC not available Flash read error ok]	M	#XXh [#FFh, #FEh, #F6h, #DFh, #00h,]	RELI_
#5d	FSClen Highbyte		#XXh	
#6d	FSClen Lowbyte		#XXh	
#7d	MXBL Highbyte		#00h	
#8d	MXBL Lowbyte		#C8h	
#9d	CALL_ID Highbyte		#XXh	
#10d	CALL_ID Lowbyte		#XXh	

Figure I.16.32: Table StartRoutineByLocalIdentifier Positive Response Message

I.16.14.6 31_1F_ED SWT: DisableFSC

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General information:

Disables a stored FSC (not IMOB)

Formula Section:

If(1) service 31_1F_ED is received
Then(1)
#If(2) NC_CONF_DGNC_31_1F = 0
#Then(2)
send negative response "RequestOutOfRange"
#Else(2)
LOC_FSC_LEN = 0
If(3) Level 3 authorisation was sucessfull
Then(3)
LV_AUTH_L3_ENA = 1
Else(3)
LV_AUTH_L3_ENA = 0

Endif(3)
ACTION_SWT_DisableFsc(IN SWID, OUT Result status)
Send positive response
#Endif(2)
Endif(1)

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	SWT_DisableFSC	M	#EDh	RELI
#4d	SWID Highword Highbyte	M	#XXh	RELI_
#5d	SWID Highword Lowbyte	M	#XXh	RELI_
#6d	SWID Lowword Highbyte	M	#XXh	RELI_
#7d	SWID Lowword Lowbyte	M	#XXh	RELI_

Figure I.16.33: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	SWT_DisableFSC	M	#EDh	RELI_
#4d	Result status] Unknown Error SWID not available FSC is not available FSC is already disabled No L3 authentication ok]	M	#XXh [#FFh, #FEh, #F6h, #F4h, #D9h #00h,]	RELI_

Figure I.16.34: Table StartRoutineByLocalIdentifier Positive Response Message

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I.16.14.7 31_1F_EE SWT: ChkFsc

General information:

SWT: Checks the stored FSC (date, swid, Serialnumber(IMOB)/VIN(NON-IMOB), signature)
A negativ response is only possible by a wrong parameter.

Formula Section:
If(1) service 31_1F_EE is received
Then(1)
#If(2) NC_COND_DGNC_31_1F <> 0
#Then(2) LOC_FSC_LEN = 0
#Endif(2)

If(2) Level 3 authorisation was sucessfull
Then(2)
LV_AUTH_L3_ENA = 1

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Else(2)
LV_AUTH_L3_ENA = 0
Endif(2)
ACTION_SWT_ChkFsc(IN SWID, OUT Result status);
If(2) Result status = "still in work"
Then(2)
Init 78h response every 10ms
Else(2)
If(3) Result status != "Message RcvFSC not received"
Then(3)
send positive response
Else(3)
send negative response "subfunction not supported" (0x12)
Endif(3)
Endif(2)
Endif(1)

/* at every 10ms if 78h response is active */

If(1) 78h response is active
Then(1)
If(2) Level 3 authorisation was sucessfull
Then(2)
LV_AUTH_L3_ENA = 1
Else(2)
LV_AUTH_L3_ENA = 0
Endif(2)
ACTION_SWT_ChkFsc(IN SWID, OUT Result status);
If(2) Result status = "still in work"
Then(2)
Do nothing
Else(2)
stop 78h response
If(3) Result status != "Message RcvFSC not received"
Then(3)
send positive response
Else(3)
send negative response "subfunction not supported" (0x12)
Endif(3)
Endif(2)
#Endif(1)

StartRoutineByLocalIdentifier Request

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Data Byte	***Parameter Name***	***Cvt***	***Hex Value***	***Mnemonic***
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	routineLocalIdentifier = ask for check FSC	M	#EEh	RELI
#4d	routineLocalIdentifier = SWID high_word_high_byte (SWT)	M	#XXh	RELI
#5d	routineLocalIdentifier = SWID high_word_low_byte (SWT)	M	#XXh	RELI
#6d	routineLocalIdentifier = SWID low_word_high_byte (SWT)	M	#XXh	RELI
#7d	routineLocalIdentifier = SWID low_word_low_byte (SWT)	M	#XXh	RELI

Figure I.16.35: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	***Parameter Name***	***Cvt***	***Hex Value***	***Mnemonic***
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	routineLocalIdentifier = ChkFCS	M	#EEh	RELI_
#4d	routineLocalIdentifier = result] Unknown error SWID not available SWID check faiure Signature invalid FSC not available FSC rejected FSC cancelled Flash read error VIN checked failed No L3 authentication VIN can not be found in ECU ok]	M	#XXh [#FFh, #FEh #FCh #F9h #F6h, #F5h, #F4h, #DFh, #DEh, #D9h, #D2h, #00h,]	RELI_

Figure I.16.36: Table StartRoutineByLocalIdentifier Positive Response Message

I.16.14.8 31_1F_F1 SWT: RcvFsc

General information:

SWT: Transfer data of FSC to ECU. FSC will be stored in EEPROM for all non-IMOB SWIDs.
A negativ response is only possible by a wrong parameter.

Formula Section:

If(1) service 31_1F_F1 is received
Then(1)
#If(2) NC_COND_DGNC_31_1F <> 0
#Then(2) LOC_FSC_LEN = 0
#Endif(2)
ACTION_SWT_CallidToSwid(INCALLID, OUT TMP_SWID**)**
If(2) Level 3 authorisation was sucessfull
Then(2)
LV_AUTH_L3_ENA = 1
Else(2)

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LV_AUTH_L3_ENA = 0
Endif(2)
ACTION_SWT_RcvFsc
(IN TMP_SWID,*FSC[x], IN received message length - 6**,** OUTResult status**)**
If(2) Result status= **"**SWID not available**"**
Then(2)
Result status="Wrong Parameter"
Endif(2)
If(2) Result status = "still in work"
Then(2)
Init 78h response every 10ms
Else(2)
send positive response
Endif(2)
Endif(1)

/* at every 10ms if 78h response is active */

If(1) 78h response is active
Then(1)
#If(2) NC_COND_DGNC_31_1F <> 0
#Then(2) LOC_FSC_LEN = 0
#Endif(2)
ACTION_SWT_CallidToSwid(IN callid, OUT TMP_SWID**)**
If(2) Level 3 authorisation was sucessfull
Then(2)
LV_AUTH_L3_ENA = 1
Else(2)
LV_AUTH_L3_ENA = 0
Endif(2)
ACTION_SWT_RcvFsc
(IN TMP_SWID,*FSC[x], IN received message length - 6**,** OUTResult status**)**
If(2) Result status= **"**SWID not available**"**
Then(2) Result status="Wrong Parameter"
Endif(2)
If(2) Result status = "still in work"
Then(2)
Do nothing
Else(2)
stop 78h response
send positive response
Endif(2)
Endif(1)

StartRoutineByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	routineLocalIdentifier = ask for store FSC to ECU	M	#F1h	RELI
#4d	routineLocalIdentifier = Telegramm number] Telegramm 1 Telegramm xx]	M	#XXh [#01h, #xxh,]	RELI
#5d	routineLocalIdentifier = CALLID high_byte (SWT)	M	#XXh	RELI
#6d	routineLocalIdentifier = CALLID low_byte (SWT)	M	#XXh	RELI
#7d-Xd	routineLocalIdentifier = FSC[X]	M	#XXh	RELI

Figure I.16.37: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	routineLocalIdentifier = ask for length of GXMODN	M	#F1h	RELI_
#4d	routineLocalIdentifier = Result status] Unknown error Invalid FSC Date Flash write error No L3 authentication Wrong Parameter No free space storing FSC Parser structure wrong ok]	M	#XXh [#FFh, #F8h, #E0h, #D9h, #D6h, #D3h, #D1h #00h,]	RELI_
#5d	routineLocalIdentifier = Telegramm number] Telegramm 1 Telegramm xx]	M	#XXh [#01h, #xxh,]	RELI_

Figure I.16.38: Table StartRoutineByLocalIdentifier Positive Response Message

I.16.14.9 31_1F_F2 SWT: SetFscLen

General information:

IMMO: Transfer length of FSC (FreiSchaltCode) to ECU
A negativ response is only possible by a wrong parameter.
The Software ID (SWID) is a 32 bit data type which contains 4 8bit fields. The CALL ID is a 16 bit short format used by KWP which is generated by 2 of the 4 SWID 8bit fields.

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	FSC function	16 bit CALLID	32 bit SWID
	CALLID_IMOB_DME1 / SWID_IMOB_DME1	Highbyte #1: 0x07 Lowbyte #0: 0x40	AppNr Highbyte #3: 0x00 AppNr Lowbyte #2: **0x07** Upgr Idx Highbyte #1: **0x40** Upgr idx DA #0 : 0x00
	CALLID_IMOB_DME2 / SWID_IMOB_DME2	Highbyte #1: 0x09 Lowbyte #0: 0x12	AppNr Highbyte #3: 0x00 AppNr Lowbyte #2: **0x09** Upgr Idx Highbyte #1: **0x12** Upgr idx DA#0 : 0x00

Formula Section:

If(1) service 31_1F_F2 is received
Then(1)
#If(2) NC_COND_DGNC_31_1F <> 0
#Then(2) LOC_FSC_LEN = 0
#Endif(2)
If(2) ((SWID == SWID_IMOB_DME1) **or** (SWID == SWID_IMOB_DME2))
Then(2) Disable Monitoring Unit /* Disable MU only for Immobilizer FSC */
Else(2)
Endif(2)
ACTION_SWT_SwidToCallid(INSWID, OUT CALLID)
ACTION_SWT_SetFscLen(IN SWID,IN FSC length, OUT Result status)
max. Block length = 5Eh /* so 3 segments will be delivered for a 268 byte FSC*/
Send positive response
Endif(1)

StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	routineLocalIdentifier = ask for FSC length	M	#F2h	RELI
#4d	routineLocalIdentifier = SWID(highword, highbyte) 1)	M	#XXh	RELI
#5d	routineLocalIdentifier = SWID(highword, lowbyte) 1)	M	#XXh	RELI
#6d	routineLocalIdentifier = SWID(lowword, highbyte) 1)	M	#XXh	RELI
#7d	routineLocalIdentifier = SWID(lowword, lowbyte) 1)	M	#XXh	RELI
#8d	routineLocalIdentifier FSC length (high byte) 1)	M	#XXh	RELI
#9d	routineLocalIdentifier FSC length (low byte) 1)	M	#XXh	RELI

Figure I.16.39: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	SWT_SetFscLen	M	#F2h	RELI_
#4d	routineLocalIdentifier = result] Unknown error SWID not available No L3 authentication Wrong parameter No free space for storing FSC ok]	M	#XXh [#FFh, #FEh, #D9h, #D6h, #D3h, #00h,]	RELI_
#5d	routineLocalIdentifier = max. Block length (high byte)	M	#00h	RELI_
#6d	routineLocalIdentifier = max. Block length (low byte)	M	#5Eh	RELI_
#7d	routineLocalIdentifier = CALLID high_byte (SWT)	M	#XXh	RELI_
#8d	routineLocalIdentifier = CALLID low_byte (SWT)	M	#XXh	RELI_

Figure I.16.40: Table StartRoutineByLocalIdentifier Positive Response Message

I.16.14.10 31_1F_F6 SWT: GetStatus

General information:

A request returns all known SWIDs and its status (stored,active,disabled,denied)

Formula Section:

If(1) service 31_1F_F6 is received
Then(1)
#If(2) NC_CONF_DGNC_31_1F = 0
#Then(2)
send negative response "RequestOutOfRange"
#Else(2)
LOC_FSC_LEN = 0
TMP_FLAG = 0
ACTION_SWT_GetSoftwareIdFunc
(OUT tmp_no_of_swids,OUT tmp_swid_buffer, OUT result status 1**)**
If(3) (result status 1 = **"** Processing successfully")
Then(3)
For TMP_U8 =0 **to** TMP_NO_OF_SWIDS**,** TMP_U8++
do
ACTION_SWT_GetStatus
(IN TMP_SWID /* from tmp_swid_buffer[TMP_U8] */,
OUT TMP_STATUS, OUT result status 2)
If (result status 2 = **"** Processing successfully"**)**
Then TMP_FLAG = 1
Endif
kwp message #8d+TMP_U8*6 .. #11d+TMP_U8*6= TMP_SWID
kwp message #12d +TMP_U8*6= 0x00
kwp message #13d+TMP_U8*6 = TMP_STATUS
Endfor
Endif(3)
If(3) (TMP_FLAG = 1)

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Then(3) kwp message #4d = "ok"
Else(3) kwp message #4d = "Unknown error"
Endif(3)
Send postive response
#Endif(2)
Endif(1)

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	SWT_GetStatus	M	#F6h	RELI

Figure I.16.41: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	SWT_GetStatus	M	#F6h	RELI_
#4d	Result status] Unknown error ok]	M	#XXh [#FFh, #00h,]	RELI_
#5d	RootCertStatus	M	#00h	RELI_
#6d	SigSCertStatus	M	#00h	RELI_
#7d	SWSigStatus	M	#02h	RELI_
#8d	First SWID Highword Highbyte	M	#XXh	RELI_
#9d	First SWID Highword Lowbyte	M	#XXh	RELI_
#10d	First SWID Lowword Highbyte	M	#XXh	RELI_
#11d	First SWID Lowword Lowbyte	M	#XXh	RELI_
#12d	First FSCSCertStatus	M	#00h	RELI_
#13d	First FSC Status SWID	M	#XXh	RELI_
...	...	...	...	...
#xxd	Last FSC Status SWID	M	#XXh	RELI_

Figure I.16.42: Table StartRoutineByLocalIdentifier Positive Response Message Hint: If no SWID is known the length of positve response is #7d

I.16.14.11 31_1F_F8 SWT: GetSoftwareId

General information:

The request returns all known SWIDs without adress of the ECU, independend if active, disabled, or inactive.

Formula Section:
If(1) service 31_1F_F8 is received

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Then(1)
#If(2) NC_CONF_DGNC_31_1F = 0
#Then(2)
send negative response "RequestOutOfRange"
#Else(2)
LOC_FSC_LEN = 0
ACTION_SWT_GetSwidFunc
(OUTNUMBER_OF_SWID, OUT SWID[], OUT Result status**)**
Send positive response
#Endif(2)
Endif(1)

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	GetSoftwareId	M	#F8h	RELI

Figure I.16.43: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	GetSoftwareId	M	#F8h	RELI_
#4d	Result status] Unknown error ok]	M	#XXh [#FFh, #00h,]	RELI_
#5d	First SWID Highword Highbyte	M	#XXh	RELI_
#6d	First SWID Highword Lowbyte	M	#XXh	RELI_
#7d	First SWID Lowword Highbyte	M	#XXh	RELI_
#8d	First SWID Lowword Lowbyte	M	#XXh	RELI_
...	...	...	...	...
#xxd	Last SWID Lowword Lowbyte	M	#XXh	RELI_

Figure I.16.44: Table StartRoutineByLocalIdentifier Positive Response Message Hint: If NUMBER_OF_SWID = 0 then the length of positve response is only #4d

I.16.14.12 31_1F_F9 SWT: GetSoftwareIdFunc

General information:

A request returns all known SWIDs of the ECU, independend if active, disabled, or inactive. The ECU adress is also delivered.

Formula Section:
If(1) service 31_1F_F9 is received
Then(1)
#If(2) NC_CONF_DGNC_31_1F = 0

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#Then(2)
send negative response "RequestOutOfRange"
#Else(2)
LOC_FSC_LEN = 0
ACTION_SWT_GetSwidFunc
(OUTNUMBER_OF_SWID, OUT SWID[], OUT Result status**)**
send positive response
#Endif(2)
Endif(1)

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI
#3d	GetSoftwareIdFunc	M	#F9h	RELI

Figure I.16.45: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = swt	M	#1Fh	RELI_
#3d	GetSoftwareIdFunc	M	#F9h	RELI_
#4d	Result status] Unknown Error ok]	M	#XXh [#FFh, #00h,]	RELI_
#5d	Address ECU	M	#12h	RELI_
#6d	First SWID Highword Highbyte	M	#XXh	RELI_
#7d	First SWID Highword Lowbyte	M	#XXh	RELI_
#8d	First SWID Lowword Highbyte	M	#XXh	RELI_
#9d	First SWID Lowword Lowbyte	M	#XXh	RELI_
...	...	...	...	...
#xxd	Last SWID Lowword Lowbyte	M	#XXh	RELI_

Figure I.16.46: Table StartRoutineByLocalIdentifier Positive Response Message Hint: If NUMBER_OF_SWID = 0 then the length of positve response is only #5d

I.16.15 31_25 switch off Injection valves

General information:

With this command the Injection valves can be switched off. The general function is described in the chapter Injection - Cylinder shut off .

Special Application conditions:

Initialisation: at reset with 00h

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Activation: LV_IGK=1 (Kl.15 on) and
STATE_ENG=02h or 03h (IS or PL) and
N<C_N_MAX_KWP

Deactivation: LV_IGK=0 (Kl.15 off) or
STATE_ENG<>02h or 03h (IS or PL) or
N>=C_N_MAX_KWP or
Diagnostic timeout
set INH_IV_KWP=00h

Service location: see list of implemented diagnostic services

Formula section:

IF activation conditions are fullfilled and
service 31_25 is received

THEN INH_IV_KWP = sent to the module Cylinder shut off
send positive response

ELSE INH_IV_KWP=00h
send negative response

ENDIF

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= shut off request for cylinder x	M	#25h	RELI_
#3d	routineEntryOption = active	M	#01h	REYO_
#4d	routineEntryOption = INH_IV_KWP	M	#XXh	REYO_

Figure I.16.47: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response SId**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIdentifier = shut off request for cylinder x	M	#25h	RELI_
#3d	routineEntryStatus = active	M	#01h	REYS_01

Figure I.16.48: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.16.16 31_2B Ruhestrom steuern

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With this command "Ansteuern Ruhestromprüfung mit IBS" is started.
Hint: Reset of B_ecojob1/2 is normaly done in BMW-module.

Additional Application conditions:

Set in case of Deactivation : B_ecojob1=0, B_ecojob2 = 0

Formula section:

If service 31_2B is received
Then Eco_.. = received values
B_ecojob1 = 1
send positive response
Else
send negative response
Endif

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= Ruhestrom_steuern	M	#2Bh	RELI_RUHE STROM
#3d	routineLocalIdentifier = set Eco_max_i	M	#XXh	REYO_I_MA X
#4d	routineLocalIdentifier = set Eco_msb	M	#XXh	REYO_MSB
#5d	routineLocalIdentifier = set Eco_mz	M	#XXh	REYO_MZ
#6d	routineLocalIdentifier = set Eco_timo	M	#XXh	REYO_TO

Figure I.16.49: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response SId**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIdentifier = Ruhestrom steuern x	M	#2Bh	RELI_RUHE STROM

Figure I.16.50: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Global Negative Responses

I.16.17 31_2E Starten Nullgang-Lernen

General information:

With this command "Nullgang-Lernen" is started.

Application conditions

Initialisation: `at reset with 00h`

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Activation: `LV_IGK=1 (Kl.15 on)`

Deactivation: `LV_IGK=0 (Kl.15 off)` **or** `Diagnostic timeout`
`set: B_nglern=0`

Service location: see list of implemented diagnostic services

Formula section:

If service 31_2E is received
Then B_nglern = 1 for 2 sec
Tvneutrin = 0.0
send positive response
Endif

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= Ruhestrom_steuern	M	#2Eh	RELI_NGL

Figure I.16.51: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response SId**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIdentifier = Ruhestrom steuern x	M	#2Eh	RELI_NGL

Figure I.16.52: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.16.18 31_2F Starten Desulfatisierung Fahrbetrieb

General information:

With this command "Desulfatisierung Fahrbetrieb" is started.

Application conditions

Initialisation: *at reset with 00h*

Activation: `LV_IGK=1 (Kl.15 on)`

Deactivation: `LV_IGK=0 (Kl.15 off)` **or** `Diagnostic timeout`

Service location: see list of implemented diagnostic services

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Formula section:

If service 31_2F is received
Then call ACTION_NOXM_StartCatHeatDesu()
send positive response
Endif

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= Start Desulfatisierung Fahrbetrieb	M	#2Eh	RELI_DESFAHR

Figure I.16.53: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response SId**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIdentifier = Start Desulfatisierung Fahrbetrieb	M	#2Eh	RELI_DESFAHR

Figure I.16.54: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.16.19 31_30 delete selective adaption values

General information:

With this comand the adaption values described in the chapter basic sw general operation -initialize non volatile datas are deleted.
All adaption values are initialized with their default values (compare detailed specifications), single adaption values according to the bit position.
If bit #4 within byte 4d ist masked (set to 1) by the tester, bit LV_POW_MNG_BAT_CHG is set to 1; after 5s LV_POW_MNG_BAT_CHG is automatically reset by the ECU to 0 again.
Within the telegram some macros are called (named with small letter below). This macros call functions over BMW- layer (see also layer- specification).

Special Application conditions:

Initialisation: at reset init with 0
Activation: LV_IGK = 1 **and**
LV_ES = 1
Deactivation: LV_IGK= 0 **and**
LV_ES = 0
Diagnostic timeout

Service location: see list of implemented diagnostic services

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Formula section:

setting of LV_POW_MNG_BAT_CHG:

IF bit position #4 in byte #4dset to 1 within tester s request
THEN set LV_POW_MNG_BAT_CHG to 1 and start timer
ELSE do nothing
ENDIF

IF LV_POW_MNG_BAT_CHG is set to 1 and timer >= 5s
THEN reset LV_POW_MNG_BAT_CHG to 0
ELSE do nothing
ENDIF

only **MSD80/MSD81:** setting/resetting LV_CYL_BAL_.../LV_MFF_. / LV_HPP_CTL_AD_CLR_EXT_REQ:
IF bit position is set to 1 with tester s request
THEN set request bit
ELSE do nothing

IF request bit is 1 and init of corresponding values is done
THEN reset request bit 100..200ms later
ELSE do nothing

request bit	corresponding values	init value:
LV_CRK_CYL_LAM_DELTA_RST_LS_EXT[NC_CBK_EX_NR]		
	DELTA_CRK_CYL_LAM[NC_CBK_EX_NR]	0.0
	CRK_CYL_LAM_DELTA_INI[NC_CBK_EX_NR]	0.0
	CTR_PHA_SHIFT_AD_TRIG[NC_CBK_EX_NR]	0
LV_CTR_CYL_BAL_RST_EXT		
	CTR_ERR_OBD_DIAG_CYL_BAL_LAM[NC_CBK_EX_NR]	0
	CTR_ERR_OBD_DIAG_CYL_BAL_ER	0
LV_CYL_BAL_AD_EOL_EXT_ADJ:	LV_CYL_BAL_LAM_AD_EOL	
	LV_CYL_BAL_ER_AD_ADD_EOL	0
	LV_CYL_BAL_ER_AD_FAC_EOL	0
	LV_CYL_BAL_LAM_SEL_AD_COLD_EOL	**0**
	LV_CYL_BAL_LAM_SEL_AD_HOT_EOL	0
LV_CYL_BAL_AD_DC_EXT_ADJ:	LV_CYL_BAL_LAM_AD_DC,	0
	LV_CYL_BAL_AD_HOM_REQ_DC	0
	LV_CYL_BAL_LAM_SEL_AD_HOT_DC	0
	LV_CYL_BAL_AD_WG_OPEN_REQ[NC_CBK_EX_NR]	0
LV_LAM_CYL_SEL_ADJ_RST_IV_EXT[NC_CBK_EX_NR]		
	FAC_LAM_CYL_SEL_ADJ_L_RNG[NC_CYL_NR]	0.0
	FAC_LAM_CYL_SEL_ADJ_H_RNG[NC_CYL_NR]	0.0
	FAC_LAM_CYL_SEL_ADJ_CST[NC_CYL_NR]	0.0
	MFF_ADD_CYL_LAM_COR[NC_CYL_NR]	0.0
	STATE_LAMB_CYL_SEL_CQ_SLOP[NC_CBK_EX_NR]	0
	LV_LAM_CYL_SEL_ADJ_H_RNG_VLD[NC_CBK_EX_NR]	0
	LV_LAM_CYL_SEL_ADJ_L_RNG_VLD[NC_CBK_EX_NR]	0
LV_MFF_FAC_AD_ER_BAL_EXT_ADJ:	FAC_TI_AD_ER_BAL[NC_CYL_NR]	1.00
LV_MFF_ADD_AD_ER_BAL_EXT_ADJ:	MFF_ADD_AD_ER_BAL [NC_CYL_NR]	0.00
LV_HPP_CTL_AD_CLR_EXT_REQ:	all adaptation values in "High pressure pump control" (02904B01.xxx)	like init for NVRAM

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StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= erase adaptive values	M	#30h	RELI
#3d	RoutineEntryStatus#1	M	#XXh	REYO_01
#4d	RoutineEntryStatus#2	M	#XXh	REYO_02
#5d	RoutineEntryStatus#3	M	#XXh	REYO_03

Figure I.16.55: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier	M	#30h	RELI_AD
#3d	RoutineEntryStatus#1	M	#XXh	REYO_01
#4d	RoutineEntryStatus#2	M	#XXh	REYO_02
#5d	RoutineEntryStatus#3	M	#XXh	REYO_03

Figure I.16.56: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Global Negative Responses

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Bit Position	Name RoutineEntryStatus#1	Mnemonic
#0	idle speed LC_AD_CLR_N_SP_IS and LC_AD_CLR_IDLE	REYO_01
#1	knock control kr_clrad()	REYO_01
#2	lambda LC_AD_CLR_EGCP and **(not MSD8x)** LC_AD_CLR_LAM	REYO_01
#3	canister purge LC_AD_CLR_CPS	REYO_01
#4	mass flows to intake manifold eisy_clrad() and LC_AD_CLR_INSY and LC_AD_CLR_IMM	REYO_01
#5	throttle position sensor (not MSD85) LC_AD_CLR_TPS (only MSD85) LC_AD_CLR_THRO	REYO_01
#6	LACO adaptation: klann_clrad() and **(not MSV80)** LC_AD_CLR_LACO:	REYO_01
#7	**MSD8x**: ACRC adaptation LC_AD_CLR_EGR	REYO_01
Bit Position	**Name RoutineEntryStatus#2**	**Mnemonic**
#0	load control ls_clrad()	REYO_01
#1	**MSD80/81:** new Nox-sensor ACTION_NOXD_CleanAdDataNS(OUT <trig_CLR_AD>) ACTION_NOXD_CleanNSAdapt() ACTION_NOXD_CleanNSShiftAdapt() ACTION_NOXD_CleanMMVNSAdapt()	REYO_02
#2	**not MSD8x:** secondary air LC_AD_CLR_SA	REYO_02
#3	**MSD8x**: VCV adaptation LV_HPP_CTL_AD_CLR_EXT_REQ	REYO_02
#4	battery change LV_POW_MNG_BAT_CHG	REYO_02
#5	RON-adaption LC_AD_CLR_RON	REYO_02
#6	adapted variants LC_AD_CLR_VAR	REYO_02
#7	**not MSD8x:** VVL-adaption LC_AD_CLR_VVL_STATE_NVMY	REYO_02
Bit Position	**Name RoutineEntryStatus#3**	**Mnemonic**
#0	IVVT LC_AD_CLR_ENSD and vns_clrad()	REYO_03
#1	missfire LC_AD_CLR_ENRD	REYO_03
#2	**only MSV80:** burn control vbr_clrad()	REYO_03
#3	**only MSD8X:** cyl. balancing for DC and EOL: LV_CYL_BAL_AD_EOL_EXT_ADJ and LV_CYL_BAL_AD_DC_EXT_ADJ	REYO_03
#4	**only MSD8x:** ER-adaptation (faktor / add) and cylinder individuel lambda adaption values LV_MFF_FAC_AD_ER_BAL_EXT_ADJ and LV_MFF_ADD_AD_ER_BAL_EXT_ADJ and LV_LAM_CYL_SEL_ADJ_RST_IV_EXT[NC_CBK_EX_NR] and LV_CTR_CYL_BAL_RST_EXT	REYO_03
#5	**only MSD8x:** phase shift adaptation, bank 1 LV_CRK_CYL_LAM_DELTA_RST_LS_EXT[1]	REYO_03
#6	**only MSD8x:** phase shift adaptation, bank 2 LV_CRK_CYL_LAM_DELTA_RST_LS_EXT[2]	REYO_03
#7	**only MSD8x:** injector needle lift control ACTION_INJR_SetFacEgyPwmAd (IN <Cyl>, IN <Fac>) for all <Cyl> with <Fac> = C_FAC_EGY_PWM_MAN[Cyl]	REYO_03

Figure I.16.57: Table StartRoutineByLocalIdentifier Bit meaning

Refer the spec.on Non Volatile Data latest spec. xx000501 for deleting the variants.

I.16.20 31_31 delete selective adaption values 2

General information:

With this comand the adaption values 2 in BMW-software are initialized with their default values.

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Special Application conditions:

Initialisation: at reset or in case of deactivation init with 0
Activation: LV_IGK = 1 (Kl.15 on) **and**
LV_ES = 1
Deactivation: LV_IGK= 0 (Kl.15 off) **or**
LV_ES = 0
Diagnostic timeout

Service location: see list of implemented diagnostic services

Formula section:

IF bit position#0 in byte#3d is set to 1 with tester s request
THEN do nothing
ENDIF
IF bit position#1 in byte#3d is set to 1 with tester s request
THEN LV_AD_CLR_LONG_LAM_EXT_ADJ[1] = 1 for 2sec.
ENDIF
IF bit position#2 in byte#3d is set to 1 with tester s request
THEN LV_AD_CLR_LONG_LAM_EXT_ADJ[2] = 1 for 2sec.
ENDIF
IF bit position#3 in byte#3d is set to 1 with tester s request
THEN LV_EFP_CTL_AD_CLR_EXT_REQ = 1 for 2sec.
ENDIF
IF bit position#4 in byte#3d is set to 1 with tester s request
THEN LV_CTR_TPS_JAM_DET_ACT_EXT_ADJ = 1 for 2sec.
ENDIF
IF bit position#5 in byte#3d is set to 1 with tester s request
THEN LV_LAM_CYL_SEL_ADJ_RST_IV_EXT[1]= 1 for 2sec.
ENDIF
IF bit position#6 in byte#3d is set to 1 with tester s request
THEN LV_LAM_CYL_SEL_ADJ_RST_IV_EXT[2]= 1 for 2sec.
ENDIF

IF bit position#7 in byte#3d is set to 1 with tester s request
THEN call ACTION_MFMA_SetEnableCondition(1),
LV_LAM_AD_INJ_CLR_AD_EXT = 1 for 2sec.
ENDIF
Hint: The result of call ACTION_MFMA_SetEnableCondition(1), is visible with LV_LAM_AD_INJ_EXT_ENA

IF bit position#6 in byte#4d is set to 1 with tester s request
THEN LV_TQ_LOSS_AD_CLR_EXT_ADJ = 1 for 2sec
ENDIF
IF bit position#7 in byte#4d is set to 1 with tester s request
THEN B_lvs_neustart = 1 /* Hint: reset of B_lvs_neustart to 0 is done in BMW-software */
ENDIF
IF bit position#5 in byte#4d is set to 1 with tester s request
THEN call ACTION_NOXM_CleanNTAdaptSul ()
call ACTION_NOXM_CleanNTAdaptAgi()
call ACTION_NOXM_CleanNTAdaptAgiMdl()
ENDIF

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IF bit position#4 in byte#4d is set to 1 with tester s request
THEN call ACTION_EXTD_InitNTEgyStop()
Hint: After call of ACTION_EXTD_InitNTEgyStop() is
EGY_DEW_NT_STOP = C_EGY_DEW_NT_STOP
ENDIF

IF bit position#3 in byte#4d is set to 1 with tester s request
THEN LV_FAC_ER_BAL_HOM_EXT_ADJ_KWP = 1 for 2 sec
ENDIF

IF bit position#2 in byte#4d is set to 1 with tester s request
THEN CTR_MIS_DET_CYL[NC_CYL_NR] = 0
ENDIF

IF bit position #1 in byte #4d set to 1 within tester s request
THEN set LV_RON_STC_CLR_KWP =1 for 5sec
ELSE do nothing
ENDIF

For other bits with value "1" in request byte#3d..#5d
do nothing

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= erase adaptive values 2	M	#31h	RELI
#3d	RoutineEntryStatus#1	M	#XXh	REYO_01
#4d	RoutineEntryStatus#2	M	#XXh	REYO_02
#5d	RoutineEntryStatus#3	M	#XXh	REYO_03

Figure I.16.58: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier	M	#31h	RELI_AD
#3d	RoutineEntryStatus#1	M	#XXh	REYO_01
#4d	RoutineEntryStatus#2	M	#XXh	REYO_02
#5d	RoutineEntryStatus#3	M	#XXh	REYO_03

Figure I.16.59: Table StartRoutineByLocalIdentifier Positive Response Message

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Bit Position	Name RoutineEntryStatus#1	Mnemonic
#0	not used	REYO_01
#1	Long Term Lambda Adaptation: LV_AD_CLR_LONG_LAM_EXT_ADJ[1]	REYO_01
#2	Long Term Lambda Adaptation: LV_AD_CLR_LONG_LAM_EXT_ADJ[2]	REYO_01
#3	EKP- AdaptationLV_EFP_CTL_AD_CLR_EXT_REQ	REYO_01
#4	Adaption Jitterfunktion Drosselklappe LV_CTR_TPS_JAM_DET_ACT_EXT_ADJ	REYO_01
#5	**only MSD80/MSD81:** LV_LAM_CYL_SEL_ADJ_RST_IV_EXT[1]	REYO_01
#6	**only MSD80/MSD81:** LV_LAM_CYL_SEL_ADJ_RST_IV_EXT[2]	REYO_01
#7	**only MSD80/MSD81:** Kleinstmengenadaption: LV_LAM_AD_INJ_CLR_AD_EXT and call ACTION_MFMA_SetEnableCondition(1)	REYO_01
Bit Position	***Name RoutineEntryStatus#2***	***Mnemonic***
#0	not used	REYO_01
#1	Kraftstoffqualitätserfassung: LV_RON_STC_CLR_KWP	REYO_02
#2	Zähler der Verbrennungsaussetzererkennung CTR_MIS_DET_CYL[NC_CYL_NR]	REYO_02
#3	**only MSD85**: Reset Zylinder Gleichstellung Homogen: LV_FAC_ER_BAL_HOM_EXT_ADJ_KWP	REYO_02
#4	**only MSD80/81 (6cyl):** Adaption Taupunkt NOX-Sensor zurücksetzen ACTION_EXTD_InitNTEgyStop()	REYO_02
#5	**MSD80/MSD81**: new NOx-Catalyst ACTION_NOXM_CleanNTAdaptSul(void) ACTION_NOXM_CleanNTAdaptAgi(void) ACTION_NOXM_CleanNTAdaptAgiMdl(void)	REYO_02
#6	Verlustmomentadaption löschen: LV_TQ_LOSS_AD_CLR_EXT_ADJ	REYO_02
#7	**only MSD80**: Restart Laufruheverbesserung: B_lvs_neustart	REYO_02
Bit Position	***Name RoutineEntryStatus#3***	***Mnemonic***
#0	not used	REYO_03
#1	not used	REYO_03
#2	not used	REYO_03
#3	not used	REYO_03
#4	not used	REYO_03
#5	not used	REYO_03
#6	not used	REYO_03
#7	not used	REYO_03

Figure I.16.60: Table StartRoutineByLocalIdentifier Bit meaning

StartRoutineByLocalIdentifier negative Response

Global Negative Responses

I.16.21 31_34 Ansteuern Zylinder Gleichstellung Homogen

General information:

With this service the function "Zylinder Gleichstellung Homogen" is started. The start is only possible in case of cleared adaptation values for cylinder balancing.

Additional Application conditions:

Initialisation at reset or at LV_IGK 1-> 0 :

LV_ER_BAL_HOM_RNG_IS_ENA_KWP = 0

Formula section:

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If(1) service 31_34 is received

Then(1)

If(2) whole array FAC_COR_AD_RNG_H_ER_BAL_HOM[NC_CYL_NR] = 0

and

whole array FAC_COR_AD_RNG_IS_ER_BAL_HOM[NC_CYL_NR] = 0

and

whole array FAC_COR_AD_RNG_L_ER_BAL_HOM[NC_CYL_NR] = 0

Then(2)

LV_ER_BAL_HOM_RNG_IS_ENA_KWP = 1

send positive response

Else(2)

send negative response "conditions not correct**"**

Endif(2)

Endif(1)

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= switch off Lambda controller	M	#34h	RELI_ZGH

Figure I.16.61: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response SId**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIDValues	M	#34h	RELI_ZGH

Figure I.16.62: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Global Negative Responses

I.16.22 31_3A Start CSERS-Diagnose

General information:

This Services handles the Cold Start Emission Reduction Strategy (CSERS) Diagnose

Additional Application conditions:

Initialisation at LV_IGK= 0 and at diagnostic timeout:

LV_CH_DIAG_EXT_REQ = 0

EFF_IGA_CST_LIM_EXT_ADJ = 0.0

FAC_CH_DIAG_EXT_ADJ_IS = 0.0

FAC_CH_DIAG_EXT_ADJ_PL = 0.0

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Formula section:

If(1) service 31_3A is received
Then(1)
EFF_IGA_CST_LIM_EXT_ADJ = received value
FAC_CH_DIAG_EXT_ADJ_IS = received value
FAC_CH_DIAG_EXT_ADJ_PL = received value
LV_CH_DIAG_EXT_REQ = 1
send positive response
Endif(1)

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= Start CSERS-Diagnose	M	#3Ah	STRBLI_
#3d	RoutineControlOption #1 = set EFF_IGA_CST_LIM_EXT_ADJ (High Byte)	M	#XXh	RELI_
#4d	RoutineControlOption #2 = set EFF_IGA_CST_LIM_EXT_ADJ (Low Byte)	M	#XXh	RELI_
#5d	RoutineControlOption #3 = set FAC_CH_DIAG_EXT_ADJ_IS	M	#XXh	RELI_
#6d	RoutineControlOption #3 = set FAC_CH_DIAG_EXT_ADJ_PL	M	#XXh	RELI_

Figure I.16.63: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response Id**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIdentifier = Start CSERS-Diagnose	M	#3Ah	STRBLI_

Figure I.16.64: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Global Negative Responses

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I.16.23 31_D9 switch off Lambda controller (not MSD80/MSD81)

General information:

With this command the Lambda Controler (bench 1 and 2) can be switched off. The general function is described in the chapter Injection - Lambda Control . The command is available for binary and linear lambda sensor systems.

Additional Application conditions:

set LV_INH_LAM_KWP=00h at LV_IGK = 0 and at diagnostic timeout

Formula section:

IF activation conditions are fullfilled and
service 31_D9 is received

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THEN LV_INH_LAM_KWP = sent to the module Lambda Control
send positive response

ELSE LV_INH_LAM_KWP remains unchanged
send negative response

ENDIF

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= switch off Lambda controller	M	#D9h	RELI_
#3d	routineEntryOption = active	M	#01h	REYO_01
#4d	routineEntryOption = LV_INH_LAM_KWP	M	#XXh	

Figure I.16.65: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response SId**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIdentifier = switch off Lambda controller	M	#D9h	RELI_
#3d	routineEntryStatus = active	M	#01h	REYS_01

Figure I.16.66: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.16.24 31_D9 switch off Lambda controller (only MSD80/MSD81)

General information:

With this command the Lambda Controler (bench 1 and 2) can be switched off. The general function is described in the chapter Injection - Lambda Control . The command is available for binary and linear lambda sensor systems.

Application conditions

Initialisation: *at reset with 00h*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout
set LV_INH_LAM_KWP=00h

Service location: see list of implemented diagnostic services

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Formula section:

IF service 31_D9 is received
THEN LV_INH_LAM_KWP = 1
ENDIF

StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= switch off Lambda controller	M	#D9h	RELI_
#3d	routineEntryOption = active	M	#01h	REYO_01
#4d	routineEntryOption = LV_INH_LAM_KWP	M	#XXh	

Figure I.16.67: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**startRoutineByLocalIdentifier Positive Response SId**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIdentifier = switch off Lambda controller	M	#D9h	RELI_
#3d	routineEntryStatus = active	M	#01h	REYS_01

Figure I.16.68: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Global Negative Responses

I.16.25 31_E1 Ansteuern Eisy- Adaptionswerte (gedrosselt)

General information:

With this service a function in the BMW- object is called (over the layer). The parameters, given from the tester via the below listet telegram, were overgiven to the function.

Application conditions

Initialisation: *at reset with 00h*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

Formula section:

IF service 31_E1 is received

THEN call BMW- function with the following parameters:
void eisymr_read_addk(sint16 Nkw, uint16 Vse_spri, uint16 Vsa_spri, sint1 Wdk_ist)

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ENDIF

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= switch off Lambda controller	M	#E1h	RELI_EISYGD
#3d	RecordValue#1 = NKW high byte	M	#XXh	REYO_ NKW
#4d	RecordValue#2 = NKW low byte	M	#XXh	REYO_ NKW
#5d	RecordValue#3 = VSE_SPRI high byte	M	#XXh	REYO_ VSE_SPRI
#6d	RecordValue#4 = VSE_SPRI low byte	M	#XXh	REYO_ VSE_SPRI
#7d	RecordValue#5 = VSA_SPRI high byte	M	#XXh	REYO_ VSA_SPRI
#8d	RecordValue#6 = VSA_SPRI low byte	M	#XXh	REYO_ VSA_SPRI
#9d	RecordValue#7 = WDK_IST high byte	M	#XXh	REYO_ WDK_IST
#10d	RecordValue#8 = WDK_IST low byte	M	#XXh	REYO_ WDK_IST

Figure I.16.69: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response SId**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIDValues	M	#E1h	RELI_EISYGD

Figure I.16.70: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.16.26 31_E2 Ansteuern Eisy- Adaptionswerte (gedrosselt mit Abgasrueckführung)

General information:

With this service a function in the BMW- object is called (over the layer). The parameters, given from the tester via the below listet telegram, were overgiven to the function.

Application conditions

Initialisation: *at reset with 00h*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

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Formula section:

IF service 31_E2 is received

THEN call BMW- function with the received parameters:
void eisypsr_read_ad(sint16 Nkw, uint16, Vse_spri, uint16 Vsa_spri,

sint16 Wdk_ist)

ENDIF

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= switch off Lambda controller	M	#E2h	RELI_EISYGDAGR
#3d	RecordValue#1 = NKW high byte	M	#XXh	REYO_ NKW
#4d	RecordValue#2 = NKW low byte	M	#XXh	REYO_ NKW
#5d	RecordValue#3 = VSE_SPRI high byte	M	#XXh	REYO_ VSE_SPRI
#6d	RecordValue#4 = VSE_SPRI low byte	M	#XXh	REYO_ VSE_SPRI
#7d	RecordValue#5 = VSA_SPRI high byte	M	#XXh	REYO_ VSA_SPRI
#8d	RecordValue#6 = VSA_SPRI low byte	M	#XXh	REYO_ VSA_SPRI
#9d	RecordValue#7 = WDK_IST high byte	M	#XXh	REYO_ WDK_IST
#10d	RecordValue#7 = WDK_IST low byte	M	#XXh	REYO_ WDK_IST

Figure I.16.71: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response SId**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIDValues	M	#E2h	RELI_EISYG DAGR

Figure I.16.72: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.16.27 31_E3 Ansteuern Krann- Adaptionswerte

General information:

With this service a function in the BMW- object is called (over the layer). The parameters, given from the tester via the below listet telegram, were overgiven to the function.

Application conditions

Initialisation: `at reset with 00h`

Activation: `LV_IGK=1 (Kl.15 on)`

Deactivation: `LV_IGK=0 (Kl.15 off)`
`Diagnostic timeout`

Service location: see list of implemented diagnostic services

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Formula section:

IF service 31_E3 is received

THEN call BMW- function with the following parameters:
void krann_read_ad (sint16 Nkw, sint16 Rk, sint16 Tans, sint16 Tmot, uint8 Ba)

ENDIF

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= switch off Lambda controller	M	#E3h	RELI_KRANN
#3d	RecordValue#1 = NKW high byte	M	#XXh	REYO_ NKW
#4d	RecordValue#2 = NKW low byte	M	#XXh	REYO_ NKW
#5d	RecordValue#3 = Rk high byte	M	#XXh	REYO_ RK
#6d	RecordValue#4 = Rk low byte	M	#XXh	REYO_ RK
#7d	RecordValue#5 = Tans high byte	M	#XXh	REYO_TANS
#8d	RecordValue#5 = Tans low byte	M	#XXh	REYO_TANS
#9d	RecordValue#5 = Tmot high byte	M	#XXh	REYO_TMOT
#10d	RecordValue#5 = Tmot high byte	M	#XXh	REYO_TMOT
#11d	RecordValue#5 = Ba	M	#XXh	REYO_BA

Figure I.16.73: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response SId**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIDValues	M	#E3h	RELI_KRAN N

Figure I.16.74: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Global Negative Responses

I.16.28 31_E4 Ansteuern Klann- Adaptionswerte

General information:

With this service a function in the BMW- object is called (over the layer). The parameters, given from the tester via the below listet telegram, were overgiven to the function.

Application conditions

Initialisation: - -

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

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Formula section:

IF service 31_E4 is received

THEN call BMW- function with the following parameters:
void klann_read_ad (sint16 nkw_loc, uint16 rk_loc, sint16 tmot_loc)

ENDIF

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= switch off Lambda controller	M	#E4h	RELI_KLANN
#3d	RecordValue#1 = nkw_loc high byte	M	#XXh	REYO_ NKW_LOC
#4d	RecordValue#2 = nkw_loc low byte	M	#XXh	REYO_ NKW_LOC
#5d	RecordValue#3 = rk_loc high byte	M	#XXh	REYO_ RK_LOC
#6d	RecordValue#4 = rk_loc low byte	M	#XXh	REYO_ RK_LOC
#7d	RecordValue#5 = tmot_loc high byte	M	#XXh	REYO_TMOT_LOC
#8d	RecordValue#5 = tmot_loc low byte	M	#XXh	REYO_TMOT_LOC

Figure I.16.75: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response SId**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIDValues	M	#E4h	RELI_KLAN N

Figure I.16.76: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.16.29 31_E5 Ansteuern AGR- Adaptionswerte

General information:

With this service a function in the BMW- object is called (over the layer). The parameter, given from the tester via the below listet telegram, were overgiven to the function.

Application conditions

Initialisation: - -

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

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Formula section:

IF service 31_E5 is received

THEN call BMW- function with the following parameters:
void eisyagr_read_ad(uint16 Agrpos)

ENDIF

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= switch off Lambda controller	M	#E5h	RELI_EISYAGR
#3d	RecordValue#1 = Agrpos (high byte)	M	#XXh	REYO_ AGRPOS
#4d	RecordValue#2 = Agrpos (low byte)	M	#XXh	REYO_ AGRPOS

Figure I.16.77: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response SId**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIDValues	M	#E4h	RELI_EISYAGR

Figure I.16.78: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Global Negative Responses

I.16.30 31_F4 cruise control - delete switch off conditions

General information:

With this comand the values described in the chapter cruise control are deleted.
All values are initialized with their default values (compare detailed specifications).
The deleted values are saved after a powerlatch phase into the non volatile memory.

Application conditions

Initialisation: *at reset*

Activation: Kl.15 on (LV_IGK=1)

Deactivation: Kl.15 off (LV_IGK=0)
Diagnostic timeout

Service location: see list of implemented diagnostic services

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Formular section:

service 31_F4 is received

IF LV_ACT_CRU_MEM_EXT_ADJ =01h (deleting of CRU-conditions)

THEN STATE_CRU_OFF_IRR =00h and
STATE_CRU_OFF_REV =00h

ELSE LV_ACT_CRU_MEM_EXT_ADJ =00h

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= erase adaptive values	M	#F4h	RELI
#3d	RecordValue # 1 = LV_ACT_CRU_MEM_EXT_ADJ	M	#XXh	RV_

Figure I.16.79: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response SId**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIdentifier	M	#30h	RELI_AD
#3d	RecordValue # 1 = LV_ACT_CRU_MEM_EXT_ADJ	M	#XXh	RV_

Figure I.16.80: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.16.31 31_F5 switch off Idle speed uplift

General information:

This function is for switch off the idle speed uplift via KWP2000(*).

Application conditions

Initialisation: *at reset with 0*

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see list of implemented diagnostic services

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Formula section:

If service 31_F5 is requested
Then LV_ACT_N_SP_IS_BAS_EXT_ADJ = 1
End If

StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= [switch off Idle speed uplift]	 M	#XXh= [#F5h,]	RELI

Figure I.16.81: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response	M	#71h	STRBLIPR
#2d	routineLocalIdentifier switch off Idle speed uplift	M	#F5h	RELI_

Figure I.16.82: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.16.32 31_F6 set default values PM for BN-SS

General information:

With this comand the values described in the chapter Power Management are set to default values. All values are initialized with their default values (compare detailed specifications).
The value LV_POW_MNG_MES_MOD is saved after a powerlatch phase into the non volatile memory.

Application conditions

Initialisation: *at reset with LV_POW_MNG_MES_MOD from NVMY*

Activation: LV_IGK=1

Deactivation: LV_IGK=0
Diagnostic timeout
Service location: see list of implemented diagnostic services

Formular section:

IF service 31_F6 is received
THEN LV_POW_MNG_MES_MOD = 01h
ELSE LV_POW_MNG_MES_MOD remains unchanged
ENDIF

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StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier	M	#F6h	RELI

Figure I.16.83: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier	M	#F6h	RELI_AD

Figure I.16.84: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Global Negative Responses

I.16.33 31_F7 Intelligente Generatorregelung

General information:

With this comand the intelligent alternator control can be switched off.

Application conditions

Initialisation: *from NVMY*

Activation: LV_IGK=1

Deactivation: LV_IGK=0
Diagnostic timeout
Service location: see list of implemented diagnostic services

Formular section:

IF service 31_F7 is received
THEN LV_ALTER_CTL_EXT_ADJ= 01h
ELSE LV_ALTER_CTL_EXT_ADJ remains unchanged
ENDIF

StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier	M	#F7h	RELI_IGR_OFF

Figure I.16.85: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier	M	#F7h	RELI_IGR_OFF

Figure I.16.86: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.16.34 31_FA Siemens interner Service

undokumentiert

I.16.35 31_FB Siemens interner Service

undokumentiert

I.16.36 31_FC Siemens interner Service

undokumentiert

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I.17 KWP2000 - SID 35h: requestUpload Service

Input data:

LV_IGK {p. 906}			

General information:

This function allows to upload data from the ECU.

Application conditions

Initialisation: at reset

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see "list of implemented diagnostic services"

I.17.1 RequestUpload Request (3-byte addressing)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestUpload Request Service Id**	**M**	**#35h**	**RU**
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (Middle Byte)	M	#XXh	MA_MB
#4d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
(#5d)	MemoryTypeIdentifier **(optional)** [linear type external FLASH external RAM internal FLASH user information field UIF]	U	#XXh [#00h #02h #05h #06h #07h]	MTI
#5d / (#6d)	DataFormatIdentifier (only uncompressed memory supported)	M	#00h	DFI
#6d / (#7d)	UncompressedMemorySize [High Byte]	M	#00h...#FFh	UCMS
#7d / (#8d)	UncompressedMemorySize [Middle Byte]	M	#00h...#FFh	UCMS
#8d / (#9d)	UncompressedMemorySize [Low Byte]	M	#00h...#FFh	UCMS

Figure I.17.1: Table RequestUpload Request Message

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I.17.2 RequestUpload Request (4-byte addressing)

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestUpload Request Service Id**	**M**	**#35h**	**RU**
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (MiddleHigh Byte)	M	#XXh	MA_MHB
#4d	MemoryAddress (MiddleLow Byte)	M	#XXh	MA_MLB
#5d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
#6d	MemoryTypeIdentifier **(mandatory, but not evaluated)** [00h ... FFh]	M	#XXh [#XXh]	MTI
#7d	DataFormatIdentifier (only uncompressed memory supported)	M	#00h	DFI
#8d	UncompressedMemorySize [High Byte]	M	#00h...#FFh	UCMS
#9d	UncompressedMemorySize [MiddleHigh Byte]	M	#00h...#FFh	UCMS
#10d	UncompressedMemorySize [MiddleLow Byte]	M	#00h...#FFh	UCMS
#11d	UncompressedMemorySize [Low Byte]	M	#00h...#FFh	UCMS

Figure I.17.2: Table RequestUpload Request Message

Remark:

For **3-byte addressing** independent from delivery of a MemoryTypeIdentifier (byte 5) by the tester´s request, the ECU automatically adds an offset to the requested memory address.
If no MemoryTypeIdentifier is delivered, the same offset as for MemoryTypeIdentifier 00h (linear addressing) is used.
This base memory offset must be subtracted from any memory address taken from the MAP- /A2L- file if 3-byte addressing is not sufficient for the address range!

For **4-byte addressing** a MemoryTypeIdentifier (byte 6) must be delivered by the tester´s request.
Though it is not evaluated or used within the ECU for this absolute addressing mode, it is necessary to decide between 3- /4-byte addressing mode.
In this 4-byte mode the absolute address delivered by the tester is used by the ECU without any memory offset.

For MSx80 (TriCore) the base memory offsets for **3-byte addressing** are:

MemoryTypeIdentifier:		**Memory offset:**	
none	(linear)	C000 0000h	
00h	(linear)	C000 0000h	
02h	(ext. FLASH)	8000 0000h	(the same as for int. FLASH)
05h	(ext. RAM)	D000 0000h	
06h	(int. FLASH)	8000 0000h	
07h	(UIF)	8000 xxxxh	not fixed yet, address might still change !!!

The supported address ranges are identical to the areas defined for the service ReadMemoryByAddress.

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I.17.3 RequestUpload positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**requestUpload Positive Response Service Id**	**M**	**#75h**	**RUPR**
#2d	TransferResponseParameter=[maxNumberOfBlockLength] = 239d	M	#EFh	TREP_ MNROBL

Figure I.17.3: Table RequestUpload Positive Response Message

I.17.4 RequestUpload negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	RequestUpload Request Service Id	M	#35h	RU
#3d	responseCode= [CanNotUpload-FromSpecificAdress]	 M 	#XXh= [#52h]	RC_

Figure I.17.4: Table RequestUpload Negative Response Message

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I.18 KWP2000 - SID 3Bh: writeDataByLocalIdentifier Service

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_FCO_KWP	O/V/S	80... 7FH	-0.128 ...0.127	0.001	-
Correction factor for consumption					
VIN_SHO [7]	O/V/S	0... FFH	0... 255	1	-
short vehicle identification number					

General information:

All implemented SID 30h services are described below.

Formula section:

I.18.1 Global negative Responses

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	writeDataByLocalIdentifier Request Service ID	M	#3Bh	WDBLI
#3d	responseCode= only general response code	M	#XXh	RC

Figure I.18.1: Table writeDataByLocalIdentifier Negative Response Message

Remark:
The detailed message of the negative response code is described in chapter "Error-Codes".

I.18.2 3B_90 - Kurze Fahrgestellnummer schreiben - writeDataByLocalIdentifier Service

General information:

With this service the short vehicle identification code is written to E2PROM. Furthermore the identification number of the dataset (Cal-ID) is written to E2PROM. The receiving of this command is interpreted as successful coding of BMW variants.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK = 1 **and** LV_ES = 1

Deactivation: LV_IGK = 0 **or** LV_ES = 0
Diagnostic timeout
Service location: see list of "implemented diagnostic services"

writeDataByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByLocalID Request Service Id**	**M**	**#3Bh**	**WDBLI**
#2d	recordLocalIdentifier = Kurze Fahrgestellnummer	M	#90h	RLI_
#3d	RecordValue = VIN_SHO[0]	M	#XXh	RV_
#4d	RecordValue = VIN_SHO[1]	M	#XXh	RV_
#5d	RecordValue = VIN_SHO[2]	M	#XXh	RV_
#6d	RecordValue = VIN_SHO[3]	M	#XXh	RV_
#7d	RecordValue = VIN_SHO[4]	M	#XXh	RV_
#8d	RecordValue = VIN_SHO[5]	M	#XXh	RV_
#9d	RecordValue = VIN_SHO[6]	M	#XXh	RV_

Figure I.18.2: Table writeDataByLocalIdentifier Request Message

writeDataByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByLocal ID Positive Response SId**	**M**	**#7Bh**	**WDBLIPR**
#2d	routineLocalIdentifier= Kurze Fahrgestellnummer	M	#90h	RLI_

Figure I.18.3: Table writeDataByLocalIdentifier Positive Response Message

writeDataByLocalIdentifier negative Response

Global Negative Responses

I.18.3 3B_C1 - write kva-factor - writeDataByLocalIdentifier Service

General information:

With this service the additive part of the correction-factor is updated.
The ECU works after that with this new value.
The additive part of this correction-factor is between -0,128 and +0,127.

Application conditions

Initialisation: at reset

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see list of "implemented diagnostic services"

writeDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByLocalID Request Service Id**	**M**	**#3Bh**	**WDBLI**
#2d	recordLocalIdentifier = KVA-factor	M	#C1h	RLI_KVA
#3d	RecordValue = FAC_FCO_KWP [remain the same negative displace max.12.8% positive displace max.12.7% (1h=0.001/bit)]	M	#XXh [#00h, #80h-FFh #01h-7Fh]	RV_KVA_KORR

Figure I.18.4: Table writeDataByLocalIdentifier Request Message

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writeDataByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByLocal ID Positive Response SId**	**M**	**#7Bh**	**WDBLIPR**
#2d	routineLocalIdentifier=KVA	M	#C1h	RLI_KVA

Figure I.18.5: Table writeDataByLocalIdentifier Positive Response Message

writeDataByLocalIdentifier negative Response

Global Negative Responses

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I.19 KWP2000 - SID 32h: stopRoutineByLocalIdentifier Service

Input data:

EFF_IGA_CST_LIM_EXT_ADJ {p. 7482}	FAC_CH_DIAG_EXT_ADJ_IS {p. 7482}	FAC_CH_DIAG_EXT_ADJ_PL {p. 7482}	LV_CH_DIAG_EXT_REQ {p. 7482}
LV_IGK {p. 906}	LV_INH_LAM_KWP {p. 7483}	LV_POW_MNG_MES_MOD {p. 7483}	

General information:

All implemented SID 32h services are described below.
Overview of supported subservices

SID number	service	Service location	MSD_81 (4cyl)	MSD_81 (6cyl)
32_2F	Stop Desulfatisierung Fahrbetrieb	ECU	X	X
33_3A	Stop CSERS-Diagnose	ECU	X	X
32_D9	stop switch off Lambda controller	ECU	X	X
32_F0	stop checksum calculation for Inca PC	ECU	-	-
32_F1	stop programming of calibration data for IncaPC	ECU	-	-
32_F6	stop default values PM for BN-SS	ECU	X	X
32_F7	switch Intelligente Generatorregelung active	ECU	X	X

I.19.1 Global negative Responses

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	stopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.19.1: Table StopRoutineByLocalIdentifier Negative Response Message

Remark:
The detailed message of the negative response code is described in chapter "Introduction".

I.19.2 32_2F stop Desulfatisierung Fahrbetrieb

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With this command the "Desulfatisierung Fahrbetrieb" is switch off.

Application conditions

Initialisation: - -

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

Formular section:

If service 32_2F is received

Then call ACTION_NOXM_StopCatHeatDesu()
Send positive response

Endif

StopRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier	M	#2Fh	RELI_DESFAHR

Figure I.19.2: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier	M	#2Fh	RELI_DESFAHR

Figure I.19.3: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response
Global Negative Responses

I.19.3 32_3A Stop CSERS-Diagnose

General information:

This Services handles the Cold Start Emission Reduction Strategy (CSERS) Diagnose

Formula section:

If(1) service 32_3A is received
Then(1)
LV_CH_DIAG_EXT_REQ = 0
EFF_IGA_CST_LIM_EXT_ADJ = 0.0

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FAC_CH_DIAG_EXT_ADJ_IS = 0.0
FAC_CH_DIAG_EXT_ADJ_PL = 0.0
send positive response

Endif(1)

StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier	M	#3Ah	RELI_ZGH

Figure I.19.4: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier	M	#3Ah	RELI_ZGH

Figure I.19.5: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response
Global Negative Responses

I.19.4 32_D9 stop switch off Lambda controller

General information:

With this command the switch off of lambda controller by KWP2000 is ended.

Application conditions

Initialisation: – –

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

Formular section:

IF service 32_D9 is received

THEN LV_INH_LAM_KWP = 00h

ELSE LV_INH_LAM_KWP remains unchanged

StopRoutineByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier	M	#D9h	RELI_

Figure I.19.6: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier	M	#D9h	RELI_

Figure I.19.7: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response
Global Negative Responses

I.19.5 32_F0 stop checksum calculation for Inca PC

General information:

With this service the tester stops the checksum calculation, which is started with the service 31_F0.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: Kl.15 off
Diagnostic timeout

Service location: see list of implemented diagnostic services

StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier = checksum calculation for IncaPC	M	#F0h	RELI_

Figure I.19.8: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**StopRoutineByLocalIdentifier Positive Response**	**M**	**#72h**	**SPRBLIPR**
#2d	RoutineLocalIdentifier = checksum calculation for IncaPC	M	#F0h	RELI_

Figure I.19.9: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response
Global Negative Responses

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I.19.6 32_F1 stop programming of calibration data for IncaPC

General information:

With this service the tester deletes the request for programming of calibration data after the power latch, which is started with the service 31_F1.
Once the programming of calibration data is started after the power latch it can not be interrupted.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

StopRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier = checksum calculation for IncaPC	M	#F1h	RELI_

Figure I.19.10: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = checksum calculation for IncaPC	M	#F1h	RELI_

Figure I.19.11: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response

Global Negative Responses

I.19.7 32_F6 stop default values PM for BN-SS

General information:

With this comand the values described in the chapter Power Management are set to default values.
The value LV_POW_MNG_MES_MOD is saved after a powerlatch phase into the non volatile memory.

Application conditions

Initialisation: *at reset with B_fapmmess from NVM*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

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Formular section:

IF service 32_F6 is received

THEN LV_POW_MNG_MES_MOD = 00h

ELSE LV_POW_MNG_MES_MOD remains unchanged

StopRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier	M	#F6h	RELI_

Figure I.19.12: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier	M	#F6h	RELI_

Figure I.19.13: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response
Global Negative Responses

I.19.8 32_F7 switch Intelligente Generatorregelung active

General information:

With this comand the intelligent altenator control is switched active again.

Application conditions

Initialisation: *from NVMY*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

Formular section:

IF service 32_F7 is received

THEN LV_ALTER_CTL_EXT_ADJ = 00h

ELSE LV_ALTER_CTL_EXT_ADJ remains unchanged

StopRoutineByLocalIdentifier Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier	M	#F7h	RELI_IGR_OFF

Figure I.19.14: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier	M	#F7h	RELI_IGR_OFF

Figure I.19.15: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response

Global Negative Responses

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I.20 Message structure

I.20.1 Request Message with Conditional Target, Source Address and length information

The following table shows a general service table structure and its syntax.

Data Byte	*Byte #*	*Parameter Name*	*CVT*	*Value*	*Mnemonic*
	#1d	**Format byte**	**M**	**#AALLLLLLb**	**FMT**
	#2d	**Target address byte**	**C**	**#12h/#EAh/#EDh/ #EFh/ #33h**	**TGT**
	#3d	**Source address byte**	**C**	**#F1h**	**SRC**
	#4d	**Additional length byte**	**C**	**#01h-#FFh**	**LEN**
#1d	#5d	Service ID Byte	M		SID
• • • • #255d	#6d • • • #259d	Data Byte #02h • • • Data Byte #255d	C • • • C	#XXh • • • #XXh	DATA
	#260d	Checksum	M	#00h-#FFh	CS

1. The input/output buffer of *BSW-KWP* is limited to 255 (#FFH) ***Bytes*** (SID included).
2. In the following description the table begins with the first data byte (see shaded part of the table above).The headers of the message-flow are always the same construction and therefore in all following diagnostic service descriptions unnecessary.

Header				*Data bytes*					*Checksum*
Fmt	**Tgt**	**Src**	**Len**	**SID**	**Data**	●	●	●	**CS**
max 4 byte				max. 255 byte					1 byte

I.20.2 Method of addressing

1. The BSW-KWP supports the physical Addressing with the Keybytes #8FEFh (startCommunicationPositive Response; Keybyte1 = #EFh, Keybyte2 = #8Fh), header with conditional target and source address information, with length information in the formatbyte or additional length byte, depending on the response length.
2. The ECU-address for **physical** adressing is #12h.
3. The ECU-address for **functional** adressing is #EFh.
4. The ECU-address for **functional** adressing powertrain CAN is #EAh actual not supported
5. The ECU-address for **functional** adressing BOS-CAN is #EDh actual not supported
6. The ECU-address for **OBD services** is #33h (functional).

I.20.3 Length byte

1. The ECU sends the response with an additional length byte, if the lenght is longer than 64 byte.
2. The ECU accepts the length information of the request in an additional length byte or in the formatbyte.

I.20.4 Header with or without Length ,Target and Source Address Information

The following two different types of headers are supported the *BSW-KWP* depending of the two high bits in the Format Byte:

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				⇦ ***Length*** ⇨				
Fmt	Tgt	Src	**Len**	SId	Data			CS
⇦ **used for *Checksum* calculation** ⇨								

Figure I.20.1: Header with address information, with additional length byte

Possible Format Bytes:

Physical Addressing	A1=1	A0=0	L5=X	L4=X	L3=X	L2=X	L1=X	L0=X
Functional Addressing	A1=1	A0=1	L5=X	L4=X	L3=X	L2=X	L1=X	L0=X

		⇦ ***Length*** ⇨				
Fmt	**Len**	SId	Data			CS
⇦ **used for *Checksum* calculation** ⇨						

Figure I.20.2: Header without address information, with optional additional length byte

Possible Format Byte:

Physical Addressing without Address Information	A1=0	A0=0	L5=X	L4=X	L3=X	L2=X	L1=X	L0=X

I.20.5 Checksum byte

1. The checksum is the sum of all bytes in the message (except the checksumbyte itself) modulo 256 (i.e. 1 byte long):
   (Checksum = Format + Target + Source + Length + Data[SID + DATA1 + + DATAn])
   or (Checksum = Format + Target + Source + Data[SID + DATA1 + + DATAn])
   or (Checksum = Format + Length + Data[SID + DATA1 + + DATAn])
   or (Checksum = Format + Data[SID + DATA1 + + DATAn])

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I.21 SID 11h: ecuReset Service

Input data:

LV_IGK {p. 906}	LV_LOCK_IMOB		

General information:

This function is for reset the ECU during a diagnostic session. Before the ECU is reset, the service writes down the EWS starting value to the E2PROM and once this is finished, the EWS starting value will be copied to flash memory. This happens only if no first code is detected in the flash memory and LV_LOCK_IMOB = 0 after service 31_83_00 has come up with response 00.
This function works only by engine speed=0rpm.

ecuReset Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**ecuReset Request Service Id**	**M**	**#11h**	**ER**
#2d	resetMode=[powerOn]	M	#01h	RM

Figure I.21.1: Table ecuReset Request Message

1. Attention, after the positive response the Communication is lost. A new Initialization is possible after the time W5(300ms).
2. This service is only possible in the reprogramming session. Only a session change to the ECU programmingMode is not sufficient to execute this service!!!

EcuReset positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**ecuReset Positive Response Service Id**	**M**	**#51h**	**ERPR**
#2d	resetMode=reset state	C	#01h	RS

Figure I.21.2: Table ecuReset Positive Response Message

EcuReset negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	ecuReset Request Service Id	M	#11h	ER
#3d	responseCode= [general response codes conditionsNotCorrect,]	 M	#XXh= [#XX #22h,]	RC

Figure I.21.3: Table ecuReset Negative Response Message

NegativeResponseCode	*Cause of Occurrence*
conditionsNotCorrect	engine is running or ignition is off

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I.22 SID 14h: clearDiagnosticInformation Service

Input data:

LC_FMY_CLR	LV_IGK {p. 906}		

I.22.1 14h - ClearDiagnosticInformation service

General information:

This function clears all diagnostic informations of the selected group.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK = 1

Deactivation: LV_IGK = 0
Diagnostic timeout
Service location: see "list of implemented diagnostic services"

ClearDiagnosticInformation Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**clearDiagnosticInformation Request Service Id**	**M**	**#14h**	**CDI**
  #2d,#3d #2d,#3d	groupOfDiagnosticInformation (HighByte,LowByte) [Clear DTC´s in all Groups Clear Powertrain DTC]	 M,M	#XXh,#XXh= [#FFh,#FFh #FFh,#FBh]	GODIN

Figure I.22.1: Table ClearDiagnosticInformation Request Message

ClearDiagnosticInformation positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**clearDiagnosticInformation Positive Response SId**	**M**	**#54h**	**CDIPR**
  #2d,#3d #2d,#3d	groupOfDiagnosticInformation (HighByte,LowByte) [Clear DTC´s in all Groups Clear Powertrain DTC]	 M,M	#XXh,#XXh= [#FFh,#FFh #FFh,#FBh]	GODIN

Figure I.22.2: Table ClearDiagnosticInformation Positive Response Message

ClearDiagnosticInformation negative Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	negativeResponse Service Id	M	#7Fh	NACK
#2d	clearDiagnosticInformation Request Service Id	M	#14h	CLRDTC
#3d	responseCode= [requestOutOfRange incorrectByteCountDuringBlockTransfer]	M	#XXh= [#31h #79h]	RC

Figure I.22.3: Table ClearDiagnosticInformation Negative Response Message

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I.23 SID 22h: readDataByCommonIdentifier Service

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Bosanfsgbd	O	0... FFH	0... 255	1	-
BOS-Lesen-Anforderung vom Tester					
CTR_BOS_READ	V	0... FFFFH	0... 65535	1	-
timeout counter for BOS read					
Ecu_sw_ref_bmw [9]	O	0	ASCII	1	-
BMW-ECU software reference					
LV_BOS_READ_REQ	V	0... 1H	0 ...1	1	-
flag indicating request BOS data for tester					

Input data:

ALTER_COD_0 {p. 4093}	ALTER_COD_1 {p. 4093}	Amo_05 {p. 8154}	Amo_10 {p. 8154}
Amo_15 {p. 8154}	Amo_20 {p. 8154}	Amo_30 {p. 8154}	Amo_40 {p. 8154}
ANG_1_RAW_VVL {p. 797}	ANG_DE_ABSV_PLAUS_CHK_VVL {p. 797}	B_cdxenonr {p. 8342}	B_dev0detec {p. 8366}
B_dev3detec {p. 8366}	B_dev6detec {p. 8366}	B_gangnull {p. 8343}	B_kupp_ext {p. 8394}
B_kwdreht {p. 8215}	B_msasw {p. 7679}	B_nggelernt {p. 8345}	B_ngimlf {p. 8345}
B_qvch2o {p. 8346}	B_spa_cist {p. 8347}	B_spa_csoll {p. 7679}	Ba_ist {p. 8154}
Ba_soll {p. 8154}	Bosbtvfbk {p. 8155}	Bosconf {p. 8155}	Bosmanip {p. 8155}
Bosmziel {p. 8155}	Bosprog2 {p. 8155}	Bosres {p. 8155}	Bosrlsm {p. 8155}
Bosrw2 {p. 8155}	Bosstate {p. 8155}	Bostoken {p. 8155}	Bszsi {p. 8155}
C_ERR_CLAS_XX {p. 5811}	CAM_EX [NC_NR_CBK_IVVT] {p. 8399}	CAM_IN [NC_NR_CBK_IVVT] {p. 8399}	CHK_STAMP {p. 7679}
CONF_EF {p. 7679}	CONF_SOF_SWI {p. 654}	CPPWM_CPS {p. 3749}	CTR_AD_COLD_LAM_AD_INJ {p. 3348}
CTR_AD_HOT_LAM_AD_INJ {p. 3348}	CTR_CDN_RBM [NC_NR_DIAG_RBM] {p. 5858}	CTR_COMP_RBM [NC_NR_DIAG_RBM] {p. 5858}	CTR_DC [NC_NR_ERR_DYN] {p. 5767}
CTR_ERR_DYN_NR {p. 5767}	CTR_ERR_HIS_NR {p. 5821}	CTR_FRC [NC_NR_ERR_DYN] {p. 5767}	CTR_KM_N_MAX {p. 4462}
CTR_N_MAX {p. 4462}	CTR_NS_AD_CYC [NC_NOX_SENS_CONF] {p. 3189}	CTR_NS_SHIFT_CYC [NC_NOX_SENS_CONF] {p. 6425}	CTR_NT_AGI_AD_CMPL_SUM {p. 3072}
CTR_NT_AGI_SO2P_FQ {p. 3072}	CTR_STC_RON_HIGH {p. 4145}	CTR_STC_RON_LOW {p. 4145}	CTR_STC_RON_MEDIUM {p. 4145}
CTR_TOIL_MAX {p. 1223}	CTR_WUP_CYC [NC_NR_ERR_DYN] {p. 5767}	DC_MAX_XX	Dfds [16] {p. 8156}

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NC_NR_CAM_CBK {p. 1507}	NC_NR_DIAG_RBM {p. 5871}	NC_NR_EDGE_CAM_EX {p. 874}	NC_NR_EDGE_CAM_IN {p. 874}
NC_NR_ERR_DYN {p. 5768}	NC_NR_ERR_HIS {p. 5821}	NC_NR_RON_KWP {p. 4145}	NC_NT_NR {p. 644}
NC_PSN_EDGE_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK] {p. 874}	NC_PSN_EDGE_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK] {p. 874}	NL [NC_CYL_NR] {p. 1962}	NR_PAT_SCC_N_MAX {p. 4462}
NT_AGI {p. 3073}	NT_AGI_SO2P_FQ_SUM {p. 3073}	NT_AGI_SUL {p. 3073}	NT_AGI_SUL_SNG [NC_NT_NR] {p. 3073}
NT_AGI_THERMO {p. 3073}	NT_AGI_THERMO_SNG [NC_NT_NR] {p. 3074}	NT_SUL_32 [NC_NT_NR] {p. 3113}	NT_SUL_H_32 [NC_NT_NR] {p. 3113}
OBD_FUP_RNG_H {p. 7308}	Oz_manip {p. 807}	Pmbackup [7] {p. 8165}	Pminfo1 [37] {p. 8165}
Pminfo2 [29] {p. 8165}	POW_CONF_IDX_EXT_REQ {p. 7682}	PROT_CONF_IDX_EXT_REQ {p. 7682}	PSN_EDGE_AD_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK] {p. 1534}
PSN_EDGE_AD_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK] {p. 1534}	PV_AV_N_MAX {p. 4462}	PV_AV_TOIL_MAX {p. 1223}	Qv_cdherst_1 {p. 7682}
Qv_cdherst_2 {p. 7682}	Qv_cdherst_3 {p. 7682}	Qv_cdherst_4 {p. 7683}	Qv_cdherst_5 {p. 7683}
Qv_cdherst_6 {p. 7683}	Qv_cdherst_7 {p. 7683}	Qv_cdherst_8 {p. 7683}	Qv_h2o {p. 8166}
Qv_h2oquali {p. 8166}	Qv_h2ostatus {p. 8166}	Qv_nv_ezm {p. 8166}	Qv_nv_zh {p. 8166}
Qv_out_1 {p. 8166}	Qv_out_2 {p. 8166}	Qv_out_3 {p. 8166}	Qv_out_4 {p. 8166}
Qv_out_5 {p. 8166}	Qv_out_m {p. 8166}	Qv_quali_1 {p. 8166}	Qv_quali_2 {p. 8166}
Qv_quali_3 {p. 8166}	Qv_quali_4 {p. 8167}	Qv_quali_5 {p. 8167}	Qv_quali_m {p. 8167}
Qv_status {p. 8167}	Qv_td1 {p. 8167}	Qv_td2 {p. 8167}	Qv_td3 {p. 8167}
Qv_td4 {p. 8167}	Qv_td5 {p. 8167}	Qvc_status_1 {p. 8167}	Qvc_status_2 {p. 8167}
Qvc_status_3 {p. 8167}	Qvc_status_4 {p. 8167}	RATIO_MMV_NS_SHIFT_DIAG [NC_NOX_SENS_CONF] {p. 6412}	S_vsmnhb {p. 807}
S_vsmnhbnv {p. 807}	Snibs {p. 8168}	St_dgenerrst_md1 {p. 8169}	St_dgenerrst_md2 {p. 8169}
St_dgengrenz1 {p. 8169}	St_dgengrenz1_md1 {p. 8169}	St_dgengrenz1_md2 {p. 8169}	St_dgengrenz2 {p. 8169}
St_dgengrenz2_md1 {p. 8169}	St_dgengrenz2_md2 {p. 8169}	St_dgengrenzerr {p. 8169}	St_dgengrenzerr_md1 {p. 8170}
St_dgengrenzerr_md2 {p. 8170}	St_dgengrenznz {p. 8170}	St_dgengrenznz_md1 {p. 8170}	St_dgengrenznz_md2 {p. 8170}
St_dgenub1 {p. 8170}	St_dgenub1_md1 {p. 8170}	St_dgenub1_md2 {p. 8170}	St_dgenub2 {p. 8170}
St_dgenub2_md1 {p. 8170}	St_dgenub2_md2 {p. 8170}	St_dgenuberr {p. 8170}	St_dgenuberr_md1 {p. 8170}

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St_dgenuberr_md2 {p. 8170}	St_dgenubnz {p. 8170}	St_dgenubnz_md1 {p. 8170}	St_dgenubnz_md2 {p. 8170}
St_dgenugen1 {p. 8170}	St_dgenugen1_md1 {p. 8170}	St_dgenugen1_md2 {p. 8170}	St_dgenugen2 {p. 8170}
St_dgenugen2_md1 {p. 8170}	St_dgenugen2_md2 {p. 8171}	St_dgenugenerr {p. 8171}	St_dgenugenerr_md1 {p. 8171}
St_dgenugenerr_md2 {p. 8171}	St_dgenugennz {p. 8171}	St_dgenugennz_md1 {p. 8171}	St_dgenugennz_md2 {p. 8171}
St_dvovrld {p. 807}	St_ngang0 {p. 8173}	St_vbrvs_aus {p. 807}	St_vbrvs_ein {p. 807}
St_vvt_err {p. 807}	STATE_CRU_OFF_IRR {p. 7227}	STATE_CRU_OFF_REV {p. 7227}	STATE_ECRAS_UP_VAR
STATE_EGY_MIN_KWP {p. 7483}	STATE_IMOB_K_EWS	STATE_MIL_ON_DIS_ EXT_REQ {p. 7683}	STATE_PSTE_3_SRC {p. 1576}
STATE_RON [NC_NR_RON_KWP] {p. 4145}	STATE_TBL_DRIV [8][6] {p. 809}	Stmsa {p. 8175}	Stmsaaa {p. 8175}
Stmsaav {p. 8175}	Stmsaea {p. 8175}	Stmsaev {p. 8175}	Swmsaav {p. 7683}
T_N_MAX {p. 4462}	T_prail_mon_xb_ypb [SY_PRAIL_MON_ANZ_ SCHWELLEN][SY_ANZ_ PRAILSENS] {p. 8175}	T_SUM_N_MAX {p. 4462}	TAM_TOIL_MAX {p. 1223}
TCO_2_MES {p. 1218}	TCO_MES {p. 1100}	TCO_TOIL_MAX {p. 1223}	Tget_b1 {p. 8177}
Tget_b2 {p. 8177}	Tget_b3 {p. 8177}	Tget_b4 {p. 8177}	Tget_b5 {p. 8177}
TI_1_HOM [NC_CYL_NR] {p. 2002}	TIA {p. 1226}	Tmot_b1 {p. 8177}	Tmot_b2 {p. 8177}
Tmot_b3 {p. 8177}	Tmot_b4 {p. 8177}	Tmot_b5 {p. 8177}	Toel_b1 {p. 8177}
Toel_b2 {p. 8177}	Toel_b3 {p. 8177}	Toel_b4 {p. 8177}	Toel_b5 {p. 8178}
TOIL_MAX_WARN {p. 1223}	TOIL_THD_TOIL_MAX {p. 1223}	TPS_AV_1 {p. 1169}	TQI_AV {p. 981}
TQI_AV_TOIL_MAX {p. 1223}	TRT_N_MAX {p. 4462}	Tumg_b1 {p. 8178}	Tumg_b2 {p. 8178}
Tumg_b3 {p. 8178}	Tumg_b4 {p. 8178}	Tumg_b5 {p. 8178}	Tvneutral {p. 8178}
Tvngang {p. 8291}	V_PVS_1 {p. 831}	VB {p. 1185}	VCC_DR_VVL {p. 811}
Verbredinfo [32]	VLS_UP [NC_CBK_EX_NR] {p. 1341}	VS {p. 1176}	VS_H_N_MAX {p. 811}
VS_MAX_SEL_EXT_REQ {p. 7683}	VS_N_MAX {p. 4462}	VS_TOIL_MAX {p. 1223}	Vvt_soll {p. 811}
Zbibs {p. 8180}	Zr_lvs_0 {p. 8180}	Zr_lvs_1 {p. 8180}	Zr_lvs_2 {p. 8180}
Zr_lvs_3 {p. 8180}	Zr_lvs_ll_reakt {p. 8180}	Zr_lvssekt_0 {p. 8180}	Zr_lvssekt_1 {p. 8180}
Zr_lvssekt_2 {p. 8180}	Zr_lvssekt_3 {p. 8180}	Zr_lvssekt_4 {p. 8181}	Zr_lvssekt_5 {p. 8181}
Zr_lvssekt_6 {p. 8181}	Zr_lvssekt_7 {p. 8181}	Zr_lvssekt_8 {p. 8181}	Zr_lvszyl_0 {p. 8181}

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Zr_lvszyl_1 {p. 8181}	Zr_lvszyl_2 {p. 8181}	Zr_lvszyl_3 {p. 8181}	Zr_lvszyl_4 {p. 8181}
Zr_lvszyl_5 {p. 8181}	Zrbosmld {p. 8181}	Zw_offkorrvr [NC_CYL_NR] {p. 8181}	Zylhubkor {p. 811}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_SENS_ZK	-	0... 1H	0 ...1	1	-
type of spark (1- sensierte Zündkerzen, 0- nicht sensierte Zündkerzen)					

Hint: don t import variables which are not used due to with NC_... suppressed services

General information:

All implemented SID 22h services are described below.

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I.23.1 Overview of implemented subservices

SID number	service	service location	MSD_81 (4cyl)	MSD_81 (6cyl)
22_10_00	Read check stamp	ECU	X	X
22_10_01	Read value BOS	ECU	X	X
22_10_0A	Read Energy saving status	ECU	X	X
22_16_00	Read Anzahl Subbusteilnehmer	ECU	X	X
22_16_01	Read Identifikation Subbusteilnehmer 1 (normaly: Batteriesensensor)	ECU	X	X
22_16_02	Read Identifikation Subbusteilnehmer 2 (normaly:elektr. Wasserpumpe)	ECU	X	X
22_16_03	Read Identifikation Subbusteilnehmer 3 (normaly:Generator 1)	ECU	X	X
22_16_04	Read Identifikation Subbusteilnehmer 34(normaly:ECRAS_UP)	ECU	-	-
22_20_00	read failure memory short	ECU	X	X
22_21_00	Read History Memory	ECU	X	X
22_25_00	Programm Reference Backup	BOOT	X	X
22_25_01	Erasing time	BOOT	X	X
22_25_02	Hardware reference	BOOT	X	X
22_25_03	Programm reference	BOOT	X	X
22_25_04	Data reference	BOOT	X	X
22_25_06	Maximum of block length	Boot-/ECU	X	X
22_30_00	MIL Codierung lesen	ECU	X	X
22_30_01	Kat Codierung lesen	ECU	X	X
22_30_10	VMAX-Codierdaten lesen	ECU	X	X
22_30_20	OL/UL Codierung lesen	ECU	X	X
22_30_30	Status-Codierung-Protokoll lesen	ECU	X	X
22_32_00	Oelwechselintervall- Codierdaten lesen	ECU	X	X
22_32_10	IGR-Codierdaten lesen	ECU	X	X
22_32_11	Xenonverbau-Codierdaten lesen	ECU	X	X
22_32_20	SPA-Codierdaten lesen	ECU	X	X
22_32_30	BZE-Codierdaten lesen	ECU	X	X
22_32_40	Abgasklappe Codierdaten lesen	ECU	X	X
22_32_50	Codierung MSA lesen	ECU	X	-
22_32_60	Read CDASMOT	ECU	X	X
22_3F_FF	Aenderungsindex Codierdaten lesen	ECU	X	X
22_40_00	Read values 4000	ECU	X	X
22_40_01	Read values “batterie generator”	ECU	X	X
22_40_02	Read Switch Position	ECU	X	X
22_40_03	Read values of engine roughness	ECU	X	X

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22_40_06	Read CAMSHAFT-Sensor Adaption	ECU	X	X
22_40_07	Read State of Functions	ECU	X	X
22_40_08	Read Throttle and MAF-Adjustment Value	ECU	X	X
22_40_0A	Read mixture values	ECU	X	X
22_40_0B	VVT Messwerte auslesen	ECU	-	-
22_40_15	Read FASTA_Messwertblock 10	ECU	X	X
22_40_16	READ IGR-values	ECU	X	X
22_40_17	READ LEM-values	ECU	X	X
22_40_18	READ MSA-values	ECU	X	X
22_40_19	Fsp. Lesen mit Freeze Frame	ECU	X	X
22_40_1A	READ BZE-values	ECU	X	X
22_40_1B	Read: Results of intelligent alternator diagnosis	ECU	X	X
22_40_1C	Ringspeicher MSA lesen	ECU	X	X
22_40_1D	Read Verbredinfo	ECU	-	-
22_40_1E	Read CBS-Zündkerzen	ECU	X	X
22_40_1F	Read BMW-PST (BMW-Programmstandsinformation)	ECU	-	-
22_40_21	READ IBS-values	ECU	X	X
22_40_22	READ PM1 Status	ECU	X	X
22_40_23	READ PM2 Status	ECU	X	X
22_40_26	Rate Based Monitoring Mode 9 auslesen	ECU	X	X
22_40_27	Rate Based Monitoring Motorsteuerung MSV80 Block 1 auslesen	ECU	-	-
22_40_27	Rate Based Monitoring Motorsteuerung MSD81 Block 1 auslesen	ECU	X	X
22_40_28	Rate Based Monitoring Motorsteuerung MSV80 Block 2 auslesen	ECU	-	-
22_40_28	Rate Based Monitoring Motorsteuerung MSD81 Block 2 auslesen	ECU	X	X
22_40_28	Rate Based Monitoring Motorsteuerung MSD85 Block 2 auslesen	ECU	-	-
22_40_2D	Messwerte Laufruhepruefung auslesen	ECU	X	X
22_40_2E	Nullgang-Erkennung lesen	ECU	X	X
22_40_2F	MSA lesen	ECU	X	X
22_40_30	FASTA_LVS_lesen	ECU	X	X
22_40_31	Laufruhe Verbesserungssystem Zylinderstatistik auslesen	ECU	X	X
22_40_32	MFMA (Kleinstmengenadaption)	ECU	X	X
22_40_35	Read: Kraftstoffqualitäterfassung	ECU	X	X

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22_40_4C	Read "Zeitanteile der erreichten Druckbereiche (beim Tausch der Kraftstoffhochdruckpumpe)"	ECU	X	X
22_40_66	Rate Based Monitoring Motorsteuerung MSD85 Block 3 auslesen	ECU	X	X
22_5F_88	Adrecovery lesen	ECU	X	X
22_5F_8B	read PM recovery	ECU	X	X
22_5F_8E	MSA deactivation lesen	ECU	X	X
22_5F_8F	MSA Abschaltverhinderer lesen	ECU	X	X
22_5F_90	IMAALLE lesen	ECU	X	X
22_5F_DE	VVT- Minhub lesen	ECU	-	-
22_5F_F0	Abgleichswert LL lesen	ECU	X	X
22_5F_F1	CO Abgleichswert lesen	ECU	-	-
22_5F_F2	Varianten lesen	ECU	X	X
22_5F_F3	Uebertemperatursicherung lesen	ECU	X	X
22_5F_F4	Fusshebelwerk Fehlbedienung lesen	ECU	X	X
22_5F_F6	Ueberdrehzahlsicherung lesen	ECU	X	X
22_5F_F7	Laufruhepruefung auslesen	ECU	X	X
22_5F_F8	Status Homogenbetrieb auslesen	ECU	X	X
22_C0_00	Read imob status (STATUS_EWS)	Boot-/ECU	X	X
22_C0_02	Read imob k_ews(tmp) (STATUS_EWS_SK)	Boot-/ECU	X	X

I.23.2 Global Application conditions (default)

If no Application conditions block is specified, use default

Application conditions

Initialisation: at reset

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout

Service location: see list of implemented diagnostic services

I.23.3 Global negative Responses (default)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service ID**	**M**	**7Fh**	**NR**
2	Request Service ID	M	22h	requestServiceID
3	responseCode (12h - subfunction not suppoerted, 22h - conditionsNotCorrectOr RequestSequenceError)	M	XXh [#12h, #22h]	responseCode

Remark:

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If no negative response is specified, send Global negative Responses
The detailed message of the negative response code is described in chapter "Error Codes".

I.23.4 22_1000 - Read check stamp

General information:

With this comand the 3 bytes of the check stamp was read out to the ecu. Those are actually in the volatile memory. In the latch off phase (n = 0 rpm and Kl.15 off) this values are written down into the non volatile memory. If the battery voltage is removed from the ECU, bevor the power latch phase ends, so the storage of the check stamp was cancelled and the value up to now was keept.
The writing of the check stamp was reserved for the customers production, that means that the check stamp can t be read by the ECU production factory.
The service only accept ram-reading.
Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier	M	10h	RCI_TSP
3	RecordCommonIdentifier	M	00h	RCI_TSP

Positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	10h	RCI_TSP
3	RecordCommonIdentifier	M	00h	RCI_TSP
4	recordValue1 CHK_STAMP Byte 2	M	XXh	RV_PST
5	recordValue2 CHK_STAMP Byte 1	M	XXh	RV_PST
6	recordValue3 CHK_STAMP Byte 0 (LSB)	M	XXh	RV_PST

I.23.5 22_1001 - Read values BOS

General information:

This function is created to read out the described values from the ecu.

Formula section:

If service 22_1001 is recieved
then
send 78 H
endif

If(1) **78H handling is activated for this function**
Then(1)
increment CTR_BOS_READ
if(2) CTR_BOS_READ > 1C2H // timeout condition
then(2) send negative response
LV_BOS_READ_REQ = 0
CTR_BOS_READ = 0

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```
                    Bosanfsgbd                  = 0
                    End data handling 78H
                                        // End data transmission to tester
      else(2)
             if(3)          LV_BOS_READ_REQ =0
             then(3)
                    If(4)          Bosconf = 1. bit
                    then(4)          Bosanfsgbd = 1
                             LV_BOS_READ_REQ = 1
                else(4)              send negative response
                             LV_BOS_READ_REQ        = 0
                             CTR_BOS_READ                = 0
                             Bosanfsgbd                    = 0
                                    End data handling 78H
                                          // End data transmission to tester
                    endif(4)
             else(3)
                    if(4)          Bosanfsgbd = Bostoken             // data for tester are ready
                    then(4) LV_BOS_READ_REQ = 0
                         send positive response
                         LV_BOS_READ_REQ        = 0
                         CTR_BOS_READ                = 0
                         Bosanfsgbd                    = 0
                         End data handling 78H
                                        // End data transmission to tester
                    endif(4)
             endif(3)
      endif(2)
endif(1)
```

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier read values	M	10h	RCI_
3	RecordCommonIdentifier	M	01h	RCI_

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	10h	RCI_BOS
3	RecordCommonIdentifier	M	01h	RCI_BOS
4	recordValue1 = Id_bosmgt for first CBS-member	M	XXh	RV_Id_bosmgt
5	recordValue2 = Bosrlsm high byte for first CBS-member	M	XXh	RV_Bosrlsm
6	recordValue3 = Bosrlsm low byte for first CBS-member	M	XXh	RV_Bosrlsm
7	recordValue4 = Bosstate for first CBS-member	M	XXh	RV_Bosstate
8	recordValue5 = Zrbosmld for first CBS-member	M	XXh	RV_Zrbosmld
9	recordValue6 = Bosbtvfbk for first CBS-member	M	XXh	RV_Bosbtvfbk
10	recordValue7 = Bosrw2 for first CBS-member	M	XXh	RV_Bosrw2
11	recordValue8 = Bosmziel for first CBS-member	M	XXh	RV_Bosmziel
12	recordValue9 = Bosjziel for first CBS-member	M	XXh	RV_Bosjziel
13	recordValue10 = Bosprog2 for first CBS-member	M	XXh	RV_Bosprog2
14	recordValue11 = Bosmanip for first CBS-member	M	XXh	RV_Bosmanip
15	recordValue12 = Bosres for first CBS-member	M	XXh	RV_Bosres
16	recordValue13 = Bostoken for first CBS-member	M	XXh	RV_Bostoken

I.23.6 22_100A - RDBCI_EGY_lesen

General information:

Read energy saving status

This function is created to read out the described values from the ecu.

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	10h	RCI_ESS
3	RecordCommonIdentifier Low Byte	M	0Ah	RCI_ESS

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	10h	RDBCI_EGY_lesen
3	RecordCommonIdentifier Low Byte	M	0Ah	RDBCI_EGY_lesen
4	recordValue1 = STATE_EGY_MIN_KWP	M	XXh	RV_STATE_EGY_MIN_KWP

I.23.7 22_1600 - Read number of intelligente subbus members

General information:

This function is created to read out the number of intelligente sensors on Subbus.

Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier read values	M	16h	RCI_
3	RecordCommonIdentifier	M	00h	RCI_

Positive Response   on service (not MSD85)

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	00h	RCI_BOS
4	RecordValue1= number of 1-bits from LF_BSD_CPT_AVL Bit0, Bit3 and Bit6 (LF_BSD_CPT_AVL & 49h) = number of sucessfully learnt intelligent sensors (posible components: Intelligent battery sensor,electrical coolant water pump and alternator) on subbus	M	XXh [00h, 01h, 02h, 03h]	RV_

Positive Response   on service (only MSD85)

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	00h	RCI_BOS
4	RecordValue1= number of 1-bits from LF_BSD_CPT_AVL Bit0, Bit3 and Bit6 (LF_BSD_CPT_AVL & 49h) + LV_VAR_ECRAS_UP = number of sucessfully learnt intelligent sensors on BSD-BUS (possible components: Intelligent battery sensor,electrical coolant water pump and alternator) plus number of sucessfully learnt intelligent sensors on LIN-BUS (possible component: ECRAS UP)	M	XXh [00h, 01h, 02h, 03h, 04h]	RV_

I.23.8 22_1601 - Read detailed informations of the first intelligent subbus member

General information:

This function is created to read out the detailed informations of the first intelligente subbus member.

Request Service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Request Service Id**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier read values	M	16h	RCI_
3	RecordCommonIdentifier	M	01h	RCI_

Formula section (not for MSD85):

If(1) service 22_16_01 is received
Then(1)
If(2) B_dev0detec = 1
Then(2) send Positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	01h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	01h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = always zero	M	00h	RCI_
7	RecordValue 4 = always zero	M	00h	RCI_
8	RecordValue 5 = Zbibs (MSB)	M	XXh	RCI_
9	RecordValue 6 = Zbibs	M	XXh	RCI_
10	RecordValue 7 = Zbibs	M	XXh	RCI_
11	RecordValue 8 = Zbibs (LSB)	M	XXh	RCI_

If (3) B_dev0detec = 0 **and** B_dev3detec = 1
Then(3) send Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	01h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	02h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number (always 0ffh)	M	FFh	RCI_
7	RecordValue 4 = BMW-part number (always 0ffh)	M	FFh	RCI_
8	RecordValue 5 = BMW-part number (always 0ffh)	M	FFh	RCI_
9	RecordValue 6 = BMW-part number (always 0ffh)	M	FFh	RCI_
10	RecordValue 7 = BMW-part number (always 0ffh)	M	FFh	RCI_
11	RecordValue 8 = BMW-part number (always 0ffh)	M	FFh	RCI_
12	RecordValue 9 = LF_CWP_INFO_COD	M	XXh	RCI_
13	RecordValue 10 = LF_POW_CWP_COD	M	XXh	RCI_

If (4) B_dev0detec = 0 and B_dev3detec = 0 and B_dev6detec = 1

Then(4) send Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	01h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	03h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number (always 0ffh)	M	FFh	RCI_
7	RecordValue 4 = BMW-part number (always 0ffh)	M	FFh	RCI_
8	RecordValue 5 = BMW-part number (always 0ffh)	M	FFh	RCI_
9	RecordValue 6 = BMW-part number (always 0ffh)	M	FFh	RCI_
10	RecordValue 7 = BMW-part number (always 0ffh)	M	FFh	RCI_
11	RecordValue 8 = BMW-part number (always 0ffh)	M	FFh	RCI_
12	RecordValue 9 = ALTER_COD_0	M	XXh	RCI_
13	RecordValue 10 = ALTER_COD_1	M	XXh	RCI_

Endif(4)
Endif(3)
Else(2) send negative Response "Request out of range" (31h)

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Endif(2)
Endif(1)

Formula section (only MSD85):

If(1) service 22_16_01 is received
Then(1)
If(2) B_dev0detec = 1
Then(2) send Positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	01h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	01h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = always zero	M	00h	RCI_
7	RecordValue 4 = always zero	M	00h	RCI_
8	RecordValue 5 = Zbibs (MSB)	M	XXh	RCI_
9	RecordValue 6 = Zbibs	M	XXh	RCI_
10	RecordValue 7 = Zbibs	M	XXh	RCI_
11	RecordValue 8 = Zbibs (LSB)	M	XXh	RCI_

Else(2)
If (3) B_dev0detec = 0 **and** B_dev3detec = 1
Then(3) send Positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	01h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	02h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number (always 0ffh)	M	FFh	RCI_
7	RecordValue 4 = BMW-part number (always 0ffh)	M	FFh	RCI_
8	RecordValue 5 = BMW-part number (always 0ffh)	M	FFh	RCI_
9	RecordValue 6 = BMW-part number (always 0ffh)	M	FFh	RCI_
10	RecordValue 7 = BMW-part number (always 0ffh)	M	FFh	RCI_
11	RecordValue 8 = BMW-part number (always 0ffh)	M	FFh	RCI_
12	RecordValue 9 = LF_CWP_INFO_COD	M	XXh	RCI_
13	RecordValue 10 = LF_POW_CWP_COD	M	XXh	RCI_

Else(3)
If (4) B_dev0detec = 0 **and** B_dev3detec **= 0 and** B_dev6detec = 1
Then(4) send Positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	01h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	03h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number (always 0ffh)	M	FFh	RCI_
7	RecordValue 4 = BMW-part number (always 0ffh)	M	FFh	RCI_
8	RecordValue 5 = BMW-part number (always 0ffh)	M	FFh	RCI_
9	RecordValue 6 = BMW-part number (always 0ffh)	M	FFh	RCI_
10	RecordValue 7 = BMW-part number (always 0ffh)	M	FFh	RCI_
11	RecordValue 8 = BMW-part number (always 0ffh)	M	FFh	RCI_
12	RecordValue 9 = ALTER_COD_0	M	XXh	RCI_
13	RecordValue 10 = ALTER_COD_1	M	XXh	RCI_

Else(4)
If (5) LV_VAR_ECRAS_UP= 1
and B_dev0detec = 0
and B_dev3detec = 0
And B_dev6detec = 0
Then(5) send Positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	01h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	3Dh	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number (always 0ffh)	M	FFh	RCI_
7	RecordValue 4 = BMW-part number (always 0ffh)	M	FFh	RCI_
8	RecordValue 5 = BMW-part number (always 0ffh)	M	FFh	RCI_
9	RecordValue 6 = BMW-part number (always 0ffh)	M	FFh	RCI_
10	RecordValue 7 = BMW-part number (always 0ffh)	M	FFh	RCI_
11	RecordValue 8 = BMW-part number (always 0ffh)	M	FFh	RCI_
12	RecordValue 9 = STATE_ECRAS_UP_VAR	M	XXh	RCI_

Else(5)
send negative Response "Request out of range" (31h)
Endif(5)
Endif(4)
Endif(3)

Endif(2)
Endif(1)

I.23.9 22_1602 - Read detailed informations of second intelligent subbus member

General information:

This function is created to read out the detailed informations of second intelligent subbus member

Request Service

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Request Service Id**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier read values	M	16h	RCI_
3	RecordCommonIdentifier	M	02h	RCI_

Formula section (not for MSD85):

If(1) service 22_16_02 is received
Then(1)
If(2) B_dev0detec = 1 **and** B_dev3detec = 1
Then(2) send Positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	02h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	02h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number (always 0ffh)	M	FFh	RCI_
7	RecordValue 4 = BMW-part number (always 0ffh)	M	FFh	RCI_
8	RecordValue 5 = BMW-part number (always 0ffh)	M	FFh	RCI_
9	RecordValue 6 = BMW-part number (always 0ffh)	M	FFh	RCI_
10	RecordValue 7 = BMW-part number (always 0ffh)	M	FFh	RCI_
11	RecordValue 8 = BMW-part number (always 0ffh)	M	FFh	RCI_
12	RecordValue 9 = LF_CWP_INFO_COD	M	XXh	RCI_
13	RecordValue 10 = LF_POW_CWP_COD	M	XXh	RCI_

Elseif(2)
If(3) (B_dev0detec = 1 **and** B_dev3detec= 0 **and** B_dev6detec = 1)
or
(B_dev0detec = 0 **and** B_dev3detec= **1 and** B_dev6detec = 1**)**
Then(3) send Positive Response

1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	02h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	03h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number (always 0ffh)	M	FFh	RCI_
7	RecordValue 4 = BMW-part number (always 0ffh)	M	FFh	RCI_
8	RecordValue 5 = BMW-part number (always 0ffh)	M	FFh	RCI_
9	RecordValue 6 = BMW-part number (always 0ffh)	M	FFh	RCI_
10	RecordValue 7 = BMW-part number (always 0ffh)	M	FFh	RCI_
11	RecordValue 8 = BMW-part number (always 0ffh)	M	FFh	RCI_
12	RecordValue 9 = ALTER_COD_0	M	XXh	RCI_
13	RecordValue 10 = ALTER_COD_1	M	XXh	RCI_

Else(3) send negative Response "Request out of range" (31h)
Endif(3)
Endif(2)
Endif(1)

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Formula section (only for MSD85):

If(1) service 22_16_02 is received
Then(1)
If(2) B_dev0detec = 1 **and** B_dev3detec = 1
Then(2) send Positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	02h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	02h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number (always 0ffh)	M	FFh	RCI_
7	RecordValue 4 = BMW-part number (always 0ffh)	M	FFh	RCI_
8	RecordValue 5 = BMW-part number (always 0ffh)	M	FFh	RCI_
9	RecordValue 6 = BMW-part number (always 0ffh)	M	FFh	RCI_
10	RecordValue 7 = BMW-part number (always 0ffh)	M	FFh	RCI_
11	RecordValue 8 = BMW-part number (always 0ffh)	M	FFh	RCI_
12	RecordValue 9 = LF_CWP_INFO_COD	M	XXh	RCI_
13	RecordValue 10 = LF_POW_CWP_COD	M	XXh	RCI_

Elseif(2)
If(3) (B_dev0detec = 1 **and** B_dev3detec= 0 **and** B_dev6detec = 1)
or
(B_dev0detec = 0 **and** B_dev3detec= 1 **and** B_dev6detec = 1)
Then(3) send Positive Response

1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	02h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	03h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number (always 0ffh)	M	FFh	RCI_
7	RecordValue 4 = BMW-part number (always 0ffh)	M	FFh	RCI_
8	RecordValue 5 = BMW-part number (always 0ffh)	M	FFh	RCI_
9	RecordValue 6 = BMW-part number (always 0ffh)	M	FFh	RCI_
10	RecordValue 7 = BMW-part number (always 0ffh)	M	FFh	RCI_
11	RecordValue 8 = BMW-part number (always 0ffh)	M	FFh	RCI_
12	RecordValue 9 = ALTER_COD_0	M	XXh	RCI_
13	RecordValue 10 = ALTER_COD_1	M	XXh	RCI_

Else(3)
If(4) LV_VAR_ECRAS_UP = 1
and
((B_dev0detec = 1 **and** B_dev3detec= 0 **and** B_dev6detec = 0)
or
(B_dev0detec = 0 **and** B_dev3detec= 1 **and** B_dev6detec = 0)
or
(B_dev0detec = 0 **and** B_dev3detec= 0 **and** B_dev6detec = 1)
)
Then(4) send Positive Response

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1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	02h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	3Dh	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number (always 0ffh)	M	FFh	RCI_
7	RecordValue 4 = BMW-part number (always 0ffh)	M	FFh	RCI_
8	RecordValue 5 = BMW-part number (always 0ffh)	M	FFh	RCI_
9	RecordValue 6 = BMW-part number (always 0ffh)	M	FFh	RCI_
10	RecordValue 7 = BMW-part number (always 0ffh)	M	FFh	RCI_
11	RecordValue 8 = BMW-part number (always 0ffh)	M	FFh	RCI_
12	RecordValue 9 = STATE_ECRAS_UP_VAR	M	XXh	RCI_

Else(4) send negative Response "Request out of range" (31h)
Endif(4)
Endif(3)
Endif(2)
Endif(1)

I.23.10 22_1603 - Read detailed informations of third intelligent subbus member

General information:

This function is created to read out the detailed informations of third intelligente subbus member.

Request Service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Request Service Id**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier read values	M	16h	RCI_
3	RecordCommonIdentifier	M	03h	RCI_

Formula section (not for MSD85):

If(1) service 22_16_03 is received
Then(1)
If(2) B_dev0detec = 1 **and** B_dev3detec= 1 **and** B_dev6detec = 1
Then(2) send Positive Response

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	03h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	03h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number (always 0ffh)	M	FFh	RCI_
7	RecordValue 4 = BMW-part number (always 0ffh)	M	FFh	RCI_
8	RecordValue 5 = BMW-part number (always 0ffh)	M	FFh	RCI_
9	RecordValue 6 = BMW-part number (always 0ffh)	M	FFh	RCI_
10	RecordValue 7 = BMW-part number (always 0ffh)	M	FFh	RCI_
11	RecordValue 8 = BMW-part number (always 0ffh)	M	FFh	RCI_
12	RecordValue 9 = ALTER_COD_0	M	XXh	RCI_
13	RecordValue 10 = ALTER_COD_1	M	XXh	RCI_

Else(2) send negative Response "Request out of range" (31h)
Endif(2)
Endif(1)

Formula section (onyl for MSD85):

If(1) service 22_16_03 is received
Then(1)
If(2) B_dev0detec = 1 **and** B_dev3detec= 1 **and** B_dev6detec = 1
Then(2) send Positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	03h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	03h	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number (always 0ffh)	M	FFh	RCI_
7	RecordValue 4 = BMW-part number (always 0ffh)	M	FFh	RCI_
8	RecordValue 5 = BMW-part number (always 0ffh)	M	FFh	RCI_
9	RecordValue 6 = BMW-part number (always 0ffh)	M	FFh	RCI_
10	RecordValue 7 = BMW-part number (always 0ffh)	M	FFh	RCI_
11	RecordValue 8 = BMW-part number (always 0ffh)	M	FFh	RCI_
12	RecordValue 9 = ALTER_COD_0	M	XXh	RCI_
13	RecordValue 10 = ALTER_COD_1	M	XXh	RCI_

Elseif(2)
If(3) LV_VAR_ECRAS_UP = 1
and
(
(B_dev0detec = 1 **and** B_dev3detec= 1 **and** B_dev6detec = 0)
or (B_dev0detec = 1 **and** B_dev3detec= 0 **and** B_dev6detec = 1)
or (B_dev0detec = 0 **and** B_dev3detec= 1 **and** B_dev6detec = 1)
)
Then(3) send Positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	03h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	3Dh	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number (always 0ffh)	M	FFh	RCI_
7	RecordValue 4 = BMW-part number (always 0ffh)	M	FFh	RCI_
8	RecordValue 5 = BMW-part number (always 0ffh)	M	FFh	RCI_
9	RecordValue 6 = BMW-part number (always 0ffh)	M	FFh	RCI_
10	RecordValue 7 = BMW-part number (always 0ffh)	M	FFh	RCI_
11	RecordValue 8 = BMW-part number (always 0ffh)	M	FFh	RCI_
12	RecordValue 9 = STATE_ECRAS_UP_VAR	M	XXh	RCI_

Else(3) send negative Response "Request out of range" (31h)
Endif(3)
Endif(2)
Endif(1)

I.23.11 22_1604 - Read detailed informations of fourth intelligent subbus member

General information:

This function is created to read out the detailed informations of fourth intelligente subbus member.

Request Service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**ReadDataByCommonIdentifier Request Service Id**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier read values	M	16h	RCI_
3	RecordCommonIdentifier	M	04h	RCI_

Formula section (not for MSD85):

If(1) service 22_16_04 is received
Then(1) send negative Response "Request out of range" (31h)
Endif(1)

Formula section (only for MSD85):

If(1) service 22_16_04 is received
Then(1)
If(2) B_dev0detec = 1
and B_dev3detec = 1
and B_dev6detec = 1
and LV_VAR_ECRAS_UP = 1
Then(2) send Positive Response

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	16h	RCI_BOS
3	RecordCommonIdentifier	M	04h	RCI_BOS
4	RecordValue 1 = Verbauort (high byte)	M	3Dh	RCI_
5	RecordValue 2 = Verbauort (low byte)	M	00h	RCI_
6	RecordValue 3 = BMW-part number (always 0ffh)	M	FFh	RCI_
7	RecordValue 4 = BMW-part number (always 0ffh)	M	FFh	RCI_
8	RecordValue 5 = BMW-part number (always 0ffh)	M	FFh	RCI_
9	RecordValue 6 = BMW-part number (always 0ffh)	M	FFh	RCI_
10	RecordValue 7 = BMW-part number (always 0ffh)	M	FFh	RCI_
11	RecordValue 8 = BMW-part number (always 0ffh)	M	FFh	RCI_
12	RecordValue 9 = STATE_ECRAS_UP_VAR	M	XXh	RCI_

Else(2) send negative Response "Request out of range" (31h)
Endif(2)
Endif(1)

I.23.12 22_1605 ..22_16FF Read detailed informations of other intelligent subbus member

General information:

This function is created to read out the detailed informations of other intelligente subbus members

Request Service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Request Service Id**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier read values	M	16h	RCI_
3	RecordCommonIdentifier	M	XXh [05h, .. FFh]	RCI_

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Formula section:

If(1) service 22_16_05..FF is received
Then(1) send negative Response "Request out of range" (31h)
Endif(1)

I.23.13 22_2000 - Read failure memory short

General information:

This function is to read out the numbers of faults in the error memory and the status of CDK (see also Fault-type-byte and fault-type extension byte (chapter OBDII functions)).

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	20h	RCI_RDTCBS
3	RecordCommonIdentifier Low Byte	M	00h	RCI_RDTCBS

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	20h	RCI_RDTCBS
3	RecordCommonIdentifier Low Byte	M	00h	RCI_RDTCBS
4	numberOfCDK - CTR_ERR_DYN_NR	M	01h-XXh	NROCDK
5..24	ListOfCDKAndStatus= [CDK0 high byte ERR_DTC[0] CDK0 low byte ERR_DTC[0] statusOfCDK 1 ERR_TYPE_BYTE[0] CDK1 high byte ERR_DTC[1] CDK1 low byte ERR_DTC[1] statusOfCDK 2 ERR_TYPE_BYTE[1] . . . CDK(NC_NR_ERR_DYN - 1) CDK(NC_NR_ERR_DYN - 1) statusOfCDK n ERR_TYPE_BYTE[NC_NR_ERR_DYN - 1]]	C C C C C C . . . C C C	[XXh XXh XXh XXh XXh XXh . . . XXh XXh XXh]	LOCDKAS

I.23.14 22_2100 - Read History Memory

General information:

This function is created to read out the history memory with all the errors (max. 10, see also History memory (chapter OBDII functions)).. The checksum calculation for each error is a simple XOR of all the bytes belonging to that error.

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	21h	RCI_
3	RecordCommonIdentifier Low Byte	M	00h	RCI_

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier= Read History Memory	M	21h	RCI_TSP
3	RecordCommonIdentifier	M	00h	RCI_TSP
4	RecordValue 1 = Error counter total (supplier name: CTR_ERR_HIS_NR)	M	XXh	RV_
5	RecordValue 2 = Error code "CDK" high byte (supplier name: HIS_COD[x])	M	XXh	RV_
6	RecordValue 3 = Error code "CDK" low byte (supplier name: HIS_COD[x])	M	XXh	RV_
7	RecordValue 4 = status DTC1 (supplier name: HIS[1][x])	M	XXh	RV_
8	RecordValue 5 = Frequency counter (supplier name: HIS[2][x])	M	XXh	RV_
9	RecordValue 6 = km-value by first occur high byte (supplier name: HIS[3][x])	M	XXh	RV_
10	RecordValue 7 = km-value by first occur low byte (supplier name: HIS[4][x])	M	XXh	RV_
11	RecordValue 8 = km-value by second occur high byte (supplier name: HIS[5][x])	M	XXh	RV_
12	RecordValue 9 = km-value by second occur low byte (supplier name: HIS[6][x])	M	XXh	RV_
13	RecordValue 8 = km-value by last occur high byte (supplier name: HIS[7][x])	M	XXh	RV_
14	RecordValue 9 = km-value by last occur low byte (supplier name: HIS[8][x])	M	XXh	RV_
15	RecordValue 10 = Error class "CLA" (supplier name: HIS[9][x])	M	FFh	RV_
16	RecordValue 11= checksum for this DTC	M	FFh	RV_
17	next failure - convention see 5d as follows	M	XXh	RV_
18	:			RV_
19	:			RV_
5 +(n*9)	RecordValue 2 +(n*9)d 11= checksum for the last DTC (maximum is 10 DTC´s)	M	FFh	RV_

I.23.15 22_2500 - Programm Reference Backup

General information:

This function is for reading the Programmreference backup from the logistic data of the ecu.

Application conditions

Initialisation: at reset

Activation: Kl.15 on
engine speed=0rpm

Deactivation: Kl.15 off
Diagnostic timeout

Service location: see list of implemented diagnostic services

Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	25h	RCI_
3	RecordCommonIdentifier Low Byte	M	00h	RCI_

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	25h	RCI_TSP
3	RecordCommonIdentifier Low Byte	M	00h	RCI_TSP
4+ 3*(12+6)	recordValue1 backup of programm reference system - cif_backup	M	XXh	RV_

I.23.16 22_2501 - Erasing time

General information:

This function ist for reading the erasing time of the flash memory of the ecu.

Application conditions

Initialisation: *at reset*

Activation: Kl.15 on
engine speed=0rpm

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see list of implemented diagnostic services

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	25h	RCI_
3	RecordCommonIdentifier Low Byte	M	01h	RCI_

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	25h	RCI_TSP
3	RecordCommonIdentifier Low Byte	M	01h	RCI_TSP
4	recordValue1 max. erasing time del_time_max	M	XXh	RV_
5	recordValue1 max. time for signature check kwp_sigt	M	XXh	RV_
6	recordValue1 max. time for ECU reset kwp_rst	M	XXh	RV_
7	recordValue1 max. time for authentification kwp_autht	M	XXh	RV_

I.23.17 22_2502 - Hardware reference

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General information:

This function ist for reading the hardware reference of the ecu.

Application conditions

Initialisation: *at reset*

Activation: Kl.15 on
engine speed=0rpm

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see list of implemented diagnostic services

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	25h	RCI_
3	RecordCommonIdentifier Low Byte	M	02h	RCI_

Positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	25h	RCI_TSP
3	RecordCommonIdentifier Low Byte	M	02h	RCI_TSP
4	recordValue1 hardware reference hw_reference	M	XXh	RV_

I.23.18 22_2503 - Programm reference

General information:

This function ist for reading the programm reference of the ecu.

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	25h	RCI_
3	RecordCommonIdentifier Low Byte	M	03h	RCI_

Positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	25h	RCI_TSP
3	RecordCommonIdentifier Low Byte	M	03h	RCI_TSP
4 6+3*12	recordValue1 ecu_sw_reference	M	XXh	RV_

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I.23.19 22_2504 - Data reference

General information:

This function ist for reading the data reference of the ecu.

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	25h	RCI_
3	RecordCommonIdentifier Low Byte	M	04h	RCI_

Figure I.23.1: Table Request Message

Positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	25h	RCI_TSP
3	RecordCommonIdentifier Low Byte	M	04h	RCI_TSP
4 6+3*17	RecordValue1 cal_ref_nr	M	XXh	RV_

I.23.20 22_2506 - Maximum of block length

General information:

This function is for reading the maximum of block length, witch is possible for the ecu.

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	25h	RCI_
3	RecordCommonIdentifier Low Byte	M	06h	RCI_

Positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	25h	RCI_TSP
3	RecordCommonIdentifier Low Byte	M	06h	RCI_TSP
4	RecordValue1 high byte = kwp_max_tel_len maximun block length	M	XXh	RV_
5	RecordValue1 low byte = kwp_max_tel_len maximun block length	M	XXh	RV_

I.23.21 22_3000 - RCI_MIL_lesen

General information:

MIL Codierung lesen

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This function is created to read out the selected value of MIL (malfunction indication lamp) variant code.

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	30h	RCI_MIL_lesen
3	RecordCommonIdentifier Low Byte	M	00h	RCI_MIL_lesen

Positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	30h	RCI_MIL_lesen
3	RecordCommonIdentifier Low Byte	M	00h	RCI_MIL_lesen
4	recordValue = STATE_MIL_ON_DIS_EXT_REQ	M	XXh	RV_STATE_MIL_ON_DIS_EXT_REQ

I.23.22 22_3001 - RCI_KAT_lesen

General information:

Kat Codierung lesen

This function is created to read out the selected value of catalyst variant code.

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	30h	RCI_KAT_lesen
3	RecordCommonIdentifier Low Byte	M	01h	RCI_KAT_lesen

Positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	30h	RCI_KAT_lesen
3	RecordCommonIdentifier Low Byte	M	01h	RCI_KAT_lesen
4	recordValue 1= LV_CAT_CONF_DIS_EXT_REQ	M	XXh	RV_LV_CAT_CONF_DIS_EXT_REQ

I.23.23 22_3010 - RCI_VMAX_lesen

General information:

VMAX-Codierdaten lesen

This function is created to read out the selected value for maximum vehicle speed. The values 0 ... 3 represent one of four possible values for maximum vehicle speed.

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Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	30h	RCI_VMAX_lesen
3	RecordCommonIdentifier Low Byte	M	10h	RCI_VMAX_lesen

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	30h	RCI_VMAX_lesen
3	RecordCommonIdentifier Low Byte	M	10h	RCI_VMAX_lesen
4	recordValue 1 = VS_MAX_SEL_EXT_REQ	M	XXh	RV_VS_MAX_SEL_EXT_REQ

I.23.24 22_3020 - RCI_CLS_lesen

General information:

STATUS_CODIERUNG_LEISTUNGSSTUFE
This function is created to read out the coding of power stage (Leistungsstufe)

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	30h	RCI_CLS_lesen
3	RecordCommonIdentifier Low Byte	M	20h	RCI_CLS_lesen

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	30h	RCI_CLS_lesen
3	RecordCommonIdentifier Low Byte	M	20h	RCI_CLS_lesen
4	recordValue 1 = POW_CONF_IDX_EXT_REQ	M	XXh	RV_POW_CONF_IDX_EXT_REQ

I.23.25 22_3030 - Status Codierung Protokoll lesen

General information:

This function is created to read out the active communication protocol (14230 <-> 15765-4).

Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	30h	RCI_CDSP
3	RecordCommonIdentifier Low Byte	M	30h	RCI_CDSP

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	30h	RCI_CDSP
3	RecordCommonIdentifier Low Byte	M	30h	RCI_CDSP
4	recordValue = PROT_CONF_IDX_EXT_REQ	M	XXh	RV_CDSP

I.23.26 22_3200 - RCI_OEL_lesen

General information:

Oelwechsel intervall- Codierdaten lesen
This function is created to read out the country dependant factors for oil change intervall.
Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	32h	RCI_OEL_lesen
3	RecordCommonIdentifier Low Byte	M	00h	RCI_OEL_lesen

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	32h	RCI_OEL_lesen
3	RecordCommonIdentifier Low Byte	M	00h	RCI_OEL_lesen
4	recordValue 1 = FAC_OIL_EXT_REQ_1	M	XXh	RV_FAC_OIL_EXT_REQ_1
5	recordValue 2 = FAC_OIL_EXT_REQ_2	M	XXh	RV_FAC_OIL_EXT_REQ_2

I.23.27 22_3210 - RCI_IGR_lesen

General information:

Read coding of IGR (Intelligente Generator-Regelung)
This function is created to read out the selected value intelligent alternator control variant code.

Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	32h	RCI_IGR_lesen
3	RecordCommonIdentifier Low Byte	M	10h	RCI_IGR_lesen

Positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	32h	RCI_IGR_lesen
3	RecordCommonIdentifier Low Byte	M	10h	RCI_IGR_lesen
4	recordValue = LV_ALTER_CTL_ENA	M	XXh	RV_ LV_ALTER_CTL_ENA

I.23.28 22_3211 - Xenonverbau-Codierdaten lesen

General information:

This function is created to read out the selected value of "xenon-filled headlight mounted" variant code.
Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	32h	RCI_CDXEN
3	RecordCommonIdentifier Low Byte	M	11h	RCI_CDXEN

Positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	32h	RCI_CDXEN
3	RecordCommonIdentifier Low Byte	M	11h	RCI_CDXEN
4	recordValue = B_cdxenonr	M	XXh	RV_B_CDXENON

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I.23.29 22_3220 - RCI_SPA_lesen

General information:

SPA-Codierdaten lesen
This function is created to read out the "Schaltpunktanzeige"

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	32h	RCI_SPA_lesen
3	RecordCommonIdentifier Low Byte	M	20h	RCI_SPA_lesen

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	32h	RCI_SPA_lesen
3	RecordCommonIdentifier Low Byte	M	20h	RCI_SPA_lesen
4	recordValue1 = B_spa_csoll	M	XXh	RV_SPA_CSOLL
5	recordValue1 = B_spa_cist	M	XXh	RV_SPA_CIST

I.23.30 22_3230 - RCI_BZE_lesen

General information:

BZE-Codierdaten lesen
This function is created to read out the "Batteriezustands Erkennung"

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	32h	RCI_BZE_lesen
3	RecordCommonIdentifier Low Byte	M	30h	RCI_BZE_lesen

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	32h	RCI_BZE_lesen
3	RecordCommonIdentifier Low Byte	M	30h	RCI_BZE_lesen
4	recordValue1 = Qv_cdherst_1	M	XXh	RV_CD_HERST1
5	recordValue2 = Qv_cdherst_2	M	XXh	RV_CD_HERST2
6	recordValue3 = Qv_cdherst_3	M	XXh	RV_CD_HERST3
7	recordValue4 = Qv_cdherst_4	M	XXh	RV_CD_HERST4
8	recordValue5 = Qv_cdherst_5	M	XXh	RV_CD_HERST5
9	recordValue6 = Qv_cdherst_6	M	XXh	RV_CD_HERST6
10	recordValue7 = Qv_cdherst_7	M	XXh	RV_CD_HERsT7
11	recordValue8 = Qv_cdherst_8	M	XXh	RV_CD_HESRT8

I.23.31 22_3240 - RCI_AGK_lesen

General information:

Read Coding Exhaust gas flap
This function is created to read out "Codierung fuer Abgasklappe auslesen"

Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	32h	RCI_AGK_lesen
3	RecordCommonIdentifier Low Byte	M	40h	RCI_AGK_lesen

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	32h	RCI_AGK_lesen
3	RecordCommonIdentifier Low Byte	M	40h	RCI_AGK_lesen
4	recordValue1 = CONF_EF	M	XXh	RV_CODIERUNG_AGK

I.23.32 22_3250 - Read Coding of MSA

General information:

With this comand the coding value of MSA is read out.

Application conditions

Initialisation: - -

Activation: LV_IGK = 1

Deactivation: LV_IGK = 0
Diagnostic timeout
Service location: see list of implemented diagnostic services

Formula Section:

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**ReadDataByCommonIdentifier Request Service Id**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier	M	32h	RCI_CDMSA
3	RecordCommonIdentifier	M	50h	RCI_CDMSA

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	32h	RCI_CDMSA
3	RecordCommonIdentifier	M	50h	RCI_CDMSA
4	recordValue1 = LV_STST_VAR_COD	M	XXh	RV_CODIERUNG_MSA

I.23.33 22_3260 - Read CDASMOT

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General information:

This function is created to read out the "Codierung elektrische Diagnose der Funktion Abschaltung Klemme 15"

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	32h	RCI_CDASMOT
3	RecordCommonIdentifier Low Byte	M	60h	RCI_CDASMOT

Positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	32h	RCI_CDASMOT
3	RecordCommonIdentifier Low Byte	M	60h	RCI_CDASMOT
5	recordValue1 = LV_IGK_OFF_ACK_ENA (0 - diagnosis off, 1- diagnosis on)	M	XXh [0h, 1h]	RV_CODIERUNG _ASMOT

I.23.34 22_4000 - RCI_MW_lesen

General information:

STATUS_MESSWERTE

This function is created to read out the described values from the ecu.

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_MW
3	RecordCommonIdentifier Low Byte	M	00h	RCI_MW

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_MW
3	RecordCommonIdentifier Low Byte	M	00h	RCI_MW
4	recordValue1 = TI_1_HOM[0] high byte	M	XXh	RV_TI_1_HOM[0]
5	recordValue2 = TI_1_HOM[0] low byte	M	XXh	RV_TI_1_HOM[0]
6	recordValue3 = FAC_LAM_LIM[[1] high byte	M	XXh	RV_FAC_LAM_LIM[[1]
7	recordValue4 = FAC_LAM_LIM[[1] low byte	M	XXh	RV_FAC_LAM_LIM[[1]
8	recordValue5 = FAC_LAM_LIM[[2] high byte	M	XXh	RV_FAC_LAM_LIM[[2]
9	recordValue6 = FAC_LAM_LIM[[2] low byte	M	XXh	RV_FAC_LAM_LIM[[2]
10	recordValue7 = VS	M	XXh	RV_VS
11	recordValue8 = N high byte	M	XXh	RV_N
12	recordValue9 = N low byte	M	XXh	RV_N
13	recordValue10 = N_SP_IS high byte	M	XXh	RV_N_SP_IS
14	recordValue11 = N_SP_IS low byte	M	XXh	RV_N_SP_IS
15	recordValue12 **=** CAM_IN[1] high byte -if word **(not MSD85)** 0 - if byte **(not MSDS85)** CAM_IN_H[1] high byte **(only MSD85)**	M	XXh	RV_CAM_IN_H[1]
16	recordValue13 = CAM_IN[1] low byte- if word **(not MSD85)** CAM_IN[1] - if byte **(not MSD85)** CAM_IN_H[1] low byte (only MSD85)	M	XXh	RV_CAM_IN_H[1]
17	recordValue14 = CAM_EX[1]	M	XXh	RV_CAM_EX[1]
18	recordValue15 = Dummy	M	FFh	RV_DUMMY_1
19	recordValue16 = TIA	M	XXh	RV_TIA
20	recordValue17 = TCO_MES	M	XXh	RV_TCO_MES
21	recordValue18 = IGA_IGC[0]	M	XXh	RV_IGA_IGC[0]
22	recordValue19 = TPS_AV_1 high byte **(not MS85)** TPS_AV_1[0] high byte **(only MSD85)**	M	XXh	RV_TPS_AV_1[1]
23	recordValue20 = TPS_AV_1 low byte **(not MSD85)** TPS_AV_1[0] low byte **(only MSD85)**	M	XXh	RV_TPS_AV_1[1]
24	recordValue21 = MAF_KGH_MES_BAS high byte **(not MSD85)** MAF_KGH_MES_BAS[0] high byte **(only MSD85)**	M	XXh	RV_MAF_KGH_MES_BAS[1]
25	recordValue22 = MAF_KGH_MES_BAS low byte **(not MSD85)** MAF_KGH_MES_BAS[0] high byte **(only MSD85)**	M	XXh	RV_MAF_KGH_MES_BAS[1]
26	recordValue23 = TQI_AV high byte	M	XXh	RV_TQI_AV
27	recordValue24 = TQI_AV low byte	M	XXh	RV_TQI_AV
28	recordValue25 = VB	M	XXh	RV_VB
29	recordValue26 = V_PVS_1 high byte	M	XXh	V_PVS_1
30	recordValue27 = V_PVS_1 low byte	M	XXh	RV_V_PVS_1
31	recordValue28 = TCO_2_MES	M	XXh	RV_TCO_2_MES
32	recordValue29 = NL[0] high byte	M	XXh	RV_NL[0]
33	recordValue30 = NL[0] low byte	M	XXh	RV_NL[0]
34	recordValue31 = NL[1] high byte	M	XXh	RV_NL[1]
35	recordValue32 = NL[1] low byte	M	XXh	RV_NL[1]
36	recordValue33 = NL[2] high byte	M	XXh	RV_NL[2]
37	recordValue34 = NL[2] low byte	M	XXh	RV_NL[2]
38	recordValue35 = NL[3] high byte	M	XXh	RV_NL[3]
39	recordValue36 = NL[3] high byte	M	XXh	RV_NL[3]
40	recordValue37 = NL[4] low byte	M	XXh	RV_NL[4]
41	recordValue38 = NL[4] low byte	M	XXh	RV_NL[4]
42	recordValue39 = NL[5] high byte	M	XXh	RV_NL[5]

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43	recordValue40 = NL[5] low byte	M	XXh	RV_NL[5]
44	recordValue41 = NL[6] low byte	M	XXh	RV_NL[6]
-	recordValue42 = NL[6] low byte	M	XXh	RV_NL[6]
46	recordValue43 = NL[7] high byte	M	XXh	RV_NL[7]
47	recordValue44 = NL[7] low byte	M	XXh	RV_NL[7]

Note: RecordValue data for not available components are FFh

I.23.35 22_4001 - RCI_BLZ_lesen

General information:

Read values batterie generator

This function is created to read out the described values from the ecu.

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_BLZ_lesen
3	RecordCommonIdentifier Low Byte	M	01h	RCI_BLZ_lesen

Positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_BLZ_lesen
3	RecordCommonIdentifier Low Byte	M	01h	RCI_BLZ_lesen
4	recordValue1 = Dfmonitor	M	XXh	Dfmonitor

I.23.36 22_4002 - RCI_SSZ1_lesen

General information:

Read Switch Position

This function is created to read the actual position of the car switches.
All switches are active 1 in the Bit position, as well as ground was switched.

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_SSZ1_lesen
3	RecordCommonIdentifier Low Byte	M	02h	RCI_SSZ1_lesen

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_SSZ1_lesen
3	RecordCommonIdentifier Low Byte	M	02h	RCI_SSZ1_lesen
4	recordValue1 = Bitfield1	M	XXh	RV_SWITCH_POSITION

Note: For data, longer than one byte, the lowest byte is sent first

Byte #	Name	Size	Conversion (hex/bin)	Conversion (physical)	Mnemonic	Resol.
#4d	Bitfield 1	1	xxxxxxx1 b xxxxxx1x b xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b	LV_IGK LV_ES LV_CS LV_IM_BLS LV_IM_BTS not used not used LV_ACCOUT_RLY	RV_LV_IGK RV_LV_ES RV_LV_CS RV_LV_IM_BLS RV_LV_IM_BTS RV_LV_ACCOUT_RLY	

I.23.37 22_4003 - RCI_MLR_lesen

General information:

Read values of engine roughness

This function is created to read out the values from the function-test engine roughness.
The calculation of the function is described in the chapter OBDII functions.

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_MLR
3	RecordCommonIdentifier Low Byte	M	03h	RCI_MLR

Positive Response on service

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_MLR
3	RecordCommonIdentifier Low Byte	M	03h	RCI_MLR
4	recordValue1 high byte = ER_MMV_IS_DIAG[0]	M	XXh	RV_ER_MMV_IS_DIAG[0]
5	recordValue2 low byte = ER_MMV_IS_DIAG[0]	M	XXh	RV_ER_MMV_IS_DIAG[0]
6	recordValue3 high byte = ER_MMV_IS_DIAG[1]	M	XXh	RV_ER_MMV_IS_DIAG[1]
7	recordValue4 low byte = ER_MMV_IS_DIAG[1]	M	XXh	RV_ER_MMV_IS_DIAG[1]
8	recordValue5 high byte = ER_MMV_IS_DIAG[2]	M	XXh	RV_ER_MMV_IS_DIAG[2]
9	recordValue6 low byte = ER_MMV_IS_DIAG[2]	M	XXh	RV_ER_MMV_IS_DIAG[2]
10	recordValue7 high byte = ER_MMV_IS_DIAG[3]	M	XXh	RV_ER_MMV_IS_DIAG[3]
11	recordValue8 low byte = ER_MMV_IS_DIAG[3]	M	XXh	RV_ER_MMV_IS_DIAG[3]
12	recordValue9 high byte = ER_MMV_IS_DIAG[4]	M	XXh	RV_ER_MMV_IS_DIAG[4]
13	recordValue10 low byte = ER_MMV_IS_DIAG[4]	M	XXh	RV_ER_MMV_IS_DIAG[4]
14	recordValue11 high byte = ER_MMV_IS_DIAG[5]	M	XXh	RV_ER_MMV_IS_DIAG[5]
15	recordValue12 low byte = ER_MMV_IS_DIAG[5]	M	XXh	RV_ER_MMV_IS_DIAG[5]
16	recordValue13 Byte = LV_SEG_AD_AVL_ER	M	XXh	RV_LV_SEG_AD_AVL_ER
17	recordValue14 high byte = VLS_UP[1]	M	XXh	RV_VLS_UP[1]
18	recordValue15 low byte = VLS_UP[1]	M	XXh	RV_VLS_UP[1]
19	recordValue16 high byte = VLS_UP[2]	M	XXh	RV_VLS_UP[2]
20	recordValue17 low byte = VLS_UP[2]	M	XXh	RV_VLS_UP[2]
21	recordValue18 high byte = ER_MMV_IS_DIAG[6]	M	XXh	RV_ER_MMV_IS_DIAG[6]
22	recordValue19 low byte = ER_MMV_IS_DIAG[6]	M	XXh	RV_ER_MMV_IS_DIAG[6]
23	recordValue 20 high byte = ER_MMV_IS_DIAG[7]	M	XXh	RV_ER_MMV_IS_DIAG[7]
24	recordValue 21 low byte = ER_MMV_IS_DIAG[7]	M	XXh	RV_ER_MMV_IS_DIAG[7]

Note: RecordValue data for not available components are FFh

I.23.38 22_4006 - RCI_NWA_lesen

General information:

Read CAMSHAFT-Sensor Adaption

This function is created to read the actual adaption data form the camshaft sensor of the engine. All switches are active 1 in the Bit position, as well as ground was switched.

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_NWA_lesen
3	RecordCommonIdentifier Low Byte	M	06h	RCI_NWA_lesen

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_NWA_lesen
3	RecordCommonIdentifier Low Byte	M	06h	RCI_NWA_lesen
4	recordValue1 = NC_PSN_EDGE_CAM_EX[1][1] high Byte	M	XXh	RV_NC_PSN_EDGE_CAM_EX[1][1]
5	RecordValue 2 = NC_PSN_EDGE_CAM_EX[1][1] low Byte	M	XXh	RV_NC_PSN_EDGE_CAM_EX[1][1]
6	RecordValue 3= NC_PSN_EDGE_CAM_EX[6][1] high Byte	M	XXh	RV_NC_PSN_EDGE_CAM_EX[6][1]
7	RecordValue 4 = NC_PSN_EDGE_CAM_EX[6][1] low Byte	M	XXh	RV_NC_PSN_EDGE_CAM_EX[6][1]
8	RecordValue 5 = NC_PSN_EDGE_CAM_IN[1][1] high Byte	M	XXh	RV_NC_PSN_EDGE_CAM_IN[1][1]
9	RecordValue 6 = NC_PSN_EDGE_CAM_IN[1][1] low Byte	M	XXh	RV_NC_PSN_EDGE_CAM_IN[1][1]
10	RecordValue 7 = NC_PSN_EDGE_CAM_IN[6][1] high Byte	M	XXh	RV_NC_PSN_EDGE_CAM_IN[6][1]
11	RecordValue 8 = NC_PSN_EDGE_CAM_IN[6][1] low Byte	M	XXh	RV_NC_PSN_EDGE_CAM_IN[6][1]
12	RecordValue 9 = PSN_EDGE_AD_CAM_IN[1] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[1] [1]
13	RecordValue 10 = PSN_EDGE_AD_CAM_IN[1] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[1] [1]
14	RecordValue 11 = PSN_EDGE_AD_CAM_IN[2] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[2] [1]
15	RecordValue 12 = PSN_EDGE_AD_CAM_IN[2] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[2] [1]
16	RecordValue 13 = PSN_EDGE_AD_CAM_IN[3] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[3] [1]
17	RecordValue 14 = PSN_EDGE_AD_CAM_IN[3] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[3] [1]
18	RecordValue 15 = PSN_EDGE_AD_CAM_IN[4] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[4] [1]
19	RecordValue 16 = PSN_EDGE_AD_CAM_IN[4] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[4] [1]
20	RecordValue 17 = PSN_EDGE_AD_CAM_IN[5] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[5] [1]
21	RecordValue 18 = PSN_EDGE_AD_CAM_IN[5] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[5] [1]
22	RecordValue 19 = PSN_EDGE_AD_CAM_IN[6] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[6] [1]
23	RecordValue 20 = PSN_EDGE_AD_CAM_IN[6] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[6] [1]
24	RecordValue 21 = PSN_EDGE_AD_CAM_EX[1] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[1] [1]
25	RecordValue 22 = PSN_EDGE_AD_CAM_EX[1] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[1] [1]
26	RecordValue 23 = PSN_EDGE_AD_CAM_EX[2] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[2] [1]
27	RecordValue 23 = PSN_EDGE_AD_CAM_EX[2] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[2] [1]
28	RecordValue 25 = PSN_EDGE_AD_CAM_EX[3] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[3] [1]

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29	RecordValue 26 = PSN_EDGE_AD_CAM_EX[3] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[3] [1]
30	RecordValue 27 = PSN_EDGE_AD_CAM_EX[4] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[4] [1]
31	RecordValue 28 = PSN_EDGE_AD_CAM_EX[4] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[4] [1]
32	RecordValue 29 = PSN_EDGE_AD_CAM_EX[5] [1] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[5] [1]
33	RecordValue 30 = PSN_EDGE_AD_CAM_EX[5] [1] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[5] [1]
34	RecordValue 31 = PSN_EDGE_AD_CAM_EX[6] [1] high Byte	M	XXh	RV_SN_EDGE_AD_CAM_EX[6] [1]
35	RecordValue 32 = PSN_EDGE_AD_CAM_EX[6] [1] low Byte	M	XXh	RV_SN_EDGE_AD_CAM_EX[6] [1]
36	RecordValue 33 = NC_PSN_EDGE_CAM_EX[1] [2] high Byte	M	XXh	RV_NC_PSN_EDGE_CAM_EX[1] [2]
37	RecordValue 34 = NC_PSN_EDGE_CAM_EX[1] [2] low Byte	M	XXh	RV_NC_PSN_EDGE_CAM_EX[1] [2]
38	RecordValue 35 = NC_PSN_EDGE_CAM_EX[6] [2] high Byte	M	XXh	RV_NC_PSN_EDGE_CAM_EX[6] [2]
39	RecordValue 36 = NC_PSN_EDGE_CAM_EX[6] [2] low Byte	M	XXh	RV_NC_PSN_EDGE_CAM_EX[6] [2]
40	RecordValue 37 = NC_PSN_EDGE_CAM_IN[1] [2] high Byte	M	XXh	RV_NC_PSN_EDGE_CAM_IN[1] [2]
41	RecordValue 38 = NC_PSN_EDGE_CAM_IN[1] [2] low Byte	M	XXh	RV_NC_PSN_EDGE_CAM_IN[1] [2]
42	RecordValue 38 = NC_PSN_EDGE_CAM_IN[6] [2] high Byte	M	XXh	RV_NC_PSN_EDGE_CAM_IN[6] [2]
43	RecordValue 39 = NC_PSN_EDGE_CAM_IN[6] [2] low Byte	M	XXh	RV_NC_PSN_EDGE_CAM_IN[6] [2]
44	RecordValue 40 = PSN_EDGE_AD_CAM_IN[1][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[1][2]
-	RecordValue 41 = PSN_EDGE_AD_CAM_IN[1][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[1][2]
46	RecordValue 42 = PSN_EDGE_AD_CAM_IN[2][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[2][2]
47	RecordValue 43 = PSN_EDGE_AD_CAM_IN[2][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[2][2]
48	RecordValue 44 = PSN_EDGE_AD_CAM_IN[3][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[3][2]
49	RecordValue - = PSN_EDGE_AD_CAM_IN[3][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[3][2]
50	RecordValue 46 = PSN_EDGE_AD_CAM_IN[4][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[4][2]
51	RecordValue 47 = PSN_EDGE_AD_CAM_IN[4][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[4][2]
52	RecordValue 48 = PSN_EDGE_AD_CAM_IN[5][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[5][2]
53	RecordValue 49 = PSN_EDGE_AD_CAM_IN[5][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[5][2]
54	RecordValue 50 = PSN_EDGE_AD_CAM_IN[6][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[6][2]
55	RecordValue 50 = PSN_EDGE_AD_CAM_IN[6][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_IN[6][2]
56	RecordValue 40 = PSN_EDGE_AD_CAM_EX[1][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[1][2]

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57	RecordValue 41 = PSN_EDGE_AD_CAM_EX[1][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[1][2]
58	RecordValue 42 = PSN_EDGE_AD_CAM_EX[2][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[2][2]
59	RecordValue 43 = PSN_EDGE_AD_CAM_EX[2][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[2][2]
60	RecordValue 44 = PSN_EDGE_AD_CAM_EX[3][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[3][2]
61	RecordValue - = PSN_EDGE_AD_CAM_EX[3][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[3][2]
62	RecordValue 46 = PSN_EDGE_AD_CAM_EX[4][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[4][2]
63	RecordValue 47 = PSN_EDGE_AD_CAM_EX[4][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[4][2]
64	RecordValue 48 = PSN_EDGE_AD_CAM_EX[5][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[5][2]
65	RecordValue 49 = PSN_EDGE_AD_CAM_EX[5][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[5][2]
66	RecordValue 50 = PSN_EDGE_AD_CAM_EX[6][2] high Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[6][2]
67	RecordValue 50 = PSN_EDGE_AD_CAM_EX[6][2] low Byte	M	XXh	RV_PSN_EDGE_AD_CAM_EX[6][2]

Note: RecordValue data for not available components are FFh

I.23.39 22_4007 - RCI_SSZ0_lesen

General information:

Read State of Functions

This function is created to read the actual condition of the engine.
All switches are active 1 in the Bit position, as well as ground was switched.

I.23.39.1 MSD 85 only

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_SSZ0_lesen
3	RecordCommonIdentifier Low Byte	M	07h	RCI_SSZ0_lesen

Positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_SSZ0_lesen
3	RecordCommonIdentifier Low Byte	M	07h	RCI_SSZ0_lesen
4	RecordValue 1 Bitfield1	M	XXh	2_BYTE_SWITCH_POSITION
5	RecordValue 2 Bitfield2	M	XXh	2_BYTE_SWITCH_POSITION
6	Not used	M	FFh	RV_DUMMY_1
7	Not used	M	FFh	RV_DUMMY_2
8	Not used	M	FFh	RV_DUMMY_3
9	Not used	M	FFh	RV_DUMMY_4

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Note: For data longer than one byte, the lowest byte is sent first

Byte	*Name*	*Size*	*Conversion (hex/bin)*	*Conversion (physical)*		*Resol.*
4	Bitfield 1	1	xxxxxxx1 b xxxxxx1x b xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b	LV_IS LV_FL LV_LS_DOWN_READY[1] LV_LS_DOWN_READY[2] LV_LS_UP_READY[2] LV_LS_UP_READY[1] LV_LAM_LSCL[2] LV_LAM_LSCL[1]	RV_LV_IS RV_LV_FL RV_LV_LS_DOWN_READY[1] RV_LV_LS_DOWN_READY[2] RV_LV_LS_UP_READY[2] RV_LV_LS_UP_READY[1] RV_LV_LAM_LSCL[2] RV_LV_LAM_LSCL[1]	
Byte	*Name*	*Size*	*Conversion (hex/bin)*	*Conversion (physical)*		*Resol.*
5	Bitfield 2	1	xxxxxxx1 b xxxxxx1x b xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b 1xxxxxxx b	not used not used LV_KD LV_DRI not used not used LV_PUC LV_TPS_AD_REQ	not used not used RV_LV_KD RV_LV_DRI not used not used RV_LV_PUC RV_LV_TPS_AD_REQ	

I.23.39.2 All other projects

General information:

This function is created to read the actual condition of the engine.
All switches are active 1 in the Bit position, as well as ground was switched.

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Request Service Id**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier = Read state of the functions	M	40h	RCI_FUN
3	RecordCommonIdentifier	M	07h	RCI_FUN

Figure I.23.2: Table ReadDataByCommonIdentifier Request Message

Positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier= Read state of the functions	M	40h	RCI_SCH
3	RecordCommonIdentifier	M	07h	RCI_SCH
4	RecordValue Bitfield1	M	XXh	RV_B1
5	RecordValue Bitfield2	M	XXh	RV_B2
6	RecordValue Bitfield3	M	XXh	RV_B3
7	RecordValue Bitfield4	M	XXh	RV_B4
8	RecordValue Bitfield5	M	XXh	RV_B5
9	RecordValue Bitfield6	M	XXh	RV_B6

Figure I.23.3: Table ReadDataByCommonIdentifier Positive Response Message

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Note: For data longer than one byte, the lowest byte is sent first

Byte	Name	Size	Conversion (hex/bin)	Conversion (physical)	Resol.
4	Bitfield 1	1	xxxxxxx1 b xxxxxx1x b xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b	LV_IS LV_FL LV_LS_DOWN_READY[1] LV_LS_DOWN_READY[2] LV_LS_UP_READY[2] LV_LS_UP_READY[1] LV_LAM_LSCL[2] LV_LAM_LSCL[1]	
Byte	**Name**	**Size**	**Conversion (hex/bin)**	**Conversion (physical)**	**Resol.**
5	Bitfield 2	1	xxxxxxx1 b xxxxxx1x b xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b 1xxxxxxx b	not used not used LV_KD LV_DRI not used not used LV_PUC LV_TPS_AD_REQ	
Byte	**Name**	**Size**	**Conversion (hex/bin)**	**Conversion (physical)**	**Resol.**
6	Bitfield 3 STATE_CRU_OFF_IRR (low_byte)	1	xxxxxxx1 b xxxxxx1x b xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b	Limit dynamic 1 Limit dynamic 2 Error clutch switch MSW error Timeout ETCU 1 Brake error not used not used	
Byte	**Name**	**Size**	**Conversion (hex/bin)**	**Conversion (physical)**	**Resol.**
7	Bitfield 4 STATE_CRU_OFF_IRR (high_byte)	1	xxxxxxx1 b xxxxxx1x b xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b	Monitoring level 2 VS plausibility ISA limp home aktive TPS limp home Error VS Time out ASR ETC limp home not used	
Byte	**Name**	**Size**	**Conversion (hex/bin)**	**Conversion (physical)**	**Resol.**
8	Bitfield 5 STATE_CRU_OFF_REV (low_byte)	1	xxxxxxx1 b xxxxxx1x b xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b	To high VS deviation Overtaking funct. To long or to high VS_DIF VS_SP_MAX to long External TQ intervention MSW request “OFF” not used not used not used	
9	Bitfield 6 STATE_CRU_OFF_REV (high_byte)	1	xxxxxxx1 b xxxxxx1x b xxxxx1xx b xxxx1xxx b xxx1xxxx b xx1xxxxx b x1xxxxxx b 1xxxxxxx b	Error VS_CAN to long Acceleration monitoring Run up lock Overtaking and VS_MAX active VS_FIL to low Engine speed limitation Brake detection MSW request HARD_OFF	

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I.23.40 22_4008 - RDBCI_DK_lesen

General information:

Read Throttle and MAF-Adjustment Value

I.23.40.1 MSD 85 only

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_DKHF
3	RecordCommonIdentifier Low Byte	M	08h	RCI_DKHF

Positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_DKHF
3	RecordCommonIdentifier Low Byte	M	08h	RCI_DKHF
4	RecordValue 1 = EISYEV_KOROFF_B_I_[0]	M	XXh	RV_EISYEV_KOROFF_B_I_[0]
5	RecordValue 2 = EISYEV_KOROFF_B_I_[1]	M	XXh	RV_EISYEV_KOROFF_B_I_[1]
6	RecordValue 3 = EISYEV_KORFAC_B_I_[0]	M	XXh	RV_EISYEV_KORFAC_B_I_[0]
7	RecordValue 4 = EISYEV_KORFAC_B_I_[1]	M	XXh	RV_EISYEV_KORFAC_B_I_[1]
8	RecordValue 5 = EISYDK_KOROFF_B_I_[0]	M	XXh	RV_EISYDK_KOROFF_B_I_[0]
9	RecordValue 6 = EISYDK_KOROFF_B_I_[1]	M	XXh	RV_EISYDK_KOROFF_B_I_[1]
10	RecordValue 7 = EISYDK_KORFAC_B_I_[0]	M	XXh	RV_EISYDK_KORFAC_B_I_[0]
11	RecordValue 8 = EISYDK_KORFAC_B_I_[1]	M	XXh	RV_EISYDK_KORFAC_B_I_[1]

I.23.40.2 All other projects

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier	M	40h	RCI_DKHF
3	RecordCommonIdentifier= Read Throttle and MAF- Adjustment Value	M	08h	RCI_DKHF

Positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	40h	RCI_
3	RecordCommonIdentifier= Read Throttle and MAF- Adjustment Value	M	08h	RCI_
4	RecordValue 1 = dummy value fix	M	00h	RV_
5	RecordValue 2 = Eisyev_koroff_b	M	XXh	RV_
6	RecordValue 3 = dummy value fix	M	00h	RV_
7	RecordValue 4 = Eisyev_korfak_b	M	XXh	RV_
8	RecordValue 5 = dummy value fix	M	00h	RV_
9	RecordValue 6 = Eisydk_koroff_b	M	XXh	RV_
10	RecordValue 5 = dummy value fix	M	00h	RV_
11	RecordValue 6 = Eisydk_korfak_b	M	XXh	RV_

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I.23.41 22_400A - RCI_GAW_lesen

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General information:

Read mixture values 'STATUS_ADAPTION_GEMISCH'
This function is created to read the actual mixture values of the engine.
Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_GAW_lesen
3	RecordCommonIdentifier Low Byte	M	0Ah	RCI_GAW_lesen

Positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_GAW_lesen
3	RecordCommonIdentifier Low Byte	M	0Ah	RCI_GAW_lesen
4	RecordValue 1 = MFF_ADD_LAM_AD_OUT[1] high Byte	M	XXh	RV_MFF_ADD_LAM_AD_OUT[1]
5	RecordValue 2 = MFF_ADD_LAM_AD_OUT[1] low Byte	M	XXh	RV_MFF_ADD_LAM_AD_OUT[1]
6	RecordValue 3 = MFF_ADD_LAM_AD_OUT[2] high Byte	M	XXh	RV_MFF_ADD_LAM_AD_OUT[2]
7	RecordValue 4 = MFF_ADD_LAM_AD_OUT[2] low Byte	M	XXh	RV_MFF_ADD_LAM_AD_OUT[2]
8	RecordValue 5 = FAC_LAM_AD_CUS[1] high Byte	M	XXh	RV_ FAC_LAM_AD_CUS[1]
9	RecordValue 6 = FAC_LAM_AD_CUS[1] low Byte	M	XXh	RV_ FAC_LAM_AD_CUS[1]
10	RecordValue 7 = FAC_LAM_AD_CUS[2] high Byte	M	XXh	RV_ FAC_LAM_AD_CUS[2]
11	RecordValue 8 = FAC_LAM_AD_CUS[2] low Byte	M	XXh	RV_ FAC_LAM_AD_CUS[2]
12	RecordValue 9 = LSHPWM_UP[1]	M	XXh	RV_LSHPWM_UP[1]
13	RecordValue 10 = LSHPWM_UP[2]	M	XXh	RV_LSHPWM_UP[2]
14	RecordValue 11 = LSHPWM_DOWN[1]	M	XXh	RV_LSHPWM_DOWN[1]
15	RecordValue 12 = LSHPWM_DOWN[2]	M	XXh	RV_LSHPWM_DOWN[2]

I.23.42 22_400B - VVT Messwerte auslesen

General information:

This function is created to read out several values of the VVL- system

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_VVT
3	RecordCommonIdentifier Low Byte	M	0Bh	RCI_VVT

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_VVT
3	RecordCommonIdentifier Low Byte	M	0Bh	RCI_VVT
4	recordValue = Vvt_soll high byte	M	XXh	RV_SOLLW_VVT
5	recordValue = Vvt_soll low byte	M	XXh	RV_SOLLW_VVT
6	recordValue = Exwink_ist high byte	M	XXh	RV_ISTW_VVT
7	recordValue = Exwink_ist low byte	M	XXh	RV_ISTW_VVT
8	recordValue = Ivvtmot[2] high byte	M	XXh	RV_I_VVT
9	recordValue = Ivvtmot[2] low byte	M	XXh	RV_I_VVT
10	recordValue = VCC_DR_VVL high byte	M	XXh	RV_U_VVT
11	recordValue = VCC_DR_VVL low byte	M	XXh	RV_U_VVT
12	recordValue = ANG_1_RAW_VVL[2] high byte	M	XXh	RV_SRF_VVT
13	recordValue = ANG_1_RAW_VVL[2] low byte	M	XXh	RV_SRF_VVT
14	recordValue = St_vvt_err	M	XXh	RV_NOTL_VVT
15	recordValue = St_dvovrld	M	XXh	RV_SUEL_VVT
16	recordValue = ANG_DE_ABSV_PLAUS_CHK_VVL high byte	M	XXh	RV_DIFF_VVT
17	recordValue = ANG_DE_ABSV_PLAUS_CHK_VVL low byte	M	XXh	RV_DIFF_VVT

I.23.43 22_4015 - RCI_FASTA10_lesen

General information:

FASTA_Messwerteblock_10_lesen
This function ist for reading the data of the FASTA (Fahrzeugnutzungsprofil).

I.23.43.1 MSD 85 only

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_FAS10
3	RecordCommonIdentifier Low Byte	M	15h	RCI_FAS10

Positive Response on service

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Data Byte	***Parameter Name***	***Cvt***	***Hex Value***	***Mnemonic***
1	**Request Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_FAS10
3	RecordCommonIdentifier Low Byte	M	15h	RCI_FAS10
4	RecordValue1 = Bszsi (high byte, high word)	M	XXh	RV_BSZS1
5	RecordValue2 = Bszsi (low byte, high word)	M	XXh	RV_BSZS1
6	RecordValue3 = Bszsi (high byte, low word)	M	XXh	RV_BSZS1
7	RecordValue4 = Bszsi (low byte, low word)	M	XXh	RV_BSZS1
	n/Md-Kennfeld			
8	RecordValue5 = STATE_TBL_DRIV[0][0]	M	XXh	nmdsfnp
9	RecordValue6 = STATE_TBL_DRIV[1][0]	M	XXh	nmdsfnp
10	RecordValue7 = STATE_TBL_DRIV[2][0]	M	XXh	nmdsfnp
11	RecordValue8 = STATE_TBL_DRIV[3][0]	M	XXh	nmdsfnp
12	RecordValue9 = STATE_TBL_DRIV[4][0]	M	XXh	nmdsfnp
13	RecordValue10= STATE_TBL_DRIV[5][0]	M	XXh	nmdsfnp
14	RecordValue11 = STATE_TBL_DRIV[6][0]	M	XXh	nmdsfnp
15	RecordValue12 = STATE_TBL_DRIV[7][0]	M	XXh	nmdsfnp
16	RecordValue13 = STATE_TBL_DRIV[0][1]	M	XXh	nmdsfnp
17	RecordValue14 = STATE_TBL_DRIV[1][1]	M	XXh	nmdsfnp
18	RecordValue15 = STATE_TBL_DRIV[2][1]	M	XXh	nmdsfnp
19	RecordValue16 = STATE_TBL_DRIV[3][1]	M	XXh	nmdsfnp
20	RecordValue17 = STATE_TBL_DRIV[4][1]	M	XXh	nmdsfnp
21	RecordValue18 = STATE_TBL_DRIV[5][1]	M	XXh	nmdsfnp
22	RecordValue19 = STATE_TBL_DRIV[6][1]	M	XXh	nmdsfnp
23	RecordValue20 = STATE_TBL_DRIV[7][1]	M	XXh	nmdsfnp
24	RecordValue21 = STATE_TBL_DRIV[0][2]	M	XXh	nmdsfnp
25	RecordValue22 = STATE_TBL_DRIV[1][2]	M	XXh	nmdsfnp
26	RecordValue23 = STATE_TBL_DRIV[2][2]	M	XXh	nmdsfnp
27	RecordValue24 = STATE_TBL_DRIV[3][2]	M	XXh	nmdsfnp
28	RecordValue25 = STATE_TBL_DRIV[4][2]	M	XXh	nmdsfnp
29	RecordValue26 = STATE_TBL_DRIV[5][2]	M	XXh	nmdsfnp
30	RecordValue27 = STATE_TBL_DRIV[6][2]	M	XXh	nmdsfnp
31	RecordValue28 = STATE_TBL_DRIV[7][2]	M	XXh	nmdsfnp
32	RecordValue29 = STATE_TBL_DRIV[0][3]	M	XXh	nmdsfnp
33	RecordValue30 = STATE_TBL_DRIV[1][3]	M	XXh	nmdsfnp
34	RecordValue31 = STATE_TBL_DRIV[2][3]	M	XXh	nmdsfnp
35	RecordValue32 = STATE_TBL_DRIV[3][3]	M	XXh	nmdsfnp
36	RecordValue33 = STATE_TBL_DRIV[4][3]	M	XXh	nmdsfnp
37	RecordValue34 = STATE_TBL_DRIV[5][3]	M	XXh	nmdsfnp
38	RecordValue35 = STATE_TBL_DRIV[6][3]	M	XXh	nmdsfnp
39	RecordValue36 = STATE_TBL_DRIV[7][3]	M	XXh	nmdsfnp
40	RecordValue37 = STATE_TBL_DRIV[0][4]	M	XXh	nmdsfnp
41	RecordValue38 = STATE_TBL_DRIV[1][4]	M	XXh	nmdsfnp
42	RecordValue39 = STATE_TBL_DRIV[2][4]	M	XXh	nmdsfnp
43	RecordValue40 = STATE_TBL_DRIV[3][4]	M	XXh	nmdsfnp
44	RecordValue41 = STATE_TBL_DRIV[4][4]	M	XXh	nmdsfnp
-	RecordValue42 = STATE_TBL_DRIV[5][4]	M	XXh	nmdsfnp
46	RecordValue43 = STATE_TBL_DRIV[6][4]	M	XXh	nmdsfnp
47	RecordValue44 = STATE_TBL_DRIV[7][4]	M	XXh	nmdsfnp

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48	RecordValue- = STATE_TBL_DRIV[0][5]	M	XXh	nmdsfnp
49	RecordValue46 = STATE_TBL_DRIV[1][5]	M	XXh	nmdsfnp
50	RecordValue47 = STATE_TBL_DRIV[2][5]	M	XXh	nmdsfnp
51	RecordValue48 = STATE_TBL_DRIV[3][5]	M	XXh	nmdsfnp
52	RecordValue49 = STATE_TBL_DRIV[4][5]	M	XXh	nmdsfnp
53	RecordValue50 = STATE_TBL_DRIV[5][5]	M	XXh	nmdsfnp
54	RecordValue51 = STATE_TBL_DRIV[6][5]	M	XXh	nmdsfnp
55	RecordValue52 = STATE_TBL_DRIV[7][5]	M	XXh	nmdsfnp
	Generatorauslastungsprofil			
56	RecordValue53 = Dfds[0]	M	XXh	dfdsprofle
57	RecordValue54 = Dfds[1]	M	XXh	dfdsprofle
58	RecordValue55 = Dfds[2]	M	XXh	dfdsprofle
59	RecordValue56 = Dfds[3]	M	XXh	dfdsprofle
60	RecordValue57 = Dfds[4]	M	XXh	dfdsprofle
61	RecordValue58= Dfds[5]	M	XXh	dfdsprofle
62	RecordValue59 = Dfds[6]	M	XXh	dfdsprofle
63	RecordValue60 = Dfds[7]	M	XXh	dfdsprofle
64	RecordValue61 = Dfds[8]	M	XXh	dfdsprofle
65	RecordValue62 = Dfds[9]	M	XXh	dfdsprofle
66	RecordValue63 = Dfds[10]	M	XXh	dfdsprofle
67	RecordValue64 = Dfds[11]	M	XXh	dfdsprofle
68	RecordValue65 = Dfds[12]	M	XXh	dfdsprofle
69	RecordValue66 = Dfds[13]	M	XXh	dfdsprofle
70	RecordValue67 = Dfds[14]	M	XXh	dfdsprofle
71	RecordValue68 = Dfds[15]	M	XXh	dfdsprofle
	Energieaufnahme Bordnetz			
72	RecordValue69 = Igenk (high byte, high word)	M	XXh	RV_IGENK
73	RecordValue70 = Igenk (low byte, high word)	M	XXh	RV_IGENK
74	RecordValue71 = Igenk (high byte, low word)	M	XXh	RV_IGENK
75	RecordValue72 = Igenk (low byte, low word)	M	XXh	RV_IGENK
	Statistik Kühlsystemtemperaturen			
76	RecordValue73 = Tmot_b1 (high byte)	M	XXh	TSTAT
77	RecordValue73 = Tmot_b1 (low byte)	M	XXh	TSTAT
78	RecordValue74 = Tmot_b2 (high byte)	M	XXh	TSTAT
79	RecordValue73 = Tmot_b2 (low byte)	M	XXh	TSTAT
80	RecordValue75 = Tmot_b3 (high byte)	M	XXh	TSTAT
81	RecordValue73 = Tmot_b3 (low byte)	M	XXh	TSTAT
82	RecordValue76 = Tmot_b4 (high byte)	M	XXh	TSTAT
83	RecordValue73 = Tmot_b4 (low byte)	M	XXh	TSTAT
84	RecordValue77 = Tmot_b5 (high byte)	M	XXh	TSTAT
85	RecordValue73 = Tmot_b5 (low byte)	M	XXh	TSTAT
86	RecordValue78 = Toel_b1 (high byte)	M	XXh	TSTAT
87	RecordValue78 = Toel_b1 (low byte)	M	XXh	TSTAT
88	RecordValue79 = Toel_b2 (high byte)	M	XXh	TSTAT
89	RecordValue78 = Toel_b2 (low byte)	M	XXh	TSTAT
90	RecordValue80 = Toel_b3 (high byte)	M	XXh	TSTAT
91	RecordValue78 = Toel_b3 (low byte)	M	XXh	TSTAT
92	RecordValue81 = Toel_b4 (high byte)	M	XXh	TSTAT
93	RecordValue78 = Toel_b4 (low byte)	M	XXh	TSTAT
94	RecordValue82 = Toel_b5 (high byte)	M	XXh	TSTAT
95	RecordValue78 = Toel_b5 (low byte)	M	XXh	TSTAT

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Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReaataByCommonIentifier Request Service Id**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier	M	40h	RCI_FAS10
3	RecordCommonIdentifier	M	15h	RCI_FAS10

Figure I.23.4: Table ReadDataByCommonIdentifier Request Message

Positive Response

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	40h	RCI_FAS10
3	RecordCommonIdentifier	M	15h	RCI_FAS10
4	RecordValue1 = Bszsi (high byte, high word)	M	XXh	RV_BSZSI
5	RecordValue2 = Bszsi (low byte, high word)	M	XXh	RV_BSZSI
6	RecordValue3 = Bszsi (high byte, low word)	M	XXh	RV_BSZSI
7	RecordValue4 = Bszsi (low byte, low word)	M	XXh	RV_BSZSI
	n/Md-Kennfeld			
8	RecordValue5 = STATE_TBL_DRIV[0][0]	M	XXh	RV_NMDS
9	RecordValue6 = STATE_TBL_DRIV[1][0]	M	XXh	RV_NMDS
10	RecordValue7 = STATE_TBL_DRIV[2][0]	M	XXh	RV_NMDS
11	RecordValue8 = STATE_TBL_DRIV[3][0]	M	XXh	RV_NMDS
12	RecordValue9 = STATE_TBL_DRIV[4][0]	M	XXh	RV_NMDS
13	RecordValue10= STATE_TBL_DRIV[5][0]	M	XXh	RV_NMDS
14	RecordValue11 = STATE_TBL_DRIV[6][0]	M	XXh	RV_NMDS
15	RecordValue12 = STATE_TBL_DRIV[7][0]	M	XXh	RV_NMDS
16	RecordValue13 = STATE_TBL_DRIV[0][1]	M	XXh	RV_NMDS
17	RecordValue14 = STATE_TBL_DRIV[1][1]	M	XXh	RV_NMDS
18	RecordValue15 = STATE_TBL_DRIV[2][1]	M	XXh	RV_NMDS
19	RecordValue16 = STATE_TBL_DRIV[3][1]	M	XXh	RV_NMDS
20	RecordValue17 = STATE_TBL_DRIV[4][1]	M	XXh	RV_NMDS
21	RecordValue18 = STATE_TBL_DRIV[5][1]	M	XXh	RV_NMDS
22	RecordValue19 = STATE_TBL_DRIV[6][1]	M	XXh	RV_NMDS
23	RecordValue20 = STATE_TBL_DRIV[7][1]	M	XXh	RV_NMDS
24	RecordValue21 = STATE_TBL_DRIV[0][2]	M	XXh	RV_NMDS
25	RecordValue22 = STATE_TBL_DRIV[1][2]	M	XXh	RV_NMDS
26	RecordValue23 = STATE_TBL_DRIV[2][2]	M	XXh	RV_NMDS
27	RecordValue24 = STATE_TBL_DRIV[3][2]	M	XXh	RV_NMDS
28	RecordValue25 = STATE_TBL_DRIV[4][2]	M	XXh	RV_NMDS
29	RecordValue26 = STATE_TBL_DRIV[5][2]	M	XXh	RV_NMDS
30	RecordValue27 = STATE_TBL_DRIV[6][2]	M	XXh	RV_NMDS
31	RecordValue28 = STATE_TBL_DRIV[7][2]	M	XXh	RV_NMDS
32	RecordValue29 = STATE_TBL_DRIV[0][3]	M	XXh	RV_NMDS
33	RecordValue30 = STATE_TBL_DRIV[1][3]	M	XXh	RV_NMDS
34	RecordValue31 = STATE_TBL_DRIV[2][3]	M	XXh	RV_NMDS
35	RecordValue32 = STATE_TBL_DRIV[3][3]	M	XXh	RV_NMDS
36	RecordValue33 = STATE_TBL_DRIV[4][3]	M	XXh	RV_NMDS
37	RecordValue34 = STATE_TBL_DRIV[5][3]	M	XXh	RV_NMDS
38	RecordValue35 = STATE_TBL_DRIV[6][3]	M	XXh	RV_NMDS
39	RecordValue36 = STATE_TBL_DRIV[7][3]	M	XXh	RV_NMDS
40	RecordValue37 = STATE_TBL_DRIV[0][4]	M	XXh	RV_NMDS
41	RecordValue38 = STATE_TBL_DRIV[1][4]	M	XXh	RV_NMDS
42	RecordValue39 = STATE_TBL_DRIV[2][4]	M	XXh	RV_NMDS
43	RecordValue40 = STATE_TBL_DRIV[3][4]	M	XXh	RV_NMDS
44	RecordValue41 = STATE_TBL_DRIV[4][4]	M	XXh	RV_NMDS
-	RecordValue42 = STATE_TBL_DRIV[5][4]	M	XXh	RV_NMDS
46	RecordValue43 = STATE_TBL_DRIV[6][4]	M	XXh	RV_NMDS
47	RecordValue44 = STATE_TBL_DRIV[7][4]	M	XXh	RV_NMDS

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48	RecordValue- = STATE_TBL_DRIV[0][5]	M	XXh	RV_NMDS
49	RecordValue46 = STATE_TBL_DRIV[1][5]	M	XXh	RV_NMDS
50	RecordValue47 = STATE_TBL_DRIV[2][5]	M	XXh	RV_NMDS
51	RecordValue48 = STATE_TBL_DRIV[3][5]	M	XXh	RV_NMDS
52	RecordValue49 = STATE_TBL_DRIV[4][5]	M	XXh	RV_NMDS
53	RecordValue50 = STATE_TBL_DRIV[5][5]	M	XXh	RV_NMDS
54	RecordValue51 = STATE_TBL_DRIV[6][5]	M	XXh	RV_NMDS
55	RecordValue52 = STATE_TBL_DRIV[7][5]	M	XXh	RV_NMDS
	Generatorauslastungsprofil			
56	RecordValue53 = Dfds[0]	M	XXh	RV_DFDS
57	RecordValue54 = Dfds[1]	M	XXh	RV_DFDS
58	RecordValue55 = Dfds[2]	M	XXh	RV_DFDS
59	RecordValue56 = Dfds[3]	M	XXh	RV_DFDS
60	RecordValue57 = Dfds[4]	M	XXh	RV_DFDS
61	RecordValue58= Dfds[5]	M	XXh	RV_DFDS
62	RecordValue59 = Dfds[6]	M	XXh	RV_DFDS
63	RecordValue60 = Dfds[7]	M	XXh	RV_DFDS
64	RecordValue61 = Dfds[8]	M	XXh	RV_DFDS
65	RecordValue62 = Dfds[9]	M	XXh	RV_DFDS
66	RecordValue63 = Dfds[10]	M	XXh	RV_DFDS
67	RecordValue64 = Dfds[11]	M	XXh	RV_DFDS
68	RecordValue65 = Dfds[12]	M	XXh	RV_DFDS
69	RecordValue66 = Dfds[13]	M	XXh	RV_DFDS
70	RecordValue67 = Dfds[14]	M	XXh	RV_DFDS
71	RecordValue68 = Dfds[15]	M	XXh	RV_DFDS
	Energieaufnahme Bordnetz			
72	RecordValue69 = Igenk (high byte, high word)	M	XXh	RV_IGENK
73	RecordValue70 = Igenk (low byte, high word)	M	XXh	RV_IGENK
74	RecordValue71 = Igenk (high byte, low word)	M	XXh	RV_IGENK
75	RecordValue72 = Igenk (low byte, low word)	M	XXh	RV_IGENK
	Statistik Kühlsystemtemperaturen			
76	RecordValue73 = Tmot_b1 (high byte)	M	XXh	RV_TMOTB1
77	RecordValue73 = Tmot_b1 (low byte)	M	XXh	RV_TMOTB1
78	RecordValue74 = Tmot_b2 (high byte)	M	XXh	RV_TMOTB2
79	RecordValue73 = Tmot_b2 (low byte)	M	XXh	RV_TMOTB2
80	RecordValue75 = Tmot_b3 (high byte)	M	XXh	RV_TMOTB3
81	RecordValue73 = Tmot_b3 (low byte)	M	XXh	RV_TMOTB3
82	RecordValue76 = Tmot_b4 (high byte)	M	XXh	RV_TMOTB4
83	RecordValue73 = Tmot_b4 (low byte)	M	XXh	RV_TMOTB4
84	RecordValue77 = Tmot_b5 (high byte)	M	XXh	RV_TMOTB5
85	RecordValue73 = Tmot_b5 (low byte)	M	XXh	RV_TMOTB5
86	RecordValue78 = Toel_b1 (high byte)	M	XXh	RV_TOELB1
87	RecordValue78 = Toel_b1 (low byte)	M	XXh	RV_TOELB1
88	RecordValue79 = Toel_b2 (high byte)	M	XXh	RV_TOELB2
89	RecordValue78 = Toel_b2 (low byte)	M	XXh	RV_TOELB2
90	RecordValue80 = Toel_b3 (high byte)	M	XXh	RV_TOELB3
91	RecordValue78 = Toel_b3 (low byte)	M	XXh	RV_TOELB3
92	RecordValue81 = Toel_b4 (high byte)	M	XXh	RV_TOELB4
93	RecordValue78 = Toel_b4 (low byte)	M	XXh	RV_TOELB4
94	RecordValue82 = Toel_b5 (high byte)	M	XXh	RV_TOELB5

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95	RecordValue78 = Toel_b5 (low byte)	M	XXh	RV_TOELB5
96	RecordValue83 = Tget_b1 (high byte)	M	XXh	RV_TGETB1
97	RecordValue83 = Tget_b1 (low byte)	M	XXh	RV_TGETB1
98	RecordValue84 = Tget_b2 (high byte)	M	XXh	RV_TGETB2
99	RecordValue83 = Tget_b2 (low byte)	M	XXh	RV_TGETB2
100	RecordValue85 = Tget_b3 (high byte)	M	XXh	RV_TGETB3
101	RecordValue83 = Tget_b3 (low byte)	M	XXh	RV_TGETB3
102	RecordValue86 = Tget_b4 (high byte)	M	XXh	RV_TGETB4
103	RecordValue83 = Tget_b4 (low byte)	M	XXh	RV_TGETB4
104	RecordValue87 = Tget_b5 (high byte)	M	XXh	RV_TGETB5
105	RecordValue83 = Tget_b5 (low byte)	M	XXh	RV_TGETB5
106	RecordValue88 = Tumg_b1 (high byte)	M	XXh	RV_TUMGB1
107	RecordValue88 = Tumg_b1 (low byte)	M	XXh	RV_TUMGB1
108	RecordValue89 = Tumg_b2 (high byte)	M	XXh	RV_TUMGB2
109	RecordValue88 = Tumg_b2 (low byte)	M	XXh	RV_TUMGB2
110	RecordValue90 = Tumg_b3 (high byte)	M	XXh	RV_TUMGB3
111	RecordValue88 = Tumg_b3 (low byte)	M	XXh	RV_TUMGB3
112	RecordValue91 = Tumg_b4 (high byte)	M	XXh	RV_TUMGB4
113	RecordValue88 = Tumg_b4 (low byte)	M	XXh	RV_TUMGB4
114	RecordValue92 = Tumg_b5 (high byte)	M	XXh	RV_TUMGB5
115	RecordValue88 = Tumg_b5 (low byte)	M	XXh	RV_TUMGB5

I.23.44 22_4016 - RCI_IGRINFO_lesen

General information:

READ IGR-values

This function ist for reading the data of the IGR (Infospeicher Intelligente Genrator Regelung).

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_IGRINFO
3	RecordCommonIdentifier Low Byte	M	16h	RCI_IGRINFO

Positive Response on service

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_IGRINFO
3	RecordCommonIdentifier Low Byte	M	16h	RCI_IGRINFO
4	RecordValue1 = Igrinfo[1]	M	XXh	RV_IGRINFO
5	RecordValue2 = Igrinfo[2]	M	XXh	RV_IGRINFO
6	RecordValue3 = Igrinfo[3]	M	XXh	RV_IGRINFO
7	RecordValue4 = Igrinfo[4]	M	XXh	RV_IGRINFO
8	RecordValue5 = Igrinfo[5]	M	XXh	RV_IGRINFO
9	RecordValue6 = Igrinfo[6]	M	XXh	RV_IGRINFO
10	RecordValue7 = Igrinfo[7]	M	XXh	RV_IGRINFO
11	RecordValue8 = Igrinfo[8]	M	XXh	RV_IGRINFO
12	RecordValue9 = Igrinfo[9]	M	XXh	RV_IGRINFO
13	RecordValue10 = Igrinfo[10]	M	XXh	RV_IGRINFO
14	RecordValue11 = Igrinfo[11]	M	XXh	RV_IGRINFO
15	RecordValue12 = Igrinfo[12]	M	XXh	RV_IGRINFO
16	RecordValue13 = Igrinfo[13]	M	XXh	RV_IGRINFO
17	RecordValue14 = Igrinfo[14]	M	XXh	RV_IGRINFO
18	RecordValue15 = Igrinfo[15]	M	XXh	RV_IGRINFO
19	RecordValue16 = Igrinfo[16]	M	XXh	RV_IGRINFO
20	RecordValue17 = Igrinfo[17]	M	XXh	RV_IGRINFO
21	RecordValue18 = Igrinfo[18]	M	XXh	RV_IGRINFO
22	RecordValue19 = Igrinfo[19]	M	XXh	RV_IGRINFO
23	RecordValue20 = Igrinfo[20]	M	XXh	RV_IGRINFO
24	RecordValue21 = Igrinfo[21]	M	XXh	RV_IGRINFO
25	RecordValue22 = Igrinfo[22]	M	XXh	RV_IGRINFO
26	RecordValue23 = Igrinfo[23]	M	XXh	RV_IGRINFO
27	RecordValue24 = Igrinfo[24]	M	XXh	RV_IGRINFO
28	RecordValue25 = Igrinfo[25]	M	XXh	RV_IGRINFO
29	RecordValue26 = Igrinfo[26]	M	XXh	RV_IGRINFO
30	RecordValue27 = Igrinfo[27]	M	XXh	RV_IGRINFO
31	RecordValue28 = Igrinfo[28]	M	XXh	RV_IGRINFO
32	RecordValue29 = Igrinfo[29]	M	XXh	RV_IGRINFO
33	RecordValue30 = Igrinfo[30]	M	XXh	RV_IGRINFO

I.23.45 22_4017 - RCI_LEMINFO_lesen

General information:

READ LEM-values

This function ist for reading the data of the LEM (Infospeicher Leistungskoordination Elektrisch Mecha-nisch).

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_LEMINFO
3	RecordCommonIdentifier Low Byte	M	17h	RCI_LEMINFO

Positive Response on service

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_LEMINFO
3	RecordCommonIdentifier Low Byte	M	17h	RCI_LEMINFO
4	RecordValue1 = Leminfo[1]	M	XXh	RV_LEMINFO
5	RecordValue2 = Leminfo[2]	M	XXh	RV_LEMINFO
6	RecordValue3 = Leminfo[3]	M	XXh	RV_LEMINFO
7	RecordValue4 = Leminfo[4]	M	XXh	RV_LEMINFO
8	RecordValue5 = Leminfo[5]	M	XXh	RV_LEMINFO
9	RecordValue6 = Leminfo[6]	M	XXh	RV_LEMINFO
10	RecordValue7 = Leminfo[7]	M	XXh	RV_LEMINFO
11	RecordValue8 = Leminfo[8]	M	XXh	RV_LEMINFO
12	RecordValue9 = Leminfo[9]	M	XXh	RV_LEMINFO
13	RecordValue10 = Leminfo[10]	M	XXh	RV_LEMINFO
14	RecordValue11 = Leminfo[11]	M	XXh	RV_LEMINFO
15	RecordValue12 = Leminfo[12]	M	XXh	RV_LEMINFO
16	RecordValue13 = Leminfo[13]	M	XXh	RV_LEMINFO
17	RecordValue14 = Leminfo[14]	M	XXh	RV_LEMINFO
18	RecordValue15 = Leminfo[15]	M	XXh	RV_LEMINFO
19	RecordValue16 = Leminfo[16]	M	XXh	RV_LEMINFO
20	RecordValue17 = Leminfo[17]	M	XXh	RV_LEMINFO
21	RecordValue18 = Leminfo[18]	M	XXh	RV_LEMINFO
22	RecordValue19 = Leminfo[19]	M	XXh	RV_LEMINFO
23	RecordValue20 = Leminfo[20]	M	XXh	RV_LEMINFO
24	RecordValue21 = Leminfo[21]	M	XXh	RV_LEMINFO
25	RecordValue22 = Leminfo[22]	M	XXh	RV_LEMINFO
26	RecordValue23 = Leminfo[23]	M	XXh	RV_LEMINFO
27	RecordValue24 = Leminfo[24]	M	XXh	RV_LEMINFO
28	RecordValue25 = Leminfo[25]	M	XXh	RV_LEMINFO
29	RecordValue26 = Leminfo[26]	M	XXh	RV_LEMINFO
30	RecordValue27 = Leminfo[27]	M	XXh	RV_LEMINFO
31	RecordValue28 = Leminfo[28]	M	XXh	RV_LEMINFO
32	RecordValue29 = Leminfo[29]	M	XXh	RV_LEMINFO
33	RecordValue30 = Leminfo[30]	M	XXh	RV_LEMINFO
34	RecordValue31 = Leminfo[31]	M	XXh	RV_LEMINFO
35	RecordValue32 = Leminfo[32]	M	XXh	RV_LEMINFO
36	RecordValue33 = Leminfo[33]	M	XXh	RV_LEMINFO
37	RecordValue34 = Leminfo[34]	M	XXh	RV_LEMINFO
38	RecordValue35 = Leminfo[35]	M	XXh	RV_LEMINFO
39	RecordValue36 = Leminfo[36]	M	XXh	RV_LEMINFO
40	RecordValue37 = Leminfo[37]	M	XXh	RV_LEMINFO

I.23.46 22_4018 - READ MSA-values

General information:

This function ist for reading the data of the MSA (Infospeicher Motor-Start/Stop Automatik).

Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_MSA
3	RecordCommonIdentifier Low Byte	M	18h	RCI_MSA

Positive Response on service

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_MSA
3	RecordCommonIdentifier Low Byte	M	18h	RCI_MSA
4	RecordValue1 = Msainfo[1]	M	XXh	RV_
5	RecordValue2 = Msainfo[2]	M	XXh	RV_
6	RecordValue3 = Msainfo[3]	M	XXh	RV_
7	RecordValue4 = Msainfo[4]	M	XXh	RV_
8	RecordValue5 = Msainfo[5]	M	XXh	RV_
9	RecordValue6 = Msainfo[6]	M	XXh	RV_
10	RecordValue7 = Msainfo[7]	M	XXh	RV_
11	RecordValue8 = Msainfo[8]	M	XXh	RV_
12	RecordValue9 = Msainfo[9]	M	XXh	RV_
13	RecordValue10 = Msainfo[10]	M	XXh	RV_
14	RecordValue11 = Msainfo[11]	M	XXh	RV_
15	RecordValue12 = Msainfo[12]	M	XXh	RV_
16	RecordValue13 = Msainfo[13]	M	XXh	RV_
17	RecordValue14 = Msainfo[14]	M	XXh	RV_
18	RecordValue15 = Msainfo[15]	M	XXh	RV_
19	RecordValue16 = Msainfo[16]	M	XXh	RV_
20	RecordValue17 = Msainfo[17]	M	XXh	RV_
21	RecordValue18 = Msainfo[18]	M	XXh	RV_
22	RecordValue19 = Msainfo[19]	M	XXh	RV_
23	RecordValue20 = Msainfo[20]	M	XXh	RV_
24	RecordValue21 = Msainfo[21]	M	XXh	RV_
25	RecordValue22 = Msainfo[22]	M	XXh	RV_
26	RecordValue23 = Msainfo[23]	M	XXh	RV_
27	RecordValue24 = Msainfo[24]	M	XXh	RV_
28	RecordValue25 = Msainfo[25]	M	XXh	RV_
29	RecordValue26 = Msainfo[26]	M	XXh	RV_
30	RecordValue27 = Msainfo[27]	M	XXh	RV_
31	RecordValue28 = Msainfo[28]	M	XXh	RV_
32	RecordValue29 = Msainfo[29]	M	XXh	RV_
33	RecordValue30 = Msainfo[30]	M	XXh	RV_
34	RecordValue31 = Msainfo[31]	M	XXh	RV_
35	RecordValue32 = Msainfo[32]	M	XXh	RV_
36	RecordValue33 = Msainfo[33]	M	XXh	RV_
37	RecordValue34 = Msainfo[34]	M	XXh	RV_
38	RecordValue35 = Msainfo[35]	M	XXh	RV_
39	RecordValue36 = Msainfo[36]	M	XXh	RV_
40	RecordValue37 = Msainfo[37]	M	XXh	RV_
41	RecordValue38 = Msainfo[38]	M	XXh	RV_
42	RecordValue39 = Msainfo[39]	M	XXh	RV_
43	RecordValue40 = Msainfo[40]	M	XXh	RV_
44	RecordValue41 = Msainfo[41]	M	XXh	RV_
-	RecordValue42 = Msainfo[42]	M	XXh	RV_
46	RecordValue43 = Msainfo[43]	M	XXh	RV_
47	RecordValue44 = Msainfo[44]	M	XXh	RV_
48	RecordValue- = Msainfo[-]	M	XXh	RV_
49	RecordValue46 = Msainfo[46]	M	XXh	RV_

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50	RecordValue47 = Msainfo[47]	M	XXh	RV_
51	RecordValue48 = Msainfo[48]	M	XXh	RV_
52	RecordValue49 = Msainfo[49]	M	XXh	RV_
53	RecordValue50 = Msainfo[50]	M	XXh	RV_

I.23.47 22_4019_000 - RDBCI_FSPFR

General information:

read Error Memory with freeze frame data extra long, extended
This function is created to read out the failure memory with all the errors including the freeze frame data. The index of the environment values allows a classification to the list of the environment values from BMW.
Record Common Identifier table usage and reading:

- record values usage as BYTE Values (Freeze Frame, Umweltbedingung, DDLI etc.) should support the full range 0x00 to 0xFF as VALID. A value that is not supported will be transmitted as 0xFF
- record values usage as WORD Values (DDLI etc.) should support the range 0x0000 to 0xFFFE as VALID. Invalid is shown with 0xFFFF.

This should enable the full range of internal Byte values to be used with no compromise, but still allow the diagnostic equipment to recognise if a value is available or not.

Formula section:

IF ERR_DTC[x] = 0000h **or**
ERR_DTC[x] = FFFFh
THEN send **negative respones**
ELSE send **positive response**

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_FSPFR
3	RecordCommonIdentifier Low Byte	M	19h	RCI_FSPFR
4	Value = Error code ERR_DTC[x] high byte	M	XXh	RV_FSFF_F
5	Value = Error code ERR_DTC[x] low byte	M	XXh	RV_FSFF_F

Positive Response on service

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Positive Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_FSPFR
3	RecordCommonIdentifier Low Byte	M	19h	RCI_FSPFR
4	RecordValue 1 = Error counter total CTR_ERR_DYN_NR	M	XXh	RV_FSFF_FZG
5	RecordValue 2 = Error code ERR_DTC[x] high byte	M	XXh	RV_FSFF_FC
6	RecordValue 3 = Error code ERR_DTC[x] low byte	M	XXh	RV_FSFF_FC
7	RecordValue 4 = status DTC1 ERR_TYPE_BYTE[x]	M	XXh	RV_FSFF_FA
8	RecordValue 5 = Cycle flag ERR_TYPE_EXT_BYTE[x]	M	XXh	RV_FSFF_ERW
9	RecordValue 6 = Frequency counter CTR_FRC[x]	M	XXh	RV_FSFF_HZ
10	RecordValue 7 = Error recover counter (HLC) CTR_DC[x]	M	XXh	RV_FSFF_HLC
11	RecordValue 8 = km-value by first occur high byte ENVD_CUS_SET_CMN[2][1]	M	XXh	RV_FSFF_KM1
12	RecordValue 9= km-value by first occur low byte ENVD_CUS_SET_CMN[3][1]	M	XXh	RV_FSFF_KM1
13	RecordValue 10 = 1.environmental value first occur ENVD_CUS_SET_SPC[1][1]	M	XXh	RV_FSFF_UW11
14	RecordValue 11 = Index for 1.environmental value	M	XXh	RV_FSFF_UW11
15	RecordValue 12 = 2.environmental value first occur ENVD_CUS_SET_SPC[2][1]	M	XXh	RV_FSFF_UW21
16	RecordValue 13 = Index for 2.environmental value	M	XXh	RV_FSFF_UW21A
17	RecordValue 14= 3.environmental value first occur ENVD_CUS_SET_SPC[3][1]	M	XXh	RV_FSFF_UW31
18	RecordValue 15 = Index for 3.environmental value	M	XXh	RV_FSFF_UW31A
19	RecordValue 16 = 4.environmental value first occur ENVD_CUS_SET_SPC[4[1]	M	XXh	RV_FSFF_UW41
20	RecordValue 17 = Index for 4.environmental value	M	XXh	RV_FSFF_UW41A
21	RecordValue 18 = km-value by second occur high byte ENVD_CUS_SET_CMN[2][2]	M	XXh	RV_FSFF_KM2
22	RecordValue 19= km-value by second occur low byte ENVD_CUS_SET_CMN[3][2]	M	XXh	RV_FSFF_KM2
23	RecordValue 20 = 1.environmental value second occur ENVD_CUS_SET_SPC[1][2]	M	XXh	RV_FSFF_UW12
24	RecordValue 21 = 2.environmental value second occur ENVD_CUS_SET_SPC[2][2]	M	XXh	RV_FSFF_UW22
25	RecordValue 22 = 3.environmental value second occur ENVD_CUS_SET_SPC[3][2]	M	XXh	RV_FSFF_UW23
26	RecordValue 23 = 4.environmental value second occur ENVD_CUS_SET_SPC[4][2]	M	XXh	RV_FSFF_UW24
27	RecordValue 24 = km-value by last occur high byte ENVD_CUS_SET_CMN[2][3]	M	XXh	RV_FSFF_KMX
28	RecordValue 25 = km-value by last occur low byte ENVD_CUS_SET_CMN[3][3]	M	XXh	RV_FSFF_KMX
29	RecordValue 26 = 1.environmental value last occur ENVD_CUS_SET_SPC[1][3]	M	XXh	RV_FSFF_UW1X
30	RecordValue 27= 2.environmental value last occur ENVD_CUS_SET_SPC[2][3]	M	XXh	RV_FSFF_UW2X
31	RecordValue 28= 3.environmental value last occur ENVD_CUS_SET_SPC[3][3]	M	XXh	RV_FSFF_UW3X
32	RecordValue 29 = 4.environmental value last occur ENVD_CUS_SET_SPC[4][3]	M	XXh	RV_FSFF_UW4X
33	RecordValue 30= Error class C_ERR_CLAS_XX	M	00h	RV_FSFF_CLA
34	RecordValue 31 = Importance counter TSF (not def. yet)	M	FFh	RV_FSFF_TSF

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35	RecordValue 32 = Debounce counter (MIL on) FLC FLC = DC_MAX_XX - CTR_DC[x]	M	XXh	RV_FSFF_FLC
36	RecordValue 33= Deleting counter DLC CTR_WUP_CYC[x]	M	XXh	RV_FSFF_DLC
37	RecordValue 34 = P code DTC " high byte ACTION_ERRM_ReadDTCLevelByDTCLevel	M	XXh	RV_FSFF_PID02
38	RecordValue 35 = P code DTC " low byte ACTION_ERRM_ReadDTCLevelByDTCLevel	M	XXh	RV_FSFF_PID02
39	RecordValue 36 = Freeze frame data 0 - STATE_LS_1 (fuel system state bench 1) ENVD_OBD[1][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID03
40	RecordValue 37 = Freeze frame data 1 - STATE_LS_2 (fuel system state bench 2) ENVD_OBD[2][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID03
41	RecordValue 38 = Freeze frame data 2 - LOAD_CLC (calculated load value) ENVD_OBD[3][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID04
42	RecordValue 39 = Freeze frame data 3 - OBD_TCO (engine coolant temperature) ENVD_OBD[4][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID05
43	RecordValue 40 = Freeze frame data 4 - OBD_LAM_COR_1 (short term fuel trim bank 1) ENVD_OBD[5][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID06
44	RecordValue 41 = Freeze frame data 5 - OBD_LAM_AD_1 (long term fuel trim bank 1) ENVD_OBD[6][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID07
-	RecordValue 42 = Freeze frame data 6 - OBD_LAM_COR_2 (short term fuel trim bank 2) ENVD_OBD[7][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID08
46	RecordValue 43 = Freeze frame data 7 - OBD_LAM_AD_2 (long term fuel trim bank 2) ENVD_OBD[8][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID09
47	RecordValue 44 = Freeze frame data 8 - OBD_FUP (fuel pressure ENVD_OBD[9][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID0A
48	RecordValue - = Freeze frame data 9 - OBD_MAP (intake manifold absolutr pressure) ENVD_OBD[10][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID0B
49	RecordValue 46 = Freeze frame data 10 - OBD_N (engine rpm, high byte) ENVD_OBD[11][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID0C
50	RecordValue 47 = Freeze frame data 11 - OBD_N (engine rpm, low byte) ENVD_OBD[12][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID0C
51	RecordValue 48 = Freeze frame data 12 - VS (vehicle speed) ENVD_OBD[13][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID0D
52	RecordValue 49 = Freeze frame data 13 - OBD_IGA_IGC (ignition timing advance cylinder 1) ENVD_OBD[14][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID0E
53	RecordValue 50 = Freeze frame data 14 - OBD_TIA (intake air temperature) ENVD_OBD[15][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID0F
54	RecordValue 51 = Freeze frame data 15 - OBD_MAF (air flow rate mass air flow sensor, high byte) ENVD_OBD[16][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID10
55	RecordValue 52 = Freeze frame data 16 - OBD_MAF (air flow rate mass air flow sensor, high byte) ENVD_OBD[17][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID10

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56	RecordValue 53 = Freeze frame data 17 - OBD_TPS_1 (absolute throttle position) ENVD_OBD[18][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID11
57	RecordValue 54 = Freeze frame data 18 - STATE_OBD_SA (commanded secondary air status) ENVD_OBD[19][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID12
58	RecordValue 55 = Freeze frame data 19 - not supported (auxilary input)	M	FFh	RV_FSFF_PID1E
59	RecordValue 56 = Freeze frame data 20 - OBD_T_AST (time since engine start, high byte) ENVD_OBD[20][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID1F
60	RecordValue 57 = Freeze frame data 21 - OBD_T_AST (time since engine start, low byte) ENVD_OBD[21][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID1F
61	RecordValue 58 = Freeze frame data 22 - not supported (fuel rail pressure relative to manifold vacuum , high byte)	M	FFh	RV_FSFF_PID22
62	RecordValue 59 = Freeze frame data 23 - not supported (fuel rail pressure relative to manifold vacuum , low byte)	M	FFh	RV_FSFF_PID22
63	RecordValue 60 = Freeze frame data 24 - OBD_FUP_RNG_H (fuel rail pressure , high byte) ENVD_OBD[22][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID23
64	RecordValue 61 = Freeze frame data 25 - OBD_FUP_RNG_H (fuel rail pressure , low byte) ENVD_OBD[23][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID23
65	RecordValue 62 = Freeze frame data 26 - not supported (commanded EGR)	M	FFh	RV_FSFF_PID2C
66	RecordValue 63 = Freeze frame data 27 - not supported (EGR error)	M	FFh	RV_FSFF_PID2D
67	RecordValue 64 = Freeze frame data 28 -CPPWM_CPS (commanded evaporative purge) ENVD_OBD[24][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID2E
68	RecordValue 65 = Freeze frame data 29 - OBD_FTL (fuel level input) ENVD_OBD[25][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID2F
69	RecordValue 66 = Freeze frame data 30 - OBD_AMP (barometric pressure) ENVD_OBD[26][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID33
70	RecordValue 67 = Freeze frame data 31 - OBD_VB (control module voltage, high byte) ENVD_OBD[27][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID42
71	RecordValue 68 = Freeze frame data 32 - OBD_VB (control module voltage, low byte) ENVD_OBD[28][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID42
72	RecordValue 69 = Freeze frame data 33 - LOAD_ABSV (absolute load value, high byte) ENVD_OBD[29][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID43
73	RecordValue 70 = Freeze frame data 34 - LOAD_ABSV (absolute load value, low byte) ENVD_OBD[30][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID43
74	RecordValue 71 = Freeze frame data 35 - OBD_LAMB_SP (commanded equivalence ratio, high byte) ENVD_OBD[31][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID44
75	RecordValue 72 = Freeze frame data 36 - OBD_LAMB_SP (commanded equivalence ratio, low byte) ENVD_OBD[32][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID44
76	RecordValue 73 = Freeze frame data 37 - OBD_TPS_REL (relative throttle position) ENVD_OBD[33][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID-

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77	RecordValue 74 = Freeze frame data 38 - OBD_TAM (ambiente air temperature) ENVD_OBD[34][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID46
78	RecordValue 75 = Freeze frame data 39 - OBD_TPS_2 (absolute throttle position, sensor 2) ENVD_OBD[35][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID47
79	RecordValue 76 = Freeze frame data 40 - not supported (absolue throttle position C)	M	FFh	RV_FSFF_PID48
80	RecordValue 77 = Freeze frame data 41 - OBD_PV_1 (accelaration pedal position, sensor 1) ENVD_OBD[36][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID49
81	RecordValue 78 = Freeze frame data 42 - OBD_PV_2 (accelaration pedal position, sensor 2) ENVD_OBD[37][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID4A
82	RecordValue 79 = Freeze frame data 43 - not supported (accelaration pedal position F)	M	FFh	RV_FSFF_PID4B
83	RecordValue 80 = Freeze frame data 44 - OBD_TPS_SP (commanded throttle position) ENVD_OBD[38][NC_NR_ERR_DYN]	M	XXh	RV_FSFF_PID4C

I.23.48 22_401A - RCI_BZEINFO_lesen

General information:

READ BZE-values

This function ist for reading the data of the BZE (Batterie Zustands Erkennung)

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_BZEINFO
3	RecordCommonIdentifier Low Byte	M	1A	RCI_BZEINFO

Positive Response on service

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_BZEINFO
3	RecordCommonIdentifier Low Byte	M	1A	RCI_BZEINFO
4	RecordValue1 = Qv_out_m	M	XXh	RV_QV_OUT_M
5	RecordValue2 = Qv_quali_m	M	XXh	RV_QV_QUALI_M
6	RecordValue3 = Qv_status	M	XXh	RV_QV_STATUS
7	RecordValue4 = Qv_out_1	M	XXh	RV_QV_OUT_1
8	RecordValue5 = Qv_out_2	M	XXh	RV_QV_OUT_2
9	RecordValue6 = Qv_out_3	M	XXh	RV_QV_OUT_3
10	RecordValue7 = Qv_out_4	M	XXh	RV_QV_OUT_4
11	RecordValue8 = Qv_out_5	M	XXh	RV_QV_OUT_5
12	RecordValue9 = Qv_quali_1	M	XXh	RV_QV_QUALI_1
13	RecordValue10 = Qv_quali_2	M	XXh	RV_QV_QUALI_2
14	RecordValue11 = Qv_quali_3	M	XXh	RV_QV_QUALI_3
15	RecordValue12 = Qv_quali_4	M	XXh	RV_QV_QUALI_4
16	RecordValue13 = Qv_quali_5	M	XXh	RV_QV_QUALI_5
17	RecordValue14 = Qv_td1 (high byte)	M	XXh	RV_QV_TD1
18	RecordValue15 = Qv_td1 (low byte)	M	XXh	RV_QV_TD1
19	RecordValue16 = Qv_td2 (high byte)	M	XXh	RV_QV_TD2
20	RecordValue17 = Qv_td2 (low byte)	M	XXh	RV_QV_TD2
21	RecordValue18 = Qv_td3 (high byte)	M	XXh	RV_QV_TD3
22	RecordValue19 = Qv_td3 (low byte)	M	XXh	RV_QV_TD3
23	RecordValue20 = Qv_td4 (high byte)	M	XXh	RV_QV_TD4
24	RecordValue20 = Qv_td4 (low byte)	M	XXh	RV_QV_TD4
25	RecordValue18 = Qv_td5 (high byte)	M	XXh	RV_QV_TD5
26	RecordValue18 = Qv_td5 (low byte)	M	XXh	RV_QV_TD5
27	RecordValue24 = Qvc_status_1	M	XXh	RV_QVC_STATUS_1
28	RecordValue25 = Qvc_status_2	M	XXh	RV_QVC_STATUS_2
29	RecordValue26 = Qvc_status_3	M	XXh	RV_QVC_STATUS_3
30	RecordValue27 = Qvc_status_4	M	XXh	RV_QVC_STATUS_4
31	RecordValue28 = Qv_nv_zh (high byte, high word)	M	XXh	RV_QV_NV_ZH
32	RecordValue29 = Qv_nv_zh (low byte, high word)	M	XXh	RV_QV_NV_ZH
33	RecordValue30 = Qv_nv_zh (ligh byte, low word)	M	XXh	RV_QV_NV_ZH
34	RecordValue31 = Qv_nv_zh (low byte, low word)	M	XXh	RV_QV_NV_ZH
35	RecordValue32 = Qv_nv_ezm (high byte)	M	XXh	RV_QV_NV_EZM
36	RecordValue33 = Qv_nv_ezm (low byte)	M	XXh	RV_QV_NV_EZM
37	RecordValue34 = Qv_h2o (high byte)	M	XXh	RV_QV_H2O
38	RecordValue35 = Qv_h2o (low byte)	M	XXh	RV_QV_H2O
39	RecordValue36 = Qv_h2oquali	M	XXh	RV_QV_H2OQUALI
40	RecordValue37 = B_qvch2o	M	XXh [0, 1]	RV_ST_QVC1
41	RecordValue38 = Qv_h2ostatus	M	XXh	RV_QV_H2OSTATUS

I.23.49 22_401B - RCI_GENINFO_lesen

General information:

Generator Diagnoseerweiterung
This function is created to read out the values from the function-test of intelligent alternator.

Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_GENINFO
3	RecordCommonIdentifier Low Byte	M	1Bh	RCI_GENINFO

Figure I.23.5: Table Request Message

Positive Response on service

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_GENINFO
3	RecordCommonIdentifier Low Byte	M	1Bh	RCI_GENINFO
4	recordValue1 = St_dgenub1 (high byte)	M	XXh	RV_ST_DGENUB1
5	recordValue2 = St_dgenub1 (low byte)	M	XXh	RV_ST_DGENUB1
6	recordValue3 = St_dgenub2 (hiigh byte)	M	XXh	RV_ST_DGENUB2
7	recordValue4 = St_dgenub2 (low byte)	M	XXh	RV_ST_DGENUB2
8	recordValue5 = St_dgenubnz (high byte)	M	XXh	RV_ST_DGENUBNZ
9	recordValue6 = St_dgenubnz (low byte)	M	XXh	RV_ST_DGENUBNZ
10	recordValue7 = St_dgenuberr	M	XXh	RV_ST_DGENUBERR
11	recordValue8 = St_dgenugen1 (high byte)	M	XXh	RV_ST_DGENUGEN1
12	recordValue9 = St_dgenugen1 (low byte)	M	XXh	RV_ST_DGENUGEN1
13	recordValue10 = St_dgenugen2 (high byte)	M	XXh	RV_ST_DGENUGEN2
14	recordValue11 = St_dgenugen2 (low byte)	M	XXh	RV_ST_DGENUGEN2
15	recordValue12 = St_dgenugennz (high byte)	M	XXh	RV_ST_DGENUGENNZ
16	recordValue13 = St_dgenugennz (low byte)	M	XXh	RV_ST_DGENUGENNZ
17	recordValue14 = St_dgenugenerr	M	XXh	RV_ST_DGENUGENERR
18	recordValue15 = St_dgengrenz1	M	XXh	RV_ST_DGENGRENZ1
19	recordValue16 = St_dgengrenz2	M	XXh	RV_ST_DGENGRENZ2
20	recordValue17 = St_dgengrenznz	M	XXh	RV_ST_DGENGRENZNZ
21	recordValue18 = St_dgengrenzerr	M	XXh	RV_ST_DGENGRENZERR
22	recordValue19 = St_dgenub1_md1 (high byte)	M	XXh	RV_ST_DGENUB1_MD1
23	recordValue20 = St_dgenub1_md1 (low byte)	M	XXh	RV_ST_DGENUB1_MD1
24	recordValue21 = St_dgenub2_md1 (high byte)	M	XXh	RV_ST_DGENUB2_MD1
25	recordValue22 = St_dgenub2_md1 (low byte)	M	XXh	RV_ST_DGENUB2_MD1
26	recordValue23 = St_dgenubnz_md1 (high byte)	M	XXh	RV_ST_DGENUBNZ_MD1
27	recordValue24 = St_dgenubnz_md1 (low byte)	M	XXh	RV_ST_DGENUBNZ_MD1
28	recordValue25 = St_dgenuberr_md1	M	XXh	RV_ST_DGENUBERR_MD1
29	recordValue26 = St_dgenugen1_md1 (high byte)	M	XXh	RV_ST_DGENUGEN1_MD1
30	recordValue27 = St_dgenugen1_md1 (low byte)	M	XXh	RV_ST_DGENUGEN1_MD1
31	recordValue28 = St_dgenugen2_md1 (high byte)	M	XXh	RV_ST_DGENUGEN2_MD1
32	recordValue29 = St_dgenugen2_md1 (low byte)	M	XXh	RV_ST_DGENUGEN2_MD1
33	recordValue30 = St_dgenugennz_md1 (high byte)	M	XXh	RV_ST_DGENUGENNZ_MD1
34	recordValue31 = St_dgenugennz_md1 (low byte)	M	XXh	RV_ST_DGENUGENNZ_MD1
35	recordValue32 = St_dgenugenerr_md1	M	XXh	RV_ST_DGENUGENERR_MD1
36	recordValue33 = St_dgengrenz1_md1	M	XXh	RV_ST_DGENGRENZ1_MD1
37	recordValue34 = St_dgengrenz2_md1	M	XXh	RV_ST_DGENGRENZ2_MD1
38	recordValue35 = St_dgengrenznz_md1	M	XXh	RV_ST_DGENGRENZNZ_MD1
39	recordValue36 = St_dgengrenzerr_md1	M	XXh	RV_ST_DGENGRENZERR_MD1
40	recordValue37 = St_dgenub1_md2 (high byte)	M	XXh	RV_ST_DGENUB1_MD2
41	recordValue38 = St_dgenub1_md2 (low byte)	M	XXh	RV_ST_DGENUB1_MD2
42	recordValue39 = St_dgenub2_md2 (high byte)	M	XXh	RV_ST_DGENUB2_MD2
43	recordValue40 = St_dgenub2_md2 (low byte)	M	XXh	RV_ST_DGENUB2_MD2
44	recordValue41 = St_dgenubnz_md2 (high hbyte)	M	XXh	RV_ST_DGENUBNZ_MD2
-	recordValue42 = St_dgenubnz_md2 (low byte)	M	XXh	RV_ST_DGENUBNZ_MD2
46	recordValue43 = St_dgenuberr_md2	M	XXh	RV_ST_DGENUBERR_MD2
47	recordValue44 = St_dgenugen1_md2 (high byte)	M	XXh	RV_ST_DGENUGEN1_MD2
48	recordValue- = St_dgenugen1_md2 (low byte)	M	XXh	RV_ST_DGENUGEN1_MD2
49	recordValue46 = St_dgenugen2_md2	M	XXh	RV_ST_DGENUGEN2_MD2

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50	recordValue47 = St_dgenugennz_md2 (high byte)	M	XXh	RV_ST_DGENUGENNZ_MD2
51	recordValue48 = St_dgenugennz_md2 (low byte)	M	XXh	RV_ST_DGENUGENNZ_MD2
52	recordValue49 = St_dgenugenerr_md2	M	XXh	RV_ST_DGENUGENERR_MD2
53	recordValue50 = St_dgengrenz1_md2	M	XXh	RV_ST_DGENGRENZ1_MD2
54	recordValue51 = St_dgengrenz2_md2	M	XXh	RV_ST_DGENGRENZ2_MD2
55	recordValue52 = St_dgengrenznz_md2	M	XXh	RV_ST_DGENGRENZNZ_MD2
56	recordValue53 = St_dgengrenzerr_md2	M	XXh	RV_ST_DGENGRENZERR_MD2
57	recordValue54 = St_dgenerrst_md1 (high byte)	M	XXh	RV_ST_DGENERRST_MD1
58	recordValue55 = St_dgenerrst_md1 (low byte)	M	XXh	RV_ST_DGENERRST_MD1
59	recordValue56 = St_dgenerrst_md2 (high byte)	M	XXh	RV_ST_DGENERRST_MD2
60	recordValue57 = St_dgenerrst_md2 (low byte)	M	XXh	RV_ST_DGENERRST_MD2

I.23.50 22_401C - Ringspeicher MSA lesen

General information:

This function is created to read out the "Ringspeicher MSA"

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	40h	RCI_MSARING
3	RecordCommonIdentifier Low Byte	M	1Ch	RCI_MSARING

Figure I.23.6: Table Request Message

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_MSARING
3	RecordCommonIdentifier Low Byte	M	1Ch	RCI_MSARING
4	recordValue1 = Msastz (high byte)	M	XXh	RV_MSASTZ
5	recordValue2 = Msastz (low byte)	M	XXh	RV_MSASTZ
6	recordValue3 = Msastzmsa (high byte)	M	XXh	RV_MSASTZMSA
7	recordValue4 = Msastzmsa (low byte)	M	XXh	RV_MSASTZMSA
8	recordValue5 = Msa_indexrs	M	XXh	RV_MSA_INDEXRS
9	recordValue6 = Msa_arravrs[1]	M	XXh	RV_MSA_ARRAVRS
10	recordValue7 = Msa_arravrs[2]	M	XXh	RV_MSA_ARRAVRS
11	recordValue8 = Msa_arravrs[3]	M	XXh	RV_MSA_ARRAVRS
12	recordValue9 = Msa_arravrs[4]	M	XXh	RV_MSA_ARRAVRS
13	recordValue10 = Msa_arravrs[5]	M	XXh	RV_MSA_ARRAVRS
14	recordValue11 = Msa_arravrs[6]	M	XXh	RV_MSA_ARRAVRS
15	recordValue12 = Msa_arravrs[7]	M	XXh	RV_MSA_ARRAVRS
16	recordValue13 = Msa_arravrs[8]	M	XXh	RV_MSA_ARRAVRS
17	recordValue14= Msa_arravrs[9]	M	XXh	RV_MSA_ARRAVRS
18	recordValue15 = Msa_arravrs[10]	M	XXh	RV_MSA_ARRAVRS
19	recordValue16 = Msa_arravrs[11]	M	XXh	RV_MSA_ARRAVRS
10	recordValue17 = Msa_arravrs[12]	M	XXh	RV_MSA_ARRAVRS
21	recordValue18 = Msa_arravrs[13]	M	XXh	RV_MSA_ARRAVRS
22	recordValue19= Msa_arravrs[14]	M	XXh	RV_MSA_ARRAVRS
23	recordValue20 = Msa_arravrs[15]	M	XXh	RV_MSA_ARRAVRS
24	recordValue21 = Msa_arravrs[16]	M	XXh	RV_MSA_ARRAVRS
25	recordValue22 = Msa_arravrs[17]	M	XXh	RV_MSA_ARRAVRS
26	recordValue23 = Msa_arravrs[18]	M	XXh	RV_MSA_ARRAVRS
27	recordValue24 = Msa_arravrs[19]	M	XXh	RV_MSA_ARRAVRS
28	recordValue25 = Msa_arravrs[20]	M	XXh	RV_MSA_ARRAVRS
29	recordValue26 = Msa_arravrs[21]	M	XXh	RV_MSA_ARRAVRS
30	recordValue27 = Msa_arravrs[22]	M	XXh	RV_MSA_ARRAVRS
31	recordValue28 = Msa_arravrs[23]	M	XXh	RV_MSA_ARRAVRS
32	recordValue29 = Msa_arravrs[24]	M	XXh	RV_MSA_ARRAVRS
33	recordValue30 = Msa_arravrs[25]	M	XXh	RV_MSA_ARRAVRS
34	recordValue31 = Msa_arravrs[26]	M	XXh	RV_MSA_ARRAVRS
35	recordValue32 = Msa_arravrs[27]	M	XXh	RV_MSA_ARRAVRS
36	recordValue33 = Msa_arravrs[28]	M	XXh	RV_MSA_ARRAVRS
37	recordValue34 = Msa_arravrs[29]	M	XXh	RV_MSA_ARRAVRS
38	recordValue35 = Msa_arravrs[30]	M	XXh	RV_MSA_ARRAVRS
39	recordValue36 = Msa_arravrs[31]	M	XXh	RV_MSA_ARRAVRS
40	recordValue37 = Msa_arravrs[32]	M	XXh	RV_MSA_ARRAVRS
41	recordValue38 = Msa_arravrs[33]	M	XXh	RV_MSA_ARRAVRS
42	recordValue39 = Msa_arravrs[34]	M	XXh	RV_MSA_ARRAVRS
43	recordValue40 = Msa_arravrs[35]	M	XXh	RV_MSA_ARRAVRS
44	recordValue41 = Msa_arravrs[36]	M	XXh	RV_MSA_ARRAVRS
-	recordValue42 = Msa_arravrs[37]	M	XXh	RV_MSA_ARRAVRS
46	recordValue43 = Msa_arravrs[38]	M	XXh	RV_MSA_ARRAVRS
47	recordValue44 = Msa_arravrs[39]	M	XXh	RV_MSA_ARRAVRS
48	recordValue- = Msa_arravrs[40]	M	XXh	RV_MSA_ARRAVRS
49	recordValue46 = Msa_arravrs[41]	M	XXh	RV_MSA_ARRAVRS
50	recordValue47 = Msa_arravrs[42]	M	XXh	RV_MSA_ARRAVRS

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51	recordValue48 = Msa_arravrs[43]	M	XXh	RV_MSA_ARRAVRS
52	recordValue49 = Msa_arravrs[44]	M	XXh	RV_MSA_ARRAVRS
53	recordValue50 = Msa_arravrs[-]	M	XXh	RV_MSA_ARRAVRS
54	recordValue51 = Msa_arravrs[46]	M	XXh	RV_MSA_ARRAVRS
55	recordValue52 = Msa_arravrs[47]	M	XXh	RV_MSA_ARRAVRS
56	recordValue53 = Msa_arravrs[48]	M	XXh	RV_MSA_ARRAVRS
57	recordValue54 = Msa_arravrs[49]	M	XXh	RV_MSA_ARRAVRS
58	recordValue55 = Msa_arravrs[50]	M	XXh	RV_MSA_ARRAVRS
59	recordValue56 = Msa_arravrs[51]	M	XXh	RV_MSA_ARRAVRS
60	recordValue57 = Msa_arravrs[52]	M	XXh	RV_MSA_ARRAVRS
61	recordValue58 = Msa_arravrs[53]	M	XXh	RV_MSA_ARRAVRS
62	recordValue59 = Msa_arravrs[54]	M	XXh	RV_MSA_ARRAVRS
63	recordValue60 = Msa_arravrs[55]	M	XXh	RV_MSA_ARRAVRS
64	recordValue61 = Msa_arravrs[56]	M	XXh	RV_MSA_ARRAVRS
65	recordValue62 = Msa_arravrs[57]	M	XXh	RV_MSA_ARRAVRS
66	recordValue63 = Msa_arravrs[58]	M	XXh	RV_MSA_ARRAVRS
67	recordValue64 = Msa_arravrs[59]	M	XXh	RV_MSA_ARRAVRS
68	recordValue65 = Msa_arravrs[60]	M	XXh	RV_MSA_ARRAVRS

I.23.51 22_401D - RCI_VERBREDINFO_lesen

General information:

This function is created to read out the "Verbredinfo" - Array

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	40h	RCI_VERBREDINFO
3	RecordCommonIdentifier Low Byte	M	1Dh	RCI_VERBREDINFO

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_VERBREDINFO
3	RecordCommonIdentifier Low Byte	M	1Dh	RCI_VERBREDINFO
4	recordValue1 = Verbredinfo[1]	M	XXh	RV_VERBREDINFO
5	recordValue2 = Verbredinfo[2]	M	XXh	RV_VERBREDINFO
6	recordValue3 = Verbredinfo[3]	M	XXh	RV_VERBREDINFO
7	recordValue4 = Verbredinfo[4]	M	XXh	RV_VERBREDINFO
8	recordValue5 = Verbredinfo[5]	M	XXh	RV_VERBREDINFO
9	recordValue6 = Verbredinfo[6]	M	XXh	RV_VERBREDINFO
10	recordValue7 = Verbredinfo[7]	M	XXh	RV_VERBREDINFO
11	recordValue8 = Verbredinfo[8]	M	XXh	RV_VERBREDINFO
12	recordValue9= Verbredinfo[9]	M	XXh	RV_VERBREDINFO
13	recordValue10 = Verbredinfo[10]	M	XXh	RV_VERBREDINFO
14	recordValue11 = Verbredinfo[11]	M	XXh	RV_VERBREDINFO
15	recordValue12 = Verbredinfo[12]	M	XXh	RV_VERBREDINFO
16	recordValue13 = Verbredinfo[13]	M	XXh	RV_VERBREDINFO
17	recordValue14= Verbredinfo[14]	M	XXh	RV_VERBREDINFO
18	recordValue15 = Verbredinfo[15]	M	XXh	RV_VERBREDINFO
19	recordValue16 = Verbredinfo[16]	M	XXh	RV_VERBREDINFO
20	recordValue17 = Verbredinfo[17]	M	XXh	RV_VERBREDINFO
21	recordValue18 = Verbredinfo[18]	M	XXh	RV_VERBREDINFO
22	recordValue19 = Verbredinfo[19]	M	XXh	RV_VERBREDINFO
23	recordValue20 = Verbredinfo[20]	M	XXh	RV_VERBREDINFO
24	recordValue21 = Verbredinfo[21]	M	XXh	RV_VERBREDINFO
25	recordValue22 = Verbredinfo[22]	M	XXh	RV_VERBREDINFO
26	recordValue23 = Verbredinfo[23]	M	XXh	RV_VERBREDINFO
27	recordValue24 = Verbredinfo[44]	M	XXh	RV_VERBREDINFO
28	recordValue25 = Verbredinfo[25]	M	XXh	RV_VERBREDINFO
29	recordValue26 = Verbredinfo[26]	M	XXh	RV_VERBREDINFO
30	recordValue27 = Verbredinfo[27]	M	XXh	RV_VERBREDINFO
31	recordValue28 = Verbredinfo[28]	M	XXh	RV_VERBREDINFO
32	recordValue29= Verbredinfo[29]	M	XXh	RV_VERBREDINFO
33	recordValue30 = Verbredinfo[30]	M	XXh	RV_VERBREDINFO
34	recordValue31 = Verbredinfo[31]	M	XXh	RV_VERBREDINFO
35	recordValue32 = Verbredinfo[32]	M	XXh	RV_VERBREDINFO

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I.23.52 22_401E - Read CBS-Daten Zündkerzen

General information:

This function is created to read out the described values from the ecu.
Input and Output data see at service 22_10_01 for MSx80.

Formula section:

If service 22_40_1E is recieved
then
send 78 H
endif

If(1) **78H handling is activated for this function**
Then(1)

```
        increment CTR_BOS_READ
        if(2)       CTR_BOS_READ > 1C2H                     // timeout condition
        then(2)         send negative response
                        LV_BOS_READ_REQ         = 0
                        CTR_BOS_READ             = 0
                        Bosanfsgbd                = 0
                        End data handling 78H
                                            // End data transmission to tester
        else(2)
                if(3)           LV_BOS_READ_REQ =0
                then(3)
                        If(4)           LC_SENS_ZK = 1
                        then(4)             Bosanfsgbd = 0AH
                                    LV_BOS_READ_REQ = 1
                    else(4)                     send negative response
                                    LV_BOS_READ_REQ         = 0
                                    CTR_BOS_READ             = 0
                                    Bosanfsgbd                = 0
                                            End data handling 78H
                                                // End data transmission to tester
                        endif(4)
                else(3)
                        if(4)           Bosanfsgbd = Bostoken              // data for tester are ready
                        then(4) LV_BOS_READ_REQ = 0
                                send positive response
                                LV_BOS_READ_REQ         = 0
                                CTR_BOS_READ             = 0
                                Bosanfsgbd                = 0
                                End data handling 78H
                                            // End data transmission to tester
                        endif(4)
                endif(3)
        endif(2)
endif(1)
```

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Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_
3	RecordCommonIdentifier Low Byte	M	1Eh	RCI_

Figure I.23.7: Table Request Message

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	40h	RCI_CBSZK_lesen
3	RecordCommonIdentifier	M	1Eh	RCI_CBSZK_lesen
4	recordValue1 = Id_bosmgt	M	XXh	RV_Id_bosmgt
5	recordValue2 = Bosrlsm (high byte)	M	XXh	RV_Bosrlsm
6	recordValue3 = Bosrlsm (low byte)	M	XXh	RV_Bosrlsm
7	recordValue4 = Bosstate	M	XXh	RV_Bosstate
8	recordValue5 = Zrbosmld	M	XXh	RV_Zrbosmld
9	recordValue6 = Bosbtvfbk	M	XXh	RV_Bosbtvfbk
10	recordValue7 = Bosrw2	M	XXh	RV_Bosrw2
11	recordValue8 = Bosmziel	M	XXh	RV_Bosmziel
12	recordValue9 = Bosjziel	M	XXh	RV_Bosjziel
13	recordValue10 = Bosprog2	M	XXh	RV_Bosprog2
14	recordValue11 = Bosmanip	M	XXh	RV_Bosmanip
15	recordValue12 = Bosres	M	XXh	RV_Bosres
16	recordValue13 = Bostoken	M	XXh	RV_Bostoken

I.23.53 22_401F - Read BMW-PST

General information:

This function is created to read out the "BMW-Programmstandsinformation"

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	40h	RCI_PST
3	RecordCommonIdentifier Low Byte	M	1Fh	RCI_PST

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_PST
3	RecordCommonIdentifier Low Byte	M	1Fh	RCI_PST
4	recordValue1 = Ecu_sw_ref_bmw[1]	M	XXh	RV_PST
5	recordValue2 = Ecu_sw_ref_bmw[2]	M	XXh	RV_PST
6	recordValue3 = Ecu_sw_ref_bmw[3]	M	XXh	RV_PST
7	recordValue4 = Ecu_sw_ref_bmw[4]	M	XXh	RV_PST
8	recordValue5 = Ecu_sw_ref_bmw[5]	M	XXh	RV_PST
9	recordValue6 = Ecu_sw_ref_bmw[6]	M	XXh	RV_PST
10	recordValue7 = Ecu_sw_ref_bmw[7]	M	XXh	RV_PST
11	recordValue8 = Ecu_sw_ref_bmw[8]	M	XXh	RV_PST
12	recordValue9 = Ecu_sw_ref_bmw[9]	M	XXh	RV_PST

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I.23.54 22_4021 - RCI_IBS_lesen

Formula section:

BMW part numbers ASCII byte 7-1   conversion from Hex to ASCII:

The value of Zbibs is limited to a valid range between 0d and 9 999 999d for converting and reporting the data as ASCII string.
Note: zbibs_rest and temp_byte are only help values for conversion, they are not accessable as online-values or RAM-cells.

IF Zbibs < 9 999 999d
THEN zbibs_rest = zbibs
ELSE zbibs_rest = 9 999 999d
ENDIF

temp_byte = (zbibs_rest /1 000 000d)
BMW part numbers ASCII byte 7 = temp_byte + 30h
zbibs_rest = Zbibs - (temp_byte * 1 000 000d)

temp_byte = (zbibs_rest /100 000d)
BMW part numbers ASCII byte 6 = temp_byte + 30h
zbibs_rest = zbibs_rest - (temp_byte * 100 000d)

temp_byte = (zbibs_rest /10 000d)
BMW part numbers ASCII byte 5 = temp_byte + 30h
zbibs_rest = zbibs_rest - (temp_byte * 10 000d)

temp_byte = (zbibs_rest /1 000d)
BMW part numbers ASCII byte 4 = temp_byte + 30h
zbibs_rest = zbibs_rest - (temp_byte * 1 000d)

temp_byte = (zbibs_rest /100d)
BMW part numbers ASCII byte 3 = temp_byte + 30h
zbibs_rest = zbibs_rest - (temp_byte * 100d)

temp_byte = (zbibs_rest /10d)
BMW part numbers ASCII byte 2 = temp_byte + 30h
zbibs_rest = zbibs_rest - (temp_byte * 10d)

BMW part numbers ASCII byte 1 = zbibs_rest + 30h

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**ReadDataByCommonIdentifier Request Service Id**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier	M	40h	RCI_IBS
3	RecordCommonIdentifier	M	21h	RCI_IBS

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**ReadDataByCommonIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	40h	RCI_IBS
3	RecordCommonIdentifier	M	21h	RCI_IBS
4	RecordValue1 BMW part numbers ASCII byte 7	M	XXh	RV_ZB_IBS
5	RecordValue2 BMW part numbers ASCII byte 6	M	XXh	RV_ZB_IBS
6	RecordValue3 BMW part numbers ASCII byte 5	M	XXh	RV_ZB_IBS
7	RecordValue4 BMW part numbers ASCII byte 4	M	XXh	RV_ZB_IBS
8	RecordValue5 BMW part numbers ASCII byte 3	M	XXh	RV_ZB_IBS
9	RecordValue6 BMW part numbers ASCII byte 2	M	XXh	RV_ZB_IBS
10	RecordValue7 BMW part numbers ASCII byte 1	M	XXh	RV_ZB_IBS
11	RecordValue8 Snibs byte 3	M	XXh	RV_SN_IBS
12	RecordValue9 Snibs byte 2	M	XXh	RV_SN_IBS
13	RecordValue10 Snibs byte 1	M	XXh	RV_SN_IBS
14	RecordValue11 Snibs byte 0	M	XXh	RV_SN_IBS
15	RecordValue12 SW-baseline IBS_DEZ byte = Ibswbase	M	XXh	RV_SW_BL_IBS
16	RecordValue13 SW-index IBS_DEZ byte = Ibswchang	M	XXh	RV_SWIDX_IBS
17	RecordValue14 HW-index IBS_DEZ byte = Ibhwversi	M	XXh	RV_HWIDX_IBS
18	RecordValue15 reserved dummy byte not used	M	FFh	RV_
19	RecordValue16 reserved dummy byte not used	M	FFh	RV_
20	RecordValue17 reserved dummy byte not used	M	FFh	RV_
21	RecordValue18 reserved dummy byte not used	M	FFh	RV_
22	RecordValue19 reserved dummy byte not used	M	FFh	RV_
23	RecordValue20 reserved dummy byte not used	M	FFh	RV_

I.23.55 22_4022 - RCI_PM1_lesen

General information:

READ PM1 Status
This function ist for reading the data (array Pminfo1)of the Powermanagement.

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_PM1_lesen
3	RecordCommonIdentifier Low Byte	M	22h	RCI_PM1_lesen

Positive Response on service

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_PM1_lesen
3	RecordCommonIdentifier Low Byte	M	22h	RCI_PM1_lesen
4	RecordValue1 = Pminfo1 Word 0 high byte	M	XXh	RV_PMINFO1
5	RecordValue2 = Pminfo1 Word 0 low byte	M	XXh	RV_PMINFO1
6	RecordValue3 = Pminfo1 Word 1 high byte	M	XXh	RV_PMINFO1
7	RecordValue4 = Pminfo1 Word 1 low byte	M	XXh	RV_PMINFO1
8	RecordValue5 = Pminfo1 Word 2 high byte	M	XXh	RV_PMINFO1
9	RecordValue6 = Pminfo1 Word 2 low byte	M	XXh	RV_PMINFO1
10	RecordValue7 = Pminfo1 Word 3 high byte	M	XXh	RV_PMINFO1
11	RecordValue8 = Pminfo1 Word 3 low byte	M	XXh	RV_PMINFO1
12	RecordValue9 = Pminfo1 Word 4 high byte	M	XXh	RV_PMINFO1
13	RecordValue10 = Pminfo1 Word 4 low byte	M	XXh	RV_PMINFO1
14	RecordValue11 = Pminfo1 Word 5 high byte	M	XXh	RV_PMINFO1
15	RecordValue12 = Pminfo1 Word 5 low byte	M	XXh	RV_PMINFO1
16	RecordValue13 = Pminfo1 Word 6 high byte	M	XXh	RV_PMINFO1
17	RecordValue14 = Pminfo1 Word 6 low byte	M	XXh	RV_PMINFO1
18	RecordValue15 = Pminfo1 Word 7 high byte	M	XXh	RV_PMINFO1
19	RecordValue16 = Pminfo1 Word 7 low byte	M	XXh	RV_PMINFO1
20	RecordValue17 = Pminfo1 Word 8 high byte	M	XXh	RV_PMINFO1
21	RecordValue18 = Pminfo1 Word 8 low byte	M	XXh	RV_PMINFO1
22	RecordValue19 = Pminfo1 Word 9 high byte	M	XXh	RV_PMINFO1
23	RecordValue20 = Pminfo1 Word 9 low byte	M	XXh	RV_PMINFO1
24	RecordValue21 = Pminfo1 Word 10 high byte	M	XXh	RV_PMINFO1
25	RecordValue22 = Pminfo1 Word 10 low byte	M	XXh	RV_PMINFO1
26	RecordValue23 = Pminfo1 Word 11 high byte	M	XXh	RV_PMINFO1
27	RecordValue24 = Pminfo1 Word 11 low byte	M	XXh	RV_PMINFO1
28	RecordValue25 = Pminfo1 Word 12 high byte	M	XXh	RV_PMINFO1
29	RecordValue26 = Pminfo1 Word 12 low byte	M	XXh	RV_PMINFO1
30	RecordValue27 = Pminfo1 Word 13 high byte	M	XXh	RV_PMINFO1
31	RecordValue28 = Pminfo1 Word 13 low byte	M	XXh	RV_PMINFO1
32	RecordValue29 = Pminfo1 Word 14 high byte	M	XXh	RV_PMINFO1
33	RecordValue30 = Pminfo1 Word 14 low byte	M	XXh	RV_PMINFO1
34	RecordValue31 = Pminfo1 Word 15 high byte	M	XXh	RV_PMINFO1
35	RecordValue32 = Pminfo1 Word 15 low byte	M	XXh	RV_PMINFO1
36	RecordValue33 = Pminfo1 Word 16 high byte	M	XXh	RV_PMINFO1
37	RecordValue34 = Pminfo1 Word 16 low byte	M	XXh	RV_PMINFO1
38	RecordValue35 = Pminfo1 Word 17 high byte	M	XXh	RV_PMINFO1
39	RecordValue36 = Pminfo1 Word 17 low byte	M	XXh	RV_PMINFO1
40	RecordValue37 = Pminfo1 Word 18 high byte	M	XXh	RV_PMINFO1
41	RecordValue38 = Pminfo1 Word 18 low byte	M	XXh	RV_PMINFO1
42	RecordValue39 = Pminfo1 Word 19 high byte	M	XXh	RV_PMINFO1
43	RecordValue40 = Pminfo1 Word 19 low byte	M	XXh	RV_PMINFO1
44	RecordValue41 = Pminfo1 Word 20 high byte	M	XXh	RV_PMINFO1
-	RecordValue42 = Pminfo1 Word 20 low byte	M	XXh	RV_PMINFO1
46	RecordValue43 = Pminfo1 Word 21 high byte	M	XXh	RV_PMINFO1
47	RecordValue44 = Pminfo1 Word 21 low byte	M	XXh	RV_PMINFO1
48	RecordValue- = Pminfo1 Word 22 high byte	M	XXh	RV_PMINFO1

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49	RecordValue46 = Pminfo1 Word 22 low byte	M	XXh	RV_PMINFO1
50	RecordValue47 = Pminfo1 Word 23 high byte	M	XXh	RV_PMINFO1
51	RecordValue48 = Pminfo1 Word 23 low byte	M	XXh	RV_PMINFO1
52	RecordValue49 = Pminfo1 Word 24 high byte	M	XXh	RV_PMINFO1
53	RecordValue50 = Pminfo1 Word 24 low byte	M	XXh	RV_PMINFO1
54	RecordValue51 = Pminfo1 Word 25 high byte	M	XXh	RV_PMINFO1
55	RecordValue52 = Pminfo1 Word 25 low byte	M	XXh	RV_PMINFO1
56	RecordValue53 = Pminfo1 Word 26 high byte	M	XXh	RV_PMINFO1
57	RecordValue54 = Pminfo1 Word 26 low byte	M	XXh	RV_PMINFO1
58	RecordValue55 = Pminfo1 Word 27 high byte	M	XXh	RV_PMINFO1
59	RecordValue56 = Pminfo1 Word 27 low byte	M	XXh	RV_PMINFO1
60	RecordValue57 = Pminfo1 Word 28 high byte	M	XXh	RV_PMINFO1
61	RecordValue58 = Pminfo1 Word 28 low byte	M	XXh	RV_PMINFO1
62	RecordValue59 = Pminfo1 Word 29 high byte	M	XXh	RV_PMINFO1
63	RecordValue60 = Pminfo1 Word 29 low byte	M	XXh	RV_PMINFO1
64	RecordValue61 = Pminfo1 Word 30 high byte	M	XXh	RV_PMINFO1
65	RecordValue62 = Pminfo1 Word 30 low byte	M	XXh	RV_PMINFO1
66	RecordValue63 = Pminfo1 Word 31 high byte	M	XXh	RV_PMINFO1
67	RecordValue64 = Pminfo1 Word 31 low byte	M	XXh	RV_PMINFO1
68	RecordValue65 = Pminfo1 Word 32 high byte	M	XXh	RV_PMINFO1
69	RecordValue66 = Pminfo1 Word 32 low byte	M	XXh	RV_PMINFO1
70	RecordValue67 = Pminfo1 Word 33 high byte	M	XXh	RV_PMINFO1
71	RecordValue68 = Pminfo1 Word 33 low byte	M	XXh	RV_PMINFO1
72	RecordValue69 = Pminfo1 Word 34 high byte	M	XXh	RV_PMINFO1
73	RecordValue70 = Pminfo1 Word 34 low byte	M	XXh	RV_PMINFO1
74	RecordValue71 = Pminfo1 Word 35 high byte	M	XXh	RV_PMINFO1
75	RecordValue72 = Pminfo1 Word 35 low byte	M	XXh	RV_PMINFO1
76	RecordValue73 = Pminfo1 Word 36 high byte	M	XXh	RV_PMINFO1
77	RecordValue74 = Pminfo1 Word 36 low byte	M	XXh	RV_PMINFO1

I.23.56 22_4023 - RCI_PM2_lesen

General information:

READ PM2 Status

This function ist for reading the data (array Pminfo2)of the Powermanagement.

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_PM2_lesen
3	RecordCommonIdentifier Low Byte	M	23h	RCI_PM2_lesen

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_PM2_lesen
3	RecordCommonIdentifier Low Byte	M	23h	RCI_PM2_lesen
4	RecordValue1 = Pminfo2 byte 0	M	XXh	RV_PMINFO2
5	RecordValue2 = Pminfo2 byte 1	M	XXh	RV_PMINFO2
6	RecordValue3 = Pminfo2 byte 2	M	XXh	RV_PMINFO2
7	RecordValue4 = Pminfo2 byte 3	M	XXh	RV_PMINFO2
8	RecordValue5 = Pminfo2 byte 4	M	XXh	RV_PMINFO2
9	RecordValue6 = Pminfo2 byte 5	M	XXh	RV_PMINFO2
10	RecordValue7 = Pminfo2 byte 6	M	XXh	RV_PMINFO2
11	RecordValue8 = Pminfo2 byte 7	M	XXh	RV_PMINFO2
12	RecordValue9 = Pminfo2 byte 8	M	XXh	RV_PMINFO2
13	RecordValue10 = Pminfo2 byte 9	M	XXh	RV_PMINFO2
14	RecordValue11 = Pminfo2 byte 10	M	XXh	RV_PMINFO2
15	RecordValue12 = Pminfo2 byte 11	M	XXh	RV_PMINFO2
16	RecordValue13 = Pminfo2 byte 12	M	XXh	RV_PMINFO2
17	RecordValue14 = Pminfo2 byte 13	M	XXh	RV_PMINFO2
18	RecordValue15 = Pminfo2 byte 14	M	XXh	RV_PMINFO2
19	RecordValue16 = Pminfo2 byte 15	M	XXh	RV_PMINFO2
20	RecordValue17 = Pminfo2 byte 16	M	XXh	RV_PMINFO2
21	RecordValue18 = Pminfo2 byte 17	M	XXh	RV_PMINFO2
22	RecordValue19 = Pminfo2 byte 18	M	XXh	RV_PMINFO2
23	RecordValue20 = Pminfo2 byte 19	M	XXh	RV_PMINFO2
24	RecordValue21 = Pminfo2 byte 20	M	XXh	RV_PMINFO2
25	RecordValue22 = Pminfo2 byte 21	M	XXh	RV_PMINFO2
26	RecordValue23 = Pminfo2 byte 22	M	XXh	RV_PMINFO2
27	RecordValue24 = Pminfo2 byte 23	M	XXh	RV_PMINFO2
28	RecordValue25 = Pminfo2 byte 24	M	XXh	RV_PMINFO2
29	RecordValue26 = Pminfo2 byte 25	M	XXh	RV_PMINFO2
30	RecordValue27 = Pminfo2 byte 26	M	XXh	RV_PMINFO2
31	RecordValue28 = Pminfo2 byte 27	M	XXh	RV_PMINFO2
32	RecordValue29 = Pminfo2 byte 28	M	XXh	RV_PMINFO2

I.23.57 22_4026 - RCI_RBMMODE9_lesen

General information:

Rate Based Monitoring Mode 9 auslesen
This function ist for reading the rate based monitoring data. It gives back the denmominators and numerators of the RBM relevant diagnoses.

Description:

API to select Rate-Based Monitoring data to be transmitted via Mode $09
based on spec 30B02601.00E
This is only for information! This chapter will not be updated when the spec 30B02601 changes!
The following paragraph descibes the data selection algorithm to be executed only once (for CPU load saving reason), upon external tool request via Mode $09, by calling an API.

Syntax : ACTION_ERRM_SelectRbmData (INOUT < ListRbmData >,
OUT < ResultRbmData >)

Parameter (in) : No parameter

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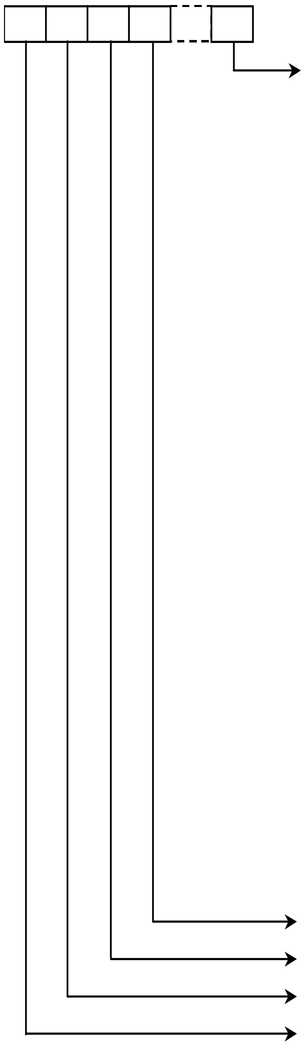
Parameter (out) : ResultRbmData
Parameter(inout) : ListRbmData
Short description : This API calculates and returns the Rate-Based Monitoring data to be transmitted to the Scan-Tool, when requested by the Mode 09$ (InfoType $08).

ResultRbmData : Indicates if the API has been executed or not.
Authorised values for ResultRbmDataSelection are :

- POSITIVE_RESPONSE : the call of the API is successful
- NEGATIVE_RESPONSE : the call of the API is unsuccessful

ListRbmData : Software structure filled-up with 20 counters of 2 bytes coming from Rate-Based Monitoring



O2 D-Sensor Monitor Conditions Encountered Counts Bank 2 (denominator - LSB byte)
O2 D-Sensor Monitor Conditions Encountered Counts Bank 2 (denominator - MSB byte)
O2 D-Sensor Monitor Completion Counts Bank 2 (numerator - LSB byte)
O2 D-Sensor Monitor Completion Counts Bank 2 (numerator - MSB byte)
O2 D-Sensor Monitor Conditions Encountered Counts Bank 1 (denominator - LSB byte)
O2 D-Sensor Monitor Conditions Encountered Counts Bank 1 (denominator - MSB byte)
O2 D-Sensor Monitor Completion Counts Bank 1 (numerator - LSB byte)
O2 D-Sensor Monitor Completion Counts Bank 1 (numerator - MSB byte)
EVAP Monitor Conditions Encountered Counts (denominator - LSB byte)
EVAP Monitor Conditions Encountered Counts (denominator - MSB byte)
EVAP Monitor Completion Condition Counts (numerator - LSB byte)
EVAP Monitor Completion Condition Counts (numerator - MSB byte)
AIR Monitor Conditions Encountered Counts (denominator - LSB byte)
AIR Monitor Conditions Encountered Counts (denominator - MSB byte)
AIR Monitor Completion Condition Counts (numerator - LSB byte)
AIR Monitor Completion Condition Counts (numerator - MSB byte)
EGR Monitor Conditions Encountered Counts (denominator - LSB byte)
EGR Monitor Conditions Encountered Counts (denominator - MSB byte)
EGR Monitor Completion Condition Counts (numerator - LSB byte)
EGR Monitor Completion Condition Counts (numerator - MSB byte)
O2 Sensor Monitor Conditions Encountered Counts Bank 2 (denominator - LSB byte)
O2 Sensor Monitor Conditions Encountered Counts Bank 2 (denominator - MSB byte)
O2 Sensor Monitor Completion Counts Bank 2 (numerator - LSB byte)
O2 Sensor Monitor Completion Counts Bank 2 (numerator - MSB byte)
O2 Sensor Monitor Conditions Encountered Counts Bank 1 (denominator - LSB byte)
O2 Sensor Monitor Conditions Encountered Counts Bank 1 (denominator - MSB byte)
O2 Sensor Monitor Completion Counts Bank 1 (numerator - LSB byte)
O2 Sensor Monitor Completion Counts Bank 1 (numerator - MSB byte)
Catalyst Monitor Conditions Encountered Counts Bank 2 (denominator - LSB byte)
Catalyst Monitor Conditions Encountered Counts Bank 2 (denominator - MSB byte)
Catalyst Monitor Completion Counts Bank 2 (numerator - LSB byte)
Catalyst Monitor Completion Counts Bank 2 (numerator - MSB byte)
Catalyst Monitor Conditions Encountered Counts Bank 1 (denominator - LSB byte)
Catalyst Monitor Conditions Encountered Counts Bank 1 (denominator - MSB byte)
Catalyst Monitor Completion Counts Bank 1 (numerator - LSB byte)
Catalyst Monitor Completion Counts Bank 1 (numerator - MSB byte)
Ignition Counter (LSB byte)
Ignition Counter (MSB byte)
OBD Monitoring Conditions Encountered Counts (general denominator - LSB byte)
OBD Monitoring Conditions Encountered Counts (general denominator - MSB byte)

The function described above is used to bring the RBM- values into KWP- buffer. The content of this KWP- buffer is given to tester with the telegram- layout described below.

Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_RBMMODE9
3	RecordCommonIdentifier Low Byte	M	26h	RCI_RBMMODE9

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**Response Service ID**	**M**	**#62**	**RDBCIPR**
#2d	RecordCommonIdentifier	M	#40	RCI_RBMM S1
#3d	RecordCommonIdentifier = Rate Based Monitoring	M	#26	RCI_RBMM S1
#4d	RecordValue#1 = CTR_CDN_OBD_RBM (high byte)	M	#XXh	DREC_1
#5d	RecordValue#2 = CTR_CDN_OBD_RBM (low byte)	M	#XXh	DREC_2
#6d	RecordValue#3 = CTR_IGK_CYC_RBM (high byte)	M	#XXh	DREC_
#7d	RecordValue#4 = CTR_IGK_CYC_RBM (low byte)	M	#XXh	DREC_
#8d	RecordValue#5 = CTR_COMP_RBM_CLC_CAT_1 (high byte)	M	#XXh	DREC_
#9d	RecordValue#6 = CTR_COMP_RBM_CLC_CAT_1 (low byte)	M	#XXh	DREC_
#10d	RecordValue#7 = CTR_CDN_RBM_CLC_CAT_1 (high byte)	M	#XXh	DREC_
#11d	RecordValue#8 = CTR_CDN_RBM_CLC_CAT_1 (low byte)	M	#XXh	DREC_
#12d	RecordValue#9 = CTR_COMP_RBM_CLC_CAT_2 (high byte)	M	#XXh	DREC_
#13d	RecordValue#10 = CTR_COMP_RBM_CLC_CAT_2 (low byte)	M	#XXh	DREC_
#14d	RecordValue#11 = CTR_CDN_RBM_CLC_CAT_2(high byte)	M	#XXh	DREC_
#15d	RecordValue#12 = CTR_CDN_RBM_CLC_CAT_2 (low byte)	M	#XXh	DREC_
#16d	RecordValue#13 = CTR_COMP_RBM_CLC_LS_UP_1 (high byte)	M	#XXh	DREC_
#17d	RecordValue#14 = CTR_COMP_RBM_CLC_LS_UP_1 (low byte)	M	#XXh	DREC_
#18d	RecordValue#15 = CTR_CDN_RBM_CLC_LS_UP_1 (high byte)	M	#XXh	DREC_
#19d	RecordValue#16 = CTR_CDN_RBM_CLC_LS_UP_1 (low byte)	M	#XXh	DREC_
#20d	RecordValue#17 = CTR_COMP_RBM_CLC_LS_UP_2 (high byte)	M	#XXh	DREC_
#21d	RecordValue#18 = CTR_COMP_RBM_CLC_LS_UP_2 (low byte)	M	#XXh	DREC_
#22d	RecordValue#19 = CTR_CDN_RBM_CLC_LS_UP_2 (high byte)	M	#XXh	DREC_
#23d	RecordValue#20 = CTR_CDN_RBM_CLC_LS_UP_2 (low byte)	M	#XXh	DREC_
#24d	RecordValue#21 = CTR_COMP_RBM_CLC_VVT (high byte)	M	#XXh	DREC_
#25d	RecordValue#22 = CTR_COMP_RBM_CLC_VVT (low byte)	M	#XXh	DREC_
#26d	RecordValue#23 = CTR_CDN_RBM_CLC_VVT (high byte)	M	#XXh	DREC_
#27d	RecordValue#24 = CTR_CDN_RBM_CLC_VVT (low byte)	M	#XXh	DREC_
#28d	RecordValue#25 = CTR_COMP_RBM_CLC_SA (high byte)	M	#XXh	DREC_
#29d	RecordValue#26 = CTR_COMP_RBM_CLC_SA (low byte)	M	#XXh	DREC_
#30d	RecordValue#27 = CTR_CDN_RBM_CLC_SA (high byte)	M	#XXh	DREC_
#31d	RecordValue#28 = CTR_CDN_RBM_CLC_SA (low byte)	M	#XXh	DREC_
#32d	RecordValue#29 = CTR_COMP_RBM_CLC_LEAK (high byte)	M	#XXh	DREC_
#33d	RecordValue#30 = CTR_COMP_RBM_CLC_LEAK (low byte)	M	#XXh	DREC_
#34d	RecordValue#31 = CTR_CDN_RBM_CLC_LEAK (high byte)	M	#XXh	DREC_
#35d	RecordValue#32 = CTR_CDN_RBM_CLC_LEAK (low byte)	M	#XXh	DREC_
#36d	RecordValue#33 = CTR_COMP_RBM_CLC_LS_DOWN_1 (high byte)	M	#XXh	DREC_
#37d	RecordValue#34 = CTR_COMP_RBM_CLC_LS_DOWN_1 (low byte)	M	#XXh	DREC_
#38d	RecordValue#35 = CTR_CDN_RBM_CLC_LS_DOWN_1 (high byte)	M	#XXh	DREC_
#39d	RecordValue#36 = CTR_CDN_RBM_CLC_LS_DOWN_1 (low byte)	M	#XXh	DREC_
#40d	RecordValue#37 = CTR_COMP_RBM_CLC_LS_DOWN_2 (high byte)	M	#XXh	DREC_
#41d	RecordValue#38 = CTR_COMP_RBM_CLC_LS_DOWN_2 (low byte)	M	#XXh	DREC_
#42d	RecordValue#39 = CTR_CDN_RBM_CLC_LS_DOWN_2 (high byte)	M	#XXh	DREC_
#43d	RecordValue#40 = CTR_CDN_RBM_CLC_LS_DOWN_2 (low byte)	M	#XXh	DREC_40

Figure I.23.8: Table ReadDataByIdentifier Positive Response Message

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I.23.58 22_4027 - RCI_RBMMS1_lesen

General information:

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Rate Based Monitoring Motorsteuerung Block 1 auslesen

This function reads out RBM values block 1.

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_RBMMS1
3	RecordCommonIdentifier Low Byte	M	27h	RCI_RBMMS1

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**ReadDataByIdentifier Response Service Id**	**M**	**#62h**	**RDBCIPR**
 #2d #3d	dataIdentifier #1 = [byte1(MSB) byte2]	M	 #40h #27h	DID_ B1 B2
#4d	RecordValue#1 = CTR_COMP_RBM_CAT_DIAG_1 high byte	M	#XXh	RV_1
#5d	RecordValue#2 = CTR_COMP_RBM_CAT_DIAG_1 low byte	M	#XXh	RV_2
#6d	RecordValue#3 = CTR_CDN_RBM_CAT_DIAG_1 high byte	M	#XXh	RV_
#7d	RecordValue#4 = CTR_CDN_RBM_CAT_DIAG_1 low byte	M	#XXh	RV_
#8d	RecordValue#5 = CTR_COMP_RBM_CAT_DIAG_2 high byte	M	#XXh	RV_
#9d	RecordValue#6 = CTR_COMP_RBM_CAT_DIAG_2 low byte	M	#XXh	RV_
#10d	RecordValue#7 = CTR_CDN_RBM_CAT_DIAG_2 high byte	M	#XXh	RV_
#11d	RecordValue#8 = CTR_CDN_RBM_CAT_DIAG_2 low byte	M	#XXh	RV_
#12d	RecordValue#9 = CTR_COMP_RBM_DYN_VLD_LS_UP_1 high byte	M	#XXh	RV_
#13d	RecordValue#10 = CTR_COMP_RBM_DYN_VLD_LS_UP_1 low byte	M	#XXh	RV_
#14d	RecordValue#11 = CTR_CDN_RBM_DYN_VLD_LS_UP_1 high byte	M	#XXh	RV_
#15d	RecordValue#12 = CTR_CDN_RBM_DYN_VLD_LS_UP_1 low byte	M	#XXh	RV_
#16d	RecordValue#13 = CTR_COMP_RBM_SHIFT_AFL_LSL_UP_1 high byte	M	#XXh	RV_
#17d	RecordValue#14 = CTR_COMP_RBM_SHIFT_AFL_LSL_UP_1 low byte	M	#XXh	RV_
#18d	RecordValue#15 = CTR_CDN_RBM_SHIFT_AFL_LSL_UP_1 high byte	M	#XXh	RV_
#19d	RecordValue#16 = CTR_CDN_RBM_SHIFT_AFL_LSL_UP_1 low byte	M	#XXh	RV_
#20d	RecordValue#17 = CTR_COMP_RBM_SHIFT_AFR_LSL_UP_1 high byte	M	#XXh	RV_
#21d	RecordValue#18 = CTR_COMP_RBM_SHIFT_AFR_LSL_UP_1 low byte	M	#XXh	RV_
#22d	RecordValue#19 = CTR_CDN_RBM_SHIFT_AFR_LSL_UP_1 high byte	M	#XXh	RV_
#23d	RecordValue#20 = CTR_CDN_RBM_SHIFT_AFR_LSL_UP_1 low byte	M	#XXh	RV_
#24d	RecordValue#21 = CTR_COMP_RBM_AIR_LSL_UP_1 high byte	M	#XXh	RV_
#25d	RecordValue#22 = CTR_COMP_RBM_AIR_LSL_UP_1 low byte	M	#XXh	RV_
#26d	RecordValue#23 = CTR_CDN_RBM_AIR_LSL_UP_1 high byte	M	#XXh	RV_
#27d	RecordValue#24 = CTR_CDN_RBM_AIR_LSL_UP_1 low byte	M	#XXh	RV_
#28d	RecordValue#25 = CTR_COMP_RBM_DYN_VLD_LS_UP_2 high byte	M	#XXh	RV_
#29d	RecordValue#26 = CTR_COMP_RBM_DYN_VLD_LS_UP_2 low byte	M	#XXh	RV_
#30d	RecordValue#27 = CTR_CDN_RBM_DYN_VLD_LS_UP_2 high byte	M	#XXh	RV_
#31d	RecordValue#28 = CTR_CDN_RBM_DYN_VLD_LS_UP_2 low byte	M	#XXh	RV_
#32d	RecordValue#29 = CTR_COMP_RBM_SHIFT_AFL_LSL_UP_2 high byte	M	#XXh	RV_
#33d	RecordValue#30 = CTR_COMP_RBM_SHIFT_AFL_LSL_UP_2 low byte	M	#XXh	RV_
#34d	RecordValue#31 = CTR_CDN_RBM_SHIFT_AFL_LSL_UP_2 high byte	M	#XXh	RV_
#35d	RecordValue#32 = CTR_CDN_RBM_SHIFT_AFL_LSL_UP_2 low byte	M	#XXh	RV_
#36d	RecordValue#33 = CTR_COMP_RBM_SHIFT_AFR_LSL_UP_2 high byte	M	#XXh	RV_
#37d	RecordValue#34 = CTR_COMP_RBM_SHIFT_AFR_LSL_UP_2 low byte	M	#XXh	RV_
#38d	RecordValue#35 = CTR_CDN_RBM_SHIFT_AFR_LSL_UP_2 high byte	M	#XXh	RV_
#39d	RecordValue#36 = CTR_CDN_RBM_SHIFT_AFR_LSL_UP_2 low byte	M	#XXh	RV_
#40d	RecordValue#37 = CTR_COMP_RBM_AIR_LSL_UP_2 high byte	M	#XXh	RV_
#41d	RecordValue#38 = CTR_COMP_RBM_AIR_LSL_UP_2 low byte	M	#XXh	RV_
#42d	RecordValue#39 = CTR_CDN_RBM_AIR_LSL_UP_2 high byte	M	#XXh	RV_
#43d	RecordValue#40 = CTR_CDN_RBM_AIR_LSL_UP_2 low byte	M	#XXh	RV_
#44d	RecordValue#41 = CTR_COMP_RBM_SMALL_LEAK high byte	M	#XXh	RV_
#-d	RecordValue#42 = CTR_COMP_RBM_SMALL_LEAK low byte	M	#XXh	RV_
#46d	RecordValue#43 = CTR_CDN_RBM_SMALL_LEAK high byte	M	#XXh	RV_
#47d	RecordValue#44 = CTR_CDN_RBM_SMALL_LEAK low byte	M	#XXh	RV_44
#48d	RecordValue#- = CTR_COMP_RBM_MEC_IVVT_IN high byte	M	#XXh	RV_

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#49d	RecordValue#46 = CTR_COMP_RBM_MEC_IVVT_IN low byte	M	#XXh	RV_
#50d	RecordValue#47 = CTR_CDN_RBM_MEC_IVVT_IN high byte	M	#XXh	RV_
#51d	RecordValue#48 = CTR_CDN_RBM_MEC_IVVT_IN low byte	M	#XXh	RV_
#52d	RecordValue#49 = CTR_COMP_RBM_MEC_IVVT_EX high byte	M	#XXh	RV_
#53d	RecordValue#50 = CTR_COMP_RBM_MEC_IVVT_EX low byte	M	#XXh	RV_
#54d	RecordValue#51 = CTR_CDN_RBM_MEC_IVVT_EX high byte	M	#XXh	RV_
#55d	RecordValue#52 = CTR_CDN_RBM_MEC_IVVT_EX low byte	M	#XXh	RV_
#56d	RecordValue#53 = NOT USED	M	#00h	RV_
#57d	RecordValue#54 = NOT USED	M	#00h	RV_
#58d	RecordValue#55 = NOT USED	M	#00h	RV_
#59d	RecordValue#56 = NOT USED	M	#00h	RV_
#60d	RecordValue#57 = NOT USED	M	#00h	RV_
#61d	RecordValue#58 = NOT USED	M	#00h	RV_
#62d	RecordValue#59 = NOT USED	M	#00h	RV_
#63d	RecordValue#60 = NOT USED	M	#00h	RV_
#64d	RecordValue#61 = NOT USED	M	#00h	RV_
#65d	RecordValue#62 = NOT USED	M	#00h	RV_
#66d	RecordValue#63 = NOT USED	M	#00h	RV_
#67d	RecordValue#64 = NOT USED	M	#00h	RV_
#68d	RecordValue#65 = NOT USED	M	#00h	RV_
#69d	RecordValue#66 = NOT USED	M	#00h	RV_
#70d	RecordValue#67 = NOT USED	M	#00h	RV_
#71d	RecordValue#68 = NOT USED	M	#00h	RV_
#72d	RecordValue#69 = CTR_COMP_RBM_TOOTH_OFF_IN_1 high byte	M	#XXh	RV_
#73d	RecordValue#70 = CTR_COMP_RBM_TOOTH_OFF_IN_1 low byte	M	#XXh	RV_
#74d	RecordValue#71 = CTR_CDN_RBM_TOOTH_OFF_IN_1 high byte	M	#XXh	RV_
#75d	RecordValue#72 = CTR_CDN_RBM_TOOTH_OFF_IN_1 low byte	M	#XXh	RV_
#76d	RecordValue#73 = CTR_COMP_RBM_TOOTH_OFF_EX_1 high byte	M	#XXh	RV_
#77d	RecordValue#74 = CTR_COMP_RBM_TOOTH_OFF_EX_1 low byte	M	#XXh	RV_
#78d	RecordValue#75 = CTR_CDN_RBM_TOOTH_OFF_EX_1 high byte	M	#XXh	RV_
#79d	RecordValue#76 = CTR_CDN_RBM_TOOTH_OFF_EX_1 low byte	M	#XXh	RV_
#80d	RecordValue#77 = NOT USED	M	#00h	RV_
#81d	RecordValue#78 = NOT USED	M	#00h	RV_
#82d	RecordValue#79 = NOT USED	M	#00h	RV_
#83d	RecordValue#80 = NOT USED	M	#00h	RV_
#84d	RecordValue#81 = NOT USED	M	#00h	RV_
#85d	RecordValue#82 = NOT USED	M	#00h	RV_
#86d	RecordValue#83 = NOT USED	M	#00h	RV_
#87d	RecordValue#84 = NOT USED	M	#00h	RV_
#88d	RecordValue#85= NOT USED	M	#00h	RV_
#89d	RecordValue#86= NOT USED	M	#00h	RV_
#90d	RecordValue#87= NOT USED	M	#00h	RV_
#91d	RecordValue#88= NOT USED	M	#00h	RV_
#92d	RecordValue#89= NOT USED	M	#00h	RV_
#93d	RecordValue#90= NOT USED	M	#00h	RV_
#94d	RecordValue#91= NOT USED	M	#00h	RV_
#95d	RecordValue#92= NOT USED	M	#00h	RV_
#96d	RecordValue#93= NOT USED	M	#00h	RV_

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#97d	RecordValue#94= NOT USED	M	#00h	RV_
#98d	RecordValue#95= NOT USED	M	#00h	RV_
#99d	RecordValue#96= NOT USED	M	#00h	RV_
#100d	RecordValue#97= NOT USED	M	#00h	RV_
#101d	RecordValue#98= NOT USED	M	#00h	RV_
#102d	RecordValue#99= NOT USED	M	#00h	RV_
#103d	RecordValue#100= NOT USED	M	#00h	RV_
#104d	RecordValue#101= NOT USED	M	#00h	RV_
#105d	RecordValue#102 = NOT USED	M	#00h	RV_
#106d	RecordValue#103= NOT USED	M	#00h	RV_
#107d	RecordValue#104= NOT USED	M	#00h	RV_
#108d	RecordValue#105 = CTR_COMP_RBM_CHK_LS_DOWN_1 high byte	M	#XXh	RV_
#109d	RecordValue#106 = CTR_COMP_RBM_CHK_LS_DOWN_1 low byte	M	#XXh	RV_
#110d	RecordValue#107= CTR_CDN_RBM_CHK_LS_DOWN_1 high byte	M	#XXh	RV_
#111d	RecordValue#108 = CTR_CDN_RBM_CHK_LS_DOWN_1 low byte	M	#XXh	RV_
#112d	RecordValue#113 = CTR_COMP_RBM_SWT_LS_DOWN_1 high byte	M	#XXh	RV_
#113d	RecordValue#114 = CTR_COMP_RBM_SWT_LS_DOWN_1 low byte	M	#XXh	RV_
#114d	RecordValue#115 = CTR_CDN_RBM_SWT_LS_DOWN_1 high byte	M	#XXh	RV_
#115d	RecordValue#116 = CTR_CDN_RBM_SWT_LS_DOWN_1 low byte	M	#XXh	RV_
#116d	RecordValue#121 = CTR_COMP_RBM_PUC_LS_DOWN_1 high byte	M	#XXh	RV_
#117d	RecordValue#122 = CTR_COMP_RBM_PUC_LS_DOWN_1 low byte	M	#XXh	RV_
#118d	RecordValue#123 = CTR_CDN_RBM_PUC_LS_DOWN_1 high byte	M	#XXh	RV_
#119d	RecordValue#124 = CTR_CDN_RBM_PUC_LS_DOWN_1 low byte	M	#XXh	RV_
#120d	RecordValue#129 = CTR_COMP_RBM_PUE_LS_DOWN_1 high byte	M	#XXh	RV_
#121d	RecordValue#130 = CTR_COMP_RBM_PUE_LS_DOWN_1 low byte	M	#XXh	RV_
#122d	RecordValue#131= CTR_CDN_RBM_PUE_LS_DOWN_1 high byte	M	#XXh	RV_
#123d	RecordValue#132 = CTR_CDN_RBM_PUE_LS_DOWN_1 low byte	M	#XXh	RV_
#124d	RecordValue#109 = CTR_COMP_RBM_CHK_LS_DOWN_2 high byte	M	#XXh	RV_
#125d	RecordValue#110 = CTR_COMP_RBM_CHK_LS_DOWN_2 low byte	M	#XXh	RV_
#126d	RecordValue#111= CTR_CDN_RBM_CHK_LS_DOWN_2 high byte	M	#XXh	RV_
#127d	RecordValue#112 = CTR_CDN_RBM_CHK_LS_DOWN_2 low byte	M	#XXh	RV_
#128d	RecordValue#117 = CTR_COMP_RBM_SWT_LS_DOWN_2 high byte	M	#XXh	RV_
#129d	RecordValue#118 = CTR_COMP_RBM_SWT_LS_DOWN_2 low byte	M	#XXh	RV_
#130d	RecordValue#119 = CTR_CDN_RBM_SWT_LS_DOWN_2 high byte	M	#XXh	RV_
#131d	RecordValue#120 = CTR_CDN_RBM_SWT_LS_DOWN_2 low byte	M	#XXh	RV_
#132d	RecordValue#125 = CTR_COMP_RBM_PUC_LS_DOWN_2 high byte	M	#XXh	RV_
#133d	RecordValue#126 = CTR_COMP_RBM_PUC_LS_DOWN_2 low byte	M	#XXh	RV_
#134d	RecordValue#127 = CTR_CDN_RBM_PUC_LS_DOWN_2 high byte	M	#XXh	RV_
#135d	RecordValue#128 = CTR_CDN_RBM_PUC_LS_DOWN_2 low byte	M	#XXh	RV_
#136d	RecordValue#133 = CTR_COMP_RBM_PUE_LS_DOWN_2 high byte	M	#XXh	RV_
#‰d	RecordValue#134 = CTR_COMP_RBM_PUE_LS_DOWN_2 low byte	M	#XXh	RV_
#138d	RecordValue#135= CTR_CDN_RBM_PUE_LS_DOWN_2 high byte	M	#XXh	RV_
#139d	RecordValue#136 = CTR_CDN_RBM_PUE_LS_DOWN_2 low byte	M	#XXh	RV_136

I.23.59 22_4028 - RCI_RBMMS2_lesen

General information:

Rate Based Monitoring Motorsteuerung Block 2 auslesen
This function reads out RBM values block 2.

Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_RBMMS2
3	RecordCommonIdentifier Low Byte	M	28h	RCI_RBMMS2

Positive Response on service

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D ata Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**ReadDataByIdentifier Response Service Id**	**M**	**#62h**	**RDBCIPR**
 #2d #3d	dataIdentifier #1 = [byte1(MSB) byte2]	M	 #40h #28h	DID_ B1 B2
#4d	RecordValue#1 = CTR_COMP_RBM_DIAGCPS high byte	M	#XXh	RV_1
#5d	RecordValue#2 = CTR_COMP_RBM_DIAGCPS low byte	M	#XXh	RV_2
#6d	RecordValue#3 = CTR_CDN_RBM_DIAGCPS high byte	M	#XXh	RV_
#7d	RecordValue#4 = CTR_CDN_RBM_DIAGCPS low byte	M	#XXh	RV_
#8d	RecordValue#5 = CTR_COMP_RBM_ROUGH_LEAK high byte	M	#XXh	RV_
#9d	RecordValue#6 = CTR_COMP_RBM_ROUGH_LEAK low byte	M	#XXh	RV_
#10d	RecordValue#7 = CTR_CDN_RBM_ROUGH_LEAK high byte	M	#XXh	RV_
#11d	RecordValue#8 = CTR_CDN_RBM_ROUGH_LEAK low byte	M	#XXh	RV_
#12d	RecordValue#9 = CTR_COMP_RBM_DMTLM high byte	M	#XXh	RV_
#13d	RecordValue#10 = CTR_COMP_RBM_DMTLM low byte	M	#XXh	RV_
#14d	RecordValue#11 = CTR_CDN_RBM_DMTLM high byte	M	#XXh	RV_
#15d	RecordValue#12 = CTR_CDN_RBM_DMTLM low byte	M	#XXh	RV_
#16d	RecordValue#13 = CTR_COMP_RBM_TH high byte	M	#XXh	RV_
#17d	RecordValue#14 = CTR_COMP_RBM_TH low byte	M	#XXh	RV_
#18d	RecordValue#15 = CTR_CDN_RBM_TH high byte	M	#XXh	RV_
#19d	RecordValue#16= CTR_CDN_RBM_TH low byte	M	#XXh	RV_
#20d	RecordValue#17= CTR_COMP_RBM_TCO_PLAUS high byte	M	#XXh	RV_
#21d	RecordValue#18= CTR_COMP_RBM_TCO_PLAUS low byte	M	#XXh	RV_
#22d	RecordValue#19 = CTR_CDN_RBM_TCO_PLAUS high byte	M	#XXh	RV_
#23d	RecordValue#20 = CTR_CDN_RBM_TCO_PLAUS low byte	M	#XXh	RV_
#24d	RecordValue#21 = CTR_COMP_RBM_TCO_STUCK high byte	M	#XXh	RV_
#25d	RecordValue#22 = CTR_COMP_RBM_TCO_STUCK low byte	M	#XXh	RV_
#26d	RecordValue#23 = CTR_CDN_RBM_TCO_STUCK high byte	M	#XXh	RV_
#27d	RecordValue#24 = CTR_CDN_RBM_TCO_STUCK low byte	M	#XXh	RV_
#28d	RecordValue#25 = CTR_COMP_RBM_TCO_2_PLAUS high byte	M	#XXh	RV_
#29d	RecordValue#26 = CTR_COMP_RBM_TCO_2_PLAUS low byte	M	#XXh	RV_
#30d	RecordValue#27 = CTR_CDN_RBM_TCO_2_PLAUS high byte	M	#XXh	RV_
#31d	RecordValue#28 = CTR_CDN_RBM_TCO_2_PLAUS low byte	M	#XXh	RV_
#32d	RecordValue#29 = CTR_COMP_RBM_TAM_PLAUS high byte	M	#XXh	RV_
#33d	RecordValue#30 = CTR_COMP_RBM_TAM_PLAUS low byte	M	#XXh	RV_
#34d	RecordValue#31 = CTR_CDN_RBM_TAM_PLAUS high byte	M	#XXh	RV_
#35d	RecordValue#32 = CTR_CDN_RBM_TAM_PLAUS low byte	M	#XXh	RV_
#36d	RecordValue#33 = CTR_COMP_RBM_VS_PLAUS high byte	M	#XXh	RV_
#37d	RecordValue#34 = CTR_COMP_RBM_VS_PLAUS low byte	M	#XXh	RV_
#38d	RecordValue#35 = CTR_CDN_RBM_VS_PLAUS high byte	M	#XXh	RV_
#39d	RecordValue#36 = CTR_CDN_RBM_VS_PLAUS low byte	M	#XXh	RV_
#40d	RecordValue#37 = CTR_COMP_RBM_FTL_OBD high byte	M	#XXh	RV_
#41d	RecordValue#38 = CTR_COMP_RBM_FTL_OBD low byte	M	#XXh	RV_
#42d	RecordValue#39 = CTR_CDN_RBM_FTL_OBD high byte	M	#XXh	RV_
#43d	RecordValue#40 = CTR_CDN_RBM_FTL_OBD low byte	M	#XXh	RV_
#44d	RecordValue#41 = CTR_COMP_RBM_OBD_LSH_DOWN_1 high byte	M	#XXh	RV_
#-d	RecordValue#42 = CTR_COMP_RBM_OBD_LSH_DOWN_1 low byte	M	#XXh	RV_
#46d	RecordValue#43 = CTR_CDN_RBM_OBD_LSH_DOWN_1 high byte	M	#XXh	RV_

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#47d	RecordValue#44 = CTR_CDN_RBM_OBD_LSH_DOWN_1 low byte	M	#XXh	RV_
#48d	RecordValue#- = CTR_COMP_RBM_OBD_LSH_DOWN_2 high byte	M	#XXh	RV_
#49d	RecordValue#46 = CTR_COMP_RBM_OBD_LSH_DOWN_2 low byte	M	#XXh	RV_
#50d	RecordValue#47 = CTR_CDN_RBM_OBD_LSH_DOWN_2 high byte	M	#XXh	RV_
#51d	RecordValue#48 = CTR_CDN_RBM_OBD_LSH_DOWN_2 low byte	M	#XXh	RV_
#52d	RecordValue#49 = CTR_COMP_RBM_OBD_VLD_LSH_UP_1 high byte	M	#XXh	RV_
#53d	RecordValue#50 = CTR_COMP_RBM_OBD_VLD_LSH_UP_1 low byte	M	#XXh	RV_
#54d	RecordValue#51 = CTR_CDN_RBM_OBD_VLD_LSH_UP_1 high byte	M	#XXh	RV_
#55d	RecordValue#52 = CTR_CDN_RBM_OBD_VLD_LSH_UP_1 low byte	M	#XXh	RV_
#56d	RecordValue#53 = CTR_COMP_RBM_OBD_VLD_LSH_UP_2 high byte	M	#XXh	RV_
#57d	RecordValue#54 = CTR_COMP_RBM_OBD_VLD_LSH_UP_2 low byte	M	#XXh	RV_
#58d	RecordValue#55 = CTR_CDN_RBM_OBD_VLD_LSH_UP_2 high byte	M	#XXh	RV_
#59d	RecordValue#56 = CTR_CDN_RBM_OBD_VLD_LSH_UP_2 low byte	M	#XXh	RV_
#60d	RecordValue#57 = CTR_COMP_RBM_CS high byte	M	#XXh	RV_
#61d	RecordValue#58 = CTR_COMP_RBM_CS low byte	M	#XXh	RV_
#62d	RecordValue#59 = CTR_CDN_RBM_CS high byte	M	#XXh	RV_
#63d	RecordValue#60 = CTR_CDN_RBM_CS low byte	M	#XXh	RV_
#64d	RecordValue#61 = CTR_COMP_RBM_ISC high byte	M	#XXh	RV_
#65d	RecordValue#62 = CTR_COMP_RBM_ISC low byte	M	#XXh	RV_
#66d	RecordValue#63 = CTR_CDN_RBM_ISC high byte	M	#XXh	RV_
#67d	RecordValue#64 = CTR_CDN_RBM_ISC low byte	M	#XXh	RV_
#68d	RecordValue#65 = CTR_COMP_RBM_MAF high byte	M	#XXh	RV_
#69d	RecordValue#66 = CTR_COMP_RBM_MAF low byte	M	#XXh	RV_
#70d	RecordValue#67 = CTR_CDN_RBM_MAF high byte	M	#XXh	RV_
#71d	RecordValue#68 = CTR_CDN_RBM_MAF low byte	M	#XXh	RV_
#72d	RecordValue69 = CTR_COMP_RBM_TIA_PLAUS high byte	M	#XXh	RV_
#73d	RecordValue70 = CTR_COMP_RBM_TIA_PLAUS low byte	M	#XXh	RV_
#74d	RecordValue71 = CTR_CDN_RBM_TIA_PLAUS high byte	M	#XXh	RV_
#75d	RecordValue72 = CTR_CDN_RBM_TIA_PLAUS low byte	M	#XXh	RV_
#76d	RecordValue#73 = CTR_COMP_RBM_AMP_PLAUS high byte	M	#XXh	RV_
#77d	RecordValue#74 = CTR_COMP_RBM_AMP_PLAUS low byte	M	#XXh	RV_
#78d	RecordValue#75 = CTR_CDN_RBM_AMP_PLAUS high byte	M	#XXh	RV_
#79d	RecordValue#76 = CTR_CDN_RBM_AMP_PLAUS low byte	M	#XXh	RV_
#80d	RecordValue77 = CTR_COMP_RBM_LOAD_TPS_PLAUS high byte	M	#XXh	RV_
#81d	RecordValue78 = CTR_COMP_RBM_LOAD_TPS_PLAUS low byte	M	#XXh	RV_
#82d	RecordValue79 = CTR_CDN_RBM_LOAD_TPS_PLAUS high byte	M	#XXh	RV_
#83d	RecordValue80 = CTR_CDN_RBM_LOAD_TPS_PLAUS low byte	M	#XXh	RV_
#84d	RecordValue#81 = NOT USED	M	#00h	RV_
#85d	RecordValue#82 = NOT USED	M	#00h	RV_
#86d	RecordValue#83 = NOT USED	M	#00h	RV_
#87d	RecordValue#84 = NOT USED	M	#00h	RV_
#88d	RecordValue#85 = NOT USED	M	#00h	RV_
#89d	RecordValue#86 = NOT USED	M	#00h	RV_
#90d	RecordValue#87 = NOT USED	M	#00h	RV_
#91d	RecordValue#88 = NOT USED	M	#00h	RV_
#92d	RecordValue#89 = CTR_COMP_RBM_MAP_DIP_PLAUS high byte	M	#XXh	RV_

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D ata Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#93d	RecordValue#90 = CTR_COMP_RBM_MAP_DIP_PLAUS low byte	M	#XXh	RV_
#94d	RecordValue#91 = CTR_CDN_RBM_MAP_DIP_PLAUS high byte	M	#XXh	RV_
#95d	RecordValue#92 = CTR_CDN_RBM_MAP_DIP_PLAUS low byte	M	#XXh	RV_
#96d	RecordValue#93 = NOT USED	M	#00h	RV_
#97d	RecordValue#94 = NOT USED	M	#00h	RV_
#98d	RecordValue#95 = NOT USED	M	#00h	RV_
#99d	RecordValue#96 = NOT USED	M	#00h	RV_
#100d	RecordValue#97 = NOT USED	M	#00h	RV_
#101d	RecordValue#98 = NOT USED	M	#00h	RV_
#102d	RecordValue#99 = NOT USED	M	#00h	RV_
#103d	RecordValue#100 = NOT USED	M	#00h	RV_
#104d	RecordValue#101 = CTR_COMP_RBM_VLS_DOWN_DIF_1 high byte	M	#XXh	RV_
#105d	RecordValue#102 = CTR_COMP_RBM_VLS_DOWN_DIF_1 low byte	M	#XXh	RV_
#106d	RecordValue#103 = CTR_CDN_RBM_VLS_DOWN_DIF_1 high byte	M	#XXh	RV_
#107d	RecordValue#104 = CTR_CDN_RBM_VLS_DOWN_DIF_1 low byte	M	#XXh	RV_
#108d	RecordValue#105 = CTR_COMP_RBM_VLS_DOWN_DIF_2 high byte	M	#XXh	RV_
#109d	RecordValue#106 = CTR_COMP_RBM_VLS_DOWN_DIF_2 low byte	M	#XXh	RV_
#110d	RecordValue#107 = CTR_CDN_RBM_VLS_DOWN_DIF_2 high byte	M	#XXh	RV_
#111d	RecordValue#108 = CTR_CDN_RBM_VLS_DOWN_DIF_2 low byte	M	#XXh	RV_
#112d	RecordValue#109 = CTR_COMP_RBM_T_ES high byte	M	#XXh	RV_
#113d	RecordValue#110 = CTR_COMP_RBM_T_ES low byte	M	#XXh	RV_
#114d	RecordValue#111 = CTR_CDN_RBM_T_ES high byte	M	#XXh	RV_
#115d	RecordValue#112 = CTR_CDN_RBM_T_ES low byte	M	#XXh	RV_
#116d	RecordValue#113 = CTR_COMP_RBM_TPS high byte	M	#XXh	RV_
#117d	RecordValue#114 = CTR_COMP_RBM_TPS low byte	M	#XXh	RV_
#118d	RecordValue#115 = CTR_CDN_RBM_TPS high byte	M	#XXh	RV_
#119d	RecordValue#116 = CTR_CDN_RBM_TPS low byte	M	#XXh	RV_
#120d	RecordValue#117 = NOT USED	M	#00h	RV_
#121d	RecordValue#118 = NOT USED	M	#00h	RV_
#122d	RecordValue#119 = NOT USED	M	#00h	RV_
#123d	RecordValue#120 = NOT USED	M	#00h	RV_
#124d	RecordValue#121 = NOT USED	M	#00h	RV_
#125d	RecordValue#122 = NOT USED	M	#00h	RV_
#126d	RecordValue#123 = NOT USED	M	#00h	RV_
#127d	RecordValue#124 = NOT USED	M	#00h	RV_
#128d	RecordValue#125 = CTR_COMP_RBM_ISC_CST high byte	M	#XXh	RV_
#129d	RecordValue#126 = CTR_COMP_RBM_ISC_CST low byte	M	#XXh	RV_
#130d	RecordValue#127 = CTR_CDN_RBM_ISC_CST high byte	M	#XXh	RV_
#131d	RecordValue#128 = CTR_CDN_RBM_ISC_CST low byte	M	#XXh	RV_
#132d	RecordValue#129 = CTR_COMP_RBM_TQ_CST high byte	M	#XXh	RV_
#133d	RecordValue#130 = CTR_COMP_RBM_TQ_CST low byte	M	#XXh	RV_
#134d	RecordValue#131 = CTR_CDN_RBM_TQ_CST high byte	M	#XXh	RV_
#135d	RecordValue#132 = CTR_CDN_RBM_TQ_CST low byte	M	#XXh	RV_
#136d	RecordValue#133 = CTR_COMP_RBM_TCO_STUCK_RNG high byte	M	#XXh	RV_
#‰d	RecordValue#134 = CTR_COMP_RBM_TCO_STUCK_RNG low byte	M	#XXh	RV_
#138d	RecordValue#135 = CTR_CDN_RBM_TCO_STUCK_RNG high byte	M	#XXh	RV_

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#139d	RecordValue#136 = CTR_CDN_RBM_TCO_STUCK_RNG low byte	M	#XXh	RV_
#140d	RecordValue#‰ = NOT USED	M	#00h	RV_
#141d	RecordValue#138 = NOT USED	M	#00h	RV_
#142d	RecordValue#139 = NOT USED	M	#00h	RV_
#143d	RecordValue#140 = NOT USED	M	#00h	RV_
#144d	RecordValue#141 = NOT USED	M	#00h	RV_
#1-d	RecordValue#142 = NOT USED	M	#00h	RV_
#146d	RecordValue#143 = NOT USED	M	#00h	RV_
#147d	RecordValue#144 = NOT USED	M	#00h	RV_
#148d	RecordValue#1- = NOT USED	M	#00h	RV_
#149d	RecordValue#146 = NOT USED	M	#00h	RV_
#150d	RecordValue#147 = NOT USED	M	#00h	RV_
#151d	RecordValue#148 = NOT USED	M	#00h	RV_
#152d	RecordValue#149 = NOT USED	M	#00h	RV_
#153d	RecordValue#150 = NOT USED	M	#00h	RV_
#154d	RecordValue#151 = NOT USED	M	#00h	RV_
#155d	RecordValue#152 = NOT USED	M	#00h	RV_
#156d	RecordValue#153 = NOT USED	M	#00h	RV_
#157d	RecordValue#154 = NOT USED	M	#00h	RV_
#158d	RecordValue#155 = NOT USED	M	#00h	RV_
#159d	RecordValue#156 = NOT USED	M	#00h	RV_
#160d	RecordValue#157 = NOT USED	M	#00h	RV_
#161d	RecordValue#158 = NOT USED	M	#00h	RV_
#162d	RecordValue#159 = NOT USED	M	#00h	RV_
#163d	RecordValue#160 = NOT USED	M	#00h	RV_
#164d	RecordValue#161 = NOT USED	M	#00h	RV_
#165d	RecordValue#162 = NOT USED	M	#00h	RV_
#166d	RecordValue#163 = NOT USED	M	#00h	RV_
#167d	RecordValue#164 = NOT USED	M	#00h	RV_
#168d	RecordValue#165 = CTR_COMP_RBM_T_ES_TCO_FAST high byte	M	#XXh	RV_
#169d	RecordValue#166 = CTR_COMP_RBM_T_ES_TCO_FAST low byte	M	#XXh	RV_
#170d	RecordValue#167 = CTR_CDN_RBM_T_ES_TCO_FAST high byte	M	#XXh	RV_
#171d	RecordValue#168 = CTR_CDN_RBM_T_ES_TCO_FAST low byte	M	#XXh	RV_
#172d	RecordValue#169 = CTR_COMP_RBM_T_ES_TCO_SLOW high byte	M	#XXh	RV_
#173d	RecordValue#170 = CTR_COMP_RBM_T_ES_TCO_SLOW low byte	M	#XXh	RV_
#→d	RecordValue#171 = CTR_CDN_RBM_T_ES_TCO_SLOW high byte	M	#XXh	RV_
#175d	RecordValue#172 = CTR_CDN_RBM_T_ES_TCO_SLOW low byte	M	#XXh	RV_
#176d	RecordValue#173 = CTR_COMP_RBM_FUP_CH_1 high byte	M	#XXh	RV_
#177d	RecordValue#→ = CTR_COMP_RBM_FUP_CH_1 low byte	M	#XXh	RV_
#178d	RecordValue#175 = CTR_CDN_RBM_FUP_CH_1 high byte	M	#XXh	RV_
#179d	RecordValue#176 = CTR_CDN_RBM_FUP_CH_1 low byte	M	#XXh	RV_
#180d	RecordValue#177 = NOT USED	M	#00h	RV_
#181d	RecordValue#178 = NOT USED	M	#00h	RV_
#182d	RecordValue#179 = NOT USED	M	#00h	RV_
#183d	RecordValue#180 = NOT USED	M	#00h	RV_
#184d	RecordValue#181 = CTR_COMP_RBM_EFF_IGA_CST_IS high byte	M	#XXh	RV_

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#185d	RecordValue#182 = CTR_COMP_RBM_EFF_IGA_CST_IS low byte	M	#XXh	RV_
#186d	RecordValue#183 = CTR_CDN_RBM_EFF_IGA_CST_IS high byte	M	#XXh	RV_
#187d	RecordValue#184 = CTR_CDN_RBM_EFF_IGA_CST_IS low byte	M	#XXh	RV_
#188d	RecordValue#185 = CTR_COMP_RBM_EFF_IGA_CST_PL high byte	M	#XXh	RV_
#189d	RecordValue#186 = CTR_COMP_RBM_EFF_IGA_CST_PL low byte	M	#XXh	RV_
#190d	RecordValue#187 = CTR_CDN_RBM_EFF_IGA_CST_PL high byte	M	#XXh	RV_
#191d	RecordValue#188 = CTR_CDN_RBM_EFF_IGA_CST_PL low byte	M	#XXh	RV_
#192d	RecordValue#189 = CTR_COMP_RBM_CAM_CST_IVVT_IN_1 high byte	M	#XXh	RV_
#193d	RecordValue#190 = CTR_COMP_RBM_CAM_CST_IVVT_IN_1 low byte	M	#XXh	RV_
#194d	RecordValue#191 = CTR_CDN_RBM_CAM_CST_IVVT_IN_1 high byte	M	#XXh	RV_
#195d	RecordValue#192 = CTR_CDN_RBM_CAM_CST_IVVT_IN_1 low byte	M	#XXh	RV_
#196d	RecordValue#193 = NOT USED	M	#00h	RV_
#197d	RecordValue#194 = NOT USED	M	#00h	RV_
#198d	RecordValue#195 = NOT USED	M	#00h	RV_
#199d	RecordValue#196 = NOT USED	M	#00h	RV_
#200d	RecordValue#197 = CTR_COMP_RBM_CAM_CST_IVVT_EX_1 high byte	M	#XXh	RV_
#201d	RecordValue#198 = CTR_COMP_RBM_CAM_CST_IVVT_EX_1 low byte	M	#XXh	RV_
#202d	RecordValue#199 = CTR_CDN_RBM_CAM_CST_IVVT_EX_1 high byte	M	#XXh	RV_
#203d	RecordValue#200 = CTR_CDN_RBM_CAM_CST_IVVT_EX_1 low byte	M	#XXh	RV_
#204d	RecordValue#201 = NOT USED	M	#00h	RV_
...	...	M	#00h	RV_
...	...	M	#00h	RV_
#231d	RecordValue#228 = NOT USED	M	#00h	RV_

I.23.60 22_402D - RCI_MWLRP_lesen

General information:

Messwerte Laufruhepruefung auslesen
This function reads out values from the engine roughness check.

I.23.60.1 MSD 85 only

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_MWLRP
3	RecordCommonIdentifier Low Byte	M	2Dh	RCI_MWLRP

Positive Response on service

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	RDBCIR
2	RecordCommonIdentifier High Byte	M	40h	RCI_MWLRP
3	RecordCommonIdentifier Low Byte	M	2Dh	RCI_MWLRP
4	Not used	M	FFh	RV_DUMMY_1
5	Not used	M	FFh	RV_DUMMY_2
6	Not used	M	FFh	RV_DUMMY_3
7	Not used	M	FFh	RV_DUMMY_4
8	RecordValue5 = Amo_05 high byte	M	XXh	RV_AMO_05
9	RecordValue6 = Amo_05 low byte	M	XXh	RV_AMO_05
10	RecordValue7 = Amo_10high byte	M	XXh	RV_AMO_10
11	RecordValue8 = Amo_10low byte	M	XXh	RV_AMO_10
12	RecordValue9 = Amo_15 high byte	M	XXh	RV_AMO_15
13	RecordValue10 = Amo_15 low byte	M	XXh	RV_AMO_15
14	RecordValue11 = Amo_20 high byte	M	XXh	RV_AMO_20
15	RecordValue12 = Amo_20 low byte	M	XXh	RV_AMO_20
16	Not used	M	FFh	RV_DUMMY_5
17	Not used	M	FFh	RV_DUMMY_6
18	Not used	M	FFh	RV_DUMMY_7
19	Not used	M	FFh	RV_DUMMY_8
20	Not used	M	FFh	RV_DUMMY_9
21	Not used	M	FFh	RV_DUMMY_10
22	Not used	M	FFh	RV_DUMMY_11
23	Not used	M	FFh	RV_DUMMY_12
24	Not used	M	FFh	RV_DUMMY_13
25	Not used	M	FFh	RV_DUMMY_14
26	Not used	M	FFh	RV_DUMMY_15
27	Not used	M	FFh	RV_DUMMY_16
28	Not used	M	FFh	RV_DUMMY_17
29	Not used	M	FFh	RV_DUMMY_18
30	Not used	M	FFh	RV_DUMMY_19
31	Not used	M	FFh	RV_DUMMY_20
32	Not used	M	FFh	RV_DUMMY_21
33	Not used	M	FFh	RV_DUMMY_22
34	Not used	M	FFh	RV_DUMMY_23
35	RecordValue32 = Lurabs_f[0] high byte	M	XXh	RV_LURABS_F[0]
36	RecordValue33 = Lurabs_f[0] low byte	M	XXh	RV_LURABS_F[0]
37	RecordValue34 = Lurdif_f[0] high byte	M	XXh	RV_LURDIF_F[0]
38	RecordValue35 = Lurdif_f[0] low byte	M	XXh	RV_LURDIF_F[0]
39	RecordValue36 = Zw_offkorrvr[0] high byte	M	XXh	RV_ZW_OFFKORRVR[0]
40	RecordValue37 = Zw_offkorrvr[0] low byte	M	XXh	RV_ZW_OFFKORRVR[0]
41	Not used	M	FFh	RV_DUMMY_24
42	Not used	M	FFh	RV_DUMMY_25
43	RecordValue40 = Lurabs_f[1] high byte	M	XXh	RV_LURABS_F[1]
44	RecordValue41 = Lurabs_f[1] low byte	M	XXh	RV_LURABS_F[1]
-	RecordValue42 = Lurdif_f[1] high byte	M	XXh	RV_LURDIF_F[1]
46	RecordValue43 = Lurdif_f[1] low byte	M	XXh	RV_LURDIF_F[1]
47	RecordValue44 = Zw_offkorrvr[1] high byte	M	XXh	RV_ZW_OFFKORRVR[1]
48	RecordValue- = Zw_offkorrvr[1] low byte	M	XXh	RV_ZW_OFFKORRVR[1]

M

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49	Not used	M	FFh	RV_DUMMY_26
50	Not used	M	FFh	RV_DUMMY_27
51	RecordValue48 = Lurabs_f[2] high byte	M	XXh	RV_LURABS_F[2]
52	RecordValue49 = Lurabs_f[2] low byte	M	XXh	RV_LURABS_F[2]
53	RecordValue50 = Lurdif_f[2] high byte	M	XXh	RV_LURDIF_F[2]
54	RecordValue51 = Lurdif_f[2] low byte	M	XXh	RV_LURDIF_F[2]
55	RecordValue52 = Zw_offkorrvr[2] high byte	M	XXh	RV_ZW_OFFKORRVR[2]
56	RecordValue53 = Zw_offkorrvr[2] low byte	M	XXh	RV_ZW_OFFKORRVR[2]
57	Not used	M	FFh	RV_DUMMY_28
58	Not used	M	FFh	RV_DUMMY_29
59	RecordValue56 = Lurabs_f[3] high byte	M	XXh	RV_LURABS_F[3]
60	RecordValue57 = Lurabs_f[3] low byte	M	XXh	RV_LURABS_F[3]
61	RecordValue58 = Lurdif_f[3] high byte	M	XXh	RV_LURDIF_F[3]
62	RecordValue59 = Lurdif_f[3] low byte	M	XXh	RV_LURDIF_F[3]
63	RecordValue60 = Zw_offkorrvr[3] high byte	M	XXh	RV_ZW_OFFKORRVR[3]
64	RecordValue61 = Zw_offkorrvr[3] low byte	M	XXh	RV_ZW_OFFKORRVR[3]
65	Not used	M	FFh	RV_DUMMY_30
66	Not used	M	FFh	RV_DUMMY_31
67	RecordValue64 = Lurabs_f[4] high byte	M	XXh	RV_LURABS_F[4]
68	RecordValue65 = Lurabs_f[4] low byte	M	XXh	RV_LURABS_F[4]
69	RecordValue66 = Lurdif_f[4] high byte	M	XXh	RV_LURDIF_F[4]
70	RecordValue67 = Lurdif_f[4] low byte	M	XXh	RV_LURDIF_F[4]
71	RecordValue68 = Zw_offkorrvr[4] high byte	M	XXh	RV_ZW_OFFKORRVR[4]
72	RecordValue69 = Zw_offkorrvr[4] low byte	M	XXh	RV_ZW_OFFKORRVR[4]
73	Not used	M	FFh	RV_DUMMY_32
74	Not used	M	FFh	RV_DUMMY_33
75	RecordValue72 = Lurabs_f[5] high byte	M	XXh	RV_LURABS_F[5]
76	RecordValue73 = Lurabs_f[5] low byte	M	XXh	RV_LURABS_F[5]
77	RecordValue74 = Lurdif_f[5] high byte	M	XXh	RV_LURDIF_F[5]
78	RecordValue75 = Lurdif_f[5] low byte	M	XXh	RV_LURDIF_F[5]
79	RecordValue76 = Zw_offkorrvr[5] high byte	M	XXh	RV_ZW_OFFKORRVR[5]
80	RecordValue77 = Zw_offkorrvr[5] low byte	M	XXh	RV_ZW_OFFKORRVR[5]
81	Not used	M	FFh	RV_DUMMY_34
82	Not used	M	FFh	RV_DUMMY_35
83	RecordValue80 = Lurabs_f[6] high byte	M	XXh	RV_LURABS_F[6]
84	RecordValue81 = Lurabs_f[6] low byte	M	XXh	RV_LURABS_F[6]
85	RecordValue82 = Lurdif_f[6] high byte	M	XXh	RV_LURDIF_F[6]
86	RecordValue83 = Lurdif_f[6] low byte	M	XXh	RV_LURDIF_F[6]
87	RecordValue84 = Zw_offkorrvr[6] high byte	M	XXh	RV_ZW_OFFKORRVR[6]
88	RecordValue85 = Zw_offkorrvr[6] low byte	M	XXh	RV_ZW_OFFKORRVR[6]
89	Not used	M	FFh	RV_DUMMY_36
90	Not used	M	FFh	RV_DUMMY_37
91	RecordValue88 = Lurabs_f[7] high byte	M	XXh	RV_LURABS_F[7]
92	RecordValue89 = Lurabs_f[7] low byte	M	XXh	RV_LURABS_F[7]
93	RecordValue90 = Lurdif_f[7] high byte	M	XXh	RV_LURDIF_F[7]
94	RecordValue91 = Lurdif_f[7] low byte	M	XXh	RV_LURDIF_F[7]
95	RecordValue92 = Zw_offkorrvr[7] high byte	M	XXh	RV_ZW_OFFKORRVR[7]
96	RecordValue93 = Zw_offkorrvr[7] low byte	M	XXh	RV_ZW_OFFKORRVR[7]
97	RecordValue94 = Amo_30 high byte	M	XXh	RV_AMO_30
98	RecordValue95 = Amo_30 low byte	M	XXh	RV_AMO_30

99	RecordValue96 = Amo_40 high byte	M	XXh	RV_AMO_40
100	RecordValue97 = Amo_40 low byte	M	XXh	RV_AMO_40

Hint: all record values which are not defined in BMW-layer.h are FFh,

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also RecordValue 65d ... 93d for 4cyl-machine,
RecordValue 78d ... 93d for 6cyl-machine

I.23.60.2 All other projects

General information:

Messwerte Laufruhepruefung auslesen

This function reads out values from the engine roughness check.

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier High Byte	M	40h	RCI_MWLRP
3	RecordCommonIdentifier Low Byte	M	2Dh	RCI_MWLRP

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	RDBCIR
2	RecordCommonIdentifier High Byte	M	40h	RCI_MWLRP
3	RecordCommonIdentifier Low Byte	M	2Dh	RCI_MWLRP
4	RecordValue1 = St_vbrvs_aus high byte	M	XXh	RV_ST_VBRVS_AUS
5	RecordValue2 = St_vbrvs_aus low byte	M	XXh	RV_ST_VBRVS_AUS
6	RecordValue3 = St_vbrvs_ein	M	XXh	RV_ST_VBRVS_EIN
7	RecordValue4 = dummy value fix	M	FFh	RV_ST_VBRVS_EINNV
8	RecordValue5 = Amo_05 high byte	M	XXh	RV_AMO_05
9	RecordValue6 = Amo_05 low byte	M	XXh	RV_AMO_05
10	RecordValue7 = Amo_10high byte	M	XXh	RV_AMO_10
11	RecordValue8 = Amo_10low byte	M	XXh	RV_AMO_10
12	RecordValue9 = Amo_15 high byte	M	XXh	RV_AMO_15
13	RecordValue10 = Amo_15 low byte	M	XXh	RV_AMO_15
14	RecordValue11 = Amo_20 high byte	M	XXh	RV_AMO_20
15	RecordValue12 = Amo_20 low byte	M	XXh	RV_AMO_20
16	RecordValue13 = [Exwinkkor high byte **(only MSV80),** FFh **(other)]**	M	XXh	RV_EXWINKKOR
17	RecordValue14 = [Exwinkkor low byte **(only MSV80),** FFh **(other)]**	M	XXh	RV_EXWINKKOR
18	RecordValue15 = Zylhubkor	M	XXh	RV_ZYLHUBKOR
19	RecordValue16 =[Minhub high byte **(only MSV80),** FFh **(other)]**	M	XXh	RV_MINHUB
20	RecordValue17 = [Minhub low byte **(only MSV80),** FFh **(other)**]	M	XXh	RV_MINHUB
21	RecordValue18 = F_minhub high byte	M	XXh	RV_F_MINHUB
22	RecordValue19 = F_minhub low byte	M	XXh	RV_F_MINHUB
23	RecordValue20 = Minhub_roh high byte	M	XXh	RV_MINHUB_ROH
24	RecordValue21 = Minhub_roh low byte	M	XXh	RV_MINHUB_ROH
25	RecordValue22 = Minhubvs high byte	M	XXh	RV_MINHUBVS
26	RecordValue23 = Minhubvs low byte	M	XXh	RV_MINHUBVS
27	RecordValue24 = Minhubvs_ist high byte	M	XXh	RV_MINHUBVS_IST
28	RecordValue25 = Minhubvs_ist low byte	M	XXh	RV_MINHUBVS_IST
29	RecordValue26 = Minhubvsnv high byte	M	XXh	RV_MINHUBVSNV
30	RecordValue27 = Minhubvsnv low byte	M	XXh	RV_MINHUBVSNV
31	RecordValue28 = S_vsmnhb	M	XXh	RV_S_VSMNHB
32	RecordValue29 = S_vsmnhbnv	M	XXh	RV_S_VSMNHBNV
33	RecordValue30 = F_tikorrvr[0] high byte	M	XXh	RV_F_TIKORRVR[0]
34	RecordValue31 = F_tikorrvr[0] low byte	M	XXh	RV_F_TIKORRVR[0]
35	RecordValue32 = Lurabs_f[0] high byte	M	XXh	RV_LURABS_F[0]
36	RecordValue33 = Lurabs_f[0] low byte	M	XXh	RV_LURABS_F[0]
37	RecordValue34 = Lurdif_f[0] high byte	M	XXh	RV_LURDIF_F[0]
38	RecordValue35 = Lurdif_f[0] low byte	M	XXh	RV_LURDIF_F[0]
39	RecordValue36 = Zw_offkorrvr[0] high byte	M	XXh	RV_ZW_OFFKORRVR[0]
40	RecordValue37 = Zw_offkorrvr[0] low byte	M	XXh	RV_ZW_OFFKORRVR[0]
41	RecordValue38 = F_tikorrvr[1] high byte	M	XXh	RV_F_TIKORRVR[1]
42	RecordValue39 = F_tikorrvr[1] low byte	M	XXh	RV_F_TIKORRVR[1]
43	RecordValue40 = Lurabs_f[1] high byte	M	XXh	RV_LURABS_F[1]
44	RecordValue41 = Lurabs_f[1] low byte	M	XXh	RV_LURABS_F[1]
-	RecordValue42 = Lurdif_f[1] high byte	M	XXh	RV_LURDIF_F[1]

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46	RecordValue43 = Lurdif_f[1] low byte	M	XXh	RV_LURDIF_F[1]
47	RecordValue44 = Zw_offkorrvr[1] high byte	M	XXh	RV_ZW_OFFKORRVR[1]
48	RecordValue- = Zw_offkorrvr[1] low byte	M	XXh	RV_ZW_OFFKORRVR[1]
49	RecordValue46 = F_tikorrvr[2] high byte	M	XXh	RV_F_TIKORRVR[2]
50	RecordValue47 = F_tikorrvr[2] low byte	M	XXh	RV_F_TIKORRVR[2]
51	RecordValue48 = Lurabs_f[2] high byte	M	XXh	RV_LURABS_F[2]
52	RecordValue49 = Lurabs_f[2] low byte	M	XXh	RV_LURABS_F[2]
53	RecordValue50 = Lurdif_f[2] high byte	M	XXh	RV_LURDIF_F[2]
54	RecordValue51 = Lurdif_f[2] low byte	M	XXh	RV_LURDIF_F[2]
55	RecordValue52 = Zw_offkorrvr[2] high byte	M	XXh	RV_ZW_OFFKORRVR[2]
56	RecordValue53 = Zw_offkorrvr[2] low byte	M	XXh	RV_ZW_OFFKORRVR[2]
57	RecordValue54 = F_tikorrvr[3] high byte	M	XXh	RV_F_TIKORRVR[3]
58	RecordValue55 = F_tikorrvr[3] low byte	M	XXh	RV_F_TIKORRVR[3]
59	RecordValue56 = Lurabs_f[3] high byte	M	XXh	RV_LURABS_F[3]
60	RecordValue57 = Lurabs_f[3] low byte	M	XXh	RV_LURABS_F[3]
61	RecordValue58 = Lurdif_f[3] high byte	M	XXh	RV_LURDIF_F[3]
62	RecordValue59 = Lurdif_f[3] low byte	M	XXh	RV_LURDIF_F[3]
63	RecordValue60 = Zw_offkorrvr[3] high byte	M	XXh	RV_ZW_OFFKORRVR[3]
64	RecordValue61 = Zw_offkorrvr[3] low byte	M	XXh	RV_ZW_OFFKORRVR[3]
65	RecordValue62 = F_tikorrvr[4] high byte	M	XXh	RV_F_TIKORRVR[4]
66	RecordValue63 = F_tikorrvr[4] low byte	M	XXh	RV_F_TIKORRVR[4]
67	RecordValue64 = Lurabs_f[4] high byte	M	XXh	RV_LURABS_F[4]
68	RecordValue65 = Lurabs_f[4] low byte	M	XXh	RV_LURABS_F[4]
69	RecordValue66 = Lurdif_f[4] high byte	M	XXh	RV_LURDIF_F[4]
70	RecordValue67 = Lurdif_f[4] low byte	M	XXh	RV_LURDIF_F[4]
71	RecordValue68 = Zw_offkorrvr[4] high byte	M	XXh	RV_ZW_OFFKORRVR[4]
72	RecordValue69 = Zw_offkorrvr[4] low byte	M	XXh	RV_ZW_OFFKORRVR[4]
73	RecordValue70 = F_tikorrvr[5] high byte	M	XXh	RV_F_TIKORRVR[5]
74	RecordValue71 = F_tikorrvr[5] low byte	M	XXh	RV_F_TIKORRVR[5]
75	RecordValue72 = Lurabs_f[5] high byte	M	XXh	RV_LURABS_F[5]
76	RecordValue73 = Lurabs_f[5] low byte	M	XXh	RV_LURABS_F[5]
77	RecordValue74 = Lurdif_f[5] high byte	M	XXh	RV_LURDIF_F[5]
78	RecordValue75 = Lurdif_f[5] low byte	M	XXh	RV_LURDIF_F[5]
79	RecordValue76 = Zw_offkorrvr[5] high byte	M	XXh	RV_ZW_OFFKORRVR[5]
80	RecordValue77 = Zw_offkorrvr[5] low byte	M	XXh	RV_ZW_OFFKORRVR[5]
81	RecordValue78 = F_tikorrvr[6] high byte	M	XXh	RV_F_TIKORRVR[6]
82	RecordValue79 = F_tikorrvr[6] low byte	M	XXh	RV_F_TIKORRVR[6]
83	RecordValue80 = Lurabs_f[6] high byte	M	XXh	RV_LURABS_F[6]
84	RecordValue81 = Lurabs_f[6] low byte	M	XXh	RV_LURABS_F[6]
85	RecordValue82 = Lurdif_f[6] high byte	M	XXh	RV_LURDIF_F[6]
86	RecordValue83 = Lurdif_f[6] low byte	M	XXh	RV_LURDIF_F[6]
87	RecordValue84 = Zw_offkorrvr[6] high byte	M	XXh	RV_ZW_OFFKORRVR[6]
88	RecordValue85 = Zw_offkorrvr[6] low byte	M	XXh	RV_ZW_OFFKORRVR[6]
89	RecordValue86 = F_tikorrvr[7] high byte	M	XXh	RV_F_TIKORRVR[7]
90	RecordValue87 = F_tikorrvr[7] low byte	M	XXh	RV_F_TIKORRVR[7]
91	RecordValue88 = Lurabs_f[7] high byte	M	XXh	RV_LURABS_F[7]
92	RecordValue89 = Lurabs_f[7] low byte	M	XXh	RV_LURABS_F[7]
93	RecordValue90 = Lurdif_f[7] high byte	M	XXh	RV_LURDIF_F[7]
94	RecordValue91 = Lurdif_f[7] low byte	M	XXh	RV_LURDIF_F[7]
95	RecordValue92 = Zw_offkorrvr[7] high byte	M	XXh	RV_ZW_OFFKORRVR[7]

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96	RecordValue93 = Zw_offkorrvr[7] low byte	M	XXh	RV_ZW_OFFKORRVR[7]
97	RecordValue94 = Amo_30 high byte	M	XXh	RV_AMO_30
98	RecordValue95 = Amo_30 low byte	M	XXh	RV_AMO_30
99	RecordValue96 = Amo_40 high byte	M	XXh	RV_AMO_40
100	RecordValue97 = Amo_40 low byte	M	XXh	RV_AMO_40

Hint: all record values which are not defined in BMW-layer.h are FFh,
also RecordValue 65d ... 93d for 4cyl-machine,
RecordValue 78d ... 93d for 6cyl-machine

I.23.61 22_402E - Nullgang-Erkennung lesen

General information:

This function is created to read out the info about "Nullgang Erkennung"

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	40h	RCI_NGE
3	RecordCommonIdentifier Low Byte	M	2Eh	RCI_NGE

Figure I.23.9: Table Request Message

Positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_NGE
3	RecordCommonIdentifier Low Byte	M	2Eh	RCI_NGE
4	recordValue1 = Tvngang (high byte)	M	XXh	RV_PHY_NG_POSITION
5	recordValue2 = Tvngang (low byte)	M	XXh	RV_PHY_NG_POSITION
6	recordValue3 = Tvneutral (high byte)	M	XXh	RV_PHY_NG_LERN
7	recordValue4 = Tvneutral (low byte)	M	XXh	RV_PHY_NG_LERN
8	recordValue5 = 0 - if B_gangnull = FALSE 1 - if B_gangnull = TRUE	M	XXh	RV_STAT_NG_ERKANNT
9	recordValue6 = 0 - if B_nggelernt = 0 1 - if B_nggelernt = 1	M	XXh	RV_STAT_NG_GELERNT
10	recordValue7 = 0 - if B_kupp_ext = FALSE 1 - if B_kupp_ext = TRUE	M	XXh	RV_STATKUP_BETAETIGT
11	recordValue8 = 0 - if B_kwdreht = FALSE 1 - if B_kwdreht = TRUE	M	XXh	RV_STAT_MOT_DREHT
12	recordValue9 = 0 - if B_ngimlf = FALSE 1 - if B_ngimlf = TRUE	M	XXh	RV_STAT_NG_IM_LF

I.23.62 22_402F - MSA lesen

General information:

This function is created to read out the state of "MotorStopAutomatik"

Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	40h	RCI_MSA
3	RecordCommonIdentifier Low Byte	M	2Fh	RCI_MSA

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	40h	RCI_MSA
3	RecordCommonIdentifier Low Byte	M	2Fh	RCI_MSA
4	recordValue1 = Stmsa (high byte, high word)	M	XXh	RV_STAT_MSA
5	recordValue2 = Stmsa (low byte, high word)	M	XXh	RV_STAT_MSA
6	recordValue3 = Stmsa (high byte, low word)	M	XXh	RV_STAT_MSA
7	recordValue4 = Stmsa (low byte, low word)	M	XXh	RV_STAT_MSA
8	recordValue5 = Stmsaav (high byte, high word)	M	XXh	RV_STAT_MSAAV
9	recordValue6 = Stmsaav (low byte, high word)	M	XXh	RV_STAT_MSAAV
10	recordValue7 = Stmsaav (high byte, low word)	M	XXh	RV_STAT_MSAAV
11	recordValue8 = Stmsaav (low byte, low word)	M	XXh	RV_STAT_MSAAV
12	recordValue9 = Stmsaev (high byte, high word)	M	XXh	RV_STAT_MSAEVV
13	recordValue10 = Stmsaev (low byte, high word)	M	XXh	RV_STAT_MSAEVV
14	recordValue11 = Stmsaev (high byte, low word)	M	XXh	RV_STAT_MSAEVV
15	recordValue12 = Stmsaev (low byte, low word)	M	XXh	RV_STAT_MSAEVV
16	recordValue13 = Stmsaaa (high byte, high word)	M	XXh	RV_STAT_MSAAA
17	recordValue14 = Stmsaaa (low byte, high word)	M	XXh	RV_STAT_MSAAA
18	recordValue15 = Stmsaaa (high byte, low word)	M	XXh	RV_STAT_MSAAA
19	recordValue16 = Stmsaaa (low byte, low word)	M	XXh	RV_STAT_MSAAA
20	recordValue17 = Stmsaea (high byte, high word)	M	XXh	RV_STAT_MSAEA
21	recordValue18 = Stmsaea (low byte, high word)	M	XXh	RV_STAT_MSAEA
22	recordValue19 = Stmsaea (high byte, low word)	M	XXh	RV_STAT_MSAEA
23	recordValue20 = Stmsaea (low byte, low word)	M	XXh	RV_STAT_MSAEA

I.23.63 22_4030 - FASTA_LVS_lesen

General information:

This function ist for reading the data of the FASTA_LVS (Fahrzeugnutzungsprofil)

Formula section:

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier	M	40h	RCI_LVS
3	RecordCommonIdentifier	M	30h	RCI_LVS

Positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	40h	RCI_LVS
3	RecordCommonIdentifier	M	30h	RCI_LVS
4	RecordValue1 = Zr_lvs_0 (high byte)	M	XXh	RV_ZR_LVS_0
5	RecordValue2 = Zr_lvs_0 (low byte)	M	XXh	RV_ ZR_LVS_0
6	RecordValue3 = Zr_lvs_1 (high byte)	M	XXh	RV_ ZR_LVS_1
7	RecordValue4 = Zr_lvs_1 (low byte)	M	XXh	RV_ ZR_LVS_1
8	RecordValue5 = Zr_lvs_2(high byte)	M	XXh	RV_ ZR_LVS_2
9	RecordValue6 = Zr_lvs_2(low byte)	M	XXh	RV_ ZR_LVS_2
10	RecordValue7 = Zr_lvs_3 (high byte)	M	XXh	RV_ ZR_LVS_3
11	RecordValue8 = Zr_lvs_3 (low byte)	M	XXh	RV_ ZR_LVS_3
12	RecordValue9 = Zr_lvssekt_0 (high byte)	M	XXh	RV_ZR_LVSSEKT_0
13	RecordValue10= Zr_lvssekt_0 (low byte)	M	XXh	RV_ZR_LVSSEKT_0
14	RecordValue11 = Zr_lvssekt_1 (high byte)	M	XXh	RV_ZR_LVSSEKT_1
15	RecordValue12 = Zr_lvssekt_1 (low byte)	M	XXh	RV_ZR_LVSSEKT_1
16	RecordValue13 = Zr_lvssekt_2 (high byte)	M	XXh	RV_ZR_LVSSEKT_2
17	RecordValue14 = Zr_lvssekt_2 (low byte)	M	XXh	RV_ZR_LVSSEKT_2
18	RecordValue15 = Zr_lvssekt_3 (high byte)	M	XXh	RV_ZR_LVSSEKT_3
19	RecordValue16 = Zr_lvssekt_3 (low byte)	M	XXh	RV_ZR_LVSSEKT_3
20	RecordValue17 = Zr_lvssekt_4 (high byte)	M	XXh	RV_ZR_LVSSEKT_4
21	RecordValue18 = Zr_lvssekt_4 (low byte)	M	XXh	RV_ZR_LVSSEKT_4
22	RecordValue19 = Zr_lvssekt_5 (high byte)	M	XXh	RV_ZR_LVSSEKT_5
23	RecordValue20 = Zr_lvssekt_5 (low byte)	M	XXh	RV_ZR_LVSSEKT_5
24	RecordValue21 = Zr_lvssekt_6 (high byte)	M	XXh	RV_ZR_LVSSEKT_6
25	RecordValue22 = Zr_lvssekt_6 (low byte)	M	XXh	RV_ZR_LVSSEKT_6
26	RecordValue23 = Zr_lvssekt_7 (high byte)	M	XXh	RV_ZR_LVSSEKT_7
27	RecordValue24 = Zr_lvssekt_7 (low byte)	M	XXh	RV_ZR_LVSSEKT_7
28	RecordValue25 = Zr_lvssekt_8 (high byte)	M	XXh	RV_ZR_LVSSEKT_8
29	RecordValue26 = Zr_lvssekt_8 (low byte)	M	XXh	RV_ZR_LVSSEKT_8
30	RecordValue27 = Zr_lvs_ll_reakt	M	XXh	RV_ZR_LVS_LL_REAKT

I.23.64 22_4031 - LVSZYL_lesen

General information:

This function ist for reading the data of the LVSZYL (LaufruheVerbesserungssystem Zylinderstatistik)

Formula section:

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier	M	40h	RCI_LVSZYL
3	RecordCommonIdentifier	M	31h	RCI_LVSZYL

Positive Response

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	40h	RCI_LVSZYL
3	RecordCommonIdentifier	M	31h	RCI_LVSZYL
4	RecordValue1 = Zr_lvszyl_0 (high byte)	M	XXh	RV_STAT_ZR_LVSZYL_0
5	RecordValue2 = Zr_lvszyl_0 (low byte)	M	XXh	RV_STAT_ZR_LVSZYL_0
6	RecordValue3 = Zr_lvszyl_1 (high byte)	M	XXh	RV_STAT_ZR_LVSZYL_1
7	RecordValue4 = Zr_lvszyl_1 (low byte)	M	XXh	RV_STAT_ZR_LVSZYL_1
8	RecordValue5 = Zr_lvszyl_2(high byte)	M	XXh	RV_STAT_ZR_LVSZYL_2
9	RecordValue6 = Zr_lvszyl_2(low byte)	M	XXh	RV_STAT_ZR_LVSZYL_2
10	RecordValue7 = Zr_lvszyl_3 (high byte)	M	XXh	RV_STAT_ZR_LVSZYL_3
11	RecordValue8 = Zr_lvszyl_3 (low byte)	M	XXh	RV_STAT_ZR_LVSZYL_3
12	RecordValue9 = Zr_lvszyl_4(high byte)	M	XXh	RV_STAT_ZR_LVSZYL_4
13	RecordValue10 = Zr_lvszyl_4(low byte)	M	XXh	RV_STAT_ZR_LVSZYL_4
14	RecordValue11= Zr_lvszyl_5 (high byte)	M	XXh	RV_STAT_ZR_LVSZYL_5
15	RecordValue12 = Zr_lvszyl_5 (low byte)	M	XXh	RV_STAT_ZR_LVSZYL_5

I.23.65 22_4032 - MFMA_lesen

General information:

This function ist for reading the data of MFMA (Kleinstmengenadaption)

Formula section:

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier	M	40h	RCI_MFMA
3	RecordCommonIdentifier	M	32h	RCI_MFMA

Positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service Id**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	40h	RCI_MFMA
3	RecordCommonIdentifier	M	32h	RCI_MFMA
4	RecordValue1 = CTR_AD_COLD_LAM_AD_INJ	M	XXh	RV_ CTR_AD_COLD_LAM_AD_INJ
5	RecordValue2 = CTR_AD_HOT_LAM_AD_INJ	M	XXh	RV_ CTR_AD_HOT_LAM_AD_INJ
6	RecordValue3 = DIST_LAM_AD_INJ_COLD (high byte)	M	XXh	RV_ DIST_LAM_AD_INJ_COLD
7	RecordValue4 = DIST_LAM_AD_INJ_COLD (low byte)	M	XXh	RV_ DIST_LAM_AD_INJ_COLD
8	RecordValue5 = DIST_LAM_AD_INJ_HOT (high byte)	M	XXh	RV_ DIST_LAM_AD_INJ_HOT
9	RecordValue6 = DIST_LAM_AD_INJ_HOT (low byte)	M	XXh	RV_ DIST_LAM_AD_INJ_HOT
10	RecordValue7 = FAC_LAM_ADJ_COR_LAM_AD_CUS[1] (high byte)	M	XXh	RV_ FAC_LAM_ADJ_COR_LAM_AD_CUS[1]
11	RecordValue8 = FAC_LAM_ADJ_COR_LAM_AD_CUS[1] (low byte)	M	XXh	RV_ FAC_LAM_ADJ_COR_LAM_AD_CUS[1]
12	RecordValue9 = FAC_LAM_ADJ_COR_LAM_AD_CUS[2] (high byte)	M	XXh	RV_ FAC_LAM_ADJ_COR_LAM_AD_CUS[2]
13	RecordValue10 =FAC_LAM_ADJ_COR_LAM_AD_CUS[2] (high byte)	M	XXh	RV_ FAC_LAM_ADJ_COR_LAM_AD_CUS[2]
14	RecordValue11 = FAC_LAM_ADJ_LAM_AD[1] (high byte)	M	XXh	RV_ FAC_LAM_ADJ_LAM_AD[1]
15	RecordValue12 = FAC_LAM_ADJ_LAM_AD[1] (low byte)	M	XXh	RV_ FAC_LAM_ADJ_LAM_AD[1]
16	RecordValue13 = FAC_LAM_ADJ_LAM_AD[2] (high byte)	M	XXh	RV_ FAC_LAM_ADJ_LAM_AD[2]
17	RecordValue14 = FAC_LAM_ADJ_LAM_AD[2] (low byte)	M	XXh	RV_ FAC_LAM_ADJ_LAM_AD[2]
18	RecordValue15 = MFF_ADD_COLD_LAM_AD_INJ[0] (high byte)	M	XXh	RV_ MFF_ADD_COLD_LAM_AD_INJ[0]
19	RecordValue16 = MFF_ADD_COLD_LAM_AD_INJ[0] (low byte)	M	XXh	RV_ MFF_ADD_COLD_LAM_AD_INJ[0]
20	RecordValue17 = MFF_ADD_HOT_LAM_AD_INJ[0] (high byte)	M	XXh	RV_ MFF_ADD_HOT_LAM_AD_INJ[0]
21	RecordValue18 = MFF_ADD_HOT_LAM_AD_INJ[0] (low byte)	M	XXh	RV_ MFF_ADD_HOT_LAM_AD_INJ[0]
22	RecordValue19 = MFF_ADD_COLD_LAM_AD_INJ[1] (high byte)	M	XXh	RV_ MFF_ADD_COLD_LAM_AD_INJ[1]
23	RecordValue20 = MFF_ADD_COLD_LAM_AD_INJ1] (low byte)	M	XXh	RV_ MFF_ADD_COLD_LAM_AD_INJ[1]
24	RecordValue 21 = MFF_ADD_HOT_LAM_AD_INJ[1] (high byte)	M	XXh	RV_ MFF_ADD_HOT_LAM_AD_INJ[1]
25	RecordValue22 = MFF_ADD_HOT_LAM_AD_INJ[1] (low byte)	M	XXh	RV_ MFF_ADD_HOT_LAM_AD_INJ[1]
26	RecordValue23 = MFF_ADD_COLD_LAM_AD_INJ[2] (high byte)	M	XXh	RV_ MFF_ADD_COLD_LAM_AD_INJ[2]
27	RecordValue24 = MFF_ADD_COLD_LAM_AD_INJ[2] (low byte)	M	XXh	RV_ MFF_ADD_COLD_LAM_AD_INJ[2]
28	RecordValue25 = MFF_ADD_HOT_LAM_AD_INJ[2] (high byte)	M	XXh	RV_ MFF_ADD_HOT_LAM_AD_INJ[2]
29	RecordValue26 = MFF_ADD_HOT_LAM_AD_INJ[2] (low byte)	M	XXh	RV_ MFF_ADD_HOT_LAM_AD_INJ[2]
30	RecordValue27 = MFF_ADD_COLD_LAM_AD_INJ[3] (high byte)	M	XXh	RV_ MFF_ADD_COLD_LAM_AD_INJ[3]
31	RecordValue28 = MFF_ADD_COLD_LAM_AD_INJ[3] (low byte)	M	XXh	RV_ MFF_ADD_COLD_LAM_AD_INJ[3]
32	RecordValue29 = MFF_ADD_HOT_LAM_AD_INJ[3] (high byte)	M	XXh	RV_ MFF_ADD_HOT_LAM_AD_INJ[3]

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33	RecordValue30 = MFF_ADD_HOT_LAM_AD_INJ[3] (low byte)	M	XXh	RV_ MFF_ADD_HOT_LAM_AD_INJ[3]
34	RecordValue31 = MFF_ADD_COLD_LAM_AD_INJ[4] (high byte)	M	XXh	RV_ MFF_ADD_COLD_LAM_AD_INJ[4]
35	RecordValue32 = MFF_ADD_COLD_LAM_AD_INJ[4] (low byte)	M	XXh	RV_ MFF_ADD_COLD_LAM_AD_INJ[4]
36	RecordValue33 = MFF_ADD_HOT_LAM_AD_INJ[4] (high byte)	M	XXh	RV_ MFF_ADD_HOT_LAM_AD_INJ[4]
37	RecordValue34 = MFF_ADD_HOT_LAM_AD_INJ[4] (low byte)	M	XXh	RV_ MFF_ADD_HOT_LAM_AD_INJ[4]
38	RecordValue35 = MFF_ADD_COLD_LAM_AD_INJ[5] (high byte)	M	XXh	RV_ MFF_ADD_COLD_LAM_AD_INJ[5]
39	RecordValue36 = MFF_ADD_COLD_LAM_AD_INJ[5] (low byte)	M	XXh	RV_ MFF_ADD_COLD_LAM_AD_INJ[5]
40	RecordValue37 = MFF_ADD_HOT_LAM_AD_INJ[5] (high byte)	M	XXh	RV_ MFF_ADD_HOT_LAM_AD_INJ[5]
41	RecordValue38 = MFF_ADD_HOT_LAM_AD_INJ[5] (low byte)	M	XXh	RV_ MFF_ADD_HOT_LAM_AD_INJ[5]
42	RecordValue39 = MFF_ADD_COLD_LAM_AD_INJ[6] (high byte)	M	XXh	RV_ MFF_ADD_COLD_LAM_AD_INJ[6]
43	RecordValue40 = MFF_ADD_COLD_LAM_AD_INJ[6] (low byte)	M	XXh	RV_ MFF_ADD_COLD_LAM_AD_INJ[6]
44	RecordValue41 = MFF_ADD_HOT_LAM_AD_INJ[6] (high byte)	M	XXh	RV_ MFF_ADD_HOT_LAM_AD_INJ[6]
-	RecordValue42 = MFF_ADD_HOT_LAM_AD_INJ[6] (low byte)	M	XXh	RV_ MFF_ADD_HOT_LAM_AD_INJ[6]
46	RecordValue43 = MFF_ADD_COLD_LAM_AD_INJ[7] (high byte)	M	XXh	RV_ MFF_ADD_COLD_LAM_AD_INJ[7]
47	RecordValue44 = MFF_ADD_COLD_LAM_AD_INJ[7] (low byte)	M	XXh	RV_ MFF_ADD_COLD_LAM_AD_INJ[7]
48	RecordValue- = MFF_ADD_HOT_LAM_AD_INJ[7] (high byte)	M	XXh	RV_ MFF_ADD_HOT_LAM_AD_INJ[7]
49	RecordValue46 = MFF_ADD_HOT_LAM_AD_INJ[7] (low byte)	M	XXh	RV_ MFF_ADD_HOT_LAM_AD_INJ[7]

Hint: transmitte 0ffh for variables which are not exist in project

I.23.66 22_4035 - Kraftstoffqualitätserfassung lesen

General information:

With this service the values for fuel quality statistic can be read.

Formula section:

If(1) service 22_40_35 is received
Then(1)
#If(2) NC_NR_RON_KWP <1
#Then(2)
send negative response "subfunction not supported"
#Else(2)
If(3) LC_RON_STC_ENA = 0
Then(3) send negative response "subfunction not supported"
Else(3) send positive response
Endif(3)
#Endif(2)
Endif(1)

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Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier high byte	M	40h	RCI_RCI_KQE
3	RecordCommonIdentifier low byte	M	35h	RCI_RCI_KQE

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier high byte	M	40h	RCI_RCI_KQE
3	RecordCommonIdentifier low byte	M	35h	RCI_RCI_KQE
4	RecordValue1 = CTR_STC_RON_LOW (high byte)	M	XXh	RV_ KQE_
5	RecordValue2 = CTR_STC_RON_LOW (low byte)	M	XXh	RV_ KQE_
6	RecordValue3 = CTR_STC_RON_MEDIUM (high byte)	M	XXh	RV_ KQE_
7	RecordValue4 = CTR_STC_RON_MEDIUM (low byte)	M	XXh	RV_ KQE_
8	RecordValue5 = CTR_STC_RON_HIGH (high byte)	M	XXh	RV_ KQE_
9	RecordValue6 = CTR_STC_RON_HIGH (low byte)	M	XXh	RV_ KQE_
10	RecordValue7 = DIST_RON_STC[1] (high byte)	M	XXh	RV_ KQE_
11	RecordValue8 = DIST_RON_STC[1] (low byte)	M	XXh	RV_ KQE_
12	RecordValue9 = STATE_RON[1]	M	XXh	RV_ KQE_
...	...	...	...	...
3*NC_NR_RON_KWP + 7	RecordValue(3* NC_NR_RON_KWP +4) = DIST_RON_STC[NC_NR_RON_KWP] (high byte)	M	XXh	RV_ KQE_
3*NC_NR_RON_KWP + 8	RecordValue(3* NC_NR_RON_KWP +5) = DIST_RON_STC[NC_NR_RON_KWP] (low byte)	M	XXh	RV_ KQE_
3*NC_NR_RON_KWP + 9	RecordValue(3* NC_NR_RON_KWP +6) = STATE_RON[NC_NR_RON_KWP]	M	XXh	RV_ KQE_

I.23.67 22_404C - Read Zeitanteile der erreichten Druckbereiche (beim Tausch der Kraftstoffhochdruckpumpe)

General information:

This function is created to read out the "Zeitanteile der erreichten Druckbereiche (beim Tausch der Kraftstoffhochdruckpumpe)"

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**Request Service ID**	**M**	**22h**	**RDBCI**
#2d	RecordCommonIdentifier High Byte	M	40h	RCI_RBMMS2
#3d	RecordCommonIdentifier Low Byte	M	4Ch	RCI_RBMMS2

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**ReadDataByIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
#2d #3d	dataIdentifier #1 =[byte1(MSB) byte2]	M	40h 4Ch	DID_B1 B2
#4d	RecordValue#1 = T_prail_mon_xb_ypb[1][1] high byte, high word	M	XXh	RV_1
#5d	RecordValue#2= T_prail_mon_xb_ypb[1][1] low byte, high word	M	XXh	RV_2
#6d	RecordValue#3= T_prail_mon_xb_ypb[1][1] high byte, low word	M	XXh	RV_
#7d	RecordValue#4= T_prail_mon_xb_ypb[1][1] low byte, low word	M	XXh	RV_
#8d	RecordValue#5 = T_prail_mon_xb_ypb[2][1] high byte, high word	M	XXh	RV_
#9d	RecordValue#6 = T_prail_mon_xb_ypb[2][1] low byte, high word	M	XXh	RV_
#10d	RecordValue#7 = T_prail_mon_xb_ypb[2][1] high byte, low word	M	XXh	RV_
#11d	RecordValue#8 = T_prail_mon_xb_ypb[2][1] low byte, low word	M	XXh	RV_

Figure I.23.10: Table ReadDataByIdentifier Positive Response Message

I.23.68 22_4066 - RCI_RBMMS3_lesen

General information:

Rate Based Monitoring Motorsteuerung Block 3 auslesen
This function reads out RBM values block 3.

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**Request Service ID**	**M**	**22h**	**RDBCI**
#2d	RecordCommonIdentifier High Byte	M	40h	RCI_RBMMS2
#3d	RecordCommonIdentifier Low Byte	M	66h	RCI_RBMMS2

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**ReadDataByIdentifier Response Service Id**	**M**	**62h**	**RDBCIPR**
#2d #3d	dataIdentifier #1 =[byte1(MSB) byte2]	M	40h 66h	DID_B1 B2
#4d	RecordValue#1 = CTR_COMP_RBM_PUC_VLD_LS_UP_1 high byte	M	XXh	RV_1
#5d	RecordValue#2 = CTR_COMP_RBM_PUC_VLD_LS_UP_1 low byte	M	XXh	RV_2
#6d	RecordValue#3 = CTR_CDN_RBM_PUC_VLD_LS_UP_1 high byte	M	XXh	RV_
#7d	RecordValue#4 = CTR_CDN_RBM_PUC_VLD_LS_UP_1 low byte	M	XXh	RV_
#8d	RecordValue#5 = CTR_COMP_RBM_PUC_VLD_LS_UP_2 high byte	M	XXh	RV_
#9d	RecordValue#6 = CTR_COMP_RBM_PUC_VLD_LS_UP_2 low byte	M	XXh	RV_
#10d	RecordValue#7 = CTR_CDN_RBM_PUC_VLD_LS_UP_2 high byte	M	XXh	RV_
#11d	RecordValue#8 = CTR_CDN_RBM_PUC_VLD_LS_UP_2 low byte	M	XXh	RV_
#12d	RecordValue#9 = CTR_COMP_RBM_OC_LS_DOWN_1 high byte	M	XXh	RV_
#13d	RecordValue#10 = CTR_COMP_RBM_OC_LS_DOWN_1 low byte	M	XXh	RV_
#14d	RecordValue#11 = CTR_CDN_RBM_OC_LS_DOWN_1 high byte	M	XXh	RV_
#15d	RecordValue#12 = CTR_CDN_RBM_OC_LS_DOWN_1 low byte	M	XXh	RV_
#16d	RecordValue#13 = CTR_COMP_RBM_OC_LS_DOWN_2 high byte	M	XXh	RV_
#17d	RecordValue#14 = CTR_COMP_RBM_OC_LS_DOWN_2 low byte	M	XXh	RV_
#18d	RecordValue#15 = CTR_CDN_RBM_OC_LS_DOWN_2 high byte	M	XXh	RV_
#19d	RecordValue#16 = CTR_CDN_RBM_OC_LS_DOWN_2 low byte	M	XXh	RV_
#20d	RecordValue#17 = CTR_COMP_RBM_SCG_LS_DOWN_1 high byte	M	XXh	RV_
#21d	RecordValue#18 = CTR_COMP_RBM_SCG_LS_DOWN_1 low byte	M	XXh	RV_
#22d	RecordValue#19 = CTR_CDN_RBM_SCG_LS_DOWN_1 high byte	M	XXh	RV_
#23d	RecordValue#20 = CTR_CDN_RBM_SCG_LS_DOWN_1 low byte	M	XXh	RV_
#24d	RecordValue#21 = CTR_COMP_RBM_SCG_LS_DOWN_2 high byte	M	XXh	RV_
#25d	RecordValue#22 = CTR_COMP_RBM_SCG_LS_DOWN_2 low byte	M	XXh	RV_
#26d	RecordValue#23 = CTR_CDN_RBM_SCG_LS_DOWN_2 high byte	M	XXh	RV_
#27d	RecordValue#24 = CTR_CDN_RBM_SCG_LS_DOWN_2 low byte	M	XXh	RV_
#28d	RecordValue#25 = CTR_COMP_RBM_OC_LSL_UP_1 high byte	M	XXh	RV_
#29d	RecordValue#26 = CTR_COMP_RBM_OC_LSL_UP_1 low byte	M	XXh	RV_
#30d	RecordValue#27 = CTR_CDN_RBM_OC_LSL_UP_1 high byte	M	XXh	RV_
#31d	RecordValue#28 = CTR_CDN_RBM_OC_LSL_UP_1 low byte	M	XXh	RV_
#32d	RecordValue#29 = CTR_COMP_RBM_OC_LSL_UP_2 high byte	M	XXh	RV_
#33d	RecordValue#30 = CTR_COMP_RBM_OC_LSL_UP_2 low byte	M	XXh	RV_
#34d	RecordValue#31 = CTR_CDN_RBM_OC_LSL_UP_2 high byte	M	XXh	RV_
#35d	RecordValue#32 = CTR_CDN_RBM_OC_LSL_UP_2 low byte	M	XXh	RV_
#36d	RecordValue#33 = CTR_COMP_RBM_CSERS_INJ high byte	M	XXh	RV_
#37d	RecordValue#34 = CTR_COMP_RBM_CSERS_INJ low byte	M	XXh	RV_
#38d	RecordValue#35 = CTR_CDN_RBM_CSERS_INJ high byte	M	XXh	RV_
#39d	RecordValue#36 = CTR_CDN_RBM_CSERS_INJ low byte	M	XXh	RV_

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Figure I.23.11: Table ReadDataByIdentifier Positive Response Message

I.23.69 22_5F88 - ADRECOVERY_lesen

General information:

This command read out the informations about the Nox-trap from ECU. This is necessary before re-programming or change of ECU.

Formula section:

If service 22_5F_88 is received

then

send positive response

endif

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier	M	5Fh	RCI_ADRECOVERY
3	RecordCommonIdentifier	M	88h	RCI_ADRECOVERY

Positive Response

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier	M	5Fh	RCI_ADRECOVERY
3	recordCommonIdentifier	M	88h	RCI_ADRECOVERY
4	recordValue1 = NT_SUL_32[1] (high word, high byte)	M	XXh	RV_NT_SUL_32[1]
5	recordValue2 = NT_SUL_32[1] (high word, low byte)	M	XXh	RV_NT_SUL_32[1]
6	recordValue3 = NT_SUL_32[1] (low word, high byte)	M	XXh	RV_NT_SUL_32[1]
7	recordValue4 = NT_SUL_32[1] (low word, low byte)	M	XXh	RV_NT_SUL_32[1]
8	recordValue5 = NT_SUL_32[2] (high word, high byte)	M	XXh	RV_NT_SUL_32[2]
9	recordValue6 = NT_SUL_32[2] (high word, low byte)	M	XXh	RV_NT_SUL_32[2]
10	recordValue7 = NT_SUL_32[2] (low word, high byte)	M	XXh	RV_NT_SUL_32[2]
11	recordValue8 = NT_SUL_32[2] (low word, low byte)	M	XXh	RV_NT_SUL_32[2]
12	recordValue9 = NT_SUL_H_32[1] (high word, high byte)	M	XXh	RV_NT_SUL_H_32[1]
13	recordValue10 = NT_SUL_H_32[1] (high word, low byte)	M	XXh	RV_NT_SUL_H_32[1]
14	recordValue11 = NT_SUL_H_32[1] (low word, high byte)	M	XXh	RV_NT_SUL_H_32[1]
15	recordValue12 = NT_SUL_H_32[1] (low word, low byte)	M	XXh	RV_NT_SUL_H_32[1]
16	recordValue13 = NT_SUL_H_32[2] (high word, high byte)	M	XXh	RV_NT_SUL_H_32[2]
17	recordValue14 = NT_SUL_H_32[2] (high word, low byte)	M	XXh	RV_NT_SUL_H_32[2]
18	recordValue15 = NT_SUL_H_32[2] (low word, high byte)	M	XXh	RV_NT_SUL_H_32[2]
19	recordValue16 = NT_SUL_H_32[2] (low word, low byte)	M	XXh	RV_NT_SUL_H_32[2]
10	recordValue17 = NT_AGI (high byte)	M	XXh	RV_NT_AGI
21	recordValue18 = NT_AGI (low byte)	M	XXh	RV_NT_AGI
22	recordValue19 = NT_AGI_SO2P_FQ_SUM (high word, high byte)	M	XXh	RV_NT_AGI_SO2P_FQ_SUM
23	recordValue20 = NT_AGI_SO2P_FQ_SUM (high word, low byte)	M	XXh	RV_NT_AGI_SO2P_FQ_SUM
24	recordValue21 = NT_AGI_SO2P_FQ_SUM (low word, high byte)	M	XXh	RV_NT_AGI_SO2P_FQ_SUM
25	recordValue22 = NT_AGI_SO2P_FQ_SUM (low word, low byte)	M	XXh	RV_NT_AGI_SO2P_FQ_SUM
26	recordValue23 = NT_AGI_SUL (high byte)	M	XXh	RV_NT_AGI_SUL
27	recordValue24 = NT_AGI_SUL (low byte)	M	XXh	RV_NT_AGI_SUL
28	recordValue25 = NT_AGI_SUL_SNG[1] high word, high byte)	M	XXh	RV_NT_AGI_SUL_SNG[1]
29	recordValue26 = NT_AGI_SUL_SNG[1] (high word, low byte)	M	XXh	RV_NT_AGI_SUL_SNG[1]
30	recordValue27 = NT_AGI_SUL_SNG[1] (low word, high byte)	M	XXh	RV_NT_AGI_SUL_SNG[1]
31	recordValue28 = NT_AGI_SUL_SNG[1] (low word, low byte)	M	XXh	RV_NT_AGI_SUL_SNG[1]
32	recordValue29 = NT_AGI_SUL_SNG[2](high word, high byte)	M	XXh	RV_NT_AGI_SUL_SNG[2]
33	recordValue30 = NT_AGI_SUL_SNG[2] (high word, low byte)	M	XXh	RV_NT_AGI_SUL_SNG[2]
34	recordValue31 = NT_AGI_SUL_SNG[2] (low word, high byte)	M	XXh	RV_NT_AGI_SUL_SNG[2]
35	recordValue32 = NT_AGI_SUL_SNG[2] (low word, low byte)	M	XXh	RV_NT_AGI_SUL_SNG[2]
36	recordValue33 = NT_AGI_THERMO (high byte)	M	XXh	RV_NT_AGI_THERMO
37	recordValue34 = NT_AGI_THERMO (low byte)	M	XXh	RV_NT_AGI_THERMO
38	recordValue35 = NT_AGI_THERMO_SNG[1] (high byte)	M	XXh	RV_NT_AGI_THERMO_SNG[1]
39	recordValue36 = NT_AGI_THERMO_SNG[1] (high byte)	M	XXh	RV_NT_AGI_THERMO_SNG[1]
40	recordValue37 = NT_AGI_THERMO_SNG[2] (high byte)	M	XXh	RV_NT_AGI_THERMO_SNG[2]
41	recordValue38 = NT_AGI_THERMO_SNG[2] (low byte)	M	XXh	RV_NT_AGI_THERMO_SNG[2]
42	recordValue39 = CTR_NT_AGI_AD_CMPL_SUM (high byte)	M	XXh	RV_CTR_NT_AGI_AD_CMPL_SUM
43	recordValue40 = CTR_NT_AGI_AD_CMPL_SUM (low byte)	M	XXh	RV_CTR_NT_AGI_AD_CMPL_SUM
44	recordValue41 = CTR_NT_AGI_SO2P_FQ (high byte)	M	XXh	RV_CTR_NT_AGI_SO2P_FQ
-	recordValue42 = CTR_NT_AGI_SO2P_FQ (low byte)	M	XXh	RV_CTR_NT_AGI_SO2P_FQ
46	recordValue43 = LV_NT_AFS_REQ_AGI	M	XXh	RV_LV_NT_AFS_REQ_AGI

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47	recordValue44 = LV_NT_AFS_REQ_AGI_TMP_3	M	XXh	RV_LV_NT_AFS_REQ_AGI_TMP_3
48	recordValue- = LV_SO2P_REQ_1	M	XXh	RV_LV_SO2P_REQ_1
49	recordValue46 = LV_SO2P_REQ_2	M	XXh	RV_LV_SO2P_REQ_2
50	recordValue47 = LV_SO2P_REQ_FQ	M	XXh	RV_LV_SO2P_REQ_FQ
51	recordValue48 =FAC_NT_AGI_LIM (high byte)	M	XXh	RV_ FAC_NT_AGI_LIM
52	recordValue49 =FAC_NT_AGI_LIM (low byte)	M	XXh	RV_ FAC_NT_AGI_LIM
53	recordValue50 = FAC_NT_AGI_MDL (high word, high byte)	M	XXh	RV_FAC_NT_AGI_MDL
54	recordValue51 = FAC_NT_AGI_MDL (high word, low byte)	M	XXh	RV_FAC_NT_AGI_MDL
55	recordValue52 = FAC_NT_AGI_MDL (low word, high byte)	M	XXh	RV_FAC_NT_AGI_MDL
56	recordValue53 = FAC_NT_AGI_MDL (low word, low byte)	M	XXh	RV_FAC_NT_AGI_MDL
57	recordValue54 = DIST_NS_NEW (high byte)	M	XXh	RV_DIST_NS_NEW
58	recordValue55 = DIST_NS_NEW (low byte)	M	XXh	RV_DIST_NS_NEW
59	recordValue56 = DIST_NT_NS_SHIFT[1] (high byte)	M	XXh	RV_DIST_NT_NS_SHIFT[1]
60	recordValue57 = DIST_NT_NS_SHIFT[1] (low byte)	M	XXh	RV_DIST_NT_NS_SHIFT[1]
61	recordValue58 = CTR_NS_AD_CYC[1] (high byte)	M	XXh	RV_ CTR_NS_AD_CYC[1]
62	recordValue59 = CTR_NS_AD_CYC[1] (low byte)	M	XXh	RV_ CTR_NS_AD_CYC[1]
63	recordValue60 = DIST_NT_NS_AD[1] (high byte)	M	XXh	RV_DIST_NT_NS_AD[1]
64	recordValue61 = DIST_NT_NS_AD[1] (low byte)	M	XXh	RV_DIST_NT_NS_AD[1]
65	recordValue62 = FAC_NOX_NS_AD[1] (high byte)	M	XXh	RV_FAC_NOX_NS_AD[1]
66	recordValue63 = FAC_NOX_NS_AD[1] (low byte)	M	XXh	RV_FAC_NOX_NS_AD[1]
67	recordValue64 = CTR_NS_SHIFT_CYC[1] (high byte)	M	XXh	RV_CTR_NS_SHIFT_CYC[1]
68	recordValue65 = CTR_NS_SHIFT_CYC[1] (low byte)	M	XXh	RV_CTR_NS_SHIFT_CYC[1]
69	recordValue66 = RATIO_MMV_NS_SHIFT_DIAG[1] (high byte)	M	XXh	RV_RATIO_MMV_NS_SHIFT_DIAG [1]
70	recordValue67 = RATIO_MMV_NS_SHIFT_DIAG[1] (low byte)	M	XXh	RV_ RATIO_MMV_NS_SHIFT_DIAG [1]

Note: In case of NC_NT_NR =1 must 0ffh transmitte for all "record Values " with array element[2])

I.23.70 22_5F8B - RCI_PMB_lesen

General information:

STATUS_PM_BACKUP
This service reads out the battery status.

Formula section:

If service 22_5F8B received
then send positive response
endif

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier high byte	M	5Fh	RCI_PMB
3	RecordCommonIdentifier low byte	M	8Bh	RCI_PMB

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier high byte	M	5Fh	RCI_PMB
3	RecordCommonIdentifier low byte	M	8Bh	RCI_PMB
4	RecordValue1 = Pmbackup[0]	M	XXh	RV_PMBACKUP[0]
5	RecordValue2 = Pmbackup[1]	M	XXh	RV_PMBACKUP[1]
6	RecordValue3 = Pmbackup[2]	M	XXh	RV_PMBACKUP[2]
7	RecordValue4 = Pmbackup[3]	M	XXh	RV_PMBACKUP[3]
8	RecordValue5 = Pmbackup[4]	M	XXh	RV_PMBACKUP[4]
9	RecordValue6 = Pmbackup[5]	M	XXh	RV_PMBACKUP[5]
10	RecordValue7 = Pmbackup[6]	M	XXh	RV_PMBACKUP[6]

I.23.71 22_5F8E - MSA deactivation lesen

General information:

This function is created to read out the state of "MotorStopAutomatik deaktivieren"

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	Request Service ID	M	22h	RDBCI
2d	RecordCommonIdentifier High Byte	M	5Fh	RCI_MSA_DEAK
3d	RecordCommonIdentifier Low Byte	M	8Eh	RCI_MSA_DEAK

Figure I.23.12: Table Request Message

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2d	RecordCommonIdentifier High Byte	M	5Fh	RCI_MSA_DEAK
3d	RecordCommonIdentifier Low Byte	M	8Eh	RCI_MSA_DEAK
4d	recordValue1 = 0 -if B_msasw = FALSE 1 - if B_msasw = TRUE	M	XXh	RV_STAT_MSA_DEAK

I.23.72 22_5F8F - MSA Abschaltverhinderer lesen

General information:

This function is created to read out the state of "Selektive Deaktivierung Abschaltverhinderer MotorStopAutomatik "

Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	Request Service ID	M	22h	RDBCI
2d	RecordCommonIdentifier High Byte	M	5Fh	RCI_MSA_DEAK_AV
3d	RecordCommonIdentifier Low Byte	M	8Fh	RCI_MSA_DEAK_AV

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2d	RecordCommonIdentifier High Byte	M	5Fh	RCI_MSA_DEAK_AV
3d	RecordCommonIdentifier Low Byte	M	8Fh	RCI_MSA_DEAK_AV
4d	recordValue1 = Swmsaav (high byte, high word)	M	XXh	RV_STAT_MSA_DEAK_AV
5d	recordValue2 = Swmsaav (low byte, high word)	M	XXh	RV_STAT_MSA_DEAK_AV
6d	recordValue3 = Swmsaav (high byte, low word)	M	XXh	RV_STAT_MSA_DEAK_AV
7d	recordValue4 = Swmsaav (low byte, low word)	M	XXh	RV_STAT_MSA_DEAK_AV

I.23.73 22_5F90 - IMAALLE lesen

General Information: This function is created to read out the described values from the ECU.

I.23.73.1 MSD 85 only

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	5Fh	RV_IMAALLE
3	RecordCommonIdentifier Low Byte	M	90h	RV_IMAALLE

Positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Request Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	5Fh	RV_IMAALLE
3	RecordCommonIdentifier Low Byte	M	90h	RV_IMAALLE
4	recordValue1 = EGY_SP_IV_EXT_ADJ[0] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[0]
5	rcord value 2 = EGY_SP_IV_EXT_ADJ[0] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[0]
6	recordValue3 = MFF_ABSV_IV_EXT_ADJ[0] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[0]
7	recordValue4 = MFF_ABSV_IV_EXT_ADJ[0] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[0]
8	recordValue5 = EGY_SP_IV_EXT_ADJ[1] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[1]
9	rcord value6 = EGY_SP_IV_EXT_ADJ[1] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[1]
10	recordValue7 = MFF_ABSV_IV_EXT_ADJ[1] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[1]
11	recordValue8 = MFF_ABSV_IV_EXT_ADJ[1] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[1]
12	recordValue9 = EGY_SP_IV_EXT_ADJ[2] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[2]
13	rcord value10 = EGY_SP_IV_EXT_ADJ[2] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[2]
14	recordValue11 = MFF_ABSV_IV_EXT_ADJ[2] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[2]
15	recordValue12 = MFF_ABSV_IV_EXT_ADJ[2] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[2]
16	recordValue139 = EGY_SP_IV_EXT_ADJ[3] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[3]
17	rcord value14 = EGY_SP_IV_EXT_ADJ[3] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[3]
18	recordValue15 = MFF_ABSV_IV_EXT_ADJ[3] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[3]
19	recordValue16 = MFF_ABSV_IV_EXT_ADJ[3] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[3]
20	recordValue17 = EGY_SP_IV_EXT_ADJ[4] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[4]
21	rcord value18 = EGY_SP_IV_EXT_ADJ[4] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[4]
22	recordValue19 = MFF_ABSV_IV_EXT_ADJ[4] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[4]
23	recordValue20 = MFF_ABSV_IV_EXT_ADJ[4] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[4]
24	recordValue21 = EGY_SP_IV_EXT_ADJ[5] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[5]
25	rcord value22 = EGY_SP_IV_EXT_ADJ[5] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[5]
26	recordValue23 = MFF_ABSV_IV_EXT_ADJ[5] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[5]
27	recordValue24 = MFF_ABSV_IV_EXT_ADJ[5] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[5]
28	recordValue25 = EGY_SP_IV_EXT_ADJ[6] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[6]
29	rcord value26 = EGY_SP_IV_EXT_ADJ[6] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[6]
30	recordValue27 = MFF_ABSV_IV_EXT_ADJ[6] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[6]
31	recordValue28 = MFF_ABSV_IV_EXT_ADJ[6] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[6]
32	recordValue29 = EGY_SP_IV_EXT_ADJ[7] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[7]
33	rcord value30 = EGY_SP_IV_EXT_ADJ[7] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[7]
34	recordValue31 = MFF_ABSV_IV_EXT_ADJ[7] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[7]
35	recordValue32 = MFF_ABSV_IV_EXT_ADJ[7] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[7]

I.23.73.2 All other projects

Description: This function is created to read out the described values from the ECU.

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	Response Service ID	M	22h	RDBCI
2	RecordCommonIdentifier High Byte	M	5Fh	RV_IMAALLE
3	RecordCommonIdentifier Low Byte	M	90h	RV_IMAALLE

Positive Response

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Data Byte	***Parameter Name***	***Cvt***	***Hex Value***	***Mnemonic***
1	Request Service ID	M	62h	RDBCIPR
2	RecordCommonIdentifier High Byte	M	5Fh	RV_IMAALLE
3	RecordCommonIdentifier Low Byte	M	90h	RV_IMAALLE
4	recordValue1 = EGY_SP_IV_EXT_ADJ[0] high byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[0]
5	rcord value 2 = EGY_SP_IV_EXT_ADJ[0] low byte	M	XXh	RV_EGY_SP_IV_EXT_ADJ[0]
6	recordValue3 = MFF_ABSV_IV_EXT_ADJ[0] high byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[0]
7	recordValue4 = MFF_ABSV_IV_EXT_ADJ[0] low byte	M	XXh	RV_MFF_ABSV_IV_EXT_ADJ[0]
...	...	...	...	...
...	...	...	...	...
...	...	...	...	...
4*NC_CYL_NR	recordValue4*NC_CYL_NR-3 = EGY_SP_IV_EXT_ADJ[NC_CYL_NR-1] high byte	M	XXh	RV_
4*NC_CYL_NR +1	recordValue4*NC_CYL_NR-2= EGY_SP_IV_EXT_ADJ[NC_CYL_NR-1] low byte	M	XXh	RV_
4*NC_CYL_NR +2	recordValue4*NC_CYL_NR-1= MFF_ABSV_IV_EXT_ADJ[NC_CYL_NR-1] high byte	M	XXh	RV_
4*NC_CYL_NR +3	recordValue4*NC_CYL_NR = MFF_ABSV_IV_EXT_ADJ[NC_CYL_NR-1] low byte	M	XXh	RV_

I.23.74 22_5FDE - VVT- Minhub lesen

General information:

This service reads out the specified value(s).

Request

Data Byte	***Parameter Name***	***Cvt***	***Hex Value***	***Mnemonic***
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier high byte	M	5Fh	RCI_
3	RecordCommonIdentifier low byte	M	DEh	RCI_

Positive Response on service

Data Byte	***Parameter Name***	***Cvt***	***Hex Value***	***Mnemonic***
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier high byte	M	5Fh	RCI_
3	RecordCommonIdentifier low byte	M	DEh	RCI_
4	RecordValue1 = Minhub high byte	M	XXh	RV_
5	RecordValue2 = Minhub low byte	M	XXh	RV_

I.23.75 22_5FF0 - RCI_LL_ABGLEICH_lesen

General information:

Abgleichswert LL lesen - ReadDataByCommonIdentifier

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With the tester via KWP telegram an idle speed offset for five different conditions can be read.
Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier high byte	M	5Fh	RCI_RCI_LL_ABGLEICH
3	RecordCommonIdentifier low byte	M	F0h	RCI_RCI_LL_ABGLEICH

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	***Response Service ID***	***M***	***62h***	***RDBCIPR***
2	RecordCommonIdentifier high byte	M	5Fh	RCI_RCI_LL_ABGLEICH
3	RecordCommonIdentifier low byte	M	F0h	RCI_RCI_LL_ABGLEICH
4	RecordValue1 = N_KWP_OFS_ACC_DRI	M	XXh	RV_ N_KWP_OFS_ACC_DRI
5	RecordValue2 = N_KWP_OFS_DRI	M	XXh	RV_ N_KWP_OFS_DRI
6	RecordValue3 = N_KWP_OFS	M	XXh	RV_N_KWP_OFS
7	RecordValue4 = N_KWP_OFS_ACC	M	XXh	RV_N_KWP_OFS_ACC
8	RecordValue5 = N_KWP_OFS_VB	M	XXh	RV_N_KWP_OFS_VB

I.23.76 22_5FF1 - CO Abgleichswert lesen

General information:

With the tester via KWP telegram the values for CO adjustment can be read.
Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier high byte	M	5Fh	RCI_
3	RecordCommonIdentifier low byte	M	F1h	RCI_

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	***Response Service ID***	***M***	***62h***	***RDBCIPR***
2	RecordCommonIdentifier high byte	M	5Fh	RCI_
3	RecordCommonIdentifier low byte	M	F1h	RCI_
4	RecordValue1 = LV_FAC_MFF_ADD_EXT_ADJ_NVMY	M	XXh	RV_
5	RecordValue2 = LV_RST_MFF_ADD_EXT_ADJ_NVMY	M	XXh	RV_
6	RecordValue3 = FAC_MFF_ADD_EXT_ADJ	M	XXh	RV_
7	RecordValue4 = MFF_ADD_EXT_ADJ[1] high byte	M	XXh	RV_
8	RecordValue5 = MFF_ADD_EXT_ADJ[1] low byte	M	XXh	RV_
9	RecordValue6 = MFF_ADD_EXT_ADJ[2] high byte	M	XXh	RV_
10	RecordValue7 = MFF_ADD_EXT_ADJ[2] low byte	M	XXh	RV_
11	RecordValue8 = MFF_ADD_EXT_ADJ_NVMY high byte	M	XXh	RV_
12	RecordValue9 = MFF_ADD_EXT_ADJ_NVMY low byte	M	XXh	RV_

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I.23.77 22_5FF2 - RCI_ECU_CONFIG_lesen

General information:

This service shows the actual recognized variants.

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier high byte	M	5Fh	RCI_ECU_CONFIG
3	RecordCommonIdentifier low byte	M	F2h	RCI_ECU_CONFIG

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier high byte	M	5Fh	RCI_ECU_CONFIG
3	RecordCommonIdentifier low byte	M	F2h	RCI_ECU_CONFIG
4	inputOutputControlParameter - LV_AT	M	XXh	RV_ LV_AT
5	inputOutputControlParameter - LV_VAR_ACIN	M	XXh	RV_LV_VAR_ACIN
6	inputOutputControlParameter - LV_VAR_AMT	M	XXh	RV_LV_VAR_AMT
7	inputOutputControlParameter - LV_VAR_ARS	M	XXh	RV_ LV_VAR_ARS
8	inputOutputControlParameter - LV_VAR_ASR	M	XXh	RV_ LV_VAR_ASR
9	inputOutputControlParameter - LV_VAR_BN	M	XXh	RV_LV_VAR_BN
10	inputOutputControlParameter - LV_VAR_BN_MSW	M	XXh	RV_LV_VAR_BN_MSW
11	inputOutputControlParameter - LV_VAR_DCC	M	XXh	RV_LV_VAR_DCC
12	inputOutputControlParameter - LV_VAR_EBOX_CFA	M	XXh	RV_LV_VAR_EBOX_CFA
13	inputOutputControlParameter - LV_VAR_ETCU	M	XXh	RV_ LV_VAR_ETCU
14	inputOutputControlParameter - LV_VAR_ICL	M	XXh	RV_LV_VAR_ETCU
15	inputOutputControlParameter - LV_VAR_MSW	M	XXh	RV_LV_VAR_MSW
16	inputOutputControlParameter - LV_VAR_PSTE	M	XXh	RV_LV_VAR_PSTE
17	inputOutputControlParameter - LV_VAR_SOF	M	XXh	RV_LV_VAR_SOF
18	inputOutputControlParameter - CONF_SOF_SWI (00h= no SOF_SWI, 01h=SOF_SWI, 02h=SOF_SWI_AMT)	M	XXh	RV_LV_VAR_SOF_SWI
19	inputOutputControlParameter - LV_VAR_BN_GEAR_REV	M	XXh	RV_LV_VAR_BN_GEAR_REV
20	inputOutputControlParameter - LV_VAR_EAC **(only MSV80)** not supported **(other)**	M	[XXh, FFh]	
21	inputOutputControlParameter - LV_VAR_VEH	M	XXh	RV_LV_VAR_VEH
22	inputOutputControlParameter - LV_VAR_SAP	M	XXh	
23	inputOutputControlParameter - LV_VAR_EF	M	XXh	RV_ LV_VAR_EF
24	inputOutputControlParameter - LV_VAR_ECRAS_UP	M	XXh	RV_ LV_VAR_ECRAS_UP
25	inputOutputControlParameter - LV_VAR_RLY_ACCOUT (not MSD85) not supported (MSD85)	M	[XXh, FFh]	RV_LV_VAR_RLY_ACCOUT
26	inputOutputControlParameter - LV_VAR_SAV	M	XXh	
27	inputOutputControlParameter - LV_VAR_RLY_ST	M	XXh	RV_LV_VAR_RLY_ST
28	inputOutputControlParameter - LV_VAR_ASR_3	M	XXh	RV_LV_VAR_ASR_3
29	inputOutputControlParameter - LV_VAR_BN_LDM	M	XXh	RV_LV_VAR_BN_LDM
30	inputOutputControlParameter - LV_VAR_BN_LTG_HDLP_L	M	XXh	RV_LV_VAR_BN_LTG_HDLP_L
31	inputOutputControlParameter - LV_VAR_LSH_DOWN	M	XXh	RV_LV_VAR_LSH_DOWN
32	inputOutputControlParameter - LV_VAR_LSH_UP	M	XXh	RV_LV_VAR_LSH_UP
33	inputOutputControlParameter - LV_VAR_ASR_4	M	XXh	RV_ LV_VAR_ASR_4
34	inputOutputControlParameter - LV_VAR_MAF	M	XXh	RV_LV_VAR_MAF
35	inputOutputControlParameter - LV_VAR_PSTE_2 **or** (LV_VAR_PSTE_3 **and** STATE_PSTE_3_SRC = "AFS")	M	XXh	RV_LV_VAR_PSTE_2
36	inputOutputControlParameter - LV_VAR_BN_EFP	M	XXh	RV_LV_VAR_BN_EFP
37	inputOutputControlParameter - LV_SENS_BAT_SMT_DET	M	XXh	RV_LV_VAR_BN_EFP
38	inputOutputControlParameter - LV_VAR_BN_TRL	M	XXh	RV_LV_VAR_BN_TRL
39	inputOutputControlParameter - not supported	M	FFh	
40	inputOutputControlParameter - LV_VAR_ECRAS_DOWN	M	XXh	RV_LV_VAR_ECRAS_DOWN
41	inputOutputControlParameter - LV_VAR_NOX **(only MSD80/MSD81)** not supported **(other)**	M	[XXh, FFh]	
42	inputOutputControlParameter - not supported	M	FFh	
43	inputOutputControlParameter - LV_VAR_ETCU_SPT **(only MSV80)** not supported **(other)**	M	[XXh, FFh]	RV_ LV_VAR_ETCU_SPT
44	inputOutputControlParameter - LV_VAR_TCT	M	XXh	RV_LV_VAR_TCT
-	inputOutputControlParameter - LV_VAR_AEB	M	XXh	RV_LV_VAR_AEB
46	inputOutputControlParameter - LV_VAR_TQ_PBR	M	XXh	RV_LV_VAR_TQ_PBR

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I.23.78 22_5FF3 - RCI_UET_lesen

General information:

This service reads out the specified value(s).

Application conditions

Initialisation: at reset the values from the NVMY

Activation: LV_IGK=1

Deactivation: LV_IGK=0
Diagnostic timeout
Service location: see list of implemented diagnostic services

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier high byte	M	5Fh	RCI_UET
3	RecordCommonIdentifier low byte	M	F3h	RCI_UET

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier high byte	M	5Fh	RCI_UET
3	RecordCommonIdentifier low byte	M	F3h	RCI_UET
4	RV_TOIL_MAX_WARN	M	XXh	RV_TOIL_MAX_WARN
5	RecordValue = VS_TOIL_MAX	M	XXh	RV_VS_TOIL_MAX
6	RecordValue = N_TOIL_MAX high byte	M	XXh	RV_N_TOIL_MAX
7	RecordValue = N_TOIL_MAX low byte	M	XXh	RV_N_TOIL_MAX
8	RecordValue = GEAR_TOIL_MAX	M	XXh	RV_GEAR_TOIL_MAX
9	RecordValue = TQI_AV_TOIL_MAX high byte	M	XXh	RV_TQI_AV_TOIL_MAX
10	RecordValue = TQI_AV_TOIL_MAX low byte	M	XXh	RV_TQI_AV_TOIL_MAX
11	RecordValue = TAM_TOIL_MAX	M	XXh	RV_TAM_TOIL_MAX
12	RecordValue = CTR_TOIL_MAX	M	XXh	RV_CTR_TOIL_MAX
13	RecordValue = TCO_TOIL_MAX	M	XXh	RV_TCO_TOIL_MAX
14	RecordValue = DIST_TOIL_MAX high byte	M	XXh	RV_DIST_TOIL_MAX
15	RecordValue = DIST_TOIL_MAX low byte	M	XXh	RV_DIST_TOIL_MAX
16	RecordValue = PV_AV_TOIL_MAX	M	XXh	RV_PV_AV_TOIL_MAX
17	RecordValue = LV_CS_TOIL_MAX	M	XXh	RV_LV_CS_TOIL_MAX
18	RecordValue = TOIL_THD_TOIL_MAX	M	XXh	RV_TOIL_THD_TOIL_MAX

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I.23.79 22_5FF4 - Fusshebelwerk Fehlbedienung lesen

General information:

This service reads out the specified value(s).

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier high byte	M	5Fh	RCI_
3	RecordCommonIdentifier low byte	M	F4h	RCI_

Positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier high byte	M	5Fh	RCI_
3	RecordCommonIdentifier low byte	M	F4h	RCI_
4	RecordValue1 = dummy fix	M	FFh	RV_

I.23.80 22_5FF6 - RCI_UEN_lesen

General information:

Exact description of the Function see file 14A06301.
Detection of an overreving event and non-volatile storage of:
An overreving event starts at exceeding the engine speed C_N_LIM_MIN and active engine speed limitation (LV_N_MAX = 1).
At each overreving event, the event frequency counter is incremented by 1. The highest engine speed reached N_MAX and the associated total running time in case of highest engine speed reached TRT_ N_MAX is only overwritten if a higher engine speed was reached.

Application conditions

Initialisation: at reset the values from the NVMY

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see list of implemented diagnostic services

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Request Service ID**	**M**	**22h**	**RDBCI**
2	RecordCommonIdentifier high byte	M	5Fh	RCI_UEN
3	RecordCommonIdentifier low byte	M	F6h	RCI_UEN

Positive Response on service

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2	RecordCommonIdentifier high byte	M	5Fh	RCI_UEN
3	RecordCommonIdentifier low byte	M	F6h	RCI_UEN
4	RecordValue = N_MAX high byte	M	XXh	RV_N_MAX
5	RecordValue = N_MAX low byte	M	XXh	RV_N_MAX
6	RecordValue = TRT_N_MAX high word high byte	M	XXh	RV_TRT_N_MAX
7	RecordValue = TRT_N_MAX high word low byte	M	XXh	RV_TRT_N_MAX
8	RecordValue = TRT_N_MAX low word high byte	M	XXh	RV_TRT_N_MAX
9	RecordValue = TRT_N_MAX low word low byte	M	XXh	RV_TRT_N_MAX
10	RecordValue = CTR_N_MAX	M	XXh	RV_CTR_N_MAX
11	RecordValue = CTR_KM_N_MAX high byte	M	XXh	RV_CTR_KM_N_MAX
12	RecordValue = CTR_KM_N_MAX low byte	M	XXh	RV_CTR_KM_N_MAX
13	RecordValue = N_GRD_N_MAX	M	XXh	RV_N_GRD_N_MAX
14	RecordValue = VS_N_MAX (**not for MSS70**) = VS_H_N_MAX (high byte, **only MSS70**)	M	XXh	RV_VS_N_MAX
15	RecordValue = PV_AV_N_MAX	M	XXh	RV_PV_AV_N_MAX
16	RecordValue = GEAR_EF_N_MAX	M	XXh	RV_GEAR_EF_N_MAX
17	RecordValue = LV_CS_N_MAX	M	XXh	RV_LV_CS_N_MAX
18	RecordValue = T_SUM_N_MAX high byte	M	XXh	RV_T_SUM_N_MAX
19	RecordValue = T_SUM_N_MAX low byte	M	XXh	RV_T_SUM_N_MAX
20	RecordValue = T_N_MAX high byte	M	XXh	RV_T_N_MAX
21	RecordValue = T_N_MAX low byte	M	XXh	RV_T_N_MAX
22	RecordValue = NR_PAT_SCC_N_MAX	M	XXh	RV_NR_PAT_SCC_N_MAX

Hint to Data Byte 14d: physical range is 0..510 km/h for MSS70, 0..255 km/h for all other

I.23.81 22_5FF7 - Laufruhepruefung auslesen

General information:

This service reads out the specified value(s).

Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**Request Service ID**	**M**	**22h**	**RDBCI**
2d	RecordCommonIdentifier high byte	M	5Fh	RCI_LRP
3d	RecordCommonIdentifier low byte	M	F7h	RCI_LRP

Figure I.23.13: Table Request Message

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2d	RecordCommonIdentifier high byte	M	5Fh	RCI_LRP
3d	RecordCommonIdentifier low byte	M	F7h	RCI_LRP
4d	RecordValue1 = St_vbrvs_aus Bit 7	M	XXh	RV_STAT_LRP_BIT7
5d	RecordValue2 = St_vbrvs_aus Bit 6	M	XXh	RV_STAT_LRP_BIT6
6d	RecordValue3 = St_vbrvs_aus Bit 5	M	XXh	RV_STAT_LRP_BIT5
7d	RecordValue4 = St_vbrvs_aus Bit 4	M	XXh	RV_STAT_LRP_BIT4
8d	RecordValue5 = St_vbrvs_aus Bit 3	M	XXh	RV_STAT_HUBEINGRIFF_INAKTIV
9d	RecordValue6 = St_vbrvs_aus Bit 2	M	XXh	RV_STAT_MINHUBEINGRIFF_INAKTIV
10d	RecordValue7 = St_vbrvs_aus Bit 1	M	XXh	RV_STAT_ZUENDWINKELEINGRIFF_INAKTIV
11d	RecordValue8 = St_vbrvs_aus Bit 0	M	XXh	RV_STAT_GEMISCHEINGRIFF_INAKTIV

Figure I.23.14: Table Positive Response Message

I.23.82 22_5FF8 - Status Homogenbetrieb auslesen

General information:

This service reads out the engine operation mode.

Application conditions

Initialisation: `at reset`

Activation: `LV_IGK=1 (Kl.15 on)`

Deactivation: `LV_IGK=0 (Kl.15 off)`
`Diagnostic timeout`
Service location: `see list of implemented diagnostic services`

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**Request Service ID**	**M**	**22h**	**RDBCI**
2d	RecordCommonIdentifier high byte	M	5Fh	RCI_LRP
3d	RecordCommonIdentifier low byte	M	F8h	RCI_LRP

Figure I.23.15: Table Request Message

Positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2d	RecordCommonIdentifier high byte	M	5Fh	RCI_LRP
3d	RecordCommonIdentifier low byte	M	F8h	RCI_LRP
4d	RecordValue1 = Ba_soll	M	XXh	RV_BA_
5d	RecordValue2 = Ba_ist	M	XXh	RV_BA_

Figure I.23.16: Table Positive Response Message

I.23.83 22_C000 - Read imob status (STATUS_EWS)

General information:

IMMO: RD_IMOB_STATUS
The service is different for boot-sw and ecu-sw.
A negativ response is possible by a wrong parameter.

Formula section:

Only for boot sw-version:
tmp_k_ews4_locked = 0

If(1) (K_EWS4[0..15] > 0x0) **and** (K_EWS4[0..15] < 0xFF) (Blank Check Page 0)
Then(1) tmp_k_ews4_locked = 1
Else(1) tmp_k_ews4_locked unchanged
Endif(1)

Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**Request Service ID**	**M**	**22h**	**RDBCI**
2d	RecordCommonIdentifier	M	C0h	RCI_TSP
3d	RecordCommonIdentifier	M	00h	RCI_TSP

Figure I.23.17: Table Request Message

StartRoutineByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1d	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2d	RecordCommonIdentifier	M	C0h	RCI_TSP
3d	RecordCommonIdentifier	M	00h	RCI_TSP
4d	RecordValue 1 = tmp_k_ews4_locked <<7 | 1 **(boot sw version)** = IMOB_KWP_STATE_0 **(ecu sw version)**	M	XXh	RV_PST
5d	RecordValue 2 = xx	M	FFh	RV_PST
6d	RecordValue 3 = xx	M	FFh	RV_PST
7d	RecordValue 4 = xx	M	FFh	RV_PST
8d	RecordValue 5 = xx	M	FFh	RV_PST
9d	RecordValue 6 = xx	M	FFh	RV_PST
10d	RecordValue 7 = xx	M	FFh	RV_PST
11d	RecordValue 8 = xx	M	FFh	RV_PST
12d	RecordValue 9 = 8- tmp_k_ews4_locked **(boot sw version)** = IMOB_KWP_STATE_8 **(ecu sw version)**	M	XXh	RV_PST
13d	RecordValue 10 = xx	M	FFh	RV_PST
14d	RecordValue 11 = xx	M	FFh	RV_PST
15d	RecordValue 12 = xx	M	FFh	RV_PST
16d	RecordValue 13 = xx	M	FFh	RV_PST
17d	RecordValue 14 = xx	M	FFh	RV_PST
18d	RecordValue 15 = xx	M	FFh	RV_PST
19d	RecordValue 16 = 1 **(boot sw version)** = IMOB_KWP_STATE_15 **(ecu sw version)**	M	XXh	RV_PST

Figure I.23.18: Table Positive Response Message

I.23.84 22_C002 - Read imob k_ews(tmp) (STATUS_EWS_SK)

General information:

IMMO: Read RD_IMOB_K_EWS (Read "temporary secret key" from ECU-Ram)
The service is different for boot-sw and ecu-sw.
A negative response is possible by a wrong parameter

Formula section:

Only for boot sw-version:

If(1) (K_EWS4[0..15] > 0x0) & & (K_EWS4[0..15] < 0xFF) (Blank Check Page 0)
Then(1) IMOB_KWP_RESP[0..15] = 0 (whole array)
Else(1)
If(2) (IMOB_KWP_K_EWS4[0..15] !=
IMOB_KWP_K_EWS4_TMP0[0..15] xor 0xFF)
(short data consistence check)
Then(2) IMOB_KWP_RESP[0..15] = 0xFF (whole array)
Else(2) IMOB_KWP_RESP[0..15] = IMOB_KWP_K_EWS4[0..15]
Endif(2)
Endif(1)

Only for ecu sw-version:

If(1) STATE_IMOB_K_EWS != NC_K_EWS_UNLOCKED
and NC_K_EWS_MAX = IMOB_NR_VLD_K_EWS4

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Then(1) IMOB_KWP_RESP[0-15] = 0 (whole array)
Else(1)
If(2) (IMOB_KWP_K_EWS4[0..15] != IMOB_KWP_K_EWS4_TMP0[0..15] xor 0xFF) (short data consistence check)
Then(2) IMOB_KWP_RESP[0..15] = 0xFF (whole array)
Else(2) IMOB_KWP_RESP[0..15] = IMOB_KWP_K_EWS4[0..15]
Endif(2)
Endif(1)

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**Request Service ID**	**M**	**22h**	**RDBCI**
2d	RecordCommonIdentifier	M	C0h	RCI_TSP
3d	RecordCommonIdentifier	M	02h	RCI_TSP

Figure I.23.19: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1d	**Response Service ID**	**M**	**62h**	**RDBCIPR**
2d	RecordCommonIdentifier	M	C0h	RCI_TSP
3d	RecordCommonIdentifier	M	02h	RCI_TSP
4d	RecordValue 1	M	FFh	RV_PST
5d	RecordValue 2	M	FFh	RV_PST
6d	RecordValue 3	M	FFh	RV_PST
7d	RecordValue 4	M	FFh	RV_PST
8d	RecordValue 5	M	FFh	RV_PST
9d	RecordValue 6	M	FFh	RV_PST
10d	RecordValue 7	M	FFh	RV_PST
11d	RecordValue 8	M	FFh	RV_PST
12d	RecordValue 9	M	FFh	RV_PST
13d	RecordValue 10	M	FFh	RV_PST
14d	RecordValue 11	M	FFh	RV_PST
15d	RecordValue 12	M	FFh	RV_PST
16d	RecordValue 13	M	FFh	RV_PST
17d	RecordValue 14	M	FFh	RV_PST
18d	RecordValue 15	M	FFh	RV_PST
19d	RecordValue 16	M	FFh	RV_PST
20d	RecordValue 17 = IMOB_KWP_RESP[0]	M	XXh	RV_PST
21d	RecordValue 18 = IMOB_KWP_RESP[1]	M	XXh	RV_PST
22d	RecordValue 19 = IMOB_KWP_ RESP[2]	M	XXh	RV_PST
23d	RecordValue 20 = IMOB_KWP_ RESP[3]	M	XXh	RV_PST
24d	RecordValue 21 = IMOB_KWP_ RESP[4]	M	XXh	RV_PST
25d	RecordValue 22 = IMOB_KWP_ RESP[5]	M	XXh	RV_PST
26d	RecordValue 23 = IMOB_KWP_ RESP[6]	M	XXh	RV_PST
27d	RecordValue 24 = IMOB_KWP_ RESP[7]	M	XXh	RV_PST
28d	RecordValue 25 = IMOB_KWP_ RESP[8]	M	XXh	RV_PST
29d	RecordValue 26 = IMOB_KWP_ RESP[9]	M	XXh	RV_PST
30d	RecordValue 27 = IMOB_KWP_ RESP[10]	M	XXh	RV_PST
31d	RecordValue 28 = IMOB_KWP_ RESP[11]	M	XXh	RV_PST
32d	RecordValue 29 = IMOB_KWP_ RESP[12]	M	XXh	RV_PST
33d	RecordValue 30 = IMOB_KWP_ RESP[13]	M	XXh	RV_PST
34d	RecordValue 31 = IMOB_KWP_ RESP[14]	M	XXh	RV_PST
35d	RecordValue 32 = IMOB_KWP_ RESP[15]	M	XXh	RV_PST

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I.24 SID 23h: readMemoryByAddress Service

Input data:

LV_IGK {p. 906}			

General information:

This function ist for reading values from the memory

Application conditions

Initialisation: *at reset*

Activation: LV_IGK = 1

Deactivation: LV_IGK = 0
Diagnostic timeout
Service location: see "list of implemented diagnostic services"

I.24.1 ReadMemoryByAddress Request (3-byte addressing)

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**ReadMemoryByAddress Request**	**M**	**#23h**	**RMBA**
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (Middle Byte)	M	#XXh	MA_MB
#4d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
(#5d)	MemoryTypeIdentifier **(optional)** [linear type external FLASH external RAM internal FLASH user information field UIF]	U	#XXh [#00h #02h #05h #06h #07h]	MTI
#5d / (#6d)	MemorySize	M	#1h...#FEh	MS

Figure I.24.1: Table ReadMemoryByAddress Request Message (3-byte addressing)

I.24.2 ReadMemoryByAddress Request (4-byte addressing)

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**ReadMemoryByAddress Request**	**M**	**#23h**	**RMBA**
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (MiddleHigh Byte)	M	#XXh	MA_MHB
#4d	MemoryAddress (MiddleLow Byte)	M	#XXh	MA_MLB
#5d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
#6d	MemoryTypeIdentifier **(mandatory, but not evaluated)** [00h ... FFh]	M	#XXh [#XXh]	MTI
#7d	MemorySize	M	#1h...#FEh	MS

Figure I.24.2: Table ReadMemoryByAddress Request Message (4-byte addressing)

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Remark:

For **3-byte addressing** independent from delivery of a MemoryTypeIdentifier (byte 5) by the tester´s request, the ECU automatically adds an offset to the requested memory address.
If no MemoryTypeIdentifier is delivered, the same offset as for MemoryTypeIdentifier 00h (linear addressing) is used.
This base memory offset must be subtracted from any memory address taken from the MAP- /A2L- file if 3-byte addressing is not sufficient for the address range!

For **4-byte addressing** a MemoryTypeIdentifier (byte 6) must be delivered by the tester´s request.
Though it is not evaluated or used within the ECU for this absolute addressing mode, it is necessary to decide between 3- /4-byte addressing mode.
In this 4-byte mode the absolute address delivered by the tester is used by the ECU without any memory offset.

For MSx80 (TriCore) the base memory offsets for **3-byte addressing** are:

MemoryTypeIdentifier:		**Memory offset:**	
none	(linear)	C000 0000h	
00h	(linear)	C000 0000h	
02h	(ext. FLASH)	8000 0000h	(the same as for int. FLASH)
05h	(ext. RAM)	D000 0000h	
06h	(int. FLASH)	8000 0000h	
07h	(UIF)	8000 xxxxh	not fixed yet, address might still change !!!

Boot Software Active			*ECU Software Active*		
Memory ID	*Range (absolute addr.)*	*Security Level*	*Memory ID*	*Range (absolute addr.)*	*Security Level*
00h (linear)	C000 0000h ...C000 FFFFh C03F C000h...C03F FFFFh	None	00h (linear)	C000 0000h ...C000 FFFFh C03F C000h...C03F FFFFh	None
02h (ext. FLASH)	8000 0000h ...801F FFFFh	None	02h (ext. FLASH)	8000 0000h ...801F FFFFh	None
05h (ext. RAM)	D000 0000h...D000 FFFFh	None	05h (ext. RAM)	D000 0000h...D000 FFFFh	None
06h (int. FLASH)	8000 0000h ...801F FFFFh	None	06h (int. FLASH)	8000 0000h ...801F FFFFh	None
07h (UIF)	8000 xxxxh ... 8000 xxxxh	None	07h (UIF)	8000 xxxxh ... 8000 xxxxh	None

Figure I.24.3: Table call conditions readMemoryByAddress (2)

I.24.3 ReadMemoryByAddress positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**ReadMemoryByAddress Positive Response**	**M**	**#63h**	**RMBAPR**
#2d . . . #nd	RecordValue#1 data 1 . . . RecordValue#m	M . . . M	#XXh . . . #XXh	RV

Figure I.24.4: Table ReadMemoryByAddress Positive Response Message

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I.24.4 ReadMemoryByAddress negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**NegativeResponse Service Id**	**S**	**#7Fh**	**NR**
#2d	ReadMemoryByAddressRequest Service Id	M	#23h	RMBA
#3d	ResponseCode= [general response code]	M	#XXh= [#XXh]	RC

Figure I.24.5: Table ReadMemoryByAddress Negative Response Message

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I.25 SID 2Eh: writeDataByCommonIdentifier Service

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_msahfkreset	O/V	0... 1H	0 ...1	1	-
Flag indicating request "Reset MSA-Tabellenspeicher"					
B_msasw	O/V	0... 1H	0 ...1	1	-
Bedingung MSA bis zum nächsten Zündungswechsel deaktivieren					
B_pmrestore	O/V	0... 1H	0 ...1	1	-
Bedingung Daten zurückgeschrieben					
B_prail_mon_clr	O/V	0... 1H	0 ...1	1	-
Raildruckmonitor zurücksetzen auf 0					
B_spa_csoll	O/V/S	0... 1H	0 ...1	1	-
Codierung SPA aus Tester					
B_zrlvs_clr	O/V	0... 1H	0 ...1	1	-
Zurücksetzen der internen Zähler des LVS					
CHK_STAMP	O/S	0... FFFFFFFFH	0... 4294967295	1	-
Check stamp written by the customers production					
CONF_EF	O/V/S	0... FFH	0... 255	1	-
Configuration of exhaust gas flap					
CTR_NS_AD_CYC_EXT_ADJ [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 65535	1	-
External Adjustment value for Counter of NOx signal gain adaptations					
CTR_NS_SHIFT_CYC_EXT_ADJ [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 65535	1	-
External values of CTR_NS_SHIFT_CYC					
CTR_NT_AGI_AD_CMPL_SUM_EXT_ADJ	O/V	0... FFFFH	0... 65535	1	-
External adjustment value for counter of completed aging adaptation					
CTR_NT_AGI_SO2P_FQ_EXT_ADJ	O/V	0... FFFFH	0... 65535	1	-
External adjustment value for counter of completed aging adaptation during FQ adaptation					
DIST_NS_NEW_EXT_ADJ	O/V	0... FFFFH	0... 524280	8	km
External adjust value for mileage counter value of last exchange of NOx sensor					
DIST_NT_NS_AD_EXT_ADJ [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 524280	8	km
External Adjustment for Current distance from last NOx signal gain adaptation					
DIST_NT_NS_SHIFT_EXT_ADJ [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 524280	8	km
External adjustment value for DIST_NT_NS_SHIFT					
EGY_SP_IV_EXT_ADJ [NC_CYL_NR]	O/V/S	0... FFFFH	0... 255	3.8911e-3	mJ
external adjusted injection valve EGY setpoint value (high flow)					
FAC_MFF_ADD_EXT_ADJ	O/V	0... FFH	-50... 49.60937	0.390625	%
Factor for CO correction in idling					
FAC_NOX_NS_AD_EXT_ADJ [NC_NOX_SENS_CONF]	O/V	0... FFFFH	0... 127.99804	1.9531e-3	-
External Adjustment for Adaptation of the NOx sensor characteristic shift					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_NT_AGI_LIM_EXT_ADJ	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
External adjustment value for limited NOx trap aging factor					
FAC_NT_AGI_MDL_EXT_ADJ	O/V	0... FFFFFFFFH	0... 0.99999	232.8e-12	-
External value for modeled aging of NT					
FAC_OIL_EXT_REQ_1	O/V/S	0... FFH	0... 2.55	0.01	-
Country dependant factor for oil change intervall via tester					
FAC_OIL_EXT_REQ_2	O/V/S	0... FFH	0... 2.55	0.01	-
Country dependant factor for oil change intervall via tester					
IDX_VAR_COD [2]	O/V/S	0... FFH	0... 255	1	-
changing index of vehicle configuration code via tester					
IMOB_KWP_K_EWS4 [16]	O	0... FFH	0... 255	1	-
Received secret key					
IMOB_KWP_K_EWS4_1 [16]	O	0... FFH	0... 255	1	-
Received secret key, 1st backup					
IMOB_KWP_K_EWS4_2 [16]	O	0... FFH	0... 255	1	-
Received secret key, 2nd back up					
IMOB_KWP_K_EWS4_TMP0 [16]	O	0... FFH	0... 255	1	-
Received secret key, temporaery					
LV_ACT_N_SP_IS_BAS_EXT_ADJ	O	0... 1H	0 ...1	1	-
logical variable for switching off the max-selection					
LV_ALTER_CTL_ENA	O/V/S	0... 1H	0 ...1	1	-
Intelligent alternator control activated					
LV_CAT_CONF_DIS_EXT_REQ	O/V/S	0... 1H	0 ...1	1	-
disable of learnig cat variants and setting variant to "no cat" via tester					
LV_FAC_MFF_ADD_EXT_ADJ_NVMY	O/V	0... 1H	0 ...1	1	-
Logical value for storing CO correction in NVMY					
LV_FHW_RST	O/V	0... 1H	0 ...1	1	-
boolean for reset of wrong used pedal unit					
LV_IGK_OFF_ACK_ENA	O/V/S	0... 1H	0 ...1	1	-
Diagnosis acknowledge IGK off enabled via service tester job (1= enabled)					
LV_KWP_ENA	O/V	0... 1H	0 ...1	1	-
logical variable for idle speed setpoint offset by tester enabled					
LV_LTG_GAS_ENA	O/V/S	0... 1H	0 ...1	1	-
xenon-filled headlights mounted					
LV_NT_AFS_REQ_AGI_TMP_3_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
External adjustment value for logical value for the request of lambda =1 operation					
LV_POW_MNG_HIS_RST	O/V	0... 1H	0 ...1	1	-
conditions for function request parking power					
LV_RST_MFF_ADD_EXT_ADJ_NVMY	O/V	0... 1H	0 ...1	1	-
Flag to reset external MFF correction to 0					
LV_SO2P_REQ_2_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
External adjustment value for request of a desulfation (forces catalyst heating)					
LV_SO2P_REQ_FQ_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
External adjustment value for logical value for active FQ adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_STST_DEAC	O/V/S	0... 1H	0 ...1	1	-
Logical value for switch off the MSA permanently					
LV_STST_VAR_COD	O/V/S	0... 1H	0 ...1	1	-
logical value for MSA-coding (0 - without MSA. 1 - with MSA)					
LV_VAR_OBDC_CAN	O/V	0... 1H	0 ...1	1	-
Variable to activate OBD communication on CAN (=1)					
LV_VVL_MIN_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by tester					
LV_VVL_MIN_NVMY_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
activation of external adjustment by tester					
MFF_ABSV_IV_EXT_ADJ [NC_CYL_NR]	O/V/S	0... FFFFH	0... 1389	0.0211948	mg/stk
External adjusted injection valve absolute MFF correction value (low flow)					
N_KWP_OFS	O/V	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 0 and LV_DRI = 0					
N_KWP_OFS_ACC	O/V	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 1 and LV_DRI = 0					
N_KWP_OFS_ACC_DRI	O/V	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 1 and LV_DRI = 1					
N_KWP_OFS_ACC_DRI_KWP	O	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 1 and LV_DRI = 1 /Byte 4 in the KWP telegramm					
N_KWP_OFS_ACC_DRI_NVMY	O/V/S	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 1 and LV_DRI = 1 stored in non volatile memory					
N_KWP_OFS_ACC_KWP	O	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 1 and LV_DRI = 0 /Byte 7 in the KWP telegramm					
N_KWP_OFS_ACC_NVMY	O/V/S	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 1 and LV_DRI = 0 stored in non volatile memory					
N_KWP_OFS_DRI	O/V	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 0 and LV_DRI = 1					
N_KWP_OFS_DRI_KWP	O	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 0 and LV_DRI = 1 /Byte 5 in the KWP telegramm					
N_KWP_OFS_DRI_NVMY	O/V/S	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 0 and LV_DRI = 1 stored in non volatile memory					
N_KWP_OFS_KWP	O	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 0 and LV_DRI = 0 /Byte 6 in the KWP telegramm					
N_KWP_OFS_NVMY	O/V/S	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at LV_ACIN = 0 and LV_DRI = 0 stored in non volatile memory					
N_KWP_OFS_VB	O/V	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at battery charging is active					
N_KWP_OFS_VB_KWP	O	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at battery charging is active /Byte 8 in the KWP telegramm					
N_KWP_OFS_VB_NVMY	O/V/S	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset at battery charging is active stored in non volatile memory					
N_SP_OFS_KWP	O/V	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset from the tester to idle speed module depend of the 5 conditions					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
N_SP_OFS_KWP_1	O	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset from the tester to idle speed module for calculation					
NT_AGI_SO2P_FQ_SUM_EXT_ADJ	O/V	0... FFFFFFH	0... 255.99998	15.3e-6	-
External adjustment value for sum of NOx trap aging factor during FQ adaptation					
NT_AGI_SUL_SNG_EXT_ADJ [NC_NT_NR]	O/V	0... FFFFFFFFH	0... 0.99999	232.8e-12	-
External adjustment value for NOx trap aging factor due to sulphur load (bench selective)					
NT_AGI_THERMO_SNG_EXT_ADJ [NC_NT_NR]	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
External adjustment value for NOx trap aging factor due to thermal aging (bench selective)					
NT_SUL_32_EXT_ADJ [NC_NT_NR]	O/V	0... FFFFFFFFH	0... 10485.6	2.4414e-6	mg
External adjustment value for NOx trap sulphur loading					
NT_SUL_H_32_EXT_ADJ [NC_NT_NR]	O/V	0... FFFFFFFFH	0... 10485.6	2.4414e-6	mg
External adjustment value for NOx trap sulphur loading for high sulphured fuel					
Pmrestore [7]	O/V	0... FFH	0... 255	1	-
Restorespeicher					
POW_CONF_IDX_EXT_REQ	O/V/S	0... 3H	0 ...3	1	-
Selected power configuration code via tester					
PROT_CONF_IDX_EXT_REQ	O/V/S	0... 2H	0 ...2	1	-
Selected data transmission protocol via tester(0/1 - 15765-4, 2 -14230)					
QOIL_DS_RST_KWP_1	O/V	0... FFH	0... 255	1	-
Reset oil quality via tester					
QOIL_DS_RST_KWP_2	O/V	0... FFH	0... 255	1	-
Reset availability via tester					
QOIL_DS_RST_KWP_3	O/V	0... FFH	0... 255	1	-
Reset number of services via tester					
QOIL_DS_RST_KWP_4	O/V	8000... 7FFFH	-32768 ...32767	1	-
Reset rest distance via tester					
QOIL_DS_RST_KWP_5	O/V	0... FFH	0... 255000	1000	km
Reset forecast way clearance via tester					
QOIL_DS_RST_KWP_6	O/V	0... FFH	0... 255	1	-
Reset target month via tester					
QOIL_DS_RST_KWP_7	O/V	0... FFH	0... 255	1	-
Reset target year via tester					
QOIL_DS_RST_KWP_8	O/V	0... FFH	0... 255	1	-
Reset forecast time clearance via tester					
QOIL_DS_RST_KWP_9	O/V	0... FFH	0... 255	1	-
Unit base for service clear via tester					
Qv_cdherst_1	O/V/S	0... FFH	0... 255	1	-
Codierung Hersteller 1					
Qv_cdherst_2	O/V/S	0... FFH	0... 255	1	-
Codierung Hersteller 2					
Qv_cdherst_3	O/V/S	0... FFH	0... 255	1	-
Codierung Hersteller 3					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Qv_cdherst_4	O/V/S	0... FFH	0... 255	1	-
Codierung Hersteller 4					
Qv_cdherst_5	O/V/S	0... FFH	0... 255	1	-
Codierung Hersteller 5					
Qv_cdherst_6	O/V/S	0... FFH	0... 255	1	-
Codierung Hersteller 6					
Qv_cdherst_7	O/V/S	0... FFH	0... 255	1	-
Codierung Hersteller 7					
Qv_cdherst_8	O/V/S	0... FFH	0... 255	1	-
Codierung Hersteller 8					
RATIO_MMV_NS_SHIFT_DIAG_EXT_ADJ [NC_NOX_SENS_CONF]	O/V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
External value of RATIO_MMV_NS_SHIFT_DIAG					
STATE_CMB_CTL_KWP	O/V	0... FFH	0... 255	1	-
carrier byte state combustion control					
STATE_CMB_CTL_NVMY_KWP	O/V/S	0... FFH	0... 255	1	-
carrier byte state combustion control non volatile saved					
STATE_HOM_AFS_REQ_EXT_ADJ	O/V	0... FFFFH	0... 65535	1	-
raw operation mode request from tester					
STATE_IV_CHG	O/V/S	0... FFFFH	0... 65535	1	-
Bit coded state indicating wether injection valve was changed - 1 on bit position x indicates injector change for logical cylinder x					
STATE_MIL_ON_DIS_EXT_REQ	O/V/S	0... 2H	0 ...2	1	-
request for variant "MIL_OFF" via tester					
Swmsaav	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Selektive temporäre Deaktivierung AVs bis zum nächsten Zündungswechsel					
Tvneutrin	O/V	0... FFFFH	0... 655.35	0.01	%
Tastverhältnis Nullgangsensor vorgeben					
VS_MAX_SEL_EXT_REQ	O/V/S	0... 3H	0 ...3	1	-
Selected maximum vehicle speed code via tester					
VVL_MIN_EXT_ADJ	O/V	0... FFFFH	0... 65.535	0.001	mm
adjustment value for minimum valve lift					
VVL_MIN_NVMY_EXT_ADJ	O/V	0... FFFFH	0... 65.535	0.001	mm
adjustment value for minimum valve lift					

Input data:

CHA_CDN_BAT {p. 797}	CONF_SOF_SWI {p. 654}	CTR_ERR_DYN_NR {p. 5767}	CTR_KM_CAN {p. 1563}
CTR_N_MAX {p. 4462}	CTR_TOIL_MAX {p. 1223}	DIST_TOIL_MAX {p. 1223}	GEAR_TOIL_MAX {p. 1223}
Id_bosrtak {p. 8159}	IMOB_CONFIG_EWS4 [4]	IMOB_NR_VLD_K_EWS4	K_EWS4 [16]
LC_N_OFS_KWP_ DISABLE {p. 7685}	LV_ACIN {p. 1564}	LV_AT {p. 654}	LV_CS_TOIL_MAX {p. 1223}
LV_DRI {p. 1302}	LV_ERR_TCO {p. 4496}	LV_ES {p. 1720}	LV_IGK {p. 906}
LV_IS {p. 1720}	LV_REQ_ISC {p. 3501}	LV_SENS_BAT_SMT_DET {p. 4095}	LV_VAR_ACIN {p. 655}
LV_VAR_AEB {p. 655}	LV_VAR_AMT {p. 655}	LV_VAR_ARS {p. 655}	LV_VAR_ASR {p. 655}

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LV_VAR_ASR_3 {p. 655}	LV_VAR_ASR_4 {p. 655}	LV_VAR_BN_EFP {p. 655}	LV_VAR_BN_GEAR_REV {p. 655}
LV_VAR_BN_LDM {p. 655}	LV_VAR_BN_LTG_HDLP_L {p. 655}	LV_VAR_BN_MSW {p. 655}	LV_VAR_BN_TRL {p. 655}
LV_VAR_CWP_LIN	LV_VAR_DCC {p. 655}	LV_VAR_EBOX_CFA {p. 655}	LV_VAR_ECRAS_DOWN {p. 4515}
LV_VAR_EF {p. 655}	LV_VAR_ETCU {p. 655}	LV_VAR_ETCU_SPT {p. 656}	LV_VAR_ICL {p. 656}
LV_VAR_LSH_DOWN {p. 656}	LV_VAR_LSH_UP {p. 656}	LV_VAR_MAF {p. 656}	LV_VAR_MAF_LEARNT {p. 656}
LV_VAR_MSW {p. 656}	LV_VAR_NOX {p. 656}	LV_VAR_PSTE {p. 656}	LV_VAR_PSTE_2 {p. 656}
LV_VAR_PSTE_3 {p. 656}	LV_VAR_RLY_ACCOUT {p. 656}	LV_VAR_RLY_ST {p. 656}	LV_VAR_SAP {p. 805}
LV_VAR_SAV {p. 805}	LV_VAR_SOF {p. 656}	LV_VAR_TCT {p. 656}	LV_VAR_TQ_PBR {p. 656}
N_MAX {p. 4462}	N_TOIL_MAX {p. 1223}	NC_CYL_NR {p. 1526}	NC_K_EWS_MAX
NC_NOX_SENS_CONF {p. 643}	NC_NT_NR {p. 644}	NT_AGI {p. 3073}	PV_AV_TOIL_MAX {p. 1223}
STATE_IMOB_K_EWS	STATE_PSTE_3_SRC {p. 1576}	TAM_TOIL_MAX {p. 1223}	TCO {p. 1100}
TCO_TOIL_MAX {p. 1223}	TOIL_MAX_WARN {p. 1223}	TOIL_THD_TOIL_MAX {p. 1223}	TQI_AV_TOIL_MAX {p. 1223}
TRT {p. 1504}	TRT_N_MAX {p. 4462}	VS_TOIL_MAX {p. 1223}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CHA_CDN_BAT_KWP_MIN	-	0... FFH	0... 127	0.4980392	Ah
minimum threshold for active battery charging due to enable conditions of idle speed offset by tester					
C_N_OFS_ACC_DRI_MAX	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset maximum threshold at LV_ACIN = 1 and LV_DRI = 1					
C_N_OFS_ACC_DRI_MIN	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset minimum threshold at LV_ACIN = 1 and LV_DRI = 1					
C_N_OFS_ACC_MAX	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset maximum threshold at LV_ACIN = 1 and LV_DRI = 0					
C_N_OFS_ACC_MIN	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset minimum threshold at LV_ACIN = 1 and LV_DRI = 0					
C_N_OFS_DRI_MAX	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset maximum threshold at LV_ACIN = 0 and LV_DRI = 1					
C_N_OFS_DRI_MIN	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset minimum threshold at LV_ACIN = 0 and LV_DRI = 1					
C_N_OFS_MAX	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset maximum threshold at LV_ACIN = 0 and LV_DRI = 0					
C_N_OFS_MIN	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset minimum threshold at LV_ACIN = 0 and LV_DRI = 0					
C_N_OFS_VB_MAX	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset maximum threshold at battery charging is active					
C_N_OFS_VB_MIN	-	80... 7FH	-256 ...254	2	rpm
idle speed setpoint offset minimum threshold at battery charging is active					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_PROT_CONF_IDX_EXT_REQ	-	0... 2H	0 ...2	1	-
init value for selected data transmission protocol via tester(0- - 15765, change with tester allowed 1 -15765, change with tester not allowed2 -14230, change with tester not allowed)					
C_TCO_MIN_MFF_ADD_EXT_ADJ	-	0... FEH	-48... 142.5	0.75	°C
Minimum TCO for CO- adjustment via tester					
C_TCO_MIN_N_OFS_KWP	-	0... FEH	-48... 142.5	0.75	°C
Minimum TCO threshold for activate idle speed offset					
C_VAR_STATE	-	0... FFH	0... 255	1	-
Country variant of the dataset					
LC_N_OFS_KWP_DISABLE	-	0... 1H	0 ...1	1	-
disable bit for idle speed setpoint offset by tester					
LC_STST_VAR_COD_ENA	-	0... 1H	0 ...1	1	-
enable STST-coding after TRT >= 10H (0- disable, 1 - enable)					

General information:

All implemented SID 2Eh services are described below.

I.25.1 Import Actions

ACTION_ECM3_DisableReq	ACTION_NOXM_WriteSulfurExtAdj(void)
ACTION_NOXM_WriteAgingExtAdj(void)	ACTION_NOXM_WriteAgiMExtAdj
ACTION_NOXD_WriteNSAdExtAdj	ACTION_NOXD_WriteNSGainDiagExtAdj
ACTION_NOXD_WriteNSShiftDiagExtAdj	ACTION_NOXD_WriteMMVNSExtAdj(void)

Overview of supported subservices

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SID number	service	MSV_80	MSD_80 (6cyl)	MSD_80 (4cyl)	MSD_81 (6cyl)	MSD_81 (4cyl)	MSD85(L4)
2E_10_00	Prüfstempel schreiben	X	X	X	X	X	X
2E_10_01	BOS löschen via Tester	X	X	X	X	X	X
2E_30_00	MIL-OFF Codierung schreiben	X	X	X	X	X	X
2E_30_01	Kat Codierung schreiben	X	X	X	X	X	X
2E_30_10	VMAX Codierung schreiben	X	X	X	X	X	X
2E_30_20	OL/UL Codierung schreiben	X	X	X	X	X	X
2E_30_30	Codierung-Protokoll schreiben	X	X	X	X	X	-
2E_32_00	Oelwechselintervall-Codierdaten schreiben	X	X	X	X	X	X
2E_32_10	IGR-Codierdaten schreiben	X	X	X	X	X	X
2E_32_11	Xenonverbau - Codierdaten schreiben	X	X	X	X	X	X
2E_32_20	Codierung SPA schreiben	X	X	X	X	X	X
2E_32_30	Codierung BZE schreiben	X	X	X	X	X	X
2E_32_40	Abgasklappe Codierung schreiben	X	X	X	X	X	X
2E_32_50	Codierung MSA schreiben	-	-	X	-	X	-
2E_32_60	Codierung CDASMOTschreiben	X	X	X	X	X	X
2E_3F_FF	Aenderungsindex der Codierdaten schreiben	X	X	X	X	X	X
2E_5F_7F	Clear "Zeitanteile der erreichten Druckbereiche (beim Tausch der Kraftstoff-hochdruckpumpe)"	X	X	X	X	X	X
2E_5F_87	LaufruheVerbesserungssystem Zaehler Reset	-	X	X	X	X	-
2E_5F_88	Schreiben NOx-Adaptationswerte	-	X	X	X	X	-
2E_5F_89	Request Reset MSA-Tabellenspeicher	-	-	X	-	X	-
2E_5F_8A	Schreiben Nullgang-Lernwert	-	-	X	-	X	-
2E_5F_8B	PMB vorgeben	X	X	X	X	X	X
2E_5F_8E	MSA_DEAK schreiben	-	-	X	-	X	-
2E_5F_8F	MSA_DEAK_AV schreiben	-	-	X	-	X	-
2E_5F_90	IMAALLE schreiben	-	X	X	X	X	X

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2E_5F_9x	IMA für Zylinder x schreiben	-	X	X	X	X	X
2E_5F_DE_00	VVT- Minhub Ansteuerung beenden	X	-	-	-	-	-
2E_5F_DE_07	VVT- Minhub ansteuern	X	-	-	-	-	-
2E_5F_DE_08	VVT- Minhub programmieren	X	-	-	-	-	-
2E_5F_F0_07	Abgleichswert LL ansteuern	X	X	X	X	X	X
2E_5F_F0_08	Abgleichswert LL programmieren	X	X	X	X	X	X
2E_5F_F1_00	CO- Abgleich beenden	X	-	-	-	-	-
2E_5F_F1_04	CO- Abgleich Reset	X	-	-	-	-	-
2E_5F_F1_07	CO- Abgleich ansteuern	X	-	-	-	-	-
2E_5F_F1_08	CO- Abgleich programmieren	X	-	-	-	-	-
2E_5F_F2_04	Varianten loeschen	X	X	X	X	X	X
2E_5F_F3_04	Uebertemperatursicherung loeschen	X	X	X	X	X	X
2E_5F_F4_04	Fusshebelwerk Fehlbedienung loeschen	X	X	X	X	X	-
2E_5F_F5_04	Powermanagement Histogramm loeschen	X	X	X	X	X	X
2E_5F_F6_04	Ueberdrehzahlsicherung loeschen	X	X	X	X	X	X
2E_5F_F7_00	Laufruheprüfung Vorgeben beenden	X	-	-	-	-	-
2E_5F_F7_07	Laufruheprüfung vorgeben	X	-	-	-	-	-
2E_5F_F7_08	Laufruheprüfung programmieren	X	-	-	-	-	-
2E_5F_F8_00	Homogenbetrieb vorgeben beenden	-	X	X	X	X	-
2E_5F_F8_07	Homogenbetrieb vorgeben	-	X	X	X	X	-
2E_C0_01	Write k_ews4	X	X	X	X	X	X

I.25.2 Standard application conditions

Initialisation at reset: 0, **except:** nonvolatile variables from NVRAM
Activation: LV_IGK = 1
Deactivation: LV_IGK = 0 **or** Diagnostic timeout
Service location: see "list of implemented diagnostic services"

Standard Global negative Responses:

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCID
#3d	General response code	M	#XX	RC

Figure I.25.1: Table: WriteDataByCommonIdentifier Negative Response Message

Remark:
The detailed message of the negative response code is described in chapter "Error codes".

I.25.3 2E_10_00 Write check stamp

General information:

With this comand the 3 bytes of the check stamp are written to the ECU (only lowest 3 byte of CHK_STAMP are used in software). Those are actually in the volatile memory. In the latch off phase (n = 0 rpm and Kl.15 off) this values are written down into the non volatile memory. If the battery voltage is removed from the ECU, bevor the power latch phase ends, the storage of the check stamp is cancelled and the value up to now was kept.
The writing of the check stamp was reserved for the customers production, that means that the check stamp can t be writen by the ECU production factory.
Because for writing CHK_STAMP NVMY programing is necessary it is written to the EEPROM during the ECU power latch. During this time the value of CHK_STAMP is buffered in RAM.

WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier	M	#10h	RCI_TSP
#3d	RecordCommonIdentifier	M	#00h	RCI_TSP
#4d	recordValue#1 = CHK_STAMP Byte 2	M	#XXh	RV_PST
#5d	recordValue#2 = CHK_STAMP Byte 1	M	#XXh	RV_PST
#6d	recordValue#3 = CHK_STAMP Byte 0 (LSB)	M	#XXh	RV_PST

Figure I.25.2: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response on service with RLI = #F0h

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	**WDBCIPR**
#2d	RecordCommonIdentifier	M	#10h	RCI_TSP
#3d	recordCommonIdentifier	M	#00h	RCI_TSP

Figure I.25.3: Table WriteDataByCommonIdentifier Positive Response Message

I.25.4 2E_10_01 Reset BOS data

General information:

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With this comand the required service data (BOS-bedarfsorientierte Servicedaten löschen) can be re-seted.
The BMW module OZ/PM/.. makes a reset if the layervalue Id_bosrtt (via QOIL_DS_RST_KWP_1) is not equal 00h.

Additional Application conditions:

Recurrence: 100 ms

Formula section:

If(1) service 2E_10_01 is received
then(1)
QOIL_DS_RST_KWP_i = corresponding record value
elseif(1)

//this part has to be calculated with a recurrence of 100ms:
if Id_bosrtak = QOIL_DS_RST_KWP_1
then QOIL_DS_RST_KWP_1 = 0
endif

WriteDataByCommonIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier high byte	M	#10h	RCI_BOS
#3d	RecordCommonIdentifier low byte	M	#01h	RCI_BOS
#4d	recordValue#1 = reset mode (fix)	M	#01h	RV_RES
#5d	recordValue#2 = QOIL_DS_RST_KWP_1	M	#XXh	RV_Id_bosrtt
#6d	recordValue#3 = QOIL_DS_RST_KWP_2	M	#XXh	RV_Bosbtvfbkt
#7d	recordValue#4 = QOIL_DS_RST_KWP_3	M	#XXh	RV_Zrbosrt
#8d	recordValue#5 = QOIL_DS_RST_KWP_4 high byte	M	#XXh	RV_Bosrlsmt
#9d	recordValue#6 = QOIL_DS_RST_KWP_4 low byte	M	#XXh	RV_Bosrlsmt
#10d	recordValue#7 = QOIL_DS_RST_KWP_9	M	#xxh	RV_Einheit
#11d	recordValue#8 = QOIL_DS_RST_KWP_5	M	#XXh	RV_Bosrw2t
#12d	recordValue#9 = QOIL_DS_RST_KWP_6	M	#XXh	RV_Bosmzielt
#13d	recordValue#10 = QOIL_DS_RST_KWP_7	M	#XXh	RV_Bosjzielt
#14d	recordValue#11 = QOIL_DS_RST_KWP_8	M	#XXh	RV_Bosprog2t
#15d	recordValue#12 = dummy value (not used)	M	#xxh	RV_RESERVE

Figure I.25.4: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	**WDBCIPR**
#2d	RecordCommonIdentifier	M	#10h	RCI_BOS
#3d	RecordCommonIdentifier	M	#01h	RCI_BOS

Figure I.25.5: Table WriteDataByCommonIdentifier Positive Response Message

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I.25.5 2E_30_00 MIL-OFF Codierung schreiben

General information:

With this command the MIL (malfunction indication lamp) can be switched off permanently. In case of a production ECU (active authentification/signature) the selection is only possible within the first 10 hours of ECU- runtime (TRT < 10 hours). The selection is stored in non volatile memory immediately during runnig time (because after coding the ECU is reset) and can not be changed after 10 hours. After 10 hours the ECU answers to the write- command with "subFunctionNotSupported."

Additional Application conditions:

Activation: LV_ES = 1 **and**
(TRT <= 10 hours - only if authentification/signature is active)

Deactivation: Diagnostic timeout **or**
(TRT > 10 hours - only if authentification/signature is active)
//send negative response code 12: subFunction NotSupported

Formula section:

IF C_VAR_STATE = 1
THEN STATE_MIL_ON_DIS_EXT_REQ = 0
ELSE **IF** recordValue#1 > 2H
THEN send negative response code 31: requestOutOfRange
ELSE STATE_MIL_ON_DIS_EXT_REQ = recordValue#1

WriteDataByCommonIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSM
#3d	RecordCommonIdentifier Low Byte	M	#00h	RCI_CDSM
#4d	recordValue#1 = STATE_MIL_ON_DIS_EXT_REQ	M	#XXh	RV_MIL

Figure I.25.6: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSM
#3d	RecordCommonIdentifier Low Byte	M	#00h	RCI_CDSM

Figure I.25.7: Table WriteDataByCommonIdentifier Positive Response Message

Meaning of C_VAR_STATE:
0 = ECE
1 = US

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I.25.6 2E_30_01 Kat Codierung schreiben

General information:

With this command automatically lerning of catalyst variants can be disabled. Catalyst variant is set to "no cat." In case of a production ECU (active authentification/signature) the selection is only possible within the first 10 hours of ECU- runtime (TRT < 10 hours). The selection is stored in non volatile memory immediately during runnig time (because after coding the ECU is reset) and can not be changed after 10 hours. After 10 hours the ECU answers to the write- command with "subFunctionNotSupported."

Additional Application conditions:

Activation: LV_ES = 1 (Engine Stop) **and**
(TRT <= 10 hours - only if authentification/signature is active)

Deactivation: Diagnostic timeout **or**
(TRT > 10 hours - only if authentification/signature is active)
//send negative response code 12: subFunctionNotSupported

Formula section:

IF recordValue#1 > 1H
THEN send negative response code 31: requestOutOfRange
ELSE LV_CAT_CONF_DIS_EXT_REQ = recordValue#1

WriteDataByCommonIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSO
#3d	RecordCommonIdentifier Low Byte	M	#01h	RCI_CDSO
#4d	recordValue#1 = LV_CAT_CONF_DIS_EXT_REQ	M	#XXh	RV_KATV

Figure I.25.8: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSO
#3d	RecordCommonIdentifier Low Byte	M	#01h	RCI_CDSO

Figure I.25.9: Table WriteDataByCommonIdentifier Positive Response Message

I.25.7 2E_30_10 VMAX Codierung schreiben

General information:

With this command one of four possible values for maximum vehicle speed is selected. In case of a production ECU (active authentification/signature) the selection is only possible within the first 10 hours

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of ECU- runtime (TRT < 10 hours). The selection is stored in non volatile memory immediately during runnig time (because after coding the ECU is reset) and can not be changed after 10 hours. After 10 hours the ECU answers to the write- command with "subFunctionNotSupported."

Additional Application conditions:

Activation: LV_ES = 1 (Engine Stop) **and**
(TRT <= 10 hours - only if authentification/signature is active)

Deactivation: Diagnostic timeout **or**
(TRT > 10 hours - only if authentification/signature is active)
//send negative response code 12: subFunction NotSupported

Formula section:

IF recordValue#1 > 3H
THEN send negative response code 31: requestOutOfRange
ELSE VS_MAX_SEL_EXT_REQ = recordValue#1

WriteDataByCommonIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSV MAX
#3d	RecordCommonIdentifier Low Byte	M	#10h	RCI_CDSV MAX
#4d	recordValue#1 = VS_MAX_SEL_EXT_REQ	M	#XXh	RV_VMAX

Figure I.25.10: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSV MAX
#3d	RecordCommonIdentifier Low Byte	M	#10h	RCI_CDSV MAX

Figure I.25.11: Table WriteDataByCommonIdentifier Positive Response Message

I.25.8 2E_30_20 OL/UL Codierung schreiben

General information:

With this command one of three power configuration codes is selected. This code is taken for the plausibility check of the two engine power variants OL ("obere Leistung") and UL ("untere Leistung"). In case of a production ECU (active authentification/signature) the selection is only possible within the first 10 hours of ECU- runtime (TRT < 10 hours). The selection is stored in non volatile memory immediately during runnig time (because after coding the ECU is reset) and can not be changed after 10 hours. After 10 hours the ECU answers to the write- command with "subFunctionNotSupported."

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Additional Application conditions:

Activation: LV_ES = 1 (Engine Stop) **and**
(TRT <= 10 hours - only if authentification/signature is active)

Deactivation: Diagnostic timeout **or**
(TRT > 10 hours - only if authentification/signature is active)
//send negative response code 12: subFunction NotSupported

Formula section:

IF recordValue#1 > 3H
THEN send negative response code 31: requestOutOfRange
ELSE POW_CONF_IDX_EXT_REQ = recordValue#1

WriteDataByCommonIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSL
#3d	RecordCommonIdentifier Low Byte	M	#20h	RCI_CDSL
#4d	recordValue#1 = POW_CONF_IDX_EXT_REQ	M	#XXh	RV_OLUL

Figure I.25.12: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSL
#3d	RecordCommonIdentifier Low Byte	M	#20h	RCI_CDSL

Figure I.25.13: Table WriteDataByCommonIdentifier Positive Response Message

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I.25.9 2E_30_30 Codierung Protokoll schreiben

General information:

With this command the ISO-protocol variant is selected. In case of a production ECU (active authentification/signature) the selection is only possible within the first 10 hours of ECU- runtime (TRT < 10 hours). The selection is stored in non volatile memory immediately during runnig time (because after coding the ECU is reset) and can not be changed after 10 hours. After 10 hours the ECU answers to the write- command with "subFunctionNotSupported."

Additional Application conditions:

Initialisation at first run of ECU:
PROT_CONF_IDX_EXT_REQ = C_PROT_CONF_IDX_EXT_REQ
Initialisation at reset or at first run of ECU:
If PROT_CONF_IDX_EXT_REQ = 2 // 14230
Then

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LV_VAR_OBDC_CAN = 0
Else
LV_VAR_OBDC_CAN = 1
Endif

Activation: LV_ES = 1 **and**
(TRT <= 10 hours - only if authentification/signature is active)

Deactivation: (TRT > 10 hours - only if authentification/signature is active)
//send negative response code 12: subFunctionNotSupported

Formula section:

If(1) recordValue#1 > 2H
Then(1) send negative response code 31: requestOutOfRange
Else(1)
If(2) C_ PROT_CONF_IDX_EXT_REQ = 0
Then (2) PROT_CONF_IDX_EXT_REQ = recordValue#1
If(3) PROT_CONF_IDX_EXT_REQ = 2 // 14230
Then(3)
LV_VAR_OBDC_CAN = 0
Else(3)
LV_VAR_OBDC_CAN = 1
Endif(3)
Else(2) send negative response subFunctionNotSupported
End(2)
End(1)

WriteDataByCommonIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSL
#3d	RecordCommonIdentifier Low Byte	M	#30h	RCI_CDSL
#4d	recordValue#1 = PROT_CONF_IDX_EXT_REQ	M	#XXh	RV_OLUL

Figure I.25.14: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#30h	RCI_CDSL
#3d	RecordCommonIdentifier Low Byte	M	#30h	RCI_CDSL

Figure I.25.15: Table WriteDataByCommonIdentifier Positive Response Message

I.25.10 2E_32_00 Oelwechselintervall- Codierdaten schreiben

General information:

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With this command two country dependant factors for oil change intervall can be coded. The selection is stored in non volatile memory immediately during runnig time (because after coding the ECU is reset).

Additional Application conditions:

Activation: LV_ES = 1

Deactivation: LV_ES =0

Formula section:

WriteDataByCommonIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#32h	RCI_CDSO
#3d	RecordCommonIdentifier Low Byte	M	#00h	RCI_CDSO
#4d	recordValue#1 = FAC_OIL_EXT_REQ_1	M	#XXh	RV_OZLF1C
#5d	recordValue#2 = FAC_OIL_EXT_REQ_2	M	#XXh	RV_OZLF2C

Figure I.25.16: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#32h	RCI_CDSO
#3d	RecordCommonIdentifier Low Byte	M	#00h	RCI_CDSO

Figure I.25.17: Table WriteDataByCommonIdentifier Positive Response Message

I.25.11 2E_32_10 IGR-Codierdaten schreiben

General information:

With this command the Intelligent alternator control can be coded.

Additional Application conditions:

Activation: LV_ES = 1

Deactivation: LV_ES = 0

Formula section:

WriteDataByCommonIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#32h	RCI_CDIGR
#3d	RecordCommonIdentifier Low Byte	M	#10h	RCI_CDIGR
#4d	recordValue#1 = LV_ALTER_CTL_ENA	M	#XXh	RV_B_CDIGRON

Figure I.25.18: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#32h	RCI_CDIGR
#3d	RecordCommonIdentifier Low Byte	M	#10h	RCI_CDIGR

Figure I.25.19: Table WriteDataByCommonIdentifier Positive Response Message

I.25.12 2E_32_11 Xenonverbau Codierdaten schreiben

General information:

With this command the mounting of xenon-filled headlights can be coded.

Additional Application conditions:

Activation: LV_ES = 1

Deactivation: LV_ES = 0

Formula section:

WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#32h	RCI_CDXEN
#3d	RecordCommonIdentifier Low Byte	M	#11h	RCI_CDXEN
#4d	recordValue#1 = LV_LTG_GAS_ENA	M	#XXh	RV_B_CDXENON

Figure I.25.20: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#32h	RCI_CDXEN
#3d	RecordCommonIdentifier Low Byte	M	#11h	RCI_CDXEN

Figure I.25.21: Table WriteDataByCommonIdentifier Positive Response Message

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I.25.13 2E_32_20 Codierung SPA

General information:

With this command the "Schaltpunktanzeige" can be coded.

Formula section:

WriteDataByCommonIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#32h	WDBCI_SPA_vorgeben
#3d	RecordCommonIdentifier Low Byte	M	#20h	WDBCI_SPA_vorgeben
#4d	Record value #1 = B_spa_csoll	M	#XXh	RV_SPA_CSOLL
#5d	Record value #2 = Dummy	M	#XXh	RV_DUMMY

Figure I.25.22: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#32h	WDBCI_SPA_vorgeben
#3d	RecordCommonIdentifier Low Byte	M	#20h	WDBCI_SPA_vorgeben

Figure I.25.23: Table WriteDataByCommonIdentifier Positive Response Message

I.25.14 2E_32_30 Codierung BZE schreiben

General information:

With this command the Intelligent alternator control can be coded.

Formula section:

WriteDataByCommonIdentifier Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#32h	WDBCI_BZE_vorgeben
#3d	RecordCommonIdentifier Low Byte	M	#30h	WDBCI_BZE_vorgeben
#4d	Record value #1 = Qv_cdherst_1	M	#XXh	RV_CD_HERST1
#5d	Record value #2 = Qv_cdherst_2	M	#XXh	RV_CD_HERST2
#6d	Record value #3 = Qv_cdherst_3	M	#XXh	RV_CD_HERST3
#7d	Record value #4 = Qv_cdherst_4	M	#XXh	RV_CD_HERST4
#8d	Record value #5 = Qv_cdherst_5	M	#XXh	RV_CD_HERST5
#9d	Record value #6 = Qv_cdherst_6	M	#XXh	RV_CD_HERST6
#10d	Record value #7 = Qv_cdherst_7	M	#XXh	RV_CD_HERST7
#11d	Record value #8 = Qv_cdherst_8	M	#XXh	RV_CD_HERST8

Figure I.25.24: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#32h	WDBCI_BZE_vorgeben
#3d	RecordCommonIdentifier Low Byte	M	#30h	WDBCI_BZE_vorgeben

Figure I.25.25: Table WriteDataByCommonIdentifier Positive Response Message

I.25.15 2E_32_40 Abgasklappe Codierung schreiben

General information:

With this command the used exhaust flap will be defined.

Formula section:

WriteDataByCommonIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#32h	WDBCI_AGK_vorgeben
#3d	RecordCommonIdentifier Low Byte	M	#40h	WDBCI_AGK_vorgeben
#4d	recordValue#1 = CONF_EF	M	#XXh	RV_CODIERUNG_AGK

Figure I.25.26: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#32h	WDBCI_AG K_vorgeben
#3d	RecordCommonIdentifier Low Byte	M	#40h	WDBCI_AG K_vorgeben

Figure I.25.27: Table WriteDataByCommonIdentifier Positive Response Message

I.25.16 2E_32_50 MSA Codierung schreiben

General information:

With this command the use of MSA will be defined.
The selection is only possible within the first 10 hours of ECU- runtime (TRT < 10 hours and LC_STST_VAR_COD = 0) or LC_STST_VAR_COD_ENA = 1. The selection is stored in non volatile memory
.
In case of LC_STST_VAR_CO_ENA = 0.no change after 10 hours is possible and the ECU answers to the write- command with "subFunctionNotSupported."

Additional Application conditions:

Activation: LV_ES = 1 **and**
(LC_STST_VAR_COD_ENA = 1
or
TRT <= 10 hours - if authentification/signature is active)

Deactivation: LV_ES = 0 **or**
(TRT > 10 hours - if authentification/signature is active
and LC_STST_VAR_COD_ENA = 0,
//send negative response code 12: subFunction NotSupported
)

Formula section:

WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#32h	WDBCI_CD MSA
#3d	RecordCommonIdentifier Low Byte	M	#50h	WDBCI_CD MSA
#4d	recordValue#1 = LV_STST_VAR_COD (0 - without MSA, 1 - with MSA)	M	#XXh	RV_CODIER UNG_MSA

Figure I.25.28: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#32h	WDBCI_CD MSA
#3d	RecordCommonIdentifier Low Byte	M	#50h	WDBCI_CD MSA

Figure I.25.29: Table WriteDataByCommonIdentifier Positive Response Message

I.25.17 2E_32_60 Codierung CDASMOT schreiben

General information:

With this function the "Codierung elektrische Diagnose der Funktion Abschaltung Klemme 15" is written in NVRAM

Formula section:

WriteDataByCommonIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	Request Service ID	M	2Eh	WDBCI
2	RecordCommonIdentifier High Byte	M	32h	WDBCI_CDASMOT
3	RecordCommonIdentifier Low Byte	M	60h	WDBCI_CDASMOT
4	recordValue#1 = LV_IGK_OFF_ACK_ENA (0 - diagnosis off, 1 - diagnosis on)	M	XXh [0h, 1h]	RV_CODIERUNG_ASMOT

WriteDataByCommonIdentifier Positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
1	**Response Service ID**	**M**	**6Eh**	**RDBCIPR**
2	RecordCommonIdentifier High Byte	M	32h	WDBCI_CDASM OT
3	RecordCommonIdentifier Low Byte	M	60h	WDBCI_ CDASMOT

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I.25.18 2E_3F_FF Aenderungsindex der Codierdaten schreiben

General information:

With this command the changing index of the coding data is written. The value is stored in non volatile memory immediately during runnig time (because after coding the ECU is reset).

Additional Application conditions:

Activation: LV_ES = 1
Deactivation: LV_ES = 0

Formula section:

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WriteDataByCommonIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#3Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#FFh	RCI_
#4d	recordValue#1 = IDX_VAR_COD[2]	M	#XXh	RV_
#5d	recordValue#2 = IDX_VAR_COD[1]	M	#XXh	RV_

Figure I.25.30: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#3Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#FFh	RCI_

Figure I.25.31: Table WriteDataByCommonIdentifier Positive Response Message

I.25.19 2E_5F_7F Clear "Zeitanteile der erreichten Druckbereiche (beim Tausch der Kraftstoffhochdruckpumpe)"

General information:

This service clears the statistic "Zeitanteile der erreichten Druckbereiche (beim Tausch der Kraftstoffhochdruck-pumpe)".

Additional application conditions:

Initialisation at reset and in case of PWL:

B_prail_mon_clr = 0

Formula section:

If(1) service 2E,5F,7F is received
Then(1)
B_prail_mon_clr = 1
Endif(1)

WriteDataByIdentifier Request

.

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*
#1d	**WriteDataByIdentifier Request Service Id**	**M**	**#2Eh**
#2d	RecordCommonIdentifier High Byte	M	#5Fh
#3d	RecordCommonIdentifier Low Byte	M	#7Fh

Figure I.25.32: Table WriteDataByIdentifier Request Message

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WriteDataByIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*
#1d	**WriteDataByIdentifier Response Service Id**	**M**	**#6Eh**
#2d	RecordCommonIdentifier High Byte	M	#5Fh
#3d	RecordCommonIdentifier Low Byte	M	#7Fh

Figure I.25.33: Table WriteDataByIdentifier Positive Response Message

I.25.20 2E_5F_87 LaufruheVerbesserungssystem Zaehler Reset

General information:

This command generate a request to reset the counter of "Laufruheverbesserungssystem" in BMW-software.

Formula section:

If service 2E_5F_87 is received
then
set B_zrlvs_clr = 1 for 2 sec.
send positive response
endif

WriteDataByCommonIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_LVSZYL_RESET
#3d	RecordCommonIdentifier	M	#87h	WDCI_LVSZYL_RESET

Figure I.25.34: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	**WDBCIPR**
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_LVSZYL_RESET
#3d	recordCommonIdentifier	M	#87h	WDCI_LVSZYL_RESET

Figure I.25.35: Table WriteDataByCommonIdentifier Positive Response Message

I.25.21 2E_5F_88 ADRECOVERY vorgeben

General information:

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This command write informations about the Nox-trap into ECU. This is necessary after reprogramming or change of ECU.

Formula section:

If service 2E_5F_88 is received
Then

store received values into corresponding variables
call ACTION_NOXM_WriteSulfurExtAdj(void)
call ACTION_NOXM_WriteAgingExtAdj(void)
call ACTION_NOXM_WriteAgiMExtAdj
call ACTION_NOXD_WriteNSAdExtAdj
call ACTION_NOXD_WriteNSShiftDiagExtAdj
call ACTION_NOXD_WriteNSGainDiagExtAdj
call ACTION_NOXD_WriteMMVNSExtAdj(void)
send positive response

endif

WriteDataByCommonIdentifier Request

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Data Byte	*Parameter Name*	*C vt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_ADRESTORE
#3d	RecordCommonIdentifier	M	#88h	WDCI_ADRESTORE
#4d	recordValue#1 = NT_SUL_32_EXT_ADJ[1] (high word, high byte)	M	#XXh	RV_NT_SUL_32[1]
#5d	recordValue#2 = NT_SUL_32_EXT_ADJ [1] (high word, low byte)	M	#XXh	RV_NT_SUL_32[1]
#6d	recordValue#3 = NT_SUL_32_EXT_ADJ [1] (low word, high byte)	M	#XXh	RV_NT_SUL_32[1]
#7d	recordValue#4 = NT_SUL_32_EXT_ADJ [1] (low word, low byte)	M	#XXh	RV_NT_SUL_32[1]
#8d	recordValue#5 = NT_SUL_32_EXT_ADJ [2] (high word, high byte)	M	#XXh	RV_NT_SUL_32[2]
#9d	recordValue#6 = NT_SUL_32_EXT_ADJ [2] (high word, low byte)	M	#XXh	RV_NT_SUL_32[2]
#10d	recordValue#7 = NT_SUL_32_EXT_ADJ [2] (low word, high byte)	M	#XXh	RV_NT_SUL_32[2]
#11d	recordValue#8 = NT_SUL_32_EXT_ADJ [2] (low word, low byte)	M	#XXh	RV_NT_SUL_32[2]
#12d	recordValue#9 = NT_SUL_H_32_EXT_ADJ [1] (high word, high byte)	M	#XXh	RV_NT_SUL_H_32[1]
#13d	recordValue#10 = NT_SUL_H_32_EXT_ADJ [1] (high word, low byte)	M	#XXh	RV_NT_SUL_H_32[1]
#14d	recordValue#11 = NT_SUL_H_32_EXT_ADJ [1] (low word, high byte)	M	#XXh	RV_NT_SUL_H_32[1]
#15d	recordValue#12 = NT_SUL_H_32_EXT_ADJ [1] (low word, low byte)	M	#XXh	RV_NT_SUL_H_32[1]
#16d	recordValue#13 = NT_SUL_H_32_EXT_ADJ [2] (high word, high byte)	M	#XXh	RV_NT_SUL_H_32[2]
#17d	recordValue#14 = NT_SUL_H_32_EXT_ADJ 2] (high word, low byte)	M	#XXh	RV_NT_SUL_H_32[2]
#18d	recordValue#15 = NT_SUL_H_32_EXT_ADJ [2] (low word, high byte)	M	#XXh	RV_NT_SUL_H_32[2]
#19d	recordValue#16 = NT_SUL_H_32_EXT_ADJ [2] (low word, low byte)	M	#XXh	RV_NT_SUL_H_32[2]
#20d	recordValue#17 = not used	M	#XXh	RV_
#21d	recordValue#18 = not used	M	#XXh	RV_
#22d	recordValue#19 = NT_AGI_SO2P_FQ_SUM_EXT_ADJ (high word, high byte)	M	#XXh	RV_NT_AGI_SO2P_FQ_SUM
#23d	recordValue#20 = NT_AGI_SO2P_FQ_SUM_EXT_ADJ (high word, low byte)	M	#XXh	RV_NT_AGI_SO2P_FQ_SUM
#24d	recordValue#21 = NT_AGI_SO2P_FQ_SUM_EXT_ADJ (low word, high byte)	M	#XXh	RV_NT_AGI_SO2P_FQ_SUM
#25d	recordValue#22 = NT_AGI_SO2P_FQ_SUM_EXT_ADJ (low word, low byte)	M	#XXh	RV_NT_AGI_SO2P_FQ_SUM
#26d	recordValue#23 = not used	M	#XXh	RV_NT_AGI_SUL
#27d	recordValue#24 = not used	M	#XXh	RV_NT_AGI_SUL
#28d	recordValue#25 = NT_AGI_SUL_SNG_EXT_ADJ [1] high word, high byte)	M	#XXh	RV_NT_AGI_SUL_SNG[1]
#29d	recordValue#26 = NT_AGI_SUL_SNG_EXT_ADJ [1] (high word, low byte)	M	#XXh	RV_NT_AGI_SUL_SNG[1]
#30d	recordValue#27 = NT_AGI_SUL_SNG_EXT_ADJ [1] (low word, high byte)	M	#XXh	RV_NT_AGI_SUL_SNG[1]

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#31d	recordValue#28 = NT_AGI_SUL_SNG_EXT_ADJ [1] (low word, low byte)	M	#XXh	RV_NT_AGI_SUL_SNG[1]
#32d	recordValue#29 = NT_AGI_SUL_SNG_EXT_ADJ [2](high word, high byte)	M	#XXh	RV_NT_AGI_SUL_SNG[2]
#33d	recordValue#30 = NT_AGI_SUL_SNG_EXT_ADJ [2] (high word, low byte)	M	#XXh	RV_NT_AGI_SUL_SNG[2]
#34d	recordValue#31 = NT_AGI_SUL_SNG_EXT_ADJ [2] (low word, high byte)	M	#XXh	RV_NT_AGI_SUL_SNG[2]
#35d	recordValue#32 = NT_AGI_SUL_SNG_EXT_ADJ [2] (low word, low byte)	M	#XXh	RV_NT_AGI_SUL_SNG[2]
#36d	recordValue#33 = not used	M	#XXh	RV_
#37d	recordValue#34 = not used	M	#XXh	RV_
#38d	recordValue#35 = NT_AGI_THERMO_SNG_EXT_ADJ [1] (high byte)	M	#XXh	RV_NT_AGI_THERMO_SNG[1]
#39d	recordValue#36 = NT_AGI_THERMO_SNG_EXT_ADJ [1] (high byte)	M	#XXh	RV_NT_AGI_THERMO_SNG[1]
#40d	recordValue#37 = NT_AGI_THERMO_SNG_EXT_ADJ [2] (high byte)	M	#XXh	RV_NT_AGI_THERMO_SNG[2]
#41d	recordValue#38 = NT_AGI_THERMO_SNG_EXT_ADJ [2] (low byte)	M	#XXh	RV_NT_AGI_THERMO_SNG[2]
#42d	recordValue#39 = CTR_NT_AGI_AD_CMPL_SUM_EXT_ADJ (high byte)	M	#XXh	RV_CTR_NT_AGI_AD_CMPL_SUM
#43d	recordValue#40 = CTR_NT_AGI_AD_CMPL_SUM_EXT_ADJ (low byte)	M	#XXh	RV_CTR_NT_AGI_AD_CMPL_SUM
#44d	recordValue#41 = CTR_NT_AGI_SO2P_FQ_EXT_ADJ (high byte)	M	#XXh	RV_CTR_NT_AGI_SO2P_FQ
#-d	recordValue#42 = CTR_NT_AGI_SO2P_FQ_EXT_ADJ (low byte)	M	#XXh	RV_CTR_NT_AGI_SO2P_FQ
#46d	recordValue#43 = not used	M	#XXh	RV_
#47d	recordValue#44 = LV_NT_AFS_REQ_AGI_TMP_3_EXT_ADJ	M	#XXh	RV_LV_NT_AFS_REQ_AGI_TMP_3
#48d	recordValue#- = not used	M	#XXh	RV_
#49d	recordValue#46 = LV_SO2P_REQ_2_EXT_ADJ	M	#XXh	RV_LV_SO2P_REQ_2
#50d	recordValue#47 = LV_SO2P_REQ_FQ_EXT_ADJ	M	#XXh	RV_LV_SO2P_REQ_FQ
#51d	ecordValue#48 = FAC_NT_AGI_LIM_EXT_ADJ (high byte)	M	#XXh	RV_FAC_NT_AGI_LIM
#52d	ecordValue#49 = FAC_NT_AGI_LIM_EXT_ADJ (low byte)	M	#XXh	RV_FAC_NT_AGI_LIM
#53	recordValue50 = FAC_NT_AGI_MDL_EXT_ADJ (high word, high byte)	M	#XXh	RV_FAC_NT_AGI_MDL_EXT_ADJ
#54	recordValue51 = FAC_NT_AGI_MDL_EXT_ADJ (high word, low byte)	M	#XXh	RV_FAC_NT_AGI_MDL_EXT_ADJ
#55	recordValue52 = FAC_NT_AGI_MDL _EXT_ADJ (low word, high byte)	M	#XXh	RV_FAC_NT_AGI_MDL_EXT_ADJ
#56	recordValue53 = FAC_NT_AGI_MDL _EXT_ADJ (low word, low byte)	M	#XXh	RV_FAC_NT_AGI_MDL_EXT_ADJ
#57	recordValue54 = DIST_NS_NEW_EXT_ADJ (high byte)	M	#XXh	RV_DIST_NS_NEW_EXT_ADJ
#58	recordValue55 = DIST_NS_NEW_EXT_ADJ (low byte)	M	#XXh	RV_DIST_NS_NEW_EXT_ADJ
#59	recordValue56 = DIST_NT_NS_SHIFT_EXT_ADJ [1] (high byte)	M	#XXh	RV_DIST_NT_NS_SHIFT_EXT_ADJ[1]
#60	recordValue57 = DIST_NT_NS_SHIFT_EXT_ADJ [1] (low byte)	M	#XXh	RV_DIST_NT_NS_SHIFT_EXT_ADJ[1]
#61	recordValue58 = CTR_NS_AD_CYL_EXT_ADJ [1] (high byte)	M	#XXh	RV_ CTR_NS_AD_CYL_EXT_ADJ[1]
#62	recordValue59 = CTR_NS_AD_CYL_EXT_ADJ [1] (low byte)	M	#XXh	RV_ CTR_NS_AD_CYL_EXT_ADJ[1]
#63	recordValue60 = DIST_NT_NS_AD_EXT_ADJ [1] (high byte)	M	#XXh	RV_DIST_NT_NS_AD_EXT_ADJ[1]
#64	recordValue61 = DIST_NT_NS_AD_EXT_ADJ [1] (low byte)	M	#XXh	RV_DIST_NT_NS_AD_EXT_ADJ[1]
#65	recordValue62 = FAC_NOX_NS_AD_EXT_ADJ [1] (high byte)	M	#XXh	RV_FAC_NOX_NS_AD_EXT_ADJ[1]

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#66	recordValue63 = FAC_NOX_NS_AD_EXT_ADJ [1] (low byte)	M	#XXh	RV_FAC_NOX_NS_AD_EXT_ADJ[1]
#67	recordValue64 = CTR_NS_SHIFT_CYC_EXT_ADJ[1] (high byte)	M	XXh	RV_CTR_NS_SHIFT_CYC_EXT_ADJ [1]
#68	recordValue65 = CTR_NS_SHIFT_CYC_EXT_ADJ[1] (low byte)	M	XXh	RV_CTR_NS_SHIFT_CYC_EXT_ADJ [1]
#69	recordValue66 = RATIO_MMV_NS_SHIFT_DIAG_EXT_ADJ[1] (high byte)	M	XXh	RV_RATIO_MMV_NS_SHIFT_DIAG_EXT_ADJ[1]
#70	recordValue67 = RATIO_MMV_NS_SHIFT_DIAG_EXT_ADJ[1] (low byte)	M	XXh	RV_RATIO_MMV_NS_SHIFT_DIAG_EXT_ADJ [1]

Table WriteDataByCommonIdentifier Request Message
(Hint: In case of NC_NT_NR =1 must 0ffh transmitte for all "recorde values " with array element[2])

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	**WDBCIPR**
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_ADRESTORE
#3d	recordCommonIdentifier	M	#88h	WDCI_ADRESTORE

Figure I.25.36: Table WriteDataByCommonIdentifier Positive Response Message

I.25.22 2E_5F_89 Request Reset MSA-Tabellenspeicher

General information:

This command the request Reset MSA-Tabellenspeicher is send to BMW-software.

Additionnal Application conditions:

Initalisation at reset and in case of LV_IGK 1-> 0:
B_msahfkreset = 0

Formula section:

If service 2E_5F_89 is received
then
B_msahfkreset = 1
send positive response
endif

Formula section:

WriteDataByCommonIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_MSA RING_HFKR ESET
#3d	RecordCommonIdentifier	M	#89h	WDCI_MSA RING_HFKR ESET WDCI_NGS

Figure I.25.37: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	**WDBCIPR**
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_MSA RING_HFKR ESET WDCI_NGS
#3d	recordCommonIdentifier	M	#89h	WDCI_MSA RING_HFKR ESET WDCI_NGS

Figure I.25.38: Table WriteDataByCommonIdentifier Positive Response Message

I.25.23 2E_5F_8A Nullgang_Lernwert_vorgeben

General information:

This command write the Nullgang_Lernwert_vorgeben to BMW-software.

Additional Application conditions:

Initalisation at reset and in case of LV_IGK 1-> 0:
Tvneutrin = 0.0

Formula section:

If service 2E_5F_8A is received
then
Tvneutrin = corresponding received values
send positive response
endif

Formula section:

WriteDataByCommonIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_NGS
#3d	RecordCommonIdentifier	M	#8Ah	WDCI_NGS
#4d	recordValue#1 = Tvneutrin (high byte)	M	#XXh	WDCI_NGS
#5d	recordValue#2 = Tvneutrin (low byte)	M	#XXh	WDCI_NGS

Figure I.25.39: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	**WDBCIPR**
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_NGS
#3d	recordCommonIdentifier	M	#8Ah	WDCI_NGS

Figure I.25.40: Table WriteDataByCommonIdentifier Positive Response Message

I.25.24 2E_5F_8B PMB_vorgeben

General information:

This command write informations about the state of battery into ECU. This is necessary after repro-gramming or change of ECU.

Formula section:

If service 2E_5F_8B is received
then
Pmrestore[7] = corresponding received values
set B_pmrestore = 1 for 5 sec.
send positive response
endif

WriteDataByCommonIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_PMB
#3d	RecordCommonIdentifier	M	#8Bh	WDCI_PMB
#4d	recordValue#1 = Pmrestore[0]	M	#XXh	RV_PMRES TORE[0]
#5d	recordValue#2 = Pmrestore[1]	M	#XXh	RV_PMRES TORE[1]
#6d	recordValue#3 = Pmrestore[2]	M	#XXh	RV_PMRES TORE[2]
#7d	recordValue#4 = Pmrestore[3]	M	#XXh	RV_PMRES TORE[3]
#8d	recordValue#5 = Pmrestore[4]	M	#XXh	RV_PMRES TORE[4]
#9d	recordValue#6 = Pmrestore[5]	M	#XXh	RV_PMRES TORE[5]
#10d	recordValue#7 = Pmrestore[6]	M	#XXh	RV_PMRES TORE[6]

Figure I.25.41: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	**WDBCIPR**
#2d	RecordCommonIdentifier	M	#5Fh	WDCI_PMB
#3d	recordCommonIdentifier	M	#8Bh	WDCI_PMB

Figure I.25.42: Table WriteDataByCommonIdentifier Positive Response Message

I.25.25 2E_5F_8E MSA_DEAK

General information:

With this command the deactivation of MSA can be switched on /off.
In the first 250 km the MSA can switched off permanently with service request 2E_5F_8E_08. After more then 250km the ECU answers on this request with "subFunctionNotSupported" and the deactivation of MSA with 2E_5F_8E_07 is only possible for the actual driving cylce.

Additional Application conditions:

Initialisation at reset or LV_IGK 1 > 0:

If *CTR_KM_CAN > 249 km* ***and*** *LV_STST_DEAC = 1*
Then *store LV_STST_DEAC = 0 in non volatile memory*
Endif
B_msasw = LV_STST_DEAC

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Formula section:

if(1) record value#1 = 0
then(1)
LV_STST_DEAC = 0

```
            B_msasw          = 0
            store LV_STST_DEAC = 0 in non volatile memory
            send positive respones
    endif(1)
    if(1)        record value#1 = 7
    then(1)
            B_msasw = 1
            send positve response
    endif(1)
    if(1)        record value#1 = 8
    then(1)
            if(2)              CTR_KM_CAN   > 249 km
            then(2)         LV_STST_DEAC = 0
                            B_msasw = 0
                            send negative response
            else(2)              LV_STST_DEAC =1
                            B_msasw = 1
                            send positive response
            endif(2)
            store LV_STST_DEAC   in non volatile memory
    else(1)
            send negative response
endif(1)
```

WriteDataByCommonIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_MSA_DEAK
#3d	RecordCommonIdentifier Low Byte	M	#8Eh	RCI_MSA_DEAK
#4d	Record value#1	M	#XXh	RV_RCTECU

Figure I.25.43: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_MSA_D EAK
#3d	RecordCommonIdentifier Low Byte		#8Eh	RCI_MSA_D EAK

Figure I.25.44: Table WriteDataByCommonIdentifier Positive Response Message

I.25.26 2E_5F_8F MSA_DEAK_AV

General information:

With this command the selective deactivation of "Abschaltverhinderer MSA"   can be coded.

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Additional Application conditions:

Initialisation at reset or LV_IGK 1 -> 0: Swmsaav = 0

Formula section:

if record value#1 = 0
then
Swmsaav = 0
send positive response
endif
if record value#1 = 7
then
Swmsaav = received value
send positve response
elseif
send negative response
endif

WriteDataByCommonIdentifier Request (only service 2E_5F_8F_00)

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_MSA_DEAK _AV
#3d	RecordCommonIdentifier Low Byte	M	#8Fh	RCI_MSA_DEAK _AV
#4d	Record value#1	M	#00h	RV_RCTECU

Figure I.25.45: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier Request (only service 2E_5F_8F_07)

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_MSA_DEAK _AV
#3d	RecordCommonIdentifier Low Byte	M	#8Fh	RCI_MSA_DEAK _AV
#4d	Record value#1	M	#07h	RV_STA
#5d	Record value#2 = Swmsaav (high byte , high word)	M	#XXh	RV_MSA_DEAK_ AV
#6d	Record value#3 = Swmsaav (low byte , high word)	M	#XXh	RV_MSA_DEAK_ AV
#7d	Record value#4 = Swmsaav (high byte , low word)	M	#XXh	RV_MSA_DEAK_ AV
#8d	Record value#5 = Swmsaav (low byte , low word)	M	#XXh	RV_MSA_DEAK_ AV

Figure I.25.46: Table WriteDataByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_MSA_DEAK_AV
#3d	RecordCommonIdentifier Low Byte		#8Fh	RCI_MSA_DEAK_AV

Figure I.25.47: Table WriteDataByCommonIdentifier Positive Response Message

I.25.27 2E_5F_90 IMAALLE programmieren

Description:

With this service all injection valve corrections are written indivudal for each cylinder. The values EGY_SP_IV_EXT_ADJ[NC_CYL_NR] and MFF_ABSV_IV_EXT_ADJ[NC_CYL_NR] must be stored in **reprogrammingresistant** non volatile memory. At first run of new ECU or in case of NVRAM error the output data must initialized with zero.
STATE_IV_CHG is used at engine stop to engine run.

Additional Application conditions:

Initialisation: at reset: from NVRAM and from reprogramming resistant NVRAM ,
at exit start: **if** STATE_IV_CHG <> 0
then STATE_IV_CHG = 0
write NVRAM "BMW coding"
endif
Activation: LV_ES = 1
Deactivation: *LV_ES = 0*

Formula Section:

If received service 2E_5F_90
then
EGY_SP_IV_EXT_ADJ[NC_CYL_NR] = corresponding received values
MFF_ABSV_IV_EXT_ADJ[NC_CYL_NR] = corresponding received values
STATE_IV_CHG(bit 0).. STATE_IV_CHG(bit NC_CYL_NR-1) = 1
send positive response
endif

WriteDataByCommonIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Request Service Id	M	#2Eh	WDBCI
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_IMAALLE
#3d	RecordCommonIdentifier Low Byte	M	#90h	RCI_IMAALLE
#4d	RecordValue#1 = - EGY_SP_IV_EXT_ADJ[0] high byte	M	#XXh	RCI_
#5d	RecordValue#2 = - EGY_SP_IV_EXT_ADJ[0] low byte	M	#XXh	RCI_
#6d	RecordValue#3 = - MFF_ABSV_IV_EXT_ADJ[0] high byte	M	#XXh	RCI_
#7d	RecordValue#4 = - MFF_ABSV_IV_EXT_ADJ[0] low byte	M	#XXh	RCI_
...	...	...	...	...
...	...	...	...	...
...	...	...	...	...
#4*NC_CYL _NR	RecordValue#(4*NC_CYL_NR-3) = EGY_SP_IV_EXT_ADJ[NC_CYL_NR-1] high byte	M	#XXh	RCI_
#4*NC_CYL _NR +1	RecordValue#(4*NC_CYL_NR -2) = EGY_SP_IV_EXT_ADJ[NC_CYL_NR-1] low byte	M	#XXh	RCI_
#4*NC_CYL _NR +2	RecordValue#(4*NC_CYL_NR -1) = MFF_ABSV_IV_EXT_ADJ[NC_CYL_NR-1] high byte	M	#XXh	RCI_
#4*NC_CYL _NR +3	RecordValue#(4*NC_CYL_NR) = MFF_ABSV_IV_EXT_ADJ[NC_CYL_NR-1] low byte	M	#XXh	RCI_

Figure I.25.48: Table WriteDataByLocalIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	WriteDataByCommonIdentifier Response Service Id	M	#6Eh	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_IMAALLE
#3d	RecordCommonIdentifier Low Byte	M	#90h	RCI_IMAALLE

Figure I.25.49: Table WriteDataByLocalIdentifier Positive Response Message

I.25.28 2E_5F_9x IMA0x programmieren

Description:

With this service cylinder balancing injection valve corrections is written only for cylinder x.

Additional Application conditions:

Initialisation at exit start: STATE_IV_CHG = 0
Activation: LV_ES = 1
Deactivation: LV_ES = 0

Formula Section:

if received service 2E_5F_9x **and** x<= NC_CYL_NR // x from 2E_5F_9x
then
EGY_SP_IV_EXT_ADJ[x-1] = received value
MFF_ABSV_IV_EXT_ADJ[x-1] = received value
STATE_IV_CHG(bit x-1) = 1
send positive response
endif

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WriteDataByCommonIdentifier Request

.

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_IMA0x
#3d	RecordCommonIdentifier Low Byte	M	#9xh	RCI_IMA0x
#4d	RecordValue#1 = - EGY_SP_IV_EXT_ADJ[x-1] high byte	M	#XXh	RCI_
#5d	RecordValue#2= - EGY_SP_IV_EXT_ADJ[x-1] low byte	M	#XXh	RCI_
#6d	RecordValue#3= - MFF_ABSV_IV_EXT_ADJ[x-1] high byte	M	#XXh	RCI_
#7d	RecordValue#4= - MFF_ABSV_IV_EXT_ADJ[x-1] low byte	M	#XXh	RCI_

Figure I.25.50: Table WriteDataByLocalIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_IMA0x
#3d	RecordCommonIdentifier Low Byte	M	#9xh	RCI_IMA0x

Figure I.25.51: Table WriteDataByLocalIdentifier Positive Response Message

I.25.29 2E_5F_DE_00 VVT- Minhub Ansteuerung beenden

General information:

When this service is received, the actuator diagnosis function stops and control is given back to the ECU control.

Formula section:

WriteDataByCommonIdentifier Request

.

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_VH
#3d	RecordCommonIdentifier Low Byte	M	#DEh	RCI_VH
#4d	Inputoutputcontrolparameter	M	#00h	IOCP_RCTECU

Figure I.25.52: Table inputoutputcontrolByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_VH
#3d	RecordCommonIdentifier Low Byte	M	#DEh	RCI_VH
#4d	Inputoutputcontrolparameter	M	#00h	IOCP_RCTECU

Figure I.25.53: Table inputoutputcontrolByCommonIdentifier Positive Response Message

I.25.30 2E_5F_DE_07 VVT- Minhub ansteuern

Description:

With this service the minimum valve lift can be adjusted.

Formula section:

WriteDataByCommonIdentifier Request

.

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_MINH
#3d	RecordCommonIdentifier Low Byte	M	#DEh	RCI_MINH
#4d	Inputoutputcontrolparameter	M	#07h	IOCP_STA
#5d	inputOutputControlParameter - VVL_MIN_EXT_ADJ high byte	M	#XXh	CS_MINH
#6d	InputOutputControlParameter - VVL_MIN_EXT_ADJ low byte	M	#XXh	CS_MINH

Figure I.25.54: Table inputoutputcontrolByLocalIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_MINH
#3d	RecordCommonIdentifier Low Byte	M	#DEh	RCI_MINH
#4d	Inputoutputcontrolparameter	M	#07h	IOCP_STA

Figure I.25.55: Table inputoutputcontrolByLocalIdentifier Positive Response Message

I.25.31 2E_5F_DE_08 VVT- Minhub programmieren

Description:

With this service the minimum valve lift can be programmed into non volatile memory after power latch phase.

Additional Application conditions:

Activation: LV_ES = 1

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Deactivation: LV_ES = 0

Formula section:

WriteDataByCommonIdentifier Request

.

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_MINH
#3d	RecordCommonIdentifier Low Byte	M	#DEh	RCI_MINH
#4d	Inputoutputcontrolparameter	M	#08h	IOCP_LTA
#5d	inputOutputControlParameter - VVL_MIN_NVMY_EXT_ADJ high byte	M	#XXh	CS_MINH
#6d	InputOutputControlParameter - VVL_MIN_NVMY_EXT_ADJ low byte	M	#XXh	CS_MINH

Figure I.25.56: Table inputoutputcontrolByLocalIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_MINH
#3d	RecordCommonIdentifier Low Byte	M	#DEh	RCI_MINH
#4d	Inputoutputcontrolparameter	M	#08h	IOCP_LTA

Figure I.25.57: Table inputoutputcontrolByLocalIdentifier Positive Response Message

I.25.32 2E_5F_F0_07 Abgleichswert LL ansteuern

General information:

With the tester via KWP telegram an idle speed offset for five different conditions can be calibrated. The idle speed setpoint offsets stored into the non volatile memory are initialized with 0 as default value. In case of a tester is connected via KWP N_KWP_OFS_ACC_DRI, N_KWP_OFS_DRI, N_KWP_OFS_ACC, N_KWP_OFS and N_KWP_OFS_VB are sent and the bit store was sent the adjusted values are stored into non volatile memory.
In case of LV_KWP_ENA = 1 and a tester is connected via KWP the adjustment values N_KWP_OFS_ACC_DRI_KWP, N_KWP_OFS_DRI_KWP, N_KWP_OFS_KWP, N_KWP_OFS_ACC_KWP and N_KWP_OFS_VB_KWP from tester are used.

N_SP_OFS_KWP is permanently used in the idle speed module, so the calculation within the KWP-module have to do permanantly.

For the time, when the tester works on the car, the max. selection should be off for this Kl.15 cycle. Now the new setting of the offsets can be made.

Additional Application conditions:

Initialisation at reset:

N_KWP_OFS_ACC_DRI = N_KWP_OFS_ACC_DRI_NVMY
N_KWP_OFS_DRI = N_KWP_OFS_DRI_NVMY

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N_KWP_OFS = N_KWP_OFS_NVMY
N_KWP_OFS_ACC = N_KWP_OFS_ACC_NVMY
N_KWP_OFS_VB = N_KWP_OFS_VB_NVMY
N_SP_OFS_KWP = 0

Activation: LV_KWP_ENA = 1

Deactivation: LV_KWP_ENA = 0

Recurrence: 10 ms

Formula section:

switch off the max-selection in this Kl.15 cycle:
IF the service 2E_5F_F0_07 is received
THEN LV_ACT_N_SP_IS_BAS_EXT_ADJ=01h
ELSE LV_ACT_N_SP_IS_BAS_EXT_ADJ=00h
ENDIF

idle speed setpoint offset at LV_ACIN = 1 and LV_DRI = 1 (N_KWP_OFS_ACC_DRI_KWP) :
IF N_KWP_OFS_ACC_DRI_KWP C_N_OFS_ACC_DRI_MAX
THEN N_KWP_OFS_ACC_DRI = C_N_OFS_ACC_DRI_MAX
ELSEIF N_KWP_OFS_ACC_DRI_KWP C_N_OFS_ACC_DRI_MIN
THEN N_KWP_OFS_ACC_DRI = C_N_OFS_ACC_DRI_MIN
ELSE N_KWP_OFS_ACC_DRI = N_KWP_OFS_ACC_DRI_KWP
ENDIF

idle speed setpoint offset at LV_ACIN = 0 and LV_DRI = 1 (N_KWP_OFS_DRI_KWP):
IF N_KWP_OFS_DRI_KWP C_N_OFS_DRI_MAX
THEN N_KWP_OFS_DRI = C_N_OFS_DRI_MAX
ELSEIF N_KWP_OFS_DRI_KWP C_N_OFS_DRI_MIN
THEN N_KWP_OFS_DRI = C_N_OFS_DRI_MIN
ELSE N_KWP_OFS_DRI = N_KWP_OFS_DRI_KWP
ENDIF

idle speed setpoint offset at LV_ACIN = 0 and LV_DRI = 0 (N_KWP_OFS_KWP):
IF N_KWP_OFS_KWP C_N_OFS_MAX
THEN N_KWP_OFS = C_N_OFS_MAX
ELSEIF N_KWP_OFS_KWP C_N_OFS_MIN
THEN N_KWP_OFS = C_N_OFS_MIN
ELSE N_KWP_OFS = N_KWP_OFS_KWP
ENDIF

idle speed setpoint offset at LV_ACIN = 1 and LV_DRI = 0 (N_KWP_OFS_ACC_KWP):
IF N_KWP_OFS_ACC_KWP C_N_OFS_ACC_MAX
THEN N_KWP_OFS_ACC = C_N_OFS_ACC_MAX
ELSEIF N_KWP_OFS_ACC_KWP C_N_OFS_ACC_MIN
THEN N_KWP_OFS_ACC = C_N_OFS_ACC_MIN
ELSE N_KWP_OFS_ACC = N_KWP_OFS_ACC_KWP
ENDIF

idle speed setpoint offset at battery charging is active (N_KWP_OFS_VB_KWP) :
IF N_KWP_OFS_VB_KWP C_N_OFS_VB_MAX
THEN N_KWP_OFS_VB = C_N_OFS_VB_MAX
ELSEIF N_KWP_OFS_VB_KWP C_N_OFS_VB_MIN
THEN N_KWP_OFS_VB = C_N_OFS_VB_MIN
ELSE N_KWP_OFS_VB = N_KWP_OFS_VB_KWP

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ENDIF

idle speed setpoint - LV_KWP_ENA :

IF TCO > C_TCO_MIN_N_OFS_KWP
and LV_ERR_TCO = 0
and LC_N_OFS_KWP_DISABLE = 0
and LV_REQ_ISC = 1
THEN LV_KWP_ENA = 1
ELSE LV_KWP_ENA = 0
ENDIF
IF LV_KWP_ENA = 0
THEN no adjustment and no programming by tester is allowed
and the ECU send ‘invalid parameter‘ response to the tester request
ELSE adjustment and programming by tester is allowed
ENDIF

Idle Speed Setpoint Offset by Tester (KWP):

IF LV_DRI = 1 **and** LV_ACIN = 1 *(AC is ready and drive engaged)*
THEN N_SP_OFS_KWP_1 = N_KWP_OFS_ACC_DRI
ELSEIF (1) LV_DRI = 1 **and** LV_ACIN = 0 *(AC is not ready and drive engaged)*
THEN (1) N_SP_OFS_KWP_1 = N_KWP_OFS_DRI
ELSEIF (2) LV_DRI = 0 **and** LV_ACIN = 0 *(AC is not ready and drive not engaged)*
THEN (2) N_SP_OFS_KWP_1 = N_KWP_OFS
ELSEIF (3) LV_DRI = 0 **and** LV_ACIN = 1 *(AC is ready and drive not engaged)*
THEN (3) N_SP_OFS_KWP_1 = N_KWP_OFS_ACC
ELSE N_SP_OFS_KWP_1 = 0
ENDIF
IF CHA_CDN_BAT > C_ CHA_CDN_BAT_KWP_MIN *(battery charging act.)*
THEN N_SP_OFS_KWP = N_SP_OFS_KWP_1 + N_KWP_OFS_VB
ELSE N_SP_OFS_KWP = N_SP_OFS_KWP_1
ENDIF

WriteDataByCommonIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_ABLL
#3d	RecordCommonIdentifier Low Byte	M	#F0h	RCI_ABLL
#4d	Inputoutputcontrolparameter	M	#07h	IOCP_STA
#5d	InputoutputLocalValue = N_KWP_OFS_ACC_DRI_KWP Value offset drive position and air condition	M	#XXh	IOLI_
#6d	InputoutputLocalValue = N_KWP_OFS_DRI_KWP Value offset drive position	M	#XXh	IOLI_
#7d	InputoutputLocalValue = N_KWP_OFS_KWP Value offset for idle speed	M	#XXh	IOLI_
#8d	InputoutputLocalValue N_KWP_OFS_ACC_KWP Value offset air condition	M	#XXh	IOLI_
#9d	InputoutputLocalValue = N_KWP_OFS_VB_KWP Value offset voltage battery	M	#XXh	IOLV

Figure I.25.58: Table inputoutputcontrolByLocalIdentifier Request Message

WriteDataByCommonIdentifier positive Response

.

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_ABLL
#3d	RecordCommonIdentifier Low Byte	M	#F0h	RCI_ABLL
#4d	Inputoutputcontrolparameter	M	#07h	IOCP_STA
#5d	InputoutputLocalValue = N_KWP_OFS_ACC_DRI_KWP Value offset drive position and air condition	M	#XXh	IOLI_
#6d	InputoutputLocalValue = N_KWP_OFS_DRI_KWP Value offset drive position	M	#XXh	IOLI_
#7d	InputoutputLocalValue = N_KWP_OFS_KWP Value offset for idle speed	M	#XXh	IOLI_
#8d	InputoutputLocalValue N_KWP_OFS_ACC_KWP Value offset air condition	M	#XXh	IOLI_
#9d	InputoutputLocalValue = N_KWP_OFS_VB_KWP Value offset voltage battery	M	#XXh	IOLV

Figure I.25.59: Table inputoutputcontrolByLocalIdentifier Positive Response Message

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I.25.33 2E_5F_F0_08 Abgleichswert LL programmieren

General information:

In a tester is connected via KWP and the bit store is received, the adjustment values from tester N_ KWP_OFS_ACC_DRI_KWP, N_KWP_OFS, N_KWP_OFS_DRI_KWP, N_KWP_OFS_ACC_KWP and N_KWP_OFS_VB_KWP are stored into the non volatile memory. The non volatile stored values are used after reset as initialization values for idle speed setpoint offset.

Additional Application conditions:

Activation: LV_KWP_ENA = 1

Deactivation: LV_KWP_ENA = 0

Formula Section:

WriteDataByCommonIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_ABLL
#3d	RecordCommonIdentifier Low Byte	M	#F0h	RCI_ABLL
#4d	Inputoutputcontrolparameter	M	#08h	IOCP_LTA
#5d	InputoutputLocalValue = N_KWP_OFS_ACC_DRI_KWP Value offset drive position and air condition	M	#XXh	IOLI_
#6d	InputoutputLocalValue = N_KWP_OFS_DRI_KWP Value offset drive position	M	#XXh	IOLI_
#7d	InputoutputLocalValue = N_KWP_OFS_KWP Value offset for idle speed	M	#XXh	IOLI_
#8d	InputoutputLocalValue N_KWP_OFS_ACC_KWP Value offset air condition	M	#XXh	IOLI_
#9d	InputoutputLocalValue = N_KWP_OFS_VB_KWP Value offset voltage battery	M	#XXh	IOLV

Figure I.25.60: Table inputoutputcontrolByLocalIdentifier Request Message

WriteDataByCommonIdentifier positive Response

.

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_ABLL
#3d	RecordCommonIdentifier Low Byte	M	#F0h	RCI_ABLL
#4d	Inputoutputcontrolparameter	M	#08h	IOCP_LTA
#5d	InputoutputLocalValue = N_KWP_OFS_ACC_DRI_KWP Value offset drive position and air condition	M	#XXh	IOLI_
#6d	InputoutputLocalValue = N_KWP_OFS_DRI_KWP Value offset drive position	M	#XXh	IOLI_
#7d	InputoutputLocalValue = N_KWP_OFS_KWP Value offset for idle speed	M	#XXh	IOLI_
#8d	InputoutputLocalValue N_KWP_OFS_ACC_KWP Value offset air condition	M	#XXh	IOLI_
#9d	InputoutputLocalValue = N_KWP_OFS_VB_KWP Value offset voltage battery	M	#XXh	IOLV

Figure I.25.61: Table inputoutputcontrolByLocalIdentifier Positive Response Message

I.25.34 2E_5F_F1_00 CO-Abgleich beenden

General information:

When this service is received, the actuator diagnosis function stops and control is given back to the ECU control.

Formula Section:

WriteDataByCommonIdentifier Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_VH
#3d	RecordCommonIdentifier Low Byte	M	#F1h	RCI_VH
#4d	Inputoutputcontrolparameter	M	#00h	IOCP_RCTECU

Figure I.25.62: Table inputoutputcontrolByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F1h	RCI_
#4d	Inputoutputcontrolparameter	M	#00h	IOCP_RCTECU

Figure I.25.63: Table inputoutputcontrolByCommonIdentifier Positive Response Message

I.25.35 2E_5F_F1_04 CO- Abgleich Reset

Description:

With this service the MFF trim value for CO- Adjust can be reset.

Additional Application conditions:

Activation: LV_VAR_LSH_UP = 0

Deactivation: LV_VAR_LSH_UP = 1

Formula section:

IF service 2E_5F_F1_04 is received
THEN LV_RST_MFF_ADD_EXT_ADJ_NVMY = 1 for 2s
ENDIF

WriteDataByCommonIdentifier Request

.

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F1h	RCI_
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_

Figure I.25.64: Table inputoutputcontrolByLocalIdentifier Request Message

WriteDataByCommonIdentifier positive Response

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F1h	RCI_
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_STA

Figure I.25.65: Table inputoutputcontrolByLocalIdentifier Positive Response Message

I.25.36 2E_5F_F1_07 CO- Abgleich ansteuern

Description:

With this service the MFF trim value for CO- Adjust can be adjusted. This is necessary for cars without catalyst.
The value from tester is written in the variable FAC_MFF_ADD_EXT_ADJ for 1 second. Then the variable FAC_MFF_ADD_EXT_ADJ is set to 0 for 1s. After the 2 seconds, the next value can be sent. During this 2 seconds no new value from tester is accepted to avoid too fast trimming (= negative response).

Additional Application conditions:

Initialisation: FAC_MFF_ADD_EXT_ADJ = 0 %
TIMER_1 = 0 s

Activation: LV_VAR_LSH_UP = 0 **and**
LV_IS = 1 **and**
CTR_ERR_DYN_NR = 0 **and**
TCO > C_TCO_MIN_MFF_ADD_EXT_ADJ

Deactivation: not activation or timeout

Formula section:

IF Service 2E_5F_F1_07 is received **and**
TIMER_1 = 0 s
THEN initialise TIMER_1 with 2 s **and**
FAC_MFF_ADD_EXT_ADJ = value from tester **and**
send positive response

ELSEIF TIMER_1 = 2 s or 1s
THEN FAC_MFF_ADD_EXT_ADJ = 0
TIMER_1 = TIMER_1 - 1s
send negative response "conditions not correct" when Service 2E_5F_F1_07 is re-ceived again
ENDIF

WriteDataByCommonIdentifier Request
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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F1h	RCI_
#4d	Inputoutputcontrolparameter	M	#07h	IOCP_STA
#5d	inputOutputControlParameter - FAC_MFF_ADD_EXT_ADJ	M	#XXh	CS_

Figure I.25.66: Table inputoutputcontrolByLocalIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F1h	RCI_
#4d	Inputoutputcontrolparameter	M	#07h	IOCP_STA

Figure I.25.67: Table inputoutputcontrolByLocalIdentifier Positive Response Message

I.25.37 2E_5F_F1_08 CO- Abgleich programmieren

Description:

With this service the MFF trim value for CO- Adjust can be programmed into non volatile memory after power latch phase.
After receiving the service 2E_5F_F1_08, the flag LV_FAC_MFF_ADD_EXT_ADJ_NVMY is set to 1 for 2 seconds. The flag LV_FAC_MFF_ADD_EXT_ADJ_NVMY triggers the CO- Adjust function to save the trim value into non volatile memory after power latch phase.

Additional Application conditions:

Activation: LV_IS = 1 **and**
LV_VAR_LSH_UP = 0 **and**
CTR_ERR_DYN_NR = 0 **and**
TCO > C_TCO_MIN_MFF_ADD_EXT_ADJ

Deactivation: not activation or timeout

Formula section:

IF service 2E_5F_F1_08 is received
THEN LV_FAC_MFF_ADD_EXT_ADJ_NVMY = 1 for 2s
ENDIF

WriteDataByCommonIdentifier Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F1h	RCI_
#4d	Inputoutputcontrolparameter	M	#08h	IOCP_LTA

Figure I.25.68: Table inputoutputcontrolByLocalIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F1h	RCI_
#4d	Inputoutputcontrolparameter	M	#08h	IOCP_LTA

Figure I.25.69: Table inputoutputcontrolByLocalIdentifier Positive Response Message

I.25.38 2E_5F_F2_04 Varianten loeschen

General information:

This service resets the bits of learned variants. Re- learning is possible depending on the learning conditions of every device (see chapter "variant coding"). If the byte on position x in the tester telegram is 01, the variant flag/variable which is dedicated to position x is set to 0 and so the variant is erased.
The variants LV_VAR_BN and LV_VAR_VEH are vehicle specific can not be reset via tester (safety reasons; see also chapter "variant coding").

Additional Application conditions:

Activation: LV_ES=1

Deactivation: LV_ES=0

Formular section:

InputOutputControlByCommonIdentifier Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F2h	RCI_
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD
#5d	inputOutputControlParameter - LV_AT	M	#XXh	
#6d	inputOutputControlParameter - LV_VAR_ACIN	M	#XXh	
#7d	inputOutputControlParameter - LV_VAR_AMT	M	#XXh	
#8d	inputOutputControlParameter - LV_VAR_ARS	M	#XXh	
#9d	inputOutputControlParameter - LV_VAR_ASR	M	#XXh	
#10d	inputOutputControlParameter - not used	M	#FFh	
#11d	inputOutputControlParameter - LV_VAR_BN_MSW	M	#XXh	
#12d	inputOutputControlParameter - LV_VAR_DCC	M	#XXh	
#13d	inputOutputControlParameter - LV_VAR_EBOX_CFA	M	#XXh	
#14d	inputOutputControlParameter - LV_VAR_ETCU	M	#XXh	
#15d	inputOutputControlParameter - LV_VAR_ICL	M	#XXh	
#16d	inputOutputControlParameter - LV_VAR_MSW	M	#XXh	
#17d	inputOutputControlParameter - LV_VAR_PSTE	M	#XXh	
#18d	inputOutputControlParameter - LV_VAR_SOF	M	#XXh	
#19d	inputOutputControlParameter - CONF_SOF_SWI	M	#XXh	
#20d	inputOutputControlParameter - LV_VAR_BN_GEAR_REV	M	#XXh	
#21d	inputOutputControlParameter - not used	M	#FFh	
#22d	inputOutputControlParameter - not used	M	#FFh	
#23d	inputOutputControlParameter - LV_VAR_SAP (not MSD80/81), not used (MSD80/81)	M	[#XXh, #FFh]	
#24d	inputOutputControlParameter - LV_VAR_EF	M	#XXh	
#25d	inputOutputControlParameter - LV_VAR_CWP_LIN **(only MSD85),** not used **(other)**	M	[#XXh, #FFh]	
#26d	inputOutputControlParameter - LV_VAR_RLY_ACCOUT (not MSD85) not supported (MSD85)	M	[#XXh, #FFh]	
#27d	inputOutputControlParameter - LV_VAR_SAV (not MSDS80/81), not used (MSD80/81)	M	[#XXh, #FFh]	
#28d	inputOutputControlParameter - LV_VAR_RLY_ST	M	#XXh	
#29d	inputOutputControlParameter - LV_VAR_ASR_3	M	#XXh	
#30d	inputOutputControlParameter - LV_VAR_BN_LDM	M	#XXh	
#31d	inputOutputControlParameter - LV_VAR_BN_LTG_HDLP_L	M	#XXh	
#32d	inputOutputControlParameter - LV_VAR_LSH_DOWN	M	#XXh	
#33d	inputOutputControlParameter - LV_VAR_LSH_UP	M	#XXh	
#34d	inputOutputControlParameter - LV_VAR_ASR_4	M	#XXh	
#35d	inputOutputControlParameter - LV_VAR_MAF and LV_VAR_MAF_LEARNT	M	#XXh	
#36d	inputOutputControlParameter - LV_VAR_PSTE_2 and LV_VAR_PSTE_3 and STATE_PSTE_3_SRC	M	#XXh	
#37d	inputOutputControlParameter - LV_VAR_BN_EFP	M	#XXh	
#38d	inputOutputControlParameter - LV_SENS_BAT_SMT_DET	M	#XXh	
#39d	inputOutputControlParameter - LV_VAR_BN_TRL	M	#XXh	
#40d	inputOutputControlParameter - not supported	M	#FFh	
#41d	inputOutputControlParameter - not supported	M	#FFh	
#42d	inputOutputControlParameter - LV_VAR_NOX (only MSD80/81) not supported (other)	M	[#XXh, #FFh]	
#43d	inputOutputControlParameter - not supported	M	#FFh	
#44d	inputOutputControlParameter - LV_VAR_ETCU_SPT	M	#XXh	
#-d	inputOutputControlParameter - LV_VAR_TCT	M	#XXh	
#46d	inputOutputControlParameter - LV_VAR_AEB	M	#XXh	
#47d	inputOutputControlParameter - LV_VAR_TQ_PBR	M	#XXh	

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Table InputOutputControlByCommonIdentifier request message
InputOutputControlByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F2h	RCI_
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD

Figure I.25.70: Table inputoutputcontrolByCommonIdentifier Positive Response Message

I.25.39 2E_5F_F3_04 Uebertemperatursicherung loeschen

General information:

The service sets the values for over temperature protection to default values.

Formula section:

IF service 2E_5F_F3_04 is received

THEN CTR_TOIL_MAX = 00h
TOIL_MAX_WARN = 00h
VS_TOIL_MAX = 00h
N_TOIL_MAX = 00h
GEAR_TOIL_MAX = 00h
TQI_AV_TOIL_MAX = 00h
TAM_TOIL_MAX = 00h
TCO_TOIL_MAX = 00h
DIST_TOIL_MAX = 00h
PV_AV_TOIL_MAX = 00h
LV_CS_TOIL_MAX = 00h
TOIL_THD_TOIL_MAX = 00h

ELSE the values keep unchanged

WriteDataByCommonIdentifier Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_UET
#3d	RecordCommonIdentifier Low Byte	M	#F3h	RCI_UET
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD

Figure I.25.71: Table inputoutputcontrolByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_UET
#3d	RecordCommonIdentifier Low Byte	M	#F3h	RCI_UET
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD

Figure I.25.72: Table inputoutputcontrolByCommonIdentifier Positive Response Message

I.25.40 2E_5F_F4_04 Fusshebelwerk Fehlbedienung loeschen

General information:

no description

Additional Application conditions:

Activation: timeout time < 5s

Deactivation: timeout time >= 5s

Formula section:

IF service 2E_5F_F4_04 is received
THEN timeout time = 0s
LV_FHW_RST = 01h
ELSE increment timeout time
ENDIF

IF timeout time >= 5s
THEN LV_FHW_RST = 00h
ELSE LV_FHW_RST reains unchanged
ENDIF

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WriteDataByCommonIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_FHW
#3d	RecordCommonIdentifier Low Byte	M	#F4h	RCI_FHW
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD

Figure I.25.73: Table inputoutputcontrolByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_FHW
#3d	RecordCommonIdentifier Low Byte	M	#F4h	RCI_FHW
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD

Figure I.25.74: Table inputoutputcontrolByCommonIdentifier Positive Response Message

I.25.41 2E_5F_F5_04 Powermanagement Histogramm loeschen

General information:

With this comand the values described in the chapter Power Management are set to default values. All values are initialized with their default values (compare detailed specifications).
After the timeout time of 5s, the function ist stopped, and the value for LV_POW_MNG_HIS_RST is set to 00h;

Additional Application conditions:

Activation: timeout ime < 5s

Deactivation: timeout time >= 5s

Formula section:

IF service 2E_5F_F5_04 is received
THEN timeout time = 0s
LV_POW_MNG_HIS_RST = 01h
ELSE increment timeout time
ENDIF

IF timeout time >= 5s
THEN LV_POW_MNG_HIS_RST = 00h
ELSE LV_POW_MNG_HIS_RST reains unchanged
ENDIF

WriteDataByCommonIdentifier Request
.

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_HISR
#3d	RecordCommonIdentifier Low Byte	M	#F5h	RCI_HISR
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD

Figure I.25.75: Table inputoutputcontrolByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_HISR
#3d	RecordCommonIdentifier Low Byte	M	#F5h	RCI_HISR
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD

Figure I.25.76: Table inputoutputcontrolByCommonIdentifier Positive Response Message

I.25.42 2E_5F_F6_04 Ueberdrehzahlsicherung loeschen

General information:

Detection of an overreving event and non-volatile storage of:
- highest engine speed reached N_MAX
- associated total running time in case of highest engine speed reached TRT_N_MAX
- event frequency counter CTR_N_MAX

An overreving event starts at exceeding the engine speed C_N_LIM_MIN and active engine speed limitation (LV_N_MAX = 1).
At each overreving event, the event frequency counter is incremented by 1. The highest engine speed reached N_MAX and the associated total running time in case of highest engine speed reached TRT_N_MAX is only overwritten if a higher engine speed was reached.
For this service authenticity is necessary.

Additional Application conditions:

Activation: LV_ES = 1 **and**
authentification is necessary

Deactivation: LV_ES= 0

Formula section:

IF service 2E_5F_F6_04 is received

THEN N_MAX = 00h
TRT_N_MAX = 00h
CTR_N_MAX = 00h

ELSE the values keep unchanged

WriteDataByCommonIdentifier Request

.

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_OVR
#3d	RecordCommonIdentifier Low Byte	M	#F6h	RCI_OVR
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD

Figure I.25.77: Table inputoutputcontrolByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_OVR
#3d	RecordCommonIdentifier Low Byte	M	#F6h	RCI_OVR
#4d	Inputoutputcontrolparameter	M	#04h	IOCP_RTD
#5d	Verify byte = 01h = ok Verify byte = 02h = not ok	M	#XXh	IOCP

Figure I.25.78: Table inputoutputcontrolByCommonIdentifier Positive Response Message

I.25.43 2E_5F_F7_00 Laufruheprüfung Vorgeben beenden

General information:

no description

Formula section:

IF service 2E_5F_F7_00 is received
THEN set STATE_CMB_CTL_KWP = 00h
ELSE STATE_CMB_CTL_KWP remains unchanged

WriteDataByCommonIdentifier Request

.

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_LRP
#3d	RecordCommonIdentifier Low Byte	M	#F7h	RCI_LRP
#4d	Inputoutputcontrolparameter	M	#00h	RV_RCTEC U

Figure I.25.79: Table inputoutputcontrolByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_LRP
#3d	RecordCommonIdentifier Low Byte	M	#F7h	RCI_LRP

Figure I.25.80: Table inputoutputcontrolByCommonIdentifier Positive Response Message

I.25.44 2E_5F_F7_07 Laufruheprüfung vorgeben

General information:

no description

Formula section:

IF one of the bytes in the telegram is > 1h
THEN send negative response code 31: requestOutOfRange
ELSE built STATE_CMB_CTL_NVMY_KWP from telegram

WriteDataByCommonIdentifier Request

.

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_LRP
#3d	RecordCommonIdentifier Low Byte	M	#F7h	RCI_LRP
#4d	Inputoutputcontrolparameter	M	#07h	RV_STA
#5d	recordValue#1 = STATE_CMB_CTL_KWP Bit 0	M	#XXh	STAT_GEMISCHEINGRIFF_INAKTIV
#6d	recordValue#2 = STATE_CMB_CTL_KWP Bit 1	M	#XXh	STAT_ZUENDWINKELEINGRIFF_INAKTIV
#7d	recordValue#3 = STATE_CMB_CTL_KWP Bit 2	M	#XXh	STAT_MINHUBEINGRIFF_INAKTIV
#8d	recordValue#4 = STATE_CMB_CTL_KWP Bit 3	M	#XXh	STAT_HUBEINGRIFF_INAKTIV
#9d	recordValue#5 = dummy value fix	M	#00h	RV_LRP_BIT4
#10d	recordValue#6 = dummy value fix	M	#00h	RV_LRP_BIT5
#11d	recordValue#7 = dummy value fix	M	#00h	RV_LRP_BIT6
#12d	recordValue#8 = dummy value fix	M	#00h	RV_LRP_BIT7

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Figure I.25.81: Table inputoutputcontrolByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	***Parameter Name***	***Cvt***	***Hex Value***	***Mnemonic***
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_LRP
#3d	RecordCommonIdentifier Low Byte	M	#F7h	RCI_LRP

Figure I.25.82: Table inputoutputcontrolByCommonIdentifier Positive Response Message

I.25.45 2E_5F_F7_08 Laufruheprüfung programmieren

General information:

no description

Additional Application conditions:

Initialisation: STATE_CMB_CTL_NVMY_KWPat clearing NVMY with 00h else from NVMY

Formula section:

IF one of the bytes in the telegram is > 1h
THEN send negative response code 31: requestOutOfRange
ELSE built STATE_CMB_CTL_NVMY_KWP from telegram

WriteDataByCommonIdentifier Request

.

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_LRP
#3d	RecordCommonIdentifier Low Byte	M	#F7h	RCI_LRP
#4d	Inputoutputcontrolparameter	M	#08h	RV_LTA
#5d	recordValue#1 = STATE_CMB_CTL_NVMY_KWP Bit 0	M	#XXh	STAT_GEMISCHEINGRIFF_INAKTIV
#6d	recordValue#2 = STATE_CMB_CTL_NVMY_KWP Bit 1	M	#XXh	STAT_ZUENDWINKELEINGRIFF_INAKTIV
#7d	recordValue#3 = STATE_CMB_CTL_NVMY_KWP Bit 2	M	#XXh	STAT_MINHUBEINGRIFF_INAKTIV
#8d	recordValue#4 = STATE_CMB_CTL_NVMY_KWP Bit 3	M	#XXh	STAT_HUBEINGRIFF_INAKTIV
#9d	recordValue#5 = dummy value fix	M	#00h	RV_LRP_BIT4
#10d	recordValue#6 = dummy value fix	M	#00h	RV_LRP_BIT5
#11d	recordValue#7 = dummy value fix	M	#00h	RV_LRP_BIT6
#12d	recordValue#8 = dummy value fix	M	#00h	RV_LRP_BIT7

Figure I.25.83: Table inputoutputcontrolByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_LRP
#3d	RecordCommonIdentifier Low Byte	M	#F7h	RCI_LRP

Figure I.25.84: Table inputoutputcontrolByCommonIdentifier Positive Response Message

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I.25.46 2E_5F_F8_00 Homogenbetrieb vorgeben beenden

General information:

When this service is received, the actuator diagnosis function stops and control is given back to the ECU control.

Formula section:

IF service 2E_5F_F8_00 is received
THEN STATE_HOM_AFS_REQ_EXT_ADJ = 00h
ELSE STATE_HOM_AFS_REQ_EXT_ADJ remains unchanged
ENDIF

WriteDataByCommonIdentifier Request

.

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_VH
#3d	RecordCommonIdentifier Low Byte	M	#F8h	RCI_VH
#4d	Inputoutputcontrolparameter	M	#00h	IOCP_RCTECU

Figure I.25.85: Table inputoutputcontrolByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F8h	RCI_
#4d	Inputoutputcontrolparameter	M	#00h	IOCP_RCTECU

Figure I.25.86: Table inputoutputcontrolByCommonIdentifier Positive Response Message

I.25.47 2E_5F_F8_07 Homogen vorgeben

General information:

When this service is received, the request for operation mode is sended to the module "operation mode request from tester".

Additional Application conditions:

Initialisation at reset or at LV_IGK 1 -> 0: STATE_HOM_AFS_REQ_EXT_ADJ = 0
Activation: LV_IS = 1
Deactivation: LV_IS = 0

Formula section:

WriteDataByCommonIdentifier Request

.

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F8h	RCI_
#4d	Inputoutputcontrolparameter	M	#07h	IOCP_
#5d	recordValue #1 = STATE_HOM_AFS_REQ_EXT_ADJ (high byte)	M	#XXh	IOCP_
#6d	recordValue #2 = STATE_HOM_AFS_REQ_EXT_ADJ(low byte)	M	#XXh	IOCP_

Figure I.25.87: Table inputoutputcontrolByCommonIdentifier Request Message

WriteDataByCommonIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#5Fh	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#F8h	RCI_
#4d	Inputoutputcontrolparameter	M	#07h	IOCP_

Figure I.25.88: Table inputoutputcontrolByCommonIdentifier Positive Response Message

I.25.48 2E_C0_01 Write k_ews4 (STEUERN_EWS)

General information:

IMMO: Write STEUERN_EWS4 (Save secret key to ECU)
A negativ response is possible by a wrong parameter and formula section.

Formula section:

Only for boot sw-version:

If(1) K_EWS4[0..255] > 0x0 and K_EWS4[0..255] < 0xFF (Blank Check Page 0)
Then(1) "Negative Response: **KWP_RC_CNCORSE**"
break
Else(1)
If(2) "record value#1" = **0x3**
Then(2) IMOB_KWP_K_EWS4 [0..15] = "record value#2..#17"
If(2a) IMOB_KWP_K_EWS4 [0-15] != 0xFF **or** 0x0 (all data not 0 or max.)
Then(2a) IMOB_KWP_K_EWS4_TMP0[0-15] =
IMOB_KWP_K_EWS4[0-15] **xor** 0xFF
"Positive Response"
Else(2a) "Negative Response
Endif(2a)
Else(2)
If(3) "record value#1" = **0x1**
Then(3)
If(4) IMOB_KWP_K_EWS4[0..15] !=
IMOB_KWP_K_EWS4_TMP0[0..15] **xor** 0xFF
Then(4) "Negative Response: **KWP_RC_CNCORSE**"
break
Else(4) "Positive Response"
***Flash*:**
IMOB_KWP_K_EWS4[0..15]
IMOB_KWP_K_EWS4_1[0..15] **xor** 0xFF
IMOB_KWP_K_EWS4_2[0..15]**xor** 0xAA
Endif(4)
Else(3) "Negative Response: **KWP_RC_SFNS_IF**"
Endif(3)
Endif(2)
Endif(1)

Only for ECU sw-version:

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```
If(1)        STATE_IMOB_K_EWS = NC_K_EWS_UNLOCKED
        and IMOB_NR_VLD_K_EWS4 < NC_K_EWS_MAX
Then(1)
        If(2)          "record value#1" = 0x3
    Then(2)
                    IMOB_KWP_K_EWS4 [0..15] =   "record value#2..#17"
                    If(2a) IMOB_KWP_K_EWS4 [0-15] != 0xFF or 0x0 (all data not 0 or max.)
                    Then(2a)            IMOB_KWP_K_EWS4_TMP0[0-15] =
                                 IMOB_KWP_K_EWS4[0-15] xor 0xFF
                                 send   "Positive Response"
                    Else(2a)            send   "Negative Response
                    Endif(2a)
                ACTION_ECM3_DisableReq            (disable MU for storage)

    Else(2)  If(3)            "record value#1" = 0x1
                  Then(3)
                      If(4)    IMOB_KWP_K_EWS4[0..15] !=
                                      IMOB_KWP_K_EWS4_TMP0[0..15] xor 0xAA
                  Then(4)          "Negative Response: KWP_RC_CNCORSE"
                             break
                  Else(4)          send "Positive Response"
                             Flash:   k_ews4[at next free block]
                                      (storage place depending on
                                      imob_nr_vld_k_ews4)
                                   IMOB_KWP_K_EWS4[0-15]
                                   IMOB_KWP_K_EWS4_1[0-15] xor 0xFF
                                   IMOB_KWP_K_EWS4_2[0-15] xor 0xAA
                             Flash:   imob_config_ews4[0-3]
                                   imob_config_ews4_1[0-3] xor 0xFF
                                   imob_config_ews4_2[0-3] xor 0xAA

                  Endif(4)
                Else(3)          "Negative Response: KWP_RC_SFNS_IF"
                    Endif(3)
    Endif(2)
Else(1)          "Negative Response: KWP_RC_CNCORSE"
Endif(1)
```

WriteDataByCommonIdentifier Request

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Request Service Id**	**M**	**#2Eh**	**WDBCI**
#2d	RecordCommonIdentifier	M	#C0h	RCI_TSP
#3d	RecordCommonIdentifier	M	#01h	RCI_TSP
#4d	recordValue#1 = IMOB_KWP_MODE_BYTE	M	#xxh	RV_PST
#5d	recordValue#2 = IMOB_KWP_K_EWS4[0]	M	#xxh	RV_PST
#6d	recordValue#3 = IMOB_KWP_K_EWS4[1]	M	#xxh	RV_PST
#7d	recordValue#4 = IMOB_KWP_K_EWS4[2]	M	#xxh	RV_PST
#8d	recordValue#5 = IMOB_KWP_K_EWS4[3]	M	#xxh	RV_PST
#9d	recordValue#6 = IMOB_KWP_K_EWS4[4]	M	#xxh	RV_PST
#10d	recordValue#7 = IMOB_KWP_K_EWS4[5]	M	#xxh	RV_PST
#11d	recordValue#8 = IMOB_KWP_K_EWS4[6]	M	#xxh	RV_PST
#12d	recordValue#9 = IMOB_KWP_K_EWS4[7]	M	#xxh	RV_PST
#13d	recordValue#10 = IMOB_KWP_K_EWS4[8]	M	#xxh	RV_PST
#14d	recordValue#11 = IMOB_KWP_K_EWS4[9]	M	#xxh	RV_PST
#15d	recordValue#12 = IMOB_KWP_K_EWS4[10]	M	#xxh	RV_PST
#16d	recordValue#13 = IMOB_KWP_K_EWS4[11]	M	#xxh	RV_PST
#17d	recordValue#14 = IMOB_KWP_K_EWS4[12]	M	#xxh	RV_PST
#18d	recordValue#15 = IMOB_KWP_K_EWS4[13]	M	#xxh	RV_PST
#19d	recordValue#16 = IMOB_KWP_K_EWS4[14]	M	#xxh	RV_PST
#20d	recordValue#17 = IMOB_KWP_K_EWS4[15]	M	#xxh	RV_PST

Figure I.25.89: WriteDataByCommonIdentifier positive Response

WriteDataByCommonIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteDataByCommonIdentifier Response Service Id**	**M**	**#6Eh**	WDBCIPR
#2d	RecordCommonIdentifier High Byte	M	#C0h	RCI_
#3d	RecordCommonIdentifier Low Byte	M	#01h	RCI_

Figure I.25.90: Table inputoutputcontrolByCommonIdentifier Positive Response Message

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I.26 SID 33h: requestRoutineResultsByLocalIdentifier Service

Input data:

B_diagigr {p. 8283}	B_maregdk_ad {p. 8344}	B_mareghub_ad {p. 797}	B_psragr_ad {p. 8346}
Eco_jobstat1 {p. 8156}	Eco_result1 {p. 8156}	INH_IV_KWP {p. 7482}	Klann_test1 {p. 8159}
Klann_test2 {p. 8159}	Krnn_test {p. 8159}	LV_CDN_DIAG_EFF_IGA_CST_IS {p. 6517}	LV_CDN_DIAG_EFF_IGA_CST_PL {p. 6517}
LV_CH_SO2P_WOUT_LIM {p. 3144}	LV_DIAG_CST_ACT {p. 6508}	LV_IGK {p. 906}	LV_INH_DIAG_EFF_IGA_CST {p. 6508}
LV_INH_LAM_KWP {p. 7483}	LV_KWP_PROG_DATA {p. 803}	LV_POW_MNG_MES_MOD {p. 7483}	LV_SO2P_REQ_2 {p. 3073}
Mrnn_test_dk {p. 8162}	Mrnn_test_pr {p. 8162}	Mrnn_test_vvt {p. 806}	NT_SUL {p. 3113}
Prnn_test_agr {p. 8165}	STATE_CH {p. 1777}	STATE_EOL_DGNC_CH_DIAG {p. 6508}	T_AST {p. 1766}
TCO_ST {p. 1100}			

General information:

All implemented SID 33h services are described below.

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I.26.1 Overview of supported subservices:

SID number	service	Service location	MSD_81 (4cyl)	MSD_81 (6cyl)
33_25	read INH_IV_KWP - Diagnos Status EV-Ausblendung	ECU	X	X
33_2B	Read result Ruhestrom Test	ECU	X	X
33_2F	Auslesen Desulfatisierung Fahrbetrieb	ECU	X	X
33_3A	Read result CSERS-Diagnose	ECU	X	X
33_D9	Read Status: switch off lambda controller	ECU	X	X
33_E0	Auslesen Eisy- Adaptionswerte (ungedrosselt)	ECU	-	-
33_E1	Auslesen Eisy- Adaptionswerte (gedrosselt)	ECU	X	X
33_E2	Auslesen Eisy- Adaptionswerte (gedrosselt mit Abgasrueckfuehrung)	ECU	X	X
33_E3	Auslesen Krann- Adaptionswerte	ECU	X	X
33_E4	Auslesen Klann-Adaptionswerte	ECU	X	X
33_E5	Auslesen AGR-Adaptionswerte	ECU	X	-
33_F0	Report results of checksum calculation for INCA PC	ECU	-	-
33_F1	Report results of programming the calibration data for INCA PC in the power latch phase	ECU	-	-
33_F6	Report Status: Steuern Messsemode stop default value	ECU	X	X
33_F7	report results of Intelligente Generatorregelung	ECU	X	X

I.26.2 Global negative Responses

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**NegativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.26.1: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

Remark:
The detailed message of the negative response code is described in chapter "Introduction".

I.26.3 33_25 Read INH_IV_KWP -diagnosis status EV-Ausblendung - requestRoutineResultsByLocalIdentifier

General information:

With this service the tester can ask for the results of the -diagnosis status EV-Ausblendung

Application conditions

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Initialisation: at reset

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout
Service location: see list of implemented diagnostic services

RequestRoutineResultsByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier	M	#25h	RELI_

Figure I.26.2: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifier	M	#25h	RELI_
#3d	RecordValue#3 = INH_IV_KWP	M	#XXh	RRS_

Figure I.26.3: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.26.4 33_2B Read result Ruhestrom Test

General information:

With this service the tester can ask for the results of "Ruhestromprüfung mit IBS"

Application conditions

Initialisation: at reset

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout
Service location: see list of implemented diagnostic services

RequestRoutineResultsByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier	M	#2Bh	RELI_RUHESTROM

Figure I.26.4: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifier	M	#2Bh	RELI_
#3d	RecordValue#1 = Eco_jobstat1	M	#XXh	RRS_FS_RU HESTROM
#4d	RecordValue#2 = Eco_result1 (high byte)	M	#XXh	RRS_RUHES TROM
#5d	RecordValue#3 = Eco_result1 (low byte)	M	#XXh	RRS_RUHES TROM

Figure I.26.5: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.26.5 33_2F Read result Desulfatisierung Fahrbetrieb

General information:

With this service the tester can ask for the results of "Desulfatisierung Fahrbetrieb"

Application conditions

Initialisation: at reset

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier	M	#2Fh	RELI_DESFAHR

Figure I.26.6: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifier	M	#2Fh	RELI_DESFA HR
#3d	RecordValue#1 = LV_CH_SO2P_WOUT_LIM	M	#XXh	RRS_ LV_CH_SO2P _WOUT_LIM
#4d	RecordValue#2 = NT_SUL (high byte)	M	#XXh	RRS_NT_SUL
#5d	RecordValue#3 = NT_SUL (low byte)	M	#XXh	RRS_NT_SUL
#6d	RecordValue#4 = LV_SO2P_REQ_2			

Figure I.26.7: Table RequestRoutineResultsLocalIdentifier Positive Response Message

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RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.26.6 33_3A Read result CSERS-Diagnose

Formula section:

If(1) service 33,3A is received
Then(1)
send positive response
Endif(1)

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier	M	#3Ah	RELI_ZGH

Figure I.26.8: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifier	M	#3Ah	RELI_ZGH
#3d	RecordValue#1 = STATE_EOL_DGNC_CH_DIAG	M	#XXh	RRS_
#4d	RecordValue#2 = LV_DIAG_CST_ACT	M	#XXh	RRS_
#5d	RecordValue#3 = LV_INH_DIAG_EFF_IGA_CST	M	#XXh	RRS_
#6d	RecordValue#4 = STATE_CH	M	#XXh	RRS_
#7d	RecordValue#5 = T_AST (high byte)	M	#XXh	RRS_
#8d	RecordValue #6 = T_AST (low byte)	M	#XXh	RRS_
#9d	RecordValue #7 = TCO_ST	M	#XXh	RRS_
#10d	RecordValue #8 = LV_CDN_DIAG_EFF_IGA_CST_IS	M	#XXh	RRS_
#11d	RecordValue #9 = LV_CDN_DIAG_EFF_IGA_CST_PL	M	#XXh	RRS_

Figure I.26.9: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.26.7 33_D9 Read status: switch off lambda controller- requestRoutineResults-ByLocalIdentifier

General information:

With this service the tester can ask for switch off lambda controller by KWP-service.

Application conditions

Initialisation: `at reset`

Activation: `LV_IGK=1 (Kl.15 on)`

Deactivation: `LV_IGK=0 (Kl.15 off)`

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Diagnostic timeout
Service location: see list of implemented diagnostic services

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier	M	#D9h	RELI_

Figure I.26.10: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifier	M	#D9h	RELI_
#3d	RecordValue#1 = LV_INH_LAM_KWP	M	#XXh	RRS_

Figure I.26.11: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.26.8 33_E0 Auslesen Eisy- Adaptionswerte (ungedrosselt)

General information:

With this service the tester can ask for the results of the Eisy- adaption.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout
Service location: see list of implemented diagnostic services

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier	M	#E0h	RELI_EISYUGD

Figure I.26.12: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifier	M	#E0h	RELI_EISYUGD
#3d	RecordValue#1 = B_mareghub_ad	M	#XXh	RRS_FS_ EISYUGD
#4d	RecordValue#2 = Mrnn_test_vvt high byte	M	#XXh	RRS_ MRNN_TEST _VVT
#5d	RecordValue#3 = Mrnn_test_vvt low byte	M	#XXh	RRS_ MRNN_TEST _VVT

Figure I.26.13: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.26.9 33_E1 Auslesen Eisy- Adaptionswerte (gedrosselt)

General information:

With this service the tester can ask for the results of the Eisy- adaption.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier	M	#E1h	RELI_EISYGD

Figure I.26.14: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifierValue	M	#E1h	RELI_EISYGD
#3d	RecordValue#1 = B_maregdk_ad	M	#XXh	RRS_FS_ EISYGD
#4d	RecordValue#2 = Mrnn_test_dk high byte	M	#XXh	RRS_ MRNN_TEST _DK
#5d	RecordValue#3 = Mrnn_test_dk low byte	M	#XXh	RRS_ MRNN_TEST _DK

Figure I.26.15: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.26.10 33_E2 Auslesen Eisy- Adaptionswerte (gedrosselt mit Abgasrueckfuehrung)

General information:

With this service the tester can ask for the results of the Eisy- adaption.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier	M	#E2h	RELI_EISYGDA GR

Figure I.26.16: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifierValue	M	#E2h	RELI_EISYGD AGR
#3d	RecordValue#1 = B_maregdk_ad	M	#XXh	RRS_FS_ EISYGD
#4d	RecordValue#2 = Mrnn_test_pr high byte	M	#XXh	RRS_ MRNN_TEST _PR
#5d	RecordValue#3 = Mrnn_test_pr low byte	M	#XXh	RRS_ MRNN_TEST _PR

Figure I.26.17: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.26.11 33_E3 Auslesen Krann- Adaptionswerte

General information:

With this service the tester can ask for the results of the KRANN- adaption.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier	M	#E3h	RELI_KRANN

Figure I.26.18: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifierValue	M	#E3h	RELI_KRANN
#3d	RecordValue#1 = dummy value fix	M	#FFh	RRS_FS_KRA NN
#4d	RecordValue#2 = Krnn_test high byte	M	#XXh	RRS_KRNN_ TEST
#5d	RecordValue#3 = Krnn_test low byte	M	#XXh	RRS_ KRNN_TEST

Figure I.26.19: Table RequestRoutineResultsLocalIdentifier Positive Response Message

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RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.26.12 33_E4 Auslesen Klann- Adaptionswerte

General information:

With this service the tester can ask for the results of the KLANN- adaption.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

RequestRoutineResultsByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier	M	#E4h	RELI_KLANN

Figure I.26.20: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifierValue	M	#E4h	RELI_KLANN
#3d	RecordValue#1 = dummy value fix	M	#FFh	RRS_FS_KLANN
#4d	RecordValue#2 = Klann_test1 high byte	M	#XXh	RRS_KLNN_READ_AD_1
#5d	RecordValue#3 = Klann_test1 low byte	M	#XXh	RRS_KLANN_READ_AD_1
#6d	RecordValue#2 = Klann_test2 high byte	M	#XXh	RRS_KLNN_READ_AD_2
#7d	RecordValue#3 = Klann_test2 low byte	M	#XXh	RRS_KLANN_READ_AD_2

Figure I.26.21: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.26.13 33_E5 Auslesen AGR - Adaptionswerte

General information:

With this service the tester can ask for the results of the AGR- adaption.

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Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

RequestRoutineResultsByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier	M	#E5h	RELI_EISYAGR

Figure I.26.22: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifierValue	M	#E5h	RELI_EISYAGR
#3d	RecordValue#1 = B_psragr_ad	M	#FFh	RRS_FS_EISYAGR
#4d	RecordValue#2 = Prnn_test_agr high byte	M	#XXh	RRS_PRNN_TEST_AGR
#5d	RecordValue#3 = Prnn_test_agr low byte	M	#XXh	RRS_PRNN_TEST_AGR

Figure I.26.23: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response

Global Negative Responses

I.26.14 33_F0 Report results of checksum calculation for IncaPC

General information:

With this service the tester can ask for the results of the checksum calculation, which is started with the service 31_F0.
If the checksum is equal to the checksum, which is given by 31_F0, the ECU reports a positive response. Otherwise a negative response is sent.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

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RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier = checksum calculation for IncaPC	M	#F0h	RELI_

Figure I.26.24: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response (= equal checksums)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifier = checksum calculation for IncaPC	M	#F0h	RELI_

Figure I.26.25: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.26.15 33_F1 Report results of programming the calibration data in the power latch of IncaPC

General information:

With this service the tester can ask for the results of the programming process of the calibration data in the power latch, which is started with the service 31_F1
Please consider that the calibration data are programmed at the end of the power latch phase. That means the ECU is not able to send the positive response for finishing the programming of the calibration data.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier = programming of calibration data in the power latch phase for IncaPC	M	#F1h	RELI_

Figure I.26.26: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response (= equal checksums)

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifier = programming of calibration data in the power latch phase for IncaPC	M	#F1h	RELI_

#3d	Programming of calibration data not yet requested:
	If (lv_kwp_prog_data = 0) => status = #84h
	IGK is still on:
	If (lv_kwp_prog_data=1 AND lv_igk=1) => status = #80h
	ECU will start the programming in the power latch phase:
	If (lv_kwp_prog_data=1 AND lv_igk=0) => status = #82h
		M	#XXh	

Figure I.26.27: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.26.16 33_F6 Read status: PM-Messmode- requestRoutineResultsByLocalIdentifier

General information:

With this service the tester can ask the state of PM-Messmode

Application conditions

Initialisation: at reset

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier	M	#F6h	RELI_

Figure I.26.28: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifier	M	#F6h	RELI_
#3d	RecordValue#1 = LV_POW_MNG_MES_MOD	M	#XXh	RRS_

Figure I.26.29: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

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I.26.17 33_F7 Report results of Intelligente Generatorregelung

General information:

With this service the tester can ask for the status Intelligente Generatorregelung , which is started with the service 31_F7

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: see list of implemented diagnostic services

RequestRoutineResultsByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier = Intelligente Generatorregelung	M	#F7h	RELI_IGR_OFF

Figure I.26.30: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response (= equal checksums)

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifier = Intelligente Generatorregelung	M	#F7h	RELI_IGR_OFF
#3d	RecordValue#1 = #05h **if** B_diagigr = 1 or #00h **if** B_diagigr = 0	M	#XXh	PRS_FS_IGR_ OFF

Figure I.26.31: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

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I.27 SID 34h: requestDownload Service

Input data:

LV_IGK {p. 906}			

General information:

This function is used for reprogramming the ECU.
Flash reprogramming is done with the following procedure:
RequestDownload, TransferData, ..., RequestTransferExit, RequestDownload, TansferData, ..., RequestTransferExit.
This means at memory address gaps during the programming session the transfer data service is finished with RequestTransferExit service. Resumption is done with a new RequestDownload-Service.

Application conditions

Initialisation: *at reset*

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see "list of implemented diagnostic services"

I.27.1 RequestDownload Request (3-byte addressing)

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestDownload Request Service Id**	**M**	**#34h**	**RD**
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (Middle Byte)	M	#XXh	MA_MB
#4d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
(#5d)	MemoryTypeIdentifier **(optional)** [external FLASH internal FLASH]	U	#XXh [#02h #06h]	MTI
#5d / (#6d)	DataFormatIdentifier [uncompresses]	M	#00h	DFI
#6d / (#7d)	UncompressedMemorySize [High Byte]	M	#00h...#FFh	UCMS
#7d / (#8d)	UncompressedMemorySize [Middle Byte]	M	#00h...#FFh	UCMS
#8d / (#9d)	UncompressedMemorySize [Low Byte]	M	#00h...#FFh	UCMS

Figure I.27.1: Table RequestDownload Request Message

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I.27.2 RequestDownload Request (4-byte addressing)

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestDownload Request Service Id**	**M**	**#34h**	**RD**
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (MiddleHigh Byte)	M	#XXh	MA_MHB
#4d	MemoryAddress (MiddleLow Byte)	M	#XXh	MA_MLB
#5d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
#6d	MemoryTypeIdentifier **(mandatory, but not evaluated)** [00h ... FFh]	M	#XXh [#XXh]	MTI
#7d	DataFormatIdentifier [uncompresses]	M	#00h	DFI
#8d	UncompressedMemorySize [High Byte]	M	#00h...#FFh	UCMS
#9d	UncompressedMemorySize [MiddleHigh Byte]	M	#00h...#FFh	UCMS
#10d	UncompressedMemorySize [MiddleLow Byte]	M	#00h...#FFh	UCMS
#11d	UncompressedMemorySize [Low Byte]	M	#00h...#FFh	UCMS

Figure I.27.2: Table RequestDownload Request Message

Remark:

For **3-byte addressing** independent from delivery of a MemoryTypeIdentifier (byte 5) by the tester s request, the ECU automatically adds an offset to the requested memory address.
If no MemoryTypeIdentifier is delivered, the same offset as for MemoryTypeIdentifier 00h (linear addressing) is used. Currently a download to this memory area is not allowed, it will be supported later on for supplier-Revival download within a restricted memory area and additional security check.
For compatibility reasons both MemoryTypeIdentifiers (02h ext. FLASH /06h int. FLASH) are supported and add the same memory offset.
This base memory offset must be subtracted from any memory address taken from the MAP- /A2L- file if 3-byte addressing is used!

For **4-byte addressing** a MemoryTypeIdentifier (byte 6) must be delivered by the tester s request.
Though it is not evaluated or used within the ECU for this absolute addressing mode, it is necessary to decide between 3- /4-byte addressing mode.
In this 4-byte mode the absolute address delivered by the tester is used by the ECU without any memory offset.

For MSx80 (TriCore) the base memory offsets for **3-byte addressing** mode of this service are:
MemoryTypeIdentifier: **Memory offset:**
none (linear) C000 0000h supported for supplier-Revival download later on
02h (ext. FLASH) 8000 0000h
06h (int. FLASH) 8000 0000h

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I.27.3 RequestDownload positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestDownload Positive Response Service Id**	**M**	**#74h**	**RDPR**
#2d	TransferResponseParameter=[maxNumberOfBlockLength]	M	#XXh	TREP_ MNROBL

Figure I.27.3: Table RequestDownload Positive Response Message

I.27.4 RequestDownload negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	negativeResponse Service Id	M	#7Fh	NR
#2d	RequestDownload Request Service Id	M	#34h	RD
#3d	responseCode= [general response code, download not allowed, conditins for programming not fulfilled]	M	#XXh= [#XXh, #40h, #22h]	RC

Figure I.27.4: Table RequestDownload Negative Response Message

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I.28 SID 36h: transferData Service

General information:

This funktion is for exchanging data after a request upload or download service.

Application conditions

Initialisation: *at reset*

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout
Service location: Boot-/ ECU-SW

TransferData Request after a request upload service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	transferData Request Service Id	M	#36h	TD

Figure I.28.1: Table TransferData Request Message after request upload

TransferData positive Response after a request upload service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	transferData Positive Response Service Id	M	#76h	TDPR
#2d	Data 1	M	#XXh	
#3d	Data 2	M	#XXh	
#nd	Data n	M	#XXh	

Figure I.28.2: Table TransferData Positive Response Message after request upload

TransferData negative Response after a request upload service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	TransferData Request Service Id	M	#36h	TD
#3d	responseCode= [general response code all bytes are uploaded]	M	#XXh= [#XXh, #53h,]	RC

Figure I.28.3: Table TransferData Negative Response Message after request upload

TransferData Request after a request download service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	transferData Request Service Id	M	#36h	TD
#2d	Data 1	M	#XXh	
#3d	Data 2	M	#XXh	
#nd	Data n	M	#XXh	

Figure I.28.4: Table TransferData Request Message after request download

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TransferData positive Response after a request download service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	transferData Positive Response Service Id	M	#76h	TDPR
#2d	number of transfer commands since 1. request high_Byte	M	#XXh	TDPR
#3d	number of transfer commands since 1. request low_Byte	M	#XXh	TDPR
#4d	status byte [reprogramming ok reprogramming not ok.]	M	#XXh [#01h, #02h]	TDPR

Figure I.28.5: Table TransferData Positive Response Message after request download

TransferData negative Response after a request download service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**NegativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	TransferData Request Service Id	M	#36h	TD
#3d	ResponseCode= [general response code conditions not correct]	M	#XXh= [#XXh, #22h,]	RC

Figure I.28.6: Table TransferData Negative Response Message after request download

Time	client (Tester)	server (ECU)
P3	transferData.Request#1[...]	
P2		transferData.PositiveResponse#1[...]
P3	transferData.Request#2[...]	
P2		transferData.PositiveResponse#2[...]
.	.	.
.	.	.
.	.	.
P3	transferData.Request#n[...]	
P2		transferData.PositiveResponse#n[...]

Figure I.28.7: Table transferData Message Flow

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I.29 SID 37h: requestTransferExit Service

Input data:

LV_IGK {p. 906}			

General information:

This function is necessary to stop the RequestDownload /RequestUpload process.
Remark: Ending a reprogramming session. There are no new informations since the last transfer data available, therefore it is not necessary to transmit a verify byte.

Application conditions

Initialisation: *at reset*

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see "list of implemented diagnostic services"

I.29.1 RequestTransferExit Request (short form)

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestTransferExit**	**M**	**#37h**	**RTE**

Figure I.29.1: Table RequestTransferExit Request Message

I.29.2 RequestTransferExit Request (3-byte addressing)

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestTransferExit**	**M**	**#37h**	**RTE**
#2d	Download / Upload MemoryAddress (High Byte) **(not evaluated)**	U	#XXh	MA_HB
#3d	Download / Upload MemoryAddress (Middle Byte) **(not evaluated)**	U	#XXh	MA_MB
#4d	Download / Upload MemoryAddress (Low Byte) **(not evaluated)**	U	#XXh	MA_LB
(#5d)	Download / Upload MemoryAddress (Low Byte) **(not evaluated)**	U	#XXh	MTI
#5d / (#6d)	MemoryTypeIdentifier **(not evaluated)**	U	#00h	DFI
#6d / (#7d)	UncompressedMemorySize [High Byte] **(not evaluated)**	U	#00h...#FFh	UCMS
#7d / (#8d)	UncompressedMemorySize [Middle Byte] **(not evaluated)**	U	#00h...#FFh	UCMS
#8d / (#9d)	UncompressedMemorySize [Low Byte] **(not evaluated)**	U	#00h...#FFh	UCMS

Figure I.29.2: Table RequestTransferExit Request Message

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I.29.3 RequestTransferExit Request (4-byte addressing)

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestTransferExit**	**M**	**#37h**	**RTE**
#2d	Download / Upload MemoryAddress (High Byte) **(not evaluated)**	U	#XXh	MA_HB
#3d	Download / Upload MemoryAddress (MiddleHigh Byte) **(not evaluated)**	U	#XXh	MA_MHB
#4d	Download / Upload MemoryAddress (Middlelow Byte) **(not evaluated)**	U	#XXh	MA_MLB
#5d	Download / Upload MemoryAddress (Low Byte) **(not evaluated)**	U	#XXh	MA_LB
#6d	MemoryTypeIdentifier **(mandatory, but not evaluated)**	U	#XXh	MTI
#7d	DataFormatIdentifier [uncompresses] **(not evaluated)**	U	#00h	DFI
#8d	UncompressedMemorySize [High Byte] **(not evaluated)**	U	#00h...#FFh	UCMS
#9d	UncompressedMemorySize [MiddleHigh Byte] **(not evaluated)**	U	#00h...#FFh	UCMS
#10d	UncompressedMemorySize [MiddleLow Byte] **(not evaluated)**	U	#00h...#FFh	UCMS
#11d	UncompressedMemorySize [Low Byte] **(not evaluated)**	U	#00h...#FFh	UCMS

Figure I.29.3: Table RequestTransferExit Request Message

Remark:

No additional formal parameters are evaluated. The only criteria checked is the request length.
Accepted request lengths and telegram formats are:
1 byte: SID
8 bytes: SID, Addr3, Addr2, Addr1, DFI, Size3, Size2, Size1
9 bytes: SID, Addr3, Addr2, Addr1, MTI, DFI, Size3, Size2, Size1
11 bytes SID, Addr4, Addr3, Addr2, Addr1, MTI, DFI, Size4, Size3, Size2, Size1

This service is only accepted after all previously defined data transfer (by RequestDownload /RequestUpload) is done, i.e. no more data is left from TransferData service.

I.29.4 RequestTransferExit positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestTransferExit PositiveResponse**	**M**	**#77h**	**PR**

Figure I.29.4: Table RequestTransferExit Positive Response Message

I.29.5 RequestTransferExit negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**NegativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	RequestTransferExit Service Id	M	#37h	RTE
#3d	ResponseCode=General response code Upload / Download not complete	M	#XXh #22h	RC

Figure I.29.5: Table RequestTransferExit Negative Response Message

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I.30 SID 3Dh: writeMemoryByAddress Service

Input data:

LV_IGK {p. 906}			

General information:

This function is used for writing values into the ECU´s memory

Application conditions

Initialisation: at reset

Activation: Kl.15 on

Deactivation: Kl.15 off
Diagnostic timeout
Service location: see "list of implemented diagnostic services"

I.30.1 WriteMemoryByAddress Request (3-byte addressing)

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteMemoryByAddress Request**	**M**	**#3Dh**	**WMBA**
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (Middle Byte)	M	#XXh	MA_MB
#4d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
(#5d)	MemoryTypeIdentifier **(optional)** [external FLASH internal FLASH user information field UIF]	U	#XXh [#02h #06h #07h]	MTI
#5d / (#6d)	MemorySize	M	#1h...#FAh	MS
#6d / (#7d) ... #nd	RecordValue #1 ... RecordValue #m	M ... U	#XXh ... #XXh	RV

Figure I.30.1: Table WriteMemoryByAddress Request Message

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I.30.2 WriteMemoryByAddress Request (4-byte addressing)

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteMemoryByAddress Request**	**M**	**#3Dh**	**WMBA**
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (MiddleHigh Byte)	M	#XXh	MA_MHB
#4d	MemoryAddress (MiddleLow Byte)	M	#XXh	MA_MLB
#5d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
#6d	MemoryTypeIdentifier **(mandatory, but not evaluated)** [00h ... FFh]	M	#XXh [#XXh]	MTI
#7d	MemorySize	M	#1h...#FAh	MS
#8d ... #nd	RecordValue #1 ... RecordValue #m	M ... U	#XXh ... #XXh	RV

Figure I.30.2: Table WriteMemoryByAddress Request Message

Remark:

For **3-byte addressing** independent from delivery of a MemoryTypeIdentifier (byte 5) by the tester´s request, the ECU automatically adds an offset to the requested memory address.
If no MemoryTypeIdentifier is delivered, the same offset as for MemoryTypeIdentifier 00h (linear addressing) is used.
This base memory offset must be subtracted from any memory address taken from the MAP- /A2L- file if 3-byte addressing is not sufficient for the address range!

For **4-byte addressing** a MemoryTypeIdentifier (byte 6) must be delivered by the tester´s request.
Though it is not evaluated or used within the ECU for this absolute addressing mode, it is necessary to decide between 3- /4-byte addressing mode.
In this 4-byte mode the absolute address delivered by the tester is used by the ECU without any memory offset.

For MSx80 (TriCore) the base memory offsets for **3-byte addressing** are:
MemoryTypeIdentifier: **Memory offset:**
02h (ext. FLASH) 8000 0000h (the same as for int. FLASH)
06h (int. FLASH) 8000 0000h
07h (UIF) 8000 xxxxh not fixed yet, address might still change !!!

Boot Software Active			*ECU Software Active*		
Memory ID	*Range (absolute addr.)*	*Security Level*	*Memory ID*	*Range (absolute addr.)*	*Security Level*
02h (ext. FLASH)	8000 xxxxh ... 8000 xxxxh	None	02h (ext. FLASH)	8000 xxxxh ... 8000 xxxxh	None
06h (int. FLASH)	8000 xxxxh ... 8000 xxxxh	None	06h (int. FLASH)	8000 xxxxh ... 8000 xxxxh	None
07h (UIF)	8000 xxxxh ... 8000 xxxxh	None	07h (UIF)	8000 xxxxh ... 8000 xxxxh	None

Figure I.30.3: Table call conditions writeMemoryByAddress

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I.30.3 WriteMemoryByAddress positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**WriteMemoryByAddress Positive Response**	**M**	**#7Dh**	**WMBAPR**
#2d	MemoryAddress (High Byte)	M	#XXh	MA_HB
#3d	MemoryAddress (Middle Byte)	M	#XXh	MA_MB
#4d	MemoryAddress (Low Byte)	M	#XXh	MA_LB
(#5d)	MemoryTypeIdentifier **(optional)** [external FLASH internal FLASH user information field UIF]	U	#XXh [#02h #06h #07h]	MTI

Figure I.30.4: Table WriteMemoryByAddress Positive Response Message

I.30.4 WriteMemoryByAddress negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**negativeResponse Service Id**	**S**	**#7Fh**	**NR**
#2d	writeMemoryByAddressRequest Service Id	M	#3Dh	WMBA
#3d	responseCode=general response code]	M	#XXh	RC

Figure I.30.5: Table WriteMemoryByAddress Negative Response Message

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I.31 SID 3Eh: testerPresent Service

Input data:

LV_IGK {p. 906}			

General information:

This funktion is for keeping KWP2000 communication alive.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off)
Diagnostic timeout

Service location: Boot-/ ECU-SW

TesterPresent Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**testerPresent Request Service Id**	**M**	**#3Eh**	**TP**
#2d	testerPresent Request Service Id [no parameter or #01h: ECU shall send a positive response #02h: ECU shall not send a positive response] **Remark:** A negative response shall be sent in any case if an error occurs	M	#XXh [-- / #01h, #02h]	TP

Figure I.31.1: Table testerPresent Request Message

TesterPresent positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**testerPresent Positive Response Service Id**	**M**	**#7Eh**	**TPPR**

Figure I.31.2: Table testerPresent Positive Response Message

TesterPresent negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	inputOutputControlByLocalIdentifier Request SId	M	#3Eh	IOBLID
#3d	responseCode=only general respons code	M	#XXh	RC

Figure I.31.3: Table InputOutputControlByLocalIdentifier negative response message

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I.32 Special test mode

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_gentestanf	O/V	0... 1H	0 ...1	1	-
Bedingung Testeransteuerung Generator					
B_testpoelsys	O/V	0... 1H	0 ...1	1	-
Flag indicating "Diagnosefunktion Oeldruckregelung"					
LAMB_SP_EXT_ADJ [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Bank selective external lambda-setpoint (EOL test)					
LV_ACT_ECRAS_EOL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Bit indicating activated ECRAS System test					
LV_ACT_N_SP_IS_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
LV for displace N_SP_IS					
LV_ACT_SA_EOL	O/V	0... 1H	0 ...1	1	-
Activation bit for secondary air EOL test					
LV_ACT_VLS_EOL_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
LV for start EOL test: Lambda sensors confused /not wired					
LV_EOL_CPS	O/V	0... 1H	0 ...1	1	-
LV for the end of line test CPS					
LV_LAM_AD_EXT_ADJ	O/V	0... 1H	0 ...1	1	-
Request of "Sperre Tankentlueftung"					
LV_LAMB_SP_EXT_ADJ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to activate bank selective external lambda-setpoint (EOL test)					
LV_NT_SO2P_EXT_ADJ_REQ_NOT_STOP	O/V	0... 1H	0 ...1	1	-
request STOP desulfation by tester (0 -stop)					
LV_NT_SO2P_EXT_ADJ_REQ_ST	O/V	0... 1H	0 ...1	1	-
request START desulfation by tester (1-start)					
LV_POIL_EXT_ADJ_ACT	O/V	0... 1H	0 ...1	1	-
Flag indicating active oil pressure diagnosis function					
LV_TCHA_DIAG_EXT_REQ	O/V	0... 1H	0 ...1	1	-
external request by tester for diagnosis of ATL					
N_SP_IS_EXT_ADJ	O/V	0... 1FE0H	0... 8160	1	rpm
idle speed setpoint from the tester					
STATE_EOL_KWP_CPS	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H	NOT_START ST_INH PAR_ NOT_ PLAUS WAIT_REL UNDEF ACT END_WOUT_ RESULT ABORTED END_WOUT_ ERR END_WITH_ ERR	-	-
State variable for EOL test: CPS					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_EOL_KWP_DMTL	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9HH	NOT_START ST_INH PAR_ NOT_ PLAUS WAIT_REL UNDEF ACT END_WOUT_ RESULT ABORTED END_WOUT_ ERR END_WITH_ ERR	-	-
State variable for end of line test DMTL					
STATE_EOL_KWP_ECRAS	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9HH	NOT_START ST_INH PAR_ NOT_ PLAUS WAIT_REL UNDEF ACT END_WOUT_ RESULT ABORTED END_WOUT_ ERR END_WITH_ ERR	-	-
State variable for EOL test: Ecras system test					
STATE_EOL_KWP_N_SP_IS	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9HH	NOT_START ST_INH PAR_ NOT_ PLAUS WAIT_REL UNDEF ACT END_WOUT_ RESULT ABORTED END_WOUT_ ERR END_WITH_ ERR	-	-
State variable for displace N_SP_IS					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_EOL_KWP_SA	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H	NOT_START ST_INH PAR_ NOT_ PLAUS WAIT_REL UNDEF ACT END_WOUT_ RESULT ABORTED END_WOUT_ ERR END_WITH_ ERR	-	-
Status of SA EOL diagnosis					
STATE_EOL_KWP_VLS	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H	NOT_START ST_INH PAR_ NOT_ PLAUS WAIT_REL UNDEF ACT END_WOUT_ RESULT ABORTED END_WOUT_ ERR END_WITH_ ERR	-	-
State variable for EOL test: Lambda sensors confused /not wired					
STATE_EOL_KWP_VVL_AD	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H 9H	NOT_START ST_INH PAR_ NOT_ PLAUS WAIT_REL UNDEF ACT END_WOUT_ RESULT ABORTED END_WOUT_ ERR END_WITH_ ERR	-	-
State variable for EOL - VVL adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_NT_SO2P_EXT_ADJ	O/V	0H 1H	FAST ALTERNATING	-	-
Additional information for desulfation mode by external request from tester					

Input data:

AMP {p. 982}	Atlsvc_dpvdk1 {p. 8154}	Atlsvc_dpvdk2 {p. 8154}	Atlsvc_dpvdk3 {p. 8154}
B_kupp {p. 8343}	C_N_MAX_KWP {p. 7439}	C_TCO_MIN_VLS_EOL {p. 8129}	C_TEG_CAT_DOWN_EOL {p. 8129}
C_VS_MAX_KWP {p. 7439}	CTL_SHIFT_LOCK_CAN {p. 1563}	CTR_NS_SHIFT_CYC_NOT_VLD [NC_NOX_SENS_CONF] {p. 6425}	CTR_NS_SHIFT_CYC_VLD [NC_NOX_SENS_CONF] {p. 6425}
CUR_DMTL_COR_FIL_EOL {p. 5960}	CUR_DMTL_REF_LEAK_EOL {p. 5960}	CUR_DMTL_ROUGH_LEAK_MIN_EOL {p. 5960}	EGY_DEW_END_NT {p. 3181}
EGY_DEW_END_NT_INT {p. 3181}	Gangi {p. 8394}	Gangi_roh	GEAR {p. 1302}
GEAR_INFO {p. 1564}	Genitest_tol {p. 8158}	Geniutest_ab {p. 8158}	I_gentest {p. 8158}
LAMB_LS_UP_AFL_EOL [NC_CBK_EX_NR] {p. 8128}	LAMB_LS_UP_AFR_EOL [NC_CBK_EX_NR] {p. 8128}	LAMB_SP [NC_CBK_EX_NR] {p. 8340}	LAMB_SP_SA_EOL
LAMB_SP_VLS_EOL [NC_CBK_EX_NR] {p. 8128}	LC_SA_SWI_ACQ {p. 1088}	LV_ACT_VLS_EOL {p. 8128}	LV_AT {p. 654}
LV_BRAKE_DET {p. 4209}	LV_CAN_TEMP_MIN_THD [NC_NOX_SENS_CONF] {p. 1399}	LV_CDN_VB_MIN_DIAG {p. 1185}	LV_CLU_SWI {p. 996}
LV_CONF_DMTL {p. 654}	LV_CS {p. 8394}	LV_CUR_DMTL_REF_DIF_MAX {p. 5963}	LV_CUR_DMTL_THD_DIF_MES {p. 5963}
LV_DET_FUC_OPEN {p. 5963}	LV_DET_REFU {p. 5963}	LV_DIAG_ACT_INH_LS_UP_DOWN [NC_CBK_EX_NR] {p. 5407}	LV_ECRAS_DOWN_EXT_ADJ {p. 7433}
LV_ECRAS_EOL_INH {p. 3863}	LV_ECRAS_UP_EXT_ADJ {p. 7433}	LV_ENA_LEAK_DMTL {p. 5964}	LV_END_DIAG_DIAGCPS {p. 5926}
LV_END_DIAG_SA_SAFM {p. 800}	LV_END_DIAG_SA_SAP {p. 800}	LV_END_DIAG_SA_SAV {p. 800}	LV_END_DIAG_SA_SYS {p. 800}
LV_EOL_CPS_ERR {p. 5926}	LV_ERR_AMP {p. 4822}	LV_ERR_AMP_PLAUS {p. 6128}	LV_ERR_CHG_LS_UP {p. 5416}
LV_ERR_CRK {p. 4455}	LV_ERR_DIAGCPS {p. 5926}	LV_ERR_ECRAS_EOL {p. 3863}	LV_ERR_FSD [NC_CBK_EX_NR] {p. 6141}

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LV_ERR_FTL_MIN {p. 4762}	LV_ERR_LOAD_TPS_ PLAUS {p. 1062}	LV_ERR_LS_UP [NC_CBK_EX_NR] {p. 5449}	LV_ERR_MAF {p. 4815}
LV_ERR_PUT_EL {p. 4828}	LV_ERR_SA_SAFM {p. 801}	LV_ERR_SA_SAP {p. 801}	LV_ERR_SA_SAV {p. 801}
LV_ERR_SA_SAV_LSL {p. 801}	LV_ERR_SA_SYS {p. 802}	LV_ERR_SAP {p. 802}	LV_ERR_SAV {p. 802}
LV_ERR_TCO {p. 4496}	LV_FCT_LIH_SA	LV_IGK {p. 906}	LV_INH_DIAGCPS {p. 5954}
LV_IS {p. 1720}	LV_LAM_AD_ENA {p. 3737}	LV_LAM_AD_END {p. 2642}	LV_LAMB_LS_UP_VLD [NC_CBK_EX_NR] {p. 2352}
LV_LS_DOWN_READY [NC_CBK_EX_NR] {p. 2416}	LV_MAF_SP_TQI_DYW_ DIAGCPS {p. 5927}	LV_MIS_STATE_A {p. 6238}	LV_MIS_STATE_B {p. 6238}
LV_PL {p. 1720}	LV_ST_END {p. 1720}	LV_T_DMTL_MAX {p. 5967}	LV_TEMP_MAX_SAP_ COIL {p. 805}
LV_VAR_AMT {p. 655}	LV_VAR_TCT {p. 656}	LV_VB_DIF_MAX {p. 5967}	LV_VB_JUMP {p. 1185}
LV_VB_RANGE_DMTL {p. 5967}	MAF_INT_MIN_VLS_EOL {p. 8128}	N {p. 1525}	N_32 {p. 1525}
NC_MAP_SENS_NR	NC_NOX_SENS_CONF {p. 643}	Nkw {p. 8215}	Nkw_poel_soll {p. 8163}
NT_SUL {p. 3113}	OPM_AV {p. 8137}	OPM_AV_DIAGCPS {p. 5954}	P_oel_ist {p. 8203}
P_oel_soll {p. 8165}	Pu {p. 8278}	PV {p. 978}	Pwg_ist {p. 8190}
SAF_DIAG_MAX {p. 807}	SAF_DIAG_MIN {p. 807}	St_alsvc	St_atlsvc_pvdk {p. 8169}
St_gentest {p. 8171}	St_testpoelsys {p. 8174}	St_testpoelsys2 {p. 8174}	STATE_DIAG_SA_LS
STATE_DIAG_SA_SAFM {p. 808}	STATE_DIAGCPS {p. 5927}	STATE_DMTL {p. 5969}	STATE_DMTL_EOL {p. 5970}
STATE_ECRAS_SYS {p. 3863}	STATE_EOL_KWP_NS_ SHIFT_DIAG [NC_NOX_SENS_CONF] {p. 6427}	STATE_KWP_SO2P {p. 3144}	STATE_KWP_SRV_AD_ REQ_VVL
STATE_LSH_DOWN [NC_CBK_EX_NR] {p. 2421}	STATE_LSH_UP [NC_CBK_EX_NR] {p. 2385}	STATE_NS_SHIFT_DIAG [NC_NOX_SENS_CONF] {p. 6427}	STATE_NT_SO2P_EXT_ ADJ_ACT {p. 3144}
STATE_VLS_EOL {p. 8128}	SUM_AFL_VLS_DIAG_ SA_1	SUM_AFL_VLS_DIAG_ SA_2	SUM_DIAG_DIAGCPS_ EOL {p. 5928}
SUM_FLOW_SP_ DIAGCPS_EOL {p. 5928}	T_NS_SHIFT_DEAC_ TEMP [NC_NOX_SENS_CONF] {p. 6427}	T_NS_SHIFT_WAIT_REP [NC_NOX_SENS_CONF] {p. 6427}	T_NT_SO2P_EXT_ADJ_ ACT {p. 3144}

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TAM {p. 1579}	TCO {p. 1100}	TEG_CAT_DOWN_MDL {p. 8236}	TEG_WALL_NT_DOWN_MDL {p. 8237}
TIA {p. 1226}	Tmot {p. 8226}	Tn_abstell {p. 8221}	TNT_MDL_L {p. 8237}
TNT_MDL_MV {p. 8237}	Toel {p. 8177}	U_gentest {p. 8179}	V {p. 979}
VLS_DOWN_AFL_EOL [NC_CBK_EX_NR] {p. 8128}	VLS_DOWN_AFR_EOL [NC_CBK_EX_NR] {p. 8128}	VS {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_TCO_MIN_SA_EOL	-	0... FEH	-48... 142.5	0.75	°C
TCO Threshold for EOL activation					

Hint for MSV80: In STATE_EOL_KWP_... is 0H = ACT and 5H = NOT_START

ACTION_NOXD_StartNNShiftDiag()
ACTION_NOXD_EndNNShiftDiag()

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I.32.1 Overview of implemented subservices

SID number	service	MSV_80	MSD_80 (4-cyl)	MSD_80 (6-cyl)	MSD_81 (4-cyl)	MSD_81 (6-cyl)	MSD85 (L4)
21_20	Read Status EOL: Secondary air system	X	-	-	-	-	-
21_22	Read Status EOL: CPS	X	-	-	-	-	-
21_26	Read Status EOL: Idle speed setpoint displace	X	-	-	-	-	-
21_27	Read Status EOL: VVL adaption	X	-	-	-	-	-
21_D5	Read Status EOL: ECRAS system test	X	X	X	X	X	X
21_DA	Read Status EOL: DMTL	X	-	-	-	-	-
21_DF	Read Status EOL: Lambda sensors confused / wrong wired	X	-	-	-	-	-
31_20	EOL Test ON: Secondary air system						
31_22	EOL Test ON: CPS	X	X	X	X	X	X
31_26	EOL Test ON: Idle speed setpoint displace	X	X	X	X	X	X
31_27	start VVL Adaptation	X	-	-	-	-	-
31_2A	Start intelligent alternator test	X	X	X	X	X	X
31_2C	Start EOL test: Oil Pressure Regulation Diagnosis	X	X	X	X	X	-
31_2D	Start EOL test: Desulfatisierung	-	X	X	X	X	-
31_33	Start EOLtest: NOX-SensorShiftDiagnosis	-	X	X	X	X	-
31_CF	Start : Sperre Tankentlueftung	-	X	X	X	X	-
31_D0	Start: Werkstattdiagnose ATL	-	X	X	X	X	X
31_D5	EOL Test ON: ECRAS system test	X	X	X	X	X	X
31_DA	EOL Test ON: DMTL	X	-	X	-	X	X
31_DF	EOL Test ON: Lambda sensors confused / wrong wired	X	X	X	X	X	X
32_20	EOL Test OFF: Secondary air system	X	-	-	-	-	X
32_22	EOL Test OFF: CPS	X	X	X	X	X	X
32_26	EOL Test OFF: Idle speed setpoint displace	X	X	X	X	X	X
32_27	Stop EOL - VVL Adaptation	X	-	-	-	-	-
32_2A	Stop intelligent alternator test	X	X	X	X	X	X
32_2C	Stop EOL test: Oil Pressure Regulation Diagnosis	X	X	X	X	X	-
32_2D	Stop EOL test: Desulfatisierung	-	X	X	X	X	-
32_33	Stop EOLtest: NOX-SensorShiftDiagnosis	-	X	X	X	X	-
32_CF	Stop : Sperre Tankentlueftung	-	X	X	X	X	-
32_D0	Stop: Werkstattdiagnose ATL	-	X	X	X	X	X

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32_D5	**Stop EOL:** ECRAS system test	**X**	**X**	**X**	**X**	**X**	**X**
32_DA	**EOL Test OFF: DMTL**	**X**	**-**	**X**	**-**	**X**	**X**
32_DF	**EOL Test OFF: Lambda sensors confused / wrong wired**	**X**	**X**	**X**	**X**	**X**	**X**
33_20	**Report EOL results: Secondary air system**	**X**	**-**	**-**	**-**	**-**	**X**
33_22	**Report EOL results: CPS**	**X**	**X**	**X**	**X**	**X**	**X**
33_26	**Report EOL results: Idle speed setpoint displace**	**X**	**X**	**X**	**X**	**X**	**X**
33_27	**Read Status EOL: VVL adaptation**	**X**	**-**	**-**	**-**	**-**	**-**
33_2A	**Read Status: inteligent alternator test**	**X**	**X**	**X**	**X**	**X**	**X**
33_2C	**Read Status EOL test: Oil Pressure Regulation Diagnosis**	**X**	**X**	**X**	**X**	**X**	-
33_2D	**Read status EOL test: Desulfatisierung**	**-**	**X**	**X**	**X**	**X**	**-**
33_33	**Read Status EOL-test: NOX-SensorShiftDiagnosis**	**-**	**X**	**X**	**X**	**X**	**-**
33_CF	**Read Statrus : Sperre Tankentlueftung**	**-**	**X**	**X**	**X**	**X**	**-**
33_D0	**Read Status: Werkstattdiagnose ATL**	**-**	**X**	**X**	**X**	**X**	**X**
33_D5	**Read Status EOL: ECRAS system test**	**X**	**X**	**X**	**X**	**X**	**X**
33_DA	**Report EOL results: DMTL**	**X**	**-**	**X**	**-**	**X**	**X**
33_DF	**Report EOL results: Lambda sensors confused / wrong wired**	**X**	**X**	**X**	**X**	**X**	**X**

I.32.2 Lambda- setpoint for external adjustment

FUNCTION DESCRIPTION:

General information:

This function is for shifting the lambda-setpoint in the lambda coordination to fulfill requests of external adjustment /EOL diagnosis.

i=1 for cylinder bank 1 and i = 2 for cylinder bank 2

Description:

The lambda-setpoint LAMB_SP_EXT_ADJ[i] is calculated as long as the activation bits:

- LV_ACT_VLS_EOL *//Lambda setpoint shifting for lambda sensor EOL test*
- LV_ACT_SA_EOL *//Lambda setpoint shifting for secondary air EOL test*

are active. The bit are set/reset by customer tool.

Application conditions

Initialisation: LV_LAMB_SP_EXT_ADJ[i] = 0
LAMB_SP_EXT_ADJ[i] = 1
at LV_IGK =1 **or** ECU reset

Recurrence: *20ms*

Activation: *LV_IGK = 1*

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Formula section:

Lambda setpoint shifting for lambda sensor EOL test
If LV_ACT_VLS_EOL = 1
Then LV_LAMB_SP_EXT_ADJ[i]= 1 *//bank 1 and bank 2*
LAMB_SP_EXT_ADJ[i] = LAMB_SP_VLS_EOL[i]

Lambda setpoint shifting for secondary air EOL test
ElseIf LV_ACT_SA_EOL = 1
Then LV_LAMB_SP_EXT_ADJ_[i] = 1 *//bank 1 and bank 2*
LAMB_SP_EXT_ADJ[i] = LAMB_SP_SA_EOL

Lambda setpoint shifting passive
Else LV_LAMB_SP_EXT_ADJ_[i] = 0 *//bank 1 and bank 2*
LAMB_SP_EXT_ADJ[i] = 1
Endif

I.32.3 Services 21_20 /31_20 /32_20 /33_20 for end of line test: SA-system test

FUNCTION DESCRIPTION:

General information:

The EOL test is performed in order to check the SA system in the factory or in the workshop. If EOL test is active (LV_ACT_EOL_SA = 1) then secondary air function (Pump and Valve) and the configurated diagnosis (depending of LC_SA_SWI_ACQ) is activated as long as EOL is requested or diagnosis is finished.

Description:

The EOL test contain the services:

- **21_20 - Read Status EOL- test**
- **31_20 - EOL Test start**
- **32_20 - EOL Test stop**
- **33_20 - Report EOL test results**

Application conditions

Initialisation: at LV_IGK 0->1 or reset
STATE_EOL_KWP_SA = NOT_START
LV_ACT_SA_EOL = 0

Recurrence: *same as SA function*

Activation: see following chapter
Service location: ECU-SW

I.32.3.1 Secondary air system diagnosis through SAF-meter (SAFM)

Description:

This service is only performed if **LC_SA_SWI_ACQ = 1**

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I.32.3.1.1 21_20 Read Status EOL- test - SA-system - ReadDataByLocalIdentifier service

ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = SA-system test	M	#20h	RELI_

Figure I.32.1: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier = SA-system test	M	#20h	RELI_
#3d	RecordValue = STATE_EOL_KWP_SA [**MSV70**:function active , **MSx80**:function not started yet conditions not correct parameter not correct funciton waiting not used **MSV70:** function not started yet, **MSx80**: function active function finished, no result function stopped function finished, no error function finished, error present]	M	#XXh [#00h, #01h, #02h #03h #04h #05h, #06h #07h #08h #09h]	RV_

Figure I.32.2: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.3: Table: readDataByLocalIdentifier Negative Response Message

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Formula section:

The determination of STATE_EOL_KWP_SA is stopped if EOL-test is stopped by tester request (service 32_20). In this case STATE_EOL_KWP_SA = NOT_START).

If LV_ACT_SA_EOL = 1
Then **If** LV_IS = 0 **or**
LV_FCT_LIH_SA = 1 **or**
LV_VB_JUMP = 1 **or**
LV_TEMP_MAX_SAP_COIL = 1 **or**
LV_ERR_MAF = 1 **or**
LV_ERR_AMP = 1 **or**
LV_ERR_AMP_PLAUS = 1 **or**
LV_ERR_TCO = 1 **or**
LV_ERR_CRK = 1 **or**
LV_ERR_FTL_MIN = 1 **or**

LV_MIS_STATE_A = 1 **or**
LV_MIS_STATE_B = 1 **or**
LV_ERR_SAV = 1 **or**
LV_ERR_SAP = 1 **or**
LV_ERR_LOAD_TPS_PLAUS = 1
Then LV_ACT_SA_EOL = 0
STATE_EOL_KWP_SA = 1H *//conditions not correct*
ElseIf LV_ERR_SA_SAFM = 1
Then LV_ACT_SA_EOL = 0
STATE_EOL_KWP_SA = 9H *//function finished, error present*
Elseif LV_ERR_SA_SAV = 1 **or**
LV_ERR_SA_SYS = 1
Then LV_ACT_SA_EOL = 0
STATE_EOL_KWP_SA = 9H *//function finished, error present*
Elseif LV_END_DIAG_SA_SAV =1 **and**
LV_END_DIAG_SA_SYS =1 **and**
LV_END_DIAG_SA_SAFM =1 **and**
LV_ERR_SA_SAV = 0 **and**
LV_ERR_SA_SYS = 0 **and**
LV_ERR_SA_SAFM = 0
Then LV_ACT_SA_EOL = 0
STATE_EOL_KWP_SA = 8H *//function finished, no error*
Endif
Else no change
Endif

I.32.3.1.2 31_20 EOL Test start - SA-system test - StartRoutineByLocalIdentifier service

Formula section:

If request 31_20 is received **and**
LV_IS = 1 **and**
TCO > C_TCO_MIN_SA_EOL **and**
LV_VB_JUMP = 0 **and**
LV_TEMP_MAX_SAP_COIL = 0 **and**
LV_ERR_SA_SAFM = 0 **and**
LV_ERR_SA_SYS = 0 **and**
LV_ERR_SA_SAV = 0 **and**
LV_ERR_MAF = 0 **and**
LV_ERR_AMP = 0 **and**
LV_ERR_AMP_PLAUS = 0 **and**
LV_ERR_TCO = 0 **and**
LV_ERR_CRK = 0 **and**
LV_ERR_FTL_MIN = 0 **and**
LV_MIS_STATE_A = 0 **and**
LV_MIS_STATE_B = 0 **and**
LV_ERR_SAV = 0 **and**
LV_ERR_SAP = 0 **and**
LV_ERR_LOAD_TPS_PLAUS = 0 **and**
(STATE_DIAG_SA_SAFM = SAFM_DIAG_END **or** SAFM_DIAG_CNL)
Then LV_ACT_SA_EOL = 1
STATE_EOL_KWP_SA = ACT *//active*

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Else STATE_EOL_KWP_SA = 1H *//conditions not correct*
Endif

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= start EOL Test - SA-system test	M	#20h	RELI_

Figure I.32.4: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = EOL Test SA-system test	M	#20h	RELI_
#3d	routineEntryStatus = EOL Test active	M	ACT	REYS_01

Figure I.32.5: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.6: Table StartRoutineByLocalIdentifier Negative Response Message

I.32.3.1.3 32_20 EOL Test OFF - SA-system test - StopRoutineByLocalIdentifier service

Formula section:

If request 32_20 is received
Then LV_ACT_SA_EOL = 0
STATE_EOL_KWP_SA = NOT_START *//function not started*
Endif

StopRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier = stop EOL Test SA-system test	M	#20h	RELI_

Figure I.32.7: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = stop EOL Test SA-system test	M	#20h	RELI_
#3d	routineEntryStatus = EOL Test inactive	M	NOT_START	REYS_01

Figure I.32.8: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.9: Table StopRoutineByLocalIdentifier Negative Response Message

I.32.3.1.4 33_20 - Report EOL results - SA-system test - RequestRoutineResultsByLocalIdentifier service

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier = ask for results SA-system test	M	#20h	RELI_

Figure I.32.10: Table RequestRoutineResultsByLocalIdentifier Request Message

Not for MSD80:RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = SA-system test	M	#20h	RELI_
#3d	RecordValue = STATE_DIAG_SA_SAFM	M	#XXh	RELI_
#4d	RecordValue = SAF_DIAG_MIN high byte	M	#XXh	RELI_
#5d	RecordValue = SAF_DIAG_MIN low byte	M	#XXh	RELI_
#4d	RecordValue = SAF_DIAG_MAX high byte	M	#XXh	RELI_
#5d	RecordValue = SAF_DIAG_MAX low byte	M	#XXh	RELI_

Figure I.32.11: Table RequestRoutineResultsLocalIdentifier Positive Response Message

Only for MSD80: RequestRoutineResultsByLocalIdentifier positive Response

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = SA-system test	M	#20h	RELI_
#3d	RecordValue = STATE_EOL_KWP_SA	M	#XXh	RELI_
#4d	RecordValue = STATE_DIAG_SA_SAFM	M	#XXh	RELI_
#5d	RecordValue = SAF_DIAG_MIN high byte	M	#XXh	RELI_
#6d	RecordValue = SAF_DIAG_MIN low byte	M	#XXh	RELI_
#7d	RecordValue = SAF_DIAG_MAX high byte	M	#XXh	RELI_
#8d	RecordValue = SAF_DIAG_MAX low byte	M	#XXh	RELI_

Figure I.32.12: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**NegativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.13: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

I.32.3.2 Secondary air system diagnosis through lambda sensor (LISL)

Description:

This service is only performed if **LC_SA_SWI_ACQ = 0**

I.32.3.2.1 21_20 Read Status EOL- test - SA-system - ReadDataByLocalIdentifier service

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = SA-system test	M	#20h	RELI_

Figure I.32.14: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier = SA-system test	M	#20h	RELI_
#3d	RecordValue = STATE_EOL_KWP_SA [**MSV70**:function active , **MSx80**:function not started yet conditions not correct parameter not correct funciton waiting not used **MSV70:** function not started yet, **MSx80**: function active function finished, no result function stopped function finished, no error function finished, error present]	M	#XXh [#00h, #01h, #02h #03h #04h #05h, #06h #07h #08h #09h]	RV_

Figure I.32.15: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.16: Table: readDataByLocalIdentifier Negative Response Message

Formula section:

The determination of STATE_EOL_KWP_SA is stopped if EOL-test is stopped by tester request (service 32_20). In this case STATE_EOL_KWP_SA = NOT_START.

If LV_ACT_SA_EOL = 1
Then **If** LV_IS = 0 **or**
LV_FCT_LIH_SA = 1 **or**
LV_VB_JUMP = 1 **or**
LV_TEMP_MAX_SAP_COIL = 1 **or**
LV_ERR_AMP = 1 **or**
LV_ERR_AMP_PLAUS = 1 **or**
LV_ERR_TCO = 1 **or**
LV_ERR_CRK = 1 **or**
LV_ERR_FTL_MIN = 1 **or**
LV_MIS_STATE_A = 1 **or**
LV_MIS_STATE_B = 1 **or**
LV_ERR_SAV = 1 **or**
LV_ERR_SAP = 1 **or**
LV_ERR_FSD[i] = 1 **or**
LV_ERR_LS_UP[i] = 1 **or**
LV_ERR_CHG_LS_UP = 1 **or**
LV_ERR_MAF = 1
Then LV_ACT_SA_EOL = 0
STATE_EOL_KWP_SA = 1H *//conditions not correct*
ElseIf LV_ERR_SA_SAV = 1 **or**
LV_ERR_SA_SAP = 1

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Then LV_ACT_SA_EOL = 0
STATE_EOL_KWP_SA = 9H *//function finished, error present*
Elseif LV_END_DIAG_SA_SAP =1 **and**
LV_ERR_SA_SAV = 0 **and**
LV_ERR_SA_SAP = 0
Then LV_ACT_SA_EOL = 0
STATE_EOL_KWP_SA = 8H *//function finished, no error*
Endif
Else no change
Endif

I.32.3.2.2 31_20 EOL Test start - SA-system test - StartRoutineByLocalIdentifier service

Formula section:

If request 31_20 is received **and**
LV_IS = 1 **and**
TCO > C_TCO_MIN_SA_EOL **and**
LV_VB_JUMP = 0 **and**
LV_TEMP_MAX_SAP_COIL = 0 **and**
LV_ERR_AMP = 0 **and**
LV_ERR_AMP_PLAUS = 0 **and**
LV_ERR_TCO = 0 **and**
LV_ERR_CRK = 0 **and**
LV_ERR_FTL_MIN = 0 **and**
LV_MIS_STATE_A = 0 **and**
LV_MIS_STATE_B = 0 **and**
LV_ERR_SAV = 0 **and**
LV_ERR_SAP = 0 **and**
LV_ERR_FSD[i] = 0 **and**
LV_ERR_LS_UP[i] = 0 **and**
LV_ERR_CHG_LS_UP = 0 **and**
LV_ERR_MAF = 0 **and**
(STATE_DIAG_SA_LS = SA_DIAG_END **or** SA_DIAG_CNL)
Then LV_ACT_SA_EOL = 1
STATE_EOL_KWP_SA = ACT *//active*
Else STATE_EOL_KWP_SA = 1H *//conditions not correct*
Endif

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= start EOL Test - SA-system test	M	#20h	RELI_
#3d	routineEntryOption = EOL Test active	M	#00h	REYO_01

Figure I.32.17: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = EOL Test SA-system test	M	#20h	RELI_
#3d	routineEntryStatus = EOL Test active	M	#00h	REYS_01

Figure I.32.18: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.19: Table StartRoutineByLocalIdentifier Negative Response Message

I.32.3.2.3 32_20 EOL Test OFF - SA-system test - StopRoutineByLocalIdentifier service

Formula section:

If request 32_20 is received
Then LV_ACT_SA_EOL = 0
STATE_EOL_KWP_SA = NOT_START *//function not started*
Endif

StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier = stop EOL Test SA-system test	M	#20h	RELI_
#3d	routineEntryOption = EOL Test inactive	M	NOT_START	REYO_01

Figure I.32.20: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = stop EOL Test SA-system test	M	#20h	RELI_
#3d	routineEntryStatus = EOL Test inactive	M	NOT_START	REYS_01

Figure I.32.21: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.22: Table StopRoutineByLocalIdentifier Negative Response Message

I.32.3.2.4 33_20 - Report EOL results - SA-system test - RequestRoutineResultsByLocalIdentifier service

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier = ask for results SA-system test	M	#20h	RELI_

Figure I.32.23: Table RequestRoutineResultsByLocalIdentifier Request Message

Not for MSD80: RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = SA-system test	M	#20h	RELI_
#3d	RecordValue = STATE_DIAG_SA_LS	M	#XXh	RELI_
#4d	RecordValue = SUM_AFL_VLS_DIAG_SA_1 high byte	M	#XXh	RELI_
#5d	RecordValue = SUM_AFL_VLS_DIAG_SA_1 low byte	M	#XXh	RELI_
#6d	RecordValue = SUM_AFL_VLS_DIAG_SA_2 high byte	M	#XXh	RELI_
#7d	RecordValue = SUM_AFL_VLS_DIAG_SA_2 low byte	M	#XXh	RELI_

Figure I.32.24: Table RequestRoutineResultsLocalIdentifier Positive Response Message

Only for MSD80: RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = SA-system test	M	#20h	RELI_
#3d	RecordValue = STATE_EOL_KWP_SA	M	#XXh	RELI_
#4d	RecordValue = STATE_DIAG_SA_LS	M	#XXh	RELI_
#5d	RecordValue = SUM_AFL_VLS_DIAG_SA_1 high byte	M	#XXh	RELI_
#6d	RecordValue = SUM_AFL_VLS_DIAG_SA_1 low byte	M	#XXh	RELI_
#7d	RecordValue = SUM_AFL_VLS_DIAG_SA_2 high byte	M	#XXh	RELI_
#8d	RecordValue = SUM_AFL_VLS_DIAG_SA_2 low byte	M	#XXh	RELI_

Figure I.32.25: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response

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Data Byte	***Parameter Name***	***Cvt***	***Hex Value***	***Mnemonic***
#1d	**NegativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.26: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

I.32.4 Services 21_22 /31_22 /32_22 /33_22 for end of line test: CPS-Check

I.32.4.1 31_22 - Start EOL-Test CPS-Check - StartRoutineByLocalIdentifier service

General information:

This funktion handles the functional check CPS also end of line test CPS called.

Application conditions

Initialisation: LV_EOL_CPS =00h at reset
STATE_EOL_KWP_CPS= NOT_START at reset

Activation: LV_IGK=1 (Kl.15 on) **and**
LV_EOL_CPS = 1

Deactivation: LV_IGK=0 (Kl.15 off) **or**
Diagnostic timeout
Servicelocation: see list of implemented diagnostic services

Formula section:

calculation of LV_EOL_CPS
IF LV_IGK=1 (Kl.15 on) **and**
LV_ST_END = 1 **and**
LV_INH_DIAGCPS = 0 **and**
VS = 0 **and**
LV_MAF_SP_TQI_DYW_DIAGCPS = 1 **and**
(OPM_AV_DIAGCPS = 1 or OPM_AV_DIAGCPs = 2) **and**
LV_ERR_DIAGCPS = 0
THEN LV_EOL_CPS = 1
ELSE LV_EOL_CPS = 0
ENDIF

calculation of STATE_EOL_KWP_CPS
IF *activation conditions are not fulfilled*
THEN STATE_EOL_KWP_CPS =**01H** // EOL_TEST_ST_INH
ELSE **IF** STATE_DIAGCPS >= 01H **AND**
LV_END_DIAG_DIAGCPS = 00H

THEN STATE_EOL_KWP_CPS = ACT // EOL_TEST_ACT

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ELSEIF STATE_DIAGCPS >= 1H **AND**
LV_END_DIAG_DIAGCPS = 1 **AND**
LV_EOL_CPS_ERR = 1
THEN STATE_EOL_KWP_CPS **=09H** // EOL_TEST_
END_WITH_ERR
ELSEIF STATE_DIAGCPS >= 1H **AND**
LV_END_DIAG_DIAGCPS = 1 **AND**
LV_EOL_CPS_ERR = 0
THEN STATE_EOL_KWP_CPS **=08H** //EOL_TEST_
END_WOUT_ERR
ELSEIF STATE_DIAGCPS = 0H
THEN STATE_EOL_KWP_CPS = NOT_START
ENDIF
ENDIF

activation of EOL test
IF service 31_22 received and activation conditions for EOL test fullfilled
THEN STATE_EOL_KWP_CPS = ACT // EOL_TEST_
ACT
LV_EOL_CPS=01H //request to start EOL test
ELSE STATE_EOL_KWP_DMTL remains unchanged
ENDIF

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= start EOL Test CPS	M	#22h	RELI_CPS

Figure I.32.27: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = start EOL Test CPS	M	#22h	RELI_CPS
#3d	routineEntryStatus = STATE_EOL_KWP_CPS	M	ACT	REYS_

Figure I.32.28: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.29: Table StartRoutineByLocalIdentifier Negative Response Message

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I.32.4.2 21_22 - Read STATUS EOL - CPS-Check - ReadDataByLocalIdentifier service

Application conditions

Initialisation: 0 at reset

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) **or**
Diagnostic timeout

Servicelocation: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier - EOL read state CPS Check	M	#22h	RELI_CPS

Figure I.32.30: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier - EOL read state CPS Check	M	#22h	RELI_CPS
#3d	RecordValue = STATE_EOL_KWP_CPS	M	#XXh	RV_S_CPS

Figure I.32.31: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.32: Table: readDataByLocalIdentifier Negative Response Message

I.32.4.3 32_22 - Stop EOL-Test CPS-Check - StopRoutineByLocalIdentifier service

Application conditions

Initialisation: 0 at reset

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) **or**
Diagnostic timeout

Servicelocation: see list of implemented diagnostic services

Formula section:

stop of EOL test
IF service 32_22 received
THEN STATE_EOL_KWP_CPS = NOT_START //EOL_TEST_NOT_ST
EOL_CPS=00H //request to stop EOL test

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ELSE STATE_EOL_KWP_CPS remains unchanged
ENDIF

StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**stopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	routineLocalIdentifier = stop EOL Test CPS	M	#22h	RELI_CPS

Figure I.32.33: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	stopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	routineLocalIdentifier = stop EOL Test CPS	M	#22h	RELI_CPS
#3d	routineEntryStatus = STATE_EOL_KWP_CPS	M	NOT_START	REYS_01

Figure I.32.34: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	stopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.35: Table StopRoutineByLocalIdentifier Negative Response Message

I.32.4.4 33_22 - Report results of - CPS EOL - RequestRoutineResultsByLocalIdentifier service

Application conditions

Initialisation: 0 at reset

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) **or**
Diagnostic timeout

Servicelocation: see list of implemented diagnostic services

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier = CPS EOL test values	M	#22h	RELI_CPS

Figure I.32.36: Table RequestRoutineResultsByLocalIdentifier Request Message

Not for MSD80: RequestRoutineResultsByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = CPS EOL test values	M	#22h	RELI_CPS
#3d	RecordValue = STATE_DIAGCPS [Step_INIT Step_1 Step_2 Step_3 CPS_RAMP LOCK_STEP]	M	#XXh [#00h, #01h, #02h, #03h, #04h, #05h,]	RELI_
#4d	RecordValue = SUM_DIAG_DIAGCPS_EOL	M	#XXh	RELI_
#5d	RecordValue = SUM_FLOW_SP_DIAGCPS_EOL	M	#XXh	RELI_

Figure I.32.37: Table RequestRoutineResultsLocalIdentifier Positive Response Message

Only for MSD80: RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = CPS EOL test values	M	#22h	RELI_CPS
#3d	RecordValue = STATE_EOL_KWP_CPS	M	#XXh	RELI_
#4d	RecordValue = STATE_DIAGCPS [Step_INIT Step_1 Step_2 Step_3 CPS_RAMP LOCK_STEP]	M	#XXh [#00h, #01h, #02h, #03h, #04h, #05h,]	RELI_
#5d	RecordValue = SUM_DIAG_DIAGCPS_EOL	M	#XXh	RELI_
#6d	RecordValue = SUM_FLOW_SP_DIAGCPS_EOL	M	#XXh	RELI_

Figure I.32.38: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**NegativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	responseCode= general response codes	M	#XXh	RC

Figure I.32.39: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

I.32.5 Services 21_26 /31_26 /32_26 /33_26 for end of line test: EOL- N_SP_IS displace

General information:

This EOL test is to calculate the N_SP_IS displace. The general function is described in the chapter System variables - Idle speed setpoint calculation .

Application conditions:

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Initialisation at reset :
STATE_EOL_KWP_N_SP_IS = NOT_START
LV_ACT_N_SP_IS_EXT_ADJ = 0
N_SP_IS_EXT_ADJ = 0

Activation: LV_IGK=1 (Kl.15 on) and
LV_IS=1 or LV_PL=1 and
N<C_N_MAX_KWP and
GEAR_INFO=0h and
VS<= C_VS_MAX_KWP and
LV_CS=0
(for LV_AT=0 and
LV_VAR_AMT=0 and
LV_VAR_TCT = 0) and
LV_BRAKE_DET=0 for LV_VAR_AMT=1

Deactivation: LV_IGK=0 (Kl.15 off) or
Diagnostic timeout

***Service location**:* ECU-SW

I.32.5.1 31_26 - ON EOL- N_SP_IS displace - StartRoutineByLocalIdentifier service

Formula section:

IF activation conditions are fullfilled and
service 31_26 is received

THEN STATE_EOL_KWP_N_SP_IS = ACT (EOL test active)
LV_ACT_N_SP_IS_EXT_ADJ=1
CTL_SHIFT_LOCK_CAN=03h
send positive response

ELSE STATE_EOL_KWP_N_SP_IS =01h (EOL test inhibited)
LV_ACT_N_SP_IS_EXT_ADJ remains unchanged
CTL_SHIFT_LOCK_CAN remains unchanged
send negative response

ENDIF

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**StartRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	RoutineLocalIdentifier= start EOL Test N_SP_IS displace	M	#26h	RELI_
#3d	RoutineEntryOption = N_SP_IS_EXT_ADJ high byte	M	#XXh	
#4d	RoutineEntryOption = N_SP_IS_EXT_ADJ low byte	M	#XXh	

Figure I.32.40: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StartRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	RoutineLocalIdentifier = EOL Test N_SP_IS displace	M	#26h	RELI_
#3d	routineEntryStatus = EOL Test active	M	#00h	REYS_01

Figure I.32.41: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**NegativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	StartRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	ResponseCode=only general response code	M	#XXh	RC

Figure I.32.42: Table StartRoutineByLocalIdentifier Negative Response Message

I.32.5.2 32_26 - OFF EOL-Test N_SP_IS displace - StopRoutineByLocalIdentifier service

Formula section:

IF service 32_26 received

THEN STATE_EOL_KWP_N_SP_IS = NOT_START (EOL test not started)
LV_ACT_N_SP_IS_EXT_ADJ =0

ELSE STATE_EOL_KWP_N_SP_IS remains unchanged
LV_ACT_N_SP_IS_EXT_ADJ remains unchanged

ENDIF

StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier = stop EOL Test N_SP_IS displace	M	#26h	RELI_

Figure I.32.43: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = stop EOL Test N_SP_IS displace	M	#26h	RELI_
#3d	routineEntryStatus = EOL Test inactive	M	NOT_START	REYS_01

Figure I.32.44: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**NegativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	ResponseCode=general response codes	M	#XXh	RC

Figure I.32.45: Table StopRoutineByLocalIdentifier Negative Response Message

I.32.5.3 21_26 - Read STATUS EOL- N_SP_IS displace - ReadDataByLocalIdentifier service

ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**ReadDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	RecordLocalIdentifier = N_SP_IS displace	M	#26h	RLI_

Figure I.32.46: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**ReadDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	RecordLocalIdentifier = N_SP_IS displace	M	#26h	RLI_
#3d	RecordValue = STATE_EOL_KWP_N_SP_IS [**MSV70**: function active, **MSX80**: function not started yet function start inhibited function start parameter not plausible **MSV70**: function not started yet, **MSx80**: function active]	M	#XXh [#00h, #01h, #02h, #05h]	RV_S_

Figure I.32.47: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**NegativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	ReadDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	ResponseCode=only general response code	M	#XXh	RC

Figure I.32.48: Table: readDataByLocalIdentifier Negative Response Message

I.32.5.4 33_26 - Report results of - N_SP_IS displace - RequestRoutineResultsByLocalIdentifier service

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier = N_SP_IS displace EOL test values	M	#26h	RELI_

Figure I.32.49: Table RequestRoutineResultsByLocalIdentifier Request Message

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Not for MSD80: RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = N_SP_IS displace EOL test values	M	#26h	RELI_
#3d	RecordValue = N high byte	M	#XXh	RELI_
#4d	RecordValue = N low byte	M	#XXh	RELI_

Figure I.32.50: Table RequestRoutineResultsLocalIdentifier Positive Response Message

Only for MSD80: RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = N_SP_IS displace EOL test values	M	#26h	RELI_
#3d	RecordValue = STATE_EOL_KWP_N_SP_IS	M	#XXh	RELI_
#4d	RecordValue = N high byte	M	#XXh	RELI_
#5d	RecordValue = N low byte	M	#XXh	RELI_ RELI_

Figure I.32.51: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**NegativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	ResponseCode= general response codes	M	#XXh	RC

Figure I.32.52: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

I.32.6 Services 21_27 /31_27 /32_27 /33_27 for end of line test: VVL adaption

I.32.6.1 31_27 - start VVL Adaptation - StartRoutineByLocalIdentifier service

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General information:

This function handles the tester adaption request. After receiving the Tester request the function sets the variables KWP_B_FA, KWP_B_FAVVTAL and VVT_KWP_EXT_AD_ERV_REQ. Then it waits till the adaption process starts which can be detected testing the STATE_AD_RUN_VVL variable. After finishing the adaption process the function returns the result of the adaption routine
The general function is described in the chapter VVL Position Sensor Adaptation .

Application conditions:

Initialisation at reset state /at restart:

STATE_EOL_KWP_VVL_AD = NOT_START

Recurrence: 10ms - see Activation

Activation: started from the KW2000 request handler when the corresponding diagnose message is received

Deactivation: response sent to the tester

Service location: see list of implemented diagnostic services

Formula section:

if (STATE_KWP_SRV_AD_REQ_VVL!= TERMINATE)
then
Send negative response with ResponseCode=22h;
//ConditionNotCorrectOrRequestSequenceError
else
if(2) ((REYS_01==01h) || (REYS_01==06h))
then(2)
Send positive response
call function Set KWP adaption request state variable with parameter (REYS_01)
else(2)
Send negative response with ResponseCode=22h;
//ConditionNotCorrectOrRequestSequenceError
endif(2)
endif

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= start EOL Test VVL adaptation	M	#27h	RELI_VVL
#3d	REYS_01= Adaption request command	M	#XXh	REYS_01

Figure I.32.53: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = EOL Test VVL adaptation	M	#27h	RELI_VVL
#3d	routineEntryStatus = EOL Test active	M	ACT	REYS_01

Figure I.32.54: Table StartRoutineByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.55: Table StartRoutineByLocalIdentifier Negative Response Message

I.32.6.2 21_27 - Read Status EOL: VVL adaption - ReadDataByLocalIdentifier service

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General information:

This funktion reports the state of the EOL VVL adaption.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) or
Diagnostic timeout

Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier STATE_EOL_KWP_VVL_AD	M	#27h	RLI_

Figure I.32.56: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier STATE_EOL_KWP_VVL_AD	M	#27h	RLI_
#3d	RecordValue = STATE_EOL_KWP_VVL_AD	M	#XXh	RV_S_

Figure I.32.57: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.58: Table: readDataByLocalIdentifier Negative Response Message

I.32.6.3 32_27 - Stop EOL - VVL Adaptation - stopRoutineByLocalIdentifier

General information:

With this comand the EOL-Test VVL adaptation is stopped. The general function is described in the chapter VVL Position Sensor Adaptation .

Application conditions

Initialisation: *at reset*

Activation: at receiving the corresponding KWP request

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Deactivation:

Service location: see list of implemented diagnostic services

Formula section:

if (request 32_27 received)
then
Send positive response
call function Set KWP adaption request state variable with parameter (TERMINATE)
endif

StopRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**stopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	routineLocalIdentifier = stop EOL Test VVL adaptation	M	#27h	RELI_VVL

Figure I.32.59: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	stopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	routineLocalIdentifier = stop EOL Test VVL adaptation	M	#27h	RELI_VVL
#3d	routineEntryStatus = EOL Test inactive	M	NOT_START	REYS_01

Figure I.32.60: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	stopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.61: Table StopRoutineByLocalIdentifier Negative Response Message

I.32.6.4 33_27 - Read Status EOL: VVL adaptation - RequestRoutineResultsByLocalIdentifier service

General information:

This function reports the state of the EOL VVL adaption.

Application conditions

Initialisation: *at reset*

Activation: LV_IGK=1 (Kl.15 on)

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Deactivation: LV_IGK=0 (Kl.15 off) or
Diagnostic timeout
Service location: see list of implemented diagnostic services

RequestRoutineResultsByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier = VVL adaptation EOL test values	M	#27h	RELI_

Figure I.32.62: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = STATE_EOL_KWP_VVL_AD	M	#27h	RELI_
#4d	RecordValue = STATE_EOL_KWP_VVL_AD	M	#XXh	

Figure I.32.63: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**NegativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	ResponseCode= general response codes	M	#XXh	RC

Figure I.32.64: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

I.32.7 Services 31_2A /32_2A /33_2A for EOL test: Generator

Application conditions

Initialisation at reset: *B_gentestanf = 0*

Recurrence: **if** B_gentestanf =1 then 100ms
else event triggered

Activation: LV_IGK=1

Deactivation: LV_IGK=0

Diagnostic timeout
Service location: see list of implemented diagnostic services

I.32.7.1 31_2A - start EOL Generatortest - StartRoutineByLocalIdentifier service

General information:

With this command the test of generatortest is started.

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Formula section:

IF service 31_2A is received

THEN B_gentestanf = 1
send positive response

ENDIF

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= Generatortest	M	#2Ah	RELI_GENU ITEST

Figure I.32.65: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response Id**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIdentifier = Generatortest	M	#2Ah	RELI_GENU ITEST
#3d	routineEntryStatus = EOL Generatortest activr	M	#05h	REYS_01

Figure I.32.66: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Global Negative Responses

I.32.7.2 32_2A - stop EOL Generatortest - stopRoutineByLocalIdentifier

General information:

With this comand the test of generatortest is switched off.

Formular section:

/* event triggered:*/
If service 32_2A is received

Then B_gentestanf = 0
send positive response

Endif

/* with 100ms recurrence: */
If St_gentest = 6 /* test finished */
or St_gentest = 7 /* test interrupted */
or St_gentest = 8 /* test conditions not fullfilled */

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Then B_gentestanf = 0
Endif

StopRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier = Generatortest	M	#2Ah	RELI_

Figure I.32.67: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = Generatortest	M	#2Ah	RELI_
#3d	routineEntryStatus = EOL Generatortest inactiv	M	#00h	REYS_01

Figure I.32.68: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response
Global Negative Responses

I.32.7.3 33_2A - read EOL Generatortest results - requestRoutineResultsByLocalIdentifier

General information:

With this service the tester can ask for the results of generatortest.

Formular section:

If service 33_2A is received

Then send positive response

Endif

RequestRoutineResultsByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier	M	#2Ah	RELI_GENUITEST

Figure I.32.69: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifier	M	#2Ah	RELI_GENUITEST
#3d	RecordValue#1 = St_gentest	M	#XXh	RRS_FS_GENUITEST
#4d	RecordValue#2 = Geniutest_err	M	#XXh	RRS_GENUITEST_ERR
#5d	RecordValue#3 = Geniutest_ab	M	#XXh	RRS_GENUITEST_AB
#6d	RecordValue#4 = Genitest_tol	M	#XXh	RRS_GENUITEST_TOL
#7d	RecordValue#5 = Genutest_tol	M	#XXh	RRS_GENUITEST_BOL
#8d	RecordValue#6 = I_gentest	M	#XXh	RRS_I_GENTEST
#9d	RecordValue#7 = U_gentest (high byte)	M	#XXh	RRS_U_GENTEST
#10d	RecordValue#8 = U_gentest (low byte)	M	#XXh	RRS_U_GENTEST

Figure I.32.70: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.32.8 Services 31_2C /32_2C /33_2C for EOL test: ODR (Oil Pressure Regulation Diagnosis)

Application conditions

Initialisation at reset: B_testpoelsys = 0
LV_POIL_EXT_ADJ_ACT = 0

Activation: LV_IGK=1

Deactivation: LV_IGK=0

Diagnostic timeout
Service location: see list of implemented diagnostic services

I.32.8.1 31_2C - start EOL ODR test - StartRoutineByLocalIdentifier service

General information:

With this command the test of ODR (Oil Pressure Regulation) is started.

Formula section:

If service 31_2C is received

Then B_testpoelsys = 1
LV_POIL_EXT_ADJ_ACT = 1
send positive response

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Endif

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= ODR	M	#2Ch	RELI_ODR

Figure I.32.71: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response Id**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIdentifier = Diagnosefunktion Oeldruckregelung	M	#2Ch	STRBLI_ODR_steuern
#3d	routineEntryStatus = EOL ODR test activ	M	#05h	REYS_01

Figure I.32.72: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.32.8.2 32_2C - stop EOL ODR test - stopRoutineByLocalIdentifier service

General information:

With this command the test of ODR (Oil Pressure Regulation) is switched off.

Formula section:

If service 32_2C is received

Then B_testpoelsys = 0
LV_POIL_EXT_ADJ_ACT = 0
send positive response

Endif

StopRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier = ODR	M	#2Ch	RELI_ODR

Figure I.32.73: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = Diagnosefunktion Oeldruckregelung beenden	M	#2Ch	SPRBLI_ODR_ende
#3d	routineEntryStatus = EOL ODR test inactiv	M	#00h	REYS_01

Figure I.32.74: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response

Global Negative Responses

I.32.8.3 33_2C - Report EOL ODR results - requestRoutineResultsByLocalIdentifier service

General information:

With this service the tester can ask for the results of the Oil Pressure Regulation diagnosis.

Formula section:

If service 33_2C is received

Then send positive response

Endif

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier = ODR	M	#2Ch	RELI_ODR

Figure I.32.75: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifier = RRRBLI_ODR_lesen	M	#2Ch	RRRBLI_ODR_lesen
#3d	RecordValue#1 = St_testpoelsys	M	#XXh	RRS_ST_TESTPOELSYS
#4d	RecordValue#2 = St_testpoelsys2	M	#XXh	RRS_ST_TESTPOELSYS2
#5d	RecordValue#3 = Toel high byte	M	#XXh	RRS_TOEL
#6d	RecordValue#4 = Toel low byte	M	#XXh	RRS_TOEL
#7d	RecordValue#5 = P_oel_soll high byte	M	#XXh	RRS_P_OEL_SOLL
#8d	RecordValue#6 = P_oel_soll low byte	M	#XXh	RRS_P_OEL_SOLL
#9d	RecordValue#7 = P_oel_ist high byte	M	#XXh	RRS_P_OEL_IST
#10d	RecordValue#8 = P_oel_ist low byte	M	#XXh	RRS_P_OEL_IST
#11d	RecordValue#9 = Nkw_soll high byte	M	#XXh	RRS_NKW_SOLL
#12d	RecordValue#10 = Nkw_soll low byte	M	#XXh	RRS_NKW_SOLL
#13d	RecordValue#11 = Nkw high byte	M	#XXh	RRS_NKW
#14d	RecordValue#12 = Nkw low byte	M	#XXh	RRS_NKW

Figure I.32.76: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.32.9 Services 31_2D /32_2D /33_2D for EOL test: Steuern Desulfatisierung

Application conditions

Initialisation at reset and at LV_IGK 1-> 0: LV_NT_SO2P_EXT_ADJ_REQ_ST = 0
STATE_NT_SO2P_EXT_ADJ = NOT_START
LV_NT_SO2P_EXT_ADJ_REQ_NOT_STOP = 1

Activation: LV_IGK=1

Deactivation: LV_IGK=0

Diagnostic timeout
Service location: see list of implemented diagnostic services

I.32.9.1 31_2D - start EOL Steuern Desulfatisierung- StartRoutineByLocalIdentifier service

General information:

With this command the desulfation is started.

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Formula section:

If service 31_2D is received

Then LV_NT_SO2P_EXT_ADJ_REQ_NOT_STOP = 1
STATE_NT_SO2P_EXT_ADJ = received value
LV_NT_SO2P_EXT_ADJ_REQ_ST = 1 (only for 2 sec)
send positive response

Endif

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= Desulfation	M	#2Dh	RELI_DES
#3d	record value #1 = STATE_NT_SO2P_EXT_ADJ	M	#XXh	RV_STATE_NT_SO2P_EXT_ADJ

Figure I.32.77: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response Id**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIdentifier = Desulfation	M	#2Dh	STRBLI_DES
#3d	routineEntryStatus = Desulfation is activ	M	#05h	REYS_01

Figure I.32.78: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.32.9.2 32_2D - stop EOL Steuern Desulfatisierung - stopRoutineByLocalIdentifier service

General information:

With this command the desulfation is switched off.

Formula section:

If service 32_2D is received

Then LV_NT_SO2P_EXT_ADJ_REQ_ST = 0
LV_NT_SO2P_EXT_ADJ_REQ_NOT_STOP = 0 (only for 2 sec)
send positive response

Endif

StopRoutineByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier = Desulfation	M	#2Dh	RELI_DES

Figure I.32.79: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = Diagnosefunktion Oeldruckregelung beenden	M	#2Dh	SPRBLI_DES_ende
#3d	routineEntryStatus = Desulfation is inactiv	M	#00h	REYS_01

Figure I.32.80: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response

Global Negative Responses

I.32.9.3 33_2D - Report EOL desulfation result - requestRoutineResultsByLocalIdentifier service

General information:

With this service the tester can ask for the results of the desulfation

Formula section:

If service 33_2D is received

Then send positive response

Endif

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier = DES	M	#2Dh	RELI_DES

Figure I.32.81: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifier = RRRBLI_DES_lesen	M	#2Dh	RRRBLI_DES_lesen
#3d	RecordValue#1 = STATE_KWP_SO2P	M	#XXh	RRS_STATE_KWP_SO2P
#4d	RecordValue#2 = STATE_NT_SO2P_EXT_ADJ_ACT	M	#XXh	RRS_STATE_NT_SO2P_EXT_ADJ_ACT
#5d	RecordValue#3 = TNT_MDL_L (high byte)	M	#XXh	RRS_TNT_MDL_L
#6d	RecordValue#4 = TNT_MDL_L (low byte)	M	#XXh	RRS_TNT_MDL_L
#7d	RecordValue#5 = TNT_MDL_MV (high byte)	M	#XXh	RRS_TNT_MDL_MV
#8d	RecordValue#6 = TNT_MDL_MV (low byte)	M	#XXh	RRS_TNT_MDL_MV
#9d	RecordValue#7 = T_NT_SO2P_EXT_ADJ_ACT (high byte)	M	#XXh	RRS_ T_NT_SO2P_EXT_ADJ_ACT
#10d	RecordValue#8 = T_NT_SO2P_EXT_ADJ_ACT (low byte)	M	#XXh	RRS_ T_NT_SO2P_EXT_ADJ_ACT
#11d	RecordValue#9 = NT_SUL (high byte)	M	#XXh	RRS_NT_SUL
#12d	RecordValue#10 = NT_SUL (low byte)	M	#XXh	RRS_NT_SUL
#13d	RecordValue#11 = LAMB_SP (high byte)	M	#XXh	RRS_LAMB_SP
#14d	RecordValue#12 = LAMB_SP (low byte)	M	#XXh	RRS_LAMB_SP
#15	RecordValue#13 = LAMB_SP[1] (high byte)	M	#XXh	RRS_LAMB_SP[1]
#16d	RecordValue#14 = LAMB_SP[1] (low byte)	M	#XXh	RRS_LAMB_SP[1]
#17d	RecordValue#15 = LAMB_SP[2] (high byte)	M	#XXh	RRS_LAMB_SP[2]
#18d	RecordValue#16 = LAMB_SP[2] (low byte)	M	#XXh	RRS_LAMB_SP[2]
#19d	RecordValue#17 =N_32	M	#XXh	RRS_N_32
#20d	RecordValue#18 =VS	M	#XXh	RRS_VS
#21d	RecordValue#19 =PV (high byte)	M	#XXh	RRS_PV
#22d	RecordValue#20 =PV (low byte)	M	#XXh	RRS_PV
#23d	RecordValue#21 =GEAR	M	#XXh	RRS_GEAR
#24d	RecordValue#22 =LV_CLU_SWI	M	#XXh	RRS_LV_CLU_SWI

Figure I.32.82: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.32.10 Services 31_33 /32_33 /33_33 for NOx-SensorShift Diagnose

Application conditions:

Initialisation at reset and at LV_IGK 0->1: Call ACTION_NOXD_EndNNShiftDiag()

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Activation: LV_IGK=1

Deactivation: LV_IGK=0

Diagnostic timeout

Service location: see list of implemented diagnostic services

I.32.10.1 31_33 - Start Werkstattdiagnose NOx-SensorShift - StartRoutineByLocalIdentifier service

General information:

With this command the "Werkstattdiagnose NOx-SensorShift" is requested

Formula section:

If(1) service 31_33 is received
Call ACTION_NOXD_StartNNShiftDiag()
send positive response
Endif(1)

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= Auftrag NOx-SensorShiftDiagnose	M	#33h	STRBLI_NOXS

Figure I.32.83: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response Id**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIdentifier = Auftrag NOx-SensorShiftDiagnose	M	#33h	STRBLI_NOXS
#3d	routineEntryStatus = Status Auftrag NOx-SensorShiftDiagnose	M	#05h	STRBLI_ATL_steuern

Figure I.32.84: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.32.10.2 32_33 - Stop Werkstatdiagnose NOx-SensorShift -stopRoutineByLocalIdentifier

General information:

With this comand the "Werkstattdiagnose NOx-SensorShift" is deactivated

Formular section:

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If service 32_33 is received
Then Call ACTION_NOXD_EndNNShiftDiag()
send positive response
Endif

StopRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier = Auftrag Werkstatdiagnose NOx-SensorShift beenden	M	#33h	STRBLI_NOXS _beenden

Figure I.32.85: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = Auftrag Werkstatdiagnose NOx-SensorShift beenden	M	#33h	STRBLI_NOXS_been den
#3d	routineEntryStatus = Status Auftrag Werkstatdiagnose NOx-SensorShift is inactiv	M	#00h	STRBLI_NOXS_been den

Figure I.32.86: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response
Global Negative Responses

I.32.10.3 33_33 - Read Status Auftrag Diagnosefunktion NOx-SensorShift - requestRoutineResultsByLocalIdentifier service

General information:

With this service the tester can read out the state of "Werkstattdiagnose NOx-SensorShift".

Formular section:

If service 33_33 is received
Then send positive response
Endif

RequestRoutineResultsByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier - Status Werkstatdiagnose NOX-SensorShift lesen	M	#33h	RRRBLI_NOXS_ lesen

Figure I.32.87: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifier - Status Werkstatdiagnose NOX-SensorShift lesen	M	#33h	RRRBLI_NOXS _lesen
#3d	RecordValue#1 = STATE_EOL_KWP_NS_SHIFT_DIAG[1]	M	#XXh	RRS_
#4d	RecordValue#2 = STATE_NS_SHIFT_DIAG[1] (high byte	M	#XXh	RRS_
#5d	RecordValue#3 = STATE_NS_SHIFT_DIAG[1] (low byte)	M	#XXh	RRS_
#6d	RecordValue#4 = EGY_DEW_END_NT (high word, high byte)	M	#XXh	RRS_
#7d	RecordValue#5 = EGY_DEW_END_NT (high word, low byte)	M	#XXh	RRS_
#8d	RecordValue#6 = EGY_DEW_END_NT (low word, high byte)	M	#XXh	RRS_
#9d	RecordValue#7 = EGY_DEW_END_NT (low word, low byte)	M	#XXh	RRS_
#10d	RecordValue#8= EGY_DEW_END_NT_INT (high word, high byte)	M	#XXh	RRS_
#11d	RecordValue#9= EGY_DEW_END_NT_INT (high word, low byte)	M	#XXh	RRS_
#12d	RecordValue#10= EGY_DEW_END_NT_INT (low word, high byte)	M	#XXh	RRS_
#13d	RecordValue#11= EGY_DEW_END_NT_INT (low word, low byte)	M	#XXh	RRS_
#14d	RecordValue#12= TEG_WALL_NT_DOWN_MDL (high byte)	M	#XXh	RRS_
#15d	RecordValue#13 = TEG_WALL_NT_DOWN_MDL (low byte)	M	#XXh	RRS_
#16d	RecordValue#14 = T_NS_SHIFT_DEAC_TEMP[1] (high byte)	M	#XXh	RRS_
#17d	RecordValue#15 = T_NS_SHIFT_DEAC_TEMP[1] (low byte)	M	#XXh	RRS_
#18d	RecordValue#16 = T_NS_SHIFT_WAIT_REP[1] (high byte)	M	#XXh	RRS_
#19d	RecordValue#17 = T_NS_SHIFT_WAIT_REP[1] (low byte)	M	#XXh	RRS_
#20d	RecordValue#18 = LV_CAN_TEMP_MIN_THD[1]	M	#XXh	RRS_
#21d	RecordValue#19 = CTR_NS_SHIFT_CYC_NOT_VLD[1]	M	#XXh	RRS_
#22d	RecordValue#20 = CTR_NS_SHIFT_CYC_VLD[1]	M	#XXh	RRS_
#23d	RecordValue#21 = OPM_AV	M	#XXh	RRS_

Figure I.32.88: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.32.11 Services 31_CF /32_CF /33_CF for : Sperre Tankentlueftung

Application conditions

Initialisation at reset and at LV_IGK 0->1: *LV_LAM_AD_ENA = 0*

Activation: LV_IGK=1

Deactivation: LV_IGK=0

Diagnostic timeout

Service location: see list of implemented diagnostic services

I.32.11.1 31_CF - Start Sperre Tankentlueftung - StartRoutineByLocalIdentifier service

General information:

With this command the "Sperre Tankentlueftung" is activated

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Formula section:

IF service 31_CF is received

THEN LV_LAM_AD_EXT_ADJ = 1
send positive response

ENDIF

StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= Auftrag Deaktivierung TEV-Regelung starten	M	#CFh	STRBLI_TEVR-steuern

Figure I.32.89: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**startRoutineByLocalIdentifier Positive Response Id**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIdentifier = Auftrag Deaktivierung TEV-Regelung starten	M	#CFh	STRBLI_TEVR-steuern
#3d	routineEntryStatus = Status Deaktivierung TEV-Regelung aktiv	M	#05h	STRBLI_TEVR-steuern

Figure I.32.90: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.32.11.2 32_CF - Stop Sperre Tankentlueftung -StopRoutineByLocalIdentifier service

General information:

With this comand the "Sperre Tankentlueftung" is deactivated

Formular section:

If service 32_CF is received

Then LV_LAM_AD_EXT_ADJ = 0
send positive response

Endif

StopRoutineByLocalIdentifier Request

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier = Auftrag Deaktivierung TEV-Regelung beenden	M	#CFh	STRBLI_TEVR-steuern

Figure I.32.91: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = Auftrag Deaktivierung TEV-Regelung beenden	M	#CFh	STRBLI_TEVR-steuern
#3d	routineEntryStatus = Status Deaktivierung TEV-Regelung inaktiv	M	#00h	STRBLI_TEVR-steuern

Figure I.32.92: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response
Global Negative Responses

I.32.11.3 33_CF - read Status Sperre Tankentlueftung - RequestRoutineResultsByLocalIdentifier service

General information:

With this service the tester can ask for the status of "Sperre Tankentlueftung".

Formular section:

If service 33_CF is received

Then send positive response

Endif

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier = Auftrag Deaktivierung TEV-Regelung Status auslesen	M	#CFh	RRRBLI_TEVR_lesen

Figure I.32.93: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifier = Auftrag Deaktivierung TEV-Regelung Status auslesen	M	#CFh	RRRBLI_TEVR_lesen
#3d	RecordValue#1 = LV_LAM_AD_ENA	M	#XXh	RRS_LV_LAM_AD_ENA
#4d	RecordValue#2 = LV_LAM_AD_END	M	#XXh	RRS_LV_LAM_AD_END

Figure I.32.94: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.32.12 Services 31_D0 /32_D0 /33_D0 for Werkstattdiagnose Abgas-Turbolader

Application conditions

Initialisation at reset and at LV_IGK 0->1: *LV_TCHA_DIAG_EXT_REQ = 0*

Activation: LV_IGK=1

Deactivation: LV_IGK=0

Diagnostic timeout

Service location: see list of implemented diagnostic services

I.32.12.1 31_D0 - Start Werkstatdiagnose Abgas-Turbolader - StartRoutineByLocalIdentifier service

General information:

With this command the "Werkstatdiagnose Abgas-Turbolader" is requested

Formula section:

If service 31_D0 is received

Then LV_TCHA_DIAG_EXT_REQ = 1
send positive response

Endif

StartRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= Auftrag Werkstatdiagnose Abgas-Turbolader starten	M	#D0h	STRBLI_ATL_steuern

Figure I.32.95: Table StartRoutineByLocalIdentifier Request Message

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StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Positive Response Id**	**M**	**#71h**	**STRBLIPR**
#2d	routineLocalIdentifier = Auftrag Werkstatdiagnose Abgas-Turbolader starten	M	#D0h	STRBLI_ATL_steuern
#3d	routineEntryStatus = Status Auftrag Werkstatdiagnose Abgas-Turbolader starten active	M	#05h	STRBLI_ATL_steuern

Figure I.32.96: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response
Global Negative Responses

I.32.12.2 32_D0 - Stop Werkstatdiagnose Abgas-Turbolader - stopRoutineByLocalIdentifier

General information:

With this comand the "Sperre Tankentlueftung" is deactivated

Formular section:

If service 32_D0 is received

Then LV_TCHA_DIAG_EXT_REQ = 0
send positive response

Endif

StopRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier = Auftrag Werkstatdiagnose Abgas-Turbolader beenden	M	#D0h	STRBLI_ATL_beenden

Figure I.32.97: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = Auftrag Werkstatdiagnose Abgas-Turbolader beenden	M	#D0h	STRBLI_ATL_beenden
#3d	routineEntryStatus = Status Auftrag Werkstatdiagnose Abgas-Turbolader inactive	M	#00h	STRBLI_ATL_beenden

Figure I.32.98: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response

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Global Negative Responses

I.32.12.3 33_D0 - read Status Auftrag Diagnosefunktion Abgasturbolader - requestRoutineResultsByLocalIdentifier service

General information:

With this service the tester can read out the state of "Werkstattdiagnose Abgasturbolader".

Formular section:

If service 33_D0 is received

Then send positive response

Endif

RequestRoutineResultsByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier - Status Werkstatdiagnose Abgasturbolader lesen	M	#D0h	RRRBLI_ATL_lesen

Figure I.32.99: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Positive Response**	**M**	**#73h**	**RRRBLIPR**
#2d	RoutineLocalIdentifier - Status Werkstatdiagnose Abgasturbolader lesen	M	#D0h	RRRBLI_ATL_ lesen
#3d	RecordValue#1 = St_atlsvc	M	#XXh	RRS_ST_ATL SVC
#4d	RecordValue#2 = St_atlsvc_pvdk	M	#XXh	RRS_ST_ATL SVC_PVDK
#5d	RecordValue#3 = AMP (high byte)	M	#XXh	RRS_AMP
#6d	RecordValue#4 = AMP (low byte)	M	#XXh	RRS_AMP
#7d	RecordValue#5 = TAM	M	#XXh	RRS_TAM
#8d	RecordValue#6 = TIA	M	#XXh	RRS_TIA
#9d	RecordValue#7 = Atlsvc_dpvdk1 (high byte)	M	#XXh	RRS_ATLSVC _DPVDK1
#10d	RecordValue#8= Atlsvc_dpvdk1 (low byte)	M	#XXh	RRS_ATLSVC _DPVDK1
#11d	RecordValue#9= Atlsvc_dpvdk2 (high byte)	M	#XXh	RRS_ATLSVC _DPVDK2
#12d	RecordValue#10= Atlsvc_dpvdk2 (low byte)	M	#XXh	RRS_ATLSVC _DPVDK2
#13d	RecordValue#11= Atlsvc_dpvdk3 (high byte)	M	#XXh	RRS_ATLSVC _DPVDK3
#14d	RecordValue#12= Atlsvc_dpvdk3 (low byte)	M	#XXh	RRS_ATLSVC _DPVDK3
#15d	RecordValue#13 = Pwg_ist (high byte)	M	#XXh	RRS_PWG_IS T
#16d	RecordValue#14 = Pwg_ist (low byte)	M	#XXh	RRS_PWG_IS T
#17d	RecordValue#15 = Tn_abstell (high byte)	M	#XXh	RRS_TN_ABS TELL
#18d	RecordValue#16 = Tn_abstell (loe byte)	M	#XXh	RRS_TN_ABS TELL
#19d	RecordValue#17 = B_kupp	M	#XXh	RRS_B_KUPP
#20d	RecordValue#18 = Gangi_roh **(MSD85)** Gangi **(not MSD85)**	M	#XXh	RRS_GANGI_ ROH
#21d	RecordValue#19 = V (high byte)	M	#XXh	RRS_V
#22d	RecordValue#20 = V (low byte)	M	#XXh	RRS_V
#23d	RecordValue#21 = Tmot (high byte)	M	#XXh	RRS_TMOT
#24d	RecordValue#22 = Tmot (low byte)	M	#XXh	RRS_TMOT
#25d	RecordValue#23 = Pu (high byte)	M	#XXh	RRS_PU
#26d	RecordValue#24 = Pu (low byte)	M	#XXh	RRS_PU
#27d	RecordValue#25 = LV_ERR_PUT_EL [1] **(MSD85)**, LV_ERR_PUT_EL **(not MSD85)**	M	#XXH	RRS_LV_ERR _PUT_EL
#28d	RecordValue#25 = LV_ERR_PUT_EL[2] **(MSD85),** #FFh **(not MSD85)**	M	#XXH	RRS_LV_ERR _PUT_EL

Figure I.32.100: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response
Global Negative Responses

I.32.13 Services 21_DA /31_DA /32_DA /33_DA for end of line test: Leakage detection

General information:

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This function shows the diagnosis status of the end of line test (EOL) of the diagnostic module tank leakage (DMTL) detection.

I.32.13.1 31_DA - ON EOL-Test DMTL - StartRoutineByLocalIdentifier service

With the service request 31_DA the EOL-DMTL-test can be started.

Application conditions

Initialisation: `STATE_EOL_KWP_DMTL = NOT_START (EOL_TEST_NOT_ST))` `at reset`

Activation: `LV_IGK=1 (Kl.15 on)`

Deactivation: `LV_IGK=0 (Kl.15 off)` **or** `Diagnostic timeout`

Servicelocation: `see list of implemented diagnostic services`

Formula section:

/* activation of DMTL-EOL test */
IF(1) service request 31_DA is received
THEN(1)
IF(2) LV_CONF_DMTL = 0
THEN(2) STATE_EOL_KWP_DMTL remains unchanged
send negative response
ELSE(2)
IF(3) conditions for EOL test are fulfilled
THEN(3) STATE_EOL_KWP_DMTL = ACT (EOL test active)
send positive response
ELSE(3) STATE_EOL_KWP_DMTL = EOL_TEST_INH (EOL test inhibited=**01H**)
send negative response
ENDIF(3)
ENDIF(2)
ENDIF(1)

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier - start EOL Test DMTL	M	#DAh	RELI_DMTL

Figure I.32.101: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = start EOL Test DMTL	M	#DAh	RELI_DMTL
#3d	routineEntryStatus = STATE_EOL_KWP_DMTL	M	ACT	REYS_01

Figure I.32.102: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.103: Table StartRoutineByLocalIdentifier Negative Response Message

I.32.13.2 21_DA - read STATUS DMTL EOL - ReadDataByLocalIdentifier service

With the service 21_DA the current status of the EOL (STATE_EOL_KWP_DMTL) test can be displayed.

Application conditions

Initialisation: `0 at reset`

Activation: `LV_IGK=1 (Kl.15 on)`

Deactivation: `LV_IGK=0 (Kl.15 off)` **or** `Diagnostic timeout`

Servicelocation: `see list of implemented diagnostic services`

ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = DMTL EOL	M	#DAh	RLI_DMTL

Figure I.32.104: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier - DMTL EOL	M	#DAh	RLI_KVA
#3d	RecordValue = STATE_EOL_KWP_DMTL	M	#XXh	RV_S_DMTL

Figure I.32.105: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.106: Table: readDataByLocalIdentifier Negative Response Message

I.32.13.3 32_DA - OFF EOL-Test DMTL - StopRoutineByLocalIdentifier service

With the service request 32_DA the EOL-DMTL-test can be stopped.

Application conditions

Initialisation: 0 at reset

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) **or**
Diagnostic timeout

Servicelocation: see list of implemented diagnostic services

Formula section:

/*stop of EOL test*/
IF service 32_DA received
THEN STATE_EOL_KWP_DMTL = NOT_START//EOL_TEST_NOT_ST
ELSE STATE_EOL_KWP_DMTL remains unchanged
ENDIF

StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**stopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	routineLocalIdentifier = stop EOL Test DMTL	M	#Dah	RELI_DMTL

Figure I.32.107: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	stopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	routineLocalIdentifier - stop EOL Test DMTL	M	#Dah	RELI_DMTL
#2d	routineEntryStatus = STATE_EOL_KWP_DMTL	M	NOT_START	REYS_01

Figure I.32.108: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	stopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.109: Table StopRoutineByLocalIdentifier Negative Response Message

I.32.13.4 33_DA - report results of - DMTL EOL - RequestRoutineResultsByLocalIdentifier service

General information:

With the service 33_DA the tester can ask for the results of DMTL end of line test which is started with the service 31_DA.

Application conditions

Initialisation: 0 at reset

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) **or** Diagnostic timeout

Servicelocation: see list of implemented diagnostic services

Formula section:

If(1) service 33_DA is received
If(2) LV_CONF_DMTL = 0
Then(2) send negative response (serviceNotSupported)
Else(2)
/* calculation of STATE_EOL_KWP_DMTL: **Only for MSD80** */
If 11h <= STATE_DMTL_EOL <=26H (DMTL cancelled)
or DMTL cancelled due to other conditions(in this case STATE_DMTL_EOL reports last active state before cancellation)
Then STATE_EOL_KWP_DMTL = EOL_TEST_ABORTED (=**07H**)

If(3) STATE_DMTL_EOL=08h (DMTL function is finished, tank tight)
Then(3) STATE_EOL_KWP_DMTL = EOL_TEST_END_WOUT_ERR (=**08H**)
Endif(3)

If(3) STATE_DMTL_EOL=09h (DMTL function is finished, small leak)
or STATE_DMTL_EOL=0Ah (DMTL function is finished, rough leak)
or STATE_DMTL_EOL=0Bh (DMTL function is finished, module error)
Then(3) STATE_EOL_KWP_DMTL = EOL_TEST_END_WITH_ERR (=**09H**)
Endif(3)

send positive response

Endif(2)
Endif(1)

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RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier - DMTL EOL test values	M	#DAh	RELI_DMTL

Figure I.32.110: Table RequestRoutineResultsByLocalIdentifier Request Message

Not for MSD80: RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = DMTL EOL test values	M	#DAh	RELI_DMTL
#3d	RecordValue = STATE_DMTL_EOL [START REF_LEAK_MES ROUGH_LEAK_MES ROUGH_LEAK_MES_LEN ROUGH_LEAK_MES_END SMALL_LEAK_MES SMALL_LEAK_MES_LEN 2.REF_LEAK_MES TANK_PROOFED SMALL_LEAK ROUGH_LEAK MODULE_ERROR ! LV_VB_RANGE_DMTL (VB out of range) ! LV_ENA_LEAK_DMTL (electrical error) LV_DET_REFU (fuel refill detected) LV_DET_FUC_OPEN (fuel cap open) LV_VB_DIF_MAX (VB fluctuation too high) LV_T_DMTL_MAX (maximum duration of diagnosis reached) LV_CUR_DMTL_REF_DIF_MAX (fluctuation of ref. current too high) LV_CUR_DMTL_THD_DIF_MES (decr. pump current during measure) END]	M	#XXh [#00h, #01h, #02h, #03h, #04h, #05h, #06h, #07h, #08h, #09h, #0Ah, #0Bh, #11h, #12h, #21h, #22h, #23h, #24h, #25h, #26h, #0Ch]	
#4d	RecordValue = CUR_DMTL_REF_LEAK_EOL high Byte	M	#XXh	
#5d	RecordValue = CUR_DMTL_REF_LEAK_EOL low Byte	M	#XXh	
#6d	RecordValue = CUR_DMTL_ROUGH_LEAK_MIN_EOL high Byte	M	#XXh	
#7d	RecordValue = CUR_DMTL_ROUGH_LEAK_MIN_EOL low Byte	M	#XXh	
#8d	RecordValue = CUR_DMTL_COR_FIL_EOL high Byte	M	#XXh	
#9d	RecordValue = CUR_DMTL_COR_FIL_EOL low Byte	M	#XXh	

Figure I.32.111: Table RequestRoutineResultsLocalIdentifier Positive Response Message

Only for MSD80: RequestRoutineResultsByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = DMTL EOL test values	M	#DAh	RELI_DMTL
#3d	RecordValue = STATE_EOL_KWP_DMTL	M	#XXh	RELI_DMTL
#4d	RecordValue = STATE_DMTL_EOL [START REF_LEAK_MES ROUGH_LEAK_MES ROUGH_LEAK_MES_LEN ROUGH_LEAK_MES_END SMALL_LEAK_MES SMALL_LEAK_MES_LEN 2.REF_LEAK_MES TANK_PROOFED SMALL_LEAK ROUGH_LEAK MODULE_ERROR ! LV_VB_RANGE_DMTL (VB out of range) ! LV_ENA_LEAK_DMTL (electrical error) LV_DET_REFU (fuel refill detected) LV_DET_FUC_OPEN (fuel cap open) LV_VB_DIF_MAX (VB fluctuation too high) LV_T_DMTL_MAX (maximum duration of diagnosis reached) LV_CUR_DMTL_REF_DIF_MAX (fluctuation of ref. current too high) LV_CUR_DMTL_THD_DIF_MES (decr. pump current during measure) END]	M	#XXh [#00h, #01h, #02h, #03h, #04h, #05h, #06h, #07h, #08h, #09h, #0Ah, #0Bh, #11h, #12h, #21h, #22h, #23h, #24h, #25h, #26h, #0Ch]	
#5d	RecordValue = CUR_DMTL_REF_LEAK_EOL high Byte	M	#XXh	RELI_DMTL
#6d	RecordValue = CUR_DMTL_REF_LEAK_EOL low Byte	M	#XXh	RELI_DMTL
#7d	RecordValue = CUR_DMTL_ROUGH_LEAK_MIN_EOL high Byte	M	#XXh	RELI_DMTL
#8d	RecordValue = CUR_DMTL_ROUGH_LEAK_MIN_EOL low Byte	M	#XXh	RELI_DMTL
#9d	RecordValue = CUR_DMTL_COR_FIL_EOL high Byte	M	#XXh	RELI_DMTL
#10d	RecordValue = CUR_DMTL_COR_FIL_EOL low Byte	M	#XXh	RELI_DMTL

Figure I.32.112: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**NegativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.113: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

I.32.14 Services 21_DF /31_DF /32_DF /33_DF for end of line test: Lambda sensors confused /wrong wired - linear sensors

I.32.14.1 31_DF EOL Test ON - Lambda sensors confused /wrong wired - StartRoutineByLocalIdentifier service

FUNCTION DESCRIPTION:

General information:

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This EOL test is to detect confused or wrong wired linear lambda sensors in order to prevent bad emmissions.

i = 1 for cylinder bank1 and i = 2 for cylinder bank 2

Application conditions

Initialisation:
```
STATE_EOL_KWP_VLS = NOT_START   at reset
LV_ACT_VLS_EOL_EXT_ADJ = 00h        at reset
```

Activation:
```
LV_IGK=1 (Kl.15 on)          and
    LV_IS = 1                          and
    TCO > C_TCO_MIN_VLS_EOL            and
    TEG_CAT_DOWN_MDL[i]
         > C_TEG_CAT_DOWN_EOL      and  //for both exhaust banks
    LV_LAMB_LS_UP_VLD[i] = 1           and  //for both exhaust banks
    LV_LS_DOWN_READY[i] = 1            and  //for both exhaust banks
    STATE_LSH_UP[i] = LSH_POW_CTL      and  //for both exhaust banks
    STATE_LSH_DOWN[i] = LSH_POW_CTL      and  //for both exhaust banks
    LV_DIAG_ACT_INH_LS_UP_DOWN[i] = 0      //for both exhaust banks
```

Deactivation:
```
LV_IGK=0 (Kl.15 off)          or
    conditions from activation not fullfilled     or
    Diagnostic timeout
```
Service location: see list of implemented diagnostic services

Formula section:

activation of EOL test

IF service 31_DF is received **and**
activation conditions for EOL test fullfilled (see above)

THEN STATE_EOL_KWP_VLS = ACT *// ACT*
LV_ACT_VLS_EOL_EXT_ADJ = 1 *//request to start EOL test*

ELSE STATE_EOL_KWP_VLS remains unchanged
LV_ACT_VLS_EOL_EXT_ADJ = 0

ENDIF

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= start EOL Test shifted lambdasensor check	M	#DFh	RELI_LSEOL

Figure I.32.114: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = EOL Test shifted lambdasensor check	M	#DFh	RELI_LSEOL
#3d	routineEntryStatus = STATE_EOL_KWP_VLS	M	ACT	REYS_01

Figure I.32.115: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.116: Table StartRoutineByLocalIdentifier Negative Response Message

I.32.14.2 21_DF Read Status EOL - Lambda sensors confused /wrong wired - ReadDataByLocalIdentifier service

Application conditions

Initialisation: *0 at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) or
Diagnostic timeout
Service location: see list of implemented diagnostic services

ReadDataByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = shifted lambdasensor check	M	#DFh	RELI_LSEOL

Figure I.32.117: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier = shifted lambdasensor check	M	#DFh	RELI_LSEOL
#3d	RecordValue = STATE_EOL_KWP_VLS	M	#XXh	RV_S_LSEOL

Figure I.32.118: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.119: Table: readDataByLocalIdentifier Negative Response Message

I.32.14.3 32_DF EOL Test OFF - Lambda sensors confused /wrong wired - StopRoutineByLocalIdentifier service

Application conditions

Initialisation: *0 at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) or
Diagnostic timeout
Service location: see list of implemented diagnostic services

Formula section:

stop of EOL test

IF service 32_DF received
THEN STATE_EOL_KWP_VLS = NOT_START *// NOT_START*
LV_ACT_VLS_EOL_EXT_ADJ = 0 *//request to stop EOL test*
ELSE STATE_EOL_KWP_VLS remains unchanged
ENDIF

StopRoutineByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier - stop EOL Test shifted lambdasensor check	M	#DFh	RELI_LSEOL

Figure I.32.120: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = stop EOL Test shifted lambdasensor check	M	#DFh	RELI_LSEOL
#3d	routineEntryStatus = STATE_EOL_KWP_VLS	M	NOT_START	REYS_01

Figure I.32.121: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	responseCode=general response codes	M	#XX	RC

Figure I.32.122: Table StopRoutineByLocalIdentifier Negative Response Message

I.32.14.4 33_DF - Report EOL results - Lambda sensors confused /wrong wired - RequestRoutineResultsByLocalIdentifier service

Application conditions

Initialisation: *0 at reset*

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) or
Diagnostic timeout

Service location: see list of implemented diagnostic services

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier = ask for shifted lambdasensor check EOL test values	M	#DFh	RELI_LSEOL

Figure I.32.123: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = shifted lambdasensor check EOL test values	M	#DFh	RELI_LSEOL
#3d	RecordValue#1 = STATE_EOL_KWP_VLS	M	#XXh	
#4d	RecordValue#2 = STATE_VLS_EOL [diagnosis inactive diagnosis 1.step diagnosis 2.step diagnosis finished, sensor OK diagnosis finished, upstream oxygen sensor shifted diagnosis finished, downstream oxygen sensor shifted diagnosis finished, upstream and downstream oxygen sensor shifted diagnosis finished, upstream oxygen sensor bank 1 not plausible diagnosis finished, upstream oxygen sensor bank 2 not plausible diagnosis finished, downstream oxygen sensor bank 1 not plausible diagnosis finished, downstream oxygen sensor bank 2 not plausible diagnosis finished, no interpretable result]	M	#XXh [#00h, #01h, #02h, #10h, #11h, #12h, #13h, #14h, #15h, #16h, #17h, #18h]	
#5d	RecordValue#3 = LAMB_LS_UP_AFR_EOL[1] high byte	M	#XXh	
#6d	RecordValue#4 = LAMB_LS_UP_AFR_EOL[1] low byte	M	#XXh	
#7d	RecordValue#5 = LAMB_LS_UP_AFR_EOL[2] high byte	M	#XXh	
#8d	RecordValue#6 = LAMB_LS_UP_AFR_EOL[2] low byte	M	#XXh	
#9d	RecordValue#7 = VLS_DOWN_AFR_EOL[1] high byte	M	#XXh	
#10d	RecordValue#8 = VLS_DOWN_AFR_EOL[1] low byte	M	#XXh	
#11d	RecordValue#9 = VLS_DOWN_AFR_EOL[2] high byte	M	#XXh	
#12d	RecordValue#10 = VLS_DOWN_AFR_EOL[2] low byte	M	#XXh	
#13d	RecordValue#11 = LAMB_LS_UP_AFL_EOL[1] high byte	M	#XXh	
#14d	RecordValue#12 = LAMB_LS_UP_AFL_EOL[1] low byte	M	#XXh	
#15d	RecordValue#13 = LAMB_LS_UP_AFL_EOL[2] high byte	M	#XXh	
#16d	RecordValue#14 = LAMB_LS_UP_AFL_EOL[2] low byte	M	#XXh	
#17d	RecordValue#15 = VLS_DOWN_AFL_EOL[1] high byte	M	#XXh	
#18d	RecordValue#16 = VLS_DOWN_AFL_EOL[1] low byte	M	#XXh	
#19d	RecordValue#17 = VLS_DOWN_AFL_EOL[2] high byte	M	#XXh	
#20d	RecordValue#18 = VLS_DOWN_AFL_EOL[2] low byte	M	#XXh	
#21d	RecordValue#19 = MAF_INT_MIN_VLS_EOL high Byte	M	#XXh	
#22d	RecordValue#20 = MAF_INT_MIN_VLS_EOL low Byte	M	#XXh	

Figure I.32.124: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**NegativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.125: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

I.32.15 Services 21_D5 /31_D5 /32_D5 /33_D5 for end of line test: ECRAS system test

FUNCTION DESCRIPTION:

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General information:

This EOL test is to test the ECRAS System. The ECRAS diagnosis will be enabled.

Application conditions

Initialisation: `at reset or LV_IGK 0->1: STATE_EOL_KWP_ECRAS = NOT_START, LV_ACT_ECRAS_EOL_EXT_ADJ = 00h`

Recurrence: *same as ECRAS diagnosis function (100ms)*

Activation: `LV_IGK=1 (Kl.15 on)`

Deactivation: `LV_IGK=0 (Kl.15 off)` **or** `Diagnostic timeout`

Service location: see list of implemented diagnostic services

Formula section:

Calculation of STATE_EOL_KWP_ECRAS:

The calculation of the state STATE_EOL_KWP_ECRAS is started with activation of LV_ACT_ECRAS_EOL_EXT_ADJ (0->1). Depending on several conditions the state and LV_ACT_ECRAS_EOL_EXT_ADJ will be set. The Determination of STATE_EOL_KWP_ECRAS is stopped after deactivation of the EOL by tester. In this case STATE_EOL_KWP_ECRAS = NOT_START (function not started). Once the calculation of the STATE_EOL_KWP_ECRAS is started, it has to be calculated with a recurrence of 100ms until deactivation.

```
If          LV_ACT_ECRAS_EOL_EXT_ADJ = 1
Then    If      LV_ECRAS_UP_EXT_ADJ = 1          or
                LV_ECRAS_DOWN_EXT_ADJ = 1        or
                LV_CDN_VB_MIN_DIAG = 0
        Then    LV_ACT_ECRAS_EOL_EXT_ADJ = 0
                STATE_EOL_KWP_ECRAS      = 01H   //conditions not correct
        ElseIf  LV_ECRAS_EOL_INH = 1             and
                LV_ERR_ECRAS_EOL = 1
        Then    LV_ACT_ECRAS_EOL_EXT_ADJ = 0
                STATE_EOL_KWP_ECRAS = 9H         //function finished, error present
        Elseif  LV_ECRAS_EOL_INH = 1
        Then    LV_ACT_ECRAS_EOL_EXT_ADJ = 0
                STATE_EOL_KWP_ECRAS = 8H         //function finished, without error
        Endif
Else    no change
Endif
```

I.32.15.1 31_D5 EOL Test ON - ECRAS system test - StartRoutineByLocalIdentifier service

Description:

If the activation service is received and the activation conditions are fulfilled the ECRAS system test is started (LV_ACT_ECRAS_EOL_EXT_ADJ 0-> 1)

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Formula section:

activation of EOL test

IF service 31_D5 is received **and**
LV_ECRAS_UP_EXT_ADJ = 0 **and**
LV_ECRAS_DOWN_EXT_ADJ = 0 **and**
LV_CDN_VB_MIN_DIAG = 1 **and**
LV_ECRAS_EOL_INH = 0
THEN STATE_EOL_KWP_ECRAS = ACT *// ACT*
LV_ACT_ECRAS_EOL_EXT_ADJ = 1 *//request to start EOL test*
ELSE STATE_EOL_KWP_ECRAS = 1H *//conditions not correct*
LV_ACT_ECRAS_EOL_EXT_ADJ *remains unchanged*
ENDIF

StartRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**startRoutineByLocalIdentifier Request Service Id**	**M**	**#31h**	**STRBLI**
#2d	routineLocalIdentifier= start EOL ECRAS system test	M	#D5h	RELI_GLFS

Figure I.32.126: Table StartRoutineByLocalIdentifier Request Message

StartRoutineByLocalIdentifier positive Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	startRoutineByLocalIdentifier Positive Response SId	M	#71h	STRBLIPR
#2d	routineLocalIdentifier = EOL ECRAS system test	M	#D5h	RELI_GLFS
#3d	routineEntryStatus = STATE_EOL_KWP_ECRAS	M	ACT	RRR_FS_G LFS

Figure I.32.127: Table StartRoutineByLocalIdentifier Positive Response Message

StartRoutineByLocalIdentifier negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	startRoutineByLocalIdentifier Request Service Id	M	#31h	STRBLI
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.128: Table StartRoutineByLocalIdentifier Negative Response Message

I.32.15.2 21_D5 Read Status EOL - ECRAS system test - ReadDataByLocalIdentifier service

Application conditions

Initialisation: 0 at reset

Activation: LV_IGK=1 (Kl.15 on)

Deactivation: LV_IGK=0 (Kl.15 off) or
Diagnostic timeout

Service location: see list of implemented diagnostic services

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ReadDataByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Request Service Id**	**M**	**#21h**	**RDBLI**
#2d	recordLocalIdentifier = ECRAS system test	M	#D5h	RELI_LSEOL

Figure I.32.129: Table readDataByLocalIdentifier Request Message

ReadDataByLocalIdentifier positive Response on service

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**readDataByLocalIdentifier Positive Response Service Id**	**M**	**#61h**	**RDBLIDPR**
#2d	recordLocalIdentifier = ECRAS system test	M	#D5h	RELI_LSEOL
#3d	RecordValue = STATE_EOL_KWP_ECRAS	M	#XXh	RV_S_LSEOL

Figure I.32.130: Table readDataByLocalIdentifier Positive Response Message

ReadDataByLocalIdentifier negative Response

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	readDataByLocalIdentifier Request Service Id	M	#21h	RDBLID
#3d	responseCode=only general response code	M	#XXh	RC

Figure I.32.131: Table: readDataByLocalIdentifier Negative Response Message

I.32.15.3 32_D5 EOL Test OFF - ECRAS system test - StopRoutineByLocalIdentifier service

Description:

If this service is received the EOL test will be stopped.

Formula section:

stop of EOL test
IF service 32_D5 received
THEN STATE_EOL_KWP_ECRAS = NOT_START *// NOT_START*
LV_ACT_ECRAS_EOL_EXT_ADJ = 0 *//request to stop EOL test*
ELSE STATE_EOL_KWP_ECRAS remains unchanged
ENDIF

StopRoutineByLocalIdentifier Request

Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**StopRoutineByLocalIdentifier Request Service Id**	**M**	**#32h**	**SPRBLI**
#2d	RoutineLocalIdentifier - stop EOL ECRAS system test	M	#D5h	RELI_GLFS

Figure I.32.132: Table StopRoutineByLocalIdentifier Request Message

StopRoutineByLocalIdentifier positive Response

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Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	StopRoutineByLocalIdentifier Positive Response	M	#72h	SPRBLIPR
#2d	RoutineLocalIdentifier = stop EOL ECRAS system test	M	#D5h	RELI_GLFS
#3d	routineEntryStatus = STATE_EOL_KWP_ECRAS	M	NOT_START	RRR_FS_ GLFS

Figure I.32.133: Table StopRoutineByLocalIdentifier Positive Response Message

StopRoutineByLocalIdentifier negative Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**negativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	StopRoutineByLocalIdentifier Request Service Id	M	#32h	SPRBLI
#3d	responseCode=general response codes	M	#XX	RC

Figure I.32.134: Table StopRoutineByLocalIdentifier Negative Response Message

I.32.15.4 33_D5 - Report EOL results - ECRAS system test - RequestRoutineResultsBy-LocalIdentifier service

Description:

The EOL state (STATE_EOL_KWP_ECRAS) and the status of the ECRAS system (STATE_ECRAS_SYS) will send if this service is received.

RequestRoutineResultsByLocalIdentifier Request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	**RequestRoutineResultsByLocalIdentifier Request Service Id**	**M**	**#33h**	**RRRBLI**
#2d	RoutineLocalIdentifier = ask EOL test state and values	M	#D5h	RELI_GLFS

Figure I.32.135: Table RequestRoutineResultsByLocalIdentifier Request Message

RequestRoutineResultsByLocalIdentifier positive Response

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1d	RequestRoutineResultsByLocalIdentifier Positive Response	M	#73h	RRRBLIPR
#2d	RoutineLocalIdentifier = ECRAS system test EOL test values	M	#D5h	RELI_GLFS
#3d	RecordValue = STATE_EOL_KWP_ECRAS	M	#XXh	RRR_FS_GLF S
#4d	RecordValue = STATE_ECRAS_SYS high byte	M	#XXh	
#5d	RecordValue = STATE_ECRAS_SYS low byte	M	#XXh	

Figure I.32.136: Table RequestRoutineResultsLocalIdentifier Positive Response Message

RequestRoutineResultsByLocalIdentifier negative Response

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Data Byte	*Parameter Name*	*Cvt*	*Hex Value*	*Mnemonic*
#1d	**NegativeResponse Service Id**	**M**	**#7Fh**	**NR**
#2d	RequestRoutineResultsByLocalIdentifier Request Service Id	M	#33h	RRRBLI
#3d	responseCode=general response codes	M	#XXh	RC

Figure I.32.137: Table RequestRoutineResultsByLocalIdentifier Negative Response Message

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I.33 Flash reprogramming procedure

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I.33.1 The message flow of flash-reprogramming with WinKFP Tool (customer reprog.)

Time	Client (DIAG-Tester)	Server (ECU)
P3 P2	ReadMemoryByAddress [UIF]	 ReadMemoryByAddress Pos.Rsp [UIF data]
P3 P2	ReadDataByCommonIdentifier [MaxResponseTime]	 ReadDataByCommonIdentifier Pos.Rsp [MaxResponseTime]
P3 P2	StartRoutineByLocalIdentifier [ProgrammingStatus]	 StartRoutineByLocalIdentifier Pos.Rsp [ProgrammingStatus]
P3 P2	ReadDataByCommonIdentifier [MaxBlockLength]	 ReadDataByCommonIdentifier Pos.Rsp [MaxBlockLength]

P3
P2
	StartDiagnosticSession [ECUProgrammingMode]	
		If (StartDiagnosticSession Neg. Rsp SAD) go on at **Label_1**
		If (StartDiagnosticSession Pos.Rsp) go on at **Label_2**

 P3 P2	**Label_1:** ReadEcuIdentification [SystemSupplierECUserialNumber]	 ReadEcuIdentification Pos.Rsp [SystemSupplierECUserialNumber]
P3 P2	StartRoutineByLocalIdentifier [AuthRequestSeed]	 StartRoutineByLocalIdentifier Pos.Rsp [AuthRequestSeed]
P3 P2	StartRoutineByLocalIdentifier [AuthSendKey]	 StartRoutineByLocalIdentifier Pos.Rsp [AuthSendKey]
P3 P2	StartDiagnosticSession [ECUProgrammingMode]	 StartDiagnosticSession Pos.Rsp
 P3 P2	**Label_2:** StartRoutineByLocalIdentifier [EraseMemory, ECU_SW or CAL_DATA]	 StartRoutineByLocalIdentifier Pos.Rsp [EraseMemory]
P3	DisableNormalMessageTransmission [functional, SuppressPosResponse]	
P3	EnableNormalMessageTransmission [physical (ECU), SuppressPosResponse]	
P3 P2	RequestDownload [ECU_SW or CAL_DATA, area #1]	 RequestDownload Pos.Rsp.
P3 P2 P3 P2 : P3 P2	TransferData [#1] TransferData [#2] : TransferData [#n]	 TransferData Pos.Rsp.[#1] TransferData Pos.Rsp. [#2] : TransferData Pos.Rsp. [#n]
P3 P2	RequestTransferExit [ECU_SW or CAL_DATA, area #1]	 RequestTransferExit Pos.Rsp.
P3 P2	RequestDownload [ECU_SW or CAL_DATA, area #2 (optional)]	 RequestDownload Pos.Rsp.
P3 P2 P3 P2 : P3 P2	TransferData [#1] TransferData [#2] : TransferData [#n]	 TransferData Pos.Rsp.[#1] TransferData Pos.Rsp. [#2] : TransferData Pos.Rsp. [#n]

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P3 P2	RequestTransferExit [ECU_SW or CAL_DATA, area #2 (optional)]	 RequestTransferExit Pos.Rsp.
P3 P2	RequestDownload [ECU_SW or CAL_DATA, area #n (optional)]	 RequestDownload Pos.Rsp.
P3 P2 P3 P2 : P3 P2	TransferData [#1] TransferData [#2] : TransferData [#n]	 TransferData Pos.Rsp.[#1] TransferData Pos.Rsp. [#2] : TransferData Pos.Rsp. [#n]
P3 P2	RequestTransferExit [ECU_SW or CAL_DATA, area #n (optional)]	 RequestTransferExit Pos.Rsp.
P3	EnableNormalMessageTransmission [functional, SuppressPosResponse]	
P3 P2	StartRoutineByLocalIdentifier [ProgrammingStatus]	 StartRoutineByLocalIdentifier Pos.Rsp [ProgrammingStatus]
P3 P2	StartRoutineByLocalIdentifier [CheckSignature, ECU_SW or CAL_DATA]	 StartRoutineByLocalIdentifier Pos.Rsp [CheckSignature]
P3 P2	StartRoutineByLocalIdentifier [ProgrammingStatus]	 StartRoutineByLocalIdentifier Pos.Rsp [ProgrammingStatus]
P3 P2	StopDiagnosticSession (only for CAL_DATA programming)	 StopDiagnosticSession Pos.Rsp
P3 P2	EcuReset (only for CAL_DATA programming)	 EcuReset Pos.Rsp
P3 P2	StartRoutineByLocalIdentifier [ProgrammingStatus] (only for CAL_DATA programming)	 StartRoutineByLocalIdentifier Pos.Rsp [ProgrammingStatus]

Table Message FlowFlash programming

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I.34 Emission related software and system configuration

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MOD_1_PID_1_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (01h - 08h)					
MOD_1_PID_2_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (09h - 10h)					
MOD_1_PID_3_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (11h - 18h)					
MOD_1_PID_4_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (19h - 20h)					
MOD_1_PID_5_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (21h - 28h)					
MOD_1_PID_6_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (29h - 30h)					
MOD_1_PID_7_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (31h - 38h)					
MOD_1_PID_8_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (39h - 40h)					
MOD_1_PID_9_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (41h - 48h)					
MOD_1_PID_A_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (49h - 50h)					
MOD_1_PID_B_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (51h - 58h)					
MOD_1_PID_C_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 01 (59h - 60h)					
MOD_2_PID_1_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (01h - 09h)					
MOD_2_PID_2_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (09h - 10h)					
MOD_2_PID_3_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (11h - 18h)					
MOD_2_PID_4_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (19h - 20h)					
MOD_2_PID_5_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (21h - 28h)					
MOD_2_PID_6_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (29h - 30h)					
MOD_2_PID_7_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (31h - 38h)					
MOD_2_PID_8_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (39h - 40h)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MOD_2_PID_9_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (41h - 48h)					
MOD_2_PID_A_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (49h - 50h)					
MOD_2_PID_B_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (51h - 58h)					
MOD_2_PID_C_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the PIDs supported by the mode 02 (59h - 60h)					
MOD_5_TID_1_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (01h - 08h)					
MOD_5_TID_10_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05(49h - 50h)					
MOD_5_TID_11_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (51h - 58h)					
MOD_5_TID_12_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (59h - 60h)					
MOD_5_TID_13_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (61h - 68h)					
MOD_5_TID_14_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (69h - 70h)					
MOD_5_TID_15_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (71h - 78h)					
MOD_5_TID_16_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (79h - 80h)					
MOD_5_TID_17_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (81h - 88h)					
MOD_5_TID_18_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (89h - 90h)					
MOD_5_TID_19_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (91h - 98h)					
MOD_5_TID_2_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (09h - 10h)					
MOD_5_TID_20_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05(99h - A0h)					
MOD_5_TID_3_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (11h - 18h)					
MOD_5_TID_4_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (19h - 20h)					
MOD_5_TID_5_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (21h - 28h)					
MOD_5_TID_6_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (29h - 30h)					
MOD_5_TID_7_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (31h - 38h)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MOD_5_TID_8_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (39h - 40h)					
MOD_5_TID_9_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 05 (41h - 48h)					
MOD_6_TID_1_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 06 (01h - 08h)					
MOD_6_TID_2_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 06 (09h - 10h)					
MOD_6_TID_3_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 06 (11h - 18h)					
MOD_6_TID_4_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 06 (19h - 20h)					
MOD_9_VIT_1_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 09 (01h - 09h) for ISO 15765-4					
MOD_9_VIT_2_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 09 (09h - 10h) for ISO 15765-4					
MOD_9_VIT_3_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 09 (11h - 18h)) for ISO 15765-4					
MOD_9_VIT_4_DIAG	O	0... FFH	0... 255	1	-
Byte which defines list of the TIDs supported by the mode 09 (19h - 20h) for ISO 15765-4					

Input data:

LV_VAR_OBDC_CAN {p. 7681}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CLC_READY_OBD_1	-	0... FFH	0... 255	1	-
Calibration byte to force readiness to 0 without calculation					
C_MOD_1_PID_1_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (01h - 08h)					
C_MOD_1_PID_2_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (09h - 10h)					
C_MOD_1_PID_3_DIAG	-	0... FFH	0... 255	1	-
Byte which defines the PIDs supported by the mode 01 (11h - 18h)					
C_MOD_1_PID_4_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (19h - 20h)					
C_MOD_1_PID_5_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (21h - 28h)					
C_MOD_1_PID_6_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (29h - 30h)					
C_MOD_1_PID_7_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (31h - 38h)					
C_MOD_1_PID_8_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (39h - 40h)					
C_MOD_1_PID_9_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (41h - 48h)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MOD_1_PID_A_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (49h - 50h)					
C_MOD_1_PID_B_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (51h - 58h)					
C_MOD_1_PID_C_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (59h - 60h)					
C_MOD_2_PID_1_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (01h - 08h)					
C_MOD_2_PID_2_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (09h - 10h)					
C_MOD_2_PID_3_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (11h - 18h)					
C_MOD_2_PID_4_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 01 (19h - 20h)					
C_MOD_2_PID_5_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (21h - 28h)					
C_MOD_2_PID_6_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (29h - 30h)					
C_MOD_2_PID_7_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (31h - 38h)					
C_MOD_2_PID_8_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (39h - 40h)					
C_MOD_2_PID_9_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (41h - 48h)					
C_MOD_2_PID_A_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (49h - 50h)					
C_MOD_2_PID_B_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (51h - 58h)					
C_MOD_2_PID_C_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the PIDs supported by the mode 02 (59h - 60h)					
C_MOD_5_TID_1_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (01h - 08h)					
C_MOD_5_TID_10_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (49h - 50h)					
C_MOD_5_TID_11_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (51h - 58h)					
C_MOD_5_TID_12_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (59h - 60h)					
C_MOD_5_TID_13_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (61h - 68h)					
C_MOD_5_TID_14_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (69h - 70h)					
C_MOD_5_TID_15_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (71h - 78h)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MOD_5_TID_16_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (79h - 80h)					
C_MOD_5_TID_17_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (81h - 88h)					
C_MOD_5_TID_18_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (89h - 90h)					
C_MOD_5_TID_19_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (91h - 98h)					
C_MOD_5_TID_2_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (09h - 10h)					
C_MOD_5_TID_20_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (99h - A0h)					
C_MOD_5_TID_3_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (11h - 18h)					
C_MOD_5_TID_4_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (19h - 20h)					
C_MOD_5_TID_5_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (21h - 28h)					
C_MOD_5_TID_6_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (29h - 30h)					
C_MOD_5_TID_7_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (31h - 38h)					
C_MOD_5_TID_8_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (39h - 40h)					
C_MOD_5_TID_9_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 05 (41h - 48h)					
C_MOD_6_TID_1_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 06 (01h - 08h)					
C_MOD_6_TID_2_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 06 (09h - 10h)					
C_MOD_6_TID_3_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 06 (11h - 18h)					
C_MOD_6_TID_4_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the TIDs supported by the mode 06 (19h - 20h)					
C_MOD_9_VIT_1_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the VITs supported by the mode 09 (01h - 08h) for ISO 15765-4					
C_MOD_9_VIT_2_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the VITs supported by the mode 09 (09h - 10h) for ISO 15765-4					
C_MOD_9_VIT_3_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the VITs supported by the mode 09 (11h - 18h) for ISO 15765-4					
C_MOD_9_VIT_4_DIAG	-	0... FFH	0... 255	1	-
Calibration byte which defines the VITs supported by the mode 09 (19h - 20h) for ISO 15765-4					
C_OBD_REQ	-	0... FFH	0... 255	1	-
Byte which indicates the OBD requirements					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_VLS_DOWN_AFL_AFR_SAE	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lean to rich threshold for downstream lambda sensor for MODE 06h					
C_VLS_DOWN_AFR_AFL_SAE	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Rich to lean threshold for downstream lambda sensor for MODE 06h					
C_VLS_DOWN_CYC_MAX_SAE	-	0... FFH	0... 1.275	0.005	V
Maximum downstream sensor test cycle voltage, Mode 5					
C_VLS_DOWN_CYC_MIN_SAE	-	0... FFH	0... 1.275	0.005	V
Minimum downstream sensor test cycle voltage, Mode 5					
LC_VAR_OBDC_CAN	-	0... 1H	0 ...1	1	-
Logical switch to activate OBD communication on CAN (=1) /or K-line (=0)					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_MOD_1_PID_1_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (01h - 08h)					
NC_MOD_1_PID_2_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (09h - 10h)					
NC_MOD_1_PID_3_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (11h - 18h)					
NC_MOD_1_PID_4_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (19h - 20h)					
NC_MOD_1_PID_5_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (21h - 28h)					
NC_MOD_1_PID_6_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (29h - 30h)					
NC_MOD_1_PID_7_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (31h - 38h)					
NC_MOD_1_PID_8_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (39h - 40h)					
NC_MOD_1_PID_9_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (41h - 48h)					
NC_MOD_1_PID_A_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (49h - 50h)					
NC_MOD_1_PID_B_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (51h - 58h)					
NC_MOD_1_PID_C_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (59h - 60h)					
NC_MOD_2_PID_1_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (01h - 08h)					
NC_MOD_2_PID_2_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (09h - 10h)					
NC_MOD_2_PID_3_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (11h - 18h)					
NC_MOD_2_PID_4_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 01 (19h - 20h)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_MOD_2_PID_5_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (21h - 28h)					
NC_MOD_2_PID_6_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (29h - 30h)					
NC_MOD_2_PID_7_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (31h - 38h)					
NC_MOD_2_PID_8_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (39h - 40h)					
NC_MOD_2_PID_9_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (41h - 48h)					
NC_MOD_2_PID_A_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (49h - 50h)					
NC_MOD_2_PID_B_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (51h - 58h)					
NC_MOD_2_PID_C_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the PIDs supported by the mode 02 (59h - 60h)					
NC_MOD_5_TID_1_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (01h - 08h)					
NC_MOD_5_TID_10_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05(49h - 50h)					
NC_MOD_5_TID_11_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (51h - 58h)					
NC_MOD_5_TID_12_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (59h - 60h)					
NC_MOD_5_TID_13_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (61h - 68h)					
NC_MOD_5_TID_14_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (69h - 70h)					
NC_MOD_5_TID_15_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (71h - 78h)					
NC_MOD_5_TID_16_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (79h - 80h)					
NC_MOD_5_TID_17_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (81h - 88h)					
NC_MOD_5_TID_18_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (89h - 90h)					
NC_MOD_5_TID_19_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (91h - 98h)					
NC_MOD_5_TID_2_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (09h - 10h)					
NC_MOD_5_TID_20_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (99h - A0h)					
NC_MOD_5_TID_3_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (11h - 18h)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_MOD_5_TID_4_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (19h - 20h)					
NC_MOD_5_TID_5_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (21h - 28h)					
NC_MOD_5_TID_6_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (29h - 30h)					
NC_MOD_5_TID_7_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (31h - 38h)					
NC_MOD_5_TID_8_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines theTIDs supported by the mode 05 (39h - 40h)					
NC_MOD_5_TID_9_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 05 (41h - 48h)					
NC_MOD_6_TID_1_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 06 (01h - 08h)					
NC_MOD_6_TID_2_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 06 (09h - 10h)					
NC_MOD_6_TID_3_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 06 (11h - 18h)					
NC_MOD_6_TID_4_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the TIDs supported by the mode 06 (19h - 20h)					
NC_MOD_9_VIT_1_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the VITs supported by the mode 09 (01h - 08h) for ISO 15765-4					
NC_MOD_9_VIT_2_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the VITs supported by the mode 09 (09h - 10h)) for ISO 15765-4					
NC_MOD_9_VIT_3_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the VITs supported by the mode 09 (11h - 18h)) for ISO 15765-4					
NC_MOD_9_VIT_4_DIAG	-	0... FFH	0... 255	1	-
Configuration byte which defines the VITs supported by the mode 09 (19h - 20h)) for ISO 15765-4					

I.34.1 Activation of OBD communication on CAN /K-line

FUNCTION DESCRIPTION:

General information:

Depending on calibration or coding, a different OBD communication can be applied.

Application conditions

Activation: `only once after ECU power-on reset`

Formula section:

If LC_VAR_OBDC_CAN = 1
Then OBD communication on CAN is active (ISO 15765 - 4)
Else **If** LV_VAR_OBDC_CAN = 1
  Then OBD communication on CAN is active (ISO 15765 - 4)
  Else OBD communication on K-line is active (ISO 9141-2, ISO 14230-4)

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Endif

Endif

I.34.2 Configuration and calibration of OBD communication on K-line (ISO 9141-2, ISO 14230-4)

Description:

MOD_i_PID /TID /VIT_j_DIAG variable definition
MOD_i_PID /_TID /_VIT_j_DIAG defines supported PIDs list for mode i. This definition depends on software **configuration** (ie if it is implemented in the software) and depends on system. Indeed, for a same software, we can have different system corresponding.
To define the software configuration, we use constants (NC_MOD_i_XXX_j_DIAG)
To define system, we use functions (F_MOD_i_XXX_j_DIAG) depends on different **calibrations**.

System configuration (calibration):
The definition of F_MOD_i_XXX_j_DIAG is: C_MOD_i_XXX_j_DIAG.

Software configuration:
The definition of all NC_MOD_x_PID_y_DIAG are inside the concerning table:

e.g. in the table below NC_MOD_x_PID_y_DIAG = **11100101 = E5h**

NC_MOD_x_PID_y_DIAG		C_MOD_x_PID_y_DIAG
BIT	Function	Supported
0	PID 10h : Function H	**Yes**
1	PID 0Fh : Function G	No
2	PID 0Eh : Function F	**Yes**
3	PID 0Dh : Function E	No
4	PID 0Ch : Function D	No
5	PID 0Bh : Function C	**Yes**
6	PID 0Ah : Function B	**Yes**
7	PID 09h : Function A	**Yes**

Formula section:

MOD_i_XXX_j_DIAG = NC_MOD_i_XXX_j__DIAG & & F_MOD_i_XXX_j_DIAG(calibration) with & & = bit per bit and.

I.34.2.1 Supported PIDs for Mode 01h

Description:

No: the PID is not supported
Yes: the PID is supported

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NC_MOD_1_PID_1_DIAG	C_MOD_1_PID_1_DIAG	
BIT	Function	Supported
0	PID 08h : Short term fuel trim - Bank 2	**Yes**
1	PID 07h : Long term fuel trim - Bank 1	**Yes**
2	PID 06h : Short term fuel trim - Bank 1	**Yes**
3	PID 05h : Engine coolant temperature	**Yes**
4	PID 04h : Calculated load value	**Yes**
5	PID 03h : Fuel system status	**Yes**
6	PID 02h : Trouble code that caused required freeze frame	No
7	PID 01h : DTCs and supported tests	**Yes**

NC_MOD_1_PID_2_DIAG	C_MOD_1_PID_2_DIAG	
BIT	Function	Supported
0	PID 10h : Air flow rate from MAF sensor	**Yes**
1	PID 0Fh : Intake air temperature	**Yes**
2	PID 0Eh : Ignition time advance	**Yes**
3	PID 0Dh : Vehicle speed	**Yes**
4	PID 0Ch : Engine RPM	**Yes**
5	PID 0Bh : Intake manifold absolute pressure	**Yes**
6	PID 0Ah : Fuel pressure (gauge)	**Yes**
7	PID 09h : Long term fuel trim - Bank 2	**Yes**

Figure I.34.1: NC_MOD_1_PID_3_DIAG

NC_MOD_1_PID_3_DIAG	C_MOD_1_PID_3_DIAG	
BIT	Function	Supported
0	PID 18h : Bank 2 Sensor 1(binary)	No
1	PID 17h : Bank 2 Sensor 2	No
2	PID 16h : Bank 2 Sensor 1	No
3	PID 15h : Bank 1 Sensor 2	**Yes**
4	PID 14h : Bank 1 Sensor 1(binary)	No
5	PID 13h : Location of oxygen sensors	**Yes**
6	PID 12h : Secondary air status	**Yes**
7	PID 11h : Absolute throttle position sensor	**Yes**

Figure I.34.2: NC_MOD_1_PID_4_DIAG

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NC_MOD_1_PID_4_DIAG	C_MOD_1_PID_4_DIAG	
BIT	Function	Supported
0	PID 20h : PIDs supported ($21 - $40)	**Yes**
1	PID 1Fh : Time since engine start	**Yes**
2	PID 1Eh : Reserved	No
3	PID 1Dh : Reserved	No
4	PID 1Ch : OBD requirements	**Yes**
5	PID 1Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2	No
6	PID 1Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1	No
7	PID 19h : Bank 2 Sensor 2 or Bank 3 Sensor 2	**Yes**

Figure I.34.3: NC_MOD_1_PID_5_DIAG

NC_MOD_1_PID_5_DIAG	C_MOD_1_PID_5_DIAG	
BIT	Function	Supported
0	PID 28h : Bank 2 Sensor 1 (Wide range O2S)	**Yes**
1	PID 27h : Bank 2 Sensor 2 (Wide range O2S)	No
2	PID 26h : Bank 2 Sensor 1 (Wide range O2S)	No
3	PID 25h : Bank 1 Sensor 2 (Wide range O2S)	No
4	PID 24h : Bank 1 Sensor 1 (Wide range O2S)	**Yes**
5	PID 23h : Fuel pressure high range (gauge)	**Yes**
6	PID 22h : Relative fuel pressure	No
7	PID 21h : Distance travelled while MIL is activated	**Yes**

Figure I.34.4: NC_MOD_1_PID_6_DIAG

NC_MOD_1_PID_6_DIAG	C_MOD_1_PID_6_DIAG	
BIT	Function	Supported
0	PID 30h : Number of warm-ups since diagnostic trouble codes cleared	**Yes**
1	PID 2Fh : Fuel Level Input	**Yes**
2	PID 2Eh : Command Evaporative Purge	**Yes**
3	PID 2Dh : EGR Error	**Yes**
4	PID 2Ch : Command EGR	**Yes**
5	PID 2Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	No
6	PID 2Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	No
7	PID 29h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	No

Figure I.34.5: NC_MOD_1_PID_7_DIAG

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NC_MOD_1_PID_7_DIAG	C_MOD_1_PID_7_DIAG	
BIT	Function	Supported
0	PID 38h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	**Yes**
1	PID 37h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	No
2	PID 36h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	No
3	PID 35h : Bank 1 Sensor 2 (Wide range O2S)	No
4	PID 34h : Bank 1 Sensor 1 (Wide range O2S)	**Yes**
5	PID 33h : Barometric Pressure	**Yes**
6	PID 32h : Evap System Vapor Pressure	No
7	PID 31h : Distance since diagnostic trouble codes cleared	**Yes**

Figure I.34.6: NC_MOD_1_PID_8_DIAG

NC_MOD_1_PID_8_DIAG	C_MOD_1_PID_8_DIAG	
BIT	Function	Supported
0	PID 40h : PIDs supported ($41 - $60)	**Yes**
1	PID 3Fh : Catalyst Temperature Bank 2, Sensor 2	**Yes**
2	PID 3Eh : Catalyst Temperature Bank 1, Sensor 2	**Yes**
3	PID 3Dh : Catalyst Temperature Bank 2, Sensor 1	**Yes**
4	PID 3Ch : Catalyst Temperature Bank 1, Sensor 1	**Yes**
5	PID 3Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	No
6	PID 3Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	No
7	PID 39h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	No

Figure I.34.7: NC_MOD_1_PID_9_DIAG

NC_MOD_1_PID_9_DIAG	C_MOD_1_PID_9_DIAG	
BIT	Function	Supported
0	PID 48h : Absolute Throttle Position C	No
1	PID 47h : Absolute Throttle Position B	**Yes**
2	PID 46h : Ambient air temperature	**Yes**
3	PID -h : Relative Throttle Position	**Yes**
4	PID 44h : Commanded Equivalence Ratio	**Yes**
5	PID 43h : Absolute Load Value	**Yes**
6	PID 42h : Control module voltage	**Yes**
7	PID 41h : Monitor status this driving cycle	**Yes**

Figure I.34.8: NC_MOD_1_PID_A_DIAG

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NC_MOD_1_PID_A_DIAG	C_MOD_1_PID_A_DIAG	
BIT	Function	Supported
0	PID 50h : Reserved	No
1	PID 4Fh : Reserved	No
2	PID 4Eh : Time since diagnostic trouble codes cleared	**Yes**
3	PID 4Dh : Minutes run by the engine while MIL activated	**Yes**
4	PID 4Ch : Commanded Throttle Actuator Control	**Yes**
5	PID 4Bh : Accelerator Pedal Position F	No
6	PID 4Ah : Accelerator Pedal Position E	**Yes**
7	PID 49h : Accelerator Pedal Position D	**Yes**

Figure I.34.9: NC_MOD_1_PID_B_DIAG

NC_MOD_1_PID_B_DIAG	C_MOD_1_PID_B_DIAG	
BIT	Function	Supported
0	PID 58h : Reserved	No
1	PID 57h : Reserved	No
2	PID 56h : Reserved	No
3	PID 55h : Reserved	No
4	PID 54h : Reserved	No
5	PID 53h : Reserved	No
6	PID 52h : Reserved	No
7	PID 51h : Reserved	No

Figure I.34.10: NC_MOD_1_PID_C_DIAG

NC_MOD_1_PID_C_DIAG	C_MOD_1_PID_C_DIAG	
BIT	Function	Supported
0	PID 60h : Reserved	No
1	PID 5Fh : Reserved	No
2	PID 5Eh : Reserved	No
3	PID 5Dh : Reserved	No
4	PID 5Ch : Reserved	No
5	PID 5Bh : Reserved	No
6	PID 5Ah : Reserved	No
7	PID 59h : Reserved	No

I.34.2.2 Supported PIDs for Mode 02h

Description:

No: the PID is not supported
Yes: the PID is supported

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NC_MOD_2_PID_1_DIAG	C_MOD_2_PID_1_DIAG	
BIT	Function	Supported
0	PID 08h : Short term fuel trim - Bank 2 and Bank 4	**Yes**
1	PID 07h : Long term fuel trim - Bank 1 and Bank 3	**Yes**
2	PID 06h : Short term fuel trim - Bank 1 and Bank 3	**Yes**
3	PID 05h : Engine coolant temperature	**Yes**
4	PID 04h : Calculated load value	**Yes**
5	PID 03h : Fuel system status	**Yes**
6	PID 02h : Trouble code that caused required freeze frame	**Yes**
7	PID 01h : DTCs and supported tests	No

Figure I.34.11: NC_MOD_2_PID_2_DIAG

NC_MOD_2_PID_2_DIAG	C_MOD_2_PID_2_DIAG	
BIT	Function	Supported
0	PID 10h : Air flow rate from MAF sensor	**Yes**
1	PID 0Fh : Intake air temperature	**Yes**
2	PID 0Eh : Ignition time advance	**Yes**
3	PID 0Dh : Vehicle speed	**Yes**
4	PID 0Ch : Engine RPM	**Yes**
5	PID 0Bh : Intake manifold absolute pressure	**Yes**
6	PID 0Ah : Fuel pressure (gauge)	**Yes**
7	PID 09h : Long term fuel trim - Bank 2 and Bank 4	**Yes**

Figure I.34.12: NC_MOD_2_PID_3_DIAG

NC_MOD_2_PID_3_DIAG	C_MOD_2_PID_3_DIAG	
BIT	Function	Supported
0	PID 18h : Not required	No
1	PID 17h : Not required	No
2	PID 16h : Not required	No
3	PID 15h : Not required	No
4	PID 14h : Not required	No
5	PID 13h : Not required	No
6	PID 12h : Secondary air status	**Yes**
7	PID 11h : Absolute throttle position sensor	**Yes**

Figure I.34.13: NC_MOD_2_PID_4_DIAG

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NC_MOD_2_PID_4_DIAG	C_MOD_2_PID_4_DIAG	
BIT	Function	Supported
0	PID 20h : PIDs supported ($21 - $40)	**Yes**
1	PID 1Fh : Time since engine start	**Yes**
2	PID 1Eh : Not required	No
3	PID 1Dh : Not required	No
4	PID 1Ch : Not required	No
5	PID 1Bh : Not required	No
6	PID 1Ah : Not required	No
7	PID 19h : Not required	No

Figure I.34.14: NC_MOD_2_PID_5_DIAG

NC_MOD_2_PID_5_DIAG	C_MOD_2_PID_5_DIAG	
BIT	Function	Supported
0	PID 28h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	No
1	PID 27h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	No
2	PID 26h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	No
3	PID 25h : Bank 1 Sensor 2 (Wide range O2S)	No
4	PID 24h : Bank 1 Sensor 1 (Wide range O2S)	No
5	PID 23h : Diesel fuel pressure (gauge)	**Yes**
6	PID 22h : Relative fuel pressure	No
7	PID 21h : Distance travelled while MIL is activated	No

Figure I.34.15: NC_MOD_2_PID_6_DIAG

NC_MOD_2_PID_6_DIAG	C_MOD_2_PID_6_DIAG	
BIT	Function	Supported
0	PID 30h : Number of warm-ups since diagnostic trouble codes cleared	No
1	PID 2Fh : Fuel Level Input	**Yes**
2	PID 2Eh : Command Evaporative Purge	**Yes**
3	PID 2Dh : EGR Error	**Yes**
4	PID 2Ch : command EGR	**Yes**
5	PID 2Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	No
6	PID 2Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	No
7	PID 29h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	No

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NC_MOD_2_PID_7_DIAG	C_MOD_2_PID_7_DIAG	
BIT	Function	Supported
0	PID 38h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	No
1	PID 37h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	No
2	PID 36h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	No
3	PID 35h : Bank 1 Sensor 2 (Wide range O2S)	No
4	PID 34h : Bank 1 Sensor 1 (Wide range O2S)	No
5	PID 33h : Barometric Pressure	**Yes**
6	PID 32h : Evap System Vapor Pressure	No
7	PID 31h : Distance since diagnostic trouble codes cleared	No

Figure I.34.16: NC_MOD_2_PID_8_DIAG

NC_MOD_2_PID_8_DIAG	C_MOD_2_PID_8_DIAG	
BIT	Function	Supported
0	PID 40h : PIDs supported ($41 - $60)	**Yes**
1	PID 3Fh : Catalyst Temperature Bank 2, Sensor 2	No
2	PID 3Eh : Catalyst Temperature Bank 1, Sensor 2	No
3	PID 3Dh : Catalyst Temperature Bank 2, Sensor 1	No
4	PID 3Ch : Catalyst Temperature Bank 1, Sensor 1	No
5	PID 3Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	No
6	PID 3Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	No
7	PID 39h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	No

Figure I.34.17: NC_MOD_2_PID_9_DIAG

NC_MOD_2_PID_9_DIAG	C_MOD_2_PID_9_DIAG	
BIT	Function	Supported
0	PID 48h : Absolute Throttle Position C	No
1	PID 47h : Absolute Throttle Position B	**Yes**
2	PID 46h : Ambient air temperature	**Yes**
3	PID -h : Relative Throttle Position	**Yes**
4	PID 44h : Commanded Equivalence Ratio	**Yes**
5	PID 43h : Absolute Load Value	**Yes**
6	PID 42h : Control module voltage	**Yes**
7	PID 41h : Monitor status this driving cycle	No

Figure I.34.18: NC_MOD_2_PID_A_DIAG

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NC_MOD_2_PID_A_DIAG		C_MOD_2_PID_A_DIAG
BIT	Function	Supported
0	PID 50h : Reserved	No
1	PID 4Fh : Reserved	No
2	PID 4Eh : Time since diagnostic trouble codes cleared	No
3	PID 4Dh : Minutes run by the engine while MIL activated	No
4	PID 4Ch : Commanded Throttle Actuator Control	**Yes**
5	PID 4Bh : Accelerator Pedal Position F	No
6	PID 4Ah : Accelerator Pedal Position E	**Yes**
7	PID 49h : Accelerator Pedal Position D	**Yes**

Figure I.34.19: NC_MOD_2_PID_B_DIAG

NC_MOD_2_PID_B_DIAG		C_MOD_2_PID_B_DIAG
BIT	Function	Supported
0	PID 58h : Reserved	No
1	PID 57h : Reserved	No
2	PID 56h : Reserved	No
3	PID 55h : Reserved	No
4	PID 54h : Reserved	No
5	PID 53h : Reserved	No
6	PID 52h : Reserved	No
7	PID 51h : Reserved	No

Figure I.34.20: NC_MOD_2_PID_C_DIAG

NC_MOD_2_PID_C_DIAG		C_MOD_2_PID_C_DIAG
BIT	Function	Supported
0	PID 60h : Reserved	No
1	PID 5Fh : Reserved	No
2	PID 5Eh : Reserved	No
3	PID 5Dh : Reserved	No
4	PID 5Ch : Reserved	No
5	PID 5Bh : Reserved	No
6	PID 5Ah : Reserved	No
7	PID 59h : Reserved	No

I.34.2.3 Supported TIDs for mode 05h

Description:

No: the TID is not supported, **Yes**: the TID is supported

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NC_MOD_5_TID_1_DIAG	C_MOD_5_TID_1_DIAG	
BIT	Function	Supported
0	TID 08h : Maximum sensor voltage for test cycle (binary) **B1S2 B2S2**	**Yes**
1	TID 07h : Minimum sensor voltage for test cycle (binary) **B1S2 B2S2**	**Yes**
2	TID 06h : Lean to rich senor switch time (binary) B1S1 B2S1	No
3	TID 05h : Rich to lean senor switch time (binary) B1S1 B2S1	No
4	TID 04h : High sensor voltage for switch time calculation (binary) B1S1 B2S1	No
5	TID 03h : Low sensor voltage for switch time calculation (binary) B1S1 B2S1	No
6	TID 02h : Lean to rich sensor threshold voltage (binary) **B1S2 B2S2**	**Yes**
7	TID 01h : Rich to lean sensor threshold voltage (binary) **B1S2 B2S2**	**Yes**

Figure I.34.21: NC_MOD_5_TID_2_DIAG

NC_MOD_5_TID_2_DIAG	C_MOD_5_TID_2_DIAG	
BIT	Function	Supported
0	TID 10h : reserved	No
1	TID 0Fh : reserved	No
2	TID 0Eh : reserved	No
3	TID 0Dh : reserved	No
4	TID 0Ch : reserved	No
5	TID 0Bh : reserved	No
6	TID 0Ah : reserved	No
7	TID 09h : reserved	No

Figure I.34.22: NC_MOD_5_TID_3_DIAG

NC_MOD_5_TID_3_DIAG	C_MOD_5_TID_3_DIAG	
BIT	Function	Supported
0	TID 18h : reserved	No
1	TID 17h : reserved	No
2	TID 16h : reserved	No
3	TID 15h : reserved	No
4	TID 14h : reserved	No
5	TID 13h : reserved	No
6	TID 12h : reserved	No
7	TID 11h : reserved	No

Figure I.34.23: NC_MOD_5_TID_4_DIAG

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NC_MOD_5_TID_4_DIAG	C_MOD_5_TID_4_DIAG	
BIT	Function	Supported
0	TID 20h : TIDs supported ($21 - $40)	**Yes**
1	TID 1Fh : reserved	No
2	TID 1Eh : reserved	No
3	TID 1Dh : reserved	No
4	TID 1Ch : reserved	No
5	TID 1Bh : reserved	No
6	TID 1Ah : reserved	No
7	TID 19h : reserved	No

Figure I.34.24: NC_MOD_5_TID_5_DIAG

NC_MOD_5_TID_5_DIAG	C_MOD_5_TID_5_DIAG	
BIT	Function	Supported
0	TID 28h : reserved	No
1	TID 27h : reserved	No
2	TID 26h : reserved	No
3	TID 25h : reserved	No
4	TID 24h : reserved	No
5	TID 23h : reserved	No
6	TID 22h : reserved	No
7	TID 21h : reserved	No

Figure I.34.25: NC_MOD_5_TID_6_DIAG

NC_MOD_5_TID_6_DIAG	C_MOD_5_TID_6_DIAG	
BIT	Function	Supported
0	TID 30h : Reserved	No
1	TID 2Fh : Reserved	No
2	TID 2Eh : Reserved	No
3	TID 2Dh : Reserved	No
4	TID 2Ch : Reserved	No
5	TID 2Bh : Reserved	No
6	TID 2Ah : Reserved	No
7	TID 29h : Reserved	No

Figure I.34.26: NC_MOD_5_TID_7_DIAG

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NC_MOD_5_TID_7_DIAG	C_MOD_5_TID_7_DIAG	
BIT	Function	Supported
0	TID 38h : Reserved	No
1	TID 37h : Reserved	No
2	TID 36h : Reserved	No
3	TID 35h : Reserved	No
4	TID 34h : Reserved	No
5	TID 33h : Reserved	No
6	TID 32h : Reserved	No
7	TID 31h : Reserved	No

Figure I.34.27: NC_MOD_5_TID_8_DIAG

NC_MOD_5_TID_8_DIAG	C_MOD_5_TID_8_DIAG	
BIT	Function	Supported
0	TID 40h : TIDs supported ($41 - $60)	**Yes**
1	TID 3Fh : Reserved	No
2	TID 3Eh : Reserved	No
3	TID 3Dh : Reserved	No
4	TID 3Ch : Reserved	No
5	TID 3Bh : Reserved	No
6	TID 3Ah : Reserved	No
7	TID 39h : Reserved	No

Figure I.34.28: NC_MOD_5_TID_9_DIAG

NC_MOD_5_TID_9_DIAG	C_MOD_5_TID_9_DIAG	
BIT	Function	Supported
0	TID 48h : Reserved	No
1	TID 47h : Reserved	No
2	TID 46h : Reserved	No
3	TID -h : Reserved	No
4	TID 44h : Reserved	No
5	TID 43h : Reserved	No
6	TID 42h : Reserved	No
7	TID 41h : Reserved	No

Figure I.34.29: NC_MOD_5_TID_10_DIAG

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NC_MOD_5_TID_10_DIAG	C_MOD_5_TID_10_DIAG	
BIT	Function	Supported
0	TID 50h : Reserved	No
1	TID 4Fh : Reserved	No
2	TID 4Eh : Reserved	No
3	TID 4Dh : Reserved	No
4	TID 4Ch : Reserved	No
5	TID 4Bh : Reserved	No
6	TID 4Ah : Reserved	No
7	TID 49h : Reserved	No

Figure I.34.30: NC_MOD_5_TID_11_DIAG

NC_MOD_5_TID_11_DIAG	C_MOD_5_TID_11_DIAG	
BIT	Function	Supported
0	TID 58h : Reserved	No
1	TID 57h : Reserved	No
2	TID 56h : Reserved	No
3	TID 55h : Reserved	No
4	TID 54h : Reserved	No
5	TID 53h : Reserved	No
6	TID 52h : Reserved	No
7	TID 51h : Reserved	No

Figure I.34.31: NC_MOD_5_TID_12_DIAG

NC_MOD_5_TID_12_DIAG	C_MOD_5_TID_12_DIAG	
BIT	Function	Supported
0	TID 60h : TIDs supported ($61 - $80)	**Yes**
1	TID 5Fh : Reserved	No
2	TID 5Eh : Reserved	No
3	TID 5Dh : Reserved	No
4	TID 5Ch : Reserved	No
5	TID 5Bh : Reserved	No
6	TID 5Ah : Reserved	No
7	TID 59h : Reserved	No

Figure I.34.32: NC_MOD_5_TID_13_DIAG

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NC_MOD_5_TID_13_DIAG	C_MOD_5_TID_13_DIAG	
BIT	Function	Supported
0	TID 68h : Reserved	No
1	TID 67h : Reserved	No
2	TID 66h : Reserved	No
3	TID 65h : Reserved	No
4	TID 64h : Reserved	No
5	TID 63h : Reserved	No
6	TID 62h : Reserved	No
7	TID 61h : Reserved	No

Figure I.34.33: NC_MOD_5_TID_14_DIAG

NC_MOD_5_TID_14_DIAG	C_MOD_5_TID_14_DIAG	
BIT	Function	Supported
0	TID 70h : Reserved	No
1	TID 6Fh : Reserved	No
2	TID 6Eh : Reserved	No
3	TID 6Dh : Reserved	No
4	TID 6Ch : Reserved	No
5	TID 6Bh : Reserved	No
6	TID 6Ah : Reserved	No
7	TID 69h : Reserved	No

Figure I.34.34: NC_MOD_5_TID_15_DIAG

NC_MOD_5_TID_15_DIAG	C_MOD_5_TID_15_DIAG	
BIT	Function	Supported
0	TID 78h : Reserved	No
1	TID 77h : Reserved	No
2	TID 76h : Reserved	No
3	TID 75h : Reserved	No
4	TID 74h : Reserved	No
5	TID 73h : Reserved	No
6	TID 72h : Reserved	No
7	TID 71h : Reserved	No

Figure I.34.35: NC_MOD_5_TID_16_DIAG

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NC_MOD_5_TID_16_DIAG	C_MOD_5_TID_16_DIAG	
BIT	Function	Supported
0	TID 80h : TIDs supported ($81 - $A0)	**Yes**
1	TID 7Fh : Reserved	No
2	TID 7Eh : Reserved	No
3	TID 7Dh : Reserved	No
4	TID 7Ch : Reserved	No
5	TID 7Bh : Reserved	No
6	TID 7Ah : Reserved	No
7	TID 79h : Reserved	No

Figure I.34.36: NC_MOD_5_TID_17_DIAG

NC_MOD_5_TID_17_DIAG	C_MOD_5_TID_17_DIAG	
BIT	Function	Supported
0	TID 88h : not defined	No
1	TID 87h : not defined	No
2	TID 86h : not defined	No
3	TID 85h : not defined	No
4	TID 84h : Fuel trim diagnosis	**Yes**
5	TID 83h : Dynamic diagnosis	**Yes**
6	TID 82h : A/F setpoint linear	**Yes**
7	TID 81h : Measured A/F ratio linear	**Yes**

Figure I.34.37: NC_MOD_5_TID_18_DIAG

NC_MOD_5_TID_18_DIAG	C_MOD_5_TID_18_DIAG	
BIT	Function	Supported
0	TID 90h : Reserved	No
1	TID 8Fh : Reserved	No
2	TID 8Eh : Reserved	No
3	TID 8Dh : Reserved	No
4	TID 8Ch : Reserved	No
5	TID 8Bh : Reserved	No
6	TID 8Ah : Reserved	No
7	TID 89h : Reserved	No

Figure I.34.38: NC_MOD_5_TID_19_DIAG

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NC_MOD_5_TID_19_DIAG	C_MOD_5_TID_19_DIAG	
BIT	Function	Supported
0	TID 98h : Reserved	No
1	TID 97h : Reserved	No
2	TID 96h : Reserved	No
3	TID 95h : Reserved	No
4	TID 94h : Reserved	No
5	TID 93h : Reserved	No
6	TID 92h : Reserved	No
7	TID 91h : Reserved	No

Figure I.34.39: NC_MOD_5_TID_20_DIAG

NC_MOD_5_TID_20_DIAG	C_MOD_5_TID_20_DIAG	
BIT	Function	Supported
0	TID A0h : TIDs supported ($A1 - $C0)	No
1	TID 9Fh : Reserved	No
2	TID 9Eh : Reserved	No
3	TID 9Dh : Reserved	No
4	TID 9Ch : Reserved	No
5	TID 9Bh : Reserved	No
6	TID 9Ah : Reserved	No
7	TID 99h : Reserved	No

I.34.2.4 Supported TIDs for Mode 06h

Description:

No: the TID is not supported
Yes: the TID is supported

NC_MOD_6_TID_1_DIAG	C_MOD_6_TID_1_DIAG	
BIT	Function	Supported
0	TID 08h : Reserved	No
1	TID 07h : Reserved	No
2	TID 06h : Oxygen sensor heater	**Yes**
3	TID 05h : Evaproative monitor	**Yes**
4	TID 04h : Reserved	No
5	TID 03h : Secondary air monitor	**Yes**
6	TID 02h : Oxygen sensor monitor	**Yes**
7	TID 01h : Catalyst monitor	**Yes**

Figure I.34.40: NC_MOD_6_TID_2_DIAG

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NC_MOD_6_TID_2_DIAG	C_MOD_6_TID_2_DIAG	
BIT	Function	Supported
0	TID 10h : reserved	No
1	TID 0Fh : reserved	No
2	TID 0Eh : reserved	No
3	TID 0Dh : reserved	No
4	TID 0Ch : reserved	No
5	TID 0Bh : reserved	No
6	TID 0Ah : reserved	No
7	TID 09h : reserved	No

Figure I.34.41: NC_MOD_6_TID_3_DIAG

NC_MOD_6_TID_3_DIAG	C_MOD_6_TID_3_DIAG	
BIT	Function	Supported
0	TID 18h : reserved	No
1	TID 17h : reserved	No
2	TID 16h : reserved	No
3	TID 15h : reserved	No
4	TID 14h : reserved	No
5	TID 13h : reserved	No
6	TID 12h : reserved	No
7	TID 11h : reserved	No

Figure I.34.42: NC_MOD_6_TID_4_DIAG

NC_MOD_6_TID_4_DIAG	C_MOD_6_TID_4_DIAG	
BIT	Function	Supported
0	TID 20h : TIDs supported ($21 - $40)	No
1	TID 1Fh : reserved	No
2	TID 1Eh : reserved	No
3	TID 1Dh : reserved	No
4	TID 1Ch : reserved	No
5	TID 1Bh : reserved	No
6	TID 1Ah : reserved	No
7	TID 19h : reserved	No

I.34.2.5 Supported TIDs for Mode 08h (not supported yet)

I.34.2.6 Supported VITs for Mode 09h

Description:

No: the VIT is not supported, **Yes**: the VIT is supported

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NC_MOD_9_VIT_1_DIAG		C_MOD_9_VIT_1_DIAG
BIT	Function	Supported
0	VIT 08h : In-Use Performance Tracking	**Yes**
1	VIT 07h : Message Count IPT	**Yes**
2	VIT 06h : Calibration Verification Numbers	**Yes**
3	VIT 05h : Number of response for Calibration Verification Numbers	**Yes**
4	VIT 04h : Calibration IDs	**Yes**
5	VIT 03h : Number of response for Calibration IDs	**Yes**
6	VIT 02h : Vehicle Identification Number	**Yes**
7	VIT 01h : Number of response for Vehicle Identification Number	**Yes**

Figure I.34.43: NC_MOD_9_VIT_2_DIAG

NC_MOD_9_VIT_2_DIAG		C_MOD_9_VIT_2_DIAG
BIT	Function	Supported
0	VIT 10h : Reserved	No
1	VIT 0Fh : Reserved	No
2	VIT 0Eh : Reserved	No
3	VIT 0Dh : Reserved	No
4	VIT 0Ch : Reserved	No
5	VIT 0Bh : Reserved	No
6	VIT 0Ah : Reserved	No
7	VIT 09h : Reserved	No

Figure I.34.44: NC_MOD_9_VIT_3_DIAG

NC_MOD_9_VIT_3_DIAG		C_MOD_9_VIT_3_DIAG
BIT	Function	Supported
0	VIT 18h : Reserved	No
1	VIT 17h : Reserved	No
2	VIT 16h : Reserved	No
3	VIT 15h : Reserved	No
4	VIT 14h : Reserved	No
5	VIT 13h : Reserved	No
6	VIT 12h : Reserved	No
7	VIT 11h : Reserved	No

Figure I.34.45: NC_MOD_9_VIT_4_DIAG

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NC_MOD_9_VIT_4_DIAG	C_MOD_9_VIT_4_DIAG	
BIT	Function	Supported
0	VIT 20h : VITs supported ($21 - $40)	No
1	VIT 1Fh : Reserved	No
2	VIT 1Eh : Reserved	No
3	VIT 1Dh : Reserved	No
4	VIT 1Ch : Reserved	No
5	VIT 1Bh : Reserved	No
6	VIT 1Ah : Reserved	No
7	VIT 19h : Reserved	No

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I.35 InfoType description for mode 09h

Input data:

MOD_9_VIT_1_DIAG {p. 7833}	MOD_9_VIT_2_DIAG {p. 7833}	MOD_9_VIT_3_DIAG {p. 7833}	MOD_9_VIT_4_DIAG {p. 7833}

I.35.1 Description of Mode 09h, VIT 00h - All supported VITs

VIT 00h - DATA A - Supported VIT 01h to 08h		
BIT	**Function**	**name**
0	VIT 08h : In-Use Performance Tracking	MOD_9_VIT_1_DIAG
1	VIT 07h : Message Count IPT	
2	VIT 06h : Calibration Verification Numbers	
3	VIT 05h : Number of response for Calibration Verification Numbers	
4	VIT 04h : Calibration IDs	
5	VIT 03h : Number of response for Calibration IDs	
6	VIT 02h : Vehicle Identification Number	
7	VIT 01h : Number of response for Vehicle Identification Number	
VIT 00h - DATA B - Supported VIT 09h to 10h		
BIT	**Function**	**name**
0	VIT 10h : reserved	MOD_9_VIT_2_DIAG
1	VIT 0Fh : reserved	
2	VIT 0Eh : reserved	
3	VIT 0Dh : reserved	
4	VIT 0Ch : reserved	
5	VIT 0Bh : reserved	
6	VIT 0Ah : reserved	
7	VIT 09h : reserved	
VIT 00h - DATA C - Supported VIT 11h to 18h		
BIT	**Function**	**name**
0	VIT 18h : reserved	MOD_9_VIT_3_DIAG
1	VIT 17h : reserved	
2	VIT 16h : reserved	
3	VIT 15h : reserved	
4	VIT 14h : reserved	
5	VIT 13h : reserved	
6	VIT 12h : reserved	
7	VIT 11h : reserved	
VIT 00h - DATA D - Supported VIT 19h to 20h		
BIT	**Function**	**name**
0	VIT 20h : VITs supported ($21 - $40)	MOD_9_VIT_4_DIAG
1	VIT 1Fh : reserved	
2	VIT 1Eh : reserved	
3	VIT 1Dh : reserved	
4	VIT 1Ch : reserved	
5	VIT 1Bh : reserved	
6	VIT 1Ah : reserved	
7	VIT 19h : reserved	

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I.35.2 Description of Mode 09h, VIT 01h - Messagecount VIN

I.35.3 Request vehicle information request message

Message direction:	External test equipment → All ECUs		
Message Type:	Request		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: MessageCount VIN	01	INFTYP

Positive responses (read InfoType value)

Request vehicle information response message

Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: MessageCount VIN	01	INFTYP
#3	MessageCount VIN = 5 response messages	05	MC_CALID

I.35.4 Description of Mode 09h, VIT 02h - VIN

Request vehicle information request message

Message direction:	External test equipment → All ECUs		
Message Type:	Request		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: VIN	02	INFTYP

I.35.5 Response positive report VIN

First positive response

Request vehicle information response message (1)

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Message direction:	ECU#1 → External test equipment		
Message Type:	Response		
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: VIN	02	INFTYP
#3	MessageCount VIN = 1st response message	01	MC_CALID
#4	Data A: Pad-byte	00	byte always 0
#5	Data B: Pad-byte	00	byte always 0
#6	Data C: Pad-byte	00	byte always 0
#7	Data D:	XX*	VIN char 0

* 30h, if there is no VIN.

Second positive response

Request vehicle information response message (2)

Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: VIN	02	INFTYP
#3	MessageCount VIN = 2nd response message	02	MC_CALID
#4	Data A:	XX*	VIN char 1
#5	Data B:	XX*	VIN char 2
#6	Data C:	XX*	VIN char 3
#7	Data D:	XX*	VIN char 4

* 30h, if there is no VIN.

thirth positive response

Request vehicle information response message (3)

Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: VIN	02	INFTYP
#3	MessageCount VIN = 3rd response message	03	MC_CALID
#4	Data A:	XX*	VIN char 5
#5	Data B:	XX*	VIN char 6
#6	Data C:	XX*	VIN char 7
#7	Data D:	XX*	VIN char 8

* 30h, if there is no VIN

forth positive response

Request vehicle information response message (4)

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Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: VIN	02	INFTYP
#3	MessageCount VIN = 4nd response message	04	MC_CALID
#4	Data A:	XX*	VIN char 9
#5	Data B:	XX*	VIN char 10
#6	Data C:	XX*	VIN char 11
#7	Data D:	XX*	VIN char 12

* 30h, if there is no VIN

fifth positive response

Request vehicle information response message (5)

Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: VIN	02	INFTYP
#3	MessageCount VIN = 5nd response message	05	MC_CALID
#4	Data A:	XX*	VIN char 13
#5	Data B:	XX*	VIN char 14
#6	Data C:	XX*	VIN char 15
#7	Data D:	XX*	VIN char 16

* 30h, if there is no VIN

I.35.6 Description of Mode 09h, VIT 03h - Messagecount Calibration IDs

I.35.7 Request vehicle information request message

Message direction:	External test equipment → All ECUs		
Message Type:	Request		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: MessageCount Calibration Id	03	INFTYP

Positive responses (read InfoType value)

Request vehicle information response message

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Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: MessageCount Calibration Id	03	INFTYP
#3	MessageCount Calibration Id = 8 response messages	08	MC_CALID

I.35.8 Description of Mode 09h, VIT 04h - Calibration IDs

Request vehicle information request message

Message direction:	External test equipment → All ECUs		
Message Type:	Request		
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: Calibration Id	04	INFTYP

I.35.9 Response positive report Calibration ID

First positive response

Request vehicle information response message (1)

Message direction:	ECU#1 → External test equipment		
Message Type:	Response		
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INFTYP
#3	MessageCount Calibration Id = 1st response message	01	MC_CALID
#4	Data A: SW version number char 1	NC_BMW_HW_NR_3 *or 30	second digit in BCD
#5	Data B: SW version number char 2	NC_BMW_HW_NR_4 *or 30	first digit in BCD
#6	Data C: SW version number char 3	NC_BMW_HW_NR_4 *or 30	second digit in BCD
#7	Data D: SW version number char 4	NC_BMW_HW_NR_5 *or 30	first digit in BCD

* 30h, if there is no HW_NR.

Second positive response

Request vehicle information response message (2)

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Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INFTYP
#3	MessageCount Calibration Id = 2nd response message	02	MC_CALID
#4	Data A: SW version number char 5	NC_BMW_HW_NR_5 *or 30	second digit in BCD
#5	Data B: SW version number char 6	NC_BMW_HW_NR_6 *or 30	first digit in BCD
#6	Data C: SW version number char 7	NC_BMW_HW_NR_6 *or 30	second digit in BCD
#7	Data D: Pad-Byte	00	byte always 0

* 30h, if there is no HW_NR.

thirth positive response

Request vehicle information response message (3)

Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INFTYP
#3	MessageCount Calibration Id = 3rd response message	03	MC_CALID
#4	Data A: Pad-Byte	00	byte always 0
#5	Data B: Pad-Byte	00	byte always 0
#6	Data C: Pad-Byte	00	byte always 0
#7	Data D: Pad-Byte	00	byte always 0

forth positive response

Request vehicle information response message (4)

Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INFTYP
#3	MessageCount Calibration Id = 4nd response message	04	MC_CALID
#4	Data A: Pad-Byte	00	byte always 0
#5	Data B: Pad-Byte	00	byte always 0
#6	Data C: Pad-Byte	00	byte always 0
#7	Data D: Pad-Byte	00	byte always 0

fifth positive response

Request vehicle information response message (5)

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Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INFTYP
#3	MessageCount Calibration Id = 5nd response message	05	MC_CALID
#4	Data A: Calibration version number char 1	CAL_NR_3 or 30*	second digit in BCD
#5	Data B: Calibration version number char 2	CAL_NR_4 or 30 *	first digit in BCD
#6	Data C: Calibration version number char 3	CAL_NR_4 or 30 *	second digit in BCD
#7	Data D: Calibration version number char 4	CAL_NR_5 or 30 *	first digit in BCD

* if no CAL_NR in software;

sixth positive response

Request vehicle information response message (6)

Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INFTYP
#3	MessageCount Calibration Id = 6nd response message	06	MC_CALID
#4	Data A: Calibration version number char 5	CAL_NR_5 or 30 *	second digit in BCD
#5	Data B: Calibration version number char 6	CAL_NR_6 or 30 *	first digits in BCD
#6	Data C: Calibration version number char 7	CAL_NR_6 or 30 *	second digit in BCD
#7	Data D: Pad-Byte	00	byte always 0

* if no CAL_NR in software;

seventh positive response

Request vehicle information response message (7)

Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INFTYP
#3	MessageCount Calibration Id = 7nd response message	07	MC_CALID
#4	Data A: Pad-Byte	00	byte always 0
#5	Data B: Pad-Byte	00	byte always 0
#6	Data C: Pad-Byte	00	byte always 0
#7	Data D: Pad-Byte	00	byte always 0

eight positive response

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Request vehicle information response message (8)

Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INFTYP
#3	MessageCount Calibration Id = 8nd response message	08	MC_CALID
#4	Data A: Pad-Byte	00	byte always 0
#5	Data B: Pad-Byte	00	byte always 0
#6	Data C: Pad-Byte	00	byte always 0
#7	Data D: Pad-Byte	00	byte always 0

I.35.10 Description of Mode 09h, VIT 05h - Messagecount Calibration verification numbers

Request vehicle information request message

Message direction:	External test equipment → All ECUs		
Message Type:	Request		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: MessageCount Calibration Verification Number	05	INFTYP

Positive responses (read InfoType value)

Request vehicle information response message

Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: MessageCount Calibration Verification Number	05	INFTYP
#3	MessageCount Calibration Verification Number = 2 response messages	02	MC_CVN

I.35.11 Description of Mode 09h, VIT 06h - Calibration verification numbers

The on-board software will calculate the CVN (CRC) based on memory content in a cyclic way.
The result will be stored non volatile. That means the previous value will be available till a new one is calculated.
At first initialisation of ECU no CVN is available till first one is calculated (app. 1min).

Request vehicle information request message (read InfoType values)

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Data Byte	Parameter Name	Hex Value	Mnemonic
#1	**Request vehicle information request SID**	**09**	**SIDRQ**
#2	InfoType (read InfoType values)	06	INFTYP

I.35.11.1 Response positive report calibration verification number

First positive response

Request vehicle information response message (1)

Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Verification Number	06	INFTYP
#3	MessageCount Calibration Verification Number = 1st response message	01	MC_CVN
#4	Data A: MSB CRC-32 Application SW	MSB (CKS_CRC_ECU)	DATA_A
#5	Data B: ...	M_H (CKS_CRC_ECU)	DATA_B
#6	Data C: ...	M_L (CKS_CRC_ECU)	DATA_C
#7	Data D: LSB CRC-32 Application SW	LSB (CKS_CRC_ECU)	DATA_D

Second positive response

Request vehicle information response message (2)

Message direction:	ECU#1 → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Verification Number	06	INFTYP
#3	MessageCount Calibration Verification Number = 2nd response message	02	MC_CVN
#4	Data A: MSB CRC-32 Calibration data	MSB (CKS_CRC_CAL)	DATA_A
#5	Data B: ...	M_H (CKS_CRC_CAL)	DATA_B
#6	Data C: ...	M_L (CKS_CRC_CAL)	DATA_C
#7	Data D: LSB CRC-32 Calibration data	LSB (CKS_CRC_CAL)	DATA_D

I.35.12 Description of Mode 09h, InfoType 07h - MessageCount IPT

Request vehicle information request message

Message direction:	External test equipment → All ECUs		
Message Type:	Request		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: MessageCount IPT	07	INFTYP

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Positive responses (read InfoType value)

Request vehicle information response message

Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: MessageCount IPT	07	INFTYP
#3	Number of messages to report In-use Performance Tracking = 8 response messages	08	MC_IPT

I.35.13 Description of Mode 09h, InfoType 08h

Request vehicle information request message

Message direction:	External test equipment → All ECUs		
Message Type:	Request		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: In-use Performance Tracking	08	INFTYP

Response positive : In-use Performance Tracking

First positive response

Request vehicle information response message (1)

Message direction:	ECU#1 → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	MessageCount Calibration Id = 1st response message	01	MC_CALID
#4	Data A: MSB (OBD Monitoring Conditions Encountered Counts - general denominator)	XX	OBDCOND_A
#5	Data B: LSB (OBD Monitoring Conditions Encountered Counts Counts - general denominator)	XX	OBDCOND_B
#6	Data C: MSB (Ignition Counter)	XX	IGNCNTR_A
#7	Data D: LSB (Ignition Counter)	XX	IGNCNTR_B

Second positive response

Request vehicle information response message (2)

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Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	MessageCount Calibration Id = 2nd response message	02	MC_CALID
#4	Data A: MSB (Catalyst Monitor Completion Counts Bank 1 - numerator)	XX	CATCOMP1_A
#5	Data B: LSB (Catalyst Monitor Completion Counts Bank 1 - numerator)	XX	CATCOMP1_B
#6	Data C: MSB (Catalyst Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	CATCOND1_A
#7	Data D: LSB (Catalyst Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	CATCOND1_B

Thirth positive response

Request vehicle information response message (3)

Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	MessageCount Calibration Id = 3nd response message	03	MC_CALID
#4	Data A: MSB (Catalyst Monitor Completion Counts Bank 2 - numerator)	XX	CATCOMP2_A
#5	Data B: LSB (Catalyst Monitor Completion Counts Bank 2 - numerator)	XX	CATCOMP2_B
#6	Data C: MSB (Catalyst Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	CATCOND2_A
#7	Data D: LSB (Catalyst Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	CATCOND2_B

Fourth positive response

Request vehicle information response message (1)

Message direction:	ECU#1 → External test equipment		
Message Type:	Response		
Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)	Mnemonic
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	MessageCount Calibration Id = 4th response message	04	MC_CALID
#4	Data A: MSB (O2 Sensor Monitor Completion Counts Bank 1 - numerator)	XX	O2SCOMP1_A
#5	Data B: LSB (O2 Sensor Monitor Completion Counts Bank 1 - numerator)	XX	O2SCOMP1_B
#6	Data C: MSB (O2 Sensor Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	O2SCOND1_A
#7	Data D: LSB (O2 Sensor Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	O2SCOND1_B

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Fifth positive response

Request vehicle information response message (2)

Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	MessageCount Calibration Id = 5th response message	05	MC_CALID
#4	Data A: MSB (O2 Sensor Monitor Completion Counts Bank 2 - numerator)	XX	O2SCOMP2_A
#5	Data B: LSB (O2 Sensor Monitor Completion Counts Bank 2 - numerator)	XX	O2SCOMP2_B
#6	Data C: MSB (O2 Sensor Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	O2SCOND2_A
#7	Data D: LSB (O2 Sensor Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	O2SCOND2_B

Sixth positive response

Request vehicle information response message (3)

Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	MessageCount Calibration Id = 6th response message	06	MC_CALID
#4	Data A: MSB (EGR Monitor Completion Condition Counts - numerator)	XX	EGRCOMP_A
#5	Data B: LSB (EGR Monitor Completion Condition Counts - numerator)	XX	EGRCOMP_B
#6	Data C: MSB (EGR Monitor Conditions Encountered Counts - denominator)	XX	EGRCOND_A
#7	Data D: LSB (EGR Monitor Conditions Encountered Counts - denominator)	XX	EGRCOND_B

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Seventh positive response

Request vehicle information response message (4)

Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	MessageCount Calibration Id = 7th response message	07	MC_CALID
#4	Data A: MSB (AIR Monitor Completion Condition Counts (Secondary Air) - numerator)	XX	AIRCOMP_A
#5	Data B: LSB (AIR Monitor Completion Condition Counts (Secondary Air) - numerator)	XX	AIRCOMP_B
#6	Data C: MSB (AIR Monitor Conditions Encountered Counts (Secondary Air) - denominator)	XX	AIRCOND_A
#7	Data D: LSB (AIR Monitor Conditions Encountered Counts (Secondary Air) - denominator)	XX	AIRCOND_B

Eighth positive response

Request vehicle information response message (4)

Message direction:	ECU → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	MessageCount Calibration Id = 8th response message	08	MC_CALID
#4	Data A: MSB (EVAP Monitor Completion Condition Counts - numerator)	XX	EVAPCOMP_A
#5	Data B: LSB (EVAP Monitor Completion Condition Counts - numerator)	XX	EVAPCOMP_B
#6	Data C: MSB (EVAP Monitor Conditions Encountered Counts - denominator)	XX	EVAPCOND_A
#7	Data D: LSB (EVAP Monitor Conditions Encountered Counts - denominator)	XX	EVAPCOND_B

Formula section:

ACTION_ERRM_SelectRbmData (
INOUT < ListRbmData >,
OUT < ResultRbmData >
)

Call **APIACTION_ERRM_SelectRbmData**
Send positive(s) response(s)

ListRbmData : Software structure filled-up with 16 counters of 2 bytes coming from Rate-Based Monitoring

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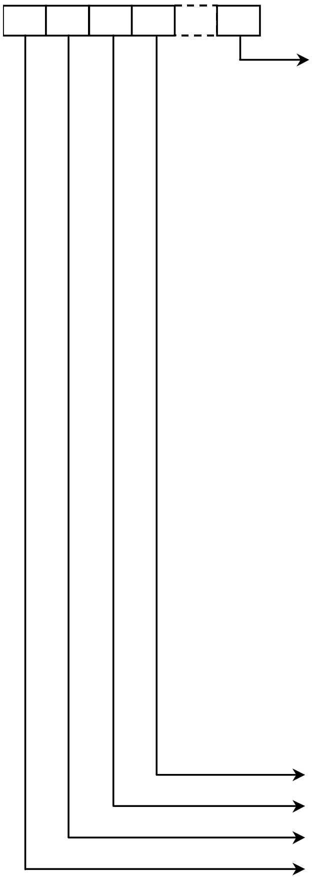

EVAP Monitor Conditions Encountered Counts (denominator - LSB byte)
EVAP Monitor Conditions Encountered Counts (denominator - MSB byte)
EVAP Monitor Completion Condition Counts (numerator - LSB byte)
EVAP Monitor Completion Condition Counts (numerator - MSB byte)
AIR Monitor Conditions Encountered Counts (denominator - LSB byte)
AIR Monitor Conditions Encountered Counts (denominator - MSB byte)
AIR Monitor Completion Condition Counts (numerator - LSB byte)
AIR Monitor Completion Condition Counts (numerator - MSB byte)
EGR Monitor Conditions Encountered Counts (denominator - LSB byte)
EGR Monitor Conditions Encountered Counts (denominator - MSB byte)
EGR Monitor Completion Condition Counts (numerator - LSB byte)
EGR Monitor Completion Condition Counts (numerator - MSB byte)
O2 Sensor Monitor Conditions Encountered Counts Bank 2 (denominator - LSB byte)
O2 Sensor Monitor Conditions Encountered Counts Bank 2 (denominator - MSB byte)
O2 Sensor Monitor Completion Counts Bank 2 (numerator - LSB byte)
O2 Sensor Monitor Completion Counts Bank 2 (numerator - MSB byte)
O2 Sensor Monitor Conditions Encountered Counts Bank 1 (denominator - LSB byte)
O2 Sensor Monitor Conditions Encountered Counts Bank 1 (denominator - MSB byte)
O2 Sensor Monitor Completion Counts Bank 1 (numerator - LSB byte)
O2 Sensor Monitor Completion Counts Bank 1 (numerator - MSB byte)
Catalyst Monitor Conditions Encountered Counts Bank 2 (denominator - LSB byte)
Catalyst Monitor Conditions Encountered Counts Bank 2 (denominator - MSB byte)
Catalyst Monitor Completion Counts Bank 2 (numerator - LSB byte)
Catalyst Monitor Completion Counts Bank 2 (numerator - MSB byte)
Catalyst Monitor Conditions Encountered Counts Bank 1 (denominator - LSB byte)
Catalyst Monitor Conditions Encountered Counts Bank 1 (denominator - MSB byte)
Catalyst Monitor Completion Counts Bank 1 (numerator - LSB byte)
Catalyst Monitor Completion Counts Bank 1 (numerator - MSB byte)
Ignition Counter (LSB byte)
Ignition Counter (MSB byte)
OBD Monitoring Conditions Encountered Counts (general denominator - LSB byte)
OBD Monitoring Conditions Encountered Counts (general denominator - MSB byte)

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I.36 Mode $04 - Clear Reset Emission Related Diag Information

I.36.1 Functional description

The purpose of this service is to provide a means for the diagnostic tool to command on-board ECM to clear the whole failure memory (all emission-related and non emission-related diagnostic information) (See Error Management specification).

Request message

Bytes	Parameter name	Hex value
#01	**Request to clear/reset emission-related diagnostic information**	**04**

The ECM shall respond to this service request with ignition ON and the engine not running and ECM not locked by immobylizer. ECUs that cannot perform this operation under other conditions, such as with the engine running, shall respond negatively with condition not correct.

Formula section

ACTION_ERRM_ClrInfoByTypeOfDtc
(
IN <ALL>
OUT <ResultClrInfo>
)

IF ResultClrInfo = INFO_CLEARED **THEN**
Positive response
ELSE
Negative response with "Condition not correct"
ENDIF

Refer to Error Management module

Example :

1. Clear number of emission-related diagnostic trouble codes stored (Mode 01h, PID 01h)
2. Clear emission-related diagnostic trouble codes (Mode 03h)
3. Clear emission-related diagnostic trouble code for the freeze frame data (Mode 01h, PID 02h)
4. Clear freeze frame data of the failure (Mode 02h)
5. Reset status of system monitoring tests (Mode 01h, PID 01h - Readiness code)
6. Clear on board monitoring test results for continuously monitored systems (Mode 07h)
7. Clear distance travelled while MIL is activated (Mode 01h, PID 21h)
8. Clear on-board monitoring test results for non-continuously monitored systems (Mode 06h)
9. Clear the LV_READY_XXX (inhibition of the result)

Positive response message

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Bytes	Parameter name	Hex value
#01	**Request to clear/reset emission-related diagnostic information positive response**	**44**

Negative response message

Bytes	Parameter name	Hex value
#1	**Negative response**	**7F**
#2	**Request to clear/reset emission-related diagnostic information**	**04**
#3	Error code = Service not supported Sub function not supported - Invalid format Condition not correct	11 12 22

Error code

Error code	Cause
Condition not correct	Engine running ECU locked by immobilizer
Service not supported	The requested mode is not supported (vehicle is not an EOBD or OBD2 system)
Sub function not supported - Invalid format	The length of the request is incorrect

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I.37 Mode $05 - Request Oxygen Sensor Monitoring Test Results

Input data:

LV_READY_XXX			

I.37.1 Functional description

The purpose of this service is to allow access to the on-board oxygen sensor monitoring test results. The same information may be obtained by the use of service $06.
The request message for test results includes a Test ID value that indicates the information requested.

Many methods may be used to calculate test results for this service by different manufacturers. If data values are to be reported using these messages that are different from those specified, ranges of test values have been assigned that can be used which have standard units of measure. The external test equipment can convert these values and display them in the standard units.

The ECU will respond to this message by transmitting the requested test data last determined by the system. The latest test results are to be retained, even over multiple ignition OFF cycles, until replaced by more recent test results. Test results are requested by Test ID.

Not all test values are applicable or supported by all vehicles. An optional feature of this service is for the ECU to indicate which Test IDs are supported. Test ID $00 is a bit-encoded value that indicates support for Test IDs from $01 to $20. Test ID $20 indicates support for Test IDs $21 through $40, etc. This is the same concept as used for PID support in services $01 and $02 as specified

If Test ID $00 is not supported, then the ECU does not use this feature to indicate Test ID support.

I.37.2 Message data bytes

I.37.2.1 Request oxygen sensor monitoring test results request message definition (read supported TIDs)

Request oxygen sensor monitoring test results request message (read supported TIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request oxygen sensor monitoring test results request SID**	**M**	**05**	**SIDRQ**
#2	Test ID	M	00-20-40-60-80-A0-C0-E0	TID
#3	O2 Sensor #	M	xx	O2SNO

I.37.2.2 Request oxygen sensor monitoring test results response message definition (report supported TIDs)

Request oxygen sensor monitoring test results response message (report supported TIDs)

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Data Byte	Parameter Name		Cvt	Hex Value	Mnemonic
#1	**Request oxygen sensor monitoring test results response SID**		**M**	**-**	**SIDPR**
#2	Test ID		M	00-20-40-60-80-A0-C0-E0	TID
#3	O2 Sensor #		M	xx	O2SNO
#4 #5 #6 #7	data record of supported Test IDs = [	Data A: supported Test IDs, Data B: supported Test IDs, Data C: supported Test IDs, Data D: supported Test IDs]	M M M M	xx xx xx xx	DATA_A DATA_B DATA_C DATA_D

I.37.2.3 Request oxygen sensor monitoring test results request message definition (read TID values)

Request oxygen sensor monitoring test results request message (read TID values)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request oxygen sensor monitoring test results request SID**	**M**	**05**	**SIDRQ**
#2	Test ID	M	xx	TID
#3	O2 Sensor #	M	xx	O2SNO

I.37.2.4 Request oxygen sensor monitoring test results response message definition (report TID values)

Request oxygen sensor monitoring test results response message (report TID values)

Data Byte	Parameter Name		Cvt	Hex Value	Mnemonic
#1	**Request oxygen sensor monitoring test results response SID**		**M**	**-**	**SIDPR**
#2	TEST ID		M	xx	TID
#3	O2 Sensor #		M	xx	O2SNO
#4 #5 #6	data record of Test ID = [	Test Value Minimum Limit Maximum Limit]	M C C	xx xx xx	TESTVAL MINLIMIT MAXLIMIT
C =	Conditional — if the supported Test ID is a constant ($01 - $04) the parameters Minimum and Maximum Limit shall not be included				

I.37.3 Parameter definition

I.37.3.1 Test ID and data byte descriptions

Test ID scaling description

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Test ID	Description	Min. ($00)	Max. ($FF)	Scaling/bit
$01 $02 $03 $04 $05 $06 $07 $08 $09 $0A	Rich to lean sensor threshold voltage (constant) Lean to rich sensor threshold voltage (constant) Low sensor voltage for switch time calculation (constant) High sensor voltage for switch time calculation (constant) Rich to lean sensor switch time (calculated) Lean to rich sensor switch time (calculated) Minimum sensor voltage for test cycle (calculated) Maximum sensor voltage for test cycle (calculated) Time between sensor transitions (calculated) Sensor period (calculated)	0 V 0 V 0 V 0 V 0 s 0 s 0 V 0 V 0 s 0 s	1.275 V 1.275 V 1.275 V 1.275 V 1.02 s 1.02 s 1.275 V 1.275 V 10.2 s 10.2 s	0.005 V 0.005 V 0.005 V 0.005 V 0.004 s 0.004 s 0.005 V 0.005 V 0.04 s 0.04 s
0B	EWMA (Exponential Weighted Moving Average) misfire counts for last 10 driving cycles (calculated) Calculation: 0.1 * (current counts) + 0.9 * (previous average) Initial value for (previous average) = 0	0 count	65535 counts	1 count per bit
0C	Misfire counts for last/current driving cycles (calculated)	0 count	65535 counts	1 count per bit
$0D-$1F	reserved - to be specified by ISO			
$21-$2F $30-$3F $41-$4F $50-$5F $61-$6F $70-$7F	manufacturer Test ID description : : : : :	0 s 0 s 0 V 0 V 0 Hz 0 counts	1.02 s 10.2 s 1.275 V 12.75 V 25.5 Hz 255 counts	0.004 s 0.04 s 0.005 V 0.05 V 0.1 Hz 1 count
$81-$9F $A1-$BF $C1-$DF $E1-$FF	manufacturer Test ID description : : :	manufacturer specific values / units : : :		

I.37.3.2 Oxygen sensor location definition

The Oxygen sensor location value used in the request message shall indicate the Oxygen Sensor location as defined by PID $13 or $1D as specified in mode 1.

Oxygen sensor location description

Oxygen sensor location (one, and only one bit can be set to a 1)		
Bit	**Sensor location[1)]**	**Alternative sensor location[2)]**
0	Bank 1 - Sensor 1	Bank 1 - Sensor 1
1	Bank 1 - Sensor 2	Bank 1 - Sensor 2
2	Bank 1 - Sensor 3	Bank 2 - Sensor 1
3	Bank 1 - Sensor 4	Bank 2 - Sensor 2
4	Bank 2 - Sensor 1	Bank 3 - Sensor 1
5	Bank 2 - Sensor 2	Bank 3 - Sensor 2
6	Bank 2 - Sensor 3	Bank 4 - Sensor 1
7	Bank 2 - Sensor 4	Bank 4 - Sensor 2
[1)] If Service $01 PID $13 supported. [2)] If Service $01 PID $1D supported.		

I.37.3.3 Test result description

The following table defines the test result.

Test Result description

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Hex	# of bytes	Description
00 - FF	1	The Test Result parameter includes either a constant or a calculated value depending on the Test ID.

I.37.3.4 Minimum and Maximum Test Limit description

The following table defines Minimum and Maximum Test Limit.

Minimum and Maximum Test Limit description

Test Limit	# of bytes	Description
Minimum	1	The minimum test limit (only for calculated test result) is the minimum value to which the test result is compared. The Test Limit value is either a minimum or a maximum value to which the test results are compared. The Test Limit unsigned numeric value
Maximum	1	The maximum test limit (only for calculated test result) is the maximum value to which the test result is compared.

Results of latest mandated on-board oxygen sensor monitoring test, see figure below.

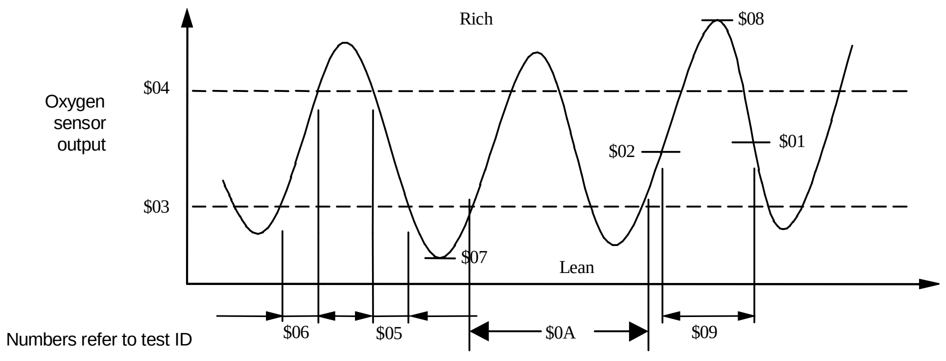

Figure I.37.1: Test ID value example

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I.38 Mode $06 - Request On Board Monit Test Results For Non Cont.-...

Input data:

LV_READY_XXX			

I.38.1 Functional description

The purpose of this service is to allow access to the results (test value and test limit) for an on-board diagnostic monitoring tests of specific components/system that are not continuously monitored.
The latest test results are to be retained, even over multiple ignition 'off' cycles, until replaced by more recent test results.

Not all TIDs are applicable or supported by all systems. Then, all ECUs must at least answer to TID 00h by sending back the list of the PIDs used.

This service can be used as an alternative to service 05h to report oxygen sensor test results.

You can find the exhaustive list of generic TIDs definition in chapter   TID description for mode 06h .
The specific list of supported TIDs for current project can be found in chapter   Emission-related software and system configuration .

Request message (read supported PIDs)

Bytes	Parameter name	Cvt	Hex value
#01	**Request on-board monitoring test results for non-continuously monitored systems**	**M**	**06**
#02	On-board diagnostic monitor ID	M	00-20-40-60-80-A0-C0-E0

Positive response (read supported PIDs)

Bytes	Parameter name	Cvt	Hex value
#01	**Request on-board monitoring test results for non-continuously monitored systems positive response**	**M**	**46**
#02	Test ID	M	00-20-40-60-80-A0-C0-E0
#03	Test limit type and component ID	M	FF
#04	Data A	M	XX
#05	Data B	M	XX
#06	Data C	M	XX
#07	Data D	M	XX

Request message (read test result)

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Bytes	Parameter name	CVT	Hex value
#01	**Request on-board monitoring test results for non-continuously monitored systems**	**M**	**06**
#02	On-board diagnostic monitor ID	M	XX

Response message (report test status)

Bytes	Parameter name		Hex value
#01	**Request on-board monitoring test results for non-continuously monitored systems positive response**	**M**	**46**
#02	Test ID	M	XX
#03	Test limit type and component ID	M	XX
#04	Test value (msb)	M	XX
#05	Test value (lsb)	M	XX
#06	Test limit (msb)	M	XX
#07	Test limit (lsb)	M	XX

Formula section:

IF LV_READY_XXX = ON **THEN**
Negative response (No result since last reset/clear)
ELSE
Positive response with test result
END

Test limit type and component ID definition

Byte #3	Value	Description
bit 0 to bit 6		Component ID - Manufacturer defined - necessary when multiple components or systems are present on the vehicle and have the same definition of test ID.
bit 7	 0 1	Most significant bit indicates type of test limit, where: Test limit is maximum value - test fails if test value is greater than this value Test limit is minimum value - test fails if test value is less than this value If the test result should be within a range of values, two messages will be returned, one with the minimum limit value and one with the maximum limit value.

Negative response message

Bytes	Parameter name	Hex value
#1	**Negative response**	7F
#2	**Request on-board monitoring test results for non-continuously monitored systems**	06
#3	Error code = Service not supported Sub function not supported - Invalid format Condition not correct	11 12 22

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I.38.1.1 Error code

Error code	Cause
Service not supported	The requested mode is not supported (vehicle is not an EOBD or OBD2 system)
Sub function not supported - Invalid format	The requested TID is not supported or the length of the request is incorrect
Condition not correct	No result since last reset/clear or Test in progress

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I.39 Mode $07 - Request On Board Monit Test Results For Cont.-...

I.39.1 Functional description

The purpose of this service is to enable the off-board test device to obtain test results for emission-related powertrain components/systems that are continuously monitored during normal driving conditions.
The intented use of this data is to assist the service technician after a vehicle repair, and after clearing diagnostic information, by reporting test results after a single driving cycle. If the test failed during the driving cycle, the DTC associated with that test will be reported. Test results reported by this service do not necessarily indicate a faulty component/system. If test results indicate a failure after additional driving, then the MIL will be illuminated and a DTC will be set and reported with Mode 03, indicating a faulty component/system. Once Service $03 indicates a faulty component/system, Service $07 may or may not continue to report it as a one-trip failure also.
If an ECU does not have stored DTCs then it shall respond with a message indicating no codes are stored by setting the parameter "Number of DTC" to 00h.

Request message

Bytes	Parameter name	CVT	Hex value
#01	**Request on-board monitoring test results for continuously monitored system**	M	07

Formula section:

ACTION_ERRM_ReadDtcByTypeOfDtc
(
IN <OBD& TEMPORARY>
IN <LAW>
INOUT <DTC1 to DTCm>
OUT <ResultDtc>
)

IF ResultDtc != NO_BUFFER_FULL
Positive response
ELSE
Negative response general reject
ENDIF

First positive response message

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Bytes	Parameter name	Hex value
#01	**Request on-board monitoring test results for continuously monitored system positive response**	47
#02	Code #1 (msb)	XX or 00
#03	Code #1 (lsb)	XX or 00
#04	Code #2 (msb)	XX or 00
#05	Code #2 (lsb)	XX or 00
#06	Code #3 (msb)	XX or 00
#07	Code #3 (lsb)	XX or 00

Next positive response message

Bytes	Parameter name	Hex value
#01	**Request on-board monitoring test results for continuously monitored system positive response**	47
#02	Code #4 (msb)	XX or 00
#03	Code #4 (lsb)	XX or 00
#04	Code #5 (msb)	XX or 00
#05	Code #5 (lsb)	XX or 00
#06	Code #6 (msb)	XX or 00
#07	Code #6 (lsb)	XX or 00

If different failures have the same stored DTC number, only one DTC number shall be reported.

The standard does not request the order in which the diagnostic trouble codes shall be transmitted.

In the case of less than 3 codes have been stored, the answer shall be completed by 0000h in order to guarantee a fixed length.

Negative response message

Bytes	Parameter name	Hex value
#1	**Negative response**	7F
#2	**Request emission-related powertrain diagnostic trouble codes**	07
#3	Error code = Service not supported Sub function not supported - Invalid format General reject	11 12 10

Error code

Error code	Cause
Service not supported	The requested mode is not supported (vehicle is not an EOBD or OBD2 system)
Sub function not supported - Invalid format	The length of the request is incorrect

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I.40 Mode $03 - Request Emission Related Diagnostic Information

I.40.1 Functional description for ISO 14 230-4

The purpose of this mode is to enable the off-board test device to obtain stored emission-related powertrain diagnostic trouble codes (DTCs).

This operation should be divided in two phases (not necessary) :

1st phase : the diagnostic tool requests the number of emission-related troubles codes (mode = 01h, PID = 01h).

If ECM does not have stored codes, then that module shall respond with a message indicating zero codes are stored.

2nd phase : the diagnostic tool requests the diagnostic troubles codes stored (mode = 03h).

If additional trouble codes are set between the time that the number of codes are reported by an ECM, and the stored codes are reported by an ECM, then the number of codes reported could exceed the number expected by the diagnostic tool. In this case the diagnostic tool should repeat this cycle until the number of codes reported equals the number expected based on the Mode 01 response.

If there is no emission-related diagnostic trouble code to report, no response is required, but for ISO 14230-4 interfaces, the module will respond with a report containing no codes. (all Codes = 00 for the response)

Request message

Bytes	Parameter name	CVT	Hex value
#01	**Request emission-related powertrain diagnostic trouble codes**	M	03

Formula section

ACTION_ERRM_ReadDtcByTypeOfDtc

(
IN <OBD & CONFIRMED>
IN <LAW>
INOUT <DTC1 to DTCm>
OUT <ResultDtc>
)

IF ResultDtc != BUFFER_FULL
Positive response
ELSE
Negative response general reject
ENDIF

First positive response message

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Bytes	Parameter name	Hex value
#01	**Request emission-related powertrain diagnostic trouble codes positive response**	43
#02	Code #1 (msb)	XX or 00
#03	Code #1 (lsb)	XX or 00
#04	Code #2 (msb)	XX or 00
#05	Code #2 (lsb)	XX or 00
#06	Code #3 (msb)	XX or 00
#07	Code #3 (lsb)	XX or 00

Next positive response if more than 3 DTC

Bytes	Parameter name	Hex value
#01	**Request emission-related powertrain diagnostic trouble codes positive response**	43
#02	Code #4 (msb)	XX or 00
#03	Code #4 (lsb)	XX or 00
#04	Code #5 (msb)	XX or 00
#05	Code #5 (lsb)	XX or 00
#06	Code #6 (msb)	XX or 00
#07	Code #6 (lsb)	XX or 00

The standard does not request the order in which the diagnostic trouble codes shall be transmitted.
In the case of less than 3 codes for a response have been stored, the answer shall be completed by 0000h in order to guarantee a fixed length.

Negative response message

Bytes	Parameter name	Hex value
#1	**Negative response**	7F
#2	**Request emission-related powertrain diagnostic trouble codes**	03
#3	Error code = Service not supported Sub function not supported - Invalid format general reject	11 12 10

Error code

Error code	Cause
Service not supported	The requested mode is not supported (vehicle is not an EOBD or OBD2 system)
Sub function not supported - Invalid format	The length of the request is incorrect

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I.41 Mode $01 - Request Current Powertrain Diagnostic

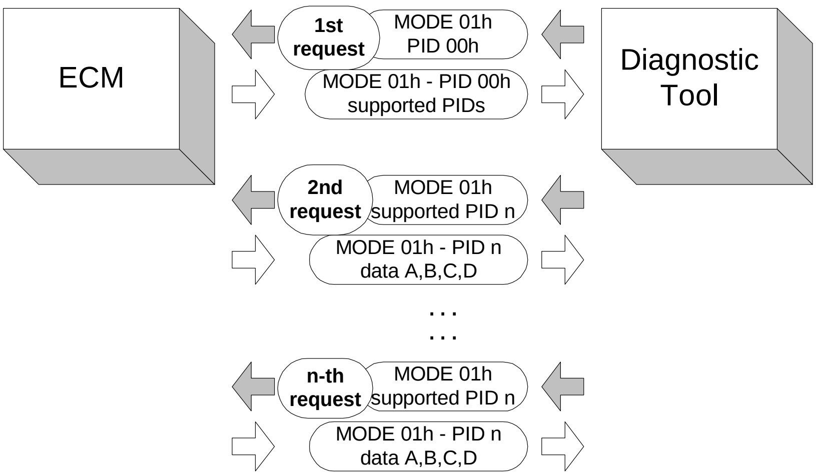
I.41.1 Functional description for ISO 14230-4

The purpose of this mode is to allow access to current emission-related data values including analog inputs and outputs, digital inputs and outputs, system status information, and calculated parameter values.

Each request contains a Parameter IDendification (PID) which indicates to the ECM the specific information to be transmitted. The information transmitted by the ECM must be the latest ones, all acquisitions shall correspond to actual measurements and not to values selected by the ECM for the limp home mode.

Not all PIDs are applicable or supported by all systems. Then, all ECUs must at least answer to PID 00h by sending back the list of the PIDs used.

You can find the exhaustive list of generic PIDs definition in chapter PID description for mode 01h . The specific list of supported PIDs can be found in chapter Emission-related software and system configuration .



Request message definition (read supported PIDs)

Byte s	Parameter name	Hex value
#01	**Request current powertrain diagnostic data**	01
#02	PID	00-20-40-60-80-A0-C0-E0

Positive reponse message definition (read supported PIDs)

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Bytes	Parameter name	Cvt	Hex value
#01	**Request current powertrain diagnostic data positive response**	M	41
#02	PID	M	00-20-40-60-80-A0-C0-E0
#03	Data A	M	XX
#04	Data B	M	XX
#05	Data C	M	XX
#06	Data D	M	XX

Request message definition (read PID value)

Bytes	Parameter name	Hex value
#01	**Request current powertrain diagnostic data**	01
#02	PID	XX

Positive response message (read PID value)

Bytes	Parameter name	Cvt	Hex value
#01	**Request current powertrain diagnostic data positive response**	M	41
#02	PID	M	XX
#03	Data A	M	XX
#04	Data B (optional)	C	XX
#05	Data C (optional)	C	XX
#06	Data D (optional)	C	XX

C =Conditional - Data B -D depend on selected PID value
M = Mandatory

Negative response message

Bytes	Parameter name	Hex value
#1	**Negative response**	7F
#2	**Request current powertrain diagnostic data**	01
#3	Error code = Service not supported Sub function not supported - Invalid format	11 12

Error code

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Error code	Cause
Service not supported	The requested mode is not supported (vehicle is not an EOBD or OBD2 system)
Sub function not supported - Invalid format	The requested PID is not supported or the length of the request is incorrect

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I.42 Mode $02 - Request Powertrain Freeze Frame Data

Import:

ACTION_ERRM_ReadFrfByDtc	**(** **IN <TypeOfFF>** **IN <FFidentifier>** **IN <DtcIdentifier>** **IN <LevelOfDTC>** **INOUT <Frf>** **OUT <ResultFrf>** **)**
This API returns a Freeze Frame related to the DTC given in parameter.	

I.42.1 Functional description for ISO 14230-4

The purpose of this mode is to allow access to emission-related data values which were stored during the freeze frame required by OBD-II regulations.

Each request contains a Parameter IDendification (PID) which indicates to the ECM the specific information to be transmitted.
The information to be transmitted is the freeze frame data which has been stored by the ECM at the failure occurrence. Like mode 01h, no limp home value shall be transmitted. The definition of the failure context is given by the frame number - in this case, we only select one failure context which is defined by the frame number 00h.

Not all PIDs are applicable or supported by all systems. Then, all ECUs must at least answer to PID 00h by sending back the list of the PIDs used.

PID 02h is the DTC that caused the freeze frame data to be stored. If freeze frame data is not stored in the ECM, the system should report 00 00h as the DTC. Any data reported when the stored DTC is 00 00h may not be valid.

You can find the exhaustive list of generic PIDs definition, scaling information, and display formats for the required freeze frame in chapter PID description for mode 02h .
The specific list of supported PIDs for current project can be found in chapter Emission-related software and system configuration .

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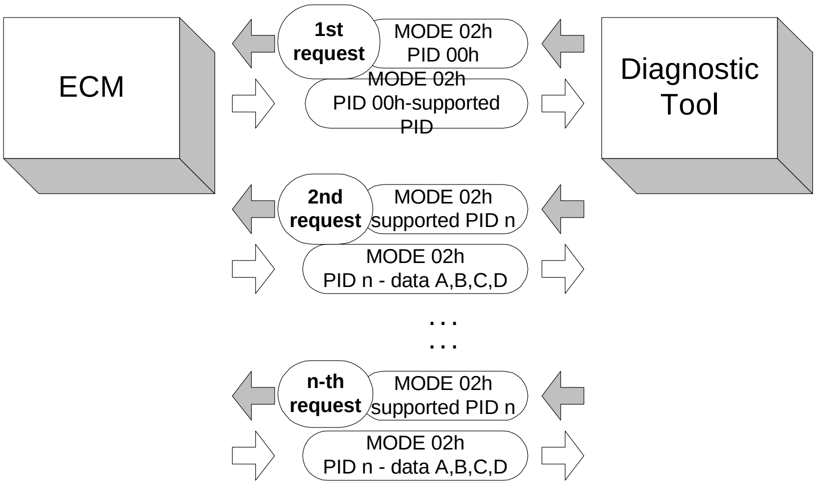

I.42.2 Message data bytes

Request message (read supported PIDs)

Bytes	Parameter name	Cvt	Hex value
#01	**Request powertrain freeze frame data**	**M**	**02**
#02	PID	M	00-20-40-60-80-A0-C0-E0
#03	Frame number	M	00

Positive response message (read supported PIDs)

Bytes	Parameter name	Cvt	Hex value
#01	**Request powertrain freeze frame data positive response**	**M**	**42**
#02	PID	M	00-20-40-60-80-A0-C0-E0
#03	Frame number	M	00
#04	Data A	M	XX
#05	Data B	M	XX
#06	Data C	M	XX
#07	Data D	M	XX

Request message (read PID value)

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Bytes	Parameter name	Cvt	Hex value
#01	**Request powertrain freeze frame data**	**M**	**02**
#02	PID	M	XX
#03	Frame number	M	00

Positive response message (read PID value)

Bytes	Parameter name	Cvt	Hex value
#01	**Request powertrain freeze frame data positive response**	**M**	**42**
#02	PID	M	XX
#03	Frame number	M	00
#04	Data A	M	XX
#05	Data B	C	XX
#06	Data C	C	XX
#07	Data D	C	XX

C = Conditional Data B -D depend on selected PID value
M = Manadatory

Negative response message

Bytes	Parameter name		Hex value
#1	**Negative response**		7F
#2	**Request current powertrain diagnostic data**		02
#3	Error code =	Service not supported	11
		Sub function not supported - Invalid format	12
		Condition not correct	22
		General reject	10

Error code

Error code	Cause
Service not supported	The requested mode is not supported (vehicle is not an EOBD or OBD2 system)
Sub function not supported - Invalid format	The requested PID is not supported The length of the request is incorrect Freeze frame number is different of 00h
Condition not correct	no freeze frame stored
General reject	Software Problem

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Formula section

ACTION_ERRM_ReadFrfByDtc

```
(
IN <LAW>
IN <FIRST>
IN <NO_DTC>
IN <LAW>
INOUT <Frf>
OUT <ResultFrf>
)
```

IF ResultFrf = BUFFER_FULL
Negative response with "General reject"
ELSE
IF ResultFrf = FRF_PRESENT **THEN**
Positive response
ELSE
IF PID = 02h **THEN**
Positive response with DTC = 0000h
ELSE
Negative response with "Condition not correct"
ENDIF
ENDIF
ENDIF

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I.43 OBDC service interpreter

Action definition

ACTION_OBDC_ReqOBDServices (<IN>,<PRM_STATE_BUF_INP>,<IN>,<PRM_STATE_LEN_INP>,<OUT>,<PRM_STATE_BUF_OUT>,<OUT>,<PRM_STATE_LEN_OUT>)	Mode: O
This action is the main interface to OBDC functionality.	

ACTION_OBDC_ReturnCode (**OUT**<PRM_STATE_COD_OBD>)	Mode: O
This action return the response code to KWP/UDS.	

ACTION_OBDC_SetMaxBuffOut (**IN**<PRM_STATE_MAX_BUF_OUT>)	Mode: O
This action set the remaining number of available bytes.	

I.43.1 ACTION_OBDC_ReqOBDServices

Description for actions:

ACTION_OBDC_ReqOBDServices (
IN < PRM_STATE_BUF_INP >,
IN < PRM_STATE_LEN_INP >,
OUT < PRM_STATE_BUF_OUT >,
OUT < PRM_STATE_LEN_OUT >)

This action is the main interface to OBDC functionality.

Parameter	Type	Hex. Limits	Phys. Limits	Resol.	Unit
PRM_STATE_BUF_INP					
See description below					
PRM_STATE_LEN_INP	U16	0..FFFF	0..65535	-	-
Number of bytes contained by PRM_STATE_BUF_INP (request length)					
PRM_STATE_BUF_OUT					
See description below					
PRM_STATE_LEN_OUT	U8	0..FF	0..255	-	-
Number of bytes contained by PRM_STATE_LEN_OUT (response length)					

FUNCTION DESCRIPTION:

General information:

This action is the entry point of the OBDC functionality.

Description:

This action will be called by the UDS/KWP.
Depending on the scan tool request, the UDS/KWP functionality calls the OBDC service interpreter. The service interpreter checks certain general conditions which are common for all the configured services. If these general conditions are true, then only the corresponding service shall be called.

Description of parameters used by ACTION_OBDC_ReqOBDServices ():

PRM_STATE_BUF_INP: Software structure filled up with the bytes of the OBD requested.

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PRM_STATE_BUF_OUT: Software structure filled up with the bytes of the OBD response.

PRM_STATE_LEN_INP: Number of bytes contained by PRM_STATE_BUF_INP (request length).

PRM_STATE_LEN_OUT: Number of bytes contained by PRM_STATE_LEN_OUT (response length).

Application conditions

Initialisation: –

Recurrence: *On scan tool request, called by KWP/ UDS*

Activation: –

Formula section:

SWITCH PRM_STATE_BUF_INP // Check the requested OBD service by the scan tool

CASE Service 01h:
Call Service 01h treatment
to fill PRM_STATE_BUF_OUT and PRM_STATE_LEN_OUT

CASE Service 02h:
Call Service 02h treatment
to fill PRM_STATE_BUF_OUT and PRM_STATE_LEN_OUT

CASE Service 03h:
Call Service 03h treatment
to fill PRM_STATE_BUF_OUT and PRM_STATE_LEN_OUT

CASE Service 04h:
Call Service 04h treatment
to fill PRM_STATE_BUF_OUT and PRM_STATE_LEN_OUT

CASE Service 06h:
Call Service 06h treatment
to fill PRM_STATE_BUF_OUT and PRM_STATE_LEN_OUT

CASE Service 07h:
Call Service 07h treatment
to fill PRM_STATE_BUF_OUT and PRM_STATE_LEN_OUT

CASE Service 08h:
Call Service 08h treatment
to fill PRM_STATE_BUF_OUT and PRM_STATE_LEN_OUT

CASE Service 09h:
Call Service 09h treatment
to fill PRM_STATE_BUF_OUT and PRM_STATE_LEN_OUT

CASE Service 0Ah:
Call Service 0Ah treatment
to fill PRM_STATE_BUF_OUT and PRM_STATE_LEN_OUT

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OTHERWISE

// Nothing to do

Negative response handling:

The only negative response allowed to be sent is CNCORSE 22h in case of conditions not fullfiled for service 04h request.

In all other cases of no positive response availability, NO RESPONSE will be sent on CAN.

I.43.2 ACTION_OBDC_ReturnCode

Description for actions:

ACTION_OBDC_ReturnCode (OUT < PRM_STATE_COD_OBD >)					
This action return the response code to KWP/UDS.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_STATE_COD_OBD	U8	0..FF	0..255	-	-
response code returned to KWP/UDS					

FUNCTION DESCRIPTION:

General information:

This action return the response code to KWP/UDS.

Description:

This action will be called by the UDS/KWP.

Depending of the treatment of OBD services, a response code is necessary to be provided to KWP/UDS.

Description of parameters used by ACTION_OBDC_ReturnCode ():

PRM_STATE_COD_OBD: Software structure filled up with the response code. This can have the values:

00h - Positive response

22h - Negative response with error code 22h

Application conditions

Initialisation: –

Recurrence: *On scan tool request, called by KWP/ UDS*

Activation: –

Formula section:

At each request set PRM_STATE_COD_OBD to one of the values above.

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I.43.3 ACTION_OBDC_SetMaxBuffOut

Description for actions:

ACTION_OBDC_SetMaxBuffOut (IN < PRM_STATE_MAX_BUF_OUT >)					
This action set the remaining number of available bytes.					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_STATE_MAX_BUF_OUT	U16	0..FFFF	0..65535	-	-
Remaining length of buffer					

FUNCTION DESCRIPTION:

General information:

This action set the remaining number of available bytes.

Description:

This action will be called by the UDS/KWP which will set the remaining number of bytes for OBD output buffer

Description of parameters used by ACTION_OBDC_SetMaxBuffOut ():

PRM_STATE_MAX_BUF_OUT: Software structure filled with the remaining number of bytes for output buffer.

Application conditions

Initialisation: –

Recurrence: `On scan tool request, called by KWP/ UDS`

Activation: –

Formula section:

At each request PRM_STATE_MAX_BUF_OUT is set by the KWP/UDS with the remaining number of bytes for output buffer.

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I.44 PID description for mode 01h

Input data:

AMP_MES {p. 1163}	C_CLC_READY_OBD_1 {p. 7833}	C_OBD_REQ {p. 7835}	CPPWM_CPS {p. 3749}
CTR_WUP_DTC_CLR {p. 5899}	DIST_ACT_MIL {p. 5899}	DIST_DTC_CLR {p. 5899}	FAC_LAM_AD_SAE [NC_CBK_EX_NR] {p. 1014}
FAC_LAM_LIM_SAE [NC_CBK_EX_NR] {p. 1014}	FUP {p. 1283}	FUP_RNG_H_MES {p. 1283}	IGA_IGC [NC_CYL_NR] {p. 1005}
IPLSL_COR [NC_CBK_EX_NR] {p. 2313}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP_SAE {p. 1015}	LOAD_ABSV {p. 5801}
LOAD_CLC {p. 5801}	MAF_KGH_MES {p. 1192}	MAP_SAE {p. 1198}	MOD_1_PID_1_DIAG {p. 7831}
MOD_1_PID_2_DIAG {p. 7831}	MOD_1_PID_3_DIAG {p. 7831}	MOD_1_PID_4_DIAG {p. 7831}	MOD_1_PID_5_DIAG {p. 7831}
MOD_1_PID_6_DIAG {p. 7831}	MOD_1_PID_7_DIAG {p. 7831}	MOD_1_PID_8_DIAG {p. 7831}	MOD_1_PID_9_DIAG {p. 7831}
MOD_1_PID_A_DIAG {p. 7831}	MOD_1_PID_B_DIAG {p. 7831}	MOD_1_PID_C_DIAG {p. 7831}	N {p. 1525}
NC_INJ_CONF {p. 626}	OBD_EGR_DIF {p. 5801}	OBD_FTL {p. 5801}	OBD_PV_1 {p. 5801}
OBD_PV_2 {p. 5801}	OBD_TAM {p. 1569}	OBD_TPS_1 {p. 5801}	OBD_TPS_2 {p. 5801}
OBD_TPS_REL {p. 5801}	OBD_TPS_SP {p. 5801}	OPG_SP_ACR {p. 3573}	PSN_LS {p. 656}
STATE_CMPL_OBD {p. 5899}	STATE_ENA_OBD {p. 5899}	STATE_LS_SAE [NC_CBK_EX_NR] {p. 2448}	STATE_OBD_SA {p. 808}
T_ACT_MIL_SAE {p. 809}	T_AST_SAE {p. 1766}	T_DTC_CLR {p. 5899}	TCO_MES {p. 1100}
TEG_CAT_DOWN_MDL {p. 8236}	TEG_CAT_UP_MDL [_i] {p. 8236}	TIA_MES {p. 1226}	VB {p. 1185}
VLS_COR_LSL [NC_CBK_EX_NR] {p. 1088}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VS {p. 1176}	

Note: This specification is according with the ISO 15031-5 issue 8.

I.44.1 Description of PID 00h - Defines Supported PIDs 01h - 20h

0 : the PID is not used

1 : the PID is used

DATA A - Supported PIDs 01h to 08h

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PID 00h - DATA A - Supported PID 01h to 08h		
BIT	**Function**	**Name**
0	PID 08h : Short term fuel trim - Bank 2	MOD_1_PID_1_DIAG
1	PID 07h : Long term fuel trim - Bank 1	
2	PID 06h : Short term fuel trim - Bank 1	
3	PID 05h : Engine coolant temperature	
4	PID 04h : Calculated load value	
5	PID 03h : Fuel system status	
6	PID 02h : Trouble code that caused required freeze frame	
7	PID 01h : DTCs and supported tests	

DATA B - Supported PIDs 09h to 10h

PID 00h - DATA B - Supported PID 09h to 10h		
BIT	**Function**	**Name**
0	PID 10h : Air flow rate from MAF sensor	MOD_1_PID_2_DIAG
1	PID 0Fh : Intake air temperature	
2	PID 0Eh : Ignition time advance	
3	PID 0Dh : Vehicle speed	
4	PID 0Ch : Engine RPM	
5	PID 0Bh : Intake manifold absolute pressure	
6	PID 0Ah : Fuel pressure (gauge)	
7	PID 09h : Long term fuel trim - Bank 2	

DATA C - Supported PIDs 11h to 18h

PID 00h - DATA C - Supported PID 11h to 18h		
BIT	**Function**	**Name**
0	PID 18h : Bank 2 Sensor 1 or Bank 3 Sensor 1	MOD_1_PID_3_DIAG
1	PID 17h : Bank 1 Sensor 4 or Bank 2 Sensor 2	
2	PID 16h : Bank 1 Sensor 3 or Bank 2 Sensor 1	
3	PID 15h : Bank 1 Sensor 2	
4	PID 14h : Bank 1 Sensor 1	
5	PID 13h : Location of oxygen sensors	
6	PID 12h : Secondary air status	
7	PID 11h : Absolute throttle position sensor	

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DATA D - Supported PIDs 19h to 20h

PID 00h - DATA D - Supported PID 19h to 20h		
BIT	**Function**	**Name**
0	PID 20h : PIDs supported ($21 - $40)	MOD_1_PID_4_DIAG
1	PID 1Fh : Time Since Engine Start	
2	PID 1Eh : Auxiliary Input Status	
3	PID 1Dh : Location of oxygen sensors	
4	PID 1Ch : OBD requirements	
5	PID 1Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2	
6	PID 1Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1	
7	PID 19h : Bank 2 Sensor 2 or Bank 3 Sensor 2	

I.44.2 Description of PID 01h - Monitor status since DTCs cleared

PID $01 definition

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PID (hex)	Description	Data byte	Scaling/bit	External test equipment SI (Metric) / English display
01	Monitor status since DTCs cleared			
	a) The bits in this PID shall report two pieces of information for each monitor: Monitor status since DTCs were last cleared, saved in NVRAM or KAM. Monitors supported on this vehicle.			
	Number of emission-related DTCs and MIL status	A (bit)	byte 1 of 4	DTC and MIL status:
	# of DTCs stored in this ECU	0-6	hex to decimal	DTC_CNT: xxxd
	Malfunction Indicator Light (MIL) Status	7	0 = MIL OFF; 1 = MIL ON	MIL: OFF or ON
	The MIL status shall indicate "OFF" during the key on, engine off bulb check unless the MIL has also been commanded "ON" for a detected malfunction.			
	Supported tests which are continuous	B (bit)	byte 2 of 4 (Low Nibble)	Support status of continuous monitors:
	Misfire monitoring	0	0 = monitor not supported (NO) 1 = monitor supported (YES)	MIS_SUP: NO or YES
	Misfire monitoring shall be supported on both, spark ignition and compression vehicles if the vehicle utilises a misfire monitor.			
	Fuel system monitoring	1	0 = monitor not supported (NO) 1 = monitor supported (YES)	FUEL_SUP: NO or YES
	Fuel system monitoring shall be supported on vehicles that utilise oxygen sensors for closed loop fuel feedback control, and utilise a fuel system monitor, typically spark ignition engines.			
	Comprehensive component monitoring	2	0 = monitor not supported (NO) 1 = monitor supported (YES)	CCM_SUP: NO or YES
	Comprehensive component monitoring shall be supported on spark ignition and compression ignition vehicles that utilise comprehensive component monitoring.			
	reserved (bit shall be reported as ‘0’)	3		---

Figure I.44.1: PID $01 definition (continued)

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PID (hex)	Description	Data byte	Scaling/bit	External test equipment SI (Metric) / English display
	Status of continuous monitoring tests since DTC cleared:	B (bit)	byte 2 of 4 (High Nibble)	Completion status of continuous monitors since DTC cleared:
	Misfire monitoring	4	0 = monitor complete, or not applicable (YES) 1 = monitor not complete (NO)	MIS_RDY: YES or NO
	Misfire monitoring shall always indicate complete for spark ignition engines. Misfire monitoring shall indicate complete for compression ignition engines after the misfire evaluation is complete.			
	Fuel system monitoring	5	0 = monitor complete, or not applicable (YES) 1 = monitor not complete (NO)	FUEL_RDY: YES or NO
	Fuel system monitoring shall always indicate complete for both spark ignition and compression ignition engines.			
	Comprehensive component monitoring	6	0 = monitor complete, or not applicable (YES) 1 = monitor not complete (NO)	CCM_RDY: YES or NO
	Comprehensive component monitoring shall always indicate complete on both spark ignition and compression ignition engines. NOTE It can be assumed that by the time any non-continuous monitors are complete, continuous comprehensive component monitoring will also be complete. Bit 6 is allowed to always indicate "complete" on spark ignition vehicles that support other non-continuous monitors.			
	reserved (bit shall be reported as ‘0’)	7		---
	Supported tests run at least once per trip	C (bit)	byte 3 of 4	Support status of non-continuous monitors:
	Catalyst monitoring	0	0 = monitor not supported (NO) 1 = monitor supported (YES)	CAT_SUP: NO or YES
	Heated catalyst monitoring	1		HCAT_SUP: NO or YES
	Evaporative system monitoring	2		EVAP_SUP: NO or YES
	Secondary air system monitoring	3		AIR_SUP: NO or YES
	A/C system refrigerant monitoring	4		ACRF_SUP: NO or YES
	Oxygen sensor monitoring	5		O2S_SUP: NO or YES
	Oxygen sensor heater monitoring	6		HTR_SUP: NO or YES
	EGR system monitoring	7		EGR_SUP: NO or YES
	Status of tests run at least once per trip	D (bit)	byte 4 of 4	Completion status of non-continuous monitors since DTCs cleared:
	Catalyst monitoring	0	0 = monitor complete, or not applicable (YES) 1 = monitor not complete (NO)	CAT_RDY: YES or NO
	Heated catalyst monitoring	1		HCAT_RDY: YES or NO
	Evaporative system monitoring	2		EVAP_RDY: YES or NO
	Secondary air system monitoring	3		AIR_RDY: YES or NO
	A/C system refrigerant monitoring	4		ACRF_RDY: YES or NO
	Oxygen sensor monitoring	5		O2S_RDY: YES or NO
	Oxygen sensor heater monitoring	6		HTR_RDY: YES or NO
	EGR system monitoring	7		EGR_RDY: YES or NO

Figure I.44.2: Data Byte

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Data Byte	Application data to use		Formating conversion used
data A	(bit 0 to 6) :	NR_DTC	-
	(bit 7) :	STATE_MIL	
data B	STATE_READY_OBD_1 *		
data C	C_STATE_READY_OBD_2		
data D	STATE_READY_OBD_2		

*) The bit 0 up to 3 of this byte is calibration value C_STATE_READY_OBD_1.
The bit 4 up to 6 of this byte indicate if the tests has been performed continuously since the reinitialization of the memorized information.

Formula section:

ACTION_ERRM_ReadQuantityOfDtc

(
IN <OBD & CONFIRMED>
IN <LAW>
INOUT <NR_DTC>
OUT <ResultQuantity>
)

ACTION_ERRM_ReadReadinessCode

(
INOUT < C_STATE_READY_OBD_2, STATE_READY_OBD_1,
STATE_READY_OBD_2>
OUT <ResultReadinessCode>
)

IF (ResultQuantity = DTC_PRESENT **OR**
ResultQuantity = NO_DTC_PRESENT) **AND**
ResultReadinessCode = POSITIVE_RESPONSE
THEN
Positive response

ELSE
No answer
ENDIF

These actions should be sent at each time we use the mode 01h PID01.
Refer to Error management module.

I.44.3 Description of PID 03h - Status of fuel system

PID $03 definition

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PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) / English display
03	Fuel system 1 status:	A (bit)	byte 1 of 2	FUELSYS1:
	(unused bits shall be reported as ‘0’; no more than one bit at a time can be set to a ‘1’ of that bank)	0	1 = Open loop - has not yet satisfied conditions to go closed loop	OL
		1	1 = Closed loop - using oxygen sensor(s) as feedback for fuel control	CL
		2	1 = Open loop due to driving conditions (e.g. power enrichment, deceleration enleanment)	OL-Drive
		3	1 = Open loop - due to detected system fault	OL-Fault
		4	1 = Closed loop, but fault with at least one oxygen sensor - may be using single oxygen sensor for fuel control	CL-Fault
		5-7	reserved (bits shall be reported as ‘0’)	---
	NOTE Fuel systems do not refer to injector banks. Fuel systems are intended to represent completely different fuel systems that can independently enter and exit closed loop fuel. Banks of injectors on a V-engine are generally not independent and share the same closed-loop enablement criteria.			
	Fuel system 2 status:	B (bit)	byte 2 of 2	FUELSYS2:
	(unused bits shall be reported as ‘0’; no more than one bit at a time can be set to a ‘1’ of that bank)	0	1 = Open loop - has not yet satisfied conditions to go closed loop	OL
		1	1 = Closed loop - using oxygen sensor(s) as feedback for fuel control	CL
		2	1 = Open loop due to driving conditions (e.g. power enrichment, deceleration enleanment)	OL-Drive
		3	1 = Open loop - due to detected system fault	OL-Fault
		4	1 = Closed loop, but fault with at least one oxygen sensor - may be using single oxygen sensor for fuel control	CL-Fault
		5-7	reserved (bits shall be reported as ‘0’)	---

IF PSN_LS = 11H **or** 33H
THEN

Data Byte	Application data to use	Formating conversion used
data A	STATE_LS_SAE [1]	no
data B	STATE_LS_SAE [2]	no

ELSE

Data Byte	Application data to use	Formating conversion used
data A	None	no
data B	None	no

ENDIF

I.44.4 Description of PID 04h - Calculated load value

PID $04 definition

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PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
04	Calculated LOAD Value!	A	0 %	100 %	100/255 %	LOAD_PCT: xxx.x %
	The OBD regulations previously defined CLV as: (current airflow / peak airflow @ sea level) * (BARO @ sea level / BARO) * 100% Various manufacturers have implemented this calculation in a variety of ways. The following definition, although a little more restrictive, will standardise and improve the accuracy the calculation. LOAD_PCT = [current airflow] / [(peak airflow at WOT@STP as a function of rpm) * (BARO/29.92) * SQRT(298/(AAT+273))] Where: STP = Standard Temperature and Pressure = 25 ^{o}C, 29.92 in Hg BARO, SQRT = square root, WOT = wide open throttle, AAT=Ambient Air Temperature and is in ^{o}C Characteristics of LOAD_PCT are: Reaches 1.0 at WOT at any altitude, temperature or rpm for both naturally aspirated and boosted engines. Indicates percent of peak available torque. Linearly correlated with engine vacuum Often used to schedule power enrichment. Compression ignition engines (diesels) shall support this PID using fuel flow in place of airflow for the above calculations. NOTE Both spark ignition and compression ignition engines shall support PID $04. See PID $43 for an additional definition of engine LOAD.					

Figure I.44.3: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	LOAD_CLC	no

I.44.5 Description of PID 05h - Engine coolant temperature

PID $05 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
05	Engine Coolant Temperature	A	-40 °C	+215 °C	1 °C with -40 °C offset	ECT: xxx °C (xxx °F)
	ECT shall display engine coolant temperature derived from an engine coolant temperature sensor or a cylinder head temperature sensor. Many diesels do not use either sensor and may substitute Engine Oil Temperature instead.					

Figure I.44.4: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	TCO_MES	Shift to different range

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I.44.6 Description of PID 06h - Short term fuel trim - Bank 1 and Bank 3

PID $06 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
06	Short Term Fuel Trim - Bank 1 (use if only 1 fuel trim value) Short Term Fuel Trim - Bank 3	A B	-100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	SHRTFT1: xxx.x % SHRTFT3: xxx.x %
	Short Term Fuel Trim Bank 1/3 shall indicate the correction being utilised by the closed loop fuel algorithm. If the fuel system is in open loop, SHRTFT1/3 shall report 0% correction. NOTE Data B shall only be included in the response message of a PID $06 if supported by the vehicle. If PID $1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 3 supported) of PID $1D if Data B of PID $06 is supported or not.					

IF PSN_LS = 11H **or** 33H
THEN

Data Byte	Application data to use	Formating conversion used
data A	FAC_LAM_LIM_SAE [1]	Shift to different range

ELSE

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	

ENDIF

I.44.7 Description of PID 07h - Long term fuel trim - Bank 1 and Bank 3

PID $07 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
07	Long Term Fuel Trim - Bank 1 (use if only 1 fuel trim value) Long Term Fuel Trim - Bank 3	A B	-100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	LONGFT1: xxx.x % LONGFT3: xxx.x %
	Fuel trim correction for Bank 1/3 stored in Non-volatile RAM or Keep-alive RAM. LONGFT shall indicate the correction being utilised by the fuel control algorithm at the time the data is requested, in both open loop and closed loop fuel control. If no correction is utilised in open loop fuel, LONGFT shall report 0% correction. If long-term fuel trim is not utilised at all by the fuel control algorithm, the PID shall not be supported. NOTE Data B shall only be included in the response message of a PID $07 if supported by the vehicle. If PID $1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 3 supported) of PID $1D if Data B of PID $07 is supported or not.					

IF PSN_LS = 33H
THEN

Data Byte	Application data to use	Formating conversion used
data A	FAC_LAM_AD_SAE [1]	-

ELSE

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Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	

ENDIF

I.44.8 Description of PID 08h - Short term fuel trim - Bank 2 and Bank 4

PID $08 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
08	Short Term Fuel Trim - Bank 2 (use if only 1 fuel trim value) Short Term Fuel Trim - Bank 4	A B	-100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	SHRTFT2: xxx.x % SHRTFT4: xxx.x %
	Short Term Fuel Trim Bank 2/4 shall indicate the correction being utilized by the closed loop fuel algorithm. If the fuel system is in open loop, SHRTFT24 shall report 0% correction. NOTE Data B shall only be included in the response message of a PID $08 if supported by the vehicle. If PID $1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 4 supported) of PID $1D if Data B of PID $08 is supported or not.					

IF PSN_LS = 11H **or** 33H
THEN

Data Byte	Application data to use	Formating conversion used
data A	FAC_LAM_LIM_SAE [2]	Shift to different range

ELSE

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	

ENDIF

I.44.9 Description of PID 09h - Long term fuel trim - Bank 2 and Bank 4

PID $09 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
09	Long Term Fuel Trim - Bank 2 (use if only 1 fuel trim value) Long Term Fuel Trim - Bank 4	A B	-100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	LONGFT2: xxx.x % LONGFT4: xxx.x %
	Fuel trim correction for Bank 2/4 stored in Non-volatile RAM or Keep-alive RAM. LONGFT shall indicate the correction being utilised by the fuel control algorithm at the time the data is requested, in both open loop and closed loop fuel control. If no correction is utilised in open loop fuel, LONGFT shall report 0% correction. If long-term fuel trim is not utilised at all by the fuel control algorithm, the PID shall not be supported. NOTE Data B shall only be included in the response message of a PID $09 if supported by the vehicle. If PID $1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 4 supported) of PID $1D if Data B of PID $09 is supported or not.					

IF PSN_LS = 33H
THEN

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Data Byte	Application data to use	Formating conversion used
data A	FAC_LAM_AD_SAE [2]	-

ELSE

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	

ENDIF

I.44.10 Description of PID 0Ah - Fuel pressure (gauge)

PID $0A definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
0A	Fuel Rail Pressure (gauge)	A	0 kPa (gauge)	765 kPa (gauge)	3 kPa per bit (gauge)	FRP: xxx kPa (xx.x psi)
	FRP shall display fuel rail pressure at the engine when the reading is referenced to atmosphere (gauge pressure).					

Figure I.44.5: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	FUP	Shift to different range

I.44.11 Description of PID 0Bh - Intake manifold absolute pressure

PID $0B definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
0B	Intake Manifold Absolute Pressure	A	0 kPa (absolute)	255 kPa (absolute)	1 kPa per bit (absolute)	MAP: xxx kPa (xx.x inHg)
	MAP shall display manifold pressure derived from a Manifold Absolute Pressure sensor, if a sensor is utilised. If a vehicle uses both a MAP and MAF sensor, both the MAP and MAF PIDs shall be supported.					

Figure I.44.6: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MAP_SAE	None

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I.44.12 Description of PID 0Ch - Engine speed

PID $0C definition

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PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
0C	Engine RPM	A , B	0 min^{-1}	16383.75 min^{-1}	¼ rpm per bit	RPM: xxxxx min^{-1}

Figure I.44.7: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB (N)	Shift to different range
data B	LSB (N)	Shift to different range

I.44.13 Description of PID 0Dh - Vehicle speed

PID $0D definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
0D	Vehicle Speed Sensor	A	0 km/h	255 km/h	1 km/h per bit	VSS: xxx km/h (xxx mph)
	VSS shall display vehicle road speed, if utilised by the control module strategy. Vehicle speed may be derived from a vehicle speed sensor, calculated by the PCM using other speed sensors, or obtained from the vehicle serial data communication bus.					

Figure I.44.8: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	VS	no

I.44.14 Description of PID 0Eh - Ignition timing advance

PID $0E definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
0E	Ignition Timing Advance for #1 Cylinder	A	-64 °	63.5 °	½ ° with 0 ° at 128	SPARKADV: xx °
	Ignition timing spark advance for #1 cylinder (not including mechanical advance)					

Figure I.44.9: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	IGA_IGC[0]	Shift to different range

I.44.15 Description of PID 0Fh - Intake air temperature

PID $0B definition

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PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
0F	Intake Air Temperature	A	-40 °C	+215 °C	1 °C with -40 °C offset	IAT: xxx °C (xxx °F)
	IAT shall display intake manifold air temperature, if utilised by the control module strategy. IAT may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.					

Figure I.44.10: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	TIA_MES	Shift to different range

I.44.16 Description of PID 10h - Air flow rate from MAF

PID $0B definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
10	Air Flow Rate from Mass Air Flow Sensor	A , B	0 g/s	655.35 g/s	0.01 g/s	MAF: xxx.xx g/s (xxxx.x lb/min)
	MAF shall display the airflow rate as measured by the MAF sensor, if a sensor is utilised.					

Figure I.44.11: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB (MAF_KGH_MES)	Kg/h into g/s
data B	LSB (MAF_KGH_MES)	Kg/h into g/s

I.44.17 Description of PID 11h - Absolute throttle position sensor

PID $0A - $11 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
11	Absolute Throttle Position	A	0 %	100 %	100/255 %	TP: xxx.x %
	Absolute throttle position (not “relative” or “learned” throttle position) shall be displayed as a normalised value, scaled from 0 to 100%. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is a 1.0 volts, TP shall display (1.0 / 5.0) = 20% at closed throttle and 50% at 2.5 volts. Throttle position at idle will usually indicate greater than 0%, and throttle position at wide open throttle will usually indicate less than 100%. For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage. NOTE See PID $- for a definition of Relative Throttle Position.					

Figure I.44.12: Data Byte

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Data Byte	Application data to use	Formating conversion used
data A	OBD_TPS_1	no

I.44.18 Description of PID 12h - Commanded secondary air status

With autolearning the value for the LV_VAR_SAP is defined to the value defined by the project

IF PID $12 supported and LV_VAR_SAP <> 0
THEN
PID $12 definition

PID (hex)	Description	Data byte	Scaling/bit	External test equipment SI (Metric) / English display
12	Commanded Secondary Air Status	A (bit)	byte 1 of 1	AIR_STAT:
	(if supported, one, and only one bit at a time can be set to a 1)	0	1 = upstream of first catalytic converter	AIR_STAT: UPS
		1	1 = downstream of first catalytic converter inlet	AIR_STAT: DNS
		2	1 = atmosphere / off	AIR_STAT: OFF
		3-7	reserved (bits shall be reported as ‘0’)	---

Figure I.44.13: Data Byte

Data Byte	Calibration data to use	Formating conversion used
data A	STATE_OBD_SA	-

ENDIF

I.44.19 Description of PID 13h - Location of oxygen sensors

PID $13 definition

PID (hex)	Description	Data byte	Scaling/bit	External test equipment SI (Metric) / English display
13	Location of Oxygen Sensors	A (bit)	byte 1 of 4	O2SLOC:
	(where sensor 1 is closest to the engine. Each bit indicates the presence or absence of an oxygen sensor at the following location)	0	1 = Bank 1 - Sensor 1 present at that location	O2S11
		1	1 = Bank 1 - Sensor 2 present at that location	O2S12
		2	1 = Bank 1 - Sensor 3 present at that location	O2S13
		3	1 = Bank 1 - Sensor 4 present at that location	O2S14
		4	1 = Bank 2 - Sensor 1 present at that location	O2S21
		5	1 = Bank 2 - Sensor 2 present at that location	O2S22
		6	1 = Bank 2 - Sensor 3 present at that location	O2S23
		7	1 = Bank 2 - Sensor 4 present at that location	O2S24

With autolearning the value for the PSN_LS is defined like this:

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IF PID 13h is supported
THEN PSN_LS is defined to the value defined by the project
ELSE PSN_LS is defined to 0
ENDIF

Data Byte	Calibration data to use	Formating conversion used
data A	PSN_LS	no

I.44.20 Description of PID 14h - Bank 1 Sensor 1 (not supported)

I.44.21 Description of PID 15h - Bank 1 Sensor 2

PID $15 definition if PID $13 is supported!

PID (hex)	Description Use if PID $13 or PID $1D are supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
15	Oxygen Sensor Output Voltage Bank 1 - Sensor 2	A	0 V	1.275 V	0.005 V	O2Sxy: x.xxx V
	Short Term Fuel Trim (B1-S2) (associated with this sensor $FF if this sensor is not used in the calculation)	B	-100.00 % (lean)	99.22 % (rich)	100/128 % (0 % at 128)	SHRTFTxy: xxx.x %
	These PIDs shall be used for a conventional, 0 to 1 Volt oxygen sensor. Any sensor with a different full scale value shall be normalised to provide nominal full scale at $C8 (200 decimal). Wide-range/linear oxygen sensors shall use PID $25 or PID $35.					

IF PSN_LS = 33H
THEN

Data Byte	Application data to use	Formating conversion used
data A	VLS_DOWN[1]	-
data B	0xFF	

ELSE

Data Byte	Application data to use	Formating conversion used
data A	NONE	-
data B	NONE	

ENDIF

I.44.22 Description of PID 16h - Bank 1 Sensor 3 or Bank 2 Sensor 1 (not supported)

I.44.23 Description of PID 17h - Bank 1 Sensor 4 or Bank 2 Sensor 2 (not supported)

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I.44.24 Description of PID 18h - Bank 2 Sensor 1 or Bank 3 Sensor 1 (not supported)

I.44.25 Description of PID 19h - Bank 2 Sensor 2 or Bank 3 Sensor 2

PID $19 definition if PID $13 is supported!

PID (hex)	Description Use if PID $13 is supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
19	Oxygen Sensor Output Voltage Bank 2 - Sensor 2	A	0 V	1.275 V	0.005 V	O2Sxy: x.xxx V
	Short Term Fuel Trim (B2-S2) (associated with this sensor $FF if this sensor is not used in the calculation)	B	-100.00 % (lean)	99.22 % (rich)	100/128 % (0 % at 128)	SHRTFTxy: xxx.x %
	These PIDs shall be used for a conventional, 0 to 1 Volt oxygen sensor. Any sensor with a different full scale value shall be normalised to provide nominal full scale at $C8 (200 decimal). Wide-range/linear oxygen sensors shall use PID $29 or PID $39.					

IF PSN_LS = 33H
THEN

Data Byte	Application data to use	Formating conversion used
Data A	VLS_DOWN[2]	-
Data B	0xFF	

ELSE

Data Byte	Application data to use	Formating conversion used
Data A	NONE	-
Data B	NONE	

ENDIF

I.44.26 Description of PID 1Ah - Bank 2 Sensor 3 or Bank 4 Sensor 1 (not supported)

I.44.27 Description of PID 1Bh - Bank 2 Sensor 4 or Bank 4 Sensor 2 (not supported)

I.44.28 Description of PID 1Ch - OBD requirements

PID $1C definition

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PID (hex)	Description	Data byte	Scaling	External test equipment SI (Metric) / English display
1C	OBD requirements to which vehicle is designed	A (hex)	byte 1 of 1 (State Encoded Variable)	OBDSUP:
		01	OBD II (California ARB)	OBD II
		02	OBD (Federal EPA)	OBD
		03	OBD and OBD II	OBD and OBD II
		04	OBD I	OBD I
		05	Not OBD compliant	NO OBD
		06	EOBD	EOBD
		07	EOBD and OBD II	EOBD and OBD II
		08	EOBD and OBD	EOBD and OBD
		09	EOBD, OBD and OBD II	EOBD, OBD and OBD II
		0A - FF	reserved by document	---

Figure I.44.14: Data Byte

Data Byte	Calibration data to use	Formating conversion used
data A	C_OBD_REQ	-

I.44.29 Description of PID 1Dh - Location of oxygen sensors (not supported)

I.44.30 Description of PID 1Eh - Auxiliary input status (not supported)

I.44.31 Description of PID 1Fh - Time Since Engine Start

PID $1F definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
1F	Time Since Engine Start	A , B	0 sec.	65,535 sec.	1 second per count	RUNTM: xxxxx sec.
	RUNTM shall increment while the engine is running. It shall freeze if the engine stalls. RUNTM shall be reset to zero during every control module power-up and when entering the key-on, engine off position. RUNTM is limited to 65,535 seconds and shall not wrap around to zero.					

Figure I.44.15: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB (T_AST_SAE)	-
data B	LSB (T_AST_SAE)	-

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I.44.32 Description of PID 20h - Supported PIDs 21h - 40h

0 : the PID is not used
1 : the PID is used

DATA A - Supported PIDs 21h - 28h

PID 20h - DATA A - Supported PID 21h to 28h		
BIT	**Function**	**Name**
0	PID 28h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	MOD_1_PID_5_DIAG
1	PID 27h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	
2	PID 26h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	
3	PID 25h : Bank 1 Sensor 2 (Wide range O2S)	
4	PID 24h : Bank 1 Sensor 1 (Wide range O2S)	
5	PID 23h : Diesel fuel pressure (gauge)	
6	PID 22h : Relative fuel pressure	
7	PID 21h : Distance travelled while MIL is activated	

DATA B - Supported PIDs 29h to 30h

PID 20h - DATA B - Supported PID 29h to 30h		
BIT	**Function**	**Name**
0	PID 30h : Number of warm-ups since diagnostic trouble codes cleared	MOD_1_PID_6_DIAG
1	PID 2Fh : Fuel Level Input	
2	PID 2Eh : Commanded Evaporative Purge	
3	PID 2Dh : EGR Error	
4	PID 2Ch : Command EGR	
5	PID 2Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	
6	PID 2Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	
7	PID 29h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	

DATA C - Supported PIDs 31h to 38h

PID 20h - DATA C - Supported PID 31h to 38h		
BIT	**Function**	**Name**
0	PID 38h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	MOD_1_PID_7_DIAG
1	PID 37h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	
2	PID 36h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	
3	PID 35h : Bank 1 Sensor 2 (Wide range O2S)	
4	PID 34h : Bank 1 Sensor 1 (Wide range O2S)	
5	PID 33h : Barometric Pressure	
6	PID 32h : Evap System Vapor Pressure	
7	PID 31h : Distance since diagnostic trouble codes cleared	

DATA D - Supported PIDs 39h to 40h

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PID 20h - DATA D - Supported PID 39h to 40h		
BIT	**Function**	**Name**
0	PID 40h : PIDs supported ($41 - $60)	MOD_1_PID_8_DIAG
1	PID 3Fh : Catalyst Temperature Bank 2, Sensor 2	
2	PID 3Eh : Catalyst Temperature Bank 1, Sensor 2	
3	PID 3Dh : Catalyst Temperature Bank 2, Sensor 1	
4	PID 3Ch : Catalyst Temperature Bank 1, Sensor 1	
5	PID 3Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	
6	PID 3Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	
7	PID 39h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	

I.44.33 Description of PID 21h - Distance travelled while MIL is activated

PID $21 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) / English display
21	**Distance Travelled While MIL is Activated**	A , B	0 km	65535 km	1 km per count	MIL_DIST: xxxxx km (xxxxx miles)
	• Conditions for “Distance travelled” counter: reset to $0000 when MIL state changes from deactivated to activated by this ECU accumulate counts in km if MIL is activated (ON) do not change value while MIL is not activated (OFF) reset to $0000 if diagnostic information is cleared either by service $04 or 40 warm-up cycles without MIL activated do not wrap to $0000 if value is $FFFF					

Figure I.44.16: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB (DIST_ACT_MIL)	-
data B	LSB (DIST_ACT_MIL)	

I.44.34 Description of PID 22h - Fuel Rail Pressure relative to manifold vacuum (not supported)

I.44.35 Description of PID 23h - Fuel Rail Pressure

IF NC_INF_CONF <> 0 *(only supported for MSD)*
THEN

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PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
23	Fuel rail pressure	A , B	0 kPa	655350 kPa	10 kPa per bit unsigned, 1 kPA = 0.1-0377 PSI	FRP: xxxxxx kPa (xxxxx.x PSI
	FRP shall display fuel rail pressure at the engine when the reading is referenced to atmosphere (gauge pressure)					

Figure I.44.17: Data Byte

Data Byte	Application data to use	Formatting conversion used
data A	MSB (FUP_RNG_H_MES)	Shift to different range
data B	LSB (FUP_RNG_H_MES)	Shift to different range

ENDIF

I.44.36 Description of PID 24h - Bank 1 Sensor 1 (Wide range)

PID $24 definition

PID (hex)	Description Use if PID $13 or PID $1D is supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
24	Equivalence Ratio (lambda) (B1-S1) Bank 1 - Sensor 1 (wide range O2S)	A , B	0	1.999	0.0000305	EQ_RATxy: x.xxx
	Oxygen Sensor Voltage (B1-S1)	C , D	0 V	7.999 V	0.000122 V	O2Sxy: x.xxx V
	PID $24 shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and voltage are displayed					

IF PSN_LS = 11H or 33H

THEN

Data Byte	Application data to use	Formating conversion used
data A	MSB (LAMB_LS_UP[1])	Shift to different range
data B	LSB (LAMB_LS_UP[1])	=
data C	MSB (VLS_COR_LSL[1])	=
data D	LSB (VLS_COR_LSL[1])	=

ELSE

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	=
data C	NONE	=
data D	NONE	=

ENDIF

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I.44.37 Description of PID 25h - Bank 1 Sensor 2 (Wide range) (not supported)

I.44.38 Description of PID 26h - Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range) (not supported)

I.44.39 Description of PID 27h - Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range) (not supported)

I.44.40 Description of PID 28h - Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range)

PID $28 definition if PID $13 is supported

PID (hex)	Description Use if PID $13 is supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
28	Equivalence Ratio (lambda) Bank 2 - Sensor 1 (wide range O2S)	A , B	0	1.999	0.0000305	EQ_RATxy: x.xxx
	Oxygen Sensor Voltage (B2-S1)	C , D	0 V	7.999 V	0.000122 V	O2Sxy: x.xxx V
	PIDs $28 shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and voltage are displayed					

IF PSN_LS = 11H or 33H

THEN

Data Byte	Application data to use	Formating conversion used
data A	MSB (LAMB_LS_UP[2])	Shift to different range
data B	LSB (LAMB_LS_UP[2])	=
data C	MSB (VLS_COR_LSL[2])	=
data D	LSB (VLS_COR_LSL[2])	=

ELSE

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	=
data C	NONE	=
data D	NONE	=

ENDIF

I.44.41 Description of PID 29h - Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range) (not supported)

I.44.42 Description of PID 2Ah - Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range) (not supported)

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I.44.43 Description of PID 2Bh - Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range) (not supported)

I.44.44 Description of PID 2C - Commanded EGR

IF NC_INF_CONF <> 0 *(only supported for MSD)*
THEN

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
2C	Commanded EGR	A	0% (no flow)	100% (max. flow)	100/255 %	EGR_PCT: xxx.x%
	Commanded EGR displayed as a percent. EGR_PCT shall be normalised to the maximum EGR commanded output control parameter. EGR systems use a variety of methods to control the amount of EGR delivered to the engine. 1) If an on/off solenoid is used - EGR_PCT shall display 0% when the EGR is commanded off, 100% when the EGR system is commanded on. 2) If a vacuum solenoid is duty cycled, the EGR duty cycle from 0 to 100% shall be displayed. 3) If a linear or stepper motor valve is used, the fully closed position shall be displayed as 0%, the fully open position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. For example, a stepper-motor EGR valve that moves from 0 to 128 counts shall display 0% at 0 counts, 100% at 128 counts and 50% at 64 counts. 4) Any other actuation method shall be normalised to display 0% when no EGR is commanded and 100% at the maximum commanded EGR position.					

Figure I.44.18: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OPG_SP_ACR	-

ENDIF

I.44.45 Description of PID 2D definition - EGR Error

IF NC_INF_CONF <> 0 *(only supported for MSD)*
THEN

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PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
2D	EGR Error = (EGR actual - EGR commanded) / EGR commanded * 100%	A	-100 % (less than commanded)	+99.22 % (more than commanded)	100/128 % (0 % at 128)	EGR_ERR: xxx.x%
	EGR error, as a percent of commanded EGR. Often, EGR valve control outputs are not in the same engineering units as the EGR feedback input sensors. For example, an EGR valve can be controlled using a duty-cycled vacuum solenoid, however, the feedback input sensor is a position sensor. This makes it impossible to display "actual" versus "commanded" in the same engineering units. EGR error solved this problem by displaying a normalised (non-dimensional) EGR system feedback parameter. EGR error is defined to be: (actual EGR - commanded EGR) / commanded EGR. For example if 10% EGR is commanded and 5% is delivered to the engine, the EGR_ERR is (5% - 10%) / 10 = -50% error. EGR_ERR may be computed using various control parameters such as position, steps, counts, etc. All EGR systems must react to quickly changing conditions in the engine; therefore, EGR_ERR will generally show errors during transient conditions. Under steady condition, the error will be minimized (no necessarily zero, however) if the EGR system is under control. If the control system does not use closed loop control, EGR_ERR shall not be supported.					

Figure I.44.19: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OBD_EGR_DIF	-

ENDIF

I.44.46 Description of PID 2Eh - Commanded Evaporative Purge

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
2E	Commanded Evaporative Purge	A	0% no flow	100% max. flow	100/255 %	EVAP_PCT: xxx.x %
	Commanded evaporative purge control valve displayed as a percent. EVAP_PCT shall be normalised to the maximum EVAP purge commanded output control parameter. 1) If an on/off solenoid is used - EVAP_PCT shall display 0% when purge is commanded off, 100% when purge is commanded on. 2) If a vacuum solenoid is duty cycled, the EVAP purge valve duty cycle from 0 to 100% shall be displayed. 3) If a linear or stepper motor valve is used, the fully closed position shall be displayed as 0%, the fully open position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. For example, a stepper-motor EVAP purge valve that moves from 0 to 128 counts shall display 0% at 0 counts, 100% at 128 counts and 50% at 64 counts. 4) Any other actuation method shall be normalised to display 0% when no purge is commanded and 100% at the maximum commanded purge position/flow.					

Figure I.44.20: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	CPPWM_CPS	-

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I.44.47 Description of PID 2Fh - Fuel Level Input

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
2F	Fuel Level Input	A	0% no fuel	100% max. fuel capacity	100/255 %	FLI: xxx.x %
	FLI shall indicate nominal fuel tank liquid fill capacity as a percent of maximum, if utilised by the control module for OBD monitoring . FLI may be obtained directly from a sensor, may be obtained indirectly via the vehicle serial data communication bus, or may be inferred by the control strategy using other sensor inputs. Vehicles that use gaseous fuels shall display the percent of useable fuel capacity.					

Figure I.44.21: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OBD_FTL	no

I.44.48 Description of PID 30h - Number of warm-ups since diagnostic trouble codes cleared

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
30	Number of warm-ups since diagnostic trouble codes cleared	A	0	255	1 warm-up per count	WARM_UPS: xxx
	Number of OBD warm-up cycles since all DTCs were cleared (via an external test eqiupment or possibly, a battery disconnect). A warm-up is defined in the OBD regulations to be sufficient vehicle operation such that coolant temperature rises by at least 22 ^{o}C (40 ^{o}F) from engine starting and reaches a minimum temperature of 70 ^{o}C (160 deg ^{o}F) (60 ^{o}C (140 ^{o}F) for diesels). This PID is not associated with any particular DTC. It is simply an indication for I/M, of the last time an external test equipment was used to clear DTCs. If greater than 255 warm ups have occurred, WARM_UPS shall remain at 255 and not wrap to zero.					

Figure I.44.22: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	CTR_WUP_DTC_CLR	-

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I.44.49 Description of PID 31h - Distance since diagnostic trouble codes cleared

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
31	Distance since diagnostic trouble codes cleared (same scaling as PID $21)	A , B	0 km	65,535 km	1 km per count	CLR_DIST: xxxxx km (xxxxx miles)
	Distance accumulated since DTCs were cleared (via an external test equipment or possibly, a battery disconnect). This PID is not associated with any particular DTC. It is simply an indication for I/M (Inspection/Maintenance), of the last time an external test equipment was used to clear DTCs. If greater than 65,535 km have occurred, CLR_DIST shall remain at 65,535 km and not wrap to zero.					

Figure I.44.23: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB(DIST_DTC_CLR)	-
data B	LSB(DIST_DTC_CLR)	

I.44.50 Description of PID 32h - Evap System Vapor Pressure (not supported)

I.44.51 Description of PID 33h - Barometric Pressure

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
33	Barometric Pressure	A	0 kPa (absolute)	255 kPa (absolute)	1 kPa per bit (absolute)	BARO: xxx kPa (xx.x inHg)
	Barometric pressure utilised by the control module. BARO is normally obtained from a dedicated BARO sensor, from a MAP sensor at key-on and during certain modes of driving, or inferred from a MAF sensor and other inputs during certain modes of driving. The control module shall report BARO from whatever source it is derived from. NOTE Some weather services report local BARO values adjusted to sea level. In these cases, the reported value may not match the displayed value on the external test equipment. NOTE If BARO is inferred while driving and stored in non-volatile RAM or Keep-alive RAM, BARO may not be accurate after a battery disconnect or total memory clear.					

Figure I.44.24: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	AMP_MES	Shift to different range

I.44.52 Description of PID 34h - Bank 1 Sensor 1 (Wide range)

PID $34 definition

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PID (hex)	Description Use if PID $13 or PID $1D is supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
34	Equivalence Ratio (lambda) Bank 1 - Sensor 1 (wide range O2S)	A , B	0	1.999	0.0000305	EQ_RATxy: x.xxx
	Oxygen Sensor Current (B1-S1)	C , D	-128 mA	127.996 mA	0.00390625 mA ($8000 = 0 mA)	O2Sxy: x.xxx mA
	PID $34 shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and current are displayed					

IF PSN_LS = 11H or 33H

THEN

Data Byte	Application data to use	Formating conversion used
data A	LAMB_LS_UP[1]	-
data B	LAMB_LS_UP[1]	
data C	IPLSL_COR[1]	-
data D	IPLSL_COR[1]	

ELSE

Data Byte	Application data to use	Formating conversion used
data A	NONE	-
data B	NONE	
data C	NONE	-
data D	NONE	

ENDIF

I.44.53 Description of PID 35h - Bank 1 Sensor 2 (Wide range) (not supported)

I.44.54 Description of PID 36h - Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range) (not supported)

I.44.55 Description of PID 37h - Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range) (not supported)

I.44.56 Description of PID 38h - Bank 2 Sensor 1 (Wide range)

PID $38 definition if PID $13 is supported

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PID (hex)	Description Use if PID $13 is supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
38	Equivalence Ratio (lambda) Bank 2 - Sensor 1 (wide range O2S)	A , B	0	1.999	0.0000305	EQ_RATxy: x.xxx
	Oxygen Sensor Current (B2-S1)	C , D	-128 mA	127.996 mA	0.00390625 mA ($8000 = 0 mA)	O2Sxy: x.xxx mA
	PIDs $38 shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and current are displayed					

IF PSN_LS = 11H or 33H

THEN

Data Byte	Application data to use	Formating conversion used
data A	LAMB_LS_UP[2]	-
data B	LAMB_LS_UP[2]	
data C	IPLSL_COR[2]	-
data D	IPLSL_COR[2]	

ELSE

Data Byte	Application data to use	Formating conversion used
data A	NONE	-
data B	NONE	
data C	NONE	-
data D	NONE	

ENDIF

I.44.57 Description of PID 39h - Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range) (not supported)

I.44.58 Description of PID 3Ah - Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range) (not supported)

I.44.59 Description of PID 3Bh - Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range) (not supported)

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I.44.60 Description of PID 3C - Catalyst Temperature Bank 1, Sensor 1

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
3C	Catalyst Temperature Bank 1, Sensor 1	A , B	-40 °C	+6513.5 °C	0.1 °C / bit with -40 °C offset	CATEMP11: xxxx.x °C (xxxx.x °F)
	CATEMP11 shall display catalyst substrate temperature for a bank 1 catalyst, if utilised by the control module strategy for OBD monitoring, or the Bank 1, Sensor 1 catalyst temperature sensor. CATEMP11 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.					

Figure I.44.25: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB(TEG_CAT_UP_MDL[1])	Shift to different range
data B	LSB(TEG_CAT_UP_MDL[1])	=

I.44.61 Description of PID 3D - Catalyst Temperature Bank 2, Sensor 1

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
3D	Catalyst Temperature Bank 2, Sensor 1	A , B	-40 °C	+6513.5 °C	0.1 °C / bit with -40 °C offset	CATEMP21: xxxx.x °C (xxxx.x °F)
	CATEMP21 shall display catalyst substrate temperature for a bank 2 catalyst, if utilised by the control module strategy for OBD monitoring, or the Bank 2, Sensor 1 catalyst temperature sensor. CATEMP21 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.					

Figure I.44.26: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB(TEG_CAT_UP_MDL[2])	Shift to different range
data B	LSB(TEG_CAT_UP_MDL[2])	=

I.44.62 Description of PID 3E - Catalyst Temperature Bank 1, Sensor 2

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
3E	Catalyst Temperature Bank 1, Sensor 2	A , B	-40 °C	+6513.5 °C	0.1 °C / bit with -40 °C offset	CATEMP12: xxxx.x °C (xxxx.x °F)
	CATEMP12 shall display catalyst substrate temperature for an additional bank 1 catalyst, if utilised by the control module strategy for OBD monitoring, or the Bank 1, Sensor 2 catalyst temperature sensor. CATEMP12 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.					

Figure I.44.27: Data Byte

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Data Byte	Application data to use	Formating conversion used
data A	MSB(TEG_CAT_DOWN_MDL[1])	Shift to different range
data B	LSB(TEG_CAT_DOWN_MDL[1])	=

I.44.63 Description of PID 3F Catalyst Temperature Bank 2, Sensor 2

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
3F	Catalyst Temperature Bank 2, Sensor 2	A , B	-40 °C	+6513.5 °C	0.1 °C / bit with -40 °C offset	CATEMP22: xxxx.x °C (xxxx.x °F)
	CATEMP22 shall display catalyst substrate temperature for an additional bank 2 catalyst, if utilised by the control module strategy for OBD monitoring, or the Bank 2, Sensor 2 catalyst temperature sensor. CATEMP22 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.					

Figure I.44.28: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB(TEG_CAT_DOWN_MDL[2])	Shift to different range
data B	LSB(TEG_CAT_DOWN_MDL[2])	=

I.44.64 Description of PID 40h - Supported PIDs 41h - 60h

0 : the PID is not used
1 : the PID is used

DATA A - Supported PIDs 41h - 48h

PID 40h - DATA A - Supported PID 41h to 48h		
BIT	**Function**	**Name**
0	PID 48h : Absolute Throttle Position C	MOD_1_PID_9_DIAG
1	PID 47h : Absolute Throttle Position B	
2	PID 46h : Ambient air temperature	
3	PID -h : Relative Throttle Position	
4	PID 44h : Command Equivalence Ratio	
5	PID 43h : Absolute Load Value	
6	PID 42h : Control module voltage	
7	PID 41h : Monitor status this driving cycle	

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PID 40h - DATA B - Supported PID 49h to 50h		
BIT	**Function**	**Name**
0	PID 50h : Reserved	MOD_1_PID_A_DIAG
1	PID 4Fh : Reserved	
2	PID 4Eh : Time since diagnostic trouble codes cleared	
3	PID 4Dh : Minutes run by the engine while MIL activated	
4	PID 4Ch : Commanded Throttle Actuator Control	
5	PID 4Bh : Accelerator Pedal Position F	
6	PID 4Ah : Accelerator Pedal Position E	
7	PID 49h : Accelerator Pedal Position D	

DATA C - Supported PIDs 51h to 58h

PID 40h - DATA C - Supported PID 51h to 58h		
BIT	**Function**	**Name**
0	PID 58h : Reserved	MOD_1_PID_B_DIAG
1	PID 57h : Reserved	
2	PID 56h : Reserved	
3	PID 55h : Reserved	
4	PID 54h : Reserved	
5	PID 53h : Reserved	
6	PID 52h : Reserved	
7	PID 51h : Reserved	

DATA D - Supported PIDs 59h to 60h

PID 40h - DATA D - Supported PID 59h to 60h		
BIT	**Function**	**Name**
0	PID 60h : Reserved	MOD_1_PID_C_DIAG
1	PID 5Fh : Reserved	
2	PID 5Eh : Reserved	
3	PID 5Dh : Reserved	
4	PID 5Ch : Reserved	
5	PID 5Bh : Reserved	
6	PID 5Ah : Reserved	
7	PID 59h : Reserved	

I.44.65 Description of PID 41 - Monitor status this driving cycle

PID $41 definition

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PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) / English display
41	Monitor status this driving cycle			
	The bit in this PID shall report two pieces of information for each monitor: 1) Monitor enable status for the current driving cycle. This bit shall indicate when a monitor is disabled in a manner such that there is no way for the driver to operate the vehicle for the remainder of the driving cycle and make the monitor run. Typical examples are: Engine-off soak not long enough (e.g., cold start temperature conditions not satisfied) Monitor maximum time limit or number of attempts/aborts exceeded Ambient air temperature too low or too high BARO too low (high altitude) The monitor shall not indicate "disabled" for operator-controlled conditions such as rpm, load, throttle position, minimum time limit not exceeded, ECT, TP, etc. 2) Monitor completion status for the current driving/monitoring cycle. Status shall be reset to "not complete" upon starting a new monitoring cycle. Note that some monitoring cycles can include various engine-operating conditions; other monitoring cycles begin after the ignition key is turned off. Some status bits on a given vehicle can utilise engine-running monitoring cycles while others can utilise engine-off monitoring cycles. Resetting the bits to "not complete" upon starting the engine will accommodate most engine-running and engine-off monitoring cycles, however, manufacturers are free to define their own monitoring cycles. NOTE PID $41 bits shall be utilised for all non-continuous monitors which are supported, and change completion status in PID $01. If a non-continuous monitor is not supported or always shows "complete", the corresponding PID $41 bits shall indicate disabled and complete. PID $41 bits may be utilised at the vehicle manufacturer's discretion for all continuous monitors which are supported with the exception of bit 03 which shall always showed CCM as enabled for spark ignition and compression ignition engines.			

Figure I.44.29: PID $41 definition (continued)

PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) / English display
41	Monitor status this driving cycle			
		A (bit)	**byte 1 of 4**	
	Reserved - shall be reported as $00	0-7		---
	Enable status of continuous monitors this monitoring cycle:	**B (bit)**	byte 2 of 4 (Low Nibble)	Enable status of continuous monitors this monitoring cycle: NO means disabled for rest of this monitoring cycle or not supported in PID $01, YES means enabled for this monitoring cycle.
	Misfire monitoring Fuel system monitoring Comprehensive component monitoring reserved (bit shall be reported as ‘0’)	0 1 2 3	0 = monitor disabled for rest of this monitoring cycle or not supported (NO) 1 = monitor enabled for this monitoring cycle (YES)	MIS_ENA: NO or YES FUEL_ENA: NO or YES CCM_ENA: YES

Figure I.44.30: PID $41 definition (continued)

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PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) / English display
41	Monitor status this driving cycle			
	Completion status of continuous monitors this monitoring cycle:	**B (bit)**	**byte 2 of 4 (High Nibble)**	**Completion status of continuous monitors this monitoring cycle:**
	Misfire monitoring C_CLC_READY_OBD_1[0] Fuel system monitoring C_CLC_READY_OBD_1[1] Comprehensive component monitoring C_CLC_READY_OBD_1[2] reserved (bit shall be reported as '0') C_CLC_READY_OBD_1[3]	4 5 6 7	See PID $01 to determine which monitors are supported 0 = monitor complete this monitoring cycle, or not supported (YES) 1 = monitor not complete this monitoring cycle (NO)	MIS_CMPL: YES or NO FUELCMPL: YES or NO CCM_CMPL: YES or NO

Figure I.44.31: PID $41 definition (continued)

PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) / English display
41	Monitor status this driving cycle			
	Enable status of non-continuous monitors this monitoring cycle:	**C (bit)**	**byte 3 of 4**	**Enable status of non-continuous monitors this monitoring cycle:**
	Catalyst monitoring Heated catalyst monitoring Evaporative system monitoring Secondary air system monitoring A/C system refrigerant monitoring Oxygen sensor monitoring Oxygen sensor heater monitoring EGR system monitoring	0 1 2 3 4 5 6 7	0 = monitor disabled for rest of this monitoring cycle (NO) 1 = monitor enabled for this monitoring cycle (YES)	CAT_ENA: YES or NO HCAT_ENA: YES or NO EVAP_ENA: YES or NO AIR_ENA: YES or NO ACRF_ENA: YES or NO O2S_ENA: YES or NO HTR_ENA: YES or NO EGR_ENA: YES or NO

Figure I.44.32: PID $41 definition (continued)

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PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) / English display
41	Monitor status this driving cycle			
	Completion status of non-continuous monitors this monitoring cycle:	**D (bit)**	**byte 4 of 4**	**Completion status of non-continuous monitors this monitoring cycle:**
	Catalyst monitoring Heated catalyst monitoring Evaporative system monitoring Secondary air system monitoring A/C system refrigerant monitoring Oxygen sensor monitoring Oxygen sensor heater monitoring EGR system monitoring	0 1 2 3 4 5 6 7	See PID $01 to determine which monitors are supported. 0 = monitor complete this monitoring cycle, or not supported (YES) 1 = monitor not complete this monitoring cycle (NO)	CAT_CMPL: YES or NO HCATCMPL: YES or NO EVAPCMPL: YES or NO AIR_CMPL: YES or NO ACRFCMPL: YES or NO O2S_CMPL: YES or NO HTR_CMPL: YES or NO EGR_CMPL: YES or NO

Figure I.44.33: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	0x00	-
data B	C_CLC_READY_OBD_1[0...3] + STATE_ENA_OBD[0...3]	
data C	STATE_ENA_OBD[8..15]	
data D	STATE_CMPL_OBD[8..15]	

I.44.66 Description of PID 42 - Control module voltage

PID $42 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
42	Control module voltage	A , B	0 V	65.535 V	0.001 V per bit	VPWR: xx.xxx V
	VPWR - power input to the control module. VPWR is normally battery voltage, less any voltage drop in the circuit between the battery and the control module. NOTE 42-volt vehicles may utilise multiple voltages for different systems on the vehicle. VPWR represents the voltage at the control module; it may be significantly different than battery voltage.					

Figure I.44.34: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB (VB)	Shift to different range
data B	LSB (VB)	

I.44.67 Description of PID 43 - Absolute Load Value

PID $43 definition

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PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
43	Absolute Load Value	A , B	0 %	25700%	100/255 %	LOAD_ABS: xxx.x%
	The absolute load value has some different characteristics than the LOAD_PCT defined in PID 04 This definition, although restrictive, will standardise the calculation. LOAD_ABS is the normalised value of air mass per intake stroke displayed as a percent. LOAD_ABS = [air mass (g/intake stroke)] / [1.184 (g/intake stroke) * cylinder displacement in litres] Derivation: air mass (g / intake stroke) = [total engine air mass (g/sec)] / [rpm (revs/min)* (1 min / 60 sec) * (1/2 # of cylinders (strokes /rev)] LOAD_ABS = [air mass (g)/intake stroke] / [maximum air mass (g)/intake stroke at WOT@STP at 100% volumetric efficiency] * 100% Where: STP = Standard Temperature and Pressure = 25 ^{o}C, 29.92 in Hg (1013 hPa) BARO, WOT = wide open throttle The quantity (maximum air mass (g)/intake stoke at WOT@STP at 100% volumetric efficiency) is a constant for a given cylinder swept volume. The constant is 1.184 (g/litre 3) * cylinder displacement (litre 3/intake stroke) based on air density at STP Characteristics of LOAD_ABS are: Ranges from 0 to approximately 0.95 for naturally aspirated engines, 0 - 4 for boosted engines Linearly correlated with engine indicated and brake torque Often used to schedule spark and EGR rates Peak value of LOAD_ABS correlates with volumetric efficiency at WOT. Indicates the pumping efficiency of the engine for diagnostic purposes. Spark ignition engine are required to support PID $43. Compression ignition (diesel) engines are not required to support this PID. NOTE See PID $04 for an additional definition of engine LOAD..					

Figure I.44.35: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB (LOAD_ABSV)	no
data B	LSB (LOAD_ABSV)	no

I.44.68 Description of PID 44 - Commanded Equivalence Ratio

Table .1 PID $44 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
44	Commanded Equivalence Ratio	A , B	0	1.999	0.0000305	EQ_RAT: x.xxx
	Fuel systems that utilise conventional oxygen sensor shall display the commanded open loop equivalence ratio while the fuel control system is in open loop. EQ_RAT shall indicate 1.0 while in closed loop fuel. Fuel systems that utilise wide-range/linear oxygen sensors shall display the commanded equivalence ratio in both open loop and closed loop operation. To obtain the actual A/F ratio being commanded, multiply the stoichiometric A/F ratio by the equivalence ratio. For example, for gasoline, stoichiometric is 14.64:1 ratio. If the fuel control system was commanding an 0.95 EQ_RAT, the commanded A/F ratio to the engine would be 14.64 * 0.95 = 13.9 A/F					

Figure I.44.36: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB(LAMB_SP_SAE [1])	Shift to different resolution
data B	LSB(LAMB_SP_SAE [1])	=

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I.44.69 Description of PID - - Relative Throttle Position

PID $- definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
-	Relative Throttle Position	A	0 %	100 %	100/255 %	TP_R: xxx.x %
	Relative or "learned" throttle position shall be displayed as a normalised value, scaled from 0 to 100%. TP_R should display a value of 0% at the "learned closed-throttle position. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is a 1.0 volts, TP shall display (1.0 - 1.0 / 5.0) = 0% at closed throttle and 30% at 2.5 volts. Because of the closed-throttle offset, wide open throttle will usually indicate substantially less than 100%. For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage. See PID $11 for a definition of Absolute Throttle Position.					

Figure I.44.37: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OBD_TPS_REL	-

I.44.70 Description of PID 46 - Ambient air temperature

PID $46 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
46	Ambient air temperature (same scaling as IAT - $0F)	A	-40 °C	+215 °C	1 °C with -40 °C offset	AAT: xxx °C / xxx °F
	AAT shall display ambient air temperature, if utilised by the control module strategy for OBD monitoring. AAT may be obtained directly from a sensor, may be obtained indirectly via the vehicle serial data communication bus, or may be inferred by the control strategy using other sensor inputs.					

Figure I.44.38: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OBD_TAM	-

I.44.71 Description of PID 47 - Absolute Throttle Position B

PID $47 definition

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PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
47	Absolute Throttle Position B	A	0 %	100 %	100/255 %	TP_B: xxx.x %
	Absolute throttle position B, if utilised by the control module, (not “relative” or “learned” throttle position) shall be displayed as a normalised value, scaled from 0 to 100%. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is a 1.0 volts, TP_B shall display (1.0 / 5.0) = 20% at closed throttle and 50% at 2.5 volts. Throttle position at idle will usually indicate greater than 0%, and throttle position at wide open throttle will usually indicate less than 100%. For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage.					

Figure I.44.39: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OBD_TPS_2	-

I.44.72 Description of PID 48 - Absolute Throttle Position C (not supported)

I.44.73 Description of PID 49 - Accelerator Pedal Position D

PID $49 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
49	Accelerator Pedal Position D	A	0 %	100 %	100/255 %	APP_D: xxx.x %
	Accelerator Pedal Position D, if utilised by the control module, (not “relative” or “learned” pedal position) shall be displayed as a normalised value, scaled from 0 to 100%. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed pedal is 1.0 volt, APP_D shall display (1.0 / 5.0) = 20% at closed pedal and 50% at 2.5 volts. Pedal position at idle will usually indicate greater than 0%, and pedal position at wide open pedal will usually indicate less than 100%. For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage.					

Figure I.44.40: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OBD_PV_1	-

I.44.74 Description of PID 4A - Accelerator Pedal Position E

PID $4A definition

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PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
4A	Accelerator Pedal Position E	A	0 %	100 %	100/255 %	APP_E: xxx.x %
	Accelerator Pedal Position E, if utilised by the control module, (not “relative” or “learned” pedal position) shall be displayed as a normalised value, scaled from 0 to 100%. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed pedal is 1.0 volt, APP_E shall display (1.0 / 5.0) = 20% at closed pedal and 50% at 2.5 volts. Pedal position at idle will usually indicate greater than 0%, and pedal position at wide open pedal will usually indicate less than 100%. For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage.					

Figure I.44.41: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OBD_PV_2	-

I.44.75 Description of PID 4B - Accelerator Pedal Position F (not supported)

I.44.76 Description of PID 4C - Commanded Throttle Actuator Control

PID $4C definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
4C	Commanded Throttle Actuator Control	A	0% (closed throttle)	100% (wide open throttle)	100/255 %	TAC_PCT: xxx.x%
	Commanded TAC displayed as a percent. TAC_PCT shall be normalised to the maximum TAC commanded output control parameter. TAC systems use a variety of methods to control the amount of throttle opening. 1) If a linear or stepper motor is used, the fully closed throttle position shall be displayed as 0%, the fully open throttle position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open throttle position. For example, a stepper-motor TAC that moves the throttle from 0 to 128 counts shall display 0% at 0 counts, 100% at 128 counts and 50% at 64 counts. 2) Any other actuation method shall be normalised to display 0% when the throttle is commanded closed and 100% when the throttle is commanded open.					

Figure I.44.42: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	OBD_TPS_SP	-

I.44.77 Description of PID 4D - Minutes run by the engine while MIL activated

PID $4D definition

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PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) / English display
4D	Minutes run by the engine while MIL activated	A, B	0 min	65535 min 1092.25 hours	1 min per count	MIL_TIME: xxxx hrs, xx min
	• Conditions for “Minutes run by the engine while MIL activated” counter: reset to $0000 when MIL state changes from deactivated to activated by this ECU accumulate counts in minutes if MIL is activated (ON) do not change value while MIL is not activated (OFF) reset to $0000 if diagnostic information is cleared either by service $04 or 40 warm-up cycles without MIL activated do not wrap to $0000 if value is $FFFF					

Figure I.44.43: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB (T_ACT_MIL_SAE)	-
data B	LSB (T_ACT_MIL_SAE)	

I.44.78 Description of PID 4E - Time since diagnostic trouble codes cleared

PID $4E definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
4E	Time since diagnostic trouble codes cleared	A, B	0 min	65535 min 1092.25 hours	1 min per count	CLR_TIME: xxxx hrs, xx min
	Time accumulated since DTCs were cleared (via an external test equipment or possibly, a battery disconnect). This PID is not associated with any particular DTC. It is simply an indication for I/M (Inspection/Maintenance), of the last time an external test equipment was used to clear DTCs. If greater than 65,535 min have occurred, CLR_TIME shall remain at 65,535 min and not wrap to zero.					

Figure I.44.44: Data Byte

Data Byte	Application data to use	Formating conversion used
data A	MSB (T_DTC_CLR)	-
data B	LSB (T_DTC_CLR)	

I.44.79 Description of PID 4F up to FFh - Reserved

PID $4F - $FF definition

PID (hex)	Description	Data Byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
4F - FF	Reserved by document	---	---	---	---	---

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I.45 PID description for mode 02h

Input data:

MOD_2_PID_1_DIAG {p. 7831}	MOD_2_PID_2_DIAG {p. 7831}	MOD_2_PID_3_DIAG {p. 7831}	MOD_2_PID_4_DIAG {p. 7831}
MOD_2_PID_5_DIAG {p. 7831}	MOD_2_PID_6_DIAG {p. 7831}	MOD_2_PID_7_DIAG {p. 7831}	MOD_2_PID_8_DIAG {p. 7831}
MOD_2_PID_9_DIAG {p. 7832}	MOD_2_PID_A_DIAG {p. 7832}	MOD_2_PID_B_DIAG {p. 7832}	MOD_2_PID_C_DIAG {p. 7832}
NC_INJ_CONF {p. 626}	PSN_LS {p. 656}		

General information:

This specification is according with the ISO 15031-5 issue 8.
" IDX" is used instead of the array definition [NC_NR_ERR_DYN].

At PSN_LS you can see the configuration of the oxygen-sensors:

PSN_LS:

BIT	Function	Status
0	Bank 1 Sensor 1	1= available, 0 = not available
1	Bank 1 Sensor 2	1= available, 0 = not available
2	Bank 1 Sensor 3	1= available, 0 = not available
3	Bank 1 Sensor 4	1= available, 0 = not available
4	Bank 2 Sensor 1	1= available, 0 = not available
5	Bank 2 Sensor 2	1= available, 0 = not available
6	Bank 2 Sensor 3	1= available, 0 = not available
7	Bank 2 Sensor 4	1= available, 0 = not available

I.45.1 Description of PID 00h - Supported PIDs 01h - 20h

0 : the PID is not used
1 : the PID is used

DATA A - Supported PIDs 01h to 08h

PID 00h - DATA A - Supported PID 01h to 08h		
BIT	**Function**	**Name**
0	PID 08h : Short term fuel trim - Bank 2 and Bank 4	MOD_2_PID_1_DIAG
1	PID 07h : Long term fuel trim - Bank 1 and Bank 3	
2	PID 06h : Short term fuel trim - Bank 1 and Bank 3	
3	PID 05h : Engine coolant temperature	
4	PID 04h : Calculated load value	
5	PID 03h : Fuel system status	
6	PID 02h : Trouble code that caused required freeze frame	
7	PID 01h : Monitor status since DTCs cleared	

DATA B - Supported PIDs 09h to 10h

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PID 00h - DATA B - Supported PID 09h to 10h		
BIT	**Function**	**Name**
0	PID 10h : Air flow rate from MAF sensor	MOD_2_PID_2_DIAG
1	PID 0Fh : Intake air temperature	
2	PID 0Eh : Ignition time advance	
3	PID 0Dh : Vehicle speed	
4	PID 0Ch : Engine RPM	
5	PID 0Bh : Intake manifold absolute pressure	
6	PID 0Ah : Fuel pressure (gauge)	
7	PID 09h : Long term fuel trim - Bank 2	

DATA C - Supported PIDs 11h to 18h

PID 00h - DATA C - Supported PID 11h to 18h		
BIT	**Function**	**Name**
0	PID 18h : Bank 2 Sensor 1 or Bank 3 Sensor 1	MOD_2_PID_3_DIAG
1	PID 17h : Bank 1 Sensor 4 or Bank 2 Sensor 2	
2	PID 16h : Bank 1 Sensor 3 or Bank 2 Sensor 1	
3	PID 15h : Bank 1 Sensor 2	
4	PID 14h : Bank 1 Sensor 1	
5	PID 13h : Location of Oxygen Sensors	
6	PID 12h : Secondary air status	
7	PID 11h : Absolute throttle position sensor	

DATA D - Supported PIDs 19h to 20h

PID 00h - DATA D - Supported PID 19h to 20h		
BIT	**Function**	**Name**
0	PID 20h : PIDs supported ($21 - $40)	MOD_2_PID_4_DIAG
1	PID 1Fh : Time Since Engine Start	
2	PID 1Eh : Auxiliary Input Status	
3	PID 1Dh : Location of oxygen sensors	
4	PID 1Ch : OBD requirements to which vehicle is designed	
5	PID 1Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2	
6	PID 1Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1	
7	PID 19h : Bank 2 Sensor 2 or Bank 3 Sensor 2	

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I.45.1.1 Description of PID 02h - Diagnostic trouble codes

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling	External test equipment SI (Metric) / English display
02	DTC that caused required freeze frame data storage ($0000 indicates no freeze frame data)	A, B	00 00	FF FF	Hexadecimal e.g. P01AB (DTCs defined in ISO 15031-6)	DTCFRZF: Pxxxx, Cxxxx, Bxxxx, Uxxxx

Formula section:

CALL API :

ACTION_ERRM_ReadFrfByDtc (

IN <FRF_LAW>,

IN <FIRST>,
IN <NO_DTC>,
IN <DTC_LAW>
INOUT <Frf>
OUT <ResultFrf>
)

IF ResultFrf == NO_FRF_PRESENT
THEN

Data Byte	Application data to use	Formating conversion used
data A	`0x00`	-
data B	`0x00`	

ELSE

Data Byte	Application data to use	Formating conversion used
data A	`Frf[0]`	-
data B	`Frf[1]`	

ENDIF

I.45.1.2 Description of PID 03h - Status of fuel system

If PSN_LS = 11H or 33H *// upstream sensors available*
Then DATA_A = ENVD_OBD_1_IDX *// FRF of STATE_LS_1*
DATA_B = ENVD_OBD_2_IDX *//FRF of STATE_LS_2*
Else PID 03h is not supported
Endif
Else

I.45.1.3 Description of PID 04h - Calculated load value

DATA_A = ENVD_OBD_3_IDX *// FRF of LOAD_CLC*

I.45.1.4 Description of PID 05h - Engine coolant temperature

DATA_A = ENVD_OBD_4_IDX *// FRF of TCO_MES*

I.45.1.5 Description of PID 06h - Short term fuel trim - Bank 1 and Bank 3

If PSN_LS = 11H or 33H *// upstream sensors available*
Then PID 06h is supported
DATA_A = ENVD_OBD_5_IDX *// FRF of OBD_LAM_COR_1*
DATA_B = NONE *//Bank 3 not supported*
Else PID 06h is not supported
Endif

I.45.1.6 Description of PID 07h - Long term fuel trim - Bank 1 and Bank 3

If PSN_LS = 33H *// upstream and downstream sensors available*
Then PID 07h is supported
DATA_A = ENVD_OBD_6_IDX *// FRF of OBD_LAM_AD_1*
DATA_B = NONE *//Bank 3 not supported*
Else PID 07h is not supported

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Endif

I.45.1.7 Description of PID 08h - Short term fuel trim - Bank 2 and Bank 4

If PSN_LS = 11H or 33H *// upstream sensors available*
Then PID 08h is supported
DATA_A = ENVD_OBD_7_IDX *// FRF of OBD_LAM_COR_2*
DATA_B = NONE *//Bank 3 not supported*
Else PID 08h is not supported
Endif

I.45.1.8 Description of PID 09h - Long term fuel trim - Bank 2 and Bank 4

If PSN_LS = 33H *// upstream and downstream sensors available*
Then PID 09h is supported
DATA_A = ENVD_OBD_8_IDX *// FRF of OBD_LAM_AD_2*
DATA_B = NONE *//Bank 3 not supported*
Else PID 07h is not supported
Endif

I.45.1.9 Description of PID 0Ah - Fuel pressure (gage)

DATA_A = ENVD_OBD_9_IDX *// FRF of OBD_FUP*

I.45.1.10 Description of PID 0Bh - Intake manifold absolute pressure

DATA_A = ENVD_OBD_10_IDX *// FRF of MAP_SAE*

I.45.1.11 Description of PID 0Ch - Engine speed

DATA_A = ENVD_OBD_11_IDX *// FRF of OBD_N (high byte)*
DATA_B = ENVD_OBD_12_IDX *// FRF of OBD_N (low byte)*

I.45.1.12 Description of PID 0Dh - Vehicle speed

DATA_A = ENVD_OBD_13_IDX *// FRF of VS*

I.45.1.13 Description of PID 0Eh - Ignition timing advance

DATA_A = ENVD_OBD_14_IDX *// FRF of OBD_IGA_IGC, cylinder 1*

I.45.1.14 Description of PID 0Fh - Intake air temperature

DATA_A = ENVD_OBD_15_IDX *// FRF of OBD_TIA*

I.45.1.15 Description of PID 10h - Air flow rate from MAF

DATA_A = ENVD_OBD_16_IDX *// FRF of OBD_MAF (high byte)*
DATA_B = ENVD_OBD_17_IDX *// FRF of OBD_MAF (low byte)*

I.45.1.16 Description of PID 11h - Absolute throttle position sensor

DATA_A = ENVD_OBD_18_IDX *// FRF of OBD_TPS_1*

I.45.1.17 Description of PID 12h - Commanded secondary air status

DATA_A = ENVD_OBD_19_IDX *// FRF of STATE_OBD_SA*

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I.45.1.18 Description of PID 1Fh - Time Since Engine Start

DATA_A = ENVD_OBD_20_IDX *// FRF of T_AST_SAE (high byte)*
DATA_B = ENVD_OBD_21_IDX *// FRF of T_AST_SAE (low byte)*

I.45.2 Description of PID 20h - Supported PIDs 21h - 40h

0 : the PID is not used, 1 : the PID is used

DATA A - Supported PIDs 21h - 28h

PID 20h - DATA A - Supported PID 21h to 28h		
BIT	**Function**	**Name**
0	PID 28h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	MOD_2_PID_5_DIAG
1	PID 27h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	
2	PID 26h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	
3	PID 25h : Bank 1 Sensor 2 (Wide range O2S)	
4	PID 24h : Bank 1 Sensor 1 (Wide range O2S)	
5	PID 23h : Diesel fuel pressure (gauge)	
6	PID 22h : Relative fuel pressure	
7	PID 21h : Distance travelled while MIL is activated	

DATA B - Supported PIDs 29h to 30h

PID 20h - DATA B - Supported PID 29h to 30h		
BIT	**Function**	**Name**
0	PID 30h : Number of warm-ups since diagnostic trouble codes cleared	MOD_2_PID_6_DIAG
1	PID 2Fh : Fuel Level Input	
2	PID 2Eh : Commanded Evaporative Purge	
3	PID 2Dh : EGR Error	
4	PID 2Ch : Command EGR	
5	PID 2Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	
6	PID 2Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	
7	PID 29h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	

DATA C - Supported PIDs 31h to 38h

PID 20h - DATA C - Supported PID 31h to 38h		
BIT	**Function**	**Name**
0	PID 38h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	MOD_2_PID_7_DIAG
1	PID 37h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	
2	PID 36h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	
3	PID 35h : Bank 1 Sensor 2 (Wide range O2S)	
4	PID 34h : Bank 1 Sensor 1 (Wide range O2S)	
5	PID 33h : Barometric Pressure	
6	PID 32h : Evap System Vapor Pressure	
7	PID 31h : Distance since diagnostic trouble codes cleared	

DATA D - Supported PIDs 39h to 40h

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PID 20h - DATA D - Supported PID 39h to 40h		
BIT	**Function**	**Name**
0	PID 40h : PIDs supported ($41 - $60)	MOD_2_PID_8_DIAG
1	PID 3Fh : Catalyst Temperature Bank 2, Sensor 2	
2	PID 3Eh : Catalyst Temperature Bank 1, Sensor 2	
3	PID 3Dh : Catalyst Temperature Bank 2, Sensor 1	
4	PID 3Ch : Catalyst Temperature Bank 1, Sensor 1	
5	PID 3Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	
6	PID 3Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	
7	PID 39h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	

I.45.2.1 Description of PID 23h - Fuel pressure

If NC_INJ_CONF <> 0 *//only supported for MSD*
Then DATA_A = ENVD_OBD_22_IDX *// FRF of OBD_FUP_RNG_H*
DATA_B = ENVD_OBD_23_IDX *// FRF of OBD_FUP_RNG_H*
Endif

I.45.2.2 Description of PID 2Eh - Commanded Evaporative purge

DATA_A = ENVD_OBD_24_IDX *// FRF of CPPWM_CPS*

I.45.2.3 Description of PID 2Fh - Fuel Level Input

DATA_A = ENVD_OBD_25_IDX *// FRF of OBD_FTL*

I.45.2.4 Description of PID 33h - Barometric Pressure

DATA_A = ENVD_OBD_26_IDX *// FRF of OBD_AMP*

I.45.3 Description of PID 40h - Supported PIDs 41h - 60h

0 : the PID is not used
1 : the PID is used

DATA A - Supported PIDs 41h - 48h

PID 40h - DATA A - Supported PID 41h to 48h		
BIT	**Function**	**Name**
0	PID 48h : Absolute Throttle Position C	MOD_2_PID_9_DIAG
1	PID 47h : Absolute Throttle Position B	
2	PID 46h : Ambient air temperature	
3	PID -h : Relative Throttle Position	
4	PID 44h : Command Equivalence Ratio	
5	PID 43h : Absolute Load Value	
6	PID 42h : Control module voltage	
7	PID 41h : Monitor status this driving cycle	

DATA B - Supported PIDs 49h to 50h

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PID 40h - DATA B - Supported PID 49h to 50h		
BIT	**Function**	**Name**
0	PID 50h : Reserved	MOD_2_PID_A_DIAG
1	PID 4Fh : Reserved	
2	PID 4Eh : Time since diagnostic trouble codes cleared	
3	PID 4Dh : Minutes run by the engine while MIL activated	
4	PID 4Ch : Commanded Throttle Actuator Control	
5	PID 4Bh : Accelerator Pedal Position F	
6	PID 4Ah : Accelerator Pedal Position E	
7	PID 49h : Accelerator Pedal Position D	

DATA C - Supported PIDs 51h to 58h

PID 40h - DATA C - Supported PID 51h to 58h		
BIT	**Function**	**Name**
0	PID 58h : Reserved	MOD_2_PID_B_DIAG
1	PID 57h : Reserved	
2	PID 56h : Reserved	
3	PID 55h : Reserved	
4	PID 54h : Reserved	
5	PID 53h : Reserved	
6	PID 52h : Reserved	
7	PID 51h : Reserved	

DATA D - Supported PIDs 59h to 60h

PID 40h - DATA D - Supported PID 59h to 60h		
BIT	**Function**	**Name**
0	PID 60h : Reserved	MOD_2_PID_C_DIAG
1	PID 5Fh : Reserved	
2	PID 5Eh : Reserved	
3	PID 5Dh : Reserved	
4	PID 5Ch : Reserved	
5	PID 5Bh : Reserved	
6	PID 5Ah : Reserved	
7	PID 59h : Reserved	

I.45.3.1 Description of PID 42 - Control module voltage

DATA_A = ENVD_OBD_27_IDX *// FRF of OBD_VB (high byte)*
DATA_B = ENVD_OBD_28_IDX *// FRF of OBD_VB (low byte)*

I.45.3.2 Description of PID 43 - Absolute Load Value

DATA_A = ENVD_OBD_29_IDX *// FRF of LOAD_ABSV (high byte)*
DATA_B = ENVD_OBD_30_IDX *// FRF of LOAD_ABSV (low byte)*

I.45.3.3 Description of PID 44 - Commanded Equivalence Ratio

DATA_A = ENVD_OBD_31_IDX *// FRF of OBD_LAMP_SP (high byte)*
DATA_B = ENVD_OBD_32_IDX *// FRF of OBD_LAMP_SP (low byte)*

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I.45.3.4 Description of PID - - Relative Throttle Position

DATA_A = ENVD_OBD_33_IDX // FRF of OBD_TPS_REL

I.45.3.5 Description of PID 46 - Ambient air temperature

DATA_A = ENVD_OBD_34_IDX // FRF of OBD_TAM

I.45.3.6 Description of PID 47 - Absolute Throttle Position B

DATA_A = ENVD_OBD_35_IDX // FRF of OBD_TPS_2

I.45.3.7 Description of PID 49 - Accelerator Pedal Position D

DATA_A = ENVD_OBD_36_IDX // FRF of OBD_PV_1

I.45.3.8 Description of PID 4A - Accelerator Pedal Position E

DATA_A = ENVD_OBD_37_IDX // FRF of OBD_PV_2

I.45.3.9 Description of PID 4C - Commanded throttle actuator control

DATA_A = ENVD_OBD_38_IDX // FRF of OBD_TPS_SP

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I.46 SID 01h: Request current powertrain diagnostic data

I.46.1 Functional description

The purpose of this service is to allow access to current emission-related data values, including analogue inputs and outputs, digital inputs and outputs, and system status information. The request for information includes a parameter identification (PID) value that indicates to the on-board system the specific information requested. PID specifications, scaling information, and display formats are included in Annex B of ISO 15031-5.4.

The ECU(s) will respond to this message by transmitting the requested data value last determined by the system. All data values returned for sensor readings will be actual readings, not default or substitute values used by the system because of a fault with that sensor.

Not all PIDs are applicable or supported by all systems. PID 00h is a bit-encoded value that indicates for each ECU which PIDs are supported. PID 00h indicates support for PIDs from 01h to 20h. PID 20h indicates support for PIDs 21h through 40h, etc. PID 00h is required for those ECUs that respond to a corresponding service 01h request message as specified in Annex A of ISO 15031-5.4.

IMPORTANT All emissions-related OBD ECUs shall support service 01h and PID 00h. Service 01h with PID 00h is defined as the universal "initialization/keep alive/ping" message for all emissions-related OBD ECUs.

The request message may contain up to six (6) PIDs. An external test equipment is not allowed to request a combination of PIDs supported and PIDs, which report data values. The ECU shall support requests for up to six (6) PIDs. The request message may contain the same PID multiple times. The ECU shall treat each PID as a separate parameter and respond with data for each PID (data returned may be different for the same PID) as often as requested.

The order of the PIDs in the response message is not required to match the order in the request message.

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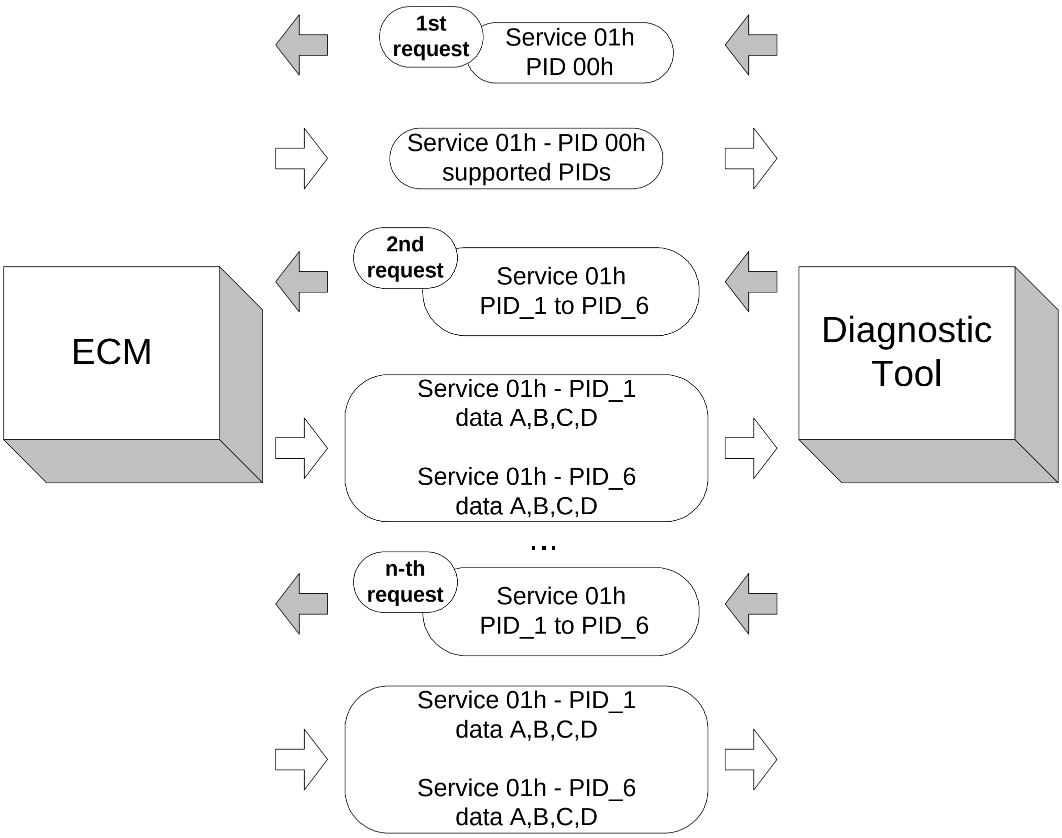

I.46.2 Message data bytes

I.46.2.1 Read supported PIDs

Request current powertrain diagnostic data request message (read supported PIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request current powertrain diagnostic data request SID**	**M**	**01**	**SIDRQ**
#2	PID#1 (PIDs supported: see Annex A of ISO 15031-5.4)	M	xx	PID
#3	PID#2 (PIDs supported: see Annex A of ISO 15031-5.4)	U	xx	PID
#4	PID#3 (PIDs supported: see Annex A of ISO 15031-5.4)	U	xx	PID
#5	PID#4 (PIDs supported: see Annex A of ISO 15031-5.4)	U	xx	PID
#6	PID#5 (PIDs supported: see Annex A of ISO 15031-5.4)	U	xx	PID
#7	PID#6 (PIDs supported: see Annex A of ISO 15031-5.4)	U	xx	PID
U = User Optional — PID may be included to avoid multiple PID supported request messages				

NOTE To request PIDs supported range from C1h - FFh another request message with PID#1 = C0h and PID#2 = E0h shall be sent to the vehicle.

I.46.2.2 Report supported PIDs

ECU(s) must respond to all supported ranges if requested. A range is defined as a block of 32 PIDs (e.g. range #1: PID 01h-20h). The ECU shall not respond to unsupported PID ranges unless subsequent ranges have a supported PID(s).

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Request current powertrain diagnostic data response message (report supported PIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request current powertrain diagnostic data response SID**	**M**	**41**	**SIDPR**
 #2 #3 #4 #5 #6	data record of supported PIDs = [1st supported PID Data A: supported PIDs, Data B: supported PIDs, Data C: supported PIDs, Data D: supported PIDs]	 M M M M M	 xx xx xx xx xx	PIDREC_ PID DATA_A DATA_B DATA_C DATA_D
:	:	:	:	:
 #n-4 #n-3 #n-2 #n-1 #n	data record of supported PIDs = [mth supported PID Data A: supported PIDs, Data B: supported PIDs, Data C: supported PIDs, Data D: supported PIDs]	 C1 C2 C2 C2 C2	 xx xx xx xx xx	PIDREC_ PID DATA_A DATA_B DATA_C DATA_D
C1 = Conditional — PID value shall be the same value as included in the request message if supported by the ECU C2 = Conditional — value indicates PIDs supported; range of supported PIDs depends on selected PID value (see C1)				

NOTE The response message shall only include the PID(s) and Data A - D which are supported by the ECU. If the request message includes (a) PID value(s) which are not supported by the ECU those shall not be included in the response message.

I.46.2.3 Read PID values

Request current powertrain diagnostic data request message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request current powertrain diagnostic data request SID**	**M**	**01**	**SIDRQ**
#2	PID#1 (see Annex B of ISO 15031-5.4)	M	xx	PID
#3	PID#2 (see Annex B of ISO 15031-5.4)	U	xx	PID
#4	PID#3 (see Annex B of ISO 15031-5.4)	U	xx	PID
#5	PID#4 (see Annex B of ISO 15031-5.4)	U	xx	PID
#6	PID#5 (see Annex B of ISO 15031-5.4)	U	xx	PID
#7	PID#6 (see Annex B of ISO 15031-5.4)	U	xx	PID
U = User Optional — the parameter may be present or not				

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I.46.2.4 Report PID values

Request current powertrain diagnostic data response message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request current powertrain diagnostic data response SID**	**M**	**41**	**SIDPR**
 #2 #3 #4 #5 #6	data record of 1st supported PID = [PID#1 data A, data B, data C, data D]	 M M C1 C1 C1	 xx xx xx xx xx	PIDREC_ PID DATA_A DATA_B DATA_C DATA_D
:	:	:	:	:
 #n-4 #n-3 #n-2 #n-1 #n	data record of mth supported PID = [PID#m data A, data B, data C, data D]	 C2 C2 C3 C3 C3	 xx xx xx xx xx	PIDREC_ PID DATA_A DATA_B DATA_C DATA_D
C1 = Conditional — “data B - D” depend on selected PID value C2 = Conditional — parameter is only present if supported by the ECU C3 = Conditional — parameters and values for “data B - D” depend on selected PID number and are only included if PID is supported by the ECU				

NOTE Not all PIDs, which are included in the request message may be supported by all emission-related ECUs, which shall comply with this specification. Therefore, each vehicle ECU, which supports at least one (1) PID, shall send a response message including the PID(s) with data.

I.46.2.5 Parameter definition

I.46.2.5.1 PIDs supported

Annex A of ISO 15031-5.4 specifies the interpretation of the data record of supported PIDs.

I.46.2.5.2 PID and data byte descriptions

Annex B of ISO 15031-5.4 specifies standardised emission-related parameters.

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I.47 SID 01h: Request current powertrain diagnostic data (Appl.Inc)

Input data:

AMP_SAE {p. 1163}	C_CLC_READY_OBD_1 {p. 7833}	C_OBD_REQ {p. 7835}	CPPWM_CPS {p. 3749}
CTR_WUP_DTC_CLR {p. 5899}	DIST_ACT_MIL {p. 5899}	DIST_DTC_CLR {p. 5899}	FAC_LAM_AD_SAE [NC_CBK_EX_NR] {p. 1014}
FAC_LAM_LIM_SAE [NC_CBK_EX_NR] {p. 1014}	FUP {p. 1283}	FUP_H_SAE {p. 5801}	FUP_MES_SAE [NC_CBK_HPP_NR]
FUP_SP_SAE [NC_CBK_HPP_NR]	IGA_IGC [NC_CYL_NR] {p. 1005}	IPLSL_COR [NC_CBK_EX_NR] {p. 2313}	LAMB_DELTA_AD_LAM_ADJ_SAE [NC_CBK_EX_NR] {p. 1014}
LAMB_DELTA_LAM_ADJ_SAE [NC_CBK_EX_NR] {p. 1014}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP_SAE {p. 1015}	LOAD_ABSV {p. 5801}
LOAD_CLC {p. 5801}	MAF_KGH_MES {p. 1192}	MAF_KGH_MES_SAE [NC_MAF_NR]	MAP_SAE {p. 1198}
N {p. 1525}	NC_CYL_NR {p. 1526}	NC_INJ_CONF {p. 626}	OBD_EGR_DIF {p. 5801}
OBD_FTL {p. 5801}	OBD_PV_1 {p. 5801}	OBD_PV_2 {p. 5801}	OBD_TAM {p. 1569}
OBD_TPS_1 {p. 5801}	OBD_TPS_2 {p. 5801}	OBD_TPS_REL {p. 5801}	OBD_TPS_SP {p. 5801}
OPG_SP_ACR {p. 3573}	STATE_CMPL_OBD {p. 5899}	STATE_ENA_OBD {p. 5899}	STATE_LS_SAE [NC_CBK_EX_NR] {p. 2448}
STATE_MIL {p. 5827}	STATE_OBD_SA {p. 808}	STATE_PSN_FUP_SAE {p. 819}	STATE_PSN_LS_SAE {p. 819}
STATE_PSN_MAF_SAE {p. 819}	STATE_PSN_TIA_SAE {p. 819}	STATE_PSN_TPS_SAE {p. 819}	STATE_VAR_SAP_SAE {p. 819}
T_ACT_MIL {p. 5899}	T_AST_SAE {p. 1766}	T_DTC_CLR {p. 5899}	TCO_MES {p. 1100}
TEG_CAT_DOWN_MDL {p. 8236}	TEG_CAT_UP_MDL [_i] {p. 8236}	TIA_MES {p. 1226}	TIA_MES_SAE [NC_SENS_NR_TIA]
TIA_THR_MES_SAE [NC_SENS_NR_TIA_THR]	TPS_REL_SAE [NC_ETC_NR]	TPS_SP_SAE [NC_ETC_NR]	VB {p. 1185}
VLS_COR_LSL [NC_CBK_EX_NR] {p. 1088}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}	VS_SAE {p. 1176}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_STATE_SRV_1_PID	V	0... FFH	0... 255	1	-
LDPM_STATE_PID_SRV_1_2_OBDC	20	0... 13H	0... 19	1	-
Table of bytes which defines the PID's supported by the service 01h (01h - A0h)					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_STATE_OBD_FUEL	V	0... FFH	0... 255	1	-
Define which type of fuel is currently being utilized by the vehicle					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_STATE_OBD_REQ_VEH	V	0... FFH	0... 255	1	-
Define which are the OBD requirements for Heavy Duty Vehicles					

Import actions:

ACTION_ERRM_ReadQuantityOfDtc (**IN**<PRM_TYPEOFDTC>,**IN**<PRM_LEVELOFDTC>,**INOUT**<PRM_QUANTITY>,**OUT**<PRM_RESULTQUANTITY>)
ACTION_ERRM_ReadReadinessCode (**INOUT**<PRM_READINESSCODE>,**OUT**<PRM_RESULTREADINESSCODE>)

General information

Depending on calibration of ID_STATE_SRV_1_PID the PID's are supported or not.

Each LDPM[0...19] of the table represents an 8 PIDs configuration:

0 => the PID is not supported
1 => the PID is supported

Application conditions:

Initialisation: –

Activation: –

Deactivation: –

Recurrence: –

Function description:

Formula section:

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I.47.1 Configuration of Emission requirements to which vehicle is designed

Description:

The vehicle is not Heavy Duty relevant, thus NC_STATE_OBD_REQ_VEH = 0h.

NC_STATE_OBD_REQ_VEH	
Function	**Hex value**
Heavy Duty Vehicles (EURO IV) B1	0E
Heavy Duty Vehicles (EURO V) B2	0F
Heavy Duty Vehicles (EURO EEC) C (gas engines)	10

Formula section:

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NC_STATE_OBD_REQ_VEH = 0h

I.47.2 Configuration of Type of fuel currently being utilized by the vehicle

Description:

The vehicle is equipped only with gasoline engines.

NC_STATE_OBD_FUEL	
Function	**Hex value**
Gasoline/petrol	01
Methanol	02
Ethanol	03
Diesel	04
Liquefied Petroleum Gas (LPG)	05
Compressed Natural Gas (CNG)	06
Propane	07
Battery/electric	08
Bi-fuel vehicle using gasoline	09
Bi-fuel vehicle using methanol	0A
Bi-fuel vehicle using ethanol	0B
Bi-fuel vehicle using LPG	0C
Bi-fuel vehicle using CNG	0D
Bi-fuel vehicle using propane	0E
Bi-fuel vehicle using battery	0F
Bi-fuel vehicle using battery and combustion engine	10
Hybrid vehicle using gasoline engine	11
Hybrid vehicle using gasoline engine on ethanol	12
Hybrid vehicle using diesel engine	13
Hybrid vehicle using battery	14
Hybrid vehicle using battery and combustion engine	15
Hybrid vehicle in regeneration mode	16

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Formula section:

NC_STATE_OBD_FUEL = 01h

I.47.3 Description of PID 00h - Defines Supported PIDs 01h - 20h

DATA A - Supported PIDs 01h to 08h

PID 00h – DATA A - Supported PID 01h to 08h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_1_PID[0]
0	PID 08h : Short term fuel trim - Bank 2	1

Continued on next page

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1	PID 07h : Long term fuel trim - Bank 1	1
2	PID 06h : Short term fuel trim - Bank 1	1
3	PID 05h : Engine coolant temperature	1
4	PID 04h : Calculated load value	1
5	PID 03h : Fuel system status	1
6	PID 02h : Trouble code that caused required freeze frame	0
7	PID 01h : DTCs and supported tests	1

DATA B - Supported PIDs 09h to 10h

PID 00h – DATA B - Supported PID 09h to 10h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_1_PID[1]
0	PID 10h : Air flow rate from MAF sensor	1
1	PID 0Fh : Intake air temperature	1
2	PID 0Eh : Ignition time advance	1
3	PID 0Dh : Vehicle speed	1
4	PID 0Ch : Engine RPM	1
5	PID 0Bh : Intake manifold absolute pressure	1
6	PID 0Ah : Fuel pressure (gauge)	1
7	PID 09h : Long term fuel trim - Bank 2	1

DATA C - Supported PIDs 11h to 18h

PID 00h – DATA C - Supported PID 11h to 18h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_1_PID[2]
0	PID 18h : Bank 2 Sensor 1 or Bank 3 Sensor 1	0
1	PID 17h : Bank 1 Sensor 4 or Bank 2 Sensor 2	0
2	PID 16h : Bank 1 Sensor 3 or Bank 2 Sensor 1	0
3	PID 15h : Bank 1 Sensor 2	1
4	PID 14h : Bank 1 Sensor 1	0
5	PID 13h : Location of oxygen sensors	1
6	PID 12h : Secondary air status	1
7	PID 11h : Absolute throttle position sensor	1

DATA D - Supported PIDs 19h to 20h

Continued on next page

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PID 00h - DATA D - Supported PID 19h to 20h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_1_PID[3]
0	PID 20h : PIDs supported ($21 - $40)	1
1	PID 1Fh : Time Since Engine Start	1
2	PID 1Eh : Auxiliary Input Status	0
3	PID 1Dh : Location of oxygen sensors	0
4	PID 1Ch : OBD requirements	1
5	PID 1Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2	0
6	PID 1Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1	0
7	PID 19h : Bank 2 Sensor 2 or Bank 3 Sensor 2	1

I.47.4 Description of PID 01h - Monitor status since DTCs cleared

PID $01 definition

PID (hex)	Description	Data byte	Scaling/bit	External test equipment SI (Metric) /English display
01	Monitor status since DTCs cleared			
	The bits in this PID shall report two pieces of information for each monitor: 1. Monitor status since DTCs were last cleared, saved in NVRAM or KAM. 2. Monitors supported on this vehicle.			
	Number of emission-related DTCs and MIL status	A (bit)	byte 1 of 4	DTC and MIL status:
	# of DTCs stored in this ECU	0-6	hex to decimal	DTC_CNT: xxxd
	Malfunction Indicator Light (MIL) Status	7	0 = MIL OFF; 1 = MIL ON	MIL: OFF or ON
	The MIL status shall indicate "OFF" during the key on, engine off bulb check unless the MIL has also been commanded "ON" for a detected malfunction.			
	Supported tests which are continuous	B (bit)	byte 2 of 4 (Low Nibble)	Support status of continuous monitors:
	Misfire monitoring	0	0 = monitor not supported (NO) 1 = monitor supported (YES)	MIS_SUP: NO or YES
	Misfire monitoring shall be supported on both, spark ignition and compression vehicles if the vehicle utilises a misfire monitor.			
	Fuel system monitoring	1	0 = monitor not supported (NO) 1 = monitor supported (YES)	FUEL_SUP: NO or YES
	Fuel system monitoring shall be supported on vehicles that utilise oxygen sensors for closed loop fuel feedback control, and utilise a fuel system monitor, typically spark ignition engines.			
	Comprehensive component monitoring	2	0 = monitor not supported (NO) 1 = monitor supported (YES)	CCM_SUP: NO or YES
	Comprehensive component monitoring shall be supported on spark ignition and compression ignition vehicles that utilise comprehensive component monitoring.			
	reserved (bit shall be reported as ‘0’)	3		- –

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PID $01 definition (continued)

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PID (hex)	Description	Data byte	Scaling/bit	External test equipment SI (Metric) /English display
	Status of continuous monitoring tests since DTC cleared:	B (bit)	byte 2 of 4 (High Nibble)	Completion status of continuous monitors since DTC cleared:
	Misfire monitoring	4	0 = monitor complete, or not applicable (YES) 1 = monitor not complete (NO)	MIS_RDY: YES or NO
	Misfire monitoring shall always indicate complete for spark ignition engines. Misfire monitoring shall indicate complete for compression ignition engines after the misfire evaluation is complete.			
	Fuel system monitoring	5	0 = monitor complete, or not applicable (YES) 1 = monitor not complete (NO)	FUEL_RDY: YES or NO
	Fuel system monitoring shall always indicate complete for both spark ignition and compression ignition engines.			
	Comprehensive component monitoring	6	0 = monitor complete, or not applicable (YES) 1 = monitor not complete (NO)	CCM_RDY: YES or NO
	Comprehensive component monitoring shall always indicate complete on both spark ignition and compression ignition engines. NOTE It can be assumed that by the time any non-continuous monitors are complete, continuous comprehensive component monitoring will also be complete. Bit 6 is allowed to always indicate "complete" on spark ignition vehicles that support other non-continuous monitors.			
	reserved (bit shall be reported as '0')	7		- –
	Supported tests run at least once per trip	C (bit)	byte 3 of 4	Support status of non-continuous monitors:
	Catalyst monitoring	0	0 = monitor not supported (NO) 1 = monitor supported (YES)	CAT_SUP: NO or YES
	Heated catalyst monitoring	1		HCAT_SUP: NO or YES
	Evaporative system monitoring	2		EVAP_SUP: NO or YES
	Secondary air system monitoring	3		AIR_SUP: NO or YES
	A/C system refrigerant monitoring	4		ACRF_SUP: NO or YES
	Oxygen sensor monitoring	5		O2S_SUP: NO or YES
	Oxygen sensor heater monitoring	6		HTR_SUP: NO or YES
	EGR system monitoring	7		EGR_SUP: NO or YES
	Status of tests run at least once per trip	D (bit)	byte 4 of 4	Completion status of non-continuous monitors since DTCs cleared:
	Catalyst monitoring	0	0 = monitor complete, or not applicable (YES) 1 = monitor not complete (NO)	CAT_RDY: YES or NO
	Heated catalyst monitoring	1		HCAT_RDY: YES or NO
	Evaporative system monitoring	2		EVAP_RDY: YES or NO
	Secondary air system monitoring	3		AIR_RDY: YES or NO
	A/C system refrigerant monitoring	4		ACRF_RDY: YES or NO
	Oxygen sensor monitoring	5		O2S_RDY: YES or NO
	Oxygen sensor heater monitoring	6		HTR_RDY: YES or NO
	EGR system monitoring	7		EGR_RDY: YES or NO

Data Byte	Application data to use		Formating conversion used
data A	(bit 0 to 6) :	NR_DTC	-
	(bit 7) :	STATE_MIL	

Continued on next page

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data B	STATE_READY_OBD_1 *	
data C	C_STATE_READY_OBD_2	
data D	STATE_READY_OBD_2	

*) The bit 0 up to 3 of this byte is calibration value C_STATE_READY_OBD_1.
The bit 4 up to 6 of this byte indicate if the tests has been performed continuously since the reinitialization of the memorized information.

Formula section:

```
ACTION_ERRM_ReadQuantityOfDtc
(
IN <OBD &  CONFIRMED>
IN <LAW>
INOUT <NR_DTC>
OUT <ResultQuantity>
)

ACTION_ERRM_ReadReadinessCode
                          (
                          INOUT < C_STATE_READY_OBD_2, STATE_READY_OBD_1,
                          STATE_READY_OBD_2>
                          OUT <ResultReadinessCode>
                          )

IF (ResultQuantity = DTC_PRESENT    OR
   ResultQuantity = NO_DTC_PRESENT) AND
   ResultReadinessCode = POSITIVE_RESPONSE
 THEN
   Positive response

ELSE
   No answer
ENDIF
```

These actions should be sent at each time we use the mode 01h PID01.
Refer to “Error management” module.

I.47.5 Description of PID 03h - Status of fuel system

```
IF          (ID_STATE_SRV_1_PID[2] &  20h)  // PID 13h is supported
THEN
 IF         (STATE_PSN_LS_SAE &  11h)
 THEN
```

PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) /English display
03	Fuel system 1 status:	A (bit)	byte 1 of 2	FUELSYS1:

Continued on next page

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	(unused bits shall be reported as '0'; no	0	1 = Open loop - has not yet satisfied conditions to go closed loop	OL
	more than one bit at a time can be set to a '1'	1	1 = Closed loop - using oxygen sensor(s) as feedback for fuel control	CL
	of that bank)	2	1 = Open loop due to driving conditions (e.g. power enrichment, deceleration enleanment)	OL-Drive
		3	1 = Open loop - due to detected system fault	OL-Fault
		4	1 = Closed loop, but fault with at least one oxygen sensor - may be using single oxygen sensor for fuel control	CL-Fault
		5-7	reserved (bits shall be reported as '0')	- –
	NOTE Fuel systems do not refer to injector banks. Fuel systems are intended to represent completely different fuel systems that can independently enter and exit closed loop fuel. Banks of injectors on a V-engine are generally not independent and share the same closed-loop enablement criteria.			
	Fuel system 2 status:	B (bit)	byte 2 of 2	FUELSYS2:
	(unused bits shall be reported as '0'; no	0	1 = Open loop - has not yet satisfied conditions to go closed loop	OL
	more than one bit at a time can be set to a '1'	1	1 = Closed loop - using oxygen sensor(s) as feedback for fuel control	CL
	of that bank)	2	1 = Open loop due to driving conditions (e.g. power enrichment, deceleration enleanment)	OL-Drive
		3	1 = Open loop - due to detected system fault	OL-Fault
		4	1 = Closed loop, but fault with at least one oxygen sensor - may be using single oxygen sensor for fuel control	CL-Fault
		5-7	reserved (bits shall be reported as '0')	- –

Data Byte	Application data to use	Formating conversion used
data A	STATE_LS_SAE[1]	no
data B	STATE_LS_SAE[2]	no

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ENDIF

I.47.6 Description of PID 04h - Calculated load value

PID $04 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
04	Calculated LOAD Value!	A	0 %	100 %	100/255 %	LOAD_PCT: xxx.x %

Continued on next page

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	The OBD regulations previously defined CLV as: (current airflow /peak airflow @ sea level) * (BARO @ sea level /BARO) * 100% Various manufacturers have implemented this calculation in a variety of ways. The following definition, although a little more restrictive, will standardise and improve the accuracy the calculation. LOAD_PCT = [current airflow] /[(peak airflow at WOT@STP as a function of rpm) * (BARO/29.92) * SQRT(298/(AAT+273))] - Where: STP = Standard Temperature and Pressure = 25°C, 29.92 in Hg BARO, SQRT = square root, - WOT = wide open throttle, AAT=Ambient Air Temperature and is in°C Characteristics of LOAD_PCT are: - Reaches 1.0 at WOT at any altitude, temperature or rpm for both naturally aspirated and boosted engines. - Indicates percent of peak available torque. - Linearly correlated with engine vacuum - Often used to schedule power enrichment. - Compression ignition engines (diesels) shall support this PID using fuel flow in place of airflow for the above calculations. NOTE Both spark ignition and compression ignition engines shall support PID $04. See PID $43 for an additional definition of engine LOAD.

Data Byte	Application data to use	Formating conversion used
data A	LOAD_CLC	no

I.47.7 Description of PID 05h - Engine coolant temperature

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
05	Engine Coolant Temperature	A	-40 °C	+215 °C	1 °C with -40 °C offset	ECT: xxx °C (xxx °F)
	ECT shall display engine coolant temperature derived from an engine coolant temperature sensor or a cylinder head temperature sensor. Many diesels do not use either sensor and may substitute Engine Oil Temperature instead.					

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Data Byte	Application data to use	Formating conversion used
data A	TCO_MES	Shift to different range

I.47.8 Description of PID 06h - Short term fuel trim - Bank 1 and Bank 3

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
06	Short Term Fuel Trim - Bank 1 (use if only 1 fuel trim value) Short Term Fuel Trim - Bank 3	A B	-100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	SHRTFT1: xxx.x % SHRTFT3: xxx.x %
	Short Term Fuel Trim Bank 1/3 shall indicate the correction being utilised by the closed loop fuel algorithm. If the fuel system is in open loop, SHRTFT1/3 shall report 0% correction. NOTE Data B shall only be included in the response message of a PID $06 if supported by the vehicle. If PID $1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 3 supported) of PID $1D if Data B of PID $06 is supported or not.					

```
IF (PID 13h is supported) THEN
     IF (Bank 1 is supported)
     THEN
```

Data Byte	Application data to use	Formating conversion used
data A	FAC_LAM_LIM_SAE[1]	Shift to different range

```
     ELSE
```

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Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	

```
    ENDIF
ENDIF
```

I.47.9 Description of PID 07h - Long term fuel trim - Bank 1 and Bank 3

PID $07 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
07	Long Term Fuel Trim - Bank 1 (use if only 1 fuel trim value) Long Term Fuel Trim - Bank 3	A B	-100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	LONGFT1: xxx.x % LONGFT3: xxx.x %
	Fuel trim correction for Bank 1/3 stored in Non-volatile RAM or Keep-alive RAM. LONGFT shall indicate the correction being utilised by the fuel control algorithm at the time the data is requested, in both open loop and closed loop fuel control. If no correction is utilised in open loop fuel, LONGFT shall report 0% correction. If long-term fuel trim is not utilised at all by the fuel control algorithm, the PID shall not be supported. NOTE Data B shall only be included in the response message of a PID $07 if supported by the vehicle. If PID $1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 3 supported) of PID $1D if Data B of PID $07 is supported or not.					

```
IF (PID 13h is supported) THEN
    IF (Bank 1 is supported)
    THEN
```

Data Byte	Application data to use	Formating conversion used
data A	FAC_LAM_AD_SAE[1]	-

```
     ELSE
```

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	

```
            ENDIF
ENDIF
```

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I.47.10 Description of PID 08h - Short term fuel trim - Bank 2 and Bank 4

PID $08 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
08	Short Term Fuel Trim - Bank 2 (use if only 1 fuel trim value) Short Term Fuel Trim - Bank 4	A B	-100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	SHRTFT2: xxx.x % SHRTFT4: xxx.x %
	Short Term Fuel Trim Bank 2/4 shall indicate the correction being utilized by the closed loop fuel algorithm. If the fuel system is in open loop, SHRTFT24 shall report 0% correction. NOTE Data B shall only be included in the response message of a PID $08 if supported by the vehicle. If PID $1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 4 supported) of PID $1D if Data B of PID $08 is supported or not.					

```
IF (PID 13h is supported)  THEN
     IF (Bank 2 is supported)
     THEN
```

Data Byte	Application data to use	Formating conversion used
data A	FAC_LAM_LIM_SAE[2]	Shift to different range

```
     ELSE
```

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	

```
     ENDIF
ENDIF
```

I.47.11 Description of PID 09h - Long term fuel trim - Bank 2 and Bank 4

PID $09 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display

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09	Long Term Fuel Trim – Bank 2 (use if only 1 fuel trim value) Long Term Fuel Trim - Bank 4	A B	-100 % (lean)	+99.22 % (rich)	100/128 % (0 % at 128)	LONGFT2: xxx.x % LONGFT4: xxx.x %
	Fuel trim correction for Bank 2/4 stored in Non-volatile RAM or Keep-alive RAM. LONGFT shall indicate the correction being utilised by the fuel control algorithm at the time the data is requested, in both open loop and closed loop fuel control. If no correction is utilised in open loop fuel, LONGFT shall report 0% correction. If long-term fuel trim is not utilised at all by the fuel control algorithm, the PID shall not be supported. NOTE Data B shall only be included in the response message of a PID $09 if supported by the vehicle.If PID $1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 4 supported) of PID $1D if Data B of PID $09 is supported or not.					

```
IF (PID 13h is supported) THEN
     IF (Bank 2 is supported)
     THEN
```

Data Byte	Application data to use	Formating conversion used
data A	FAC_LAM_AD_SAE[2]	-

```
     ELSE
     ENDIF
ENDIF
```

I.47.12 Description of PID 0Ah - Fuel pressure (gauge)

PID $0A definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
0A	Fuel Rail Pressure (gauge)	A	0 kPa(gauge)	765 kPa (gauge)	3 kPa per bit (gauge)	FRP: xxx kPa (xx.x psi)
	FRP shall display fuel rail pressure at the engine when the reading is referenced to atmosphere (gauge pressure).					

Data Byte	Application data to use	Formating conversion used
data A	FUP	Shift to different range

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I.47.13 Description of PID 0Bh - Intake manifold absolute pressure

PID $0B definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
0B	Intake Manifold Absolute Pressure	A	0 kPa (absolute)	255 kPa (absolute)	1 kPa per bit (absolute)	MAP: xxx kPa (xx.x inHg)
	MAP shall display manifold pressure derived from a Manifold Absolute Pressure sensor, if a sensor is utilised. If a vehicle uses both a MAP and MAF sensor, both the MAP and MAF PIDs shall be supported.					

Data Byte	Application data to use	Formating conversion used
data A	MAP_SAE	None

I.47.14 Description of PID 0Ch - Engine speed

PID $0C definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
0C	Engine RPM	A , B	0 min^{-1}	16383.75 min^{-1}	¼ rpm per bit	RPM: xxxxx min^{-1}

Data Byte	Application data to use	Formating conversion used
data A	MSB (N)	Shift to different range
data B	LSB (N)	Shift to different range

I.47.15 Description of PID 0Dh - Vehicle speed

PID $0D definition

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PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
0D	Vehicle Speed Sensor	A	0 km/h	255 km/h	1 km/h per bit	VSS: xxx km/h (xxx mph)
	VSS shall display vehicle road speed, if utilised by the control module strategy. Vehicle speed may be derived from a vehicle speed sensor, calculated by the PCM using other speed sensors, or obtained from the vehicle serial data communication bus.					

Data Byte	Application data to use	Formating conversion used
data A	VS_SAE	no

I.47.16 Description of PID 0Eh - Ignition timing advance

PID $0E definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
0E	Ignition Timing Advance for #1 Cylinder	A	-64 °	63.5 °	½ ° with 0 ° at 128	SPARKADV: xx °
	Ignition timing spark advance for #1 cylinder (not including mechanical advance)					

Data Byte	Application data to use	Formating conversion used
data A	IGA_IGC[0]	Shift to different range

I.47.17 Description of PID 0Fh - Intake air temperature

PID $0B definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display

Continued on next page

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0F	Intake Air Temperature	A	-40 °C	+215 °C	1 °C with -40 °C off-set	IAT: xxx °C (xxx °F)
	IAT shall display intake manifold air temperature, if utilised by the control module strategy. IAT may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.					

Data Byte	Application data to use	Formating conversion used
data A	TIA_MES	Shift to different range

I.47.18 Description of PID 10h - Air flow rate from MAF

PID $0B definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
10	Air Flow Rate from Mass Air Flow Sensor	A , B	0 g/s	655.35 g/s	0.01 g/s	MAF: xxx.xx g/s (xxxx.x lb/min)
	MAF shall display the airflow rate as measured by the MAF sensor, if a sensor is utilised.					

Data Byte	Application data to use	Formating conversion used
data A	MSB (MAF_KGH_MES)	Kg/h into g/s
data B	LSB (MAF_KGH_MES)	Kg/h into g/s

I.47.19 Description of PID 11h - Absolute throttle position sensor

PID $0A - $11 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
11	Absolute Throttle Position	A	0 %	100 %	100/255 %	TP: xxx.x %

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	Absolute throttle position (not "relative" or "learned" throttle position) shall be displayed as a normalised value, scaled from 0 to 100%. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is a 1.0 volts, TP shall display (1.0 /5.0) = 20% at closed throttle and 50% at 2.5 volts. Throttle position at idle will usually indicate greater than 0%, and throttle position at wide open throttle will usually indicate less than 100%. For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage. NOTE See PID $45 for a definition of Relative Throttle Position.

Data Byte	Application data to use	Formating conversion used
data A	OBD_TPS_1	no

I.47.20 Description of PID 12h - Commanded secondary air status

With autolearning the value for the STATE_VAR_SAP_SAE is defined to the value defined by the project.

IF (ID_STATE_SRV_1_PID[2] & 40h) **AND** (STATE_VAR_SAP_SAE <> 0)
THEN

PID $12 definition

PID (hex)	Description	Data byte	Scaling/bit	External test equipment SI (Metric) /English display
12	Commanded Secondary Air Status	A (bit)	byte 1 of 1	AIR_STAT:
	(if supported, one, and only	0	1 = upstream of first catalytic converter	AIR_STAT: UPS
	one bit at a time can be set	1	1 = downstream of first catalytic converter inlet	AIR_STAT: DNS
	to a 1)	2	1 = atmosphere /off	AIR_STAT: OFF
		3-7	reserved (bits shall be reported as '0')	- –

Data Byte	Calibration data to use	Formating conversion used
data A	STATE_OBD_SA	-

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ENDIF

I.47.21 Description of PID 13h - Location of oxygen sensors

PID $13 definition

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PID (hex)	Description	Data byte	Scaling/bit	External test equipment SI (Metric) /English display
13	Location of Oxygen Sensors	A (bit)	byte 1 of 4	O2SLOC:
	(where sensor 1 is closest	0	1 = Bank 1 - Sensor 1 present at that location	O2S11
	to the engine. Each bit	1	1 = Bank 1 - Sensor 2 present at that location	O2S12
	indicates the presence or	2	1 = Bank 1 - Sensor 3 present at that location	O2S13
	absence of an oxygen	3	1 = Bank 1 - Sensor 4 present at that location	O2S14
	sensor at the following	4	1 = Bank 2 - Sensor 1 present at that location	O2S21
	location)	5	1 = Bank 2 - Sensor 2 present at that location	O2S22
		6	1 = Bank 2 - Sensor 3 present at that location	O2S23
		7	1 = Bank 2 - Sensor 4 present at that location	O2S24

```
IF     (ID_STATE_SRV_1_PID[2] &  20h)  // PID 13h is supported
THEN   STATE_PSN_LS_SAE is defined to the value defined by the project
ELSE   STATE_PSN_LS_SAE = 0
ENDIF
```

Data Byte	Calibration data to use	Formating conversion used
data A	STATE_PSN_LS_SAE	no

I.47.22 Description of PID 15h - Bank 1 Sensor 2

PID $15 definition if PID $13 is supported!

PID (hex)	Description Use if PID $13 or PID $1D are supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
15	Oxygen Sensor Output Voltage Bank 1 – Sensor 2	A	0 V	1.275 V	0.005 V	O2Sxy: x.xxx V
	Short Term Fuel Trim (B1-S2) (associated with this sensor $FF if this sensor is not used in the calculation)	B	-100.00 % (lean)	99.22 % (rich)	100/128 % (0 % at 128)	SHRTFTxy: xxx.x %
	These PIDs shall be used for a conventional, 0 to 1 Volt oxygen sensor. Any sensor with a different full scale value shall be normalised to provide nominal full scale at $C8 (200 decimal). Wide-range/linear oxygen sensors shall use PID $25 or PID $35.					

```
IF (PID 13h is supported) THEN
     IF (Bank 1 sensor 2 is supported) THEN
```

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Data Byte	Application data to use	Formating conversion used
data A	VLS_DOWN[1]	-
data B	0xFF	

```
    ELSE
```

Data Byte	Application data to use	Formating conversion used
data A	NONE	-
data B	NONE	

```
    ENDIF
ENDIF
```

I.47.23 Description of PID 19h - Bank 2 Sensor 2 or Bank 3 Sensor 2

PID $19 definition if PID $13 is supported!

PID (hex)	Description Use if PID $13 is supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
19	Oxygen Sensor Output Voltage Bank 2 – Sensor 2	A	0 V	1.275 V	0.005 V	O2Sxy: x.xxx V
	Short Term Fuel Trim (B2-S2) (associated with this sensor $FF if this sensor is not used in the calculation)	B	-100.00 % (lean)	99.22 % (rich)	100/128 % (0 % at 128)	SHRTFTxy: xxx.x %
	These PIDs shall be used for a conventional, 0 to 1 Volt oxygen sensor. Any sensor with a different full scale value shall be normalised to provide nominal full scale at $C8 (200 decimal). Wide-range/linear oxygen sensors shall use PID $29 or PID $39.					

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```
IF (PID 13h is supported) THEN
     IF (Bank 2 sensor 2 is supported) THEN
```

Data Byte	Application data to use	Formating conversion used
Data A	VLS_DOWN[2]	-
Data B	0xFF	

```
    ELSE
```


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Data Byte	Application data to use	Formating conversion used
Data A	NONE	-
Data B	NONE	

```
   ENDIF
ENDIF
```

I.47.24 Description of PID 1Ch - OBD requirements

PID $1C definition

PID (hex)	Description	Data byte	Scaling	External test equipment SI (Metric) /English display
1C	OBD requirements to which vehicle is designed	A (hex)	byte 1 of 1 (State Encoded Variable)	OBDSUP:
		01	OBD II (California ARB)	OBD II
		02	OBD (Federal EPA)	OBD
		03	OBD and OBD II	OBD and OBD II
		04	OBD I	OBD I
		05	Not OBD compliant	NO OBD
		06	EOBD	EOBD
		07	EOBD and OBD II	EOBD and OBD II
		08	EOBD and OBD	EOBD and OBD
		09	EOBD, OBD and OBD II	EOBD, OBD and OBD II
		0A - FF	reserved by document	- –

Data Byte	Calibration data to use	Formating conversion used
data A	C_OBD_REQ	-

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I.47.25 Description of PID 1Fh - Time Since Engine Start

PID $1F definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
1F	Time Since Engine Start	A , B	0 sec.	65,535 sec.	1 second per count	RUNTM: xxxxx sec.

Continued on next page

	RUNTM shall increment while the engine is running. It shall freeze if the engine stalls. RUNTM shall be reset to zero during every control module power-up and when entering the key-on, engine off position. RUNTM is limited to 65,535 seconds and shall not wrap around to zero.

Data Byte	Application data to use	Formating conversion used
data A	MSB (T_AST_SAE)	-
data B	LSB (T_AST_SAE)	-

I.47.26 Description of PID 20h - Supported PIDs 21h - 40h

0 : the PID is not used
1 : the PID is used

DATA A - Supported PIDs 21h - 28h

PID 20h - DATA A - Supported PID 21h to 28h		
BIT	**Function**	**Bitmask: ID_STATE_SRV_1_PID[4]**
0	PID 28h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	1
1	PID 27h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	0
2	PID 26h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	0
3	PID 25h : Bank 1 Sensor 2 (Wide range O2S)	0
4	PID 24h : Bank 1 Sensor 1 (Wide range O2S)	1
5	PID 23h : Fuel pressure high-range (gauge)	1
6	PID 22h : Relative fuel pressure	0
7	PID 21h : Distance travelled while MIL is activated	1

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DATA B - Supported PIDs 29h to 30h

PID 20h - DATA B - Supported PID 29h to 30h		
BIT	**Function**	**Bitmask: ID_STATE_SRV_1_PID[5]**
0	PID 30h : Number of warm-ups since diagnostic trouble codes cleared	1
1	PID 2Fh : Fuel Level Input	1
2	PID 2Eh : Commanded Evaporative Purge	1
3	PID 2Dh : EGR Error	1
4	PID 2Ch : Command EGR	1
5	PID 2Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	0

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6	PID 2Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	0
7	PID 29h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	0

DATA C - Supported PIDs 31h to 38h

PID 20h - DATA C - Supported PID 31h to 38h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_1_PID[6]
0	PID 38h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	1
1	PID 37h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	0
2	PID 36h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	0
3	PID 35h : Bank 1 Sensor 2 (Wide range O2S)	0
4	PID 34h : Bank 1 Sensor 1 (Wide range O2S)	1
5	PID 33h : Barometric Pressure	1
6	PID 32h : Evap System Vapor Pressure	0
7	PID 31h : Distance since diagnostic trouble codes cleared	1

DATA D - Supported PIDs 39h to 40h

PID 20h - DATA D - Supported PID 39h to 40h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_1_PID[7]
0	PID 40h : PIDs supported ($41 - $60)	1
1	PID 3Fh : Catalyst Temperature Bank 2, Sensor 2	1
2	PID 3Eh : Catalyst Temperature Bank 1, Sensor 2	1
3	PID 3Dh : Catalyst Temperature Bank 2, Sensor 1	1
4	PID 3Ch : Catalyst Temperature Bank 1, Sensor 1	1
5	PID 3Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	0
6	PID 3Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	0
7	PID 39h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	0

I.47.27 Description of PID 21h - Distance travelled while MIL is activated

PID $21 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
21	**Distance Travelled While MIL is Activated**	A , B	0 km	65535 km	1 km per count	MIL_DIST: xxxxx km (xxxxx miles)

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	Conditions for “Distance travelled” counter: • reset to $0000 when MIL state changes from deactivated to activated by this ECU • accumulate counts in km if MIL is activated (ON) • do not change value while MIL is not activated (OFF) • reset to $0000 if diagnostic information is cleared either by service $04 or 40 warm-up cycles without MIL activated • do not wrap to $0000 if value is $FFFF	

Data Byte	Application data to use	Formating conversion used
data A	MSB (DIST_ACT_MIL)	-
data B	LSB (DIST_ACT_MIL)	

I.47.28 Description of PID 23h - Fuel Rail Pressure

```
IF          NC_INF_CONF <> 0   (only supported for MSD)
THEN
```

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
23	Fuel rail pressure	A , B	0 kPa	655350 kPa	10 kPa per bit unsigned, 1 kPA = 0.1450377 PSI	FRP: xxxxxx kPa (xxxxx.x PSI
	FRP shall display fuel rail pressure at the engine when the reading is referenced to atmosphere (gauge pressure)					

Data Byte	Application data to use	Formatting conversion used
data A	MSB (FUP_H_SAE)	Shift to different range
data B	LSB (FUP_H_SAE)	Shift to different range

```
ENDIF
```

I.47.29 Description of PID 24h - Bank 1 Sensor 1 (Wide range)

PID $24 definition

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PID (hex)	Description Use if PID $13 or PID $1D is supported!	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
24	Equivalence Ratio (lambda) (B1-S1) Bank 1 – Sensor 1 (wide range O2S)	A , B	0	1.999	- 0.0000305	EQ_RATxy: x.xxx
	Oxygen Sensor Voltage (B1-S1)	C , D	0 V	7.999 V	0.000122 V	O2Sxy: x.xxx V
	PID $24 shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and voltage are displayed					

```
IF (PID 13h is supported) THEN
     IF (Bank 1 is supported) THEN
```

Data Byte	Application data to use	Formating conversion used
data A	MSB (LAMB_LS_UP[1])	Shift to different range
data B	LSB (LAMB_LS_UP[1])	=
data C	MSB (VLS_COR_LSL[1])	=
data D	LSB (VLS_COR_LSL[1])	=

```
     ELSE
```

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	=
data C	NONE	=
data D	NONE	=

```
     ENDIF
ENDIF
```

I.47.30 Description of PID 28h - Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range)

PID $28 definition if PID $13 is supported

PID	Description	Data	Min.	Max.	Scaling/ bit	External test equipment
						Continued on next page

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(hex)	Use if PID $13 is supported!	byte	value	value		SI (Metric) /English display
28	Equivalence Ratio (lambda) Bank 2 – Sensor 1 (wide range O2S)	A , B	0	1.999	- 0.0000305	EQ_RATxy: x.xxx
	Oxygen Sensor Voltage (B2-S1)	C , D	0 V	7.999 V	0.000122 V	O2Sxy: x.xxx V
	PIDs $28 shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and voltage are displayed					

```
IF (PID 13h is supported) THEN
     IF (Bank 2 is supported) THEN
```

Data Byte	Application data to use	Formating conversion used
data A	MSB (LAMB_LS_UP[2])	Shift to different range
data B	LSB (LAMB_LS_UP[2])	=
data C	MSB (VLS_COR_LSL[2])	=
data D	LSB (VLS_COR_LSL[2])	=

```
     ELSE
```

Data Byte	Application data to use	Formating conversion used
data A	NONE	Shift to different range
data B	NONE	=
data C	NONE	=
data D	NONE	=

```
     ENDIF
ENDIF
```

I.47.31 Description of PID 2C - Commanded EGR

```
IF          NC_INJ_CONF <> 0   (only supported for MSD)
THEN
```

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display

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2C	Commanded EGR	A	0% (no flow)	100% (max. flow)	100/255 %	EGR_PCT: xxx.x%
	Commanded EGR displayed as a percent. EGR_PCT shall be normalised to the maximum EGR commanded output control parameter. EGR systems use a variety of methods to control the amount of EGR delivered to the engine. 1) If an on/off solenoid is used – EGR_PCT shall display 0% when the EGR is commanded off, 100% when the EGR system is commanded on. 2) If a vacuum solenoid is duty cycled, the EGR duty cycle from 0 to 100% shall be displayed. 3) If a linear or stepper motor valve is used, the fully closed position shall be displayed as 0%, the fully open position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. For example, a stepper-motor EGR valve that moves from 0 to 128 counts shall display 0% at 0 counts, 100% at 128 counts and 50% at 64 coun 4) Any other actuation method shall be normalised to display 0% when no EGR is commanded and 100% at the maximum commanded EGR position.					

Data Byte	Application data to use	Formating conversion used
data A	OPG_SP_ACR	Shift to different range

ENDIF

I.47.32 Description of PID 2D definition - EGR Error

IF NC_INJ_CONF <> 0 *(only supported for MSD)*
THEN

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
2D	EGR Error = (EGR actual – EGR commanded) /EGR commanded * 100%	A	-100 % (less than commanded)	+99.22 % (more than commanded)	100/128 % (0 % at 128)	EGR_ERR: xxx.x%

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	EGR error, as a percent of commanded EGR. Often, EGR valve control outputs are not in the same engineering units as the EGR feedback input sensors. For example, an EGR valve can be controlled using a duty-cycled vacuum solenoid, however, the feedback input sensor is a position sensor. This makes it impossible to display "actual" versus "commanded" in the same engineering units. EGR error solved this problem by displaying a normalised (non-dimensional) EGR system feedback parameter. EGR error is defined to be: (actual EGR – commanded EGR) /commanded EGR. For example if 10% EGR is commanded and 5% is delivered to the engine, the EGR_ERR is (5% - 10%) /10 = -50% error. EGR_ERR may be computed using various control parameters such as position, steps, counts, etc. All EGR systems must react to quickly changing conditions in the engine; therefore, EGR_ERR will generally show errors during transient conditions. Under steady condition, the error will be minimized (no necessarily zero, however) if the EGR system is under control. If the control system does not use closed loop control, EGR_ERR shall not be supported.

Data Byte	Application data to use	Formating conversion used
data A	OBD_EGR_DIF	-

ENDIF

I.47.33 Description of PID 2Eh - Commanded Evaporative Purge

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
2E	Commanded Evaporative Purge	A	0% no flow	100% max. flow	100/255 %	EVAP_PCT: xxx.x %
	Commanded evaporative purge control valve displayed as a percent. EVAP_PCT shall be normalised to the maximum EVAP purge commanded output control parameter. 1) If an on/off solenoid is used – EVAP_PCT shall display 0% when purge is commanded off, 100% when purge is commanded on. 2) If a vacuum solenoid is duty cycled, the EVAP purge valve duty cycle from 0 to 100% shall be displayed. 3) If a linear or stepper motor valve is used, the fully closed position shall be displayed as 0%, the fully open position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open position. For example, a stepper-motor EVAP purge valve that moves from 0 to 128 counts shall display 0% at 0 counts, 100% at 128 counts and 50% at 64 counts. 4) Any other actuation method shall be normalised to display 0% when no purge is commanded and 100% at the maximum commanded purge position/flow.					

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Data Byte	Application data to use	Formating conversion used
data A	CPPWM_CPS	-

I.47.34 Description of PID 2Fh - Fuel Level Input

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
2F	Fuel Level Input	A	0% no fuel	100% max. fuel capacity	100/255 %	FLI: xxx.x %
	FLI shall indicate nominal fuel tank liquid fill capacity as a percent of maximum, if utilised by the control module for OBD monitoring . FLI may be obtained directly from a sensor, may be obtained indirectly via the vehicle serial data communication bus, or may be inferred by the control strategy using other sensor inputs. Vehicles that use gaseous fuels shall display the percent of useable fuel capacity.					

Data Byte	Application data to use	Formating conversion used
data A	OBD_FTL	no

I.47.35 Description of PID 30h - Number of warm-ups since diagnostic trouble codes cleared

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
30	Number of warm-ups since diagnostic trouble codes cleared	A	0	255	1 warm-up per count	WARM_UPS: xxx
	Number of OBD warm-up cycles since all DTCs were cleared (via an external test eqiupment or possibly, a battery disconnect). A warm-up is defined in the OBD regulations to be sufficient vehicle operation such that coolant temperature rises by at least 22^{o}C (40^{o}F) from engine starting and reaches a minimum temperature of 70^{o}C (160 deg^{o}F) (60^{o}C (140^{o}F) for diesels). This PID is not associated with any particular DTC. It is simply an indication for I/M, of the last time an external test equipment was used to clear DTCs. If greater than 255 warm ups have occurred, WARM_UPS shall remain at 255 and not wrap to zero.					

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Data Byte	Application data to use	Formating conversion used
data A	CTR_WUP_DTC_CLR	-

I.47.36 Description of PID 31h - Distance since diagnostic trouble codes cleared

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
31	Distance since diagnostic trouble codes cleared (same scaling as PID $21)	A , B	0 km	65,535 km	1 km per count	CLR_DIST: xxxxx km (xxxxx miles)
	Distance accumulated since DTCs were cleared (via an external test equipment or possibly, a battery disconnect). This PID is not associated with any particular DTC. It is simply an indication for I/M (Inspection/ Maintenance), of the last time an external test equipment was used to clear DTCs. If greater than 65,535 km have occurred, CLR_DIST shall remain at 65,535 km and not wrap to zero.					

Data Byte	Application data to use	Formating conversion used
data A	MSB(DIST_DTC_CLR)	-
data B	LSB(DIST_DTC_CLR)	

I.47.37 Description of PID 33h - Barometric Pressure

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
33	Barometric Pressure	A	0 kPa (absolute)	255 kPa (absolute)	1 kPa per bit (absolute)	BARO: xxx kPa (xx.x inHg)

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	Barometric pressure utilised by the control module. BARO is normally obtained from a dedicated BARO sensor, from a MAP sensor at key-on and during certain modes of driving, or inferred from a MAF sensor and other inputs during certain modes of driving. The control module shall report BARO from whatever source it is derived from. NOTE Some weather services report local BARO values adjusted to sea level. In these cases, the reported value may not match the displayed value on the external test equipment. NOTE If BARO is inferred while driving and stored in non-volatile RAM or Keep-alive RAM, BARO may not be accurate after a battery disconnect or total memory clear.

Data Byte	Application data to use	Formating conversion used
data A	AMP_SAE	Shift to different range

I.47.38 Description of PID 34h - Bank 1 Sensor 1 (Wide range)

PID $34 definition if PID $13 is supported

PID (hex)	Description Use if PID $13 or PID $1D is supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
34	Equivalence Ratio (lambda) Bank 1 - Sensor 1 (wide range O2S)	A , B	0	1.999	0.0000305	EQ_RATxy: x.xxx
	Oxygen Sensor Current (B1-S1)	C , D	-128 mA	- 127.996 mA	0.00390625 mA ($8000 = 0 mA)	O2Sxy: x.xxx mA
	PID $34 shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and current are displayed					

```
IF (PID 13h is supported) THEN
     IF (Bank 1 is supported) THEN
```

Data Byte	Application data to use	Formating conversion used
data A	LAMB_LS_UP[1]	-
data B	LAMB_LS_UP[1]	
data C	IPLSL_COR[1]	-
data D	IPLSL_COR[1]	

```
     ELSE
```

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Data Byte	Application data to use	Formating conversion used
data A	NONE	-
data B	NONE	
data C	NONE	-
data D	NONE	

```
    ENDIF
ENDIF
```

I.47.39 Description of PID 38h - Bank 2 Sensor 1 (Wide range)

PID $38 definition if PID $13 is supported

PID (hex)	Description Use if PID $13 is supported!	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
38	Equivalence Ratio (lambda) Bank 2 - Sensor 1 (wide range O2S)	A , B	0	1.999	0.0000305	EQ_RATxy: x.xxx
	Oxygen Sensor Current (B2-S1)	C , D	-128 mA	- 127.996 mA	0.00390625 mA ($8000 = 0 mA)	O2Sxy: x.xxx mA
	PIDs $38 shall be used for linear or wide-ratio Oxygen Sensors when equivalence ratio and current are displayed					

```
IF (PID 13h is supported) THEN
    IF (Bank 2 is supported) THEN
```

Data Byte	Application data to use	Formating conversion used
data A	LAMB_LS_UP[2]	-
data B	LAMB_LS_UP[2]	
data C	IPLSL_COR[2]	-
data D	IPLSL_COR[2]	

```
    ELSE
```

Data Byte	Application data to use	Formating conversion used
data A	NONE	-
data B	NONE	
data C	NONE	-
data D	NONE	

```
    ENDIF
```

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ENDIF

I.47.40 Description of PID 3C - Catalyst temperature Bank 1, Sensor 1

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
3C	Catalyst Temperature Bank 1, Sensor 1	A , B	-40 °C	+6513.5 °C	0.1 °C /bit with -40 °C offset	CATEMP11: xxxx.x °C (xxxx.x °F)
	CATEMP11 shall display catalyst substrate temperature for a bank 1 catalyst, if utilised by the control module strategy for OBD monitoring, or the Bank 1, Sensor 1 catalyst temperature sensor. CATEMP11 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.					

Data Byte	Application data to use	Formating conversion used
data A	MSB(TEG_CAT_UP_MDL[1])	Shift to different range
data B	LSB(TEG_CAT_UP_MDL[1])	=

I.47.41 Description of PID 3D - Catalyst temperature Bank 2, Sensor 1

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
3D	Catalyst Temperature Bank 2, Sensor 1	A , B	-40 °C	+6513.5 °C	0.1 °C /bit with -40 °C offset	CATEMP21: xxxx.x °C (xxxx.x °F)
	CATEMP21 shall display catalyst substrate temperature for a bank 2 catalyst, if utilised by the control module strategy for OBD monitoring, or the Bank 2, Sensor 1 catalyst temperature sensor. CATEMP21 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.					

Data Byte	Application data to use	Formating conversion used
data A	MSB(TEG_CAT_UP_MDL[2])	Shift to different range
data B	LSB(TEG_CAT_UP_MDL[2])	=

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I.47.42 Description of PID 3E - Catalyst temperature Bank 1, Sensor 2

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
3E	Catalyst Temperature Bank 1, Sensor 2	A , B	-40 °C	+6513.5 °C	0.1 °C /bit with -40 °C offset	CATEMP12: xxxx.x °C (xxxx.x °F)
	CATEMP12 shall display catalyst substrate temperature for an additional bank 1 catalyst, if utilised by the control module strategy for OBD monitoring, or the Bank 1, Sensor 2 catalyst temperature sensor. CATEMP12 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.					

Data Byte	Application data to use	Formating conversion used
data A	MSB(TEG_CAT_DOWN_MDL[1])	Shift to different range
data B	LSB(TEG_CAT_DOWN_MDL[1])	=

I.47.43 Description of PID 3F - Catalyst temperature Bank 2, Sensor 2

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
3F	Catalyst Temperature Bank 2, Sensor 2	A , B	-40 °C	+6513.5 °C	0.1 °C /bit with -40 °C offset	CATEMP22: xxxx.x °C (xxxx.x °F)
	CATEMP22 shall display catalyst substrate temperature for an additional bank 2 catalyst, if utilised by the control module strategy for OBD monitoring, or the Bank 2, Sensor 2 catalyst temperature sensor. CATEMP22 may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.					

Data Byte	Application data to use	Formating conversion used
data A	MSB(TEG_CAT_DOWN_MDL[2])	Shift to different range
data B	LSB(TEG_CAT_DOWN_MDL[2])	=

I.47.44 Description of PID 40h - Supported PIDs 41h - 60h

0 : the PID is not used
1 : the PID is used

DATA A - Supported PIDs 41h - 48h

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PID 40h - DATA A - Supported PID 41h to 48h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[8]
0	PID 48h : Absolute Throttle Position C	0
1	PID 47h : Absolute Throttle Position B	1
2	PID 46h : Ambient air temperature	1
3	PID 45h : Relative Throttle Position	1
4	PID 44h : Command Equivalence Ratio	1
5	PID 43h : Absolue Load Value	1
6	PID 42h : Control module voltage	1
7	PID 41h : Monitor status this driving cycle	1

DATA A - Supported PIDs 49h - 50h

PID 40h - DATA B - Supported PID 49h to 50h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[9]
0	PID 50h : Max. value for Air Flow Rate	0
1	PID 4Fh : Max. value for Equivalence Ratio	0
2	PID 4Eh : Time since diagnostic trouble codes cleared	1
3	PID 4Dh : Minutes run by the engine while MIL activated	1
4	PID 4Ch : Commanded Throttle Actuator Control	1
5	PID 4Bh : Accelerator Pedal Position F	0
6	PID 4Ah : Accelerator Pedal Position E	1
7	PID 49h : Accelerator Pedal Position D	1

DATA C - Supported PIDs 51h to 58h

PID 40h - DATA C - Supported PID 51h to 58h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[10]
0	PID 58h : Long term fuel trim Bank 2	1
1	PID 57h : Short term fuel trim Bank 2	1
2	PID 56h : Long term fuel trim Bank 1	1
3	PID 55h : Short term fuel trim Bank 1	1
4	PID 54h : Evap System Vapor Pressure	0
5	PID 53h : Absolute Evap System Vapor Pressure	0
6	PID 52h : Alcohol Fuel Percentage	0
7	PID 51h : Type of fuel used by the vehicle	0

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DATA D - Supported PIDs 59h to 60h

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PID 40h - DATA D - Supported PID 59h to 60h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_1_PID[11]
0	PID 60h : PIDs supported ($61 - $80)	1 (If NC_CYL_NR = 8)
1	PID 5Fh : Emission requirements to which vehicle is designed	0
2	PID 5Eh : Engine Fuel Rate	0
3	PID 5Dh : Fuel Injection Timing	0
4	PID 5Ch : Engine Oil Temperature	0
5	PID 5Bh : Hybrid Battery Pack Remaining Life	0
6	PID 5Ah : Relative Accelerator Pedal Position	0
7	PID 59h : Fuel Rail Pressure (absolute)	0

I.47.45 Description of PID 41 - Monitor status this driving cycle

PID $41 definition

PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) /English display
41	Monitor status this driving cycle			
	The bit in this PID shall report two pieces of information for each monitor: 1) Monitor enable status for the current driving cycle. This bit shall indicate when a monitor is disabled in a manner such that there is no way for the driver to operate the vehicle for the remainder of the driving cycle and make the monitor run. Typical examples are: Engine-off soak not long enough (e.g., cold start temperature conditions not satisfied) Monitor maximum time limit or number of attempts/aborts exceeded Ambient air temperature too low or too high BARO too low (high altitude) The monitor shall not indicate "disabled" for operator-controlled conditions such as rpm, load, throttle position, minimum time limit not exceeded, ECT, TP, etc. 2) Monitor completion status for the current driving/monitoring cycle. Status shall be reset to "not complete" upon starting a new monitoring cycle. Note that some monitoring cycles can include various engine-operating conditions; other monitoring cycles begin after the ignition key is turned off. Some status bits on a given vehicle can utilise engine-running monitoring cycles while others can utilise engine-off monitoring cycles. Resetting the bits to "not complete" upon starting the engine will accommodate most engine-running and engine-off monitoring cycles, however, manufacturers are free to define their own monitoring cycles. NOTE PID $41 bits shall be utilised for all non-continuous monitors which are supported, and change completion status in PID $01. If a non-continuous monitor is not supported or always shows "complete", the corresponding PID $41 bits shall indicate disabled and complete. PID $41 bits may be utilised at the vehicle manufacturer's discretion for all continuous monitors which are supported with the exception of bit 03 which shall always showed CCM as enabled for spark ignition and compression ignition engines.			

PID $41 definition (continued)

PID	Description	Data	Scaling/bit	External test equipment

Continued on next page

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(hex)		Byte		SI (Metric) /English display
41	Monitor status this driving cycle			
		A (bit)	**byte 1 of 4**	
	Reserved - shall be reported as $00	0-7		- –
	Enable status of continuous monitors this monitoring cycle:	**B (bit)**	**byte 2 of 4 (Low Nibble)**	**Enable status of continuous monitors this monitoring cycle: NO means disabled for rest of this monitoring cycle or not supported in PID $01, YES means enabled for this monitoring cycle.**
	Misfire monitoring	0	0 = monitor disabled for rest of this monitoring cycle or not supported (NO) 1 = monitor enabled for this monitoring cycle (YES)	MIS_ENA: NO or YES FUEL_ENA: NO or YES CCM_ENA: YES
	Fuel system monitoring	1		
	Comprehensive component monitoring	2		
	reserved (bit shall be reported as '0')	3		

PID $41 definition (continued)

PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) /English display
41	Monitor status this driving cycle			
	Completion status of continuous monitors this monitoring cycle:	**B (bit)**	**byte 2 of 4 (High Nibble)**	**Completion status of continuous monitors this monitoring cycle:**
	Misfire monitoring C_CLC_READY_OBD_1[0]	4	See PID $01 to determine which monitors are supported 0 = monitor complete this monitoring cycle, or not supported (YES) 1 = monitor not complete this monitoring cycle (NO)	MIS_ CMPL: YES or NO FUELCMPL: YES or NO CCM_ CMPL: YES or NO
	Fuel system monitoring C_CLC_READY_OBD_1[1]	5		
	Comprehensive component monitoring C_CLC_READY_OBD_1[2]	6		
	reserved (bit shall be reported as '0') C_CLC_READY_OBD_1[3]	7		

PID $41 definition (continued)

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PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) /English display
41	Monitor status this driving cycle			
	Enable status of non-continuous monitors this monitoring cycle:	**C (bit)**	**byte 3 of 4**	**Enable status of non-continuous monitors this monitoring cycle:**
	Catalyst monitoring	0	0 = monitor disabled for rest of this monitoring cycle (NO) 1 = monitor enabled for this monitoring cycle (YES)	CAT_ENA: YES or NO
	Heated catalyst monitoring	1		HCAT_ENA: YES or NO
	Evaporative system monitoring	2		EVAP_ENA: YES or NO
	Secondary air system monitoring	3		AIR_ENA: YES or NO
	A/C system refrigerant monitoring	4		ACRF_ENA: YES or NO
	Oxygen sensor monitoring	5		O2S_ENA: YES or NO
	Oxygen sensor heater monitoring	6		HTR_ENA: YES or NO
	EGR system monitoring	7		EGR_ENA: YES or NO

PID $41 definition (continued)

PID (hex)	Description	Data Byte	Scaling/bit	External test equipment SI (Metric) /English display
41	Monitor status this driving cycle			
	Completion status of non-continuous monitors this monitoring cycle:	**D (bit)**	**byte 4 of 4**	**Completion status of non-continuous monitors this monitoring cycle:**
	Catalyst monitoring	0	See PID $01 to determine which monitors are supported. 0 = monitor complete this monitoring cycle, or not supported (YES) 1 = monitor not complete this monitoring cycle (NO)	CAT_CMPL: YES or NO
	Heated catalyst monitoring	1		HCATCMPL: YES or NO
	Evaporative system monitoring	2		EVAPCMPL: YES or NO
	Secondary air system monitoring	3		AIR_CMPL: YES or NO
	A/C system refrigerant monitoring	4		ACRFCMPL: YES or NO
	Oxygen sensor monitoring	5		O2S_CMPL: YES or NO
	Oxygen sensor heater monitoring	6		HTR_CMPL: YES or NO
	EGR system monitoring	7		EGR_CMPL: YES or NO

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Data Byte	Application data to use	Formating conversion used
data A	0x00	-
data B	C_CLC_READY_OBD_1[0...3] + STATE_ENA_OBD[0...3]	
data C	STATE_ENA_OBD[8..15]	

Continued on next page

data D	STATE_CMPL_OBD[8..15]	

I.47.46 Description of PID 42 - Control module voltage

PID $42 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
42	Control module voltage	A , B	0 V	65.535 V	0.001 V per bit	VPWR: xx.xxx V
	VPWR – power input to the control module. VPWR is normally battery voltage, less any voltage drop in the circuit between the battery and the control module. NOTE 42-volt vehicles may utilise multiple voltages for different systems on the vehicle. VPWR represents the voltage at the control module; it may be significantly different than battery voltage.					

Data Byte	Application data to use	Formating conversion used
data A	MSB (VB)	Shift to different range
data B	LSB (VB)	

I.47.47 Description of PID 43 - Absolute Load Value

PID $43 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
43	Absolute Load Value	A , B	0 %	25700%	100/255 %	LOAD_ABS: xxx.x%

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	The absolute load value has some different characteristics than the LOAD_PCT defined in PID 04 This definition, although restrictive, will standardise the calculation. LOAD_ABS is the normalised value of air mass per intake stroke displayed as a percent. LOAD_ABS = [air mass (g/intake stroke)] /[1.184 (g/intake stroke) * cylinder displacement in litres] Derivation: air mass (g /intake stroke) = [total engine air mass (g/sec)] /[rpm (revs/min)* (1 min /60 sec) * (1/2 # of cylinders (strokes /rev)] LOAD_ABS = [air mass (g)/intake stroke] /[maximum air mass (g)/intake stroke at WOT@STP at 100% volumetric efficiency] * 100% Where: STP = Standard Temperature and Pressure = 25^{o}C, 29.92 in Hg (1013 hPa) BARO, WOT = wide open throttle The quantity (maximum air mass (g)/intake stoke at WOT@STP at 100% volumetric efficiency) is a constant for a given cylinder swept volume. The constant is 1.184 (g/litre 3) * cylinder displacement (litre 3/intake stroke) based on air density at STP Characteristics of LOAD_ABS are: Ranges from 0 to approximately 0.95 for naturally aspirated engines, 0 – 4 for boosted engines Linearly correlated with engine indicated and brake torque Often used to schedule spark and EGR rates Peak value of LOAD_ABS correlates with volumetric efficiency at WOT. Indicates the pumping efficiency of the engine for diagnostic purposes. Spark ignition engine are required to support PID $43. Compression ignition (diesel) engines are not required to support this PID. NOTE See PID $04 for an additional definition of engine LOAD..

Data Byte	Application data to use	Formating conversion used
data A	MSB (LOAD_ABSV)	no
data B	LSB (LOAD_ABSV)	no

I.47.48 Description of PID 44 - Commanded Equivalence Ratio

Table .1 — PID $44 definition

PID	Description	Data	Min.	Max.	Scaling/ bit	External test equipment
(hex)		byte	value	value		SI (Metric) /English display
44	Commanded Equivalence Ratio	A , B	0	1.999	0.0000305	EQ_RAT: x.xxx

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	Fuel systems that utilise conventional oxygen sensor shall display the commanded open loop equivalence ratio while the fuel control system is in open loop. EQ_RAT shall indicate 1.0 while in closed loop fuel. Fuel systems that utilise wide-range/linear oxygen sensors shall display the commanded equivalence ratio in both open loop and closed loop operation. To obtain the actual A/F ratio being commanded, multiply the stoichiometric A/F ratio by the equivalence ratio. For example, for gasoline, stoichiometric is 14.64:1 ratio. If the fuel control system was commanding an 0.95 EQ_RAT, the commanded A/F ratio to the engine would be 14.64 * 0.95 = 13.9 A/F

Data Byte	Application data to use	Formating conversion used
data A	MSB(LAMB_SP_SAE[1])	Shift to different resolution
data B	LSB(LAMB_SP_SAE[1])	=

I.47.49 Description of PID 45 - Relative Throttle Position

PID $45 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
45	Relative Throttle Position	A	0 %	100 %	100/255 %	TP_R: xxx.x %
	Relative or "learned" throttle position shall be displayed as a normalised value, scaled from 0 to 100%. TP_R should display a value of 0% at the "learned closed-throttle position. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is a 1.0 volts, TP shall display (1.0 – 1.0 /5.0) = 0% at closed throttle and 30% at 2.5 volts. Because of the closed-throttle offset, wide open throttle will usually indicate substantially less than 100%. For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage. See PID $11 for a definition of Absolute Throttle Position.					

Data Byte	Application data to use	Formating conversion used
data A	OBD_TPS_REL	-

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I.47.50 Description of PID 46 - Ambient air temperature

-

PID $46 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
46	Ambient air temperature (same scaling as IAT - $0F)	A	-40 °C	+215 °C	1 °C with -40 °C offset	AAT: xxx °C /xxx °F
	AAT shall display ambient air temperature, if utilised by the control module strategy for OBD monitoring. AAT may be obtained directly from a sensor, may be obtained indirectly via the vehicle serial data communication bus, or may be inferred by the control strategy using other sensor inputs.					

Data Byte	Application data to use	Formating conversion used
data A	OBD_TAM	-

I.47.51 Description of PID 47 - Absolute Throttle Position B

PID $47 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
47	Absolute Throttle Position B	A	0 %	100 %	100/255 %	TP_B: xxx.x %
	Absolute throttle position B, if utilised by the control module, (not "relative" or "learned" throttle position) shall be displayed as a normalised value, scaled from 0 to 100%. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is a 1.0 volts, TP_B shall display (1.0 /5.0) = 20% at closed throttle and 50% at 2.5 volts. Throttle position at idle will usually indicate greater than 0%, and throttle position at wide open throttle will usually indicate less than 100%. For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage.					

Data Byte	Application data to use	Formating conversion used
data A	OBD_TPS_2	-

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I.47.52 Description of PID 49 - Accelerator Pedal Position D

PID $49 definition

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PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
49	Accelerator Pedal Position D	A	0 %	100 %	100/255 %	APP_D: xxx.x %
	Accelerator Pedal Position D, if utilised by the control module, (not “relative” or “learned” pedal position) shall be displayed as a normalised value, scaled from 0 to 100%. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed pedal is 1.0 volt, APP_D shall display (1.0 /5.0) = 20% at closed pedal and 50% at 2.5 volts. Pedal position at idle will usually indicate greater than 0%, and pedal position at wide open pedal will usually indicate less than 100%. For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage.					

Data Byte	Application data to use	Formating conversion used
data A	OBD_PV_1	-

I.47.53 Description of PID 4A - Accelerator Pedal Position E

PID $4A definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
4A	Accelerator Pedal Position E	A	0 %	100 %	100/255 %	APP_E: xxx.x %
	Accelerator Pedal Position E, if utilised by the control module, (not “relative” or “learned” pedal position) shall be displayed as a normalised value, scaled from 0 to 100%. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed pedal is 1.0 volt, APP_E shall display (1.0 /5.0) = 20% at closed pedal and 50% at 2.5 volts. Pedal position at idle will usually indicate greater than 0%, and pedal position at wide open pedal will usually indicate less than 100%. For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage.					

Data Byte	Application data to use	Formating conversion used
data A	OBD_PV_2	-

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I.47.54 Description of PID 4C - Commanded Throttle Actuator Control

PID $4C definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) / English display
4C	Commanded Throttle Actuator Control	A	0% (closed throttle)	100% (wide open throttle)	100/255 %	TAC_PCT: xxx.x%
	Commanded TAC displayed as a percent. TAC_PCT shall be normalised to the maximum TAC commanded output control parameter. TAC systems use a variety of methods to control the amount of throttle opening. 1) If a linear or stepper motor is used, the fully closed throttle position shall be displayed as 0%, the fully open throttle position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open throttle position. For example, a stepper-motor TAC that moves the throttle from 0 to 128 counts shall display 0% at 0 counts, 100% at 128 counts and 50% at 64 counts. 2) Any other actuation method shall be normalised to display 0% when the throttle is commanded closed and 100% when the throttle is commanded open.					

Data Byte	Application data to use	Formating conversion used
data A	OBD_TPS_SP	-

I.47.55 Description of PID 4D - Minutes run by the engine while MIL activated

PID $4D definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
4D	Minutes run by the engine while MIL activated	A, B	0 min	65535 min 1092.25 hours	1 min per count	MIL_TIME: xxxx hrs, xx min

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	Conditions for “Minutes run by the engine while MIL activated” counter: • reset to $0000 when MIL state changes from deactivated to activated by this ECU • accumulate counts in minutes if MIL is activated (ON) • do not change value while MIL is not activated (OFF) • reset to $0000 if diagnostic information is cleared either by service $04 or 40 warm-up cycles without MIL activated • do not wrap to $0000 if value is $FFFF	

Data Byte	Application data to use	Formating conversion used
data A	MSB (T_ACT_MIL)	-
data B	LSB (T_ACT_MIL)	

I.47.56 Description of PID 4E - Time since diagnostic trouble codes cleared

PID $4E definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/ bit	External test equipment SI (Metric) /English display
4E	Time since diagnostic trouble codes cleared	A, B	0 min	65535 min 1092.25 hours	1 min per count	CLR_TIME: xxxx hrs, xx min
	Time accumulated since DTCs were cleared (via an external test equipment or possibly, a battery disconnect). This PID is not associated with any particular DTC. It is simply an indication for I/M (Inspection/ Maintenance), of the last time an external test equipment was used to clear DTCs. If greater than 65,535 min have occurred, CLR_TIME shall remain at 65,535 min and not wrap to zero.					

Data Byte	Application data to use	Formating conversion used
data A	MSB (T_DTC_CLR)	-
data B	LSB (T_DTC_CLR)	

I.47.57 Description of PID 55 – Short term fuel trim Bank 1

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PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
55	Short Term Secondary O2 Sensor Fuel Trim	A , B	-100 %	+99,22 %	100/128 %	
	Short Term Secondary O2 Sensor Fuel Trim Bank 1/3 shall indicate the correction being utilised by the closed loop fuel algorithm. If the fuel system is in open loop, STSO2FT shall report 0% correction. NOTE Data B shall only be included in the response message of a PID $55 if supported by the vehicle. If PID $1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 3 supported) of PID $1D if Data B of PID $55 is supported or not. If PID $13 is supported, then DATA B of PID $55 shall not be supported.					

```
IF (PID 13h is supported) THEN
     IF (Bank 1 is supported) AND (Bank 1 Sensor 2 is supported)
     THEN
```

Data Byte	Application data to use	Formating conversion used
data A	LAMB_DELTA_LAM_ADJ_SAE[1]	-
data B	NONE	-

```
     ELSE
```

Data Byte	Application data to use	Formating conversion used
data A	NONE	
data B	NONE	-

```
    ENDIF
ENDIF
```

I.47.58 Description of PID 56 – Long term fuel trim Bank 1

PID $56 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
56	Long Term Secondary O2 Sensor Fuel Trim	A , B	-100 %	+99,22 %	100/128 %	

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	Secondary O2 Sensor Fuel trim correction for Bank 1/3 stored in Non-volatile RAM or Keep-alive RAM. LGSO2FT shall indicate the correction being utilised by the fuel control algorithm at the time the data is requested, in both open loop and closed loop fuel control. If no correction is utilised in open loop fuel, LGSO2FT shall report 0% correction. If secondary O2 sensor long-term fuel trim is not utilised at all by the fuel control algorithm, the PID shall not be supported. NOTE Data B shall only be included in the response message of a PID $56 if supported by the vehicle. If PID $1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 3 supported) of PID $1D if Data B of PID $56 is supported or not. If PID $13 is supported, then DATA B of PID $56 shall not be supported.

```
IF (PID 13h is supported) THEN
     IF (Bank 1 is supported) AND (Bank 1 Sensor 2 is supported)
     THEN
```

Data Byte	Application data to use	Formating conversion used
data A	LAMB_DELTA_AD_LAM_ADJ_SAE[1]	-
data B	NONE	-

```
    ELSE
```

Data Byte	Application data to use	Formating conversion used
data A	NONE	-
data B	NONE	-

```
   ENDIF
ENDIF
```

I.47.59 Description of PID 57 – Short term fuel trim Bank 2

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
55	Short Term Secondary O2 Sensor Fuel Trim	A , B	-100 %	+99,22 %	100/128 %	
	Short Term Secondary O2 Sensor Fuel Trim Bank 2/4 shall indicate the correction being utilised by the closed loop fuel algorithm. If the fuel system is in open loop, STSO2FT shall report 0% correction. NOTE Data B shall only be included in the response message of a PID $57 if supported by the vehicle. If PID $1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 4 supported) of PID $1D if Data B of PID $57 is supported or not. If PID $13 is supported, then DATA B of PID $57 shall not be supported.					

```
IF (PID 13h is supported) THEN
```

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```
IF (Bank 2 is supported) AND (Bank 2 Sensor 2 is supported)
THEN
```

Data Byte	Application data to use	Formating conversion used
data A	LAMB_DELTA_LAM_ADJ_SAE[2]	-
data B	NONE	-

```
ELSE
```

Data Byte	Application data to use	Formating conversion used
data A	NONE	
data B	NONE	-

```
    ENDIF
ENDIF
```

I.47.60 Description of PID 58 - Long term fuel trim Bank 2

PID $58 definition

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling/bit	External test equipment SI (Metric) /English display
58	Long Term Secondary O2 Sensor Fuel Trim	A , B	-100 %	+99,22 %	100/128 %	
	Secondary Sensor Fuel trim correction for Bank 2/4 stored in Non-volatile RAM or Keep-alive RAM. LGSO2FT shall indicate the correction being utilised by the fuel control algorithm at the time the data is requested, in both open loop and closed loop fuel control. If no correction is utilised in open loop fuel, LGSO2FT shall report 0% correction. If post O2 sensor long-term fuel trim is not utilised at all by the fuel control algorithm, the PID shall not be supported. NOTE Data B shall only be included in the response message of a PID $58 if supported by the vehicle.If PID $1D Oxygen Sensor Location of Bank 1, 2, 3, 4 is supported then the external test equipment shall determine based on the data content (Bank 4 supported) of PID $1D if Data B of PID $58 is supported or not. If PID $13 is supported, then DATA B of PID $58 shall not be supported.					

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```
IF (PID 13h is supported) THEN
     IF (Bank 2 is supported) AND (Bank 2 Sensor 2 is supported)
     THEN
```

Data Byte	Application data to use	Formating conversion used
data A	LAMB_DELTA_AD_LAM_ADJ_SAE[2]	-
data B	NONE	-

```
     ELSE
```


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Data Byte	Application data to use	Formating conversion used
data A	NONE	-
data B	NONE	-

```
    ENDIF
ENDIF
```

I.47.61 Description of PID 60 - Supported PIDs 61h – 80h

0 : the PID is not used
1 : the PID is used

DATA A - Supported PIDs 61h - 68h

PID 60h - DATA A - Supported PID 61h to 68h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[12]
0	PID 68h : Intake Air Temperature Sensor	1 (If NC_CYL_NR = 8)
1	PID 67h : Engine Coolant Temperature	0
2	PID 66h : Mass Air Flow Sensor	1 (If NC_CYL_NR = 8)
3	PID 65h : Auxiliary Inputs /Outputs	0
4	PID 64h : Engine Percent Torque Data	0
5	PID 63h : Engine Reference Torque	0
6	PID 62h : Actual Engine -Percent Torque	0
7	PID 61h : Driver's Demand Engine - Percent Torque	0

DATA A - Supported PIDs 69h - 70h

PID 60h - DATA B - Supported PID 69h to 70h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[13]
0	PID 70h : Boost Pressure Control	0
1	PID 6Fh : Turbocharger Compressor Inlet Pressure	0
2	PID 6Eh : Injection Pressure Control System	0
3	PID 6Dh : Fuel Pressure Control System	1 (If NC_CYL_NR = 8)
4	PID 6Ch : Commanded Throttle Actuator Control and Relative Throttle Position	1 (If NC_CYL_NR = 8)
5	PID 6Bh : Exhaust Gas Recirculation Temperature	0
6	PID 6Ah : Commanded Diesel Intake Air Flow Control and Relative Intake Air Flow Position	0
7	PID 69h : Commanded EGR and EGR Error	0

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DATA A - Supported PIDs 71h - 78h

PID 60h - DATA C - Supported PID 71h to 78h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[14]
0	PID 78h : Exhaust Gas Temperature Bank 1	0
1	PID 77h : Charge Air Cooler Temperature	0
2	PID 76h : Turbocharger B Temperature	0
3	PID 75h : Turbocharger A Temperature	0
4	PID 74h : Turbocharger RPM	0
5	PID 73h : Exhaust Pressure	0
6	PID 72h : Wastegate Control	0
7	PID 71h : Variable Geometry Turbo Control	0

DATA A - Supported PIDs 79h - 80h

PID 60h - DATA D - Supported PID 79h to 80h		
BIT	Function	Bitmask: ID_STATE_SRV_1_PID[15]
0	PID 80h : PIDs supported ($81 - $A0)	0
1	PID 7Fh : Engine Run Time	0
2	PID 7Eh : PM NTE control area status	0
3	PID 7Dh : NOx NTE control area status	0
4	PID 7Ch : Diesel Particulate Filter Temperature	0
5	PID 7Bh : Diesel Particulate Filter Bank 2	0
6	PID 7Ah : Diesel Particulate Filter Bank 1	0
7	PID 79h : Exhaust Gas Temperature Bank 2	0

I.47.62 Description of PID 66h – Mass air flow sensor (If NC_CYL_NR = 8)

PID $66 definition

Data Byte	Application data to use	Formating conversion used
data A	STATE_PSN_MAF_SAE	-
data B	MSB (MAF_KGH_MES_SAE[1])	-
data C	LSB (MAF_KGH_MES_SAE[1])	-
data D	MSB (MAF_KGH_MES_SAE[2])	-
data E	LSB (MAF_KGH_MES_SAE[2])	-

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I.47.63 Description of PID 68h – Intake Air Temperature Sensor (If NC_CYL_NR = 8)

TABLE B84 - PID $68 DEFINITION

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
68	Intake Air Temperature Sensor					
	Support of Intake Air Temperature Sensor Data	A (bit)	Byte 1 of 7			
	IAT Bank 1, Sensor 1 supported	A, bit 0	0	1	1 = IAT Bank 1, Sensor 1 data supported	
	IAT Bank 1, Sensor 2 supported	A, bit 1	0	1	1 = IAT Bank 1, Sensor 2 data supported	
	IAT Bank 1, Sensor 3 supported	A, bit 2	0	1	1 = IAT Bank 1, Sensor 3 data supported	
	IAT Bank 2, Sensor 1 supported	A, bit 3	0	1	1 = IAT Bank 2, Sensor 1 data supported	
	IAT Bank 2, Sensor 2 supported	A, bit 4	0	1	1 = IAT Bank 2, Sensor 2 data supported	
	IAT Bank 2, Sensor 3 supported	A, bit 5	0	1	1 = IAT Bank 2, Sensor 3 data supported	
	reserved (bits shall be reported as '0')	A, bits 6 - 7	0	0		
	Intake Air Temperature Bank 1, Sensor 1	B	-40 °C	215 °C	1 °C with -40 °C offset	IAT 11: xxx °C (xxx °F)
	IAT Bank 1, Sensor 1 shall display intake manifold air temperature, if utilised by the control module strategy. IAT may be obtained directly from a sensor, or may be inferred by the control strategy using other sensor inputs.					
	Intake Air Temperature Bank 1, Sensor 2	C	-40 °C	215 °C	1 °C with -40 °C offset	IAT 12: xxx °C (xxx °F)
	IAT Bank 1, Sensor 2 shall display intake manifold air temperature, if utilised by the control module strategy.					
	Intake Air Temperature Bank 1, Sensor 3	D	-40 °C	215 °C	1 °C with -40 °C offset	IAT 13: xxx °C (xxx °F)
	IAT Bank 1, Sensor 3 shall display intake manifold air temperature, if utilised by the control module strategy.					
	Intake Air Temperature Bank 2, Sensor 1	E	-40 °C	215 °C	1 °C with -40 °C offset	IAT 21: xxx °C (xxx °F)
	IAT Bank 2, Sensor 1 shall display intake manifold air temperature, if utilised by the control module strategy.					
	Intake Air Temperature Bank 2, Sensor 2	F	-40 °C	215 °C	1 °C with -40 °C offset	IAT 22: xxx °C (xxx °F)
	IAT Bank 2, Sensor 2 shall display intake manifold air temperature, if utilised by the control module strategy.					
	Intake Air Temperature Bank 2, Sensor 3	G	-40 °C	215 °C	1 °C with -40 °C offset	IAT 23: xxx °C (xxx °F)
	IAT Bank 2, Sensor 3 shall display intake manifold air temperature, if utilised by the control module strategy.					

Figure I.47.1:

Data Byte	Application data to use	Formating conversion used
data A	STATE_PSN_TIA_SAE	-
data B	TIA_MES_SAE[1]	-
data C	TIA_THR_MES_SAE[1]	-
data D	0 (not defined)	-
data E	TIA_MES_SAE[2]	-

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data F	TIA_THR_MES_SAE[2]	-
data G	0 (not defined)	-

I.47.64 Description of PID 6Ch – Commanded Throttle Actuator Control and Relative Throttle Position (If NC_CYL_NR = 8)

PID $6C definition

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
6C	Commanded Throttle Actuator Control and Relative Throttle Position					
	Support of Throttle Actuator Control System Data	A	Byte 1 of 5			
	Commanded Throttle Actuator A Control supported	A, bit 0	0	1	1 = Cmd Throttle Actuator A Control data supported	
	Relative Throttle A Position supported	A, bit 1	0	1	1 = Relative Throttle A Position data supported	
	Commanded Throttle Actuator B Control supported	A, bit 2	0	1	1 = Cmd Throttle Actuator B Control data supported	
	Relative Throttle B Position supported	A, bit 3	0	1	1 = Relative Throttle B Position data supported	
	reserved (bits shall be reported as '0')	A, bits 4 - 7	0	0		
	Commanded Throttle Actuator A Control	B	0 % (closed throttle)	100 % (wide open throttle)	100/255 %	TAC_A_CMD: xxx.x%
	Commanded TAC displayed as a percent. TAC_A_CMD shall be normalised to the maximum TAC commanded output control parameter. TAC systems use a variety of methods to control the amount of throttle opening. 1) If a linear or stepper motor is used, the fully closed throttle position shall be displayed as 0%, the fully open throttle position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open throttle position. For example, a stepper-motor TAC that moves the throttle 0 to 127 counts shall display 0% at 0 counts (report $00), 100% at 127 counts (report $FF) and 50.2% at 64 counts (report $80). 2) Any other actuation method shall be normalised to display 0% when the throttle is commanded closed and 100% when the throttle is commanded open.					
	Relative Throttle A Position	C	0 %	100 %	100/255 %	TP_A_REL: xxx.x %
	Relative or "learned" throttle position shall be displayed as a normalised value, scaled from 0 to 100%. TP_A_REL should display a value of 0% at the "learned closed-throttle position. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is at 1.0 volts, TP_A_REL shall display (1.0 – 1.0 / 5.0) = 0% at closed throttle and 30% at 2.5 volts. Because of the closed-throttle offset, wide open throttle will usually indicate substantially less than 100%. For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage. See PID $11 for a definition of Absolute Throttle Position.					
	Commanded Throttle Actuator B Control	D	0 % (closed throttle)	100 % (wide open throttle)	100/255 %	TAC_B_CMD: xxx.x%

Figure I.47.2:

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TABLE B88 - PID $6C DEFINITION (CONTINUED)

PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
6C	Commanded TAC displayed as a percent. TAC_B_CMD shall be normalised to the maximum TAC commanded output control parameter. TAC systems use a variety of methods to control the amount of throttle opening. 1) If a linear or stepper motor is used, the fully closed throttle position shall be displayed as 0%, the fully open throttle position shall be displayed as 100%. Intermediate positions shall be displayed as a percent of the full-open throttle position. For example, a stepper-motor TAC that moves the throttle from 0 to 127 counts shall display 0% at 0 counts (report $00), 100% at 127 counts (report $FF) and 50.2% at 64 counts (report $80). 2) Any other actuation method shall be normalised to display 0% when the throttle is commanded closed and 100% when the throttle is commanded open.					
	Relative Throttle B Position	E	0 %	100 %	100/255 %	TP_B_REL: xxx.x %
	Relative or "learned" throttle position shall be displayed as a normalised value, scaled from 0 to 100%. TP_B_REL should display a value of 0% at the "learned closed-throttle position. For example, if a 0 to 5.0 volt sensor is used (uses a 5.0 volt reference voltage), and the closed throttle position is at 1.0 volts, TP_B_REL shall display (1.0 – 1.0 / 5.0) = 0% at closed throttle and 30% at 2.5 volts. Because of the closed-throttle offset, wide open throttle will usually indicate substantially less than 100%. For systems where the output is proportional to the input voltage, this value is the percent of maximum input reference voltage. For systems where the output is inversely proportional to the input voltage, this value is 100% minus the percent of maximum input reference voltage. See PID $11 for a definition of Absolute Throttle Position.					

Figure I.47.3:

Data Byte	Application data to use	Formating conversion used
data A	STATE_PSN_TPS_SAE	-
data B	TPS_SP_SAE[1]	
data C	TPS_REL_SAE[1]	-
data D	TPS_SP_SAE[2]	
data E	TPS_REL_SAE[2]	-

I.47.65 Description of PID 6Dh – Fuel Pressure Control System (If NC_CYL_NR = 8)

PID $6D definition

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PID (hex)	Description	Data Byte	Min. Value	Max. Value	Scaling/Bit	External Test Equipment SI (Metric) / English Display
6D	Fuel Pressure Control System					
	Support of Fuel Pressure Control System Data	A (bit)	Byte 1 of 611			
	Commanded Fuel Rail Pressure A supported	A, bit 0	0	1	1 = Commanded Fuel Rail Pressure A data supported	
	Fuel Rail Pressure A supported	A, bit 1	0	1	1 = Fuel Rail Pressure A data supported	
	Fuel Temperature A supported	A, bit 2	0	1	1 = Fuel Temperature A data supported	
	Commanded Fuel Rail Pressure B supported	A, bit 3	0	1	1 = Commanded Fuel Rail Pressure B data supported	
	Fuel Rail Pressure B supported	A, bit 4	0	1	1 = Fuel Rail Pressure B data supported	
	Fuel Temperature B supported	A, bit 5	0	1	1 = Fuel Temperature B data supported	
	reserved (bits shall be reported as '0')	A, bits 36 - 7	0	0		
	Commanded Fuel Rail Pressure A	B,C	0 kPa	655350 kPa	10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI	FRP_A_CMD: xxxxxx kPa (xxxxx.x PSI)
	FRP_A_CMD shall display commanded fuel rail pressure when the reading is referenced to atmosphere (gage pressure).					
	Fuel Rail Pressure A	D,E	0 kPa	655350 kPa	10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI	FRP_A: xxxxxx kPa (xxxxx.x PSI)
	FRP_A shall display fuel rail pressure when the reading is referenced to atmosphere (gage pressure).					
	Fuel Rail Temperature A	F	-40 °C	215 °C	1 °C with -40 °C offset	FRT_A: xxx °C (xxx °F)
	FRT_A shall display fuel rail temperature.					
	Commanded Fuel Rail Pressure B	G,H	0 kPa	655350 kPa	10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI	FRP_B_CMD: xxxxxx kPa (xxxxx.x PSI)
	FRP_B_CMD shall display commanded fuel rail pressure when the reading is referenced to atmosphere (gage pressure).					
	Fuel Rail Pressure B	I,J	0 kPa	655350 kPa	10 kPa per bit unsigned, 1 kPa = 0.1450377 PSI	FRP_B: xxxxxx kPa (xxxxx.x PSI)
	FRP_B shall display fuel rail pressure when the reading is referenced to atmosphere (gage pressure).					
	Fuel Rail Temperature B	K	-40 °C	215 °C	1 °C with -40 °C offset	FRT_B: xxx °C (xxx °F)
	FRT_B shall display fuel rail temperature.					

Figure I.47.4:

Data Byte	Application data to use	Formating conversion used
data A	STATE_PSN_FUP_SAE	-
data B	MSB (FUP_SP_SAE[1])	-
data C	LSB (FUP_SP_SAE[1])	-
data D	MSB (FUP_MES_SAE[1])	-
data E	LSB (FUP_MES_SAE[1])	-
data F	0 (not defined)	-
data G	MSB (FUP_SP_SAE[2])	-
data H	LSB (FUP_SP_SAE[2])	-
data I	MSB (FUP_MES_SAE[2])	-
data J	LSB (FUP_MES_SAE[2])	-

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data K	0 (not defined)	-

I.47.66 Description of PID 80h - Supported PIDs 81h - A0h (not supported)

0 : the PID is not used
1 : the PID is used

DATA A - Supported PIDs 81h - 88h

PID 80h - DATA A - Supported PID 81h to 88h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_1_PID[16]
0	PID 88h : ISO/SAE reserved	0
1	PID 87h : Intake Manifold Absolute Pressure	0
2	PID 86h : Particulate Matter (PM) Sensor	0
3	PID 85h : NOx Control System	0
4	PID 84h : Manifold Surface Temperature	0
5	PID 83h : NOx Sensor	0
6	PID 82h : Engine Run Time for AECD #6 -#10	0
7	PID 81h : Engine Run Time for AECD #1 -#5	0

DATA A - Supported PIDs 89h - 90h

PID 80h - DATA B - Supported PID 89h to 90h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_1_PID[17]
0	PID 90h : ISO/SAE reserved	0
1	PID 8Fh : ISO/SAE reserved	0
2	PID 8Eh : ISO/SAE reserved	0
3	PID 8Dh : ISO/SAE reserved	0
4	PID 8Ch : ISO/SAE reserved	0
5	PID 8Bh : ISO/SAE reserved	0
6	PID 8Ah : ISO/SAE reserved	0
7	PID 89h : ISO/SAE reserved	0

DATA A - Supported PIDs 91h - 98h

PID 80h - DATA C - Supported PID 91h to 98h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_1_PID[18]
0	PID 98h : ISO/SAE reserved	0

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1	PID 97h : ISO/SAE reserved	0
2	PID 96h : ISO/SAE reserved	0
3	PID 95h : ISO/SAE reserved	0
4	PID 94h : ISO/SAE reserved	0
5	PID 93h : ISO/SAE reserved	0
6	PID 92h : ISO/SAE reserved	0
7	PID 91h : ISO/SAE reserved	0

DATA A - Supported PIDs 99h – A0h

PID 80h - DATA D - Supported PID 99h to A0h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_1_PID[19]
0	PID A0h : ISO/SAE reserved	0
1	PID 9Fh : ISO/SAE reserved	0
2	PID 9Eh : ISO/SAE reserved	0
3	PID 9Dh : ISO/SAE reserved	0
4	PID 9Ch : ISO/SAE reserved	0
5	PID 9Bh : ISO/SAE reserved	0
6	PID 9Ah : ISO/SAE reserved	0
7	PID 99h : ISO/SAE reserved	0

I.47.67 Description of PID 88h up to FFh - Reserved

PID $84 - $FF definition

PID	Description	Data	Min.	Max.	Scaling/ bit	External test equipment
(hex)		Byte	value	value		SI (Metric) /English display
88 - FF	ISO/SAE reserved	- –	- –	- –	- –	- –

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I.48 SID 02h: Request powertrain freeze frame data

Import actions:

ACTION_ERRM_ReadFrfByDtc (**IN**<PRM_TYPEOFFF>,**IN**<PRM_FFIDENTIFIER>,**IN**<PRM_DTCIDENTIFIER>,**IN**<PRM_LEVELOFDTC>,**INOUT**<PRM_FRF>,**OUT**<PRM_RESULTFRF>)

I.48.1 Functional description

The purpose of this service is to allow access to emission-related data values in a freeze frame. This allows expansion to meet manufacturer specific requirements not necessarily related to the required freeze frame, and not necessarily containing the same data values as the required freeze frame. The request message includes a parameter identification (PID) value that indicates to the on-board system the specific information requested. PID specifications, scaling information, and display formats for the freeze frame are included in Annex B of ISO 15031-5.4.

The ECU(s) will respond to this message by transmitting the requested data value stored by the system. All data values returned for sensor readings will be actual stored readings, not default or substitute values used by the system because of a fault with that sensor.

Service 02h PID 02h indicates the DTC that caused the freeze frame data to be stored. If freeze frame data is not stored in the ECU, the system shall report 00 00h as the DTC.

The frame number byte will indicate 00h for the freeze frame data. Manufacturers may optionally save additional freeze frames and use this service to obtain that data by specifying the freeze frame number in the request message. If a manufacturer uses these additional freeze frames, they will be stored under conditions specified by the manufacturer, and contain data specified by the manufacturer.

Not all PIDs are applicable or supported by all systems. PID 00h is a bit-encoded value that indicates for each ECU which PIDs are supported. PID 00h indicates support for PIDs from 01h to 20h. PID 20h indicates support for PIDs 21h through 40h, etc. PID 00h is required for those ECUs that respond to a corresponding service 02h request message as specified in Annex A of ISO 15031-5.4.

The order of the PIDs in the response message is not required to match the order in the request message.

The request message may contain up to three (3) PIDs. An external test equipment is not allowed to request a combination of PIDs supported and PIDs, which report data values. The ECU shall support requests for up to three (3) PIDs. The request message may contain the same PID multiple times. The ECU shall treat each PID as a separate parameter and respond with data for each PID as often as requested.

Proper response from server/ECU for ISO 15765-4 protocol:

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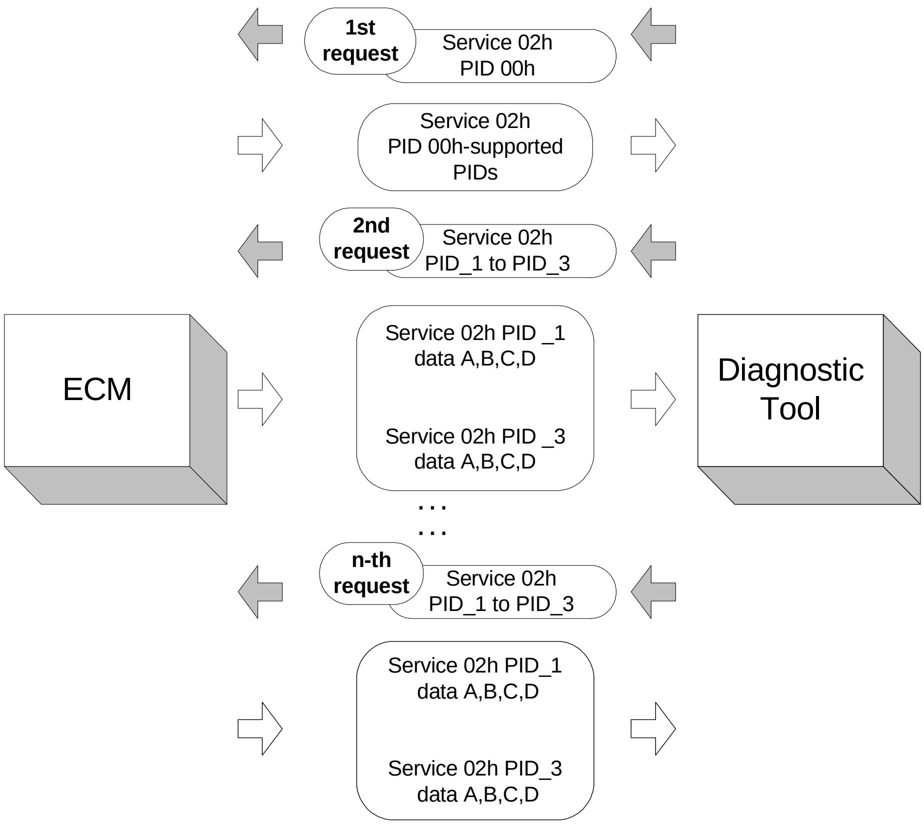
Service 02h not supported	The ECU shall not respond
Service 02h supported PID requested, no Freeze Frame stored	PID 02h indicates 0000h, but if PIDs are requested, ECU must not respond except if supported PIDs (00h, 20h, ...) have been requested, then the ECU shall send a response with the supported PID and data bytes
Service 02h unsupported PID requested, no Freeze Frame stored	PID 02h indicates 0000h, but if PIDs are requested, ECU must not respond except for support PIDs 00h, 20h, etc.
Service 02h supported PID requested, Freeze Frame stored	Respond within P2 timing
Service 02h unsupported PID requested, Freeze Frame stored	The ECU shall not respond



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I.48.2 Message data bytes

I.48.2.1 Read supported PIDs

Request powertrain freeze frame data request message (read supported PIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request powertrain freeze frame data request SID**	**M**	**02**	**SIDRQ**
#2	PID#1 (PIDs supported: Annex A of ISO 15031-5.4)	M	xx	PID
#3	frame #	M	xx	FRNO_
#4	PID#2 (PIDs supported: Annex A of ISO 15031-5.4)	U	xx	PID
#5	frame #	U/C	xx	FRNO_
#6	PID#3 (PIDs supported: Annex A of ISO 15031-5.4)	U	xx	PID
#7	frame #	U/C	xx	FRNO_

U = User Optional — PID may be included to reduce multiple PID supported request messages
C = Conditional — parameter is only included if preceding PID# is included

NOTE To request PIDs supported range from 61h - FFh, multiple request messages with PIDs = 60h, 80h, A0h, C0h and E0h shall be sent to the vehicle.

I.48.2.2 Report supported PIDs

ECU(s) must respond to all supported ranges if requested. A range is defined as a block of 32 PIDs (e.g. range #1: PID 01h-20h). The ECU shall not respond to unsupported PID ranges unless subsequent ranges have a supported PID(s).

Request powertrain freeze frame data response message (report supported PIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request powertrain freeze frame data response SID**	**M**	**42**	**SIDPR**
#2	1st supported PID	M	00	PID
#3	frame #	M	xx	FRNO_
	data record of supported PIDs = [			DATAREC
#4	Data A: supported PIDs,	M	xx	DATA_A
#5	Data B: supported PIDs,	M	xx	DATA_B
#6	Data C: supported PIDs,	M	xx	DATA_C
#7	Data D: supported PIDs]	M	xx	DATA_D
:	:	:	:	:
#n-5	mth supported PID	C1	xx	PID
#n-4	frame #	C1	xx	FRNO_
	data record of supported PIDs = [			DATAREC
#n-3	Data A: supported PIDs,	C2	xx	DATA_A
#n-2	Data B: supported PIDs,	C2	xx	DATA_B
#n-1	Data C: supported PIDs,	C2	xx	DATA_C
#n	Data D: supported PIDs]	C2	xx	DATA_D

C1 = Conditional — PID value shall be the same value as included in the request message if supported by the ECU
C2 = Conditional — value indicates PIDs supported; range of supported PIDs depends on selected PID value (see C1)

NOTE The response message shall only include the PID(s) and Data A - D which are supported by the ECU. If the request message includes (a) PID value(s) which are not supported by the ECU those shall not be included in the response message.

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I.48.2.3 Read freeze frame PID values

Request powertrain freeze frame data request message (read freeze frame PID values)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request powertrain freeze frame data request SID**	**M**	**02**	**SIDRQ**
#2	PID#1 (see Annex B of ISO 15031-5.4)	M	xx	PID
#3	frame #	M	xx	FRNO
#4	PID#2 (see Annex B of ISO 15031-5.4)	U	xx	PID
#5	frame #	C1	xx	FRNO
#6	PID#3 (see Annex B of ISO 15031-5.4)	U	xx	PID
#7	frame #	C1	xx	FRNO

U = User Optional — the parameter may be present or not
C1 = Conditional — parameter is only present if preceding PID# is present

I.48.2.4 Report freeze frame PID values

Request powertrain freeze frame data response message (report freeze frame PID values)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request powertrain freeze frame data response SID**	**M**	**42**	**SIDPR**
#2	1st supported PID	M	xx	PID_
#3	frame #	M	xx	FRNO_
#4 #5 #6 #7	data record of 1st supported PID = [data A, data B, data C, data D]	M C1 C1 C1	xx xx xx xx	DATA_A DATA_B DATA_C DATA_D
:	:	:	:	:
#2	mth supported PID	C2	xx	PID_
#3	frame #	C2	xx	FRNO_
#4 #5 #6 #7	data record of mth supported PID = [data A, data B, data C, data D]	C3 C4 C4 C4	xx xx xx xx	DATA_A DATA_B DATA_C DATA_D

C1 = Conditional — "data B - D" depend on selected PID
C2 = Conditional — parameter shall be the same value as included in the request message and only present if supported
C3 = Conditional — data A shall be included if preceding PID is supported
C4 = Conditional — parameters and values for "data B - D" depend on selected PID number

I.48.2.5 Parameter definition

I.48.2.5.1 PIDs supported

Annex A of ISO 15031-5.4 specifies the interpretation of the data record of supported PIDs.

I.48.2.5.2 PID and data byte descriptions

Annex B of ISO 15031-5.4 specifies standardised emission-related parameters.

I.48.2.5.3 Frame # description

The frame number identifies the freeze frame, which includes emission-related data values in case an emission-related DTC is detected by the ECU.

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I.48.2.6 Formula section

ACTION_ERRM_ReadFrfByDtc

(
IN <LAW>
IN <FIRST>
IN <NO_DTC>
IN <LAW>
INOUT <Frf>
OUT <ResultFrf>
)

IF (PID = X0h) where PID X0h means PID 00h, 20h, 40h, 60h, 80h, A0h, C0h, E0h
THEN
Positive response
ELSE
IF ResultFrf = FRF_PRESENT **THEN**
Positive response
ELSE
IF PID = 02h **THEN** Positive response with DTC = 0000h
ELSE No answer
ENDIF
ENDIF
ENDIF

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I.49 SID 02h: Request powertrain freeze frame data (Appl. Inc.)

Input data:

NC_CYL_NR {p. 1526}	NC_INJ_CONF {p. 626}	STATE_PSN_LS_SAE {p. 819}	STATE_VAR_SAP_SAE {p. 819}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_STATE_SRV_2_PID	V	0... FFH	0... 255	1	-
LDPM_STATE_PID_SRV_1_2_OBDC	20	0... 13H	0... 19	1	-
Table of bytes which defines the PID's supported by the service 02h (01h - A0h)					

Action definition

ACTION_ERRM_ReadFrfByDtc (**IN**<PRM_TYPEOFFF>,**IN**<PRM_FFIDENTIFIER>,**IN**<PRM_DTCIDENTIFIER>, **IN**<PRM_LEVELOFDTC>,**INOUT**<PRM_FRF>,**OUT**<PRM_RESULTFRF>)	Mode: O
This API returns a freeze frame or a part of freeze frame.	

Parameter	**Type**	**Hex.Limits**	**Phys.Limits**	**Resol.**	**Unit**
PRM_TYPEOFFF	in	0... FFFFH	0... 65535	1	-
Type of Freeze Frame					
PRM_FFIDENTIFIER	in	0... FFH	0... 255	1	-
Freeze frame number					
PRM_DTCIDENTIFIER	in	0... FFH	0... 255	1	-
DTC number					
PRM_LEVELOFDTC	in	01H 02H	LAW CUS	-	-
OBD or Customer DTC					
PRM_FRF	inout	0... FFH	0... 255	1	-
Pointer to buffer for Freeze frame					
PRM_RESULTFRF	out	0... FFH	0... 255	1	-
Result of Freeze frame reading					

General information

Depending on calibration of ID_STATE_SRV_2_PID the PID's are supported or not.

Each LDPM[0...19] of the table represents an 8 PIDs configuration:

0 => the PID is not supported
1 => the PID is supported

"PID 13h is supported" means – (ID_STATE_SRV_1_PID[2] & 20h)
"PID 1Dh is supported" means – (ID_STATE_SRV_1_PID[3] & 08h)
"Bank 1 is supported" means – ((STATE_PSN_LS_SAE & 0Fh) OR (STATE_PSN_LS_1_SAE & 03h))
"Bank 2 is supported" means – ((STATE_PSN_LS_SAE & F0h) OR (STATE_PSN_LS_1_SAE & 0Ch))
"Bank 1 – Sensor 2 is supported" means – ((STATE_PSN_LS_SAE & 02h) OR (STATE_PSN_LS_1_SAE & 02h))

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"Bank 2 – Sensor 2 is supported" means – ((STATE_PSN_LS_SAE & 20h) OR (STATE_PSN_LS_1_SAE & 08h))

" IDX" is used instead of the array definition [NC_NR_ERR_DYN].

At STATE_PSN_LS_SAE you can see the configuration of the oxygen-sensors:

BIT	Function	Status
0	Bank 1 Sensor 1	1= available, 0 = not available
1	Bank 1 Sensor 2	1= available, 0 = not available
2	Bank 1 Sensor 3	1= available, 0 = not available
3	Bank 1 Sensor 4	1= available, 0 = not available
4	Bank 2 Sensor 1	1= available, 0 = not available
5	Bank 2 Sensor 2	1= available, 0 = not available
6	Bank 2 Sensor 3	1= available, 0 = not available
7	Bank 2 Sensor 4	1= available, 0 = not available

Application conditions:

Initialisation: –

Activation: –

Deactivation: –

Recurrence: –

Function description:

Formula section:

I.49.1 Description of PID 00h - Supported PIDs 01h - 20h

DATA A - Supported PIDs 01h to 08h

PID 00h - DATA A - Supported PID 01h to 08h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[0]
0	PID 08h : Short term fuel trim - Bank 2 and Bank 4	**1**
1	PID 07h : Long term fuel trim - Bank 1 and Bank 3	**1**
2	PID 06h : Short term fuel trim - Bank 1 and Bank 3	**1**
3	PID 05h : Engine coolant temperature	**1**
4	PID 04h : Calculated load value	**1**
		Continued on next page

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5	PID 03h : Fuel system status	**1**
6	PID 02h : Trouble code that caused required freeze frame	**1**
7	PID 01h : Monitor status since DTCs cleared	0

DATA B - Supported PIDs 09h to 10h

PID 00h - DATA B - Supported PID 09h to 10h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[1]
0	PID 10h : Air flow rate from MAF sensor	**1**
1	PID 0Fh : Intake air temperature	**1**
2	PID 0Eh : Ignition time advance	**1**
3	PID 0Dh : Vehicle speed	**1**
4	PID 0Ch : Engine RPM	**1**
5	PID 0Bh : Intake manifold absolute pressure	**1**
6	PID 0Ah : Fuel pressure (gauge)	**1**
7	PID 09h : Long term fuel trim - Bank 2	**1**

DATA C - Supported PIDs 11h to 18h

PID 00h - DATA C - Supported PID 11h to 18h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[2]
0	PID 18h : Bank 2 Sensor 1 or Bank 3 Sensor 1	0
1	PID 17h : Bank 1 Sensor 4 or Bank 2 Sensor 2	0
2	PID 16h : Bank 1 Sensor 3 or Bank 2 Sensor 1	0
3	PID 15h : Bank 1 Sensor 2	0
4	PID 14h : Bank 1 Sensor 1	0
5	PID 13h : Location of Oxygen Sensors	**1**
6	PID 12h : Secondary air status	**1**
7	PID 11h : Absolute throttle position sensor	**1**

DATA D - Supported PIDs 19h to 20h

PID 00h - DATA D - Supported PID 19h to 20h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[3]
0	PID 20h : PIDs supported ($21 - $40)	**1**

Continued on next page

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1	PID 1Fh : Time Since Engine Start	**1**
2	PID 1Eh : Auxiliary Input Status	0
3	PID 1Dh : Location of oxygen sensors	0
4	PID 1Ch : OBD requirements to which vehicle is designed	0
5	PID 1Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2	0
6	PID 1Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1	0
7	PID 19h : Bank 2 Sensor 2 or Bank 3 Sensor 2	0

I.49.1.1 Description of PID 02h - Diagnostic trouble codes

PID (hex)	Description	Data byte	Min. value	Max. value	Scaling	External test equipment SI (Metric) /English display
02	DTC that caused required freeze frame data storage	A, B	00 00	FF FF	Hexadecimal e.g. P01AB	DTCFRZF: Pxxxx, Cxxxx, Bxxxx, Uxxxx
	($0000 indicates no freeze frame data)				(DTCs defined in ISO 15031-6)	

Formula section:

```
CALL API :
ACTION_ERRM_ReadFrfByDtc     (
                       IN <FRF_LAW>,
                       IN <FIRST>,
                       IN <NO_DTC>,
                       IN <DTC_LAW>
                       INOUT <Frf>
                       OUT <ResultFrf>
                       )
IF ResultFrf   == NO_FRF_PRESENT

THEN
```

Data Byte	Application data to use	Formating conversion used
data A	0x00	-
data B	0x00	

ELSE

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Data Byte	Application data to use	Formating conversion used
data A	Frf[0]	-
data B	Frf[1]	

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I.49.1.2 Description of PID 03h - Status of fuel system

```
If       PID 13h is supported
Then
    If        (STATE_PSN_LS_SAE &  11h)          // upstream sensors available
    Then
              DATA_A = ENVD_OBD_1_IDX
              DATA_B = ENVD_OBD_2_IDX
    Endif
Endif
```

I.49.1.3 Description of PID 04h - Calculated load value

DATA_A = ENVD_OBD_3_IDX

I.49.1.4 Description of PID 05h - Engine coolant temperature

DATA_A = ENVD_OBD_4_IDX

I.49.1.5 Description of PID 06h - Short term fuel trim - Bank 1 and Bank 3

```
If (PID 13h is supported) Then
     If (Bank 1 is supported) Then
                    DATA_A = ENVD_OBD_5_IDX
                    DATA_B = NONE                  //Bank 3 not supported
     Endif
Endif
```

I.49.1.6 Description of PID 07h - Long term fuel trim - Bank 1 and Bank 3

```
If (PID 13h is supported) Then
      If (Bank 1 is supported) Then
                     DATA_A = ENVD_OBD_6_IDX
                     DATA_B = NONE              //Bank 3 not supported
      Endif
Endif
```

I.49.1.7 Description of PID 08h - Short term fuel trim - Bank 2 and Bank 4

```
If (PID 13h is supported) Then
     If (Bank 2 is supported) Then
                    DATA_A = ENVD_OBD_7_IDX
                    DATA_B = NONE               //Bank 3 not supported
     Endif
Endif
```

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I.49.1.8 Description of PID 09h - Long term fuel trim - Bank 2 and Bank 4

```
If (PID 13h is supported) Then
     If (Bank 2 is supported) Then
                    DATA_A = ENVD_OBD_8_IDX
                    DATA_B = NONE                  //Bank 3 not supported
     Endif
Endif
```

I.49.1.9 Description of PID 0Ah - Fuel pressure (gauge)

DATA_A = ENVD_OBD_9_IDX

I.49.1.10 Description of PID 0Bh - Intake manifold absolute pressure

DATA_A = ENVD_OBD_10_IDX

I.49.1.11 Description of PID 0Ch - Engine speed

DATA_A = ENVD_OBD_11_IDX
DATA_B = ENVD_OBD_12_IDX

I.49.1.12 Description of PID 0Dh - Vehicle speed

DATA_A = ENVD_OBD_13_IDX

I.49.1.13 Description of PID 0Eh - Ignition timing advance

DATA_A = ENVD_OBD_14_IDX

I.49.1.14 Description of PID 0Fh - Intake air temperature

DATA_A = ENVD_OBD_15_IDX

I.49.1.15 Description of PID 10h - Air flow rate from MAF

DATA_A = ENVD_OBD_16_IDX
DATA_B = ENVD_OBD_17_IDX

I.49.1.16 Description of PID 11h - Absolute throttle position sensor

DATA_A = ENVD_OBD_18_IDX

I.49.1.17 Description of PID 12h - Commanded secondary air status

```
If      (ID_STATE_SRV_2_PID[2] &  40h) and  (STATE_VAR_SAP_SAE <> 0)
Then    DATA_A = ENVD_OBD_19_IDX
Endif
```

I.49.1.18 Description of PID 1Fh - Time Since Engine Start

DATA_A = ENVD_OBD_20_IDX
DATA_B = ENVD_OBD_21_IDX

I.49.2 Description of PID 20h - Supported PIDs 21h - 40h

0 : the PID is not used,   1 : the PID is used

DATA A - Supported PIDs 21h - 28h

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PID 20h - DATA A - Supported PID 21h to 28h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[4]
0	PID 28h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	0
1	PID 27h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	0
2	PID 26h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	0
3	PID 25h : Bank 1 Sensor 2 (Wide range O2S)	0
4	PID 24h : Bank 1 Sensor 1 (Wide range O2S)	0
5	PID 23h : High fuel pressure (gauge)	**1**
6	PID 22h : Relative fuel pressure	0
7	PID 21h : Distance travelled while MIL is activated	0

DATA B - Supported PIDs 29h to 30h

PID 20h - DATA B - Supported PID 29h to 30h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[5]
0	PID 30h : Number of warm-ups since diagnostic trouble codes cleared	0
1	PID 2Fh : Fuel Level Input	**1**
2	PID 2Eh : Commanded Evaporative Purge	**1**
3	PID 2Dh : EGR Error	0
4	PID 2Ch : Command EGR	0
5	PID 2Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	0
6	PID 2Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	0
7	PID 29h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	0

DATA C - Supported PIDs 31h to 38h

PID 20h - DATA C - Supported PID 31h to 38h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[6]
0	PID 38h : Bank 2 Sensor 1 or Bank 3 Sensor 1 (Wide range O2S)	0
1	PID 37h : Bank 1 Sensor 4 or Bank 2 Sensor 2 (Wide range O2S)	0
2	PID 36h : Bank 1 Sensor 3 or Bank 2 Sensor 1 (Wide range O2S)	0
3	PID 35h : Bank 1 Sensor 2 (Wide range O2S)	0
4	PID 34h : Bank 1 Sensor 1 (Wide range O2S)	0
5	PID 33h : Barometric Pressure	**1**
6	PID 32h : Evap System Vapor Pressure	0
7	PID 31h : Distance since diagnostic trouble codes cleared	0

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DATA D - Supported PIDs 39h to 40h

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PID 20h - DATA D - Supported PID 39h to 40h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[7]
0	PID 40h : PIDs supported ($41 - $60)	**1**
1	PID 3Fh : Catalyst Temperature Bank 2, Sensor 2	0
2	PID 3Eh : Catalyst Temperature Bank 1, Sensor 2	0
3	PID 3Dh : Catalyst Temperature Bank 2, Sensor 1	0
4	PID 3Ch : Catalyst Temperature Bank 1, Sensor 1	0
5	PID 3Bh : Bank 2 Sensor 4 or Bank 4 Sensor 2 (Wide range O2S)	0
6	PID 3Ah : Bank 2 Sensor 3 or Bank 4 Sensor 1 (Wide range O2S)	0
7	PID 39h : Bank 2 Sensor 2 or Bank 3 Sensor 2 (Wide range O2S)	0

I.49.2.1 Description of PID 23h – Fuel pressure

```
If      NC_INJ_CONF <> 0                //only MSD
Then    DATA_A = ENVD_OBD_22_IDX
        DATA_B = ENVD_OBD_23_IDX
Endif
```

I.49.2.2 Description of PID 2Eh – Commanded Evaporative purge

DATA_A = ENVD_OBD_24_IDX

I.49.2.3 Description of PID 2Fh - Fuel Level Input

DATA_A = ENVD_OBD_25_IDX

I.49.2.4 Description of PID 33h - Barometric Pressure

DATA_A = ENVD_OBD_26_IDX

I.49.3 Description of PID 40h - Supported PIDs 41h - 60h

0 : the PID is not used
1 : the PID is used

DATA A - Supported PIDs 41h - 48h

PID 40h - DATA A - Supported PID 41h to 48h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[8]
0	PID 48h : Absolute Throttle Position C	0
1	PID 47h : Absolute Throttle Position B	**1**
2	PID 46h : Ambient air temperature	**1**
3	PID 45h : Relative Throttle Position	**1**
4	PID 44h : Command Equivalence Ratio	**1**
5	PID 43h : Absolue Load Value	**1**
6	PID 42h : Control module voltage	**1**
		Continued on next page

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7	PID 41h : Monitor status this driving cycle	0

DATA B - Supported PIDs 49h to 50h

PID 40h - DATA B - Supported PID 49h to 50h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[9]
0	PID 50h :External test equipment config. information #2	0
1	PID 4Fh :External test equipment config. information #1	0
2	PID 4Eh : Time since diagnostic trouble codes cleared	0
3	PID 4Dh : Minutes run by the engine while MIL activated	0
4	PID 4Ch : Commanded Throttle Actuator Control	**1**
5	PID 4Bh : Accelerator Pedal Position F	0
6	PID 4Ah : Accelerator Pedal Position E	**1**
7	PID 49h : Accelerator Pedal Position D	**1**

DATA C - Supported PIDs 51h to 58h

PID 40h - DATA C - Supported PID 51h to 58h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[10]
0	PID 58h : Long term fuel trim Bank 2	**1**
1	PID 57h : Short term fuel trim Bank 2	0
2	PID 56h : Long term fuel trim Bank 1	**1**
3	PID 55h : Short term fuel trim Bank 1	0
4	PID 54h : Evap System Vapor Pressure	0
5	PID 53h : Absolute Evap System Vapor Pressure	0
6	PID 52h : Alcohol Fuel Percentage	0
7	PID 51h : Type of fuel used by the vehicle	0

DATA D - Supported PIDs 59h to 60h

PID 40h - DATA D - Supported PID 59h to 60h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[11]
0	PID 60h : PIDs supported ($61 - $80)	**1**(If NC_CYL_NR = 8)
1	PID 5Fh : Emission requirements to which vehicle is designed	0
2	PID 5Eh : Engine Fuel Rate	0

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3	PID 5Dh : Fuel Injection Timing	0
4	PID 5Ch : Engine Oil Temperature	0
5	PID 5Bh : Hybrid Battery Pack Remaining Life	0
6	PID 5Ah : Relative Accelerator Pedal Position	0
7	PID 59h : Fuel Rail Pressure (absolute)	0

I.49.3.1 Description of PID 42 - Control module voltage

DATA_A = ENVD_OBD_27_IDX
DATA_B = ENVD_OBD_28_IDX

I.49.3.2 Description of PID 43 - Absolute Load Value

DATA_A = ENVD_OBD_29_IDX
DATA_B = ENVD_OBD_30_IDX

I.49.3.3 Description of PID 44 - Commanded Equivalence Ratio

DATA_A = ENVD_OBD_31_IDX
DATA_B = ENVD_OBD_32_IDX

I.49.3.4 Description of PID 45 - Relative Throttle Position

DATA_A = ENVD_OBD_33_IDX

I.49.3.5 Description of PID 46 - Ambient air temperature

DATA_A = ENVD_OBD_34_IDX

I.49.3.6 Description of PID 47 - Absolute Throttle Position B

DATA_A = ENVD_OBD_35_IDX

I.49.3.7 Description of PID 49 - Accelerator Pedal Position D

DATA_A = ENVD_OBD_36_IDX

I.49.3.8 Description of PID 4A - Accelerator Pedal Position E

DATA_A = ENVD_OBD_37_IDX

I.49.3.9 Description of PID 4C – Commanded throttle actuator control

DATA_A = ENVD_OBD_38_IDX

I.49.3.10 Description of PID 56 – Long term fuel trim bank 1

```
If (PID 13h is supported) Then
     If (Bank 1 is supported) and (Bank 1 Sensor 2 is supported) Then
              DATA_A = ENVD_OBD_39_IDX
     Endif
Endif
```

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I.49.3.11 Description of PID 58 – Long term fuel trim bank 2

```
If (PID 13h is supported) Then
    If (Bank 2 is supported) and (Bank 2 Sensor 2 is supported) Then
    DATA_A = ENVD_OBD_40_IDX
    Endif
Endif
```

I.49.4 Description of PID 60h - Supported PIDs 61h – 80h

0 : the PID is not used
1 : the PID is used

DATA A - Supported PIDs 61h - 68h

PID 60h - DATA A - Supported PID 61h to 68h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[12]
0	PID 68h : Intake Air Temperature Sensor	**1**(If NC_CYL_NR = 8)
1	PID 67h : Engine Coolant Temperature	0
2	PID 66h : Mass Air Flow Sensor	**1**(If NC_CYL_NR = 8)
3	PID 65h : Auxiliary Inputs /Outputs	0
4	PID 64h : Engine Percent Torque Data	0
5	PID 63h : Engine Reference Torque	0
6	PID 62h : Actual Engine -Percent Torque	0
7	PID 61h : Driver's Demand Engine - Percent Torque	0

DATA A - Supported PIDs 69h - 70h

PID 60h - DATA B - Supported PID 69h to 70h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[13]
0	PID 70h : Boost Pressure Control	0
1	PID 6Fh : Turbocharger Compressor Inlet Pressure	0
2	PID 6Eh : Injection Pressure Control System	0
3	PID 6Dh : Fuel Pressure Control System	**1**(If NC_CYL_NR = 8)
4	PID 6Ch : Commanded Throttle Actuator Control and Relative Throttle Position	**1**(If NC_CYL_NR = 8)
5	PID 6Bh : Exhaust Gas Recirculation Temperature	0
6	PID 6Ah : Commanded Diesel Intake Air Flow Control and Relative Intake Air Flow Position	0
7	PID 69h : Commanded EGR and EGR Error	0

DATA A - Supported PIDs 71h - 78h

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PID 60h - DATA C - Supported PID 71h to 78h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[14]
0	PID 78h : Exhaust Gas Temperature Bank 1	0
1	PID 77h : Charge Air Cooler Temperature	0
2	PID 76h : Turbocharger B Temperature	0
3	PID 75h : Turbocharger A Temperature	0
4	PID 74h : Turbocharger RPM	0
5	PID 73h : Exhaust Pressure	0
6	PID 72h : Wastegate Control	0
7	PID 71h : Variable Geometry Turbo Control	0

DATA A - Supported PIDs 79h - 80h

PID 60h - DATA D - Supported PID 79h to 80h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[15]
0	PID 80h : PIDs supported ($81 - $A0)	0
1	PID 7Fh : Engine Run Time	0
2	PID 7Eh : PM NTE control area status	0
3	PID 7Dh : NOx NTE control area status	0
4	PID 7Ch : Diesel Particulate Filter Temperature	0
5	PID 7Bh : Diesel Particulate Filter Bank 2	0
6	PID 7Ah : Diesel Particulate Filter Bank 1	0
7	PID 79h : Exhaust Gas Temperature Bank 2	0

I.49.4.1 Description of PID 66h – Mass air flow sensor (If NC_CYL_NR = 8)

Data Byte	Application data to use	Remark
data A	DATA_A = ENVD_OBD_41_IDX	*//Support status*
data B	DATA_B = ENVD_OBD_42_IDX	*//MSB – Measured S1*
data C	DATA_C = ENVD_OBD_43_IDX	*//LSB – Measured S1*
data D	DATA_D = ENVD_OBD_44_IDX	*//MSB – Measured S2*
data E	DATA_E = ENVD_OBD_45_IDX	*//LSB – Measured S2*

I.49.4.2 Description of PID 68h – Intake Air Temperature Sensor (If NC_CYL_NR = 8)

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Data Byte	Application data to use	Remark
data A	DATA_A = ENVD_OBD_46_IDX	*//Support status*
data B	DATA_B = ENVD_OBD_47_IDX	*//IAT B1S1*
data C	DATA_C = ENVD_OBD_48_IDX	*//IAT B1S2*
data D	DATA_D = 0 (not defined)	*//IAT B1S3*
data E	DATA_E = ENVD_OBD_49_IDX	*//IAT B2S1*
data F	DATA_F = ENVD_OBD_50_IDX	*//IAT B2S2*
data G	DATA_G = 0 (not defined)	*//IAT B1S3*

I.49.4.3 Description of PID 6Ch – Commanded Throttle Actuator Control and Relative Throttle Position (If NC_CYL_NR = 8)

Data Byte	Application data to use	Formating conversion used
data A	DATA_A = ENVD_OBD_51_IDX	*//Support status*
data B	DATA_B = ENVD_OBD_52_IDX	*//Commanded 1*
data C	DATA_C = ENVD_OBD_53_IDX	*//Position 1*
data D	DATA_D = ENVD_OBD_54_IDX	*//Commanded 2*
data E	DATA_E = ENVD_OBD_55_IDX	*//Position 2*

I.49.4.4 Description of PID 6Dh – Fuel Pressure Control System (If NC_CYL_NR = 8)

Data Byte	Application data to use	Remark
data A	DATA_A = ENVD_OBD_56_IDX	*//Support status*
data B	DATA_B = ENVD_OBD_57_IDX	*//MSB – Commanded 1*
data C	DATA_C = ENVD_OBD_58_IDX	*//LSB – Commanded 1*
data D	DATA_D = ENVD_OBD_59_IDX	*//MSB – Measured 1*
data E	DATA_E = ENVD_OBD_60_IDX	*//LSB – Measured 1*
data F	DATA_F = 0 (not defined)	*//Temperature 1*
data G	DATA_G = ENVD_OBD_61_IDX	*//MSB – Commanded 2*
data H	DATA_H = ENVD_OBD_62_IDX	*//LSB – Commanded 2*
data I	DATA_I = ENVD_OBD_63_IDX	*//MSB – Measured 2*
data J	DATA_J = ENVD_OBD_64_IDX	*//LSB – Measured 2*
data K	DATA_K = 0 (not defined)	*//Temperature 2*

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I.49.5 Description of PID 80h - Supported PIDs 81h - A0h (not supported)

0 : the PID is not used
1 : the PID is used

DATA A - Supported PIDs 81h - 88h

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PID 80h - DATA A - Supported PID 81h to 88h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[16]
0	PID 88h : ISO/SAE reserved	0
1	PID 87h : Intake Manifold Absolute Pressure	0
2	PID 86h : Particulate Matter (PM) Sensor	0
3	PID 85h : NOx Control System	0
4	PID 84h : Manifold Surface Temperature	0
5	PID 83h : NOx Sensor	0
6	PID 82h : Engine Run Time for AECD #6 -#10	0
7	PID 81h : Engine Run Time for AECD #1 -#5	0

DATA A - Supported PIDs 89h - 90h

PID 80h - DATA B - Supported PID 89h to 90h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[17]
0	PID 90h : ISO/SAE reserved	0
1	PID 8Fh : ISO/SAE reserved	0
2	PID 8Eh : ISO/SAE reserved	0
3	PID 8Dh : ISO/SAE reserved	0
4	PID 8Ch : ISO/SAE reserved	0
5	PID 8Bh : ISO/SAE reserved	0
6	PID 8Ah : ISO/SAE reserved	0
7	PID 89h : ISO/SAE reserved	0

DATA A - Supported PIDs 91h - 98h

PID 80h - DATA C - Supported PID 91h to 98h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[18]
0	PID 98h : ISO/SAE reserved	0
1	PID 97h : ISO/SAE reserved	0
2	PID 96h : ISO/SAE reserved	0
3	PID 95h : ISO/SAE reserved	0
4	PID 94h : ISO/SAE reserved	0
5	PID 93h : ISO/SAE reserved	0
6	PID 92h : ISO/SAE reserved	0
7	PID 91h : ISO/SAE reserved	0

DATA A - Supported PIDs 99h – A0h

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PID 80h - DATA D - Supported PID 99h to A0h		
BIT	**Function**	**Bitmask:** ID_STATE_SRV_2_PID[19]
0	PID A0h : ISO/SAE reserved	0
1	PID 9Fh : ISO/SAE reserved	0
2	PID 9Eh : ISO/SAE reserved	0
3	PID 9Dh : ISO/SAE reserved	0
4	PID 9Ch : ISO/SAE reserved	0
5	PID 9Bh : ISO/SAE reserved	0
6	PID 9Ah : ISO/SAE reserved	0
7	PID 99h : ISO/SAE reserved	0

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I.50 SID 03h: Request emission-related diagnostic trouble codes

Import actions:

ACTION_ERRM_ReadDtcByTypeOfDtc (<IN>,<TypeOfDtc>,<IN>,<LevelOfDtc>,<INOUT>,<ListOfDtc>,<OUT>,<ResultDtc>)
ACTION_ERRM_ReadQuantityOfDtc (**IN**<PRM_TYPEOFDTC>,**IN**<PRM_LEVELOFDTC>,**INOUT**<PRM_QUANTITY>,**OUT**<PRM_RESULTQUANTITY>)

I.50.1 Functional description

The purpose of this service is to enable the external test equipment to obtain confirmed emission-related DTCs (diagnostic trouble codes).

Send a Service $03 request for all emission-related DTCs. Each ECU that has DTCs will respond with one (1) message containing all emission-related DTCs. If an ECU does not have emission-related DTCs then it shall respond with a message indicating no DTCs are stored by setting the parameter # of DTC to 00h
.
DTCs are transmitted in two (2) bytes of information for each DTC. The first two (2) bits (high order) of the first (1) byte for each DTC indicate whether the DTC is a Powertrain, Chassis, Body, or Network DTC (refer to ISO 15031-6 for additional interpretation of this structure). The second two (2) bits will indicate the first digit of the DTC (0 through 3). The second (2) nibble of the first (1) byte and the entire second (2) byte are the next three (3) hexadecimal characters of the actual DTC reported as hexadecimal. A Powertrain DTC transmitted as 0143h shall be displayed as P0143.

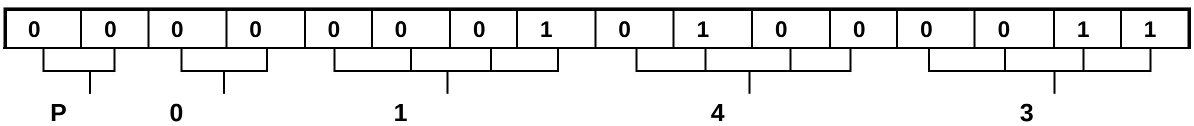

Figure I.50.1: Diagnostic trouble code encoding example DTC P0143

I.50.2 Message data bytes

I.50.2.1 Request message definition

Request emission-related DTC request message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request emission-related DTC request SID	M	03	SIDRQ

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I.50.2.2 Response message definition

Request emission-related DTC response message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request emission-related DTC response SID**	**M**	**43**	**SIDPR**
#2	# of DTC = [no emission-related DTCs stored emission-related DTCs stored]	M	xx = [00, 01 - FF	#OFDTC
#3 #4	DTC#1 (High Byte) DTC#1 (Low Byte)	C C	xx xx	DTC1HI DTC1LO
:	:	:	xx	
#n-1 #n	DTC#m (High Byte) DTC#m (Low Byte)	C C	xx xx	DTCmHI DTCmLO
C = Conditional — DTC#1 - DTC#m are only included if # of DTC parameter value ≠ $00				

I.50.2.3 Parameter definition

I.50.2.3.1 # of DTC parameter description

The # of DTC parameter reports the emission-related DTC(s) currently (at the time of the request message processing) stored in the ECU(s).

I.50.2.4 Formula section

ACTION_ERRM_ReadQuantityOfDtc

(
IN <OBD& CONFIRMED>
IN <LAW>
INOUT <NR_DTC>
OUT <ResultQuantity>
)

ACTION_ERRM_ReadDtcByTypeOfDtc

(
IN <OBD& CONFIRMED>
IN <LAW>
INOUT <DTC1 to DTCm>
OUT <ResultDtc>
)

IF ResultDtc != BUFFER_FULL **THEN**
Positive response
ELSE
No answer
ENDIF

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I.51 SID 04h: Clear/reset emission-related diagnostic inf.

Input data:

LV_ES {p. 1720}	LV_IGK {p. 906}	NLC_ERR_CLR_ENG_RUN_SAE {p. 8026}	

Action definition

ACTION_OBDC_Srv04Cnd (**OUT**<PRM_STATE_SRV_4_RESP>)	Mode: O
This function permit to clear all failures in dynamic memory, or not	

Import actions:

ACTION_ERRM_ClrInfoByTypeOfDtc (<IN>,<TypeOfDtc>,<OUT>,<ResultClrInfo>)
ACTION_OBDC_Srv04CndSp (**OUT**<PRM_STATE_SRV_4_SP_RESP>)
ACTION_OBDC_Srv04SpActions ()

I.51.1 Functional description

The purpose of this service is to provide a means for the external test equipment to command ECUs to clear the whole failure memory (all emission-related and non emission-related diagnostic information) (refer to Error Management module)

This includes:

1. MIL and number of diagnostic trouble codes (can be read with Service 01h, PID 01h)
2. Clear the I/M (Inspection/Maintenance) readiness bits (Service 01h, PID 01h and 41h)
3. Confirmed diagnostic trouble codes (can be read with Service 03h)
4. Pending diagnostic trouble codes (can be read with Service 07h)
5. Diagnostic trouble code for freeze frame data (can be read with Service 02h, PID 02h)
6. Freeze frame data (can be read with Service 02h)
7. Status of system monitoring tests (can be read with Service 01h, PID 01h)
8. On-board monitoring test results (can be read with Service 06h)
9. Distance travelled while MIL is activated (can be read with Service 01h, PID 21h)
10. Number of warm-ups since DTCs cleared (can be read with Service 01h, PID 30h)
11. Distance travelled since DTCs cleared (can be read with Service 01h, PID 31h)
12. Time run by the engine while MIL is activated (can be read with Service 01h, PID 4Dh)

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13. Time since diagnostic trouble codes cleared (can be read with Service 01h, PID 4Eh)
14. Reset misfire counts of standardized Test ID 0Bh to zero (can be read with Service 06h)

Description of parameter OUT used by function ACTION_OBDC_Srv04Cnd ():

PRM_STATE_SRV_4_RESP: Result to say if the function is done or not.

Authorised values for PRM_STATE_SRV_4_RESP are:
(1) The call of the function is successful
(0) The call of the function is not successful

Description for actions:

ACTION_OBDC_Srv04Cnd (OUT < PRM_STATE_SRV_4_RESP >)					
This function permit to clear all failures in dynamic memory, or not. In this function the project should define their own conditions in order to permit or not the clearing performed with Service 04h					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_STATE_SRV_4_RESP	OUT	00H..FFH	0..255	1	-
Result to say if the function is done or not					

The purpose of this function is to define the conditions in order to permit to clear all failures in dynamic memory, or not.
All ECUs shall respond to this request message with ignition ON, with the engine not running.

Formula section:

```
IF NLC_ERR_CLR_ENG_RUN_SAE THEN
    IF LV_IGK
    THEN
            PRM_STATE_SRV_4_RESP = 1
      ELSE
            PRM_STATE_SRV_4_RESP = 0
      ENDIF
ELSE
    IF LV_IGK AND LV_ES
    THEN
            PRM_STATE_SRV_4_RESP = 1
      ELSE
            PRM_STATE_SRV_4_RESP = 0
      ENDIF
ENDIF
```

I.51.2 Message data bytes

I.51.2.1 Request message

Bytes	Parameter name	Hex value
#01	**Request to clear/reset emission-related diagnostic information**	04

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For safety and/or technical design reasons, ECUs that can not perform this operation under other conditions, such as with the engine running shall send a negative response message with response code 22h - conditionsNotCorrect.

I.51.2.1.1 Formula section

If there are used the generic conditions in order to check if the clearing of all failures in dynamic memory, can be performed or not, this is the sequence to be respected:

```
    IFACTION_OBDC_Srv04Cnd()
  THEN
        ACTION_ERRM_ClrInfoByTypeOfDtc
                                    (
                                    IN <ALL>
                                    OUT <ResultClrInfo>
                                    )
        CALL ACTION_OBDC_Srv04SpActions()
            Positive response;
    ELSE
            Negative response with "Condition not correct";
    ENDIF
```

If there are used the project specific conditions in order to check if the clearing of all failures in dynamic memory, can be performed or not, this is the sequence to be respected:

```
    IFACTION_OBDC_Srv04CndSp()
  THEN
        ACTION_ERRM_ClrInfoByTypeOfDtc
                                    (
                                    IN <ALL>
                                    OUT <ResultClrInfo>
                                    )
        CALL ACTION_OBDC_Srv04SpActions()
            Positive response;
    ELSE
            Negative response with "Condition not correct";
    ENDIF
```

I.51.2.2 Positive response message

Bytes	Parameter name	Hex value
#01	**Request to clear/reset emission-related diagnostic information positive response**	44

I.51.2.3 Negative response message

Bytes	Parameter name	Hex value
#1	**Negative response**	7F
#2	**Request to clear/reset emission-related diagnostic information**	04
#3	Error code = Condition not correct	22

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I.51.2.4 Error code

Error code	Cause
Condition not correct	In case of ECU can not perform the clearing

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I.52 SID 04h: Clear/reset emission-related diagnostic inf. (Appl. Inc.)

Input data:

N_32 {p. 1525}	VS {p. 1176}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_32_MAX_CLR_FMY_SRV_4	V	0... FFH	0... 8160	32	rpm
Maximum engine speed threshold to erease error memory in service 04					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_ERR_CLR_ENG_RUN_SAE	-	0... 1H	0 ...1	1	-
Byte which indicates if the erase will be done when engine is running or not					

Action definition

ACTION_OBDC_Srv04CndSp (**OUT**<PRM_STATE_SRV_4_SP_RESP>)	Mode: O
This function permit to clear all failures in dynamic memory, or not	

Parameter	Type	Hex.Limits	Phys.Limits	Resol.	Unit
PRM_STATE_SRV_4_SP_RESP	out	0... FFH	0... 255	1	-
Result to say if the function is done or not					

ACTION_OBDC_Srv04SpActions ()	Mode: O
This function permit to project to add their own manufacturer specific "clearing/resetting" actions	

General information

The purpose of this function is to define the conditions in order to permit to clear all failures in dynamic memory, or not.

Application conditions:

Initialisation: –

Activation: –

Deactivation: –

Recurrence: –

Function description:

Formula section:

I.52.1 Definition of NLC_ERR_CLR_ENG_RUN_SAE

Description:

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Erase with or without engine running - NLC_ERR_CLR_ENG_RUN_SAE	
Value	**Description**
0	The clearing of failures is performed when engine is NOT running
1	The clearing of failures is performed when engine is running

Formula section:
NLC_ERR_CLR_ENG_RUN_SAE = 1

I.52.2 ACTION_OBDC_Srv04CndSp

I.52.2.1 Description of parameter OUT used by function ACTION_OBDC_Srv04CndSp():

Description:

PRM_STATE_SRV_4_SP_RESP: Result to say if the function is done or not.

Authorised values for PRM_STATE_SRV_4_SP_RESP are:

(1) The call of the function is successful
(0) The call of the function is not successful

Formula section:

```
IF    VS = 0                AND
      N_32 < C_N_32_MAX_CLR_FMY_SRV_4
THEN
      PRM_STATE_SRV_4_SP_RESP = 1
ELSE
      PRM_STATE_SRV_4_SP_RESP = 0
ENDIF
```

I.52.3 ACTION_OBDC_Srv04SpActions

I.52.3.1 Description of parameter OUT used by function ACTION_OBDC_Srv04SpActions():

Description:

Other manufacturer specific "clearing/resetting" actions may also occur in response to the Service $04 request.

Formula section:

ACTION not used yet

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I.53 SID 06h: Request on-board monitoring testS - specific syst

I.53.1 Functional description

The purpose of this service is to allow access to the results for on-board diagnostic monitoring tests of specific components /systems that are continuously monitored (e.g. mis-fire monitoring) and non-continuously monitored (e.g. catalyst system).

The request message for test values includes an On-Board Diagnostic Monitor ID (see Annex D of ISO 15031-5.4) that indicates the information requested. Unit and Scaling information is included in Annex E of ISO 15031-5.4.

The vehicle manufacturer is responsible for assigning "Manufacturer Defined Test IDs" for different tests of a monitored system. The latest valid test values (results) are to be retained, even over multiple ignition OFF cycles, until replaced by more recent test values (results). Test values (results) are requested by On-Board Diagnostic Monitor ID. Test values (results) are always reported with the Minimum and Maximum Test Limits. The Unit and Scaling ID included in the response message defines the scaling and unit to be used by the external test equipment to display the test values (results), Minimum Test Limit, and Maximum Test Limit information.

If an On-Board Diagnostic Monitor has not been completed at least once since Clear/reset emission-related diagnostic information or battery disconnect, then the parameters Test Value (Results), Minimum Test Limit, and Maximum Test Limit shall be set to zero (0000h) values.

Not all On-Board Diagnostic Monitor IDs are applicable or supported by all systems. On-Board Diagnostic Monitor ID 00h is a bit-encoded value that indicates for each ECU which On-Board Diagnostic Monitor IDs are supported. On-Board Diagnostic Monitor ID 00h indicates support for On-Board Diagnostic Monitor IDs from 01h to 20h. On-Board Diagnostic Monitor ID 20h indicates support for On-Board Diagnostic Monitor IDs 21h through 40h, etc. This is the same concept for PIDs/TIDs/InfoTypes support in services 01h, 02h, 06h, 08h, and 09h. On-Board Diagnostic Monitor ID 00h is required for those ECUs that respond to a corresponding service 06h request message as specified in Annex A of ISO 15031-5.4.

The request message including supported On-Board Diagnostic Monitor IDs may contain up to six (6) OBDMIDs. A request message including an On-Board Diagnostic Monitor ID, which reports test values shall only contain one (1) OBDMID. An external test equipment is not allowed to request a combination of OBDMIDs supported and a single OBDMID, which report test values. The ECU shall support requests for up to six (6) supported OBDMIDs and only one (1) OBDMID which reports test values.

A unique method must be utilized for displaying data for monitors that have multiple tests. Many OBD monitors have multiple tests that that are done in either a serial or parallel manner. If a monitor uses multiple OBD Monitor ID/Test ID combinations that may not all complete at the same time, the following method shall be used to update the stored test results at the time of monitor completion:

After the monitor completes, update all Monitor ID/Test ID combinations (or test results) that were utilized by the monitor with appropriate passing or failing results. If a test result (or Monitor ID/Test ID) was not utilized during this monitoring event, set the Test Values and Minimum and Maximum Test Limits to their initial values (0000h, test not completed). Test results from the previously completed monitoring events shall not be mixed with test results from the current completed monitoring event.

In some cases, test results (or Monitor ID/Test ID combinations) will be displayed as being incomplete even though the monitor (as indicated by PID 41h) was successfully completed and either passed or

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failed. In other cases, some Test IDs will show passing results while others will show failing results after the monitor (as indicated by PID 41h) was successfully completed and failed. Note that OBD-II regulations prohibit a passing monitor from showing any failing test results. If an initial, serial test indicates a failure and a subsequent re-test of the system indicates a passing result, the test that was utilized to make the passing determination should be displayed, while the failing test that was utilized to make the initial determination should be reset to it's initial values (0000h, test not completed).

As an example of a serial monitor, an evaporative system monitor can fail for a large evaporative system leak and never continue to test for small leaks or very small leaks. In this case, the Test ID for the large leak would show a failing result, while the small leak test and the very small leak test would show incomplete. As an example of the parallel monitor, a purge valve flow monitor can pass by having a large rich lambda shift, a large lean lambda shift or a large engine rpm increase. If the purge valve is activated and a large rich lambda shift occurs, the Test ID for the rich lambda shift would show a passing result while the other two Test IDs would show incomplete. Since some Test IDs for a completed monitor will show incomplete, PID 41h must be used to determine monitor completion status.

I.53.2 Message data bytes

I.53.2.1 Read supported OBDMIDs

Request on-board monitoring test results for specific monitored systems request message (read supported OBDMIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request on-board monitoring test results for specific monitored systems request SID**	**M**	**06**	**SIDRQ**
#2	On-Board Diagnostic Monitor ID (OBDMIDs supported: Annex A of ISO 15031-5.4)	M	xx	OBDMID
#3	On-Board Diagnostic Monitor ID (OBDMIDs supported: Annex A of ISO 15031-5.4)	U	xx	OBDMID
#4	On-Board Diagnostic Monitor ID (OBDMIDs supported: Annex A of ISO 15031-5.4)	U	xx	OBDMID
#5	On-Board Diagnostic Monitor ID (OBDMIDs supported: Annex A of ISO 15031-5.4)	U	xx	OBDMID
#6	On-Board Diagnostic Monitor ID (OBDMIDs supported: Annex A of ISO 15031-5.4)	U	xx	OBDMID
#7	On-Board Diagnostic Monitor ID (OBDMIDs supported: Annex A of ISO 15031-5.4)	U	xx	OBDMID
U = User Optional — OBDMID may be included to avoid multiple OBDMID supported request messages				

NOTE To request OBDMIDs supported range from C1h - FFh another request message with OBDMID#1 = C0h and OBDMID#2 = E0h shall be sent to the vehicle

I.53.2.2 Report supported OBDMIDs

ECU(s) must respond to all supported ranges if requested. A range is defined as a block of 32 OBDMIDs (e.g. range #1: OBDMID 01h-20h). The ECU shall not respond to unsupported OBDMID ranges unless subsequent ranges have a supported OBDMID(s).

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Request on-board monitoring test results for specific monitored systems response message (report supported OBDMIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request on-board monitoring test results for specific monitored systems response SID**	**M**	**46**	**SIDPR**
	data record of supported OBDMID = [			OBDMIDREC
#2	1st supported OBDMID	M	xx	OBDMID
#3	Data A: supported OBDMIDs,	M	xx	DATA_A
#4	Data B: supported OBDMIDs,	M	xx	DATA_B
#5	Data C: supported OBDMIDs,	M	xx	DATA_C
#6	Data D: supported OBDMIDs]	M	xx	DATA_D
:	:	:	:	:
	data record of supported OBDMID = [			OBDMIDREC
#n-4	mth supported OBDMID	C1	xx	OBDMID
#n-3	Data A: supported OBDMIDs,	C2	xx	DATA_A
#n-2	Data B: supported OBDMIDs,	C2	xx	DATA_B
#n-1	Data C: supported OBDMIDs,	C2	xx	DATA_C
#n	Data D: supported OBDMIDs]	C2	xx	DATA_D
C1 = Conditional — OBDMID value shall be the same value as included in the request message if supported by the ECU C2 = Conditional — value indicates OBDMIDs supported; range of supported OBDMIDs depends on selected OBDMID value (see C1)				

NOTE The response message shall only include the OBDMID(s) and Data A - D which are supported by the ECU. If the request message includes (a) OBDMID value(s) which are not supported by the ECU those shall not be included in the response message.

I.53.2.3 Read OBDMID test values

Request on-board monitoring test results for specific monitored systems request message (read OBDMID test values)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request on-board monitoring test results for specific monitored systems request SID**	**M**	**06**	**SIDRQ**
#2	On-Board Diagnostic Monitor ID	M	xx	OBDMID

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I.53.2.4 Report OBDMID test values

Request on-board monitoring test results for specific monitored systems response message (report OBDMID test values)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request on-board monitoring test results for specific monitored systems response SID**	**M**	**46**	**SIDPR**
	data record of supported OBDMID = [			OBDMIDREC
#2	On-Board Diagnostic Monitor ID	M	xx	OBDMID
#3	Std./Manuf. Defined TID#1	M	xx	S/MDTID
#4	Unit And Scaling ID#1	M	xx	UASID
#5	Test Value (High Byte)#1	M	xx	TVHI
#6	Test Value (Low Byte)#1	M	xx	TVLO
#7	Min. Test Limit (High Byte)#1	M	xx	MINTLHI
#8	Min. Test Limit (Low Byte)#1	M	xx	MINTLLO
#9	Max. Test Limit (High Byte)#1	M	xx	MAXTLHI
#10	Max. Test Limit (Low Byte)#1]	M	xx	MAXTLLO
:	:	:	:	:
	data record of supported OBDMID = [			OBDMIDREC
#n-8	On-Board Diagnostic Monitor ID	C1	xx	OBDMID
#n-7	Std./Manuf. Defined TID#m	C2	xx	S/MDTID
#n-6	Unit And Scaling ID#m	C2	xx	UASID
#n-5	Test Value (High Byte)#m	C2	xx	TVHI
#n-4	Test Value (Low Byte)#m	C2	xx	TVLO
#n-3	Min. Test Limit (High Byte)#m	C2	xx	MINTLHI
#n-2	Min. Test Limit (Low Byte)#m	C2	xx	MINTLLO
#n-1	Max. Test Limit (High Byte)#m	C2	xx	MAXTLHI
#n	Max. Test Limit (Low Byte)#m]	C2	xx	MAXTLLO

C1 = Conditional — parameter is only present if more than one (1) Manufacturer Defined TID is supported by the ECU for the requested Monitor ID.
C2 = Conditional — parameter and value depends on selected Manufacturer Defined TID number and are only included if the Manufacturer Defined TID is supported by the ECU. The value shall be zero (00h) in case the On-Board Diagnostic Monitor has not been completed at least once since Clear/reset emission-related diagnostic information or battery disconnect.

I.53.2.5 Response code

Note : The response is given following the condition made by the project.
Here is an example :

Formula section:

IF Conditions from the specification XXI06Q01.XXX are fullfield
THEN
Positive response with test result
ELSE
Positive response with all data equal to 0000h
ENDIF

I.53.3 Parameter definition

I.53.3.1 On-Board Diagnostic Monitor IDs supported

The On-Board Diagnostic Monitor IDs supported is the same concept as used for PID support in services 01h and 02h as specified in Annex A of ISO 15031-5.4.

I.53.3.2 On-Board Diagnostic Monitor ID description

The On-Board Diagnostic Monitor ID is a one (1) byte parameter and is defined in Annex D of ISO 15031-5.4. An On-Board Diagnostic Monitor may have more than one (1) monitor test (Test ID).

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I.53.3.3 Standardised and Manufacturer Defined Test ID description

The Standardised and Manufacturer Defined Test ID is a one (1) byte parameter. For example, the On-Board Diagnostic Monitor " Oxygen Sensor Monitor Bank 1 - Sensor 1" may have the following Standardised Test ID:
The table below specifies the range of identifiers.

Standardised Test ID description

Range (Hex)	Description
00	ISO/SAE reserved
01	Rich to lean sensor threshold voltage (constant)
02	Lean to rich sensor threshold voltage (constant)
03	Low sensor voltage for switch time calculation (constant)
04	High sensor voltage for switch time calculation (constant)
05	Rich to lean sensor switch time (calculated)
06	Lean to rich sensor switch time (calculated)
07	Minimum sensor voltage for test cycle (calculated)
08	Maximum sensor voltage for test cycle (calculated)
09	Time between sensor transitions (calculated)
0A	Sensor period (calculated)
0B	EWMA (Exponential Weighted Moving Average) misfire counts for last ten (10) driving cycles (calculated, rounded to an integer value) General EWMA calculation: 0.1 * (current misfire counts) + 0.9 * (previous misfire counts average) Initial value for (previous misfire counts average) = 0 Note: Internal ECU calculation registers with precision higher than one count must be used and retained to calculate the contents of registers 0Bh and 0Ch to prevent rounding errors. If this is not done, these registers will never count back down to zero after misfire stops. The calculations must be done using the high precision registers, then rounded to the nearest integer value to be output as register 0Bh and 0Ch High_Precision_EWMA_Misfire_Counts $_{current}$ = Rounded [(0.1) * High_Precision_Misfire_Counts $_{current}$ + (0.9) * High_Precision_EWMA_Misfire_Counts $_{previous}$] Where: Rounded means rounded to the nearest integer. The high precision values are never reported, they are only used for internal calculations. This TEST ID shall be reported with OBD Monitor IDs A2h - ADh and the Scaling ID 24h.
0C	Misfire counts for last/current driving cycles (calculated, rounded to an integer value)
0D - 7F	Reserved for future standardisation

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Manufacturer Defined Test ID description

Range (Hex)	Description
80 - FE	Manufacturer Defined Test ID range - this parameter is an identifier for the test performed within the On-Board Diagnostic Monitor.
FF	Reserved by document

Results of latest mandated on-board oxygen sensor monitoring tests, see figure below.

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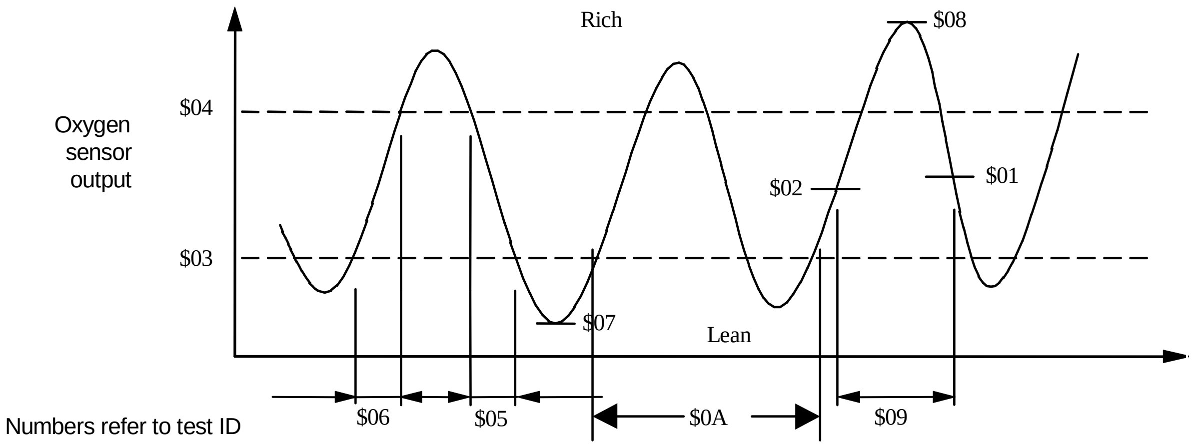

Figure I.53.1: 1 Standardised Test ID value example

I.53.3.4 Unit and Scaling ID definition

The Unit and Scaling ID is a one (1) byte identifier to reference the scaling and unit to be used by the external test equipment to calculate and display the test values (results), Minimum Test Limit, and the Maximum Test Limit for the Standardised and Manufacturer Defined Test ID requested. All standardised Unit And Scaling IDs are specified in Annex E of ISO 15031-5.4.

I.53.3.5 Test Value (result) description

The Test Value represents the test result and is defined in the table below.

Test Value description

Parameter name	# of bytes	Description
Test Value	2 (High and Low Byte)	Test Value (Result) - this value shall be calculated and displayed by the external test equipment based on the Unit and Scaling ID included in the response message. The Test Value shall be within the Minimum and Maximum Test Limit to indicate a "Pass" result.

I.53.3.6 Minimum Test Limit description

The Minimum Test Limit parameter is defined in the table below.

Minimum Test Limit description

Parameter name	# of bytes	Description
Minimum Test Limit	2 (High and Low Byte)	The Minimum Test Limit shall be calculated and displayed by the external test equipment based on the Unit and Scaling ID included in the response message. The Unit and Scaling IDs are specified in Annex E of ISO 15031-5.4. The Minimum Test Limit shall be the minimum value for the monitor identified by the On-Board Diagnostic Monitor ID. For the Standardised Test IDs which are constant values the Minimum Test Limit shall be the same value as reported for the Test Value. It is the vehicle manufacturer's responsibility to provide information whether a Test Value which equals the Minimum Test Value results in a "Pass" or "Fail" condition.

I.53.3.7 Maximum Test Limit description

The Maximum Test Limit parameter is defined in the table below.

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Maximum Test Limit description

Parameter name	# of bytes	Description
Maximum Test Limit	2 (High and Low Byte)	The Maximum Test Limit shall be calculated and displayed by the external test equipment based on the Unit and Scaling ID included in the response message. The Unit and Scaling IDs are specified in Annex E of ISO 15031-5.4. The Maximum Test Limit shall be the maximum value for the monitor identified by the On-Board Diagnostic Monitor ID. For the Standardised Test IDs which are constant values the Maximum Test Limit shall be the same value as reported for the Test Value. It is the vehicle manufacturer's responsibility to provide information whether a Test Value which equals the Maximum Test Value results in a "Pass" or "Fail" condition.

I.53.4 Standard definition Monitor

Standard On-Board Diagnostic Monitor ID definition

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OBDMID (Hex)	On-Board Diagnostic Monitor ID name
00	OBD Monitor IDs supported (01h - 20h)
01	Exhaust Gas Sensor Monitor Bank 1 - Sensor 1
02	Exhaust Gas Sensor Monitor Bank 1 - Sensor 2
03	Exhaust Gas Sensor Monitor Bank 1 - Sensor 3
04	Exhaust Gas Sensor Monitor Bank 1 - Sensor 4
05	Exhaust Gas Sensor Monitor Bank 2 - Sensor 1
06	Exhaust Gas Sensor Monitor Bank 2 - Sensor 2
07	Exhaust Gas Sensor Monitor Bank 2 - Sensor 3
08	Exhaust Gas Sensor Monitor Bank 2 - Sensor 4
09	Exhaust Gas Sensor Monitor Bank 3 - Sensor 1
0A	Exhaust Gas Sensor Monitor Bank 3 - Sensor 2
0B	Exhaust Gas Sensor Monitor Bank 3 - Sensor 3
0C	Exhaust Gas Sensor Monitor Bank 3 - Sensor 4
0D	Exhaust Gas Sensor Monitor Bank 4 - Sensor 1
0E	Exhaust Gas Sensor Monitor Bank 4 - Sensor 2
0F	Exhaust Gas Sensor Monitor Bank 4 - Sensor 3
10	Exhaust Gas Sensor Monitor Bank 4 - Sensor 4
11 - 1F	Reserved by document for future standardisation
20	OBD Monitor IDs supported (21h - 40h)
21	Catalyst Monitor Bank 1
22	Catalyst Monitor Bank 2
23	Catalyst Monitor Bank 3
24	Catalyst Monitor Bank 4
25 - 30	Reserved by document for future standardisation
31	EGR Monitor Bank 1
32	EGR Monitor Bank 2
33	EGR Monitor Bank 3
34	EGR Monitor Bank 4
35	VVT Monitor Bank 1
36	VVT Monitor Bank 2
37	VVT Monitor Bank 3
38	VVT Monitor Bank 4
39	EVAP Monitor (Cap Off)
3A	EVAP Monitor (0.090")
3B	EVAP Monitor (0.040”)
3C	EVAP Monitor (0.020”)

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OBDMID (Hex)	On-Board Diagnostic Monitor ID name
3D	Purge Flow Monitor
3E - 3F	Reserved by document for future standardisation
40	OBD Monitor IDs supported (41h - 60h)
41	Exhaust Gas Sensor Heater Monitor Bank 1 - Sensor 1
42	Exhaust Gas Sensor Heater Monitor Bank 1 - Sensor 2
43	Exhaust Gas Sensor Heater Monitor Bank 1 - Sensor 3
44	Exhaust Gas Sensor Heater Monitor Bank 1 - Sensor 4
-	Exhaust Gas Sensor Heater Monitor Bank 2 - Sensor 1
46	Exhaust Gas Sensor Heater Monitor Bank 2 - Sensor 2
47	Exhaust Gas Sensor Heater Monitor Bank 2 - Sensor 3
48	Exhaust Gas Sensor Heater Monitor Bank 2 - Sensor 4
49	Exhaust Gas Sensor Heater Monitor Bank 3 - Sensor 1
4A	Exhaust Gas Sensor Heater Monitor Bank 3 - Sensor 2
4B	Exhaust Gas Sensor Heater Monitor Bank 3 - Sensor 3
4C	Exhaust Gas Sensor Heater Monitor Bank 3 - Sensor 4
4D	Exhaust Gas Sensor Heater Monitor Bank 4 - Sensor 1
4E	Exhaust Gas Sensor Heater Monitor Bank 4 - Sensor 2
4F	Exhaust Gas Sensor Heater Monitor Bank 4 - Sensor 3
50	Exhaust Gas Sensor Heater Monitor Bank 4 - Sensor 4
51 - 5F	Reserved by document for future standardisation
60	OBD Monitor IDs supported (61h - 80h)
61	Heated Catalyst Monitor Bank 1
62	Heated Catalyst Monitor Bank 2
63	Heated Catalyst Monitor Bank 3
64	Heated Catalyst Monitor Bank 4
65 - 70	Reserved by document for future standardisation
71	Secondary Air Monitor 1
72	Secondary Air Monitor 2
73	Secondary Air Monitor 3
74	Secondary Air Monitor 4
75 - 7F	Reserved by document for future standardisation
80	OBD Monitor IDs supported (81h - A0h)
81	Fuel System Monitor Bank 1
82	Fuel System Monitor Bank 2
83	Fuel System Monitor Bank 3
84	Fuel System Monitor Bank 4

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OBDMID (Hex)	On-Board Diagnostic Monitor ID name
85	Boost Pressure Control Monitor Bank 1
86	Boost Pressure Control Monitor Bank 2
87 - 8F	ISO/SAE reserved
90	NOx Adsorber Monitor Bank 1
91	NOx Adsorber Monitor Bank 2
92 - 97	ISO/SAE reserved
98	NOx Catalyst Monitor Bank 1
99	NOx Catalyst Monitor Bank 2
9A - 9F	ISO/SAE reserved
A0	OBD Monitor IDs supported (A1h - C0h)
A1	Mis-Fire Monitor General Data
A2	Mis-Fire Cylinder 1 Data
A3	Mis-Fire Cylinder 2 Data
A4	Mis-Fire Cylinder 3 Data
A5	Mis-Fire Cylinder 4 Data
A6	Mis-Fire Cylinder 5 Data
A7	Mis-Fire Cylinder 6 Data
A8	Mis-Fire Cylinder 7 Data
A9	Mis-Fire Cylinder 8 Data
AA	Mis-Fire Cylinder 9 Data
AB	Mis-Fire Cylinder 10 Data
AC	Mis-Fire Cylinder 11 Data
AD	Mis-Fire Cylinder 12 Data
AE	Mis-Fire Cylinder 13 Data
AF	Mis-Fire Cylinder 14 Data
B0	Mis-Fire Cylinder 15 Data
B1	Mis-Fire Cylinder 16 Data
B2	PM Filter Monitor Bank 1
B3	PM Filter Monitor Bank 2
B4 - BF	ISO/SAE reserved
C0	OBD Monitor IDs supported (C1h - E0h)
C1 - DF	Reserved by document for future standardisation
E0	OBD Monitor IDs supported (E1h - FFh)
E1 - FF	Vehicle Manufacturer defined OBDMIDs

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I.54 SID 06h: Request on-board monitoring testS - specific syst (Appl.Inc)

Input data:

C_CTR_SWT_LS_DOWN {p. 5153}	C_CUR_DMTL_REF_ LEAK_MAX {p. 5972}	C_CUR_DMTL_REF_ LEAK_MIN {p. 5972}	C_SAF_DIAG_MAX {p. 812}
C_SAF_DIAG_MIN {p. 812}	C_SUM_AFL_VLS_MIN_ DIAG_SA_1 {p. 1088}	C_SUM_CNL_SMALL_ LEAK_MES_MAX {p. 5973}	C_VLS_DOWN_AFL_AFR_ SAE {p. 7836}
C_VLS_DOWN_AFR_AFL_ SAE {p. 7836}	C_VLS_MIN_DIAG_PUC_ LS_DOWN {p. 4277}	C_VLS_THD_DIAG_SCP_ LS_DOWN {p. 4268}	CAM_DYN_IVVT_EX_SAE [NC_NR_CBK_IVVT] {p. 8399}
CAM_DYN_IVVT_EX_ TOL_SAE [NC_NR_CBK_IVVT] {p. 8399}	CAM_DYN_IVVT_IN_SAE [NC_NR_CBK_IVVT] {p. 8399}	CAM_DYN_IVVT_IN_TOL_ SAE [NC_NR_CBK_IVVT] {p. 8399}	CL_MMV_DIAGCPS_MAX_ SAE {p. 5926}
CL_MMV_DIAGCPS_MIN_ SAE {p. 5926}	CL_MMV_SAE {p. 5926}	CTR_MIS_DC_CYL [NC_CYL_NR] {p. 6237}	CTR_MIS_DC_MMV_CYL [NC_CYL_NR] {p. 6237}
CTR_MIS_TOT_DC {p. 6237}	CTR_SAVE_SWT_LS_ DOWN [NC_CBK_EX_NR] {p. 5151}	EFF_CAT_DIAG_OBD [NC_CBK_EX_NR] {p. 5515}	EFF_CAT_MAX_DIAG_ OBD [NC_CBK_EX_NR] {p. 5515}
FAC_DLY_LSL_UP_DIAG_ SAE [NC_CBK_EX_NR] {p. 5346}	FAC_DLY_LSL_UP_DIAG_ TOL_SAE [NC_CBK_EX_NR] {p. 5346}	FAC_DYN_LSL_UP_DIAG_ SAE [NC_CBK_EX_NR] {p. 5346}	FAC_DYN_LSL_UP_DIAG_ TOL_SAE [NC_CBK_EX_NR] {p. 5346}
LC_SA_SWI_ACQ {p. 1088}	LV_ERR_MEM_XX {p. 5767}	LV_READY_XX {p. 5881}	M6_CTR_CNL_SMALL_ LEAK_MES {p. 5967}
M6_CUR_DMTL_COR_ FIL_CID18 {p. 5968}	M6_CUR_DMTL_DMTLS_ TEST {p. 5968}	M6_CUR_DMTL_REF_ LEAK {p. 5968}	M6_CUR_DMTL_ROUGH_ LEAK_END {p. 5968}
M6_CUR_DMTL_ROUGH_ LEAK_LEN_END {p. 5968}	M6_CUR_DMTL_SMALL_ LEAK_END {p. 5968}	M6_CUR_DMTL_THD_ DMTLS_TEST {p. 5968}	M6_CUR_DMTL_THD_ ROUGH_LEAK {p. 5968}
M6_CUR_DMTL_THD_ ROUGH_LEAK_LEN {p. 5968}	MAF_DIAGCPS_SAE {p. 5927}	MAF_DIAGCPS_THD_SAE {p. 5927}	NC_CYL_NR {p. 1526}
NC_NR_CPS_CP	R_IT_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}	R_IT_THD_OBD_LSH_ DOWN [NC_CBK_EX_NR] {p. 5198}	SAF_DIAG_MAX_SAE {p. 1088}
SAF_DIAG_MIN_SAE {p. 1088}	STATE_EVAP_SAE {p. 819}	STATE_PSN_LS_1_SAE {p. 819}	STATE_PSN_LS_SAE {p. 819}
STATE_VAR_SAP_SAE {p. 819}	SUM_AFL_VLS_DIAG_ SA_1_SAE {p. 1088}	SUM_AFL_VLS_DIAG_ SA_2_SAE {p. 1088}	SUM_DIAG_DIAGCPS_ SAE {p. 5928}

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SUM_DIAG_DIAGCPS_ SAE_1	SUM_DIAG_DIAGCPS_ SAE_2	SUM_DIAGCPS_MAX_ SAE {p. 5928}	TTIP_OBD_LSH_UP_ MES_BOL_SAE [NC_CBK_EX_NR] {p. 5439}
TTIP_OBD_LSH_UP_ MES_SAE [NC_CBK_EX_NR] {p. 5439}	TTIP_OBD_LSH_UP_ MES_TOL_SAE [NC_CBK_EX_NR] {p. 5439}	VLS_DOWN_MAX_DC [NC_CBK_EX_NR] {p. 1503}	VLS_DOWN_MIN_DC [NC_CBK_EX_NR] {p. 1503}
VLS_DOWN_PUC_SAVE [NC_CBK_EX_NR] {p. 4276}	VLS_DOWN_PUE_BOL_ SAE [NC_CBK_EX_NR] {p. 5169}	VLS_DOWN_PUE_SAE [NC_CBK_EX_NR] {p. 5170}	VLS_DOWN_PUE_TOL_ SAE [NC_CBK_EX_NR] {p. 5170}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_STATE_SRV_6_TID [NC_NR_TID]	-	0... FFH	0... 255	1	-
LDP_STATE_TID_ID_STATE_SRV_6	NC_ NR_ TID	0... FFH	0... 255	1	-
Table of bytes which defines the TIDs supported by the service 06h ISO 15765-4					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_TID	-	0... FFH	0... 255	1	-
Define how many TIDs are supported by the project					

FUNCTION DESCRIPTION:

General information:

In the table **ID_STATE_SRV_6_TID** theconfigured OBDMID's and TID's can be calibrated.

I.54.1 Configuration for supported OBDMID's

Description:

If an OBDMID is supported, then in column "Supported" "1" is configured, if not "0" is configured.

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OBDMID (HEX)	Function	Supported
01	Exhaust Gas Sensor Monitor Bank 1 - Sensor 1	**1**
02	Exhaust Gas Sensor Monitor Bank 1 - Sensor 2	**1**
03	Exhaust Gas Sensor Monitor Bank 1 - Sensor 3	0
04	Exhaust Gas Sensor Monitor Bank 1 - Sensor 4	0
05	Exhaust Gas Sensor Monitor Bank 2 - Sensor 1	**1**
06	Exhaust Gas Sensor Monitor Bank 2 - Sensor 2	**1**
07	Exhaust Gas Sensor Monitor Bank 2 - Sensor 3	0
08	Exhaust Gas Sensor Monitor Bank 2 - Sensor 4	0
09	Exhaust Gas Sensor Monitor Bank 3 - Sensor 1	0
0A	Exhaust Gas Sensor Monitor Bank 3 - Sensor 2	0
0B	Exhaust Gas Sensor Monitor Bank 3 - Sensor 3	0
0C	Exhaust Gas Sensor Monitor Bank 3 - Sensor 4	0
0D	Exhaust Gas Sensor Monitor Bank 4 - Sensor 1	0
0E	Exhaust Gas Sensor Monitor Bank 4 - Sensor 2	0
0F	Exhaust Gas Sensor Monitor Bank 4 - Sensor 3	0
10	Exhaust Gas Sensor Monitor Bank 4 - Sensor 4	0
11 - 1F	**ISO/SAE reserved**	0
20	**OBD Monitor IDs supported ($21 - $40)**	**1**
21	Catalyst Monitor Bank 1	**1**
22	Catalyst Monitor Bank 2	**1**
23	Catalyst Monitor Bank 3	0
24	Catalyst Monitor Bank 4	0
25 - 30	**ISO/SAE reserved**	0
31	EGR Monitor Bank 1	0
32	EGR Monitor Bank 2	0
33	EGR Monitor Bank 3	0
34	EGR Monitor Bank 4	0
35	VVT Monitor Bank 1	**1**
36	VVT Monitor Bank 2	**1**
37	VVT Monitor Bank 3 (**IF** NC_CYL_NR = 8)	**1**
38	VVT Monitor Bank 4 (**IF** NC_CYL_NR = 8)	**1**
39	EVAP Monitor (Cap Off)	0
3A	EVAP Monitor (0.090")	0
3B	EVAP Monitor (0.040”)	**1**
3C	EVAP Monitor (0.020”)	**1**
3D	Purge Flow Monitor	**1**
3E - 3F	**ISO/SAE reserved**	0
40	**OBD Monitor IDs supported ($41 - $60)**	**1**
41	Exhaust Gas Sensor Heater Monitor Bank 1 - Sensor 1	**1**

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OBDMID (HEX)	Function	Supported
42	Exhaust Gas Sensor Heater Monitor Bank 1 - Sensor 2	**1**
43	Exhaust Gas Sensor Heater Monitor Bank 1 - Sensor 3	0
44	Exhaust Gas Sensor Heater Monitor Bank 1 - Sensor 4	0
-	Exhaust Gas Sensor Heater Monitor Bank 2 - Sensor 1	**1**
46	Exhaust Gas Sensor Heater Monitor Bank 2 - Sensor 2	**1**
47	Exhaust Gas Sensor Heater Monitor Bank 2 - Sensor 3	0
48	Exhaust Gas Sensor Heater Monitor Bank 2 - Sensor 4	0
49	Exhaust Gas Sensor Heater Monitor Bank 3 - Sensor 1	0
4A	Exhaust Gas Sensor Heater Monitor Bank 3 - Sensor 2	0
4B	Exhaust Gas Sensor Heater Monitor Bank 3 - Sensor 3	0
4C	Exhaust Gas Sensor Heater Monitor Bank 3 - Sensor 4	0
4D	Exhaust Gas Sensor Heater Monitor Bank 4 - Sensor 1	0
4E	Exhaust Gas Sensor Heater Monitor Bank 4 - Sensor 2	0
4F	Exhaust Gas Sensor Heater Monitor Bank 4 - Sensor 3	0
50	Exhaust Gas Sensor Heater Monitor Bank 4 - Sensor 4	0
51 - 5F	**ISO/SAE reserved**	0
60	**OBD Monitor IDs supported ($61 - $80)**	**1**
61	Heated Catalyst Monitor Bank 1	0
62	Heated Catalyst Monitor Bank 2	0
63	Heated Catalyst Monitor Bank 3	0
64	Heated Catalyst Monitor Bank 4	0
65 - 70	**ISO/SAE reserved**	0
71	Secondary Air Monitor 1	**1**
72	Secondary Air Monitor 2	**1**
73	Secondary Air Monitor 3	0
74	Secondary Air Monitor 4	0
75 - 7F	**ISO/SAE reserved**	0
80	**OBD Monitor IDs supported ($81 - $A0)**	**1**
81	Fuel System Monitor Bank 1	0
82	Fuel System Monitor Bank 2	0
83	Fuel System Monitor Bank 3	0
84	Fuel System Monitor Bank 4	0
85	Boost Pressure Control Monitor Bank 1	0
86	Boost Pressure Control Monitor Bank 2	0
87 - 8F	ISO/SAE reserved	0
90	NOx Adsorber Monitor Bank 1	0
91	NOx Adsorber Monitor Bank 2	0
92 - 97	ISO/SAE reserved	0
98	NOx Catalyst Monitor Bank 1	0

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OBDMID (HEX)	Function	Supported
99	NOx Catalyst Monitor Bank 2	0
9A - 9F	ISO/SAE reserved	0
A0	**OBD Monitor IDs supported ($A1 - $C0)**	**1**
A1	Mis-Fire Monitor General Data	**1**
A2	Mis-Fire Cylinder 1 Data	**1**
A3	Mis-Fire Cylinder 2 Data	**1**
A4	Mis-Fire Cylinder 3 Data	**1**
A5	Mis-Fire Cylinder 4 Data	**1**
A6	Mis-Fire Cylinder 5 Data (**IF** NC_CYL_NR = 6 **or** 8)	**1**
A7	Mis-Fire Cylinder 6 Data (**IF** NC_CYL_NR = 6 **or** 8)	**1**
A8	Mis-Fire Cylinder 7 Data (**IF** NC_CYL_NR = 8)	**1**
A9	Mis-Fire Cylinder 8 Data (**IF** NC_CYL_NR = 8)	**1**
AA	Mis-Fire Cylinder 9 Data	0
AB	Mis-Fire Cylinder 10 Data	0
AC	Mis-Fire Cylinder 11 Data	0
AD	Mis-Fire Cylinder 12 Data	0
AE	Mis-Fire Cylinder 13 Data	0
AF	Mis-Fire Cylinder 14 Data	0
B0	Mis-Fire Cylinder 15 Data	0
B1	Mis-Fire Cylinder 16 Data	0
B2	PM Filter Monitor Bank 1	0
B3	PM Filter Monitor Bank 2	0
B4 - BF	ISO/SAE reserved	0
C0	OBD Monitor IDs supported (C1h - E0h)	0
C1 - DF	Reserved by document for future standardisation	0
E0	OBD Monitor IDs supported (E1h - FFh)	0
E1 - FF	Vehicle manufacturer defined OBDMIDs	0

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I.54.2 Configuration of calibratable TID's

Description:

The table ID_STATE_SRV_6_TID will be filled with calibrated TID values. Each position in the table will have an associated TID and OBDMID.

- If the calibration of the TID = xy => TID is sended with xy
- If the calibration of the TID = 0 => TID is not supported
- If the calibration of all TID's of the OBDMID = 0 => OBDMID is not supported

Example:
If for instance in a project will be supported the following TIDs:
TIDs 01h, 02h, 03h, 04h, 05h, 81h, 82h, 90h, 98h, C1h

=> configure NC_NR_TID = 10
(LDP_STATE_TID_ID_STATE_SRV_6 automatically is set to 10)
=> ID_STATE_SRV_6_TID will have the dimension 10.

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Configuration of the table ID_STATE_SRV_6_TID:

pos / val	x[0]	x[1]	x[2]	x[3]	x[4]	x[5]	x[6]	x[7]	x[8]	x[9]
	01h	**02h**	**03h**	**02h**	**05h**	**81h**	**82h**	**81h**	**98h**	**C1h**
	OBDMID yy			**OBDMID zz**				**OBDMID vv**		

Each position in table will have an associated OBDMID:
Postion 0: TID 01h => for OBDMID yy
Postion 1: TID 02h => for OBDMID yy
Postion 2: TID 03h => for OBDMID yy

Postion 3: TID 02h => for OBDMID zz
Postion 4: TID 05h => for OBDMID zz
Postion 5: TID 81h => for OBDMID zz
Postion 6: TID 82h => for OBDMID zz
Postion 7: TID 81h => for OBDMID vv
Postion 8: TID 98h => for OBDMID vv
Postion 9: TID C1h => for OBDMID vv

Each OBDMID can be disabled separately:
e.g. if at position x[0], x[1], x[2] configure value 00h => OBDMID yy is **not supported**.

Formula section:

IF **ALL** configured TIDs for the same OBDMID have value **00h**
THEN OBDMID **IS NOT SUPPORTED**
ELSE OBDMID **IS SUPPORTED**
ENDIF

I.54.3 Configuration of table-size

Description:

The table-size of ID_STATE_SRV_6_TID depends on number of defined TID's (= NC_NR_TID), see Tables ff.
In order to have only one calibration for all BMW engines (4, 6, 8 cyl) the table is configured for the maximum number of OBDMID's /TID's (= 8 cyl). If one OBDMID is not supported due to configuration (e.g. OBDMID A9 in a 4 cyl engine) => Calibration data in the table on this position is not considered.

Formula section:

TID's are defined from position 0...59 => NC_NR_TID = 60

I.54.4 Description of OBDMID 01h - 06h (Lambda sensor diagnosis)

General information:

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Additional to the calibration the support of the OBDMID's can be learnt. Depending on the learning result (see STATE_PSN_LS_SAE and STATE_PSN_LS_1_SAE) the OBDMID 01h - 06h are supported or not.

I.54.4.1 Description of OBDMID 01h - Oxygen Sensor Monitor Bank 1 - Sensor 1

Formula section:

IF (STATE_PSN_LS_SAE & 01h**) OR (**STATE_PSN_LS_1_SAE & 01h**)**
THEN OBDMID 01h **IS SUPPORTED**
ELSE OBDMID 01h **IS NOT SUPPORTED**
ENDIF

Dynamic diagnosis - TID 83	
Position in table	[0]
Unit and scaling	04h (Raw value 0...FFFFh / 0...65.535)
Test value	FAC_DYN_LSL_UP_DIAG_SAE[1]
Min test limit	0 = 0000h
Max test limit	FAC_DYN_LSL_UP_DIAG_TOL_SAE[1] (e.g. 0.9)
Delay diagnosis - TID 84	
Position in table	[1]
Unit and scaling	04h (Raw value 0...FFFFh / 0...65.535)
Test value	FAC_DLY_LSL_UP_DIAG_SAE[1]
Min test limit	0 = 0000h
Max test limit	FAC_DLY_LSL_UP_DIAG_TOL_SAE[1] (e.g. 0.9)

Formula section:

IF ID_STATE_SRV_6_TID[see Table above]<> 0
THEN TID is supported
IF LV_READY_DYN_VLD_LS_UP[1] = 0 **OR**
LV_ERR_MEM_DYN_VLD_LS_UP[1] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF

I.54.4.2 Description of OBDMID 02h - Oxygen Sensor Monitor Bank 1 - Sensor 2

Formula section:

IF (STATE_PSN_LS_SAE & 02h**) OR (**STATE_PSN_LS_1_SAE & 02h**)**
THEN OBDMID 02h **IS SUPPORTED**
ELSE OBDMID 02h **IS NOT SUPPORTED**
ENDIF

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Rich to lean sensor threshold voltage - TID 01	
Position in table	[2]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	C_VLS_DOWN_AFR_AFL_SAE
Min test limit	0V = 0000h
Max test limit	C_VLS_THD_DIAG_SCP_LS_DOWN
Lean to rich sensor threshold voltage - TID 02	
Position in table	[3]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	C_VLS_DOWN_AFL_AFR_SAE
Min test limit	0V = 0000h
Max test limit	C_VLS_THD_DIAG_SCP_LS_DOWN
Low sensor voltage for switch time calculation - TID 07	
Position in table	[4]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	VLS_DOWN_MIN_DC[1]
Min test limit	0V = 0000h
Max test limit	C_VLS_THD_DIAG_SCP_LS_DOWN
High sensor voltage for switch time calculation - TID 08	
Position in table	[5]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	VLS_DOWN_MAX_DC[1]
Min test limit	0V = 0000h
Max test limit	C_VLS_THD_DIAG_SCP_LS_DOWN
Switching time diagnosis - TID 91	
Position in table	[6]
Unit and scaling	05h (Raw value 0...FFFFh / 0...2)
Test value	CTR_SAVE_SWT_LS_DOWN[1]
Min test limit	0 = 0000h
Max test limit	C_CTR_SWT_LS_DOWN (e.g. 1)

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0 *//each seperate*
THEN TID is supported
IF LV_READY_SWT_LS_DOWN[1] = 0 **OR**
LV_ERR_MEM_SWT_LS_DOWN[1] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF

Lean to rich diagnosis - TID 92	
Position in table	[7]
Unit and scaling	B1h (Voltage per time 8000...7FFFh / -65536 ...65534)
Test value	VLS_DOWN_PUE_SAE[1]
Min test limit	VLS_DOWN_PUE_BOL_SAE[1]
Max test limit	VLS_DOWN_PUE_TOL_SAE[1]

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Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported

IF LV_READY_PUE_LS_DOWN[1] = 0 **OR**
LV_ERR_MEM_PUE_LS_DOWN[1] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF

Rich to lean diagnosis - TID 93	
Position in table	[8]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	VLS_DOWN_PUC_SAVE[1]
Min test limit	0 = 0000h
Max test limit	C_VLS_MIN_DIAG_PUC_LS_DOWN

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
IF LV_READY_PUC_LS_DOWN[1] = 0 **OR**
LV_ERR_MEM_PUC_LS_DOWN[1] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF

I.54.4.3 Description of OBDMID 05h - Oxygen Sensor Monitor Bank 2 - Sensor 1

Formula section:

IF (STATE_PSN_LS_SAE & 10h) **OR** (STATE_PSN_LS_1_SAE & 04h)
THEN OBDMID 05h **IS SUPPORTED**
ELSE OBDMID 05h **IS NOT SUPPORTED**
ENDIF

Dynamic diagnosis - TID 83	
Position in table	[9]
Unit and scaling	04h (Raw value 0...FFFFh / 0...65.535)
Test value	FAC_DYN_LSL_UP_DIAG_SAE[2]
Min test limit	0 = 0000h
Max test limit	FAC_DYN_LSL_UP_DIAG_TOL_SAE[2] (e.g. 0.9)
Delay diagnosis - TID 84	
Position in table	[10]
Unit and scaling	04h (Raw value 0...FFFFh / 0...65.535)
Test value	FAC_DLY_LSL_UP_DIAG_SAE[2]
Min test limit	0 = 0000h
Max test limit	FAC_DLY_LSL_UP_DIAG_TOL_SAE[2] (e.g. 0.9)

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Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0

THEN TID is supported
IF LV_READY_DYN_VLD_LS_UP[2] = 0 **OR**
LV_ERR_MEM_DYN_VLD_LS_UP[2] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF

I.54.4.4 Description of OBDMID 06h - Oxygen Sensor Monitor Bank 2 - Sensor 2

Formula section:

IF (STATE_PSN_LS_SAE & 20h**) OR (**STATE_PSN_LS_1_SAE & 08h**)**
THEN OBDMID 06h **IS SUPPORTED**
ELSE OBDMID 06h **IS NOT SUPPORTED**
ENDIF

Rich to lean sensor threshold voltage - TID 01	
Position in table	[11]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	C_VLS_DOWN_AFR_AFL_SAE
Min test limit	0V = 0000h
Max test limit	C_VLS_THD_DIAG_SCP_LS_DOWN
Lean to rich sensor threshold voltage - TID 02	
Position in table	[12]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	C_VLS_DOWN_AFL_AFR_SAE
Min test limit	0V = 0000h
Max test limit	C_VLS_THD_DIAG_SCP_LS_DOWN
Low sensor voltage for switch time calculation - TID 07	
Position in table	[13]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	VLS_DOWN_MIN_DC[2]
Min test limit	0V = 0000h
Max test limit	C_VLS_THD_DIAG_SCP_LS_DOWN
High sensor voltage for switch time calculation - TID 08	
Position in table	[14]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	VLS_DOWN_MAX_DC[2]
Min test limit	0V = 0000h
Max test limit	C_VLS_THD_DIAG_SCP_LS_DOWN
Switching time diagnosis - TID 91	
Position in table	[15]
Unit and scaling	05h (Raw value 0...FFFFh / 0...2)
Test value	CTR_SAVE_SWT_LS_DOWN[2]
Min test limit	0 = 0000h
Max test limit	C_CTR_SWT_LS_DOWN (e.g. 1)

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Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0 *//each seperate*
THEN TID is supported
IF LV_READY_SWT_LS_DOWN[2] = 0 **OR**
LV_ERR_MEM_SWT_LS_DOWN[2] = 1

THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF

Lean to rich diagnosis - TID 92	
Position in table	[16]
Unit and scaling	B1h (Voltage per time 8000...7FFFh / -65536 ...65534)
Test value	VLS_DOWN_PUE_SAE[2]
Min test limit	VLS_DOWN_PUE_BOL_SAE[2]
Max test limit	VLS_DOWN_PUE_TOL_SAE[2]

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
IF LV_READY_PUE_LS_DOWN[2] = 0 **OR**
LV_ERR_MEM_PUE_LS_DOWN[2] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF

Rich to lean diagnosis - TID 93	
Position in table	[17]
Unit and scaling	0Ah (Voltage 0...FFFFH / 0...8V)
Test value	VLS_DOWN_PUC_SAVE[2]
Min test limit	0 = 0000h
Max test limit	C_VLS_MIN_DIAG_PUC_LS_DOWN

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
IF LV_READY_PUC_LS_DOWN[2] = 0 **OR**
LV_ERR_MEM_PUC_LS_DOWN[2] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF

I.54.5 Description of OBDMID 21 - 22h (Catalyst diagnosis)

General information:

Additional to the calibration the support of the OBDMID’s can be learnt. Depending on the learning result (see STATE_PSN_LS_SAE and STATE_PSN_LS_1_SAE) the OBDMID 21h - 22h are supported or not.

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I.54.5.1 Description of OBDMID 21h - Catalyst Monitor Bank 1

Formula section:

IF (STATE_PSN_LS_SAE & 03h) **OR** (STATE_PSN_LS_1_SAE & 03h)
THEN OBDMID 21h **IS SUPPORTED**
ELSE OBDMID 21h **IS NOT SUPPORTED**
ENDIF

OSC method (linear system) - TID 81	
Position in table	[18]
Unit and scaling	05h (Raw value 0...FFFFh / 0...2)
Test value	EFF_CAT_DIAG_OBD[1]
Min test limit	0 = 0000h
Max test limit	EFF_CAT_MAX_DIAG_OBD[1]

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
  IF LV_READY_CAT_DIAG[1] = 0 **OR**
  LV_ERR_MEM_CAT_DIAG[1] = 1
  THEN Positive response with test result
  ELSE Positive response with all data equal to 0000h
  ENDIF
ELSE TID is not supported
ENDIF

I.54.5.2 Description of OBDMID 22h - Catalyst Monitor Bank 2

Formula section:

IF (STATE_PSN_LS_SAE & 30h) **OR** (STATE_PSN_LS_1_SAE & 0Ch)
THEN OBDMID 22h **IS SUPPORTED**
ELSE OBDMID 22h **IS NOT SUPPORTED**
ENDIF

OSC method (linear system) - TID 81	
Position in table	[19]
Unit and scaling	05h (Raw value 0...FFFFh / 0...2)
Test value	EFF_CAT_DIAG_OBD[2]
Min test limit	0 = 0000h
Max test limit	EFF_CAT_MAX_DIAG_OBD[2]

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
  IF LV_READY_CAT_DIAG[2] = 0 **OR**
  LV_ERR_MEM_CAT_DIAG[2] = 1
  THEN Positive response with test result

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ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF

I.54.6 Description of OBDMID 35h - VVT Monitor Bank 1

I.54.6.1 Camshaft position deviation diagnosis - Inlet 1 (If NC_CYL_NR = 4 or 6)

Steady and dynamic deviation - **TID 98**	
Position in table	[20]
Unit and scaling	1Ch (Angle 0...FFFFh / 0...655.35°)
Test value	CAM_DYN_IVVT_IN_SAE[1]
Min test limit	0h
Max test limit	CAM_DYN_IVVT_IN_TOL_SAE[1]

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
IF LV_READY_MEC_IVVT_IN = 0 **OR**
LV_ERR_MEM_MEC_IVVT_IN = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF

I.54.6.2 Camshaft position deviation diagnosis - Inlet 1 (If NC_CYL_NR = 8)

Steady and dynamic deviation - **TID 98**	
Position in table	[20]
Unit and scaling	1Ch (Angle 0...FFFFh / 0...655.35°)
Test value	CAM_DYN_IVVT_IN_SAE[1]
Min test limit	0h
Max test limit	CAM_DYN_IVVT_IN_TOL_SAE[1]

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
IF LV_READY_MEC_IVVT_IN[1] = 0 **OR**
LV_ERR_MEM_MEC_IVVT_IN[1] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF

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I.54.7 Description of OBDMID 36h - VVT Monitor Bank 2

I.54.7.1 Camshaft position deviation diagnosis - Exhaust 1 (If NC_CYL_NR = 4 or 6)

Steady and dynamic deviation - **TID 98**	
Position in table	[21]
Unit and scaling	1Ch (Angle 0...FFFFh / 0...655.35°)
Test value	CAM_DYN_IVVT_EX_SAE[1]
Min test limit	0h
Max test limit	CAM_DYN_IVVT_EX_TOL_SAE[1]

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
  IF LV_READY_MEC_IVVT_EX = 0 **OR**
  LV_ERR_MEM_MEC_IVVT_EX = 1
  THEN Positive response with test result
  ELSE Positive response with all data equal to 0000h
  ENDIF
ELSE TID is not supported
ENDIF

I.54.7.2 Camshaft position deviation diagnosis - Exhaust 1 (If NC_CYL_NR = 8)

Steady and dynamic deviation - **TID 98**	
Position in table	[21]
Unit and scaling	1Ch (Angle 0...FFFFh / 0...655.35°)
Test value	CAM_DYN_IVVT_EX_SAE[1]
Min test limit	0h
Max test limit	CAM_DYN_IVVT_EX_TOL_SAE[1]

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
  IF LV_READY_MEC_IVVT_EX[1] = 0 **OR**
  LV_ERR_MEM_MEC_IVVT_EX[1] = 1
  THEN Positive response with test result
  ELSE Positive response with all data equal to 0000h
  ENDIF
ELSE TID is not supported
ENDIF

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I.54.8 Description of OBDMID 37h - VVT Monitor Bank 3

I.54.8.1 Camshaft position deviation diagnosis - Inlet 2 (If NC_CYL_NR = 8)

Steady and dynamic deviation - **TID 98**	
Position in table	[22]
Unit and scaling	1Ch (Angle 0...FFFFh / 0...655.35°)
Test value	CAM_DYN_IVVT_IN_SAE[2]
Min test limit	0h
Max test limit	CAM_DYN_IVVT_IN_TOL_SAE[2]

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
  IF LV_READY_MEC_IVVT_IN[2] = 0 **OR**
  LV_ERR_MEM_MEC_IVVT_IN[2] = 1
  THEN Positive response with test result
  ELSE Positive response with all data equal to 0000h
  ENDIF
ELSE TID is not supported
ENDIF

I.54.9 Description of OBDMID 38h - VVT Monitor Bank 4

I.54.9.1 Camshaft position deviation diagnosis - Exhaust 2 (If NC_CYL_NR = 8)

Steady and dynamic deviation - **TID 98**	
Position in table	[23]
Unit and scaling	1Ch (Angle 0...FFFFh / 0...655.35°)
Test value	CAM_DYN_IVVT_EX_SAE[2]
Min test limit	0h
Max test limit	CAM_DYN_IVVT_EX_TOL_SAE[2]

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
  IF LV_READY_MEC_IVVT_EX[2] = 0 **OR**
  LV_ERR_MEM_MEC_IVVT_EX[2] = 1
  THEN Positive response with test result
  ELSE Positive response with all data equal to 0000h
  ENDIF
ELSE TID is not supported
ENDIF

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I.54.10 Description of OBDMID 3Bh - 3Dh (EVAP diagnosis)

General information:

Additional to the calibration the support of the OBDMID's can be learnt. OBDMID 3Bh - 3Ch are only supported if the vehicle is equipped with DMTL module.

Formula section:

IF STATE_EVAP_SAE <> 0
THEN OBDMID 3Bh - 3Ch are supported
ELSE OBDMID 3Bh - 3Ch are not supported
ENDIF

I.54.10.1 Description of OBDMID 3B - EVAP Monitor Large (0.040" /1.0mm)

Leak detection DMTL - Long cycle - TID 81	
Position in table	[24]
Unit and scaling	0Dh (Current 0...FFFFh / 0...256 mA)
Test value	M6_CUR_DMTL_ROUGH_LEAK_LEN_END
Min test limit	M6_CUR_DMTL_THD_ROUGH_LEAK_LEN
Max test limit	FFFFh (256 mA)
Leak detection DMTL - Short cycle - TID 82	
Position in table	[25]
Unit and scaling	0Dh (Current)
Test value	M6_CUR_DMTL_ROUGH_LEAK_END
Min test limit	M6_CUR_DMTL_THD_ROUGH_LEAK
Max test limit	FFFFh (256 mA)

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0 *//each seperate*
THEN TID's are supported
  IF LV_READY_ROUGH_LEAK = 0 **OR**
  LV_ERR_MEM_ROUGH_LEAK = 1
  THEN Positive response with test result
  ELSE Positive response with all data equal to 0000h
  ENDIF
ELSE TID' s are not supported
ENDIF

DMTL module - Signal error - TID 8B	
Position in table	[26]
Unit and scaling	24h (Counts 0...FFFFh / 0....65535)
Test value	M6_CTR_CNL_SMALL_LEAK_MES
Min test limit	0h
Max test limit	C_SUM_CNL_SMALL_LEAK_MES_MAX

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0 *//each seperate*
THEN TID's are supported
  IF LV_READY_DMTL_SIG = 0 **OR**
  LV_ERR_DMTL_SIG = 1
  THEN Positive response with test result
  ELSE Positive response with all data equal to 0000h

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ENDIF
ELSE TID's are not supported
ENDIF

DMTL module - Plausibility error - TID 8C	
Position in table	[27]
Unit and scaling	0Dh (Current 0...FFFFh / 0...256 mA)
Test value	M6_CUR_DMTL_DMTLS_TEST
Min test limit	0h
Max test limit	M6_CUR_DMTL_THD_DMTLS_TEST

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0 *//each seperate*
THEN TID's are supported
IF LV_READY_DMTL_PLAUS = 0 **OR**
LV_ERR_MEM_DMTL_PLAUS = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID's are not supported
ENDIF

DMTL module - MIN error - TID 8D	
Position in table	[28]
Unit and scaling	0Dh (Current 0...FFFFh / 0...256 mA)
Test value	M6_CUR_DMTL_COR_FIL_CID18
Min test limit	C_CUR_DMTL_REF_LEAK_MIN
Max test limit	FFFFh

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0 *//each seperate*
THEN TID's are supported
IF LV_READY_DMTL_MIN = 0 **OR**
LV_ERR_MEM_DMTL_MIN = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID's are not supported
ENDIF

DMTL module - MAX error - TID 8E	
Position in table	[29]
Unit and scaling	0Dh (Current 0...FFFFh / 0...256 mA)
Test value	M6_CUR_DMTL_COR_FIL_CID18
Min test limit	0h
Max test limit	C_CUR_DMTL_REF_LEAK_MAX

Formula section:

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IF ID_STATE_SRV_6_TID[see Table above] <> 0 *//each seperate*
THEN TID's are supported
IF LV_READY_DMTL_MAX = 0 **OR**
LV_ERR_MEM_MAX = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID's are not supported
ENDIF

I.54.10.2 Description of OBDMID 3C - EVAP Monitor Small (0.020" /0.5 mm)

Leak detection DMTL - Short cycle - TID 3C	
Position in table	[30]
Unit and scaling	0Dh (Current 0...FFFFh / 0...256 mA)
Test value	M6_CUR_DMTL_SMALL_LEAK_END
Min test limit	M6_CUR_DMTL_REF_LEAK
Max test limit	FFFFh (256 mA)

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
IF LV_READY_SMALL_LEAK = 0 **OR**
LV_ERR_MEM_SMALL_LEAK = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF

I.54.10.3 Description of OBDMID 3D - EVAP Purge Flow monitor (If NC_NR_CPS_CP = 1)

Functional check TEV - Step 1 - TID 81	
Position in table	[31]
Unit and scaling	05h (Raw value 0...FFFFh / 0...2)
Test value	CL_MMV_SAE
Min test limit	CL_MMV_DIAGCPS_MIN_SAE
Max test limit	CL_MMV_DIAGCPS_MAX_SAE
Functional check TEV - Step 2 - TID 82	
Position in table	[32]
Unit and scaling	03h (Raw value 0....FFFFh / 0...655,35)
Test value	SUM_DIAG_DIAGCPS_SAE
Min test limit	0h(0)
Max test limit	SUM_DIAGCPS_MAX_SAE
Functional check TEV - Step 3 - TID 83	
Position in table	[33]
Unit and scaling	2Dh (Weight per stroke 0...FFFFh / 0...655,35 mg/stk)
Test value	MAF_DIAGCPS_SAE
Min test limit	0h (0 mg/stk)
Max test limit	MAF_DIAGCPS_THD_SAE

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Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0 *//each seperate*
THEN TID's are supported
IF LV_READY_DIAGCPS = 0 **OR**
LV_ERR_MEM_DIAGCPS = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID's are not supported
ENDIF

I.54.10.4 Description of OBDMID 3D - EVAP Purge Flow monitor (If NC_NR_CPS_CP = 2)

Functional check TEV_1 - Step 2 - TID 82	
Position in table	[34]
Unit and scaling	24h (Raw value 0....FFFFh / 0...65535)
Test value	SUM_DIAG_DIAGCPS_SAE_1
Min test limit	0h(0)
Max test limit	SUM_DIAGCPS_MAX_SAE

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TIDs are supported
IF LV_READY_DIAGCPS_1 = 0 **OR**
LV_ERR_MEM_DIAGCPS_1 = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TIDs are not supported
ENDIF

Functional check TEV_2 - Step 2 - TID 82	
Position in table	[35]
Unit and scaling	24h (Raw value 0....FFFFh / 0...65535)
Test value	SUM_DIAG_DIAGCPS_SAE_2
Min test limit	0h(0)
Max test limit	SUM_DIAGCPS_MAX_SAE

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TIDs are supported
IF LV_READY_DIAGCPS_2 = 0 **OR**
LV_ERR_MEM_DIAGCPS_2 = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TIDs are not supported

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ENDIF

I.54.11 Description of OBDMID 41h - 46h (Oxygen sensor heater diagnosis)

General information:

Additional to the calibration the support of the OBDMID's can be learnt. Depending on the learning result (see STATE_PSN_LS_SAE and STATE_PSN_LS_1_SAE) the OBDMID 41h - 46h are supported or not.

I.54.11.1 Description of OBDMID 41h Oxygen Sensor Heater Monitor Bank 1 Sensor 1

Formula section:

IF (STATE_PSN_LS_SAE & 01h) **OR** (STATE_PSN_LS_1_SAE & 01h)
THEN OBDMID 41h **IS SUPPORTED**
ELSE OBDMID 41h **IS NOT SUPPORTED**
ENDIF

Sensor temperature - TID 85	
Position in table	[36]
Unit and scaling	16h (Temperature 0000...FFFF / -40...6513.5°C)
Test value	TTIP_OBD_LSH_UP_MES_SAE[1]
Min test limit	TTIP_OBD_LSH_UP_MES_BOL_SAE[1]
Max test limit	TTIP_OBD_LSH_UP_MES_TOL_SAE[1]

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
  IF LV_READY_OBD_VLD_LSH_UP[1] = 0 **OR**
  LV_ERR_MEM_OBD_VLD_LSH_UP[1] = 1
  THEN Positive response with test result
  ELSE Positive response with all data equal to 0000h
  ENDIF
ELSE TID is not supported
ENDIF

I.54.11.2 Description of OBDMID 42h Oxygen Sensor Heater Monitor Bank 1 Sensor 2

Formula section:

IF (STATE_PSN_LS_SAE & 02h) **OR** (STATE_PSN_LS_1_SAE & 02h)
THEN OBDMID 42h **IS SUPPORTED**
ELSE OBDMID 42h **IS NOT SUPPORTED**
ENDIF

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Sensor resistance - TID 81	
Position in table	[37]
Unit and scaling	14h (Resistance 0...FFFFh / 0...65535 Ohm)
Test value	R_IT_OBD_LSH_DOWN[1]
Min test limit	0h
Max test limit	R_IT_THD_OBD_LSH_DOWN[1]

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
IF LV_READY_OBD_LSH_DOWN[1] = 0 **OR**
LV_ERR_MEM_OBD_LSH_DOWN[1] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF

I.54.11.3 Description of OBDMID -h Oxygen Sensor Heater Monitor Bank 2 Sensor 1

Formula section:

IF (STATE_PSN_LS_SAE & 10h**) OR (**STATE_PSN_LS_1_SAE & 04h**)**
THEN OBDMID -h **IS SUPPORTED**
ELSE OBDMID -h **IS NOT SUPPORTED**
ENDIF

Sensor temperature - TID 85	
Position in table	[38]
Unit and scaling	16h (Temperature 0000...FFFF / -40...6513.5°C)
Test value	TTIP_OBD_LSH_UP_MES_SAE[2]
Min test limit	TTIP_OBD_LSH_UP_MES_BOL_SAE[2]
Max test limit	TTIP_OBD_LSH_UP_MES_TOL_SAE[2]

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
IF LV_READY_OBD_VLD_LSH_UP[2] = 0 **OR**
LV_ERR_MEM_OBD_VLD_LSH_UP[2] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF

I.54.11.4 Description of OBDMID 46h Oxygen Sensor Heater Monitor Bank 2 Sensor 2

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Formula section:

IF (STATE_PSN_LS_SAE & 20h) **OR** (STATE_PSN_LS_1_SAE & 08h)
THEN OBDMID 46h **IS SUPPORTED**
ELSE OBDMID 46h **IS NOT SUPPORTED**
ENDIF

Sensor resistance - TID 81	
Position in table	[39]
Unit and scaling	14h (Resistance 0...FFFFh / 0...65535 Ohm)
Test value	R_IT_OBD_LSH_DOWN[2]
Min test limit	0h
Max test limit	R_IT_THD_OBD_LSH_DOWN[2]

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
IF LV_READY_OBD_LSH_DOWN[2] = 0 **OR**
LV_ERR_MEM_OBD_LSH_DOWN[2] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF

I.54.12 Description of OBDMID 71h - 72h (Secondary air diagnosis)

General information:

Additional to the calibration the support of the OBDMID's can be learnt. OBDMID 71h - 72h are only supported if the vehicle is equipped with SA pump. Depending on Hardware configuration only one monitor is active (via lambda-sensor **or** flow meter).

Formula section:

IF STATE_VAR_SAP_SAE <> 0
THEN OBDMID 71h - 72h are supported
IF LC_SA_SWI_ACQ = 1
THEN OBDMID 71h is not supported *//SA flow meter equipped*
ELSE OBDMID 72h is not supported *//SA flow meter not equipped*
ENDIF
ELSE OBDMID 71h - 72h are not supported
ENDIF

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I.54.12.1 Description of OBDMID 71h - Secondary air monitor with lambda sensor

Monitoring of minimum flow rate - TID 81	
Position in table	[40]
Unit and scaling	01h (Raw value 0...FFFFh / 0...65535)
Test value	MIN [SUM_AFL_VLS_DIAG_SA_1_SAE, SUM_AFL_VLS_DIAG_SA_2_SAE]
Min test limit	C_SUM_AFL_VLS_MIN_DIAG_SA_1
Max test limit	FFFFh (65535)

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
IF LV_READY_SA_SAP = 0 **OR**
LV_ERR_MEM_SA_SAP = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID is not supported
ENDIF

I.54.12.2 Description of OBDMID 72h - Secondary air monitor with SA flow meter

Monitoring of minimum flow rate - TID 82	
Position in table	[41]
Unit and scaling	27h (Weight per time 0...FFFFh / 0...655,35 g/s)
Test value	SAF_DIAG_MIN_SAE
Min test limit	0h
Max test limit	C_SAF_DIAG_MIN
Monitoring of minimum flow rate - TID 83	
Position in table	[42]
Unit and scaling	27h (Weight per time 0...FFFFh / 0...655,35 g/s)
Test value	SAF_DIAG_MAX_SAE
Min test limit	0h
Max test limit	C_SAF_DIAG_MAX

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0 *//each seperate*
THEN TID are supported
IF LV_READY_SA_SYS = 0 **OR**
LV_ERR_MEM_SA_SYS = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID are not supported
ENDIF

I.54.13 Description of OBDMID A1h...A9h Misfire Clinder Data

Description:

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Depending on the number of cylinder (NC_CYL_NR) the following OBDMID's are supported or not and the corresponding variables are different:

Configuration for OBDMID's A2...A9				
OBDMID / Cylinder	**NC_CYL_NR = 4**	**NC_CYL_NR = 6**	**NC_CYL_NR = 8**	**NC_CYL_NR = tbd**
OBDMID A2 / Cylinder 1	**0**	**0**	**0**	
OBDMID A3 / Cylinder 2	**3**	**4**	**7**	
OBDMID A4 / Cylinder 3	**1**	**2**	**5**	
OBDMID A5 / Cylinder 4	**2**	**5**	**2**	
OBDMID A6 / Cylinder 5	Not supported	**1**	**1**	
OBDMID A7 / Cylinder 6	Not supported	**3**	**4**	
OBDMID A8 / Cylinder 7	Not supported	Not supported	**6**	
OBDMID A9 / Cylinder 8	Not supported	Not supported	**3**	

e.g. data from OBDMID A4 (If 8-cyl engine):

- CTR_MIS_DC_CYL[5]
- CTR_MIS_DC_MMV_CYL[5]
- LV_READY_MIS[5]
- LV_ERR_MEM_MIS[5]

I.54.14 Description of OBDMID A1h - Mis-fire Monitor General Data

Mis-Fire Monitor General Data - TID 0C	
Position in table	[43]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_TOT_DC
Min test limit	0
Max test limit	65535 = FFFFh

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0
THEN TID is supported
  IF LV_READY_MIS[0] = 0 **OR**
  LV_ERR_MEM_MIS[0] = 1
  THEN Positive response with test result
  ELSE Positive response with all data equal to 0000h
  ENDIF
ELSE TID is not supported
ENDIF

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I.54.15 Description of OBDMID A2h Mis-fire Clinder 1 Data

Mis-Fire Count for Last/Current driving cycle - TID 0C	
Position in table	[44]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh
EWMA Mis-Fire Count for Last 10 driving cycle - TID 0B	
Position in table	[45]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_MMV_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0 *//each seperate*
THEN TID's are supported
IF LV_READY_MIS[see table] = 0 **OR**
LV_ERR_MEM_MIS[see table] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID's are not supported
ENDIF

I.54.16 Description of OBDMID A3h - Mis-fire Cylinder 2 Data

Mis-Fire Count for Last/Current driving cycle - TID 0C	
Position in table	[46]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh
EWMA Mis-Fire Count for Last 10 driving cycle - TID 0B	
Position in table	[47]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_MMV_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh

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Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0 *//each seperate*
THEN TID's are supported
IF LV_READY_MIS[see table] = 0 **OR**
LV_ERR_MEM_MIS[see table] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID's are not supported

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ENDIF

I.54.17 Description of OBDMID A4h - Mis-fire Cylinder 3 Data

Mis-Fire Count for Last/Current driving cycle - TID 0C	
Position in table	[48]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh
EWMA Mis-Fire Count for Last 10 driving cycle - TID 0B	
Position in table	[49]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_MMV_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0 *//each seperate*
THEN TID's are supported
IF LV_READY_MIS[see table] = 0 **OR**
LV_ERR_MEM_MIS[see table] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID's are not supported
ENDIF

I.54.18 Description of OBDMID A5h - Mis-fire Cylinder 4 Data

Mis-Fire Count for Last/Current driving cycle - TID 0C	
Position in table	[50]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh
EWMA Mis-Fire Count for Last 10 driving cycle - TID 0B	
Position in table	[51]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_MMV_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0 *//each seperate*
THEN TID's are supported
IF LV_READY_MIS[see table] = 0 **OR**
LV_ERR_MEM_MIS[see table] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h

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ENDIF
ELSE TID's are not supported
ENDIF

I.54.19 Description of OBDMID A6h - Mis-fire Cylinder 5 Data

Mis-Fire Count for Last/Current driving cycle - TID 0C	
Position in table	[52]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh
EWMA Mis-Fire Count for Last 10 driving cycle - TID 0B	
Position in table	[53]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_MMV_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0 *//each seperate*
THEN TID's are supported
IF LV_READY_MIS[see table] = 0 **OR**
LV_ERR_MEM_MIS[see table] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID's are not supported
ENDIF

I.54.20 Description of OBDMID A7h - Mis-fire Cylinder 6 Data

Mis-Fire Count for Last/Current driving cycle - TID 0C	
Position in table	[54]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh
EWMA Mis-Fire Count for Last 10 driving cycle - TID 0B	
Position in table	[55]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_MMV_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh

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Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0 *//each seperate*
THEN TID's are supported
IF LV_READY_MIS[see table] = 0 **OR**
LV_ERR_MEM_MIS[see table] = 1

THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID's are not supported
ENDIF

I.54.21 Description of OBDMID A8h - Mis-fire Cylinder 7 Data

Mis-Fire Count for Last/Current driving cycle - TID 0C	
Position in table	[56]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh
EWMA Mis-Fire Count for Last 10 driving cycle - TID 0B	
Position in table	[57]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_MMV_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh

Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0 *//each seperate*
THEN TID's are supported
IF LV_READY_MIS[see table] = 0 **OR**
LV_ERR_MEM_MIS[see table] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID's are not supported
ENDIF

I.54.22 Description of OBDMID A9h - Mis-fire Cylinder 8 Data

Mis-Fire Count for Last/Current driving cycle - TID 0C	
Position in table	[58]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh
EWMA Mis-Fire Count for Last 10 driving cycle - TID 0B	
Position in table	[59]
Unit and scaling	24h (Counts 0...FFFFh / 0...65535)
Test value	CTR_MIS_DC_MMV_CYL[see table]
Min test limit	0 =0000h
Max test limit	65535 = FFFFh

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Formula section:

IF ID_STATE_SRV_6_TID[see Table above] <> 0 *//each seperate*
THEN TID's are supported

IF LV_READY_MIS[see table] = 0 **OR**
LV_ERR_MEM_MIS[see table] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
ELSE TID's are not supported
ENDIF

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I.55 SID 07h: Request emission-related diagnostic trouble codes - pending

Import actions:

ACTION_ERRM_ReadDtcByTypeOfDtc	(<IN>,<TypeOfDtc>,<IN>,<LevelOfDtc>,<INOUT>,<ListOfDtc>,<OUT>,<ResultDtc>)
ACTION_ERRM_ReadQuantityOfDtc	(**IN**<PRM_TYPEOFDTC>,**IN**<PRM_LEVELOFDTC>,**INOUT**<PRM_QUANTITY>,**OUT**<PRM_RESULTQUANTITY>)

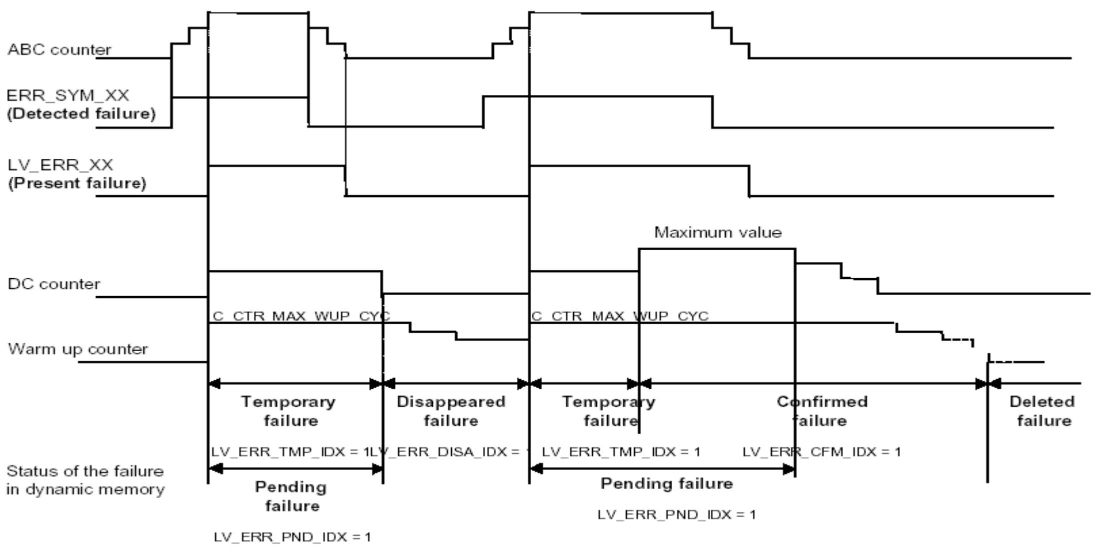
I.55.1 Functional description for ISO 15765-4

The purpose of this service is to enable the external test equipment to obtain pending diagnostic trouble codes detected during current or last completed driving cycle for emission-related components /systems that are tested or continuously monitored during normal driving conditions. Service 07h is required for all DTCs and is independent of Service 03h.

The intended use of this data is to assist the service technician after a vehicle repair, and after clearing diagnostic information, by reporting test results after a single driving cycle. If the test failed during the driving cycle, the DTC associated with that test will be reported. Test results reported by this service do not necessarily indicate a faulty component /system. If test results indicate a failure after additional driving, then the MIL will be illuminated and a DTC will be set and reported with service 03h, indicating a faulty component /system. This service can always be used to request the results of the latest test, independent of the setting of a DTC.

Test results for these components /systems are reported in the same format as the DTCs in Service $03 - refer to the functional description for service $03.

If an ECU does not have stored DTCs then it shall respond with a message indicating no codes are stored by setting the parameter "Number of DTC" to 00h.



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I.55.2 Message data bytes

I.55.2.1 Request message definition

Request emission-related diagnostic trouble codes detected during current or last completed driving cycle request message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request emission-related diagnostic trouble codes detected during current or last completed driving cycle request SID**	**M**	**07**	**SIDRQ**

I.55.2.2 Response message definition

Request emission-related diagnostic trouble codes detected during current or last completed driving cycle response message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request emission-related diagnostic trouble codes detected during current or last completed driving cycle response SID**	**M**	**47**	**SIDPR**
#2	# of DTC = [no emission-related DTCs # of emission-related DTCs]	M	 00 01 - FF	#OFDTC
#3 #4	DTC#1 (High Byte) DTC#1 (Low Byte)	C C	xx xx	DTC1HI DTC1LO
:	:	:	xx	
#n-1 #n	DTC#m (High Byte) DTC#m (Low Byte)	C C	xx xx	DTCmHI DTCmLO
C = Conditional — DTC#1 - DTC#m are only included if # of DTC parameter value ≠ $00				

I.55.2.3 Formula section

ACTION_ERRM_ReadQuantityOfDtc

(
IN <OBD& PENDING>
IN <LAW>
INOUT <NR_DTC>
OUT <ResultQuantity>
)

ACTION_ERRM_ReadDtcByTypeOfDtc

(
IN <OBD& PENDING>
IN <LAW>
INOUT <DTC1 to DTCm>
OUT <ResultDtc>
)

IF ResultDtc != BUFFER_FULL
THEN
Positive response
ELSE
No answer
ENDIF

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I.56 SID 08h: Request control of on-board system, test/component

Import actions:

ACTION_OBDC_Srv08EvapSysLeak (**OUT**<No Name available>)

I.56.1 Functional description

The purpose of this service is to enable the external test equipment to control the operation of an on-board system, test or component.
The data bytes will be specified, if necessary, for each Test ID in Annex F of ISO 15031-5.4, and will be unique for each Test ID.

Possible uses for these data bytes in the request message are:

1. Turn on-board system/test/component ON
2. Turn on-board system/test/component OFF
3. Cycle on-board system/test/component for n seconds.

Possible uses for these data bytes in the response message are:

1. Report system status
2. Report test results

Not all TIDs are applicable or supported by all systems. TID 00h is a bit-encoded value that indicates for each ECU which TIDs are supported. TID 00h indicates support for TIDs from 01h to 20h. TID 20h indicates support for TIDs 21h through 40h, etc. TID 00h is required for those ECUs that respond to a corresponding service $08 request message as specified in Annex A of ISO 15031-5.4.

The order of the TIDs in the response message is not required to match the order in the request message.

The request message including supported Test IDs may contain up to six (6) Test IDs. A request message including a Test ID with optional data shall only contain one (1) Test ID. An external test equipment is not allowed to request a combination of Test IDs supported and a single Test ID with optional data. The ECU shall support requests for up to six (6) supported Test IDs and only one (1) Test ID with optional data.

I.56.2 Message data bytes

I.56.2.1 Read supported TIDs

Request control of on-board device request message (read supported TIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request control of on-board device request SID**	**M**	**08**	**SIDRQ**
#2	TID#1 (Test IDs supported: Annex A of ISO 15031-5.4)	M	xx	TID
#3	TID#2 (Test IDs supported: Annex A of ISO 15031-5.4)	U	xx	TID
#4	TID#3 (Test IDs supported: Annex A of ISO 15031-5.4)	U	xx	TID
#5	TID#4 (Test IDs supported: Annex A of ISO 15031-5.4)	U	xx	TID
#6	TID#5 (Test IDs supported: Annex A of ISO 15031-5.4)	U	xx	TID
#7	TID#6 (Test IDs supported: Annex A of ISO 15031-5.4)	U	xx	TID
U = User Optional — TID may be included to avoid multiple TID supported request messages				

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NOTE To request TIDs supported range from C1h - FFh another request message with TID#1 = C0h and TID#2 = E0h shall be sent to the vehicle

I.56.2.2 Report supported TIDs

ECU(s) must respond to all supported ranges if requested. A range is defined as a block of 32 TIDs (e.g. range #1: TID 01h-20h). The ECU shall not respond to unsupported TID ranges unless subsequent ranges have a supported TID(s).

Request control of on-board device response message (report supported TIDs)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request control of on-board device response message SID**	**M**	**48**	**SIDPR**
	data record of supported TIDs = [			TIDREC_
#2	1^{st} supported TID	M	xx	TID
#3	Data A: supported TIDs,	M	xx	DATA_A
#4	Data B: supported TIDs,	M	xx	DATA_B
#5	Data C: supported TIDs,	M	xx	DATA_C
#6	Data D: supported TIDs]	M	xx	DATA_D
:	:	:	:	:
	data record of supported TIDs = [			TIDREC_
#n-4	m^{th} supported TID	C1	xx	TID
#n-3	Data A: supported TIDs,	C2	xx	DATA_A
#n-2	Data B: supported TIDs,	C2	xx	DATA_B
#n-1	Data C: supported TIDs,	C2	xx	DATA_C
#n	Data D: supported TIDs]	C2	xx	DATA_D

C1 = Conditional — TID value shall be the same value as included in the request message if supported by the ECU
C2 = Conditional — value indicates TIDs supported; range of supported TIDs depends on selected TID value (see C1)

NOTE The response message shall only include the TID(s) and Data A - D which are supported by the ECU. If the request message includes (a) TID value(s) which are not supported by the ECU those shall not be included in the response message.

I.56.2.3 Read TID values

Request control of on-board device request message (read TID values)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request control of on-board device request SID**	**M**	**08**	**SIDRQ**
	data record of Test ID = [			TIDREC
#2	Test ID (request Test ID values)	M/C1	xx	TID
#3	Data A,	C2	xx	DATA_A
#4	Data B,	C2	xx	DATA_B
#5	Data C,	C2	xx	DATA_C
#6	Data D,	C2	xx	DATA_D
#7	Data E]	C2	xx	DATA_E

C1 = Conditional — Test ID value shall be one of the supported Test IDs of previous response message
C2 = Conditional — presence and values of Data A - E parameter depend on Test ID

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I.56.2.4 Report TID values

Request control of on-board device response message (report TID values)

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	**Request control of on-board device response SID**	**M**	**48**	**SIDPR**
	data record of Test ID = [			TIDREC
#2	Test ID (report Test ID values)	M/C1	xx	TID
#3	Data A,	C2	xx	DATA_A
#4	Data B,	C2	xx	DATA_B
#5	Data C,	C2	xx	DATA_C
#6	Data D,	C2	xx	DATA_D
#7	Data E]	C2	xx	DATA_E

C1 = Conditional — Test ID value shall be the same value as included in the request message
C2 = Conditional — presence and values of Data A - E parameter depend on Test ID

I.56.2.5 Negative response message

Bytes	Parameter name	Hex value
#1	**Negative response**	7F
#2	**Request current powertrain diagnostic data**	08
#3	Error code = Condition not correct	22

I.56.2.5.1 Error code

Error code	Cause
Condition not correct	system conditions are not proper to run evaporative system leak test

I.56.2.6 Parameter definition

I.56.2.6.1 Test IDs supported

Refer to Annex A of ISO 15031-5.4.

I.56.2.6.2 Test ID description

Refer to Annex F of ISO 15031-5.4.

I.56.3 Description of TID 01h - Evaporative system leak test

I.56.3.1 Request message

Bytes	Parameter name	Hex value
#1	Request control of on-board system, test, or component	08
#2	Test ID = Evaporative system leak activation	01

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Formula section:

I.56.3.2 IF ACTION_OBDC_Srv08EvapSysLeak()

THEN

I.56.3.3 Send Positive response message

Bytes	Parameter name	Hex value
#1	Request control of on-board system, test, or component response	48
#2	Test ID = Evaporative system leak activation	01

ELSE

Send negative response message with response code 22h - conditionsNotCorrect

Data Byte	Description (all values are in hexadecimal)	Byte Value (Hex)
#1	Negative Response Service Identifier	7F
#2	Request control of on-board device request SID	08
#3	Negative Response Code: conditionsNotCorrect	22

ENDIF

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I.57 SID 09h: Request vehicle information

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_CKS_BOOT_1_SAE	O/S	0... FFFFFFFFH	0... 4294967295	1	-
CRC for CBOOT					
STATE_CKS_BOOT_2_SAE	O/S	0... FFFFFFFFH	0... 4294967295	1	-
CRC for SBOOT					
STATE_CKS_CAL_SAE	O/S	0... FFFFFFFFH	0... 4294967295	1	-
CRC for CALIB					
STATE_CKS_ECU_SAE	O/S	0... FFFFFFFFH	0... 4294967295	1	-
CRC for ECU					
STATE_CKS_SEL_SEG_SAE	O/S	0... FFFFFFFFH	0... 4294967295	1	-
CRC for several or all segments of memory					
STATE_CKS_SEL_SEG_SPC_SAE	O/S	0... FFFFFFFFH	0... 4294967295	1	-
CRC for a specific segment of memory					

Input data:

NC_STATE_CKS_CONF_ CAN {p. 8090}	NC_STATE_COMP_TYP_ CAN {p. 8090}	NC_STATE_SRV_9_CAN_ VIT	

Import actions:

ACTION_ERRM_SelectRbmData (<INOUT>,<PRM_CTR_MOD_9_RBM[36]>,<OUT>,<PRM_RES_MOD_9>)
ACTION_INFR_GetChecksumCks (**IN**<PRM_SW_COMPONENTS>,**OUT**<PRM_CHECKSUM>,**OUT**<PRM_STATUS>)
ACTION_INFR_GetStatusCks (**IN**<PRM_SW_COMPONENTS>,**IN**<PRM_COMMOND>,**OUT**<PRM_STATUS>)
ACTION_INFR_StartCks (**IN**<PRM_SW_COMPONENTS>,**OUT**<PRM_STATUS>)
ACTION_OBDC_GetCALIDCalib (**OUT**<No Name available>)
ACTION_OBDC_GetCALIDCBoot (**OUT**<No Name available>)
ACTION_OBDC_GetCALIDECU (**OUT**<No Name available>)
ACTION_OBDC_GetCALIDSBoot (**OUT**<No Name available>)
ACTION_OBDC_GetCALIDSelSeg (**OUT**<No Name available>)
ACTION_OBDC_GetCALIDSelSegSpc (**OUT**<No Name available>)
ACTION_OBDC_GetECUNAME (**OUT**<No Name available>)
ACTION_OBDC_GetVIN (**OUT**<No Name available>)

I.57.1 Functional description

The purpose of this service is to enable the off-board test device to request vehicle specific information such as Vehicle Identification Number (VIN) and calibration IDs.

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I.57.1.1 Read supported Info Type

I.57.1.1.1 Request message

Bytes	Parameter name	CVT	Hex value
#1	**Request vehicle information**	M	09
#2	Info Type#1 (VITs supported : 01h - 20h)	M	00
#3	Info Type#2 (VITs supported : 21h - 40h)	U	20
#4	Info Type#3 (VITs supported : 41h - 60h)	U	40
#5	Info Type#4 (VITs supported : 61h - 80h)	U	60
#6	Info Type#5 (VITs supported : 81h - A0h)	U	80
#7	Info Type#6 (VITs supported : A1h - C0h)	U	A0

U = User optional	Info Type may be included to avoid multiple Info Type supported request messages

To request Info Types supported range from C1h to FFh another request message with Info Type1 = C0h and Info Type2 = E0h shall be sent to the vehicle.

I.57.1.1.2 Positive response message

Bytes	Parameter name	CVT	Hex value
#1	**Request vehicle information**	M	49
#2	Info Type = 1st supported Info Type	M	00
#4	Supported Info Type 01h - 08h	M	XX
#5	Supported Info Type 09h - 10h	M	XX
#6	Supported Info Type 11h - 18h	M	XX
#7	Supported Info Type 19h - 20h	M	XX
#n-4	Info Type = mth supported Info Type	C1	XX
#n-3	Supported Info Type m1h - m8h	C2	XX
#n-2	Supported Info Type m9h - (m+1)0h	C2	XX
#n-1	Supported Info Type (m+1)1h - (m+1)8h	C2	XX
#n	Supported Info Type (m+1)9h - (m+2)0h	C2	XX

C1 = Conditional	Info Type value shall be the same value as included in the request message if supported by the ECU
C2 = Conditional	Value indicates Info Type supported, the range of supported Info Type depends on selected Info Type value

The response message shall only include the Info Types and Data A - D which are supported by the ECU. If the request message includes (a) Info Type value(s) which are not supported by the ECU, those shall not be included in the response message.

I.57.1.2 Read Info Type values

I.57.1.2.1 Request message

Bytes	Parameter name	CVT	Hex value
#1	**Request vehicle information**	M	09
#2	Info Type (Read Info Type values)	M	02, 04, 06, 08, 0A, 0B

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I.57.1.2.2 Positive response message

Bytes	Parameter name	CVT	Hex value
#1	**Request vehicle information**	M	49
#2	Info Type (Report Info Type values)	M/C1	02, 04, 06, 08, 0A, 0B
#3	Number of data items	M/C1	XX
#4	Data #1	M/C2	XX
#5	Data #2	C2	XX
#n	Data #m	C2	XX

C1 = Conditional	Info Type value shall be the same value as included in the request message
C2 = Conditional	Data #2 to Data #m depend on selected Info Type value

I.57.1.3 Negative response message

Bytes	Parameter name	CVT	Hex value
#1	**Negative response**	M	7F
#2	**Request emission-related powertrain diagnostic trouble codes**	M	09
#3	Error code = Request correctly received response pending	M	78

I.57.1.3.1 Error code

Error code	Cause
Request correctly received response pending	The on-board processor requires significant time to calculate the CRCs

I.57.2 Description of Service 09h, INFOTYPE 00h

DATA A - Supported INFOTYPEs 01h to 08h

INFOTYPE 00h - DATA A - Supported INFOTYPE 01h to 08h		
BIT	**Function**	**name**
0	INFOTYPE 08h : In-use Performance Tracking data byte description for spark ignition engines	NC_STATE_SRV_9_CAN_VIT[0]
1	INFOTYPE 07h : Not supported	
2	INFOTYPE 06h : Calibration Verification Numbers	
3	INFOTYPE 05h : Not supported	
4	INFOTYPE 04h : Calibration IDs	
5	INFOTYPE 03h : Not supported	
6	INFOTYPE 02h : Vehicule Identification Number	
7	INFOTYPE 01h : Not supported	

DATA B - Supported INFOTYPEs 09h to 10h

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INFOTYPE 00h - DATA B - Supported INFOTYPE 09h to 10h		
BIT	**Function**	**name**
0	INFOTYPE 10h : reserved	NC_STATE_SRV_9_CAN_VIT[1]
1	INFOTYPE 0Fh : reserved	
2	INFOTYPE 0Eh : reserved	
3	INFOTYPE 0Dh : reserved	
4	INFOTYPE 0Ch : reserved	
5	INFOTYPE 0Bh : In-use Performance Tracking data byte description for compression ignition engines	
6	INFOTYPE 0Ah : ECUNAME	
7	INFOTYPE 09h : Not supported	

DATA C - Supported INFOTYPEs 11h to 18h

INFOTYPE 00h - DATA C - Supported INFOTYPE 11h to 18h		
BIT	**Function**	**name**
0	INFOTYPE 18h : reserved	NC_STATE_SRV_9_CAN_VIT[2]
1	INFOTYPE 17h : reserved	
2	INFOTYPE 16h : reserved	
3	INFOTYPE 15h : reserved	
4	INFOTYPE 14h : reserved	
5	INFOTYPE 13h : reserved	
6	INFOTYPE 12h : reserved	
7	INFOTYPE 11h : reserved	

DATA D - Supported INFOTYPEs 19h to 20h

INFOTYPE 00h - DATA D - Supported INFOTYPE 19h to 20h		
BIT	**Function**	**name**
0	INFOTYPE 20h : INFOTYPEs supported ($21 - $40)	NC_STATE_SRV_9_CAN_VIT[3]
1	INFOTYPE 1Fh : reserved	
2	INFOTYPE 1Eh : reserved	
3	INFOTYPE 1Dh : reserved	
4	INFOTYPE 1Ch : reserved	
5	INFOTYPE 1Bh : reserved	
6	INFOTYPE 1Ah : reserved	
7	INFOTYPE 19h : reserved	

I.57.3 Description of Service 09h, INFOTYPE 02h - VIN

VIN = 17 characters and should be reported as ASCII values

Request vehicle information request message

Message direction:	External test equipment → All ECUs		
Message Type:	Request		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: 02 - VIN (Vehicle Identification Number)	02	INFTYP

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Formula section:

CALL ACTION_OBDC_*GetVIN* ()

CONSTRUCT Positive response

I.57.3.1 Response positive report Vehicle Identification Number (VIN)

Request vehicle information response message

Message direction:	ECU #1 → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: 02 - VIN (Vehicle Information Number)	02	INFTYP
#3	Number of data items: 01	01	NODI
#4	Data_A: VIN Character 1	XX	VIN
#5	Data_B: VIN Character 2	XX	VIN
#6	Data_C: VIN Character 3	XX	VIN
#7	Data_D: VIN Character 4	XX	VIN
#8	Data_E: VIN Character 5	XX	VIN
#9	Data_F: VIN Character 6	XX	VIN
#10	Data_G: VIN Character 7	XX	VIN
#11	Data_H: VIN Character 8	XX	VIN
#12	Data_I: VIN Character 9	XX	VIN
#13	Data_J: VIN Character 10	XX	VIN
#14	Data_K: VIN Character 11	XX	VIN
#15	Data_L: VIN Character 12	XX	VIN
#16	Data_M: VIN Character 13	XX	VIN
#17	Data_N: VIN Character 14	XX	VIN
#18	Data_O: VIN Character 15	XX	VIN
#19	Data_P: VIN Character 16	XX	VIN
#20	Data_Q: VIN Character 17	XX	VIN

I.57.4 Description of Service 09h, INFOTYPE 04h - Calibration IDs

A Calibration ID will be reported for the ECM, depending on the software architecture. Calibration ID can include a maximum of 16 ASCII characters. Calibration ID can contain only printable ASCII characters, and will be reported as ASCII values.
Calibration ID should uniquely identify the software installed in the ECM.
The amount of Calibration Id is included in the "Number of data items" parameter.
About Calibration coherence identifier definition sees the file: ECU reprogramming, coherence system (Chapter 0)

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Request vehicle information request message

Message direction:	External test equipment → All ECUs		
Message Type:	Request		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: Calibration Id	04	INFTYP

Formula section:

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```
IF (NC_STATE_COMP_TYP_CAN AND 0x20) = 0x20        //requested only one CALID for ECM
THEN CALL ACTION_OBDC_GetCALIDSelSeg()
ELSE                                               //several CALID requested
    IF (NC_STATE_COMP_TYP_CAN AND 0x01) = 0x01
    THEN CALL ACTION_OBDC_GetCALIDCBoot()
    ENDIF

    IF (NC_STATE_COMP_TYP_CAN AND 0x02) = 0x02
    THEN CALL ACTION_OBDC_GetCALIDSBoot()
    ENDIF

    IF (NC_STATE_COMP_TYP_CAN AND 0x04) = 0x04
    THEN CALL ACTION_OBDC_GetCALIDCalib()
    ENDIF

    IF (NC_STATE_COMP_TYP_CAN AND 0x08) = 0x08
    THEN CALL ACTION_OBDC_GetCALIDECU()
    ENDIF

    IF (NC_STATE_COMP_TYP_CAN AND 0x10) = 0x10
    THEN CALL ACTION_OBDC_GetCALIDSelSegSpc()
    ENDIF
ENDIF
CONSTRUCT Positive response
```

I.57.4.1 Response positive report Calibration ID

Request vehicle information response message

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Message direction:	ECU#1 → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Id	04	INFTYP
#3	Number of data items:	XX	NODI
#4	Data_A: Calibration ID for XXX: char 1	XXX	CALID
#5	Data_B: Calibration ID for XXX: char 2	XXX	CALID
#6	Data_C: Calibration ID for XXX: char 3	XXX	CALID
#7	Data_D: Calibration ID for XXX: char 4	XXX	CALID
#8	Data_E: Calibration ID for XXX: char 5	XXX	CALID
#9	Data_F: Calibration ID for XXX: char 6	XXX	CALID
#10	Data_G: Calibration ID for XXX: char 7	XXX	CALID
#11	Data_H: Calibration ID for XXX: char 8	XXX	CALID
#12	Data_I: Calibration ID for XXX: char 9	XXX	CALID
#13	Data_J: Calibration ID for XXX: char 10	XXX	CALID
#14	Data_K: Calibration ID for XXX: char 11	XXX	CALID
#15	Data_L : Calibration ID for XXX: char 12	XXX	CALID
#16	Data_M : Calibration ID for XXX: char 13	XXX	CALID
#17	Data_N : Calibration ID for XXX: char 14	XXX	CALID
#18	Data_O : Calibration ID for XXX: char 15	XXX	CALID
#19	Data_P : Calibration ID for XXX: char 16	XXX	CALID
----	------	-----	-----
#n	Data_A: Calibration ID for YYY: char 1	YYY	CALID
#n+1	Data_B: Calibration ID for YYY: char 2	YYY	CALID
# n+2	Data_C: Calibration ID for YYY: char 3	YYY	CALID
# n+3	Data_D: Calibration ID for YYY: char 4	YYY	CALID
# n+4	Data_E: Calibration ID for YYY: char 5	YYY	CALID
# n+5	Data_F: Calibration ID for YYY: char 6	YYY	CALID
# n+6	Data_G: Calibration ID for YYY: char 7	YYY	CALID
# n+7	Data_H: Calibration ID for YYY: char 8	YYY	CALID
# n+8	Data_I: Calibration ID for YYY: char 9	YYY	CALID
# n+9	Data_J: Calibration ID for YYY: char 10	YYY	CALID
# n+10	Data_K: Calibration ID for YYY: char 11	YYY	CALID
# n+11	Data_L : Calibration ID for YYY: char 12	YYY	CALID
# n+12	Data_M : Calibration ID for YYY: char 13	YYY	CALID
# n+13	Data_N : Calibration ID for YYY: char 14	YYY	CALID
# n+14	Data_O : Calibration ID for YYY: char 15	YYY	CALID
# n+15	Data_P : Calibration ID for YYY: char 16	YYY	CALID

Note:

- The sequence of the 16 bytes (Data_A - Data_P) from #n to #n+15 is depending of the components number. This is depending of how many components are configured in the configuration byte NC_ STATE_COMP_TYP_CAN.
- e.g. (if it is configured to 1 component we have only one sequence of 16 bytes, if it is configured to 2 components we have two sequences of 16 bytes, and so on).
- e.g. if it is configured to 1 component than the positive response will be constructed using only one data set for CALID and the length of response is 19 bytes.
- e.g. if it is configured to 2 components than the positive response will be constructed using two data sets for CALID XXX, and YYY and the length of response is 35 bytes.
- the order of the CALID in the response is the same like in the NC_STATE_COMP_TYP_CAN:

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Positive response

SID	InfoType	1st group of 16 bytes	2nd group of 16 bytes	3rd group of 16 bytes	4th group of 16 bytes	5th group of 16 bytes
49	04	CALID for one area or a combination of several or all section areas of the ECU	ECU CALID	CALIB CALID	SBOOT CALID	CBOOT CALID

I.57.5 Description of Service 09h, INFOTYPE 06h - Calibration verification numbers

The on-board software will calculate the CVN (CRC) based on memory content
If the calculation does not use all four bytes, the CVN shall be right justified and filled with 00h.
The amount of CVNs is included in the "Number of data items" parameter.

Request vehicle information request message (read InfoType values)

Data Byte	Parameter Name	Hex Value	Mnemonic
#1	**Request vehicle information request SID**	**09**	**SIDRQ**
#2	InfoType (read InfoType values)	06	INFTYP

I.57.5.1 Response positive report calibration verification number

Request vehicle information response message

Message direction:	ECU#1 → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: Calibration Verification Number	06	INFTYP
#3	Number of data items:	XX	NODI
#4	Data_A : 1st byte of CRC for XXX calculation value	XXX	DATA_A
#5	Data_B : 2nd byte of CRC for XXX calculation value	XXX	DATA_B
#6	Data_C : 3rd byte of CRC for XXX calculation value	XXX	DATA_C
#7	Data_D : 4th byte of CRC for XXX calculation value	XXX	DATA_D
----	-----	-----	-----
#n	Data_A : 1st byte of CRC for YYY calculation value	YYY	DATA_A
#n+1	Data_B : 2nd byte of CRC for YYY calculation value	YYY	DATA_B
#n+2	Data_C : 3rd byte of CRC for YYY calculation value	YYY	DATA_C
#n+3	Data_D : 4th byte of CRC for YYY calculation value	YYY	DATA_D

Note:

- The sequence of the 4 bytes (Data_A - Data_D) from #n to #n+3 is depending of the components number. This is depending of how many components are configured in the configuration byte NC_STATE_COMP_TYP_CAN.
- e.g. (if it is configured to 1 component we have only one sequence of 4 bytes, if it is configured to 2 components we have two sequences of 4 bytes, and so on).
- the order of the CVNs in the response is the same like in the NC_STATE_COMP_TYP_CAN:

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Positive response

SID	InfoType	1st group of 4 bytes	2nd group of 4 bytes	3rd group of 4 bytes	4th group of 4 bytes	5th group of 4 bytes
49	06	CRC for one area or a combination of several or all section areas of the ECU	ECU CRC	CALIB CRC	SBOOT CRC	CBOOT CRC

Application conditions

Initialisation:

```
At NVMINI system event:
  STATE_CKS_BOOT_1_SAE = 0
  STATE_CKS_BOOT_2_SAE = 0
  STATE_CKS_ECU_SAE = 0
  STATE_CKS_CAL_SAE = 0
  STATE_CKS_SEL_SEG_SAE = 0
  STATE_CKS_SEL_SEG_SPC_SAE = 0
```

Recurrence: –

Activation: –

Formula section:

IF NC_STATE_CKS_CONF_CAN **is** 1
THEN
AT RESET:
Restore values for **STATE_CKS_SEL_SEG_SPC_SAE, STATE_CKS_SEL_SEG_SAE, STATE_CKS_BOOT_1_SAE, STATE_CKS_BOOT_2_SAE, STATE_CKS_ECU_SAE, STATE_CKS_CAL_SAE** from NVMY
ENDIF

At reception of the request the correct flow is:

IF NC_STATE_CKS_CONF_CAN **is** 1
THEN (1)
IF for the first time after a reprogramming event of the ECU(s), the checksum computation is not ready
THEN (2)
A negative response message with response code 78h - RequestCorrectlyReceived-ResponsePending must be sent by the ECU(s) until the checksum computation is done and positive response message is available
ELSE (2)
Check if checksum is done
IF checksum for all COMPONENTs, depending of the configuration of the project is done
if (**ACTION_INFR_GetStatusCks** (component, NC_CKSC_CMD_CHK_READY) == component)
THEN (3)
Intitialize **STATE_CKS_SEL_SEG_SPC_SAE, STATE_CKS_SEL_SEG_SAE, STATE_CKS_BOOT_1_SAE, STATE_CKS_BOOT_2_SAE, STATE_CKS_ECU_SAE, STATE_CKS_CAL_SAE**, with CKS values:

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IF (NC_STATE_COMP_TYP_CAN & 20h) //Ony one CKS requested for ECM
THEN STATE_CKS_SEL_SEG_SAE = **ACTION_INFR_GetChecksumCks** (component for several sections)
ENDIF
IF (NC_STATE_COMP_TYP_CAN & 10h) //Other specific area (e.g. Volcano)
THEN STATE_CKS_SEL_SEG_SPC_SAE = **ACTION_INFR_GetChecksumCks** (component for several sections)
ENDIF
IF (NC_STATE_COMP_TYP_CAN & 08h) //ECU area
THEN STATE_CKS_ECU_SAE = **ACTION_INFR_GetChecksumCks** (component for ECU area)
ENDIF
IF (NC_STATE_COMP_TYP_CAN & 04h) //CALIB area
THEN STATE_CKS_CAL_SAE = **ACTION_INFR_GetChecksumCks** (component for CALIB area)
ENDIF
IF (NC_STATE_COMP_TYP_CAN & 02h) //SBOOT area
THEN STATE_CKS_BOOT_2_SAE = **ACTION_INFR_GetChecksumCks** (component for SBOOT area)
ENDIF
IF (NC_STATE_COMP_TYP_CAN & 01h) //CBOOT area
THEN STATE_CKS_BOOT_1_SAE = **ACTION_INFR_GetChecksumCks** (component for CBOOT area)
ENDIF
IF (NC_STATE_COMP_TYP_CAN & 20h) //Ony one CKS requested for ECM
THEN Send positive(s) response(s) only for STATE_CKS_SEL_SEG_SAE
ELSE Send positive(s) response(s) for configured areas
ENDIF

ELSE (3)
Send positive(s) response(s) with the values for CKS restored at RESET
ENDIF (3)
ENDIF (2)
ELSE (1)
IF NC_STATE_CKS_CONF_CAN **is** 2
IF crc calculation not started (the negative response « 78 pending response » was not sent at all)
THEN (4)
Start crc calculation
CALL ACTION_INFR_StartCks (component)
Send negative response "78h pending response"
ELSE (4)
AT each recall before next response check if checksum is done
IF checksum for all COMPONENTs, depending of the configuration of the project is done
if (**ACTION_INFR_GetStatusCks** (component, NC_CKSC_CMD_CHK_READY) == component)
THEN (5)
Intitialize **STATE_CKS_SEL_SEG_SPC_SAE, STATE_CKS_SEL_SEG_SAE, STATE_CKS_BOOT_1_SAE, STATE_CKS_BOOT_2_SAE, STATE_CKS_ECU_SAE, STATE_CKS_CAL_SAE**, with CKS values:
IF (NC_STATE_COMP_TYP_CAN & 20h) //Ony one CKS requested for ECM
THEN STATE_CKS_SEL_SEG_SAE = **ACTION_INFR_GetChecksumCks** (component for several sections)

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ENDIF
IF (NC_STATE_COMP_TYP_CAN & 10h) //Other specific area (e.g. Volcano)
THEN STATE_CKS_SEL_SEG_SPC_SAE = **ACTION_INFR_GetChecksumCks** (component for several sections)
ENDIF
IF (NC_STATE_COMP_TYP_CAN & 08h) //ECU area
THEN STATE_CKS_ECU_SAE = **ACTION_INFR_GetChecksumCks** (component for ECU area)
ENDIF
IF (NC_STATE_COMP_TYP_CAN & 04h) //CALIB area
THEN STATE_CKS_CAL_SAE = **ACTION_INFR_GetChecksumCks** (component for CALIB area)
ENDIF
IF (NC_STATE_COMP_TYP_CAN & 02h) //SBOOT area
THEN STATE_CKS_BOOT_2_SAE = **ACTION_INFR_GetChecksumCks** (component for SBOOT area)
ENDIF
IF (NC_STATE_COMP_TYP_CAN & 01h) //CBOOT area
THEN STATE_CKS_BOOT_1_SAE = **ACTION_INFR_GetChecksumCks** (component for CBOOT area)
ENDIF
IF (NC_STATE_COMP_TYP_CAN & 20h) //Ony one CKS requested for ECM
THEN Send positive(s) response(s) only for STATE_CKS_SEL_SEG_SAE
ELSE Send positive(s) response(s) for configured areas
ENDIF
ENDIF (6)
ELSE (5)
Send negative response "78h pending response"
ENDIF (5)
ENDIF (4)
ENDIF (1)

I.57.6 Description of Service 09h, InfoType 08h

Request vehicle information request message

Message direction:	External test equipment → All ECUs		
Message Type:	Request		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information request SID	09	SIDRQ
#2	In-use Performance Tracking data byte description for spark ignition engines	08	INFTYP

Formula section:

CALL ACTION_ERRM_SelectRbmData(<PRM_CTR_MOD_9_RBM[36]>, <PRM_RES_MOD_9>)
CONSTRUCT positive response with PRM_CTR_MOD_9_RBM[0].. PRM_CTR_MOD_9_RBM[19]

I.57.6.1 Response positive report In-Use Performance Tracking

Request vehicle information response message

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Message direction:	ECU#1 → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: In-use Performance Tracking	08	INFTYP
#3	Number of data items: 20	14	NODI
#4	Data A1: MSB (OBD Monitoring Conditions Encountered Counts - general denominator)	XX	OBDCOND_A
#5	Data A2: LSB (OBD Monitoring Conditions Encountered Counts - general denominator)	XX	OBDCOND_B
#6	Data B1: MSB (Ignition Cycle Counter)	XX	IGNCNTR_A
#7	Data B2: LSB (Ignition Cycle Counter)	XX	IGNCNTR_B
#8	Data C1: MSB (Catalyst Monitor Completion Counts Bank 1 - numerator)	XX	CATCOMP1_A
#9	Data C2: LSB (Catalyst Monitor Completion Counts Bank 1 - numerator)	XX	CATCOMP1_B
#10	Data D1: MSB (Catalyst Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	CATCOND1_A
#11	Data D2: LSB (Catalyst Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	CATCOND1_B
#12	Data E1: MSB (Catalyst Monitor Completion Counts Bank 2 - numerator)	XX	CATCOMP2_A
#13	Data E2: LSB (Catalyst Monitor Completion Counts Bank 2 - numerator)	XX	CATCOMP2_B
#14	Data F1: MSB (Catalyst Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	CATCOND2_A
#15	Data F2: LSB (Catalyst Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	CATCOND2_B
#16	Data G1: MSB (O2 Sensor Monitor Completion Counts Bank 1 - numerator)	XX	O2SCOMP1_A
#17	Data G2: LSB (O2 Sensor Monitor Completion Counts Bank 1 - numerator)	XX	O2SCOMP1_B
#18	Data H1: MSB (O2 Sensor Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	O2SCOND1_A
#19	Data H2: LSB (O2 Sensor Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	O2SCOND1_B
#20	Data I1: MSB (O2 Sensor Monitor Completion Counts Bank 2 - numerator)	XX	O2SCOMP2_A
#21	Data I1: LSB (O2 Sensor Monitor Completion Counts Bank 2 - numerator)	XX	O2SCOMP2_B
#22	Data J1: MSB (O2 Sensor Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	O2SCOND2_A
#23	Data J2: LSB (O2 Sensor Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	O2SCOND2_B
#24	Data K1 MSB (EGR/VVT Monitor Completion Condition Counts - numerator)	XX	EGRCOMP_A
#25	Data K2: LSB (EGR/VVT Monitor Completion Condition Counts - numerator)	XX	EGRCOMP_B
#26	Data L1: MSB (EGR/VVT Monitor Conditions Encountered Counts - denominator)	XX	EGRCOND_A
#27	Data L2: LSB (EGR/VVT Monitor Conditions Encountered Counts - denominator)	XX	EGRCOND_B
#28	Data M1: MSB (AIR Monitor Completion Condition Counts (Secondary Air) - numerator)	XX	AIRCOMP_A

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Message direction:	ECU#1 → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#29	Data M2: LSB (AIR Monitor Completion Condition Counts (Secondary Air) - numerator)	XX	AIRCOMP_B
#30	Data N1: MSB (AIR Monitor Conditions Encountered Counts (Secondary Air) - denominator)	XX	AIRCOND_A
#31	Data N2: LSB (AIR Monitor Conditions Encountered Counts (Secondary Air) - denominator)	XX	AIRCOND_B
#32	Data O1: MSB (EVAP Monitor Completion Condition Counts - numerator)	XX	EVAPCOMP_A
#33	Data O2: LSB (EVAP Monitor Completion Condition Counts - numerator)	XX	EVAPCOMP_B
#34	Data P1: MSB (EVAP Monitor Conditions Encountered Counts - denominator)	XX	EVAPCOND_A
#35	Data P2: LSB (EVAP Monitor Conditions Encountered Counts - denominator)	XX	EVAPCOND_B
#36	Data Q1: MSB (Secondary O2 Sensor Monitor Completion Counts Bank 1 - numerator)	XX	SO2SCOMP1_A
#37	Data Q2: LSB (Secondary O2 Sensor Monitor Completion Counts Bank 1 - numerator)	XX	SO2SCOMP1_B
#38	Data R1: MSB (Secondary O2 Sensor Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	SO2SCOND1_A
#39	Data R2: LSB (Secondary O2 Sensor Monitor Conditions Encountered Counts Bank 1 - denominator)	XX	SO2SCOND1_B
#40	Data S1: MSB (Secondary O2 Sensor Monitor Completion Counts Bank 2 - numerator)	XX	SO2SCOMP2_A
#41	Data S2: LSB (Secondary O2 Sensor Monitor Completion Counts Bank 2 - numerator)	XX	SO2SCOMP2_B
#42	Data T1: MSB (Secondary O2 Sensor Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	SO2SCOND2_A
#43	Data T2: LSB (Secondary O2 Sensor Monitor Conditions Encountered Counts Bank 2 - denominator)	XX	SO2SCOND2_B

I.57.7 Description of Service 09h, INFOTYPE 0Ah - ECUNAME

The number of the data bytes reported to the scan tool for InfoType 0Ah must be 20 ASCII characters.

Request vehicle information request message

Message direction:	External test equipment → All ECUs		
Message Type:	Request		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information request SID	09	SIDRQ
#2	InfoType: 0A - ECUNAME	0A	INFTYP

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Formula section:

CALL ACTION_OBDC_GetECUNAME()
CONSTRUCT Positive response

I.57.7.1 Response positive report ECUNAME

Request vehicle information response message

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Message direction:	ECU #1 → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	InfoType: 0A - ECUNAME	0A	INFTYP
#3	Number of data items: 01	01	NODI
#4	Data_A: ECU Acronym Character 1	XX	ECU
#5	Data_B: ECU Acronym Character 2	XX	ECU
#6	Data_C: ECU Acronym Character 3	XX	ECU
#7	Data_D: ECU Acronym Character 4	XX	ECU
#8	Data_E: Delimiter	"-"	-
#9	Data_F: Reported text name Character 1	YY	ECUNAME
#10	Data_G: Reported text name Character 2	YY	ECUNAME
#11	Data_H: Reported text name Character 3	YY	ECUNAME
#12	Data_I: Reported text name Character 4	YY	ECUNAME
#13	Data_J: Reported text name Character 5	YY	ECUNAME
#14	Data_K: Reported text name Character 6	YY	ECUNAME
#15	Data_L: Reported text name Character 7	YY	ECUNAME
#16	Data_M: Reported text name Character 8	YY	ECUNAME
#17	Data_N: Reported text name Character 9	YY	ECUNAME
#18	Data_O: Reported text name Character 10	YY	ECUNAME
#19	Data_P: Reported text name Character 11	YY	ECUNAME
#20	Data_Q: Reported text name Character 12	YY	ECUNAME
#21	Data_R: Reported text name Character 13	YY	ECUNAME
#22	Data_S: Reported text name Character 14	YY	ECUNAME
#23	Data_T: Reported text name Character 15	YY	ECUNAME

I.57.8 Description of Service 09h, InfoType 0Bh

Request vehicle information request message

Message direction:	External test equipment → All ECUs		
Message Type:	Request		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information request SID	09	SIDRQ
#2	In-use Performance Tracking data byte description for compression ignition engines	0B	INFTYP

Formula section:

CALL ACTION_ERRM_SelectRbmData(<PRM_CTR_MOD_9_RBM[36]>, <PRM_RES_MOD_9>)
CONSTRUCT positive response with PRM_CTR_MOD_9_RBM[20].. PRM_CTR_MOD_9_RBM[35]

I.57.8.1 Response positive report In-Use Performance Tracking

Request vehicle information response message

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Message direction:	ECU#1 → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#1	Request vehicle information response SID	49	SIDPR
#2	In-use Performance Tracking data byte description for compression ignition engines	0B	INFTYP
#3	Number of data items: 16	10	NODI
#4	Data A1: MSB (OBD Monitoring Conditions Encountered Counts - general denominator)	XX	OBDCOND_A
#5	Data A2: LSB (OBD Monitoring Conditions Encountered Counts - general denominator)	XX	OBDCOND_B
#6	Data B1: MSB (Ignition Cycle Counter)	XX	IGNCNTR_A
#7	Data B2: LSB (Ignition Cycle Counter)	XX	IGNCNTR_B
#8	Data C1: MSB (NMHC Catalyst Monitor Completion Condition Counts - numerator)	XX	HCCATCOMP_A
#9	Data C2: LSB (NMHC Catalyst Monitor Completion Condition Counts - numerator)	XX	HCCATCOMP_B
#10	Data D1: MSB (NMHC Catalyst Monitor Conditions Encountered Counts - denominator)	XX	HCCATCOND_A
#11	Data D2: LSB (NMHC Catalyst Monitor Conditions Encountered Counts - denominator)	XX	HCCATCOND_B
#12	Data E1: MSB (NOx Catalyst Monitor Completion Condition Counts - numerator)	XX	NCATCOMP_A
#13	Data E2: LSB (NOx Catalyst Monitor Completion Condition Counts - numerator)	XX	NCATCOMP_B
#14	Data F1: MSB (NOx Catalyst Monitor Conditions Encountered Counts - denominator)	XX	NCATCOND_A
#15	Data F2: LSB (NOx Catalyst Monitor Conditions Encountered Counts - denominator)	XX	NCATCOND_B
#16	Data G1: MSB (NOx Adsorber Monitor Completion Condition Counts - numerator)	XX	NADSCOMP_A
#17	Data G2: LSB (NOx Adsorber Monitor Completion Condition Counts - numerator)	XX	NADSCOMP_B
#18	Data H1: MSB (NOx Adsorber Monitor Conditions Encountered Counts - denominator)	XX	NADSCOND_A
#19	Data H2: LSB (NOx Adsorber Monitor Conditions Encountered Counts - denominator)	XX	NADSCOND_B
#20	Data G1: MSB (PM Filter Monitor Completion Condition Counts - numerator)	XX	PMCOMP_A
#21	Data G2: LSB (PM Filter Monitor Completion Condition Counts - numerator)	XX	PMCOMP_B
#22	Data H1: MSB (PM Filter Monitor Conditions Encountered Counts - denominator)	XX	PMCOND_A
#23	Data H2: LSB (PM Filter Monitor Conditions Encountered Counts - denominator)	XX	PMCOND_B
#24	Data I1: MSB (Exhaust Gas Sensor Monitor Completion Condition Counts - numerator)	XX	EGSCOMP_A
#25	Data I2: LSB (Exhaust Gas Sensor Monitor Completion Condition Counts - numerator)	XX	EGSCOMP_B
#26	Data J1: MSB (Exhaust Gas Sensor Monitor Conditions Encountered Counts- denominator)	XX	EGSCOND_A
#27	Data J2: LSB (Exhaust Gas Sensor Monitor Conditions Encountered Counts- denominator)	XX	EGSCOND_B
#28	Data K1: MSB (EGR/VVT Monitor Completion Condition Counts - numerator)	XX	EGRCOMP_A

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Message direction:	ECU#1 → External test equipment		
Message Type:	Response		
Data Byte	**Description (all values are in hexadecimal)**	**Byte Value (Hex)**	**Mnemonic**
#29	Data K2: LSB (EGR/VVT Monitor Completion Condition Counts - numerator)	XX	EGRCOMP_B
#30	Data L1: MSB (EGR/VVT Monitor Conditions Encountered Counts - denominator)	XX	EGRCOND_A
#31	Data L2: LSB (EGR/VVT Monitor Conditions Encountered Counts - denominator)	XX	EGRCOND_B
#32	Data M1: MSB (Boost Pressure Monitor Completion Condition Counts - numerator)	XX	BPCOMP_A
#33	Data M2: LSB (Boost Pressure Monitor Completion Condition Counts - numerator)	XX	BPCOMP_B
#34	Data N1: MSB (Boost Pressure Monitor Conditions Encountered Counts - denominator)	XX	BPCOND_A
#35	Data N2: LSB (Boost Pressure Monitor Conditions Encountered Counts - denominator)	XX	BPCOND_B

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I.58 SID 09h: Request vehicle information (Appl. Inc.)

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CTR_CDN_RBM_CLC_CAT_1	V	0... FFFFH	0... 65535	1	-
Denominator of CAT_1 group					
CTR_CDN_RBM_CLC_CAT_2	V	0... FFFFH	0... 65535	1	-
Denominator of CAT_1 group					
CTR_CDN_RBM_CLC_LEAK	V	0... FFFFH	0... 65535	1	-
Denominator of LEAK group					
CTR_CDN_RBM_CLC_LS_DOWN_1	V	0... FFFFH	0... 65535	1	-
Denominator of LS_DOWN_1 group					
CTR_CDN_RBM_CLC_LS_DOWN_2	V	0... FFFFH	0... 65535	1	-
Denominator of LS_DOWN_2 group					
CTR_CDN_RBM_CLC_LS_UP_1	V	0... FFFFH	0... 65535	1	-
Denominator of LS_UP_1 group					
CTR_CDN_RBM_CLC_LS_UP_2	V	0... FFFFH	0... 65535	1	-
Denominator of LS_UP_2 group					
CTR_CDN_RBM_CLC_SA	V	0... FFFFH	0... 65535	1	-
Denominator of SA group					
CTR_CDN_RBM_CLC_VVT	V	0... FFFFH	0... 65535	1	-
Denominator of VVT group					
CTR_COMP_RBM_CLC_CAT_1	V	0... FFFFH	0... 65535	1	-
Numerator of CAT_1 group					
CTR_COMP_RBM_CLC_CAT_2	V	0... FFFFH	0... 65535	1	-
Numerator of CAT_1 group					
CTR_COMP_RBM_CLC_LEAK	V	0... FFFFH	0... 65535	1	-
Numerator of EVAM group					
CTR_COMP_RBM_CLC_LS_DOWN_1	V	0... FFFFH	0... 65535	1	-
Numerator of LS_DOWN_1 group					
CTR_COMP_RBM_CLC_LS_DOWN_2	V	0... FFFFH	0... 65535	1	-
Numerator of LS_DOWN_2 group					
CTR_COMP_RBM_CLC_LS_UP_1	V	0... FFFFH	0... 65535	1	-
Numerator of LS_UP_1 group					
CTR_COMP_RBM_CLC_LS_UP_2	V	0... FFFFH	0... 65535	1	-
Numerator of LS_UP_2 group					
CTR_COMP_RBM_CLC_SA	V	0... FFFFH	0... 65535	1	-
Numerator of SA group					
CTR_COMP_RBM_CLC_VVT	V	0... FFFFH	0... 65535	1	-
Numerator of VVT group					
ECU_CVN_CAL	V	0... FFFFFFFFH	0... 4294967295	1	-
Calibration verification Number from Calibration data					
ECU_CVN_PROG	V	0... FFFFFFFFH	0... 4294967295	1	-
Calibration verification Number from ECU Program					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ECU_ID_CAL [NC_NR_CAL_CHAR_LEN]	V	0	ASCII	1	-
Calibration identification number - Data - (16 byte - ASCII) for OBD communication					
ECU_ID_SW [NC_NR_CAL_CHAR_LEN]	V	0	ASCII	1	-
Calibration identification number - Program - (16 byte - ASCII) for OBD communication					
ECU_VIN [NC_NR_VIN_CHAR_LEN]	V	0	ASCII	1	-
Vehicle identification number (17 byte - ASCII) for OBD communication					

Input data:

STATE_CKS_CAL_SAE {p. 8073}	STATE_CKS_ECU_SAE {p. 8073}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
ID_STATE_SRV_9_CAN_VIT	-	0... FFH	0... 255	1	-
LDP_STATE_VIT_ID_STATE_SRV_9	4	0... 03H	0 ...3	1	-
Table of bytes which defines the INFOTYPEs supported by the service 09h (01h - 20h) - ISO 15765-4					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_NR_CAL_CHAR_LEN	-	0... FFH	0... 255	1	-
Number of ASCI elements used for Calibration Identification (=16)					
NC_NR_VIN_CHAR_LEN	-	0... FFH	0... 255	1	-
Number of ASCI elements used for Vehicle Identification (=17)					
NC_STATE_CKS_CONF_CAN	-	0... FFH	0... 255	1	-
byte which defines the response method for service $09 InfoType $06					
NC_STATE_COMP_TYP_CAN	-	0... FFH	0... 255	1	-
byte which defines the components used in a ECU					
NC_STATE_SEL_SEG_CAN	-	0... FFH	0... 255	1	-
Configuration byte which defines area of an ECU					
NC_STATE_SEL_SEG_SPC_CAN	-	0... FFH	0... 255	1	-
Configuration byte which defines a specific area of an ECU					

Action definition

ACTION_OBDC_GetCALIDCalib (**OUT**<No Name available>)	Mode: O
This action fill the CALIB CALID with the correct values from the project	

ACTION_OBDC_GetCALIDCBoot (**OUT**<No Name available>)	Mode: O
This action fill the CBOOT CALID with the correct values from the project	

ACTION_OBDC_GetCALIDECU (**OUT**<No Name available>)	Mode: O
This action fill the ECU CALID with the correct values from the project	

ACTION_OBDC_GetCALIDSBoot (**OUT**<No Name available>)	Mode: O
This action fill the SBOOT CALID with the correct values from the project	

ACTION_OBDC_GetCALIDSelSeg (**OUT**<No Name available>)	Mode: O
This action fill the several or all segments of memory CALID with the correct values from the project	

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ACTION_OBDC_GetCALIDSelSegSpc (**OUT**<No Name available>)	Mode: O
This action fill the specific segment of memory CALID with the correct values from the project	

ACTION_OBDC_GetECUNAME (**OUT**<No Name available>)	Mode: O
This action fills the emission related ECU Name	

ACTION_OBDC_GetVIN (**OUT**<No Name available>)	Mode: O
This action fill the VIN with the correct values from the project	

Import actions:

ACTION_ERRM_SelectRbmData (<INOUT>,<PRM_CTR_MOD_9_RBM[36]>,<OUT>,<PRM_RES_MOD_9>)

I.58.1 NC_STATE_CKS_CONF_CAN

NC_STATE_CKS_CONF_CAN	
Value	**Description**
1	Method #1: The CVN(s) must not be computed on demand, but instead shall be computed at least once per trip. A trip shall be of reasonable length (e.g. 5 - 10 minutes). The computed CVN(s) shall be stored in NVM (Non Volatile Memory) for immediate access by the external test equipment. Once the computation is completed for the very first time after a reprogramming event of the ECU(s) or a battery disconnect, the results shall be made available to the external test equipment even if the engine is running. If the CVN(s) are requested before they have been computed a negative response message with response code $78 - RequestCorrectlyReceived-ResponsePending shall be sent by the ECU(s) until the positive response message is available for the ISO 14230-4 and ISO 15765-4 protocols.
2	Method #2: If method #1 does not apply the ECU(s)' on-board software shall compute the CVN(s) on an external test equipment request message. If the ECU(s) are not able to send an immediate positive response message a negative response message with response code $78 - RequestCorrectlyReceived-ResponsePending shall be sent by the ECU(s) until the positive response message is available for the ISO 14230-4 and ISO 15765-4 protocols.

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Formula section:

NC_STATE_CKS_CONF_CAN = 1

I.58.2 NC_STATE_COMP_TYP_CAN

NC_STATE_COMP_TYP_CAN		
BIT	**Function**	**Supported**
0	Use CBOOT area	0
1	Use SBOOT area	0
2	Use CALIB area	**1**
3	Use ECU area	**1**
4	One area or a combination of several or all section areas of the ECU	0
5	Dummy value, always 0	0
6	Dummy value, always 0	0
7	Dummy value, always 0	0

Formula section:

see Table

I.58.3 NC_STATE_SEL_SEG_CAN

NC_STATE_SEL_SEG_CAN	
Value	**Description**
XX	The value of the define represent the area of one component or a a combination of several or all section areas of the ECU

NC_STATE_SEL_SEG_CAN = 0 (not used)

I.58.4 NC_STATE_SEL_SEG_SPC_CAN

NC_STATE_SEL_SEG_SPC_CAN	
Value	**Description**
XX	The value of the define represent the area of one component of the ECM (e.g. Volcano)

NC_STATE_SEL_SEG_SPC_CAN = 0 (not used)

I.58.5 NC_NR_VIN_CHAR_LEN

NC_NR_VIN_CHAR_LEN	
Value	**Description**
XX	Number of ASCI elements used for Vehicle Identification

NC_NR_VIN_CHAR_LEN = 17 dez

I.58.6 NC_NR_CAL_CHAR_LEN

NC_NR_CAL_CHAR_LEN	
Value	**Description**
XX	Number of ASCI elements used for Calibration Identification

NC_NR_CAL_CHAR_LEN = 16 dez

I.58.7 Supported INFOTYPEs for Service 09h - ISO 15765-4

Description:

In the table **ID_STATE_SRV_9_CAN_VIT** each byte represents an 8 INFOTYPEs configuration

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ID_STATE_SRV_9_CAN_VIT[0]	Supported INFOTYPEs from 01h - 08h	
BIT	**Function**	**Supported**
0	INFOTYPE 08h : In-Use Performance Tracking	**1**
1	INFOTYPE 07h : Not used	0
2	INFOTYPE 06h : Calibration Verification Numbers	**1**
3	INFOTYPE 05h : Not used	0
4	INFOTYPE 04h : Calibration IDs	**1**
5	INFOTYPE 03h : Not used	0
6	INFOTYPE 02h : Vehicule Identification Number	**1**
7	INFOTYPE 01h : Not used	0

Figure I.58.1: ID_STATE_SRV_9_CAN_VIT[1]

ID_STATE_SRV_9_CAN_VIT[1]	Supported INFOTYPEs from 09h - 10h	
BIT	**Function**	**Supported**
0	INFOTYPE 10h : Reserved	0
1	INFOTYPE 0Fh : Reserved	0
2	INFOTYPE 0Eh : Reserved	0
3	INFOTYPE 0Dh : Reserved	0
4	INFOTYPE 0Ch : Reserved	0
5	INFOTYPE 0Bh : Reserved	0
6	INFOTYPE 0Ah : ECUNAME	**1**
7	INFOTYPE 09h : Reserved	0

Figure I.58.2: ID_STATE_SRV_9_CAN_VIT[2]

ID_STATE_SRV_9_CAN_VIT[2]	Supported INFOTYPEs from 11h - 18h	
BIT	**Function**	**Supported**
0	INFOTYPE 18h : Reserved	0
1	INFOTYPE 17h : Reserved	0
2	INFOTYPE 16h : Reserved	0
3	INFOTYPE 15h : Reserved	0
4	INFOTYPE 14h : Reserved	0
5	INFOTYPE 13h : Reserved	0
6	INFOTYPE 12h : Reserved	0
7	INFOTYPE 11h : Reserved	0

Figure I.58.3: ID_STATE_SRV_9_CAN_VIT[3]

ID_STATE_SRV_9_CAN_VIT[3]	Supported INFOTYPEs from 19h - 20h	
BIT	**Function**	**Supported**
0	INFOTYPE 20h : INFOTYPEs supported ($21 - $40)	0
1	INFOTYPE 1Fh : Reserved	0
2	INFOTYPE 1Eh : Reserved	0
3	INFOTYPE 1Dh : Reserved	0
4	INFOTYPE 1Ch : Reserved	0
5	INFOTYPE 1Bh : Reserved	0
6	INFOTYPE 1Ah : Reserved	0
7	INFOTYPE 19h : Reserved	0

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I.58.8 Description of Service 09h, INFOTYPE 02h - VIN

Description:

Vehicle Identification Number (VIN) = 17 characters and should be reported as ASCII values

Description for actions:

ACTION_OBDC_*GetVIN* (OUT < PRM_STATE_VIN >)					
This action fill the VIN with the correct values from the project					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_STATE_VIN[0..16]	IN	0...FFH	0...255	1	[-]
See description bellow					

FUNCTION DESCRIPTION:

Description of parameter OUT used by action **ACTION_OBDC_*GetVIN*** ():

PRM_STATE_VIN:
Software structure of 17 ASCI elements filled up with VIN. This structure has to be filled byte by byte. For visualization the variables ECU_VIN[0...16] are filled at ACTION request (ASCI format) or once after power up reset (after CVN calc. is finished).

PRM_STATE_VIN[0] = kwp_io_vin[0] *// VIN Character 0*
PRM_STATE_VIN[1] = kwp_io_vin[1] *// VIN Character 1*
PRM_STATE_VIN[2] = kwp_io_vin[2] *// VIN Character 2*
PRM_STATE_VIN[3] = kwp_io_vin[3] *// VIN Character 3*
PRM_STATE_VIN[4] = kwp_io_vin[4] *// VIN Character 4*
PRM_STATE_VIN[5] = kwp_io_vin[5] *// VIN Character 5*
PRM_STATE_VIN[6] = kwp_io_vin[6] *// VIN Character 6*
PRM_STATE_VIN[7] = kwp_io_vin[7] *// VIN Character 7*
PRM_STATE_VIN[8] = kwp_io_vin[8] *// VIN Character 8*
PRM_STATE_VIN[9] = kwp_io_vin[9] *// VIN Character 9*
PRM_STATE_VIN[10] = kwp_io_vin[10] *// VIN Character 10*
PRM_STATE_VIN[11] = kwp_io_vin[11] *// VIN Character 11*
PRM_STATE_VIN[12] = kwp_io_vin[12] *// VIN Character 12*
PRM_STATE_VIN[13] = kwp_io_vin[13] *// VIN Character 13*
PRM_STATE_VIN[14] = kwp_io_vin[14] *// VIN Character 14*
PRM_STATE_VIN[15] = kwp_io_vin[15] *// VIN Character 15*
PRM_STATE_VIN[16] = kwp_io_vin[16] *// VIN Character 16*

I.58.9 Description of Service 09h, INFOTYPE 04h - Calibration IDs

Description:

A Calibration ID will be reported for the ECM, depending on the software architecture. Calibration ID can include a maximum of 16 ASCII characters. Calibration ID can contain only printable ASCII characters, and will be reported as ASCII values. Calibration ID should uniquely identify the software installed in the ECM. The amount of Calibration Id is included in the "Number of data items" parameter. About Calibration coherence identifier definition see the file : ECU reprogramming, coherence system (Chapter 0)

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I.58.9.1 API for configuration of Customer Boot CALID: ACTION_OBDC_GetCALIDCBoot (OUT < PRM_STATE_BOOT_1 >)

Description for actions:

ACTION_OBDC_*GetCALIDCBoot* (OUT < PRM_STATE_BOOT_1 >)					
This action fill the CBOOT CALID with the correct values from the project					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_STATE_BOOT_1[0...15]	IN	0...FFH	0...255	1	[-]
Name of supplier CBOOT-ID					

FUNCTION DESCRIPTION:

Description of parameter OUT used by action **ACTION_OBDC_*GetCALIDCBoot*** ():

PRM_STATE_BOOT_1:
Software structure of 16 ASCI elements filled up with CBOOT CALID(Calibration Identifications only for CBOOT area). This structure has to be filled byte by byte.

PRM_STATE_BOOT_1[0] = not used *//CBOOT CALID Character 1*
PRM_STATE_BOOT_1[1] = not used *//CBOOT CALID Character 2*
PRM_STATE_BOOT_1[2] = not used *//CBOOT CALID Character 3*
PRM_STATE_BOOT_1[3] = not used *//CBOOT CALID Character 4*
PRM_STATE_BOOT_1[4] = not used *//CBOOT CALID Character 5*
PRM_STATE_BOOT_1[5] = not used *//CBOOT CALID Character 6*
PRM_STATE_BOOT_1[6] = not used *//CBOOT CALID Character 7*
PRM_STATE_BOOT_1[7] = not used *//CBOOT CALID Character 8*
PRM_STATE_BOOT_1[8] = not used *//CBOOT CALID Character 9*
PRM_STATE_BOOT_1[9] = not used *//CBOOT CALID Character 10*
PRM_STATE_BOOT_1[10] = not used *//CBOOT CALID Character 11*
PRM_STATE_BOOT_1[11] = not used *//CBOOT CALID Character 12*
PRM_STATE_BOOT_1[12] = not used *//CBOOT CALID Character 13*
PRM_STATE_BOOT_1[13] = not used *//CBOOT CALID Character 14*
PRM_STATE_BOOT_1[14] = not used *//CBOOT CALID Character 15*
PRM_STATE_BOOT_1[15] = not used *//CBOOT CALID Character 16*

I.58.9.2 API for configuration of supplier Boot CALID: ACTION_OBDC_GetCALIDSBoot (OUT < PRM_STATE_BOOT_2 >)

Description for actions:

ACTION_OBDC_*GetCALIDSBoot* (OUT < PRM_STATE_BOOT_2 >)					
This action fill the SBOOT CALID with the correct values from the project					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_STATE_BOOT_2[0...15]	IN	0...FFH	0...255	1	[-]
Name of supplier SBOOT-ID					

FUNCTION DESCRIPTION:

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Description of parameter OUT used by action **ACTION_OBDC_*GetCALIDSBoot*** ():

PRM_STATE_BOOT_2:
Software structure of 16 ASCI elements filled up with SBOOT CALID(Calibration Identifications only for SBOOT area). This structure has to be filled byte by byte.

PRM_STATE_BOOT_2[0] = not used *//SBOOT CALID Character 1*
PRM_STATE_BOOT_2[1] = not used *//SBOOT CALID Character 2*
PRM_STATE_BOOT_2[2] = not used *//SBOOT CALID Character 3*
PRM_STATE_BOOT_2[3] = not used *//SBOOT CALID Character 4*
PRM_STATE_BOOT_2[4] = not used *//SBOOT CALID Character 5*
PRM_STATE_BOOT_2[5] = not used *//SBOOT CALID Character 6*
PRM_STATE_BOOT_2[6] = not used *//SBOOT CALID Character 7*
PRM_STATE_BOOT_2[7] = not used *//SBOOT CALID Character 8*
PRM_STATE_BOOT_2[8] = not used *//SBOOT CALID Character 9*
PRM_STATE_BOOT_2[9] = not used *//SBOOT CALID Character 10*
PRM_STATE_BOOT_2[10] = not used *//SBOOT CALID Character 11*
PRM_STATE_BOOT_2[11] = not used *//SBOOT CALID Character 12*
PRM_STATE_BOOT_2[12] = not used *//SBOOT CALID Character 13*
PRM_STATE_BOOT_2[13] = not used *//SBOOT CALID Character 14*
PRM_STATE_BOOT_2[14] = not used *//SBOOT CALID Character 15*
PRM_STATE_BOOT_2[15] = not used *//SBOOT CALID Character 16*

I.58.9.3 API for configuration of Calibration area CALID: ACTION_OBDC_GetCALIDECU (OUT < PRM_STATE_ECU >)

Description for actions:

ACTION_OBDC_*GetCALIDECU* (OUT < PRM_STATE_ECU >)					
This action fill the ECU CALID with the correct values from the project					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_STATE_ECU[0...15]	IN	0...FFH	0...255	1	[-]
See description bellow					

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FUNCTION DESCRIPTION:

Description of parameter OUT used by action **ACTION_OBDC_*GetCALIDECU*** ():

PRM_STATE_ECU:
Software structure of 16 ASCI elements filled up with ECU CALID(Calibration Identifications only for ECU area). This structure has to be filled byte by byte. For visualization the variable ECU_ID_SW[0...15] is filled at ACTION request or once after power up reset (after CVN calc. is finished).

PRM_STATE_ECU[0] = low nibble from bmw_hw_nr[2] *//ECU CALID Character 1*
PRM_STATE_ECU[1] = high nibble from bmw_hw_nr[3] *//ECU CALID Character 2*
PRM_STATE_ECU[2] = low nibble from bmw_hw_nr[3] *//ECU CALID Character 3*
PRM_STATE_ECU[3] = high nibble from bmw_hw_nr[4] *//ECU CALID Character 4*
PRM_STATE_ECU[4] = low nibble from bmw_hw_nr[4] *//ECU CALID Character 5*
PRM_STATE_ECU[5] = high nibble from bmw_hw_nr[5] *//ECU CALID Character 6*

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PRM_STATE_ECU[6] = low nibble from bmw_hw_nr[5] //ECU CALID Character 7
PRM_STATE_ECU[7] = 00h //ECU CALID Character 8
PRM_STATE_ECU[8] = 00h //ECU CALID Character 9
PRM_STATE_ECU[9] = 00h //ECU CALID Character 10
PRM_STATE_ECU[10] = 00h //ECU CALID Character 11
PRM_STATE_ECU[11] = 00h //ECU CALID Character 12
PRM_STATE_ECU[12] = 00h //ECU CALID Character 13
PRM_STATE_ECU[13] = 00h //ECU CALID Character 14
PRM_STATE_ECU[14] = 00h //ECU CALID Character 15
PRM_STATE_ECU[15] = 00h //ECU CALID Character 16

I.58.9.4 API for configuration of ECU SW CALID: ACTION_OBDC_GetCALIDCalib (OUT $<$ PRM_STATE_CAL $>$)

Description for actions:

ACTION_OBDC_*GetCALIDCalib* (OUT < PRM_STATE_CAL >)					
This action fill the CALIB CALID with the correct values from the project					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_STATE_CAL[0...15]	IN	0...FFH	0...255	1	[-]
See description bellow					

FUNCTION DESCRIPTION:

Description of parameter OUT used by action **ACTION_OBDC_*GetCALIDCalib*** ():

PRM_STATE_CAL:
Software structure of 16 ASCI elements filled up with CALIB CALID(Calibration Identifications only for Calibration area). This structure has to be filled byte by byte.

Remark:
bmw_cal_nr[0..6] has to be defined inside the project as interface, because the actual CALIB CALID must be evaluated from the BMW_UIF (reprog-history) table first. For visualization the variable ECU_ID_CAL[0...15] is filled at ACTION request or once after power up reset (after CVN calc. is finished).

PRM_STATE_CAL[0] = bmw_cal_nr[0] //CALIB CALID Character 1
PRM_STATE_CAL[1] = bmw_cal_nr[1] //CALIB CALID Character 2
PRM_STATE_CAL[2] = bmw_cal_nr[2] //CALIB CALID Character 3
PRM_STATE_CAL[3] = bmw_cal_nr[3] //CALIB CALID Character 4
PRM_STATE_CAL[4] = bmw_cal_nr[4] //CALIB CALID Character 5
PRM_STATE_CAL[5] = bmw_cal_nr[5] //CALIB CALID Character 6
PRM_STATE_CAL[6] = bmw_cal_nr[6] //CALIB CALID Character 7
PRM_STATE_CAL[7] = not used //CALIB CALID Character 8
PRM_STATE_CAL[8] = not used //CALIB CALID Character 9
PRM_STATE_CAL[9] = not used //CALIB CALID Character 10
PRM_STATE_CAL[10] = not used //CALIB CALID Character 11
PRM_STATE_CAL[11] = not used //CALIB CALID Character 12
PRM_STATE_CAL[12] = not used //CALIB CALID Character 13

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PRM_STATE_CAL[13] = not used //CALIB CALID Character 14
PRM_STATE_CAL[14] = not used //CALIB CALID Character 15
PRM_STATE_CAL[15] = not used //CALIB CALID Character 16

I.58.9.5 API for configuration of a defined specific area CALID: ACTION_OBDC_GetCALIDSelSegSpc (OUT < PRM_STATE_SEL_SEG_SPC >)

Description for actions:

ACTION_OBDC_*GetCALIDSelSeg* (OUT < PRM_STATE_SEL_SEG >)					
This action fill the several or all segments of memory CALID with the correct values from the project					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_STATE_SEL_SEG[0...15]	IN	0...FFH	0...255	1	[-]
See description bellow					

FUNCTION DESCRIPTION:

Description of parameter OUT used by action **ACTION_OBDC_*GetCALIDSelSeg*** ():

PRM_STATE_SEL_SEG:
Software structure of 16 ASCI elements filled up with SEGMENT CALID(Calibration Identifications only for several or all segments of memory). This structure has to be filled byte by byte.

PRM_STATE_SEL_SEG[0] = not used //SEGMENT CALID Character 1
PRM_STATE_SEL_SEG[1] = not used //SEGMENT CALID Character 2
PRM_STATE_SEL_SEG[2] = not used //SEGMENT CALID Character 3
PRM_STATE_SEL_SEG[3] = not used //SEGMENT CALID Character 4
PRM_STATE_SEL_SEG[4] = not used //SEGMENT CALID Character 5
PRM_STATE_SEL_SEG[5] = not used //SEGMENT CALID Character 6
PRM_STATE_SEL_SEG[6] = not used //SEGMENT CALID Character 7
PRM_STATE_SEL_SEG[7] = not used //SEGMENT CALID Character 8
PRM_STATE_SEL_SEG[8] = not used //SEGMENT CALID Character 9
PRM_STATE_SEL_SEG[9] = not used //SEGMENT CALID Character 10
PRM_STATE_SEL_SEG[10] = not used //SEGMENT CALID Character 11
PRM_STATE_SEL_SEG[11] = not used //SEGMENT CALID Character 12
PRM_STATE_SEL_SEG[12] = not used //SEGMENT CALID Character 13
PRM_STATE_SEL_SEG[13] = not used //SEGMENT CALID Character 14
PRM_STATE_SEL_SEG[14] = not used //SEGMENT CALID Character 15
PRM_STATE_SEL_SEG[15] = not used //SEGMENT CALID Character 16

I.58.9.6 API for configuration of a defined area CALID: ACTION_OBDC_GetCALIDSelSeg (OUT < PRM_STATE_SEL_SEG >)

Description for actions:

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ACTION_OBDC_*GetCALIDSelSeg* (OUT < PRM_STATE_SEL_SEG >)					
This action fill the several or all segments of memory CALID with the correct values from the project					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_STATE_SEL_SEG[0...15]	IN	0...FFH	0...255	1	[-]
See description bellow					

FUNCTION DESCRIPTION:

Description of parameter OUT used by action **ACTION_OBDC_*GetCALIDSelSeg*** ():

PRM_STATE_SEL_SEG:
Software structure of 16 ASCI elements filled up with SEGMENT CALID(Calibration Identifications only for several or all segments of memory). This structure has to be filled byte by byte.

PRM_STATE_SEL_SEG[0] = not used *//SEGMENT CALID Character 1*
PRM_STATE_SEL_SEG[1] = not used *//SEGMENT CALID Character 2*
PRM_STATE_SEL_SEG[2] = not used *//SEGMENT CALID Character 3*
PRM_STATE_SEL_SEG[3] = not used *//SEGMENT CALID Character 4*
PRM_STATE_SEL_SEG[4] = not used *//SEGMENT CALID Character 5*
PRM_STATE_SEL_SEG[5] = not used *//SEGMENT CALID Character 6*
PRM_STATE_SEL_SEG[6] = not used *//SEGMENT CALID Character 7*
PRM_STATE_SEL_SEG[7] = not used *//SEGMENT CALID Character 8*
PRM_STATE_SEL_SEG[8] = not used *//SEGMENT CALID Character 9*
PRM_STATE_SEL_SEG[9] = not used *//SEGMENT CALID Character 10*
PRM_STATE_SEL_SEG[10] = not used *//SEGMENT CALID Character 11*
PRM_STATE_SEL_SEG[11]= not used *//SEGMENT CALID Character 12*
PRM_STATE_SEL_SEG[12] = not used *//SEGMENT CALID Character 13*
PRM_STATE_SEL_SEG[13] = not used *//SEGMENT CALID Character 14*
PRM_STATE_SEL_SEG[14] = not used *//SEGMENT CALID Character 15*
PRM_STATE_SEL_SEG[15] = not used *//SEGMENT CALID Character 16*

I.58.9.7 Description of Service 09h, INFOTYPE 0Ah - ECUNAME

Description for actions:

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ACTION_OBDC_*GetECUNAME*(OUT <PRM_STATE_ECU_NAME>)					
This action fills the emission related ECU Name					
Parameter	**Type**	**Hex. Limits**	**Phys. Limits**	**Resol.**	**Unit**
PRM_STATE_ECU_NAME[0...19]	IN	0...FFH	0...255	1	[-]
See description bellow					

FUNCTION DESCRIPTION:

Description of parameter OUT used by action ACTION_OBDC_GetECUNAME():

PRM_STATE_ECU_NAME:
Software structure of 20 ASCII characters filled up with ECU Name of an emission related ECU. This structure has to be field byte by byte.

Defined field assignment:

- Data bytes 1-4, XXXX , contains ECU acronym, and
- Data byte 5, - , contains delimiter, and
- Data bytes 6-20, YYYYYYYYYYYYYYY , contains text name

ECU acronyms:
The first 4 bytes from the response of InfoType 0Ah have to be one of the acronyms described in the table bellow.

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The emissions-related ECUs (control modules) have to report the external test equipment acronym and name as listed below. This table is not complete and emissions-related ECUs not listed in the table must be reported to ISO/SAE for definition.

External test equipment reported acronym (max 1 - 4 chars.)	**Full name of Control Module/ECU**	**External test equipment reported name (max 14 chars + 1 optional digit)**
ABS, ABS1, ABS2	Anti-Lock Brake System (ABS) Control Module	**AntiLockBrake**
AFCM, AFC1, AFC2	Alternative Fuel Control Module	**AltFuelCtrl**
AHCM, AHC1, AHC2	Auxiliary Heater Control Module	**AuxHeatCtrl**
AWDC, AWD1, AWD2	All Wheel Drive Control Module	**AllWhlDrvCtrl**
BECM, BEC1, BEC2	Battery Energy Control Module	**B+EnergyCtrl**
BSCM,BSC1, BSC2	Brake System Control Module	**BrakeSystem**
CRCM, CRC1, CRC2	Cruise Control Module	**CruiseControl**
CTCM, CTC1, CTC2	Coolant Temperature Control Module	**CoolTempCtrl**
DMCM, DMC1, DMC2	Drive Motor Control Module	**DriveMotorCtrl**
ECCI, ECC1, ECC2	Emissions Critical Control Information	**EmisCritInfo**
ECM, ECM1, ECM2	Engine Control Module	**EngineControl**
FACM. FAC1, FAC2	Fuel Additive Control Module	**FuelAddCtrl**
FICM, FIC1, FIC2	Fuel Injector Control Module	**FuelInjCtrl**
FPCM, FPC1, FPC2	Fuel Pump Control Module	**FuelPumpCtrl**
4WDC, 4WD1, 4WD2	Four-Wheel Drive Clutch Control Module	**4WhlDrvClCtrl**
GPCM, GPC1, GPC2	Glow Plug Control Module	**GlowPlugCtrl**
GSM, GSM1, GSM2	Gear Shift Control Module	**GearShiftCtrl**
HPCM, HPC1, HPC2	Hybrid Powertrain Control Module	**HybridPtrCtrl**
IPC, IPC1, IPC2	Instrument Panel Cluster (IPC) Control Module	**InstPanelClust**
PCM, PCM1, PCM2	Powertrain Control Module	**PowertrainCtrl**
RDCM, RDC1, RDC2	Reductant Control Module	**ReductantCtrl**
SGCM, SGC1, SGC2	Starter / Generator Control Module	**Start/GenCtrl**
TACM, TAC1, TAC2	Throttle Actuator Control Module	**ThrotActCtrl**
TCCM, TCC1, TCC2	Transfer Case Control Module	**TransfCaseCtrl**
TCM, TCM1, TCM2	Transmission Control Module	**TransmisCtrl**

External test equipment reported name: **ECM -EngineControl**

PRM_STATE_ECU_NAME[0] = E
PRM_STATE_ECU_NAME[1] = C
PRM_STATE_ECU_NAME[2] = M
PRM_STATE_ECU_NAME[3] = $00
PRM_STATE_ECU_NAME[4] = "-" *//delimiter*
PRM_STATE_ECU_NAME[5] = E
PRM_STATE_ECU_NAME[6] = n
PRM_STATE_ECU_NAME[7] = g
PRM_STATE_ECU_NAME[8] = i
PRM_STATE_ECU_NAME[9] = n
PRM_STATE_ECU_NAME[10] = e
PRM_STATE_ECU_NAME[11] = C
PRM_STATE_ECU_NAME[12] = o

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PRM_STATE_ECU_NAME[13] = n
PRM_STATE_ECU_NAME[14] = t
PRM_STATE_ECU_NAME[15] = r
PRM_STATE_ECU_NAME[16] = o
PRM_STATE_ECU_NAME[17] = l
PRM_STATE_ECU_NAME[18] = $00
PRM_STATE_ECU_NAME[19] = $00

I.58.9.8 Visualization for Service 09h - RBM data

Description:

This function is used to visualize the Service 09h data for measuring proposed. If the ACTION is called by SCAN-Tool, the variables are filled up.

Application conditions

Initialisation: *0 at reset*

Recurrence: *–*

Activation: *at ACTION request or once after power up reset (after CVN calc. is finished)*

Formula section:

ACTION_ERRM_SelectRbmData()
ListRbmData : Software structure filled-up with 20 counters of 2 bytes coming from Rate-Based Monitoring. The first 4 bytes are not used for visualization.

First Byte...............Last Byte

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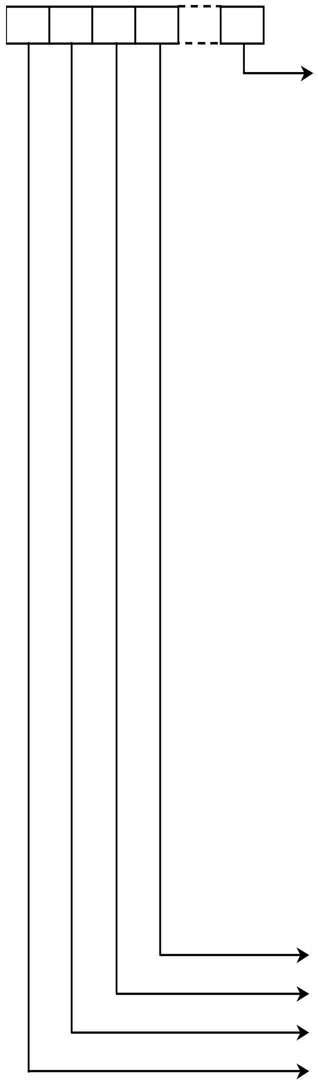

CTR_CDN_RBM_CLC_LS_DOWN_2 (O2 D Bank 2 denominator - LSB byte)
CTR_CDN_RBM_CLC_LS_DOWN_2 (O2 DBank 2 denominator - MSB byte)
CTR_COMP_RBM_CLC_LS_DOWN_2 (O2 D Bank 2 numerator - LSB byte)
CTR_COMP_RBM_CLC_LS_DOWN_2 (O2 D Bank 2 numerator - MSB byte)
CTR_CDN_RBM_CLC_LS_DOWN_1 (O2 D Bank 1 denominator - LSB byte)
CTR_CDN_RBM_CLC_LS_DOWN_1 (O2 D Bank 1 denominator - MSB byte)
CTR_COMP_RBM_CLC_LS_DOWN_1 (O2 D Bank 1 numerator - LSB byte)
CTR_COMP_RBM_CLC_LS_DOWN_1 (O2 D Bank 1 numerator - MSB byte)
CTR_CDN_RBM_CLC_LEAK (EVAP denominator - LSB byte)
CTR_CDN_RBM_CLC_LEAK (EVAP denominator - MSB byte)
CTR_COMP_RBM_CLC_LEAK (EVAP numerator - LSB byte)
CTR_COMP_RBM_CLC_LEAK (EVAP numerator - MSB byte)
CTR_CDN_RBM_CLC_SA (AIR denominator - LSB byte)
CTR_CDN_RBM_CLC_SA (AIR denominator - MSB byte)
CTR_COMP_RBM_CLC_SA (AIR numerator - LSB byte)
CTR_COMP_RBM_CLC_SA (AIR numerator - MSB byte)
CTR_CDN_RBM_CLC_VVT (VVT denominator - LSB byte)
CTR_CDN_RBM_CLC_VVT (VVT denominator - MSB byte)
CTR_COMP_RBM_CLC_VVT (VVT numerator - LSB byte)
CTR_COMP_RBM_CLC_VVT (VVT numerator - MSB byte)
CTR_CDN_RBM_CLC_LS_UP_2 (O2 Bank 2 denominator - LSB byte)
CTR_CDN_RBM_CLC_LS_UP_2 (O2 Bank 2 denominator - MSB byte)
CTR_COMP_RBM_CLC_LS_UP_2 (O2 Bank 2 numerator - LSB byte)
CTR_COMP_RBM_CLC_LS_UP_2 (O2 Bank 2 numerator - MSB byte)
CTR_CDN_RBM_CLC_LS_UP_1 (O2 Bank 1 denominator - LSB byte)
CTR_CDN_RBM_CLC_LS_UP_1 (O2 Bank 1 denominator - MSB byte)
CTR_COMP_RBM_CLC_LS_UP_1 (O2 Bank 1 numerator - LSB byte)
CTR_COMP_RBM_CLC_LS_UP_1 (O2 Bank 1 numerator - MSB byte)
CTR_CDN_RBM_CLC_CAT_2 (CAT Bank 2 denominator - LSB byte)
CTR_CDN_RBM_CLC_CAT_2 (CAT Bank 2 denominator - MSB byte)
CTR_COMP_RBM_CLC_CAT_2 (CAT Bank 2 numerator - LSB byte)
CTR_COMP_RBM_CLC_CAT_2 (CAT Bank 2 numerator - MSB byte)
CTR_CDN_RBM_CLC_CAT_1 (CAT Bank 1 denominator - LSB byte)
CTR_CDN_RBM_CLC_CAT_1 (CAT Bank 1 denominator - MSB byte)
CTR_COMP_RBM_CLC_CAT_1 (CAT Bank 1 numerator - LSB byte)
CTR_COMP_RBM_CLC_CAT_1 (CAT Bank 1 numerator - MSB byte)
Not used - Ignition Counter (LSB byte)
Not used - Ignition Counter (MSB byte)
Not used - OBD Monitoring Conditions Encountered Counts (LSB byte)
Not used- OBD Monitoring Conditions Encountered Counts (MSB byte)

I.58.9.9 Visualization for Service 09h - VIN data

Description:

This function is used to visualize the Service 09h data for measuring proposed. If the VIN is called by SCAN-Tool, the variables are filled up.

Application conditions

Initialisation: `0 at reset`

Recurrence: `–`

Activation: `at ACTION request or once after power up reset (after CVN calc. is finished)`

Formula section:

ECU_CVN_PROG = STATE_CKS_ECU_SAE

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ECU_CVN_CAL = STATE_CKS_CAL_SAE

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I.59 SID 0Ah: Request emission related diagnostic trouble codes - permanent

Import actions:

ACTION_ERRM_ReadDtcByTypeOfDtc (<IN>,<TypeOfDtc>,<IN>,<LevelOfDtc>,<INOUT>,<ListOfDtc>,<OUT>,<ResultDtc>)
ACTION_ERRM_ReadQuantityOfDtc (**IN**<PRM_TYPEOFDTC>,**IN**<PRM_LEVELOFDTC>,**INOUT**<PRM_QUANTITY>,**OUT**<PRM_RESULTQUANTITY>)

I.59.1 Functional description

The purpose of this service is to enable the external test equipment to obtain all DTCs with "permanent DTC" status. These are DTCs that are "confirmed" and are retained in the non-volatile memory of the server until the appropriate monitorfor each DTC has determined that the malfunction is no longer presentand is not commanding the MIL on.

Service $0A is required for all emissions-related DTCs. The intended use of this data is to prevent vehicles from passing an in-use inspection simply by disconnecting the battery or clearing DTCs with a scan tool prior to the inspection. The presence of permanent DTCs at an inspection without the MIL illuminated is an indication that a proper repair was not verified by the on-board monitoring system.

Permanent DTCs shall be stored in non-volatile memory (NVRAM) and may not be erased by any diagnostic services (generic or enhanced) or by disconnecting power to the ECU.

A confirmed DTC shall be stored as a permanent DTC no later than the end of the ignition cycle and subsequently at all times that the confirmed DTC is commanding the MIL on (e.g., for currently failing systems but not during the 40 warm-up cycle self-healing process).

Permanent DTCs may be erased if:
- The OBD II system itself determines that the malfunction that caused the permanent fault code to be stored is no longer present and is not commanding the MIL on, e.g., three consecutive complete driving cycles with no malfunction, or as specified by the OBD regulations,
- After clearing fault information in the ECU (i.e., through the use of a diagnostic service or battery disconnect), the diagnostic monitor for the malfunction that caused the permanent DTC to be stored has fully executed (i.e., has executed the minimum number of checks necessary for MIL illumination) and determined the malfunction is no longer present, e.g., one complete driving cycle with no malfunction or as specified by the OBD regulations.

-Permanent fault codes may be erased when the ECU containing the permanent DTCs is reprogrammed if the readiness status for all monitored components and systems is set to not complete in conjunction with the reprogramming event.

Note that due to implementation timing differences during the phase-in of permanent DTCs, there may be cases where some ECUs support permanent DTCs while other ECUs do not.

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I.59.2 Message data bytes

I.59.2.1 Request message definition

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request emission-related diagnostic trouble codes with permanent status request SID	M	0A	SIDRQ

I.59.2.2 Response message definition

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
#1	Request emission-related diagnostic trouble codes with permanent status response SID	M	4A	SIDPR
#2	# of DTC = [no emission-related DTCs with permanent status # of emission-related DTCs with permanent status]	M	Xx = [00, 01 -FF]	#OFDTC
#3 #4	DTC#1 (High Byte) DTC#1 (Low Byte)	C C	xx xx	DTC1HI DTC1LO
:	:	:	xx	
#n-1 #n	DTC#m (High Byte) DTC#m (Low Byte)	C C	xx xx	DTCmHI DTCmLO
C = Conditional — DTC#1 - DTC#m are only included if # of DTC parameter value ≠ $00.				

I.59.2.3 Parameter definition

This service does not support any parameters.

I.59.2.4 Formula section

ACTION_ERRM_ReadQuantityOfDtc

(
IN <PERMANENT>
IN <LAW>
INOUT <NR_DTC>
OUT <ResultQuantity>
)

ACTION_ERRM_ReadDtcByTypeOfDtc

(
IN <PERMANENT>
IN <LAW>
INOUT <DTC1 to DTCm>
OUT <ResultDtc>
)

IF ResultDtc != BUFFER_FULL **THEN**
Positive response
ELSE
No answer
ENDIF

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I.60 Test identification description for mode 05h

Input data:

C_LAMB_BAS_COR_MIN {p. 812}	C_LAMB_DELTA_I_MAX_ DIAG {p. 5217}	C_LAMB_DELTA_I_MIN_ DIAG {p. 5217}	C_VLS_DOWN_CYC_ MAX_SAE {p. 7836}
C_VLS_DOWN_CYC_MIN_ SAE {p. 7836}	FAC_DYN_LSL_DIAG_ SAE [NC_CBK_EX_NR] {p. 1006}	FAC_DYN_LSL_DIAG_ TOL_SAE [NC_CBK_EX_NR] {p. 1006}	LAMB_DELTA_I_SAVE_ DIAG [NC_CBK_EX_NR] {p. 5215}
LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	MOD_5_TID_1_DIAG {p. 7832}	MOD_5_TID_10_DIAG {p. 7832}	MOD_5_TID_11_DIAG {p. 7832}
MOD_5_TID_12_DIAG {p. 7832}	MOD_5_TID_13_DIAG {p. 7832}	MOD_5_TID_14_DIAG {p. 7832}	MOD_5_TID_15_DIAG {p. 7832}
MOD_5_TID_16_DIAG {p. 7832}	MOD_5_TID_17_DIAG {p. 7832}	MOD_5_TID_18_DIAG {p. 7832}	MOD_5_TID_19_DIAG {p. 7832}
MOD_5_TID_2_DIAG {p. 7832}	MOD_5_TID_20_DIAG {p. 7832}	MOD_5_TID_3_DIAG {p. 7832}	MOD_5_TID_4_DIAG {p. 7832}
MOD_5_TID_5_DIAG {p. 7832}	MOD_5_TID_6_DIAG {p. 7832}	MOD_5_TID_7_DIAG {p. 7832}	MOD_5_TID_8_DIAG {p. 7833}
MOD_5_TID_9_DIAG {p. 7833}	PSN_LS {p. 656}	VLS_DOWN_MAX_DC [NC_CBK_EX_NR] {p. 1503}	VLS_DOWN_MIN_DC [NC_CBK_EX_NR] {p. 1503}

FUNCTION DESCRIPTION:

General information:

Read on-board oxygen sensor monitoring test results by an external tester. The use of this mode is optional, depending on the method used by the vehicle manufacturer to comply with the requirement for oxygen sensor monitoring.
Mode05 is only supported if lambda sensors are mounted (PSN_LS = 11H or 33H, see below).
PSN_LS:

BIT	Function	Status
0	Bank 1 Sensor 1	1= available, 0 = not available
1	Bank 1 Sensor 2	1= available, 0 = not available
2	Bank 1 Sensor 3	1= available, 0 = not available
3	Bank 1 Sensor 4	1= available, 0 = not available
4	Bank 2 Sensor 1	1= available, 0 = not available
5	Bank 2 Sensor 2	1= available, 0 = not available
6	Bank 2 Sensor 3	1= available, 0 = not available
7	Bank 2 Sensor 4	1= available, 0 = not available

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Formula section:

If PSN_LS = 33h *//means, that*
Bank1 /Sensor 1 and

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Bank2 /Sensor 1 and
Bank1 /Sensor 2 and
Bank2 /Sensor 2 *are available.*

Then all defined TID are supported
ElseIf PSN_LS = 11h *//means, that Bank1 /Sensor1 and Bank2 Sensor1 are available.*
Then only TID $81, $82, $83, $83 are supported
Else Mode 5 is not supported
Endif

I.60.1 Supported Test ID of MODE $05

I.60.1.1 MODE $05, Test ID $00, DATA A Supported TIDs $01 ... $08

MODE $05 — Request Oxygen Sensor Monitoring Test Results				
TID $00 — DATA A — Supported TIDs $01 ... $08				
BIT	Function	Supported if	output available for	
0	TID $08: Maximum sensor voltage for test cycle (calculated)	PSN_LS = 33H and MOD_5_TID_1_DIAG (bit 0)	upstream	No
			downstream	**Yes**
1	TID $07: Minimum sensor voltage for test cycle (calculated)	PSN_LS = 33H and MOD_5_TID_1_DIAG (bit 1)	upstream	No
			downstream	**Yes**
2	TID $06: Lean to rich sensor switch time (calculated)	Not supported	upstream	No
3	TID $05: Rich to lean sensor switch time (calculated)	Not supported	upstream	No
4	TID $04: High sensor voltage for switch time calculation (constant)	Not supported	upstream	No
5	TID $03: Low sensor voltage for switch time calculation (constant)	Not supported	upstream	No
6	TID $02: Lean to rich sensor threshold voltage (constant)	PSN_LS = 33H and MOD_5_TID_1_DIAG (bit 6)	upstream	No
			downstream	**Yes**
7	TID $01: Rich to lean sensor threshold voltage (constant) ,	PSN_LS = 33H and MOD_5_TID_1_DIAG (bit 7)	upstream	No
			downstream	**Yes**

I.60.1.2 MODE $05, Test ID $00, DATA B /C /D Supported TIDs $09 ... $20 (Reserved)

I.60.1.3 MODE $05, Test ID $20, DATA A /B /C /D Supported TIDs $21 ... $40 (Reserved)

I.60.1.4 MODE $05, Test ID $40, DATA A /B /C /D Supported TIDs $41 ... $60 (Reserved)

I.60.1.5 MODE $05, Test ID $60, DATA A /B /C /D Supported TIDs $61 ... $80 (Reserved)

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I.60.1.6 MODE $05, Test ID $80, DATA A Supported TIDs $81 ... $88

MODE $05 — Request Oxygen Sensor Monitoring Test Results				
TID $80 — DATA A — Supported TIDs $81 ... $88				
BIT	Function	Supported if	output available	
0	TID $88: reserved			
1	TID $87: reserved			
2	TID $86: reserved			
3	TID $85: reserved			
4	TID $84: fuel trim diagnosis	PSN_LS = 33H or 11H and MOD_5_TID_17_DIAG (bit 3)	upstream	**Yes**
5	TID $83: sensor dynamics diagnosis	PSN_LS = 33H or 11H and MOD_5_TID_17_DIAG (bit 2)	upstream	**Yes**
6	TID $82: actual a/f setpoint	PSN_LS = 33H or 11H and MOD_5_TID_17_DIAG (bit 1)	upstream	**Yes**
7	TID $81: actual a/f-ratio linear	PSN_LS = 33H or 11H and MOD_5_TID_17_DIAG (bit 0)	upstream	**Yes**

I.60.1.7 MODE $05, Test ID $80, DATA B Supported TIDs $89 ... $A0 (Reserved)

I.60.2 PID definition for MODE 05

I.60.2.1 MODE $05, Test ID $01 Downstream (B1S2 and B2S2) , Rich to lean threshold voltage

MODE $05 — Request Oxygen Sensor Monitoring Test Results	
TID $01 — Rich to lean sensor threshold voltage downstream B1S2 B2S2 (constant)	
	Project System Variables
test value	C_VLS_DOWN_CYC_MIN_SAE
min. value	**not required**
max. value	**not required**

TID $01 — DATA A - Test value			
	SAE 1979		Project definitions
min. value	0[V]	min. value	0[V] (00H)
max. value	1.275[V]	max. value	1.275[V] (FFH)
scaling	0.005[V] (1 V @ C8h)	scaling	0.005[V]
display		test value	C_VLS_DOWN_CYC_MIN_SAE

I.60.2.2 MODE $05, Test ID $02 Downstream (B1S2 and B2S2) , Lean to rich threshold voltage

MODE $05 — Request Oxygen Sensor Monitoring Test Results	
TID $02 — Lean to rich sensor threshold voltage downstream B1S2 B2S2 (constant)	
	Project System Variables
test value	C_VLS_DOWN_CYC_MAX_SAE
min. value	**not required**
max. value	**not required**

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TID $02 — DATA A - Test value			
	SAE 1979		Project definitions
min. value	0[V]	min. value	0[V] (00H)
max. value	1.275[V]	max. value	1.275[V] (FFH)
scaling	0.005[V] (1 V @ C8h)	scaling	0.005[V]
display		test value	C_VLS_DOWN_CYC_MAX_SAE

I.60.2.3 MODE $05, Test ID $07 Downstream (B1S2 and B2S2), Minimum voltage for test cycle

MODE $05 — Request Oxygen Sensor Monitoring Test Results	
TID $07 — Minimum sensor voltage for test cycle downstream B1S2 B2S2	
	Project System Variables
test value	VLS_DOWN_MIN_DC[NC_CBK_EX_NR]
min. value	0[V] (00H)
max. value	1.275[V] (FFH)

TID $07 — DATA A - Test value			
	SAE 1979		Project definitions
min. value	0[V] (00H)	min. value	0[V] (00H)
max. value	1.275[V] (FFH)	max. value	5[V] (3FFH)
scaling	0.005[V]	scaling	0.005[V]
display		test value	VLS_DOWN_MIN_DC[NC_CBK_EX_NR]
TID $07 — DATA B - Minimum test limit			
	SAE 1979		Project definitions
min. value	0[V] (00H)	*min. value*	
max. value	1.275[V] (FFH)	*max. value*	
scaling	0.005[V]	*scaling*	
display		*test value*	0[V] (0H)
TID $07 — DATA C - Maximum test limit			
	SAE 1979		Project definitions
min. value	0[V] (00H)	*min. value*	
max. value	1.275[V] (FFH)	*max. value*	
scaling	0.005[V]	*scaling*	
display		*test value*	1.275[V] (FFH)

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I.60.2.4 MODE $05, Test ID $08 Downstream (B1S2 and B2S2), Maximum voltage for test cycle

MODE $05 — Request Oxygen Sensor Monitoring Test Results	
TID $08 — Maximum sensor voltage for test cycle downstream B1S2 B2S2	
	Project System Variables
test value	VLS_DOWN_MAX_DC[NC_CBK_EX_NR]
min. value	0[V] (00H)
max. value	1.275[V] (FFH)

TID $08 — DATA A - Test value			
	SAE 1979		Project definitions
min. value	0[V] (00H)	*min. value*	0[V] (00H)
max. value	1.275[V] (FFH)	*max. value*	5[V] (3FFH)
scaling	0.005[V]	*scaling*	0.005[V]
display		*test value*	VLS_DOWN_MAX_DC[NC_CBK_EX_NR]
TID $08 — DATA B - Minimum test limit			
	SAE 1979		Project definitions
min. value	0[V] (00H)	*min. value*	
max. value	1.275[V] (FFH)	*max. value*	
scaling	0.005[V]	*scaling*	
display		*test value*	0[V] (0H)
TID $08 — DATA C - Maximum test limit			
	SAE 1979		Project definitions
min. value	0[V] (00H)	*min. value*	
max. value	1.275[V] (FFH)	*max. value*	
scaling	0.005[V]	*scaling*	
display		*test value*	1.275[V] (FFH)

I.60.2.5 MODE $05, Test ID $81 Upstream (B1S1 and B2S1) , Actual A/F-ratio

MODE $05 — Request Oxygen Sensor Monitoring Test Results	
TID $81 — Actual A/F-ratio WRAF sensor upstream B1S1 B2S1 (calculated)	
	Project System Variables
test value	LAMB_LS_UP[NC_CBK_EX_NR]
min. value	C_LAMB_BAS_COR_MIN
max. value	2 (FFH)

TID $81 — DATA A - Test value			
	SAE 1979		Project definitions
min. value	0 (00H)	min. value	0s (00H)
max. value	2 (FFH)	max. value	32 (7FFFH)
scaling	0.00781	scaling	0.98e-3
display		test value	LAMB_LS_UP[NC_CBK_EX_NR]
TID $81 — DATA B - Minimum test limit			
	SAE 1979		Project definitions
min. value	0 (00H)	min. value	0s (00H)
max. value	2 (FFH)	max. value	32 (7FFFH)
scaling	0.00781	scaling	0.98e-3
display		min. limit	C_LAMB_BAS_COR_MIN
TID $81 — DATA C - Maximum test limit			
	SAE 1979		Project definitions
min. value	0 (00H)	min. value	
max. value	2 (FFH)	max. value	
scaling	0.00781	scaling	
display		max. limit	2 (FFH)

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I.60.2.6 MODE $05, Test ID $82 Upstream (B1S1 and B2S1), Actual A/F-setpoint

MODE $05 — Request Oxygen Sensor Monitoring Test Results	
TID $82 — Actual A/F-setpoint WRAF sensor upstream B1S1 B2S1 (calculated)	
	Project System Variables
test value	LAMB_SP[NC_CBK_EX_NR]
min. value	C_LAMB_BAS_COR_MIN
max. value	2 (FFH)

TID $82 — DATA A - Test value			
	SAE 1979		Project definitions
min. value	0 (00H)	*min. value*	0s (00H)
max. value	2 (FFH)	*max. value*	32 (7FFFH)
scaling	0.00781	*scaling*	0.98e-3
display		*test value*	LAMB_SP[NC_CBK_EX_NR]
TID $82 — DATA B - Minimum test limit			
	SAE 1979		Project definitions
min. value	0 (00H)	*min. value*	0s (00H)
max. value	2 (FFH)	*max. value*	32 (7FFFH)
scaling	0.00781	*scaling*	0.98e-3
display		*min. limit*	C_LAMB_BAS_COR_MIN
TID $82 — DATA C - Maximum test limit			
	SAE 1979		Project definitions
min. value	0 (00H)	*min. value*	
max. value	2 (FFH)	*max. value*	
scaling	0.00781	*scaling*	
display		*max. limit*	2 (FFH)

I.60.2.7 MODE $05, Test ID $83 Upstream (B1S1 and B2S1), Dynamic diagnosis

MODE $05 — Request Oxygen Sensor Monitoring Test Results	
TID $83 — sensor dynamic upstream B1S1 B2S1 (calculated)	
	Project System Variables
test value	FAC_DYN_LSL_DIAG_SAE[NC_CBK_EX_NR]
min. value	0 (00H)
max. value	FAC_DYN_LSL_DIAG_TOL_SAE[NC_CBK_EX_NR]

TID $83 — DATA A - Test value			
	SAE 1979		Project definitions
min. value	0 (00H)	min. value	-327.68 (8000H)
max. value	3.99998 (FFH)	max. value	327.67 (7FFFH)
scaling	0.0156	scaling	0.01 [-]
display		test value	FAC_DYN_LSL_DIAG_SAE[i]
TID $83 — DATA B — Minimum test limit			
	SAE 1979		Project definitions
min. value	0 (00H)	min. value	
max. value	3.99998 (FFH)	max. value	
scaling	0.0156	scaling	
display		min. limit	0 (00H)
TID $83 — DATA C — Maximum test limit			
	SAE 1979		Project definitions
min. value	0 (00H)	min. value	
max. value	3.99998 (FFH)	max. value	327.67 (7FFFH)
scaling	0.0156	scaling	0.01 [-]
display		max. limit	FAC_DYN_LSL_DIAG_TOL_SAE[i]

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I.60.2.8 MODE $05, Test ID $84 Upstream (B1S1 and B2S1), Fuel trim sensor diagnosis

MODE $05 — Request Oxygen Sensor Monitoring Test Results	
TID $84 — fuel trim sensor diagnosis upstream B1S1 B2S1 (calculated)	
	Project System Variables
test value	LAMB_DELTA_I_SAVE_DIAG[NC_CBK_EX_NR]
min. value	C_LAMB_DELTA_I_MIN_DIAG
max. value	C_LAMB_DELTA_I_MAX_DIAG

TID $84 — DATA A - Test value			
	manuf. def.		Project definitions
min. value	-0.125 (00H)	min. value	-0.125 (F800H)
max. value	+0.125 (FFH)	max. value	+0.125 (800H)
scaling	9.80392e-4 (0.25/256)	scaling	6,1035E-5 [-]
display		test value	LAMB_DELTA_I_SAVE_DIAG[i]
TID $84 — DATA B Minimum test limit			
	manuf. def.		Project definitions
min. value	-0.125 (00H)	min. value	-0.125 (F800H)
max. value	+0.125 (FFH)	max. value	+0.125 (800H)
scaling	9.80392e-4 (0.25/256)	scaling	6,1035E-5 [-]
display		min. limit	C_LAMB_DELTA_I_MIN_DIAG
TID $84 — DATA C — Maximum test limit			
	manuf. def.		Project definitions
min. value	-0.125 (00H)	min. value	-0.125 (F800H)
max. value	+0.125 (FFH)	max. value	+0.125 (800H)
scaling	9.80392e-4 (0.25/256)	scaling	6,1035E-5 [-]
display		*max. limit*	C_LAMB_DELTA_I_MAX_DIAG

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I.61 Test identification description for mode 06h

Input data:

C_CL_MMV_DIAGCPS {p. 5929}	C_CTR_SWT_LS_DOWN {p. 5153}	C_CUR_DMTL_REF_ LEAK_MAX {p. 5972}	C_CUR_DMTL_REF_ LEAK_MIN {p. 5972}
C_SAF_DIAG_MAX {p. 812}	C_SAF_DIAG_MIN {p. 812}	C_SUM_AFL_VLS_MIN_ DIAG_SA_1 {p. 1088}	C_SUM_CNL_SMALL_ LEAK_MES_MAX {p. 5973}
C_SUM_DIAGCPS_MAX {p. 5930}	CAT_DIAG_MOD_6 [NC_CBK_EX_NR] {p. 1037}	CAT_MAX_DIAG_MOD_6 [NC_CBK_EX_NR] {p. 1037}	CL_MMV_SAE {p. 5926}
CTR_SAVE_SWT_LS_ DOWN [NC_CBK_EX_NR] {p. 5151}	FAC_DYN_LSL_DIAG_ SAE [NC_CBK_EX_NR] {p. 1006}	FAC_DYN_LSL_DIAG_ TOL_SAE [NC_CBK_EX_NR] {p. 1006}	LC_SA_SWI_ACQ {p. 1088}
LV_CONF_DMTL {p. 654}	LV_ERR_MEM_XX {p. 5767}	LV_READY_XX {p. 5881}	M6_CTR_CNL_SMALL_ LEAK_MES {p. 5967}
M6_CUR_DMTL_COR_ FIL_CID18 {p. 5968}	M6_CUR_DMTL_COR_ FIL_CID19 {p. 5968}	M6_CUR_DMTL_DMTLS_ TEST {p. 5968}	M6_CUR_DMTL_REF_ LEAK {p. 5968}
M6_CUR_DMTL_ROUGH_ LEAK_END {p. 5968}	M6_CUR_DMTL_ROUGH_ LEAK_LEN_END {p. 5968}	M6_CUR_DMTL_SMALL_ LEAK_END {p. 5968}	M6_CUR_DMTL_THD_ DMTLS_TEST {p. 5968}
M6_CUR_DMTL_THD_ ROUGH_LEAK {p. 5968}	M6_CUR_DMTL_THD_ ROUGH_LEAK_LEN {p. 5968}	MAF_DIAGCPS_SAE {p. 5927}	MAF_DIAGCPS_THD_SAE {p. 5927}
MOD_6_TID_2_DIAG {p. 7833}	MOD_6_TID_3_DIAG {p. 7833}	MOD_6_TID_4_DIAG {p. 7833}	PSN_LS {p. 656}
R_IT_OBD_LSH_DOWN [NC_CBK_EX_NR] {p. 5198}	R_IT_THD_OBD_LSH_ DOWN [NC_CBK_EX_NR] {p. 5198}	SAF_DIAG_MAX_SAE {p. 1088}	SAF_DIAG_MIN_SAE {p. 1088}
SUM_AFL_VLS_DIAG_ SA_1_SAE {p. 1088}	SUM_AFL_VLS_DIAG_ SA_2_SAE {p. 1088}	SUM_DIAG_DIAGCPS_ SAE {p. 5928}	TTIP_OBD_LSH_UP_ MES_BOL_SAE [NC_CBK_EX_NR] {p. 5439}
TTIP_OBD_LSH_UP_ MES_SAE [NC_CBK_EX_NR] {p. 5439}	TTIP_OBD_LSH_UP_ MES_TOL_SAE [NC_CBK_EX_NR] {p. 5439}		

I.61.1 Overview of all implemented TID’s

FUNCTION DESCRIPTION:

General information:

The CID is calculatated depending if the Threshold is working as a "Maximum" or "Minimum" threshold. The "Minimum" CID is always the "Maximum" CID + **80h**.

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For example:

TID 03h /CID 05/85h : Secondary Air Monitor 1 - LinLam Min flow bank 1/2
=> CID 05h is a "Maximum" Threshold
=> CID 85h is a "Minimum" Threshold (85h = 05h + **80h**)

List of all TIDs
Catalyst monitor
TID 01h / CID 01h : Catalyst monitor Bank1
TID 01h / CID 02h : Catalyst monitor Bank2
Oxygen sensor monitor
TID 02h / CID 15h : Oxygen sensor monitor Bank1 - Sensor1 - Dynamic
TID 02h / CID 30h : Oxygen sensor monitor Bank1 - Sensor2 - Switchtime
TID 02h / CID 18 : Oxygen sensor monitor Bank2 - Sensor1 - Dynamic
TID 02h / CID 32h : Oxygen sensor monitor Bank2 - Sensor2 - Switchtime
Secondary air monitor
TID 03h / CID 20h : Secondary Air Monitor 2 - SA - meter Min flow, Step 1
TID 03h / CID 21h : Secondary Air Monitor 2 - SA - meter Min flow, Step 2
TID 03h / CID 05h(85h) : Secondary Air Monitor 1 - LinLam Min flow bank 1/2
Evaporative monitor
TID 05h / CID 07h(87h) : EVAP monitor - CPS check - Step 1
TID 05h / CID 08h : EVAP monitor - CPS check - Step 2
TID 05h / CID 09h : EVAP monitor - CPS check - Step 3
TID 05h / CID 13h : EVAP monitor - Module error - Max error
TID 05h / CID 14h : EVAP monitor - Module error - Plausibility error
TID 05h / CID 17h : EVAP monitor - Module error - Signal error
TID 05h / CID 12h(92h) : EVAP monitor - Module error - Min error
TID 05h / CID 15h(95h) : EVAP monitor - DMTL - Rough leak - Short cycle
TID 05h / CID 16h(96h) : EVAP monitor - DMTL - Small leak
TID 05h / CID 18h(98h) : EVAP monitor - DMTL - Rough leak - Long cycle
Oxygen heater monitor
TID 06h / CID 03h : Oxygen Sensor Heater Monitor Bank 1 - Sensor 2 - R
TID 06h / CID 04h : Oxygen Sensor Heater Monitor Bank 2 - Sensor 2 - R
TID 06h / CID 05h/85h:Oxygen Sensor Heater Monitor Bank 1-Sensor 1 - TTIP
TID 06h / CID 06h/86h:Oxygen Sensor Heater Monitor Bank 2-Sensor 1 - TTIP

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I.61.2 Supported TIDs 01h - C0h

I.61.2.1 Description of TID 00h - Supported TIDs 01h - 20h

TID 00h - DATA A - Supported TID 01h to 08h		
BIT	**Function**	**Name**
0	TID 08h : Reserved	MOD_6_TID_1_DIAG
1	TID 07h : Reserved	
2	TID 06h : Oxygen sensor heater monitor	
3	TID 05h : Evaporative monitor	
4	TID 04h : Reserved	
5	TID 03h : Secondary air monitor	
6	TID 02h : Oxygen sensor monitor	
7	TID 01h : Catalyst monitor	
TID 00h - DATA B - Supported TID 09h to 10h		
BIT	**Function**	**Name**
0	TID 10h : reserved	MOD_6_TID_2_DIAG
1	TID 0Fh : reserved	
2	TID 0Eh : reserved	
3	TID 0Dh : reserved	
4	TID 0Ch : reserved	
5	TID 0Bh : reserved	
6	TID 0Ah : reserved	
7	TID 09h : reserved	
TID 00h - DATA C - Supported TID 11h to 18h		
BIT	**Function**	**Name**
0	TID 18h : reserved	MOD_6_TID_3_DIAG
1	TID 17h : reserved	
2	TID 16h : reserved	
3	TID 15h : reserved	
4	TID 14h : reserved	
5	TID 13h : reserved	
6	TID 12h : reserved	
7	TID 11h : reserved	
TID 00h - DATA D - Supported TID 19h to 20h		
BIT	**Function**	**Name**
0	TID 20h : TIDs supported ($21 - $40)	MOD_6_TID_4_DIAG
1	TID 1Fh : reserved	
2	TID 1Eh : reserved	
3	TID 1Dh : reserved	
4	TID 1Ch : reserved	
5	TID 1Bh : reserved	
6	TID 1Ah : reserved	
7	TID 19h : reserved	

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I.61.3 Description of TID 01 - Catalyst monitoring

<u>**General information:**</u>

TID 01 is only supported if the vehicle is equipped with lambda sensors UP and DOWN

<u>**Formula section:**</u>

If PSN_LS = 33H
Then TID 01 is supported
Else TID 01 is not supported
Endif

I.61.3.1 CID 01h - Bank 1

OSC method (linear system)	
Std/Manufacturer defined **CID**	01h
Unit and scaling	NONE
Test value	CAT_DIAG_MOD_6[1]
Min test limit	NONE
Max test limit	CAT_MAX_DIAG_MOD_6[1]

Formula section:

IF LV_READY_CAT_DIAG[1] = 0 **OR**
LV_ERR_MEM_CAT_DIAG[1] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF

I.61.3.2 CID 02h - Bank 2

OSC method (linear system)	
Std/Manufacturer defined **CID**	02h
Unit and scaling	NONE
Test value	CAT_DIAG_MOD_6[2]
Min test limit	NONE
Max test limit	CAT_MAX_DIAG_MOD_6[2]

Formula section:

IF LV_READY_CAT_DIAG[2] = 0 **OR**
LV_ERR_MEM_CAT_DIAG[2] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF

I.61.4 Description of TID 02h - Lambda sensor diagnosis

General information:

TID 02 is only supported if the vehicle is equipped with lambda sensors UP and DOWN or UP.

Formula section:

If PSN_LS = 33H or 11H

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Then TID 02 is supported
If PSN_LS = 11H
Then CID 30h /32h are not supported
//no Downstream sensors
Endif
Else TID 02 is not supported
Endif

I.61.4.1 CID 15h - Dynamic diagnosis (linear), Bank 1

Sensor dynamic diagnosis	
Std/Manufacturer defined **CID**	15h (MAX)
Unit and scaling	NONE
Test value	FAC_DYN_LSL_DIAG_SAE[1]
Min test limit	0
Max test limit	FAC_DYN_LSL_DIAG_TOL_SAE[1]

Formula section:

IF LV_READY_DYN_VLD_LS_UP[1] = 0 **OR** LV_ERR_MEM_DYN_VLD_LS_UP[1] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF

I.61.4.2 CID 18h - Dynamic diagnosis (linear), Bank 2

Sensor dynamic diagnosis	
Std/Manufacturer defined **CID**	18h (MAX)
Unit and scaling	NONE
Test value	FAC_DYN_LSL_DIAG_SAE[2]
Min test limit	0
Max test limit	FAC_DYN_LSL_DIAG_TOL_SAE[2]

Formula section:

IF LV_READY_DYN_VLD_LS_UP[2] = 0 **OR** LV_ERR_MEM_DYN_VLD_LS_UP[2] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF

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I.61.4.3 CID 30h - Switchtime diagnosis (downstream binary), Bank 1

Switchtime diagnosis	
Std/Manufacturer defined **CID**	30h
Unit and scaling	NONE
Test value	CTR_SAVE_SWT_LS_DOWN[1]
Min test limit	NONE
Max test limit	C_CTR_SWT_LS_DOWN

Formula section:

IF LV_READY_SWT_LS_DOWN[1] = 0 **OR**
LV_ERR_MEM_SWT_LS_DOWN[1] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF

I.61.4.4 CID 32h - Switchtime diagnosis (downstream binary), Bank 2

Switchtime diagnosis	
Std/Manufacturer defined CID	32h
Unit and scaling	NONE
Test value	CTR_SAVE_SWT_LS_DOWN[2]
Min test limit	NONE
Max test limit	C_CTR_SWT_LS_DOWN

Formula section:

IF LV_READY_SWT_LS_DOWN[2] = 0 **OR**
LV_ERR_MEM_SWT_LS_DOWN[2] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF

I.61.5 Description of TID 03h - Secondary air monitoring

General information:

TID 03h is only supported if SA pump is learnt. Depending of hardware configuration in the car only one type of SA monitioring is active (via lambda-sensor **or** flow meter).

Formula section:

If LV_VAR_SAP = 1
Then TID 03 is supported
If LC_SA_SWI_ACQ = 1
Then CID 05h(=85h) are not supported *//no diagnosis via lambda sensor*

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Else CID 20h and 21h are not supported *//no diagnosis via SAF meter*
Endif
Else TID 03 is not supported
Endif

I.61.5.1 CID 20h/21h - Secondary air monitor with flow meter (SAFM)

Monitoring of minimum flow rate	
Std/Manufacturer defined **CID**	20h
Unit and scaling	NONE
Test value	SAF_DIAG_MIN_SAE
Min test limit	NONE
Max test limit	C_SAF_DIAG_MIN
Monitoring of minimum flow rate	
Std/Manufacturer defined **CID**	21h
Unit and scaling	NONE
Test value	SAF_DIAG_MAX_SAE
Min test limit	NONE
Max test limit	C_SAF_DIAG_MAX

Formula section:

IF LV_READY_SA_SYS = 0 **OR**
LV_ERR_MEM_SA_SYS = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
Endif

I.61.5.2 CID 85h - Secondary air monitor with lambda sensor (LISL)

Monitoring of minimum flow rate, Bank 1 / Bank 2	
Std/Manufacturer defined **CID**	85h (identifier 05h + 80h)
Unit and scaling	NONE
Test value	**MIN [** SUM_AFL_VLS_DIAG_SA_1_SAE; SUM_AFL_VLS_DIAG_SA_2_SAE **]**
Min test limit	C_SUM_AFL_VLS_MIN_DIAG_SA_1
Max test limit	NONE

Formula section:

IF LV_READY_SA_SAP = 0 **OR**
LV_ERR_MEM_SA_SAP = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF
1.1
Description of TID 05h - Evaporative Monitor

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General information:

All DMTL related CID's are only supported if the CAR is equipped with the DMTL module.

Formula section:

If LV_CONF_DMTL = 0
Then CID's 13h/14h/17h/ 12h(=92h)/15h(=95h)/16h(=96h)/18h(=98h)
... are not supported
Else all CID's of TID 05h are supported
Endif

I.61.5.3 CID 09h/87h/88h - Purge Flow monitor (TEV check)

Functional check TEV - Step 1	
Std/Manufacturer defined **CID**	87h (identifier 07h + 80h)
Unit and scaling	NONE
Test value	CL_MMV_SAE
Min test limit	C_CL_MMV_DIAGCPS
Max test limit	NONE
Functional check TEV - Step 2	
Std/Manufacturer defined **CID**	08h
Unit and scaling	NONE
Test value	SUM_DIAG_DIAGCPS_SAE
Min test limit	NONE
Max test limit	C_SUM_DIAGCPS_MAX
Functional check TEV - Step 3	
Std/Manufacturer defined **CID**	09h
Unit and scaling	NONE
Test value	MAF_DIAGCPS_SAE
Min test limit	NONE
Max test limit	MAF_DIAGCPS_THD_SAE

Formula section:

IF LV_READY_DIAGCPS = 0 **OR**
LV_ERR_MEM_DIAGCPS = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF

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I.61.5.4 CID 13h/14h/17h/92h - DMTL module diagnosis

DMTL module - MAX error	
Std/Manufacturer defined **CID**	13h
Unit and scaling	NONE
Test value	M6_CUR_DMTL_COR_FIL_CID19
Min test limit	NONE
Max test limit	C_CUR_DMTL_REF_LEAK_MAX

Formula section:

IF LV_READY_DMTL_MAX = 0 **OR**
LV_ERR_MEM_DMTL_MAX = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF

DMTL module - Plausibility error	
Std/Manufacturer defined **CID**	14h
Unit and scaling	NONE
Test value	M6_CUR_DMTL_DMTLS_TEST
Min test limit	NONE
Max test limit	M6_CUR_DMTL_THD_DMTLS_TEST

Formula section:

IF LV_READY_DMTL_PLAUS = 0 **OR**
LV_ERR_MEM_DMTL_PLAUS = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF

DMTL module - Signal error	
Std/Manufacturer defined **CID**	17h
Unit and scaling	NONE
Test value	M6_CTR_CNL_SMALL_LEAK_MES
Min test limit	NONE
Max test limit	C_SUM_CNL_SMALL_LEAK_MES_MAX

Formula section:

IF LV_READY_DMTL_SIG = 0 **OR**
LV_ERR_MEM_DMTL_SIG = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF

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DMTL module - MIN error	
Std/Manufacturer defined **CID**	92h (identifier 12h + 80h)
Unit and scaling	NONE
Test value	M6_CUR_DMTL_COR_FIL_CID18
Min test limit	C_CUR_DMTL_REF_LEAK_MIN
Max test limit	NONE

Formula section:

IF LV_READY_DMTL_MIN = 0 **OR**
LV_ERR_MEM_DMTL_MIN = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF

I.61.5.5 CID 95h/98h - Rough-leak diagnosis

Leak detection DMTL - Long cycle	
Std/Manufacturer defined **CID**	98h (identifier 18h + 80h)
Unit and scaling	NONE
Test value	M6_CUR_DMTL_ROUGH_LEAK_LEN_END
Min test limit	M6_CUR_DMTL_THD_ROUGH_LEAK_LEN
Max test limit	NONE
Leak detection DMTL - Short cycle	
Std/Manufacturer defined **CID**	95h (identifier 15h + 80h)
Unit and scaling	NONE
Test value	M6_CUR_DMTL_ROUGH_LEAK_END
Min test limit	M6_CUR_DMTL_THD_ROUGH_LEAK
Max test limit	NONE

Formula section:

IF LV_READY_ROUGH_LEAK = 0 **OR**
LV_ERR_MEM_ROUGH_LEAK = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF

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I.61.5.6 CID 96h - Small-leak diagnosis

Leak detection DMTL - Short cycle	
Std/Manufacturer defined **CID**	96h (identifier 16h + 80h)
Unit and scaling	NONE
Test value	M6_CUR_DMTL_SMALL_LEAK_END
Min test limit	M6_CUR_DMTL_REF_LEAK
Max test limit	NONE

Formula section:

IF LV_READY_SMALL_LEAK = 0 **OR**
LV_ERR_MEM_SMALL_LEAK = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF

I.61.6 Description of TID 06h - Oxygen sensor heater monitoring

General information:

TID 06 is only supported if the vehicle is equipped with lambda sensors UP and DOWN or UP.

Formula section:

If PSN_LS = 33H or 11H
Then TID 06 is supported
If PSN_LS = 11H
Then CID 03h /04h are not supported *//no Downstream sensors*
Endif
Else TID 06 is not supported
Endif

I.61.6.1 CID 05h /85h - Oxygen sensor heater monitor, Bank 1 Sensor 1 (linear)

Sensor temperature	
Std/Manufacturer defined **CID**	05h (MAX) 85h (MIN)
Unit and scaling	NONE
Test value	TTIP_OBD_LSH_UP_MES_SAE[1]
Min test limit	TTIP_OBD_LSH_UP_MES_BOL_SAE[1]
Max test limit	TTIP_OBD_LSH_UP_MES_TOL_SAE[1]

Formula section:

IF LV_READY_OBD_VLD_LSH_UP[1] = 0 **OR**
LV_ERR_MEM_OBD_VLD_LSH_UP[1] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h

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ENDIF

I.61.6.2 CID 03h - Oxygen sensor heater monitor, Bank 1 Sensor 2 (binary)

Sensor resistance	
Std/Manufacturer defined **CID**	03h
Unit and scaling	NONE
Test value	R_IT_OBD_LSH_DOWN[1]
Min test limit	NONE
Max test limit	R_IT_THD_OBD_LSH_DOWN[1]

Formula section:

IF LV_READY_OBD_LSH_DOWN[1] = 0 **OR**
LV_ERR_MEM_OBD_LSH_DOWN[1] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF

I.61.6.3 CID 06h /86h - Oxygen sensor heater monitor, Bank 2 Sensor 1 (linear)

Sensor temperature	
Std/Manufacturer defined **CID**	06h (MAX) 86h (MIN)
Unit and scaling	NONE
Test value	TTIP_OBD_LSH_UP_MES_SAE[2]
Min test limit	TTIP_OBD_LSH_UP_MES_BOL_SAE[2]
Max test limit	TTIP_OBD_LSH_UP_MES_TOL_SAE[2]

Formula section:

IF LV_READY_OBD_VLD_LSH_UP[2] = 0 **OR**
LV_ERR_MEM_OBD_VLD_LSH_UP[2] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF

I.61.6.4 CID 04h - Oxygen sensor heater monitor, Bank 2 Sensor 2 (binary)

Sensor resistance	
Std/Manufacturer defined **CID**	04h
Unit and scaling	NONE
Test value	R_IT_OBD_LSH_DOWN[2]
Min test limit	NONE
Max test limit	R_IT_THD_OBD_LSH_DOWN[2]

Formula section:

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IF LV_READY_OBD_LSH_DOWN[2] = 0 **OR**
LV_ERR_MEM_OBD_LSH_DOWN[2] = 1
THEN Positive response with test result
ELSE Positive response with all data equal to 0000h
ENDIF

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J - EOL

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J.1 Upstream lambda sensor test

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_LS_UP_AFL_EOL [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Frozen Lambda value for lambda sensor EOL diagnos confused wired					
LAMB_LS_UP_AFR_EOL [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Frozen Lambda value for lambda sensor EOL diagnos confused wired					
LAMB_SP_VLS_EOL [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Bank selective setpoint (LS mix EOL test)					
LV_ACT_VLS_EOL	O/V	0... 1H	0 ...1	1	-
Activation bit for lambda sensor EOL diagnos confused wired					
LV_VLS_EOL_SHIFT_REP_INH	V	0... 1H	0 ...1	1	-
Bit to prevent endless loop of lambda shifts					
MAF_INT_MIN_VLS_EOL	O/V	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral for lambda sensor EOL diagnos confused wired					
STATE_VLS_EOL	O/V	0H 1H 2H 3H 4H 10H 11H 12H 13H 14H 15H 16H 17H 18H	OFF STEP_1 STEP_2 WAIT TIMEOUT FINISHED ERR_UP ERR_DOWN ERR_UP_ DOWN ERR_UP_1 ERR_UP_2 ERR_DOWN_1 ERR_DOWN_2 NO_RESULT	-	-
Status of lambda sensor EOL diagnos confused wired					
T_WAIT_VLS_EOL_OPM_SWI	V	0... FFFFH	0... 1310.7	0.02	s
Time waiting for operation mode switch					
VLS_DOWN_AFL_EOL [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Frozen VLS value for lambda sensor EOL diagnos confused wired					
VLS_DOWN_AFR_EOL [NC_CBK_EX_NR]	O/V	0... 3FFH	0... 4.99511	4.8828e-3	V
Frozen VLS value for lambda sensor EOL diagnos confused wired					

Input data:

C_OPM_EXT_REQ_VLS_EOL {p. 1763}	LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LV_ACT_VLS_EOL_EXT_ADJ {p. 7763}	LV_IGK {p. 906}
MAF_CYL {p. 8277}	NC_FAC_MAF_INT_20 {p. 651}	OPM_REQ_CUS {p. 8137}	VLS_DOWN [NC_CBK_EX_NR] {p. 967}

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_LS_UP_AFL_EOL	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lean Lambda threshold for lambda sensor EOL diagnosis					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_LAMB_LS_UP_AFR_EOL	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Rich Lambda threshold for lambda sensor EOL diagnosis					
C_LAMB_SP_VLS_EOL_AFL	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda setpoint AFL for lambda sensor EOL diagnos confused wired					
C_LAMB_SP_VLS_EOL_AFR	-	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda setpoint AFR for lambda sensor EOL diagnos confused wired					
C_MAF_INT_MIN_VLS_EOL	-	0... FFFFH	0... 1820.41666	0.0277778	g
MAF integral threshold for lambda sensor EOL diagnos confused wired					
C_T_WAIT_VLS_EOL_OPM_SWI	-	0... FFFFH	0... 1310.7	0.02	s
Time threshold waiting for operation mode switch					
C_TCO_MIN_VLS_EOL	-	0... FEH	-48... 142.5	0.75	°C
TCO threshold for VLS EOL diagnosis					
C_TEG_CAT_DOWN_EOL	-	0... FFFFH	-48... 1459.305	0.023	°C
TEG_CAT_DOWN threshold for VLS EOL diagnosis					
C_VLS_AFL_EOL	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Lean VLS threshold for lambda sensor EOL diagnosis					
C_VLS_AFR_EOL	-	0... 3FFH	0... 4.99511	4.8828e-3	V
Rich VLS threshold for lambda sensor EOL diagnosis					

FUNCTION DESCRIPTION:

General information:

This EOL test is to detect confused or wrong wired lambda sensors in order to prevent bad emmissions for a two cylinder bank system, therefore:

i = 1 for cylinder bank 1 and i = 2 for cylinder bank 2

Description:

This EOL-test is activated by customer-tool by setting LV_ACT_VLS_EOL_EXT_ADJ = 1. At the same time a switch to the correct engine operation mode (e.g. homogenous combustion mode) is triggered in another software module. The function goes to the state WAIT until the correct combustion mode is reached (indicated by OPM_REQ_CUS = C_OPM_EXT_REQ_VLS_EOL). Meanwhile a timer T_WAIT_VLS_EOL_OPM_SWI is incremented. If this timer exceeds the threshold C_T_WAIT_VLS_EOL_OPM_SWI, the switch to the correct engine operation mode failed. So the function goes to state TIMEOUT and the test is stopped. The test can only be restarted, when a stop command is sent from tester (LV_ACT_VLS_EOL_EXT_ADJ = 0) and the start command is sent again (LV_ACT_VLS_EOL_EXT_ADJ = 1).

When the engine is in correct operation mode, STEP-1 is started with shifting the Lambda-setpoint (bank 2 lean /bank 1 rich) for C_MAF_INT_MIN_VLS_EOL. After reaching the MAF integral there is the first freezing of VLS values. After this STEP-2 is started inverse (bank 2 rich /bank 1 lean). After reaching the MAF integral there is the second freezing of VLS values.
In STEP-3 it is checked, if the frozen values are valid. If YES the EOL result is calculated (resuming with STEP_4). If NO (the frozen values of the downstream sensors are in an undefined band between rich and lean), STEP_1 and STEP_2 are started again, to validate these values. The setting and checking of the flag LV_VLS_EOL_SHIFT_REP_INH makes sure, that this validation is done only one time and the test can not enter an endless loop of STEP_1 and STEP_2.

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After this the EOL result STATE_VLS_EOL is calculated finally (STEP-4), by comparing the frozen values with calibratable thresholds.
The idea is, that at rich lambda setpoint LAMB_LS_UP and VLS_DOWN of the corresponding exhaust bank must show "rich" values. Analogous the same at lean lambda setpoint. If the frozen values are confused for bank 1 and 2 (lean value at rich setpoint and vice versa), then the corresponding sensors (upstream and/or downstream) are confused wired. If the frozen values do not cross the thresholds, the corresponding sensor signal is stucking.

The test is also used for failure analysis by the mechanics at the garage in the field.

Application conditions

Initialisation: `LAMB_SP_VLS_EOL[i] = 1` **and** `remaining outputs = 0 at initialization routine of start EOL test` **or**
`ECU reset` **or**
`Clearing error memory` **or**
`LV_IGK 0->1`

Recurrence: *20ms*

Activation:

If LV_ACT_VLS_EOL_EXT_ADJ 0 - -> 1
Then Start function with WAIT
Else STATE_VLS_EOL = OFF
Endif

Deactivation: LV_ACT_VLS_EOL_EXT_ADJ = 0
Action at deactivation: set LAMB_SP_VLS_EOL[i] = 1 **and** remaining outputs = 0

Formula section:

WAIT
IF OPM_REQ_CUS = C_OPM_EXT_REQ_VLS_EOL
THEN Continue with STEP_1
ELSE **IF** T_WAIT_VLS_EOL_OPM_SWI > C_T_WAIT_VLS_EOL_OPM_SWI
THEN STATE_VLS_EOL = TIMEOUT
Stop calculation and deactivate function without reset of all variables
ELSE increment timer T_WAIT_VLS_EOL_OPM_SWI
ENDIF
ENDIF

STEP-1, First bankwise lambdasetpoint shifting
STATE_VLS_EOL = STEP_1
Start calculation of MAF_INT_MIN_VLS_EOL
MAF_INT_MIN_VLS_EOL = MAF_INT_MIN_VLS_EOL + MAF_CYL*NC_FAC_MAF_INT_20
LV_ACT_VLS_EOL = 1 *for lambda coordination*
LAMB_SP_VLS_EOL[1] = C_LAMB_SP_VLS_EOL_AFR *bank1 = rich*
LAMB_SP_VLS_EOL[2] = C_LAMB_SP_VLS_EOL_AFL *bank2 = lean*
If MAF_INT_MIN_VLS_EOL >= C_MAF_INT_MIN_VLS_EOL
Then LAMB_LS_UP_AFR_EOL[1] = LAMB_LS_UP[1]
LAMB_LS_UP_AFL_EOL[2] = LAMB_LS_UP[2]
VLS_DOWN_AFR_EOL[1] = VLS_DOWN[1]
VLS_DOWN_AFL_EOL[2] = VLS_DOWN[2]
LAMB_SP_VLS_EOL[1] = 1 *reset*
LAMB_SP_VLS_EOL[2] = 1 *reset*

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MAF_INT_MIN_VLS_EOL = 0 *reset*
Continue with STEP-2
Else Integration is still active
Endif

STEP-2, Second bankwise lambdasetpoint shifting
STATE_VLS_EOL = STEP_2
Start calculation of MAF_INT_MIN_VLS_EOL
MAF_INT_MIN_VLS_EOL = MAF_INT_MIN_VLS_EOL + MAF_CYL*NC_FAC_MAF_INT_20
LV_ACT_VLS_EOL = 1 *for lambda coordination*
LAMB_SP_VLS_EOL[1] = C_LAMB_SP_VLS_EOL_AFL *bank1 = lean*
LAMB_SP_VLS_EOL[2] = C_LAMB_SP_VLS_EOL_AFR *bank2 = rich*
If MAF_INT_MIN_VLS_EOL >= C_MAF_INT_MIN_VLS_EOL
Then LAMB_LS_UP_AFL_EOL[1] = LAMB_LS_UP[1]
LAMB_LS_UP_AFR_EOL[2] = LAMB_LS_UP[2]
VLS_DOWN_AFL_EOL[1] = VLS_DOWN[1]
VLS_DOWN_AFR_EOL[2] = VLS_DOWN[2]
LAMB_SP_VLS_EOL[1] = 1 *reset*
LAMB_SP_VLS_EOL[2] = 1 *reset*
MAF_INT_MIN_VLS_EOL = 0 *reset*
Continue with STEP-3, “Validation”
Else Integration is still active
Endif

STEP-3, Validation of froozen VLS values
If (C_VLS_AFL_EOL < VLS_DOWN_AFR_EOL[1] < C_VLS_AFR_EOL **or**
C_VLS_AFL_EOL < VLS_DOWN_AFR_EOL[2] < C_VLS_AFR_EOL **or**
C_VLS_AFL_EOL < VLS_DOWN_AFL_EOL[1] < C_VLS_AFR_EOL **or**
C_VLS_AFL_EOL < VLS_DOWN_AFL_EOL[2] < C_VLS_AFR_EOL) **and**
LV_VLS_EOL_SHIFT_REP_INH = 0
Then Repeat STEP-1 for the second cycle
LV_VLS_EOL_SHIFT_REP_INH = 1
Else Continue with STEP-4 “Calculation”
LV_ACT_VLS_EOL = 0 *reset*
Endif

STEP-4, Calculation of test results STATE_VLS_EOL
Remark: After the first error status is detected the calculation is stopped

EOL test finished, all sensors O.K.
If LAMB_LS_UP_AFR_EOL[1] < C_LAMB_LS_UP_AFR_EOL **and**
LAMB_LS_UP_AFR_EOL[2] < C_LAMB_LS_UP_AFR_EOL **and**
VLS_DOWN_AFR_EOL[1] > C_VLS_AFR_EOL **and**
VLS_DOWN_AFR_EOL[2] > C_VLS_AFR_EOL **and**
LAMB_LS_UP_AFL_EOL[1] > C_LAMB_LS_UP_AFL_EOL **and**
LAMB_LS_UP_AFL_EOL[2] > C_LAMB_LS_UP_AFL_EOL **and**
VLS_DOWN_AFL_EOL[1] < C_VLS_AFL_EOL **and**
VLS_DOWN_AFL_EOL[2] < C_VLS_AFL_EOL
Then **STATE_VLS_EOL = FINISHED**

EOL test finished, UP sensors confused

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Elseif LAMB_LS_UP_AFR_EOL[1] > C_LAMB_LS_UP_AFR_EOL **and**
LAMB_LS_UP_AFR_EOL[2] > C_LAMB_LS_UP_AFR_EOL **and**
VLS_DOWN_AFR_EOL[1] > C_VLS_AFR_EOL **and**
VLS_DOWN_AFR_EOL[2] > C_VLS_AFR_EOL **and**
LAMB_LS_UP_AFL_EOL[1] < C_LAMB_LS_UP_AFL_EOL **and**
LAMB_LS_UP_AFL_EOL[2] < C_LAMB_LS_UP_AFL_EOL **and**
VLS_DOWN_AFL_EOL[1] < C_VLS_AFL_EOL **and**
VLS_DOWN_AFL_EOL[2] < C_VLS_AFL_EOL
Then **STATE_VLS_EOL = ERR_UP**

EOL test finished, DOWN sensors confused
Elseif LAMB_LS_UP_AFR_EOL[1] < C_LAMB_LS_UP_AFR_EOL **and**
LAMB_LS_UP_AFR_EOL[2] < C_LAMB_LS_UP_AFR_EOL **and**
VLS_DOWN_AFR_EOL[1] < C_VLS_AFR_EOL **and**
VLS_DOWN_AFR_EOL[2] < C_VLS_AFR_EOL **and**
LAMB_LS_UP_AFL_EOL[1] > C_LAMB_LS_UP_AFL_EOL **and**
LAMB_LS_UP_AFL_EOL[2] > C_LAMB_LS_UP_AFL_EOL **and**
VLS_DOWN_AFL_EOL[1] > C_VLS_AFL_EOL **and**
VLS_DOWN_AFL_EOL[2] > C_VLS_AFL_EOL
Then **STATE_VLS_EOL = ERR_DOWN**

EOL test finished, UP& DOWN sensors confused
Elseif LAMB_LS_UP_AFR_EOL[1] > C_LAMB_LS_UP_AFR_EOL **and**
LAMB_LS_UP_AFR_EOL[2] > C_LAMB_LS_UP_AFR_EOL **and**
VLS_DOWN_AFR_EOL[1] < C_VLS_AFR_EOL **and**
VLS_DOWN_AFR_EOL[2] < C_VLS_AFR_EOL **and**
LAMB_LS_UP_AFL_EOL[1] < C_LAMB_LS_UP_AFL_EOL **and**
LAMB_LS_UP_AFL_EOL[2] < C_LAMB_LS_UP_AFL_EOL **and**
VLS_DOWN_AFL_EOL[1] > C_VLS_AFL_EOL **and**
VLS_DOWN_AFL_EOL[2] > C_VLS_AFL_EOL
Then **STATE_VLS_EOL = ERR_UP_DOWN**

EOL test finished, UP1 not plausible
Elseif LAMB_LS_UP_AFR_EOL[1] > C_LAMB_LS_UP_AFR_EOL **or**
LAMB_LS_UP_AFL_EOL[1] < C_LAMB_LS_UP_AFL_EOL
Then **STATE_VLS_EOL = ERR_UP_1**

EOL test finished, UP2 not plausible
Elseif LAMB_LS_UP_AFR_EOL[2] > C_LAMB_LS_UP_AFR_EOL **or**
LAMB_LS_UP_AFL_EOL[2] < C_LAMB_LS_UP_AFL_EOL
Then **STATE_VLS_EOL = ERR_UP_2**

EOL test finished, DOWN1 not plausible
Elseif VLS_DOWN_AFR_EOL[1] < C_VLS_AFR_EOL **or**
VLS_DOWN_AFL_EOL[1] > C_VLS_AFL_EOL
Then **STATE_VLS_EOL = ERR_DOWN_1**

EOL test finished, DOWN2 not plausible
Elseif VLS_DOWN_AFR_EOL[2] < C_VLS_AFR_EOL **or**
VLS_DOWN_AFL_EOL[2] > C_VLS_AFL_EOL
Then **STATE_VLS_EOL = ERR_DOWN_2**

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EOL test finished, no result

Else **STATE_VLS_EOL = NO_RESULT**

Endif

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R - Customer provided functions

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R.1 Customer adaptation module: AIRT

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_tumers	O/V	0... 1H	0 ...1	1	-
Ambient temperature via CAN faulty, substitute value is taken					
Tans	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
intake air temperature					
Tumg	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
ambient temperature (modelled)					
Tumg_can	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
ambient temperature					
Tvld	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
Air temperature up turbo charger					

Input data:

LV_TAM_CAN_ERR {p. 1567}	TAM {p. 1579}	TIA {p. 1226}	TIA_TCHA {p. 1226}

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions

Initialisation: *at reset:* 0: Tumg_can, B_tumers
first measured value: Tumg, Tans, Tvld
at PWL: last measured value: Tumg, Tans, Tvld
last valid value: Tumg_can
0: B_tumers

Recurrence: 100ms: Tumg, Tumg_can, Tans, Tvld, B_tumers

Activation: every engine state

Deactivation:

Formula section:

Remark: all formulas are valid in a **physical** meaning

Tans = TIA
Tumg = TAM
Tumg_can = TAM
Tvld = TIA_TCHA
B_tumers = LV_TAM_CAN_ERR

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R.2 Customer adaptation module: CBMD

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_ase_abgas	O/V	0... 1H	0 ...1	1	-
Logical variable for CARB A misfire criterion confirmed					
B_ase_kat	O/V	0... 1H	0 ...1	1	-
Logical variable for CARB B misfire criterion confirmed					
B_hmm_clc	O/V	0... 1H	0 ...1	1	-
Logical variable for the deactivation of all AFL- mode relevant modules.					
B_sch_clc	O/V	0... 1H	0 ...1	1	-
Logical variable for the deactivation of all S- mode relevant modules.					
B_sk_homla1	O/V	0... 1H	0 ...1	1	-
flag for switching to HOM_AFS due to faults in non-HOM_AFS					
B_vb_hmm	O/V	0... 1H	0 ...1	1	-
Inhibit of AFL mode due to project specific requests.					
B_vb_sch	O/V	0... 1H	0 ...1	1	-
Inhibit of stratified mode due to project specific requests.					
LAMB_SP_S_EXT	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
lambda setpoint for stratified mode					
LV_FUP_SP_SWI	O/V	0... 1H	0 ...1	1	-
Flag for fuel pressure setpoint switch					
LV_HOM_ACT	O/V	0... 1H	0 ...1	1	-
Homogeneous ignition and injection parameters are applied to the engine					
LV_HOM_AFL_ACT	O/V	0... 1H	0 ...1	1	-
Homogeneous air fuel lean mode active					
LV_HOM_AFS_ACT	O/V	0... 1H	0 ...1	1	-
Logical variables indicates active homogeneous stoichiometric state					
LV_HOM_AFS_REQ	O/V	0... 1H	0 ...1	1	-
Request for AFS mode					
LV_HOM_ENA	O/V	0... 1H	0 ...1	1	-
catalyst heating home					
LV_HOM_RUN	O/V	0... 1H	0 ...1	1	-
Flag to activate homogeneous calculations					
LV_IGA_AND_INJ_SWI	O/V	0... 1H	0 ...1	1	-
Logical variable controlling igintion and injection mode (stratified or homogeneous).					
LV_IGA_AND_INJ_SWI_1	O/V	0... 1H	0 ...1	1	-
Logical variable controlling igintion and injection mode (stratified or homogeneous).					
LV_IGA_AND_INJ_SWI_2	O/V	0... 1H	0 ...1	1	-
Logical variable controlling igintion and injection mode (stratified or homogeneous).					
LV_IGA_AND_INJ_SWI_HOMS	O/V	0... 1H	0 ...1	1	-
Logical variable controlling igintion and injection mode (stratified or homogeneous-stratified).					
LV_IGA_AND_INJ_SWI_HOMS_1	O/V	0... 1H	0 ...1	1	-
Logical variable controlling igintion and injection mode (stratified or homogeneous-stratified), for bank 1					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_IGA_AND_INJ_SWI_HOMS_2	O/V	0... 1H	0 ...1	1	-
Logical variable controlling igintion and injection mode (stratified or homogeneous-stratified)., for bank 2					
LV_S_ACT	O/V	0... 1H	0 ...1	1	-
Stratified ignition and injection parameters are applied to the engine					
LV_S_ENA	O/V	0... 1H	0 ...1	1	-
catalyst heating home					
LV_S_RUN	O/V	0... 1H	0 ...1	1	-
Flag to activate stratified calculations					
LV_SP_RATE_CYL_EGR_SWI	O/V	0... 1H	0 ...1	1	-
Flag for EGR setpoint rate					
OPM_AV	O/V	0H 1H 2H 3H 8H	- S AFS AFL LIH	-	-
actual engine operation mode					
OPM_REQ	O/V	0H 1H 2H 3H 8H	- S AFS AFL LIH	-	-
Requested engine operation mode (for operation switch manager)					
OPM_REQ_CUS	O/V	0... FFFFH	0... 65535	1	-
Actual engine operation mode (16bit)					
STATE_CMB_CTL	O/V	0H 1H 2H 3H 4H 5H 6H 7H 8H	HOM_AFS AFS_TO_AFL HOM_AFL AFL_TO_AFS HOM_TO_S BACKS S S_TO_HOM BACKHOM	-	-
States of the combustion management					

Input data:

B_esp_h1 {p. 8343}	B_esp_h2 {p. 8343}	B_esp_hs1 {p. 8343}	B_esp_hs2 {p. 8343}
B_hmm_akt {p. 8343}	B_hom_akt {p. 8343}	B_hstoech {p. 8343}	B_prsoll_h {p. 8346}
B_sch_akt {p. 8346}	B_schicht {p. 8346}	B_verb_h {p. 8347}	B_verb_s {p. 8347}
Ba_ist {p. 8154}	Ba_soll {p. 8154}	Baw_ist {p. 8155}	ECU_STATE {p. 1091}
La_abgas1 {p. 8160}	La_abgas2 {p. 8160}	LV_AFL_CLC {p. 1822}	LV_INH_AFL {p. 1822}
LV_INH_S {p. 1822}	LV_MIS_STATE_A {p. 6238}	LV_S_CLC {p. 1822}	LV_SWI_AFS_MON {p. 6786}

Application conditions

Initialisation at reset: `0, except LAMB_SP_S_EXT = 1.00`

Recurrence : `10 ms`

Activation: *at every engine state*

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Deactivation: – –

R.2.1 Outputs for BMW which are defined as CBMD exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Formula section:

if ECU_STATE = "PWL"
then
B_ase_abgas = 0
B_ase_kat = 0
B_vb_hmm = 0
B_vb_sch = 0
B_hmm_clc = 0
B_sch_clc = 0

else
B_ase_abgas = LV_MIS_STATE_B
B_ase_kat = LV_MIS_STATE_A
B_vb_hmm = LV_INH_AFL
B_vb_sch = LV_INH_S
B_hmm_clc = LV_AFL_CLC
B_sch_clc = LV_S_CLC
B_sk_homla1 = LV_SWI_AFS_MON
Endif

R.2.2 Outputs for supplier aggregates

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs can be different from the specified values due to the input data attributes.

Formula section:

Remark: all formulas are valid in a **physical** meaning
LV_S_RUN = B_sch_akt
LV_HOM_RUN = B_hom_akt
LV_HOM_AFS_REQ = B_hstoech
OPM_AV = Ba_ist
OPM_REQ = Ba_soll
OPM_REQ_CUS = Baw_ist
LV_ S_ACT = B_schicht
LV_HOM_ACT = ! B_schicht
LV_IGA_AND_INJ_SWI_1 = B_esp_h1
LV_IGA_AND_INJ_SWI = B_esp_h1
LV_IGA_AND_INJ_SWI_2 = B_esp_h2
LV_IGA_AND_INJ_SWI_HOMS_1 = B_esp_hs1

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```
LV_IGA_AND_INJ_SWI_HOMS          =      B_esp_hs1
LV_IGA_AND_INJ_SWI_HOMS_2      =      B_esp_hs2
LV_FUP_SP_SWI            =      B_prsoll_h
LV_HOM_AFL_ACT      =      B_hmm_akt
if    Ba_ist =2   and  LV_HOM_AFL_ACT =0
then        STATE_CMB_CTL=0Hex          HOM_AFS
else        if Ba_ist =2   and  LV_HOM_AFL_ACT =1
        then        STATE_CMB_CTL=2Hex          HOM_AFL
        else        if Ba_ist=1 or Ba_ist=3
                then    STATE_CMB_CTL=6Hex          S
                endif
        endif
endif

If        Ba_ist = 1
then            LV_SP_RATE_CYL_EGR_SWI = 0
else            LV_SP_RATE_CYL_EGR_SWI = 1
endif
If              STATE_CMB_CTL = 0Hex
Then        LV_HOM_AFS_ACT        =        1
Else        LV_HOM_AFS_ACT        =        0
Endif
LV_S_ENA          = ! B_verb_s
LV_HOM_ENA          =! B_verb_h
LAMB_SP_S_EXT = 0,5*(La_abgas1 + La_abgas2)
```

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R.3 Customer adaptation module: CHRG

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
RFPPWM	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
PWM output recirculation flap					
WGPWM [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
PWM output wastegate[NC_CBK_EX_NR]					

Input data:

LV_ERR_WG_DR [NC_CBK_EX_NR]	LV_RFPPWM_EXT_ADJ [NC_NR_TCHA] {p. 7434}	LV_VAR_TCHA {p. 656}	LV_WGPWM_EXT_ADJ [NC_NR_TCHA] {p. 7435}
NC_CBK_EX_NR {p. 1829}	NC_NR_TCHA	RFPPWM_EXT_ADJ [NC_NR_TCHA] {p. 7435}	Tvulv {p. 8178}
Tvwg {p. 8178}	Tvwg2 {p. 8178}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_WGPWM_SUB_DIAG	-	0... FFFFH	0... 99.99847	1.5259e-3	%
PWM output wastegate in case of electrical failure					

R.3.1 Outputs for supplier Aggregates

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation: *0 at reset*

Recurrence: *all 10 ms*

Activation:

```
every engine state if LV_VAR_TCHA = 1   // control of HW pins
via WGPWM,                                             RFPPWM
only in case of turbo
charger variant
    In power latch phase:
    WGPWM[NC_CBK_EX_NR]      =      0
                     RFPPWM              =      last calcuclated
value
```

Formula section:

```
If          LV_WGPWM_EXT_ADJ[1] = 0
Then
      IF        LV_ERR_WG_DR[1]  =  0
   Then         WGPWM[1]         = Tvwg
         Else        WGPWM[1]         = C_WGPWM _SUB_DIAG
Else
                WGPWM[1]      =  WGPWM_EXT_ADJ[1]
```

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```
Endif

If                LV_WGPWM_EXT_ADJ[2] = 0
Then
        IF        LV_ERR_WG_DR[2]   =   0
    Then          WGPWM[2]          = Tvwg2
            Else          WGPWM[2]          = C_WGPWM _SUB_DIAG
Else
                  WGPWM[2]       =   WGPWM_EXT_ADJ[2]
Endif


If          LV_RFPPWM_EXT_ADJ[1]   = 0
Then
        RFPPWM = Tvulv
Else
        RFPPWM = RFPPWM_EXT_ADJ[1]
Endif
```

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R.4 CUSF - Requirements to infrastructure interface

General Information:

In-/Output for Functions
A Function with the property INPUT is provided by the supplier
A Function with the property OUTPUT is provided by BMW

Application Conditions:

Initialisation: -
Recurrence: `At function request`
Activation: `every engine state`
Deactivation: -

Function description:

This functions must be provided by the supplier-SW to the BMW-SW at the Layerinterface.

Formula section:

Name	Parameter	return value	In-/Output	Remark
Layer_DisableISR	void	void	Eingang	deactivation of all ISR
Layer_EnableISR	void	void	Eingang	activation of all ISR
Layer_GetSystemTime1ms	void	uint32	Eingang	systemtime with 1ms resolution
Layer_GetSystemTime1us	void	uint32	Eingang	systemtime with 1 us resolution

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R.5 Customer reference list

FUNCTION DESCRIPTION:

General information:

This document is used to handle the configuration mangement of desired implementation of the customer OBJ files. For each SW release a fitting list of OBJ file references has to be created. The list is sorted in alphabetic order.

Description:

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atlstat
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atmph
atmph_n53
atmph_svc
ausy_ak
ausy_kat
ausy_turb
bgcreng
bgkuppl
bgllgen
bls
blsagr
blsatl
blsdisa
blsdk
blshub
blstempk
bs
co2mng
deavanos
dgen
dibs
dqlt
eavanos
eavnskt
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eisy_llk
eisy_mr
eisy_psreg
eisy_sr
eisy_verd
eisyagr

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gen_fasta
igr
igrdiag
igrsbcalc
imdgen
inv_ipol
ipmna_dynkor
ipmna_genkor
ipmna_genstoff
ipmna_loadresp
ipmna_md2ierr
ipmna_statmbilanz
ipmna_statmkor
kf_ipol
kl_ipol
krann
kt_ibs
lamko
layer
ldstgen
lemdiag
llpmctrl
llranh
lolimot
mdanman
mdar
mdbafak
mdbanl
mdbaprio
mdbaschalt
mddmk
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mdres
mdreskrll
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mdrk
mlp

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pmbattregen
pmcbsbatt
pmdiag
pmmsa
pmmsadiag
pmprsvcalc
pmsoccalc
pmsocfit
pmsockor
pmsocstart
pmspgw
pmubnkor
pmukomp
pmverbentl
pmverbmng
poel_reg
railko
restgas
services_msd80
ss_msv
sst
ulvout
ulvreg
wes
wese
wm_nl
wm_start
wmewapu
wmkft
wmprio

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wmschalt
wmzusta
zwaus
zwgrund
zwopt

No version numbers of OBJ-Files are available !

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R.6 Dynamic requirements of customer provided functionality

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_N_MAX_CLC_AUSY_TURB_SEG	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call ausy_turb_seg					
LV_N_MAX_CLC_EISY_VERD_SEG	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call eisy_verd_seg					
LV_N_MAX_CLC_KLANN_20MS	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call klann_20ms					
LV_N_MAX_CLC_MDBAFAK_10MS	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call mdbafak_10ms					
LV_N_MAX_CLC_MDBANL_10MS	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call mdanl_10ms					
LV_N_MAX_CLC_MDBAPRIO_10MS	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call mdbaprio_10ms					
LV_N_MAX_CLC_MDRK_SEG	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call mdrk_seg					
LV_N_MAX_CLC_RAILKO_10MS	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call railko_10ms					
LV_N_MAX_CLC_ULVOUT_10MS	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call ulvout_10ms					
LV_N_MAX_CLC_ULVREG_10MS	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call ulvreg_10ms					
LV_N_MAX_CLC_WESE_SEG	O/V	0... 1H	0 ...1	1	-
Flag indicating runtime reduction on function call wese_seg					

Input data:

LV_VAR_TCHA {p. 656}	N {p. 1525}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_HYS_CLC_AUSY_TURB_SEG	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call ausy_turb_seg (default: 200 rpm)					
C_N_HYS_CLC_EISY_VERD_SEG	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call eisy_verd_seg (default: 200 rpm)					
C_N_HYS_CLC_KLANN_20MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call klann_20ms (default: 200 rpm)					
C_N_HYS_CLC_MDBAFAK_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call mdbafak_10ms (default: 200 rpm)					
C_N_HYS_CLC_MDBANL_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call mdbanl_10ms (default: 200 rpm)					
C_N_HYS_CLC_MDBAPRIO_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call mdbaprio_10ms (default: 200 rpm)					
C_N_HYS_CLC_MDRK_SEG	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call mdrk_seg (default: 200 rpm)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_N_HYS_CLC_RAILKO_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call railko_10ms (default: 200 rpm)					
C_N_HYS_CLC_ULVOUT_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call ulvout_10ms (default: 200 rpm)					
C_N_HYS_CLC_ULVREG_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call ulvreg_10ms (default: 200 rpm)					
C_N_HYS_CLC_WESE_SEG	-	0... 1FE0H	0... 8160	1	rpm
Engine speed hysteresis for runtime reduction on function call wese_seg (default: 200 rpm)					
C_N_MAX_CLC_AUSY_TURB_SEG	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call ausy_turb_seg (default: 4000 rpm)					
C_N_MAX_CLC_EISY_VERD_SEG	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call eisy_verd_seg (default: 4000 rpm)					
C_N_MAX_CLC_KLANN_20MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call klann_20ms (default: 4000 rpm)					
C_N_MAX_CLC_MDBAFAK_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call mdbafak_10ms (default: 4000 rpm)					
C_N_MAX_CLC_MDBANL_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call mdbanl_10ms (default: 4000 rpm)					
C_N_MAX_CLC_MDBAPRIO_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call mdbaprio_10ms (default: 400rpm)					
C_N_MAX_CLC_MDRK_SEG	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call mdrk_seg (default: 4000 rpm)					
C_N_MAX_CLC_RAILKO_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call railko_10ms (default: 4000 rpm)					
C_N_MAX_CLC_ULVOUT_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call ulvout_10ms (default: 4000 rpm)					
C_N_MAX_CLC_ULVREG_10MS	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call ulvreg_10ms (default: 4000 rpm)					
C_N_MAX_CLC_WESE_SEG	-	0... 1FE0H	0... 8160	1	rpm
Engine speed threshold for runtime reduction on function call wese_seg (default: 4000 rpm)					

General information:

This module is a customer request out of the BMW-supplier Software Layer, where the scheduling of BMW tasks is defined. For detailled information on the scheduling of BMW tasks please refer to the corresponding layer specification.

To prevent the CPU from overload the scheduling of some BMW tasks may be halved via engine speed thresholds or switched of via LV_VAR_TCHA. In case engine speed exceeds the corresponding threshold only each 2^{nd} function call will be conducted.

Application conditions

Initialisation: `all = 0 at reset`

Recurrence: `seg and 10ms, 20ms`

Activation: `always`

Deactivation: –

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Formula section:

Function call MDBAPRIO_10MS:

If N $>$ C_N_MAX_CLC_MDBAPRIO_10MS
Then LV_N_MAX_CLC_MDBAPRIO_10MS = 1
Endif

If N $<$ C_N_MAX_CLC_MDBAPRIO_10MS - C_N_HYS_CLC_MDBAPRIO_10MS
Then LV_N_MAX_CLC_MDBAPRIO_10MS = 0
Endif

If LV_N_MAX_CLC_MDBAPRIO_10MS = 1
Then only each 2nd function call for MDBAPRIO_10MS will be conducted
Else each function call for MDBAPRIO_10MS will be conducted
Endif

Function call WESE_SEG:

If N $>$ C_N_MAX_CLC_WESE_SEG
Then LV_N_MAX_CLC_WESE_SEG = 1
Endif

If N $<$ C_N_MAX_CLC_WESE_SEG - C_N_HYS_CLC_WESE_SEG
Then LV_N_MAX_CLC_WESE_SEG = 0
Endif

If LV_N_MAX_CLC_WESE_SEG = 1
Then only each 2nd function call for WESE_SEG will be conducted
Else each function call for WESE_SEG will be conducted
Endif

Function call MDRK_SEG:

If N $>$ C_N_MAX_CLC_MDRK_SEG
Then LV_N_MAX_CLC_MDRK_SEG = 1
Endif

If N $<$ C_N_MAX_CLC_MDRK_SEG - C_N_HYS_CLC_MDRK_SEG
Then LV_N_MAX_CLC_MDRK_SEG = 0
Endif

If LV_N_MAX_CLC_MDRK_SEG = 1
Then only each 2nd function call for MDRK_SEG will be conducted
Else each function call for MDRK_SEG will be conducted
Endif

Function call KLANN_20MS:

If N $>$ C_N_MAX_CLC_KLANN_20MS
Then LV_N_MAX_CLC_KLANN_20MS = 1
Endif

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If N $<$ C_N_MAX_CLC_KLANN_20MS - C_N_HYS_CLC_KLANN_20MS
Then LV_N_MAX_CLC_KLANN_20MS = 0
Endif

If LV_N_MAX_CLC_KLANN_20MS = 1
Then only each 2^{nd} function call for KLANN_20MS will be conducted
Else each function call for KLANN_20MS will be conducted
Endif

Function call EISY_VERD_SEG:

If N $>$ C_N_MAX_CLC_EISY_VERD_SEG
Then LV_N_MAX_CLC_EISY_VERD_SEG = 1
Endif

If N $<$ C_N_MAX_CLC_EISY_VERD_SEG - C_N_HYS_CLC_EISY_VERD_SEG
Then LV_N_MAX_CLC_EISY_VERD_SEG = 0
Endif

If LV_N_MAX_CLC_EISY_VERD_SEG = 1
Then only each 2^{nd} function call for EISY_VERD_SEG will be conducted
Else each function call for EISY_VERD_SEG will be conducted
Endif

Function call MDBAFAK_10MS:

If N $>$ C_N_MAX_CLC_MDBAFAK_10MS
Then LV_N_MAX_CLC_MDBAFAK_10MS = 1
Endif

If N $<$ C_N_MAX_CLC_MDBAFAK_10MS - C_N_HYS_CLC_MDBAFAK_10MS
Then LV_N_MAX_CLC_MDBAFAK_10MS = 0
Endif

If LV_N_MAX_CLC_MDBAFAK_10MS = 1
Then only each 2^{nd} function call for MDBAFAK_10MS will be conducted
Else each function call for MDBAFAK_10MS will be conducted
Endif

Function call MDBANL_10MS:

If N $>$ C_N_MAX_CLC_MDBANL_10MS
Then LV_N_MAX_CLC_MDBANL_10MS = 1
Endif

If N $<$ C_N_MAX_CLC_MDBANL_10MS - C_N_HYS_CLC_MDBANL_10MS
Then LV_N_MAX_CLC_MDBANL_10MS = 0
Else do nothing
Endif

If LV_N_MAX_CLC_MDBANL_10MS = 1

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Then only each 2^{nd} function call for MDBANL_10MS will be conducted
Else each function call for MDBANL_10MS will be conducted
Endif

Function call RAILKO_10MS:

If N $>$ C_N_MAX_CLC_RAILKO_10MS
Then LV_N_MAX_CLC_RAILKO_10MS = 1
Endif

If N $<$ C_N_MAX_CLC_RAILKO_10MS - C_N_HYS_CLC_RAILKO_10MS
Then LV_N_MAX_CLC_RAILKO_10MS = 0
Else do nothing
Endif

If LV_N_MAX_CLC_RAILKO_10MS = 1
Then only each 2^{nd} function call for RAILKO_10MS will be conducted
Else each function call for RAILKO_10MS will be conducted
Endif

Function call AUSY_TURB_SEG

If N $>$ C_N_MAX_CLC_AUSY_TURB_SEG
Then LV_N_MAX_CLC_AUSY_TURB_SEG = 1
Endif

If N $<$ C_N_MAX_CLC_AUSY_TURB_SEG - C_N_HYS_CLC_AUSY_TURB_SEG
Then LV_N_MAX_CLC_AUSY_TURB_SEG = 0
Endif

If LV_N_MAX_CLC_AUSY_TURB_SEG = 1
Then only each 2^{nd} function call for AUSY_TURB_SEG will be conducted
Else each function call for AUSY_TURB_SEG will be conducted

Functions, called depending on LV_VAR_TCHA:

If(1) LV_VAR_TCHA = 1
Then(1)
atlstat_10ms,
atlad_100ms,
atldiag_100ms,
atldiag_10ms,
atlgls_10ms,
atlob_20ms,
atlob_50ms,
atlout_10ms,
atlpump_10ms,
atlreg_10ms,
atlstat_10ms,

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blsatl_10ms,
blsatl_20ms,
blsatl_50ms,
eisy_diag_nl100ms,
mdrfmxatl_50ms will be conducted

Function call ULVOUT_10MS:

If N $>$ C_N_MAX_CLC_ULVOUT_10MS
Then LV_N_MAX_CLC_ULVOUT_10MS = 1
Endif

If N $<$ C_N_MAX_CLC_ULVOUT_10MS - C_N_HYS_CLC_ULVOUT_10MS
Then LV_N_MAX_CLC_ULVOUT_10MS = 0
Endif

If LV_N_MAX_CLC_ULVOUT_10MS = 1
Then only each 2^{nd} function call for ULVOUT_10MS will be conducted
Else each function call for ULVOUT_10MS will be conducted
Endif

Function call ULVREG_10MS:

If N $>$ C_N_MAX_CLC_ULVREG_10MS
Then LV_N_MAX_CLC_ULVREG_10MS = 1
Endif

If N $<$ C_N_MAX_CLC_ULVREG_10MS - C_N_HYS_CLC_ULVREG_10MS
Then LV_N_MAX_CLC_ULVREG_10MS = 0
Endif

If LV_N_MAX_CLC_ULVREG_10MS = 1
Then only each 2^{nd} function call for ULVREG_10MS will be conducted
Else each function call for ULVREG_10MS will be conducted
Endif

Endif(1)

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R.7 Interface definitions of customer provided functionality

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Absch_korr	O/V/S	8000... 7FFFH	-50... 49.99847	1.5259e-3	-
Korrekturwert Abschaltung					
Agr_rate	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
EGR rate					
Agr_soll	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Exhaused gas setpoint					
Agrpos_soll	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
AGR-Ventil Sollposition					
Amo_05	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Amplitude 0,5 Motorordnung					
Amo_10	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Amplitude 1,0 Motorordnung					
Amo_15	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Amplitude 1,5 Motorordnung					
Amo_20	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Amplitude 2,0 Motorordnung					
Amo_30	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Amplitude 3. Motorordnung					
Amo_40	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Amplitude 4. Motorordnung					
Aspr	O/V	0... FFH	0... 204	0.8	°CRK
setpoint outlet camshaft					
Atlr	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Stellgröße Regler und Vorsteuerung					
Atlsvc_dpvdk1	O/V	8000... 7FFFH	-1280... 1279.96093	0.0390625	hPa
Differenzdruck vor DK beider Turbolader					
Atlsvc_dpvdk2	O/V	8000... 7FFFH	-1280... 1279.96093	0.0390625	hPa
Differenzdruck vor DK mit Turbolader 1					
Atlsvc_dpvdk3	O/V	8000... 7FFFH	-1280... 1279.96093	0.0390625	hPa
Differenzdruck vor DK mit Turbolader 1					
Atlvst	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Stellgröße Anteil Vorsteuerung					
Ba_ist	O/V	0... FFH	0... 255	1	km/m
Actual engine operation mode					
Ba_soll	O/V	0... FFH	0... 255	1	-
requested engine operation mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Ba_subist	O/V	0... FFH	0... 255	1	-
Actual engine operation mode					
Ba_subsoll	O/V	0... FFH	0... 255	1	-
requested engine operation mode					
Ba_switch_uek	O/V	0... FFH	0... 255	1	-
Schalter für Wandfilmkompensation					
Ba_wm_ist	O/V	0... FFH	0... 255	1	-
Ist-Betriebsart Wärmemanagementkoordinator					
Baw_ist	O/V	0... FFFFH	0... 65535	1	-
Betriebsart und Subbetriebsart IST					
Baw_prio	O/V	0... FFFFH	0... 65535	1	-
priorisierte Betriebsart und Subbetriebsart					
Baw_soll	O/V	0... FFFFH	0... 65535	1	-
Betriebsart und Subbetriebsart SOLL					
Bosbtvfbk	O/V/S	0... FFH	0... 255	1	%
Verfügbarkeit Motoröl					
Bosconf	O/V/S	0... FFFFFFFFH	0... 4294967295	1	-
Bos-Teilnehmer: Bit 1 = OZ; Bit 8 = PM					
Bosfxid2	O/V/S	0... FFFFH	0... 65535	1	-
ID_Funktion_BOS_Meldung_2					
Bosid2	O/V/S	0... FFH	0... 255	1	-
ID2_BOS_Meldung_2					
Bosjziel	O/V/S	0... FFH	0... 255	1	-
Zieltermin_Jahr_BOS_Meldung_2					
Bosmanip	O/V	0... FFH	0... 255	1	-
Manipulationsbyte					
Bosmziel	O/V/S	0... FFH	0... 255	1	month
Zieltermin_Monat_BOS_Meldung_2					
Bosprog2	O/V/S	0... FFH	0... 255	1	month
Prognose_Intervall_Zeit_BOS_Meldung_2					
Bosres	O/V/S	0... FFH	0... 255	1	-
BOS_Reserve					
Bosrlsm	O/V/S	8000... 7FFFH	-32768 ...32767	1	-
Remaining milage for oil (from combi)					
Bosrw2	O/V/S	0... FFH	0... 255000	1000	km
Prognose_Intervall_Weg_BOS_Meldung_2					
Bosstate	O/V	0... FFH	0... 255	1	-
Einheit für Restlaufstrecke					
Bostoken	O/V	0... FFH	0... 255	1	-
Teilen der BOS-Schnittstelle zwischen OZ und PM (0= frei, 1= besetzt vom OZ, 8= besetzt vom PM)					
Bszsi	O/V/S	0... FFFFFFFFH	0... 4294967295	1	-
Betriebsstundenzaehler					
Ctrcbr	O/V	0... FFH	0... 255	1	-
Steuerung Stromzweige					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Ctrpcos	O/V	0... FFH	0... 255	1	-
Steuerung Standverbraucher					
Ctrprio	O/V	0... FFH	0... 255	1	-
Steuerung Spitzenreduzierung Priorität					
Ctrpriocf	O/V	0... FFH	0... 255	1	-
Steuerung Spitzenreduzierung Priorität Komfort					
Ctrpwrcos	O/V	0... FFFFH	0... 65535	1	-
Steuerung Leistung Sonderverbraucher					
Ctrpwspcos	O/V	0... FFH	0... 127.5	0.5	%
Steuerung Leistung Sonderverbraucher					
D_soc	O/V/S	0... 7FFFH	0... 99.99694	3.0518e-3	-
Abstand zur Startfähigkeitsgrenze					
Dfds [16]	O/V/S	0... FFH	0... 255	1	-
Generatorauslastungsprofil					
Dffgen	O/V	0... FFH	0... 100	0.3921569	%
calculated DF-signal from alternator					
Dfmonitor	O/V	0... FFH	0... 100	0.3921569	%
condition of battery load					
Dla_soll_puls [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-8... 7.99975	244.1e-6	-
Lambdadifferenzen aus Pulsation					
Drf_spuel	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	%
Delta RF das in der Überschneidung durchgespuelt wird					
Dwese2_h [NC_CYL_NR]	O/V	E200... 5A00H	-180 ...540	0.0234375	°CRK
Differenz zw. Einspritzende 2. Einspritzung Homogen und Zündung					
Dzw_agr_hs	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Deltazündwinkel AGR-Korrektur (homogen-schicht)					
Dzw_agr_kor	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
ignition angle correction for external exhaust gas recirculation					
Dzw_annm	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Referenzwert für B_kftkr, mittlerer adaptierter Spätziehwinkel					
Dzw_krkorll	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°CRK
Verschiebung ZW-Frühgrenze bei Klopfen im LL					
Dzwo_lam_kor	O/V	80... 7FH	-64... 63.5	0.5	°CRK
Grundreferenzzündwinkel Lambdakorrektur					
Dzwot	O/V	80... 7FH	-64... 63.5	0.5	°CRK
Grundreferenzzündwinkel Temperaturkorrektur					
Eco_jobstat1	O/V	0... FFH	0... 255	1	-
Eco Job 1 Rueckgabewer					
Eco_result1	O/V	0... FFFFH	0... 81.99874	1.2512e-3	A
ECOS Ruhestrom 1					
Eisyagr_korfak_b	O/V	0... FFH	0... 1.99218	0.0078125	-
Abgleich AGR-Modell (Faktor)					
Eisydk_korfak_b	O/V	0... FFH	0... 1.99218	0.0078125	-
Abgleich DK-Modell (Faktor)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Eisydk_koroff_b	O/V	80... 7FH	-1024 ...1016	8	kg/h
Abgleich DK-Modell (Offset)					
Eisyev_korfak_b	O/V	0... FFH	0... 1.99218	0.0078125	-
Abgleich EV-Modell (Faktor)					
Eisyev_koroff_b	O/V	80... 7FH	-1024 ...1016	8	kg/h
Abgleich EV-Modell (Offset)					
Espr	O/V	0... FFH	0... 204	0.8	°CRK
setpoint inlet camshaft					
Espr_mod_soll [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Aktueller Einspritzmodus (Sollvorgabe)					
Eta_labas	O/V	8000... 7FFFH	-200... 199.99389	6.1035e-3	%
Lambdawirkungsgrad bei Lambda_bas_cor					
Eta_labas_sol	O/V	8000... 7FFFH	-200... 199.99389	6.1035e-3	%
Lambda-Wirkungsgrad					
Eta_lambda_1	O/V	8000... 7FFFH	-200... 199.99389	6.1035e-3	%
Lambda-Wirkungsgrad, Bank1					
Eta_lambda_2	O/V	8000... 7FFFH	-200... 199.99389	6.1035e-3	%
Lambda-Wirkungsgrad, Bank 2					
Eta_md_uesp	O/V	8000... 7FFFH	-200... 199.99389	6.1035e-3	%
Wirkungsgradkorrektur beim Überspülen					
Eta_mdkh	O/V	8000... 7FFFH	-200... 199.99389	6.1035e-3	%
Wirkungsgradkorrektur bei Katheizen					
Eta_zw_minres	O/V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
Minimal möglicher Zündwinkelwirkungsgrad für Momentenreserve bezogen auf min. Zündwinkel					
F_atlad	O/V/S	0... FFFFH	0... 1.99996	30.5e-6	-
Atl-Regler Adaptionsfaktor					
F_atldyn	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Überspülfaktor					
F_bsmdres	O/V/S	0... FFH	0... 0.99609	3.9063e-3	-
Faktor Bauteilschutz zur Begrenzung der Drehmomentreserve (bei Nox-Katheizen)					
F_llr_ba	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for operation mode transition					
F_lradap1	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	-
Lambdaadaptionswert Bank1					
F_lradap2	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	-
Lambdaadaptionswert Bank2					
F_nst_ba	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for operation mode transition for TI_CAST					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
F_rkkorwl_hs	O/V	0... FFFFH	0... 3.99993	61e-6	-
Warmlaufkorrektur Homogen-Schicht nur für 1. Einspritzung					
F_rkkorwl_s	O/V	0... FFFFH	0... 3.99993	61e-6	-
Warmlaufkorrektur Schicht nur für 1. Einspritzung					
F_sicher_zw	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Überblendfaktor aus Verbrennungsregelung für Zündwinkel					
F_st_ba	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for operation mode transition for MFF_CST					
F_tikorzsk [NC_CYL_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
zylinderindividueller Einspritzkorrektur aus VBR					
F_vl_aus	O/V	0... FFFFH	0... 3.99993	61e-6	-
load factor for switching off full load					
F_vwi_ba	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Faktor zur Überblendung des Vorlagerungswinkels					
F_wl_ba	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for operation mode transition for TI_WUP_1					
F_wnwkh	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for fading ignition angle in case of catalyst heating					
F_wnwkhk	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Überblendfaktor (warm/kalt) für Spreizung und Zündhaken während Katheizen					
F_zw_hsplit	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Faktor zur Überblendung von Größen des Zündpfads					
Genitest_tol	O/V	0... FFH	0... 99.60937	0.390625	%
Toleranzbereich für Abweichung vom Sollwert Strom					
Geniutest_ab	O/V	0... FFH	0... 255	1	-
GENIUTEST Abbruchbedingung					
Geniutest_err	O/V	0... FFH	0... 255	1	-
GENIUTESTFehler					
Genutest_tol	O/V	0... FFH	0... 99.60937	0.390625	%
Def_f_ub_b100					
I_batt	O/V	0... FFFFH	-200... 5042.8	0.08	A
battery current					
I_craweng	O/V	8000... 7FFFH	-32768 ...32767	1	A
Strombedarf Motor					
I_gen	O/V	0... FFH	0... 255	1	A
Generatorstrom					
I_genmax	O/V	0... FFH	0... 255	1	A
Generatormaximalstrom					
I_gentest	O/V	0... FFH	0... 255	1	A
Modellierter Generatorstrom für Tester für Generatortest					
I_ges	O/V	0... FFFFH	0... 63.99902	976.599e-6	-
Gesamtübersetzung					
I_ha	O/V	0... FFFFH	0... 63.99902	976.599e-6	-
Übersetzung Hinterachse					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Ibhwversi	O/V	0... FFH	0... 255	1	-
IBS Hardwareversion					
Ibsderrs1	O/V/S	0... FFH	0... 255	1	-
Dibs Fehlerzähler BSD					
Ibsderrs2	O/V/S	0... FFFFH	0... 65535	1	-
Dibs Fehlerzähler EBSD					
Ibspreco2	O/V/S	0... FFH	0... 255	1	-
Vorteiler für Ibsderrs2					
Ibswbase	O/V	0... FFH	0... 255	1	-
IBS Softwarebaseline					
Ibswchang	O/V	0... FFH	0... 255	1	-
IBS SW-Änderungsstatus					
Id_bosmg	O/V	0... FFFFH	0... 65535	1	-
Id für Motoröl (BOS Kombi)					
Id_bosmgt	O/V	0... FFH	0... 255	1	-
ID für Motoröl (BOS-Tester)					
Id_bosmsg	O/V	0... FFH	0... 255	1	-
Id für Motoröl (BOS Kombi)					
Id_bosrtak	O/V	0... FFH	0... 255	1	-
Acknowledge reset durchgeführt					
Ierrgrenz	O/V	0... FFH	0... 31.875	0.125	A
Begrenzter Erregerstrom Generator 1					
Igenk	O/V/S	F32	-	F32	-
Generator aufintegriert					
Igrinfo [30]	O/V/S	0... FFH	0... 255	1	-
information storage for IGR (intelligente Generatorreglung)					
Injekt_hub_h	O/V	0... FFH	0... 255	1	-
Injektorhub Homogen					
Injekt_hub_hs	O/V	0... FFH	0... 255	1	-
Injektorhub Homogen-Schicht					
Injekt_hub_s	O/V	0... FFH	0... 255	1	-
Injektorhub Schicht					
Klann_mw1	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	-
Lambdaadaptionsmittelwert Bank1					
Klann_mw2	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	-
Lambdaadaptionsmittelwert Bank2					
Klann_test1	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	-
Lambdaadaptionswert für Tester Bank1					
Klann_test2	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	-
Lambdaadaptionswert für Tester Bank2					
Krnn_test	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Testerwert NN KR-Adaption					
Ktupcsctr	O/V/S	0... FFFFH	0... 65535	1	-
Fehlerzähler EBSD Checksumme					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
La_abgas1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Berechnete Lambda in Abgas inklusiv Durchspülung in sch, hos und hom					
La_abgas2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Berechnete Lambda in Abgas inklusiv Durchspülung in sch, hos und hom					
La_bas1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Basis-Lambda soll Bank 1					
La_bas2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Basis-Lambda soll Bank 2					
La_bs1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
lambda for catalyst overheating prevention bank 1					
La_bs2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
lambda for catalyst overheating prevention bank 2					
La_ref_homm	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda Sollwert Homogen mager					
La_sollreg [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda setpoint for controller (with lambda pulsation)					
Leminfo [40]	O/V/S	0... FFH	0... 255	1	-
information storage for LEM (Leistungskoordination Elektrisch Mechanisch)					
Lurabs_f [NC_CYL_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	-
gefilterte Laufruhedeltas eines Zylinders					
Lurdif_f [NC_CYL_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	-
gefilterte Laufruhedeltas eines Zylinders					
Md_can_dmee	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
theoretisches Moment für Getriebesteuerung					
Md_gennm_na	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
filtered torque losses due to alternator					
Md_getriebe_hs	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
torque losses for manual gear					
Md_max_klima	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
air-conditioning-compressor limit torque					
Md_na_ges	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
total torque losses for additive engine devices					
Md_na_ges_f	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
filtered total torque losses for additive engine devices					
Md_rad_ist	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Ist-Moment an den Antriebsrädern					
Md_rad_istlm	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Ist-Radmoment aus Luftmasse ohne externe Eingriffe					
Md_rad_ksoll	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
koordiniertes Wunschradmoment					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Md_rad_max	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Max. Radmoment					
Md_rad_min	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Schleppmoment unbefeuert					
Md_reib_sa	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Reibmoment					
Md_res_atlsvc	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Angeforderte Momentenreserve während der Turboladerdiagnose					
Md_res_max	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
max mögliche Momentenreserve					
Mdi_fzdyn	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Wunschkupplungsmoment nach Fahrdynamikfilterung					
Mdi_fzdyn_res	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Moment nach Fahrdynamikfilterung mit Momentenreserve					
Mdi_ist_m	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Über alle Zylinder gemitteltes inneres Motormoment					
Mdi_max	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
maximales inneres Moment					
Mdi_max_l1	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Maximales inneres Moment					
Mdi_min_hs	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Minimal mögliche Moment in Schicht					
Mdi_min_s	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres minimales Moment im Schicht					
Mdi_ml_soll	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Max. torque at air					
Mdi_ml_sollvb	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Soll-Moment Luftpfad vor Sicherheitsbegrenzung					
Mdi_nregl_plus	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Inneres Moment Drehzahlregler langsamer Pfad (erhöhend)					
Mdi_nregs_plus	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Inneres Moment Drehzahlregler schneller Pfad (erhöhend)					
Mdi_opt_l1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
reference indicated engine torque					
Mdi_opt_s	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Motormoment Schicht					
Mdi_reib	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
torque losses					
Mdi_res_max	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Moment incl. max mögliche Momentenreserve ohne Einfluss LL					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Mdi_res_maxll	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Moment incl. max mögliche Momentenreserve mit Einfluss LL					
Mdi_s_istm	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Ist-Moment im Schichtbetrieb über alle Zylinder gemittelt					
Mdi_soll	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Sollmoment					
Mdi_soll [_k]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Sollmoment					
Mdi_soll_l	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Sollmoment					
Mdi_soll_lk	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Soll-Moment langsamer Pfad ohne Sicherheitseingriff					
Mdi_wunsch	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Inneres Fahrerwunschmoment mit Begrenzung ohne Eingriffe					
Mdi_zw_soll	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
torque setpoint from ignition path					
Mdi_zw_sollcan	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
inneres Sollmoment-über den Zw einzustellen					
Mdi_zw_sollvb	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Soll-Moment Zündpfad vor Sicherheitsbegrenzung					
Mdk_max	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
max. torque at clutch					
Mdk_min	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Minimales Kupplungsmoment					
Mdk_wunsch	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
torque setpoint at clutch before filter					
Mdk_wunsch_filt	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Gefiltertes Wunschmoment					
Mdk_wunsch_ipm	O	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Torque request for IPM					
Mk_soll_h [NC_CYL_NR][NC_NR_IV_PLS]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Kraftstoffmasse Homogen als Sollwert					
Mk_soll_s	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Kraftstoffmasse Schicht als Sollwert					
Mkzyl_soll_hs [NC_CYL_NR][NC_NR_IV_PLS]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Kraftstoffmasse Homogenschicht als Sollwert (zylinderindividuell, je Einspritzung)					
Mkzyl_soll_s [NC_CYL_NR][4]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Kraftstoffmasse Schicht als Sollwert (zylinderindividuell, je Einspritzung)					
Mrnn_test_dk	O/V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Testerwert NN DK-Adaption					
Mrnn_test_pr	O/V	8000... 7FFFH	-2... 1.99993	61e-6	-
Testerwert NN PR-Adaption					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Ms_res_max	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
max Luftmassenstrom der durch Momentenreserve angefordert werden kann					
Msa_arravrs [60]	O/V/S	0... FFH	0... 255	1	-
Ringspeicher Abschaltverhinderer					
Msa_indexrs	O/V/S	0... FFH	0... 255	1	-
Index fuer den Ringspeicher Abschaltverhinderer					
Msagr	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
AGR-Massenstrom					
Msainfo [50]	O/V/S	0... FFH	0... 255	1	-
information storage for MSA (Motor-Start/Stop-Automatik)					
Msastz	O/V/S	0... FFFFH	0... 65535	1	-
Zaehler aller Startversuche					
Msastzmsa	O/V/S	0... FFFFH	0... 65535	1	-
Zaehler aller MSA-Startversuche					
Msdk	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
mass flow through throttle					
Msdk_f	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
mass flow through throttle					
Msnlgofs_tmp	O/V/S	8000... 7FFFH	-1024... 1023.96875	0.03125	kg/h
Leckluft Adaptionswert					
Mszyl	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
mass flow to cylinder					
Mszyl_ges	O/V	0... FFFFH	0... 6553.5	0.1	kg/h
total inducted air mass, including EGR					
N_dzm	O/V	0... 7FFFH	0... 32767	1	rpm
Angezeigte Drehzahl					
N_gen	O/V	0... 7FFFH	0... 32767	1	rpm
Generatordrehzahl					
N_nstart	O/V	0... 7FFFH	0... 32767	1	rpm
Motordrehzahl nach Motorstart					
Nelueft_wm	O/V	0... FFH	0... 99.60937	0.390625	%
Solldrehzahl E-Lüfter Vorgabe WM					
Newp_soll	O/V	0... FFH	0... 255	1	-
Solldrehzahl elektrische Wasserpumpe					
Nkw_poel_notl	O/V	0... 7FFFH	0... 32767	1	rpm
Max. Drehzahl bei defektem Ölsystem (Bauteilschutz)					
Nkw_poel_soll	O/V	0... 7FFFH	0... 32767	1	rpm
Soll LL-Drehzahl aus Öldruckregelung (für HLL, Testerbetrieb...)					
Nmax_ba	O/V	0... 7FFFH	0... 32767	1	rpm
Maximal-Drehzahl bei aktueller Betriebsart					
Nsl_koor	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
LL-Solldrehzahl, koordiniert					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Nslb	O/V	0... 7FFFH	0... 32767	1	rpm
engine speed correction due to battery load-bilanz					
Oz_krz2cnt	O/V	0... FFH	0... 255	1	-
Zähler 20er- Packet Niveaumessung					
Oz_krzcnt	O/V	0... FFH	0... 255	1	-
Zähler 10er- Packet Niveaumessung					
Oz_krzkor	O/V	0... FFH	0... 74.70703	0.2929688	-
Niveaumessung OrientierungsMw					
Oz_krzkor2k	O/V	0... FFH	0... 74.70703	0.2929688	-
Niveaumessung 20er- Packet					
Oz_kvbog	O/V/S	0... FFFFH	0... 65535	1	-
Zugeteilte Bonuskraftstoffmenge					
Oz_kvbsm_ul	O/V/S	0... FFFFFFFFH	0... 524288	122.1e-6	-
Kraftstoffverbrauch seit letztem Ölwechsel					
Oz_lf1t	O/V/S	0... FFH	0... 2.55	0.01	-
Länderfaktor 1 codiert					
Oz_lf2t	O/V/S	0... FFH	0... 2.55	0.01	-
Länderfaktor 2 codiert					
Oz_lgmwcnt	O/V	0... FFH	0... 255	1	-
Zähler LangzeitMw Niveaumessung					
Oz_lp	O/V	0... FFH	0... 255	1	-
Für "Ölkannenanzeige im Display"					
Oz_lv	O/V	0... FFH	0... 255	1	-
Erforderliche Nachfüllmenge Motoröl					
Oz_nivakt	O/V	0... FFH	0... 74.70703	0.2929688	-
Aktuelles Ölniveau für den DIS-Tester					
Oz_nivkor	O/V	0... FFH	0... 74.70703	0.2929688	-
Niveaumessung korrigiertes Ölniveau					
Oz_nivkrzt	O/V	0... FFH	0... 74.70703	0.2929688	-
Kurzzeit-Ölniveau-Mittelwert für den DIS-Tester					
Oz_nivlangt	O/V/S	0... FFH	0... 74.70703	0.2929688	-
Langzeit-Ölniveau-Mittelwert für den DIS-Tester					
Oz_oelkm	O/V/S	0... FFFFH	0... 655350	10	km
Oelkilometer					
Oz_oelzeit	O/V	0... FFFFH	0... 65535	1	-
Öllaufzeit					
Oz_oricnt	O/V	0... FFH	0... 255	1	-
Zähler OriMw Niveaumessung					
Oz_permakt	O/V	0... FFFFH	0... 5.9999	91.6e-6	-
Aktuelle Ölpermittivität für den DIS-Tester					
Oz_permbog	O/V/S	0... FFFFH	0... 5.9999	91.6e-6	-
Zugeteilter Permittivitätsbonus					
Oz_permex	O/V/S	0... FFFFH	0... 5.9999	91.6e-6	-
Permittivität für Bewertung aufgereitet (extrapoliert)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Oz_permlow	O/V/S	0... FFFFH	0... 5.9999	91.6e-6	-
Aufbereitete Permittivität bei letztem Ölwechsel					
Oz_permoff	O/V	0... FFFFH	0... 5.9999	91.6e-6	-
Offset für Permittivitätskorrektur					
Oz_reset	O/V	0... FFH	0... 255	1	-
Status der Reset-Art an Kombi					
Oz_rwkvb	O/V	8000... 7FFFH	-327680 ...327670	10	km
Restweg aus Kraftstoffverbrauch abgeleitet					
Oz_rwperm	O/V	8000... 7FFFH	-327680 ...327670	10	km
Restweg aus Permittivität abgeleitet					
Oz_tempakt	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Aktuelle Öltemperatur für den DIS-Tester					
Oz_vormw	O/V	0... FFH	0... 74.70703	0.2929688	-
Niveaumessung VorMw					
Oz_vormwcnt	O/V	0... FFH	0... 255	1	-
Zähler VorMw Niveaumessung					
P_oel_soll	O/V	0... FFFFH	0... 65535	1	hPa
Sollwert Öldruck					
Pldr_soll	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
Ladedruck Sollwert					
Pm_klemmstat	O/V	0... FFH	0... 255	1	-
Klemmenstatus bei Tiefentladung					
Pmbackup [7]	O/V	0... FFH	0... 255	1	-
Backupspeicher					
Pminfo1 [37]	O/V/S	0... FFFFH	0... 65535	1	%
Infospeicher 1					
Pminfo2 [29]	O/V/S	0... FFH	0... 255	1	-
Infospeicher 2					
Poel_fpwm	O/V	0... FFH	0... 255	1	Hz
Frequenz PWM Ansteuerung Öldruck-Regelventi					
Prail_out_s	O/V	0... FFFFH	0... 39.99938	610.4e-6	MPa
Raildruckvorgabe von BMW, gültig nur wenn B_prailsw gesetzt ist.					
Prail_soll	O/V	0... FFFFH	0... 39.99938	610.4e-6	MPa
Raildruckvorgabe von BMW, gültig nur wenn B_prailsw gesetzt ist.					
Prnn_test	O/V	8000... 7FFFH	-2... 1.99993	61e-6	-
Testerwert NN PR-Adaption					
Prnn_test_agr	O/V	8000... 7FFFH	-2... 1.99993	61e-6	-
Testerwert NN AGR-Adaption					
Ps	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
manifold pressure					
Ps_ist	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
measured manifold pressure					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Pspvdk	O/V	0... FFFFH	0 ...1	15.3e-6	-
pressure quotient at throttle					
Pspvdk_soll	O/V	0... FFFFH	0... 3.99993	61e-6	-
Druckverhältnis über Drosselklappe Sollwert					
Psreg [_i]	O/V	8000... 7FFFH	-2... 1.99993	61e-6	-
Saugrohrdruckregler I-Anteil					
Pssol	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
Soll-Saugrohrdruck					
Ptc_pwr	O/V	0... FFH	0... 127.5	0.5	%
Maximale Leistung, die der PTC einstellen darf					
Q_abgnox	O/V	8000... 7FFFH	-20480... 20479.375	0.625	W
Wärmestrom [W] von Abgas an Abgasanlage hinter Noxkat					
Qv_h2o	O/V/S	0... FFFFH	0... 63.99902	976.599e-6	-
bisheriger Wasserverlust					
Qv_h2oquali	O/V/S	0... FFH	0... 99.60937	0.390625	%
Qualtitätswert für Wasserverlust					
Qv_h2ostatus	O/V/S	0... FFH	0... 255	1	Ah
Statuswert für Entwicklung Wasserverlust					
Qv_nv_ezm	O/V/S	8000... 7FFFH	-32... 31.99902	976.599e-6	-
mittlerer Fehler über alle Hystereseberechnungen					
Qv_nv_start	O/V/S	80... 7FH	-128 ...127	1	A
Aus Start berechneter Kapazitätsverlust					
Qv_nv_zh	O/V/S	0... FFFFFFFFH	0... 4294967295	1	-
Zahl der Hystereseberechnungen					
Qv_out_1	O/V/S	80... 7FH	-128 ...127	1	A
Kapazitätsverlust letzter Start					
Qv_out_2	O/V/S	80... 7FH	-128 ...127	1	A
Kapazitätsverlust 2. letzter Start					
Qv_out_3	O/V/S	80... 7FH	-128 ...127	1	A
Kapazitätsverlust 3. letzter Start					
Qv_out_4	O/V/S	80... 7FH	-128 ...127	1	A
Kapazitätsverlust 4. letzter Start					
Qv_out_5	O/V/S	80... 7FH	-128 ...127	1	A
Kapazitätsverlust 5. letzter Start					
Qv_out_m	O/V/S	0... FFH	0... 99.60937	0.390625	%
Gültiger gemittelter Kapazitätsverlust					
Qv_quali_1	O/V/S	0... FFH	0... 99.60937	0.390625	%
Qualitätsindex für letzten Qv-Wert					
Qv_quali_2	O/V/S	0... FFH	0... 99.60937	0.390625	%
Qualitätsindex für 2. letzten Qv-Wert					
Qv_quali_3	O/V/S	0... FFH	0... 99.60937	0.390625	%
Qualitätsindex für 3. letzten Qv-Wert					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Qv_quali_4	O/V/S	0... FFH	0... 99.60937	0.390625	%
Qualitätsindex für 4. letzten Qv-Wert					
Qv_quali_5	O/V/S	0... FFH	0... 99.60937	0.390625	%
Qualitätsindex für 5. letzten Qv-Wert					
Qv_quali_m	O/V/S	0... FFH	0... 99.60937	0.390625	%
Qualitätsindex für gemittelten Qv-Wert					
Qv_status	O/V/S	80... 7FH	-128 ...127	1	-
Prozessstatus /Trend für gemittelten Qv-Wert					
Qv_td1	O/V/S	0... FFFFH	0... 65535	1	h
Zeit seit Qv_out_1 - Berechnung					
Qv_td2	O/V/S	0... FFFFH	0... 65535	1	h
Zeitabstand zwischen Qv_out_1 und Qv_out_2					
Qv_td3	O/V/S	0... FFFFH	0... 65535	1	h
Zeitabstand zwischen Qv_out_2 und Qv_out_3					
Qv_td4	O/V/S	0... FFFFH	0... 65535	1	h
Zeitabstand zwischen Qv_out_3 und Qv_out_4					
Qv_td5	O/V/S	0... FFFFH	0... 65535	1	h
Zeitabstand zwischen Qv_out_4 und Qv_out_5					
Qvc_status_1	O/V/S	0... FFH	0... 99.60937	0.390625	%
Ausgang für Schlüsselgröße 1					
Qvc_status_2	O/V/S	0... FFH	0... 99.60937	0.390625	%
Ausgang für Schlüsselgröße 2					
Qvc_status_3	O/V/S	0... FFH	0... 255	1	Ah
Ausgang für Schlüsselgröße 3					
Qvc_status_4	O/V/S	80... 7FH	-128 ...127	1	-
Ausgang für Schlüsselgröße 4					
Rf	O/V	0... 7530H	0... 300	0.01	%
relative cylinder filling					
Rf_ig_ist	O/V	0... 7530H	0... 300	0.01	%
Inertgas-Anteil im Brennraum					
Rf_res_max	O/V	0... 7530H	0... 300	0.01	%
Maximale rel. Füllung aus MD-Reserve für Katheizen					
Rf_soll	O/V	0... 7530H	0... 300	0.01	%
setpoint relative cylinder filling					
Rf_vl	O/V	0... 7530H	0... 300	0.01	%
maximum setpoint relative cylinder filling					
Rfv_vns	O/V	0... 7530H	0... 300	0.01	%
Relative Füllung für Vanos					
Rk_add_wf	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
Wandfilmkorrektur DI Homogen					
Rk_kor_h	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
rel. Kraftstoffmasse homogen stationär					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Rk_kor_kva	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
Korrigierte Kraftstoffmasse für Kraftstoffverbrauchsanzeige					
Rk_korres_hs	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
Korrigiertes Rk_soll mit Momentenreserve (homogen-schicht)					
Rk_korres_s	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
Korrigiertes Rk_soll mit Momentenreserve (schicht)					
Rk_vlo_hs	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
Umschaltgrenze Homogenschicht					
Rk_vlo_s	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
Umschaltgrenze Schicht					
Rkte_max	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
Max zul. Menge Kraftstoff aus TE					
Rkte_md	O/V	8000... 7FFFH	-1600... 1599.95117	0.0488281	%
Momentenrelevanter Teil der Kraftstoffmasse					
Rqpcos	O/V	0... FFH	0... 255	1	-
Anforderung Standverbraucher					
Rt_bastatg_h	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Relative Zeit Homogen Betrieb gesamter Motorlauf					
Rt_bastatg_hs	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Relative Zeit Homogen-Schicht-Betrieb gesamter Motorlauf					
Rt_bastatg_s	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Relative Zeit Schicht-Betrieb gesamter Motorlauf					
Rt_bastatg_sa	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Relative Zeit Homogen Betrieb gesamter Motorlauf					
Selspcos	O/V	0... FFH	0... 255	1	-
Selection special consumers					
Snibs	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Seriennummer IBS					
Spa_art	O/V	0... FFH	0... 255	1	-
Anzeigeart für Schaltpunktanzeige					
Spa_art_2	O/V	0... FFH	0... 255	1	-
Anzeigeart für Schaltpunktanzeige 2					
Spa_gang	O/V	0... FFH	0... 255	1	-
Gang für die Schaltpunktanzeige					
St_aekh	O/V/S	0... FFH	0... 255	1	-
Carrier Byte "Aussetzererkennung Katheizen"					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_aekh_ae	O/V	0... FFH	0... 255	1	-
Statuswort Aussetzer erkannt zylinderselektiv					
St_ar1	O/V	0... FFH	0... 255	1	-
Statuswort Antiruckel					
St_atldiag2_out	O/V	0... FFH	0... 255	1	-
Statusbyte Interface Ausgang					
St_atlstat	O/V	0... FFH	0... 255	1	-
Statuswort Laderstatus					
St_atlsvc	O/V	0... FFH	0... 255	1	-
Status während der Diagnose der Abgasturbolader					
St_atlsvc_pvdk	O/V	0... FFH	0... 255	1	-
Ergebnis der Diagnosefunktion der Abgasturbolader					
St_atlsvc_start	O/V	0... FFH	0... 255	1	-
Status nach Aufruf der Diagnosefunktion der Abgastutbolader					
St_ba_agf	O/V	0... FFH	0... 255	1	-
Status Betriebsarten angefordert					
St_blsdisa2	O/V	0... FFH	0... 255	1	-
Statuswort BLSDISA Ausgang					
St_blshub	O/V	0... FFH	0... 255	1	-
Statuswort BLSHUB					
St_bns	O/V/S	0... FFH	0... 255	1	-
Statusbyte Bordnetzstabilität					
St_deavns2	O/V/S	0... FFH	0... 255	1	-
Status Bedingung Vanos im Anschlag					
St_dgen0	O/V	0... FFH	0... 255	1	-
Statusbyte DGEN					
St_dgenerrst_md1	O/V/S	0... FFFFH	0... 65535	1	-
Statusbyte Fehlerzuweisung zu Messdatensatz1					
St_dgenerrst_md2	O/V/S	0... FFFFH	0... 65535	1	-
Statusbyte Fehlerzuweisung zu Messdatensatz2					
St_dgengrenz1	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit X (z.B. 10min)					
St_dgengrenz1_md1	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit X (z.B. 10min) zu 1. Messdatensatz					
St_dgengrenz1_md2	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit X (z.B. 10min) zu 2. Messdatensatz					
St_dgengrenz2	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit Y (z.B. 30min)					
St_dgengrenz2_md1	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit Y (z.B. 30min) zu 1. Messdatensatz					
St_dgengrenz2_md2	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit Y (z.B. 30min) zu 2. Messdatensatz					
St_dgengrenzerr	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Erregerstrombegrenzung					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_dgengrenzerr_md1	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Erregerstrombegrenzung zu 1. Messdatensatz					
St_dgengrenzerr_md2	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Erregerstrombegrenzung zu 2. Messdatensatz					
St_dgengrenznz	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit Z (z.B. 2min)					
St_dgengrenznz_md1	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit Z (z.B. 2min) zu 1. Messdatensatz					
St_dgengrenznz_md2	O/V/S	0... FFH	0... 31.875	0.125	A
Mittelwert der Erregerstrombegrenzung über applizierbare Zeit Z (z.B. 2min) zu 2. Messdatensatz					
St_dgenub1	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Mittelwert der Batteriespannung über applizierbare Zeit X (z.B. 10min)					
St_dgenub1_md1	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Mittelwert der Batteriespannung über applizierbare Zeit X (z.B. 10min) zu 1. Messdatensatz					
St_dgenub1_md2	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Mittelwert der Batteriespannung über applizierbare Zeit X (z.B. 10min) zu 2 Messdatensatz					
St_dgenub2	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Mittelwert der Batteriespannung über applizierbare Zeit X (z.B. 30min)					
St_dgenub2_md1	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Mittelwert der Batteriespannung über applizierbare Zeit X (z.B. 30min) zu 1. Messdatensatz					
St_dgenub2_md2	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Mittelwert der Batteriespannung über applizierbare Zeit X (z.B. 30min) zu 2. Messdatensatz					
St_dgenuberr	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Batteriespannung					
St_dgenuberr_md1	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Batteriespannung zu 1. Messdatensatz					
St_dgenuberr_md2	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Batteriespannung zu 2. Messdatensatz					
St_dgenubnz	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Statuswort Messung Spannung Ub					
St_dgenubnz_md1	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Mittelwert der Batteriespannung über applizierbare Zeit Z (z.B. 2min) zu 1. Messdatensatz					
St_dgenubnz_md2	O/V/S	0... FFFFH	0... 6173.397	0.0942	V
Mittelwert der Batteriespannung über applizierbare Zeit Z (z.B. 2min) zu 2. Messdatensatz					
St_dgenugen1	O/V/S	0... FFFFH	0... 6553.5	0.1	V
Mittelwert der Generatorsollspannung über applizierbare Zeit X (z.B. 10min)					
St_dgenugen1_md1	O/V/S	0... FFFFH	0... 6553.5	0.1	V
Mittelwert der Generatorsollspannung über applizierbare Zeit X (z.B. 10min) zu 1. Messdatensatz					
St_dgenugen1_md2	O/V/S	0... FFFFH	0... 6553.5	0.1	V
Mittelwert der Generatorsollspannung über applizierbare Zeit X (z.B. 10min) zu 2. Messdatensatz					
St_dgenugen2	O/V/S	0... FFFFH	0... 6553.5	0.1	V
Mittelwert der Generatorsollspannung über applizierbare Zeit Y (z.B. 30min)					
St_dgenugen2_md1	O/V/S	0... FFFFH	0... 6553.5	0.1	V
Mittelwert der Generatorsollspannung über applizierbare Zeit X (z.B. 30min) zu 1. Messdatensatz					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_dgenugen2_md2	O/V/S	0... FFH	0... 25.5	0.1	V
Mittelwert der Generatorsollspannung über applizierbare Zeit X (z.B. 30min) zu 2. Messdatensatz					
St_dgenugenerr	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Generatorsollspannung					
St_dgenugenerr_md1	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Generatorsollspannung zu 1. Messdatensatz					
St_dgenugenerr_md2	O/V/S	0... FFH	0... 255	1	-
Fehlerstati zur Generatorsollspannung zu 2. Messdatensatz					
St_dgenugennz	O/V/S	0... FFFFH	0... 6553.5	0.1	V
Statuswort Messung Spannung Ugen					
St_dgenugennz_md1	O/V/S	0... FFFFH	0... 6553.5	0.1	V
Mittelwert der Generatorsollspannung über applizierbare Zeit Z (z.B. 2min) zu 1. Messdatensatz					
St_dgenugennz_md2	O/V/S	0... FFFFH	0... 6553.5	0.1	V
Mittelwert der Generatorsollspannung über applizierbare Zeit Z (z.B. 2min) zu 2. Messdatensatz					
St_dibs0	O/V/S	0... FFH	0... 255	1	-
Bitbasis dibs					
St_disa_bmw	O/V	0... FFH	0... 255	1	-
Status Disa					
St_dps	O/V	0... FFH	0... 255	1	-
Statuswort					
St_dsc_mradist	O/V	0... FFH	0... 255	1	-
Status Ist-Radmoment					
St_ecostat2	O/V/S	0... FFH	0... 255	1	-
Ecos Statusbyte 2					
St_eisy_hfm	O/V	0... FFH	0... 255	1	-
Status Eisy adaption					
St_eisyad_read	O/V/S	0... FFH	0... 255	1	-
Status Eisy adaption					
St_eisydiag1	O/V	0... FFH	0... 255	1	-
Diagnose Mslam					
St_eisydiag2	O/V	0... FFH	0... 255	1	-
Diagnose Mslam					
St_entlast_loc	O/V	0... FFH	0... 255	1	-
Status ENTLAST_LOC					
St_es_urstart	O/V	0... FFH	0... 255	1	-
Status Urstart					
St_fas_mradist	O/V	0... FFH	0... 255	1	-
Status Radmoment Ist					
St_fw	O/V	0... FFH	0... 255	1	-
Statuswort mdfw					
St_gen	O/V	0... FFH	0... 255	1	-
Status Generator					
St_gentest	O/V	0... FFH	0... 255	1	-
Status Generatortest					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_gl_adapt	O/V	0... FFH	0... 255	1	-
Statusbyte adaption KH					
St_hhs	O/V	0... FFH	0... 255	1	-
carrierbyte HHS					
St_igroutnv	O/V/S	0... FFH	0... 255	1	-
Statusbyte St_igrout					
St_imdgen0	O/V	0... FFH	0... 255	1	-
Statuswort Imdgen					
St_injad_quit	O/V	0... FFH	0... 255	1	-
Quittung Adaptionsanforderung d. Kleinstmengen					
St_kath_ena	O/V	0... FFH	0... 255	1	-
Statuswort erlaubte Katheizmassnahmen					
St_klann_ad1	O/V	0... FFH	0... 255	1	-
Statusbyte fuer klann_ad1					
St_klann_ad2	O/V	0... FFH	0... 255	1	-
Statusbyte fuer klann_ad2					
St_ldm_kupp	O/V	0... FFH	0... 255	1	-
Status_Kraftschluss					
St_ldstgen	O/V	0... FFH	0... 255	1	-
Lastzustand Generator					
St_llranh0	O/V	0... FFH	0... 255	1	-
Statusbyte Leerlaufdrehzahlanhebung					
St_mdar0	O/V	0... FFH	0... 255	1	-
Statuswort mdar 0					
St_mdar1	O/V	0... FFH	0... 255	1	-
Statuswort mdar 1					
St_mdar2	O/V	0... FFH	0... 255	1	-
Statuswort mdar2					
St_mdbafak	O/V	0... FFH	0... 255	1	-
Status MDBAFAK					
St_mdbafak2	O/V	0... FFH	0... 255	1	-
Status MDBAFAK					
St_mdbanl_pwgll	O/V	0... FFH	0... 255	1	-
Statuswort für Bits					
St_mdbanl2	O/V	0... FFH	0... 255	1	-
Statusbyte Notlaufmanager					
St_mdinfo_ges	O/V	0... FFH	0... 255	1	-
Status Momenteneingriffe					
St_mdk	O/V	0... FFH	0... 255	1	-
Status Momentenstruktur					
St_mdrk2	O/V	0... FFH	0... 255	1	-
Statusbyte					
St_mdrv_anz	O/V	0... FFH	0... 255	1	-
Über dieses Signal wird die MDrive- Anzeige im Kombi gesteuert.					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_mdrv_dsc	O/V	0... FFH	0... 255	1	-
Das Signal gibt an, welcher Modus für das System DSC im M-Drive voreingestellt ist.					
St_mdrv_eng	O/V	0... FFH	0... 255	1	-
Das Signal gibt an, welcher Modus für die Motorsteuerung im M-Drive voreingestellt ist.					
St_mdrv_mod_grb	O/V	0... FFH	0... 255	1	-
Das Signal gibt an, welcher Modus für das Getriebe im MDrive voreingestellt ist.					
St_mdrv_stg_grb	O/V	0... FFH	0... 255	1	-
Das Signal gibt an, welche Drive- Logic-Stufe für das Getriebe im M-Drive voreingestellt ist.					
St_mini	O/V	0... FFH	0... 255	1	-
Statuswort für Bits					
St_msaa	O/V	0... FFH	0... 255	1	-
Statusbyte msaa					
St_msaanz	O/V	0... FFFFH	0... 65535	1	-
Statusword msaanz					
St_msabs	O/V	0... FFH	0... 255	1	-
Statusbyte MSA-Betriebstrategie					
St_msdssm	O/V	0... FFH	0... 255	1	-
Statuswort mdssm					
St_ngang	O/V/S	0... FFH	0... 255	1	-
Status Nullgangerkennung					
St_ngang0	O/V	0... FFH	0... 255	1	-
Status Nullgangerkennung					
St_nmax_ba	O/V	0... FFH	0... 255	1	-
Statuswort für CC Meldung Drehzahlbegrenzung aus MDBA					
St_oz_o	O/V	0... FFH	0... 255	1	-
Statusbyte für Ausgänge OZ					
St_ozbg0	O/V	0... FFH	0... 255	1	-
Statuswort OZBG					
St_pmdiag0	O/V	0... FFH	0... 255	1	-
Statuswort PMDIAG					
St_pmdiag1	O/V	0... FFH	0... 255	1	-
Statuswort PMDIAG					
St_pmprsvcalc1	O/V	0... FFH	0... 255	1	-
Statuswort PMPRSVCALC					
St_poelreg2	O/V	0... FFH	0... 255	1	-
Status Öldruckregelung 2					
St_pr	O/V	0... FFH	0... 255	1	-
Status Raildruck					
St_prailpulskor	O/V	0... FFH	0... 255	1	-
Container für Bits					
St_prestoppmsa	O/V	0... FFH	0... 255	1	-
Statuswort f. MSA-Prestopp					
St_qvc1	O/V	0... FFH	0... 255	1	-
Status QVC					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_rail	O/V	0... FFH	0... 255	1	-
Statuswort Raildruckregler					
St_rf1	O/V	0... FFH	0... 255	1	-
Statusbyte					
St_rk_kva	O/V	0... FFH	0... 255	1	-
Container für Bits					
St_sa	O/V	0... FFH	0... 255	1	-
Statuswort Schubabschaltung					
St_sa_atmph	O/V	0... FFH	0... 255	1	-
Statusbyte Ausgang Schubabschaltung von ATMPH					
St_sleep	O/V	0... FFH	0... 255	1	-
Statusbyte Sleep					
St_sondenheiz	O/V	0... FFH	0... 255	1	-
Statusbyte St_sondenheiz					
St_statmkor1	O/V	0... FFH	0... 255	1	-
Statuswort					
St_testpoelsys	O/V	0... FFH	0... 255	1	-
Statuswort für Überprüfung Ölsystem im Testerbetrieb					
St_testpoelsys2	O/V	0... FFH	0... 255	1	-
Zusätzliche Info zu Überprüfung Öldrucksystem im Testerbetrieb					
St_ti_b	O/V	0... FFH	0... 255	1	-
Status "Begrenzung der Einspritzzeit"					
St_tiausgang	O/V	0... FFH	0... 255	1	-
Status Einspritzung					
St_ubw	O/V/S	0... FFH	0... 255	1	-
carrierbyte "Spannungswaechter"					
St_ugenkor0	O/V	0... FFH	0... 255	1	-
Status Ugenkor					
St_vbrzyl_aus	O/V	0... FFFFH	0... 65535	1	-
Status Zylindergleichstellung					
St_vsa	O/V	0... FFH	0... 255	1	-
Status Anschlagadaption Auslass					
St_vse	O/V	0... FFH	0... 255	1	-
Status Anschlagadaption Einlass					
St_wesb_s	O/V	0... FFH	0... 255	1	-
Status Einspritzwinkel 3. Einspritzung Schicht Wesb/Wese					
St_wese	O/V	0... FFH	0... 255	1	-
Status Einspritzwinkel					
St_wm1	O/V	0... FFH	0... 255	1	-
Statusbyte fuer Ausgang WM-Koordinator					
St_zwbts1	O/V	0... FFH	0... 255	1	-
Status Bauteilschutzfunktion					
St_zwgrund	O/V	0... FFH	0... 255	1	-
Statuswort ZWGRUND					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Stat_fofumx_anf	O/V	0... FFFFH	0... 65535	1	-
Anforderung maximale Folgefunken (Zylinderselektiv)					
Stat_lvs	O/V	0... FFH	0... 255	1	-
Stufe Laufruheverbesserung in Schicht					
Stat_sv_reg1	O/V	0... FFH	0... 255	1	-
Status Standverbraucher registriert Teil 1					
Stat_sv_reg2	O/V	0... FFH	0... 255	1	-
Status Standverbraucher registriert Teil 2					
Stat_zyl_aus	O/V	0... FFH	0... 255	1	-
Zylinderausblendanforderung					
Stmsa	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Status MSA und Funktionsabschalter					
Stmsaaa	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Status MSA Abschaltaufforderer					
Stmsaav	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Status MSA aktiv und bereit und Abschaltverhinderer					
Stmsaea	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Status MSA Einschaltaufforderer					
Stmsaev	O/V	0... FFFFFFFFH	0... 4294967295	1	-
Status MSA Einschaltverhinderer					
Stpcos	O/V	0... FFH	0... 255	1	-
Status Standverbraucher					
T_batt	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
battery temperature					
T_ikat1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemperatur im Kat, Bank1					
T_ikat1_stat	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
stationäre Abgastemperatur im Kat, Bank1					
T_ikat2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemperatur im Kat, Bank2					
T_ikat2_stat	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
stationäre Abgastemperatur im Kat, Bank2					
T_prail_mon_xb_ypb [SY_PRAIL_MON_ANZ_ SCHWELLEN][SY_ANZ_PRAILSENS]	O/V/S	0... FFFFFFFFH	0... 42949672.95	0.01	s
Raildruckmonitor: aufintegrierte Zeit des Raildrucks Prail_ist_xpb von Rail ix zwischen Schwellen iy					
T2histshort	O/V	0... FFH	0... 3808	14.933333	min
Zeit, indem der Ruhestrom bei 80..200mA liegt					
T3histshort	O/V	0... FFH	0... 3808	14.933333	min
Zeit, indem der Ruhestrom bei 200..1000mA liegt					
T4histshort	O/V	0... FFH	0... 3808	14.933333	min
Zeit, indem der Ruhestrom größer als 1000mA liegt					
Tabg_asens	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Modellierte Abgastemperatur am Temperatursensor (Rohr 15)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Tabg_demax1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Max. Temperatur für Desulfatisierung Bank1					
Tabg_demax2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Max. Temperatur für Desulfatisierung Bank2					
Tabg_demaxav	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Gemittelte max.Temperatur für Desulfatisierung					
Tabg_desul	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
max. Temperatur im Unterbodenkat für Desulfatisierung					
Tabg_ikat_av	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemp. im Kat gemittelt					
Tabg_inok1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Temperatur im Noxkat 1.Mono Bank1					
Tabg_inok2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Temperatur im Noxkat 1.Mono Bank2					
Tabg_nk_av	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Gemittelte Temperatur nach Kat					
Tabg_nk1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemp. nach Kat Bank 1					
Tabg_nk2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemp. nach Kat Bank 2					
Tabg_nnok1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Temperatur im Noxkat 2.Mono Bank1					
Tabg_nnok2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Temperatur im Noxkat 2.Mono Bank2					
Tabg_nok_av	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Mittelwert der Temperaturen im Monolith Unterbodenkat					
Tabg_nok_av1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Mittelwert der Temperaturen im Monolith Unterbodenkat Bank1					
Tabg_nok_av2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Mittelwert der Temperaturen im Monolith Unterbodenkat Bank2					
Tabg_nokmax	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Maximum der Temperaturen im Monolith Unterbodenkat					
Tabg_nokmax1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Maximum der Temperaturen im Monolith Unterbodenkat Bank1					
Tabg_nokmax2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Maximum der Temperaturen im Monolith Unterbodenkat bank 2					
Tabg_nokmin	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Minimum der Temperaturen im Monolith Unterbodenkat					
Tabg_r10	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemperatur nach Rohr 10, nach Kat, Bank2					
Tabg_r9	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemperatur nach Rohr 9, nach Kat, Bank1					
Tabg_vk_av	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Gemittelte Temperatur vor Kat					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Tabg_vk1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemperatur vor Kat, Bank1					
Tabg_vk2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Abgastemperatur vor Kat, Bank2					
Td_wese [NC_CYL_NR][2]	O/V	0... FFFFH	0... 262.14	0.004	ms
Zeitabstände Einspritzung Schicht (Zylinder, 1-2)					
Td_wese23min_hs [NC_CYL_NR]	O/V	0... FFFFH	0... 262.14	0.004	ms
minimaler Zeitabstand Einspritzung zw. 2 und 3 in Homogen-Schicht					
Tevt_mdl	O	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Temperatur am Einlassventil modelliert					
Tgen	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Generatortemperatur					
Tget_b1	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Temperatur < 80°C					
Tget_b2	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
80°C =< Temperatur =< 109°C					
Tget_b3	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
110°C =< Temperatur =< 124°C					
Tget_b4	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
125°C =< Temperatur =< 129°C					
Tget_b5	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Temperatur > 129°C					
Tlrgen	O/V	0... FFH	0... 25.5	0.1	s
physical input for load response time					
Tmot_b1	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Temperatur < 98°C					
Tmot_b2	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
98°C =< Temperatur =< 112°C					
Tmot_b3	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
113°C =< Temperatur =< 120°C					
Tmot_b4	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
121°C =< Temperatur =< 125°C					
Tmot_b5	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Temperatur > 125°C					
Toel	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
Öltemperaturausgabe					
Toel_b1	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Temperatur < 80°C					
Toel_b2	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
80°C =< Temperatur =< 110°C					
Toel_b3	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
110°C =< Temperatur =< 135°C					
Toel_b4	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
135°C =< Temperatur =< 150°C					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Toel_b5	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Temperatur > 150°C					
Toel_oz	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
Öltemperaturausgabe					
Tumg_abst	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
Abstell-Aussentemperatur					
Tumg_b1	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Temperatur < 3°C					
Tumg_b2	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
3°C =< Temperatur =< 19°C					
Tumg_b3	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
20°C =< Temperatur =< 29°C					
Tumg_b4	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
30°C =< Temperatur =< 39°C					
Tumg_b5	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Temperatur > 39°C					
Tumg_battab	O/V	FE0C... 5DCH	-50 ...150	0.1	°C
Abstell-Umgebungstemperatur Batterie					
Tv_kft	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Ausgegebenes TV für KFT					
Tv_poel	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Tastverhältnis Öeldruck-Regelventil					
Tvneutral	O/V/S	0... FFFFH	0... 655.35	0.01	%
Tastverhältnis Nullgangsensor					
Tvulv	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Tastverhältnis Umluftventil					
Tvwg	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Wastegate 1 PWM Ausgang					
Tvwg2	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Wastegate 2 PWM Ausgang					
Tw_m1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Rohrwandtemperatur vor Kat, Bank 1					
Tw_m2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Rohrwandtemperatur vor Kat, Bank 2					
Tw_nk1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Rohrwandtemperatur nach Kat, Bank 1					
Tw_nk2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Rohrwandtemperatur nach Kat, Bank 2					
Tw_noxsens	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Rohrwandtemperatur am Noxsensor					
U_batt	O/V	0... FFFFH	6... 22.38375	0.00025	V
Batteriespannung von IBS gemessen					
U_gen	O/V	0... FFFFH	0... 6553.5	0.1	V
generator voltage					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
U_gentest	O/V	0... FFFFH	0... 6553.5	0.1	V
Sollspannung für Tester für Generatortest					
Ubt	O/V	0... FFFH	0... 61.425	0.015	V
voltage battery					
ulev	O	0... FFH	0... 255	1	-
Spannungsebene (internal used)					
Ulev	O	0... FFH	0... 255	1	-
Spannungsebene (internal used)					
Vsa_spri	O/V	0... FFFFH	0... 6553.5	0.1	°CRK
spread angle outlet camshaft					
Vsa_sprn	O/V	0... FFFFH	0... 6553.5	0.1	°CRK
spread angle outlet camshaft at reference conditions (warm engine)					
Vsadw_md6_mx	O/V	0... FFFFH	0... 655.35	0.01	°CRK
Testlimit Regelabweichung Vanos Auslass für Mode$06					
Vsadw_md6_tst	O/V/S	0... FFFFH	0... 655.35	0.01	°CRK
Testergebnis Regelabweichung Vanos Auslass für Mode$06					
Vse_spri	O/V	0... FFFFH	0... 6553.5	0.1	°CRK
spread angle inlet camshaft					
Vse_sprn	O/V	0... FFFFH	0... 6553.5	0.1	°CRK
spread angle intlet camshaft at reference conditions (warm engine)					
Vsedw_md6_mx	O/V	0... FFFFH	0... 655.35	0.01	°CRK
Testlimit Regelabweichung Vanos Einlass für Mode$06					
Vsedw_md6_tst	O/V/S	0... FFFFH	0... 655.35	0.01	°CRK
Testergebnis Regelabweichung Vanos Einlass für Mode$06					
Wdk_diag	O/V	0... 1000H	0... 100	0.0244141	%
Berechneter Winkel der Drosselklappe aus Hauptfüllungsignal					
Wdk_soll	O/V	0... 1000H	0... 100	0.0244141	%
setpoint throttle opening					
Wes_soll_h [NC_CYL_NR][NC_PLS_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Soll Einspritzwinkel homogen					
Wesb_s [NC_CYL_NR]	O/V	E200... 5A00H	-180 ...540	0.0234375	°CRK
Winkel Einspritzbeginn Haupteinspritzung schicht zylinderindividuell					
Wesb1_h [NC_CYL_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Einspritzbeginn 1. Einspritzung Homogen					
Wesb1_hs [NC_CYL_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Einspritzbeginn 1. Einspritzung Homogen-stratified					
Wesb2max_h	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Frühest möglicher Einspritzbeginnwinkel 2. Einspritzung Homogen					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Wesb3max	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Frühest möglicher Einspritzbeginnwinkel 3. Einspritzung Homogen					
Wesb4_s [NC_CYL_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Einspritzbeginn 3. Einspritzung Schicht					
Wesbkh_s [NC_CYL_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Einspritzbeginn Katheizeinspritzung Schicht					
Wese_s [NC_CYL_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Winkel Einspritzende Haupteinspritzung Schicht zylinderindividuell					
Wese2_h [NC_CYL_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Einspritzendewinkel 2. Einspritzung Homogen absolut zum ZOT					
Wese2_hs [NC_CYL_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Einspritzende 2. Einspritzung Homogen-stratified					
Wese3_h [NC_CYL_NR]	O/V	E200... 5A00H	-180 ...540	0.0234375	°CRK
Einspritzendewinkel 3. Einspritzung Homogen absolut zum ZOT					
Wese3_hs [NC_CYL_NR]	O/V	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Einspritzendewinkel 3. Einspritzung Homogen-Schicht					
Zbibs	O/V/S	0... FFFFFFFFH	0... 4294967295	1	-
Zusbaunummer					
Zr_lvs_0	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufe 0 LVS					
Zr_lvs_1	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufe 1 LVS					
Zr_lvs_2	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufe 2 LVS					
Zr_lvs_3	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufe 3 LVS					
Zr_lvs_ll_reakt	O/V/S	0... FFH	0... 255	1	-
Anzahl der schnellen LVS Reaktionen im Leerlauf					
Zr_lvssekt_0	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 0					
Zr_lvssekt_1	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 1					
Zr_lvssekt_2	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 2					
Zr_lvssekt_3	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 3					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Zr_lvssekt_4	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 4					
Zr_lvssekt_5	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 5					
Zr_lvssekt_6	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 6					
Zr_lvssekt_7	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 7					
Zr_lvssekt_8	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung in Sektor 8					
Zr_lvszyl_0	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung durch Zylinder 0					
Zr_lvszyl_1	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung durch Zylinder 1					
Zr_lvszyl_2	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung durch Zylinder 2					
Zr_lvszyl_3	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung durch Zylinder 3					
Zr_lvszyl_4	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung durch Zylinder 4					
Zr_lvszyl_5	O/V/S	0... FFFFH	0... 65535	1	-
Anzahl Stufenerhöhung durch Zylinder 5					
Zrbosmld	O/V/S	0... FFH	0... 255	1	-
Servicezähler für BOS-Meldung					
Zw_grund1	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Grundzündwinkel ohne Kr mit Kr- und ROZ-Adaption Bank 1					
Zw_grund2	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Grundzündwinkel ohne Kr mit Kr- und ROZ-Adaption Bank 2					
Zw_offkorrvr [NC_CYL_NR]	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Zündwinkelkorrektur durch Verbrennungsregelung					
Zw_opt1	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Optimaler Zündwinkel mit Tmot- und Lambdaeinfluss Bank 1					
Zw_opt2	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Optimaler Zündwinkel mit Tmot- und Lambdaeinfluss Bank 2					
Zw_soll_hs [NC_CYL_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°CRK
Zündwinkel der über die TPU ausgegeben wird. Dieser Zündwinkel ist für den Homogen- Schichtbetrieb gültig.					
Zw_soll_s [NC_CYL_NR]	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°CRK
Zündwinkel der über die TPU ausgegeben wird. Dieser Zündwinkel ist für den Homogen- und den Schichtbetrieb gültig.					

General information:

Data description of BMW outputs. For more detailed information on datatypes and short description please refer to the BMW layer specification.

Application conditions

Initialisation: 0

```
 except :
I_ha:         63
Bosconf :           from nonvolatile memory
```

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```
Eisyagr_korfak_b:  1
F_atlad:                  from nonvolatile memory
T_prail_mon_xb_ypb[i][j]:  From NVMY
Vsadw_md6_tst, Vsedw_md6_tst:  From NVMY
F_ffboost :                1
F_szboost :        1
La_bs1/ 2 :                  2
Oz_kvbsm_ul :        from nonvolatile memory
Ps :                        Pu
St_ldstgen :        2
Tumg_abst :        from nonvolatile memory
Tumg_battab :        from nonvolatile memory
Eta_labas, Eta_labas_sol:  100%
Eta_lambda_1, Eta_lambda_2:  100 %
Nmax_ba:                9000 rpm
Absch_korr:        from nonvolatile memory
Bosfxid2:                  from nonvolatile memory
Bosid2:                  from nonvolatile memory
D_soc:                  from nonvolatile memory
Eta_md_uesp:        100%
Eta_mdkh:                  100%
F_bsmdres:   1.0
Ibsderrs1:           from nonvolatile memory
Ibsderrs2:                from nonvolatile memory
Ibspreco2:                  from nonvolatile memory
Ktupcsctr:                from nonvolatile memory
La_sollreg[NC_CBK_EX_NR]:       1.0
Msa_arravrs[60]        from nonvolatile memory
Msa_indexrs        from nonvolatile memory
Msastz              from nonvolatile memory
Msastzmsa        from nonvolatile memory
Nmax_ba:                9000
Oz_nivlangt:        from nonvolatile memory
Oz_oelkm:                from nonvolatile memory
St_dibs0              from nonvolatile memory
Bosjziel                from nonvolatile memory
Bosmziel                from nonvolatile memory
Bosprog2              from nonvolatile memory
Bosres                from nonvolatile memory
Bosrw2                from nonvolatile memory
Tabg_r10                first valid value
Tabg_r9              first valid value
Tabg_vk1              first valid value
Tabg_vk2              first valid value
Tw_m1                first valid value
Tw_m2              first valid value
Stat_sv_reg1        first valid value
Stat_sv_reg2        first valid value
Tabg_demax1        first calculated value
Tabg_demax2        first calculated value
Tabg_demaxav        first calculated value
Tabg_ikat_av        first calculated value
Tabg_nk1              first calculated value
Tabg_nk2              first calculated value
Tabg_nk_av        first calculated value
Tabg_vk_av        first calculated value
Bosbtvfbk:                  from nonvolatile memory
```

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```
Bosrlsm:                from nonvolatile memory
Oz_kvbog:                from nonvolatile memory
Pminfo1[37]:        from nonvolatile memory
Pminfo2[29]:   from nonvolatile memory
Zrbosmld:                from nonvolatile memory
St_bns              from nonvolatile memory
St_ubw              from nonvolatile memory
St_deavns2       last calculated value
St_sleep              1
Tw_nk1              first calculated value
Tw_nk2               first calculated value
Oz_permbog       from non volatile memory
Oz_permex       from non volatile memory
Oz_permlow       from non volatile memory
Oz_lf1t:                 from non volatile memory
Oz_lf2t:                 from non volatile memory
Igrinfo[30]:                 from non volatile memory
Leminfo[40]:          from non volatile memory
Msainfo[50]:          from non volatile memory
St_igroutnv:          from non volatile memory
Pspvdk_soll:        1.00
Psreg_i:                1.00
Prnn_test:           last calculated value
Prnn_test_agr:        last calculated value
Poel_fpwm:   244 Hz
Tabg_desul, Tabg_inok1, Tabg_inok2,  Tabg_nnok1,  Tabg_nnok2,
Tabg_nok_av,  Tabg_nok_av1, Tabg_nok_av2, Tabg_nokmax, Tabg_
nokmax1, Tabg_nokmax2, Tabg_nokmin, Q_abgnox, Tw_noxsens:
first calculated value
Read from NVRAM:
  Bszsi, Dfds[16], Igenk, Genitest_tol, Genitest_bol, Qv_h2o,
Qv_h2oquali, Qv_h2ostatus, St_ecostat2, St_spa2, Zr_lvs_ll_
reakt
Initialisation by BMW:
   Bosstate, Id_bosmg, Id_bosmsg, Oz_lp, Oz_lv, Ba_ist,Krn_
test, U_gen, Wdk_diag, Zbibs, Zw_grund1, Zw_grund2, Zw_opt1,
Zw_opt2, Mrnn_test_dk,  Qv_nv_ezm, Qv_nv_ezm, Qv_nv_start,
Qv_nv_zh, Qv_out_1, Qv_out_2, Qv_out_3, Qv_out_4, Qv_out_5,
Qv_out_m, Qv_quali_1, Qv_quali_2, Qv_quali_3, Qv_quali_4, Qv_
quali_5, Qv_quali_m, Qv_status, Qv_td1, Qv_td2, Qv_td3, Qv_
td4, Qv_td5, Qvc_status_1, Qvc_status_2, Qvc_status_3, Qvc_
status_4, Msnlgofs_tmp, Tvneutral, St_dgen.., Mdi_max, St_
ngang,
Calculated in PWL:
 Last valid value:      Dfds[16] (once), Lurabs_f/ Lurdif_
f, Rt_bastatg_sa
```

Recurrence:

10 ms
 except :
segment :   Zw_md[NC_CYL_NR] , Ps, Ps_ist, Pspvdk, Rf, Mk_soll_s, Mkzyl_soll_s[NC_CYL_NR] [NC_NR_INJ_PULSES+1], Msagr, Msdk, Msdk_f, Mszyl, Mszyl_ges, Lurdif_f/ Lurabs_f, Wesb1_h, Wesb1_hs, Wese2_hs, Wese_s, Wese2_h[NC_CYL_NR], Mkzyl_soll_hs[NC_CYL_NR] [NC_NR_INJ_PULSES], Mk_soll_h[NC_CYL_NR] [NC_NR_INJ_PULSES], F_rkkorwl_hs, F_rkkorwl_s, Msnlgofs_tmp, Wese3_h[NC_CYL_NR], Amo_05, Amo_10, Amo_15, Amo_20, Amo_30, Amo_40, Dla_soll_puls[NC_CBK_EX_NR], Td_wese[NC_CYL_NR][2],

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Td_wese23min_hs[NC_CYL_NR], Wesb2max_h, Wesb3max_h Wesb4_s[NC_CYL_NR], Wese3_hs[NC_CYL_NR], Injekt_hub_h, Injekt_hub_hs, Injekt_hub_s, Stat_fofumx_anf, Stat_lvs, Stat_zyl_aus, Wesbkh_s[NC_CYL_NR], B_aekh_akt, St_aekh, St_aekh_ae, St_injad_quit, St_wesb_s, Wesb_s[NC_CYL_NR], Zw_offkorrvr[NC_CYL_NR], Rk_kor_kva, St_prailpulskor, St_rk_kva,
F_tikorzsk[NC_CYL_NR], Espr_mod_soll[NC_CYL_NR],
Wes_soll_h[NC_CYL_NR][NC_PLS_NR], Zr_lvs_ll_reakt,

St_es_urstart

5 ms : Exwink_soll, Tv_vvtlr

20 ms: Wdk_diag, F_lradap1, F_lradap2

100 ms : Nsl_koor , I_craweng , I_gen , St_dgen0 , St_gen , St_ldstgen, Tv_kft, Ba_subsoll, Ba_subist, Ibsderrs1, Ibsderrs2, Ibspreco2, Ktupcsctr, Ptc_pwr, St_dibs0, U_batt, I_batt, Pm_klemmstat, Stat_sv_reg1, Stat_sv_reg2, T2histshort, T3histshort, T4histshort, St_pmdiag0, St_pmdiag1, Rt_bastatg_sa, Krn_test, U_gen, Mrnn_test_dk, Igrinfo[30], Leminfo[40], Msainfo[50], Prnn_test, Prnn_test_agr,St_entlast_loc, St_igroutnv, St_eisydiag1, St_eisydiag2, St_imdgen0, F_atlad, St_hhs, Klann_test1, Klann_test2, I_gentest, U_gentest, St_gentest, Eco_jobstat1,Eco_result1, St_ecostat2, Pmbackup[7], St_nmax_ba, St_vbrzyl_aus, St_atlsvc, St_atlsvc_pvdk, St_atlsvc_start, Zr_lvs_0,Zr_lvs_1,Zr_lvs_2,Zr_lvs_3, Zr_lvssekt_0, , Zr_lvssekt_1, Zr_lvssekt_2 , Zr_lvssekt_3, Zr_lvssekt_4, Zr_lvssekt_5, Zr_lvssekt_6, Zr_lvssekt_7, Zr_lvssekt_8,Zr_lvszyl_0, Zr_lvszyl_2 Zr_lvszyl_3,Zr_lvszyl_4, Zr_lvszyl_5, St_sondenheiz, Atlsvc_dpvdk1, Atlsvc_dpvdk2,Atlsvc_dpvdk3, St_atldiag2_out, Klann_mw1, Klann_mw2, St_mdbanl_pwgll, Mrnn_test_pr, Vsadw_md6_mx, Vsadw_md6_tst, Vsedw_md6_mx, Vsedw_md6_tst

200 ms : Newp_soll , St_egs1, Md_max_klima,
ba_wm_ist, Tabg_r10, Tabg_r9, Tabg_vk1, Tabg_vk2, Tw_m1, Tw_m2, Tabg_demax1, Tabg_demax2, Tabg_demaxav, Tabg_ikat_av, Tabg_nk1, Tabg_nk2, Tabg_nk_av, Tabg_vk_av, St_wm1, Tw_nk1, Tw_nk2, Tabg_desul, Tabg_inok1, Tabg_inok2, Tabg_nnok1, Tabg_nnok2, Tabg_nok_av, Tabg_nok_av1, Tabg_nok_av2, Tabg_nokmax, Tabg_nokmax1, Tabg_nokmax2, Tabg_nokmin, T_ikat1_stat, T_ikat2_stat, Tumg_b1, Tumg_b2, Tumg_b3, Tumg_b4, Tumg_b5, Tget_b1, Tget_b2, Tget_b3, Tget_b4, Tget_b5, Toel_b1, Toel_b2, Toel_b3, Toel_b4, Toel_b5, Tmot_b1, , Tmot_b2, Tmot_b3, Tmot_b4, Tmot_b5, T_ikat1, T_ikat2, F_bsmdres, Q_abgnox, Tw_noxsens

1000 ms : Bosbtvfbk , Bosrlsm , Bosstate , Dfmonitor , Nslb , Id_bosmg , Id_bosmgt , Id_bosmsg , Nelueft_wm , Oz_kvbog Oz_kvbsm_ul Oz_lp , Oz_lv , Oz_oelzeit, Oz_permbog, Oz_permex, Oz_permlow, Oz_permoff, Oz_rwkvb, Oz_rwperm, St_ozbg0 , Toel , Toel_oz , Tumg_abst , Tumg_battab , Zrbosmld , Absch_korr, Bosfxid2, Bosid2, D_soc, Oz_nivakt, Oz_nivkrzt, Oz_nivlangt, Oz_reset, Bosjziel, Bosmziel, Bosprog2, Bosres, Bosrw2, Oz_permakt, Oz_tempakt, Bszsi, Igenk, Dzw_annm, Ibhwversi, Ibswbase, Ibswchang, Snibs, Zbibs,Oz_lf1t, Oz_lf2t, Bosconf, Bostoken, Id_bosrtak, St_ubw, Oz_krz2cnt, Oz_krzcnt, Oz_krzkor2k, Oz_krzor, Oz_lgmwcnt, Oz_nivkor, Oz_oricnt, Oz_vormw, Oz_vormwcn, Qv_nv_ezm, Qv_nv_start, Qv_nv_zh, Qv_out_1, Qv_out_2, Qv_out_3, Qv_out_4, Qv_out_5, Qv_out_m, Qv_quali_1, Qv_quali_2, Qv_quali_3, Qv_quali_4, Qv_quali_5, Qv_quali_m,Qv_status, Qv_td1, Qv_td2, Qv_td3, Qv_td4, Qv_td5, Qvc_status_1, Qvc_status_

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2, Qvc_status_3, Qvc_status_4, Oz_oelkm, St_dgen.., Genitest_tol, Geniutest_ab, Geniutest_err, Genutest_tol, Qv_h2o, Qv_h2oquali, Qv_h2ostatus, St_qvc1
background : Rf_vl, F_wnwkh, F_wnwkhk
once per driving cycle : Dfds[16]
triggered by event : St_sleep

Activation:

calculation activation is defined in BMW code
with special values at power latch phase:
0 : St_mdinfo_ges, St_ldm_kupp, F_wnwkh, Md_rad_ist, Md_rad_max, Md_rad_min, St_atlout, Dzwo_lam_kor, Dzwot, I_batt, Mdi_ml_sollvb, Mdi_zw_sollvb, Mdk_wunsch_filt, Tvwg, Tvwg2, St_ar1, St_rail, St_vsa, St_vse, Tvulv, Mdk_wunsch_ipm, Mdk_max, F_wnwkh, I_ges, Eta_labas, Eta_labas_soll, Eta_lambda_1, Eta_lambda_2,Dzw_annm, St_entlast_loc, St_gl_adapt, Bostoken, Id_bosrtak,F_zw_hsplit, Mdi_reib, Rk_kor_h, Dla_soll_puls[NC_CBK_EX_NR], Md_can_dmee, St_prestoppmsa, Espr_mod_soll[NC_CYL_NR],
Wes_soll_h[NC_CYL_NR][NC_PLS_NR], Md_na_ges_f, St_es_urstart, Mrnn_test_pr
1: Eisyagr_korfak_b F_rkkorwl_hs, F_rkkorwl_s, La_sollreg[NC_CBK_EX_NR], F_bsmdres
63: I_ha
100%: Eta_md_uesp, Eta_mdkh
9000: Nmax_ba
last calculated value: Amo_05, Amo_10, Amo_15, Amo_20, Amo_30, Amo_40, St_deavns2, Tw_nk1, Tw_nk2, Pssol, Mdi_max_l1, Krn_test, Pspdvk_soll, Mrnn_test_dk, Oz_lf1t, Oz_lf2t, St_imdgen0, Rfv_vns, Atlr, Atlvst, F_atlad, Pldr_soll, Klann_test1, Klann_test2, Oz_krz2cnt, Oz_krzcnt, Oz_krzkor2k, Oz_krzkor, Oz_lgmwcnt , Oz_nivkor, Oz_oricnt, Oz_vormw, Oz_vormwcnt, Qv_nv_ezm, Qv_nv_ezm, Qv_nv_start, Qv_nv_zh, Qv_out_1, Qv_out_2, Qv_out_3, Qv_out_4, Qv_out_5, Qv_out_m, Qv_quali_1, Qv_quali_2, Qv_quali_3, Qv_quali_4, Qv_quali_5, Qv_quali_m, Qv_status, Qv_td1, Qv_td2, Qv_td3, Qv_td4, Qv_td5, Qvc_status_1, Qvc_status_2, Qvc_status_3, Qvc_status_4, St_ngang0, Stmsa, Stmsaaa, Stmsaav, Stmsaev, T_ikat1_stat, T_ikat2_stat, F_lradap1, F_lradap2, F_sicher_zw, Msnlgofs_tmp, Stmsaaa, Stmsaea, Tvneutral, St_blshub, Oz_oelkm, St_mdbafak2, St_wese, St_blsdisa2, Drf_spuel, I_gentest, U_gentest, St_dgen..., St_gentest, St_testpoelsys, St_testpoelsys2, Eco_jobstat1, Eco_result1, Genitest_tol, Genitest_bol, Md_reib_sa, Qv_h2o, Qv_h2oquali, Qv_h2ostatus, St_ecostat2, St_qvc1, St_klann_ad1, St_klann_ad2, Msa_arravrs[60] ,Msa_indexrs, Msastz, Msastzmsa, St_msabs, St_nmax_ba, St_vbrzyl_aus, T_ikat1, T_ikat2, Dzw_agr_hs,Prnn_test, Prnn_test_agr, Md_res_atlsvc, St_atlsvc, St_atlsvc_pvdk, St_atlsvc_start, St_sondenheiz, Zw_offkorrvr[NC_CYL_NR], Rk_kor_kva, St_prailpulskor, St_rk_kva, St_atldiag2_out, F_tikorzsk[NC_CYL_NR], Mdi_max, Rk_korres_hs, Rk_korres_s, Klann_mw1, Klann_mw2, St_mdbanl_pwgll, St_ngang, Md_gennm_na, Zr_lvs_ll_reakt, T_prail_mon_xb_ypb[i][j]
last value : St_wm1, St_ewp, St_lklps1, Ba_ist, Wdk_diag, Bosconf, Bosmanip, St_hhs, St_msaa, St_msaanz, St_ubw, Stat_zyl_aus
Last valid value: Vsadw_md6_mx, Vsadw_md6_tst, Vsedw_md6_mx, Vsedw_md6_tst

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Non volatile Data handling

The following non volatile data must not be initialised but keep their value in case the ECU was newly flashed with a new software version ("flash resistant data")

T_prail_mon_xb_ypb[SY_PRAIL_MON_ANZ_SCHWELLEN][SY_ANZ_PRAILSENS]		

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R.8 Customer adaptation module: CYBL

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_gl_ad	O/V	0... 1H	0 ...1	1	-
Lambdaadaption am Bandende hat fertig gelernt					
B_gl_adder	O/V	0... 1H	0 ...1	1	-
ER_Balancing am Bandende hat additiv adaptiert					
B_gl_adz	O/V	0... 1H	0 ...1	1	-
Lambdaadaption ist nötig, zyklisch während Motorbetrieb zu 1 gesetzt					
B_gl_adz_offset1	O/V	0... 1H	0 ...1	1	-
Zylinderselektive Adaption vom Lambda-Offset auf Bank1 ist erfolgt.					
B_gl_adz_offset2	O/V	0... 1H	0 ...1	1	-
Zylinderselektive Adaption vom Lambda-Offset auf Bank 2 ist erfolgt.					
B_gl_hz	O/V	0... 1H	0 ...1	1	-
Zylindersel. Lambdaregelung fordert homogen an, zyklisch während dem Motorbetrieb zu 1 gesetzt					
B_gl_wg1	O/V	0... 1H	0 ...1	1	-
Zylindersel. Lambdaregelung fordert öffne WG1 an, zyklisch während dem Motorbetrieb zu 1 gesetzt					
B_gl_wg2	O/V	0... 1H	0 ...1	1	-
Zylindersel. Lambdaregelung fordert öffne WG2 an, zyklisch während dem Motorbetrieb zu 1 gesetzt					
B_gl_zsk	O/V	0... 1H	0 ...1	1	-
Zylindersel. Lambdaregelung kalt am Bandende hat fertig adaptiert					
B_gl_zsw	O/V	0... 1H	0 ...1	1	-
Zylindersel. Lambdaregelung warm am Bandende hat fertig adaptiert					
B_gl_zswz	O/V	0... 1H	0 ...1	1	-
Zylindersel. Lambdaregelung warm ist nötig, zyklisch während Motorbetrieb zu 1 gesetzt					
B_injad_anf	O/V	0... 1H	0 ...1	1	-
Anforderung Kleinstmengenadaption					
B_lamzylact_1	O/V	0... 1H	0 ...1	1	-
Bedingung CILC aktiv (Bank 1)					
B_lamzylact_2	O/V	0... 1H	0 ...1	1	-
Bedingung CILC aktiv (Bank 2)					
B_lurzylact	O/V	0... 1H	0 ...1	1	-
Bedingung CYBL aktiv					
F_tizyl [NC_CYL_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	-
zylinderindividueller Einspritzfaktor					
FAC_MFF_COR_EXT_LAM_AD_INJ [NC_CYL_NR]	O/V	8000... 7FFFH	-50... 49.99847	1.5259e-3	%
External fuel mass correction factor (combustion controller)					
Km_inj_tausch_zyl [NC_CYL_NR]	O/V/S	0... FFFFH	0... 655350	10	km
Km-Stand bei dem die letzte Injektorcodierung vorgenommen wurde					
LV_INH_BAL_CUS	O/V	0... 1H	0 ...1	1	-
CILC and CYBL inhibt by external request					

Input data:

B_ext_zylstop {p. 8343}	DIST_IV_CHG [NC_CYL_NR] {p. 2289}	F_tikorzsk [NC_CYL_NR] {p. 8158}	FAC_TI_BAL [NC_CYL_NR] {p. 3215}

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LV_CYL_BAL_AD_HOM_REQ_DC {p. 4066}	LV_CYL_BAL_AD_WG_OPEN_REQ [NC_CBK_EX_NR] {p. 4066}	LV_CYL_BAL_ER_AD_ADD_EOL {p. 4043}	LV_CYL_BAL_LAM_AD_ADD_DC [NC_CBK_EX_NR] {p. 4066}
LV_CYL_BAL_LAM_AD_DC {p. 4066}	LV_CYL_BAL_LAM_AD_EOL {p. 4043}	LV_CYL_BAL_LAM_SEL_AD_COLD_EOL {p. 4043}	LV_CYL_BAL_LAM_SEL_AD_HOT_DC {p. 4066}
LV_CYL_BAL_LAM_SEL_AD_HOT_EOL {p. 4043}	LV_LAM_CYL_ENA [NC_CBK_EX_NR] {p. 2864}	LV_TI_CYL_BAL_ER_ACT {p. 4022}	STATE_LAM_AD_INJ_ACT [NC_CBK_EX_NR] {p. 3379}

R.8.1 Outputs for BMW which are not defined as CYBL exported data

FUNCTION DESCRIPTION:

Adaption to BMW environment.

Application conditions:

Initialisation at reset or at exit power latch phase:
1: B_gl_ad, B_gl_adder, B_gl_zsk, B_gl_zsw
0: B_gl_adz, B_gl_hz, B_gl_zswz , B_gl_wg1, B_gl_wg2, B_lamzylact_1, B_lamzylact_2, B_lurzylact, B_injad_anf, B_gl_adz_offset1, B_gl_adz_offset2
1.0: F_tizyl[NC_CYL_NR]
Last calculated value: Km_inj_tausch_zyl[ANZAHL_ZYLINDER]

Recurrence: 10 ms: B_gl_ad, B_gl_adder, B_gl_adz, B_gl_hz B_gl_zsk, B_gl_zsw, B_gl_zswz, B_gl_wg1, B_gl_wg2
20ms: B_injad_anf
100ms: F_tizyl[NC_CYL_NR], B_lamzylact_1, B_lamzylact_2, B_lurzylact, B_gl_adz_offset1, B_gl_adz_offset2, Km_inj_tausch_zyl[ANZAHL_ZYLINDER]

Special values at PWL:
Last calculated value: Km_inj_tausch_zyl[ANZAHL_ZYLINDER]

Activation: every engine state

Formula section:

If ECU_STATE = "PWL"
Then
B_gl_ad = 1
B_gl_adder = 1
B_gl_zsk = 1
B_gl_zsw = 1
B_gl_adz = 0
B_gl_hz = 0
B_gl_zswz = 0
B_gl_wg1 = 0
B_gl_wg2 = 0
B_injad_anf = 0

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Km_inj_tausch_zyl[ANZAHL_ZYLINDER] = Last calculated value
Else
B_gl_ad = LV_CYL_BAL_LAM_AD_EOL
B_gl_adder = LV_CYL_BAL_ER_AD_ADD_EOL
B_gl_adz = LV_CYL_BAL_LAM_AD_DC
B_gl_adz_offset1 = LV_CYL_BAL_LAM_AD_ADD_DC[1]
B_gl_adz_offset2 = LV_CYL_BAL_LAM_AD_ADD_DC[2]
B_gl_hz = LV_CYL_BAL_AD_HOM_REQ_DC
B_gl_zsk = LV_CYL_BAL _LAM_SEL_AD_COLD_EOL
B_gl_zsw = LV_CYL_BAL _LAM_SEL_AD_HOT_EOL
B_gl_zswz = LV_CYL_BAL_LAM_SEL_AD_HOT_DC
B_gl_wg1 = LV_CYL_BAL_AD_WG_OPEN_REQ[1]
B_gl_wg2 = LV_CYL_BAL_AD_WG_OPEN_REQ[2]
B_lamzylact_1 = LV_LAM_CYL_ENA[1]
B_lamzylact_2 = LV_LAM_CYL_ENA[2]
B_lurzylact = LV_TI_CYL_BAL_ER_ACT
F_tizyl[NC_CYL_NR] = FAC_TI_BAL[NC_CYL_NR]
Km_inj_tausch_zyl[ANZAHL_ZYLINDER] = DIST_IV_CHG[NC_CYL_NR]
if STATE_LAM_AD_INJ_ACT[1] > 0
or STATE_LAM_AD_INJ_ACT[2] > 0
then B_injad_anf = 1
else B_injad_anf = 0
endif
Endif

R.8.2 Outputs for supplier aggregates

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation at reset or exit "PWL": 0

Recurrence : 100 ms: LV_INH_BAL_CUS
Segment: FAC_MFF_COR_EXT_LAM_AD_INJ[NC_CYL_NR]

Activation : *every engine state*

Formula section:

LV_INH_BAL_CUS = B_ext_zylstop
FAC_MFF_COR_EXT_LAM_AD_INJ[NC_CYL_NR] = F_tikorzsk[NC_CYL_NR]

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R.9 Customer adaptation module: DRRQ

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_bls	O/V	0... 1H	0 ...1	1	-
Driver request; pedal value					
Pwg_ist	O/V	8000... 7FFFH	-800... 799.97558	0.0244141	%
Pedalwert Fahrerwunsch in %					
Pwg_ist_roh	O/V	8000... 7FFFH	-800... 799.97558	0.0244141	%
Pedalwert Fahrerwunsch in %, Rohwert					
Pwg_max	O/V	8000... 7FFFH	-800... 799.97558	0.0244141	%
Maximum selection of Pwg_ist and virtual pedal value					

Input data:

LV_BRAKE_DET {p. 4209}	LV_IGK {p. 906}	PV_CUS {p. 1269}	PV_CUS_RAW {p. 1269}
PV_MAX {p. 1269}			

R.9.1 Outputs for BMW which are defined as DRRQ exported data

FUNCTION DESCRIPTION:

Adaption to BMW environment.
Remark: The really possible resolution and limits of the output are different to the specified values due to the input data attributes.

Application conditions

Initialisation: *0% at reset*

Recurrence: 10ms
Note:
Pwg_ist(_roh) has to be updated directly after PV_CUS(_RAW) has been calculated.
Pwg_max has to be updated directly after PV_MAX has been calculated.

Activation: after reset

Deactivation: after power latch phase

Formula section:

Remark: all formulas are valid in a **physical** meaning

If LV_IGK = 1
Then Pwg_ist = PV_CUS
Pwg_ist_roh = PV_CUS_RAW
Pwg_max = PV_MAX
Else Pwg_ist = 0%

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Pwg_ist_roh = 0%
Pwg_max = 0%

R.9.2 Outputs for BMW which are not defined as DRRQ exported data

FUNCTION DESCRIPTION:

Adaption to BMW environment.

Application conditions

Initialisation: –

Recurrence: 100ms

Activation: after reset (always)

Deactivation: –

Formula section:

B_bls = LV_BRAKE_DET

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R.10 Customer adaptation module: DRVB

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_ACT_AJ	O/V	0... 1H	0 ...1	1	-
LV anti-jerk function active					
TQI_REQ_TRA	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Indicated torque request after transient torque function					

Input data:

B_ar_akt {p. 8342}	Mdi_reib {p. 8161}	Mdk_wunsch_filt {p. 8162}	

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation: at reset and at each activation and deactivation: all outputs are initialised with 0

Recurrence : 10 ms

Activation: *LV_IGK = 1*

Deactivation: LV_IGK = 0

Formula section:

Remark: all formulas are valid in a **physical** meaning

LV_ACT_AJ = B_ar_akt
TQI_REQ_TRA = Mdk_wunsch_filt - Mdi_reib

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R.11 Customer adaptation module: ECM2

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_dkpu	O/V	0... 1H	0 ...1	1	-
LV for activation of engine speed limitation monitoring					
B_siko_rechnet	O/V	0... 1H	0 ...1	1	-
Activation condition for fuel cut off monitoring fulfilled					
FAC_MFF_TQ_COR_SCAV	O/V	8000... 7FFFH	-200... 199.99389	6.1035e-3	%
Efficiency correction factor for scavenging					
TQ_LOSS_ADD_FIL	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Filtered additional torque losses					
TQ_REQ_CLU_GB	O/V	0... FFH	0... 510	2	Nm
Torque request from manual gearbox (torque losses)					
TQI_N_CTL_TCT_FAST	O/V	0... FFH	0... 510	2	Nm
Fast torque request of n-controller for TCT					
TQI_N_CTL_TCT_SLOW	O/V	0... FFH	0... 510	2	Nm
Slow torque request of n-controller for TCT					

Input data:

Eta_md_uesp {p. 8157}	LV_N_LIM_ETC_MON {p. 6790}	LV_TQI_MON_ACT_MON {p. 6791}	Md_getriebe_hs {p. 8160}
Md_na_ges_f {p. 8160}	Mdi_nregl_plus {p. 8161}	Mdi_nregs_plus {p. 8161}	

R.11.1 Outputs for BMW functions which are not defined as ECM2 exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation: at reset all 0
at PWL: B_siko_rechnet = 0

Recurrence : 40 ms

Activation: B_dkpu: every engine state
B_siko_rechnet: every engine state except PWL

Formula section:

B_dkpu = LV_N_LIM_ETC_MON
B_siko_rechnet = LV_TQI_MON_ACT_MON

R.11.2 Outputs for supplier functions which are defined as BMW exported data

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FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation: FAC_MFF_TQ_COR_SCAV =100%
TQ_REQ_CLU_GB = 0 Nm
TQI_N_CTL_TCT_FAST = 0 Nm
TQI_N_CTL_TCT_SLOW = 0 Nm
TQ_LOSS_ADD_FIL = 0 Nm

Recurrence : FAC_MFF_TQ_COR_SCAV:10ms
TQ_REQ_CLU_GB: 40ms
TQI_N_CTL_TCT_FAST: 40ms
TQI_N_CTL_TCT_SLOW: 40ms
TQ_LOSS_ADD_FIL: 40ms

Activation: *every engine state*

Formula section:

Remark: all formulas are valid in a **physical** meaning

FAC_MFF_TQ_COR_SCAV = Eta_md_uesp
TQ_REQ_CLU_GB = Md_getriebe_hs
TQI_N_CTL_TCT_FAST = Mdi_nregs_plus
TQI_N_CTL_TCT_SLOW = Mdi_nregl_plus
TQ_LOSS_ADD_FIL = Md_na_ges_f

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R.12 Customer adaptation module: EGCP

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_lamson_ok1	O/V	0... 1H	0 ...1	1	-
Lambdasonde VK, Bank1, bereit					
B_lamson_ok2	O/V	0... 1H	0 ...1	1	-
Lambdasonde VK, Bank2, bereit					
B_pruef1	O/V	0... 1H	0 ...1	1	-
Lambda coordination request to change set point for active plausibility test					
B_pruef2	O/V	0... 1H	0 ...1	1	-
Lambda coordination request to change set point for active plausibility test					
B_sbblsu	O/V	0... 1H	0 ...1	1	-
operability status of the lambda sensor (delayed), exhaust cylinderbank 1					
B_sbblsu2	O/V	0... 1H	0 ...1	1	-
operability status of the lambda sensor (delayed), exhaust cylinderbank 2					
La_pruef1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda set point for active plausibility test bank 1					
La_pruef2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda set point for active plausibility test bank 2					
Lam_son1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda signal value of the WRAF sensor					
Lam_son2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda signal value of the WRAF sensor					
Ulams_1	O/V	0... 7FFH	0... 9.99511	4.8828e-3	V
corrected output signal of the lambda sensor, exhaust cylinderbank 1					
Ulams_2	O/V	0... 7FFH	0... 9.99511	4.8828e-3	V
corrected output signal of the lambda sensor, exhaust cylinderbank 2					

Input data:

LAMB_LS_UP [NC_CBK_EX_NR] {p. 2313}	LAMB_SP_DIAG_LS_UP_DOWN [NC_CBK_EX_NR] {p. 2437}	LV_INH_LSCL [NC_CBK_EX_NR] {p. 2544}	LV_LAMB_LS_UP_VLD [NC_CBK_EX_NR] {p. 2352}
LV_LAMB_SP_REQ_DIAG_ACT [NC_CBK_EX_NR] {p. 2437}	NC_CBK_EX_NR {p. 1829}	VLS_UP_COR [NC_CBK_EX_NR] {p. 2315}	

R.12.1 Outputs for BMW which are defined as EGCP exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
i = 1 ... NC_CBK_EX_NR

Application conditions:

Initialisation at reset or at exit power latch state:
B_pruef1, B_pruef2, B_sbblsu, B_sbblsu2

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B_lamson_ok1, B_lamson_ok2 = 0
La_pruef1 = La_pruef2 = 1.00
Lam_son1, Lam_son2, Ulams_1, Ulams_2 : first calculation

Activation: every engine state, except power latch phase
Deactivation : at power latch phase
Values at power latch phase :

Lam_son1 = Lam_son2 = 1.0
La_pruef1 = La_pruef2 = 1.0
B_pruef1 = B_pruef2 = 0
B_lamson_ok1, B_lamson_ok2 = 0
B_sbblsu = B_sbblsu2 = 1
Ulams_1= Ulams_2 = 0 V

Recurrences: 10 ms Lam_son1/2, Ulams_1/2, B_lamson_ok1, B_lamson_ok2
100 ms La_pruef1/2 , B_pruef1/2, B_sbblsu, B_sbblsu2

Formula section:

Lam_son1 = LAMB_LS_UP[1]
Lam_son2 = LAMB_LS_UP[2]
La_pruef1 = LAMB_SP_DIAG_LS_UP_DOWN[1]
La_pruef2 = LAMB_SP_DIAG_LS_UP_DOWN[2]
B_pruef1 = LV_LAMB_SP_REQ_DIAG_ACT[1]
B_pruef2 = LV_LAMB_SP_REQ_DIAG_ACT[2]
B_sbblsu = not(LV_INH_LSCL[1])
B_sbblsu2 = not(LV_INH_LSCL[2])
Ulams_1 = VLS_UP_COR[1]
Ulams_2 = VLS_UP_COR[2]
B_lamson_ok1 = LV_LAMB_LS_UP_VLD[1]
B_lamson_ok2 = LV_LAMB_LS_UP_VLD[2]

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R.13 Customer adaptation module: EGRC

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Agrpos	O/V	0... FFFFH	0... 99.9985	0.001526	%
Current EGR valve position delivered to BWM software					
B_agr_ktrl	O/V	0... 1H	0 ...1	1	-
EGR control active					
EGR_RATIO_SP	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
EGR-Ratio Setpoint					
OPG_SP_REQ_ACR	O/V	0... FFFH	0... 99.97558	0.0244141	%
Actuator valve position setpoint request in normal operation					

Input data:

Agr_soll {p. 8154}	Agrpos_soll {p. 8154}	LV_ACR_CTL_ENA {p. 3599}	OPG_ACR {p. 1097}

R.13.1 BMW software to ACRC adaptation

FUNCTION DESCRIPTION:

This function is used for the adaptation to BMW customer software. *Remark:* the really possible resolution and limits of the outputs can be different from the specified values due to the input data attributes. The variables has to be executed before the ACRC functionality is calculated.

Application conditions

Initialization: at RST all to zero

Recurrence: 10 ms

Activation: *at all engine operating states*

Deactivation: no deactivation

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Formula section:

EGR_RATIO_SP = Agr_soll
if LV_ACR_CTL_ENA == 1
then OPG_SP_REQ_ACR = Agrpos_soll
else OPG_SP_REQ_ACR = 0
endif

R.13.2 ACRC to BMW software adaptation

FUNCTION DESCRIPTION:

This function is used for the adaptation to BMW customer software. *Remark:* the really possible resolution and limits of the outputs can be different from the specified values due to the input data attributes. The variable has to be executed after the ACRC functionality is calculated.

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Application conditions

Initialization: at RST set all to

Recurrences: 10 ms

Activation: *at all engine operating states*

Deactivation: *no deactivation*

Formula section:

B_agr_ktrl = LV_ACR_CTL_ENA
Agrpos = OPG_ACR

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R.14 Customer adaptation module: EGTR

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_desu_fett	O	0... 1H	0 ...1	1	-
Request of a fast desulfation (instead of an alternating desulfation					
B_desu_puls	O/V	0... 1H	0 ...1	1	-
Flag to be passed to the lambda stimulation coordination					
B_kathom	O/V	0... 1H	0 ...1	1	-
Request of lambda = 1 operation mode					
B_rgnkat	O/V	0... 1H	0 ...1	1	-
Logical value for regeneration phase request					
B_rgnkat_hla1	O/V	0... 1H	0 ...1	1	-
Request regeneration lambda = 1					
D_la_sa1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
lambda controller set point shift					
D_la_sa2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
lambda controller set point shift					
La_desu_kh1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda setpoint during catalyst heating for desulfation bank 1					
La_desu_kh2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda setpoint during catalyst heating for desulfation bank 2					
La_desu1	O	0... FFFFH	0... 15.99975	244.1e-6	-
Absolut lambda setpoint for lambda pulsation, desulfation bank1					
La_desu2	O	0... FFFFH	0... 15.99975	244.1e-6	-
Absolut lambda setpoint for lambda pulsation, desulfation bank2					
La_es	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda setpoint for desulfation					
La_puls1	O/V	80... 7FH	-0.125... 0.12402	976.599e-6	-
Lambda setpoint for forced stimulation					
La_puls2	O/V	80... 7FH	-0.125... 0.12402	976.599e-6	-
Lambda setpoint for forced stimulation					
La_rgn1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
lambda setpoint for catalyst regeneration					
La_rgn2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
lambda setpoint for catalyst regeneration					
LAMB_PLS_EXT_CUS [NC_CBK_EX_NR]	O/V	F800... 7FFH	-0.125... 0.12493	61e-6	-
lambda set point deviation from external source					
LV_PUC_LOCK_TNT	O/V	0... 1H	0 ...1	1	-
LV suppression of PUC due to high Nox trap temperature					

Input data:

B_vb_sa_nk {p. 8347}	Dla_soll_puls [NC_CBK_EX_NR] {p. 8156}	ECU_STATE {p. 1091}	La_soll_stat1
La_soll_stat2	La_soll1	La_soll2	LAMB_PLS_O2L_OSC [NC_CBK_EX_NR] {p. 2563}

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LAMB_PULS_SO2P [NC_CBK_EX_NR] {p. 3150}	LAMB_RGN [NC_CBK_EX_NR] {p. 2885}	LAMB_SO2P [NC_CBK_EX_NR] {p. 3129}	LAMB_SP_CH_SO2P [NC_CBK_EX_NR] {p. 2169}
LAMB_SP_DELTA_CAT_ PURGE [NC_CBK_EX_NR] {p. 2939}	LAMB_SP_DIAG_AFL [NC_CBK_EX_NR] {p. 5589}	LV_DIAG_AFL_REQ {p. 5589}	LV_NT_AFS_REQ {p. 2982}
LV_RGN_REQ_NTLD_AFS {p. 2983}	LV_SO2P_FAST_REQ {p. 3129}	LV_SO2P_LAMB_PULS {p. 3129}	LV_SO2P_REQ {p. 3129}
NC_CBK_EX_NR {p. 1829}	TQ_ADD_SO2P {p. 6582}		

R.14.1 Outputs for BMW functions which are not defined as EGTR exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions:

Initialisation at reset or at exit power latch phase :
0.0 : La_puls1 /2, D_la_sa1/2, La_desu1/2
0: B_kathom, B_rgnkat_hla1, B_desu_fett, B_desu_puls, B_rgnkat
1.0: La_rgn1/2, La_desu_kh1/2, La_es

Recurrence : 100 ms La_es
10 ms B_rgnkat, La_rgn1, La_rgn2, B_kathom, B_rgnkat_hla1
20ms D_la_sa1, D_la_sa2, B_desu_fett, B_desu_puls
seg La_puls1 /2, La_desu1/2, La_desu_kh1/2
Activation: every engine state, except at power latch phase
Deactivation: at power latch phase
Values at deactivation: 0, except B_rgnkat, B_kathom,B_rgnkat_hla1=1

Formula section:

Remark: all formulas are valid in a **physical** meaning

```
B_rgnkat       =     LV_RGN_NT_REQ OR LV_DIAG_AFL_REQ

IF (LV_RGN_NT_REQ == 0 AND LV_DIAG_AFL_REQ ==1)
THEN %lambda setpoint for TWC lean diagnosis after regeneration
     La_rgn1 = LAMB_SP_DIAG_AFL[1]
     La_rgn2 = LAMB_SP_DIAG_AFL[2]
ELSE %lambda setpoint for regeneration
     La_rgn1 = LAMB_RGN[1]
     La_rgn2 = LAMB_RGN[2]
ENDIF
```

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La_es = LAMB_SO2P[1]
D_la_sa1 = LAMB_SP_DELTA_CAT_PURGE[1]
D_la_sa2 = LAMB_SP_DELTA_CAT_PURGE[2]
La_puls1 = LAMB_PLS_O2L_OSC[1]
La_puls2 = LAMB_PLS_O2L_OSC[2]
B_kathom = LV_NT_AFS_REQ
B_desu_fett = LV_SO2P_FAST_REQ AND LV_SO2P_REQ
La_desu1 = 1 + LAMB_PULS_SO2P[1]
La_desu2 = 1 + LAMB_PULS_SO2P[2]
B_desu_puls = LV_SO2P_LAMB_PULS
La_desu_kh1 = LAMB_SP_CH_SO2P[1]
La_desu_kh2 = LAMB_SP_CH_SO2P[2]
B_rgnkat_hla1 = LV_RGN_REQ_NTLD_AFS

R.14.2 Outputs for supplier functions which are defined as BMW exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions

Initialisation: LAMB_PLS_EXT_CUS[NC_CBK_EX_NR] = 0
LV_PUC_LOCK_TNT = 0

Recurrence : **200ms:** LV_PUC_LOCK_TNT
Segment synchronous: LAMB_PLS_EXT[NC_CBK_EX_NR] **(synchronised with the update of Dla_soll_puls):**

Activation: *every engine state*

Formula section:

Remark: all formulas are valid in a **physical** meaning

LV_PUC_LOCK_TNT = B_vb_sa_nk
LAMB_PLS_EXT_CUS[1] = Dla_soll_puls[1] **(synchronised with the update of Dla_soll_puls)**
LAMB_PLS_EXT_CUS[2] = Dla_soll_puls[2] **(synchronised with the update of Dla_soll_puls)**

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R.15 Customer adaptation module: ENLU

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_poel	O/V	0... 1H	0 ...1	1	-
Bedingung Öldrucksschalter					
B_poelsoltst	O/V	0... 1H	0 ...1	1	-
Bedingung Sollwert Öldruck über Tester					
B_td_og	O/V	0... 1H	0 ...1	1	-
Bedingung Abkühlzeit gültig					
B_td_ogok	O/V	0... 1H	0 ...1	1	-
condition state machine once valid calculated					
B_toel	O/V	0... 1H	0 ...1	1	-
Bedingung tr und tv gültig					
Bosbtvfbkt	O/V	0... FFH	0... 255	1	-
Verfügbarkeit vom Tester					
Bosjzielt	O/V	0... FFH	0... 255	1	-
Zieltermin Jahr vom Tester					
Bosmzielt	O/V	0... FFH	0... 255	1	-
Zieltermin_Monat vom Tester					
Bosprog2t	O/V	0... FFH	0... 255	1	-
Prognose Intervall Zeit vom Tester					
Bosrlsmt	O/V	8000... 7FFFH	-32768 ...32767	1	-
Restlaufstrecke Motoröl vom Tester					
Bosrw2t	O/V	0... FFH	0... 255000	1000	km
Prognose Intervall Weg vom Tester					
DIST_RESI_OIL	O/V	8000... 7FFFH	-32768 ...32767	1	-
Ausgabewert Restlaufstrecke Motoröl					
DIST_RESI_OIL_KM	O/V	0... FFH	0... 255	1	-
Einheit der BOS-Info (km)					
FRQ_POIL_PWM	V	0A... FFH	10... 255	1	Hz
Frequency of the oil pressure actuator PWM					
Id_bosrtt	O/V	0... FFH	0... 255	1	-
ID f BOS_Reset vom Tester					
idbosmsg	O	0... FFH	0... 255	1	-
Kennung für BOS-Meldung vom Kombi					
LV_LOIL_VLD_WR	O/V	0... 1H	0 ...1	1	-
Flag to set LV_SOIL_VLD_LOIL and LV_T_COOL_VLD_LOIL					
LV_POIL_SWI_CUS	O/V	0... 1H	0 ...1	1	-
Condition oil pressure display (from customer)					
LV_SOIL_VLD_LOIL_CUS	O/V	0... 1H	0 ...1	1	-
Oil temperature valid from customer					
LV_T_COOL_VLD_LOIL_CUS	O/V	0... 1H	0 ...1	1	-
Cool off time valid from customer					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Oz_lf1c	O/V	0... FFH	0... 2.55	0.01	-
Länderfaktor 1 codiert					
Oz_lf2c	O/V	0... FFH	0... 2.55	0.01	-
Länderfaktor 2 codiert					
Oz_nivr	O/V	0... FFH	0... 255	1	-
oil sensor raw value of oil level					
Oz_permr	O/V	0... FFFFH	0... 65535	1	-
ÖZS: oil sensor raw value of oil permitivity					
Oz_status	O/V	0... FFH	0... 255	1	-
ÖZS: status information of oil sensor					
Oz_tempr	O/V	0... FFH	0... 255	1	-
ÖZS: oil sensor raw value of oil temperature					
P_oel_ist	O/V	8000... 7FFFH	-32768 ...32767	1	hPa
Ist Öldruck					
P_oelsol_tst	O/V	0... FFH	0... 8160	32	hPa
Sollwert Öldruck über Tester					
POIL_PWM	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Tastverhältnis Öldruck-Regelventil					
POIL_SP	O/V	0... 4E20H	0... 20	0.001	bar
setpoint of oil pressure					
QOIL_DS_CAN_2_1	O/V	0... FFH	0... 255	1	-
ID2 BOS message 2					
QOIL_DS_CAN_2_2	O/V	0... FFFFH	0... 65535	1	-
ID function BOS message 2					
QOIL_DS_CAN_2_3	O/V	0... FFH	0... 255000	1000	km
Forecast intermittent way BOS message 2					
QOIL_DS_CAN_2_4	O/V	0... FFH	0... 255	1	-
target-date year BOS message 2					
QOIL_DS_CAN_2_5	O/V	0... FFH	0... 255	1	-
target-date month BOS message 2					
QOIL_DS_CAN_2_6	O/V	0... FFH	0... 255	1	-
Forecast intermittent time BOS message 2					
STATE_LOIL	O/V	0... FFH	0... 255	1	-
fluid-level engine-oil					
STATE_OIL_AVL	O/V	0... FFH	0... 255	1	-
Rest-Verfügbarkeit Motoröl in Prozent					
STATE_OIL_REQ	O/V	0... FFH	0... 255	1	-
Recommended refill volume engine-oil					
Td_og_cnt	O/V	0... 64H	0... 100	1	-
Zähler für fallende Flanken im Töns Signal					
Td_og_icnt	O/V	0... FFFFH	0... 655.35	0.01	s
Time between flanks					
Td_og_tk	O/V	0... FFFFH	0... 6553.5	0.1	s
Abkühlzeit vom TÖNS					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Td_og_tr	O/V	0... FFFFH	0... 6553.5	0.1	s
Referntzeit					
Td_og_tv	O/V	0... FFFFH	0... 6553.5	0.1	s
Abkühlzeit Vom TÖNS					
Td_og_uplcnt	O/V	0... 64H	0... 100	1	-
Zähler für unplausible Signale					
Tget	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	°C
gear box oil temperature					
Toel_getr	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	°C
gear box oil temperature					
Toel_mdl	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
oil temperature model					
TOIL	O/V	0... C8H	-40 ...160	1	°C
Oil temperature					
TOIL_MES	O/V	0... C8H	-40 ...160	1	°C
oil temperature					
TOIL_STOP	O/V	0... C8H	-40 ...160	1	°C
Oil temperature at transition to ES					
zrbosmld	O/V/S	0... FFH	0... 255	1	-
anzuzeigender Zähler für durchgeführten Ölservice					
Zrbosrt	O/V	0... FFH	0... 255	1	-
Servicezählerwert vom Tester					

Input data:

B_poel_rot {p. 8346}	Bosbtvfbk {p. 8155}	Bosfxid2 {p. 8155}	Bosid2 {p. 8155}
Bosjziel {p. 8155}	Bosmziel {p. 8155}	Bosprog2 {p. 8155}	Bosrlsm {p. 8155}
Bosrw2 {p. 8155}	Bosstate {p. 8155}	CTR_EDGE_FALL_LOIL {p. 797}	CTR_SIG_NOT_VLD_LOIL {p. 797}
FAC_OIL_EXT_REQ_1 {p. 7680}	FAC_OIL_EXT_REQ_2 {p. 7680}	Id_bosmsg {p. 8159}	Id_bosrtak {p. 8159}
LC_POIL_CTL_ENA {p. 903}	LV_BIOS_POIL_SWI {p. 903}	LV_ERR_POIL_DR {p. 4357}	LV_POIL_PWM_EXT_ADJ {p. 7434}
LV_POIL_SP_EXT_ADJ {p. 7434}	LV_SOIL_VLD_LOIL {p. 804}	LV_ST_END {p. 1720}	LV_STATE_RUN_LOIL {p. 804}
LV_T_COOL_VLD_LOIL {p. 805}	LV_T_ES_NOT_PLAUS {p. 4467}	N {p. 1525}	NC_CYL_NR {p. 1526}
Oz_kvbsm_ul {p. 8164}	Oz_lp {p. 8164}	Oz_lv {p. 8164}	oznivr {p. 4095}
ozpermr_w {p. 4095}	ozstatus	oztempr	P_oel_soll {p. 8165}
Poel_fpwm {p. 8165}	POIL {p. 903}	POIL_PWM_EXT_ADJ {p. 7435}	POIL_SP_EXT_ADJ {p. 7435}
QOIL_DS_RST_KWP_1 {p. 7682}	QOIL_DS_RST_KWP_2 {p. 7682}	QOIL_DS_RST_KWP_3 {p. 7682}	QOIL_DS_RST_KWP_5 {p. 7682}
QOIL_DS_RST_KWP_6 {p. 7682}	QOIL_DS_RST_KWP_7 {p. 7682}	QOIL_DS_RST_KWP_8 {p. 7682}	QOIL_DS_RST_KWP_9 {p. 7682}
T_COOL_LOIL {p. 809}	T_EDGE_FALL_LOIL {p. 809}	T_REF_SIG_LEN_LOIL {p. 809}	T_TEMP_SIG_LEN_LOIL {p. 809}

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TEMP_GB {p. 1580}	Toel {p. 8177}	Tv_poel {p. 8178}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_POIL_PWM_ERR_SUB	-	0... FFH	0... 99.60937	0.390625	%
Substitute value of POIL_PWM in case of detected failure on oil pressure actuator					
C_T_TIA_TCO_DIAG	-	1... FFFFH	1... 65535	1	s
time condiotion for toil-, tco-, tecu- and tia diagnosis					
C_TOIL_SUB_DIAG	-	0... C8H	-40 ...160	1	°C
substitute oil temperature					

Import actions:

ACTION_INFR_SetFrqPwmPoilDr (**IN**<frq_poil_pwm>)
ACTION_INFR_SetPwmPoilDr (**IN**<poil_pwm>)

R.15.1 Outputs for BMW functions which are defined as ENLU exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation:

```
0 at reset, Td_og_icnt = 0s
 first valid value:  Tget
                          Oz_lf1c  = FAC_OIL_EXT_REQ_1
                          Oz_lf2c  = FAC_OIL_EXT_REQ_2
          P_oel_ist     = POIL

Recurrence :      1000ms:       Toel_mdl, Oz_permr, Oz_status,
Oz_tempr, Oz_nivr,
                                 Zrbosrt, Id_bosrtt, Bosbtvfbkt,
Bosrlsmt,
            Bosrw2t, Bosmzielt, Bosjzielt, Bosprog2t
 100 ms:       Toel_getr, B_td_ogok, B_poel, Td_og_icnt, Td_
og_cnt, Td_og_tk, Td_og_tr, Td_og_tv, Td_og_uplcnt, B_toel,
B_td_og
 10 ms:        Tget, P_oelsol_tst, P_oel_ist, B_poelsoltst

  Activation:          every engine state
During power latch:
         Tget, P_oel_ist:   last valid value
                P_oelsol_tst, B_poelsoltst, Bosrlsmt = 0
```

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Formula section:

Remark: all formulas are valid in a **physical** meaning
Toel_getr = Tget = TEMP_GB
Toel_mdl = C_TOIL_SUB_DIAG
Oz_nivr = oznivr
Oz_tempr = oztempr
Oz_permr = ozpermr_w
Oz_status = ozstatus

Id_bosrtt = QOIL_DS_RST_KWP_1
Bosbtvfbkt = QOIL_DS_RST_KWP_2
Zrbosrt = QOIL_DS_RST_KWP_3
IF QOIL_DS_RST_KWP_9 = 1
THEN Bosrlsmt = QOIL_DS_RST_KWP_4
ELSE Bosrlsmt = 8000h (*unplausibel*)
Bosrw2t = QOIL_DS_RST_KWP_5
Bosmzielt = QOIL_DS_RST_KWP_6
Bosjzielt = QOIL_DS_RST_KWP_7
Bosprog2t = QOIL_DS_RST_KWP_8
Oz_lf1c = FAC_OIL_EXT_REQ_1
Oz_lf2c = FAC_OIL_EXT_REQ_2
P_oel_ist = POIL
B_poelsoltst = LV_POIL_SP_EXT_ADJ
B_poel = LV_BIOS_POIL_SWI

if LV_ST_END = 1
then P_oelsol_tst = POIL_SP_EXT_ADJ
else P_oelsol_tst = 0
endif
if NC_CYL_NR = 6
then
Td_og_cnt = 0
Td_og_icnt = 0
Td_og_tk = 0
Td_og_tr = 0
Td_0g_tv = 0
Td_og_uplcnt = 0
B_toel = 0
B_td_og = 0
B_td_ogok = !LV_T_ES_NOT_PLAUS
else Td_og_icnt = T_EDGE_FALL_LOIL
Td_og_cnt = CTR_EDGE_FALL_LOIL
Td_og_tk = T_COOL_LOIL
Td_og_tr = T_REF_SIG_LEN_LOIL
Td_og_tv = T_TEMP_SIG_LEN_LOIL
Td_og_uplcnt = CTR_SIG_NOT_VLD_LOIL
B_toel = LV_SOIL_VLD_LOIL // before ozgg_100ms()
B_td_og = LV_T_COOL_VLD_LOIL // before ozgg_100ms()
B_td_ogok = LV_STATE_RUN_LOIL
endif

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R.15.2 Outputs for supplier aggregates

FUNCTION DESCRIPTION:

Adaptation to BMW environment

Application conditions

Initialisation:

```
at reset:    DIST_RESI_OIL = Bosrlsm
             STATE_OIL_AVL = Bosbtvfbk
       FRQ_POIL_PWM = 244 Hz
       ACTION_INFR_SetFrqPwmPoilDr(IN <FRQ_POIL_PWM>).
after BMW-ini2 (calcualtion like in formula section):
idbosmsg, STATE_OIL_AVL, OIL_DS_CAN_2_1,
QOIL_DS_CAN_2_2, QOIL_DS_CAN_2_3,
OIL_DS_CAN_2_4, QOIL_DS_CAN_2_5, QOIL_DS_CAN_2_6,
DIST_RESI_OIL, zrbosmld
  at LV_ES 0->1 :  TOIL_STOP
```

Recurrence:

```
10ms:  POIL_SP, POIL_PWM, FRQ_POIL_PWM, LV_POIL_SWI_CUS
100 ms:  LV_SOIL_VLD_LOIL_CUS, LV_T_COOL_VLD_LOIL_CUS, LV_
LOIL_VLD_WR
1000 ms:    TOIL_MES, TOIL, DIST_RESI_OIL,
           DIST_RESI_OIL_KM, STATE_OIL_AVL,
       idbosmsg,QOIL_DS_CAN_2_1,QOIL_DS_CAN_2_2,
       QOIL_DS_CAN_2_3, QOIL_DS_CAN_2_4, QOIL_DS_CAN_2_5, QOIL_
DS_CAN_2_6, zrbosmld
```

Activation: *every engine state*

Formula section:

TOIL_MES = Toel
TOIL = Toel
DIST_RESI_OIL = Bosrlsm
DIST_RESI_OIL_KM = Bosstate
STATE_OIL_AVL = Bosbtvfbk
zrbosmld = Zrbosmld
idbosmsg = Id_bosmsg
STATE_OIL_REQ = Oz_lv
STATE_LOIL = Oz_lp
QOIL_DS_CAN_2_1 = Bosid2
QOIL_DS_CAN_2_2 = Bosfxid2
QOIL_DS_CAN_2_3 = Bosrw2
QOIL_DS_CAN_2_4 = Bosjziel
QOIL_DS_CAN_2_5 = Bosmziel
QOIL_DS_CAN_2_6 = Bosprog2
LV_POIL_SWI_CUS = B_poel_rot
POIL_SP = P_oel_soll
FRQ_POIL_PWM = Poel_fpwm
If LC_POIL_CTL_ENA = 1
then **ACTION_INFR_SetFrqPwmPoilDr(IN** <FRQ_POIL_PWM>**)**
    if N = 0 **and** LV_POIL_PWM_EXT_ADJ = 1
    then POIL_PWM = POIL_PWM_EXT_ADJ

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```
        else            if          LV_ERR_POIL_DR = 0
                    then    POIL_PWM = Tv_poel
                    else    POIL_PWM = C_POIL_PWM_ERR_SUB
                    endif
            endif
            ACTION_INFR_SetPwmPoilDr(IN <POIL_PWM>)
            // Due to the used HW module CLK6 the specified resolution of POIL_PWM
            // (1.5259e-3) can not be realised.  The CLK6 is limited by following technical
            // data:  4.47 Hz (0.2237ms) ...  292941.45 Hz (3.413µs)

else
            "no connection to I/O Software"
endif
LV_SOIL_VLD_LOIL_CUS = B_toel                   // after ozgg_100ms()
LV_T_COOL_VLD_LOIL_CUS = B_td_og               // after ozgg_100ms()
If LV_LOIL_VLD_WR = 0
    then    LV_LOIL_VLD_WR = 1                  // after ozgg_100ms()
    else    LV_LOIL_VLD_WR = 0                  // after ozgg_100ms()
endif
```

R.15.2.1 Oil Temperature at Engine Stopping TOIL_STOP

TOIL_STOP is determined at each transition to ES. TOIL_STOP will be stored in the non-volatile memory during the ECU's self holding phase.
By occuring of EEPROM error TOIL_STOP should be initialized with -40 °C (0x0h).

Initialisation: with stored value

Formula section:

TOIL_STOP = TOIL

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R.16 Customer adaptation module: ENOS

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_sa	-	0... 1H	0 ...1	1	-
1: pull fuel cut off					
B_sae	O/V	0... 1H	0 ...1	1	-
1: trailing throttle					
B_start	O/V	0... 1H	0 ...1	1	-
1: start condition					
B_startende	O/V	0... 1H	0 ...1	1	-
1: start left to running engine					
LV_ETCU_PUC_REQ	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Schubabschaltung nach Schubrückschaltung"					
LV_INH_PUC_CUS	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Schubabschaltung verboten"					
Nwe	O/V	0... 7FFFH	0... 32767	1	rpm
reactivation engine speed					

Input data:

B_safast_egs {p. 8346}	B_ums_vbsa {p. 8347}	LV_PU {p. 1720}	LV_PUC {p. 1720}
LV_ST_END {p. 1720}	N_MIN_PUC {p. 1720}		

R.16.1 Outputs for BMW which are defined as ENOS exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation: 0 , **except**
B_start = 1
B_startende = 0 at reset and at transition LV_ES 0 -> 1

Recurrences: 10 ms: B_startende, B_start
20 ms: B_sa, B_sae

Activation: *every engine state*

Formula section:

B_sa = LV_PUC
B_sae = LV_PU
B_start = ! LV_ST_END

B_startende = LV_ST_END

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R.16.2 Outputs for BMW which are not defined as ENOS exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation: 0

Recurrences: 20 ms

Activation: *every engine state*

Formula section:

Remark: all formulas are valid in a **physical** meaning

if LV_IGK = 1
then Nwe = N_MIN_PUC
else Nwe = 0
endif

R.16.3 Outputs for supplier aggregates

FUNCTION DESCRIPTION:

Application conditions

Initialisation: *at reset : 0*
at power latch phase : 0

Recurrence: 100 ms
10 ms: LV_ETCU_PUC_REQ

Activation: *at every engine state*

Formula section:

LV_INH_PUC_CUS = B_ums_vbsa
LV_ETCU_PUC_REQ = B_safast_egs

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R.17 Customer adaptation module: ENRD

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Fak_er_schw	O/V	0... FFH	0... 2.55	0.01	-
Quotient aus Engine Roughness und dem Schwellenwert der Aussetzererkennung					
Lur [NC_CYL_NR]	O/V	8000... 7FFFH	-32768 ...32767	1	1/s**2
engine roughness cylinder selektiv					
Lur_aus_quo	O/V	0... FFH	0... 1.99218	0.0078125	-
Quotient Laufunruhewert /Aussetzerschwelle					

Input data:

ER_AV_QUO {p. 1469}	ER_CYL [NC_CYL_NR] {p. 1454}	NC_CYL_NR {p. 1526}	

R.17.1 Outputs for BMW functions which are defined as ENRD exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation at reset or at exit PWL: 0

Recurrence : every segment

Activation: every engine state

Special value at PWL: Lur_aus_quo = 0
Fak_er_schw = 0

Formula section:

Remark: all formulas are valid in a **physical** meaning

Lur[NC_CYL_NR] = ER_CYL[NC_CYL_NR]
Lur_aus_quo = ER_AV_QUO
Fak_er_schw = ER_AV_QUO

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R.18 Customer adaptation module: ENSC

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_llr_on	O/V	0... 1H	0 ...1	1	-
Logical variable for idle speed controller activatIon request					
FAC_TQ_ADD_IS_OPM_SEL	O/V	0... FFH	0... 0.99609	3.9062e-3	-
Torque reserve for idle speed interpolation factor for operation switch manager					
Md_anfhi	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Moment Anfahrhilfe					
Md_res_anfhi	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Moment Anfahrhilfe					
Mdi_llrad	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Idle speed controller, adaptation					
Mdi_llri	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
idle speed controller, I-part					
Mdi_llrp	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
idle speed controller, P/D-part slow					
Mdi_llrzw	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
idle speed controller, P/D-part fast					
Mdi_res_llmn	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
torque reserve at idle, lower limit					
Mdi_res_llmx	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
torque reserve at idle, limitation for stabilizing the ISC at high torque reserves					
N_SP_IS_BRAKE	O/V	0... 7FFFH	0... 32767	1	rpm
idle speed correction due to accumulator charge					
N_SP_IS_POIL_CTL	O/V	0... 1FE0H	0... 8160	1	rpm
idle speed correction due to oil pressure regulator					
N_SP_IS_POW_1	O/V	0... 1FE0H	0... 8160	1	rpm
Idle speed correction due to accumulator charge					
Nkw_soll	O/V	0... 7FFFH	0... 32767	1	rpm
Solldrehzahl					
Nsllm	O/V	0... 7FFFH	0... 32767	1	rpm
Idle speed setpoint without drivetrain engaged (LV_DRI = 0)					
Nstat	O/V	0... 7FFFH	0... 32767	1	rpm
Idle speed setpoint without guidance					

Input data:

ECU_STATE {p. 1091}	F_llr_ba {p. 8157}	LV_REQ_ISC {p. 3501}	N_SP_IS {p. 1122}
N_SP_IS_2 {p. 1122}	Nkw_poel_soll {p. 8163}	Nsl_koor {p. 8163}	Nslb {p. 8164}
TQ_ADD_IS_BOL {p. 3544}	TQ_ADD_PL_DROF {p. 1112}	TQ_DIF_ADD_IS_TOL {p. 3544}	TQ_DIF_I_IS {p. 3441}
TQ_DIF_IS_AD {p. 3518}	TQ_DIF_P_D_FAST_IS {p. 3441}	TQ_DIF_P_D_SLOW_IS {p. 3442}	TQ_DROF_FAST {p. 1112}
TQ_DROF_SLOW {p. 1112}			

R.18.1 Outputs for BMW which are defined as ENSC exported data

FUNCTION DESCRIPTION:

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Adaptation to BMW environment.
Remark: The really possible physical limits of the outputs are different to the specified values due to the input data attributes.

Application conditions

Initialisation at reset or at exit power latch phase: 0

Recurrences: Mdi_llri, Nstat : 20 ms
all others : 10 ms

Activation: *every engine state*

Deactivation: – –

Formula section:

Remark: all formulas are valid in a **physical** meaning

B_llr_on = LV_REQ_ISC
If ECU_STATE = "PWL"
Then
Mdi_llrad = 0
Mdi_llri = 0
Mdi_llrp = 0
Mdi_llrzw = 0
Mdi_res_llmn = 0
Mdi_res_llmx = 0
Nstat = 0
Md_anfhi = 0
Md_res_anfhi = 0
Elseif
Mdi_llrad = TQ_DIF_IS_AD
Mdi_llri = TQ_DIF_I_IS
Mdi_llrp = TQ_DIF_P_D_SLOW_IS
Mdi_llrzw = TQ_DIF_P_D_FAST_IS
Mdi_res_llmn = TQ_ADD_IS_BOL
Mdi_res_llmx = TQ_DIF_ADD_IS_TOL
Nstat = N_SP_IS
Md_anfhi = TQ_DROF_FAST
Md_res_anfhi = (TQ_DROF_SLOW - TQ_DROF_FAST) + TQ_ADD_PL_DROF
Endif

R.18.2 Outputs for BMW which are not defined as ENSC exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions:

Initialisation at reset or at exit power latch phase: 0
Recurrence: 10 ms
Activation: every engine state

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Formula section:

Remark: all formulas are valid in a **physical** meaning

Nsllm = N_SP_IS_2
If ECU_STATE = “PWL”
then
Nkw_soll = 0
else
Nkw_soll = N_SP_IS
endif

R.18.3 Outputs for supplier Aggregates

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation: `all outputs = 0 at Reset`

Recurrence: `N_SP_IS_POW_1 is updated every 1000 ms`
`N_SP_IS_BRAKE is updated every 100 ms`
`FAC_TQ_ADD_IS_OPM_SEL, N_SP_IS_POIL_CTL is updated every 10 ms`

Activation: *every engine state*

Formula section:

Remark: all formulas are valid in a **physical** meaning

N_SP_IS_BRAKE = Nsl_koor
N_SP_IS_POW_1 = Nslb
FAC_TQ_ADD_IS_OPM_SEL = F_llr_ba
N_SP_IS_POIL_CTL = Nkw_poel_soll

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R.19 Customer adaptation module: ENSD

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_kwdreht	O/V	0... 1H	0 ...1	1	-
engine speed > 0 rpm					
B_kwnotl	O/V	0... 1H	0 ...1	1	-
error detected at crank engine position determination system					
Kw_pos	O/V	0... FFFFH	0... 1535.97656	0.0234375	°CRK
Engine position, absolute					
Nkw	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
engine speed					
Nkw_grad	O/V	80... 7FH	-4096 ...4064	32	rpm/s
engine speed gradient					
Nkw_zahn	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
Engine speed calculated from T_TOOTH					
Seg5z [24]	O/V	0... FFFFH	0... 65.535	0.001	ms
Segment time for 5 tooth					
Segakt	O/V	0... FFH	0... 255	1	-
segment number					
Vsa_adp_ext	O/V	0... FFFFH	0... 6553.5	0.1	°CRK
Theoretical engine position for exhaust camshaft i edge 6					
Vse_adp_ext	O/V	0... FFFFH	0... 6553.5	0.1	°CRK
Theoretical engine position for intake camshaft i edge 6					

Input data:

LV_ERR_CRK {p. 4455}	LV_ES {p. 1720}	LV_FIRST_VLD_TOOTH {p. 1505}	LV_ST_END {p. 1720}
LV_SYN_VLD {p. 1506}	LV_T_SEG_5_TOOTH_VLD {p. 1042}	N {p. 1525}	N_GRD {p. 1525}
N_TOOTH_CUS {p. 1042}	NC_CYL_NR {p. 1526}	NC_NR_CAM_CBK {p. 1507}	NC_PSN_EDGE_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK] {p. 874}
NC_PSN_EDGE_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK] {p. 874}	PSN_ENG {p. 1525}	SEG_NR {p. 1525}	

Import actions:

ACTION_INFR_GetT5T (**IN**<idx>,**OUT**<time>)

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R.19.1 Outputs for BMW functions

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions:

Initialisation **at reset:**

If NC_CYL_NR = 6
Vse_adp_ext = NC_PSN_EDGE_CAM_IN[6][1]
Vsa_adp_ext = NC_PSN_EDGE_CAM_EX[6][1]

Else
Vse_adp_ext = NC_PSN_EDGE_CAM_IN[1][1]
Vsa_adp_ext = NC_PSN_EDGE_CAM_EX[1][1]

end
0: B_kwnotl, B_kwdreht, Nkw, Segakt, Nkw_grad, Nkw_zahn, Seg5z[24]
720°CRK: Kw_pos

at LV_ES 0-> 1: B_kwdreht = 0, Nkw = 0

at PWL : 0: B_kwnotl, Segakt, Nkw_grad

Recurrence : B_kwnotl, Segakt: segment

Kw_pos, Nkw_grad, Nkw_zahn, B_kwdreht: 10ms
Vse_adp_ext, Vse_adp_ext: once at reset
Seg5z[24]: Segment, after "Segment time acquisition for partial segments"
Nkw: If LV_ST_END = 0
Then recurrence is 10ms
Else recurrence is segment
Endif

Activation: every engine state

Formula section:

Remark: all formulas are valid in a **physical** meaning

B_kwnotl = LV_ERR_CRK
B_kwdreht = LV_FIRST_VLD_TOOTH
Nkw = N
Segakt = SEG_NR
If(1) LV_T_SEG_5_TOOTH_VLD = 1
then(1) *transfer of measured times from BSW to ASW*
Seg5z(idx) = ACTION_INFR_GetT5T(
IN idx
OUT time)
For idx derived from SEG_NR as depicted in following table:

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SEG_NR	0	1	2	3	4	5
idx	16...19	20...23	0...3	4...7	8...11	12...15

else(1) For idx = 0...23
Seg5z(idx) = FFFFH
endif(1)

If LV_SYN_VLD = 1
Kw_pos = PSN_ENG
Else
Kw_pos = 720 °CRK
end
Nkw_grad = N_GRD
Nkw_zahn = N_TOOTH_CUS

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R.20 Customer adaptation module: ENSL

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_nlf	O/V	0... 1H	0 ...1	1	-
Notluftfahren aktiv					
B_ska	O/V	0... 1H	0 ...1	1	-
SKA aktiv, ausgelöst über Ebene 1, 2 oder 3					
Mdi_nmax	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Maximum torque at engine speed limitation					
N_LIH_PRS_OIL	O/V	0... 1FE0H	0... 8160	1	rpm
Required engine speed limit by customer for oil pressure limp home mode					
N_MAX_LIH_STATE_CMB_S	O/V	0... 1FE0H	0... 8160	1	rpm
Engine speed limit for required stratified limp home mode					
Nmax_var	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
Actual engine speed limit depending on TOIL - red area (BN2000)					

Input data:

LV_ERR_ECU_CKS {p. 4232}	LV_ERR_ECU_RAM {p. 4232}	LV_MAF_BLS_DIAG {p. 4820}	LV_MTC_LIH_ACT {p. 4216}
LV_MTC_LIH_CUR_OFF {p. 4982}	LV_N_LIM_REQ_MON {p. 6877}	LV_TPS_MTC_N_LIM {p. 4982}	N_MAX_THD_2 {p. 1148}
Nkw_poel_notl {p. 8163}	Nmax_ba {p. 8163}	TQI_N_MAX {p. 3779}	

R.20.1 Outputs for BMW functions which are not defined as ENSL exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions

Initialisation: Mdi_nmax = 1000 Nm
B_nlf, B_ska, Nmax_var = 8000 rpm
Value at PWL: last calculated value: B_nlf, B_ska

Recurrence : 10 ms

Activation: every engine state

Formula section:

Remark: all formulas are valid in a **physical** meaning

Mdi_nmax = TQI_N_MAX
Nmax_var = N_MAX_THD_2
IF LV_N_LIM_REQ_MON == 1 **OR** // Request from safty
LV_TPS_MTC_N_LIM == 1 **OR** **// Request** from ETC diagnosis
LV_MTC_LIH_ACT== 1 **OR** **// Request from PVS diagnosis**

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LV_MAF_BLS_DIAG==1 **OR // MAF error and brake active**
LV_ERR_ECU_CKS ==1 **OR // Request from Checksum calculation**
LV_ERR_ECU_RAM == 1 // Request from RAM check

THEN B_ska = 1
ELSE B_ska = 0
END
B_nlf = LV_MTC_LIH_CUR_OFF

R.20.2 Outputs for supplier functions

FUNCTION DESCRIPTION:

General information:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Description:

Above a specific engine speed, the calculation of the stratified combustion mode is switched off. To enable a stratified limp home mode even when the stratified combustion mode calculation is switched off, the engine speed limitation N_MAX_LIH_STATE_CMB_S is introduced to reactivate stratified mode calculation. The BMW-variable Nmax_ba from the Layer is copied to the supplier-variable N_MAX_LIH_STATE_CMB_S

Application conditions

Initialisation:	`N_MAX_LIH_STATE_CMB_S = Nmax_ba` `N_LIH_PRS_OIL = Nkw_poel_notl`
Recurrence:	`N_MAX_LIH_STATE_CMB_S: 100 ms` `N_LIH_PRS_OIL: 10ms`
Activation:	*at every engine operating state*
Deactivation:	-

Formula section:

Remark: all formulas are valid in a **physical** meaning

N_MAX_LIH_STATE_CMB_S = Nmax_ba

N_LIH_PRS_OIL = Nkw_poel_notl

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R.21 Customer adaptation module: ENSS

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_abgewuergt	O/V	0... 1H	0 ...1	1	-
Motor abgewürgt					
B_dc_new	O/V	0... 1H	0 ...1	1	-
Neuer Fahrzyklus mit Klemmenwechsel					
B_motlaeuft	O/V	0... 1H	0 ...1	1	-
Running engine without starter, only through combustion					
B_msacanerr	O/V	0... 1H	0 ...1	1	-
CAN error of MSA relevant signals					
B_msadeakt	O/V	0... 1H	0 ...1	1	-
Bedingung MSADeaktivierung					
B_msaklimaav	O/V	0... 1H	0 ...1	1	-
Bedingung MSA-Abschaltverhinderer von KLIMA					
B_msaklimaea	O/V	0... 1H	0 ...1	1	-
Bedingung MSA-EinschaltauffordERER von KLIMA					
B_msastopt	O/V	0... 1H	0 ...1	1	-
Motor stop because MSAt					
B_msavadapt	O/V	0... 1H	0 ...1	1	-
MSA inhibition due to adaption					
B_msaverh	-	0... 1H	0 ...1	1	-
Bedingung MSAVerhinderung					
B_schlok	O/V	0... 1H	0 ...1	1	-
Boolean for key detected					
LV_ERR_STST	O/V	0... 1H	0 ...1	1	-
MSA error					
LV_LSH_DOWN_OFF_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
request switch off heating of downstream lambda sonde, bank selektiv					
LV_LSH_NS_OFF_REQ	O/V	0... 1H	0 ...1	1	-
request switch off heating of NOx-sensor					
LV_LSH_UP_OFF_REQ [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
request switch off heating of upstream lambda sonde, bank selektiv					
LV_STST_ACT	O/V	0... 1H	0 ...1	1	-
MSA active					
LV_STST_ACT_READY	O/V	0... 1H	0 ...1	1	-
MSA active and ready					
LV_STST_PRE_STOP_REQ	O/V	0... 1H	0 ...1	1	-
Preliminary MSA engine stop request					
LV_STST_ST_REQ_CUS	O/V	0... 1H	0 ...1	1	-
MSA engine start request					
LV_STST_ST_RLS	O/V	0... 1H	0 ...1	1	-
MSA engine start release					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_STST_STOP_REQ_CUS	O/V	0... 1H	0 ...1	1	-
MSA engine stop request					
T_CTR_ES	V	0... FFH	0... 2550	10	ms
time until detection of delayed engine stop					
Tn_abstell	O	0... FFFFH	0... 65535	1	s
engine off duration time (resolution s)					
Tn_abstellm	O/S	0... FFFFH	0... 65535	1	min
Engine off duration time (resolution min)					
Tn_start_10	O/V	0... FFFFH	0... 655350	10	ms
time after engine start					
Tn_start_1s	O/V	0... FFFFH	0... 65535	1	s
Zeit nach Startende in 1s aufgelöst					
Zr_seg_nstart	O	0... FFFFH	0... 65535	1	-
Cycle counter at start and after start (reset at exit start to after start)					

Input data:

B_hlsh1_off {p. 8343}	B_hlsh2_off {p. 8343}	B_hlsu1_off {p. 8343}	B_hlsu2_off {p. 8343}
B_hnox_off {p. 8343}	B_msaakt {p. 8344}	B_msaaktber {p. 8344}	B_msaerr {p. 8345}
B_msaprestopp {p. 8345}	B_msastart {p. 8345}	B_msastartf {p. 8345}	B_msastopp {p. 8345}
C_NR_CBK_EX {p. 944}	CYC_CAST {p. 1766}	ECU_STATE {p. 1091}	LV_DC {p. 5746}
LV_ENG_RUN_CMB {p. 800}	LV_ERR_CAN_STST {p. 800}	LV_IGK {p. 906}	LV_KEY_VLD {p. 1566}
LV_ST_END {p. 1720}	LV_STALL {p. 1766}	LV_STST_DEAC_ACT {p. 804}	LV_STST_ES {p. 804}
LV_STST_INH_ACT {p. 804}	LV_STST_INH_CDN_AD {p. 804}	NC_CBK_EX_NR {p. 1829}	STATE_STST_REQ_CAN {p. 809}
T_AST {p. 1766}	T_ES_CUS {p. 1444}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_T_CTR_ES	-	0... FFH	0... 2550	10	ms
delay time for detection of engine stop					

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R.21.1 Outputs for BMW functions which are defined as ENSS exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions

Initialisation: 0

Recurrence : event triggered / 10ms: B_abgewuergt, T_CTR_ES
10 ms: Zr_seg_nstart,Tn_start_10, B_motlaeuft, B_msadeakt,
B_msaverh, B_schlok
Remark: the resolution of T_AST is 100 ms

1000ms: Tn_start_1s

Activation: *every engine state*

Formula section:

Remark: all formulas are valid in a **physical** meaning

if ECU_STAT = "PWL"
then B_motlaeuft = 0
Tn_start_10 = 0
Tn_start_1s = 0
else Tn_start_10 = T_AST
Tn_start_1s = T_AST
B_motlaeuft = LV_ENG_RUN_CMB
B_msadeakt = LV_STST_DEAC_ACT
B_msaverh = LV_STST_INH_ACT
B_schlok = LV_KEY_VLD
endif

Zr_seg_nstart = CYC_CAST

/* at LV_ES 0-> 1 */
T_CTR_ES = C_T_CTR_ES

/* every 10ms */
if(1) LV_ES = 1
then(1) decrement T_CTR_ES
If(2) transition T_CTR_ES->0 **and** LV_IGK = 1
Then(2)
If(3) LV_STST_ES = 0
Then(3) B_abgewuergt = 1
call abwuerg_ini()
Else(3) call msastopp_ini()
Endif(3)
Endif(2)
Endif(1)

/* at LV_ST_END 0 -> 1*/
B_abgewuergt = 0

R.21.2 Outputs for BMW functions which are not defined as ENSS exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions

Initialisation: 0

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Recurrence :

```
10 ms:     Tn_abstell        Remark:  the input data recurrence is 1000ms
              B_msacanerr, B_msavadapt, B_msastopt, B_dc_new
100ms:        B_msaklimaav, B_msaklimaea
1000 ms:       Tn_abstellm
```

Activation:

```
 every ECU state, including WAKE_UP
 Except B_msacanerr, B_msavadapt
Value in power latch phase:    last valid value
               Except:  B_dc_new = 0
```

Formula section:

Remark: all formulas are valid in a **physical** meaning
B_dc_new = LV_DC

Tn_abstell = T_ES_CUS * 60
Hint:
T_ES_CUS only has a resolution of 1 minute, but Tn_abstell must have a resolution of 1 second ! Thus Tn_abstell jumps in 60 sec steps.
Tn_abstellm = T_ES_CUS
B_msacanerr = LV_ERR_CAN_STST
B_msavadapt = LV_STST_INH_CDN_AD
If ECU_STATE = "PWL"
Then B_msastopt = 0
Else B_msastopt = LV_STST_ES
If STATE_STST_REQ_CAN = " NO_REQ"
or STATE_STST_REQ_CAN = " INVALID_SIGNAL"
Then B_msaklimaav= 0,B_msaklimaea= 0
Endif
If STATE_STST_REQ_CAN = "START_REQ"
Then B_msaklimaav= 0,B_msaklimaea= 1
Endif
If STATE_STST_REQ_CAN = "STOP_REQ"
Then B_msaklimaav= 0,B_msaklimaea= 0
Endif
If STATE_STST_REQ_CAN = "START_INH"
Then B_msaklimaav= 0,B_msaklimaea= 0
Endif
If STATE_STST_REQ_CAN = "STOP_INH"
Then B_msaklimaav= 1,B_msaklimaea= 0
Endif
Endif

R.21.3 Outputs for supplier aggregates, customer (supplier

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

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Application conditions

Initialisation: 0

Recurrence : 10 ms / 100ms

Activation: *at every engine state*

Deactivation: –

Formula section:

```
/* recurrence 10ms */
LV_STST_ACT                = B_msaakt
LV_STST_ACT_READY          = B_msaaktber
LV_ERR_STST                = B_msaerr
LV_STST_ST_RLS             = B_msastartf
LV_STST_ST_REQ_CUS         = B_msastart
LV_STST_STOP_REQ_CUS       = B_msastopp
LV_STST_PRE_STOP_REQ       = B_msaprestopp

/* recurrence 100ms */
LV_LSH_NS_OFF_REQ = B_hnox_off
If      C_NR_CBK_EX = 2          //OL configuration
then
        LV_LSH_DOWN_OFF_REQ[1] = B_hlsh1_off
        LV_LSH_DOWN_OFF_REQ[2] = B_hlsh2_off
        LV_LSH_UP_OFF_REQ[1] = B_hlsu1_off
        LV_LSH_UP_OFF_REQ[2] = B_hlsu2_off
Else        // C_NR_CBK_EX = 1 , UL configuration
        LV_LSH_DOWN_OFF_REQ[1] = B_hlsh1_off
        LV_LSH_DOWN_OFF_REQ[2] = B_hlsh1_off
        LV_LSH_UP_OFF_REQ[1] = B_hlsu1_off
        LV_LSH_UP_OFF_REQ[2] = B_hlsu1_off
EndIf
```

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R.22 Customer adaptation module: ENTE

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_elu600	O/V	0... 1H	0 ...1	1	-
Learnt cooling fan variant					
B_lklps_ln	O/V	0... 1H	0 ...1	1	-
Boolean for learnt variant ECRAS_UP					
B_lklps_ln1	O/V	0... 1H	0 ...1	1	-
Boolean for learnt variant ECRAS_DOWN					
B_nkmtemp	O/V	0... 1H	0 ...1	1	-
Boolean for low coolant temperature (from IHKA)					
Ba_ist_ewp	O/V	0... AH	0... 10	1	-
internal operation state of the CWP					
ECTPWM_CLC	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Calculated pulse width modulated signal for the electronic controlled thermostat					
L_pwmout	O/V	0... FFH	0... 99.60937	0.390625	%
Electric fan control pulse width modulation					
LV_ECRAS	O/V	0... 1H	0 ...1	1	-
Indication of air flaps being closed (1)/open (0)					
LV_ECRAS_DOWN	O/V	0... 1H	0 ...1	1	-
SV label for B_LKLPS1 (from layer)					
LV_ECRAS_UP	O/V	0... 1H	0 ...1	1	-
SV label for B_LKLPS (from layer)					
LV_LIH_COC_ON	O/V	0... 1H	0 ...1	1	-
Limp home cooling circuit - engine ovrtemperature - request to transmission					
LV_TEMP_ENG_WARN_1	O/V	0... 1H	0 ...1	1	-
1: activate yellow warning lamp for TCO overtemperature (Check-Control-Messages in BN vehicles)					
LV_TEMP_ENG_WARN_2	O/V	0... 1H	0 ...1	1	-
1: activate red warning lamp for TCO overtemperature (Check-Control-Messages in BN vehicles)					
LV_TEMP_ENG_WARN_3	O/V	0... 1H	0 ...1	1	-
1: activate gearshift up for TCO overtemperature (Check-Control-Messages in BN vehicles)					
Md_na_el	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Torque loss of the electronic controled cooling fan(s)					
Md_na_ewapu	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Torque losses electric water pump					
N_PERC_ECF	O/V	0... FFH	0... 99.60937	0.390625	%
percentage value of electronic fan speed setpoint					
N_REL_CWP_SP	O/V	0... FFH	0... 255	1	-
Setpoint of EWAPU sent via bsd-component driver					
STATE_COC	O/V	0... FFH	0... 255	1	-
State coolant circuit management					
Tka	O/V	EC78... 7FFFH	-50... 327.67	0.01	°C
Coolant temperature at radiator outlet					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Tmot	O/V	EC78... 7FFFH	-50... 327.67	0.01	°C
Coolant temperature					
Tmot_abstell	O/V	EC78... 7FFFH	-50... 327.67	0.01	°C
Coolant temperature at engine stop					
Tmot_start	O/V	EC78... 7FFFH	-50... 327.67	0.01	°C
Coolant temperature at engine start					
Tmot_start_dc	O/V	EC78... 7FFFH	-50... 327.67	0.01	°C
Coolant temperature at first start of driving cycle					
Tsg	O/V	EC78... 7FFFH	-50... 327.67	0.01	°C
Temperatur Steuergerät					

Input data:

B_lklps {p. 8344}	B_lklps1 {p. 8344}	B_ntlkws {p. 8346}	B_tmmi_warn1 {p. 8347}
B_tmmi_warn2 {p. 8347}	B_tmmi_warn3 {p. 8347}	Ba_wm_ist {p. 8155}	ECFPWM_ECF {p. 1045}
ECU_STATE {p. 1091}	LV_FAN_VAR_AD {p. 803}	LV_N_REL_CWP_SP_EXT_ADJ {p. 7434}	LV_REQ_TCO_L {p. 1567}
LV_VAR_ECRAS_DOWN {p. 4515}	LV_VAR_ECRAS_UP {p. 655}	N_REL_CWP_SP_EXT_ADJ {p. 7435}	Nelueft_wm {p. 8163}
Newp_soll {p. 8163}	STATE_CWP_INT {p. 4537}	STATE_ENG {p. 1720}	TCO {p. 1100}
TCO_2 {p. 1218}	TCO_ST {p. 1100}	TCO_ST_DC {p. 1100}	TCO_STOP {p. 1100}
TECU {p. 1256}	TQ_LOSS_CWP_EL {p. 6658}	TQ_LOSS_ECF {p. 6580}	Tv_kft {p. 8178}

R.22.1 Outputs for BMW functions

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the output are different from the specified values due to the input data attributes.

Application conditions

Initialisation: all 0
except B_lklps_ln = true , Tmot_start=TCO; Tmot=TCO; Tmot_abstell = TCO_STOP, Tsg = TECU
(this init has to be done after the init process of tco/ tecu-acquisition)

Recurrence : 10ms: Md_na_el, Md_na_ewapu
100 ms: Tmot, Tka, L_pwmout, B_elu600, Tsg, Tmot_start_dc
200 ms: B_lklps_ln, B_lklps_ln1
Ba_ist_ewp, B_nkmtemp
1000 ms: Tmot_start, Tmot_abstell

Activation: *every engine state*

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Formula section:

Remark: all formulas are valid in a **physical** meaning
Tmot = TCO
Tmot_start_dc = TCO_ST_DC
If STATE_ENG = 0
Then Tmot_start = TCO
Else Tmot_start = TCO_ST
Endif
If ECU_STATE = 4 "power latch"
Then Tmot_abstell = TCO_STOP
Endif
Tka = TCO_2
L_pwmout = ECFPWM_ECF
Ba_ist_ewp = STATE_CWP_INT
Md_na_el = TQ_LOSS_ECF
Md_na_ewapu = TQ_LOSS_CWP_EL
B_nkmtemp = LV_REQ_TCO_L
B_elu600 = LV_FAN_VAR_AD
B_lklps_ln = LV_VAR_ECRAS_UP
B_lklps_ln1 = LV_VAR_ECRAS_DOWN
Tsg = TECU

R.22.2 Outputs for supplier functions

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the output are different from the specified values due to the input data attributes.

Application conditions

Initialisation: `all 0 at reset`

Recurrence : `100 ms: ECTPWM_CLC`
`200 ms: N_REL_CWP_SP, LV_LIH_COC_ON, LV_TEMP_ENG_WARN_1, LV_TEMP_ENG_WARN_2, LV_TEMP_ENG_WARN_3, STATE_COC, LV_ECRAS, N_PERC_ECF, LV_ECRAS_UP, LV_ECRAS_DOWN`

Activation: `every engine state`

Formula section:

ECTPWM_CLC = Tv_kft
N_PERC_ECF = Nelueft_wm
LV_LIH_COC_ON = B_ntlkws
LV_TEMP_ENG_WARN_1 = B_tmmi_warn1
LV_TEMP_ENG_WARN_2 = B_tmmi_warn2
LV_TEMP_ENG_WARN_3 = B_tmmi_warn3
STATE_COC = Ba_wm_ist // up to now not used; planned to put on CAN

LV_ECRAS = 0
LV_ECRAS_UP = B_lklps

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LV_ECRAS_DOWN = B_lklps1

IF LV_N_REL_CWP_SP_EXT_ADJ = 1
THEN N_REL_CWP_SP = N_REL_CWP_SP_EXT_ADJ * 2,55 [1/%]
ELSE N_REL_CWP_SP = Newp_soll
ENDIF

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R.23 Customer adaptation module: EVAC

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_dtev_aktiv	O/V	0... 1H	0 ...1	1	-
Inhibition of MAP-control requested by fc cps					
B_eol_tev	O/V	0... 1H	0 ...1	1	-
Bedingung BandendeTEV-Check aktiv					
B_te	O/V	0... 1H	0 ...1	1	-
1: canister purge valve is not closed					
B_te_la1	O/V	0... 1H	0 ...1	1	-
air fuel stechiometric for CP					
B_teblg	O/V	0... 1H	0 ...1	1	-
Bedingung Beladungsgrad wird gelernt					
B_tev_erf	O/V	0... 1H	0 ...1	1	-
Request to inhib Catalyst and O2 sensor diagnosis for allowing purge canister activation					
B_tev_zu	O/V	0... 1H	0 ...1	1	-
Logical value for CPS valve closed					
Fakf	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Moving mean value of the canister load CL					
LV_CP_INH_CUS	O/V	0... 1H	0 ...1	1	-
CPS-INH request from customer					
Mdi_res_tev	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
torque reserve for canister purge at idle					
MFF_ADD_TQ_CP	O/V	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
TQ relevant mass flow					
MFF_MAX_CP_CUS	O/V	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
Maximum mass flow from canister purge					
MFF_MAX_HOMS_CUS	O/V	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
MFF threshold for engine operation mode change HOM <-> HOMS					
MFF_MAX_S_CUS	O/V	8000... 7FFFH	-694.51059 ...694.4894	0.0211948	mg/stk
MFF threshold for engine operation mode change HOMS <-> S					
Mste	O/V	0... FFFFH	0... 25.5996	390.6e-6	kg/h
mass flow through canister purge valve					
Rktev	O/V	8000... 7FFFH	-16... 15.99951	488.299e-6	-
fuel correction due to canister purge					
Status_tev	O/V	0... FFH	0... 255	1	-
State canister purge					

Input data:

B_tev_stopp {p. 8347}	C_MAF_REF {p. 8279}	C_MFF_FAC {p. 8245}	CL_MMV {p. 3698}
ECU_STATE {p. 1091}	LV_CP_ACT_REQ {p. 3636}	LV_CP_CLOSE_ACT {p. 3749}	LV_EOL_CPS {p. 7763}
LV_INH_MAP_CTL_ DIAGCPS {p. 5926}	LV_LAMB_AFS_CP {p. 3700}	MAF_CPS {p. 3636}	MFF_ADD_CYL_CP {p. 3692}

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Rk_vlo_hs {p. 8168}	Rk_vlo_s {p. 8168}	Rkte_max {p. 8168}	Rkte_md {p. 8168}
STATE_CP {p. 3637}	TQ_ADD_CP {p. 3562}		

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_DIAGCPS_EOL_HOM_REQ	-	0... 1H	0 ...1	1	-
Homogeneous AFS request due to acive EOL DIAGCPS					

R.23.1 Outputs for BMW functions which are defined as EVAC exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions (for BMW variables):

Initialisation: 0 at reset
Recurrence : 10 ms
Rktev, Mste 20 ms
100ms: B_dtev_aktiv
Activation: every engine state, except power latch phase
Deactivation: power latch phase
Value at power latch phase: 0, Fakf: last valid value

Formula section:

Remark: all formulas are valid in a **physical** meaning

If ECU_STATE = "PWL"
Then
Mdi_res_tev = 0
B_dtev_aktiv = 0
B_eol_tev = 0
B_tev_erf = 0
B_tev_zu = 0
Rktev = 0
Mste = 0
B_te_la1 = 0
B_te = 0
Status_tev = 0
B_teblg = 0
Else
Mdi_res_tev = TQ_ADD_CP
B_dtev_aktiv = LV_INH_MAP_CTL_DIAGCPS
B_eol_tev = LV_EOL_CPS
B_tev_erf = LV_CP_ACT_REQ
B_tev_zu = LV_CP_CLOSE_ACT
Rktev = MFF_ADD_CYL_CP /(C_MAF_REF * C_MFF_FAC)
Status_tev = STATE_CP
Mste = MAF_CPS

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B_te_la1 = LV_LAMB_AFS_CP **or** (LC_DIAGCPS_EOL_HOM_REQ **and** LV_EOL_CPS)
B_te = **!** LV_CP_CLOSE_ACT
Fakf = CL_MMV

If STATE_CP = RAMP_OPEN (8H) **or** RAMP_OPEN_FAST (9H)
or MAX_PURGE (AH)
Then B_teblg = 1
Else B_teblg = 0
Endif
Endif

R.23.2 Outputs for supplier aggregates, customer (supplier

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs can be different from the specified values due to the input data attributes.

Application conditions (for supplier variables):

Initialisation: 0
Recurrence : 10 ms
Activation: at every engine state

Formula section:

Remark: all formulas are valid in a **physical** meaning

LV_CP_INH_CUS = B_tev_stopp
MFF_MAX_CP_CUS = Rkte_max * C_MAF_REF * C_MFF_FAC
MFF_ADD_TQ_CP = Rkte_md * C_MAF_REF * C_MFF_FAC
MFF_MAX_S_CUS = Rk_vlo_s * C_MAF_REF * C_MFF_FAC
MFF_MAX_HOMS_CUS = Rk_vlo_hs * C_MAF_REF * C_MFF_FAC

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R.24 Customer adaptation module: EXTC

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_atlsvc_if	O/V	0... 1H	0 ...1	1	-
Testeranfordung für Diagnosefunktion der Abgasturbolader					
B_bsakt_zuli1	O/V	0... 1H	0 ...1	1	-
Boolean for active catalyst overheating control bank 2					
B_bsakt_zuli2	O/V	0... 1H	0 ...1	1	-
Boolean for active catalyst overheating control bank 1					
B_kath	O	0... 1H	0 ...1	1	-
Catalyst heating function general					
Baw_katman1	O/V	0... FFFFH	0... 65535	1	-
Statuswort Katheizanforderung - "priorisierter" Wunsch					
Baw_katman2	O/V	0... FFFFH	0... 65535	1	-
Statuswort Katheizanforderung - "alternativ" Wunsch					
Drfkh_s	O/V	8000... 7FFFH	-327.68 ...327.67	0.01	%
differences for S - CH					
Dwesb3_kh_s	O/V	E200... 5A00H	-180 ...540	0.0234375	°CRK
Delta Zündwinkel Einspritzbeginn 3.EinspritzungSchicht					
Dwese2_kh_h	O/V	E200... 5A00H	-180 ...540	0.0234375	°CRK
Delta Zündwinkel Einspritzende 2. Einspritzung homogen					
Dzw_kh_s	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Catalyst heating ignition angle difference (stratified)					
FAC_MAF_REL_EGR_COR	O/V	0... BB8H	0... 300	0.1	%
Relative filling, EGR-corrected					
FAC_TQ_ADD_SO2P_EXT	O/V	0... FFH	0... 0.99609	3.9063e-3	-
External factor reducing torque reserve for desulfation catalyst heating					
La_bszuli1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda for catalyst overheating prevention bank 1					
La_bszuli2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda for catalyst overheating prevention bank 2					
La_kh1	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda catalyst heating					
La_kh2	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambda catalyst heating					
LAMB_COP [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda for catalyst overheating prevention bank 1+2					
LV_CH	O/V	0... 1H	0 ...1	1	-
Auxiliary Function " Catalyst Heating Spark"					
LV_CH_AST_REQ_TCHA_DIAG	O/V	0... 1H	0 ...1	1	-
Activation of catalyst heating function requested for turbo charger diagnosis					
LV_CH_INH	O/V	0... 1H	0 ...1	1	-
Inhibition of general catalyst heating					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_LAMB_COP [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Lambda setpoint calculation for catalyst overheating prevention is active					
LV_PUC_INH_TEMP_CAT	O/V	0... 1H	0 ...1	1	-
Flag to inhibit PUC operation due to too high TEMP_CAT					
LV_TCHA_DIAG_REQ	O/V	0... 1H	0 ...1	1	-
Request of ATL-Diagnosis					
LV_TCHA_DIAG_REQ_OFF	V	0... 1H	0 ...1	1	-
request to switch off ATL-diagnosis					
Mdi_res_kh	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Torque reserve for catalyst heating					
P_rail_kh	O/V	0... FFFFH	0... 39.99938	610.4e-6	MPa
Rail pressure from catalyst heating manager					
Prio_katman1	O/V	80... 7FH	-128 ...127	1	-
Priority number (highest wish) of catalyst heating manager					
Prio_katman2	O/V	80... 7FH	-128 ...127	1	-
Priority number (second wish) of catalyst heating manager					
TQ_ADD_CH_TCHA_DIAG	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque reserve for turbocharger diagnosis - to be realized via catalyst heating					
Wesb1kh_h [NC_CYL_NR]	O/V	E200... 5A00H	-180 ...540	0.0234375	°CRK
Einspritzbegin 1. Einspritzung homogen					

Input data:

B_atlsvc {p. 8342}	B_atlsvc_khm {p. 8342}	B_bs1 {p. 8342}	B_bs2 {p. 8342}
B_vb_sa {p. 8347}	B_vbkhm_notl {p. 8347}	Baw_ist {p. 8155}	C_MAF_REF {p. 8279}
CRK_INJ_BAS [NC_CYL_NR] {p. 2122}	EOI_2_DELTA_MPLH_CH {p. 2159}	F_bsmdres {p. 8157}	FUP_SP_CH {p. 3611}
IGA_DIF_S_CH {p. 1943}	La_bs1 {p. 8160}	La_bs2 {p. 8160}	LAMB_COP_CUS [_i] {p. 2195}
LAMB_SP_CH [NC_CBK_EX_NR] {p. 2169}	LV_TCHA_DIAG_EXT_REQ {p. 7763}	MAF_DIF_S_CH {p. 6529}	Md_res_atlsvc {p. 8161}
NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NR_PRI_CH_MOD {p. 1796}	NR_PRI_CH_MOD_REQ {p. 1796}
Rfv_vns {p. 8167}	SOI_1_MPLH_CH [NC_CYL_NR] {p. 2154}	SOI_MPLP_DIF_CH {p. 2188}	STATE_CH {p. 1777}
STATE_CH_MOD_IVVT {p. 1040}	STATE_CH_MOD_IVVT_REQ {p. 1040}	TQ_ADD_CH {p. 6582}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_TCHA_DIAG_EXT_REQ	-	0... 1H	0 ...1	1	-
switch for manual start of ATL-diagnosis (default: 0)					

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R.24.1 Outputs for BMW functions which are defined as EXTC exported data

FUNCTION DESCRIPTION:

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Adaptation to BMW environment.

Application conditions:

Initialisation at reset or at exit power latch phase:
0 ,except La_bszuli1/2 = 2.00, La_kh1/2 = 1.00
Recurrence : seg Dwesb3_kh_s, Dwese2_kh_h,
Wesb1kh_h[ANZAHL_ZYLINDER], P_rail_kh, Dzw_kh_s
10 ms Mdi_res_kh, La_kh1/2,
La_bszuli1, La_bszuli2, Drfkh_s, Baw_katman1, Baw_katman2
100ms Prio_katman1/2, B_kath, B_atlsvc_if
200ms B_bsakt_zuli1, B_bsakt_zuli2

Activation: every engine state, except power latch phase
Deactivation: at power latch phase, except B_kath
Values at Deactivation: 0, except P_rail_kh: last calculated value

Formula section:

Remark: all formulas are valid in a **physical** meaning
Mdi_res_kh = TQ_ADD_CH
La_bszuli1 = LAMB_COP_CUS_1
La_bszuli2 = LAMB_COP_CUS_2
B_bsakt_zuli1 = LV_LAMB_COP_CUS_1
B_bsakt_zuli2 = LV_LAMB_COP_CUS_2
Dwesb3_kh_s = SOI_MPLP_DIF_CH
Dwese2_kh_h = EOI_2_DELTA_MPLH_CH
La_kh1 = LAMB_SP_CH[1]
La_kh2 = LAMB_SP_CH[2]
Baw_katman1 = STATE_CH_MOD_IVVT_REQ
Baw_katman2 = STATE_CH_MOD_IVVT
Dzw_kh_s = IGA_DIF_S_CH

Wesb1kh_h[ANZAHL_ZYLINDER]
= SOI_1_MPLH_CH[NC_CYL_NR] + CRK_INJ_BAS[0]
Drfkh_s = MAF_DIF_S_CH /C_MAF_REF
Prio_katman1 = NR_PRI_CH_MOD_REQ
Prio_katman2 = NR_PRI_CH_MOD
P_rail_kh = FUP_SP_CH
B_kath = LV_CH
B_atlsvc_if = LV_TCHA_DIAG_REQ

R.24.2 Outputs for supplier aggregates

FUNCTION DESCRIPTION:

Adaptation to BMW environment

Application conditions

Initialisation at reset: 0, except LAMB_COP[NC_CBK_EX_NR] = 2.00
FAC_TQ_ADD_SO2P_EXT = 1.00
Initalisation at LV_IGK 0-> 1: LV_TCHA_DIAG_REQ_OFF
= 0

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Recurrence: 10ms: LAMB_COP[NC_CBK_EX_NR], LV_LAMB_COP[NC_CBK_EX_NR], LV_LAMB_COP, FAC_MAF_REL_EGR_COR, LV_CH , LV_CH_INH, TQ_ADD_CH_TCHA_DIAG
100ms: LV_PUC_INH_TEMP_CAT, LV_TCHA_DIAG_REQ, LV_TCHA_DIAG_REQ_OFF, LV_CH_AST_REQ_TCHA_DIAG
200ms: FAC_TQ_ADD_SO2P_EXT

Activation: *every engine state*

Formula section:

LAMB_COP[1] = La_bs1
LAMB_COP[2] = La_bs2
LV_LAMB_COP[1] = B_bs1
LV_LAMB_COP[2] = B_bs2
LV_LAMB_COP = B_bs2 or B_bs1
LV_PUC_INH_TEMP_CAT = B_vb_sa
FAC_MAF_REL_EGR_COR = Rfv_vns

if one of the following combinations of the bit values (bit 4 to bit 11) of Baw_ist is active

Bit 15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
				0	0	0	0	0	1	0	0				
				0	0	0	0	0	1	0	1				
				0	0	0	0	0	1	1	1				
				0	0	0	0	1	0	1	0				
				0	0	0	0	1	0	1	1				
				0	0	0	0	1	1	0	0				
				0	0	0	0	1	1	0	1				
				0	0	0	0	1	1	1	0				

then LV_CH = 1
else LV_CH = 0
endif

LV_CH_INH = B_vbkhm_notl
FAC_TQ_ADD_SO2P_EXT = F_bsmdres
TQ_ADD_CH_TCHA_DIAG = Md_res_atlsvc
if B_atlsvc switch 1 -> 0
then LV_TCHA_DIAG_REQ_OFF = 1
endif
LV_TCHA_DIAG_REQ = (LC_TCHA_DIAG_EXT_REQ **or** LV_TCHA_DIAG_EXT_REQ)

and not(LV_TCHA_DIAG_REQ_OFF)
LV_CH_AST_REQ_TCHA_DIAG = B_atlsvc_khm

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R.25 Customer adaptation module: EXTD

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_atm_tpnk1	O/V	0... 1H	0 ...1	1	-
Dew point has been reached post cat. specific bank 1 downstream					
B_atm_tpnk2	O/V	0... 1H	0 ...1	1	-
Dew point has been reached post cat. specific bank 2 downstream					
B_atm_tpvk1	O/V	0... 1H	0 ...1	1	-
Bedingung Taupunktende erreicht Lambdasonde vor Kat1					
B_atm_tpvk2	O/V	0... 1H	0 ...1	1	-
Bedingung Taupunktende erreicht Lambdasonde vor Kat2					
EGY_DEW_NT_DOWN	O/V	8000... 7FFFH	-20480... 20479.375	0.625	W
amount of energy brought into exhaust system for nox trap dew point detection					
LV_CHECK_MDL_ST	O/V	0... 1H	0 ...1	1	-
Flag for modelling start					
Tabg_sens1	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Signal exhaust gas temperature sensor 1					
Tabg_sens2	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
Signal exhaust gas temperature sensor 2					
TEG_CAT_DOWN_MDL	O/V	0... 7FF0H	0... 2047	0.0625	°C
Bank selektive modelled exhaust gas temperature downstream for interfaces					
TEG_CAT_DOWN_MDL [_i]	O	0... 7FF0H	0... 2047	0.0625	°C
Exhaust gas temperature downstream Cat					
TEG_CAT_DOWN_MDL_BAS [NC_CBK_EX_NR]	O/V	0... FFFFH	-48 ...1	0.023	°C
Model of exhaust temperature post catalyst downstream					
TEG_CAT_UP_MDL [_i]	O	0... 7FF0H	0... 2047	0.0625	°C
Bank selektive modelled exhaust gas temperature upstream for interfaces					
TEG_CAT_UP_MDL [NC_CBK_EX_NR]	O/V	0... 7FF0H	0... 2047	0.0625	°C
Modelled exhaust gas temperature; engine out (bank selective)					
TEG_DYN	O/V	0... 7FF0H	0... 2047	0.0625	°C
Modelled exhaust gas temperature upstream for interfaces					
TEG_STAT_MAX	O/V	0... 7FF0H	0... 2047	0.0625	°C
Gemittelte max. Temperatur für Desulfatisierung					
TEG_STAT_MAX_1	O/V	0... 7FF0H	0... 2047	0.0625	°C
Max. Temperatur für Desulfatisierung Bank 1					
TEG_STAT_MAX_2	O/V	0... 7FF0H	0... 2047	0.0625	°C
Max. Temperatur für Desulfatisierung Bank 2					
TEG_WALL_CAT_DOWN_MDL [NC_CBK_EX_NR]	O/V	0... FFFFH	-48 ...1	0.023	°C
Model of exhaust wall temperature post catalyst downstream					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TEG_WALL_CAT_UP_MDL [NC_CBK_EX_NR]	O/V	0... FFFFH	-48 ...1	0.023	°C
Model of exhaust wall temperature pre catalyst upstream					
TEG_WALL_NT_DOWN_MDL	O/V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
exhaust manifold wall temperature at NOX-sensor					
TEG_WALL_NT_DOWN_MDL_ST	O/V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
exhaust manifold wall temperature at NOX-sensor at start					
TEMP_CAT	O/V	0... FFFFH	-33... 990.98437	0.015625	°C
Modelled exhaust gas temperature downstream for interfaces					
TEMP_CAT_DYN_MDL [NC_CBK_EX_NR]	O/V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
Modelled catalyst temperature under dynamic conditions					
TEMP_CAT_STAT_MDL [NC_CBK_EX_NR]	O/V	0... 7FFFH	-273.15... 1774.7875	0.0625	°C
modeled catalyst monolith temperature (bank selective)					
Tkat_mod	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
modelled catalyst temperature					
TNT_MDL_1 [NC_NT_NR]	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Modelled NOx catalyst temperature of the first monolith					
TNT_MDL_2 [NC_NT_NR]	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Modelled NOx catalyst temperature of the second monolith					
TNT_MDL_H	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Maximum of modelled NOx catalyst monolith temperatures					
TNT_MDL_H_1	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Maximum of modelled NOx catalyst monolith temperatures, bank 1					
TNT_MDL_H_2	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Maximum of modelled NOx catalyst monolith temperatures, bank 2					
TNT_MDL_L	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Minimum of modelled NOx catalyst monolith temperatures					
TNT_MDL_MAX_AVL	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Maximum attainable monolith temp. for active Nox cat. desulfation					
TNT_MDL_MV	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Temperature NoX-trap mean value					
TNT_MDL_MV_SNG [NC_NT_NR]	O/V	0... FFFFH	0... 1023.98437	0.015625	°C
Mean value of the two modelled NOx catalyst monolith temperatures for each exhaust branch					

Input data:

LV_ST_END {p. 1720}	LV_STST_STOP_CYC_MEM {p. 805}	LV_TEG_CAT_DOWN_MIN_THD [NC_CBK_EX_NR] {p. 2446}	LV_TEG_MIN_THD [NC_CBK_EX_NR] {p. 2446}
NC_CBK_EX_NR {p. 1829}	NC_NT_NR {p. 644}	Q_abgnox {p. 8166}	T_ikat1 {p. 8175}
T_ikat1_stat {p. 8175}	T_ikat2 {p. 8175}	T_ikat2_stat {p. 8175}	Tabg_demax1 {p. 8176}
Tabg_demax2 {p. 8176}	Tabg_demaxav {p. 8176}	Tabg_desul {p. 8176}	Tabg_ikat_av {p. 8176}
Tabg_inok1 {p. 8176}	Tabg_inok2 {p. 8176}	Tabg_nk_av {p. 8176}	Tabg_nk1 {p. 8176}
Tabg_nk2 {p. 8176}	Tabg_nnok1 {p. 8176}	Tabg_nnok2 {p. 8176}	Tabg_nok_av {p. 8176}

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Tabg_nok_av1 {p. 8176}	Tabg_nok_av2 {p. 8176}	Tabg_nokmax {p. 8176}	Tabg_nokmax1 {p. 8176}
Tabg_nokmax2 {p. 8176}	Tabg_nokmin {p. 8176}	Tabg_r10 {p. 8176}	Tabg_r9 {p. 8176}
Tabg_vk_av {p. 8176}	Tabg_vk1 {p. 8177}	Tabg_vk2 {p. 8177}	TEG_PCAT_DOWN_COR [NC_CBK_EX_NR] {p. 3181}
Tw_m1 {p. 8178}	Tw_m2 {p. 8178}	Tw_nk1 {p. 8178}	Tw_nk2 {p. 8178}
Tw_noxsens {p. 8178}			

R.25.1 Output for BMW functions which are not defined as EXTD exported data

FUNCTION DESCRIPTION:

Remark: all formulas are valid in a **physical** meaning

Application conditions:

Initialisation at reset or at exit power latch phase for variables with BMW-naming convention:
0 °C: Tkat_mod
0: B_atm_tpnk1, B_atm_tpnk2, B_atm_tpvk1, B_atm_tpvk2
First valid value: Tabg_sens1, Tabg_sens2, Tabg_sensturb1,Tabg_sensturb2
Recurrence: 200ms
Activation: at every engine state
Deactivation: - –

Formula section:

B_atm_tpvk1 = LV_TEG_MIN_THD[1]
B_atm_tpvk2 = LV_TEG_MIN_THD[2]
B_atm_tpnk1 = LV_TEG_CAT_DOWN_MIN_THD[1]
B_atm_tpnk2 = LV_TEG_CAT_DOWN_MIN_THD[2]
If ECU_STATE is not"PWL"
then
Tkat_mod = TEG_CAT_DOWN_MDL
Tabg_sens1 = TEG_PCAT_DOWN_COR[1]
If NC_NT_NR = 2
then
Tabg_sens2 = TEG_PCAT_DOWN_COR[2]
else
Tabg_sens2 = TEG_PCAT_DOWN_COR[1]

Endif

R.25.2 Outputs for supplier aggregates

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs can be different from the specified values due to the input data attributes.

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Application conditions

Initialisation for variables with supplier-naming convention: 0 °C

Except:

```
EGY_DEW_NT_DOWN      =      Q_abgnox
TEG_CAT_DOWN_MDL_BAS[1] =  Tabg_r9
TEG_CAT_DOWN_MDL_BAS[2] =  Tabg_r10
TEG_CAT_UP_MDL[1] = Tabg_vk1
TEG_CAT_UP_MDL[2] = Tabg_vk2
TEG_CAT_UP_MDL_1 = Tabg_vk1
TEG_CAT_UP_MDL_2 = Tabg_vk2
TEG_STAT_MAX_1 = Tabg_demax1
TEG_STAT_MAX_2 = Tabg_demax2
TEG_STAT_MAX = Tabg_demaxav
TEMP_CAT = Tabg_ikat_av
TEG_CAT_DOWN_MDL[1] = Tabg_nk1
TEG_CAT_DOWN_MDL[2] = Tabg_nk2
TEG_CAT_DOWN_MDL_1 = Tabg_nk1
TEG_CAT_DOWN_MDL_2 = Tabg_nk2
TEG_CAT_DOWN_MDL = Tabg_nk_av
TEG_WALL_NT_DOWN_MDL_ST       = Tw_noxsens
TEG_WALL_NT_DOWN_MDL      = Tw_noxsens
TEG_DYN = Tabg_vk_av
TEMP_CAT_DYN_MDL[1]      = T_ikat1
TEMP_CAT_DYN_MDL[2]      = T_ikat2
TEMP_CAT_STAT_MDL[1]      = T_ikat1_stat
TEMP_CAT_STAT_MDL[2]      = T_ikat2_stat
TNT_MDL_MAX_AVL      = Tabg_desul
TNT_MDL_1[1]    =Tabg_inok1
TNT_MDL_1[2]    =Tabg_inok2
TNT_MDL_2[1]    =Tabg_nnok1
TNT_MDL_2[2]    =Tabg_nnok2
TNT_MDL_MV    =Tabg_nok_av
TNT_MDL_MV_SNG[1]=Tabg_nok_av1
TNT_MDL_MV_SNG[2]=Tabg_nok_av2
TNT_MDL_H          =Tabg_nokmax
TNT_MDL_H_1    =Tabg_nokmax1
TNT_MDL_H_2    =Tabg_nokmax2
TNT_MDL_L     =Tabg_nokmin
```

Recurrence : 200 ms

Activation: *every engine state*

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Formula section:

Remark: all formulas are valid in a **physical** meaning

EGY_DEW_NT_DOWN = Q_abgnox
TEG_WALL_CAT_UP_MDL[1] = Tw_m1
TEG_WALL_CAT_UP_MDL[2] = Tw_m2
TEG_WALL_CAT_DOWN_MDL[1] = Tw_nk1
TEG_WALL_CAT_DOWN_MDL[2] = Tw_nk2
TEG_CAT_DOWN_MDL_BAS[1] = Tabg_r9
TEG_CAT_DOWN_MDL_BAS[2] = Tabg_r10
TEG_CAT_UP_MDL[1] = Tabg_vk1
TEG_CAT_UP_MDL[2] = Tabg_vk2
TEG_STAT_MAX_1 = Tabg_demax1
TEG_STAT_MAX_2 = Tabg_demax2
TEG_STAT_MAX = Tabg_demaxav
TEMP_CAT = Tabg_ikat_av
TEG_CAT_DOWN_MDL[1] = Tabg_nk1
TEG_CAT_DOWN_MDL[2] = Tabg_nk2
TEG_CAT_DOWN_MDL = Tabg_nk_av
TEG_WALL_NT_DOWN_MDL = Tw_noxsens
TEG_DYN = Tabg_vk_av
TEMP_CAT_DYN_MDL[1] = T_ikat1
TEMP_CAT_DYN_MDL[2] = T_ikat2
TEMP_CAT_STAT_MDL[1] = T_ikat1_stat
TEMP_CAT_STAT_MDL[2] = T_ikat2_stat
TNT_MDL_MAX_AVL = Tabg_desul
TNT_MDL_1[1] =Tabg_inok1
TNT_MDL_1[2] =Tabg_inok2
TNT_MDL_2[1] =Tabg_nnok1
TNT_MDL_2[2] =Tabg_nnok2
TNT_MDL_MV =Tabg_nok_av
TNT_MDL_MV_SNG[1]=Tabg_nok_av1
TNT_MDL_MV_SNG[2]=Tabg_nok_av2
TNT_MDL_H =Tabg_nokmax
TNT_MDL_H_1 =Tabg_nokmax1
TNT_MDL_H_2 =Tabg_nokmax2
TNT_MDL_L =Tabg_nokmin

If(1) LV_ES = 1
Then(1)
LV_CHECK_MDL_ST = 0
Else(1)
If(2) LV_CHECK_MDL_ST = 0
And TEG_WALL_NT_DOWN_MDL(n-1) <> TEG_WALL_NT_DOWN_MDL(n)
Then(2)
LV_CHECK_MDL_ST = 1
If LV_STST_STOP_CYC_MEM = 0
Then TEG_WALL_NT_DOWN_MDL_ST = TEG_WALL_NT_DOWN_MDL
Endif
Endif(2)
Endif(1)

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R.26 Customer adaptation module: FMSP

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_dosp_akt	O	0... FFH	0... 255	1	-
Injection mode requested					
B_wst	O	0... 1H	0 ...1	1	-
Auxiliary function "Re-start"					
CTR_MFF_SP_HOM_BAS_TMP [NC_CBK_EX_NR]	V	0... FFH	0... 255	1	-
Counter for calculation of MFF_SP_HOM_BAS_TMP					
F_start	O	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
cold start enrichment					
F_vst	O	0... FFFFH	0... 63.99902	976.599e-6	-
mixture enrichment due to warm-up and cold after start enrichment					
FAC_1_HOM_COR [NC_CYL_NR]	V	0... FFFFH	0... 0.99998	15.3e-6	-
MFF additive correction on 1st. injection pulse (homogeneous modus)					
FAC_1_S_COR [NC_CYL_NR]	V	0... FFFFH	0... 0.99998	15.3e-6	-
MFF additive correction on 1st. injection pulse (stratified modus)					
FAC_2_HOM_COR [NC_CYL_NR]	V	0... FFFFH	0 ...1	15.3e-6	-
MFF additive correction on 2nd. injection pulse (homogeneous modus)					
FAC_2_S_COR [NC_CYL_NR]	V	0... FFFFH	0 ...1	15.3e-6	-
MFF additive correction on 2nd. injection pulse (stratified modus)					
FAC_3_HOM_COR [NC_CYL_NR]	V	0... FFFFH	0 ...1	15.3e-6	-
MFF additive correction on 3rd. injection pulse (homogeneous modus)					
FAC_3_S_COR [NC_CYL_NR]	V	0... FFFFH	0 ...1	15.3e-6	-
MFF additive correction on 3rd. injection pulse (stratified modus)					
FAC_MFF_COR_INJ_MOD	O/V	0... FFH	0... 1.99218	0.0078125	-
Mass fuel flow correction at different homogeneous injection mode					
FAC_MFF_COR_INJ_MOD_S	O/V	0... FFH	0... 1.99218	0.0078125	-
Mass fuel flow correction at different injection stratified mode					
FAC_MFF_CST_OPM_SEL	O/V	0... FFH	0... 0.99609	3.9062e-3	-
start fuel mass flow interpolation factor for operation switch manager					
FAC_MFF_WUP_HOMS	O/V	0... FFH	0... 1.99218	0.0078125	-
Mass fuel flow correction during homogeneous lean warm-up phase					
FAC_MFF_WUP_S	O/V	0... FFH	0... 1.99218	0.0078125	-
Mass fuel flow correction stratified warm-up phase					
FAC_MPLP_COR [NC_CYL_NR]	V	0... FFFFH	0... 0.99998	15.3e-6	-
MFF additive correction on post injection pulse (stratified modus)					
FAC_TI_CAST_OPM_SEL	O/V	0... FFH	0... 0.99609	3.9062e-3	-
post start injection time correction interpolation factor for operation switch manager					
FAC_TI_WUP_OPM_SEL	O/V	0... FFH	0... 0.99609	3.9062e-3	-
warm up injection time correction interpolation factor for operation switch manager					
INJ_MOD_HOM_REQ	O/V	0... FFH	0... 255	1	-
injection mode selection hom (single /multi)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
INJ_MOD_S_REQ	O/V	0... FFH	0... 255	1	-
injection mode selection strat (single /multi)					
LF_MFF_HOM	O/V	0... FFH	0... 255	1	-
Bitfield to indicate homogeneous injection mapping and ignition coupling.					
LV_ADD_PULSE_ENA	O/V	0... 1H	0 ...1	1	-
Switch to enable additional injection pulse at homogeneous mode, single injection mode (injection update at transient operation)					
LV_EOI_ST_ENA	O/V	0... 1H	0 ...1	1	-
Indicates if an EOI based start is requested					
LV_FCO_COR_REQ	O/V	0... 1H	0 ...1	1	-
Anforderung Verbrauchsberechnung mit korrigierter Kraftstoffmasse					
LV_ST_H_PRS	-	0... 1H	0 ...1	1	-
Flag indicating high pressure start requested					
LV_ST_INJ_AUTH	O/V	0... 1H	0 ...1	1	-
Flag indicating injection authorized					
LV_TI_COR_WF_OPM_1_ACT	O/V	0... 1H	0 ...1	1	-
wall film operation mode switch					
MFF_ADD_WF	O/V	8000... 7FFFH	-694.5... 694.4788	0.02119-	mg/stk
Total fuel amount for wall film compensation					
MFF_SP_1_EXT_COR [NC_CYL_NR]	O/V	8000... 7FFFH	-694.5... 694.4788	0.02119-	mg/stk
Fuel mass setpoint external correction for the first pulse (aging and coding corr.)					
MFF_SP_1_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Cylinder individual mass fuel flow setpoint for homogeneous mode, first pulse					
MFF_SP_1_HOMS [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the first pulse at homogeneous-stratified mode					
MFF_SP_1_S [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the first pulse at stratified mode					
MFF_SP_1_S_TMP	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the third pulse at stratified mode, for temporary calculations					
MFF_SP_2_EXT_COR [NC_CYL_NR]	O/V	8000... 7FFFH	-694.5... 694.4788	0.02119-	mg/stk
Fuel mass setpoint external correction for the second pulse (aging and coding corr.)					
MFF_SP_2_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the second pulse at homogeneous mode					
MFF_SP_2_HOMS [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the second pulse at homogeneous-stratified mode					
MFF_SP_2_S [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the second pulse at stratified mode					
MFF_SP_2_S_TMP	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the second pulse at stratified mode, for temporary calculations					
MFF_SP_3_EXT_COR [NC_CYL_NR]	O/V	8000... 7FFFH	-694.5... 694.4788	0.02119-	mg/stk
Fuel mass setpoint external correction for the third pulse (aging and coding corr.)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MFF_SP_3_HOM [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the third pulse at homogeneous mode					
MFF_SP_3_HOMS [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the second pulse at homogeneous-stratified mode					
MFF_SP_3_S [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the third pulse at stratified mode					
MFF_SP_BAS	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Momentary fuel mass setpoint without adaptation					
MFF_SP_BAS_S	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Momentary stratified fuel mass setpoint without adaptation					
MFF_SP_FCO_COR	O/V	8000... 7FFFH	-694.5... 694.4788	0.02119-	mg/stk
Korrigierte Kraftstoffmasse für Kraftstoffverbrauchsanzeige					
MFF_SP_HOM_BAS [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint for homogeneous mode (exhaust gas bank specific)					
MFF_SP_HOM_BAS_TMP [NC_CBK_EX_NR]	V	0... FFFFFFFFH	0... 91030893	0.0211948	mg/stk
Temp. variable: Mass fuel flow setpoint for homogeneous mode (exhaust gas bank specific)					
MFF_SP_HOM_MPG_TMP [NC_NR_IV_PLS]	V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint for homogeneous mode (temporary value) for FUMU.					
MFF_SP_HOM_TMP [NC_NR_IV_PLS]	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow setpoint for homogeneous mode (temporary value).					
MFF_SP_HOMS	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass flow setpoint at homogeneous-stratified combustion mode					
MFF_SP_HOMS_PRED	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass flow setpoint if homogeneous-stratified combustion mode would be active					
MFF_SP_MPLP [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the post pulse at stratified mode					
MFF_SP_MPLP_EXT_COR [NC_CYL_NR]	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint external correction for the post pulse (aging and coding corr.)					
MFF_SP_S	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass in stratified combustion					
MFF_SP_S_PRED	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Predicted mass fuel flow setpoint if stratified combustion mode would be active					
MFF_SP_S_SWI_HOM	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Mass fuel flow expected after switiching from strattified to homogeneous mode					
NR_INJ_PLS_HOM_REQ	O/V	0... 3H	0 ...3	1	-
Number of requested injection pulses for homogeneous mode					
NR_INJ_PLS_HOM_REQ_TMP	-	0... FFH	0... 255	1	-
Number of requested injection pulses for homogeneous mode, for temporary calculations					
NR_INJ_PLS_S_REQ	O/V	0... 3H	0 ...3	1	-
Number of requested injection pulses for stratified or homogeneous-stratified mode					
Rk_1	O	0... FFFFH	0... 31.99951	488.299e-6	-
relative fuel mass cylinder bank i					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Rk_2	O	0... FFFFH	0... 31.99951	488.299e-6	-
relative fuel mass cylinder bank i					
Rk_kh_s	O/V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
Mass fuel flow of the post injection during CH					
Rk2_kh_h	O/V	8000... 7FFFH	-100... 99.99694	3.0518e-3	%
relative fuel mass cylinder bank i					

Input data:

B_espr_start {p. 8343}	B_hd_start {p. 8343}	B_rkkor_kva {p. 8346}	Ba_switch_uek {p. 8155}
C_INJ_MOD_SP_MAN {p. 3334}	C_MFF_REF	CTR_CYL_NR_ST_CLC {p. 1754}	CTR_CYL_NR_STOP_CLC {p. 1754}
ECU_STATE {p. 1091}	Espr_mod_soll [NC_CYL_NR] {p. 8157}	F_nst_ba {p. 8157}	F_rkkorwl_hs {p. 8158}
F_rkkorwl_s {p. 8158}	F_st_ba {p. 8158}	F_wl_ba {p. 8158}	FAC_LAM_AD_BAL [NC_CBK_EX_NR] {p. 1014}
FAC_LAM_ADJ_COR_ LAM_AD_CUS [NC_CBK_EX_NR] {p. 8309}	FAC_ST_AMP {p. 2099}	FAC_ST_REST {p. 2094}	INJ_MOD_GLOBAL {p. 3328}
LC_INJ_MOD_SP_MAN_ ENA {p. 3335}	LV_CH {p. 8232}	LV_HOM_AFL_ACT {p. 8136}	LV_IGA_AND_INJ_SWI_ HOMS {p. 8136}
LV_REST {p. 1766}	LV_S_ACT {p. 8137}	LV_S_CLC {p. 1822}	LV_ST_END {p. 1720}
MFF_ADD_BAL [NC_CYL_NR] {p. 3215}	MFF_ADD_BAL_EXT [NC_CYL_NR] {p. 3261}	MFF_ADD_LAM_AD_INJ [NC_CYL_NR] {p. 3405}	MFF_LAM_ADD_LAM_AD_ OUT [NC_CBK_EX_NR] {p. 2642}
MFF_MPLP_CH {p. 2179}	MFF_SP_2_MPLH_CH {p. 2164}	MFF_SP_HOM [NC_CBK_EX_NR] {p. 2151}	MFF_SP_MV {p. 2151}
Mk_soll_h [NC_CYL_ NR][NC_NR_IV_PLS] {p. 8162}	Mk_soll_s {p. 8162}	Mkzyl_soll_hs [NC_CYL_ NR][NC_NR_IV_PLS] {p. 8162}	N {p. 1525}
NC_INJ_MOD_MASK_2 {p. 2045}	NC_INJ_MOD_MULTI {p. 2045}	NC_INJ_MOD_SINGLE {p. 2045}	NC_LAMB_REF [NC_CYL_NR] {p. 812}
NC_NR_IV_PLS {p. 627}	Rk_add_wf {p. 8167}	Rk_kor_h {p. 8167}	Rk_kor_kva {p. 8168}
Rk_korres_hs {p. 8168}	Rk_korres_s {p. 8168}	SEG_NR {p. 1525}	TI_CAST {p. 2100}
TI_WUP {p. 2109}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ADD_PULSE_ENA	-	0... 2H	0 ...2	1	-
Constant for enabling additional pulses in case of injection time update at transient conditions, homogeneous mode (0 = disable, 1 = enable, 2 = enable at start end)					
C_FAC_MPLP_COR	-	0... FFFFH	0... 0.99998	15.3e-6	-
Constant defining how quantitatively the additive adaptation value shall be used in the post injection pulse					
C_MAF_REF	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Reference air mass flow for the calculation of MAF and MAF_MAX_COR					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_MFF_FAC	-	0... FFFFH	0... 0.12499	1.9073e-6	-
Constant for stoichiometric air/fuel ratio (=1/14.7)					
C_MFF_SP_1_HOM_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the first pulse in homogeneus mode (manual adjustment)					
C_MFF_SP_1_HOMS_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the first pulse in homogeneous-stratified mode (manual adjustment)					
C_MFF_SP_1_S_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the first pulse in stratified mode (manual adjustment)					
C_MFF_SP_2_HOM_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the second pulse in homogeneus mode (manual adjustment)					
C_MFF_SP_2_HOMS_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the second pulse in homogeneous-stratified mode (manual adjustment)					
C_MFF_SP_2_S_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the second pulse in stratified mode (manual adjustment)					
C_MFF_SP_3_HOM_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the third pulse in homogeneous mode (manual adjustment)					
C_MFF_SP_3_HOMS_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the third pulse in homogeneous-stratified mode (manual adjustment)					
C_MFF_SP_3_S_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the third pulse in stratified mode (manual adjustment)					
C_MFF_SP_MPLP_MAN	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Fuel mass setpoint for the post pulse in stratified mode (manual adjustment)					
IP_FAC_MFF_ADD_BAL_EXT	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_MFF_IP_FAC_MFF_ADD_EXT	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Weighting factor for additive aging and coding corrections on MFF					
IP_FAC_MFF_ADD_LAM_AD_INJ	-	0... FFFFH	0... 1.99996	30.5e-6	-
LDP_MFF_IP_FAC_MFF_LAM_AD_INJ	8	0... FFFFH	0... 1389	0.0211948	mg/stk
Weighting factor for the additive corrections from the function Minimum Fuel Mass Adaptation					
IP_FAC_MFF_COR_HOMS	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MFF_IP_FAC_MFF_COR_HOMS	12	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_IP_FAC_MFF_COR_HOMS	10	0... 1FE0H	0... 8160	1	rpm
Fuel mass correction factor for operation mode HOMS					
IP_FAC_MFF_COR_MPLH	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MFF_IP_FAC_MFF_COR_MPLH	12	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_IP_FAC_MFF_COR_MPLH	10	0... 1FE0H	0... 8160	1	rpm
Fuel mass correction factor for injection mode double injection - homogenous					
IP_FAC_MFF_COR_MPLH_3	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MFF_IP_FAC_MFF_COR_MPLH_3	12	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_IP_FAC_MFF_COR_MPLH_3	10	0... 1FE0H	0... 8160	1	rpm
Fuel mass correction factor for injection mode triple injection - homogenous					
IP_FAC_MFF_COR_MPLS	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MFF_IP_FAC_MFF_COR_MPLS	12	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_IP_FAC_MFF_COR_MPLS	10	0... 1FE0H	0... 8160	1	rpm
Fuel mass correction factor for injection mode double injection - statified					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
IP_FAC_MFF_COR_MPLS_3	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MFF_IP_FAC_MFF_COR_MPLS_3	12	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_IP_FAC_MFF_COR_MPLS_3	10	0... 1FE0H	0... 8160	1	rpm
Fuel mass correction factor for injection mode triple injection - statified					
IP_FAC_MFF_COR_SNGH	V	0... FFH	0... 1.99218	0.0078125	-
LDP_MFF_IP_FAC_MFF_COR_SNGH	12	0... FFFFH	0... 1389	0.0211948	mg/stk
LDP_N_IP_FAC_MFF_COR_SNGH	10	0... 1FE0H	0... 8160	1	rpm
Fuel mass correction factor for injection single injection - homogenous					
LC_FAC_MFF_HOM_COR_ENA	-	0... 1H	0 ...1	1	-
Switch for activation of fuel mass correction in homogenous mode					
LC_FAC_MFF_HOMS_COR_ENA	-	0... 1H	0 ...1	1	-
Switch for activation of fuel mass correction in HOMS mode					
LC_FAC_MFF_S_COR_ENA	-	0... 1H	0 ...1	1	-
Switch for activation of fuel mass correction in stratified mode					
LC_FAC_S_COR_ENA	-	0... 1H	0 ...1	1	-
Enable additive compensation over all stratified injection pulses					
LC_FAC_S_COR_MAN	-	0... 1H	0 ...1	1	-
Manual switch to enable additive compensation of third injection pulse per calibration constant					
LC_MFF_ADD_AD_LAM_OUT_MAN	-	0... 1H	0 ...1	1	-
Manual switch to consider lambda adaptation values for MFF_SP_1_S calculation					
LC_MFF_COR_CH_ENA	-	0... 1H	0 ...1	1	-
Switch for activation of injection mode dependend fuel mass correction during catalyst heating					
LC_MFF_COR_ST_ENA	-	0... 1H	0 ...1	1	-
Switch for activation of injection mode dependend fuel mass correction during start					
LC_MFF_MPG_NEW	-	0... 1H	0 ...1	1	-
Switch to activate new fuel mass mapping within layer.					
LC_MFF_SP_HOM_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual homogeneus mode active					
LC_MFF_SP_HOMS_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual homogeneous-stratified mode active					
LC_MFF_SP_S_MAN_ACT	-	0... 1H	0 ...1	1	-
Switch for manual stratified mode active					

R.26.1 Outputs for BMW functions which are defined as FMSP exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
i = 1, 2 (index cylinder bank)

Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions:

Initialisation: at reset and at exit ECU_STATE "PWL":
0, except F_vst = 1.00

Recurrence : segment : (Mk_hom_ext_1,Mk_hom_ext_2)

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(Mk_hom_ext), B_dosp_akt, F_vst,Rk_i, Rk2_kh_h, Rk2_kh_s

10 ms: B_wst, F_start
At "First valid tooth" and before module M904B (High pressure pump control)
Activation: every engine state
Deactivation: -

Formula section:

Remark: all formulas are valid in a **physical** meaning

if ECU_STATE "PWL"
then

B_dosp_akt = 0
B_wst = 0
F_start = 0
F_vst = 1.00
Rk_1 = 0
Rk_2 = 0
Rk2_kh_h = 0
Rk_kh_s = 0

else

B_wst = LV_REST

If ((INJ_MOD_GLOBAL & NC_INJ_MOD_MASK_2) == NC_INJ_MOD_SINGLE)
Then B_dosp_akt = 0 (single injection activ)
Else B_dosp_akt = 1 (multi injection activ)
Endif

F_vst = TI_WUP + TI_CAST

$$Rk\_i = \frac{MFF\_SP\_HOM\_i}{C\_MAF\_REF * C\_MFF\_FAC}$$

Umrechnung von supplier [mg/str] in [%] mit:
Rk2_kh_h = MFF_SP_2_MPLH_CH /C_MFF_REF*100%
Rk_kh_s = MFF_MPLP_CH /C_MFF_REF*100%

F_start = FAC_ST_REST * FAC_ST_AMP *100%
endif

R.26.2 Outputs for supplier-aggregates

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

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Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions:

Initialisation at reset: 0

Expect:
INJ_MOD_HOM_REQ = NC_INJ_MOD_SINGLE
INJ_MOD_S_REQ = NC_INJ_MOD_SINGLE
FAC_MFF_WUP_S = 1
FAC_MFF_WUP_HOMS = 1
FAC_MFF_COR_INJ_MOD = 1
FAC_MFF_COR_INJ_MOD_S = 1
For x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
FAC_1_S_COR[x] = 1
FAC_2_S_COR[x] = 0
FAC_3_S_COR[x] = 0
FAC_MPLP_COR[x] = C_FAC_MPLP_COR
Endfor

Recurrence : LV_ST_END = 0: 10 ms
LV_ST_END = 1: segment synchronous
Note: Please pay attention before integrating this function in the SW. This function shall be calculated before the module 'Calculation of MFF setpoint'.
CTR_CYL_NR_ST_CLC , CTR_CYL_NR_STOP_CLC and LV_S_CLC must be calculated before calculation of this module
Any other order of calculation should not be changed
FAC_MFF_CST_OPM_SEL,
FAC_TI_CAST_OPM_SEL,
FAC_TI_WUP_OPM_SEL
Expect: 10ms : MFF_SP_HOMS_PRED, MFF_SP_S_PRED

Activation: every engine state
Deactivation: -

Formula section:

Remark: all formulas are valid in a **physical** meaning

LV_FCO_COR_REQ = B_rkkor_kva
MFF_SP_FCO_COR = Rk_kor_kva * C_MAF_REF * C_MFF_FAC

MFF_ADD_WF = Rk_add_wf*C_MAF_REF*C_MFF_FAC

MFF_SP_S_SWI_HOM = Rk_kor_h * C_MAF_REF * C_MFF_FAC

FAC_MFF_WUP_S = F_rkkorwl_s
FAC_MFF_WUP_HOMS = F_rkkorwl_hs

IF LC_MFF_MPG_NEW = 1
THEN
Only element 0 is used to indicate injection mode

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```
        Bit 0 of LF_MFF_HOM = Bit 0 of Espr_mod_soll[0]
        Bit 1 of LF_MFF_HOM = Bit 2 of Espr_mod_soll[0]
        Bit 2 of LF_MFF_HOM = Bit 3 of Espr_mod_soll[0]
        Bit 3 of LF_MFF_HOM = Bit 4 of Espr_mod_soll[0]
        Bit 4 of LF_MFF_HOM = Bit 5 of Espr_mod_soll[0]
       Note: Bits 0, 1 and 2 of LF_MFF_HOM[x] state that the fuel mass on the respective pulse is
       unequal to zero (=1) or equal to zero (=0), which means that this pulse shall not be carried out.
        Bits 3 and 4 state that pulse 2 resp. pulse 3 are ignition coupled (=1) or not (=0).
 ENDIF

NR_INJ_PLS_HOM_REQ_TMP = 0

IF CTR_CYL_NR_ST_CLC ≠ CTR_CYL_NR_STOP_CLC
THEN                                                  // runtime reduction is inactive
          MFF_SP_HOM_BAS_TMP[ ] = 0                      // all NC_CBK_EX_NR elements
          CTR_MFF_SP_HOM_BAS_TMP[ ] = 0                  // all NC_CBK_EX_NR elements
ENDIF

If      LC_MFF_SP_HOM_MAN_ACT = 1
Then
        For      x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
        MFF_SP_1_HOM[x]      =       C_MFF_SP_1_HOM_MAN
        MFF_SP_2_HOM[x]        =            C_MFF_SP_2_HOM_MAN
        MFF_SP_3_HOM[x]        =            C_MFF_SP_3_HOM_MAN
        Endfor

        IF MFF_SP_1_HOM[0] > 0
        THEN
              NR_INJ_PLS_HOM_REQ_TMP = NR_INJ_PLS_HOM_REQ_TMP OR 0x1     ...bitwise
        ENDIF
        IF MFF_SP_2_HOM[0] > 0
        THEN
              NR_INJ_PLS_HOM_REQ_TMP = NR_INJ_PLS_HOM_REQ_TMP OR 0x2     ...bitwise
        ENDIF
        IF MFF_SP_3_HOM[0] > 0
        THEN
              NR_INJ_PLS_HOM_REQ_TMP = NR_INJ_PLS_HOM_REQ_TMP OR 0x4     ...bitwise
        ENDIF
Else
        For      x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
        IF LC_MFF_MPG_NEW = 1
        THEN
            IF LV_ST_END = 0 AND (LF_MFF_HOM BitwiseAND 7h = 4) // only third bit is set
            THEN - high pressure start with fuel mass on pulse 3
                MFF_SP_1_HOM[x]              =   0
                MFF_SP_2_HOM[x]              =   Mk_soll_h[x][2]   // zero based indexing
                MFF_SP_3_HOM[x]              =   0
            ELSE
                IF LV_ST_END = 0 AND (LF_MFF_HOM BitwiseAND 7h = 2)
                                                 // only second bit is set
                THEN - high pressure start with fuel mass on pulse 2
                      MFF_SP_1_HOM[x]        =   0
```

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```
                MFF_SP_2_HOM[x]          =   Mk_soll_h[x][1]   // zero based indexing
                MFF_SP_3_HOM[x]          =   0
          ELSE
                tmp = 0          // Note: tmp is a temporary counter counting from 0 to 3.
                MFF_SP_HOM_MPG_TMP[ ] = 0          // all NC_NR_IV_PLS elements
                FOR i = 0 TO NC_NR_IV_PLS - 1 DO
                      IF Bit i of LF_MFF_HOM = 1
                      THEN
                         MFF_SP_HOM_MPG_TMP [tmp] = Mk_soll_h[x][i]
                         tmp = tmp + 1
                      ENDIF
                ENDFOR
                MFF_SP_1_HOM[x]          = MFF_SP_HOM_MPG_TMP [0]
                MFF_SP_2_HOM[x]          = MFF_SP_HOM_MPG_TMP [1]
                MFF_SP_3_HOM[x]       = MFF_SP_HOM_MPG_TMP [2]
          ENDIF
      ENDIF
   ELSE

         MFF_SP_1_HOM[x]                =   Mk_soll_h[x][0]
         MFF_SP_2_HOM[x]        =       Mk_soll_h[x][1]
         MFF_SP_3_HOM[x]                =   Mk_soll_h[x][2]
   ENDIF

  MFF_SP_HOM_BAS_TMP[[NC_LAMB_REF[bit x]]new =
         MFF_SP_HOM_BAS_TMP[[NC_LAMB_REF[bit x]] +
         (MFF_SP_1_HOM[x] + MFF_SP_2_HOM[x] + MFF_SP_3_HOM[x])

Increment CTR_MFF_SP_HOM_BAS_TMP [NC_LAMB_REF[bit x]] by 1

   IF MFF_SP_1_HOM[x] > 0
   THEN
         NR_INJ_PLS_HOM_REQ_TMP = NR_INJ_PLS_HOM_REQ_TMP OR 0x1     ...bitwise
   ENDIF
   IF MFF_SP_2_HOM[x] > 0
   THEN
         NR_INJ_PLS_HOM_REQ_TMP = NR_INJ_PLS_HOM_REQ_TMP OR 0x2     ...bitwise
   ENDIF
   IF MFF_SP_3_HOM[x] > 0
   THEN
         NR_INJ_PLS_HOM_REQ_TMP = NR_INJ_PLS_HOM_REQ_TMP OR 0x4     ...bitwise
   ENDIF
   Endfor
Endif
```

% mean homogeneous mass fuel flow set point (sum over all pulses) assigned to each exhaust gas bank, without any correction. or adaptation

(Calculation of mean value while runtime optimization only once every 720° Crank, outside of runtime optimization every segment)

```
FOR i = 0 TO NC_CBK_EX_NR - 1 DO
      IF CTR_MFF_SP_HOM_BAS_TMP [i] >= (NC_CYL_NR /NC_CBK_EX_NR)
      THEN
```

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```
            MFF_SP_HOM_BAS[i]new =
                    MFF_SP_HOM_BAS_TMP[i]/(NC_CYL_NR /NC_CBK_EX_NR)
            CTR_MFF_SP_HOM_BAS_TMP [i] = 0
            MFF_SP_HOM_BAS_TMP[i] = 0
    ENDIF
ENDFOR
```

% Fuel mass setpoint of current cylinder [x] without adaptation for the fuel consumption calculation

```
        MFF_SP_BAS =            MFF_SP_1_HOM[SEG_NR] + MFF_SP_2_HOM[SEG_NR] + MFF_
        SP_3_HOM[SEG_NR]

IF NR_INJ_PLS_HOM_REQ_TMP > 3
THEN
    INJ_MOD_HOM_REQ = NC_INJ_MOD_MULTI
    NR_INJ_PLS_HOM_REQ = 3
    IF (LC_FAC_MFF_HOM_COR_ENA = 1)
        FAC_MFF_COR_INJ_MOD = IP_FAC_MFF_COR_MPLH_3(MFF_SP_BAS, N)
ELSE
        FAC_MFF_COR_INJ_MOD = 1
    ENDIF

ELSE
    IF NR_INJ_PLS_HOM_REQ_TMP = 3
    THEN
         INJ_MOD_HOM_REQ = NC_INJ_MOD_MULTI
         NR_INJ_PLS_HOM_REQ = 2
        IF ( LC_FAC_MFF_HOM_COR_ENA = 1 AND
            ( LV_CH =0 OR LC_MFF_COR_CH_ENA =1) AND
            ( LV_ST_END=1 OR LC_MFF_COR_ST_ENA=1) )
            FAC_MFF_COR_INJ_MOD = IP_FAC_MFF_COR_MPLH(MFF_SP_BAS, N)
    ELSE
            FAC_MFF_COR_INJ_MOD = 1
                    ENDIF
    ELSE
         INJ_MOD_HOM_REQ = NC_INJ_MOD_SINGLE
         NR_INJ_PLS_HOM_REQ = 1
        IF (LC_FAC_MFF_HOM_COR_ENA = 1 AND
                ( LV_ST_END=1 OR LC_MFF_COR_ST_ENA=1) )
        THEN
            FAC_MFF_COR_INJ_MOD = IP_FAC_MFF_COR_SNGH(MFF_SP_BAS, N)
         ELSE
            FAC_MFF_COR_INJ_MOD = 1
         ENDIF

    ENDIF
ENDIF

If(4)     LV_S_CLC = 1
Then(4)
    IF      LC_MFF_SP_HOMS_MAN_ACT = 1
        Then
        For x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
```

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MFF_SP_1_HOMS[x] = C_MFF_SP_1_HOMS_MAN
MFF_SP_2_HOMS[x] = C_MFF_SP_2_HOMS_MAN
MFF_SP_3_HOMS[x] = C_MFF_SP_3_HOMS_MAN
Endfor
Else
For x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
MFF_SP_1_HOMS[x] = Mkzyl_soll_hs[x][0]
MFF_SP_2_HOMS[x] = Mkzyl_soll_hs[x][1]
MFF_SP_3_HOMS[x] = Mkzyl_soll_hs[x][2]
Endfor
MFF_SP_HOMS = MFF_SP_1_HOMS[x] +MFF_SP_2_HOMS[x] + MFF_SP_3_HOMS[x]
(x = latest segment)
Endif

If LC_MFF_SP_S_MAN_ACT = 1
Then
For x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
MFF_SP_1_S[x] = C_MFF_SP_1_S_MAN
MFF_SP_2_S[x] = C_MFF_SP_2_S_MAN
MFF_SP_3_S[x] = C_MFF_SP_3_S_MAN
MFF_SP_MPLP[x] = C_MFF_SP_MPLP_MAN
Endfor
MFF_SP_S = C_MFF_SP_1_S_MAN + C_MFF_SP_2_S_MAN + C_MFF_SP_3_S_MAN + C_MFF_SP_MPLP_MAN
Else
For x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
MFF_SP_1_S[x] = Mkzyl_soll_s[x][0]
MFF_SP_2_S[x] = Mkzyl_soll_s[x][1]
MFF_SP_3_S[x] = Mkzyl_soll_s[x][2]
MFF_SP_MPLP[x] = Mkzyl_soll_s[x][3]
Endfor
MFF_SP_S = Mk_soll_s

Endif

If ((LC_INJ_MOD_SP_MAN_ENA = 0) and (LV_IGA_AND_INJ_SWI_HOMS = 1))
or
((LC_INJ_MOD_SP_MAN_ENA = 1) and (C_INJ_MOD_SP_MAN = 'HOMS' or
C_INJ_MOD_SP_MAN = 'HOMS-SNG' or
C_INJ_MOD_SP_MAN = 'HOMS+PLS3'))
Then
MFF_SP_S_TMP = 0

For x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
MFF_SP_1_S[x] = MFF_SP_1_HOMS[x]
MFF_SP_2_S[x] = MFF_SP_2_HOMS[x]
MFF_SP_3_S[x] = MFF_SP_3_HOMS[x]
MFF_SP_MPLP[x] = 0
MFF_SP_S_TMP= MFF_SP_S_TMP + MFF_SP_1_HOMS[x] + MFF_SP_2_HOMS[x] + MFF_SP_3_HOMS[x]

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Endfor
MFF_SP_S = MFF_SP_S_TMP /
(CTR_CYL_NR_STOP_CLC - CTR_CYL_NR_ST_CLC + 1)

Endif

% Fuel mass setpoint of current cylinder [x] without adaptation for the fuel consumption calculation

IF LV_S_ACT = 1 OR LV_HOM_AFL_ACT = 1
THEN
MFF_SP_BAS = MFF_SP_1_S[SEG_NR] + MFF_SP_2_S[SEG_NR] +
MFF_SP_3_S[SEG_NR]
ENDIF

MFF_SP_BAS_S = MFF_SP_1_S[SEG_NR] + MFF_SP_2_S[SEG_NR] +
MFF_SP_3_S[SEG_NR]

Endif(4)

Injection mode selection: at BMW the main pulse are the 2nd pulse if there is no 1st pulse the 2nd pulse will copied to the 1st puls:

If(1) LV_ST_END = 1
Then(1)
At start end:
MFF_SP_1_S_TMP = 0
MFF_SP_2_S_TMP = 0
If (2) LC_MFF_SP_HOM_MAN_ACT = 1
Then(2)
For x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
Check, if all fuel masses for the first and the second pulse strat. Mode are zero
MFF_SP_1_S_TMP = MFF_SP_1_S_TMP OR MFF_SP_1_S[x]
wise
MFF_SP_2_S_TMP = MFF_SP_2_S_TMP OR MFF_SP_2_S[x]
wise
Endfor
Else(2)

For x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
% distribution factors of MFF correction between the injection pulses
MFF_SP_HOM_TMP = MFF_SP_1_HOM[x]+ MFF_SP_2_HOM[x]+
MFF_SP_3_HOM[x]

FAC_1_HOM_COR[x] = MFF_SP_1_HOM[x] /MFF_SP_HOM_TMP
FAC_2_HOM_COR[x] = MFF_SP_2_HOM[x] /MFF_SP_HOM_TMP
FAC_3_HOM_COR[x] = 1- (FAC_1_COR[x]+ FAC_2_COR[x])

% MFF correction of 1st. pulse due to Lambda Adaptation and Cylinder Balancing
MFF_SP_1_HOM[x] =

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(MFF_LAM_ADD_LAM_AD_OUT[NC_LAMB_REF[bit x]] + MFF_ADD_BAL[x]) * FAC_1_HOM_COR[x] +
MFF_SP_1_HOM[x]* **(**1+ (FAC_LAM_AD_BAL[NC_LAMB_REF[bit x]] /100%)**)**

% MFF correction of 1^{st}. pulse due to injector coding , aging predictive correction and minimum fuel mass adaptation

MFF_SP_1_EXT_COR[x] =
MFF_ADD_BAL_EXT[x] * IP_FAC_MFF_ADD_BAL_EXT(MFF_SP_1_HOM[x])

+
MFF_ADD_LAM_AD_INJ[x] *
IP_FAC_MFF_ADD_LAM_AD_INJ(MFF_SP_1_HOM[x])

MFF_SP_1_HOM[x] = MFF_SP_1_HOM[x] * FAC_MFF_COR_INJ_MOD +
MFF_SP_1_EXT_COR[x]

If(3) MFF_SP_2_HOM[x] $>$ 0
Then(3)

% 2^{nd}. pulse MFF correction

MFF_SP_2_HOM[x] =
(MFF_LAM_ADD_LAM_AD_OUT[NC_LAMB_REF[bit x]] + MFF_ADD_BAL[x]) * FAC_2_HOM_COR[x] +
MFF_SP_2_HOM[x]* **(**1+ (FAC_LAM_AD_BAL[NC_LAMB_REF[bit x]] /100%)**)**

% MFF correction of 2^{nd} pulse due to injector coding , aging predictive correction and minimum fuel mass adaptation

MFF_SP_2_EXT_COR[x] =
MFF_ADD_BAL_EXT[x] * IP_FAC_MFF_ADD_BAL_EXT(MFF_SP_2_HOM[x])
+
MFF_ADD_LAM_AD_INJ[x] *
IP_FAC_MFF_ADD_LAM_AD_INJ(MFF_SP_2_HOM[x])

MFF_SP_2_HOM[x] = MFF_SP_2_HOM[x] * FAC_MFF_COR_INJ_MOD +
MFF_SP_2_EXT_COR[x]

Endif(3)

If(4) MFF_SP_3_HOM[x] $>$ 0
Then(4)

% 3^{rd}. pulse MFF correction

MFF_SP_3_HOM[x] =
(MFF_LAM_ADD_LAM_AD_OUT[NC_LAMB_REF[bit x]] + MFF_ADD_BAL[x]) *
FAC_3_HOM_COR[x] +
MFF_SP_3_HOM[x]* **(**1+ (FAC_LAM_AD_BAL[NC_LAMB_REF[bit x]] /100%)**)**

% MFF correction of 3^{rd}. pulse due to injector coding, aging predictive correction and minimum fuel mass adaptation

MFF_SP_3_EXT_COR[x] =
MFF_ADD_BAL_EXT[x] * IP_FAC_MFF_ADD_BAL_EXT(MFF_SP_3_HOM[x])
+
MFF_ADD_LAM_AD_INJ[x] *
IP_FAC_MFF_ADD_LAM_AD_INJ(MFF_SP_3_HOM[x])

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MFF_SP_3_HOM[x] = MFF_SP_3_HOM[x] * FAC_MFF_COR_INJ_MOD +
MFF_SP_3_EXT_COR[x]
Endif(4)

Check, if all fuel masses for the first and the second pulse strat. Mode are zero
MFF_SP_1_S_TMP = MFF_SP_1_S_TMP OR MFF_SP_1_S[x]
wise
MFF_SP_2_S_TMP = MFF_SP_2_S_TMP OR MFF_SP_2_S[x]
wise

Endfor
Endif(2)
Else(1)
At start:
MFF_SP_1_S_TMP = 0
MFF_SP_2_S_TMP = 0
LV_EOI_ST_ENA = 0

For x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
Check, if all fuel masses for the first and the second pulse strat. Mode are zero
MFF_SP_1_S_TMP = MFF_SP_1_S_TMP **OR** MFF_SP_1_S[x]
wise
MFF_SP_2_S_TMP = MFF_SP_2_S_TMP **OR** MFF_SP_2_S[x]
wise
Endfor

If NR_INJ_PLS_HOM_REQ_TMP = 2
Then (high pressure start)
LV_EOI_ST_ENA = 1
For x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC

MFF_SP_1_HOM[x] = MFF_SP_2_HOM[x]*
(1+(FAC_LAM_ADJ_COR_LAM_AD_CUS[NC_LAMB_REF[bit x]] /100%)**)**

MFF_SP_2_HOM[x] = 0
Endfor
Else (low pressure start)
For x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC

MFF_SP_1_HOM[x] = MFF_SP_1_HOM[x]*
(1+ (FAC_LAM_ADJ_COR_LAM_AD_CUS [NC_LAMB_REF[bit x]] /100%)**)**
MFF_SP_2_HOM[x] = MFF_SP_2_HOM[x]*
(1+ (FAC_LAM_ADJ_COR_LAM_AD_CUS [NC_LAMB_REF[bit x]] /100%)**)**
MFF_SP_3_HOM[x] = MFF_SP_3_HOM[x]*
(1+ (FAC_LAM_ADJ_COR_LAM_AD_CUS [NC_LAMB_REF[bit x]] /100%)**)**
Endfor
Endif
Endif(1)

If(11) LV_S_CLC = 1

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Then(11)

In case of homogeneous-stratified mode, copy the fuel masses for homs to the fuel masses for stratified mode (mapping):

```
IF(1a) ((LC_INJ_MOD_SP_MAN_ENA = 0) and (LV_IGA_AND_INJ_SWI_HOMS = 1))
       or
       ((LC_INJ_MOD_SP_MAN_ENA = 1) and (C_INJ_MOD_SP_MAN = 'HOMS' or
                                          C_INJ_MOD_SP_MAN = 'HOMS-SNG' or
                                                   C_INJ_MOD_SP_MAN = 'HOMS+PLS3'))
THEN(1a) homs mode
           IF (LC_FAC_MFF_HOMS_COR_ENA = 1)
            FAC_MFF_COR_INJ_MOD_S =
                          IP_FAC_MFF_COR_HOMS(MFF_SP_BAS_S, N)
      ELSE
            FAC_MFF_COR_INJ_MOD_S = 1
      ENDIF

           IF MFF_SP_2_S_TMP > 0
           THEN homs tripple injection - no pulse mapping
                    INJ_MOD_S_REQ = NC_INJ_MOD_MULTI
                    NR_INJ_PLS_S_REQ = 3
           ELSE
             IF MFF_SP_1_S_TMP > 0
             THEN homs double injection
                    INJ_MOD_S_REQ = NC_INJ_MOD_MULTI
                    NR_INJ_PLS_S_REQ = 2
                      For           x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC

          MFF_SP_2_S[x] = MFF_SP_3_S[x]
             MFF_SP_3_S[x] =          0
                      Endfor
             ELSE homs single injection
                    INJ_MOD_S_REQ = NC_INJ_MOD_SINGLE
               NR_INJ_PLS_S_REQ = 1
                 For           x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
                    MFF_SP_1_S[x] = MFF_SP_3_S[x]
        MFF_SP_2_S[x] =          0
                 MFF_SP_3_S[x] =        0
                 Endfor
        ENDIF
      ENDIF

ELSE(1a) s mode has to be calculated
        IF          MFF_SP_1_S_TMP > 0
         THEN s tripple injection - no pulse mapping
             INJ_MOD_S_REQ = NC_INJ_MOD_MULTI
             NR_INJ_PLS_S_REQ = 3
      IF (LC_FAC_MFF_S_COR_ENA = 1)
         FAC_MFF_COR_INJ_MOD_S=
            IP_FAC_MFF_COR_MPLS_3(MFF_SP_BAS_S,N)
           ELSE
                  FAC_MFF_COR_INJ_MOD_S = 1
      ENDIF
         ELSE
```

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IF (LC_FAC_MFF_S_COR_ENA = 1)
FAC_MFF_COR_INJ_MOD_S=
IP_FAC_MFF_COR_MPLS(MFF_SP_BAS_S,N)
ELSE
FAC_MFF_COR_INJ_MOD_S = 1
ENDIF
IF MFF_SP_2_S_TMP > 0
THEN s double injection
INJ_MOD_S_REQ = NC_INJ_MOD_MULTI
NR_INJ_PLS_S_REQ = 2
For x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
MFF_SP_1_S[x] = MFF_SP_2_S[x]
MFF_SP_2_S[x] = MFF_SP_3_S[x]
MFF_SP_3_S[x] = 0
Endfor
ELSE s single injection
INJ_MOD_S_REQ = NC_INJ_MOD_SINGLE
NR_INJ_PLS_S_REQ = 1
For x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC
MFF_SP_1_S[x] = MFF_SP_3_S[x]

MFF_SP_2_S[x] = 0
MFF_SP_3_S[x] = 0
Endfor
ENDIF
ENDIF
ENDIF(1a) puls mapping

Statement usefull for ECM2
IF LV_IGA_AND_INJ_SWI = 0
THEN FAC_MFF_COR_INJ_MOD = FAC_MFF_COR_INJ_MOD_S
ENDIF

Corrections for fuel masses due to cylinder balancing
IF(3) LC_MFF_ADD_AD_LAM_BAL_MAN = 1 **AND**
LV_ST_END = 1 **AND**
LC_MFF_SP_S_MAN_ACT = 0
THEN(3) corrections have to be calculated

Calculation of correction factors

For x = CTR_CYL_NR_ST_CLC to CTR_CYL_NR_STOP_CLC

% MFF correction distribution factors

IF(5a) LC_FAC_S_COR_ENA = 1
THEN(5a)
% Calculation of the additive Lambda Adaption distribution factor over all pulses (default value: the additive adaptation considered only on the first pulse).

IF(5b) LC_FAC_S_COR_MAN = 0

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Then(5b)
FAC_1_S_COR[x] = MFF_SP_1_S[x] /(MFF_SP_1_S[x] + MFF_SP_2_S[x] + MFF_SP_3_S[x] + MFF_SP_MPLP[x])

FAC_2_S_COR[x] = MFF_SP_2_S[x] /(MFF_SP_1_S[x] + MFF_SP_2_S[x] + MFF_SP_3_S[x] + MFF_SP_MPLP[x])

FAC_3_S_COR[x] = MFF_SP_3_S[x] /(MFF_SP_1_S[x] + MFF_SP_2_S[x] + MFF_SP_3_S[x] + MFF_SP_MPLP[x])

FAC_MPLP_COR[x] = 1 - (FAC_1_S_COR[x] + FAC_2_S_COR[x] + FAC_3_S_COR[x])
Else(5b)
FAC_1_S_COR[x] = MFF_SP_1_S[x] /(MFF_SP_1_S[x] + MFF_SP_2_S[x] + MFF_SP_3_S[x])

FAC_2_S_COR[x] = MFF_SP_2_S[x] /(MFF_SP_1_S[x] + MFF_SP_2_S[x] + MFF_SP_3_S[x])

FAC_3_S_COR[x] = MFF_SP_3_S[x] /(MFF_SP_1_S[x] + MFF_SP_2_S[x] + MFF_SP_3_S[x])

FAC_MPLP_COR[x] = C_FAC_MPLP_COR
Endif(5b)
Endif(5a)

Note: In case of a division by zero, the corresponding variable FAC_SP_... should be set to zero!

Calculation of corrected fuel masses due to cylinder balancing:

% 1st. pulse MFF correction - first pulse is always calculated
MFF_SP_1_S[x] = (MFF_LAM_ADD_LAM_AD_OUT[NC_LAMB_REF[bit x]] + MFF_ADD_BAL[x]) * FAC_1_S_COR[x] +
MFF_SP_1_S[x]* **(**1+ (FAC_LAM_AD_BAL[NC_LAMB_REF[bit x]] /100%)**)**

% MFF correction of 1st. pulse due to injector coding, aging predictive correction and minimum fuel mass adaptation
MFF_SP_1_EXT_COR[x] =
MFF_ADD_BAL_EXT[x] * IP_FAC_MFF_ADD_BAL_EXT(MFF_SP_1_S[x])

+
MFF_ADD_LAM_AD_INJ[x] *
IP_FAC_MFF_ADD_LAM_AD_INJ(MFF_SP_1_S[x])

MFF_SP_1_S[x] = MFF_SP_1_S[x] * FAC_MFF_COR_INJ_MOD_S +
MFF_SP_1_EXT_COR[x]

IF (NR_INJ_PLS_S_REQ >= 2)
THEN second pulse is calculated in case of double or triple injection
% 2nd. pulse MFF correction

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MFF_SP_2_S[x] = (MFF_LAM_ADD_LAM_AD_OUT[NC_LAMB_REF[bit x]] + MFF_ADD_BAL[x]) * FAC_2_S_COR[x] +
MFF_SP_2_S[x]* **(**1+ (FAC_LAM_AD_BAL[NC_LAMB_REF[bit x]] /100%)**)**

% MFF correction of 2^{nd}. pulse due to injector, aging predictive correction and minimum fuel mass adaptation MFF_SP_2_EXT_COR[x] =
MFF_ADD_BAL_EXT[x] * IP_FAC_MFF_ADD_BAL_EXT(MFF_SP_2_S[x])

+
MFF_ADD_LAM_AD_INJ[x] *
IP_FAC_MFF_ADD_LAM_AD_INJ(MFF_SP_2_S[x])

MFF_SP_2_S[x] = MFF_SP_2_S[x] * FAC_MFF_COR_INJ_MOD_S +
MFF_SP_2_EXT_COR[x]

ELSE
MFF_SP_2_S[x] = 0
ENDIF

IF (NR_INJ_PLS_S_REQ >= 3)
THEN third pulse is calculated in case of triple injection
% 3^{rd}. pulse MFF correction
MFF_SP_3_S[x] = (MFF_LAM_ADD_LAM_AD_OUT[NC_LAMB_REF[bit x]] + MFF_ADD_BAL[x]) * FAC_3_S_COR[x] +
MFF_SP_3_S[x]* **(**1+ (FAC_LAM_AD_BAL[NC_LAMB_REF[bit x]] /100%)**)**

% MFF correction of 3^{rd}. pulse due to injector coding , aging predictive correction and minimum fuel mass adaptation MFF_SP_3_EXT_COR[x] =
MFF_ADD_BAL_EXT[x] * IP_FAC_MFF_ADD_BAL_EXT(MFF_SP_3_S[x])

+
MFF_ADD_LAM_AD_INJ[x] *
IP_FAC_MFF_ADD_LAM_AD_INJ(MFF_SP_3_S[x])

MFF_SP_3_S[x] = MFF_SP_3_S[x] * FAC_MFF_COR_INJ_MOD_S +
MFF_SP_3_EXT_COR[x]

MFF_SP_MPLP[x] = 0 (No post injection at triple injection!)
ELSE
MFF_SP_3_S[x] = 0

Post pulse is possible in case of **no** triple injection:
MFF_SP_MPLP[x] = (MFF_LAM_ADD_LAM_AD_OUT[NC_LAMB_REF[bit x]] + MFF_ADD_BAL[x]) * FAC_MPLP_COR[x] +
MFF_SP_MPLP[x]* **(**1+ (FAC_LAM_AD_BAL[NC_LAMB_REF[bit x]] /100%)**)**

% MFF correction of post pulse due to injector coding, aging predictive correction and minimum fuel mass adaptation
MFF_SP_MPLP_EXT_COR[x] =
MFF_ADD_BAL_EXT[x] * IP_FAC_MFF_ADD_BAL_EXT(MFF_SP_MPLP[x])

+
MFF_ADD_LAM_AD_INJ[x] *
IP_FAC_MFF_ADD_LAM_AD_INJ(MFF_SP_MPLP[x])

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```
                MFF_SP_MPLP[x] = MFF_SP_MPLP[x] + MFF_SP_MPLP_EXT_COR[x]
        ENDIF

        Endfor

ENDIF(3)
Endif(11)

If(5)       LC_INJ_MOD_SP_MAN_ENA = 1
Then(5)
        If  (6)     C_INJ_MOD_SP_MAN = 'SNGH'
             or
             C_INJ_MOD_SP_MAN = 'DISABLE'
        Then(6)
             INJ_MOD_HOM_REQ = NC_INJ_MOD_SINGLE
             INJ_MOD_S_REQ = NC_INJ_MOD_SINGLE
        Endif(6)
        If(7)       C_INJ_MOD_SP_MAN = 'MPLH'
             or
             C_INJ_MOD_SP_MAN = 'MPLH+PLS3'
        Then(7)
             INJ_MOD_HOM_REQ = NC_INJ_MOD_MULTI
             INJ_MOD_S_REQ = NC_INJ_MOD_SINGLE
        Endif(7)

        If      (8)     (C_INJ_MOD_SP_MAN = 'SNGS'
             or
             C_INJ_MOD_SP_MAN = 'HOMS-SNG')
             and
             LV_S_CLC=1
        Then(8)
             INJ_MOD_HOM_REQ = NC_INJ_MOD_SINGLE
             INJ_MOD_S_REQ = NC_INJ_MOD_SINGLE
        Endif(8)

        If(9)       (C_INJ_MOD_SP_MAN = 'MPLS'
             or
             C_INJ_MOD_SP_MAN = 'MPLS+PLS3')
             and
             LV_S_CLC=1
        Then(9)
             INJ_MOD_HOM_REQ = NC_INJ_MOD_SINGLE
             INJ_MOD_S_REQ = NC_INJ_MOD_MULTI
        Endif(9)

        If      (10)    (C_INJ_MOD_SP_MAN = 'HOMS'
             or
             C_INJ_MOD_SP_MAN = 'HOMS+PLS3')
             and
             LV_S_CLC=1
        Then(10)
```

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INJ_MOD_HOM_REQ = NC_INJ_MOD_SINGLE
INJ_MOD_S_REQ = NC_INJ_MOD_MULTI
Endif(10)
Endif(5)
FAC_MFF_CST_OPM_SEL = F_st_ba
FAC_TI_CAST_OPM_SEL = F_nst_ba
FAC_TI_WUP_OPM_SEL = F_wl_ba
LV_TI_COR_WF_OPM_1_ACT = Ba_switch_uek (vice versa)
LV_ST_H_PRS = B_hd_start
LV_ST_INJ_AUTH = B_espr_start

Calculation of LV_ADD_PULSE_ENA

IF (C_ADD_PULSE_ENA = 1)
OR
((C_ADD_PULSE_ENA = 2) **AND** (LV_ST_END = 1))
THEN
LV_ADD_PULSE_ENA = 1
ELSE
LV_ADD_PULSE_ENA = 0
ENDIF

/* with 10ms recurrence */
MFF_SP_HOMS_PRED = Rk_korres_hs* C_MAF_REF * C_MFF_FAC
MFF_SP_S_PRED = Rk_korres_s* C_MAF_REF * C_MFF_FAC

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R.27 Customer adaptation module: FUSL

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_aprail_hom	O/V	0... 1H	0 ...1	1	-
Anforderung Diagnose - Raildruck Homogen					
B_aprail_ndnotl	O/V	0... 1H	0 ...1	1	-
Anforderung Diagnose - Raildruck Niederdrucknotlauf					
B_prail_h	O/V	0... 1H	0 ...1	1	-
Request homogen					
B_prailvcv_h	O/V	0... 1H	0 ...1	1	-
Request homogen VCV open					
B_prailvfd_h	O/V	0... 1H	0 ...1	1	-
Request LIH low pressure					
FUP_H_SP_S_EXT	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint for stratified mode, high range					
FUP_SP_EXT	O/V	0... FFFFH	0... 347776	5.3067216	hPa
Fuel pressure setpoint BMW					
LV_FUP_SP_EXT_REQ	O/V	0... 1H	0 ...1	1	-
External request of fuel pressure setpoint (high pressure)					
LV_SYM_FUP_ST_NO_RISE	O/V	0... 1H	0 ...1	1	-
Logical variable indicating insufficient fuel pressure increase after injection release in high pressure start					
Prail_ist	O/V	0... FFFFH	0... 39.99938	610.4e-6	MPa
Rail pressure					

Input data:

B_prailsw {p. 8346}	B_st_hd_prail_abbr	FUP {p. 1283}	FUP_SP_EXT_ADJ {p. 7431}
LV_FUP_HOM_REQ {p. 803}	LV_FUP_LIH_HOM_REQ {p. 4001}	LV_FUP_LIH_HOM_VCV_OPEN_REQ {p. 4001}	LV_FUP_LIH_L_PRS_CTL_REQ {p. 4001}
LV_FUP_LIH_REQ {p. 988}	LV_FUP_SP_REQ_EXT_ADJ {p. 7434}	Prail_out_s {p. 8165}	Prail_soll {p. 8165}

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Adaptation to BMW environment.

Application conditions

Initialisation: 0

Activation: all engine operating states
Recurrences: 10 ms

Formula section:

B_aprail_hom = LV_FUP_HOM_REQ
B_aprail_ndnotl = LV_FUP_LIH_REQ
B_prail_h = LV_FUP_LIH_HOM_REQ
B_prailvcv_h = LV_FUP_LIH_HOM_VCV_OPEN_REQ
B_prailvfd_h = LV_FUP_LIH_L_PRS_CTL_REQ
Prail_ist = FUP

R.27.1 Outputs for supplier aggregates, BMW(supplier

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs can be different from the specified values due to the input data attributes.

Application conditions

Initialisation: `at resat: all = 0hex`

Recurrence : `10 ms`

Activation:
```
every engine state
   In power latch phase:
   LV_FUP_SP_EXT_REQ = 0
```

Formula section:

Remark: all formulas are valid in a **physical** meaning
Endif

FUP_H_SP_S_EXT = Prail_out_s
If LV_FUP_SP_REQ_EXT_ADJ = 0
then FUP_SP_EXT = Prail_soll
else FUP_SP_EXT = FUP_SP_EXT_ADJ
LV_FUP_SP_EXT_REQ = B_prailsw
endif
LV_SYM_FUP_ST_NO_RISE = B_st_hd_prail_abbr

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R.28 Customer adaptation module: IGRE

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Fu_time_zyl [NC_CYL_NR]	O/V	0... FFFFH	0... 255.99609	3.9063e-3	ms
zylinderindividuelle Funkenbrenndauer					
Stat_fofumx_ist	O/V	0... FFFFH	0... 65535	1	-
Umsetzung maximale Folgefunken					
STATE_MPL_CYL_IGN	O/V	0... FFFFH	0... 65535	1	-
request of maximal number of follow ignition pulses (bit coded cylinder individuel)					

Input data:

ECU_STATE {p. 1091}	LV_ST_END {p. 1720}	NC_CYL_NR {p. 1526}	Stat_fofumx_anf {p. 8175}
V_DUR_IGC [NC_CYL_NR] {p. 920}			

R.28.1 Outputs for BMW functions

FUNCTION DESCRIPTION:

Adaptations to BMW environment.

Application conditions

Initialisation at reset or at exit PWL: *0*

Recurrence: *segment*

Activation: at every engine state

Deactivation: – –

Formula section:

Stat_fofumx_ist = 0

Fu_time_zyl[NC_CYL_NR] = V_DUR_IGC[NC_CYL_NR]

R.28.2 Outputs for supplier aggregates

FUNCTION DESCRIPTION:

Adaptations to BMW environment.

Application conditions

Initialisation: *0 at reset*

Recurrence: ***if*** *LV_ST_END* **=** *0 or ECU_STATE = "PWL"*
then *recurrence is 10ms*
else *recurrence is segment synchron*

Activation: at every engine state

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Deactivation: – – –

Formula section:

STATE_MPL_CYL_IGN = Stat_fofumx_anf

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R.29 Customer adaptation module: IGSP

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_IGA_OPM_SEL	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Ignition interpolation factor for operation switch manager					
IGA_ADD_CMB_CTL [NC_CYL_NR]	O/V	80... 7FH	-48... 47.625	0.375	°CRK
ignition angle correction due to combustion control function					
IGA_AV_H_RNG_HOMS_1 [NC_CYL_NR]	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
HOMS ignition angle in wide range applied on cylinder x					
IGA_AV_H_RNG_S_1 [NC_CYL_NR]	O/V	FA60... 5A0H	-90 ...90	0.0625	°CRK
Ignition angle applied on cylinder CYL in stratified combustion					
IGA_BAS_COR	O/V	0... FFH	-35.625 ...60	0.375	°CRK
corrected basic ignition angle					
IGA_BAS_COR_CBK [NC_CBK_EX_NR]	O/V	0... FFH	-35.625 ...60	0.375	°CRK
corrected basic ignition angle, bank selective					
IGA_REF_COR	O/V	0... FFH	-35.625 ...60	0.375	°CRK
Corrected reference ignition angle					
IGA_REF_COR_CBK [NC_CBK_EX_NR]	O/V	0... FFH	-35.625 ...60	0.375	°CRK
corrected reference ignition angle bank selective					
IGA_REF_EGR_HOM_COR	O/V	80... 7FH	-48... 47.625	0.375	°CRK
additive reference ignition angle correction due to EGR influence in HOM					
IGA_REF_EGR_HOMS_COR	O/V	80... 7FH	-48... 47.625	0.375	°CRK
additive reference ignition angle correction due to EGR influence in HOMS					
IGA_REF_LAMB_COR	O/V	80... 7FH	-48... 47.625	0.375	°CRK
Additive lambda correction of IGA_REF					
IGA_REF_TEMP_COR	O/V	80... 7FH	-48... 47.625	0.375	°CRK
Additive temperature correction of IGA_REF					
LV_IGA_MIN_EXT	O/V	0... 1H	0 ...1	1	-
Flag to enable external IGA_MIN					
LV_IGA_ST_OPM_SEL	O/V	0... 1H	0 ...1	1	-
condition for IGA_ST operation mode, 1 = OPM_1, 0 = OPM_2					
Zw_ks	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Grundzündwinkel bei KR-Sicherheitsspätverstellung					
Zw_md [NC_CYL_NR]	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
ignition angle after torque intervention					
Zw_min	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
minimum ignition angle					
Zw_out_mw	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	°CRK
Ignition angle applied on the respective cylinder (0 to 5)					
Zw_ve [NC_CYL_NR]	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
basic ignition angle, application correction and knock control included					

Input data:

B_gdst {p. 8343}	B_zwmin_ext {p. 8348}	Dzw_agr_hs {p. 8156}	Dzw_agr_kor {p. 8156}
F_zw_hsplit {p. 8158}	IGA [NC_CYL_NR] {p. 1828}	IGA_ADJ_MAX_KNK {p. 1960}	IGA_IGC_0_5_H_RNG {p. 1559}
IGA_IGC_H_RNG [NC_CYL_NR] {p. 1876}	IGA_MIN_H_RNG {p. 1828}	LV_S_CLC {p. 1822}	NC_CBK_EX_NR {p. 1829}

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NC_CYL_NR {p. 1526}	Zw_grund1 {p. 8181}	Zw_grund2 {p. 8181}	Zw_offkorrvr [NC_CYL_NR] {p. 8181}
Zw_opt1 {p. 8181}	Zw_opt2 {p. 8181}	Zw_soll_hs [NC_CYL_NR] {p. 8181}	Zw_soll_s [NC_CYL_NR] {p. 8181}

R.29.1 Outputs for BMW functions which are defined as IGSP exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions:

Initialisation at reset or at exit power latch phase:
Zw_ks = IGA_ADJ_MAX_KNK
Zw_min = 0°crk
Zw_ve[NC_CYL_NR] = IGA[NC_CYL_NR]
Zw_md[NC_CYL_NR] = 0°crk
Zw_out_mw = IGA_IGC_0_5_H_RNG *\/* IGA_IGC_0_5_H_RNG is initialized with C_IGA_INI_H_RNG */*

Recurrences: segment: Zw_ks, Zw_min, Zw_ve[NC_CYL_NR], Zw_md[NC_CYL_NR], Zw_out_mw,

Activation: every engine state, except power latch phase
Deactivation: at power latch phase
Values at deactivation: 0, except:

Zw_out_mw = IGA_IGC_0_5_H_RNG

Formula section:

Remark: all formulas are valid in a **physical** meaning

Zw_ks = IGA_ADJ_MAX_KNK
Zw_min = IGA_MIN_H_RNG
Zw_ve[NC_CYL_NR] = IGA[NC_CYL_NR]
Zw_md[NC_CYL_NR] = IGA_IGC_H_RNG[NC_CYL_NR]
Zw_out_mw = IGA_IGC_0_5_H_RNG

R.29.2 Outputs for supplier aggregates

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

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Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions:

Initialisation at reset or at exit power latch phase :
all values 0 phys
Except first calculation after init of BMW-values:
IGA_REF_COR_CBK[NC_CBK_EX_NR], IGA_REF_COR, IGA_BAS_COR_CBK[NC_CBK_EX_NR], IGA_BAS_COR
Recurrence : segment: IGA_AV_H_RNG_S_1[NC_CYL_NR], AV_H_RNG_HOMS_1[NC_CYL_NR], IGA_ADD_CMB_CTL[NC_CLY_NR]
10ms : FAC_IGA_OPM_SEL, IGA_BAS_COR, IGA_REF_COR, IGA_REF_LAMB_COR, IGA_REF_TEMP_COR, LV_IGA_ST_OPM_SEL IGA_IGC_HOM_S[NC_CYL_NR], IGA_REF_COR_1, IGA_REF_COR_2, IGA_BAS_COR_1, IGA_BAS_COR_2, LV_IGA_MIN_EXT, IGA_REF_EGR_HOM_COR, IGA_REF_EGR_HOMS_COR
Activation: at every engine state
Deactivation: - –

Formula section:

Remark: all formulas are valid in a **physical** meaning

If LV_S_CLC = 1
then
IGA_AV_H_RNG_S_1[NC_CYL_NR] = Zw_soll_s[NC_CYL_NR]
IGA_AV_H_RNG_HOMS_1 [NC_CYL_NR] = Zw_soll_hs[NC_CYL_NR]
IGA_REF_EGR_HOMS_COR = Dzw_agr_hs
endif
FAC_IGA_OPM_SEL = F_zw_hsplit
IGA_BAS_COR_CBK[1] = Zw_grund1
IGA_BAS_COR_CBK[2] = Zw_grund2
IGA_BAS_COR = 0.5 * (IGA_BAS_COR_CBK[1] + IGA_BAS_COR_CBK[2])
LV_IGA_ST_OPM_SEL= B_gdst
IGA_ADD_CMB_CTL[NC_CLY_NR] = Zw_offkorrvr[NC_CYL_NR]
IGA_REF_COR_CBK[1] = Zw_opt1
IGA_REF_COR_CBK[2] = Zw_opt2
IGA_REF_COR = 0.5 * (IGA_REF_COR_CBK[1] + IGA_REF_COR_CBK[2])
IGA_REF_EGR_HOM_COR = Dzw_agr_kor
IGA_REF_LAMB_COR = Dzwo_lam_kor
IGA_REF_TEMP_COR = Dzwot
LV_IGA_MIN_EXT = B_zwmin_ext

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R.30 Customer adaptation module: INJR

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_zylab1	O/V	0... 1H	0 ...1	1	-
Logical value for single cylinder cut off bank 1					
B_zylab2	O/V	0... 1H	0 ...1	1	-
Logical value for single cylinder cut off bank 2					
CTR_SEG_IGN_INJ_SYN_DEAC	V	0... FFH	0... 255	1	-
Segment counter until deactivation of ignition injection synchronization in HOM mode.					
EOI_2_HOM_CUS [NC_CYL_NR]	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
End of the second injection for homogeneus mode, absolute value					
EOI_3_HOMS_CUS [NC_CYL_NR]	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
End of the third injection for homogeneous stratified mode					
EOI_3_S_CUS [NC_CYL_NR]	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
End of the third injection for stratified mode					
Espr_mod [NC_CYL_NR]	O/V	0... FFH	0... 255	1	-
Aktueller Einspritzmodus					
Eta_zyl_aus	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Actual efficiency fuel cut-off					
FAC_EOI_OPM_SEL	O/V	0... FFH	0... 0.99609	3.9062e-3	-
injection phasing correction interpolation factor for operation switch manager					
INH_IV_CUS	O	0... FFH	0... 255	1	-
shut off pattern requested by customer					
LF_SOI_S_ENA	O/V	0... FFH	0... 255	1	-
Bitfield to enable SOI-based stratified injection; cylinder individual (bit 0 stands for cyl 0 ...); 0 = use EOI, 1 = use SOI					
LFT_L_IV_REQ_HOM_CUS	O	0... FFH	0... 255	1	-
Dynamic injector needle lift selection request by customer for homogeneous combustion mode					
LFT_L_IV_REQ_HOMS_CUS	O	0... FFH	0... 255	1	-
Dynamic injector needle lift selection request by customer for homogeneous-stratified combustion mode					
LFT_L_IV_REQ_S_CUS	O	0... FFH	0... 255	1	-
Dynamic injector needle lift selection request by customer for stratified combustion mode					
LV_EOI_2_DELTA_HOM_CUS	O/V	0... 1H	0 ...1	1	-
Switch between EOI_2_HOM_CUS (LV... = 0) or EOI_2_DELTA_HOM_CUS (LV = 1) for phasing of second hom. Injection pulse					
LV_HOMS_ACT	O/V	0... 1H	0 ...1	1	-
Indicates if HOMS is active					
LV_IGN_INJ_SYN_DEAC	O/V	0... 1H	0 ...1	1	-
Flag if there is no synchronisation needed between ignition and injection					
LV_LAM_AD_INJ_CUS_ACK [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Customer acknowlegde flag for injection mode control handshake					
LV_MPLH_ACT	O/V	0... 1H	0 ...1	1	-
Indicates if homogeneous mode with split injection is active					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_MPLP_ACT	O/V	0... 1H	0 ...1	1	-
Indicates if stratified mode with post injection is active					
LV_MPLP_ENA	O/V	0... 1H	0 ...1	1	-
Enable post injection					
LV_PRS_COR_MPLH_ENA_CUS	O/V	0... 1H	0 ...1	1	-
Switch to enable/disable fuel rail pressure pulsation correction for homogeneous multi injection; customer provided					
LV_PRS_COR_SNGH_ENA_CUS	O/V	0... 1H	0 ...1	1	-
Switch to enable/disable fuel rail pressure pulsation correction for homogeneous single injection; customer provided					
LV_TI_LIM_ACT	O/V	0... 1H	0 ...1	1	-
1: injection time limited by cycle time (720°crk)					
SOI_1_HOM_CUS [NC_CYL_NR]	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
Start of the first injection for homogeneous mode					
SOI_1_HOMS_CUS [NC_CYL_NR]	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
Start of the first injection for homogeneous stratified mode					
SOI_2_MAX_CUS	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
Maximum start of the second injection					
SOI_3_S_CUS [NC_CYL_NR]	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
Start of the post injection during stratified mode					
SOI_MPLP_CUS [NC_CYL_NR]	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
Start of the post injection during stratified mode					
SOI_S_CUS [NC_CYL_NR]	O	E200... 5A00H	-180 ...540	0.0234375	°CRK
Start of injeciton for last stratified pulse					
St_injad_anf [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
state of adaptions request for "Kleinstmengen"					
T_DLY_1_2_S_CUS [NC_CYL_NR]	O	0... FFFFH	0... 262.14	0.004	ms
Time delay between first and second pulse for stratified mode					
T_DLY_2_3_MIN_HOMS_CUS [NC_CYL_NR]	O	0... FFFFH	0... 262.14	0.004	ms
Minimum time delay between second and third pulse for homogeneous-stratified mode					
T_DLY_2_3_S_CUS [NC_CYL_NR]	O	0... FFFFH	0... 262.14	0.004	ms
Time delay between second and third pulse for stratified mode					
TCYL_MDL_CUS	O/V	8000... 7FFFH	-2048... 2047.9375	0.0625	K
Modelled cylinder air temperature - customer provided.					
Ti_1_homext	O/V	0... FFFFH	0... 838.848	0.0128	ms
effektive Einspritzzeit Bank 1					
Ti_2_homext	O/V	0... FFFFH	0... 838.848	0.0128	ms
effektive Einspritzzeit Bank 2					
Wese	O/V	0... FFFFH	0... 1535.97656	0.0234375	°CRK
Angle of end of injection					

Input data:

B_nesps_ena {p. 8345}	B_prailpulskor_ee {p. 8346}	B_prailpulskor_me {p. 8346}	B_temxon {p. 8347}
B_wese2h_abs {p. 8347}	Baw_ist {p. 8155}	CTR_CYL_NR_ST_CLC {p. 1754}	Dwese2_h [NC_CYL_NR] {p. 8156}
ECU_STATE {p. 1091}	EFF_SCC_AV {p. 6665}	EOI_1_HOM {p. 2122}	F_vwi_ba {p. 8158}
INJ_MOD [NC_CYL_NR] {p. 2037}	Injekt_hub_h {p. 8159}	Injekt_hub_hs {p. 8159}	Injekt_hub_s {p. 8159}

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LC_MFF_MPG_NEW {p. 8246}	LF_MFF_HOM {p. 8242}	LV_S_CLC {p. 1822}	LV_SCC [NC_CBK_EX_NR] {p. 2295}
LV_ST_END {p. 1720}	NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_LAMB_REF [NC_CYL_NR] {p. 812}
NC_PLS_NR	St_injad_quit {p. 8172}	St_wesb_s {p. 8174}	Stat_zyl_aus {p. 8175}
STATE_LAM_AD_INJ_ACT [NC_CBK_EX_NR] {p. 3379}	Td_wese [NC_CYL_NR][2] {p. 8177}	Td_wese23min_hs [NC_CYL_NR] {p. 8177}	Tevt_mdl {p. 8177}
TI_1_HOM [NC_CYL_NR] {p. 2002}	TI_2_HOM [NC_CYL_NR] {p. 2003}	TI_3_HOM [NC_CYL_NR] {p. 2003}	Wes_soll_h [NC_CYL_NR][NC_PLS_NR] {p. 8179}
Wesb_s [NC_CYL_NR] {p. 8179}	Wesb1_h [NC_CYL_NR] {p. 8179}	Wesb1_hs [NC_CYL_NR] {p. 8179}	Wesb2max_h {p. 8179}
Wesbkh_s [NC_CYL_NR] {p. 8180}	Wese_s [NC_CYL_NR] {p. 8180}	Wese2_h [NC_CYL_NR] {p. 8180}	Wese2_hs [NC_CYL_NR] {p. 8180}
Wese3_h [NC_CYL_NR] {p. 8180}	Wese3_hs [NC_CYL_NR] {p. 8180}		

R.30.1 Outputs for BMW functions which are defined as INJR exported data

FUNCTION DESCRIPTION:

General information:

Adaptation to BMW environment.

Application conditions:

Initalisation at reset or at exit power latch phase (BMW-variables):

0 all, except: Eta_zyl_aus = 100 %
Recurrences: segment: B_zylab1/2, Espr_mod[NC_CYL_NR], Wese
10 ms: Eta_zyl_aus, Ti_1_homext, Ti_2_homext
100ms: St_injad_anf

Activation: every engine state
Deactivation: - –

Formula section:

B_zylab1 = LV_SCC_1
B_zylab2 = LV_SCC_2
If ECU_STATE = "PWL"
Then
Espr_mod[NC_CYL_NR] = 0
Wese = 0
Eta_zyl_aus = 0
Ti_1_homext = 0
Ti_2_homext = 0
St_injad_anf [NC_CBK_EX_NR] = 0

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Elseif
Espr_mod[NC_CYL_NR] = INJ_MOD[NC_CYL_NR]
Wese = EOI_1_HOM
St_injad_anf [NC_CBK_EX_NR] = STATE_LAM_AD_INJ_ACT[NC_CBK_EX_NR]
Eta_zyl_aus = EFF_SCC_AV * 100
IF NC_CBK_EX_NR $>$ 1 *(please note physical meaning)*
THEN
Ti_1_homext = 0
Ti_2_homext = 0
FOR x = 0 **TO** (NC_CYL_NR - 1)
IF (NC_LAMB_REF **AND** 2^x) 0 *(bitwise)*
THEN
Bank 2:
Ti_2_homext += TI_1_HOM[x] + TI_2_HOM[x] + TI_3_HOM[x]
ELSE
Bank 1:
Ti_1_homext += TI_1_HOM[x] + TI_2_HOM[x] + TI_3_HOM[x]
ENDIF
ENDFOR
Ti_1_homext = Ti_1_homext /(NC_CYL_NR /NC_CBK_EX_NR)
Ti_2_homext = Ti_2_homext /(NC_CYL_NR /NC_CBK_EX_NR)
ELSE
Ti_1_homext = 0
FOR x = 0 **TO** (NC_CYL_NR - 1)
Ti_1_homext += TI_1_HOM[x] + TI_2_HOM[x] + TI_3_HOM[x]
ENDFOR
Ti_1_homext = Ti_1_homext /NC_CYL_NR
ENDIF
Endif

R.30.2 Outputs for supplier aggregates

FUNCTION DESCRIPTION:

General information:

Adaptation to BMW environment.

Application conditions

Initialisation(supplier-Variables): 0, except LV_EOI_2_DELTA_HOM_CUS = 1
// SOI_3_S_CUS is not valid any more for post injection. It is set to a default value to keep the interface to aggr. EXTC stable. Post injection has to disabled for the function sample!
SOI_3_S_CUS[NC_CYL_NR] = 140 (each element)

Recurrence : 10 ms: LV_TI_LIM_ACT, FAC_EOI_OPM_SEL, LV_MPLP_ENA, LV_MPLH_ACT, LV_MPLP_ACT, LV_HOMS_ACT

20ms: LV_LAM_AD_INJ_CUS_ACK[NC_CBK_EX_NR]

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```
                          if       LV_ST_END =   0   or at power latch
phase
                          then       recurrence of the following
vaules is 10ms
                               SOI_1_HOM_CUS[NC_CYL_NR],
                               EOI_3_S_CUS[NC_CYL_NR],
                               T_DLY_1_2_S_CUS[NC_CYL_NR],
      T_DLY_2_3_S_CUS[NC_CYL_NR],
      SOI_MPLP_CUS[NC_CYL_NR],
              SOI_1_HOMS_CUS[NC_CYL_NR],
              EOI_2_HOMS_CUS[NC_CYL_NR],
      EOI_3_HOMS_CUS[NC_CYL_NR],
      T_DLY_2_3_MIN_HOMS_CUS[NC_CYL_NR],
              EOI_2_HOM_CUS[NC_CYL_NR],
              EOI_3_HOM_CUS[NC_CYL_NR],
SOI_2_MAX_CUS,
       LV_EOI_2_DELTA_HOM_CUS,
LF_SOI_S_ENA,
SOI_S_CUS[NC_CYL_NR],
INH_IV_CUS,
LFT_L_IV_REQ_S_CUS,
LFT_L_IV_REQ_HOM_CUS,
LFT_L_IV_REQ_HOMS_CUS,
LV_PRS_COR_SNGH_ENA_CUS,
LV_PRS_COR_MPLH_ENA_CUS
LV_IGN_INJ_SYN_DEAC

    else       recurrence of the following vaules is segment
synchron
                               SOI_1_HOM_CUS[NC_CYL_NR],
                               EOI_3_S_CUS[NC_CYL_NR],
                               T_DLY_1_2_S_CUS[NC_CYL_NR],
      T_DLY_2_3_S_CUS[NC_CYL_NR],
              SOI_MPLP_CUS[NC_CYL_NR],
              SOI_1_HOMS_CUS[NC_CYL_NR],
              EOI_2_HOMS_CUS[NC_CYL_NR],
      EOI_3_HOMS_CUS[NC_CYL_NR],
      T_DLY_2_3_MIN_HOMS_CUS[NC_CYL_NR],
              EOI_2_HOM_CUS[NC_CYL_NR],
              EOI_3_HOM_CUS[NC_CYL_NR],
SOI_2_MAX_CUS,
       LV_EOI_2_DELTA_HOM_CUS,
LF_SOI_S_ENA,
       SOI_S_CUS[NC_CYL_NR],
INH_IV_CUS,
LFT_L_IV_REQ_S_CUS,
LFT_L_IV_REQ_HOM_CUS,
LFT_L_IV_REQ_HOMS_CUS,
LV_PRS_COR_SNGH_ENA_CUS,
LV_PRS_COR_MPLH_ENA_CUS
LV_IGN_INJ_SYN_DEAC
  100ms:         TCYL_MDL_CUS
```

Activation: at every engine state

Deactivation: - -

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Formula section:

Remark: all formulas are valid in a **physical** meaning

```
If        LV_S_CLC = 1
then
        EOI_3_S_CUS[NC_CYL_NR]                 = Wese_s[NC_CYL_NR]
        T_DLY_ 1_2_S_CUS[NC_CYL_NR]            = Td_wese[NC_CYL_NR][1]
        T_DLY_2_3_S_CUS[NC_CYL_NR]             = Td_wese[NC_CYL_NR][2]
        SOI_MPLP_CUS[NC_CYL_NR]                = Wesbkh_s[NC_CYL_NR]
        SOI_1_HOMS_CUS[NC_CYL_NR]              = Wesb1_hs[NC_CYL_NR]
        EOI_2_HOMS_CUS[NC_CYL_NR]              = Wese2_hs[NC_CYL_NR]
        EOI_3_HOMS_CUS[NC_CYL_NR]              = Wese3_hs[NC_CYL_NR]
        T_DLY_2_3_MIN_HOMS_CUS[NC_CYL_NR]      = Td_wese23min_hs[NC_CYL_NR]
        LF_SOI_S_ENA                           = St_wesb_s
        SOI_S_CUS[NC_CYL_NR]                   = Wesb_s[NC_CYL_NR]
endif
INH_IV_CUS                                     = Stat_zyl_aus
FAC_EOI_OPM_SEL                                = F_vwi_ba
LFT_L_IV_REQ_S_CUS                             = Injekt_hub_s
LFT_L_IV_REQ_HOM_CUS                           = Injekt_hub_h
LFT_L_IV_REQ_HOMS_CUS                          = Injekt_hub_hs
If        Bit 0 of St_injad_quit is 1
Then   LV_LAM_AD_INJ_CUS_ACK[1] = 1
Else    LV_LAM_AD_INJ_CUS_ACK[1] = 0
Endif
If        Bit 1 of St_injad_quit is 1
Then   LV_LAM_AD_INJ_CUS_ACK[2] = 1
Else    LV_LAM_AD_INJ_CUS_ACK[2] = 0
endif

LV_MPLP_ENA                      = B_nesps_ena
If                               LC_MFF_MPG_NEW = 1
Then
   IF (Bit 3 of LF_MFF_HOM is set) or (Bit 4 of LF_MFF_HOM is set)
     //Note: zero based indexing is used for LF_MFF_HOM
   THEN
        LV_IGN_INJ_SYN_DEAC = 0
        CTR_SEG_IGN_INJ_SYN_DEAC = NC_CYL_NR
   ELSE
        IF CTR_SEG_IGN_INJ_SYN_DEAC > 0
        THEN
             Decrement CTR_SEG_IGN_INJ_SYN_DEAC by 1
        ENDIF
        IF CTR_SEG_IGN_INJ_SYN_DEAC = 0
        THEN
             LV_IGN_INJ_SYN_DEAC = 1
        ENDIF
   ENDIF
   For x = 0 to NC_CYL_NR-1 do
     SOI_1_HOM_CUS[x] = Wes_soll_h[x][0]
     If Bit 1 of LF_MFF_HOM = 1
            //Note: zero based indexing is used for LF_MFF_HOM
```

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```
        Then
                EOI_2_HOM_CUS[x] = Wes_soll_h[x][1]
        Else
                EOI_2_HOM_CUS[x] = Wes_soll_h[x][2]
        Endif
        EOI_3_HOM_CUS[x] = Wes_soll_h[x][2]
      Endfor
Else - LC_MFF_MPG_NEW = 0
    IF B_wese2h_abs = 0
    THEN
        LV_IGN_INJ_SYN_DEAC = 0
        CTR_SEG_IGN_INJ_SYN_DEAC = NC_CYL_NR
    ELSE
        IF CTR_SEG_IGN_INJ_SYN_DEAC > 0
        THEN
            Decrement CTR_SEG_IGN_INJ_SYN_DEAC by 1
        ENDIF
        IF CTR_SEG_IGN_INJ_SYN_DEAC = 0
        THEN
            LV_IGN_INJ_SYN_DEAC = 1
        ENDIF
    ENDIF
    For x = 0 to NC_CYL_NR-1 do
        SOI_1_HOM_CUS[x] = Wesb1_h[x]
       If B_wese2h_abs = 0
       Then
            EOI_2_HOM_CUS[x] = Dwese2_h[x]
        Else
            EOI_2_HOM_CUS[x] = Wese2_h[x]
        Endif
        EOI_3_HOM_CUS[x] = Wese3_h[x]
    Endfor
Endif

If      ECU_STATE = "PWL"
Then
LV_TI_LIM_ACT                                   = 0
        LV_EOI_2_DELTA_HOM_CUS                            = 1
        EOI_3_HOM_CUS[NC_CYL_NR]                             = 0
SOI_2_MAX_CUS                                     = 0

Elseif
                        LV_TI_LIM_ACT                        =   B_temxon
        If      LC_MFF_MPG_NEW = 1
                        Then
                         LV_EOI_2_DELTA_HOM_CUS =
                          (Bit 3 of LF_MFF_HOM) OR (Bit 4 of LF_MFF_HOM)
                          //Note: zero based indexing is used for LF_MFF_HOM
    Else
                         LV_EOI_2_DELTA_HOM_CUS = NOT(B_wese2h_abs)
                        Endif
```

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```
        SOI_2_MAX_CUS                          = Wesb2max_h
Endif

If          ( Baw_ist and 0xff ) = 66 or ( Baw_ist and 0xff ) = 226 or ( Baw_ist and 0xff ) = 82
Then
            LV_MPLH_ACT = 1
Elseif
            LV_MPLH_ACT = 0
Endif

If          ( Baw_ist and 0xff ) = 65
Then
            LV_MPLP_ACT = 1
Elseif
            LV_MPLP_ACT = 0
Endif

If          ( Baw_ist and 0xff ) = 19
Then
            LV_HOMS_ACT = 1
Elseif
            LV_HOMS_ACT = 0
Endif

LV_PRS_COR_MPLH_ENA_CUS = B_prailpulskor_me
LV_PRS_COR_SNGH_ENA_CUS = B_prailpulskor_ee

/* with 100ms recurrence */
TCYL_MDL_CUS = Tevt_mdl + 273.15   /* Attention: transfer of °C to K */
```

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R.31 Customer adaptation module: INSY

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_disa_akt	O/V	0... 1H	0 ...1	1	-
Bedingung DISA aktiv					
Dpsr	O/V	8000... 7FFFH	-1280... 1279.96093	0.0390625	hPa
differential manifold pressure					
Dpsr_seg	O/V	8000... 7FFFH	-1280... 1279.96093	0.0390625	hPa
differential manifold pressure, calculated segment synchronous					
EGR_RATIO	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Air mass flow at EGR valve /air mass flow to cylinder					
FAC_MAF_AD_EGR_KWP	O/V	8000... 7FFFH	-2... 1.99993	61e-6	-
Testerwert NN PR-Adaption					
FAC_MAF_AD_THR_KWP	O/V	8000... 7FFFH	-1... 0.99996	30.5e-6	-
Testerwert NN DK-Adaption					
FAC_MAF_REL	O/V	0... BB8H	0... 300	0.1	%
relative filling					
Fho	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
altitude factor					
Ftbr	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Filtered volumetric efficiency correction factor due to temperature effects					
ISAPWM	O	0... FFFFH	0... 99.99847	1.5259e-3	%
idle speed actuator duty cycle, linearised					
ISAPWM_ISA	O	0... FFFFH	0... 99.99847	1.5259e-3	%
Idle speed actuator duty cycle					
ISAPWM_MMV	O	0... FFFFH	0... 99.99847	1.5259e-3	%
idle speed actuator duty cycle moving mean value					
LV_TPS_SUB_DIAG_NOT_VLD	O/V	0... 1H	0 ...1	1	-
Bedingung Berechnung DKWinkel aus Signal des HF-Sensors ungedrosselt					
LV_VIM_1_CUS	O/V	0... 1H	0 ...1	1	-
Setpoint disa flap 1 specified by customer					
LV_VIM_2_CUS	O/V	0... 1H	0 ...1	1	-
Request from BMW for open variable intake manifold 2					
LV_VIM_INH_CUS	O/V	0... 1H	0 ...1	1	-
Enable bit for VIM					
MAF	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
calculated mass air flow					
MAF_CYL	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Air mass flow to cylinder [kg/h]					
MAF_CYL_STK	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Air mass flow to cylinder [mg/stk]					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
MAF_EGR	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Air mass flow at EGR valve					
MAF_EGR_NEUT_GAS	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Neutral Gas component of Exhaust Gas Recirculation					
MAF_KGH_FG_PRED	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Predicted fresh gas out of the manifold					
MAF_MAX_COR	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Maximum available fresh air going into the cylinder					
MAF_MDL_MV	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Model air mass flow mean value [kg/h]					
MAF_SCAV_EXT	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Delta RF					
MAF_SP	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
MAF setpoint output for inverse air path					
MAF_THR	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Air mass flow at the throttle					
MAP	O/V	0... FFFFH	0... 5434	0.0829175	hPa
Manifold pressure					
MAP_DRV1	O/V	8000... 7FFFH	-82.91752 ...82.91499	2.5304e-3	hPa/ms
First derivative of intake manifold pressure					
MAP_SP	O/V	0... FFFFH	0... 5434	0.0829175	hPa
mainfold air pressure setpoint					
Mshfm_ist	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
measured mass air flow					
Mshfm2_ist	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Massenstrom vom HFM Bank 2					
Mslui	O/V	0... FFFFH	0... 29.12667	444.4e-6	kg
measured mass air flow integral					
PQ	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Pressure quotient at the throttle					
PQ_EGR_SP	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
pressure quotient between exhaused branch and MAP					
PQ_SP	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
PQ-setpoint					
PRS_IM_CTL_I	O/V	8000... 7FFFH	-2... 1.99993	61e-6	-
Saugrohrdruckregler I-Anteil					
Ps_abs	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
Absolute Pressure of manifold					
Ps_abs_t100	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
Absolute Pressure of manifold, 100ms					
Pu	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
ambient pressure					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Pvagr	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
egr pressur					
Pvdkds	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
pressure upstream throttle					
Pvdkds_t100	O/V	0... FFFFH	0... 2559.96093	0.0390625	hPa
pressure upstream throttle, 100ms					

Input data:

Agr_rate {p. 8154}	AMP_MES {p. 1163}	B_disa_stopp {p. 8342}	B_disa1_auf {p. 8342}
B_disa2_auf {p. 8342}	B_wdkdiag_ugd {p. 8347}	Drf_spuel {p. 8156}	ECU_STATE {p. 1091}
EFF_VOL_TEMP_COR_MMV {p. 1206}	FAC_AMP {p. 1163}	LV_ES {p. 1720}	LV_VAR_TCHA {p. 656}
LV_VIM_RLS {p. 3622}	MAF_KGH {p. 1195}	MAF_KGH_MES {p. 1192}	MAF_KGH_MES_TCHA [NC_MAF_SENS_CONF] {p. 1192}
MAP_DIP_MES_BAS {p. 1198}	MAP_DIP_MES_BAS_2SEG {p. 1198}	MAP_MES_BAS {p. 1198}	Mrnn_test_dk {p. 8162}
Msagr {p. 8163}	Msdk {p. 8163}	Mszyl {p. 8163}	Mszyl_ges {p. 8163}
N {p. 1525}	NC_MAF_FAC_CYL {p. 2889}	NC_MAF_SENS_CONF {p. 604}	Prnn_test {p. 8165}
PRS_EX {p. 1167}	PRS_EX_EGR {p. 1167}	Ps {p. 8165}	Pspvdk {p. 8166}
Pspvdk_soll {p. 8166}	PSREG	Pssol {p. 8166}	PUT {p. 1209}
PUT_MES_BAS {p. 1198}	Rf {p. 8167}	Rf_ig_ist {p. 8167}	Rf_soll {p. 8167}
Rf_vl {p. 8167}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_FAC_MAF_TCHA	-	0... FFFFH	0... 3.99993	61e-6	-
Factor for conversion of mass air flow from one to two banks					
C_FAC_MAF_TCHA_0	-	0... FFFFH	0... 3.99993	61e-6	-
Factor for conversion of mass air flow from bank one					
C_FAC_MAF_TCHA_1	-	0... FFFFH	0... 3.99993	61e-6	-
Factor for conversion of mass air flow from bank two					
C_MAF_REF	-	0... FFFFH	0... 1389	0.0211948	mg/stk
Reference air mass flow for the calculation of MAF and MAF_MAX_COR					
LC_MAF_TCHA_MES	-	0... 1H	0 ...1	1	-
Switch for calculation of Mshfm_ist/m by model (0) or by sensor (1), only for N54					

R.31.1 Outputs for BMW functions which are defined as INSY exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation: `at reset: Ftbr = 1.0 , all others =0`

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Recurrence :

```
Ftbr :     100 ms
 Mshfm_ist, Mshfm2_ist:     segment
    Mslui :     200 ms
```

Activation: *every engine state*

Formula section:

Remark: all formulas are valid in a **physical** meaning

Ftbr = EFF_VOL_TEMP_COR_MMV

If LC_MAF_TCHA_MES = 0

Then

Mshfm_ist = MAF_KGH_MES

Mshfm2_ist = 0

Else

Mshfm_ist = MAF_KGH_MES_TCHA[0] * C_FAC_MAF_TCHA_0 + MAF_KGH_MES_TCHA[1] * C_FAC_MAF_TCHA_1

Mshfm2_ist = MAF_KGH_MES_TCHA[1]

Endif

Mslui = $Mslui_{n-1}$ + MAF_KGH * **Error!** after reading the maximum value 29.13 kg the calculation of Mslui is stopped.

Pvagr = PRS_EX_EGR

R.31.2 Outputs for BMW functions which are not defined as INSY exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions

Initialisation:

```
Dpsr:     0 hPa
Dpsr_seg:       0 hPa
Ps_abs :          0 hPa
Ps_abs_t100:        0 hPa
Fho:                1.0
Pvdkds:        AMP_MES
Pvdkds_t100:        AMP_MES
Pu:                AMP_MES
B_disa_akt:         0
```

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Recurrence :

```
segment:  Dpsr_seg
                     100ms:      Fho      Remark:  the update
rate of FAC_AMP is 1000 ms only
                     100 ms:      Pu      Remark:  the update
rate of AMP_MES is 1000 ms only
                     10ms :           B_disa_akt, Ps_abs_
t100, Pvdkds_t100
    if       LV_VAR_TCHA = 0
                     then      Pvdkds:        100 ms
                     else      Pvdkds:        segment
                     endif
    if        LV_ES = 1
    then       Dpsr:  100ms, Ps_abs:  10ms
    elseif       Dpsr, Ps_abs:  segment
```

Activation: *every engine state*

Deactivation: - -

Formula section:

Remark: all formulas are valid in a **physical** meaning

Pvdkds = PUT
Pvdkds_t100 = PUT_MES_BAS
Pu = AMP_MES
B_disa_akt = LV_VIM_RLS
Ps_abs_t100 = MAP_MES_BAS
Fho = FAC_AMP
if ECU_STATE= "PWL"
then Dpsr_seg = 0
Dpsr = 0
else Dpsr_seg = MAP_DIP_MES_BAS
Dpsr = MAP_DIP_MES_BAS_2SEG
Ps_abs = MAP_MES_BAS
endif

R.31.3 Outputs for supplier aggregates

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs can be different from the specified values due to the input data attributes.

Application conditions

Initialisation at reset: *0, except PQ_EGR_SP= 0.99998, PRS_IM_CTL_I=1*

Recurrence:

```
 if  LV_ES = 1 then   10ms
         Endif
         If LV_ES= 0
         Then
10ms:       PQ_SP, LV_TPS_SUB_DIAG_NOT_VLD,        MAF_EGR_
NEUT_GAS, FAC_MAF_AD_THR_KWP,        FAC_MAF_AD_EGR_KWP, LV_
VIM_INH_CUS,     LV_VIM_1_CUS, LV_VIM_2_CUS , MAF_SCAV_EXT,
PRS_IM_CTL_I
```

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```
segment:  other
      (Hint:  the update rate of the input data can
be slower )
endif
```

Activation: *every engine state*

Formula section:

Remark: all formulas are valid in a **physical** meaning

EGR_RATIO = Agr_rate
MAF_EGR = Msagr
MAF_EGR_NEUT_GAS = Rf_ig_ist * C_MAF_REF
MAF_KGH_FG_PRED = Msdk
MAF_MDL_MV = Msdk_f
MAF_CYL = Mszyl
MAF_CYL_STK = Mszyl_ges * NC_MAF_FAC_CYL /N
MAP = Ps
PQ = Pspvdk
PQ_SP = Pspvdk_soll
If LV_ES = 1
Then MAF = 0
Else MAF = Rf * C_MAF_REF
Endif
MAF_SP = Rf_soll * C_MAF_REF
FAC_MAF_REL = Rf
MAF_MAX_COR = Rf_vl * C_MAF_REF
ISAPWM = 0 (init., never change)
ISAPWM_MMV = 0 (init., never change)
ISAPWM_ISA = 0 (init., never change)
MAP_SP = Pssol
MAP_DRV1 = (MAP$_N$ - MAP$_{N-1}$) /T_SEG_AV recurrence: segment
PQ_EGR_SP = MAP_SP /PRS_EX
MAF_THR = Msdk
LV_TPS_SUB_DIAG_NOT_VLD = B_wdkdiag_ugd
FAC_MAF_AD_THR_KWP = Mrnn_test_dk
FAC_ MAF_AD_EGR_KWP = Prnn_test
LV_VIM_INH_CUS = B_disa_stopp
LV_VIM_1_CUS = B_disa1_auf
LV_VIM_2_CUS = B_disa2_auf
MAF_SCAV_EXT = Drf_spuel * C_MAF_REF
PRS_IM_CTL_I = Psreg_i

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R.32 Customer adaptation module: INTC

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
A_quer	O/V	8000... 7FFFH	-64... 63.99804	1.9531e-3	m/s**2
Vehicle acceleration transversal					
Acfzgl	O/V	80... 7FH	-32... 31.75	0.25	m/s**2
vehicle acceleration longitudinal					
Acfzgq	O/V	80... 7FH	-32... 31.75	0.25	m/s**2
Fahrzeugquerbeschleunigung					
B_abgasklappe	O/V	0... 1H	0 ...1	1	-
Bedingung Schaltung Abgasklappe (True = Klappe geöffnet)					
B_abliactiv	O/V	0... 1H	0 ...1	1	-
state of low beam: 0 = off, 1 = on					
B_anhang	O/V	0... 1H	0 ...1	1	-
information of trailer					
B_btvsa	O/V	0... 1H	0 ...1	1	-
condition for cam setpoint for exhaust cam via external service device (Tester)					
B_btvse	O/V	0... 1H	0 ...1	1	-
condition for cam setpoint for inlet cam via external service device (Tester)					
B_cdigronw	O/V	0... 1H	0 ...1	1	-
IGR-Codierdaten schreiben bzw. einlesen in die DDE/DME					
B_cdxenonw	O/V	0... 1H	0 ...1	1	-
Xenonverbau-Codierdaten schreiben					
B_ckl30	O/V	0... 1H	0 ...1	1	-
condition kl30					
B_ckl50	O/V	0... 1H	0 ...1	1	-
condition terminal 50 (via CAN) active					
B_diagigr	O/V	0... 1H	0 ...1	1	-
Flag "Diagnosejob gesetzt"					
B_dscakt	O/V	0... 1H	0 ...1	1	-
DSC Aktivität					
B_dzm_dyn	O/V	0... 1H	0 ...1	1	-
Anforderung Drehzahlmesserdynamisierung					
B_egs_khl1	O/V	0... 1H	0 ...1	1	-
condition for request of cooling stage 1 frorm gear box					
B_egs_khl2	O/V	0... 1H	0 ...1	1	-
condition for request of cooling stage 2 frorm gear box					
B_fagurt	O/V	0... 1H	0 ...1	1	-
Fahrergurtschloß geschlossen					
B_fe	O/V	0... 1H	0 ...1	1	-
Flag " Fertigungsmodus aktive"					
B_fetrawedeak	O/V	0... 1H	0 ...1	1	-
Flag " Fertigungs-, Transport- und Werkstattmodus inaktive"					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_ftauf1	O/V	0... 1H	0 ...1	1	-
Boolean for driver’s door open					
B_gangwechsel_gs	O/V	0... 1H	0 ...1	1	-
Gangwechsel aktiv					
B_gen_ext	O	0... 1H	0 ...1	1	-
status for external adjustment generator					
B_hz	O/V	0... 1H	0 ...1	1	-
Increased engine heating power request by AC /INSTR3					
B_iliactiv	O/V	0... 1H	0 ...1	1	-
state of interior lighting: 0 = off, 1 = on					
B_keinhs_gs	O/V	0... 1H	0 ...1	1	-
Wenn=0 wird die Maxdrehzahl mit Prädiktion abgeregelt					
B_kupp1	O/V	0... 1H	0 ...1	1	-
St_bgkuppl					
B_ldm_ena	O	0... 1H	0 ...1	1	-
status for required torque via LDM enabled					
B_ldm_nofil	O/V	0... 1H	0 ...1	1	-
Fast torque adjustment by LDM					
B_lklps_kl1	O/V	0... 1H	0 ...1	1	-
Anforderung LKLPS "auf" von IHKA					
B_lklps_kl2	O/V	0... 1H	0 ...1	1	-
Anforderung LKLPS "ganz auf" von IHKA					
B_mhauf1	O/V	0... 1H	0 ...1	1	-
Boolean for engine hood open					
B_msadltgpd	O/V	0... 1H	0 ...1	1	-
Diagnose MSA-Leitung: Bit für die peramanente Deaktivierung MSA					
B_msadltgtd	O/V	0... 1H	0 ...1	1	-
Diagnose MSA-Leitung: Bit für die temporäre Deaktivierung MSA					
B_msafzg	O/V	0... 1H	0 ...1	1	-
Variante MSA-Fahrzeug					
B_msataster	O/V	0... 1H	0 ...1	1	-
Boolean for MSA button pressed					
B_nosa	O/V	0... 1H	0 ...1	1	-
Fuel cutoff prohibition by LDM					
B_schalt_dkg	O/V	0... 1H	0 ...1	1	-
Drehzahlregelung aktiv					
B_schalt_ldm	O/V	0... 1H	0 ...1	1	-
Anforderung Schalthinweis über CC-Meldung vom LDM					
B_sport_schalter	O/V	0... 1H	0 ...1	1	-
Sport switch activated					
B_taleer	O/V	0... 1H	0 ...1	1	-
Bedingung Tank leer					
B_tra	O/V	0... 1H	0 ...1	1	-
Flag " Transportmodus aktive"					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_tstkvs	O/V	0... 1H	0 ...1	1	-
Bedingung Funktionsanforderung Kraftstoffsystemdiagnose					
B_we	O/V	0... 1H	0 ...1	1	-
Flag " Werkstattmodus aktive"					
Batt_class	O/V/S	0... FFH	0... 255	1	-
Classification of the vehicle battery					
Baw_tester	O/V	0... FFFFH	0... 65535	1	-
Testeranforderung von Zulieferer					
Bordnetz	O/V	1... 2H	1 ...2	1	-
=1: CAN 11Hex =2: CAN 12Hex; bordnetz2000 is present					
Bosfxid2r	O/V/S	0... FFFFH	0... 65535	1	-
ID_Funktion_BOS_Rückstellung_2					
Bosid2r	O/V/S	0... FFH	0... 255	1	-
ID_2_BOS_Rückstellung_2					
Bosjzielr	O/V/S	0... FFH	0... 255	1	-
Zieltermin_Monat_BOS_Rückstellung_2					
Bosmzielr	O/V/S	0... FFH	0... 255	1	-
Zieltermin_Jahr_BOS_Rückstellung_2					
Bosprog2r	O/V/S	0... FFH	0... 255	1	-
Prognose_Intervall_Zeit_BOS_Rückstellung_2					
Bosrlsmr	O	8000... 7FFFH	-32768 ...32767	1	-
Remaining milage for oil (from combi)					
Bosrw2r	O/V/S	0... FFH	0... 255000	1000	km
Prognose_Intervall_Weg_BOS_Rückstellung_2					
Bosun	O/V	0... FFH	0... 255	1	-
Einheit für Bosrlsmr					
Bosunt	O/V	0... FFH	0... 255	1	-
Einheit für Bosrlsmt					
Bosv	O/V	0... FFH	0... 255	1	-
availability of kombi					
CUR_RNG_CTL	O/V	0... FFH	0... 255	1	-
Control current path					
Dm_ab_fws	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Fahrwiderstand					
Fahrzeug	O/V	0... FFH	0... 255	1	-
Vehicle variant					
Fetrawe	O/V	0... FFH	0... 255	1	-
Implementierung Fertigungs-, Transport- und Werkstattmodus mit Tester auslesen					
GR_DT	O/V	0... FFH	0... 31.875	0.125	-
Gear ratio factor for monitoring					
GS_IDC_DISP_RAW	O/V	0... FFH	0... 255	1	-
Gearshift signal - display type					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
GS_IDC_GEAR_RAW	O/V	0... FFH	0... 255	1	-
Gearshift signal - setpoint for gear					
I_eff_gs	O/V	0... FFFFH	0... 511.992	0.0078125	1/m
Strangverstärkung					
Id_bosrst	O/V	0... FFH	0... 255	1	-
ID2_BOS_resetting					
Id_bosrtw	O/V	0... FFFFH	0... 65535	1	-
ID_function_BOS_resetting					
idfbosmg_w	O/V	0... FFFFH	0... 65535	1	-
ID for engine oil (BOS Kombi)					
Ikurz_ogr	O/V/S	0... FFH	0... 2550	10	A
maximum short-current from CAS (vehicle-specific)					
Ikurz_ugr	O/V/S	0... FFH	0... 2550	10	A
minimum short-current from CAS (vehicle-specific)					
Ipm_typ_fp	O/V	0... FFH	0... 255	1	-
iPM-Fahrertyp zur Beeinflussung der Pedalauswertung					
Ipm_typ_mdkw	O/V	0... FFH	0... 255	1	-
iPM-Fahrertyp zur Beeinflussung der Soll-Momentenbestimmung					
Iwakeupgr	O/V/S	0... FFH	0... 0.255	0.001	A
No-load-current (vehicle-specific)					
Km_st	O/V	0... FFFFH	0... 655350	10	km
Kilometer reading at engine start based on last DC					
Km_st_1	O/V/S	0... FFFFFFFFH	0... 4294967295	1	-
Wegstrecke_km auf 1 km genau					
Kvaverbr	O/V	0... FFFFH	0... 65535	1	µl
fuel consumption [micro liter]					
La_soll_tester [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 15.99975	244.1e-6	-
Lambdaanforderung Tester					
LV_CAN_SND_MSG_PWR_MNG_0	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung POWERMANAGMENT VERBRAUCHERSTEUERUNG Sendeanforderung"					
LV_CAN_SND_MSG_PWR_MNG_1	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung POWERMANAGMENT BATTERIESPANNUNG Sendeanforderung"					
LV_GS_DOWN	O/V	0... 1H	0 ...1	1	-
Gear-shift down					
LV_GS_UP	O/V	0... 1H	0 ...1	1	-
Gear-shift up					
LV_INH_STST_CDN	O/V	0... 1H	0 ...1	1	-
Condition for Start-Stop					
LV_LDM_DRIV_ACT	O/V	0... 1H	0 ...1	1	-
Condition LDM driver active					
LV_LDM_OFF	O/V	0... 1H	0 ...1	1	-
LDM off requested by DME					
LV_OIL_CNS_WARN_1	O/V	0... 1H	0 ...1	1	-
LV warning oil consumption					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_OIL_CNS_WARN_2	O/V	0... 1H	0 ...1	1	-
LV warning oil consumption					
LV_STST_STOP	O/V	0... 1H	0 ...1	1	-
flag indicating engine is in STST(MSA)-Stop					
Md_kupp_schalt	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Kupplungsaufnahmemoment					
Md_rad_asrl	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Momentenbegrenzung ASR langsamer Pfad					
Md_rad_asrs	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Momentenbegrenzung ASR schneller Pfad					
Md_rad_msrl	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Begrenzungsmoment aus Motorschleppmomentenregelung langsamer Pfad					
Md_rad_msrs	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Begrenzungsmoment aus Motorschleppmomentenregelung schneller Pfad					
Md_rad_soll	O/V	7FFFFFFFH 80000000... H	214748364.7 -214748364.8...	-	Nm
Soll-Radmoment					
Mdk_kupp_verl	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Kupplungslastmoment bei aktiver Drehzahlregelung					
N_ab_m	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
gemessene Abtriebsdrehzahl					
N_DISP_DYN	O/V	0... 1FE0H	0... 8160	1	rpm
dynamisated N for display in ICL (Kombi)					
N_idlms	O/V	0... FFH	0... 255	1	-
request idlespeed-increase from powermanagement					
N_rad_hl	O/V	8000... 7FFFH	-512... 511.98437	0.015625	rad/s
Raddrehzahl hnten links					
N_rad_hr	O/V	8000... 7FFFH	-512... 511.98437	0.015625	rad/s
Raddrehzahl hnten rechts					
N_rad_vl	O/V	8000... 7FFFH	-512... 511.98437	0.015625	rad/s
Raddrehzahl vorn links					
N_rad_vr	O/V	8000... 7FFFH	-512... 511.98437	0.015625	rad/s
Raddrehzahl vorn rechts					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
N_schalt_dkg	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
Vom DKG geforderte Motordrehzahl					
Nelueft_klima	O/V	0... FFH	0... 99.60937	0.390625	%
Anforderung E-Lüfter Drehzahl von IHKA als PWM-Signal					
Nelueft_lenk	O/V	0... FFH	0... 99.60937	0.390625	%
E-Lüfteranforderung von derLenkhilfe					
Nturb	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
primary gear box revolution					
Pbrems	O/V	0... FFH	0... 99.60937	0.390625	bar
brake pressure					
Pbremsu	O/V	0... FFFFH	0... 65535	1	hPa
Vacuum of brake servo unit					
Pmsv [15]	O/V/S	0... FFH	0... 255	1	-
powermanagement Standverbraucher					
POW_CTL_PARK_CNS	O/V	0... FFH	0... 255	1	-
Control park consumer					
POW_CTL_PRI_PEAK_RED	O/V	0... FFH	0... 255	1	-
Control priority peak reduction					
POW_CTL_PRI_PEAK_RED_CFT	O/V	0... FFH	0... 255	1	-
Control priority peak reduction comfort					
POW_CTL_PWR_CNS_1	O/V	0... FFFFH	0... 65535	1	-
Control power consumer					
POW_CTL_PWR_CNS_2	O/V	0... FFH	0... 127.5	0.5	%
Control power special consumer					
Prg_getr	O/V	0... FH	0... 15	1	-
State mode ETCU					
PWM_NEUT_PSN_GB	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
Pulse width of the PLCD-Sensor					
Qs_anf_klima	O/V	0... FFH	0... 99.60937	0.390625	%
heat flow request					
rqpcos	O/V	0... FFH	0... 255	1	-
Request park consumer					
selspcos	O/V	0... FFH	0... 255	1	-
Selection special consumers					
St_dsc_can	O/V	0... FFH	0... 255	1	-
Status DSC					
St_dsc_mradsoll	O/V	0... FFH	0... 255	1	-
Sollwert Qualifier zum Signal Soll_Radmoment_Antriebsstrang_Summe_Stabilisierung					
St_fas_mradsoll	O/V	0... FFFFH	0... 65535	1	-
Sollwert Qualifier zum Signal Soll_Radmoment_Antriebsstrang_Summe_FAS					
St_fzg_1	O/V	0... FFFFFFFFH	0... 4294967295	1	-
carrier double-word 1 of all learned variants for customer environment					
St_fzg_2	O/V	0... FFFFFFFFH	0... 4294967295	1	-
carrier double-word 1 of all learned variants for customer environment					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_fzg_ass	O/V	0... FH	0... 15	1	-
Status ldm via CAN					
St_kupp_dkg	O/V	0... FFH	0... 255	1	-
Zustand der Anfahrkuppling					
St_kupp_smg	O/V	0... FFH	0... 255	1	-
Status Kupplung SMG-Getriebe					
st_ldstgen	O/V	0... FFH	0... 255	1	-
generator load					
St_mdrv_taster	O/V	0... FFH	0... 255	1	-
Das Signal gibt an, ob der MDrive- Taster betätigt wurde. Dieser ist in den M-Fahrzeugen fest auf die Sonderfunktion2- Taste gelegt.					
St_modus_dkg	O/V	0... FFH	0... 255	1	-
Status torque request from TCT (DKG)					
St_rennstart_dkg	O/V	0... FFH	0... 255	1	-
Statuswort Rennstart DKG					
St_wk	O/V	0... FFH	0... 255	1	-
Status converter clutch					
STATE_EGY_CNS_OFF	O/V	0... FFH	0... 255	1	-
state all electrical consumers off					
STATE_ENGG_POS	O/V	0... FFH	0... 255	1	-
Status Kraftschluss					
STATE_SPT_DISP_CAN	O/V	0H 1H 2H 3H 4... FFH undef3186d56570-44d400H	00_SPORT_ INACTIVE01_ SPORT_ ACTIVE Not defined 11_SIGNAL_ NOT_VALID undefnot definednot defined not defined undef	-	-
Lamp status Mdrive					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_SPT_ECU_CAN	O/V	0H 1H 2H FH	0000_NO_ CHANGE 0001_MAP1 0010_MAP2 1111_INVALID	-	-
CAN: Mdrive ECU sport mode					
STATE_SPT_ESP_CAN	O/V	0H 1H 2H 4H 7H	000_NO_ CHANGE 001_ESP_OFF 010_ESP_ON 100_ESP_ON_ SPORT 111_INVALID	-	-
CAN: MDrive ESP sport mode					
STATE_SPT_MOD_GB	O/V	0... 7H	0 ...7	1	-
CAN: Mdrive default transmission mode					
STATE_SPT_STEP_GB	O/V	0... FH	0... 15	1	-
CAN: Mdrive default drive-logic-level for transmission					
STATE_TQ_WHEEL	O/V	0... FFH	0... 255	1	-
state torque wheel					
STATE_TQ_WHEEL_DRIV_ASI_AV	O/V	0... FFH	0... 255	1	-
actual state of TQ_WHEEL_DRIV_ASI functionality (get from layer)					
STATE_TQ_WHEEL_TCS_AV	O/V	0... FFH	0... 255	1	-
Actual state of TQ_Wheel_TCS functionality (get from Layer)					
stpcos	O/V	0... FFH	0... 255	1	-
Status park consumers					
T_jahr	O/V	0... FFFFH	0... 65535	1	-
Borddatum, Jahr					
T_monate	O/V	0... FFFFH	0... 65535	1	-
Borddatum, Monat					
T_tag	O/V	0... FFFFH	0... 65535	1	-
Borddatum, Tag					
Tn_start_kl15	O/V	0... FFFFH	0... 6553.5	0.1	s
Zeit nach Startende (ohne MSA-Restarts)					
TQ_ECU_ETCU	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Actual torque ECU/ETCU					
TQ_MAX_ACC	O/V	0... FFH	0... 127.5	0.5	Nm
air-conditioning-compressor limit torque					
TQ_MAX_WHEEL	O/V	0... FFFFH	-32000 ...33535	1	Nm
Max. Radmoment					
TQ_MIN_WHEEL_L	O/V	0... FFFFH	-32000 ...33535	1	Nm
Schleppmoment unbefeuert					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQ_WHEEL	O/V	0... FFFFH	-32000 ...33535	1	Nm
Ist-Moment an den Antriebsrädern					
Tvngang	O/V	0... FFFFH	0... 655.35	0.01	%
PWM of neutral gear sensor					
U_gen_ext	O/V	0... FFFFH	0... 6553.5	0.1	V
adjustment value for alternator voltage setpoint					
V_can	O/V	0... FFFFH	0... 6553.5	0.1	km/h
Vehicle speed from CAN					
V_krapu	O/V	0... FFH	0... 255	1	l/h
Required amount of fuel					
V_rad	O/V	0... FFFFH	0... 6553.5	0.1	km/h
Fahrzeuggeschwindigkeit vom DSC-Raddrehzahl					
Verbstatus [10]	O/V	0... FFH	0... 255	1	-
Verbraucherstatus					
Voltank	O/V	0... 9F6H	0... 255	0.1	l
Fuel tank level					
Vsa_btsoll	O/V	0... FFFFH	-128... 52300	0.8	°CRK
Cam setpoint for exhaust cam via external service device (Tester)					
Vse_btsoll	O/V	0... FFFFH	-128... 52300	0.8	°CRK
Cam setpoint for inlet cam via external service device (Tester)					
W_afs	O/V	8000... 7FFFH	-3276.8 ...3276.6	0.1	°
Steering wheel sensor angle					
W_dafs	O/V	8000... 7FFFH	-3276.8 ...3276.6	0.1	°/s
Steering wheel sensor angle velocity					
Zrbosr	O/V	0... FFH	0... 255	1	-
counter_resetting_BOS_resetting					
Ztageabs	O/V	0... FFFFH	0... 65535	1	-
day counter absolute (counts the days at sufficient mains voltage)					

Input data:

AC_VEH_LGT_TCS {p. 1561}	AC_VEH_TRV_TCS {p. 1561}	ANG_PSTE {p. 1561}	B_hschalt_komb {p. 8343}
B_ldm_akt04 {p. 8344}	B_ldm_off {p. 8344}	B_lklps {p. 8344}	B_mol_vb {p. 8344}
B_mol_vl {p. 8344}	B_msaccid2 {p. 8345}	B_msastops {p. 8345}	B_pmbsdanf {p. 8346}
B_pmvsdanf {p. 8346}	B_rschalt_komb {p. 8346}	B_verb_off {p. 8347}	Bosconf {p. 8155}
BRAKE_PRS {p. 1561}	CAM_SP_EX_EXT_ADJ {p. 7431}	CAM_SP_IN_EXT_ADJ {p. 7431}	CONF_SWI_EFP_OUT {p. 654}
CTR_KM_BN {p. 1563}	CTR_KM_CAN {p. 1563}	CTR_RST_BOS_RST {p. 1563}	Ctrcbr {p. 8155}
Ctrpcos {p. 8156}	Ctrprio {p. 8156}	Ctrpriocf {p. 8156}	Ctrpwrcos {p. 8156}
Ctrpwspcos {p. 8156}	CUR_SC_MAX_CAN {p. 1563}	CUR_SC_MIN_CAN {p. 1563}	CUR_WKU_CAN {p. 1563}
DIST_RESI_OIL_KM {p. 8202}	dm_ab_fws {p. 1563}	ECU_STATE {p. 1091}	EFPPWM_CAN {p. 988}
FAC_GB_GAIN {p. 1564}	FAC_IS_INC_REQ {p. 1564}	FAC_POW_MNG_VST_CNS [15] {p. 1564}	FCO {p. 3846}

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FTL {p. 1564}	HEAT_REQ_PERC {p. 1564}	I_ges {p. 8158}	Id_bosmg {p. 8159}
IDX_BAT_CAN {p. 1564}	LAMB_SP_EXT_ADJ [NC_CBK_EX_NR] {p. 7763}	LC_EFPPWM_CTL {p. 1587}	lpm_typ_fp
lpm_typ_mdkw	LV_ACT_ECRAS_EXT_ ADJ {p. 798}	LV_ALTER_CTL_ENA {p. 7680}	LV_ALTER_CTL_EXT_ADJ {p. 7482}
LV_CAM_SP_EX_EXT_ ADJ {p. 7433}	LV_CAM_SP_IN_EXT_ADJ {p. 7433}	LV_CS_2 {p. 1565}	LV_DRIV_BELT_CLOSE {p. 800}
LV_DRIV_DOOR_OPEN {p. 1565}	LV_EF {p. 3614}	LV_GS {p. 1565}	LV_GS_IDC_LDM {p. 1566}
LV_HOOD_OPEN {p. 1566}	LV_IGK_OFF_ACK_ PERM_DEAC {p. 803}	LV_IGK_OFF_ACK_TMP_ DEAC {p. 803}	LV_KEY_AUX {p. 1566}
LV_KEY_VLD {p. 1566}	LV_LDM_ENA {p. 6615}	LV_LTG_GAS_ENA {p. 7680}	LV_LTG_HDLP_L_ON {p. 1566}
LV_LTG_INL_ON {p. 1566}	LV_N_DISP_DYN {p. 1566}	LV_N_REL_CWP_SP_ EXT_ADJ {p. 7434}	LV_N_SP_TCT {p. 1566}
LV_REQ_HEAT {p. 1567}	LV_RLY_ST_CAN {p. 1567}	LV_RNG_L_REQ {p. 6570}	LV_STATE_TRL {p. 1567}
LV_STST_SWI_ACT {p. 805}	LV_TCS_CTL_ACT {p. 1567}	LV_V_ALTER_SP_EXT_ ADJ {p. 7435}	LV_VAR_BN {p. 655}
LV_VAR_DCC {p. 655}	LV_VAR_STST {p. 805}	Md_can_dmee {p. 8160}	Md_max_klima {p. 8160}
Md_rad_ist {p. 8160}	Md_rad_max {p. 8161}	Md_rad_min {p. 8161}	N_dzm {p. 8163}
N_ECF {p. 1568}	N_ECF_CAN {p. 1569}	N_GB {p. 1569}	N_GB_OUT {p. 1569}
N_SP_TCT {p. 1569}	N_WHEEL_FN_LE {p. 806}	N_WHEEL_FN_RI {p. 806}	N_WHEEL_RE_LE {p. 806}
N_WHEEL_RE_RI {p. 806}	NC_CYL_NR {p. 1526}	OPM_EXT_REQ {p. 1763}	PBSU {p. 807}
QOIL_DS_RST_CAN_1_5 {p. 1569}	QOIL_DS_RST_CAN_2_3 {p. 1569}	QOIL_DS_RST_CAN_2_5 {p. 1569}	QOIL_DS_RST_CAN_2_6 {p. 1569}
QOIL_DS_RST_KWP_9 {p. 7682}	Rqpcos {p. 8168}	Selspcos {p. 8168}	Spa_art {p. 8168}
Spa_gang {p. 8168}	St_dsc_mradist {p. 8171}	St_fas_mradist {p. 8171}	St_ldm_kupp {p. 8172}
St_ldstgen {p. 8172}	St_mdinfo_ges {p. 8172}	St_mdrv_anz {p. 8172}	St_mdrv_dsc {p. 8173}
St_mdrv_eng {p. 8173}	St_mdrv_mod_grb {p. 8173}	St_mdrv_stg_grb {p. 8173}	STATE_ACK_IGK_OFF {p. 1570}
STATE_AVL_BOS_RST {p. 1570}	STATE_CC {p. 1571}	STATE_CLU_AMT {p. 1571}	STATE_DI_PUC {p. 1572}
STATE_EGY_MIN_KWP {p. 7483}	STATE_ETCU_CLU {p. 1573}	STATE_ETCU_PROG_ INFO {p. 1574}	STATE_ID_FCT_BOS_RST {p. 1574}

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STATE_ID2_BOS_RST {p. 1574}	STATE_IGK_HW {p. 1575}	STATE_LDM {p. 1575}	STATE_MAX_AC_ST {p. 1575}
STATE_SP_DYN_WHEEL {p. 1576}	STATE_SPT_SWI {p. 1576}	STATE_TCS_CAN {p. 1577}	STATE_TCT_INTV {p. 1578}
STATE_TEMP_GB {p. 1578}	STATE_TQ_WHEEL_DRIV_ASI {p. 809}	STATE_TQ_WHEEL_TCS_SLOW {p. 809}	STATE_VAR_DET_CUS_1 {p. 657}
STATE_VAR_DET_CUS_2 {p. 657}	STATE_VEH_CNS [10] {p. 1578}	Stpcos {p. 8175}	T_AST_BAL {p. 3261}
T_CAN {p. 1579}	T_CLK_ICL_DISP_1 {p. 1579}	T_CLK_ICL_DISP_2 {p. 1579}	T_CLK_ICL_DISP_3 {p. 1579}
TQ_SP_WHEEL {p. 6615}	TQ_TCT_CAN {p. 1582}	TQ_WHEEL_TCS_FAST {p. 810}	TQ_WHEEL_TCS_SLOW {p. 810}
V_ALTER_SP_EXT_ADJ {p. 7438}	VAR_VEH {p. 657}	VEL_ANG_PSTE {p. 1582}	VFF_EFP {p. 989}
VS_H {p. 1176}	WHEEL {p. 1582}		

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_REQ_FSD_EOL	-	0... 1H	0 ...1	1	-
Switch for external adjustment of fuel-system diagnosis					

R.32.1 Outputs for BMW functions which are exported data from IGR (Intelligente Generatorreglung)

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions:

Initialisations: first calculation at reset,
Except: Verbstatus[10] : 0
0 at reset:
Mdk_kupp_verl, St_dkg_schalt, N_schalt_dkg, B_schalt_dkg, St_kupp_dkg, St_rennstart_dkg, St_modus_dkg, Tn_start_kl15
0 at power latch phase:
Mdk_kupp_verl, St_dkg, N_schalt_dkg, B_schalt_dkg, St_kupp_dkg, St_rennstart_dkg, St_modus_dkg, Tn_start_kl15

Recurrence : 100 ms: B_cdigronw, B_cdxenonw, B_diagigr, B_fe, B_fetrawedeak, B_tra, B_we, Fetrawe, Verbstatus[10], Tn_start_kl15
20ms: St_rennstart_dkg

10ms: Mdk_kupp_verl, St_dkg, N_schalt_dkg, B_schalt_dkg,

St_kupp_dkg, St_modus_dkg

Activation: *At every ECU state (including WakeUp)*
Deactivation: *After power latch phase*

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Formula section:

Remark: all formulas are valid in a **physical** meaning

Verbstatus[10] = STATE_VEH_CNS[10]
B_cdigronw = LV_ALTER_CTL_ENA
B_cdxenonw = LV_LTG_GAS_ENA
B_diagigr = LV_ALTER_CTL_EXT_ADJ
Fetrawe = STATE_EGY_MIN_KWP

If STATE_EGY_MIN_KWP = "PASSIV"
Then B_fetrawedeak = 1
Else B_fetrawedeak = 0
Endif
If STATE_EGY_MIN_KWP = "EGY_1"
Then B_fe = 1
Else B_fe = 0
Endif
If STATE_EGY_MIN_KWP = "EGY_2"
Then B_tra = 1
Else B_tra = 0
Endif
If STATE_EGY_MIN_KWP = "EGY_3"
Then B_we = 1
Else B_we = 0
Endif
Mdk_kupp_verl = TQ_TCT_CAN
N_schalt_dkg = N_SP_TCT
B_schalt_dkg = LV_N_SP_TCT
St_kupp_dkg = STATE_ETCU_CLU
St_rennstart_dkg = STATE_MAX_AC_ST
St_modus_dkg = STATE_TCT_INTV
Tn_start_kl15 = T_AST_BAL

R.32.2 VVTI interface adaptation

FUNCTION DESCRIPTION:

Adaption to BMW environment.
Remark: The really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions

Initialisation at reset: 0, except : *Vse_btsoll = 0 °crk*
Vsa_btsoll = 0 °crk

Recurrence: 100ms: Pbrems
10 ms: all other variables

Activation: *at every engine operating state*

Deactivation: – –

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Formula section:

If ECU_STATE = "PWL" then
Vse_btsoll = 0 °crk
Vsa_btsoll = 0 °crk
B_btvse = 0
B_btvsa = 0
elseif
Inlet CAM: Vse_btsoll = CAM_SP_IN_EXT_ADJ
B_btvse = LV_CAM_SP_IN_EXT_ADJ
Exhaust CAM: Vsa_btsoll = CAM_SP_EX_EXT_ADJ
B_btvsa = LV_CAM_SP_EX_EXT_ADJ

brake pressure: Pbrems = BRAKE_PRS
endif

R.32.3 CAN interface adaptation - Outputs to BMW- environment

FUNCTION DESCRIPTION:

Adaption to BMW environment.

Application conditions:

Initialisation at reset or at exit power latch phase:

0: B_dscakt, B_dzm_dyn, B_gangwechsel_gs, B_keinhs_gs, B_hz, B_iliactiv, B_abliactiv,Qs_anf_klima, Ztageabs, B_ckl50, B_ckl30, B_ldm_nofil, B_nosa, Acfzgq, Acfzgl, I_eff_gs, T_jahr, T_monate, T_tag, Md_rad_soll, Nelueft_klima, Nelueft_lenk, St_wk, N_idlms, Bosrlsmr B_ldm_ena, B_gen_ext, V_can, A_quer, B_tstkvs, St_fzg_ass, Kvaverbr, B_egs_khl1, B_egs_khl2, Bosv, Nturb, B_anhang, St_kupp_smg, V_krapu,Bosanfsgbd, Bosun, Bosunt , B_taleer, Dm_ab_fws, Ipm_typ_fp, Ipm_typ_mdkw, Baw_tester, Md_kupp_schalt, N_rad_hl, N_rad_hr, N_rad_vl, N_rad_vr, St_dsc_mradsoll, St_fas_mradsoll, N_ab_m, B_schalt_ldm, B_fagurt, St_dsc_can, B_msadltgpd, B_msadltgtd, Prg_getr, V_rad, St_mdrv_taster

1: B_lklps_kl1, B_lklps_kl2,

1.0: La_soll_tester[NC_CBK_EX_NR]

32000 Nm: Md_rad_asrl, Md_rad_asrs

-32000 Nm: Md_rad_msrl, Md_rad_msrs

Ikurz_ogr = value out of non-volatile memory after reset
Ikurz_ugr = value out of non-volatile memory after reset
Iwakeupgr = value out of non-volatile memory after reset
Bosfxid2r = value out of non-volatile memory after reset
Bosid2r = value out of non-volatile memory after reset
Bosprog2r = value out of non-volatile memory after reset
Bosrw2r = value out of non-volatile memory after reset
Km_st_1 = value out of non-volatile memory after reset
Bosjzielr = value out of non-volatile memory after reset
Bosmzielr = value out of non-volatile memory after reset
Batt_class = value out of non-volatile memory after reset
U_gen_ext = first calculated value

Pmsv[15] = FAC_POW_MNG_VST_CNS[15] *//from non volatile memory*

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if LV_VAR_BN = 1
then Bordnetz = 2
else Bordnetz = 1
endif

special values at power latch phase:

0: B_dscakt, B_dzm_dyn, _gangwechsel_gs, B_keinhs_gs, B_hz, I_eff_gs, Md_rad_soll, Nelueft_klima, St_wk, A_quer, B_taleer, B_tstkvs, B_ldm_nofil, B_nosa, Bosrlsmr, V_krapu, Nturb, Baw_tester, Md_kupp_schalt, N_rad_hl, N_rad_hr, N_rad_vl, N_rad_vr, St_dsc_mradsoll, St_fas_mradsoll, N_ab_m, B_msadltgpd, B_msadltgtd, Prg_getr

1: B_lklps_kl1, B_lklps_kl2, B_fagurt, St_dsc_can

last valid value: B_gen_ext, U_gen_ext

last calculated value: Acfzgl, Acfzgq

Continue calc.: St_mdrv_taster

1.0: La_soll_tester[NC_CBK_EX_NR]

32000 Nm: Md_rad_asrl, Md_rad_asrs

-32000 Nm: Md_rad_msrl, Md_rad_msrs

Recurrence: **1000ms**: Bosv, Qs_anf_klima, Ztageabs, Acfzgq, Acfzgl, Bosfxid2r, Bosid2r, Bosprog2r, Km_st_1, Bosjzielr, Bosmzielr, Bosrw2r, T_jahr, T_monate, T_tag, B_anhang, Bosrlsmr, Zrbosr, Bosun

Bosunt

200ms : B_hz , Km_st, Kvaverbr,B_lklps_kl1, B_lklps_kl2

100ms : B_dscakt, Ikurz_ogr, Ikurz_ugr, Iwakeupgr, Batt_class, B_iliactiv,B_abliactiv, B_ckl50, Nelueft_klima, Nelueft_lenk, B_gen_ext, U_gen_ext, B_taleer, B_tstkvs, Ikurz_ogr, Ikurz_ugr, Iwakeupgr, N_idlms, Prg_getr

10ms: B_dzm_dyn, B_gangwechsel_gs, B_keinhs_gs, B_egs_khl1, B_egs_khl2, Pmsv[15], B_ldm_nofil, B_nosa, I_eff_gs, Md_rad_soll, V_krapu, Nturb, St_wk, B_ldm_ena, V_can, A_quer, St_fzg_ass, St_kupp_smg, La_soll_tester[NC_CBK_EX_NR], Baw_tester, Dm_ab_fws, Ipm_typ_fp, Ipm_typ_mdkw, Md_rad_asrl, Md_rad_asrs, Md_rad_msrl, Md_rad_msrs, N_ab_m, N_rad_hl, N_rad_hr, N_rad_vl, N_rad_vr, St_dsc_mradsoll, St_fas_mradsoll, B_schalt_ldm, B_fagurt, St_dsc_can, B_msadltgpd, B_msadltgtd, V_rad, St_mdrv_taster

Note: B_hz has to be updated directly after LV_REQ_HEAT has been calculated.

Activation: After reset
Deactivation: After power latch phase

Formula section:

Prg_getr = STATE_ETCU_PROG_INFO
B_msadltgpd = LV_IGK_OFF_ACK_PERM_DEAC
B_msadltgtd = LV_IGK_OFF_ACK_TMP_DEAC
B_dscakt = LV_TCS_CTL_ACT
B_dzm_dyn = LV_N_DISP_DYN
B_fagurt = LV_DRIV_BELT_CLOSE
B_gangwechsel_gs = LV_GS
B_hz = LV_REQ_HEAT

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B_keinhs_gs = 0
Km_st = CTR_KM_CAN (update every 200ms)
Kvaverbr = FCO (low word)
Md_rad_asrl = TQ_WHEEL_TCS_SLOW
Md_rad_asrs = TQ_WHEEL_TCS_FAST
Md_rad_msrl = TQ_WHEEL_TCS_SLOW
Md_rad_msrs = TQ_WHEEL_TCS_FAST
N_ab_m = N_GB_OUT
N_rad_hl = N_WHEEL_RE_LE
N_rad_hr = N_WHEEL_RE_RI
N_rad_vl = N_WHEEL_FN_LE
N_rad_vr = N_WHEEL_FN_RI
St_dsc_mradsoll = STATE_TQ_WHEEL_TCS_SLOW
St_fas_mradsoll = STATE_TQ_WHEEL_DRIV_ASI
If STATE_SPT_SWI == 1
Then St_mdrv_taster = 2H
Else St_mdrv_taster = STATE_SPT_SWI
Endif

B_iliactiv = LV_LTG_INL_ON
B_abliactiv = LV_LTG_HDLP_L_ON
Zrbosr = CTR_RST_BOS_RST
if STATE_TEMP_GB = 1H
then B_egs_khl1 = 1
else B_egs_khl1 = 0
endif
if STATE_TEMP_GB = 2H
then B_egs_khl2 = 1
else B_egs_khl2 = 0
endif
if LV_VAR_BN = 1
then Bosv = STATE_AVL_BOS_RST
else Bosv = 0
endif
Qs_anf_klima = HEAT_REQ_PERC
Nturb = N_GB
B_anhang = LV_STATE_TRL
Pmsv[15] = FAC_POW_MNG_VST_CNS[15]
Ztageabs = T_CAN
B_ckl50 = LV_RLY_ST_CAN
B_ckl30 = LV_KEY_AUX
If Bit 1 or Bit 2 of STATE_SP_DYN_WHEEL is set to 1
then B_ldm_nofil = 1
else B_ldm_nofil = 0
endif
If STATE_DI_PUC = 1
then B_nosa = 1
else B_nosa = 0
endif
Acfzgl = AC_VEH_LGT_TCS
Acfzgq = AC_VEH_TRV_TCS
Bosfxid2r = QOIL_DS_RST_CAN_2_2

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Bosid2r = QOIL_DS_RST_CAN_2_1
Bosrw2r = QOIL_DS_RST_CAN_2_3
I_eff_gs = FAC_GB_GAIN
Km_st_1 = CTR_KM_BN
Bosjzielr = QOIL_DS_RST_CAN_2_5
Bosmzielr = QOIL_DS_RST_CAN_2_4
Bosprog2r = QOIL_DS_RST_CAN_2_6
T_jahr = T_CLK_ICL_DISP_3
T_monate = T_CLK_ICL_DISP_2
T_tag = T_CLK_ICL_DISP_1
Md_rad_soll = TQ_SP_WHEEL

Nelueft_klima = (N_ECF/14) * 100%
Nelueft_lenk = N_ECF_CAN
St_wk = STATE_CC
Bosrlsmr = QOIL_DS_RST_CAN_1_5
B_ldm_ena = LV_LDM_ENA
B_gen_ext = LV_V_ALTER_SP_EXT_ADJ
V_can = VS_H
A_quer = AC_VEH_TRV_TCS
U_gen_ext = V_ALTER_SP_EXT_ADJ
B_tstkvs = LC_REQ_FSD_EOL
B_lklps_kl1 = 1
B_lklps_kl2 = 1
Batt_class = IDX_BAT_CAN
Ikurz_ogr = CUR_SC_MAX_CAN
Ikurz_ugr = CUR_SC_MIN_CAN
Iwakeupgr = CUR_WKU_CAN
Id_bosrtw = STATE_ID_FCT_BOS_RST
Id_bosrst = STATE_ID2_BOS_RST
N_idlms = FAC_IS_INC_REQ
St_fzg_ass = STATE_LDM
St_kupp_smg = STATE_CLU_AMT

Bosun = DIST_RESI_OIL_KM
Bosunt = QOIL_DS_RST_KWP_9

```
//      V_krapu    =  RQAM_FU,  because RQAM_FU is not exported from CAN-spec. use:
If(1)       LV_VAR_BN = 1
Then(1)
            // for  BN200=, taken from 17400J03.00x:
  If               CONF_SWI_EFP_OUT        =       !1
  Then
            If               LC_EFPPWM_CTL = 0
               Then               V_krapu       =       VFF_EFP
               Else       V_krapu       =        EFPPWM_CAN
  Endif
Else(1)
            // for CAN11, taken from 17400J02.00x:
            V_krapu       = VFF_EFP
Endif(1)
```

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Dm_ab_fws = dm_ab_fws
Ipm_typ_fp = ipm_typ_fp
Ipm_typ_mdkw = ipm_typ_mdkw
La_soll_tester[NC_CBK_EX_NR] = LAMB_SP_EXT_ADJ[NC_CBK_EX_NR]
Baw_tester = OPM_EXT_REQ

if (LV_FTL_CAN_ERR==0 **and** LV_FTL_OBD_INH_L==1)
then B_taleer = 1
else B_taleer = 0
endif

B_schalt_ldm = LV_GS_IDC_LDM
St_dsc_can = STATE_TCS_CAN
V_rad = WHEEL

R.32.4 CAN interface adaptation - Inputs from BMW- environment

FUNCTION DESCRIPTION:

Adaption to BMW- environment

Application conditions

Initialisation: 0
Except:
st_ldstgen = 2

Recurrence: 100 ms except:
1000 ms: idfbosmg_w, LV_OIL_CNS_WARN_1, LV_OIL_CNS_WARN_2
10 ms: St_mdinfo_ges, TQ_WHEEL, TQ_MAX_WHEEL, TQ_MIN_WHEEL_L, STATE_ENGG_POS, LV_LDM_OFF, LV_GS_UP, LV_GS_DOWN, LV_LDM_DRIV_ACT, GR_DT, STATE_TQ_WHEEL, TQ_MAX_ACC, STATE_TQ_WHEEL_DRIV_ASI_AV, STATE_TQ_WHEEL_TCS_AV, LV_INH_STST_CDN GS_IDC_GEAR_RAW, GS_IDC_DISP_RAW, TQ_ECU_ETCU, N_DISP_DYN, LV_STST_STOP, STATE_SPT_DISP_CAN, STATE_SPT_ESP_CAN, STATE_SPT_ECU_CAN, STATE_SPT_MOD_GB, STATE_SPT_STEP_GB

Activation: After reset
Except:
0 : St_mdinfo_ges, TQ_WHEEL, TQ_MAX_WHEEL, TQ_MIN_WHEEL_L, STATE_ENGG_POS
Value at PWL
0: LV_LDM_OFF, LV_GS_UP, LV_GS_DOWN, LV_LDM_DRIV_ACT, GR_DT, STATE_TQ_WHEEL
GS_IDC_GEAR_RAW, GS_IDC_DISP_RAW, TQ_ECU_ETCU
Last calculated value: LV_OIL_CNS_WARN_1, LV_OIL_CNS_WARN_2
ECU_STATE = WAKE_UP:
Continue calc.: STATE_SPT_DISP_CAN, STATE_SPT_ESP_CAN, STATE_SPT_ECU_CAN, STATE_SPT_MOD_GB, STATE_SPT_STEP_GB

Deactivation: *After power latch phase*

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Formula section:

All formulas are valid in a physical meaning!

TQ_MAX_ACC = Md_max_klima
LV_OIL_CNS_WARN_1 = B_mol_vb
LV_OIL_CNS_WARN_2 = B_mol_vl
CUR_RNG_CTL = Ctrcbr
POW_CTL_PARK_CNS = Ctrpcos
POW_CTL_PRI_PEAK_RED = Ctrprio
POW_CTL_PRI_PEAK_RED_CFT = Ctrpriocf
POW_CTL_PWR_CNS_1 = Ctrpwrcos
POW_CTL_PWR_CNS_2 = Ctrpwspcos
idfbosmg_w = Id_bosmg
rqpcos = Rqpcos
selspcos = Selspcos
stpcos = Stpcos
st_ldstgen = St_ldstgen

IF B_verb_off = 1
THEN STATE_EGY_CNS_OFF = 1
ELSE STATE_EGY_CNS_OFF = 0
ENDIF

TQ_WHEEL = Md_rad_ist
STATE_TQ_WHEEL = St_mdinfo_ges
TQ_MAX_WHEEL = Md_rad_max
TQ_MIN_WHEEL_L = Md_rad_min
STATE_ENGG_POS = St_ldm_kupp
If(1) St_mdrv_anz = 1 /* If Sport switch is inactive */
Then(1) STATE_SPT_DISP_CAN = 0 /* Set M-Drive display to OFF */
Else(1)
 If(2) St_mdrv_anz = 2 /* If Sport switch is active */
 Then(2) STATE_SPT_DISP_CAN = 1 /* Set M-Drive display to ON */
 Else(2) STATE_SPT_DISP_CAN = 3 /* Else set no value for "not valid" */
 Endif(2)
Endif(1)

STATE_SPT_ESP_CAN = St_mdrv_dsc
STATE_SPT_ECU_CAN = St_mdrv_eng
STATE_SPT_MOD_GB = St_mdrv_mod_grb
STATE_SPT_STEP_GB = St_mdrv_stg_grb

If B_pmvsdanf = 1
Then LV_CAN_SND_MSG_PWR_MNG_0 = B_pmvsdanf
endif

//check if transition in STATE_ACK_IGK_OFF, if yes set LV_CAN_SND_.._1 = 1 for 3 recurrencies (300ms):
If STATE_ACK_IGK_OFF 0->1
or STATE_IGK_HW 2->0
or STATE_IGK_HW 1->0
or STATE_IGK_HW 1->2

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Then *counter_ack* = 3
Else *counter_ack* = *counter_ack* -1
Endif

If B_pmbsdanf = 1 **or** *counter_ack* $>$ 0
Then LV_CAN_SND_MSG_PWR_MNG_1 = 1
Endif

LV_LDM_OFF = B_ldm_off
If LV_VAR_DCC = 1 **or** (B_hschalt_komb = 1 **and** B_rschalt_komb = 1)
Then LV_GS_UP = 0
Else LV_GS_UP = B_hschalt_komb
Endif

If LV_VAR_DCC = 1 **or**
(B_hschalt_komb = 1 **and**
B_rschalt_komb = 1)
Then LV_GS_DOWN = 0
Else LV_GS_DOWN = B_rschalt_komb
Endif

LV_LDM_DRIV_ACT = B_ldm_akt04
GR_DT = I_ges
STATE_TQ_WHEEL_TCS_AV = St_dsc_mradist
STATE_TQ_WHEEL_DRIV_ASI_AV = St_fas_mradist
LV_INH_STST_CDN = B_msaccid2

GS_IDC_GEAR_RAW = Spa_gang
GS_IDC_DISP_RAW = Spa_art
TQ_ECU_ETCU = Md_can_dmee (conversion!)
N_DISP_DYN = N_dzm
LV_STST_STOP = B_msastops

R.32.5 Common variables adaptation

FUNCTION DESCRIPTION:

Adaption to BMW environment.

General information:

The variable Fahrzeug is updated only during ECU initialization.

Application conditions:

Initialisation at reset:

IF VAR_VEH = 1 **THEN** Fahrzeug = 65
IF VAR_VEH = 2 **THEN** Fahrzeug = 90
IF VAR_VEH = 3
THEN Fahrzeug = 46
ELSE Fahrzeug = 60
ENDIF

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Recurrence:
Activation: at every engine operating state

Deactivation: -

Formula section:

R.32.6 Outputs for BMW functions which are defined as MISC exported data

R.32.6.1 Import Actions

#if (NC_CYL_NR = 4)
ACTION_INFR_GetPwmNgs(OUT <pwm_neut_psn_gb>)
This action reads the PWM value of the PLCD-Sensor (NGS)
#endif

Application conditions:

Initialisation at reset: 0
except first calculation B_msafzg = LV_VAR_STST,
First calculation: B_sport_schalter

Recurrence: 10ms
Activation: every engine state

Deactivation: -

Special values at PWL:
Last calc. value: B_sport_schalter

Formula section:

B_kupp1 = LV_CS_2
B_msafzg = LV_VAR_STST
B_sport_schalter = LV_RNG_L_REQ
St_fzg_1 = STATE_VAR_DET_CUS_1
St_fzg_2 = STATE_VAR_DET_CUS_2
if ECU_STATE = PWL
then
Tvngang = 0
Elseif
B_abgasklappe = not(LV_EF)
Voltank = FTL
W_afs = ANG_PSTE
W_dafs = VEL_ANG_PSTE
B_ftauf1 = LV_DRIV_DOOR_OPEN
B_mhauf1 = LV_HOOD_OPEN
B_msataster = LV_STST_SWI_ACT
Pbremsu = PBSU
If NC_CYL_NR = 4
then

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```
        ACTION_INFR_GetPwmNgs(PWM_NEUT_PSN_GB)
         Tvngang          = PWM_NEUT_PSN_GB
    else          PWM_NEUT_PSN_GB = 0
         Tvngang          = 0
    endif

endif
```

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R.33 Customer adaptation module: KNCK

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_clradkr	O/V	0... 1H	0 ...1	1	-
Reset of the stored knock adaption value by service tool					
B_klopfen	O/V	0... 1H	0 ...1	1	-
Knock event					
B_krakt	O/V	0... 1H	0 ...1	1	-
Knock control activation (=0 inactive; 1=active)					
B_krdws	O/V	0... 1H	0 ...1	1	-
Max sprark retard for knock control limb home value active (=0 inactive; 1=active)					
B_krndy	O/V	0... 1H	0 ...1	1	-
Condition engine speed dynamic for knkock control					
B_warml_zykl	O/V	0... 1H	0 ...1	1	-
Warmlaufzyklus abgeschlossen					
B_zwkraa	O/V	0... 1H	0 ...1	1	-
Spark retard caused by torque request activ (0=active; 1=incative)					
Dzw_kr [NC_CYL_NR]	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
spark retard due to knock control					
Dzw_mkr	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Spark retard by knock control without adaptation (average value)					
IGA_IS_TQ_KNK	O/V	0... 80H	-48 ...0	0.375	°CRK
Torgue reserve for knockcontrol in idle speed					
IGA_MV_ADJ_KNK_CUS	O/V	0... 80H	-48 ...0	0.375	°CRK
Mean spark retard of knock control incl. knock- and fuel quality adaptation by customer					
IGA_MV_ADJ_KNK_RON	O/V	FE0C... 258H	-50 ...60	0.1	°CRK
Mean spark retard of knock control incl. knock- and fuel quality adaptation for RON quantification.					
LV_AD_CLR_RON	V	0... 1H	0 ...1	1	-
toggle bit for reseting of RON-adaption value					
LV_IGA_TRA_KNK	O/V	0... 1H	0 ...1	1	-
Flag for instationary correction active					
St_knk	O/V	0... FFH	0... 255	1	-
Injection shut off by knock pre-ignition					
Zyl_akt	O/V	0... FFH	0... 255	1	-
Spark retard by knock					

Input data:

B_zwdyn {p. 8348}	CYL_ID_KNK {p. 1960}	Dzw_annm {p. 8156}	Dzw_krkorll {p. 8156}
ECU_STATE {p. 1091}	IGA_BAS_COR {p. 8266}	IGA_IGC_H_RNG [NC_CYL_NR] {p. 1876}	IGA_KNK [NC_CYL_NR] {p. 1960}
IGA_MV_KNK {p. 1960}	INH_IV_KNK {p. 1960}	KNK_CTL_DIS {p. 1952}	LC_AD_CLR_RON {p. 527}
LV_KNK {p. 1961}	LV_KNK_CTL_ENA {p. 1961}	LV_KNK_TRA_N {p. 1962}	LV_TQ_IGA_ACT {p. 1948}
LV_WUP_CYC {p. 5746}	NC_CYL_NR {p. 1526}	OPM_AV {p. 8137}	

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_IGA_DELTA_KNK_AD_ENA	-	0... FFH	-48... 47.625	0.375	°CRK
delta ignition angle for activation of knock adaptation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LC_AD_IS_AFL_ACT	-	0... 1H	0 ...1	1	-
KRAAN-adaption in engine operation mode "AFL" (0 - disable, 1 - enable)					

R.33.1 Outputs for BMW functions which are defined as KNOCK exported data

FUNCTION DESCRIPTION:

Adaption to BMW environment.
Remark: The really possible resolution and limits of the output are different to the specified values due to the input data attributes.

Application conditions:

Initialisation at reset or at exit power latch phase:
all output variables are initialized with 0hex
Recurrence: 10ms: B_krakt, B_krdws, B_krndy, B_warml_zykl, B_zwkraa, St_knk
every segment: B_klopfen, Zyl_akt, Dzw_mkr
the whole if-clause arround the calculation of
Dzw_kr[NC_CYL_NR]
Activation: at every engine state
Deactivation: - –

Formula section:

Remark: all formulas are valid in a **physical** meaning

if (LC_AD_CLR_RON 0 -> 1 **or** LC_AD_CLR 0 -> 1
or tester request "alle Adaptionswerte löschen"
or tester request "RON adaption löschen")
then $LV\_AD\_CLR\_RON_n$ = **1**
endif
B_cladkr = LV_AD_CLR_RON
B_warml_zykl = LV_WUP_CYC
If ECU_STATE = "PWL"
Then
Dzw_mkr = 0
Zyl_akt = 0
Dzw_kr[NC_CYL_NR] = 0
B_krdws = 0
B_krndy = 0
B_zwkraa = 0
B_klopfen = 0
St_knk = 0
Elseif
Dzw_mkr = IGA_MV_KNK
if (0) CYL_ID_KNK = 0
then (0) Dzw_kr[1] = IGA_KNK[1]
else (0) **if** (1) CYL_ID_KNK = 1
then (1) Dzw_kr[2] = IGA_KNK[2]
else (1) **if** (2)CYL_ID_KNK = 2

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```
                              then (2) Dzw_kr[3] = IGA_KNK[3]
                              else (2)          if  (3) CYL_ID_KNK = 3
                                      then (3)  Dzw_kr[4] = IGA_KNK[4]
                                      else (3)          if  (4) CYL_ID_KNK = 4
                                             then (4)  Dzw_kr[5] = IGA_KNK[5]
                                             else (4)   Dzw_kr[6] = IGA_KNK[6]
                                             endif (4)
                                      endif (3)
                              endif (2)
                     endif (1)
    endif (0)

    B_krakt              =      LV_KNK_CTL_ENA
    B_krdws              =      KNK_CTL_DIS
    B_krndy              =      LV_KNK_TRA_N
    Zyl_akt              =      CYL_ID_KNK
    B_klopfen            =      LV_KNK
    St_knk               =      INH_IV_KNK
       If        LV_TQ_IGA_ACT=0
                 or         ( OPM_AV = "AFS"
                  and  (         ((IGA_BAS_COR - C_IGA_DELTA_KNK_AD_ENA)
                                ≤ (IGA_IGC_H_RNG[0] - IGA_KNK[0]))
                or  ((IGA_BAS_COR - C_IGA_DELTA_KNK_AD_ENA)
                              ≤ (IGA_IGC_H_RNG[1] - IGA_KNK[1]))
                        ...
             or  ((IGA_BAS_COR - C_IGA_DELTA_KNK_AD_ENA)
                              ≤ (IGA_IGC_H_RNG[NC_CYL_NR-1]- IGA_KNK[NC_CYL_NR-1])
                       )
                   )
             or          ( OPM_AV = "AFL"   and LC_AD_IS_AFL_ACT=1 )
     Then        B_zwkraa = 1
     Else        B_zwkraa = 0
     Endif

Endif
```

R.33.2 Outputs for supplier aggregates

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Recurrence: *10 ms*
Activation: *every engine state*

Formula section:

LV_IGA_TRA_KNK = B_zwdyn
IGA_IS_TQ_KNK = Dzw_krkorll
IGA_MV_ADJ_KNK_CUS = Dzw_annm

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IGA_MV_ADJ_KNK_RON = Dzw_annm *// same range and resolution as BMW variable*

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R.34 Customer adaptation module: LACO

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_lrad_akt1	O	0... 1H	0 ...1	1	-
Bit indicating KLANN Bk1 shall be activated (STATE_LAM_AD[1] == "FAC_L")					
B_lrad_akt2	O	0... 1H	0 ...1	1	-
Bit indicating KLANN Bk2 shall be activated (STATE_LAM_AD[2] == "FAC_L")					
B_lrad_deak1	O	0... 1H	0 ...1	1	-
Bit indicating KLANN Bk1 shall be deactivated due to an error					
B_lrad_deak2	O	0... 1H	0 ...1	1	-
Bit indicating KLANN Bk2 shall be deactivated due to an error					
B_zwgemad_1	O	0... 1H	0 ...1	1	-
Zwangsgemischadaption Bank 1					
B_zwgemad_2	O	0... 1H	0 ...1	1	-
Zwangsgemischadaption Bank 2					
CTR_KM_CAN_OLD	V	0... FFFFH	0... 655350	10	km
Last vehicle kilometer update					
CTR_KM_DELTA_LAM_ADJ_LAM_AD_CUS	V/S	0... FFFFH	0... 655350	10	km
Vehicle kilometer diff. between current value and the one for the last long term adaptation					
CTR_KM_LAM_ADJ_LAM_AD_CUS	V/S	0... FFFFH	0... 655350	10	km
Vehicle kilometer at the last long term customer lambda adaptation stored in NVMY					
CTR_LAM_ADJ_LAM_AD_CUS	V/S	0... FFH	0... 255	1	-
Current number of long term adaptations carried out					
EGY_LAM_ADJ_COR_LAM_AD_CUS [NC_CYL_NR]	O/V	8000... 7FFFH	-127.5019 ...127.49805	3.89105e-3	mJ
Energy value of the Long term customer Lambda Adaption					
ERR_SYM_LAM_AD_CUS [NC_CBK_EX_NR]	O/V	0... 8H	0 ...8	1	-
Detected symptom of the diagnosis for the long term adaptation					
F_LAKOR [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-100... 99.9969482422	3.05176e-3	%
Factor for the injection time correction					
F_lrad_in1	O	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lambda Adaption initial value (Bank 1)					
F_lrad_in2	O	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lambda Adaption initial value (Bank 2)					
FAC_LAM_AD_CUS [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Lambda Adaption carried out by customer (multiplicative share)					
FAC_LAM_AD_CUS_SHIFT [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Output value for shift of Lambda adaptation due to customer function					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_LAM_ADJ_COR_LAM_AD_CUS [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Long term customer Lambda Adaption (multiplicative share) via fuel mass setpoint					
FAC_LAM_ADJ_LAM_AD_CUS [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Long term customer Lambda Adaption (multiplicative share)					
FAC_LAM_ADJ_LIM_LAM_AD_CUS [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Long term customer Lambda Adaption (multiplicative share) limited					
FAC_LAM_ADJ_MAX_LAM_AD_CUS [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Maximun value from the Lambda Adaptation as input to Long term customer Lambda Adaption					
FAC_LAM_ADJ_ST_LAM_AD_CUS [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Long term customer Lambda Adaption during engine start (multiplicative share)					
FAC_LAM_ADJ_TMP_LAM_AD_CUS [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Temporary value of the Long term customer Lambda Adaption (multiplicative share)					
FAC_LAM_CYL_SEL_LAM_AD_CUS [NC_CYL_NR]	V/S	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Cylinder individual long term customer Lambda Adaption (multiplicative share)					
FAC_LAM_TMP_ST_LAM_AD_CUS [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Temporary value of the Long term customer Lambda Adaption for the engine start(multiplicative share)					
FAC_LAM_UPD_LAM_AD_CUS [NC_CBK_EX_NR]	V	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
New update value to the Long term customer Lambda Adaption					
LV_CDN_DIAG_LAM_AD_CUS [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Condition of the diagnosis for the long term adaptation fullfiled					
LV_END_DIAG_LAM_AD_CUS [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
End of the diagnosis for the long term adaptation					
LV_ERR_LAM_AD_CUS [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag that indicates that the long term adaptation exceeds its limits					
LV_FAC_LAM_AD_CUS_SHIFT [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag to request shift of Lambda adaptation due to customer function					
LV_FAC_LIM_MAX_LAM_AD_CUS [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flag indicating that the customer lambda adaptation is over the max threshold					
LV_FAC_LIM_MIN_LAM_AD_CUS [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
Flga indicating that the customer lambda adaptation is under the min threshold					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LV_INH_LSCL_CUS [NC_CBK_EX_NR]	O/V	0... 1H	0 ...1	1	-
-					
LV_LAM_ADJ_LAM_AD_CUS_ENA	V	0... 1H	0 ...1	1	-
Conditions to carriy out the long term adaptations are fullfiled					

Input data:

B_la_stopp1 {p. 8344}	B_la_stopp2 {p. 8344}	B_lradap1_mn {p. 8344}	B_lradap1_mx {p. 8344}
B_lradap2_mn {p. 8344}	B_lradap2_mx {p. 8344}	CTR_KM_CAN {p. 1563}	ERR_INH_LAM_AD_ACT [NC_CBK_EX_NR] {p. 1014}
F_lradap1 {p. 8157}	F_lradap2 {p. 8157}	FAC_L_RNG_LAM_AD [NC_CBK_EX_NR] {p. 2641}	FAC_LAM_LIM_FIL [NC_CBK_EX_NR] {p. 1014}
FAC_LAM_MV_MMV [NC_CBK_EX_NR] {p. 2462}	FAC_LAM_PCTL_CUS [NC_CBK_EX_NR] {p. 1014}	Klann_mw1 {p. 8159}	Klann_mw2 {p. 8159}
Klann_test1 {p. 8159}	Klann_test2 {p. 8159}	LC_AD_CLR_LONG_LAM_ 1 {p. 527}	LC_AD_CLR_LONG_LAM_ 2 {p. 527}
LV_AD_CLR_LONG_LAM_ EXT_ADJ [NC_CBK_EX_NR] {p. 7482}	LV_FAC_LAM_AD_SHIFT_ END [NC_CBK_EX_NR] {p. 2642}	LV_LAM_AD_DEAC_ERR [NC_CBK_EX_NR] {p. 2721}	LV_LAM_AD_EXT {p. 1016}
LV_LAM_LIM_LAM_AD [NC_CBK_EX_NR] {p. 6141}	LV_PWL {p. 988}	LV_ST {p. 1720}	LV_ST_END {p. 1720}
NC_CBK_EX_NR {p. 1829}	NC_CYL_NR {p. 1526}	NC_LAMB_REF [NC_CYL_NR] {p. 812}	STATE_IV_CHG {p. 7683}
STATE_LAM_AD [NC_CBK_EX_NR] {p. 2643}	TCO_ST {p. 1100}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_ABC_DEC_LAM_AD_CUS	-	0... FFH	0... 255	1	-
Anti bounce counter increment of the diagnosis for the long term adaptation					
C_ABC_INC_LAM_AD_CUS	-	0... FFH	0... 255	1	-
Anti bounce counter increment of the diagnosis for the long term adaptation					
C_ABC_MAX_LAM_AD_CUS	-	0... FFH	0... 255	1	-
Anti bounce counter increment of the diagnosis for the long term adaptation					
C_CRLC_LAM_ADJ_LAM_AD_CUS	-	0... FFH	0 ...1	3.92157e-3	-
Correlation constant for the long term adaptation					
C_CRLC_LAM_ADJ_MAX_LAM_AD_CUS	-	0... FFH	0 ...1	3.92157e-3	-
Correlation constant to calculate the maximun input to the long term adaptation					
C_CTR_KM_THD_LAM_AD_CUS	-	0... FFFFH	0... 655350	10	km
Distance to carry out next long term customer lambda adaptation					
C_CTR_MAX_LAM_ADJ_LAM_AD_CUS	-	0... FFH	0... 255	1	-
Number of maximum allowed long term adaptations (if LC_CTR_MAX_LAM_ADJ_LAM_AD_CUS = 1)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_EGY_LAM_ADJ_LAM_AD_CUS	-	0... FFFFH	0... 255	3.89105e-3	mJ
Conversion factor for the long term adaptation from % MFF to mJ					
C_FAC_LAM_ADJ_MAX_LAM_AD_CUS	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Maximun limit of the long term customer lambda adaptation					
C_FAC_LAM_ADJ_MIN_LAM_AD_CUS	-	8000... 7FFFH	-50... 49.9984741211	1.52588e-3	%
Minimun limit of the long term customer lambda adaptation					
C_FAC_LAM_ADJ_ST_MAX_LAM_AD_CUS	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Maximun limit of the long term customer lambda adaptation during engine start					
C_FAC_LAM_ADJ_ST_MIN_LAM_AD_CUS	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Minimun limit of the long term customer lambda adaptation during engine start					
C_FAC_LAM_ERR_MAX_LAM_AD_CUS	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Upper threshold value of the long term customer lambda adaptation for the diagnosis					
C_FAC_LAM_ERR_MIN_LAM_AD_CUS	-	8000... 7FFFH	-50... 49.99847412	1.52588e-3	%
Lower threshold value of the long term customer lambda adaptation for the diagnosis					
IP_FAC_COR_ST_LAM_AD_CUS	-	0... FFH	0 ...1	3.92157e-3	-
LDP_TCO_ST_LAM_AD_CUS	8	0... FEH	-48... 142.5	0.75	°C
Weighting factor for the long term adaptation during engine start					
LC_CTR_MAX_LAM_ADJ_LAM_AD_CUS	-	0... 1H	0 ...1	1	-
Logical switch to enable a limitation in the number of long term adaptations					
LC_EGY_LAM_AD_CUS_ENA	-	0... 1H	0 ...1	1	-
Logical switch to enable long term adaptation via injector needle lift correction					
LC_EGY_LAM_AD_CUS_ST_ENA	-	0... 1H	0 ...1	1	-
Logical switch to enable long term adaptation via injector needle lift correction during engine start					
LC_LAM_AD_CUS_CLR	-	0... 1H	0 ...1	1	-
Logical switch to reset the anti bounce counter for the long term adaptation diagnosis					
LC_LAM_ADJ_LAM_AD_CUS_ENA	-	0... 1H	0 ...1	1	-
Logical switch to enable the long term lambda adaptation					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NC_IDX_DIAG_LAM_AD_CUS	-	0... FFFFH	0... 65535	1	-
Failure index for diagnostic instance LAM_AD_CUS					

Import actions:

ACTION_ERRM_FilterSymptom (**IN**<PRM_IDX_DIAG>,**IN**<PRM_LV_CDN_DIAG>,**IN**<PRM_ERR_SYM>,**IN**<PRM_C_ABC_INC>, **IN**<PRM_C_ABC_DEC>,**IN**<PRM_C_ABC_MAX>,**OUT**<PRM_LV_ERR>)
ACTION_ERRM_GetErrSym (**IN**<IDX_DIAG>,**OUT**<ERR_SYM>)
ACTION_ERRM_GetLvCdnDiag (**IN**<IDX_DIAG>,**OUT**<LV_CDN_DIAG>)
ACTION_ERRM_GetLvEndDiag (**IN**<IDX_DIAG>,**OUT**<LV_END_DIAG>)
ACTION_ERRM_GetLvErr (**IN**<IDX_DIAG>,**OUT**<LV_ERR>)

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General information:

Signal flow diagram:

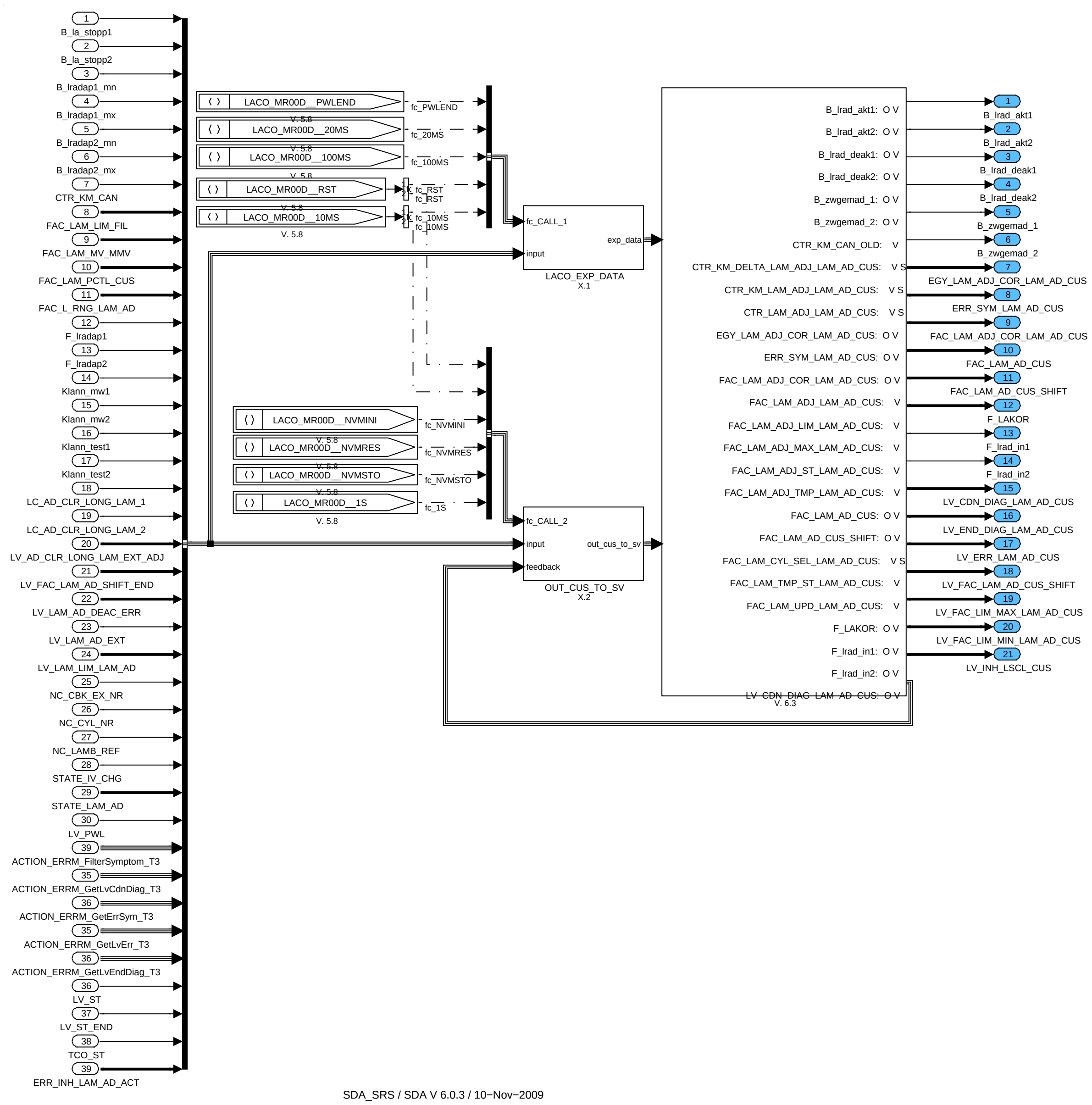

Figure R.34.1: :

R.34.1 Outputs for BMW functions which are defined as LACO exported data

General information:

FUNCTION DESCRIPTION:
Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

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Application conditions:

Initialisation:	`RST, PWLEND, Deactivation`
Recurrence:	`10MS, 20MS, 100MS`
Activation:	`LV_PWL==0`
Deactivation:	`LV_PWL==1`

Function description:

Formula section:

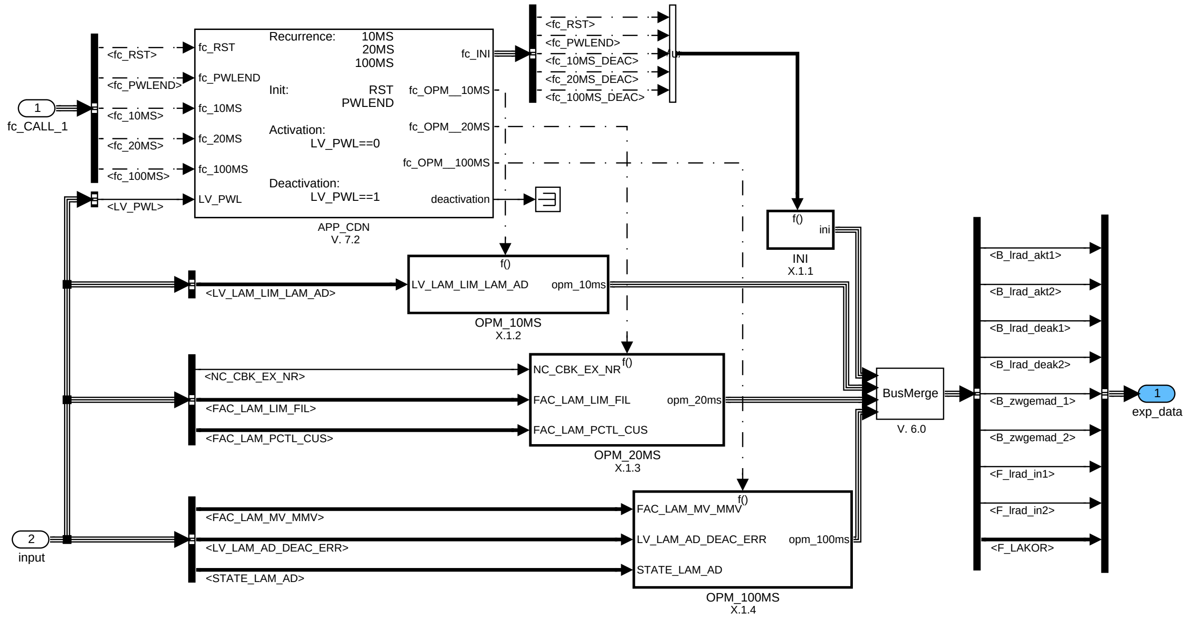

Figure R.34.2: :

R.34.1.1 Initialisation at reset or at exit power latch phase:

Initialized to 0 at reset or at exit power latch.

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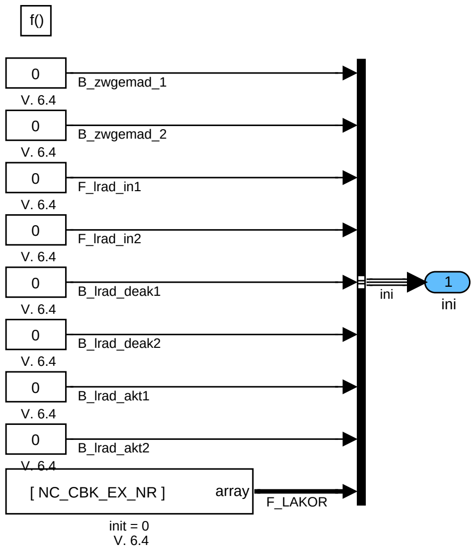

Figure R.34.3: :

R.34.1.2 Calculation of B_zwgemad_1 and B_zwgemad_2

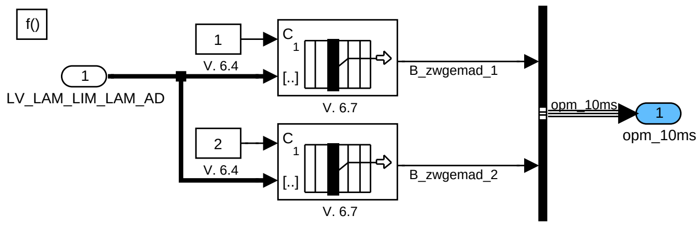

Figure R.34.4: :

R.34.1.3 For loop

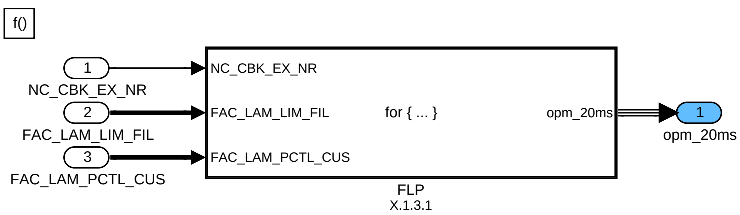

Figure R.34.5: :

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R.34.1.3.1 Calculation of F_LAKOR

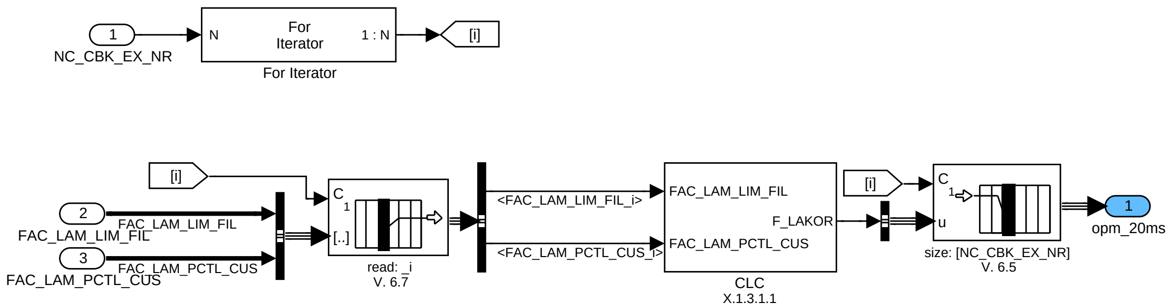

Figure R.34.6: :

R.34.1.3.1.1 F_LAKOR is the sum of FAC_LAM_LIM_FIL and FAC_LAM_PCTL_CUS

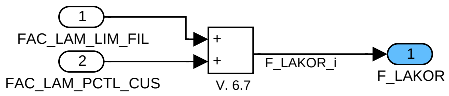

Figure R.34.7: :

R.34.1.4 Calculation at 100ms recurrence.

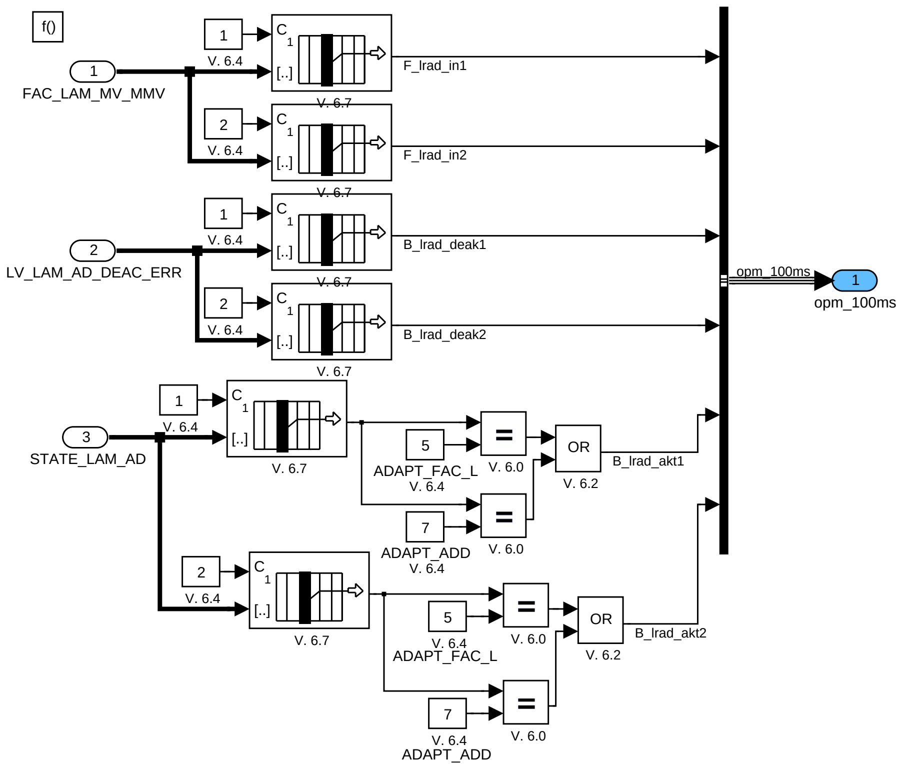

Figure R.34.8: :

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R.34.2 Outputs of customer to SV functions

General information:

FUNCTION DESCRIPTION:
Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions:

Initialisation:	`RST, NVMINI, NVMRES, NVMSTO`
Recurrence:	`10MS, 1S`
Activation:	`always`
Deactivation:	`never`

Function description:

Formula section:

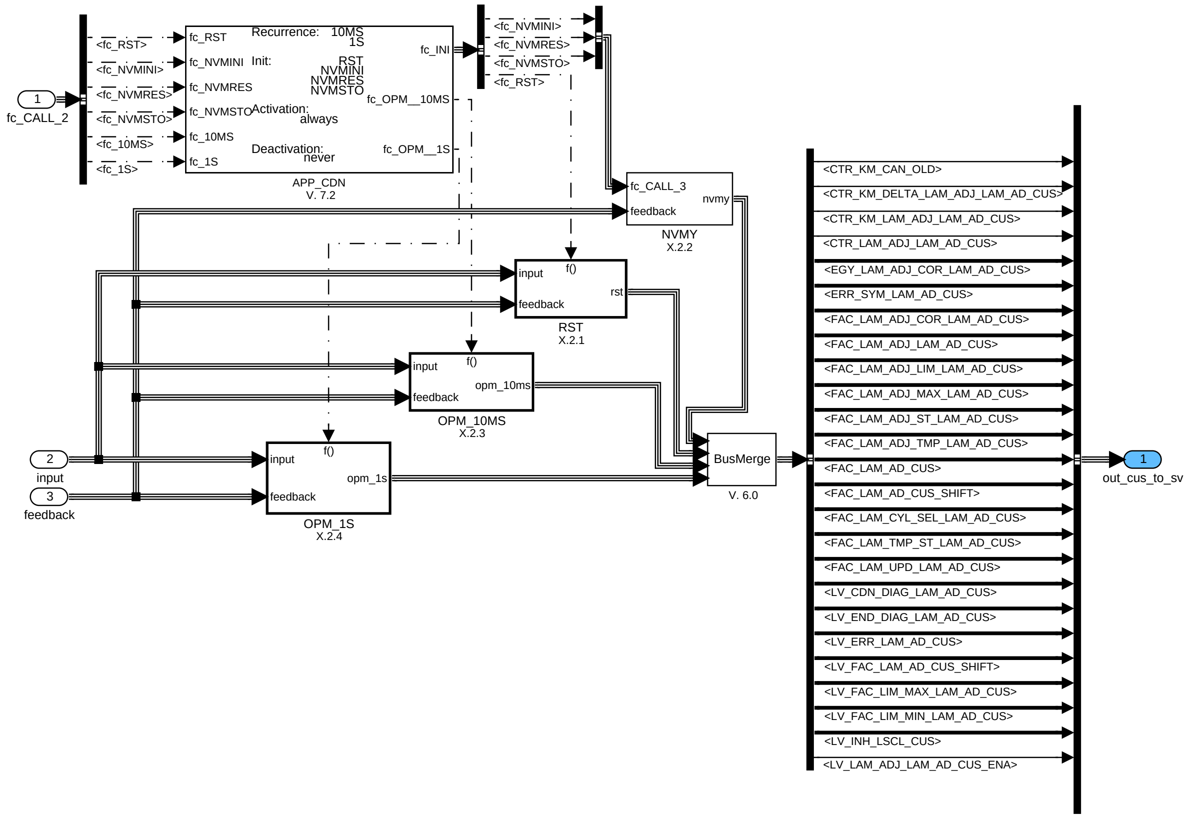

Figure R.34.9: :

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R.34.2.1 Except FAC_LAM_ADJ_LAM_AD_CUS all others variables shall be initialized with 0.

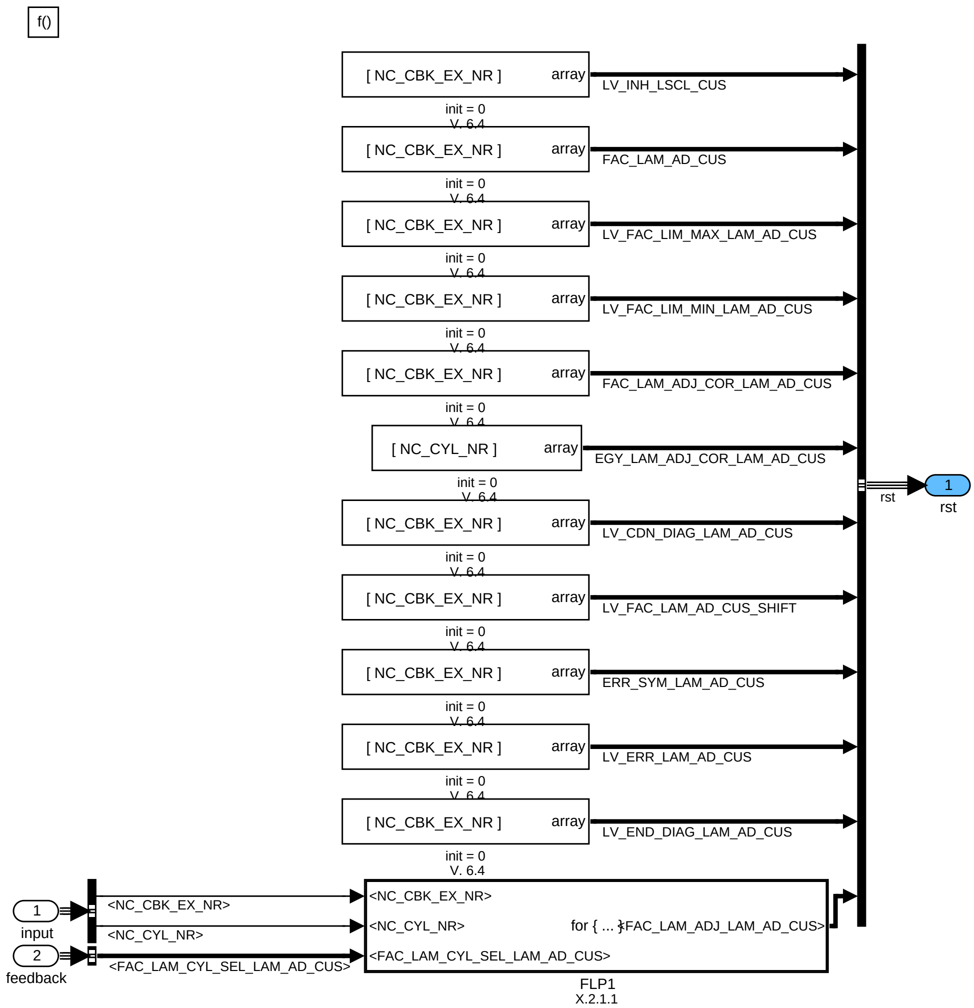

Figure R.34.10: :

R.34.2.1.1 // The sum below shall be done for each exhaust gas bank over the cylinders belonging to it.

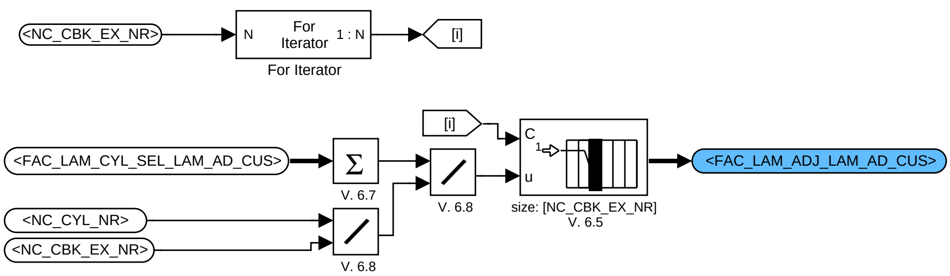

Figure R.34.11: :

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R.34.2.2 Non volatile data

FAC_LAM_CYL_SEL_LAM_AD_CUS[x], CTR_KM_LAM_ADJ_LAM_AD_CUS CTR_KM_DELTA_LAM_ADJ_LAM_AD_CUS and CTR_LAM_ADJ_LAM_AD_CUS shall be initialised with their stored values in NVMY.

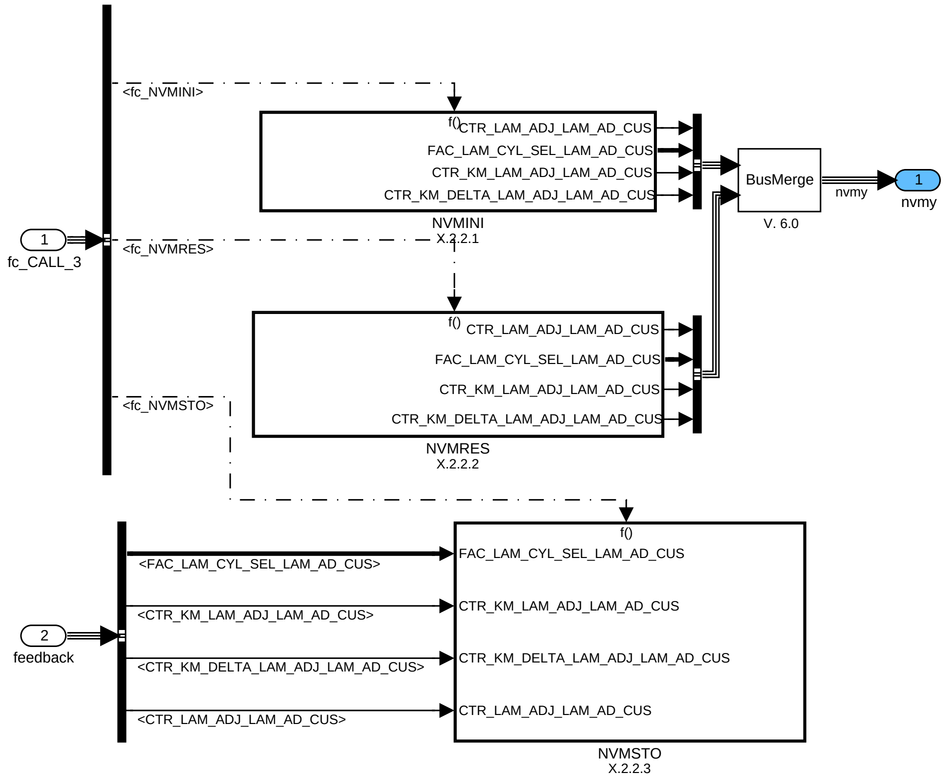

Figure R.34.12: :

R.34.2.2.1 Initialization of NVMY variables

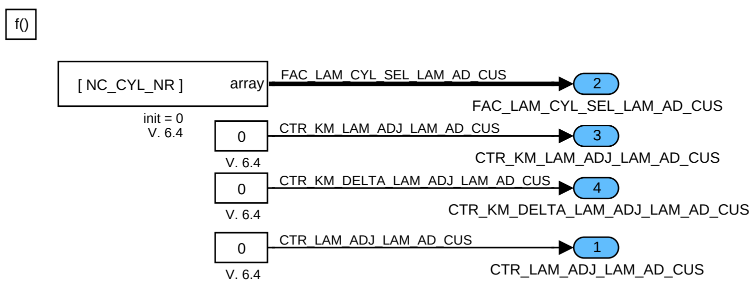

Figure R.34.13: :

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R.34.2.2.2 Read NVMY variables

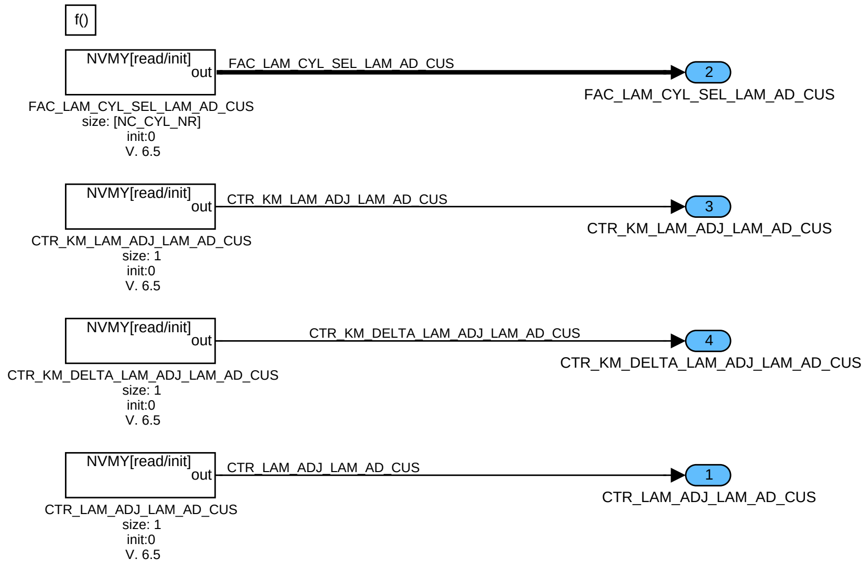

Figure R.34.14: :

R.34.2.2.3 Store NVMY variables

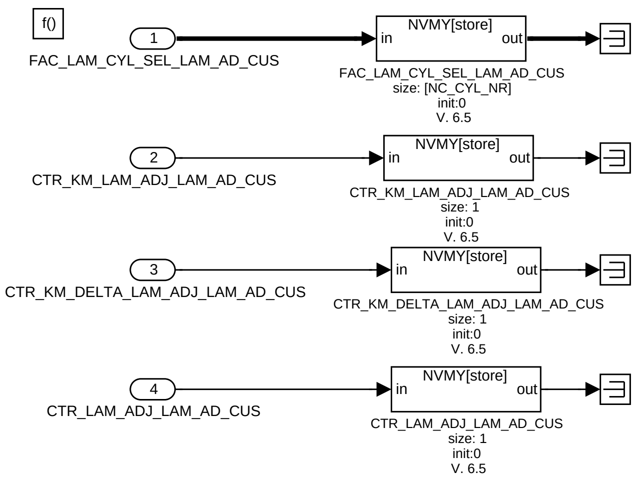

Figure R.34.15: :

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R.34.2.3 Calculation

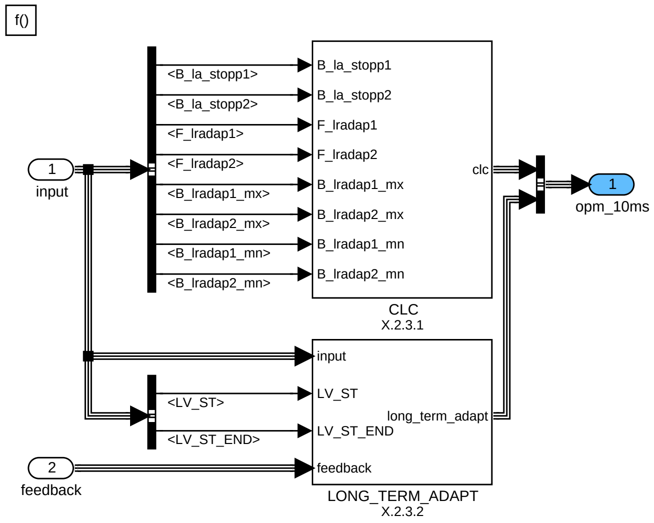

Figure R.34.16: :

R.34.2.3.1 % Contiuously update of current customer Lambda Adaptation value

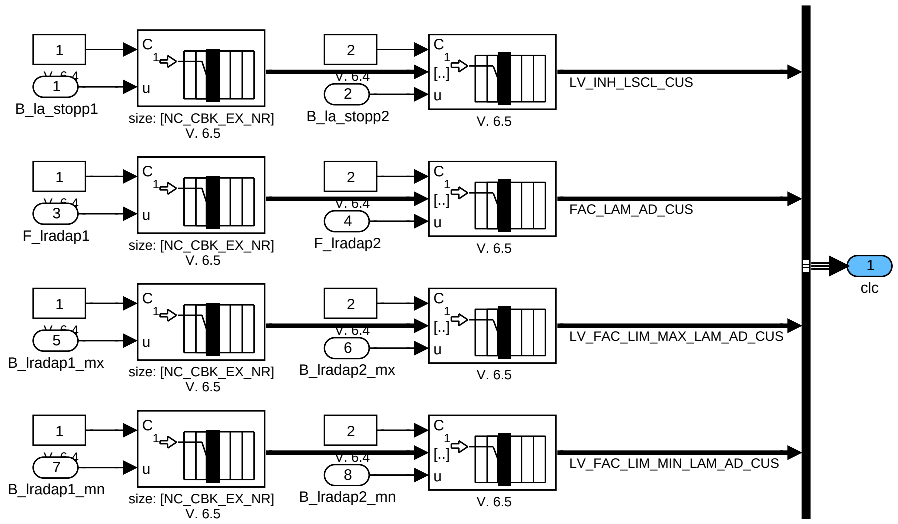

Figure R.34.17: :

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R.34.2.3.2 % Long term Lambda Adaptation

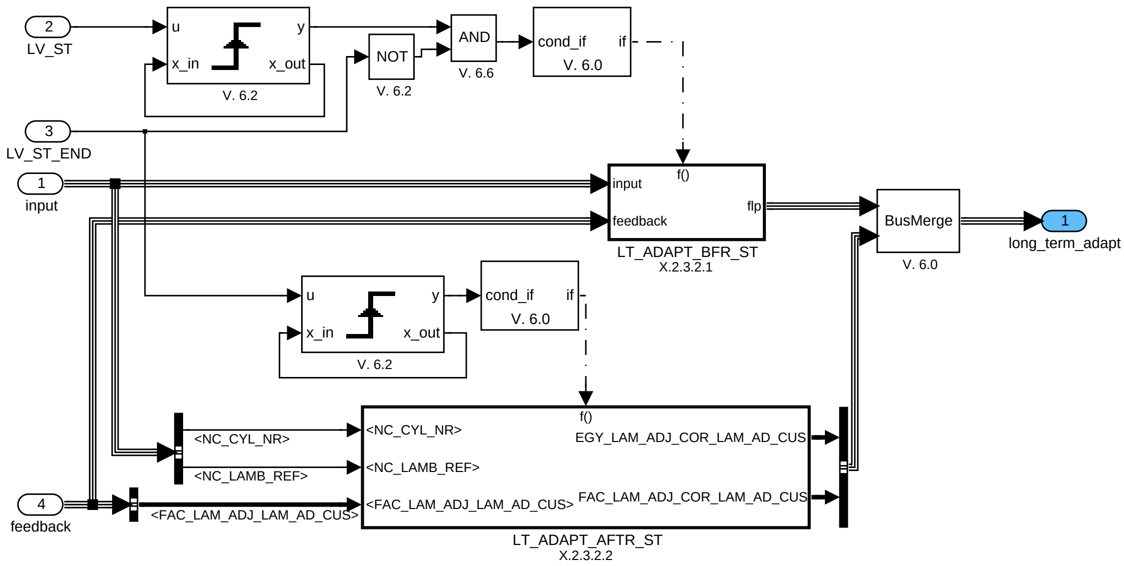

Figure R.34.18: :

R.34.2.3.2.1 // case: no update beeing carry out // calculation below shall be done once

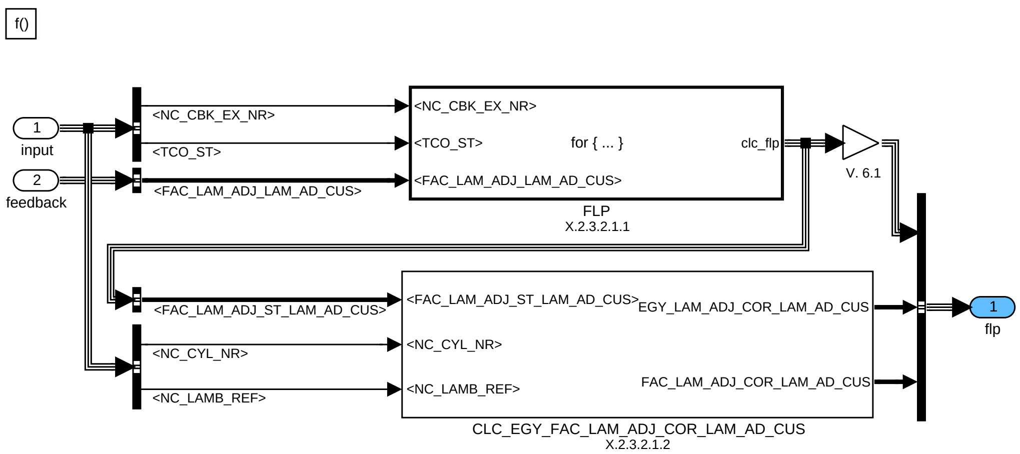

Figure R.34.19: :

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R.34.2.3.2.1.1 Calculation

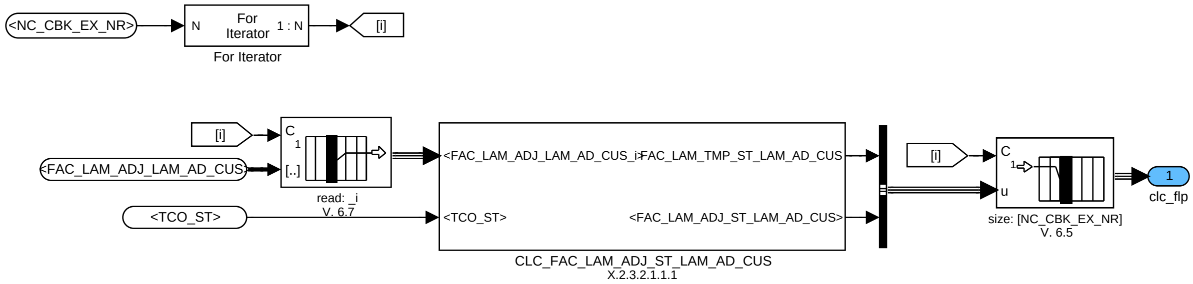

Figure R.34.20: :

R.34.2.3.2.1.1.1 Calculation of FAC_LAM_TMP_ST_LAM_AD_CUS and FAC_LAM_ADJ_ST_LAM_AD_CUS

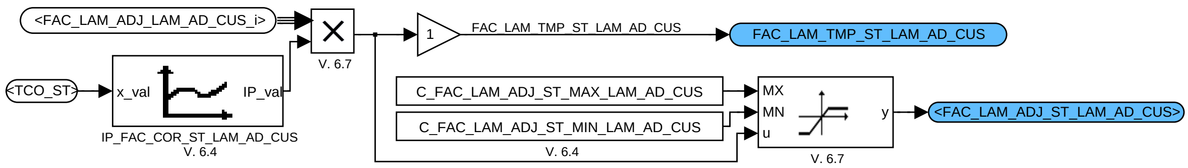

Figure R.34.21: :

R.34.2.3.2.1.2 Calculation of EGY_LAM_ADJ_COR_LAM_AD_CUS and FAC_LAM_ADJ_COR_LAM_AD_CUS using LC_EGY_LAM_AD_CUS_ENA as switch

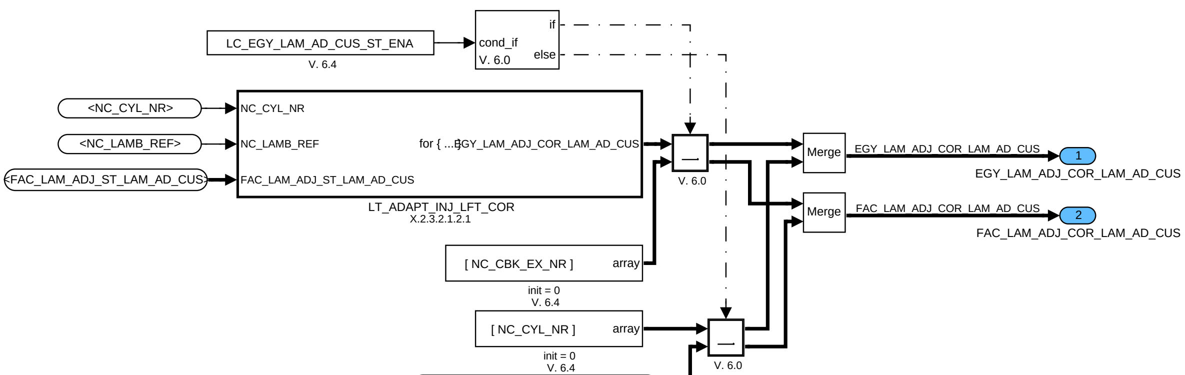

Figure R.34.22: :

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R.34.2.3.2.1.2.1 Calculation of EGY_LAM_ADJ_COR_LAM_AD_CUS

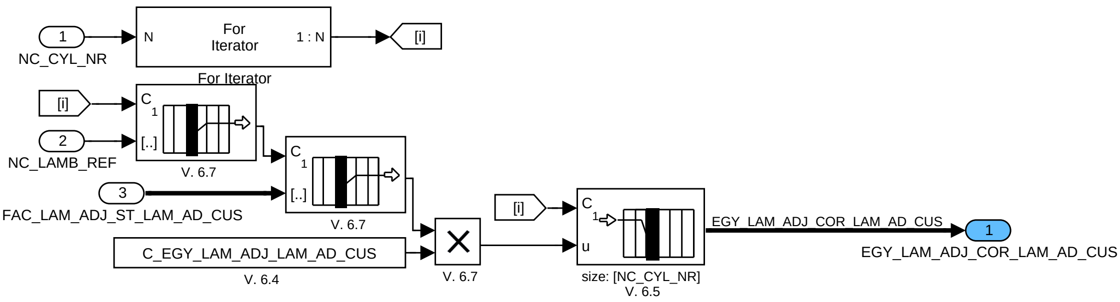

Figure R.34.23: :

R.34.2.3.2.2 // case: no update beeing carry out // calculation of long term adaptation after start

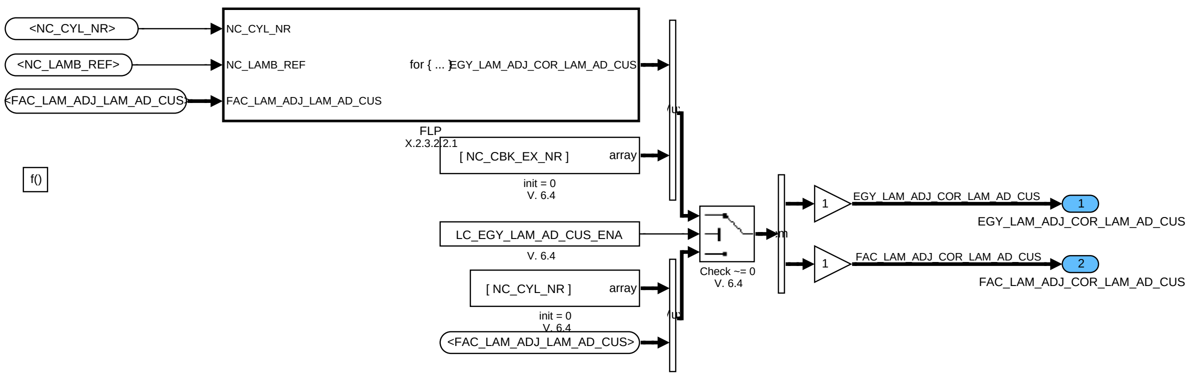

Figure R.34.24: :

R.34.2.3.2.2.1 EGY_LAM_ADJ_COR_LAM_AD_CUS Calculation of EGY_LAM_ADJ_COR_LAM_AD_CUS

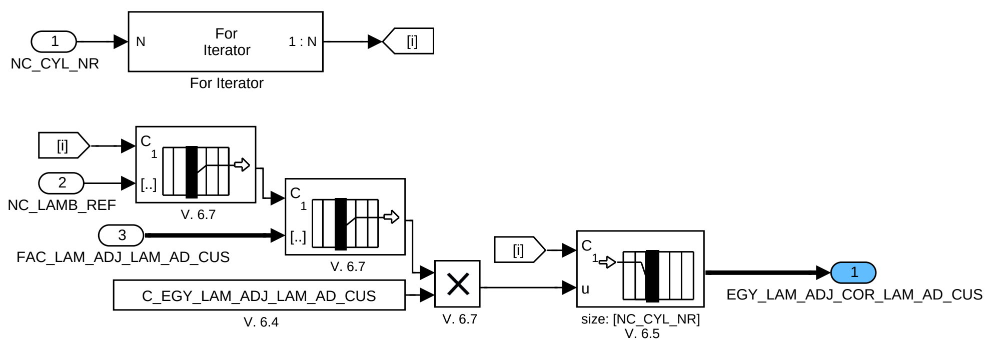

Figure R.34.25: :

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R.34.2.4 Formula section

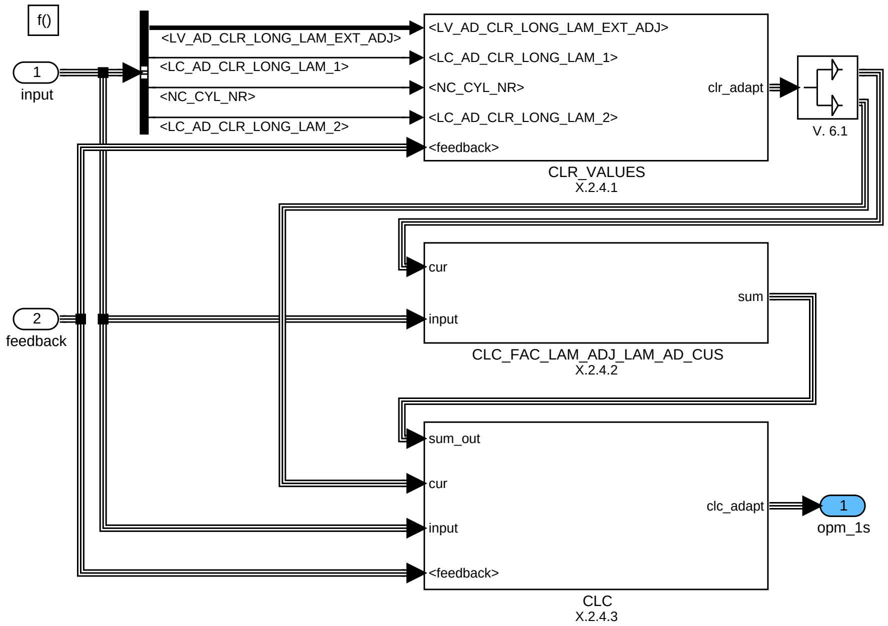

Figure R.34.26: :

R.34.2.4.1 Clear adaptations value

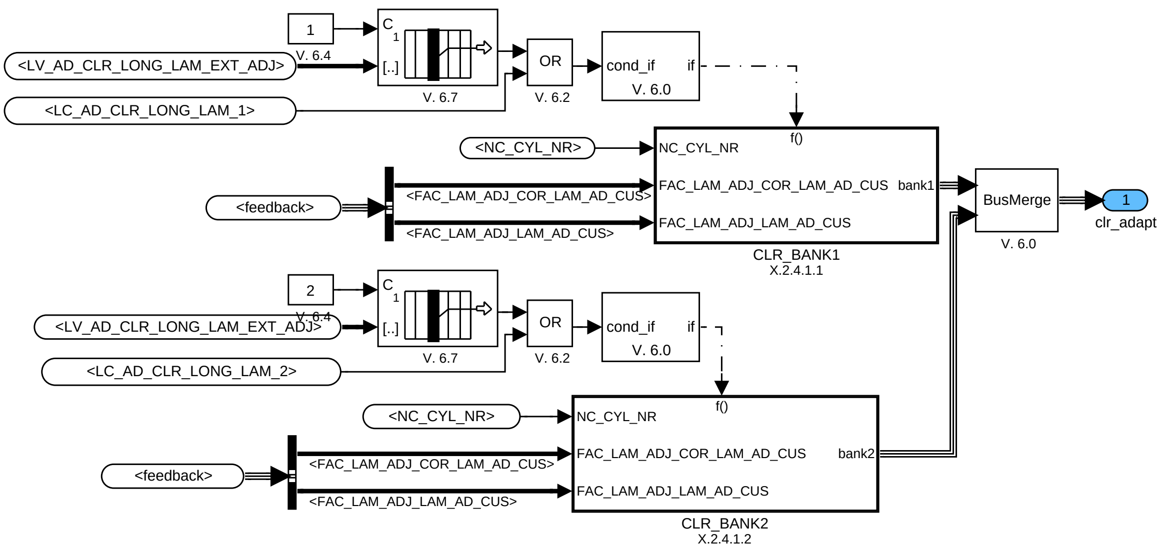

Figure R.34.27: :

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R.34.2.4.1.1 // case: clear adaptions value for bank 1 by external request:

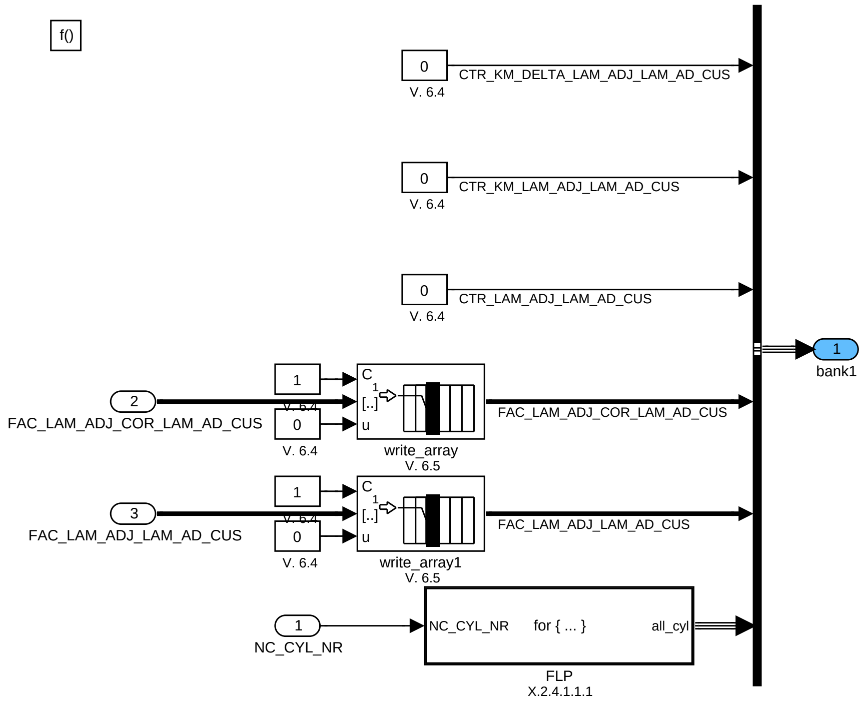

Figure R.34.28: :

R.34.2.4.1.1.1 Clear values for bank1

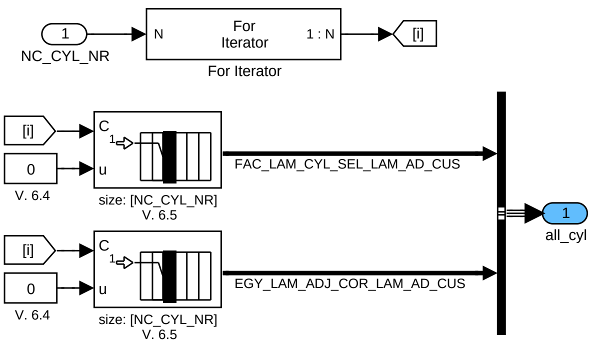

Figure R.34.29: :

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R.34.2.4.1.2 // clear adaptions value for bank 2 by external request:

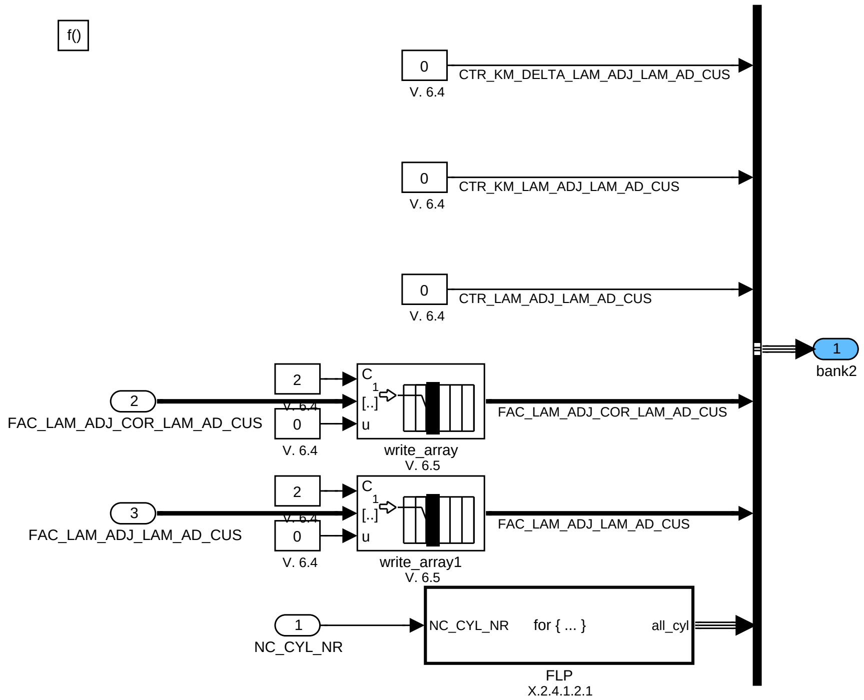

Figure R.34.30: :

R.34.2.4.1.2.1 Clear values for bank2

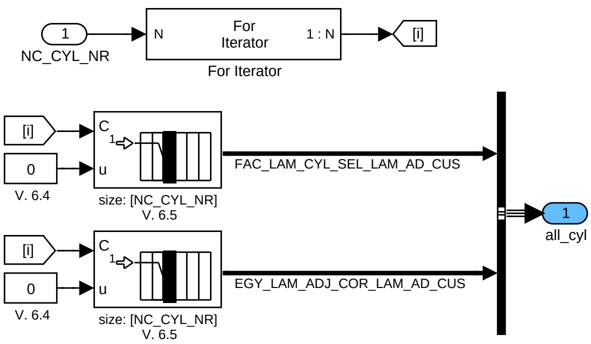

Figure R.34.31: :

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R.34.2.4.2 Calculation

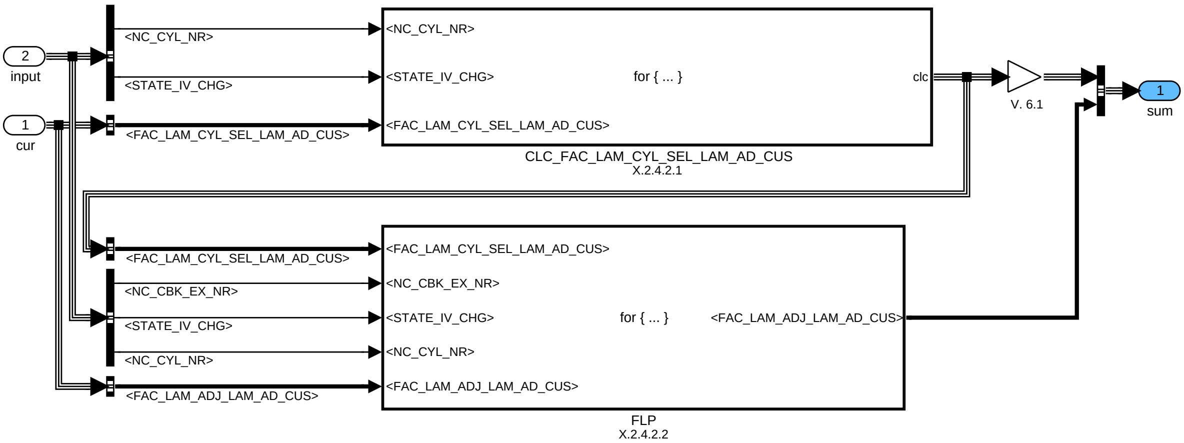

Figure R.34.32: :

R.34.2.4.2.1 Calculation of FAC_LAM_CYL_SEL_LAM_AD_CUS

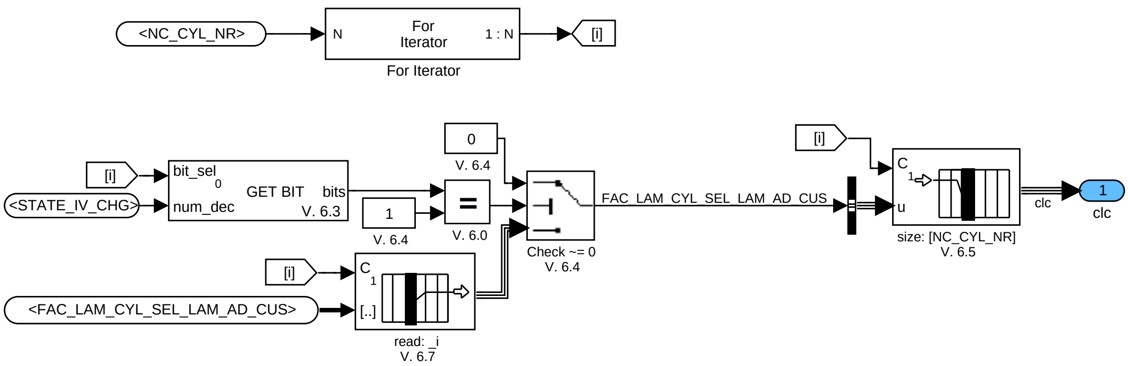

Figure R.34.33: :

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R.34.2.4.2.2 Calculation of FAC_LAM_ADJ_LAM_AD_CUS

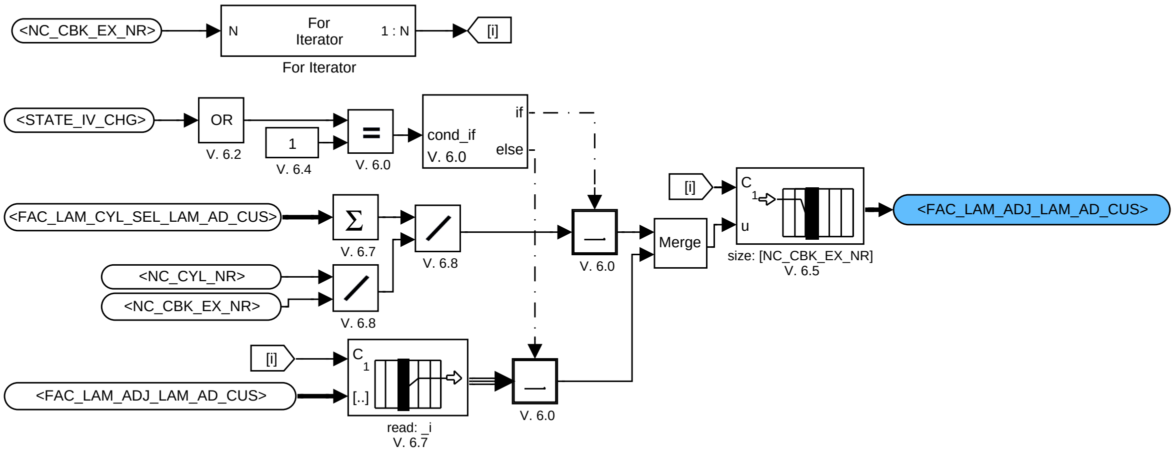

Figure R.34.34: :

R.34.2.4.3 Calculation

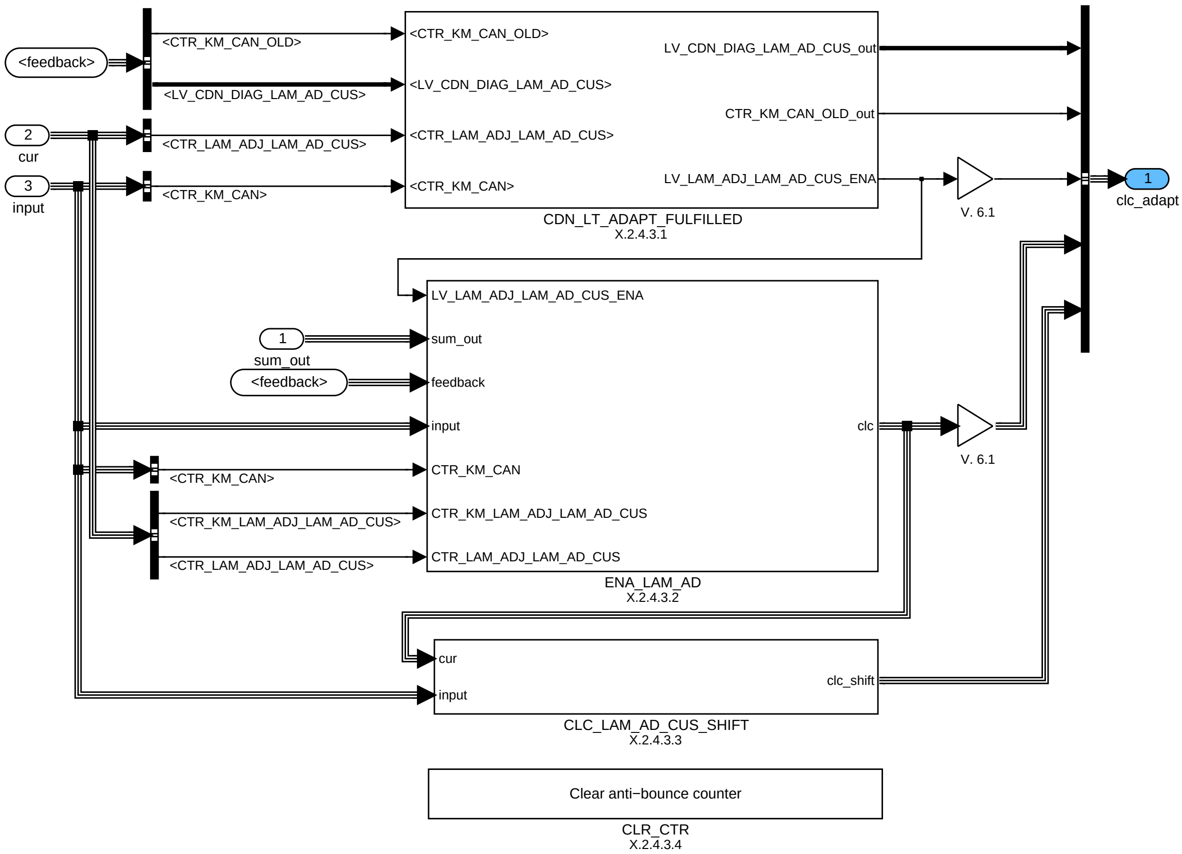

Figure R.34.35: :

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R.34.2.4.3.1 Calculation of CTR_KM_CAN_OLD, LV_LAM_ADJ_LAM_AD_CUS_ENA.

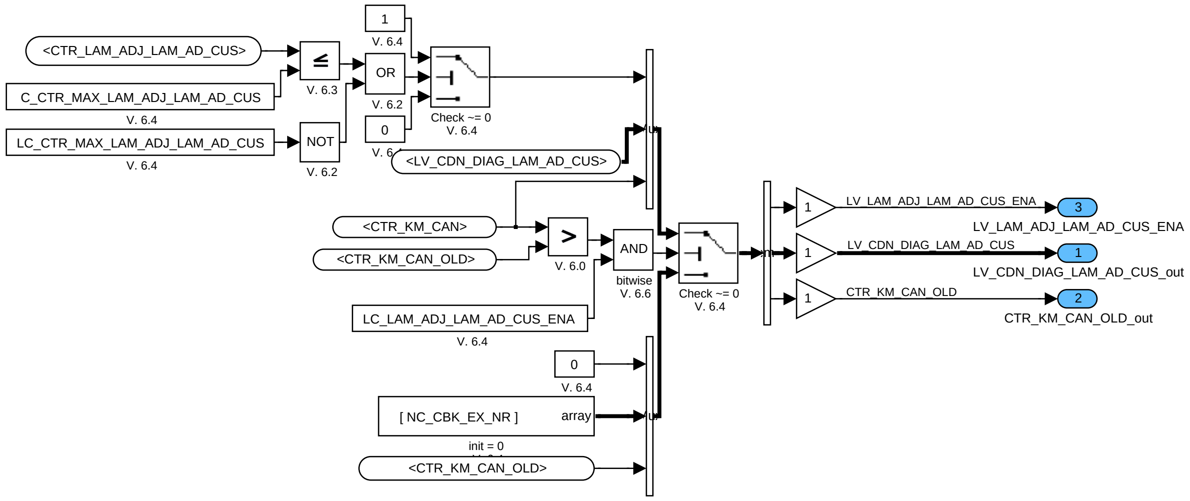

Figure R.34.36: :

R.34.2.4.3.2 Update long term adaptation

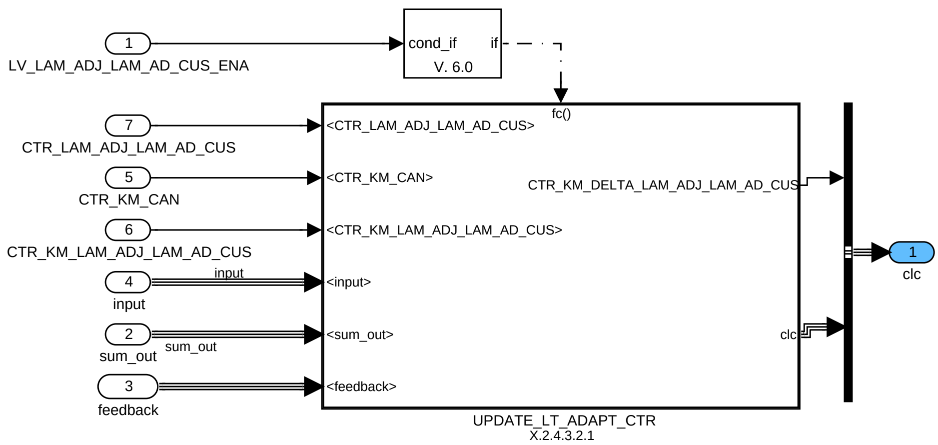

Figure R.34.37: :

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R.34.2.4.3.2.1 %update long term adaptation temporary counter

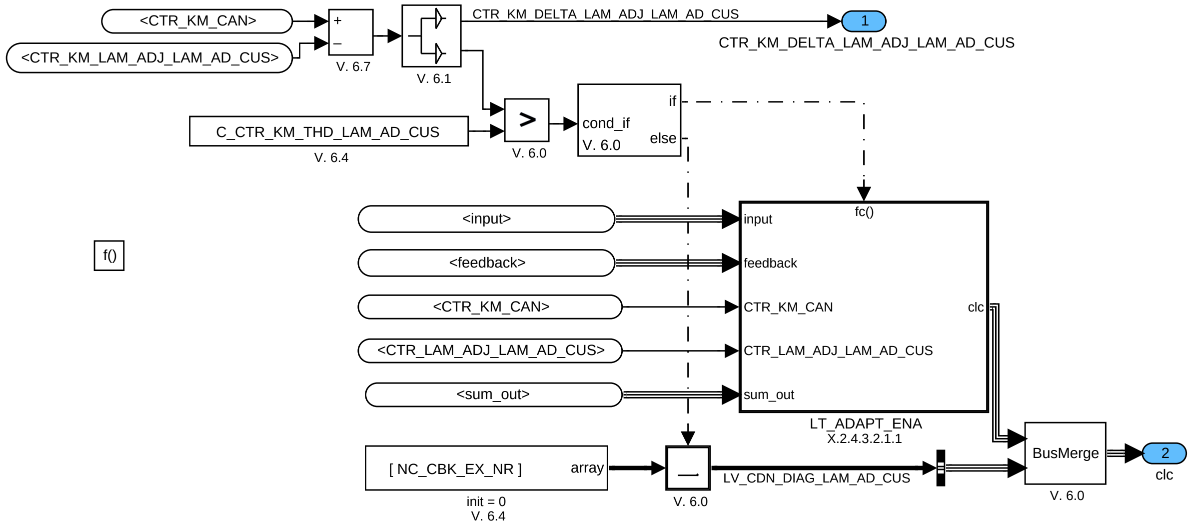

Figure R.34.38: :

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R.34.2.4.3.2.1.1 Long term adaptation enabled

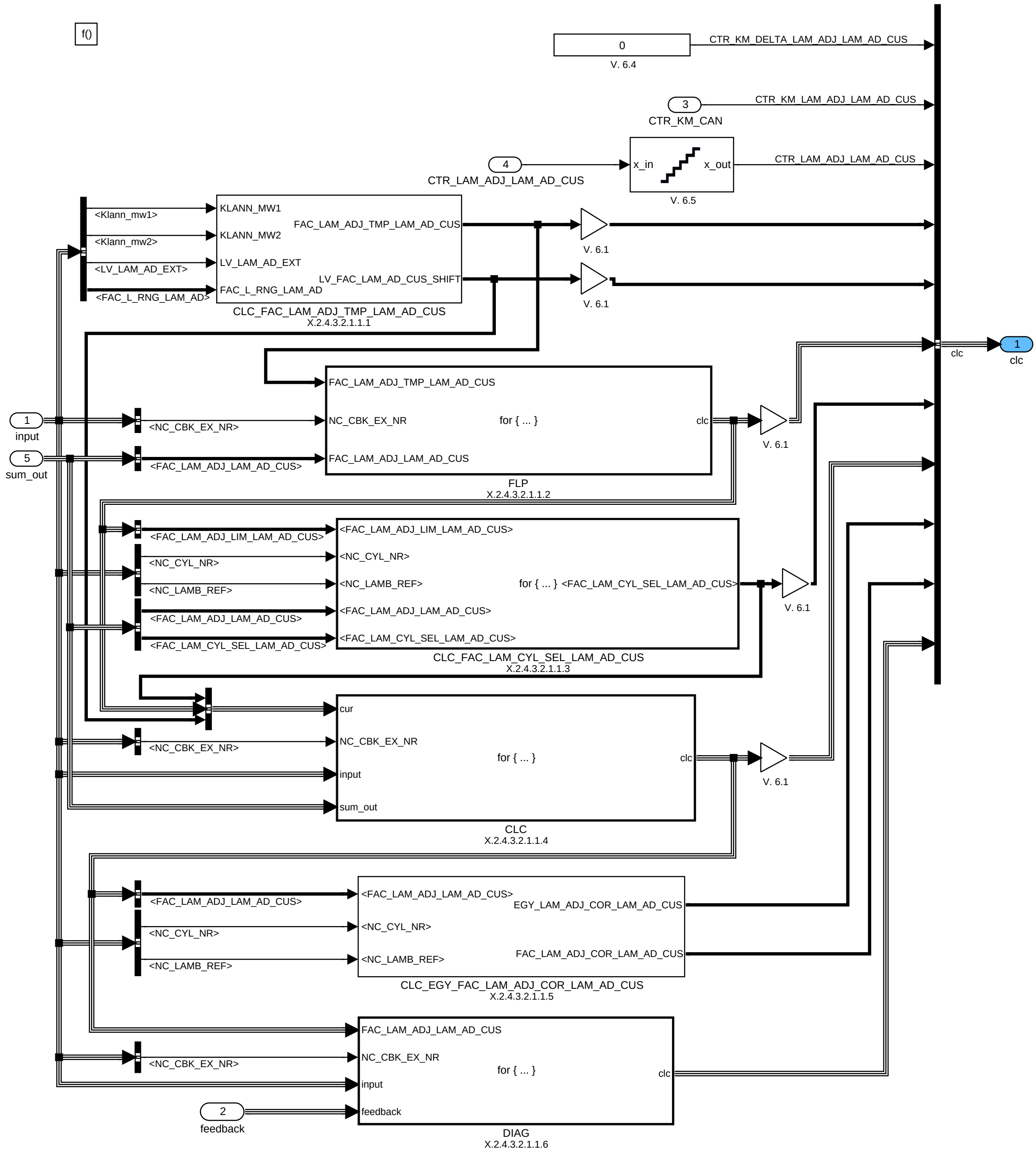

Figure R.34.39: :

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R.34.2.4.3.2.1.1.1 Calculation

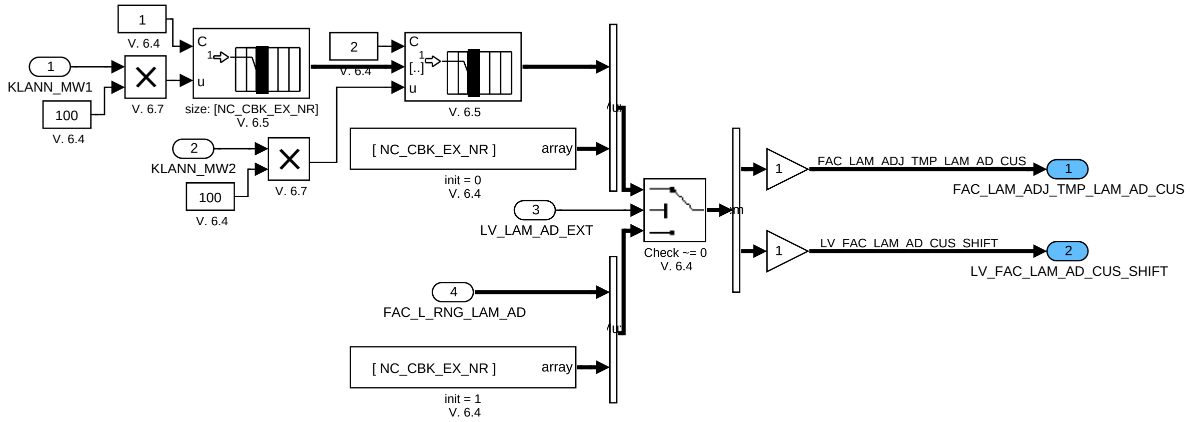

Figure R.34.40: :

R.34.2.4.3.2.1.1.2 Calculation

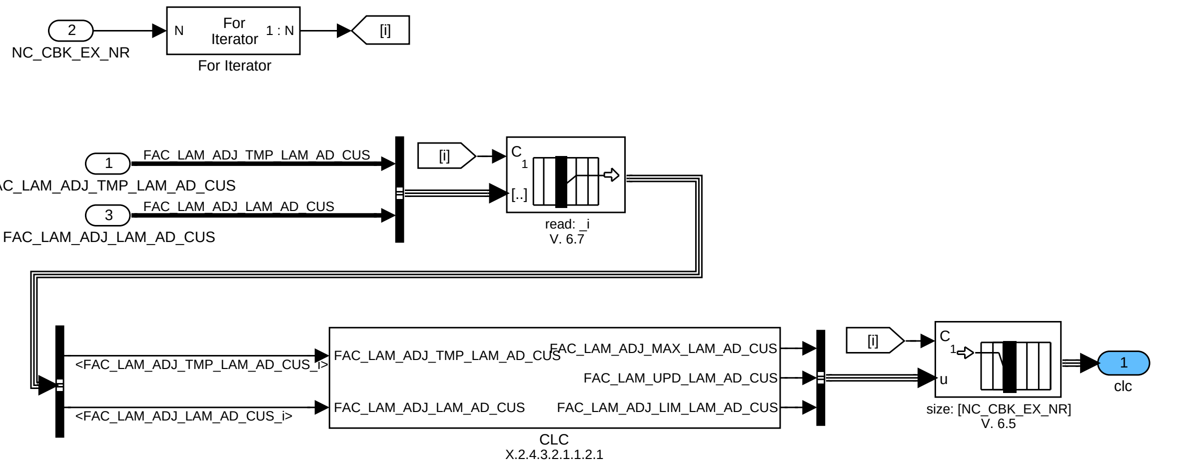

Figure R.34.41: :

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R.34.2.4.3.2.1.1.2.1 Calculation of FAC_LAM_ADJ_MAX_LAM_AD_CUS, FAC_LAM_UPD_LAM_AD_CUS and FAC_LAM_ADJ_LIM_LAM_AD_CUS

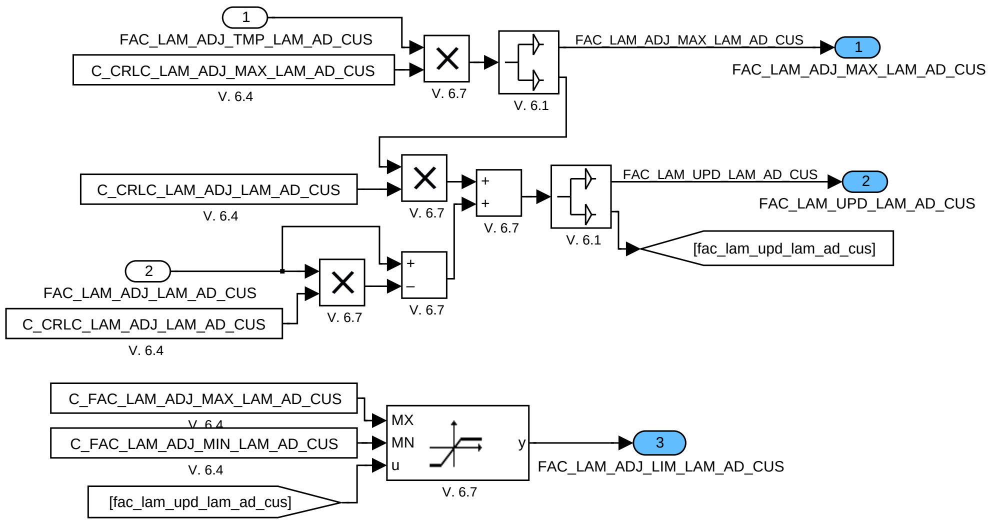

Figure R.34.42: :

R.34.2.4.3.2.1.1.3 Calculation of FAC_LAM_CYL_SEL_LAM_AD_CUS

long term adaptation based on the BMW KLANN adaptation values
long term adaptation based on the SiemensVDO adaptation values

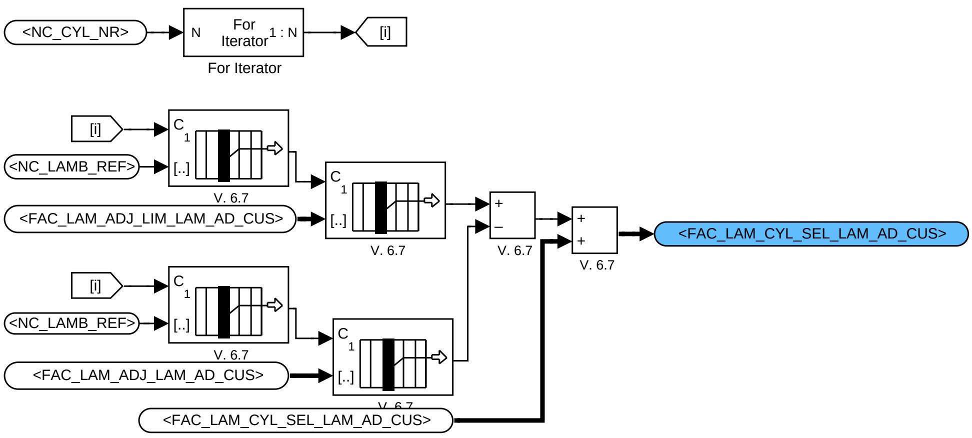

Figure R.34.43: :

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R.34.2.4.3.2.1.1.4 Calculation

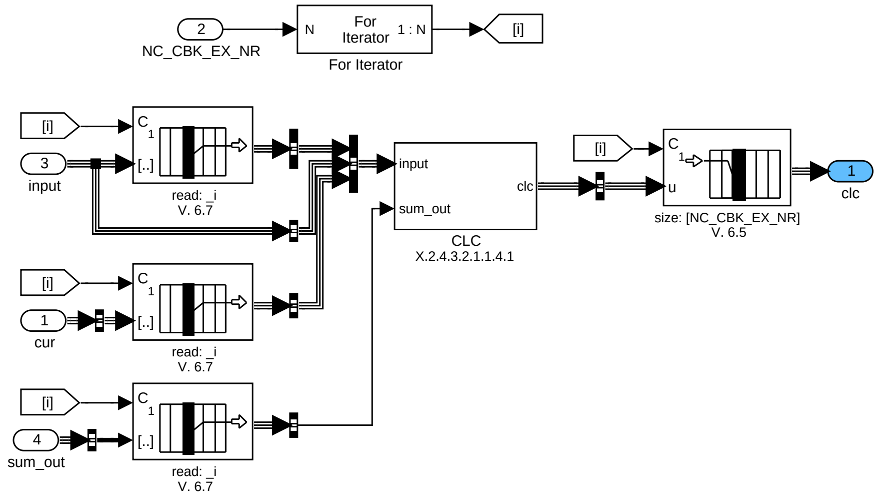

Figure R.34.44: :

R.34.2.4.3.2.1.1.4.1 Calculation of FAC_LAM_AD_CUS_SHIFT and FAC_LAM_ADJ_LAM_AD_CUS

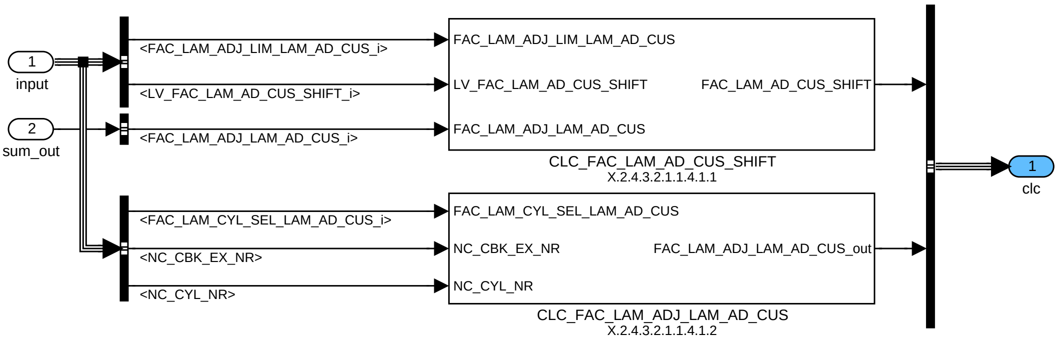

Figure R.34.45: -:

R.34.2.4.3.2.1.1.4.1.1 Calculation of FAC_LAM_AD_CUS_SHIFT

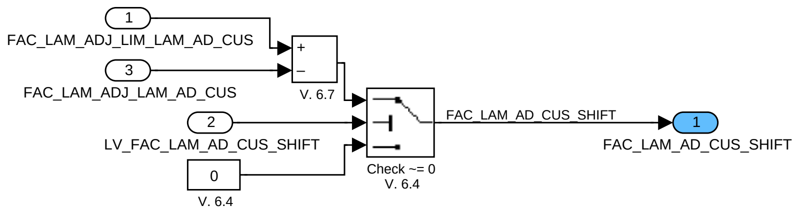

Figure R.34.46: :

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R.34.2.4.3.2.1.1.4.1.2 Calculation of FAC_LAM_ADJ_LAM_AD_CUS

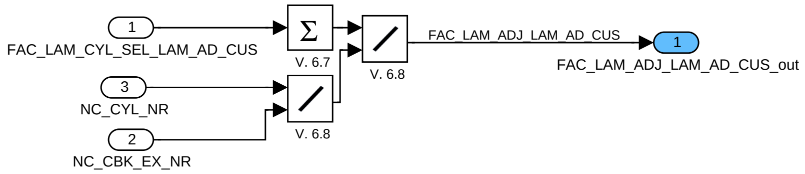

Figure R.34.47: :

R.34.2.4.3.2.1.1.5 Long term adaptation via injector needle lift correction Long term adaptation via fuel mass setpoint correction

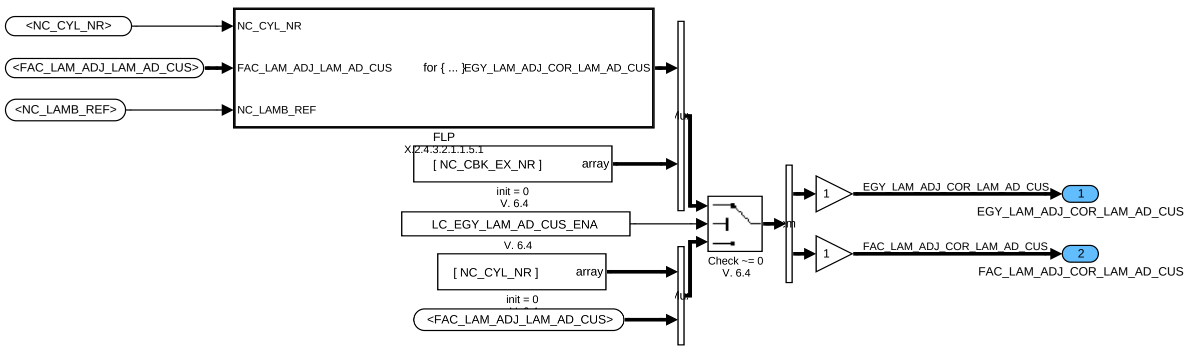

Figure R.34.48: :

R.34.2.4.3.2.1.1.5.1 Calculation of EGY_LAM_ADJ_COR_LAM_AD_CUS

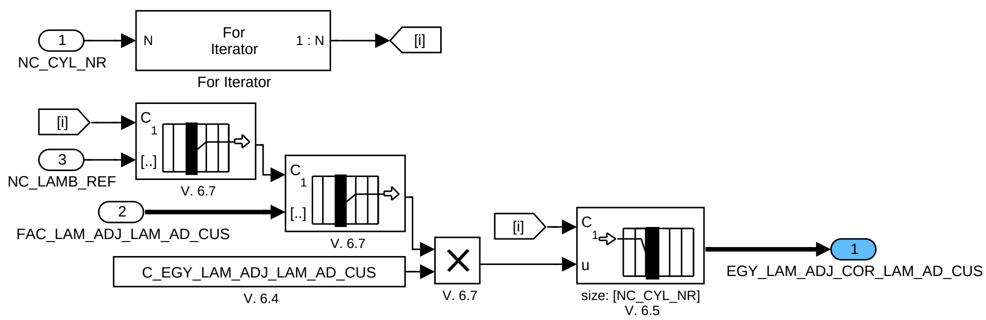

Figure R.34.49: :

R.34.2.4.3.2.1.1.6 Diagnosis of long term adaptation

Configuration for diagnostic symptoms:

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Diagnostic GS	Symptom description	Symptom	Filter type
Diagnosis for the Long Term Adaptation	-	*SYM_0*	STD
	Long term adaptation too high	*SYM_1*	
	-	*SYM_2*	
	-	*SYM_3*	

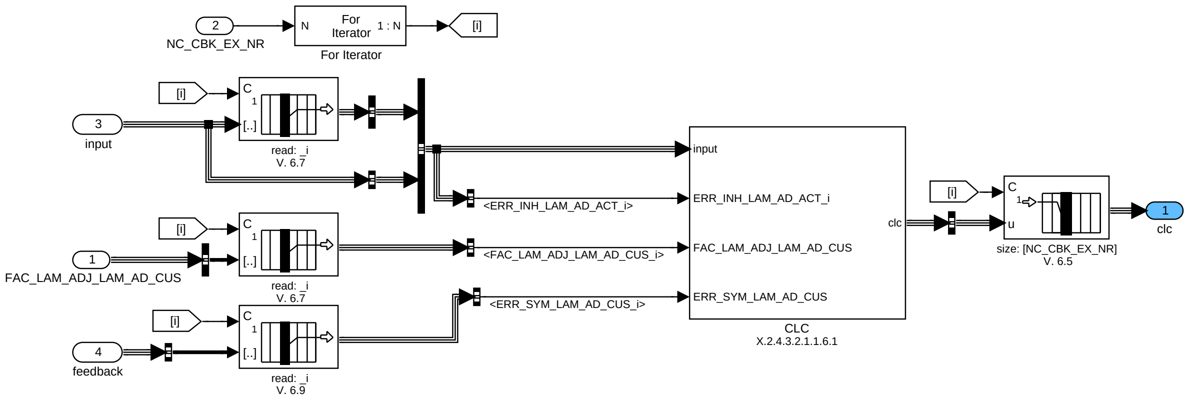

Figure R.34.50: :

R.34.2.4.3.2.1.1.6.1 Calculation

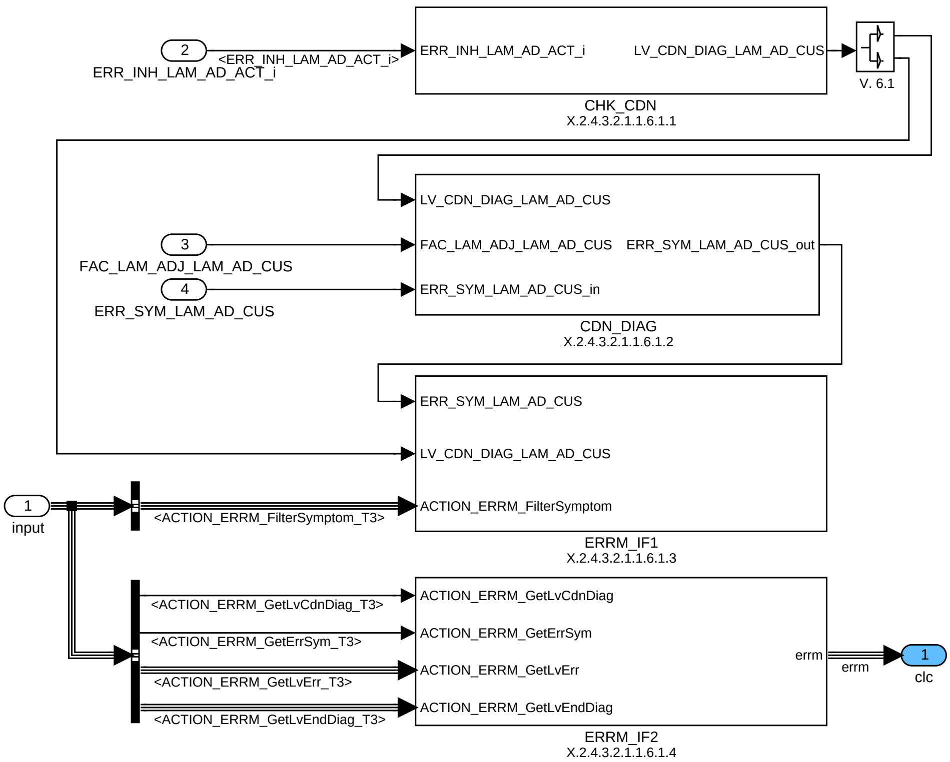

Figure R.34.51: :

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R.34.2.4.3.2.1.1.6.1.1 Calculation of Condition flag

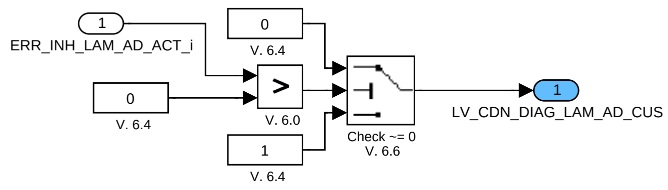

Figure R.34.52: :

R.34.2.4.3.2.1.1.6.1.2 Check Condition

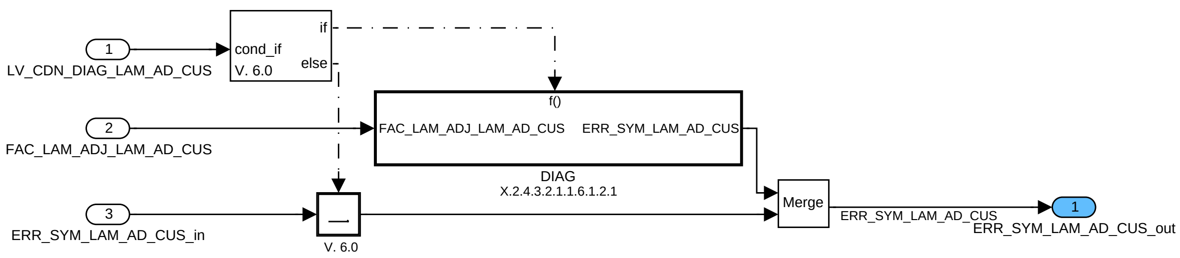

Figure R.34.53: :

R.34.2.4.3.2.1.1.6.1.3 Condition fulfilled: Symptom Evaluation

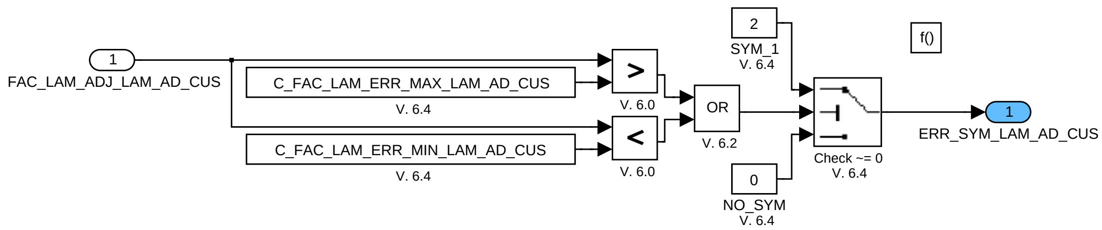

Figure R.34.54: :

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R.34.2.4.3.2.1.1.6.1.4 ERRM filter

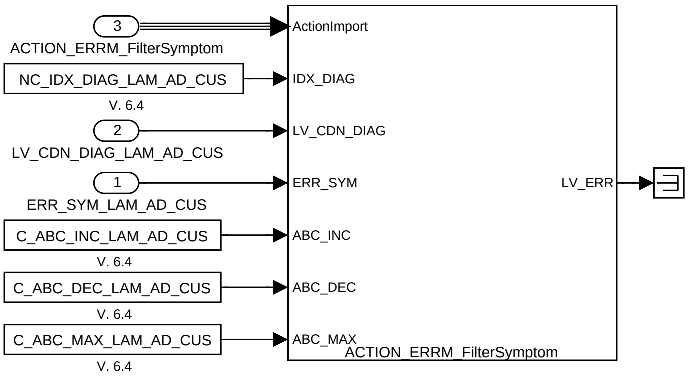

Figure R.34.55: :

R.34.2.4.3.2.1.1.6.1.5 Outputs from ERRM

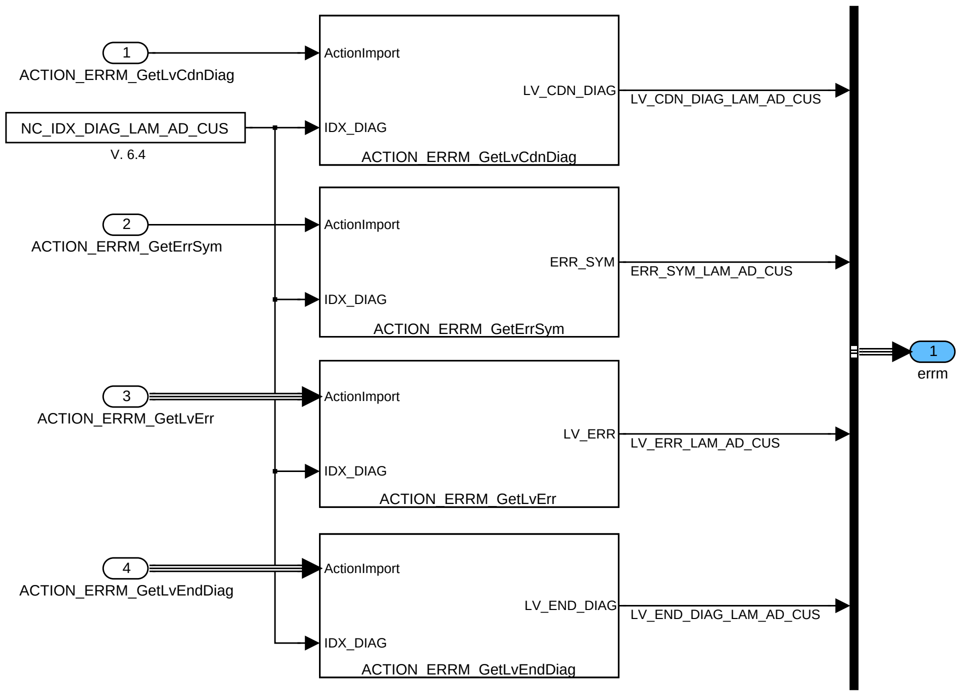

Figure R.34.56: :

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R.34.2.4.3.3 For loop

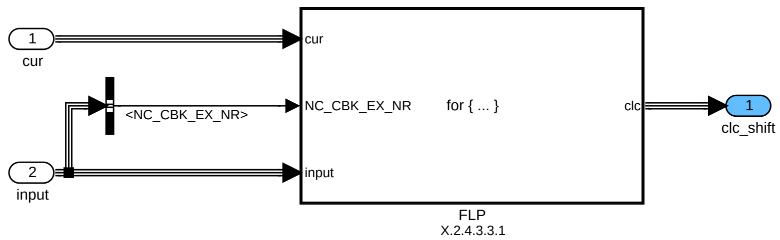

Figure R.34.57: :

R.34.2.4.3.3.1 Calculation

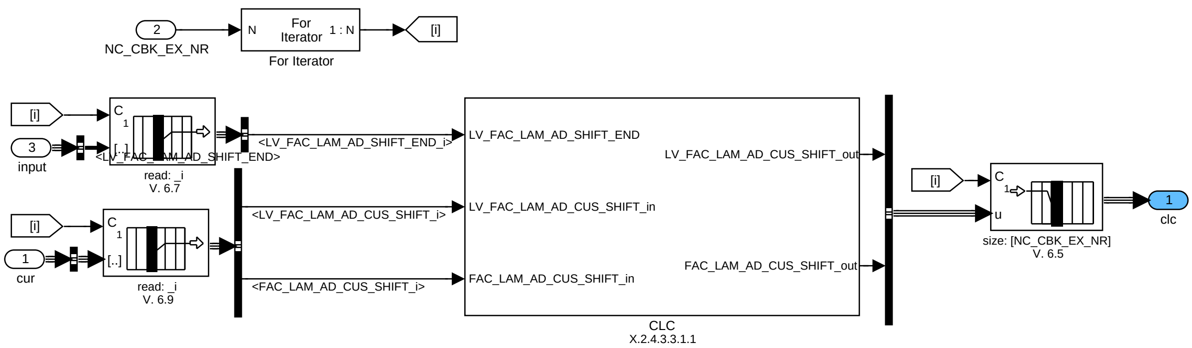

Figure R.34.58: :

R.34.2.4.3.3.1.1 Calculation of LV_FAC_LAM_AD_CUS_SHIFT and FAC_LAM_AD_CUS_SHIFT

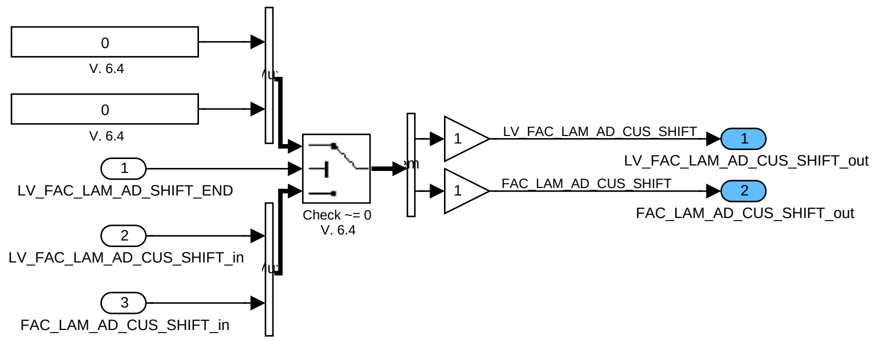

Figure R.34.59: :

R.34.2.4.3.4 Clear anti-bounce counter if LC_LAM_AD_CUS_CLR is true

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R.35 Customer adaptation module: LASP

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
LAMB_BAS [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Bank selective basic lambda setpoint					
LAMB_BAS_H_RES [NC_CBK_EX_NR]	O/V	0... 7FFFFH	0... 31.99993	61e-6	-
Bank selective basic lambda setpoint with high resolution					
LAMB_HOM_AFL	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda setpoint for homogeneous lean combustion					
LAMB_SP	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda setpoint					
LAMB_SP [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 31.99902	976.599e-6	-
Lambda setpoint					
LAMB_SP_HOM [NC_CBK_EX_NR]	O/V	0... 7FFFH	0... 1.99993	61e-6	-
Lambda setpoint with high resolution					

Input data:

Dla_soll_puls [NC_CBK_EX_NR] {p. 8156}	La_bas1 {p. 8160}	La_bas2 {p. 8160}	La_ref_homm {p. 8160}
La_sollreg [NC_CBK_EX_NR] {p. 8160}	NC_CBK_EX_NR {p. 1829}		

R.35.1 Outputs for BMW for supplier aggregates

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs can be different from the specified values due to the input data attributes.

Application conditions

Activation: `LV_ST_END = 1`

Deactivation: `LV_ST_END = 0`

Initialisation : `1`

Recurrence:

```
10 ms
 Except LAMB_HOM_AFL:  20 ms
 Except LAMB_SP_HOM[1] and LAMB_SP_HOM[2], which shall be
segment synchronous; LAMB_SP_HOM[1] shall be synchronised with
the update rate of La_sollreg1 and similarly LAMB_SP_HOM[2]
with La_sollreg2.
Except LAMB_SP[1], LAMB_SP[2], LAMB_SP:  segment synchronous
```

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Formula section:

LAMB_SP_HOM[1] = La_sollreg[1] - Dla_soll_puls[1]
LAMB_SP_HOM[2] = La_sollreg[2] - Dla_soll_puls[2]
LAMB_SP[1] = La_sollreg[1] - Dla_soll_puls[1]
LAMB_SP[2] = La_sollreg[2] - Dla_soll_puls[2]
LAMB_SP = (LAMB_SP[1]+ LAMB_SP[2]) /2
LAMB_HOM_AFL = La_ref_homm
LAMB_BAS_H_RES[NC_CBK_EX_NR] = La_ref_homm
LAMB_BAS[1] = La_bas1
LAMB_BAS[2] = La_bas2

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R.36 Carrierbyte bitmasking

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_aekh_akt	O/V	0... 1H	0 ...1	1	-
Flag indicating " BMW seitige Aussetzererkennung im Katheizbetrieb aktiv"					
B_ar_akt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Anti jerk active"					
B_atlsvc	O/V	0... 1H	0 ...1	1	-
Diagnosefunktion der Abgasturbolader aktiv					
B_atlsvc_khm	O/V	0... 1H	0 ...1	1	-
Anforderung Katheizmanager während der Turboladerdiagnose					
B_bns	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Bordnetzstabilität"					
B_bosmsgc	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung für Sendung der BOS Meldung"					
B_bs1	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung bauteilschutz aktiv 1"					
B_bs2	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung bauteilschutz aktiv 2"					
B_ccbtnach	O/V	0... 1H	0 ...1	1	-
Flag indicating "Batterie nachladen"					
B_ccbttdfk	O/V	0... 1H	0 ...1	1	-
Flag indicating "Batterie prüfen"					
B_ccbttknt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Batteriekontakt /-anschlüsse prüfen!"					
B_ccpmerr	O/V	0... 1H	0 ...1	1	-
Flag indicating "Batterieüberwachung ausgefallen"					
B_ccprio	O/V	0... 1H	0 ...1	1	-
Flag indicating "Komfortverbraucher eingeschränk"					
B_ccruhver	O/V	0... 1H	0 ...1	1	-
Flag indicating "Erhöhte Batterieentladung im Stand"					
B_cdxenonr	O/V	0... 1H	0 ...1	1	-
Xenonverbau-Codierdaten lesen					
B_codierpm	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Sendeanforderung Anfrage Codierung PWM"					
B_dash	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Dashpozänderungsbegrenzung aktiv"					
B_disa_stopp	O/V	0... 1H	0 ...1	1	-
Flag indicating "DISA Ventil schliessen"					
B_disa1_auf	O/V	0... 1H	0 ...1	1	-
Anforderung Disa 1 öffnen aus BMW-Modul					
B_disa2_auf	O/V	0... 1H	0 ...1	1	-
Anforderung Disa 2 öffnen aus BMW-Modul					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_ecobusy	O/V/S	0... 1H	0 ...1	1	-
Ecos Ruhestrommessung busy					
B_esp_h1	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Einspritzung homogen Bank 1"					
B_esp_h2	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Einspritzung homogen Bank 2"					
B_esp_hs1	O/V	0... 1H	0 ...1	1	-
Injection homogeneous-stratiefied mode bank 1					
B_esp_hs2	O/V	0... 1H	0 ...1	1	-
Injection homogeneous-stratiefied mode bank 2					
B_espr_start	O/V	0... 1H	0 ...1	1	-
Flag indicating "Einspritzung wird ausgeführt"					
B_ext_zylstop	O/V	0... 1H	0 ...1	1	-
Bedingung CILC und CYBL stoppen					
B_gangnull	O/V	0... 1H	0 ...1	1	-
Bedingung MSA bis zum nächsten Zündungswechsel deaktivieren					
B_gdst	O/V	0... 1H	0 ...1	1	-
Flag indicating " Schnelle Rampe fuer Vollhubeinstellung "					
B_genoff	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Generator ausgeschaltet"					
B_hd_start	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Einspritzung wird ausgeführt"					
B_hlsh1_off	O/V	0... 1H	0 ...1	1	-
Bedingung Sondenheizung LSU Nachkat Bank 1 ausschalten					
B_hlsh2_off	O/V	0... 1H	0 ...1	1	-
Bedingung Sondenheizung LSU Nachkat Bank 2 ausschalten					
B_hlsu1_off	O/V	0... 1H	0 ...1	1	-
Bedingung Sondenheizung LSU Vorkat Bank 1 ausschalten					
B_hlsu2_off	O/V	0... 1H	0 ...1	1	-
Bedingung Sondenheizung LSU Vorkat Bank 2 ausschalten					
B_hmm_akt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung homogen mager aktiv"					
B_hnox_off	O/V	0... 1H	0 ...1	1	-
Bedingung Heizung Nox-Sensor ausschalten					
B_hom_akt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Homogenbetriebberechnung aktiv"					
B_hschalt_komb	O/V	0... 1H	0 ...1	1	-
Upshift request to instrument cluster (CC message)					
B_hstoech	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Homogenstoechiometrisch angefordert"					
B_kl61	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Klemme 61"					
B_kupp	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Kupplung"					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_la_stopp1	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Lambdaregler Bank 1 stopp"					
B_la_stopp2	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Lambdaregler Bank 2 stopp"					
B_ldm_akt04	O/V	0... 1H	0 ...1	1	-
LDM active					
B_ldm_off	O/V	0... 1H	0 ...1	1	-
Shut off of LDM by ECU					
B_lklps	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Luftklappensteuerung Zu"					
B_lklps1	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Luftklappensteuerung down Zu"					
B_llrein	O/V	0... 1H	0 ...1	1	-
Logical variable for coordination engine start torque and minimum torque and clutch					
B_lradap1_mn	O/V	0... 1H	0 ...1	1	-
Gemischadaption am min. Anschlag, Bank1					
B_lradap1_mx	O/V	0... 1H	0 ...1	1	-
Gemischadaption am max. Anschlag, Bank1					
B_lradap2_mn	O/V	0... 1H	0 ...1	1	-
Gemischadaption am min. Anschlag, Bank2					
B_lradap2_mx	O/V	0... 1H	0 ...1	1	-
Gemischadaption am max. Anschlag, Bank2					
B_lroff	O/V	0... 1H	0 ...1	1	-
Flag indicating "Drehzahlschwelle für LR-Funktion Generator 1aktiv"					
B_lsd	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Lastschlagdämpfungsänderungsbegrenzung aktiv"					
B_maregdk_ad	O/V	0... 1H	0 ...1	1	-
Adaption Massenstromregler auf DK erstmalig erfolgt					
B_mdimin_sa	O/V	0... 1H	0 ...1	1	-
Bedingung minimal mögliches Moment eingestellt für Freigabe Schubabschalten					
B_mol_sf	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bed. Ölzustands-Sensorfehler"					
B_mol_vb	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Ölverbrauchswarnung"					
B_mol_vl	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Ölverbrauchswarnung"					
B_mrmslam	O/V	0... 1H	0 ...1	1	-
Bedingung MS-Abgleich soll über Lambda passieren					
B_msaakt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung MSA aktiv"					
B_msaaktber	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung MSA aktiv und bereit"					
B_msaanz1	O/V	0... 1H	0 ...1	1	-
Flag indicating " MSA-Anzeige bei Abschaltverhinderer"					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_msaanz2	O/V	0... 1H	0 ...1	1	-
Flag indicating " MSA-Anzeige bei Einschaltverhinderer"					
B_msaccid2	O/V	0... 1H	0 ...1	1	-
Bedingung MSA deaktiviert					
B_msaerr	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Fehler MSA"					
B_msaprestopp	O/V	0... 1H	0 ...1	1	-
Preliminary MSA engine stop request					
B_msastart	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Startanforderung MSA"					
B_msastartf	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Startfreigabe MSA"					
B_msastarts	O/V	0... 1H	0 ...1	1	-
Motor wegen MSA gestartet					
B_msastopp	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Stoppanforderung MSA"					
B_msastops	O/V	0... 1H	0 ...1	1	-
Flag indicating "MSA-Stoppstatus für Powermanagement"					
B_mslam1_diag	O/V	0... 1H	0 ...1	1	-
not used flag					
B_mslam2_diag	O/V	0... 1H	0 ...1	1	-
not used flag					
B_nesps_akt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Nacheinspritzung Schicht wird ausgeführt"					
B_nesps_ena	O/V	0... 1H	0 ...1	1	-
Flag indicating "Nacheinspritzung Schicht möglich"					
B_nggelernt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Nullgangposition gelernt"					
B_ngimlf	O/V	0... 1H	0 ...1	1	-
Flag indicating "Nullgangsignal im Lernfenster"					
B_nmax_ba_cc	O/V	0... 1H	0 ...1	1	-
Bedingung CC Meldung durch Drehzahlbegrenzung aus MDBA					
B_notafu	O/V	0... 1H	0 ...1	1	-
Getriebe Not-Anfahrunterstützung					
B_nplmslam_mn	O/V	0... 1H	0 ...1	1	-
not used flag					
B_nplmslam_mx	O/V	0... 1H	0 ...1	1	-
not used flag					
B_nplmslam2_mn	O/V	0... 1H	0 ...1	1	-
not used flag					
B_npmlslam2_mx	O/V	0... 1H	0 ...1	1	-
not used flag					
B_nsub	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Solldrehzahlanhebung bei niedriger Ladebilanz"					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_ntlkws	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Notlauf Kühlkreislauf"					
B_oeltemp	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung gültiger Öltemp Messwert"					
B_oelverb	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung für ausgelöste Ölverbrauchswarnung"					
B_oelverl	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung für ausgelöste Ölverlustswarnung"					
B_oztemic	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung QLT-Temic-verbaut"					
B_pmbsdanf	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung POWERMANAGMENT BATTERIESPANNUNG Sendeanforderung"					
B_pmvsdanf	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung POWERMANAGMENT VERBRAUCHERSTEUERUNG Sendeanforderung"					
B_poel_gelb	O/V	0... 1H	0 ...1	1	-
Bedingung Öldruckkontrolllampe gelb (CC ID 427)					
B_poel_rot	O/V	0... 1H	0 ...1	1	-
Bedingung Öldruckkontrollleuchte rot (CC ID 212)					
B_prailpulskor_ee	O/V	0... 1H	0 ...1	1	-
Druckpulsationskorrektur für homogene Einfacheinspitzung ein-/ausgeschaltet					
B_prailpulskor_me	O/V	0... 1H	0 ...1	1	-
Druckpulsationskorrektur für homogene Mehrfacheinspitzung ein-/ausgeschaltet					
B_prailsw	O/V	0... 1H	0 ...1	1	-
External fuel pressure setpoint request					
B_prsoll_h	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Raildruckkennfeld"					
B_psragr_ad	O/V	0... 1H	0 ...1	1	-
Adaption AGR					
B_psrhub_ad	O/V	0... 1H	0 ...1	1	-
Flag indicating "Adaption Druckregler auf Hub erstmalig erfolgt"					
B_qvch2o	O/V	0... 1H	0 ...1	1	-
Bit für zu hohen Wasserverlus					
B_rkkor_kva	O/V	0... 1H	0 ...1	1	-
Anforderung Verbrauchsberechnung mit korrigierter Kraftstoffmasse					
B_rschalt_komb	O/V	0... 1H	0 ...1	1	-
Downshift request to instrument cluster (CC message)					
B_safast_egs	O/V	0... 1H	0 ...1	1	-
Flag indicating "Schnelles Schubabschalten nach EGS-Schaltungen erlaubt"					
B_sch_akt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Schichtberechnung aktiv"					
B_schicht	O/V	0... 1H	0 ...1	1	-
Flag indicating "Motor läuft im Schichtbetrieb"					
B_sleepwait	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung einschlafen verhindern"					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_spa_cist	O/V	0... 1H	0 ...1	1	-
Zurückgemeltdete Codierung SPA					
B_temxon	O/V	0... 1H	0 ...1	1	-
Flag indicating "Begrenzung der Einspritzzeit"					
B_tev_stopp	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Stop Tev"					
B_tmmi_warn1	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Warnlampe Stufe 1 (gelb) an MMI"					
B_tmmi_warn2	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Warnlampe Stufe 2 (rot) an MMI"					
B_tmmi_warn3	O/V	0... 1H	0 ...1	1	-
Flag indicating "Ansteuerung der MMI-Meldung "bitte hochschalten""					
B_ums_vbsa	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Schubabschaltung verboten"					
B_urst	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Urstart is aktiv"					
B_vb_sa	O/V	0... 1H	0 ...1	1	-
Flag indicating "Schubabschalten verboten wg. niedriger KatTemp."					
B_vb_sa_nk	O/V	0... 1H	0 ...1	1	-
Prohibition of clinder cut off due to high underfloor temperature					
B_vbkhm_notl	O/V	0... 1H	0 ...1	1	-
Bedingung Verbot Katheizen					
B_verb_h	O/V	0... 1H	0 ...1	1	-
Flag indicating "Verbot Homogen"					
B_verb_off	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung elektrische Verbraucher aus"					
B_verb_s	O/V	0... 1H	0 ...1	1	-
Flag indicating "Verbot Schicht"					
B_vlschalt	O/V	0... 1H	0 ...1	1	-
Flag indicating "Lader Status"					
B_vsa_an	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Vanos Auslass im Anschlag"					
B_vsaadp	O/V	0... 1H	0 ...1	1	-
Flag indicating "Anschlagadaption Auslassspreizung variable NWS"					
B_vse_an	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Vanos Einlass im Anschlag"					
B_vseadp	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Vanos Einlass im Anschlag"					
B_vsean_loc	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Vanos Einlass im Anschlag beim letzten abstellen"					
B_wdkdiag_ugd	O/V	0... 1H	0 ...1	1	-
Bedingung Berechnung DKWinkel aus Signal des HF-Sensors ungedrosselt					
B_wese2h_abs	O/V	0... 1H	0 ...1	1	-
Winkel für 2. Einspritzung Homogen aus Wese2_h[Anz_Zyl] benutzen					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_zw_dynman	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Dynamik"					
B_zwdyn	O/V	0... 1H	0 ...1	1	-
Flag indicating "Bedingung Dynamik für Modul zwgrund"					
B_zwmin_ext	O/V	0... 1H	0 ...1	1	-
Bedingung minimaler Zündwinkel von extern					
St_abgasklappe	O/V	0... FFH	0... 255	1	-
Statuswort für Abgasklappe					
St_agr	O	0... FFH	0... 255	1	-
Carrierbyte for status exhaust gas recirculation					
St_anf_prail	O/V	0... FFH	0... 255	1	-
Carrierbyte for status pressure request					
St_anman1	O/V	0... FFH	0... 255	1	-
carrierbyte for status of anman					
St_atldiag2_in	O/V	0... FFH	0... 255	1	-
Statusbyte Interface Eingang					
St_auss	O/V	0... FFH	0... 255	1	-
Status Aussetzerschwellen					
St_ba	O/V	0... FFH	0... 255	1	-
carrierbyte for status of operating mode					
St_bgkuppl	O/V	0... FFH	0... 255	1	-
Carrierbyte for status of clutch					
St_bls	O/V	0... FFH	0... 255	1	-
carrierbyte for status of brake light switch					
St_blsdisa1	O/V	0... FFH	0... 255	1	-
carrierbyte for status of ???					
St_btvns	O/V	0... FFH	0... 255	1	-
carrierbyte for status of VANOS					
St_ckl15	O/V/S	0... FFH	0... 255	1	-
carrierbyte for status of terminal signals via CAN					
St_clc	O/V	0... FFH	0... 255	1	-
carrierbyte for status of combustion mode					
St_cybl	O/V	0... FFFFH	0... 65535	1	-
Carrierword for Gleichstellung					
St_cybl2	O/V	0... FFH	0... 255	1	-
Statuswort für Bits					
St_desul	O/V	0... FFH	0... 255	1	-
carrierbyte for status of desulfuration					
St_devxdetec	O/V/S	0... FFH	0... 255	1	-
Ergebnis BSD-Lernfunktion					
St_dk_diag	O/V/S	0... FFH	0... 255	1	-
carrierbyte for status of TPS diagnosis					
St_dkg	O/V	0... FFH	0... 255	1	-
Anforderungsmodus					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_dkheiz	O/V	0... FFH	0... 255	1	-
Statuswort für Drosselklappenheizung					
St_dkratio	O/V	0... FFH	0... 255	1	-
carrierbyte for status of TPS ???					
St_dtev	O/V	0... FFH	0... 255	1	-
Status TEV-Diagnose					
St_dyndzm	O/V	0... FFH	0... 255	1	-
Statuswort					
St_ecostat1	O/V	0... FFH	0... 255	1	-
Ecos Statusbyte 1					
St_egs	O/V	0... FFH	0... 255	1	-
carrierbyte for status of AT (automatic transmission)					
St_ekp	O/V	0... FFH	0... 255	1	-
carrierbyte for status of electronic fuel pump					
St_elu	O/V/S	0... FFH	0... 255	1	-
carrierbyte for status of electrical cooling fan					
St_fdc	O/V	0... FFH	0... 255	1	-
carrierbyte for status of driving dynamics control units					
St_fgr	O/V	0... FFH	0... 255	1	-
carrierbyte for status of cruise control					
St_fi_nsobd	O/V	0... FFH	0... 255	1	-
Container für Bits					
St_gen_ext	O	0... FFH	0... 255	1	-
Carrierbyte for status external adjustment generator					
St_genallg	O/V	0... FFH	0... 255	1	-
carrierbyte for status of general alternator input values					
St_generator	O/V	0... FFH	0... 255	1	-
carrierbyte for status of alternator					
St_genll	O/V	0... FFH	0... 255	1	-
carrierbyte for status of 'LR' inputs (infos from alternator)					
St_gentester	O/V	0... FFH	0... 255	1	-
Statusbyte Generatortest					
St_getrdaten	O/V	0... FFH	0... 255	1	-
Status Getriebedaten					
St_getriebe	O/V	0... FFH	0... 255	1	-
carrierbyte for status of gearbox					
St_gglsu2	O/V	0... FFH	0... 255	1	-
carrierbyte for status of WRAF sensors					
St_igrin	O/V	0... FFH	0... 255	1	-
Carrierbyte for St_igrin					
St_igrinnv	O/V/S	0... FFH	0... 255	1	-
Carrierbyte " St_igrinnv"					
St_katueb	O/V	0... FFH	0... 255	1	-
carrierbyte for status of catalyst monitoring					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_kl15	O/V	0... FFH	0... 255	1	-
carrierbyte for status of ignition key					
St_klopfen	O/V	0... FFH	0... 255	1	-
carrierbyte for status of knock					
St_kr	O/V	0... FFH	0... 255	1	-
carrierbyte for status of knock control					
St_kr1	O/V	0... FFH	0... 255	1	-
carrierbyte for status of knock control (1)					
St_ksdiag	O/V	0... FFH	0... 255	1	-
Carrierbyte for status "Testeranforderung für Fuel-System-Diagnose"					
St_lam_ad_1	O/V	0... FFH	0... 255	1	-
Status Lambdaadaption Bank1					
St_lam_ad_2	O/V	0... FFH	0... 255	1	-
Status Lambdaadaption Bank2					
St_lamson	O/V	0... FFH	0... 255	1	-
Statuswort Lambdasonden					
St_ll	O/V	0... FFH	0... 255	1	-
carrierbyte for status of idle speed					
St_llr	O/V	0... FFFFH	0... 65535	1	-
carrierwords for status of idle speed control					
St_loadresp	O/V	0... FFH	0... 255	1	-
carrierbyte for status of loadresp					
St_lvs_in	O/V	0... FFH	0... 255	1	-
Statuswort für LVS Eingangsgrößen					
St_lvs_in_nv	O/V/S	0... FFH	0... 255	1	-
Statuswort für LVS Eingangsgrößen nichtflüchtig					
St_mdba_in	O/V	0... FFH	0... 255	1	-
Statuswort für Eingang MDBA					
St_mdbaprio_in	O/V	0... FFH	0... 255	1	-
Statusbyte Bit-Layereingänge Mdbaprio					
St_mkwchn	O/V	0... FFH	0... 255	1	-
carrierbyte for status of ‘master crankshaft					
St_motmsa	O/V	0... FFH	0... 255	1	-
Statuswort Motorzustand					
St_motzustd	O/V	0... FFFFH	0... 65535	1	-
carrierword for status of engine state					
St_msae	O/V	0... FFFFH	0... 65535	1	-
carrierword for msae					
St_msae2	O/V	0... FFH	0... 255	1	-
Statusword msae 2					
St_msaklima	O/V	0... FFH	0... 255	1	-
carrierbyte MSA-Beeinflussung with KLIMA					
St_msasiko	O/V	0... FFH	0... 255	1	-
Statuswort MSA-Plausi					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_oz	O/V	0... FFH	0... 255	1	-
carrierbyte for status of OEZS					
St_oz [_i]	O/V	0... FFH	0... 255	1	-
carrierbyte for status of OEZS					
St_pmcbsin	O/V	0... FFH	0... 255	1	-
Carrierbyte for ???					
St_pmi	O/V/S	0... FFH	0... 255	1	-
carrierbyte for status of inputs for low cost power management					
St_pmi_nv	O/S	0... FFH	0... 255	1	-
Carrierbyte for status of "Eingänge LCP non volatile"					
St_poel	O/V	0... FFH	0... 255	1	-
carrierbyte for oil switch					
St_poelreg1	O/V	0... FFH	0... 255	1	-
Status Öldruckregelung 1					
St_pruef	O/V	0... FFH	0... 255	1	-
carrierbyte for status of lambda request for plausibility test					
St_pwf	O/V	0... FFH	0... 255	1	-
Carrierbyte for status of power fail					
St_rail_tester	O/V	0... FFH	0... 255	1	-
Statuswort Raildruckregler					
St_sawe	O/V	0... FFH	0... 255	1	-
carrierbyte for status of fuel cut-off /restart fuel feed					
St_siko	O/V	0... FFH	0... 255	1	-
carrierbyte for status of ETC monitoring					
St_sk	O/V	0... FFH	0... 255	1	-
Carrierbyte for status of HOM_AFS					
St_slp	O/V	0... FFH	0... 255	1	-
carrierbyte for status of secondary air pump					
St_sls	O/V	0... FFH	0... 255	1	-
carrierbyte for status of secondary air system					
St_spa2	O/V/S	0... FFH	0... 255	1	-
Status SPA					
St_start	O/V	0... FFH	0... 255	1	-
Carrierbyte for status of start					
St_szboost	O/V	0... FFH	0... 255	1	-
Carrierbyte for status of dwell time prolongation					
St_tank	O/V	0... FFH	0... 255	1	-
Carrierbyte for status tank					
St_tevanst	O/V	0... FFH	0... 255	1	-
carrierbyte for status of canister purge control					
St_tevein	O/V	0... FFH	0... 255	1	-
carrierbyte for status of canister purge valve					
St_ti	O/V	0... FFH	0... 255	1	-
carrierbyte for status of injection					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
St_tp	O	0... FFH	0... 255	1	-
Statuswort					
St_tum	O/V	0... FFH	0... 255	1	-
Carrierbyte for status of tum					
St_vbrzyl_ein	O/V	0... FFFFH	0... 65535	1	-
Status Zylindergleichstellung					
St_wdkdiag	O/V	0... FFH	0... 255	1	-
Carrierbyte for status "Status 3. Poti"					
St_wm	O/V	0... FFH	0... 255	1	-
carrierbyte for status of WM-coordinator input					
St_wuerg	O/V	0... FFH	0... 255	1	-
Statuswort für Abwürgerkennung					
St_zwbts	O/V	0... FFH	0... 255	1	-
carrierbyte for status of catalyst overheating prevention					
St_zwgemad	O/V	0... FFH	0... 255	1	-
Statuswort für Bits					
St_zwktibs	O/V	0... FFH	0... 255	1	-
carrierbyte for status of IBS communication					
St_zylab	O/V	0... FFH	0... 255	1	-
carrierbyte for status of cylinder shut-off					
Status_kwnot	O/V	0... FFH	0... 255	1	-
carrierbyte for status of crankshaft limp-home					

Input data:

B_abgasklappe {p. 8283}	B_abgewuergt {p. 8220}	B_agr_ktrl {p. 8197}	B_atlsvc_if {p. 8232}
B_auss_b1 {p. 8360}	B_cdigronw {p. 8283}	B_cdxenonw {p. 8283}	B_crashgen {p. 8366}
B_dc_new {p. 8220}	B_desu_fett {p. 8199}	B_desu_puls {p. 8199}	B_dev0detec {p. 8366}
B_dev1detec {p. 8366}	B_dev2detec {p. 8366}	B_dev3detec {p. 8366}	B_dev4detec {p. 8366}
B_dev5detec {p. 8366}	B_dev6detec {p. 8366}	B_dev7detec {p. 8366}	B_disa_akt {p. 8277}
B_dkheiz_ende {p. 8377}	B_dkratio_h {p. 8377}	B_dscakt {p. 8283}	B_dzm_dyn {p. 8283}
B_ecojob1 {p. 7482}	B_ecojob2 {p. 7482}	B_eol_tev {p. 8229}	B_fagurt {p. 8283}
B_fe {p. 8283}	B_fetrawedeak {p. 8283}	B_fgr_akt {p. 8390}	B_fi_nsobd1 {p. 8363}
B_fi_nsobd2 {p. 8363}	B_ftauf1 {p. 8284}	B_gang_rueck {p. 8394}	B_gangwechsel_gs {p. 8284}
B_gen_ext {p. 8284}	B_gentestanf {p. 7763}	B_gl_ad {p. 8187}	B_gl_adder {p. 8187}
B_gl_adz {p. 8187}	B_gl_adz_offset1 {p. 8187}	B_gl_adz_offset2 {p. 8187}	B_gl_hz {p. 8187}
B_gl_wg1 {p. 8187}	B_gl_wg2 {p. 8187}	B_gl_zsk {p. 8187}	B_gl_zswz {p. 8187}
B_injad_anf {p. 8187}	B_jumpstart {p. 8367}	B_kath {p. 8232}	B_keinhs_gs {p. 8284}
B_kupp1 {p. 8284}	B_lamson_ok1 {p. 8195}	B_lamson_ok2 {p. 8195}	B_lamzylact_1 {p. 8187}
B_lamzylact_2 {p. 8187}	B_ldm_ena {p. 8284}	B_ldm_nofil {p. 8284}	B_lklps_kl1 {p. 8284}
B_lklps_kl2 {p. 8284}	B_lklps_ln {p. 8225}	B_lklps_ln1 {p. 8225}	B_lrad_akt1 {p. 8308}
B_lrad_akt2 {p. 8308}	B_lrad_deakt1	B_lrad_deakt2	B_lurzylact {p. 8187}
B_lvs_neustart {p. 7482}	B_mhauf1 {p. 8284}	B_motlaeuft {p. 8220}	B_msacanerr {p. 8220}
B_msadeakt {p. 8220}	B_msadltgpd {p. 8284}	B_msadltgtd {p. 8284}	B_msadxcav {p. 797}
B_msahfkreset {p. 7679}	B_msaklimaav {p. 8220}	B_msaklimaea {p. 8220}	B_msaled

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B_msalederr	B_msastopp_siko	B_msastopt {p. 8220}	B_msasw {p. 7679}
B_msataster {p. 8284}	B_msavadapt {p. 8220}	B_msaverh {p. 8220}	B_nglern {p. 7482}
B_nosa {p. 8284}	B_nsadap_anf {p. 8363}	B_nsdiag_anf {p. 8363}	B_pmrestore {p. 7679}
B_poel {p. 8202}	B_poelsoltst {p. 8202}	B_rgnkat_hla1 {p. 8199}	B_safast {p. 8379}
B_schalt_dkg {p. 8284}	B_schalt_ldm {p. 8284}	B_schlok {p. 8220}	B_siko_rechnet {p. 8193}
B_sk_homla1 {p. 8136}	B_spa_csoll {p. 7679}	B_sta {p. 8367}	B_start {p. 8209}
B_taleer {p. 8284}	B_td_og {p. 8202}	B_td_ogok {p. 8202}	B_teblg {p. 8229}
B_testpoelsys {p. 7763}	B_toel {p. 8202}	B_tra {p. 8284}	B_tstkvs {p. 8285}
B_warml_zykl {p. 8304}	B_we {p. 8285}	B_wst {p. 8241}	B_zrlvs_clr {p. 7679}
B_zwgemad_1 {p. 8308}	B_zwgemad_2 {p. 8308}	ECU_STATE {p. 1091}	KNK_CTL_DIS {p. 1952}
LV_AD_CLR_RON {p. 8304}	LV_AFL_CLC {p. 1822}	LV_ALTER_BSD_PROT_2 {p. 4094}	LV_ALTER_ERR_EL {p. 4094}
LV_ALTER_ERR_MEC {p. 4094}	LV_ALTER_ERR_TEMP {p. 4094}	LV_ALTER_IF_ACT {p. 4094}	LV_ALTER_RD_TBL_6 {p. 799}
LV_AT {p. 654}	LV_BRAKE_DET {p. 4209}	LV_CAM_SP_CH {p. 799}	LV_CAM_SP_EX_EXT_ADJ {p. 7433}
LV_CAM_SP_IN_EXT_ADJ {p. 7433}	LV_CS_CUS {p. 1419}	LV_CWP_BLOCK_DEAC {p. 4094}	LV_DRI {p. 1302}
LV_ERR_BSD {p. 4834}	LV_FAN_VAR_AD {p. 803}	LV_GS_ACT {p. 6658}	LV_IGK {p. 906}
LV_INH_AFL {p. 1822}	LV_INH_DPS_REG_CPSDIAG {p. 803}	LV_INH_LSCL [NC_CBK_EX_NR] {p. 2544}	LV_INH_S {p. 1822}
LV_KEY_AUX {p. 1566}	LV_KNK_CTL_ENA {p. 1961}	LV_KNK_TRA_N {p. 1962}	LV_LAMB_CH {p. 803}
LV_LOAD_RESP_ALTER_CND_1 {p. 4094}	LV_LOAD_RESP_ALTER_THD_ACT_SP {p. 8368}	LV_LTG_HDLP_L_ON {p. 1566}	LV_LTG_INL_ON {p. 1566}
LV_MFF_S_POST_CH {p. 804}	LV_N_MON_CWP_DEAC {p. 4095}	LV_NT_AFS_REQ {p. 2982}	LV_REQ_HEAT {p. 1567}
LV_REQ_ISC {p. 3501}	LV_RGN_NT_REQ {p. 2983}	LV_RLY_ST_CAN {p. 1567}	LV_S_CLC {p. 1822}
LV_SENS_BAT_SMT_DET {p. 4095}	LV_SO2P_ACT {p. 3129}	LV_SOF_SWI {p. 3851}	LV_TI_CH {p. 1775}
LV_TQ_CRU_ACT {p. 6706}	LV_TQ_IGA_ACT {p. 1948}	LV_TQ_MIN_CLU {p. 8379}	NC_CBK_EX_NR {p. 1829}
St_aekh {p. 8168}	St_ar1 {p. 8169}	St_atldiag2_out {p. 8169}	St_atloutif_out
St_atlstat {p. 8169}	St_ba_agf {p. 8169}	St_blshub {p. 8169}	St_bns {p. 8169}
St_deavns2 {p. 8169}	St_dgen0 {p. 8169}	St_dibs0 {p. 8171}	St_disa_bmw {p. 8171}
St_dps {p. 8171}	St_ecostat2 {p. 8171}	St_eisy_hfm {p. 8171}	St_eisyad_read {p. 8171}
St_eisydiag1 {p. 8171}	St_eisydiag2 {p. 8171}	St_es_urstart {p. 8171}	St_gl_adapt {p. 8172}
St_hhs {p. 8172}	St_igroutnv {p. 8172}	St_imdgen0 {p. 8172}	St_kath_ena {p. 8172}
St_ldstgen {p. 8172}	St_llranh0 {p. 8172}	St_mdar0 {p. 8172}	St_mdar1 {p. 8172}
St_mdar2 {p. 8172}	St_mdbafak {p. 8172}	St_mdbanl_pwgll {p. 8172}	St_mdbanl2 {p. 8172}

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St_mdk {p. 8172}	St_mini {p. 8173}	St_msaa {p. 8173}	St_msaanz {p. 8173}
St_msabs {p. 8173}	St_ngang0 {p. 8173}	St_nmax_ba {p. 8173}	St_oz_o {p. 8173}
St_ozbg0 {p. 8173}	St_pmdiag0 {p. 8173}	St_pmdiag1 {p. 8173}	St_pmprsvcalc1 {p. 8173}
St_poelreg2 {p. 8173}	St_pr {p. 8173}	St_prestoppmsa {p. 8173}	St_qvc1 {p. 8173}
St_rail {p. 8174}	St_sa {p. 8174}	St_sleep {p. 8174}	St_sondenheiz {p. 8174}
St_statmkor1 {p. 8174}	St_ti_b {p. 8174}	St_tiausgang {p. 8174}	St_ugenkor0 {p. 8174}
St_vbrzyl_aus {p. 8174}	St_vsa {p. 8174}	St_vse {p. 8174}	St_wm1 {p. 8174}
St_zwbts1 {p. 8174}	St_zwgrund {p. 8174}	Stat_sv_reg1 {p. 8175}	Stat_sv_reg2 {p. 8175}
STATE_CH {p. 1777}	STATE_CLU_AMT {p. 1571}	STATE_ETC_LIH {p. 4982}	STATE_TEMP_GB {p. 1578}
STATE_TPS_DIAG {p. 4982}	Stpcos {p. 8175}		

R.36.1 Carrierbytes St_.. which are defined as supplier outputs

FUNCTION DESCRIPTION:

General information:

Adaptation to BMW environment

Application conditions

Initialisation at reset or at exit ECU_STATE "PWL": all variables St_.. are initialised with 0 except:

```
St_abgasklappe = 1
St_blsdisa1     =  last calculated value
St_devxdetec              =  last valid value
St_dk_diag              =              first
valid value
St_dkheiz              = 1
St_elu              =  first value
St_elu(0)              =  last stored value
St_fdc              =  first valid value
St_fdc(0)              =  first measured value
St_getriebe              =  first valid value
St_getriebe(0)              =  first measured value


If              LV_VAR_BN = 0
then              St_kl15(0) = 1
else              St_kl15(0) = 0
endif

St_pmi_nv(0) = last stored value
St_pmi_nv(1) = last stored value
St_pmi_nv = last value from nonvolatile memory
St_spa2      = last value from nonvolatile memory
St_lvs_in_nv = last value from nonvolatile memory
```

Recurrence: seg: St_zylab, (if LV_ST_END = 1), St_szboost (if LV_ES = 0)

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```
            Status_kwnot, St_ti

 5ms:  St_dk_diag, St_klopfen, St_dkratio
 10 ms:  St_zylab.  (if LV_ST_END = 0),
            St_szboost ( if LV_ES = 1 )
            St_anman1, St_ba, St_bgkuppl, St_btvns, St_clc,
St_dtev, St_egs, St_ekp, St_fdc, St_fgr, St_generator, St_
getriebe, St_katueb, St_kr, St_kr1, St_ll, St_llr (wird beim
ersten LL-Regler ein gesetzt und nicht mehr geändert), St_
loadresp, St_motzustd, St_slp, St_sls, St_start, St_tevein,
St_tevanst, St_pmi, St_pmi_nv, St_agr, St_sk, St_anf_prail,
St_cybl, St_blsdisa1 , St_poelreg1, St_msae, St_dkg, St_auss,
St_lamson, St_zwgemad, St_abgasklappe, St_dyndzm, St_getrdaten,
St_spa2, St_fi_nsobd, St_motmsa, St_wuerg, St_msae2, St_mdba_
in, St_msasiko, St_mdbaprio_in, St_siko, St_rail_tester
 20 ms:  St_desul, St_kl15, St_sawe, St_zwktibs (via BSD call)
 100 ms:  St_atldiag2_in, St_bls, St_ckl15, St_elu, St_genallg,
St_genll, St_gglsu2, St_gen_ext, St_tank, St_ksdiag, St_pruef,
St_tum, St_pmi_nv, St_tum, St_oz_i, St_entlast_loc, St_igrin,
St_igrinnv, St_poel, St_gentester, St_ecostat1, St_dkheiz,
St_vbrcyl_ein, St_msaklima, St_lam_ad_1, St_lam_ad_2, St_lvs_
in, St_lvs_in_nv, St_cybl2
 200 ms:  St_zwbts, HKWBits2_1000ms, St_wm, St_tp,
 1000 ms:  St_oz
 Once at ECU init:  St_devxdetec, St_pwf
 BSD: St_zwktibs
Activation:      after reset

  During power latch phase:  all variables are zero, except:
  St_atldiag2_in = last calculated value
            St_abgasklappe = last calculated value
            St_blsdisa1   = last calculated value
            St_ckl15 is calculated in the PWL phase
            St_ckl15(0) =  received value
            St_ckl15(1) =  received value
            St_devxdetec =  last valid value
            St_dk_diag = last calculated value
            St_dkheiz =  last calculated value
            St_ecostat1 =  last calculated value
            St_egs =  last value
            St_egs(0) =  last valid value
            St_egs(1) =  last valid value
            St_egs(2) =  last valid value
            St_ekp(3) =  last valid value
            St_elu =  last calculated value
            St_fdc =  last valid value
            St_fdc(0) =  last measured value
            St_genallg =  last value
            St_genallg(0) =  last value
            St_genallg(2) =  last value
            St_genallg(3) =  last value
            St_genallg(4) =  last value
            St_generator =  last calculated value
            St_generator(0) =  last valid value
            St_generator(2) =  last valid value
            St_generator(3) =  last valid value
            St_generator(4) =  last valid value
```

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```
St_generator(5) =  last valid value
St_generator(6) =  last calculated value
St_genll =  last value
St_genll(0) =  last value
St_genll(2) =  last value
St_getriebe =  last valid value
St_getriebe(0) =  last valid value
St_gglsu2(0) =  1
St_gglsu2(1) =  1
St_katueb(0) =  1
St_katueb(1) =  1
St_loadresp =  last value
St_loadresp(0) =  last value
St_mdba_in = last calculated value
St_msae =   last value
St_oz(0) = last calculated value
St_oz(1) = last calculated value
St_oz_i(0) = last value
St_oz_i(1) = last value
St_oz_i(4) = last calculated value
St_pmi(0) is calculated in the PWL phase
St_pmi(1) is calculated in the PWL phase
St_pmi(2) is calculated in the PWL phase
St_pmi(3) is calculated in the PWL phase
St_pmi(4) is calculated in the PWL phase
St_poel =  last value
St_slp(0) = last valid value
St_slp(2) = last valid value
St_sls(0) = last value
St_start =  last calculated value
St_zylab(0) is calculated in the PWL phase
St_zylab(1) is calculated in the PWL phase
St_zwktibs(0) is calculated in the PWL phase
St_tum(0) = last calculated value
St_pmi_nv is calculated in the PWL phase
St_wm   =   last value
St_tum   =   last calculated value
St_gen_ext is calculated in the PWL phase
St_sk    =  last value
St_tank =  last calculated value
St_wdkdiag = last calculated value
St_igrin is calculated in the PWL phase
St_gentester =  last calculated value
St_zwgemad =  last calculated value
St_szboost  is calculated in the PWL phase
St_vbrcyl_ein =  last calculated value
St_msa_klima = last calculated value
St_spa2   = last calculated value
St_fi_nsobd   = last calculated value
St_wuerg =   last calculated value
St_lvs_in =   last calculated value
St_msae2 =   last calculated value
St_mdbaprio_in = last calculated value
St_lvs_in_nv = last calculated value
St_cybl2 = last calculated value
St_rail_tester = Last calculated value
```

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Deactivation: `after power latch phase`

Formula section:
As the applied bitmasks are automatically generated by a script file, there is no separate arrangement stated in this specification.

R.36.2 Carrierbytes B_.. which are defined as BMW outputs

FUNCTION DESCRIPTION:

General information:

Adaptation to BMW environment

Application conditions:

Initialisation at reset or at exit power latch phase:
All values B_.. are initialised with 0, except for:
B_bns = last stored value
B_dash = first measured value
B_lsd = first measured value
B_safast_egs = first measured value
B_vsa_an = last calculated value
B_vse_an = last calculated value
B_lklps = last valid value
B_lklps1 = last valid value
B_disa1_auf = 1
B_disa2_auf = 1
B_maregdk_ad = last calculated value
B_mrmslam = first valid value
B_diagigr = last stored value
B_ecobusy = from nonvoltile memory
B_spa_cist from nonvoltile memory
B_nmax_ba_cc = 1
B_psrhub_ad = last calculated value
B_psragr_ad = last calculated value

Recurrence:
10 ms: B_ar_akt, B_bns, B_dash, B_disa_stopp, B_esp_h1, B_esp_h2, B_espr_start, B_prailsw, B_hd_start, B_hmm_akt, B_hom_akt, B_hstoech, B_kupp, B_la_stopp1, B_la_stopp2, B_lroff, B_lsd, B_nesps_akt, B_nesps_ena, B_prsoll_h, B_sch_akt, B_schicht, B_temxon, B_tev_stopp, B_ulv, B_verb_h, B_verb_s, B_vsa_an, B_vsaadp, B_vse_an, B_vseadp, B_zw_dynman, B_zwdyn, St_fup_bmw, B_gdst, B_esp_hs1, B_esp_hs2, B_hschalt_komb, B_ldm_akt04, B_ldm_off, B_rschalt_komb, B_prailsw, B_disa1_auf , B_disa2_auf, B_msaakt, B_msaaktber, B_msaerr, B_msastart, B_msastartf, B_msastopp, B_msastops, B_gangnull, B_poel_gelb, B_poel_rot, B_vlschalt, B_mdimin_sa, B_zwmin_ext, B_msaprestopp, B_spa_cist, B_msastarts, B_nmax_ba_cc, B_notafu,B_msaccid2, B_vbkhm_notl, B_msaanz1, B_msaanz2, B_nggelernt, B_ngimlf

20 ms: B_wdkdiag_ugd
100 ms: B_atlsvc_khm, ccbtnach, B_ccbttdfk, B_ccbttknt, B_ccpmerr, B_ccprio, B_ccruhver, B_codierpm, B_diagigr, B_genoff, B_kl61, B_pmbsdanf, B_pmvsdanf, B_ums_vbsa, B_verb_off, B_maregdk_ad, B_ecobusy, B_lradap1_mn, B_lradap1_mx, B_lradap2_mn, B_lradap2_mx, B_ext_zylstop, B_psrhub_ad , B_psragr_ad, B_hlsh1_off, B_hlsh2_off,B_hlsu1_off, B_hlsu2_off, B_hnox_off, B_atlsvc

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200 ms: B_bs1, B_bs2, B_ewp_swsp, B_lklps, B_lklps1,B_ntlkws, B_tmmi_warn1, B_tmmi_warn2, B_tmmi_warn3, B_vb_sa_nk
1000 ms: B_bosmsgc, B_mol_sf, B_mol_vb, B_mol_vl, B_nsub, B_oeltemp, B_oelverb, B_oelverl, B_oztemic, B_vb_sa, B_qvch2o
by event: B_sleepwait
seg: B_mrmslam, B_wese2h_abs, B_aekh, B_prailpulskor_ee, B_prailpulskor_me, B_rkkor_kva, B_urst
ini2: B_vsean_loc

Activation: after reset
Deactivation: During power latch phase: all variables B_.. are 0, except for:
B_atlsvc = last calculated value
B_atlsvc_khm = last calculated value
B_bns is calculated in the PWL phase
B_bosmsgc = last calculated value
B_ccbtnach is calculated in the PWL phase
B_ccbttdfk is calculated in the PWL phase
B_ccbttknt is calculated in the PWL phase
B_ccpmerr is calculated in the PWL phase
B_ccprio is calculated in the PWL phase
B_ccruhver is calculated in the PWL phase
B_codierpm is calculated in the PWL phase
B_dash = last valid value
B_ext_zylstop= last valid value
B_ewp_swsp= last value
B_genoff = last valid value
B_kl61 = last calculated value
B_lklps is calculated in the PWL phase
B_lklps1 is calculated in the PWL phase
B_lroff = last value
B_lsd = last valid value
B_safast_egs = last valid value
B_mol_sf = last calculated value
B_mol_vb = last calculated value
B_mol_vl = last calculated value
B_msaakt = last valid value
B_msaaktber= last valid value
B_msaerr = last valid value
B_msastart = last valid value
B_msastartf = last valid value
B_msastopp = last valid value
B_nggelernt = last calculated value
B_ngimlf = last calculated value
B_nsub = last calculated value
B_ntlkws = last calculated value
B_oeltemp = last calculated value
B_oelverb = last calculated value
B_oelverl = last calculated value
B_oztemic = last calculated value
B_pmbsdanf is calculated in the PWL phase
B_pmvsdanf is calculated in the PWL phase
B_sleepwait is calculated in the PWL phase

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B_verb_off = last calculated value
B_vsa_an = last calculated value
B_vsaadp = last calculated value
B_vse_an = last calculated value
B_vseadp = last calculated value
B_disa1_auf = last calculated value
B_disa2_auf = last calculated value
B_maregdk_ad = last calculated value
B_mrmslam = last valid value
B_poelanz = last calculated value
B_diagigr is calculated in the PWL phase
B_gangnull = last calculated value
B_poel_gelb = last calculated value
B_poel_rot = last calculated value
B_vlschalt = last calculated value
B_qvch2o = last calculated value
B_spa_cist = last calculated value
B_lradap1_mn = last calculated value
B_lradap1_mx = last calculated value
B_lradap2_mn = last calculated value
B_lradap2_mx = last calculated value
B_msastarts = last valid value
B_nmaxc_ba_cc = last calculated value
B_psrhub_ad = last calculated value
B_psragr_ad = last calculated value
B_hlsh1_off = last valid value
B_hlsh2_off = last valid value
B_hlsu1_off = last valid value
B_hlsu2_off = last valid value
B_hnox_off = last valid value
B_msaccid2= last calculated value
B_vbkhm_notl= last calculated value
B_prailpulskor_ee = last calculated value
B_prailpulskor_me = last calculated value
B_rkkor_kva = last calculated value
B_msastops = last valid value

Formula section:

As the applied bitmasks are automatically generated by a script file, there is no separate arrangement stated in this specification.

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R.37 Customer adaptation module: MISF

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_auss_b1	O/V	0... 1H	0 ...1	1	-
Bedingung 1. 1000er Intervall					
LV_ER_CLC_MIS_DET_CUS_SPC	O/V	0... 1H	0 ...1	1	-
Enable engine roughness and misfire detection based on customer specific algorithm					
MIS_DET_ENA_CUS_SPC	O/V	0... FFH	0... 255	1	-
Misfire detection enabling condition based on customer specific algorithm, Carrier structure					
MIS_STATE_CUS_SPC	O/V	0... FFH	0... 255	1	-
Status carrier byte of actual detected misfire through customer specific algorithm					
Zr_auss_a	O/V	0... FFFFH	0... 65535	1	-
Aussetzer CARB A					
Zr_auss_b [NC_CYL_NR]	O/V	0... FFFFH	0... 65535	1	-
Aussetzer CARB, zylinderindividuell					
Zr_auss_suma	O/V	0... FFFFH	0... 65535	1	-
Aussetzer Summe CARB A					
Zr_auss_sumb	O/V	0... FFFFH	0... 65535	1	-
Aussetzer Summe CARB B					
Zr_ausszyk_b4	O/V	0... FFH	0... 255	1	-
CARB B4 Zyklen mit Aussetzern					
Zrbk_auss_a [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Aussetzer CARB A, bankweise					
Zrbkmx_auss_a [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 65535	1	-
Schwelle Aussetzer CARB A, bankweise					
Zrmx_auss_a	O/V	0... FFFFH	0... 65535	1	-
Schwelle Aussetzer CARB A					
Zrmx_auss_b1	O/V	0... FFFFH	0... 65535	1	-
Schwelle Aussetzer CARB B1					
Zrmx_auss_b4	O/V	0... FFFFH	0... 65535	1	-
Schwelle Aussetzer CARB B4					

Input data:

B_aekh_akt {p. 8342}	C_MIS_SUM_A_CBK_ THD_AT {p. 6240}	C_MIS_SUM_A_CBK_ THD_MT {p. 6240}	C_MIS_SUM_A_THD_AT {p. 6240}
C_MIS_SUM_A_THD_MT {p. 6240}	C_MIS_SUM_B4_THD_AT {p. 6240}	C_MIS_SUM_B4_THD_MT {p. 6240}	ECU_STATE {p. 1091}
MIS_CTR_B [NC_CYL_NR] {p. 6238}	MIS_SUM_A {p. 6238}	MIS_SUM_A_CBK [NC_CBK_EX_NR] {p. 6238}	MIS_SUM_B {p. 6238}
St_aekh {p. 8168}	St_aekh_ae {p. 8169}		

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R.37.1 Outputs for BMW functions

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

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Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions:

Initialisation at reset or at exit powerlatch: 0
Recurrence : 10ms
Activation: every engine state

Formula section:

Remark: all formulas are valid in a **physical** meaning

```
        If(1)        ECU_STATE = "PWL"
        Then(1)
          B_auss_b1 = 0
  Elseif(1)
          B_auss_b1                       = not(LV_END_MIS_B1)
          Zr_auss_a                       = MIS_SUM_A
          Zr_ausszyk_b4                   = CTR_DET_MIS_B4
          Zrbk_auss_a[NC_CBK_EX_NR]       = MIS_SUM_A_CBK[NC_CBK_EX_NR]
          Zr_auss_b[NC_CYL_NR]            = MIS_CTR_B[NC_CYL_NR]
          Zr_auss_suma                    = MIS_SUM_A
          Zr_auss_sumb                    = MIS_SUM_B
          If(2) LV_AT = 1
          Then(2)
          Zrbkmx_auss_a[NC_CBK_EX_NR] = C_MIS_SUM_A_CBK_THD_AT
             Zrmx_auss_a                  =  C_MIS_SUM_A_THD_AT
             Zrmx_auss_b1                 =  C_MIS_SUM_B1_THD_AT
             Zrmx_auss_b4                 =  C_MIS_SUM_B4_THD_AT
          Elseif(2)
          Zrbkmx_auss_a[NC_CBK_EX_NR] = C_MIS_SUM_A_CBK_THD_MT
             Zrmx_auss_a                  =  C_MIS_SUM_A_THD_MT
             Zrmx_auss_b1                 =  C_MIS_SUM_B1_THD_MT
             Zrmx_auss_b4                 =  C_MIS_SUM_B4_THD_MT
          Endif(2)
  Endif(1)
```

R.37.2 Outputs for supplier MISF Aggregate

FUNCTION DESCRIPTION:

Adaptation to BMW environment

Application conditions

Initialisation: *at reset or at exit powerlatch:* 0
Recurrence: *Segment*
Activation: *every engine state*

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Formula section:

LV_ER_CLC_MIS_DET_CUS_SPC = B_aekh_akt
MIS_STATE_CUS_SPC = St_aekh_ae
MIS_DET_ENA_CUS_SPC = St_aekh

Important Note for the calling sequence :

R.37.3 The following calling sequence should be maintained only for the segment task which

R.37.4 calculates outputs for supplier MISF Aggregate. That is the segment task for this function should be called only after the following calculation

1. Misfire calculation functions from supplier.
2. VRAMO - Misfire calcuation from BMW

After VRAMO, copying BMW variables to supplier variables is done, and hence used in next segment raster of supplier misfire functions.

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R.38 Customer adaptation module: NOXD

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_fi_nsobd1	O/V	0... 1H	0 ...1	1	-
Summenfehler Nox Sensor OBD1					
B_fi_nsobd2	O/V	0... 1H	0 ...1	1	-
Summenfehler Nox Sensor OBD2					
B_nsadap_anf	O/V	0... 1H	0 ...1	1	-
Status Anforderung Noxsensoradaption					
B_nsdiag_anf	O/V	0... 1H	0 ...1	1	-
Status Anforderung Noxsensordiagnose					
Baw_nsadap	O/V	0... FFFFH	0... 65535	1	-
Betriebsarten-Anforderung Noxsensoradaption					
Baw_nsdiag	O/V	0... FFFFH	0... 65535	1	-
Betriebsarten-Anforderung Noxsensordiagnose					

Input data:

ECU_STATE {p. 1091}	LV_ERR_NS_OBD_1 [NC_NOX_SENS_CONF] {p. 4915}	LV_ERR_NS_OBD_2 [NC_NOX_SENS_CONF] {p. 6320}	LV_NS_AD_REQ {p. 3189}
LV_NS_SHIFT_CMB_INT_REQ {p. 6426}	NC_NOX_SENS_CONF {p. 643}	STATE_NS_SHIFT_CMB_REQ {p. 6427}	STATE_OPM_REQ_NS_AD {p. 3189}

R.38.1 Outputs for BMW functions which are not defined as NOXD exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation at reset and at exit "PWL": 0

Recurrence : 10 ms

Activation: *every engine state*

Formula section:

B_fi_nsobd1 = LV_ERR_NS_OBD_1[1]
B_fi_nsobd2 = LV_ERR_NS_OBD_2[1]
If ECU_STAT = "PWL"
Then B_nsadap_anf = 0
B_nsdiag_anf = 0
Baw_nsadap = 0
Baw_nsdiag = 0
Else B_nsadap_anf = LV_NS_AD_REQ
B_nsdiag_anf = LV_NS_SHIFT_CMB_INT_REQ

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Baw_nsadap = STATE_OPM_REQ_NS_AD
Baw_nsdiag = STATE_NS_SHIFT_CMB_REQ

Endif

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R.39 Customer adaptation module: NOXM

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
F_grad_katalt	O/V	8000... 0H	-0.1 ...0	3.0518e-6	1/km
Nox-Kat-Alterungsgradient					
F_katalt	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Nox-Kat-Alterung					
F_katalt_tabg	O/V	0... FFFFH	0... 0.99998	15.3e-6	-
Thermische Nox-Kat-Alterung					

Input data:

ECU_STATE {p. 1091}	FAC_NT_AGI_LIM {p. 3072}	NT_AGI_THERMO {p. 3073}	NT_AGI_THERMO_GRD {p. 3107}

R.39.1 Outputs for BMW functions

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions:

Initialisation at reset or at exit powerlatch:

F_grad_katalt = NT_AGI_THERMO_GRD
F_katalt = FAC_NT_AGI_LIM
F_katalt_tabg = NT_AGI_ THERMO

Recurrence : 200ms
Activation: every engine state

Formula section:

Remark: all formulas are valid in a **physical** meaning

If ECU_STATE = not("PWL")
Then
F_grad_katalt = NT_AGI_THERMO_GRD
F_katalt = FAC_NT_AGI_LIM
F_katalt_tabg = NT_AGI_ THERMO
end

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R.40 Customer adaptation module: PWSL

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_bsdprot1	O/V	0... 1H	0 ...1	1	-
condition for BSD protocol controller type 1					
B_bsdprot2	O/V	0... 1H	0 ...1	1	-
condition for BSD protocol controller type 2					
B_crashgen	O	0... 1H	0 ...1	1	-
condition alternator shut off at crash					
B_dev0detec	O/V	0... 1H	0 ...1	1	-
bit 0 of learned LF_BSD_CPT_AVL					
B_dev1detec	O/V	0... 1H	0 ...1	1	-
bit 1 of learned LF_BSD_CPT_AVL					
B_dev2detec	O/V	0... 1H	0 ...1	1	-
bit 2 of learned LF_BSD_CPT_AVL					
B_dev3detec	O/V	0... 1H	0 ...1	1	-
bit 3 of learned LF_BSD_CPT_AVL					
B_dev4detec	O/V	0... 1H	0 ...1	1	-
bit 4 of learned LF_BSD_CPT_AVL					
B_dev5detec	O/V	0... 1H	0 ...1	1	-
bit 5 of learned LF_BSD_CPT_AVL					
B_dev6detec	O/V	0... 1H	0 ...1	1	-
bit 6 of learned LF_BSD_CPT_AVL					
B_dev7detec	O/V	0... 1H	0 ...1	1	-
bit 7 of learned LF_BSD_CPT_AVL					
B_fabttreg	O/V	0... 1H	0 ...1	1	-
condition note battery change					
B_fahisrst	O/V	0... 1H	0 ...1	1	-
condition reset histogram					
B_fapmmess	O/V	0... 1H	0 ...1	1	-
condition measure method PM					
B_genactiv	O/V	0... 1H	0 ...1	1	-
condition alternator interface activ					
B_genfbsd	O/V	0... 1H	0 ...1	1	-
communication fault BSD-alternator (old: LV_GEN_IF_OFF)					
B_genfel	O/V	0... 1H	0 ...1	1	-
electrical fault alternator					
B_genfht	O/V	0... 1H	0 ...1	1	-
(excess) temperature fault alternator					
B_genfme	O/V	0... 1H	0 ...1	1	-
mechanical fault alternator					
B_ibsactiv	O/V	0... 1H	0 ...1	1	-
Bedingung IBS erkannt					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_ierr_ext	O/V	0... 1H	0 ...1	1	-
Anforderung Grenzerregerstrom vom Tester					
B_jumpstart	O/V	0... 1H	0 ...1	1	-
Bedingung Jumpstart					
B_kl15_ep	O/V	0... 1H	0 ...1	1	-
1: ignition on					
B_kl15_vorab	O/V	0... 1H	0 ...1	1	-
active during delayed ignition switch off					
B_loadre_ext	O/V	0... 1H	0 ...1	1	-
Anforderung Loadresponse vom Tester					
B_lrfoff	O/V	0... 1H	0 ...1	1	-
shut of the load response threshold for alternator (copy)					
B_lrreg1ak	O/V	0... 1H	0 ...1	1	-
load response condition (for register 1) alternator activ					
B_rd_gentyp	O/V	0... 1H	0 ...1	1	-
read alternator type and manufacturer					
B_sta	O/V	0... 1H	0 ...1	1	-
flag indicating that automatic starter function is active					
B_ulcp	O/V	0... 1H	0 ...1	1	-
Ultra-low-cost powermanagement enabled					
Batt_coort	O	0... FFH	0... 255	1	-
position battery (read out of coding)					
Bsdcontrol	O	0... FFH	0... 255	1	-
Communication coordination byte					
Bsddata	O	0... FFH	0... 255	1	-
Content of register					
Bsdgencv	O	0... FFH	0... 255	1	-
chip version alternator					
Bsdgenregv	O	0... FFH	0... 255	1	-
controller version alternator					
Bsdregadr	O	0... FFH	0... 255	1	-
Actual register number					
CTR_BSD_ERR_CHK_SUM_2	O	0... FFFFH	0... 65535	1	-
Fehlerzähler EBSD Checksumme					
CTR_IBS_ERR_1	-	0... FFH	0... 255	1	-
Dibs Fehlerzähler BSD					
CTR_IBS_ERR_2	-	0... FFFFH	0... 65535	1	-
Dibs Fehlerzähler EBSD					
CTR_PWR_ERR_PREV_DIV_2	-	0... FFH	0... 255	1	-
Vorteiler für Ibsderrs2					
CUR_ALTER_EXCT_LIM_SP	O	0... 1FH	0... 7.75	0.25	A
Setpoint alternator exciting current limitation					
CUR_ALTER_MAX	O/V	0... FFH	0... 255	1	A
maximum current alternator					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CUR_GEN	O/V	0... FFH	0... 255	1	A
Short term solution for satisfaction of CAN, representing the alternator current (will be replaced by CUR_GEN)					
Dfgrob	O	0... FFH	0... 255	1	-
DF rough value (occupancy factor) from alternator					
Dfsiggen	O	0... FFH	0... 99.60937	0.390625	%
occupancy of alternator					
Gen_manufak	O	0... FFH	0... 255	1	-
manufacturer identifier alternator					
Gen_typkenn	O	0... FFH	0... 255	1	-
type identifier alternator alternator					
IBS_COD	O	0... FFH	0... 255	1	-
IBS Hardwareversion					
IBS_SW_BASE	O	0... FFH	0... 255	1	-
IBS Softwarebaseline					
Ierr	O	0... FFH	0... 31.875	0.125	A
exciting current alternator					
Ierr_grenz_ext	O	0... FFH	0... 31.875	0.125	A
Grenzerregerstrom vom Tester					
Ierrfgrenz	O	0... FFH	0... 31.875	0.125	A
actual value exciting current limitation alternator					
LOAD_BAT	O/V	0... FFH	0... 99.60937	0.390625	%
DF-Monitor for accumulator charge in %					
LOAD_CDN_BAT	O/V/S	0... FFH	0... 99.60937	0.390625	%
condition of battery load (for serial communication)					
LV_ALTER_SWI_OFF	O/V	0... 1H	0 ...1	1	-
Logical variable indicating 'alternator switched off =1'					
LV_LOAD_RESP_ALTER_THD_ACT_SP	O/V	0... 1H	0 ...1	1	-
shut of the load response threshold for alternator (setpoint)					
LV_N_SP_IS_POW_ACT	O/V	0... 1H	0 ...1	1	-
1: idle speed increase due to low accumulator charge					
LV_N_SP_IS_PWR_STAB	O/V	0... 1H	0 ...1	1	-
request for idle speed setpoint due to power management request for power supply stability					
N_ALTER	O/V	8000... 7FFFH	-32768 ...32767	1	rpm
alternator speed					
N_ST_POW_MOD	O/V	0... FFH	0... 8160	32	rpm
engine speed at start for power modul					
NR_ADD_IBS	O	0... FFFFFFFFH	0... 4294967295	1	-
Zusbaunummer					
NR_IBS	O	0... FFFFFFFFH	0... 4294967295	1	-
Seriennummer IBS					
POW_REL_ALTER_CLC	O/V	0... FFH	0... 99.60937	0.390625	%
calculated DF-signal from alternator					
STATE_ALTER	O/V	0... FFH	0... 255	1	-
Alternator status					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
STATE_CUR_ENG_CNS	O/V	8000... 7FFFH	-32768 ...32767	1	A
current consumption of engine					
STATE_IBS_SW_CHG	O	0... FFH	0... 255	1	-
IBS SW-Änderungsstatus					
T_LOAD_RESP_ALTER_SP	O/V	0... 3H	0... 15	5	s
Setpoint for alternator 1 load response time					
Tchip	O	8000... 7FFFH	-3276.8 ...3276.7	0.1	°C
chip temperature alternator					
Td_f_ierr	O	0... FFH	0... 2.55	0.01	s
calibratible filter time for exciting current (alternator powermanagement)					
Td_rdgenreg2	O	0... FFH	0... 25.5	0.1	s
calibratible time period for reading register 2 (alternator powermanagement)					
TEMP_ALTER	O/V	0... FEH	-48... 142.5	0.75	°C
Temperature alternator (for environmental fault memory)					
Tlrfgen	O	0... FFH	0... 25.5	0.1	s
actual value alternator load response time					
Tlrgen_ext	O	0... FFH	0... 25.5	0.1	s
Loadresponse vom Tester					
TQ_LOSS_ALTER	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque consumption of alternator at crankshaft *					
U_fgen	O	0... FFFFH	0... 6553.5	0.1	V
received voltage alternator (copy of voltage setpoint send to the bus)					
U_gensollpm	O	8000... 7FFFH	-128... 127.99609	3.9062e-3	V
Alternator voltage setpoint from power module					
Ub	O	0... FFFFH	0... 6173.397	0.0942	V
battery voltage					
Uregnom	O	0... FFFFH	0... 6553.5	0.1	V
nominal voltage alternator					
V_ALTER_SP	O/V	0... 3FH	10.6 ...16.9	0.1	V
setpoint alternator 1 voltage					
V_LEVEL	O/V	0... FFH	0... 255	1	-
voltage level					
VB_POW_MNG	O/V	0... FFFH	0... 61.425	0.015	V
current battery voltage					
W_ub	O	0... FFH	0... 24.021	0.0942	V
battery voltage raw value					

Input data:

ALTER_COD_0 {p. 4093}	ALTER_COD_1 {p. 4093}	ALTER_COD_2 {p. 4093}	ALTER_COD_3 {p. 4093}
B_bns {p. 8342}	B_genoff {p. 8343}	B_lroff {p. 8344}	B_nsub {p. 8345}
B_sleepwait {p. 8346}	BSD_SENS_BAT_SMT_ADR {p. 4093}	BSD_SENS_BAT_SMT_INFO {p. 4093}	C_T_RD_PER_ALTER_TBL_2 {p. 4097}
CUR_ALTER_EXCT {p. 4093}	CUR_ALTER_EXCT_LIM {p. 4093}	Dffgen {p. 8156}	Dfmonitor {p. 8156}
ECU_STATE {p. 1091}	I_craweng {p. 8158}	I_gen {p. 8158}	I_genmax {p. 8158}

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lbhwversi {p. 8159}	lbsderrs1 {p. 8159}	lbsderrs2 {p. 8159}	lbspreco2 {p. 8159}
lbswbase {p. 8159}	lbswchang {p. 8159}	lerrgrenz {p. 8159}	Ktupcsctr {p. 8159}
LF_BSD_CPT_AVL {p. 4093}	LF_BSD_SENS_BAT_SMT_CTL {p. 4093}	LV_ALTER_BSD_PROT_2 {p. 4094}	LV_ALTER_ERR_IF {p. 4094}
LV_ALTER_ERR_MEC {p. 4094}	LV_ALTER_ERR_TEMP {p. 4094}	LV_ALTER_IF_ACT {p. 4094}	LV_IGK {p. 906}
LV_IGK_PREL {p. 906}	LV_LOAD_RESP_ALTER_CND_1 {p. 4094}	LV_LOAD_RESP_ALTER_THD_ACT {p. 4095}	LV_POW_MNG_BAT_CHG {p. 7483}
LV_POW_MNG_HIS_RST {p. 7680}	LV_POW_MNG_MES_MOD {p. 7483}	LV_PWL_LOCK_CDN_CUS_INH {p. 7483}	LV_SENS_BAT_SMT_ACT {p. 4095}
LV_SENS_BAT_SMT_DET {p. 4095}	LV_ST {p. 1720}	LV_VAR_BN {p. 655}	LV_VAR_VEH {p. 656}
LV_VB_JUMP {p. 1185}	Md_gennm_na {p. 8160}	N_gen {p. 8163}	N_nstart {p. 8163}
NC_PWL_LOCK_CDN_CUS {p. 3778}	POW_REL_ALTER {p. 4095}	POW_REL_ALTER_L_RES {p. 4096}	PWL_LOCK_CDN {p. 3776}
Snibs {p. 8168}	St_gen {p. 8171}	STATE_EFP_CRASH_CAN {p. 1573}	T_FIL_CUR_EXCT_ALTER {p. 4096}
T_LOAD_RESP_ALTER {p. 4096}	TEMP_ALTER_MC {p. 4096}	Tgen {p. 8177}	Tlrgen {p. 8177}
U_gen {p. 8178}	Ubt {p. 8179}	Ulev {p. 8179}	V_ALTER {p. 4096}
V_ALTER_NOM {p. 4096}	V_GEN_TAR {p. 1582}	VB {p. 1185}	VB_BAS {p. 831}
Zbibs {p. 8180}			

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_BAT_PSN	-	0... FFH	0... 255	1	-
Position of battery in vehicle					
ID_ALTER_EXCT_LIM_SP	-	0... 1FH	0... 7.75	0.25	A
LDP_ALTER_COD_0	8	0... 7H	0 ...7	1	-
Setting of CUR_ALTER_EXCT_LIM_SP in dependence of ALTER_COD_0					
LC_ALTER_EXCT_LIM_SP	-	0... 1H	0 ...1	1	-
logical constant: software swich to choose BSD					
LC_PWSL_ENA	-	0... 1H	0 ...1	1	-
Ultra-low-cost powermanagement enabled					

R.40.1 Outputs for BMW functions which are not defined as PWSL exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the output are different from the specified values due to the input data attributes.

General information:

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In case of vehicle variant E60 the DME takes over certain functionalities of the former Powermodul -ECU. If no IBS is implemented in the car these functionalities are calculated by the ultra-low-cost-powermanagement (an add-on to the actual powermanagement).

Application conditions

Initialisation: `all 0 after reset`

except:

ALTER_COD_0 = 7 H // initalisation to max value
ALTER_COD_1 = 1F H // initalisation to max value

If LV_VAR_BN = 0 **then** *// for CAN 11*
B_kl15_ep = 1
B_kl15_vorab = 1
endif
Ub = Batt_coort = W_ub = 1^{st} valid ADC-value
U_fgen x = 1^{st} calculated value
Gen_manufak = Gen_typkenn = 255
B_rd_gentyp = 1
B_dev0..7detec = LF_BSD_CPT_AVL

Recurrence : all BSD driver timing

except:

Batt_coort = once at ECU init
10 ms: B_crashgen, W_ub, B_kl15_vorab, B_sta, B_jumpstart
20 ms: B_kl15_ep, Ub
50 ms: Gen_typkenn, Gen_manufak
100 ms: VB_POW_MNG, ulev, B_fabttreg, B_fahisrst, B_fapmmess, U_gensollpm, B_ulcp , Cur_gen, B_dev0..7detec
Once only,
never changed: Ierr_grenz_ext = 31.87 A
TIrgen_ext , B_ierr_ext, B_loadre_ext = 0

Activation: *every ECU - State (including Wakeup)*

Formula section:

Remark: all formulas are valid in a physical meaning

B_dev0..7detec = LF_BSD_CPT_AVL
B_kl15_ep = LV_IGK
B_kl15_vorab = LV_IGK_PREL
B_lrreg1ak = LV_LOAD_RESP_ALTER_CND_1
B_genactiv = LV_ALTER_IF_ACT
B_genfel = LV_ALTER_ERR_EL
B_genfme = LV_ALTER_ERR_MEC
B_genfht = LV_ALTER_ERR_TEMP
B_genfbsd = LV_ALTER_ERR_IF
B_sta = LV_ST

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B_ierr_ext = 0
B_loadre_ext = 0
B_fabttreg = LV_POW_MNG_BAT_CHG
B_fahisrst = LV_POW_MNG_HIS_RST
B_fapmmess = LV_POW_MNG_MES_MOD
B_ibsactiv = LV_SENS_BAT_SMT_ACT

If LV_ALTER_BSD_PROT_2 = 1
Then B_lrfoff = ! LV_LOAD_RESP_ALTER_THD_ACT(n-1)
Else B_lrfoff = ! LV_LOAD_RESP_ALTER_THD_ACT
Endif

Batt_coort = C_BAT_PSN
Bsddata = BSD_SENS_BAT_SMT_INFO
Bsdregadr = BSD_SENS_BAT_SMT_ADR
Bsdcontrol = LF_BSD_SENS_BAT_SMT_CTL
Bsdgenregv = ALTER_COD_2
Bsdgencv = ALTER_COD_3
Dfsiggen = POW_REL_ALTER
Dfgrob = POW_REL_ALTER_L_RES
Gen_manufak = ALTER_COD_0
Gen_typkenn = ALTER_COD_1
If ECU_STATE = "PWL"
Then Ierr = 0
Else Ierr = CUR_ALTER_EXCT
B_jumpstart = LV_VB_JUMP
endif
Ierrfgrenz = CUR_ALTER_EXCT_LIM
Tchip = TEMP_ALTER_MC
Td_f_ierr = T_FIL_CUR_EXCT_ALTER
Td_rdgenreg2 = C_T_RD_PER_ALTER_TBL_2
U_fgen = V_ALTER
U_gensollpm = V_GEN_TAR
Uregnom = V_ALTER_NOM
VB_POW_MNG = Ubt
Ub = VB
ulev = Ulev
W_ub = VB_BAS * 5,747
Hint: Conversion from 0...5V (10 bit) of VB_BAS to 0...24V (8 bit) of W_ub.
(HW potential divider 28.7 V /26 V; 5,747 = 28.7 V /5 V)
If STATE_EFP_DRASH_CAN = 2
then B_crashgen = 1
else B_crashgen = 0
endif

If LV_VAR_BN = 1 **and** LV_VAR_VEH = 0 **and**
(LV_SENS_BAT_SMT_DET = 0 or LC_PWSL_ENA = 1)
then B_ulcp = 1
else B_ulcp = 0
endif

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If LV_ALTER_BSD_PROT_2 = 1
then B_bsdprot1 = 0 and
B_bsdprot2 = 1
else B_bsdprot1 = 1 and
B_bsdprot2 = 0
endif

Tlrfgen = T_LOAD_RESP_ALTER (according the translation tablebelow)
for writing into register 1 (three bit s for information reserved)

ID_KFTLRGEN2_INV	n=0	n=1	n=2	n=3	n=4	n=5	n=6	n=7	output data: T_lrfgen
tn [sec]	0	0,2	0,4	3	6	9	12	15	input data: T_LOAD_RESP_ALTER

Depending on ALTER_COD_0 and ALTER_COD_1 the load response should be read/writen out/into register 1 (see fkt-LR-write). tn [sec] can t be send by BSD directly because the number of protocoll bits are limited. This bit combination has to be translated according the tables. Translation from bit combination to tn [sec] and vice versa. If the input data is between two break points, then the minimum break point must be used.

R.40.2 Outputs for supplier Aggregates, customer(supplier

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation: `all 0 after reset`

Except:

V_ALTER_SP = 1^{st} calculated value
T_LOAD_RESP_ALTER_SP = 1^{st} calculated value

Recurrence: 1000ms: LV_N_SP_IS_POW_ACT, LOAD_BAT, LOAD_CDN_BAT, hwversi, ibswbase, ibswchang, snibs, zbibs, B_sleepwait
100ms: V_ALTER_SP, T_LOAD_RESP_ALTER_SP, LV_ALTER_SWI_OFF, STATE_CUR_ENG_CNS, LV_LOAD_RESP_ALTER_THD_ACT_SP, st_i_gen, STATE_ALTER, st_gen, CUR_ALTER_MAX, TEMP_ALTER , , ibsderrs1, ibsderrs2, ibspreco2, ktupcsctr
10ms: N_ST_POW_MOD, TQ_LOSS_ALTER, POW_REL_ALTER_CLC, CUR_ALTER_EXCT_LIM_SP,
T_LOAD_RESP_ALTER_SP, LV_N_SP_IS_PWR_STAB, N_ALTER

Activation: every ECU - State (including Wakeup)

Formula section:

Remark: all formulas are valid in a **physical** meaning

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LV_ALTER_SWI_OFF = B_genoff
CUR_ALTER_EXCT_LIM_SP = Ierrgrenz
If CUR_ALTER_EXCT_LIM_SP == 0 **and** LC_ALTER_EXCT_LIM_SP == 1
Then CUR_ALTER_EXCT_LIM_SP = ID_ALTER_EXCT_LIM_SP
Else CUR_ALTER_EXCT_LIM_SP = CUR_ALTER_EXCT_LIM_SP
Endif
CUR_ALTER_MAX = I_genmax
LOAD_CDN_BAT = Dfmonitor
LOAD_BAT = Dfmonitor
LV_N_SP_IS_POW_ACT = B_nsub
LV_LOAD_RESP_ALTER_THD_ACT_SP = ! B_lroff
N_ALTER = N_gen
N_ST_POW_MOD = N_nstart
POW_REL_ALTER_CLC = Dffgen
STATE_ALTER = St_gen
st_gen = STATE_ALTER (short time solution for satisfact. of CAN)

STATE_CUR_ENG_CNS = I_craweng
CUR_GEN = I_gen
TQ_LOSS_ALTER = Md_gennm_na
TEMP_ALTER = Tgen
V_ALTER_SP = U_gen
T_LOAD_RESP_ALTER_SP = Tlrgen (according the translation tables below)

for writing into register 0 (two bit s for information reserved)

ID_KFTLRGEN1	n=0	n=1	n=2	n=3	input data: T_lrgen
tn [sec]	0	3	6	9	output data: T_LOAD_RESP_ALTER_SP

for writing into register 1 (three bit s for information reserved)

ID_KFTLRGEN2	n=0	n=1	n=2	n=3	n=4	n=5	n=6	n=7	input: T_lrgen
tn [sec]	0	0,2	0,4	3	6	9	12	15	output data: T_LOAD_RESP_ALTER_SP

Depending on ALTER_COD_0 and ALTER_COD_1 the load response should be read/written out/into register 0 or register 1 (see fkt-LR-write). tn [sec] can t be send by BSD directly because the number of protocoll bits are limited. This bit combination has to be translated according the tables. Translation from bit combination to tn [sec] and vice versa. If the input data is between two break points, then the minimum break point must be used.

ibhwversi = Ibhwversi
ibsderrs1 = Ibsderrs1
ibsderrs2 = Ibsderrs2
ibspreco2 = Ibspreco2
ibswbase = Ibswbase
ibswchang = Ibswchang
ktupcsctr = Ktupcsctr
snibs = Snibs
zbibs = Zbibs
LV_N_SP_IS_PWR_STAB = B_bns

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IF B_sleepwait = 1 **and**
LV_PWL_LOCK_CDN_CUS_INH = 0
THEN PWL_LOCK_CDN[NC_PWL_LOCK_CDN_CUS] = 1
//"set power-latch lock condition corresponding to
NC_PWL_LOCK_CDN_CUS in PWL_LOCK_CDN"

ELSE PWL_LOCK_CDN[NC_PWL_LOCK_CDN_CUS] = 0
//"reset power-latch lock condition corresponding to
NC_PWL_LOCK_CDN_CUS in PWL_LOCK_CDN"
ENDIF

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R.41 Customer adaptation module: SAIR

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_fasls	O/V	0... 1H	0 ...1	1	-
1: activation of secondary air pump is possible					
B_genslp	O/V	0... 1H	0 ...1	1	-
1: secondary air pump is active (condition for voltage request SAP)					
B_sls	O/V	0... 1H	0 ...1	1	-
1: secondary air pump is active					
Md_na_sls	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
torque losses secondary air pump					
Ms_sl	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Massenstrom Sekundärluft					

Input data:

SAF_KGH {p. 807}			

R.41.1 Outputs for BMW functions which are not defined as SAIR exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation: `all variables are initialisied with 0`

Recurrence: **200 ms:** `Ms_sl`

Activation: `every engine state`
In the power latch phase:
`0: Ms_sl`

Formula section:

B_fasls = 0

B_genslp =0
B_sls = 0
Md_na_sls = 0 Nm
Ms_sl = SAF_KGH

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R.42 Customer adaptation module: THRO

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_dkerr_2pot	O/V	0... 1H	0 ...1	1	-
Bedingung beide DK-Potis defekt					
B_dkheiz_ende	O/V	0... 1H	0 ...1	1	-
Bedingung Heizturnus Drosselklappe beendet					
B_dkratio_h	O/V	0... 1H	0 ...1	1	-
Homogener Betrieb angefordert					
TPS_SP_MDL	O/V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Desired throttle angle based on customer intake model					
TPS_SUB_DIAG	O/V	0... 3FFFH	0... 119.5	7.2941e-3	°TPS
Substitute TPS_AV value calculated out of IMM					
Wdk_ist	O/V	8000... 7FFFH	-800... 799.97558	0.0244141	%
Actual throttle angle					

Input data:

C_TPS_SP_MAX {p. 6555}	LV_MTC_HEAT_READY {p. 6531}	STATE_TPS_DIAG {p. 4982}	TPS_AV {p. 1169}
Wdk_diag {p. 8179}	Wdk_soll {p. 8179}		

FUNCTION DESCRIPTION:

General information:

Adaption to BMW environment.
Remark: The really possible resolution and limits of the output are different to the specified values due to the input data attributes.

Application conditions:

Initialisation at reset or at exit power latch phase
0
except:
Wdk_ist = TPS_AV after first valid sampling
B_dkheiz_ende = 1
Recurrence: 10ms
Except: 5ms: B_dkratio_h
100ms: B_dkheiz_ende
segment: Wdk_ist

Note: Wdk_ist has to be updated directly after TPS_AV has been calculated. Wdk_ist have to be hold on last calculated value during power latch phase.
Activation: at every engine stat
Deactivation: at power latch phase
Values at deactivation: B_dkratio_h: 0

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B_dkerr_2pot, TPS_SUB_DIAG, TPS_SP_MDL, Wdk_ist, B_dkheiz_ende : un-changed

Formula section:

Remark: all formulas are valid in a **physical** meaning

TPS_SP_MDL = (Wdk_soll/100%) C_TPS_SP_MAX
Wdk_ist = (TPS_AV /C_TPS_SP_MAX) 100%
If STATE_TPS_DIAG = TPS_DBL_ERROR //8H
Then B_dkerr_2pot = 1
Else B_dkerr_2pot = 0
Endif
If STATE_TPS_DIAG = 1 or 2 or 4
Then B_dkratio_h = 1
Else B_dkratio_h = 0
Endif

TPS_SUB_DIAG = (Wdk_diag/100%) C_TPS_SP_MAX
B_dkheiz_ende = LV_MTC_HEAT_READY

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R.43 Customer adaptation module: TQDR

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_safast	O/V	0... 1H	0 ...1	1	-
Bedingung schnelles Schubabschalten					
EFF_LAMB_AV	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Actual lambda efficiency					
EFF_LAMB_AV_CBK [NC_CBK_EX_NR]	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Actual lambda efficiency, bank specific					
EFF_LAMB_BAS_COR	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Basic lambda efficiency					
EFF_LAMB_SP_BAS	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Basic lambda setpoint efficiency					
Eta_zw_ist1	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Ignition efficiency actual ignition angle bank selective					
Eta_zw_ist2	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Ignition efficiency actual ignition angle bank selective					
Eta_zw_min	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Ignition efficiency minimum ignition angle					
Eta_zw_mint	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Ignition efficiency					
Eta_zwve_m	O/V	0... 7FFFH	0... 99.99694	3.0518e-3	%
Mean value ignition angle efficiency					
Eta_zylausbas	O/V	0... FFFFH	0... 199.99694	3.0518e-3	%
Basic efficiency fuel cut-off pattern					
F_wnwkhk_sw	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Überblendfaktor (warm/kalt) für Spreizung und Zündhaken während Katheizen von Zulieferer					
FAC_CAM_CH	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for weighting FAC_EFF_IGA at Catalyst heating					
FAC_EFF_IGA_CH	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for fading ignition angle efficiency in case of catalyst heating					
FAC_EFF_IGA_SCAV	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for fading ignition angle efficiency in case of scavenging operation					
FAC_EFF_IGA_SECU	O/V	0... FFH	0... 0.99609	3.9063e-3	-
Factor for fading ignition angle efficiency in case of cold/warm engine					
LV_GS_ACT_FL	O/V	0... 1H	0 ...1	1	-
Logical bit which indicates gear shift at full load condition					
LV_TQ_IGA_ENA	O/V	0... 1H	0 ...1	1	-
Torque intervention for ignition released					
LV_TQ_MIN_CLU	O/V	0... 1H	0 ...1	1	-
Logical variable for coordination engine start torque and minimum torque and clutch					
LV_TQI_BOL_SET	O/V	0... 1H	0 ...1	1	-
Logical variable it is set if TQI_SP falls below TQI_BOL					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Mdi_bas	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Basic indicated engine torque					
Mdi_katschutz	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
torque limitation for catalyst protection					
Mdi_vmax	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
torque limitation for vehicle speed limitation					
Mdk_ist	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
minimum torque at clutch					
Mdk_ist_lm	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Ist-Moment aus Luftmasse ohne externe Eingriffe					
Mdk_max_gs	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Begrenzung maximales Kupplungsmoment durch EGS-Notlauf					
TQ_MAX_CLU	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum torque at clutch					
TQ_MIN_CLU	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Minimum torque at clutch					
TQI_AV_HOM	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Actual indicated engine torque for homogeneous mode					
TQI_AV_S	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Actual indicated engine torque in stratified mode					
TQI_MAX	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum indicated torque					
TQI_MIN_HOMS	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min Reference indicated engine torque for HOMS					
TQI_MIN_S	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Min Reference indicated engine torque for stratified mode					
TQI_REF	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Reference indicated engine torque					
TQI_REF_MAX	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum indicated torque from IP_TQI_REF at MAF_MAX_COR					
TQI_REF_S	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Indicated reference engine torque for stratified mode					
TQI_SP_MAF	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Indicated engine torque for determination of air mass flow setpoint in homogeneous mode					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit

Input data:

B_llrein {p. 8344}	B_mdimin_sa {p. 8344}	B_vlschalt {p. 8347}	B_zw_dynman {p. 8348}
ECU_STATE {p. 1091}	EFF_IGA_AV_CBK [NC_CBK_EX_NR] {p. 1845}	EFF_IGA_BAS_COR_KNK_FIL {p. 1845}	EFF_IGA_MIN {p. 1845}
EFF_IGA_MIN_TEG {p. 1845}	EFF_SCC_BAS {p. 6665}	Eta_labas {p. 8157}	Eta_labas_sol {p. 8157}
Eta_lambda_1 {p. 8157}	Eta_lambda_2 {p. 8157}	Eta_zw_minres {p. 8157}	F_atldyn {p. 8157}
F_sicher_zw {p. 8158}	F_wnwkh {p. 8158}	F_wnwkhk {p. 8158}	FAC_EFF_IGA_CH_SP {p. 3601}
LV_FCUT_FAST {p. 6675}	LV_TQ_LIM_INTV {p. 6692}	Mdi_ist_m {p. 8161}	Mdi_max {p. 8161}
Mdi_max_l1 {p. 8161}	Mdi_min_hs {p. 8161}	Mdi_min_s {p. 8161}	Mdi_ml_soll {p. 8161}
Mdi_opt_l1 {p. 8161}	Mdi_opt_s {p. 8161}	Mdi_s_istm {p. 8162}	Mdk_max {p. 8162}
Mdk_min {p. 8162}	NC_CBK_EX_NR {p. 1829}	STATE_TCT_INTV {p. 1578}	TQ_AV {p. 6656}
TQ_GS_SLOW_BN {p. 1581}	TQ_MAF {p. 1581}	TQI_BAS {p. 6661}	TQI_CAT_PROT {p. 6659}

R.43.1 Outputs for BMW functions which are defined as TQDR exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation at reset or at exit power latch phase: Mdi_bas, B_safast , F_wnwkhk_sw, Mdk_ist_lm = 0
Mdi_vmax = 1000 Nm
Eta_zylausbas,Eta_zw_min = 100%
Mdk_ist : first calculation
Mdk_max_gs = +3276.7 Nm

Recurrence: 10 ms: Mdi_bas, Mdi_vmax, Mdk_ist, Mdk_ist_lm, Eta_zw_min, Eta_zylausbas, F_wnwkhk_sw, Mdk_max_gs
20ms: B_safast

Activation: every engine state

Deactivation: – –

Formula section:

Remark: all formulas are valid in a **physical** meaning
Mdi_vmax = TQI_VS_MAX
If(1) ECU_STATE = "PWL"
Then(1)
B_safast = 0
Eta_zw_min = 0 %
Mdi_bas = 0

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Eta_zylaus_bas = 100%
Mdk_ist_lm = 0 Nm
Mdk_max_gs = +3276.7 Nm

Elseif(1)
B_safast = LV_FCUT_FAST
Eta_zw_min = EFF_IGA_MIN * 100%
Mdi_bas = TQI_BAS
Mdk_ist = TQ_AV
Eta_zylausbas = EFF_SCC_BAS * 100%
F_wnwkhk_sw = FAC_EFF_IGA_CH_SP
Mdk_ist_lm = TQ_MAF
If (2) STATE_TCT_INTV = "TQ_DEC" /* BMW: ST_MOD_DKG */

Then(2) Mdk_max_gs = TQ_GS_SLOW_BN
/* CAN value TORQ_TAR_ADJR_POS_EGS */
Else(2)
If (3) STATE_TCT_INTV = " NO_INTERVENTION"
or STATE_TCT_INTV = " INVALID"
Then(3) Mdk_max_gs = +3276.7 Nm
Endif(3)
Endif(2)
Endif(1)

R.43.2 Outputs for BMW functions which are not defined as TQDR exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions:

Initialisation at reset or exit Power Latch Phase:
Eta_zw_ist1 = Eta_zw_ist2 =
Eta_zwve_m = Eta_zw_mint = 100 %
Mdi_katschutz = 1000 Nm
Recurrence : 10 ms , except Eta_zwve_m segment
Activation: every engine state
Deactivation: - –

Formula section:
Remark: all formulas are valid in a **physical** meaning

Eta_zw_ist1 = EFF_IGA_AV_CBK[1] * 100%
Eta_zw_ist2 = EFF_IGA_AV_CBK[2] * 100%
Eta_zw_mint = EFF_IGA_MIN_TEG * 100%

If ECU_STATE = "PWL"
Then

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Eta_zwve_m = 0%
Mdi_katschutz = 1000 Nm
Elseif
Eta_zwve_m = EFF_IGA_BAS_COR_KNK_FIL * 100%
Mdi_katschutz = TQI_CAT_PROT
Endif

R.43.3 Outputs for supplier aggregates, BMW(supplier

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Initialisation at reset:
0.0: TQI_AV_HOM ,TQI_MIN_S , TQI_MIN_HOMS,TQI_REF_MAX ,TQI_SP_MAF, TQI_REF, TQI_AV, TQI_AV_S , TQI_REF_S , FAC_EFF_IGA_CH, TQ_MAX_CLU, FAC_EFF_IGA_SECU, TQ_MIN_CLU, FAC_EFF_IGA_SCAV
0: LV_TQ_IGA_ENA , LV_TQI_BOL_SET, LV_GS_ACT_FL , LV_TQ_MIN_CLU
1.0: EFF_LAMB_AV, EFF_LAMB_AV_CBK[NC_CBK_EX_NR], EFF_LAMB_BAS_COR , EFF_LAMB_SP_BAS
1023.96875 Nm: TQI_MAX

Recurrence : 10 ms TQI_REF, TQI_REF_MAX, TQI_SP_MAX, TQI_AV_HOM, TQI_REF_S, LV_TQ_IGA_ENA, TQI_MIN_HOMS
EFF_LAMB_AV, EFF_LAMB_BAS_COR, TQI_AV_S, EFF_LAMB_SP_BAS, FAC_CAM_CH, TQ_MAX_CLU, TQI_MIN_S , EFF_LAMB_AV_CBK[NC_CBK_EX_NR], LV_TQI_BOL_SET, LV_GS_ACT_FL , FAC_EFF_IGA_SECU, LV_TQ_MIN_CLU, TQ_MIN_CLU, FAC_EFF_IGA_SCAV, TQI_MAX
bgn FAC_EFF_IGA_CH

Activation: at every engine state
Deactivation: -

Formula section:

Remark: all formulas are valid in a **physical** meaning

TQI_REF = Mdi_opt_l1
EFF_LAMB_AV_CBK[1] = Eta_lambda_1 /100%
EFF_LAMB_AV_CBK[2] = Eta_lambda_2 /100%
EFF_LAMB_AV = 0.5 * (EFF_LAMB_AV_CBK[1] + EFF_LAMB_AV_CBK[2])
EFF_LAMB_BAS_COR = Eta_labas /100%
TQI_AV_S = Mdi_s_istm
TQI_AV_HOM = Mdi_ist_m
TQI_MAX = Mdi_max
TQI_REF_S = Mdi_opt_s
EFF_LAMB_SP_BAS = Eta_labas_sol /100%
TQI_REF_MAX = Mdi_max_l1
TQI_SP_MAF = Mdi_ml_soll

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TQI_MIN_S = Mdi_min_s
If LV_TQ_LIM_INTV = 1
then LV_TQ_IGA_ENA = 1
else LV_TQ_IGA_ENA = B_zw_dynman
endif
FAC_CAM_CH = F_wnwkh
FAC_EFF_IGA_CH = F_wnwkhk
TQ_MAX_CLU = Mdk_max
TQI_MIN_HOMS = Mdi_min_hs
LV_TQI_BOL_SET = B_mdimin_sa
LV_GS_ACT_FL = B_vlschalt
FAC_EFF_IGA_SECU = F_sicher_zw
LV_TQ_MIN_CLU = B_llrein
TQ_MIN_CLU = Mdk_min
FAC_EFF_IGA_SCAV = F_atldyn

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R.44 Customer adaptation module: TQLO

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
FAC_TQ_LOSS_OPM_SEL	O/V	0... FFH	0... 0.99609375	0.00390625	-
Torque loss interpolation factor for opeartion switch manager					
Md_na_defrost	O/V	8000... 7FFFH	0... 3276.7	0.1	Nm
torque losses for defroster means					
Md_na_mlad	O/V	8000... 7FFFH	0... 3276.7	0.1	Nm
torque losses for mechanical charger					
Md_na_thermo	O/V	8000... 7FFFH	0... 3276.7	0.1	Nm
torque losses for thermostat					
TQ_LOSS	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Overall torque losses (unfiltered value)					
TQ_LOSS_ADD	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
total torque losses for additive engine devices					
TQ_LOSS_REQ_CLU	O/V	8000... 7FFFH	0... 1023.97	0.03125	Nm
Overall torque losses (filtered value)					

Input data:

Md_na_ges {p. 8160}	Md_reib_sa {p. 8161}	Mdi_reib {p. 8161}	TQ_LOSS_SCHA {p. 6658}
TQ_LOSS_THERMO {p. 6659}	TQ_LOSS_WIN_HEAT {p. 6659}		

General Information

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application Condition

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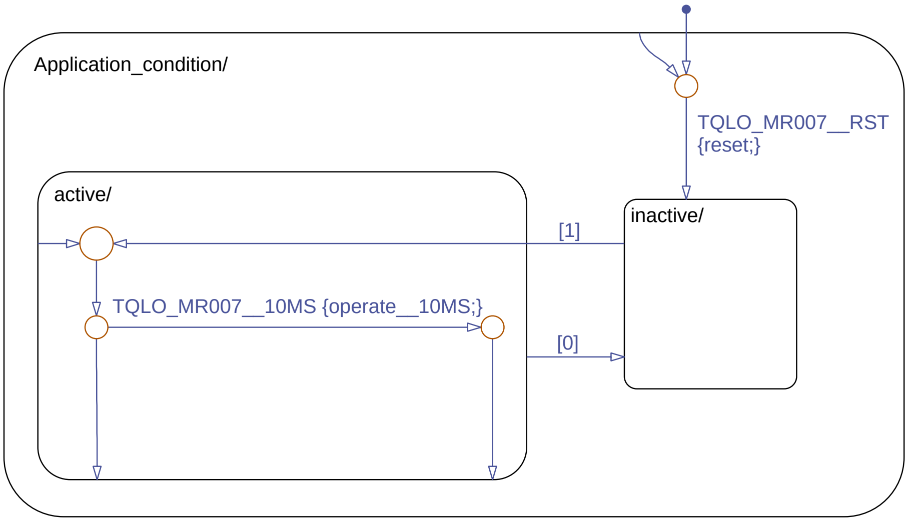

Figure R.44.1: TQLO_MR007/APP_CDN/APPCND

Function Description

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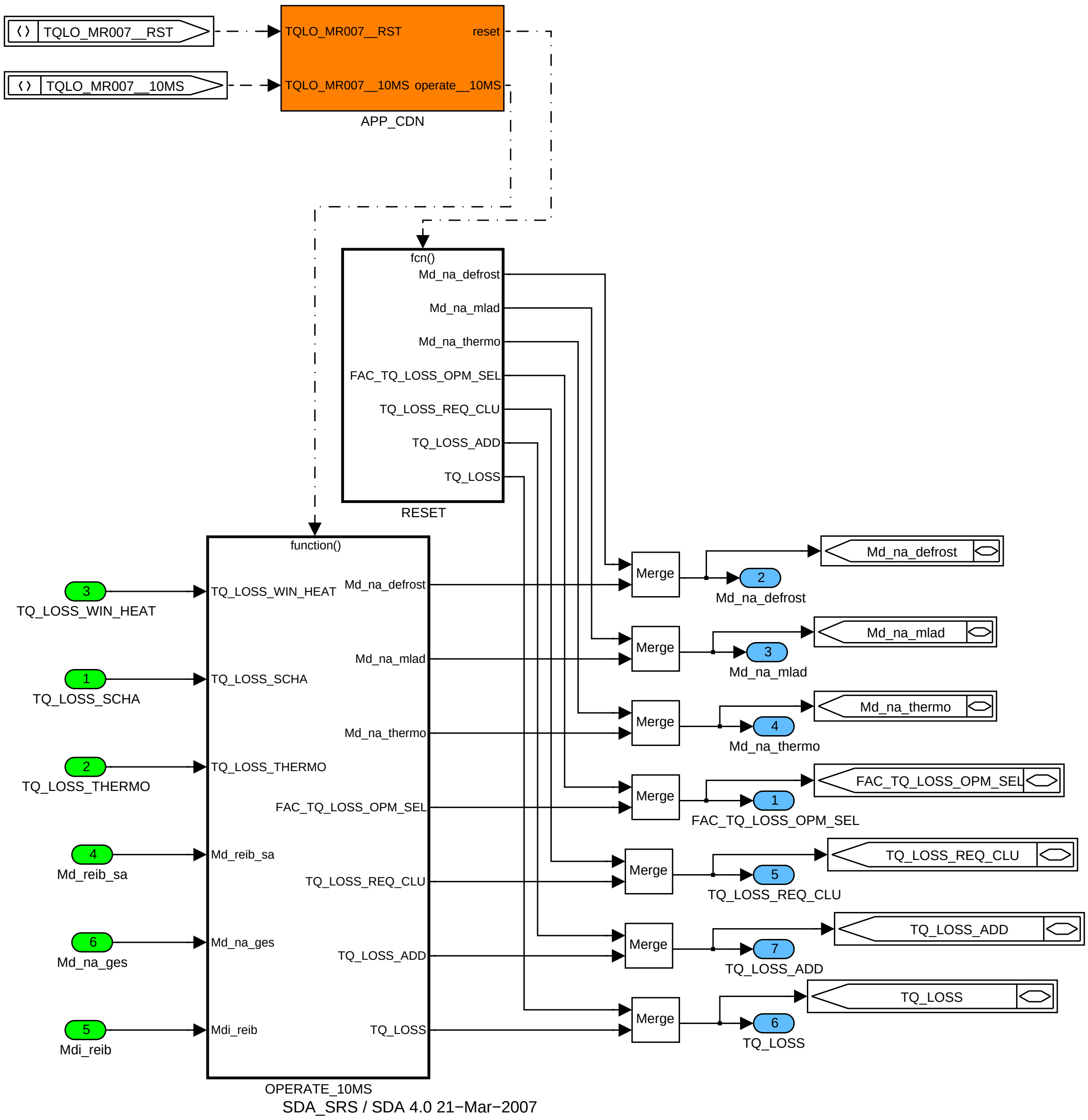

Figure R.44.2: TQLO_MR007

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R.44.1 Recurence: 10 ms

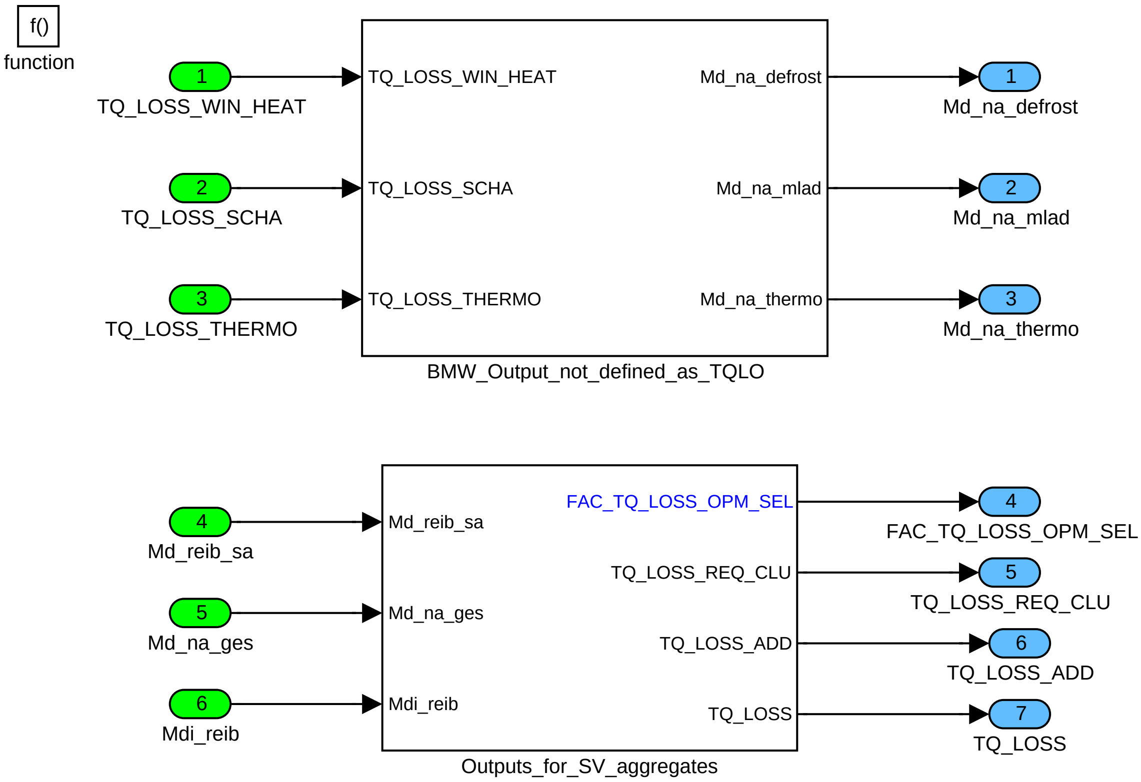

Figure R.44.3: TQLO_MR007/OPERATE_10MS

BMW output not defined as TQLO

Outputs for BMW functions which are not defined as TQLO exported data

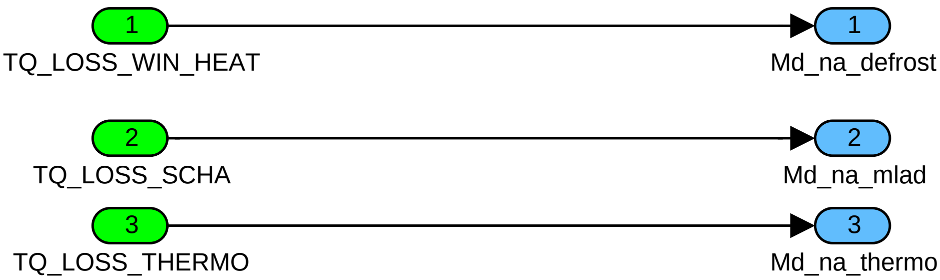

Figure R.44.4: TQLO_MR007/OPERATE_10MS/BMW_Output_not_defined_as_TQLO

Outputs for SV aggregates

Remark: all formulas are valid in a physical meaning.

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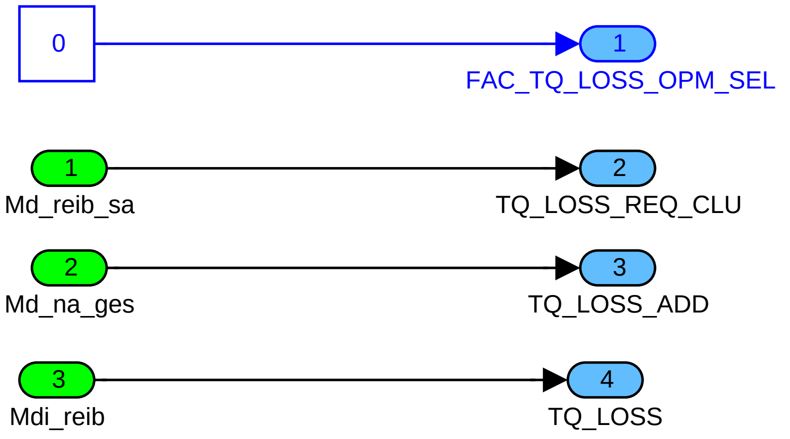

Figure R.44.5: TQLO_MR007/OPERATE_10MS/Outputs_for_SV_aggregates

R.44.2 Reset

All outputs are set to zero.

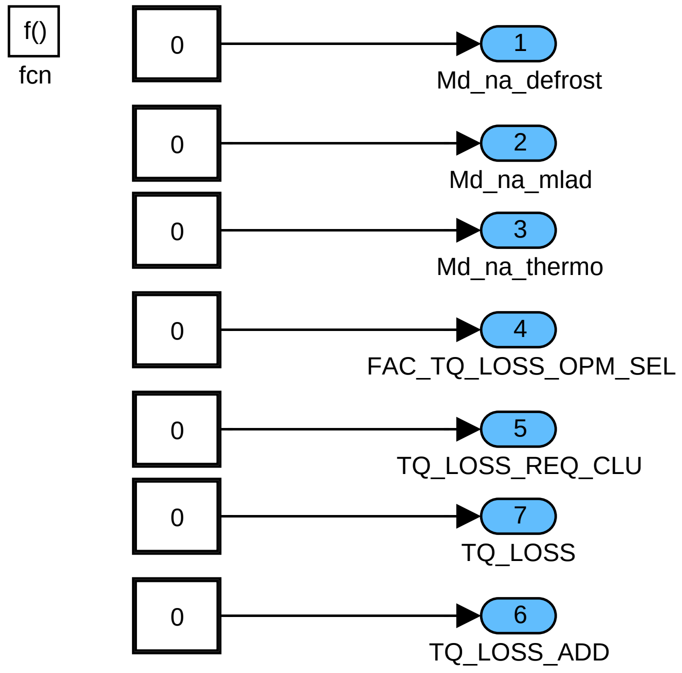

Figure R.44.6: TQLO_MR007/RESET

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R.45 Customer adaptation module: TQSP

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_fgr_akt	O/V	0... 1H	0 ...1	1	-
cruise control active					
B_ll_roh	O/V	0... 1H	0 ...1	1	-
Condition idle speed (raw value)					
B_vl	O/V	0... 1H	0 ...1	1	-
condition full load					
EFF_IGA_MIN_ADD_MAX	O/V	0... FFFFH	0... 1.99996	30.5e-6	-
Minimum possible ignition efficiency for catalyst heating					
LOAD_THD_FL	O/V	0... FFFFH	0... 3.99993	61e-6	-
load threshold for Full load recognition					
MAF_ADD_MAX	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
Maximum possible engine load for catalyst heating - mg/Stk					
MAF_KGH_ADD_MAX	O/V	0... FFFFH	0... 2047.96875	0.03125	kg/h
Maximum possible engine load for catalyst heating - kg/h					
MAF_SP_TQI	O/V	0... FFFFH	0... 1389	0.0211948	mg/stk
mass air flow setpoint for torque intervention					
Mdi_fsb	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
Momentenbegrenzung bei aktivierter Feststellbremse					
Mdi_pmax	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
indicated engine torque for power limitation					
Mdi_res_st	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
torque reserve at engine start					
Mdi_siko_l	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
torque limitation monitoring, slow path					
Mdi_siko_s	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
torque limitation monitoring, fast path					
Mdr_wunsch	O/V	0... FFFFH	0... 255.99609	3.9063e-3	%
scaling factor requested torque at clutch					
TQ_ADD_MAX	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
maximum torque reserve at clutch					
TQ_REQ_CLU	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Driver requested torque at clutch after IS-PL transition					
TQ_REQ_IPM	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Torque request for IPM					
TQI_ADD_MAX	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum possible indicated engine torque inclusive torque reserve at IGA_MIN and ISC reserve limitation					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
TQI_ADD_MAX_TOL	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Maximum possible indicated engine torque inclusive torque reserve at IGA_MIN					
TQI_EMS	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Requested indicated engine torque without external interventions					
TQI_REQ_FAST	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
limited torque request for fast path					
TQI_REQ_FAST_SEL	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
fast indicated engine torque request selected					
TQI_REQ_SLOW	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
limited torque request for slow path					
TQI_REQ_SLOW_SEL	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
slow indicated engine torque request selected					
TQI_REQ_TRA_FAST	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
requested indicated torque for fast path					
TQI_SP	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque setpoint fast path					
TQI_SP_CAN	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
setpoint indicated engine torque for CAN calculations					
TQI_SP_CBK [NC_CBK_EX_NR]	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque setpoint for ignition path (bank selective)					
TQI_SP_S	O/V	8000... 7FFFH	-1024... 1023.96875	0.03125	Nm
Torque setpoint for stratified combustion mode without interventions of ISC and AJC					

Input data:

C_MAF_REF {p. 8279}	ECU_STATE {p. 1091}	Eta_zw_minres {p. 8157}	F_vl_aus {p. 8158}
FAC_TQ_REQ_CLU {p. 6706}	LV_CT {p. 1442}	LV_FL_RAW {p. 1759}	LV_TQ_CRU_ACT {p. 6706}
Mdi_fzdyn {p. 8161}	Mdi_res_max {p. 8161}	Mdi_res_maxll {p. 8162}	Mdi_soll {p. 8162}
Mdi_soll_l {p. 8162}	Mdi_soll_lk {p. 8162}	Mdi_wunsch {p. 8162}	Mdi_zw_soll {p. 8162}
Mdi_zw_soll_i [NC_CBK_EX_NR]	Mdi_zw_sollcan {p. 8162}	Mdk_wunsch {p. 8162}	Mdk_wunsch_ipm {p. 8162}
Ms_res_max {p. 8163}	N_32 {p. 1525}	Rf_res_max {p. 8167}	Rf_soll {p. 8167}
TQ_ADD_ST {p. 810}	TQI_P_MAX {p. 6697}	TQI_PBR_MAX {p. 6697}	TQI_REQ_LIM_FAST {p. 6692}
TQI_REQ_LIM_SLOW {p. 6692}			

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Application conditions

Initialisation at reset:: Mdi_fsb = 1000 Nm
Mdi_pmax = 1000 Nm
All other = 0h

Recurrence : 10 ms

Activation: *every engine state*

R.45.1 Outputs for BMW functions

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Formula section*:*
Remark: all formulas are valid in a **physical** meaning

if ECU_STATE = "PWL"
then
B_ll_roh = 0
Mdi_pmax = 1000 Nm
Mdi_fsb = 1000 Nm
else
B_ll_roh = LV_CT
Mdi_pmax = TQI_P_MAX
Mdi_fsb = TQI_PBR_MAX
endif

Mdr_wunsch = FAC_TQ_REQ_CLU *100%
B_fgr_akt = LV_TQ_CRU_ACT
B_vl = LV_FL_RAW
Mdi_res_st = TQ_ADD_ST
Mdi_siko_l = TQI_REQ_LIM_SLOW
Mdi_siko_s = TQI_REQ_LIM_FAST

R.45.2 Outputs for supplier aggregates

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs can be different from the specified values due to the input data attributes.

Formula section:

Remark: all formulas are valid in a **physical** meaning

EFF_IGA_MIN_ADD_MAX = Eta_zw_minres /100 %
LOAD_THD_FL = F_vl_aus

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MAF_ADD_MAX = Rf_res_max * C_MAF_REF
MAF_SP_TQI = Rf_soll * C_MAF_REF
TQ_ADD_MAX = Md_res_max
TQ_REQ_CLU = Mdk_wunsch
TQI_ADD_MAX = Mdi_res_maxll
TQI_ADD_MAX_TOL = Mdi_res_max
TQI_EMS = Mdi_wunsch
TQI_REQ_FAST = Mdi_soll
TQI_REQ_FAST_SEL = Mdi_soll_k
TQI_REQ_SLOW_SEL = Mdi_soll_lk
TQI_REQ_TRA_FAST = Mdi_fzdyn
TQI_SP = Mdi_zw_soll
TQI_SP_CBK[NC_CBK_EX_NR] = Mdi_zw_soll_i[NC_CBK_EX_NR]
TQI_SP_CAN = Mdi_zw_sollcan
TQI_REQ_SLOW = Mdi_soll_l
MAF_KGH_ADD_MAX = Ms_res_max

If ECU_STATE = "PWL"
Then
TQI_SP_S = 0 Nm
TQ_REQ_IPM = 0 Nm
Else
TQI_SP_S = Mdi_zw_soll
TQ_REQ_IPM = Mdk_wunsch_ipm
Endif

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R.46 Customer adaptation module: TRSM

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
B_autget	O/V	0... 1H	0 ...1	1	-
Automatic transmission rcognized					
B_fs	O/V	0... 1H	0 ...1	1	-
Logic variable for gear engaged					
B_gang_rueck	O/V	0... 1H	0 ...1	1	-
Logic varaiable for reverse gear					
B_kupp_ext	O/V	0... 1H	0 ...1	1	-
Clutch switch information from BMW					
Gangi	O/V	0... FFH	0... 255	1	-
Actual gear					
LV_CS	O/V	0... 1H	0 ...1	1	-
Clutch switch information from Siemens					
Md_getriebe	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
gear box torque					
Mdi_gsl_minus	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
GS torque intervention slow decrement					
Mdi_gsl_plus	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
GS torque intervention slow increment					
Mdi_gss_minus	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
GS torque intervention fast decrement					
Mdi_gss_plus	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
GS torque intervention fast increment					
Mdi_res_gs	O/V	D8F0... 2710H	-1000 ...1000	0.1	Nm
GS torque intervention fast increment					

Input data:

B_kupp {p. 8343}	ECU_STATE {p. 1091}	GEAR {p. 1302}	GR_AT {p. 1302}
LV_AT {p. 654}	LV_CS_CUS {p. 1419}	LV_DRI {p. 1302}	LV_VAR_TCT {p. 656}
STATE_GEAR_REV_CAN {p. 1574}	TQ_ADD_TRANS {p. 6710}	TQ_CONV {p. 6710}	TQI_GS_FAST_DEC {p. 6718}
TQI_GS_FAST_INC {p. 6718}	TQI_GS_SLOW_DEC {p. 6719}	TQI_GS_SLOW_INC {p. 6719}	

R.46.1 Outputs for BMW functions which are defined as TRSM exported data

FUNCTION DESCRIPTION:
Adaptation to BMW environment.

Application conditions

Initialisation : 0
Except: B_autget = first measured Value

Recurrence : 10 ms

Activation : *every engine state*

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Formula section:

If ECU_STATE != "PWL"
Then B_fs = LV_DRI
B_autget = LV_AT
Endif
If STATE_GEAR_REV_CAN = 0 **or** ECU_STATE = "PWL"
Then
B_gang_rueck = 0
Else
B_gang_rueck = 1
Endif

R.46.2 Outputs for BMW functions which are not defined as TRSM exported data

DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions:

Initialisation at reset:
Mdi_xxx_minus = 1000 Nm
Mdi_xxx_plus, Mdi_res_gs, Md_getriebe = 0 Nm
B_kupp_ext = first measured Value
Gangi = 0
Recurrence : 10 ms
Activation: every engine state
Deactivation: - –

Formula section:

Remark: all formulas are valid in a **physical** meaning

B_kupp_ext = LV_CS_CUS
Md_getriebe = TQ_CONV

If ECU_STATE = "PWL"
then

Mdi_gsl_minus = 1000 Nm
Mdi_gsl_plus = 0 Nm
Mdi_gss_minus = 1000 Nm
Mdi_gss_plus = 0 Nm
Mdi_res_gs = 0 Nm
else
Mdi_gsl_minus = TQI_GS_SLOW_DEC
Mdi_gsl_plus = TQI_GS_SLOW_INC
Mdi_gss_minus = TQI_GS_FAST_DEC

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Mdi_gss_plus = TQI_GS_FAST_INC
Mdi_res_gs = TQ_ADD_TRANS
If (LV_AT = 1& & GR_AT = 0 & & LV_DRI=1) or
(LV_VAR_TCT = 1 & & GR_MT = 0 & & LV_DRI = 1)
then

Gangi = 255 {Rückwärtsgang}

else

Gangi = GEAR

Endif

R.46.3 Outputs for supplier aggregates

FUNCTION DESCRIPTION:

Adaptation to BMW environment.

Application conditions

Initialisation : `LV_CS = 0`

Recurrence : `10 ms`

Activation : *every engine state*

Formula section:

LV_CS = B_kupp

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R.47 Customer adaptation module: VHSC

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Mdi_accl_plus	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
torque increase for slow torque intervention during DCC					
Mdi_accs_plus	O/V	8000... 7FFFH	-3276.8 ...3276.7	0.1	Nm
Torque increase for fast torque intervention during DCC					
Mdr_fgr	O/V	0... FFFFH	0... 255.99609	3.9063e-3	%
Relatives Wunschmoment vom Fahrgeschwindigkeitsregler					

Input data:

FAC_TQ_REQ_CRU {p. 6737}	TQI_DCC_FAST_INC {p. 6731}	TQI_DCC_SLOW_INC {p. 6731}	

R.47.1 Outputs for BMW functions which are not defined as VHSC exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: The really possible physical limits of the outputs are different to the specified values due to the input data attributes.

Application conditions

Initialisation: *0 at reset*

Recurrence : 10 ms

Activation: *every engine state*

Formula section:

Remark: all formulas are valid in a **physical** meaning
Mdi_accl_plus = TQI_DCC_SLOW_INC
Mdi_accs_plus = TQI_DCC_FAST_INC
Mdr_fgr = FAC_TQ_REQ_CRU * 100 %

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R.48 Customer adaptation module: VIMA

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Disa_ist	O/V	0... FFFFH	0... 99.99847	1.5259e-3	%
actual position variable intake manifold					

Input data:

VIM_AV {p. 3622}			

R.48.1 Outputs for BMW functions which are not defined as VIMA exported data

FUNCTION DESCRIPTION:

Adaptation to BMW environment.
Remark: the really possible resolution and limits of the outputs are different from the specified values due to the input data attributes.

Application conditions:

Initialisation at reset or at exit power latch phase: 0 %
Recurrence : 10 ms
Activation: every engine state,
Deactivation: - –

Formula section:

Remark: all formulas are valid in a **physical** meaning

Disa_ist = VIM_AV

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R.49 Customer adaptation module: VVTI

Data definition:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
CAM_DYN_IVVT_EX_SAE [NC_NR_CBK_IVVT]	O/V	0... FFFFH	0... 655.35	0.01	°
Camshaft position change during dynamic diagnosis at symptom setting - diagnostic tester information; exhaust					
CAM_DYN_IVVT_EX_TOL_SAE [NC_NR_CBK_IVVT]	O/V/S	0... FFFFH	0... 655.35	0.01	°
Camshaft position change during dynamic diagnosis at symptom setting - diagnostic tester information max value; exhaust					
CAM_DYN_IVVT_IN_SAE [NC_NR_CBK_IVVT]	O/V	0... FFFFH	0... 655.35	0.01	°
Camshaft position change during dynamic diagnosis at symptom setting - diagnostic tester information; inlet					
CAM_DYN_IVVT_IN_TOL_SAE [NC_NR_CBK_IVVT]	O/V/S	0... FFFFH	0... 655.35	0.01	°
Camshaft position change during dynamic diagnosis at symptom setting - diagnostic tester information max value; inlet					
CAM_EX [NC_NR_CBK_IVVT]	O/V	0... FFH	-40.125 ...-135.75	-0.375	°CRK
Current position of exhaust camshaft as engine quantity					
CAM_IN [NC_NR_CBK_IVVT]	O/V	0... FFH	60... 155.625	0.375	°CRK
Actual position inlet CAM VVTI					
CAM_SP_IVVT_EX	O	0... FFH	-40... -135.625	-0.375	°CRK
Exhaust CAM setpoint for VVTI					
CAM_SP_IVVT_IN	O	0... FFH	60... 155.625	0.375	°CRK
Inlet CAM setpoint for VVTI					
CAM_SP_REF_EX	O	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Exhaus camshaft target spread at reference conditions (warm engine)					
CAM_SP_REF_IN	O	8000... 7FFFH	-768... 767.97656	0.0234375	°CRK
Inlet camshaft target spread at reference conditions (warm engine)					
LV_CAM_LOCK_IVVT_EX [NC_NR_CBK_IVVT]	O/V	0... 1H	0 ...1	1	-
VVT on exhaust camshaft in locked position at engine start					
LV_CAM_LOCK_IVVT_IN [NC_NR_CBK_IVVT]	O/V	0... 1H	0 ...1	1	-
VVT on intake camshaft in locked position at engine start					
LV_DI_AD_REF_CAM_IVVT_EX	O/V	0... 1H	0 ...1	1	-
Adaptation of exhaust camshaft reference position: 0 = enabled, 1 = disabled					
LV_DI_AD_REF_CAM_IVVT_IN	O/V	0... 1H	0 ...1	1	-
Adaptation of inlet camshaft reference position: 0 = enabled, 1 = disabled					
Nwa1_pos	O	0... FFFFH	0... 6553.5	0.1	°CRK
New exhaust camshaft edge (el. falling)					
Nwa1_time	O/V	0... 7FFFFFFFH	0... 2147483647	1	ms
Time stamp at new exhaust camshaft edge (el. falling)					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
Nwe1_pos	O	0... FFFFH	0... 6553.5	0.1	°CRK
New inlet camshaft edge (el. falling)					
Nwe1_time	O/V	0... 7FFFFFFFH	0... 2147483647	1	ms
Time stamp at new inlet camshaft edge (el. falling)					
Vsa_sprs_kh	O	0... FFFFH	0... 6553.5	0.1	°CRK
Cam setpoint for exhaust cam via catalyst heating					
Vse_sprs_kh	O	0... FFFFH	0... 6553.5	0.1	°CRK
Cam setpoint for inlet cam via catalyst heating					

Input data:

Aspr {p. 8154}	B_vsa_an {p. 8347}	B_vsaadp {p. 8347}	B_vse_an {p. 8347}
B_vseadp {p. 8347}	CAM_SP_CH_EX {p. 3601}	CAM_SP_CH_IN {p. 3601}	Espr {p. 8157}
IDX_EDGE_CAM_EX [NC_NR_CAM_CBK] {p. 871}	IDX_EDGE_CAM_IN [NC_NR_CAM_CBK] {p. 871}	LV_END_DIAG_MEC_IVVT_EX {p. 1059}	LV_END_DIAG_MEC_IVVT_IN {p. 1059}
LV_ES {p. 1720}	LV_SYN_CAM_EX [NC_NR_CAM_CBK] {p. 872}	LV_SYN_CAM_IN [NC_NR_CAM_CBK] {p. 872}	LV_SYN_VLD {p. 1506}
LV_VLD_PSN_CAM_EX [NC_NR_CAM_CBK] {p. 872}	LV_VLD_PSN_CAM_IN [NC_NR_CAM_CBK] {p. 872}	NC_NR_CAM_CBK {p. 1507}	NC_NR_CBK_IVVT {p. 604}
NC_NR_EDGE_CAM_EX {p. 874}	NC_NR_EDGE_CAM_IN {p. 874}	NC_PSN_EDGE_CAM_EX [NC_NR_EDGE_CAM_EX][NC_NR_CAM_CBK] {p. 874}	NC_PSN_EDGE_CAM_IN [NC_NR_EDGE_CAM_IN][NC_NR_CAM_CBK] {p. 874}
PSN_CAM_EX [NC_NR_CAM_CBK] {p. 1533}	PSN_CAM_IN [NC_NR_CAM_CBK] {p. 1533}	Vsa_spri {p. 8179}	Vsa_sprn {p. 8179}
Vsadw_md6_mx {p. 8179}	Vsadw_md6_tst {p. 8179}	Vse_spri {p. 8179}	Vse_sprn {p. 8179}
Vsedw_md6_mx {p. 8179}	Vsedw_md6_tst {p. 8179}		

Calibration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
C_CAM_INI_EX	-	0... FFH	-40... -135.625	-0.375	°CRK
Initialization value for exhaust camshaft					
C_CAM_INI_IN	-	0... FFH	60... 155.625	0.375	°CRK
Initialization value for inlet camshaft					
LC_NOT_ADJ_CAM_IVVT_EX [NC_NR_CBK_IVVT]	-	0... 1H	0 ...1	1	-
Camshaft_EX_i: 0 = with adjustment, 1 = without adjustment					
LC_NOT_ADJ_CAM_IVVT_IN [NC_NR_CBK_IVVT]	-	0... 1H	0 ...1	1	-
Camshaft_IN_i: 0 = with adjustment, 1 = without adjustment					

Configuration data:

Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_IVVT_EX	-	0... 1H	0 ...1	1	-
Exhaust side configuration: 0 = without actuator, 1 = with actuator					

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Name	Mode	Hex. limits	Phys. limits	Resol.	Unit
NLC_IVVT_IN	-	0... 1H	0 ...1	1	-
Inlet side configuration: 0 = without actuator, 1 = with actuator					

R.49.1 Interfaces served by customer OBJ Files

FUNCTION DESCRIPTION:

Adaption to BMW environment.
Remark: The really possible resolution and limits of the output are different to the specified values due to the input data attributes.

NC_NR_CBK_IVVT indicates the number of camshaft cylinder banks and it is set to 1 in this project.

NC_NR_CAM_CBK indicates whether camshaft sensor(s) is present in one or both cylinder banks.

Application conditions

Initialisation:

```
at reset
 CAM_EX [1]  =  C_CAM_INI_EX
 CAM_IN [1]=  C_CAM_INI_IN
CAM_SP_IVVT_EX = C_CAM_INI_EX
 CAM_SP_IVVT_IN  = C_CAM_INI_IN
 CAM_SP_REF_EX = C_CAM_INI_EX
 CAM_SP_REF_IN = C_CAM_INI_IN
 LV_DI_AD_REF_CAM_IVVT_IN = 1
 LV_DI_AD_REF_CAM_IVVT_EX = 1
  Vsa_sprs_kh = - C_CAM_INI_EX; Vse_sprs_kh = C_CAM_INI_IN
 LV_CAM_LOCK_IVVT_EX[i] = B_vsa_an (out of NVMY)
 LV_CAM_LOCK_IVVT_INEX[i] = B_vse_an (out of NVMY)
 NLC_IVVT_IN = 1
 NLC_IVVT_EX = 1
 Restored from NVMY:
 CAM_DYN_IVVT_EX_SAE[NC_NR_CBK_IVVT]
 CAM_DYN_IVVT_IN_SAE[NC_NR_CBK_IVVT]
 CAM_DYN_IVVT_EX_TOL_SAE[NC_NR_CBK_IVVT]
 CAM_DYN_IVVT_IN_TOL_SAE[NC_NR_CBK_IVVT]
 At clearing error memory
 CAM_DYN_IVVT_EX_SAE[NC_NR_CBK_IVVT] = 0
 CAM_DYN_IVVT_EX_TOL_SAE[NC_NR_CBK_IVVT] = 0
 CAM_DYN_IVVT_IN_SAE[NC_NR_CBK_IVVT] = 0
 CAM_DYN_IVVT_IN_TOL_SAE[NC_NR_CBK_IVVT] = 0
```

Special values at PWL:
Last valid value: CAM_DYN_IVVT_EX_SAE[NC_NR_CBK_IVVT]
CAM_DYN_IVVT_EX_TOL_SAE[NC_NR_CBK_IVVT]
CAM_DYN_IVVT_IN_SAE[NC_NR_CBK_IVVT]
CAM_DYN_IVVT_IN_TOL_SAE[NC_NR_CBK_IVVT]

Recurrence: segment synchronous
Except :
10ms: LV_DI_AD_REF_CAM_IVVT_IN,
LV_DI_AD_REF_CAM_IVVT_EX,

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LV_CAM_LOCK_IVVT_EX[NC_NR_CBK_IVVT], LV_CAM_LOCK_IVVT_IN[NC_NR_CBK_IVVT]

100ms: CAM_DYN_IVVT_EX_SAE[NC_NR_CBK_IVVT]
CAM_DYN_IVVT_EX_TOL_SAE[NC_NR_CBK_IVVT]
CAM_DYN_IVVT_IN_SAE[NC_NR_CBK_IVVT]
CAM_DYN_IVVT_IN_TOL_SAE[NC_NR_CBK_IVVT]

Activation:
LV_ES = 1   0

Deactivation:
LV_ES = 0   1

Formula section:

Remark: all formulas are valid in a **physical** meaning

CAM_EX[1] = - Vsa_spri
CAM_IN[1] = Vse_spri
CAM_SP_IVVT_EX = - Aspr
CAM_SP_IVVT_IN = Espr
CAM_SP_REF_EX = - Vsa_sprn
CAM_SP_REF_IN = Vse_sprn

With i = 1...NC_NR_CAM_CBK:

If LV_SYN_CAM_IN[i] = 1
And LV_SYN_VLD = 1
And IDX_EDGE_CAM_IN[i] = 2 /3 /5 /6 /*relevant edge on intake camshaft ?*/
Then

Nwe1_pos = NC_PSN_EDGE_2 /3 /5 /6_CAM_IN[i] + PSN_CAM_IN[i]
Nwe1_time is updated by calling the Makro getSystemTime1ms()

Else

do nothing

Endif

If LV_SYN_CAM_EX[i] = 1
And LV_SYN_VLD = 1
And IDX_EDGE_CAM_EX[i] = 2 /3 /5 /6 /* relevant edge on exhaust camshaft ?*/
Then

Nwa1_pos = NC_PSN_EDGE_2 /3 /5 /6_CAM_EX[i] + PSN_CAM_EX[i]
Nwa1_time is updated by calling the Makro getSystemTime1ms()

Else

do nothing

Endif

Remark: Starting with the SW releases 4DB7100S only engines with a 3-teeth-target-wheel are supported ! Older engines with a 4-teeth-target-wheel have to use older SW !

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Vsa_sprs_kh = - CAM_SP_CH_EX
Vse_sprs_kh = CAM_SP_CH_IN

If LV_VLD_PSN_CAM_IN[i] = 1 **and** /*sensor self adaptation ended*/
B_vseadp = 1 /*adaptation enabled by BMW*/
Then LV_DI_AD_REF_CAM_IVVT_IN = 0 /*inlet ref.-pos.-adap. enabled*/
Else LV_DI_AD_REF_CAM_IVVT_IN = 1 /*inlet ref.-pos.-adap. disabled*/
Endif

If LV_VLD_PSN_CAM_EX[i] = 1 **and** /*sensor self adaptation ended*/
B_vsaadp = 1 /*adaptation enabled by BMW*/
Then LV_DI_AD_REF_CAM_IVVT_EX = 0 /*inlet ref.-pos.-adap. enabled*/
Else LV_DI_AD_REF_CAM_IVVT_EX = 1 /*inlet ref.-pos.-adap. disabled*/
Endif
LV_CAM_LOCK_IVVT_EX[i] = B_vsa_an
LV_CAM_LOCK_IVVT_IN[i] = B_vse_an
If LV_END_DIAG_MEC_IVVT_IN[1] = 1
Then CAM_DYN_IVVT_IN_SAE[1] = Vsedw_md6_tst
CAM_DYN_IVVT_IN_TOL_SAE[1] = Vsedw_md6_mx
Else keep old value
Endif
If LV_END_DIAG_MEC_IVVT_EX[1] = 1
Then CAM_DYN_IVVT_EX_SAE[1] = Vsadw_md6_tst
CAM_DYN_IVVT_EX_TOL_SAE[1] = Vsadw_md6_mx
Else keep old value
Endif

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